

RoaDyn® S650 System 2000

Type 9268A...

Wheel Force Sensor for Heavy Vehicles, SUVs, LCV

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

- Modular design with replaceable measuring cells and components
- CAD/FEM supported design: optimization of local stresses
- High strength/low measuring wheel weight in combination with high rigidity
- Precise signal measurement with individually calibrated strain gage load cells
- Automatic identification of components by ID chip
- Individual load cell calibration values taken into account
- Tested structural fatigue strength e.g. to SAEJ328
- Versions for twin rims and super singles available

Description

The RoaDyn S650 measuring wheel has a modular, versatile design for mounting on hubs and rim geometries. Six individual load cells are connected by adapter parts to a rim and to the vehicle hub. The requirements are met with regard to strength, mass and moment of inertia. The signals are amplified immediately in the load cells and fed via short cables to the wheel electronics Type 5241A.... Here they are filtered, digitized and coded. The data stream is transmitted via a rotor/stator pair Type 5242A6/5240A1,5... to the wheel inner side, transformed in the on-board electronic unit Type 9891A... and output to a data acquisition device.

This measuring wheel is designed for exceptionally high forces and moments associated with heavy vehicles such as SUVs, off-road and light commercial vehicles. Because of often large wheel offsets, the load on the wheels is particularly high, specially with regard to moments. The anticipated stresses are determined using FEM methods, and the design optimized with regard to strength, safety and weight. Vibration fatigue limit investigations on individual components and measuring wheels of various sizes make it possible to estimate the life of the measuring wheel structure.

Individual load cells Type 9190A are calibrated in the factory and produce out temperature-compensated, amplified measuring signals in the three spatial directions. Identification data, calibration data and zero positions of individual forces are saved allowing appropriate analysis in the vehicle coordinate system on the basis of individual calibrated values.



The high measuring accuracy is retained during transmission, since digitization takes place on the wheel, thus eliminating transmission interference. Knowledge of the individual signals measured allows rapid diagnosis in the event of malfunctions. Individual cells can be exchanged without impairing the function of the wheel force sensor.

Additional signals on the rotating wheel, such as tire pressure, temperature, etc. can be directly connected to the wheel electronics and transmitted along with the wheel signals. Kistler offers optional amplifier modules Type 2237A... for this purpose. The wheel electronics Type 5241A... is available in versions with 20 ... 24 channels. It can be used for all measuring wheel types S6xy, V6HT and V6MT. The unit is equipped with analog filters; it digitizes all incoming measuring signals and modulates a data stream, which is fed from the rotating measuring wheel via the transmission unit to on-board electronics.

For transmission to the on-board electronic unit Type 9891A..., preference is given to the inside of the wheel using rotor Type 5242A5 and stator Type 5240A1.5.... The out-board transmission unit 5248A0 is also offered as an alternative. The out-board transmission unit Type 5248A0 is standard for twin and super-single versions.

Note: see data sheets 5240A_000-561, 5248A_000-562 and 9891A_000-563 for the transmission units and the on-board electronics.

9268A_000-497e-10.09

Technical Data

Measuring range ¹⁾	F_x kN	-50 ... 50
	F_y kN	-30 ... 30
	F_z kN	-50 ... 50
	M_x kN-m	-6 ... 6
	M_y kN-m	-6 ... 6
	M_z kN-m	-6 ... 6
Rotary angle accuracy	°	≈0,1
Weight measuring wheel ²⁾	m kg	≈18,3

Maximum Loads

Degree of protection	IP64	
Operating temperature range		
Al components	°C	<120
Maximum speed (<280 km/h)	min ⁻¹	2 300
Max. impact accelerations	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	% v.E.	≤0,5
Hysteresis	% v.E.	≤0,5

Permitted alternating stress (rotating bending fatigue test)
The requirements according to SAE J328 are exceeded.
500 000 LW 5,5 kN-m

- ¹⁾ It is assumed that these extreme values do not occur simultaneously. The moments refer to the wheel center.
- ²⁾ With 6x16" aluminum rim, rotor, wheel electronics, hub adapter, but without ET adapter, wheel bolts and tires
- Details for the modal analysis should always refer to the measuring wheel with rim and tire system. The tires attenuate frequencies above 300 Hz. Parameters are available for several combinations, which can be viewed on request.
- Overloads: The design of the wheel force sensor allows overloads to occur without restricting measurability. We will be pleased to provide you with information in this regard. The tolerance to overloads depends very much on their multi-axle situation; it is not possible to give an accurate estimate within a general description because of the many combination possibilities. A separate indication of overloads for individual force directions is not appropriate, since no single axle load conditions occur at the wheel. If the wheel force sensor is overloaded, its remaining service life may be reduced, even if no immediate damage is visible or detectable.

