

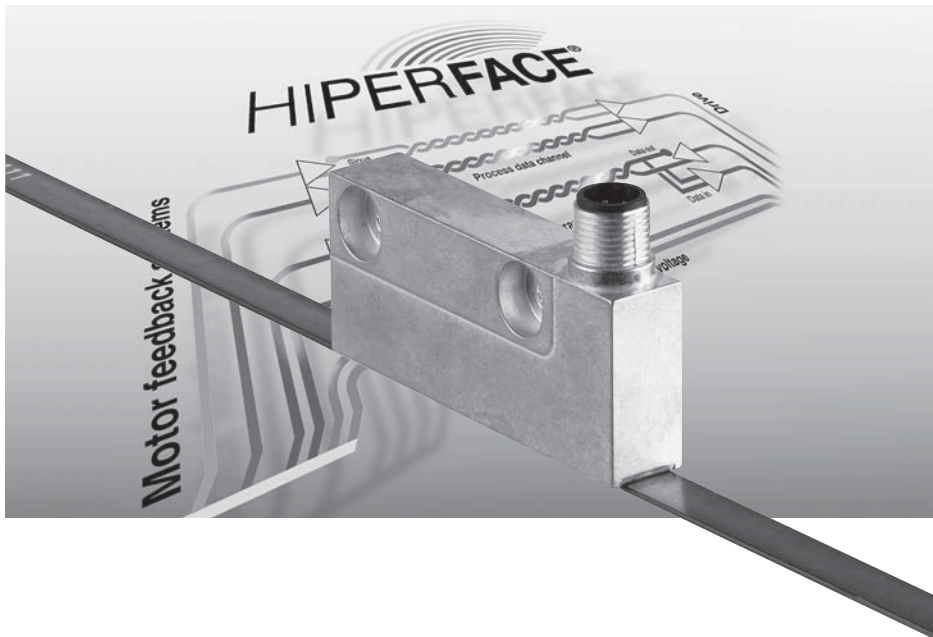


## Encoders

Rotary Encoders Incremental/Absolute  
Linear Encoders  
Motor Feedback Systems

**SICK**  
Sensor Intelligence.

# TTK70: Absolute, non-contact linear measuring system for linear motors



In order to calculate the absolute position value, the reading head detects both the absolute and the incremental component without making contact.

The absolute position value thus created can be transmitted to a controller via the HIPERFACE® interface. In parallel, the incremental component is made available for evaluation as a sine/cosine signal with 1 Vp-t-p.

	<b>Period length 1 mm</b>
<b>Linear Motor Feedback Systems</b>	

The linear measuring system TTK70 consists of a reading head and magnetic tape. The magnetic tape has a magnetic code which forms the measuring scale.



The code consists of an incremental and an absolute track (twin-track tape).

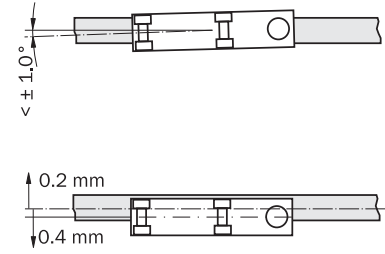
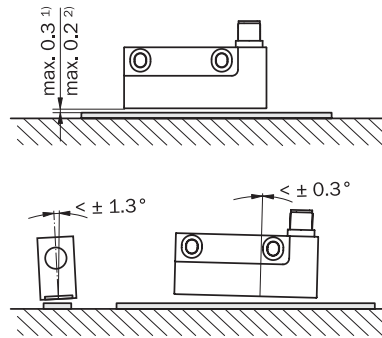
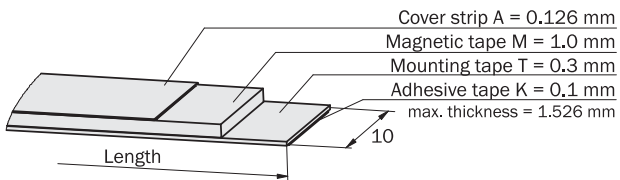
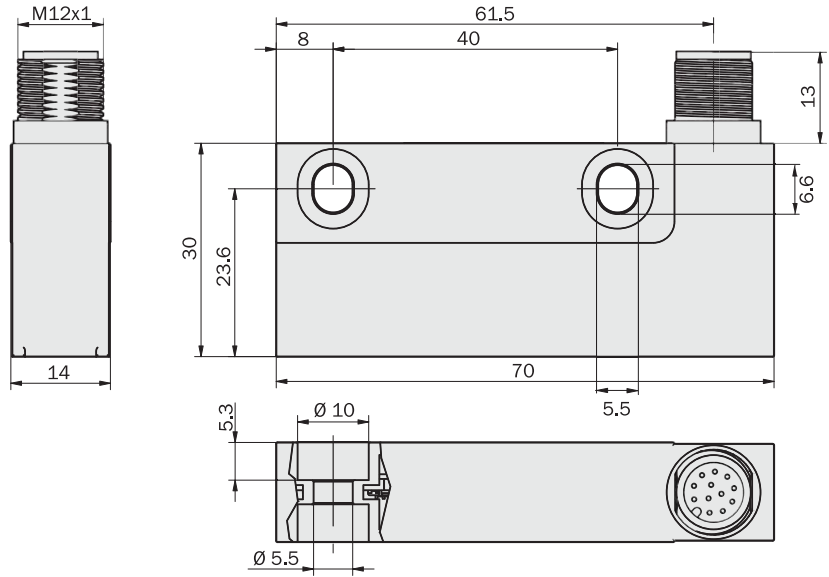


← → **Period length**  
**1 mm**

Linear Motor Feedback Systems

- Measurement length up to 4 m
- Non-contact length measuring system, wear-free
- Absolute position determination, no reference run
- Length-independent position sensing time
- Electronically adjustable  
Protection class up to IP 65

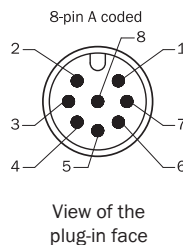
**Dimensions and positional tolerances**



- 1) Without strip band
- 2) With band

General tolerances according to DIN ISO 2768-mk

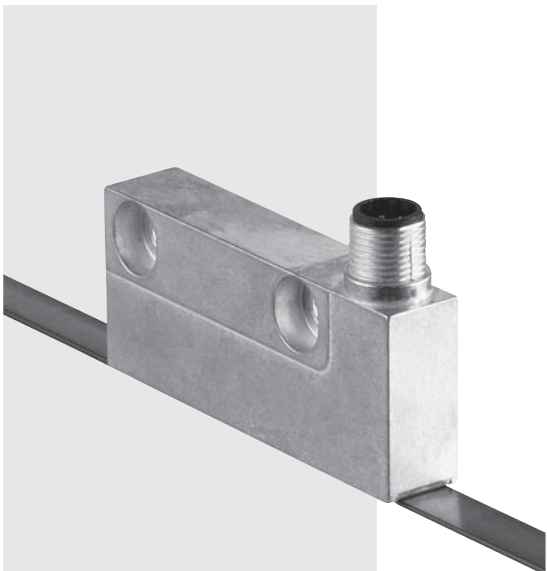
**PIN and wire allocation**



PIN	Colour of wires	Signal	Explanation
1	brown	REFSIN	Process data channel
2	white	+ SIN	Process data channel
3	black	REFCOS	Process data channel
4	pink	+ COS	Process data channel
5	grey or yellow	Data +	RS-485 Parameter channel
6	green or purple	Data -	RS-485 Parameter channel
7	blue	GND	Ground connection
8	red	+ U <sub>s</sub>	Encoder Supply voltage
	Screen		Housing potential

Screening via plug housing

Electronically adjustable via Programming Tool



**Accessories**

Connection systems (page 382)

Programming Tool (page 383)

Technical data to DIN 32878		TTK70 HIPERFACE®	
<b>Period length</b>	1 mm		
<b>Max. Measurement length</b>	4,000 mm		
<b>Magnetic tape length</b>	Measurement length + 80 mm (min. 200 mm)		
<b>Dimensions</b>	mm (see dimensional drawing)		
<b>Max. distance of the sensor to the magnetic tape</b>			
without cover band	0.3 mm		
with cover band	0.2 mm		
<b>Mass</b>			
read head	0.08 kg		
magnetic tape	0.18 kg/m		
<b>Material</b>			
read head	zinc diecasting		
magnetic tape	17410 Hard ferrite 9/28 P		
<b>Code type for the absolut value</b>	Binary		
<b>Measurement step at interpolation of the sine/cosine signals</b>			
<b>with e. g. 12 bits</b>	0.244 µm		
<b>System accuracy</b>	< ± 10 µm		
<b>Repeatability</b>			
unidirectional	< 5 µm		
bidirectional	< 15 µm		
<b>Operating speed up to which the absolute position can be reliably produced</b>			
	1.5 m/s		
<b>Max. Operating speed</b>	10 m/s		
<b>Permitted mounting tolerance</b>	See dimensional drawing page 374		
<b>Working temperature range</b>	-30 ... +85 °C		
<b>Storage temperature range</b>	-40 ... +100 °C (without packaging)		
<b>Permissible relative humidity</b>	100 % (condensation permitted)		
<b>Temperature coefficient magnetic tape</b>	(11 ± 1) × 10 <sup>-6</sup> /K		
<b>Maximum permitted ambient field strength to guarantee compliance with the quoted accuracy values <sup>1)</sup></b>			
	< 3 .. 4 kA/m (3.8 .. 5 mT)		
<b>Maximum permitted field strength to ensure that the magnetic tape is not permanently damaged</b>			
	< 150 kA/m (< 190 mT)		
<b>Resistance (read head)</b>			
to shocks to EN 60068-2-27	30 g/6 ms		
to vibration to EN 60068-2-6	20 g/10 ... 2,000 Hz		
<b>Protection class to IEC 60529 <sup>2)</sup></b>	IP 65		
<b>EMC <sup>3)</sup></b>			
<b>Operating voltage range</b>	7 ... 12 V		
<b>Recommended supply voltage</b>	8 V		
<b>Max. operating current, no load</b>	< 55 mA <sup>4)</sup>		
<b>Available memory area</b>			
within EEPROM 2048 <sup>5)</sup>	1,792 bytes		
<b>Interface signals</b>			
Process data channel = SIN, REFSIN, COS, REFCOS	Analogue, differential		
Parameter channel = RS 485	Digital		

<sup>1)</sup> The maximum permitted external field influence is reached when the position value deviates from the original value (without external field influence) by more than 5 µm. This value is reached when, at the sensor location, a field strength of 3 ... 4 kA/m (3.8 .. 5 mT) occurs in addition to the field strength of the magnetic tape.

<sup>2)</sup> With mating plug mounted

<sup>3)</sup> To EN 61000-6-2 and EN 61000-6-3  
The EMC according to the standards quoted is achieved when the motor feedback system is mounted in an electrically conductive housing, which is connected to the central earthing point of the motor controller via a cable screen.  
The GND (OV) connection of the supply voltage is also connected to earth there.  
Users must perform their own tests when other screen designs are used.

<sup>4)</sup> 100 mA approx. during adjustment

<sup>5)</sup> If applying the electronic type label, in connection with numeric controllers, attention should be paid to Patent EP 425 912 B 2; Application of the electronic type label in connection with speed regulation is exempt.

① **Magnetic tape** Working temperature range -20 ... +70 °C  
Storage temperature range -30 ... +85 °C

#### Ordering information

##### Length measuring system TTK70

Type	Part no.	Description
TTK70-HXA0-K02	1037434	Read head

#### Ordering information

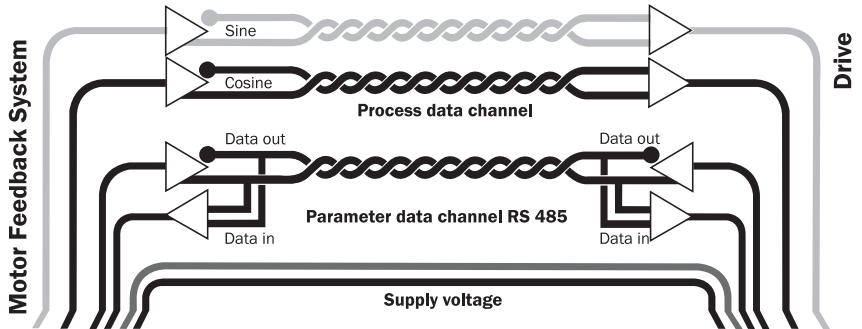
##### Magnetic tape with adhesive tape and cover band incl. ①

Type	Part no.	Description
MVM-0M5-2MC-MKLB	6037415	Magnetic tape 0.5 m
MVM-01M-2MC-MKLB	6037417	Magnetic tape 1.0 m
MVM-1M5-2MC-MKLB	6037418	Magnetic tape 1.5 m
MVM-02M-2MC-MKLB	6037419	Magnetic tape 2.0 m
MVM-2M5-2MC-MKLB	6037420	Magnetic tape 2.5 m
MVM-03M-2MC-MKLB	6037421	Magnetic tape 3.0 m
MVM-3M5-2MC-MKLB	6037422	Magnetic tape 3.5 m
MVM-04M-2MC-MKLB	6037423	Magnetic tape 4.0 m

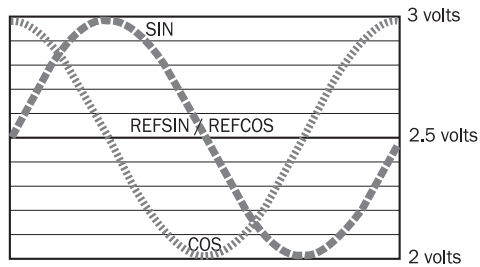


**Electrical interface**

- Safe data transmission
- High information content
- Electronic type label
- Only 8 leads
- Bus-enabled parameter channel
- Process data channel in real time



**Signal specification of the process data channel**



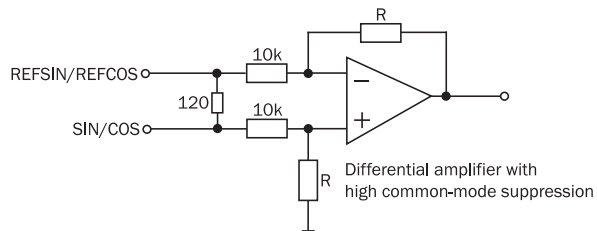
Access to the process data used for speed control, i.e. to the sine and cosine signals, is practically always "online". When the supply voltage is applied, the speed controller has access to this information at any time.

Sophisticated technology guarantees stable amplitudes of the analogue signals across all specified environmental conditions, with a maximum variation of only 20 %.

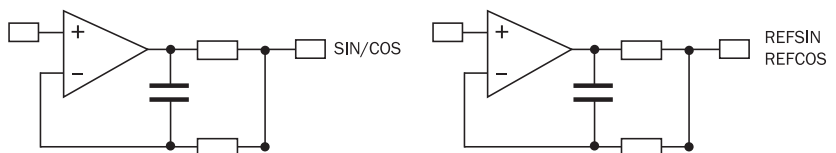
**Characteristics applicable to all permissible environmental conditions**

Signal	Value/Units
Signal peak, peak $V_{SS}$ of SIN, COS	0.9 ... 1.1 V
Signal offset REFSIN, REFCOS	2.2 ... 2.8 V

**Recommended receiver circuit for sine and cosine signals**



**The output circuit of the process data channel within the SinCos encoder**



Further informations to the interface see HIPERFACE®-description part no. 8010701



Type-specific settings	TTK70
Type ID (command 52h)	FFh
Free EEPROM [bytes]	1,792
Address	40h
Mode_485	E4h
Codes 0 ... 3	55h
Counter	0

Overview of commands supported			TTK70
Command byte	Function	Code 0 <sup>1)</sup>	Comments
42h	Read position (5 bits per sine/cosine period)		31.25 µm
43h	Set position	•	
44h	Read analogue value		Channel number 48h Temperature [°C]
46h	Read counter		
47h	Increase counter		
49h	Reset counter	•	
4Ah	Read data		
4Bh	Save data		
4Ch	Determine status of a data field		
4Dh	Create data field		
4Eh	Determine available memory area		
4Fh	Change access code		
50h	Read encoder status		
52h	Read out name plate		Encoder type = FFh
53h	Encoder reset		
55h	Allocate encoder address	•	
56h	Read serial number and program version		
57h	Configure serial interface	•	
67h	Change serial interface temporary		
6Ah	Set position with internal synchronization	•	see page 380
6Bh	Sensor adjustment (during commissioning) *	•	see page 378/379

<sup>1)</sup> The commands thus labelled include the parameter "Code 0". Code 0 is a byte inserted into the protocol, for additional safeguarding of vital system parameters against accidental overwriting. When shipped, "Code 0" = 55h.

