



**Nm RWT430/440**



**Description**

The Digital RWT430/440 series transducers with separate electronics now offer cost effective, non-contact digital rotary torque measurement, using Surface Acoustic Wave technology, suitable for torque monitoring, testing or controlling drive mechanisms. The RWT430/440 series transducers and their technology are particularly appropriate for OEM applications.

The RWT430/440 torque sensors replaces the RWT330/340 series and feature all new electronics that have produced significant performance gains in resolution, frequency response, reduced sensor current consumption and faster digital data throughput. Transducer overload has also been increased to 300%.

**The RWT430 series transducers offer**

- Fixed voltage or current analog outputs (one for torque and the other for speed or power) for interfacing with analog instrumentation
- BIT Self-diagnostics for letting the manufacturer know that the transducer's torque, speed ratings and calibration due date have not been exceeded.
- Simple 'Sensor status' output pin
- Sensors to monitor shaft temperature for better compensation and accuracy

**Benefits**

- Minimal shaft length - High shaft stiffness
- Low inertia – High Speed capability because electronics are not fixed onto shaft
- Non contact/brushless measurement
- High Bandwidth
- 300% safe mechanical overload
- High accuracy (0.25%) and resolution (0.02%)
- Excellent noise immunity
- Separate digital electronics
- Operates both statically and dynamically - clockwise/anti-clockwise
- Any full scale torque can be specified within standard range: 1Nm through to 13,000Nm
- Lifetime warranty

Consult factory for ranges greater than 13KNm  
High speeds available on request

**Technology**

The patented technology is the measurement of the resonant frequency change in 'frequency dependent' Surface Acoustic Wave (SAW) devices, caused when strain is applied. The signal is coupled via a non-contact RF rotating couple from the shaft to a fixed pick-up. A separate electronics module enables the resonant frequencies to be measured and offer user selectable features, digital outputs and diagnostics. SAW devices are not affected by magnetic fields.

**Whereas, the RWT440 series transducers offer**

- Digital outputs, such as RS232, CANbus and USB, for interfacing with modern instrumentation and laptops
- Digital input for configuring transducer via PC
- 2 x user selectable voltage or current analog outputs (one for torque and the other for speed, power or peak torque) for interfacing with analog instrumentation
- Transducer configuration software to allow user to change transducer variables
- BIT Self-diagnostics for letting users know data is trustworthy, that the transducer's torque, speed ratings and calibration due date have not been exceeded
- Simple 'Sensor status' output pin
- Sensors to monitor shaft temperature for better compensation and accuracy
- Ability to connect up to 10 transducers using USB

**Specific software**

We offer an easy to use advanced torque monitoring software, available to assist data recording and instrumentation displays that interface with Windows based PCs. Features include: 3 types of display, text files compatible with Matlab and Excel and Real time chart plotting. See TorqView datasheet for more details.

LabView VIs are available for users to design their own process control applications. DLLs are also available for users to write their own custom software.



## Standard Specifications

Parameter	Condition	Data							Units
<b>RWT430/440 Torque measurement system</b>									
Measurement method	Strain Dependent Surface Acoustic Wave Resonators (interrogated by an incremental electronic scanning method)								
Torque range	(See Notes 1 & 2 below)	0 – 1 [0 – 10]	0 – 1.1 to 0 – 20 [0 – 11 to 0 – 200]	0 – 21 to 0 – 100 [0 – 201 to 0 – 1000]	0 – 101 to 0 – 500 [0 – 1001 to 0 – 5000]	0 – 501 to 0 – 2000 [0 – 5001 to 0 – 20000]	0 – 2001 to 0 – 13000 [0 – 20001 to 0 – 175000]		Nm [lbf·in]
Shaft size (diameter)		6	12	20	30	50	75		mm
<b>Rotation speed / angle of rotation measurement system</b>									
Measurement method	Opto switch through slotted disc								
Direct output signal	Pulse output direct from opto switch (TTL, 5V square wave), output is independent of any analog or digital processing.								
Digital Processing Techniques	Processing Method Update rate for analog and digital outputs								
Processing modes run simultaneously and can be applied to either analog channel or accessed individually via a digital connection.	Mode 1 (Slow Method) Frequency Count	1							Hz
	Mode 2 (Fast Method) Period Count	0 RPM < 2000 RPM > 2000 RPM	1 RPM				RPM x ( 1 / ( ⌊ ( RPM - 1 ) / 2000 ⌋ + 1 ) )		Hz
Rotational speed (max)	(See Note 3)	30,000	20,000	15,000	12,000	9,000	6,000		RPM
<b>Temperature</b>									
Measurement method	IR temperature sensor monitoring actual shaft temperature								
Temperature accuracy		±1							°C
Reference temperature, T <sub>RT</sub>		20							°C
Operating range, ΔT <sub>O</sub>		-10 to +50							°C
Storage range, ΔT <sub>S</sub>		-20 to +70							°C
Temperature drift (FS)	Max	0.05							%FS/°C
<b>Specifications</b>									
Combined non-linearity and hysteresis		±0.25 (±0.5 for 2.5Nm and below)							%FS
Resolution		0.02							%FS
Repeatability		0.1							%FS
<b>RWT430 Series Transducers ONLY</b>									
Accuracy	20°C, SM (See Note 4)	±0.25 (±0.5 for 2.5Nm and below)							%FS
3dB Bandwidth	(See Notes 5&6)	312 (default ave. = 16)							Hz
<b>RWT440 Series Transducers ONLY</b>									
Digital averaging	(See Note 5)	2	4	8	16	32	64	128	N
Accuracy	20°C, SM (See Note 4)	±	±0.5	±0.4	±0.25	±0.25	±0.25	±0.25	%FS
3dB Bandwidth	(See Note 6)	2500	1250	625	312	156	78	39	Hz
<b>Analog output</b>									
Output voltages (Torque/Speed/Power)		Options available: ±1 / ±5 / ±10 / Unipolar (RWT430 Series default setting is ±5Vdc) (RWT440 Series output voltages are user selectable)							Vdc
Load impedance		Maximum 1							KΩ
Output currents (Torque/Speed/Power)		Options available: 4-20 / 0-20 / 12mA (RWT440 Series output currents are user selectable)							mA
4-20mA Loop resistance		Should not exceed 400							Ω
<b>Digital output (RWT440 Series Transducers ONLY)</b>									
Connections		CAN Bus			RS232			USB	
Configuration		CAN 2.0B, 11bit Message Identifiers			Data Bits: 8, Parity: None, Stop Bits: 1			USB 2.0 Full speed	
Baud Rate(s)		1 Mbps, 500 Kbps, 250 Kbps, 100 Kbps			115200 bps, 38400 bps, 9600 bps			12 Mbps	
<b>Power supply</b>									
Nominal voltage, V <sub>S</sub>		12 to 32 (max)							V
Current consumption, I <sub>S</sub>		230 (max) @ 12 VDC							mA
Power consumption, W <sub>S</sub>		3							W
Allowed residual ripple of supply voltage, V <sub>ripple</sub>		500 (above nominal supply voltage)							mVp-p
<b>Electromagnetic compatibility</b>									
EMC compatibility		EN 61326:2006							

Note 1: Any torque/FSD is possible between ranges – please specify max rated torque.

Note 2: Max rated torque should not be exceeded.

Note 3: Please consult factory for applications requiring rotational speeds that exceed maximum figures given. Transducers fitted for IP65 will have running speeds considerably reduced, increased drag torque and accuracy can be affected.

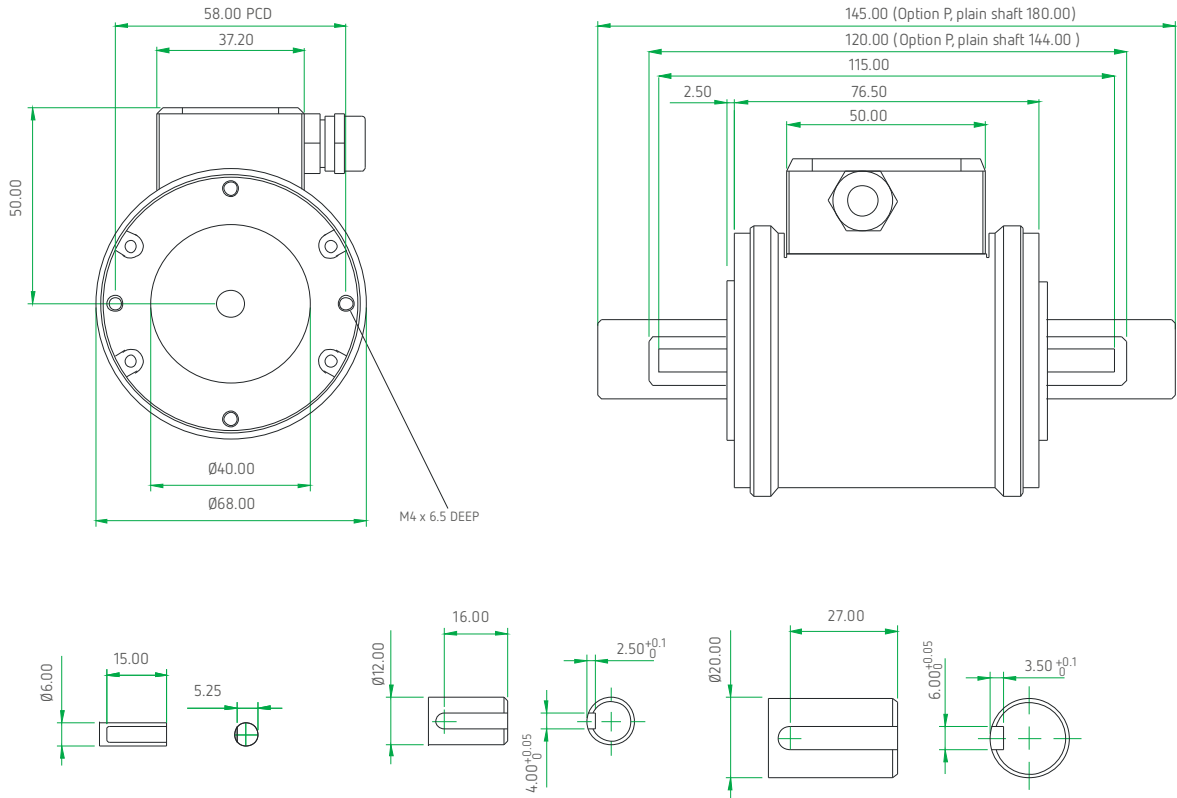
Note 4: SM – Static Mode. Dynamic values will depend upon user application and has to be adjusted accordingly.

Note 5: Digital averaging can be configured by user to optimise accuracy/frequency response for specific user applications. Digital averaging default setting is N=16. For details see User Manual.

Note 6: >5KHz Sample Rate. Up to 10KHz sample rate possible, please consult factory. Digital averaging also affects the analog output, max analog output 3dB Bandwidth = 5KHz when digital average is 1.

Note 7: Output rate figures are calculated from the time taken to capture 10000 torque readings. Testing was conducted with each connection method configured at its maximum baud rate. The maximum output rate available for CAN and USB is dependant on the transducers setup. USB – USB is a host based bus architecture, because of this the output rate achievable will be affected by other bus traffic and host activity. USB has two transfer modes, Single Transfer which requests 1 r reading at a time and Bulk Transfer which transfers readings in blocks of 50 Torque/Speed pairs. CAN Bus – to achieve a Torque reading output rate of 10KHz, the Speed reading output rate must be reduced to 100Hz.

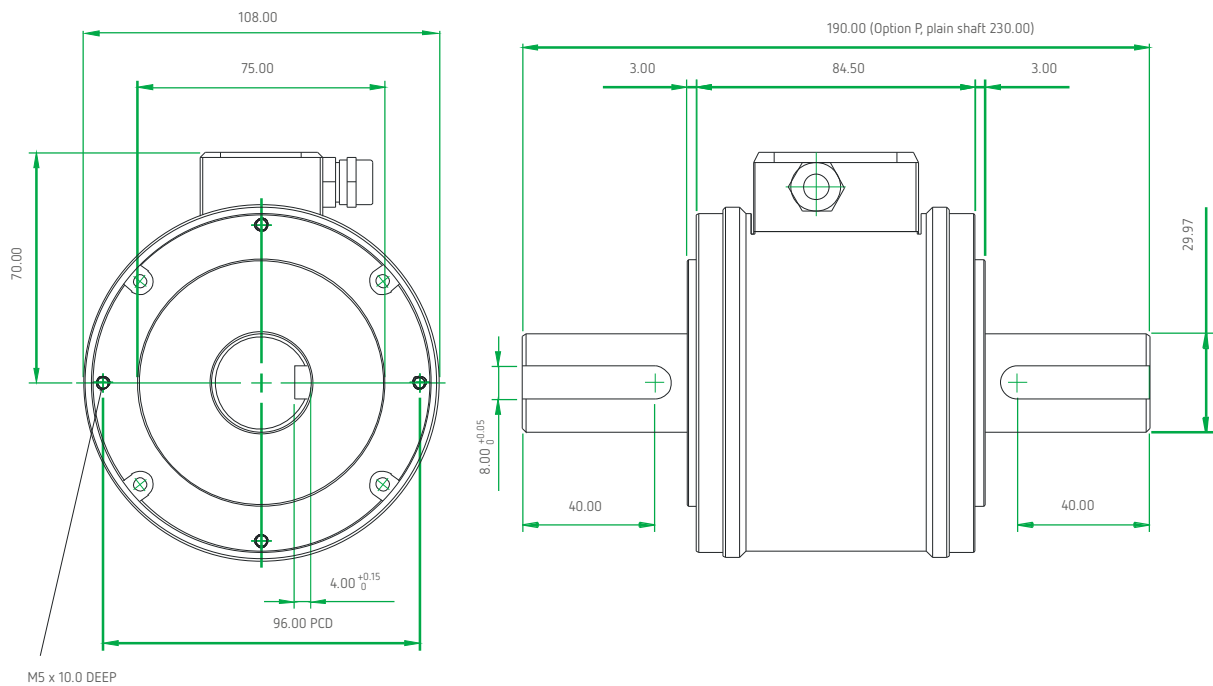
■ Dimensions (1Nm to 100Nm)



Measurement units: Millimetres (mm)

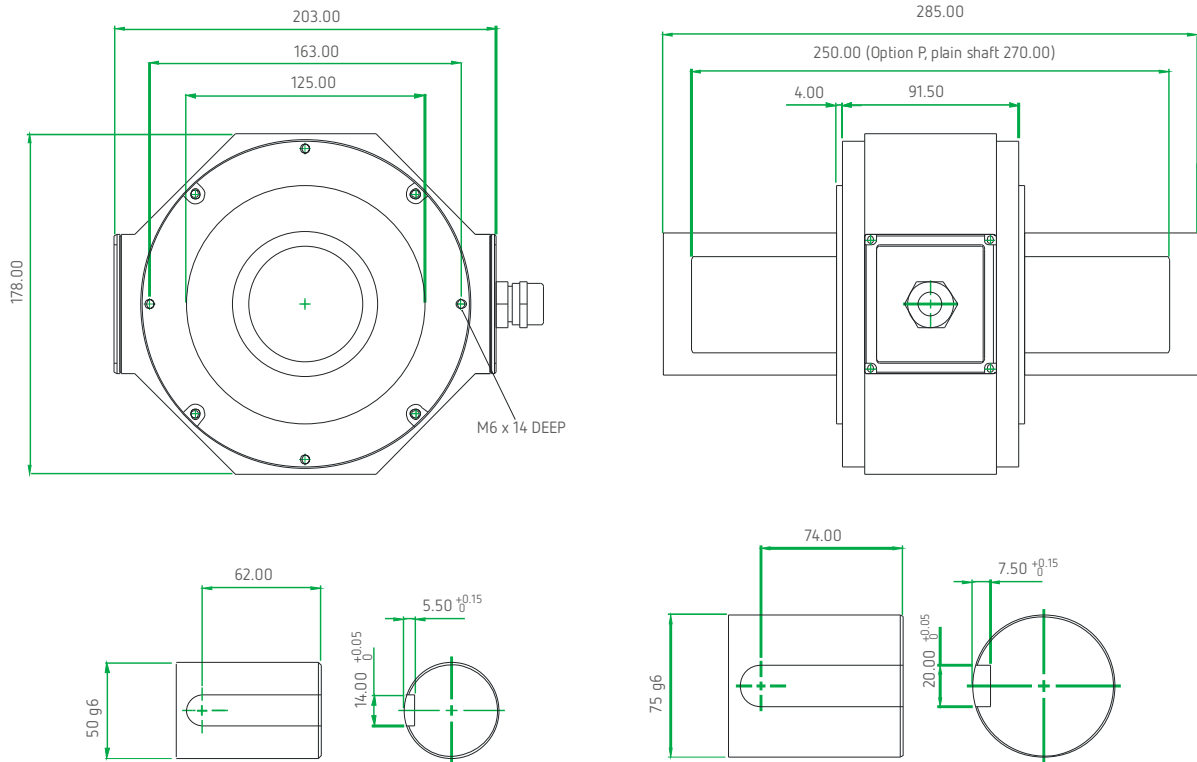
Parameter	Data												Units
Torque (Max)	1	2.5	3.9	6	8.5	13	17.5	20	30	55	85	100	Nm
Shaft Code	CF	DA	DF	DB	DC	DG	DD	DE	EB	EC	ED	EE	
Shaft Size (Diameter)	6				12				20				mm
Torsional Stiffness	0.23	1.28	1.3	1.32	1.6	1.7	1.8	1.9	4.1	6.4	8.1	9.2	KNm/rad
Mass moment of inertia, $I_v$	0.45	5.96	6.00	6.04	6.13	6.18	6.24	6.42	22.9	23.9	25.4	27.2	$\times 10^{-6}$ kg m <sup>2</sup>
Max measurable load limit	120 (of rated torque)												%
Static safe load breaking	300 (of rated torque)												%
Shaft weight, approx	0.03	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.36	0.37	0.40	0.41	kg
Transducer with shaft weight, approx (1 dp)	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.9	0.9	0.9	0.9	kg

**■ Dimensions (101Nm to 500Nm)**



Parameter	Data					Units
<b>Mechanical Properties</b>						
Torque (Max)	175	225	265	350	500	Nm
Shaft Code	FA	FB	FC	FD	FE	
Shaft Size (Diameter)	30					mm
Torsional stiffness	32.9	35.6	37.2	37.9	39.8	kNm/rad
Mass moment of inertia	138.9	143.1	147.7	151.9	174.2	$\times 10^{-6} \text{ kg m}^2$
Max measurable load limit	120 (of rated torque)					%
Static safe load breaking	300 (of rated torque)					%
Shaft weight, approx	1.1	1.1	1.1	1.2	1.2	kg
Transducer with shaft weight, approx (1 dp)	2.3	2.3	2.3	2.4	2.4	kg

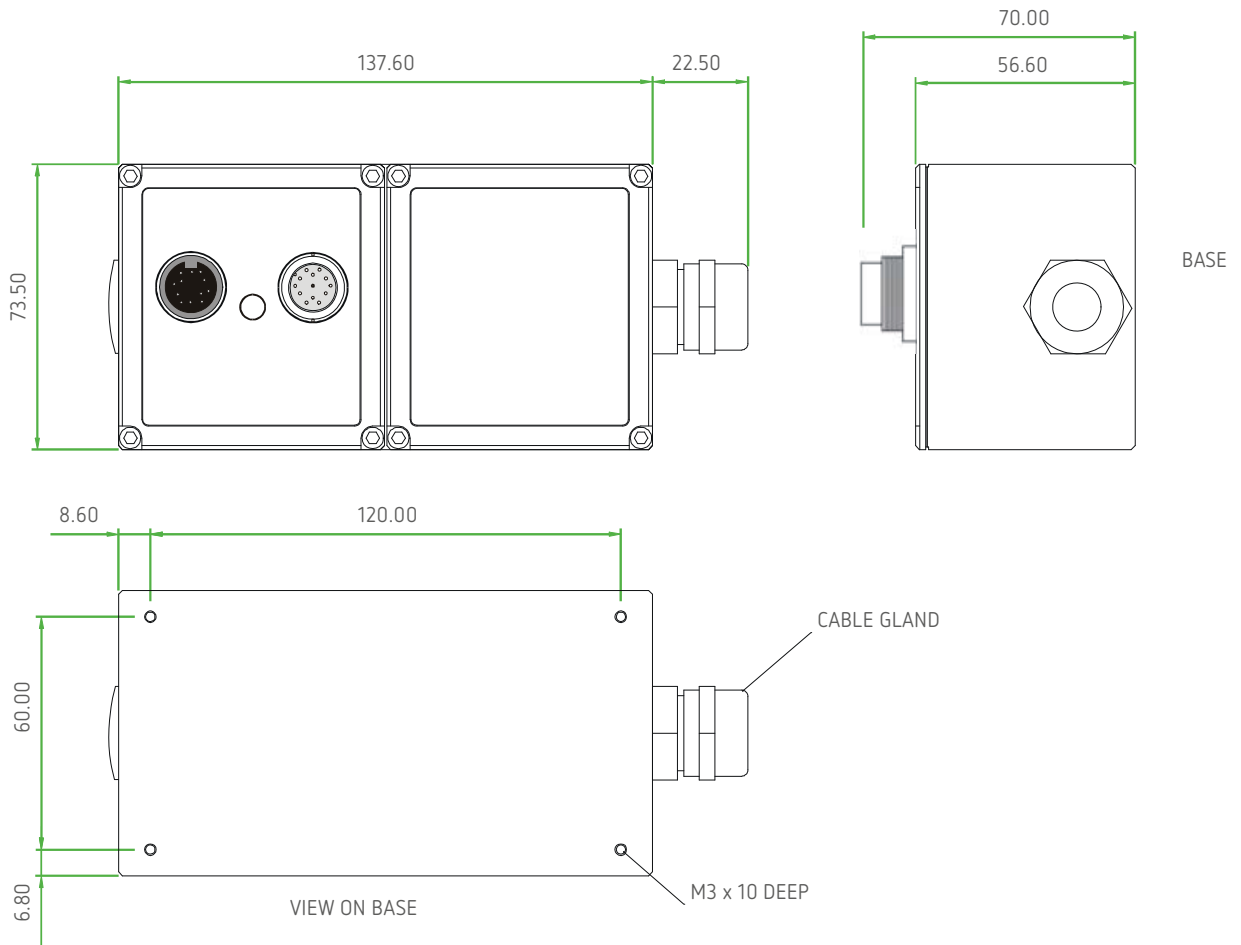
■ Dimensions (501Nm to 13000Nm)



Measurement units: Millimetres (mm)

Parameter	Data										Units
<b>Mechanical Properties</b>											
Torque (Max)	650	850	1100	1350	2000	3000	4000	6000	10000	13000	Nm
Shaft Code	GE	GA	GB	GC	GD	HA	HB	HC	HF	HG	
Shaft Size (Diameter)	50					75					Mm
Torsional Stiffness	TBC	TBC	199.2	TBC	214.1	TBC	TBC	914.4	945.5	TBC	kNm/rad
Mass moment of inertia	TBC	TBC	1330	TBC	1497	TBC	TBC	7932.7	9407.1	TBC	$\times 10^{-6} \text{ kg m}^2$
Max measurable load limit	120 (of rated torque)										%
Static safe load breaking	300 (of rated torque)										%
Shaft weight, approx	TBC	TBC	3.9	TBC	4.1	TBC	TBC	10.2	10.6	11.2	kg
Transducer with shaft weight, approx	TBC	TBC	7.1	TBC	7.3	TBC	TBC	13.4	13.8	14.4	kg

■ Electronics Module



Measurement units: Millimetres (mm)

## Standard Range

● – Standard feature    ◇ – Optional feature

Torque, Speed, Power Outputs	RWT430 / 440 Series		Option Code	Remarks
	RWT430	RWT440		
Torque only	430	440		
Torque & Speed (60 pulses/rev)	431			User to specify RPM/FSD when ordering
Torque & Power (60 pulses/rev)	433			User to specify Power/FSD when ordering
Torque & Speed (60 pulses/rev) or Power		441		Outputs are user selectable
<b>Standard features</b>				
Keyed Shaft Ends	●	●	K	1Nm will have flats
Voltage output ±5v FSD (Fixed)	●		B	
Voltage outputs from ±1v to ±10v FSD and unipolar (Variable)		●		Output is user selectable
RS232 output		●		
Torque Averaging & Torque Peak		●		
Self Diagnostics	●	●		
Internal temperature measurement	●	●		Value available on RWT440 series only
Deep grooved shielded bearings with oil lubrication	●	●		
Ingress Protection (IP) 54	●	●		
Link Cable (1.5m)	●	●		From sensor head to electronics module
<b>Optional features</b>				
Plain Shaft Ends	◇	◇	P	Shaft length will be longer than keyed end shafts – consult factory for length
Splined Shaft Ends	◇	◇	T	Consult factory for details
Voltage output ±1v FSD (Fixed)	◇		A	In place of Option B
Voltage output ±10v FSD (Fixed)	◇		C	In place of Option B
Customer Specified Voltage Output (Fixed)	◇		U	In place of Option B. User to specify range/scale when ordering
Current output 0-20mA (Fixed)	◇		D	In place of Voltage output options
Current output 4-20mA (Fixed)	◇		E	In place of Voltage output options
Current output 12±8mA (Fixed)	◇		V	In place of Voltage output options
Current output 0-20mA, 4-20mA & 12±8mA (Variable)		◇	F	Current output is user selectable and in place of Voltage output. However user can reselect a Voltage output, if required. (Note 8)
USB2.0 full speed 12 Mbps Digital output		◇	G	
CANbus output		◇	H	In place of RS232
High Speed Bearings (See Note 9 below)	◇	◇	J	
Sealed Bearings	◇	◇	S	Consult factory for maximum speed allowance
Ingress Protection (IP) 65 – for sensor and electronics (See Note 10 below)	◇	◇	L	
Ingress Protection (IP) 65 – Cavity 'D' connectors in lead b/w sensor & electronics	◇	◇	M	
Cavity 'D' connectors in lead b/w sensor & electronics	◇	◇	N	
Link Cable (>1.5m)	◇	◇	R	Consult factory for length

Note 8: 2 x analog channels available. Default settings are Channel 1 (voltage/current) – torque. Channel 2 (voltage/current) – speed or power, if ordered.

Note 9: At very high speeds, for better balance the factory recommend plain or splined shafts.

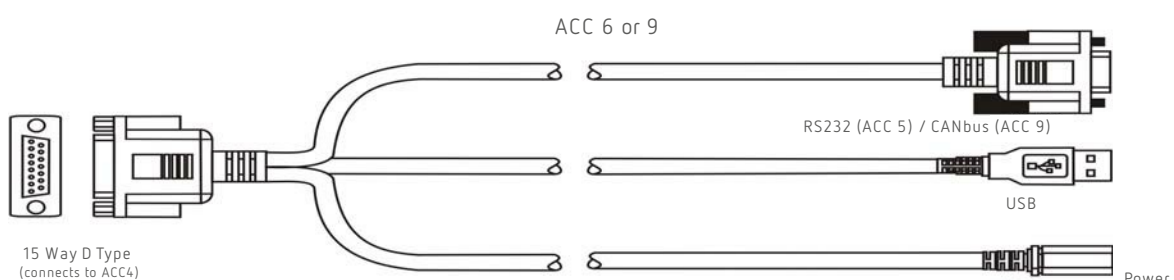
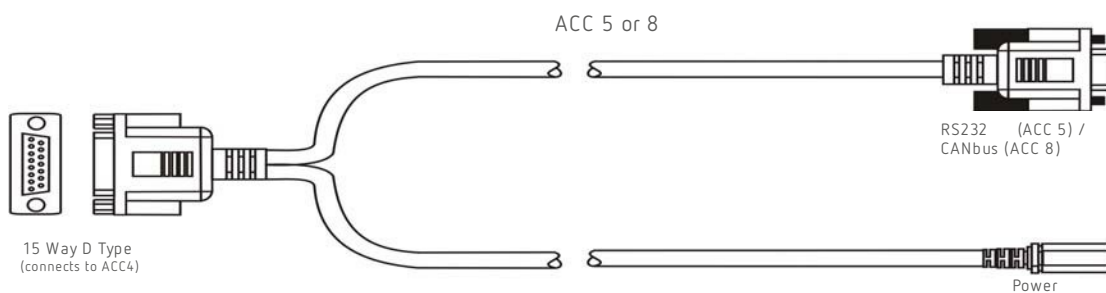
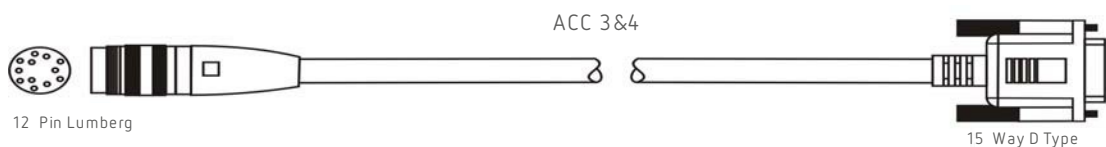
Note 10: Transducers fitted for IP65 will have running speeds considerably reduced, increased drag torque and accuracy can be affected.

**Connector and Lead Options**

Connectors & Leads	RWT430	RWT440	Option Code	Remarks/Purpose
Analog Connector 12 Pin Lumberg (female)	◇	◇	ACC 1	For user to self wire
Digital Connector 12 Pin Lumberg (male)		◇	ACC 2	For user to self wire
Analog Lead (Length 2.5m) 12 Pin Lumberg (female) to 15 way 'D' type connector (female)	◇	◇	ACC 3	For connecting RWT to user's system via 15 pin 'D' connector
Digital Lead (Length 2.5m) 12 Pin Lumberg (male) to 15 way 'D' type connector (male)		◇	ACC 4	For connecting RWT to user's system via 15 pin 'D' connector
Digital Lead Adapter (Length 1m) 15 Way 'D' type (female) to RS232 and Power Connectors		◇	ACC 5	For connecting RWT to PC via RS232 [Also needs Digital Lead (ACC4) to connect to RWT]
Digital Lead Adapter (Length 1m) 15 Way 'D' type (female) to RS232, USB and Power Connectors		◇	ACC 6	For connecting RWT to PC via USB (Option G) or RS232 [Also needs Digital Lead (ACC4) to connect to RWT]
Digital Lead Adapter (Length 1m) 15 Way 'D' type (female) to CANbus and Power Connectors		◇	ACC 8	For connecting RWT to PC via CANbus (Option H) [Also needs Digital Lead (ACC4) to connect to RWT]
Digital Lead Adapter (Length 1m) 15 Way 'D' type (female) to CANbus, USB and Power Connectors		◇	ACC 9	For connecting RWT to PC via USB (Option G) or CANbus (Option H) [Also needs Digital Lead (ACC4) to connect to RWT]

**RWT430/440 Series Torque Transducers – Additional related products**

	Code	Remarks/Purpose
Transducer Display ETD	ETD	Display readout
AC Mains Adapter Power Supply	PSU 1	For providing 12-32Vdc
Transducer Signal Breakout Unit	SBU 2	
TorqView	TV	Torque Monitoring Software





**Ordering information**

When you order a Torque Transducer please note that any torque/FSD is possible between ranges – please specify rated torque and options using the following format:

For example: <i>RWT</i>	431 - 15Nm -	K-CL	A 'basic' transducer with torque and speed outputs, rated and calibrated to 15Nm FSD with keyed ends, ±10v and IP65 protection.
Your transducer requirement: <i>RWT</i>			
Max speed (if applicable)		RPM	
Connector & Lead options		(if applicable) <i>See over</i>	
Additional related products		(if applicable) <i>See over</i>	

**Glossary of terms and definitions used in this datasheet**

- *Surface Acoustic Wave (SAW)* - An acoustic wave travelling along the surface of a material having some elasticity, with amplitude that typically decays exponentially with the depth of the substrate.
- *Strain dependent SAW resonators* – A type of elastic SAW device, which changes its resonant properties when it is subjected to axial strain/compression. TorqSense uses this principle, which is protected by a number of patents.
- *Incremental Electronic Scan (IES)* – The most successful and precise method for interrogating strain dependent SAW resonators. The IES interrogation method uses a processor controlled frequency synthesiser to excite the SAW resonators over a defined range of frequencies and measure the reflected signal. TorqSense uses this patented method.
- *Resolution of the IES method* - The minimum measurable number corresponding to the stress/strain sensitive resonance point of the SAW resonator. The value is limited by following the factors:
  - frequency resolution of the synthesiser, which is 1000 times greater than overall resolution of the system.
  - relationship between frequency response and resolution. Increments of the resolution will proportionally decrease the system's frequency response. TorqSense systems are optimised for the best performance that suits most applications. However, on the RWT440 series models customers do have the capability to adjust the system performance.
- *Frequency response of the IES method* – The measure of the TorqSense system's response at the output to a signal of varying frequency at its input. The frequency response is typically characterised by the magnitude of the system's response, measured in dB. There are two ways of characterising the system's frequency response:
  - 0.1dB frequency range, where the output magnitude of the signal is different to the input magnitude of the signal by not more than 0.1dB (practically absolutely identical).
  - 3dB frequency range, where the output magnitude of the signal is 0.707 of the input signal. This is a common standard for most applications, unless it specifically says otherwise. This standard is also used to characterise the TorqSense system's frequency response.
- *Accuracy* - The degree of conformity of a measured or calculated quantity, which will show the same or similar results. Accuracy of the overall TorqSense system is limited by the combined error of several factors such as linearity, hysteresis, temperature drifts and other parameters affecting measurements. If errors in the system are known or can be estimated, an overall error or uncertainty of measurement can be calculated.
- *Digital averaging* – The application of algorithms to reduce white noise. In any electronic system, electronic white noise is mixed with the signal and this noise usually limits the accuracy. To reduce the influence of white noise and increase the accuracy of the system different averaging algorithms can be applied. In the TorqSense system a flying digital averaging technique is applied to reduce the white noise commensurate with the level of accuracy required. However, as any averaging algorithm works as a low pass filter, the more averaging that is applied the lower the frequency response. Therefore, each Torqsense system should be optimised to the customer's requirements by choosing the right combination of accuracy/frequency response. Please see relevant part of the Datasheet and User Manual.

*Data parameters measured at +20°C*

The information provided herein is to the best of our knowledge true and accurate, it is provided for guidance only. All specifications are subject to change without prior notification.

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Germany/Austria/Switzerland  
info@althen.de

Benelux  
sales@althen.nl

France  
info@althensensors.fr

Sweden  
info@althensensors.se

USA/Canada  
info@althensensors.com

Other countries  
info@althensensors.com