



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. LBL, SBL, USBL Positioning, Communication. Parabolic Antennas Underwater. Reference Hydrophone, Noise Measurement. Signal detection in strong currents.	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. Studies of Ocean Turbulence and Flow, Marine Hydrodynamics.
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Specification

The hydrophone is tested in water unless stated otherwise.					
Part Number:	BII7014FGDF	BII7014FGSE	BII7014PGDF	BII7014PGSE	BII7014PGSELP
Sensitivity @ 1 kHz:	-206.0 + 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/VHz.				
Usable Frequency:	In Water: 10 Hz ~ 260 kHz at ±3dB V/μPa.				1 ~ 250 kHz
	In Air: 10 Hz ~ 12 kHz at -3dB V/μPa.				1 ~ 12 kHz
Built-in Filters:	1. Default: -3dB Bandpass Pass Filter: 3 Hz to 260 kHz.				
	2. Bespoke High Pass or Band Pass filter. Specify when ordering. Note: a. Minimum high pass filter f _{-3dB} : 3 Hz.				
	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 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:	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.				
	Bespoke Fixed Gain Preamp .		Programmable Gain Preamp .		30, 60 dB.
	Default: 40 dB. Bespoke: 20 to 60 dB.		0/20/40/60 dB.		
	If buyer does NOT specify a preamp, BII will use a low noise preamp in the hydrophone.				
Gain Selection Voltage: (Programmable Gain Preamp)	N/A		CMOS/TTL Compatible		
			Logic Low 0: Gain Selection Wire to COM or 0 to +0.8VDC.		
Directivity Pattern:	Omnidirectional and Toroidal. Refer to Graph of Directivity Pattern .				
Side Lobe Level:	No side lobes.				
Output Type:	Differential	Single Ended	Differential	Single Ended	Single Ended
	To reject Electromagnetic Interference (EMI) over long cable, the differential (balanced) output is recommended.				
Maximum Output V _{omax} :	V _{omax} = Supply Voltage V _s - 4, in V _{pp} .				Supply Voltage V _s - 1.
Overload Pressure Level:	206 or [20*log(V _{omax} /2.828) – Sensitivity], whichever is less. in dB μPa.				
Acceleration Sensitivity:	111.0 dBμPa/(m/s ²) at Acoustic Axis. ≤ 108 dBμPa/(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) 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:	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.			up to 150 m	
Connector:	SE: Single ended Output, DF: Differential Output. 1. Default: Wire Leads (WL) 2. Male BNC (BNC) (Max. Diameter Φ 14.3 mm), for SE ONLY. 3. SMA (Plug, Male Pin) (SMA), Voltage Rating: 335 V _{RMS} Continuous. (Max. Diameter Φ 9.24 mm), for SE ONLY. 4. SMC (Plug, Female Socket) (SMC), Voltage Rating: 335 V _{RMS} Continuous. (SMC) (Max. Diameter Φ 6.4 mm), for SE ONLY. 5. 1/8" (3.5mm) TRS Plug (TRS) (Max. Diameter Φ 10.5 mm), for SE or DF. 6. XLR Plug (pin) (XLR) (Max. Diameter Φ 20.2 mm), for SE or DF. 7. MIL-5015 Style (pin) (MIL) (Max. Diameter Φ 30 mm with 3 contacts), for SE or DF. 8. Underwater Mateable Connector (pin) (UMC) (Max. Diameter Φ 21.5 to Φ 35 mm), for SE or DF. 9. +9VDC Battery Snap (BS), for +9VDC or +18VDC power supply. 10. 4mm Banana Plug Pair (Red and Black Color) (BP), for DC power supply ONLY.				
	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
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):	16 mA	13 mA	13 mA	9 mA	2.1 mA
Size:	Φ D = Φ 21 mm, Length \geq 90 mm and 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. Receiving sensitivity in air is same to the one in water in low frequency range.					

How to Order Hydrophones. The default options are for stock items which are regularly available.

FG: Fixed Gain; PG: Programmable Gain; DF: Differential Output; SE: Single Ended Output. LP: Low Power; HPF: High Pass Filter; LPF: Low Pass Filter.					
Part Number	-Preamp Gain	-HPF/LPF	-Mounting	-Cable Length	-Connectors for Signal/Gain/DC Supply
BII7014FGDF BII7014FGSE	Default: 40 dB. Bespoke: 20 to 60 dB.	-3dB Filter Frequencies, in Hz, kHz. Default: 3Hz to 260kHz.	Refer to Options. Default: Free Hanging.	in meter. Default: 10m.	Refer to Options. Default: Wire Leads.
BII7014PGDF BII7014PGSE	0/20/40/60 dB.				
BII7014PGSELP	30/60 dB.				
Example of Part Number:		Description			
BII7014FGSE-40dB-Default-FH-10m-BNC/BS		BII7014FGSE Hydrophone, 40dB Gain Preamplifier, Default Filters, Free Hanging, 10m Shielded Cable, Connector: Male BNC for Signals, Battery Snap for +9VDC Batteries.			
BII7014FGDF-40dB-20Hz-FH-10m-XLR		BII7014FGDF Hydrophone, 40dB Gain Preamplifier, 20Hz High Pass Filter, Free Hanging, 10m Shielded Cable, Connector: 4-pin XLR for Signals and DC Supply.			
BII7014FGDF-40dB-100Hz-FH-3m-UMC		BII7014FGDF Hydrophone, 40dB Gain Preamplifier, 100Hz High Pass Filter, Free Hanging, 3m Shielded Cable, Connector: 4-pin Underwater Mateable Connector for Signals and DC Supply.			
BII7014PGDF-0/20/40/60dB-10Hz/200kHz-FH-100m-XLR/WL/BS		BII7014PGDF Hydrophone, 0/20/40/60dB Programmable Preamplifier, 10Hz to 200kHz 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.			
BII7014PGDF-0/20/40/60dB-10Hz/200kHz-FH-100m-XLR		BII7014PGDF Hydrophone, 0/20/40/60dB Programmable Preamplifier, 10Hz to 200kHz Band Pass Filter, Free Hanging, 100m Shielded Cable, Connector: 6-pin XLR Plug 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	Underwater/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/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
4mm Banana Plug Pair: Red Plug for +VDC, Black Plug for Common of the DC power supply.					

