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.

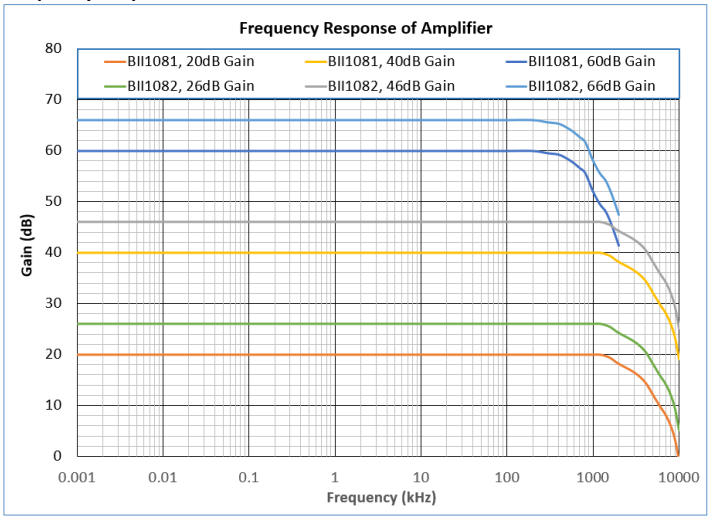
BII1080 Series Low Noise Preamplifier: 1 Hz to 2.2 MHz, 5.2 nV/√Hz, 3.1 (fA/√Hz).

Specification

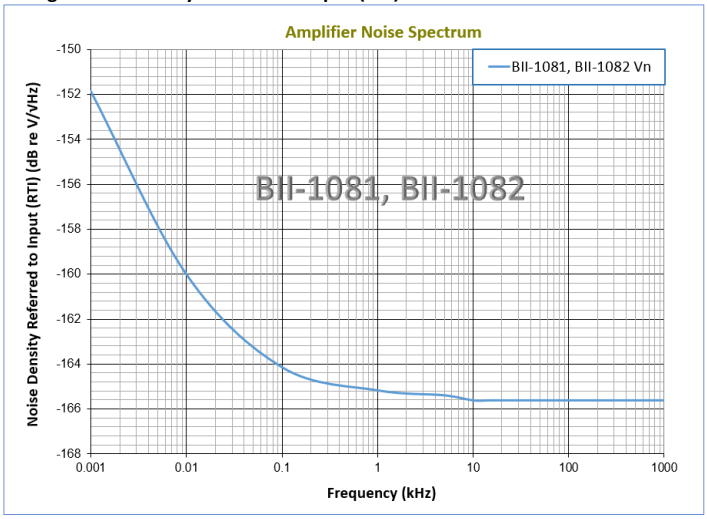
Low Noise Preamplifier:	**BII1081**	**BII1082**
Input Type:	Differential, either single ended (**SE**) or differential (**DF**) input signals are accepted.	
Input Referred Noise: (f ≥ 1 kHz)	e_n = 5.2 (nV/√Hz), i_n = 3.1 (fA/√Hz).	
	Roughly, electronic noise density at input, RTI, $V_n^2 = e_n^2 + [\, i_n$ * impedance of the transducer (or hydrophone)$]^2$.	
Input Impedance R_i:	R_i ≤ 44 MΩ at Gain ≤ 40 dB.	R_i ≤ 44 MΩ at Gain ≤ 46 dB.
	R_i ≤ 5 MΩ at 40 < Gain ≤ 60 dB.	R_i ≤ 5 MΩ at 46 < Gain ≤ 66 dB.
	Specify when ordering to set up -3dB high pass filter frequency with Capacitance C_h of a piezoelectric sensor.	
Maximum Input:	2.4 Vpp or (Maximum Output V_{omax})/Gain, whichever is less.	
Built-in Filter:	White noise level is proportional to the square root of bandwidth.	
	Filters of Preamps. 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.	
	System Filters Consisting of Standalone Piezoelectric Hydrophones and Standalone Preamps. **-3dB High Pass Frequency:** $f_{-3dBH} = 1/(2\pi R_i C_h)$. that is, $R_i = 1/(2\pi f_{-3dBH} * C_h)$. R_i: Input Resistance or Impedance of Preamp. C_h: Capacitance of piezoelectric hydrophone/sensor/transducer at 1 kHz (non-resonance measurement) or f_s (resonance measurement such as NDT pulsing system). For example: (1) hydrophone 10nF at 1kHz and preamp R_i 44MΩ constitute high pass filter with -3dB frequency 0.36Hz. (2) hydrophone 10nF at 1kHz and preamp R_i 5MΩ constitute high pass filter with -3dB frequency 3.18Hz.	
Gain Options:	20, 40, or 60 dB.	26, 46, or 66 dB.
-3dB Bandwidth:	1 Hz to 2.2 MHz at Gain ≤ 40 dB.	1 Hz to 2.2 MHz at Gain ≤ 46 dB.
	1 Hz to 0.6 MHz at Gain = 60 dB.	1 Hz to 0.6 MHz at Gain = 66 dB.
Settling Time, 0.1%:	48 ns	
Output Type:	Single-ended (**SE**)	Differential or Balanced (**DF**)
Output Impedance:	50 Ω.	
Maximum Output V_{omax}:	V_{omax} = (Supply Voltage Vs - 4), in Vpp.	
Cable Driving Capability:	200 m cable	
Supply Voltage Vs:	+7.5 to +32 VDC	
Current (Quiescent):	13 mA	17 mA
Suggested DC Supply:	+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.	
Operating Temperature:	-40 to 60 °C or -40 to 140 °F	
Storage Temperature:	-40 to 60 °C or -40 to 140 °F	
Package	**Coated PCB with Wires and Wire Leads**	
Input Wiring:	5cm wires, twisted.	
	Differential Input Wiring: **Red**: Input Signal +, **Blue**: Input Signal -, and Use **Power Supply Common** as input signal common.	
	Single-ended Input Wiring: **Red**: Input Signal, **Blue**: Input Common and wire **Blue wire** to **Power Supply Common.**	
Output Wiring:	5cm wires, twisted.	
	White: Output Signal. **Black**: Output Common.	White: Output Signal +, **Blue**: Output Signal -. **Black**: Output Common.
Power Supply Wiring:	5cm wires, twisted. **Red**: +VDC, **Black**: Common. Common of DC Power Supply is the commons of input and output.	
Size:	Coated PCB LxWxH = 33x10x5 mm	Coated PCB LxWxH = 40x10x5 mm
Weight:	6 grams	9 grams
Package	**Metal Housing with four mounting holes**	
Input Connector:	1. BNC Jack (**BNC**): for Single Ended Signal. 2. 3.5 mm or 1/8" TRS Jack (**TRS35**): for Differential Signal.	
Output Connector:	BNC Jack (**BNC**)	3.5 mm TRS Jack (**TRS35**).
Power Supply:	Power Connector Jack on Housing. Power Supply Cable: DCBP24, DCBS18V.	
Size:	LxWxH = 81.03x38x31 mm	
Weight:	100 grams	

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.

