



## Hydrophone and Ultrasonic Preamplifier

BII's low noise low power preamplifiers (amplifiers) have built-in filters and their gains are fixed or programmable with digital and analog control. These preamplifiers (amplifiers) are custom-fit for use in broadband (wideband) underwater SONAR, ultrasonic (Ultrasound, NDT, AE) system and material study.

### Typical Applications

Hydrophone, SONAR, Underwater Communication, Navigation. Seafloor-mapping, Sub-bottom Investigation, Sediment Profiler, Acoustic Image. Streamer/Towed Array, Sonobuoy, Target Strength Testing.	Ultrasonic (Ultrasound, AE, NDT) Testing, Material Characterization. Low Noise Ultrasonic Preamplifier, Instrumentation, Pulse Amplifier. Sonic Cavitation Noise.
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## BII1080 Series Low Noise Preamplifier: 1 Hz to 2.2 MHz, 5.2 nV/√Hz, 3.1 (fA/√Hz).

### Specification

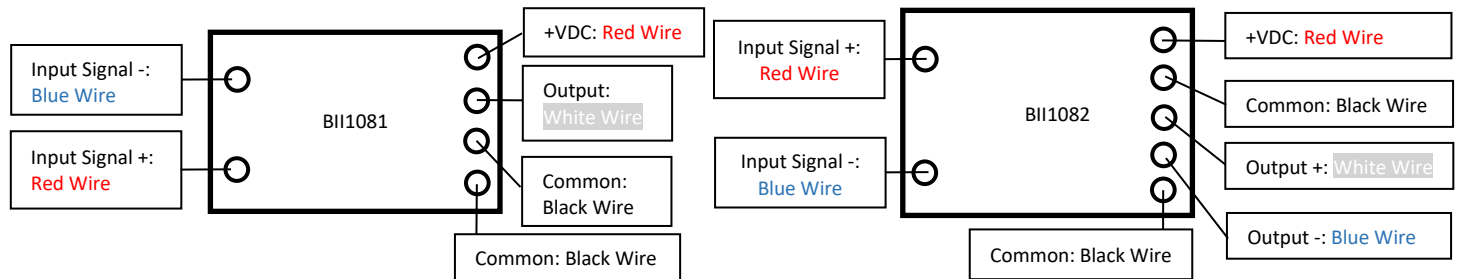
<b>HPF:</b> High Pass Filter; <b>BPF:</b> Band Pass Filter; <b>LPF:</b> Low Pass Filter. <b>SE:</b> Single-ended, <b>DF:</b> Differential. <b>RTI:</b> Referred to the input of the preamp. <b>R<sub>i</sub>:</b> Input Impedance. <b>V<sub>s</sub>:</b> Supply Voltage. <b>I<sub>q</sub>:</b> Quiescent Current; <b>V<sub>omax</sub>:</b> Output Voltage Swing; <b>Z<sub>o</sub>:</b> Output Impedance. <b>TRS:</b> 3.5 mm TRS Jack.		
<b>Low Noise Preamplifier:</b>	<b>BII1081</b>	<b>BII1082</b>
<b>Input Type:</b>	Differential, either single ended ( <b>SE</b> ) or differential ( <b>DF</b> ) input signals are accepted.	
<b>Input Referred Noise:</b> (f ≥ 1 kHz)	Gain ≥ 20 dB: e <sub>n</sub> = 5.2 (nV/√Hz), i <sub>n</sub> = 3.1 (fA/√Hz).	
	Gain = 10 dB: e <sub>n</sub> = 12.0 (nV/√Hz), i <sub>n</sub> = 3.1 (fA/√Hz).	
	Roughly, electronic noise density at input, RTI, V <sub>n</sub> <sup>2</sup> = e <sub>n</sub> <sup>2</sup> + [i <sub>n</sub> * impedance of the transducer (or hydrophone)] <sup>2</sup> .	
<b>Input Impedance R<sub>i</sub>:</b>	R <sub>i</sub> ≤ 44 MΩ at Gain ≤ 40 dB.	
	R <sub>i</sub> ≤ 5 MΩ at 40 < Gain ≤ 60 dB.	
	Specify when ordering to set up -3dB high pass filter frequency with Capacitance C <sub>n</sub> of a piezoelectric sensor.	
<b>Maximum Input:</b>	2.4 Vpp or (Maximum Output V <sub>omax</sub> )/Gain, whichever is less.	
<b>Built-in Filter:</b>	White noise level is proportional to the square root of bandwidth.	
	<b>Filters of Preamps.</b> Both oceanic 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 1 kHz, you may specify a high pass filter of a preamp with -3dB cut-off frequency 100 Hz to improve signal to noise ratio of the signals of the interest.	
	<b>HPF:</b> First Order; <b>LPF:</b> Second Order.	
	<b>System Filters Consisting of Standalone Piezoelectric Hydrophones and Standalone Preamps.</b>	
	<b>-3dB High Pass Frequency:</b> f <sub>-3dBH</sub> = 1/(2πR <sub>i</sub> C <sub>n</sub> ). that is, R <sub>i</sub> = 1/(2π f <sub>-3dBH</sub> *C <sub>n</sub> ). R <sub>i</sub> : Input Resistance or Impedance of Preamp. C <sub>n</sub> : Capacitance of piezoelectric hydrophone/sensor/transducer at 1 kHz (non-resonance measurement) or f <sub>s</sub> (resonance measurement such as NDT pulsing system). <b>For example:</b> (1) hydrophone 10nF at 1kHz and preamp R <sub>i</sub> 44MΩ constitute high pass filter with -3dB frequency 0.36Hz. (2) hydrophone 10nF at 1kHz and preamp R <sub>i</sub> 10MΩ constitute high pass filter with -3dB frequency 3.18Hz.	
<b>Gain Options:</b>	10, 20, 40, or 50 dB.	20, 26, 40, or 60 dB.
<b>-3dB Bandwidth:</b>	Note: Gain < 20 dB is available with higher Input Referred Voltage Noise. Refer to <a href="#">Input Referred Noise</a> .	
	1 Hz to 2.2 MHz at Gain ≤ 40 dB.	
<b>Settling Time, 0.1%:</b>	48 ns	
<b>Output Type:</b>	Single-ended ( <b>SE</b> )	Differential or Balanced ( <b>DF</b> )
<b>Output Impedance:</b>	50 Ω.	10 Ω.
<b>Maximum Output V<sub>omax</sub>:</b>	V <sub>omax</sub> = (Supply Voltage V <sub>s</sub> - 4), in Vpp.	
<b>Cable Driving Capability:</b>	1. 50Ω-Impedance Matching Coaxial Cable System: ≥ 300m.	
	2. Custom-fit Cable Length up to 305 m or 1000 ft, refer to <a href="#">Cable-Drive Capability</a> . The chart is based on 5Vpp Sinusoidal signals. Maximum cable length which a hydrophone can drive is proportional to output voltage level of the hydrophone.	
<b>Supply Voltage V<sub>s</sub>:</b>	+7.5 to +32 VDC	
<b>Current (Quiescent):</b>	13 mA	17 mA
<b>Suggested DC Supply:</b>	+9VDC Batteries, 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 above rated voltage. DO NOT use switching mode DC power supply.	
<b>Operating Temperature:</b>	-40 to 60 °C or -40 to 140 °F	
<b>Storage Temperature:</b>	-40 to 60 °C or -40 to 140 °F	

