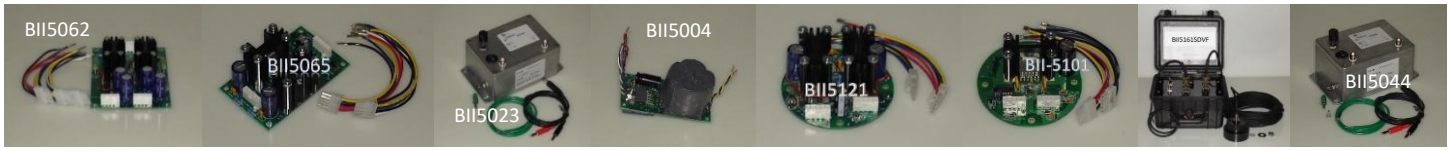
SE=SL-TL+AG-NL

Benthowave Instrument Inc.

Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revised on 2025/01/02

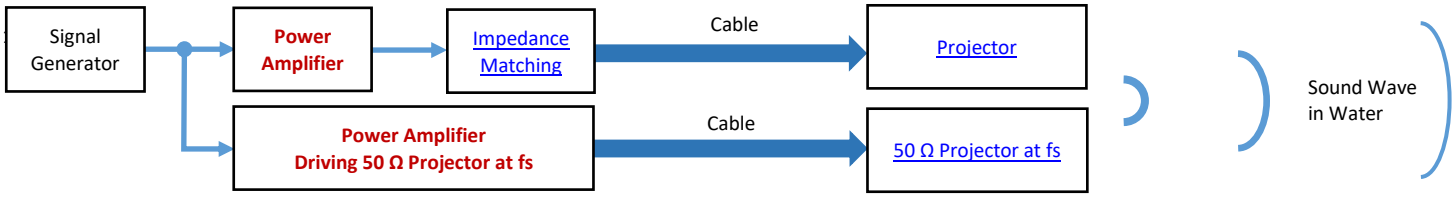


BII5110 Series Power Amplifier Driving Sonar Transducer / Projector

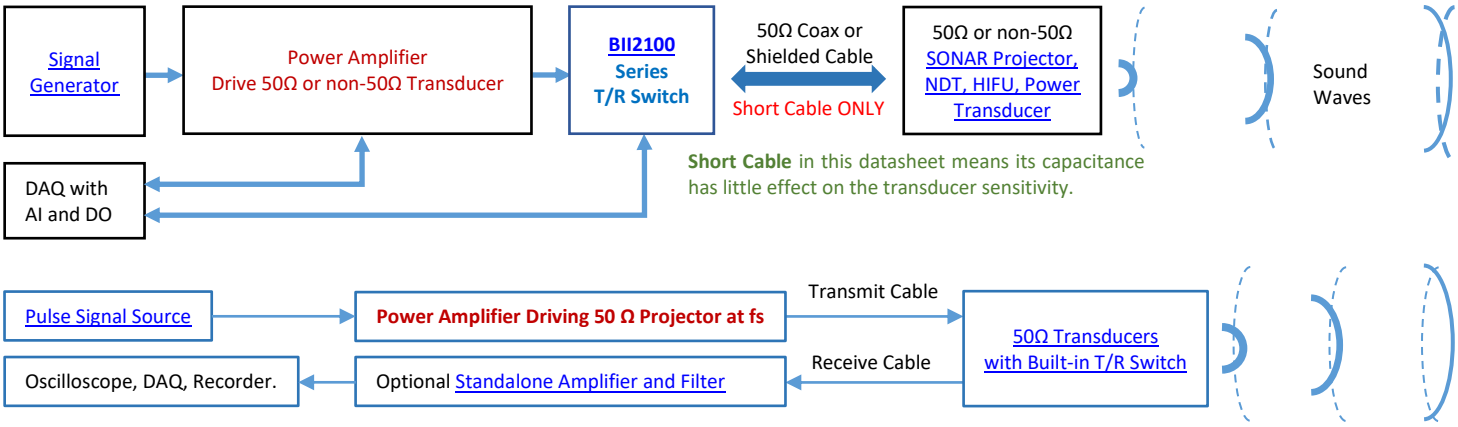
BII5110 series are switching power amplifiers which offer high efficiency and low power consumption for use in underwater, NDT, and HIFU acoustic pulsing system. Input and output signals of the PA are pulse signals: Single Pulse, Burst Pulses, and Spikes.

SYSTEM CONFIGURATION

(a) Transmitting Sounds.



(b) Transmitting and Receiving Sounds.



Related Product:

Underwater Transducer: SONAR, NDT, and HIFU	Impedance Matching between Transducers and Amplifiers

APPLICATIONS

Sub-bottom Investigation, Seafloor-mapping System	Acoustic Modem, Communication, Acoustic Beacon/Transponder
Navigation Echosounder, Underwater Acoustic Positioning	Fishery Sounder, Netsonde, Dipping Sonar, Sonobuoy, HIFU Transducer, Cavitation
Robotics, Proximity Detection, Sound Ranging	Automatic Sizing, Sorting & Positioning of Parts
Level Measurement, Speed Measurement	Counting, Monitoring, Remote Control, Alarming, Motion Detection
Edge Detection, Web Guiding System	Surface/Profile Characterization and Quality Control

Which Power Amplifier, Linear or Switching, Is Suitable to Drive Piezoelectric SONAR, HIFU, and NDT Transducers?

Parameter	Linera Power Amplifier	Switching Power Amplifier
Input Signal:	Analog Voltage Signals from Analog Output or D/A Converter.	Digital Voltage Signals from Digital Outputs.
Output Signal:	Analog Signals: SINE, SINE Pulse, Chirp/FM, FSK, PSK, Spikes, etc.	Pulse Signals: Square Signal, Spikes, Single Pulse, etc.
Power Efficiency:	η ≤ 70%	η ≥ 90%
Power Capacity:	High Power with Heavy Bulky Physical Size.	High Power with Light Small Physical Size.
Air-Flow Cooling:	Forced-air Fan is necessary in high power CW applications.	Not necessary in most high power applications.
Harmonics:	None or very low.	Odd frequency Harmonics.
	Impedance matching device, Piezoelectric transducers and Air/water/Solids are bandpass filters which attenuate specific signals.	

