



BII2110 Series T/R (Transmitting and Receiving) Switch Modules

A BII2110 Series T/R switch module provides an integrated solution for a wide range of acoustic applications based on Emitting and Listening Timing Techniques. The device works at active mode (Transmitting Sounds) and passive mode (Listening Sounds). It integrates a T/R switch, a bandpass filter, and a low noise Automatic Gain Control (AGC) amplifier into one compact housing.

Built-in AGC (Automatic Gain Control) Amplifier: 100 dB Automatic Gain Range, 2kHz to 1MHz Bandwidth.

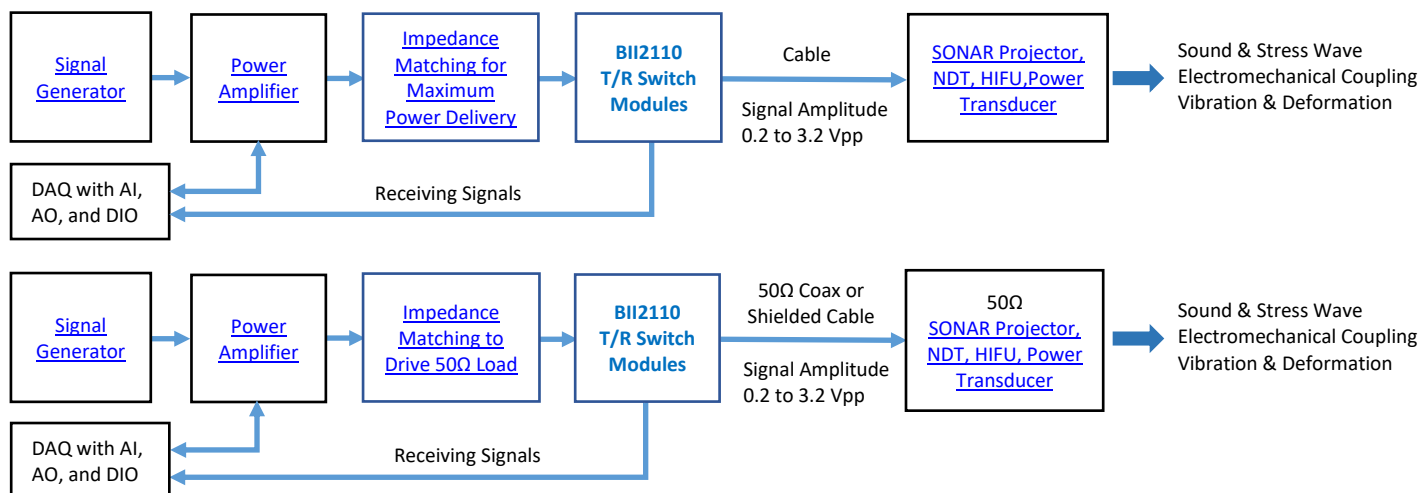
An Automatic Gain Control (AGC) amplifier is a dynamic adaptive electronic system whose gain changes automatically with input levels of continuous waveform (CW) or pulsed signals such as SINE pulses, Chirp/FM pulses, BFSK/FSK, etc. Its output signal level is always in detectable range for DAQ modules (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. The AGC amplifier automatically compensate the propagation losses in water, air, and solids.



