

#### 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 <u>low power preamplifiers</u> 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...

BIJ7010 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 <u>preamplifier</u> 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.

BIJ7016 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;  $\rho$ -Fluid Density; x-Position.

#### **Typical Applications**

Towed/Dipping Hydrophone, Sonobuoy.	Detection of Ultrasonic Cavitation Noise, Thermoacoustics in Gas.
LBL, SBL, USBL Positioning.	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:	BII7015FGDF	BII7015FGSE	BII7015PGDF	BII7015PGSE		
Sensitivity at 1kHz:	-210 + Preamp Gain $\pm$ 2 dB V/µPa.					
(dB V/μPa)	-170	-170	-210, -190, -170, -150	-180, -140.		
FFVS:	Refer to Graph of FFVS vs. Fre	quency. Free-field Voltage Sens	itivity.	-		
Pressure Noise Density:	Refer to Graph of Pressure Noise Density, Referred to Input (RTI), in µPa/VHz.					
	In Water: 1 Hz $\sim$ 400 kHz at ±	3dB V/μPa.				
Usable Frequency.	In Air: 1 Hz $\sim$ 15 kHz at -3dB \	//μPa.				
	Bespoke Fixed Gain Preamp. Programmable Gain Preamp.					
	40 dB.	40 dB.	0/20/40/60 dB.	30/70 dB.		
Preamp Gain (dB):	If buyer does NOT specify a pr	reamp, BII will use a low noise p	reamp in the hydrophone.			
	Note: If Digital Outputs or swi	itches are used to select gains, \	<b>/oltage Protection Rating or Abs</b>	olute Maximum Voltage Ratings		
	of these devices must be grea	ter than V <sub>s</sub> Supply Voltage.				
Gain Selection Voltage:			CMOS/TTL Compatible			
(Programmable Gain Preamn)	N/A		Logic Low 0: Gain Selection W	ire to COM or 0 to +0.8VDC.		
(Fregrammable Gammedip)			Logic High 1: Gain Selection W	'ire Open or +2.4 to Vs.		
	Bespoke High Pass Filer or Bar	nd Pass filter. Specify -3dB cut-o	ff frequencies when ordering.			
	If buyer does NOT specify -3d	B cut-off frequencies, BII will us	e default -3dB cut-off frequencie	es suitable to the hydrophone.		
Built-in Filters:	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.					
Directivity Pattern:	Omnidirectional and Toroidal.	Refer to Graph of <u>Beam Pattern</u>	<u>n</u> .			
Output Type:	Differential Output ( <b>DF</b> )	Single Ended Output (SE)	Differential Output ( <b>DF</b> )	Single Ended Output (SE)		
	To reject Electromagnetic Interference (EMI) over long cable, the differential (balanced) output is recommended.					
Maximum Output V <sub>omax</sub> :	V <sub>omax</sub> = (Supply Voltage V <sub>s</sub> - 4), in Vpp.					
Overload Pressure Level:	210 or (20*log(Vomax/2.828) – Sensitivity) which ever is less, in dB μPa.					
Acceleration Sensitivity:	115.1 dBµPa/(m/s <sup>2</sup> ) 115.1 dBµPa/(m/s <sup>2</sup> ) at Acoustic Axis. ≤ 113.0 dBµPa/(m/s <sup>2</sup> ) at other directions.					
Maximum 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:	2. Free-hanging with Male Underwater Connector (FHUWC).					
	3. Ihru-hole Inch Mounting with Single O-ring Sealing (THISO, 7/16"-20x22 UNF-ZA).					
	4. Ihru-hole Inch Mounting with Double O-ring Sealing (THIDO, 7/16"-20x25 UNF-2A).					
	5. Bolt Fastening Mounting (Plastics) ( <b>BFMP</b> , M12x1.5).					
	b. Boit Fastening Wounting (Fiastics) (BFMP, NP13/8").					
	7. Bort Fastening Wounting (stainless Steel) (BHMSS, 5/8"-18x22 UNF).					
Please refer to online document <u>AcousticSystem.pdf</u> for a complete list of Mounting Options and				and more details.		
	Four Conductor Shielded Cable (SC) Six Conductor Shielded Cable (SC)					
Cable Length:	1. Default: 10 m. 2. Custom-fi	t Cable Length up to 305 m.				