Wiring Information of Hydrophones with Two-bit Programmable Gain Preamps:

Single Ended Output:	Wire Leads	9V Battery Snap and BNC Male/SMA/SMC	Underwater/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/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	
4mm Banana Plug Pair: Red Plug for +VDC, Black Plug for Common of the DC power supply.					
Selecting Sensitivity FFVS of Two-bit Digitally Programmable					
FFVS Selection Wire A1	FFVS Selection Wire A0	Hydrophone Sensitivity at 1kHz			
0 (Logic Low)	0 (Logic Low)	-206.0+ 0dB V/μPa			
0 (Logic Low)	1 (Logic High)	-206.0+ 20dB V/μPa			
1 (Logic High)	0 (Logic Low)	-206.0+ 40dB V/μPa			
1 (Logic High)	1 (Logic High)	-206.0+ 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)	-206.0 + 30 dB V/μPa				
1 (Logic High)	-206.0 + 60 dB V/μPa				

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.

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 do I use Gain Selection wires in field?

1. Manual Gain Selection.

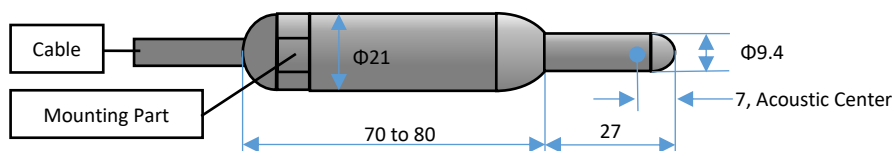
When a **Gain Selection wire** is floating or open, its digital logic is High or “1”.

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.

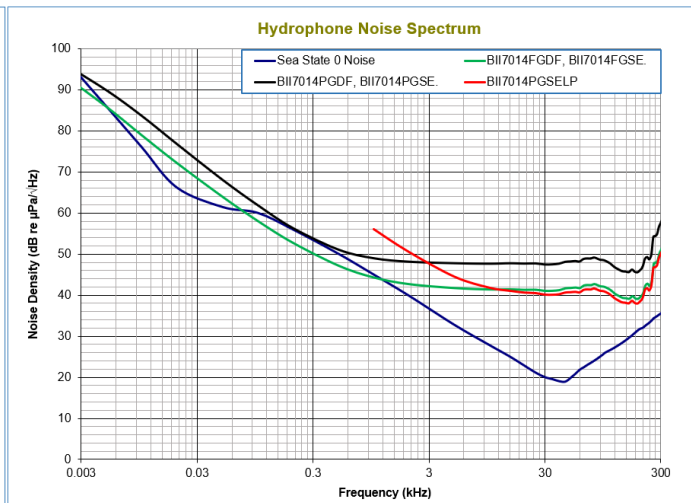
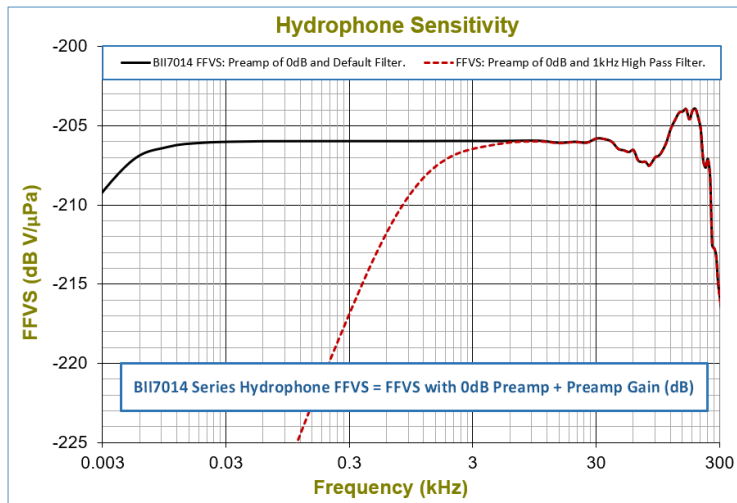
2. Gain Selection with Digital Outputs. Digital Outputs of a DAQ (data acquisition device) select gains with TTL/CMOS logic levels.

Physical Size (Dimensional Unit: mm):



Free-field Voltage Sensitivity (FFVS):

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



Directivity Response Pattern:

