
CORRSYS

DATRON

Sensorsysteme GmbH



MSW/S

Measurement Steering Wheel

*for non-contact measurement of
steering speed and angle*

USER MANUAL VOLUME I

Sensor Hardware

Note:

For a general description of the CeCalWin Pro Software please refer to the separate user manual Volume II.

For the specific software description for the MSW/S Sensor please refer to the separate user manual Volume III.

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In a continuous effort to improve our products CORRSYS-DATRON reserves the right to change specifications without prior notice.

General Information

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Safety Instructions

Please read carefully before operating the equipment.

CORRSYS-DATRON is not responsible for damage that may occur when this system is used in any way other than that for which it is intended.

To assure safe and proper operation, all supplied equipment, components and/or accessories must be carefully transported and stored, as well as professionally installed and operated. Careful maintenance and usage in full accordance with operating instructions is imperative.

CORRSYS-DATRON equipment should be installed and operated only by qualified persons who are familiar with devices of this type.

Local regulations may not permit the operation of motor vehicles on public highways while the equipment is mounted on the exterior of the vehicle.

- Use the equipment only for intended applications. Improper application is not advised.
- Do not modify or change the equipment or its accessories in any way.
- Improper use or mounting of the equipment may affect the safety of the vehicle and/or occupants.
- The equipment must not be mounted and/or operated in any way that may compromise vehicle and/or occupant safety.
- Equipment must be mounted firmly and securely.
- **Use only original equipment, components and/or accessories included in the scope of delivery.**
- Do not use defective or damaged equipment, components and/or accessories .
- Always note correct pin assignments and operating voltages when connecting equipment to power supplies, data acquisition/evaluation systems, and/or any other applicable system or component. Equipment may be damaged if not properly connected and/or operated.
- For additional information, please call the CORRSYS-DATRON Hotline: ++49 (6441) 9282-82 or email: hotline@corrsys-datron.com.



Danger

Working with an airbag-equipped wheel requires utmost caution due to high risk of injury. It is imperative to observe all instructions of the wheel manufacturer.

Exclusion of liability:

CORRSYS-DATRON Sensorsysteme GmbH assumes no liability if the MSW /S Sensor is used with an airbag-equipped steering wheel. CORRSYS-DATRON recommend the installation of a steering wheel without airbag for testing purposes.



Installation of the MSW /S Sensor may void the vehicle warranty!



1. Overview



MSW /S Measurement Steering Wheel

*for
non-contact measurement of
steering speed and steering angle*

50 Nm version for passenger cars
250 Nm version for utility vehicles

Article no.
MSW /S 50 Nm - 14256
MSW /S 250 Nm - 14257

The MSW /S Sensor is a measuring steering wheel designed especially for use with passenger cars and utility vehicles.

The MSW /S Sensor mounts between the steering wheel and the steering shaft. A central aperture makes mounting easy. To permit universal application, an adapter for connection to the steering shaft gearing can be produced to your specifications.

For optimum safety, the MSW /S Sensor has a high breaking moment. As an additional safety measure, four driving pins ensure steerability in the event of breakage.

Electronics are incorporated into the sensor. Power supply and signal output are provided via a 14-pin Lemos connection.

Features

- Operating temperature range: -20 ... +60° C
- Resolution: up to 7200 pulses per rotation (with MSW Processor)
- Power supply: 10 ... 36 V DC
- Incorporated electronics
- Telemetry transmission of the torque signal (from rotor to stator)
- Torque measurement not influenced by bearing friction
- Non-contact, optical steering-angle sensor
- Airbag adaptation possible
- Low mounting depth
- Mounts easily to the steering column via central bore
- Universal mounting on passenger vehicles and trucks
- 100% overload protection at the nominal torque rating
- Steering ability at all times, even in the event of breakage

