Communication Transducer: Toroidal Beam

BII7510 Series Communication Transducer: Wideband, Low Qm

BII7510 series are broadband (low Qm) 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.

Modulations

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

Typical Applications

Remote Control and Telemetry	Underwater Acoustic Network
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

Specification

Part Number:	BII7511H	BII7511HIM
Signal Type:	Pulsed SINE, Chirp, PSK, FSK, etc.; Pulsed Square Waveform; CW.	
Directivity Pattern:	Toroidal Beam at fs; Omnidirectional at f ≤ 14 kHz.	
-3dB Beam Width:	Refer to Directional Response Pattern.	
Side Lobe Level:	No Side Lobes	
Free Capacitance C_f:	25 nF ± 10% @ 1 kHz	
Dissipation D:	0.005 @ 1 kHz	
Resonant Frequency f_s:	33 kHz ± 10%	
	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.**	
Operating Frequency:	N/A	Minimum, 5 kHz
Quality Factor Q_m at f_s:	2.5.	2.1
	Note: -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:	≥ 0.80	
Power Factor at f_s:	≥ 0.35	≥ 0.95
TVR at f_s:	142.0 ±2 dB µPa/V@1m, Refer to **TVR Graph**, Transmitting Voltage Response.	
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**.	50 Ω
Driving Voltage V_i at f_s:	**Transducer without Impedance Matching Unit**	**Transducer with Impedance Matching Unit**
	Pulsed Driving Signal and Duty Cycle D < 100%: Maximum V_i, V_{imax} = √(MIPP/G_{max}) or 300, whichever is less, in V_{rms}.	**Pulsed Driving Signal and Duty Cycle D < 100%:** V_{imax} = √(MIPP * |Z|), in V_{rms}. Z is impedance at fs.
	Continuous Operation at 100% Duty Cycle: Maximum V_i, V_{imax} = √(MCIP/G_{max}), in V_{rms}.	**Continuous Operation at 100% Duty Cycle:** Maximum V_i, V_{imax} = √(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, G_{max} is maximum G at f_s.	
MIPP at f_s:	Maximum Input Pulse Power at f_s: $P_i = V_i^2 * G_{max}$ or 400 Watts, whichever is less.	
MPW at MIPP and f_s:	60 Seconds, Maximum Pulse Width at MIPP and at f_s.	
MCIP at f_s:	95 Watts, Maximum Continuous Input Power at f_s. TBD, to be determined.	
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:	-194.2 ± 2 dB V/µPa, Free-field Voltage Sensitivity.	
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ 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 or 3 MPa Pressure, 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) 5. End-face Mounting (EFM) 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. 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: 1 m. 2. Custom.
Connector:	1. Default: Wire Leads (WL) 2. Male BNC (BNC) (Max. Diameter Φ14.3 mm) 3. MIL-5015 Style (pin) (5015) (Max. Diameter Φ30 mm with 3 contacts) 4. 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 = Φ38x58 mm and actual length depends on Mounting Parts.
Weight in Air:	≥ 2 kg with 10 m cable. Actual weight depends on Mounting Parts, Cable Types and Length.
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, BIIxxxx-IM6Ω: BIIxxxx transducer with built-in Impedance Matching unit as a 6 Ω 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.
Potable Transmitter:	BII8030 series portable acoustic transmitters.
Portable T/R System:	BII8080 series portable transmit and receive systems.

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.

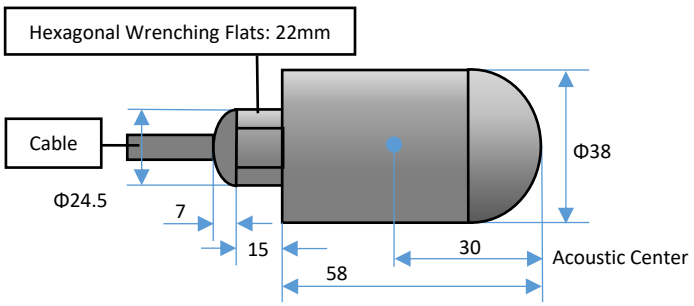
Wiring:	**Two Conductor Shielded Cable**	**Coax/BNC**	**Underwater Connector**	**MIL-5015 Connector**
Signal	White or Red	Center Contact	Contact 2	Contact C
Signal Common	Black	Shield	Contact 1	Contact B
Shielding and Grounding	Shield	Shield	Contact 3	Contact A

How to Order Transducer

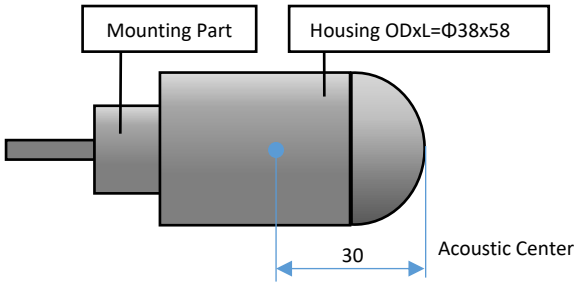
Part Number	**-Mounting Part**	**-Cable Length in Meter**	**-Cable Type**	**-Connector Type**
Example:	Description			
BII7511H-FH-6m-SC-UMC	BII7511H Transducer, Free Hanging, 6m Shielded Cable, Male Underwater Mateable Connector.			
BII7511H-HT-FH-6m-RG178-SMC	BII7511H Transducer, Service Temperature: -10 °C to 120 °C, or 14 °F to 248 °F. Free Hanging, 6m RG178 Coax, SMC (Plug, Female Socket).			
BII7511HIM-FH-10m-RG58-BNC	BII7511HIM Transducer, Built-in Impedance Matching Network to 50Ω, Free Hanging, 10m RG58 Coax, Male BNC.			
BII7511H-IM8Ω-FH-10m-SC-WL	BII7511H Transducer, Built-in Impedance Matching Network to 8Ω, Free Hanging, 10m Shielded Cable, Wire Leads.			
BII7511H-TS-IM8Ω-FH-10m-SC-WL	BII7511H 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 mounting parts. Please refer to online information of mounting options.

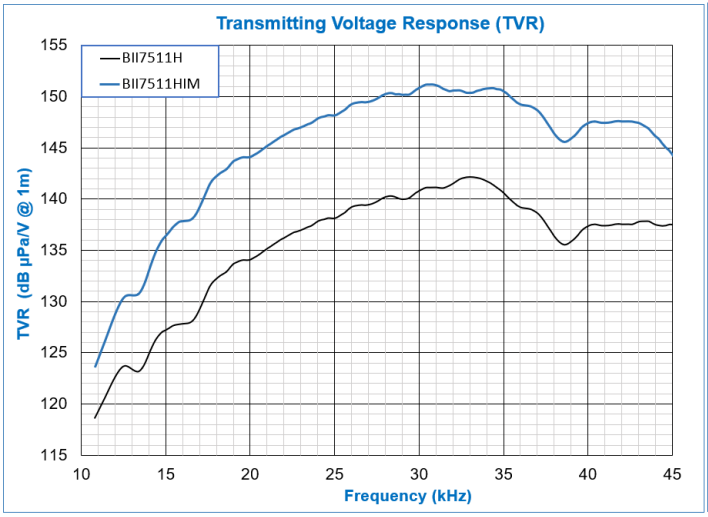
a. Size information of Free Hanging.



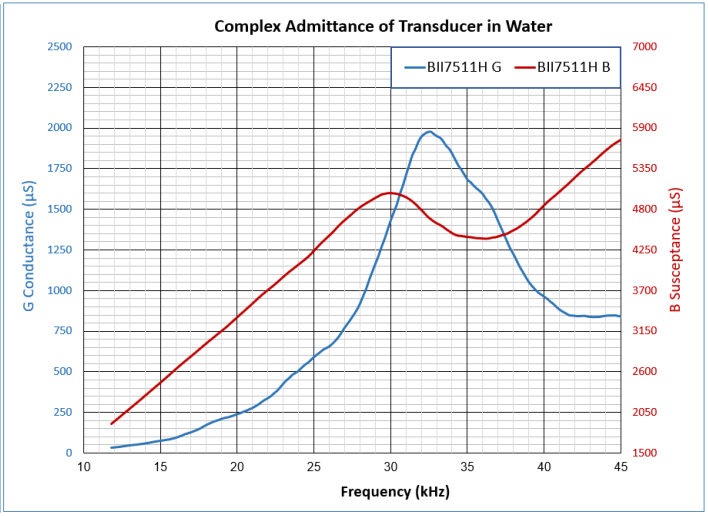
b. General Size information.



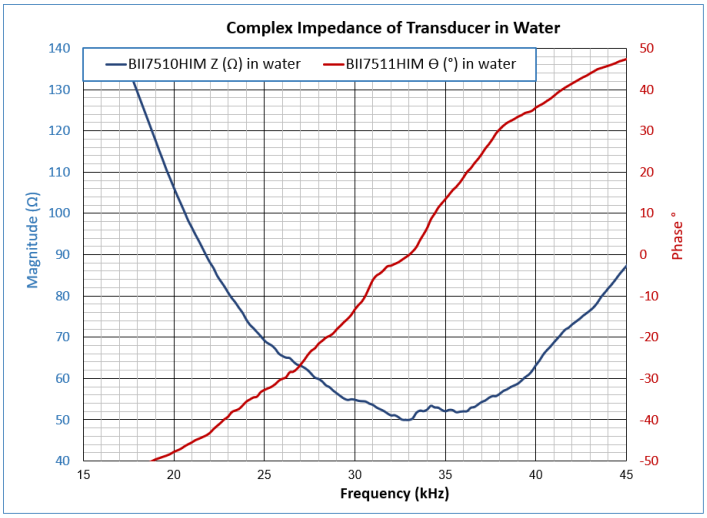
TVR (Transmitting Voltage Response)



Admittance



Impedance



Directional Response Pattern