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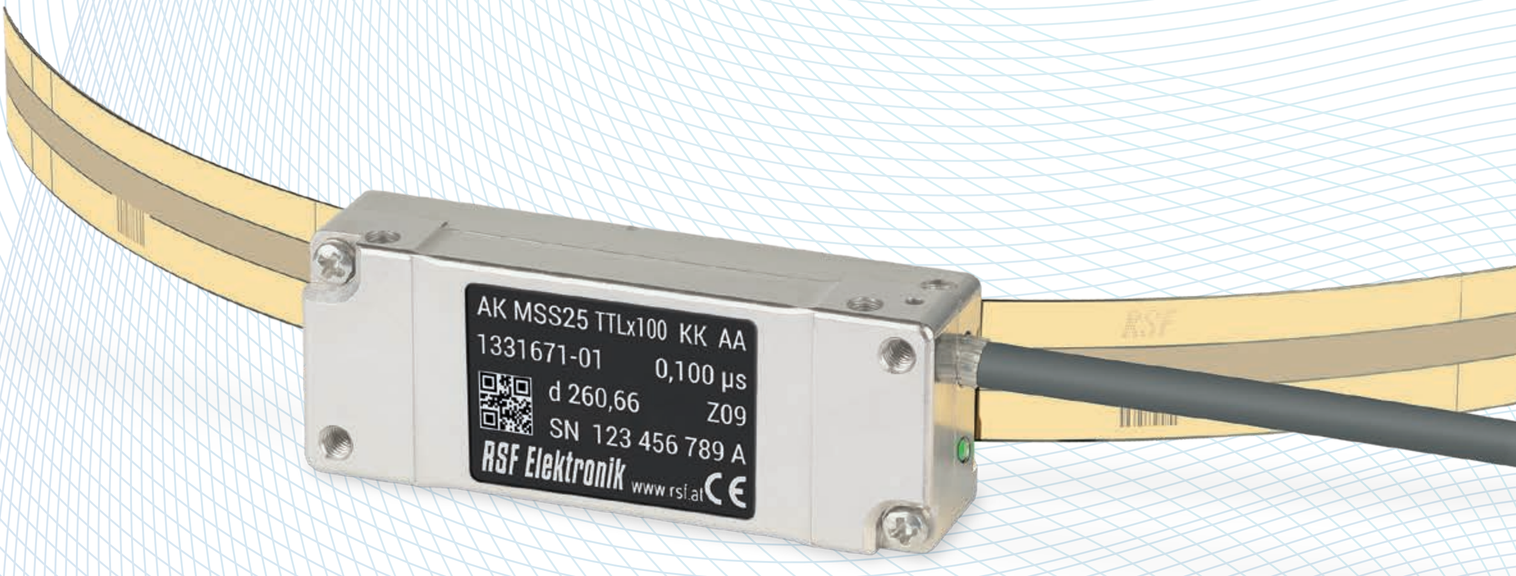
MSS 25

MODULAR ANGLE ENCODER WITH SINGLEFIELD SCANNING



CONTENT

SCANNING PRINCIPLE SINGLEFIELD SCANNING

The modular angle encoder MSS 25 works with the photoelectric measuring principle and a **singlefield reflective scanning** method. A graduation pattern with 40 µm grating period is used on a steel tape.

The regulated light of an infrared LED is collimated by a condenser lens and passes through the grid of the reticle. After being reflected from the graduation carrier the infrared LED generates a periodic intensity distribution on the structured sensor.

The sensor generates high qualitiy sinusoidal signals which are highly insensitive to possible contaminations.

The regulation of the LED ensures a constant signal amplitude, guaranteeing stability in the case of temperature fluctuations as well as with long-run operation.

