



### 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

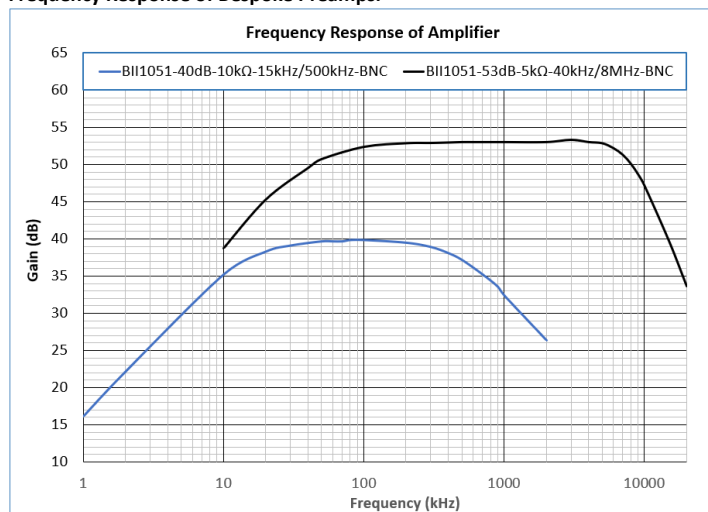
Hydrophone, SONAR, Underwater Communication, Navigation. Seafloor-mapping, Sub-bottom/Sediment Profiler, Acoustic Image. Streamer/Towed Array, Sonobuoy, Target Strength Testing.	Ultrasonic (Ultrasound, AE, NDT) Testing, Material Characterization. Low Noise Ultrasonic Preamplifier, Ultrasonic Instrumentation, Pulse Amplifier. Sonic Cavitation Noise.
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#### BII1050 Series Low Noise Ultrasonic Preamplifier: 0.02 Hz to 10 MHz, 1 nV/VHz, 0.8 fA/VHz.

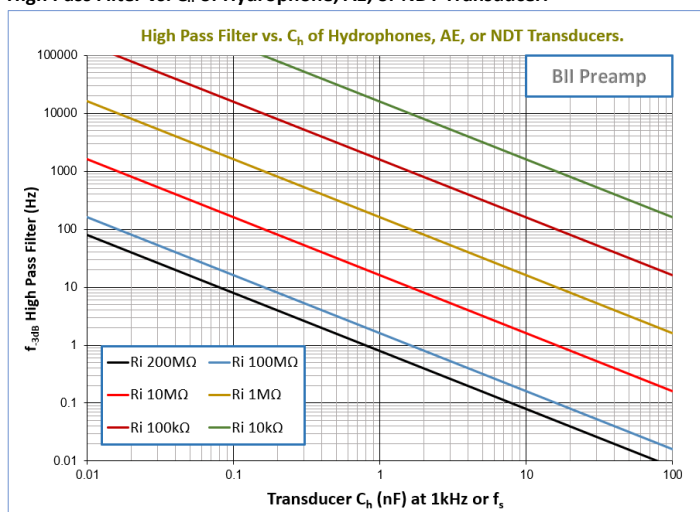
#### Specification

e <sub>n</sub> : Input Referred Voltage Noise at 1kHz; i <sub>n</sub> : Input Referred Current Noise at 1kHz; V <sub>s</sub> : Supply Voltage VDC; I <sub>q</sub> : Quiescent Supply Current; BPF: Band Pass Filter; HPF: High Pass Filter; SE: Single-ended; DF: Differential. Rectangular PCB Size: LxWxH. BNC Jack: for Single Ended Signal. 3.5 mm TRS Jack: for Differential Signal.						
Preamplifier:	BII1051	BII1053	BII1052	BII1054	BII1055	BII1056
Input Type:	Differential, either single ended (SE) or differential (DF) input signals are accepted.					
Input Referred Noise: (f ≥ 1 kHz).	e <sub>n</sub> : 1 nV/VHz		e <sub>n</sub> : 10.0 nV/VHz		e <sub>n</sub> : 1 nV/VHz	e <sub>n</sub> : 10.0 nV/VHz
	i <sub>n</sub> : 1.6 pA/VHz		i <sub>n</sub> : 0.8 fA/VHz		i <sub>n</sub> : 1.6 pA/VHz	i <sub>n</sub> : 0.8 fA/VHz
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> .						
Input Impedance:	≤ 500 kΩ		≤ 200 MΩ		≤ 500 kΩ	≤ 200 MΩ
	Specify when ordering to set up -3dB high pass filter frequency with Capacitance C <sub>n</sub> of a piezoelectric sensor.					
	R <sub>i</sub> 50Ω matches 50Ω coax cable impedance and damps down NDT transducer to achieve good transient or pulse response or reduce decaying time (or ringing) of the transducer.					
	To avoid adverse effects of parasitic components of a resistor, input impedance ≤ 5kΩ is recommended for MHz applications.					
Maximum Input:	2.4 Vpp or (Maximum Output)/Gain, whichever is less.					
Built-in Filter:	BPF		BPF		HPF	HPF
	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.					
	System Filters Consisting of Standalone Piezoelectric Hydrophones and Standalone Preamps.					
	-3dB High Pass Frequency: 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). For example: (1) Hydrophone 10nF at 1kHz and preamp R <sub>i</sub> 200MΩ constitute high pass filter with -3dB frequency 0.08Hz. (2) NDT Transducer 10nF at f <sub>s</sub> and preamp R <sub>i</sub> 50Ω constitute high pass filter with -3dB frequency 318.3kHz.					
Gain of Pass Band:	40 dB, 60 dB.		40 dB, 60 dB.		40 dB	40 dB
-3dB Bandwidth:	1 Hz ~ 10 MHz at 40dB Gain. 1 Hz ~ 8 MHz at 60dB Gain.		0.02Hz ~ 1.5MHz at 40dB. 0.02 Hz ~ 600 kHz at 60dB.		1 Hz ~ 8 MHz	0.02 Hz ~ 450 kHz
Settling Time, 0.01%:	0.4 μS		4 μS		0.4 μS	4 μS
Output Type:	SE	DF	SE	DF	SE	SE
Output Impedance:	50 Ω		10 Ω		50 Ω	10 Ω
Maximum Output V <sub>omax</sub> :	(Supply Voltage - 4), in Vpp.					
Cable Driving Capability:	200 m		200 m		20 m	20 m
Power Supply V <sub>s</sub> :	+7.5 to +32 VDC		+8.5 to +32 VDC		+7.5 to +32 VDC	+8.5 to +32 VDC
Quiescent Current:	14.2 mA	12.7 mA	8.3 mA	9.8 mA	7.7 mA	4.8 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 (TRS35): for Differential Signal.					
Output Connector:	BNC Jack	3.5 mm TRS Jack	BNC Jack	3.5 mm TRS Jack	BNC Jack	BNC Jack
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:	70 to 85 gram					
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 of Bespoke Preamps.



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



Standard BII1055 and BII1056 (Metal Housing). BII keeps standard parts in stock.

Standard BII1055 and BII1056 (Metal Housing). BI keeps standard parts in stock.			
Part Number	- <u><a href="#">R<sub>i</sub></a></u> Input Impedance, Refer to <u><a href="#">R<sub>i</sub>C<sub>h</sub> Filter</a></u> .	-Input Connector	- <u><a href="#">DC Supply Type</a></u>
BII1055	500 KΩ.	BNC: BNC Jack. TRS: 3.5mm TRS Jack.	<u><a href="#">DCBP24</a></u> , <u><a href="#">DCBS18V</a></u> .
	50 KΩ		
	5 KΩ		
	50 Ω.		
BII1056	200 MΩ.		
	20 MΩ.		
	2 MΩ.		
Example:	Description:		
BII1055-500kΩ-TRS-DCBP24:	BII1055, Preamp, Input Impedance: 500kΩ, Input: TRS Jack. DC Supply Cable: DCBP24.		
BII1055-50kΩ-BNC-DCBP24:	BII1055, Preamp, Input Impedance: 50kΩ, Input: BNC Jack. DC Supply Cable: DCBP24.		
BII1055-5kΩ-BNC-DCBP24:	BII1055, Preamp, Input Impedance: 50kΩ, Input: BNC Jack. DC Supply Cable: DCBP24.		
BII1055-50Ω-BNC-DCBP24:	BII1055, Preamp, Input Impedance: 50Ω, Input: BNC Jack. DC Supply Cable: DCBP24.		
BII1056-200MΩ-BNC-DCBP24:	BII1056, Preamp, Input Impedance: 200MΩ, Input: BNC Jack. DC Supply Cable: DCBP24.		
BII1056-20MΩ-TRS-DCBP24:	BII1056, Preamp, Input Impedance: 20MΩ, Input: TRS Jack. DC Supply Cable: DCBP24.		
BII1056-2MΩ-TRS-DCBP24:	BII1056, Preamp, Input Impedance: 2MΩ, Input: TRS Jack. DC Supply Cable: DCBP24.		

How to Order Bespoke Preamplifiers with Metal Housing. Non-stock.

Part Number	-Gain	- $R_i$ Input Impedance.	-HPF/LPF	-Input Connector	-Accessory Cable Length	-Type
BII1051, BII1053, BII1052, BII1054.	40dB, 60dB.	Refer to <a href="#">R<sub>i</sub>C<sub>h</sub> Filter</a> .	-3dB Bandpass Frequency, in Hz, kHz, MHz.	BNC: BNC Jack. TRS: 3.5mm TRS Jack.	Blank or Default: No Accessories. <a href="#">A1</a> , <a href="#">A2</a> , <a href="#">A3</a> , or <a href="#">A4</a> . <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .	

**High Pass Filter of the preamp** is the combination of  $R_iC_h$  High Pass Filter and HPF High Pass Filter.  $R_iC_h$  High Pass Filter is determined by  $C_h$ .

To avoid adverse effects of parasitic components of a resistor, input impedance  $\leq 5k\Omega$  is recommended for MHz applications.

<b>Example:</b>	<b>Description:</b>					
BII1051-40dB-50Ω-0.1MHz/10MHz-BNC-DCBP24:	BII1051, Preamp, 40dB Gain, Input Impedance: 50Ω, -3dB Band Pass Filter: 0.1MHz to 10MHz; Input: BNC Jack. DC Supply Cable: DCBP24.					
BII1051-40dB-50kΩ-1kHz/1MHz-TRS-DCBP24:	BII1051, Preamp, 40dB Gain, Input Impedance: 50kΩ, -3dB Band Pass Filter: 1kHz to 1MHz; Input: TRS Jack. DC Supply Cable: DCBP24.					
BII1054-60dB-1MΩ-1Hz/200kHz-BNC-30m-A4-DCBS18V:	BII1054, Preamp, 60dB Gain, Input Impedance: 1MΩ, -3dB Band Pass Filter: 1Hz to 200kHz; Input: BNC Jack. Accessory: 30m A4. DC Supply Cable: DCBS18V.					
BII1054-60dB-1MΩ-1Hz/200kHz-TRS-30m-A4-DCBS18V:	BII1054, Preamp, 60dB Gain, Input Impedance: 1MΩ, -3dB Band Pass Filter: 1Hz to 200kHz; Input: TRS Jack. Accessory: 30m A4. DC Supply Cable: DCBS18V.					

### Signals and Wiring of Panel-Mount Connectors

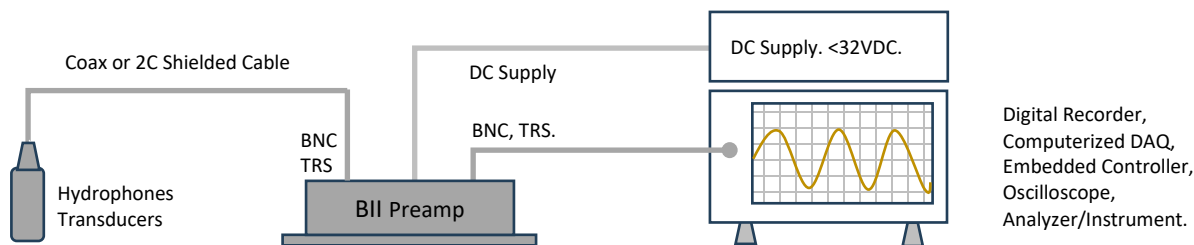
Input or Output Signals		Power Supply
Single Ended (SE)	Differential/Balanced (DF):	Single DC Supply
BNC Jack	3.5mm TRS Jack	Power Jack
Center: Signal Shield: Common	Tip: Signal +, Positive or Hot. Ring: Signal -, Negative or Cold. Sleeve: Common/Ground.	Center Contact: +VDC. Shell: Common.
<b>Metal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

### 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	Power Plug
	XLR (Balanced Audio)	

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

#### System Wirings of Standalone Preamp.

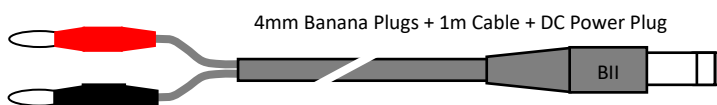


#### Accessories:

**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.

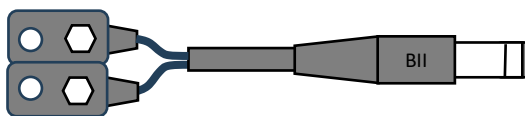
<b>Red Banana Plug or Red Wire Lead:</b> +VDC.	<b>Black Banana Plug or Black Wire Lead:</b> Common.	<b>Cable Shield, if any:</b> Shielding.
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One 1m DC supply cable. One end is with Red and Black Banana Plugs, another end of the cable is with DC Power 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.**

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

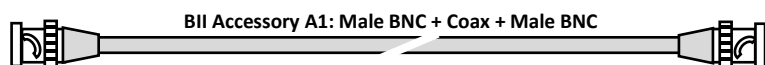
To Two 9V Batteries.



