Data sheet

fos4Test dyn (12Ch, CAN, triple)

Fiber optic measurement device

Product highlights

The features of fos4Test dyn (12Ch, CAN, triple) include:

- 12 fiber Bragg grating sensor channels
- Inherent galvanic isolation
- Sample rate 1,000 Hz
- Optical half-bridge capability
- Supply voltage 12 to 24 V
- True anti-aliasing
- PTPv2[1] upgrade capability
- CAN interface

1 General description

The fos4Test dyn (12Ch, CAN, triple) device measures the wavelength of attached Fiber Bragg grating (FBG) sensors. To accomplish this, it generates broadband light which is distributed through the optical cables to the attached FBG sensors. From there a narrow section of the spectrum is reflected. The mean wavelength (or Bragg wavelength) of the reflected signal is dependent to the desired measurand (e.g. temperature, strain or acceleration).

The fos4Test dyn (12Ch, CAN, triple) measurement unit determines the Bragg wavelengths of all attached sensors and provides the individual sensor wavelengths on the ETHERNET or CAN data interface.

2 Setting a new standard for load 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.

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

The fos4Test dyn (12Ch, CAN, triple) instrument combines the specific advantages of optical sensors and the established handling of conventional electrical resistive strain gauges.

3 Vibration measurement with band limitation

The fos4Test dyn (12Ch, CAN, triple) instrument is the first fiber Bragg grating measurement device that is suited for vibration measurement.

The fos4Test dyn (12Ch, CAN, triple) device features synchronous sampling of 1000 Hz for each channel while providing anti-alias filtering prior to sampling. The sensor signal bandwidth is up to 175 Hz.

Unlike other FBG measurement devices, aliasing effects are thus prevented[2]. This is an essential requirement for control applications and vibration measurements according to DIN 45662.

4 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.

5 Applications

The fos4Test dyn (12Ch, CAN, triple) 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.

6 Working principle

A fos4Test dyn (12Ch, CAN, triple) instrument consists of twelve independent measurement channels. Each channel transmits light at wavelength a 1550 nm into the sensing fiber. At one point within the fiber a Bragg grating sensor reflects a certain wavelength of the incoming light, depending on the value of the measurand. The wavelength of the light reflected from the fiber Bragg grating sensor λ is proportional to the physical quantity being measured (strain, temperature, acceleration etc.).

The incoming light is converted into an analogue voltage signal, which is proportional to the sensor wavelength λ.

Each analogue signal is then low pass filtered and converted to a digital value by an analogue to digital converter. Depending on the type of sensor the corresponding measurand is calculated from this.

Each measurement channel's sampling frequency can be adjusted individually.

Each measurement channel has its own microcontroller where the current sensor wavelength is calculated.

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

[1] Precision Time Protocol (IEEE1588)

[2] i.e. compliance with Nyquist–Shannon's sampling theorem

7 System connectivity

The fos4Test dyn (12Ch, CAN, triple) instruments connect easily with your measurement environment by IPv6 Ethernet connection or via CAN connection.

8 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 2 µs.
The synchronization uncertainty is typically below 400 ns.

9 Passive conductive cooling

The fos4Test dyn (12Ch, CAN, triple) 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).

10 Product specifications

Ethernet interface	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Connector		RJ45
Rating		10/100 Mbps
Protocol type		IPv6
CAN interface	**U**nit	**fos4Test dyn (12Ch, CAN, triple)**
Connector		RJ45
Connector pin-out		Cia-303-1
Rating		10 - 1000 kbps
Protocol type		CANopen
Optical interface	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Laser class		1
Optical output power per channel	mW	<10, usually 2
Optical output wavelength	nm	1550
Optical connector type		LC/APC or F3000
Fiber type		SMF 28 compatible

Power interface	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Connector		MC 1,5/2 – GF-3,81
Supply voltage	V	12 ... 24
Power consumption	W	< 30
Temperature characteristics	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Storage temperature	°C	-40 ... +85
Calibrated operating temperature	°C	-20 ... +65
Warm up time	min	45[3]
Relative humidity	%	10 ... 90, non-condensing
IP protection class		IP20
Dimensions	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Height	mm	72.2
Width	mm	340
Depth	mm	173
Weight	kg	1.5

[3] Time between power supply on and operation within specifications

General parameter	Unit	fos4Test dyn (12Ch, CAN, triple)
Number of sensor channels		12
FBG-sensor sampling rate	Hz	50000 when using Ethernet 100 when using CAN
3 dB cut-off frequency (fos4Test dyn (12Ch, CAN, triple))	Hz	variable when using Ethernet 44 when using CAN
Internal sample synchrony	ns	< 20
External sample synchrony	µs	< 4[4,5]
Measurement range (@ 1550 nm)	nm	±4
MTBF	h	> 100,000
Measurement accuracy		
Wavelength reproducibility[6]	pm	±10
Absolute accuracy	pm	±50
Wavelength stability over temperature range	pm	±20
Temperature drift @ 25°C ± 3°C	pm	±10
Noise[7]	pm	< 1
Resolution	pm	0.024
FBG parameter	**Unit**	**fos4Test dyn (12Ch, CAN, triple)**
Sensor type		Fiber Bragg grating
Reflectivity	%	70 ±20
Full width half maximum	pm	400 ... 600
Side lobe suppression	dB	> 12
Available sensors		
Strain measurement		fos4Strain, fos4Strain expert
Temperature measurement		fos4Temp
Vibration measurement		fos4Acc (1D, 2D, 3D)

[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 over 100 front-side-connector mating cycles

[7] Standard deviation at a sampling frequency of 5 Hz