Benthowave Instrument Inc.

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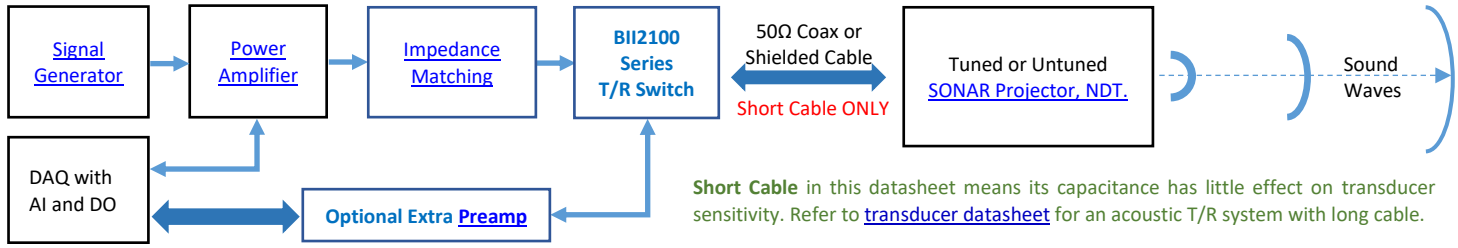
BII2100 Series T/R (Transmitting and Receiving) Switch Modules

A BII2100 Series T/R Switching Modules 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 DPGA preamplifier (Digitally Programmable Gain Amplifier) into one compact housing. Gain-selection is accomplished by a two-bit or one-bit digital word (TTL/CMOS level compatible).

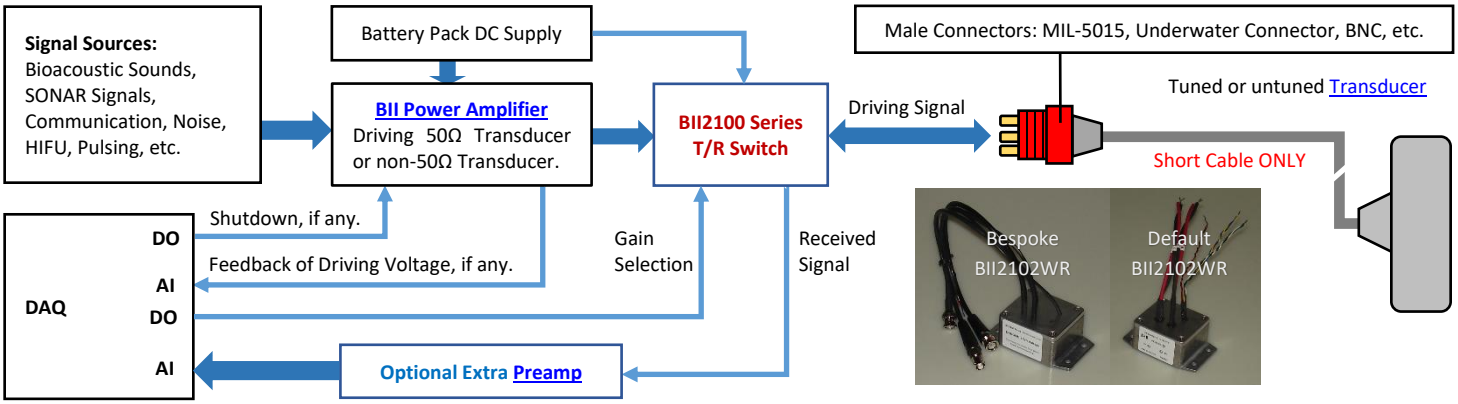
Typical Applications

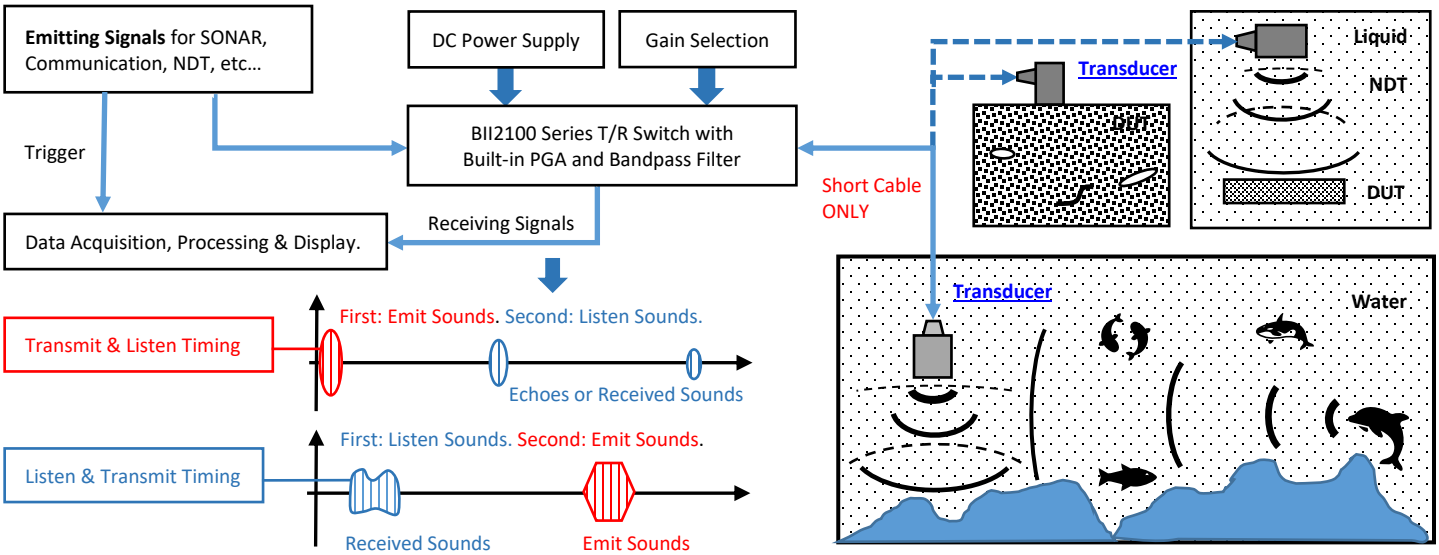
Echo Sounder (Navigation/Object Avoidance, Depth/Distance Sounder, Wave-height Sensor), Target Strength Measurement, Sub-bottom Profilers, Side-scan SONAR, Fishery SONAR, Transponders, Positioning, Beacon, Communication and Telemetry, Artificial Acoustic Target, Acoustic Speedometers (Doppler SONAR), 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



Short Cable in this datasheet means its capacitance has little effect on transducer sensitivity. Refer to transducer datasheet for an acoustic T/R system with long cable.





Specifications

PD: Pulse Duration; **D**: Duty Cycle; **V_T**: Transmit Voltage, in Vpp; **R_{TX}**: Resistance of Tuned Transducer, in Ω; **G**: Conductance of Untuned Transducer, in S.					
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.					
Part Number	**BII2102WR, BII2102WR60.**	**BII2102MIL**	**BII2102BNC**	**BII2103BNC**	**BII2104BNC**
	ACTIVE	**ACTIVE**	**ACTIVE**	**ACTIVE**	**ACTIVE**
	WR: Wire/Cable Bundles; **BNC:** Panel Mount BNC; **MIL**: Panel Mount MIL-5015 Connector. **BII2102WR60** is a bespoke BII2102WR with 0/20/40/60dB, singled output and 10mA current consumption, its bespoke parameters are reference to **WR60**.				
	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.				
Applications:	Embedded	Standalone	Standalone	Standalone	Standalone
	Half-duplex or Semi-duplex Acoustic System: transmitting sounds and receiving sounds at separate timing.				
Echo Sounding Distance:	≥ 0.3 m	≥ 0.3 m	≥ 0.3 m	≥ 0.01 m and Far Field.	≥ 0.01 m and Far Field.
	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 correction to 1 relies on the impedance matching network in the system.				
	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 BII2102WR, End user grounds end user's system for safety.				
Housing:	Aluminum Housing.				
	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:	150 grams	0.7 kg	0.7 kg	0.7 kg	0.7 kg
Size LxWxH (mm):	95x59x35	146.9x91.7x67	146.9x91.7x67	146.9x91.7x67	146.9x91.7x67
Operation Temperature:	-10 to +60 °C, or 14 to 140 °F.				
Storage Temperature:	-20 to +60 °C, or -4 to 140 °F.				
Transmitting Sounds					
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.				
Operating Frequency fs:	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
	fs is resonant frequency of a transducer at which maximum TVR exists.				
Impedance Matching:	No, not included.				
Voltage Gain:	Transmitting Voltage Gain: 20*log((V_{drive} in Vpp – 1.2 Vpp)/V_{drive}), in dB.				
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, $P_{peak} = V_T^2/50Ω$, approximately.				
	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:	0.15 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
Receiving Sounds					
Receiving Gain (dB):	20, 40, 60, 80.	20, 40, 60, 80.	20, 40, 60, 80.	20, 60.	40.
	WR60: 0/20/40/60.				
	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 BII2103BNC with 20, 40, 80 dB Gain options. A programmable gain preamp with 0/20dB is a solution. 2. Your project needs a BII2104BNC 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)	0.3 to 350kHz	0.3 to 350kHz	0.3 to 350kHz	3kHz to 4.5MHz	10kHz to 17MHz
	-3 dB bandwidth of receiving signal processing. Built-in, 2nd order, 40 dB/Decade Roll-off.				
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. WR60: 12 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 WR60: Single-ended	Differential	Single Ended	Single Ended	Single Ended
Output Signal Range:	Supply Voltage Vs - 4, in Vpp.				
Cable Length:	0.15 m	N/A	N/A	N/A	N/A
Cable:	Twisted Wire Bundle	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:	0.15 m	N/A	N/A	N/A	N/A
Gain Selection Cable:	Twisted Wire Bundle	N/A	N/A	N/A	N/A
Connector:	Wire Leads	TRS Jack Panel Mount	TRS 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) WR60 Gain(dB) -3dB Bandwidth 0 0 20 0 1 MHz 0 1 40 20 1 MHz 1 0 60 40 1 MHz 1 1 80 60 350 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: BII2102BNC-MV.				
	Bespoke DC Supply Voltage Vs: **+45 to +60 VDC**. Appending **-HV** to part number. For example: BII2102BNC-HV.				
Current (Quiescent):	22 mA WR60: 10 mA	22 mA	22 mA	19 mA	8.2 to 12.5 mA
DC Power Supply Cable:	Twisted 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.

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 BII2102WR and BII2102MIL 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}.	BII2102WR	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}.	BII2102WR	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}.	BII2102WR	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}.	BII2102WR BII2102MIL	PD = 1mS, D ⩽ 10% PD = 1mS, D ⩽ 10%

Step 3. **Determine Receiving Bandwidth.** Operating f is 8kHz. Refer to Input Referred Noise en.
To reduce electronic noise, at same time, to avoid affecting 8kHz echo signal, -3dB bandpass filter of receiving can be set to 0.8 to 80 kHz.
Take BII2102WR 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.
BII2102WR, BII2102MIL, BII2102BNC, BII2103BNC, 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}.	BII2102WR, BII2102MIL, BII2102BNC, BII2103BNC.	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 BII2102BNC 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.

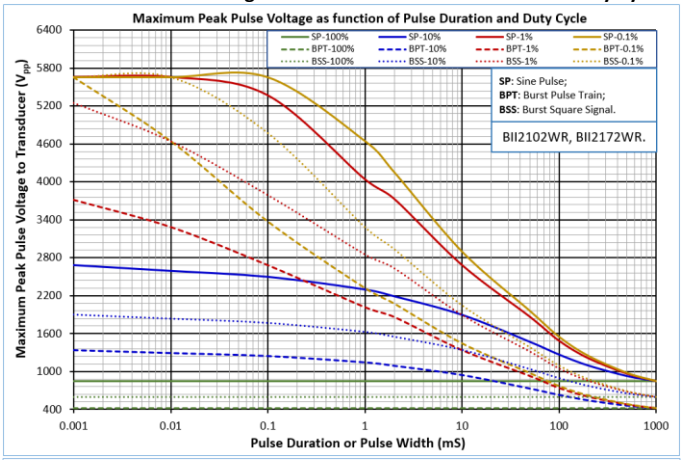
Acoustic Project III: 1MHz NDT.
Requisites: (1) **Electrical Peak Power to NDT Transducer** P_{peak} = 2000 W_{peak}, Positive or Negative Voltage Spike: 50 nS to 1 µs, D ≤ 1%;
(2) Transmit and Receive **Frequency**: 1 MHz.
Transducer Options: 50Ω **Transducer**, Z = 50 Ω, 1 MHz.

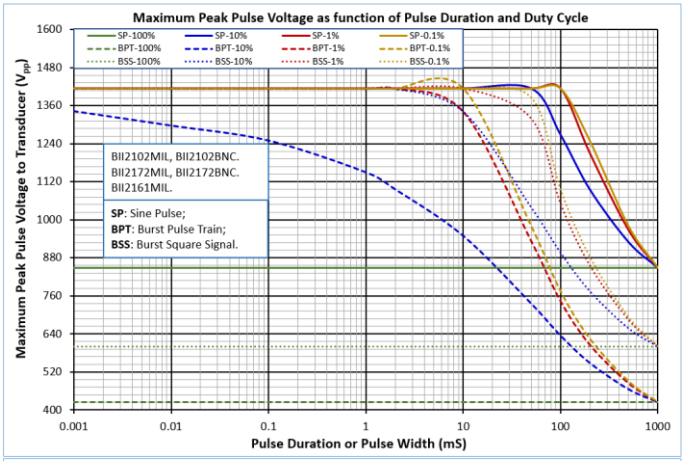
Step 1. **Signal Types.** Referring to Typical Signals for Active SONAR… in BII's Acoustic Transducers and Measurement Handbook.
Step 2. Refer to Max. Transmit Current, Pulse Power Capacity during PD and Maximum Peak Pulse Voltage as function of Pulse Duration and Duty Cycle.
BII2104BNC, meet limitations above.

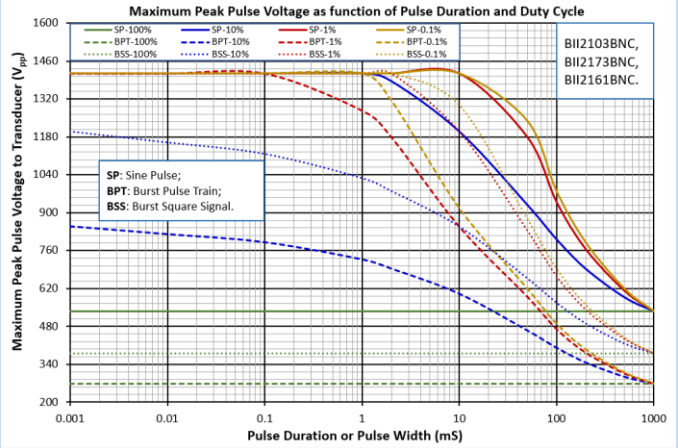
Signal Types	Approximately Exciting Voltage to Transducer	TR Switch	PD and D
Voltage Spike (**VS**) to 50Ω transducer achieving 2000W P_{peak}:	$V_{tx} = \sqrt{P_{peak} * R_{TX}}$ = 316.2 V_{peak}.	BII2174BNC.	PD = 50 nS to 1 µs; D ≤ 1%.

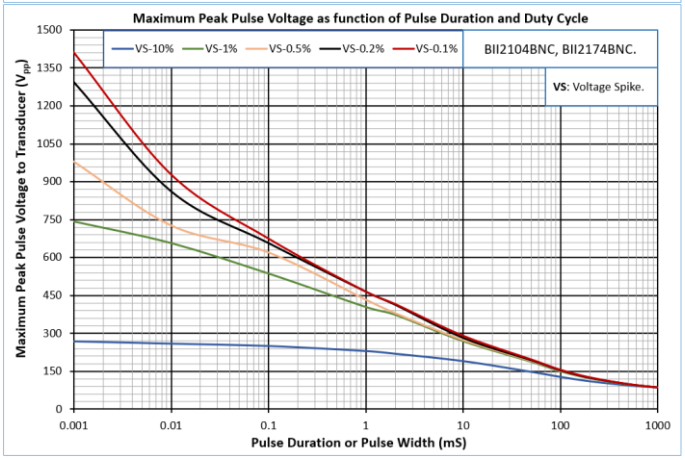
Step 3. **Determine Receiving Noise Level at input**. Refer to Input Referred Noise en.
-3dB bandpass filter of receiving is fixed to 10 kHz to 17 MHz.
Take BII2104BNC and FFVS of NDT Transducer = -206.0 dBV/µPa as an example, equivalent pressure noise level at input from electronics, approximately:
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.

