Miniature Probe Hydrophone & AE Sensor

BII-7180 Series Miniature Probe Hydrophone and AE Sensor

Underwater Sounds: BII-7180 series are miniature hydrophones with small aperture size and usable up to 3 MHz. Conical and omnidirectional directivity patterns are available. Multiple miniature probe hydrophones can be configured as a vector hydrophone (vector sensor) or array for uses in extraction of directional information (source location), measurement of particle velocity, particle acceleration and pressure gradient.

The probe hydrophones are practical and handy tools for research and application of Helmholtz Integral Equation in underwater acoustics and for the measurement of pressure or intensity distribution of near-field and far-field radiated from vibrational and acoustical sound sources underwater.

NDT in Solids: receiving audible and ultrasonic sounds, acoustic emission (AE), structural health monitoring (SHM), metallurgical properties of metals, etc... The couplant such as water or gel is a must-have material to provide efficient acoustic coupling between the receiving face of the hydrophone and the piece under test (the subject). The hydrophones can be glued on or inside subject permanently with adhesives such as epoxy.

NDT in Fluids: uses in waterlike and airlike fluids for the analysis of their macroscopic and microscopic, physical and chemical properties.

BII-7180 series MUST not be used with flammable and/or explosive materials, and not used in Solvents such as hydrochloric acid, isopropyl alcohol, ethyl lactate, acetone, xylene, Iso hexanes, mineral spirits, etc...

Technical Notes:

Particle Velocity in x direction ux = - 1/(jωρ)*(ap/ax); ρ: Density; ap/ax: Pressure Gradient in the x direction.

Dipole Vector Hydrophone: Voltage Response V=M*(d/λ)*cosθ; M: Amplitude Constant related to element sensitivity; d: spacing distance between two elements; θ: Arriving angle from the axis of the two elements.

$$\text{Helmholtz Integral: } p(\vec{r}) = \frac{1}{4\pi}\iint\left[\frac{e^{-jkR}}{R}j\omega\rho u(\vec{r_0}) + p(\vec{r_0})\frac{\partial}{\partial n_0}\left(\frac{e^{-jkR}}{R}\right)\right]dS_0$$

Typical Applications

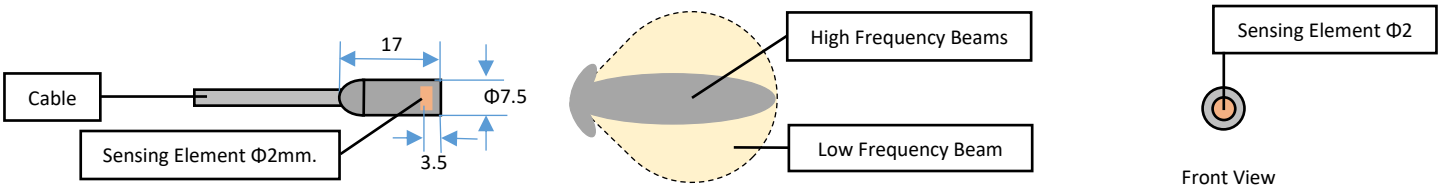
Study of Acoustic Radiation Field	General Purpose Hydrophone, Reference Hydrophone
Ultrasonic Testing and Analysis	Acoustic Emission (AE), Structural Health Monitoring (SHM), Thermoacoustic Tomography
Helmholtz Integral in Acoustics	Near-field Calibration and Measurement
Elements of Vector Hydrophones/Array	High Sound Level Measurement (Warning: Cavitation will damage hydrophone)
Research in Boundary Element Acoustics	Trouble-shooting, Maintenance and Development of Transducers and Array