## 1. Coated PCB with Wires and Wire Leads.

Input Wiring:	5cm wires, twisted.	
	<b>Differential Input Wiring:</b> <b>Red:</b> Input Signal +, <b>Blue:</b> Input Signal -, and Use <b>Power Supply Common</b> as input signal common.	
	<b>Single-ended Input Wiring:</b> <b>Red:</b> Input Signal, <b>Blue:</b> Input Common and wire <b>Blue Wire</b> to <b>Power Supply Common</b> .	
Output Wiring:	5cm wires, twisted.	
	<b>Differential Output Wiring:</b> <b>White:</b> Output Signal +, <b>Blue:</b> Output Signal -, <b>Black:</b> Output Common.	
	<b>Single-ended Output Wiring:</b> <b>White:</b> Output Signal, <b>Black:</b> Output Common.	
Power Supply Wiring:	5cm wires, twisted.	
	<b>Red:</b> +VDC.	
	<b>Black:</b> Common.	
	Common of DC Power Supply is the commons of input and output.	
Size:	BII1081 Coated PCB LxWxH = 33x10x5 mm	BII1082 Coated PCB LxWxH = 40x10x5 mm
Weight:	BII1081: 6 grams	BII1082: 9 grams

Coated PCB Wiring: "Output -" is the reverse (180° phase difference) of "Output +". "Output -" MUST NOT be connected to Common or Ground.

Signal Input Type of Coated PCB: Differential, either single ended (SE) or differential (DF) input signals are accepted. Refer to [Input Wiring](#).



Standard BII1081 and BII1082, Coated PCB. BII keeps standard parts in stock.

Part Number	<a href="#">-Gain</a>	<a href="#">-R<sub>i</sub> Input Impedance</a>	<a href="#">-LPF</a>	<a href="#">-PCB</a>
BII1081	40dB.	Refer to <a href="#">R<sub>C</sub> Filter</a> .	Low Pass Filter: 2.2 MHz.	Coated PCB
BII1082		44 MΩ, 10MΩ, or 1MΩ.		
<b>Example:</b>		<b>Description:</b>		
BII1081-40dB-44MΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		
BII1081-40dB-10MΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		
BII1081-40dB-1MΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		
<a href="#">BII1082-40dB-44MΩ-2.2MHz-PCB:</a>		<a href="#">BII1082, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.</a>		
<a href="#">BII1082-40dB-10MΩ-2.2MHz-PCB:</a>		<a href="#">BII1082, Preamp, 40dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.</a>		
<a href="#">BII1082-40dB-1MΩ-2.2MHz-PCB:</a>		<a href="#">BII1082, Preamp, 40dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.</a>		

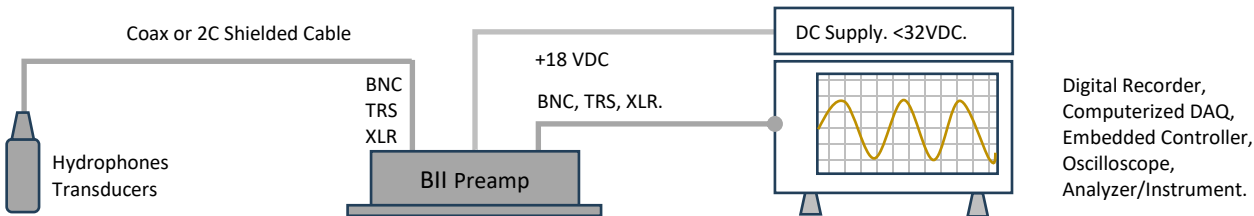
## How to Order Bespoke Preamplifiers (Coated PCB).

Part Number	-Gain	- $R_i$ Input Impedance	-LPF	-PCB
BII1081	In dB.	$R_i = 1/(2\pi f_{-3dBH} * C_h)$ . Refer to <a href="#">R<sub>C</sub> Filter</a> .	-3dB Low Pass Frequency, in Hz, kHz, or MHz.	Coated PCB
BII1082				
<b>Example:</b>		<b>Description:</b>		
BII1081-20dB-20MΩ-1MHz-PCB:		BII1081, Preamp, 20dB Gain, Input Impedance: 20MΩ, -3dB Low Pass Filter: 1MHz, Coated PCB.		
BII1082-40dB-2MΩ-300kHz-PCB:		BII1082, Preamp, 40dB Gain, Input Impedance: 2MΩ, -3dB Low Pass Filter: 300kHz. Coated PCB.		

**2. Metal or Plastic Housing with Four Mounting Holes.**

- BNC:** "Bayonet Neill–Concelman", miniature quick connect/disconnect radio/audio frequency connector used for coaxial cable. **Fastening Type:** Bayonet Lock.
- XLR:** Employed for balanced audio interconnections, 3 to 7 contacts. **Fastening Type:** Latch Lock. **Only supported by BII Plastic Housing because of its large size.**
- 3.5mm TRS** stand for Tip, Ring, and Sleeve, miniature, quick connect/disconnect audio frequency connector used for shielded cable. **Fastening Type:** None.
- DIN:** Electrical cylindrical connectors, 3 to 14 contacts,  $\Phi 20$ mm diameter, used for audio, RF, digital, and DC or AC power signals. **Fastening Type:** Threaded.
- DC Power Connector:** Supply DC voltage and current to devices, miniature, quick connect/disconnect, used for shielded cable. **Fastening Type:** None.

Packages:	Signal Type	Small Metal Housing with Four Mounting Holes	Large Metal or Plastic Housing with Four Mounting Holes
Input Connector:	Single Ended	BNC Jack (BNC)	BNC Jack (BNC)
	Differential	3.5 mm (1/8") TRS Jack (TRS35)	XLR Plug with with 3 Sockets (XLR)
Output Connector:	Single Ended	BNC Jack (BNC)	BNC Jack (BNC)
	Differential	3.5 mm (1/8") TRS Jack (TRS35)	XLR Plug with with 3 Sockets (XLR)
Power Supply:	DC Power Connector Jack on Housing. Options of Power Supply Cable: <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .		
Size LxWxH (mm):	77x50.6x33 (No BNC Jacks) or 77x50.6x43 (with BNC Jacks)		109.45x83.4x65 (No BNC Jacks) or 109.45x83.4x67 (with BNC Jacks)
Weight:	100 grams $\pm$ 10%		150 grams $\pm$ 10%
Accessories:	A1: Bespoke length RG58, RG174, or RG178 Coax with BNC Male to BNC Male. A2: Bespoke length cable with 3.5mm TRS Plug to 3.5mm TRS Plug. A3: Bespoke length cable with 3.5mm TRS Plug to Wire Leads. A4: Bespoke length cable with 3.5mm TRS Plug to XLR Receptacle with 3 Male Pins. A7: Bespoke length cable with XLR Receptacle Male Pin to Wire Leads. Default: 1m.		

**System Wirings of Standalone Preamp, Metal and Plastic Housing.****Components of an Acoustic Receiving System.****Standard Preamps, Metal or Plastic Housing.** BII keeps standard parts in stock.

