

High technology support

RTS-E/E2/S torque sensor

Rotation Torque Sensor

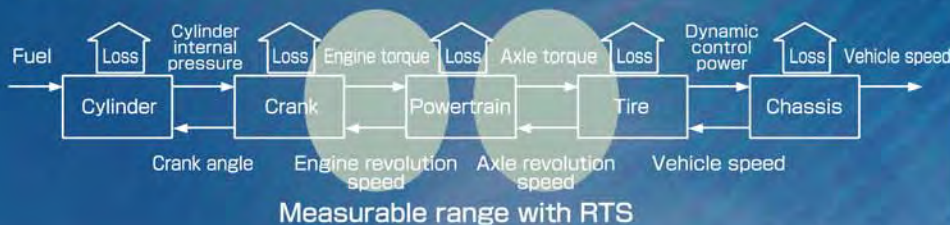
Advantages

- Torque sensor featuring 1/3000 high resolution and robust construction
- Directly attachable to either the engine axle or CVJ
- Real torque measurement using component force measurement
- Double range with high accuracy (without degrading the total accuracy)

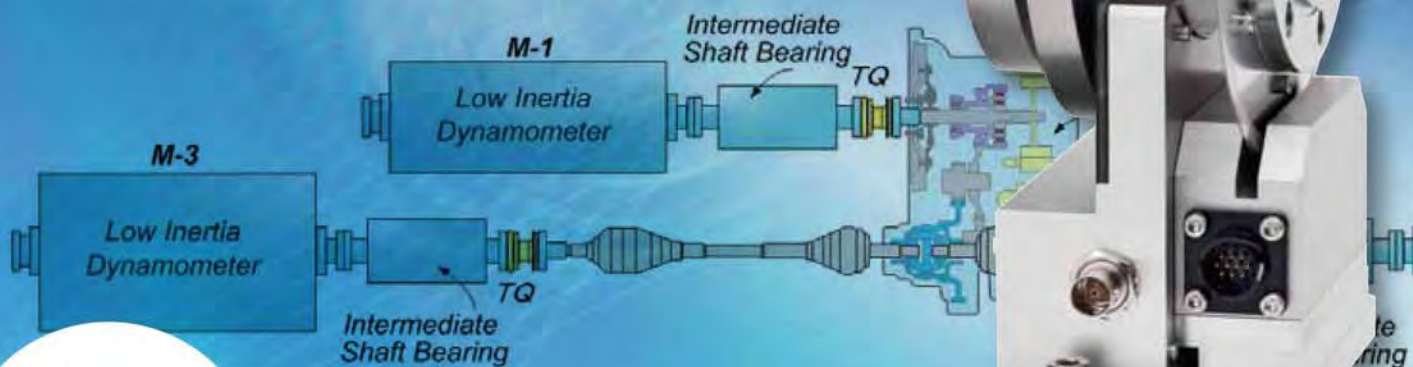
Capabilities

- Nominal torque : 200 Nm - 5 kNm
- Total accuracy : 0.03%
- Double range : Total accuracy of 1/3000 is guaranteed at 1/5 of full scale
- Maximum rpm : RTS-E/E2 10,000 rpm (200 Nm) - 3,000 rpm (5 kNm)
: RTS-S 12,000 rpm (200 Nm) - 10,000 rpm (5 kNm)

Energy Flow Model for the Torque Demand Concept



Measurable range with RTS



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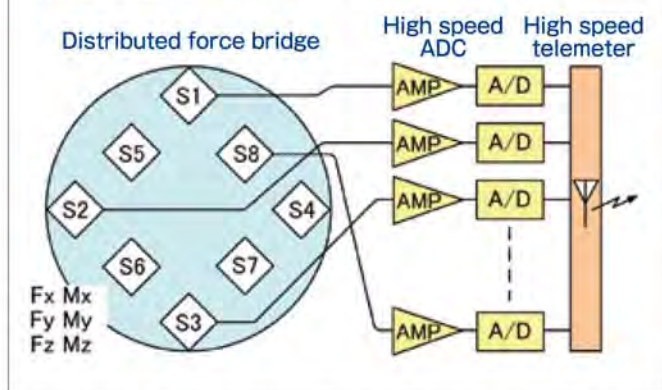
The RTS is a shaft torque sensor with distributed force detection, created from A&D's DSP technology. The RTS enables simultaneous, non-contact measurement of torque, thrust, and radial forces. It can measure and display high-speed, detailed phenomenon 10 times faster and at 10 times the

● High accuracy of 0.03%

Features of distributed force measurement technology

- With conventional torque sensors and component force meters, there is a bridge circuit made up of 4 strain gauges for each torque or component force. However, the RTS utilizes a distributed force system that evenly distributes 4 dedicated element strain gauges on the sensors.
- The distributed force detection method makes it possible to perform model calculations using components' forces in the area of strain. This makes it possible to calculate true torque precisely without interference from thrust and radial forces, while still simultaneously measuring the thrust and radial forces.
- Because torque is measured as multiple distributed forces, it is possible to lower the noise of model-calculated torque signals compared to conventional methods.
- The distributed force detection method uses 4-element strain gauges. These specially designed strain gauges are arranged for heat balance within an extremely small area to form a bridge circuit that eliminates the influence of heat gradients and temperature changes.

RTS exclusive 4 element torsion gauges

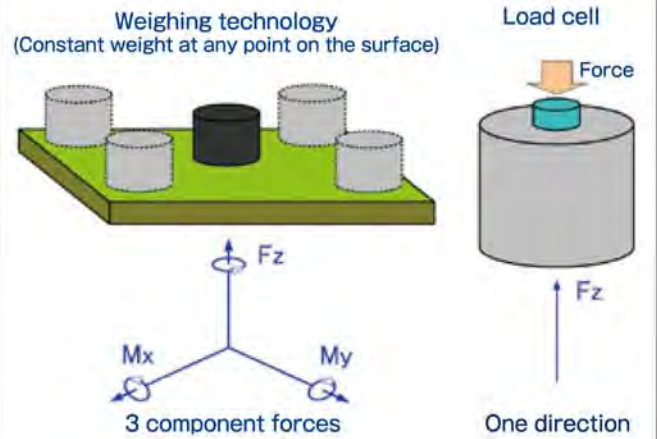


Non-contact sensor based on telemetry technology

- Our development of high speed, large capacity telemeters contributes to our non-contact, simultaneous, highly-accurate measurements.
- Detected distributed power is A/D transformed inside the sensor. The large amount of distributed force data is transferred with the high speed telemeter, enabling lossless signal transfer.

● Component illustration of RTS-S series

Concept of distributed forces



Model cycle processing and frame measurement

The torsion gauge signal is digital and is calculated by the DSP system at high speed using the matrix-vector method.

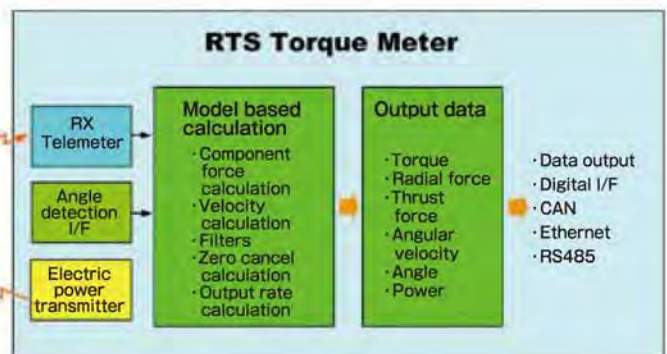
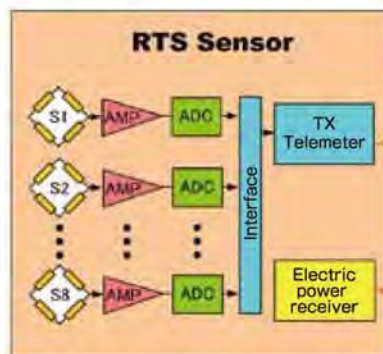
- Digital/analog data linkage
 - Noise-free and high precision torque can be used as a feedback signal via the digital data link. All data can be stored on a PC.
 - CAN, Ethernet, RS485
 - Analog system, DA voltage output $\pm 10\text{ V}$
- Frame measurement (RTS-E)
 - It is possible to start recording the frame measurement by timer, interval and external trigger.
 - Frame data output : 20 μsec (50 kHz) sampling data is block transferred.

Rotation synchronization measurement

- A slit disk rotary encoder installed on the sensor measures the rotation angle simultaneously. The angle information calculated enables output angular velocity, component force, and power.



RTS-S Sensor



AD7893 Torque Meter

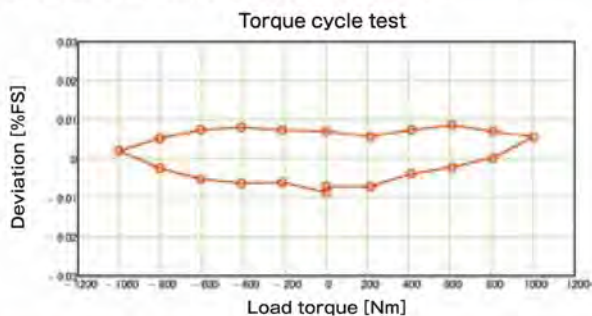
To externally connected equipment

● **RTS torque sensor evaluation**

Example of torque meter features

■ **Cycle test**

This test loads positive and negative torque continuously. This is the most difficult evaluation method for torque meters. The RTS shows a performance of 0.01% FS (FS=1 kNm).



■ **Weight-type torque calibration test**

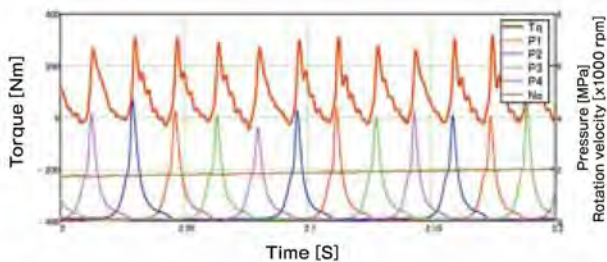
By installing the torque sensor directly to the calibration arm, there is no need for error-causing intermediate bearings. Thus, highly accurate calibration is possible. The RTS has enough stiffness to endure even radial force.



Example validation of high speed response

■ **Torque waveform and combustion pressure of cylinders.**

The detected torque waveform differs according to each cylinder, and it can be accurately understood that combustion cylinder pressure and torque waveform has synchronized.



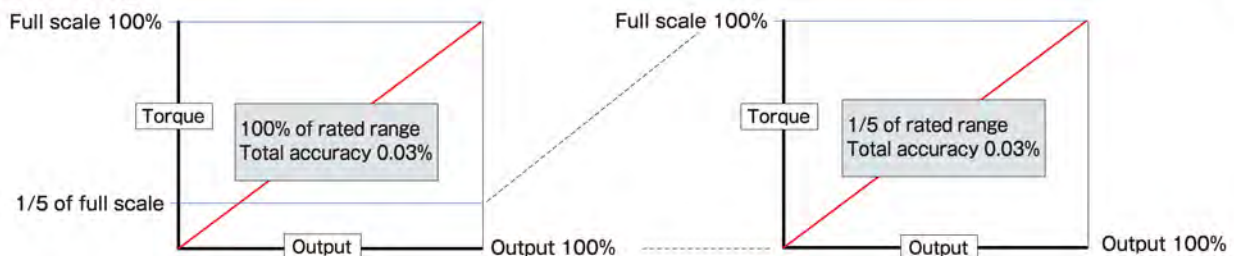
■ **Torque measurement at an engine bench**

This is an example of combustion pressure testing. The RTS sensor is installed between the crank shaft and the fly wheel (inertia equivalent to the gear box).



● **Accuracy that can only be obtained with double range equipped (optional)**

Users usually select sensor range according to the maximum torque value during testing. However, the desirable measurement range tends to be too wide to measure with one sensor. The RTS series can be used in double range mode at 1/5 of full scale without degrading total accuracy, so it can cover anything from a small measurement range to a large measurement range.



● **5kHz high speed digital response enables total digital control**



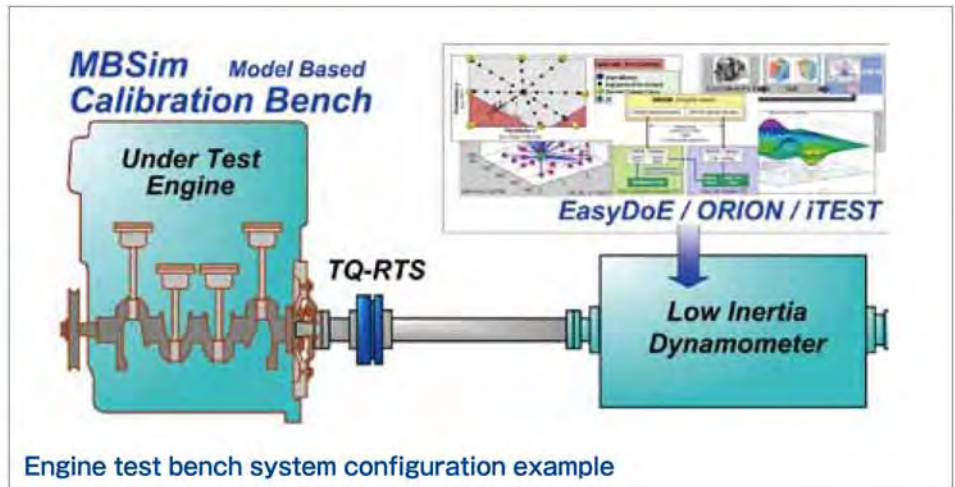
RTS series is capable of 5 kHz high speed response. Due to this ability, everything from the sensor signal to real measurement data of the control system is treated as a digital value. Thus, these values can be used with a digital controller as a feedback signal or real measurement value.

Measurement and control system using a CPU system

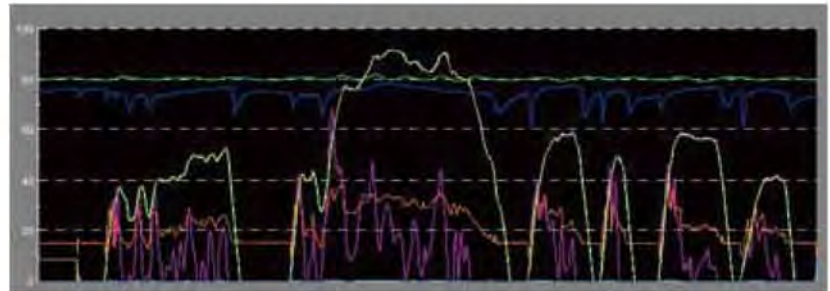
The RTS sensor is designed to withstand harsh conditions of torsion stiffness, torsion angle and Even in configurations demanding radial and thrust load conditions, each component moment

● Engine bench testing example

Torque generated from combustion pressure reaches torque several times higher than the engine's nominal torque. The RTS sensor, with its high accuracy, wide dynamic range, and high response time, enables to analyze the behavior of generated torque and combustion pressure in a multi cylinder engine.

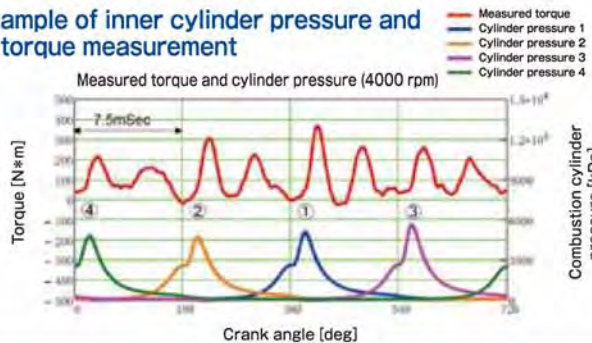


Engine bench testing system



Engine bench testing simulation example

Test example of inner cylinder pressure and instant torque measurement



The data sample above exemplifies the testing at A&D's test lab. Instant torque waveforms for each cylinder can be measured.

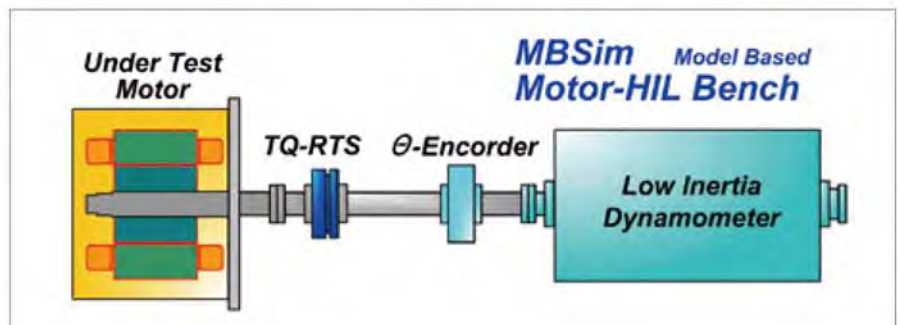
Note : For instant torque measurement, estimated maximum torque value must be in the RTS measurable range. Overload measurement value is not guaranteed.



RTS sensor directly connected to engine crank shaft

● Utilization for motor torque testing

The RTS sensor can also be used for motor testing for EV development. With high accuracy and stiffness, it provides solutions to user testing requirements.



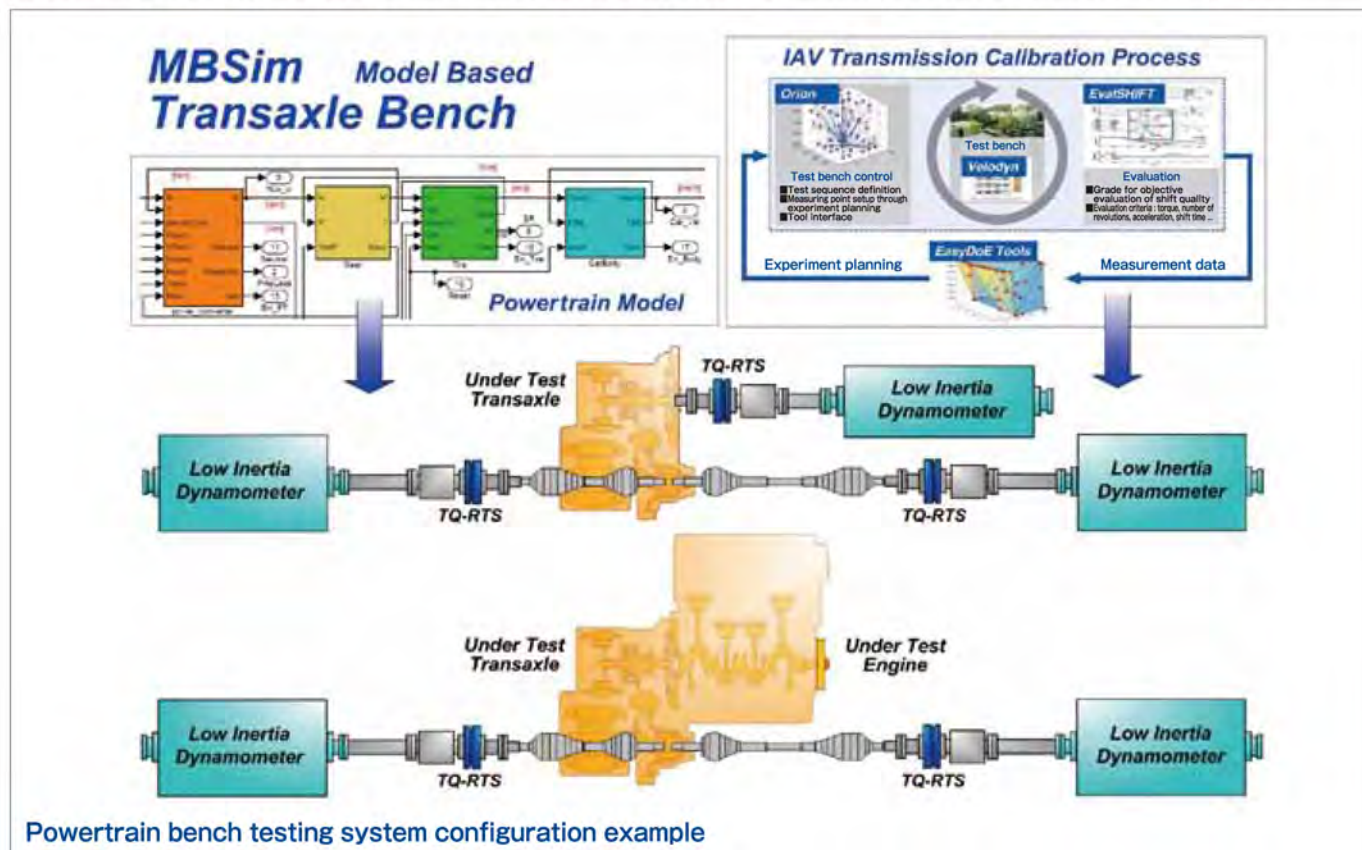
maximum bending moment.
is accurately and separately measured.

High technology support ▶

RTS-E/E2/S
Rotation Torque Sensor

● Power train testing example

For transaxle testing, there are two measurement methods. One is using a real engine for the driving force, and the other is using a hypothetical engine (motor driven). Testing these requires a wide dynamic range of load torque for the output shaft because there is high load during ignition and extremely low load during coasting. To address errors caused by intermediate bearings, a torque sensor that is directly connectable to the input and output shaft is indispensable. The RTS sensor is superior in this aspect.



Powertrain bench testing system configuration example



RTS directly connected to the drive shaft



RTS directly connected to the drive shaft



Ignition simulation with hypothetical engine (motor driven)



Powertrain testing system

RTS directly connected to the load motor

Torque sensor specification of RTS-E/E2 series

Measurement range	200 Nm	500 Nm	1 kNm	2 kNm	5 kNm (Option)	Unit	Remark
Model	RTS-E200	RTS-E500	RTS-E1K	RTS-E2K	RTS-E5K		
Performance specification							
Rated capacity (RC)	200	500	1k	2k	5k	Nm	
Total error range	0.03					%RC	*1
Non-linearity	0.02					%RC	*2
Hysteresis	0.02					%RC	*3
Repeatability	0.01					%RC	*4
Resolution	0.02					%RC	*5
Temperature specification							
Temperature effect at zero point	0.003					%RC/°C	
Temperature effect on sensitivity	0.003					%Load/°C	
Temperature range for compensation	-10 to +60					°C	
Temperature range for operation	-20 to +80					°C	
Temperature range for preservation	-20 to +85					°C	
Rotation specification							
Maximum rpm	10,000			6,600	3,300	rpm	
Continuous rpm	10,000			6,000	3,000	rpm	
Rotation variation at zero point	0.05					%RC	
Machine characteristics							
Inertia moment	5.8×10^{-3}	5.8×10^{-3}	5.8×10^{-3}	19.7×10^{-3}	42.0×10^{-3}	kg·m ²	
Torsion stiffness	0.3×10^3	0.8×10^3	1.6×10^3	5.6×10^3	7.7×10^3	kNm/rad	
Torsion resonance frequency	5.6	5.6	5.8	5.6	4.3	kHz	
Torsion angle	0.6×10^{-3}	0.6×10^{-3}	0.6×10^{-3}	0.6×10^{-3}	0.7×10^{-3}	rad	*6
Allowable overload	200					%RC	
Maximum overload	500					%RC	
Maximum thrust load	5	10	20	30	50	kN	
Maximum radial load	5	10	20	30	50	kN	
Maximum curve moment	0.2	0.5	1	5	5	kNm	
Weight of rotor	3.4	3.4	3.4	5.5	8.8	kg	

*1 : Measured with static torque testing including non-linearity and hysteresis. *2~*3 : Number for reference.

*4 : Measured with static torque testing. *5 : @BW=100 Hz. *6 : Torsion angle on rated torque value.

Top-of-the-line meter with high accuracy and high performance (RTS-E)



- This model boasts both high accuracy and high performance.
- It can respond to six component force measurements and is capable of complex analysis.
Rated torque : 200 Nm - 5 kNm
Total accuracy : 0.03%
Maximum number of revolutions : 10,000 rpm - 3,300 rpm

Display specification of AD7891 torque meter (double range capable)

Display	5.7 inch TFT LC
Contents	<ul style="list-style-type: none"> • Digital indication of six component forces, torque, radial and thrust force • Indicated range and graph scale can be customized • Trend graph of six component forces (horizontal axis indicates time) • Measuring sample of 50 kHz
Data output	
Interface	<ul style="list-style-type: none"> • Analog voltage (0 to ±10 V) • Digital data output • CAN, Ethernet, RS485 • Filter output • Binary and text

Professional-use torque meter with high accuracy (RTS-E2)



- This model is used exclusively for torque measurement.
Rated torque : 200 Nm - 5 kNm
Total accuracy : 0.03%
Maximum number of revolutions : 10,000 rpm - 3,300 rpm

Display capabilities of AD7893 torque meter

Display	3.5 inch TFT LC
Contents	<ul style="list-style-type: none"> • Digital indication and torque measurement only • Six component forces can be shown on the monitor • Indicated range and graph scale can be customized • Analog signal output rate : 10 kHz • Digital signal output rate : 5 kHz
Data output	
Interface	<ul style="list-style-type: none"> • Analog voltage (0 to ±10 V) • Digital data output • CAN, Ethernet, RS485 • Filter output • Binary and text

Selection guide for RTS series (options)

In addition, for your convenience, we offer a double range type with guaranteed 1/3000 resolution operating simultaneously at 1/5 of full scale.

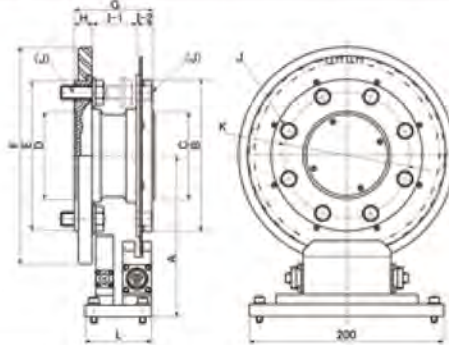
Series/Capacity	200 Nm	500 Nm	1 kNm	2 kNm	5 kNm	Double range capability
RTS-E	○	○	○	○	○	Option
RTS-E2	○	○	○	○	○	Option

Note : For instant torque measurements, the expected maximum torque value must be within the RTS measurable range.
The allowable overload range does not indicate an accuracy guarantee for values exceeding the measurable range.

● **RTS-E/E2/S series torque sensor chart**

RTS-E/E2 series

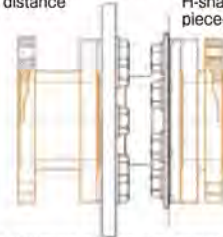
Model	A	φB	φC	φD	φE	φF	G	H	I-1	I-2	J	φK	L	Bolt strength class	Tightening torque
RTS-E200Nm	148	φ120.8	φ75 g5	φ75 H6	φ120	φ188	70	15	38	17	2x8-φ10.2	φ101.5	68	Over 10.9	60 Nm
RTS-E500Nm/1kNm	148	φ120.8	φ75 g5	φ75 H6	φ120	φ188	70	15	38	17	2x8-φ10.2	φ101.5	68	Over 10.9	60 Nm
RTS-E2kNm	165.5	φ155.8	φ90 g5	φ90 H6	φ155	φ223	80	18	46	16	2x8-φ14.2	φ130	68	Over 10.9	160 Nm
RTS-E5kNm	180	φ183.8	φ110 g5	φ110 H6	φ183	φ254	107	180	61	23	2x8-φ16.2	φ155.5	98	Over 10.9	270 Nm



H-shaping distance pieces (optional)

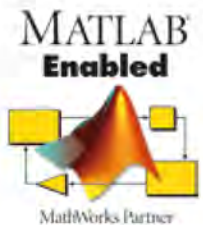
H-shaping distance piece-A

H-shaping distance piece-B



H-shaping distance pieces are sometimes necessary for taking highly accurate measurements. A&D can manufacture custom designs according to customer requirements.

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Safety Warning!

● Please read the instruction manuals carefully before use.



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