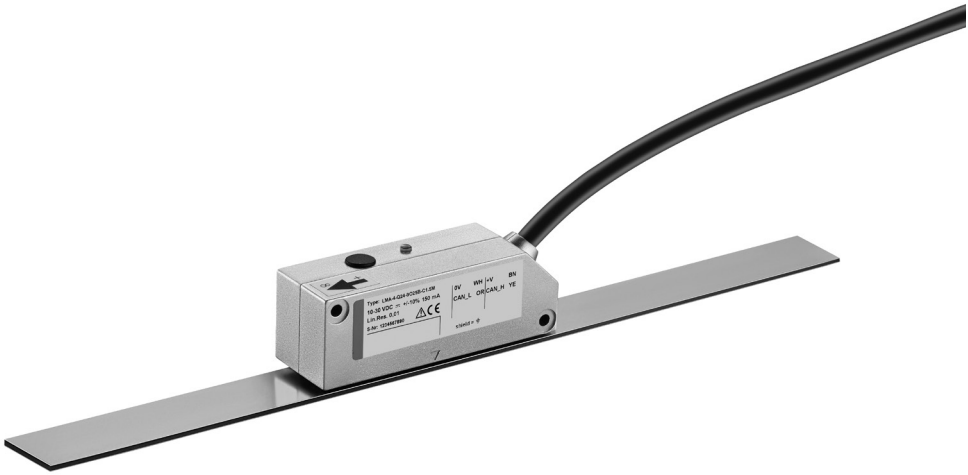
Manual

LMA-4 / LMAT-4

Absolute Magnetic Length Measurement System with 10 µm Resolution



- Absolute measuring
- Direct contact free measurement
- Up to 20 m measuring length
- Resolution 10 µm
- Changes of position are also recognized without voltage – no calibration necessary
- Automatically recognition of too big distance between sensor and magnetic tape (LED)

Manual

LMA-4 / LMAT-4

Absolute Magnetic Length Measurement System

Contents

1. General

1.1 Information Operating Manual

This manual contains important information regarding the handling of the device. For your own safety and operational safety, please observe all safety warnings and instructions.
Precondition for safe operation is the compliance with the specified safety and handling instructions. Moreover, the existing local accident prevention regulations and the general safety rules at the site of operation have to be observed.
Please read the operating manual carefully before starting to work with the device! It is part of the product and should be kept close to the device and accessible for the staff at any time. The illustrations in the manual are for better demonstration of the facts. They are not necessarily to scale and can slightly differ from the actual design.

1.2 Terms and Abbreviations

Abbreviation/Term	Explanation
LSB	**L**east **S**ignificant **B**it
MSB	**M**ost **S**ignificant **B**it

1.3 Explanation of Symbols

Special notes in this manual are characterized by symbols. The notes are introduced by signal words which express the magnitude of danger. Please follow this advice and act carefully in order to avoid accidents and damage and injuries

Warning notes:

	**DANGER!** This symbol in connection with the signal word “Danger” indicates an immediate danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	**WARNING!** This symbol in connection with the word “Warning” means a possibly impending danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.

	**CAUTION!** This symbol in connection with the signal word “Caution” indicates a possibly dangerous situation. Failure to heed these instructions can lead to minor injuries or damage of property.

Special safety instructions:

	**DANGER!** This symbol in connection with the signal word “Danger” indicates an immediate danger for the life and health of persons due to voltage. Failure to heed these instructions can result in serious damage to health and even fatal injury. The operations may only be carried out by a professional electrician.

Tips and recommendations:

	**NOTICE!** ... points out useful tips and recommendations as well as information for an efficient and trouble-free operation.

References:
(☞ 1.2) Marks a reference to chapter 1.2 of this manual.

1.4 Demounting and Disposal

Unless acceptance and disposal of returned goods are agreed upon, demount the device considering the safety instructions of this manual and dispose it with respect to the environment.

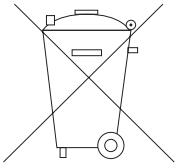
Before demounting:

Disconnect the power supply and secure against restart. Then disconnect the supply lines physically and discharge remaining energy. Remove operational supplies and other material.

Disposal:

Recycle the decomposed elements:

· Metal components in scrap metal
· Electronic components in electronic scrap
· Recycle plastic components
· Dispose the remaining components according to their material consistence



⚠	**CAUTION!** Wrong disposal causes environmental damages! Electronic scrap, electronic components, lubricants and other auxiliary materials are subject to special refuse and can only be disposed by authorized specialists!

Local authorities and waste management facilities provide information about environmentally sound disposal.

2. Safety

CAUTION!
Please read the operating manual carefully, before using the device!
Observe the installation instructions!
Only start up the device if you have understood the operating manual.
The operating company is obliged to take appropriate safety measure.
The initial operation may only be performed by qualified and trained staff.

2.1 General Causes of Risk

This chapter gives an overview of all important safety aspects to guarantee an optimal protection of employees and a safe and trouble-free operation. Non-observance of the instructions mentioned in this operating manual can result in hazardous situations.

2.2 Conventional Use

The device is only conceived for the conventional use described in this manual.

The LMA-4 length measurement system only serves to measure lengths.

CAUTION!
Danger through non conventional use!
Non-intended use and non-observance of this operating manual can lead to dangerous situations.
Therefore:
· Only use the device as described
· Strictly follow the instructions of this manual
Avoid in particular:
· Remodelling, refitting or changing of the construction or single components with the intention to alter the functionality or scope of the device.

Claims resulting from damages due to non-conventional use are not possible. Only the operator is liable for damages caused by non-conventional use.

3. Transport and Storage

3.1 Safety Instructions for Transport, Unpacking and Loading

CAUTION!
Transport the package (box, palette etc.) professionally.
Do not throw, hit or fold it.

3.2 Handling of Packaging Material

Notes for proper disposal: ☞1.4.

3.3 Inspection of Transport

Check the delivery immediately after the receipt for completeness and transport damage. In case of externally recognizable transport damages:

· Do not accept the delivery or only accept under reserve.
· Note the extent of damages on the transportation documents or delivery note.
· File complaint immediately.

NOTICE!
Claim any damage immediately after recognizing it. The claims for damage must be filed in the lawful reclaim periods.

3.4 Storage

Store the device only under the following conditions:

· Do not store outside
· Keep dry and dust-free
· Do not expose to aggressive media
· Protect from direct sun light
· Avoid mechanical shocks
· Storage temperature (☞ 5 Technical Data) needs to be observed
· Relative humidity (☞ 5 Technical Data) must not be exceeded
· Inspect packages regularly if stored for an extensive period of time (>3 months)

4. Product Features

The series LMA-4 is an absolute length measurement system. Sensor and translator and interpolation unit are together in one housing. The LMAT-4 magnetic tape is adhered to a clear area. The LMA-4 can be mounted with a max. distance of 1.5 mm. (2.0 mm sensor distance to the magnetic tape with reduced measuring accuracy).
Different interfaces are available (SSI, CANopen (DS406)).
Typical applications are handling systems, conveyor and storage technology, hydraulic presses, stamping machines, casting machines, linear slides, linear drives and pick and place systems.

Overview of features:
· no reference necessary
· direct contact free measurement
· distance between sensor and magnetic tape can be between 0.1... 1.5 mm
->Distance not OK = LED glow red
· up to 20 m measuring length
· high resolution 10 µm
· repeat accuracy +/- 10 µm.
· inured against dirt

4.1 Functional Principle

A hall sensor and a magneto-resistive impedance measuring bridge are guided over a two-track magnetic tape with a fine-interpolation trace and an absolute trace. Together with the sensor line the absolute track provides an absolute value and the fine-interpolation trace provides together with the interpolation electronic the measuring systems high resolution.

Figure 1 shows two magnetic traces, with north pole and south pole magnetization. The fine interpolation trace encloses alternately north and south pole traces with a distance of 1 mm, these are scanned with resistance bridges and provide a resolution of 0.01 mm. The absolute value provides the sensor line with 16 single Hall sensors, these sensors are scanning the code sections of the north and south poles. The absolute value on the magnetic tape recurs every 20 m.

Figure 1: Coding

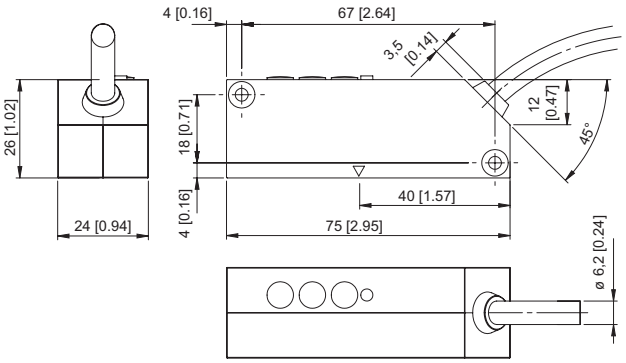
5. Technical Data

5.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the sensor and gives the exact type designation (=order reference, see typ designation). Furthermore, the type label contains a unique, traceable device number, the production date as well as the hardware and software versions.
When corresponding with Turck always indicate this data.

5.2 Dimensions Sensor

Dimensions in mm [inch]



5.3 Technical Data Sensor LMA-4

Mechanical characteristics	
Weight	0.41 lbs [0.19 kg]
Working temperature	+14°F to +157°F [-10°C to +70°C] (non condensing)
Storage temperature	-13°F to +185°F [-25°C to +85°C]
Protection	IP40 acc. to DIN 60529
Housing	Die-cast zinc
Max. traverse speed	permanent absolute positions reading 13.12 ft/s (4 m/s)
Shock resistance to EN 60068-2-27	500 g (5000 m/s²), 1 ms
Vibration strength to EN 60068-2-6	30 g (300 m/s²), 10 - 2000 Hz
Distance sensor / magnetic band	0.01 - 1.5 mm incl. masking tape (recommended 0.5 mm)
Measuring length	max. 20 m
Type of connection (Standard)	cabel PUR 1.5 m, open cable ends

Electrical characteristics	
Power supply	10 - 30 V DC ±10%
Residual ripple	< 10 %
Current consumption	max. 150 mA
Reverse polarity protection	yes
Short circuit proof	yes
RoHS compliant acc. to EU guideline 2011/65/EU	

Accuracy	
Measuring principle	absolute
System accuracy at +68°F [20°C]	max. ± (150 + 20 x L) µm L = measuring length in meters
Repeat accuracy	±10 µm
Resolution	0.01 mm
LED, red	lights up when distance too large

SSI interface		
Output driver		RS485 transceiver type
Permissible load / channel		max. 20 mA
Signal level	HIGH LOW	typ. 3.8 V at I_{Load} = 20 mA typ. 1.3 V
Clock rate		25 bit (24 + 1 failurebit for distance)
Code		Binary / Gray (Default) switchable
SSI clock rate		80 kHz - 0.4 MHz
Monoflop time		≤ 40 µs
Data refresh rate		≤ 250 µs

CANopen interface	
Interface	CAN High-Speed acc. to ISO 11898, Basic and Full CAN, CAN specification 2.0 B
Protocol	CANopen
Baud rate	250 kbit/s; 125 ... 1000 kbit/s configurable
Termination	yes/no via rotary switch
Node address	1 ... 15 configurable (Default 1)
LSS protocol	CIA LSS protocol DS305 Global command support for node address and baud rate, Selective commands via attributes of the identity object.