Question: 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 to Extend Input and Output Wires of BII Power Amplifiers (PCB Package for Embedded Applications.)?

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

1. **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.
2. **Banana Jack and Plug, Fully Insulated, Free Hanging (In-Line)**. Crimp or Solder. Crimp is recommended.

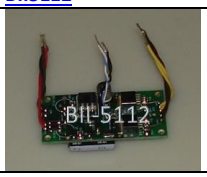
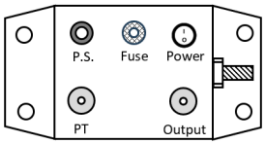
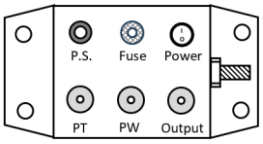
Note: a. by default, BII does NOT provide these connectors. If buyer needs connectors, please specify when ordering.

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

ABSOLUTE MAXIMUM RATINGS

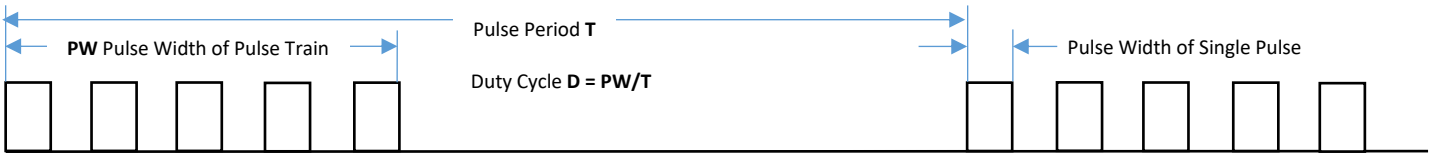
DC Supply Voltage	+30 V
Input Voltage Range	-0.5 V to 5.5 V
Output Peak Current	9 A

SPECIFICATIONS

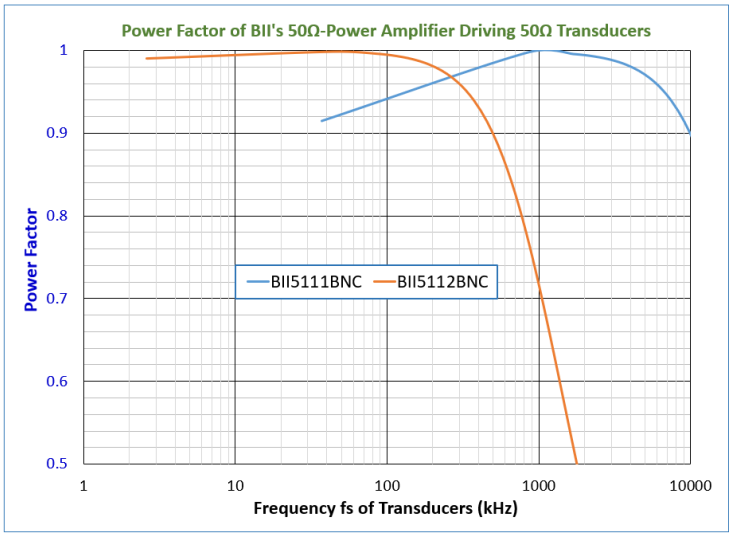
	BII5111	BII5112	BII5111BNC	BII5112BNC
Power Amplifier:				
Status:	**ACTIVE**	**ACTIVE**	**ACTIVE**	**ACTIVE**
	ACTIVE: Product device recommended for new designs. **LIFEBUY**: BII has announced that the device will be discontinued, and a lifetime-buy period is in effect. **OBSOLETE**: BII has discontinued the production of the device.			
Waterproof:	Not waterproof. **Always use the device in Dry Air for electrical safety.**			
Operating Frequency:	50 kHz to 10 MHz	5 kHz to 500 kHz	50 kHz to 10 MHz	5 kHz to 500 kHz
	Warning: Operating Frequency range is absolutely determined by impedance matching network and transducer. Please observe the frequency range of both impedance matching network and transducer to avoid damage of the power amplifier. Refer to load.			
Source Level Capability: (in Water)	191.0 + η + DI	194.1 + η + DI	191.0 + η + DI	194.1 + η + DI
	in dB re µPa at 1m. DI: Directivity Index (dB) of Transducer, η: Transducer Efficiency, in dB.			
Operating Mode:	Switching Mode.			
Gain:	Output Voltage/Input Voltage.			
Input Signal Type:	DC Coupling.			
	Positive Pulse & Pulse Trains. 50nS ≤ Pulse Width ≤ 200mS. Duty Cycle ≤ 50%.	Positive Pulse & Pulse Trains. 1µS ≤ Pulse Width ≤ 200mS. Duty Cycle ≤ 25%.	Positive Pulse & Pulse Trains. 50nS ≤ Pulse Width ≤ 200mS. Duty Cycle ≤ 50%.	Positive Pulse & Pulse Trains. 1µS ≤ Pulse Width ≤ 200mS. Duty Cycle ≤ 25%.
	Logic Signals, TTL/CMOS Logic Level Compatible.			
	Note: Pulse Width PW (or Pulse Duration PD) in this document include pulse widths of pulse trains and single pulse.			
	Warning: Neither Negative Pulse nor Negative Pulse Trains are suitable to the device.			
Input Connector:	None, Wire Leads.	None, Wire Leads.	BNC Jack, Panel Mounted.	BNC Jack, Panel Mounted.
Input Impedance:	1 MΩ || 5 pF			
