



NUMERIK JENA

LIE 5 Exposed Linear Encoder

Instruction for Installation

Contents

1	Notes on safety	3		
1.1	General information	3		
1.2	Directives on instrument safety and electromagnetic compatibility (EMC)	3		
1.3	Transport, storage, unpacking	3		
1.4	Notes on use	5		
1.5	Notes on maintenance	5		
2	Delivery specification	6		
	<i>Standard version</i>	6		
	<i>Optional</i>	6		
3	Installation	7		
3.1	Installation conditions	7		
	<i>Installation position</i>	7		
	<i>Counting direction</i>	8		
	<i>Cable</i>	8		
	<i>Extension cable</i>	8		
	<i>Electromagnetic compatibility (EMC) and concept of shielding</i>	9		
	<i>Connectors, pin assignment</i>	11		
	<i>Recommended connection circuits</i>	15		
3.2	Installation of scale tape without using guide tapes	18		
3.2.1	Requirements	18		
3.2.2	Installation of DOUBLEFLEX scale tapes (as per MV50... ordering key)	18		
3.2.3	Installation of SINGLEFLEX scale tapes (as per MV51... ordering key)	20		
3.3	Installation of scale tape with using guide tapes (as per MV52... and MV 53... ordering key)	22		
3.3.1	Requirements	22		
3.3.2	Installation of guide tapes	22		
3.3.3	Installation of DOUBLEFLEX scale tapes	24		
3.3.4	Installation of SINGLEFLEX scale tapes	26		
3.4	Installation of scanning head	29		
4	Technical specification	33		
	<i>Resolution and accuracy (definition)</i>	33		
	<i>Mechanical data</i>	34		
	<i>Electrical data</i>	36		
	<i>Ambient conditions</i>	36		
5	Ordering key	37		

1 Notes on safety

1.1 General information

Make sure to familiarize yourself thoroughly with the contents of these installation instructions before installing and starting up the measuring system. On request, our service department or authorized dealers will provide you with supplementary information.

Please refer to the relevant operating instructions for the functions of the measuring system in conjunction with auxiliary electronic units, counters, displays and controls, and the fundamental mechanical instruments such as processing machines, measuring instruments, etc.



Observe notes and warnings in text!

1.2 Directives on instrument safety and electromagnetic compatibility (EMC)

The measuring system conforms to relevant regulations for technical equipment (Legislation on Product Safety), revision 1992.10.23 and the appropriate rules for the prevention of accidents.

The manufacturer is responsible for compliance of the overall system including the basic mechanical unit, the measuring system and the additional electric units, with the directives of the Legislation on Product Safety.

The same applies to the EMC regulations.

The measuring system meets the safety requirements for electrical measuring systems, control devices, control apparatus and laboratory instruments IEC 1010-1. Proof of the electromagnetic compatibility EMC for industrial regions was provided by type tests according to

EN 50081-1	Noise emission
IEC 801-2	Immunity against electrostatic discharges; Air discharge 8 kV, contact discharge 4 kV
IEC 801-4	Immunity against rapid transients; evaluation criterion B

Only use the instrument as intended by the manufacturer in order to maintain this status and adhere to the notes and warnings given in these installation instructions.

The measuring system conforms to EG standards and carries the CE label.

1.3 Transport, storage, unpacking

The measuring system may only be transported in its original packing. The same is recommended for storage. This applies in particular for the DOUBLEFLEX scale tapes. Always use the original packing for the transport of the DOUBLEFLEX tapes:

Lengths up to ~ 3 m	⇒ laid out straight;
Lengths exceeding 3 m	⇒ laid out in an "eight"-shape



Caution!

Never store, transport or handle the DOUBLEFLEX scale tape while rolled up.

SINGLEFLEX scale tapes may be rolled up with a minimum curvature radius of 140 mm. No restrictions apply to the length.

Handling the DOUBLEFLEX scale tape:

The great metrological benefits of the DOUBLEFLEX tape are a result of the adhesive layer between the scale tape and the carrier tape.

To make sure that this layer is not impaired, observe the following:

- Only remove the DOUBLEFLEX type from its packing at the site of installation and immediately prior to installation
- Do not separate the scale tape from the carrier tape
- Also make sure that the scale and the carrier tape are not inadvertently separated, particularly at the ends
- Handle the DOUBLEFLEX tape in such a way that the bending does not exceed 100 mm and the unsupported length between two supporting points 800 mm, tapes with a length up to 1200 mm must be supported about 300 mm from each end, longer ones in several points
- Avoid cross- and lengthwise displacements between the scale tape and the carrier tape



Caution!

In case of a transverse shifting (for example caused by transportation) of the carrier tape to the grating tape a correction is possible by a (*only*) lateral force.

Before assembling the carrier and grating tape have to flush together over the whole length.

On the other hand there is the danger of lifting the grating tape from the carrier tape during the mounting into the mounting groove.

In case of unintentional lift off the ends of the grating tape from the carrier tape the complete DOUBLEFLEX scale is to send back to the producer for restoration the adhesive layer.

1.4 Notes on use

- Comply with applicable pin assignment if auxiliary electronic units are connected (counter, displays, controls)
- Use the measuring system only with the supply voltage described in the installation instructions
- **Disconnect voltage supply before connecting or disconnecting plugs**
- Integrate the measuring system in instruments, machines or devices in such a way that it is protected against contamination
- Protect the scale against mechanical damage
- Protect the scanning head which contains electronic units against shock, impact and humidity

1.5 Notes on maintenance

Modifications and repairs of this measuring system may only be carried out by the manufacturer or appropriately authorized persons. The manufacturer is not liable for damages caused by unauthorized handling of the measuring system. All warranty claims are forfeited by unauthorized handling.

Measuring system

The measuring system requires no maintenance whatsoever. Open measuring systems are sensitive to contamination and must therefore be protected against dirt by way of a suitable construction by the user.

The graduation of the scale tape (tape surface) and the side of the scanning head (scanning window) facing the scale tape are in special need of protection. They are particularly sensitive to rough and irregular contamination and deposits (e.g. oil, grease, water).

Depending on the position in which the system has been installed and the ambient condition, it may be necessary to clean the tape surface or scanning window from time to time. If the monitoring signal output by the scanning head is used, a cleaning request is displayed without the functions of the measuring system being impaired.

When cleaning the components, make sure that the sensor and the scale are not scratched by any deposited particles. Dirt should be removed using a soft brush or oil-free compressed air. For subsequent cleaning, cotton wool or a soft cloth are ideal, for tenacious stains acetone or methylated spirit.

**Caution!**

Acetone and methylated spirit are inflammable!

DOUBLEFLEX scale tape

- When cleaning the DOUBLEFLEX scale tape, make sure to always wipe it lengthwise. If the tape is wiped crosswise, the scale tape may be displaced with respect to the carrier tape, resulting in impaired measuring functions.

- No cleaning solvent must flow under the scale tape, as this might affect the adhesive layer between the scale and the carrier tapes, resulting in the scale lifting off.
- If the adhesive tape comes into contact with solvent, the adhesive agent may start to dissolve, reducing the adhesive power.

2 Delivery specification

Standard version

- LIE5 scanning head according to ordering specification (see chapter *Ordering key*)
- DOUBLEFLEX scale tape according to ordering specification or
- SINGLEFLEX scale tape according to ordering specification
- Spacing gage for installing the scanning head (marking: 20 St or 100 St, depending on graduation period)
- Installation instructions

Optional

- Guide tapes for DOUBLEFLEX scale tape, recommended if mounting groove or mounting edge are not available, (Figs. 1 and 2)
- Guide tapes for SINGLEFLEX scale tape
- Guide tape mounting device (FAV)
- Spacing gage for guide tape mounting device
- Extension cable

3 Installation

3.1 Installation conditions

Installation position

The measuring system can be installed in any position.

However, to eliminate the possibility of marked contamination it should be installed so that the graduation of the scale tape is in a vertical position.

Adopt suitable measures to

- prevent dirt and particles settling on the measuring system during use;
- install the measuring system so that the graduated surface and the scanning window of the scanning head are easily accessible for cleaning.

Preferably, the tape should be mounted in a groove or along an edge:

- The grooves or edges serve as an installation orientation for straight mounting of the tapes, particularly very long ones
- For the DOUBLEFLEX scale tape, they also serve as a stop to prevent any displacement between the scale tape and the carrier tape

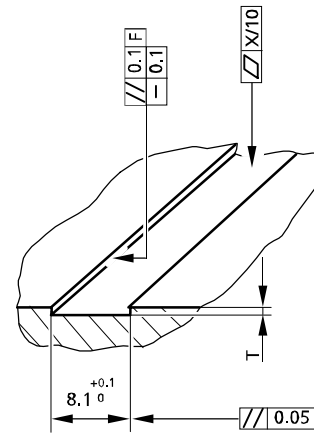


Fig. 1: Mounting groove

Accuracy classes	X
1 μm	0.003
2 μm	0.006
3 μm	0.009
5 μm	0.009

Scale tape	T
SINGLEFLEX	0.5-0.1
DOUBLEFLEX	0.7-0.1

F = machine guideway

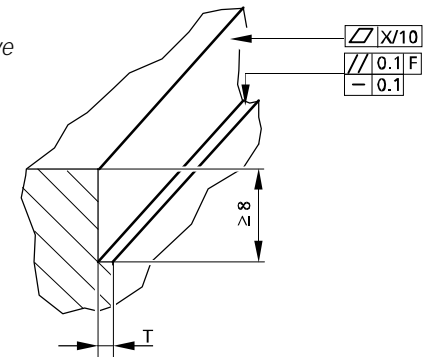


Fig. 2: Mounting edge

If the design does not provide grooves or edges (e.g. when mounting the scale tape on granite surfaces), flexible guide tapes can be used which are available as an option.

They assume the function of a groove.

Grooves, stops or guide tapes are required for DOUBLEFLEX tapes which are longer than 300 mm.

Counting direction

The counting direction of the system is positive (increasing measuring values) if the scanning head opposite the scale tape moves in the direction of the cable outlet.

Cable

- Mount the scanning head on the rigid, the scale tape on the mobile part of the machine, if possible; otherwise, provide a strain relief near the scanning head
- The cables of the measuring system and the connecting cable must be laid away from interference sources (mains cables, fuses, motors, magnetic valves, power supplies); normally, a distance of 100 mm will be sufficient
- When installing the measuring system in the machine, lay the cable so that it cannot be damaged by the moving carriage
- Make sure the cables' permissible bending radius r as a function of their outside diameter ($d = 5.3$ mm) is not exceeded:

bent once:	$r \geq 11$ mm
bent several times:	$r \geq 26$ mm
moving constantly:	$r \geq 50$ mm

Extension cable

Use of original extension cable is recommended for optimum adaptation to the encoder and maximum resistance against electro magnetic interference.

Please consult the encoder manufacture before using a self-made cable.

It is to avoid absolutely to use the encoder cable for transmission other signals (non-encoder signals).

Electromagnetic compatibility (EMC) and concept of shielding

(Fig. 3 – page 10)

Observe the following to ensure maximum protection against electrical and magnetic interference:

- Mount the measuring system to ensure good galvanic conductivity (seating surfaces paint-free, conductive threads of mounting screws and threads in machine component)
- Measuring systems without connectors on cables:
 - for directly connection to the additional electronic units mount the external shield of the cable to ensure good galvanic conductivity with the earth potential
 - for using cable connections (terminal blocks and so on) connect both external cable shieldings and connect to the shielding of cable connections *(see Fig. 3: Concept of shielding)*
 - use shielded connectors

For permanently fixed cables on measuring system the concept of shielding is metted.

- For using of ZE-additional electronic unit connect the ZE housing to ensure good galvanic conductivity; or for insulated installation connect the ZE housing at the shortest distance by an additional potential equalization line with the machine's protective earth (Cu line with cross section $\geq 6 \text{ mm}^2$)

Please contact our service department or that of the appropriate manufacturer if you experience any problems when working with specific display or control units.

The measuring system conforms to the EN 50081-1 and EN 50082-2 regulations provided it is mounted and operated in accordance with these directives and the conditions given in these instructions.

(See also chapter 1, Notes on safety)

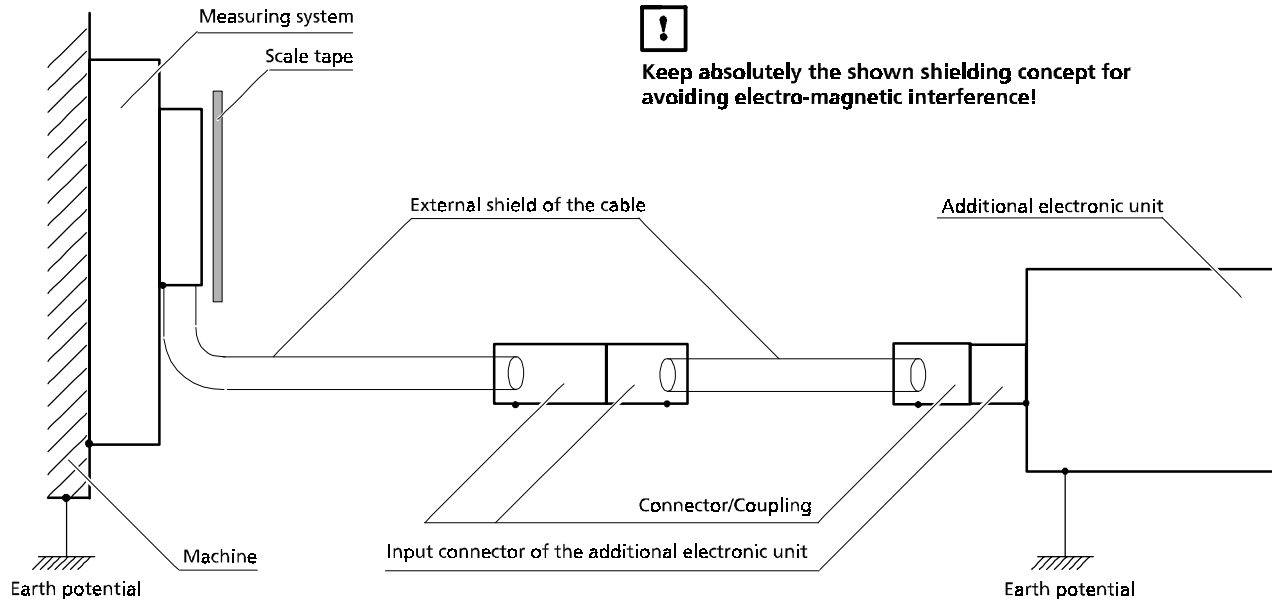
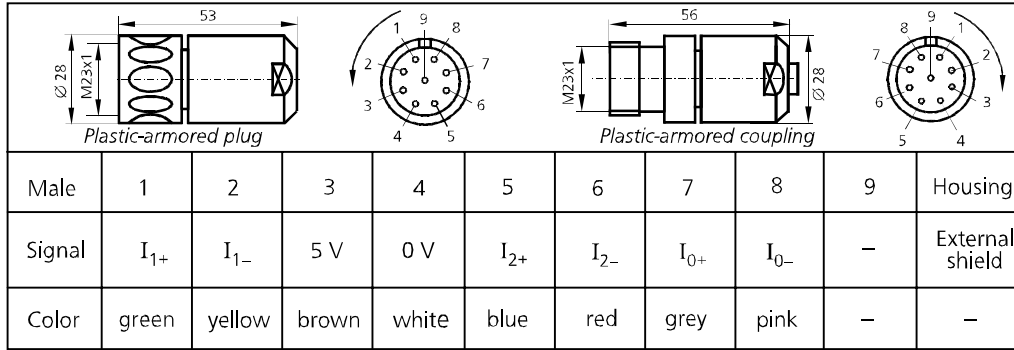


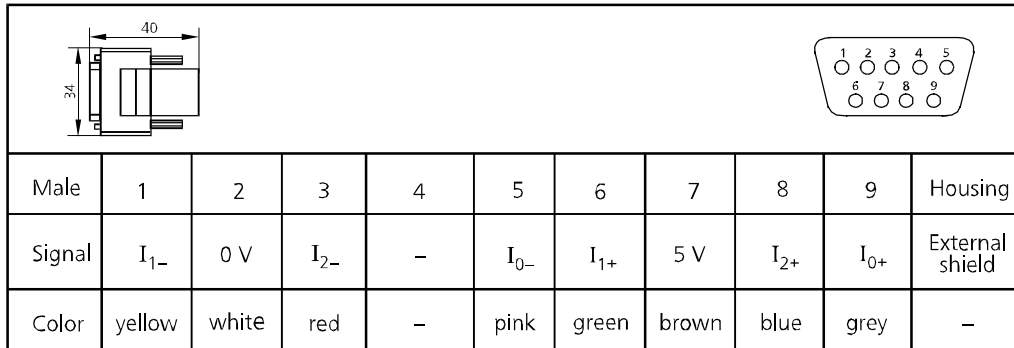
Fig. 3: Concept of shielding

Connectors, pin assignment



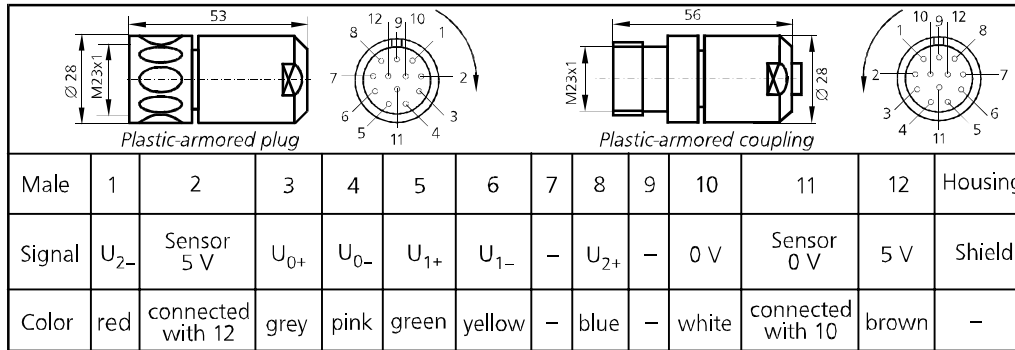
~ 11 μA_{pp}

Fig. 4:
Current interface 11 μA_{pp}
9-pin connector (male)
9-pin coupling (male)




~ 11 μA_{pp}

Fig. 5:
Current interface 11 μA_{pp}
9-pin D sub connector (male)



 $1 V_{pp}$

Fig. 7:
Voltage interface $1 V_{pp}$
12-pin connector (male)
12-pin coupling (male)



Male	1	2	3	4	5	6	7	8	9	Housing
Signal	U_{1-}	0 V	U_{2-}	–	U_{0-}	U_{1+}	5 V	U_{2+}	U_{0+}	External shield
	\bar{Z}_1	0 V	\bar{Z}_2	NAS	\bar{R}	Z_1	5 V	Z_2	R	
Color	yellow	white	red	violet	pink	green	brown	blue	grey	–

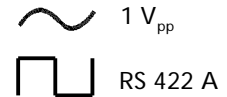
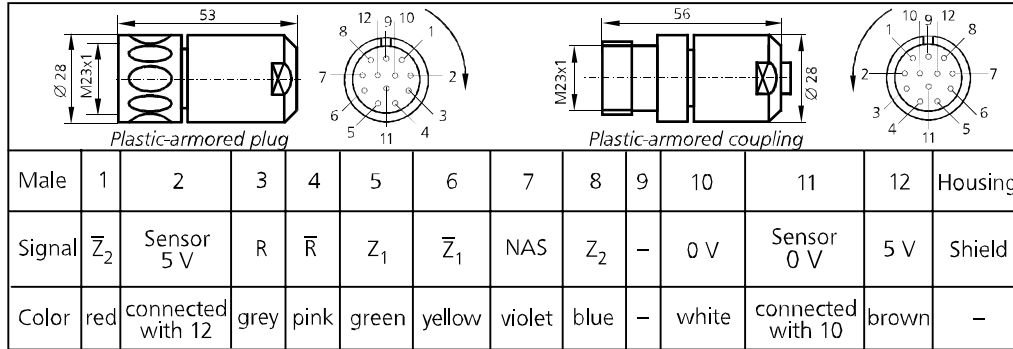
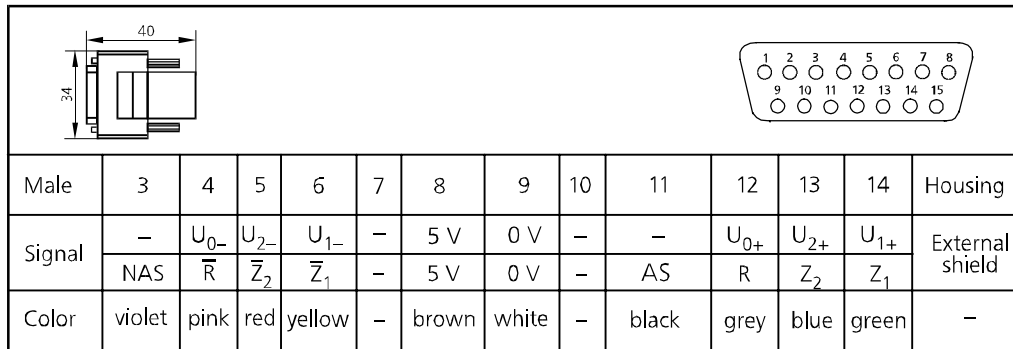


Fig. 9:
Voltage interface 1 V_{pp}
Square-wave interface
9-pin D sub connector (male)
NAS: negated monitoring
signal



 RS 422 A

Fig. 10:
Square-wave interface
12-pin connector (male)
12-pin coupling (male)




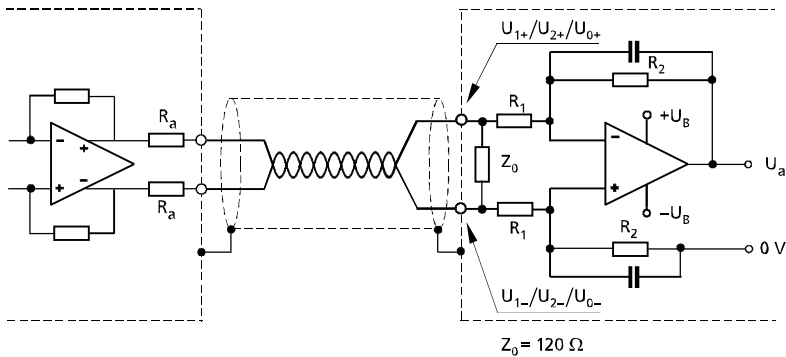
 1 V_{pp}
 RS 422 A

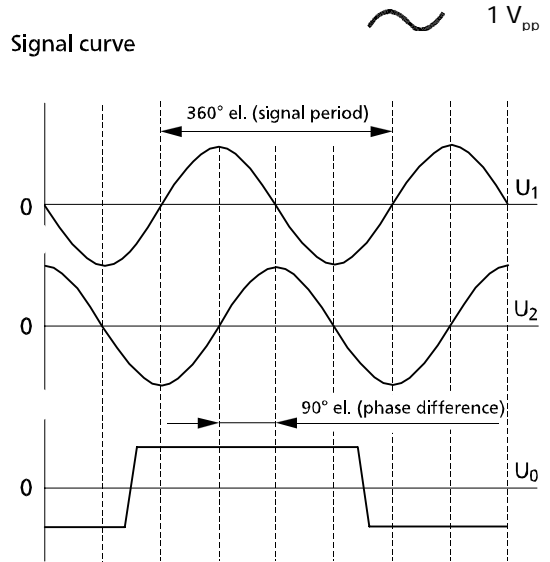
Fig. 11:
Voltage interface 1 V_{pp}
Square-wave interface
15-pin D sub connector
(male)
NAS: negated monitoring
signal
AS: monitoring signal

Recommended connection circuits

Circuit



Signal curve



Difference signals measured on Z_0 :

