



Omnidirectional Spherical Hydrophone

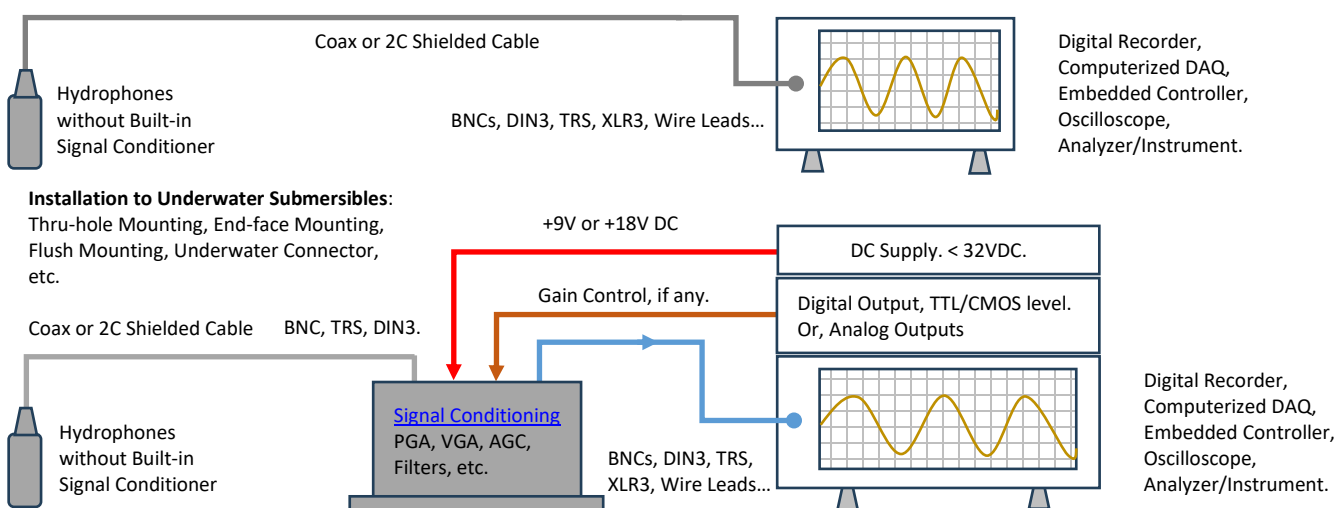
BII7000 Series Omnidirectional Spherical Hydrophone

BII's spherical hydrophones provide omnidirectional responses up to 700kHz and offer excellent acoustic characteristics of low noise and durability, which make these hydrophones ideal for a wide range of oceanography applications. Bespoke built-in preamplifiers allow the hydrophones to be used with long extension cables with no loss in sensitivity. The customized built-in filters increase Signal-to-Noise Ratio, reject unwanted noise, and avoid saturation.

Typical Applications

Sonobuoy, Dipping Hydrophone. LBL, SBL, USBL Positioning, Communication. Parabolic Antennas Underwater. Reference Hydrophone, Noise Measurement.	Detection of Ultrasonic Cavitation Noise, Thermoacoustics in Gas. Passive Acoustic Monitoring (PAM System). Array Element, Vector Hydrophone Element. Marine Bioacoustics, Phantom-power Hydrophone, Sound Recording.
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System Configuration of Receiving Sounds and Waves.



Specification

The hydrophone is tested in water unless stated otherwise.	
Part Number:	BII7005
Sensitivity @ 1kHz:	-205.0 dB V/μPa ± 2dB with 0.15m shielded cable/Wire Leads. 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.
FFVS:	Free-field Voltage Sensitivity, Refer to Graph of FFVS vs. Frequency .
Usable Frequency: in Water, at ±3 dB V/μPa.	1.6 Hz ~ 400 kHz at ± 3dB V/μPa. C _h and R _i constitute a high pass filter. -3dB high pass filter f _{-3dB} = 1/(2πR _i C _h). R _i : Input Resistance or Impedance of Preamp. C _h : Capacitance of hydrophone at 1 kHz. For example: A BII7005 and a BII preamp of R _i = 200 MΩ are used to detect sounds, -3dB high pass frequency of detection = 1.6 Hz.
Usable Frequency in Air:	1.6 Hz ~ 12 kHz at -3dB V/μPa.
Capacitance C_h @ 1kHz:	0.515 nF ± 10% with 0.15m Shielded Cable/Wire Leads.
Dissipation @ 1kHz:	0.006
Noise Density at f << f_s: dB μPa/√Hz	38.6 - 10*log f 1. f in kHz; f _s : 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.
Signal Conditioning:	If your project need extra signal conditioning before data acquisition, please refer to signal conditioning , and order separately. 1. Programmable Gain Amplifier (PGA), 0/20/40/60 dB, etc. 2. Variable Gain Amplifier (VGA): 60 to 70 dB Range. 3. Automatic Gain Control (AGC) Amplifier: 100 dB Gain Dynamic Range. 4. Amplifiers with Built-in, High-pass, Low-pass, and Band-pass Filters. Packages: Standalone Devices for portable uses, and Coated PCB with Wire Bundles for underwater submersibles.
Directivity Pattern:	Omnidirectional and Toroidal. Refer to Graph of Directivity Pattern .
-3dB Beam Width:	Refer to Graph of Directivity Pattern .
Side Lobe Level:	No side lobes.

Signal Output Type:	Differential Output. Differential signal has better capability to reduce and reject EMI noise, especially over long cable.
Acceleration Sensitivity:	133.4 dB μ Pa/(m/s ²)
Underwater Projector:	No
Operating Depth:	Maximum 500 m or 5 MPa pressure. 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 (THM-M10, THM-7/16"). 3. Thru-hole Mounting with Double O-ring (THDO-7/16") 4. Bolt Fastening Mounting (Stainless Steel) (BFM-M6, BFM-7/16"). 5. Bolt Fastening Mounting (Plastics) (BFMP-M12, or BFMP-NPT3/8"). 6. Free-hanging with Male Underwater Connector (FHUWC-3P) Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.
Cable Options:	1. Default: Shielded Cable with Twisted Pair and PVC Jacket, Φ D=3.6 mm (SC36). 2. Shielded Cable with Twisted Pair and PVC Jacket, Φ D=6.0 mm (SC60). 3. Shielded Cable with Twisted Pair and Polyurethane Jacket, Φ D=4.7 mm (SC47). 4. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, Φ D=3.2 mm (SC32), up to 200°C. Non-waterproof, for dry use ONLY. Differential/balanced signals over shielded twisted pair cable is recommended to reject Electromagnetic Interference (EMI).
Cable Length:	1. Default: 2 m. 2. Custom-fit Cable Length.
Connector:	1. Default: Wire Leads (WL) 2. 1/8" (3.5mm) TRS Plug (TRS), Max. Diameter Φ 10.5 mm. 3. DIN Receptacle with 3 Male Pins (DIN3), (Max. Diameter Φ 17 mm). 4. XLR Receptacle with 3 Male Pins (XLR3), Max. Diameter Φ 20.2 mm. 5. Underwater Mateable Connector (3 pin) (UMC3P), Max. Diameter Φ 21.5 to Φ 35 mm. UMC3P is from global manufacturers of underwater connectors. Its part number is listed in quote in detail. Underwater Mateable Connectors are for underwater uses. Other connectors/wire leads are for dry uses and are not waterproofed.
Size:	Φ D = Φ 10.0 mm, Length $\geq$ 25.4 mm and actual length depends on Mounting Parts.
Weight:	$\geq$ 0.03 kg with 0.15m cable. Actual weight depends on Mounting Parts, Cable Types and Length.
Operation Temperature:	1. Default: -10°C to +60°C or 14°F to 140°F. 2. Bespoke: -10°C to 120°C, or 14°F to 248°F. Append -HT to part number. Maximum Operating Depth at 120°C or 248°F: 100 m.
Storage Temperature:	-20°C to +60°C or -4°F to 140°F.
Array Design Service:	Line (Linear) Array, Rectangular Planar Array, and Circular Planar Array design: Side Lobe Level SLL, -3dB Beam Angle θ -3dB; Array Element Spacing d; Array Element Number N; Beam Steering, FFVS loss, and mutual effects among these parameters.
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 Standard Hydrophones. BII Keeps Standard Products in Stock.

Hydrophone Part Number	-Mounting Part	-Cable Length	-Cable Type	-Connector Type
Standard BII7005	BFMP-NPT3/8"	2 m (6.56 ft)	SC60 Shielded Cable with Twisted Pair	WL, TRS, XLR, DIN.
Bespoke BII7005	Refer to options.	Bespoke.	Refer to options.	Refer to Options.
Example:	Description			
BII7005-BFMP-NPT3/8"-2m-SC60-WL	BII7005 Hydrophone, Bolt-fastening Mounting: BFMP-NPT3/8", 2m Shielded Cable with Twisted Pair SC60, Wire Leads.			
BII7005-BFMP-NPT3/8"-10m-SC60-XLR	BII7005 Hydrophone, Bolt-fastening Mounting: BFMP-NPT3/8", 10m Shielded Cable with Twisted Pair SC60, Connector: XLR.			
BII7005-FH-10m-SC60-TRS	BII7005 Hydrophone, Free Hanging, 10m Shielded Cable with Twisted Pair SC60, TRS Plug.			
BII7005-FH-10m-SC60-XLR3	BII7005 Hydrophone, Free Hanging, 10m Shielded Cable with Twisted Pair SC60, XLR Receptacle with 3 Male Pins.			
BII7005-FH-10m-SC60-WL	BII7005 Hydrophone, Free Hanging, 10m Shielded Cable with Twisted Pair SC60, Wire Leads.			

Wirings

Differential Output:	Wire Leads	UMC3P	DIN3	TRS	XLR3
Signal +	White or Red	Pin 2	Pin 3	Tip, Positive/Hot	Pin 2, Positive/Hot.
Signal -	Black	Pin 1	Pin 1	Ring, Negative/Cold	Pin 3, Negative/Cold.
Common & Shielding	Shield	Pin 3	Pin 2	Sleeve, Ground/Common	Pin 1, Shield/Ground.

Question:

What if the mating connector of my DAQ module or recording device is NOT available from BII? A bespoke connector adaptor might be assembled by BII and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations. Many adaptors for standard connectors are available in worldwide electronic suppliers such as BNC to SMA, BNC to SMC, XLR to TRS, etc. Check out your local suppliers.

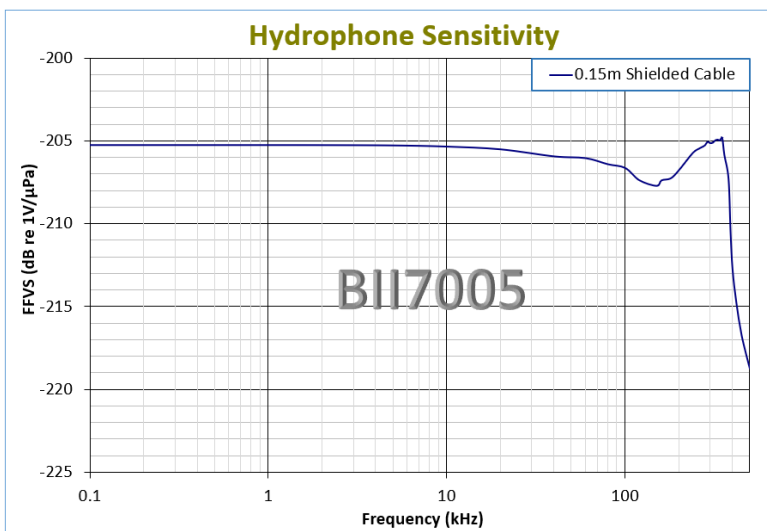
Is impedance matching necessary between hydrophones/sensors and preamplifiers/Recorders/Analyzers? it is NOT necessary to do impedance matching in low frequency range applications in which electromagnetic wave lengths are much greater than the cable length. High frequency transducers such as NDT pulsing transducers need 50 Ω impedance matching among transducers, cables, and analyzers/digitizers.

My acoustic sensors generate differential signals in MHz range, are TRS connectors suitable for my applications? BII's test shows TRS connectors (Plug and Jack) of BII preamps can be used up to 20 MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: 1M Ω | 20pF, Signal Source: DDS Signal Generator.

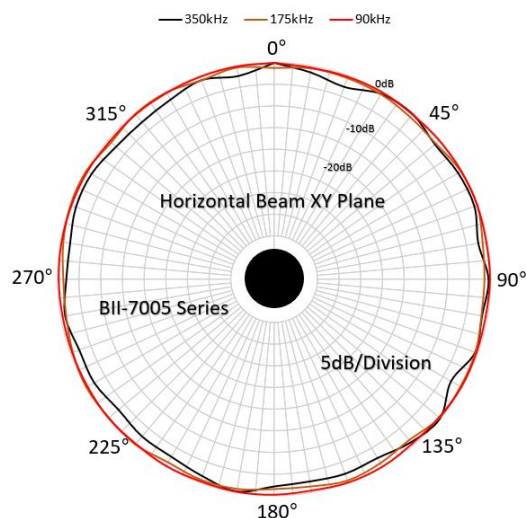
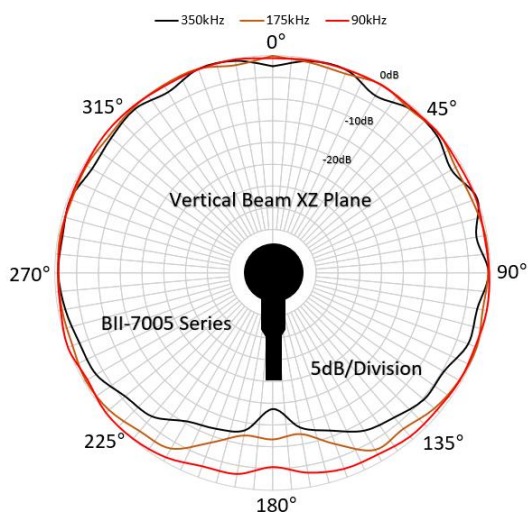
Can 3.5mm (1/8") TRS be configured for single-ended signal of a hydrophone/transducer which does not have built-in preamplifier? Yes, the preamp with differential-input TRS can accept single-ended signals from hydrophones/transducers whose TRS wiring should be like followings: **TRS Tip:** Signal. **TRS Ring and Sleeve:** Both terminals are soldered together for Signal Common and Shielding. Common and shielding should be "one-point" contact.

Can BII explain why the capacitance of my hydrophone/transducer affect high pass filtering? (1). Hydrophone/transducer is high impedance devices in low frequency range. Its simplified complex impedance = $j/(2\pi f C_h)$, C_h is the capacitance of hydrophone/transducer, f is frequency in Hz. This impedance is in series with preamp R_i and can reach several M Ω to hundreds M Ω depending on C_h and f . (2). Most high-performance operational amplifiers (IC chips) can use input resistors R_i up to 1 to 200 M Ω to avoid bumping into saturation issue.

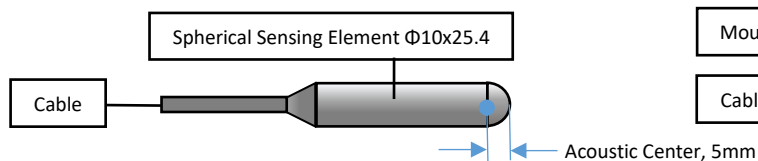
Free-field Voltage Sensitivity (FFVS):



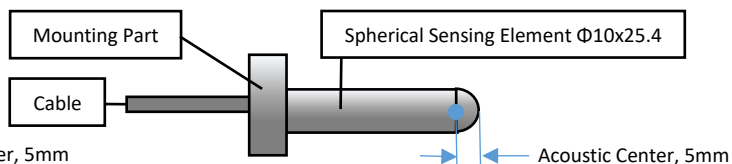
Directivity Pattern



Physical Size (Dimensional Unit: mm) of Free Hanging:

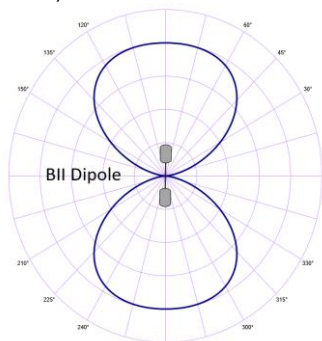
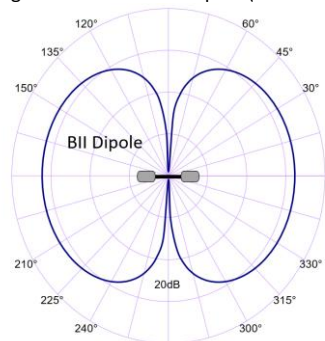


Physical Size (Dimensional Unit: mm) with Mounting Part:

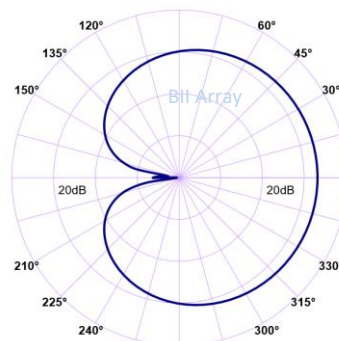


Simple Array Consisting of Hydrophones.

“Figure 8” Pattern of a Dipole (Pressure-Gradient).



Cardioid Pattern



Linear Array with BII Discrete Hydrophones

