Miniature Probe Hydrophone & AE Sensor

BII7180 Series Miniature Probe Hydrophone and AE Sensor

Underwater Sounds: BII7180 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.

BII7180 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.

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

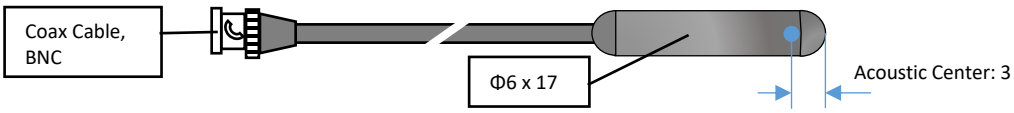
Part Number:	BII7181
Sensitivity @ 1 kHz:	-224.5 ± 2 dB V/µPa, with 2m Coax/BNC.
	Sensitivity Loss over Extension Cable (dB) = 20*log[C_h/(C_h+C_c)]. C_h: Hydrophone Capacitance; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.
FFVS:	Refer to Graph of **FFVS vs. Frequency**. Free-field Voltage Sensitivity.
Usable Frequency:	**In Water**: 5 Hz ~ 1 MHz at ±3 dB V/µPa.
	In Air: 5 Hz ~ 20 kHz at -3 dB V/µPa.
	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. when a BII7181 and a BII preamp of R_i = 200 MΩ are used to detect sounds, -3dB high pass frequency of detection = 1.5 Hz.
Capacitance @1 kHz:	0.53 nF ± 10% + Cable Capacitance. Generally, cable capacitance = 100 pF/meter.
Dissipation @1 kHz:	0.005
Noise Density at f << fs: dB µPa/√Hz	53.9 – 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:	Omnidirectional Beam to Toroidal Beam, Refer to Graph of **Directivity Pattern.**
Output Type:	Single Ended
Acceleration Sensitivity:	124.6 dB µPa/(m/s²)
Underwater Projector:	Yes.
Resonance fs:	500 kHz
TVR at fs:	141.0 dB µPa/V at 1m.
	Approximately, TVR drops 12dB/octave below fs and drops 6dB/octave above fs.
Maximum Drive Voltage:	250 Vpp
Maximum Pulse Length:	100 mS at Maximum Drive Voltage
Duty Cycle in Water:	10% at Maximum Drive Voltage; 100% at ≤ 30 Vpp or 10.6 Vrms.
Operating Depth:	Maximum: 300 m or 3 MPa pressure and limited by the cable length if the cable has wire leads or a non-waterproof connector.
Mounting Options:	1. Free Hanging (FH) 2. Free-hanging with Male Underwater Connector (FHUWC) 3. Thru-hole Mounting with Single O-ring (THSO) 4. Thru-hole Mounting with Double O-ring (THDO) 5. Bolt Fastening Mounting (Plastics) (BFMP) and Metric Thread Mounting. 6. Bolt Fastening Mounting (Stainless Steel) (BFMSS)

	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.			
Cable Options:	Coax RG174/U (**RG174**).		Coax RG178/U (**RG178**).	
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:	ΦD x L = Φ6 x 17 mm. Actual length depends on Mounting Parts if any.			
Weight:	37 grams with 2m Coax/BNC Male. Actual weight depends on Mounting Parts, Cable Types and Length.			
Operation Temperature:	-10°C to +75°C or 14°F to 167°F.		-10°C to +120°C or 14°F to 248°F.	
Storage Temperature:	-20°C to +60°C or -4°F to 140°F.			
Wiring	**Wire Leads**	**Underwater Connector**	**BNC/SMA/SMC**	**Coax with Wire Leads**
Signal	White or Red	Pin 2	Center Contact	Coax Center Contact
Signal Common	Black	Pin 1	Shield	Coax Shield
Shielding	Shield	Pin 3	Shield	Coax Shield
Underwater Projector Application: for 50Ω BNC/SMA/SMC connector, it is buyer's sole responsibility to make sure that the BNC/SMA/SMC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC/SMA/SMC is not intended for hand-held use at voltages above 30Vac/60Vdc.				
Do NOT use the hydrophone as a sound projector in the air otherwise the hydrophone will be damaged.				
Sound Measurement in Air: The hydrophones can be used to detect sounds in air. The sensitivity in air is same to the one in water in low frequency range.				

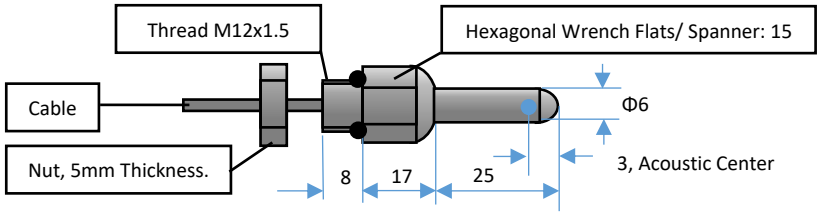
How to Order Hydrophones

Part Number	**-Mounting Part**	**-Cable Length in Meter**	**-Cable Type**	**-Connector Type**
Example:	Description			
BII7181-FH-2m-RG174-BNC	BII7181 Hydrophone, Free Hanging, 2m RG174 Coax, Male BNC.			

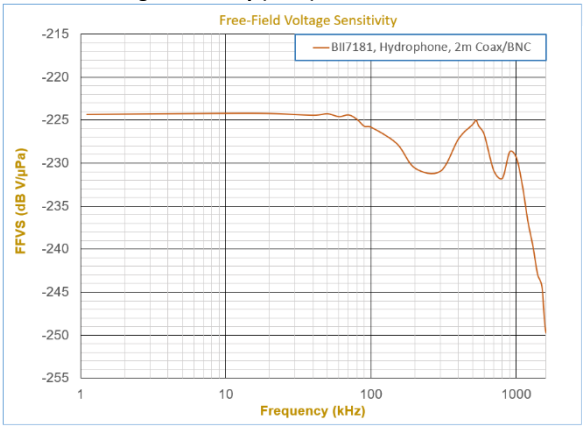
Physical Size (Dimension Unit: mm):
Free Hanging (Depth Rating limited by cable length).



Bolt-fastening Mounting (Plastics) BFMP (300m Depth or 3MPa Ratings) or Thread Mounting into a submersible enclosure (IP68, tighten with o-ring).



Free-field Voltage Sensitivity (FFVS):



Directivity Pattern: