Benthowave Instrument Inc.

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BII2170 Series T/R (Transmitting and Receiving) Switch Modules for SONAR & NDT Transducers

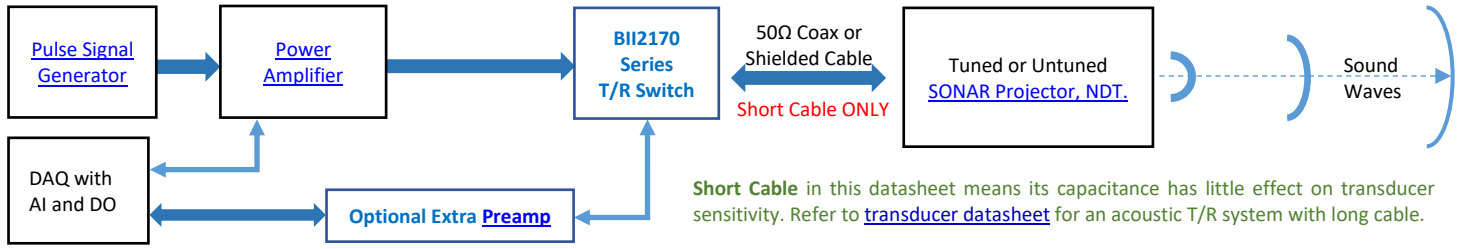
A BII2170 Series T/R switch module is an integrated solution for a wide range of acoustic applications based on Emitting and Listening Timing Techniques. The device works at active mode (Transmitting Sounds) and passive mode (Listening Sounds) with a **transducer** which can radiate and receive sounds. A BII2170 device integrates an impedance matching network, a T/R switch, a bandpass filter, and a low noise DPGA preamplifier (Digitally Programmable Gain Amplifier) or a Fixed Gain Amplifier (FGA) into one compact housing. Gain-selection is accomplished by a two-bit or one-bit digital word (TTL/CMOS level compatible). The built-in impedance matching network is customized to match impedance between the power amplifier and the transducer at operating frequency, generally at resonance frequency fs.

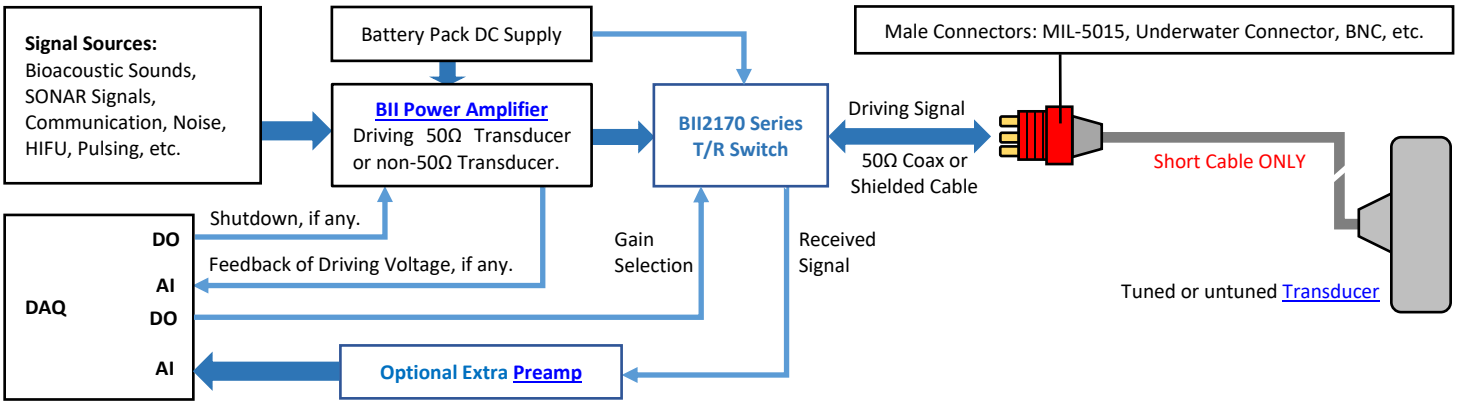
Tips: Separation of transmitting element and receiving element below 1MHz can improve receiving performances such as lower noise level, optimum directivity, and higher sensitivity etc. BII manufactures transducers with separated transmitting elements and receiving elements to achieve better acoustic performances below 1MHz.

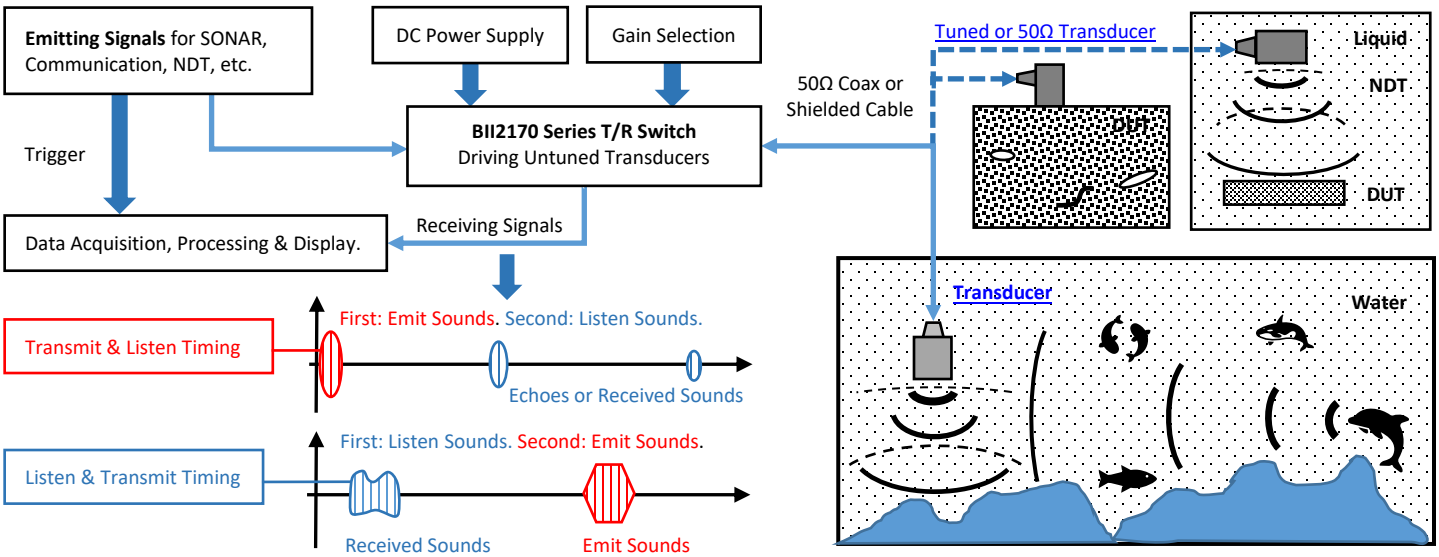
Typical Applications

Echo Sounder (Navigation/Object Avoidance, Depth/Distance Sounder, Wave-height Sensor), Target Strength Measurement, Sub-bottom Profilers, Side-scan SONAR, Fishery SONAR, Transponders, Positioning, Beacon, Communication and Telemetry, Artificial Acoustic Target, Acoustic Speedometers (Doppler SONAR), Sound Velocity Profiler, Marine Bioacoustics, Acoustic Deterrent Devices, Ocean Current Profiling, Flow Meter, NDT (Non-destructive Test), Diagnostic Ultrasounds, Ultrasonic Test and Analysis, Material Study.

Acoustic Transmitting and Receiving System with Untuned or 50Ω Transducers







SPECIFICATIONS

PD: Pulse Duration; **D**: Duty Cycle; **V_T**: Transmit Voltage; **R_{TX}**: Resistance of Tuned Transducer; **G**: Conductance of a Untuned Transducer.					
FG: Fixed Gain; **PG**: Programmable Gain; **DF**: Differential Output; **SE**: Single Ended Output; **BPF**: Band Pass Filter; **HPF**: High Pass Filter; **LPF**: Low Pass Filter.					
T/R Switch Modules	**BII2172WR**	**BII2172MIL**	**BII2172BNC**	**BII2173BNC**	**BII2174BNC**
	ACTIVE	**ACTIVE**	**ACTIVE**	**ACTIVE**	**ACTIVE**
	WR: Wire/Cable Bundles; **BNC:** Panel Mount BNC; **MIL**: Panel Mount MIL-5015 Connector.				
	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 production of the device.				
Typical Applications:	Embedded	Standalone	Standalone	Standalone	Standalone
	Half-duplex or Semi-duplex Acoustic System: transmitting sounds and receiving sounds at separate timing.				
Signal Type:	Spike, SINE Pulse, Chirp, PSK, FSK; Pulse, Square Waveform; Continuous Waveform, etc…				
Echo Sounding Distance:	≥ 0.3 m	≥ 0.3 m	≥ 0.3 m	≥ 3 mm to 0.03 m	≥ 3 mm to 0.03 m
	Dependent on the **near-field distance**, bandwidth, and operating frequency of a transducer.				
Transducers:	**Tuned transducers:** Reactance is cancelled out. There is pure resistance at operating frequency fs, and Power Factor = 1.				50Ω Transducer
	Untuned transducers: There is complex impedance (G-B, R-X, or Z-θ) at operating frequency fs and Power Factor < 1. Power Factor is corrected to 1 with the impedance matching network in the device.				
	Note: Tuned transducers can achieve much higher acoustic power than untuned transducers.				
DC Supply Fuse:	None	Panel Mount	Panel Mount	Panel Mount	Panel Mount
		Panel Mount Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".			
DC Switch:	None	Turn ON/OFF DC power supply.			
Grounding:	N/A	GWL18	GWL18	GWL18	GWL18
	Warning: for BII2172WR, End user grounds end user's system for safety.				
Housing:	Plastic Housing	Metal Enclosure	Metal Enclosure	Metal Enclosure	Metal Enclosure
	Note: BII uses third-party's metal housing in production. Because of variation of suppliers' production, BII reserve the right to use different enclosures whose functions are compatible to the ones listed in this specification.				
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.**				
Weight:	2 to 6 kg.	0.9 to 3 kg.	0.9 to 3 kg.	0.2 to 2 kg	0.2 to 2 kg
Size LxWxH, ΦDxH (mm): Depending on Power.	Φ104x(100 to 150). 104x104x(100 to 150). 121x121x(100 to 150).	147.2x67.2x55. 146.9x91.7x56. 146.9x91.7x85. 180.5x110.3x93.	147.2x67.2x55. 146.9x91.7x56. 146.9x91.7x85. 180.5x110.3x93.	147.2x67.2x55. 146.9x91.7x56. 146.9x91.7x85. 180.5x110.3x93.	147.2x67.2x55. 146.9x91.7x56. 146.9x91.7x85. 180.5x110.3x93.
Operation Temperature:	-10 to +60 °C, or 14 to 140 °F.				
Storage Temperature:	-20 to +60 °C, or -4 to 140 °F.				
Sound Transmitting					
Signal Type:	**Pulsing Signals of SONAR, Communication, NDT**: Tone Burst (Sinusoidal) Excitation, Chirp Pulse, Square Wave Pulse, Spike (Shock) Pulse, Coded Excitation (Barker/Golay), etc.				
	Continuous Signals, Arbitrary Signals, Aquatic/Marine Animal Sounds, Ambient and Ship/Vehicle Noises, etc.				
f_s Range:	100 Hz to 1 MHz	100 Hz to 1 MHz	100 Hz to 1 MHz	30 kHz to 2 MHz	0.1 to 10 MHz
	f_s is resonant frequency of a transducer at which maximum TVR exists.				
Operating Range of f_s:	0.5f_s to 1.5f_s.				
	Take an example of f_s=50 kHz specified during ordering, respective TR Switch can work with transducers whose f_s is from 25 to 75kHz.				
Impedance Matching:	Yes, built-in, Impedance matching between Signal Source and Transducer for maximum power delivery.				
Voltage Gain at f_s:	= 10*$\log_{10}(R_{TX}/R_o)$, in dB. **R_o**: Output Resistance of Signal Source. R_{TX}: Resistance of a **tuned transducer** at f_s.				
	≈ 10*$\log_{10}(1/(R_oG))$, in dB. **R_o**: Output Resistance of Signal Source. G: Conductance of a **untuned transducer** at f_s.				
Transmit Voltage **V_T**:	Refer to Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle. V_T in Vpp.				
	Warning: Transmit Voltage exceeding Maximum Peak Pulse Voltage destroy the T/R Switch.				
Max. Transmit Current:	13 A_{rms}	10 A_{rms}	1 A_{rms}, continuous.		
			5 A_{peak} at PD ≤ 10 mS.		
			10 ~ 20 A_{peak} at PD ≤ 1 µS.		
Pulse Power Capacity during PD:	≤ 2500 W_{RMS}	≤ 2000 W_{RMS}	≤ 100 W_{RMS}, continuous.		
			≤ 500 W_{RMS}, PD ≤ 10 mS and D ≤ 1%.		
			≤ 2000 W_{RMS}, PD ≤ 1 µS and D ≤ 1%.		
	Warning: Pulse Power exceeding the rating of a TR Switch will damage the device.				
	SINE Pulse: Average Pulse Power during PD to Tuned Transducer (Resistive Load R_{TX}), $P_{avg} = V_T^2/(8R_{TX})$. **Burst Square Signal**: Average Pulse Power during PD to Tuned Transducer (Resistive Load R_{TX}), $P_{avg} = V_T^2/(4R_{TX})$. **Burst Pulse Train**: Average Pulse Power during PD to Tuned Transducer (Resistive Load R_{TX}), $P_{avg} = V_T^2/(2R_{TX})$.				
	SINE Pulse: Average Pulse Input Power to Untuned Transducer (Complex Load), $P_{avg} = V_T^2*G/8$. **Burst Square Signal**: Average Pulse Input Power to Untuned Transducer (Complex Load), $P_{avg} = V_T^2*G/4$. **Burst Pulse Train**: Average Pulse Input Power to Untuned Transducer (Complex Load), $P_{avg} = V_T^2*G/2$.				
	Positive or Negative Voltage Spike: Peak Pulse Power during PD to 50Ω Transducer, $P_{peak} = V_T^2/50Ω$, aproximately.				
	Signal Types: Referring to Typical Signals for Active SONAR… in Acoustic Transducers and Measurement Handbook.				
	Warning: Pulse Power exceeding power rating of a transducer will damage the transducer.				
Cable Length:	0.3 m.	N/A	N/A	N/A	N/A
Cable:	Wires	N/A	N/A	N/A	N/A
Connector:	Wire Leads	Panel Mount	Panel Mount	Panel Mount	Panel Mount
		MIL-5015 Connector	BNC Jack	BNC Jack	BNC Jack
Sound Receiving					
Receiving Gain (dB):	20, 40, 60, 80.	20, 40, 60, 80.	20, 40, 60, 80.	20, 60.	40.

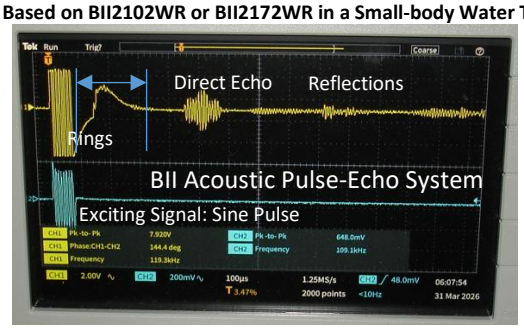
	How do I extend the programmable gain of a BII's TR Switch? BII recommends an extra standalone preamp or programmable preamp to extend gain options. For example: 1. Your project needs a BII2173BNC with 20, 40, 80 dB Gain options. A programmable gain preamp with 0/20dB is a solution. 2. Your project needs a BII2174BNC with 40, 80 dB Gain options. A programmable gain preamp with 0/40dB is a solution.				
Frequency Range:	10Hz to 350kHz at 80dB 10Hz to 1MHz at ≤ 60dB	10Hz to 350kHz at 80dB 10Hz to 1MHz at ≤ 60dB	10Hz to 350kHz at 80dB 10Hz to 1MHz at ≤ 60dB	3kHz to 4.5MHz	10kHz to 17MHz
Gain Vs. Frequency:	Frequency Response of Receiving Gain.				
Band Pass Filter: (Default)	Default: 0.1*fs to 10*fs.				10kHz to 17MHz
	-3 dB bandwidth of receiving signal processing. Built-in, 2nd order, 40 dB/Decade Roll-off.				
	Note: The narrower the pass band of the filter is, the lower the ambient and electronic noises are.				
Band Pass Filter: (Bespoke)	HPF ≥ 10Hz. LPF ≤ 350kHz.	HPF ≥ 10Hz. LPF ≤ 350kHz.	HPF ≥ 10Hz. LPF ≤ 350kHz.	HPF ≥ 3kHz. LPF ≤ 4.5MHz.	N/A
	Note: The narrower the pass band of the filter is, the lower the ambient and electronic noises are.				
Filters of Receiving Signals. 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 30 kHz, you may specify a high pass filter of a preamp with -3dB cut-off frequency 3 kHz to improve signal to noise ratio of the signals of the interest.					
Input Referred Noise e_n: (at f ≥ 1 kHz)	10.7 nV/√Hz.	10.7 nV/√Hz.	10.7 nV/√Hz.	8.4 nV/√Hz.	4.0 nV/√Hz.
	Total equivalent pressure noise level at input, $P_n\ in\ dB\ \mu Pa = 20 * LOG_{10}(e_n * \sqrt{BW}) - FFVS - 180.$				
	BW: -3dB bandwidth of receiving. **FFVS**: Free field voltage response of receiving.				
Input Dynamic Range:	90 dB at 10 kHz Bandwidth				
Settling Time, 0.01%:	2 µs	2 µs	2 µs	1.2 µs	42 nS
Received Signal					
Output Impedance:	50 Ω				
Cable Drive Capability:	50 m				
Output Signal:	Waveform, AC Coupled.				
Output Signal Type:	Differential	Differential	Single Ended	Single Ended	Single Ended
Output Signal Range:	Supply Voltage Vs - 4, in Vpp.				
Cable Length:	0.3 m	N/A	N/A	N/A	N/A
Cable:	Coax RG174	N/A	N/A	N/A	N/A
Connector:	Wire Leads	XLR Jack Panel Mount	BNC Jack Panel Mount	BNC Jack Panel Mount	BNC Jack Panel Mount
Receiving Gain Selection:					
Cable Length:	0.3 m	N/A	N/A	N/A	N/A
Gain Selection Cable:	Shielded Cable	N/A	N/A	N/A	N/A
Connector:	Wire Leads	DIN Jack Panel Mount	DIN Jack Panel Mount	BNC Panel Mount	N/A
Gain Selection:	A 2-bit digital output word.			1-bit digital output.	N/A
	TTL/CMOS Compatible. Logic Low 0: 0 to +0.8 VDC from digital outputs, or Gain Selection Wire is short to Digital COMMON. Logic High 1: +2.4 VDC to +Vs from digital outputs, or Gain Selection Wire Opens. Vs: Power Supply Voltage.				
Truth Table:	A1 A0 Gain(dB) Bandwidth 0 0 20 1 MHz 0 1 40 1 MHz 1 0 60 1 MHz 1 1 80 350 kHz			A0 Gain(dB) 0 20 1 60	N/A
DC Power Supply					
DC Supply Voltage Vs:	Default: +8.5 to +32 VDC.				
	Bespoke DC Supply Voltage Vs: **+30 to +45 VDC**. Appending **-MV** to part number. For example: BII2172BNC-MV.				
	Bespoke DC Supply Voltage Vs: **+45 to +60 VDC**. Appending **-HV** to part number. For example: BII2172BNC-HV.				
Current (Quiescent):	22 mA	22 mA	22 mA	19 mA	8.2 to 12.5 mA
DC Power Supply Cable:	Wire Bundle, Wire Leads.	1. DCBS18V, or 2. DCBP24.	1. DCBS18V, or 2. DCBP24.	1. DCBS18V, or 2. DCBP24.	1. DCBS18V, or 2. DCBP24.
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.				

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. Metal chassis and/or metal housing of the device MUST be grounded for operation safety.
4. Cable shield MUST be grounded for operation safety.
5. 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.

Acoustic Pulse-Echo System with 110 kHz Sine Pulse Based on BII2102WR or BII2172WR in a Small-body Water Tank:



How to Choose BII TR Switch and Transducers (tuned or untuned) according to my acoustic project?

Acoustic Project I: Sub-Bottom Profiling.
Requisites: **Electrical Average Power to Transducer** P_{avg} = 1000W during 1ms pulse duration; **Operating Frequency**: 8 kHz.
Transducer Options: (1) **A untuned transducer** G_{max} = 0.73mS, B= 0.8mS at f_s = 8kHz.
(2) **A series-tuned transducer** R_{TX} = 400Ω at f_s = 8kHz.

Step 1. **Signal Types.** Referring to **Typical Signals for Active SONAR…** in BII's Acoustic Transducers and Measurement Handbook.
Step 2. Refer to Max. Transmit Current, Pulse Power Capacity during PD and Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle.
Both BII2172WR and BII2172MIL meet limitations above.

Signal Types	Exciting Voltage to Transducer	TR Switch	PD and D
Sine Pulse (**SP**) to untuned transducer achieving 1000W P_{avg}:	$V_{tx} = \sqrt{8 * P_{avg}/G_{max}}$ = 3310 V_{pp}.	BII2172WR	PD = 1mS and D ⩽ 1%
Burst Square Signal (**BSS**) to untuned transducer achieving 1000W P_{avg}:	$V_{tx} = \sqrt{4 * P_{avg}/G_{max}}$ = 2341 V_{pp}.	BII2172WR	PD = 1mS and D ⩽ 1%
Sine Pulse (**SP**) to series-tuned transducer achieving 1000W P_{avg}:	$V_{tx} = \sqrt{8 * P_{avg} * R_{TX}}$ = 1789 V_{pp}.	BII2172WR	PD = 1mS, D ⩽ 10%
Burst Square Signal (**BSS**) to series-tuned transducer achieving 1000W P_{avg}:	$V_{tx} = \sqrt{4 * P_{avg} * R_{TX}}$ = 1265 V_{pp}.	BII2172WR	PD = 1mS, D ⩽ 10%
		BII2172MIL	PD = 1mS, D ⩽ 10%

Step 3. **Determine Receiving Bandwidth.** Operating f is 8 kHz. Refer to Input Referred Noise en.
To reduce electronic noise, at same time, to avoid affecting 8 kHz echo signal, -3dB bandpass filter of receiving can be set to 0.8 to 80 kHz.
Take BII2172WR and FFVS = -180.0 dBV/µPa as an example, equivalent pressure noise level at input from electronics, approximately:
P_n = -110.4 dBV – FFVS of the transducer = 69.6 dB µPa.

Acoustic Project II: Underwater Communication.
Requisites: (1) **Electrical Average Power to Spherical Transducer** P_{avg} = 300 W during 10 ms pulse duration, D=10%;
(2) Transmit and Receive **Communication Carrier Frequency**: 35 kHz.
Transducer Options: (1) **Untuned spherical transducer** BII7523 G_{max} = 10.8 mS, B= 8 mS at f_s = 35 kHz.
(2) **Series-tuned spherical transducer** BII7523ST R_{TX} = 60 Ω at f_s = 35 kHz.

Step 1. **Signal Types.** Referring to Typical Signals for Active SONAR… in BII's Acoustic Transducers and Measurement Handbook.
Step 2. Refer to Max. Transmit Current, Pulse Power Capacity during PD and Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle.
BII2172WR, BII2172MIL, BII2172BNC, BII2173BNC, meet limitations above.

Signal Types	Exciting Voltage to Transducer	TR Switch	PD and D
Sine Pulse (**SP**) to untuned transducer achieving 300W P_{avg}:	$V_{tx} = \sqrt{8 * P_{avg}/G_{max}}$ = 471.4 V_{pp}.	BII2172WR, BII2172MIL, BII2172BNC, BII2173BNC.	PD = 10mS, D = 10%.
Burst Square Signal (**BSS**) to untuned transducer achieving 300W P_{avg}:	$V_{tx} = \sqrt{4 * P_{avg}/G_{max}}$ = 333.4 V_{pp}.		
Sine Pulse (**SP**) to series-tuned transducer achieving 300W P_{avg}:	$V_{tx} = \sqrt{8 * P_{avg} * R_{TX}}$ = 379.5 V_{pp}.		
Burst Square Signal (**BSS**) to series-tuned transducer achieving 300W P_{avg}:	$V_{tx} = \sqrt{4 * P_{avg} * R_{TX}}$ = 268.4 V_{pp}.		

Step 3. **Determine Receiving Bandwidth.** Carrier frequency f = 35kHz. Refer to Input Referred Noise en.
To reduce electronic noise, at same time, to avoid affecting 35kHz communication signal, -3dB bandpass filter of receiving can be set to 3.5 to 350 kHz.
Take BII2172BNC and BII7523 FFVS = -197.0 dBV/µPa as an example, equivalent pressure noise level at input from electronics, approximately:
P_n = -104.0 dBV – FFVS of the transducer = 93.0 dB µPa.

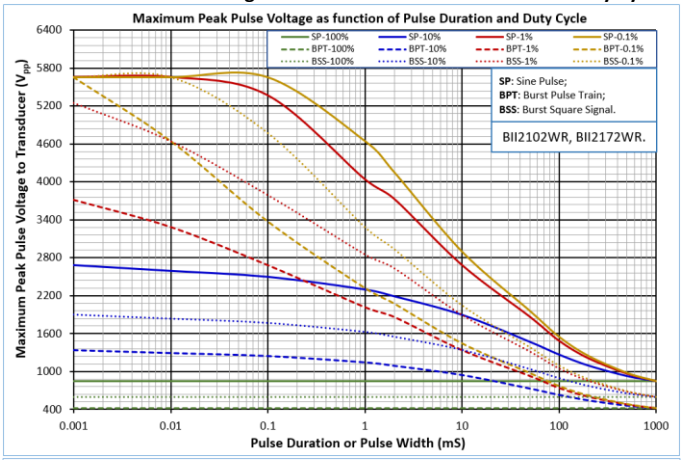
Acoustic Project III: 1MHz NDT.
Requisites: (1) **Electrical Peak Power to NDT Transducer** P_{peak} = 2000 W_{peak}, Positive or Negative Voltage Spike: 50 nS to 1 µs, D ≤ 1%;
(2) Transmit and Receive **Frequency**: 1 MHz.
Transducer Options: 50Ω **Transducer**, Z = 50 Ω, 1 MHz.

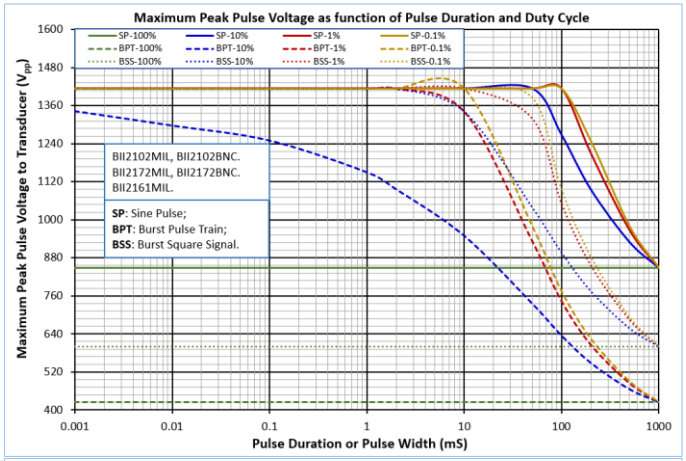
Step 1. **Signal Types.** Referring to Typical Signals for Active SONAR… in BII's Acoustic Transducers and Measurement Handbook.
Step 2. Refer to Max. Transmit Current, Pulse Power Capacity during PD and Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle.
BII2174BNC meet limitations above.

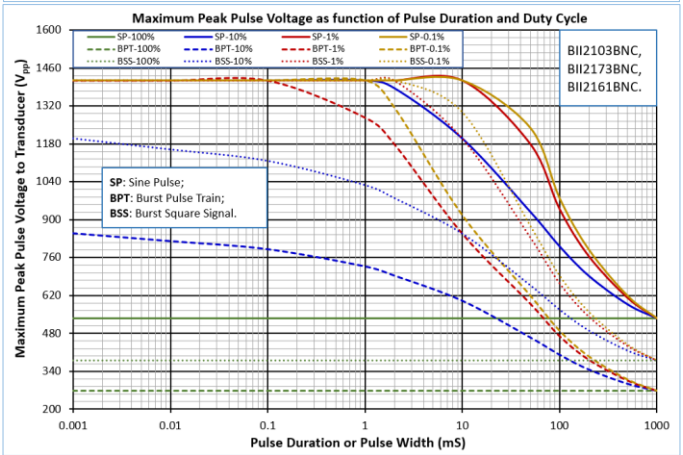
Signal Types	Approximately Exciting Voltage to Transducer	TR Switch	PD and D
Voltage Spike (**VS**) to 50Ω transducer achieving 2000W P_{peak}:	$V_{tx} = \sqrt{P_{peak} * R_{TX}}$ = 316.2 V_{peak}.	BII2174BNC.	PD = 50 nS to 1 µs; D ≤ 1%.

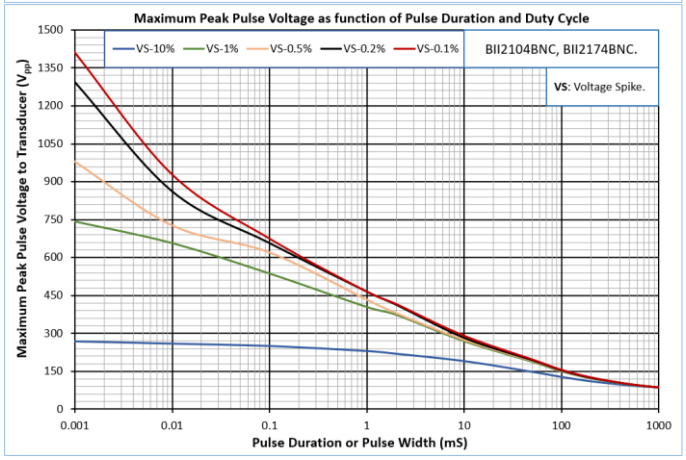
Step 3. **Determine Receiving Noise Level at input**. Refer to Input Referred Noise en.
-3dB bandpass filter of receiving is fixed to 10 kHz to 17 MHz.
Take BII2174BNC and FFVS of NDT Transducer = -206.0 dBV/µPa as an example, equivalent pressure noise level at input from electronics, approximately:
P_n = -95.6 dBV – FFVS of the transducer = 110.3 dB µPa.

Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle.

