

# RESR angle encoder system



## The RESR is a one-piece stainless steel ring with graduations marked directly onto the periphery.

The RESR offers impressive accuracy with resolution to 0.008 arc second, suiting the most demanding precision applications.

Read by Renishaw's filtering optics readheads, including the RGH20, RGH34, RGH35 and RGH40, the system has a high tolerance to dirt, scratches and greasy fingerprints that can cause other encoder systems to miscount.

The low profile RESR, with a large internal diameter, is easy to design into most installations. More importantly, its low mass, low inertia design will not compromise system performance. A repeatable reference mark is available to provide a home (datum) position, while Renishaw's RGH40 readhead with filtering optics offers dual limit sensors.

## System features

- High speed, non-contact, optical performance
- Graduation accuracy to  $\pm 0.5$  arc second
- Angular resolution to 0.008 arc second
- System repeatability to 0.008 arc second
- Wide range of sizes and line counts provide compatibility with industry standard controllers ( $\text{\O}52$  mm to  $\text{\O}550$  mm with line counts from 4,096 to 86,400)
- Patented taper mount simplifies integration and minimises installation errors
- Filtering optics provide excellent dirt immunity
- UHV compatible
- Low magnetic permeability as standard
- Compact size for easy integration
- Low mass and low inertia
- Compatible with RGH20, RGH34, RGH35 or RGH40 readheads to offer industry standard analogue or digital incremental outputs with reference mark option
- Integral set-up LED on all Renishaw encoders for quick set-up and instant "health check" at any time
- Ultra-low inertia versions also available in 75 mm, 100 mm, 150 mm and 200 mm sizes

**Data sheet**  
RESR angle encoder system

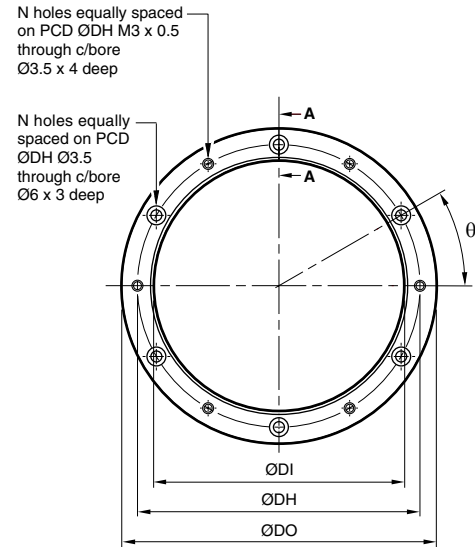
**Installation drawing ('A' section)**

Nominal external diameter (mm)		52	57	75	100	103	104
Line count	20 $\mu\text{m}$ pitch	8,192	9,000	11,840	15,744	16,200	16,384
	40 $\mu\text{m}$ pitch	4,096	4,500	5,920	7,872	8,100	8,192
DO (mm)		52.20 52.10	57.35 57.25	75.40 75.30	100.30 100.20	103.20 103.00	104.40 104.20
DI (mm)		30.04 30.00	37.04 37.00	55.04 55.00	80.04 80.00	80.04 80.00	80.04 80.00
Mounting Holes	DH (mm)	40	47	65	90	90	90
	N	6	6	6	6	6	6
	$\theta$	30°	30°	30°	30°	30°	30°

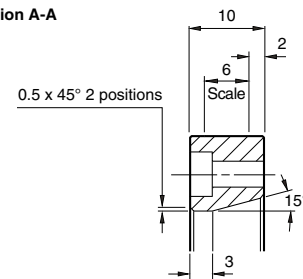
Nominal external diameter (mm)		115	150	200	206	209	229
Line count	20 $\mu\text{m}$ pitch	18,000	23,600	31,488	32,400	32,768	36,000
	40 $\mu\text{m}$ pitch	9,000	11,800	15,744	16,200	16,384	18,000
DO (mm)		114.70 114.50	150.40 150.20	200.40 200.20	206.50 206.10	208.80 208.40	229.40 229.00
DI (mm)		95.04 95.00	130.04 130.00	180.04 180.00	186.05 186.00	186.05 186.00	209.05 209.00
Mounting Holes	DH (mm)	105	140	190	196	196	219
	N	6	9	12	12	12	12
	$\theta$	30°	20°	15°	15°	15°	15°

