Benthowave Instrument Inc.
SE=SL-TL+AG-NL Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revised on 2025/2/19

Miniature Communication Transducer: Toroidal Beam

BII7510 Series Miniature Transducers: Low to Medium Qm, 180 to 190 dB µPa, 50 to 400 kHz.
BII7510 series are broadband (Low to Medium Q_m) 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 for Communications
Pulsed FSK, Chirp-type FSK, Frequency Hopping DSSS PSK CDMA/DSSS

Typical Applications

Underwater Communication and Positioning	Hydrophones, AE Sensors, Ultrasonic Sources, Acoustic Elements for Arrays
Acoustic Beacons: Pingers, Locator, Transponder and Tags	Material Study and Medical Research

Specification

Acoustic Element	**BII7510-60**	**BII7510-80**	**BII7510-100**	**BII7510-130**	**BII7510-185**	**BII7510-240**	**BII7510-360**
Signal Type:	Pulsed SINE, Chirp, PSK, FSK, etc.; Pulsed Square Waveform.						
Directivity Pattern:	Toroidal Beam at f_s; Omnidirectional at $f \le f_{omni}$.						
f_{omni}:	27 kHz	34 kHz	40 kHz	50 kHz	75 kHz	110 kHz	110 kHz
-3dB Beam Width:	Horizontal x Vertical = Omni x 75° at f_s						
Side Lobe Level:	No side lobes						
Free Capacitance C_f: (Tolerance ±10%)	0.8 nF	0.8 nF	0.56 nF	0.47 nF	0.22 nF	0.1 nF	0.053 nF
	Capacitance of a Transducer = C_h + Cable Capacitance. Cable Capacitance = 100 pF/meter generally.						
Dissipation D:	0.015	0.012	0.005	0.005	0.005	0.005	0.01
Resonant Frequency f_s: ± 5%	60 kHz	80 kHz	100 kHz	130 kHz	185 kHz	240 kHz	360 kHz
	1. Efficiency is low in the frequency range far from f_s, so it is NOT recommended to operate transducer at frequency far from f_s. **2. Transducer can operate in low power at frequency far from fs, the input power P_i should be much less than 1% MCIP at f_s.**						
Quality Factor Q_m at f_s:	3.4	6.5	6.0	4.0	2.0	2.8	3.0
	-3dB bandwidth $\Delta f = f_s/Q_m$. Qm determines the transient response or the rise and fall rings of steady-state response.						
Efficiency η at f_s:	0.85	0.71	0.75	0.73	0.74	0.76	0.70
Power Factor at f_s:	0.68	0.84	0.82	0.80	0.26	0.8	0.7
TVR at f_s (µPa/V at 1m):	135.5 dB	138.1 dB	135.6 dB	136.5 dB	130.5 dB	130.0 dB	130.6 dB
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**.						
Driving Voltage V_i at f_s:	**Pulsed Driving Signal and Duty Cycle D < 100%:** Maximum V_i, V_{imax} = 600 V_{rms}.						
Input Power P_i:	$P_i = V_i^2 * G$. Refer to **G-B Graph:** G is conductance, G_{max} is maximum G at f_s.						
MIPP at f_s:	Maximum Input Pulse Power at f_s: $P_i = V_i^2 * G_{max}$.						
MPW:	Maximum Pulse Width 150 mS at f_s and Maximum Drive Voltage, Continuous Operation at 30 Vrms.						
Maximum Duty Cycle:	10% at f_s and Maximum Drive Voltage, Continuous Operation at 30 Vrms.						
FFVS at f_s:	-188.1 dB	-189.0 dB	-193.5 dB	-196.6 dB	-203.7 dB	-205.0 dB	-207.5 dB
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ G: Conductance at f_s; B: Susceptance at f_s; C_c: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly.						
Receiving Sound Level SL:	SL = 20*logV_o - FFVS, dB µPa. Receiving Voltage V_o is in unit of V_{rms}.						
Operating Depth:	Maximum 300 m and 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 (**THSO**) 3. Thru-hole Mounting with Double O-ring (**THDO**) 4. Bolt Fastening Mounting (Stainless Steel) (**BFMSS**) Please refer to online document **AcousticSystem.pdf** for a complete list of Mounting Options and more details.						
Cable:	1. Two Conductor Shielded Cable (**SC**), Rubber or PVC Jacket. 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=3.2 mm (**SC32**), up to 200°C, AWG26 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: 1 m. 2. Custom.						
Connector:	1. Default: Wire Leads (**WL**) 2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm) 3. SMA (Plug, Male Pin) (**SMA**), Voltage Rating: 335 VRMS Continuous. (Max. Diameter Φ9.24 mm) 4. SMC (Plug, Female Socket) (**SMC**), Voltage Rating: 250 VRMS Continuous. (SMC) (Max. Diameter Φ6.4 mm) SMA with RG178 Coax. Service Temperature: up to 155°C or 311°F.						

	5. MIL-5015 Style (pin) (**MIL**) (Max. Diameter Φ30 mm with 3 contacts) 6. Underwater Mateable Connector (pin) (**UMC**) (Max. Diameter Φ21.5 to Φ35 mm) Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.						
Size (ΦDxL, mm):	Φ20.5 x 49	Φ17.3 x 48	Φ15.7 x 44.5	Φ12.6 x 30	Φ9.4 x 18.5	Φ7.4 x 16	Φ7.4 x 16
	Actual length depends on Mounting Parts.						
Weight (in air):	34.5 grams	27.5 grams	15 grams	11 grams	8 grams	8 grams	8 grams
	Actual weight depends on Cable Types and Length. Generally, 65.5 g/m of shielded cable.						
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.						
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.						
Impedance Matching:	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices, or append **-IM** to the part number for integrating BII6000 into the transducer, and specify impedance in Ω. For example, BIIxxxxIM8Ω: BIIxxxx transducer with built-in Impedance Matching unit as a 8Ω load.						
TR Switch:	BII2100 Transmitting & Receiving Switch. Order Separately as standalone devices.						
Temperature Sensor:	1. Default: No built-in temperature sensor. 2. Built-in temperature sensor. Append **-TS** to part number (BIIxxxxTS) for integrating a temperature sensor in the transducer.						

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.

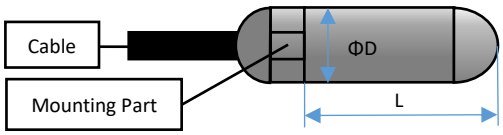
for 50Ω BNC/SMA/SMC connector, it is buyer's sole responsibility to make sure that the BNC/SMA/SMC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC/SMA/SMC is not intended for hand-held use at voltages above 30Vac/60Vdc.

Wiring:	**Shielded Cable/Wire Leads**	**Coax/BNC**	**Underwater Connector**	**MIL-5015 Connector**
Signal:	White or Red	Center Contact	Contact 2	Contact C
Signal Common:	Black	Shield	Contact 1	Contact B
Shielding and Grounding:	Shield	Shield	Contact 3	Contact A
Note:	Wire Leads: Dry Use.	Dry Use	Underwater Use	Dry Use

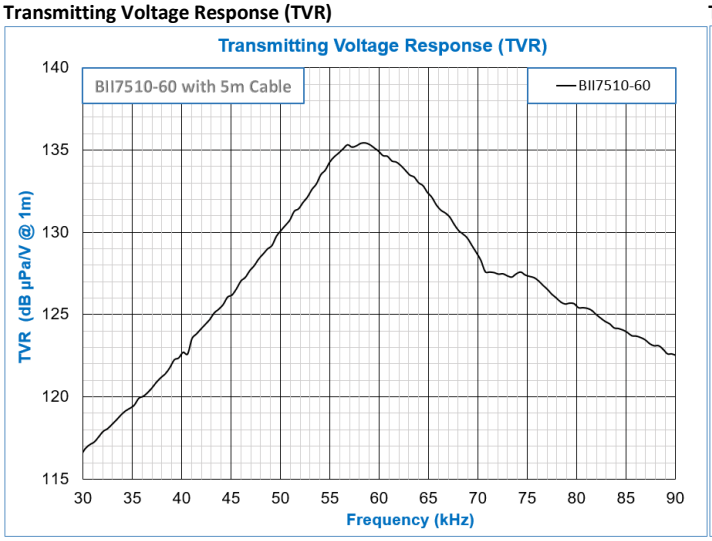
How to Order Transducer

Part Number	**-Mounting Part**	**-Cable Length in Meter**	**-Cable Type**	**-Connector Type**
Example:	Description			
BII7510-185-FH-6m-SC-UMC	BII7510-185 Transducer, Free Hanging, 6m Shielded Cable, Male Underwater Mateable Connector.			
BII7510-185-HT-FH-6m-RG178-SMC	BII7510-185 Transducer, Service Temperature: -10 °C to 120 °C, or 14 °F to 248 °F. Free Hanging, 6m RG178 Coax, SMC (Plug, Female Socket).			
BII7510-185-IM50Ω-FH-10m-RG58-BNC	BII7510-185 Transducer, Built-in Impedance Matching Network to 50Ω, Free Hanging, 10m RG58 Coax, Male BNC.			
BII7510-185-IM8Ω-FH-10m-SC-WL	BII7510-185 Transducer, Built-in Impedance Matching Network to 8Ω, Free Hanging, 10m Shielded Cable, Wire Leads.			
BII7510-185-TS-IM8Ω-FH-10m-SC-WL	BII7510-185 Transducer, Built-in Temperature Sensor, Built-in Impedance Matching Network to 8Ω, Free Hanging, 10m Shielded Cable, Wire Leads.			

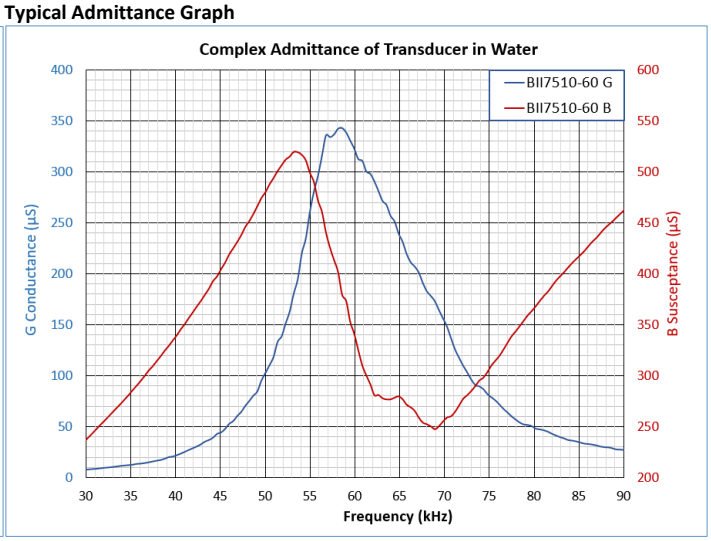
Physical Size (Dimensional Unit: mm): The overall length varies with the length of the mounting part.



Transmitting Voltage Response (TVR)



Typical Admittance Graph



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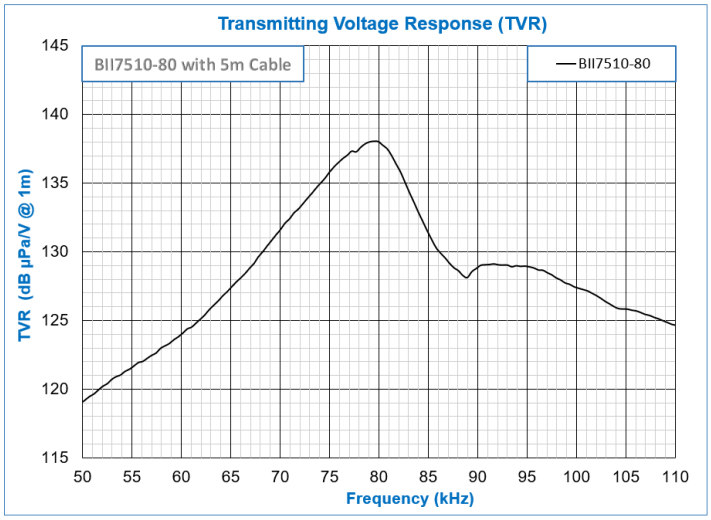
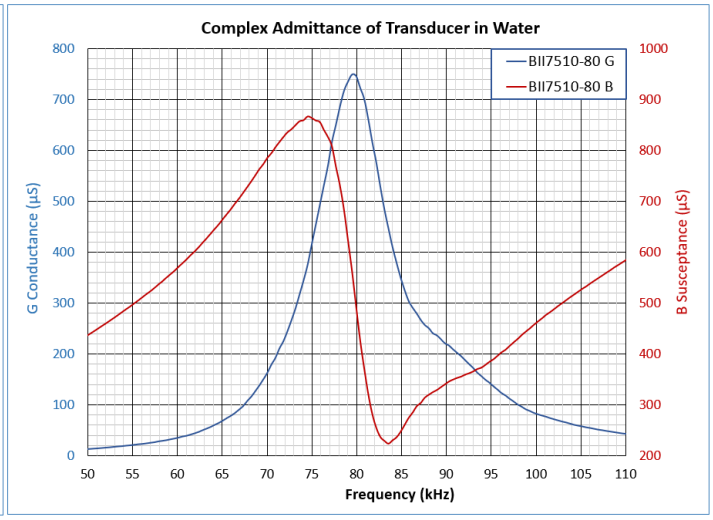
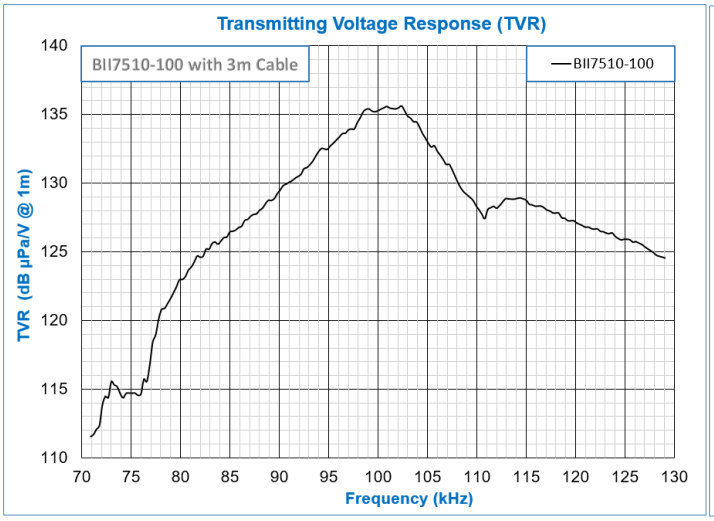
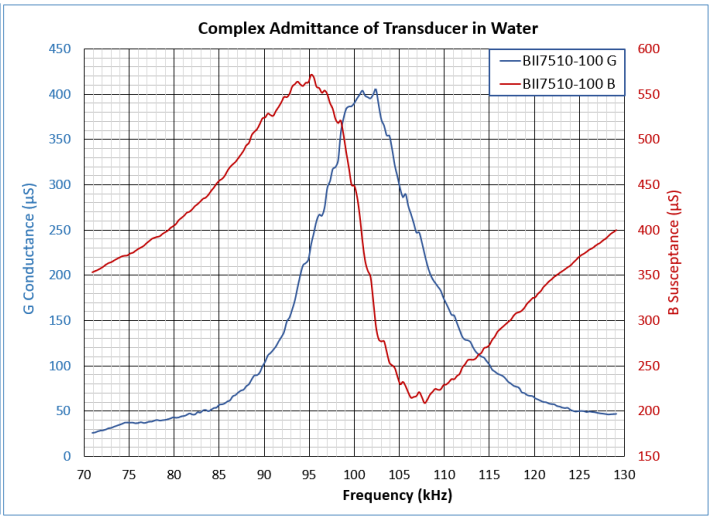
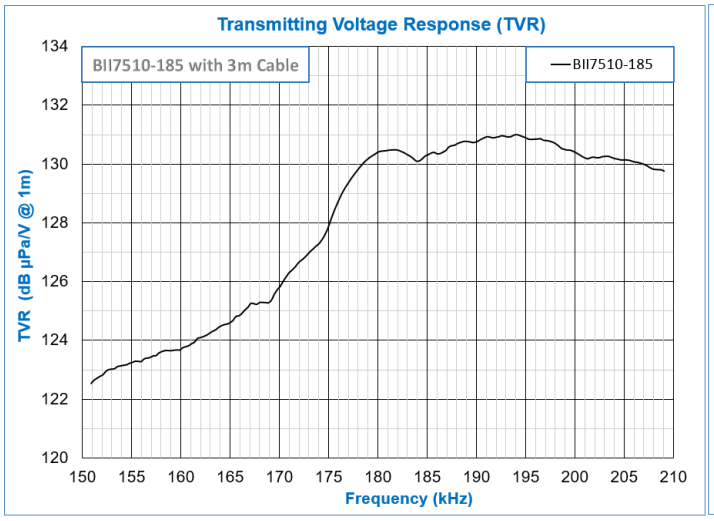
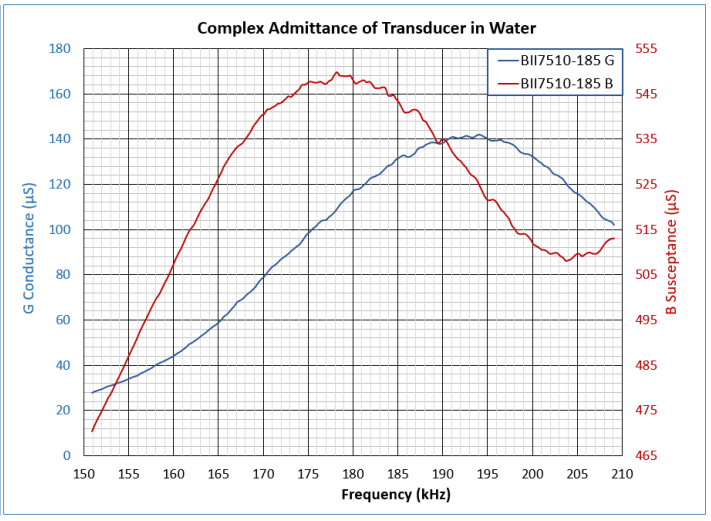




