



BII7140 Series Acoustic Array Elements

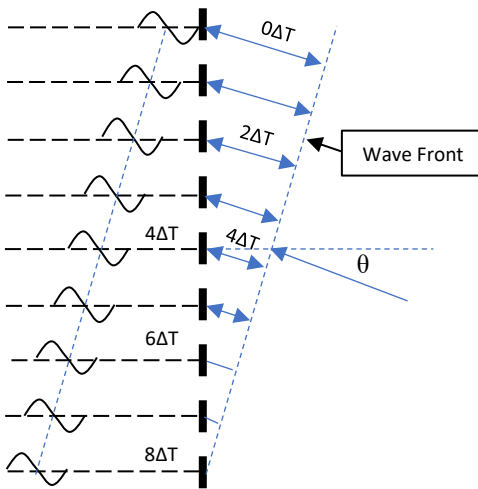
Acoustic Elements for underwater and ultrasonic (air) Arrays, Streamers, Beacons, and Positioning. These acoustic elements feature small size, low cost and easy integration, and are ready to be assembled in discrete arrays such as linear (broadside, end-fire, Mills Cross), planar and 3-D arrays to implement 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 [Omnidirectional \(Toroidal\) Beam Elements](#) and [Planar Array Elements](#) for Linear and Planar Array.

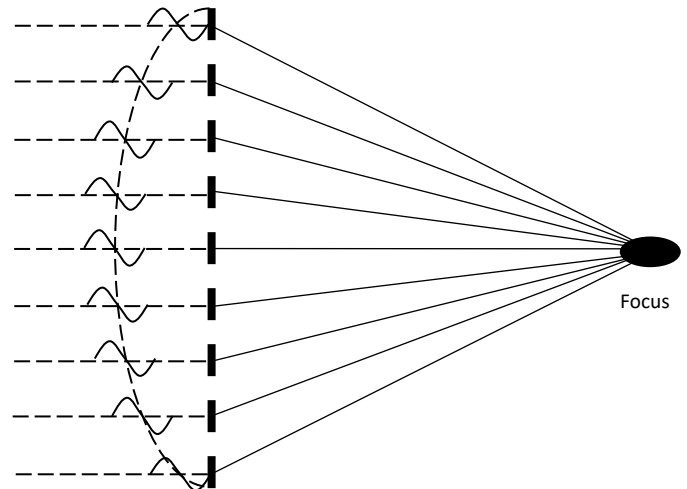
Typical Applications:

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

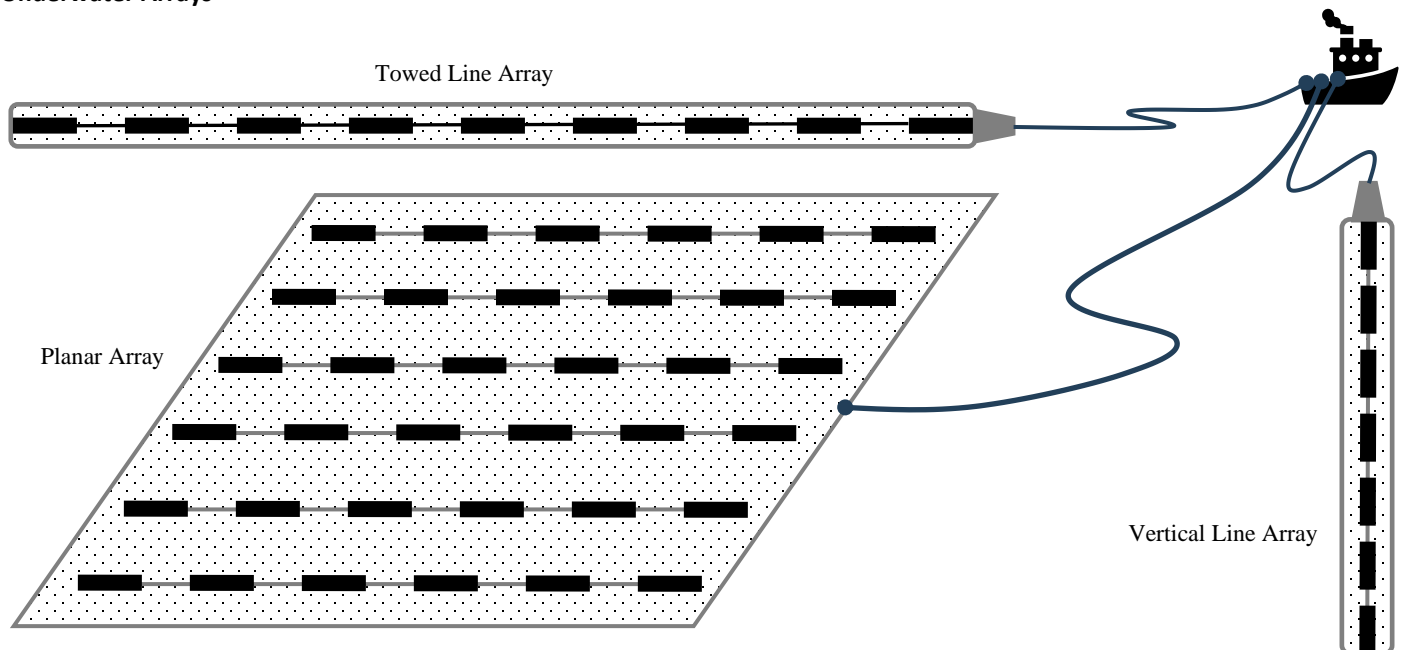
Linear (Rectangular) Array Beam Steering



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	-206±2	-210±2	
Sensitivity Matching: (at 1kHz)	Sensitivity Loss over Extension Cable (dB) = 20*log[(C_n/(C_n+C_c))]. C _n : 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.								
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 $f_{-3dB} = 1/(2\pi R_i C_n)$. R _i : Input Resistance or Impedance of Preamp. C _n : Capacitance of hydrophone at 1 kHz. when a BII7143 and a BII preamp of R _i = 200 MΩ are used to detect sounds, -3dB high pass frequency of detection = 0.06 Hz.								
Capacitance@1kHz, ±10%:	2.92nF	1.5nF	13.4nF	2.26nF	0.27nF	0.12nF	0.65nF	0.34nF	
Dissipation@1kHz:	0.011	0.008	0.02	0.005	0.008	0.008	0.005	0.005	
Noise Density at f << f _s : dB μPa/√Hz	33.1~10logf	31.0~10logf	33.0~10logf	35.3~10logf	24.0~10logf	27.6~10logf	31.4~10logf	34.4~10logf	
Output Signal Type:	Differential		Single-Ended		Single Ended		Differential		
Sensing Element:	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/s ²))	109.2	109.6	115.2	129.2	108.4	103.4	111.0	115.0	
Underwater Projector:	No			Yes. Do NOT drive projectors in air.			No		
Resonance f _s : (±5%)	N/A			120kHz	100kHz	130kHz	N/A		
Quality factor Q _m at f _s :	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 f _s (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.								
Cable/Wiring/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: Three AWG26 Wires (AWG26, 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: 0.15m. 2. Customized: up to 100m.								
Electrical Leads:	1. Default: Wire Leads (WL). 2. Solder Pins (SP). 3. BNC Male (BNC).								
Mounting Options:	Free Hanging (FH)								
Maximum Depth:	300 m	500 m	300 m	950 m					
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	
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.								
Wiring of Differential:	Two Conductor Shielded Cable			AWG26 Wires		Solder Pins			
Signal +	White or Red			White or Red		Pin 1			
Signal -	Black			Black		Pin 3			
Common & Shielding	Shield			Green		Pin 2			
Wiring of Single Ended:	Two Conductor Shielded Cable			AWG26 Wires		Coax with Wire Leads		Solder Pins	
Signal	White or Red			White or Red		Center Contact		Pin 1	
Signal Common	Black			Black		Shield		Pin 2	
Shielding	Shield			N/A		Shield		N/A	
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.									

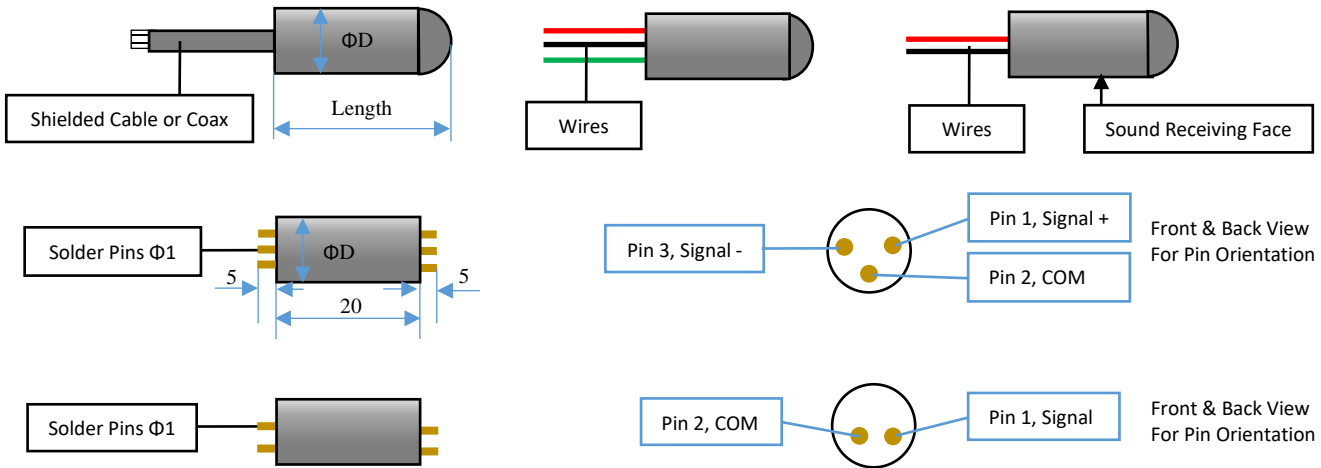
For 50Ω BNC Male connector, it is buyer's sole responsibility to make sure that the (female) BNC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC is not intended for hand-held use at voltages above 30Vac/60Vdc.

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.

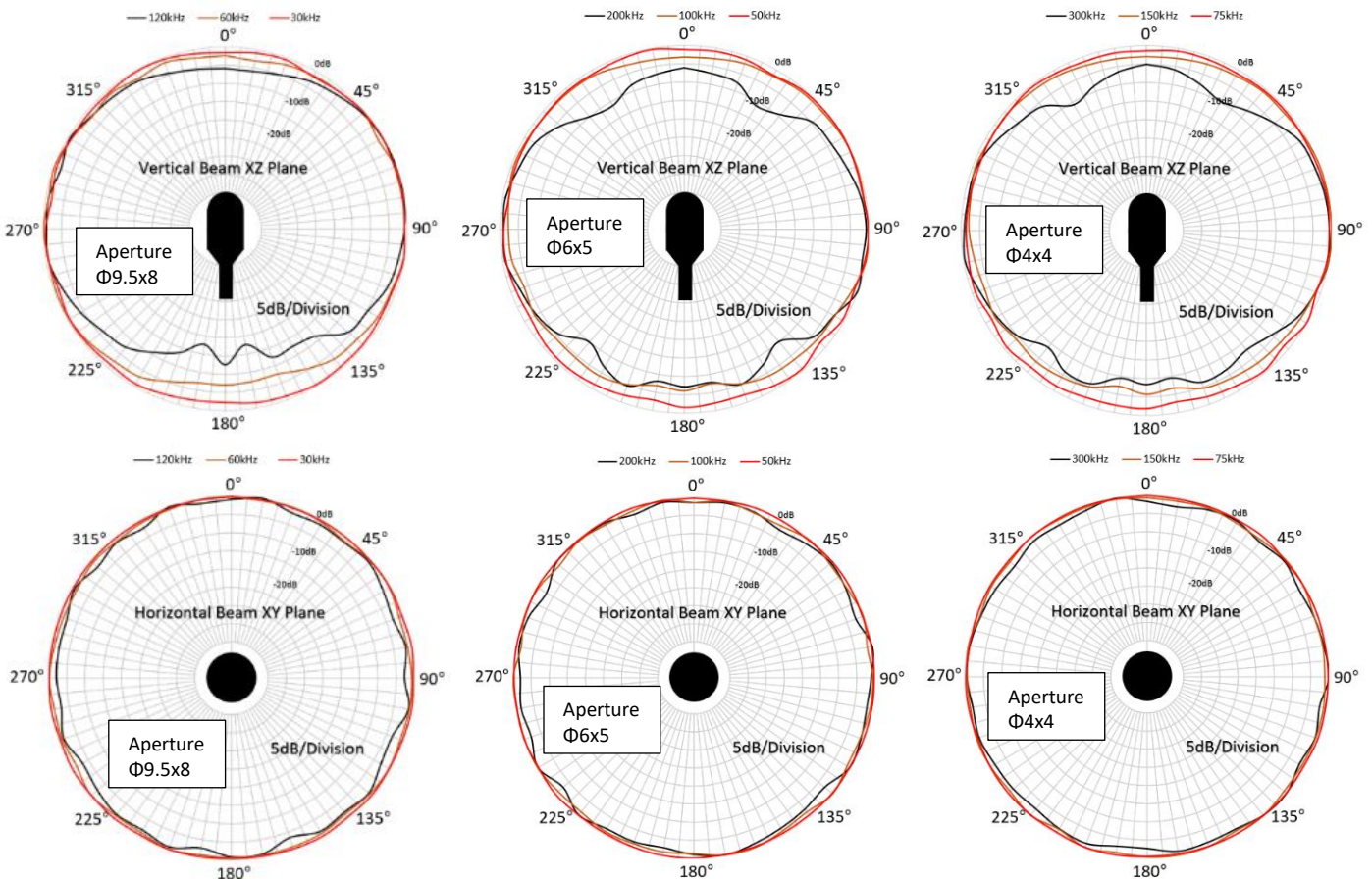
How to Order

Hydrophone	-Cable Length	-Cable	-Connector	-Sensitivity Matching Tolerance
Part Number	in meter	Refer to Options	Refer to Options	Refer to Options. in dB V/μPa, at 1kHz.
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.			

Physical Size (Dimensional Unit: mm):



Directivity Pattern



Specifications of Planar Array Elements (Conical Beam)

Acoustic Planar Array Element	BII7149	BI7070 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 1kHz. 2. Hydrophones whose sensitivity variations are out of specified tolerance are rejected.				
Built-in Preamp:	No. Standalone preamplifier is available by separate order to drive long cable.				
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 $f_{-3dB} = 1/(2\pi R_i C_h)$. 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 = 200 MΩ are used to detect sounds, -3dB high pass frequency of detection = 2.81 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:	143.6 along acoustic axis; Other direction: 141.0, at dB μPa/(m/s ²).				
Underwater Projector:	Yes. Do NOT use projectors in air to avoid damage.				
Resonance Frequency fs:	420 ± 5% kHz				
Quality factor Q _m 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. 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: 1 m. 2. Customized: up to 20 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.					

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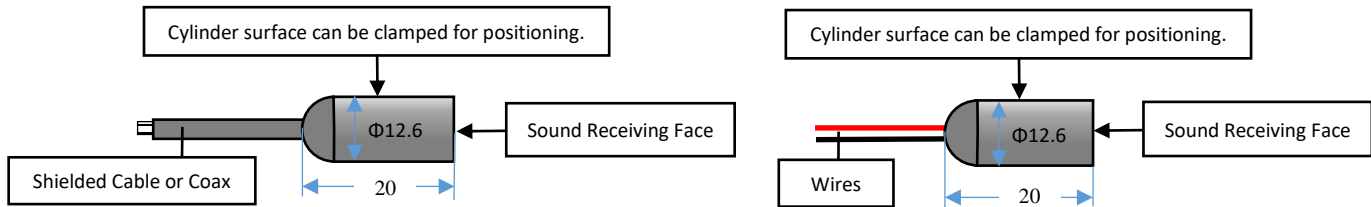
How to Order

Hydrophone	-Cable Length	-Cable	-Connector	-Sensitivity Matching Tolerance
BII7149	in meter	Refer to Options	Refer to Options	Refer to Options. in dB V/ μ Pa, 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

