Data sheet
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RENISHAW
apply innovation™

RESM rotary scale



The RESM is a one-piece stainless steel ring with 20 µm or 40 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 VIONiC™, TONiC™ and QUANTiC™ 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.

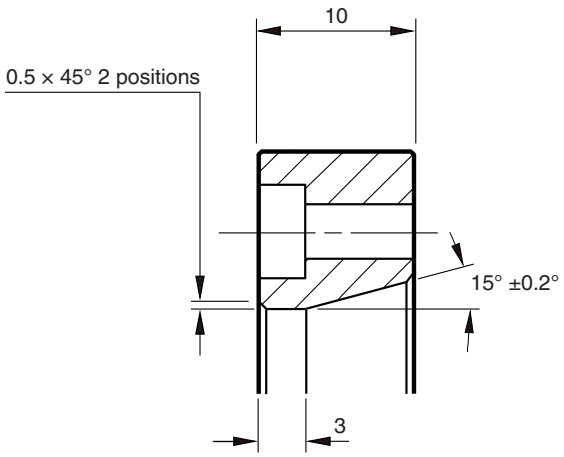
System features

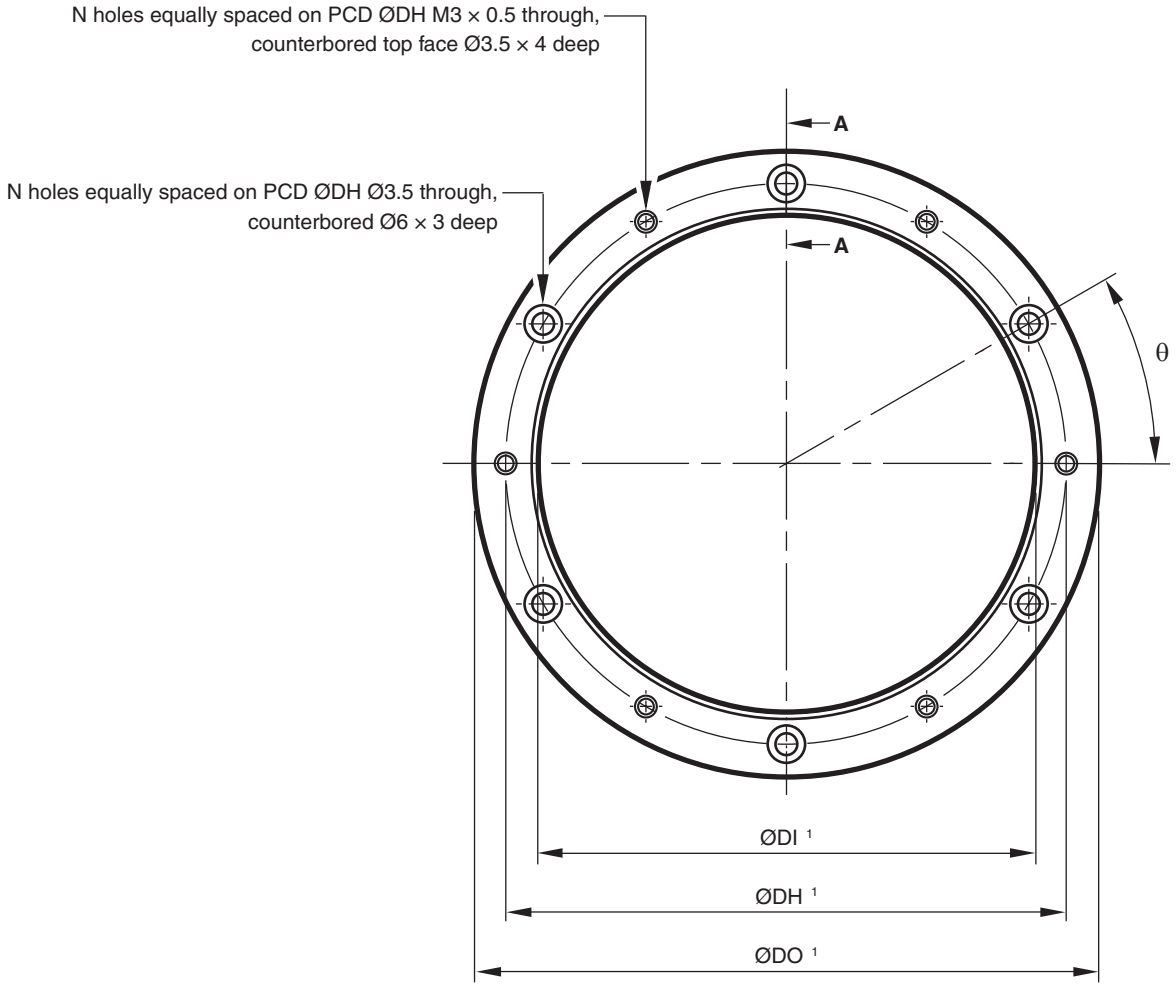
- **Compatible with the VIONiC, TONiC and QUANTiC encoder systems offering industry standard analogue or digital incremental outputs**
- ***IN-TRAC* bi-directional optical reference mark**
- **Typical installed accuracy to ±1.9 arc second (550 mm ring)**
- **Patented taper mount simplifies integration and minimises installation errors**
- **Large internal diameter for ease of integration**
- **Available in sizes from Ø52 mm to Ø550 mm with line counts from 4 096 to 86 400**
- **Custom sizes also available**
- **Low mass and low inertia**
- **Ultra-low inertia versions also available**
- **REST20 is a RESM20 with two reference marks, for use on dual readhead systems in partial arc applications**

RESM 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.

