



## 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/Sediment Profiler, Acoustic Image. Streamer/Towed Array, Sonobuoy, Target Strength Testing.	Ultrasonic (Ultrasound, AE, NDT) Testing, Material Characterization. Low Noise Ultrasonic Preamplifier, Ultrasonic Instrumentation, Pulse Amplifier. Sonic Cavitation Noise, Bottom Moored Systems.
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### BII1060 Series Low Power Low Noise Preamplifier: Hand-held, Portable, Battery-operated Systems.

Low Power Low Noise Preamplifiers for acoustical instruments: Hydrophones, Air Transducers, Acoustic Emission Sensors, and Ultrasonic Transducers (Non-destructive Testing). Uses in underwater sound (oceanography and hydrography), sonic and ultrasonic engineering, electroacoustics, communication, bioacoustics, exploration seismology and seismic wave, physical acoustics, acoustical imaging, and material study.

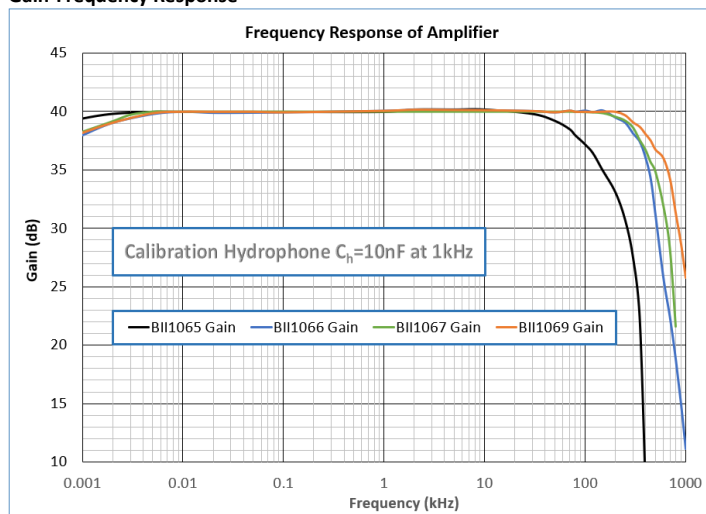
## Specification

HPF: High Pass Filter; BPF: Band Pass Filter. SE: Single-ended, DF: Differential. RTI: Referred to the input of the preamp.  $R_i$ : Input Impedance.  $V_s$ : Supply Voltage.  $I_Q$ : Quiescent Current;  $V_{omax}$ : Output Voltage Swing;  $Z_o$ : Output Impedance.

