BII7010 Series Broadband Hydrophone: Low Noise, Low Power, and Low Frequency

The directional response patterns are omnidirectional in low frequency range and toroidal in high frequency range. Typical quality factor Q are 2 in useful frequency range. Pulsed sounds reach stable state quickly and its ringing is short. Custom-fit hydrophones with low power preamplifiers consume 40μA to 0.6mA which is a great merit for battery-powered portable acoustic system.

These hydrophones provide low-cost solutions for underwater recording, listening, and laboratory acoustics from 0.02Hz to 500kHz. They come with coax/shielded cables and underwater mateable/BNC/TRS/XLR/MIL-5015 style connectors and are ready to be integrated into underwater acoustic systems. They support digital recorders and DAQs (A/D Converter). the output signal can be used for speaker system and headphone.

Small size and broadband of bespoke BII7015 offers benefit for uses in parabolic receivers underwater to achieve high pressure gain and the narrowest beam width which are the merits in weak signal detection and searching, directional high speed communication, etc...

BII7010 Hydrophones with integrated low power preamplifiers and filters are ideal gears to amplify the weak signals underwater and reject ambient noises. Its compact and small size avoid interferences to acoustic field under test. The preamplifier integrated in the hydrophone can drive cable up to 1000m without signal loss. These features allow them to be used in long line arrays (streamers) and large planar arrays.

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. they can measure the sound radiations and pressure changes in turbulent processes and flows.

BII7016 hydrophones is specialized to measures low frequency underwater sounds and pressure fluctuations down to 0.02 Hz: Surface Waves (Wave-height Sensor), Turbulences, seismic, ocean traffics, industrial noises, precipitations, biologics, ...

Sound Excitation by Turbulence: $\frac{1}{c^2}\frac{\partial^2 p}{\partial t^2} - \Delta p = \rho \frac{\partial^2 v_i v_k}{\partial x_i \partial x_k}$ v-Velocity of Turbulence Flow; c-Sound Speed in Fluid; p-Pressure; ρ-Fluid Density; x-Position.

Typical Applications

Towed/Dipping Hydrophone, Sonobuoy.	Detection of Ultrasonic Cavitation Noise, Thermoacoustics in Gas.
LBL, SBL, USBL Positioning, Communication.	Passive Acoustic Monitoring (PAM System).
Parabolic Antennas Underwater.	Array Element, Vector Hydrophone Element.
Reference Hydrophone, Noise Measurement.	Marine Bioacoustics, Phantom-power Hydrophone, Sound Recording.
Signal detection in strong currents.	Studies of Ocean Turbulence and Flow, Marine Hydrodynamics.

Specification

The hydrophone is tested in water unless stated otherwise.					
Part Number:	BII7012FGDF	BII7012FGSE	BII7012PGDF	BII7012PGSE	BII7012PGSELP
Sensitivity @ 1 kHz:	-198 + Preamp Gain, ± 2 dB V/μPa.				
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**.**				
Usable Frequency:	**in Water**: 1 Hz ~ 90 kHz at ±3dB V/μPa.				1 kHz to 90 kHz.
	in Air: 1 Hz ~ 7.2 kHz at -3dB V/μPa.				1 kHz to 7.2 kHz.
Built-in Filters:	Bespoke High Pass Filer or Band Pass filter. Specify -3dB cut-off frequencies when ordering.				
	If buyer does NOT specify -3dB cut-off frequencies, BII will use default -3dB cut-off frequencies suitable to the hydrophone.				
	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 200 Hz, 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.				
Preamp Gain (dB):	Bespoke Fixed Gain Preamp. Default: 40 dB. Bespoke: -40 to +60 dB.		Bespoke Programmable Gain Preamp. 0/20/40/60 dB.		30, 60 dB.
	If buyer does NOT specify a preamp, BII will use a low noise preamp in the hydrophone.				
	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	Single Ended
	To reject Electromagnetic Interference (EMI) over long cable, the differential (balanced) output is recommended.				
	Differential output is NOT suitable for hydrophones whose usable frequencies are greater than 1 MHz when 50/75Ω impedance matching is necessary over long cable.				
Maximum Output V_{omax}:	Supply Voltage V_s - 4, in Vpp.				Supply Voltage V_s – 1.
Overload Pressure Level:	198 or (20*log(V_{omax}/2.828) – Sensitivity) whichever is less. in dB μPa.				
Acceleration Sensitivity:	103.8 dBμPa/(m/s²) at Acoustic Axis. ≤ 103 dBμPa/(m/s²) 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**) 3. Thru-hole Mounting with Single O-ring (**THSO**) 4. Thru-hole Mounting with Double O-ring (**THDO**) 5. Bolt Fastening Mounting (Plastics) (**BFMP**) 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:	Two or Four Conductor Shielded Cable (SC)		Six Conductor Shielded Cable (SC)		

