



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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Specification

The hydrophone is tested in water unless stated otherwise.				
FG: Fixed Gain; PG: Programmable Gain; DF: Differential Output; SE: Single Ended Output; BPF: Band Pass Filter; HPF: High Pass Filter; LPF: Low Pass Filter.				
Part Number:	BII7001FGDF	BII7001FGSE	BII7001PGDF	BII7001PGSE
Sensitivity @ 1 kHz:	-196.5 + Preamp Gain, ± 2 dB V/ μ Pa.			
	-160.0 dB	-160.0 dB	-190.5, -150.5 dB	-176.5, -136.5 dB
FFVS:	Refer to Graph of FFVS vs. Frequency . Free-field Voltage Sensitivity.			
Pressure Noise Density:	Refer to Graph of Pressure Noise Density , Referred to Input (RTI), in μ Pa/ $\sqrt{\text{Hz}}$.			
Built-in Filters: at -3dB V/ μ Pa.	Bespoke HPF .	Bespoke BPF .	Bespoke BPF .	Bespoke BPF .
	Minimum HPF: 3 Hz.	Minimum HPF: 1.5 Hz.	Minimum HPF: 1.5 Hz.	Minimum HPF: 1.5 Hz.
	in Water: 3 Hz ~ 180 kHz	1.5 Hz ~ 180 kHz	1.5 Hz ~ 180 kHz	1.5 Hz ~ 180 kHz
	in Air: 3 Hz ~ 5 kHz	1.5 Hz ~ 5 kHz	1.5 Hz ~ 5 kHz	1.5 Hz ~ 5 kHz
	1. Reduce Noise. Both ocean ambient noises and the self-noises of electronic devices decrease when frequency increases. It is recommended to choose a built-in high pass filter to reject noises in low frequency range. For example, if you are interested in the signals greater than 1 kHz, you may specify a high pass filter with -3dB cut-off frequency at 100 Hz to improve signal to noise ratio of the signals of the interest.			
	2. Avoid Saturation. When there are strong low frequency noises, disturbances, and/or vibrations, resulting from rough surface waves and/or mechanical movements of the platform, it is recommended to specify a high pass filter to avoid hydrophone saturation in these low frequency ranges.			
Preamp Gain (dB):	Low Power Fixed Gain Preamp		Programmable Gain Preamp.	
	36.5 dB.	36.5 dB.	6, 46 dB.	20, 60 dB.
	Note: If Digital Outputs or switches are used to select gains, Voltage Protection Rating or Absolute Maximum Voltage Ratings of these devices must be greater than V_s Supply Voltage.			
Gain Selection Voltage: (Programmable Gain Preamp)	N/A		CMOS/TTL Compatible Logic Low 0: Gain Selection Wire to COM or 0 to +0.8 VDC. Logic High 1: Gain Selection Wire Open or +2.4 VDC to V_s .	
Directivity Pattern:	Omnidirectional and Toroidal. Refer to Graph of Directivity Response Pattern .			
Side Lobe Level:	No side lobes.			
Signal Output Type:	Differential	Single Ended	Differential	Single Ended
	Differential signal has better capability to reduce and reject EMI noise, especially over long cable.			
Maximum Output V_{omax} :	Supply Voltage $V_s - 4$, in Vpp.	$V_s - 5$, in Vpp.	$V_s - 4$, in Vpp.	$V_s - 5$, in Vpp.
Overload Pressure Level:	197 or $(20 \cdot \log(V_{\text{omax}}/2.828) - \text{Sensitivity})$ whichever is less. in dB μ Pa.			
Acceleration Sensitivity:	134.0 dB μ Pa/(m/s ²) at Acoustic Axis; ≤ 130 dB μ Pa/(m/s ²) at other directions.			
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. Default: Free Hanging (FH).			
	2. Free-hanging with Male Underwater Connector (FHUWC-3P, FHUWC-4P, FHUWC-6P).			
	3. Thru-hole Inch Mounting with Single O-ring Sealing (THM-7/16").			
	4. Thru-hole Inch Mounting with Double O-ring Sealing (THDO-7/16").			
	5. Bolt Fastening Mounting (Plastics) (BFMP-M12).			
	6. Bolt Fastening Mounting (Plastics) (BFMP-NPT3/8").			
	7. Bolt Fastening Mounting (Stainless Steel) (BFM-7/16").			
	8. Bolt Fastening Mounting (Stainless Steel) (BFM-5/8").			
	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.			
	Cable Options:	Four Conductor Shielded Cable (SC)		Six Conductor Shielded Cable (SC)
Cable Length:	≤ 1000 m	≤ 200 m	≤ 1000 m	≤ 200 m
Connector:	SE: Single ended Output, DF: Differential Output.			
	1. Default: Wire Leads (WL)			
	2. Male BNC (BNC) (Max. Diameter $\Phi 14.3$ mm), for SE ONLY.			
	3. 1/8" (3.5mm) TRS Plug (TRS) (Max. Diameter $\Phi 10.5$ mm), for SE or DF.			
	4. XLR Receptacle with 3 Male Pins (XLR3), (Max. Diameter $\Phi 20.2$ mm), for SE or DF. XLR Receptacle with 4 Male Pins (XLR4), (Max. Diameter $\Phi 20.2$ mm), for SE or DF. XLR Receptacle with 6 Male Pins (XLR6), (Max. Diameter $\Phi 20.2$ mm), for SE or DF.			
	5. Underwater Mateable Connector (4 pins) (UMC4P) (Max. Diameter $\Phi 21.5$ to $\Phi 35$ mm), for SE or DF.			

	Underwater Mateable Connector (6 pins) (UMC6P) (Max. Diameter Φ 21.5 to Φ 35 mm), for SE or DF. UMC is from global manufacturers of underwater connectors. Its part number is listed in quote in detail.			
	6. +9VDC Battery Snap (BS), for +9VDC or +18VDC power supply.			
	7. 4mm Banana Plug Pair (Red and Black Color) (BP), for DC power supply ONLY.			
	Underwater Mateable Connectors are for underwater uses. Other connectors/wire leads are for dry uses and are not waterproofed.			
Supply Voltage Vs:	+7.5 to +32 VDC	+6 to +32 VDC	+8.2 to +32 V	+8.2 to +32 VDC
Suggested DC Supply:	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included. DO NOT use variable power supply whose maximum supply voltage is higher than the rated voltage. DO NOT use switching mode DC power supply.			
Current (Quiescent):	7.0 mA	3.1 mA	13 mA	9.0 mA
Size:	Free Hanging: Φ D = Φ 21 mm, Overall Length = 115 mm. Other Mounting Types: actual length depends on Mounting Parts.			
Weight:	\geq 0.55 kg with 10m cable. Actual weight depends on Mounting Parts, Cable Types and Length.			
Operation Temperature:	-10 °C to +60 °C or 14 °F to 140 °F.			
Storage Temperature:	-20 °C to +60 °C or -4 °F to 140 °F.			
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.

FG: Fixed Gain; PG: Programmable Gain; DF: Differential Output; SE: Single Ended Output.					
Part Number	-Mounting	-Cable Length	-Connectors for Signal	/Gain Selection	/DC Supply
BII7001PGDF	FH: Free Hanging. BFMP-3/8"NPT: Bolt-fastening Mounting.	20 m (98.4 ft)	WL, TRS, or XLR3, XLR4, XLR6, BS.		
Example of Part Number:	Description				
BII7001PGDF-FH-20m-WL	BII7001PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: None, Wire leads.				
BII7001PGDF-BFMP-3/8"NPT-20m-WL	BII7001PGDF Hydrophone, Bolt-fastening Mounting: BFMP-3/8"NPT, 20m Shielded Cable, Connector: None, Wire leads.				
BII7001PGDF-BFMP-3/8"NPT-20m-TRS/WL/BS	BII7001PGDF Hydrophone, Bolt-fastening Mounting: BFMP-3/8"NPT, 20m Shielded Cable, Connector: TRS for Signal, Wire Leads for Gain Selection, 9V Battery Snap for DC Supply.				
BII7001PGDF-FH-20m-XLR3/WL/BS	BII7001PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: XLR3 for Signal, Wire leads for Gain Selection, Battery Snaps for +9VDC Batteries.				
BII7001PGDF-FH-20m-XLR6	BII7001PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: XLR Receptacle with 6 Male Pins.				

How to Order Bespoke Hydrophones. Non-stock.

FG: Fixed Gain; PG: Programmable Gain; DF: Differential Output; SE: Single Ended Output; LP: Low Power; LN: Low Noise; HPF: High Pass Filter; LPF: Low Pass Filter.						
Part Number	-HPF/LPF	-Mounting	-Shielded Cable Length	-Connectors for Signal	/Gain Selection	/DC Supply
BII7001FGDF BII7001FGSE	-3dB Filter Frequencies, In Hz, kHz.	Mounting Options.	in meter. Up to 200m (656 ft) or 305m (1000 ft).	Connector Options for Signals, Gain Selection (if any), and DC Supply.		
BII7001PGDF BII7001PGSE						
Example of Part Number:		Description				
BII7001FGSE-10Hz/30kHz-FH-20m-BNC/BS		BII7001FGSE Hydrophone, Band Pass Filter: 10Hz to 30kHz, Free Hanging, 20m Shielded Cable, Connector: Male BNC for Signals, Battery Snap for +9VDC Batteries.				
BII7001FGDF-10Hz-BFM-7/16"-100m-XLR3/BS		BII7001FGDF Hydrophone, High Pass Filter: 10Hz, Bolt Fastening Mounting BFM-7/16", 100m Shielded Cable, Connector: 3-pin XLR for Signals and Battery Snap for +9VDC Batteries.				
BII7001FGDF-10Hz-FH-0.6m-UMC4P		BII7001FGDF Hydrophone, High Pass Filter: 10Hz, Free Hanging, 0.6m Shielded Cable, Connector: 4-pin Underwater Mateable Connector for Signals and DC Supply.				
BII7001PGDF-10Hz/50kHz-FH-100m-XLR3/WL/BS		BII7001PGDF Hydrophone, Band Pass Filter: 10Hz to 50kHz, Free Hanging, 100m Shielded Cable, Connector: XLR3 for Signal, Wire leads for Gain Selection, Battery Snap for +9VDC Batteries.				
BII7001PGDF-10Hz/50kHz-THM-7/16"-0.6m-WL		BII7001PGDF Hydrophone, Band Pass Filter: 10Hz to 50kHz, Thru-hole Mounting THM-7/16", 0.6m Shielded Cable, Wire leads for Signal, Gain Selection, and DC Supply.				
BII7001PGSE-Default-FH-100m-SC-XLR6		BII7001PGSE Hydrophone, Default Band Pass Filter, Free Hanging, 100m Shielded Cable, Connector: XLR Receptacle with 6 Male Pins for Signals, Gain Selections, and DC Supplies.				

Wiring Information of Hydrophones with Fixed-gain Preamps:

Single Ended Output:	Wire Leads	BNC Male/SMA/SMC, 9V Battery Snap	UMC4P or XLR4 Connector	XLR3 and 9V Battery Snap	TRS Plug and 9V Battery Snap
+VDC	Red	Female Snap	Pin 3	Battery Female Snap	Battery Female Snap
Common	Black	Male Snap	Pin 1	Battery Male Snap	Battery Male Snap
Signal	White	Center Pin or Contact	Pin 2	XLR Pin 2	TRS Tip
Signal Common	Blue, Green, or Yellow	BNC/SMA/SMC Shield	Pin 4	XLR Pin 1 and Pin 3	TRS Ring and Sleeve
Shielding	Shield	N/A	N/A	XLR Metal Shell	N/A
Differential Output:	Wire Leads	UMC4P or XLR4 Connector		XLR3 + 9V Battery Snap	TRS + 9V Battery Snap
+VDC	Red	Pin 3		Battery Female Snap	Battery Female Snap
Common	Black	Pin 1		Battery Male Snap	Battery Male Snap
Signal+	White	Pin 2		XLR Pin 2	TRS Tip
Signal-	Blue, Green or Yellow	Pin 4		XLR Pin 3	TRS Ring
Signal Common	N/A	N/A		XLR Pin 1	TRS Sleeve
Shielding	Shield	N/A		XLR Metal Shell	N/A

Wiring Information of Hydrophones with One-Bit-Word Programmable Gain Preamps:

Differential Output:	Wire Leads	UMC6P or XLR6 Connector		XLR3 + 9V Battery Snap		TRS + 9V Battery Snap
+VDC	Red	Pin 3		Battery Female Snap		Battery Female Snap
Common	Black	Pin 1		Battery Male Snap, XLR Pin 1.		Battery Male Snap, TRS Sleeve.
Digital Common	Yellow or Brown	Pin 5		Yellow or Brown		Yellow or Brown
Digital A0 (FFVS Selection)	Blue	Pin 6		Blue		Blue
Output Signal+	White	Pin 2		XLR Pin 2		TRS Tip
Output Signal -	Green	Pin 4		XLR Pin 3		TRS Ring
Shielding	Shield	N/A		XLR Metal Shell		N/A
Single-Ended Output:	Wire Leads	UMC6P or XLR6 Connector	9V Battery Snap and BNC Male/SMA/SMC	XLR3 + 9V Battery Snap		TRS + 9V Battery Snap
+VDC	Red	Pin 3	Battery Female Snap	Battery Female Snap		Battery Female Snap
Common	Black	Pin 1	Battery Male Snap	Battery Male Snap, XLR Pin 1.		Battery Male Snap, TRS Sleeve.
Digital Common	Yellow or Brown	Pin 5	Yellow or Brown	Yellow or Brown		Yellow or Brown
Digital A0 (FFVS Selection)	Blue	Pin 6	Blue	Blue		Blue
Output Signal	White	Pin 2	BNC/SMA/SMC Center	XLR Pin 2		TRS Tip
Output Signal Common	Green	Pin 4	BNC/SMA/SMC Shield	XLR Pin 3		TRS Ring
Shielding	Shield	N/A	Shield	XLR Metal Shell		N/A
4mm Banana Plug Pair: Red Plug for +VDC, Black Plug for Common of the DC power supply.						
Selecting Sensitivity of One-Bit-Word Digitally Programmable						
FFVS Selection Wire A0	BII7001PGDF Sensitivity FFVS at 1kHz.		BII7001PGSE Sensitivity FFVS at 1kHz.			
0 (Logic Low)	-196.5 + 6 dB V/μPa		-196.5 + 20 dB V/μPa			
1 (Logic High)	-196.5 + 46 dB V/μPa		-196.5 + 60 dB V/μPa			

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.

What if the connector of my analyzer (instrument) is SMA or SMC Connector? Buyer may order a SMA (or SMC) to BNC (Male) adaptor from local electronic distributors in buyer's country. BII may ship the adaptor as accessory of the device if buyer requests when ordering. **By default, BII does NOT supply the adaptor as accessories.**

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 50Ω 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: 1MΩ | 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 MΩ to hundreds MΩ 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 MΩ to avoid bumping into saturation issue.

Can the hydrophone with differential outputs be wired to single-ended inputs of a DAQ device (Data Acquisition Equipment) such as an Oscilloscope? Yes, output+ and Common of a BII hydrophone can be used a single-ended signal, or Output- and Common of the hydrophone can be used a single-ended signal. **But, neither output+ nor output- of the hydrophone can be wired to common which is going to destroy the hydrophone by short circuit.**

How to increase hydrophone sensitivity for extremely weak sounds?

BII low noise hydrophone with built-in preamp (Differential Output) -> Long Cable -> Standalone Preamp -> Analyzing Instrument or Recorder.

How do I use Gain Selection wires in field?

(1). Manual Gain Selection.

When a **Gain Selection wire** is floating or open, its digital logic is High or "1".

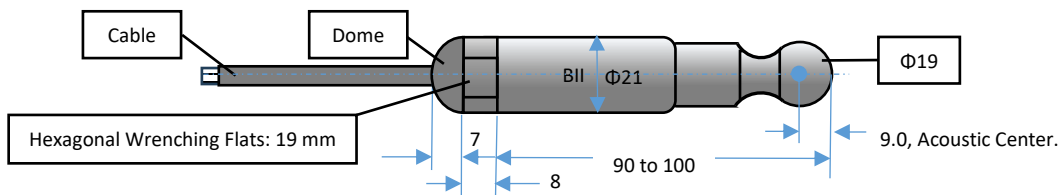
When a **Gain Selection wire** is short to **Digital Common**, its digital logic is Low or "0".

Sensitivity of a Hydrophone is fixed when its Gain Selection wires are fixed to **Digital Common** or open (floating) during operation.

(2). Gain Selection with Digital Outputs. Digital Outputs of a DAQ (data acquisition device) select gains with TTL/CMOS logic levels.

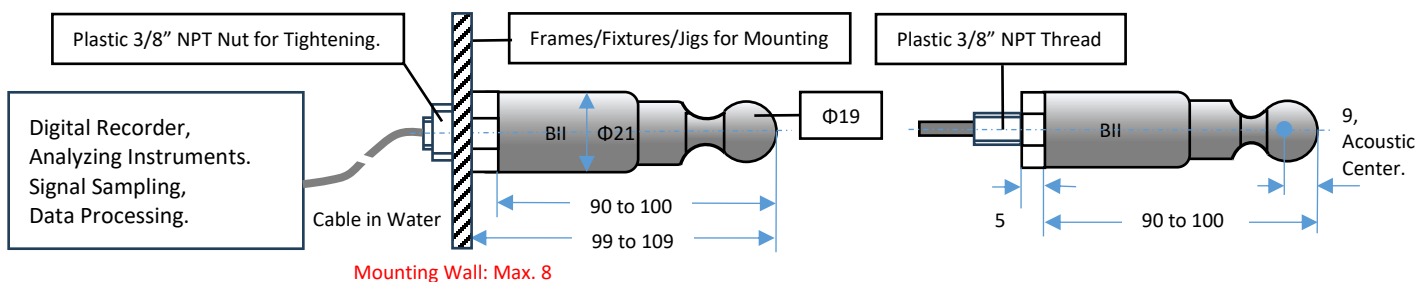
Physical Size (Dimensional Unit: mm): The overall length varies with the length of the built-in preamplifier and mounting parts.

1. Free Hanging with Smooth Domes.

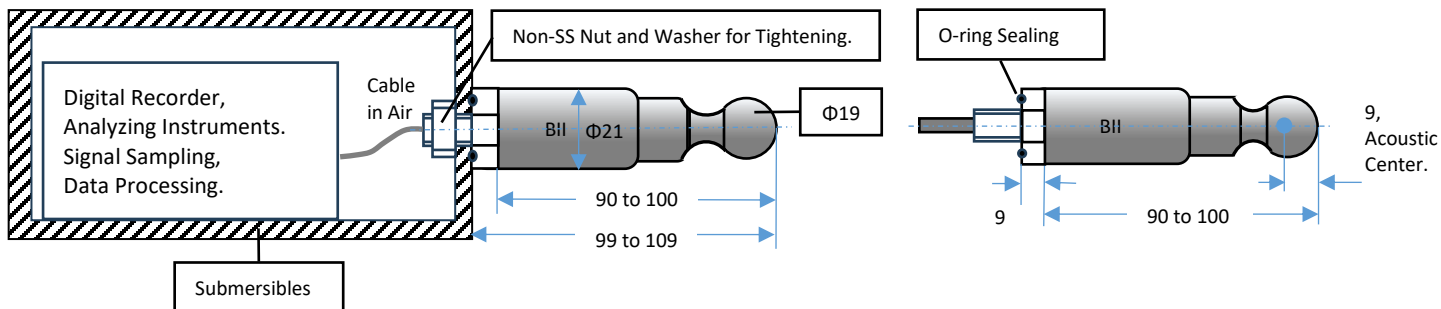


The hydrophone body has streamlined hemispherical domes which minimize the drag forces and the hydrodynamic noise caused by the hydrophone in motion or the flow past the hydrophone.

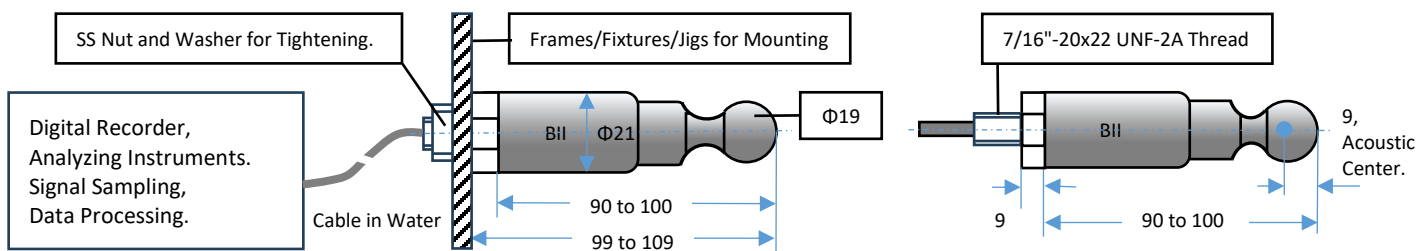
2. Bolt-Fastening Mounting BFM-NPT3/8", 3/8" NPT Thread Length: 15mm. Nut Height: 5mm.



