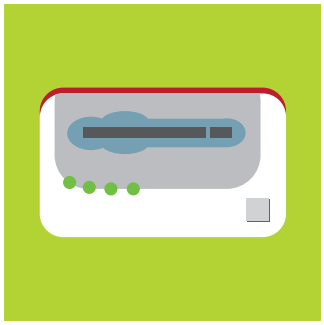
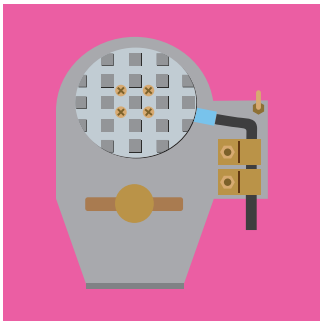
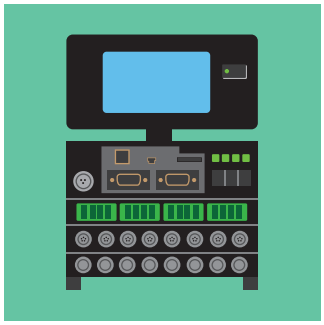
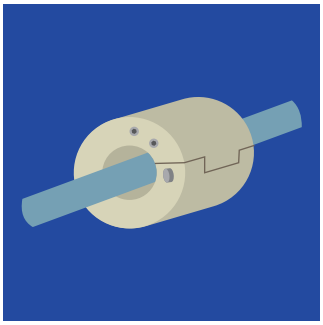
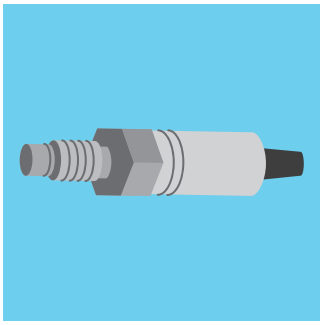
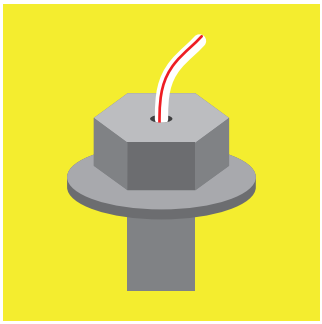
TML

AUTOMOTIVE INSTRUMENTATION



Tokyo Measuring Instruments Laboratory Co., Ltd.

AUTOMOTIVE MEASURING SYSTEM

Among the mechanism in an automobile, there are many items to be measured such as the maintenance of the engine and the electrical components, the effectiveness of power transfer to the drive wheels, the driving stability that determines the riding comfort, and the braking performance that controls the driving of a car. Our automotive measuring products allow you to build an all-in-one system for in-vehicle measurement, incorporating even a recorder and a computer.

●Powertrain (Power transfer)

Wheel Torque Transducer LTW Series
6-Component Wheel Force Transducer SLW Series
Frictional Torque Sensor System FGDH-4A

●Suspension (Driving stability)

6-Component Wheel Force Transducer SLW Series
Frictional Torque Sensor System FGDH-4A
Steering Torque/Angle Transducer HLA-50B

●Braking

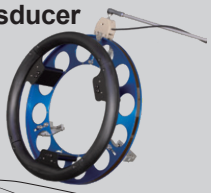
Wheel Torque Transducer LTW Series
6-Component Wheel Force Transducer SLW Series
Braking Pedal Force Transducer MLA-NA

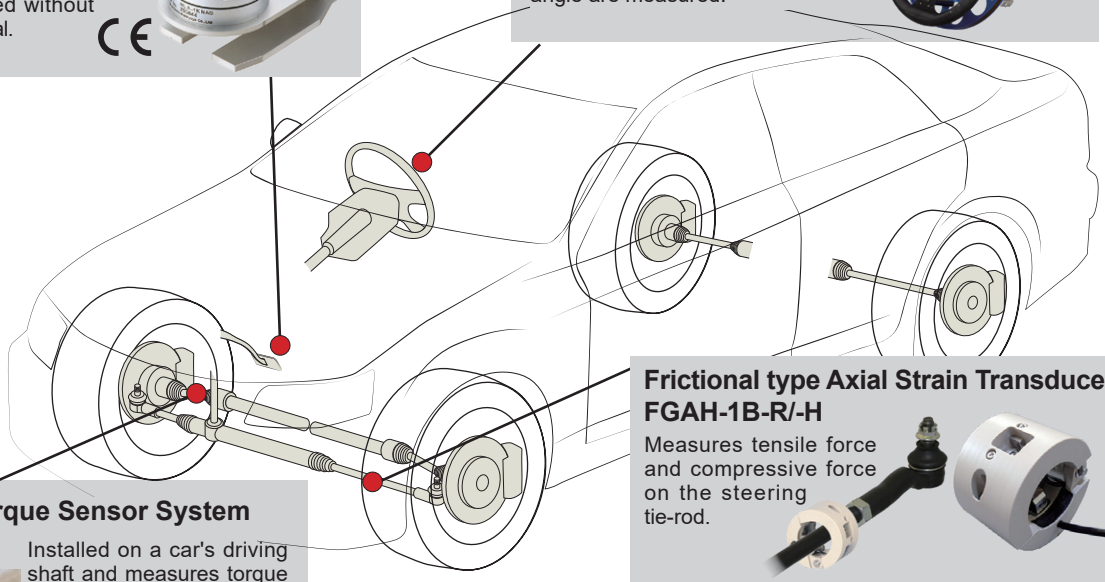
Braking Pedal Force Transducer MLA-NA

This is a load cell to measure the brake pedal force. It can easily be attached without modifying the pedal.

Steering Torque/Angle Transducer HLA-50B

By attaching the transducer to the steering column of a passenger car, steering torque and steering angle are measured.





Frictional type Axial Strain Transducer FGAH-1B-R/-H

Measures tensile force and compressive force on the steering tie-rod.

Frictional Torque Sensor System FGDH-4A

Installed on a car's driving shaft and measures torque by digital transmission and reception.

Wheel Torque Transducer LTW-NA (Slip-ring type)

The wheel torque measuring system measures the driving torque and braking torque while driving in analog output form. It incorporates an encoder and can measure the rotation speed in addition to the torque.

6-Component Wheel Force Transducer SLW-F / SLW-NC (Slip-ring type)

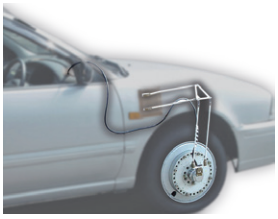
The signals sent from the 6-component wheel force transducer (SLW series) attached to the axle shaft are amplified by the exclusive 6-component wheel force analyzer (MF-660) to be converted into digital values. The digitized measured values are used to perform real-time computational correction for the crosstalk correction between component forces, the rotation correction to cancel the rotational influence on the transducer, and the moment position correction. After the correction, forces of forth/back (Fx), right/left (Fy) and vertical (Fz), and moment (Mx, My, Mz) around each force axis are output in analog form.

SLW-NC

SLW-25KNF

6-Component Wheel Force Measuring System

Slip-ring type SLW-NC/SLW-F 6-Component Wheel Force Transducer



Miniature 6-Component Force Analyzer
MF-660

Smart Dynamic Strain Recorder
DC-204R / DC-204Ra

Small Multi-channel Data Acquisition System
Multi-Recorder
TMR Series

Wheel Torque Measuring System

Slip-ring type LTW-NA Wheel Torque Transducer

DA / DC series
Dynamic Strainmeters

Small Multi-channel Data Acquisition System
Multi-Recorder
TMR Series

Smart Dynamic Strain Recorder
DC-204R / DC-204Ra

Pedal Force Measuring System

Braking Pedal Force Transducer MLA-NA

Smart Dynamic Strain Recorder
DC-204R / DC-204Ra

Small Multi-channel Data Acquisition System
Multi-Recorder
TMR Series

Frictional Torque Sensor System

FGDH-4A NEW

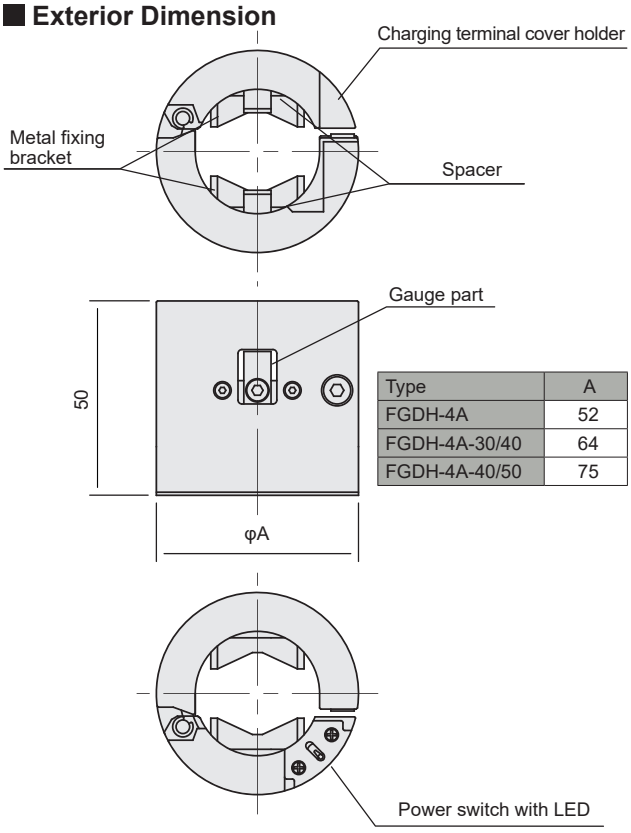
Easy torque measurement by simply fitting!

Feature

- **Longer measurement time! (Conventional FGDH-3A: 6 hours, New product FGDH-4A: 10 hours) Lasts approx. 1.7 times longer!**
- **Switchable between three ranges of ±3200, ±6400, ±16000×10^{-6}**
- **Available as a transmitting unit for affixed strain gauges!**
- **High-speed processing means that the delay time for digital telemetry is less than 1/10th of that of conventional systems!**

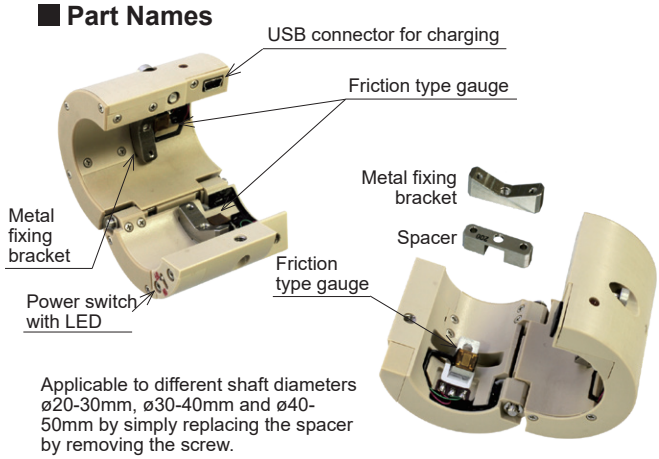
The FGDH-4A friction-type torque sensor system measures the torque generated on a rotating shaft and transmits the digital data wirelessly.
The radio bandwidth of 2.4 GHz allows for long transmission distances and easy installation of a receiving antenna.
The sensor is simply mounted by clamping the shaft and fastening with screws.
The applicable shaft diameter is ø20-30mm, ø30-40mm and ø40-50mm.

■ Exterior Dimension



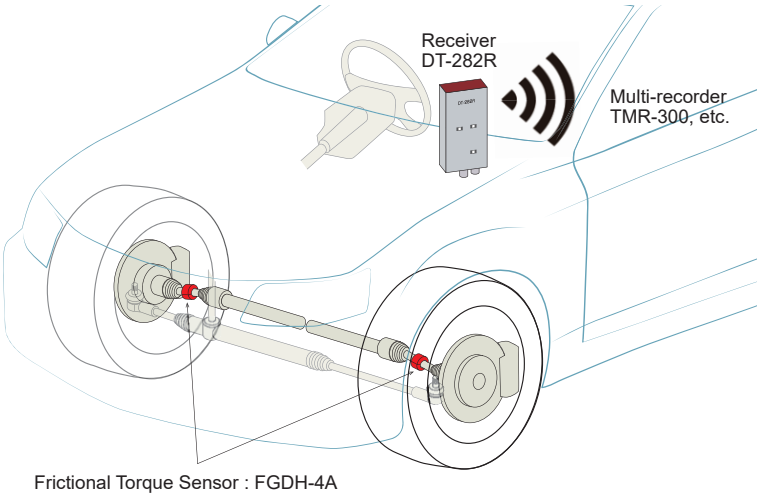
Type	A
FGDH-4A	52
FGDH-4A-30/40	64
FGDH-4A-40/50	75

■ Part Names



Applicable to different shaft diameters ø20-30mm, ø30-40mm and ø40-50mm by simply replacing the spacer by removing the screw.

■ Frictional Torque Sensor System



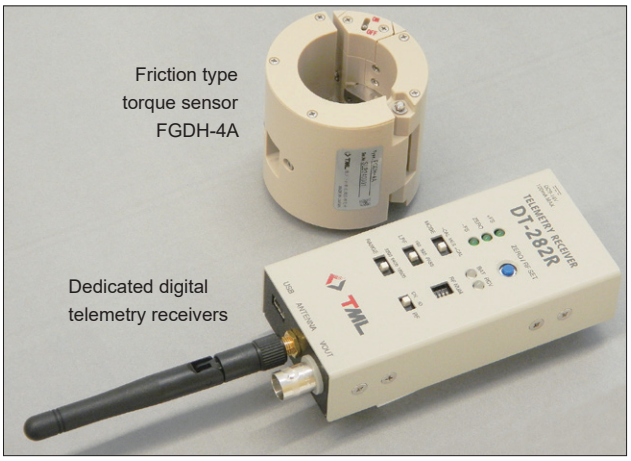
Frictional Torque Sensor : FGDH-4A

Specification

Type	FGDH-4A	FGDH-4A-30/40	FGDH-4A-40/50
Applicable shaft diameter	φ20.0 to 30.0mm	φ30.0 to 40.0mm	φ40.0 to 50.0mm
Capacity	Depends on the diameter (outer and inner), material, surface roughness and surface treatment of the shaft*		
Output	Depends on the diameter (outer and inner), material, surface roughness and surface treatment of the shaft*		
Allowable temperature	-20 to +60 °C (No dew condensation)		
Sampling frequency	5kHz		
Frequency response	1kHz		
Wireless specifications	2.4 GHz band advanced low power data communication system		
Number of radio channels	16 channels (paired with receiver radio channels)		
External Dimensions	φ52×50mm	φ64×50mm	φ75×50mm
Weight(spacer excluded)	Approx. 85 g (Excluding spacers)	Approx. 130 g (Excluding spacers)	Approx. 160 g (Excluding spacers)
Protection rating	Equivalent to IP51		
Continuous operating time	Approx. 10 hours (23 °C ±5 °C)		
Power supply	lithium-ion rechargeable battery		
Accessory	USB charger (FGDHF-51) / USB cable (mini-B-A) CR-6187		

* Some shafts may not be applicable depending on the shaft material, surface roughness and surface treatment.
Please contact the sales person in charge in advance.

Test conditions
- Torque 500N·m
- Output 2500mV(equivalent to 8000 x 10^{-6} strain)
- Non-linearity 1%RO(when output is 8000 x 10^{-6} strain)
- Conditions of test piece
  1. Diameter 20mm
  2. Material SNCM439
  3. Elastic Modulus 210000 N/ mm^2(test result by TML)
  4. Poisson's Ratio 0.29(test result by TML)
  5. Surface roughness Ra3.2
  6. Hardness HRC38



Specification Dedicated digital telemeter receiver DT-282R

Radio part	
Received point	1
Wireless specification	2.4 GHz band advanced low-power data communication compliant
Number of radio channels	16 channels (Switching by radio channel switching SW)
Wireless antenna connection terminal	SMA connector
Power output section	
Voltage output connector	BNC connector
Voltage output	±5V Selected by strain output range selector switch ±16000×10^{-6} strain ±6400×10^{-6} strain ±3200×10^{-6} strain
Voltage output accuracy	±0.5% FS (whole system)
Stability Zero point	±0.55mV/°C (whole system)
Stability Sensitivity	±0.05% FS/°C (whole system)
S/N ratio	47dB (whole system)
Calibration output level	±5V
Low-pass filter	100Hz, 500Hz, PASS (1kHz)(-3dB±1dB)
Equilibrium adjustment range	±6000×10^{-6} strain
Equalization accuracy	±5mV
Display and operation	Strain output range selector switch, LPF selector switch, calibration output selector switch, balance adjustment switch, output level LED

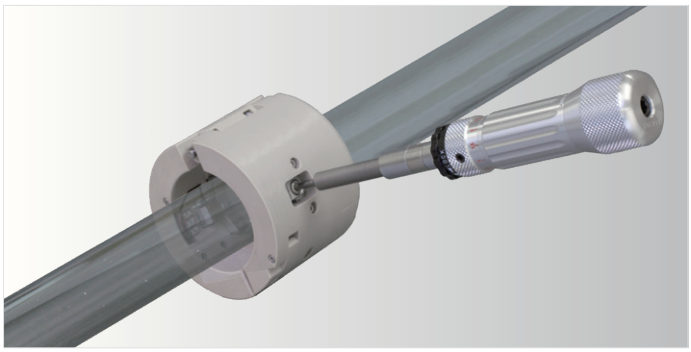
General	
Rated voltage	DC9 to 16 V
Current consumption	80mA MAX (DC12V supply +23 °C±5°C)
Operating temperature /humidity range	0 to +50°C 85%RH or less (excluding condensation)
External dimension	48(W)×23.5(H)×100(D)mm (Excluding projections)
Weight	Approx. 140 g
Accessory	BNC coaxial cable (CR-31) DC power cable (CR-062) Receiver antenna

* DT-282R is not compatible with DT-182R

Dedicated digital
telemeter receiver
DT-282R

Products related to Frictional Torque Sensor System

Torque screwdriver



When fastening the sensor, use a torque screwdriver and always tighten to the specified tightening torque.
Insufficient tightening may cause the sensor to break or fall. (Tightening torque 0.5-0.6 N•m)
* Can also be used for Frictional type Axial Strain Transducer

FGDHF-11B

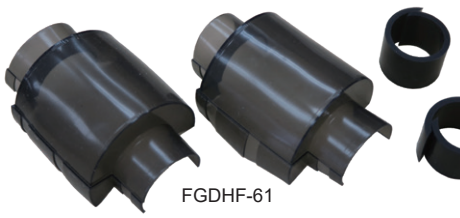
FGDHF-12B
FGDHF-14B
FGDHF-15B

Torque screwdriver handle	FGDHF-11B	
Replacement shafts for torque screwdrivers	FGDHF-12B	(M3: For holder fixing/Gauge mounting)
	FGDHF-13B	(M4)
	FGDHF-14B	(M2.5: USB port)
	FGDHF-15B	(M2: Spacer replacement)

Friction type torque sensor system storage trunk

Storage Trunk	FGDHF-21	(FGDH-4A)
	FGDHF-22	(FGDH-4A-30/40)
	FGDHF-23	(FGDH-4A-40/50)

Frictional Torque Sensor Protective Cover



Adaptor for adjustment
2 each of 5 sizes included

FGDHF-61

Frictional Torque Sensor Protective Cover

FGDHF-61	(FGDH-4A)
FGDHF-62	(FGDH-4A-30/40)
FGDHF-63	(FGDH-4A-40/50)

FGDHF-61 Combined weight		FGDHF-62 Combined weight		FGDHF-63 Combined weight	
Adapter size	Weight	Adapter size	Weight	Adapter size	Weight
φ21	Approx.34g	φ31	Approx.47g	φ41	Approx.59g
φ23	Approx.31g	φ33	Approx.43g	φ43	Approx.53g
φ25	Approx.27g	φ35	Approx.38g	φ45	Approx.47g
φ27	Approx.24g	φ37	Approx.33g	φ47	Approx.40g
φ29	Approx.20g	φ39	Approx.28g	φ49	Approx.34g

Steering Torque and Angle Transducer

HLA-50B 50N·m

made-to-order

Directly mountable on the steering wheel

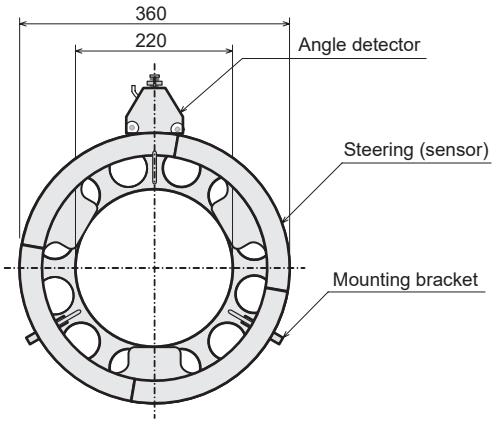
Feature

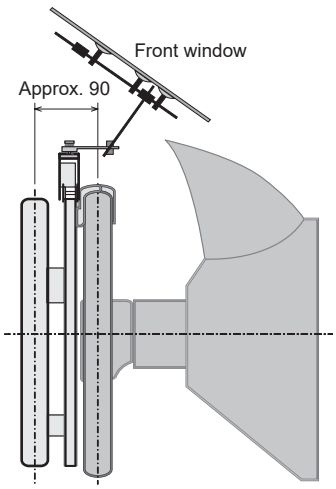
- **Installation possible on cars of various types (applicable to steering outer-diameter of 240-400mm)**
- **No need to remove the existing steering wheel**
- **Easily attached and detached**
- **Excellent operability**
- **Steering torque is detected by strain gauges and torque output by telemetry**

This is a steering torque and angle transducer for evaluation test of traveling performance of a car.
It can be easily mounted on the steering wheel, has high measurement accuracy and is easy to operate.
It does not affect existing steering wheel switches or electronic circuits.

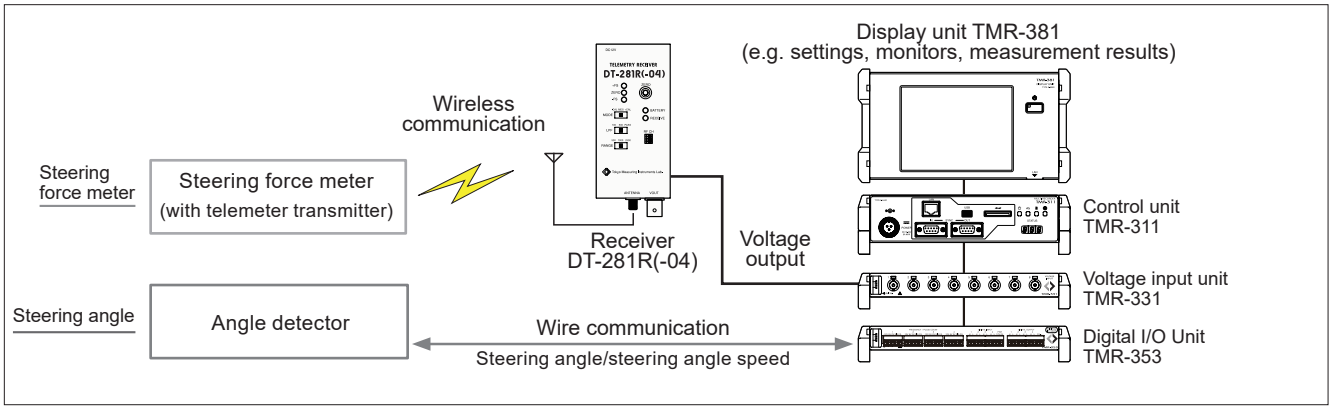
Protection ratings : IP 40 equivalent

External dimensions





System block diagram



Specification Steering Torque and Angle Transducer HLA-50B

Steering ability	
Capacity	50N•m
Rated output	Approx. 4 V (DT-281R(-04): at 2500 με range)
Non-linearity	1%RO
Hysteresis	1%RO
Temperature characteristics of zero point	0.1%RO/°C
Allowable overload	120%
Continuous operating time	approx. 10 hours (23±5°C)
Weight	approx. 1.8 kg (excluding battery)
Wireless specification	2.4 GHz band advanced low power data communication system
Steering angle	
Output pulse	Approx. 11000 pulses / 360°
Response time	approx. 3160 deg./sec
Weight	approx. 60 g
Input/output cable	φ4 0.18 mm^2 6-conductor vinyl cable 1 m
Attached cable	φ4 0.18 mm^2 6-conductor vinyl cable 4 m free end
common feature	
Operating temperature range	0 to +40°C (no icing)
Allowable temperature range	-10 to +60°C (no icing)
Protection class	IP40 equivalent
Compatible steering wheel diameters	φ240 - φ400 (depending on steering wheel shape)
Compatible steering grip diameter	φ30 - φ50 (depending on steering wheel shape)

Remarks	AAA batteries x 2 (secondary batteries can be used)

*1 Calculated values based on 2 x AAA batteries at 23 ± 5°C. Continuous use time may vary depending on the measurement environment and individual batteries, and is not a guaranteed value

*2 Depending on the shape of the steering wheel, installation may not be possible and is not a guaranteed value

*3 Polarity for both steering force and steering angle is clockwise for positive output

Related Product

Angle detector	HLA-ANG
Steering Torque and Angle Transducer Positioning Jig	HLAF-11B
Steering Torque and Angle Transducer Finder Pickup Fixture	HLAF-12B
Aluminum trunk	HLAF-13B
Telemeter receiver for Steering Torque and Angle Transducer	DT-281R(-04)

Specification Telemetry receiver DT-281R(-04)

Wireless part	
Wireless specifications	2.4 GHz band advanced low-power data communication system
Number of channels	16 channels
Antenna connection terminal	SMA connector
Display/operation	Reception signal strength LED / transmitter battery voltage LED / radio channel switching switch
Voltage output unit	
Voltage output connector	BNC connector
Voltage output	±5 V Selected by strain output range selector switch (±500×10^{-6} strain, ±1000×10^{-6} strain, ±2500×10^{-6} strain)
Voltage output accuracy	±0.5% FS (entire system)
Stability Zero point	±0.55mV/°C
Stability Sensitivity	±0.05%FS/°C
SN ratio	47 dB (whole system)
Calibration output	±5V
Low-pass filter	100 Hz, 500 Hz, PASS (1 kHz) (-3 dB ± 1 dB)
Balancing adjustment range	±6000×10^{-6} strain
Balancing accuracy	±5mV
Displayand operation	Strain output range selector switch LPF selector switch/calibration output selector switch Balance adjustment switch/output level LED
Overall	
Power supply voltage	DC 9 to 16V
Current consumption	80mA MAX (DC12V supply, +23°C±5°C)
Operating temperature range	0 to +50°C 85%RH or less (without condensation)
Dimensions	48(W)×23.5(H)×100(D)mm (excluding protruding parts)
Weight	approx. 140 g

Standard accessory

- Operation manual 1
- Certificate 1
- BNC coaxial cable (CR-31) 1
- DC power supply cable (CR-062) 1
- Receiving antenna 1

Option

- 2.4 GHz telemetry antenna cable 1m (CR-4701)
- 2.4 GHz telemetry antenna cable 3m (CR-4703)
- 2.4 GHz telemetry antenna cable 5m (CR-4705)
- AC adapter (CR-1867)

Telemetry receiver
DT-281R(-04)

Telemeter system for shafts

Telemeter transmitter for shaft

DT-223T

Easy installation by clamping the drive shaft
No need to install transmitter and receiver antennas in close proximity!

Feature

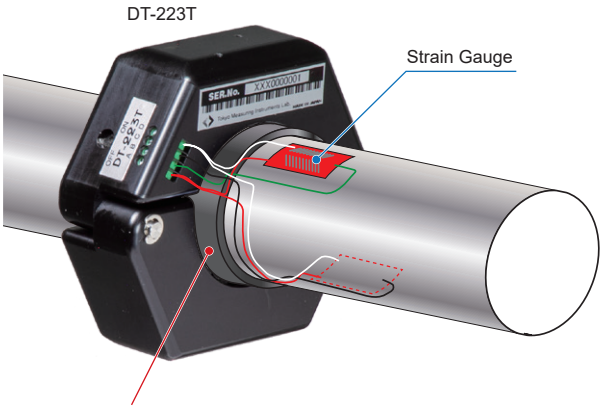
- Easy installation by clamping the drive shaft
- Shaft length of 27mm enables installation in narrow areas
- Powered by a single CR-type cylindrical lithium battery (CR2) for easy replacement on site
- Uses 2.4GHz wireless bandwidth
- Built-in transmitting antenna
- The main body mounting hole is 40mm dia. and can be inserted with a spacer, etc., allowing mounting on a wide variety of shaft diameters
- Strain values are transmitted as digital values. Strain values are pre-calibrated, so no calibration is required
- Sampling rate of 200μs (5kHz) sampling
- Full scale ±25000 x 10^{-6} strain DT-223T (transmitter)
- Can be used by simply connecting the bridge to a screw-type terminal block (no solder required)
- Telemeter system DT-281R-1 (receiver)
- Equipped with sleep function

Telemeter transmitter for shaft
DT-223T

Telemetry receiver
DT-281R-1

This product is a telemeter transmitter for shafts using a 2.4GHz low-power radio module.
Combined with the telemeter system receiver DT-281R-1, a telemeter system for drive shafts can be easily constructed.
The structure allows easy installation by clamping the drive shaft, so it can be used for a variety of applications other than torque measurement.
The 2.4GHz radio bandwidth allows measurement not only when the receiving antenna can be installed near the transmitter, but also when the distance between the transmitter and receiver is long, such as when the object is large, such as a large vehicle, or when the object has a wide range of motion.

Image of installation on shaft



Telemeter transmitter for shaft

■ Specification Telemeter transmitter for shaft (DT-223T)

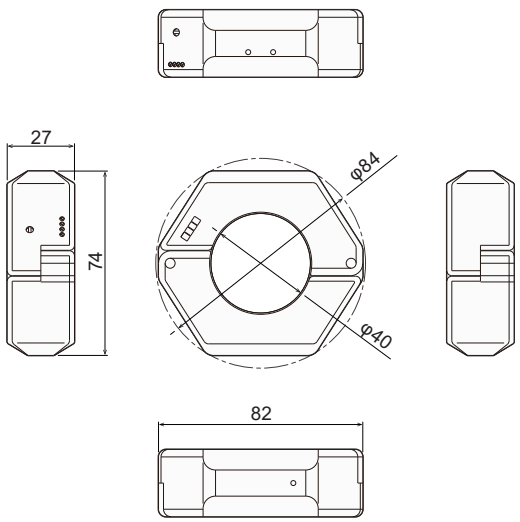
Strain measurement part	
Number of measuring point	1point
Applicable Gauge Resistance	120 to 1000Ω (4G bridge)
Bridge voltage	2.0V±8%
Measuring range	±25000 x 10^{-6} strain (including initial unbalance)
Measuring accuracy	±0.2%FS
Sampling frequency	5kHz(200μs)
Response frequency	DC to 1kHz(-3dB±1dB)
Resolution	1×10^{-6}strain
Stability Zero point	±0.8×10^{-6} strain /°C
Sensitivity	±0.01%FS/°C
Input terminal	Screw connection terminal block (Applicable wire size max. 0.5 mm^2)
Supply voltage measurement section	
Number of measuring point	1 point
Measuring range	1.3 to 3.6V
Radio part	
Wireless specification	2.4GHz Band Advanced Small Power Data Communication System
Number of wireless channels	16 channels (paired with receiver radio channels)
Antenna	built-in
Battery power input section	
Power	1 CR-type cylindrical lithium battery (CR2)
Continuous use time	Approx. 4 hours
Comprehensive	
Supported Device	DT-281R-1
Power save function	Goes to sleep when receiver is not present
Operating temperature and humidity range	-30 to +70°C, 85%RH or less (excluding condensation, not applicable to batteries)
Vibration resistance	100m/s^2 3-direction
External dimensions	82(W)×74(H)×27(D) (excluding protruding parts)
Housing Material	Resin
Weight	Approx. 130g
Standard accessories	
User's manual 1	
Warranty 1	
Option	
Telemeter transmitter spacer for shaft （DTF-11-***）	

* The **** in the telemeter transmitter spacer for shaft (DTF-11-***) indicates the shaft diameter. For example, if the shaft diameter is Φ20.5mm, the model name of the spacer is DTF-11-205.
* DT-223T/DT-281R-1 is not compatible with DT-123T/DT-181R and DT-221T/DT-281R.

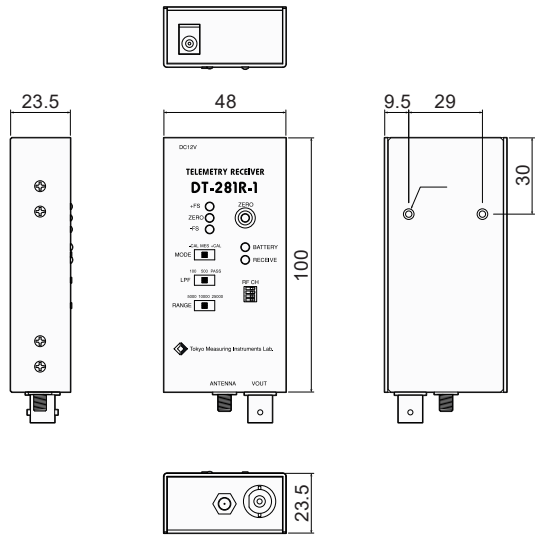
■ Specification Telemetry receiver (DT-281R-1)

Radio part (unit)	
Wireless specification	2.4GHz Band Advanced Small Power Data Communication System
Number of Channels	16
Antenna connection terminal	SMA Connector
Display and Operation	Reception signal strength LED/Transmitter battery voltage LED/Radio channel selector switch
Voltage output section	
Voltage output connector	BNC Connector
Voltage output range	Selected by ±5V strain output range selector switch (±25000×10^{-6} strain, ±10000×10^{-6} strain, ±5000×10^{-6} strain)
Voltage output accuracy	±0.5% FS (entire system)
Stability Zero point	±0.55mV/°C
Sensitivity	±0.05%FS/°C
Stability	Sensitivity
SN ratio	47dB (entire system)
Low-pass filter	100Hz, 500Hz, PASS(1kHz) (–3dB±1dB)
Equilibrium adjustment range	±6000×10^{-6} strain
Equalization accuracy	±5mV
Display and Operation	Strain output range selector switch LPF selection switch/Calibration output selection switch Balance adjustment switch/Output level LED
Comprehensive	
Supported Device	DT-223T
Power	DC 9 to 16V
Current Consumption	80mA MAX(DC12V supply, +23°C±5°C)
Operating temperature range	0 to +50°C 85%RH or less (excluding condensation)
External dimensions	48(W)×23.5(H)×100(D)mm (excluding protruding parts)
Weight	Approx. 140g
Standard Accessories	
User's manual 1	
Warranty 1	
BNC coaxial cable (CR-31) 1	
DC power cable (CR-062) 1	
Receiver antenna 1	
Option	
Antenna Cable for 2.4GHz Telemetry 1m (CR-4701)	
2.4GHz Telemeter Antenna Cable 3m (CR-4703)	
2.4GHz telemeter antenna cable 5m (CR-4705)	

■ External dimensions (DT-223T)



■ External dimensions (DT-281R-1)

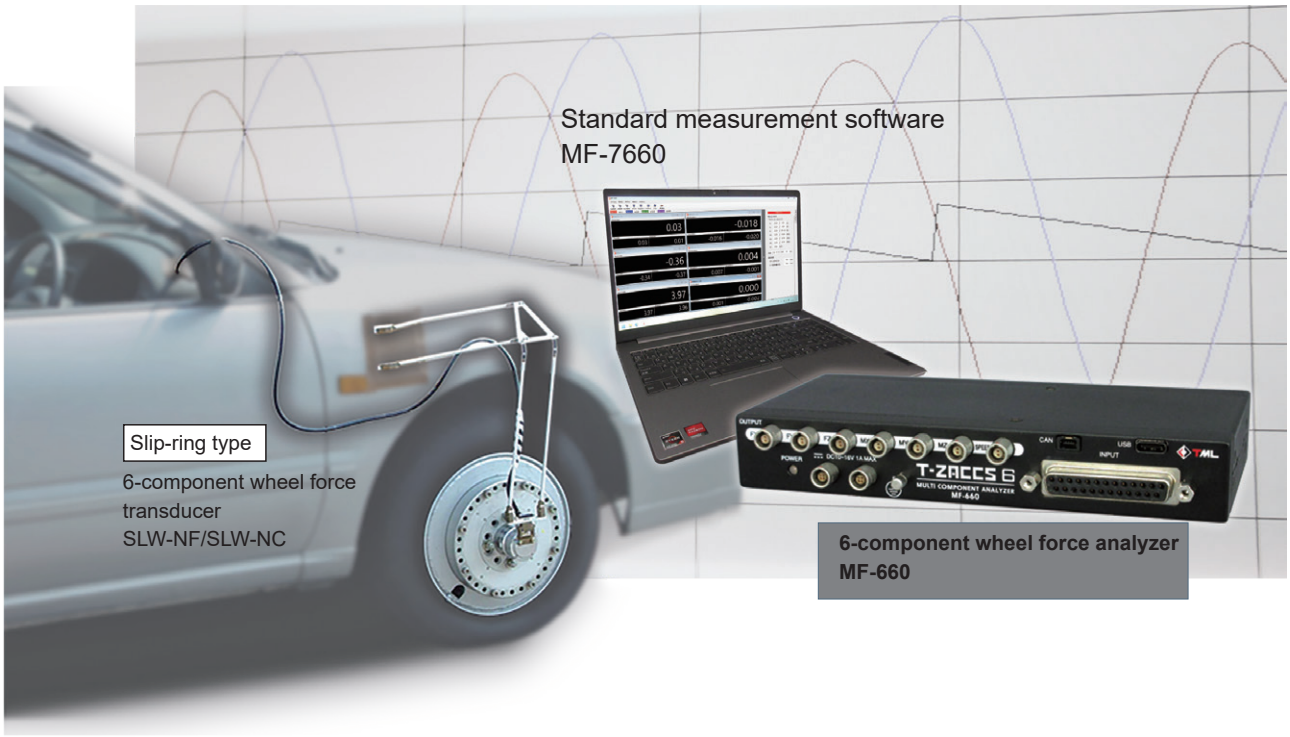


Introduction to the Telemetry System

The telemetering system was developed for strain measurement of objects such as moving or rotating bodies, where wired measurements are not possible. The strain values are converted to digital form (A/D conversion) and transmitted by the transmitter. Since the strain values are calibrated, no further calibration is required. On the receiver side, the received data is converted back to analog form (D/A conversion) and provides a calibrated voltage output.

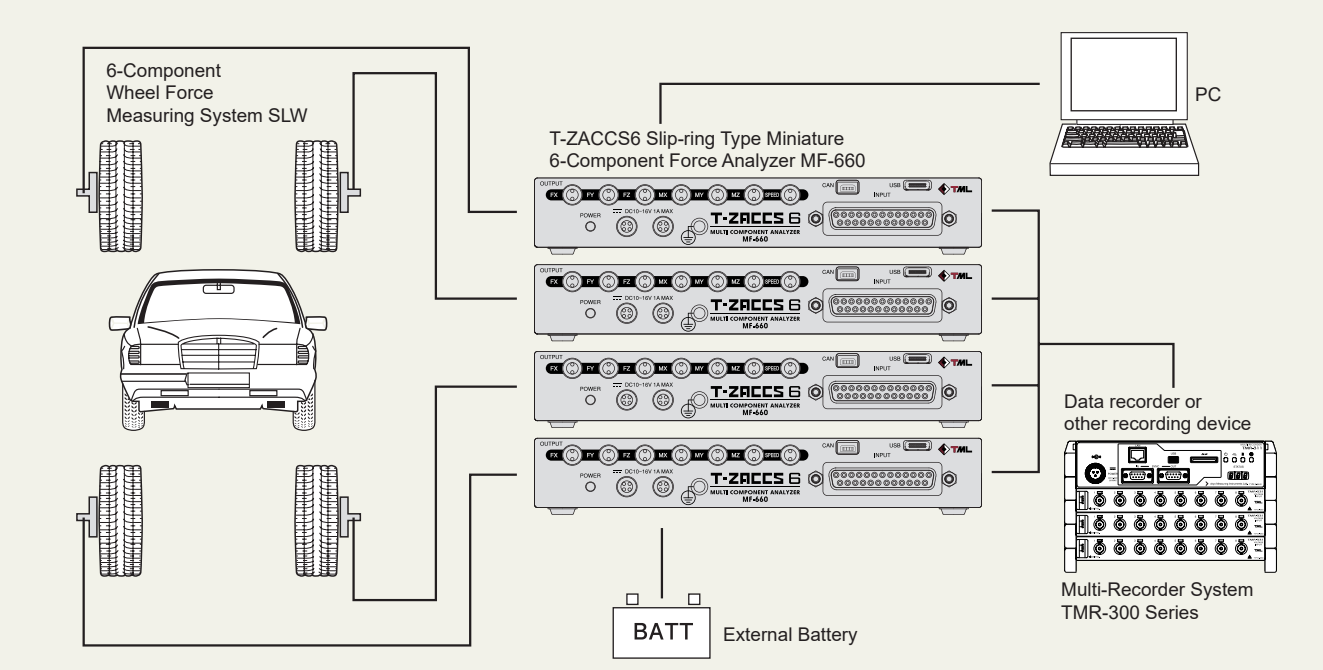
Transmitter	Receiver	Feature
Telemeter Transmitter DT-221T  **Steering Torque and Angle Transducer HLA-50B** 	**Telemetry receiver DT-281R** **DT-281R(-04)** 	• Uses 2.4GHz band for wireless bandwidth • High-speed sampling at 10 kHz (100 μs) • Voltage output range switchable among ±5000, ±10000, and ±25000 x 10^{-6} strain • DT-281R(-04) for steering force angle meter has three selectable voltage output ranges: ±500, ±1000, and ±2500 x 10^{-6} strain.
Telemeter transmitter for shaft DT-223T 	**Telemetry receiver DT-281R-1** 	• Uses 2.4GHz band for wireless bandwidth • 5kHz (200μs) sampling • Sleep function installed • Voltage output range switchable among ±5000, ±10000, and ±25000 x 10^{-6} strain
Frictional Type Torque Sensor FGDH-4A 	**Dedicated telemetry receiver DT-282R** 	• No adhesion required due to the use of friction type gauges • Easily mounted on drive shaft for immediate measurement • Compatible with drive shafts of different diameters by replacing the spacer(φ20-30mm) • Uses a 2.4GHz low-power radio module with a long communication distance • The digital transmitter/receiver system is highly resistant to noise and requires no wiring work • Response frequency is 1kHz • Equipped with rechargeable battery • Power save function for long time measurement • Output voltage range switchable between ±3200, ±6400, and ±16000 x 10^{-6} strain • Can be used as a transmitting unit with 4-gauge method input

Slip-ring type
6-Component Wheel Force Measuring System



The slip-ring type 6-component wheel force measuring system is composed of the 6-component wheel force transducer SLW-NC as the sensor and the 6-component force analyzer MFT-306 as the measuring device. The analyzer MFT-306 is an ultracompact model at 160 (W) × 25 (H) × 75 (D) mm. Settings and monitor display are by computer, and control is possible of up to 4 analyzers.

■ System block diagram



Slip-ring type Compact and Lightweight 6-Component Wheel Force Transducer

SLW-25KNF Fx, Fy, Fz 25kN Mx, My, Mz 4kN-m

made-to-order

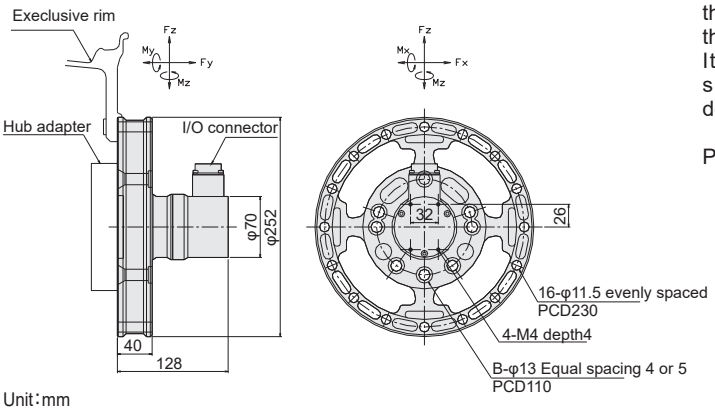
Feature

- **High Precision**
- **Compact and Light Weight (approx. 3.3 kg)**
- **Can be mounted on various vehicle models using exclusive rims and hub adaptors**
- **Easy installation to an actual car**
- **Running in the rain possible because of the waterproof structure**
- **Built-in slip ring and rotary encoder assembly incorporates vibration resistance**
- **Three-phase rotary encoder precisely detects the angle at all times.**
- **Characteristic data are easily input to the measuring instrument using the included media.**

This load cell detects the external forces that a tire receives from the road surface during driving by resolving them into orthogonal three-component forces and three moments around them.
It is effective for measurement of road surface thrust load, suspension dynamic characteristics, and verification and development of vehicle control systems such as stability control.

Protection ratings : IP 54 equivalent

External Dimensions



Unit：mm

Specification

Type	SLW-25KNF
Capacity	Fx, Fy, Fz 25kN Mx, My, Mz 4kN-m
Non-linearity	1% RO
Hysteresis	1% RO
Temperature effect on zero	0.05% RO/°C
Temperature effect on span	0.05% /°C
Compensated temperature range	−10 to +60°C
Temperature range	−20 to +80°C
Allowable Overload*	Fx, Fy, Fz, Mx, My, Mz 130%
Critical Overload*	Fx, Fy, Fz, Mx, My, Mz 150%
Maximaum rotarion	2500 rpm
Fixing to hub	Using hub adapter Applicable hubs 100-4/100-5/114.3-4/114.3-5 hole, etc.
Fixing to tire	Using exclusive rim Applicable rim : 12-in. or larger
Input/ Output cable	φ9mm multi-core shielded polyurethane cable 5m
Weight	Approx. 3.3kg

*Allowable overloads are not guaranteed when all listed component forces are simultaneously input.
*This specification is for static input. Impact loads may cause load transducer failure or damage.

Slip-ring type 6-Component Wheel Force Measuring System

Slip-ring type 6-Component Wheel Force Transducer

SLW-NC Fx, Fy, Fz 20/30kN Mx, My, Mz 3/6kN-m

made-to-order

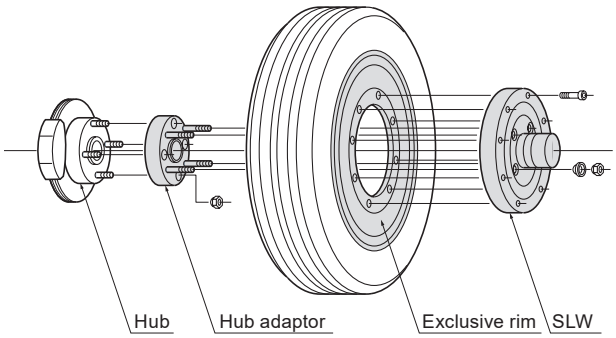
Feature

- **High stability**
- **Light weight**
- **Possible installation to various vehicles using exclusive rim and hub adaptor**
- **Easy fixture to a real car**
- **Waterproof construction making driving in the rain possible**

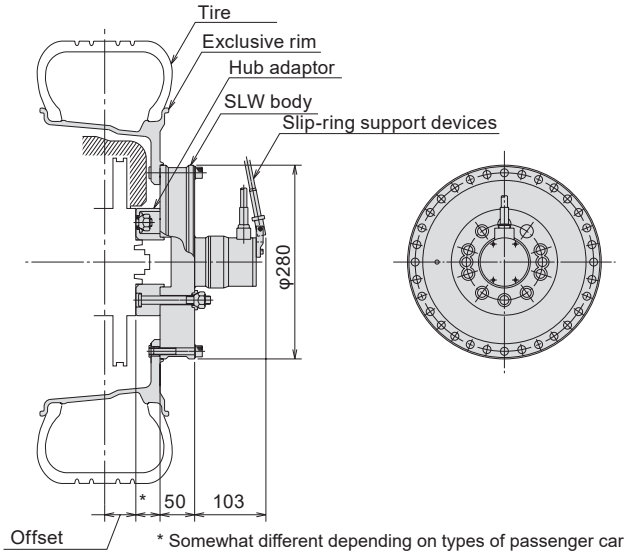
This is a load cell which measures an external force passed to the tire from the road surface while the car is running, by breaking the force down into orthogonal three-component force and three moments around the force axes. Highly precise measurement is possible in every driving condition owing to its load detecting part with reasonably arranged strain gauges, slip ring and rotary encoder assembly with improved vibration resistance, and waterproof structure. This transducer is used together with the exclusive 6-component force analyzer MF-660. The 6-component force is indicated in a coordinate system based on the car body.
The rotary encoder necessary for angle calculation is built in, and a slip ring support device is available as a related product to keep the reference position of the encoder constant with respect to the vehicle body.

Protection ratings : IP 54 equivalent

How to Install



External Dimensions



* Somewhat different depending on types of passenger car

Specifications

Type	SLW-20KNC	SLW-30KNC
Capacity	Fx, Fy, Fz 20kN Mx, My, Mz 3kN-m	Fx, Fy, Fz 30kN Mx, My, Mz 6kN-m
Non-linearity	1%RO	
Hysteresis	1%RO	
Temperature effect on zero	0.02%RO/ °C	
Temperature effect on span	0.01%/ °C	
Overload	Fx, Fy, Fz 150% Mx, My, Mz 130%	Fx, Fy, Fz 130% Mx, My, Mz 130%
Compensated temperature range	-10 to +60 °C	
Temperature range	-20 to +80 °C	
Maximum rotation	2500 rpm	
Fixing to hub	Using hub adaptor Applicable hub : 100.0-4/100.0-5/114.3-4/114.3-5 holes	
Fixing to tire	Using exclusive rim Applicable rim : 12-in. or larger	
Input/Output cable	φ9mm multi-core shielded polyurethane cable 5m	
Weight	5.2 kg.	5.6 kg.

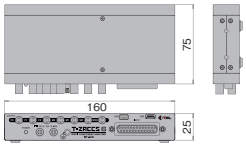
T-ZACCS6 Slip-ring Type Miniature 6-Component Force Analyzer MF-660

The 6-Component Wheel Force Transducer attached to the axle measures the external forces that the tire receives from the road surface in the form of three orthogonal forces and three moments around them.
After digitally converting the strain detected by the 6-Component Wheel Force Transducer, the instrument performs physical quantity conversion, correction for mutual interference between the force components, rotation correction (X and Z components only) using the angle signal from the rotary encoder attached to the 6-Component Wheel Force Transducer, and offset position correction between the 6-Component Wheel Force Transducer and tire center. After calculation, the measured 6-Component Force and tire speed are output as voltage and CAN signals.

Feature

- **Compact and lightweight, with connectors concentrated on the front panel, making it easy to install in any space**
- **Various correction calculations are processed in real time to calculate 6-component forces**
- **Calculated 6-component force data and tire speed are output by CAN signal as well as voltage output**
- **Characteristic data of the 6-Component Wheel Force Transducer can be easily set from the included control software**

External Dimensions



Specifications (MF-660)

Input Unit	
Adaptive Transducer	Strain gauge type 6-Component Wheel Force Transducer SLW-NC, SLW-NF
Number of measurement point	6
Bridge Power Supply	DC4.8V
Measuring range	±8000×10^{-6} strain (including balancing adjustment range)
Balance adjustment range	±2000×10^{-6} strain
Response frequency	DC to 400Hz (−3dB±1dB)
Encoder pulse (Angle detection)	360 pulses/rev. (phase A, phase B) 1 pulse/rev. (Z phase)
Correction Unit	
Interference correction range	±12.7% RO or less
Offset position correction range	-100 to 200mm
Rotation correction response range	Max. 2500rpm
Tire radius setting range	200 to 500mm
Voltage Output Unit	
Full scale setting range	(200 to 8000)×10-6 Strain equivalent
6 divider voltage output range	±5V, 0 to +5V
6-component voltage output accuracy	±0.2%FS (5kΩ load)
Low pass filter	20Hz, 50Hz, 100Hz, PASS (phase flat type)
Tire rotation speed output voltage	0V/0rpm to +5V/2500rpm (±5V setting) +2.5V/0rpm to +5V/2500rpm (at 0 to +5V setting)
Tire rotation speed output accuracy	±0.5%FS (5kΩ load)
Calibration output voltage	-5V, 0V, +5V (when ±5V setting) 0V, +2.5V, +5V (when 0 to +5V setting)
Calibration output accuracy	±0.2%FS (5kΩ load)
Sensitivity stability	±0.02%/°C
zero-point stability	±1×10^{-6} Strain/°C
SN ratio	46dB$_{P-P}$ or higher
CAN output	
Number of port	1
Protocol	ISO-11898-2 compliant
bit rate	50kbps to 1Mbps
Output Cycle	1msec to 1sec
Output Data	6-Component Wheel Force, Angle of rotation, Speed of rotation
Interface	USB 2.0 compliant
Power Supply	DC 10 to 16V 1.0A MAX
Vibration resistance	30m/s2 (10 to 150Hz)
Operating temperature and humidity range	0 to +50°C, 85% RH or less (excluding condensation)
External dimension	160(W)×25(H)×75(D)mm (excluding protruding parts)
Weight	Approx. 500g

Specifications (Application software MF-7660)

6-Component Wheel Force Transducer Characteristic Data Setting	
Model name	Enter the model name of the 6-Component Wheel Force Transducer
Serial number	Enter the serial number of the axle 6-component force load cell
Capacity	Enter capacity of axle 6-component force load cell
Rated output	Input the rated output of the axle 6-component force load cell
Mutual interference	Enter mutual interference correction values for 6-component axle force load cell
Velocity correction	Enter the speed correction value of the axle 6-component force load cell
Measurement condition setting	
Output voltage full scale	Equivalent to 200×10^{-6} strain to set capacity
Output voltage shift	Can be set from +full scale to -full scale
Output voltage	Select ±5V or 0 to +5V
Low-pass filter	Select from 20, 50, 100 Hz, PASS
Tire dynamic load radius	Enter the dynamic load radius of the tire
Wheel offset	Enter wheel offset value
CAN setting	
ID Setup	Set ID and standard/extended bit
Transmission cycle	Set the transmission cycle of measured values
Bit rate	Set CAN bus bit rate
Monitor	
Display channel	Any wheel, any channel can be displayed
Display Contents	Displays monitored values and ±peak values for FX, FY, FZ, MX, MY, MZ, and SPEED
List	
List	Display of axle 6-Component Force Transducer characteristics data and measurement condition settings
Print	Printing a list of listings
System	
Box number	Set the box number of the measuring instrument
Mounting position of load cell	Select wheel position
Balanced operation selection	Select rotational or non-rotational balance
Unit selection	Selection of monitor display units (SI units/gravity units)
Other	
Version Information	Instrument and application software version information
Balance	
Balancing action	Balancing action on selected wheel or all wheels
Calibration output	
Output voltage	+ Select from + full scale output, - full scale output, or 0V output
Calibration output	Calibration output for selected wheel or all wheels
peak reset	
peak reset	Reset 6-component force ± peak value for selected wheel or all wheels

Wheel Torque Measurement

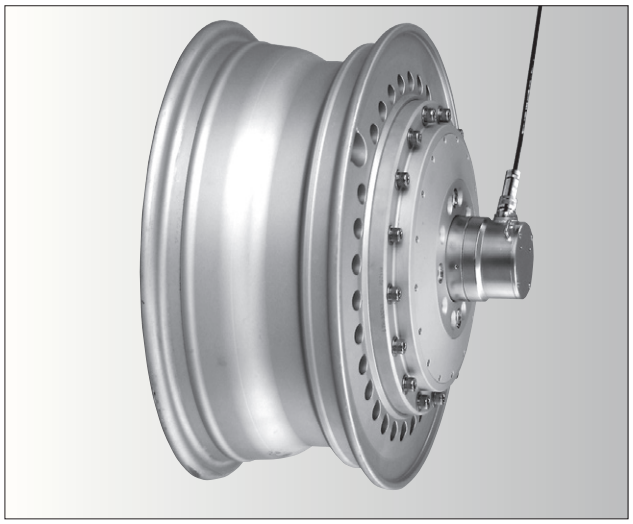
Slip-ring and encoder built in

made-to-order

LTW-NA 2.5kN·m

Feature

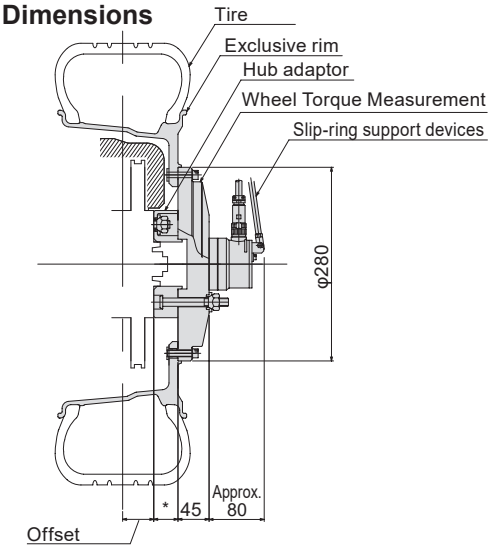
- **Lightweight**
- **Waterproof structure allows measurement in rain**
- **Special rim and adapter for each car model available, allowing measurement with the same offset as under standard conditions**



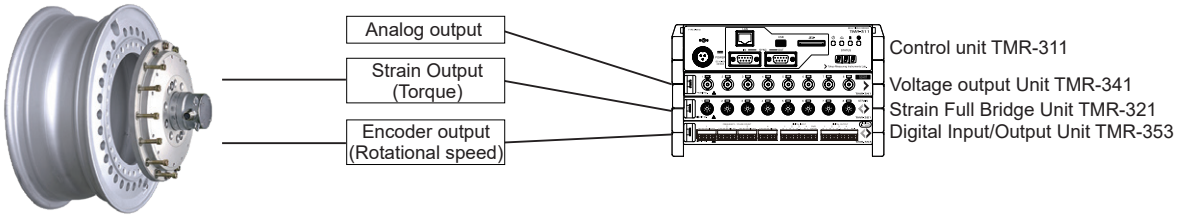
This is a torque transducer for measuring driving torque and braking torque while an automobile is traveling. Torque can be measured with analog output by connecting the slip-ring and dynamic strainmeter that come standard. The slip-ring has a built-in encoder, allowing an F/V converter to be connected for counting output pulse and thereby measure rotational velocity. Preparing a special rim and hub adapter also allows the torque transducer to be installed to any passenger automobile.

IP code IP 54-equivalent

External Dimensions



* Somewhat different depending on types of passenger car



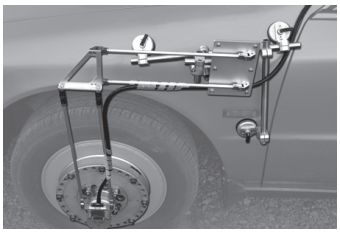
Specifications

Type	LTW-2.5KNA
Input/output system	Slip-ring and encoder built in
Capacity (gravitating system reference value)	2.5 kN-m (255 kgf-m)
Rated output	1 mV/V (2000 × 10^{-6} strain) ±10%
Nonlinearity	0.3% RO
Hysteresis	0.3% RO
Temperature effect on zero	0.01% RO/ °C
Temperature effect on span	0.01%/ °C
Compensated temperature range	−20 to +80 °C (no freezing)
Allowable temperature range	−30 to +100 °C (no freezing)
Allowable overload	150%
Allowable bending moment	3.5 kN-m
Allowable wheel load	20 kN
Allowable exciting voltage	20 V
Input/output resistance	700 Ω ±5%
Effect of wheel load	0.5% RO or less for 5 kN wheel load
Effect of side load	0.5% RO or less for 3 kN side load (300-mm tire radius)
Applicable wheel size	12-in. or larger all types
Applicable hub size	100 4-hole, 100 5-hole, 114.3 4-hole, 114.3 5-hole, etc. all types
Weight	Approx. 15 kg (15 × 6J wheel mounted)
Supplied cable	CT6-8P5/SWP-NP+SNP (ø6mm 8-conductor shielded polyurethane cable 5 m)

Other than the above capacity, we can also make 5 kN-m, etc.

Related products of 6-Component Wheel Force Transducers and Wheel Torque Transducers

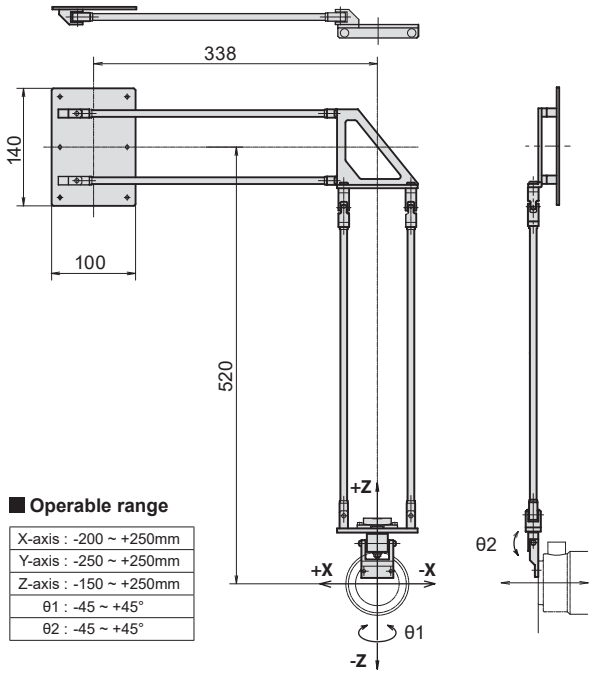
Slip ring support device
SLWF-11/-12



A slip-ring type axle 6-component force load cell and a slip-ring support device SLWF-12 are mounted on a tire and secured with a suction cup type mounting fixture SLWF-13.

The 6-Component Wheel Force Transducer SLW-NC displays 6-component forces in a coordinate system based on the vehicle body.
Angle calculation of the coordinate system is performed by a built-in rotary encoder, and a slip ring support device is installed to keep the reference position of the encoder constant.
Two types of slip ring support devices are available: SLWF-11 for the right wheel and SLWF-12 for the left wheel.

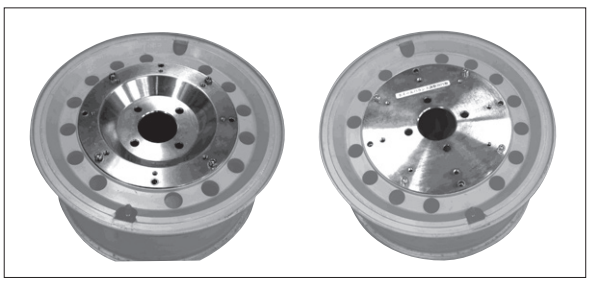
External Dimensions



Operable range

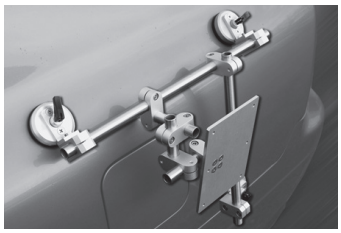
X-axis : -200 ~ +250mm
Y-axis : -250 ~ +250mm
Z-axis : -150 ~ +250mm
θ1 : -45 ~ +45°
θ2 : -45 ~ +45°

Wheel balancing plate



Used to mount tires on special rims and to adjust the rotation balance.

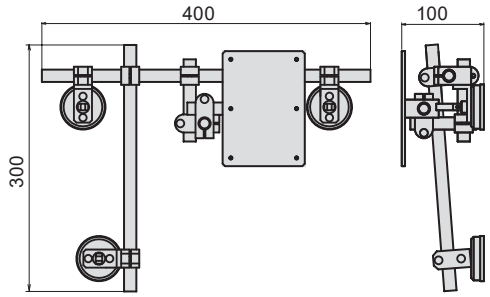
Sucker type
Slip ring support device attachment jig
SLWF-13



SLWF-13 fixture mounted on a car body only

The slip ring support device and encoder type angle detection unit support device of the 6-Component Wheel Force Transducer SLW-NC can be attached to the vehicle body with three suction cups.
Position adjustment after installation is also simplified.

External Dimensions



Related products of Wheel Torque Gauge
Wheel torque gauge support device LTW-11

Fix the output cable from the slip ring type wheel torque transducer LTW-NA to the vehicle body.

Support List

Wheel balancing plate type	SLWF-21	SLWF-22
Compatible axle 6-component force load cell	SLW-NC Flat type	SLW-NC Offset type

Note: Offset type specifications are for larger wheel widths and dedicated rim offsets.

Wheel balancing plate type	LTWF-21	LTWF-22
Compatible Wheel Torque Gauge	LTW-NA Flat type	LTW-NA Offset type

Note: Offset type specifications are for larger wheel widths and dedicated rim offsets.

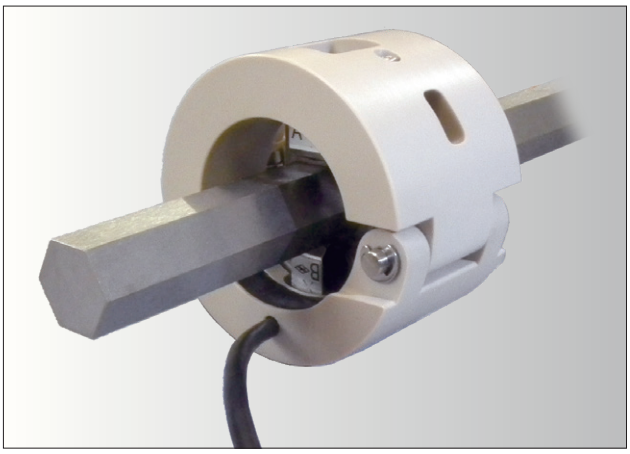
Frictional Axial Strain Transducer

FGAH-1B-R / FGAH-1B-H

Compatible with hexagonal shafts

Feature

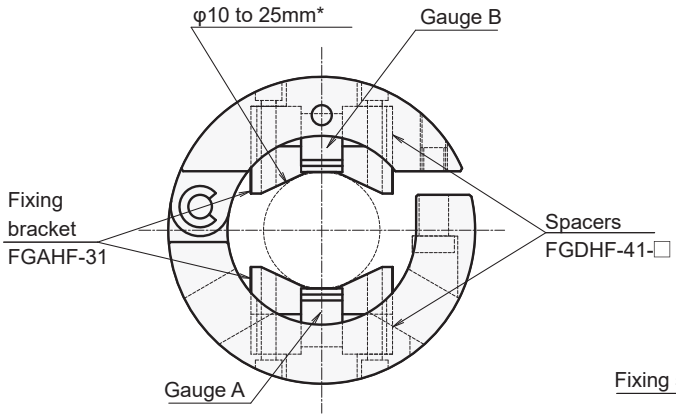
- **No need to remove an in-place rod; simply clamps on**
- **Compatible with hexagonal shafts**
- **Applicable rod diameters are ø10 to 25 mm, width across flats 13 to 25 mm**
- **Compact, lightweight design allowing installation even in narrow spaces**
- **Friction type strain gage eliminates the need for strain gage attachment work and can be removed for reuse**
- **Friction strain gages are provided with test data from tensile calibrations to calculate calibration coefficients for different shaft diameters**



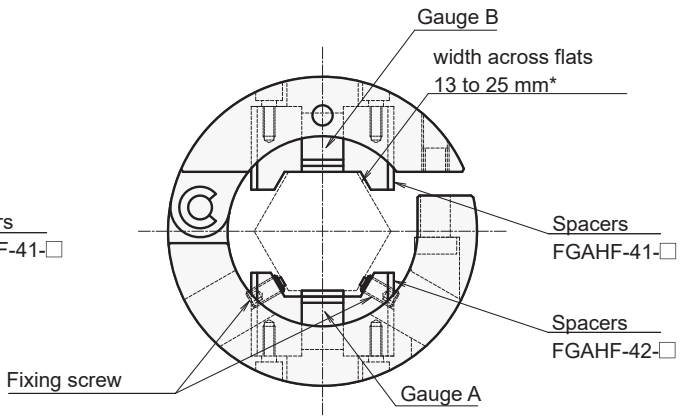
The friction type axial strainmeter is a sensor to measure axial strain of tie rods (tension rods).
In conventional tie rod axial force measurement using strain gauges or load cells, removal or processing of the tie rods is indispensable.
The axial strainmeter uses a friction-type strain gage, so there is no need to remove or modify the tie rods.
By replacing the spacer and fixture, it can be used to measure the axial strain of round rods and hexagonal cross section rods.

External Dimensions

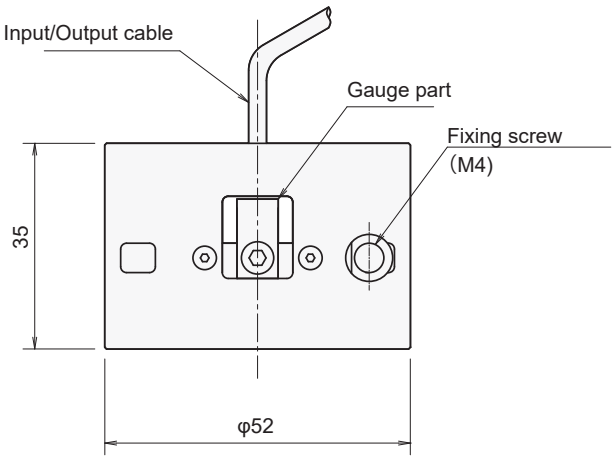
FGAH-1B-R (Round shape)



FGAH-1B-H (Hexagon shape)



* The diameter of the mounting rod can be adjusted in 0.1 mm increments with a spacer
□ is applicable shaft diameter



Installation image

Installation on steering tie-rod

Specifications

Type	FGAH-1B-R	FGAH-1B-H
Applicable shaft	Round shape Φ10 ~ 25mm	Hexagon shape Width across flats 10~25mm
Capacity	±1000×10^{-6} strain	
Rated output	Approx. 2600×10^{-6} strain	
Non-linearity	1%RO	
Allowable temperature range	-30 ~ +60°C (no dew condensation)	
Frequency response	Approx. 6.5kHz	
Input/output resistance	1000Ω±3%	
Dimensions	Approx. Φ52x35mm	
Weight	Approx.55g(excluding spacers and cable)	
Protection rating	Equivalent to IP51	
Recommended exciting voltage	2V	
Allowable exciting voltage	5V	
Input/output cable	Φ3.2mm 0.08mm² 4-core shielded vinyl cable 5m	

Test condition (Specimen)

1) Rod	10mm dia.
2) Material	SNCM439
3) Modulus of elasticity	208000 N/mm² (our test result)
4) Poisson's ratio	0.29 (our test result)
5) Surface roughness	Ra0.8
6) Hardness	HRC38

Test condition (Specimen)

1) Rod	Hexagonal two-face width 13mm
2) Material	SNCM439
3) Modulus of Elasticity	210000N/mm² (Our test result)
4) Poisson's ratio	0.29 (our test result)
5) Surface roughness	Ra0.8
6) Hardness	HRC38

*:Depending on the rod material, surface roughness, and surface treatment, there may be cases where this product is not applicable. Please contact our sales representative in advance.

*Option:

		Type name	Remarks
Friction type strain gauge		CBFC-2	Gage A,B set
FGAH-1B-R (Round shape)	Spacers	FGDHF-41	Set of 2
	Fixing bracket	FGAHF-31	Set of 2
FGAH-1B-H (Hexagon shape)	Spacers	FGAHF-41	For Gauge A 1 pc.
	Spacers	FGAHF-42	For Gauge B 1 pc.

Related Product

Torque screwdriver handle	FGDHF-11B	
Replacement shafts for torque screwdrivers	FGDHF-12B	(M3 :For holder fixing/gauge mounting)
	FGDHF-15B	(M2 : Spacer replacement)

Tie-rod Loadcell

TCLT-NA 2kN ~ 20kN

made-to-order

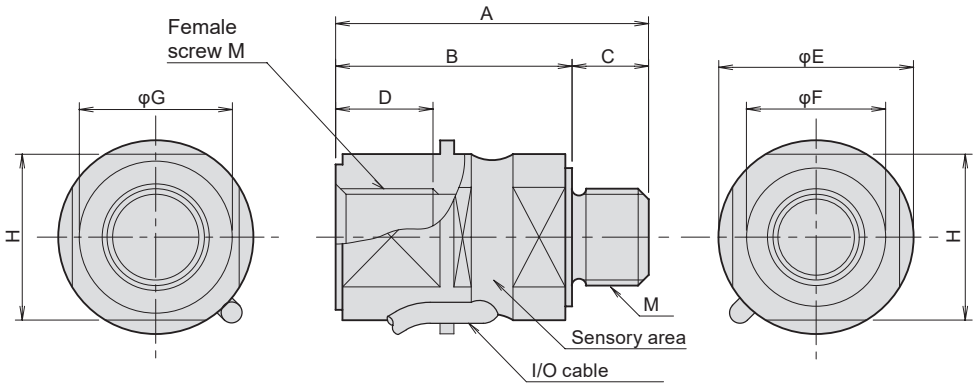
Feature

- **Easy installation using connection thread between tie-rod and tie-rod end**
- **3 kinds of thread prepared for installation on various tie-rods**
- **6 types are available depending on the combination of thread and capacity**

The TCLT-NA is a load cell designed to measure the tensile and compressive force applied to the tie-rod of a car.