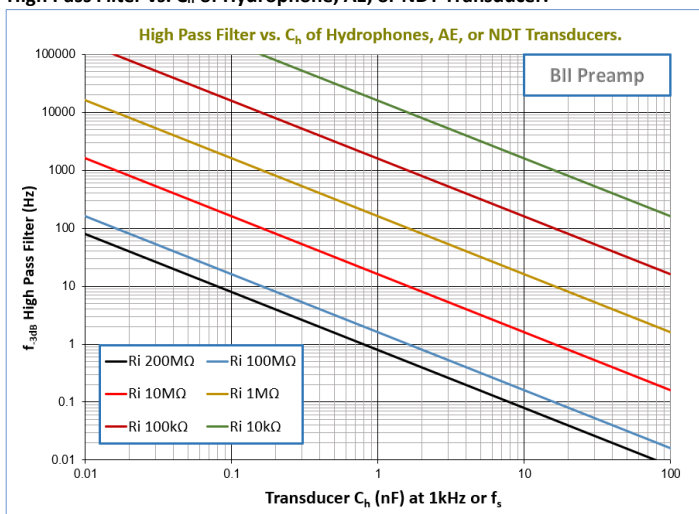
Low Noise Preamplifier:	BII1065	BII1066	BII1067	BII1069
Input Type:	Differential, either single ended (SE) or differential (DF) input signals are accepted.			
Input Referred Noise: RTI, $f \geq 1$ kHz.	$e_n = 14$ nV/VHz. $i_n = 0.5$ fA/VHz.	$e_n = 5$ nV/VHz. $i_n = 85$ fA/VHz.	$e_n = 21$ nV/VHz. $i_n = 160$ fA/VHz.	$e_n = 7$ nV/VHz. $i_n = 170$ fA/VHz.
	Roughly, electronic noise density at input, RTI, $V_n^2 = e_n^2 + [i_n * \text{impedance of the transducer (or hydrophone)}]^2$ .			
Input Impedance $R_i$ :	$\leq 100$ M $\Omega$	$\leq 20$ M $\Omega$	$\leq 20$ M $\Omega$	$\leq 20$ M $\Omega$
	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.			
	HPF	HPF	HPF	HPF
	Customized high pass filter, specify -3dB cut-off frequencies when ordering.			
	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.			
Built-in Filter:	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 $R_i$ 100M $\Omega$ constitute high pass filter with -3dB frequency 0.159Hz. (2) hydrophone 10nF at 1kHz and preamp $R_i$ 20M $\Omega$ constitute high pass filter with -3dB frequency 0.795Hz. (3) hydrophone 10nF at 1kHz and preamp $R_i$ 2M $\Omega$ constitute high pass filter with -3dB frequency 7.950Hz. (4) hydrophone 10nF at 1kHz and preamp $R_i$ 200k $\Omega$ constitute high pass filter with -3dB frequency 79.50Hz.			
Gain of Pass Band:	40dB	40dB	40dB	40dB
	Differential Output: Gain in dB = $20 * \log(\text{Differential Output}/\text{Input})$ . Single-ended Output: Gain in dB = $20 * \log(\text{Single-ended Output}/\text{Input})$ .			
-3dB Bandwidth:	0.1 Hz to 100 kHz	1 Hz to 350 kHz	1 Hz to 350 kHz	1 Hz to 500 kHz
Settling Time, 0.01%:	35 $\mu$ S	6 $\mu$ S	12 $\mu$ S	6 $\mu$ S
Output Type:	DF: Differential	DF: Differential	SE: Single Ended	DF: Differential
Output Impedance:	10 $\Omega$	10 $\Omega$	10 $\Omega$	50 $\Omega$
Maximum Output $V_{omax}$ :	$V_s - 3.4$ , Vpp.	$V_s - 2.0$ , Vpp.	$V_s - 0.7$ , Vpp.	$V_s - 4.0$ , Vpp.
Cable Driving Capability:	200 m	150 m	60 m	1000 m
Power Supply $V_s$ :	+4.5 to +32, VDC.	+4.5 to +32, VDC.	+3.4 to +32, VDC.	+7.5 to +32, VDC.
Quiescent Current $I_Q$ :	1.05 mA	1.45 mA	1.55 mA	7.0 mA
Suggested DC Supply:	1.2 V to 12.6 V Batteries (AA, AAA, C, and D, 9V, Coin Cell, Marine and Automobile). 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 70 °C or -40 to 158 °F			
Storage Temperature:	-40 to 70 °C or -40 to 158 °F			
Package	Metal Housing with four mounting holes			
Input Connector:	1. BNC Jack (BNC): for Single Ended Signal. 2. 3.5 mm TRS Jack (TRS): for Differential Signal.			
Output Connector:	3.5 mm TRS Jack (TRS)	3.5 mm TRS Jack (TRS)	BNC Jack (BNC)	3.5 mm TRS Jack (TRS)
Power Supply:	Power Connector Jack on Housing. Power Supply Cable: <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .			
Size LxWxH:	77x50.6x33 mm (TRS Jacks) or 77x50.6x43 mm (BNC Jacks).			
Weight:	75 grams			