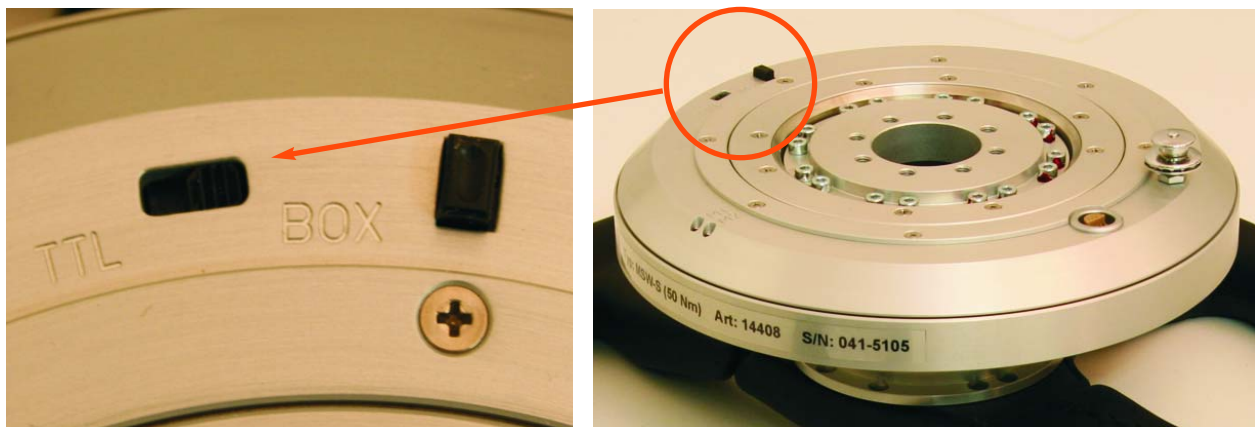
Application

Universally applicable steering wheel for acquisition of the following measurements:

- Steering moment
- Steering angle
- Steering speed

The MSW /S Measurement Steering Wheel is equipped with a selector switch, which enables operation with or without the MSW Processor.

- Select BOX to operate the MSW /S with the MSW Processor.
- Select TTL to operate the MSW /S without the MSW Processor.





MSW Processor

for
CORRSYS-DATRON
MSW /S
Measurement Steering Wheels

Article no.
MSW Processor 14075

The MSW Processor processes signals output by the MSW /S Sensor. These include steering angle, steering speed, and steering torque. The Processor handles acquisition, calculation, filtering, and output of all measurement parameters, and also supplies voltage to the MSW /S Sensor.

It provides several outputs, e.g. analog, digital, CAN, RS232, and USB.

All signals are available via standardized connectors.

You can select whether you want to use the MSW /S Sensor with or without the processor via a built-in selector switch (see page 7). When the MSW /S Sensor is used without the Processor, power supply and signal output are effected via a 15-pin D-Sub connector.

Features

- Reverse-polarity protection
- Supports 50 Nm and 250 Nm MSW Measurement Steering Wheels with analog sensor output (MSW /S)
- Supports Motorola and Intel formats
- CAN Termination resistor switchable via CORRSYS-DATRON CeCalWin Software
- Online display of all output signals with CeCalWin Software
- Software zero-point balance via CeCalWin
- Easy set-up via CeCalWin
- Upgrade for existing Measurement Steering Wheels without analog output (MSW /S) possible

1.1 Operating Principle

Steering torque acquisition

Torque values are acquired using a specially designed measuring body equipped with strain gauges. Friction and clearance of the integrated ball bearings do not influence the accuracy of the sensor. Torque applied to the steering wheel is transferred directly through the measuring body and into the steering shaft. Bearing friction may have a minor influence on the subjective judgement of the test driver.

The torque signal is transmitted from the rotor to the stator via a short-distance telemetry system, which operates on the basis of frequency coding. Power supply of the DMS application is inductively effected via the telemetry antennas. No internal battery required. An external zero-point balance for output signals M1 and M2 may be effected via two potentiometers.

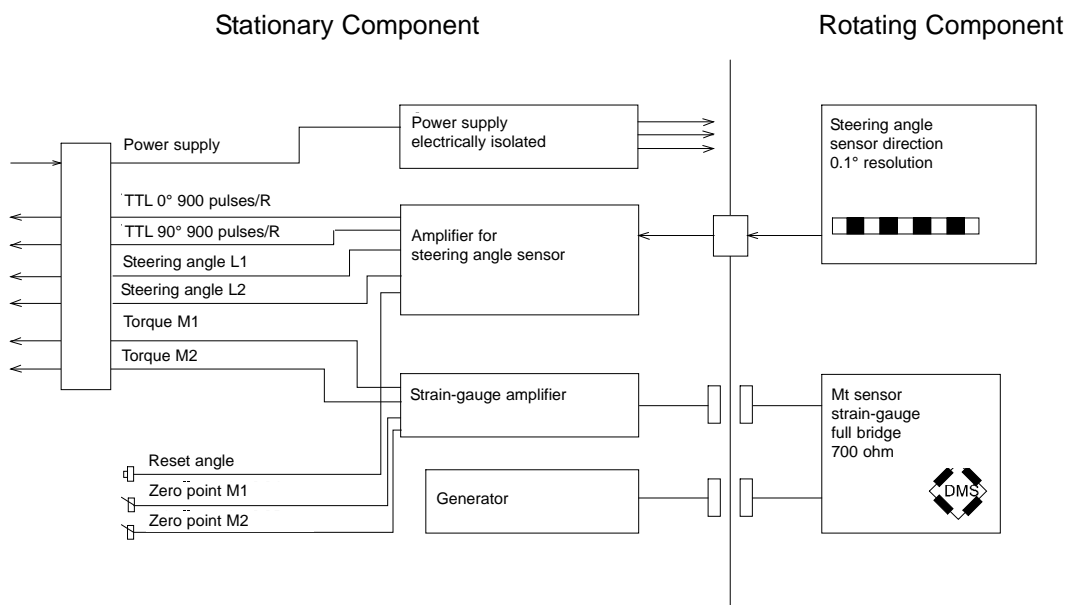
Steering angle acquisition

Two TTL signals, phase-shifted 90°, are generated by an incremental drum (which produces 900 pulses per rotation) and a non-contact, optical sensor. An electronic, four-flank evaluation of the TTL signals produces 3600 pulses per rotation. The summing of the pulses generates the analog output signal. The phase-shifted pulse sequence enables the identification of the direction of rotation. An adjustable caliper on the MSW Sensor allows the steering-angle signal to be set to 0 with the steering wheel in any position desired. The measuring steering wheel is capable of spinning without restriction.

Steering speed

Steering speed must be calculated externally by differentiating the angle signal. The two 90° phase-shifted TTL signals (900 pulses per rotation) are output via the Lemos connector.

1.2 Block Diagram



2. Extent of Delivery



Standard Extent of Delivery

1. (1) MSW /S Sensor, art.no. 14408 / 14409
2. (1) Flange for standard steering wheel
3. (1) Standard steering wheel, art.no. 11042 / 11043
4. (1) Signal/power cable, 14-pin. Lemos plug / 15-pin. D-Sub plug, 3 m, art.no. 13945
 - (1) Counterpart of the snap fastener (for anti-rotation device)
 - (1) Transport case, art.no. 11225

Options / Accessories

- MSW Processor, art.no. 14075
- Signal and power cable, 15-pin D-Sub (female) / 6x BNC + 2x bunch plug, 1.5 m, art.no. 10528
- Adapter for steering shaft gearing (custom-fabricated), art.no. 11439
- Adaptation of customer-supplied and/or airbag-equipped steering wheels available
- Steering wheel adapter universal, passenger car \varnothing 280...420 mm, art.no. 16188
- Steering wheel adapter universal, truck \varnothing 620 mm
- Angle adapter for signal cable, art.no. 14791

Additional options available upon request.

3. Technical Data

3.1 Specifications MSW /S

Overall Specifications

Nominal temperature range:	0°C ... +70°C
Operating temperature range:	-20°C ... +80° C, temperature compensated
Power supply:	10 ... 36 V DC, short-circuit proof
Power consumption:	approx. 380 mA (12 V/DC)
Connector:	14 pin Lemos on housing
Weight, sensor* - passenger car:	approx. 2.5 kg
- utility vehicle:	approx. 3.6 kg
Weight, standard steering wheel:	approx. 1.4 kg
Mass moment of inertia:	60 kgcm ²

* with standard steering wheel flange, without steering wheel and steering shaft adapter

Steering torque (*when operated without processor*)

Passenger Car Version:

Output M1	1 V = 5 Nm	range: ± 50 Nm
Output M2	1 V = 1 Nm	range: ± 10 Nm

Utility Vehicle Version:

Output M1	1 V = 25 Nm	range: ± 250 Nm
Output M2	1 V = 5 Nm	range: ± 50 Nm

Both outputs are available in parallel. The analog output of the smaller measuring range will reach the point of saturation when the specified range is exceeded.

Linearity deviation:	better ±0.5% of the measuring range final value M1 including hysteresis, typical ±0.2%
Low pass filter:	100 Hz (standard)
Nominal index:	10 V (nominal signal interval between torque = 0 and measuring range final value M1 or M2)
Index tolerance:	±0.15% for M1
Zero point balance:	via potentiometer with load-free steering wheel, separate for M1 and M2 (up to approx. ±100mV)
Temperature influence on the zero signal (<i>in the nominal temperature range</i>):	
M1:	< ±0.8% relative to the nominal index M1
M2:	< ±4.0% relative to the nominal index M2
Overload protection:	100% overload on measuring range final value M1 without damage
Breaking moment:	passenger car = 250 Nm, utility vehicle = 600 Nm

Steering angle

Output L1	1 V = 125°	range: ±1250°
Output L2	1 V = 20°	range: ±200°

Both outputs are available in parallel. The analog output of the smaller measuring range will reach the point of saturation when the specified range is exceeded.

Angle resolution:	0.1°
Nominal index:	10 V (nominal signal interval between angle = 0 and measuring range final value L1 or L2)
Index tolerance:	±0.1% for L1
Zero-point balance:	with caliper at the steering wheel, possible at any steering wheel position
Temperature influence in the nominal temperature range to the zero signal of L1:	<± 0.3% relative to the nominal index L1
of L2:	<± 1.0% relative to the nominal index L2
Measuring error:	according to the index tolerance

Steering Speed

Output TTL 0°:	900 pulses/rotation
Output TTL 90°:	900 pulses/rotation, 90° phase-shifted towards TTL 0°

The steering speed must be calculated externally by differentiating the angle signal. The angle signal is output as two TTL signals, phase-shifted 90°.

Maximum steering speed:	1000°/sec
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3.2 Specifications MSW Processor

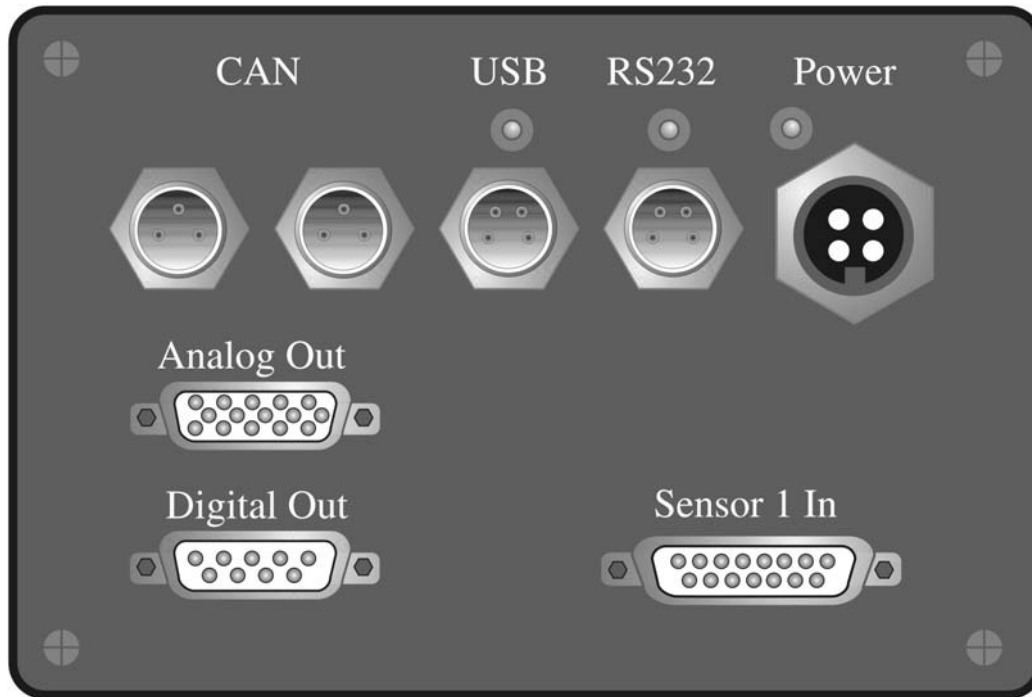
Input voltage:	10 ... 36 V DC, reverse polarity protected	
Sensor input::	for direct connection to the MSW	
Angle resolution:	0.05°	
Analog outputs:	steering torque M1 (±50 / 250 Nm)	-10...10V
	steering torque M2 (±10 / 50 Nm)	-10...10V
	steering angle L1 (±1250°)	-10...10V
	steering angle L2 (±200°)	-10...10V
	steering speed (±1000 °/s)	-10...10V
DA converter resolution:	0.008 Nm, 0.04°, 0.04°/s	
Digital outputs:	steering torque	
	steering angle	
	steering speed	
CAN Output:	CAN V2.0B	

