



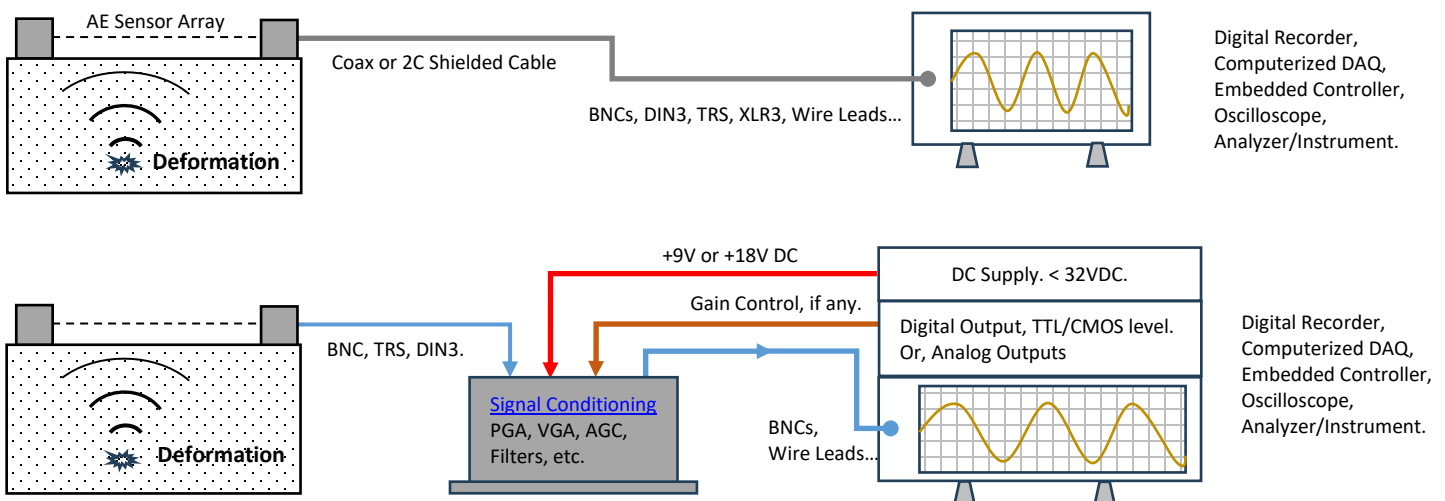
BII7230 Series AE Sensors for Acoustic Emission Testing

AE (acoustic emission) sensors with aperture $\Phi 2$ to $\Phi 12.7$ mm detects wideband stress wave released by the structural (Macro or Micro) deformation: cracking, leaking, ageing under load, chemical reaction, temperature gradients, etc. AE sensors are used as contact sensors in air and liquids/water (immersion sensors) to detect AE sources up to 198°C (388°F), or as embedded AE sensors which are encapsulated in structures/materials for Structural Health Monitoring (SHM). Linear and planar phase arrays can be configured with these small-aperture AE sensors to position AE sources. When AE sensors are used in air, the couplant (water, gel, grease, oils, adhesives, and commercial couplant.) is a necessary material to provide efficient acoustic coupling between the sensor face and the piece under test (DUT).

AE sensors with preamps can transmit signals over long cable without degrading signals up to 1000m. This feature presents a solution for long-distance health monitoring of a structure.

Typical Applications:	Examination of Structure	Structural Health Monitoring SHM	Material Study	Control and Monitoring of Manufacturing Process
Related Products:	Miniature AE Sensor: BII7180 Series	NDT Transducers: BII7690 Series	Directional Hydrophone (Acoustic Sensor): BII7070 Series	

AE (Acoustic Emission) Detection System



Specification of AE Sensor

FFVS: Free-field Voltage Sensitivity, in dB V/ μ Pa; SE: Single-ended Output; DF: Differential Output.						
The sensitivity FFVS of BII's AE sensors is calibrated in water at 23 °C.						
AE Sensor	BII7231SE	BII7231DF	BII7232SE	BII7232DF	BII7233	BII7235
Applications:	Contact sensors in air and immersion sensors in liquids or water, AE Sensor Array Elements, and Embedded AE Sensors.					
FFVS (V/ μ Pa):	-202dB	-198dB	-202dB	-198 dB	-211 dB	-214 dB
	Sensitivity Loss over Extension Cable (dB) = $20 \cdot \log[C_h/(C_h+C_c)]$. Valid for hydrophone without preamplifier. C_h : Hydrophone Capacitance; C_c : Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.					
FFVS:	Refer to Graph of FFVS vs. Frequency . Free-field Voltage Sensitivity.					
Usable Frequency:	1 to 350kHz	1 to 350kHz	1 to 350kHz	1 to 350kHz	1 to 700kHz	1kHz to 1.2MHz
	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 BII7233SE and a BII preamp of $R_i = 1 \text{ M}\Omega$ are used to detect sounds, -3dB high pass frequency of detection = 1.7684 kHz.					
Quality Factor Q_m :	1 to 3	1 to 3	1 to 3	1 to 3	2 to 4	2 to 4
	Broadband. Q_m determines the transient response or the rise and fall rings of steady-state response.					
Capacitance C_h :	0.32nF	0.1nF	0.1nF	0.1 nF	0.09 nF	0.27 nF
Dissipation D:	0.015	0.015	0.015	0.015	0.005	0.02
Noise Density at $f \ll f_s$: dB μ Pa/V/Hz	1. f in kHz; f_s : 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.					
Total Noise Density:	Depends on standalone preamp .					
Sensing Aperture ΦD :	$\Phi 12.7 \text{ mm}$	$\Phi 12.7 \text{ mm}$	$\Phi 6 \text{ mm}$	$\Phi 12.7 \text{ mm}$	$\Phi 2 \text{ mm}$	$\Phi 3 \text{ mm}$
Directivity Pattern:	Conical Beam.					
-3dB Beam Width:	$58.9^\circ C/(f \cdot \Phi D)$, in °. C: sound velocity or stress wave speed in load medium. f: Operating Frequency.					
Side Lobe Level:	No side lobes when -3dB Beam Width $\geq 50^\circ$. $\leq -17.7 \text{ (dB)}$ when -3dB Beam Width $< 50^\circ$.					
Signal Output Type:	SE	DF	SE	DF	SE	SE

Preamplifier:	No					
Housing Material:	Plastics	Plastics	SS316/316L	SS316/316L	Plastics	Plastics
	Plastic housing resists attack by acids, alkalis, salt solutions and most other chemicals. There is no risk of corrosion when exposed to naturally corrosive conditions. It does not rust or corrode from electrochemical and galvanic environment. Solvents shall not be used with the AE sensors, such as hydrochloric acid, isopropyl alcohol, ethyl lactate, acetone, xylene, Iso hexanes, mineral spirits, etc...					
	316/316L Stainless Steel possesses excellent corrosion resistance and be used in a variety of marine and chemical-processing applications. It maintains its corrosion resistance up to the maximum temperature.					
Max. Water Depth:	300 m	300 m	Use in Air Only	Use in Air Only	10 m	10 m
Operating water depth is limited by the cable length if the cable has wire leads or a non-waterproof connector.						
Mounting:	1. AE sensors are installed on the DUT (device under test) with mechanical clamping or epoxy adhesives. 2. AE sensors can be embedded onto the DUT with potting and encapsulation compounds. BII does NOT provide clamp parts and encapsulation compounds.					
Cable Type:	RG174	SC60	RG178	SC32	RG178	RG178
Cable Information:	1. Coax RG174/U (RG174) (for Single Ended Output ONLY) 2. Coax RG178/U (RG178) (for Single Ended Output ONLY), up to 200°C. 3. Coax RG58/U (RG58) (for Single Ended Output ONLY) 4. Shielded Cable with Polyurethane Jacket, ΦD=2.6 mm (SC26) 5. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, ΦD=3.2 mm (SC32), up to 200°C. Not water-proof. 6. Shielded Cable with Twisted Pair and Polyurethane Jacket, ΦD=4.7 mm (SC47) 7. Default: Shielded Cable with Twisted Pair and PVC Jacket, ΦD=6.0 mm (SC60) (for Differential Output ONLY) 8. Shielded Cable with Rubber Jacket, ΦD=6.5 mm (SC65) Differential (balanced) output with shielded Twisted Pair Cable is recommended to reject Electromagnetic Interference (EMI) over long cable.					
Cable Orientation:	Cable goes out from side wall or top end face of the housing. Refer to Outline Drawings .					
Cable Length:	1. Default: 1 m. 2. Customization: Custom-fit Cable Length					
Connector Type:	BNC Male	Wire Leads	Wire Leads	Wire Leads	BNC	BNC
Customization: Bespoke Connector.						
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. BNC with RG178 Coax: Service Temperature up to 165°C or 329°F. 3. 1/8" (3.5mm) TRS Plug (TRS), Max. Diameter Φ10.5 mm, for SE or DF. 4. DIN Receptacle with 3 Male Pins (DIN3), (Max. Diameter Φ17 mm). for SE or DF. 5. XLR Receptacle with 3 Male Pins (XLR3), Max. Diameter Φ20.2 mm, for SE or DF. 6. Underwater Mateable Connector (2 pin) (UMC2P), Max. Diameter Φ21.5 to Φ35 mm, for SE. Underwater Mateable Connector (3 pin) (UMC3P), Max. Diameter Φ21.5 to Φ35 mm, for SE or DF. UMC3P is from global manufacturers of underwater connectors. Its part number is listed in quote in detail. Underwater Mateable Connectors are for underwater uses. Other connectors/wire leads are for dry uses and are not waterproofed.					
Weight:	56 grams	56 grams	65 grams	86 grams	36 grams	36 grams
Weight depends on Cable Types and Length.						
Overall Size (ΦDxH):	Φ21x20 mm	Φ21x20 mm	Φ9.8x15 mm	Φ15.8x15 mm	Φ6.2x15mm	Φ8x6.2mm
Service Temperature:	-20 to 60 °C, or -4 to 140 °F		-20 to 198 °C, or -4 to 388°F		-20 to 120 °C, or -4 to 248 °F	
Storage Temperature:	-20°C to +60 °C or -4°F to 140 °F.					

How to Order

Part Number	-Cable Length in Meter	-Cable Type	-Connector Type
Example:	Description		
BII7233-2m-RG178-BNC	BII7233 AE Sensor, 2m RG178 Coax, Male BNC.		

Wiring of AE Sensor without Preamp.

Differential Output:	Wire Leads	UMC3P	DIN3	TRS	XLR3
Signal +	White or Red	Pin 2	Pin 3	Tip, Positive/Hot	Pin 2, Positive/Hot.
Signal -	Black	Pin 1	Pin 1	Ring, Negative/Cold	Pin 3, Negative/Cold.
Common & Shielding	Shield	Pin 3	Pin 2	Sleeve, Ground/Common	Pin 1, Shield/Ground.
Single Ended Output:	Wire Leads	UMC3P	DIN3	BNC/SMA/SMC	Coax with Wire Leads
Signal	White or Red	Pin 2	Pin 3	Center Contact	Coax Center Contact
Signal Common	Black	Pin 1	Pin 1	Shield	Coax Shield
Shielding	Shield	Pin 3	Pin 2	Shield	Coax Shield

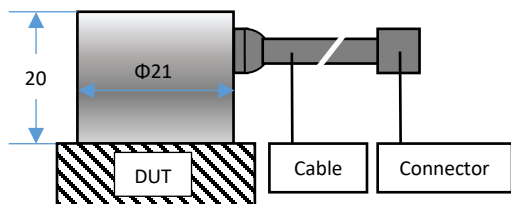
Question:

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

- Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
- 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.
- 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.

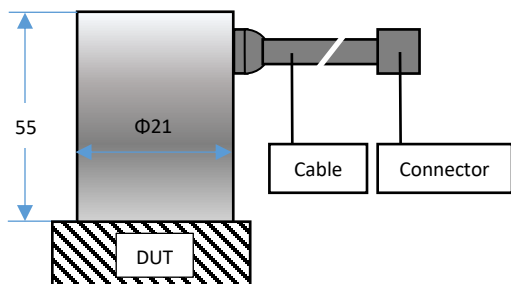
Outline Drawings of AE Sensors and Installation on DUT.

BII7231SE and BII7231DF AE Sensor Plastic Housing (Unit: mm):



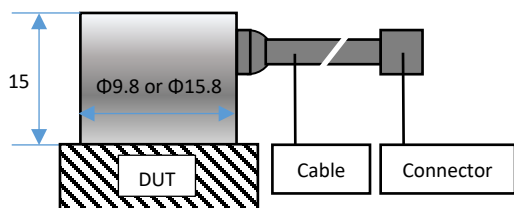
1. Housing: Plastics. No Preamplifier or with Built-in Preamp.
2. Air or Underwater Uses. Maximum Underwater Depth: 300 m.
3. Service Temperature: -20 to 60 °C or -4 to 140 °F.
4. No Preamp.

BII7231PGDF AE Sensor Plastic Housing (Unit: mm):



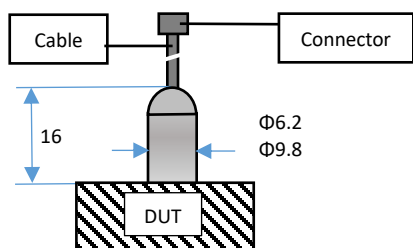
1. Housing: Plastics. No Preamplifier or with Built-in Preamp.
2. Air or Underwater Uses. Maximum Underwater Depth: 300 m.
3. Service Temperature: -20 to 60 °C or -4 to 140 °F.
4. Built-in Programmable Gain Preamp.

BII7232SE and BII7232DF AE Sensor Stainless 316 Housing (Unit: mm):



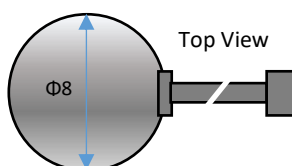
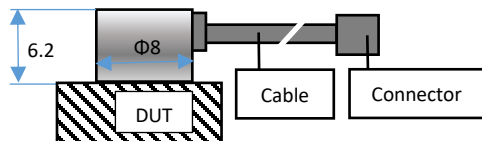
1. Housing: Plastics. No Preamplifier.
2. Use in Air, Not for Underwater Use.
3. Service Temperature of the Sensing Head: -20 to 198 °C or -4 to 390 °F.
4. Service Temperature of BNC Connectors: -40 to 165 °C or -40 to 329 °F.
5. No Preamp.

BII7233SE and BII7233DF AE Sensor Plastic Housing (Unit: mm):



1. Housing: Plastics. No Preamplifier.
2. Small Size suitable for AE Sensor Array.
3. Maximum Underwater Depth: 10 m.
4. Service Temperature: -20 to 120 °C, or -4 to 248 °F.
5. Cable Options: RG178B/U.
6. Connector: Wire Leads, BNC, SMA, SMC, etc.
7. No Preamp.

BII7235 AE Sensor Plastic Miniature Housing (Unit: mm):



1. Housing: Plastics. No Preamplifier.
2. Suitable for AE Sensor Array and Embedded Applications.
3. Maximum Underwater Depth: 10 m.
4. Service Temperature: -20 to 120 °C, or -4 to 248 °F.
5. Cable Options: RG178B/U.
6. Connector: Wire Leads, BNC, SMA, SMC, etc.
7. No Preamp.

Free-field Voltage Sensitivity (FFVS) in Water.

