

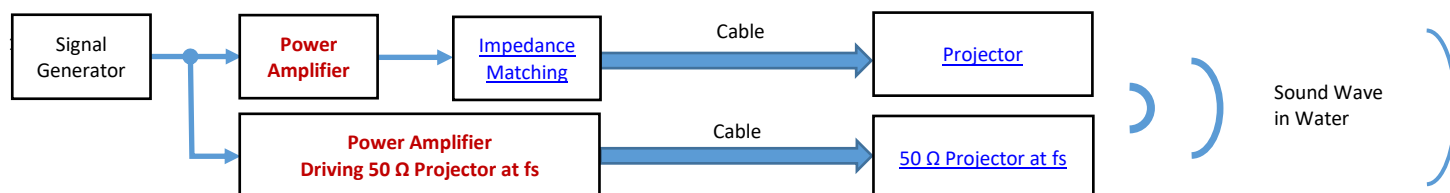
## BII5020 Series Power Amplifier

### DESCRIPTION

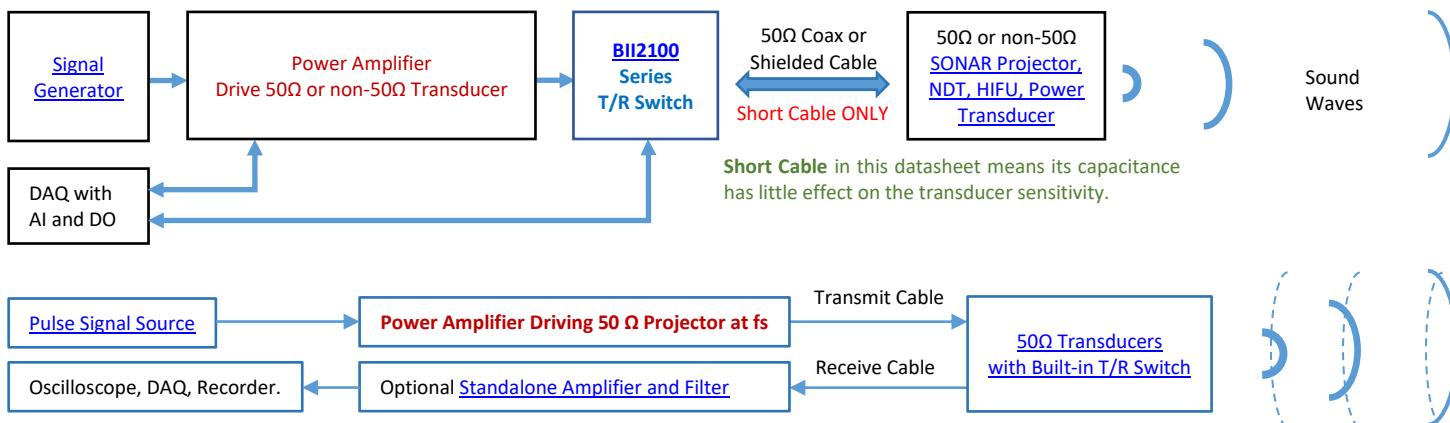
BII5020 series linear power amplifiers are ideal to drive piezoelectric transducers used in acoustic systems of underwater, air, and ultrasonics (solids).

### SYSTEM CONFIGURATION

#### (a) Transmitting Sounds.



#### (b) Transmitting and Receiving Sounds.



### Related Product:

<a href="#">Underwater Transducer</a> : SONAR, NDT, and HIFU	<a href="#">Impedance Matching</a> between Transducers and Amplifiers
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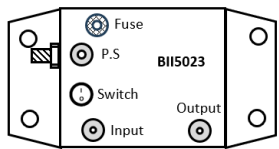
### APPLICATIONS

Object Detection and Tracking, Bioacoustic and Biological Research.	Underwater Wireless Communication/Modem.
Distance Gage, Navigation, Obstacle Avoidance.	Acoustic Beacon & Positioning: Pinger and Transponders.
Phantom Echo Generation, Phantom Clicks, Sound Playback.	FSK, PSK and Spread Spectrum System.