IP code IP 53-equivalent

External Dimensions



Type \ dimension	A	B	C	D	E	F	G	H	M
TCLT-2KNA-10	36	27	9	11	24	14	18	21	M10×1.25
TCLT-5KNA-10									
TCLT-5KNA-12	40	31	9	13	28	17	20	24	M12×1.25
TCLT-10KNA-12									
TCLT-10KNA-14	45	34	11	15	28	20	23	24	M14×1.5
TCLT-20KNA-14									

Specifications

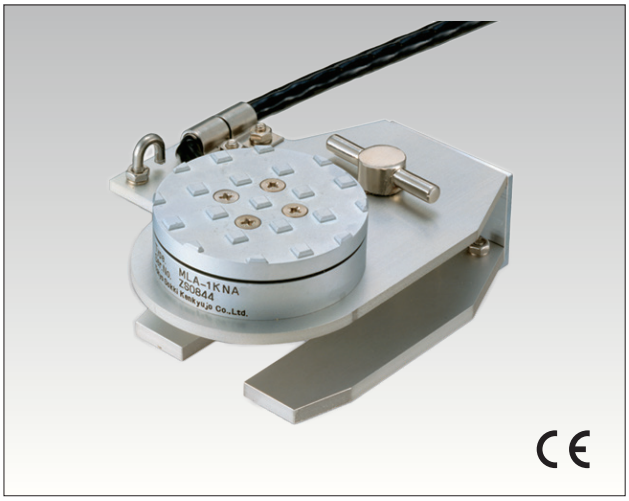
Type	TCLT-2KNA-10	TCLT-5KNA-10	TCLT-5KNA-12	TCLT-10KNA-12	TCLT-10KNA-14	TCLT-20KNA-14
Capacity	2kN	5kN		10kN		20kN
Mounting screw	M10×1.25		M12×1.25		M14×1.5	
Rated output	Approx.1500×10^{-6} strain	Approx.2000×10^{-6} strain				Approx.3000×10^{-6} strain
Nonlinearity	0.5%RO					
Allowable temperature range	0.5%RO					
Allowable temperature range	-10 to +60 °C					
Recommended Applied Voltage	2V or less					
Allowable applied voltage	5V					
I/O cable	φ3mm 0.05mm^2 4-conductor shielded chloroprene cable 0.2m Tip R03 connector					
Attached cable	φ3 0.05mm^2 4-conductor shielded chloroprene cable with R03 connector 3m NDIS plug at the end					

Pedal Force Transducer

MLA-NA 1kN

Feature

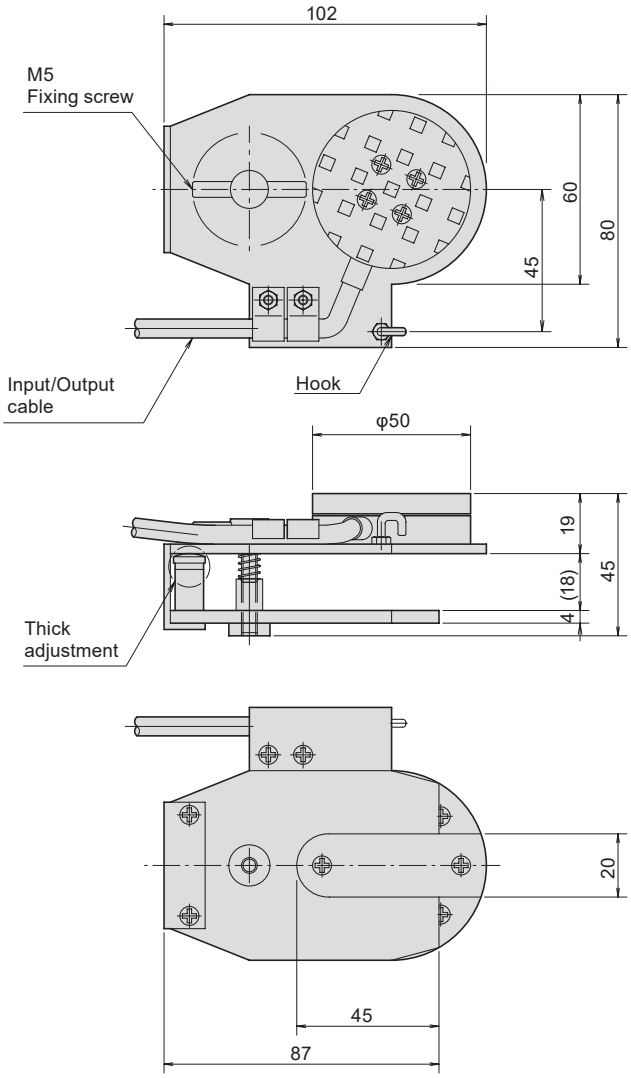
- **Easy installation**
- **Constructed thin and light**
- **Little measurement error caused by the position to step on the pedal**
- **Comes with hook for displacement transducer wire**



The MLA-NA is a transducer to measure the footing force of a car's brake pedal. The transducer can be easily installed without altering the pedal. The cable used is so tough not to be damaged in a hard motion.

Protection ratings : IP 51 equivalent

External Dimensions



Specifications

Type	MLA-1KNA
Capacity	1kN
Rated Output	1mV/V (2000×10^{-6} strain) ±10%
Non-linearity	0.3%RO
Hysteresis	0.3%RO
Temperature effect on zero	0.1%RO/ °C
Temperature effect on span	0.05%/ °C
Compensated temperature range	-10 to +60 °C
Temperature range	-10 to +60 °C
Over load	150%
Input/output resistance	350Ω±1%
Recommended exciting voltage	Less than 5V
Allowable exciting voltage	10V
Zero balance	10%RO
Input/Output cable	φ6mm 0.08mm^2 4-core shielded polyurethane cable 4m
Weight	250g

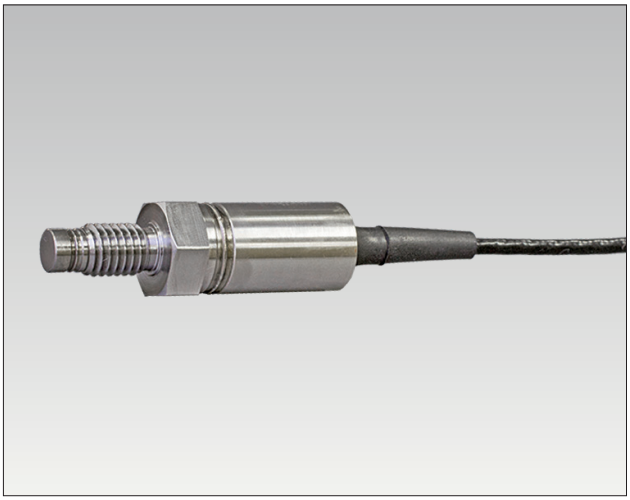
Small High-temperature Pressure Transducer with built-in amplifier

PWFA-PA 2 ~ 20MPa

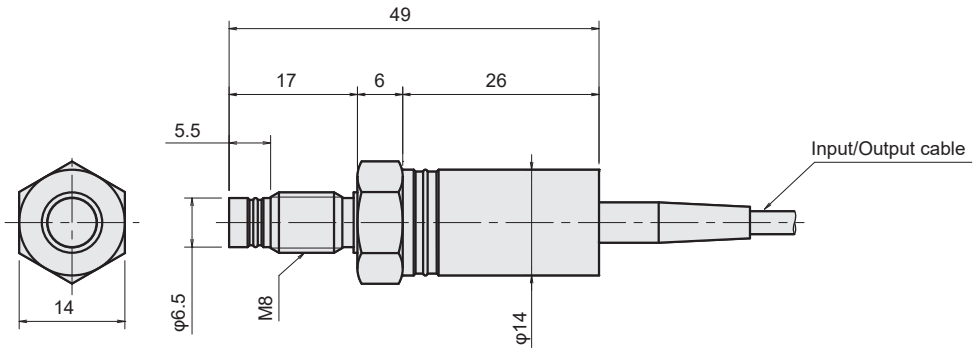
A small pressure transducer most suited to dynamic measurement around the engine at high temperature up to 120°C

Feature

- **Excellent anti-vibration characteristics**
- **Measurement possible in high temperature ranges of up to 120 °C**
- **Light weight of 45 g, which is less than half of conventional products**
- **Overall length after installation is 32 mm, which is less than one third of conventional products**
- **Easy-to-install bolt shape (M8 size)**



External Dimensions



Specifications

Type	PWFA-2MPA	PWFA-5MPA	PWFA-10MPA	PWFA-20MPA
Capacity	2MPa	5MPa	10MPa	20MPa
Output voltage	0.5 ~ 5 V			
Non-linearity	0.5%RO			
Hysteresis	0.5%RO			
Temperature effect on zero	0.1%RO/°C			
Temperature effect on span	0.03%/°C			
Compensated temperature range	-20 ~ +120°C			
Allowable temperature range	-20 ~ +120°C			
SN ratio	50 dB or more			
Load resistance	5 kΩ or more			
Frequency response of amplifier	DC ~ 1 kHz			
Over load	150%			
Power source	DC 12 (11~15) V 30 mA max.			
Tightening torque	12 N•m			
Mounting thread	M8			
Materials of pressure media	SUS630			
Weight	45 g			
Protection ratings	IP65 equivalent			
Input/Output cable	Φ 3 mm 0.08 mm^2 4-core shielded Teflon cable 2 m			

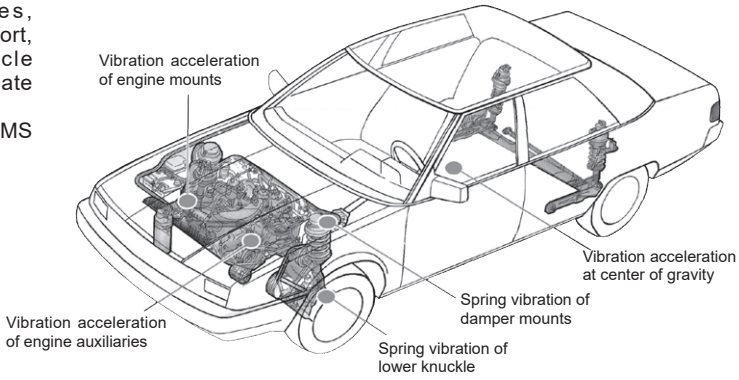
In addition to the above, we can also manufacture custom-made products.

*The zero point may shift slightly during long-term continuous use at high temperatures. Please note that this may occur in the case of static measurement.

Introduction of Accelerometers for Automotive

In the measurement of automobiles and vehicles, accelerometers are used to measure vibration, ride comfort, and vehicle behavior, and the acceleration of vehicle acceleration, deceleration, and turning are used to evaluate vehicle driving characteristics.
Our accelerometers are available with strain gages or MEMS as the sensing part.
Both are capable of measuring from the DC level.

Vibration Acceleration of Automobile Parts



Main Accelerometer Selection

type name \ Capacity m/s²			20	40	100	200	500	1000	2000	Allowable overload	Response frequency
Compact	3-axis type	ARM-A-T	X/Y direction 100m/s² Z direction 400m/s²							3 times	200Hz
High response, high capacity	1-axis type	ARGH-A					●	●	●	10 to 40 times	2kHz
	3-axis type	ARGH-A-T					●	●			
High response low capacity	1-axis type	ARGL-A	●	●	●	●				100 to 1000 times	200Hz
	3-axis type	ARGL-A-T	●	●	●	●					

The accelerometers in this catalog are intended for measurement indoors or in an equivalent location and under conditions not subject to water droplets, etc.

ARM-A-T (Small Tri-axial Acceleration Transducer)

1/2 in weight and volume compared with our conventional transducers

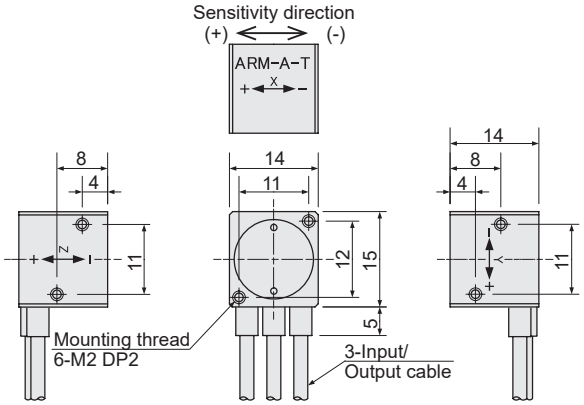
Feature

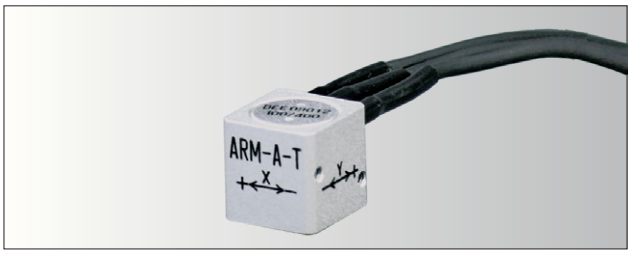
- **The world's smallest and lightest class transducer of strain gauge type**
- **Identical gravity position for 3 axes**
- **Easy handling**

This is a tri-axial acceleration transducer for the fields of machines, vehicles, shipbuilding, civil works and architcture.