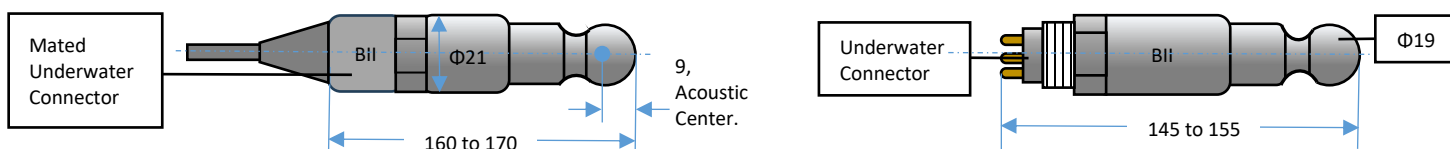
3. Thru-hole Mounting (Inch Thread) with Single O-ring Sealing THM-7/16" (7/16"-20x22 UNF-2A).



4. Bolt-Fastening Mounting BFM-7/16" (7/16"-20x22 UNF-2A).



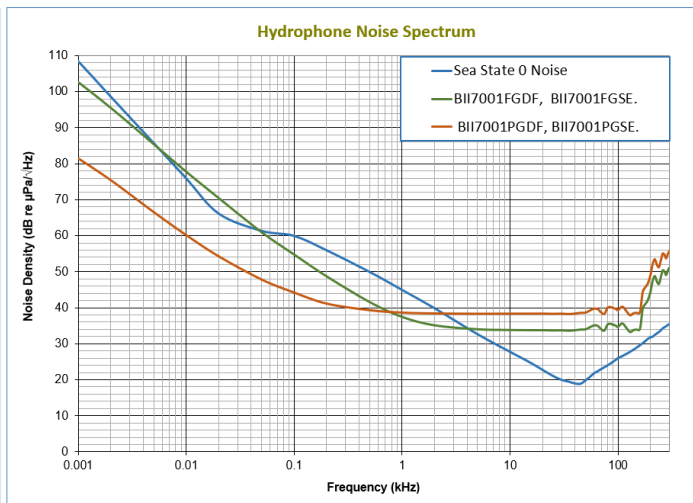
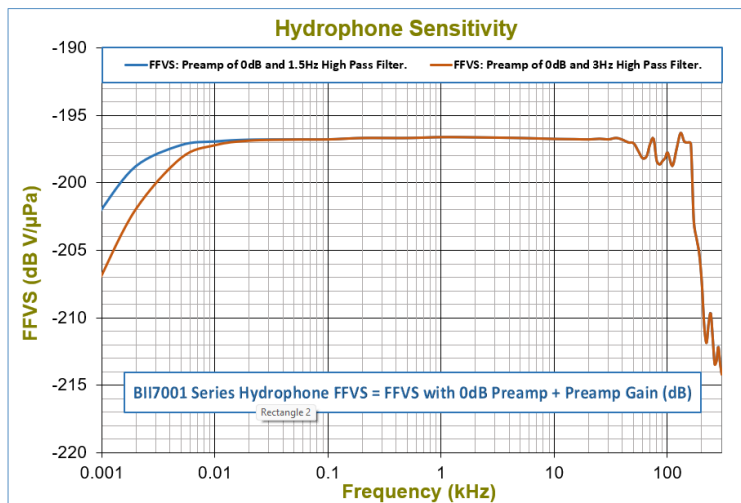
5. Free-hanging with Underwater Connector FHUWC-4P, 4 Pins (Fixed Sensitivity); FHUWC-6P, 6 Pins (Programmable Sensitivity).



6. More Mounting/Installation Options: Please refer to online document [AcousticSystem.pdf](#) for a complete list of Mounting Options and details.

Free-field Voltage Response (FFVS):

Pressure Noise Density (RTI, referred to the input):



Directivity Response Pattern:

