Magnetic linear encoders
TMLS

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**Basic specifications and sorting**

Coding/marking of the linear magnetic encoders:

**e.g.: TMLS-05A-02**
- **TMLS** – magnetic linear encoder
  - **05** - resolution: 5 \( \mu \text{m} \)
  - **A** – shape of the case
  - **02** – distance between the poles of the magnetic tape

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**TMLS-01A-02 PRECISE magnetic linear encoder**

- Recommended magn. tape: MT-02-008
- Resolution: 1 \( \mu \text{m} \)
- Accuracy (with the tape): up to +/-10 \( \mu \text{m} \), within distance of 2 mm: up to +/-4 \( \mu \text{m} \)
- Velocity: max. 1.5 m/s
- Length of the armoured cable: 3 m

**TMLS-05A-02 magnetic linear encoder**

- Recommended m.tape: MT-02-02/MT-02-008
- Resolution: 5 \( \mu \text{m} \)
- Accuracy: up to +/-20 \( \mu \text{m} \)/up to +/-10 \( \mu \text{m} \)
- Velocity: max. 2.5 m/s
- Length of the armoured cable: 3 m

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**TMLS-05A-05 magnetic linear encoder**

- Recommended magn. tape: MT-05-02
- Resolution: 5 \( \mu \text{m} \)
- Accuracy (with the tape): up to +/-30 \( \mu \text{m} \)
- Velocity: max. 3 m/s
- Length of the armoured cable: 3 m

**TMLS-25B-02 magnetic linear encoder**

- Recommended magn. tape: MT-02-02
- Resolution: 25 \( \mu \text{m} \)
- Accuracy (with the tape): up to +/-25 \( \mu \text{m} \)
- Velocity: max. 10 m/s
- Length of the non-armoured cable: 2 m

**Reference point (Z signal) is not used**
TMLS-01G-02 PRECISE guided magn. linear encoder

Recommended magn. tape: MT-02-008
Resolution: 1 µm
Accuracy (with the tape): up to +/-10 µm, within distance of 2 mm: up to +/-4 µm
Velocity: max. 1.5 m/s
Length of the armoured cable: 3 m
The guidance does not enable to use the reference point (Z signal)

TMLS-05G-02 guided magn. linear encoder

Recommended m.tape: MT-02-02/MT-02-008
Resolution: 5 µm
Accuracy: up to +/-20 µm/up to +/-10 µm
Velocity: max. 2.5 m/s
Length of the armoured cable: 3 m
The guidance does not enable to use the reference point (Z signal)

TMLS-01C-02 miniature magn. lin. encoder

Recommended magn. tape: MT-02-008
Resolution: 1 µm
Accuracy (with the tape): up to +/-10 µm
Velocity: max. 1.5 m/s
Length of the non-armoured cable: 3 m
Reference point (Z signal) is not used

TMLS-05C-02 miniature magn. lin. encoder

Recommended magn. tape: MT-02-02
Resolution: 5 µm
Accuracy (with the tape): up to +/-20 µm
Velocity: max. 2.5 m/s
Length of the non-armoured cable: 3 m
Reference point (Z signal) is not used
TMLS-01D-02 miniature magn. lin. encoder

Recommended magn. tape: MT-02-008
Resolution: 1 µm
Accuracy (with the tape): up to +/-10 µm
Velocity: max. 1.5 m/s
Length of the non-armoured cable: 3 m
Reference point (Z signal) is not used

TMLS-05D-02 miniature magn. lin. encoder

Recommended magn. tape: MT-02-02
Resolution: 5 µm
Accuracy (with the tape): up to +/-20 µm
Velocity: max. 2.5 m/s
Length of the non-armoured cable: 3 m
Reference point (Z signal) is not used

Common parameters:

Power supply: 5 V
Output: TTL, optional RS-422 (RS-422 cannot be used for the TMLS-25B-02 and miniature C, D)
Operating temperature: 0 – 85 °C
Degree of protection: IP67
Output signals can be converted by our converters to the following outputs: TTL, HTL, RS-422

We can deliver according to customer needs (not valid for the TMLS-25B-02 and the miniature C, D):
- any resolution,
- any length of the cable up to 17 m with the TTL output and up to 40 m with the RS-422 output,
- miniature C, D encoders and the TMLS-25B-02 encoder with the cable up to 7 m (TTL output), or up to 40 m with the converter,
- armoured or non-armoured cable,
- special cables with small bending radius for the energy chains
Description of the CANON 9 pin, D-Sub9 connector:

All the encoders produced and delivered by our company are equipped with the same CANON 9 pin, D-Sub9 connector.

**Output: TTL**

<table>
<thead>
<tr>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal</td>
<td>---</td>
<td>0V</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>A</td>
<td>Uc+5V</td>
<td>B</td>
<td>Z</td>
</tr>
<tr>
<td>Colour</td>
<td>---</td>
<td>green</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>yellow</td>
<td>brown</td>
<td>grey</td>
<td>white</td>
</tr>
</tbody>
</table>

(Screening of the cable is connected to the body of the connector)

**Output: RS-422**

<table>
<thead>
<tr>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal</td>
<td>-A</td>
<td>0V</td>
<td>-B</td>
<td>---</td>
<td>-Z</td>
<td>A</td>
<td>Uc+5V</td>
<td>B</td>
<td>Z</td>
</tr>
<tr>
<td>Colour</td>
<td>red</td>
<td>green</td>
<td>pink</td>
<td>---</td>
<td>blue</td>
<td>yellow</td>
<td>brown</td>
<td>grey</td>
<td>white</td>
</tr>
</tbody>
</table>

(Screening of the cable is connected to the body of the connector)

The following mark indicates position of the sensing chip inside the case of the encoder. Take this position into consideration during adjusting air gap in installations with a magnetic (ferit) rings or magnetic tapes fastened onto circular surfaces, e.g. angular measurement of a dividing device.
Dimensions of the encoders:

TMLS-01A-02
TMLS-05A-02
TMLS-05A-05

TMLS-01G-02
TMLS-05G-02

TMLS-25B-02

TMLS-01C-02
TMLS-01D-02
TMLS-05C-02
TMLS-05D-02
MT magnetic tape

Coding/marking of the magnetic tape

e.g.: MT-02-02
    MT – magnetic tape
    02 - distance between the poles: 2 mm
    02 – accuracy of the magnetic tape (up to +/- 0.020 mm; from 2017 up to +/- 0.018 mm)

Types of the magnetic tape

<table>
<thead>
<tr>
<th>Magnetic tape</th>
<th>Distance between poles</th>
<th>Guaranteed accuracy along the whole length</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-02-008 Precise</td>
<td>2 mm</td>
<td>up to +/- 8 µm</td>
</tr>
<tr>
<td>MT-02-02</td>
<td>2 mm</td>
<td>up to +/- 18 µm</td>
</tr>
<tr>
<td>MT-05-02</td>
<td>5 mm</td>
<td>up to +/- 20 µm</td>
</tr>
<tr>
<td>MT-25-02</td>
<td>2.5 mm</td>
<td>up to +/- 20 µm</td>
</tr>
</tbody>
</table>

Dimensions of the MT-02-008 Precise, MT-02-02, MT-05-02, MT-25-02 magnetic tapes

Width: 10 mm
Thickness: 1.3 mm
Max. length: 48 m

Air gap between the TMLS magnetic encoder and the MT magnetic tape

The air gap is measured between the bottom surface of the encoder case and the stainless steel cover tape.
In general, the air gap should be as small as possible and constant within the measuring range. For quick inspection / adjustment of the air gap, folded office paper is sufficient (you achieve an air gap of 0.2 mm this way). In general, small air gap encreases accuracy of the measurement. However, any contact between the stainless steel cover tape / cover profile and the read head is not allowed. In such a case the read head or the tape may become worn and damaged.
<table>
<thead>
<tr>
<th>Magnetic encoder</th>
<th>Colour of the sleeve</th>
<th>Recommended magnetic tape</th>
<th>Distance between poles</th>
<th>Air gap between the read head and the magn. tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMLS-01A-02 Precise</td>
<td>Green</td>
<td>MT-02-008</td>
<td>2 mm</td>
<td>0,1-0,3 mm</td>
</tr>
</tbody>
</table>
| TMLS-05A-02 Blue | MT-02-02 (MT-02-008) *1
|                    |                      | 2 mm                     | 0,2-0,4 mm                                      |
| TMLS-05A-05 Black | MT-05-02             | 2 mm                     | 0,2-1,5 mm                                      |
| TMLS-25B-02 ------ | MT-02-02             | 5 mm                     | 0,2-0,4 mm                                      |
| TMLS-01G-02 Precise green | MT-02-008  |
|                    |                      | 2 mm                     | 0,1-0,3 mm *2                                    |
| TMLS-05G-02 blue | MT-02-02 (MT-02-008) *1
|                    |                      | 2 mm                     | 0,2-0,4 mm *2                                    |
| TMLS-01C-02 Precise ------ | MT-02-008  |
|                    |                      | 2 mm                     | 0,1-0,3 mm                                    |
| TMLS-05C-02 ------ | MT-02-02 (MT-02-008) *1
|                    |                      | 2 mm                     | 0,2-0,4 mm                                    |
| TMLS-01D-02 Precise ------ | MT-02-008  |
|                    |                      | 2 mm                     | 0,1-0,3 mm                                    |
| TMLS-05D-02 ------ | MT-02-02 (MT-02-008) *1
|                    |                      | 2 mm                     | 0,2-0,4 mm                                    |
| TMLS-10A-25 (BC-02) ------ | MT-25-02  |
|                    |                      | 2.5 mm                   | 0,2-0,4 mm                                    |

* 1 Higher accuracy (up to +/- 10 µm) can be achieved with the MT-02-008 Precise magnetic tape.
* 2 Correct air gap is ensured by a slider of the encoder which is guided by the APG-01 profile.

Other installation tolerances of the read head and the tape

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Page 8
Aluminium protective profiles:

The AP-01, AP-02 and APG-01 protective profiles are generally designed to protect the magnetic tape from mechanical damage.

If the application is free of dirt or the magnetic tape cannot be mechanically damaged or small dimensions of the application do not allow the use of aluminum protective profiles, the tape can be installed directly as follows:

Stick the MT-0x-0x magnetic tape onto a properly cleaned and degreased surface (remove the protective foil from the self-adhesive side of the magnetic tape). Stick the self-adhesive stainless steel cover tape onto the magnetic tape. It is possible to mechanically secure both ends of the tape against peeling (drill and screw). The self-adhesive stainless steel cover tape is included in the delivery of the magnetic tape of the length up to 10 m.

AP-01 aluminium protective profile

This profile ensures complete protection of the magnetic tape against environmental contaminants such as dust and coolants and against mechanical damage.

The profile is destined for measuring systems, e.g. profile projectors or measuring frames. It is unsuitable for metalworking machines, where chips from harder material (than aluminum) can get between the AP-01 aluminum profile and the aluminum read head, causing abrasion. In extreme cases (especially when there are no periodic maintenance / cleaning of the machines), the profile or the read head may become worn.

The profile consists of a base profile and a cover profile. These profiles are connected using the M3x5 mm screws which belong to the scope of delivery. The base profile is attached by means of screws M4 with special low heads - these screws belong to the scope of delivery. The cover profile contains a groove for the magnetic tape.
AP-02 aluminium protective profile

This profile, together with the L-cover and the end pieces, is designed for demanding environment where hard metals are machined. The profile is manufactured by a drawing process. Thanks to this method it is dimensionally identical along the whole length. The surface is coated by natural elox. Mount the profile by the M4 low head screws using the holes, distance between the holes is 100 mm. Than insert the magnetic tape into the profile groove. Insert the stainless steel tape on the magnetic tape (into another groove in the profile) and secure it by means of a sealing rubber - "black rubber string", diameter 2 mm (use a screwdriver to push it into the groove). Thanks to the stainless steel tape, the magnetic tape is protected against all environmental influences (coolants, metal chips, dust, etc.). In addition, the hard chips "slip" over the hard stainless steel tape and do not damage the carrier profile / magnetic tape and the read head. It is recommended to use the L-cover to increase protection. The L-cover is fixed by screws and nuts (insert the nuts into the AP-02 profile groove). Fasten the end pieces to the ends of the L-cover.

The L-cover, end pieces and screws and nuts for the L-cover do not belong to the standard delivery of the AP-02 profile and must be ordered separately. The stainless steel tape, rubber string and screws belong to the standard delivery of the AP-02 profile.
APG-01 aluminium protective profile (linear guidance)

This profile is destined for long travelling axes over 2.2 m together with the TMLS-05G-02 and TMLS-01G-02 encoders.

If you use the AP-01 or AP-02 profiles longer than 2.2 m, adjustment of the constant air gap of 0.2-0.3 mm is relatively difficult. A suitable solution is the APG-01 profile with the G-head which are equipped with a sliding and durable plastic slider. The slider and grooves of the profile ensure the prescribed constant air gap and other installation conditions. Furthermore, if the base surface is not ideally parallel to the sensor path, the flexible sensor clip (part of the sensor delivery) or a hinged connected holder align these irregularities.

The profile is manufactured by a drawing process. Thanks to this method it is dimensionally identical along the whole length. The surface is coated by natural elox.

Mount the profile by the M4 low head screws using the holes, distance between the holes is 100 mm. Than insert the magnetic tape into the profile groove. Insert the stainless steel tape on the magnetic tape (into another groove in the profile) and secure it by means of a sealing rubber - "black rubber string", diameter 2 mm (use a screwdriver to push it into the groove). Thanks to the stainless steel tape, the magnetic tape is protected against all environmental influences (coolants, metal chips, dust, etc.). In addition, the hard chips "slip" over the hard stainless steel tape and do not damage the carrier profile / magnetic tape and the read head.

After installation of the profile, magnetic tape and stainless steel tape, place the G-head (slider) to the lateral grooves of the profile.
Installation of the AP aluminium protective profile

Installation of the AP-01 profile

a. Choose correct place for the encoder.
b. Mark and drill holes with M4 threads. Distances between the holes depend on the length of the profile.
c. Screw the profile onto the machine and check parallelity between the surface and the axis of movement.
d. Tighten the screws of the base profile.
e. Put the cover profile onto the base profile and screw it slightly.
f. Insert the magnetic tape into the groove (dark side up) and tighten the screws of the cover profile.
g. It is recommended to stick both ends of the magnetic tape by a silicone sealant or to use the self-adhesive bottom surface of the magnetic tape (remove part of the paper cover).
h. Install the magnetic sensor to ensure a constant air gap between the top of the aluminum profile and the bottom of the magnetic sensor according to the table on page 8. Adjust the parallelism between the sensor and the profile to ± 0.15 mm.
i. We recommend to use the mounting kit designed for our encoders.

AP-01 aluminium profile

Installation of the AP-02 profile

a. Choose correct place for the encoder.
b. Mark and drill holes with M4 threads. Distances between the holes depend on the length of the profile.
c. Screw the profile onto the machine and check parallelity between the surface and the axis of movement (refer to the picture).
d. Tighten the screws of the profile.
e. Insert the magnetic tape into the groove (dark side up). You can stick the tape onto the profile using the self-adhesive side (remove the paper cover).
f. Insert the stainless steel tape over the magnetic tape.
g. Push the sealing rubber (black rubber string, diameter 2 m) into the grooves over the stainless steel tape. This prevents the tapes from movement.
h. Install the magnetic sensor to ensure a constant air gap between the top of the aluminum profile and the bottom of the magnetic sensor according to the table on page 8. Adjust the parallelism between the sensor and the profile to ± 0.15 mm.
i. We recommend to use the mounting kit designed for our encoders.
Installation of the L-cover

a. Insert the M3-nuts into the T-groove of the profile.
b. Put the L-cover onto the upper part of the profile.
c. Fasten the L-cover using the M3 screws.

d. Insert the stainless steel tape loosely into the groove.

e. Insert the magnetic tape into the groove (dark side up). You can stick the tape onto the profile using the self-adhesive side (remove the paper cover).

Installation of the APG profile and the TMLS-05G-02 encoder

a. Choose correct place for the encoder.
b. Mark and drill holes with M4 threads. Distances between the holes depend on the length of the profile.
c. Screw the profile onto the machine and check parallelity between the surface and the axis of movement (refer to the picture).
d. Tighten the screws of the profile.

e. Insert the stainless steel tape loosely into the groove.

f. Insert the magnetic tape into the groove (dark side up). You can stick the tape onto the profile using the self-adhesive side (remove the paper cover).

g. Do bočních drážek nad krycím nerezovým páskem vložte těsnící gumu – tímto dojde k pevnému zajištění krycího nerezového pásku a zároveň k zajištění magnetického pásku.
h. Push the sealing rubber (black rubber string, diameter 2 m) into the grooves over the stainless steel tape. This prevents the tapes from movement.
i. Fasten the flexible clip to the head from any side. The clip can be mounted to any holder. Refer to the next paragraph Mounting holders for the magnetic encoders.

NOTE: the APG linear guidance and dimensions of the TMLS-05G-02 guided encoder are the same as the BC-02 battery powered digital readout system. These encoders have different parameters but their dimensions and way of installation are equal!!!
Mounting holders for the TMLS-05A/01A encoders

1) Flat holder – small (Fig. a)
2) Flat holder – big (Fig. b)
3) Square holder (Fig. c)
4) Mounting kit contains: big flat holder (1pc), square holder (1pc), cable ties (nylon cable ties 100 mm, 5 pcs + nylon cable ties 250 mm, 5 pcs), nylon cable clips (5 pcs)

![Images of mounting holders and mounting kit]

Installation of the reference point (encoders according to the page: 2-4)

- Reference point of the encoder is defined by a magnet supplied with the encoder. Install this magnet next to the profile within distance of about 1-2 mm from the red point on the encoder head. The marked side of the magnet must be oriented to the encoder head. The magnet must be located on the marked side of the head (refer to the figure).

- The reference signal generated by the magnet is processed in the digital readout. Accuracy and repeatability of indication of the reference point depends on the velocity of movement. Less speed brings higher accuracy.

- **Approach always to the reference point from the same side.**

![Reference point of the magnetic encoder]