Input Logic Voltage Level:	TTL and CMOS Compatible. **Logic Low "0":** 0 to 0.8V. **Logic High "1":** 3.5 to 5V.			
Output Type:	AC Coupling.			
	Single-ended	Differential	Single-ended	Single-ended
Output Connector:	None	None	BNC Jack, Panel Mounted.	BNC Jack, Panel Mounted.
Output Signal:	Pulsed/Burst Pulse Train.			
Output Voltage, High, V_H:	Vs – 0.025, in Vpp.	2*(Vs – 0.025), in Vpp.	3.65*(Vs – 0.025), in Vpp.	7.3*(Vs – 0.025), in Vpp.
Output Voltage, Low, V_L:	≤ 0.025 V			
Output Current I_o:	≤ 8 A peak	≤ 8 A peak	≤ 2.2 A peak	≤ 2.2 A peak
	Warning: Over-current leads to damage of the power amplifier. Please carefully calculate the current delivered to the load before putting the device into service. Load Current $I_o = V_H/Load$.			
Load:	Tuned Transducers or resistive load. Note: A Tuned Transducer is resistive load (Not reactive load) at its operating frequency.			
	Warning: Do not use the power amplifier to drive untuned transducers (active load) with pulse waves. Highly capacitive or reactive load may cause over-current issue, which will destroy the device, with high frequency pulse signals.			
	≥ V_H/I_o or 3.375Ω, whichever is greater.	≥ V_H/I_o or 3.375Ω, whichever is greater.	50Ω Transducers.	50Ω Transducers.
Pulse Power Capability:	108.0W@+27VDC 85.0W@+24VDC 21.0W@+12VDC	216.0W@+27VDC 170.0W@+24VDC 42.0W@+12VDC	108.0W@+27VDC 85.0W@+24VDC 21.0W@+12VDC	216.0W@+27VDC 170.0W@+24VDC 42.0W@+12VDC
Power Efficiency:	Driving Tuned Transducers (**Resistive load**): 98.0%@+27VDC Supply. 97.7%@+24VDC Supply. 95.4%@+12VDC Supply.			
Supply Voltage Vs:	+10 to +27 VDC. Warning: DC Power Supply exceeding +27VDC may destroy the device.			
Suggested DC Supply:	Marine Battery, Automobile Battery, or DC Power Supply with Grounded Output and Protection of Output Current Limit.			
	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.			
Quiescent Current:	1 mA.	2 mA.	1 mA.	2 mA.
DC Supply Connector:	60 mm Wire Bundle	60 mm Wire Bundle	Sheathed Banana Jack	Sheathed Banana Jack
Fuse:	N/A	N/A	5A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".	5A, 250VAC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".
Accessory Cable:	60 mm Wire Bundles	60 mm Wire Bundles	1. DC Power Supply Cables: **DCBP24**.	
Cable Connector:	Wire Leads	Wire Leads	2. Grounding Cable: **GWL18**.	
Package:	PCB	PCB	Metal Enclosure	Metal Enclosure
Grounding Terminal:	N/A	N/A	Grounding Stud #10-24.	Grounding Stud #10-24.
Mounting Holes:	4 x Φ3.2mm (Φ0.126")	4 x Φ3.2mm (Φ0.126")	4 x Φ5.5mm (Φ0.217")	4 x Φ5.5mm (Φ0.217")
	Screws are not supplied.			
Size LxWxH (mm):	68.6x36.1x36	68.6x36.1x36	146.9x91.7x55	146.9x91.7x55
Weight in Air:	25 grams	30 grams	0.68 kg	0.7 kg
Operating Temperature:	-20 to 70°C or -4 to 158°F			
Storage Temperature:	-20 to 70°C or -4 to 158°F			

