Fiberoptic Electric Field Sensor

DATASHEET

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The EOFS Electric-field sensor provides an analog response to the electrical field from kHz to 40GHz. It is based on packaging an electro-optical crystal with a dual fiber collimator, consisting entirely of non-metallic materials, having an ultra-high electrical damage threshold (>10 MV/m and 10W/cm^2 power density) and harsh environment compatibility, including temperature, pressure, liquid, X-rays, and gamma rays. Since it does not disturb the field, the measurement has high fidelity. We produce horizontal and vertical sensors to detect electrical fields in 3D. We offer several package configurations for general use, liquid immersion, vacuum chamber compatibility, permittivity matching, and 3D vector sensing. Custom design is our specialty.

The readout unit is sold separately. The operation principle is launching a laser beam through optic fibers and detecting the amplitude changes. The readout has a multichannel capability. The system is well suited to remotely and non-intrusively measure electric fields in demanding applications.

Features

- No metal parts
- Passive
- Miniature
- Optical fiber readout
- High shock/vibration resistance
- High sensitivity
- Wide bandwidth
- High damage threshold

Applications

- PAA radar tests
- Antennas characterization
- Plasma process control
- Military Active Denial Systems
- HPM, HRI and EMP systems

Specifications

E-filed Sensor		Typical	Max	Unit
Frequency Bandwidth	Ultra-high	18	40	GHz
	High	7		GHz
	Low		250	MHz
Sensitivity [1]	Ultra-high frequency	20		mV/m-Hz$^{1/2}$
	High frequency	10		mV/m-Hz$^{1/2}$
	Low frequency	5		mV/m-Hz$^{1/2}$
Cut-off Frequency	Ultra-high frequency	10		MHz
	High frequency	10		MHz
	Low frequency	30[2]		Hz
Maximum detectable E-field [3]		200		kV/m
Damage E-field			5	MV/m
Package Dimension		See design		

Note:
[1] Defined by measuring with a 1550nm laser at 20mW and 100MHz
[2] Sensitivity drops significantly at f < 50Hz
[3] Possible to be increased up to 2MV/m in special LF version, please contact us

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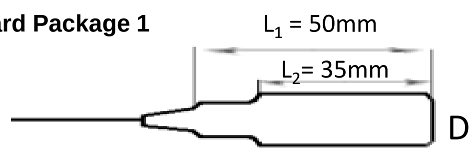
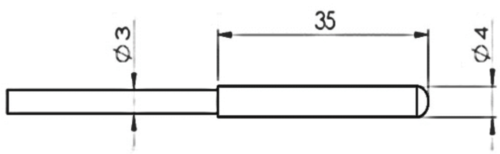
Mechanical Dimensions (mm)

Standard Package 1



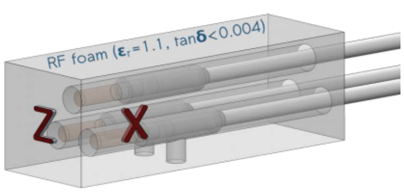
D (Standard) = 8mm in diameter

Mini Package 2



D (Ultra-small)=4mm in diameter

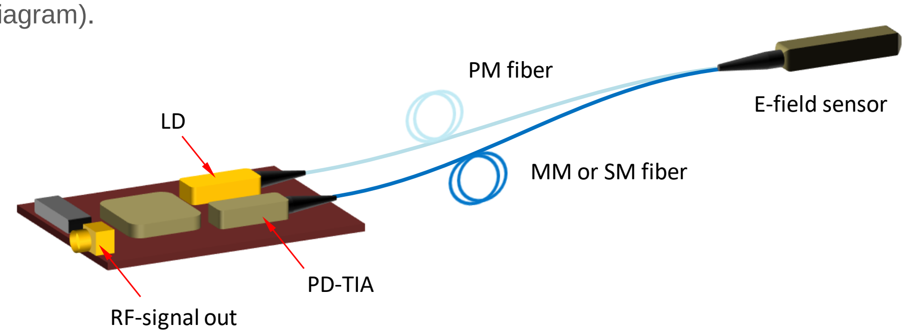
Custom Package



Application Note

1) **System Configuration of E-field Measurements**

The E-field detection by using a fiber optic sensor (EOFS) and the readout system is straightforward, as shown below. The Photonic E-field measurement system (PEFS, sale separately) is composed of one laser diode (LD), one photodetector (PD) with the amplifier, and an oscilloscope or spectrum analyzer (not shown in the following schematic diagram).



The fiber-coupled LD is connected to the fiber E-field sensor, and the output of the probing laser from the sensor is connected to the PD in the readout module (PEFS). The electric signal from PD should be connected to either the oscilloscope or the spectrum analyzer for measuring the E-field. Because the output electric signal is highly dependent on the laser power, PD, and TIA performances, the measurement set-up must be calibrated for the quantitative measurements.

2) EOFS Calibration

For characterizing/calibrating the fiber optic sensor EOFS and the module, the TEM cell or parallel electrodes must be used, as schematically shown in Fig.2 and Fig.3 respectively.

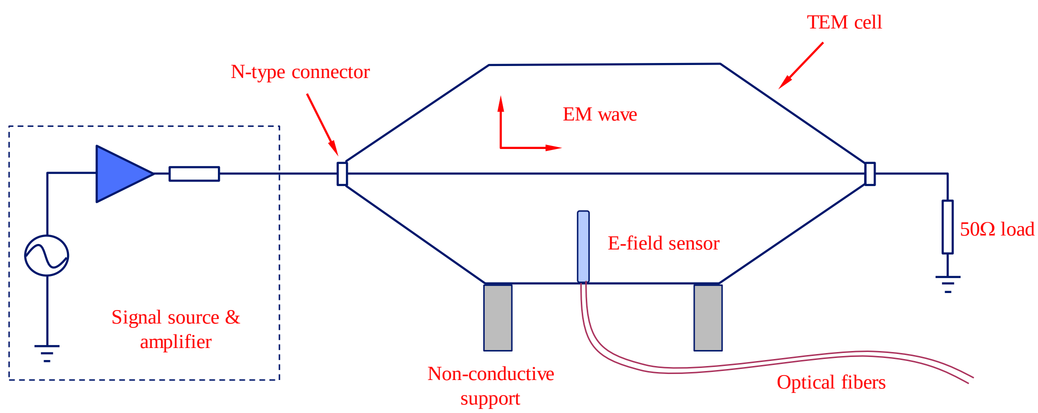


Figure 2: Schematic diagram of EOFS (high frequency) set up in TEM cell

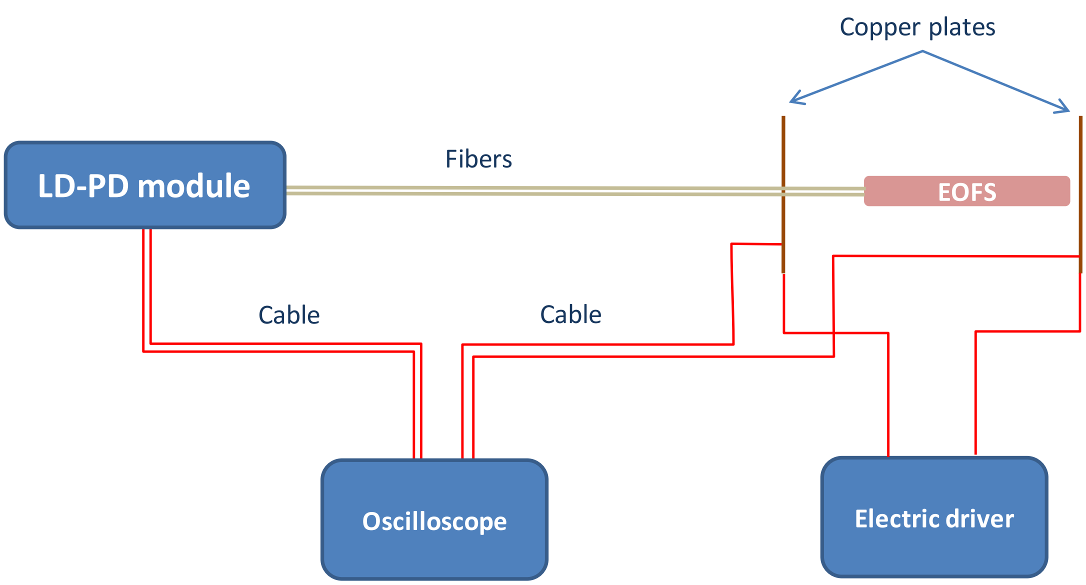


Figure 3: Schematic diagram of low frequency E-field measurement

3) System Calibration

The sensor's responsivity highly depends on the frequency and the system parameters, such as the laser power, and the PD's responsivity and TIA gain in the laser readout module (PEFS). So, the onsite calibration in the measurement system of EOFS and PEFS is highly recommended to quantitively measure the E-field strength, once the whole system is set up.

The electric signal can be expressed approximately on the function of E-filed strength as follows.

$$\Delta V\,(f) = \alpha E(f) + \beta E^2(f)$$

Where α, β are the coefficients to be determined through the calibration test, which depend on the input laser power and TIA gain. E is the electric field strength (V/m), f is the frequency of the E-field.

Ordering Information

	□□	□	□	□	1	□	□	□
Prefix	**Type**	**Configuration**	**Package**	**Fiber Cover**	**Fiber Type (input)**	**Fiber Type (output)**	**Fiber Length**	**Connector**
EOFS-	LNGITUD[2] 7GHz = 11 LNGITUD[2] 250MHz = 12 LNGITUD[2] 18GHz = 18 LNGITUD[2] 40GHz = 04 LNGITUD[2] Special = 00 LTRL[3] 7GHz = L1 LTRL[3] 250MHz = L2 LTRL[3] 18GHz = L8 LTRL[3] 40GHz = L4 LTRL[3] Special = L0	Ambient = 1 Liquid = 2 Vacuum = 3	Standard = 1 Small[4] = 2 Ultrasmall[5] = 3 Special=0	Bare fiber=1 900µm tube=3 Special=0	Panda PM=1 Special=0	62.5/125µm[6] fiber=1 SMF-28=2 Special=0	0.25m=1 0.5m=2 1.0m=3 Special=0	FC/PC=2 FC/APC=3 SC/PC=4 SC/APC=5 Special=0

[1]. For frequencies >10GHz, the output fiber must be SMF-28.
[2]. Longitudinal E-field
[3]. Lateral E-field
[4]. Small: 4.5mm x 4.5mm x 50mm.
[5]. Ultra-Small: 3.5mm x 3.5mm x 50mm.
[6]. 62.5/125µm fiber available for frequency ≤ 250MHz only.
Red is specially made.

NOTE:
Additional fiber cable extensions can be purchased through this link: https://agiltron.com/category/optical-fiber-patch-jump-cables/