Benthowave Instrument Inc.
SE=SL-TL+AG-NL Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revised on 2025/04/19

BII7140 Series Acoustic Array Elements

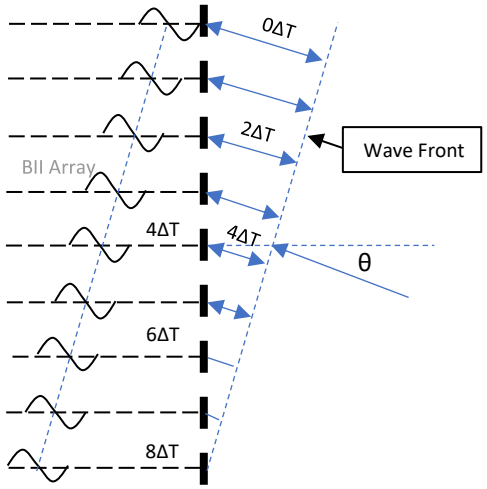
Acoustic Elements for underwater and ultrasonic (air) Arrays, Streamers, Beacons, and Positioning. These acoustic elements feature small size, low cost and easy integration, and are ready to be assembled in discrete arrays such as linear (broadside, end-fire, Mills Cross), planar and 3-D arrays to implement different acoustic applications. Depending on the operating frequency, these elements can be treated as Points, Lines or Rectangle Aperture in array signal processing. Beam steering, array focusing, bearing measurement, side-lobe suppression, and user-defined beam pattern (broad or narrow) can be achieved by complex weighting (Digital or FFT Beamforming) technique. Differential output and shielded twisted pair cable provide great EMI noise rejection over long cable. Multiple elements can be combined in series or parallel to make up an array distributing hundreds meters in field.
BII manufactures two types of array elements: Omnidirectional (Toroidal) Beam Elements for Linear Array and Planar Array Elements for Planar Array.

Typical Applications:

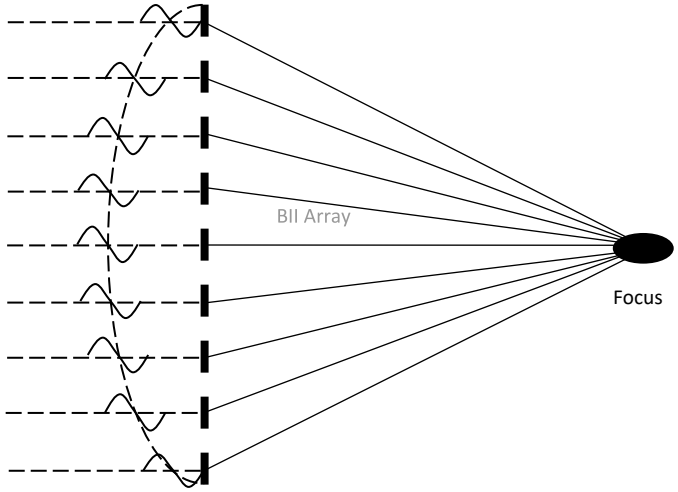
Oil-filled Streamer Element/Towed Array/Seabed Array.	Acoustic Beacons: Pingers, Tags and Remote Tracking; Acoustic Positioning.
Monitoring Seismic Sources/Airgun/Watergun/Seismology.	Array Focusing and Beam Steering, Vector Hydrophone Element.
Passive Acoustic Monitoring System (PAM System), Sonobuoy.	Marine Seismic Detector/Exploration/Borehole Seismic.

Related Products Hydrophone Preamplifier with Filters Low Noise Broadband Hydrophone as Discrete Array Elements

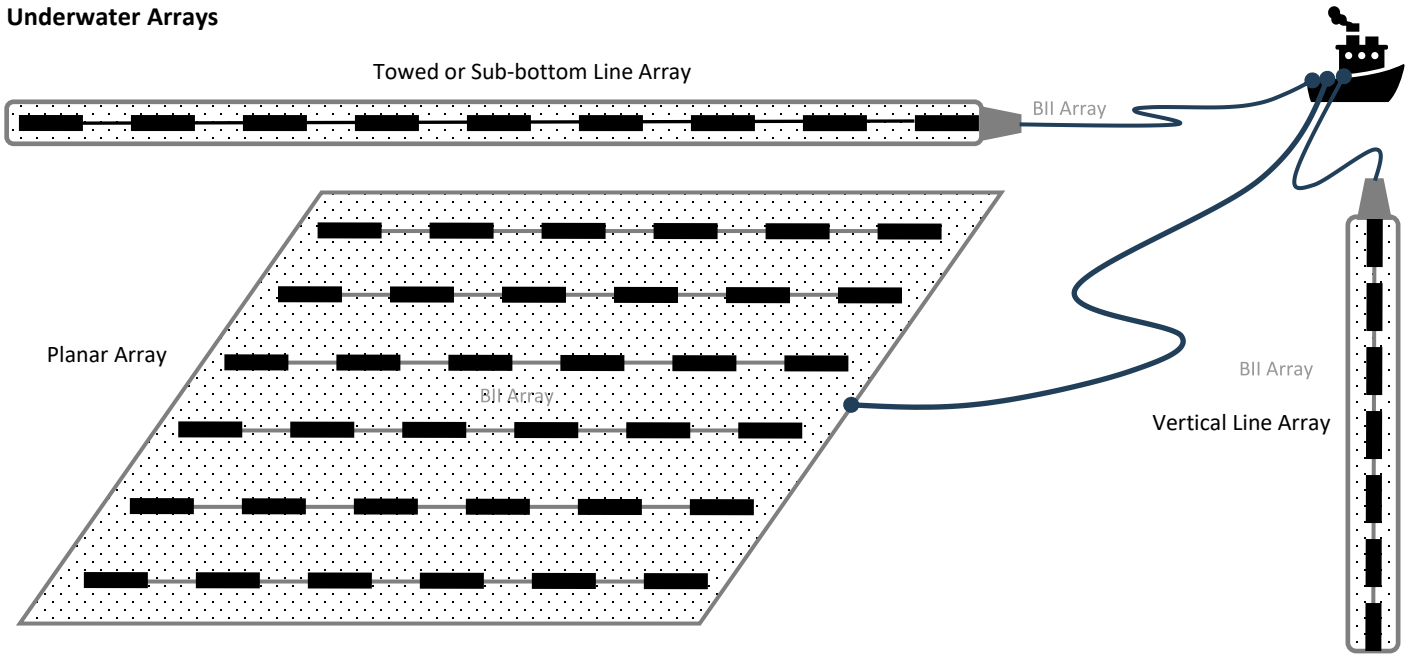
Linear (Rectangular) Array Beam Steering



Linear, Annular, and Planar Array Beam Focusing



Underwater Arrays



Specifications of Omnidirectional (Toroidal) Beam Directivity Elements

Customization: Acoustic Elements with larger aperture are available: Sensitivity FFVS up to -186 dB V/µPa, Low Frequency to 0.1 Hz.								
Acoustic Array Element	**BII7141**	**BII7142**	**BII7143**	**BII7144**	**BII7145**	**BII7146**	**BII7147**	**BII7148**
Aperture Size (ΦDxL, mm):	Φ9.5x8	Φ9.5x8	Φ9.5x8	Φ9.5x8	Φ9.5x8	Φ7.5x7	Φ6x5	Φ4x4
Sensitivity@1kHz: (dBV/µPa)	-202±2	-201±2	-207±2	-205±2	-185±2	-185±2	-205.5±1.5	-210±2
	Sensitivity Loss over Extension Cable (dB) = 20*log[C_h/(C_h+C_c)]. C_h: Hydrophone Capacitance; C_c: Capacitance of Extension Cable. Shielded cable is of 100pF/meter roughly.							
	For example, sensitivity of a BII7143 with 100m cable ≈ -207.0 + 20*log (13.4nF/(13.4nF+10nF) = -211.84 dBV/µPa.							
Sensitivity Matching: (at 1kHz)	Tolerance: a. ±2.0 (Default); b. ±1.0; c. ±0.5; d. ±0.3; e. ±0.1; in dB V/µPa. 1. Sensitivity is tested at 1 kHz. 2. Hydrophones whose sensitivity variations are out of specified tolerance are rejected.							
Usable Frequency (±3dB V/µPa)	**In Water:**	0.1Hz~120kHz			1Hz~140kHz	1Hz~180kHz	1Hz~230kHz	10Hz~350kHz
	In Air:	0.1Hz ~ 9kHz			1Hz ~ 9kHz	1Hz ~ 10kHz	1Hz ~ 12kHz	10Hz ~ 15kHz
	Minimum Usable Frequency depends on -3dB high pass filter $f_{-3dB} = 1/(2\pi R_i C_h)$. R_i: Input Resistance or Impedance of Preamp. C_h: Capacitance of hydrophone at 1 kHz. (1) when a BII7141 and a BII preamp of R_i = 200 MΩ are used to detect sounds, -3dB high pass frequency of detection = 0.27 Hz. (2) when a BII7143 and a BII preamp of R_i = 100 MΩ are used to detect sounds, -3dB high pass frequency of detection = 0.12 Hz.							
Built-in Preamplifier:	No. Standalone preamplifier is available by separate order to drive long cable.							
	Customized Standalone Preamp for uses in oil-filled linear array: (1) Potted, Depth Rating: 5MPa. (2) Input/Output Options: Shielded Cable or Twisted Pairs.							
Capacitance@1kHz, ±10%:	2.92nF	1.5nF	13.4nF	2.26nF	0.27nF	0.12nF	0.54nF	0.34nF
Dissipation@1kHz:	0.011	0.008	0.02	0.005	0.008	0.008	0.005	0.005
Noise Density at f << fs: dB µPa/√Hz	33.1–10logf	31.0–10logf	33.0–10logf	35.3–10logf	24.0–10logf	27.6–10logf	31.0–10logf	34.4–10logf
	1. f in kHz; fs: Resonance Frequency which is close to the frequency of maximum FFVS. 2. Noise densities in this datasheet are calculated values with transducer parameters being measured in water. 3. As hydrophones works with preamps or data acquisition modules, total noise density is determined by all noise sources. Generally, the total noise density is much higher than the ones stated in this datasheet.							
Output Signal Type:	Differential		Single-Ended		Single Ended		Differential	
Sensing Element:	Shielded		Shielded		Unshielded		Shielded	
Unshielded sensing elements pick up EMI noise if any in air and shallow water. Electronic filters are recommended in subsequent signal processing circuit.								
Acceleration Sensitivity: (dB µPa/(m/s²))	**Axial Plane** is XZ or Vertical Plan. **XY Plane** is Horizontal Plane which is perpendicular to acoustic axis.							
	Axial:	109.2	109.6	115.2	129.2	108.4	103.4	111.0	115.0
	XY:	≤ 80.0	≤ 80.0	≤ 113.0	≤ 127.0	≤ 110.6	≤ 106.0	≤ 80.0	≤ 80.0
	Bespoke Vibration Compensation available upon request: When suspended from a ship or boat, buoy, or used in towed array, the hydrophone experiences a large movement and induced vibration resulting from surface waves, currents, hydrodynamic flow turbulence, cable movement, etc... The translational acceleration in axial direction can be cancelled with special design and construction, and acceleration sensitivity in other directions are also lower (partially cancelled). Spurious signals caused by induced vibration can be reduced. Acceleration Sensitivity with Compensation: 1. ≤ 60 to 90 dB in axial direction or XZ Plane. 2. ≤ 60 to 90 dB in XY Pane.							
Underwater Projector:	No			Yes. Do NOT drive projectors in air.			No	
Resonance fs: (±5%)	N/A			120kHz	100kHz	130kHz	N/A	
Quality factor Qm at fs:	N/A			4.0	2.7	2.7	N/A	
Maximum Drive Voltage:	N/A			300 Vrms.			N/A	
Maximum Pulse Width:	N/A			100 mS			N/A	
Maximum Duty Cycle:	N/A			10% at Maximum Drive Voltage. 100% at 10.6 Vrms.			N/A	
TVR at fs (dB µPa/V@1m):	N/A			134.6	137.0	133.5	N/A	
Directivity Pattern:	Omnidirectional in low frequency range, Toroidal in high frequency range. Refer to graph of **Beam Pattern**.							
Electrical Insulation:	> 500 MΩ at 500 VDC.							
Shielded Cable, Twisted Pair, Pins:	1. Default: Differential or Single Ended Output: Shielded Two Conductor Cable (ΦD=2.6mm, TPU Jacket) (**SC26**) Differential or Single Ended Output: Shielded **Twisted** Two Conductor Cable (ΦD=3.6mm, PVC Jacket) (**SC36**) Single Ended Output: Coax RG174/U (ΦD=2.8mm) (**RG174**) 2. Single Ended Output: Coax RG178/U (ΦD=1.8mm) (**RG178**) 3. Differential or Single Ended Output: **Twisted Pair**, AWG26 Wires (PVC Jacket by default or Teflon Jacket upon request) (**WR**) 4. Differential or Single Ended Output: **Solder Pins** on Both Ends: Brass alloy with gold finish, Φ1x5 mm. (**SP**)							
Cable/Wire Length:	1. Default: 0.15 m. 2. Customized: up to 1 m.							
Electrical Leads:	1. Default: Wire Leads (**WL**). 2. Solder Pins (**SP**). 3. BNC Male (**BNC**).							
Mounting Options:	Free Hanging (FH)							
Maximum Depth:	150 m	350 m	150 m	900 m	900 m	950 m	500 m	700 m
	Limited by the cable length if the cable has wire leads or a non-waterproof connector.							
Housing Size (Cable & Wire):	ΦD x Length = Φ12.6 x 25 mm					Φ11x25	Φ9.5x18	Φ7.5x16
Overall Size (Solder Pins):	ΦD x Length = Φ12.6 x 30 mm					Φ12.6 x 30	N/A	N/A
Weight (in air):	9 grams					10 grams	7 grams	6 grams
	Actual weight depends on Cable Types and Length.							
Operation Temperature:	1. Shielded Cable and RG174 Coax: -10°C to +70°C or 14°F to 158°F. 2. AWG26 Wires: -10°C to +105°C or 14°F to 221°F. 3. RG178 Coax and Solder Pins: -10°C to +120°C or 14°F to 248°F.							
Storage Temperature:	-20°C to +60°C or -4°F to 140°F.							
Customization:	Please contact BII to customize BII7140 series for your specific acoustic projects.							
WARNING for Projector Applications: DANGER — HIGH VOLTAGE on wires. Wires shall be insulated for safety. DO NOT TOUCH THE WIRES BEFORE THE DRIVING SIGNAL IS SHUT DOWN. Cable shield must be grounded firmly for safety.								

For 50Ω BNC Male connector, it is buyer's sole responsibility to make sure that the (female) BNC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC is not intended for hand-held use at voltages above 30Vac/60Vdc.

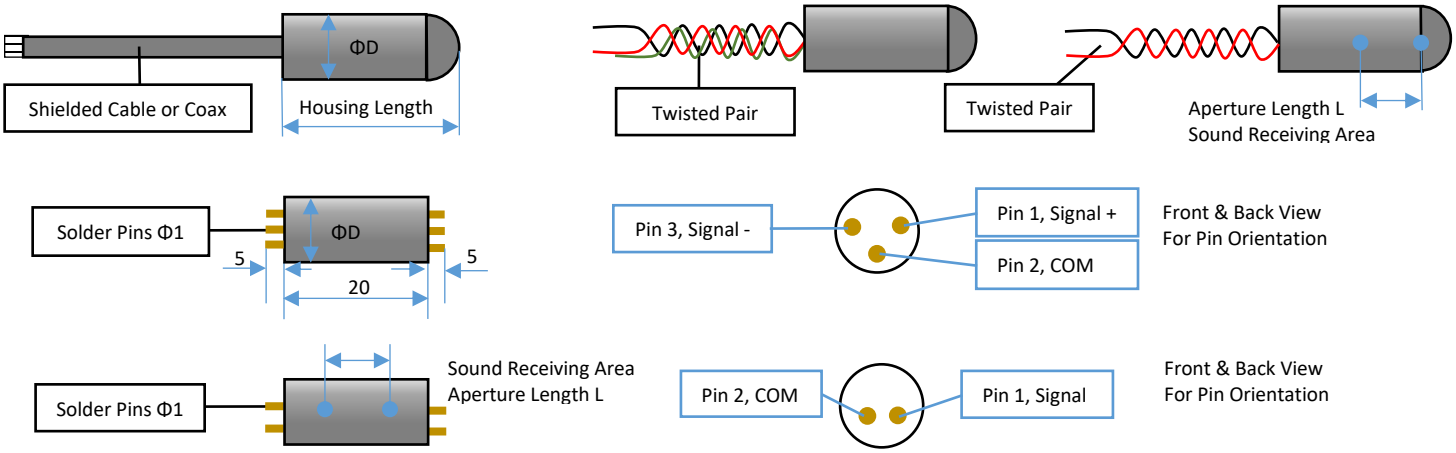
Sound Measurement in Air: The hydrophones can be used to detect sounds in air. Receiving sensitivity in air is same to the one in water in low frequency range.

How to Order and Hydrophone Wirings

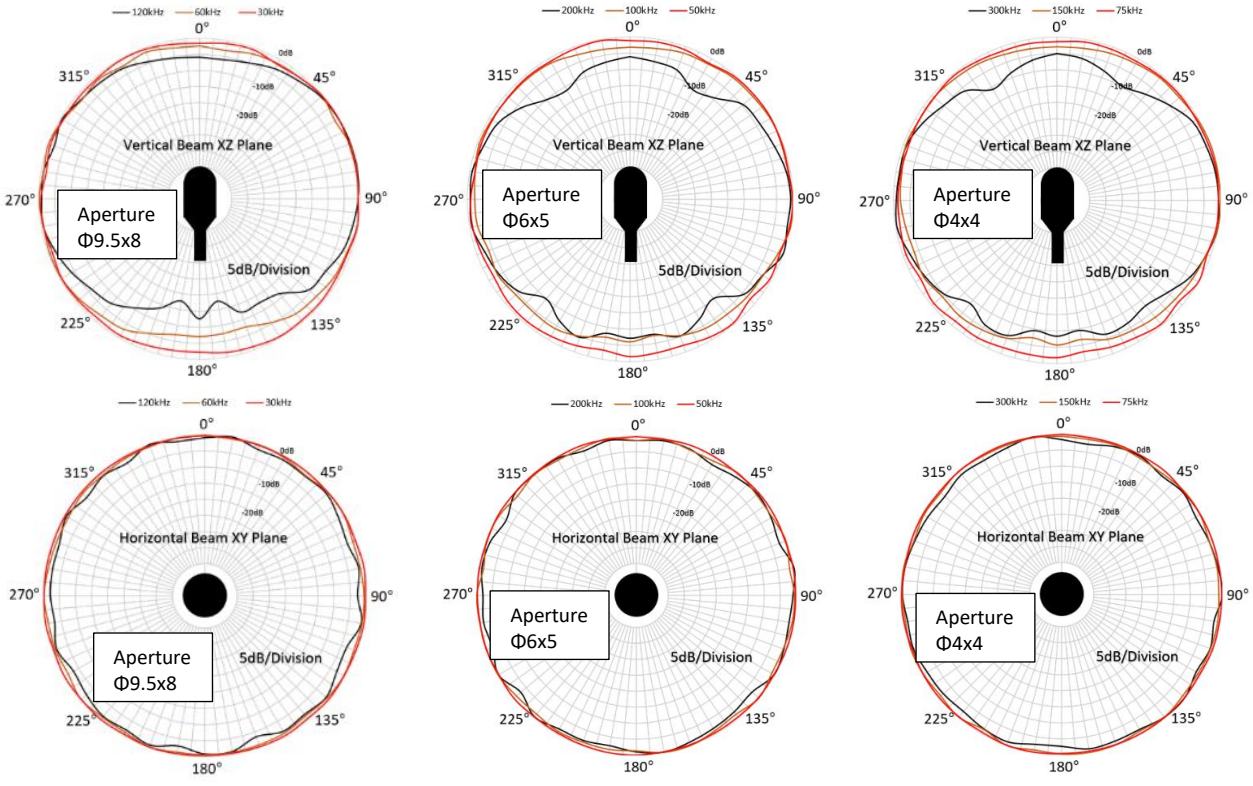
BII714x	**-Cable Length in m**	**-Cable**	**-Connector**	**-Sensitivity Matching Tolerance**
Example of Part Number:	Description			
BII7141-0.15m-SC36-WL-2dB	BII7141 Hydrophone, 0.15m Shielded Twisted Cable (ΦD=3.6mm), Wire Leads. Sensitivity Matching Tolerance: ±2.0 dB.			
BII7141-1m-AWG26-WL-1dB	BII7141 Hydrophone, 1m AWG26 Wires (Three 1m wires), Wire Leads. Sensitivity Matching Tolerance: ±1.0 dB.			
BII7143-50m-RG174-BNC-1dB	BII7143 Hydrophone, 50m RG174 Coax with BNC male. Sensitivity Matching Tolerance: ±1.0 dB.			

Wiring of Differential:	**Two Conductor Shielded Cable**	**Twisted Pair**	**Solder Pins**	
Signal +	White or Red	White	Pin 1	
Signal -	Black	Black	Pin 3	
Common & Shielding	Cable Shield	Green	Pin 2	
Wiring of Single Ended:	**Two Conductor Shielded Cable**	**Twisted Pair**	**Coax with Wire Leads**	**Solder Pins**
Signal	White or Red	White	Center Contact	Pin 1
Signal Common	Black	Black	Cable Shield	Pin 2
Shielding	Cable Shield	N/A	Coax Shield	N/A

Physical Size (Dimensional Unit: mm):



Directivity Pattern



Specifications of Planar Array Elements (Conical Beam)

Acoustic Planar Array Element	**BII7149**	**BII7070 Series Planar Array Element**
Typical Applications:	Linear and Planar Array.	
Aperture Size:	Length x Width = 6.5 x 6.5 mm, Square Planar Aperture.	
Sensitivity @ 1kHz:	-205.5 + Sensitivity Loss over the cable, dB V/µPa. Variation: ± 2 dB.	
	Sensitivity Loss over Extension Cable (dB) = 20*log[C_h/(C_h+C_c)]. C_h: Hydrophone Capacitance; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.	
	For example, sensitivity of a BII7149 with 1m cable ≈ -205.5 + 20*log (0.286nF/(0.286nF+0.1nF) = -208.1 dBV/µPa.	
Sensitivity Matching:	Tolerance: a. ±2.0 (Default); b. ±1.0; c. ±0.5; d. ±0.3; e. ±0.1; in dB V/µPa. 1. Sensitivity is tested at 1 kHz. 2. Hydrophones whose sensitivity variations are out of specified tolerance are rejected.	
Built-in Preamplifier:	No. Standalone preamplifier is available by separate order to drive long cable.	
	Customized Standalone Preamp for uses in oil-filled linear array: (1) Potted, Depth Rating: 5 MPa. (2) Input/Output Options: Shielded Cable or Twisted Pairs.	
Usable Frequency:	**in Water**: 10 Hz ~ 550 kHz at ±3dB V/µPa.	
	in Air: 10 Hz ~ 16 kHz, in -3dB V/µPa.	
	Usable frequency of an array is limited by geometry tolerance of installation comparing to sound wavelength.	
	Minimum Usable Frequency depends on -3dB high pass filter f_{-3dB} = 1/(2π$R_i$$C_h$). R_i: Input Resistance or Impedance of Preamp. C_h: Capacitance of hydrophone at 1 kHz. When a BII7149 and a BII preamp of R_i = 100 MΩ are used to detect sounds, -3dB high pass frequency of detection = 5.62 Hz.	
Capacitance C_h @ 1kHz:	0.286 nF ±10%	
Dissipation @ 1kHz:	0.026	
Noise Density at f << fs: dB µPa/√Hz	44.6 – 10*log f	
	1. f in kHz; fs: Resonance Frequency which is close to the frequency of maximum FFVS. 2. Noise densities in this datasheet are calculated values with transducer parameters being measured in water. 3. As hydrophones works with preamps or data acquisition modules, total noise density is determined by all noise sources. Generally, the total noise density is much higher than the ones stated in this datasheet.	
Output Signal Type:	Single Ended	
Shielding of Sensing Element:	Shielded	
Acceleration Sensitivity: µPa/(m/s²).	143.6 dB along acoustic axis; Other directions: ≤ 141.0 dB.	
	Bespoke Vibration Compensation, available upon request: When suspended from a ship or boat, buoy, or used in towed array, the hydrophone experiences a large movement and induced vibration resulting from surface waves, currents, hydrodynamic flow turbulence, cable movement, etc... The translational acceleration in axial direction can be cancelled with special design and construction, and acceleration sensitivity in other directions are also lower (partially cancelled). Spurious signals caused by induced vibration can be reduced. Acceleration Sensitivity with Compensation: 1. ≤ 80 to 100 dB in axial direction of the hydrophone. 2. ≤ 90 to 110 dB in other directions of the hydrophone.	
Underwater Projector:	Yes. Do NOT use projectors in air to avoid damage.	
Resonance Frequency fs:	420 ± 5% kHz	
Quality factor Qm at fs:	3.5	
Maximum Drive Voltage:	1. Default: 300 Vrms. 2. Customized to 600 Vrms.	
Maximum Pulse Width:	100 mS	
Maximum Duty Cycle:	10% at Maximum Drive Voltage. 100% at 10.6 Vrms.	
TVR at fs (dB µPa/V@1m):	≤ 150.0	
Directivity Pattern:	Conical Beam	
-3dB Beam Width:	9900°/f(kHz)	
Electrical Insulation:	> 500 MΩ at 500 VDC.	
Mounting Options:	Free Hanging (FH)	
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.	
Housing Size:	ΦD x Length = Φ12.6 x 20 mm	
Weight (in air):	10 grams, Actual weight depends on Cable Types and Length.	
Cable:	1. Coax RG174/U (ΦD=2.8mm) (**RG174**). 2. Coax RG178/U (ΦD=1.8mm) (**RG178**). 3. **Twisted Pair**: Two AWG26 Wires (AWG26, PVC Jacket by default or Teflon Jacket upon request) (**WR**). 4. Shielded **Twisted** Two Conductor Cable (ΦD=3.6mm, PVC Jacket) (**SC36**). 5. Shielded Two Conductor Cable (ΦD=2.6mm, TPU Jacket) (**SC26**)	
Cable Length:	1. Default: 0.15 m. 2. Customized: up to 10 m.	
Connector:	1. Default: Wire Leads (**WL**) 2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm). 3. SMA (Plug, Male Pin) (**SMA**), Voltage Rating: 335 VRMS Continuous. (Max. Diameter Φ9.24 mm). 4. SMC (Plug, Female Socket) (**SMC**), Voltage Rating: 335 VRMS Continuous. (SMC) (Max. Diameter Φ6.4 mm). 5. 1/8" (3.5mm) TRS Plug (**TRS35**) (Max. Diameter Φ10.5 mm). 6. Underwater Mateable Connector (pin) (**UMC**) (Max. Diameter Φ21.5 to Φ35 mm). Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.	
Operation Temperature:	1. Shielded Cable and RG174 Coax: -10°C to +70°C or 14°F to 158°F. 2. AWG26 Wires: -10°C to +105°C or 14°F to 221°F. 3. RG178 Coax: -10°C to +120°C or 14°F to 248°F. Note: Limited by connector service temperature if any.	
Storage Temperature:	-20°C to +60°C or -4°F to 140°F.	
Customization:	Please contact BII to customize BII7140 series for your specific acoustic projects.	