Nominal external diameter (mm)		255	300	350	413	417	550
Line count	20 $\mu\text{m}$ pitch	40,000	47,200	55,040	64,800	65,536	86,400
	40 $\mu\text{m}$ pitch	20,000	23,600	27,520	32,400	32,768	43,200
DO (mm)		254.80 254.40	300.40 300.20	350.40 350.20	412.70 412.30	417.40 417.00	550.20 549.80
DI (mm)		235.06 235.00	280.06 280.00	330.06 330.00	392.08 392.00	380.10 380.00	510.10 510.00
Mounting Holes	DH (mm)	245	290	340	402	390	520
	N	12	16	16	18	18	20
	$\theta$	15°	11.25°	11.25°	10°	10°	9°

**General outline and dimensions** Dimensions and tolerances in mm



**Section A-A**

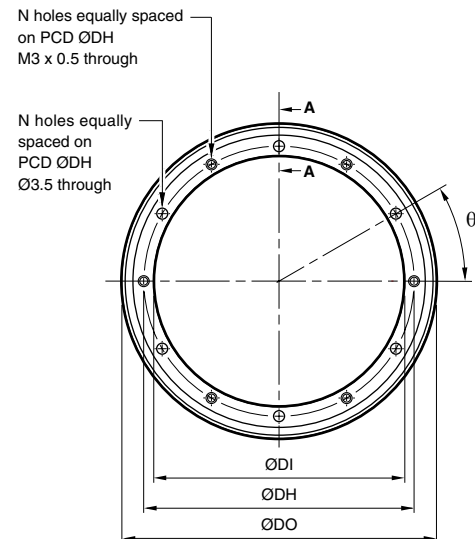
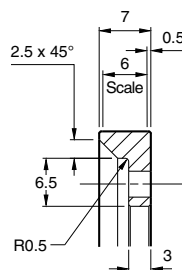


**Note:**  $\theta$  is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 20°.

**Installation drawing ('B' section)**

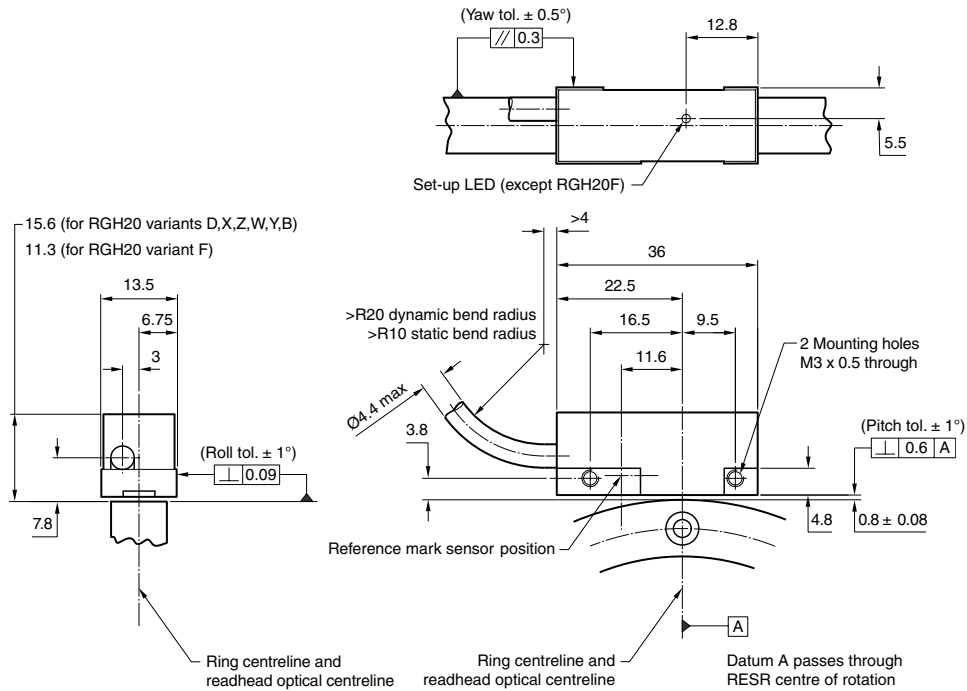
Nominal external diameter (mm)		75	100	150	200
Line count	20 $\mu\text{m}$ pitch	11,840	15,744	23,600	31,488
	40 $\mu\text{m}$ pitch	5,920	7,872	11,800	15,744
DO (mm)		75.40 75.30	100.30 100.20	150.40 150.20	200.40 200.20
DI (mm)		55.04 55.00	80.04 80.00	130.04 130.00	180.04 180.00
Mounting Holes	DH (mm)	61	86	136	186
	N	6	6	9	12
	$\theta$	30°	30°	20°	15°

**Section A-A**



**Note:**  $\theta$  is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 20°.

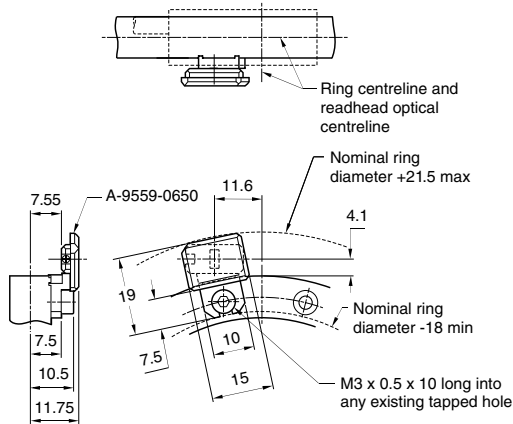
**RGH20 on 'A' section RESR** General outline and dimensions. Dimensions and tolerances in mm  
(Please see RESR Installation guide M-9559-0675 for installation drawings of RGH34, RGH35 and RGH40 mounted on RESR)



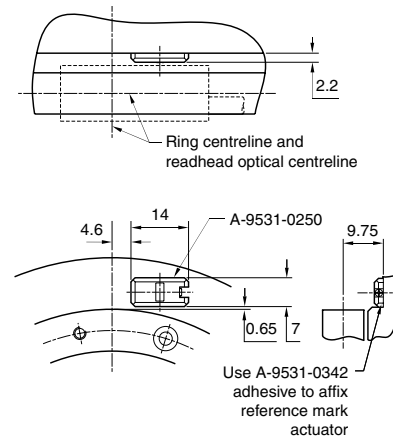
**RGH20 reference mark options**

(Please see RESR Installation guide M-9559-0675 for details of reference mark options for RGH34, RGH35 and RGH40)

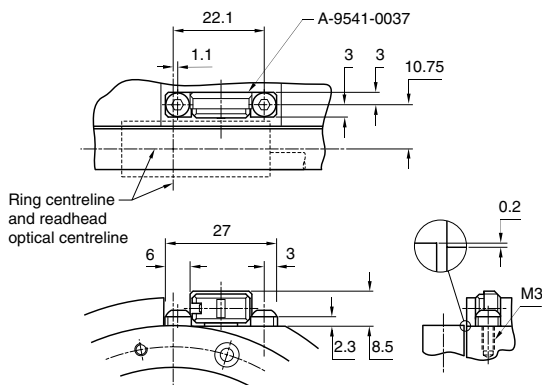
1. Using A-9559-0650



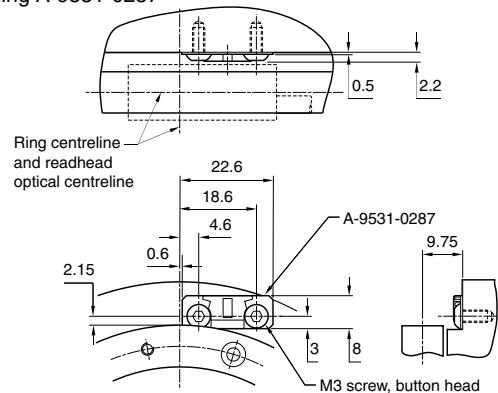
2. Using A-9531-0250



3. Using A-9541-0037



4. Using A-9531-0287





## Maximum speed (rpm)

### For RGH20 readhead reading from 20 µm pitch rings.

For details of maximum speeds for other readhead resolution/ring options, please contact your local representative.