REQUIREMENTS ON AN INCREMENTAL MODULAR ANGLE ENCODER

- CONTAMINATION RESISTANCE
- IMMUNITY AGAINST AGING AND TEMPERATURE CHANGES
- HIGH CIRCUMFERENTIAL SPEED
- EASY MOUNTING - LARGE MOUNTING TOLERANCES
- STANDARD DIMENSIONS
- NO MECHANICAL BACKLASH
- ZERO FRICTIONAL FORCE
- REFERENCE MARKS, REPEATABLE FROM BOTH TRAVERSING DIRECTIONS

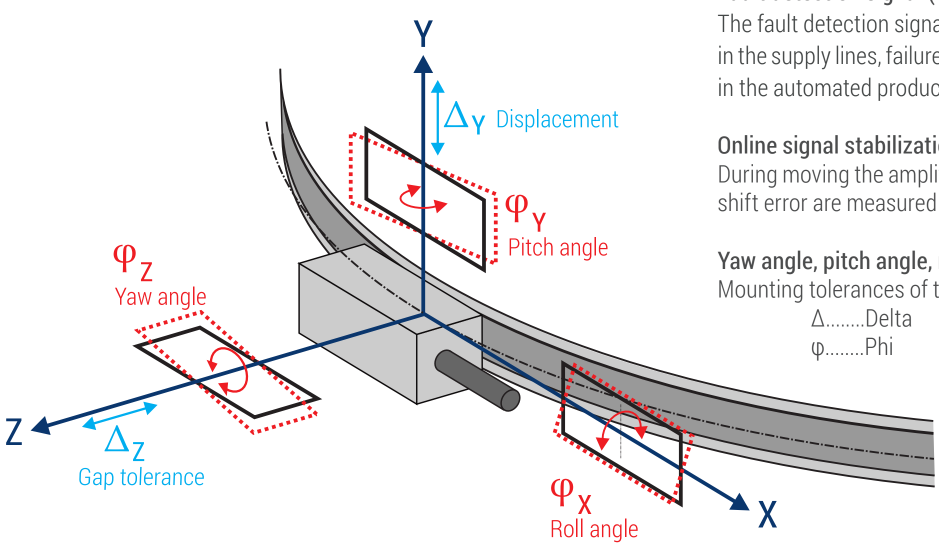
MSS 25 MEETS ALL THESE REQUIREMENTS!

TERM EXPLANATIONS

Grating period
A grating is a continuous series of lines and spaces printed on the graduation carrier. The width of one line and one space is called the period of the grating. The lines and spaces are accurately placed on the scale.

Signal period
When scanning the grating, the encoder head produces sinusoidal signals with a period equal to the grating period.

Interpolation
The sinusoidal signal period can be electronically divided into equal parts. The interpolation circuitry generates a square-wave edge for each division.



Measuring step
The smallest digital counting step produced by an encoder.

Reference pulse (reference mark)
There is an additional track of marks printed next to the grating to allow a user to find an absolute position along the length of the scale.
A one increment wide signal is generated when the encoder head passes the reference mark on the scale.
This is called a “true” reference mark since it is repeatable in both directions. Subsequent electronics use this pulse to assign a preset value to the absolute reference mark position.

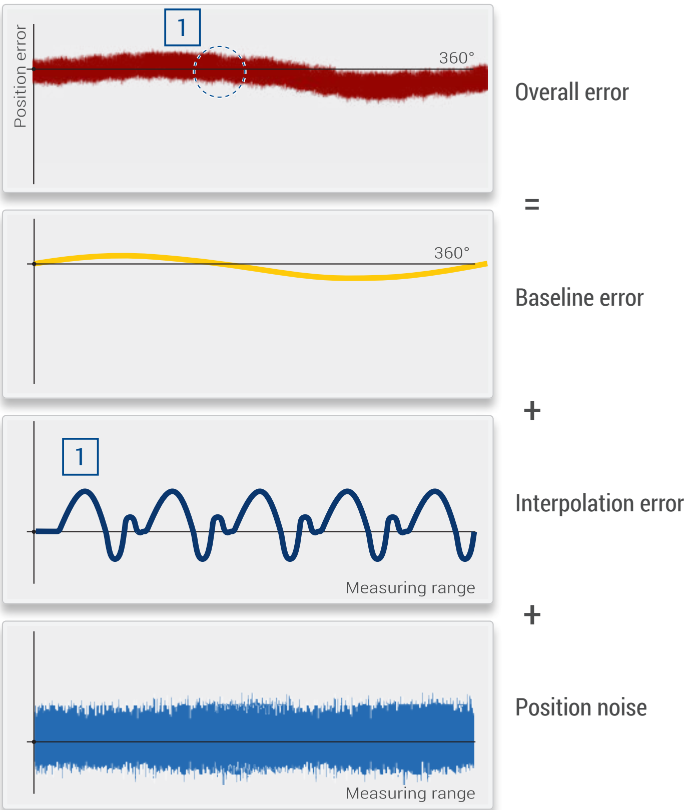
Line rates
Number of the grating periods per rotation.

Fault detection signal ($\overline{US}$)
The fault detection signal indicates fault conditions such as an interruption in the supply lines, failure of the light source, etc. For example, it can be used in the automated production for the machine switch-off.

Online signal stabilization
During moving the amplitude, offset-error, amplitude differences and phase shift error are measured and stabilized cyclically.

Yaw angle, pitch angle, roll angle, displacement, gap tolerance
Mounting tolerances of the scanning head relative to the scale.
Δ........Delta
φ........Phi

ACCURACY DEFINITION



The accuracy of an encoder is mainly determined by the baseline error of the scale unit, the interpolation error of the optoelectronic scanning and the position noise.

The baseline error is the error of the scale unit identified in a measurement room under optimum conditions, along a determined measuring length, without any interpolation error and position noise.

The indicated accuracy grade represents the maximum possible baseline error based on the available measuring range.

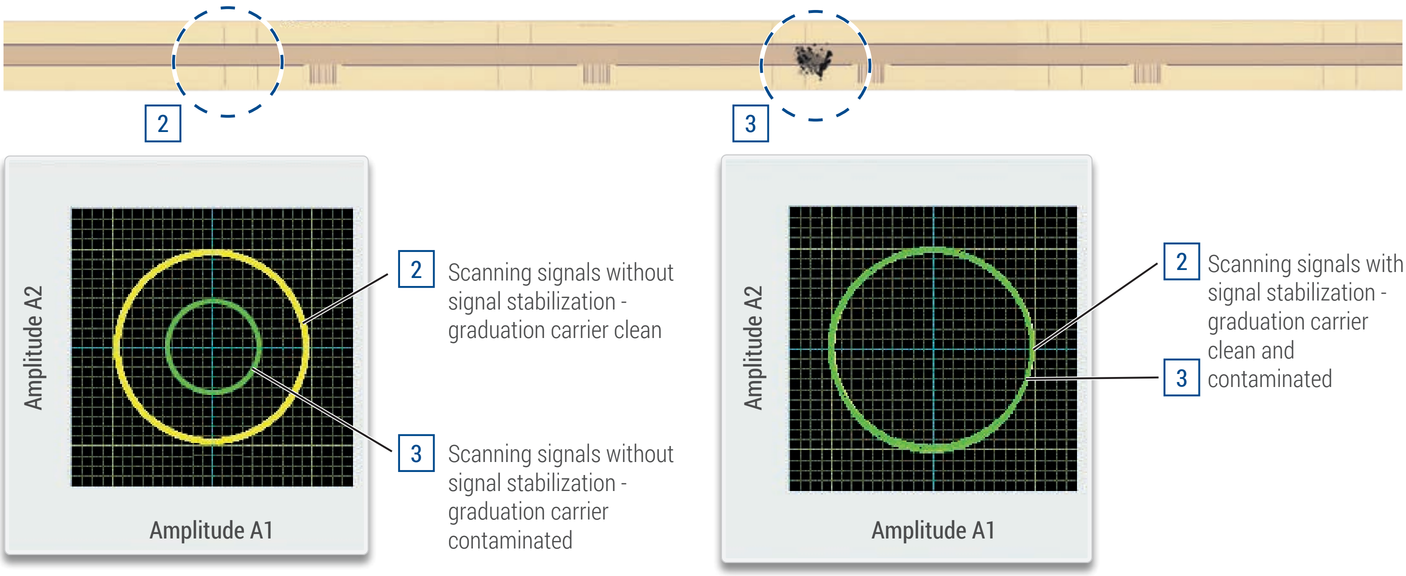
With modular angle encoders, an eccentric mounting of the graduation carrier additionally results in a measurement error according to the following formula:

$$\Delta\varphi = \pm \frac{412 \times e}{D}$$

$\Delta\varphi$ = Measuring error due to eccentricity ["]
e = Resulting eccentricity of the tape scale in [µm]
D = Scanning diameter [mm]