Protection ratings : IP 61 equivalent

External Dimensions





Specifications

Type	ARM-A-T
Numbers of measurement	3 directions
Capacity	X- and Y-directions 100m/s² Z-direction 400m/s²
Rated output	0.5mV/V(1000×10⁻⁶ strain)
Non-linearity	1%RO
Frequency response range	DC~200Hz (Sensitivity deviation ±10%)
Natural frequency	X- and Y-directions 500Hz Z-direction 1400Hz
Cross sentivity	3%RO (at 100m/s² load)
Allowable temperature range	-10 ~ +60°C
Over load	300%
Input/Output resistance	X- and Y-directions 1000Ω Z-direction 200Ω
Recommended exciting voltage	2V or less
Allowable exciting voltage	5V
Input/Output cable	φ2.2mm 0.05mm² 4-core shielded vinyl cable 5m
Weight	13g

ARGL-A / ARGL-A-T (Small High-response Low-capacity)

Its small, light-weight and robust acceleration sensor

Feature

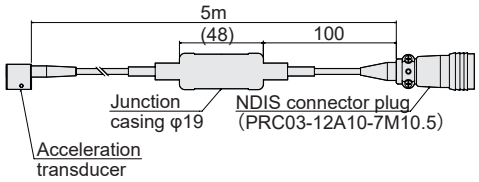
- **Small and light-weight**
- **Measurement in 3-directions possible with the same size as a uni-axial model(ARGL-A-T)**
- **Wide frequency response range**
- **Outputs of 3-directions are measured by one input/ output cable(ARGL-A-T)**
- **Measurement possible from DC level**
- **No need of external power supply**
- **Excellent temperature characteristics and frequency response**
- **Sensitivity loss is not caused by an extension cable**

The ARGL-A / ARGL-A-T is a small and high-response acceleration transducer incorporating a MEMS-based acceleration sensor. Its small, light-weight and robust structure allows the use of this transducer for the measurement in various fields such as machines, vehicles, ships, civil engineering and construction. This transducer can be just connected to our dc-exciting dynamic strain meter and measured without the need of an external power supply.

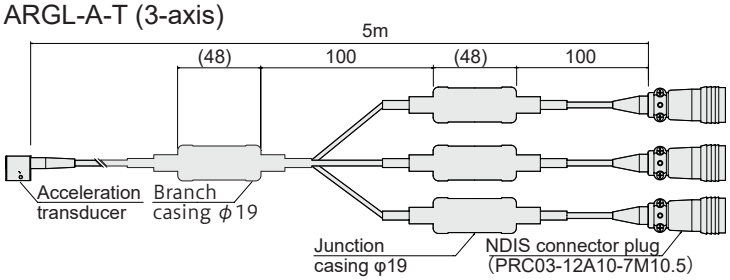
Protection ratings : IP 61 equivalent

■ External Dimensions

ARGL-A (1-axis)



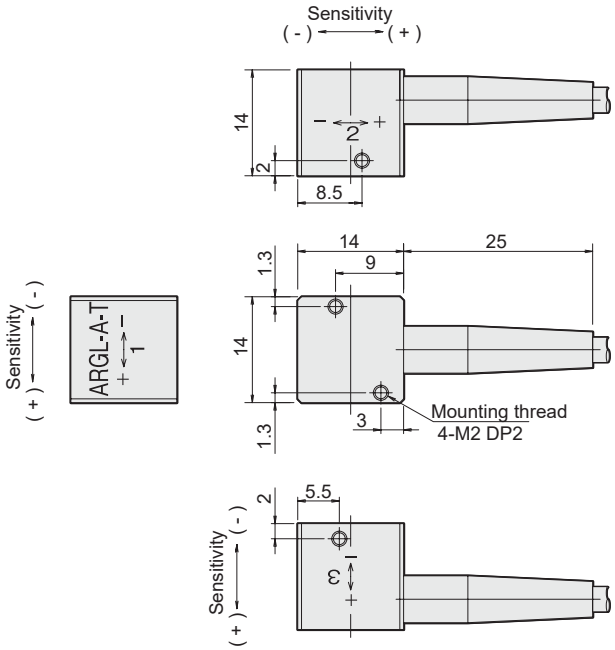
ARGL-A-T (3-axis)



■ Specifications

Type 1-axis / 3-axis	ARGL-20A / ARGL-20A-T	ARGL-40A / ARGL-40A-T	ARGL-100A / ARGL-100A-T	ARGL-200A / ARGL-200A-T
Capacity	20m/s²	40m/s²	100m/s²	200m/s²
Rated output	Equivalent to 800×10⁻⁶ strain ±10%			
Non-linearity	2%RO			
Frequency response range	DC ~ 200 Hz (sensitivity deviation ±5%)			
Zero balance	Equivalent to 900×10⁻⁶ strain ±10%			
Allowable temperature range	-10 ~ +60°C			
Allowable overload	20000m/s² 100000%	20000m/s² 50000%	20000m/s² 20000%	20000m/s² 10000%
Allowable exciting voltage	DC2.0 ~ 3.6V			
Current consumption	15mA MAX (DC2V)			
Input/Output cable	φ3.2mm 0.08mm² 4-core shielded vinyl cable 5m, NDIS plug attached on the end.			
Weight	Approx. 10 g			

- The zero balance is the output at no load and depends on the condition of the measuring instrument.
- TMR-321, DC-204R and DC-204Ra accept the use of a remote sensing cable (CR-6184).

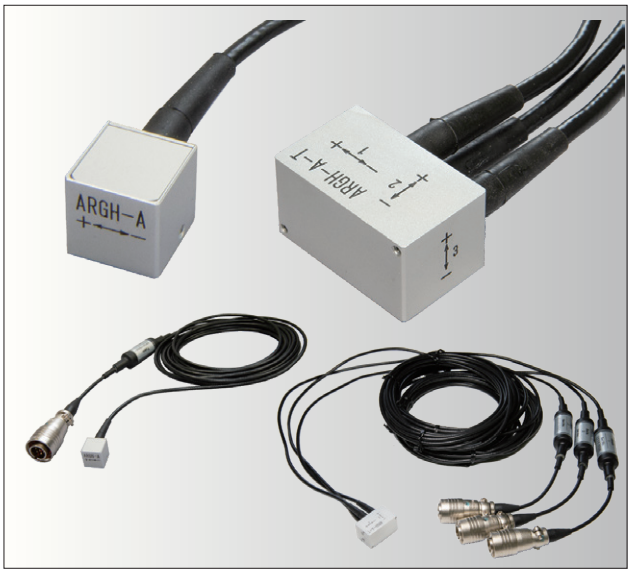


ARGH-A / ARGH-A-T (Small High-response Low-capacity)

Its small, light-weight and robust acceleration sensor

Feature

- **Small and light-weight**
- **Wide frequency response range**
- **Measurement possible from DC level**
- **No need of external power supply**
- **Excellent temperature characteristics and frequency response**
- **Sensitivity loss is not caused by an extension cable**

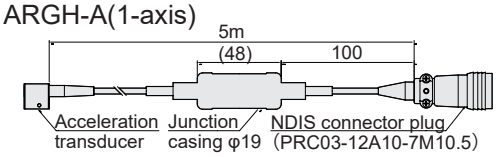


The ARGH-A / ARGH-A-T is a small and high-response acceleration transducer incorporating a MEMS-based acceleration sensor. Its small, light-weight and robust structure allows the use of this transducer for the measurement in various fields such as machines, vehicles, ships, civil engineering and construction. This transducer can be just connected to our dc-exciting dynamic strain meter and measured without the need of an external power supply.

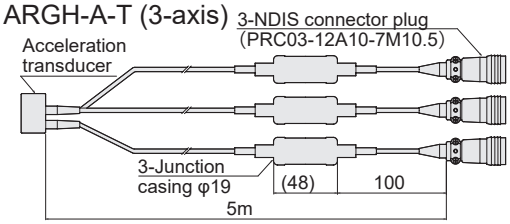
Protection ratings : IP 61 equivalent

External Dimensions

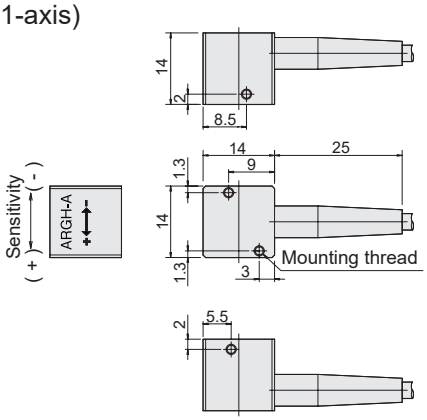
ARGH-A(1-axis)



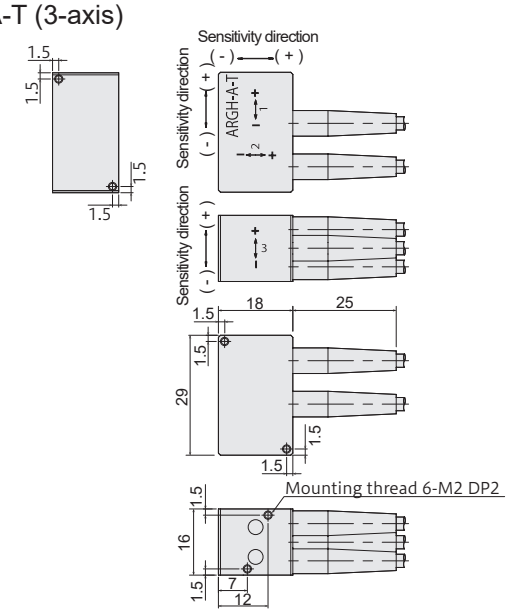
ARGH-A-T (3-axis)



ARGH-A(1-axis)



ARGH-A-T (3-axis)



Specifications

Type 1-axis / 3-axis	ARGH-500A ARGH-500A-T	ARGH-1000A ARGH-1000A-T	ARGH-2000A
Capacity	500m/s²	1000m/s²	2000m/s²
Rated output	Equivalent to 1800×10⁻⁶ strain ±10%		
Non-linearity	2%RO		
Frequency response range	DC ~ 2kHz (sensitivity deviation ±5%)		
Zero balance	Equivalent to 2250×10⁻⁶ strain ±15%		
Allowable temperature range	-10 ~ +60°C		
Allowable overload	20000m/s² 4000%	20000m/s² 2000%	20000m/s² 1000%
Allowable exciting voltage	DC2.0 ~ 3.6V		
Current consumption	20mA MAX (DC2V)		
Input/Output cable	φ3.2mm 0.08mm² 4-core shielded vinyl cable 5m, NDIS plug attached on the end.		
Weight	Approx. 10 g		

- The zero balance is the output at no load and depends on the condition of the measuring instrument.
- TMR-321, DC-204R and DC-204Ra accept the use of a remote sensing cable (CR-6184).

Introduction of measuring instrument

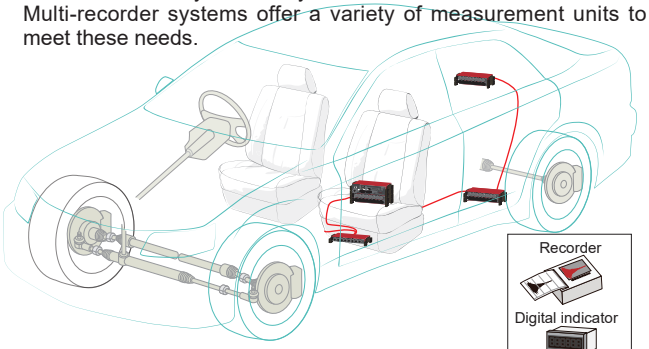
Multi-Recorder TMR-300 Series

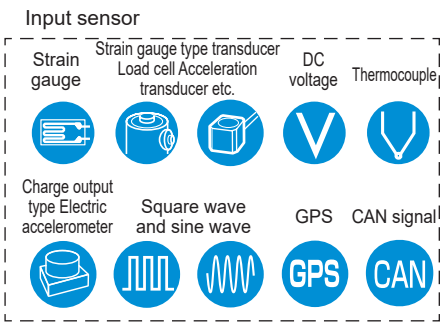
Measuring instruments that serve as the hub of an in-vehicle measurement system

Feature

- **Operation by DC power source**
- **Excellent vibration tolerance and compact size suitable for vehicle onboard measurement**
- **High resolution mode (0.1×10^{-6}) provided (for Strain full bridge unit and Strain 1G2G4G unit)**
- **High speed sampling of 100 kHz**
- **USB and LAN interface provided**
- **32GB SD card acceptable**

The TMR series multi-recorder is a compact multi-channel data recording system that can be easily combined with various measurement units for sensor inputs according to the purpose.
Its small size and light weight make it ideal for in-vehicle measurements where installation space is limited.
Automotive measurements include a wide variety of test items such as driving performance evaluation tests, operability, ride comfort, and safety, and many sensors are used.
Multi-recorder systems offer a variety of measurement units to meet these needs.





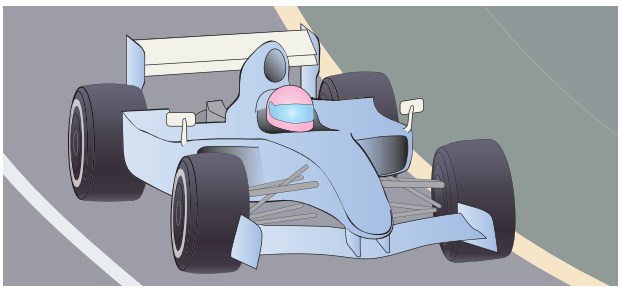
Smart Dynamic Strain Recorder DC-204R / DC-204Ra

Compact and lightweight measuring instrument suitable for small-scale measurements or measurements with limited installation space

Feature

- **4-channel configuration with miniature size like postcard**
- **200 kHz sampling (at the fastest in 1-channel mode)**
- **Simultaneous 50 kHz sampling for 4 channels**
- **Capable of measuring a large strain of up to 80000 x 10^{-6} strain (with 0.5 V excitation)**
- **Data recording in compact flash card of 2 Gbyte capacity**
- **Automatic data protection against power failure. When the power is droped unexpectedly, stops measurement and stores data before turning off the power.**
- **Data format conforms to DADiSP format**
- **External start / stop and external trigger**
- **Sensor open-circuit check function**
- **USB Interface installed and standard control software supplied**

The DC-204R/DC-204Ra are CF card recording type dynamic strainmeters that measure strain, DC voltage, and thermocouple temperature.
The DC-204Ra is equipped with an analog output (±5 V) for waveform output to an external recorder or automotive ECU. Up to 8 units and 32 channels can be combined using the dedicated software and controller DC-7204 that come as standard accessories.



It is effective for measurement of vehicles with limited space for measuring instruments, such as racing cars.

DC-204Ra (Analog output)

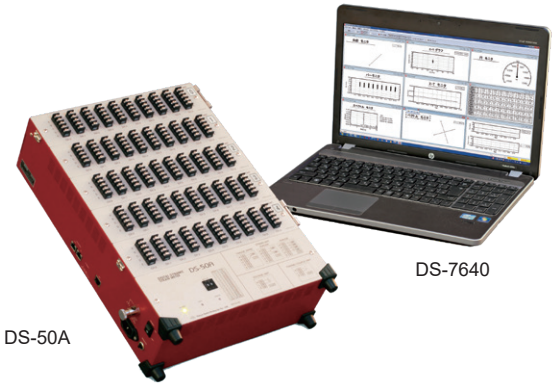
Battery driving in combination with the battery pack BA-104 (option) is possible

Multi-channel Dynamic Strainmeter DS-50A

Multi-axis road simulation of dynamic stress states

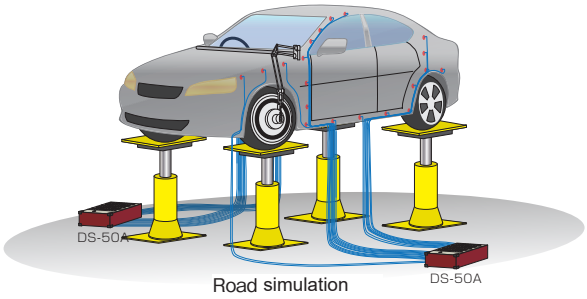
Feature

- **Simultaneous measurement of 20 sets (1,000 channels) is available at the maximum.**
- **1kHz sampling at the fastest when 1 set is used.**
- **Accommodates mixed strain and voltage units**
- **Comes standard with measurement software**



DS-7640

DS-50A



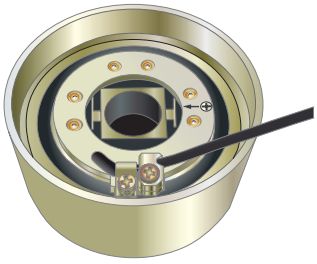
Road simulation

In the automotive industry, computer aided engineering (CAE) is being used to reduce the number of prototypes manufactured, but verification of stress analysis simulations by driving actual vehicles and bench testing is also considered important.
In this context, we have conducted a reproduction test of analysis using multi-axial load simulation with rosette gauges to verify the results of approximate solutions.
The DS-50A dynamic strainmeter incorporates a bridge box with 50 channels per unit to realize compact, multi-point dynamic strain measurement.
To meet the requirements of multi-channel systems, we offer the dedicated dynamic measurement software Visual LOG RD-7640 (sold separately), which enables the calculation of peak stress from principal stress analysis.

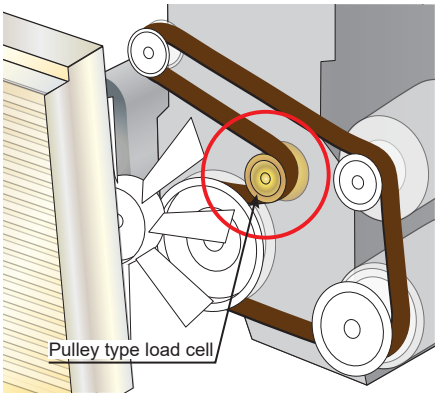
Automotive Custom Products

Automotive-related measurements sometimes require special sensors and measuring instruments tailored to the purpose and conditions of use.
In addition to order-made sensors for testing, we also undertake strain gage installation on actual parts. Please contact us.
Here are some of the custom-made products we have manufactured in the past.

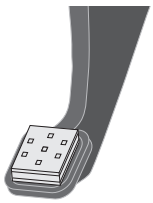
Pulley type load cell



Capable of measuring dynamic radial loads occurring on pulleys
Allowable rotation is 15,000rpm



Parking pedal Force Transducer



Parking pedal
Force Transducer

The force to depress the parking pedal can be measured.

Other

- **Telemeter unit mounting jig**
- **Wheel torque side force transducer**
- **Power window load cell**
- **Angle meter**
- **Accelerator pedal force transducer**

We also offer strain gauge installation on various other parts.

Introduction of Strain Gauge

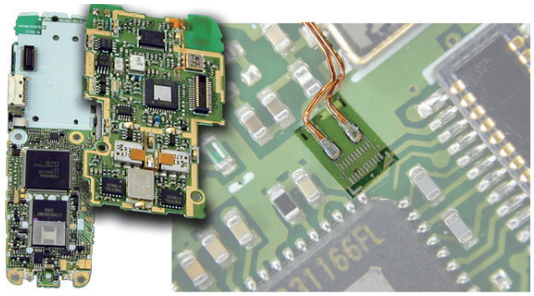
Miniature strain gauge application

TML strain gages are used to directly measure the strength of objects to be measured, and in response to increasingly sophisticated technology, strain gages have been newly added to the lineup as smarter sensors to meet such applications. We will introduce various applications that have been developed and proven in the automotive, aircraft, and industrial machinery fields by specifying the object and purpose of measurement. Please contact us for specific measurement plans. We will provide you with detailed information on how to select strain gages, adhesives, and other materials, as well as installation procedures.

Ultra-miniature strain gauge measurement in less space area

F series (Single axis) -196 ~ +150°C
EFLK/EFLX (Single axis) -196 ~ +300°C
EFCA/EFRA (2- / 3-axis) -196 ~ +200°C

Miniaturization of printed circuit boards and mounted parts is required for components used in automobiles, personal computers, and industrial machinery.
We offer a lineup of ultra-compact strain gages that can be installed in a smaller area as strain gages that directly measure these mechanical characteristics.



Compensated temperature range

F series	+10 ~ +100℃
EFLK/EFLX	+10 ~ +150℃
EFCA/EFRA	0 ~ +150℃

Bonding adhesive applicable

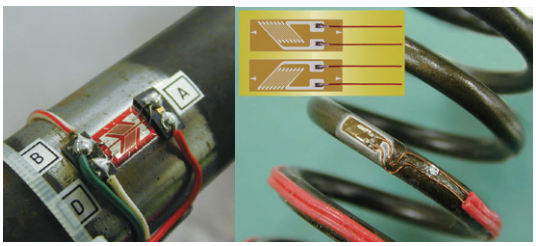
CN	(-196 ~ +120 °C)
EB-2	(-60 ~ +200 °C)
C-1	(-196 ~ +200 °C)
NP-50	(-30 ~ +300 °C)

Gauge patterns	Element	Type	Gauge size(mm) Length	Gauge size(mm) Width	Backing size(mm) Length	Backing size(mm) Width	Resistance
FLAB-03 (×3)	Single axis	FLAB-03	0.3	1.4	3	2	120
FLKB-1		FLKB-1	1	0.7	4.5	1.4	120
EFLK-02 (×3)		EFLK-02	0.2	0.8	1.6	1.2	120
EFLX-02 (×3)		EFLX-02	0.2	0.8	1.8	1.2	120
EFRA-05 (×3)	0°/90° 2-axis Stacked	EFCA-05-002LE	0.5	0.4	φ3.8		120
	0°/45°/90° 3-axis Stacked	EFRA-05-002LE	0.5	0.4	φ3.8		120
	-002LE: Polyimide insulated gauge lead of 2-cm pre-attached						

Shearing strain/Torque measurements

QFLT[QF series] -20 ~ +200°C

The gauges measure strains in 45-degree direction generated by shearing stress. The narrow gauge size is suitable for fine spring. The polyimide resin backing makes the use in temperatures up to 200°C possible. Standard self-temperature-compensation is for materials with a linear expansion coefficient of 11 x 10^{-6}/°C, but self-compensated strain gauges for other materials can be manufactured to order.



Compensated temperature range +10 ~ +100℃

Bonding adhesive applicable

CN	(-20～+120 °C)
C-1	(-20～+200 °C)
NP-50	(-30～+200 °C)

Gauge patterns	Element	Type	Gauge size(mm) Length	Gauge size(mm) Width	Backing size(mm) Length	Backing size(mm) Width	Resistance
QFLT-05A (×3)	Single axis Shearing strain	QFLT-05A-11	0.5	0.66	4.0	1.3	120
QFLT-05B (×3)		QFLT-05B-11	0.5	0.66	4.0	1.3	120
QFLT-1A (×3)		QFLT-1A-11	1	1.1	5.7	2	120
QFLT-1B (×3)		QFLT-1-350A-11 -002LE	1	1.1	5.7	2	350
		QFLT-1B-11	1	1.1	5.7	2	120
		QFLT-1-350B-11	1	1.1	5.7	2	350
	-002LE: Polyimide insulated gauge lead of 2-cm pre-attached						

Bolt Strain Gauge

BTM series -10 ~ +80°C

These gauges are used for measurement of tensile strain of bolt. They are simply inserted into pre-drilled hole in the bolt with exclusive adhesives. This method is recommendable when an ordinary strain gauges can not be mounted on the bolt surface. Accurate tensile force measurement is possible by calibrating the bolt after installing the bolt gauges.

Gauge Lead :

BTM-6C/-1C

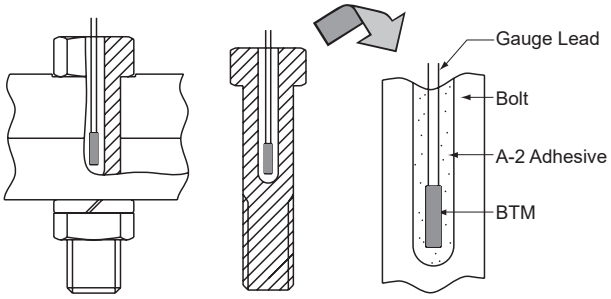
Φ0.14mm Polyurethane leadwire (Cu) of 80mm

BTM-6CTA

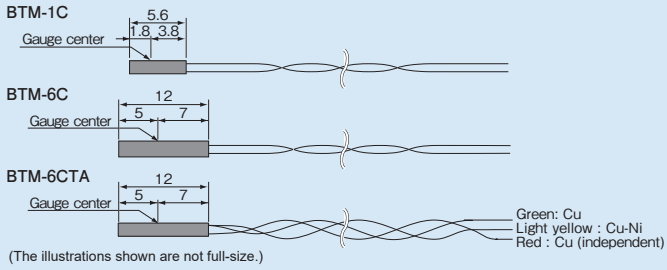
Φ0.14mm Polyurethane leadwire (Cu) of 80mm

Φ0.12mm Polyester leadwire (Cu-Ni) of 80mm

*Polyurethane insulation of the gauge leads is easily removed by heat of soldering iron, while Polyester sheath is removed by chemical solvent.



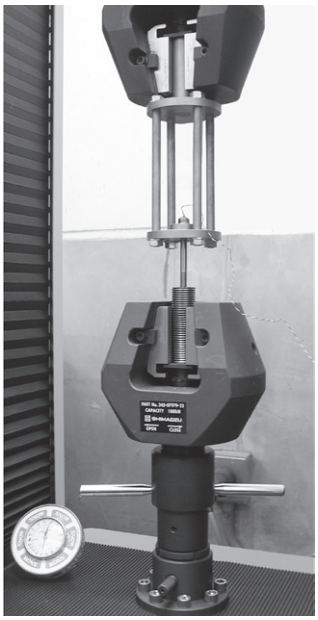
Bonding adhesive applicable
A-2 (-10 ~ +80 °C)

Gauge patterns	Type	Gauge size(mm) Length	Gauge size(mm) Width	Backing size(mm) Length	Backing size(mm) Width	Resistance
	BTM-1C (Hole drilled:Φ1.6mm)	1	0.7	5.6	1.4	120
	BTM-6C (Hole drilled:Φ2.0mm)	6	1.0	12.0	1.7	120
	BTM-6CTA (Hole drilled:Φ2.0mm) Temperature integrated applicable in -10~+80°C	6	1.0	12.0	1.7	120

(The illustrations shown are not full-size.)

Bolt strain gauge installation/calibration service

Unlike the bonding of general strain gages, the use of gages for bolts requires drilling of bolts, strain gage embedding, and load calibration. To ensure effective use of strain gages for bolts To ensure effective use of gages for bolts, we offer gage installation for measuring axial force of bolts. We can drill holes in supplied bolts, install gauges, connect cables, and perform load calibration. We also handle high-temperature gauges. Please contact us.

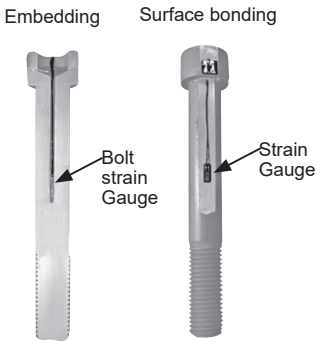


Installation Methods

Strain gauges are either embedded inside the bolt or attached to the surface, and a selection will be made according to the conditions of use.

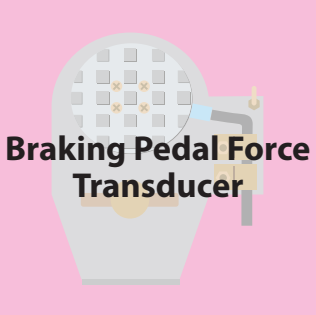
Burying: Strain gauges for bolts (BTM-Series)/
High Temperature Buried Tension Bolt
Machine a φ0.8, φ1.6 or φ2 mm hole in the bolt center and bury a gauge for bolts inside using the dedicated adhesive.
The damage on strain gauge from the washer during bolt tightening is avoided.We accept orders for high-temperature tension bolts (operating temperature range: -40°C to +150°C) using the embedded type strain gauges for high-temperature applications.

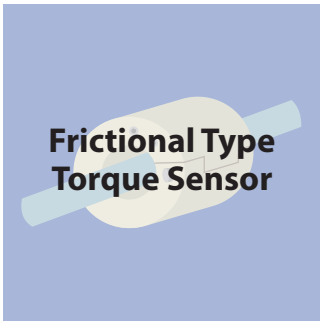
Attach: F, QF, ZF, EF, CEF, CF-Series
Two pieces are attached in symmetrical positions (facing each other) on the bolt shank to cancel the influence of bending. To prevent damage to the strain gauge during bolt installation or due to contact with washers, the surface of the shank is scraped for installing the strain gauge. Select a strain gauge according to the temperature and environment of use.

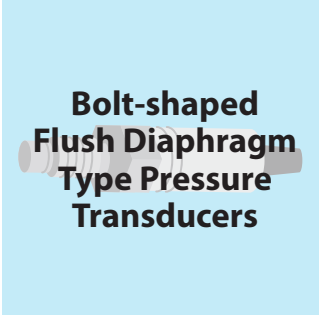


Installation method	Embedding type				Surface bonding type		
Sensor	Embedding strain gauge				Strain gauge		
Operating temperature	−30 to +100°C	−40 to +150°C	−10 to +80°C	−40 to +150°C	−269 to +80°C	40 to +80°C	−40 to +300°C
Machining	Machining hole diameter Ø0.8		Machining hole diameter Ø1.6, Ø2.0		Surface processing		
Applicable bolt	M3 or more	M6 or more	M3 or more		M3 or more		
others			Available with temperature measurement function		Axial force measurement, bending measurement, torque measurement		

Instruments and calibration machines used for the calibration service are periodically calibrated and inspected by public institutions complying with the national standards.
For more information on strain gage bonding and calibration services, please contact us.







Approval Certificate **ISO9001**
Design and manufacture of strain gauges, strain measuring equipment and transducers

The contents of this catalog are subject to change without prior notice.
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