Application

- Measuring operating loads during typical vehicle driving maneuvers
- Input data for the design of new components
- Verification of design loads
- Measuring test stand control data for road simulators
- (Permanent) application as multi-axle force measuring unit in road simulators
- Development of active chassis control systems such as ABS, ESP, etc.
- Investigations of vehicle behavior in specific or critical driving situations
- Input data for fatigue calculations and numeric simulations
- Development of computer models (MKS, Adams)

Usually several measuring wheels (4 or 2 wheels) are used. Occasionally measurements with a single measuring wheel are also employed for component or tire development. The various test vehicles require adaptation to new wheel/hub geometries. The modular design of the measuring wheels and proficient support by Kistler application centers has proved successful for this purpose.

At the same time as the measuring wheels, systems for wheel motion measurement or optical sensors (such as Corrsys sensors or sensors from other manufacturers for measuring tire and body slip angle, speed or accelerations) can also be used. Adaptations for applying individual sensors to the measuring wheels are available in the Kistler product range.

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 9268A2. Further information is contained in the data sheet 9268A_000-582.



Fig. 1: RoadDyn® S650 Type 9268A3 as twin tire measuring wheel

9268A_000-497e-10.09

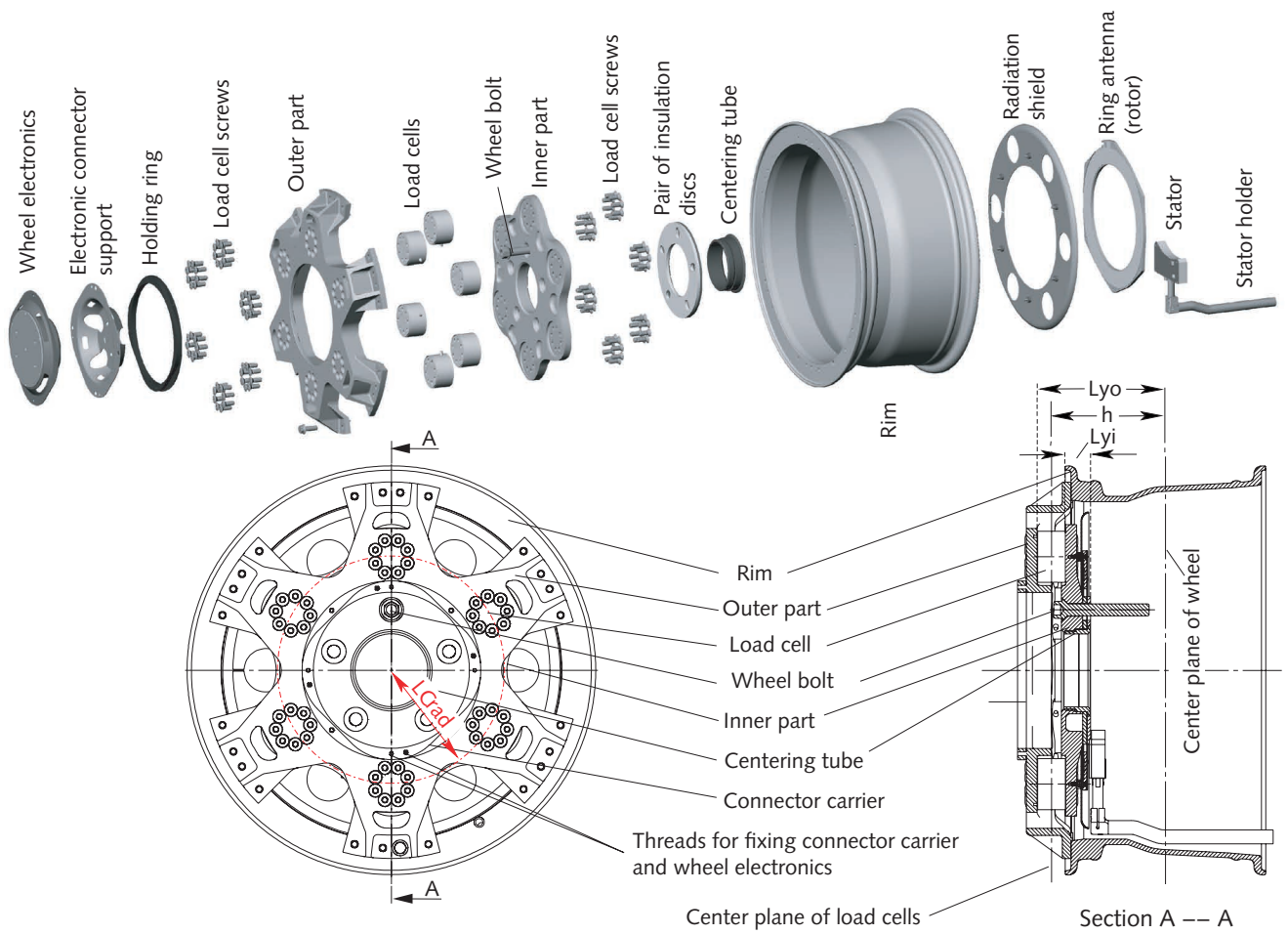


Fig. 2: RoaDyn® S650 structure/components for standard applications with in-board transmission

S625

S635

S650

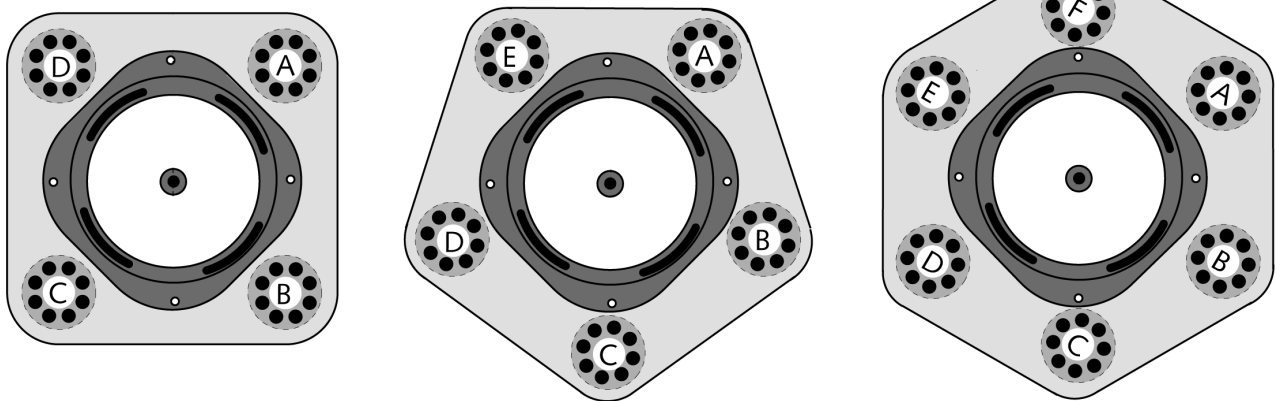


Fig. 3: Expandability of the RoaDyn® S measuring wheel system. The measuring wheel can be adapted for higher load limits or a test stand by expanding the wheel force system with exchangeable measuring cells and mechanical adaptations

9268A_000-497e-10.09

9268A_000-497e-10.09

Configuration of the RoadDyn® S650 System 2000

Measuring Wheel with Wheel Force Sensor, Wheel Electronics, Outer Part, Rim and Tires Type 9268A1 with 9731A6, Z39913A..., 5241A...		In-Board Transmission Unit consisting of Rotor and Stator Type 5242A..., 5240A...		Extension Cable Type 30430Axx Connection between Stator and On-Board Electronics		On-Board Electronics Type 9891A...		Remote Control for On-Board Electronics with Connecting Cable Type 5685A2	
--	--	--	--	--	--	---------------------------------------	--	--	--

Measuring Wheel with Wheel Force Sensor, Wheel Electronics, Outer Part, Rim and Tires Type 9268A1 with 5141A..., 5248A0, 9731A6, Z39913A...		Out-Board Transmission Unit Type 5248A0		Extension Cable Type 30430Axx Connection between Stator and On-Board Electronics		On-Board Electronics Type 9891A...		Remote Control for On-Board Electronics with Connecting Cable Type 5685A2	
--	--	--	--	--	--	---------------------------------------	--	--	--

Mounting

The sensor can be mounted with rims of most available sizes. Please contact Kistler applications advisers for further information.

Adaptation to the Hub

There is a wide variety of hub geometries on present-day vehicles. They are described among other characteristics by the following parameters:

- Number of stay bolts or tapped holes
- Dimensions of wheel bolts or stay bolts and nuts (thread diameter, pitch, length, thread length)
- Hole-circle diameter of the wheel bolt connections
- Dimensions of the axle centering as fitting dimension
- Wheel offset
- Brake contours
- Parts protruding from the hub

This makes it necessary to obtain precise details prior to adapter manufacture. For this purpose, a check list is available in Kistler document 002-280 which, when filled out precisely, will considerably shorten the time spent on clearing up details.

Mounting the Stator Type 5240A... with In-Board Transmission

With in-board transmission, a suitable mounting device is mounted on the wheel carrier or suspension strut for the stator. The position of the stator and the location of the support is then established with a gauge.

With the stator installed, mounting a measuring wheel is comparable with that of a production wheel. The stator can also remain mounted on the vehicle if this is running on production wheels. When the measuring wheels are remounted, measurements can be made again immediately.

With out-board transmission, a support arm e.g. 9883A must additionally be included in the vehicle setup, to which the cable to the on-board electronics is fixed.

Included Accessories	Type/Art. No.
• Precision measuring cells (strain gage basis), completely encapsulated, 1 set (6) per wheel	9190A46.6
• Internal part, 1 per wheel	9729A6
• Connector holder for wheel electronics, 1 per wheel	Z39904
• Radiation shield, 1 per wheel	Z39902
• Load cell screws for fastening, 1 set per wheel	Z30073

Accessories (absolutely essential for completing a measuring wheel)

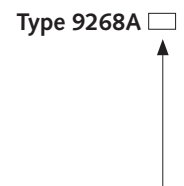
• External part, 1 per measuring wheel	9731A6
• Rim, 1 per measuring wheel	Z39913A...
• Ring antenna (rotor), 1 per measuring wheel	5242A6
• Wheel electronics, 1 per measuring wheel	5241A...
• Hub adapter package, containing heat absorbing washers, centering sleeve and wheel bolts – 1 per measuring wheel	9711A3 Z39900 Z39901
• Wheel offset adapter, 1 per wheel	9713A...

Optional Accessories

Optional Accessories	Type/Art. No.
• Transport case for 1 measuring wheel with tires, 1 per measuring wheel	V712.0004
• Precision spirit level, 1 per measuring system	Z30208
• Adjuster gage for stator mounting, 1 per system	Z39911Q
• Load cell tester, 1 per measuring system	5984A
• Tire mounting tool, 1 per measuring system	Z30210
• Universal adapter for balancing machine, 1 per measuring system	V035.0000
• Key for centering sleeve Type Z39901, 1 per measuring system	Z30205
• 3-channel strain gage bridge amplifier (SGAM)	2237A1
• 3-channel thermocouple amplifier (TCAM)	2237A2

Ordering Key

RoaDyn S650 wheel force sensor for traction measurement	1
RoaDyn S650 wheel force sensor for traction measurement on light commercial vehicles as twin	3
RoaDyn S650 wheel force sensor for traction measurement on light commercial vehicles as super single	4



9268A_000-497e-10.09

This information corresponds to the current state of knowledge. Kistler reserves the right to make technical changes. Liability for consequential damage resulting from the use of Kistler products is excluded.