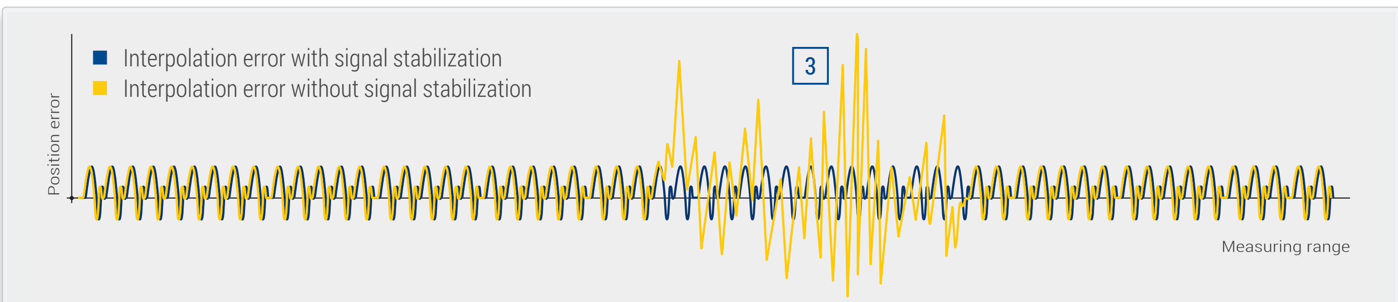
Effect of contamination on the quality and amplitude of scanning signal

Graduation carrier contaminated by fluids, dust, particles, fingerprints etc.

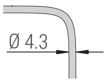


Effect of contamination on the interpolation error

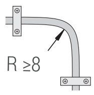
Graduation carrier contaminated by fluids, dust, particles, fingerprints etc.



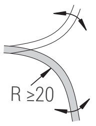
SHIELDING, PIN ASSIGNMENTS



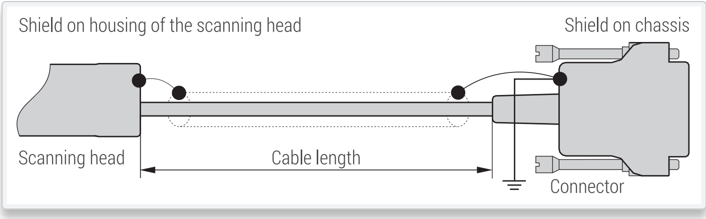
Shielded PUR-cable.
Drag chain qualified.



Bending radius
fixed mounting



Bending radius
continuous flexing

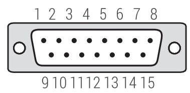


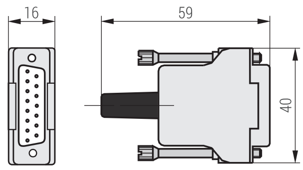
15-pin D-sub

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sinusoidal voltage signals 1 Vpp	Occupied	0 V Sensor	nc	RI−	A2−	A1−	+5 V Sensor	+5 V	0 V	Occupied	Occupied	RI+	A2+	A1+	nc
Square-wave signals via line driver	Test*/ occupied	0 V Sensor	$\overline{US}$	$\overline{RI}$	$\overline{T2}$	$\overline{T1}$	+5 V Sensor	+5 V	0 V	Occupied	Occupied	RI	T2	T1	nc

- * Test = **analog signal switch-over for setup**.
  By applying +5 V to the test pin, the test signals (sinusoidal micro-current signals 11 µApp) are switched to the output connector.
- Sensor: the sensor pins are bridged in the chassis with the particular power supply.
- The shield is connected with the chassis.
- Pins or wires marked "occupied" or "nc" must not be used by the customer.

Pin assginment
(viwe on pins)





Mass: 28 g

INTERFACES

SINUSOIDAL VOLTAGE SIGNALS 1Vpp

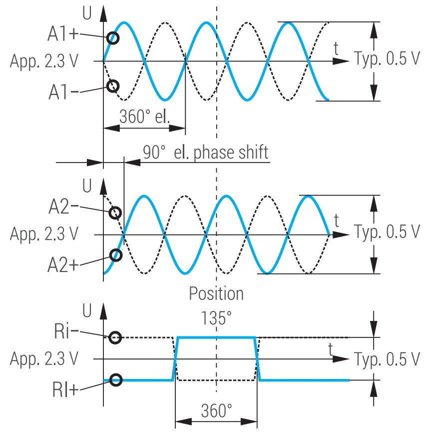
(drawing shows "positive counting direction")
Two sinusoidal voltage signals A1 and A2 and one reference mark signal (all with inverted signals).

Power supply: +5 V ±10 %, max. 130 mA (unloaded)
Track signals (differential voltage A1+ to A1− resp. A2+ to A2−):
Signal amplitude 0.6 Vpp to 1.2 Vpp; typ. 1 Vpp
(with terminating impendance Zo = 120 Ω between A1+ to A1− resp. A2+ to A2−)

Reference mark
(differential voltage RI+ to RI−):
Useable component 0.2 up to 0.85 V; typical 0.5 V
(with terminating impedance Zo = 120 Ω between RI+ to RI−)

Advantage:
- High traversing speed with long cable lengths possible

Voltage signals (1 Vpp)



SQUARE-WAVE SIGNALS

(drawing shows "positive counting direction")
With interpolation electronics (for times -5, -10, -20, -25, -50 or -100) the photoelement output signals are converted into two square-wave signals that have a phase shift of 90°. Output signals either can be "single ended" or line driver "differential" (RS 422). One measuring step reflects the measuring distance between two edges of the square-wave signals.

The controls/DRO´s must be able to detect each edge of the square-wave signals. The minimum edge separation a_{min} is listed in the technical data and refers to a measurement at the output of the interpolator (inside the scanning head). Propagation-time differences in the line driver, the cable and the line receiver reduce the edge separation.

Propagation-time differences:

Line driver:	max. 10 ns
Cable:	0.2 ns per meter
Line receiver:	max. 10 ns refered to the recommended line receiver circuit

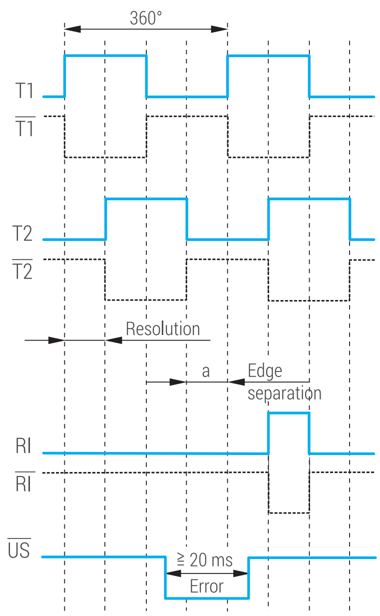
To prevent counting errors, the controls/DRO´s must be able to process the resulting edge separation.

Example:
a_{min} = 100 ns, 10 m cable
100 ns - 10 ns - 10 x 0.2 ns - 10 ns = 78 ns

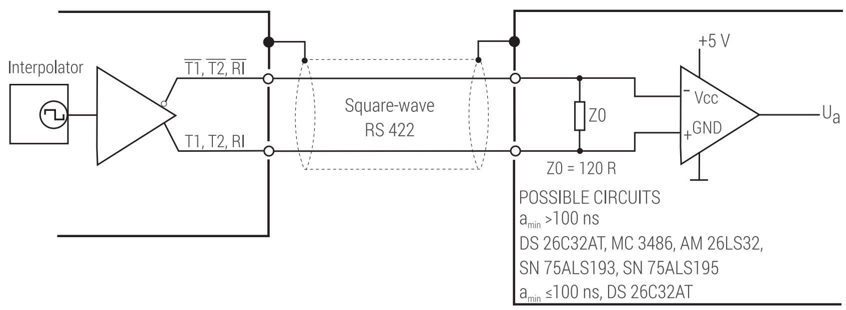
Power supply: +5 V ±10%, max. 165 mA (unloaded)

Advantage:
- Noise immune signals
- No further subdividing electronics necessary

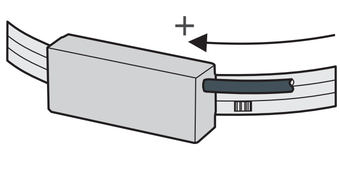
Square wave signals „differential“



Recommended line receiver circuit



Positive rotation direction



MSS 25 TECHNICAL DATA

- Segment version
- Steel tape scale with adhesive tape
- Grating period: 40 µm
- Easy mounting due to large mounting tolerances
- High circumferential speed
- Integrated subdividing electronics: up to times 200