Part Number	-Gain	- <u>R<sub>i</sub></u> Input Impedance.	-LPF	-Input/Output Connector	-Accessory Cable Length	-Type
BII1081	40dB	Refer to <u>R<sub>C</sub> Filter</u> .	-3dB LPF: 2.2MHz.	BNC/BNC, TRS/BNC, XLR/BNC.	0.6m, 0.9m, 1.8m, 10m, 20m. <u>A1 to A7</u> . <u>DCBP24</u> , <u>DCBS18V</u> .	
BII1082	40dB	44 MΩ, 10MΩ, or 1MΩ.		TRS/TRS, XLR/XLR.		
Example:		Description:				
BII1081-40dB-10MΩ-2.2MHz-BNC/BNC-DCBP24:		BII1081, Preamp, 40dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 2.2MHz, Input and Output: BNC Jacks. DC Supply Cable: DCBP24.				
BII1081-40dB-44MΩ-2.2MHz-TRS/BNC-DCBP24:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input: TRS Jack, Output: BNC Jack. DC Supply Cable: DCBP24.				
BII1081-40dB-44MΩ-2.2MHz-XLR/BNC-DCBP24:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input: XLR Jack, Output: BNC Jack. DC Supply Cable: DCBP24.				
BII1082-40dB-44MΩ-2.2MHz-TRS/TRS-DCBP24:		BII1082, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input and Output: TRS Jacks, DC Supply Cable: DCBP24.				
BII1082-40dB-1MΩ-2.2MHz-XLR/XLR-20m-A7-DCBS18V:		BII1082, Preamp, 40dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 2.2MHz, Input and Output: XLR Jacks, 20m A7 Cable Accessories, DC Supply Cable: DCBS18V.				

**How to Order Bespoke Preamplifiers (Metal or Plastic Housing).**

Part Number	-Gain	- $R_i$ Input Impedance.	-LPF	-Input/Output Connector	-Accessory Cable Length	-Type
BII1081	In dB	$R_i = 1/(2\pi f_{-3dBH} * C_h)$ .	-3dB LPF, in Hz, kHz, or MHz.	BNC/BNC, TRS/BNC, XLR/BNC.	Cable Length in meter. <a href="#">A1 to A7</a> . <a href="#">DCBP24</a> , <a href="#">DCBS18V</a>	
BII1082		Refer to <a href="#">R<sub>C</sub> Filter</a> .		TRS/TRS, XLR/XLR.		
Example:		Description:				
BII1081-20dB-10MΩ-1MHz-BNC/BNC:		BII1081, Preamp, 20dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 1MHz, Input and Output: BNC Jacks.				
BII1081-40dB-44MΩ-1MHz-TRS/BNC:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 1MHz, Input: TRS Jack, Output: BNC Jack.				
BII1082-60dB-1MΩ-200kHz-TRS/TRS-DCBS18V:		BII1082, Preamp, 60dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 200kHz, Input and Output: TRS Jacks, DC Supply Cable: DCBS18V.				
BII1082-60dB-1MΩ-200kHz-XLR/XLR-100m-A7-DCBS18V:		BII1082, Preamp, 60dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 200kHz, Input and Output: XLR Jacks, 100m A7 Cable Accessories, DC Supply Cable: DCBS18V.				

## Signals and Wiring of Panel-Mount Connectors

Input or Output Signals			Power Supply
Single Ended (SE)	Differential/Balanced (DF):		Single DC Supply
BNC Jack	3.5mm TRS Jack	XLR (Balanced Audio)	Power Jack
Center: Signal Shield: Common	Tip: Signal +, Positive or Hot. Ring: Signal -, Negative or Cold. Sleeve: Common/Ground.	Pin 2, Positive/Hot. Pin 3, Negative/Cold. Pin 1, Shield/Ground.	Center Contact: +VDC. Shell: Common.
Metal Case is for shielding and grounding.			

## Signals and Wiring of Accessory Cables

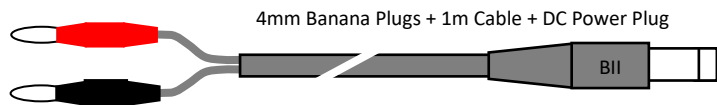
Input or Output Signals			DC Supply Cable
Single Ended (SE)	Differential/Balanced Signal (DF)		Single DC Supply
BNC and Coax	3.5mm TRS and Cable	XLR (Balanced Audio)	Power Plug
Center: Signal Shield: Common	Tip, White Wire: Signal +. Ring, Black Wire: Signal -. Sleeve, Shield: Common.	Pin 2, Positive/Hot. Pin 3, Negative/Cold. Pin 1, Shield/Ground.	Red Banana Plug: +VDC. Black Banana Plug: Common. Cable Shield, if any: Shielding.
Warning: "Signal -" is the reverse (180° phase difference) of "Signal +", and "Signal -" MUST NOT be connected to Common or Ground.			

## Accessories:

Part Number: DCBP24.

## To Terminals of DC Supply:

- One Red 4mm Banana Plug.
- One Black 4mm Banana Plug.



DC Power Plug.  
To DC Power Jack of the Device.

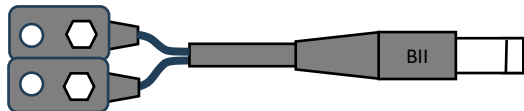
Red Banana Plug or Red Wire Lead: +VDC.	Black Banana Plug or Black Wire Lead: Common.	Cable Shield, if any: Shielding.
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One 1m DC supply cable. One end is with Red and Black Banana Plugs, another end of the cable is with DC Power Plug. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

Part Number: DCBS18V.

Two 9V Battery Snaps + 0.3m (12") Cable + DC Power Plug

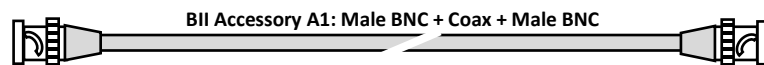
To Two 9V Batteries.



DC Power Plug.  
To DC Power Jack of the Device.

One 0.3m (12") DC supply cable. One end is two 9V Battery Snaps which supplies +18VDC to amplifiers, another end of the cable is with DC Power Plug.

A1: Bespoke length RG58, RG174, or RG178 Coax with BNC Male to BNC Male. Default: 0.6m.



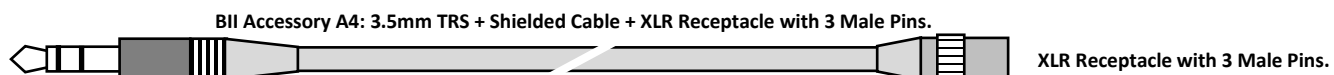
A2: Bespoke length cable with 3.5mm TRS Plug to 3.5mm TRS Plug. Default: 1.828m.



A3: Bespoke length cable with 3.5mm TRS Plug to Wire Leads. Default: 0.9m.

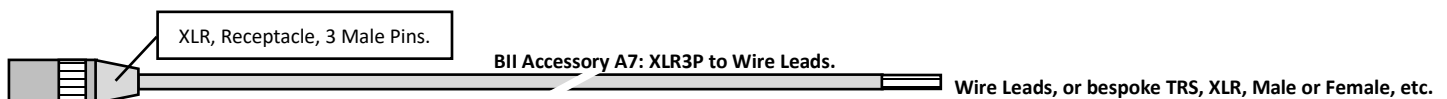


A4: Bespoke length cable with 3.5mm TRS Plug to XLR Receptacle with 3 Male Pins. Default: 0.9m.

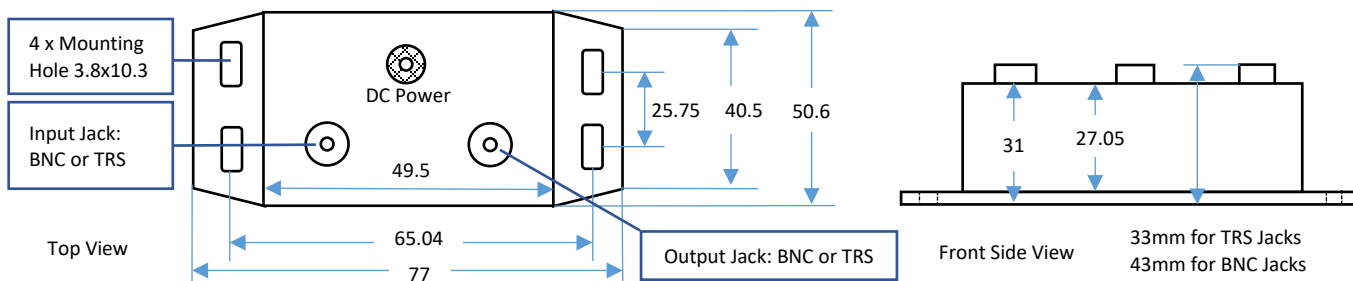


Most recorders and analyzers use XLR Plug with 3 Female Sockets on front panel as differential/balance input connector and BII's XLR of A4 is compatible to it.

