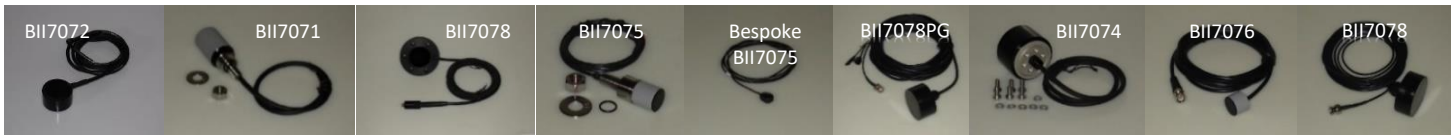


BII7079 Low Noise Hydrophone: Noise Level Below Sea State Zero

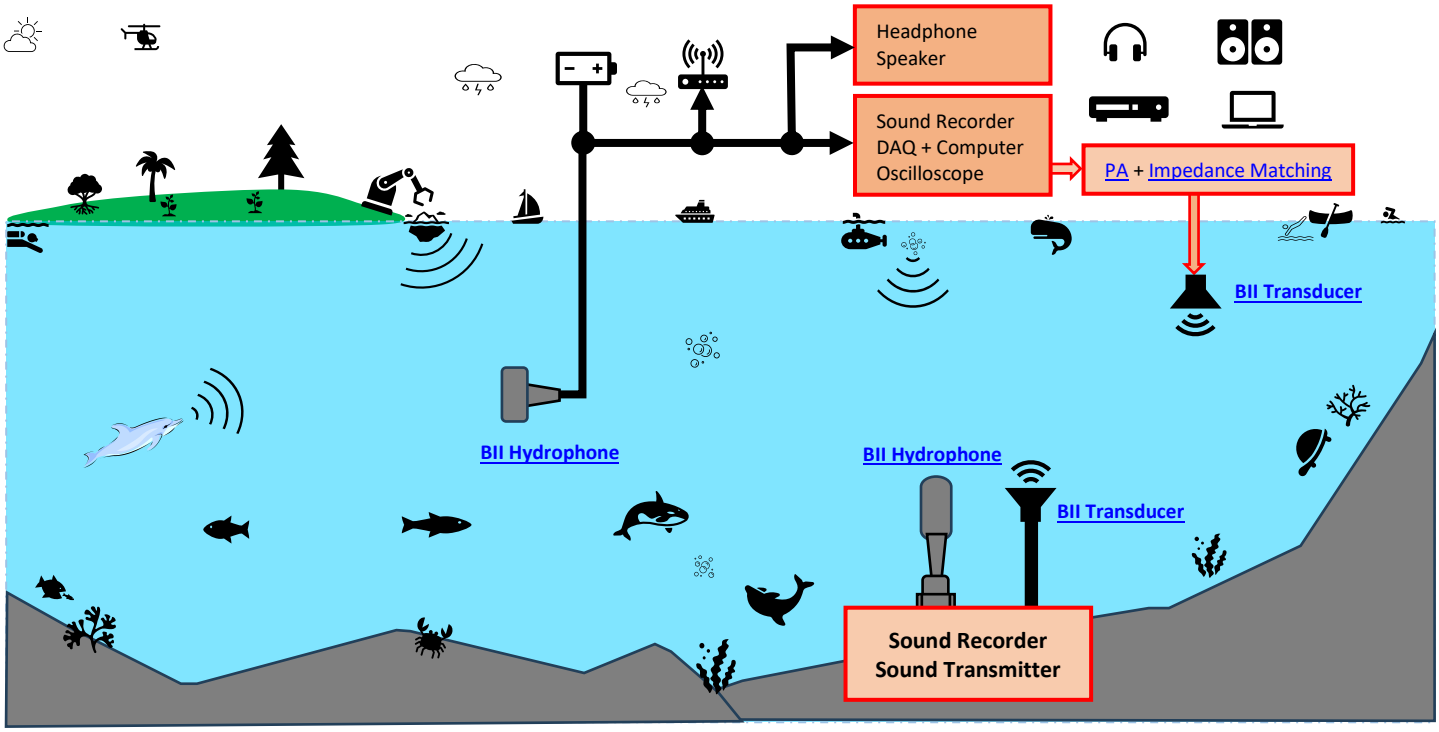
BII7079 Low noise directional hydrophones have conical beams for uses in detection of weak signals, broadband signals, pipeline leaks, and tracking of sound sources underwater. These acoustic sensors are also designed for applications in air to detect acoustic emission and stress waves. (Note: The couplant such as water or gel is a necessary material to provide efficient acoustic coupling between the hydrophone face and the piece under test in air applications.)

Below the critical frequency fc, the hydrophones are of single beam without side lobes. This feature makes the hydrophone be an ideal candidate for target angle estimation systems or sound source tracking systems. A spatial array of multiple hydrophones can be set up for directional noise-measurement system.

The hydrophones can measure underwater sounds and pressure fluctuations down to 1Hz: Surface Waves (Wave-height Sensor), Turbulences, seismic, ocean traffics, industrial noises, precipitations, biologics, ...

The preamplifier integrated in the hydrophone can drive cable up to 200m without signal loss. Available cable terminals include audio connectors (TRS, XLR), BNC, and underwater mateable connectors. The housing and mounting part are corrosion resistant plastics and/or stainless steels.

Underwater Sound Listening, Recording, and Communication



Typical Applications

Underwater Sounds Recording, Listening, and Communication, Marine Bioacoustics, Passive Acoustic Monitoring (PAM System).	Coastal/Offshore Processes, Engineering & Management, Wave-Structure Interaction, Wave-height Sensor, Wave and Tide Recorder/Logger.
Oceanic Ambient Noise Measurement, Surface Waves, Ocean Turbulences, Hydrodynamics, Marine Geophysics.	Battery-Powered Instruments: Sonobuoy, Recorder, Transponder, Acoustic Release...

Questions

How do I set up my professional sound recorders to work with BII Hydrophones?

1. BII hydrophones have their own DC power supply to support **Line Input** of recorders, and **Do NOT** use phantom power 48V which may destroy the hydrophones.
2. **Maximum Input Level (Line Input)** of recorders should be large enough to avoid saturation or clipping during recording.
   Equivalent Input Noise of recorders should be low enough for the recorders to be sensitive to weak signal of the interest.
3. **Sampling Rate** of the recorder should be fast enough to avoid missing high frequency sound of the interest. Generally, the **Sampling Rate** should be at least two times greater than the maximum frequency of sound.
4. Calculate the **memory size of data storage** according to sampling rate, resolution, sampling channels, and recording time, and use suitable recording media.
5. Calculate **battery service life** according to battery power and consuming current.
6. When the cable is greater than 5m, **balanced signal or differential signal** is recommended to be in use over the cable.

How do I playback the recorded sounds in water?

System Setup: Recorder (Recorded Sounds) with **Line or Phone Output** -> Audio Power Amplifiers -> Impedance Matching Device -> Transducers (Projectors).

Specification

Part Number:	BII7079FGDF	BII7079FGSE	BII7079PGDF	BII7079PGSE
Sensitivity FFVS @ 1 kHz:	(-184 + Preamp Gain) dB V/µPa. Variation: ± 2 dB.			
	-164 dB ± 2	-164 dB ± 2	-164, -134 dB, ± 2.	-164, -134 dB, ± 2.
			-174, -144 dB, ± 2.	-174, -144 dB, ± 2.
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 µPa/√Hz**.**			
Built-in Filter:	Bespoke HPF, or BPF.	Bespoke HPF, or BPF.	Bespoke HPF, or BPF.	Bespoke HPF, or BPF.
	Minimum high pass filter f-3dB = 4 Hz.		Minimum high pass filter f-3dB = 16 Hz.	
	Default, in Water: 8 Hz ~ 70 kHz at -3dB V/µPa.		Default, in Water: 16 Hz ~ 70 kHz at -3dB V/µPa.	
	Default, in Air: 8 Hz ~ 3 kHz at -3dB V/µPa		Default, in Air: 16 Hz ~ 3 kHz at -3dB V/µPa	
	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):	Fixed Gain Preamp.		Programmable Gain Preamp.	
	Default: 20 dB.		Default: 20, 50 dB.	
	Bespoke Options: 10, 20, 26, 30, 40, or 50 dB.		Bespoke Options: 10/40 dB, or 20/50 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.	
Receiving Face:	Circular Planar Face			
Directivity Pattern:	Conical Beam, Refer to **Graph of Directivity Pattern**.			
-3dB Beam Width:	1700°/f(kHz)			
Frequency f_{-3dBML}:	15 kHz, f_{-3dBML}: Main Lobe drops -3dB at ±90° normal to acoustic axis.			
Critical Frequency f_c:	36 kHz, f_c: Side lobes exist in the case of operating frequency f > fc; The hydrophone has no side lobe in the case of f ≤ fc.			
±90° Sidelobe Frequency f_n:	49 kHz, f_n: First Side Lobes exist at ±90° normal to acoustic axis in the case of operating frequency f = fn.			
Sidelobe Level:	< -17.8 dB when f > fc; No side lobe when f ≤ fc.			
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}:	V_{omax} = (Supply Voltage Vs - 4) Vpp.		(Supply Voltage Vs – 3.4) Vpp.	
Overload Pressure Level:	184 or [20*log(V_{omax}/2.828) – Sensitivity], whichever is less. in dB µPa.			
Acceleration Sensitivity:	152.7 dB µPa/(m/s²) along acoustic axis. Other direction: 142.5 dB µPa/(m/s²).			
Operating Depth:	Maximum 100 m or 1 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. Thru-hole Mounting with Single O-ring (**THM-M10, THM-7/16", or THM-5/8".)** 3. Thru-hole Mounting with Double O-ring (**THDO-7/16"**) 4. Bolt Fastening Mounting (Stainless Steel) (**BFM-7/16", or BFM-5/8".**) 5. Bolt Fastening Mounting (Plastics) (**BFMP-NPT3/8"**) 7. Free-hanging with Male Underwater Connector (**FHUWC-4P, FHUWC-6P.**) 8. End-face Mounting (**EFMS**) 9. Flange Mounting (**FGM-Φ110)** 10. Flush Mounting (**FSM-M55)**			
	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.			
Cable Orientation:	1. Default: Perpendicular to end face of hydrophone. 2. Customization: Perpendicular to side wall of hydrophone (Generally, this is used to reduce the overall length of hydrophone), Appending **SW** to the part number.			
Cable Options:	Four Conductor Shielded Cable (**SC**)		Six Conductor Shielded Cable (**SC**)	
Cable Length:	Default: 20 m.			
	Custom-fit up to 305m.	Custom-fit up to 100m.	Custom-fit up to 200m with 20/50 dB, or 40m with 10/40 dB.	
Connector:	**SE**: Single ended Output, **DF**: Differential Output. 1. Default: Wire Leads (**WL**) 2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm), for SE ONLY. 3. 1/8" (3.5mm) TRS Plug (**TRS**) (Max. Diameter Φ10.5 mm), for SE or DF. 4. XLR Receptacle with 4 Male Pins (**XLR4**), (Max. Diameter Φ20.2 mm), for SE or DF. XLR Receptacle with 6 Male Pins (**XLR6**), (Max. Diameter Φ20.2 mm), for SE or DF. 5. Underwater Mateable Connector (4 pins) (**UMC4P**) (Max. Diameter Φ21.5 to Φ35 mm), for SE or DF. Underwater Mateable Connector (6 pins) (**UMC6P**) (Max. Diameter Φ21.5 to Φ35 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.			
	Gain Selection Wires are of wire leads. Buyer may assemble connector to wires of **Gain Selection**.			
	Underwater Mateable Connectors are for underwater uses. Other connectors/wire leads are for dry uses and are not waterproofed.			
Supply Voltage Vs:	+8.5 to +32 VDC.	+8.5 to +32 VDC	+8 to +32 V	+8 to +32 V
Suggested DC Supply:	+9 VDC 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):	9.8 mA	4.8 mA	17 mA	13 mA
Size:	Free Hanging: ΦDxL=Φ60x30 mm, Other Mounting Types: actual length depends on Mounting Parts.			
Weight:	≥ 1.0 kg with 20m 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; **BPF**: Band Pass Filter; **HPF**: High Pass Filter; **LPF**: Low Pass Filter.						
Part Number	**-Gain and Filter**	**-Mounting**	**-Cable Length**	**-Connectors for Signal**	**/Gain Selection**	**/DC Supply**
BII7079PGDF	Default.	FH: Free Hanging. BFM-5/8": Bolt-fastening Mounting.	20 m (65.6 ft)	WL, TRS, or XLR3, XLR4, XLR6, BS.		

Example of Part Number:	**Description**
BII7079PGDF-FH-20m-WL	BII7079PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: None, Wire leads.
BII7079PGDF-FH-20m-XLR3/WL/BS	BII7079PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: XLR3 for Signal, Wire leads for Gain Selection, Battery Snaps for +9VDC Batteries.
BII7079PGDF-FH-20m-XLR6	BII7079PGDF Hydrophone, Free Hanging, 20m Shielded Cable, Connector: XLR Receptacle with 6 Male Pins.
BII7079PGDF-BFM-5/8"-20m-WL	BII7079PGDF Hydrophone, Bolt-fastening Mounting: BFM-5/8", 20m Shielded Cable, Connector: None, Wire leads.
BII7079PGDF-BFM-5/8"-20m-TRS/WL/BS	BII7079PGDF Hydrophone, Bolt-fastening Mounting: BFM-5/8", 20m Shielded Cable, Connector: TRS for Signal, Wire Leads for Gain Selection, 9V Battery Snap for DC Supply.

How to Order Bespoke Hydrophones. Non-stock.

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	**-Preamp Gain**	**-HPF or HPF/LPF**	**-Mounting**	**-Shielded Cable Length**	**-Connectors for Signal**	**/Gain Selection**	**/DC Supply**
BII7079FGDF BII7079FGSE	Fixed, in dB.	-3dB Filter Frequencies, In Hz, kHz.	Mounting Options.	in meter. Up to 200m (656 ft).	Connector Options for Signals, Gain Selection (if any), and DC Supply.		
BII7079PGDF BII7079PGSE	Programmable, in dB.						

Example of Part Number:	**Description**
BII7079FGSE-26dB-4Hz/30kHz-FH-30m-BNC/BS	BII7079FGSE Hydrophone, Gain: 26dB, Band Pass Filter: 4Hz to 30kHz, Free Hanging, 30m Shielded Cable, Connector: Male BNC for Signals, Battery Snap for +9VDC Batteries.
BII7079FGDF-26dB-10Hz-BFM-7/16"-100m-XLR3/BS	BII7079FGDF Hydrophone, Gain: 26dB, 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.
BII7079FGDF-26dB-10Hz-FH-0.6m-UMC4P	BII7079FGDF Hydrophone, Gain: 26dB, High Pass Filter: 10Hz, Free Hanging, 0.6m Shielded Cable, Connector: 4-pin Underwater Mateable Connector for Signals and DC Supply.
BII7079PGDF-20/50dB-16Hz/50kHz-FH-100m-XLR3/WL/BS	BII7079PGDF Hydrophone, Gain: 20/50dB, Band Pass Filter: 16Hz to 50kHz, Free Hanging, 100m Shielded Cable, Connector: XLR3 for Signal, Wire leads for Gain Selection, Battery Snap for +9VDC Batteries.
BII7079PGDF-10/40dB-16Hz/50kHz-THM-7/16"-0.6m-WL	BII7079PGDF Hydrophone, Gain: 10/40dB, Band Pass Filter: 16Hz to 50kHz, Thru-hole Mounting THM-7/16", 0.6m Shielded Cable, Wire leads for Signal, Gain Selection, and DC Supply.
BII7079PGSE-Default-FH-100m-SC-XLR6	BII7079PGSE Hydrophone, Gain: Default, Band Pass Filter: Default, 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, 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	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.					
FFVS Selection Wire A0	**BII7079PGDF and BII7079PGSE: Sensitivity FFVS at 1kHz.**				
0 (Logic Low)	-184 + 10 dB V/µPa		-184 + 20 dB V/µPa		
1 (Logic High)	-184 + 40 dB V/µPa		-184 + 50 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".

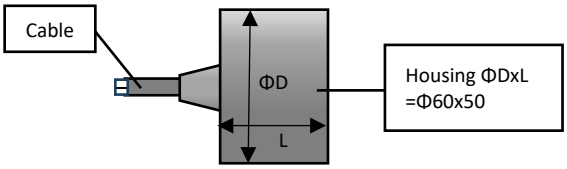
Sensitivity of a Hydrophone is fixed when its Gain Selection wires are fixed to **Digital Common** or open (floating) during operation.

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

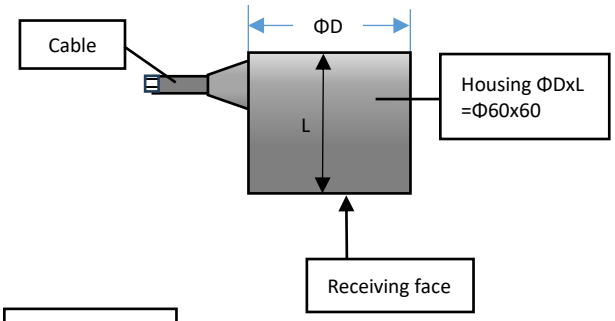
Physical Size (Dimensional Unit: mm): The overall length varies with the length of the built-in preamplifier and mounting parts.

1. Free Hanging.

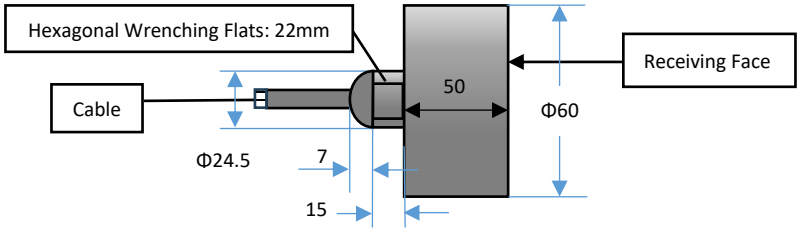
a. General Size information.



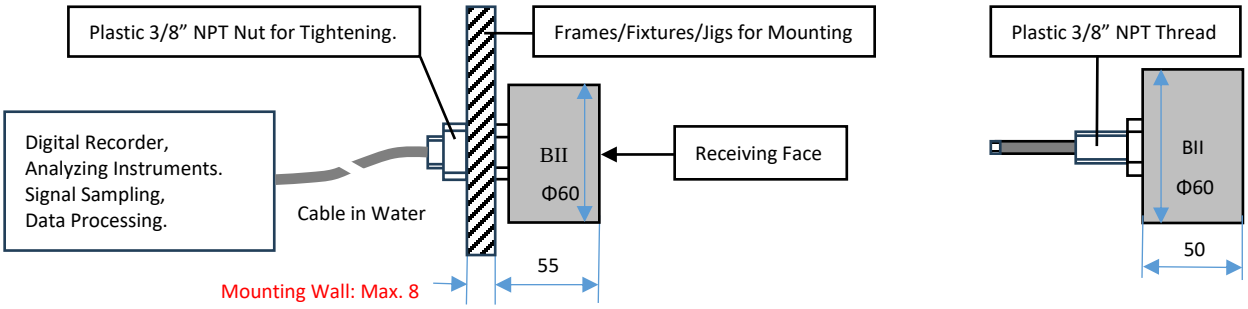
b. Size information of Customized Cable Orientation: Side Wall (-SW).



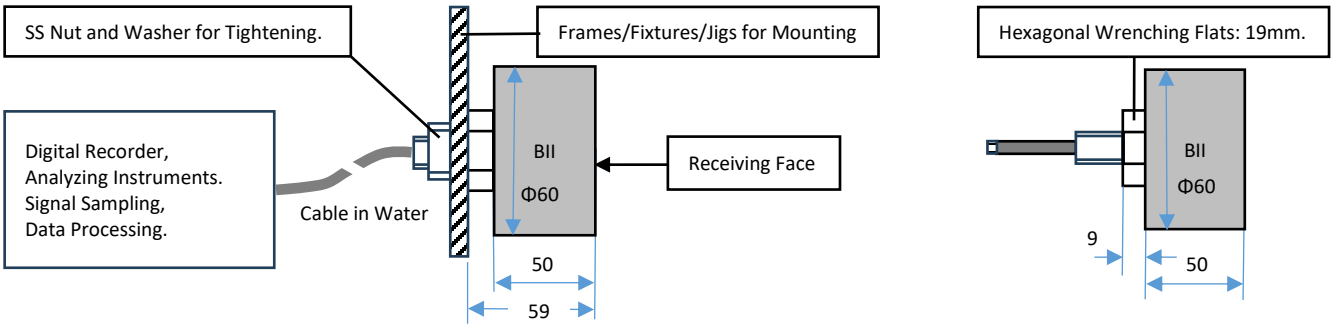
c. Size information of Free Hanging.



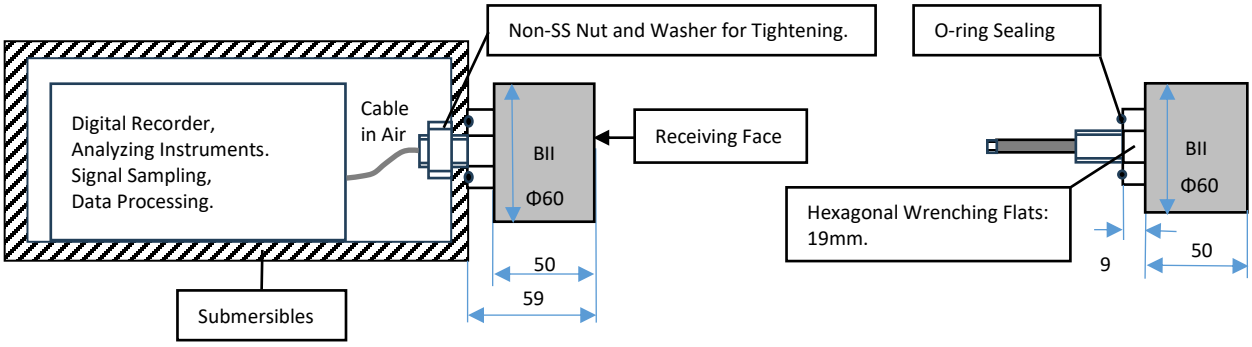
2. Bolt-Fastening Mounting BFM-NPT3/8”, 3/8” NPT Thread Length: 15mm. Nut Height: 5mm.



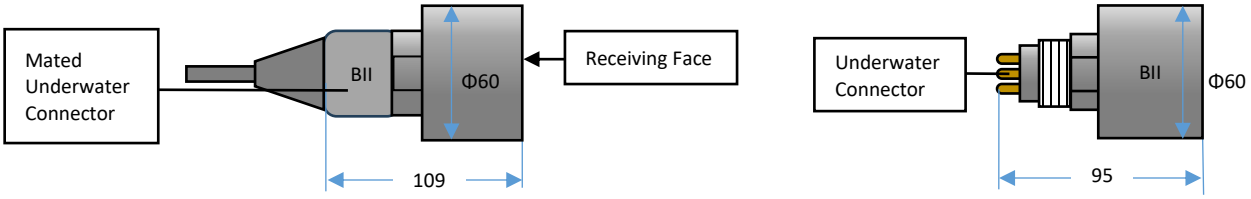
3. Bolt-Fastening Mounting BFM-7/16” (7/16"-20x22 UNF-2A), or BFM-5/8” (5/8"-18x22 UNF).



4. Thru-hole Mounting (Inch Thread) with Single O-ring Sealing THM-7/16” (7/16"-20x22 UNF-2A), or BFM-5/8” (5/8"-18x22 UNF).

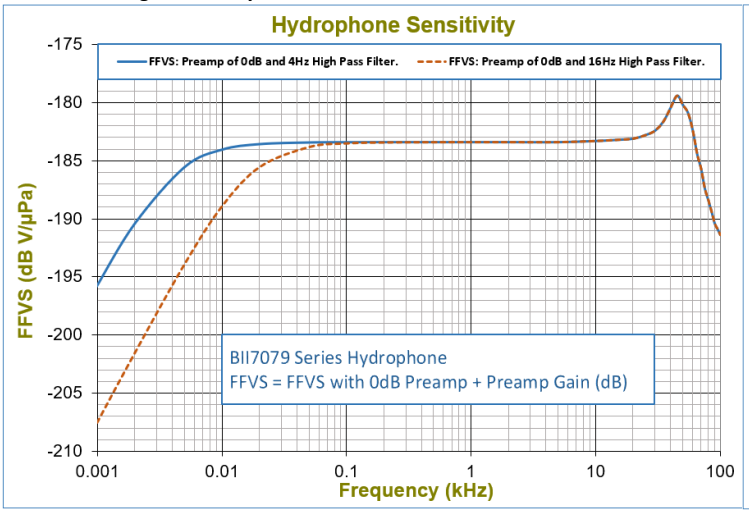


5. Free-hanging with Underwater Connector FHUWC-4P, 4 Pins (Fixed Sensitivity); FHUWC-6P, 6 Pins (Programmable Sensitivity).

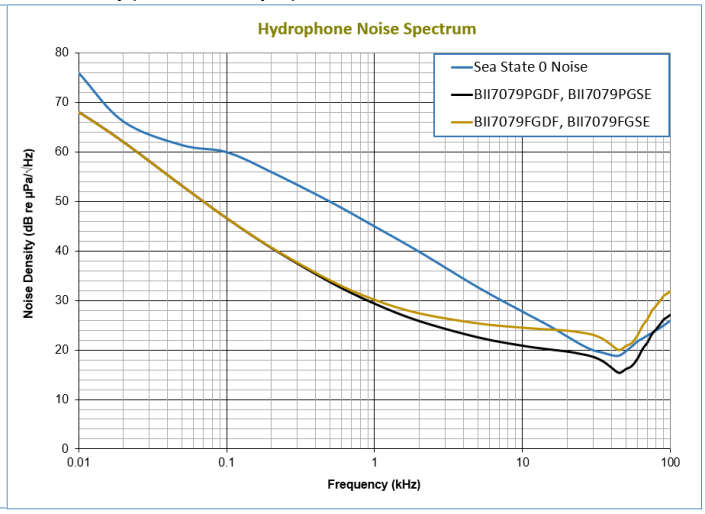


6. More Mounting/Installation Options: Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and details.

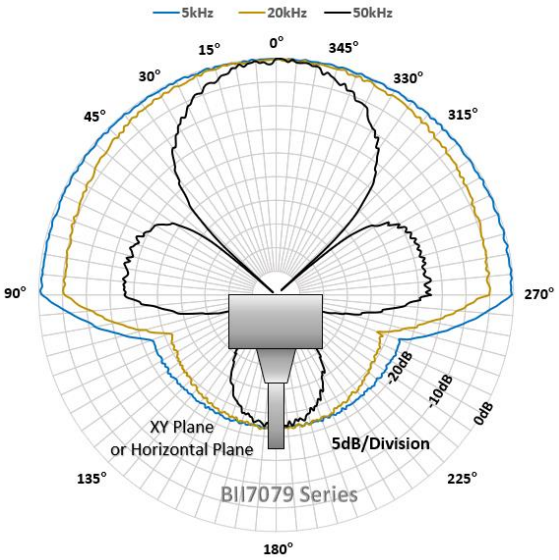
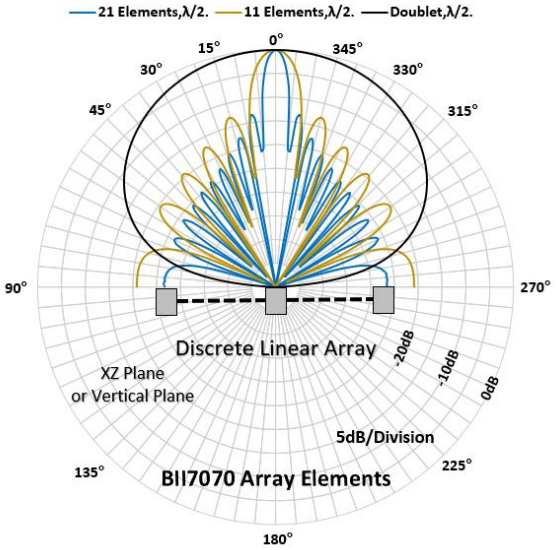
Free-field Voltage Sensitivity:



Noise Density (Referred to Input):



Directivity Pattern:



Linear Array with BII7070 Series Elements