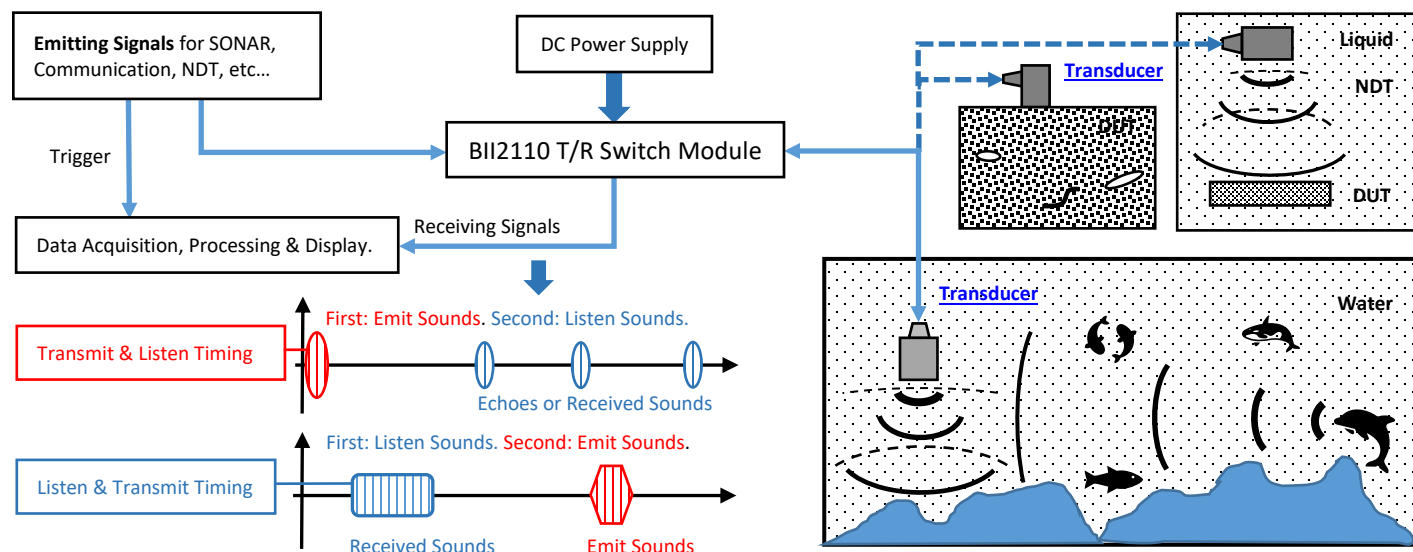
Typical Applications:

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.