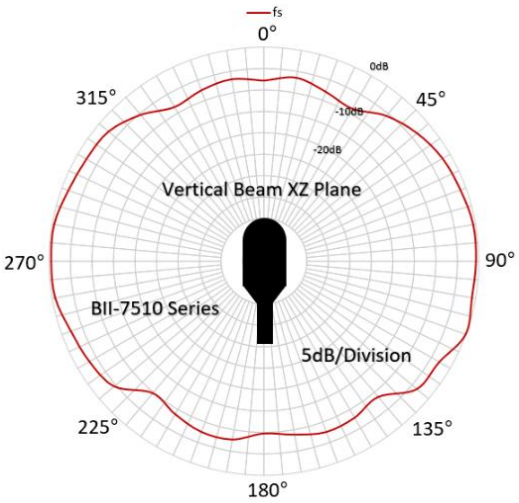


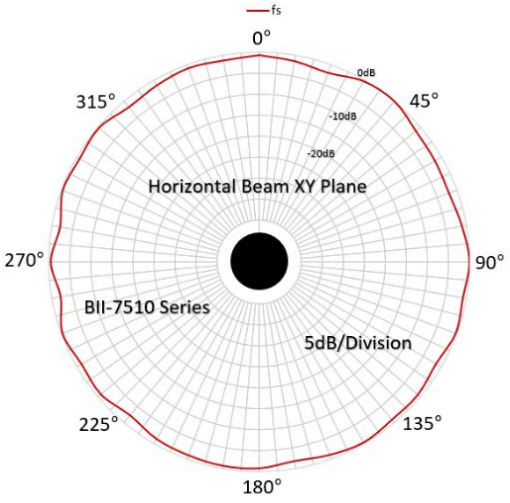






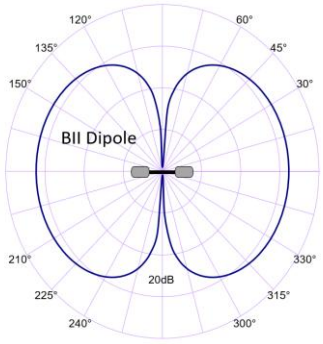
Directivity Pattern

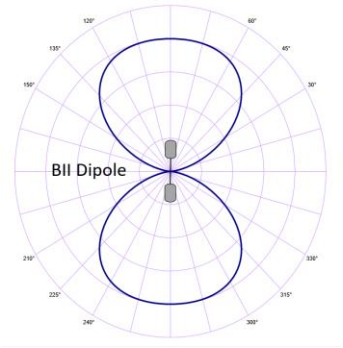




Simple Array Consisting of 2 or 3 Transducers.

"Figure 8" Pattern of a Dipole (Pressure-Gradient).





Cardioid Pattern= Pressure Hydrophone + Dipole.