All outputs are protected against overvoltage and short circuit;

PC-Interfaces:	RS232
	USB 1.1
Adjustable Filter time:	8...512 ms or unfiltered
Data update rate:	250 Hz

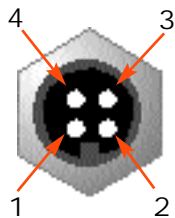
3.3 Pin Assignments

3.3.1 Connections MSW Processor



3.3.2 Pin assignment: Power cable

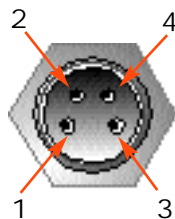
Cable: #K001-140-12-5m



AMP-4M-V connector male	
Pin 1:	+12V
Pin 2:	+12V
Pin 3:	GND
Pin 4:	GND

3.3.3 Pin assignment: RS232 cable

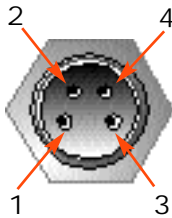
Cable: #K045-14N-10-2m



Binder 718 flange connector male	
Pin 1:	TXT
Pin 2:	RXD
Pin 3:	DGND
Pin 4:	DGND

3.3.4 Pin assignment: USB cable

Cable: #K041-14N-20-2m



Binder 718 flange connector female

Pin 1: D+

Pin 2: D-

Pin 3: DGND

Pin 4: Switch

3.3.5 Pin assignment: CAN cable

Cable: #K030-14N-10-2m



Binder 718 flange connector male

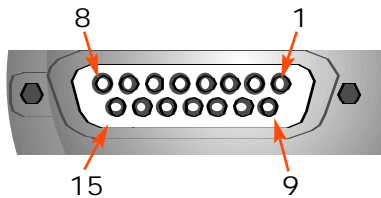
Pin 1: CAN_High

Pin 3: CAN_Low

Pin 4: DGND

3.3.6 Pin assignment: Sensor 1 In

Cable: #K041-1E2-20-3m



15 pin D-Sub connector male

Pin 1 steering torque +

Pin 2 steering torque -

Pin 3 n.c.

Pin 4 n.c.

Pin 5 TTL 0°/ Sine

Pin 6 TTL 0°/ Cosine

Pin 7 +12VSENS

Pin 8 GNDSSENS

Pin 9 zero caliper

Pin 10 GND

Pin 11 GND n.c.

Pin 12 GND

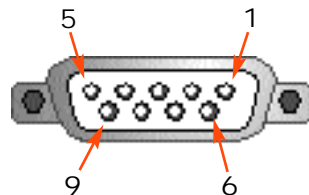
Pin 13 GND

Pin 14 reserved

Pin 15 PE

3.3.7 Pin assignment: Digital Out

Cable: K041-341-10-1m



9 pin DSub connector female

Pin 1: n.c.

Pin 2: steering torque

Pin 3: steering speed

Pin 4: n.c.

Pin 5: GND

Pin 6: n.c.

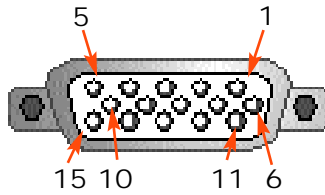
Pin 7: nc..

Pin 8: steering angle

Pin 9: reserved

3.3.8 Pin assignment: Sensor 1 Out

Cable: #K041-561-10-1m



15 pin HDSub connector female

Pin 1: steering torque M1

Pin 2: steering speed

Pin 3: steering torque M2

Pin 4: reserved

Pin 5: n.c.

Pin 6: steering angle L1

Pin 7: n.c.

Pin 8: steering angle L2

Pin 9: n.c.

Pin 10: AGND

Pin 11: n.c..

Pin 12: n.c.

Pin 13: n.c.

Pin 14: n.c.

Pin 15: n.c..

4. Set-up and Connection

4.1 Pre-installation safety instructions

Improper mounting of the sensor may affect the safety of the vehicle!

Mounting the sensor on the vehicle may invalidate the vehicle warranty and/or be illegal for use on public highways!

The steering wheel should be installed and operated only by qualified persons who are familiar with devices of this type.

Exercise extreme caution when working with an airbag-equipped steering wheel, as there is greater risk of injury. It is imperative that users precisely follow the manufacturer's operating instructions for the airbag.