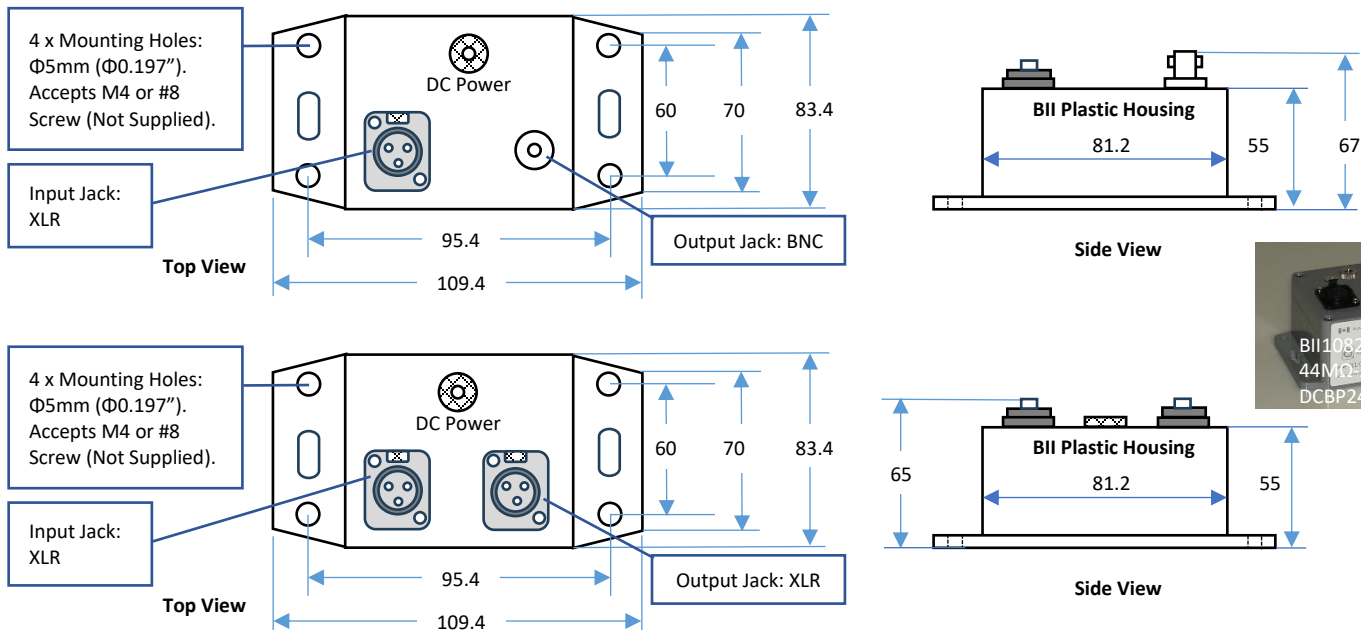
A7 Receiving Signal Cable. Part Number: XLR-P-WL-1m, Bespoke length cable with XLR Receptacle Male Pin to Wire Leads. Default: 1m.



**Metal Housing, Outline Dimensions (mm), Illustration only, the scale is not 1:1.**



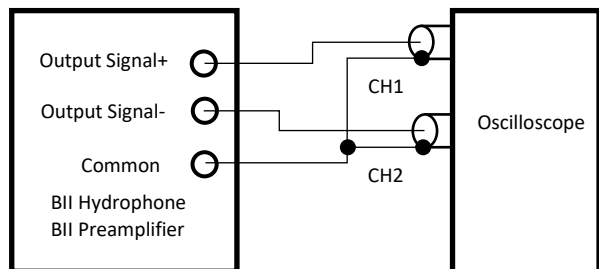
**Plastic Housing, Outline Dimensions (mm), Illustration only, the scale is not 1:1.**



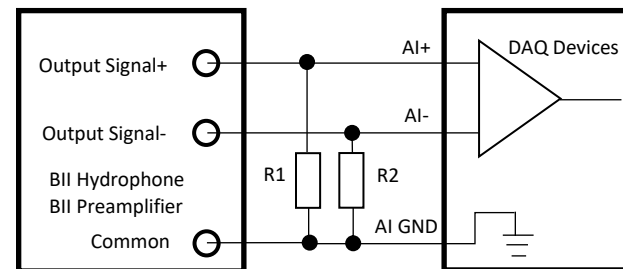
**Preamplifier Wirings to DAQ (Data Acquisition):** DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

**R1 and R2 resistors are NOT necessary for most applications.** If DAQ saturation occurs, use  $R1 = R2 = 10\text{k}\Omega$  to  $1\text{M}\Omega$  resistors.

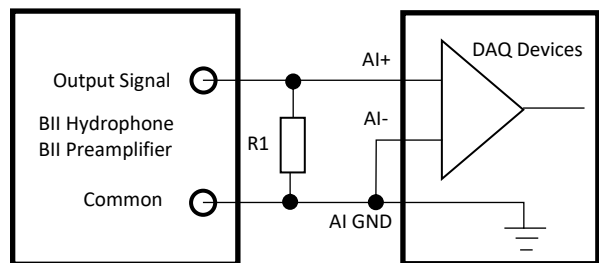
**BII's Differential Output to BNC Input of an Oscilloscope**



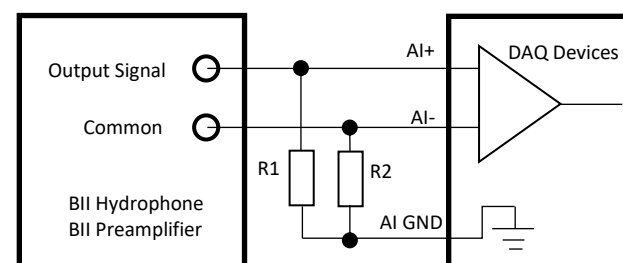
**BII's Differential Output to Differential Input of a DAQ**