<b>Accessories:</b>	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.			
<b>Package</b>	Coated PCB with Wires and Wire Leads			
<b>Input Wiring:</b>	5cm wires, twisted.			
	Differential Input Wiring: <b>Red:</b> Input Signal +, <b>Blue:</b> Input Signal -, and Use Power Supply Common as input signal common.			
	Single-ended Input Wiring: <b>Red:</b> Input Signal, <b>Blue:</b> Input Common and wire <b>Blue Wire</b> to Power Supply Common.			
<b>Output Wiring:</b>	5cm wires, twisted.			
	Differential Output Wiring: <b>White:</b> Output Signal +, <b>Blue:</b> Output Signal -, Black: Output Common.			
	Single-ended Output Wiring: <b>White:</b> Output Signal, Black: Output Common.			
<b>Power Supply Wiring:</b>	5cm wires, twisted. <b>Red:</b> +VDC, Black: Common. Common of DC Power Supply is the commons of input and output.			
<b>Size (LxWxH):</b>	33x8.9x5 mm	33x8.9x5 mm	29.2x11.43x5 mm	30x8.9x5 mm
<b>Weight:</b>	3 grams	3 grams	3 grams	3 grams

### Gain-Frequency Response



### High Pass Filter vs. $C_h$ of Hydrophone, AE, or NDT Transducer.



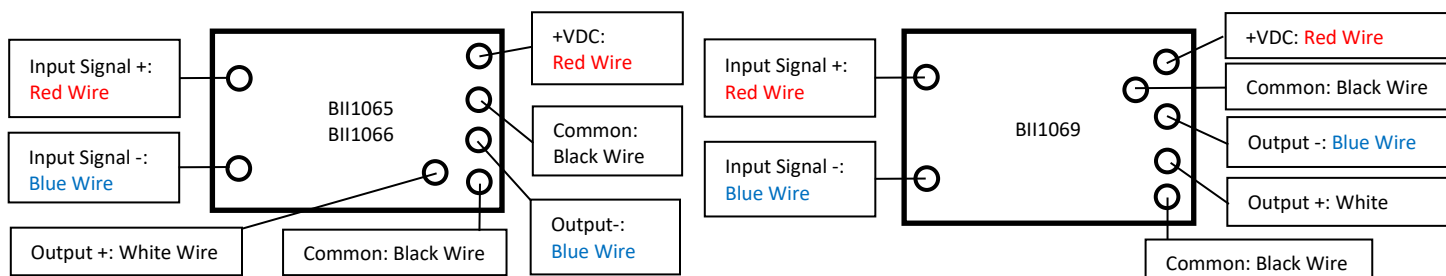
**Phase Measurement:** By default, BII does not measure **phase response vs. frequency**. Phase measurement is available upon request when ordering.

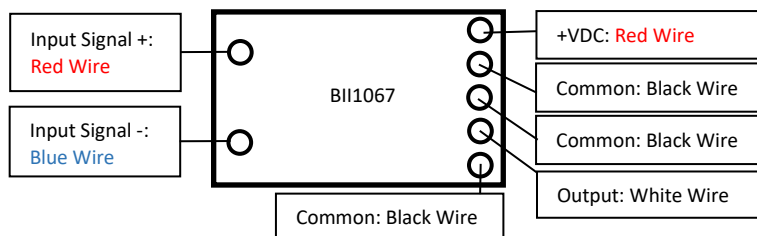
**Standard Coated PCB.** BII keeps standard parts in stock.

Standard Coated PCB: All keeps standard parts in stock.		
Part Number	- <u>R<sub>i</sub></u> Input Impedance.	-PCB
BII1065	100 MΩ.	Cotaed PCB. 5cm Wires.
BII1066	20 MΩ.	
BII1067	20 MΩ.	
BII1069	20 MΩ.	
	2 MΩ.	
	200 kΩ.	
<b>-3dB High Pass Frequency:</b> $f_{3dBH} = 1/(2\pi R_i C_h)$ . Refer to <a href="#">Built-in Filter</a> , <a href="#">R<sub>i</sub>C<sub>h</sub> Filter</a> and <a href="#">-3dB Bandwidth</a> .		
Example:	Description:	
BII1065-100MΩ-PCB:	BII1065, Preamp, Input Impedance: 100MΩ, Coated PCB with 5cm Wires.	
<a href="#">BII1066-20MΩ-PCB:</a>	<a href="#">BII1066, Preamp, Input Impedance: 20MΩ, Coated PCB with 5cm Wires.</a>	
BII1067-20MΩ-PCB:	BII1067, Preamp, Input Impedance: 20MΩ, Coated PCB with 5cm Wires.	
<a href="#">BII1069-20MΩ-PCB:</a>	<a href="#">BII1069, Preamp, Input Impedance: 20MΩ, Coated PCB with 5cm Wires.</a>	
BII1069-2MΩ-PCB:	BII1069, Preamp, Input Impedance: 2MΩ, Coated PCB with 5cm Wires.	
BII1069-200kΩ-PCB:	BII1069, Preamp, Input Impedance: 200kΩ, Coated PCB with 5cm Wires.	

**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 Metal Housing.** BII keeps standard parts in stock.

Part Number	-R <sub>i</sub>	-Input/Output Connector	-Accessory Cable Length	-Accessory Type
BII1065	100 MΩ.	TRS/TRS, or BNC/TRS.	0.6m, 0.9m, 1.8m, 10m, 20m, 50m, 100m, 200m, 305m.	A1, A2, A3, or A4. DCBP24, DCBS18V.
BII1066	20 MΩ.	TRS/TRS, or BNC/TRS.		
BII1067	20 MΩ.	TRS/BNC or BNC/BNC.		
BII1069	20 MΩ. 2 MΩ. 200 kΩ.	TRS/TRS, or BNC/TRS.		

**-3dB High Pass Frequency:**  $f_{-3dBH} = 1/(2\pi R_i C_h)$ . Refer to [Built-in Filter](#), [R<sub>i</sub>C<sub>h</sub> Filter](#) and [-3dB Bandwidth](#).

Example:	Description:
BII1065-100MΩ-TRS/TRS-50m-A3- DCBS18V:	BII1065, Preamp, Input Impedance: 100MΩ, Input/Output: TRS/TRS Jacks. 50m A3 Cable Accessories. DC Supply Cable: DC-DCBS18V.
BII1065-100MΩ-BNC/TRS-50m-A4- DCBS18V:	BII1065, Preamp, Input Impedance: 100MΩ, Input/Output: BNC/TRS Jacks. 50m A4 Cable Accessories. DC Supply Cable: DC-DCBS18V.
BII1066-20MΩ-TRS/TRS-50m-A3- DCBS18V:	BII1066, Preamp, Input Impedance: 20MΩ, Input/Output: TRS/TRS Jacks, 50m A3 Cable Accessories. DC Supply Cable: DC-DCBS18V.
BII1066-20MΩ-BNC/TRS-50m-A4- DCBS18V:	BII1066, Preamp, Input Impedance: 20MΩ, Input/Output: BNC/TRS Jacks, 50m A4 Cable Accessories. DC Supply Cable: DC-DCBS18V.
BII1067-20MΩ-TRS/BNC-DCBS18V:	BII1067, Preamp, Input Impedance: 20MΩ, Input/Output: TRS/BNC Jacks. DC Supply Cable: DC-DCBS18V.
BII1067-20MΩ-BNC/BNC-DCBS18V:	BII1067, Preamp, Input Impedance: 20MΩ, Input/Output: BNC/BNC Jacks. DC Supply Cable: DC-DCBS18V.
BII1069-20MΩ-TRS/TRS-100m-A3-DCBS18V:	BII1069, Preamp, Input Impedance: 20MΩ, Input/Output: TRS/TRS Jacks, 100m A3 Cable Accessories. DC Supply Cable: DCBS18V.
BII1069-20MΩ-BNC/TRS-100m-A4-DCBS18V:	BII1069, Preamp, Input Impedance: 20MΩ, Input/Output: BNC/TRS Jacks, 100m A4 Cable Accessories. DC Supply Cable: DCBS18V.
BII1069-2MΩ-TRS/TRS-100m-A3-DCBS18V:	BII1069, Preamp, Input Impedance: 2MΩ, Input/Output: TRS/TRS Jacks, 100m A3 Cable Accessories. DC Supply Cable: DCBS18V.
BII1069-2MΩ-BNC/TRS-100m-A4-DCBS18V:	BII1069, Preamp, Input Impedance: 2MΩ, Input/Output: BNC/TRS Jacks, 100m A4 Cable Accessories. DC Supply Cable: DCBS18V.
BII1069-200kΩ-TRS/TRS-100m-A3-DCBS18V:	BII1069, Preamp, Input Impedance: 200kΩ, Input/Output: TRS/TRS Jacks, 100m A3 Cable Accessories. DC Supply Cable: DCBS18V.
BII1069-200kΩ-BNC/TRS-100m-A4-DCBS18V:	BII1069, Preamp, Input Impedance: 200kΩ, Input/Output: BNC/TRS Jacks, 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 (1/8") 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.

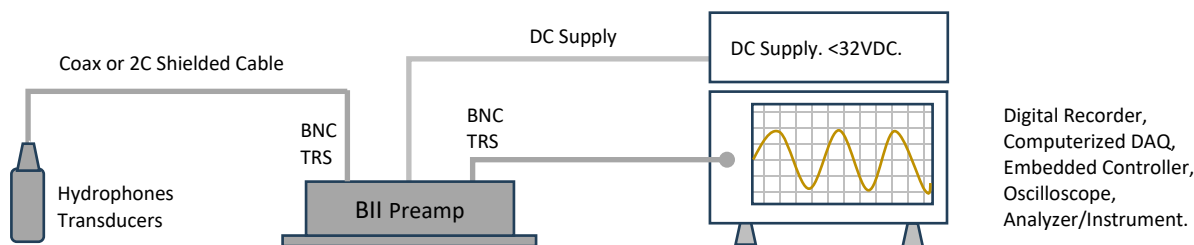
**Metal Case is for shielding and grounding.**

#### 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 (1/8") TRS and Cable	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.

**Warning:** "Signal -" is the reverse (180° phase difference) of "Signal +", and "Signal -" MUST NOT be connected to Common or Ground.

## System Wirings of Standalone Preamp.

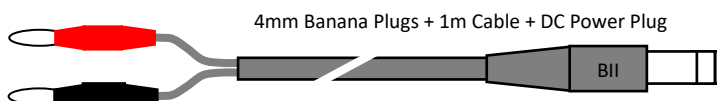


## Accessories:

**Part Number: DCBP24.**

### To Terminals of DC Supply:

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

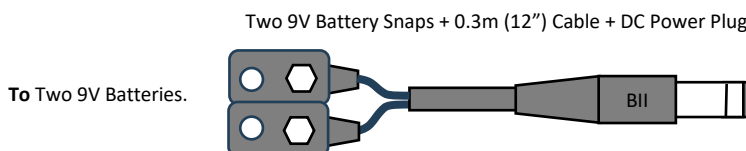


DC Power Plug.  
To DC Power Jack of the Device.

<b>Red Banana Plug or Red Wire Lead:</b> +VDC.	<b>Black Banana Plug or Black Wire Lead:</b> Common.	<b>Cable Shield, if any:</b> 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.**



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.**



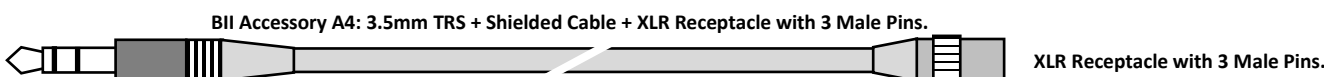
**A2: Bespoke length cable with 3.5mm TRS Plug to 3.5mm TRS Plug. Default: 1.828m.**



**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.

## 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.**

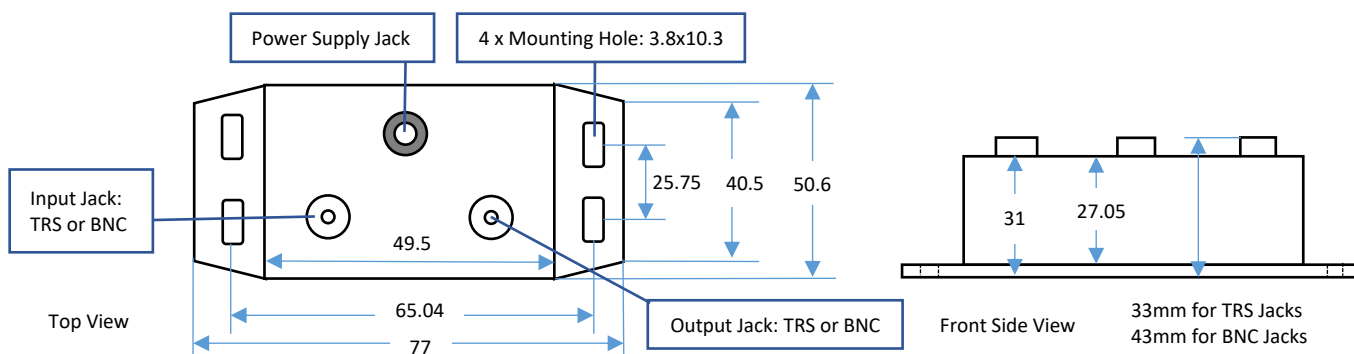
**My acoustic sensors generate differential signals in MHz range, are TRS connectors of BII preamps suitable for my applications?** Our test shows the TRS connectors (Plug and Jack) of BII preamps can be used up to 20MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: 1M $\Omega$  || 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 M $\Omega$  to hundreds M $\Omega$  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 M $\Omega$  to avoid bumping into saturation issue.

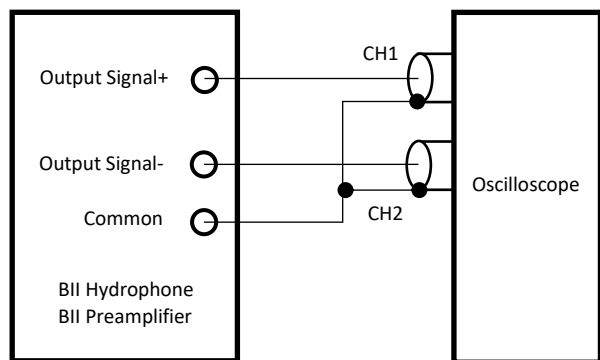
**My recorder (or signal processing device) is about 100m away from the hydrophone (or AE Sensor), which type of preamplifiers should I choose?** Choose differential-output preamps to drive the 100m cable and ensure that your data acquisition device can accept differential signals.

#### Metal Housing with four mounting holes, Outline Dimensions (mm)



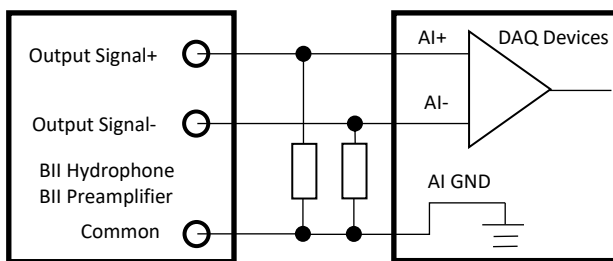
**Preamplifier Wirings to DAQ (Data Acquisition):** DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

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



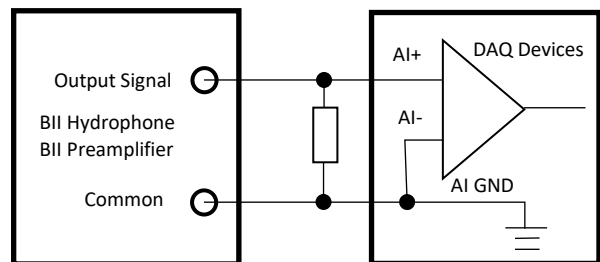
#### BII's Differential Output to Differential Input of a DAQ

If input impedance of a DAQ device is greater than 100M $\Omega$ , use following wiring with one 100k $\Omega$  to 1M $\Omega$  resistor.



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

If input impedance of a DAQ device is greater than 100M $\Omega$ , use following wiring with one 100k $\Omega$  to 1M $\Omega$  resistor.



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