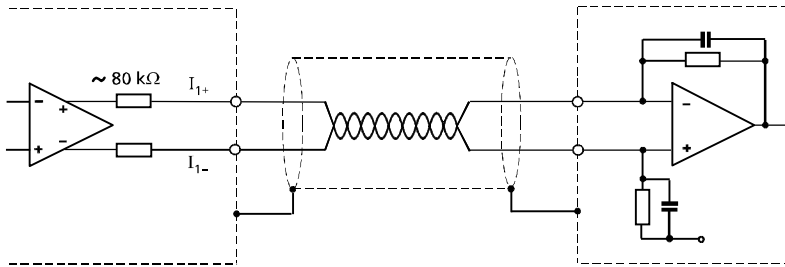
$$U_1 = U_{1+} - U_{1-} = 0.6 \dots 1.2 V_{pp} \quad (\text{rated voltage: } 1 V_{pp})$$

$$U_2 = U_{2+} - U_{2-} = 0.6 \dots 1.2 V_{pp} \quad (\text{rated voltage: } 1 V_{pp})$$

$$U_0 = U_{0+} - U_{0-} = 0.5 \dots 1.2 V \quad (\text{rated voltage: } 0.8 V)$$

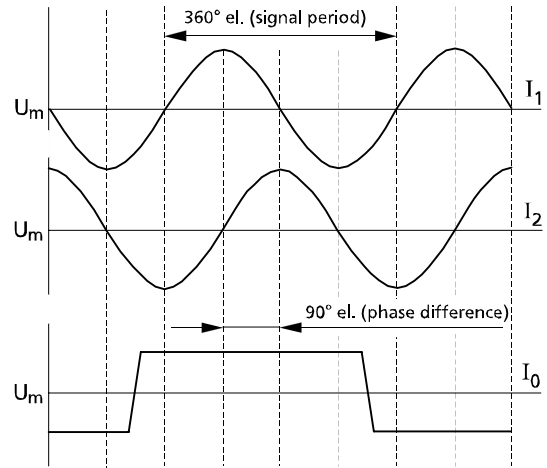
Fig. 12: Voltage output

Circuit



Signal curve

 $11\mu A_{pp}$



$U_m = 2.5 V \pm 0.5 V$

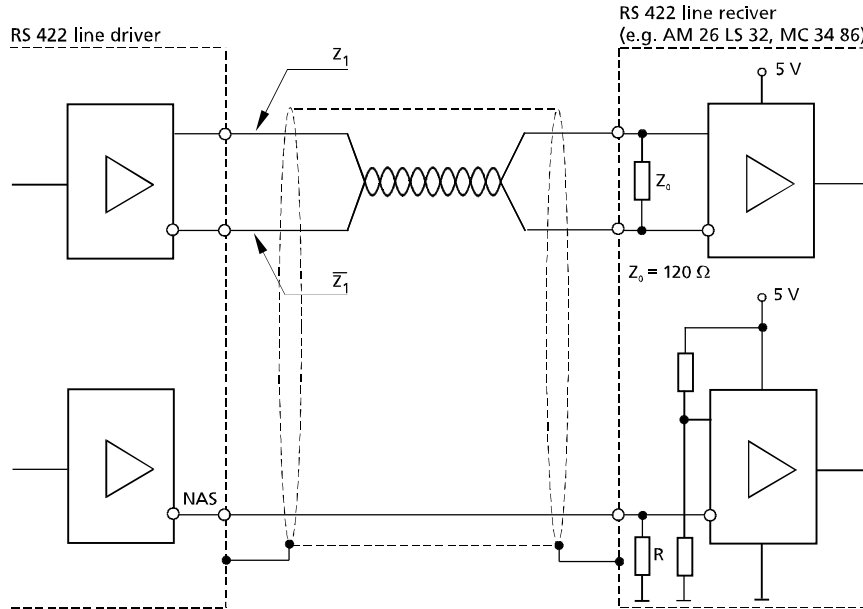
$I_1 = 7.0 \dots 16 \mu A_{pp}$

$I_2 = 7.0 \dots 16 \mu A_{pp}$

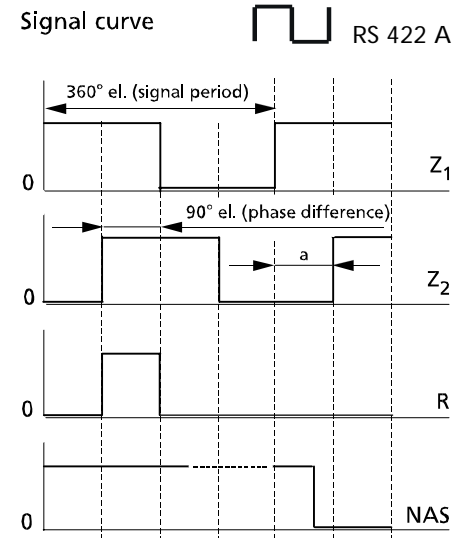
$I_0 = 5.5 \dots 15 \mu A$

Fig. 13: Current output

Circuit



Signal curve



NAS high:
measuring system functioning;
input signals within tolerance range
NAS low:
measuring system in disorder
a:
minimum flank distance as a
function of interpolation factor and
travel speed (see table page 35)

For avoiding electro-magnetic interference the cable adaptation with a terminate resistor of 120 Ω is necessary. In case of connection more than one parallel signal inputs to the encoder output (for example linear motors with parallel connection to position controller, speed controller, excelleration controller) pay attention on a resulting terminate resistor of $Z_{0res} \approx 120 \Omega$.

Fig. 14: Square-wave output RS 422 A

3.2 Installation of scale tape without using guide tapes

3.2.1 Requirements

- The mounting surfaces must be prepared according to the installation drawings:
 - Groove (*Fig. 22b – page 31*)
 - Stop edge (*Fig. 22a – page 31*)
 - Flat surface (*Fig. 21 – page 30*)
- When the tape is installed without the use of a groove or stop edge, a suitable rigid stop at the side or end must be used (preferably at the fixed end of the DOUBLEFLEX scale tapes), e.g. a stop measure or stop rail. The stop must implement the position and tolerance of the stop edge as specified in (*Fig. 22 a*).



Caution!

The stop must not be displaced during installation.

3.2.2 Installation of DOUBLEFLEX tapes (tapes as per MV 50... ordering key)

Preparation

- Use a solvent (e.g. acetone, methylated spirits) to clean the adhesion surfaces of the machine.



Caution!

Make sure that no alien elements are left on the adhesion surface.

When applying the scale tape, make sure that no alien elements can get between the scale tape and the base surface.

Alien elements between the tape and the base (machine component) cause local differences in the spacing between the scale and the scanning head and may thus result in deficiencies of the measuring system and/or in measuring errors.

Before assembling the carrier and grating tape have to flush together over the whole length. On the other hand there is the danger of lifting the grating tape from the carrier tape during the mounting into the mounting groove.

Correction by a (*only*) lateral force.

- Adhere to relevant protection rules when applying the adhesive.



Caution!

- Loctite 480 J is a quick-action adhesive on a cyanacrylic base; it sets when exposed to air and has a potlife of 2 minutes.
- Loctite 480 J sticks together skin and eye lids within seconds.
- Keep Loctite 480 J out of the reach of children.

- Do not inhale the adhesive fumes and use it in well ventilated rooms only.
- Make sure to avoid skin and eye contact.
- If your skin has stuck together, soak it in warm soap water and then use a blunt object to carefully peel it apart.
- If any of the adhesive got into your eye, rinse thoroughly with water and consult an ophthalmologist.
- Use water to set spilled adhesive.
- Store in a cool place at 5 °C.

Procedure

(Fig. 15 – page 21)

- Use a scribing pin, for example, to mark the center of the reference point on the adhesion surface of the machine (6.3 mm from the end and 4 mm from the side of the DOUBLEFLEX scale tape).
Apply one drop of adhesive (epoxy resin or Loctite 480 J) on the marked spot.
- Peel off ~ 70 mm of the red protective film on the back of the carrier tape.



Caution!

The adhesive tape now exposed must not be brought into contact with other materials due to its strong adhesive force.

- Fold out the protective film toward the stop-free side beside the DOUBLEFLEX tape or the groove; apply a drop of Loctite 480 J and dip the reference point into this drop within ~ 2 minutes (= potlife of adhesive).
- Place the ponding pad in the adhesive drop, at the same time sticking down the first ~ 50 mm of the DOUBLEFLEX scale tape.



Caution!

In the adhesive area (exposed adhesive tape) the DOUBLEFLEX scale tape must be positioned precisely against the stop on the machine component or in the groove.

- Carefully pull out the protective film sideways and press the scale tape against the adhesive surface of the machine component from the reference point in the direction of the tape end (using your thumb or a rounded object).
The pressure point should lie ~ 30 mm to 50 mm behind the line separating the adhesive tape and the protective film.



Note!

Make sure that the full length of the DOUBLEFLEX scale tape is lodged securely against the stop mechanism.

3.2.3 Installation of SINGLEFLEX scale tapes (tapes as per MV51... ordering key)

Preparation

- Use a solvent (e.g. acetone, methylated spirits) to clean the adhesion surfaces of the machine.



Caution!

Make sure that no alien elements are left on the adhesion surface.

When applying the scale tape, make sure that no alien elements can get between the scale tape and the base surface.

Alien elements between the tape and the base (machine component) cause local differences in the spacing between the scale and the scanning head and may thus result in deficiencies of the measuring system and/or in measuring errors.

Procedure

(Fig. 16 – page 21)

- Peel off ~ 70 mm of the red protective film on the back of the carrier tape.



Caution!

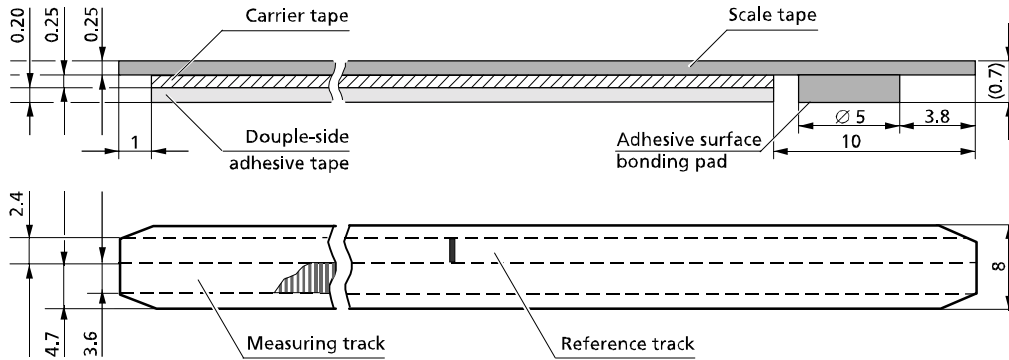
The adhesive tape now exposed must not be brought into contact with other materials due to its strong adhesive force.

- Fold out the protective film toward the stop-free side beside the SINGLEFLEX tape or the groove.
- Place the scale tape with the end from which the protective film has been removed against the end and side stop mechanisms.
- Carefully pull out the protective film sideways and press the scale tape against the adhesive surface of the machine component (using your thumb or a rounded object). The pressure point should lie ~ 30 to 50 mm behind the line separating the adhesive tape and the protective film.



Note!

Make sure that the full length of the SINGLEFLEX scale tape is lodged securely against the stop mechanism.



For measuring lengths exceeding 300 mm, a groove, stop edge or guide tape is required!

Fig. 15: DOUBLEFLEX scale tape

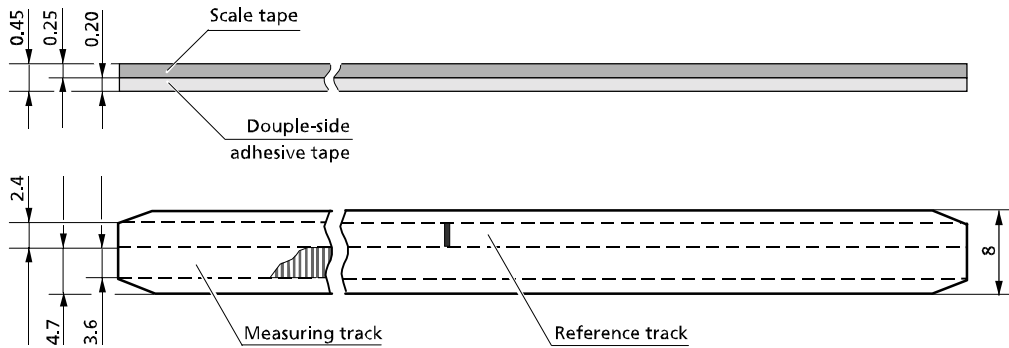


Fig. 16: SINGLEFLEX scale tape

3.3 Installation of scale tape with using guide tapes (as per MV52... and MV 53... ordering key)

3.3.1 Requirements

- The mounting surfaces must be prepared according to the installation drawings:
Flat surface (*Fig. 21 – page 30*)
- Guide tapes are suitable for both DOUBLEFLEX and SINGLEFLEX scale tapes.
However, they differ in thickness where they have been adapted to the thickness of the scale tapes when these are supplied:
DOUBLEFLEX scale tape: $t = 0.7 \text{ mm}$
SINGLEFLEX scale tape: $t = 0.5 \text{ mm}$
- Make sure that the guide tapes for DOUBLEFLEX tapes are not used on SINGLEFLEX tapes and vice versa

3.3.2 Installation of guide tapes

Preparation

- Use a solvent (e.g. acetone, methylated spirits) to clean the adhesion surfaces of the machine.



Caution!

Make sure that no alien elements are left on the adhesion surface.

When applying the scale tape, make sure that no alien elements can get between the scale tape and the base surface.

Alien elements between the tape and the base (machine component) cause local differences in the spacing between the scale and the scanning head and may thus result in deficiencies of the measuring system and/or in measuring errors.

- Make sure the guide tape mounting device (FAV) is installed correctly. The grating structure shown on the FAV must coincide with the grating structure of the steel tape (*Figs. 17/21 – pages 27/30*).

Note:

If the way the FAV is installed provides no access to setting screw 1, setting screw 2 must be used. If this is the case, setting screw 1 remains in position "off".

Operation of setting screw 2:

"off" position means:

setting screw 2 is flush with the FAV housing.

"on" position means:

setting screw 2 is turned clockwise all the way into the FAV housing.

Procedure

(Figs. 17 ... 20 – pages 27/28)

- Bring the red setting screw 1 into "off" position by turning it clockwise (groove in screw slot on "off") setting screw 2 is flush with the FAV housing.
- Screw the FAV in place of the LIE 5 scanning head in the appropriate place on the machine using the spacing gage to set a distance of 0.25 mm between the tape seating surface and the bottom side of the FAV.
- Move the machine carriage to bring the FAV into position 1 (~150 mm to the right of the tape end) (Fig. 17).
- Slide the guide tapes from the right into the FAV grooves, inserting them up to the end of the tape.
- Lift up guide tape 1 and peel the protective film ~10 mm off the adhesive tape in the direction of guide tape 2; replace guide tape 1 on the seating surface (Fig. 18).
- Lift up guide tape 2, pull the protective film of guide tape 1 ~20 ... 30 mm through under guide tape 2 and peel the protective film of guide tape 2 ~10 ... 20 mm sideways towards the front; replace guide tape 2 on the seating surface (Fig. 19).
- Move the FAV with the carriage into position 2 (~20 mm right of tape end).
Remove the protective films from both adhesive tapes until the right-hand edge of the FAV is reached (Fig. 20).

- Bring setting screw 1 into "on" position by turning it in arrow direction (groove in screw slot on "on"). The guide tapes are now pressed against the support by spring force.
- Move the FAV with the carriage to the right-hand scale tape end while peeling off both protective films along with the FAV/carriage motion until they are completely removed.
- Bring setting screw 1 into "off" position by turning it against arrow direction. Remove the FAV from the machine component. Press the right-hand ends of the guide tapes against the support, making sure not to displace them in sideways direction.

The guide tapes have thus been aligned and attached parallel to the carriage motion, in the correct position relative to the scanning head window and with the necessary distance from each other.

3.3.3 Installation of DOUBLEFLEX tapes (tapes as per MV 52... ordering key)

Preparation

- Prepare the adhesion surfaces in accordance with 3.3.2 *Installation of the guide tapes – Prepare*.
- Adhere to relevant protection rules when applying the adhesive.



Caution!

- **Loctite 480 J is a quick-action adhesive on a cyanacrylic base; it sets when exposed to air and has a potlife of 2 minutes.**
- **Loctite 480 J sticks together skin and eye lids within seconds.**
- **Keep Loctite 480 J out of the reach of children.**
- **Do not inhale the adhesive fumes and use it in well ventilated rooms only.**
- **Make sure to avoid skin and eye contact.**
- **If your skin has stuck together, soak it in warm soap water and then use a blunt object to carefully peel it apart.**
- **If any of the adhesive got into your eye, rinse thoroughly with water and consult an ophthalmologist.**
- **Use water to set spilled adhesive.**
- **Store in a cool place at 5 °C.**

Procedure

(Fig. 15 – page 21)

- Use a scribing pin, for example, to mark the center of the bonding pad on the adhesion surface of the machine (6.3 mm from the end and 4 mm from the side of the DOUBLEFLEX scale tape).

Apply one drop of adhesive (epoxy resin or Loctite 480 J) on the marked spot.

- Peel off ~ 70 mm of the red protective film on the back of the carrier tape.

**Caution!**

The adhesive tape now exposed must not be brought into contact with other materials due to its strong adhesive force.

- Fold the protective film out of the groove formed by the guide tapes; apply a drop of Loctite 480 and dip the bonding pad into this drop within ~ 2 minutes (= potlife of adhesive).
- Place the bonding pad in the adhesive drop, at the same time sticking down the first ~ 50 mm of the DOUBLEFLEX scale tape.

**Caution!**

In the adhesive area the DOUBLEFLEX scale tape must be positioned precisely in the groove.

- Carefully pull out the protective film sideways and press the scale tape against the adhesive surface of the machine component from the reference point in the direction of the tape end (using your thumb or a rounded object). The pressure point should lie ~ 30 mm to 50 mm behind the line separating the adhesive tape and the protective film.

3.3.4 Installation of SINGLEFLEX tapes (tapes as per MV 53... ordering key)

Preparation

- Use a solvent (e.g. acetone, methylated spirits) to clean the adhesion surfaces of the machine.



Caution!

Make sure that no alien elements are left on the adhesion surface.

When applying the scale tape, make sure that no alien elements can get between the scale tape and the base surface.

Alien elements between the tape and the base (machine component) cause local differences in the spacing between the scale and the scanning head and may thus result in deficiencies of the measuring system and/or in measuring errors.

Procedure

(Fig. 16 – page 21)

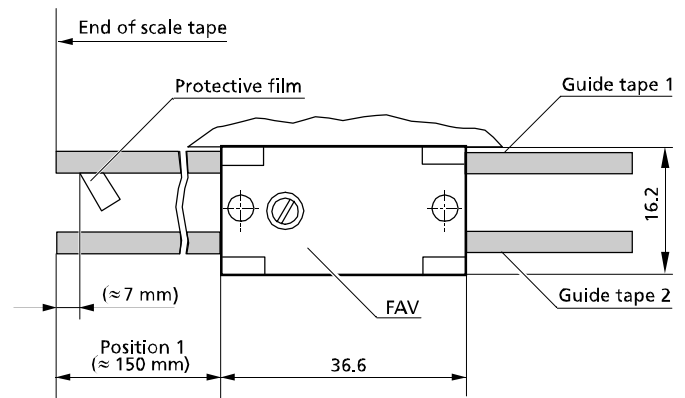
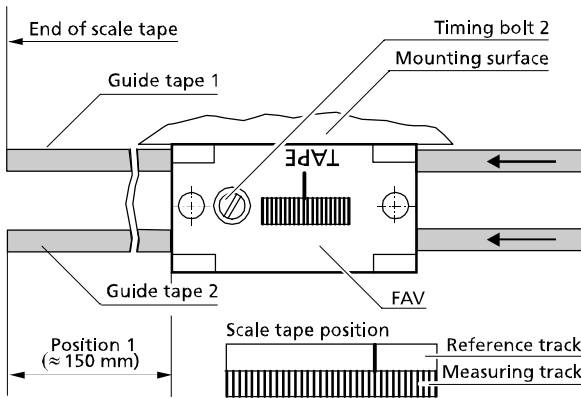
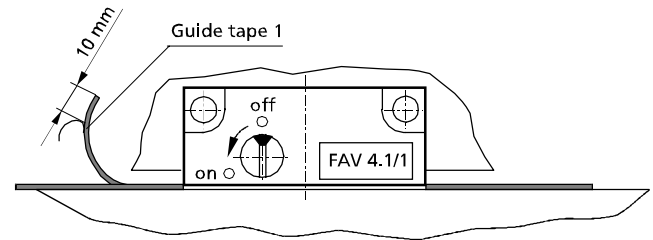
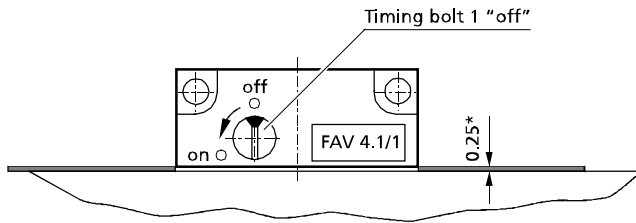
- Peel off ~ 70 mm of the red protective film on the back of the carrier tape.



Caution!

The adhesive tape now exposed must not be brought into contact with other materials due to its strong adhesive force.

- Fold the protective film out of the groove formed by the guide tapes.
- Place the scale tape with the end from which the protective film has been removed against the front end stop.
- Carefully pull out the protective film sideways and press the scale tape against the adhesive surface of the machine component (using your thumb or a rounded object). The pressure point should lie ~ 30 mm ... 50 mm behind the line separating the adhesive tape and the protective film.



* It is recommended to use the FAV guide tape mounting device supplied.

Fig. 17: Installation of guide tapes

Fig. 18: Installation of guide tapes

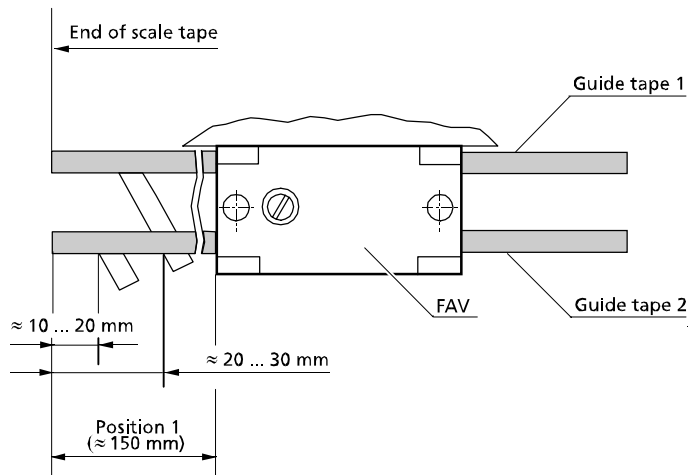
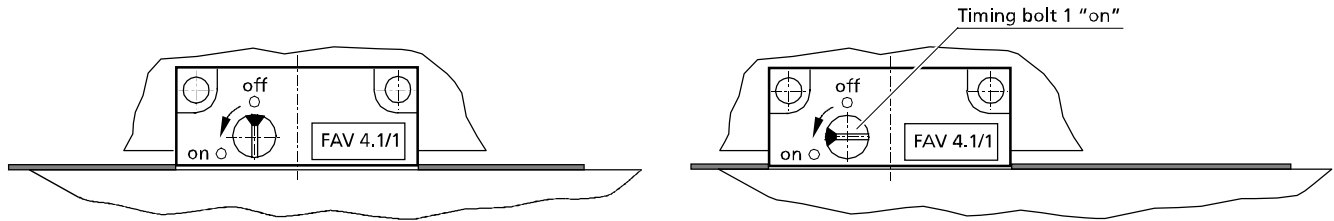


Fig. 19: Installation of guide tapes

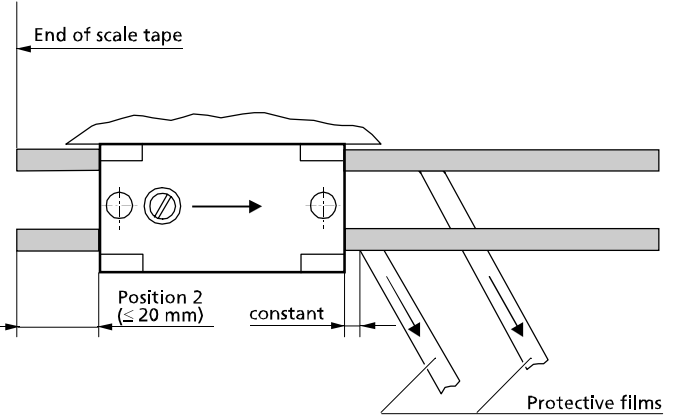


Fig. 20: Installation of guide tapes

3.4 Installation of scanning head

Requirements

- The mounting surface must be prepared according to the installation drawing (Figs. 21/22 – pages 30/31)
- Please observe the installation conditions (see chapter 5.1 *Installation conditions*)

Preparation

- Remove the protective foil from the graduated surface of the scale tape.
- Remove the protective foil from the sensor.
- Carefully clean the sensor surface of the scanning head with a lint-free cloth, using a solvent (acetone, methylated spirits) if necessary; (see chapter 1.5 *Notes on maintenance*).
- Clean the mounting surfaces of the scanning head and the machine component.

Procedure

(Figs. 21/22 – pages 30/31)

- Screw the scanning head on the prepared mounting surface so that it can still be shifted.
- Slide the spacing gage in linear direction between the scale tape surface and the scanning head.

- Slide the scanning head against the spacing gage and tighten the two mounting screws evenly and lightly. It must be possible to still shift the spacer foil.
- Tighten the two mounting screws in turn while checking whether the spacing gage can still be shifted.
- Remove the spacing gage.
- If the removal of the spacing gage presents any problems, unscrew the scanning head and repeat the installation starting with step 2.
- Lay the scanning head cable including the strain relief near the scanning head.
- Carefully clean the scale tape surface (graduation) with a lint-free cloth, using a solvent (acetone, methylated spirits) if necessary; (see chapter 1.5, *Notes on maintenance*).
- Connect the measuring system cables with the auxiliary electronic units, taking into account the connector assignment.



Caution!

The evaluation electronics must not be ON, as this may lead to functional interference or breakdowns. It would then be necessary to recalibrate the measuring system.

- Switch on the evaluation electronics and perform a function check.

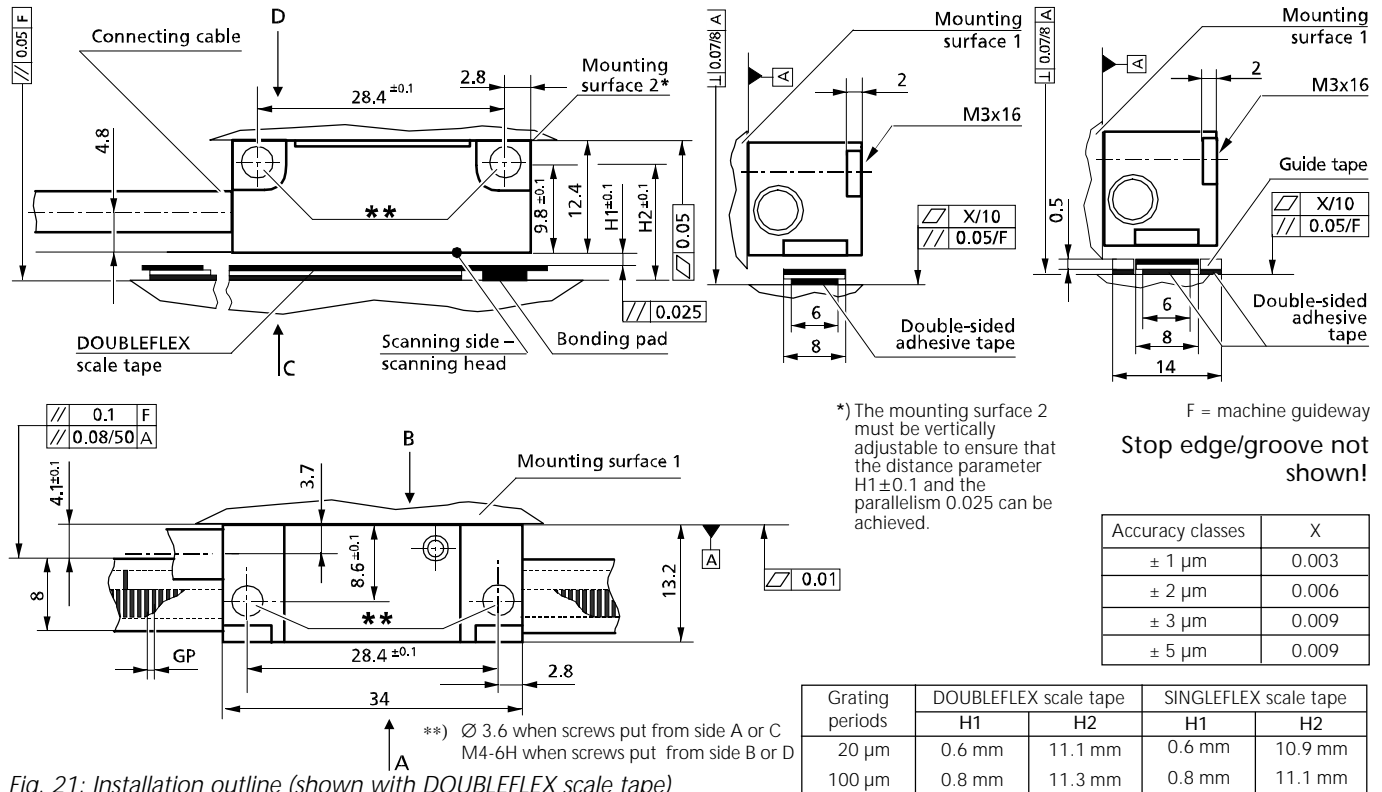
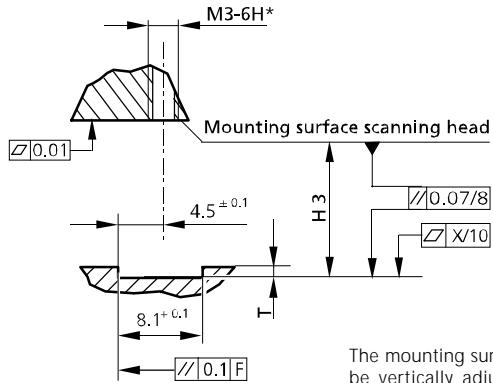


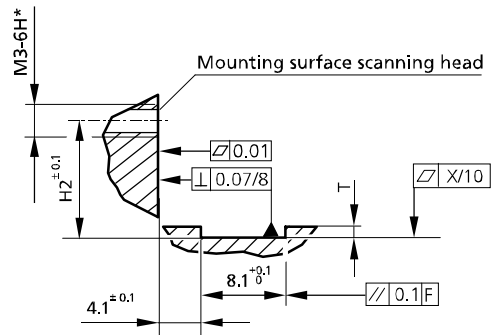
Fig. 21: Installation outline (shown with DOUBLEFLEX scale tape)

a



The mounting surface must be vertically adjustable to ensure that the distance parameter H1 (see Fig. 21) and the parallelism 0.025 can be achieved.

b



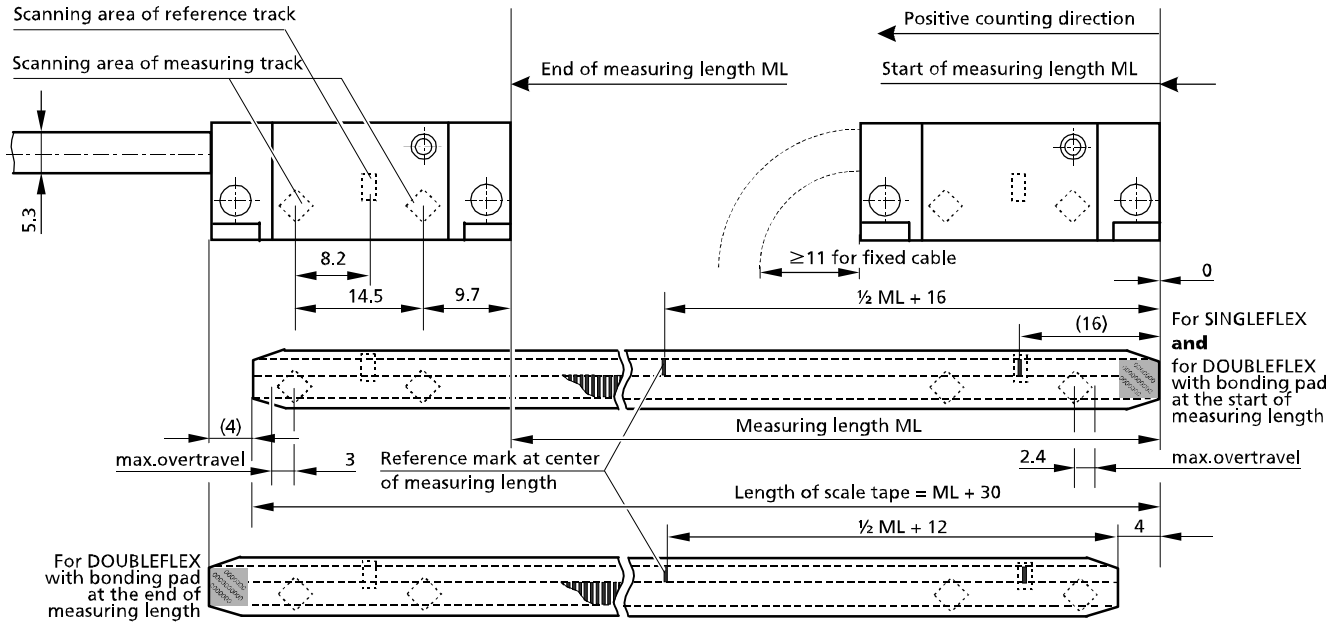
*) minimum thread depth 7 mm
F = machine guideway

Grating periods	H2		H3	
	DOUBLEFLEX scale tape	SINGLEFLEX scale tape	DOUBLEFLEX scale tape	SINGLEFLEX scale tape
20 μm	11.1 mm	10.9 mm	13.7 mm	13.5 mm
100 μm	11.3 mm	11.1 mm	13.9 mm	13.7 mm

Scale tape	T
SINGLEFLEX	0.5 – 0.1
DOUBLEFLEX	0.7 – 0.1

Accuracy classes	X
± 1 μm	0.003
± 2 μm	0.006
± 3 μm	0.009
± 5 μm	0.009

Figs. 22a and 22b: Mounting surfaces



Position of scanning head an viewing direction: Scanning head drawn with lateral offset to the scale tape, from top through the scanning head on the scale tape.

Fig. 23: Definition of measuring distance

4 Technical specification

Resolution and accuracy (definition)

A difference must always be made between the resolution and the accuracy of a measuring system. The two parameters are not directly interdependent and may differ from each other.

Resolution

The resolution of a linear measuring system describes the least possible displacement of the scanning head against the scale which can still be discerned by the evaluation electronics (display, control).

It depends on (*see table 1*)

- the graduation period of the scale
- the signal interpolation factor (internally or in auxiliary electronic unit)
- the evaluation mode in the counter

Accuracy

The accuracy of linear measuring systems is specified in accuracy classes.

The extreme error values for any max. one-meter section of the measured length lie within the specified accuracy class of $\pm a \mu\text{m}$ with respect to their mean value.

For measuring lengths up to 1 m, the tolerance ($\pm a \mu\text{m}$) refers to the actual measuring length .

The accuracy applies to a reference temperature of 20 °C.

With exposed linear measuring systems, the definition of the accuracy class applies only to the scale. This is called scale accuracy.

Table 1

Graduation period of scale	Signal period of sinus signals	Interpolation factor	Signal period after interpolation	Resolution after evaluation in counter		
				1x	2x	4x
20 μm	20 μm	none	20 μm	20 μm	10 μm	5 μm
		5x	4 μm		2 μm	1 μm
		10x	2 μm	2 μm	1 μm	0.5 μm
		25x	0.8 μm			0.2 μm
		50x	0.4 μm		0.2 μm	0.1 μm

Mechanical data	DOUBLEFLEX scale tape	steel
	Linear expansion coefficient	$\sim 10.5 \times 10^{-6} \text{ deg}^{-1}$
	Grating periods (GP) (~150 mm to the right of the tape end)	20 μm ; 100 μm ; others on request
	Accuracy classes	$\pm 1 \mu\text{m}$, $\pm 2 \mu\text{m}$; $\pm 3 \mu\text{m}$; $\pm 5 \mu\text{m}$
	Measuring lengths	up to 30 m
	Reference marks	periodically every 50 mm; distance coded at $1000 \times \text{GP}$; at the center of the measured length; others on request
	Recommended resolution	0.1 μm ; 0.2 μm ; 0.5 μm ; 1 μm ; 5 μm ; 10 μm
	Scanning head dimensions	34 x 13.2 x 12.4 mm ³
	Weight of scanning head without cable	$\sim 20 \text{ g}$
	Max. travel speed, depending on auxiliary electronic units	see table 2: Travel speed restrictions caused by signal tolerances have already been taken into account in the table.

Table 2

Increment GP = 20 μm	5 μm	1 μm		0.5 μm		0.2 μm		0.1 μm	
Increment GP = 100 μm	25 μm	5 μm		2.5 μm		1 μm		0.5 μm	
Interpolation	none	5x		10x		25x		50x	
Max. travel speed GP = 20 μm	480 m/min	150 m/min	480 m/min	40 m/min	360 m/min	16 m/min	140 m/min	8 m/min	70 m/min
Max. travel speed GP = 100 μm	2400 m/min	750 m/min	2400 m/min	200 m/min	1800 m/min	80 m/min	700 m/min	40 m/min	350 m/min
Min. flank distance	0.6 μs	0.25 μs	28 ns	0.25 μs	28 ns	0.25 μs	28 ns	0.25 μs	28 ns
Min. clock frequency (of counter)	2 MHz	4 MHz	36 MHz	4 MHz	36 MHz	4 MHz	36 MHz	4 MHz	36 MHz

Electrical data	Scanning frequency	max. 400 kHz for counting signal
	Output interfaces	
	– voltage output	1 V _{pp} with integrated line driver
	– current output	11 μA _{pp}
	– square-wave output	RS 422 A; optionally with internal signal interpolation 5/10/25/50x
	Supply voltage	5 V ± 10%
	Power consumption	
	– voltage output	< 50 mA
	– current output	< 30 mA
	– square-wave output (RS 422 A)	< 150 mA
Cable lengths		
	– cable permanently connected to the scanning head	1 m with connector; other lengths on request; for greater lengths use extension cable
	– permissible total cable lengths	max. 18 m for current output 11 μA _{pp} max. 100 m for voltage output 1 V _{pp} max. 100 m for square-wave output RS 422 A
Ambient conditions	Operating temperature range	0°C ... +55°C
	Storage temperature range	–20°C ... +70°C
	Vibration (50 Hz ... 2000 Hz)	≤ 200 ms ⁻²
	Shock (11 ms)	≤ 400 ms ⁻²

Scale tape

MV	5	0	-	1	1	B	P	00770
----	---	---	---	---	---	---	---	-------

Designation example**Material**

5	steel tape/ two-field sensor
---	------------------------------

measuring length (ML) in mm

Design type

0	DOUBLEFLEX, standard
1	SINGLEFLEX, standard
2	DOUBLEFLEX, with guide tape
3	SINGLEFLEX, with guide tape

Grating periods (GP)

P	20 μm
R	100 μm

Accuracy class

1	$\pm 1 \mu\text{m}$
2	$\pm 2 \mu\text{m}$
3	$\pm 3 \mu\text{m}$
4	$\pm 5 \mu\text{m}$

Position of reference mark (RM)

O	none
B	RM at the center of measuring length
C	RM 35 mm from start of ML *
D	RM 35 mm from front of ML and 35 mm from end of ML *
E	customized version *
F	RM distance coded at 1000xGP
N	RM at 50 mm spacings, starting at center of measuring length

Bonding pad position

0	none ¹
1	at start of measuring length ²
5*	at end of measuring length ²

1) only for SINGLEFLEX scale tape
 2) only for DOUBLEFLEX scale tape
 *) no standard, supplied with surcharge
 E: specified in XXXXX mm from start of measuring length

Scanning head

LIE 5 1 P C X F H 0

Designation example

Model type

L	linear encoder
I	incremental
E	exposed

Pin assignment

0	standard
X	customized version*

*) No standard, supplied with surcharge.

Installation conditions

1	bore Ø 3.6 in the scanning head
2	thread M4 in the scanning head

Connectors on cable

A	no connector
D	9pin; D-Sub; male; straight
H	12pin; plug; round; male; plastic-armored
I	9pin; plug; round; male; plastic-armored
K	12pin; coupling; male; plastic-armored
O	15pin; D-Sub; male; straight
S	customized plug on request *)
Z	15pin; D-Sub; electronic in the connector

Grating period GP

P	20 µm
R	100 µm

Output signals

B	sinusoidal signal 11 µA _{pp}
C	sinusoidal signal 1 V _{pp}
K	square-wave signal RS 422 A without interpolation
L	square-wave signal RS 422 A with interpolation 5x
M	square-wave signal RS 422 A with interpolation 10x
I	square-wave signal RS 422 A with interpolation 25x
N	square-wave signal RS 422 A with interpolation 50x

**) not for output signals N (with 50x interpolation)

Cable fixed to scanning head

F	1 m
G**)	2 m
K**)	3 m
0	other length (up to 3m)

X	distinguishing mark for clock frequency of counter on request (only valid for versions with interpolation)
---	--

For greater lengths use extension cable.



NUMERIK JENA GmbH

Ilmstraße 4
D-07743 Jena
Germany

Telephone ++49 3641 47 28 21

Fax ++49 3641 47 28 20

E-mail info.nj@numerikjena.de

Internet www.numerikjena.de

LIE 5-A-e-07/00

Subject to change without notice – 07/00