

# Initial Commissioning of Motors

TM460



## **Prerequisites and requirements**

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Training modules	TM210 – Working with Automation Studio TM400 – Introduction to Motion Control TM410 – Working with Integrated Motion Control
Software	Automation Studio 3.0.90 PLCopen library V2.280
Hardware	None

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# Introduction

## 1 INTRODUCTION

The quality of motion control plays a decisive role in determining the quality, precision and dynamic capabilities of the overall process. To maximize this quality, you must first know or calculate the characteristics of the motor as precisely as possible.



B&R drive system

This training module describes the requirements a motor must fulfill in order to be operated on a B&R servo drive. It also explains how to calculate the motor's parameters, insert them in Automation Studio and prepare the motor for operation, step by step.



This documentation applies to the synchronous, induction and linear motors from the ACOPOS system.

The descriptions do not apply to the ACOPOSinverter system.

### 1.1 Training module objectives

With the help of selected examples that illustrate typical application tasks, you will learn how to program and configure the various functions.

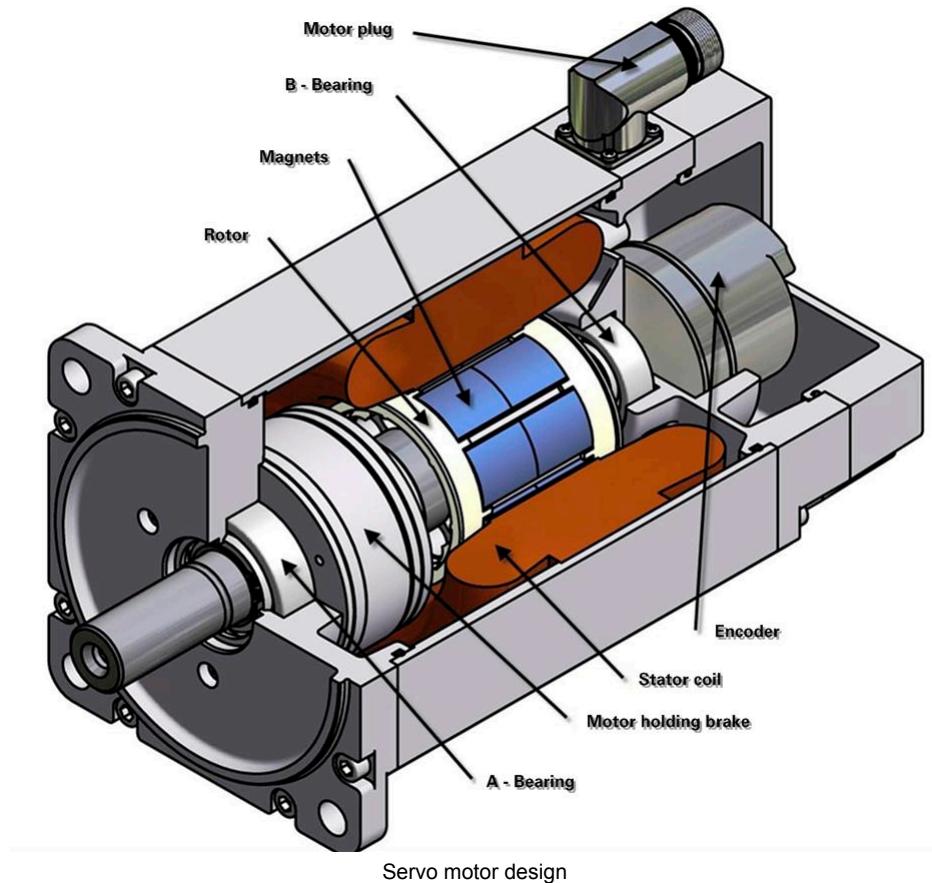
#### You will learn...

- ... the requirements for operating a motor on a B&R servo drive
- ... the characteristics that affect compatibility
- ... the parameters in the parameter table for the motor, encoder, temperature sensor and holding brake
- ... the steps for preparing a motor suitable for operation with the ACOPOS system

## 2 SELECTION CRITERIA

**A number of components are needed to operate a motor on a servo drive:**

- Encoder system:  
The encoder returns the current position of the shaft to the servo drive. There are some applications that work without an encoder interface.
- Temperature sensor:  
The temperature sensor is used to monitor the winding temperature of the connected motor. This monitoring can be used to protect the motor winding and other components from potential overheating.
- Holding brake:  
The holding brake prevents the motor shaft from moving when the controller is switched off and has come to a standstill. It is not a safety criteria, however.



Servo motor design

# Selection criteria

## 2.1 Component compatibility

A general criteria when selecting a motor is to make sure it is compatible with the type of ACOPOS servo drive being used.

A key value here is the electrical stress of the connected motor. For more information on dimensioning, see the Automation Studio Online Help system or the user's manual.



For the ACOPOS and ACOPOSMulti systems, the electrical stress<sup>1</sup> of the connected motor falls under limit curve A as defined in IEC TS 60034-25.



[Hardware \ Motion control \ ACOPOS \ Technical data \ ACOPOS servo drives \ ACOPOS ... \ Technical data](#)

[Hardware \ Motion control \ ACOPOSMulti \ Technical data \ Inverter modules 8BVI ... \ Technical data](#)

[Hardware \ Motion control \ ACOPOS ... \ Dimensioning](#)

### 2.1.1 Motor

The following table contains an overview of potential motor designs and indicates which design can be used with a B&R servo drive:

		Movement type	
		Rotary	Linear
Motor type	Synchronous	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Asynchronous	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Table: Motor type vs. movement type



The most important criterion for the motor is the dielectric strength of the insulation. The motor could suffer considerable damage or even be destroyed if the dielectric strength of the insulation and the motor's maximum rate of rise in voltage are smaller than the servo drive's maximum value.

<sup>1</sup> Limit curves are defined in the IEC TS 60034-25 for coordinating between motors and their isolation system and inverters. These values define the relationship between the maximum occurring phase – phase voltage on the motor terminals and the corresponding rise time. To evaluate an inverter according to a limit curve, all of the PWM edges evaluated must fall below this limit value curve. The ACOPOSMulti inverter modules correspond to the limit curve A in accordance with IEC TS 60034-25. The winding insulation of the connected motors must be suited for loads of the limit value curve A in accordance with IEC TS 60034-25

### 2.1.2 Encoders

The following encoder interfaces can be used in the ACOPOS system:

- EnDat™
- Resolver
- Incremental encoder
- Hiperface™
- SSI
- Sin/Cos encoder



An encoder

EnDat and resolver encoders are used in B&R motors. These encoder systems should also be preferred when using 3rd party motors. When using any interface, make sure that the encoder interfaces match the data of the ACOPOS plug-in cards. In particular, check the counting frequency and the supply voltage.



Induction motors can also be operated without an encoder in UF mode.



Permanent magnet synchronous motors can be controlled when operating without an encoder (PLCopen library V2.300).

Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Encoder interface

Motion \ Reference manual \ ACP10 \ NC objects \ NC object "ncAXIS" \ Controller \ Controller mode "ncUF"

### 2.1.3 Temperature sensor

Although not an absolute requirement, the selected motor should have a temperature sensor. The ACOPOS system supports various types with different functionality. Preferably, type KTY83-110 temperature sensors are to be used.

Type	Description
Linear thermistor	The value of a linear thermistor changes at an approximately linear rate across its measurement range. Either NTC or PTC thermistors can be used. The current motor temperature can be read. The advantage of this is that the motor can be protected actively.
PTC switch	A PTC switch produces a jump in resistance when it reaches the nominal response temperature. It is therefore only possible to determine whether or not the motor is too hot.
Thermal switches	A thermal switch is an encased bimetallic switch equipped with hysteresis, usually in the form of an N.C. switch.

Table: Overview of types and their distinguishing features



If no temperature sensor is used, then monitoring is based only on the calculated temperature model, which is always active in parallel.

## Selection criteria



[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Temperature sensor](#)

[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Temperature model](#)

### 2.1.4 Holding brakes

A holding brake must have a rated voltage of 24 V in order to be controlled directly by the ACOPOS. The maximum current consumption must be lower than the maximum current provided by the ACOPOS.

In cases where a holding brake with different characteristics must be used, it can be connected via an additional circuit.



Cutaway view of a holding brake



[Hardware \ Motion control \ ACOPOS \ Technical data \ ACOPOS servo drives \ ACOPOS ... \ Technical data](#)

[Hardware \ Motion control \ ACOPOSmulti \ Technical data \ Inverter modules 8BVI ... \ Technical data](#)

[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Holding brake](#)

### 3 INSTALLATION

#### 3.1 Delivery

Check the motor for any damage when you remove it from the transport packaging. Protruding parts such as the motor or encoder connectors are at particular risk of damage.

In very rare cases, transport safeguards may have been used on the motor to prevent the rotor from turning. If so, then they must be removed.

If possible, the motor should not yet be connected to the machine mechanics. This is a precaution to prevent potential damage that could occur from unexpected movement during motor setup.

#### 3.2 Wiring

The motor can now be connected to the ACOPOS using the motor cable and encoder cable.

Cables pre-assembled for use with ACOPOS are available for B&R motors. For 3rd party motors, consult the ACOPOS User's Manual for information on the pin assignments for each cable.



Be sure to accurately observe all of the safety notices in the ACOPOS manual when wiring in order to prevent personal and material damage. Failure to observe the safety notices can result in death or injury!



The shielding for the motor and encoder cables absolutely must be connected in order to prevent possible interference which could negatively affect control performance.



[Hardware \ Motion control \ ACOPOS \ Wiring](#)

[Hardware \ Motion control \ ACOPOS \ Wiring \ Cables \ Motor cables \ Cable schematic](#)

# Parameter identification and configuration

## 4 PARAMETER IDENTIFICATION AND CONFIGURATION

All motor characteristics must be specified in order for the servo drive to operate the motor and protect it from damage.