The breaking moment of the measuring steering wheel for automobiles is 250 Nm. For utility vehicles the value is 600 Nm. Incorporated driving pins enable you to continue steering the vehicle, even in the event of mechanical failure.

The standard MSW /S Sensor does not accommodate the normal accessories and functions that are incorporated in the original manufacturer's steering wheel: i.e, horn, airbag, speed control etc.

4.2 Application instructions steering shaft adapter and steering wheel adapter

Factory-installed steering shaft adapters and/or steering wheel adapters are **firm components** of the MSW /S Sensor. **Do not remove** these parts and **do not loosen or remove** any screws that are secured with thread-locking compound.

If user applications require modification or operation in excess of load specifications, please contact CORRSYS-DATRON for information regarding sensor upgrades.

Mounting of the steering shaft adapter and steering wheel must not generate or transfer mechanical stress or tension to the housing area of the MSW /S. Use only screws of specified length!

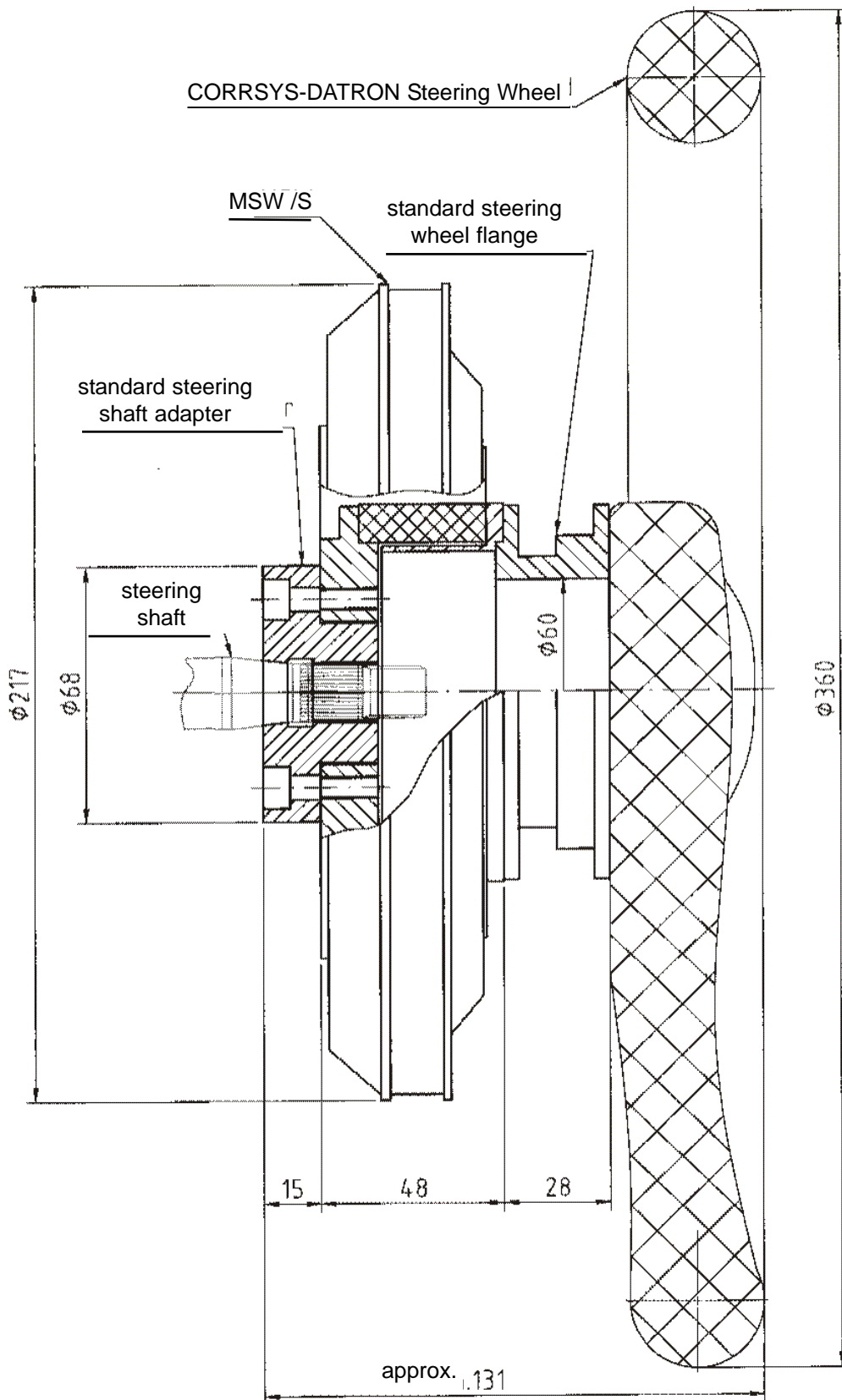
Improper operation and/or unauthorized modification of the MSW /S Sensor unit will immediately void the manufacturer warranty.