1 The dimensions DO, DI and DH for the RESM 'A' section rings are listed on the following page.

RESM specifications (‘A’ section)

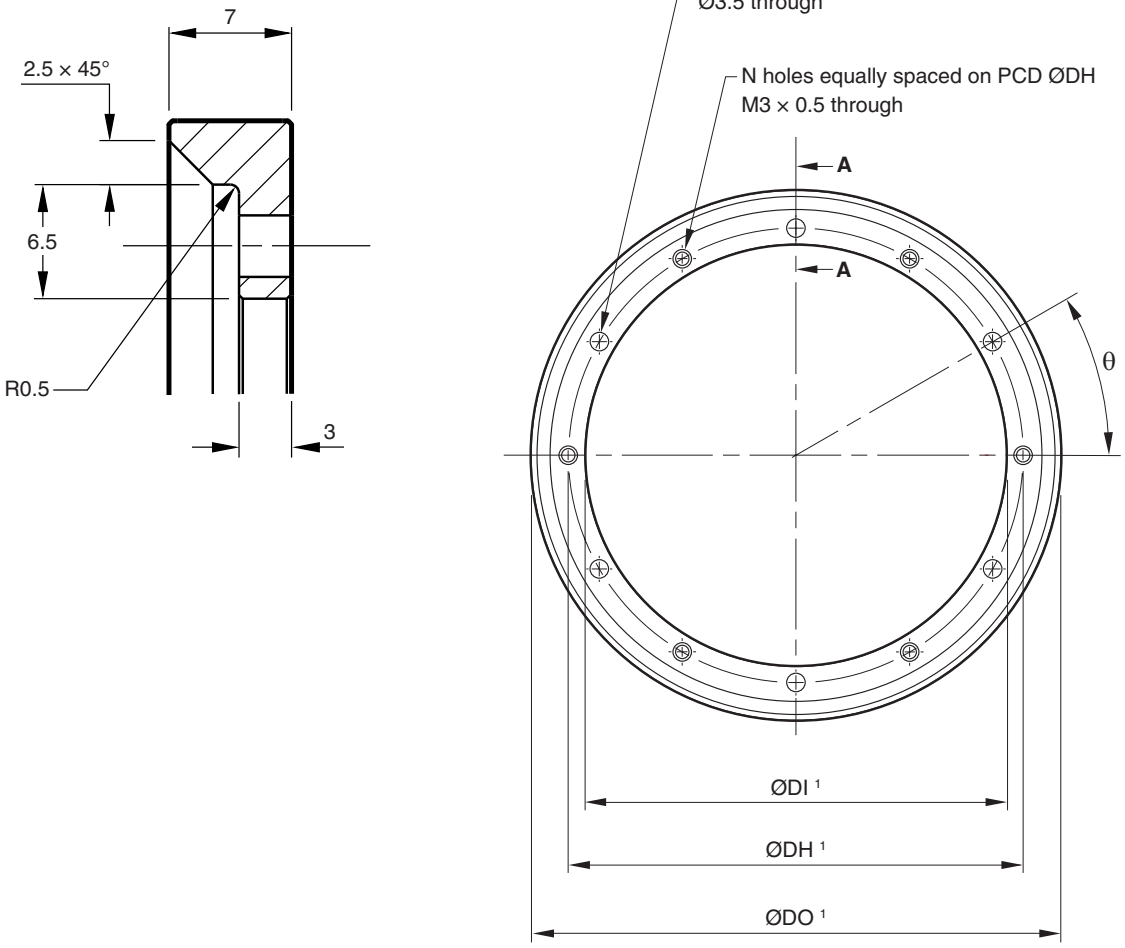
Nominal external diameter (mm)	Line count		DO (mm)	DI (mm)	Mounting holes		
	RESM20	RESM40			DH (mm)	N	θ
52	8 192	4 096	52.20 52.10	30.04 30.00	40	6	30°
57	9 000	4 500	57.35 57.25	37.04 37.00	47	6	30°
75	11 840	5 920	75.40 75.30	55.04 55.00	65	6	30°
94	14 800	7 400	94.30 94.26	74.59 74.55	84.5	6	30°
100	15 744	7 872	100.30 100.20	80.04 80.00	90	6	30°
103	16 200	8 100	103.20 103.00	80.04 80.00	90	6	30°
104	16 384	8 192	104.40 104.20	80.04 80.00	90	6	30°
115	18 000	9 000	114.70 114.50	95.04 95.00	105	6	30°
124	19 478	9 740	124.10 123.90	104.04 104.00	114	6	30°
150	23 600	11 800	150.40 150.20	130.04 130.00	140	9	20°
172	27 000	13 500	172.04 171.84	152.04 152.00	162	9	20°
183	28 800	14 400	183.45 183.25	163.04 163.00	173	9	20°
200	31 488	15 744	200.40 200.20	180.04 180.00	190	12	15°
206	32 400	16 200	206.50 206.10	186.05 186.00	196	12	15°
209	32 768	16 384	208.80 208.40	186.05 186.00	196	12	15°
229	36 000	18 000	229.40 229.00	209.05 209.00	219	12	15°
255	40 000	20 000	254.80 254.40	235.06 235.00	245	12	15°
300	47 200	23 600	300.40 300.20	280.06 280.00	290	16	11.25°
350	55 040	27 520	350.40 350.20	330.06 330.00	340	16	11.25°
413	64 800	32 400	412.70 412.30	392.08 392.00	402	18	10°
417	65 536	32 768	417.40 417.00	380.10 380.00	390	18	10°
489 [1]	76 800	38 400	489.12 488.72	451.10 450.90	462	20	18°
550	86 400	43 200	550.20 549.80	510.10 510.00	520	20	9°

[1] There are no tapped holes on the 489 mm ring.

RESM installation drawing (‘B’ section)

Dimensions and tolerances in mm

Section A-A



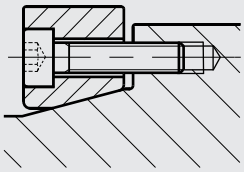
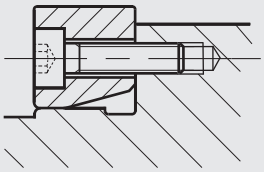
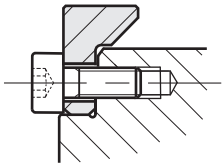
NOTE: θ is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 2θ.

[1] The dimensions DO, DI and DH for the RESM 'B' section rings are listed on the following page.

RESM specifications ('B' section)

Nominal external diameter (mm)	Line count		DO (mm)	DI (mm)	Mounting holes		
	RESM20	RESM40			DH (mm)	N	θ
52	8 192	4 096	52.20 52.10	32.04 32.00	38	6	30°
57	9 000	4 500	57.35 57.25	37.04 37.00	43	6	30°
75	11 840	5 920	75.40 75.30	55.04 55.00	61	6	30°
100	15 744	7 872	100.30 100.20	80.04 80.00	86	6	30°
115	18 000	9 000	114.70 114.50	95.04 95.00	101	6	30°
150	23 600	11 800	150.40 150.20	130.04 130.00	136	9	20°
165	25 920	12 960	165.10 164.90	145.04 145.00	151	9	20°
200	31 488	15 744	200.40 200.20	180.04 180.00	186	12	15°

RESM mounting methods

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

For further information on installation and mounting options, refer to the relevant system installation guides, which are available from your local Renishaw representative, or can be downloaded from: **www.renishaw.com/encoderinstallationguides**.

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.

NOTE: For REST20 rings the second reference mark is located 180° from the first reference mark.

Compatible readheads

	VIONiC	TONiC	QUANTiC
			
Scale type	RESM20/REST20	RESM20/REST20	RESM40
Pitch	20 µm	20 µm	40 µm
Outputs	Digital resolutions from 5 µm to 2.5 nm direct from the readhead	Analogue 1 Vpp. Digital resolutions from 5 µm to 1 nm from an interface	Analogue 1 Vpp. Digital resolutions from 10 µm to 50 nm direct from the readhead
SDE (typical)	∅ > 135 mm < ±15 nm ∅ ≤ 135 mm < ±20 nm	±30 nm	∅ > 135 mm < ±150 nm ∅ ≤ 135 mm < ±80 nm [1]
Jitter (RMS)	Down to 1.6 nm	Down to 0.5 nm	Down to 2.73 nm
Maximum speed	12 m/s	10 m/s	24 m/s [1]

[1] Digital variants

Readhead features

- Filtering optics and Auto Gain Control for high reliability and solid Lissajous signals.
- Dynamic signal processing ensures ultra-low Sub-Divisional Error (SDE). Result: smoother scanning performance.
- High signal-to-noise ratio provides ultra-low jitter for optimum positional stability.
- Auto-phasing of *IN-TRAC* reference mark.
- Clocked outputs ensure optimised speed performance for all resolutions, for a wide variety of industry-standard controllers.
- DOP Dual output interfaces available to provide simultaneous analogue and digital outputs (TONiC systems only).

Operating specifications

Material		303/304 stainless steel
Coefficient of thermal expansion (at 20 °C)		15.5 ±0.5 µm/m/°C
Temperature	Storage	–20 °C to +70 °C
	Operating	0 °C to +70 °C

Nominal external diameter (mm)		**52**	**57**	**75**	**94**	**100**	**103**	**104**
Nominal internal diameter (mm)		30 [1]	37	55	75	80	80	80
Line count	RESM20 (20 µm)	8 192	9 000	11 840	14 800	15 744	16 200	16 384
	RESM40 (40 µm)	4 096	4 500	5 920	7 400	7 872	8 100	8 192
Mass (kg)	'A' section	0.098	0.1	0.15	0.18	0.2	0.24	0.26
	'B' section	0.043	0.049	0.068	-	0.094	-	-
Moment of inertia (kg mm²)	'A' section	46	61	161	338	425	519	561
	'B' section	22	31	79	-	202	-	-

Nominal external diameter (mm)		**115**	**124**	**150**	**165**	**172**	**183**	**200**
Nominal internal diameter (mm)		95	104	130	145	152	163	180
Line count	RESM20 (20 µm)	18 000	19 478	23 600	25 920	27 000	28 800	31 488
	RESM40 (40 µm)	9 000	9 740	11 800	12 960	13 500	14 400	15 744
Mass (kg)	'A' section	0.23	0.26	0.32	-	0.36	0.40	0.43
	'B' section	0.1	-	0.15	0.16	-	-	0.2
Moment of inertia (kg mm²)	'A' section	644	849	1 581	-	2 400	3 006	3 928
	'B' section	296	-	740	970	-	-	1 822

Nominal external diameter (mm)		**206**	**209**	**229**	**255**	**300**	**350**	**413**
Nominal internal diameter (mm)		186	186	209	235	280	330	392
Line count	RESM20 (20 µm)	32 400	32 768	36 000	40 000	47 200	55 040	64 800
	RESM40 (40 µm)	16 200	16 384	18 000	20 000	23 600	27 520	32 400
Mass (kg)	'A' section	0.44	0.5	0.5	0.54	0.66	0.78	0.93
	'B' section	-	-	-	-	-	-	-
Moment of inertia (kg mm²)	'A' section	4 315	4 960	6 000	8 112	13 962	22 606	37 945
	'B' section	-	-	-	-	-	-	-

Nominal external diameter (mm)		**417**	**489**	**550**
Nominal internal diameter (mm)		380	451	510
Line count	RESM20 (20 µm)	65 536	76 800	86 400
	RESM40 (40 µm)	32 768	38 400	43 200
Mass (kg)	'A' section	1.76	2.13	2.53
	'B' section	-	-	-
Moment of inertia (kg mm²)	'A' section	70 386	118 244	178 598
	'B' section	-	-	-

[1] 32 mm for 'B' section ring.