Cable Length:	1. Default: 10 m. 2. Custom-fit Cable Length up to 305 m.				
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 (pin) (**XLR**) (Max. Diameter Φ20.2 mm), for SE or DF. 5. MIL-5015 Style (pin) (**MIL**) (Max. Diameter Φ30 mm with 3 contacts), for SE or DF. 6. Underwater Mateable Connector (pin) (**UMC**) (Max. Diameter Φ21.5 to Φ35 mm), for SE or DF. 7. +9VDC Battery Snap (**BS**) (Exclusive to preamplified hydrophone)				
	Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.				
Supply Voltage V_s:	+7.5 to +32 VDC	+7.5 to +32 VDC	+8.2 to +32 V	+8.2 to +32 V	+4.5 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):	16 mA	13 mA	13 mA	9 mA	2.1 mA
	Preamplifier dependent.				
Size:	Free Hanging: ΦD = Φ25.4 mm, Overall Length = 67 mm. Other Mounting Types: actual length depends on Mounting Parts.				
Weight:	≥ 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 Hydrophones.

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	**-Preamp Gain, dB**	**-HPF/LPF**	**-Mounting**	**-Cable Length**	**-Connectors for Signal/Gain/DC Supply**
BII7012FGDF BII7012FGSE	Default: 40 dB.	-3dB Filter Frequencies, In Hz, kHz. Default: 0.6Hz to 200kHz	Refer to Options. Default: Free Hanging.	in meter. Default: 10m.	Refer to Options. Default: Wire Leads.
BII7012PGDF BII7012PGSE	0/20/40/60 dB.				
BII7012PGSELP	30/60 dB.	Default: 1kHz to 200kHz.			
Example of Part Number:		Description			
BII7012FGSE-26dB-0.3kHz-FH-10m-SC-BNC/BS		BII7012FGSE Hydrophone, 26dB Gain Preamplifier, 0.3kHz High Pass Filter, Free Hanging, 10m Shielded Cable, Connector: Male BNC for Signals, Battery Snap for +9VDC Batteries.			
BII7012FGDF-26dB-0.3kHz-FH-10m-SC-XLR		BII7012FGDF Hydrophone, 26dB Gain Preamplifier, 0.3kHz High Pass Filter, Free Hanging, 10m Shielded Cable, Connector: 4-pin XLR for Signals and DC Supply.			
BII7012FGDF-26dB-0.3kHz-FH-3m-SC-UMC		BII7012FGDF Hydrophone, 26dB Gain Preamplifier, 0.3kHz High Pass Filter, Free Hanging, 3m Shielded Cable, Connector: 4-pin Underwater Mateable Connector for Signals and DC Supply.			
BII7012PGDF-0/20/40/60dB-10Hz/100kHz-FH-100m-SC-XLR/WL/BS		BII7012PGDF Hydrophone, 0/20/40/60dB Programmable Preamplifier, 10Hz to 100kHz Band Pass Filter, Free Hanging, 100m Shielded Cable, Connector: 3-pin XLR Plug for Signals, Wire leads for Gain Selection, Battery Snap for +9VDC Batteries.			
BII7012PGDF-0/20/40/60dB-10Hz/100kHz-FH-100m-SC-XLR		BII7012PGDF Hydrophone, 0/20/40/60dB Programmable Preamplifier, 10Hz to 100kHz Band Pass Filter, Free Hanging, 100m Shielded Cable, Connector: 6-pin XLR Plug for Signals, Gain Selections, and DC Supplies.			

Question:

What if the mating connector of my DAQ module or recording device is NOT available from BII?

1. Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
2. A connector adaptor might be assembled by BII by customization, and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations.
3. 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.

Wiring Information of Hydrophones with Fixed-gain Preamps:

Single Ended Output:	**Wire Leads**	**BNC Male/SMA/SMC, 9V Battery Snap**	**Underwater or XLR Connector**	**XLR Plug 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**	**Underwater or XLR Connector**		**XLR + 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 Two-bit Programmable Gain Preamps:

Single Ended Output:	**Wire Leads**	**9V Battery Snap and BNC Male/SMA/SMC**	**Underwater or XLR Connector**	**XLR Plug + 9V Battery Snap**	**TRS Plug + 9V Battery Snap**
+VDC	Red	Battery Female Snap	Pin 3	Battery Female Snap	Battery Female Snap
Common	Black	Battery Male Snap	Pin 1	Battery Male Snap	Battery Male Snap

Digital Common		Black		Black	Black
Digital A1 (Gain Selection)	Yellow or Brown	Yellow or Brown	Pin 5	Yellow or Brown	Yellow or Brown
Digital A0 (Gain Selection)	Blue	Blue	Pin 6	Blue	Blue
Output Signal	White	BNC/SMA/SMC Center	Pin 2	XLR Pin 2	TRS Tip
Output Signal Common	Green	BNC/SMA/SMC Shield	Pin 4	XLR Pin 1 and Pin 3	TRS Ring and Sleeve
Shielding	Shield	Shield	N/A	XLR Metal Shell	N/A

Differential Output:	**Wire Leads**	**Underwater or XLR Connector**	**XLR Plug + 9V Battery Snap**	**TRS Plug + 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			Black	Black
Digital A1 (Gain Selection)	Yellow or Brown	Pin 5	Yellow or Brown	Yellow or Brown
Digital A0 (Gain 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

Selecting Sensitivity FFVS of Two-bit Digitally Programmable		
FFVS Selection Wire A1	**FFVS Selection Wire A0**	**Sensitivity at 1kHz**
0 (Logic Low)	0 (Logic Low)	-198 + 0dB V/µPa
0 (Logic Low)	1 (Logic High)	-198 + 20dB V/µPa
1 (Logic High)	0 (Logic Low)	-198 + 40dB V/µPa
1 (Logic High)	1 (Logic High)	-198 + 60dB V/µPa

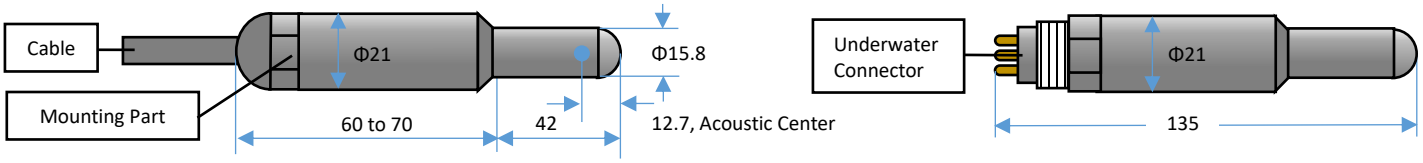
Wiring Information of Hydrophones with One-Bit-Word Programmable Gain Preamps:

Single-Ended Output:	**Wire Leads**	**Underwater/XLR Connector**	**9V Battery Snap and BNC Male/SMA/SMC**	**XLR + 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

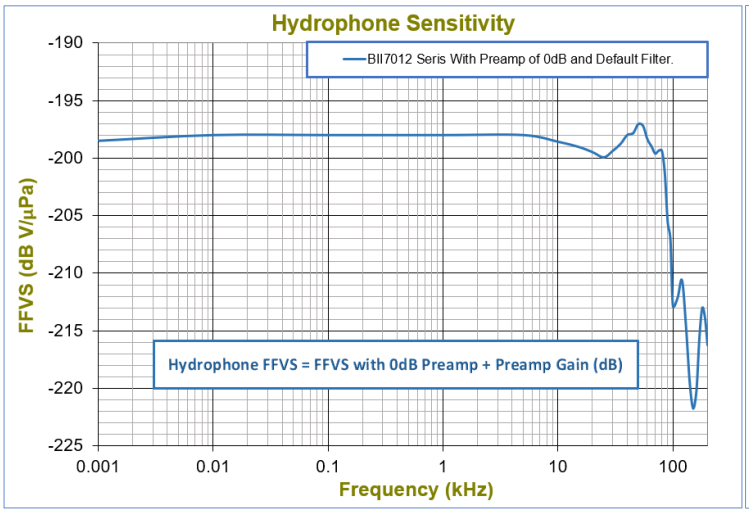
4mm Banana Plug Pair: Red Plug for +VDC, **Black Plug** for Common of the DC power supply.

Selecting Sensitivity of One-Bit-Word Digitally Programmable	
FFVS Selection Wire A0	**Sensitivity FFVS at 10kHz.**
0 (Logic Low)	-198 + 30 dB V/µPa
1 (Logic High)	-198 + 60 dB V/µPa

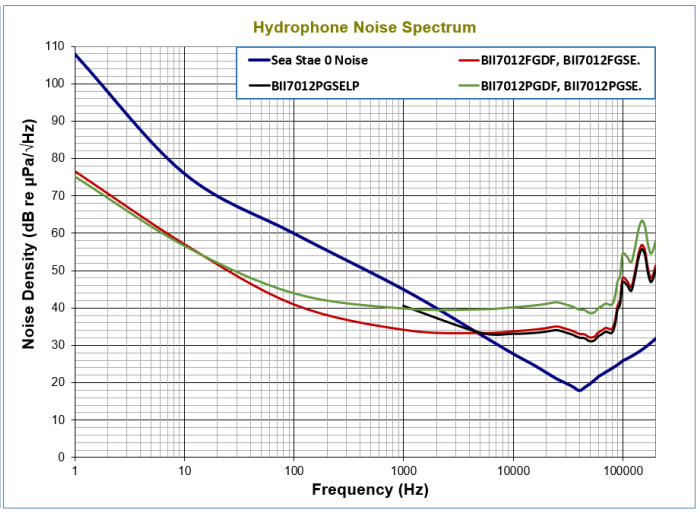
Physical Size (Dimensional Unit: mm): The overall length varies with the length of the built-in preamplifier.



Free-field Voltage Response (FFVS):



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



Directivity Response Pattern: