SE=SL-TL+AG-NL

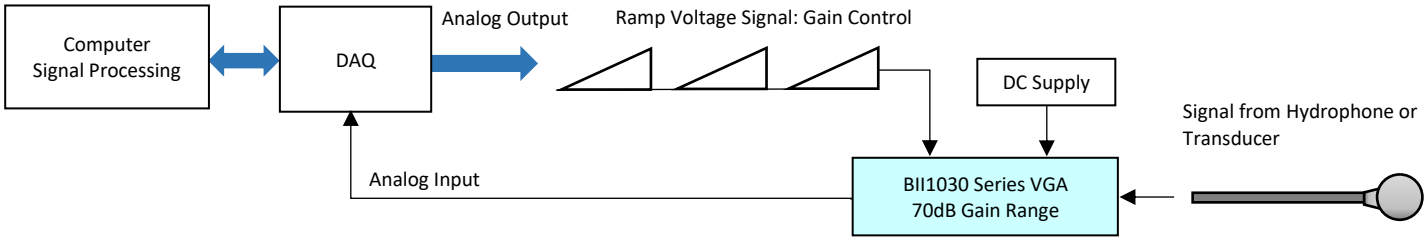
Benthowave Instrument Inc.

Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revised on 2025/01/09

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 -40logR-2αR (R: Spherical Spreading Distance, α: Attenuation Coefficient) when working with voltage ramp gain control signals. This VGA amplifier also help to reduce dynamic range of A/D converters.



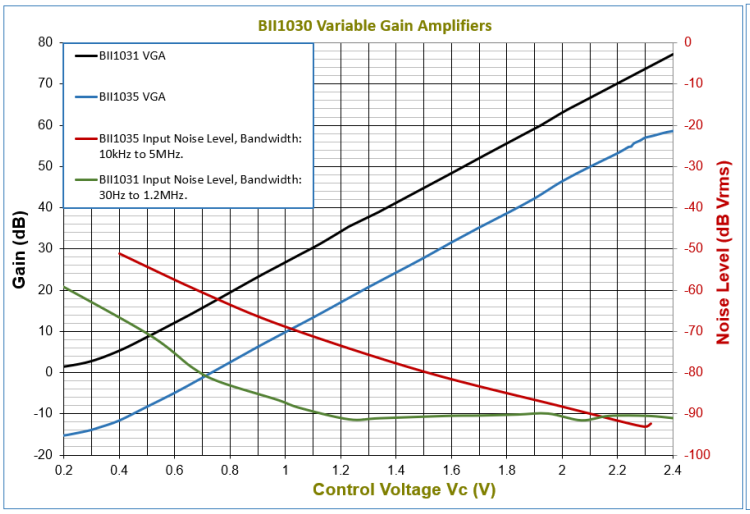
Typical Applications	
Programmable Hydrophone, Ultrasound, NDT, AE	TVG (Time Varying Gain) Amplifier, Range Compensation
Echo Sounding System: Image, Fishery, and Plankton Sonar	Communication, Array Amplitude Shading

Specifications

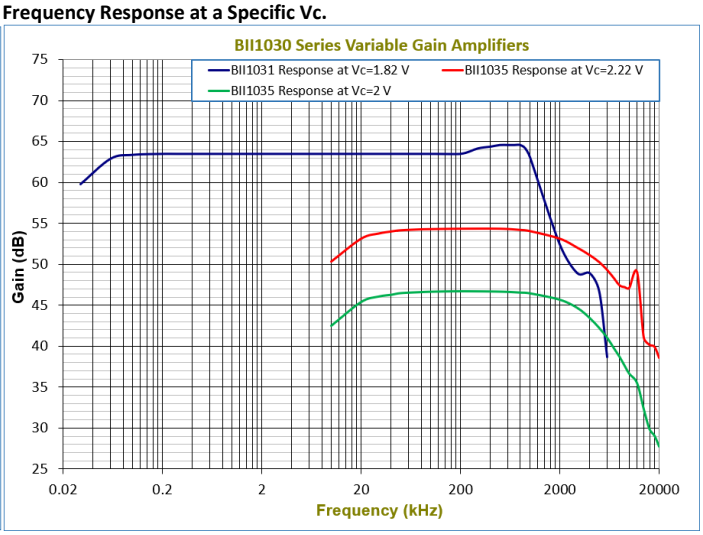
VGA Amplifier	**BII1031**	**BII1035**
Input Type:	Differential or single ended	Single Ended
Input Referred Noise: (f ≥ 1 kHz)	e_n: 10 nV/√Hz, i_n: 0.8 fA/√Hz	e_n: 1.8 nV/√Hz, i_n: 2.7 pA/√Hz
	Roughly, electronic noise density at input, RTI, $V_n^2 = e_n^2 + [\, i_n$ * impedance of the transducer (or hydrophone)$]^2$.	
	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.	
Input Impedance:	20 MΩ || 11pF. Refer to R_iC_h Filter.	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}/Gain, whichever is less.	2.5 Vpp or V_{omax}/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: Fouth Order.	**High Pass Filter Type:** Second Order.
	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:** $f_{-3dBH} = 1/(2\pi R_i C_h)$. 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 20MΩ constitute high pass filter with -3dB frequency 0.795Hz. (2) a NDT or AE Transducer 5nF at fs and a BII1035 R_i = 50Ω 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:	Refer to Gain vs. Vc.	Refer to Gain vs. Vc.
	Vc: Gain Control Voltage in Volt, DC.	
Gain Control Voltage Vc:	DC Coupling. +0.4 to +2.4 VDC. Warning: Vc < -10VDC or Vc> +10VDC will damage the device permanently. 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:	**Active**: Control Voltage Vc > 50 mVDC. **Shut-Down**: 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 ±1.5 Vp	V_{omax} = 3 Vpp or ±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:	**Active**: 43 mA. **Shut-Down**: 11 mA.	**Active**: 36 mA. **Shut-Down**: 4 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 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. 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. 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: DCBP24, DCBS18V.	
Size LxWxH:	**Metal Housing** with four Mounting Holes: 95x59x35 mm. **Plastic Housing** with four Mounting Holes: 109.45x83.4x67 mm.	
Weight:	90.0 gram	

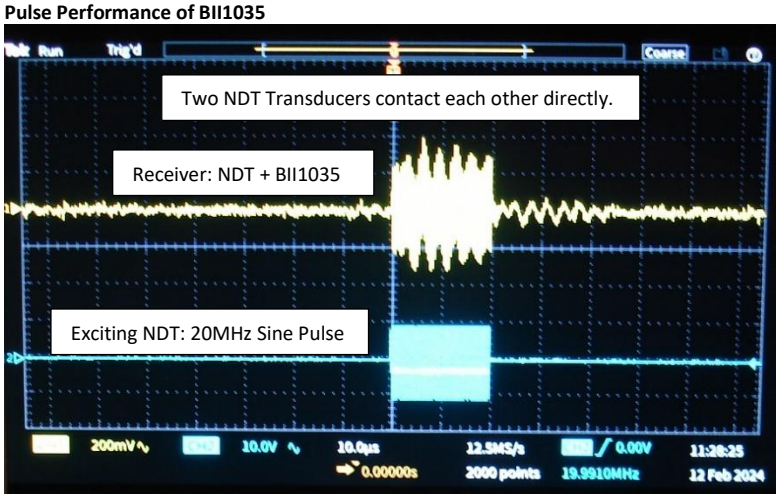
BII1031 and BII1035 VGA Gain and Noise vs. Vc.



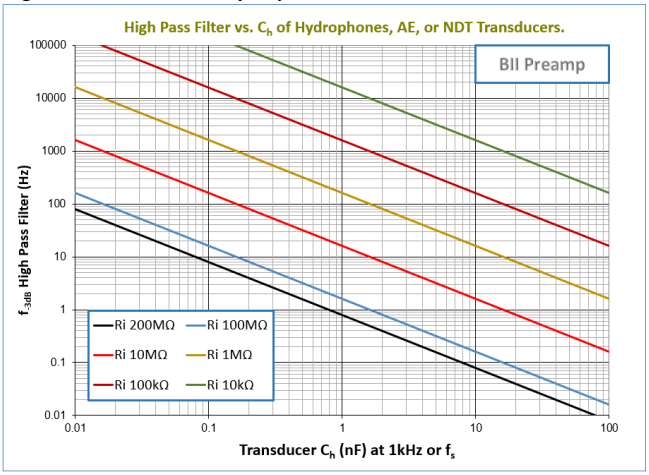
Frequency Response at a Specific Vc.



Pulse Performance of BII1035



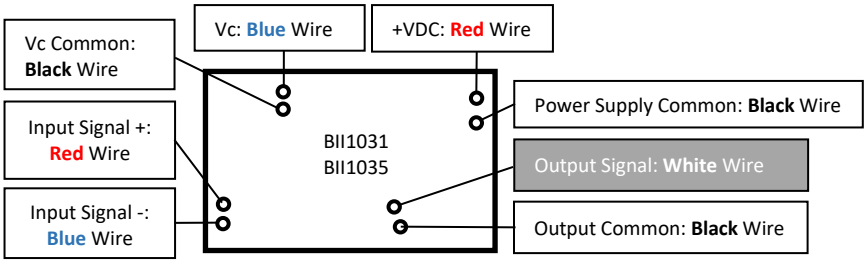
High Pass Filter vs. Ch of Hydrophone, AE, or NDT Transducer.



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

Part Number	-HPF (High Pass Filter)	-Package
BII1031	30 Hz, 1 kHz, or 10 kHz.	PCB: Coated PCB.
BII1035	N/A	
Note: High Pass Filter of the preamp is the combination of R_iC_h High Pass Filter and **HPF** Filter. R_iC_h High Pass Filter is determined by Hydrophone C_h.		
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.

Part Number	-HPF (High Pass Filter).	-Input Connector	-Accessory Type
BII1031	30 Hz, 1kHz, or 10kHz.	**BNC**: BNC Jack. **TRS**: 3.5mm TRS Jack. **XLR**: Plug with 3 Sockets.	DCBP24, DCBS18V.
BII1035	N/A	**BNC**: BNC Jack.	
Note: High Pass Filter of the preamp is the combination of R_iC_h High Pass Filter and **HPF** Filter. R_iC_h High Pass Filter is determined by Hydrophone C_h.			
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.		

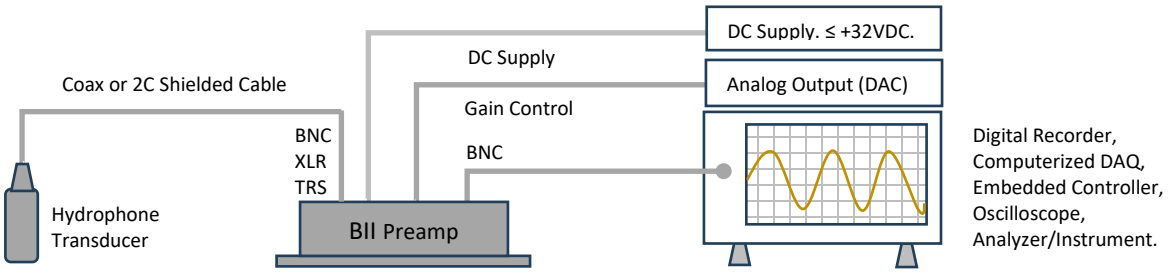
Signals and Wiring of Panel-Mount Connectors

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**	**XLR**	**BNC Jack**	**Power Jack,**
Center: Signal Shield: Common	Tip: Signal +. Ring: Signal -. Sleeve: Common.	Socket 2: Positive. Socket 3: Negative. Socket 1: Common.	Conductor: Vc. Shield: Common.	Center Contact: +VDC. Shell: Common.
Metal Case is for shielding and grounding.				

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**	**XLR and Cable**	**BNC and Coax**	**Power Plug**
Center: Signal Shield: Common	Tip, White Wire: Signal +. Ring, Black Wire: Signal -. Sleeve, Shield: Common.	Pin 2: Positive, White Wire. Pin 3: Negative, Black Wire. Pin 1: Common, Shield.	Conductor: Vc. Shield: Common.	Red Banana Plug or Red Wire Lead: +VDC. Black Banana Plug or Black Wire Lead: Common. Cable Shield, if any: Shielding.

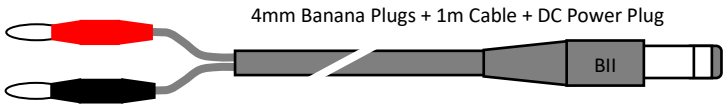
System Wirings of Standalone Preamp.



Accessories:

Part Number: DCBP24.

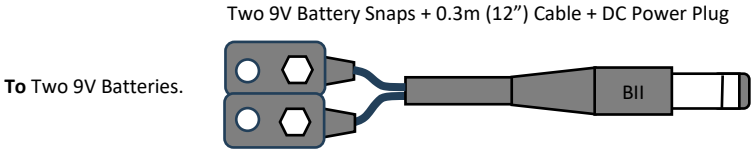
To Terminals of DC Supply:
a. One Red 4mm Banana Plug.
b. One Black 4mm Banana Plug.



