



TPM⁺ Servo actuator

Operating manual

WITTENSTEIN



motion control

Revision history

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Service

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1 On this manual

This operating manual contains necessary information for the safe operation of the servo actuator TPM⁺, referred to as servo actuator in the following.

The operator must make sure that this operating manual read through by all persons assigned to install, operate, or maintain the servo actuator, and that they understand it.

Store the operating manual within reach near the servo actuator.

1.1 Signal words

The following signal words are used to bring your attention to dangers, prohibitions, and important information:

	 DANGER This signal word points out to an imminent danger that can cause serious injuries and even death.
	 WARNING This signal word points out to a possible danger that can cause serious injuries and even death.
	 CAUTION This signal word points out to a possible danger that can cause slight to serious injuries.
	CAUTION This signal word (without warning symbol) points out to a possible danger that can cause material damage.
	INFORMATION This signal word draws your attention to application tips or especially important information when handling the servo actuator.

1.2 Safety symbols

The following safety symbols are used to bring your attention to dangers, prohibitions, and important information:



General danger



Hot surface



Suspended loads



Danger of pull-in



Environment protection



Information



Electric voltage

1.3 Information symbols

The following information symbols are used:

- requires you to carry out an action
- ➡ indicates the results of an action
- ① provides additional information on handling

2 Safety

This operating manual, especially the safety instructions and the rules and regulations valid for the operating site, must be observed by all persons working with the servo actuator.

In addition to the safety specifications mentioned in the operating manual, the general and also the local regulations on the prevention of accidents and on environmental protection should be observed.

2.1 EC low-voltage directive

The servo actuator has been constructed in accordance with EC directive 73/23/EEC. During installation and connection of the electrical components, the relevant regulations have to be observed (for example wire cross sections, fuse protection, etc.).

Meeting all requirements for the entire system is the responsibility of the system's manufacturer.

2.2 Dangers

The servo actuator has been constructed according to current technological standards and accepted safety regulations. To avoid danger to the operator or damage to the machine, the servo actuator may be put to use only for its intended usage (see chapter 2.4 "Intended use") and in a technically flawless and safe state.

2.3 Personnel

Only persons who have read and understood this operating manual may carry out work on the servo actuator.

2.4 Intended use

The servo actuator is suitable for all industrial applications that do not come under article 2 of the EC directive 2002/95/EC (usage restriction of certain dangerous materials in electrical and electronic equipment).

2.5 Guarantee and Liability

Guarantee and liability claims are excluded for personal injury and material damage if the claims derive from one or more of the following causes:

- improper use
- improper assembly/disassembly or improper operation
- operation of the servo actuator when safety devices and equipment are defective
- operation of a heavily soiled servo actuator
- non-observance of information on transport and storage
- modifications or reconstructions that have been carried out without the written authorisation of **WITTENSTEIN motion control GmbH**
- improper or neglected maintenance and repair

2.6 General safety instructions



WARNING

Objects flung out by rotating components can cause serious injuries.

- Remove objects and tools from the servo actuator before putting it into operation.

**! WARNING**

Rotating components on the servo actuator can pull in parts of the body and cause serious injuries and even death.

- Keep a sufficient distance to rotating machinery while the servo actuator is running.

**! WARNING**

Damaged cables or plugs can lead to lethal current pulses.

- Immediately replace damaged cables or plugs.

**! WARNING**

During generator operation voltage is induced. This can lead to lethal current pulses.

- Ensure that no plugs and connections are laying open during generator operation.

**! CAUTION**

Hot servo actuator housing can cause serious burns.

- Touch the servo actuator housing only when wearing protective gloves or after the servo actuator has been idle for some time.

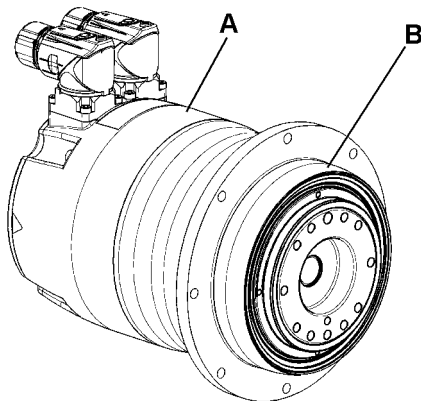
**INFORMATION**

Solvents can pollute soil and water.

- Use and dispose of cleaning solvents appropriately.

3 Description of the servo actuator

3.1 General Information



The servo actuator is a combination of a low-planetary gearhead and an AC servomotor. The output bearing is designed to receive high external tilting moments.

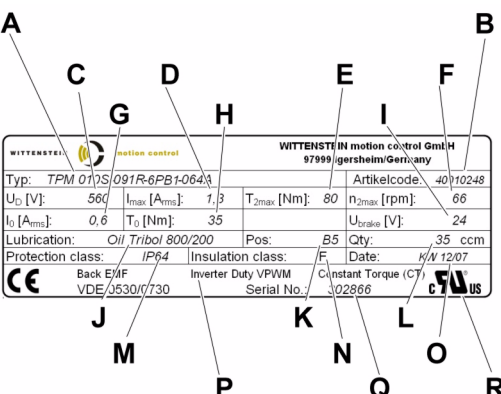
There are two centring mechanisms for the output flange.

The AC servomotor is a brushless 3-phase synchronous motor, with excitation by means of permanent magnets located on the rotor. A resolver or optical encoder takes care of the commutation or speed control.

An optional permanent-magnet holding brake is integrated into the motor.

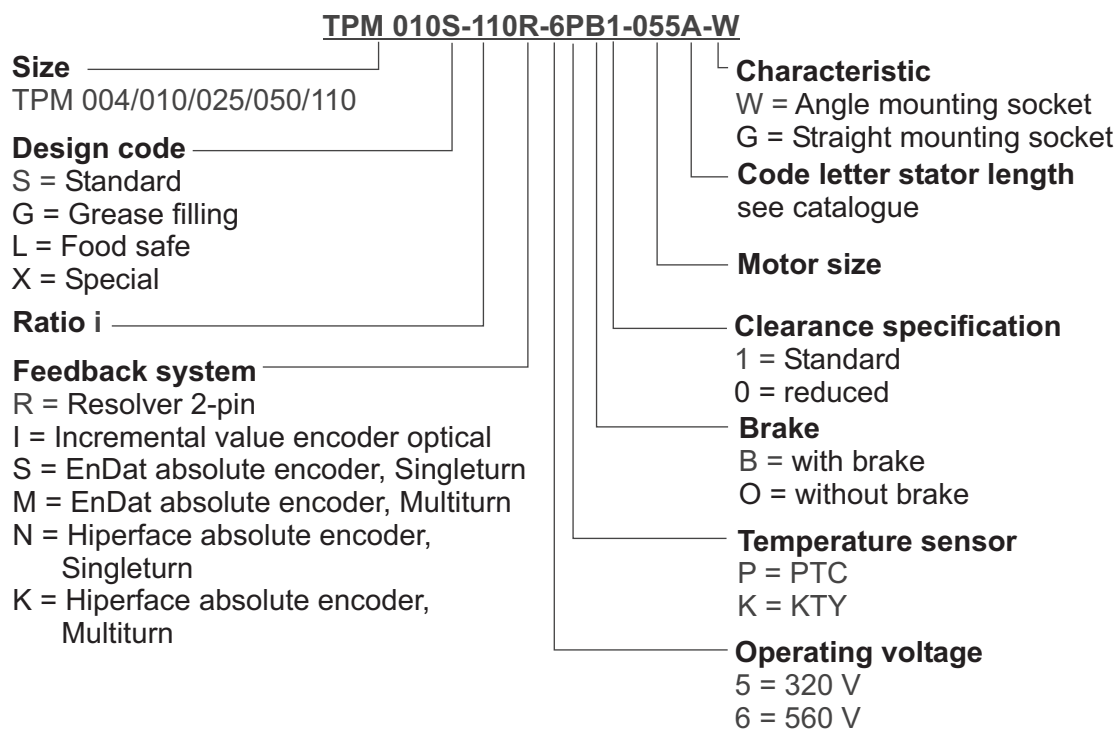
3.2 Type plate

The type plate is attached to the gearhead housing.

		Designation
	A	Ordering codes (see chapter 3.3 "Ordering codes")
	B	Article code
	C	Intermediate voltage
	D	Maximum permitted current
	E	Maximum moment of the gear output
	F	Maximum gear output speed
	G	Continuous stall current
	H	Continuous stall moment at gear output
	I	Brake voltage
	J	Lubricant
	K	Mounting position
	L	Lubricant quantity
	M	Type of protection
	N	Insulation class
	O	Date
	P	Specifications for UL approval
	Q	Series number
	R	UL logo

Tbl-1: Type plate

3.3 Ordering key



3.4 Performance statistics

Please refer to the appendix of this operation manual for the maximum permitted speeds and torques.

3.5 Weight

The standard weights of the servo actuators are specified in the table "Tbl-2". Depending on the design, the actual dimension can deviate by up to 10%.

Size TPM ⁺		004	010	025	050	110
Without brake	i=21 i=31	2,6	4,9	9	21,3	37,1
	i=61 i=91	2,4	4,4	7,6	15,1	35,9
With brake	i=21 i=31	3	5,3	9,8	23,7	39,6
	i=61 i=91	2,7	4,9	8,4	16,2	38,3

Tbl-2: Weight

4 Transport and storage

4.1 Scope of delivery

- Check the completeness of the delivery against the delivery note.
- ① Missing parts or damage must be notified immediately in writing to the carrier the insurance, or **WITTENSTEIN motion control GmbH**.

4.2 Packaging

The servo actuator is delivered packed in foil and cardboard boxes.

- Dispose of the packaging materials at the recycling sites intended for this purpose. Observe the locally valid regulations for disposals.

4.3 Transport

	CAUTION Impacts caused for instance by dropping or setting down too quickly may damage the servo actuator. • Use only hoisting equipment and transportation devices with sufficient capacity. • The permitted lifting weight of a hoist may not be exceeded. • Lower the servo actuator slowly.
	⚠ WARNING Suspended loads may fall and cause serious injuries and even death. • Do not stand under suspended loads.

For specifications on the weights see Chapter 3.5 "Weight".

4.4 Storage

Store the servo actuator in horizontal position and dry surroundings at a temperature of 0 °C to +30 °C in the original packaging. Store the servo actuator for a maximum of 2 years.

For storage logistics we recommend the "first in – first out" principle.

5 Assembly

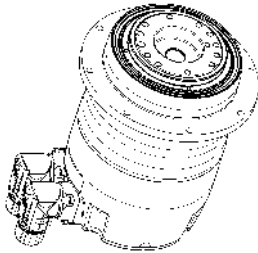
	CAUTION
	Loose or overloaded screw connections can damage the servo actuator. • Use a calibrated torque wrench to tighten and check all screw connections for which a tightening torque has been specified.

5.1 Preparation

	CAUTION
	Pressurised air can damage the servo actuator seals. • Do not use pressurised air to clean the servo actuator.

- Remove the anti-corrosion agent from the output flange of the servo actuator. Use a clean, lint-free cloth moistened with a suitable cleaning agent (grease dissolving but non-aggressive).
- Check the fitting surfaces in addition for damage and foreign bodies.

5.2 Mounting the servo actuator on a machine



- Smear screw-bonding agent (e.g. Loctite 243) onto the fastening bolts.
- Fasten the servo actuator on the machine with the bolts through the holes (A).
 - ① Mount the servo actuator in such a way that the type plate remains legible.
 - ① Do not use washers (e.g. plain washers, tooth lock washers).
 - ① For screw sizes and specified torques refer to chapter 9.1 "Specifications on mounting onto a machine", table "Tbl-5".

5.3 Mounting on the output side

	CAUTION
	Distortions during mounting operations can damage the servo actuator. • Mount gearwheels and toothed belt pulleys onto the output flange without forcing. • Do not on any account attempt an assembly by force or hammering! • Only use suitable tools and equipment for assembly.

- ① For screw sizes and specified torques refer to chapter 9.2 Thread in output flange, table "Tbl-6".

5.4 Installing electrical connections

	 DANGER Electrically live components may result in electric shocks when touched and can cause serious injuries and even death. • Observe the five safety rules of electrical engineering before starting electrical installations: - Disconnect. - Make sure that it cannot be switched on again. - Make sure there is no voltage. - Ground and short-circuit. - Cover or close off neighboring, electrified parts.
	 DANGER Electric operation during moisture may result in electric shocks and can cause serious injuries and even death. • Only execute the electric assembly in dry areas.
	INFORMATION The cables of all servo actuators need to be laid out in such a way that a minimum bending radius of 10 x diameter is kept. The cables may be twisted by no more than $\pm 30^\circ$ over a length of 1 m.

6 Startup and operation

	! WARNING Objects flung out by rotating components can cause serious injuries. Remove objects and tools from the servo actuator before putting it into operation.
	! WARNING Rotating components on the servo actuator can pull in parts of the body and cause serious injuries and even death. Keep a sufficient distance to rotating machinery while the servo actuator is running.
	! CAUTION Hot servo actuator housing can cause serious burns. Touch the servo actuator housing only when wearing protective gloves or after the servo actuator has been idle for some time.

Operational conditions and requirements for the surroundings:

- Because of the factory-filled lubricant, the ambient temperature may not lie under 0 °C, or over +40 °C. Operating temperature may not exceed +90 °C.
① For other conditions of use, please consult our Customer Service Department.
- Only use the servo actuator up to its maximum limit values, see chapter 3.4 "Performance statistics".
- Only use the servo actuator in a clean, dust-free and dry environment.

6.1 Data for the electrical startup

The specified data is intended for the electrical startup.

	CAUTION The servo controllers of the different manufacturers generally use an individual annotation of the data. If the data is disregarded, the drive and/or the servo controller may be damaged. - Accurately inspect the listed units and control the conformance with the units of the servo controller. - If the units differ, make the necessary adjustment accordingly.
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- ① In some servo controllers there is a dependence between the individual parameters. We would be glad to assist you in finding the correct entries.
- ① We provide adjusted and certified quick start guides for the servo controllers of the following manufacturers. These guides provide article codes of pre-manufactured cable sets and an assignment of the servo actuators to the regulator product sizes alongside the parameters.
 - Bosch Rexroth EcoDrive
 - Bosch Rexroth IndraDrive
 - B&R Acopos
 - Control Techniques UniDrive SP
 - Danaher Motion Servostar
 - Siemens SimoDrive 611 U/D

- Siemens MasterDrive
- Siemens Sinamics

This data reflects the technical characteristics and the limit values of the standard combinations of the TPM+ series in regard to the gearhead ratio and the stator length in general units.

- Select the data for the TPM⁺ version you are using.
 - Chapter 9.4.1 "Motor data TPM⁺ 320V, i = 16, 21, 31"
 - Chapter 9.4.2 "Motor data TPM⁺ 320V, i = 61, 64, 91"
 - Chapter 9.4.3 "Motor data TPM⁺ 560V, i = 16, 21, 31"
 - Chapter 9.4.4 "Motor data TPM⁺ 560V, i = 61, 64, 91"
- Select the according product size of the desired servo controller in regard to the application data.

7 Maintenance and disposal

	⚠ CAUTION Hot servo actuator housing can cause serious burns. • Touch the servo actuator housing only when wearing protective gloves or after the servo actuator has been idle for some time.
	⚠ WARNING Rotating components on the servo actuator can pull in parts of the body and cause serious injuries and even death. • Disconnect the machine from the mains before starting maintenance work. • Secure the machine against restarting during maintenance work.
	⚠ WARNING The permanent magnets of the rotor send a strong magnetic field, which becomes active during the disassembling of the servo actuator. • Observe the general safety instructions (e.g. for pacemaker patients) for working in strong magnetic fields.

7.1 Maintenance work

7.1.1 Visual inspection

- Check the entire servo actuator and the moved cables for exterior damage.
- The radial shaft seals are subject to wear. Therefore also check the servo actuator for leakage during each visual inspection.
 - ① You can find more general information on radial shaft seals on our partner's Internet site at <http://www.simrit.de>.
 - ① Check the mounting position, so that no foreign medium (e.g. oil) has collected on the output flange.

7.2 Startup after maintenance work

- Clean the outside of the servo actuator.
- Assemble all safety devices.
- Do a trial run before releasing the servo actuator again for operation.

7.3 Maintenance schedule

Maintenance work	At start-up	After 500 operating hours or 3 months	Yearly
Visual inspection	X	X	X

Tbl-3: Maintenance schedule

7.4 Notes on the lubricant used



INFORMATION

A change of lubricant in servoactuators of this design is not necessary. All bearings are permanently lubricated at the factory.

7.5 Supplementary information

Consult our Customer Service Department for supplementary information on disassembly and on disposal of the servo actuator.

- Dispose of the servo actuator at the recycling sites intended for this purpose.
 - ① Observe the locally valid regulations for disposal.

8 Malfunctions

	CAUTION	
	Changed operational behaviour can be an indication of existing damage to the servo actuator, or cause damage to the servo actuator. Do not put the servo actuator back into operation until the cause of the malfunction has been rectified.	
Fault	Possible cause	Solution
Increased operating temperature	Selected construction too weak for task, nominal operating exceeded	Check the technical specifications.
	Motor is heating the gearhead	Check the controller's settings.
	Ambient temperature too high	Ensure adequate cooling.
Increased noises during operation	Damaged bearings	Please consult our Customer Service Department.
	Damaged gear teeth	
Loss of lubricant	Lubricant quantity too high	Wipe off discharged lubricant and continue to watch the gearhead. Lubricant discharge must stop after a short time.
	Seals not tight	Please consult our Customer Service Department.
Motor does not start	Power supply interrupted	Check the connections.
	Wiring of motor and/or encoder not correct	Check the wiring of the motor phases and the motor encoder.
	Blown fuse	Check for errors and replace the fuse.
	Incorrect controller parameters	Check that the motor parameters are suitable in regards to the implemented servo actuator.
	Motor protection has been triggered	Check for errors. Check whether the motor protection setting is correct.
Wrong direction of rotation	Wrong set value specification for the servo controller	Check servo controller/ converter. Check the set value specifications and the polarities.

Fault	Possible cause	Solution
Motor is droning and has a high power consumption	Drive is blocked	Check the drive.
	Error in the encoder line	Check the encoder line.
	Incorrect controller parameters	Check that the motor parameters are suitable in regards to the implemented servo actuator.
	Brake does not release	(See error "Brake does not release")
Brake does not release	Voltage drop along the supply line > 10%	Ensure that the connected voltage is correct. Check the cable cross-section.
	Incorrect brake connection	Check the connection for correct polarity and voltage.
	Short circuit in the coil or at body of brake coil	Please consult our Customer Service Department.
Holding brake slips	Stopping torque of the brake exceeded	Check the construction plan.
Acceleration times are not met	Load is too high	Check the construction plan.
	Power limiting active	Check the controller parameters.
Position error	Shielding of the encoder line insufficient	Inspect the shielding of the connection cables.
	Disturbing pulse from the brake, manufacturer protection (varistor) defective	Please consult our Customer Service Department.
	mechanical coupling between the motor shaft and encoder defective	Please consult our Customer Service Department.

Tbl-4: Malfunctions

- ① It is helpful for the error search and the optimisation of the controller settings, if you note the current through the cycle (functionality of the servo controller) and make it available as a data file.

9 Appendix

9.1 Specifications on mounting onto a machine

Through-holes in servo actuator housing				
Type/size	Bore Ø [mm]	Quantity x diameter [] x [mm]	For Screw size/ property class	Tightening torque [Nm]
TPM 004	79	8 x 4.5	M4 / 10.9	4.1
TPM 010	109	8 x 5.5	M5 / 10.9	8.1
TPM 025	135	8 x 5.5	M5 / 10.9	8.1
TPM 050	168	12 x 6.6	M6 / 10.9	14
TPM 110	233	12 x 9.0	M8 / 10.9	34
TPMA 025	135	16 x 5.5	M5 / 10.9	8.1
TPMA 050	168	24 x 6.6	M6 / 10.9	14
TPMA 110	233	24 x 9.0	M8 / 10.9	34

Tbl-5: Specifications on mounting onto a machine

9.2 Thread in output flange

Type/size	Indexing bore hole Ø	Quantity x	For	Tightening torque
		Thread x	Property class	
		Depth		
	[mm]	[] x [mm] x [mm]		[Nm]
TPM 004	5 H 7	7xM5x7	10.9	8,1
TPM 010	6 H 7	7xM6x10	10.9	14
TPM 025	6 H 7	11xM6x12	10.9	14
TPM 050	8 H 7	11xM8x15	10.9	34
TPM 110	10 H 7	11xM10x20	10.9	67
TPMA 025	-	12xM8x12	10.9	34
TPMA 050	-	12xM10x15	10.9	67
TPMA 110	-	12xM12x19	10.9	117

Tbl-6: Thread in output flange (ISO 9409)

9.3 Tightening torques for common thread sizes in general mechanics

	Tightening torques [Nm] for threads												
Property class	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
8.8	1,28	2,9	5,75	9,9	24	48	83	132	200	275	390	530	675
10.9	1,8	4,1	8,1	14	34	67	117	185	285	390	550	745	950
12.9	2,15	4,95	9,7	16,5	40	81	140	220	340	470	660	890	1140

TbI-7: Tightening torques for common thread sizes

9.4 Technical Specifications TPM⁺

9.4.1 Motor data TPM⁺ 320V, i = 16, 21, 31

General data						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Stator length	mm	30	30	45	60	75
Pole pair number	p	4	4	6	6	6
Stall torque	Nm	0,70	1,00	5,40	13,50	16,40
Stall current	A _{eff}	1,80	2,10	9,60	23,20	16,40
Torque constant	Nm / A _{eff}	0,40	0,50	0,56	0,58	1,00
Voltage constant	V _{eff} / krpm	24,35	30,53	34,28	35,18	60,72
Winding resistance at 20 °C	Ohm terminal-terminal	9,39	7,53	0,75	0,15	0,30
Winding inductance	mH terminal-terminal	11,09	7,58	1,98	1,00	2,40
Electrical time constants	msec	0,80	1,01	2,64	6,70	7,40
Data for ratio i = 16						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	2,00	3,70	12,40	28,90	43,90
Maximum current	A _{eff}	5,50	11,00	30,00	69,30	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,23	0,41	2,73	10,60	14,14
Moment of inertia (without brake)	kgcm ²	0,21	0,39	2,61	9,61	13,14

Data for ratio i = 21						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	1,60	3,70	12,40	25,30	43,90
Maximum current	A _{eff}	4,60	11,00	30,00	60,60	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,22	0,41	2,73	10,60	14,14
Moment of inertia (without brake)	kgcm ²	0,20	0,39	2,61	9,61	13,14
Data for ratio i = 31						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	1,40	3,40	10,30	22,30	43,90
Maximum current	A _{eff}	3,90	10,00	24,80	53,30	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,22	0,41	2,74	10,47	13,84
Moment of inertia (without brake)	kgcm ²	0,20	0,39	2,62	9,47	12,84

TbI-8: Motordata TPM⁺ 320V, i = 16, 21, 31

9.4.2 Motor data TPM⁺ 320V, i = 61, 64, 91

General data						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Stator length	mm	15	15	15	15	60
Pole pair number	p	4	4	6	6	6
Stall torque	Nm	0,40	0,70	1,90	3,40	13,50
Stall current	A _{eff}	1,20	1,50	3,20	6,10	22,30
Torque constant	Nm / A _{eff}	0,27	0,45	0,58	0,55	0,58
Voltage constant	V _{eff} / krpm	16,33	27,39	35,35	33,77	35,18
Winding resistance at 20 °C	Ohm terminal-terminal	12,48	13,30	4,49	1,33	0,15
Winding inductance	mH terminal-terminal	10,00	10,00	6,31	3,70	1,00
Electrical time constants	msec	0,45	0,75	1,41	2,80	6,70

Data for ratio i = 61						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,60	1,40	4,30	7,80	22,70
Maximum current	A _{eff}	2,30	3,80	10,00	20,80	54,20
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,14	0,24	1,04	3,41	10,42
Moment of inertia (without brake)	kgcm ²	0,12	0,22	0,92	2,41	9,42
Data for ratio i = 64						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,50	1,30	4,20	7,80	21,60
Maximum current	A _{eff}	2,20	3,60	9,70	20,80	51,60
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,13	0,24	1,03	3,39	10,36
Moment of inertia (without brake)	kgcm ²	0,11	0,22	0,91	2,39	9,36
Data for ratio i = 91						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,40	0,90	2,90	5,80	15,20
Maximum current	A _{eff}	1,50	2,40	6,50	15,00	36,20
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,14	0,24	1,03	3,39	10,36
Moment of inertia (without brake)	kgcm ²	0,12	0,22	0,91	2,39	9,36

Tbl-9: Motor data TPM⁺ 320V, i = 61, 64, 91

9.4.3 Motor data TPM⁺ 560V, i = 16, 21, 31

General data						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Stator length	mm	30	30	45	60	75
Pole pair number	p	4	4	6	6	6
Stall torque	Nm	0,70	1,20	5,50	13,50	16,40
Stall current	A _{eff}	1,00	1,20	5,60	13,40	16,30
Torque constant	Nm / A _{eff}	0,69	0,96	0,98	1,00	1,00

General data						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Voltage constant	Ve _{ff} / krpm	42,18	58,50	59,50	60,94	60,94
Winding resistance at 20 °C	Ohm terminal- terminal	28,18	21,30	2,20	0,45	0,32
Winding inductance	mH terminal- terminal	33,28	22,80	5,95	3,01	2,41
Electrical time constants	msec	1,18	1,10	2,70	6,74	7,42
Data for ratio i = 16						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	2,00	3,80	12,10	28,90	43,90
Maximum current	A _{eff}	3,20	5,20	17,00	40,00	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,23	0,41	2,73	10,60	14,14
Moment of inertia (without brake)	kgcm ²	0,21	0,39	2,61	9,61	13,14
Data for ratio i = 21						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	1,60	3,80	12,10	25,30	43,90
Maximum current	A _{eff}	2,60	5,20	17,00	35,00	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,22	0,41	2,73	10,60	14,14
Moment of inertia (without brake)	kgcm ²	0,20	0,39	2,61	9,61	13,14
Data for ratio i = 31						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	1,40	3,40	10,30	22,30	43,90
Maximum current	A _{eff}	2,20	4,70	14,30	30,80	70,00
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,22	0,41	2,74	10,47	13,84
Moment of inertia (without brake)	kgcm ²	0,20	0,39	2,62	9,47	12,84

TbI-10: Motor data TPM⁺ 560V, i = 16, 21, 31

9.4.4 Motor data TPM⁺ 560V, i = 61, 64, 91

Motor data						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Stator length	mm	15	15	15	15	60
Pole pair number	p	4	4	6	6	6
Stall torque	Nm	0,40	0,70	1,90	3,40	13,50
Stall current	A _{eff}	0,70	0,90	1,80	3,50	12,90
Torque constant	Nm / A _{eff}	0,46	0,78	1,01	0,96	1,00
Voltage constant	V _{eff} / krpm	28,28	47,52	61,25	58,50	60,94
Winding resistance at 20 °C	Ohm terminal- terminal	37,44	40,00	13,46	4,00	0,45
Winding inductance	mH terminal- terminal	30,01	30,00	18,92	11,10	3,01
Electrical time constants	msec	0,80	0,75	1,40	2,80	6,74
Data for ratio i = 61						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,60	1,40	4,40	7,80	22,70
Maximum current	A _{eff}	1,30	2,20	5,90	12,00	31,30
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,14	0,24	1,04	3,41	10,42
Moment of inertia (without brake)	kgcm ²	0,12	0,22	0,92	2,41	9,42
Data for ratio i = 64						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,50	1,30	4,20	7,80	21,60
Maximum current	A _{eff}	1,30	2,10	5,60	12,00	29,80
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,13	0,24	1,03	3,39	10,36
Moment of inertia (without brake)	kgcm ²	0,11	0,22	0,91	2,39	9,36

Data for ratio i = 91						
		TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Maximum torque	Nm	0,40	0,90	2,90	5,80	15,20
Maximum current	A _{eff}	0,90	1,40	3,80	8,70	20,90
Maximum speed	1 / min	6000	6000	6000	5000	5000
Moment of inertia (with brake)	kgcm ²	0,14	0,24	1,03	3,39	10,36
Moment of inertia (without brake)	kgcm ²	0,12	0,22	0,91	2,39	9,36

TbI-11: Motor data TPM⁺ 560V, i = 61, 64, 91

9.4.5 Technical data resolver

Ordering code: TPM_xxxS-xxxR-xxxx-xxxx-xx-xxx		
	TPM ⁺ 004	TPM ⁺ 010; 025; 050; 110
Size	Size 08	Size 15
Type	TS2605 N31 E64	TS2620 N21 E11
Input voltage	7V _{eff} 10kHz	7V _{eff} 10kHz
Ratio	0,5+-5%	0,5+-5%
Fault	+/- 10'max	+/- 10'max
Zero voltage	20mV _{eff} max	20mV _{eff} max
Phase shift	+10° nominal	0° nominal
Impedance ZR0	140 Ohm	70 + j 100 Ohm
Impedance ZS0	-	180 + j 300 Ohm
Impedance ZSS	120 Ohm	175 + j 257 Ohm
Max. operating temperature	155 °C	155 °C

TbI-12: Technical data resolver

9.4.6 Technical specifications Stegmann Hiperface

Singleturn	
Ordering code: TPM_xxxS-xxxN-xxxx-xxxx-xx-xxx	
	TPM ⁺ 004 - 110
Type	SKS36
Operating voltage	7-12V
Protocol	Hiperface
Number of sin/cos periods per revolution	128

Multiturn	
Ordering code: TPM_xxxS-xxxK-xxxx-xxxx-xx-xxx	
	TPM ⁺ 004 - 110
Type	SKM36
Operating voltage	7-12V
Protocol	Hiperface
Number of sin/cos periods per revolution	128
Number of Multiturn revolutions	4096

Tbl-13: Technical specifications Stegmann Hiperface

9.4.7 Technical specifications Heidenhain_EnDat

Singleturn EnDat	
Ordering code: TPM_xxxS-xxxS-xxxx-xxxx-xx-xxx	
	TPM ⁺ 004 - 110
Type	ECN 1113
Operating voltage	5V
Protocol	EnDat 2.1
Distinguishable positions via EnDat protocol/revolutions	8192
Number of sin/cos periods per revolution	512
Multiturn EnDat	
Ordering code: TPM_xxxS-xxxM-xxxx-xxxx-xx-xxx	
	TPM ⁺ 004 - 110
Type	ECN 1125
Operating voltage	5V
Protocol	EnDat 2.1
Distinguishable positions via EnDat protocol/revolutions	8192
Number of sin/cos periods per revolution	512
Number of Multiturn revolutions	4096

Tbl-14: Technical specifications Heidenhain_EnDat

9.4.8 Technical specifications Heidenhain Incremental

Incremental	
Ordering code: TPM_xxxS-xxxI-xxxx-xxxx-xx-xxx	
	TPM ⁺ 004 - 110
Type	ERN 1185
Operating voltage	5V
Number of sin/cos periods per revolution	2048

Tbl-15: Technical specifications Heidenhain Incremental

9.4.9 Technical specifications temperature sensor KTY

KTY 84-130	
Ordering code: TPM_xxxS-xxxx-xKxx-xxxx-xx-xxx	
Temperature [°C]	Resistance, type. [Ohm]
-30	391
-20	424
-10	460
0	498
10	538
20	581
25	603
30	626
40	672
50	722
60	773
70	826
80	882
90	940
100	1000
110	1062
120	1127
130	1194
140	1262
150	1334
160	1407
170	1482
180	1560
190	1640
200	1722

Tbl-16: Technical specifications temperature sensor KTY

9.4.10 Technical specifications temperature sensor PTC

PTC STM 160	
Ordering code: TPM_xxxS-xxxx-xPxx-xxxx-xx-xxx	
Deactivation in case of fault	
Characteristic line in accordance with DIN 44081/44082	
Temperature [°C]	Resistance [Ohm]
< 140 °C	20 - 250 Ohm
140 - 155°C	250 - 550 Ohm
155 - 165°C	550 - 1330 Ohm
165 - 175°C	1330 - 4000 Ohm
> 175 °C	> 4000 Ohm

TbI-17: Technical specifications temperature sensor PTC

9.4.11 Technical specifications brake

Ordering code: TPM_xxxS-xxxx-xxBx-xxxx-xx-xxx						
	Unit	TPM ⁺ 004	TPM ⁺ 010	TPM ⁺ 025	TPM ⁺ 050	TPM ⁺ 110
Voltage	V DC	24	24	24	24	24
Power consumption	A DC	0,4	0,4	0,4	0,8	0,8
Holding torque at 100 °C	Nm	1,1	1,1	2,2	11	11
Opening time	msec	12	12	30	40	40
Closing time	msec	6	6	15	20	20

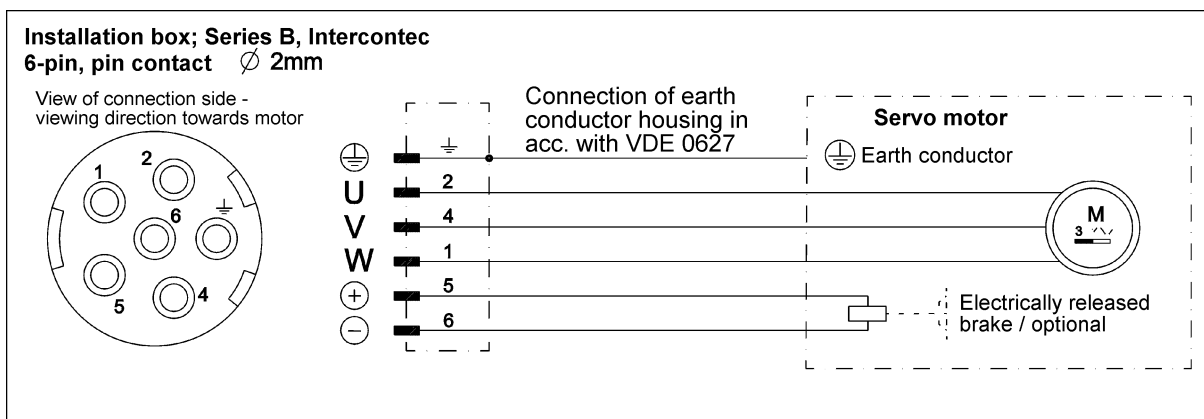
TbI-18: Technical specifications brake

The listed opening and closing times are noted without the use of an additional wiring of the brake.

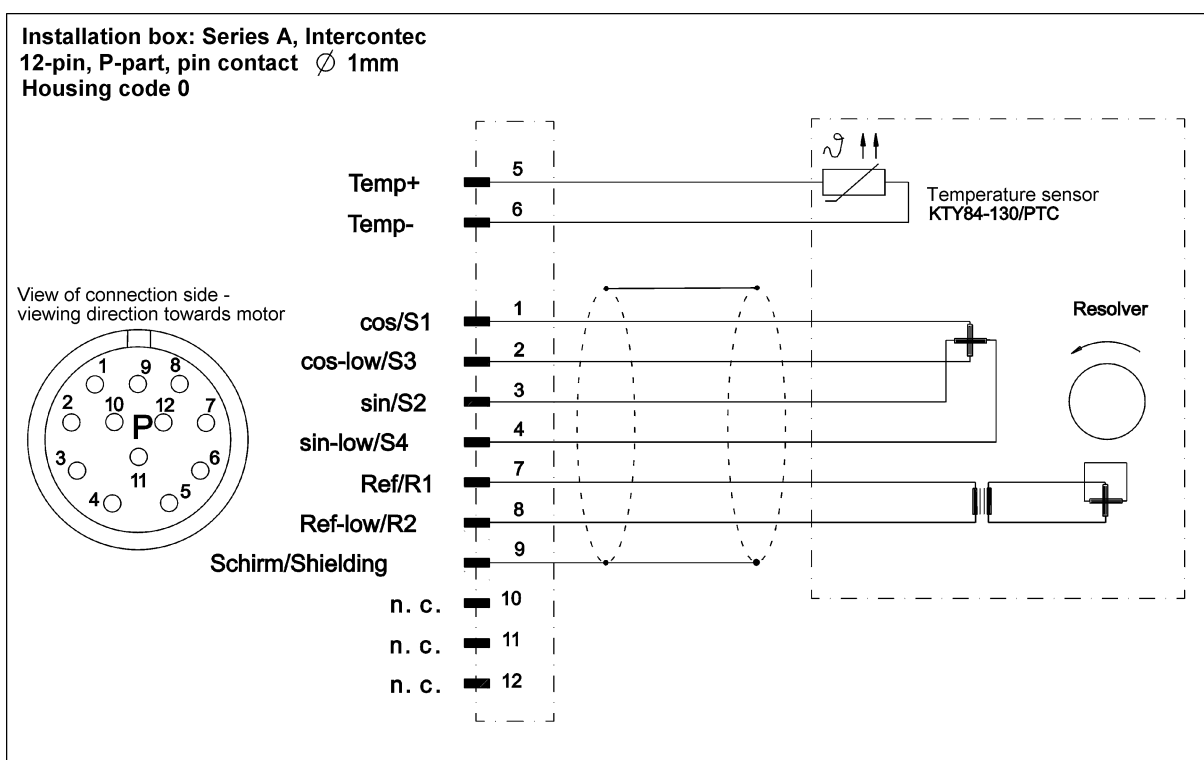
- ① To avoid interfering signals from the switching of the brake, in general an additional wiring, e.g. in form of a varistor, should be added. Please observe the guidelines from the used servo controller manufacturer.

9.4.12 Connection overview: Resolver

Performance – resolver

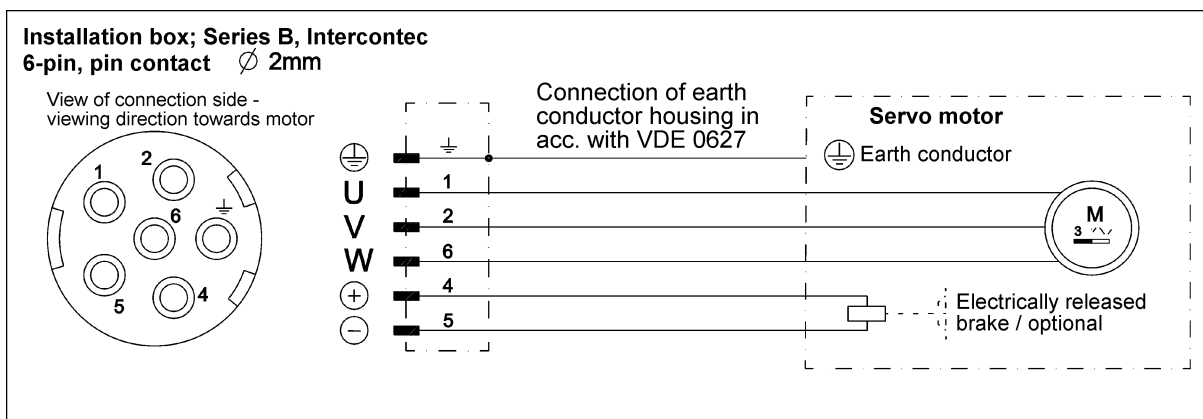


Signal – resolver

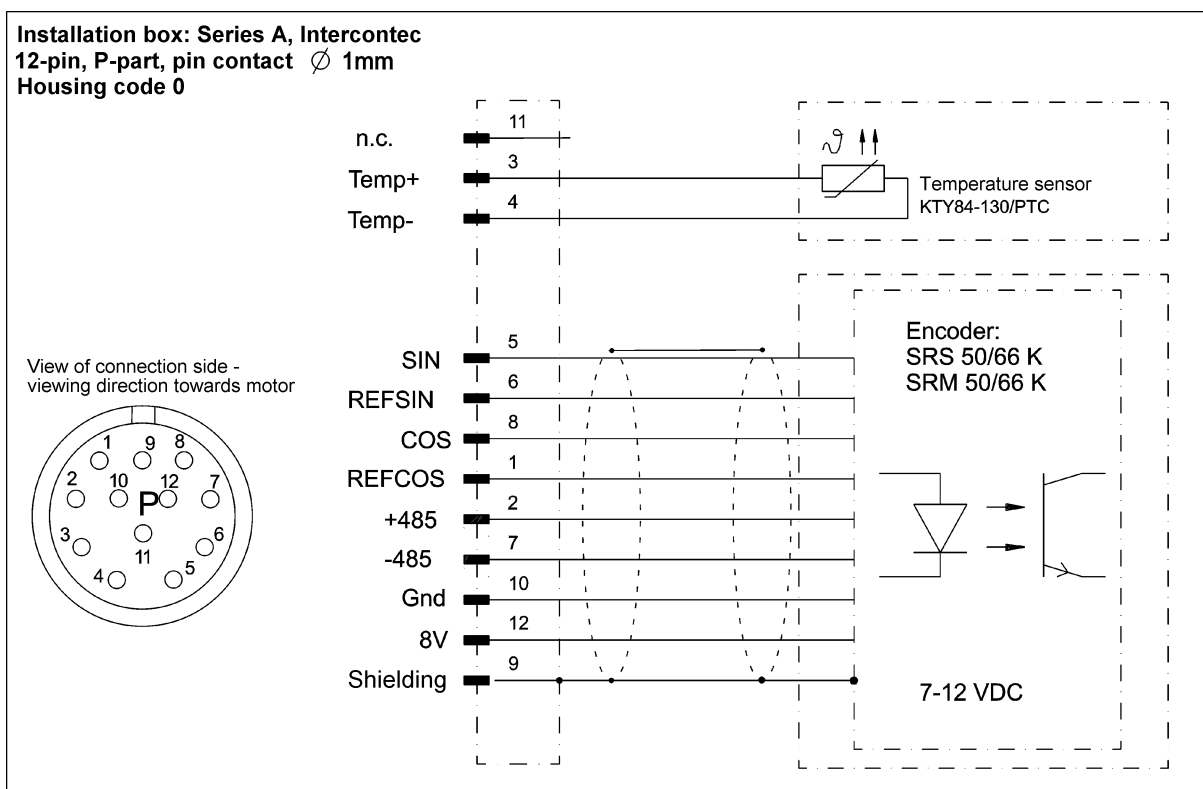


9.4.13 Connection overview: Optical encoder

Optical encoder – performance



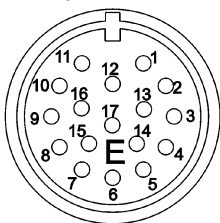
Stegmann encoder – signal



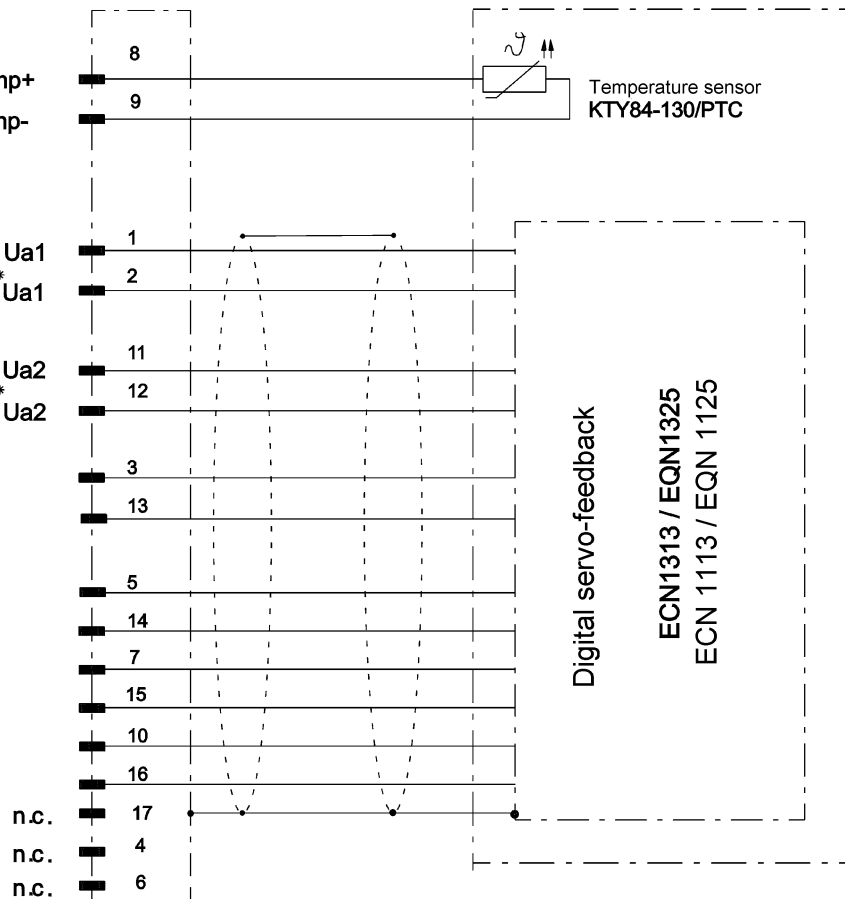
Heidenhain encoder – signal

Installation box: Series A, Intercontec
 17-polig, E-part, pin contact $\varnothing$ 1mm
 Housing code 0

