BII7500 Series High Power Piston Transducer: Low Frequency

DESCRIPTION

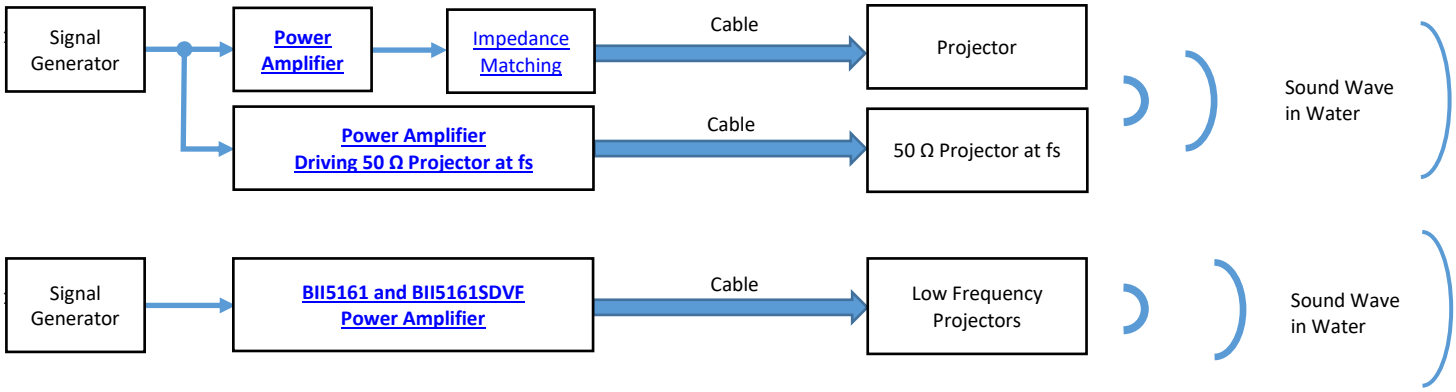
BII's piston transducers are made from Tonpilz (Langevin, Sandwich, Transmission Line) elements with features of high power, medium Qm, and low frequency. Custom-fit array can be set up with multiple transducers in field to increase sound level and achieve narrow beam.

TYPICAL APPLICATIONS

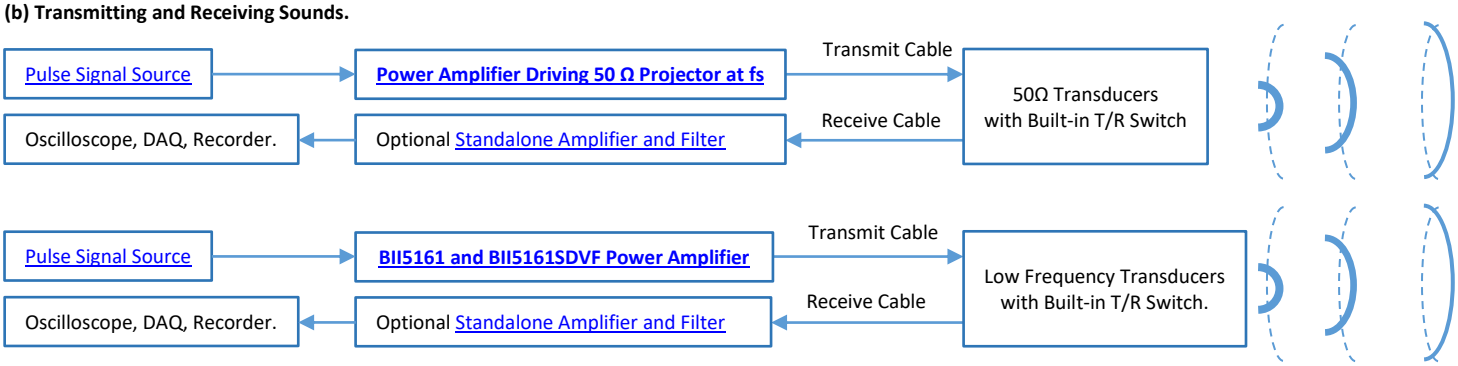
Array Element: Parametric, Linear, Planar & Cylindrical Array	Echosounding, Navigation, Obstacle Avoidance, Long Rang Transmission
Seabed Penetration/Sediment Profiler/Sub-bottom Profiling	Synthetic Aperture Imaging and Synthetic Aperture Sequential Imaging
Artificial Acoustic Target, Echo-Repeater	Underwater Communication and Telephone
Pinger/Locator/Transponder/Positioning/Tracking	Fishery Sonar, Bioacoustics, Marine Animal Behavior Research
Direction-finding Sonar/Multi-beam Sonar	Acoustic Deterrent to Marine Animals, Bioacoustic Stimuli

SYSTEM CONFIGURATION

(a) Transmitting Sounds.



(b) Transmitting and Receiving Sounds.



RELATED PRODUCTS

Power Amplifier for SONAR, NDT, and HIFU	Impedance Matching between Transducers and Amplifiers	Transmit and Receive Switch with Preamp and Filter

TRANSDUCER SPECIFICATIONS

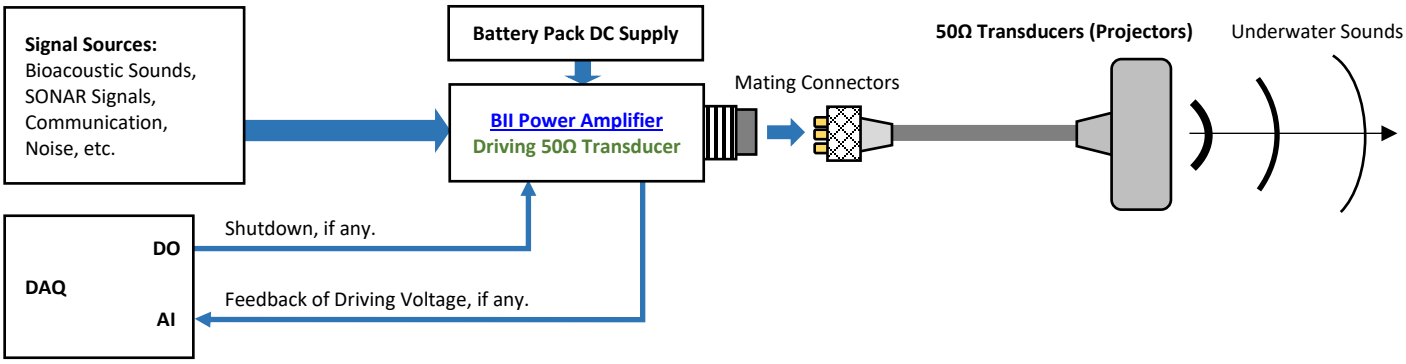
SPECIFICATIONS

Transducer:	**BII7506/8**	**BII7506/8-IM50Ω**
Resonant Frequency f_s:	8 kHz and 14 kHz, ± 10%.	
Transmitting Frequency:	f_s ± 20%*f_s	f_s ± 25%*f_s
	Minimum Transmitting Frequency: None.	Minimum Transmitting Frequency: TBD. To be determined.
	Operating Frequency < Minimum Transmitting Frequency: transducer impedance is very low which causes over-current issue to power amplifier, and results in overheat issue (damage) to power amplifier and the transducer.	
Impedance Matching:	No	Built-in, Impedance matching to 50Ω by default.
	TVR and FFVS variation of a transducer with built-in Impedance Matching Network: TVR increases, FFVS decreases.	
Signal Type:	SINE Pulses, Chirp, PSK, FSK, Pulsed Square Waveform, Continuous Signals, Arbitrary Signals, etc.	
	SONAR/Communication/Pulsing Signals, Aquatic/Marine Animal Sounds, Ambient and Ship/Vehicle Noises, etc.	
Directivity Pattern:	Conical Beam at fs. Refer to Graph of Directivity Pattern. Omnidirectional at f ≤ f_{omni} or Omnidirectional at f << f_s.	
f_{omni}:	1 kHz.	
-3dB Beam Width:	70° at f_s	

Side Lobe Level:	No side lobes	
Free Capacitance C_f:	17 nF ± 10% @ 1 kHz	N/A
	With cable, C_f increases by (Cable Length * 0.1nF/meter).	
Dissipation D:	0.005 @ 1 kHz	N/A
Quality Factor Q_m at f_s:	5.0	4.0
	-3dB bandwidth $\Delta f = f_s/Q_m$. Qm determines the transient response or the rise and fall rings of steady-state response.	
η_{ea} at f_s:	0.52 in Water, Electroacoustic Efficiency, Load Medium Dependent.	
η_{ea} at f << f_s:	at f << fs, η_{ea} / $\eta_{ea\ at\ fs} \approx 0.1225*(k*\Phi D)^2$. Wave Number k = 2π/λ; ΦD = Transducer Diameter.	
	1. Electroacoustic Efficiency η_{ea} is quite low at f << f_s and drops gradually at f > f_s, so it is NOT recommended for transducers to emit high power sounds at frequencies far from f_s. Otherwise, transducer may be damaged by overheating. **2. Transducer can emit low power sounds at frequencies far from f_s. For example, input power $P_i \le \eta_{ea}$*MIPP at f ≤ 0.8*f_s and $P_i \le$ 0.2*MIPP at f ≥ 1.3*f_s.**	
Power Factor at f_s:	0.7	≥ 0.95
TVR at f_s:	Refer to TVR Chart, Transmitting Voltage Response. Tolerance: ±2 dB.	
	145.0 ± 2 dB µPa/V@1m.	152.2 ± 2 dB µPa/V@1m for BII7506/8-IM50Ω.
Radiation Sound Level SL:	SL = 20*logV_i + TVR, dB µPa@1m. Driving Voltage V_i is in unit of V_{rms}.	
Admittance or Impedance:	Refer to G-B Chart.	1. Default: Z = 50*$e^{j\theta}$, in Ω, and Phase Angle |θ| ≤ 20° at fs. 2. Customization: refer to Impedance Matching at f_s.
Driving Voltage V_i at f_s: (V_{imax}: Maximum V_i.)	**Pulsed Driving Signal and Duty Cycle D < 100%:** $V_{imax} = \sqrt{(MIPP/G_{max})}$ or **600**, whichever is less, in V_{rms}.	**Pulsed Driving Signal and Duty Cycle D < 100%:** $V_{imax} = \sqrt{(MIPP * \|Z\|)}$, in V_{rms}. Z is impedance at fs.
	Continuous Operation at 100% Duty Cycle: $V_{imax} = \sqrt{(MCIP/G_{max})}$, in V_{rms}.	**Continuous Operation at 100% Duty Cycle:** $V_{imax} = \sqrt{(MCIP * \|Z\|)}$, in V_{rms}.
	To achieve higher sound level, built-in impedance matching is recommended to step up driving voltage inside the transducer.	
Input Power P_i:	$P_i = V_i^2 * G$. Refer to G-B Graph: G is conductance.	$P_i = V_i^2 / Z$ at f_s. Z is impedance at f_s.
MIPP at f_s:	$V_i^2 * G_{max}$ or 1400 Watts, whichever is less.	2500 Watts.
MPW at MIPP and f_s:	100 Seconds.	
MCIP at f_s:	50 Watts.	
MIPP: Maximum Input Pulse Power. **MPW**: Maximum Pulse Width. **MCIP**: Maximum Continuous Input Power. **f_s:** Resonance Frequency. **G_{max}** is maximum G at f_s.		
How to determine pulse width, duty cycle and off-time with input pulse power (peak power) at f_s: 1. Determine the input pulse power (IPP, peak power) with sound intensity required by the project. IPP MUST be less than MIPP. 2. Pulse Width ≤ (MIPP * MPW*(120°c-T)/103°c)/IPP. T: Water Temperature in °c. 3. Duty Cycle D ≤ MCIP*(120°c-T)/103°c)/IPP. 4. Off-time ≥ PW*(1-D)/D.		
FFVS at f_s:	-167 ± 2 dB V/µPa.	-175 ± 2 dB V/µPa for BII7506/8 -IM50Ω.
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ **G**: Conductance at f_s; **B**: Susceptance at f_s; **C_c**: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly. **FFVS**: Free-field Voltage Sensitivity. Please refer to online document AcousticSystem.pdf for conversion between G-B and Z-θ, if necessary.	
FFVS at f << f_s:	-172 ± 2 dB V/µPa.	N/A
	Sensitivity Loss over Extension Cable (dB) = 20*log[C_h/(C_h+C_c)]. Valid for hydrophone without preamplifier. C_h: Hydrophone Capacitance; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.	
Receiving Sound Level SL:	SL = 20*logV_o - FFVS, dB µPa. Receiving Voltage V_o is in unit of V_{rms}.	
Receiving Frequency:	50 Hz to 1.5*f_s.	f_s ± 25%*f_s
Operating Depth:	Maximum, 100 m or 1 MPa Pressure.	Maximum, 100 m or 1 MPa Pressure.
	Limited by the cable length if the cable has wire leads or a non-waterproof connector.	
Mounting Options:	1. Default: Free Hanging (**FH**) 2. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-3/8".**) 3. End-face Mounting (**EFMM**) 4. Flange Mounting (**FGM-Φ220)**	
	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.	
Cable Options:	1. Shielded Cable (**SC**), Rubber or PVC Jacket. SC with Two Conductors for transmit signal; SC with 4 conductors for receive signal. 2. 50 Ω RG58 Coax (**RG58**). 3. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, ΦD=4.0 mm (**SC40**), up to 200°C, AWG20 Conductors (Not Water-proofed, ONLY for Dry Air Use). 4. Two Conductor Unshielded Cable (**USC**) for Underwater Connector 2 pins.	
	Handling: Do not use the cable to support transducer weight in air and water if the transducer has a mounting part. Do not bend the cable.	
Cable Length:	1. Default: 15 m with non-underwater connector. 0.6m with Underwater Mateable Connector (2 pins) (**UMC2P**). 2. Custom-fit.	
Connector Options:	1. Default: Wire Leads (**WL**), for Transmit, Receive Signal, and DC Power Supply. 2. Underwater Mateable Connector (2 pins) (**UMC2P**) (Max. Diameter Φ21.5 to Φ35 mm). Locking Sleeve: DLSA-M. Underwater Mateable Connector (3 pins) (**UMC3P**) (Max. Diameter Φ21.5 to Φ35 mm). Locking Sleeve: DLSA-M. Underwater Mateable Connector (4 pins) (**UMC4P**) (Max. Diameter Φ21.5 to Φ35 mm). Locking Sleeve: DLSA-M. Undewater Mateable Connectors are fixed with 0.6m unshielded cable. UMC is from global manufacturers of underwater connectors. Its part number is listed in quote in detail. 3. MIL-5015 Style (3 pin) (**MIL3P**) (Max. Diameter Φ19 to Φ30 mm). MIL-5015 Style (4 pin) (**MIL4P**) (Max. Diameter Φ19 to Φ30 mm). 4. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm), for Transmit or Receive Grounded Signal.	

	6. 1/8" (3.5mm) TRS Plug (**TRS**) (Max. Diameter Φ10.5 mm), for Receive Signal ONLY. 7. +9VDC Battery Snap (**BS**), +9VDC or +18VDC power supply for Built-in T/R Switch Module. 8. 4mm Banana Plug Pair (Red and Black Color) (**BP**), DC power supply for Built-in T/R Switch Module.	
	Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.	
Physical Size:	ΦD = Φ168 mm, Length ≥ 100 mm.	ΦD = Φ168 mm, Length ≥ 140 mm.
	Actual length depends on Mounting Parts and/or Add-on Parts such as -TR, -IM, etc.	
Weight in Air:	≥ 7.5 kg with 15 m cable.	≥ 8 kg with 15 m cable.
	Actual weight depends on Mounting Parts, Cable Types and Length, and/or Add-on Parts such as -TR, -IM, etc.	
Operation Temperature:	-10 °C to +60 °C or 14 °F to 140 °F.	
Storage Temperature:	-20 °C to +60 °C or -4 °F to 140 °F.	
Impedance Matching at f_s:	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices or append **-IMxxΩ** to the part number for integrating BII6000 into the transducer and specify impedance in Ω at fs. For example, BII7506/8-IM8Ω: BII7506/8 transducer with built-in Impedance Matching unit as 8Ω load at fs.	
	Phase Angle |θ| of Complex Impedance ≤ 20° at fs.	
TR Switch Module:	BII2100 Transmitting & Receiving Switch Module with Built-in Preamp and Bandpass Filter. Order Separately as standalone devices or append **-TR** to the part number for integrating BII2100 into the transducer. For example, BII7506/8-TR: BII7506/8 transducer with built-in T/R Switch Module.	
Temperature Sensor:	1. Default: No built-in temperature sensor. 2. Built-in temperature sensor. Append **-TS** to part number (BII7506/8-TS) for integrating a temperature sensor in the transducer.	
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.	
WARNING: DANGER — HIGH VOLTAGE on wires. Wires shall be insulated for safety. DO NOT TOUCH THE WIRES BEFORE THE DRIVING SIGNAL IS SHUT DOWN. Cable shield must be grounded firmly for safety.		
for 50Ω BNC connector, it is buyer's sole responsibility to make sure that the BNC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC is not intended for hand-held use at voltages above 30Vac/60Vdc.		

System Block Diagram of Generate Sounds



Wiring Information of a Transducer without T/R Switch.

Transducer Wiring:	**Shielded Cable**	**Coax, BNC.**	**UMC3P, Locking Sleeve: DLSA-M.**	**MIL3P**	**XLR3P**
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 1
Please contact us for bespoke wirings of differential transducers such as dipole, quadrupole, multimode rings, and flextensional sources.					
Wiring of Unshielded Cable:	**Wire Leads WL**	**UMC2P** (0.6m USC Cable originally coming from manufacturer of the connector, Fixed.). Locking Sleeve: DLSA-M.			
Signal	White	Contact 2			
Signal Common	Black	Contact 1			

Wiring Information of Temperature Signal.

Temperature Sensor Wiring:	**Shielded Cable**	**Coax, BNC**	**Underwater Connector UMC2P. Locking Sleeve: DLSA-M.**	**XLR3P**	**TRS Plug**
Signal:	White or Red	Center Contact	Contact 2	Pin 2	Tip
Signal Common:	Black	Shield	Contact 1	Pin 3	Ring
Shielding and Grounding	Shield	Shield	N/A	Pin 1	Sleeve

How to Order Transducers without T/R Switches. The default options are for stock items which are regularly available.

FH: Free Hanging. **SC for Transmit**: Shielded Cable (Rubber Jacket, 600V) with 2 conductors. **Coax**: 50 Ω Coaxial Cable. **WL**: Wire Leads.					
Undewater Mateable Connector UMC2P is fixed with 0.6m unshielded cable (USC).					
Part Number	**-Appendage**	**-Mounting**	**-Cable Length**	**-Cable Type**	**-Connector for signals of Transmit and Temperature Sensor**
BII7506/8	Default: **None**.	Default: **BFM-FH-3/8**".	Default: **15m or 0.6m**.	**SC** for low frequency signal. **USC** for UMC2P Connector.	Default: **WL**.

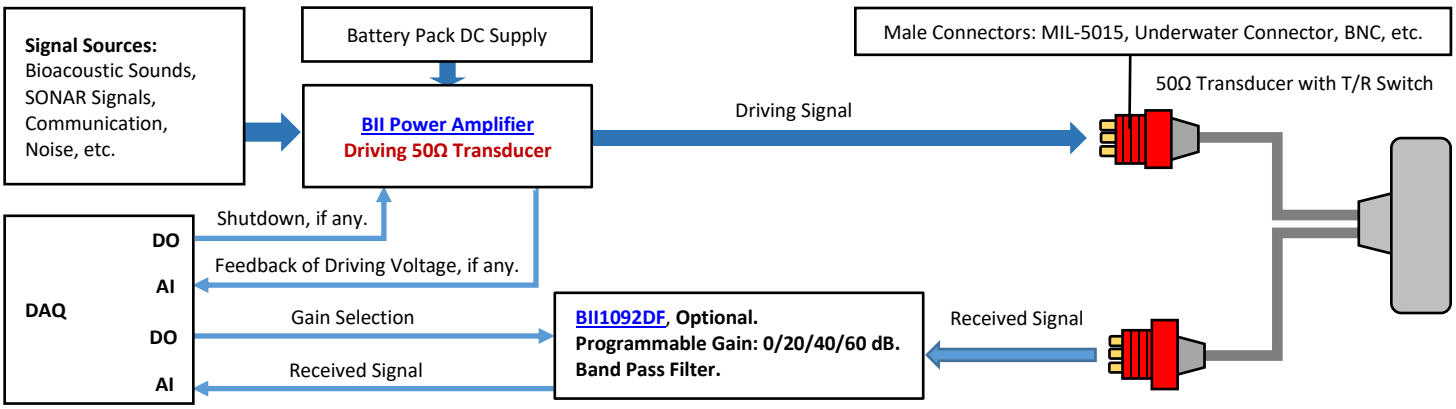
Example:	**Description**
BII7506/8-BFM-FH-15m-SC-WL	**BII7506/8 Transducer, Bolt-Fastening Mounting with Free Hanging: BFM-FH, 15m Shielded Cable, Wire Leads.**

BII7506/8-BFM-FH-3/8"-0.6m-USC-UMC2P	BII7506/8 Transducer, Bolt Fastening Mounting with Free Hanging: BFM-FH-3/8", 0.6m Unshielded Cable, Male Underwater Mateable Connector with Locking Sleeve: DLSA-M.
BII7506/8-IM50Ω-FH-20m-SC-MIL3P	BII7506/8 Transducer, Built-in Impedance Matching Network as 50Ω load at fs, Free Hanging, 20m RG58 Coax, 3 pin MIL-5015 Connector MIL3P.
BII7506/8-IM8Ω-FH-15m-SC-UMC3P	BII7506/8 Transducer, Built-in Impedance Matching Network as 8Ω load at fs, Free Hanging, 15m Shielded Cable, 3 pin Underwater Mateable Connector UMC3P.

Transducer Specifications with Built-in T/R Switch and 50Ω Impedance Matching for Sound Transmitting and Receiving.

Part Number:	BII7506/8-TR-IM50Ω.
	Refer to Transducer Specifications for transducer specs. This table lists specifications of add-on part of TR Switches.
Impedance Matching at fs:	**-IM50Ω**: Integrated inside transducer housing and transform its impedance to be 50Ω at fs. $Z = 50*e^{j\theta}$, in Ω, and Phase Angle $\lvert\theta\rvert \le 20°$ at fs.
Receiving Preamp and Filter:	**-TR: Transmitting & Receiving Switch Module,** a bespoke fixed gain preamp and a bespoke bandpass filter are built inside transducer housing to receive sounds.
Sensitivity @ fs:	-167.0 + Preamp Gain, ± 2 dB V/µPa.
Sensitivity @ f << fs:	-172.0 + Preamp Gain, ± 2 dB V/µPa.
FFVS:	Refer to Graph of FFVS vs. Frequency. Free-field Voltage Sensitivity.
Sensitivity Loss:	No Sensitivity Loss over Cable.
Preamp Gain:	20 dB
-3dB Receiving Bandwidth:	1. Default: 50 Hz to 40 kHz. 2. Customized with fs, specify when ordering.
	Minimum -3dB cut-off frequency of high pass filter: 50 Hz.
	Band Pass Filter: 1st order, 20 dB/Decade Roll-off.
	1. Reduce Noise. Both ocean 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 8 kHz, you may specify a high pass filter with -3dB cut-off frequency at 800 Hz to improve signal to noise ratio of the signals of the interest. 2. Avoid Saturation. When there are strong low frequency noises, disturbances, and/or vibrations, resulting from rough surface waves and/or mechanical movements of the platform, it is recommended to specify a high pass filter to avoid hydrophone saturation in these low frequency ranges.
Pressure Noise Density:	Refer to Graph of Pressure Noise Density, Referred to Input (RTI), in µPa/√Hz.
Input Dynamic Range:	≥ 100 dB at 100 kHz Bandwidth.
Output Signal Type:	Differential
Output Impedance:	10 Ω
Cable Drive Capability:	200 m
Cable:	Four Conductor Shielded Cable
Connector:	Refer to Connector Options.
Signal Conditioning:	Standalone Programmable Gain Amplifier and Filters to compensate the loss of sound propagation and spreading. Order separately.
Power Supply of Receiving Circuit	
Supply Voltage V_s:	+8.5 to +32 VDC
Current (Quiescent):	6.8 mA
Suggested DC Supply:	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included. DO NOT use variable power supply whose maximum supply voltage is higher than the above rated voltage. DO NOT use switching mode DC power supply.
DC Supply Cable:	Two Conductor Shielded Cable if the cable of Receiving Signal is Coax.
DC Supply Connector:	Refer to Connector Options.

System Setup of Transmitting and Receiving Sounds.



Wiring Information of Transmitting Sounds of a Transducer with T/R Switch.

Transducer Wiring:	Shielded Cable	Coax, BNC.	UMC3P, Locking Sleeve: DLSA-M.	MIL3P	XLR3P
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 1
Please contact us for bespoke wirings of differential transducers such as dipole, quadrupole, multimode rings, and flextensional sources.					
Wiring of Unshielded Cable:	**Wire Leads WL**	**UMC2P** (0.6m USC Cable originally coming from manufacturer of the connector, Fixed.). Locking Sleeve: DLSA-M.			
Signal	White	Contact 2			
Signal Common	Black	Contact 1			

Wiring Information of Receiving Sounds of a Transducer with T/R Switch.

Differential Output:	Wire Leads	UMC4P/XLR4P Connector	XLR3P + 9V Battery Snap	TRS + 9V Battery Snap
+VDC	Red	Pin 3	Battery Female Snap	Battery Female Snap
Common	Black	Pin 1	Battery Male Snap	Battery Male Snap
Signal+	White	Pin 2	XLR Pin 2	TRS Tip
Signal-	Blue, Green, or Yellow	Pin 4	XLR Pin 3	TRS Ring
Signal Common	N/A	N/A	XLR Pin 1	TRS Sleeve
Shielding	Shield	N/A	XLR Metal Shell	N/A
Optional DC Supply Connector: 4mm Banana Plug Pair, Red Plug for +VDC, **Black Plug** for Common of the DC power supply.				

How to Order Transducers with -TR-IM50Ω. The default options are for stock items which are regularly available.

FH: Free Hanging. **SC for Low Frequency Transmit**: Shielded Cable (Rubber Jacket, 600V) with 2 conductors. **Coax for High Frequency Transmit:** 50 Ω Coaxial Cable. **SC for Low Frequency Receive**: Shielded Cable with 4 conductors. **Coax for High Frequency Receive:** 50 Ω Coaxial Cable. **WL**: Wire Leads. **HPF**: -3dB High Pass Filter Frequency. **LPF**: -3dB Low Pass Filter Frequency. **Cable of Temperature sensor** is two-conductor shielded cable. **Cable of DC Supply** is two-conductor shielded cable in case that receive cable is coax.

Receiving Cable is fixed to be four-conductor Shielded cable. Transmitting cable can be customized to be Coax or two-conductor shielded cable.

Length of Transmitting and receiving cables are same in default.

Undewater Mateable Connector UMC2P and UMC4P are fixed with 0.6m unshielded cables.

Part Number	-Preamp Gain	-HPF/LPF	-Mounting	-Cable Length	-Transmit Cable	-Connector for signals of Transmit/ Receive/DC Supply/Temperature
BII7506/8-TR-IM50Ω	Default: **20dB**	-3dB Receive bandpass Frequencies. Default: **50 Hz to 40 kHz**	Default: **BFM-FH-3/8".**	Default: **15m.**	Default: **SC**.	Default: **WL**.