SCANNING HEAD

Model	AK MSS 25 1 Vpp	AK MSS 25 TTLx5	AK MSS 25 TTLx10	AK MSS 25 TTLx20	AK MSS 25 TTLx25	AK MSS 25 TTLx50	AK MSS 25 TTLx100	AK MSS 25 TTLx200
Interface	∿	⎍	⎍	⎍	⎍	⎍	⎍	⎍
Measuring step [°]	Depending on external interpolation	360° / (LPR × 20)	360° / (LPR × 40)	360° / (LPR × 80)	360° / (LPR × 100)	360° / (LPR × 200)	360° / (LPR × 400)	360° / (LPR × 800)
Integrated interpolation	--	Times 5	Times 10	Times 20	Times 25	Times 50	Times 100	Times 200
Max. circumferential speed at scanning diameter D	10.00 m/s	6.40 m/s	3.20 m/s	2.40 m/s	1.92 m/s	1.92 m/s	0.96 m/s	0.96 m/s
Max. output frequency	250 kHz	--	--	--	--	--	--	--
Edge separation a_{min}	--	300 ns	300 ns	200 ns	200 ns	100 ns	100 ns	50 ns
Electrical connection	Cable, 1 m or 3 m with D-sub connector 15-pin (male)							
Voltage supply	+5 V ±10 %							
Power consumption	Max. 907 mW (unloaded)							
Current consumption	Max. 165 mA (unloaded)							
Vibration 40 Hz to 2000 Hz Shock 8 ms	≤ 150 m/s^2 (EN 60 068-2-6) ≤ 750 m/s^2 (EN 60 068-2-27)							
Temperature	Operating temperature: 0 °C to +70 °C, storage temperature: −20 °C to +70 °C							
Mass	Scanning head AK: 21 g, cable: 25 g/m, D-sub connector: 28 g							

GRADUATION CARRIER

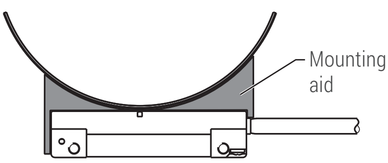
Model	**MB MSS 25 SK:** Steel tape scale segment with adhesive tape
Coefficient of expansion	$\alpha_{therm} \approx 10 \times 10^{-6}\ K^{-1}$
Possible scanning diameter	▪ > 50 mm to ≤ 800 mm (at larger diameters MS 25 applicable) ▪ > 50 mm to ≤ 400 mm: scale segment is pre-bent in factory. ▪ > 400 mm: scale segment is not pre-bent.
Accuracy of the grating (based on neutral axis)	±15 µm/m
Theoretical lines per revolution (360°)	LPR = (D − 0.2) × π / 0.04
Reference mark	▪ Standard: one reference mark at any location within the measuring range ▪ On request: additional or distance-coded reference marks
Mass	20 g/m

CONFORMITIES AND CERTIFICATIONS

RoHS	2011/65/EU, 2015/863/EU
EMV	2014/30/EU
UL-Product-Certifications	B 022705 0009, U8V 022705 0005, CB 022705 0006

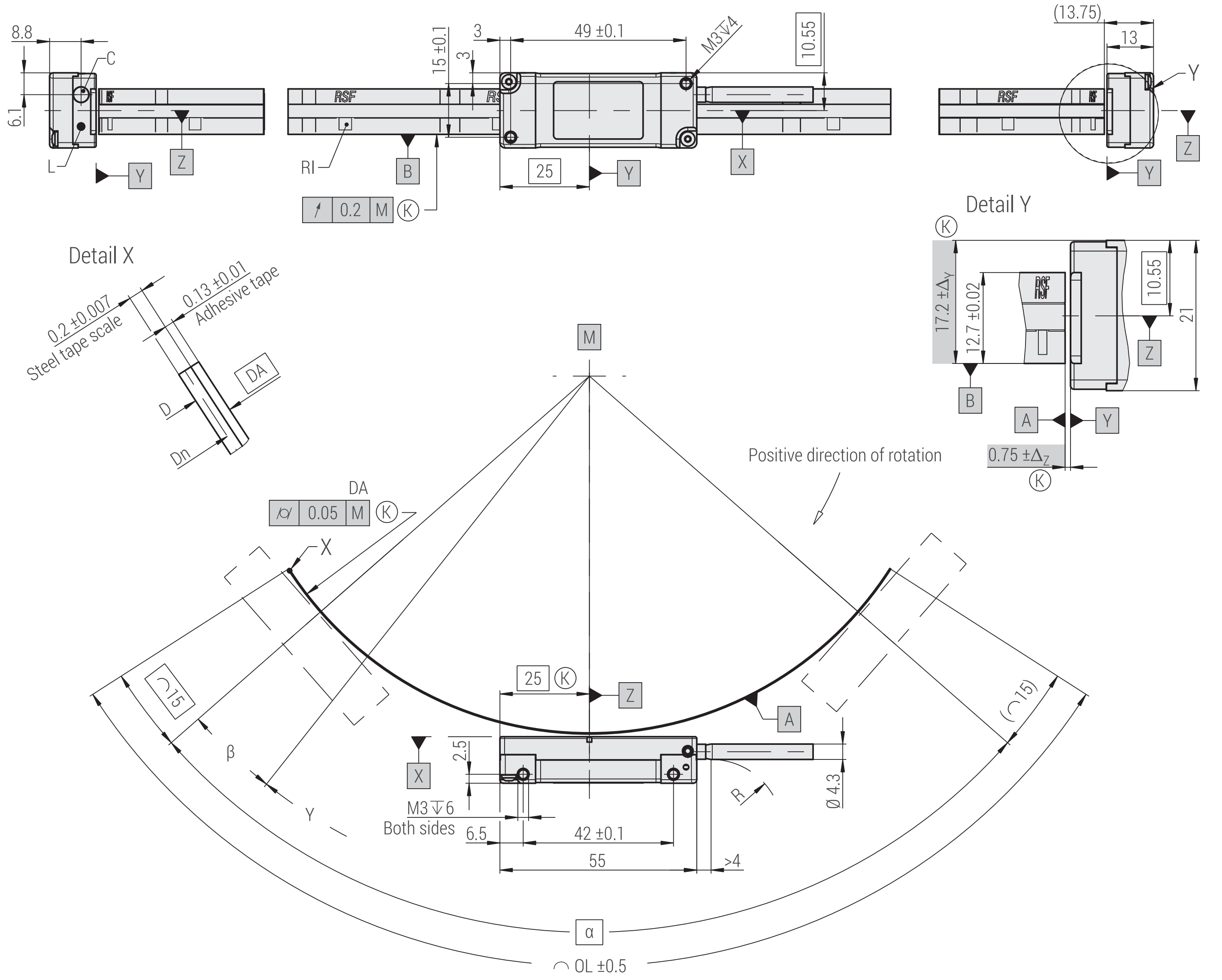
OPTIONAL ACCESSORY

Mounting aid MH MSS 25:



External testing device PWT 101:

MSS 25 DIMENSIONS, MOUNTING TOLERANCES



M = Rotary axis		Permissible position deviation of the scanning head - scale tape	
OL = Length of tape		Reference plane A B	
α = Measuring range [°]		Δ_Y = Displacement, ±0.5	
D = Scanning diameter (> 50 mm)		Δ_Z = Gap tolerance, ±0.1	
DA = Mating diameter		φ_Z = ±1.00 mrad or ±0.06° (yaw angle)	
DN = Neutral axis		φ_Y = ±3.60 mrad or ±0.20° (pitch angle)	
(K) = Required mating dimensions		φ_X = ±5.00 mrad or ±0.29° (roll angle)	
RI = Reference mark(s)			
β = Any position of the reference mark from the beginning of measuring range [°]		Calculations:	
		OL = 30 + (D −0.20) × π × α / 360°	
γ = Additional reference mark [°]		D = DA + 0.66 (MB MSS 25 SK)	
C = Cable		D = DA + 0.4 (MB MSS 25 SO)	
L = LED function display			
R = Bending radius: stat. R ≥ 8 mm, dyn. R ≥ 20 mm			

mm

Tolerancing ISO 8015
ISO 2768: 1989 - m H
< 6 mm: ±0.2 mm

DISTRIBUTION CONTACTS

AUSTRIA *Corporate Head Quarters*	RSF Elektronik Ges.m.b.H.	A-5121 Tarsdorf 93	☏ +43 62 78 81 92-0 FAX +43 62 78 81 92-79	e-mail: info@rsf.at internet: www.rsf.at
BELGIUM	HEIDENHAIN NV/SA	Pamelse Klei 47 1760 Roosdaal	☏ +32 (54) 34 3158 FAX +32 (54) 34 3173	e-mail: sales@heidenhain.be internet: www.heidenhain.be
FRANCE	HEIDENHAIN FRANCE sarl	2 Avenue de la Christallerie 92310 Sèvres	☏ +33 1 41 14 30 00 FAX +33 1 41 14 30 30	e-mail: info@heidenhain.fr internet: www.heidenhain.fr
GREAT BRITAIN	HEIDENHAIN (GB) Ltd.	200 London Road Burgess Hill West Sussex RH15 9RD	☏ +44 1444 247711 FAX +44 1444 870024	e-mail: sales@heidenhain.co.uk internet: www.heidenhain.co.uk
ITALY	HEIDENHAIN ITALIANA S.r.l.	Via Asiago, 14 20128 Milan	☏ +39 02 27075-1 FAX +39 02 27075-210	e-mail: info@heidenhain.it internet: www.heidenhain.it
NETHERLANDS	HEIDENHAIN NEDERLAND B.V.	Copernicuslaan 34 6716 BM EDE	☏ +31 318-581800 FAX +31 318-581870	e-mail: verkoop@heidenhain.nl internet: www.heidenhain.nl
SPAIN	FARRESA ELECTRONICA S.A	Les Corts 36-38 08028 Barcelona	☏ +34 93 4 092 491 FAX + 34 93 3 395 117	e-mail: farresa@farresa.es internet: www.farresa.es
SWEDEN	HEIDENHAIN Scandinavia AB	Storsätragränd 5 SE-12739 Skärholmen	☏ +46 8 531 933 50 FAX +46 8 531 933 77	e-mail: sales@heidenhain.se internet: www.heidenhain.se
SWITZERLAND	HEIDENHAIN (SCHWEIZ) AG	Vieristrasse 14 8603 Schwerzenbach	☏ +41 44 806 27 27 FAX +41 44 806 27 28	e-mail: verkauf@heidenhain.ch internet: www.heidenhain.ch
CHINA	DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd	Tian Wei San Jie, Area A, Beijing Tianzhu Airport Industrial Zone Shunyi District, Beijing 101312	☏ +86 10 80 42-0000	e-mail: sales@heidenhain.com.cn internet: www.heidenhain.com.cn
ISRAEL	MEDITAL Hi-Tech	7 Leshem Str. 47170 Petach Tikva	☏ +972 0 3 923 33 23 FAX +972 0 3 923 16 66	e-mail: avi@medital.co.il internet: www.medital.co.il
JAPAN	HEIDENHAIN K.K.	Hulic Kojimachi Bldg., 9F 3-2 Kojimachi, Chiyoda-ku Tokyo, 102-0083	☏ +81 3 3234 7781 FAX +81 3 3262 2539	e-mail: sales@heidenhain.co.jp internet: www.heidenhain.co.jp
KOREA	HEIDENHAIN LTD.	75, Jeonpa-ro 24beon-gil, Manan-gu, Anyang-si 14087 Gyeonggi-do	☏ +82 31 380 5200 FAX +82 31 380 5250	e-mail: info@heidenhain.co.kr internet: www.heidenhain.co.kr
SINGAPORE	HEIDENHAIN PACIFIC PTE LTD.	51, Ubi Crescent 408593 Singapore	☏ +65 67 49 32 38 FAX +65 67 49 39 22	e-mail: info@heidenhain.com.sg internet: www.heidenhain.com.sg
TAIWAN	HEIDENHAIN CO., LTD.	No. 29, 33rd Road; Taichung Industrial Park Taichung 40768	☏ +886 4 2358 89 77 FAX +886 4 2358 89 78	e-mail: info@heidenhain.tw internet: www.heidenhain.com.tw
USA	HEIDENHAIN CORPORATION	333 East State Parkway Schaumburg, IL 60173-5337	☏ +1 847 490 11 91	e-mail: info@heidenhain.com internet: www.heidenhain.com

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A-5121 Tarsdorf ■ ☏ +43 (0)6278 / 8192-0 ■ FAX +43 (0)6278 / 8192-79 ■ e-mail: info@rsf.at ■ internet: www.rsf.at