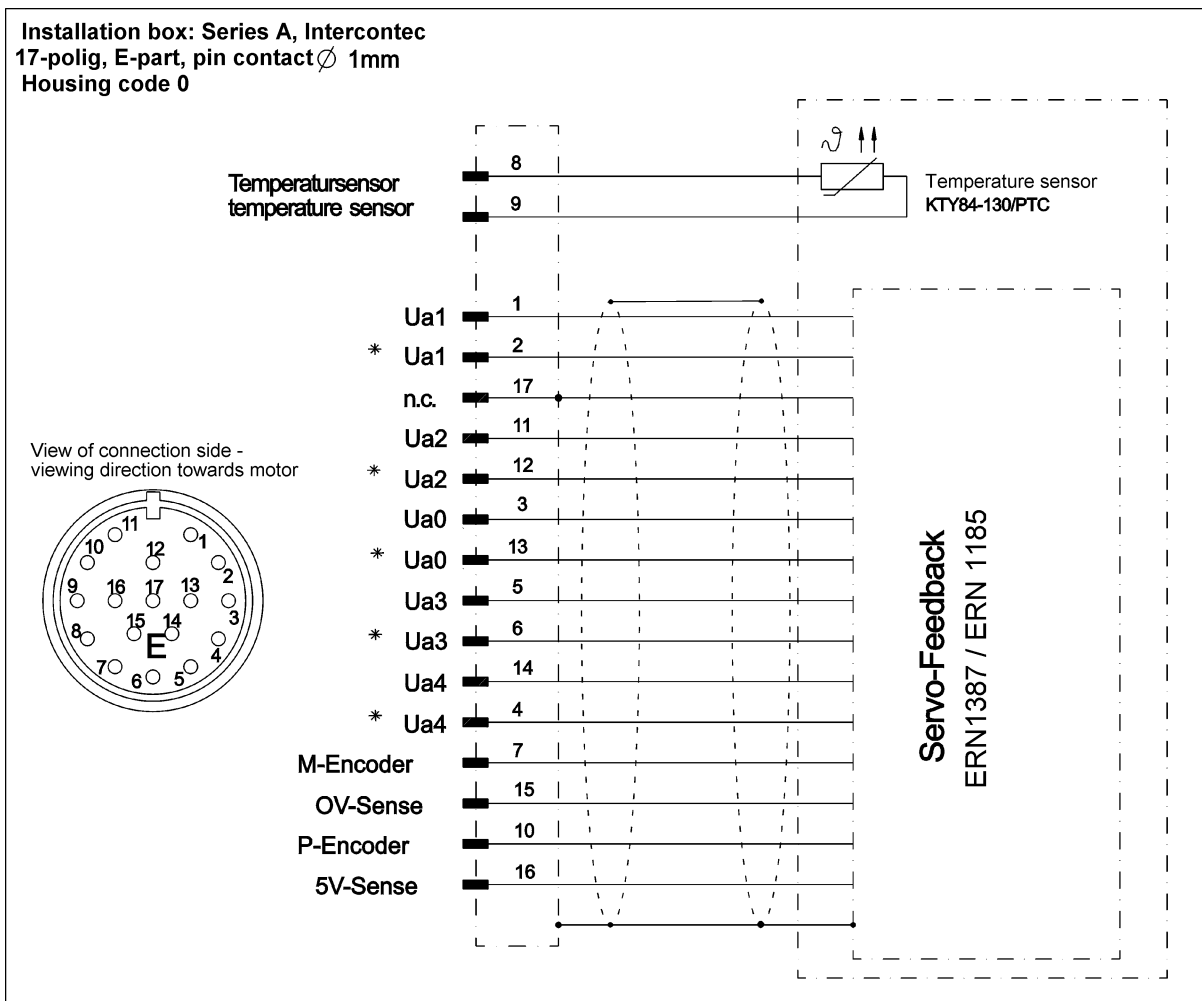
View of connection side -
 viewing direction towards motor



Daten/data
 * Daten/data
 Takt/clock
 * Takt/clock
 M-Encoder
 0V-Sense
 P-Encoder
 5V-Sense



Heidenhain encoder (incremental) – signal



9.4.14 Cable setup/Cable cross-section

For ambient temperatures up to +30 °C the following applies:

Continuous stall current	Cable
up to 16 A	4 x 1,5mm ² & 2 x 0,75mm ²
over 16 A	4 x 2,5mm ² & 2 x 1mm ²

Tbl-19: Cable setup/Cable cross-section