

TONiC™ DOP (dual output) encoder system



Renishaw's TONiC series encoders are now available with simultaneous dual output interfacing.

The robust DOP interface can be situated up to 10 m from the TONiC readhead and offers simultaneous analogue and digital outputs with interpolation to 1 nm resolution. Digital outputs are clocked for optimised speed performance at all resolutions for industry-standard controllers.

The readhead is complemented by the latest evolution of RGSZ20 gold tape scale, REXM ultra-high accuracy angle encoder and *FASTRACK*™/RTLC scale system with bi-directional optical *IN-TRAC*™ reference marks, in addition to established RSLM stainless steel scale, RELM high accuracy Invar scale and RESM rotary rings.

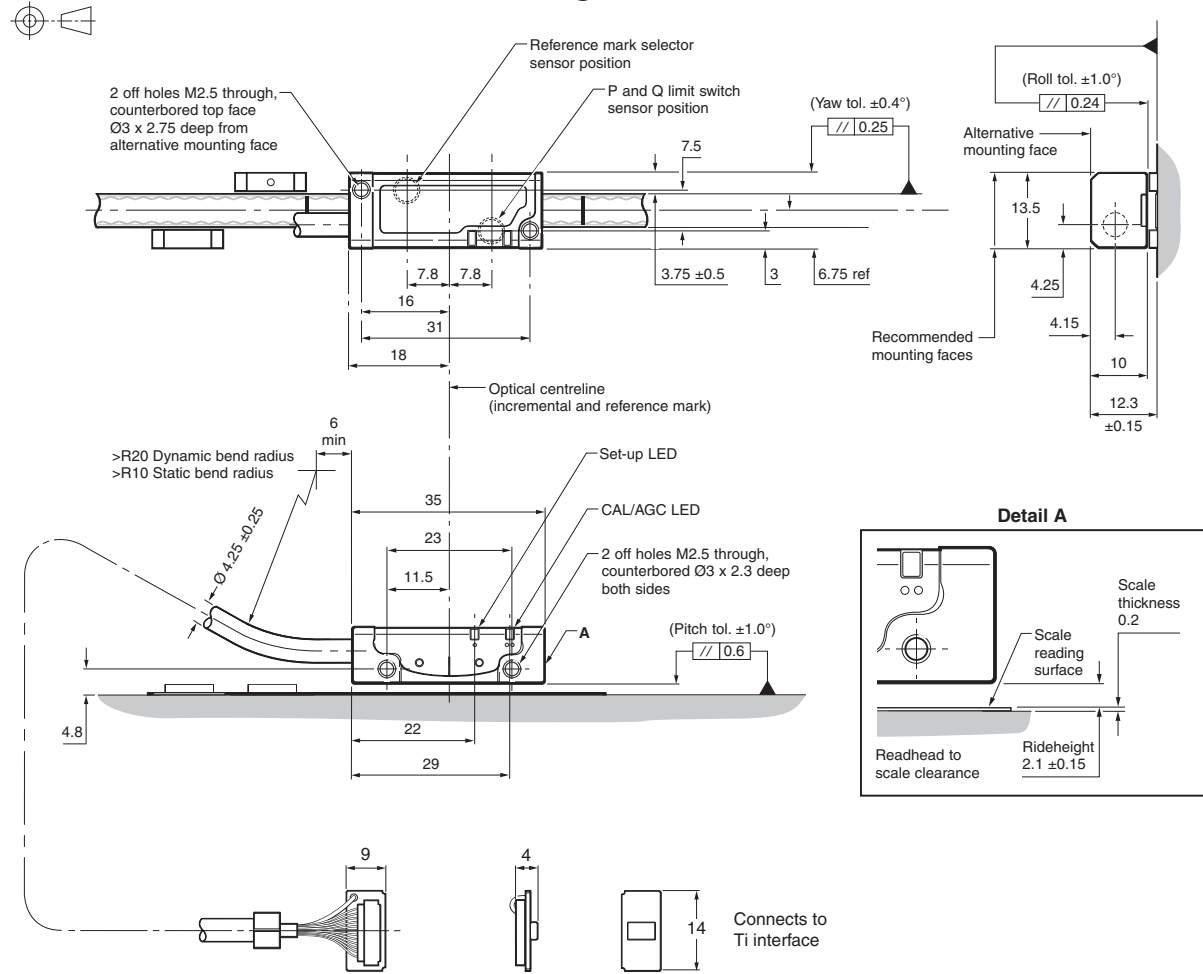
For ultimate reliability and high dirt immunity, TONiC readheads incorporate third-generation filtering optics, tuned for even lower noise (jitter), further enhanced by dynamic signal processing including Auto Gain Control and Auto Offset Control. The result is low sub-divisional error (SDE) giving smoother velocity control for improved scanning performance and increased positional stability.