When shipping a MSW /S Sensor to CORRSYS-DATRON for calibration, please include all original accessories to prevent delays in service.



Improper operation and/or unauthorized modification of the MSW /S Sensor will invalidate calibration.

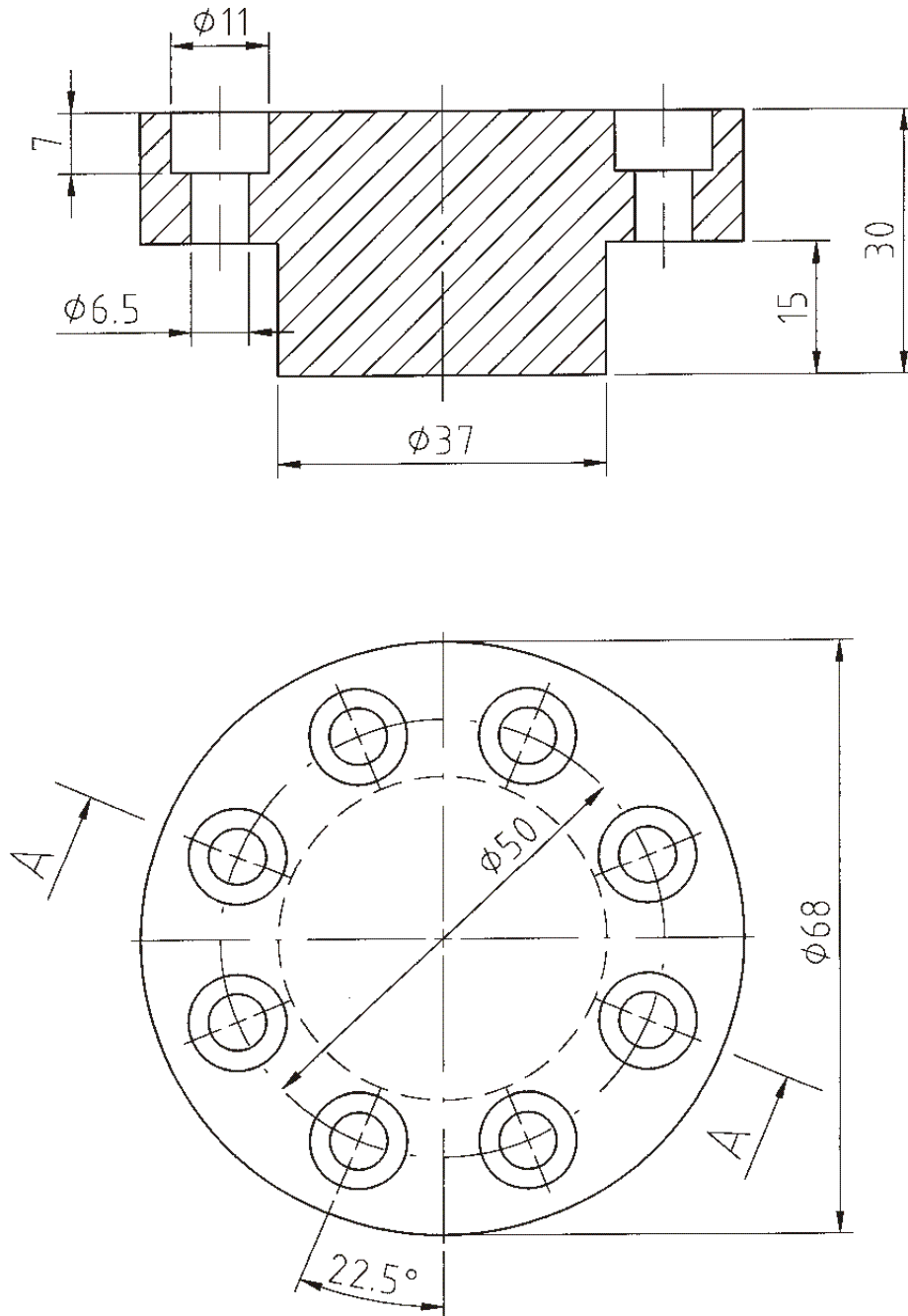
4.3 Technical Drawing MSW /S Sensor



4.4 Technical Drawing Standard Steering Shaft Adapter

An adapter for connection to the steering shaft gearing can be produced to your specifications.
Material: Ck 45