On B&R motors with an EnDat encoder, the motor data is saved directly in the encoder's memory. The ACOPOS system draws them from here automatically.

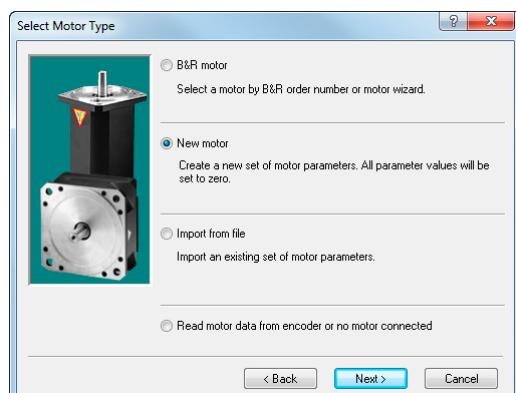
This chapter looks at how to configure the motor in Automation Studio.

Only 3rd party motors are covered, since the data required for B&R motors is already available in Automation Studio.

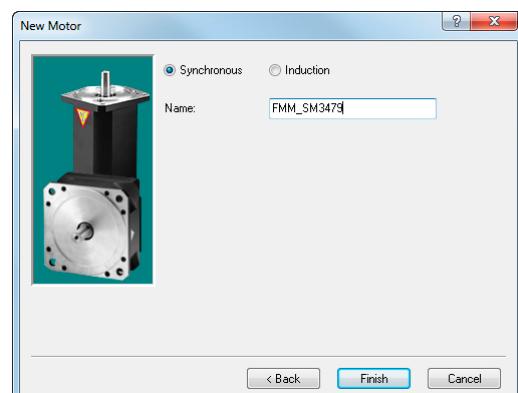
The best way to load the motor data to the servo drive is with a parameter table. This can be assigned directly to the respective axis in the NC mapping table.

### Adding a new motor to the Automation Studio project

When an axis is inserted, a dialog box opens for selecting the motor. Here you can select an existing motor, import motor data or set up a new synchronous or induction motor.



Selecting a new motor



Naming a new synchronous motor

Alternatively, you can insert the parameter group "Motor" into an existing ACOPOS parameter table. When you do this, the same selection dialog boxes appear. These parameter tables can also be used for multiple axes.

Clicking on "Finish" inserts a blank motor template into the parameter table. This contains all of the parameters required for operation.

Name	ID	Value	Unit	Description
IF3.ST1				[8V1090.00-2]
M1				FMM_SM3479
General parameters				
MOTOR_TYPE	30	0x0002		Motor: Type
MOTOR_COMPATIBILITY	31	0x0203		Motor: Software compatibility
MOTOR_WIND_CONNECT	46			Motor: Winding connection
MOTOR_POLEPAIRS	47			Motor: Number of pole-pairs
Brake parameters				
Thermo sensor parameters				
Motor parameters				
Isolation parameters				
MOTOR_WIND_TEMP_MAX	74		°C	Temperature sensor: Limit temperature

Parameter table for a synchronous motor

The drive data can now be entered in the parameter table.



Pay attention to the units used when entering the values. The units are listed in the "Units" column of the parameter table. Descriptions of the various parameters can be found in the Help system.



[Motion \ Reference manual \ ACP10 \ ACOPOS parameter IDs \ Overview](#)

[Motion \ Project creation \ Motion control \ Creating an axis \ Follow wizard](#)

[Motion \ Project creation \ Motion control \ Configuration modules \ ACOPOS parameter table](#)

[Motion \ Project creation \ Motion control \ Configuration modules \ NC mapping table](#)

## 4.1 Synchronous motor

When adding a synchronous motor, you will need all of the motor data.

If any of the required information is not provided in the data sheet, you will need to request it from the manufacturer.

For some parameters, the values can also be measured, estimated or calculated. A complete overview can be found in the Automation Studio Help system.

The ACOPOS applies a replacement value for some parameters. This makes it possible to operate the motor, but there is no guarantee that these values are suitable for a particular motor.



[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Synchronous motor](#)

### Exercise: New synchronous motor

Create a new parameter table and configure the synchronous motor with the model number 110B31-0640-D03JD-AA:

# Parameter identification and configuration

	Series 110B31- 0640- D03JD-AA	Series 110B32- 0700- D03JD-AA	Series 110B33- 0640- D03JD-AA	
<b>Rated Values</b>				
Peak torque (c.d.f. 15%)*	[Nm]	10	17	26
Stall torque (c.d.f. 100%)*	[Nm]	4.5	8	12
Rated torque (c.d.f. 100%)*	[Nm]	3	5	9
Rated speed	[min <sup>-1</sup> ]	3000	3000	1500
Peak current (per phase) (c.d.f. 15%)*	[A <sub>RMS</sub> ]	14.0	14.0	14.0
Stall current (per phase) (c.d.f. 100%)*	[A <sub>RMS</sub> ]	6.4	7	6.4
Rated current (per phase) (c.d.f. 100%)*	[A <sub>RMS</sub> ]	4.4	4.5	4.9
Max. DC link voltage	[V <sub>DC</sub> ]	370	370	370
* Mounting Flange 200 x 240 x 20 mm <sup>3</sup>				
<b>Technical Data Motor</b>				
Motor constant (at 25 °C)	[Nm/W <sup>1/2</sup> ]	0.52	0.79	1.12
Torque constant	[Nm/A]	0.70	1.14	1.88
Voltage constant	[V/1000min <sup>-1</sup> ]	36.6	59.4	97.5
Winding resistance (at 25 °C)	[Ω]	0.90	1.05	1.40
Winding inductivity	[mH]	3.00	4.00	6.00
Maximum current per phase	[A <sub>RMS</sub> ]	14.0	14.0	14.0
Number of pole pairs		3	3	3
Motor inertia	[kgm <sup>2</sup> ×10 <sup>-3</sup> ]	0.57	1.10	1.70
Insulation class		JAT ISO, DV-155 J VIII		
Ambient temperature	[°C]	-20...+40		
Protection class		IP54		
Max. axial load	[N]	250		
Max. radial load	[N]	600		
Max. axial load during assembly	[N]	2000		
Mass	[kg]	6.3	9.5	12.4
Motor length (L)	[mm]	175	225	275

Data sheet for synchronous motor 110B31-0640-D03JD-AA



When using this data sheet for actual operation, the rated voltage must be requested from the manufacturer.



The wire cross section must be specified for the temperature model to function properly.

This is not specified in this data sheet and must be requested from the manufacturer.

If a parameter is set to 0, the ACOPOS assumes a default value. However, the default value provides only moderate protection.

See "[Solution: Synchronous motor configuration](#)"

## 4.2 Induction motor

There are several ways to determine the parameters for configuring the induction motor.

**These include the following:**

- [4.2.1 "Take parameters from the motor data sheet"](#)
- [4.2.2 "Calculate parameters from data on power rating plate"](#)
- [4.2.3 "Automatic parameter identification"](#)

## 4.2.1 Take parameters from the motor data sheet:

A simple way to configure the parameters is to use the data from the data sheet. Some values not listed on the data sheet can be estimated or calculated. Consult the Automation Studio Help system for information on how to determine these values.



It is a good idea to check or recalculate manufacturer specifications.



[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Induction motor](#)

## 4.2.2 Calculate parameters from data on power rating plate

When using an induction motor, all of the required motor characteristics can be calculated using the data from the power rating plate. A calculation table can be found in the Automation Studio Help system.

MOTOR_POWER_RATED	3 ~ Mot.	IP 55/54	Th.Cl.F	(F)
MOTOR_CURR_RATED	IM B3			
MOTOR_VOLTAGE_RATED	V	A	kW	1/min
MOTOR_POWER_FACTOR	350 Y	60,00	28,00	0,88
MOTOR_FREQ_RATED	398 Y	56,00	29,00	0,87
MOTOR_SPEED_RATED	450 Y	52,00	30,00	0,84
	EN 60034			68,0
				2000
				S1
				2300
				S1
				2650
				S1
				max. 8000 /min
			TEMP – SENSOR KTY 84 – 130	ENCODER D01 2048 S/R
				CODE-Nr.: 412

Parameters on the power rating plate

Input			Output		
Please insert the data for the used connection			ACOPOS motor data (star equivalent circuit)		
Parameter	Value	U	Bezeichnung	Wert	U
MOTOR_VOLTAGE_RATED	460	V <sub>rms</sub>	MOTOR_STATOR_RESISTANCE	0,260	Ω
MOTOR_FREQUENCY_NOMINAL	60	Hz	MOTOR_ROTOR_RESISTANCE	0,260	Ω
MOTOR_CURR_RATED	20	A <sub>rms</sub>	MOTOR_MUTUAL_INDUCTANCE	0,1236	H
MOTOR_SPEED_RATED	1765	rpm	MOTOR_STATOR_INDUCTANCE	0,00212	H
MOTOR_POWER_FACTOR	0,924	1	MOTOR_ROTOR_INDUCTANCE	0,00212	H
			MOTOR_POLEPAIRS	2	1
			MOTOR_CURR_STALL	20	A <sub>rms</sub>
			MOTOR_CURR_RATED	20	A <sub>rms</sub>
			MOTOR_CURR_MAX	166,48	A <sub>rms</sub>
			MOTOR_MAGNETIZING_CURR	5,56	A <sub>rms</sub>
			MOTOR_TORQ_STALL	77,97	Nm
			MOTOR_TORQ_RATED	77,97	Nm
			MOTOR_TORQ_MAX	675,29	Nm

Calculation table for missing parameters (from Automation Studio Help system)

