

RESM angle encoder



The RESM is a one-piece stainless steel ring with 20 µm scale marked directly onto the periphery, featuring the *IN-TRAC*™ auto-phase optical reference mark.

The RESM offers impressive accuracy with resolution to 0.00075 arc second, suiting the most demanding precision applications.

Read by Renishaw's new **TONiC**™ and established **SiGNUM**™ encoder systems, it has high tolerance to dirt, scratches and greasy fingerprints that can cause other encoder systems to miscount.

The low profile RESM, with large internal diameter, is easy to design into most installations. Equally important, its low mass, low inertia design does not compromise system performance. Available in a wide range of sizes and line counts, providing compatibility with industry standard controllers.

System features

- Compatible with the new **TONiC** encoder range and the established **SiGNUM** system to offer industry standard analogue or digital incremental outputs
- Patented taper mount simplifies integration and minimises installation errors
- Large internal diameter for ease of integration
- Available in sizes from Ø52 mm to Ø550 mm with line counts from 8 192 to 86 400
- Custom sizes also available
- Low mass and low inertia
- Ultra-low inertia versions also available
- Integral set-up LED on readhead for quick set-up and instant 'health check' at any time
- Dual limits (**SiGNUM** only)
- *IN-TRAC* bi-directional optical reference mark
- High speed operation, up to 4 591 rev/min (12.5 m/s)
- Graduation accuracy to ± 0.5 arc second (550 mm ring)
- Low-noise analogue 1 Vpp version
- New high-resolution, 2 and 1 nm digital versions (**TONiC** only)
- Angular resolution to 0.00075 arc second
- System repeatability to 0.00225 arc second

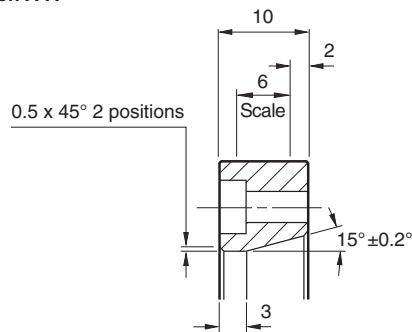
Data sheet

RESM angle encoder system

Installation drawing ('A' section)

Dimensions and tolerances in mm

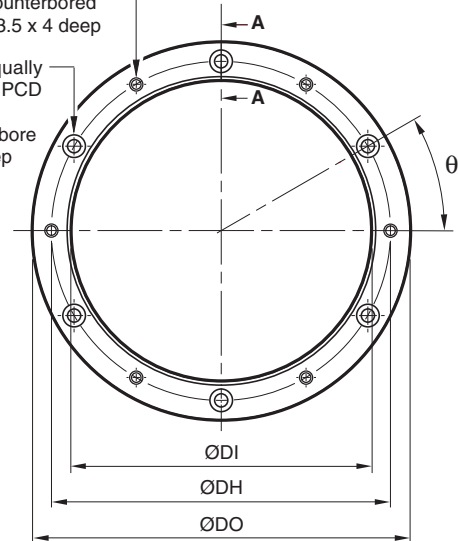
Section A-A



NOTE: θ is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 2θ .

N holes equally spaced on PCD \varnothing DH M3 x 0.5 through, counterbored top face \varnothing 3.5 x 4 deep

N holes equally spaced on PCD \varnothing DH \varnothing 3.5 through, c/bore \varnothing 6 x 3 deep



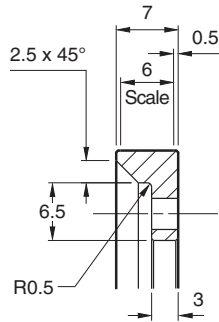
Nominal external diameter (mm)	Line count	DO (mm)	DI (mm)	Mounting holes		
				DH (mm)	N	θ
52	8 192	52.20 52.10	30.04 30.00	40	6	30°
57	9 000	57.35 57.25	37.04 37.00	47	6	30°
75	11 840	75.40 75.30	55.04 55.00	65	6	30°
100	15 744	100.30 100.20	80.04 80.00	90	6	30°
103	16 200	103.20 103.00	80.04 80.00	90	6	30°
104	16 384	104.40 104.20	80.04 80.00	90	6	30°
115	18 000	114.70 114.50	95.04 95.00	105	6	30°
150	23 600	150.40 150.20	130.04 130.00	140	9	20°
200	31 488	200.40 200.20	180.04 180.00	190	12	15°
206	32 400	206.50 206.10	186.05 186.00	196	12	15°
209	32 768	208.80 208.40	186.05 186.00	196	12	15°
229	36 000	229.40 229.00	209.05 209.00	219	12	15°
255	40 000	254.80 254.40	235.06 235.00	245	12	15°
300	47 200	300.40 300.20	280.06 280.00	290	16	11.25°
350	55 040	350.40 350.20	330.06 330.00	340	16	11.25°
413	64 800	412.70 412.30	392.08 392.00	402	18	10°
417	65 536	417.40 417.00	380.10 380.00	390	18	10°
489	76 800	489.12 488.72	451.10 450.90	462	20	*18°
550	86 400	550.20 549.80	510.10 510.00	520	20	9°

*NOTE: There are no tapped holes on the 489 mm ring

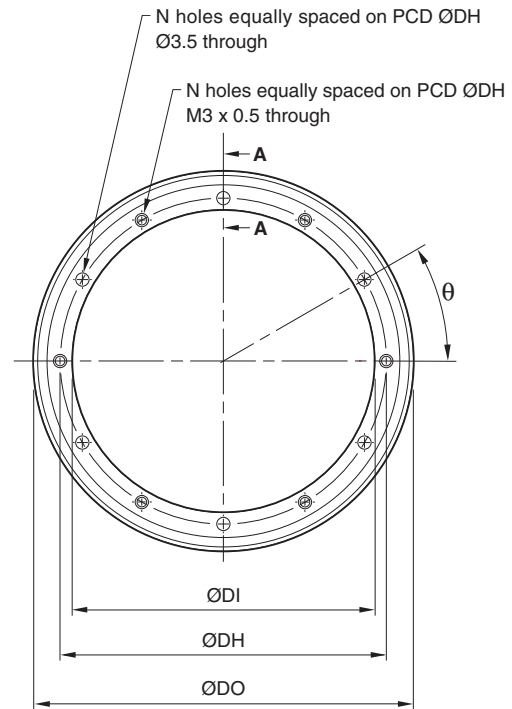
Installation drawing ('B' section)

Dimensions and tolerances in mm

Section A-A

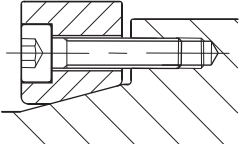
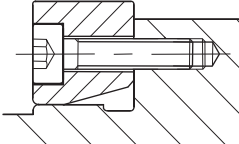
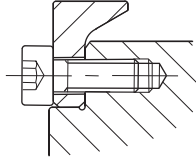


NOTE: θ is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 2θ .



Nominal external diameter (mm)	DO (mm)	DI (mm)	DH (mm)	N	θ
75	75.40 75.30	55.04 55.00	61	6	30°
100	100.30 100.20	80.04 80.00	86	6	30°
150	150.40 150.20	130.04 130.00	136	9	20°
200	200.40 200.20	180.04 180.00	186	12	15°

Mounting methods

	Taper mount	Interference fit
'A' section		
'B' section	Not applicable	
Notes	<p>Recommended for all installations</p> <p>Offers highest accuracy. Enables simplest adjustment. Enables eccentricity to be compensated. Offers excellent mechanical stability against thermal cycling, shock and vibration. Minimises cost of substrate preparation.</p>	<p>Alternative installation</p> <p>Will not correct eccentricity of the supporting shaft.</p>

For further information on installation and mounting options, please refer to the TONiC T2000 Installation guide (M-9653-9161) or SIGNUM RESM installation guide (M-9572-9106), which are available from your local representative, or can be downloaded from: www.renishawsupport.com

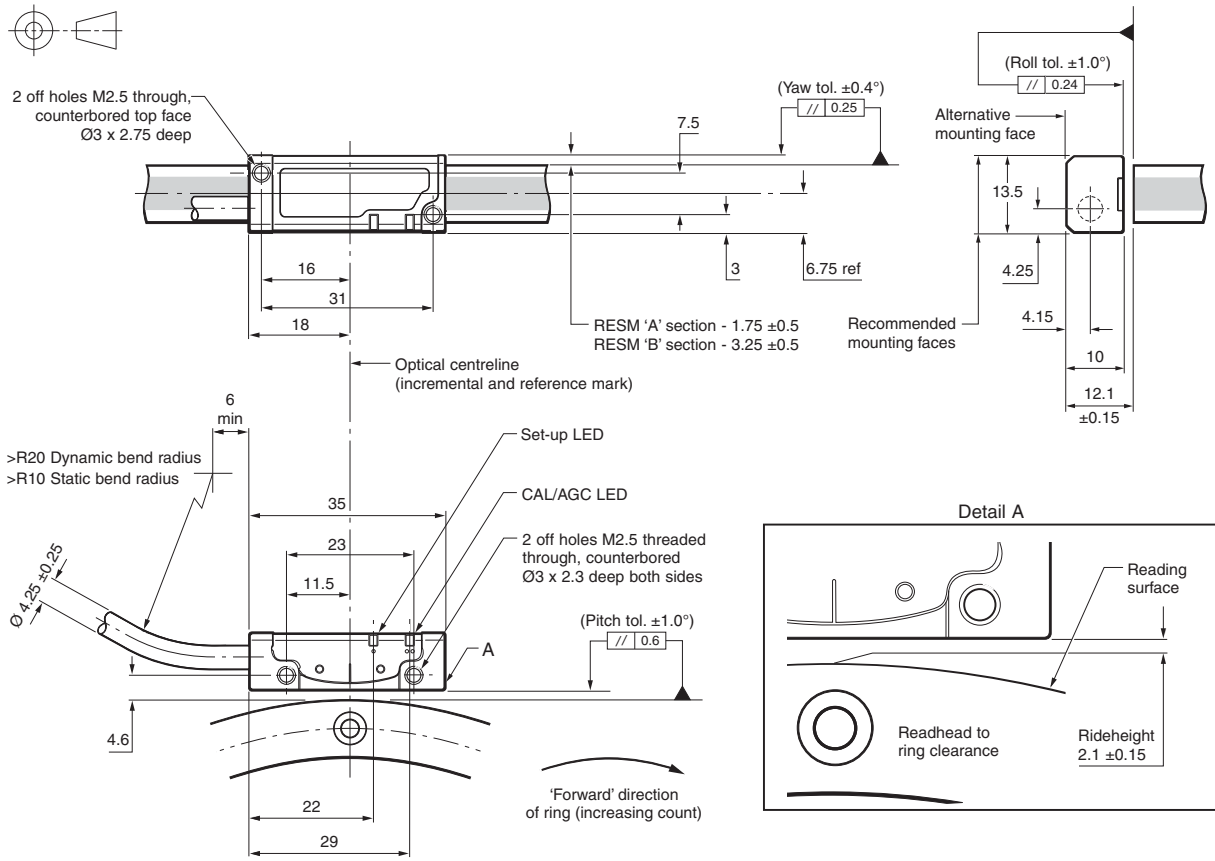
Reference mark position



IN-TRAC reference mark is embedded in the scale, radially aligned with the centre of the mounting hole to the left of the 'Renishaw' logo, within ± 0.5 mm. No external actuators or physical adjustment are required.

TONiC2000 readhead mounted on 'A' section RESM

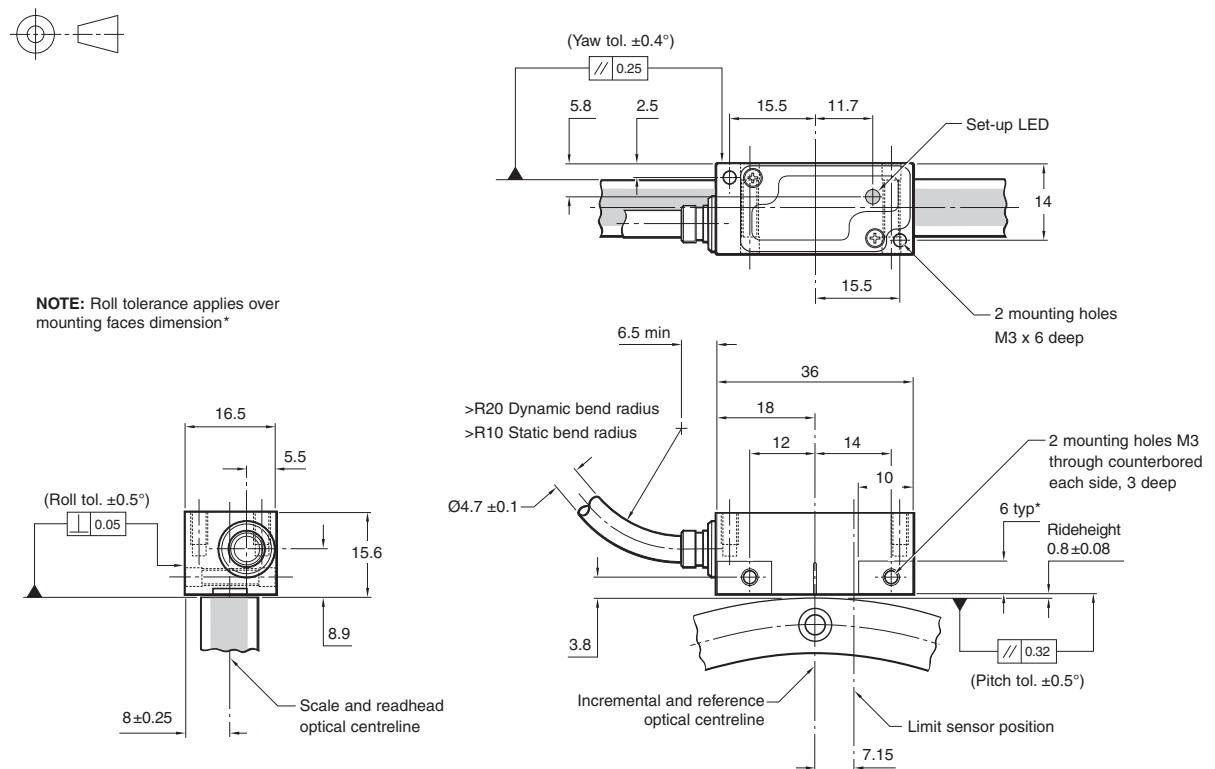
Dimensions and tolerances in mm



For TONiC readhead installation details refer to the TONiC T2000 Installation guide (M-9653-9161). This can be downloaded from www.renishawsupport.com/encoders or contact your local Renishaw representative.

SiGNUM readhead mounted on 'A' section RESM

Dimensions and tolerances in mm



For SiGNUM installation details refer to the SiGNUM RESM installation guide (M-9572-9106). This can be downloaded from www.renishawsupport.com/encoders or contact your local Renishaw representative.

Operating specifications

Material	303/304 stainless steel			
Coefficient of expansion	17 $\mu\text{m}/\text{m}/^\circ\text{C}$ (ppm/ $^\circ\text{C}$)			
Temperature	Storage	-20 $^\circ\text{C}$ to +70 $^\circ\text{C}$	Operating	SiGNUM 0 $^\circ\text{C}$ to + 85 $^\circ\text{C}$ TONiC 0 $^\circ\text{C}$ to + 70 $^\circ\text{C}$

Nominal external diameter (mm)	52	57	75	100	103	104	115	150	200	206	
Nominal internal diameter (mm)	30	37	55	80	80	80	95	130	180	186	
Line count	8 192	9 000	11 840	15 744	16 200	16 384	18 000	23 600	31 488	32 400	
Mass (kg)	'A' section	0.1	0.1	0.15	0.2	0.25	0.25	0.25	0.3	0.4	0.45
	'B' section	–	–	0.07	0.1	–	–	–	0.15	0.2	–
Moment of inertia (kgmm ²)	'A' section	47	63	160	420	510	550	640	1 600	3 800	4 300
	'B' section	–	–	78	200	–	–	–	720	1 800	–

Nominal external diameter (mm)	209	229	255	300	350	413	417	489	550	
Nominal internal diameter (mm)	186	209	235	280	330	392	380	451	510	
Line count	32 768	36 000	40 000	47 200	55 040	64 800	65 536	76 800	86 400	
Mass (kg)	'A' section	0.5	0.5	0.55	0.65	0.75	0.9	1.76	2.12	2.67
	'B' section	–	–	–	–	–	–	–	–	–
Moment of inertia (kgmm ²)	'A' section	4 900	5 900	8 000	14 000	22 000	37 000	70 000	120 000	188 000
	'B' section	–	–	–	–	–	–	–	–	–

On-scale limits - SiGNUM systems only

For applications such as partial arc, dual on-scale limits can be used on 'A' section rings having an external diameter of 100 mm or more. Self adhesive limit markers are available in 10 mm, 20 mm and 50 mm lengths as pre-aligned pairs on backing paper.

Accuracy

Nominal external diameter (mm)	Graduation accuracy (arc second)	System accuracy (arc second)
52	±3.97	±4.28
57	±3.62	±3.91
75	±2.75	±2.97
100	±2.06	±2.23
103	±2.00	±2.16
104	±1.98	±2.14
115	±1.79	±1.94
150	±1.38	±1.49
200	±1.03	±1.11
206	±1.00	±1.08
209	±0.99	±1.07
229	±0.90	±0.97
255	±0.81	±0.87
300	±0.69	±0.74
350	±0.59	±0.64
413	±0.50	±0.54
417	±0.50	±0.54
489	±0.42	±0.46
550	±0.38	±0.41

Graduation accuracy is the maximum difference between the angle measured by a single readhead and the true rotation of the encoder as graduated. Application disturbances such as eccentricity are not included.

System accuracy is graduation accuracy plus SDE. Effects such as eccentricity influence installed accuracy; for application advice, please contact your local representative.

Data sheet
RESM angle encoder system

Maximum speed (rev/min)

For details of maximum speeds for other clocked options, please contact your local representative.

TONiC system: For 50 MHz clocked option.

Nominal external diameter (mm)	Line count	Output resolution											Analogue
		Ti0004 5 µm	Ti0020 1 µm	Ti0040 0.5 µm	Ti0100 0.2 µm	Ti0200 0.1 µm	Ti0400 50 nm	Ti1000 20 nm	Ti2000 10 nm	Ti4000 5 nm	Ti10KD 2 nm	Ti20KD 1 nm	
52	8 192	3 673	3 673	3 673	2 380	1 190	597	238	119	59	24	12	3 673
57	9 000	3 351	3 351	3 351	2 171	1 086	544	217	109	54	22	11	3 351
75	11 840	2 546	2 546	2 546	1 650	825	414	165	83	41	17	8.0	2 546
100	15 744	1 910	1 910	1 910	1 238	619	310	124	62	31	12	6.0	1 910
103	16 200	1 854	1 854	1 854	1 202	601	301	120	60	30	12	6.0	1 854
104	16 384	1 836	1 836	1 836	1 190	595	298	119	59	30	12	6.0	1 836
115	18 000	1 661	1 661	1 661	1 076	538	270	108	54	27	11	5.0	1 661
150	23 600	1 273	1 273	1 273	825	413	207	83	41	21	8.0	4.0	1 273
200	31 488	955	955	955	619	309	155	62	31	15	6.0	3.0	955
206	32 400	927	927	927	601	300	151	60	30	15	6.0	3.0	927
209	32 768	914	914	914	592	296	148	59	30	15	6.0	3.0	914
229	36 000	834	834	834	540	270	136	54	27	14	5.0	3.0	834
255	40 000	749	749	749	485	243	122	49	24	12	5.0	2.0	749
300	47 200	637	637	637	413	206	103	41	21	10	4.0	2.0	637
350	55 040	546	546	546	354	177	89	35	18	9.0	4.0	2.0	546
413	64 800	462	462	462	300	150	75	30	15	7.0	3.0	1.0	462
417	65 536	458	458	458	297	148	74	30	15	7.0	3.0	1.0	458
489	76 800	391	391	391	253	127	63	25	13	6.0	3.0	1.0	391
550	86 400	347	347	347	225	113	56	23	11	6.0	2.0	1.0	347

SiGNUM system: For 40 MHz clocked option.