Transmitting and Receiving System Configuration



System Block Diagram of Acoustic Pulse-echo and Communication Systems



Part Number	BII2111MIL		BII2111BNC			
	ACTIVE		ACTIVE			
	MIL: Panel Mount MIL-5015 Jack.		BNC: Panel Mount BNC Jack.			
	ACTIVE: Product device recommended for new designs. LIFEBUY: BII has announced that the device will be discontinued, and a lifetime-buy period is in effect. OBSOLETE: BII has discontinued the production of the device.					
Applications:	Standalone Device					
Frequency Range:	2 kHz to 1 MHz					
Power Capacity:	Refer to Cable and Connector Information .					
Signal Type:	Voltage Spikes, Sine Pulses, Chirp/FM Pulses, BFSK/FSK, etc.					
Echo Sounding Distance:	≥ 0.01 m, dependent on the bandwidth and operating frequency of a transducer.					
Transducers:	Transducer which can transmit and receive sounds.					
	For general-purpose applications, all kinds of piezoelectric transducers work with BII T/R Switch.					
	For better receiving performance such as lower threshold or larger dynamic range, following transducers are recommended: Transducers with neither impedance matching nor tuning.					
Supply Voltage V _s :	+16 to +32 VDC					
Current (Quiescent):	21.3 mA					
Fuse:	Panel Mount					
Power Supply Cable:	Panel Mount Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".					
Suggested DC Supply:	9V Battery, Marine Battery, Automobile Battery, Battery Pack, Subsea Battery, or DC Power Supply with Grounded Output and Protection of Output Current Limit.					
Grounding:	GWL16					
Housing:	Aluminum Housing.					
Weight:	0.7 kg	0.65 kg				
Size LxWxH (mm):	146.9x91.7x67					
Mounting:	Four holes and/or slots for installing the device to a firm base. Refer to the respective drawings for the size.					
	Fasteners (Screws, Washers, Nuts, etc.) for installing or mounting the devices: not included .					
Operation Temperature:	-10 to +60 °C, or 14 to 140 °F.					
Storage Temperature:	-20 to +60 °C, or -4 to 140 °F.					
Sound Transmitting						
Operating Frequency f _s :	2 kHz ~ 1 MHz					
	One BII's T/R Switch ONLY support one f _s . Specify only one f _s when ordering BII TR Switch. f _s is resonant frequency of a transducer at which maximum TVR exists.					
Impedance Matching:	No, not included.					
Driving Voltage V _{drive} :	1. Refer to cable options . 2. A shorter pulse width PW and a lower duty cycle D allow a BII TR switch to handle a higher power without damage.					
Transmitting Voltage Gain:	20*log((V _{drive} in Vpp - 1.2 Vpp)/V _{drive}), in dB.					
Maximum Power:	Limited by the transducer, cable, and duty cycle and pulse length of the signal, whichever is less.					
Duty Cycle D and Pulse Length (or Pulse Duration) PW vs. Driving Current and Voltage. Applicable to all models of BII2110 series.						
Duty Cycle D:	D ≤ 15%	15% < D ≤ 20%	20% < D ≤ 38%	38% < D ≤ 70%	70% < D ≤ 90%	90% < D ≤ 100%
Maximum Pulse Width:	40 mS	50 mS	150 mS	290 mS	400 mS	Continuous
Maximum Driving Current:	10 Arms	8 Arms	5 Arms	3 Arms	2 Arms	1 Arms
Max. Driving Voltage V _{drive} :	Depending on the impedance of a specific transducer. Enclosed in datasheet emailed to buyers after T/R SW manufacturing.					
Cable:	None					
Connector:	Panel-Mount MIL-5015 Type Connector (MIL).			Panel-mount BNC Jack.		
Cable and Connector Information for High Power Signals (from Power Amplifier and to Transducers). Non-UL Uses.						
Cable Options:	Transducer Cable Types			Ratings of Voltage, Current or Power, and Temperature.		
	AWG18 Wires (WR), Special Order.			3000 Vrms, 10 Arms.		
	Two Conductor Shielded Cable (SC)			600 Vrms, 5 Arms.		
	High Temperature Shielded Cable (HTSC199)			600 Vrms, 6 Arms, up to +199°C or 390 °F, Non-waterproof.		
	Coax RG58 (50Ω) (RG58)			1400 Vrms, 4 Arms.		
	Coax RG174/U (50Ω) (RG174)			1100 Vrms, 1.6 Arms.		
	Coax RG178B/U (50Ω) (RG178).			750 Vrms, 0.86 Arms, up to +200°C or 390°F.		
Connector Options:	Transducer Connector Type			Ratings of Voltage, Current or Power, and Temperature.		
	1. Wire Leads (WL), Special Order.			Used for Cables or Wires.		
	2. 50Ω BNC (BNC), Bayonet Lock. Panel Mount or In-line. In-line BNC: Input uses Pin, output uses Socket. Panel Mount BNC: Both Input and Output use BNC Jacks.			500Vrms, 316W. Used for Metal Enclosures or Coax Cables.		
	3. MIL-5015 Type Connector (MIL), Thread Fastening. Panel Mount or In-line. Input uses Pin, output uses Socket.			500Vrms, 13 A; Up to +125°C or 257°F, or, 900Vrms, 13 A; Up to +125°C or 257°F. Used for Metal Enclosures or Shielded Cables.		
	4. Underwater Mateable Connector (UMC), Thread Fastening. Panel Mount or In-line. Input uses Pin, output uses Socket.			600Vrms, 10A. Waterproof, IP68. Used for Metal Enclosures or Shielded Cables.		
<p>How to choose cable and connector for BII devices: Driving Voltage V_{drive} (V_{rms}) = $\sqrt{RMS\ Power * \frac{G}{G^2+B^2}}$.</p> <p>BII lists G-B data at f_s and/or the graph of G-B vs Frequency in online datasheet.</p> <p>Case 1. Deliver 1000 Wrms to 3 kΩ transducer at f_s. Note: G/(G²+B²)=3 kΩ is the resistive load of the transducer in load medium at f_s. Driving voltage to transducer V_{drive} = $\sqrt{1000 * 3000} = 1732\ V_{rms}$. The current to 3 kΩ transducer I_{drive} = V_{drive}/R_L = 1732Vrms/3000Ω = 0.57733 A_{rms}.</p>						