Nominal external diameter	Line count	Digital readhead resolution								Analogue 1 Vpp
		20 µm	5 µm	1 µm	0.5 µm	0.2 µm*	0.1 µm†	50 nm†	20 nm††	
52 mm	8,192	2,938	1,836	1,101	257	257	129	110	55	1,652
57 mm	9,000	2,680	1,675	1,005	235	235	117	101	50	1,507
75 mm	11,840	2,037	1,273	763	178	178	89	76	38	1,146
100 mm	15,744	1,527	954	572	134	134	67	57	29	859
103 mm	16,200	1,483	926	556	130	130	65	56	28	834
104 mm	16,384	1,469	918	550	129	129	64	55	28	826
115 mm	18,000	1,328	830	498	116	116	58	50	25	747
150 mm	23,600	1,018	636	381	89	89	45	38	19	573
200 mm	31,488	763	477	286	67	67	33	29	14	429
206 mm	32,400	741	463	277	65	65	32	28	14	417
209 mm	32,768	731	457	274	64	64	31	27	14	411
229 mm	36,000	667	417	250	58	58	29	25	13	375
255 mm	40,000	599	374	224	52	52	26	22	11	337
300 mm	47,200	509	318	190	45	45	22	19	10	286
350 mm	55,040	436	272	163	38	38	19	16	8.2	245
413 mm	64,800	370	231	138	32	32	16	14	6.9	208
417 mm	65,536	366	229	137	32	32	16	14	6.9	206
550 mm	86,400	278	174	104	24	24	12	10	5.2	156

\*6 MHz version †12 MHz version ††RGH20F with RGF interface

## Maximum speed (rpm)

### For RGH40 readhead reading from 40 µm pitch rings.

For details of maximum speeds for other readhead resolution/ring options, please contact your local representative.

Nominal external diameter	Line count	Digital readhead resolution							Analogue 1 Vpp
		40 µm	10 µm	5 µm	2 µm	1 µm	0.2 µm**	0.1 µm**	
52 mm	4,096	3,687	2,938	2,209	1,472	918	479	221	2,938
57 mm	4,500	3,352	2,680	2,011	1,341	838	436	201	2,680
75 mm	5,920	2,553	2,037	1,532	1,021	637	332	153	2,037
100 mm	7,872	1,911	1,527	1,146	764	477	248	115	1,527
103 mm	8,100	1,858	1,483	1,114	743	464	241	111	1,483
104 mm	8,192	1,840	1,469	1,104	736	460	239	110	1,469
115 mm	9,000	1,662	1,328	997	665	415	216	100	1,328
150 mm	11,800	1,274	1,018	764	510	318	166	76	1,018
200 mm	15,744	955	763	573	382	239	124	57	763
206 mm	16,200	927	741	556	371	232	121	56	741
209 mm	16,384	915	731	549	366	229	119	55	731
229 mm	18,000	834	667	501	334	209	108	50	667
255 mm	20,000	749	599	449	300	187	97	45	599
300 mm	23,600	637	509	382	255	159	83	38	509
350 mm	27,520	546	436	328	218	136	71	33	436
413 mm	32,400	463	370	278	185	116	60	28	370
417 mm	32,768	458	366	275	183	114	59	27	366
550 mm	43,200	347	278	208	139	87	45	20	278

\*\*20 MHz version

## Resolution

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

**Note:** 1 arc second resolution = 1.296 x 10<sup>6</sup> counts per revolution = 2.778 x 10<sup>-4</sup> degree resolution.

### 20 µm pitch RESR

	Nominal external diameter (line count)	RGH20 digital resolution (interpolation factor)							
		5 µm (x 4)	1 µm (x 20)	0.5 µm (x 40)	0.2 µm (x 100)	0.1 µm (x 200)	50 nm (x 400)	20 nm* (x 1000)	10 nm* (x 2000)
Standard outside diameters	75 mm (11,840)	≈ 27.4"	≈ 5.47"	≈ 2.74"	≈ 1.1"	≈ 0.55"	≈ 0.27"	≈ 0.11"	≈ 0.055"
	100 mm (15,744)	≈ 20.6"	≈ 4.12"	≈ 2.06"	≈ 0.82"	≈ 0.41"	≈ 0.21"	≈ 0.082"	≈ 0.041"
	150 mm (23,600)	≈ 13.7"	≈ 2.75"	≈ 1.37"	≈ 0.55"	≈ 0.27"	≈ 0.14"	≈ 0.055"	≈ 0.027"
	200 mm (31,488)	≈ 10.3"	≈ 2.06"	≈ 1.03"	≈ 0.41"	≈ 0.21"	≈ 0.1"	≈ 0.041"	≈ 0.021"
	300 mm (47,200)	≈ 6.9"	≈ 1.37"	≈ 0.69"	≈ 0.27"	≈ 0.14"	≈ 0.069"	≈ 0.027"	≈ 0.014"
	350 mm (55,040)	≈ 5.9"	≈ 1.18"	≈ 0.59"	≈ 0.24"	≈ 0.12"	≈ 0.059"	≈ 0.024"	≈ 0.012"
	550 mm (86,400)	≈ 3.75"	≈ 0.75"	≈ 0.38"	≈ 0.15"	≈ 0.08"	≈ 0.04"	≈ 0.015"	≈ 0.008"
2° line count	52 mm (8,192)	≈ 39.6"	≈ 7.9"	≈ 3.96"	≈ 1.58"	≈ 0.79"	≈ 0.4"	≈ 0.16"	≈ 0.08"
	104 mm (16,384)	≈ 19.8"	≈ 3.96"	≈ 1.98"	≈ 0.79"	≈ 0.4"	≈ 0.2"	≈ 0.08"	≈ 0.04"
	209 mm (32,768)	≈ 9.89"	≈ 1.98"	≈ 0.99"	≈ 0.4"	≈ 0.2"	≈ 0.1"	≈ 0.04"	≈ 0.02"
	417 mm (65,536)	≈ 4.9"	≈ 0.99"	≈ 0.49"	≈ 0.2"	≈ 0.1"	≈ 0.05"	≈ 0.02"	≈ 0.01"
Subdivisions of degrees	57 mm (9,000)	0.01°	0.002°	0.001°	0.0004°	0.0002°	0.0001°	0.00004°	0.00002°
	115 mm (18,000)	0.005°	0.001°	0.0005°	0.0002°	0.0001°	0.00005°	0.00002°	0.00001°
	229 mm (36,000)	0.0025°	0.0005°	0.00025°	0.0001°	0.00005°	0.000025°	0.00001°	0.000005°
Subdivisions of arc second	103 mm (16,200)	20"	4"	2"	0.8"	0.4"	0.2"	0.08"	0.04"
	206 mm (32,400)	10"	2"	1"	0.4"	0.2"	0.1"	0.04"	0.02"
	255 mm <sup>1</sup> (40,000)	8.1"	1.62"	0.81"	0.32"	0.16"	0.081"	0.032"	0.016"
	413 mm (64,800)	5"	1"	0.5"	0.2"	0.1"	0.05"	0.02"	0.01"

\*Resolutions achieved using RGH20F with RGF interface <sup>1</sup>Line count as a multiple of 1000

