Communication & Miniature Transducer: Toroidal Beam

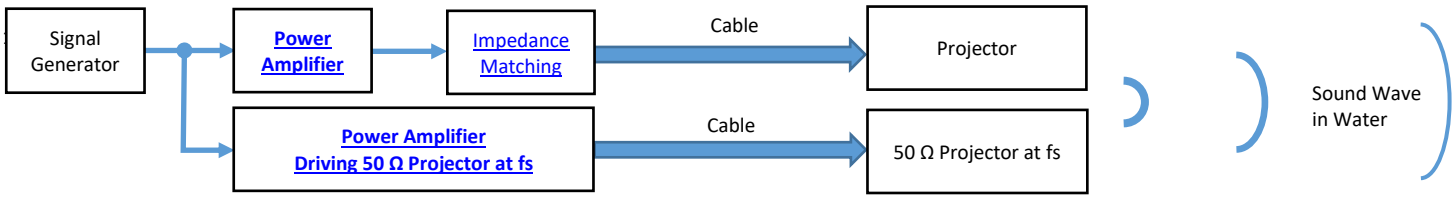
Low-Qm BII7510 series are broadband high power communication transducers with toroidal directivity pattern for uses in voice and message channels underwater especially in the horizontal plane, which is designed for analog and digital communication underwater. Carrier frequencies of 3.5 to 360 kHz support long range and short range communication underwater. The information can be exchanged from 10km away with low frequency sounds.
Medium-Qm BII7510 series are miniature transducers with toroidal directivity pattern for uses in underwater communication especially in the horizontal plane, and in material study and medical research as ultrasonic sources and sensors. Frequencies of 50 to 400 kHz and sound levels of 180 to 190 dB µPa support short to long range sound propagation in water, liquids, rubber-like material, and solids. Their miniature sizes make them be suitable to be embedded in materials.

Modulations: Pulsed FSK, Chirp-type FSK, Frequency Hopping DSSS PSK CDMA/DSSS

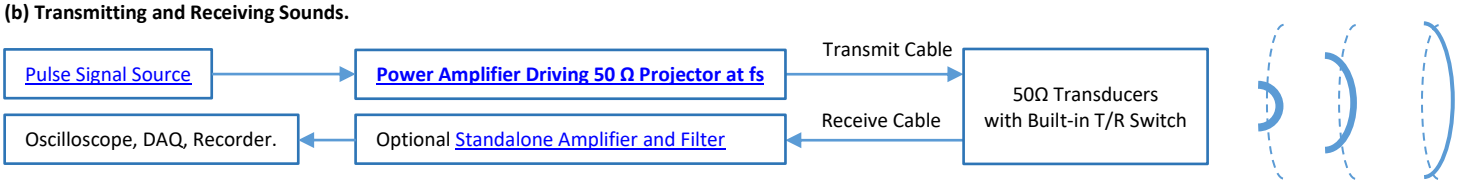
Typical Applications

Remote Control and Telemetry	Underwater Acoustic Network, Acoustic Elements for Arrays
Artificial Acoustic Target, Echo-Repeater	Diver Communication, Underwater Telephone
Acoustic Deterrent to Marine Animals	Pinger/Tag/Locator/Transponder/Beacon/Acoustic Release
Playback Marine Animal Voices/Calls/Whistles/Songs/Clicks	Marine Animal Behavior Research, Bioacoustic Stimuli
Material Study and Medical Research	Hydrophones, AE Sensors, Ultrasonic Sources

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 Specification

Communication Transducer:	**BII7511**	**BII7511-IM50Ω**
Resonant Frequency f_s:	48 kHz ± 5%	
Transmitting Frequency:	f_s ± 20%*f_s	f_s ± 25%*f_s
	Minimum Transmitting Frequency: None.	Minimum Transmitting Frequency: 10 kHz.
	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. Generally, this is true for low frequency transducers. R_{IM}: Impedance-Matched Resistance such as 50 Ω. G: Transducer Conductance at Operating Frequency.	
Signal Type:	Pulsed SINE, Chirp, PSK, FSK, Pulsed Square Waveform, etc.	
Directivity Pattern:	Toroidal Beam at fs; Omnidirectional at f ≤ 19 kHz.	
-3dB Beam Width:	Horizontal x Vertical = Omni x 70° at fs.	
Side Lobe Level:	No side lobes.	
Free Capacitance C_f:	5.1 nF @ 1 kHz	N/A
Dissipation D:	0.005 @ 1 kHz	N/A
Quality Factor Q_m at f_s:	3.	≤ 2.5
	-3dB bandwidth $\Delta f = f_s/Q_m$. Qm determines the transient response or the rise and fall rings of steady-state response.	
$\eta_{ea\ at\ fs}$ at f_s:	0.89 in Water, Electroacoustic Efficiency, Load Medium Dependent.	
η_{ea} at f << f_s:	at f << fs, $\eta_{ea} / \eta_{ea\ at\ fs} \approx (k*\Phi D)^2$. Wave Number $k = 2\pi/\lambda$; 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 ≤ 0.2*MIPP at f ≥ 1.3*f_s.	

Power Factor at f_s:	0.43	≥ 0.94
TVR at f_s:	137.0 ± 2 dB µPa/V@1m	152.0 ± 2 dB µPa/V@1m
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 Graph**.	Z = 50*$e^{j\theta}$, in Ω, and Phase Angle $\|\theta\| \le 20°$ at fs. Refer to **Z-θ Graph**.
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:	Maximum Input Pulse Power at f_s: $P_I = V_i^2 * G_{max}$ or 106 Watts, whichever is less.	
MPW at MIPP and f_s:	2 Seconds, Maximum Pulse Width at MIPP and at f_s.	
MCIP at f_s:	27 Watts, Maximum Continuous Input Power at f_s.	
How to determine pulse width, duty cycle and off-time with input pulse power (peak power) at fs: **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:	-203.0 ± 2 dB V/µPa, Free-field Voltage Sensitivity.	-210 ± 2 dB V/µPa
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ G: Conductance at f_s; B: Susceptance at f_s; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly. Please refer to online document **AcousticSystem.pdf** for conversion between G-B and Z-θ, if necessary.	
FFVS at f << f_s:	-197.0 ± 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:	1 Hz to 1.5*f_s.	f_s ± 25%*f_s
Operating Depth:	Maximum, 600 m or 4 MPa Pressure.	Maximum, 300 m or 3 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. Thru-hole Mounting with Single O-ring (**THM-7/16"**) 3. Thru-hole Mounting with Double O-ring (**THDO-7/16"**) 4. Bolt Fastening Mounting (Stainless Steel) (**BFM-7/16"**). 5. Bolt Fastening Mounting (Stainless Steel) (**BFM-5/8"**) 6. Bolt-Fastening Mounting with Free Hanging (**BFM-FH)** 7. Free-hanging with Male Underwater Connector (**FHUWC-3P, FHUWC-4P, FHUWC-6P**).	
	Please refer to online document **AcousticSystem.pdf** for a complete list of Mounting Options and more details.	
Cable Options:	1. Two Conductor 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. 50 Ω RG174/U Coax (**RG174**) 4. 50 Ω RG178/U Coax (RG178) (Operating Temperature Range: -70°C To +200°C) 5. 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).	
	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. 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. XLR Receptacle with 3 Male Pins (**XLR3P**), (Max. Diameter Φ20.2 mm), for SE or DF. XLR Receptacle with 4 Male Pins (**XLR4P**), (Max. Diameter Φ20.2 mm), for SE or DF. 5. DIN Receptacle with 3 Male Pins (**DIN3P**), (Max. Diameter Φ17 mm), for SE or DF. DIN Receptacle with 4 Male Pins (**DIN4P**), (Max. Diameter Φ17 mm), for SE or DF. 6. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm), for Transmit or Receive Grounded Signal. **BNC with RG178 Coax**: Service Temperature up to 165°C or 329°F.	
	7. 1/8" (3.5mm) TRS Plug (**TRS**) (Max. Diameter Φ10.5 mm), for Receive Signal ONLY. 8. +9VDC Battery Snap (**BS**), +9VDC or +18VDC power supply for Built-in T/R Switch Module. 9. 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:	Free Hanging: Φ28.5 x 60 mm	Free Hanging: ΦD = Φ60 mm, Length = 110 mm.
	Actual length depends on Mounting Parts and/or Add-on Parts such as -TR, -IM, -HT, etc.	
Weight in Air:	≥ 0.8 kg with 10 m cable.	≥ 1.0 kg with 10 m cable.

	Actual weight depends on Mounting Parts, Cable Types and Length, and/or Add-on Parts such as -TR, -IM, -HT, etc.
Operation Temperature:	1. Default: -10 °C to +60 °C or 14 °F to 140 °F. 2. Bespoke High Temperature Transducer: -10 °C to 120 °C, or 14 °F to 248 °F. Append **-HT** to part number.
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, BIIxxxx-IM8Ω: BIIxxxx 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, BIIxxxx-TR: BIIxxxx 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 (BIIxxxx-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.	

Wiring Information of a Transducer without T/R Switch.

Transducer Wiring:	**Shielded Cable**	**Coax, BNC.**	**UMC3P, Locking Sleeve: DLSA-M.**	**MIL3P**	**DIN3P**	**XLR3P**
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 3	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 1	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 2	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.

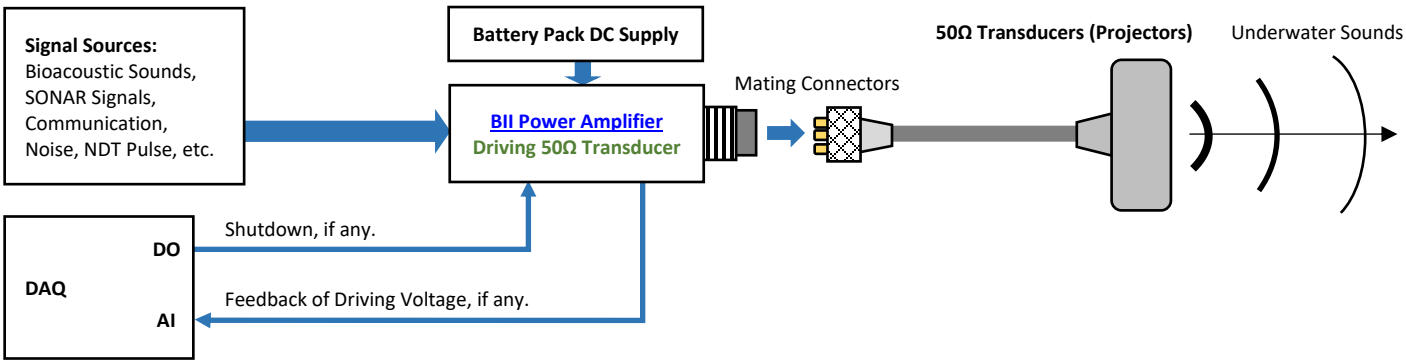
Temperature Sensor Wiring:	**Shielded Cable**	**Coax, BNC**	**Underwater Connector UMC2P. Locking Sleeve: DLSA-M.**	**DIN3S**	**TRS Plug**
Signal:	White or Red	Center Contact	Contact 2	Socket 3	Tip
Signal Common:	Black	Shield	Contact 1	Socket 1	Ring
Shielding and Grounding	Shield	Shield	N/A	Socket 2	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.					
Part Number	-Appendage	-Mounting	**-Cable Length**	-Cable Type	-Connector for signals of Transmit and Temperature Sensor
BII7511	Default: **None**.	Default: **BFM-FH**.	Default: **15m**.	**SC or Coax**	Default: **WL**.

Example:	**Description**
BII7511-BFM-FH-15m-SC-WL	**BII7511 Transducer, Bolt-Fastening Mounting with Free Hanging: BFM-FH, 15m Shielded Cable, Wire Leads.**
BII7511-BFM-5/8"-0.6m-UMC2P	BII7511 Transducer, Bolt Fastening Mounting BFM-5/8", 0.6m Cable, Male Underwater Mateable Connector.
BII7511-HT-FH-6m-RG178-BNC	BII7511 Transducer, Service Temperature: -10 °C to 120 °C, or 14 °F to 248 °F. Free Hanging, 6m RG178 Coax, BNC Male.
BII7511-IM50Ω-FH-20m-RG58-BNC	BII7511 Transducer, Built-in Impedance Matching Network as 50Ω load at fs, Free Hanging, 20m RG58 Coax, Male BNC.
BII7511-IM8Ω-FH-10m-SC-XLR3P	BII7511 Transducer, Built-in Impedance Matching Network as 8Ω load at fs, Free Hanging, 10m Shielded Cable, XLR Plug.
BII7511-TS-IM8Ω-FH-10m-SC-WL/TRS	BII7511 Transducer, Built-in Temperature Sensor, Built-in Impedance Matching Network to 8Ω at fs, Free Hanging, 10m Shielded Cable, Wire Leads for Transmit Signal, TRS for Temperature Signal.

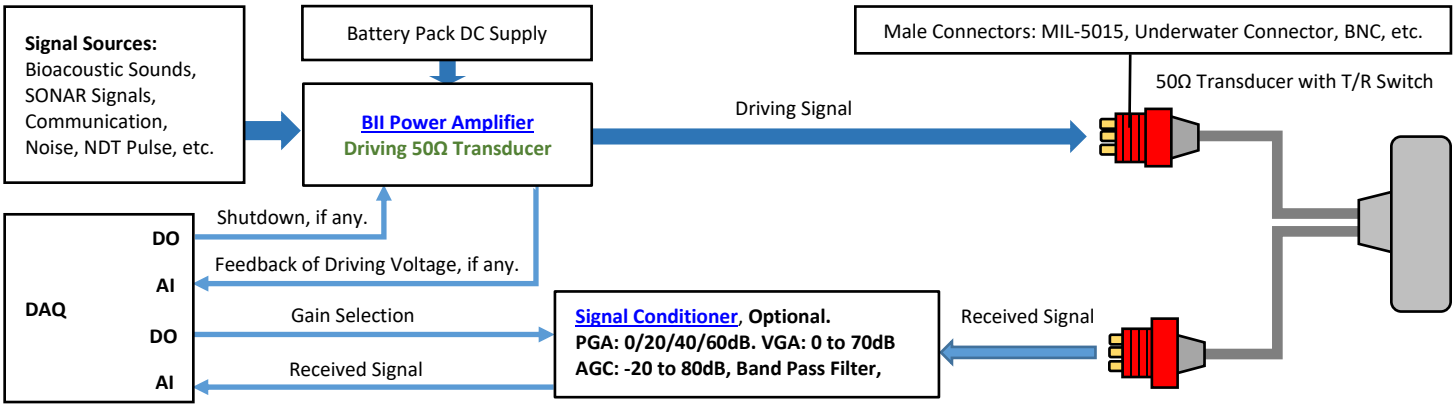
System Block Diagram of Generate Sounds



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

Part Number:	BII7511-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. 1. Avoid saturation caused by strong sounds levels in low frequency range. 2. Avoid signal loss over cable. 3. Avoid signal loss caused by impedance matching network which is built inside transducers.
Sensitivity @ fs:	-203.0 + Preamp Gain, ± 2 dB V/µPa.
Sensitivity @ f << fs:	-197.0 + Preamp Gain, ± 2 dB V/µPa.
Sensitivity Loss:	No Sensitivity Loss over Cable.
Preamp Gain:	1. Default: 40 dB. 2. Bespoke: 0 dB to 60 dB.
-3dB Receiving Bandwidth:	1. Default: 2 to 80 kHz. 2. Customized with fs, specify when ordering.
	Minimum -3dB cut-off frequency of high pass filter: 2 kHz.
	Band Pass Filter: 1st order, 20/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 20 kHz, you may specify a high pass filter with -3dB cut-off frequency at 2 to 5 kHz 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.
Voltage Noise RTI e_n:	7.0 nV/√Hz at default gain.
Current Noise RTI i_n:	0.56 fA/√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**	**DIN3P**	**XLR3P**
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 3	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 1	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 2	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	DIN4P	DIN3P/XLR3P + 9V BS		TRS + 9V BS
+VDC	Red	Pin 3	Pin 4	Battery Female Snap		Battery Female Snap
Common	Black	Pin 1	Pin 1	Battery Male Snap		Battery Male Snap
Signal+	White	Pin 2	Pin 3	DIN Pin3	XLR Pin 2	TRS Tip
Signal-	Blue, Green, or Yellow	Pin 4	Pin 2	DIN Pin1	XLR Pin 3	TRS Ring
Signal Common	N/A	Pin 1	Pin 1	DIN Pin2	XLR Pin 1	TRS Sleeve
Shielding	Shield	Metal Shell	Metal Shell	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**
BII7511-TR-IM50Ω	Default: **40 dB**	-3dB Receive bandpass Frequencies. Default: **2kHz to 80kHz**	Default: **BFM-FH**.	Default: **15m.**	**SC or Coax.** Default: **SC**.	Default: **WL**.

Example:	**Description**
BII7511-TR-IM50Ω-40dB-2kHz/80kHz-BFM-FH-15m-SC-WL	**BII7511 Transducer, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 40dB, Receive Bandpass Filter: 2kHz to 80kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH, 15m Cables, Transmitting Cable: Shielded Cable, Wire Leads.**
BII7511-TR-IM50Ω-40dB-2kHz/80kHz-BFM-FH-10m-SC-MIL3P/XLR4P/BS	BII7511 Transducer, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 40dB, Receive Bandpass Filter: 2kHz to 100kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH, 10m 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.
BII7511-TR-IM50Ω-40dB-2kHz/30kHz-FH-10m-RG58-BNC/BNC/BS/TRS	BII7511 Transducer, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 40dB, Receive Bandpass Filter: 2kHz to 30kHz. Free Hanging, 10m cables, Transmitting Cable: RG58 Coax, BNC Male Connector for Transmit Signal, BNC Male for Receive Signal, 9V Battery Snap for DC Supply, TRS for Temperature Signal.
BII7511-TS-TR-IM50Ω-40dB-10kHz/80kHz-BFM-FH-10m-SC-MIL3P/XLR4P/BS/TRS	BII7511 Transducer, Built-in Temperature Sensor, Built-in T/R Switch, Built-in Impedance Matching Network as 50Ω load at fs, Receive Gain: 40dB, Receive Bandpass Filter: 10kHz to 100kHz. Bolt-Fastening Mounting with Free Hanging: BFM-FH, 10m 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 the signal is polluted by EMI noises and system ground loop noises, and before it is attenuated by capacitance, inductance, and resistance of cables. But its price is a little bit higher than standalone T/R Switch Module.

Cable and Connector Information for Signals of Hydrophones and Power Transducers (Projectors). Non-UL Uses.

	Wire and Cable Types	**Ratings of Voltage, Current or Power, and Temperature.**
Cables:	AWG18 Wires (**WR**).	3000 Vrms, 10 Arms.
	Two Conductor Shielded Cable (**SC**).	600 Vrms, 5 Arms. -50°C To +90°C, or -58°F to 194°F.
	Two Two-conductor Shielded Cable Bundle (**2SC**).	600 Vrms, 10 Arms. -50°C To +90°C, or -58°F to 194°F.
	Two, Four or Six Conductor Shielded Cable (**SCxx**).	60 to 600 Vrms, 0.2 Arms to 10A, for Hydrophone Use ONLY. -40°C to +80°C or -40°F to 176°F.
	High Temperature Shielded Cable (**HTSC199**).	600 Vrms, 6 Arms, up to +199°C or 390 °F, Non-waterproof.
	Twisted High Temperature Wire Bundles.	300 or 1000 Vrms, 6.5 Arms, up to +200°C or 392°F.
	Coax RG58 (50Ω) (**RG58**).	1400 Vrms, 4 Arms. -40°C To +80°C or -40°F to 176°F.
	Coax RG174/U (50Ω) (**RG174**).	1100 Vrms, 1.6 Arms. -40°C To +75°C or -40°F to 167°F.
	Coax RG178B/U (50Ω) (**RG178**).	750 Vrms, 0.86 Arms, -70°C To +200°C or -94°F to 392°F.
Connectors:	**Connector Type**	**Ratings of Voltage, Current or Power, and Temperature.**
	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. (1) -65°C ~ 165°C, or -85°F ~ 329°F. (2) -40°C ~ 85°C, or -40°F ~ 185°F. Used for Grounded Signal with Metal Enclosures or Coax Cables.
	3. MIL-5015 Type Connector (**MIL**), Thread Fastening.	500Vrms, 13 A; Up to +125°C or 257°F, or,

	Panel Mount or In-line. Input uses Pin, output uses Socket.	900Vrms, 13 A; Up to +125°C or 257°F. Used for Metal Enclosures or Shielded Cables.
	4. Circular Connector DIN EN (**DIN**), Thread Fastening. Panel Mount or In-line. Input uses Pin, Output uses Socket.	250Vrms, 10 A; -40°C to +100°C or -40°F to 212°F. Used for Metal Enclosures or Shielded Cables.
	5. 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.
	6. 3.5mm or 1/8" TRS (**TRS35**), Panel Mount with Jack, In-line with Plug, for analog audio signals.	30Vrms, 0.3A; -25°C to +75°C or -13°F to +167°F. Used for Metal Enclosures or Shielded Cables.
	7. Underwater Mateable Connector (**UMC**), Thread Fastening. Panel Mount or In-line. Input uses Pin, Output uses Socket.	600Vrms, 10A. Waterproof, IP68. 3000m Ocean Depth. -40°C ~ 60°C, or -40°F ~ 140°F. 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.

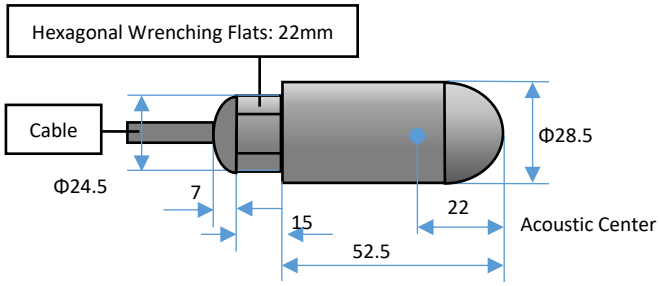
Case 2. Deliver 500 Wrms to 300 Ω transducer at f_s. Note: $G/(G^2+B^2)$=300 Ω is the resistive load of the transducer in load medium at f_s.
Driving voltage to transducer $V_{drive} = \sqrt{500 * 300}$ = 387.3 V_{rms}. The current to 300 Ω transducer $I_{drive} = V_{drive}/R_L$ = 387.3Vrms/300Ω = 1.291 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.

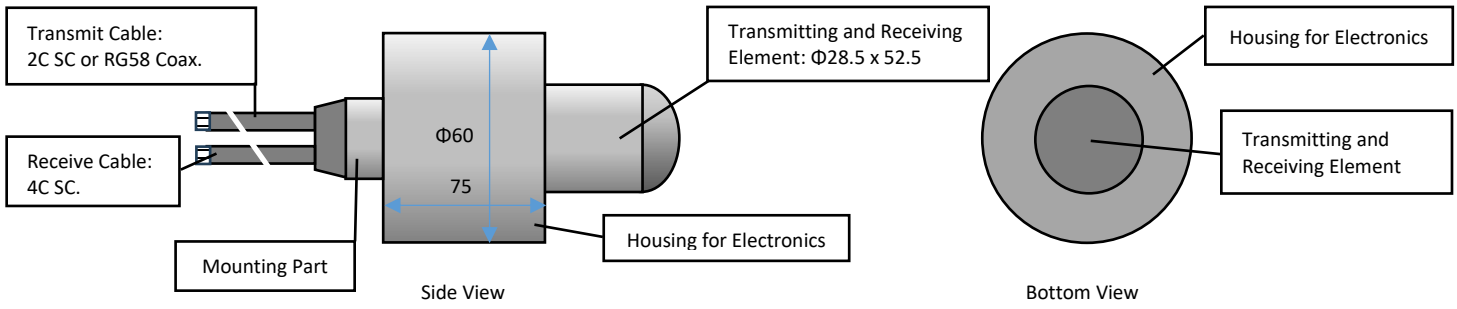
Physical Size (Dimensional Unit: mm): The overall length varies with the length of mounting parts. Please refer to online information of mounting options.

a. General Size information.