Therefore, AWG18 Wire and Wire leads are suitable.	
Case 2. Deliver 500 Wrms to 300 Ω transducer at f_s . Note: $G/(G^2+B^2)=300\ \Omega$ is the resistive load of the transducer in load medium at f_s . Driving voltage to transducer $V_{drive} = \sqrt{500 * 300} = 387.3\ V_{rms}$. The current to 300 Ω transducer $I_{drive} = V_{drive}/R_L = 387.3V_{rms}/300\Omega = 1.291\ A_{rms}$. Therefore, Two Conductor Shielded Cable and MIL-5015 Type Connector or Underwater Mateable Connector (UMC) are suitable.	
Case 3. Deliver 300 Wrms to 50 Ω transducer at f_s . Driving voltage to transducer $V_{drive} = \sqrt{300 * 50} = 122.5\ V_{rms}$. The current to 50 Ω transducer $I_{drive} = V_{drive}/R_L = 122.5V_{rms}/50\Omega = 2.45A_{rms}$. Therefore, 50 Ω RG58 Coax and BNC are suitable.	
Please contact us for bespoke wirings of differential transducers such as dipole, quadrupole, multimode rings, and flextensional sources.	
Sound Receiving	
Automatic Gain Range:	-20 to 80 dB
-3dB Bandwidth:	2 kHz to 1 MHz.
	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 10 kHz, you may specify a high pass filter of a preamp with -3dB cut-off frequency 5 kHz to improve signal to noise ratio of the signals of the interest.
High Pass Filter:	Built-in, Customized, Specify -3dB cut-off frequency when ordering.
	White noise level is proportional to the square root of bandwidth. The narrower the pass band of the filter is, the lower the ambient and electronic noises are.
Input Couling:	AC
Input Referred Noise: (at $f \geq 1\ kHz$)	$e_n=10.0\ nV/\sqrt{Hz}$, $i_n=0.8\ fA/\sqrt{Hz}$. Roughly electronic noise density at input, RTI, $V_n^2 = e_n^2 + [i_n * \text{impedance of a transducer (or hydrophone)}]^2$. RTI: Reference to Input.
Input Dynamic Range:	$\geq 90\ dB$
Input Range of Receiver:	(-103 +FFVS) to (17 + FFVS). For example: A hydrophone has FFVS of -190 dB V/ μPa , detection range = 87 to 207 dB μPa .
Settling Time, 0.01%:	3 μs to 0.1%, Output Step 10 Vpp.
Received Signal	
Output Couling:	AC
Output Signal Range:	0.2 to 3.2 Vpp, or -23 to 1.07 dB Wrms.
Output Impedance:	50 Ω
Cable Drive Capability:	200 m
Output Signal:	Waveform, AC Coupled.
Output Signal Type:	Single Ended
Output Connector:	BNC Jack
WARNING: The buyer observes the National Electrical Code or other related codes of buyer's country to assemble and integrate this device into buyer's product or system and follow the code to ground and insulate this device. It is buyer's sole responsibility to make sure the proper insulation and grounding for operating safety before putting the device into service. Dangerous voltages, capable of causing injury or death, are present in this device. DO NOT TOUCH THE DEVICE, ITS WIRES, CABLES, AND CONNECTORS BEFORE THE POWER SUPPLIES AND SIGNAL SOURCES ARE SHUT DOWN. 1. All exposed bare wires, metal wires, wire leads, and solders shall be insulated with insulation material such as heat shrink tubing, electric/insulating tape, etc. The insulation voltage must be greater than twice the maximum voltage of the device. 2. This device MUST be firmly grounded for operation safety. 3. Coax with BNC is not intended for hand-held use at voltages above 30VAC/60VDC. It is buyer's sole responsibility to make sure that the BNC shield of the signal source is firmly grounded for operation safety before hooking up the device to the signal source.	

Questions

How do I assemble #10 Ring Terminal or 4mm Banana Plug to Grounding Cable?

- for #10 Ring Terminal, crimp or solder is acceptable. Please choose a suitable crimp tool for crimping connector and cable, or a suitable solder station for soldering.
- for 4mm Banana Plug, solder is acceptable. Please choose a suitable solder station for soldering.

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.**

What if connectors of my transducers and/or power amplifiers are NOT MIL-5015 type connectors?

The custom-made adaptors are recommended such as MIL-5015 to BNC, MIL-5015 to Underwater connectors, MIL-5015 to XLR, etc. BII can manufacture these adaptors which bridge your devices and BII devices. Please discuss with BII for customizations.

Frequencies of my pingers (transponder, or beacon) range from 20 kHz to 300 kHz, what are the gains of a BII AGC to amplify or attenuate the signals automatically?

Gain of a BII AGC varies from -20 dB to 100 dB to amplify or attenuate input signal of 100 Hz to 200 kHz.

Gain of a BII AGC varies from -20 dB to 80 dB to amplify or attenuate input signal of 200 kHz to 2 MHz.

How do I wire BII devices to audio connectors (XLR or TRS) of my recording devices?

BII devices has panel-mount TRS or BNC jack as output connector. The custom-made adaptors are recommended such as BNC to XLR, BNC to TRS, etc. BII can manufacture these adaptors which bridge your devices and BII devices. Please discuss with BII for customizations.

My acoustic applications are in MHz range, are TRS connectors of BII devices 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: 1M Ω | 30pF, Signal Source: DDS Signal Generator.

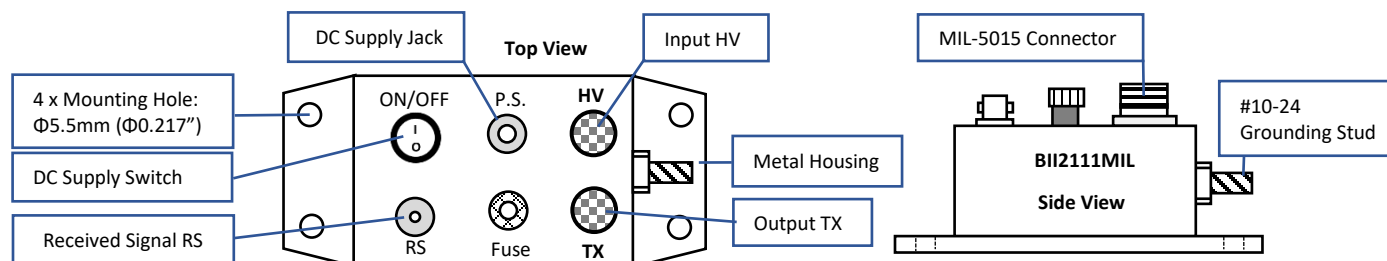
Ordering Information of BII2110 Series.

Power: RMS or Peak Power delivered to Transducer from PA, in RMS Watt (Sine/Chirp Pulses, etc.) or Peak Watt (Spike or Single Pulse for NDT). **The POWER can be ignored with blank if RMS power of the transducer and/or the amplifier is known. In these cases, BII will use RMS power of the transducer and/or the amplifier to design the power capacity of the device;** **V_{drive}:** Maximum Driving Voltage to transducer, in Vrms; **PW:** Maximum Pulse Width in μ S, mS, or S; **D:** Maximum Duty Cycle in %; **fs:** Transducer Resonance, in kHz or MHz; **Z_{TX}:** Transducer Impedance at fs, in Ω ; **θ :** Transducer Phase in $^{\circ}$; **Z_{IM}:** Impedance for Optimum Power Transfer from the PA to the Transducer, in Ω ; **PA:** Power Amplifier; **TX:** Transducer; **PN:** Part Number. **HPF:** -3dB High Pass Filter of Receiving, **LPF:** -3dB Low Pass Filter of Receiving. Refer to [Power Amplifier](#) for available options and wirings. Refer to [Transducer](#) for available options and wirings.

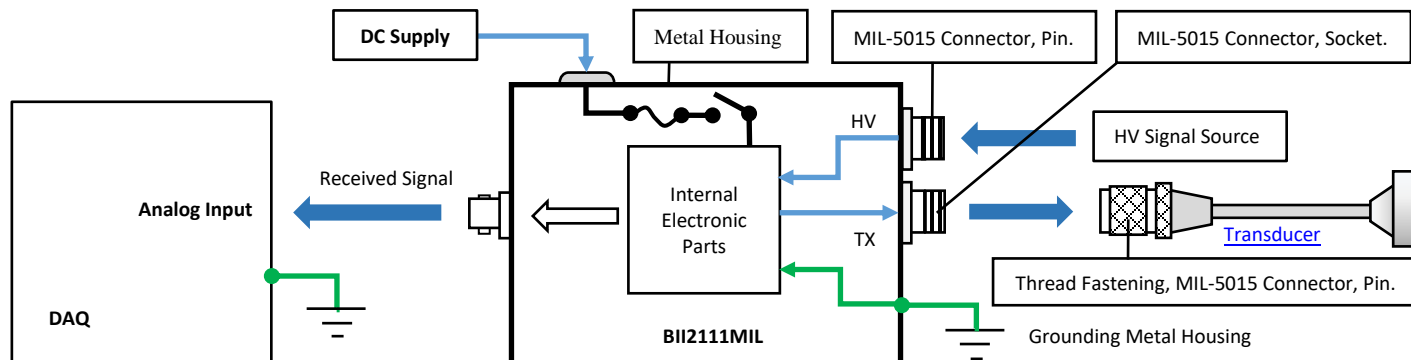
1. BII211MIL

HV Connector to High Voltage Source: Panel Mount MIL-5015 Pin. **TX Connector to Transducer:** Panel Mount MIL-5015, Socket.

Metal Enclosure, Overall Size: LxWxH = 146.9x91.7x67 mm. Mounting Hole $\Phi 5.5\text{mm}$ ($\Phi 0.217''$) accepts M5 or #10 screw. Screws are not supplied.



System Block Diagram and Wirings



Wirings:

Signals	BII2111MIL		
HV Signals:	MIL-5015 Style Connector, Panel Mount, 3-Contact Mating Connector, Pin.		
	Signal of High Voltage Source	Contact C	
	Signal Common of High Voltage Source	Contact B	
	Shielding and Grounding	Contact A	
TX Signals:	MIL-5015 Style Connector, Panel Mount, MIL-5015, 3-Contact Mating Connector, Socket.		
	Signal of Transducer	Contact C	
	Signal Common of Transducer	Contact B	
	Shielding and Grounding	Contact A	
Received Signal:	Panel Mount BNC Jack.		
	Signal	BNC Center Contact	
	Signal Common, Shielding, Grounding.	Metal Shell Body	
Power Supply:	Panel Mount Power Jack and DC Supply Cable Pair: Part Number DC-PPBP-24 .		
	+VDC	Center Contact	Red 4mm Banana Plug
	Signal Common, Shielding, Grounding.	Metal Shell Contact	Black 4mm Banana Plug

DC Supply Switch: Turn ON and Turn OFF DC Supply. "1" -> ON; "0" -> OFF.

Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".

Accessories: 1. Included: One DC supply cables, Part Number: [DC-PPBP-24](#). 2. Included: One Grounding Cable, Part Number: [GWL18](#).