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

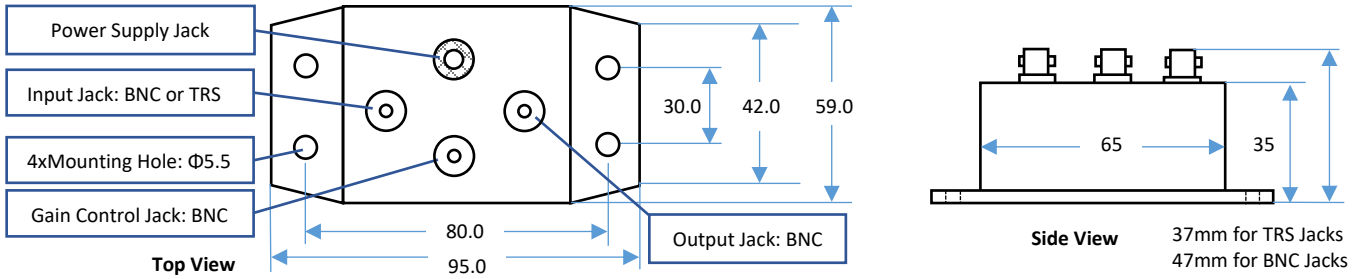
One 1m DC supply cable. One end is with Red and Black Banana Plugs, another end of the cable is with DC Power Plug. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

Part Number: DCBS18V.

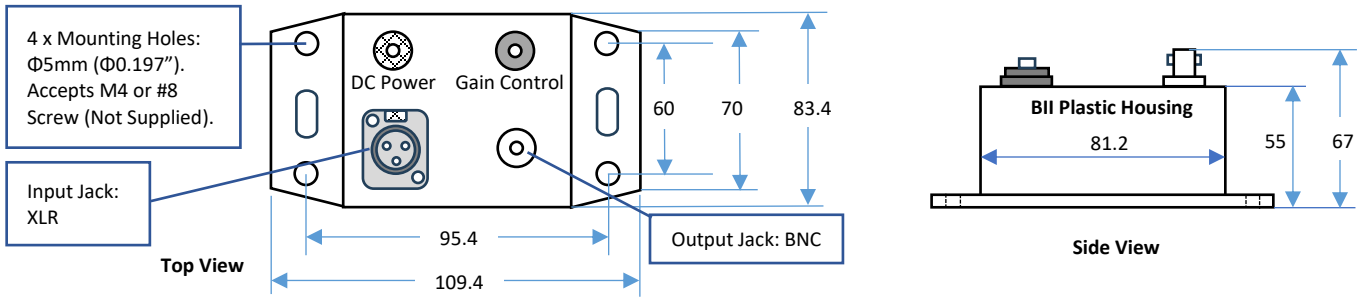


One 0.3m (12") DC supply cable. One end is two 9V Battery Snaps which supplies +18VDC to amplifiers, another end of the cable is with DC Power Plug.

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

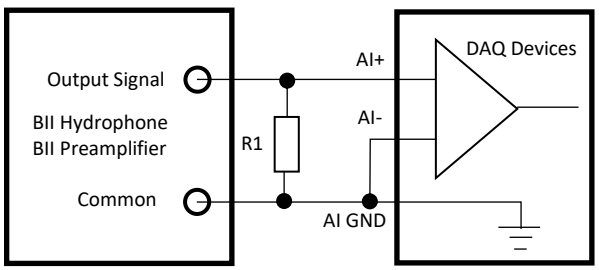


Plastic Housings Outline Dimensions (mm), Illustration only, the scale is not 1:1.

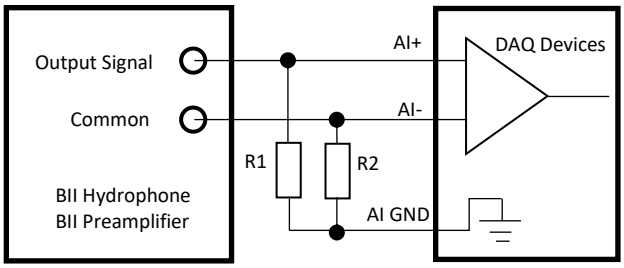


Preamplifier Wirings to DAQ (Data Acquisition): DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.
R1 and R2 resistors are NOT necessary for most applications. If DAQ saturation occurs, use R1 = R2 = 10kΩ to 1MΩ resistors.

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 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.

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 = $j/(2\pi fC_h)$, 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.