Single Ended Output:	**Wire Leads**	**Underwater Connector**	**BNC/SMA/SMC**	**Coax with Wire Leads**	**TRS Unbalanced mono**

Signal	White or Red	Pin 2	Center Contact	Coax Center Contact	Tip
Signal Common	Black	Pin 1	Shield	Coax Shield	Ring & Sleeve
Shielding	Shield	Pin 3	Shield	Coax Shield	Ring & Sleeve
WARNING for Projector Applications: DANGER — HIGH VOLTAGE on wires. Wires shall be insulated for safety. DO NOT TOUCH THE WIRES BEFORE THE DRIVING SIGNAL IS SHUT DOWN. Cable shield must be grounded firmly for safety.					
For 50Ω BNC Male connector, it is buyer's sole responsibility to make sure that the (female) BNC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC is not intended for hand-held use at voltages above 30Vac/60Vdc.					
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.					

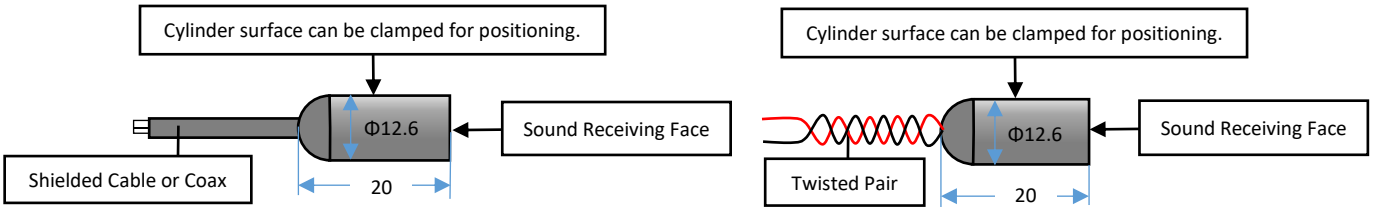
How to Order

Hydrophone	**-Cable Length**	**-Cable**	**-Connector**	**-Sensitivity Matching Tolerance**
BII7149	in meter	Refer to Options	Refer to Options	Refer to Options. in dB V/µPa, at 1kHz.
Example of Part Number:	Description			
BII7149-1m-RG174-BNC-2dB	BII7149 Hydrophone, 1m RG174/U Coax Cable, BNC Male, Sensitivity Matching Tolerance: ±2.0 dB.			
BII7149-1m-RG174-WL-1dB	BII7149 Hydrophone, 1m RG174/U Coax Cable, Wire Leads. Sensitivity Matching Tolerance: ±1.0 dB.			

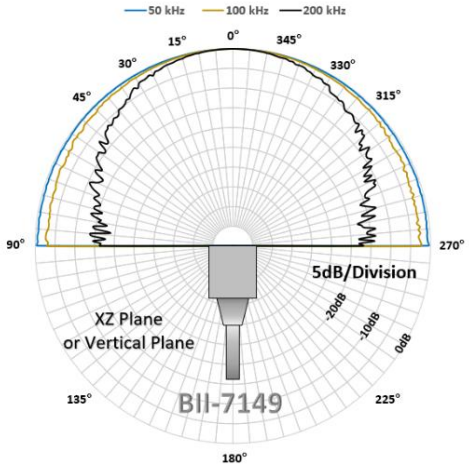
Physical Size (Dimensional Unit: mm):

The cylinder surface of the element can be used for clamps or jigs to position the element. To avoid damaging element surface:

1. The clamping force should be less than 5 N.
2. The surfaces of the clamps or jigs must be smooth and do not have any sharp and spike.

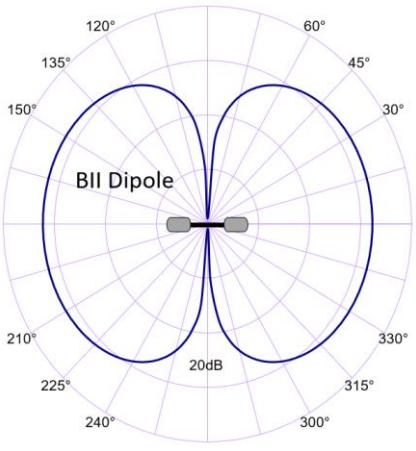


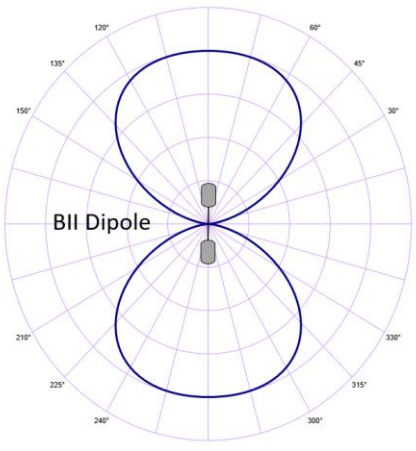
Directivity Pattern



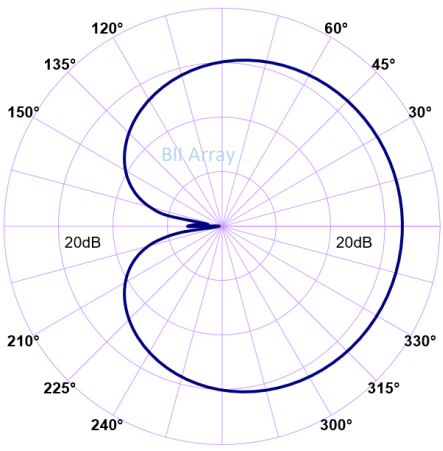
Simple Array Consisting of 2 or 3 Hydrophones.

"Figure 8" Pattern of a Dipole (Pressure-Gradient).



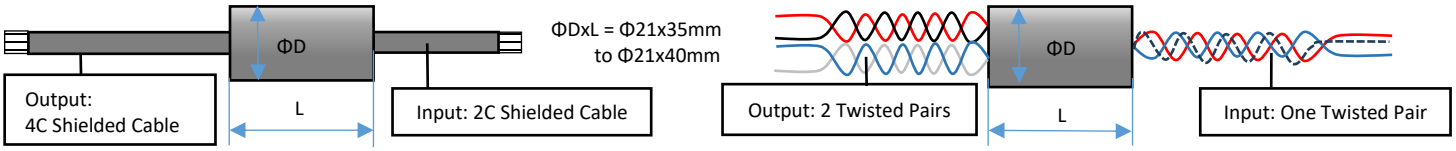


Cardioid Pattern= Omnidirectional Hydrophone + Dipole.



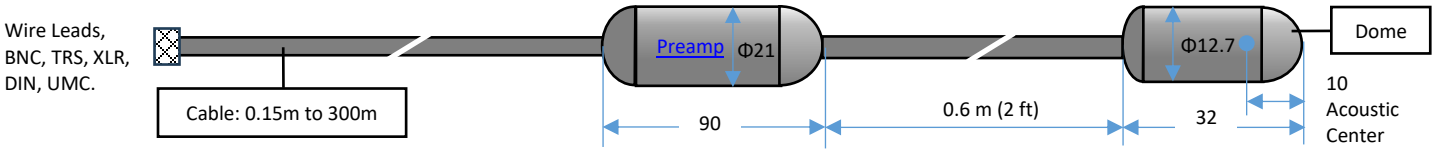
Customized Standalone Preamp for uses in oil-filled linear array, 5MPa (or 500m Water Depth) pressure rating.

Physical Size (Dimensional Unit: mm):



Differential Input	2C Shielded Cable	One Twisted Pair	Differential Output and DC Supply Cable	4C Shielded Cable	Two Twisted Pair
Input +	White or Red Wire	Red Wire	Output +	White Wire	White Wire
Input -	Black Wire	Blue Wire	Output -	Blue Wire	Blue Wire
---	---	---	DC Supply	Red Wire	Red Wire
---	---	---	DC Supply Common and Output Common	Black Wire	Black Wire
Input Common & Shielding	Cable Shield	Black Wire	Shielding	Cable Shield	N/A
Single Ended Input	**2C Shielded Cable**	**One Twisted Pair**	**Differential Output and DC Supply Cable**	**4C Shielded Cable**	**Two Twisted Pair**
Input	White Wire	Red Wire	Output	White Wire	White Wire
Input Common	Black Wire	Blue Wire	Output Common	Black Wire	Black Wire
---	---	---	DC Supply	Red Wire	Red Wire
---	---	---	DC Supply Common	Black Wire	Black Wire
Shielding	Shielded	N/A	Shielding	Cable Shield	N/A

BII7013FGDF Hydrophone as Array Element: Free Hanging with Smooth Domes for an Linear Discrete Array. Illustration Only, Size Scale is NOT 1:1.



The streamlined hemispherical domes minimize drag forces and hydrodynamic noises caused by the hydrophone in motion or the flow past the hydrophone.