HIWIN®

Motion Control & Systems

Assembly Instructions

Linear Motor Axis LMX, LMV

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Contents

1. General information

1.1 About these assembly instructions

1.1.1 Version management

Table 1.1 **Version management**

Version	Date	Comment
05-0	November 2020	LMSSA and Appendix2: Technical data removed from document
04-4	August 2019	Addition of LMSSA, LMX1A
04-3	July 2017	Addition of air bearing system
04-2	October 2016	Update of "Declaration of Incorporation"
04-1	June 2016	Various corrections
04-0	December 2015	Linear motor components removed from document, layout modified
03-0	May 2014	Format modified, technical data modified, new motor type LMSA
02-1	January 2013	Technical data modified
01-0	January 2010	Initial creation of assembly instructions

1.1.2 Requirements

We assume that

- operating staff are trained in the safe operation practices for linear motor axes and have read and understood these assembly instructions in full;
- maintenance staff maintain and repair the linear motor axes in such a way that they pose no danger to people, property or the environment.

1.1.3 Availability

These assembly instructions must remain constantly available to all persons who work with or on the linear motor axes.

1.2 Depictions used in these assembly instructions

1.2.1 Instructions

Instructions are indicated by triangular bullet points in the order in which they are to be carried out.
Results of the actions carried out are indicated by ticks.

Example:

▶ Position the linear motor axis on the mounting holes.
▶ Place the mounting bolts into the mounting holes and tighten in a spiral pattern to a torque of 10 Nm.

✓ Linear motor axis is mounted.

1.2.2 Lists

Lists are indicated by bullet points.

Example:
The linear motor axis must not be operated:

- outdoors
- in potentially explosive atmospheres
- ...

1.2.3 Depiction of safety notices

Safety notices are always indicated using a signal word and sometimes also a symbol for the specific risk (see section 1.2.4 "Symbols used").
The following signal words and risk levels are used:

⚠ DANGER!

Imminent danger!
Non-compliance with the safety notices will result in serious injury or death!

⚠ WARNING!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of serious injury or death!

⚠ CAUTION!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of slight to moderate injury!

ATTENTION!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of damage to property or environmental pollution!

1.2.4 Symbols used

The following symbols are used in these assembly instructions and on the linear motor axes:

Table 1.2 **Warning signs**

	Warning of dangerous electrical voltage!		Warning of hot surfaces!
	Warning of magnetic fields!		Warning of automatic restart or start!
	Risk of hand injuries!		Substance hazardous to the environment!
	Warning of danger from movements!		

Table 1.3 **Mandatory signs**

	Wear protective gloves!		Isolate before work!

1.2.5 Information

NOTE Describes general information and recommendations.

1.3 Warranty and liability

The manufacturer's "General conditions of sale and delivery" apply.

1.4 Manufacturer's details

Table 1.4 **Manufacturer's details**

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Phone	+49 (0) 781 932 78-0
Technical customer service	+49 (0) 781 932 78-77
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Technical customer service fax	+49 (0) 781 932 78-97
E-mail	info@hiwin.de
Website	www.hiwin.de

1.5 Copyright

1.6 Product monitoring

Please inform HIWIN, the manufacturer of the linear motor axes, of:

- accidents
- potential sources of danger in the linear motor axes
- anything in these assembly instructions which is difficult to understand

2. Basic safety notices

⚠ DANGER!

Danger from strong magnetic fields!
Strong magnetic fields around linear motor axes pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.

- ▶ Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from linear motor axes.

ATTENTION!

Risk of physical damage to watches and magnetic storage media.
Strong magnetic forces may destroy watches and magnetisable data storage media near to the linear motor axes!

- ▶ Do not bring watches or magnetisable data storage media into the vicinity (<300 mm) of the linear motor axes!

2.1 Intended use

The linear motor axes is a linear drive and guiding system for the precise positioning of fixed mounted loads, e.g. system components within an automated system, in terms of time and location.
The LMX linear motor axes are designed for installation and operation in horizontal positions and therefore do not feature parking brakes in their standard versions. In the case of vertical assembly, a parking brake, weight compensation device or both must be retrofitted. The loads to be moved must either be mounted on to the forcer or the end plates.
The LMV1L-SA linear motor axis can be used for vertical applications. This type features magnetic weight compensation. An optional parking brake can be installed. The loads to be moved must either be mounted on to the forcer or the end plates.

The linear axes can be mounted on top of one another to create multi-axis systems.
The specified linear motor axis systems may not be used outdoors or in hazardous areas where there is a risk of explosions.
All linear motor axis systems may only be used for the stated intended purpose.

- The linear motor axis system must be operated within its specified performance limits (see Chapter 4 "General technical data").
- Observation of the assembly instructions and compliance with the maintenance and repair regulations are prerequisites for the intended use of the linear motor axis system.
- Any other use of the linear motor axis system shall be considered as contrary to the intended use.
- Use only genuine spare parts from HIWIN GmbH.

2.2 Reasonably foreseeable misuse

The linear motor axis must not be operated:

- Outdoors
- In potentially explosive atmospheres

2.3 Conversions and modifications

Conversions or modifications of the linear motor axis are not permitted!

2.4 Residual risks

Normal operation of the linear motor axis constitutes no residual risks.
Warnings about risks that may arise during maintenance and repair work are provided in the relevant sections.

2.5 Personnel requirements

Only authorised persons may carry out work on the linear motor axis! They must be familiar with the safety equipment and regulations before starting work (see Table 2.1).

Table 2.1 **Personnel requirements**

Activity	Qualification
Normal operation	Trained personnel
Cleaning	Trained personnel
Maintenance	Trained specialist personnel of the operator or manufacturer
Repairs	Trained specialist personnel of the operator or manufacturer

2.6 Protective equipment

2.6.1 Personal protective equipment

Table 2.2 **Personal protective equipment**

Operating phase	Personal protective equipment
Normal operation	When in the vicinity of the linear motor axis, the following personal protective equipment is required: – Safety shoes
Cleaning	When cleaning the linear motor axis, the following personal protective equipment is required: – Safety shoes
Maintenance and repairs	When carrying out maintenance and repairs, the following personal protective equipment is required: – Safety shoes

2.6.2 Protective equipment on the linear axis

Linear axes are fitted with end position dampers.

- After every traverse, these dampers must be tested at the end positions and, if necessary, replaced.
- The machine may not be operated without end position dampers or when they are damaged!

2.7 Labels on linear motor axes

2.7.1 Warning symbols

Table 2.3 **Warning symbols**

Pictogram	Type and source of danger	Protective measures
	Danger from strong magnetic fields!	Persons whose health may be endangered by strong magnetic fields must keep a safe distance (1 m) from the linear motor axes!
 	Danger of electric shock!	Disconnect the power supply of the linear motor axes before maintenance or repairs!
	Danger from hot surfaces!	Let hot surfaces cool down before touching them!
	Danger from movements!	Keep out of the machine's area of movements! Prevent unauthorised access to the danger area! Secure vertical linear motor axes against lowering or falling after switching OFF the motor!
	Risk of hand injuries!	Constant force spring (weight compensation): Do not unmount stator and slider!

2.7.2 Type plate

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Type: LMX1A-SA21-1-0872-A-1-E-0-CL
S/N: HSN0000002009
Art. No: 8.00930 Year built: 2020

Rated current I_c:	2.1A	Mass of stage:	42kg
Rated force F_c:	103.0N	Max. DC bus:	500 VDC
Max. current I_p:	6.3A	Temp.sensor:	PTC120
Max. force F_p:	289.0N		

Fig. 2.1 **Type plate – here for an LMX1A linear motor axis**

3. Description of the linear motor axis

3.1 Field of application

The linear motor axis is used for traversing and (linear) movement of fixed mounted loads on the carriage. Depending on the model, it can be mounted and operated horizontally or vertically.

3.2 Main components of the linear motor axis

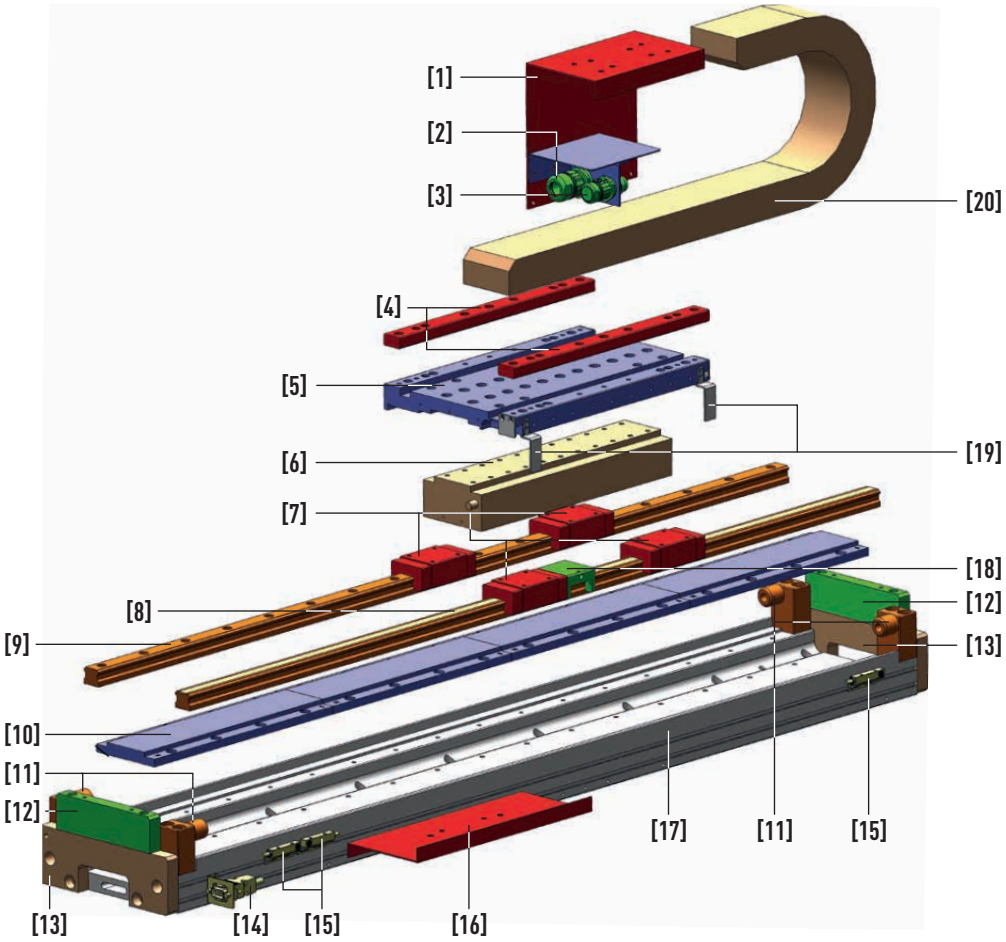


Fig. 3.1 **Main components of the linear motor axis**

Table 3.1 **Main components of the linear motor axis**

Pos.	Component	Pos.	Component
1	Holding plate for energy chain	11	Stopping buffer
2	Motor plug coupling	12	Spacer for sheet metal cover (optional)
3	Encoder plug coupling	13	Profile end caps
4	Assembly plates for sheet metal cover (optional)	14	Limit and reference switch connectors
5	Carriage (forcer carrier plate)	15	Limit and reference switches with mounting bracket
6	Forcer (primary part of linear motor)	16	Holding plate for energy chain
7	Linear guideway blocks	17	Basic profile
8	Rail with magnetic scale (MAGIC-PG)	18	MAGIC-PG distance measuring system
9	Standard rail	19	Cam switches for limit and reference switches
10	Stator (secondary part of linear motor)	20	Energy chain, cable routing

3.3 Functional description

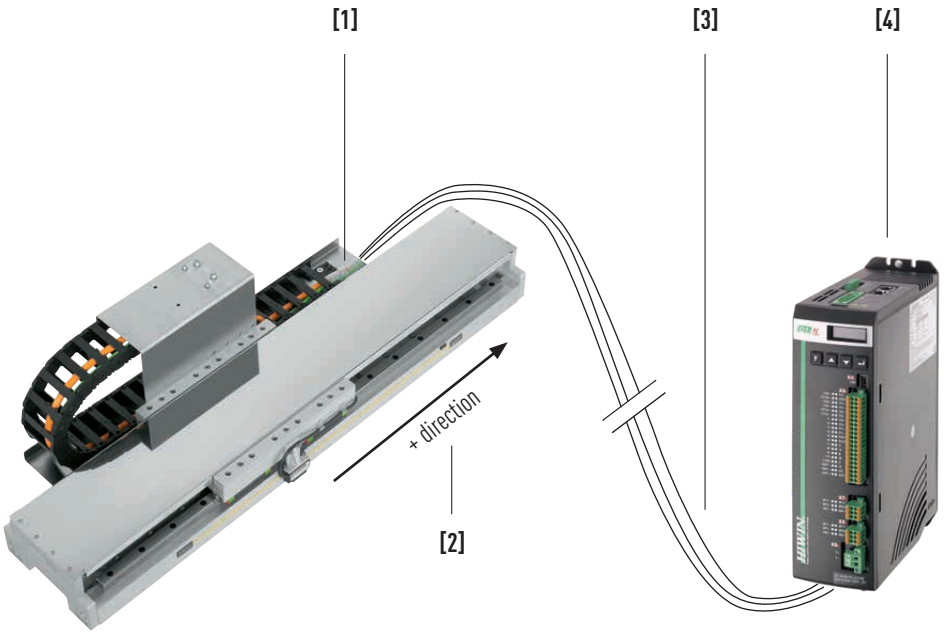


Fig. 3.2 **Principle of the linear motor axis**

Table 3.2 **Components and functionality**

Pos.	Function
1	Energy supply (standard version or customer-specific version)
2	Positive (+) direction of motion. This is defined via the position of the reference switch. By default, this is located on the same side as the limit switch connector
3	Motor cables, distance measuring system, limit switches
4	Drive D1-N

A linear motor axis comprises a basic profile with integrated linear guideways. These both absorb the forces exerted by the weights, accelerations, and processes and provide precise guiding for the carriage. The axis is driven by linear motors.

A linear motor consists of two components, the forcer (primary part) with coils and the stator (secondary part) with permanent magnets. The coils carrying alternating current generate a magnetic field that changes over time and interacts with the steady magnetic field of the stator. The resulting force is used to generate linear motion.
The linear motor components are supplied as separate parts.

The distance travelled is measured by a high-resolution distance measuring system that is either integrated in the rail or mounted on the side of the basic profile. The motor, limit switch, and distance measuring system cables are routed through the energy chain to the drive. The current this supplies to the motor is such that the linear motor axis carriage executes precisely that movement specified e.g. by a higher level controller.

3.4 Linear motor axis types

3.4.1 LMX1A

- Complete axis with iron-core motor, type LMSA
- Ideal for applications with high continuous power requirements
- Optional enclosure by metal cover or bellow cover
- Stroke is measured via optical or magnetic distance measuring system incrementally or absolutely depending on requirements

3.4.2 LMX1E

- Complete axis with coreless motor, type LMC
- Ideal for applications with a high degree of synchronization requirements
- Optional enclosure by metal cover or bellow cover
- Stroke is measured via optical distance measuring system incrementally or absolutely

3.4.3 LMV

- Highly dynamic positioning axis, for vertical and horizontal applications
- Compact, zero-play setup
- Maximised mechanical rigidity
- Protected against dust

3.4.4 LMX1L-SC

- Load mounted securely on carriage
- Horizontal mounting position
- Motor type LMSC
- Forcer arranged between two stators for high power density on short carriages
- Optical or magnetic distance measuring systems (incremental/absolute)

3.4.5 Cross table

- Combination of axis from the LMX series
- With coreless or iron-core motors

3.4.6 Gantry systems

- Standardized gantry systems with coreless motors or iron-core motors

3.5 Linear motor types

LMCxx – the dynamic sprinter

- Three-phase, ironless synchronous linear motor
- Lightweight and extremely dynamic
- Extremely high synchronism
- Sandwich arrangement of permanent magnets suppresses magnetic forces of attraction in the guiding system
- Intermediate circuit voltage up to 340 VDC
- Suitable for drives with up to 240 VAC

LMSxx – the solid all-rounder

- Three-phase, iron-core synchronous linear motor
- High power density
- Low cogging torque
- Intermediate circuit voltage up to 600 VDC
- Suitable for drives with up to 3 × 420 VAC

LMSAxx – the compact power pack

- Three-phase, iron-core synchronous linear motor
- Very high power density
- Very flat design
- Intermediate circuit voltage up to 600 VDC/750 VDC
- Suitable for drives with up to 3 × 420 VAC

LMSCxx

- Three-phase, iron-core synchronous linear motor
- The forcer arranged between two stators suppresses magnetic forces of attraction
- This reduces the load on the guiding rail and generates a high power density on a relatively short carriage
- Intermediate circuit voltage up to 600 VDC
- Suitable for drives with up to 3 × 420 VAC

LMFAxx – the cooled heavy-duty drive

- Three-phase, iron-core synchronous linear motor
- Efficient liquid cooling system
- High power density
- Minimal cogging torque
- Intermediate circuit voltage up to 750 VDC
- Suitable for drives with up to 3 × 560 VAC

3.6 Distance measuring system

3.6.1 Linear distance measuring system

NOTE

Please note the documentation included with this product for distance measuring systems not described in these assembly instructions.

Depending on its type, the linear motor axis features an optical or a magnetic distance measuring system. The installed distance measuring system is fully cabled and is connected to the controller via a separate connector (see Section 6.6.4).

3.6.2 Optical distance measuring system

ATTENTION!

Damage of the measuring scale caused by scratching!
The measuring scale of the optical measuring system may be damaged by improper handling.
▶ Handle the measuring scale with care!

NOTE

For assembly, disassembly, operation and cleaning, please consult the manufacturer's separate operating instructions.

Characteristics:
- Works on a non-contact basis
- Various resolutions available
- Fitted with flexible measuring scale and reference marker
- On the LMX1L and LMX1E, the measuring scale is protected with a cover plate

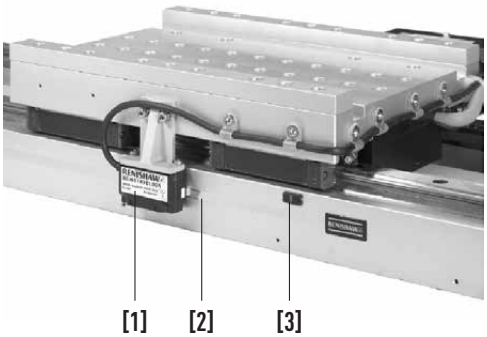


Fig. 3.3 **Optical distance measuring system**

Table 3.3 **Optical distance measuring system components**

Pos.	Components
1	Optical sensor
2	Measuring scale
3	Reference marker

3.6.3 HIWIN MAGIC magnetic distance measuring system

ATTENTION!

Damage to the magnetic distance measuring system!
Strong magnetic fields and vibrations can damage the magnetic distance measuring system.
- ▶ Protect the magnetic distance measuring system against strong magnetic fields!
- ▶ Protect the magnetic distance measuring system against strong vibrations!

Characteristics:
- Suitable for use in harsh industrial environments
- Oil, dirt, vibration, and shock resistant
- Electrically shielded housing
- Signal output in real time

Fig. 3.4 **HIWIN MAGIC magnetic distance measuring system**

Table 3.4 **HIWIN MAGIC components**

Pos.	Components
4	Encoder
5	Magnetic scale

The distance measuring system consists of a magnetic measuring body on a stainless steel carrier strip, the magnetic scale **[5]**, and the encoder **[4]**.
In most cases, the magnetic scale is attached to the side of the linear motor axis and protected under a cover plate against contact. The encoder is fitted on the carriage.

See the separate assembly instructions for further technical details of the HIWIN MAGIC and HIWIN MAGIC-PG distance measuring systems.

NOTE

3.6.4 HIWIN MAGIC-PG magnetic distance measuring system

ATTENTION!

Damage to the magnetic distance measuring system!
Strong magnetic fields and vibrations can damage the magnetic distance measuring system.
- ▶ Protect the magnetic distance measuring system against strong magnetic fields!
- ▶ Protect the magnetic distance measuring system against strong vibrations!

Characteristics:
- Suitable for use in harsh industrial environments
- Oil, dirt, vibration, and shock resistant
- Electrically shielded housing
- Signal output in real time
- Available for HG20 and HG25 sizes

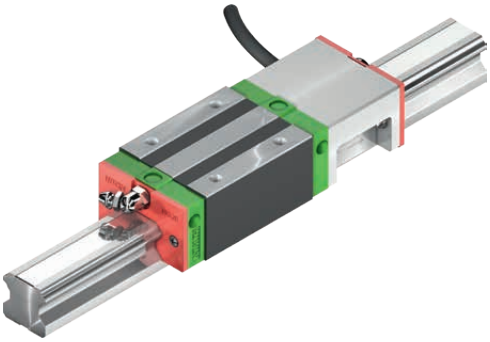


Fig. 3.5 **HIWIN MAGIC-PG magnetic distance measuring system**

3.7 Limit switches

Depending on the type, two optical or two inductive PNP-switching proximity switches generate a signal to the controller upon reaching the end of the travel distance. The limit switches are supplied pre-wired and operational (for pin assignment see Section 6.6.5).

3.8 Energy chain (optional)

Characteristics:
- Safe and protected cable routing
- Available in standard size or to suit customer needs
- Supplied assembled and ready for use
- Complies with UL, CSA, IEC and CE standards

Please observe manufacturer's instructions for retrofitting.

3.9 Clamping element (optional)

Clamping elements are not suitable for repeated braking as they wear quickly. NOTE

The response time of the clamping element depends on the cross-section and the length of the compressed air connection between the brake and the ventilation shift valve. The shifting time of the valve must also be considered. NOTE

For connections, see Section 6.6.10

Characteristics:

- Pneumatic clamping element
- Emergency stop capability (activated at zero pressure)
- Mounted between blocks in order not to affect dimensions and travel distance
- Can be supplied in various sizes
- Holding force between 200 and 800 N
- Operating pressure between 5.5 and 6 bar
- Applicable in parallel for higher holding forces

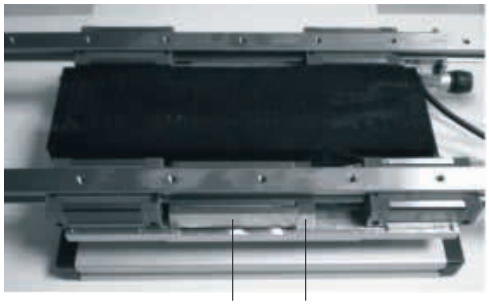


Fig. 3.6 **Pneumatic clamping element**

Table 3.5 **Clamping element components**

Pos.	Component
1	Clamping element
2	Pneumatic connection

3.10 Pneumatic weight compensation (optional)

Characteristics:

- Reduces the force load of the linear motor axis during vertical movements
- Available for all LMX and LMV linear motor axes
- Operating pressure max. 6 bar (set so that currentless linear motor axis is not deactivated)
- Max. travel speed 1.8 m/s
- Max. stroke < 500 mm

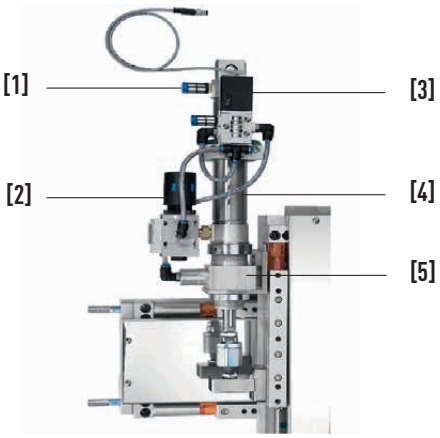


Fig. 3.7 **Pneumatic weight compensation device**

Table 3.6 **Components of the pneumatic weight compensation device**

Pos.	Components
1	Sound absorber
2	Pressure control valve
3	Solenoid valve
4	Pressure cylinder
5	Clamping element

3.11 Weight compensation with magnetic constant force spring (optional)

⚠ CAUTION!

Danger of injury from constant force springs!
Constant force springs can behave like tensioned springs. Sliders of constant force springs fast to their rest position as soon as they are released, even then, if the machine is disconnected from the power supply.

- Appropriate precautions must be taken in dealing with constant force springs to prevent injury to persons!

⚠ CAUTION!

Danger from strong magnetic fields!
Sliders of constant force springs consist mainly of neodymium magnets (NdFeB magnets). These are much stronger than "ordinary" magnets.

- Maintain a safety distance!

Characteristics:

- Reduces the force load of the linear motor axis during vertical movements
- Available for LMV1LSA linear motor axes
- Max. travel speed 5.0 m/s
- Max. stroke = 275 mm
- Weight compensation up to 60 N
- Constant force throughout the total stroke range

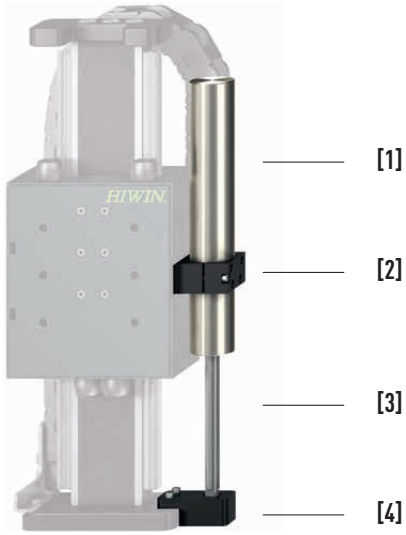


Fig. 3.8 **Weight compensation with magnetic constant force spring**

Table 3.7 **Weight compensation components with magnetic constant force spring**

Pos.	Components
1	Stator (constant force spring)
2	Mounting flange
3	Slider (constant force spring)
4	Adapter plate

3.12 Hall sensor (optional)

⚠ CAUTION!

Risk of injury and material damage!
An incorrectly installed or connected Hall sensor may cause uncontrolled motor movements which can lead to injuries or might damage the machine.
▶ Assembly of the Hall sensor only by qualified personnel!

Hall sensors with analogue and digital output signal are available for each linear motor. The analogue Hall sensors have a sin/cos output signal of 1 V_{PP} (see Fig. 3.9). The digital Hall sensors have three square signals offset through 120° (see Fig. 3.10).

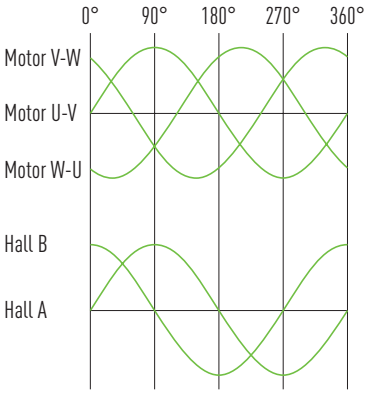


Fig. 3.9 **Output signal from analogue Hall sensor with differential output**

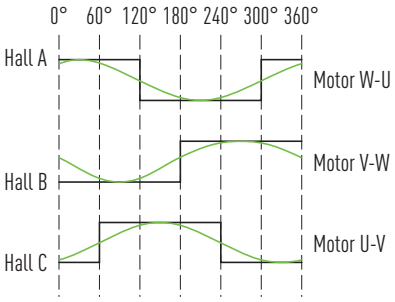


Fig. 3.10 **Output signal from digital Hall sensor with single ended output**

- Sensor signal either 0 or 1.
- A combined analysis of the motor voltage supply and Hall sensor determines reliably the motor's sense of direction.
- Analysis based on the rotor displacement angle between 0° and 90° (ideally 0° and 45°).

4. General technical data

Table 4.1 **General technical data**

	LMX1E-	LMX1L-S	LMX1L-SC	LMV1L-SA
Linear motor type	LMC	LMS	LMSC	LMSA
v_{max} [m/s]	5	4	4	2.5
amax [m/s²]	100 [3)]	50 [3)]	50	50
Total length [mm]	4,000	4,000	4,000	543
Repeatability [mm]	±0.001 [1)]	±0.001 [1)]	±0.001 [1)]	±0.005 [4)]
Accuracy [mm/300 mm]	±0.005 [1)]	±0.005 [1)]	±0.005 [1)]	±0.005 [4)]
Straightness [mm/300 mm]	± 0.005	± 0.005	± 0.005	± 0.005
Evenness [mm/300 mm]	± 0.005	± 0.005	± 0.005	± 0.005

[1)] Values apply to optical incremental distance measuring system (sin/cos signal) with 40 µm period.
[2)] Values apply to the HIWIN MAGIC magnetic incremental distance measuring system with sine/cosine signal.
[3)] The use of bellow covers may pose restrictions on the maximum acceleration.
[4)] Values apply to the magnetic absolute distance measuring system

Further technical details can be found in catalog "Linear Motors & Distance Measuring Systems"

5. Transport and installation

5.1 Delivery

5.1.1 Delivery state

The linear motor axes are supplied fully assembled, function tested and ready for connection. To prevent damage arising during transport, the linear motor axes are provided with a transportation safety device.

5.1.2 Scope of delivery

For the scope of delivery, please see the contractual documentation.

5.2 Transport to the installation site

⚠ DANGER!

Danger from strong magnetic fields!
Strong magnetic fields around linear motor axes pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.

- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from linear motor axes.

⚠ CAUTION!

Danger from heavy loads!
Lifting heavy loads may damage your health.

- Use a hoist of an appropriate size when positioning heavy loads!
- Observe applicable occupational health and safety regulations when handling suspended loads!
- Only lift from the suspension points provided!

ATTENTION!

Risk of physical damage to watches and magnetic storage media.
Strong magnetic forces may destroy watches and magnetisable data storage media near to the linear motor axes!

- Do not bring watches or magnetisable data storage media into the vicinity (<300 mm) of the linear motor axes!

ATTENTION!

Damage of the linear motor axis!
The linear motor axis may be damaged by mechanical loading.

- Only lift the linear motor axis using the suspension points provided (Fig. 5.2)!
- For longer linear motor axes, provide additional protection of the centre section.
- Ensure that the linear motor axis does not bend as this could permanently damage accuracy.
- During transport, do not transport any additional loads on the linear motor axis!
- Secure the linear motor axis and components against tilting!

- Lock the forcer in place during transport using a transportation safety device **[1]** (Fig. 5.1).
- Screw suitable load-bearing screws into the threaded holes **[2]** on the front sides (Fig. 5.2).
- Attach all 4 screws to a suitable hoist.
- Ensure even load distribution while lifting.

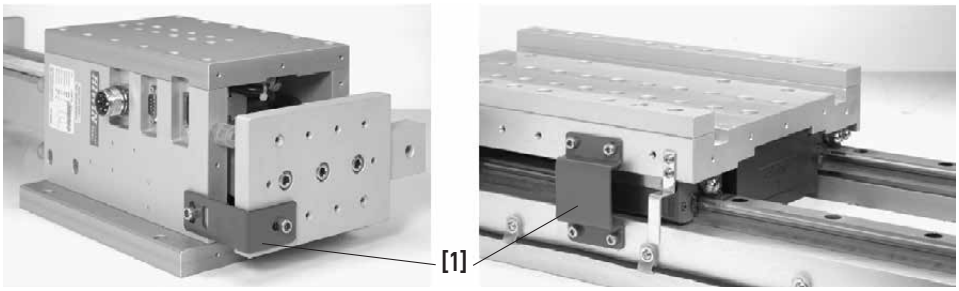


Fig. 5.1 **Transportation safety device on various linear motor axes**

Fig. 5.2 **Load-bearing screws**

5.3 Requirements at the installation site

5.3.1 Ambient conditions

Ambient temperature	+5 °C to +40 °C
Installation site	flat, dry, vibration-free
Atmosphere	not corrosive, not explosive

5.3.2 Safety equipment to be provided by the operator

Possible safety equipment/measures:

- Personal protective equipment in accordance with UVV (German accident prevention regulations)
- Zero-contact protective equipment
- Mechanical protective equipment

5.4 Storage

⚠ DANGER!

Danger from strong magnetic fields!
Strong magnetic fields around linear motor axes pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.

- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from linear motor axes.

- Store the linear motor axis in its transport packaging.
- Only store the linear motor axis in dry, frost-free areas with a corrosion-free atmosphere.
- Clean and protect used linear motor axes before storage.
- When storing the linear motor axis, attach signs warning of magnetic fields.

5.5 Unpacking and installing

ATTENTION!

Damage of attachments!
Attachments may be damaged by mechanical loading.

- Secure and manoeuvre the linear motor axis using the suspension points provided!

NOTE

The linear motor axis may only be installed and operated indoors.

NOTE

The LMX linear motor axes are designed exclusively for horizontal installation. During installation, these linear motor axes must not exceed an angle of 1° on the X and Y-axes as it does not feature a parking brake.

- Remove protective film.
- Carefully transport the linear motor axis on the load-bearing screws to the specified installation site.
- Ensure that the maintenance points are easily accessible.
- Dispose of packaging in an environmentally friendly way.

6. Assembly and connection

⚠ DANGER!

Danger from electrical voltage!
Before and during assembly, disassembly and repair work, dangerous currents may flow.
- Work may only be carried out by a qualified electrician and with the power supply disconnected!
- Before carrying out work on the linear motor axis, disconnect the power supply and protect it from being switched back on!

⚠ WARNING!

Risk of crushing from strong forces of attraction!
Danger of injury from crushing and damage to the forcer or stator caused by very strong forces of attraction.
- Ensure that the forcer only comes close to the stator when the linear guideway can absorb the forces!

⚠ WARNING!

Risk of crushing from strong forces of attraction!
There is a risk of crushing from the strong forces of attraction emitted by the stators, as they are assembled with opposing polarity!
- Assemble the stators carefully!
- Do not place fingers or objects between the stators!

⚠ CAUTION!

Risk of crushing from carriages!
Danger of injury from crushing and damage to the linear motor axis caused by movement of the carriage due to gravity, as it does not feature brakes in its standard version.
- Ensure that the linear motor axis does not exceed 1° horizontal deviation on the X and Y-axes during installation!

⚠ CAUTION!

Risk of crushing from the forcer!
Danger of injury from crushing and damage to the forcer through uncontrolled movements during assembly.
- Ensure that the forcer is locked in place during assembly using a lateral transportation safety device!

⚠ CAUTION!

Danger from heavy loads!
Lifting heavy loads may damage your health.
- Use a hoist of an appropriate size when positioning heavy loads!
- Observe applicable occupational health and safety regulations when handling suspended loads!
- Only lift from the suspension points provided (see Section 5.2)!

The mounting surface must have an evenness of 0.03 mm over 300 mm. NOTE

The linear motor axis may only be assembled by specialist personnel. NOTE

6.1 Assembling the linear motor axis LMX1E, LMX1A, LMX1L-SC

NOTE

Secure the screws with retaining rings to prevent them from accidentally coming loose!

- Drill mounting holes in the mounting surface in accordance with dimensional drawing.
- Clean mounting surface.
- Position the linear motor axis on the mounting holes.
- Place the mounting bolts in the mounting holes from above and tighten them in a spiral motion from inside to outside with a torque of 10 Nm.

✓ The linear motor axis is assembled.

6.2 Assembling the linear motor axis LMV1L-SA

NOTE

Secure the screws with retaining rings to prevent them from accidentally coming loose!

6.2.1 LMV1L-SA with moving forcer

- Drill the end plates' mounting holes in the mounting surface in accordance with scale drawing (see catalog "Linear Motors & Distance Measuring Systems")
- Clean mounting surface
- Position end plates on the mounting holes
- Place the mounting bolts in the mounting holes and tighten them in a spiral motion from inside to outside with a torque of 10 Nm

✓ The linear motor axis is assembled.

6.2.2 LMV1L-SA with moving linear motor axis

- Drill the forcer's mounting holes in the mounting surface in accordance with scale drawing (see catalog "Linear Motors & Distance Measuring Systems")
- Clean mounting surface
- Position end plates on the mounting holes
- Place the mounting bolts in the mounting holes and tighten them in a spiral motion from inside to outside with a torque of 10 Nm

✓ The linear motor axis is assembled.

6.3 Assembly of a moved load

- Clean the mounting surface on the linear motor axis that is to receive the load.
- Clean the mounting surface of the load.
- Position the load over the corresponding mounting holes on the mounting surface.
- Place the mounting bolts in the mounting holes and tighten them in a spiral motion from inside to outside with a torque of 10 Nm.
- Remove the transportation safety device from the forcer.
- Check the free movement of the load over the entire travel distance.

✓ The load is assembled on the linear motor axis.