Overview of status messages			
Error type	Status code	Description	TTK70
	00h	The encoder has recognised no error	•
<b>Initialisation</b>	01h	Adjustment data faulty	•
	02h	Faulty internal angular offset	•
	03h	Data field partitioning table damaged	•
	04h	Analogue limit values not available	•
	05h	Internal I <sup>2</sup> C bus not operational	•
	06h	Internal checksum error	•
<b>Protocol</b>	09h	Parity error	•
	0Ah	Checksum of the data transmitted is incorrect	•
	0Bh	Unknown command code	•
	0Ch	Number of data transmitted is incorrect	•
	0Dh	Command argument transmitted is not allowed	•
<b>Data</b>	0Eh	The selected data field must not be written to	•
	0Fh	Incorrect access code	•
	10h	Size of data field stated cannot be changed	•
	11h	Word address stated, is outside data field	•
	12h	Access to non-existent data field	•
<b>Position</b>	20h	Sensor is not adjusted or is in adjustment mode.	•
	21h	Distance magnetic tape/sensor too high	•
	23h	Positional error	•
<b>Other</b>	1Ch	Monitoring the value of the analogue signals (process data)	•
	1Eh	Encoder temperature critical	•
	08h	Counter overflow	•

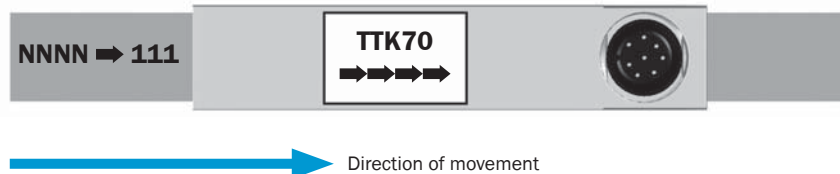
Further informations to the interface see HIPERFACE®-description part no. 8010701

### Sensor adjustment 6Bh

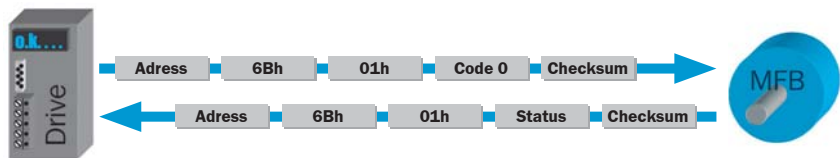
For the linear sensor TTK70 it is mandatory, prior to initial commissioning, to perform an adjustment run (calibration) in order to calibrate the sensor to the magnetic tape.

The sensor adjustment is integrated into the HIPERFACE® Programming Tool (part no. 1034252) from software version 3.2 onwards. The three necessary steps are described on the two following pages.

An important requirement for correct adjustment is that the sensor is correctly positioned over the magnetic tape. This is illustrated below:



### Starting the sensor adjustment

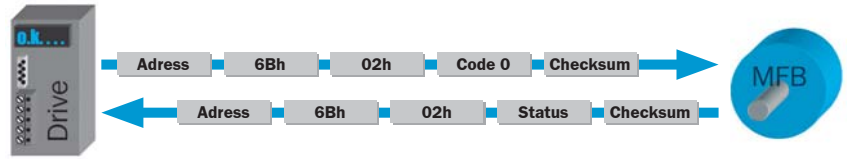


The adjustment is **not** started when the following error conditions exist:

- ▶ Number of transmitted command bytes incorrect (WRONG\_COMMAND\_LENGTH, 0Ch),
- ▶ incorrect access code entered (ERR\_ACCESS\_CODE, 0Fh),
- ▶ incorrect command arguments entered (WRONG\_ARGUMENT, 0Dh)

If the adjustment starts correctly, this is displayed in the status byte by the value 01h. This value identifies the starting value of a counter which runs from 01h to 0Fh and displays the different states of the adjustment procedure. In addition, in the upper 4 bits of the status byte, another counter also runs and counts the number of 1 mm period cycles. This counter is reset depending on the state of the adjustment procedure. **Having entered the above command sequence, the sensor must be moved smoothly in the plug connector/cable outlet direction at a speed of < 3 mm/s.**

### Checking the adjustment procedure



During the movement of the sensor, for state control, the state of adjustment can be controlled with the above command sequence. Two counters, in which the current state is mapped, run in the status byte. The following states are allocated to the counter values in the lower 4 bits of the status byte:

- 01h .. 03h:** incremental adjustment; determination of the signal amplitudes and the offset values of the analogue signals (SIN, COS). The counter in the upper half byte runs from of 1 .. 8.
- 04h .. 08h:** determination of the offset value between analogue value and incremental counter. The counter value in the upper half byte is now irrelevant.
- 09h .. 0Fh:** determination of the offset value between absolute track and incremental track. The counter value in the upper half byte is irrelevant.

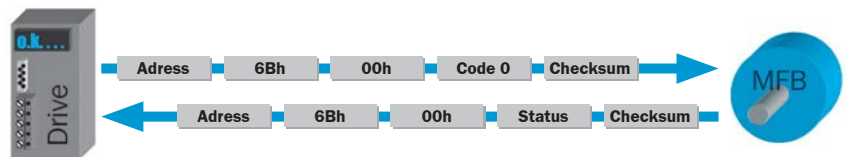
If faulty analogue values are detected during the incremental adjustment, the adjustment is aborted with an error message (ANALOG\_RANGE\_CHECK, 1Ch). In this situation, the sensor no longer operates correctly, and a position value cannot be calculated!

During adjustment, commands relating to the position value (R\_Pos, 42h; W\_Pos, 43h; \_Pos-Aligned, 6Ah) are answered with an error message (ERR\_NOT\_CALIBRATED, 20h).

The adjustment is ended after 20-25 mm approx. and/or when the counter has the value 15 (xFh) in the lower 4 bits.

### Ending/stopping the adjustment

The adjustment must be explicitly stopped by the command sequence below.

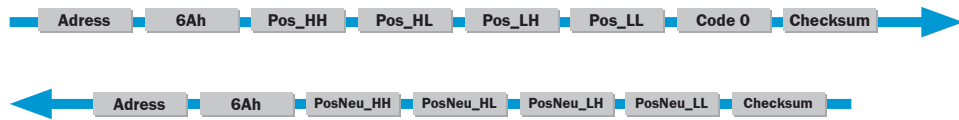


For a successfully executed adjustment, the status byte returns a value which specifies the number of adjustments performed so far. By saving the determined values in the EEPROM, the command execution time is approximately 12 ms. Immediately afterwards, the absolute position can be accessed.

If the adjustment is aborted prior to ending the same, by the stop command, the original adjustment values are re-accepted, and the error message **ERR\_NOT\_CALIBRATED (20h)** is output.

If "Stop Calibration" (adr,6Bh,00h,55h,cs) is performed during "normal" operation of the commands, the value **08h (NOT\_ALLOWED)** is output as an error message.

**Set position with internal synchronization 6 Ah**



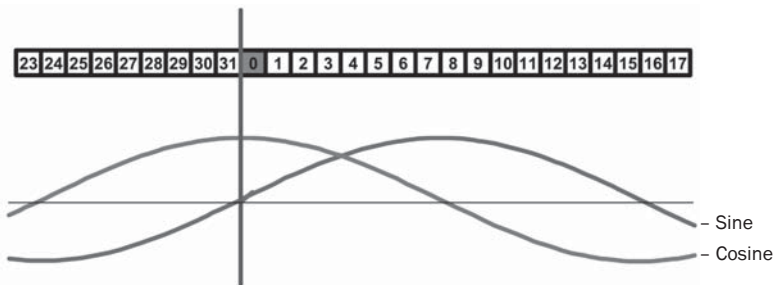
With this command, the encoder position is set such that the required position value points to the beginning of a period of the SIN signal. This is achieved by not changing, in contrast to the command “Set position” (43h), the lower 5 bits of the position value, as these are responsible for the interpolation within a period.

The position value given in the command is transmitted in the unsigned long format with the LSB right-aligned and saved to non-volatile memory. The value range is between 0 .. 127999 and must be interpreted as a multiple of 1/32mm.

The following events trigger an error message:

- Number of transmitted command bytes wrong (WRONG\_COMMAND\_LENGTH, 0Ch)
- Wrong access code entered (ERR\_ACCESS\_CODE, 0Fh),
- Internal error occurred, which would lead to an invalid position value (ERR\_INT\_ANGLE\_OFFSET, 02h),
- Encoder is not adjusted (ERR\_NOT\_CALIBRATED, 20h),
- Transmitted command argument is invalid (WRONG\_ARGUMENT, 0Dh),
- Internal checksum error (ERR\_CHKSUM, 06h)

5 LSB  
of the digital  
absolute position



**Codification magnetic tape**

The absolute coding of the magnetic tape allows a max. measuring range of 4095.999mm. As the resolution of the position data is 1/32 mm, the resulting numeric value for the maximum measuring range is 131072.



**Internal position calculation TTK70**

Position value (-3072 .. 00 .. +127999):

To avoid rapid jumps to the maximum value, around the 0 position, the max. measuring range is limited to 4000mm (= 128000 \* 1/32mm). Therefore, in the negative direction of travel, a range of -96mm (= -3072 \* 1/32mm) can be detected.



Due to the positional calculations performed inside the TTK70, during commissioning it is necessary to send the command "6Ah" (Position set with internal synchronisation) at the start of the magnetic tape.

**Dimensional drawings and ordering information**

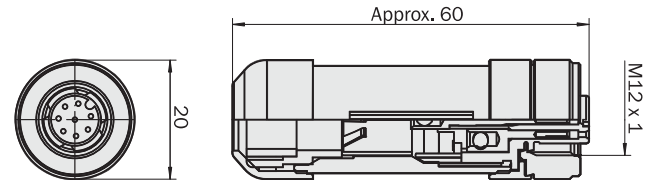
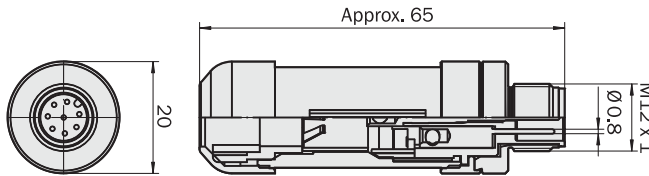
**Round screw system M12**

**Cable connector M12 male, 8-pin, straight, screened, for field assembly (adapter side)**

Type	Part no.	Contacts/cable diameter
STE-1208-GA	6028370	8 / 4 ... 8 mm

**Cable connector M12 female, 8-pin, straight, screened, for field assembly (adapter side)**

Type	Part no.	Contacts/cable diameter
DOS-1208-GA	6028369	8 / 4 ... 8 mm



**Cable HIPERFACE®, 8 wires, per metre 4 x 2 x 0,15 mm<sup>2</sup>**

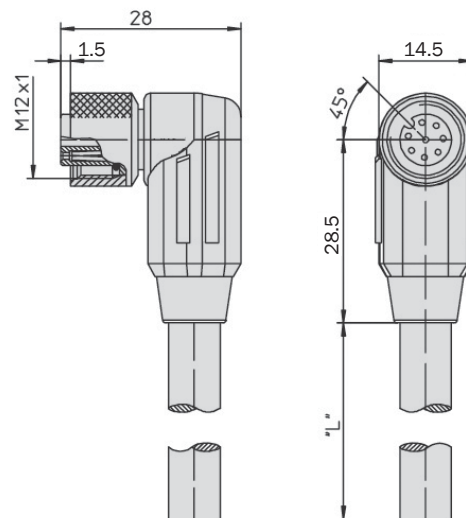
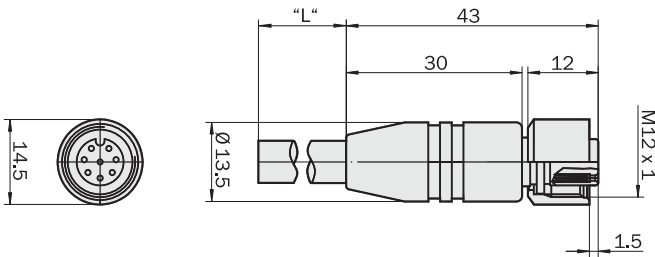
Type	Part no.	Wires
LTG-2708-MW	6028361	8

**Female connector M12, 8-pin, straight, pre-wired with cable 8-wire, 4 x 2 x 0.25 mm<sup>2</sup>, screened, flexible (adapter side)**

Type	Part no.	Contacts	Cable length „L“
DOL-1208-G02MAC1	6032866	8	2.0 m
DOL-1208-G05MAC1	6032867	8	5.0 m
DOL-1208-G10MAC1	6032868	8	10.0 m
DOL-1208-G20MAC1	6032869	8	20.0 m

**Right angled M12, 8-pin female connector, pre-wired with cable 8 cores, 4 x 2 x 0.25mm<sup>2</sup>, screened, suitable for use in a drag chain (adapter side)**

Type	Part no.	Cores	Cable length „L“
DOL-1208-W02MAC1	6037724	8	2.0 m
DOL-1208-W05MAC1	6037725	8	5.0 m
DOL-1208-W10MAC1	6037726	8	10.0 m
DOL-1208-W20MAC1	6037727	8	20.0 m



**Dimensional drawings and ordering information****Programming Tool****Programming Tool for TTK70 with HIPERFACE® interface**

Type	Part no.
PGT-03-S	1034252