

RoaDyn[®] S625 System 2000

Type 9266A...

Wheel Force Sensor for Passenger Cars

Wheel force sensor for measuring three forces and moments on a rotating wheel; a major constituent in modern vehicle development.

- Very light yet rigid sensor/measuring wheel
- Precise signal acquisition with individually calibrated strain gage load cells
- Sensor identification and digitization in wheel electronics
- Digital data transfer with in-board or out-board transmission
- Tested fatigue strength, e.g. to SAE J378
- For 12" or 13" rims in aluminium, from 14 ... 18" rims in composite CFR/aluminium

Description

The wheel force sensor is mounted on a vehicle as a complete wheel and measures multiaxial loads imposed on the vehicle by the pavement. It enables precise measurement of forces and moments, each of which are represented as three vectors in an orthogonal reference system. During measurement the measuring wheel replaces the standard wheel. It therefore has to meet the latter's strength requirements and must not affect the kinematics or the handling. In particular, a sensor must be sufficiently adaptable to cater for a particular range of wheel sizes and hub connection geometries. The geometry and if necessary the heat dissipation of the brake components must be taken into account.

The wheel force sensor with carbon fiber reinforced composite rim comes much closer to the standard weight than competing concepts made of aluminium or steel. The rim design for 14 ... 18" wheel diameters combines an aluminium rim ring with a matched wheel disk manufactured from carbon fiber reinforced plastic (CFR). The positive and frictional nature of the connection makes it very strong. The "inside part" makes the connection with the hub and also consists of CFR. Four load cells connect the rim and this part. The assembly is adapted to suit the different hub geometries with an adapter package and wheel offset adapter.

The measuring wheels for 12" and 13" rims represent a special version. These wheels are also equipped with four load cells, but all of the adapter parts are made of aluminium and due to the limited amount of room around the hub are only offered with an out-board transmission.



The RoaDyn S6xy family of measuring wheels use normalized individual 9190A load cells, which are individually calibrated after manufacture. Serial number, calibration data and zero of the individual forces are stored on an ID chip. The three measured signals are compensated for temperature. In addition the interchangeable load cells can be used for all sensors of the RoaDyn S6xy family.

When the electronics are switched on, sensor components identify themselves and allow systematic computation based on the available individual values.

The high measuring accuracy of the precision load cells is retained during transmission. This is because digitization takes place on the measuring wheel to prevent transmission interference (for example from brake heat, movement, vibration, etc) having any effect. The measurement of individual values with separate load cells also leads to an improvement in the interchannel crosstalk. And the fact that the original load cell signals are known allows rapid error diagnostics. Individual load cells can be replaced without impairing the overall quality of the sensor.

The integration of cutting edge digital transmission and data processing techniques leads to reliable provision of measurement data free from interference and to user friendly system operation. In addition to the wheel load data, further sensors can be connected to the wheel transmission unit. Provision has been made for the option of storing signals from (for example, steering angle or camber angle) sensors in the vicinity

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of the wheel that have been amplified and converted with the wheel data. The measured signals are filtered and digitized in the Type 5241A... wheel electronics unit. A pulse code module (PCM) modulates a serial stream of data transmitted at 2Mbps. Transmission into the interior of the automobile is standard, as this offers major advantages for tests carried out on public roads or off-road.

The wireless data transmission unit consists of a Type 5242A4 rotor rotating with the wheel and a Type 5240A... stator for mounting on the spring/shock absorber system of the automobile. For exact positioning and alignment of the stator a Type Z39911 alignment gage is included. Kistler offers alternative the Type 5248A0 external transmission unit if this data transfer configuration is required. The transmission units are described in detail on separate data sheets 5240A_000-561 and 5248A_000-562.

From the raw data in the rotating wheel coordinate system, the Type 9891A... on-board electronics system performs real-time computation of the required data in a coordinate system fixed relative to the wheel. The System 2000 on-board electronics are described on data sheet 9891A_000-563.

Application

To obtain measurement data from particular vehicles they are generally mounted with four or with two RoaDyn S625 measuring wheels. For corresponding measurements for component or tire development only one measuring wheel is used.

The ongoing process of measurement and data acquisition allows continuous improvement and development of active chassis and powertrain systems (such as ABS, ESP, etc) for controlling vehicle dynamics. The acquired measurement data can be used to supplement fatigue calculations and numerical simulations. The measuring wheels yield precise raw data and measurements for developing computer models of entire automobiles or components of specific models. Load assumptions underlying automobile design can be verified when a prototype is available and design errors uncovered promptly. As a supplementary service Kistler provides adapters for optical sensors from various suppliers for measuring kinematic variables such as camber angle, slip angle, side slip angle, speed and acceleration. The particular adapters for mounting the different sensors are available from Kistler.



Fig. 1: Passenger car with RoaDyn® S625 System 2000

The measuring wheel system described above can also be used on a vehicle test stand. Its daily exclusive use on a test stand requires, among other things, special technical characteristics, which have led to the development of a special system Type 9266A2 in aluminium. Further information is contained in the data sheet 9266A_000-580.



Fig. 2: Race car with RoaDyn® S625 System 2000

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Technical Data

Measuring range (with 4 load cells)	F_x	kN	± 20
	F_y	kN	± 15
	F_z	kN	± 20
	M_x	kN·m	± 4
	M_y	kN·m	± 4
	M_z	kN·m	± 4
Rotation angle accuracy		°	$\approx 0,1$
Max. weight* of measuring wheel	m	kg	≈ 10

Maximum Loads

Fatigue strength (SAE J328)	kN	2,6
Degree of Protection		IP64
Operating temperature range		
Aluminium components	°C	<120
CFR components	°C	<110

Maximum speed (≈ 280 km/h)		min^{-1}	2 300
Max. shock acceleration	x	g	≤ 40
	y	g	≤ 20
	z	g	≤ 40

Accuracy

Crosstalk	$F_y \rightarrow F_x, F_z$	%	≤ 1
	$F_x \leftrightarrow F_z$	%	≤ 1
	$F_x, F_z \rightarrow F_y$	%	≤ 2
Linearity		% FSO	$\leq 0,5$
Hysteresis		% FSO	$\leq 0,5$

*including 14" rim, hub adapter and stator, but excluding tire

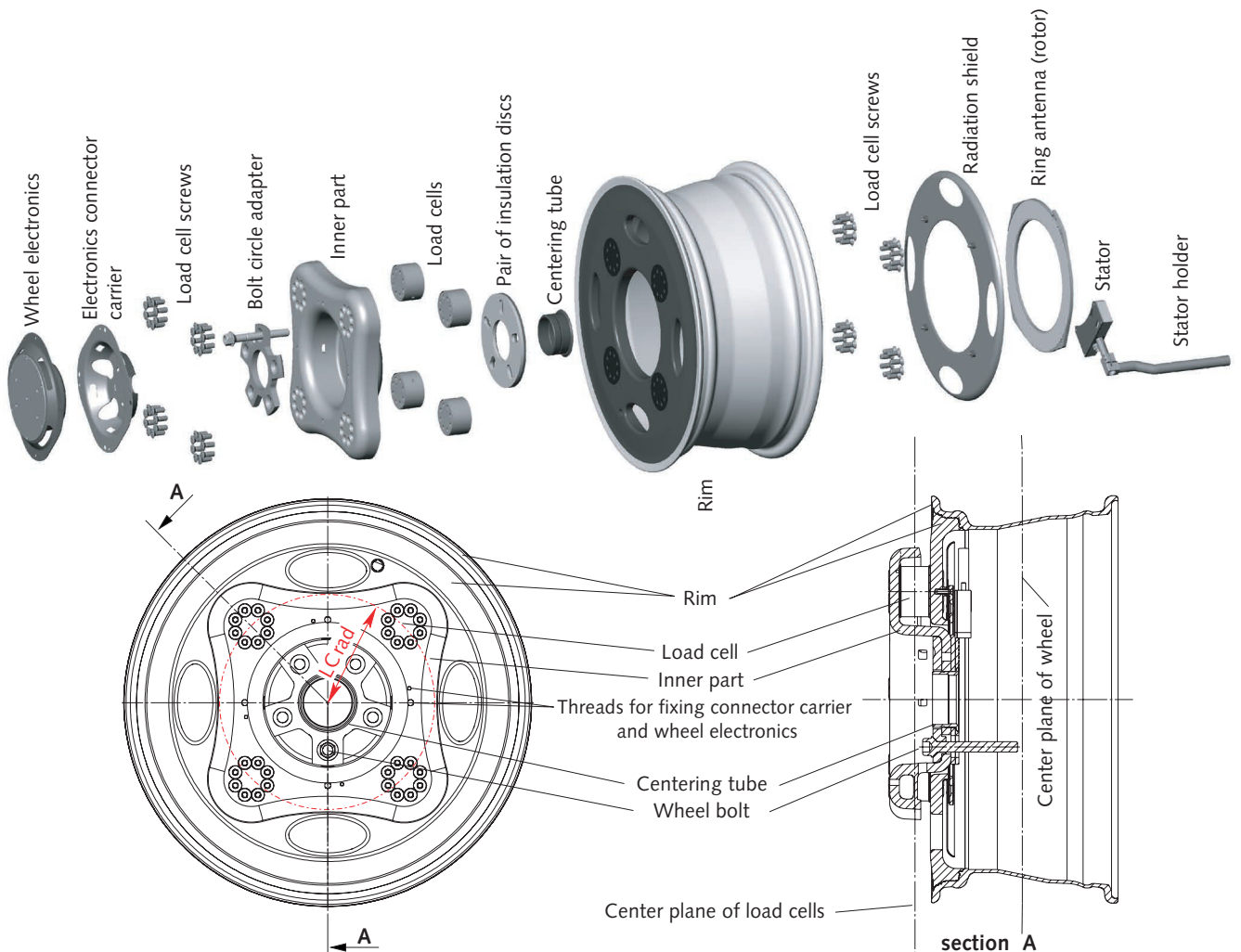


Fig. 3: Exploded view showing arrangement of components of RoaDyn® S625 with in-board transmission unit

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Configuration of RoadDyn® S625 System 2000

<p>Sensor</p> <p>Type 9266A1</p> 	<p>In-Board Transmission Unit consisting of Rotor, Stator and Cable for Connection to System 2000 On-Board Electronics</p> <p>Type 5242A..., 5240A..., Z30430Ax</p> 	<p>System 2000 On-Board Electronics</p> <p>Type 9891A...</p> 	<p>Remote Control Unit for System 2000 On-Board Electronics</p> <p>Type 5685A2</p> 
<p>Sensor</p> <p>Type 9266A1</p> 	<p>Out-Board Transmission Unit for System 2000 with Connecting Cable</p> <p>Type 5248A..., Z30430Ax</p> 	<p>System 2000 On-Board Electronics</p> <p>Type 9891A...</p> 	<p>Remote Control Unit for System 2000 On-Board Electronics</p> <p>Type 5685A2</p> 

Accessories Included

- Stator mounting gage

Type/Art. No.
Z39911

Ordering Key

Type 9266A

Optional Accessories

- Load cell bolts, titanium, 16 pcs. per cell **Type/Art. No.** Z30074
- Stator mounting gage, 1 pc. per measuring system **Type/Art. No.** Z39907
- Carrying case for on-board electronics system, 1 pc. per measuring system **Type/Art. No.** V712.0001
- Carrying case for accessories, 1 pc. per measuring system **Type/Art. No.** V712.0002
- Carrying case for 1 measuring wheel with tire, 1 pc. per measuring wheel **Type/Art. No.** V712.0004
- Precision spirit level, 1 pc. per measuring system **Type/Art. No.** Z30208
- Load cell tester, 1 pc. per measuring system **Type/Art. No.** 5984A
- Tire mounting aid, 1 pc. per measuring system **Type/Art. No.** Z30210
- Universal adapter for balancing machine 1 pc. per measuring system **Type/Art. No.** V035.0000
- Wrench for centering sleeve Type Z39901, 1 pc. per measuring system **Type/Art. No.** Z30205
- Protective board, 1 pc. per measuring system **Type/Art. No.** Z39909
- Strain gage bridge amplifier (SGAM) **Type/Art. No.** 2237A1
- Thermocouple amplifier (TCAM) **Type/Art. No.** 2237A2

RoaDyn S625 CFR Wheel force sensor for passenger cars	1
RoaDyn S625 aluminium Wheel force sensor for passenger cars for 12" and 13" rim size	3



Fig. 4: RoaDyn® S625 made of aluminium with out-board transmission for small rims

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