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.**



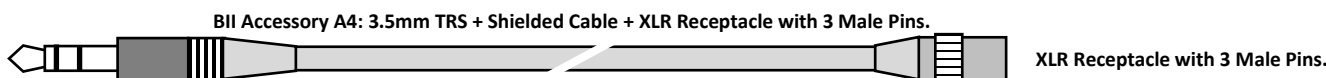
**A2: Bespoke length cable with 3.5mm TRS Plug to 3.5mm TRS Plug. Default: 1.828m.**



**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.

#### 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.**

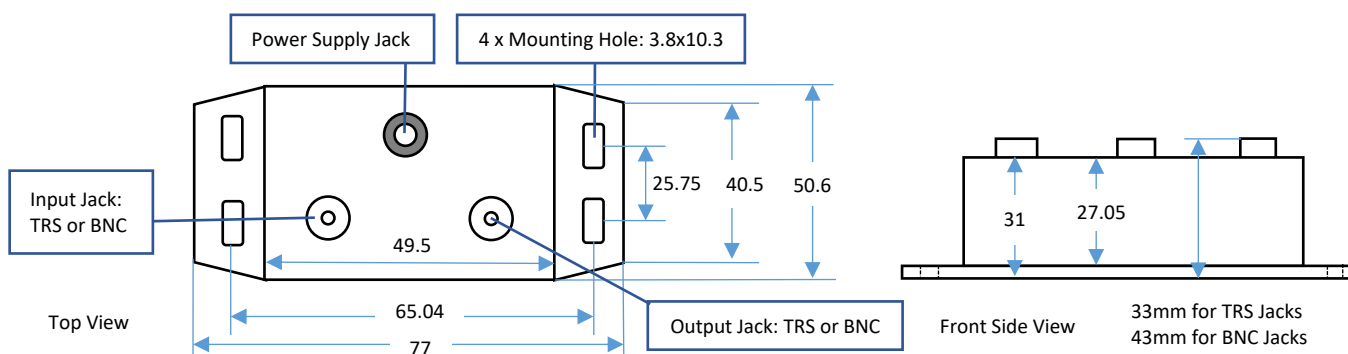
**My acoustic sensors generate differential signals in MHz range, are TRS connectors of BII preamps suitable for my applications?** Our test shows the TRS connectors (Plug and Jack) of BII preamps can be used up to 20 MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: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

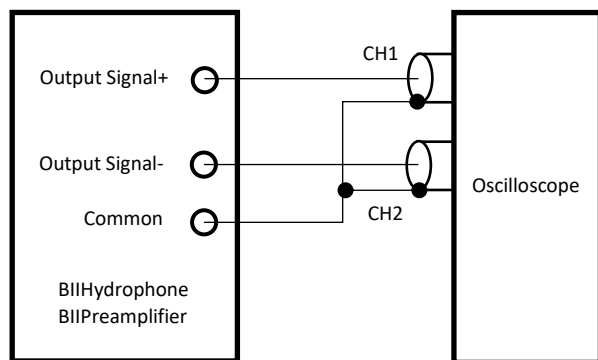
**My recorder (or signal processing device) is about 100m away from the hydrophone (or AE Sensor), which type of preamplifiers should I choose?** Choose differential-output preamps to drive the 100m cable and ensure that your data acquisition device can accept differential signals.

#### BII1050 Series Preamplifier Metal Housing Package, Outline Dimensions (mm)

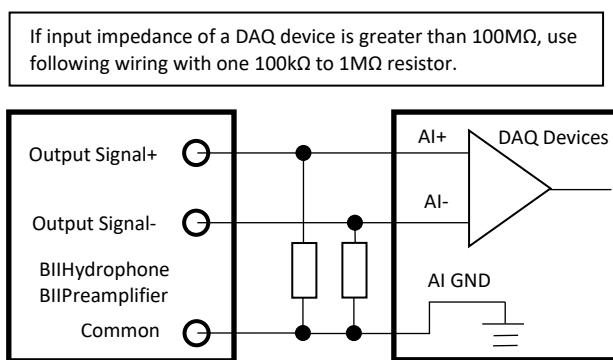


**Preamplifier Wirings to DAQ (Data Acquisition):** DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

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

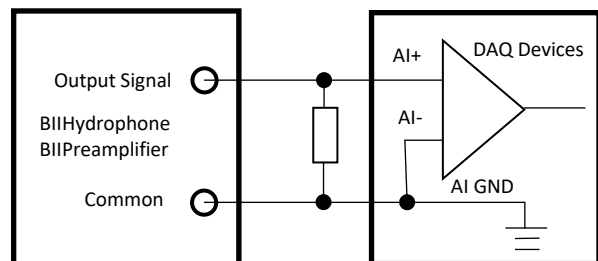


#### BII's Differential Output to Differential Input of a DAQ



#### 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