## 40 µm pitch RESR

	Nominal external diameter (line count)	RGH40 digital resolution (interpolation factor)						
		10 µm (x 4)	5 µm (x 8)	2 µm (x 20)	1 µm (x 40)	0.2 µm (x 200)	0.1 µm (x 400)	50 nm (x 800)
Standard outside diameters	75 mm (5,920)	≈ 54.7"	≈ 27.4"	≈ 11"	≈ 5.47"	≈ 1.1"	≈ 0.55"	≈ 0.27"
	100 mm (7,872)	≈ 41.2"	≈ 20.6"	≈ 8.23"	≈ 4.12"	≈ 0.82"	≈ 0.41"	≈ 0.21"
	150 mm (11,800)	≈ 27.5"	≈ 13.7"	≈ 5.5"	≈ 2.75"	≈ 0.55"	≈ 0.27"	≈ 0.14"
	200 mm (15,744)	≈ 20.6"	≈ 10.3"	≈ 4.12"	≈ 2.06"	≈ 0.41"	≈ 0.21"	≈ 0.1"
	300 mm (23,600)	≈ 13.8"	≈ 6.9"	≈ 2.75"	≈ 1.37"	≈ 0.27"	≈ 0.14"	≈ 0.069"
	350 mm (27,520)	≈ 11.8"	≈ 5.9"	≈ 2.36"	≈ 1.18"	≈ 0.24"	≈ 0.12"	≈ 0.059"
	550 mm (43,200)	≈ 7.5"	≈ 3.75"	≈ 1.5"	≈ 0.75"	≈ 0.15"	≈ 0.08"	≈ 0.04"
2 <sup>nd</sup> line count	52 mm (4,096)	≈ 79.1"	≈ 39.6"	≈ 15.8"	≈ 7.9"	≈ 1.58"	≈ 0.79"	≈ 0.4"
	104 mm (8,192)	≈ 39.6"	≈ 19.8"	≈ 7.91"	≈ 3.96"	≈ 0.79"	≈ 0.4"	≈ 0.2"
	209 mm (16,384)	≈ 19.7"	≈ 9.89"	≈ 3.96"	≈ 1.98"	≈ 0.4"	≈ 0.2"	≈ 0.1"
	417 mm (32,768)	≈ 9.9"	≈ 4.9"	≈ 1.98"	≈ 0.99"	≈ 0.2"	≈ 0.1"	≈ 0.05"
Subdivisions of degrees	57 mm (4,500)	0.02°	0.01°	0.004°	0.002°	0.0004°	0.0002°	0.0001°
	115 mm (9,000)	0.01°	0.005°	0.002°	0.001°	0.0002°	0.0001°	0.00005°
	229 mm (18,000)	0.005°	0.0025°	0.001°	0.0005°	0.0001°	0.00005°	0.000025°
Subdivisions of arc second	103 mm (8,100)	40"	20"	8"	4"	0.8"	0.4"	0.2"
	206 mm (16,200)	20"	10"	4"	2"	0.4"	0.2"	0.1"
	255 mm <sup>†</sup> (20,000)	16.2"	8.1"	3.24"	1.62"	0.32"	0.16"	0.081"
	413 mm (32,400)	10"	5"	2"	1"	0.2"	0.1"	0.05"

<sup>†</sup>Line count as a multiple of 1000

## Accuracy

Nominal external diameter	Graduation error (arc second)	System error (arc second) for 20 µm systems	System error (arc second) for 40 µm systems
52 mm	± 4.0	± 5.6	± 6.3
57 mm	± 3.6	± 5.1	± 5.8
75 mm	± 2.8	± 3.9	± 4.4
100 mm	± 2.1	± 2.9	± 3.3
103 mm	± 2.0	± 2.8	± 3.2
104 mm	± 2.0	± 2.8	± 3.2
115 mm	± 1.8	± 2.5	± 2.9
150 mm	± 1.4	± 1.9	± 2.2
200 mm	± 1.0	± 1.4	± 1.7
206 mm	± 1.0	± 1.4	± 1.6
209 mm	± 1.0	± 1.4	± 1.6
229 mm	± 0.9	± 1.3	± 1.4
255 mm	± 0.8	± 1.1	± 1.3
300 mm	± 0.7	± 1.0	± 1.1
350 mm	± 0.6	± 0.8	± 0.9
413 mm	± 0.5	± 0.7	± 0.8
417 mm	± 0.5	± 0.7	± 0.8
550 mm	± 0.4	± 0.5	± 0.6

Graduation error 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 error is graduation error plus SDE.

Effects such as eccentricity influence installed performance; for application advice please contact your local representative.

For worldwide contact details, please visit our main website at [www.renishaw.com/contact](http://www.renishaw.com/contact)