5.4 Technical Data Magnetic Tape

Magnetic band LMAT-4		
Pole gap		basic pole pitch 5 mm
Dimensions	width thickness	20 mm 1.8 mm incl. masking tape
Relative linear expansion		$\Delta L = L \times \alpha \times \Delta a$ L = measuring length in meters $\alpha = 16 \times 10^{-6}$ 1/K temperature coefficient Δa = relative temperature change based on +68°F [20°C] in °K
Working temperature		-4 to +158°F (-20°C to +70°C)
Storage temperature		-4 to +176°F (-20°C to +80°C)
Mounting		adhesive joint
Additional lengt		100 mm in order to obtain an optimal measuring result, the magnetic band should be about 0.1 m longer than the required measuring length
Min. bending radius for storage		≥ 150 mm
Relative humidity		max. 95%, non-condensing
Double side glue tape		3M-9088 (notice handling manual), other on request
Available length		max. 20 m; Mind. length 0.2 m
Influence of external magnetic fields		External magnetic fields must not exceed 64 mT (640 Oe; 52kA/m) at the surface of the magnetic tape. Higher values will damage or destroy the magnetic tape code. Magnetic fields > 1 mT at the measuring system has negative influences on the system's accuracy.
Protection class		IP65

5.5 Order code

Part Number Key: Magnetic Sensor LMA-4

A		B		C		D
LMA-4	-	Q24	-	JC25B	-	C1.5M

A	Type
LMA-4	Linear Magnetic, Absolute

B	Housing
Q24	24 mm, IP40

C	Voltage Supply and Type
JC25B	10-30VDC, SSI, 25-bit Gray/Binary Code
9O25B	10-30VDC, CANopen, 25-bit

D	Type of Connection
C1.5M	Radial Cable (1.5 m PUR)

Part Number Key: Magnetic Band LMAT-4

A		B
LMAT-4	-	0010

A	Type
LMAT-4	10 mm, Linear Magnetic Tape, 1 mm Pole Gap

B	Length*		
0010	1.0 m	0060	6.0 m
0020	2.0 m	0100	10.0 m
0040	4.0 m	0200	20.0 m
0050	5.0 m	-	-

*measuring range = Length - 0.1 m

6. Installation and First Start-Up

NOTICE!
Please read the operating manual carefully before using the device! Strictly observe the Installation instructions! In case of damage caused by failure to observe this operating manual, the warranty expires.
Turck is not liable for any secondary damage and for damage to persons, property or assets.
The operator is obliged to take appropriate safety measures. The first start-up may only be performed by staff that has been trained and authorized by the operator.

6.1 Operating Area

WARNING!
Do not use the device in explosive or corrosive environments! The device must not be installed close to sources of strong inductive or capacitive interference or strong electrostatic fields!

CAUTION!
The electrical connections must be made by suitably qualified personnel in accordance with local regulations.

The device may be designed for switchboard mounting. During work on the switchboard, all components must be de-energized if there is a danger of touching the energized parts! (protection against contacts)

Wiring works may only be performed in the de-energized state!

Thin cable strands have to be equipped with end sleeves!

Before switching on the device, connections and plug connectors have to be checked!

The device must be mounted in a way that it is protected against harmful environmental influences such as splashing water, solvents, vibration, shock and severe pollution and the operating temperature must not be exceeded.

6.2 Mounting of the Magnetic Tape

6.2.1 Structure of magnetic tape

In the standard case the magnetic tape is delivered as described here. The tape must be bonded on the mounting surface.

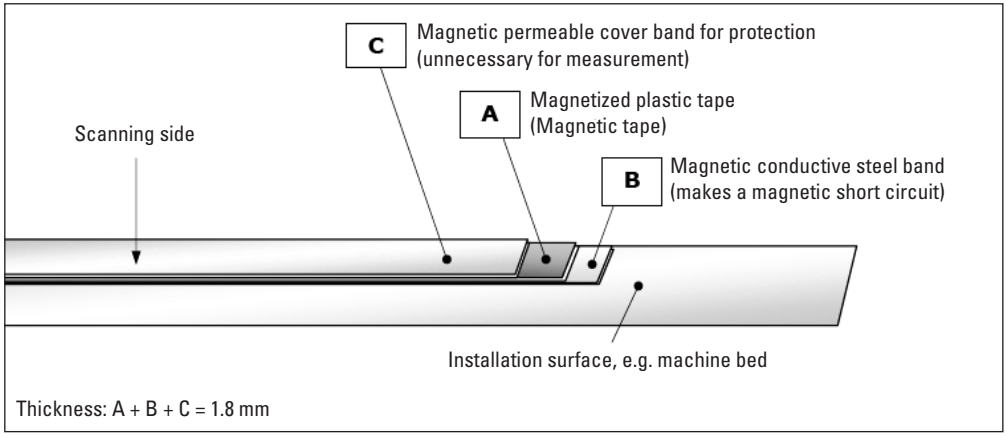


Figure 2: Structure of magnetic tape

The Magnetic tape consists of 3 components:

A The magnetized, highly flexible plastic tape, connected on the lower side with…

B …Magnetic conductable and flexible stainless steel tape. It protects the plastic tape from mechanical damages and is a magnetic short circuit at the same time. This increases significantly the functional security under extreme magnetic influences. Both parts A and B are already factory-bonded.

C …To keep the flexibility for transport and installation, the third part a stainless, magnetic permeable steel tape is delivered separately. It serves for mechanical protection of the plastic tape, is already equipped with a sticky tape and must be bonded on the magnetic plastic tape after installation.

6.2.2 Handling

To avoid tension in the tape, it should not be twisted or stored with the magnetized plastic tape to the inside minimum radius of curvature 150 mm).

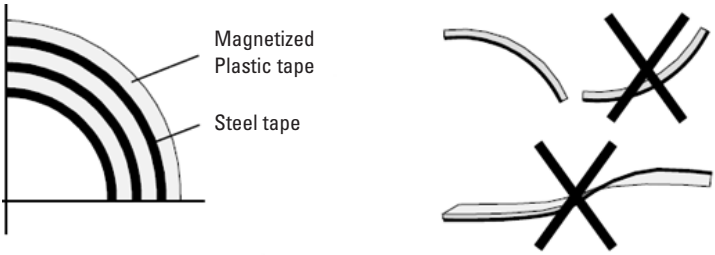


Figure 3: Handling magnetic tape and Transport 1

6.2.3 Instructions for putting in place

The supplied adhesive tapes adhere well on clean, dry and flat surfaces. The surface should be machined the better as the contamination at the place of installation is severe. We recommend a surface finish of $R_a < 3{,}2$ ($R_z < = 25$ / N8). Typical solvents for cleaning the surfaces are 50/50 isopropyl alcohol/water mixture or heptane. High installation pressure ensures good surface contact. The favourable installation temperature lies between +21° and +38°C.

We advise against installation if the temperature of the surfaces to be bonded is lower than +10°C, since the adhesive becomes too solid and sufficient immediate adhesion may not be achievable in these conditions. After proper installation, the strength of the bond is ensured even at negative temperatures. Experience has shown that the definitive adhesive strength is reached after about 72 hours (at +21°C). Use only the supplied adhesive tape for the installation.

6.2.4 Cutting to length and putting in place

	NOTICE! When putting the magnetic tape in place, pay attention to the marks on the magnetic tape and on the sensor head. Improper assembly will deliver wrong values. A magnetic tape that is already installed is destroyed in case of removal and cannot be re-used. Also respect the counting direction of the measuring system. Before putting it in place, the magnetic tape and the cover tape must be cut to the exact length.

Magnetic tape length = measuring length + sensor length
The best installation location for the magnetic tape is in a groove or against an edge.

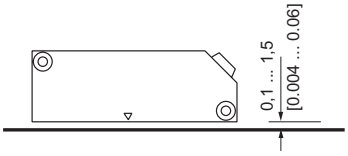
Stick the tape in place as follows:
The magnetic tape and the steel tape have been assembled already at the factory. The adhesive tape is applied on the carrier side (steel tape). Now position the magnetic tape and stick it in place. The easiest is to stick the magnetic tape in two steps. First remove the protective foil up to the half and stick the tape in place, then remove the remaining length. Finally, stick the cover tape on the visible dark brown magnetized plastic tape.

6.3 Mounting / Installation of the Sensor

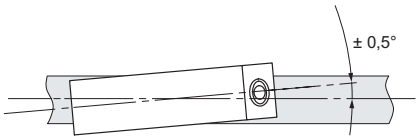
NOTICE!
The correct distance sensor / magnetic tape is monitored and displayed by the LED on the sensor.
-> Distance not correct = LED glow red

When installing the sensor head use two M3 screws. Tolerances for distance and angle must be observed.

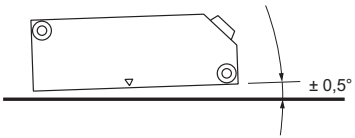
Dimensions in mm [inch]
Distance sensor / magnetic band (incl. masking tape)

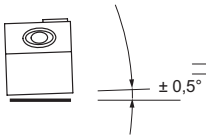


Torsion

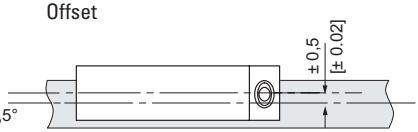


Tilting





Offset



6.3.1 Mounting direction of LMA-4 sensor to magnetic tape

Sensor and magnetic tape have to be mounted to the same direction (direction of arrow): The provided pole searcher film allows to determine the respective pole pitches when lying on the tape. From that the following installation direction results:

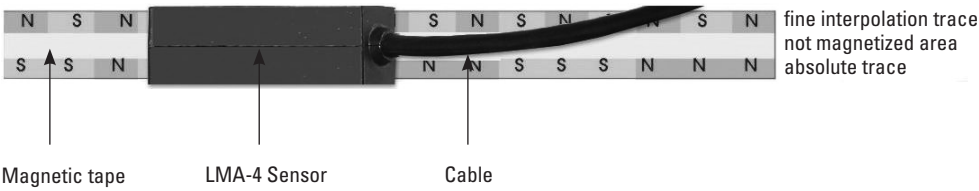


Figure 4: Mounting sensor to magnetic tape

Markers on tape and sensor are additional indicators for the mounting direction.

Observe mounting direction

7. Design and Functions

7.1 Connections and Interfaces

The following chapters give detailed information about connections and interfaces.

7.2 Interface SSI

Principle of the function: If the clock is not interrupted for the time Tm-T/2 (output of further 25 periods), the shift register clocks once again the same data value (error recognition in evaluation).

Some encoders contain a Power Failure Bit (PFB):

With LMA-4 the PFB is always “low“.

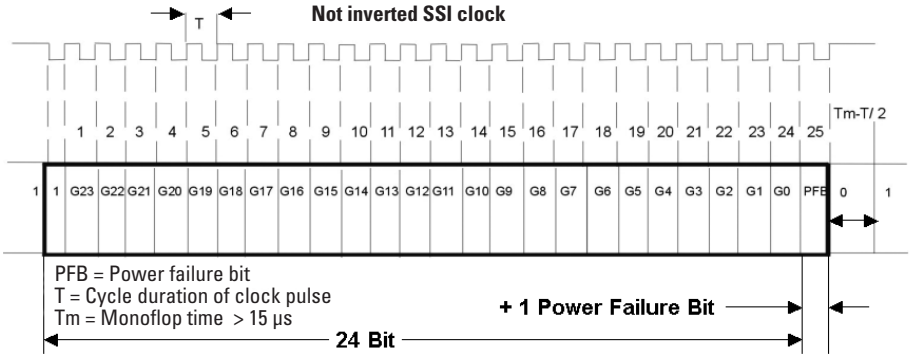
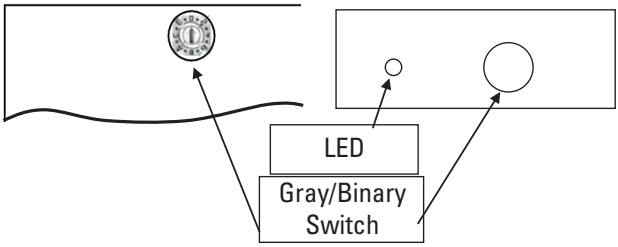


Figure 5: Readout of data (2-time with 25 clocking)

By using the decoding switch, which is located behind a protection cap on the top of the sensor, the data format of the SSI interface can be changed over with the help of a micro screwdriver from Binary code to Gray code.

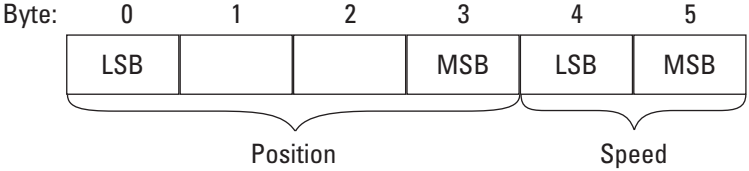


Position	Code
1	Binary
0	Gray*

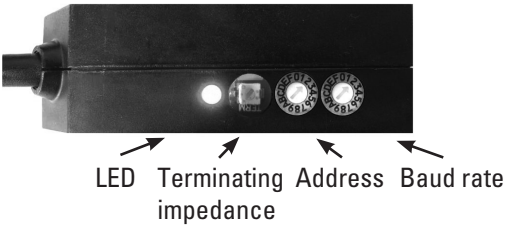
*default

7.3 Interface CANopen

The measuring system with a CAN interface is equipped in compliance with CANopen Standard DS406. A NMT command is issued to start the communication.
The following identifiers are given:
CAN - Identifier
(6 Byte telegram)
181 (16) = Identifier
First 4 bytes = Position (Resolution 0.01 mm), Baud rate 250 KB/s
Following 2 bytes = speed in mm/s



The CAN-Identifier can be adjusted in the range of $181_{(16)}$ to $18F_{(16)}$ by a decoding switch, which is located behind a protection cap on the top of the sensor housing:



Position 0 of the address coding switch fetches the address from the memory. If no address is saved in the memory, the default setting 181h is used.
Position 8 of the bit rate coding switch fetches the bit rate stored in the EEPROM If no bit rate has been saved, it will be set to 1 Mbit/s.

Position	CAN Identifier
0	Identifier from memory
1	181
2	182
3	183
4	184
5	185
6	186
7	187

Position	CAN Identifier
8	188
9	189
A	18A
B	18B
C	18C
D	18D
E	18E
F	18F

Position	Baud rate
8	Baud rate from memory
9	1M
A	800k
B	500k
C	250k*
D	125k
E	100k
F	50k

*default

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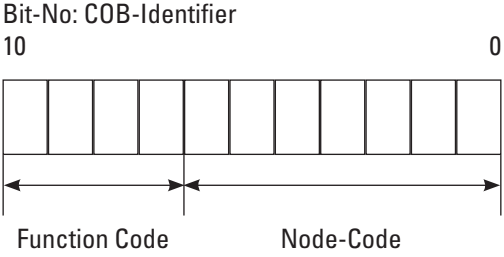
Objects and Function Code in the Predefined Connection Set
For easier management of the Identifiers, CANopen uses the "Predefined Master/Slave Connection Set", where all identifiers are defined with standard values in the object dictionary. These identifiers can however be changed and customized via SDO access.



The 11-bit Identifier is made up of a **4-bit function code** and a **7-bit node number**.

NOTICE!
The higher the value of the COB-Identifier, the lower is its priority!