Accuracy

Nominal external diameter	Typical installed accuracy [2]					
	'A' section [1]		'B' section		'A' section - dual head	
mm	arc second	µm	arc second	µm	arc second	µm
52	±12.7	±1.6	±21.1	±2.7	±3.4	±0.4
57	±11.8	±1.6	±19.5	±2.7	±3.2	±0.4
75	±9.5	±1.7	±14.9	±2.7	±2.6	±0.5
94	±7.9	±1.8	-	-	±2.25	±0.5
100	±7.5	±1.8	±11.3	±2.7	±2.2	±0.5
103	±7.4	±1.8	-	-	±2.1	±0.5
104	±7.3	±1.8	-	-	±2.1	±0.5
115	±6.8	±1.9	±9.9	±2.8	±2	±0.5
124	±6.3	±1.9	-	-	±1.8	±0.5
150	±5.5	±2.0	±7.7	±2.8	±1.6	±0.6
165	-	-	±7.0	±2.8	-	-
172	±5.0	±2.1	-	-	±1.45	±0.6
183	±4.7	±2.1	-	-	±1.35	±0.6
200	±4.3	±2.1	±5.8	±2.8	±1.3	±0.6
206	±4.2	±2.1	-	-	±1.3	±0.6
209	±4.2	±2.1	-	-	±1.3	±0.6
229	±3.9	±2.2	-	-	±1.2	±0.7
255	±3.6	±2.2	-	-	±1.1	±0.7
300	±3.1	±2.3	-	-	±1	±0.7
350	±2.8	±2.4	-	-	±0.9	±0.8
413	±2.4	±2.4	-	-	±0.8	±0.8
417	±2.4	±2.4	-	-	±0.8	±0.8
489	±2.1	±2.5	-	-	±0.7	±0.8
550	±1.9	±2.6	-	-	±0.6	±0.9

[1] Taper mounted installations recommend an installation of ±3 µm at the bolt hole locations; adjustments are not possible for bore mounted systems.

[2] 'Typical' installations are a result of graduation and installation errors combining and, to some magnitude, cancelling.

All rings supplied are tested to ensure a minimum installed accuracy grade. The manufactured installed accuracy limit is dependent on the ring type:

- A section rings : ±5 µm (±7.5 µm for Ø413 mm ring)
- B section rings : ±8 µm

$$\text{Minimum installed accuracy in arc seconds} = \frac{\text{Minimum installed accuracy (µm)}}{\text{Ring diameter (mm)}} \times 412.5$$

Refer to Appendix for system accuracy figures.

Maximum speed (rev/min)

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

VIONiC system: For 50 MHz clocked option

Nominal external diameter (mm)	Line count	Output resolution												
		5 µm	1 µm	0.5 µm	0.2 µm	0.1 µm	50 nm	40 nm	25 nm	20 nm	10 nm	5 nm	2.5 nm
52	**8 192**	4 407	4 407	4 407	2 663	1 332	666	533	333	266	133	66	33
57	**9 000**	4 021	4 021	4 021	2 429	1 215	607	486	304	243	122	61	30
75	**11 840**	3 056	3 056	3 056	1 846	923	462	369	231	185	92	46	23
94	**14 800**	2 438	2 438	2 438	1 473	738	368	295	184	147	74	37	18
100	**15 744**	2 292	2 292	2 292	1 385	693	346	277	173	138	69	35	17
103	**16 200**	2 225	2 225	2 225	1 344	672	336	269	168	134	67	34	17
104	**16 384**	2 204	2 204	2 204	1 331	666	333	266	166	133	67	33	17
115	**18 000**	1 993	1 993	1 993	1 204	602	301	241	150	120	60	30	15
124	**19 478**	1 848	1 848	1 848	1 117	559	279	223	140	112	56	28	14
150	**23 600**	1 528	1 528	1 528	923	462	231	185	115	92	46	23	12
165	**25 920**	1 389	1 389	1 389	839	420	210	168	105	84	42	21	11
172	**27 000**	1 332	1 332	1 332	805	403	201	161	101	81	40	20	10
183	**28 800**	1,252	1,252	1,252	757	379	189	151	95	76	38	19	9
200	**31 488**	1 146	1 146	1 146	692	346	173	138	87	69	35	17	8.7
206	**32 400**	1 113	1 113	1 113	672	336	168	134	84	67	34	17	8.4
209	**32 768**	1 097	1 097	1 097	663	331	166	133	83	66	33	17	8.3
229	**36 000**	1 001	1 001	1 001	605	302	151	121	76	60	30	15	7.6
255	**40 000**	899	899	899	543	272	136	109	68	54	27	14	6.8
300	**47 200**	764	764	764	462	231	115	92	58	46	23	12	5.8
350	**55 040**	655	655	655	396	198	99	79	49	40	20	10	5.0
413	**64 800**	555	555	555	335	168	84	67	42	34	17	8.4	4.2
417	**65 536**	550	550	550	332	166	83	66	41	33	17	8.3	4.2
489	**76 800**	469	469	469	283	142	71	57	35	28	14	7.1	3.6
550	**86 400**	417	417	417	252	126	63	50	31	25	13	6.3	3.2

Maximum speed (rev/min)

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

TONiC system: For 50 MHz clocked option

Nominal external diameter (mm)	Line count	Digital output resolution											Analogue output
		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	Ti0000
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	8.1	2 546
94	14 800	2 032	2 032	2 032	1 317	658	330	132	66	33	13	7	2 032
100	15 744	1 910	1 910	1 910	1 238	619	310	124	62	31	12	6.1	1 910
103	16 200	1 854	1 854	1 854	1 202	601	301	120	60	30	12	5.9	1 854
104	16 384	1 836	1 836	1 836	1 190	595	298	119	59	30	12	5.9	1 836
115	18 000	1 661	1 661	1 661	1 076	538	270	108	54	27	11	5.3	1 661
124	19 478	1 540	1 540	1 540	998	499	250	100	50	25	10	5	1 540
150	23 600	1 273	1 273	1 273	825	413	207	83	41	21	8.3	4.1	1 273
165	25 920	1 157	1 157	1 157	750	375	188	75	38	19	8	4	1 157
172	27 000	1 110	1 110	1 110	720	360	180	72	36	18	7	4	1 110
183	28 800	1 044	1 044	1 044	676	338	170	68	34	17	7	3	1 044
200	31 488	955	955	955	619	309	155	62	31	15	6.2	3.1	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	5.9	2.9	914
229	36 000	834	834	834	540	270	136	54	27	14	5.4	2.7	834
255	40 000	749	749	749	485	243	122	49	24	12	4.9	2.4	749
300	47 200	637	637	637	413	206	103	41	21	10	4.1	2.0	637
350	55 040	546	546	546	354	177	89	35	18	8.8	3.5	1.7	546
413	64 800	462	462	462	300	150	75	30	15	7.5	3.0	1.5	462
417	65 536	458	458	458	297	148	74	30	15	7.4	3.0	1.5	458
489	76 800	391	391	391	253	127	63	25	13	6.3	2.5	1.2	391
550	86 400	347	347	347	225	113	56	23	11	5.6	2.3	1.1	347

Maximum speed (rev/min)

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

QUANTiC system: For 50 MHz clocked option

Nominal external diameter (mm)	Line count	Digital output resolution							Analogue output
		10 µm	5 µm	1 µm	0.5 µm	0.2 µm	0.1 µm	50 nm	1 Vpp
52	4 096	8 815	8 815	8 815	6 659	2 663	1 332	666	7 346
57	4 500	8 042	8 042	8 042	6 075	2 429	1 215	607	6 701
75	5 920	6 112	6 112	6 112	4 617	1 846	923	462	5 093
94	7 400	4 876	4 876	4 876	3 684	1 473	737	368	4 064
100	7 872	4 584	4 584	4 584	3 463	1 385	693	346	3 820
103	8 100	4 450	4 450	4 450	3 362	1 344	672	336	3 708
104	8 192	4 407	4 407	4 407	3 329	1 331	666	333	3 673
115	9 000	3 986	3 986	3 986	3 011	1 204	602	301	3 321
124	9 740	3 697	3 697	3 697	2 792	1 117	558	279	3080
150	11 800	3 056	3 056	3 056	2 308	923	462	231	2 546
165	12 960	2 778	2 778	2 778	2 099	839	420	210	2 315
172	13 500	2 665	2 665	2 665	2 013	805	403	201	2 221
183	14 400	2 505	2 505	2 505	1 892	757	378	189	2 087
200	15 744	2 292	2 292	2 292	1 731	692	346	173	1 910
206	16 200	2 225	2 225	2 225	1 681	672	336	168	1 854
209	16 384	2 193	2 193	2 193	1 657	663	331	166	1 828
229	18 000	2 002	2 002	2 002	1 512	605	302	151	1 668
255	20 000	1 798	1 798	1 798	1 358	543	272	136	1 498
300	23 600	1 528	1 528	1 528	1 154	462	231	115	1 273
350	27 520	1 310	1 310	1 310	989	396	198	99	1 091
413	32 400	1 110	1 110	1 110	838	335	168	84	925
417	32 768	1 099	1 099	1 099	830	332	166	83	916
489	38 400	937	937	937	708	283	142	71	781
550	43 200	833	833	833	630	252	126	63	694

Resolution

VIONiC with RESM20

The RESM20 offers a range of standard ring diameters, as well as sizes that offer line counts that provide 2^n counts per revolution or resolutions that are precise sub-divisions of degrees or arc seconds.

NOTE: 1 arc second resolution = 1.296×10^6 counts per revolution ≈ 2.778×10^{-4} degree resolution.