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88-88-18108-08					
	SE: Single ended Output, DF: Differential Output.				
Connector:	1. Default: Wire Leads (WL)				
	2. Male BNC (BNC) (Max. Diameter Φ14.3 mm), for SE ONLY.				
	3. SMA (Plug, Male Pin) (SMA), Voltage Rating: 335 V <sub>RMs</sub> Continuous. (Max. Diameter Φ9.24 mm), for SE ONLY.				
	4. SMC (Plug, Female Socket) (SMC), Voltage Rating: 335 V <sub>RMS</sub> Continuous. (SMC) (Max. Diameter Φ6.4 mm), for SE ONLY.				
	5. 1/8" (3.5mm) TRS Plug ( <b>TRS</b> ) (Max. Diameter Ф10.5 mm), for SE or DF.				
	6. XLR Receptacle with 3 Male Pins ( <b>XLR3</b> ), (Max. Diameter Φ20.2 mm), for SE or DF.				
	XLR Receptacle with 4 Male Pins ( <b>XLR4</b> ), (Max. Diameter $\Phi$ 20.2 mm), for SE or DF.				
	XLR Receptacle with 6 Male Pins ( <b>XLR6</b> ), (Max. Diameter Φ20.2 mm), for SE or DF.				
	7. MIL-5015 Style (pin) ( <b>MIL</b> ) (Max. Diameter Φ30 mm with 3 contacts), for SE or DF.				
	8. Underwater Mateable Connector (pin) ( <b>UMC</b> ) (Max. Diameter $\Phi$ 21.5 to $\Phi$ 35 mm), for SE or DF.				
	9. +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 Vs:	+4.5 to +32 VDC, Preamplifier dependent.				
	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included.				
Suggested DC Supply:	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):	0.4 to 22 mA, Preamplifier dependent				
Size:	$\Phi D = \Phi 21 \text{ mm}$ , Length $\geq 90 \text{ mm}$ and actual length depends on Mounting Parts.				
Weight:	$\ge$ 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 h	ydrophones can be used to detect sounds in air. Receiving sensitivity in air is same to the one in water in low frequency range.				
Wiring Information of Hydrophon	nes with Fixed-gain Preamps:				

#### Wiring Information of Hydrophones with Fixed-gain Preamps:

Wiring of Single Ended Output:	Wire Leads	BNC Male/SMA/SMC,	Underwater or	XLR3 Plug and	TRS Plug and
winning of Single Ended Output.		9V Battery Snap	XLR4 Connector	9V Battery Snap	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
Wiring of Differential Output:	Wire Leads	Underwater or XLR6 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:

Wiring of Single Ended Output:	Wire Leads	9V Battery Snap and	Underwater or XLR6 Connector		XLR3 Plug + 9V	TRS Plug + 9V Battery Snap
5 · · · 5 · · · · · · · · · ·		BNC Male/SMA/SMC			Battery Snap	,.,.,
+VDC	Red	Battery Female Snap	Pin 3		Battery Female Snap	Battery Female Snap
Common	Plack	Battery Male Snap	Din 1		Battery Male Snap	Battery Male Snap
Digital Common	DIACK	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
Wiring of Differential Output:	Wire Leads	Underwater or XLR6 Connector XLF		XLR Plug	+ 9V Battery Snap	TRS Plug + 9V Battery Snap
+VDC	Red	Pin 3 Batte		Battery F	emale Snap	Battery Female Snap
Common	Plack	Die 1		Battery Male Snap, XLR Pin 1.		Battery Male Snap, TRS Sleeve.
Digital Common	DIdLK	P111 1		Black		Black
Digital A1 (Gain Selection)	Yellow or Brown	Pin 5 Yello		Yellow or	r Brown	Yellow or Brown
Digital A0 (Gain Selection)	Blue	Pin 6 E		Blue		Blue
Output Signal +	White	Pin 2 XL		XLR Pin 2	-	TRS Tip
Output Signal -	Green	Pin 4 XLR P		XLR Pin 3		TRS Ring
Shielding	Shield	N/A XLR Me		XLR Meta	al Shell	N/A
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)			-210 + 0 V/µPa		-210 + 30 V/μPa
0 (Logic Low)	1 (Logic High)			-210 + 20 V/μPa		-210 + 70 V/μPa
1 (Logic High)	0 (Logic Low)		-210 + 40 V/µPa		N/A	
1 (Logic High)	1 (Logic High)			-210 + 60 V/μPa		N/A



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# Physical Size (Dimensional Unit: mm):



## Free-field Voltage Sensitivity (FFVS):



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

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Beam Pattern:



