AD7832 series torque meter specifications

Torque sensor																Unit	Remark
Model		AD7832															
		S200	S200D1	S500	S500D1	S1K	S1KD1	S2K	S2KD1	S5K	S5KD1						
Performance specifications	Rated capacity (RC)	200		500		1k		2K		5K						Nm	
	Full scale (FS)	200	200/40	500	500/100	1k	1k/200	2k	2k/400	5k	5k/1k					Nm	*1
	Total error range	0.03														%FS	*2
	Non-linearity	(0.02)														%RC	*3
	Hysterisis	(0.02)														%RC	*3
	Repeatability	0.01														%RC	*4
	Resolution	0.02														%RC	*5
Temperature specifications	Temperature effect at zero point	0.003														%RC/℃	
	Temperature effect on sensitivity	0.003														%Load/℃	
	Temperature range for compensation	-10~+60														℃	
	Temperature range for operation	-20~+80														℃	
	Temperature range for preservation	-20~+85														℃	
Rotation specifications	Maximum rpm	12000						10000								r/min	
	Continuous rpm	12000						10000								r/min	
	Rotation variation at zero point	0.05														%RC	*6
Machine characteristics	Moment of inertia	4.0×10^{-3}		5.0×10^{-3}		6.0×10^{-3}		9.0×10^{-3}		14.0×10^{-3}						kg·m²	
	Torsional stiffness	1.2×10^{3}		1.1×10^{3}		1.7×10^{3}		2.2×10^{3}		3.6×10^{3}						kNm/rad	
	Torsional resonance frequency	7.9		7.9		8.3		7.8		8.0						kHz	
	Torsion angle	0.2×10^{-3}		0.4×10^{-3}		0.6×10^{-3}		0.9×10^{-3}		1.4×10^{-3}						rad	*7
	Allowable overload	200		150												%RC	
	Maximum overload	500		300												%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		2		5						kNm	
	Weight of rotor	2.4		2.8		2.8		3.6		4.8						kg	

Sensor signal processor			
Model		AD7893-S	Unit
Exterior	Exterior dimensions	97(W)×97(H)×208.2(D)	mm
	Weight	1.2	kg
Electric specifications	Power supply	Input: 90 - 240V 50-60Hz, output: DC12V3A. Supply from AC adaptor	
	Power consumption	20 (AC adaptor included)	W
	Operation temperature range	10 - 40	℃
Interface	Rotary pulse input	Line driver differential input (RS422/485 conformity) 3ch (A phase, B phase, Z phase)	
	CAN	Hi-speed CAN (differential signal I/F) CAN 2.0B 1ch	
	Analog output	Single end output 3ch (torque, revolution velocity and revolution angle)	
	Digital input	Current drive input by photocoupler insulation (sink type) 2ch (range switch, zero point adjustment)	
	Digital output	Open collector output by photocoupler insulation, 3ch (range switch, status and watchdog output)	
	Serial communication	RS485 1 port	

*1 : Hi/Lo
*2 : Measured with static torque testing including non-linearity and hysteresis.
*3 : Reference number
*4 : Measured with static torque testing.
*5 : BW=100HZ
*6 : Value after revolution zero calibration
*7 : Torsion angle on rated torque value.

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⚠ Safety Warning! ●Please read the instruction manuals carefully before use.

A&D ...Clearly a Better Value

A&D Company, Limited
3-23-14 Higashi Ikebukuro Toshima Ku, Tokyo 170-0013 JAPAN
Telephone:[81](3) 5391-6132 Fax:[81](3) 5391-6148
http://www.aandd.jp

A&D Technology, Inc.
4622 Runway Blvd. Ann Arbor, MI 48108 U.S.A
Telephone:[1](734) 973-1111 Fax:[1](734) 973-1103
http://www.aanddtech.com

A&D Europe GmbH
Im Leuschnerpark 4, D-64347 Griesheim, GERMANY
Telephone:[49](6155) 605 250 Fax:[49](6155) 605 100

A&D Technology Trading (Shanghai) Co., Ltd.
21A, Majesty Building, No.138 Pudong Avenue, Pudong New Area, Shanghai, 200120, CHINA
Telephone:[86](21) 3393-2340 Fax:[86](21) 3393-2347

A&D Europe GmbH UK Branch
Unit 24/26 Blacklands Way Abingdon Business Park, Abingdon, Oxon OX14 1DY UNITED KINGDOM
Telephone:[44](1235) 550420 Fax:[44](1235) 550485

A&D Australasia Pty Ltd.
32 Dew Street, Thebarton, South Australia 5031 AUSTRALIA
Telephone:[61](8) 8301-8100 Fax:[61](8) 8352-7409

A&D KOREA Limited
Manhattan Bldg. 8F, 36-2 Yoido-dong, Youngdeungpo-gu, Seoul, KOREA
Telephone:[82](2) 780-4101 Fax:[82](2) 782-4280

●Appearances and/or specifications subject to improvement without notice.
●Contents of this catalog last updated March 2013.

*AD7832-ADCC-01-BP2-133xx

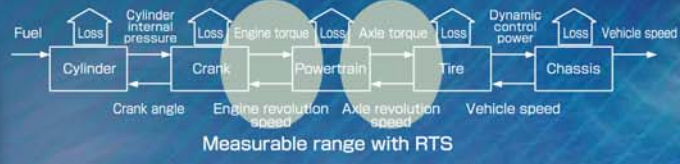
MBSim
Model Based Simulation

High technology support
AD7832 series torque sensor
Rotation Torque Sensor (RTS)

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 : 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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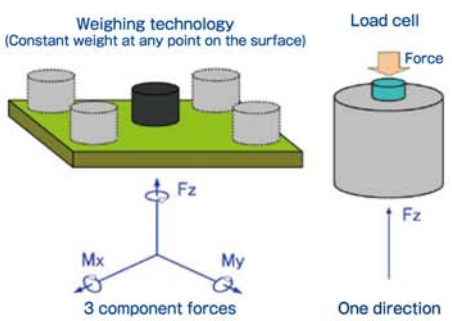
**The AD7832 series is a range of torque sensors with distributed force detection, created with A&D's DSP technology and high-speed telemetry technology.
The AD7832 series enables simultaneous, non-contact measurement of torque, thrust, and radial forces.
The series can measure and display high-speed, detailed phenomena faster and at a higher resolution than conventional sensors.**

●High accuracy of 0.03%

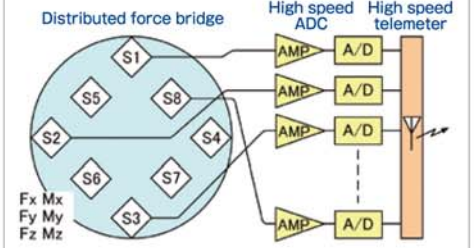
Features of distributed force measurement technology

- Conventional torque sensors and component force meters have a bridge circuit made up of 4 strain gauges for each torque or component force. However, the AD7832 series 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 these other 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.

Concept of distributed forces



RTS exclusive 4 element torsion gauges



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 ±10 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.

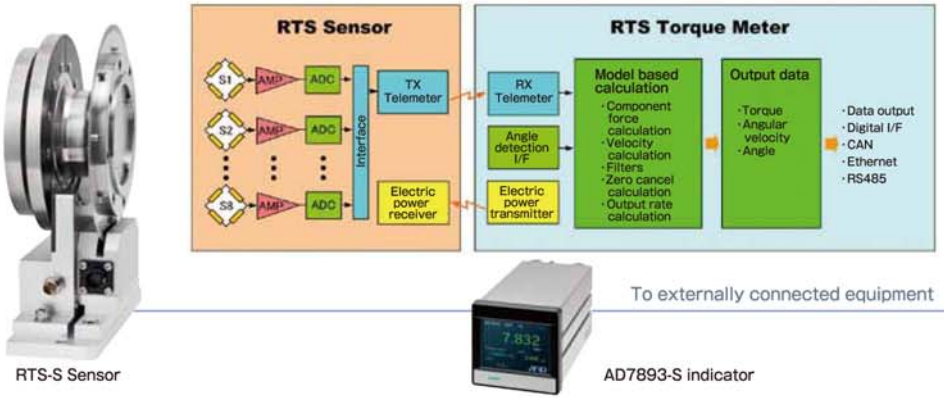
Non-contact sensor based on telemetry technology

- 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.

Rotation synchronization measurement

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

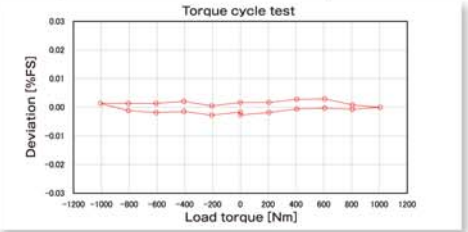
●Component illustration of AD7832 series



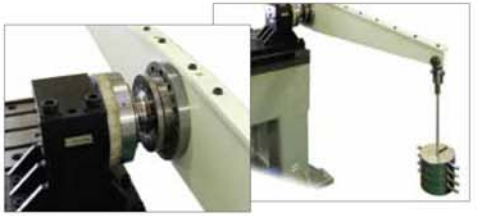
●RTS torque sensor evaluation

Example of torque meter features

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

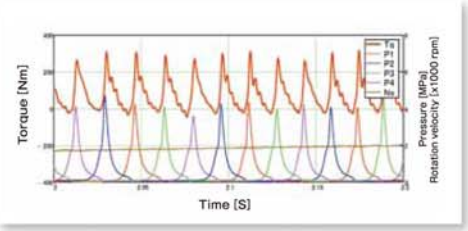


■Weight-type torque calibration test
By installing the torque sensor directly to the calibration arm, there is no need for error-causing intermediate bearings. Thus, highly accurate calibration is possible. The AD7832 series has enough stiffness to endure even radial force.



Example of validation of high speed response

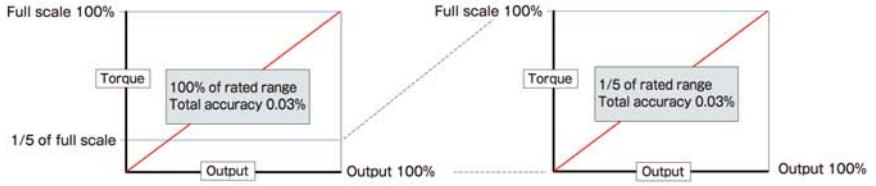
■Torque waveform and combustion pressure of cylinders.
The detected torque waveform differs according to each cylinder, and it can be accurately understood that combustion cylinder pressure and torque waveform has synchronized.



■Torque measurement at an engine bench
This is an example of combustion pressure testing. The AD7832 series 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 one.



●5kHz high speed digital response enables total digital control

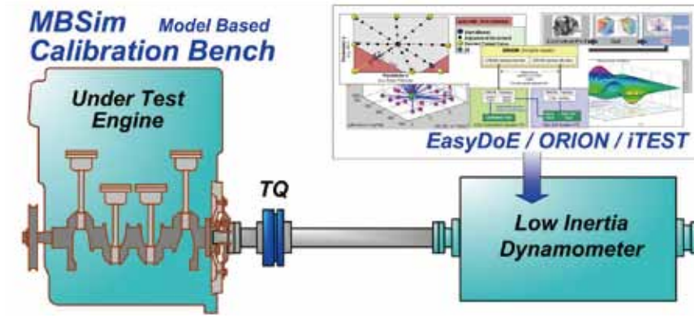
Measurement and control system using a CPU system

The AD7832 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.

AD7832 series sensors are designed to withstand harsh conditions of torsion stiffness, torsion angle and maximum bending moment. Even in configurations demanding radial and thrust load conditions, each component moment is accurately and separately measured.

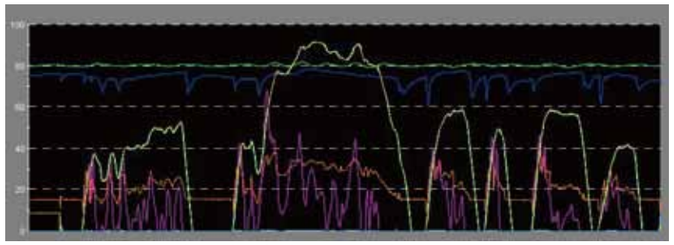
●Engine bench testing example

Torque generated from combustion pressure reaches torque several times higher than the engine's nominal torque. The high accuracy, wide dynamic range and high response time of the AD7832 series of sensors enables them to analyze the behavior of generated torque and combustion pressure in a multi cylinder engine.



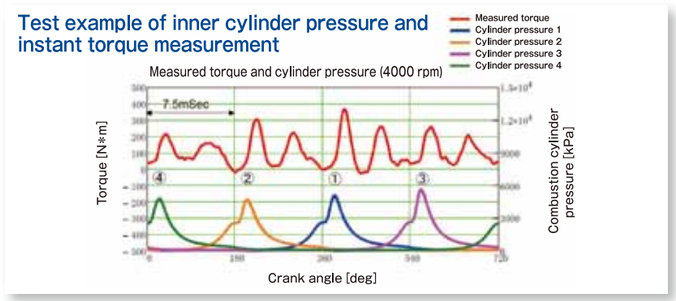
Engine test bench system configuration example

Engine bench testing system



Engine bench testing simulation example

RTS sensor directly connected to engine crank shaft

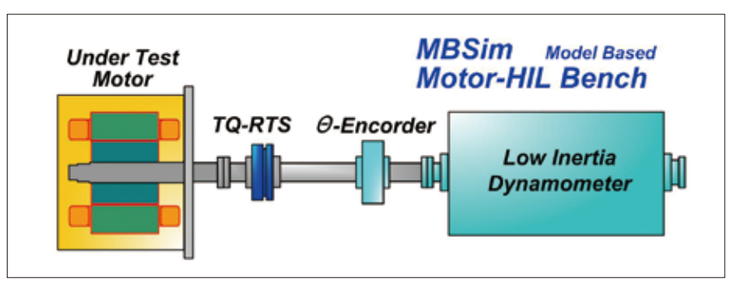


The data sample above exemplifies the testing at A&D's test lab. Instant torque waveforms for each cylinder can be measured.

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

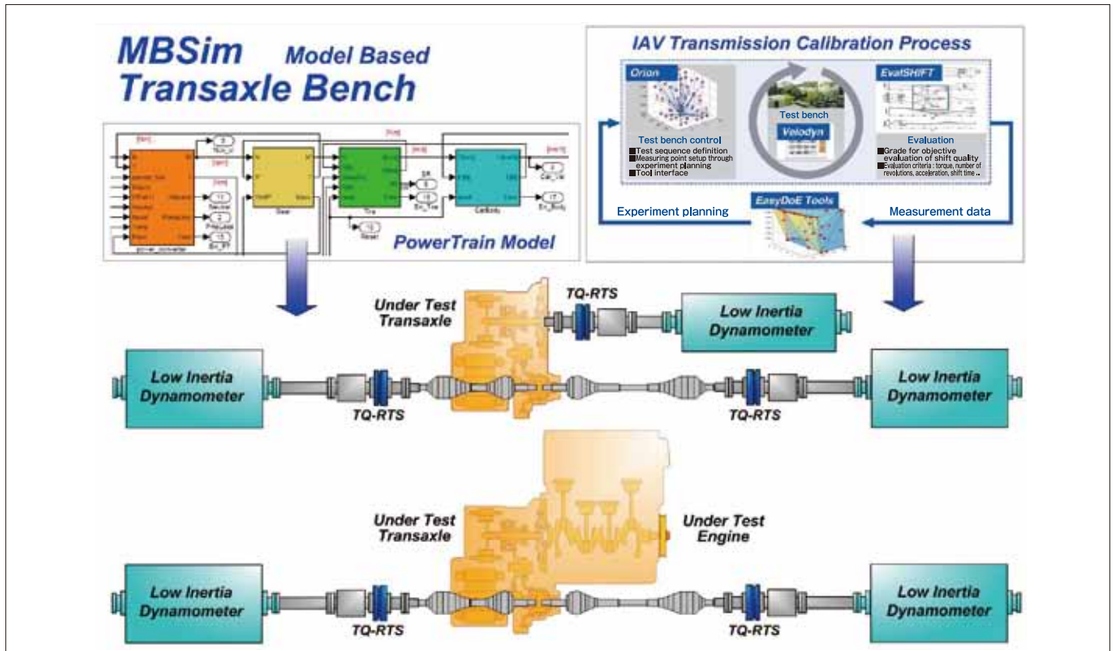
●Utilization for motor torque testing

AD7832 series sensors can also be used for motor testing for EV development. With high accuracy and stiffness, they provide solutions to user testing requirements.



●Power train testing example

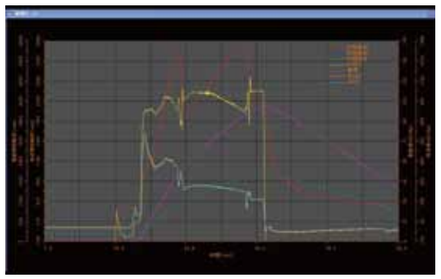
For transaxle testing, there are two measurement methods. One is using a real engine for the driving force, and the other is using a hypothetical engine (motor driven). Testing these requires a wide dynamic range of load torque for the output shaft because there is high load during ignition and extremely 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. AD7832 series sensors are superior in this aspect.



Powertrain bench testing system configuration example

AD7832 series sensor directly connected to the drive shaft

AD7832 series sensor directly connected to the drive shaft



Ignition simulation with hypothetical engine (motor driven)

Powertrain testing system

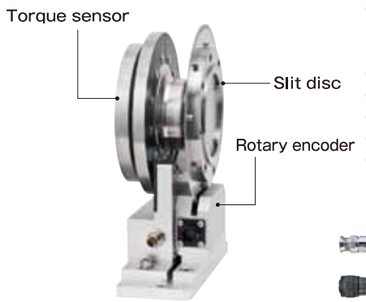
AD7832 series sensor directly connected to the load motor

The AD7832 series is a range of torque sensors with distributed force detection method, created with A&D's DSP and high-speed telemetry technology. These torque sensors achieve high 1/3000 sensitivity and robustness at the same time.
Therefore, it is possible to mount them directly to the engine crank shaft and CVJ shaft for precise torque measurement.

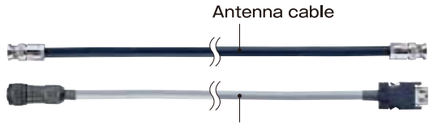
Customers can select two kinds of configuration (Set-A or Set-B) as a standard. Depending on the applications of the user, the rotation detector type, cable length, etc. Can be selected from the available options.

AD7832A Set-A configuration

Scope of supply : Torque sensor, sensor signal processor, rotary encoder, slit disc, antenna cable and encoder cable
Measurement parameters : Shaft torque, revolution velocity and rotation angle



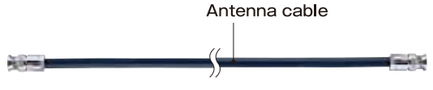
- Torque sensor range : 200Nm, 500Nm, 1kNm, 2kNm or 5kNm
  All ranges support single or dual range
  (Needs to be selected before shipping)
- Sensor signal processor : AD7893-S
- Optical slit disc: 90-slit disc
- Rotary encoder
- Antenna cable length : 20m
- Encoder cable length : 20m



AD7832A Set-B configuration

Scope of supply : Torque sensor, sensor signal processor and antenna cable

- Shaft torque range options : 200Nm, 500Nm, 1kNm, 2kNm or 5kNm
  All ranges support single or dual range
  (Needs to be selected before shipping)
- Sensor signal processor : AD7893-S
- Antenna cable length : 20m



AD7893-S Sensor signal processor specification

- Measurement
  Torque
  Revolution velocity
  Revolution angle※
- External I/O
  Analog output (+/-10V)
  Digital output (CAN2.0B)
  Digital I/O (contact points)
  Rotary pulse input
- Display
  Numerical measurement display
  Trend graph display
- Processing
  Low pass filter
  Polarity conversion
  Torque rotation zero correction
  Torque temperature zero correction
  Zero adjustment

※Not included in Set B

Selection guide

			Sensor signal processor AD7893S	Rotary encoder AD7832-01-001	Rotary encoder AD7832-01-002	Rotary encoder AD7832-01-003	Rotary encoder AD7832-01-004	Slit disc AD7832-02-001	Slit disc AD7832-02-004	Slit disc AD7832-02-007	Slit disc AD7832-02-0010	Antenna cable AD7832-03-001	Antenna cable AD7832-03-002	Antenna cable AD7832-03-003	Encoder cable AD7832-04-001	Encoder cable AD7832-04-002	Encoder cable AD7832-04-003
Torque sensor	AD7832-S200	200Nm	✓	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S500	500Nm	✓	–	✓	–	–	–	✓	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S1K	1kNm	✓	–	✓	–	–	–	✓	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S2K	2kNm	✓	–	–	✓	–	–	–	✓	–	✓	✓	✓	✓	✓	✓
	AD7832-S5K	5kNm	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	✓	✓
Dual range	AD7832-S200D1	200Nm	✓	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S500D1	500Nm	✓	–	✓	–	–	–	✓	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S1KD1	1kNm	✓	–	✓	–	–	–	✓	–	–	✓	✓	✓	✓	✓	✓
	AD7832-S2KD1	2kNm	✓	–	–	✓	–	–	–	✓	–	✓	✓	✓	✓	✓	✓
	AD7832-S5KD1	5kNm	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	✓	✓

Torque sensor

With slit disc

Measurement range
200Nm
500Nm
1kNm
2kNm
5kNm

Without slit disc

Rotary encoder

AD7832-01-001 For 200Nm
AD7832-01-002 For 500Nm
For 1kNm
AD7832-01-003 For 2kNm
AD7832-01-004 For 5kNm

Sensor signal processor

AD7893-S

Slit disc

AD7832-02-001 For 200Nm
AD7832-02-004 For 500Nm
For 1kNm
AD7832-02-007 For 2kNm
AD7832-02-010 For 5kNm

Fixed antenna

Included in the torque sensor

Antenna cable

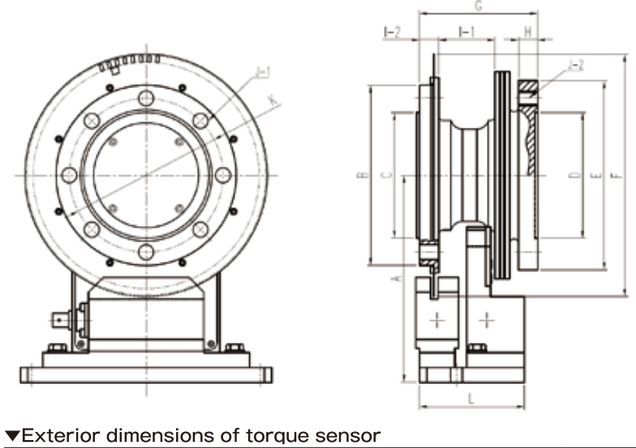
AD7832-03-001 20m
AD7832-03-002 10m
AD7832-03-003 5m

Encoder cable

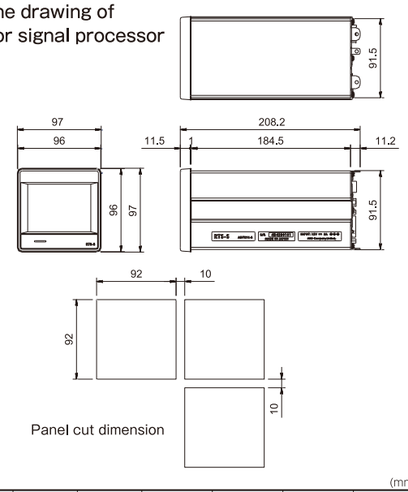
AD7832-04-001 20m
AD7832-04-002 10m
AD7832-04-003 5m

Exterior dimensions of AD7832-S series

Outline drawing of torque sensor



Outline drawing of sensor signal processor



▼Exterior dimensions of torque sensor

(mm)

Model	A	ΦB	ΦC	ΦD	ΦE	ΦF ※1	G	H	I-1	I-2	J-1	J-2	ΦK	L
AD7823-S200	140	Φ114.8	Φ85g5	Φ85H6	Φ120	Φ164	70	12	31.5	10.5	8-Φ8.2	8-M8	Φ100	62
AD7823-S500/S1K	140	Φ121.8	Φ85g5	Φ85H6	Φ128	Φ164	80	13	38	13	8-Φ10.2	8-M10	Φ104	71
AD7823-S2K	140	Φ129.8	Φ85g5	Φ85H6	Φ138	Φ172	100	15	54	15	8-Φ12.2	8-M12	Φ110	89
AD7832-S5K	140	Φ139.8	Φ85g5	Φ85H6	Φ150	Φ182	110	17	60	17	8-Φ14.2	8-M14	Φ120	97

※1 90PPR