	Nominal external diameter (line count)	VIONiC digital resolution (interpolation factor)										
		5 µm (×4)	1 µm (×20)	0.5 µm (×40)	0.2 µm (×100)	0.1 µm (×200)	50 nm (×400)	40 nm (×500)	25 nm (×800)	20 nm (×1 000)	10 nm (×2 000)	5 nm (×4 000)	2.5 nm (×8 000)
Standard outside diameters	75 mm (11 840)	≈ 27.4"	≈ 5.47"	≈ 2.74"	≈ 1.1"	≈ 0.55"	≈ 0.27"	≈ 0.22"	≈ 0.14"	≈ 0.11"	≈ 0.055"	≈ 0.028"	≈ 0.014"
	94 mm (14 800)	≈ 21.9"	≈ 4.4"	≈ 2.2"	≈ 0.9"	≈ 0.44"	≈ 0.22"	≈ 0.18"	≈ 0.11"	≈ 0.09"	≈ 0.044"	≈ 0.022"	≈ 0.011"
	100 mm (15 744)	≈ 20.6"	≈ 4.12"	≈ 2.06"	≈ 0.82"	≈ 0.41"	≈ 0.21"	≈ 0.16"	≈ 0.010"	≈ 0.082"	≈ 0.041"	≈ 0.021"	≈ 0.010"
	124 mm (19 478)	≈ 16.6"	≈ 3.3"	≈ 1.7"	≈ 0.7"	≈ 0.33"	≈ 0.17"	≈ 0.13"	≈ 0.08"	≈ 0.07"	≈ 0.033"	≈ 0.017"	≈ 0.008"
	150 mm (23 600)	≈ 13.7"	≈ 2.75"	≈ 1.37"	≈ 0.55"	≈ 0.27"	≈ 0.14"	≈ 0.11"	≈ 0.07"	≈ 0.055"	≈ 0.028"	≈ 0.014"	≈ 0.007"
	172 mm (27 000)	≈ 12.0"	≈ 2.4"	≈ 1.2"	≈ 0.5"	≈ 0.24"	≈ 0.12"	≈ 0.10"	≈ 0.06"	≈ 0.05"	≈ 0.024"	≈ 0.012"	≈ 0.006"
	200 mm (31 488)	≈ 10.3"	≈ 2.06"	≈ 1.03"	≈ 0.41"	≈ 0.21"	≈ 0.1"	≈ 0.08"	≈ 0.05"	≈ 0.041"	≈ 0.021"	≈ 0.010"	≈ 0.005"
	255 mm [1] (40 000)	≈ 8.1"	≈ 1.62"	≈ 0.81"	≈ 0.32"	≈ 0.16"	≈ 0.081"	≈ 0.06"	≈ 0.04"	≈ 0.032"	≈ 0.016"	≈ 0.0081"	≈ 0.004"
	300 mm (47 200)	≈ 6.9"	≈ 1.37"	≈ 0.69"	≈ 0.27"	≈ 0.14"	≈ 0.069"	≈ 0.05"	≈ 0.03"	≈ 0.027"	≈ 0.014"	≈ 0.0069"	≈ 0.003"
	350 mm (55 040)	≈ 5.9"	≈ 1.18"	≈ 0.59"	≈ 0.24"	≈ 0.12"	≈ 0.059"	≈ 0.05"	≈ 0.03"	≈ 0.024"	≈ 0.012"	≈ 0.0059"	≈ 0.003"
	489 mm (76 800)	≈ 4.22"	≈ 0.84"	≈ 0.42"	≈ 0.17"	≈ 0.084"	≈ 0.042"	≈ 0.03"	≈ 0.02"	≈ 0.017"	≈ 0.0084"	≈ 0.0042"	≈ 0.002"
	550 mm (86 400)	≈ 3.75"	≈ 0.75"	≈ 0.38"	≈ 0.15"	≈ 0.075"	≈ 0.38"	≈ 0.03"	≈ 0.02"	≈ 0.015"	≈ 0.075"	≈ 0.038"	≈ 0.002"
2^n line count	52 mm (8 192)	≈ 39.6"	≈ 7.9"	≈ 3.96"	≈ 1.58"	≈ 0.79"	≈ 0.4"	≈ 0.32"	≈ 0.20"	≈ 0.16"	≈ 0.079"	≈ 0.040"	≈ 0.020"
	104 mm (16 384)	≈ 19.8"	≈ 3.96"	≈ 1.98"	≈ 0.79"	≈ 0.4"	≈ 0.2"	≈ 0.16"	≈ 0.010"	≈ 0.08"	≈ 0.040"	≈ 0.020"	≈ 0.010"
	209 mm (32 768)	≈ 9.89"	≈ 1.98"	≈ 0.99"	≈ 0.4"	≈ 0.2"	≈ 0.1"	≈ 0.8"	≈ 0.05"	≈ 0.04"	≈ 0.02"	≈ 0.0099"	≈ 0.005"
	417 mm (65 536)	≈ 4.9"	≈ 0.99"	≈ 0.49"	≈ 0.2"	≈ 0.1"	≈ 0.05"	≈ 0.04"	≈ 0.02"	≈ 0.02"	≈ 0.0099"	≈ 0.0049"	≈ 0.002"
Subdivisions of degrees	57 mm (9 000)	0.01°	0.002°	0.001°	0.0004°	0.0002°	0.0001°	0.00008°	0.00005°	0.00004°	0.00002°	0.00001°	0.000005°
	115 mm (18 000)	0.005°	0.001°	0.0005°	0.0002°	0.0001°	0.00005°	0.00004°	0.00003°	0.00002°	0.00001°	0.000005°	0.000003°
	229 mm (36 000)	0.0025°	0.0005°	0.00025°	0.0001°	0.00005°	0.000025°	0.00002°	0.00001°	0.00001°	0.000005°	0.0000025°	0.000001°
Subdivisions of arc second	103 mm (16 200)	20"	4"	2"	0.8"	0.4"	0.2"	0.16"	0.10"	0.08"	0.040"	0.020"	0.010"
	165 mm (25 920)	12.50"	2.5"	1.25"	0.5"	0.25"	0.125"	0.1"	0.0625"	0.05"	0.025"	0.0125"	0.00625"
	183 mm (28 800)	11.25"	2.25"	1.125"	0.45"	0.225"	0.1125"	0.09"	0.05625"	0.045"	0.0225"	0.01125"	0.005625"
	206 mm (32 400)	10"	2"	1"	0.4"	0.2"	0.1"	0.08"	0.05"	0.04"	0.020"	0.010"	0.0050"
	413 mm (64 800)	5"	1"	0.5"	0.2"	0.1"	0.05"	0.04"	0.03"	0.02"	0.010"	0.0050"	0.003"

[1] Line count as a multiple of 1 000.

NOTES:

- The symbol " indicates units of arc seconds.
- Numbers preceded with a ≈ symbol show rounded resolution values. To calculate the exact resolution in arc seconds, use the following equation:

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

Resolution

TONiC with RESM20

The RESM20 offers a range of standard ring diameters, as well as sizes that offer line counts that provide 2^n counts per revolution or resolutions that are precise sub-divisions of degrees or arc seconds.

NOTE: 1 arc second resolution = 1.296×10^6 counts per revolution ≈ 2.778×10^{-4} degree resolution.

	Nominal external diameter (line count)	TONiC digital resolution (interpolation factor)										
		5 µm (×4)	1 µm (×20)	0.5 µm (×40)	0.2 µm (×100)	0.1 µm (×200)	50 nm (×400)	20 nm (×1 000)	10 nm (×2 000)	5 nm (×4 000)	2 nm (×10 000)	1 nm (×20 000)
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"
	94 mm (14 800)	≈ 21.9"	≈ 4.38"	≈ 2.19"	≈ 0.88"	≈ 0.44"	≈ 0.22"	≈ 0.09"	≈ 0.044"	≈ 0.022"	≈ 0.009"	≈ 0.0044"
	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"
	124 mm (19 478)	≈ 16.6"	≈ 3.33"	≈ 1.66"	≈ 0.67"	≈ 0.33"	≈ 0.17"	≈ 0.07"	≈ 0.033"	≈ 0.017"	≈ 0.007"	≈ 0.0033"
	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"
	172 mm (27 000)	≈ 12.0"	≈ 2.40"	≈ 1.2"	≈ 0.48"	≈ 0.24"	≈ 0.12"	≈ 0.05"	≈ 0.024"	≈ 0.012"	≈ 0.005"	≈ 0.0024"
	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 [1] (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"	≈ 0.075"	≈ 0.038"	≈ 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"
	165 mm (25 920)	12.5"	2.5"	1.25"	0.5"	0.25"	0.125"	0.05"	0.025"	0.0125"	0.005"	0.0025"
	183 mm (28 800)	11.25"	2.25"	1.125"	0.45"	0.225"	0.1125"	0.05"	0.0225"	0.01125"	0.005"	0.00225"
	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"

[1] Line count as a multiple of 1 000.

NOTES:

- The symbol " indicates units of arc seconds.
- Numbers preceded with a ≈ symbol show rounded resolution values. To calculate the exact resolution in arc seconds, use the following equation:

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

Resolution

QUANTiC with RESM40

The RESM40 offers a range of standard ring diameters, as well as sizes that offer line counts that provide 2^n counts per revolution or resolutions that are precise sub-divisions of degrees or arc seconds.

NOTE: 1 arc second resolution = 1.296×10^6 counts per revolution ≈ 2.778×10^{-4} degree resolution.

	Nominal external diameter (line count)	QUANTiC digital resolution (interpolation factor)						
		10 µm (×4)	5 µm (×8)	1 µm (×40)	0.5 µm (×80)	0.2 µm (×200)	0.1 µm (×400)	50 nm (×800)
Standard outside diameters	75 mm (5 920)	≈ 54.73"	≈ 27.36"	≈ 5.47"	≈ 2.74"	≈ 1.09"	≈ 0.55"	≈ 0.27"
	94 mm (7 400)	≈ 43.8"	≈ 21.9"	≈ 4.4"	≈ 2.2"	≈ 0.876"	≈ 0.438"	≈ 0.219"
	100 mm (7 872)	≈ 41.16"	≈ 20.58"	≈ 4.12"	≈ 2.06"	≈ 0.82"	≈ 0.41"	≈ 0.21"
	124 mm (9 740)	≈ 33.3"	≈ 16.6"	≈ 3.3"	≈ 1.7"	≈ 0.665"	≈ 0.333"	≈ 0.166"
	150 mm (11 800)	≈ 27.46"	≈ 13.73"	≈ 2.75"	≈ 1.37"	≈ 0.55"	≈ 0.27"	≈ 0.14"
	172 mm (13 500)	≈ 24.0"	≈ 12.0"	≈ 2.4"	≈ 1.2"	≈ 0.48"	≈ 0.24"	≈ 0.12"
	200 mm (15 744)	≈ 20.58"	≈ 10.29"	≈ 2.06"	≈ 1.03"	≈ 0.41"	≈ 0.21"	≈ 0.10"
	255 mm [1] (20 000)	≈ 16.20"	≈ 8.10"	≈ 1.62"	≈ 0.81"	≈ 0.32"	≈ 0.16"	≈ 0.08"
	300 mm (23 600)	≈ 13.73"	≈ 6.86"	≈ 1.37"	≈ 0.69"	≈ 0.27"	≈ 0.14"	≈ 0.07"
	350 mm (27 520)	≈ 11.77"	≈ 5.89"	≈ 1.18"	≈ 0.59"	≈ 0.24"	≈ 0.12"	≈ 0.06"
	489 mm (38 400)	≈ 8.44"	≈ 4.22"	≈ 0.84"	≈ 0.42"	≈ 0.17"	≈ 0.08"	≈ 0.04"
	550 mm (43 200)	≈ 7.50"	≈ 3.75"	≈ 0.75"	≈ 0.38"	≈ 0.15"	≈ 0.08"	≈ 0.04"
2^n line count	52 mm (4 096)	≈ 79.10"	≈ 39.55"	≈ 7.91"	≈ 3.96"	≈ 1.58"	≈ 0.79"	≈ 0.40"
	104 mm (8 192)	≈ 39.55"	≈ 19.78"	≈ 3.96"	≈ 1.98"	≈ 0.79"	≈ 0.40"	≈ 0.20"
	209 mm (16 384)	≈ 19.78"	≈ 9.89"	≈ 1.98"	≈ 0.99"	≈ 0.40"	≈ 0.20"	≈ 0.10"
	417 mm (32 768)	≈ 9.89"	≈ 4.94"	≈ 0.99"	≈ 0.49"	≈ 0.20"	≈ 0.10"	≈ 0.05"
Subdivisions of degrees	57 mm (4 500)	0.02°	0.01°	0.002°	0.001°	0.0004°	0.0002°	0.0001°
	115 mm (9 000)	0.01°	0.005°	0.001°	0.0005°	0.0002°	0.0001°	0.00005°
	229 mm (18 000)	0.005°	0.0025°	0.0005°	0.00025°	0.0001°	0.00005°	0.000025°
Subdivisions of arc second	103 mm (8 100)	40"	20"	4"	2"	0.8"	0.4"	0.2"
	165 mm (12 960)	25"	12.5"	2.5"	1.25"	0.5"	0.25"	0.125"
	183 mm (14 400)	22.5"	11.25"	2.25"	1.125"	0.45"	0.225"	0.1125"
	206 mm (16 200)	20"	10"	2"	1"	0.4"	0.2"	0.1"
	413 mm (32 400)	10"	5"	1"	0.5"	0.2"	0.1"	0.05"