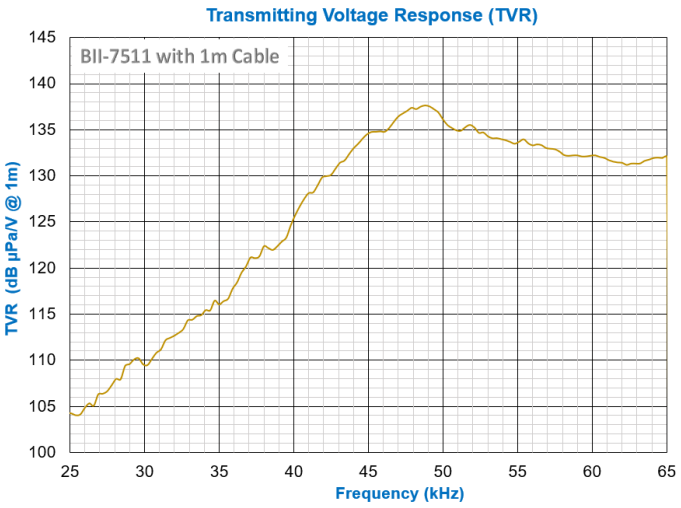
b. Size information of Free Hanging with Cable Gland.



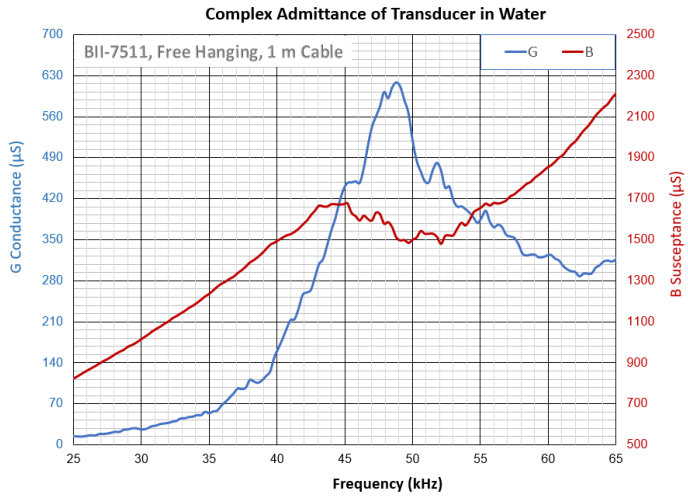
Physical Size of Transducers with Built-in T/R Switch and 50Ω Impedance Matching (Dimensional Unit: mm)



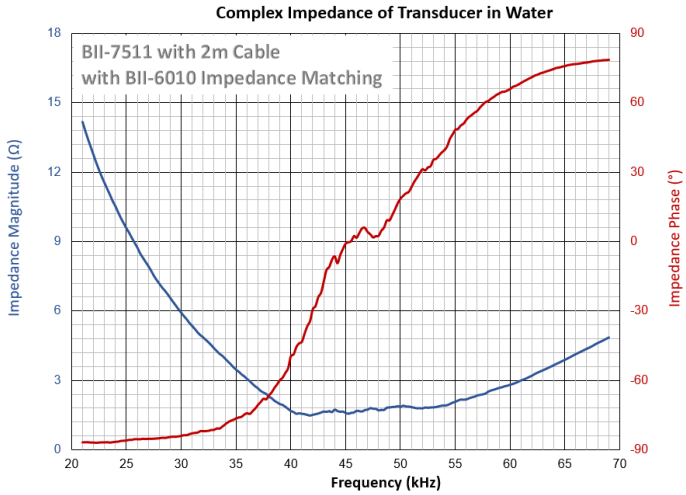
TVR (Transmitting Voltage Response)



Admittance in Water



Impedance in Water: Impedance Matching to 2Ω at fs



Directivity Pattern