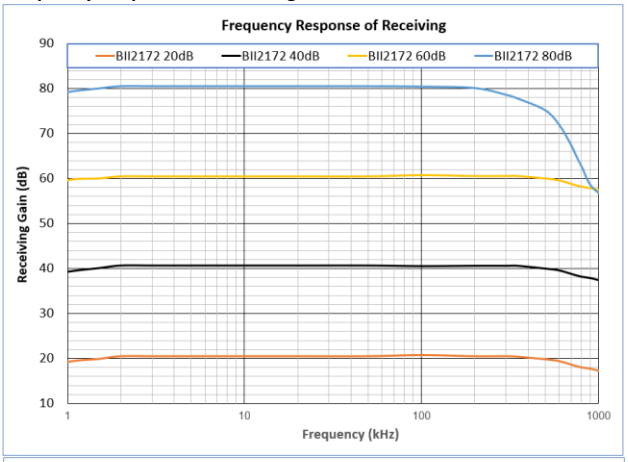


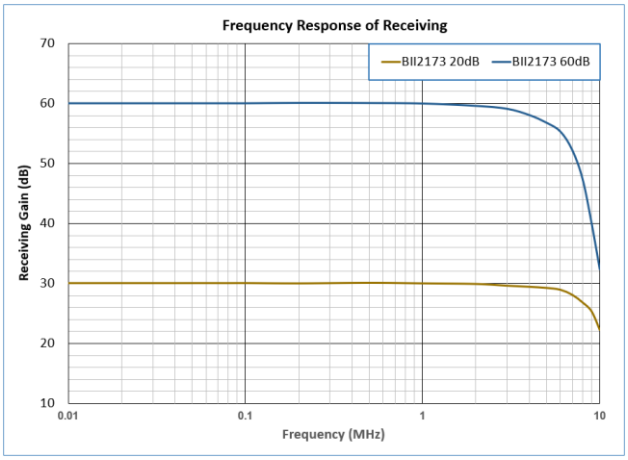


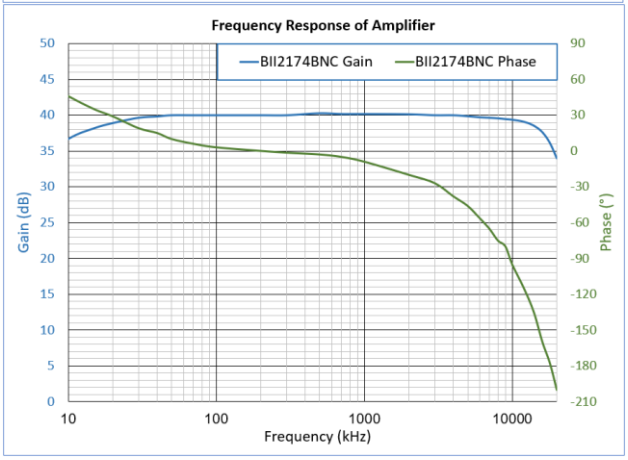




Frequency Response of Receiving Gain







Ordering Information of BII2170 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; **PW**: Maximum Pulse Width in μS, mS, or S; **D:** Maximum Duty Cycle in %; **fs:** Frequency of Impedance Matching, in kHz or MHz, Generally fs is resonant frequnecy; $\boldsymbol{Z_{TX}}$**:** Transducer Impedance, in Ω; **θ:** Transducer Phase in °; $\boldsymbol{Z_{IM}}$**:** 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. BII2172WR for Embedded High Power Applications.

T/R Switch Module with Wire/Cable Bundles and Wire Leads as Embedded Components being installed into end user's grounded enclosure.

Fuse/Fuse Holder, DC Switch, and Grounding Stud are NOT included. Grounding Cable is NOT included.

Fasteners (Screw, Washer, Nut etc.) for mounting/installation are NOT included.

Buyer grounds buyer's enclosure for safety: Buyer applies suitable Fuse/Fuse Holder, DC Switch, and Grounding Stud in buyer's DC power distributing system.

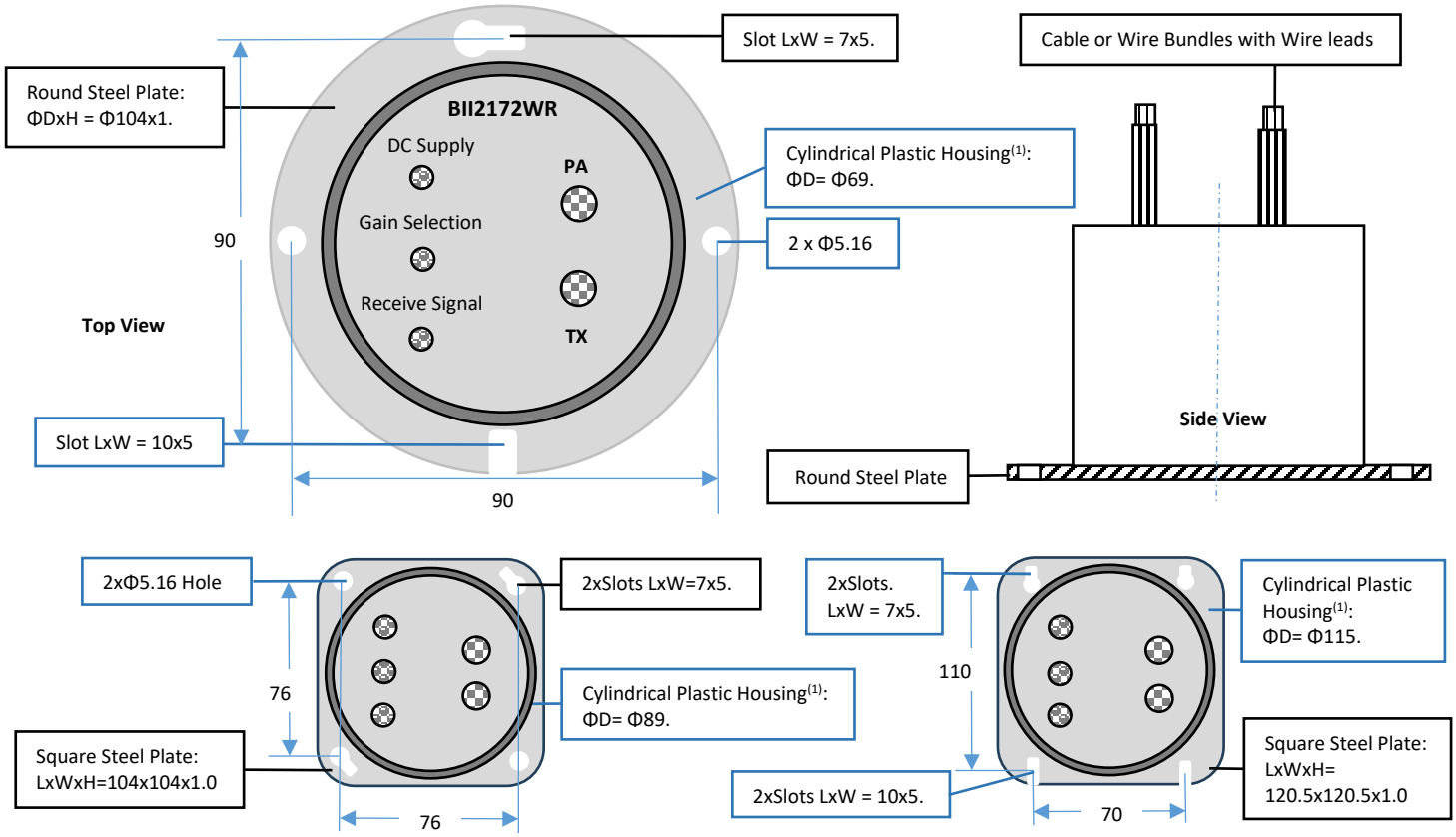
Outline Dimensions (mm), Illustration ONLY, scale is NOT 1:1.

PA Wires as Input Wirings to Outputs of Power Amplifiers; **TX wires** as Output Wirings to Transducer.

(1). Cylindrical Plastic Housing.

Plastic Cylindrical Housing with a Round or Square Steel Chassis, Four Mounting Hole/Slots, Accept #10 or M5 Screw. Housing Height: Varies with Power Capacity.

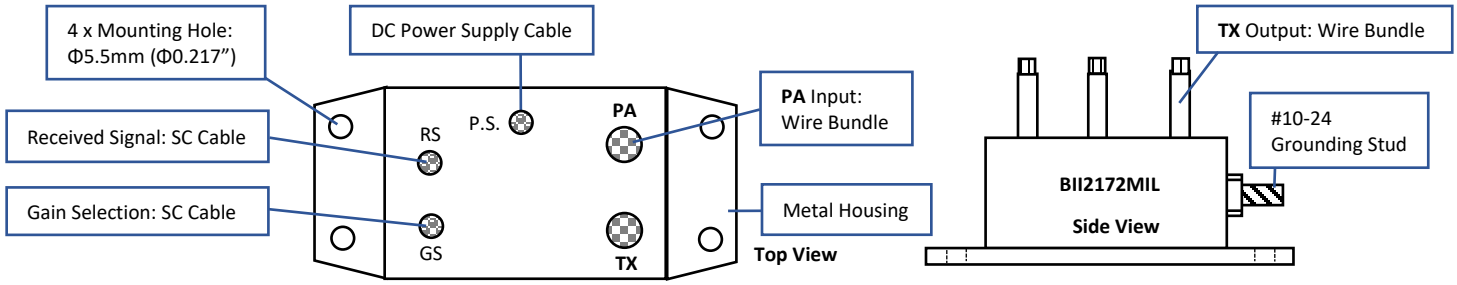
Overall Size varies with Power Capacity: ΦDxH = Φ104x(100 to 150), LxWxH = 104x104x(100 to 150), or LxWxH = 120.5x120.5x(100 to 150).



Note: (1) Height and Diameter of Cylindrical Plastic Housing and Round or Square Steel Chassis are determined by power rating.

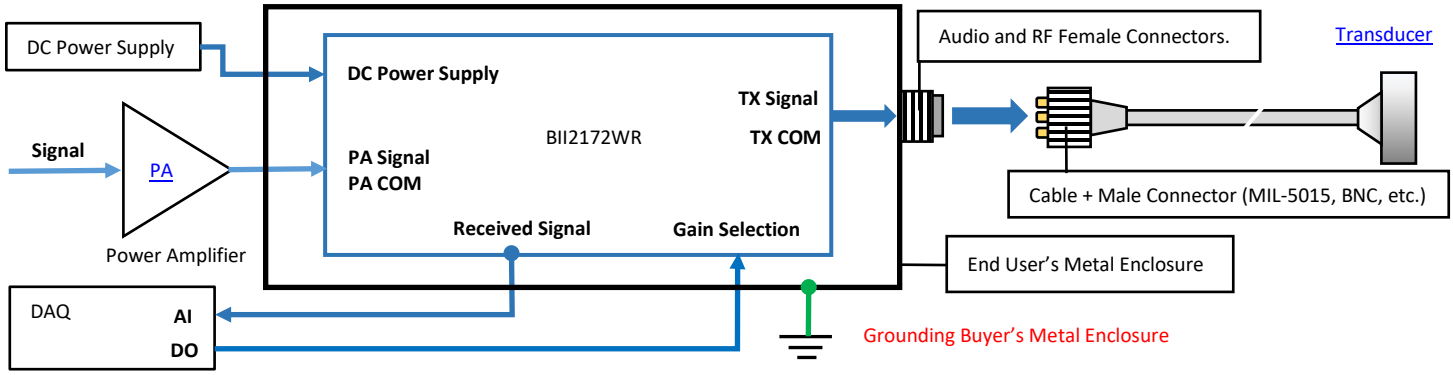
(2). Metal Enclosure.

Overall Size: LxWxH = 147.2x67.2x55, 146.9x91.7x56, 146.9x91.7x85 or 180.5x110.3x93 mm. Four Mounting Holes Φ5.5mm (Φ0.217") accepts M5 or #10 screw.

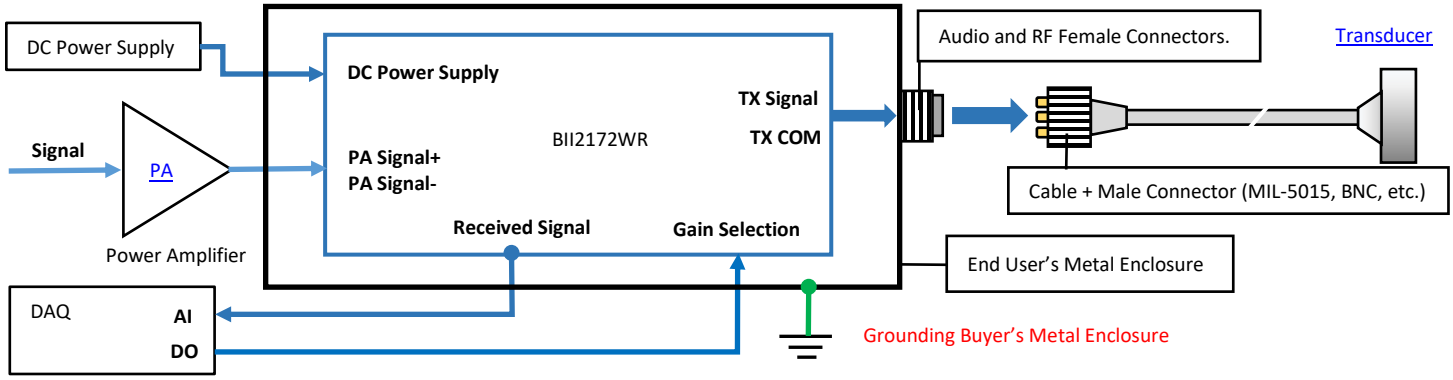


System Block Diagram as Embedded Components.

(1) Power Amplifier with Single-ended Output



(2) Power Amplifier with Differential Output



Wiring Information of Wire Bundles and Wire Leads

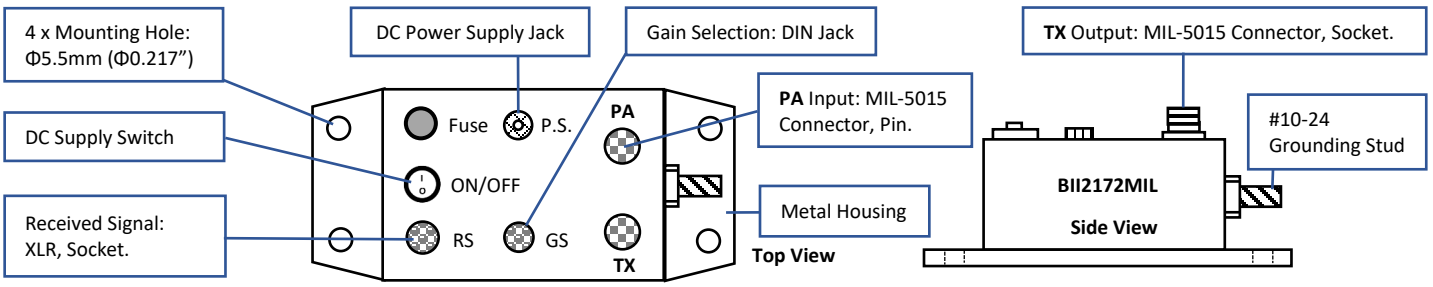
PA Wires as Input Wirings to Outputs of Power Amplifiers; TX wires as Output Wirings to Transducers.		
Signals	**BII2172WR, T/R Switch Modules.**	
PA Signal: Coming from a Signal Source such as Power Amplifiers. Warning: High Voltage !	**Wire Bundles with Wire Leads,** Label "1".	
	Signal or Signal +	Red Wire, AWG18.
	Signal Common, or Signal -	Black Wire, AWG18.
TX Signals: To a Transducer or Projector. Warning: High Voltage !	**Wire Bundles with Wire Leads,** Label "0".	
	Signal	Red Wire, AWG18.
	Signal Common	Black Wire, AWG18.
Received Signal: To Differential Inputs of a Data Acquisition Module.	**Two Conductor Shielded Cable with Wire Leads**	
	Signal +	White or Red Wire
	Signal -	Black Wire
	Signal Common	Shield
Gain Selection: Coming from Digital Outputs of a Data Acquisition Module. CMOS/TTL Compatible.	**Two Conductor Shielded Cable with Wire Leads**	
	Digital A1	White or Red Wire
	Digital A0	Black Wire
	Digital Common	Shield
Power Supply: Coming from DC Power Supply or Batteries.	**Two Conductor Shielded Cable , DCBS18V.**	
	+VDC	Red Wire
	Common	Black Wire
	Shielding	Shield
Wire/Cable Bundle Length: 0.3m.		
Warning: Install the device into End User's metal enclosure, and grounding metal enclosure for Operating Safety. All exposed bare wires, metal wires, wire leads, and solders shall be insulated with insulation material such as heat shrink tubing, fully insulated wire splicing connectors, etc. The insulation voltage must be greater than at least TWO TIMES the source voltage.		

How to Order, refer to Ordering Information of BII2170 Series for explanations of the terms or initials.

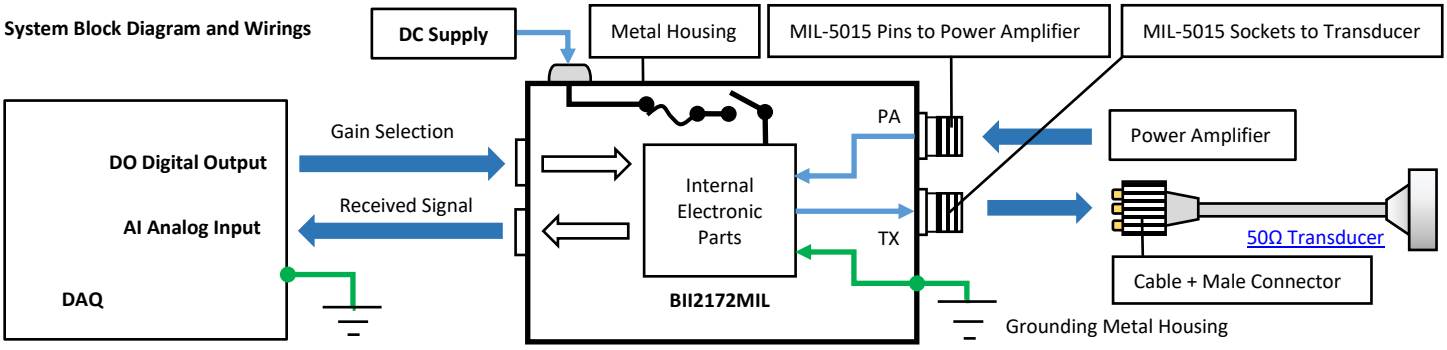
	DC Supply Vs	Transducer Parameter	Matching Impedance	Receiving Band Pass Filter
BII2172WR	Default. -MV. -HV.	-BII Transducer's Part Number. -fs/Z_{TX}/θ. -f_s/R_{TX}.	-BII PA Part Number. -Z_{IM}.	-HPF/LPF. Default: (0.1*f_s)/(10*f_s).

Example of Part Number:	**Description**
BII2172WR-HV-30kHz/300Ω/-60°-50Ω-20Hz/350kHz	BII2172WR, T/R Switch Module, Bespoke DC Supply Vs: **HV**, Transducer Parameter: 30kHz, Z=300Ω, θ=-60°, Impedance Matching to 50Ω; -3dB Receiving Bandwidth: 20Hz to 350 kHz.
BII2172WR-BII7563/70-BII5101-7kHz/350kHz	BII2172WR, T/R Switch Module, Default DC Supply Vs, Transducer Parameter: BII7563/70, Impedance Matching to BII5101; -3dB Receiving Bandwidth: 7 to 350 kHz.

2. BII2172MIL with Panel-mount Connectors as Standalone Devices.



System Block Diagram and Wirings



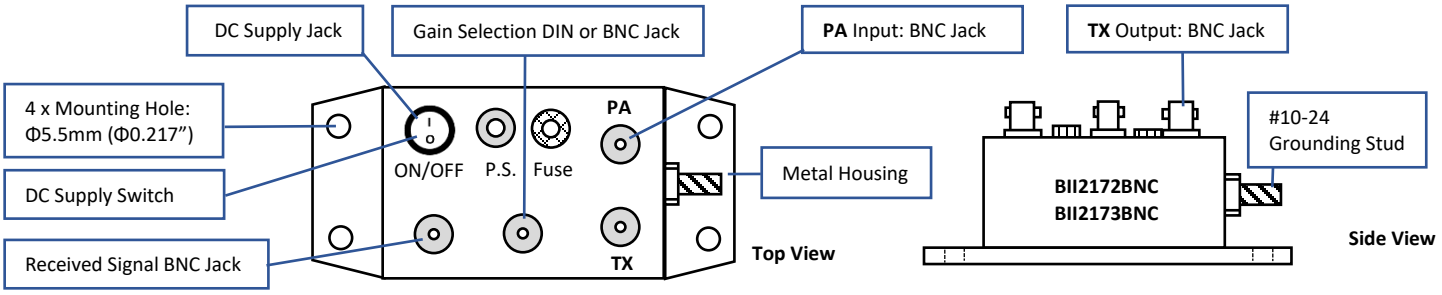
Signals	BII2172MIL T/R Switch Modules		
PA Signal: Coming from a Signal Source such as Power Amplifiers. Warning: High Voltage !	**MIL-5015 Style Connector, Panel Mount, 3-Contact Mating Connector, Pin.**		
	Signal or Signal +		Contact C
	Signal Common, or Signal -		Contact B
	Shielding and Grounding		Contact A
TX Signals: To a Transducer or Projector. Warning: High Voltage !	**MIL-5015 Style Connector, Panel Mount, 3-Contact Mating Connector, Socket.**		
	Signal of Transducer		Contact C
	Signal Common of Transducer		Contact B
	Shielding and Grounding		Contact A
Received Signal: To Differential Inputs of a Data Acquisition Module.	**Received Signal**	**XLR Plug**	**Shielded Cable/Wire Leads**
	Signal+	Pin 2, Positive/Hot.	Red or White Wire
	Signal-	Pin 3, Negative/Cold.	Black Wire
	Signal Common	Pin 1, Shield/Ground.	Shield
	Shielding	Shell	
Gain Selection: Coming from Digital Outputs of a Data Acquisition Module. CMOS/TTL Compatible.	**Gain Selection**	**DIN Plug**	**Shielded Cable/Wire Leads**
	A1	Pin 3	Red Wire
	A0	Pin 1	Black Wire
	Digital Common	Pin 2	Shield
	Shielding	Shell	
Power Supply: Coming from DC Power Supply or Batteries.	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.		
	+VDC	Center Contact	Red Banana Plug
	Common and Shielding	Metal Shell Contact	Black Banana Plug
Metal Enclosure, Overall Size: LxWxH = 180.5x110.3x93 mm. Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.			
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**			
Fuse: One included, refer to Fuse and Holder.			
Accessories Included: 1. One DC supply cable **DCBP24.** 2. One Grounding Cable **GWL18**. 3. One Gain Selection Cable **DIN-P-WL-1m.** 4. One Receiving Signal Cable **XLR-P-WL-1m.**			
Grounding Metal Case for operating safety. **Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.			
When A1 and A0 are open, their TTL/CMOS logic level is High or 1. Receiving Gain is maximum gain 80dB by default.			
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 BII2170 Series for explanations of the terms or initials.

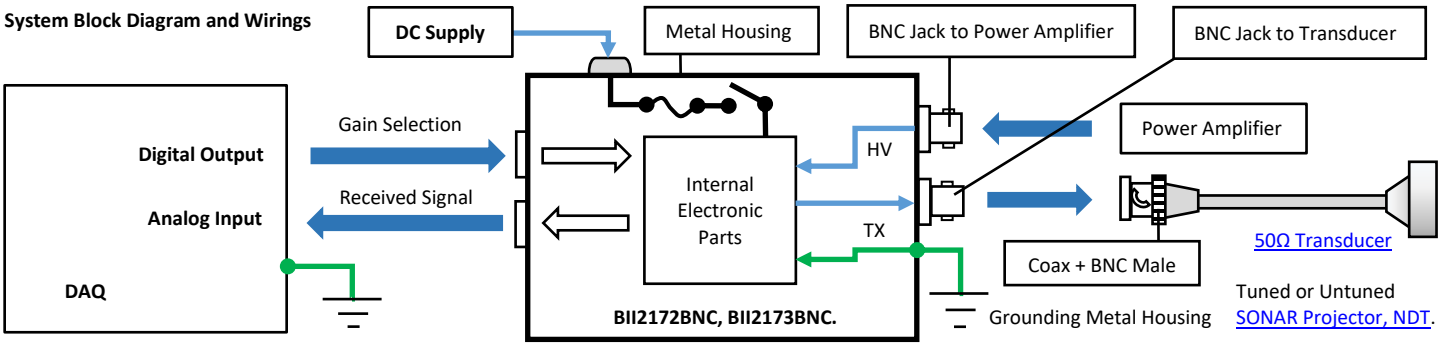
	DC Supply Vs	Transducer Parameter	Matching Impedance	Receiving Band Pass Filter
BII2172MIL	Default. -MV. -HV.	-BII Transducer's Part Number. -fs/Z_{TX}/θ. -f_s/R_{TX}.	-BII PA Part Number. -Z_{IM}.	-HPF/LPF. Default: (0.1*f_s)/(10*f_s).

Example of Part Number:	**Description**
BII2172MIL-MV-BII7523-50Ω-100Hz/350kHz	BII2172MIL, T/R Switch Module, Bespoke DC Supply Vs: **MV**, Transducer Parameter: BII7523, Impedance matching to 50Ω; Receiving Bandwidth (-3dB): 100Hz to 350kHz.
BII2172MIL-40kHz/200Ω/-60°-BII5065-1kHz/200kHz	BII2172MIL, T/R Switch Module, Default DC Supply Vs, Transducer Parameter: 40kHz, Z=200Ω, θ=-60°, Impedance Matching to BII5065 Power Amplifier; -3dB Receiving Bandwidth: 1 to 200kHz.

3. BII2172BNC, BII2173BNC.



System Block Diagram and Wirings

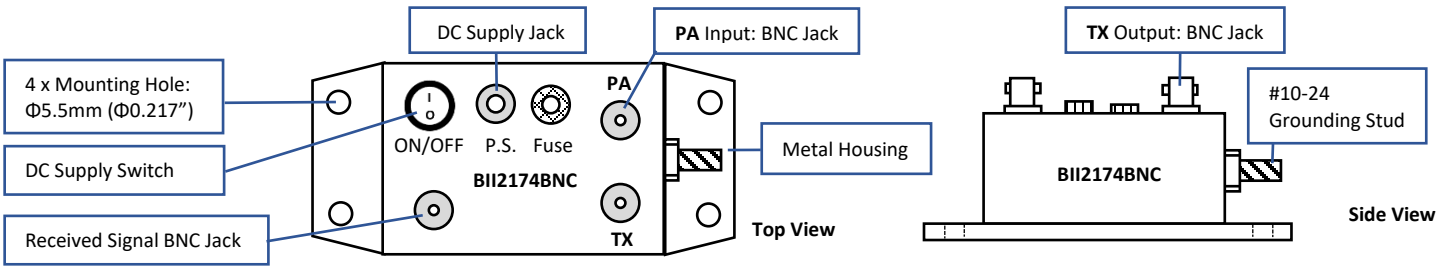


Signals	BII2172BNC, BII2173BNC, T/R Switch Modules.		
PA Signal: Coming from a Signal Source such as Power Amplifiers. Warning: High Voltage !	**50Ω BNC Connector, Panel Mount, Jack.**		
	Signal		Center Conductor
	Signal Common		Body Metal Shell.
	Shielding and Grounding		Body Metal Shell.
TX Signals: To a Transducer or Projector. Warning: High Voltage!	**50Ω BNC Connector, Panel Mount, Jack.**		
	Signal of Transducer		Center Conductor
	Signal Common of Transducer		Body Metal Shell.
	Shielding and Grounding		Body Metal Shell.
Received Signal: To Differential Inputs of a Data Acquisition Module.	**Panel Mount BNC Jack.**		
	Signal		Center Conductor
	Signal Common, Shielding, and Grounding		Body Metal Shell.
Gain Selection for BII2172BNC: Coming from Digital Outputs of a Data Acquisition Module. CMOS/TTL Compatible.	**Gain Selection**	**DIN Plug**	**Shielded Cable/Wire Leads**
	A1	Pin 3	Red Wire
	A0	Pin 1	Black Wire
	Digital Common	Pin 2	Shield
	Shielding	Shell	
Gain Selection for BII2173BNC: Coming from Digital Outputs of a Data Acquisition Module. CMOS/TTL Compatible.	**Panel Mount BNC Jack.**		
	A0		Center Conductor
	Digital Common, Shielding, Grounding.		Body Metal Shell.
Power Supply: Coming from DC Power Supply or Batteries.	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.		
	+VDC	Center Contact	Red Banana Plug
	Common and Shielding	Metal Shell Contact	Black Banana Plug
Metal Enclosure, Overall Size: LxWxH = 146.9x91.7x85 or 180.5x110.3x93mm. Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.			
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**			
Fuse: One included, refer to Fuse and Holder.			
Accessories Included: 1. One DC supply cable **DCBP24.** 2. One Grounding Cable **GWL18**.			
Grounding Metal Case for operating safety. **Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.			
When A0 are open, their TTL/CMOS logic level is High or 1. Receiving Gain is maximum gain 60dB by default.			
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.			

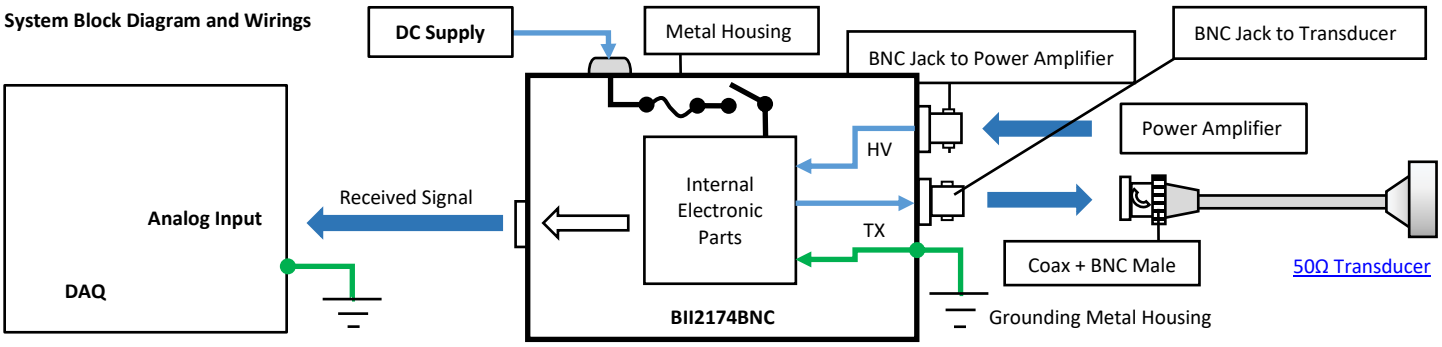
How to Order, refer to Ordering Information of BII2170 Series for explanations of the terms or initials.

BII TR Switch PN	DC Supply Vs	Transducer Parameter	Matching Impedance	Receiving Band Pass Filter
BII2172BNC, BII2173BNC.	Default. -MV. -HV.	-BII Transducer's Part Number. -fs/Z_{TX}/θ. -f_s/R_{TX}.	-BII PA Part Number. -Z_{IM}.	-HPF/LPF. -HPF. Default: (0.1*f_s)/(10*f_s).
Example of Part Number:		**Description**		
BII2172BNC-HV-40kHz/200Ω/-60°-50Ω-20Hz		BII2172BNC, T/R Switch Module, Bespoke DC Supply Vs: **HV**, Transducer Parameter: 40kHz, Z=200Ω, θ=-60°, Impedance Matching to 50Ω; -3dB Receiving High Pass Filter: 20Hz.		
BII2173BNC-BII7692-Φ12.7mmx1MHz-BII5121-0.1MHz/4.5MHz		BII2173BNC, T/R Switch Module, Default DC Supply Vs, Transducer Parameter: BII7692-Φ12.7mmx1MHz, Impedance Matching to BII5121 Power Amplifier; -3dB Receiving Bandwidth: 0.1 to 4.5 MHz.		

4. BII2174BNC



System Block Diagram and Wirings

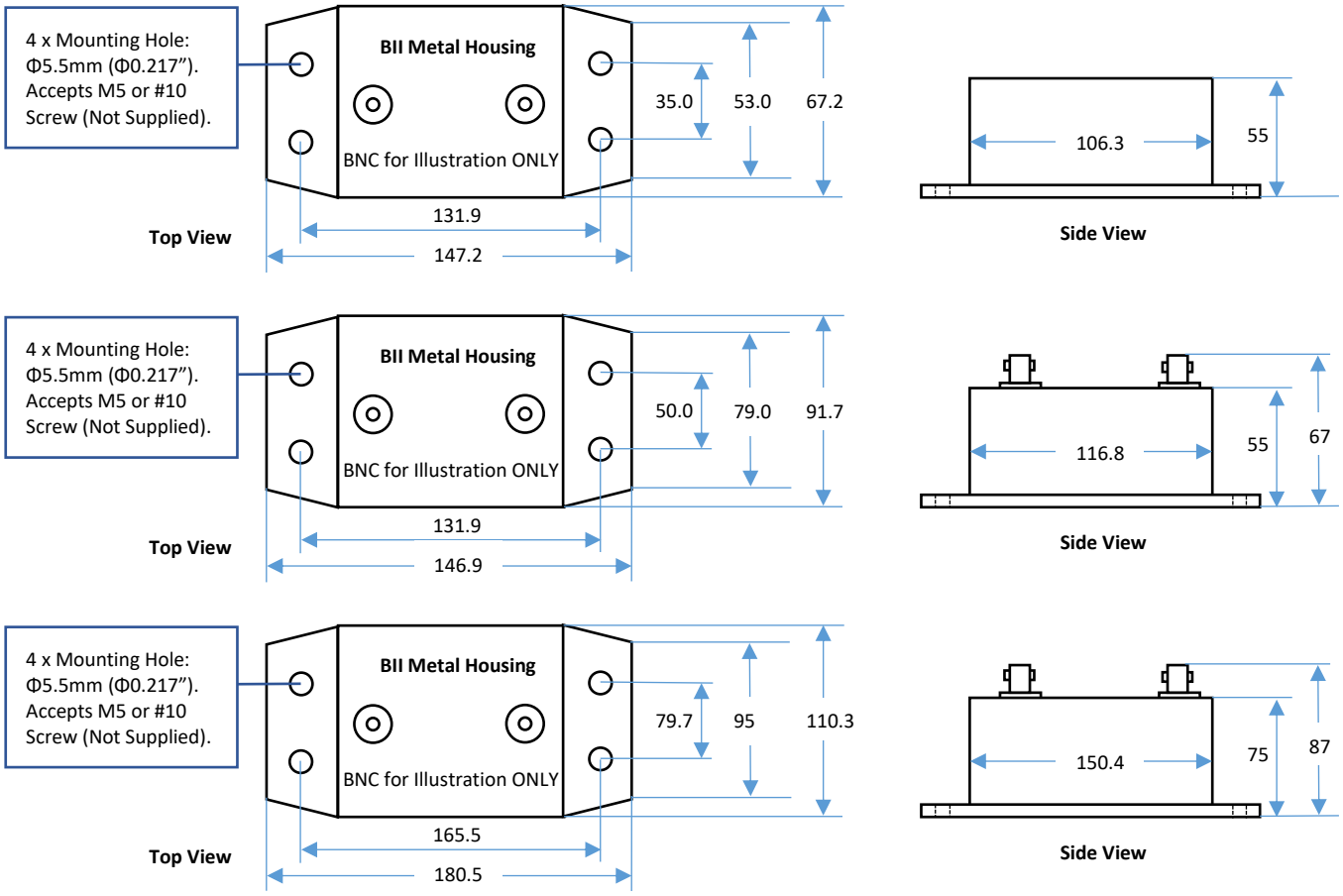


Signals	BII2174BNC T/R Switch Modules.		
PA Signal: Coming from a Signal Source such as Power Amplifiers. Warning: High Voltage !	**50Ω BNC Connector, Panel Mount, Jack.**		
	Signal		Center Conductor
	Signal Common		Body Metal Shell.
	Shielding and Grounding		Body Metal Shell.
TX Signals: To a Transducer or Projector. Warning: High Voltage!	**50Ω BNC Connector, Panel Mount, Jack.**		
	Signal of Transducer		Center Conductor
	Signal Common of Transducer		Body Metal Shell.
	Shielding and Grounding		Body Metal Shell.
Received Signal: To Differential Inputs of a Data Acquisition Module.	**Panel Mount BNC Jack.**		
	Signal		Center Conductor
	Signal Common, Shielding, and Grounding		Body Metal Shell.
Power Supply: Coming from DC Power Supply or Batteries.	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.		
	+VDC	Center Contact	Red Banana Plug
	Common and Shielding	Metal Shell Contact	Black Banana Plug
Metal Enclosure, Overall Size: LxWxH = 146.9x91.7x85 mm. Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.			
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**			
Fuse: One included, refer to Fuse and Holder.			
Accessories Included: 1. One DC supply cable **DCBP24.** 2. One Grounding Cable **GWL18**.			
Grounding Metal Case for operating safety. **Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.			
When A0 are open, their TTL/CMOS logic level is High or 1. Receiving Gain is maximum gain 60dB by default.			
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 BII2170 Series for explanations of the terms or initials.

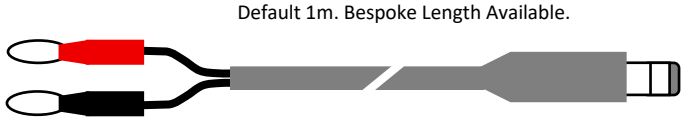
BII TR Switch PN	DC Supply Vs	Transducer Parameter	Matching Impedance
BII2174BNC.	Default. -MV. -HV.	-BII Transducer's Part Number. -fs/50Ω	-BII PA Part Number. $-Z_{IM}$.
Example of Part Number:	**Description**		
BII2174BNC-BII7692IM50Ω-Φ12.7mmx1MHz-BII5121	BII2174BNC, T/R Switch Module, Default DC Supply Vs, Transducer Parameter: BII7692IM50Ω-Φ12.7mmx1MHz, Impedance Matching to BII5121 Power Amplifier.		
BII2174BNC-HV-1MHz/50Ω-5Ω	BII2174BNC, T/R Switch Module, Bespoke DC Supply HV, 1MHz 50Ω Transducer, Impedance Matching to 5Ω.		

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



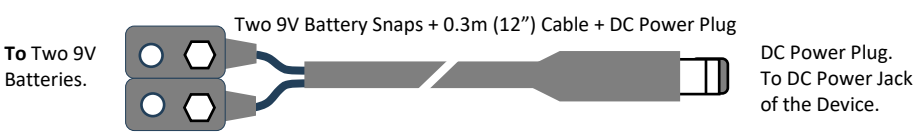
Accessories:

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



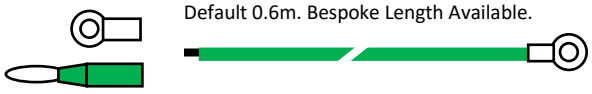
Red Banana Plug: +VDC. **Black Banana Plug:** Common.
One 1m DC supply cable. One end of the cable is with DC Power Plug, another end is Red and Black Banana Plugs. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

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.



DC Supply Cable: DCWL24. One 1m DC supply cable with Wire Leads and DC Power Plug.

2. Grounding Cable and Terminals

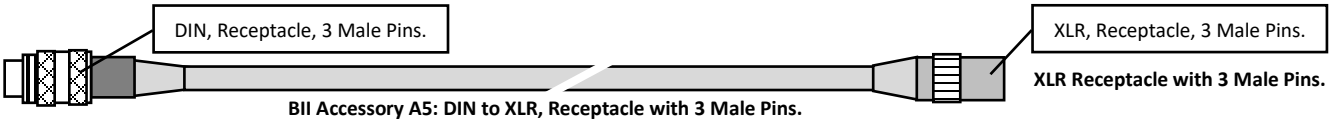


Grounding Cable, Part Number: GWL18, Support Single-Point Grounding with Multiple Devices.

One 0.6m AWG 18 Green Wire (or Green with a Yellow Stripe) 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 of connectors to grounding cable at buyer's cost.

Accessory Cable.

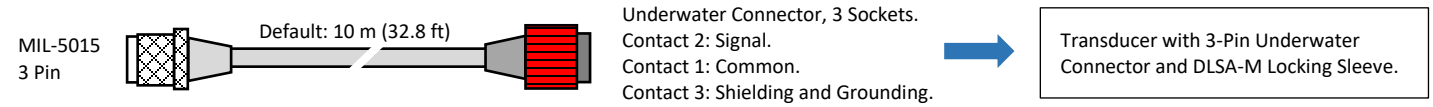
A5 DIN to XLR Cable. Part Number: DIN3P-XLR3P-1m, Bespoke length cable with DIN Receptacle with 3 Male Pins to XLR3 Receptacle with 3 Male Pins. Default: 1m.



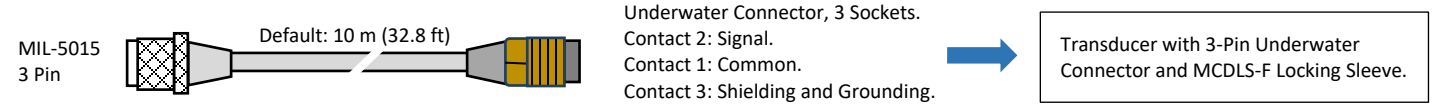
A6 Gain Selection Cable. Part Number: DIN-P-WL-1m, Bespoke length cable with DIN Receptacle with 3 Male Pins to Wire Leads. Default: 1m.

A7 Receiving Signal Cable. Part Number: XLR-P-WL-1m, Bespoke length cable with XLR Receptacle Male Pin to Wire Leads. Default: 1m.