# Parameter identification and configuration

Parameter name	Manufacturer data for a motor in star connection	Motor parameter for 2 parallel connected motors in delta connection	Unit
MOTOR_VOLTAGE_RATED	400	230,9	V <sub>ms</sub>
MOTOR_STATOR_RESISTANCE	1,840401864	0,307	Ω
MOTOR_STATOR_INDUCTANCE	0,00499831	0,00083	H
MOTOR_MUTUAL_INDUCTANCE	0,11557379	0,019	H
MOTOR_ROTOR_RESISTANCE	1,840401864	0,307	Ω
MOTOR_ROTOR_INDUCTANCE	0,00499831	0,00083	H
MOTOR_TORQ_STALL	15	30,00	Nm
MOTOR_TORQ_RATED	15	30,00	Nm
MOTOR_TORQ_MAX	40,5	81,00	Nm
MOTOR_CURR_STALL	8,2	28,41	A <sub>ms</sub>
MOTOR_CURR_RATED	8,2	28,41	A <sub>ms</sub>
MOTOR_CURR_MAX	48,36	167,59	A <sub>ms</sub>
MOTOR_MAGNETIZING_CURR	3,451476835	11,96	A <sub>ms</sub>
MOTOR_WIND_CROSS_SECT	1,3000	4,5033	mm <sup>2</sup>
MOTOR_SPEED_MAX	1500	2598	rpm

Calculation table for star-delta and parallel circuits (from Automation Studio Help system)



These values must be entered according to type of motor circuit (Y/Δ)



Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Induction motor \ Parameter estimation from power rating plate data

Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Induction motor \ Parameter conversion for motor connections

## 4.2.3 Automatic parameter identification

Automatic parameter identification is the easiest way to get the exact motor characteristics.

To do this, different test signals are automatically applied to the motor output by the servo drive and their reactions are monitored. The identification quality is determined by matching a model with the measured values.

### Procedure:

- Enter parameters from power rating plate
- Start test procedure
- Evaluate quality of parameters

### Enter parameters from power rating plate

The first step is to enter all the required parameters from the power rating plate:

Parameter	Description
PIDENT_MOTOR_TYPE	1...Induction motor
PIDENT_CURR_RATED	Nominal current
PIDENT_VOLTAGE_RATED	Nominal voltage
PIDENT_SPEED_RATED	Nominal speed
PIDENT_COS_PHI	Active power factor
PIDENT_FREQ_RATED	Rated frequency

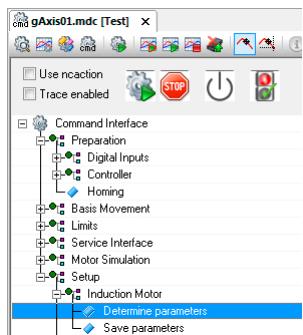
Table: Parameters required for configuration



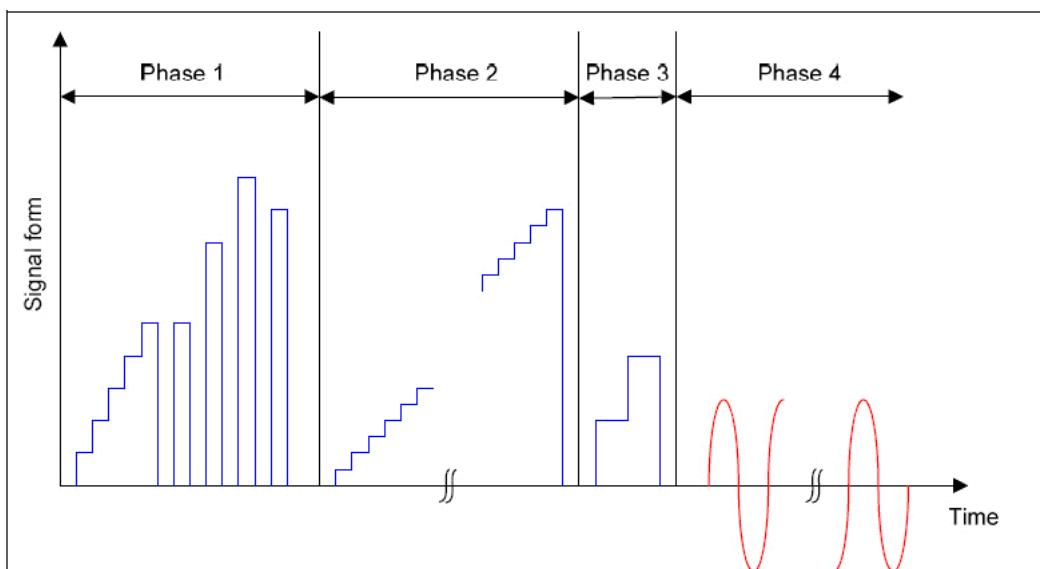
Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Motor data \ Parameter IDs

## Start test procedure

The test procedure can be started from the NC Test or using the parameter CMD\_PIDENT (ParID 997).



Starting parameter identification using the command interface in the NC Test



Signal form for parameter identification



Motion \ Diagnostics \ NC Test \ Command interface

Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Motor data \ Identification of the motor parameters using test signals

## Evaluate quality of parameters

The parameters PIDENT\_STATE (ParID 996) = 0 and PIDENT\_FIT (ParID 998) ≠ 0.0 indicate that the identification process is complete. PIDENT\_FIT indicates whether or not the procedure was successful:

PIDENT_FIT	Evaluation
80.1% ... 100%	Good
60.1% ... 80%	Satisfactory

Table: Evaluating the quality of the identified parameters

# Parameter identification and configuration

PIDENT_FIT	Evaluation
≤ 60%	Unsatisfactory
0.0%	Invalid

Table: Evaluating the quality of the identified parameters

The evaluation can also be read in the NC Test:

Structure			
Name	Value	Unit	Description
nc_obj_inf			NC Object Information
simulation			Simulation Mode
global			Global Parameters
network			Network
dig_in			Digital Inputs
encoder_if			Encoder Interface
limit			Limit value
controller			Controller
move			Movement
setup			Setup
status	ncOFF		Status
detail	ncOFF		Detail
datobj			Data object
motor_induction			Induction motor
status			Status
mode	ncOFF		Mode
ok	ncFALSE		Operation complete
error	ncFALSE		Error
quality	0	%	Quality of parameter identification
parameter			Parameters
motor_phasing			Motor phasing

Reading the quality of the identified parameters in the NC Test

After identification is complete, all parameters can be read and saved in a parameter table. Repeating the procedure 2-3 times can improve the quality of the identification.



Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Motor data \ Procedure

Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Motor data \ Notes

## Exercise: Parameter identification using the power rating plate

Use the power rating plate to create a parameter table for the induction motor AEG AMF V 1325 ZA 2:  
Use the delta circuit parameters:



Power rating plate for induction motor AEG AMF V 1325 ZA 2

See ["Solution: Induction motor configuration"](#)

## 4.3 Synchronous linear motor

The ACOPOS system can be used to operate synchronous linear motors. However, there is an extra step involved. All ACOPOS parameters are designed for rotary axes, so linear motor data must first be converted.

This can be done using the conversion table included in the Automation Studio Help system:

Name	Value	Unit	Name	Value	Unit
MOTOR_POLEPAIR_WIDTH	0.0281	m	t Reference length = $r_p \cdot z_p$ [m]	0.281	m
MOTOR_LINEAR_SPEED_NOMINAL	5	m/s	MOTOR_POLEPAIRS	10	-
MOTOR_LINEAR_SPEED_MAX	5	m/s	MOTOR_SPEED_RATED	1068	min <sup>-1</sup>
MOTOR_FORCE_STALL	10,5	N	MOTOR_SPEED_MAX	1068	min <sup>-1</sup>
MOTOR_FORCE_RATED	10,5	N	MOTOR_TORQ_STALL	0,47	Nm
MOTOR_FORCE_MAX	21	N	MOTOR_TORQ_RATED	0,47	Nm
MOTOR_LINEAR_VOLTAGE_CONSTANT	4,00	V <sub>rms</sub> /(m/s)	MOTOR_TORQ_MAX	0,94	Nm
MOTOR_FORCE_CONST	60	N/A <sub>rms</sub>	MOTOR_VOLTAGE_CONST	18,73	mV/min
MOTOR_MASS	4,7	kg	MOTOR_TORQ_CONST	2,683	Nm/A <sub>rms</sub>
ENCODER: Type	SinCos		MOTOR_INERTIA	0,0094005	kNm <sup>2</sup>
ENCODER: Line length	1000	um/Line	SCALE_ENCOD_INCR	4603904	Inc/p <sub>P</sub>
MOTOR_BRAKE_FORCE_RATED	860	N	MOTOR_BRAKE_TORQ_RATED	38,46	Nm
Input fields: Enter values					
Output fields					

Table for converting linear to rotary axes



Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Synchronous linear motor

Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Synchronous linear motor \ Parameter conversion from linear motor to synchronous motor

### Exercise: Create a parameter table for a linear motor

Create a parameter table for the linear motor BLMX-502-B.

## Parameter identification and configuration

Motor Model	Units	BLMX-382	BLMX-502
<b>Performance Specifications</b>			
Continuous @ 1.36 bar Force 20 psi	N lb	1,030.0 231.0	1,186.0 266.0
Continuous Force, no air	N lb	669.0 150.0	816.0 184.0
Peak Force	N lb	4,120 924	4,744 1064
<b>Electrical Specifications</b>			
Winding Designation		-A -B	-A -B
BEMF, line-line	V/m/s V/in/s	74.02 1.88	145.67 3.70
Continuous @ 1.36 bar Current 20 psi	Amp <sub>pk</sub> Amp <sub>rms</sub>	16.12 11.40	8.06 5.70
Continuous Current, no air	Amp <sub>pk</sub> Amp <sub>rms</sub>	10.47 7.40	5.23 3.70
Force Constant, Sine Drive	N/Amp <sub>pk</sub> lb/Amp <sub>pk</sub> N/Amp <sub>rms</sub> lb/Amp <sub>rms</sub>	63.64 14.35 90.00 20.30	127.28 28.71 180.00 40.60
Motor Constant	N/V/W lb/V/W	3.60 7.57	41.20 9.30
Thermal @ (1.36 bar, 20 psi) Resistance (no cooling)	°C/W	0.11 0.25	0.11 0.24
Resistance, 25°C, line-line	ohms	3.4	13.6
Resistance, 125°C, line-line	ohms	4.8	19.0
Inductance, line-line	mH	3.0	12.0
Max Terminal Voltage	VDC	320	320
<b>Mechanical Specifications</b>			
Air Flow	m <sup>3</sup> /s SCFM	5.4x10 <sup>-3</sup> 11.4	6.4x10 <sup>-3</sup> 13.7
Coil Weight	kg lb	3.4 7.5	4.45 9.8
Coil Length	mm in	382.0 15.0	502.0 19.8
Heat Sink Area [Thickness 25.4mm (1in)]	mm in	254x406 10x16	254x510 10x20
Magnet Track Weight	kg/m lb/ft	37.26 25.10	37.26 25.10
Magnetic Pole Pitch	mm in	30.00 1.18	30.00 1.18

Data sheet for linear motor BLMX-502-B

The values for "MOTOR\_LINEAR\_SPEED\_NOMINAL" and "MOTOR\_LINEAR\_SPEED\_MAX" are not listed:

These can be assumed to be 5 m/s.

See ["Solution: Synchronous linear motor configuration"](#)

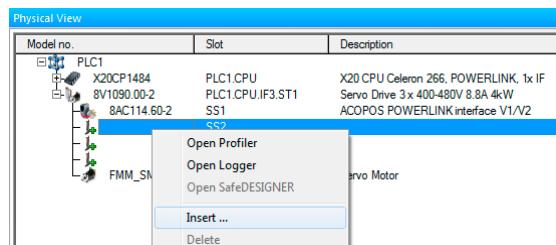
## 4.4 Encoder interface

Once all motor data has been entered in the parameter table, it is time to configure the next component; the encoder. This is done by inserting an encoder interface in the Physical View or by inserting a parameter group that corresponds to the model number of the ACOPOS encoder interface card.

The parameters for the encoder interface are typically entered in the parameter table via the Drive Wizard. You can change the type of encoder interface later on by re-inserting it in the Physical View.

### Insert an encoder interface

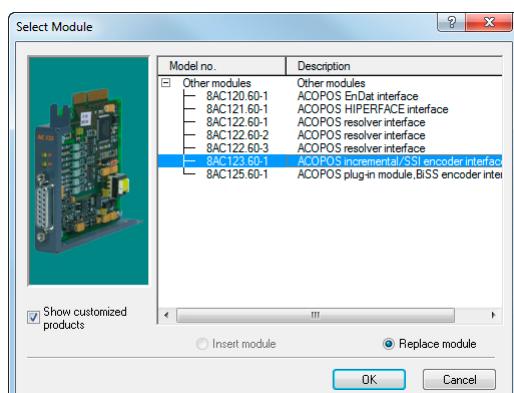
Right click in the Physical View to insert an encoder interface under the drive.



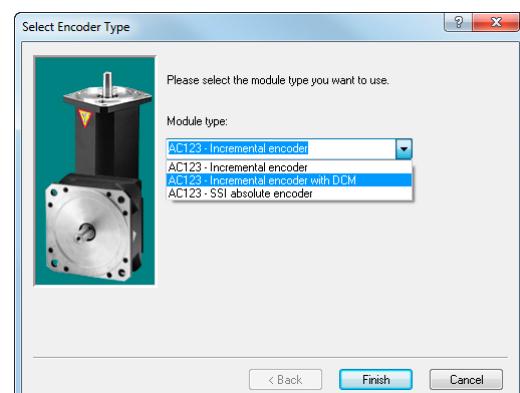
Inserting the encoder interface

Or you can enter the parameter group that corresponds to the model number of the ACOPOS encoder interface card in the ACOPOS parameter table. You need to enter the number of the slot where the encoder interface card will be inserted.

Then you can specify the encoder interface and the exact type of encoder:



Selecting the encoder interface



Selecting the type of encoder: Incremental encoder with DCM2

When you're finished with this dialog box, a parameter group is inserted in the table containing all of the parameters required for operating the encoder.

Name	ID	Value	Unit	Description
IF3.ST1				
M1				
SS2				
ENCOD_TYPE	97	ncINC		Encoder1: Type
SCALE_ENCOD_INCR	109	0		Encoder1: Encoder scaling: increments per SCALE_ENCOD_MOTOR_REV motor revolutions
ENCOD_REF_DCM_DISTANCE	739	0	Lines	Encoder1: DCM Basic distance
ENCOD_REF_DCM_DIFF	21	0	Lines	Encoder1: DCM Distance difference
ENCOD_LINE_CHK_IGNORE	727	0		Encoder1: Ignore check

Parameter group for an incremental encoder with DCM

# Parameter identification and configuration



Motion \ Reference manual \ ACOPOS drive functions \ Motor

Motion \ Reference manual \ ACP10 \ ACOPOS parameter IDs \ Encoder 1, 2, 3

## Exercise: Encoder configuration

Configure the respective plug-in card and encoder for each motor:

- 1) Synchronous motor: EnDat encoder
- 2) Induction motor: Incremental encoder with 512 inc/rev
- 3) Linear motor: Sin/Cos encoder

Parameter	Value / description
Material measure	Graduated metal rule with AURODUR grid division
Division period	20 µm
Therm. expansion coefficient	Depends on the mounting surface
Accuracy class	± 5 µm
Measurement length ML in mm	140
Reference marks	One at the middle of the measurement length
Limit switch	L1/L2 with 2 different magnets Output signals: TTL (without cable driver)
Max. movement speed	240 m/min
Vibration 55 to 2,000 Hz	Vibration 55 to 2000 Hz ≤ 200 m/s <sup>2</sup> (EN 60068-2-6)
Shock 11 ms	≤ 500 m/s <sup>2</sup> (EN 60068-2-27)
Operating temperature	0 to 50°C
Mass	Scanning head: 20 g (not including cable) Scale: approx. 115g + 250 g/m length Connection cable: 70 g/m
Supply voltage	5 V ± 5% / < 200 mA (without load)
Incremental signals	TTL
Signal period	integr. 5x interpolation: 4 µm integr. 10x interpolation: 2 µm
Electrical connection	3 m cable with DSUB plug (15-pin); Interface electronics integrated in the plug
Max. cable length	20 m

Table: Overview of encoder data

The reference length must be used as the basis for calculating the linear motor encoder's resolution. The resolution can also be found in the conversion table (Linear → Rotary).

See "[Solution: Encoder configuration](#)"

## 4.5 Temperature sensor

The parameters required for the temperature sensor are already contained in the motor structure's parameter table and can now be filled in.

Name	ID	Value	Unit	Description
IF3.ST1				8V1090.00-2
M1				FMM_SM3479
General parameters				
Brake parameters				
Thermo sensor parameters				
MOTOR_TEMPSENS_PAR1	64			Temperature sensor: Parameter 1
MOTOR_TEMPSENS_PAR2	65			Temperature sensor: Parameter 2
MOTOR_TEMPSENS_PAR3	66			Temperature sensor: Parameter 3
MOTOR_TEMPSENS_PAR4	67			Temperature sensor: Parameter 4
MOTOR_TEMPSENS_PAR5	68			Temperature sensor: Parameter 5
MOTOR_TEMPSENS_PAR6	69			Temperature sensor: Parameter 6
MOTOR_TEMPSENS_PAR7	70			Temperature sensor: Parameter 7
MOTOR_TEMPSENS_PAR8	71			Temperature sensor: Parameter 8
MOTOR_TEMPSENS_PAR9	72			Temperature sensor: Parameter 9
MOTOR_TEMPSENS_PAR...	73			Temperature sensor: Parameter 10
MOTOR_THERMAL_CONST	75	s		Motor: Thermal time constant for MOTOR_COMPATIBILITY 0x0202
Motor parameters				
Isolation parameters				
MOTOR_WIND_TEMP_MAX	74	°C		Temperature sensor: Limit temperature 8AC123.00
SS2				

Parameters for the temperature sensor



Depending on the particular temperature sensor, certain parameters may or may not be needed. Parameters that are not required should be set to "0.0".



[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Temperature sensor](#)

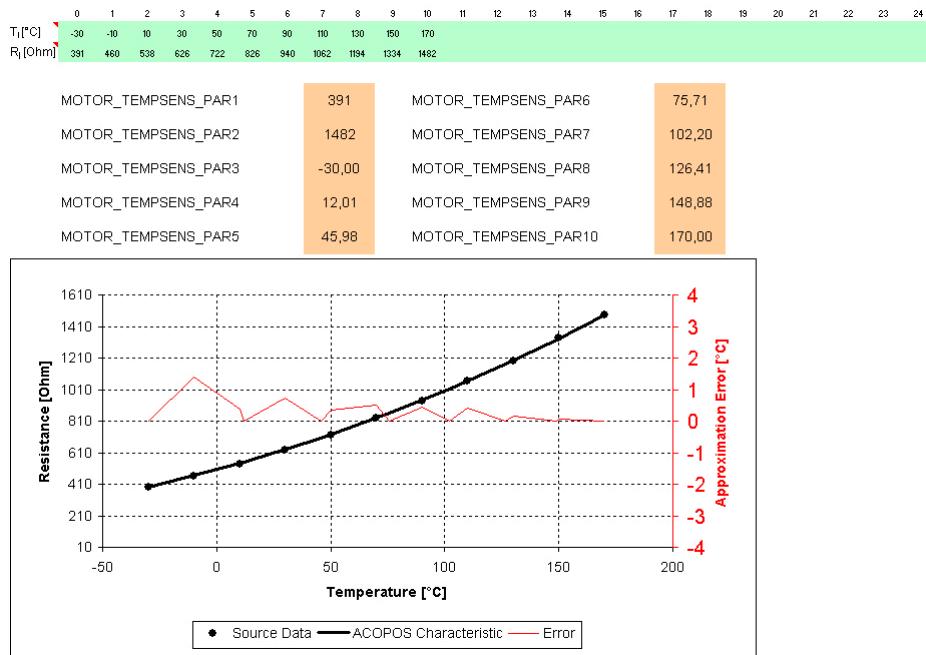
[Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Temperature model](#)

[Motion \ Reference manual \ ACP10 \ ACOPOS parameter IDs \ Temperature sensor](#)

The parameters for the PTC switch and thermal switch can be entered with the help of the data sheet.

For the linear thermistor you'll also need a conversion table. The conversion table can be found in the Automation Studio Help system.

# Parameter identification and configuration



Parameter calculation for a thermistor



Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Temperature sensor \ Thermistor  
  \ Example

## Exercise: Configuration of a temperature module

Configure the following temperature sensors:

- 1) Synchronous motor with a KTY81-120 sensor

Consult the conversion table in the Automation Studio Help system for assistance

AMBIENT TEMPERATURE		TEMP. COEFF. (%/K)	KTY81-110			KTY81-120				
(`C)	(`F)		RESISTANCE (` $\Omega$ )		TEMP. ERROR (K)	RESISTANCE (` $\Omega$ )		TEMP. ERROR (K)		
			MIN.	TYP.		MIN.	TYP.			
-55	-67	0.99	475	490	505	±3.02	470	490	510	±4.02
-50	-58	0.98	500	515	530	±2.92	495	515	535	±3.94
-40	-40	0.96	552	567	582	±2.74	547	567	588	±3.78
-30	-22	0.93	609	624	638	±2.55	603	624	645	±3.62
-20	-4	0.91	669	684	698	±2.35	662	684	705	±3.45
-10	14	0.88	733	747	761	±2.14	726	747	769	±3.27
0	32	0.85	802	815	828	±1.91	793	815	836	±3.08
10	50	0.83	874	886	898	±1.67	865	886	907	±2.88
20	68	0.80	950	961	972	±1.41	941	961	982	±2.66
25	77	0.79	990	1000	1010	±1.27	980	1000	1020	±2.54
30	86	0.78	1029	1040	1051	±1.39	1018	1040	1061	±2.68
40	104	0.75	1108	1122	1136	±1.64	1097	1122	1147	±2.97
50	122	0.73	1192	1209	1225	±1.91	1180	1209	1237	±3.28
60	140	0.71	1278	1299	1319	±2.19	1265	1299	1332	±3.61
70	158	0.69	1369	1392	1416	±2.49	1355	1392	1430	±3.94
80	176	0.67	1462	1490	1518	±2.8	1447	1490	1532	±4.3
90	194	0.65	1559	1591	1623	±3.12	1543	1591	1639	±4.66
100	212	0.63	1659	1696	1733	±3.46	1642	1696	1750	±5.05
110	230	0.61	1762	1805	1847	±3.83	1744	1805	1865	±5.48
120	248	0.58	1867	1915	1963	±4.33	1848	1915	1982	±6.07
125	257	0.55	1919	1970	2020	±4.66	1899	1970	2040	±6.47
130	266	0.52	1970	2023	2077	±5.07	1950	2023	2097	±6.98
140	284	0.45	2065	2124	2184	±6.28	2043	2124	2205	±8.51
150	302	0.35	2145	2211	2277	±8.55	2123	2211	2299	±11.43

Data sheet - KTY81-120

- 2) Induction motor without temperature sensor
- 3) Linear motor with thermal switch (NC)

The sensor is triggered at 120°C.

See "[Solution: Temperature sensor configuration](#)"

# Parameter identification and configuration

## 4.6 Holding brakes

As for the temperature sensors, the parameters for the holding brake are also included in the motor parameters.

PLC1.CPU1F3.ST1.M1 [Motor Parameters]				
Name	ID	Value	Unit	Description
IF3.ST1				8V1090.00-2
M1				FMM_SM3479
General parameters				
Brake parameters				
MOTOR_BRAKE_CURR_RATED	42	A		Motor holding brake: Rated current
MOTOR_BRAKE_TORQ_RATED	43	Nm		Motor holding brake: Rated torque
MOTOR_BRAKE_ON_TIME	44	s		Motor holding brake: Engaging delay
MOTOR_BRAKE_OFF_TIME	45	s		Motor holding brake: Release delay
Thermo sensor parameters				
Motor parameters				
Isolation parameters				
SS2				8AC123.00

Parameters for the holding brake

If a holding brake is used, the respective PartIDs can be written with values. The current and voltage on the servo holding brake connection are monitored. Therefore, all values must be set to 0 if a holding brake is not present in order to prevent error messages.



Motion \ Reference manual \ ACOPOS drive functions \ Motor \ Holding brake

Motion \ Reference manual \ ACP10 \ ACOPOS parameter IDs \ Motor holding brake

### Exercise: Configuring a holding brake

Configure the holding brake 06.P1 for the synchronous motor.

	01.P1	02.P1	03.P1	05.P1	06.P1	07.P1	08.P1	09.P1	10.P1
M <sub>2N</sub> 20° C [Nm]	0,4	1	2	4,5	9	18	38	72	145
M <sub>stat.</sub> 100° C [Nm]	0,35	0,8	1,8	4	8	15	32	65	130
M <sub>dyn.</sub> 20° C [Nm]	0,3	0,8	1,7	3,8	7,5	15	28	55	110
[kgm <sup>2</sup> ]	0,001	0,001	0,001	0,001	0,0015	0,004	0,012	0,036	0,10
[min <sup>-1</sup> ]	3000	3000	3000	3000	2000	2000	2000	2000	2000
W <sub>R0,1</sub> P1 [kJ]	200	300	410	580	890	1290	2900	6200	13000
[kgm <sup>2</sup> ]	0,001	0,001	0,001	0,001	0,0015	0,004	0,012	0,036	0,10
[min <sup>-1</sup> ]	3000	3000	3000	3000	2000	2000	2000	2000	2000
n <sub>max</sub> [min <sup>-1</sup> ]	10000	10000	10000	10000	10000	10000	10000	8000	8000
Anker Teil J									
Armature									
...10 ...20/30 [10 <sup>4</sup> kgm <sup>2</sup> ]	0,01	0,014	0,045	0,122	0,37	1,15	4,00	11,5	39,0
0,013	0,021	0,068	0,18	0,54	1,66	5,56	16,0	53,0	
Gewicht P1.110. Weight [kg]	0,075	0,11	0,15	0,30	0,46	0,9	1,6	2,85	5,35
Schaltzeiten									
Switching times									
t <sub>2</sub> * [ms]	10	12	25	35	40	50	90	140	190
t <sub>i=*</sub> [ms]	2	2	2	2	2	3	3	7	12
t <sub>i=*</sub> [ms]	6	6	6	7	7	10	22	25	65

\* siehe B7, Seite 10

\* see B7, page 10

Legend

M <sub>2N</sub> Nennmoment nach Einlauf (Schlupfzahl 20 min <sup>-1</sup> )	[Nm]	M <sub>2N</sub> rated torque after running in process (slip speed 20 rpm)	[Nm]
M <sub>stat.</sub> 100° C Nennmoment bei 100° C (Schlupfzahl 20 min <sup>-1</sup> )	[Nm]	M <sub>stat.</sub> 100°C rated torque at 100° C (slip speed 20 rpm)	[Nm]
M <sub>dyn.</sub> 20° C Schaltmoment bei angegebenen Bedingungen	[Nm]	M <sub>dyn.</sub> 20° C switching torque at specified conditions	[Nm]
M <sub>erf</sub> erforderliches Drehmoment	[Nm]	M <sub>erf</sub> required torque	[Nm]
M <sub>L</sub> Lastmoment	[Nm]	M <sub>L</sub> load torque	[Nm]
M <sub>A</sub> dynamisches Bremsmoment	[Nm]	M <sub>A</sub> dynamic braking torque	[Nm]
J Massenträgheitsmoment	[kgm <sup>2</sup> ]	J moment of inertia	[kgm <sup>2</sup> ]
P Antriebsleistung	[kW]	P driving power	[kW]
n Drehzahl	[min <sup>-1</sup> ]	n speed	[rpm]
K Sicherheitsfaktor (K≥2)	[·]	K safety factor (K≥2)	[·]
X <sub>min</sub> Nennluftspalt	[mm]	X <sub>min</sub> nominal air gap	[mm]
X <sub>max</sub> maximaler Luftsputz, bei dem der Anker anzieht	[mm]	X <sub>max</sub> max. air gap at which the armature attracts	[mm]
W <sub>R</sub> Reibarbeit	[J]	W <sub>R</sub> friction work	[J]
W <sub>R,0,1</sub> Reibarbeit bis 0,1mm Abrieb	[kJ]	W <sub>R,0,1</sub> friction work until 0,1mm wear	[kJ]

Data sheet - Holding brake 06.P1 (t1...Switch-on delay)

The data sheet doesn't list a nominal current for the holding brake. For this example we can assume a value of 1.2 A.

See "[Solution: Holding brake configuration](#)"

# Commissioning

## 5 COMMISSIONING

Once all the motor components have been configured, we can begin preparing the components for operation. Ideally, the motor shaft can move freely. This simplifies the process.

### 5.1 Holding brakes

The holding brake should first be operated manually (from the NC Test) to ensure functionality.

**The ParID CMD\_BRAKE (ParID 86) can be used to execute the following commands:**

- ncSWITCH\_ON ... Engage brake
- ncSWITCH\_OFF ... Disengage brake

After the switch-off command has been written, you should hear a "clicking" sound and should be able to move the shaft by hand.



In the event of a hanging load, the motor should be located on the lower stop position. Otherwise, the axis will fall when the brake is disengaged which can cause damage to the mechanics.

#### Possible sources of error:

- Holding brake circuit interrupted
- Circuit polarity reversed

### 5.2 Temperature sensor

The startup process for temperature sensors depends on the type of sensor being used:

Sensor type	Testing sequence
Linear thermistor	<ul style="list-style-type: none"><li>• Monitor the temperature in the NC Test at room temperature (without pre-heating or load).</li><li>• The case of over-temperature due to internal or external rise in temperature must be tested.</li><li>• Must be tested for broken connection.</li><li>• Must be tested for broken connection.</li></ul>
PTC switch	<ul style="list-style-type: none"><li>• The case of over-temperature due to internal or external rise in temperature must be tested.</li><li>• Must be tested for broken connection.</li><li>• Must be tested for short circuit.</li></ul>
Thermal switches	<ul style="list-style-type: none"><li>• The case of over-temperature at nominal response temperature due to internal or external rise in temperature must be tested.</li><li>• Over-temperature can be easily tested using switches.</li></ul>

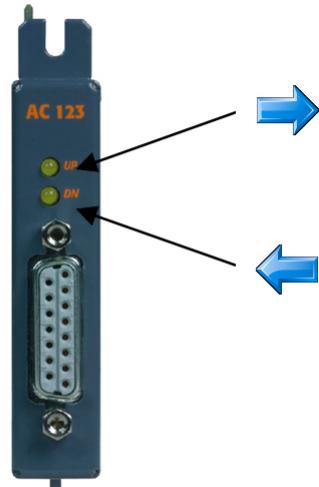
### 5.3 Encoders

Unlike temperature sensors, there is no difference between encoder interfaces when starting up the encoder.

The encoder (or shaft) must first be rotated manually while checking the LEDs on the plug-in card. The LEDs should light up according to the direction of rotation.

The next step is to manually rotate the shaft to a certain degree (preferably 360°) and to monitor how the actual position behaves (direction, resolution).

If open circuit recognition is supported by the encoder, this can be tested by removing the plug from the plug-in card.



AC123 plug-in card - LEDs indicate direction of rotation

**The following conditions may cause the encoder to react in a manner other than expected:**

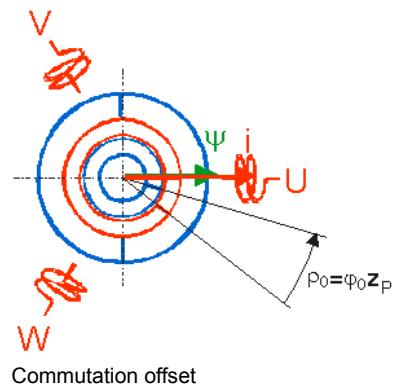
- Incorrect wiring
- Shielding not connected
- Faulty plug-in module or encoder
- Incorrect configuration

### 5.4 Motor phasing

The motor can now be started up. The following sequence is different for synchronous and induction motors. One more important step is needed for synchronous motors without which motor control would not be possible; phasing.

Phasing is used in synchronous motors to determine on which encoder position the field direction rotates. The difference between this position and the current rotor position is known as the "commutation offset"  $\rho_0$ .

Furthermore, phasing can be used to check the wiring as well as the motor and encoder's direction of rotation. The number of pole pairs is also calculated.



With an induction motor, phasing is performed in stepper mode in order to check the wiring, the direction of rotation and the number of pole pairs. Unlike synchronous motors, phasing is not required for operating the motor.

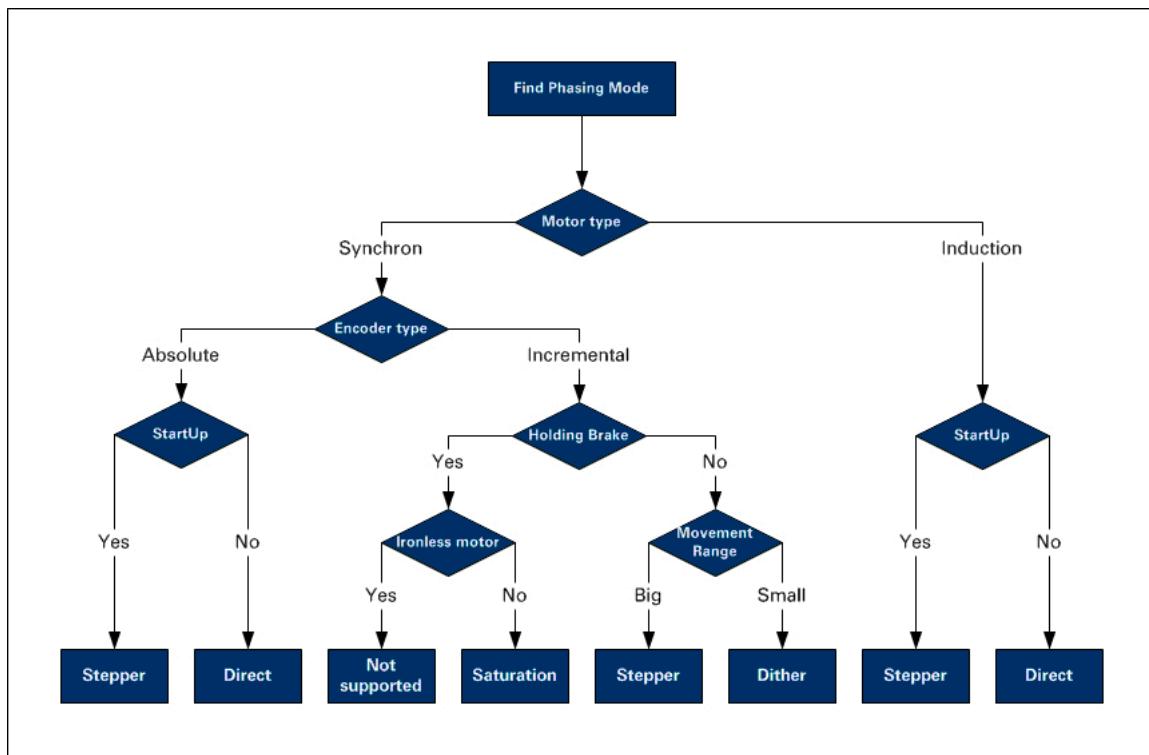
There are a number of factors that determine which phasing should be used.



Make sure that the mode selected is appropriate for the motor and mechanics. Failure to do so can cause serious damage.

# Commissioning

This decision tree and the corresponding table can help you make the right choice:



Parameter ID	Meaning	Permitted values
PHASING_MODE (ParID 276)	Phasing mode	<ul style="list-style-type: none"> <li>• Saturation mode, Saturation (0)</li> <li>• Stepper mode (1)</li> <li>• Dither mode (2)</li> <li>• Direct mode (3)</li> </ul>
CMD_PHASING (ParID 334)	Starting and stopping phasing	<ul style="list-style-type: none"> <li>• ncSWITCH_ON</li> <li>• ncSWITCH_OFF</li> </ul>
MOTOR_COMMUT_OFFSET (ParID 63)	Commutation offset for direct mode (3)	<ul style="list-style-type: none"> <li>• -2PI .. 2 PI [rad]</li> </ul>

Table: Parameter IDs required for phasing

Modes 0 – 2 are used to determine the commutation offset, whereas direct mode is used to set the commutation offset to the value of the parameter MOTOR\_COMMUT\_OFFSET (ParID 63).



The phasing procedure should be repeated and checked 2-3 times to prevent measurement errors.

Once a satisfactory result has been achieved, the value can be stored as a motor parameter in the parameter table when using an absolute value encoder.

When using an incremental encoder, phasing must be repeated each time the ACOPOS is restarted or after each encoder error. This way phasing is performed every time the machine is "switched-on". The advantage of this is that phasing is also performed whenever the motor or encoder is replaced.

Phasing is not necessary when using B&R motors because the commutation offset is either 0 (resolver) or is stored in the EnDat memory.



[Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Phasing \ Parameter IDs](#)

[Motion \ Reference manual \ ACOPOS drive functions \ Drive identification \ Motor \ Phasing \ Function \(Requirements, Selection criteria\)](#)

## 6 CONTROLLER SETTINGS

Once the motor is in operation, the control quality can be improved by fine-tuning the settings for the controller cascade. Information on doing this can be found in training module TM450 and in the Automation Studio Help system.

An integrated auto-tuning process simplifies the process of identifying the control parameters. Autotuning is also supported for hanging loads.



- Motion \ Commissioning \ Autotuning \
- Motion \ Reference manual \ ACOPOS drive functions \ Drive control
- Motion \ Reference manual \ ACOPOS drive functions \ Drive control \ Position controller \ Function \ Feed forward controller
- Motion \ Reference manual \ NC objects \ NC object "ncAXIS" \ Setup (V1.24 and higher) \ Setup for controllers (autotuning)

## 7 COMMISSIONING CHECKLIST

### Component compatibility

Element	Subcategory	Note	OK
2.1.1 "Motor"	Type of motor, type of movement		<input type="checkbox"/>
	Dielectric strength of the insulation		<input type="checkbox"/>
	Rate of rise in voltage		<input type="checkbox"/>
2.1.2 "Encoders"	Encoder interface		<input type="checkbox"/>
2.1.3 "Temperature sensor"	Sensor type		<input type="checkbox"/>
2.1.4 "Holding brakes"	Nominal voltage		<input type="checkbox"/>
	Maximum current		<input type="checkbox"/>

Table: Component compatibility

### Installation

Subcategory	Note	OK
Motor cable properly connected		<input type="checkbox"/>
Motor cable shielded		<input type="checkbox"/>
Encoder cable properly connected		<input type="checkbox"/>
Encoder cable shielded, drive system grounded		<input type="checkbox"/>

Table: Installation

### Parameterization

Element	Subcategory	Note	OK
4 "Parameter identification and configuration"	4.1 "Synchronous motor" 4.2 "Induction motor" 4.3 "Synchronous linear motor"		<input type="checkbox"/>
4.4 "Encoder interface"	Plug-in card		<input type="checkbox"/>
	Interface type		<input type="checkbox"/>
4.5 "Temperature sensor"	Sensor type / Name		<input type="checkbox"/>
4.6 "Holding brakes"			<input type="checkbox"/>

Table: Parameterization

## Commissioning checklist

### Commissioning

Element	Subcategory	Note	OK
5.1 "Holding brakes"	"Clicking" sound when switching		<input type="checkbox"/>
	Shaft able to be rotated by hand		<input type="checkbox"/>
5.2 "Temperature sensor"	Measure room temperature		<input type="checkbox"/>
	Cable break		<input type="checkbox"/>
5.3 "Encoders"	Direction of rotation → LEDs		<input type="checkbox"/>
	Encoder resolution		<input type="checkbox"/>
5.4 "Motor phasing"	Phasing mode → Phasing		<input type="checkbox"/>
	6 "Controller settings"		<input type="checkbox"/>

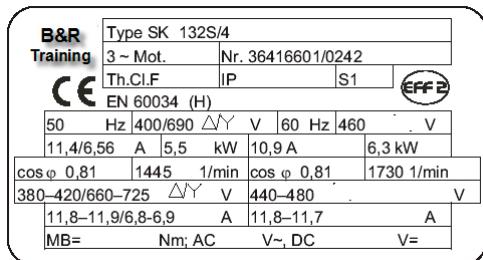
Table: Commissioning

## 8 EXERCISES

### Exercise: Configuration of an induction motor

Configure the following motor and its components:

- 1) Induction motor in a delta circuit



Induction motor parameter chip

- 2) Temperature sensor: KTY83-110

AMBIENT TEMPERATURE			TEMP. COEFF. (%K)	KTY83-110			KTY83-120			
(°C)	(°F)	RESISTANCE (Ω)			TEMP. ERROR (K)	(K)	RESISTANCE (Ω)			
		MIN.	TYP.	MAX.			MIN.	TYP.	MAX.	
-55	-67	0.97	485	500	515	±3.08	480	500	520	±4.11
-50	-58	0.98	510	525	540	±2.99	504	525	545	±4.04
-40	-40	0.93	562	577	592	±2.81	558	577	598	±3.88
-30	-22	0.91	617	632	647	±2.62	611	632	654	±3.72
-20	-4	0.88	677	691	708	±2.42	670	691	713	±3.56
-10	14	0.85	740	754	768	±2.2	732	754	776	±3.37
0	32	0.83	807	820	833	±1.97	798	820	841	±3.18
10	50	0.80	877	899	902	±1.72	868	889	910	±2.97
20	68	0.78	951	962	973	±1.45	942	962	983	±2.74
25	77	0.76	990	1000	1010	±1.31	980	1000	1020	±2.62
30	86	0.75	1027	1039	1050	±1.14	1017	1039	1060	±2.77
40	104	0.73	1105	1118	1132	±1.7	1093	1118	1143	±3.07
50	122	0.71	1185	1202	1219	±1.98	1173	1202	1231	±3.39
60	140	0.69	1268	1288	1309	±2.27	1255	1288	1321	±3.73
70	158	0.67	1355	1379	1402	±2.58	1341	1379	1416	±4.08
80	176	0.65	1445	1472	1500	±2.9	1430	1472	1515	±4.44
90	194	0.63	1537	1569	1601	±3.24	1522	1569	1617	±4.82
100	212	0.61	1633	1670	1707	±3.59	1617	1670	1723	±5.22
110	230	0.60	1732	1774	1816	±3.95	1714	1774	1834	±5.63
120	248	0.58	1834	1882	1929	±4.34	1815	1882	1948	±6.08
125	257	0.57	1886	1937	1987	±4.53	1867	1937	2008	±6.28
130	266	0.57	1939	1993	2048	±4.73	1919	1993	2068	±6.5
140	284	0.55	2047	2107	2167	±5.14	2028	2107	2188	±6.98
150	302	0.54	2158	2225	2292	±5.57	2138	2225	2314	±7.43
160	320	0.52	2272	2346	2420	±6.02	2249	2346	2444	±7.92
170	338	0.51	2389	2471	2553	±6.47	2364	2471	2578	±8.43
175	347	0.51	2449	2535	2621	±6.71	2423	2535	2648	±8.68

Value table - KTY83-110

- 3) Encoders

Incremental encoder with 1024 inc/rev

See ["Solution: Configuration for induction motor exercise"](#)

## Summary

### 9 SUMMARY

Understanding how the various motor parameters work allows us to configure any motor to be used with an ACOPOS system. The quality of the motor parameters and the encoder signal play a key role in determining the control quality of an axis.



A motor should be commissioned step by step, with testing at each step along the way. This is the only quick and effective path to success.

## 10 SOLUTIONS

### Solution: Synchronous motor configuration

MOTOR_VOLTAGE_RATED	48	330	V	Motor: Rated voltage
MOTOR_VOLTAGE_CONST	49	36.6	mV/min	Motor: Voltage constant
MOTOR_SPEED_RATED	50	3000	1/min	Motor: Rated speed
MOTOR_SPEED_MAX	51	9000	1/min	Motor: Maximum speed
MOTOR_TORQ_STALL	52	4.5	Nm	Motor: Stall torque
MOTOR_TORQ_RATED	53	3	Nm	Motor: Rated torque
MOTOR_TORQ_MAX	54	10	Nm	Motor: Peak torque
MOTOR_TORQ_CONST	55	0.70	Nm/A	Motor: Torque constant
MOTOR_CURR_STALL	56	6.4	A	Motor: Stall current
MOTOR_CURR_RATED	57	4.4	A	Motor: Rated current
MOTOR_CURR_MAX	58	14	A	Motor: Peak current
MOTOR_WIND_CROSS_SECT	59	0	mm <sup>2</sup>	Motor: Line cross section
MOTOR_STATOR_RESISTANCE	60	0.9	Ohm	Motor: Stator resistance
MOTOR_STATOR_INDUCTANCE	61	0.0003	Henry	Motor: Stator inductance
MOTOR_INERTIA	62	0.57	kNm <sup>2</sup>	Motor: Moment of inertia
MOTOR_COMMUT_OFFSET	63	0	rad	Motor: Commutation offset
MOTOR_TAU_THERM	849	0	s	Motor: Thermal time constant

Synchronous motor parameter table

### Solution: Induction motor configuration

MOTOR_VOLTAGE_RATED	48	460	V	Motor: Rated voltage
MOTOR_VOLTAGE_CONST	49	0	mV/min	Motor: Voltage constant
MOTOR_SPEED_RATED	50	3440	1/min	Motor: Rated speed
MOTOR_SPEED_MAX	51	10000	1/min	Motor: Maximum speed
MOTOR_TORQ_STALL	52	23.78	Nm	Motor: Stall torque
MOTOR_TORQ_RATED	53	23.78	Nm	Motor: Rated torque
MOTOR_TORQ_MAX	54	183.78	Nm	Motor: Peak torque
MOTOR_TORQ_CONST	55	0	Nm/A	Motor: Torque constant
MOTOR_CURR_STALL	56	15.3	A	Motor: Stall current
MOTOR_CURR_RATED	57	15.3	A	Motor: Rated current
MOTOR_CURR_MAX	58	93.73	A	Motor: Peak current
MOTOR_WIND_CROSS_SECT	59	0	mm <sup>2</sup>	Motor: Line cross section
MOTOR_STATOR_RESISTANCE	60	0.78	Ohm	Motor: Stator resistance
MOTOR_STATOR_INDUCTANCE	61	0.00378	Henry	Motor: Stator inductance
MOTOR_INERTIA	62	0	kNm <sup>2</sup>	Motor: Moment of inertia
MOTOR_COMMUT_OFFSET	63	0	rad	Motor: Commutation offset
MOTOR_ROTOR_INDUCTANCE	76	0.78	Ohm	Motor: Rotor resistance
MOTOR_ROTOR_INDUCTANCE	77	0.00378	Henry	Motor: Rotor inductance
MOTOR_MUTUAL_INDUCTANCE	78	0.1205	Henry	Motor: Mutual inductance
MOTOR_MAGNETIZING_CURRENT	79	5.6	A	Motor: Magnetizing current
MOTOR_TAU_THERM	849	0	s	Motor: Thermal time constant

Induction motor parameter table

### Solution: Synchronous linear motor configuration

MOTOR_VOLTAGE_RATED	48	230	V	Motor: Rated voltage
MOTOR_VOLTAGE_CONST	49	27.17	mV/min	Motor: Voltage constant
MOTOR_SPEED_RATED	50	10000	1/min	Motor: Rated speed
MOTOR_SPEED_MAX	51	10000	1/min	Motor: Maximum speed
MOTOR_TORQ_STALL	52	5.66	Nm	Motor: Stall torque
MOTOR_TORQ_RATED	53	5.66	Nm	Motor: Rated torque
MOTOR_TORQ_MAX	54	22.65	Nm	Motor: Peak torque
MOTOR_TORQ_CONST	55	0.32	Nm/A	Motor: Torque constant
MOTOR_CURR_STALL	56	25.03	A	Motor: Stall current
MOTOR_CURR_RATED	57	25.03	A	Motor: Rated current
MOTOR_CURR_MAX	58	100.13	A	Motor: Peak current
MOTOR_WIND_CROSS_SECT	59	0	mm <sup>2</sup>	Motor: Line cross section
MOTOR_STATOR_RESISTANCE	60	1.3	Ohm	Motor: Stator resistance
MOTOR_STATOR_INDUCTANCE	61	0.001	Henry	Motor: Stator inductance
MOTOR_INERTIA	62	0.0001014	kNm <sup>2</sup>	Motor: Moment of inertia
MOTOR_COMMUT_OFFSET	63	0	rad	Motor: Commutation offset
MOTOR_TAU_THERM	849	0	s	Motor: Thermal time constant

Linear motor parameter table

# Solutions

## Solution: Encoder configuration

SS2	ENCOD_TYPE	97	ncINC	8AC123.00
	SCALE_ENCOD_INCR	109	2048	Encoder1: Type
	ENCOD_LINE_CHK_IGNORE	727	0	Encoder1: Encoder scaling: increments per SCALE_ENCOD_MOTOR_REV motor revolutions Encoder1: Ignore check

Incremental encoder configuration

SS2	ENCOD_TYPE	97	ncINC	8AC123.00
	SCALE_ENCOD_INCR	109	24576000	Encoder1: Type
	ENCOD_LINE_CHK_IGNORE	727	0	Encoder1: Encoder scaling: increments per SCALE_ENCOD_MOTOR_REV motor revolutions Encoder1: Ignore check

Sin/Cos encoder configuration

## Solution: Temperature sensor configuration

Thermo-Sensor-Parameter	MOTOR_TEMPSENS_PAR1	64	567	Temperature sensor: Parameter 1
	MOTOR_TEMPSENS_PAR2	65	2211	Temperature sensor: Parameter 2
	MOTOR_TEMPSENS_PAR3	66	40	Temperature sensor: Parameter 3
	MOTOR_TEMPSENS_PAR4	67	0.91	Temperature sensor: Parameter 4
	MOTOR_TEMPSENS_PAR5	68	30.36	Temperature sensor: Parameter 5
	MOTOR_TEMPSENS_PAR6	69	57.42	Temperature sensor: Parameter 6
	MOTOR_TEMPSENS_PAR7	70	81.71	Temperature sensor: Parameter 7
	MOTOR_TEMPSENS_PAR8	71	104.15	Temperature sensor: Parameter 8
	MOTOR_TEMPSENS_PAR9	72	126.33	Temperature sensor: Parameter 9
	MOTOR_TEMPSENS_PAR10	73	150	Temperature sensor: Parameter 10

Thermistor configuration

Thermo-Sensor-Parameter	MOTOR_TEMPSENS_PAR1	64	0	Temperature sensor: Parameter 1
	MOTOR_TEMPSENS_PAR2	65	0	Temperature sensor: Parameter 2
	MOTOR_TEMPSENS_PAR3	66	120	Temperature sensor: Parameter 3
	MOTOR_TEMPSENS_PAR4	67	0	Temperature sensor: Parameter 4
	MOTOR_TEMPSENS_PAR5	68	0	Temperature sensor: Parameter 5
	MOTOR_TEMPSENS_PAR6	69	0	Temperature sensor: Parameter 6
	MOTOR_TEMPSENS_PAR7	70	0	Temperature sensor: Parameter 7
	MOTOR_TEMPSENS_PAR8	71	0	Temperature sensor: Parameter 8
	MOTOR_TEMPSENS_PAR9	72	0	Temperature sensor: Parameter 9
	MOTOR_TEMPSENS_PAR10	73	0	Temperature sensor: Parameter 10

PTC switch configuration

## Solution: Holding brake configuration

Brake parameters	MOTOR_BRAKE_CURR_RATED	42	1.4	A	Motor holding brake: Rated current
	MOTOR_BRAKE_TORQ_RATED	43	7.5	Nm	Motor holding brake: Rated torque
	MOTOR_BRAKE_ON_TIME	44	0.007	s	Motor holding brake: Engaging delay
	MOTOR_BRAKE_OFF_TIME	45	0.04	s	Motor holding brake: Release delay

Holding brake configuration

## Solution: Configuration for induction motor exercise

Name	ID	Value	Unit	Description
F3 ST2		8V1090.00-2		
SS2		8AC123.00		
ENCOD_TYPE	97	ncINC		Encoder1: Type
SCALE_ENCOD_INCR	109	4096		Encoder1: Encoder scaling: increments per SCALE_ENCOD_MOTOR_REV motor revolutions
ENCOD_LINE_CHK_IGNORE	727	0		Encoder1: Ignore check
M1		FFM_ASM_123		
General parameters				
MOTOR_TYPE	30	0x0001		Motor: Type
MOTOR_COMPATIBILITY	31	0x0203		Motor: Software compatibility
MOTOR_WIND_CONNECT	46	1		Motor: Winding connection
MOTOR_POLEPAIRS	47	2		Motor: Number of pole-pairs
Brake parameters				
MOTOR_BRAKE_CURR_RATED	42	0	A	Motor holding brake: Rated current
MOTOR_BRAKE_TORQ_RATED	43	0	Nm	Motor holding brake: Rated torque
MOTOR_BRAKE_ON_TIME	44	0	s	Motor holding brake: Engaging delay
MOTOR_BRAKE_OFF_TIME	45	0	s	Motor holding brake: Release delay
Thermo sensor parameters				
MOTOR_TEMPSENS_PAR1	64	632		Temperature sensor: Parameter 1
MOTOR_TEMPSENS_PAR2	65	2471		Temperature sensor: Parameter 2
MOTOR_TEMPSENS_PAR3	66	-30		Temperature sensor: Parameter 3
MOTOR_TEMPSENS_PAR4	67	10.76		Temperature sensor: Parameter 4
MOTOR_TEMPSENS_PAR5	68	44.53		Temperature sensor: Parameter 5
MOTOR_TEMPSENS_PAR6	69	74.33		Temperature sensor: Parameter 6
MOTOR_TEMPSENS_PAR7	70	101.11		Temperature sensor: Parameter 7
MOTOR_TEMPSENS_PAR8	71	125.67		Temperature sensor: Parameter 8
MOTOR_TEMPSENS_PAR9	72	148.56		Temperature sensor: Parameter 9
MOTOR_TEMPSENS_PAR10	73	170.00		Temperature sensor: Parameter 10
MOTOR_THERMAL_CONST	75	0	s	Motor: Thermal time constant for MOTOR_COMPATIBILITY 0x0202
Motor parameters				
MOTOR_VOLTAGE_RATED	48	230	V	Motor: Rated voltage
MOTOR_VOLTAGE_CONST	49	0	mV/min	Motor: Voltage constant
MOTOR_SPEED_RATED	50	1445	1/min	Motor: Rated speed
MOTOR_SPEED_MAX	51	6000	1/min	Motor: Maximum speed
MOTOR_TORQ_STALL	52	36.35	Nm	Motor: Stall torque
MOTOR_TORQ_RATED	53	36.35	Nm	Motor: Rated torque
MOTOR_TORQ_MAX	54	216.49	Nm	Motor: Peak torque
MOTOR_TORQ_CONST	55	0	Nm/A	Motor: Torque constant
MOTOR_CURR_STALL	56	11.4	A	Motor: Stall current
MOTOR_CURR_RATED	57	11.4	A	Motor: Rated current
MOTOR_CURR_MAX	58	55.24	A	Motor: Peak current
MOTOR_WIND_CROSS_SECT	59	0	mm²	Motor: Line cross section
MOTOR_STATOR_RESISTANCE	60	0.755	Ohm	Motor: Stator resistance
MOTOR_STATOR_INDUCTANCE	61	0.00673	Henry	Motor: Stator inductance
MOTOR_INERTIA	62	0	kgm²	Motor: Moment of inertia
MOTOR_COMMUT_OFFSET	63	1e+006	rad	Motor: Commutation offset
MOTOR_ROTOR_RESISTANCE	76	0.755	Ohm	Motor: Rotor resistance
MOTOR_ROTOR_INDUCTANCE	77	0.00673	Henry	Motor: Rotor inductance
MOTOR_MUTUAL_INDUCTANCE	78	0.1354	Henry	Motor: Mutual inductance
MOTOR_MAGNETIZING_CURR	79	5.03	A	Motor: Magnetizing current
MOTOR_TAU_THERM	849	0	s	Motor: Thermal time constant
Isolation parameters				
MOTOR_WIND_TEMP_MAX	74	0	°C	Temperature sensor: Limit temperature

Induction motor configuration in delta circuit



# Training modules

## TRAINING MODULES

- TM210 – Working with Automation Studio
- TM213 – Automation Runtime
- TM220 – The Service Technician on the Job
- TM223 – Automation Studio Diagnostics
- TM230 – Structured Software Development
- TM240 – Ladder Diagram (LD)
- TM241 – Function Block Diagram (FBD)
- TM242 – Sequential Function Chart (SFC)
- TM246 – Structured Text (ST)
- TM250 – Memory Management and Data Storage
- TM261 – Closed Loop Control with LOOPCONR
- TM400 – Introduction to Motion Control
- TM410 – Working with Integrated Motion Control
- TM440 – Motion Control: Basic Functions
- TM441 – Motion Control: Multi-axis Functions
- TM450 – ACOPOS Control Concept and Adjustment
- TM460 – Initial Commissioning of Motors
- TM480 – The Basics of Hydraulics
- TM481 – Valve-based Hydraulic Drives
- TM482 – Hydraulic Servo Pump Drives
- TM500 – Introduction to Integrated Safety
- TM510 – Working with SafeDESIGNER
- TM530 – Developing Safety Applications
- TM540 – Integrated Safe Motion Control
- TM600 – Introduction to Visualization
- TM610 – Working with Integrated Visualization
- TM630 – Visualization Programming Guide
- TM640 – Alarms, Trends and Diagnostics
- TM670 – Advanced Visual Components
- TM800 – APROL System Concept
- TM811 – APROL Runtime System
- TM812 – APROL Operator Management
- TM813 – APROL XML Queries and Audit Trail
- TM830 – APROL Project Engineering
- TM890 – The Basics of LINUX

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