TIEDEMANN

Laser Microphone

Unique Acoustic Measuring System for Process Control or Non-Destructive Material Testing (NDT)

Typical Applications

This is a rugged, diaphragm-free, broadband microphone designed for acoustic applications in gases in the mPa-to-Pa range. The frequency response extends into the MHz range.

In addition to pure acoustic measurement, it is particularly suitable for measurements in process control and non-destructive material testing. Every process has its typical noises, which go far beyond our audible frequency range. For example, the filling of a small vial in the pharmaceutical sector generates typical noises when a certain filling level is reached.

Everybody knows the effect when a wineglass has a small crack that the sound of the glass sounds duller when bumped than without a crack. In the same way, you can excite a workpiece or a weld seam with a laser pulse and then listen to the typical sounds.

In addition to the actual laser microphone, we also offer peripherals such as a data acquisition system and analysis software on request.

With the help of the patented technology, the sensor is almost immune to damage caused by high-pressure amplitudes. The acoustic detection is 10 times larger than the current state of the art. It offers an unprecedented superior measurement bandwidth.

Technology

For the detection of sound waves, conventional microphones use diaphragms or other moving parts as mediators between the incoming acoustic and the resulting electrical quantity. With acoustic ultrasonic sensors based on piezoelectric crystals, the approach is similar: the acoustic wave deforms the crystal mechanically. In contrast, the patented idea behind the laser microphones is to exploit a different, completely different property of sound: The fact that the sound changes the speed of light.

In a rigid Fabry-Pérot laser interferometer consisting of two miniaturized mirrors, the sound pressure changes the refractive index of the air. This changes the optical wavelength and the light transmission, which consequently leads to the respective electrical signal. Unlike conventional microphones, the optical microphone is the world's first microphone without moving parts. No mechanically movable or physically deformable parts are involved. As a result, the sensors show a convincing frequency bandwidth that is free of mechanical resonance. The sensor principle is very sensitive. In fact, refractive index changes below 10^{-14} can be detected with this technology. This corresponds to pressure changes of 1 µPa.

Technical Data

Sensor:

Microphone:	fiber-coupled laser microphone
Measuring method:	membrane-free, optical, contact-free
Electromagnetic interference (EMI):	none
Application media:	gas
Frequency range:	10 Hz - 1 MHz
Dynamic pressure range:	100 dB
Self-noise, BW 1 Hz at 100 kHz:	50 µPa (1 kHz)
Self-noise level:	50 mPa over the entire bandwidth
Max. sound pressure for THD <3%:	400 Pa
Max. sound pressure level f. THD <3%:	146 dB rel 20 µPa
Damage threshold:	>194 dB rel 20 µPa
Sensitivity:	10 mV/Pa (1kHz, 50 Ohm)
Directional sensitivity:	omnidirectional
Calibration:	calibrated
Size of the sensorhead:	diameter: 5 mm; length: 38 mm
Weight of sensorhead:	10 g
Fiber cable length:	5 m (others on request, max. 150 m)
Operating temperature sensor:	-20°C to 100°C (0 F to 210 F)

Laser Control Unit:

Sensor Output voltage:	± 15 V (high impedance), ± 7.5 V (50 Ohm)
Sensor output connection:	BNC
Sensor output impedance:	50 Ohm
Size of control unit:	220 mm x 330 mm; Height: 95 mm
Weight of control unit:	8 kg
Power supply (signal conditioning):	120/230 V ± 5%, 50/60 Hz
Power consumption:	<50 W
Operating temperature of control unit:	15°C to 30°C (60 F to 85 F)

Other sensitivities for higher or lower sound levels in gas or liquids on request.