### ABSOLUTE MAXIMUM RATINGS

Power Amplifier	BII5021, BII5022	BII5023
Supply Voltage:	+44 VDC	+44 VDC
Output Peak Current:	5 A	1.32 A
Input Voltage:	10 Vpp	10 Vpp

### SPECIFICATIONS

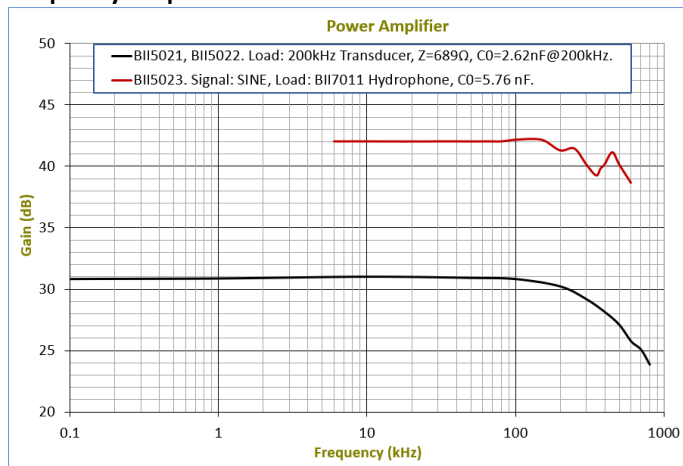
	<a href="#">BII5021</a>	<a href="#">BII5022</a>	<a href="#">BII5023</a>
Power Amplifier			
Status:	<b>ACTIVE</b> <b>ACTIVE:</b> Product device recommended for new designs. <b>LIFEBUY:</b> BII has announced that the device will be discontinued, and a lifetime-buy period is in effect. <b>OBSOLETE:</b> BII has discontinued the production of the device.		
Waterproof:	Not waterproof. <b>Always use the device in Dry Air for electrical safety.</b>		
Operating frequency: (Small Signal)	100 Hz to 500 kHz		4.5 to 500 kHz.
	<b>Small Signal:</b> Load $\geq 100\Omega$ , Output Voltage $\leq$ Half $V_{omax}$ , Output Current $\leq$ Half $I_{omax}$ . <b>Warning:</b> the device performance degrades if operating frequency less than Minimum Operating Frequency.		
Signal Type:	Pulsed Signals.	<b>Pulsed Signals ONLY</b> to avoid overheat and damage.	

	Continuous Signals.	<b>Pulse Width PW</b> ≤ 100 mS, and <b>Duty Cycle D</b> ≤ 25%.	Continuous Signals.
<b>Source Level Capability: (in Water)</b>	188.6 + DI. in dB re μPa at 1m. DI: Directivity Index (dB) of the transducer.		
<b>Operating Mode:</b>	Linear		
<b>Impedance Matching:</b>	No Built-in Impedance Matching.		Built-in Impedance Matching.
<b>Gain:</b>	30.9 dB or x 35.		42 dB or x 125.6
<b>Input Type:</b>	Single ended		Single ended
<b>Input Connector:</b>	On-board	None, Wire Bundles.	BNC Jack
<b>Input Impedance:</b>	20 KΩ    7 pF		
<b>Maximum Input Level:</b>	Maximum Output Voltage $V_{o_{max}}$ /Gain or 2Vpp whichever is less.		1 Vpp
<b>Output Type:</b>	Differential		Single ended
<b>Output Connector:</b>	On-board	None, Wire Bundles.	BNC Jack
<b>Voltage Output:</b>	<b>4.2 Ap current output:</b> Maximum $V_{o_{max}} = (V_s - 7)$ , in Vp. <b>0.6 Ap current output:</b> Maximum $V_{o_{max}} = (V_s - 3.1)$ , in Vp.		Input Level * Gain, or 125.6 Vpp.
<b>Current Output:</b>	$I_o \leq 4.2$ A peak.	$I_o \leq 5$ A peak.	$I_o \leq 1.32$ A peak.
<b>Load:</b>	$\geq V_o/I_o$	$\geq V_o/I_o$	Driving 50 Ω Transducers.
<b>Stand-by Control Voltage: (Shut-down)</b>	TTL/CMOS Compatible. <b>Logic Low "0"</b> : Output Disabled. 0 to +0.8 VDC. <b>Logic High "1"</b> : Output enabled. +2.4 VDC to Supply Voltage Level Vs.		Not Available.
<b>Output Disable Time:</b>	1 μS		N/A
<b>Output Enable Time:</b>	3 μS		N/A
<b>Full Power Bandwidth:</b>	150Hz to 90kHz@+42VDC Supply. 150Hz to 100kHz@+36VDC Supply. 150Hz to 200kHz@+24VDC Supply. 150Hz to 500kHz@+12VDC Supply.		Refer to <a href="#">Frequency Response</a> .
<b>RMS Power Capability: (SINE Signal)</b>	86W@+42VDC Supply. 71W@+36VDC Supply. 41W@+24VDC Supply. 11W@+12VDC Supply.		
<b>Power Efficiency: (Operating at <math>I_{o_{max}}</math>)</b>	Driving Tuned Transducers (Resistive load): 30% at +12 VDC. 55% at +24 VDC. 62% at +36 VDC. 64% at +42 VDC. Driving Untuned Transducers: Power Efficiency of driving tuned transducers*cosθ. θ: Impedance Phase of Untuned Transducers.		Driving Tuned Transducers (Resistive load): 30% at +12 VDC. 55% at +24 VDC.
<b>DC Supply Voltage Vs:</b>	+8 to +42 VDC <b>Warning: DC Supply voltage greater than <a href="#">MAXIMUM RATINGS</a> will damage the devices.</b>		+8 to +30 VDC
<b>DC Supply Current Is:</b>	3.6 A at Maximum Power Output. <b>DC Supply Current of Pulsing Signals:</b> When a device works with pulsing signals such as SINE pulse or voltage spikes, the DC current from DC power supply is much less than the rating. $Current = Rated\ DC\ Supply\ Current * \sqrt{D}$ . D: Duty Cycle of the pulsing signal = Pulse Width / Period. For example: Driving a Transducer with SINE pulse whose D = 1%, DC current from DC power supply Is = 3.6A * $\sqrt{0.01}$ = 0.36 A.		
<b>Suggested DC Supply:</b>	Marine Battery and Automobile Battery, or DC Power Supply with Grounded Output and Protection of Output Current Limit. <b>Fully charged 12V Automobile or Marine Battery are from 12.6 to 14.4 VDC. Ensure that voltage of battery pack is less than maximum DC supply voltage.</b>		
<b>Quiescent Current:</b>	<b>Active:</b> 36 mA. <b>Shutdown:</b> 16 mA.		36 mA
<b>DC Supply Connector:</b>	On-board	None, Wire Bundle.	DC Power Jack.
<b>Fuse:</b>	N/A	N/A	5A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".
<b>Accessory Cable:</b>	6" or 0.15 m wires	60 mm wires	1. DC Power Supply Cables: <a href="#">DCBP24</a> .
<b>Cable Connector:</b>	Wire Leads	Wire Leads	2. Grounding Cable: <a href="#">GWL18</a> .
<b>Package:</b>	PCB	PCB	Metal Enclosure
<b>Grounding Terminal:</b>	N/A	N/A	Grounding Stud #10-24.
<b>Mounting Holes:</b>	4 x Φ4.87mm	4 x Φ3.2mm	4 x Φ5.5mm. Accept M5 and #10 Screws.
	Screws are not supplied.		
<b>Size (mm):</b>	Round PCB: ΦDxH = Φ101.6x50.8	Rectangular PCB: LxWxH = 68.6x36.1x36	Metal Enclosure: LxWxH = 180.5x110.3x75
<b>Weight in Air:</b>	170 grams	46 grams	1.2 kg
<b>Operating Temperature:</b>	-20 to 70°C or -4 to 158°F		
<b>Storage Temperature:</b>	-20 to 70°C or -4 to 158°F		
<b>Note: Forced-air cooling by a fan is recommended to cool down the amplifier during service of full power and continuous waveform.</b>			
<b>WARNING: The buyer should observe 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.</b>			

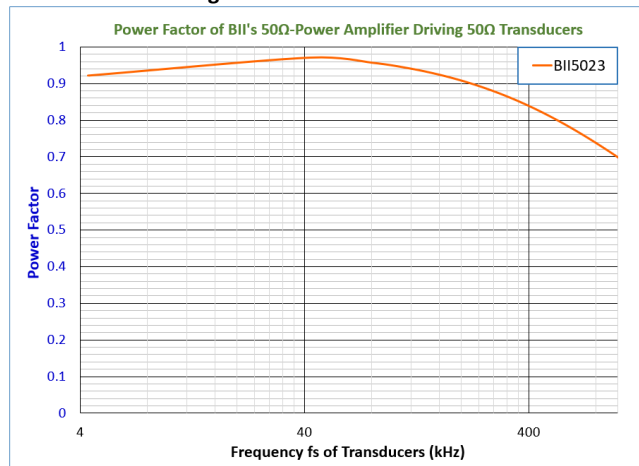
#### Question: Are 50Ω Power Amplifiers suitable to drive non-50Ω transducers?

Answers: 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.

## Frequency Response

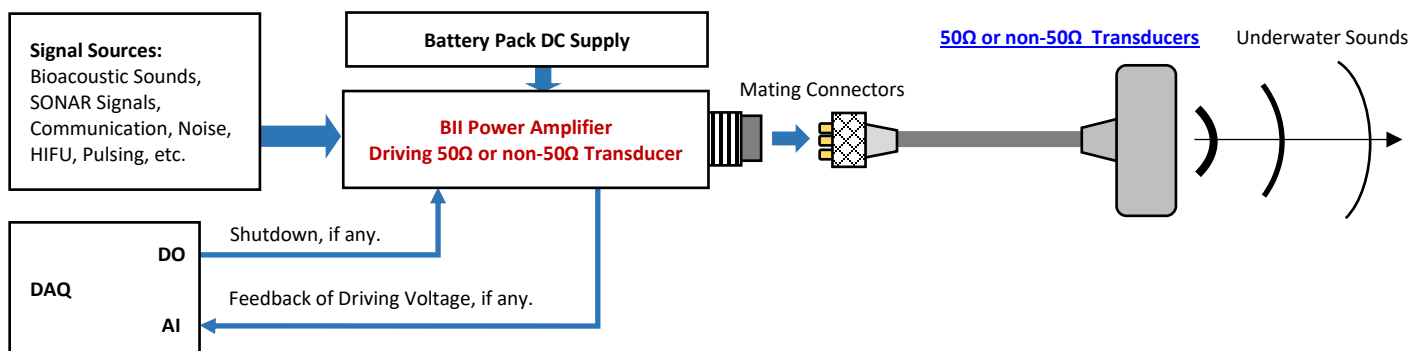


## Power Factor Driving 50Ω Transducers

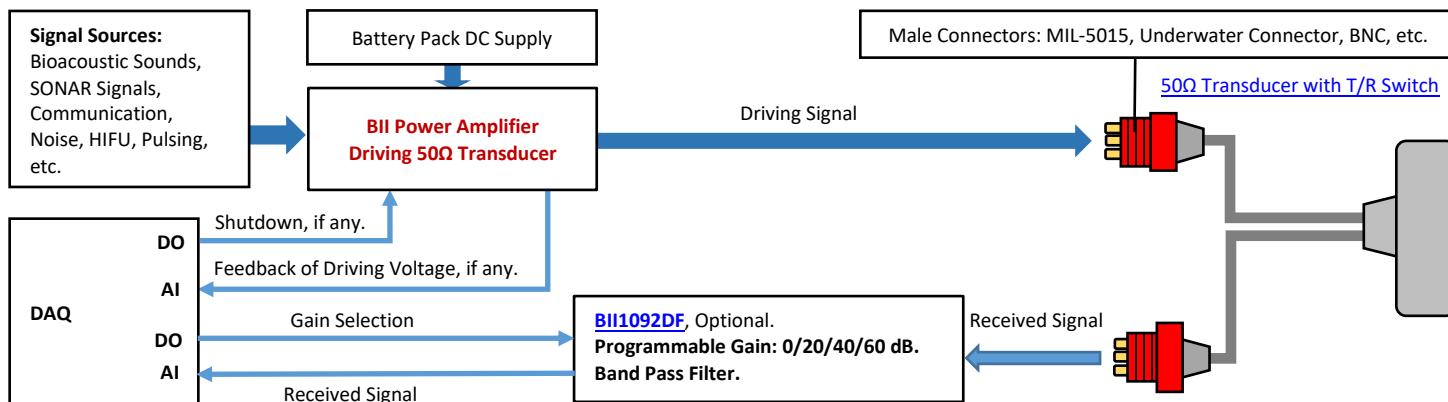
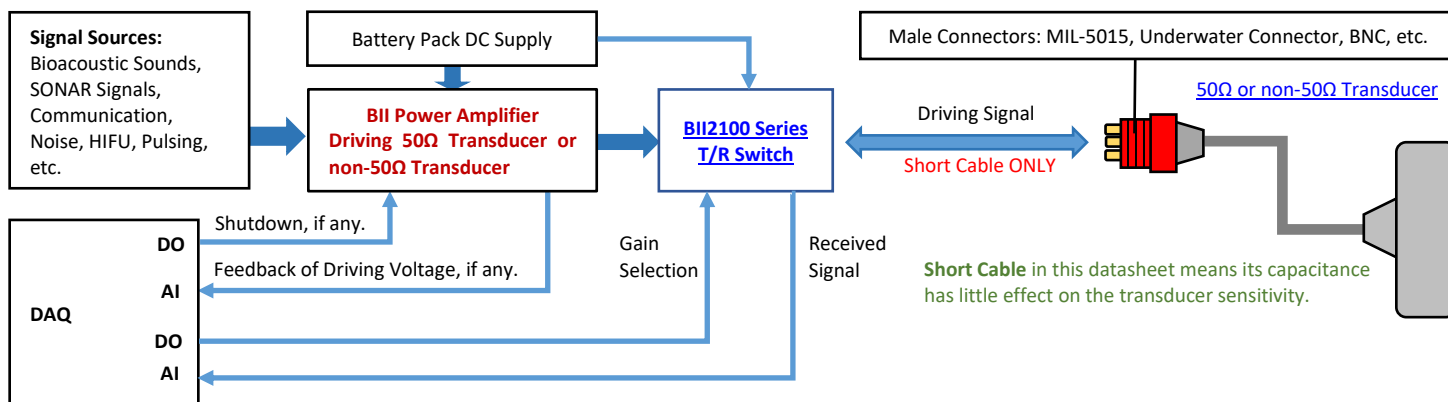


## Acoustic System Block Diagram

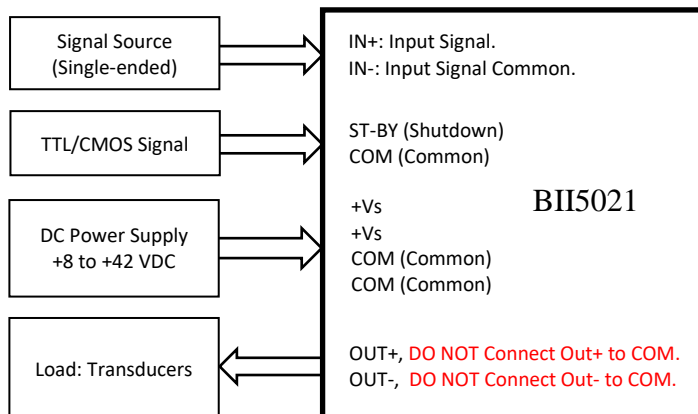
### 1. Generate Sounds and Waves.



### 2. Transmitting and Receiving Sounds and Waves



**BII5021 SUGGESTED WIRING:**



**BII5021 ST-BY SWITCH (Shutdown SWITCH)**

OFF Position: Output Enabled.  
DIO Position: TTL/CMOS Logic High -> Output Enabled.  
TTL/CMOS Logic Low -> Output Disabled.

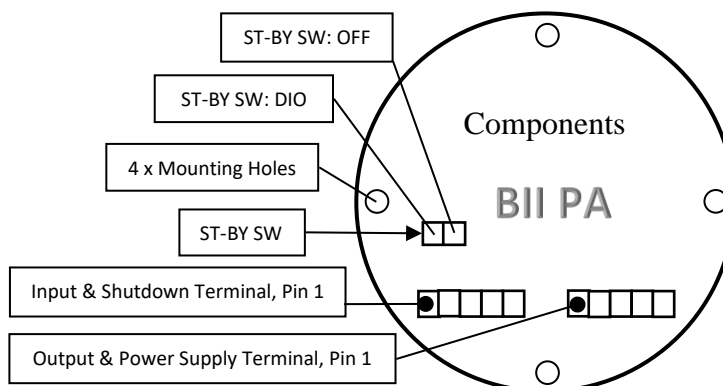
**BII5021 TERMINALS and WIRINGS**

**Input and ST-by (Shutdown) Terminal**

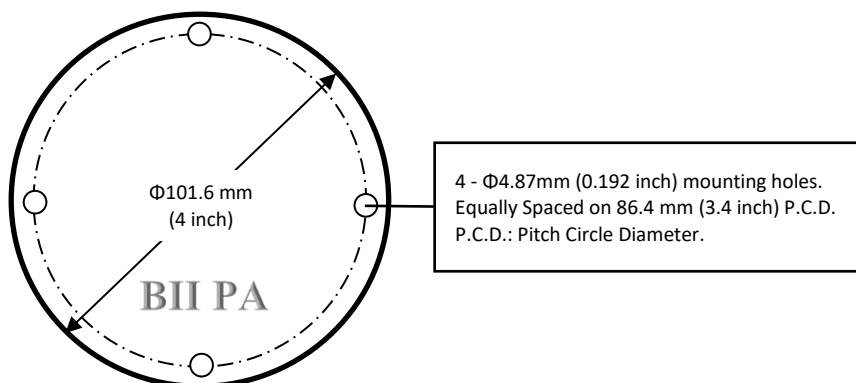
Pin 1: ST-BY (Shutdown)	White,	6" Wire
Pin 2: COM (Common)	Black,	6" Wire
Pin 3: IN+ (Input Signal)	Blue,	6" Wire
Pin 4: IN- (Input Common)	Yellow,	6" Wire
Pin 5: COM (Common)	Black,	6" Wire

**Output and Power Supply Terminal**

Pin 1: +Vs	Red,	6" Wire
Pin 2: +Vs	Red,	6" Wire
Pin 3: COM (Common)	Black,	6" Wire
Pin 4: OUT+	Blue,	6" Wire
Pin 5: OUT-	Yellow,	6" Wire



**BII5021 Physical Size (unit mm):  $\Phi D \times H = \Phi 101.6 \times 50.8 \text{ mm}$**



**How to Extend Input and Output Wires of BII5021 Power Amplifiers (PCB Package for Embedded Applications.)?**

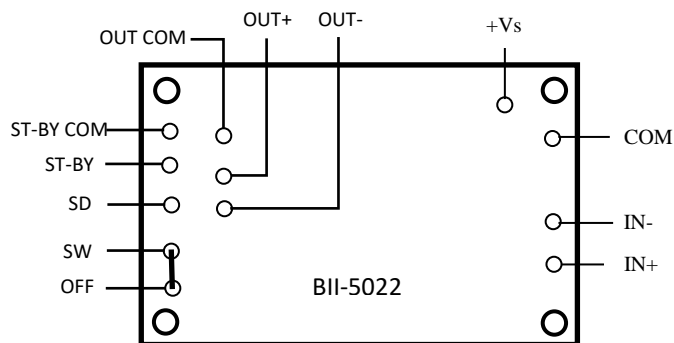
Input and output wires of BII5021 PA (PCB Package) are 0.15m (6") **AWG16 wires** with wire leads.

- Butt Splice Connectors, Fully Insulated.** Buyers shall refer to the instructions of the manufacturer to strip proper wire leads and crimp the connector for secure connection. If possible, **heat shrink tube** is recommended to sheath the splice and function as strain relief.
- Banana Jack and Plug, Fully Insulated, Free Hanging (In-Line).** Crimp or Solder. Crimp is recommended.

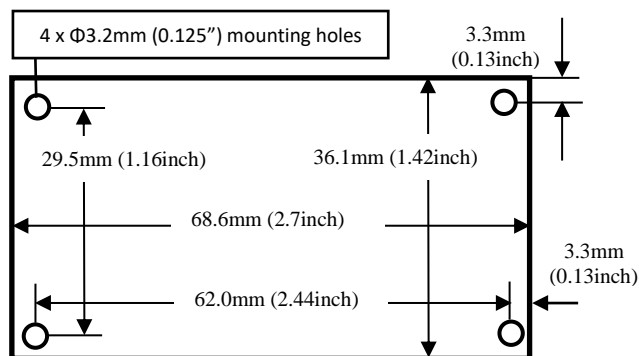
**Note:** a. by default, BII does NOT provide these connectors. If buyer needs connectors, please specify when ordering.

b. When wiring, please ensure insulation (avoid short circuit to damage the devices) and safety of operation.

## BII5022 CONTROLS and TERMINALS:



## BII5022 Physical Size:

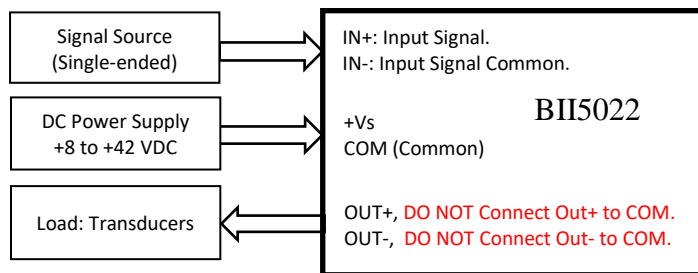


Wire Leads	Signal	Wires' Colour	Wire Leads	Signal	Wires' Colour
IN+	Input Signal	White	ST-BY	Shut Down Control	Default: PCB Via Pad, BII does not solder wire.
IN-	Input Signal common	Blue	ST-BY COM	Shut Down Control Common	Default: PCB Via Pad, BII does not solder wire.
COM	Power Supply Common	Black	SD	Shut-down pin	Default: PCB Via Pad, BII does not solder wire.
+Vs	Power Supply Voltage	Red	SW	Shut-down pin	Default: SW is wired to OFF
OUT-	Negative Output	Yellow	OFF	Shut-down OFF pin	Default: OFF is wired to SW
OUT+	Positive Output	Blue	OUT COM	Output Common	Default: PCB Via Pad, BII does not solder wire.

**Default Factory-set:** SW is wired to OFF, shut-down function is not available. To use shut-down function:  
 1. Cut off the wire between SW and OFF. 2. Solder a wire from SW to SD. 3. Solder wires to ST-BY and ST-BY COM respectively.

## BII5022 SUGGESTED WIRING:

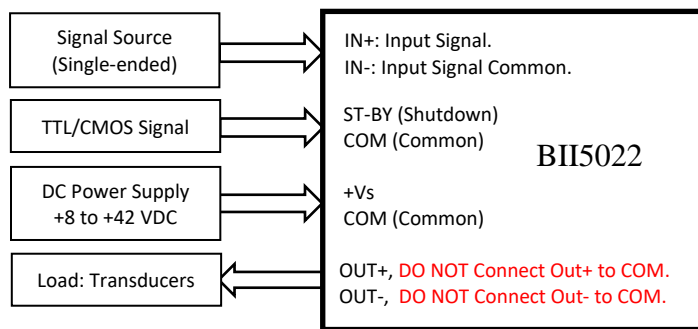
### 1. Shut-down function is not available. SW is wired to OFF.



Warning: Outputs of the Power amplifier are differential, DO NOT Connect Out + or Out - to COM.

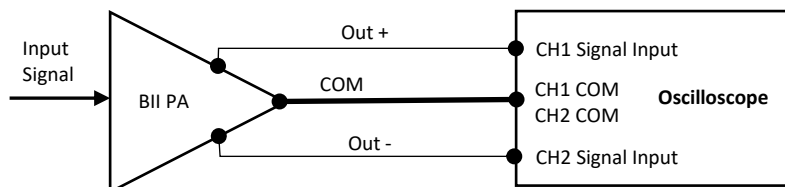
### 2. Shut-down function is available.

To use shut-down function: Cut off the wire between SW and OFF. Solder a wire from SW to SD; Solder wires to ST-BY and ST-BY COM respectively.



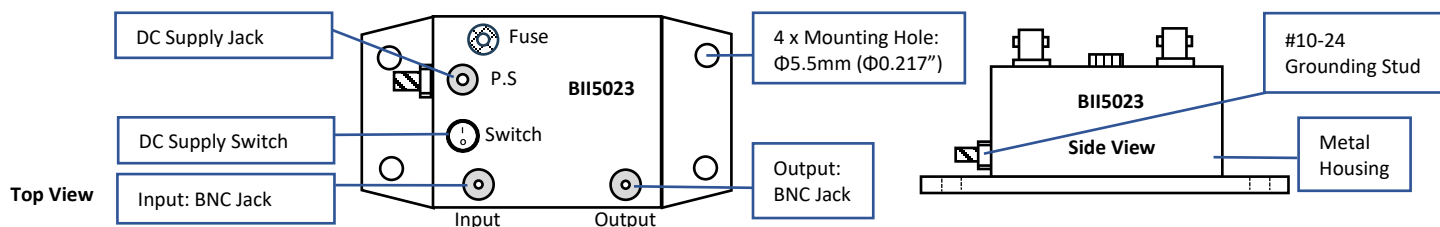
Warning: Outputs of the Power amplifier are differential, DO NOT Connect Out + or Out - to COM.

## Measure Differential Output of BII Power Amplifiers

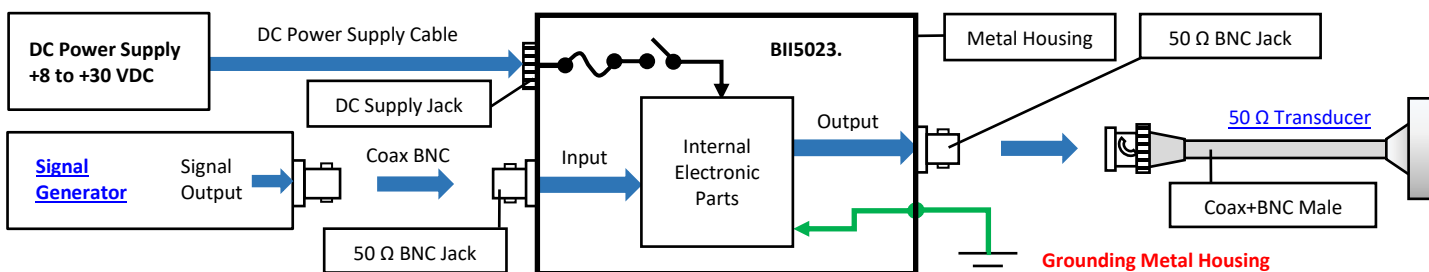


Warning: Outputs of the Power amplifier are differential, DO NOT Connect Out + or Out - to any COM.

**BII5023:** Input and Output Connectors: BNC Jack. Metal Enclosure, Overall Size: LxWxH = 180.5x110.3x75mm. Mounting Hole  $\Phi 5.5\text{mm}$  ( $\Phi 0.217''$ ) accepts M5 or #10 screw. Screws are not supplied.



**System Block Diagram and Wiring:** Driving 50  $\Omega$  Transducer with BNC Male.



Signal Generator	BII5023		50 $\Omega$ Transducer
BNC Jack	Input: BNC Jack	Output: BNC Jack	Coax + In-line BNC Plug (Male)
Signal: Center Socket	Signal: Center Socket	Signal: Center Socket	Signal: Center Pin
Common: Body.	Grounded Common: Body.	Grounded Common: Body.	Common: Body.
DC Power Supply:	DC Power Jack. Center Contact: +VDC, Shell: Grounded Common.		
DC Supply Switch:	Turn ON and Turn OFF DC Supply. "I" -> ON; "O" -> OFF.		
Fuse:	5A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".		
Accessories:	1. One DC Power Supply Cables: <a href="#">DCBP24</a> . 2. One Grounding Cable, Part Number: <a href="#">GWL18</a> .		
Grounding Metal Case for operating safety.	<b>Grounding Stud:</b> #10-24 Screw 316SS. Nut and Washer are included. Support Single-Point Grounding with Multiple Devices. <b>Note: The body of Power Supply Jack is connected to metal case.</b>		
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

BII5023	-Adaptor Accessory
Example of Part Number:	Description
BII5023	BII5023, Linear Power Amplifier.
BII5023-MIL-SUMC	BII5023, Linear Power Amplifier with Adaptor Accessory: MIL-SUMC.

#### What if the connector of my transducer/projector is SMA or SMC Connector?

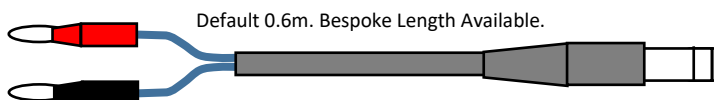
Buyer may order a BNC to SMA (or SMC) adaptor from local electronic distributors in buyer's country. BII may ship the adaptor as accessory of the device. Please discuss with BII for customizations.



#### DC Supply Cable Pair: Part Number DCBP24.

##### 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.

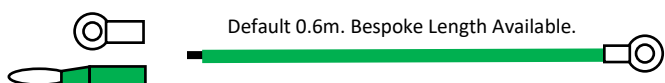
#### Red Banana Plug: +VDC. Black Banana Plug: Common.

One 0.6m 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.

#### Grounding Cable and Terminals

##### 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.

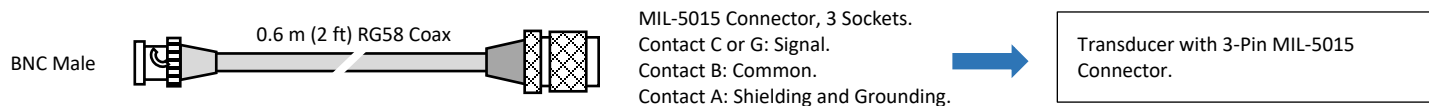
#### Grounding Cable, Part Number: GWL18, Support Single-Point Grounding with Multiple Devices.

One 0.6m AWG 18 Green Wire with #10 Ring Terminal and Wire Lead. One #10 Ring Terminal and one 4mm Banana Plug (Green) are included.

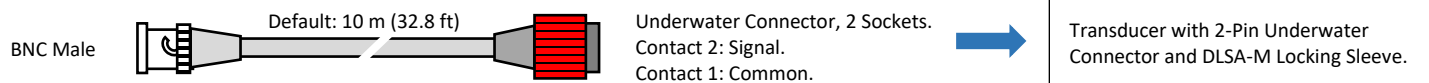
Depending on buyer's grounding terminal type, buyer assembles #10 Ring Terminal, 4mm Banana Plug, or other type of connectors to grounding cable at buyer's cost.

**Adaptor Accessory:**

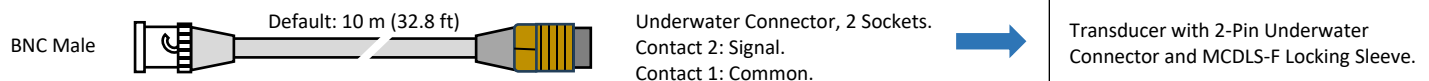
**(1) BNC-MIL**, BNC Male (Pin) to MIL3S (MIL-5015 type 3-Socket Connector Thread Fastening)



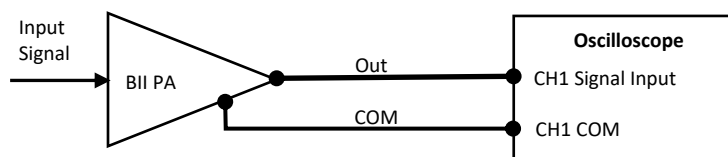
**(2) BNC-UMC**, BNC Male to UMC2S (Underwater Connector, 2 Sockets, Locking Sleeve: DLSA-F, Size:  $\Phi 35.5 \times 33.5$  mm)



**(3) BNC-SUMC**, BNC Male to Small UMC2S (Underwater Connector, 2 Sockets, Thread Locking, Size:  $\Phi 22 \times 28$  mm)



**Measure Single Ended Output of BII Power Amplifiers**



**Warning:**

1. Outputs of the power amplifier is high voltage, choose suitable oscilloscope probe with correct attenuation and voltage rating.
2. for operating safety, ensure proper grounding, and shut down power supply of the device before handling the cables, wiring and hookup, etc.

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