Example:	Description
BII7506/8-TR-IM50Ω-20dB-50Hz/40kHz-BFM-FH-3/8"-15m-SC-WL	**BII7506/8 Transducer, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 20dB, Receive Bandpass Filter: 50Hz to 40kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH-3/8", 15m cables, Transmitting Cable: Shielded Cable, Wire Leads.**
BII7506/8-TR-IM50Ω-20dB-50Hz/40kHz-BFM-FH-3/8"-15m-SC-MIL3P/XLR4P/BS	BII7506/8 Transducer, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 20dB, Receive Bandpass Filter: 50Hz to 40kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH-M8, 15m cables, Transmitting Cable: Shielded Cable, 3 Pin MIL-5015 Connector for Transmit Signal, 4 Pin XLR for Receive Signal, 9V Battery Snap for DC Supply.
BII7506/8-TS-TR-IM50Ω-20dB-50Hz/40kHz-BFM-FH-3/8"-15m-SC-MIL3P/XLR4P/BS/TRS	BII7506/8 Transducer, Built-in Temperature Sensor, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 20dB, Receive Bandpass Filter: 5kHz to 40kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH-3/8", 15m cables, Transmitting Cable: Shielded Cable, 3 Pin MIL-5015 Connector for Transmit Signal, 4 Pin XLR for Receive Signal, 9V Battery Snap for DC Supply, TRS for Temperature Signal.

Question:

What if the mating connector of my DAQ module or recording device is NOT available from BII?

1. Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
2. A connector adaptor might be assembled by BII by customization, and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations.
3. Many adaptors for standard connectors are available in worldwide electronic suppliers such as BNC to SMA, BNC to SMC, XLR to TRS, etc. Check out your local suppliers.

What are the advantage and disadvantage of a built-in T/R Switch Module comparing to a standalone T/R Switch Module?

A built-in T/R Switch Module amplifies the received signal of the sensing element before received signal is polluted by EMI noises and system ground loop noises, and before the received signal is attenuated by impedance matching network (if any), and capacitance, inductance, and resistance of cables. But its price is a little bit higher than standalone T/R Switch Module.

What are the features of the transducer when operating f << fs (fs is resonance frequency)?

1. Roughly, the TVR drops at 6dB/Octave or 20dB/Decade. 2. Power factor drops to be half per octave or one tenth per decade. 3. Efficiency drops with frequency decreasing. More and more electrical energy is consumed by transducer to be converted to heat which damage the transducer when the temperature inside transducer is over 100°C to 120°C (212°F to 248°F) roughly. Therefore, (1) when a transducer operates at f << fs, the driving power from power amplifier MUST be low enough to avoid damage. (2) Use a low frequency transducer whose fs is at or very close to the frequencies of the interest.

Cable and Connector Information for High Power Signals (from Power Amplifier and to Transducers). Non-UL Uses.

	Wire and Cable Types	Ratings of Voltage, Current or Power, and Temperature.
Cable:	AWG18 Wires (**WR**)	3000 Vrms, 10 Arms.
	Two Conductor Shielded Cable (**SC**)	600 Vrms, 5 Arms.
	Two Two-conductor Shielded Cable Bundle (2**SC**)	600 Vrms, 10 Arms.
	High Temperature Shielded Cable (**HTSC199**)	600 Vrms, 6 Arms, up to +199°C or 390 °F, Non-waterproof.
	Coax RG58 (50Ω) (**RG58**)	1400 Vrms, 4 Arms.
	Coax RG174/U (50Ω) (**RG174**)	1100 Vrms, 1.6 Arms.
	Coax RG178B/U (50Ω) (**RG178**).	750 Vrms, 0.86 Arms, up to +200°C or 390°F.

	Connector Type	Ratings of Voltage, Current or Power, and Temperature.
Connector:	1. Wire Leads (**WL**)	Used for Cables or Wires.
	2. 50Ω BNC (**BNC**), Bayonet Lock. Panel Mount or In-line. In-line BNC: Input uses Pin, output uses Socket. Panel Mount BNC: Both Input and Output use BNC Jacks.	500Vrms, 316W. -65°C to 165°C, or -53.9°F to 329°F. Used for Grounded Signal with Metal Enclosures or Coax Cables.
	3. MIL-5015 Type Connector (**MIL**), Thread Fastening. Panel Mount or In-line. Input uses Pin, output uses Socket.	500Vrms, 13 A; Up to +125°C or 257°F, or, 900Vrms, 13 A; Up to +125°C or 257°F. Used for Metal Enclosures or Shielded Cables.
	4. XLR Connector (**XLR**), Positive Latchlock. Panel Mount or In-line. Input uses Pin, output uses Socket.	133Vrms, 15 A; -25°C to +75°C or -13°F to +167°F. Used for Metal Enclosures or Shielded Cables.
	5. Underwater Mateable Connector (**UMC**), Thread Fastening. Panel Mount or In-line. Input uses Pin, output uses Socket.	600Vrms, 10A. Waterproof, IP68. Used for Metal Enclosures or Shielded Cables.

How to choose cable and connector for BII devices: Driving Voltage V_{drive} (V_{rms}) = $\sqrt{RMS\ Power * \frac{G}{G^2+B^2}}$.

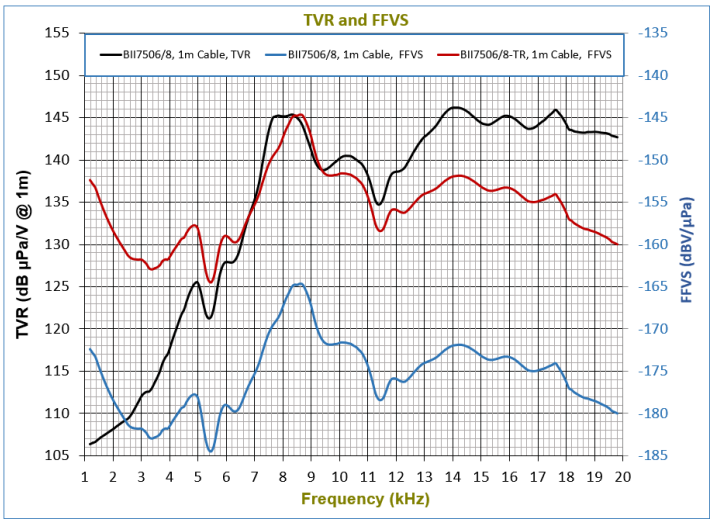
BII lists G-B data at fs and/or the graph of G-B vs Frequency in online datasheet.