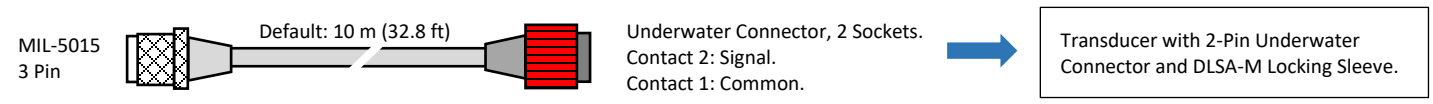
Accessory A9: MIL-UMCF3S, MIL-5015 (3 Pins) to UMC3S (Underwater Connector, 3 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



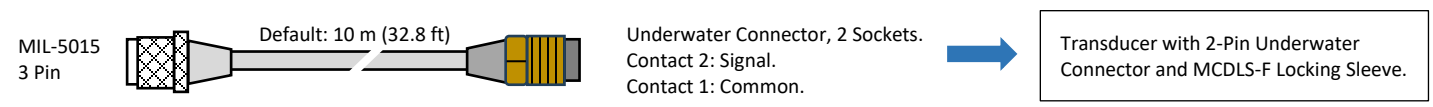
Accessory A10: MIL-SUMC3S, MIL-5015 (3 Pins) to Small UMC3S (Underwater Connector, 3 Sockets, Thread Locking, Size: Φ22x28mm)



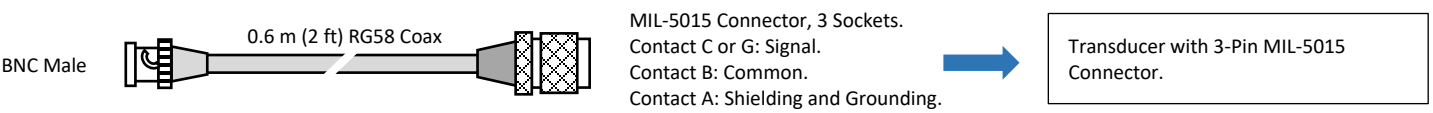
Accessory A11: MIL-UMCF2S, MIL-5015 (3 Pins) to UMC2S (Underwater Connector, 2 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



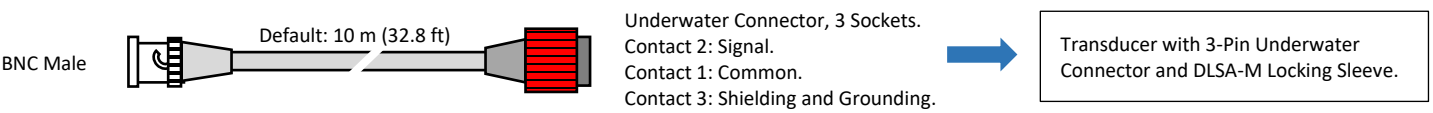
Accessory A12: MIL-SUMC2S, MIL-5015 (3 Pins) to Small UMC2S (Underwater Connector, 2 Sockets, Thread Locking, Size: Φ22x28mm)



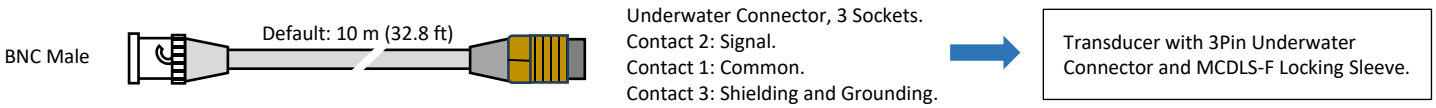
Accessory A13: BNC-MIL3S, BNC Male (Pin) to MIL3S (MIL-5015 type 3-Socket Connector Thread Fastening)



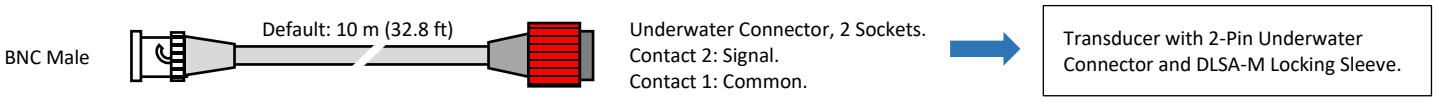
Accessory A14: BNC-UMCF3S, BNC Male to UMC3S (Underwater Connector, 3 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



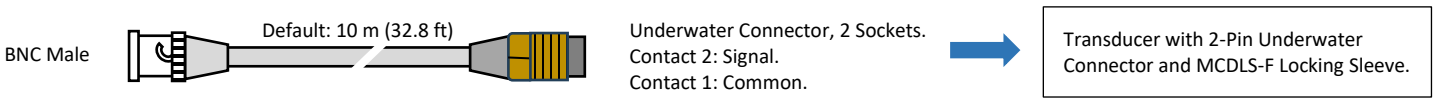
Accessory A15: BNC-SUMC3S, BNC Male to Small UMC3S (Underwater Connector, 3 Sockets, Thread Locking, Size: Φ22x28mm)



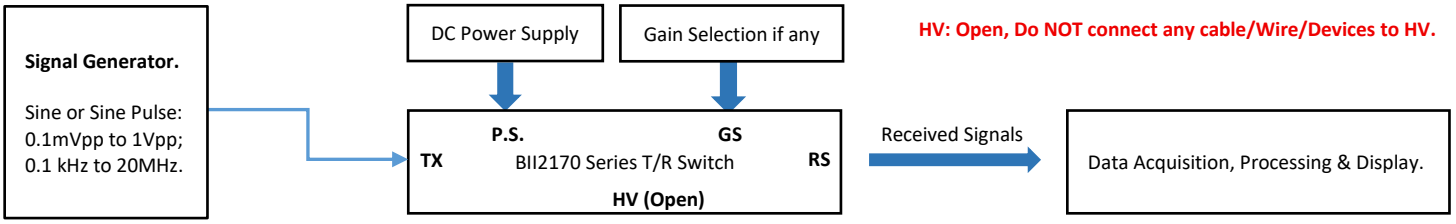
Accessory A16: BNC-UMCF2S, BNC Male to UMC2S (Underwater Connector, 2 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



Accessory A17: BNC-SUMC2S, BNC Male to Small UMC2S (Underwater Connector, 2 Sockets, Thread Locking, Size: Φ22x28mm)



How to Calibrate Receiving Gains of BII TR Switch?
BII calibrates receiving gains. Buyer may test receiving gain during troubleshooting and/or commissioning of the system.



Questions:

How do I assemble #10 Ring Terminal or 4mm Banana Plug to Grounding Cable?
1. for #10 Ring Terminal, crimp or solder is acceptable. Please choose a suitable crimp tool to crimp connector and cable, or a suitable solder station for soldering.
2. for 4mm Banana Plug, solder is acceptable. Please choose a suitable solder station for soldering.

What if the connector of my transducer/projector is SMA or SMC Connector?
Buyer may order a BNC to SMA (or SMC) adaptor from local electronic distributors in buyer's country. BII may ship the adaptor as accessory of the device. Please discuss with BII for customizations.

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.

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.

What if my data acquisition device does not have Digital Output for Gain Selection?
Besides Digital Output, the gain selection can be implemented with two switches connecting and disconnecting from A1 to Digital COMMON, and from A0 and Digital COMMON. Please refer to Gain Selection.

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: 1MΩ||30pF, Signal Source: DDS Signal Generator.

How do I connect the wire of BII6000 device to my devices?
WARNING: HIGH VOLTAGES MAY BE PRESENT AT THE OUTPUT OF THIS UNIT. DO NOT TOUCH THE DEVICE, ITS WIRES, CABLES, AND CONNECTORS BEFORE THE POWER SUPPLIES AND SIGNAL SOURCES ARE SHUT DOWN.
1. **Wire Splicing Methods: Soldering or Crimp**. 2. **Proper Insulation for Safety**: All exposed bare wires, metal wires, wire leads, solders, and joints are insulated with insulation material such as heat shrink tubing, fully insulated wire splice connector, etc. The insulation voltage must be greater than twice the maximum voltage of the device. 3. **Grounding the device** (including metal chassis and/or metal housing, cable shield, etc.) firmly for operation safety.

Are 50Ω Power Amplifiers suitable to drive non-50Ω transducers?
if the impedance of a transducer is greater than 50 Ω at operating frequency, the 50Ω Power Amplifiers can drive this non-50Ω transducer, but the power delivered to non-50Ω transducer is reduced.

How do I connect the wire of BII Power Amplifier to my devices?
WARNING: HIGH VOLTAGES MAY BE PRESENT AT THE OUTPUT OF THIS UNIT. DO NOT TOUCH THE DEVICE, ITS WIRES, CABLES, AND CONNECTORS BEFORE THE POWER SUPPLIES AND SIGNAL SOURCES ARE SHUT DOWN.

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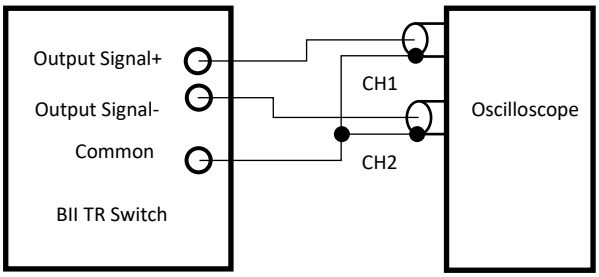
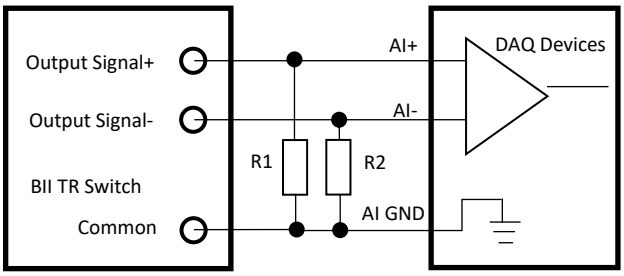
Preamplifier Wirings to DAQ (Data Acquisition): DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.
R1 and R2 resistors are NOT necessary for most applications. If DAQ saturation occurs, use R1 = R2 = 10kΩ to 1MΩ resistors.

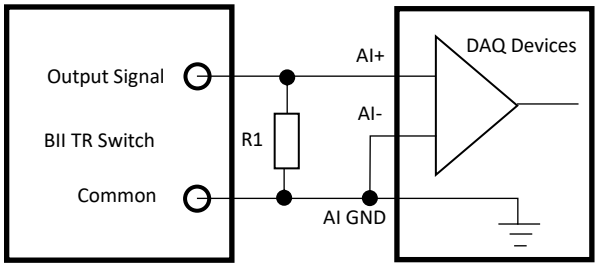
BII's Differential Output to BNC Input of an Oscilloscope



BII's Differential Output to Differential Input of a DAQ



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



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