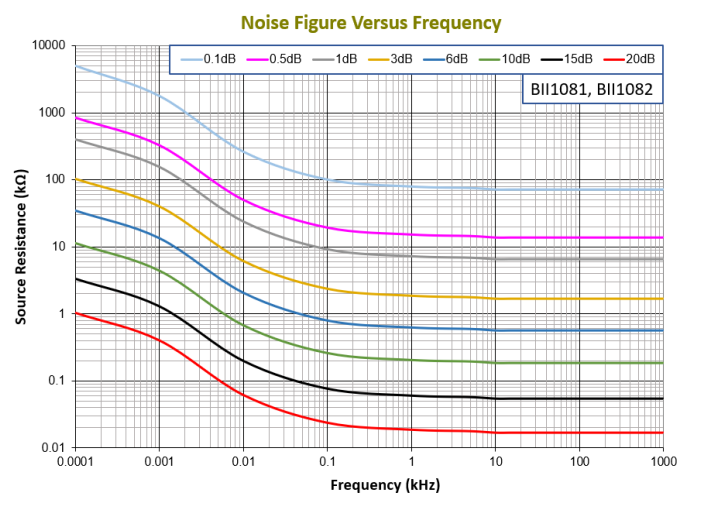
Frequency Response



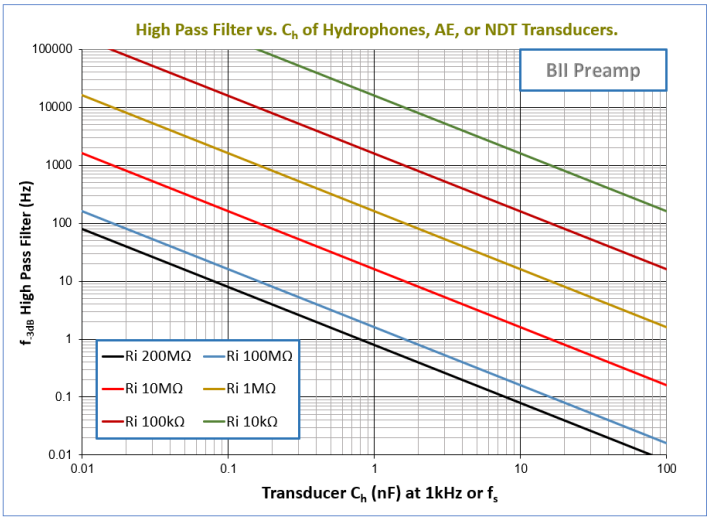
Voltage Noise Density Referred to Input (RTI):



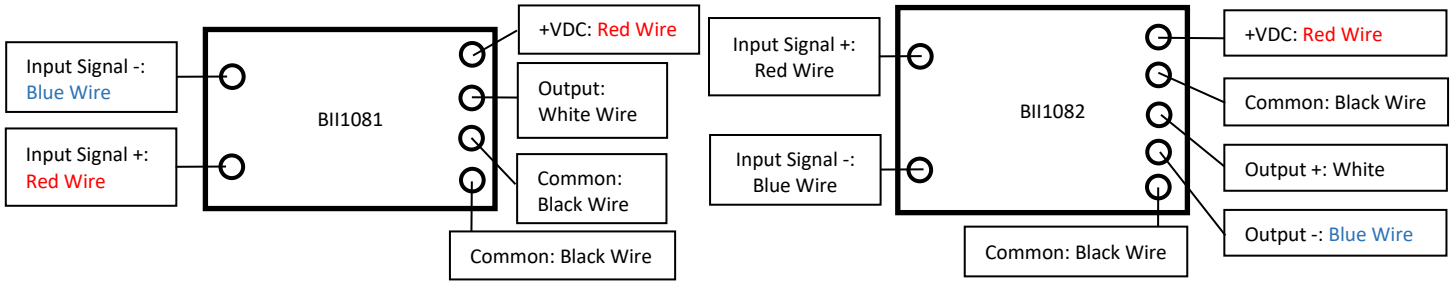
Noise Figure vs. Frequency and Source Impedance.



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



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.

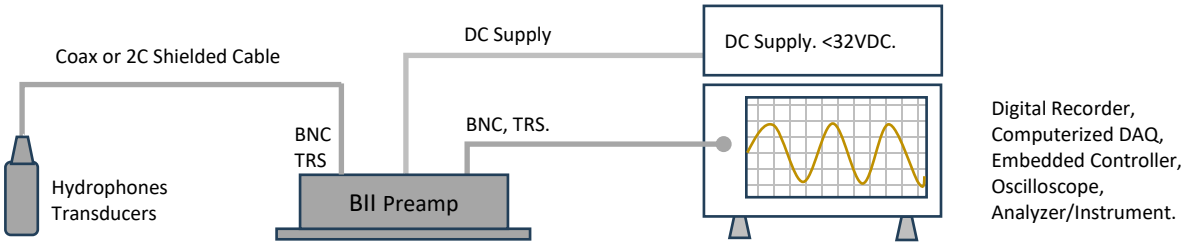
Part Number	**-Gain**	**-R_i** Input Impedance	**-LPF**	**-PCB**
BII1081	40dB.	Refer to R_iC_h Filter. 44 MΩ, 5 MΩ, or 500 kΩ.	Low Pass Filter: 2.2 MHz.	Cotaed PCB
BII1082	46dB.			
Example:		**Description:**		
BII1081-40dB-44MΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		
BII1081-40dB-5MΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 5MΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		
BII1081-40dB-500kΩ-2.2MHz-PCB:		BII1081, Preamp, 40dB Gain, Input Impedance: 500kΩ, -3dB Low Pass Filter: 2.2MHz, Coated PCB.		

BII1082-46dB-44MΩ-2.2MHz-PCB:	BII1082, Preamp, 46dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.
BII1082-46dB-5MΩ-2.2MHz-PCB:	BII1082, Preamp, 46dB Gain, Input Impedance: 5MΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.
BII1082-46dB-500kΩ-2.2MHz-PCB:	BII1082, Preamp, 46dB Gain, Input Impedance: 500kΩ, -3dB Low Pass Filter: 2.2MHz. Coated PCB.

How to Order Bespoke Preamplifiers (Coated PCB).

Part Number	**-Gain**	**-R_i** Input Impedance	**-LPF**	**-PCB**
BII1081 BII1082	In dB.	$R_i = 1/(2\pi f_{-3dBH} * C_h)$. Refer to R_iC_h Filter.	-3dB Low Pass Frequency, in Hz, kHz, or MHz.	Cotaed PCB
Example:		**Description:**		
BII1081-20dB-20MΩ-300kHz-PCB:		BII1081, Preamp, 20dB Gain, Input Impedance: 20MΩ, -3dB Low Pass Filter: 300kHz, Coated PCB.		
BII1082-46dB-1MΩ-300kHz-PCB:		BII1082, Preamp, 46dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 300kHz. Coated PCB.		

System Wirings of Standalone Preamp.



Standard BII1081 and BII1082 (Metal Housing). BII keeps standard parts in stock.

Part Number	**-Gain**	**-R_i** Input Impedance.	**-LPF**	**-Input Connector**	**-Accessory Cable Length**	**-Type**
BII1081	40dB.	Refer to R_iC_h Filter. 44 MΩ, 5 MΩ, or 500kΩ.	-3dB Low Pass Frequency: 2.2 MHz.	**BNC**: BNC Jack. **TRS**: 3.5mm TRS Jack.	0.6m, 0.9m, 1.8m, 10m, 20m. A1, A2, A3, A4. DCBP24, DCBS18V.	
BII1082	46dB.					
Example:		**Description:**				
BII1081-40dB-44MΩ-2.2MHz-BNC-DCBP24:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input: BNC Jack. DC Supply Cable: DCBP24.				
BII1081-40dB-44MΩ-2.2MHz-TRS-DCBP24:		BII1081, Preamp, 40dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input: TRS Jack. DC Supply Cable: DCBP24.				
BII1082-46dB-44MΩ-2.2MHz-BNC-DCBP24:		BII1082, Preamp, 46dB Gain, Input Impedance: 44MΩ, -3dB Low Pass Filter: 2.2MHz, Input: BNC Jack, DC Supply Cable: DCBP24.				
BII1082-46dB-5MΩ-2.2MHz-TRS-20m-A4-DCBS18V:		BII1082, Preamp, 46dB Gain, Input Impedance: 5MΩ, -3dB Low Pass Filter: 2.2MHz, Input: TRS Jack, 20m A4 Cable Accessories, DC Supply Cable: DCBS18V.				
BII1082-46dB-500kΩ-2.2MHz-TRS-20m-A4-DCBS18V:		BII1082, Preamp, 46dB Gain, Input Impedance: 500kΩ, -3dB Low Pass Filter: 2.2MHz, Input: TRS Jack, 20m A4 Cable Accessories, DC Supply Cable: DCBS18V.				

How to Order Bespoke Preamplifiers (Metal Housing).

Part Number	**-Gain**	**-R_i** Input Impedance.	**-LPF**	**-Input Connector**	**-Accessory Cable Length**	**-Type**
BII1081 BII1082	In dB.	$R_i = 1/(2\pi f_{-3dBH} * C_h)$. Refer to R_iC_h Filter.	-3dB Low Pass Frequency, in Hz, kHz, or MHz.	**BNC**: BNC Jack. **TRS**: 3.5mm TRS Jack.	Cable Length in meter. A1, A2, A3, A4. DCBP24, DCBS18V	
Example:		**Description:**				
BII1081-40dB-10MΩ-1MHz-BNC:		BII1081, Preamp, 40dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 1MHz, Input: BNC Jack.				
BII1081-40dB-10MΩ-1MHz-TRS:		BII1081, Preamp, 40dB Gain, Input Impedance: 10MΩ, -3dB Low Pass Filter: 1MHz, Input: TRS Jack.				
BII1082-66dB-1MΩ-200kHz-BNC-100m-A4-DCBS18V:		BII1082, Preamp, 66dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 200kHz, Input: BNC Jack, 100m A4 Cable Accessories, DC Supply Cable: DCBS18V.				
BII1082-66dB-1MΩ-200kHz-TRS-100m-A4-DCBS18V:		BII1082, Preamp, 66dB Gain, Input Impedance: 1MΩ, -3dB Low Pass Filter: 200kHz, Input: TRS Jack, 100m A4 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**	**Power Jack**
Center: Signal Shield: Common	Tip: Signal +, Positive or Hot. Ring: Signal -, Negative or Cold. Sleeve: Common/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	Tip, White Wire: Signal +.	Pin 2, Positive/Hot.	Red Banana Plug: +VDC.

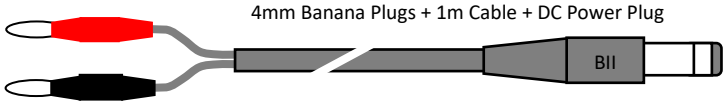
Shield: Common	Ring, Black Wire: Signal -. Sleeve, Shield: Common.	Pin 3, Negative/Cold. Pin 1, Shield/Ground.	Black Banana Plug: Common. Cable Shield, if any: Shielding.
Warning: "Signal –" is the reverse (180° phase difference) of "Signal +", and "Signal –" MUST NOT be connected to Common or Ground.			

Accessories:

Part Number: DCBP24.

To Terminals of DC Supply:
a. One Red 4mm Banana Plug.
b. One Black 4mm Banana Plug.

4mm Banana Plugs + 1m Cable + DC Power Plug



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

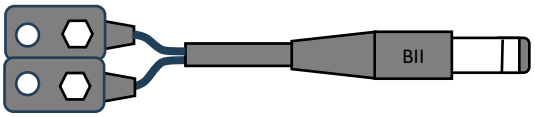
Red Banana Plug or Red Wire Lead: +VDC.	**Black Banana Plug or Black Wire Lead:** Common.	**Cable Shield, if any**: Shielding.

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.

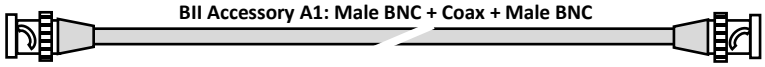


DC Power Plug.
To DC Power Jack of the Device.

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.

BII Accessory A1: Male BNC + Coax + Male BNC

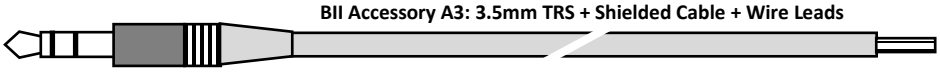


A2: Bespoke length cable with 3.5mm TRS Plug to 3.5mm TRS Plug. Default: 1.828m.

BII Accessory A2: 3.5mm TRS + Shielded Cable + 3.5mm TRS

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

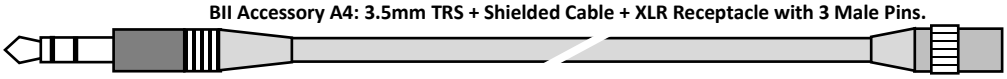
BII Accessory A3: 3.5mm TRS + Shielded Cable + Wire Leads



Wire Leads

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

BII Accessory A4: 3.5mm TRS + Shielded Cable + XLR Receptacle with 3 Male Pins.



XLR Receptacle with 3 Male Pins.

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.

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**.

