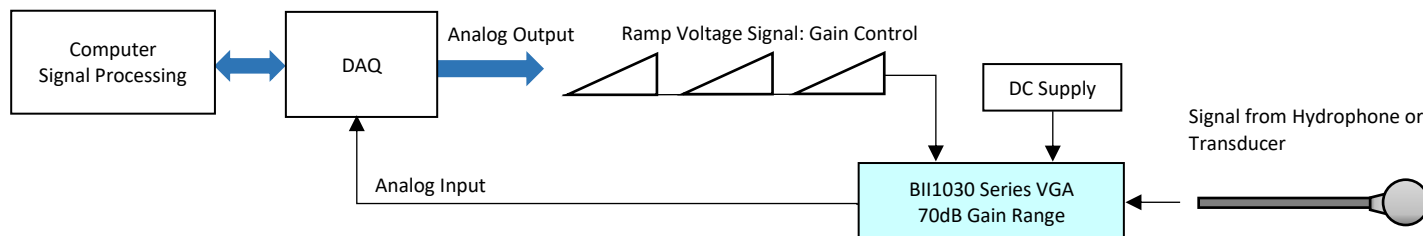




### BII1030 Series VGA Amplifier

#### Variable Gain Amplifier (VGA): 70 dB Gain Range

BII1030 series are variable gain amplifiers (VGA) whose gains are set by positive voltages to amplify the weak signals from hydrophones, receiving arrays, and ultrasound transducers. It can also be used as TVG (Time Varying Gain) amplifiers in active SONAR and ultrasound system to compensate the transmission (propagation) loss such as  $-40\log R - 2\alpha R$  ( $R$ : Spherical Spreading Distance,  $\alpha$ : Attenuation Coefficient) when working with voltage ramp gain control signals. This VGA amplifier also help to reduce dynamic range of A/D converters.



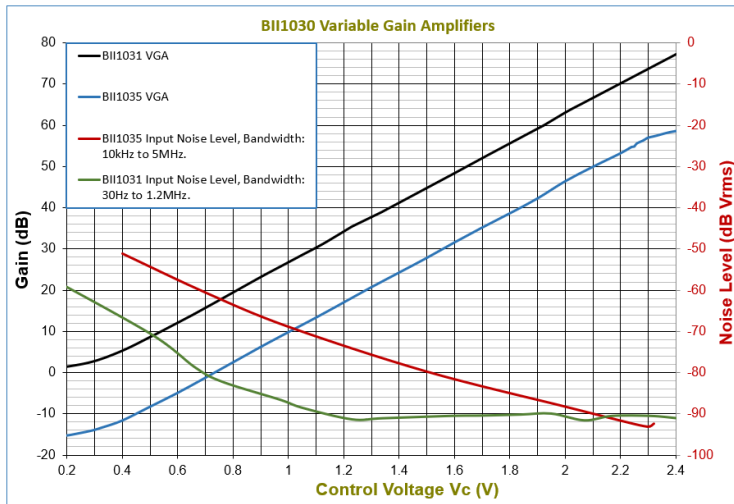
| Typical Applications                                     |                                                       |
|----------------------------------------------------------|-------------------------------------------------------|
| Programmable Hydrophone, Ultrasound, NDT, AE             | TVG (Time Varying Gain) Amplifier, Range Compensation |
| Echo Sounding System: Image, Fishery, and Plankton Sonar | Communication, Array Amplitude Shading                |

#### Specifications

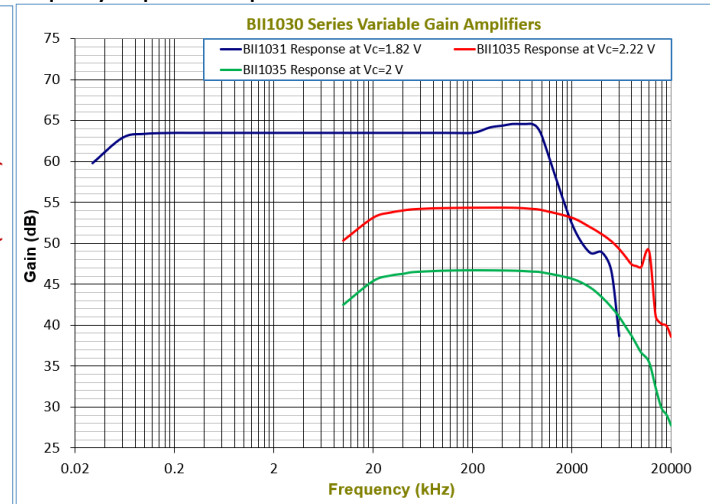
| VGA Amplifier                              | BII1031                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | BII1035                                                |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Input Type:                                | Differential or single ended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Single Ended                                           |
| Input Referred Noise:<br>( $f \geq 1$ kHz) | $e_n$ : 10 nV/VHz, $i_n$ : 0.8 fA/VHz<br><b>Roughly, electronic noise density at input, <math>RTI</math>, <math>V_n^2 = e_n^2 + [i_n * \text{impedance of the transducer (or hydrophone)}]^2</math>.</b><br><b>White noise level is proportional to the square root of bandwidth. Narrow bandwidth should be customized to reduce the white noise level at output with which the weak signals may be inundated.</b>                                                                                                                                                                                                                                                                                                       | $e_n$ : 1.8 nV/VHz, $i_n$ : 2.7 pA/VHz                 |
| Input Impedance:                           | 20 MΩ    11pF. Refer to <a href="#">R<sub>i</sub>C<sub>h</sub> Filter</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 50 Ω                                                   |
|                                            | $R_i$ : 50Ω of BII1035 matches the 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                        |
| Maximum Input:                             | 1.2 Vpp or $V_{omax}/\text{Gain}$ , whichever is less.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2.5 Vpp or $V_{omax}/\text{Gain}$ , whichever is less. |
| Built-in Filter:                           | High Pass Filter: 30 Hz, 1 kHz, or 10 kHz. Customized.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | High Pass Filter: 10 kHz.                              |
|                                            | High Pass Filter Type: Fourth Order.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | High Pass Filter Type: Second Order.                   |
|                                            | <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>System Filters Consisting of Standalone Piezoelectric Hydrophones and Standalone Preamps.</b><br><b>-3dB High Pass Frequency:</b> $f_{-3dBH} = 1/(2\pi R_i C_h)$ . that is, $R_i = 1/(2\pi f_{-3dBH} * C_h)$ .<br>$R_i$ : 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). <a href="#">For example</a> ,<br>(1) hydrophone 10nF at 1kHz and preamp $R_i$ 20MΩ constitute high pass filter with -3dB frequency 0.795Hz.<br>(2) a NDT or AE Transducer 5nF at $f_s$ and a BII1035 $R_i = 50\Omega$ constitute high pass filter with -3dB frequency 636.6kHz. |                                                        |
| Gain Range:                                | 0 to 70 dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -12 to 55 dB                                           |
| Gain Scaling Factor:                       | 36 dB/V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 36 dB/V                                                |
| Gain vs. Vc:                               | <a href="#">Refer to Gain vs. Vc.</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <a href="#">Refer to Gain vs. Vc.</a>                  |
|                                            | Vc: Gain Control Voltage in Volt, DC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |
| Gain Control Voltage Vc:                   | DC Coupling, +0.4 to +2.4 VDC.<br><b>Warning: Vc &lt; -10VDC or Vc &gt; +10VDC will damage the device permanently.</b><br>The noise at Gain Control causes output variation or may cause the device unstable. Gain-Control signal shall be of very low noise.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                        |
| Shut-Down/Active:                          | <b>Active:</b> Control Voltage Vc > 50 mVDC.<br><b>Shut-Down:</b> Control Voltage Vc: 0 to 50 mVDC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                        |
| -3dB Bandwidth:                            | 30 Hz to 1 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.01 to 10 MHz                                         |
| Settling Time, 0.1%:                       | 2 μs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.2 μs                                                 |
| Output Type:                               | Single-ended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                        |
| Output Impedance:                          | 50 Ω                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                        |
| Maximum Output $V_{omax}$ :                | $V_{omax} = 3$ Vpp or $\pm 1.5$ Vp                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | $V_{omax} = 3$ Vpp or $\pm 1.5$ Vp                     |
| Cable Driving Capability:                  | 1000 meters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 50 Ω Coax Cable                                        |
| Power Supply Vs:                           | +8.5 to +32 VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | +6 to +40 VDC                                          |
| Quiescent Current:                         | <b>Active:</b> 43 mA. <b>Shut-Down:</b> 11 mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Active:</b> 36 mA. <b>Shut-Down:</b> 4 mA.          |
| Suggested DC Supply:                       | +9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included.<br>DO NOT use variable power supply whose maximum supply voltage is higher than the above rated voltage.<br>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                 | 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.                                                                                                                     |          |
|                         | Single-ended Output Wiring: White: Output Signal, Black: Output Common.                                                                 |          |
| Gain Control Vc Wiring: | 5cm wires, twisted.                                                                                                                     |          |
|                         | Analog Gain Control: Blue: Gain Control Voltage. Black: Common.                                                                         |          |
| Power Supply Wiring:    | 5cm wires, twisted. Red: +VDC, Black: Common.<br>Common of DC Power Supply is the commons of input and output, and gain control if any. |          |
| Weight:                 | 15 grams                                                                                                                                |          |
| Size:                   | Coated PCB: LxWxH = 56x22x13mm.                                                                                                         |          |
| Package                 | Metal Housing with four mounting holes                                                                                                  |          |
| Input Connector:        | 1. 3.5mm TRS Jack or XLR Plug with 3 Sockets: Differential Signal.<br>2. BNC Jack: Single Ended Signal.                                 | BNC Jack |
| Output Connector:       | BNC Jack                                                                                                                                |          |
| Gain Control:           | BNC Jack                                                                                                                                |          |
| Power Supply:           | Power Connector Jack on Housing. Power Supply Cable: <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> .                                 |          |
| Size LxWxH:             | Metal Housing with four Mounting Holes: 95x59x35 mm.<br>Plastic Housing with four Mounting Holes: 109.45x83.4x67 mm.                    |          |
| Weight:                 | 90.0 gram                                                                                                                               |          |

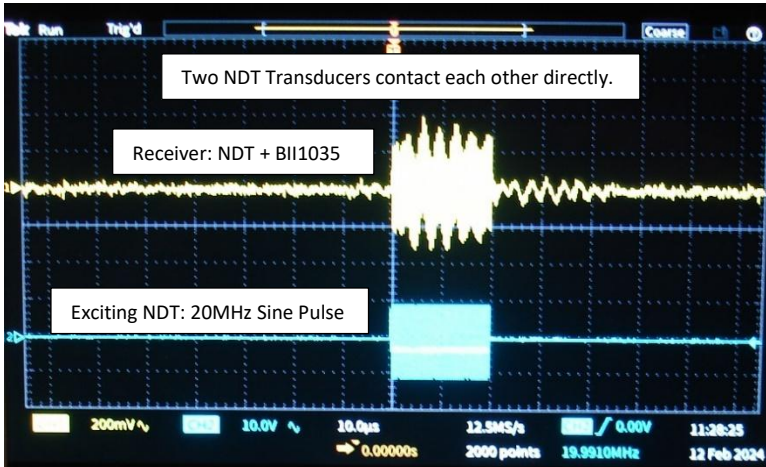
**BII1031 and BII1035 VGA Gain and Noise vs. Vc.**



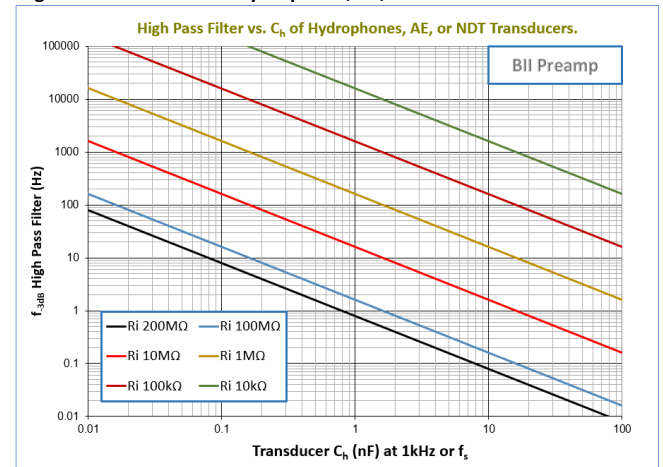
**Frequency Response at a Specific Vc.**