- Compact readhead (35 x 13.5 x 10 mm)
- Detachable DOP interface with integral interpolation to 1 nm resolution (0.00075 arc seconds) and simultaneous digital and analogue outputs
- Compatible with RGSZ20 gold tape scale, *FASTRACK*/RTLC scale system, RSLM, RELM, RESM, RESD and REXM with customer-selectable *IN-TRAC* auto-phase optical reference mark (datum)
- Third-generation filtering optics optimised for even lower noise (jitter)
- Dynamic signal processing inside the readhead, provides ultra-low cyclic error of typically ± 30 nm
- Auto Gain Control ensures consistent signal strength for long-term reliability
- Increased ride height tolerance and patented set-up LED for ease of installation
- Maximum speed to 10 m/s (3.24 m/s at 0.1 μ m resolution)
- Integral dual limits (linear only)
- Operating temperature to 70 °C



TONiC readhead installation drawing

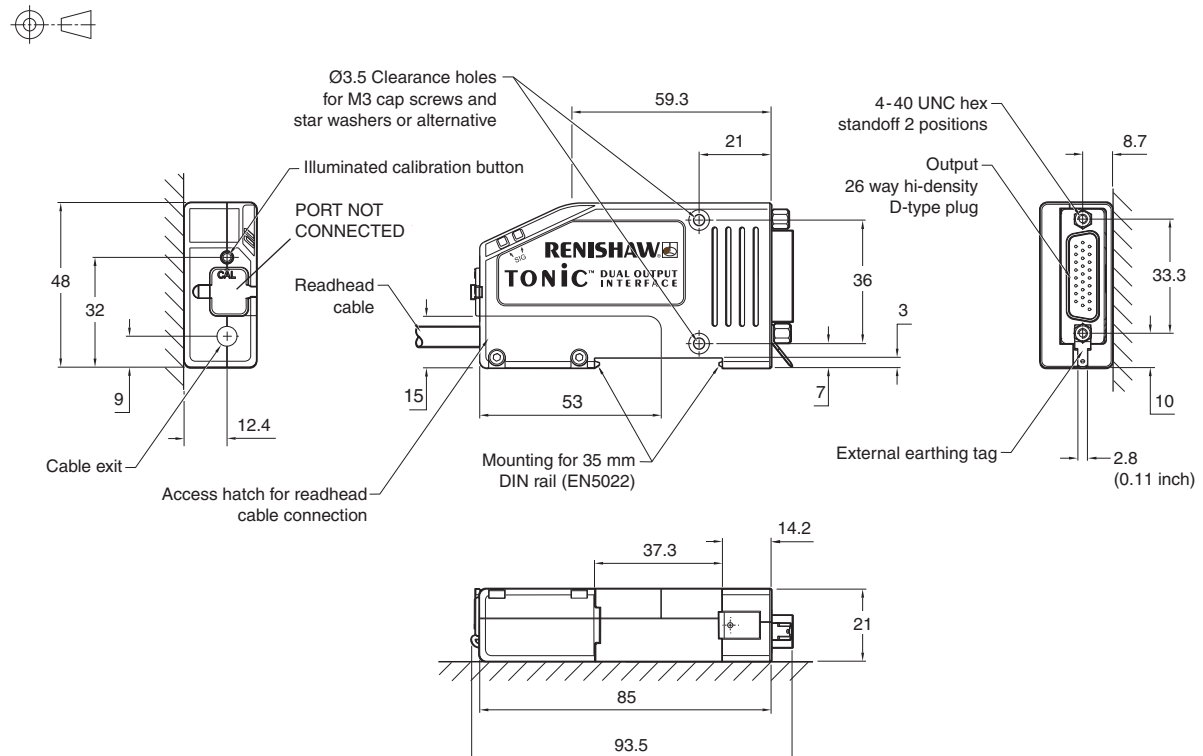
Dimensions and tolerances in mm




NOTE: RGSZ20 only shown. For detailed installation drawings, refer to TONiC T100x (M-9653-9154), TONiC T101x (M9653-9225), TONiC T20x1 (M-9653-9161) and TONiC REXM (M-9653-9248) Installation guides. Refer to RGSZ20 (L-9517-9348) RELM (L-9517-9219), RSLM (L-9517-9305), RESM (L-9517-9154) and REXM (L-9517-9318) Data sheets for scale information.

DOP installation drawing

Dimensions and tolerances in mm



Operating and electrical specifications

Power supply	5V ±10%	<275 mA (typical)
	NOTE: Current consumption figures refer to unterminated systems. For digital outputs, a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs, a further 20 mA will be drawn when terminated with 120 Ω. Power from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950. Ripple 200 mVpp maximum @ frequency up to 500 kHz	
Temperature (system)	Storage	-20 °C to +70 °C
	(readhead) Operating	0 °C to +70 °C
	(interface) Operating	0 °C to +70 °C
Humidity	Rated up to +40 °C, 95% maximum relative humidity (non-condensing)	
Sealing (readhead)	IP40	
	(interface)	IP30
Acceleration (readhead)	Operating	500 m/s ² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
Shock (system)	Non-operating	1000 m/s ² , 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
Vibration (system)	Operating	100 m/s ² max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
Mass	Readhead	10 g
	Interface	205 g
	Cable	26 g/m
EMC compliance (system)	BS EN 61326-1: 2006	
Environmental	Compliant with EU Directive 2002/95/EC (RoHS)	
Readhead cable	Double-shielded, outside diameter 4.25 ±0.25 mm Flex life >20 x 10 ⁶ cycles at 20 mm bend radius UL recognised component 	

NOTE: Class 1 LED product. Invisible LED radiation.

Speed

Minimum receiver clock frequency (MHz)	Maximum speed (m/s)										
	DOP0004 5 µm	DOP0020 1 µm	DOP0040 0.5 µm	DOP0100 0.2 µm	DOP0200 0.1 µm	DOP0400 50 nm	DOP1000 20 nm	DOP2000 10 nm	DOP4000 5 nm	DOP10KD 2 nm	DOP20KD 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	4.00	1.62	0.810	0.400	0.162	0.081	0.041	0.016	0.0081
8	10	6.48	3.24	1.29	0.648	0.324	0.130	0.065	0.032	0.013	0.0065
6	10	4.50	2.25	0.90	0.450	0.225	0.090	0.045	0.023	0.009	0.0045
4	10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034
1	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)										

Angular speed depends on ring diameter - use the following equation to convert to rev/min.

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \quad \text{Where } V = \text{maximum linear speed (m/s) and } D = \text{external diameter of RESM or REXM (mm)}$$

System features

Reference mark

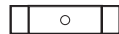
Form	<i>IN-TRAC</i> reference mark, directly in incremental track Refer to RGSZ, <i>FASTTRACK</i> /RTLCL, RELM, RSLM, RESM, RESD or REXM Data sheets for reference mark location Bi-directionally repeatable across full speed and temperature range Electronically phased, requires no physical adjustment
Selection	T1xx0 : Single reference mark selection by magnetic actuator (A-9653-0143), customer positioned T1xx1 and T2xx1 : No selector required, all reference marks output
Repeatability	Unit of resolution repeatability, over full operating temperature and speed

Dual limit switches (linear systems only)

Form	Magnetic actuators for P and Q limit switches 10 mm P limit, North pole facing – A-9653-0138 10 mm Q limit, South pole facing – A-9653-0139 20 mm P limit, North pole facing – A-9653-0237 20 mm Q limit, South pole facing – A-9653-0238 50 mm P limit, North pole facing – A-9653-0235 50 mm Q limit, South pole facing – A-9653-0236
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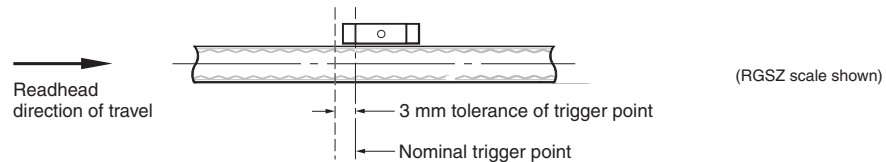
Typical P magnet



Typical Q magnet

Trigger point	Leading edge of magnet from direction of travel
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Trigger point tolerance



Mounting	Self-adhesive
Position	Customer placed at desired locations
Repeatability	<0.1 mm

Dynamic signal processing

Real time signal conditioning for optimized performance across a range of operating conditions

- Automatic Gain Control (AGC)
- Automatic Offset Control (AOC)

Ultra low cyclic error of ± 30 nm

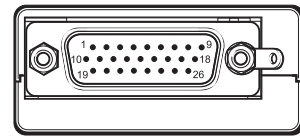
Calibration

Simple calibration at the press of a button, no physical adjustment required

Optimization of incremental and reference mark signals

Connections DOP output

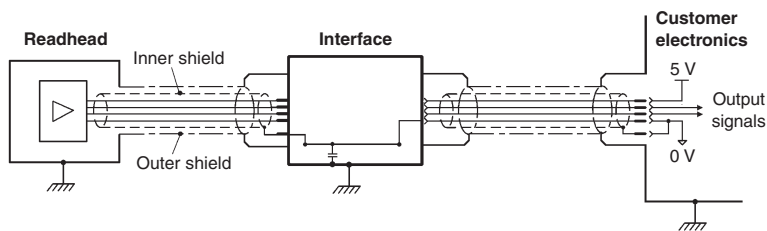
Function	Output type	Signal	Pin	
Power		5 V Power	26	
		5 V Sense	18	
		0 V Power	9	
		0 V Sense	8	
Incremental signals	RS422A digital	A+	24	
		A-	6	
		B+	7	
		B-	16	
	Analogue	Cosine	V_{1+}	1
		Sine	V_{2+}	2
Reference mark	RS422A digital	Z+	15	
		Z-	23	
	Analogue	V_{0+}	12	
		V_{0-}	20	
Alarm	RS422A digital	E+	25	
		E-	17	
Limits	Open collector	P	4	
		Q	13	
Readhead set-up	-	X	10	
Shield	-	Inner shield	Not connected	
	-	Outer shield	Case	



26 pin high density D type plug

Electrical connections

TONIC DOP system grounding and shielding



IMPORTANT: The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0V at receiving electronics only. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0V and earth, which could cause electrical noise issues.

NOTE: The external earthing tag on the interface should be used when mounting the interface on a DIN rail

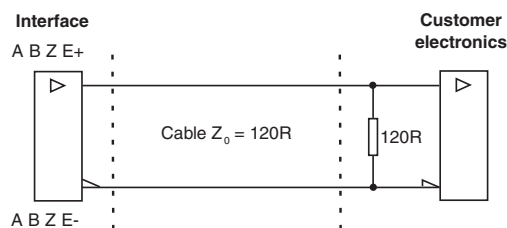
Maximum cable length

Readhead to interface: 10 m
 Interface to controller: Dependent on output frequency. See table below for details.

Receiver clock frequency (MHz)	Maximum cable length (m)
40 to 50	10
<40	50
analogue	50

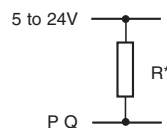
Recommended signal termination

Digital outputs



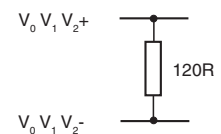
Standard RS422A line receiver circuitry

Limit outputs



*Select R so max. current does not exceed 20 mA
 Alternatively, use a suitable relay or opto-isolator

Analogue outputs

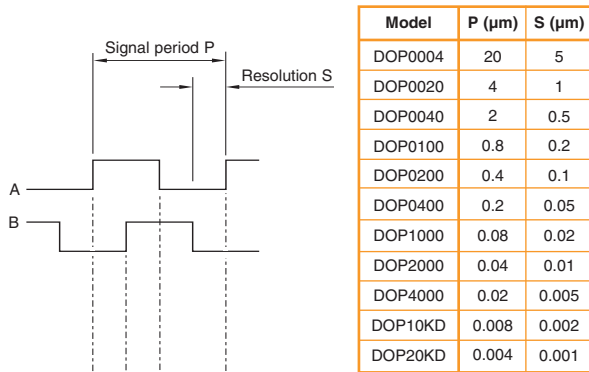


Output specifications

Digital output signals

Form - Square wave differential line driver to EIA RS422A
 (except limits P and Q)

†**Incremental** 2 channels A and B in quadrature
 (90° phase shifted)



†**Reference**



†**Wide reference**

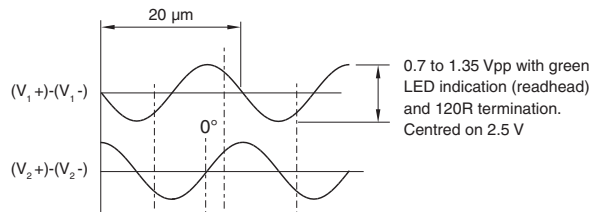


NOTE: Select 'standard' or 'wide' reference at time of ordering, to match the requirements of the controller being used.

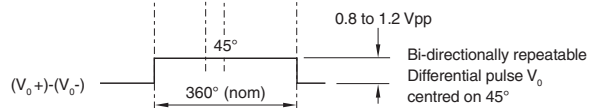
Analogue output signals

NOTE: Analogue signals are available direct from the T1000/T2000 readhead

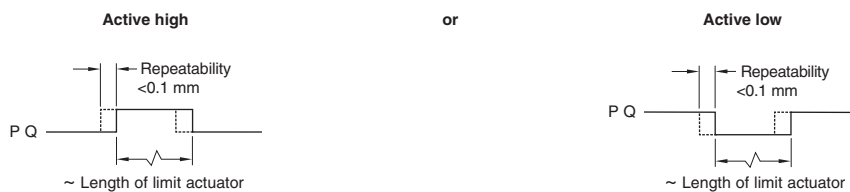
†**Incremental** 2 channels V_1 and V_2 differential sinusoids in quadrature
 (90° phase shifted)



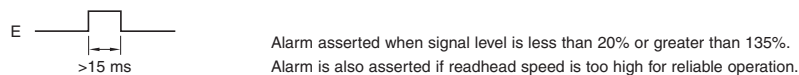
†**Reference**



Limits Open collector output, asynchronous pulse



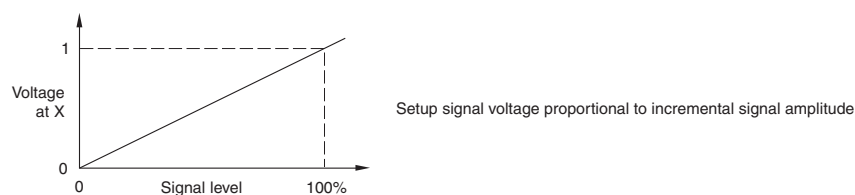
†**Alarm** Asynchronous pulse



3-state alarm (option)

Differentially transmitted signals forced open circuit for >15 ms when alarm conditions valid.

