fos4Test nSens

Measurement unit for the measurement with optical sensors

Data sheet Version 1.2

Product highlights

fos4Test nSens:

- 4 fiber Bragg grating sensor channels
- Up to 9 sensors per channel at 5 nm sensor spacing
- Inherent galvanic isolation
- Sample rate 100 Hz
- Easy device cascading
- Supply voltage 12 to 24 V
- PTP [1]

fos4Test nSens extended:

- All features of fos4Test nSens
- Up to 18 sensors per channel at 5 nm sensor spacing

Setting a new standard for strain measurement

Advantages of fiber optic measurement technology include extreme sensor durability without EMI, ESD or isolation problems. Repeatable measurements of very high strain levels are feasible as well as the use of such sensors within harsh environments like high voltage transformer, microwave ovens or explosive settings.

With the extremely long-lasting fiber optic sensors, measurements at very high strain levels at high cycle rates are possible. Hence, for monitoring a device over its lifetime, fiber optics is an ideal technology.

Very small dimensions are another core characteristic of fiber optic sensors. This offers the opportunity to implement them in applications, where conventional temperature and strain sensors cannot be used.

In the field of strain measurement the characteristics of conventional resistive strain gauges such as synchronous sampling, signal band limitation or halfbridges for temperature compensation are now available with the fos4Test instrument series.

The fos4Test nSens instruments combine the specific advantages of optical sensors and the established handling of conventional electrical resistive strain gauges.

Distributed monitoring of structures

The fos4Test nSens FBG measurement device was designed for distributed measurements. With up to 32 sensors per device (or 64 with extended wavelength range), it is possible to monitor entire structures (e.g. large lightweight structures) in a cost-efficient way.

With multiplexing of multiple sensors per fiber the fos4Test nSens can be used for structural health or condition monitoring applications.

[1] Precision Time Protocol (IEEE1588) upgrade capability

Ease of use

The instruments and the user interface have been designed with focus on ease of use. This makes optical measurement accessible without deep knowledge of the underlying technology.

Applications

The fos4Test nSens instruments have proven their performance amongst other applications in wind turbine blade monitoring installations. Installed in the rotating hub of several multi megawatt wind turbines, the system is being exposed to harsh environmental conditions such as vibration, temperature cycles and moisture.

Working principle

A fos4Test nSens instrument consists of four independent measurement channels. Each channel transmits light at wavelength ranging from 1525 nm to 1570 nm into the sensing fiber. An extended wavelength range with 1510 nm to 1595 nm is available. Different Bragg gratings within the fiber reflect certain wavelengths of the incoming light, depending on the value of the measurand. The wavelength of the light reflected from the fiber Bragg grating sensor is proportional to the physical quantity being measured (strain, temperature, acceleration etc.).

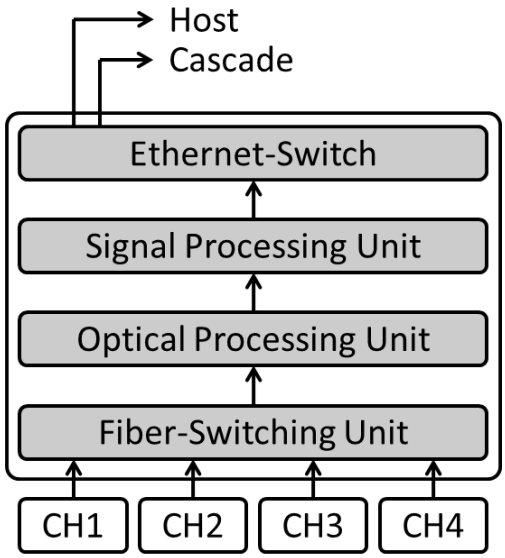
Signal processing

The incoming light is detected and analyzed by an optical processing unit.

Each channel may be amplified with an individual gain to allow for compensation of bending loss or dirty connectors.

The peaks of the different Bragg sensors are detected and digitized by the signal processing unit.

All sensor data is then transferred to the host PC via Ethernet.



System connectivity

The fos4Test nSens instruments connect easily with your measurement environment by IPv6 Ethernet connection.

Scalability

Several fos4Test nSens instruments may be cascaded in chain mode, without additional equipment required. Each fos4Test nSens features two Ethernet communication channels and CAN Channels respectively with RJ45 LAN/ Ethernet connectors.

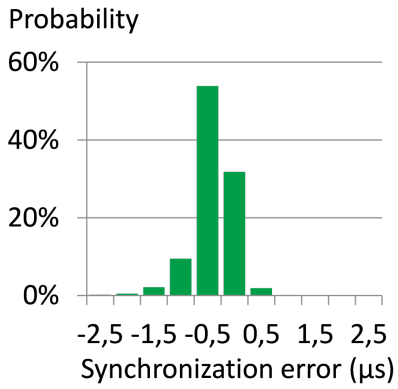
Synchrony and synchronization

Internal hardware synchronisation allows a sampling synchrony of 20 ns between individual channels of a device.

Several fos4Test devices and other devices in the measurement environment that support the IEEE 1588 protocol can be synchronized with a typical synchronization accuracy of below 4 µs.

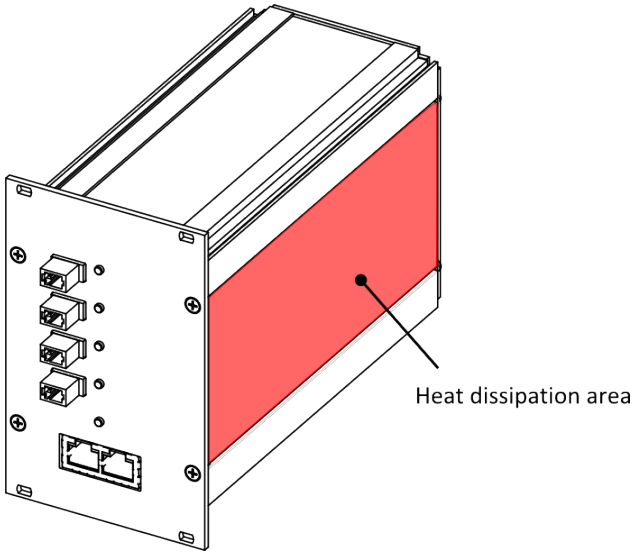
The synchronization uncertainty is typically below 400 ns.

Typical synchrony [2]



Passive conductive cooling

The fos4Test nSens instruments are designed for conductive cooling with low thermal resistance. No fans or active mechanical cooling are required. This allows dense integration into housings with a high protection rating (e.g. IP65).



Mounting options

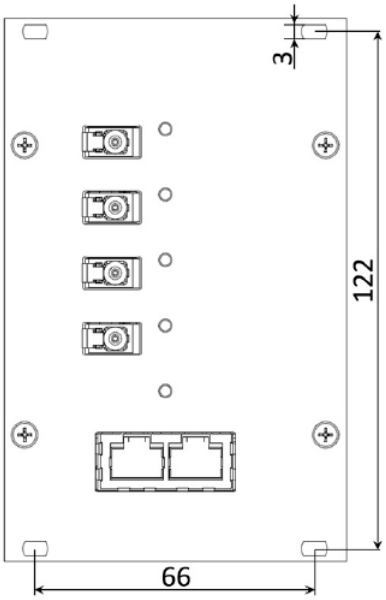
See table on next page for device dimensions.

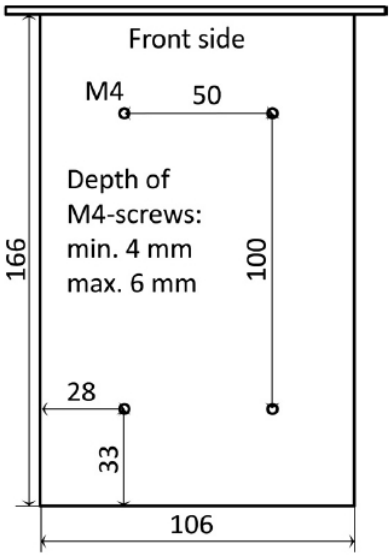
The measurement device is designed for:

- **19'' rack**
  fos4Test nSens devices can be mounted in standard 19'' racks with four M3 screws
- **Side mounting**
  The heat dissipation area may be mounted to other heat conducting structures with four M4 screws.

[2] Measurement results over 12 hours operation for displayed channel: µ=-0.63 µs, σ=0.37 µs

Mechanical drawings [3]





Included accessories

- Power supply 110 V / 230 V, 15 W
- Ethernet interface cable
- Data storage medium
- fos4Test C compliant driver
- User manual
- Data sheet

Additional equipment and software

- MATLAB and python bindings
- Cleaning kit for fiber optic connectors
- Fiber optic sensors and cables
- Fiber optic extensions

Further information

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[3] Drawing is not to scale

Technical Specs - fos4Test nSens

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General			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Optical channels		4 (up to 32)	
Sampling rate per sensor	Hz	100 (4 channel version)	
Sensors per channel		9	18
		(assuming 5 nm spacing)	
Messbereich	nm	1525 ... 1570	1510 ... 1595
External sample synchrony [4, 5]	µs	<4	
MTBF	h	>100.000	

Measurement accuracy			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Wavelength reproducability [6]	pm	0.1	
Absolute accuracy	pm	10 (2 with int. reference)	
Wavelength stability	pm	10 (2 with int. reference)	
Measurement uncertainty [7]	pm	0.1	
Resolution	pm	0.024	

Sensor specification			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Sensor type		Faser Bragg Gitter	
FWHM	pm	100 ... 1500	
Reflectivity		10 ... 100	
Center wavelength	nm	1527.5 ... 1567.5	1512.5 ... 1592.5
Optical connector type		LC/APC or F3000	
Fiber type		SMF28 compatible	

Ethernet interface			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Connector		RJ45	
Bit rate		10/100 Mbps	
Protocol		IPv6	

Optical interface			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Laser class		1	
Optical output power per channel	mW	<10 (typ. 5)	
Optical output wavelength	nm	1525 ... 1570	1510 ... 1595
Optical connector type		LC/APC or F3000	
Fiber type		SMF28 compatible	

4 Measurement results over 12 hours operation for displayed channel: µ=-0.63 µs, σ=0.37 µs
5 Precision Time Protocol (PTP)
6 measured connections to the front during 100 cycles
7 Standard deviation with a sampling rate of 5 Hz

Power interface			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Connector		MC 1,5/2 - GF-3,81	
Supply voltage	V	12-24 DC	
Power consumption	W	<15	

Temperature characteristics			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Storage temperature	°C	-20 ... +65	
Operating temperature	°C	+5 ... +40	
Warm up time	min	45	

Dimension			
Parameter	**Unit**	**fos4Test nSens**	**nSens ext**
Housing		19" rack	
Dimension (Height/Width/Depth)	mm	128.4 (3U) / 81 (16HP) / 170.5	
Weight	kg	1.5	