6.4 Assembling the Hall sensor

Use two M3 screws to secure the Hall sensor to the mounting holes provided for the forcer. If the Hall sensor is not secured directly to the forcer, but e.g. on the carriage, then the distance between the forcer and Hall sensor must always be an integral multiple of the Pole pair pitch 2τ (see technical data for the affected series). On this assembly variant, the supplied spacers can be used for precise adjustments to the distance. The Hall sensor must be mounted flush to the bottom side of the forcer.

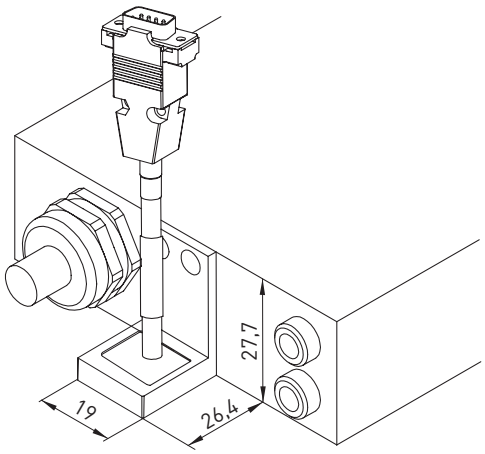


Fig. 6.1 **Example mounting of a Hall sensor to an LMFA linear motor**

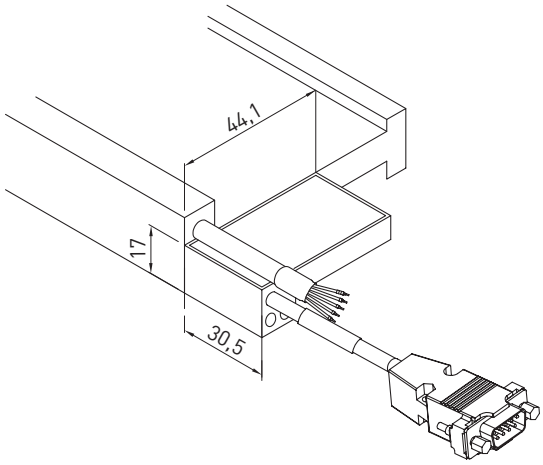


Fig. 6.2 **Example mounting of a Hall sensor to an LMC linear motor**

6.5 Assembly of axis components

⚠ DANGER!

Danger from electrical voltage!
Before and during assembly, disassembly and repair work, dangerous currents may flow.
- Work may only be carried out by a qualified electrician and with the power supply disconnected!
- Before carrying out work on the linear motor axis, disconnect the power supply and protect it from being switched back on!

ATTENTION!

Damage of the measuring scale!
Risk of damage to the measuring scale of the magnetic measuring system caused by strong magnetic fields or shocks.
- Do not subject the measuring scale to any strong magnetic fields (keep a minimum distance from the permanent magnets of the linear motor axes and from the magnetic devices)!
- Avoid strong shocks!
- Avoid application in the presence of magnetic dust!

6.5.1 Assembling the profile rails

- Adjust the reference profile rail on the stop edge of the basic profile.
- Assemble the reference profile rail on the basic profile.

✓ The rail is assembled.

6.5.2 Assembling block and forcer

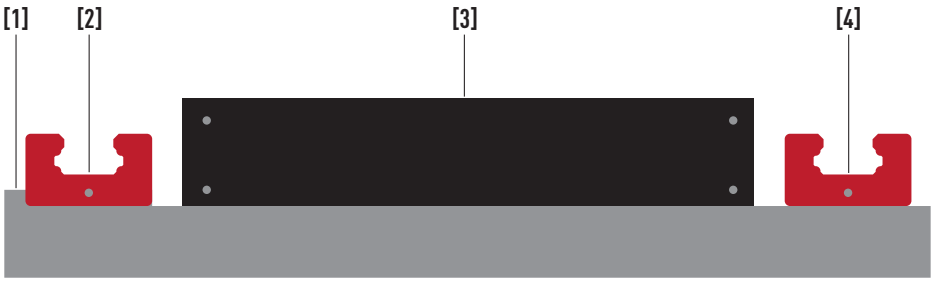


Fig. 6.3 **Configuration of the block and forcer on the carriage**

Table 6.1 **Components of the block with forcer**

Pos.	Component
1	Stop edge of the reference block
2	Reference block (for MAGIC-PG with assembled measuring scale)
3	Forcer
4	Following block

- Clean the mounting surface before assembly.
- Press the reference block **[2]** on the stop edge **[1]** and screw tightly using corresponding mounting bolts with a tightening torque of 6 Nm.
- Use medium-strength screw retention.
- The following profile rails are only positioned in place.

✓ The blocks are assembled.

- Press the forcer **[3]** on the stop edge **[2]** and screw tightly using corresponding mounting bolts and with a tightening torque of 8 Nm.

✓ The forcer is assembled.

6.5.3 Assembling carriage with forcer

⚠ WARNING!

Risk of crushing from strong forces of attraction!
Danger of injury from crushing and damage to the forcer or stator caused by very strong forces of attraction.
- Ensure that the forcer only comes close to the stator when the linear guideway can absorb the forces!

Secure the screws with retaining rings to prevent them from accidentally coming loose! **NOTE**

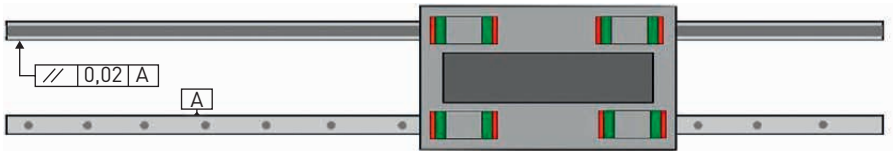


Fig. 6.4 **Assembling carriage with forcer**

- Slide the carriage with forcer on to the profile rails from one side.
- Tighten the retaining bolts of the following block.

✓ The carriage with forcer is assembled.

6.5.4 Assembling the stators

⚠ WARNING!

Risk of crushing from strong forces of attraction!
There is a risk of crushing from the strong forces of attraction emitted by the stators, as they are assembled with opposing polarity!

- Assemble the stators carefully!
- Do not place fingers or objects between the stators!

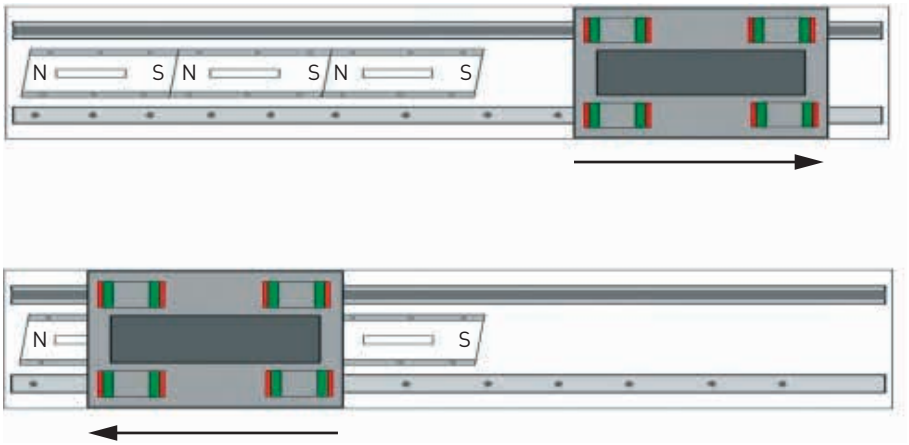


Fig. 6.5 **Assembling the stators**

- Shift the carriage on the end to one side.
- Assemble stators (HIWIN magnet tracks) with opposing polarity.
- Attach stators with suitable retaining bolts.
- Slide the carriage over the assembled stators.
- Assemble the rest of the stators.

✓ The stators (HIWIN magnet tracks) are assembled.

6.5.5 Assembling the reference switch

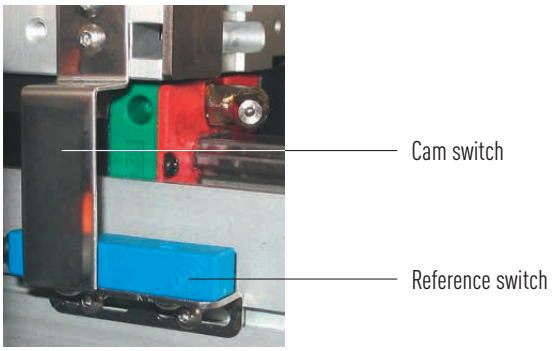


Fig. 6.6 **Reference switch and cam switch (linear motor axis)**

NOTE

Distance between cam switch and reference switch may not exceed 2 mm.

- Secure cam switch to moving part of the linear motor axis.
- Secure reference switch to stationary part of the linear motor axis.

6.6 Electrical connection

⚠ DANGER!

Danger from electrical voltage!
If linear motors are incorrectly earthed, there is a danger of electric shock.
- Before connecting the electrical power supply, ensure that the linear motor axis is correctly earthed via the PE rail in the switch cabinet!

⚠ DANGER!

Danger from electrical voltage!
Electrical currents may flow even if the motor is not moving.
- Ensure that the linear motor axis is disconnected from the power supply before the electrical connections are detached from the motors!
- After disconnecting the drive amplifier from the power supply, wait at least 5 minutes before touching live parts or breaking connections!
- For safety reasons, measure the voltage in the intermediate circuit and wait until it has fallen below 40 V!

Observe the separate assembly instructions of the drive amplifier!

NOTE

- Supplied with cabling ready for operation
- All necessary connections via three connectors

6.6.1 Connecting iron-core motors

The temperature sensor system cable is routed as standard through the motor's extension cable. Both cables are therefore connected to the motor plug. For continuous currents up to 30 A, we recommend the M23 couplings and plugs; for continuous currents over 30 A, the M40 couplings and plugs.

Table 6.2 **Recommended motor plugs up to 30 A continuous current for LMS, LMSA, LMSC and LMFA motors**

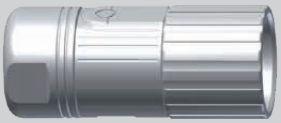
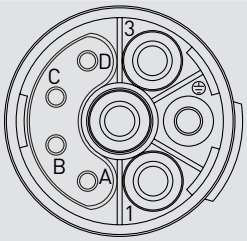
Coupling M23/M40, 8-pin	Plug M23/M40, 8-pin	Pole configuration
		 Plug-side view of coupling

Table 6.3 **Pin assignment in motor plug M23/M40, 8-pin**

Motor cable	Pin no.	Signal	Function	Extension cable
Black-1	1	U	Motor phase	Black-1
Black-2	4	V	Motor phase	Black-2
Black-3	3	W	Motor phase	Black-3
LMFA				
Red	A	T+ [1]	Thermal protection	Red
Yellow	B	T– [1]	Thermal protection	Yellow
Black	C	T+ [2]	Thermal protection	Black
White	D	T– [2]	Thermal protection	White
LMS, LMSA, LMSC				
Brown	A	T+ [1]	Thermal protection	Red
Blue	B	T– [1]	Thermal protection	Yellow
–	C	–	–	Black
–	D	–	–	White
Green/yellow	Protective earth/ground		GND	Green/yellow

[1] PTC temperature sensor
[2] KTY84 temperature sensor (LMFA only)

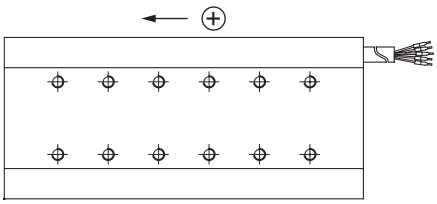


Fig. 6.7 **Direction of movement for connection according to Table 6.3**

6.6.2 Connecting ironless motors

The temperature sensor system cable is routed as standard through the motor's extension cable. Both cables are therefore connected to the motor plug.

Table 6.4 **Recommended motor plugs suitable for LMC motors**

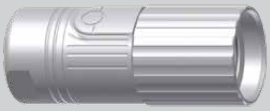
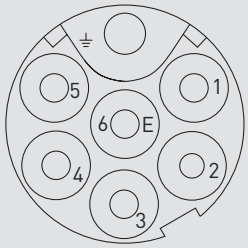
Coupling M17, 7-pin	Plug M17, 7-pin	Pole configuration
		 Plug-side view of coupling

Table 6.5 **Pin assignment in motor plug M17, 7-pin**

Motor cable	Pin no.	Signal	Function	Extension cable
Brown	1	U	Motor phase	Black-1
White	4	V	Motor phase	Black-2
Grey	3	W	Motor phase	Black-3
Yellow	5	T+ [1)]	Thermal protection	Black-5
Green	6	T– [1)]	Thermal protection	Black-6
	2	—	Not assigned	—
Green/yellow	Protective earth/ground	—	GND	Green/yellow

[1)] PTC temperature sensor

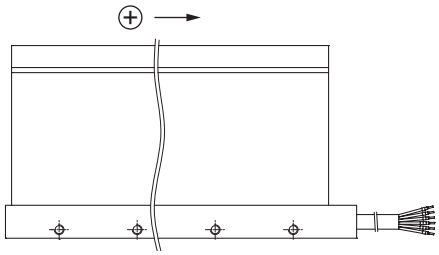


Fig. 6.8 **Direction of movement for connection according to Table 6.5**

6.6.3 Temperature sensor function and connection

6.6.3.1 Temperature monitoring

To protect the motor windings against thermal damage, every motor is equipped with a triple positive temperature coefficient (PTC) sensor, type SNM 100 (LMC linear motor) or SNM 120 (LMS, LMSA, LMSC and LMFA linear motors) in accordance with DIN 44082-M180. Since the degree of heating of the individual motor phases can be very different in direct drives, a PTC sensor is fitted in each phase winding (U, V and W). Each PTC element has a "quasi-switching" characteristic, i.e. the resistance suddenly increases close to the rated temperature (switching threshold, see Fig. 6.9). As a result of the low thermal capacity and good thermal contact with the motor winding, the PTC sensor responds very quickly to a temperature increase, thus ensuring reliable motor protection. The PTC elements located in every phase winding in HIWIN motors are wired in series; they connect via two wires.

NOTE

These PTC elements do not have a linear characteristic curve and therefore are not suitable for determining the current motor temperature.
It is a mandatory requirement that the PTC elements are connected to protect the motor.

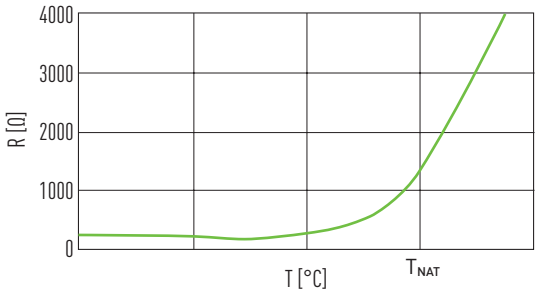


Fig. 6.9 **PTC sensors characteristic curve (T_{RRT} = rated response temperature)**

6.6.3.2 Temperature measurement

Some frequency converters have the capability of adjusting the temperature-dependent motor parameters according to the measured motor temperature. To determine the current motor temperature, it is usual to integrate a type KTY84 PTC thermistor into the motor.
The KTY84 has a nearly linear characteristic curve (see Fig. 6.10) and is therefore well suited to temperature measurement. Its hot resistance at 100 °C is approx. 1000 Ω, while its cold resistance at 20 °C is approx. 580 Ω.
The KTY84 is placed between two phase windings in the motor. If an excessive temperature occurs in a phase winding that is not monitored, this cannot be displayed or evaluated immediately. Furthermore, the KTY84 has slow response characteristics compared to the "quasi-switching" PTC element, which are insufficient for rapid shutdown.

NOTE

It is not acceptable to evaluate the KTY84 for motor protection purposes.

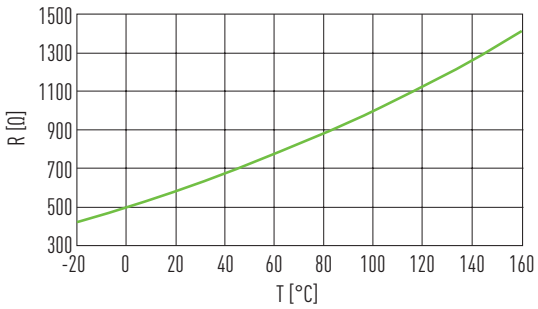


Fig. 6.10 **KTY sensors characteristic curve**

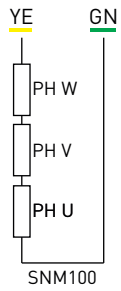


Fig. 6.11 **Temperature sensor: LMC**

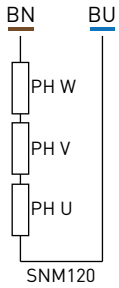


Fig. 6.12 **Temperature sensor: LMS, LMSA, LMSC**

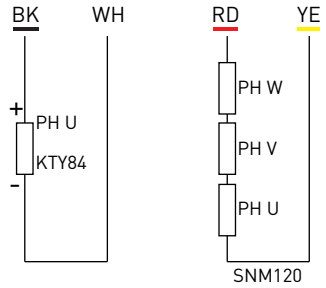


Fig. 6.13 **Temperature sensor: LMFA**

Connection to the drive amplifier

The temperature monitoring circuits can normally be connected directly to the drive control. If the protective separation requirements in accordance with EN 61800-5-1 are to be fulfilled, the sensors must be connected to the decoupling modules provided by the drive manufacturers.

6.6.4 Connecting the linear distance measuring system

ATTENTION!

Danger of EMC interference in the encoder signal!

- Make sure that the encoder cable has been shielded correctly!
- Ensure that the shielding is in full contact across the connectors!
- Ensure that the pairs of wires with the sin/cos signal are shielded separately!

NOTE

If you wish to have a positive counting direction in the opposite direction, when connecting to the electronic evaluation system, you must switch "V1+" with "V2+" and "V1–" with "V2–".

- The linear distance measuring system is installed ready for operation in the linear motor axis.
- Connection via a 15-pin Sub-D connector / 17-pin round connector.
- Depending on the configuration, optical or magnetic incremental distance measuring system installed (sin/cos plug).
- Plug pin assignment identical for optical and magnetic systems.

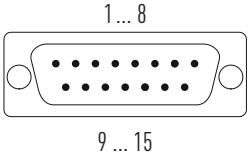


Fig. 6.14 **PIN assignment of Sub-D connector for distance measuring system**

Fig. 6.15 **PIN assignment of round connector for distance measuring system, front view of motor side**

Table 6.6 **Connecting the distance measuring system – 1**

Colour of encoder cable			Sub-D connector and round connector PIN no.	Signal	Colour of cable on measuring system	Output signals from the distance measuring system
Optical	**MAGIC/MAGIC-PG**					
Blue	Yellow	Yellow	1	V1–	Green	cos–
Red	Green	Green	9	V1+	Yellow	cos+
Brown	Brown	Brown	4 and 5	5 V	Red 0.5	Voltage supply
Green	Red	Red	2	V2–	Black	sin–
White	White	White	12 and 13	0 V	Black 0.5	GND
Grey	Grey	Grey	11	V0–	Red	Ref–
Purple	Purple	Purple	3	V0+	Orange	Ref+
Yellow	Blue	Blue	10	V2+	Brown	sin+
–	–	–	15	–	Internal shield	–
–	–	–	Connector housing	–	External shield	–
Option: Motor temperature analysis	Brown		6	T+	Yellow	–
	Blue		8	T–	Blue	–

Table 6.7 **Connecting the distance measuring system – 2**

Colour of encoder cable			Sub-D connector and round connector PIN no.	Colour of cable on measurement system	Output signals from the distance measuring system
Biss C 1 V_{PP}	**Biss C TTL**	**Hyperface**			
Brown	Brown	Black	1	Green	cos–/B–
White	White	Pink	9	Yellow	cos+/B+
Red	Red	Red	4 and 5	Blue/red 0.5 and grey	Voltage supply
Black	Black	Brown	2	Black	sin–/A–
Blue	Blue	Blue	12 and 13	Brown/blue 0.5 and blue	GND
Pink	Pink	Green or violet	3	Orange	Data–
Grey	Grey	Grey or yellow	11	Red	Data+
Purple	Purple	White	10	Brown	sin+/A+
Yellow	Yellow		7	White/black	CLK+
Green	Green		6	White/yellow	CLK–
Grey/violet	Grey/violet		8	–	Start set
–	–		15	Internal shield	
–	–		Connector housing	External shield	

6.6.5 Limit switch connection

- Two optical or inductive proximity switches in PNP design as limit switches are installed ready for operation in the linear motor axis.
- Connection via a 9-pin Sub-D connector

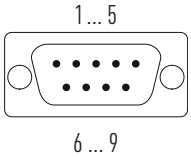


Fig. 6.16 **Pin assignment of the limit switch connector**

6.6.5.1 Pin assignment of the inductive limit switch

Table 6.8 **Connector assignment of inductive limit switch**

Limit switch cable	PIN no.	Colour of limit switch cable	Signal
Switch 2 black	1	White (positive)	2 – A\
Blue	2	Blue	GND– 0 V
Switch 3 black	3	Green (reference)	3 – A\
–	4	Yellow	–
–	5	Grey	–
Brown	6	Brown	+ 24 VDC
Switch 1 black	7	Pink (negative)	1 – A\
–	8	Red	–
–	9	Black	–

6.6.5.2 Pin assignment of optical limit switches

- Connect L contacts (1–L, 2–L) to 24 V. The optical limit switch functions as an N/C contact.
- Connect L contacts (1–L, 2–L) to 0 V. The optical limit switch functions as an N/O contact.

Table 6.9 **Connector assignment of optical limit switch**

Limit switch cable	PIN no.	Colour of limit switch cable	Signal
Switch 2 black	1	White (positive)	2 – OUT
Blue	2	Blue	GND– 0 V
Switch 2 pink	3	Green	2–L
Switch 3 black	4	Yellow	3–OUT
Switch 3 pink	5	Grey	3–L
Brown	6	Brown	+ 24 VDC
Switch 1 black	7	Pink (negative)	1–OUT
Switch 1 pink	8	Red	1–L
–	9	Black	–

6.6.6 Connecting the cables

NOTE

If cables other than those listed below are used, this may lead to damage and malfunctioning. The manufacturer shall not be liable for damages arising from use of unapproved cables.

- The LMCx, LMSx, LMSAx and LMFAx linear motor axes are fitted with PTC sensors for measuring temperatures
- Standard: Temperature sensors are continued via a motor power cable. The temperature sensor cable is therefore fitted along with the motor connector!

6.6.6.1 Motor cable for iron-core motors LMS, LMSA, LMSC and LMFA

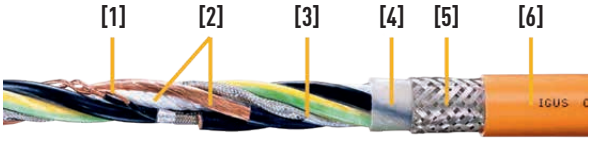


Fig. 6.17 **igus Chainflex CF27 servo cable PUR**

[1] Special conductor with high bending resistance
[2] Power conductor with the signal pair elements twisted together around core cords of high tensile strength
[3] Braided pair copper shield of extremely high bending resistance
[4] Extruded in the interstices
[5] Braided copper shield of high bending resistance
[6] Pressure extruded pure mixture

- For the highest demands
- PUR outer sheath
- Shielded
- Oil and coolant resistant
- High impact strength
- Flame resistant
- Hydrolysis and microbe resistant
- PVC and halogen resistant

Source: igus

6.6.6.2 Motor cable of ironless motors LMC

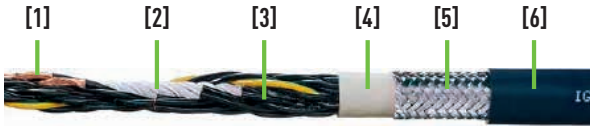


Fig. 6.18 **igus Chainflex CF10 control cable TPE**

- For the highest demands
- TPE outer sheath
- Shielded
- Oil resistant
- Bio oil resistant
- PVC and halogen resistant
- Low-temperature flexibility
- Hydrolysis and microbe resistant

Source: igus

[1] Special conductor with particularly high bending resistance
[2] Core element of high tensile strength
[3] Unit stranding around core cords of high tensile strength
[4] Extruded in the interstices
[5] Braided copper shield of high bending resistance
[6] Pressure extruded TPE mixture

A suitable cable must be used for the energy chain. HIWIN uses igus energy chains with the corresponding motor cables.

6.6.6.3 Encoder cable

Fig. 6.19 **igus Chainflex CF211 measuring system cable PVC**

- For high demands
- PVC outer sheath
- Shielded
- Oil resistant according to VDE
- Flame resistant

Source: igus

[1] Core element of high tensile strength
[2] Fine wired special conductor
[3] Wires laid up with short pitch
[4] Braided copper shield of high bending resistance
[5] Pressure extruded

The quality of the encoder cable has a significant effect on the control performance of the linear motor axis. For this reason, it is important to use a high-quality cable suitable for energy chains. It is especially important to ensure separate shielding for the pairs of wires that transfer the analogue sine and cosine signals of the 1 V_{PP} output signal. This ensures that longer encoder cables (up to 15 m) can be used without a problem and EMC interference is shielded effectively.

6.6.6.4 Limit switch cable

Fig. 6.20 **igus Chainflex CF240 data cable PVC**

- For high demands
- PVC outer sheath
- Shielded
- Oil resistant according to VDE
- Flame resistant

Source: igus

[1] Fine wired special conductor
[2] Layer stranding with particularly short pitch
[3] Braided copper shield of high bending resistance
[4] Pressure extruded

Requirements only concerning energy chain suitability.

6.6.7 Pneumatic circuit diagram outline

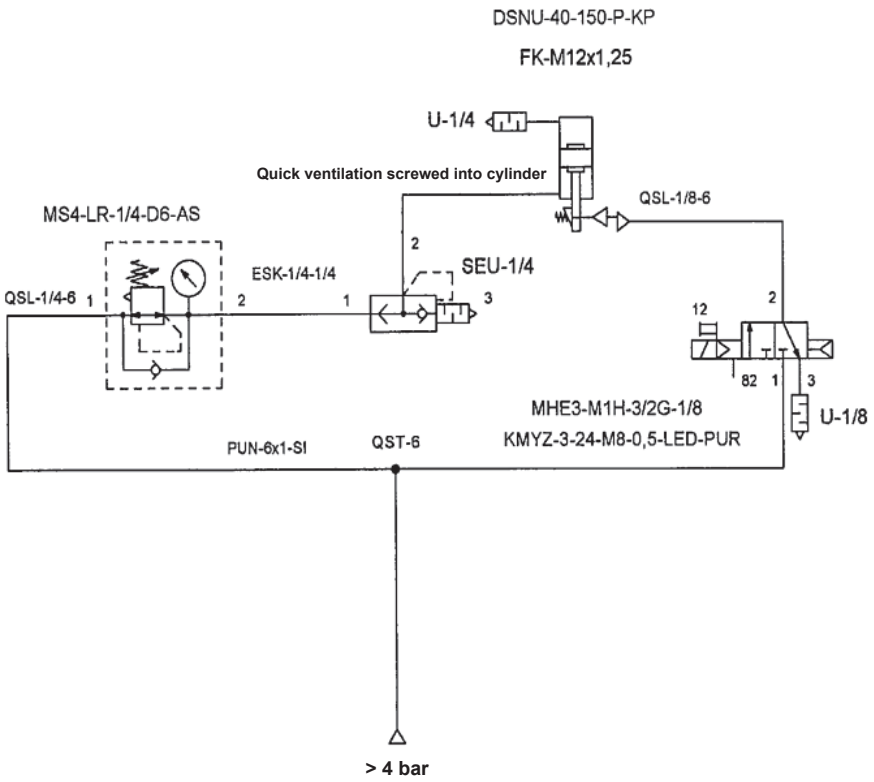


Fig. 6.21 **Circuit diagram outline for the pneumatic weight compensation device**

- Shift valve directly next to clamping element in order to avoid switching delays.
- For pneumatic packages.

6.6.8 Air supply connection

Table 6.10 **Air supply requirements**

Pressure [bar]	Air supply pressure: 6 – 10 Operating pressure: 2 – 5.5
Humidity	< 65 % rh (non-condensing)
Air tubes	Material: Polyurethane Size: At least 4 mm inside diameter Before pressure regulating: Max. operating pressure of tube > air supply After pressure regulating: Max. operating pressure of tube > system operating pressure
Particle filter	< 5 µm

To maintain normal operation, it is recommended to use an air tank. To prevent particles from clogging the orifices of the air bearing, the compressed air must be filtered to 5 microns. Also keep the air in the non-condensing humidity range and oil-free. Before connecting to the air bearing system, the air supply should pass the pressure regulating valve. Make sure the operating pressure is within the specifications (see Table 6.10).

6.6.9 Power supply

The minimum cross-section of the mains connection cable depends on:

- Local requirements (see VDE 0100 part 523 and VDE 0298 part 4)
- Ambient temperature
- Required rated current of the converter

Table 6.11 **Typical values for power supply**

Amplifier rated current [A]	Connected load [kVA]	Max. cable cross-section of the clamps [mm²]	Recommended fuse (gL) [A]
4.0	1.7	2.5	1 × 10
5.5	2.3	2.5	1 × 16
5.7	4.2	2.5	3 × 10
10.0	7.3	2.5	3 × 16
17.0	12.4	4.0	3 × 25

6.6.10 Connecting the pneumatic clamping element

NOTE

For short reaction times of the clamping element, keep the compressed air pipe as short as possible. Place the solenoid valve as close as possible to the clamping element.

▶ Connect the compressed air supply to the pneumatic connection.

6.6.11 Connecting the Hall sensor

The Hall sensors are delivered with open cable ends, M17 round connectors, or 9-pin sub-D connectors.

Connecting the analogue Hall sensor

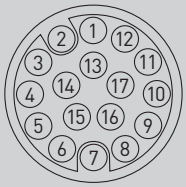
Pin assignment of open cable ends (cable length 500 mm):

Table 6.12 **Pin assignment of Hall sensor with open cable ends**

Colour of Hall sensor cable	Signal
Blue	Hall A+
Green	Hall A–
Yellow	Hall B+
Grey	Hall B–
White	5 V
Brown	0 V
Shielding	Shielding

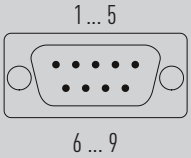
Pin assignment of round connector (coupling) M17, 17-pin (cable length 500 mm):

Table 6.13 **Pin assignment of Hall sensor round connector**

Colour of Hall sensor cable	Coupling M17 – pin no.	Signal	Drawing
Blue	9	Hall A+	
Green	1	Hall A–	
Yellow	10	Hall B+	
Grey	2	Hall B–	
White	4	5 V	
Brown	12	0 V	
Housing	Housing	Shielding	

Assignment of 9-pin Sub-D connector (cable length 500 mm):

Table 6.14 **Pin assignment of Hall sensor Sub-D connector**

Colour of Hall sensor cable	Coupling M17 – pin no.	Signal	Drawing
Blue	2	Hall A+	
Green	3	Hall A–	
Yellow	4	Hall B+	
Grey	5	Hall B–	
White	1	5 V	
Brown	6	0 V	
Housing	Housing	Shielding	

Connecting the digital Hall sensor
Pin assignment of open cable ends (cable length 500 mm):

Table 6.15 **Pin assignment of Hall sensor with open cable ends**

Colour of Hall sensor cable	Signal
White	Hall A
Grey	Hall B
Yellow	Hall C
Brown	5 V
Green	0 V
Shielding	Shielding

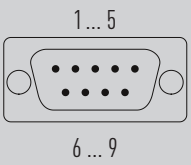
Pin assignment of round connector (coupling) M17, 17-pin (cable length 500 mm):

Table 6.16 **Pin assignment of Hall sensor round connector**

Colour of Hall sensor cable	Coupling M17 – pin no.	Signal	Drawing
White	14	Hall A	
Grey	16	Hall B	
Yellow	17	Hall C	
Brown	5	5 V	
Green	13	0 V	
—	Housing	Shielding	

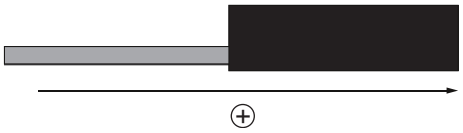
Assignment of 9-pin Sub-D connector (cable length 500 mm):

Table 6.17 **Pin assignment of Hall sensor Sub-D connector**

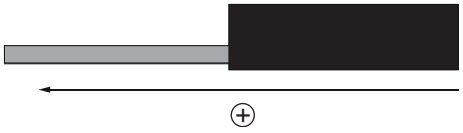
Colour of Hall sensor cable	Coupling M17 – pin no.	Signal	Drawing
White	2	Hall A	
Grey	3	Hall B	
Yellow	4	Hall C	
Brown	1	5 V	
Green	5	0 V	
—	Housing	Shielding	

Analogue Hall sensor signals are analysed via a second encoder input.
Tracks A and B must be modified to the counting direction and the motor's mounted position.

Hall sensor counts in the direction of the distance measuring system.
Positive travel direction away from the motor cable.
Distance measuring system: Track sin Track cos
Hall sensor: Track A Track B



Hall sensor counts in the opposite direction of the distance measuring system.
Positive travel direction towards the motor cable.
Distance measuring system: Track sin Track cos
Hall sensor: Track B Track A



7. Commissioning

7.1 Switching on the linear motor axis

⚠ DANGER!

Danger from strong magnetic fields!
Strong magnetic fields around linear motor axes pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.

- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from linear motor axes.

⚠ WARNING!

Risk of crushing from strong forces of attraction!
Strong magnetic forces may attract steel or iron objects from the linear motor axis and cause crushing!

- No heavy (> 1 kg) or large (> 1 dm^2) steel or iron objects should be introduced by hand into the immediate surrounding area (approx. 50 mm) of the magnet track!
- Use suitable tools only.

⚠ WARNING!

Risk of crushing from moving carriage!
The carriage may cause damage to limbs through its movement at the end position of the machine.

- The operator should provide protective equipment to prevent from reaching into the danger area of the machine!

⚠ CAUTION!

Risk of burns!
The motor heats up during operation and thus touching the motor can lead to burns!

- Provide protective devices and warning notices at the motor!

ATTENTION!

Risk of physical damage to watches and magnetic storage media.
Strong magnetic forces may destroy watches and magnetisable data storage media near to the linear motor axes!

- Do not bring watches or magnetisable data storage media into the vicinity (<300 mm) of the linear motor axes!

ATTENTION!

Damage of the linear motor axis!
Danger of material damage through uncontrolled movements of the carriage in the case of a power cut!

- Ensure that the buffer stops are fitted in the end positions on both sides of the linear motor axis!

NOTE

The operator should provide a controller pursuant to DIN EN ISO 12100 that prevents the machine from being started up unintentionally after power is restored, troubleshooting or the machine is stopped.

- Switch off the controller.
- Pull out the motor cable.
- Connect distance measuring system cable (see Section 6.6.4).
- Switch on the controller.
- Check the distance measuring system (see separate assembly instructions for the drive amplifier and distance measuring system).
- Switch off the controller.
- Connect the motor cable (see Sections 6.6.1 and 6.6.2).
- Switch on the controller.
- Perform test run at slow speed.
- Perform test under usage conditions.

✓ The linear motor axis is ready for operation.

7.2 Programming

The programming of the linear motor axis depends on the controller and drive amplifier used. Observe the assembly instructions for the controller and drive amplifier!

NOTE

8. Maintenance and cleaning

⚠ WARNING!

Unauthorised repairs on the system
Unauthorised work on the system creates the risk of injuries and may invalidate the warranty.
- ▶ The system must only be serviced by specialist personnel!

NOTE

Use only suitable, non-hazardous agents. Please observe the manufacturer's safety data sheets.

During maintenance:
- ▶ Secure the linear motor axis against being switched on without authorisation.
- ▶ Disconnect the power supply of the linear motor axis.
- ▶ Secure the linear motor axis against being switched back on without authorisation.

8.1 Linear motor

NOTE

Ensure that no parts are located between the forcer and the magnet track!

- ○ The linear motor operates maintenance-free.

8.2 Distance measuring system

8.2.1 Magnetic distance measuring system

NOTE

Ensure that no dirt particles are located between the encoder and the measuring scale!

- ○ The magnetic distance measuring system works on a non-contact basis and thus requires no maintenance.
- ○ Steel cover as mechanical protection on the measuring scale

Check the magnetic distance measuring system regularly for soiling, cleaning this when necessary. Otherwise, accumulating dirt particles will detach under the constant pressure of the cover plate.

8.2.2 Optical distance measuring system

NOTE

Ensure that no dirt particles are located between the encoder and the measuring scale! Only clean using a soft cloth in order to avoid scratching the measuring scale!

- ○ The optical distance measuring system works on a non-contact basis and thus requires no maintenance.

Regularly check the measuring scale for dirt and clean if necessary, as otherwise the surface of the measuring scale may become scratched and may no longer function correctly.

8.3 Electromechanical components

The energy chain and the cable have a limited lifetime.
For example, the energy chain is specified for 4 million cycles. However, the lifetime cannot be calculated exactly due to ambient conditions and drive performance.
The following components should therefore be regularly checked for wear and correct position, and should be replaced if necessary (wearing parts are not covered by the warranty):

- Cable in the energy chain (e.g. signs of abrasion on the cable insulation)
- Cable plug connections
- Distance between the cam switch and sensors (common cause of malfunction of the limit/reference switch)

In critical production situations, make sure that there is a stock of wearing parts! NOTE

8.4 Pneumatic weight compensation device and spring force clamping (optional)

- Weight compensation and spring force clamping operate maintenance free, but not wear free (the wearing parts are not covered by the warranty).
- HIWIN linear motor axes can be fitted with clamping elements suitable for emergency stops or, when installed vertically, with pneumatic weight compensation cylinders.
- Should the brake pads become worn, the entire clamping element must be replaced.
- Should the effectiveness of the weight compensation device be reduced, the entire weight compensation cylinder must be replaced.

In critical production situations, make sure that there is a stock of wearing parts! NOTE

8.5 Magnetic weight compensation

- Examine and, if necessary, lubricate the magnetic weight compensation every three months or every ten million cycles.

In critical production situations, make sure that there is a stock of wearing parts! NOTE

Ensure that old grease, dirt and chippings are removed from the slider before lubrication. NOTE

Use only lubricants for slide bearings of consistency class DIN 51818, NLGI1 NOTE

8.6 Fan (optional)

The service life of the fan is specified in operating hours by the manufacturer of this product (see this manufacturer's data sheets).
The fan's attached filter must be examined regularly for clogging and, if necessary, replaced. The examination intervals depend on the environment's soiling levels.

8.7 Linear guideway

8.7.1 Lubrication

As with rolling bearings, the rails of linear motor axes require a sufficient supply of lubricant. This lubrication reduces wear, protects against dirt and deposits, prevents corrosion and extends service life.

NOTE **Observe the instructions of the lubricant manufacturer.**

Check the miscibility of different lubricants. Lubricants of the same classification (e.g. CL) and similar viscosity (maximum difference of one class) are miscible.
Greases are miscible when their base oil and thickening types are the same. The viscosity of the base oil must be similar and the NGLI class may be different by a maximum of one grade.

NOTE **Ensure that old grease, dirt and chippings are removed from the profile rails before lubrication.**

NOTE **Only use lubricants that are in accordance with DIN 51825, KP2K of the consistency class NGLI2.**

NOTE **Ensure that only lubricants without solid lubricant particles (e.g. graphite or MoS_2) are used!**

NOTE **Further information about lubrication and selection of approved lubricants can be found in the assembly instructions for linear guideways at www.hiwin.de.**

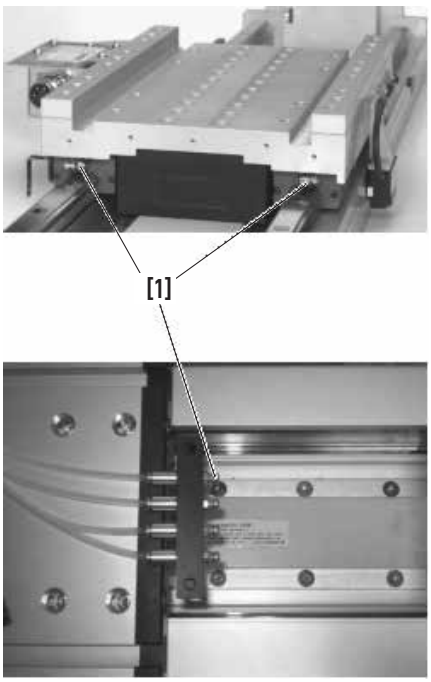


Fig. 8.1 **Grease nipples on linear guideways**

- Relubricating interval every 200 – 600 operating hours or 1000 km.
- For nominal size 20, grease quantity 0.6 g. For vertical installation, the lubricant quantity is increased by approx. 50 %.
- Initial lubrication ex works.
- Relubrication as standard through grease nipple **[1]** with standard grease guns.
- Optional relubrication through lubrication adapter integrated in the central lubrication system.
- LMH1L linear motor axes must be fitted with a strip lubricator for ease of maintenance.

For linear motor axes with sheet metal cover:

▶ Move the carriage to the limit stop.

✓ Grease nipple can now be accessed.

For linear motor axes with bellow cover:

▶ Detach the bellows from the carriage.

✓ Grease nipple can now be accessed.

8.8 Cleaning

8.8.1 Profile rails

Dirt can settle and accumulate over time on unprotected profile rails. Profile rails must therefore be regularly checked for dirt and cleaned if necessary.

8.8.2 Air bearing system

Dirt can settle and accumulate over time on the guiding surface of the air bearing. Guiding surface must therefore be regularly checked for dirt and cleaned if necessary.

Avoid moving the forcer housing without air supply! Connect and switch on the air supply before assembling the moved load (see Section 6.6.8!

NOTE

Ensure that no dirt particles are located between the air bearing and the guiding surface!

NOTE

Before cleaning, it is recommended that clean and dry compressed air is used to blow away small particles and dust. The guiding surface should be cleaned with isopropyl alcohol.

9. Faults

Table 9.1 **Fault table**

Fault	Possible cause	Remedy
Motor does not start	Supply cables disconnected	Check connections, plug contacts may be compressed, repair if necessary. The connectors have seals, which means that a certain screw connection resistance must be overcome.
	Fuse has tripped via motor protection	Check motor protection for the right settings, remedy defects if necessary
Upon restart, the drive reports a fault during commutation	Motor phases connected incorrectly	Check rotational direction
	Encoder counting direction incorrect	Change the sin and cos pair of wires in the encoder plug
	Carriage is too close to the limit switch/limit stop	Disconnect power supply to axis and move carriage manually into the centre of the axis
	Forcer blocked, clamping element blocked	Check forcer manually for free movement, readjust vertical weight compensation, open clamp
	Vertical use, no symmetrical force ratios	
	Additional drive resistance e.g. additional sealing variant, without parameter adjustment	Change parameters in the drive amplifier
Axis overspeeds upon restart	Commutation incorrect	See fault during commutation
		Check commutation parameters in the drive, activate speed monitoring
	EMC interference with the encoder signal	Check the shielding of the connectors and cables
Axis overspeeds in positioning mode	Programming error in the position transfer, invalid acceleration ordered	Activate security settings in the drive amplifier, such as speed monitoring, permissible position errors etc.
Motor hums and has a high current consumption	Clamping element blocked	Check the compressed air supply and/or power supply of the brake
Motor heats up too much (measure temperature)	Rated power exceeded as duty cycle is too long	Adapt load cycle to the rated power of the motor
	Cooling insufficient	Rectify cooling air supply or open cooling air passages, retrofit external fan if necessary
	Carriage is difficult to move	Check lubrication of the guidings, check for foreign bodies in the traversing range
	Ambient temperature too high	Observe permissible temperature range
	Load cycle has been modified	Calculate load cycle and adapt accordingly
	Drive amplifier motor commutation does not function properly	Adapt commutation parameters of the drive amplifier
Operating noise from the forcer	Relubrication required or bearing damage	Lubrication or consultation with HIWIN GmbH
After homing, there is an offset of 1 mm	The position of the cam switch is exactly between two index pulses of the MAGIC-PG	Shift of the cam switch by approx. 0.5 mm
The axis generates cracking noises when it is subject to control	EMC interference in the encoder signal	Encoder cables must be used with separately shielded sin and cos signal pairs
	Commutation incorrect	Optimise commutation parameters.

Table 9.1 **Fault table – continued**

Fault	Possible cause	Remedy
The forcer jerks while moving and generates operating noise that is not caused by the profile rail	EMC interference in the encoder signal, encoder cable plug connection defective, pin bent in plug	Place motor cable and/or encoder cable shield in full contact with the earthing terminal of the amplifier, check pin in plug
Position discrepancies after several hours of operation		Use mains filter to stabilise voltage
		Attach ferrite cores to the motor cable
		Earth the forcer and/or stators separately (particularly important for granite carriers)

10. Disposal

ATTENTION!

Danger caused by environmentally hazardous substances!
The danger to the environment depends on the type of substance used.
- Clean contaminated parts thoroughly before disposal!
- Clarify the requirements for safe disposal with disposal companies and, where appropriate, with the competent authorities!

Table 10.1 **Disposal**

Fluids	
Lubricants	dispose of as hazardous waste in an environmentally friendly way
Soiled cleaning cloths	dispose of as hazardous waste in an environmentally friendly way
Linear motor axis	
Cabling, electrical components	dispose of as electrical waste
PP components (e.g. energy chain)	dispose of separately
Steel components (e.g. profile rail)	dispose of separately
Aluminium components (e.g. profile)	dispose of separately

11. Appendix 1: Order codes

11.1 Order code for LMX1A linear motor axes

LM	X	1	A	SA21	1	0872

Linear motor axis

Axis type:
X: Horizontal axis

Number of axes:
1: Single axis

Stroke length [mm]

Number of carriages

Motor type:
LMSAxx: Motor size

Axis profile:
A: Iron-core motors (LMSA)

Continuation order code for LMX1A linear motor axes:

A	1	E	0	CL	XXX

Distance measuring system:
A: Optical, period 40 µm, analogue 1 V_{PP} sin/cos
E: Magnetic, digital TTL, resolution 1 µm
G: Optical, digital TTL, resolution 1 µm
K: Optical, digital TTL, resolution 0.1 µm
X: – Magnetic, absolute, with BiSS C interface
– Magnetic, absolute, with HIPERFACE interface
– Optical, absolute, encapsulated, with EnDat interface
– Optical, absolute, encapsulated, with DRIVE-CLiQ interface
– Optical, absolute, encapsulated, with FANUC interface

Limit switches:
0: None
1: Inductive, PNP (standard)
2: Inductive, NPN

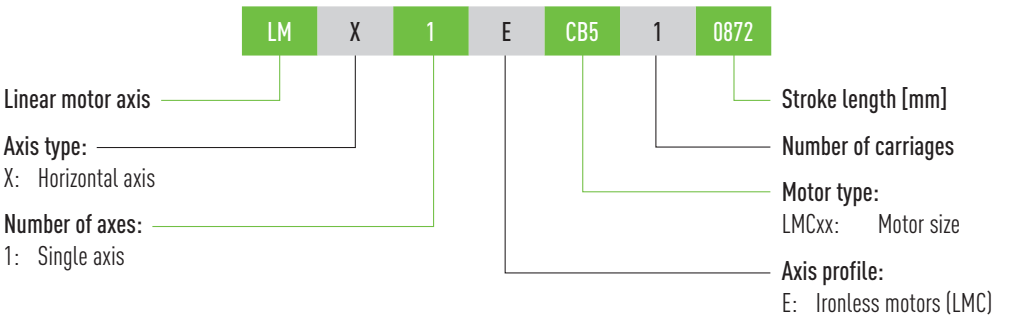
Limit switch connector:
E: Front side Sub-D connector
S: Side outlet, 300 mm Sub-D connector

Job number of drawing, several forcers, hall sensor, weight compensation, brake, special mounting holes

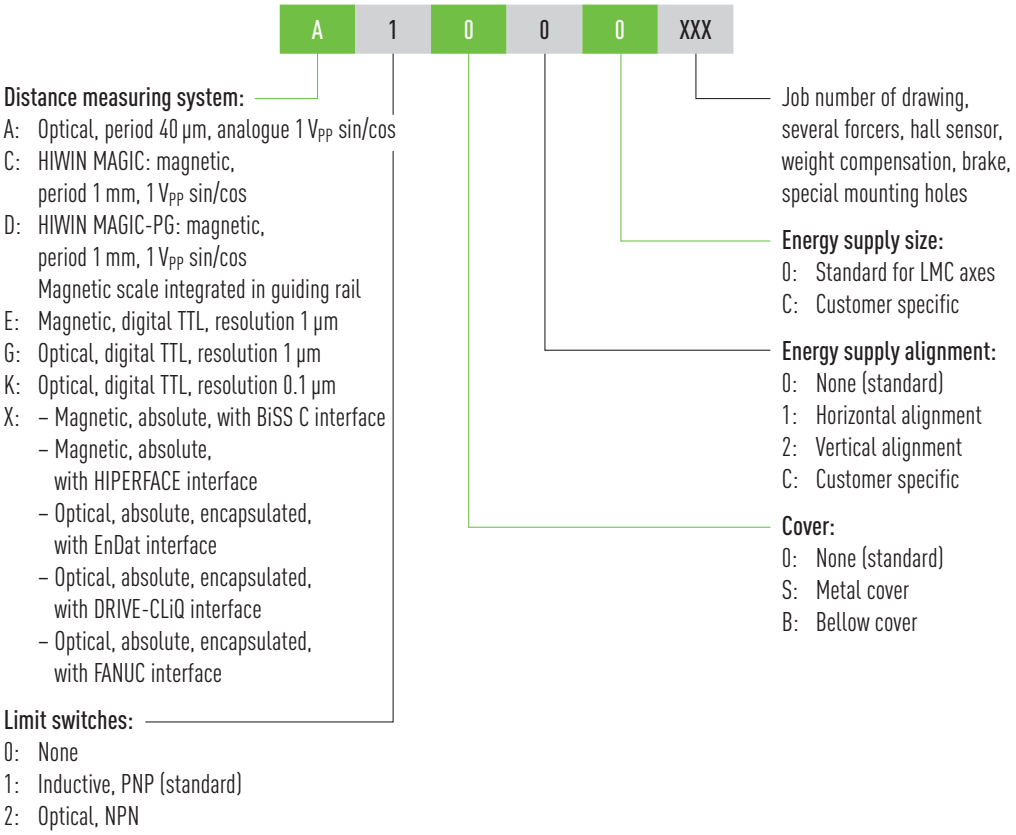
Central lubrication:
0: None
CL With central lubrication

Energy chain:
0: None
V1: Vertical, inside cross-section: 21 × 25 mm
V2: Vertical, inside cross-section: 21 × 38 mm
V3: Vertical, inside cross-section: 21 × 50 mm
V4: Vertical, inside cross-section: 21 × 68 mm
H1: Horizontal, inside cross-section: 21 × 25 mm
H2: Horizontal, inside cross-section: 21 × 38 mm

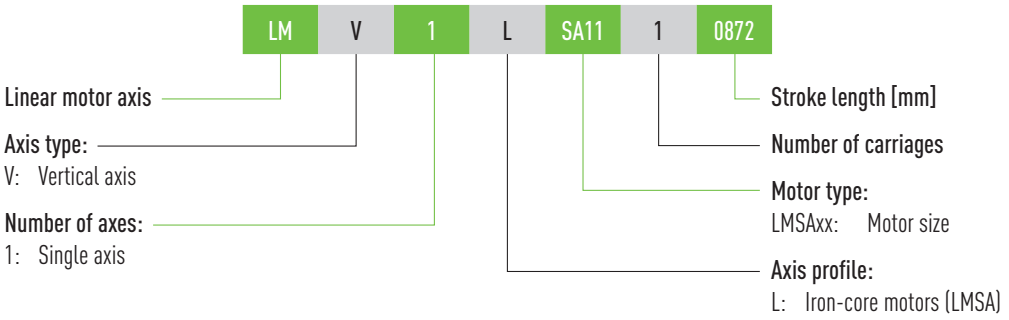
11.2 Order code for LMX1E linear motor axes



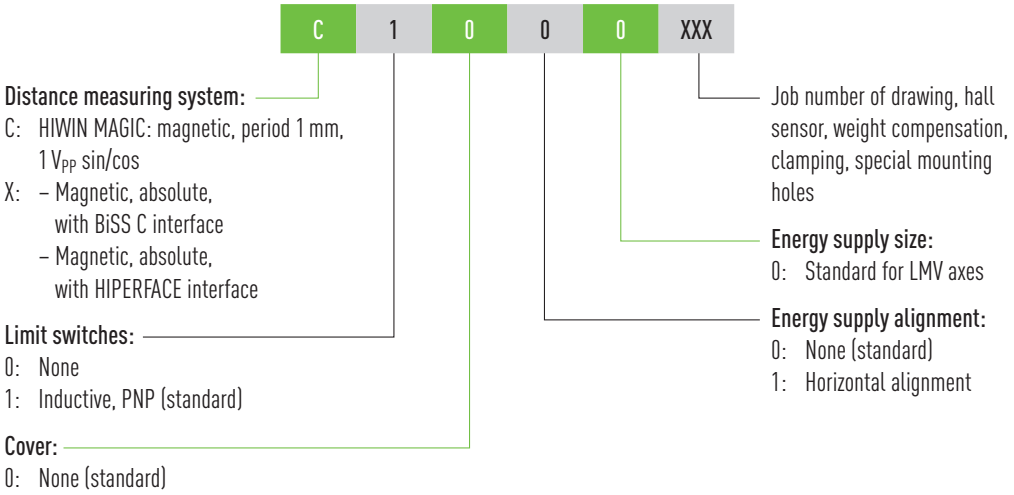
Continuation order code for LMX1E linear motor axes:



11.3 Order code for LMV linear motor axes



Continuation order code for LMV linear motor axes:



11.4 Order code for LMX2L cross tables

Linear motor axis

Axis type:
X: Horizontal axis

Number of axes:
2: Two axes

Motor type of lower axis:
LMSxx: Motor size

Motor type of upper axis:
LMSxx: Motor size

Axis profile:
L: Iron-core motors (LMS)
C: Customised

Continuation order code for LMX2L cross tables:

Stroke length of upper axis [mm]

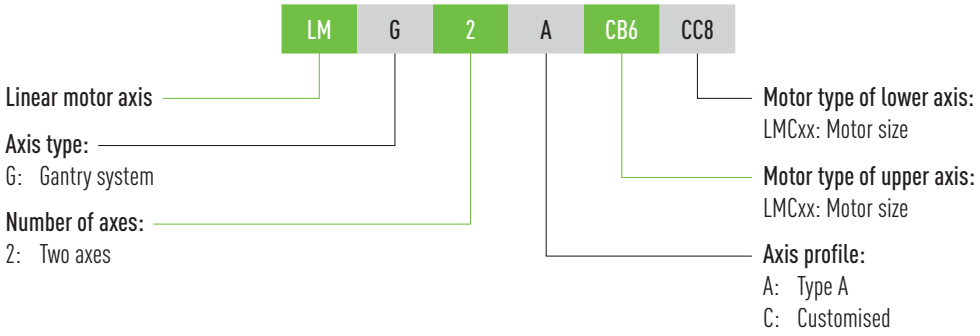
Stroke length of lower axis [mm]

Distance measuring system:
A: Optical, period 40 µm, analogue 1 V_{PP} sin/cos
C: HIWIN MAGIC: magnetic, period 1 mm, 1 V_{PP} sin/cos
D: HIWIN MAGIC-PG: magnetic, period 1 mm, 1 V_{PP} sin/cos
Magnetic scale integrated in guiding rail
X: – Magnetic, absolute, with BiSS C interface
– Magnetic, absolute, with HIPERFACE interface
– Optical, absolute, encapsulated, with EnDat interface
– Optical, absolute, encapsulated, with DRIVE-CLiQ interface
– Optical, absolute, encapsulated, with FANUC interface
– Optical, digital TTL, resolution 1 µm

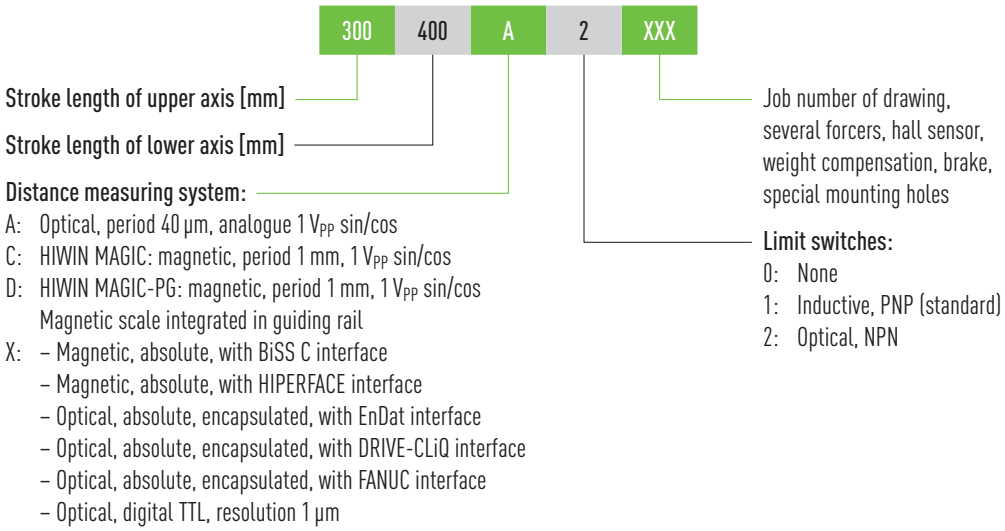
Job number of drawing, several forcers, hall sensor, weight compensation, brake, special mounting holes

Limit switches:
0: None
1: Inductive, PNP (standard)
2: Optical, NPN

11.5 Order code for LMG2A-C gantry systems



Continuation order code for LMG2A-C gantry systems:



12. Declaration of Incorporation

in the sense of the EC Machinery Directive 2006/42/EC, Annex II 1. B for partly completed machinery

Manufacturer: HIWIN GmbH, Brücklesbünd 1, 77654 Offenburg

Documentation department: HIWIN GmbH, Brücklesbünd 1, 77654 Offenburg

Description and identification of the partly completed machinery:
Product designation: Linear motor axis
Series/type designation: LMX, LMV, LMG, ...
Year of manufacture: 2019 onwards

It is hereby declared that the following essential requirements of the Machinery Directive 2006/42/EC have been fulfilled:
1.1.3, 1.1.5, 1.2.1, 1.3.3, 1.3.4, 1.3.7, 1.3.9, 1.5.1, 1.5.8, 1.5.9, 1.6.2, 1.6.3, 1.5.5, 1.1.2, 1.3.2, 1.5.4

Moreover, it is declared that the relevant technical documentation specified under Annex VII Part B has been compiled.
It is hereby explicitly declared that the partly completed machine complies with all of the pertinent conditions in the following EC Directives.

2006/42/EC	EC Machinery Directive
2014/30/EU	Directive on electromagnetic compatibility
2011/65/EU	RoHS Directive on the restriction of hazardous substances

A reference to the harmonised standards used, as referred to in Article 7(2)

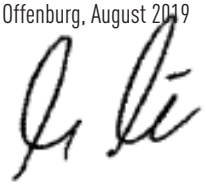
EN ISO 13732-1:2008	Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces – Part 1: Hot surfaces (ISO 13732-1:2008)
EN ISO 12100:2010-11	Safety of machinery – General principles for design – Risk assessment and risk reduction (ISO 12100:2010)
EN 60204-1:2006/AC:2010	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
EN ISO 13849-1:2016-06	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of control systems – Part 2: Validation

The manufacturer or the authorised person undertakes to transmit, in response to a reasoned request by the national authorities, the relevant documentation on the partly completed machinery.

This is without prejudice to the intellectual property rights of the manufacturer!

Important note! The partly completed machinery may not be commissioned until it has been ascertained that the machinery into which this partly completed machinery is to be incorporated is compliant with the provisions of this Directive.

Offenburg, August 2019

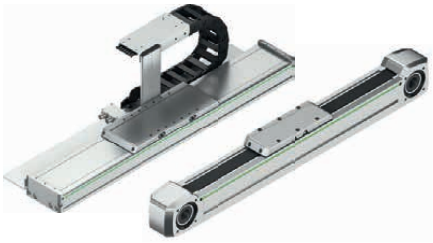


Werner Mäurer
Managing Director

We live motion.

Linear Guideways

Ballscrews



Linear Axes

Linear Axis Systems

Torque Motors

Robots

Linear Motor Components

Rotary Tables

Drives & Servo Motors

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