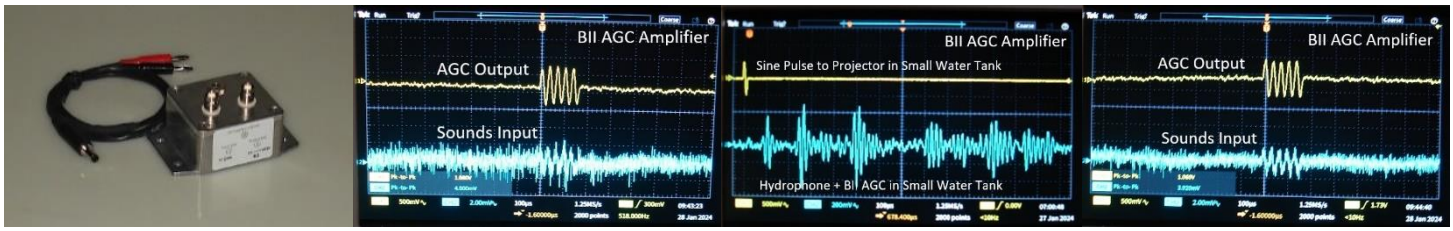


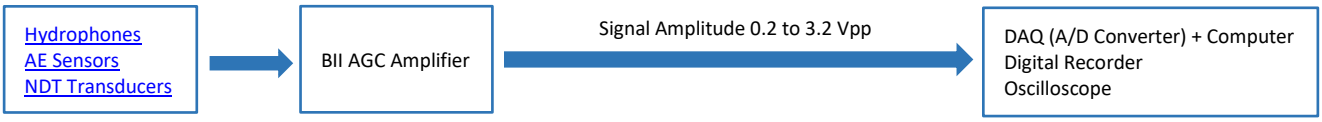
BII2000 Series AGC (Automatic Gain Control) Amplifier: 100 dB Gain Dynamic Range, 100Hz to 1MHz Bandwidth.

BII's Automatic Gain Control (AGC) amplifier is a dynamic adaptive electronic system whose gain changes automatically with input levels of continuous waveform (CW) or pulsed signals such as SINE pulses, Chirp/FM pulses, BFSK/FSK, etc. Its output signal level is always in detectable range for DAQ modules (A/D Converters) although the input signal levels vary in a wide range. That is, the AGC effectively attenuates the strong input signals to avoid saturation and amplifies weak signal to be in the range of Volt. BII AGCs are necessary components in acoustic systems to automatically compensate the propagation losses in water, air, and solids.

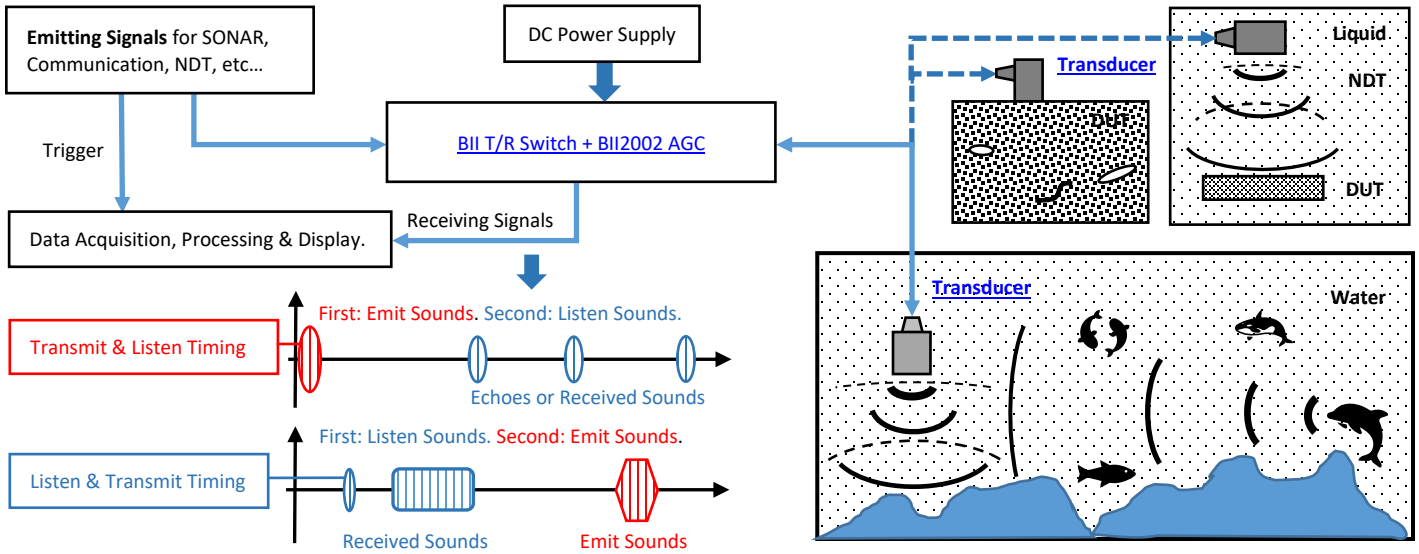
Typical Applications:

Underwater Communication/Pinger/Beacons/Transponder.	Acoustic Modem, BFSK/FSK Signal Conditioning.
Echosounding, Marine Mammal Research, Bioacoustics.	Navigation, Positioning, Acoustic Tag.
Doppler SONAR, Speed Measurement, Artificial Acoustic Target.	Ultrasonic Pulsing System, NDT, AE, Diagnostic Ultrasound, Material Study.

System Setup (DC Power Supply is not shown.)



System Block Diagram of Acoustic Pulse-echo and Communication Systems

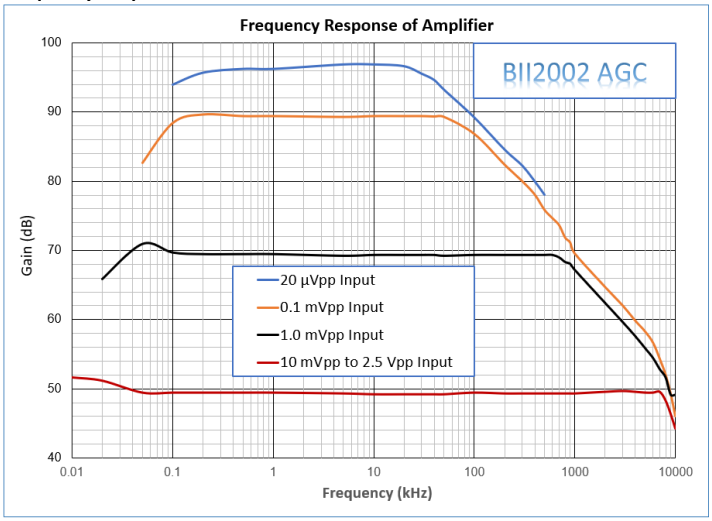


Specification:

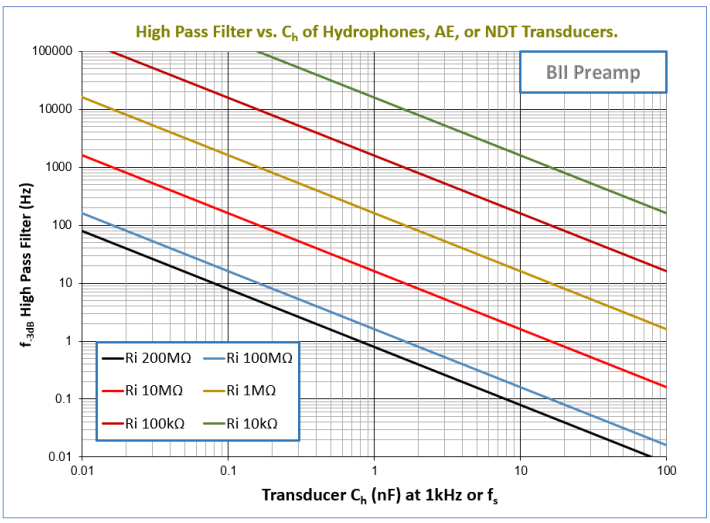
AGC Amplifier	**BII2002**
Signal Types:	Sine Pulses, Chirp/FM Pulses, BFSK/FSK, Continuous Signals, etc.
	Pulse duration of pulsed/burst signals such as SONAR and NDT signals should be greater than 10µS to achieve stable output signal.
Automatic Gain Range:	-20 to 80 dB
High Pass Filter:	Built-in. Specify -3dB cut-off frequency when ordering. White noise level is proportional to the square root of bandwidth.
-3dB Bandwidth:	100 Hz ~ 1 MHz, Input level dependant. Refer to Frequency Response.
	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 500 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:** $f_{-3dB} = 1/(2\pi R_i C_h)$. 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: hydrophone 1nF at 1kHz and preamp R_i 10MΩ constitute high pass filter with -3dB frequency 15.9Hz.
Settling Time:	3 µS to 0.1%, Output Step 10 Vpp.
Input Level Range V_i:	20 µVpp to 20 Vpp, or -103 to +17 dB Vrms.
Input Range of Receiver:	(V_i dB Vrms - Receiver Sensitivity dB V/µPa), in µPa.

	For example, a hydrophone has FFVS of -190 dB V/µPa, Detection range = (-103 +190) to (17 + 190) = 87 to 207 dB µPa.
Input Impedance:	10 MΩ || 11 pF. Refer to R_iC_h Filter.
Input Couling:	AC
Input Signal Type:	Differential (DF) and Single ended (SE) are acceptable.
Input Referred Noise:	e_n = 10.0 nV/√Hz, i_n = 0.8 fA/√Hz.
(at f ≥ 1 kHz)	Roughly, electronic noise density at input, $V_n^2 = e_n^2 + [\, i_n$*impedance of the transducer (or hydrophone)$]^2$.
Input Dynamic Range:	≥ 90 dB
Output Level:	0.2 to 3.2 Vpp, or -23 to 1.07 dB Vrms.
Output Type:	Single Ended
Output Impedance:	50 Ω
Output Couling:	AC
Capability of Driving Cable:	50 m
Supply Voltage V_s:	+16 to +32 VDC
Current (Quiescent):	21.3 mA
Suggested DC Supply:	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included. DO NOT use variable power supply whose maximum supply voltage is higher than the above rated voltage. DO NOT use switching mode DC power supply.
Operating Temperature:	-40°C to 60°C, or -40°F to 140°F.
Storage Temperature:	-20°C to 60°C, or -4°F to 140°F.
Package	**Coated PCB with Wires and Wire Leads**
Input Wiring:	5cm wires, twisted.
	Differential Input Wiring: **Red**: Input Signal +, **Blue**: Input Signal -, and Use **Power Supply Common** as input signal common.
	Single-ended Input Wiring: Red: Input Signal, **Blue**: Input Common and wire **Blue Wire** to **Power Supply Common.**
Output Wiring:	5cm wires.
	Twisted. **White**: Output Signal, **Black**: Output Common.
Power Supply Wiring:	5cm wires, twisted. **Red**: +VDC, **Black**: Common. Use this common as differential input common.
Weight:	20 grams
Size:	ΦDxH = Φ48x15 mm
Package	**Metal Housing with four mounting holes**
Input Connector:	TRS Jack (Differential), or BNC Jack (Single-ended).
Output Connector:	BNC Jack
Power Supply Connector:	Power Connector Jack
Power Supply Cable:	DCBP24
Weight:	0.25 kg
Size:	LxWxH = 95x59x47mm

Frequency Response



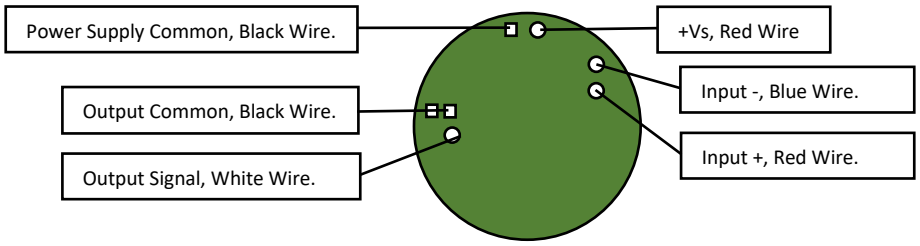
High Pass Filter vs. Ch of Hydrophone, AE, or NDT Transducer.



Standard Coated PCB. BII keeps standard parts in stock.

Part Number	**-HPF** High Pass Filter	**-PCB**
BII2002	100 Hz, 1 kHz, 10 kHz.	PCB: Coated PCB
Note: 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 Hydrophone C_h.		
Example:	**Description:**	
BII2002-100Hz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 100Hz, PCB.	
BII2002-1kHz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 1kHz, PCB.	
BII2002-10kHz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 10kHz, PCB.	

Coated PCB Layout and Wiring.



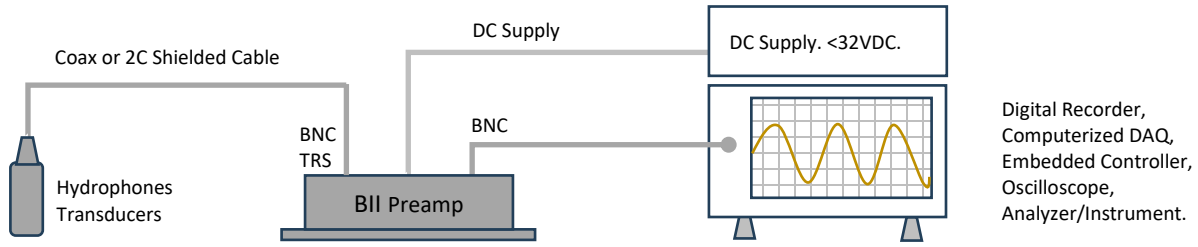
Standard Metal Housing. BII keeps standard parts in stock.

Part Number	**-HPF** High Pass Filter	**-Input Connector**
BII2002	100 Hz, 1 kHz, 10 kHz.	**BNC**: BNC Jack. **TRS**: 3.5mm TRS Jack.
Note: 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 Hydrophone C_h.		
Example:	**Description:**	
BII2002-100Hz-TRS:	BII2002, AGC Amplifier, -3dB High Pass Filter: 100Hz, Input: TRS Jack.	
BII2002-1kHz-TRS:	BII2002, AGC Amplifier, -3dB High Pass Filter: 1kHz, Input: TRS Jack.	
BII2002-10kHz-BNC:	BII2002, AGC Amplifier, -3dB High Pass Filter: 10kHz, Input: BNC Jack.	

Wiring

Input		**Output**	**Power Supply**
BNC Jack	**TRS Jack**	**BNC Jack**	**Power Jack**
Center: Signal Shield: Common	Tip: Signal +, Positive or Hot. Ring: Signal -, Negative or Cold. Sleeve: Common/Ground.	Center: Signal Shield: Common	Center Contact: +VDC Shell: Common

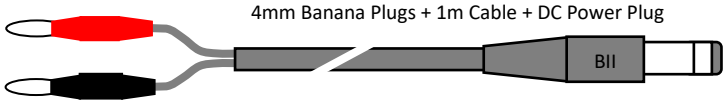
System Wirings of Standalone Preamp.



Accessories:

Part Number: DCBP24.

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



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

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

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

Questions

Frequencies of my pingers (transponder, or beacon) range from 20 kHz to 100 kHz, what are the gains of BII AGC to amplify the signals automatically? Gain-bandwidth of BII AGC is 250MHz. that is, BII AGC can amplify 20 kHz signals with 80 dB (x10000 times) and amplify 100 kHz signals with 66 dB (x2000 times).

What if the connector of my transducer/sensor is SMA or SMC Connector? Buyer may order a SMA (or SMC) to BNC (Male) adaptor from local electronic distributors in buyer's country. BII may ship the adaptor as accessory of the device. Please specify this request when ordering. **By default, BII does NOT supply the adaptor as accessories.**

How do I wire 50Ω transducer/sensor to BII AGC Amplifier? BII AGC Amplifier has non-50Ω input resistance. One T type BNC adaptor and one 50Ω BNC terminal are necessary between 50Ω transducer/sensor and BII AGC to change the impedance of BII AGC 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**.

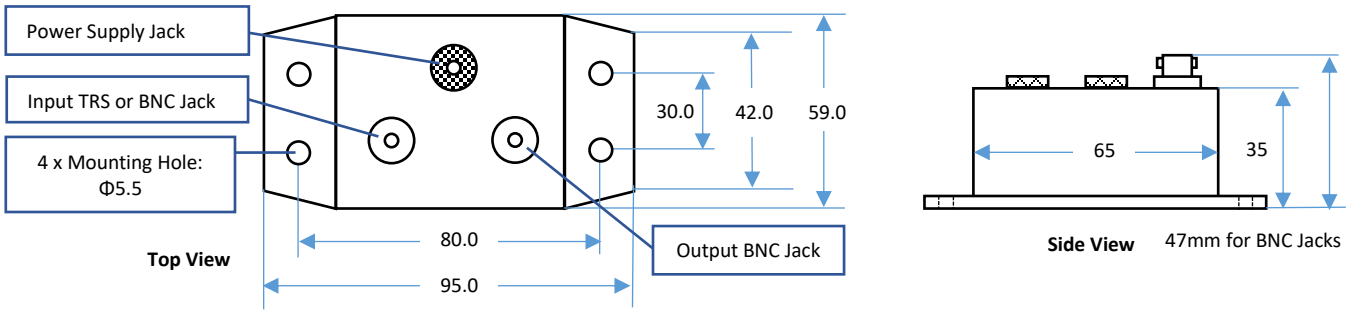
How do I wire BII AGC Amplifier to audio connectors (XLR or TRS) of my recording devices? BII AGC Amplifier has panel mount BNC jack as output connector. Therefore, one cable assembly from male BNC to XLR or male BNC to TRS plug are necessary between BII AGC and the recording devices. BII may ship the cable assembly as accessory of the device. Please specify this request when ordering. **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.

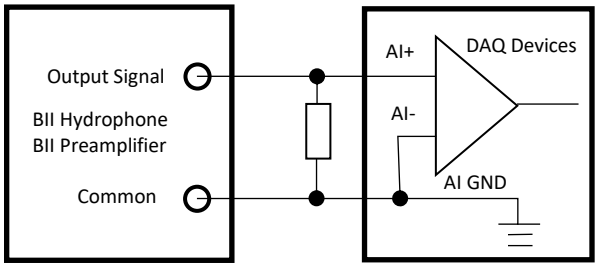
Can BII explain why the capacitance of my hydrophone/transducer affect high pass filtering? (1). Hydrophone/transducer is high impedance devices in low frequency range. Its simplified complex impedance = $j/(2\pi f C_h)$, C_h is the capacitance of hydrophone/transducer, f is frequency in Hz. This impedance 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.

Outline Dimensions (mm)



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

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



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

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