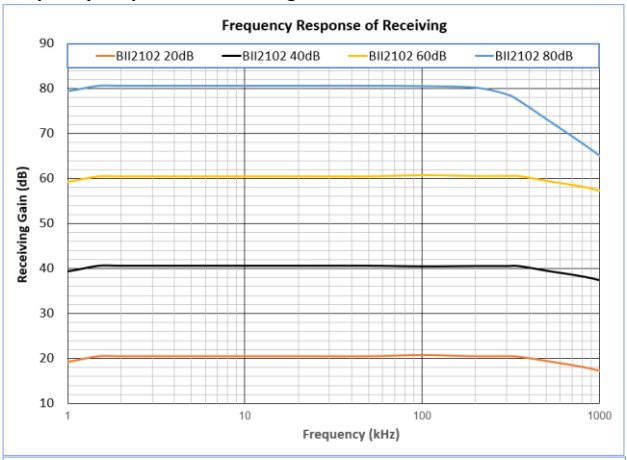


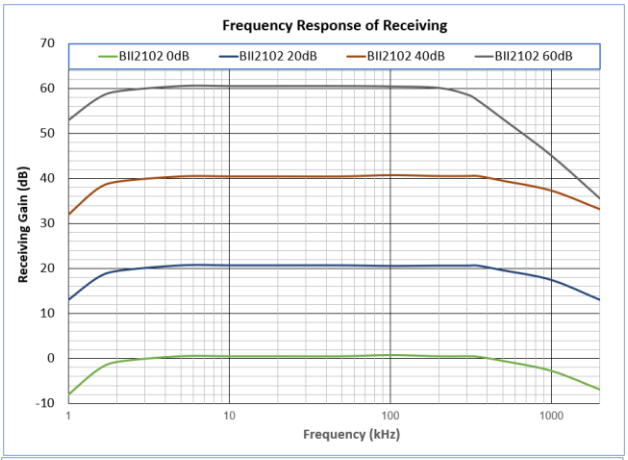


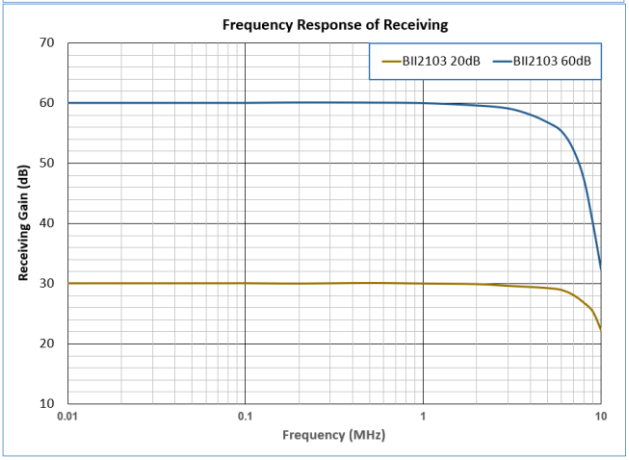


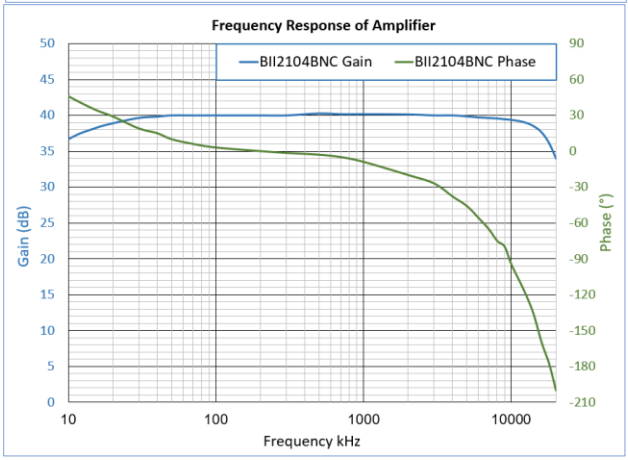


Frequency Response of Receiving Gain



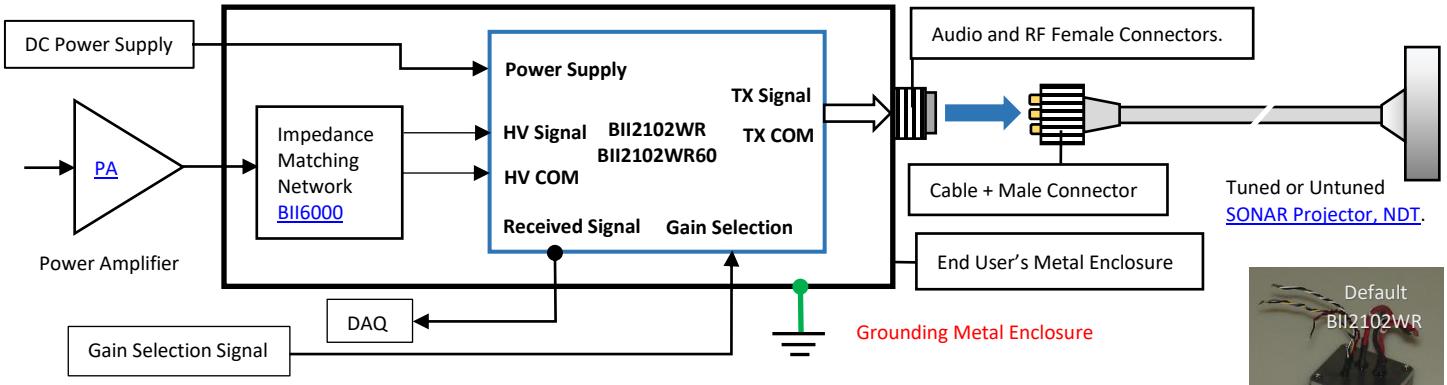




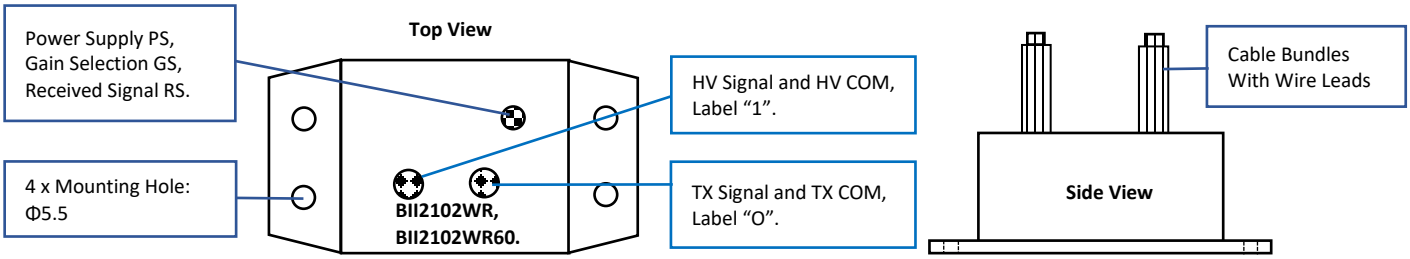


1. BII2102WR. T/R Switch Modules as Embedded Components.

System Block Diagram:



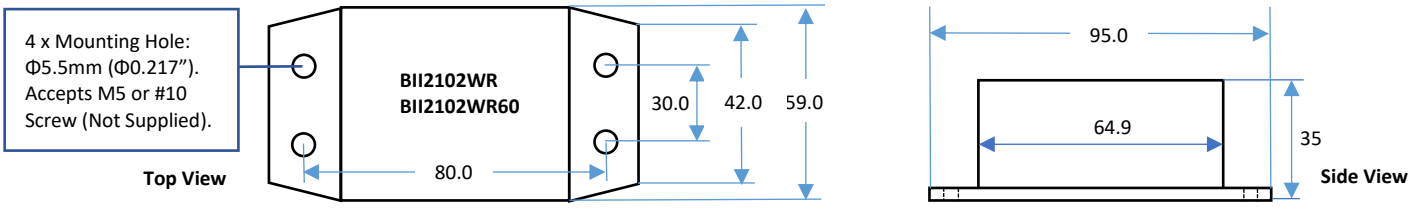
Metal Housing with Cable/Wire Bundles and Wire Leads.



Wirings:

Signals	BII2102WR
HV Signals:	AWG18 Wires + Wire Leads: **Red Wire**, To Signal of High Voltage Source, Label "1". **Black Wire**, To Common of High Voltage Source, Label "1".
TX Signals:	AWG18 Wires + Wire Leads: **Red Wire**, To Signal of Transducer, Label "0". **Black Wire**, To Common of Transducer, Label "0".
Received Signal:	**Differential Signal:** Twisted Wire Bundle. **Signal+**: White Wire, **Signal-**: Blue Wire. **Common**: **Black** Wire.
	WR60: Single-ended, RG174/U Coax. **Signal:** Coax Center Wire**. Common:** Coax Shield**.**
Gain Selection:	Twisted Wire Bundle: **Digital A1**: Yellow Wire. **Digital A0**: Blue Wire. **Digital Common**: **Black** Wire.
Power Supply:	Twisted Wire Bundle: **+VDC**: **Red** Wire; **Common**: **Black** Wire.
	Power Supply Common is connected to metal enclosure at inside of the enclosure.
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, electric/insulating tape, etc. The insulation voltage must be greater than at least TWO TIMES the source voltage.	

Metal Housings, Outline Dimensions (mm), Illustration only, the scale is not 1:1. LxWxH = 95x59x35 mm.

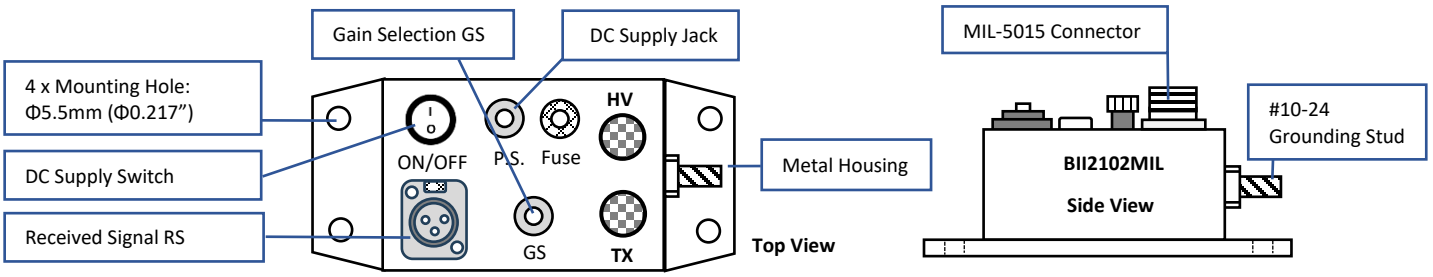


How to Order

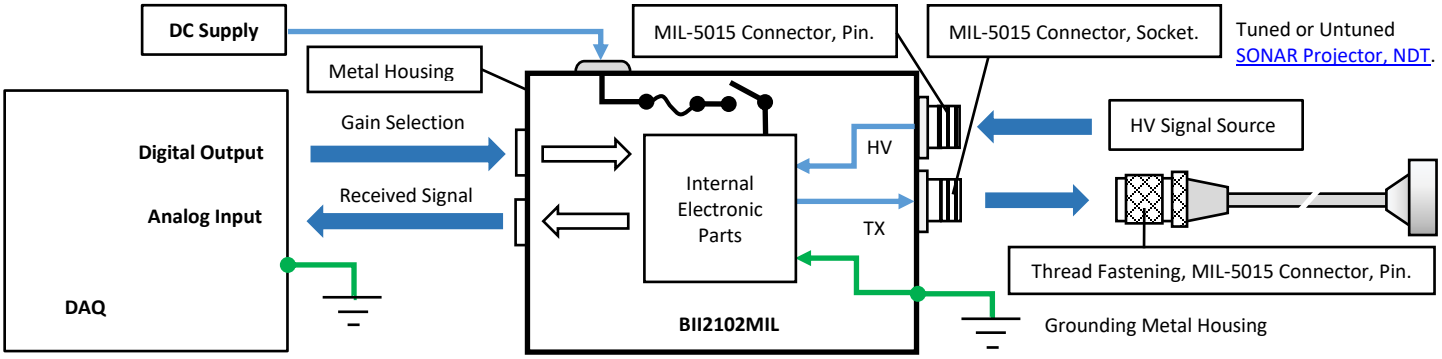
Part Number	-DC Supply Voltage Vs	-Receiving Bandpass Filter: HPF/LPF
BII2102WR, BII2102WR60.	Default. -MV. -HV.	Default: 0.3 to 350 kHz. Bespoke bandpass filter.
Example of Part Number:	**Description**	
BII2102WR-HV	BII2102WR, T/R Switch Module, Bespoke DC Supply Voltage Vs: **HV**, Default Receiving Bandpass filter: 0.3 to 350 kHz.	
BII2102WR-1kHz/350kHz	BII2102WR, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 1 to 350 kHz.	
BII2102WR-10Hz/100kHz	BII2102WR, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 10 Hz to 100 kHz.	
BII2102WR60-HV	BII2102WR60, T/R Switch Module, Bespoke DC Supply Voltage Vs: **HV**, Default Receiving Bandpass filter: 0.3 to 350 kHz.	
BII2102WR60-1kHz/350kHz	BII2102WR60, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 1 to 350 kHz.	

2. BII2102MIL: Standalone T/R Switch Modules.

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 Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.



System Block Diagram and Wirings



Wirings:

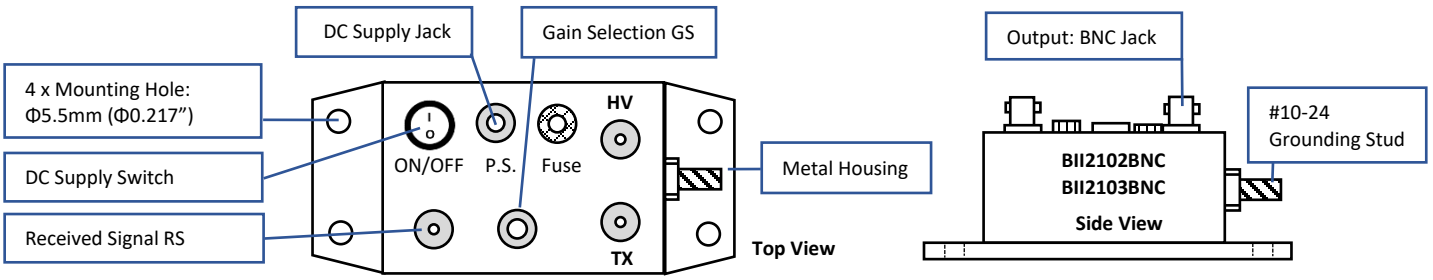
Signals	BII2102MIL Standalone T/R Switch Modules		
HV Signals:	**MIL-5015 Style Connector, Panel Mount, 3-Contact Mating Connector, Pin.**		
	Signal of High Voltage Source	Contact C	
	Signal Common of High Voltage Source	Contact B	
	Shielding and Grounding	Contact A	
TX Signals:	**MIL-5015 Style Connector, Panel Mount, 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 XLR Jack and Accessory A7: XLR3P-WL.**		
	Signal+	Pin 2, Positive/Hot.	White Wire
	Signal-	Pin 3, Negative/Cold.	Red or Black Wire
	Signal Common, Shielding, Grounding.	Pin 1, Shield/Ground.	Shield
Gain Selection:	**Panel Mount TRS Jack and Accessory A3: TRS-WL.**		
	A1	TRS Tip	White Wire
	A0	TRS Ring	Red or Black Wire
	Digital Common, Shielding, Grounding.	TRS Sleeve	Shield
Power Supply:	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.		
	+VDC	Center Contact	Red Wire
	Common	Metal Shell Contact	Black Wire
	Shielding and Grounding.	Metal Shell	Shield
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**			
Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, ¼" x 1-1/4".			
Accessories included: 1. One DC supply cable **DCBP24**. 2. One Grounding Cable **GWL18**. 3. One Gain Selection Cable **TRS-WL**. 4. One Receive Signal Cable **XLR3P-WL**.			
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

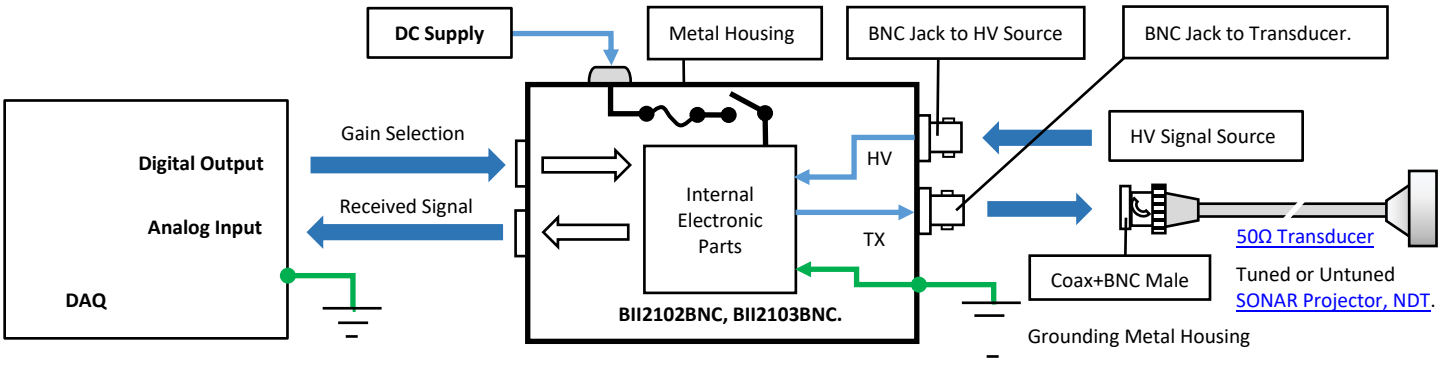
Part Number	-**DC Supply Voltage Vs**	-**Receiving Bandpass Filter: HPF/LPF**
BII2102MIL	Default. -MV. -HV.	Default: 0.3 to 350 kHz. Bespoke bandpass filter.
Example of Part Number:	**Description**	
BII2102MIL-HV	BII2102MIL, T/R Switch Module, Bespoke DC Supply Voltage Vs: **HV**, Default Receiving Bandpass filter: 0.3 to 350 kHz.	
BII2102MIL-1kHz/350kHz	BII2102MIL, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 1 to 350 kHz.	
BII2102MIL-10Hz/100kHz	BII2102MIL, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 10 Hz to 100kHz.	

3. BII2102BNC and BII2103BNC: Standalone T/R Switch Modules.

HV Connector to High Voltage Source: Panel Mount BNC Jack. **TX Connector to Transducer**: Panel Mount BNC Jack. **BNC Jack Rating: 500Vrms, 316W.**
Metal Enclosure, Overall Size: LxWxH = 146.9x91.7x67 mm. Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.



System Block Diagram and Wirings



Wirings:

Signals	BII2102BNC and BII2103BNC: Standalone T/R Switch Modules			
HV Signals:	**50Ω BNC Connector, Panel Mount, Jack.**			
	Signal of High Voltage Source	Center Conductor		
	Signal Common of High Voltage Source	Body Metal Shell.		
	Shielding and Grounding	Body Metal Shell.		
TX Signals:	**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:	**Panel Mount BNC Jack.**			
	Signal	Center Conductor		
	Signal Common, Shielding, and Grounding	Body Metal Shell.		
Gain Selection:	**Panel Mount TRS Jack and Accessory A3: TRS-WL.**			
	BII2102BNC	BII2103BNC	TRS Plug	Wire Leads
	A1	Reserved	TRS Tip	White Wire
	A0	A0	TRS Ring	Red or Black Wire
	Digital Common, Shielding, Grounding.	Digital Common, Shielding, Grounding.	TRS Sleeve	Shield
Power Supply:	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.			
	+VDC	Center Contact		Red Wire
	Common	Metal Shell Contact		Black Wire
	Shielding	Metal Shell		Shield
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**				
Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".				
Accessories included: 1. One DC supply cable **DCBP24**. 2. One Grounding Cable **GWL18**. 3. One TRS Cable for Gain Selection **TRS-WL.**				
Grounding Metal Case for operating safety. **Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.				
BII2102BNC: When A1 and A0 are open, their TTL/CMOS logic level is High or 1. Receiving Gain is maximum gain 80dB by default.				
BII2103BNC: 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.				

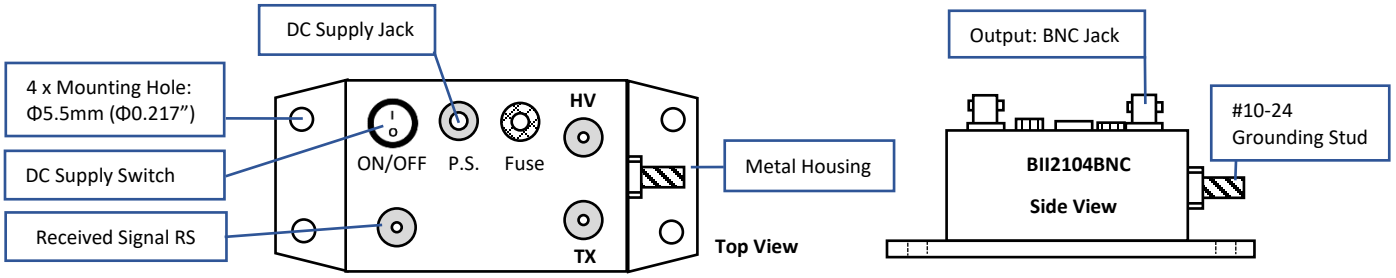
How to Order

Part Number	-DC Supply Voltage Vs	-Receiving Bandpass Filter: HPF/LPF
BII2102BNC	Default. -MV. -HV.	Default: 0.3 to 350 kHz, or Bespoke bandpass filter.
BII2103BNC		Default: 3 kHz to 4.5 MHz, or Bespoke bandpass filter.
Example of Part Number:	**Description**	
BII2102BNC-HV	BII2102BNC, T/R Switch Module, Bespoke DC Supply Voltage Vs: **HV**, Default Receiving Bandpass filter: 0.3 to 350 kHz.	
BII2103BNC	BII2103BNC, T/R Switch Module, Default DC Supply Voltage Vs, Default Receiving Bandpass filter: 3 kHz to 4.5 MHz.	
BII2103BNC-30kHz/3MHz	BII2103BNC, T/R Switch Module, Default DC Supply Voltage Vs, Bespoke Receiving Bandpass filter: 30 kHz to 3 MHz.	

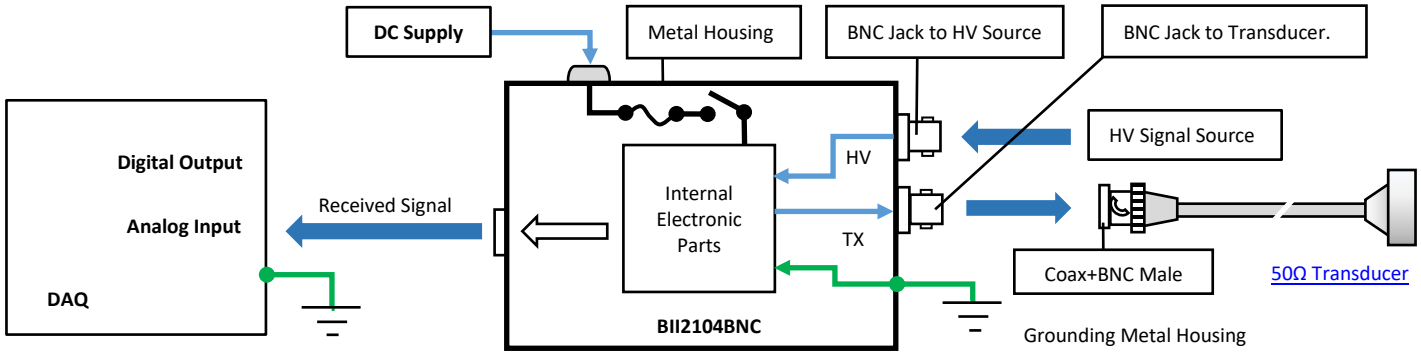
4. BII2104BNC: Standalone T/R Switch Modules.

HV Connector to High Voltage Source: Panel Mount BNC Jack. **TX Connector to Transducer**: Panel Mount BNC Jack. **BNC Jack Rating: 500Vrms, 316W.**

Metal Enclosure, Overall Size: LxWxH = 146.9x91.7x67 mm. Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.



System Block Diagram and Wirings



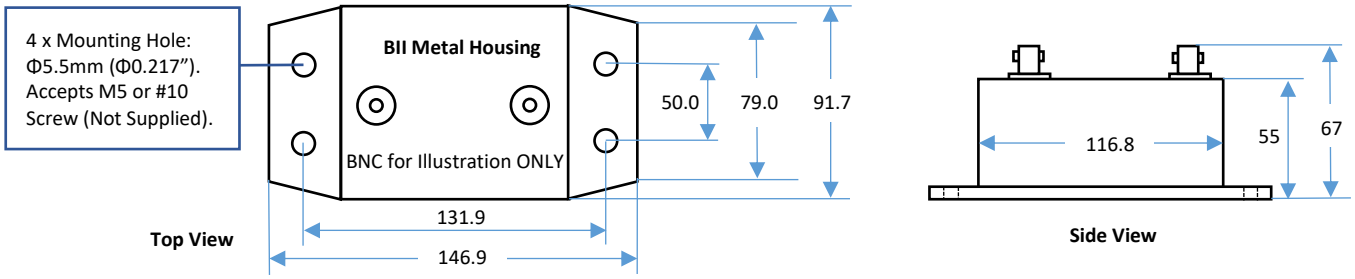
Wirings:

Signals	BII2104BNC Standalone T/R Switch Modules		
HV Signals:	**50Ω BNC Connector, Panel Mount, Jack.**		
	Signal of High Voltage Source	Center Conductor	
	Signal Common of High Voltage Source	Body Metal Shell.	
	Shielding and Grounding	Body Metal Shell.	
TX Signals:	**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:	**Panel Mount BNC Jack.**		
	Signal	Center Conductor	
	Signal Common, Shielding, and Grounding	Body Metal Shell.	
Power Supply:	**Panel Mount Power Jack and DC Supply Cable Pair**: Part Number DCBP24.		
	+VDC	Center Contact	Red Wire
	Common	Metal Shell Contact	Black Wire
	Shielding	Metal Shell	Shield
DC Supply Switch: Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**			
Fuse: 0.3A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".			
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.			
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

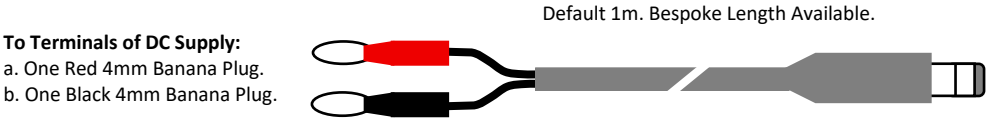
Part Number	-**DC Supply Voltage Vs**
BII2104BNC	Default, -MV, or -HV.
Example of Part Number:	**Description**
BII2104BNC	BII2104BNC, T/R Switch Module, Default DC Supply Voltage Vs.
BII2104BNC-HV	BII2104BNC, T/R Switch Module, Bespoke DC Supply Voltage Vs: **HV.**

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



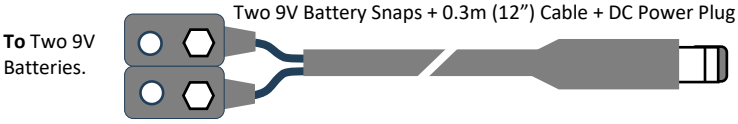
Accessories:

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



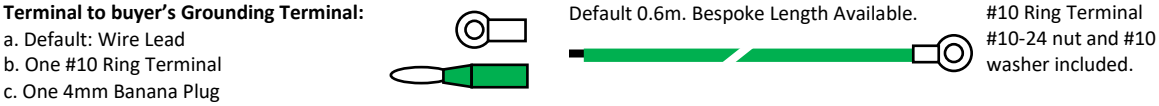
Red Banana Plug: +VDC. **Black Banana Plug:** Common.
One 1m DC supply cable. One end of the cable is with DC Power Plug, another end is Red and Black Banana Plugs. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

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.



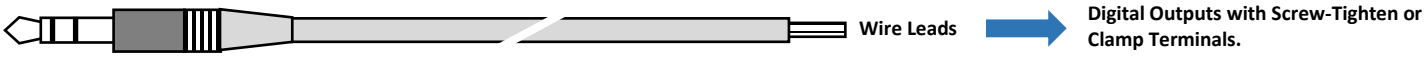
DC Supply Cable: DCWL24. One 1m DC supply cable with Wire Leads and DC Power Plug.

2. Grounding Cable and Terminals



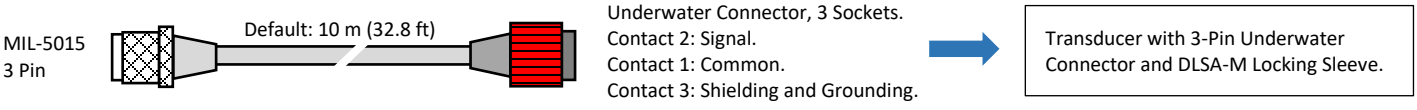
Grounding Cable, Part Number: GWL18, Support Single-Point Grounding with Multiple Devices.
One 0.6m AWG 18 Green Wire (or Green with a Yellow Stripe) with #10 Ring Terminal and Wire Lead. One #10 Ring Terminal and one 4mm Banana Plug (Green) are included. Depending on buyer's grounding terminal type, buyer assembles #10 Ring Terminal, 4mm Banana Plug, or other type of connectors to grounding cable at buyer's cost.

3. Gain Selection Cable for BII2102MIL, BII2102BNC, and BII2103BNC.
Accessory A3: TRS-WL. Bespoke length cable with 3.5mm TRS Plug to Wire Leads. Default: 0.9m.

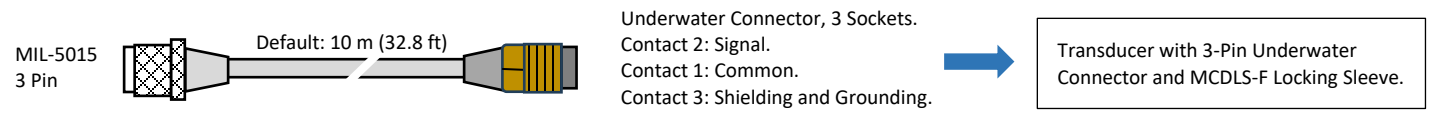


4. Received Signal Cable for BII2102MIL
Accessory A7: XLR3P-WL. Bespoke length cable with XLR Receptacle Male Pin to Wire Leads. Default: 1m.

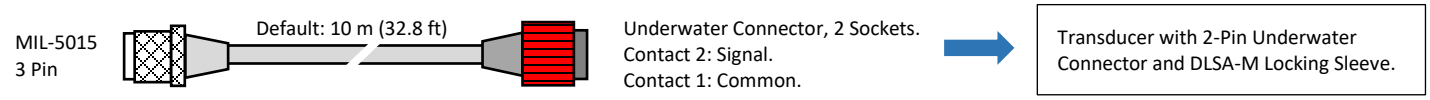
Accessory Cable.
Accessory A9: MIL-UMCF3S, MIL-5015 (3 Pins) to UMC3S (Underwater Connector, 3 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



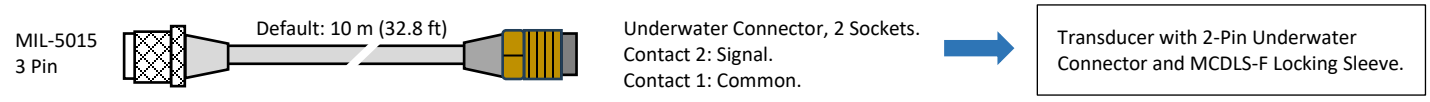
Accessory A10: MIL-SUMC3S, MIL-5015 (3 Pins) to Small UMC3S (Underwater Connector, 3 Sockets, Thread Locking, Size: Φ22x28mm)



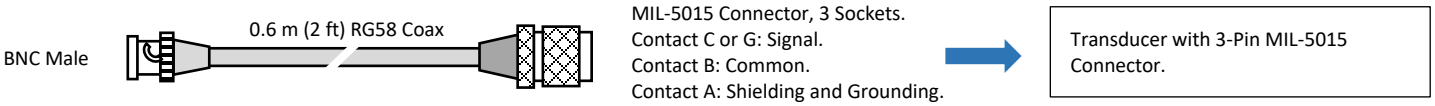
Accessory A11: MIL-UMCF2S, MIL-5015 (3 Pins) to UMC2S (Underwater Connector, 2 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



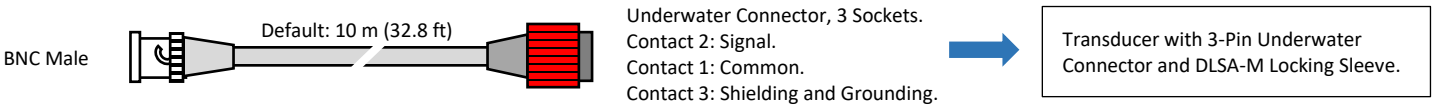
Accessory A12: MIL-SUMC2S, MIL-5015 (3 Pins) to Small UMC2S (Underwater Connector, 2 Sockets, Thread Locking, Size: Φ22x28mm)



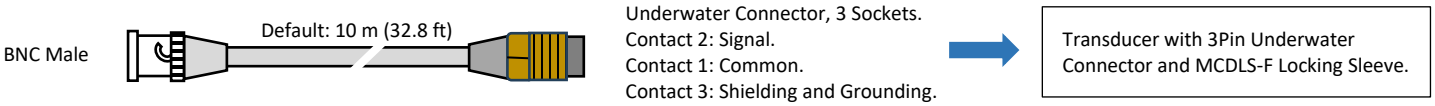
Accessory A13: BNC-MIL3S, BNC Male (Pin) to MIL3S (MIL-5015 type 3-Socket Connector Thread Fastening)



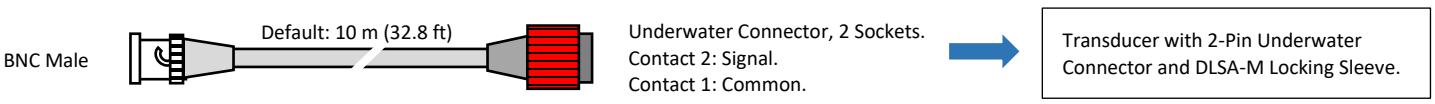
Accessory A14: BNC-UMCF3S, BNC Male to UMC3S (Underwater Connector, 3 Sockets, Locking Sleeve: DLSA-F, Size: Φ35.5x33.5mm)



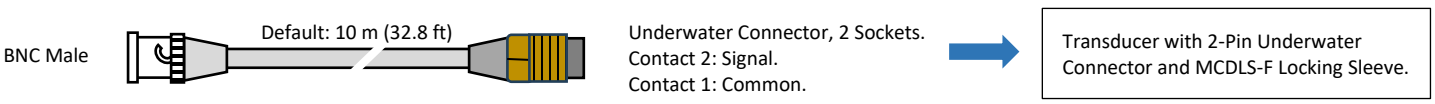
Accessory A15: BNC-SUMC3S, BNC Male to Small UMC3S (Underwater Connector, 3 Sockets, Thread Locking, Size: Φ22x28mm)



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

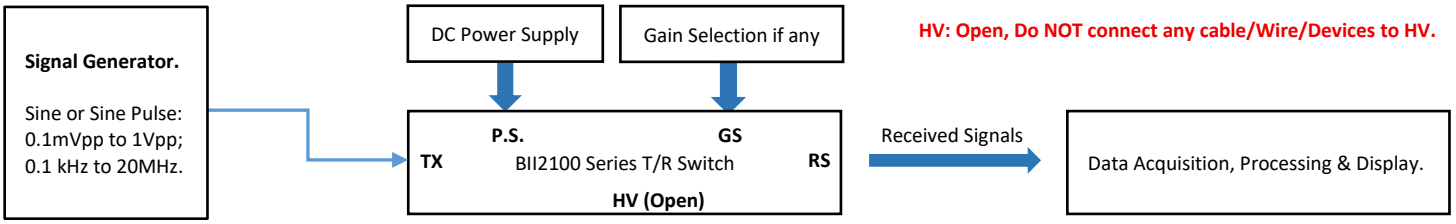


Accessory A17: BNC-SUMC2S, BNC Male to Small UMC2S (Underwater Connector, 2 Sockets, Thread Locking, Size: Φ22x28mm)

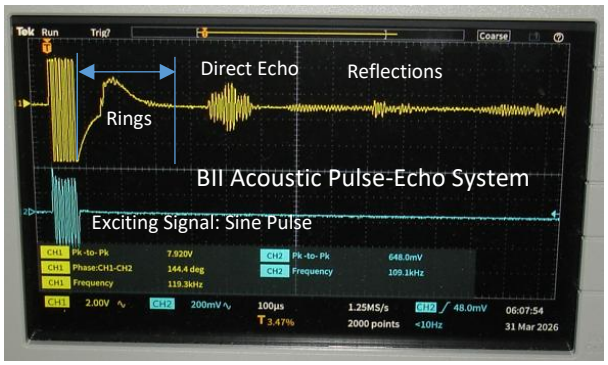


How to Calibrate Receiving Gains of BII TR Switch?

BII calibrates receiving gains. Buyer may test receiving gain during troubleshooting and/or commissioning of the system.



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



Questions

Can BII2102 series be used with 500kHz transducers to transmit and receive 500kHz signal?

Yes, BII2102 series can be used up to 1MHz with gains of 20, 40 and 60 dB, please refer to Frequency Response of Receiving Gain for receiving gain variations. When ordering, refer to "How to Order" of a specific model, and specify fs of 500kHz and other necessary parameters.

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 for crimping 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 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?

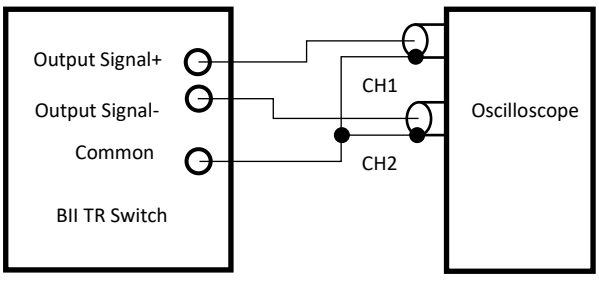
BII device has panel-mount XLR or BNC jack as output connector. The custom-made adaptors are recommended such as BNC to XLR, BNC to TRS, etc. BII can manufacture these adaptors which bridge your devices and BII devices. Please discuss with BII for customizations.

What if my data acquisition device does not have Digital Output for Gain Selection?

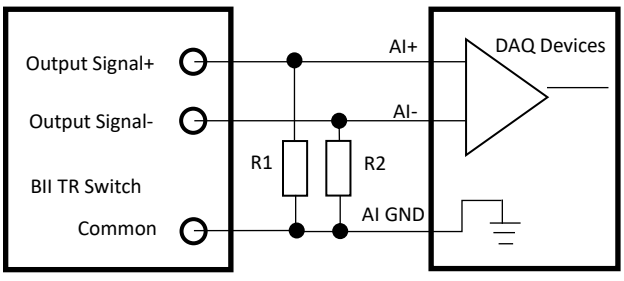
Besides Digital Output, the gain selection can be implemented with two switches connecting and disconnecting from A1 to Digital COMMON, and from A0 and Digital COMMON. Please refer to Gain Selection.

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.

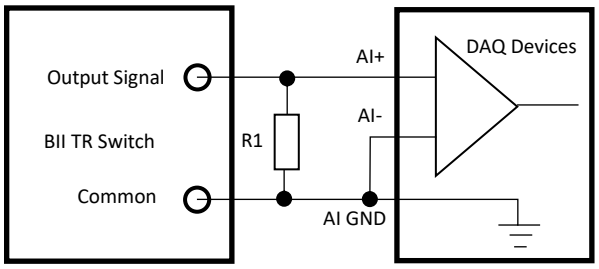
BII's Differential Output to BNC Input of an Oscilloscope



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