SPECIFICATIONS

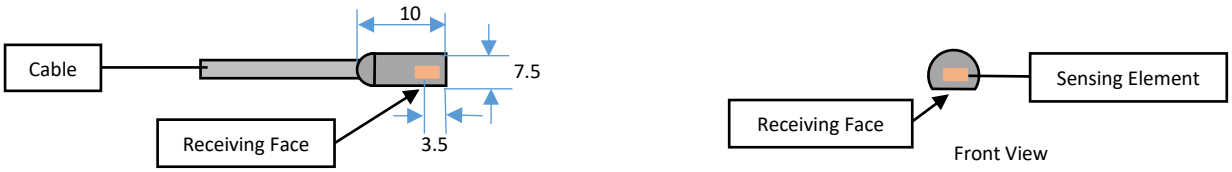
Part Number:	BII-7184EF	BII-7184SW
Aperture Size:	Sensing Element: ΦD = Φ2 mm	
Sensitivity @ 1kHz:	-217.0 dB V/μPa with 2m Coax/BNC. Variation: ±3 dB.	
	Sensitivity Loss over Extension Cable (dB) = 20*log[C_h/(C_h+C_c)]. Valid for hydrophone without preamplifier. C_h: Hydrophone Capacitance; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.	
Free-field Voltage Sensitivity:	Refer to Graph of **FFVS vs. Frequency**.	
Usable Frequency in Water:	50 Hz ~ 3 MHz	
	Minimum Usable Frequency depends on -3dB high pass filter f_{-3dB} = 1/(2π$R_i$$C_h$). R_i: Input Resistance or Impedance of Preamp. C_h: Capacitance of hydrophone at 1 kHz.	
Usable Frequency in Air:	50 Hz ~ 60 kHz at -3 dB V/μPa.	
Capacitance @1kHz:	0.08 nF ± 10% + Cable Capacitance. Generally, cable capacitance = 100 pF/meter.	
Dissipation @1kHz:	0.02	
Noise Density at f << fs: dB μPa/√Hz	64.5 – 10*log f	
	1. f in kHz; fs: Resonance Frequency which is close to the frequency of maximum FFVS. 2. Noise densities in this datasheet are calculated values with transducer parameters being measured in water. 3. As hydrophones works with preamps or data acquisition modules, total noise density is determined by all noise sources. Generally, the total noise density is much higher than the ones stated in this datasheet.	
Directivity Pattern:	Conical Beam	
Beam Width:	θ_{-3dB} = 44175°/f(kHz). θ_{-6dB} = 60961.5°/f(kHz). θ_{-10dB} = 79515°/f(kHz). f: Operating Frequency in kHz.	
Side Lobes:	< -17.8 dB with θ_{-3dB} ≤ 49°. No side lobe with θ_{-3dB} > 49°.	
Signal Output Type:	Single Ended.	
Acceleration Sensitivity:	130.0 dB μPa/(m/s²) at Acoustic Axis. 112.6 dBμPa/(m/s²) at other directions.	
Acoustic Source:	Yes.	
Resonance fs:	2 MHz ± 10%	
TVR at fs:	153 dB μPa/V at 1m. Approximately, TVR drops 12dB/octave below fs and drops 6dB/octave above fs.	
Maximum Drive Voltage:	150 Vpp	
Maximum Pulse Length:	1 mS at Maximum Drive Voltage	
Duty Cycle in Water:	1% at Maximum Drive Voltage. 100% at ≤ 30 Vpp or 10.6 Vrms.	
Maximum Operating Depth:	50 m and limited by the cable length if the cable has wire leads or a non-waterproof connector.	
Mounting Options:	1. Default: Free Hanging (FH) 2. Thru-hole Mounting with Single O-ring (THSO) 3. Thru-hole Mounting with Double O-ring (THDO) 4. Bolt Fastening Mounting (Plastics) (BFMP)	

	5. Bolt Fastening Mounting (Stainless Steel) (BFMSS) 6. Flush Mounting (FSM) Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.		
Cable Options:	1. Default: Coax RG174/U (RG174) 2. Coax RG178/U (RG178) up to 200°C. 3. Shielded Cable with Polyurethane Jacket, ΦD=2.6 mm (SC26) 4. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, ΦD=3.2 mm (SC32), up to 200°C. Not water-proof. 6. Shielded Cable with Twisted Pair and PVC Jacket, ΦD=3.6 mm (SC36) 7. Shielded Cable with Twisted Pair and Polyurethane Jacket, ΦD=4.7 mm (SC47)		
Cable Orientation:	Perpendicular to end face of hydrophone	Perpendicular to side wall of hydrophone.	
Cable Length:	1. Default: 2 m. 2. Custom-fit Cable Length.		
Connector:	1. Default: Wire Leads (WL) 2. Male BNC (BNC) (Max. Diameter Φ14.3 mm). 3. SMA (Plug, Male Pin) (SMA), Voltage Rating: 335 V_{RMS} Continuous. (Max. Diameter Φ9.24 mm). 4. SMC (Plug, Female Socket) (SMC), Voltage Rating: 335 V_{RMS} Continuous. (SMC) (Max. Diameter Φ6.4 mm). 5. Underwater Mateable Connector (pin) (UMC) (Max. Diameter Φ21.5 to Φ35 mm). Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.		
Size:	ΦDxH = Φ7.5x17 mm	ΦDxH = Φ7.5x10 mm	
Weight:	33 grams with 2m RG174 Coax/BNC. Actual weight depends on Mounting Parts, Cable Types and Length.		
Operation Temperature:	-10°C to +70°C or 14°F to 158°F.		
Storage Temperature:	-20°C to +70°C or -4°F to 158°F.		
Wiring of Single Ended Output:	**Wire Leads**	**Underwater Connector**	**BNC/SMA/SMC**
Signal	White or Red	Pin 2	Center Contact
Signal Common	Black	Pin 1	Shield
Shielding	Shield	Pin 3	Shield

Physical Size (unit: mm, Illustration ONLY, Scale is not 1:1) (BII-7184EF):



Physical Size (unit: mm, Illustration ONLY, Scale is not 1:1) (BII-7184SW):



Free-field Voltage Sensitivity in Water: