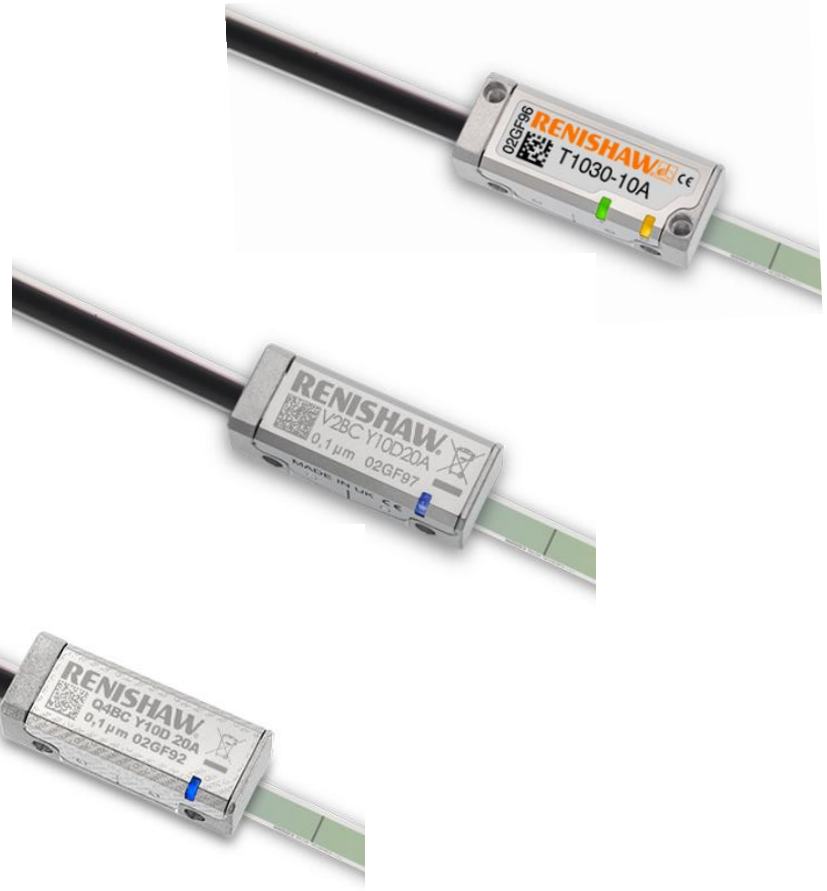
RGH22 to TONiC/VIONiC/QUANTiC

Linear system upgrade path



Benefits when upgrading from RGH22 to TONiC/VIONiC/QUANTiC

- Smaller size than RGH22
- Increased set-up tolerances for easier installation
- TONiC/ADT View diagnostic software:
  - Easier installation optimization
  - Enhanced reliability
- Higher performance:
  - Lower Sub-Divisional Error (SDE)
  - Higher speeds and resolutions
- Superior *IN-TRAC* reference marks:
  - No manual adjustment of reference mark during calibration
- Adaptor brackets available, for easy mechanical upgrade

Note: Only digital outputs are available from VIONiC. RGH22 analogue output systems should therefore be upgraded to TONiC or QUANTiC analogue output systems

RGH22/TONiC/VIONiC/QUANTiC installation

The following six slides contain installation drawings of RGH22 and all upgrade products covered in this document. The scales shown for the upgrade products are the RKLC series, as these are the most compatible with the RGS scale used with the RGH22 readhead, being substrate mastered scales of similar cross-section.

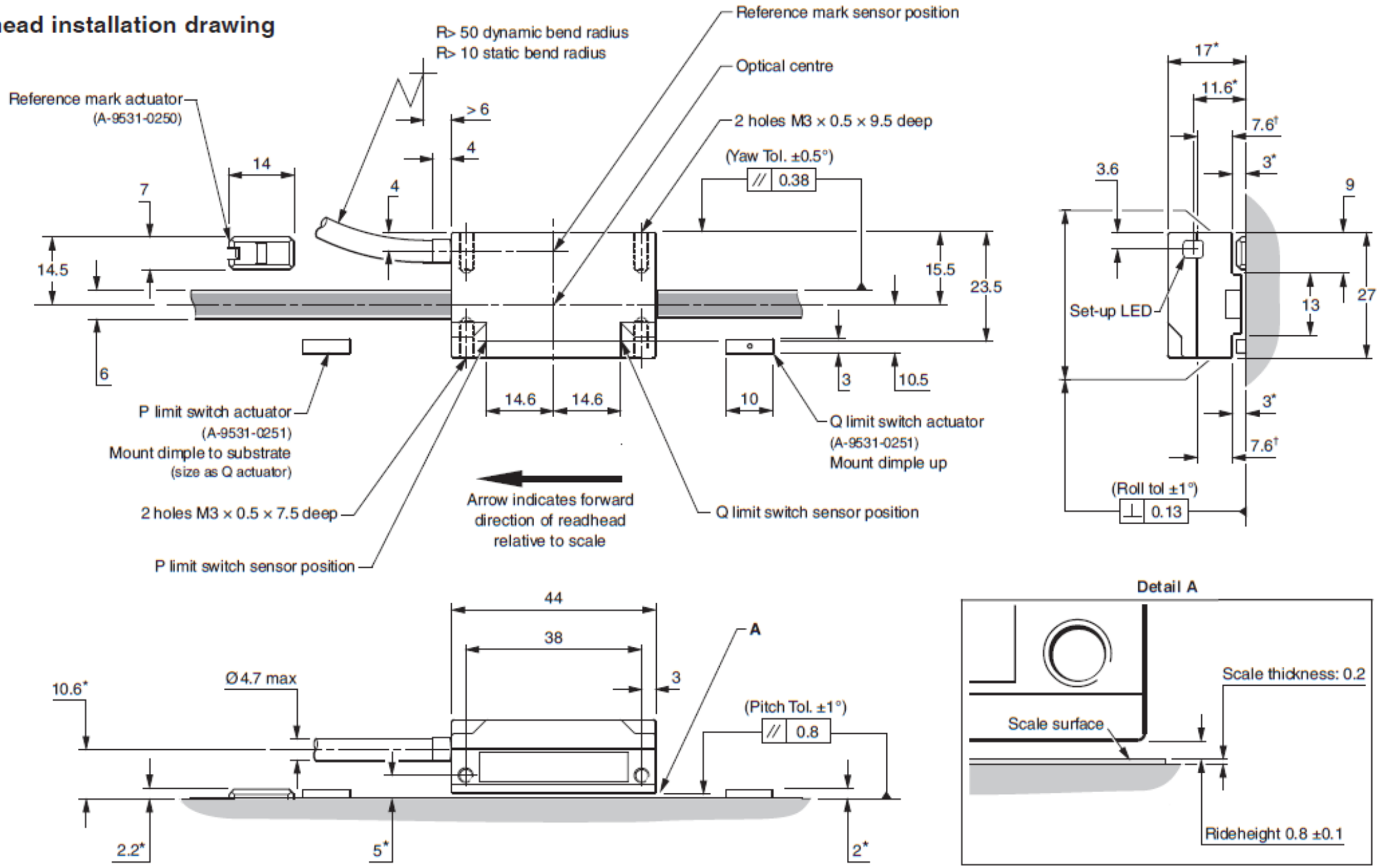
The last two of these slides show installation drawings incorporating the two adaptor brackets available to simplify mechanical upgrade. The selection of bracket depends upon the original RGH22 readhead orientation and positions the upgraded readhead with the same scale, reference mark and optical centerlines. Adaptor bracket mounting holes are the same as the RGH22 readhead, so the customer can continue to use their existing mounting arrangement. Adaptor bracket kits include appropriate screws to fix to the upgraded readhead.

Dimensional differences relating to installation can be seen by studying the installation drawings, with critical differences being highlighted in the two subsequent slides.

Important note: If the customer is currently using existing adaptor brackets B (A-9531-0262), D (A-9531-0267), E (A-9531-0268), F (A-9531-0269), G (A-9531-0270) or J (A-9531-0264), the new adaptor bracket can simply be connected to their existing one. However, this double bracket arrangement might compromise the stiffness of the readhead mounting so it is advisable for the customer to redesign the bracket arrangement to eliminate adaptor brackets altogether.

Note: Further details about installation of the various possible upgrade systems can be found in the relevant installation guides available to download from the Renishaw.com.

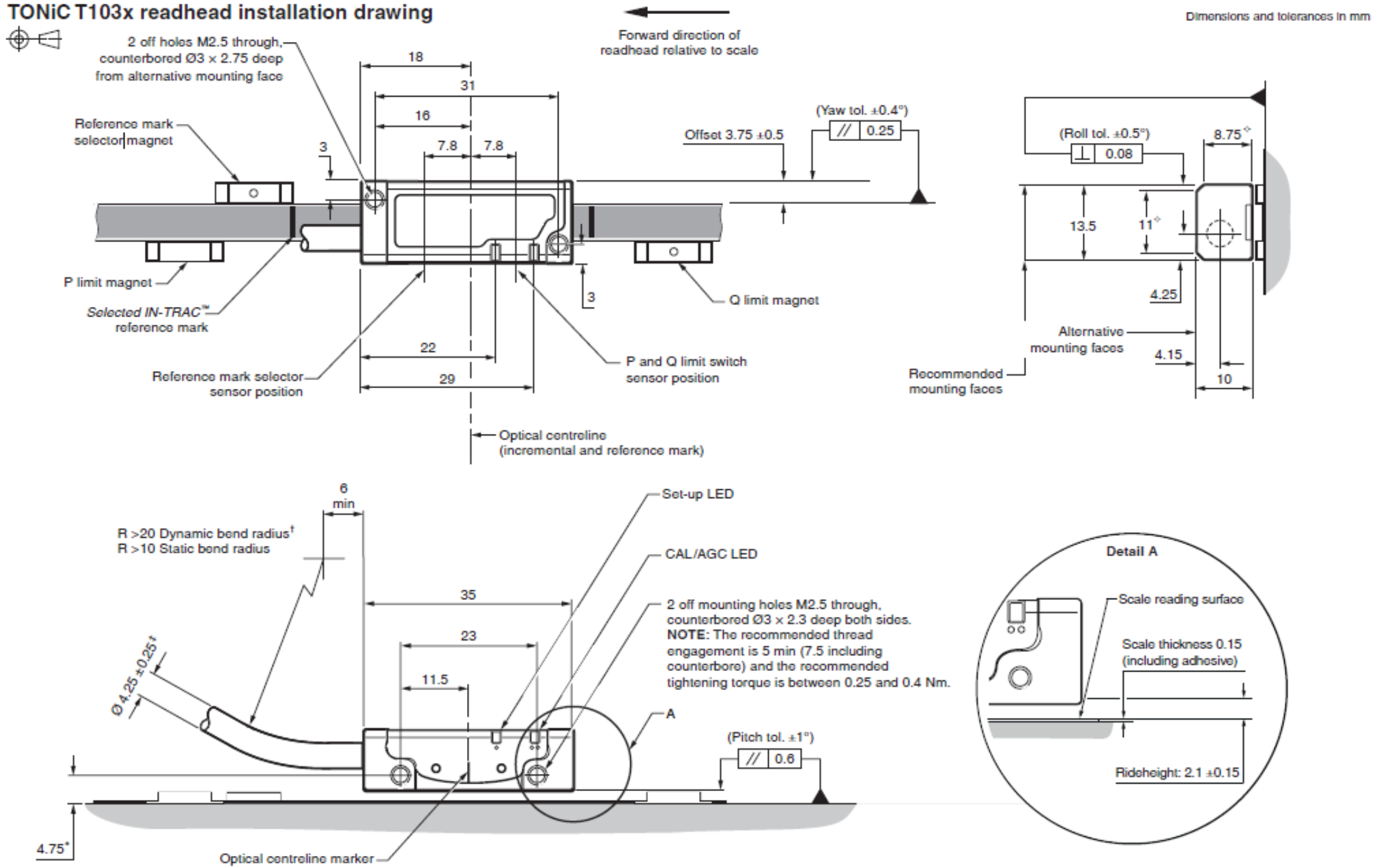
RGH22 readhead installation drawing



*Dimensions measured from substrate. †Alternative mounting faces

TONiC T103x readhead installation drawing

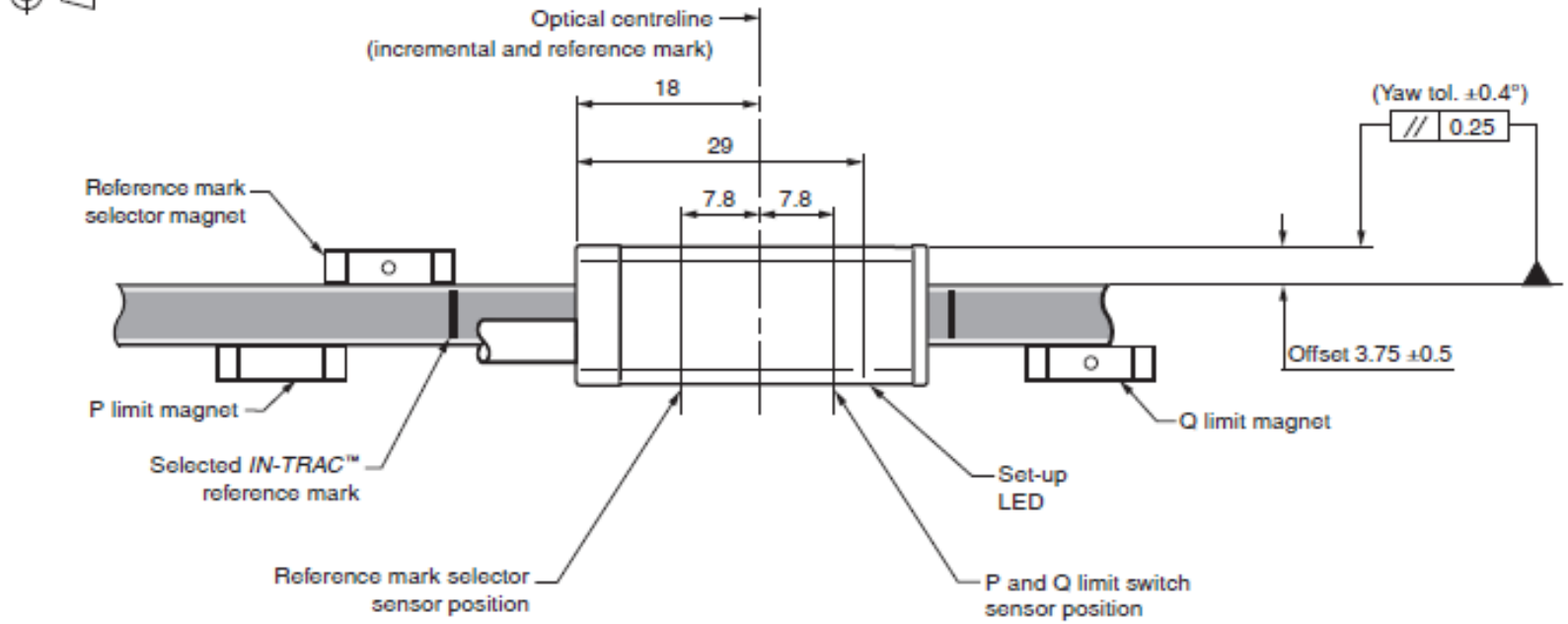
Dimensions and tolerances in mm

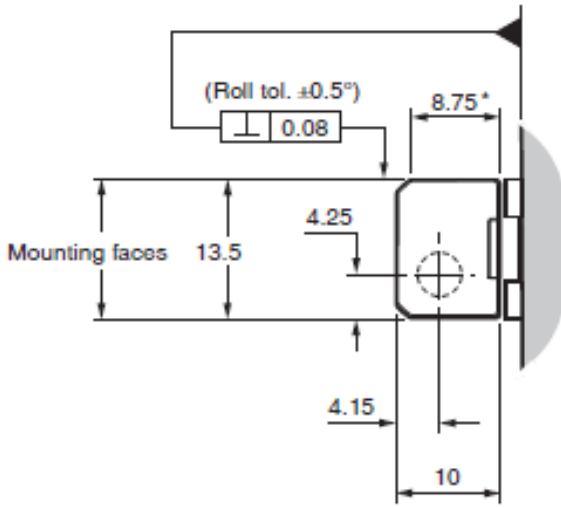


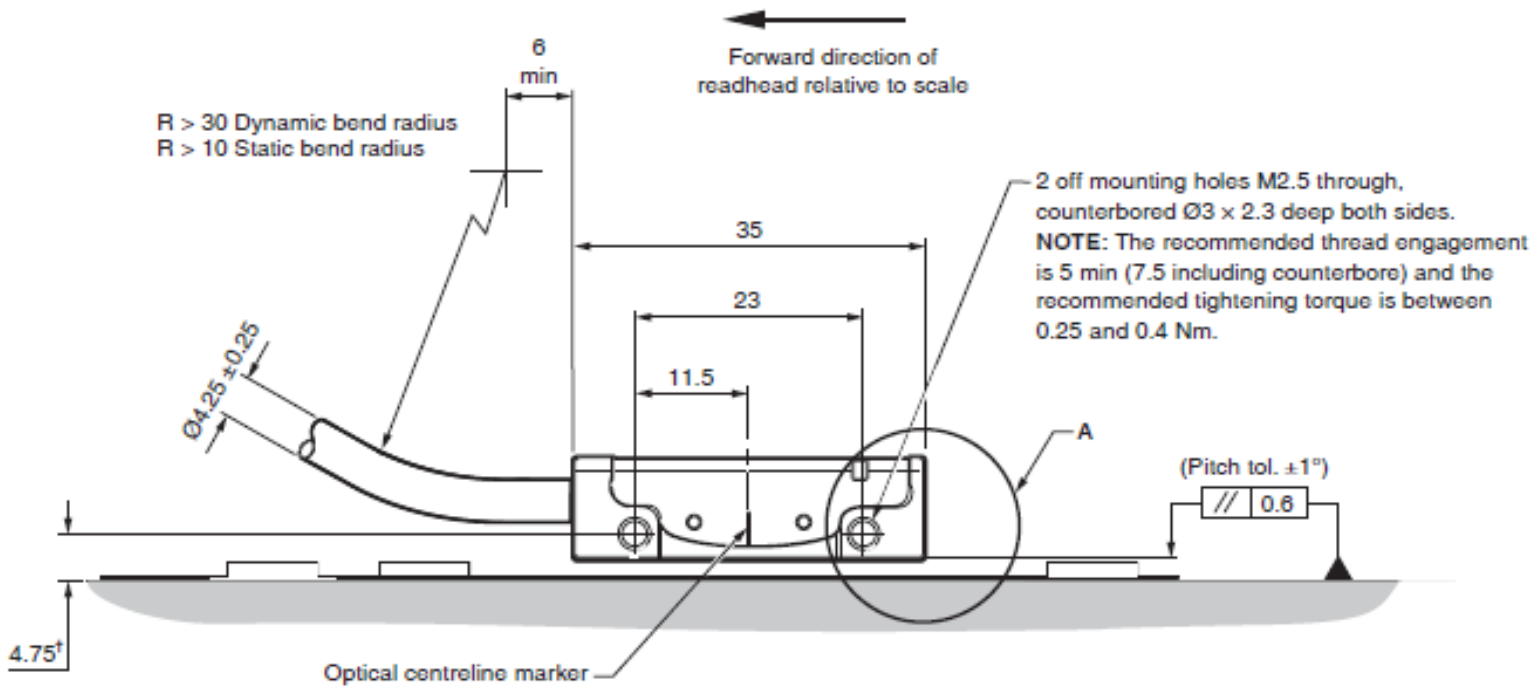
*Dimension from substrate surface. †Dynamic bend radius not applicable for UHV cables. ‡UHV cable diameter 3 approx. ✧Extent of mounting faces.

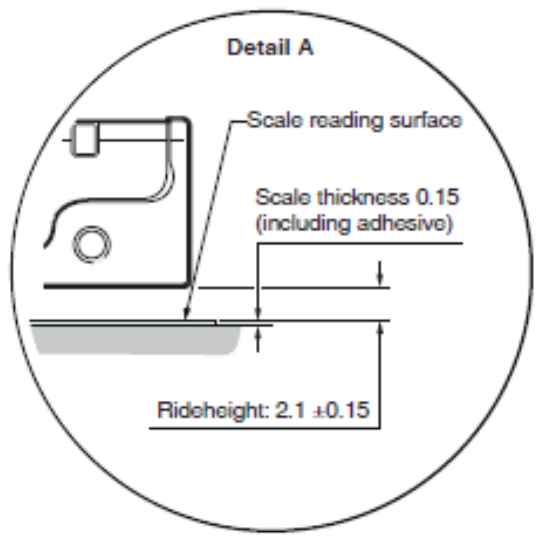
VIONiC readhead installation drawing

Dimensions and tolerances in mm



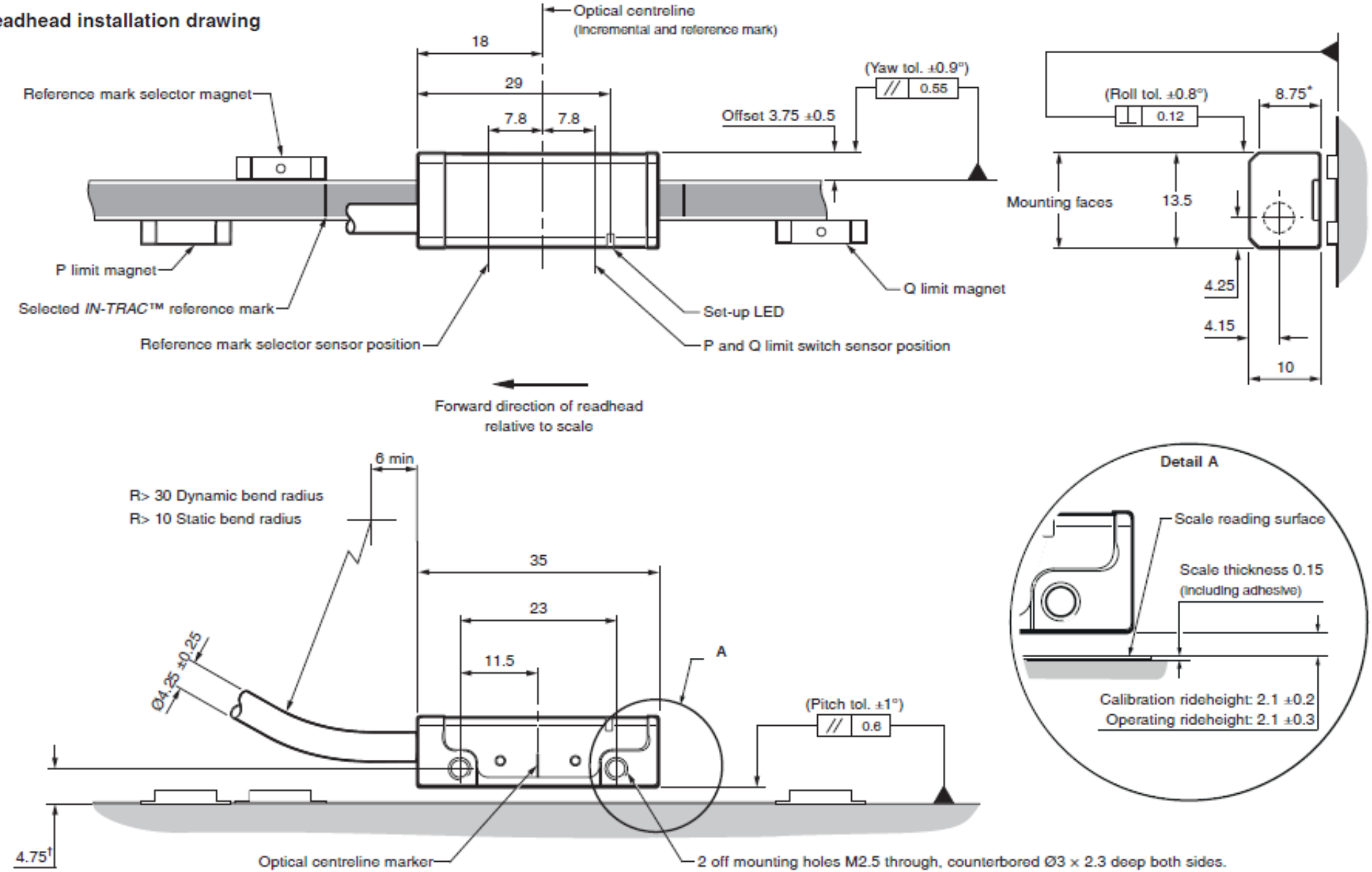






*Extent of mounting face. †Dimension from substrate surface.

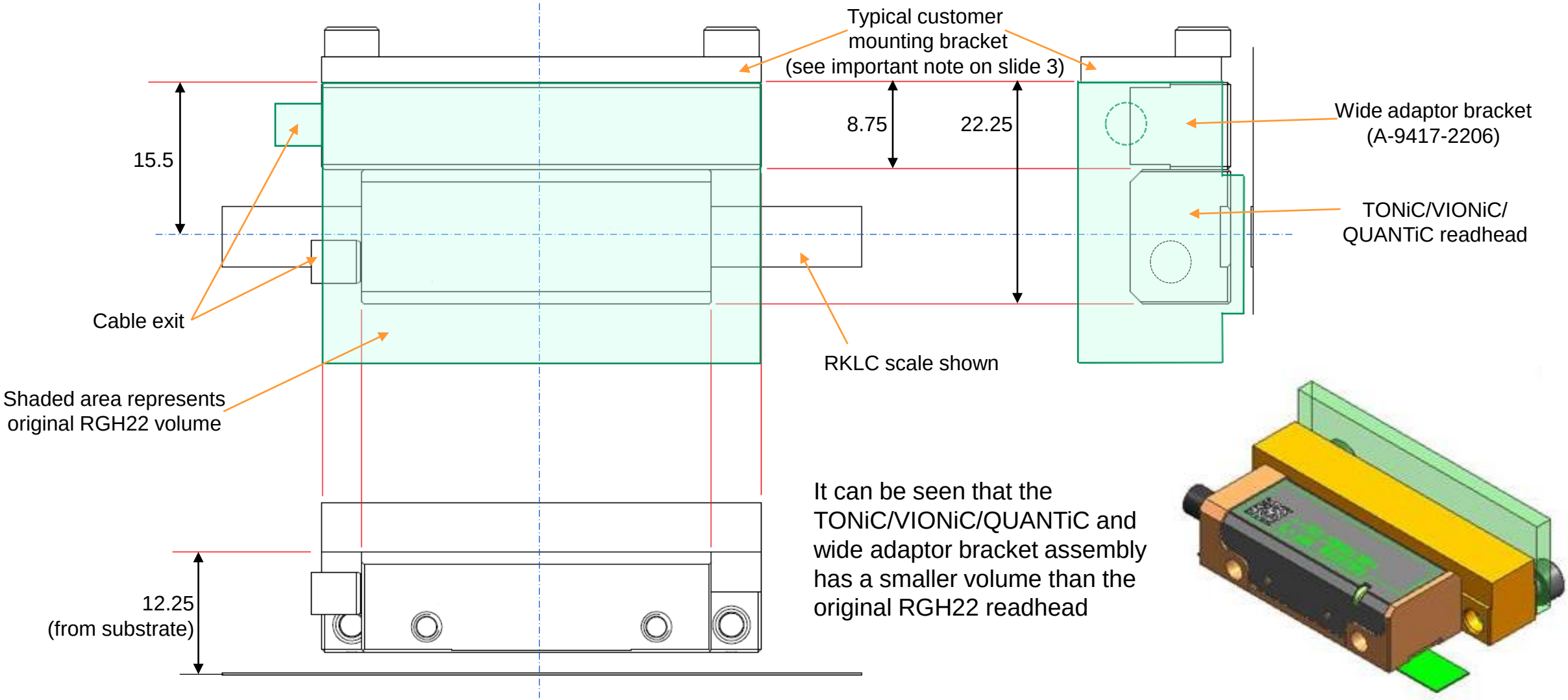
QUANTiC readhead installation drawing



*Extent of mounting face. †Dimension from substrate surface.

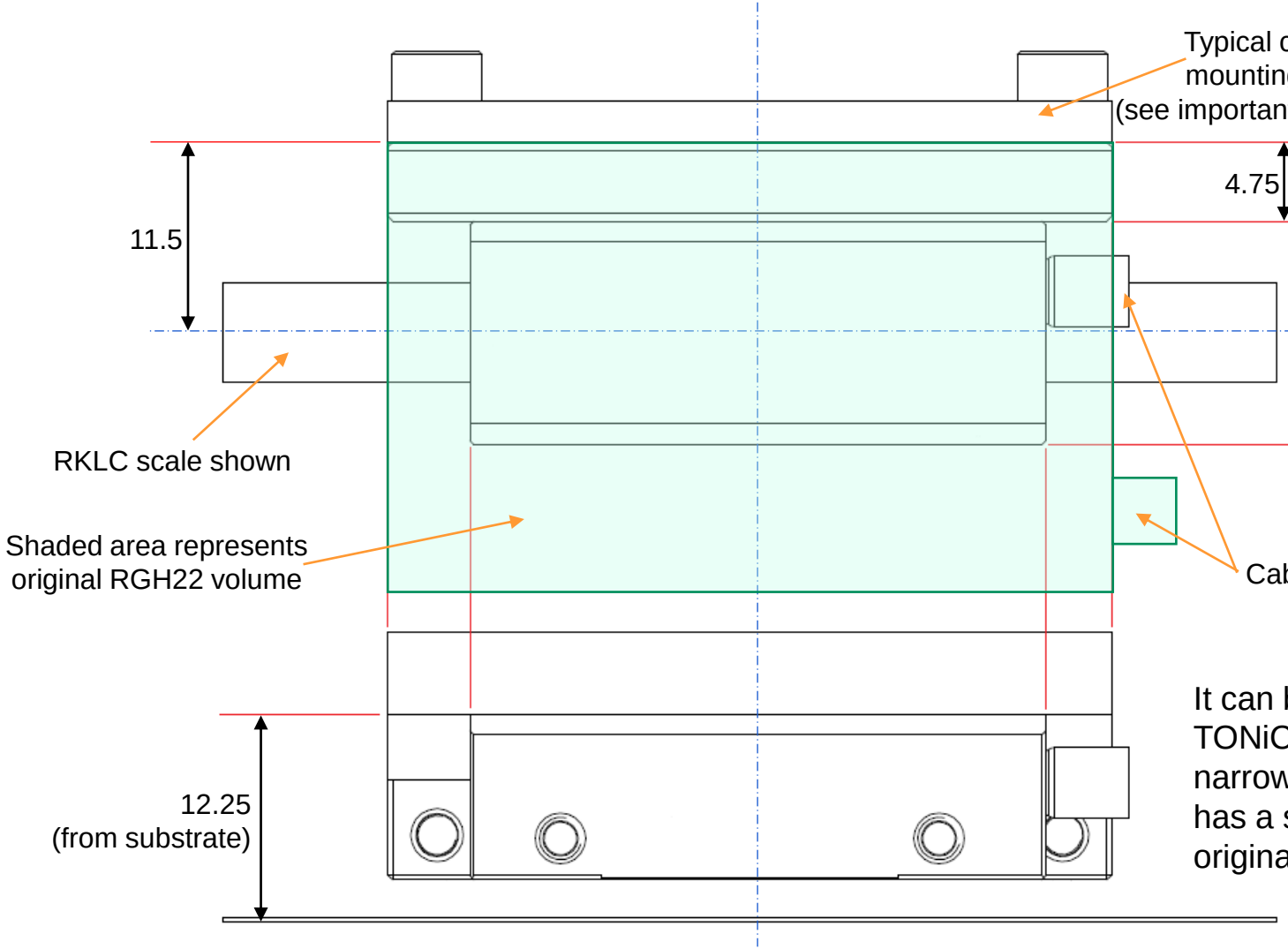
NOTE: The recommended thread engagement is 5 min (7.5 including counterbore) and the recommended tightening torque is between 0.25 and 0.4 Nm.

Upgrade to TONiC/VIONiC/QUANTiC using wide adaptor bracket

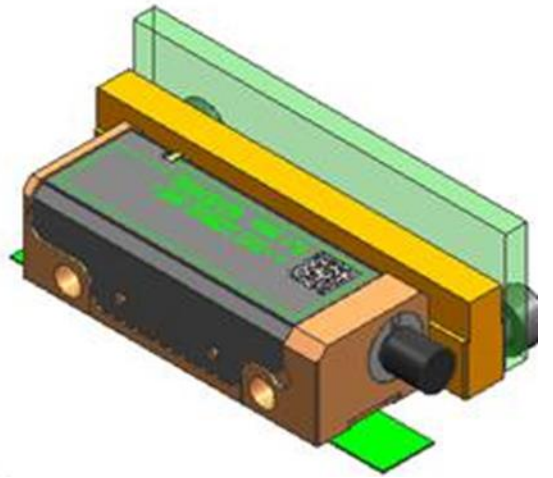


It can be seen that the TONiC/VIONiC/QUANTiC and wide adaptor bracket assembly has a smaller volume than the original RGH22 readhead

Upgrade to TONiC/VIONiC/QUANTiC using narrow adaptor bracket



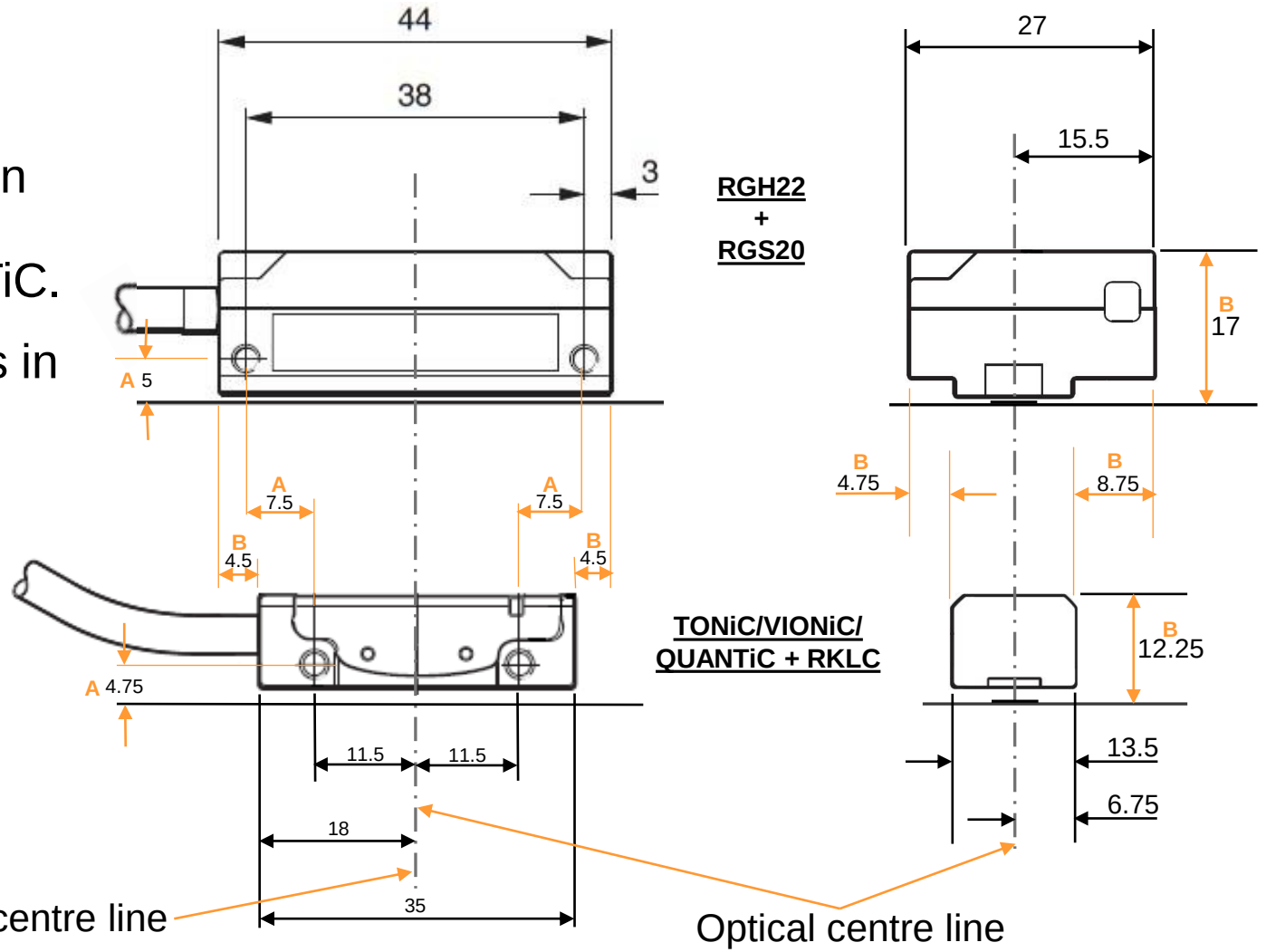
It can be seen that the TONiC/VIONiC/QUANTiC and narrow adaptor bracket assembly has a smaller volume than the original RGH22 readhead



Critical dimensional differences relating to installation
(when not using adaptor brackets)

Diagram showing the critical dimensional differences at installation between RGH22 and TONiC/VIONiC/QUANTiC.

In particular, differences in the position of the mounting holes and readhead extremes, in relation to the common optical centre line



Dimensions A show the differences in mounting hole positions, including height above substrate

Dimensions B show the differences in the readhead envelope

Critical dimensional differences relating to installation

Feature/specification		RGH22	TONiC	VIONiC	QUANTiC
Mounting holes*	Spacing (mm)	38	23		
	Thread diameter	M3	M2.5		
	Height above substrate (mm)	5	4.75		
Scale centreline offset from mounting face (mm)		11.5/15.5 depending on readhead orientation	6.75		
Overall height from substrate (mm)		17	12.25		
Installation tolerances	Ride height (±mm)	0.1	0.15	0.15	0.3 (operating)
	Roll (±°)	1	0.5	0.5	0.8
	Pitch (±°)	1	1	1	1
	Yaw (±°)	0.5	0.4	0.4	0.9
Maximum readhead cable length (m)		5	10	3	3 (digital) 5 (analogue)

* Differences in size/position of mounting holes are of no consequence if using adaptor brackets

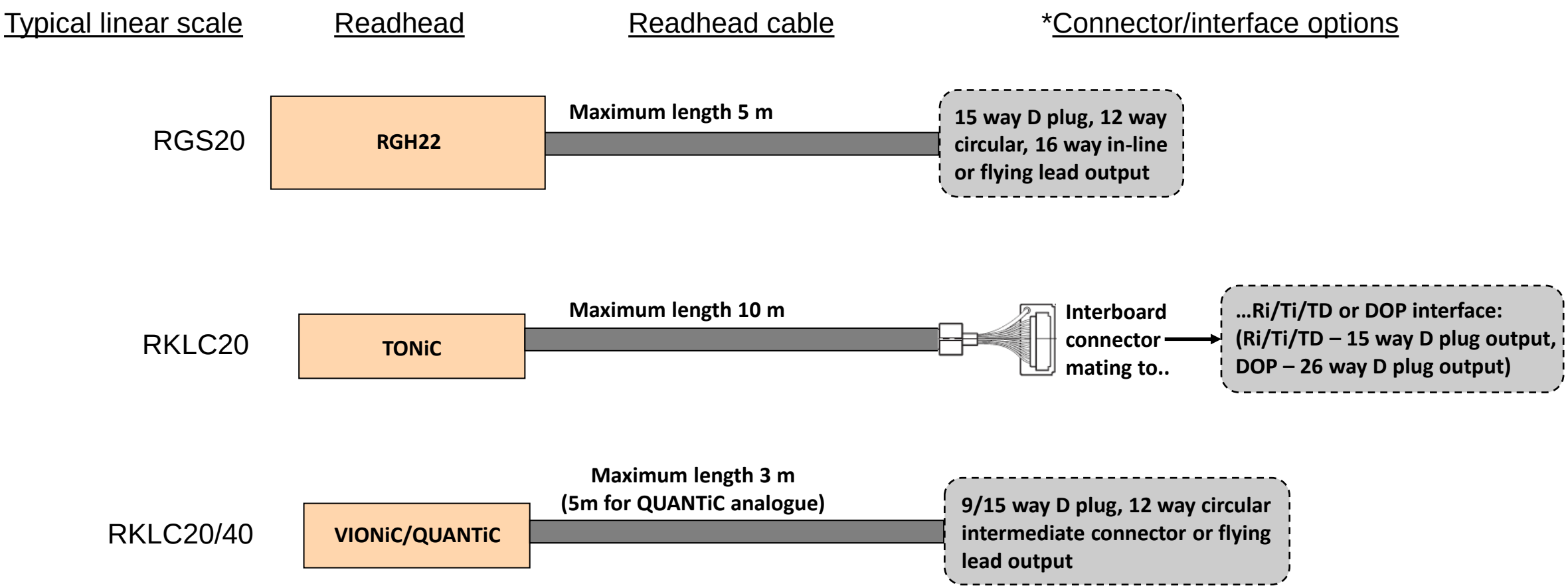
RGH22 to TONiC/VIONiC/QUANTiC system differences to consider when upgrading

The table below and following slides contain details of system configurations, pinouts, maximum speeds and other differences to consider when upgrading from RGH22 to any of the products covered in this document.

Component/ feature	RGH22	TONiC	VIONiC	QUANTiC
Typical scale	RGS20	RKLC20		RKLC40
Scale pitch (µm)	20			40
Interface	N/A	Ti/Ri	N/A	
Output	Digital or analogue	Digital or analogue from Ti/Ri interface	Digital only	Digital or analogue
Reference mark/ limit switch	Magnetic reference mark and single/dual magnetic limit switches using actuator fitted alongside scale	Optical *IN-TRAC,* no actuator required, although selector magnet may be needed depending on application		

Note: Further details about RGH22 and the various possible upgrade systems can be found in the relevant installation guides available to download from Renishaw.com.

System configuration differences



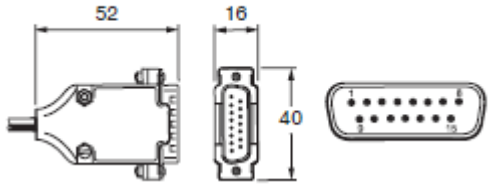
*Connector and interface output pinouts follow standard Renishaw practice. See following pages or relevant installation guides at Renishaw.com for details

RGH22 pinouts (digital)

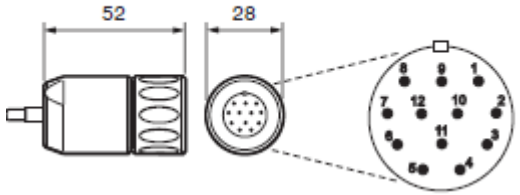
Digital RS422A outputs - RGH22D, X, Z, Y, H, P, Q, R and S

Function	Signal		Colour	15-way D-type plug (D)	12-way circular (R)	16-way in-line connector (X)
Power	5 V		Brown	7	2	A
			Brown (link)	8	12	M
	0 V		White	2	10	B
			White (link)	9	11	N
Incremental signals	A	+	Green	14	5	G
		–	Yellow	6	6	D
	B	+	Blue	13	8	R
		–	Red	5	1	F
Reference mark	Z	+	Violet	12	3	K
		–	Grey	4	4	O
Limit switch*	Q		Pink	10	–	H
Alarm	E	+	Black	11	9	I
		–	Orange	3	7	P
External set-up	X		Clear	1	–	E
Shield	Inner		Green / Yellow	15	11 (link)	L
	Outer		–	Case	Case	Case

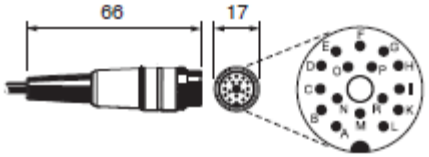
15-way D-type plug (termination code D)



12-way circular plug (termination code R)



16-way in-line connector plug (termination code X)



*Dual limit versions (RGH22P, Q, R, S and H) utilise the black wire (pin 11) as the P limit output.
The 'E' alarm signal on these versions is only available at the orange wire as a single-ended E– output.

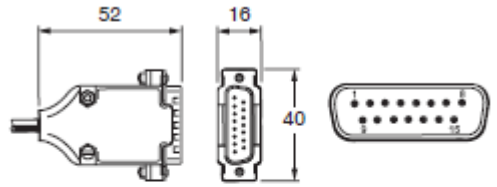
RGH22 pinouts (analogue)

Analogue 1 Vpp outputs - RGH22A and B

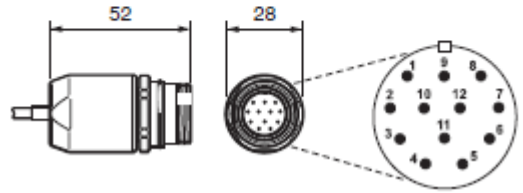
Function	Signal		Colour	15-way D-type plug (L)	12-way circular (V)	12-way circular coupling (W)	16-way in-line connector (X)
Power	5 V		Brown	4	2	2	A
			Brown (link)	5	12	12	M
	0 V		White	12	10	10	B
			White (link)	13	11	11	N
Incremental signals	V_1	+	Red	9	5	5	F
		–	Blue	1	6	6	R
	V_2	+	Yellow	10	8	8	D
		–	Green	2	1	1	G
Reference mark	V_0	+	Violet	3	3	3	K
		–	Grey	11	4	4	O
Limit switch*	V_q		Pink	8	N/C	N/C	H
External set-up	V_x		Clear	7	N/C	N/C	E
Reference mark uni-directional operation‡	BID		Black	6	9†	9††	I
	DIR		Orange	14	7†	7††	P
Shield	Inner		Green / Yellow	15	11 (link)	11 (link)	L
	Outer		–	Case	Case	Case	Case

*Dual limit versions (RGH22A) utilise the clear wire (pin 7) as the V_p limit output. The V_x external set-up signal on these versions is not available.
Dual limit readheads are only available with F, L or X terminations.

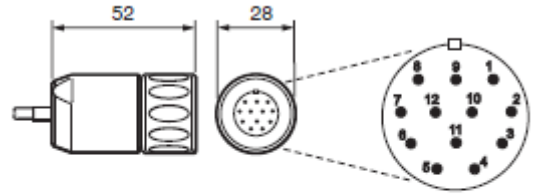
15-way D-type plug (termination code L)



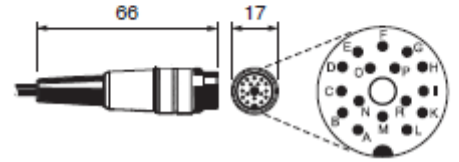
12-way circular coupling (termination code W)



12-way circular plug (termination code V)



16-way in-line connector plug (termination code X)



TONiC Ti and TD interface pinouts

Interface output (analogue) TI0000 only

Function	Output type		Signal		Pin
Power			5 V Power		4
			5 V Sense		5
			0 V Power		12
			0 V Sense		13
Incremental signals	Analogue	Cosine	V_1	+	9
				-	1
		Sine	V_2	+	10
				-	2
Reference mark	Analogue		V_0	+	3
				-	11
Limits	Open collector		V_p		7
			V_q		8
Set-up	–		V_x		6
Calibrate	–		CAL		14
Shield	–		Inner shield		Not connected
	–		Outer shield		Case

Interface output (digital) TI0004 to TI20KD and TD4000 to TD0040

Function	Output type	Signal		Interface: TI0004 - TI20KD Pin	Interface: TD4000 - TD0040 Pin
Power		5 V		7, 8	7, 8
		0 V		2, 9	2, 9
Incremental	RS422A Digital	A	+	14	14
			-	6	6
		B	+	13	13
			-	5	5
Reference mark	RS422A Digital	Z	+	12	12
			-	4	4
Limits	Open collector	P†		11	–
		Q‡		10	–
Set-up	RS422A Digital	X		1	1
Alarm‡	–	E	+	–	11
			-	3	3
Resolution switching‡	–			–	10
Shield	–	Inner		–	–
	–	Outer		Case	Case

†Becomes alarm (E+) for Ti options E, F, G, H

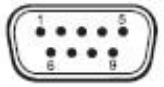
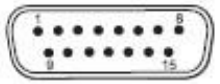
‡The alarm signal can be output as a line driver signal or 3-state. Please select the preferred option at time of ordering.

‡On TD interfaces pin 10 should be connected to 0 V to switch to lower resolution.

Output connector for all interfaces; 15 way D-type plug

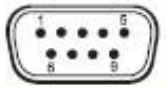
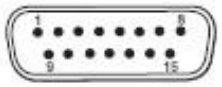
For Ri and DOP interface outputs, see relevant installation guides at Renishaw.com

VIONiC and QUANTiC pinouts (digital)

							
Function	**Signal**		**Colour**	**9-way D-type (A)**	**15-way D-type (D)**	**15-way D-type alternative pin-out (H)**	**12-way circular connector† (X)**	**14-way JST (J)**
Power	5 V		Brown	5	7, 8	4, 12	G	10
	0 V		White	1	2, 9	2, 10	H	1
Incremental	A	+	Red	2	14	1	M	7
		–	Blue	6	6	9	L	2
	B	+	Yellow	4	13	3	J	11
		–	Green	8	5	11	K	9
Reference mark	Z	+	Violet	3	12	14	D	8
		–	Grey	7	4	7	E	12
Limits	P		Pink	-	11	8	A	14
	Q		Black	-	10	6	B	13
Alarm	E	–	Orange	-	3	13	F	3
Remote CAL*	CAL		Clear	9	1	5	C	4
Shield	-		Screen	Case	Case	Case	Case	Ferrule

* Remote CAL line must be connected for use with ADTi 100

QUANTiC analogue pinouts

Function		Signal		Colour	 9-way D-type (A)	 15-way D-type (L)	15-way D-type alternative pin-out (H)	 14-way JST (J)
Power		5 V		Brown	5	4, 5	4, 12	10
		0 V		White	1	12, 13	2, 10	1
Incremental	Cosine	V_1	+	Red	2	9	1	7
			–	Blue	6	1	9	2
	Sine	V_2	+	Yellow	4	10	3	11
			–	Green	8	2	11	9
Reference mark		V_0	+	Violet	3	3	14	8
			–	Grey	7	11	7	12
Limits		V_p		Pink	-	7	8	14
		V_q		Black	-	8	6	13
Setup		V_x		Clear	-	6	13	-
Remote CAL*		CAL		Orange	9	14	5	4
Shield		-		Screen	Case	Case	Case	Ferrule

* Remote CAL line must be connected for use with ADTi-100

Speed comparison – RGH22, TONiC, VIONiC, QUANTiC

As can be seen from the following pages, TONiC, VIONiC and QUANTiC maximum speeds are significantly higher than those of RGH22, particularly for lower resolutions, higher clock options and analogue versions. When upgrading from an RGH22D/X/Z/P/Q/R non-clocked output to a clocked output TONiC, VIONiC or QUANTiC, customers should select the lowest clock frequency option that will satisfy their resolution and maximum speed requirements. A worked example is shown below:

Worked example – upgrading from non-clocked to clocked system

Existing customer system…….. RGH22Z (0.5 µm resolution)
Maximum speed requirement……2.8 m/s
Upgrade system…….. VIONiC

The excerpt from the VIONiC speed table shows that the customer would first select the 0.5 µm resolution column, then select the lowest clocked output option that would satisfy the maximum speed requirement, in this case, option 08 (8 MHz)

NOTE: For VIONiC and QUANTiC Other clocked output options are available where necessary to ensure system compatibility when upgrading

Clocked output option (MHz)	D (5 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)
50	12	12	12	7.25
40	12	12	12	5.80
25	12	12	9.06	3.63
20	12	12	8.06	3.22
12	12	10.36	5.18	2.07
10	12	8.53	4.27	1.71
08	12	6.91	3.45	1.38
06	12	5.37	2.69	1.07
04	12	3.63	1.81	0.730
01	4.53	0.910	0.450	0.180

RGH22 speed tables

Digital readheads

Non-clocked output readheads

Head type	Maximum speed (m/s)	Lowest recommended counter input frequency (MHz)
D and P (5 µm)	10	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}}\right) \times 4$ safety factor
X and Q (1 µm)	5	
Z and R (0.5 µm)	3	

Clocked output readheads

The RGH22Y, S and H readheads are available with a variety of different clocked outputs.
Customers must ensure they comply with the lowest recommended counter input frequency.

Options	Maximum speed (m/s)		Lowest recommended counter input frequency (MHz)
	Head type		
	Y and S (0.1 µm)	**H** (50 nm)	
61	1.3	0.6	20
62	0.7	0.3	10
63	0.35	0.15	5

Analogue readheads

RGH22A and B - 4 m/s (–3dB)

TONiC interface (Ti and Ri) speed tables

Ti interface

Clocked output option (MHz)	Maximum speed (m/s)										
	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
50	10	10	10	6.48	3.240	1.625	0.648	0.324	0.162	0.065	0.032
40	10	10	10	5.40	2.700	1.350	0.540	0.270	0.135	0.054	0.027
25	10	10	8.10	3.24	1.620	0.810	0.324	0.162	0.081	0.032	0.016
20	10	10	6.75	2.70	1.350	0.670	0.270	0.135	0.068	0.027	0.013
12	10	9	4.50	1.80	0.900	0.450	0.180	0.090	0.045	0.018	0.009
10	10	8.10	4.05	1.62	0.810	0.400	0.162	0.081	0.041	0.016	0.0081
08	10	6.48	3.24	1.29	0.648	0.324	0.130	0.065	0.032	0.013	0.0065
06	10	4.50	2.25	0.90	0.450	0.225	0.090	0.045	0.023	0.009	0.0045
04	10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034
01	4.2	0.84	0.42	0.16	0.084	0.042	0.017	0.008	0.004	0.0017	0.0008
Analogue output	10 (-3dB)										

Ri interface (non-clocked outputs)

Analogue Ri interface
10 m/s (-3dB)

Interface model	Maximum speed (m/s)
0004 (5 µm)	10
0020 (1 µm)	10
0040 (0.5 µm)	10

Ri interface (clocked outputs)

Maximum speed (mm/s)			Minimum receiver clock frequency (MHz)
0100 (0.2 µm)	**0200** (0.1 µm)	**0400** (50 nm)	
–	800	400	12
–	500	250	10
800	400	200	6
500	250	120	4

VIONiC speed table

Clocked output option (MHz)	Maximum speed (m/s)											
	5 µm (D)	1 µm (X)	0.5 µm (Z)	0.2 µm (W)	0.1 µm (Y)	50 nm (H)	40 nm (M)	25 nm (P)	20 nm (I)	10 nm (O)	5 nm (Q)	2.5 nm (R)
50	12	12	12	7.25	3.63	1.81	1.45	0.906	0.725	0.363	0.181	0.091
40	12	12	12	5.80	2.90	1.45	1.16	0.725	0.580	0.290	0.145	0.073
25	12	12	9.06	3.63	1.81	0.906	0.725	0.453	0.363	0.181	0.091	0.045
20	12	12	8.06	3.22	1.61	0.806	0.645	0.403	0.322	0.161	0.081	0.040
12	12	10.36	5.18	2.07	1.04	0.518	0.414	0.259	0.207	0.104	0.052	0.026
10	12	8.53	4.27	1.71	0.850	0.427	0.341	0.213	0.171	0.085	0.043	0.021
08	12	6.91	3.45	1.38	0.690	0.345	0.276	0.173	0.138	0.069	0.035	0.017
06	12	5.37	2.69	1.07	0.540	0.269	0.215	0.134	0.107	0.054	0.027	0.013
04	12	3.63	1.81	0.730	0.360	0.181	0.145	0.091	0.073	0.036	0.018	0.009
01	4.53	0.910	0.450	0.180	0.090	0.045	0.036	0.023	0.018	0.009	0.005	0.002

QUANTiC speed table

Clocked output option (MHz)	Maximum speed (m/s)						
	T (10 µm)	D (5 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)	Y (0.1 µm)	H (50 nm)
50	24	24	24	18.13	7.25	3.626	1.813
40	24	24	24	14.50	5.80	2.900	1.450
25	24	24	18.13	9.06	3.63	1.813	0.906
20	24	24	16.11	8.06	3.22	1.611	0.806
12	24	24	10.36	5.18	2.07	1.036	0.518
10	24	24	8.53	4.27	1.71	0.853	0.427
08	24	24	6.91	3.45	1.38	0.691	0.345
06	24	24	5.37	2.69	1.07	0.537	0.269
04	24	18.13	3.63	1.81	0.73	0.363	0.181
01	9.06	4.53	0.91	0.45	0.18	0.091	0.045
Analogue output	20 (–3dB)						

Other significant differences/considerations

Feature/specification		RGH22	TONiC	VIONiC	QUANTiC	Notes
Readhead cable	Wire size (awg)	28	32			If in-line or customer terminated connectors are used in the readhead cable, care is required when upgrading due to the thinner wires, screening and number of cores in upgrade products.
	Number of cores	Double screen + 12 cores		Single screen + 12 cores		
	flex life (x 10^6 cycles)	20 @ 50mm bending radius	20 @ 20mm bending radius	20 @ 30mm bending radius		
Sub-divisional error (SDE) (±nm)		150	30	15	80 (digital) 120 (analogue)	Performance benefit of upgrade
Limit switch and reference mark capability		Single or dual limit switch and reference mark	Dual limit switches and reference mark			Functional / performance benefit of upgrade
Reference mark repeatability		Uni-directional (magnetic)	Bi-directional (*IN-TRAC* reference mark)			
Analogue reference mark width		126°	360° nominal			Consideration of input electronics
Readhead operating temperature (°C)		0 to 55	0 to 70			Functional benefit of upgrade
Scale accuracy (µm/m)		15 (RGS20)	5 (RKLC 20, RKLC 40H) 15 (RKLC 40)			Performance benefit of upgrade and RKLC stainless steel scales are more robust