Grounding Metal Case for operating safety. Grounding Stud: #10-24 Screw 316SS. Nut and Washer are included.

1. Install the device to a safe solid object to avoid sliding. An air free-flowing area and good thermal conducting object allow the device to cool down.
2. Never use the device in the event of slide happening, otherwise, loss of the device into water, property damage, and person injury may occur.

How to Order, refer to [Ordering Information of BII2110 Series](#) for explanations of the terms or initials.

BI12111MIL	-fs	-ZTX	-V _{drive} or BI1 Power Amplifier	-PW	-D	-HPF
Example of Part Number:			Description			
BI12111MIL-30kHz-300Q-BI15068MIL-100mS-20%-3kHz			BI12111MIL, T/R Switch Module, Transducer: 30kHz, 300Q; Driving Signal to Transducer: BI15068MIL Power Amplifier, Maximum Pulse Width 100mS, Maximum Duty Cycle 20%; Receiving Highpass Filter: 3kHz.			
Warning: The TR Switch will be damaged if the driving signal exceeds Maximum Driving Voltage, Maximum Pulse Width, or Maximum Duty Cycle.						

Accessories:

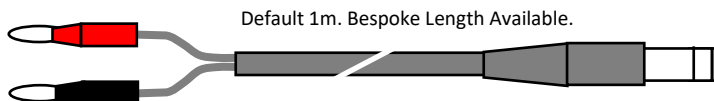
1. DC Supply Cable

Red Banana Plug or Red Wire Lead: +VDC.	Black Banana Plug or Black Wire Lead: Common.	Cable Shield, if any: Shielding.
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Part Number: DC-PPBP-24.

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.

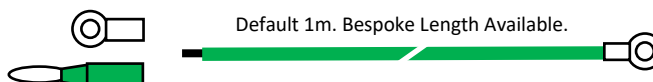
One 1m DC supply cable. One end of the cable is with DC Power Plug, another end is Red and Black Banana Plugs. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

2. Grounding Cable and Terminals

Grounding Cable, Part Number: GWL18 or GWL16, Support Single-Point Grounding with Multiple Devices. One 1m AWG 18 or AWG 16 Green Wire with #10 Ring Terminal and Wire Lead. One #10 Ring Terminal and one 4mm Banana Plug (Green) are included. Depending on buyer's grounding terminal type, buyer assembles #10 Ring Terminal, 4mm Banana Plug, or other type connector to grounding cable at buyer's cost.

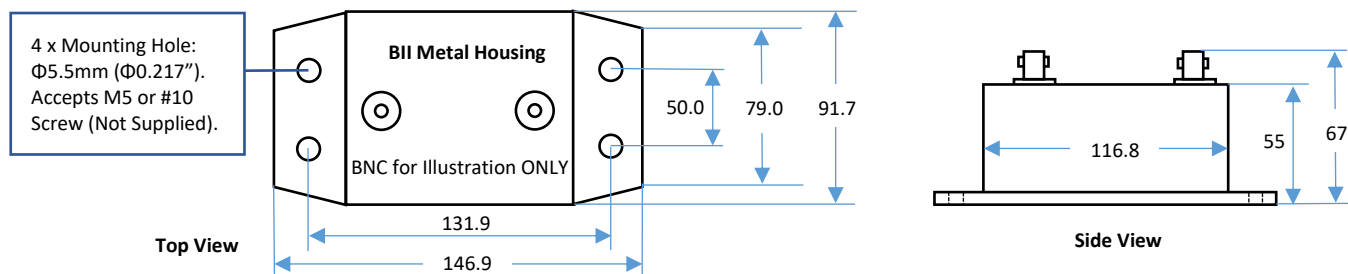
Terminal to buyer's Grounding Terminal:

- Default: Wire Lead
- One #10 Ring Terminal
- One 4mm Banana Plug



#10 Ring Terminal
#10-24 nut and #10 washer included.

Metal 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.

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.

