



## 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

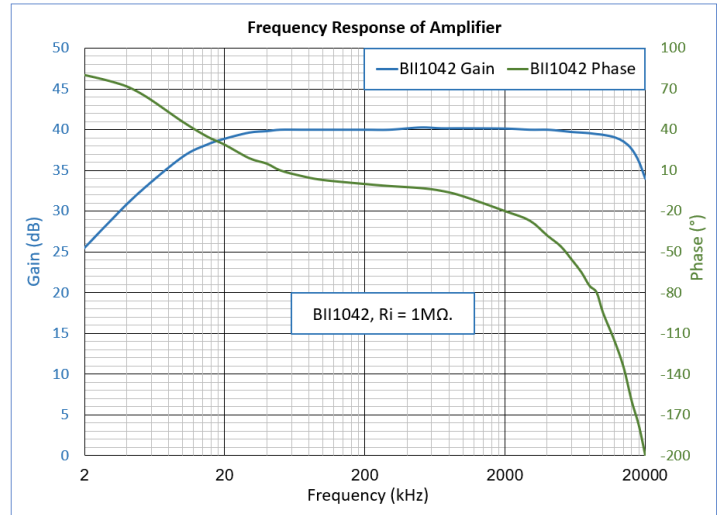
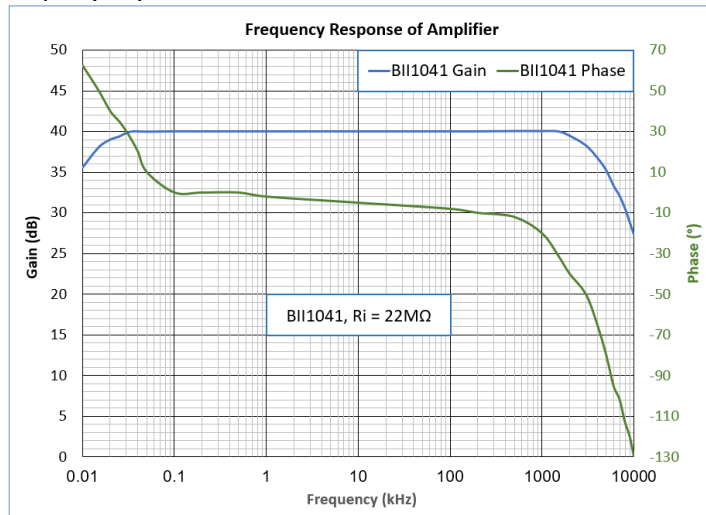
Hydrophone, SONAR, Underwater Communication, Navigation. Seafloor-mapping, Sub-bottom Investigation, Sediment Profiler, Acoustic Image. Target Strength Testing, Towed Array, Sonobuoy, Bottom Moored Systems.	Ultrasonic (Ultrasound, AE, NDT) Testing, Material Characterization. Low Noise Ultrasonic Preamplifier/Instrumentation, Pulse Amplifier. Sonic Cavitation Noise, Hand-held, Portable, Battery-operated Systems.
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### BII1040 Series Low Noise Ultrasonic Preamplifier: 12 Hz to 17 MHz, 3.0 nV/VHz, 4 fA/VHz.

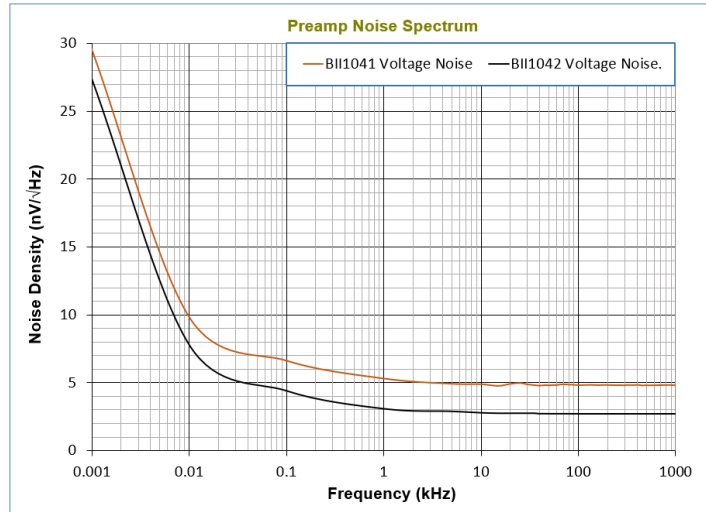
### Specification

Low Noise Preamplifier:	BII1041	BII1042
Input Type:	Single-ended	
Input Referred Noise: ( $f \geq 1$ kHz)	Voltage Noise $e_n = 5.2$ nV/VHz. Current Noise $i_n = 4$ fA/VHz.	Voltage Noise $e_n = 3.0$ nV/VHz. Current Noise $i_n = 4$ fA/VHz.
	<b>Roughly, electronic noise density at input, <math>RTI, V_n^2 = e_n^2 + [i_n * \text{impedance of the transducer (or hydrophone)}]^2</math>.</b>	
Input Impedance $R_i$ :	22 M $\Omega$    8 pF.	1 M $\Omega$    8 pF.
	Specify when ordering to set up -3dB high pass filter frequency with Capacitance $C_h$ of a piezoelectric sensor. Refer to <a href="#">R<sub>i</sub>C<sub>h</sub> Filter</a> .	
	$R_i$ 50 $\Omega$ matches 50 $\Omega$ coax cable impedance and damps down NDT transducer to achieve good transient or pulse response or reduce decaying time (or ringing) of the transducer.	
	End user may set input impedance to be 50 $\Omega$ with a T type BNC adaptor and a 50 $\Omega$ BNC Terminator.	
Maximum Input:	(Maximum Output $V_{omax}$ )/Gain. Refer to <a href="#">Max. Input vs. Supply Voltage</a> .	
$C_h R_i$ High Pass Filter:	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. Built-in high pass filter rejects noises in low frequency range and improve signal to noise ratio of the signals of the interest in NDT pulse or AE frequency range.	
	<b><math>C_h R_i</math> High Pass Filters is formed with <math>C_h</math> of Piezoelectric Hydrophones and <math>R_i</math> of Preamps.</b> <b>Its -3dB High Pass Frequency:</b> $f_{-3dBH} = 1/(2\pi R_i C_h)$ . 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). <b>For example:</b> (1) Hydrophone 1nF at 1kHz and preamp $R_i$ 22M $\Omega$ constitute high pass filter with -3dB frequency 7.2 Hz. (2) Hydrophone 1nF at 1kHz and preamp $R_i$ 1M $\Omega$ constitute high pass filter with -3dB frequency 159 Hz. (3) NDT Transducer 10nF at $f_s$ and preamp $R_i$ 50 $\Omega$ constitute high pass filter with -3dB frequency 318.3 kHz.	
-3dB Bandwidth:	12 Hz to 4 MHz	10 kHz to 17 MHz
	Refer to <a href="#">Frequency Response</a> . <b>Bandpass filter Type:</b> Second Order.	
	<b>When a hydrophone (no preamp) works with a preamp, -3dB high pass frequency is the higher one of <math>C_h R_i</math> High Pass Filter and -3dB Bandwidth.</b>	
Gain of Pass Band:	40 dB	40 dB
Settling Time, 0.1%:	42 nS	
Output Type:	Single-ended	
Output Impedance:	50 $\Omega$	
Maximum Output $V_{omax}$ :	$V_{omax} = (\text{Supply Voltage } V_s - 4)$ , in Vpp.	
Cable Driving Capability:	1. 50 $\Omega$ -Impedance Matching Coaxial Cable System: $\geq 300m$ .	
	2. Non-Coaxial Shielded Cable: Refer to <a href="#">Chart of Cable-Drive Capacity</a> .	
Power Supply $V_s$ :	+9 to +30 VDC.	+12 to +30 VDC.
	<b>Warning: The device will be destroyed with <math>V_s \geq +32VDC</math>.</b>	<b>Warning: The device will be destroyed with <math>V_s \geq +36VDC</math>.</b>
Quiescent Current:	8.0 mA with +9 VDC.	8.2 mA with +12 VDC.
	8.8 mA with +12 VDC.	12.5 mA with +18 VDC.
	10.5 mA with +18 VDC.	14.0 mA with +24 VDC.
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 Supplies, Not Included.	
	DO NOT use variable power supplies whose maximum supply voltage are higher than the above rated voltage.	
	DO NOT use switching mode DC power supplies whose noise levels and harmonics are high.	
Operating Temperature:	-40 to 70 °C or -40 to 158 °F	
Storage Temperature:	-40 to 70 °C or -40 to 158 °F	
Package	<b>Metal Housing with four mounting holes</b>	
Input Connector:	BNC Jack (BNC)	
Output Connector:	BNC Jack (BNC)	
Power Supply:	Power Connector Jack on Housing. Power Supply Cable: <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .	
Size LxWxH:	77x50.6x43 mm	
Weight:	147 grams.	

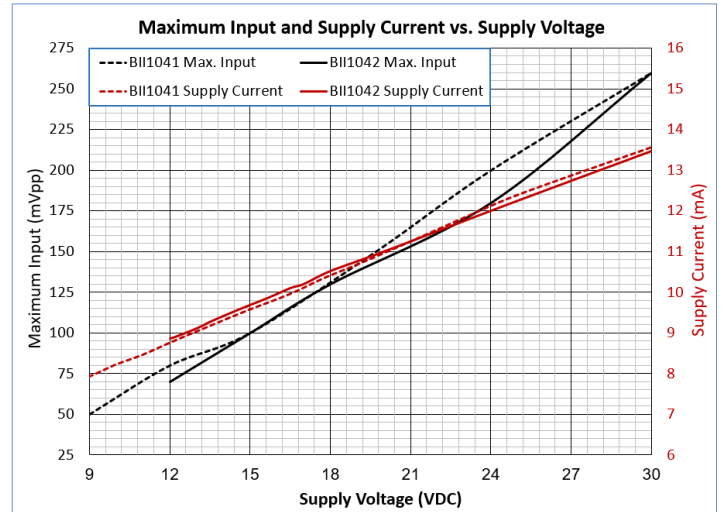
### Frequency Response



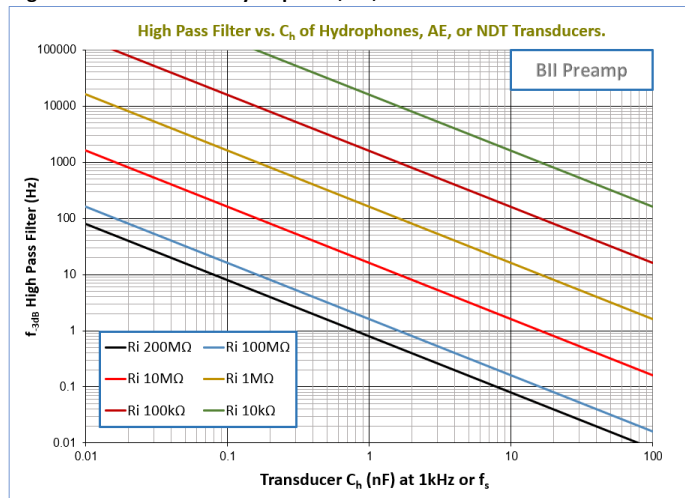
### Voltage Noise Density Referred to Input (RTI):



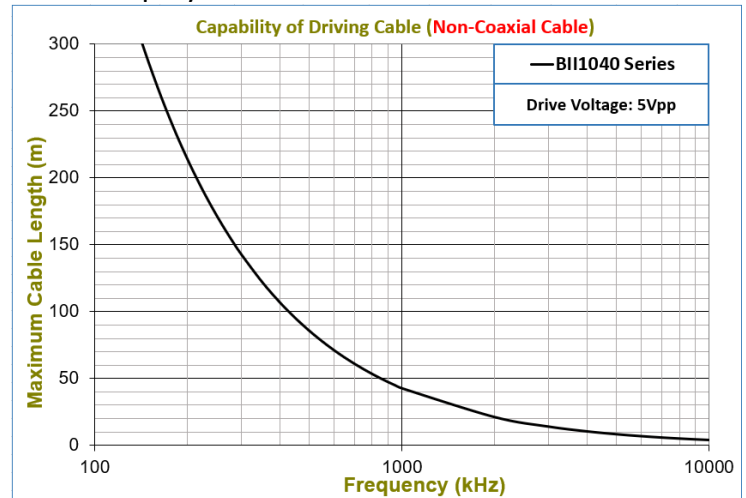
### Maximum Input and Supply Current vs. Supply Voltage



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



### Cable-Drive Capacity



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

Part Number	-R <sub>i</sub> Input Impedance. Refer to <a href="#">R<sub>i</sub>C<sub>n</sub> Filter</a> , <a href="#">Built-in Filter</a> , and <a href="#">-3dB Bandwidth</a> .	-DC Supply Accessory Type
BII1041	22 MΩ (fixed).	<a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .
BII1042	1 MΩ (fixed).	
High Pass Filter of the preamp is the combination of R <sub>i</sub> C <sub>n</sub> High Pass Filter and HPF High Pass Filter. R <sub>i</sub> C <sub>n</sub> High Pass Filter is determined by Hydrophone C <sub>n</sub> .		
Example:	Description:	
BII1041-DCBS18V:	BII1041, Preamp, Input Impedance: 22MΩ, DC Supply Cable: DCBS18V.	
BII1042-DCBP24:	BII1042, Preamp, Input Impedance: 1MΩ, DC Supply Cable: DCBP24.	

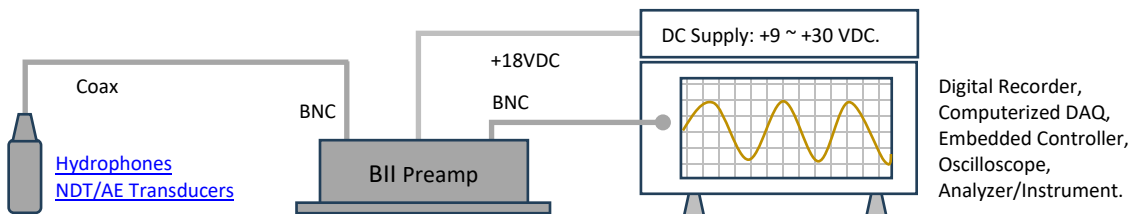
## Signals and Wiring of Panel-Mount Connectors

Input or Output Signals	Power Supply
<b>BNC Jack, Single Ended (SE).</b>	<b>Power Jack, Single DC Supply</b>
Center: Signal	Center Contact: +VDC.
Shield: Common	Shell: Common.
<b>Metal Case is for shielding and grounding.</b>	

## Signals and Wiring of Accessory Cables

Input or Output Signals	DC Supply Cable
<b>BNC and Coax, Single Ended (SE).</b>	<b>Power Plug, Single DC Supply</b>
Center: Signal	Red Banana Plug: +VDC.
Shield: Common	Black Banana Plug: Common.
	Cable Shield, if any: Shielding.

## System Wirings of Standalone Preamp.

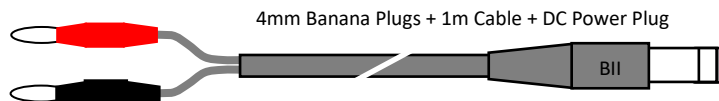


## Accessories:

**Part Number: DCBP24.** One 1m DC supply cable with Red and Black Banana Plugs, and DC Power Plug.

### To Terminals of DC Supply:

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

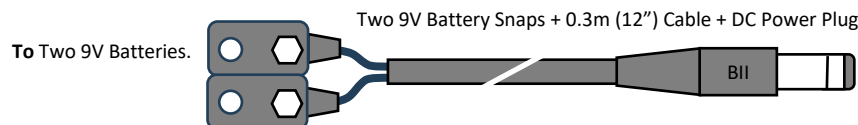


DC Power Plug.  
To DC Power Jack of the Device.

<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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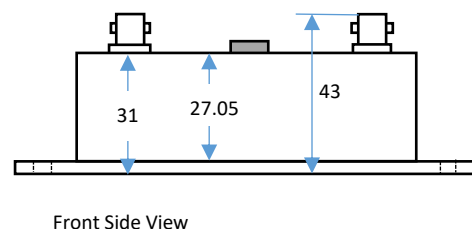
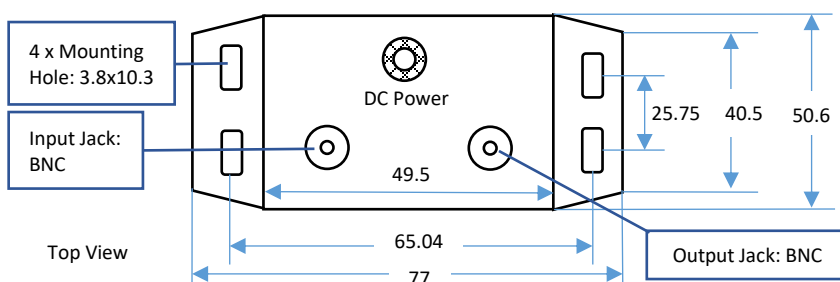
**Part Number: DCBS18V.** One 0.3m (12") DC supply cable with two 9V Battery Snaps which supplies +18VDC to amplifiers, and one DC Power Plug.

*Note: BII will modify internal circuit to ensure the supply voltage to be within Vs range of BII1042.*



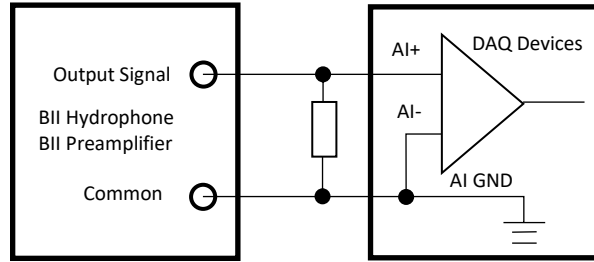
DC Power Plug.  
To DC Power Jack of the Device.

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

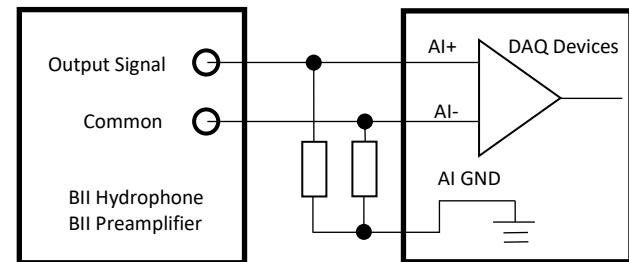


## BII's Single-Ended Output to Single-Ended Input of a DAQ

If DAQ saturation occurs, use  $R_1=R_2=10k\Omega$  to  $1M\Omega$  resistors.



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



## 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.

**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.