***Set-up**

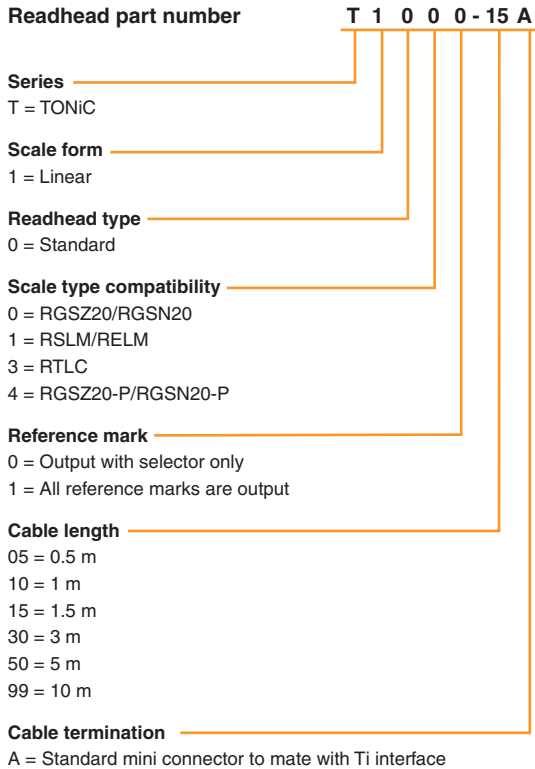


*Set-up signals as shown are not present during calibration routine

†Inverse signals not shown for clarity

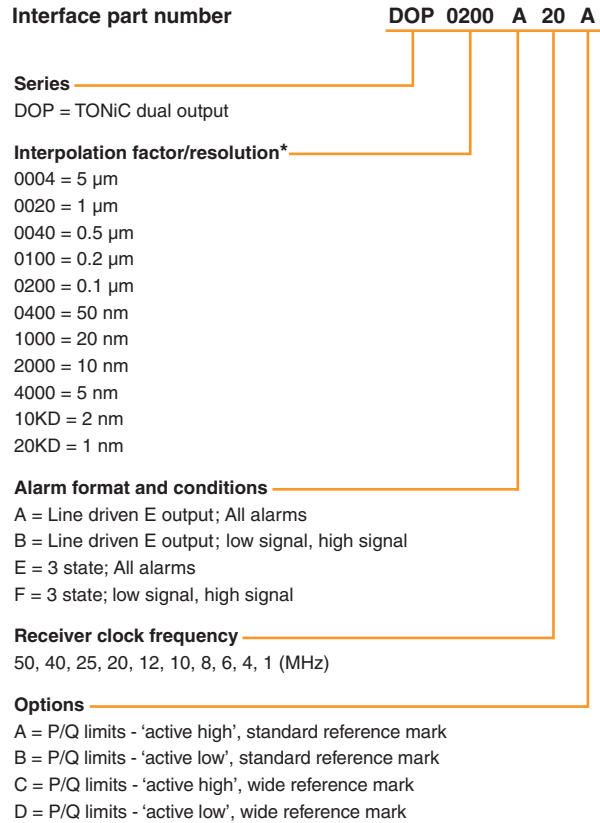
T1xxx linear readhead

Compatible with RGSZ20, RSLM or RELM scale.



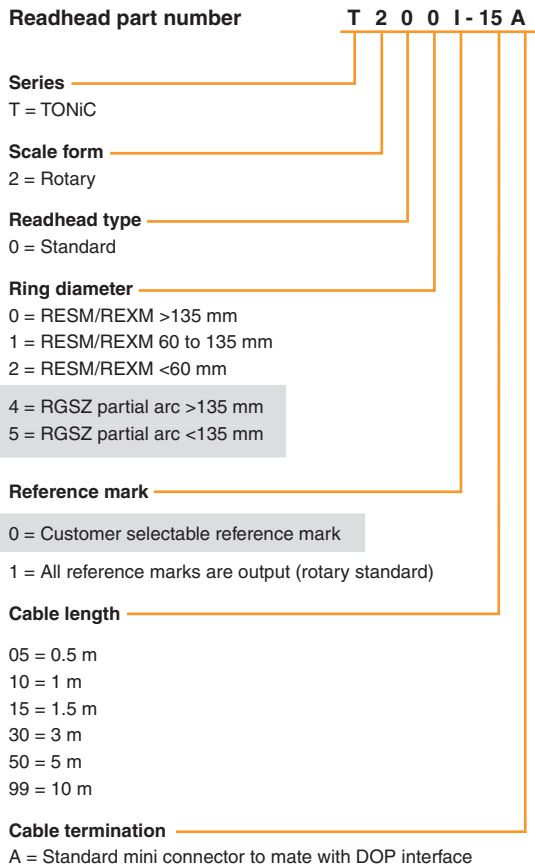
DOP interface

Compatible with all TONiC readheads



T2xxx rotary readhead

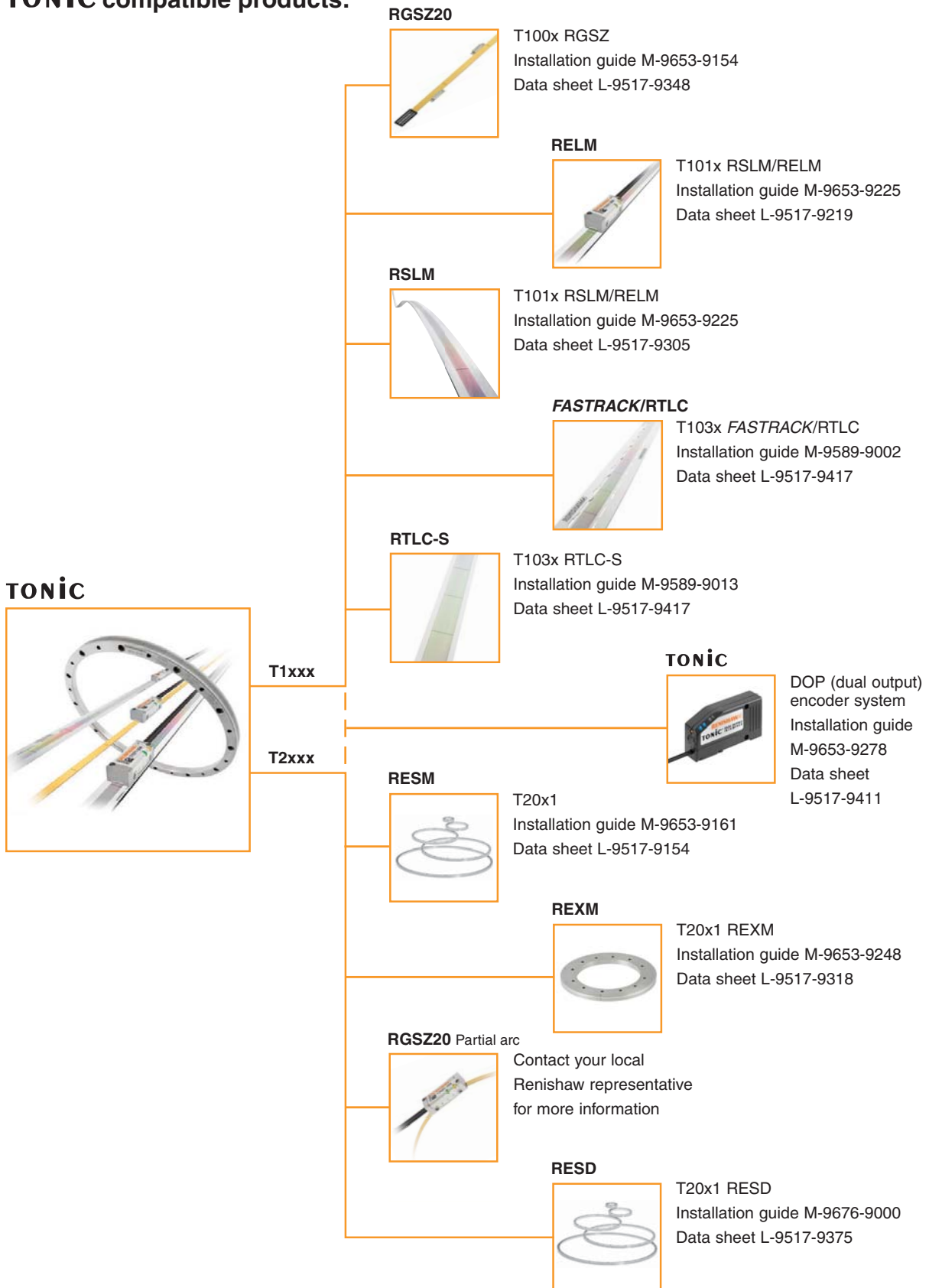
Compatible with RESM, RESD and REXM rings



*Contact Renishaw for other interpolation factors.

Please contact your local Renishaw representative if you require a partial arc application

TONIC compatible products:



For worldwide contact details, please visit our main website at www.renishaw.com/contact

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