Case 1. Deliver 1000 Wrms to 3 kΩ transducer at f_s. Note: $G/(G^2+B^2)$=3 kΩ is the resistive load of the transducer in load medium at f_s.
Driving voltage to transducer $V_{drive} = \sqrt{1000 * 3000}$ = 1732 V_{rms}. The current to 3 kΩ transducer $I_{drive} = V_{drive}/R_L$ = 1732Vrms/3000Ω = 0.57733 A_{rms}.
Therefore, AWG18 Wire and Wire leads are suitable.

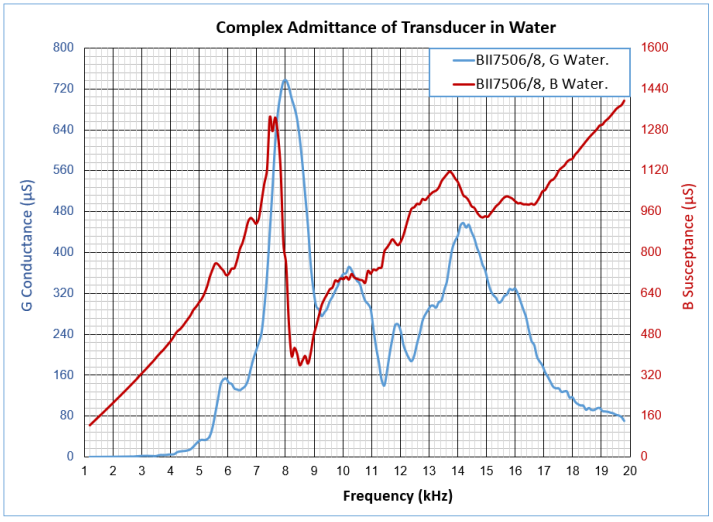
Case 2. Deliver 500 Wrms to 300 Ω transducer at f_s. Note: $G/(G^2+B^2)$=300 Ω is the resistive load of the transducer in load medium at f_s.
Driving voltage to transducer $V_{drive} = \sqrt{500 * 300}$ = 387.3 V_{rms}. The current to 300 Ω transducer $I_{drive} = V_{drive}/R_L$ = 387.3Vrms/300Ω = 1.291 A_{rms}.
Therefore, Two Conductor Shielded Cable and MIL-5015 Type Connector or Underwater Mateable Connector (UMC) are suitable.

Case 3. Deliver 300 Wrms to 50 Ω transducer at f_s.
Driving voltage to transducer $V_{drive} = \sqrt{300 * 50}$ = 122.5 V_{rms}. The current to 50 Ω transducer $I_{drive} = V_{drive}/R_L$ = 122.5Vrms/50Ω = 2.45A_{rms}.
Therefore, 50Ω RG58 Coax and BNC are suitable.

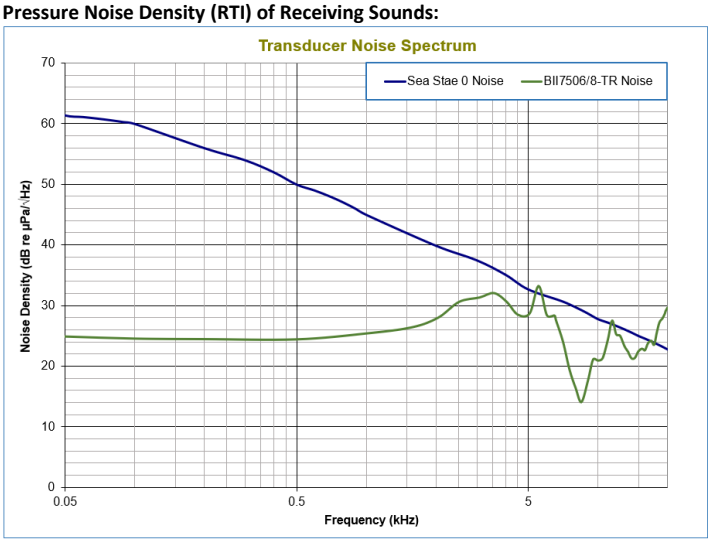
Transmitting Voltage Response (TVR) and Free-field Voltage Sensitivity (FFVS):



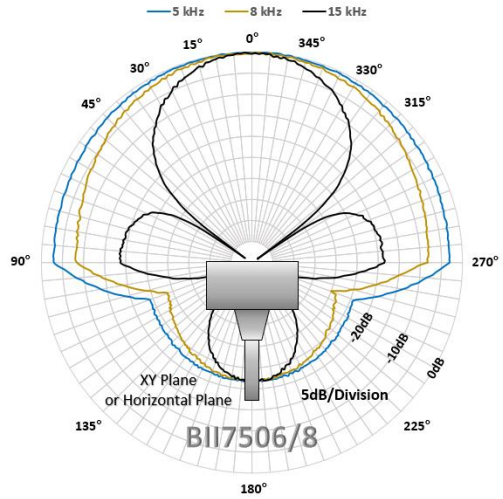
Admittance in Water:



Pressure Noise Density (RTI) of Receiving Sounds:

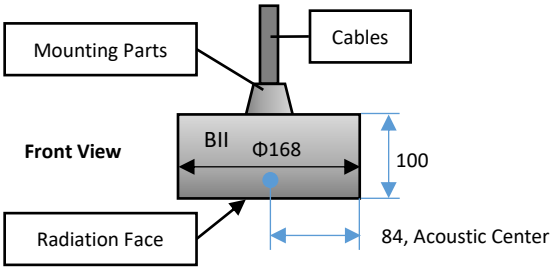


Directivity Pattern:

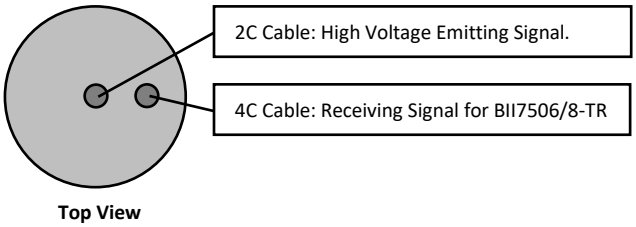


Physical Size (Dimensional Unit: mm): The overall length varies with the length of mounting parts. Please refer to online information of mounting options.
Note: Length of BII7506/8-TR and BII7506/8-TR-IM50Ω are greater than the length of BII7506/8 about 20 to 30mm.
Two-Conductor shielded cables of BII7506/8, BII7506/8-TR, and BII7506/8-TR-IM50Ω: High Voltage Transmit Signal to Transducer.
Four-Conductor shielded cables of BII7506/8-TR and BII7506/8-TR-IM50Ω: Received Signal from Transducer. Note: BII7506/8 does NOT have this cable.

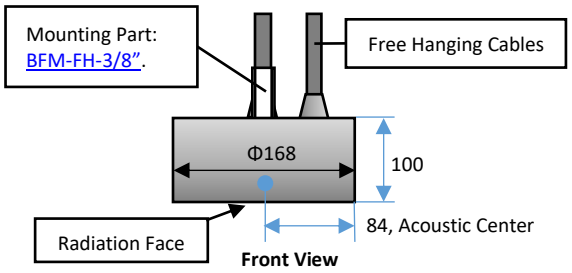
(1) Free Hanging



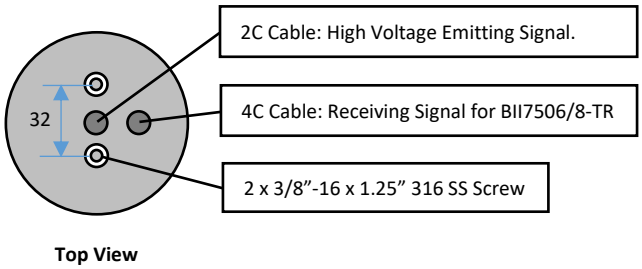
Cable-out Layout.



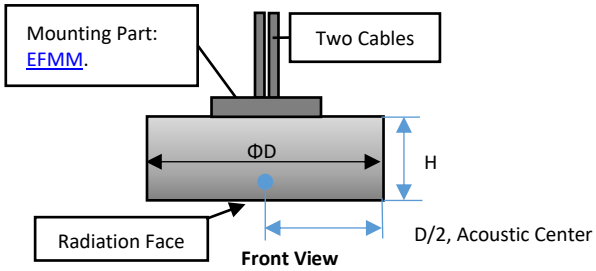
(2) Bolt Fastening Mount with Free Hanging Cable (BFM-FH-3/8").



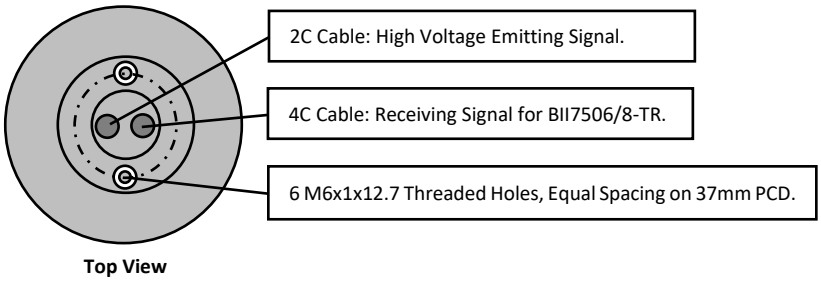
Cable-out Layout.



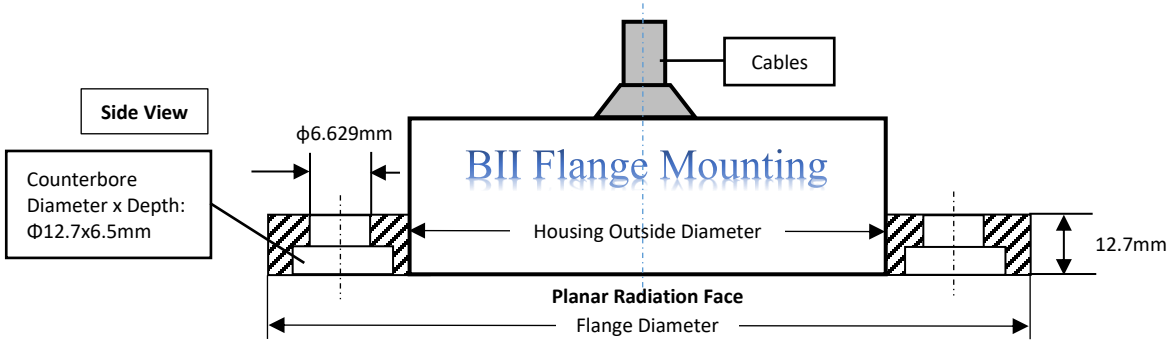
(3) End-face Mounting for Multi-Channel (EFMM)



Cable-out Layout for



(4) Flange Mounting (FGM-Φ220)



Part Number	Flange Diameter (mm)	Pitch Circle Diameter PCD (mm)	Housing Outside Diameter (mm)	M6x1 Mounting Hole Number on PCD	Flange Thickness (mm)
FGM-Φ220	Φ220	Φ195	Φ168	8	12.7

6. More Mounting/Installation Options: Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and details.