Broadcast (network-wide) Objects

object	function code (binary)	resulting COB-ID	Communication Parameters at Index
NMT	0000	0	–
SYNC	0001	128 (80h)	1005h, 1006h, 1007h

Peer-To Peer (device-to-device) Objects

object	function code (binary)	resulting COB-ID	Communication Parameters at Index
EMERGENCY	0001	129 (81h) – 255 (FFh)	1014h, 1015h
PDO1 (tx)	0011	385 (181h) – 511 (1FFh)	1800h
PDO2 (tx)	0101	641 (281h) – 767 (2FFh)	1801h
NMT Error Control	1110	1793 (701h) – 1919 (77Fh)	1016h, 1017h

7.3.1 Process Data Transmission

The **2 PDO services** PDO1 (tx) and PDO2 (tx) are available for process data transmission. A PDO transmission can be **asynchronously** (event-driven) or by a change in the process value of the sensor data.

Standard setting for the mapping of the transmit PDO1&2:

Mapping	**TPDO1 (1800h)**	**TPDO2 (1801h)**
Mapping object	1A00h	1A01h
Entry	0x60040020	0x60300110
Object	6004h	6030h
Subindex	00	00
Data length	20h (32 Bit)	10h (16 Bit)
	Asynchronous	Asynchronous

Transmit PDO 1 (1800h) / Position asynchronous

Default COB-ID is 180 + Node number: Example 180h + 3Fh = 1BFh

Massage	**Byte 0**	**Byte 1**	**Byte 2**	**Byte 3**
1BF	**Position LSB**	**XX**	**XX**	**Position MSB**

The position values can have a maximum value of $0 – (2^{32} - 1)$.

Transmit PDO2 (1801h) / Speed

Default COB-ID is 280 + Node number: Example 280h + 3Fh = 2BFh

Message	**Byte 4**	**Byte 5**
2BF	**Speed LSB**	**Speed MSB**

The speed can have a maximum value of $0 – (2^{16} - 1)$.

7.3.2 Service Data Transmission

SDO-COB-ID

The following identifiers are available as a standard for the SDO services:

SDO (tx) (Encoder ⇨ Master): 580h (1408) + node number
SDO (rx) (Master ⇨ Encoder): 600h (1536) + node number
The SDO identifiers cannot be modified!

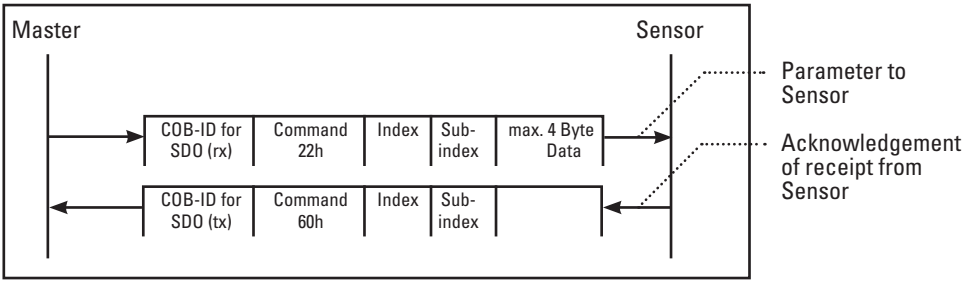
The command byte describes the type of the SDO message:

Command (Expedited Protocol)	Type	Function
22h	SDO (rx), Initiate Download Request	Send parameters to sensor (Data length max. 4 Byte)
23h	SDO (rx), Initiate Download Request	Send parameters to sensor (Data length = 4 Byte)
2Bh	SDO (rx), Initiate Download Request	Send parameters to sensor (Data length = 2 Byte)
2Fh	SDO (rx), Initiate Download Request	Send parameters to sensor (Data length = 1 Byte)
60h	SDO (tx), Initiate Download Response	Acknowledgement of the transfer to the Master
40h	SDO (rx), Initiate Upload Request	Acknowledgement of receipt by Master
43h	SDO (tx), Initiate Upload Response	Parameter to Master, data length = 4 Byte (Unsigned 32)
4Bh	SDO (tx), Initiate Upload Response	Parameter to Master, data length = 2 Byte (Unsigned 16)
4Fh	SDO (tx), Initiate Upload Response	Parameter to Master, data length = 1 Byte (Unsigned 8)
80h	SDO (tx), Abort Domain Transfer	Encoder sends an error code to Master

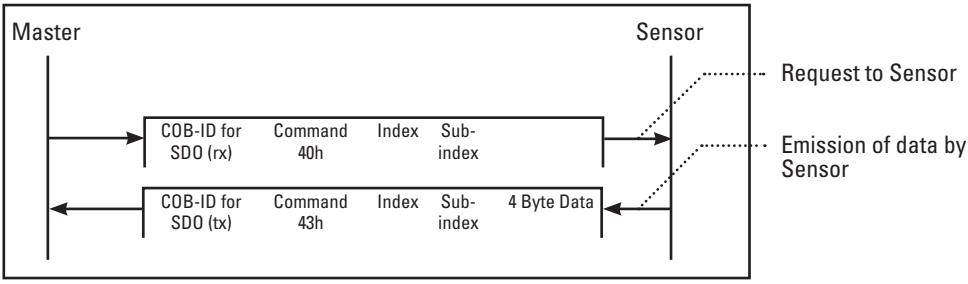
NOTICE!
An error message (Command 80h) replaces the normal acknowledgement (response) in case of an error.
The error message includes as well communication protocol errors (e.g. wrong command byte) as object dictionary access errors (e.g. wrong index, write attempt on a read-only object, wrong data length, etc.).

The error codes are in the device profile (DSP 406).

Example of a service data transmission to and from the Sensor



Transmission of parameters from Master to Sensor



Request for parameters from Master to Sensor

7.3.3 LSS services
LSS Hardware requirements (LSS address)

All LSS slaves must have a valid entry in the object dictionary for the Identity Object [1018h] in order to be able to carry out a selective configuration of the node. This Object is made of the following subindices:

- **Vendor-ID (numerical number)**
- **Product-Code (numerical number)**
- **Revision-Number (major an minor revision as numerical number)**
- **Serial-Number (numerical number)**
- LSS-Master CAN-ID 2021
- LSS-Slave CAN-ID 2020

A product code, a revision number and a serial number are set by the manufacturer. The LSS address must be univocal in the network.

LSS operative restrictions
In order to ensure a perfect LSS functionality, all devices in the network must support the LSS services. There can only be one LSS master. All nodes must be started up with the same baud rate. LSS communication can only take place in “Stop“ mode or in “Pre-Operational“ mode.

7.3.4 First start-up - General settings on the device

Baud rate

The baud rate can be modified using a CANopen software, via the corresponding LSS service.

Default setting: 250 kBit/s

Baud rate in KBit/s
10
20
50
100
125
250
500
1000

To be considered for the corresponding baud rate

The selected cycle time (see Object 1800h, subindex 5 Event timer) must be larger than the duration of the bus transmission in order to allow an error-free PDO transmission!

For baud rate 10 KBaud: Minimum cycle time 14 ms
For baud rate 20 KBaud: Minimum cycle time 10 ms
For baud rate 50 KBaud: Minimum cycle time 4 ms

Activate new baud rate using LSS Command 21d (0x15).

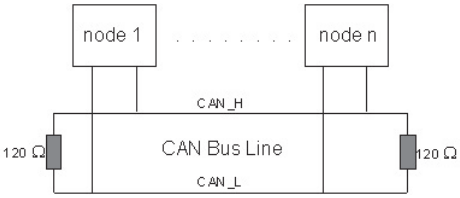
Node number
The node number can also be modified **by software** via the corresponding **LSS service**.

Default setting: 0x3F (63 decimal)

Node number 0 is reserved and may not be used by any node.
The resulting node numbers lie in the range **1...0Fh** hexadecimal (1...15 decimal)

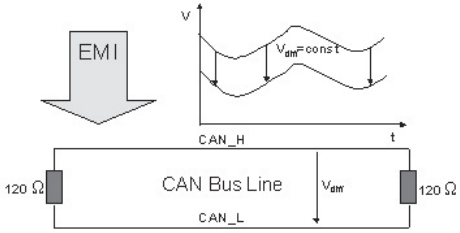
NOTICE!
The acceptance of a new node number only becomes by means of an **NMT-Reset Node** command.
All settings within the objects table are saved in an EEprom.

Termination
Default setting: 0x01 (bus termination active)



CAN is a 2-wire bus system to which all participants are connected in parallel (i. e. with short stub lines. The bus must be terminated at both ends with a bus termination resistor of 120 (or 121) ohms in order to avoid reflections. This is also necessary even for very short line lengths!

On the LMA-4, the CAN bus termination can be set by means of a rotary switch.



Since the CAN signals are represented on the bus as differential levels, the CAN line is comparatively insensitive to interference (EMI). Interferences always affect both lines, and therefore they almost do not modify the differential level.

Bus length
With CAN, the maximum bus length is mainly limited by the signal propagation time. The multimaster bus access procedure (arbitration) requires an almost simultaneous presence of the signals (for the duration of one before scanning) at all nodes. Since the signal propagation time is almost constant in the CAN connections (transceiver, optocoupler, CAN controller), the line length must be adapted to the baud rate.

Baud-Rate	Bus length
1 MBit/s	< 20 m*
500 kBit/s	< 100 m
250kBit/s	**< 250 m**
125kBit/s	< 500 m
50 kBit/s	< 1000 m
20 kBit/s	< 2500 m
10 kBit/s	< 5000 m

*) the length of 40 m for 1 MBit/s is often quoted in the literature for CAN. However, this does not apply to networks with optodecoupled CAN controllers. The worst-case calculation with optocouplers gives, for 1 MBit/s, a maximum bus length of 5 m - experience shows however that 20 m can be reached without problem.

NOTICE!
For bus lengths exceeding 1000 m, the use of repeaters may become necessary.

7.3.5 Layer Setting Services (LSS services)
Exactly two conditions must be met for devices to be connected to a CANopen network - all devices must have the same baud rate and every device must have a unique node address within the network. The condition for a use under LSS is that there is a 1:1 CAN connection with the device. A special dialogue mode then allows modifying the baud rate and the node address. **COB-ID 0x7E5** is sent from the master to the slave, the slave answers with **COB-ID 0x7E4.** LSS messages are always 8-byte long. Unused bytes are reserved and should be filled with 0.

A **"Switch Mode Global"** command is sent to switch a device in LSS configuration mode:

0x04	0x01	reserved

This command is not confirmed.

The following command calls for the "Inquire Node-ID" service.

0x5E	reserved

If the command was carried out successfully, the slave answers with:

0x5E	Node ID	reserved

If no feedback answer is received from the device, the LSS service may not be supported, or the baud rate may be incorrect.

The "Configure Node-ID" command is used to re-configure the **node address**:

0x11	Node ID	reserved

The error code is included in the answer of the slave device:

0x11	Error code	Error extension	reserved

Error code 0 means that the command has been accepted -
Error code 1 indicates an invalid Node ID.
The remaining error codes are reserved. The error extension includes manufacturer-specific information can only be used in case of error code 0xFF.

The baud rate is activated with the command “Configure Bit Timing Parameters“.

0x13	Bit timing	Table entry	reserved

The following baud rates are standardized by CiA:

Baudrate table 0x00
Baudrate: 1000 kBit/s
800 kBit/s
500 kBit/s
250 kBit/s (default value)
125 kBit/s
100 kBit/s
50 kBit/s

Again, the device answers with an error code:

0x13	Error code	Error extension	reserved

Error code 0 means that the command has been accepted -
Error code 1 indicates an invalid Node ID.
The remaining error codes are reserved. The error extension includes manufacturer-specific information can only be used in case of error code 0xFF.

Both network-specific parameters have now been modified, and the new parameters must be saved using “Store Configuration“:

0x17	reserved

Again, the device answers with an error code:

0x17	Error code	Error extension	reserved

Error code 0 means that the command has been accepted - Error code 1 indicates an invalid Node ID.
The remaining error codes are reserved. The error extension includes manufacturer-specific information can only be used in case of error code 0xFF.

To complete the LSS service, the device is switched back from the LSS configuration mode to the Preoperational mode with the command “Switch Mode Global“:

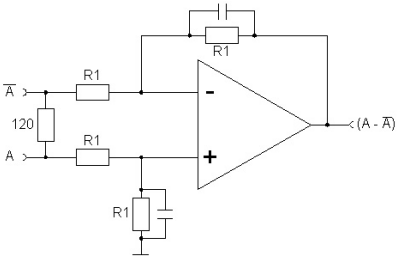
0x04	0x00	reserved

Default settings on delivery
Devices with cable outlet

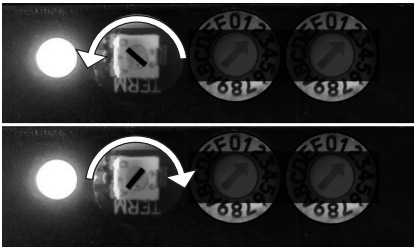
Description	Setting	Software
Baud rate	250 kBit/s	Object 2100h = 05h
Node address	1	Object 2101h = 01h
Termination	on	by rotary switch

7.4 Termination independence

As standard the interfaces CANopen, is supplied with a termination impedance of 120 Ω inside of the interface input. The termination impedance can be deactivated with the S3 switch. The SSI interface is also supplied with an integrated termination impedance.



Example “emulation switching“



Position of the switch:
Termination impedance: OFF

Position of the switch:
Termination impedance: ON

In order to deactivate the termination impedance switch S3 use micro- screwdrivers counter-clockwise.

7.5 Offset

After the installation of the magnetic tape and the measuring system (sensor head), a value is transmit by the interface. Because this value does not conform to the machine zero point, an offset should to be deposited at the controller side.

NOTICE!
An offset is necessary in each case of a replacement of the LMA-4 encoder (sensor head) or magnetic tape.

7.6 Pin Connections

7.6.1 SSI- and CANopen Interface

Pin Connection SSI-Interface Cable 1

Signal cable	SSI	CAN
White	0V/GND	0V/GND
Brown	+10-30 VDC	+ 10-30 VDC
Yellow	D +	CAN high
Orange	D -	CAN low
Green	C +	–
Violet	C -	–
Grey	–	–
Black	–	–
Shield	PE* ⏚	PE* ⏚

*) Connect shield only at the device!

8. Disturbances

This chapter describes possible causes for disturbances and measures for their removal. In case of increased disturbances, please follow the measures for fault clearance in chapter 8.1. In case of disturbances that cannot be eliminated by following the advice and the fault clearance measures given here, please contact the manufacturer (see second page).

8.1 Fault Clearance

CAUTION!
The device, the connection line and the signal cable must not be installed next to sources of interference that emit strong inductive or capacitive interference or strong electrostatic fields.

External perturbations can be avoided thorough suitable cable routing.

The drain of the signal output cable should only be connected to the following circuit on one side. The drain should not be grounded on both sides. Signal cables always have to be routed separately from the load power line. A safety distance of at least 0,5 m has to be kept from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, clocked controllers etc!

If interferences occur in spite of all the items stated above being observed, please proceed as follows:

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0,1 µF / 100 Ω)
2. Installation of recovery diodes via DC-inductors
3. Installation of RC-circuits via the different motor phases (in the terminal box of the motor)
4. Do **not** connect protective earth and ground
5. Connect a main filter ahead of the external power pack

8.2 Re-start after Fault Clearance

After the fault clearance:

1. Reset the emergency stop mechanism if necessary
2. Reset the error report at the super-ordinate system if necessary
3. Ensure that there are no persons in the danger area
4. Follow the instructions from chapter 6

WARNING!
Danger of injury through non-conventional fault clearance!

Non-conventional fault clearance can lead to severe injuries and damage of property.

Therefore:
- Any work to clear the faults may only be performed by sufficiently qualified staff
- Arrange enough space before starting the works
- Make sure that the mounting area is clean and tidy. Loose components and tools are sources of accidents

If components need to be replaced:
- Pay attention to a correct installation of the spare parts
- Reinstall all the fixing elements properly
- Before turning on the device, ensure that all covers and safety equipment is installed correctly and functions properly

9. Maintenance

The device is maintenance-free.

WARNING!
Danger through non-conventional maintenance!

Non-conventional maintenance can lead to severe injuries and damage of property.

Therefore:
Maintenance works may only be completed by staff that has been authorized and trained by the operator.

10. Cleaning

WARNING!
The device can only be cleaned with a damp cloth, do not use aggressive cleanser!