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.

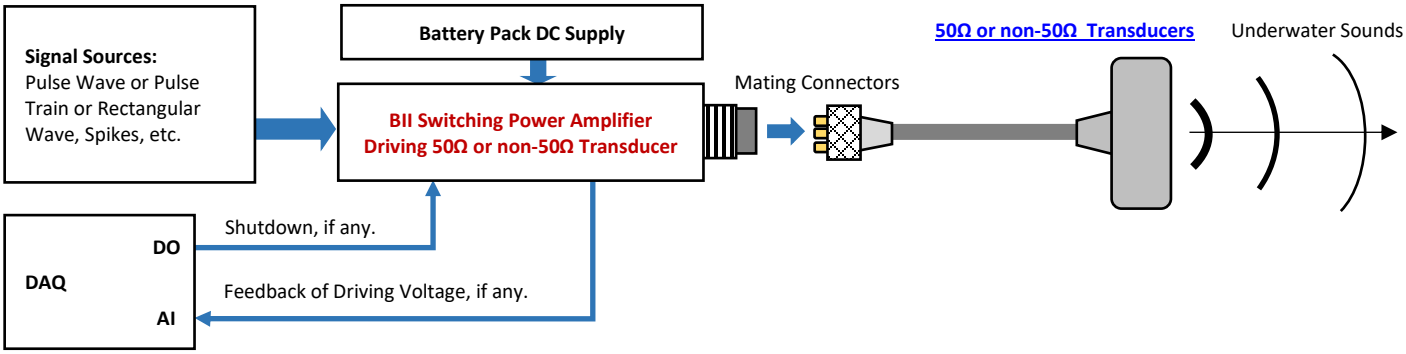
Pulse Width



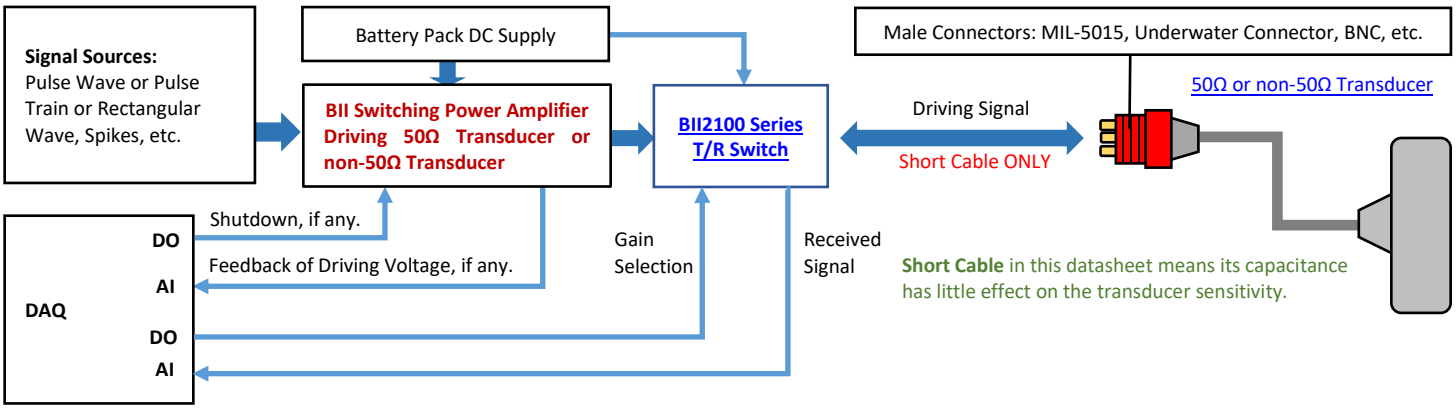
Power Factor Driving 50Ω Transducers

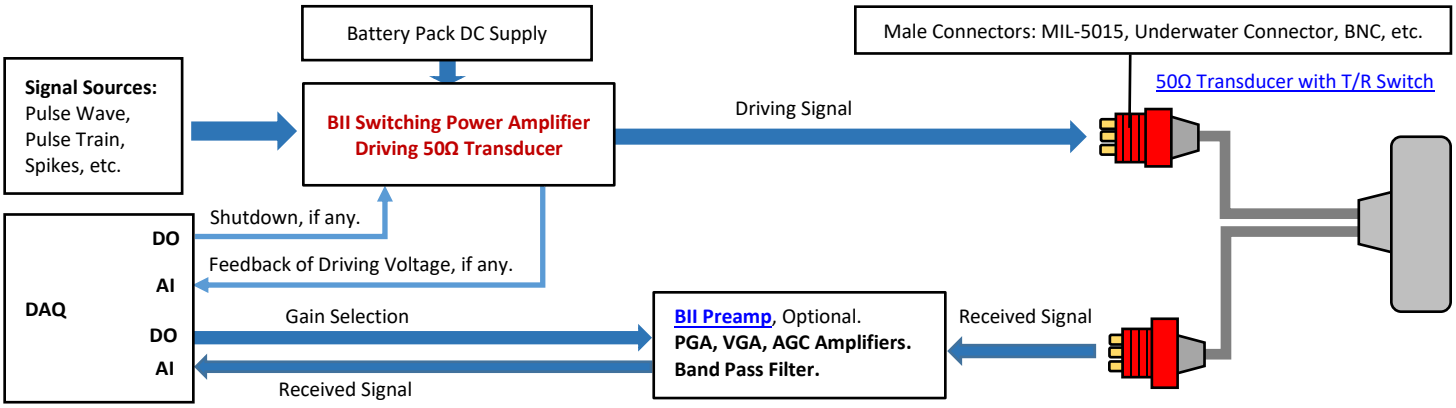


Acoustic System Block Diagram
1. Generate Sounds and Waves.

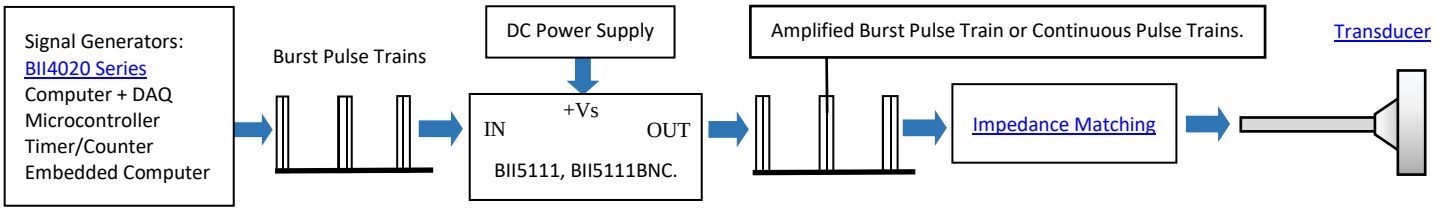


2. Transmitting and Receiving Sounds and Waves

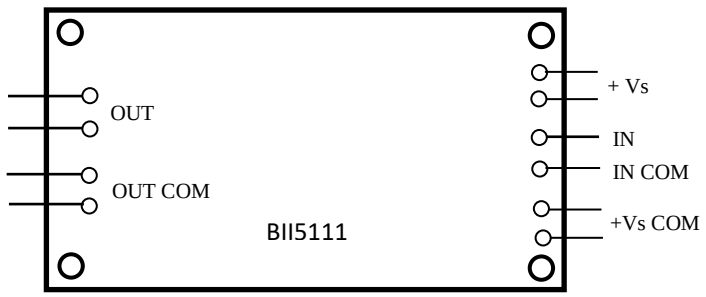




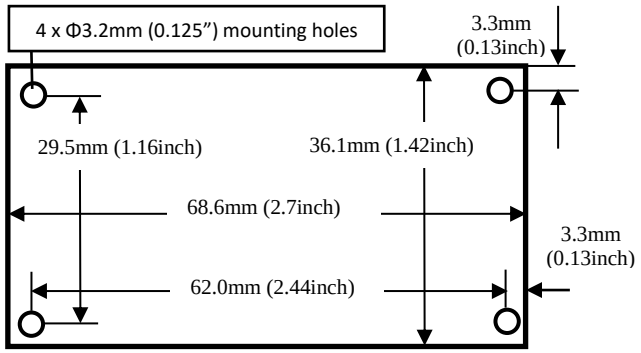
BII5111 and BII5111BNC Signal Block Diagram



BII5111 CONTROLS and TERMINALS:

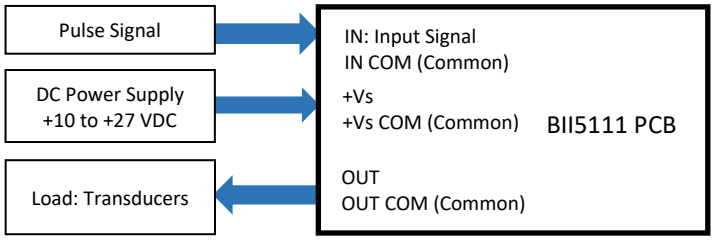


BII5111 Physical Size (PCB):



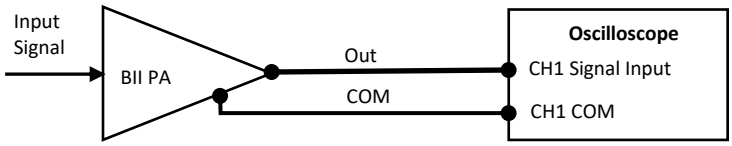
Wire Leads	Signal	Wires' Colour	Wire Leads	Signal	Wires' Colour
IN	Input Signal	White, 60mm	**OUT**	Output	Red x 2, 60mm
IN COM	Input Signal common	Black, 60mm	**OUT COM**	Output Common	Black x 2, 60mm
+Vs	Power Supply Positive Voltage	Red x 2, 60mm	**Vs COM**	Power Supply Common	Black x 2, 60mm

SUGGESTED WIRING for BII5111:



Generation of Square Waveform and Pulse Signal:		
Digital I/O Board or Microcontroller Digital I/O port.	Timer circuit or astable multivibrator.	Benthowave's SONAR signal generation modules.
SHIPMENT: Assembled board, Qty.: 1		

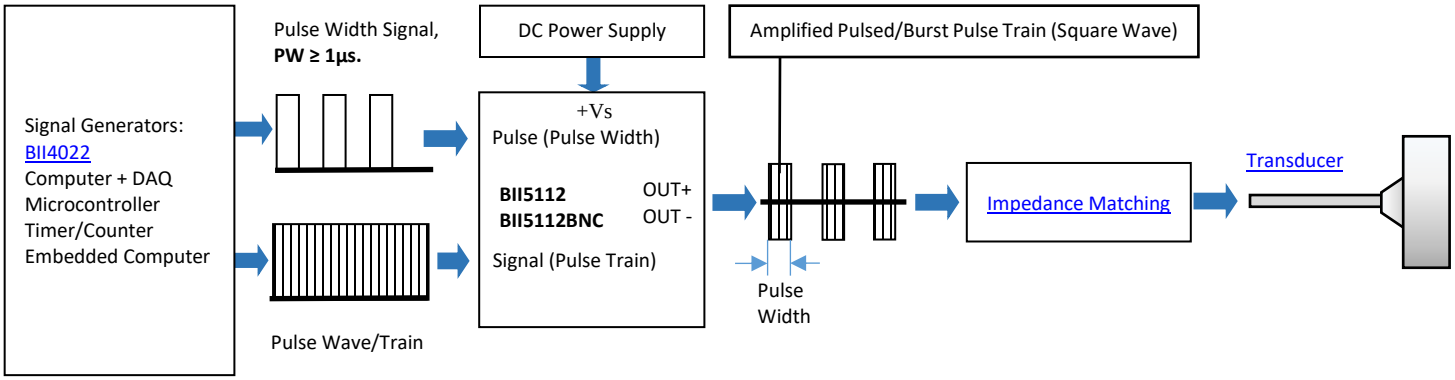
Measure Single Ended Output of BII Power Amplifiers



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 handing the cables, wiring and hookup, etc.

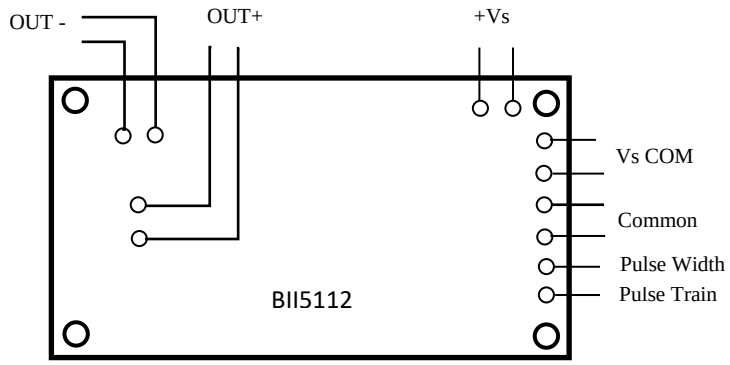
BII5112 and BIII5112BNC Signal Block Diagram.

Pulse Operation	Continuous Operation:
1. Apply Pulse Signal with Pulse Width ≥ 1 µS to **Pulse (Pulse Width)** terminal. 2. Apply Pulse Train to **Signal (Pulse Train)** terminal.	1. Apply Logic High or "1" to **Pulse (Pulse Width)** terminal. 2. Apply Pulse Train to **Signal (Pulse Train)** terminal.

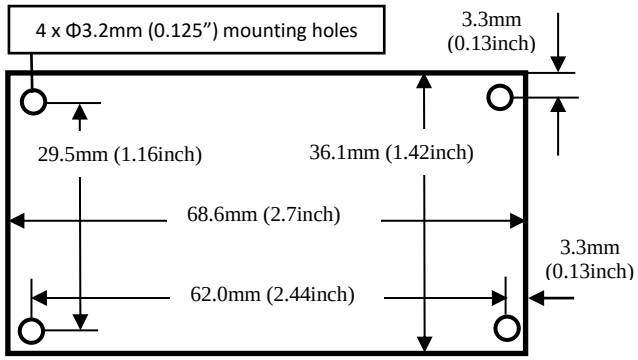


Generation of Square Waveform and Pulse Signal:		
Digital I/O Board or Microcontroller Digital I/O port.	Timer circuit or astable multivibrator.	Benthowave's SONAR signal generation modules.
SHIPMENT: Assembled board, Qty.: 1		

BII5112 CONTROLS and TERMINALS:

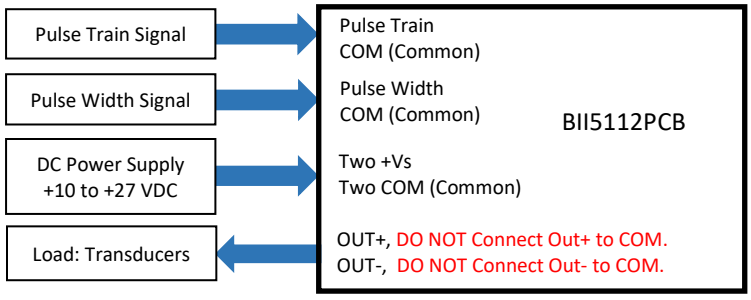


BII5112 Physical Size:



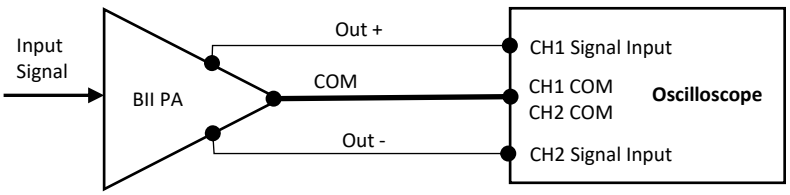
Wire Leads	Signal	Wires' Colour	Wire Leads	Signal	Wires' Colour
Vs COM	Power Supply Common	Black x 2	**Pulse Train**	Input Pulse Wave/Train	White
+Vs	Power Supply Positive Voltage	Red x 2	**Pulse Width**	Pulse Width Signal	Blue
OUT+	Output +	Brown x 2	**Common**	Common	Black x 2
OUT -	Output -	Yellow x 2			

BII5112 Series SUGGESTED WIRING:



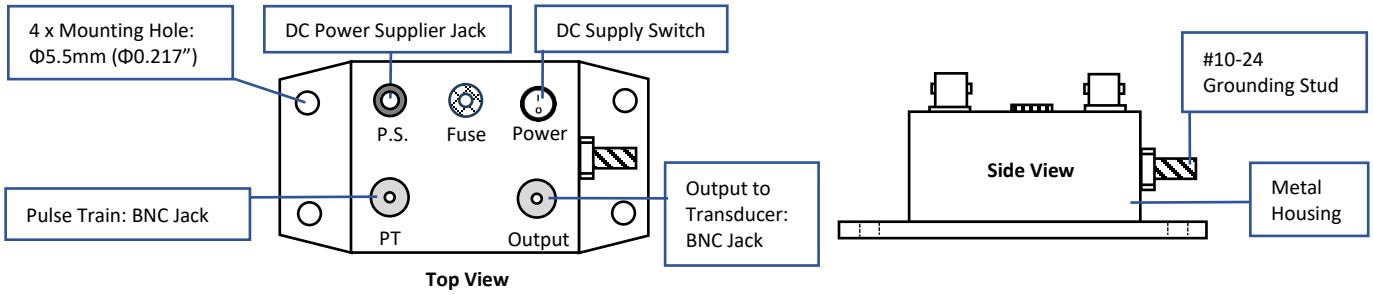
Warning: Outputs of the Power amplifier are differential.
DO NOT Connect Out + or Out - to COM.

Measure Differential Output of BII Power Amplifiers

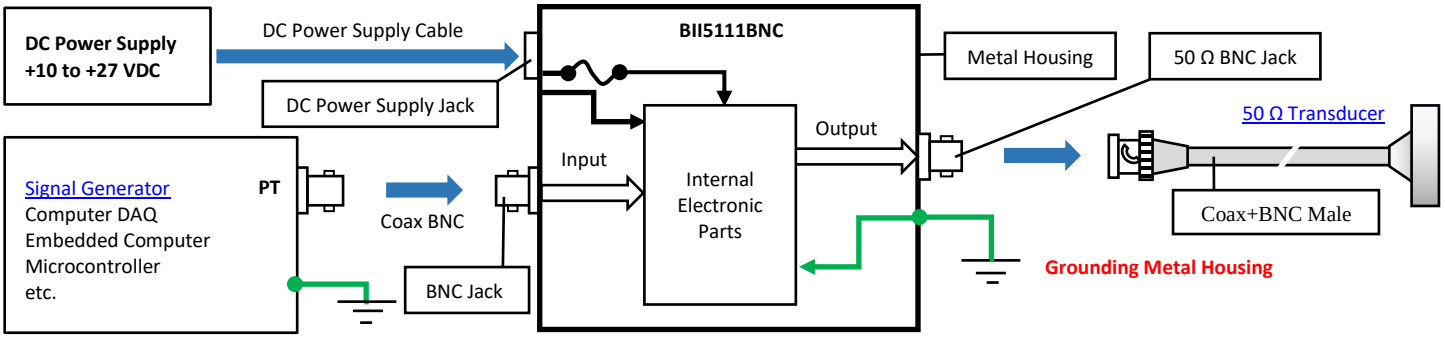


Warning: Outputs of the Power amplifier are differential,
DO NOT Connect Out + or Out - to any COM.

BII5111BNC
Output Connector: BNC Jack. Metal Enclosure, Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.
Overall Size: LxWxH = 146.9x91.7x55mm.
PT: Pulse Train. **P.S.**: Power Supply.



System Block Diagram and Wiring: Driving 50Ω Transducer with BNC Male.

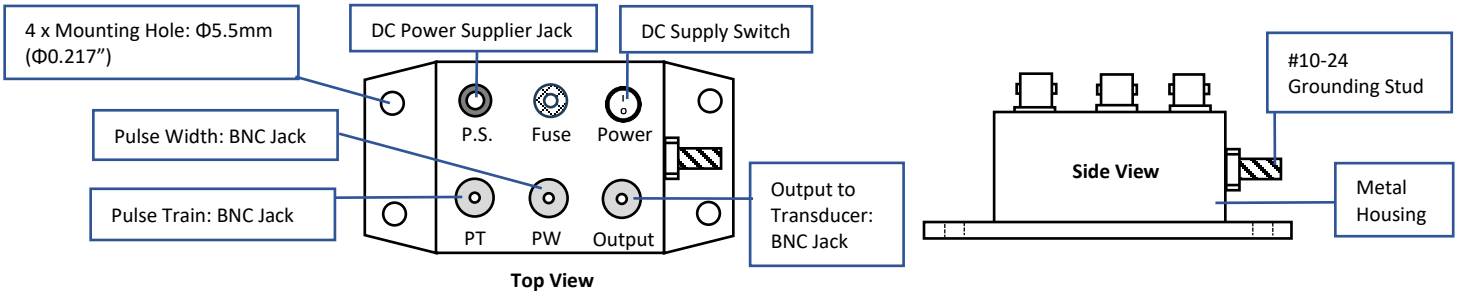


Buyer's Signal Source	**BII5111NC Input: Pulse Train**	**BII5111BNC Output: Pulse Train**	**Transducer Cable and Connectors**
BNC Jack	**Two BNC Jacks**	**BNC Jack**	**Coax + In-line BNC Plug (Male)**
Signal: Center Socket	Signal: Center Socket	Signal: Center Socket	Signal: Center Pin
Common: Body.	Grounded Common: Body.	Grounded Common: Body.	Common: Body.
DC Power Supply:	**Red Sheathed Banana Jack**: +VDC. **Black Sheathed Banana Jack**: Common of the DC Power Supply.		
DC Supply Switch:	Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**		
Fuse:	5A, 250VAC or 60VDC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".		
Accessories Included:	1. DC supply cables, Part Number: DCBP24. 2. One Grounding Cable, Part Number: GWL18.		
Grounding Metal Case for operating safety.	**Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.		
1. Install the device to a safe solid object to avoid sliding. An air free-flowing area and good thermal conducting object allow the device to cool down. 2. Never use the device in the event of slide happening, otherwise, loss of the device into water, property damage, and person injury may occur.			

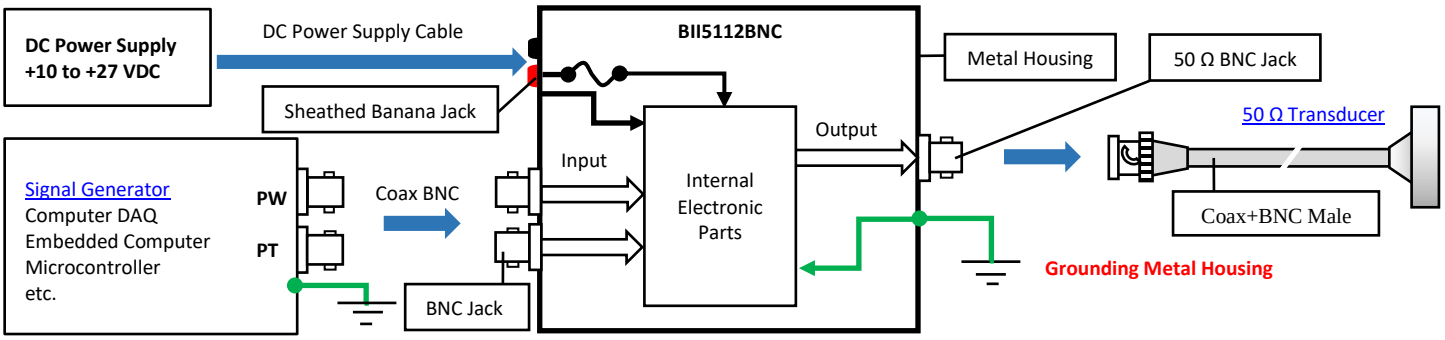
How to Order.

Example of Part Number:	Description
BII5111BNC	BII5111BNC, Switching Power Amplifiers.

BII5112BNC
Output Connector: BNC Jack. Metal Enclosure, Mounting Hole Φ5.5mm (Φ0.217") accepts M5 or #10 screw. Screws are not supplied.
Overall Size: LxWxH = 146.9x91.7x55mm.
PW: Pulse Width. **PT**: Pulse Train. **P.S.**: Power Supply.



System Block Diagram and Wiring: Driving 50Ω Transducer with BNC Male.

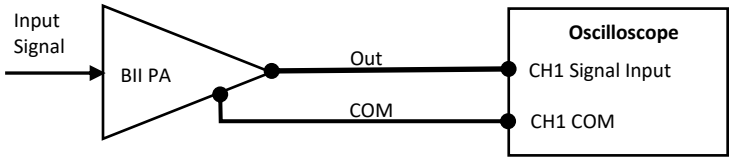


Buyer's Signal Source	BII5112BNC, Input: Pulse Width and Pulse Train.	BII5112BNC Output	Transducer Cable and Connectors
BNC Jack	**Two BNC Jacks**	**BNC Jack**	**Coax + In-line BNC Plug (Male)**
Signal: Center Socket	Signal: Center Socket	Signal: Center Socket	Signal: Center Pin
Common: Body.	Grounded Common: Body.	Grounded Common: Body.	Common: Body.
DC Power Supply:	**Red Sheathed Banana Jack**: +VDC. **Black Sheathed Banana Jack**: Common of the DC Power Supply.		
DC Supply Switch:	Turn ON and Turn OFF DC Supply. **"I" -> ON; "O" -> OFF.**		
Fuse:	5A, 250VAC or 60VDC, Slow-Blow, 3AB, 3AG, 1/4" x 1-1/4".		
Accessories Included:	1. DC supply cables, Part Number: DCBP24. 2. One Grounding Cable, Part Number: GWL18.		
Grounding Metal Case for operating safety.	**Grounding Stud:** #10-24 Screw 316SS. Nut and Washer are included.		
1. Install the device to a safe solid object to avoid sliding. An air free-flowing area and good thermal conducting object allow the device to cool down. 2. Never use the device in the event of slide happening, otherwise, loss of the device into water, property damage, and person injury may occur.			

How to Order.

Example of Part Number:	Description
BII5112BNC	BII5112BNC, Switching Power Amplifiers.

Measure Single Ended Output of BII Power Amplifiers

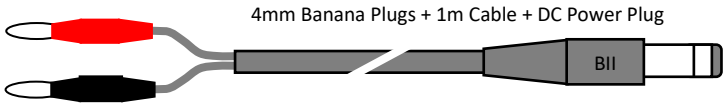


Warning:
1. Outputs of the power amplifier is high voltage, choose suitable oscilloscope probe with correct attenuation and voltage rating.
2. for operating safety, ensure proper grounding, and shut down power supply of the device before handing the cables, wiring and hookup, etc.

Accessories:

Part Number: DCBP24.

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



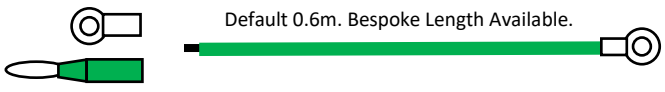
DC Power Plug.
To DC Power Jack of the Device.

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

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

Grounding Cable and Terminals

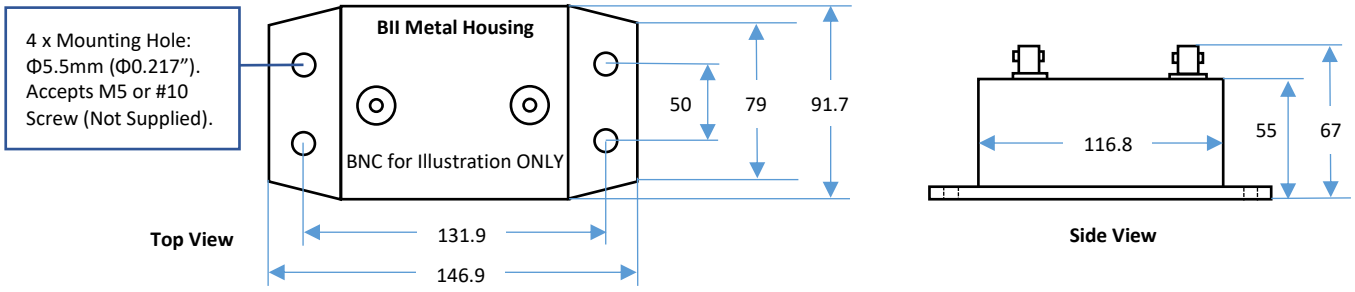
Terminal to buyer's Grounding Terminal:
a. Default: Wire Lead
b. One #10 Ring Terminal
c. One 4mm Banana Plug



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

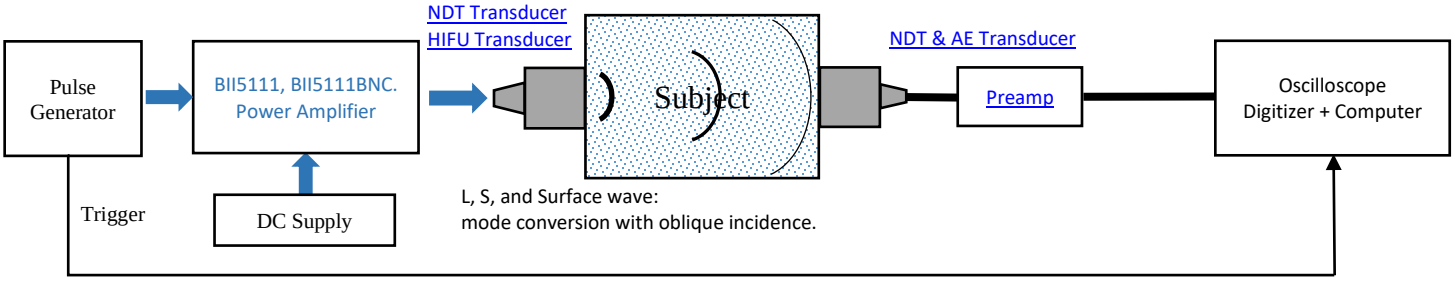
Grounding Cable, Part Number: GWL18, Support Single-Point Grounding with Multiple Devices.
One 0.6m AWG 18 Green Wire with #10 Ring Terminal and Wire Lead. One #10 Ring Terminal and one 4mm Banana Plug (Green) are included.
Depending on buyer's grounding terminal type, buyer assembles #10 Ring Terminal,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

BII5111BNC and BII5112BNC, (Sizes are in bracket), Metal Housings, Outline Dimensions (mm), Illustration only, the scale is not 1:1.

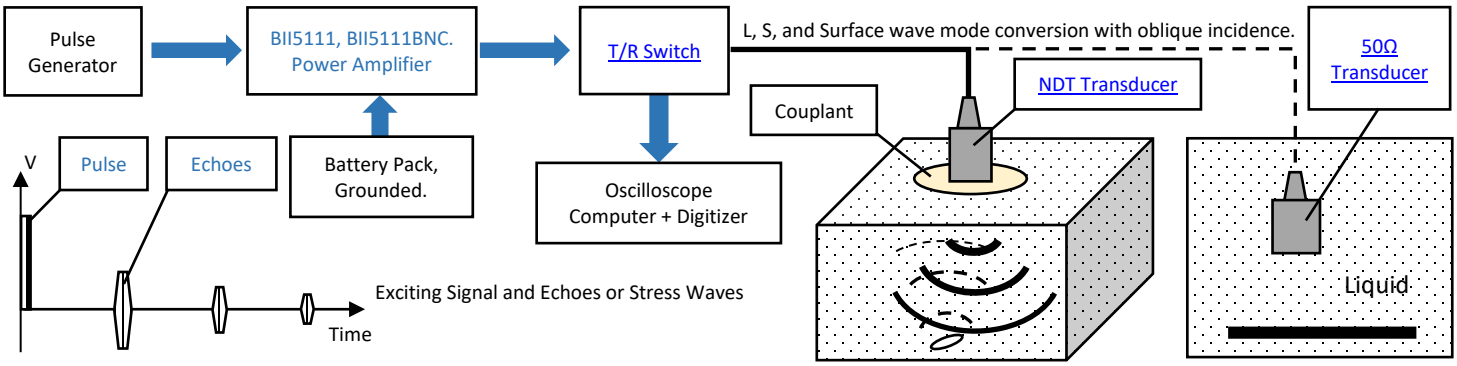


Application Notes

(1) NDT Pulser.



(2) NDT Pulser and Receiver.



3. Typical Waveform of Broadband Acoustic Pulsing Systems: Pulse Generator + BII5111 + Bespoke BII6010 + 500Ω Transducer, 300Vp, 90Wrms.