Nominal external diameter (mm)	Line count	Output resolution										Analogue*	
		Si-NN-0004 5 µm	Si-NN-0020 1 µm	Si-NN-0040 0.5 µm	Si-NN-0100 0.2 µm	Si-NN-0200 0.1 µm	Si-NN-0400 50 nm	Si-NN-1000 20 nm	Si-NN-2000 10 nm	Si-HN-4000 5 nm	Si-NN-0000 1 Vpp	Si-NN-0001 1 Vpp	
52	8 192	4 591	4 591	4 591	1 836	918	459	184	99	50	4 591	1 102	
57	9 000	4 188	4 188	4 188	1 675	837	418	167	90	45	4 188	1 105	
75	11 840	3 183	3 183	3 183	1 273	636	318	127	69	34	3 183	764	
100	15 744	2 387	2 387	2 387	954	477	238	95	52	26	2 387	573	
103	16 200	2 318	2 318	2 318	927	463	231	92	50	25	2 318	556	
104	16 384	2 296	2 296	2 296	918	459	229	91	50	25	2 296	551	
115	18 000	2 076	2 076	2 076	830	415	207	83	45	22	2 076	498	
150	23 600	1 592	1 592	1 592	636	318	159	63	34	17	1 592	382	
200	31 488	1 194	1 194	1 194	477	238	119	47	26	13	1 194	286	
206	32 400	1 159	1 159	1 159	463	231	115	46	25	13	1 159	278	
209	32 768	1 142	1 142	1 142	456	228	114	45	25	12	1 142	274	
229	36 000	1 042	1 042	1 042	416	208	104	41	23	11	1 042	250	
255	40 000	936	936	936	374	187	93	37	20	10	936	225	
300	47 200	796	796	796	318	159	79	31	17	8.6	796	191	
350	55 040	682	682	682	272	136	68	27	15	7.4	682	164	
413	64 800	578	578	578	231	115	57	23	12	6.2	578	139	
417	65 536	572	572	572	229	114	57	23	12	6.2	572	137	
489	76 800	488	488	488	195	98	49	20	11	5.3	488	117	
550	86 400	434	434	434	176	87	43	17	9.4	4.7	434	104	

*NOTE: Si-NN-0000 is the high-speed version of the 1 Vpp analogue interface, suitable for both high-speed and general applications. Si-NN-0001 is the low-noise version of the 1 Vpp analogue interface, incorporating additional noise filtering to provide even better positional stability and smoother velocity control. To achieve this, the maximum speed is limited. Si-NN-0001 is suitable for advanced applications requiring the most precise motion control and it is also suitable for general applications that do not require high-speed operation.

Resolution

The RESM offers a range of standard ring diameters, as well as sizes that offer line counts that provide 2ⁿ counts per revolution or resolutions that are precise sub-divisions of degrees or arc seconds.

NOTE: 1 arc second resolution = 1.296 x 10⁶ counts per revolution ≈ 2.778 x 10⁻⁴ degree resolution.

	Nominal external diameter (line count)	SIGNUM or TONiC digital resolution (interpolation factor)									TONiC digital resolution (interpolation factor)	
		5 μm (x4)	1 μm (x20)	0.5 μm (x40)	0.2 μm (x100)	0.1 μm (x200)	50 nm (x400)	20 nm (x1 000)	10 nm (x2 000)	5 nm (x 4 000)	2 nm (x10 000)	1 nm (x20 000)
Standard outside diameters	75 mm (11 840)	≈ 27.4"	≈ 5.47"	≈ 2.74"	≈ 1.1"	≈ 0.55"	≈ 0.27"	≈ 0.11"	≈ 0.055"	≈ 0.028"	≈ 0.011"	≈ 0.0055"
	100 mm (15 744)	≈ 20.6"	≈ 4.12"	≈ 2.06"	≈ 0.82"	≈ 0.41"	≈ 0.21"	≈ 0.082"	≈ 0.041"	≈ 0.021"	≈ 0.0082"	≈ 0.0041"
	150 mm (23 600)	≈ 13.7"	≈ 2.75"	≈ 1.37"	≈ 0.55"	≈ 0.27"	≈ 0.14"	≈ 0.055"	≈ 0.028"	≈ 0.014"	≈ 0.0055"	≈ 0.0027"
	200 mm (31 488)	≈ 10.3"	≈ 2.06"	≈ 1.03"	≈ 0.41"	≈ 0.21"	≈ 0.1"	≈ 0.041"	≈ 0.021"	≈ 0.010"	≈ 0.0041"	≈ 0.0020"
	255 mm† (40 000)	≈ 8.1"	≈ 1.62"	≈ 0.81"	≈ 0.32"	≈ 0.16"	≈ 0.081"	≈ 0.032"	≈ 0.016"	≈ 0.0081"	≈ 0.0032"	≈ 0.0016"
	300 mm (47 200)	≈ 6.9"	≈ 1.37"	≈ 0.69"	≈ 0.27"	≈ 0.14"	≈ 0.069"	≈ 0.027"	≈ 0.014"	≈ 0.0069"	≈ 0.0027"	≈ 0.0014"
	350 mm (55 040)	≈ 5.9"	≈ 1.18"	≈ 0.59"	≈ 0.24"	≈ 0.12"	≈ 0.059"	≈ 0.024"	≈ 0.012"	≈ 0.0059"	≈ 0.0024"	≈ 0.0012"
	489 mm (76 800)	≈ 4.22"	≈ 0.84"	≈ 0.42"	≈ 0.17"	≈ 0.084"	≈ 0.042"	≈ 0.017"	≈ 0.0084"	≈ 0.0042"	≈ 0.0017"	≈ 0.00084"
	550 mm (86 400)	≈ 3.75"	≈ 0.75"	≈ 0.38"	≈ 0.15"	≈ 0.075"	≈ 0.38"	≈ 0.015"	≈ 0.0075"	≈ 0.0038"	≈ 0.0015"	≈ 0.00075"
2 ⁿ line count	52 mm (8 192)	≈ 39.6"	≈ 7.9"	≈ 3.96"	≈ 1.58"	≈ 0.79"	≈ 0.4"	≈ 0.16"	≈ 0.079"	≈ 0.040"	≈ 0.016"	≈ 0.0079"
	104 mm (16 384)	≈ 19.8"	≈ 3.96"	≈ 1.98"	≈ 0.79"	≈ 0.4"	≈ 0.2"	≈ 0.08"	≈ 0.040"	≈ 0.020"	≈ 0.0080"	≈ 0.0040"
	209 mm (32 768)	≈ 9.89"	≈ 1.98"	≈ 0.99"	≈ 0.4"	≈ 0.2"	≈ 0.1"	≈ 0.04"	≈ 0.02"	≈ 0.0099"	≈ 0.0040"	≈ 0.0020"
	417 mm (65 536)	≈ 4.9"	≈ 0.99"	≈ 0.49"	≈ 0.2"	≈ 0.1"	≈ 0.05"	≈ 0.02"	≈ 0.0099"	≈ 0.0049"	≈ 0.0020"	≈ 0.00099"
Subdivisions of degrees	57 mm (9 000)	0.01°	0.002°	0.001°	0.0004°	0.0002°	0.0001°	0.00004°	0.00002°	0.00001°	0.000004°	0.000002°
	115 mm (18 000)	0.005°	0.001°	0.0005°	0.0002°	0.0001°	0.00005°	0.00002°	0.00001°	0.000005°	0.000002°	0.000001°
	229 mm (36 000)	0.0025°	0.0005°	0.00025°	0.0001°	0.00005°	0.000025°	0.00001°	0.000005°	0.0000025°	0.000001°	0.0000005°
Subdivisions of arc second	103 mm (16 200)	20"	4"	2"	0.8"	0.4"	0.2"	0.08"	0.040"	0.020"	0.0080"	0.0040"
	206 mm (32 400)	10"	2"	1"	0.4"	0.2"	0.1"	0.04"	0.020"	0.010"	0.0040"	0.0020"
	413 mm (64 800)	5"	1"	0.5"	0.2"	0.1"	0.05"	0.02"	0.010"	0.0050"	0.0020"	0.0010"