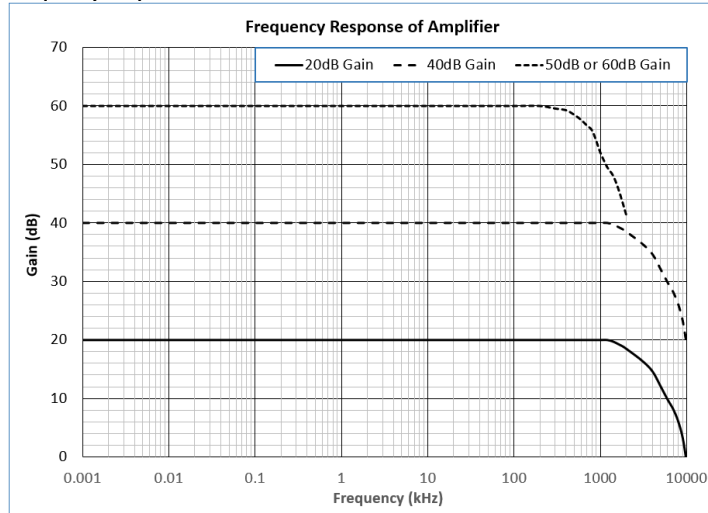
**BII's Single-Ended Output to Single-Ended Input of a DAQ**



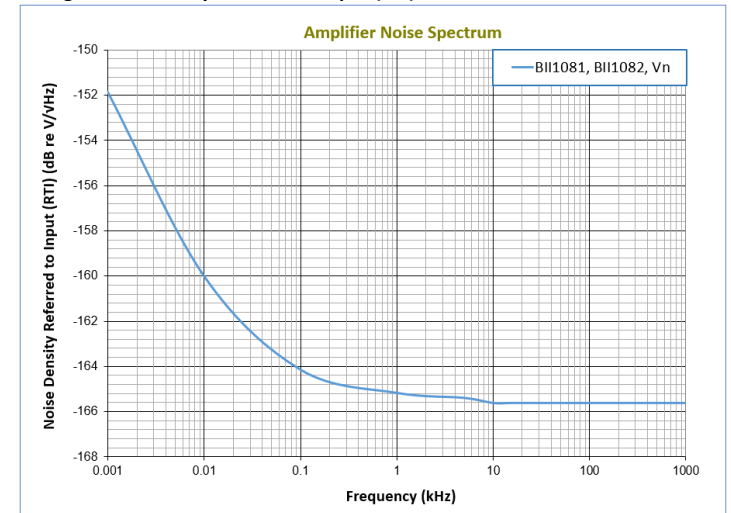
**BII's Single-Ended Output to Differential Input of a DAQ**



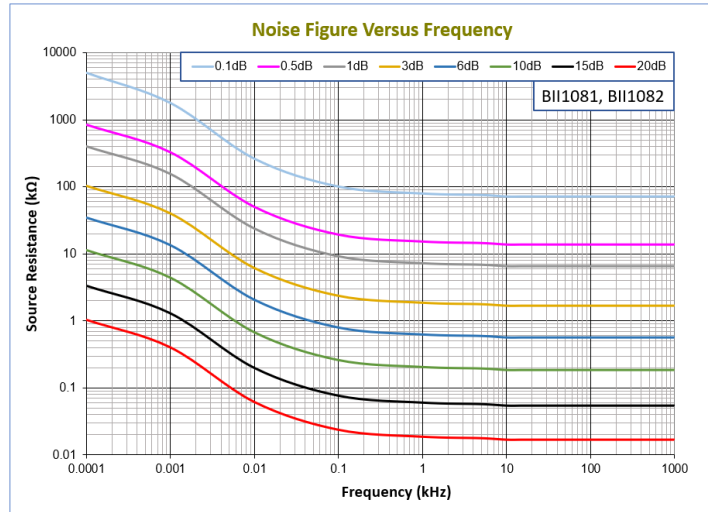
## Frequency Response



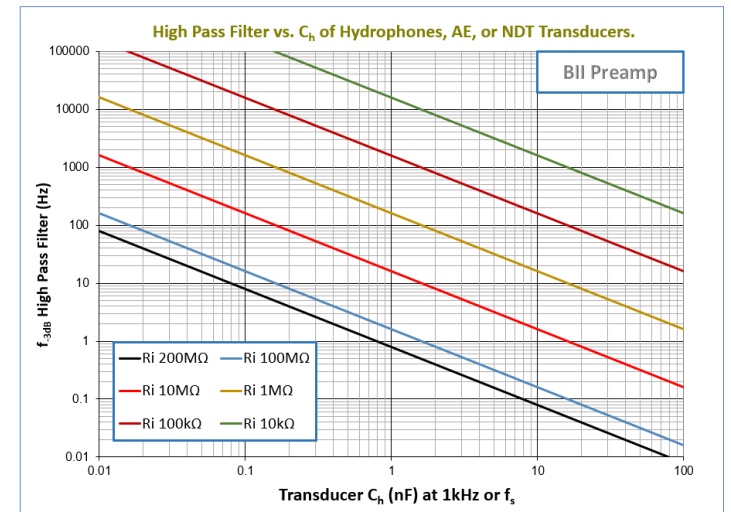
## Voltage Noise Density Referred to Input (RTI):



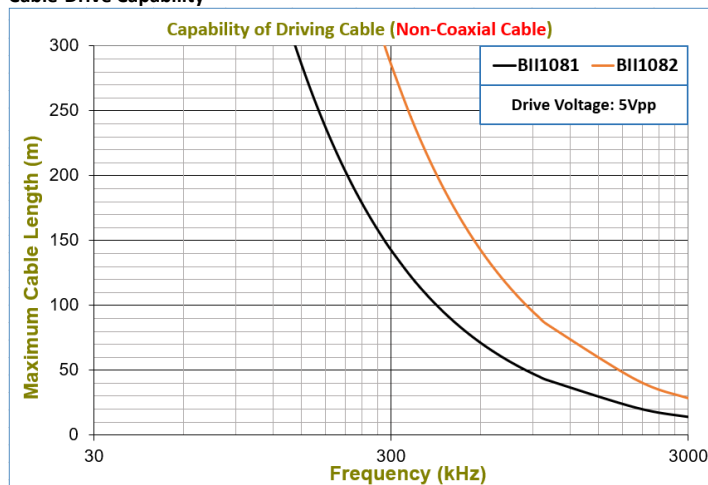
## Noise Figure vs. Frequency and Source Impedance.



## High Pass Filter vs. Ch of Hydrophones, AE, or NDT Transducers.



## Cable-Drive Capability





## Questions

**What if the connector of my transducer/sensor is SMA or SMC Connector?** SMA (or SMC) to BNC (Male) adaptors are available from many electronic distributors. BII may sell the adaptor as an accessory of the device upon request. **By default, BII does NOT supply the adaptor as accessories.**

**How do I wire 50Ω transducer/sensor to preamplifiers in high frequency applications?** Many BII preamplifiers have non-50Ω input resistances which does NOT match 50Ω in high frequency applications. Therefore, one T type BNC adaptor and one 50Ω BNC terminal are necessary between 50Ω transducer/sensor and the preamplifier to change the impedance of the preamp to be 50Ω. BII may ship T type BNC adaptor and one 50Ω BNC terminal as accessories of the device. Please specify this request when ordering. **By default, BII does NOT supply these two parts as accessories.** By the way it is NOT necessary to do 50Ω matching in low frequency range applications in which electromagnetic wave lengths are much greater than the cable length.

**How do I wire BII preamplifiers to audio connectors XLR Plug with 3 Female Sockets (Differential Signal) of my recording devices?** BII Preamplifiers have panel mount TRS Jacks as output connectors. Please order accessory A4 with preamplifiers. **By default, BII does NOT supply the cable assembly as accessories.**

**My acoustic sensors generate differential signals in MHz range, are TRS connectors of BII preamps suitable for my applications?** Our test shows the TRS connectors (Plug and Jack) of BII preamps can be used up to 20MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: 1MΩ | 30pF, Signal Source: DDS Signal Generator.

**Can 3.5mm (1/8") TRS be configured for single-ended signal of a hydrophone/transducer which does not have built-in preamplifier?** Yes, the preamp with differential-input TRS can accept single-ended signals from hydrophones/transducers whose TRS wiring should be like followings: **TRS Tip:** Signal. **TRS Ring and Sleeve:** Both terminals are soldered together for Signal Common and Shielding. Common and shielding should be "one-point" contact.

**Can BII explain why capacitances of hydrophones/transducers affect high pass filtering?** (1). Hydrophone/transducer is high impedance devices in low frequency range. Its simplified complex impedance  $= j/(2\pi f C_h)$ ,  $C_h$  is the capacitance of hydrophone/transducer,  $f$  is frequency in Hz. This impedance is in series with preamp  $R_i$  and can reach several MΩ to hundreds MΩ depending on  $C_h$  and  $f$ . (2). Most high-performance operational amplifiers (IC chips) can use input resistors  $R_i$  up to 1 to 200 MΩ to avoid bumping into saturation issue.

**My recorder (or signal processing device) is about 100m away from the hydrophone (or AE Sensor), which type of preamplifiers should I choose?** Choose differential-output preamps to drive the 100m cable and ensure that your data acquisition device can accept differential signals.