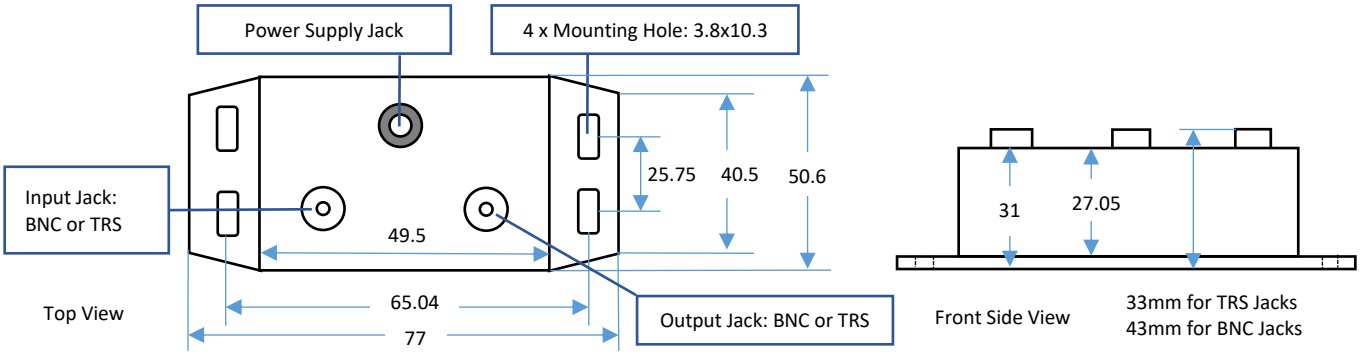
My acoustic sensors generate differential signals in MHz range, are TRS connectors of BII preamps suitable for my applications? Our test shows the TRS connectors (Plug and Jack) of BII preamps can be used up to 20MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: 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 = $j/(2\pi fC_h)$, 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.

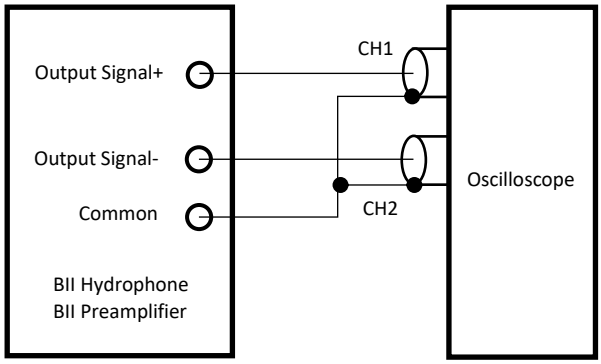
My recorder (or signal processing device) is about 100m away from the hydrophone (or AE Sensor), which type of preamplifiers should I choose? Choose differential-output preamps to drive the 100m cable and ensure that your data acquisition device can accept differential signals.

Fixed Gain Preamplifier Metal Housing Package, Outline Dimensions (mm)



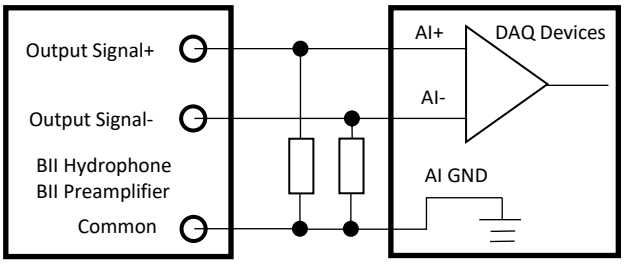
Preamplifier Wirings to DAQ (Data Acquisition): DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

BII's Differential Output to BNC Input of an Oscilloscope



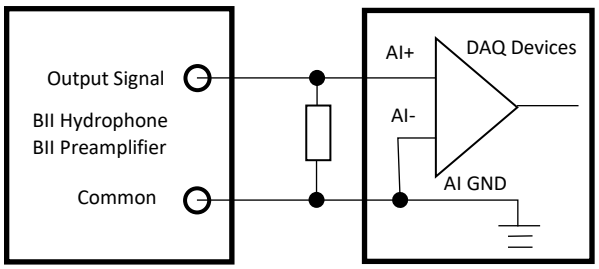
BII's Differential Output to Differential Input of a DAQ

If input impedance of a DAQ device is greater than 100MΩ, use following wiring with one 100kΩ to 1MΩ resistor.



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

If input impedance of a DAQ device is greater than 100MΩ, use following wiring with one 100kΩ to 1MΩ resistor.



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