†Line count as a multiple of 1000

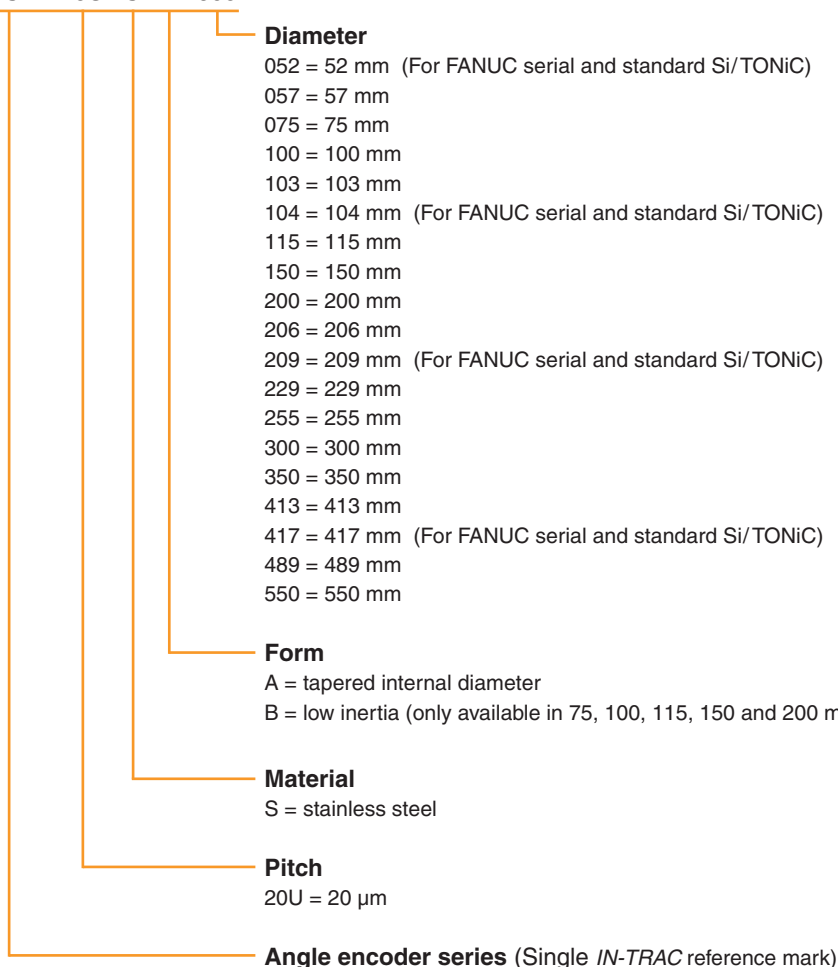
NOTE: The symbol " indicates units of arc seconds.

NOTE: Numbers preceded with a ≈ symbol show rounded resolution values. To calculate the exact resolution in arc seconds, use the following equation:

$$\theta \text{ (arc seconds)} = \frac{1.296 \times 10^6}{[\text{Line count}] \times [\text{Interpolation factor}]}$$

Angle encoder part numbers

RESM 20U S A 300



- Diameter**
 052 = 52 mm (For FANUC serial and standard Si/TONiC)
 057 = 57 mm
 075 = 75 mm
 100 = 100 mm
 103 = 103 mm
 104 = 104 mm (For FANUC serial and standard Si/TONiC)
 115 = 115 mm
 150 = 150 mm
 200 = 200 mm
 206 = 206 mm
 209 = 209 mm (For FANUC serial and standard Si/TONiC)
 229 = 229 mm
 255 = 255 mm
 300 = 300 mm
 350 = 350 mm
 413 = 413 mm
 417 = 417 mm (For FANUC serial and standard Si/TONiC)
 489 = 489 mm
 550 = 550 mm

- Form**
 A = tapered internal diameter
 B = low inertia (only available in 75, 100, 115, 150 and 200 mm diameters)

- Material**
 S = stainless steel

- Pitch**
 20U = 20 µm

Angle encoder series (Single *IN-TRAC* reference mark)

RESM compatible readheads

RESM



TONiC T2000
 Installation guide M-9653-9161
 Data sheet L-9517-9337



SIGNUM
 Installation guide M-9572-9106
 Data sheet L-9517-9155

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