[1] Line count as a multiple of 1 000.

NOTES:

- The symbol " indicates units of arc seconds.
- Numbers preceded with a ≈ symbol show rounded resolution values. To calculate the exact resolution in arc seconds, use the following equation:

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

Rotary scale part numbers

RESM 20U S A 300

Ring diameter

052 = 52 mm	115 = 115 mm	206 = 206 mm	417 = 417 mm
057 = 57 mm	124 = 124 mm	209 = 209 mm	489 = 489 mm
075 = 75 mm	150 = 150 mm	229 = 229 mm	550 = 550 mm
094 = 94 mm	165 = 165 mm	255 = 255 mm	
100 = 100 mm	172 = 172 mm	300 = 300 mm	
103 = 103 mm	183 = 183 mm	350 = 350 mm	
104 = 104 mm	200 = 200 mm	413 = 413 mm	

Form

A = Tapered internal diameter

B = Low inertia (only available in 52 mm, 57 mm, 75 mm, 100 mm, 115 mm, 150 mm, 165 mm and 200 mm diameters)

Material

S = Stainless steel

Pitch

20U = 20 µm

40U = 40 µm (RESM rotary scale series only)

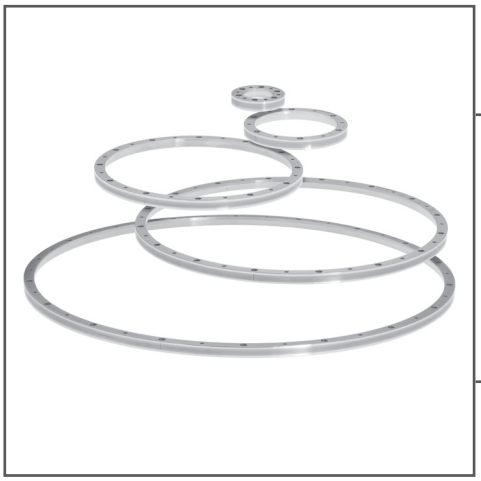
Rotary scale series

RESM = Single reference mark for axes capable of full rotation

REST = Two reference marks for partial-rotation axes (20 µm pitch only)

Compatible products

RESM



RESM20



VIONiC



TONiC

RESM40



QUANTiC

Appendix

Graduation and system accuracy

Nominal external diameter	Graduation accuracy		System accuracy		
			VIONiC	TONiC	QUANTiC
mm	arc second	µm	arc second	arc second	arc second
52	±2.3	±0.3	±2.4	±2.5	±2.9
57	±2.2	±0.3	±2.3	±2.4	±2.8
75	±1.9	±0.4	±2.0	±2.1	±2.4
94	±1.7	±0.4	±1.8	±1.9	±2.1
100	±1.7	±0.4	±1.7	±1.8	±2.0
103	±1.6	±0.4	±1.7	±1.8	±2.0
104	±1.6	±0.4	±1.7	±1.8	±1.9
115	±1.6	±0.4	±1.6	±1.7	±1.8
124	±1.6	±0.4	±1.7	±1.7	±1.9
150	±1.4	±0.5	±1.4	±1.4	±1.6
165	±1.3	±0.5	±1.4	±1.4	±1.5
172	±1.3	±0.5	±1.3	±1.4	±1.5
183	±1.3	±0.5	±1.3	±1.3	±1.4
200	±1.2	±0.6	±1.2	±1.2	±1.3
206	±1.2	±0.6	±1.2	±1.2	±1.3
209	±1.2	±0.6	±1.2	±1.2	±1.3
229	±1.1	±0.6	±1.1	±1.2	±1.2
255	±1.0	±0.7	±1.1	±1.1	±1.2
300	±1.0	±0.7	±1.0	±1.0	±1.1
350	±0.9	±0.8	±0.9	±0.9	±1.0
413	±0.8	±0.8	±0.8	±0.9	±0.9
417	±0.8	±0.8	±0.8	±0.8	±0.9
489	±0.8	±0.9	±0.8	±0.8	±0.8
550	±0.7	±1.0	±0.7	±0.7	±0.8

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. For application advice, contact your local Renishaw representative.

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