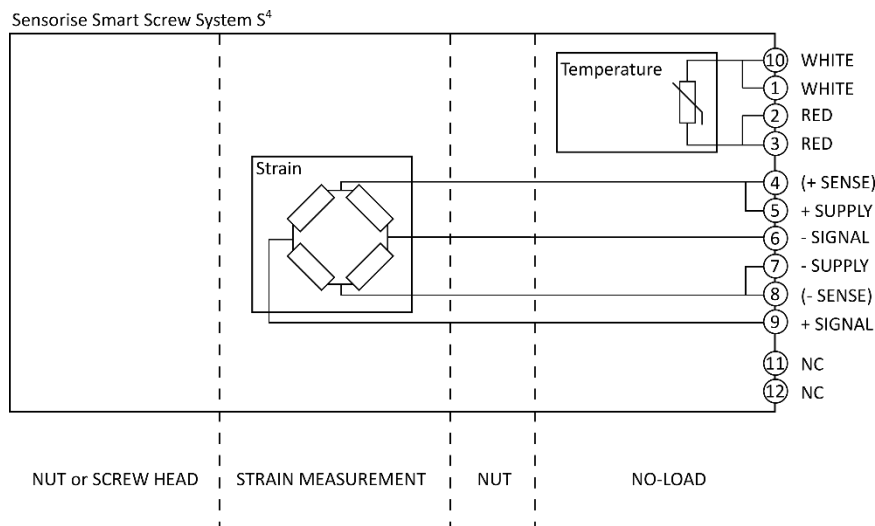# Sensorise Smart Screw System S$^4$

## Features

- Strain measurement via bridge-circuit
- Measurement of static and dynamic loads
- Temperature measurement via RTD
- Connectivity via standard M12 connectors
- Measurement system resistant against humidity, oil, diluted acids and alkalis and many solvents

## Applications

- Flanges
- Wind turbines
- Water turbines
- Vessel engines
- Large aggregates
- Oil and gas production
- Remote installations

## Functional Block Diagram



## General Discription

The Sensorise Smart Screw System S$^4$ is a measurement system that is integrated into the thread of the screw or bolt.

The axial pre-tension of the screw and its temperature are provided as measurement signals via standard M12 connectors for simple and robust installation.

The S$^4$ has been designed for harsh environmental conditions. The system is completely passive, eliminating the risk of failed active electronic components inside the mechanical part.

S$^4$ screws can be mounted like regular screws and exhibit the specified mechanical characteristics of normed screws. This makes retrofitting of existing machines with S$^4$ screws straightforward.

Screw and sensor elements are robust and highly integrated – the sensor becomes part of the screw during the manufacturing process and cannot be disassembled. The sensor system is very versatile and can be adapted to custom screw designs – contact Sensorise for your application.

**S4 Specifications**

| Parameter | | Units | Comments |
|---|---|---|---|
| TEMPERATURE | | | |
| Type | Pt100 | | Pt1000 optionally available |
| Resistance | 100 | Ohm | @ 20 °C |
| Range | -50 .. +100 | °C | |
| Tolerance | Class B | | |
| STRAIN | | | |
| Type | Integrated strain gauge | | |
| Bridge resistance | 350 .. 5000 | Ohm | Resistance depends on screw dimensions and is marked on screw |
| Temperature coefficient | < 10 | ppm | |
| Bridge supply voltage | 5 | V DC | |
| Amplifier sensitivity | 0.2 .. 2 | mV/V | Depending on active strain measurement length |
| MECHANICAL | | | |
| Connector type | M12 | | |
| Screw types | Hex Bolts Stud Bolts Treaded Rods | | Custom designs available upon request |
| Connector placement | Nut-side | | Head-side optionally available |
| Minimum thread | M20 or G 5/8" | | Custom designs available upon request |
| Maximum screw length | Dependent on thread size | | |
| No-Load distance | 16 | mm | Recess for connectivity |

**Certifications**\*

| | |
|---|---|
| DIN EN ISO 9001 : 2015 | Bureau Veritas |
| AD-2000/WO | RINA Certification |
| Pressure Equipment Direvtive 2014/68/EU | ASME Code Section III |
| KTA 1401, AVS D 100/50 | KSB – NCA-3800 and 100CFR21 |
| KTA 3201.1 und 3211.1 | Emerson – NCA-4250 |
| DNV GL | Kobe Steel Ltd. – NCR-Regulations |

\*more upon request

**Absolute Maximum Ratings**

| Parameter | | Units | Comments |
|---|---|---|---|
| Storage temperature range | -65 .. +150 | °C | |
| Operating temperature range - dry | -40 .. +100 | °C | Up to +150 °C available upon request |
| Operating temperature range - wet | -40 .. +60 | °C | |
| Bridge supply voltage | 10 | V | |

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**!** **Screw and mechanical construction must be properly grounded!**

**Take special caution when performing welding activities on the mechanical construction – avoid if possible! S4 screws must not be placed in the path of the welding current!**

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**Mechanical Mounting**

Although S4 screws are designed for harsh environments, handle the system with care. Do not drop the screws as the M12 connector or the thread might get damaged. Remove the protective sleeve right before mounting. The sensor inside the thread is well protected, however keep it away from sharp or abrasive objects that could reach the bottom of the thread. Do not force the screw into its hole and avoid touching the sides of the holes, especially with sensor-equipped tensioning bolts.Mount the S4 screw like a regular screw using torque wrenches or hydraulic tools. Do not exceed recommended pre-tension of the screw as specified by the screw manufacturer.

**Electrical Connectivity**

Connect the screw with standard M12 sensor cables to the measurement equipment. Shielded cables are recommended for cables longer than 10 m and environments with high electromagnetic interference, e.g. close to electric motors or power electronics. Protect your measurement equipment from electromagnetic discharges, e.g. lightning strikes in outdoor applications taking appropriate measures.

**Signal Amplification and Data Acquisition**

TEMPERATURE

Many data acquisition devices offer inputs for RTD measurement. S$^4$ screws support 2-, 3- and 4-wire measurement. For highest precision, especially when using long cables, 4-wire measurement is recommended.

STRAIN

S$^4$ screws are compatible with most industrial strain gauge amplifiers. The recommended bridge supply voltage is 5 V DC. 4- and 6-wire measurement is supported.

For highest precision and EMC compatibility, 6-wire measurement is recommended. To effectively filter out 50 Hz noise, a cut-off frequency of 20 Hz or lower is recommended. If you expect higher frequencies (e.g. due to machine vibration) to be present, amplifiers with higher cut off-frequencies can be used. Taring to mid-range (12 mA for a 4..20 mA output signal) is recommended for later software-temperature compensation.

**Calibration and Temperature Drift**

S4 screws are delivered non-calibrated as a standard. To detect screw failure (lose nuts, cracked screw), taring the amplifier after tightening and setting thresholds for a (relative) value change is sufficient.

Due to the sensor element being distributed over the lengths of the screw, temperature drift is possible and can not be compensated completely inside the S$^4$ screw. It is at the user's discretion to compensate for temperature drift with the help of the temperature signal in software.

**Typical Output Signal for Strain**
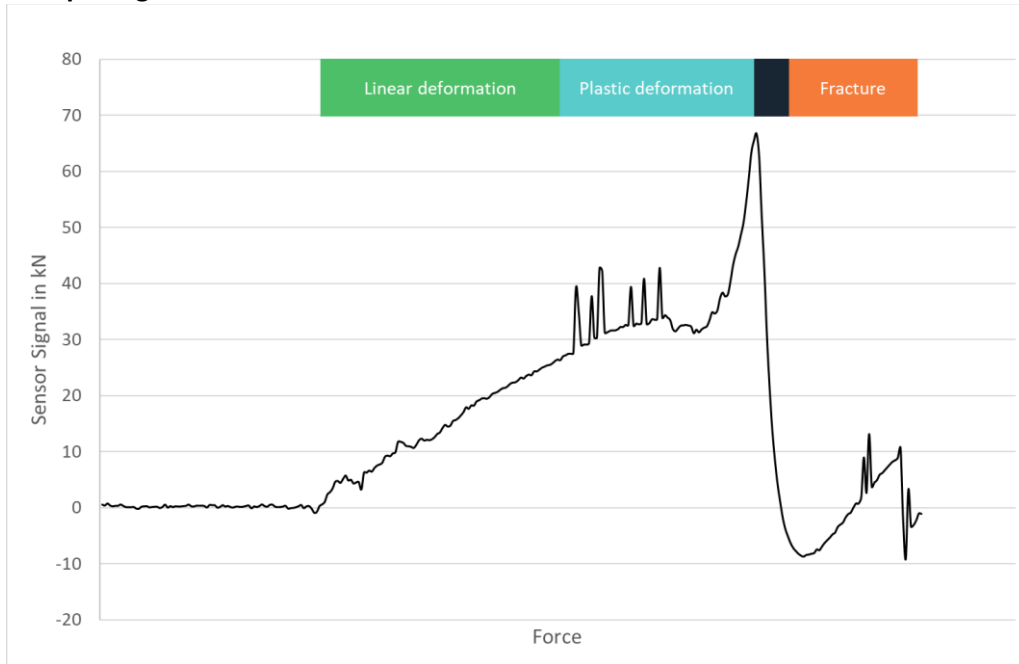


**Additional Products and Services**

Sensorise supports your applications from sensor to cloud! Screws and bolts, amplifiers, industrial data acquisition, cloud connectivity and storage are available as well as a seasoned team of experts to build custom data interpretation models.

**Contact Information**

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