**Pulse Performance of BII1035**



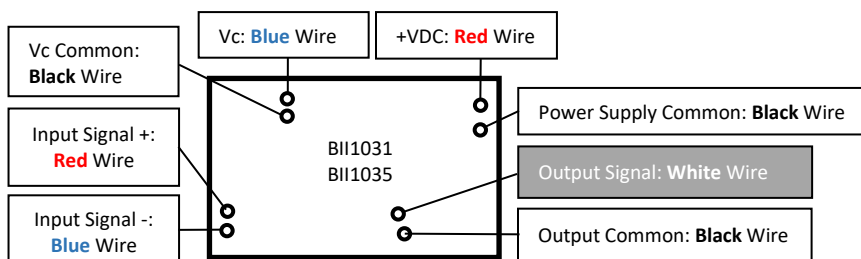
**High Pass Filter vs. Ch of Hydrophone, AE, or NDT Transducer.**



Standard BII1031 and BII1035, Coated PCB. BII keeps standard parts in stock.

| Standard BII1031 and BII1035, Coated PCB. BII keeps standard parts in stock.                                                                                                                        |                                                            |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|------------------|
| Part Number                                                                                                                                                                                         | -HPF (High Pass Filter)                                    | -Package         |
| BII1031                                                                                                                                                                                             | 30 Hz, 1 kHz, or 10 kHz.                                   | PCB: Coated PCB. |
| BII1035                                                                                                                                                                                             | N/A                                                        |                  |
| <b>Note: High Pass Filter of the preamp is the combination of <u>R<sub>Ch</sub> High Pass Filter</u> and HPF Filter. R<sub>Ch</sub> High Pass Filter is determined by Hydrophone C<sub>h</sub>.</b> |                                                            |                  |
| Example:                                                                                                                                                                                            | Description:                                               |                  |
| BII1031-30Hz-PCB:                                                                                                                                                                                   | BII1031, Preamp, -3dB High Pass Filter: 30Hz, Coated PCB.  |                  |
| BII1031-1kHz-PCB:                                                                                                                                                                                   | BII1031, Preamp, -3dB High Pass Filter: 1kHz, Coated PCB.  |                  |
| BII1031-10kHz-PCB:                                                                                                                                                                                  | BII1031, Preamp, -3dB High Pass Filter: 10kHz, Coated PCB. |                  |
| BII1035-PCB:                                                                                                                                                                                        | BII1035, Preamp, Coated PCB.                               |                  |

Coated PCB Wiring:



Standard BII1031 and BII1035 with Metal or Plastic Housing. BII keeps standard parts in stock.

| Standard BII1031 and BII1035 with Preamp of Various Readings. All keeps standard parts in stock.                                                                                                                |                                                                                          |                                                                                          |                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------|
| Part Number                                                                                                                                                                                                     | -HPF (High Pass Filter).                                                                 | -Input Connector                                                                         | -Accessory Type                                    |
| BII1031                                                                                                                                                                                                         | 30 Hz, 1kHz, or 10kHz.                                                                   | <b>BNC:</b> BNC Jack.<br><b>TRS:</b> 3.5mm TRS Jack.<br><b>XLR:</b> Plug with 3 Sockets. | <a href="#">DCBP24</a> , <a href="#">DCBS18V</a> . |
| BII1035                                                                                                                                                                                                         | N/A                                                                                      | <b>BNC:</b> BNC Jack.                                                                    |                                                    |
| <b>Note:</b> High Pass Filter of the preamp is the combination of <a href="#">R<sub>Ch</sub> High Pass Filter</a> and HPF Filter. R <sub>Ch</sub> High Pass Filter is determined by Hydrophone C <sub>h</sub> . |                                                                                          |                                                                                          |                                                    |
| Example:                                                                                                                                                                                                        | Description:                                                                             |                                                                                          |                                                    |
| BII1031-30Hz-XLR-DCBP24:                                                                                                                                                                                        | BII1031, Preamp, -3dB High Pass Filter: 30Hz, Input: XLR Jack. DC Supply Cable: DCBP24.  |                                                                                          |                                                    |
| BII1031-1kHz-TRS-DCBP24:                                                                                                                                                                                        | BII1031, Preamp, -3dB High Pass Filter: 1kHz, Input: TRS Jack. DC Supply Cable: DCBP24.  |                                                                                          |                                                    |
| BII1031-10kHz-BNC-DCBP24:                                                                                                                                                                                       | BII1031, Preamp, -3dB High Pass Filter: 10kHz, Input: BNC Jack. DC Supply Cable: DCBP24. |                                                                                          |                                                    |
| BII1035-BNC-DCBP24:                                                                                                                                                                                             | BII1035, Preamp, Input: BNC Jack. DC Supply Cable: DCBP24.                               |                                                                                          |                                                    |

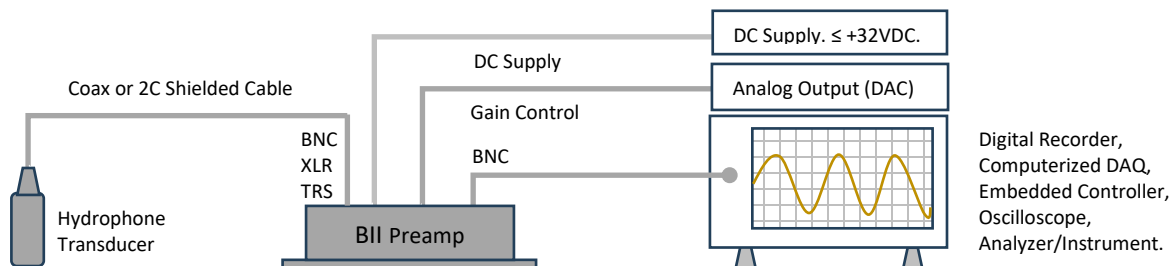
Signals and Wiring of Panel-Mount Connectors

| Input or Output Signals                           |                                                      | Gain Selection                                                  | Power Supply                                                                 |
|---------------------------------------------------|------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------|
| Single Ended (SE)                                 | Differential/Balanced (DF)                           | Analog Voltage Signal                                           | Single DC Supply.                                                            |
| BNC Jack                                          | 3.5mm TRS and Cable                                  | BNC Jack                                                        | Power Jack,                                                                  |
| Center: Signal<br>Shield: Common                  | Tip: Signal +.<br>Ring: Signal -.<br>Sleeve: Common. | Socket 2: Positive.<br>Socket 3: Negative.<br>Socket 1: Common. | Conductor: Vc.<br>Shield: Common.<br>Center Contact: +VDC.<br>Shell: Common. |
| <b>Metal Case is for shielding and grounding.</b> |                                                      |                                                                 |                                                                              |

Signals and Wiring of Accessory Cables

| Input and Output Signals                      |                                                                                      | Gain Selection                                                                         | DC Supply Cable                                                                                                                                                   |
|-----------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Single Ended (SE), Differential/Balanced (DF) |                                                                                      | Analog Voltage Signal                                                                  | Single DC Supply.                                                                                                                                                 |
| BNC and Coax                                  | 3.5mm TRS and Cable                                                                  | BNC and Coax                                                                           | Power Plug                                                                                                                                                        |
| Center: Signal<br>Shield: Common              | Tip, White Wire: Signal +.<br>Ring, Black Wire: Signal -.<br>Sleeve, Shield: Common. | Pin 2: Positive, White Wire.<br>Pin 3: Negative, Black Wire.<br>Pin 1: Common, Shield. | Conductor: Vc.<br>Shield: Common.<br>Red Banana Plug or Red Wire Lead: +VDC.<br>Black Banana Plug or Black Wire Lead: Common.<br>Cable Shield, if any: Shielding. |

System Wirings of Standalone Preamp.



## Accessories:

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

Default 1m. Bespoke Length Available.

### 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.

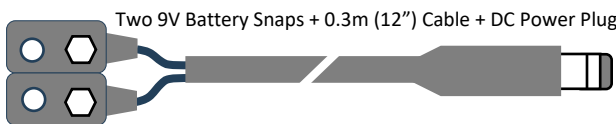


**Red Banana Plug:** +VDC. **Black Banana Plug:** Common.

One 1m DC supply cable. One end of the cable is with DC Power Plug, another end is Red and Black Banana Plugs. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

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

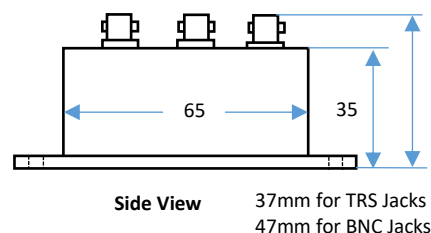
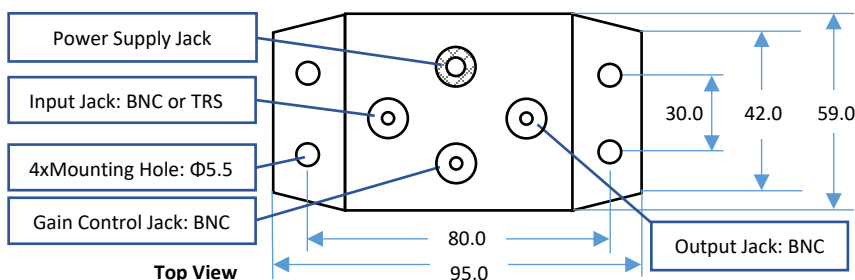
To Two 9V Batteries.



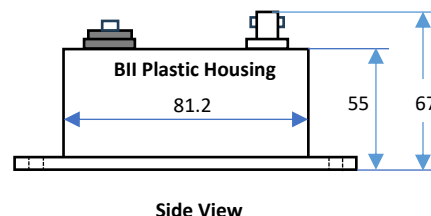
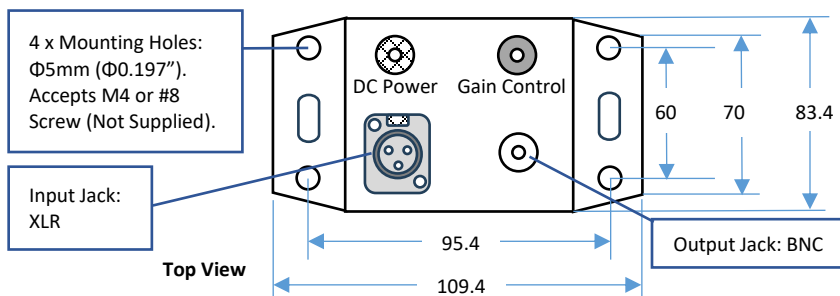
DC Power Plug.  
To DC Power Jack  
of the Device.



**Variable Gain Preamplifiers BII1030 Series with Metal Housing** LxWxH = 95x59x35, Outline Dimensions (mm)



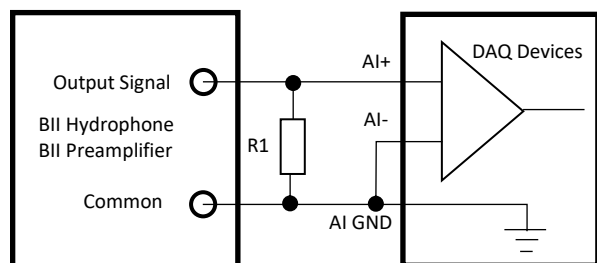
**Plastic Housings Outline Dimensions (mm), Illustration only, the scale is not 1:1.**



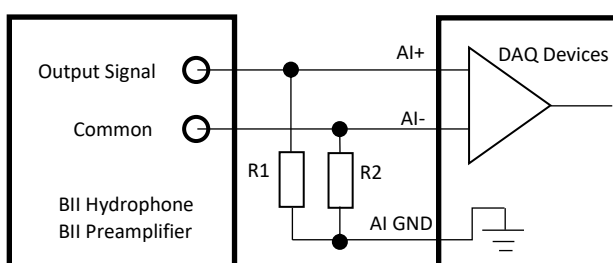
**Preamplifier Wirings to DAQ (Data Acquisition Hardware):** DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

**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 Single-Ended Output to Single-Ended Input of a DAQ**



**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 50 $\Omega$  transducer/sensor to preamplifiers in high frequency applications?** Many BII preamplifiers have non-50 $\Omega$  input resistances which does NOT match 50 $\Omega$  in high frequency applications. Therefore, one T type BNC adaptor and one 50 $\Omega$  BNC terminal are necessary between 50 $\Omega$  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.

**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, BII1031 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.