The outer dimensions are as shown below:



4.5 Mounting the sensor

4.5.1 Sensor with standard steering wheel and standard steering shaft adapter

Essentially, the mounting of the measuring steering wheel corresponds to the mounting of an original-equipment steering wheel.

- Remove the original steering wheel according to the manufacturer's instructions
- Affix the steering shaft adapter
- Remove the plastic horn cover from the standard steering wheel
- If required, unscrew the horn contact from the standard steering wheel
- Place the MSW Sensor onto the steering shaft
- Bolt on the steering shaft nut or bolt
 - Attention!** Please refer to vehicle manufacturer torque specifications when tightening the bolt
- Re-attach the horn contact
- Replace the plastic horn cover
- Affix the counterpart of the snap fastener to a thin piece of sheet metal. Bend the sheet metal so it can be attached to the steering console. Hose clamps, cable clips, adhesive tape, etc., can be used for this purpose.
- Connect signal/power supply cable to the MSW Sensor and apply supply voltage (9 ... 32 V/DC).

4.5.2 MSW /S Sensor with special versions of the steering wheel or steering shaft adapters

Customers who order adaptations of a serial steering wheel (also airbag steering wheel) including the steering shaft adapter will receive application-specific mounting instructions.

4.6 Start-Up

After connecting the power supply, the measuring steering wheel is ready for operation. You can scan the individual signals from the signal/power supply cable connected to the MSW Sensor.

The following signal outputs are available:

- Steering torque, M1
- Steering torque, M2
- Steering angle, L1
- Steering angle, L2
- Angle signal, TTL 0°
- Angle signal, TTL 90°

Resetting the torque outputs

The torque outputs are factory-calibrated. However, mechanical influences occurring during mounting or as a result of aging and/or extended storage may cause a slight zero-drift. Drift can be balanced at the MSW using the potentiometer located at the rear of the sensor. Available adjustment is approximately ± 100 mV for each analog output (M1, M2).

Reset of the steering angle outputs

Analog outputs L1 and L2 can be set to 0 V via a caliper at the rear of the sensor. The zero value can be reassigned at any desired steering wheel position, but is not saved by the sensor when supply voltage is switched-off.

5. Troubleshooting

When troubleshooting the MSW /S Sensor begin by checking the following:

Cables and power supply

- Check all connections to determine that each is complete and that the system is connected to a power supply that provides voltage output within the specified range.
- Check to determine that the correct cables have been used for all connections.
- The following problems can be caused by incorrect or incomplete cable connections and/or connection to incorrect power supply voltage:
 - Output signals are not available to data acquisition and/or connected PC.
 - A sensor will not go out of standstill mode with vehicle motion.

Software

If one or more output signals appear to be incorrect, the sensor may have been set-up incorrectly via CeCalWin Pro Software. Check all relevant settings in CeCalWin Pro:

- Check calibration factor

EMC interference

If the sensor starts to send output signals without vehicle motion, triggering may have been caused by excessive EMC interference from the test vehicle. To correct this condition, reset the sensor by disconnecting from power and then re-connecting, or by switching power off and then back on at the power distribution box. If the condition persists, disconnect sensor from vehicle ground and isolate it at all mounting points

MSW Processor displays the steering angle with too low resolution

Check, if the switch on the back of the MSW /S Sensor is set for operation with MSW Processor.

If none of the above recommendations provides a solution, you may wish to contact CORRSYS-DATRON. Before doing so, please be ready to supply the following:

- A .ccw file saved from CeCalWin software to serve as an example of the problem or fault condition.
- A list of all which outputs that appear to be problematic, i.e. CAN, RS-232.
- The serial numbers of all relevant components.



Note: With the MSW/S Sensor you have purchased a premium, high-precision product. To assure continued optimum performance, we recommend that you send it to CORRSYS-DATRON once per year for inspection, maintenance, and calibration."