Omnidirectional Spherical Transducer

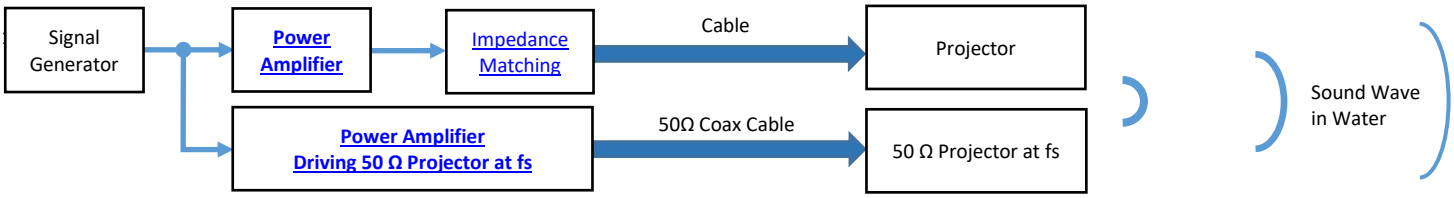
BII7520 series spherical transducers ranging from 2 to 300kHz provide omnidirectional directivity response and broadband response.

Typical Applications

Remote Control, Telemetry, Drifting Array Artificial Acoustic Target, Echo-Repeater Acoustic Deterrent to Marine Animals Playback Marine Animal Voices/Calls/Whistles/Songs/Clicks	Underwater Acoustic Network, Spherical Point Source Diver Communication, Underwater Telephone Pinger/Tag/Locator/Transponder/Beacon/Acoustic Release Marine Animal Behavior Research, Bioacoustic Stimuli

SYSTEM CONFIGURATION

Transmitting Sounds.



RELATED PRODUCTS

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

Specification

Part Number:	BII7520-15	BII7520-15-IM50Ω
Resonant Frequency f_s:	15 kHz ± 10%	
Transmitting Frequency:	f_s ± 20%*f_s	f_s ± 25%*f_s
	Minimum Transmitting Frequency: None.	Minimum Transmitting Frequency: 2.5 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 50 Ω.
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:	Omnidirectional Beam.	
-3dB Beam Width:	Vertical Beam Angle ≥ 250° and Horizontal Beam Angle = 360°, at f_s.	
Side Lobe Level:	No side lobes.	
Free Capacitance C_f:	160 nF ± 10% @ 1 kHz	N/A
	With cable, C_f increases by (Cable Length * 0.1nF/meter).	
Dissipation D:	0.0038 @ 1 kHz	N/A
Quality Factor Q_m at f_s:	2.3	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.	
η_{ea} at f_s:	0.93 in Water, Electroacoustic Efficiency, Load Medium Dependent.	
η_{ea} at f << f_s:	at f << fs, $\eta_{ea} / \eta_{ea\ at\ fs} \approx 0.25*(k*\Phi D)^2$. Wave Number $k = 2\pi/\lambda$; ΦD = Transducer Diameter.	
	1. Driving Transducer with Continuous Signals: (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. **2. Driving Transducer with Pulsing Signals such as SINE Pulses:** Electroacoustic Efficiency η_{ea} is quite low at f << f_s and drops gradually at f > f_s, so it is recommended for transducers to emit high power sounds at frequencies far from f_s with **Pulsing Signals with Duty Cycle ≤ 10%, Pulse Length ≤ 100mS**. Otherwise, transducer may be damaged by overheating.	
Power Factor at f_s:	0.63	≥ 0.94
TVR at f_s:	Refer to TVR Chart, Transmitting Voltage Response. **Tolerance**: ±2 dB.	
	150.0 dB µPa/V at 1m.	148.0 dB µPa/V at 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 Chart.	Refer to Z-θ Chart. 1. Default: $Z = 50*e^{j\theta}$, in Ω, and Phase Angle $\lvert\theta\rvert \le 20°$ 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%:** $V_{imax} = \sqrt{(MIPP * \lvert Z\rvert)}$, 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:** $V_{imax} = \sqrt{(MCIP * \lvert Z\rvert)}$, 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 800 Watts, whichever is less.	
MPW at MIPP and f_s:	100 Seconds, Maximum Pulse Width at MIPP and at f_s.	
MCIP at f_s:	500 Watts, Maximum Continuous Input Power at f_s.	
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:	-193.2 ± 2 dB V/µPa, Free-field Voltage Sensitivity.	-190.6 ± 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:	-187.0 ± 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:	0.1 Hz to 1.5*fs.	fs ± 25%*fs
Operating Depth:	Maximum, 200 m or 2 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-5/8".)** 3. Bolt Fastening Mounting (Stainless Steel) (**BFM-5/8".**) 4. Free-hanging with Male Underwater Connector (**FHUWC-2P, FHUWC-3P.**) 5. End-face Mounting (**EFMS.**)	
	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 or 3 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: (a) 15 m. (b) 0.6m with Underwater Mateable Connector (2 pins) (**UMC2P**) and (3 pins) (**UMC3P**). 2. Custom-fit.	
Connector:	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. 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). 4. XLR Receptacle with 3 Male Pins (**XLR3P**), (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. 6. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm), for Transmit or Receive Grounded Signal.	
	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: ΦD = Φ108 mm, Length = 115 mm.	Free Hanging: ΦD = Φ108 mm, Length = 200 mm.
	Actual length depends on Mounting Parts and/or Add-on Parts such as -IM, etc.	
Weight in Air:	0.83 kg with 1 m cable.	≥ 1.8 kg with 1 m cable.
	Generally, cable weight: 41g/m (RG58 Coax), 66g/m (2C SC Cable), 78g/m (2C USC Cable).	
	Actual weight depends on Mounting Parts, Cable Types and Length, and/or Add-on Parts such as -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.	
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.	
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.	
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.

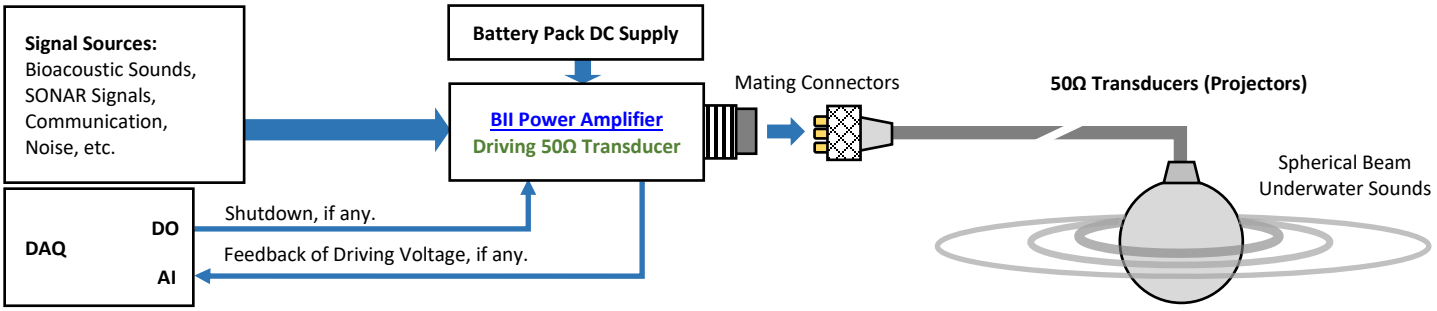
Transducer Wiring:	Shielded Cable	Coax, BNC.	UMC3P, Locking Sleeve: DLSA-M.	MIL3P	DIN3P	XLR3P
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 3	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 1	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 2	Pin 1
Wiring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

How to Order Transducers. 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	**-Impedance Matching**	**-Mounting**	**-Cable Length**	**-Cable Type**	**-Connector**
BII7520-15	None or IM50Ω.	Default: **FH**, or **BFM-5/8**".	Default: **15m or 0.6m**.	**Default: SC.** **USC** for UMC2P Connector. **RG58** for 50Ω.	Default: **WL**. **BNC** for 50Ω.

Example:	**Description**
BII7520-15-BFM-5/8"-15m-SC-WL	**BII7520-15 Transducer, Bolt-Fastening Mounting: BFM-5/8", 15m Shielded Cable, Wire Leads.**
BII7520-15-IM50Ω-BFM-5/8"-15m-RG58-BNC	**BII7520-15 Transducer, Impedance Matching to 50Ω at fs, Bolt-Fastening Mounting: BFM-5/8", 15m RG58 Coax, Male BNC.**
BII7520-15-FH-0.6m-USC-UMC2P	BII7520-15 Transducer, Free Hanging, 0.6m Unshielded Cable, 2-pins Male Underwater Mateable Connector with Locking Sleeve: DLSA-M.
BII7520-15-IM50Ω-BFM-5/8"-0.6m-USC-UMC2P	BII7520-15 Transducer, Impedance Matching to 50Ω at fs, Bolt-Fastening Mounting: BFM-5/8", 0.6m Unshielded Cable, 2-pins Male Underwater Mateable Connector with Locking Sleeve: DLSA-M.
BII7520-15-FH-30m-SC-XLR3P	BII7520-15 Transducer, Free Hanging, 30m Shielded Cable, 3-pins XLR Plug.

System Block Diagram of Generate Sounds



Question:

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

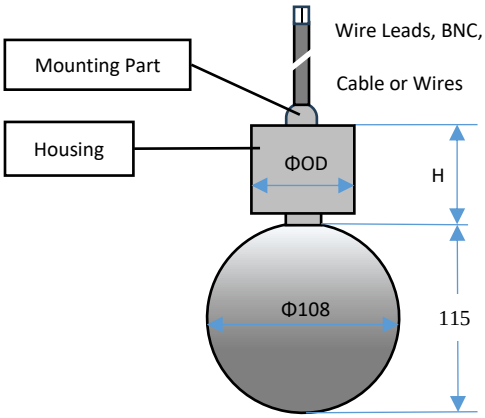
1. Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
2. A connector adaptor might be assembled by BII by customization, and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations.
3. Many adaptors for standard 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 features of the transducer when operating f << fs (fs is resonance frequency)?

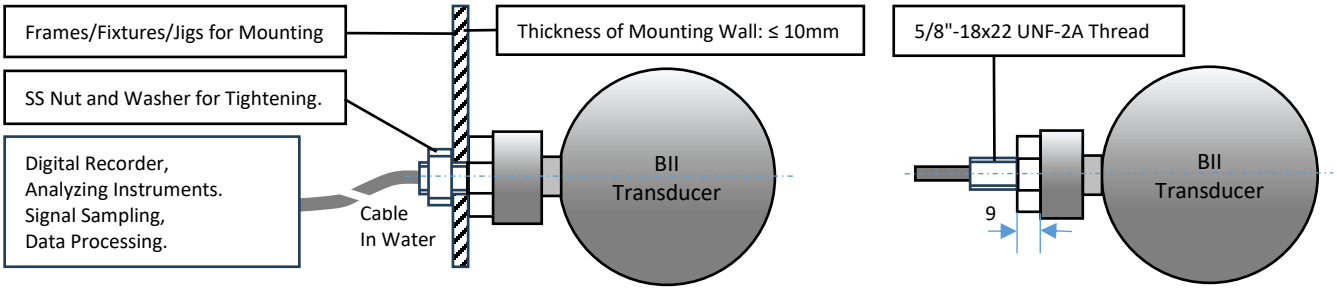
1. Roughly, the TVR drops at 6dB/Octave or 20dB/Decade. 2. Power factor drops to be half per octave or one tenth per decade. 3. Efficiency drops with frequency decreasing. More and more electrical energy is consumed by transducer to be converted to heat which damage the transducer when the temperature 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.

Physical Size (Dimensional Unit: mm): The overall length varies with the length of mounting parts. Please refer to online information of mounting options.
Note: Following drawings are based on BII7520-15, and are suitable for BII7520-15-IM50Ω except an extra housing of Impedance matching network.

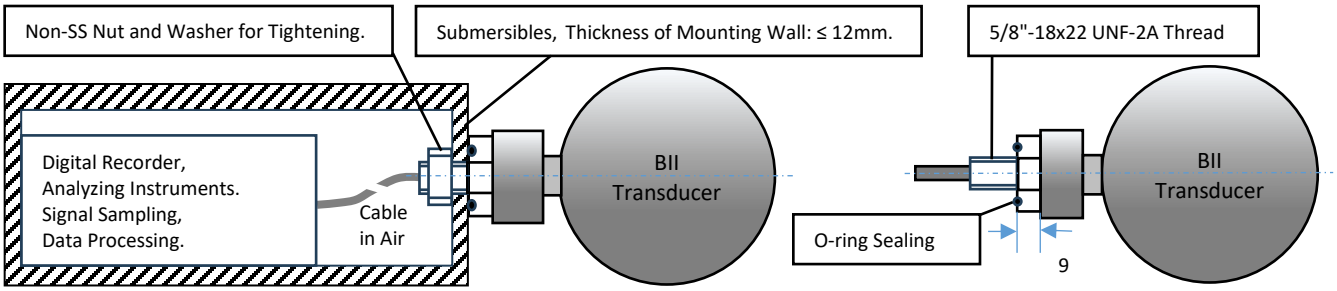
1. BII7520-15: ΦODxH = Φ33x(15 to 20), **BII7520-15-IM50Ω**: ΦODxH = Φ89x(70 to 80). Varies with connector options.



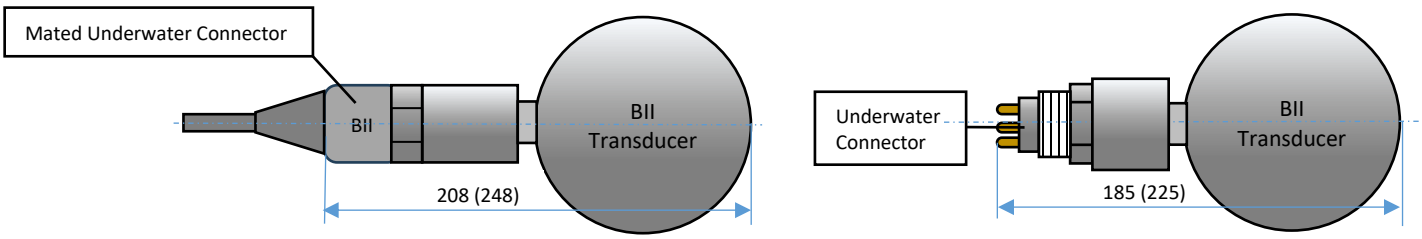
2. Bolt-Fastening Mounting: BFM-5/8" (5/8"-18x22 UNF-2A).



3. Thru-hole Mounting (Inch Thread) with Single O-ring Sealing: THM-5/8" (5/8"-18x27 UNF-2A).

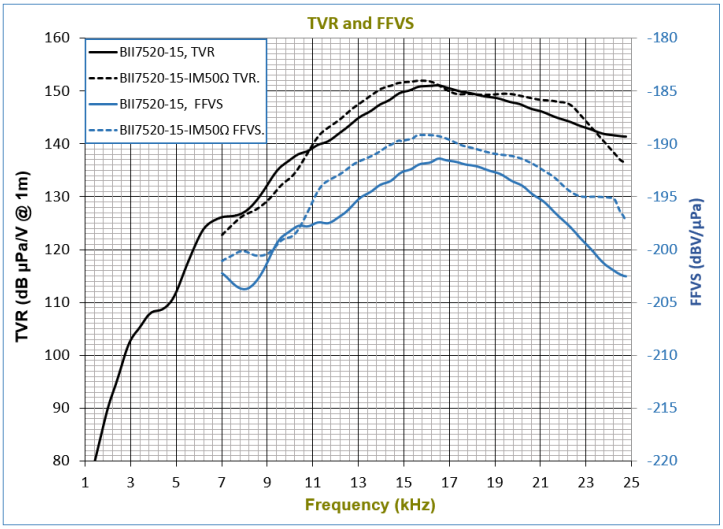


4. Free-hanging with Underwater Connector: FHUWC-2P, 2 Pins (Unshielded Cable); FHUWC-3P, 3 Pins (Shielded Cable).
Note: dimension in bracket is for BII7520-15-IM50Ω.

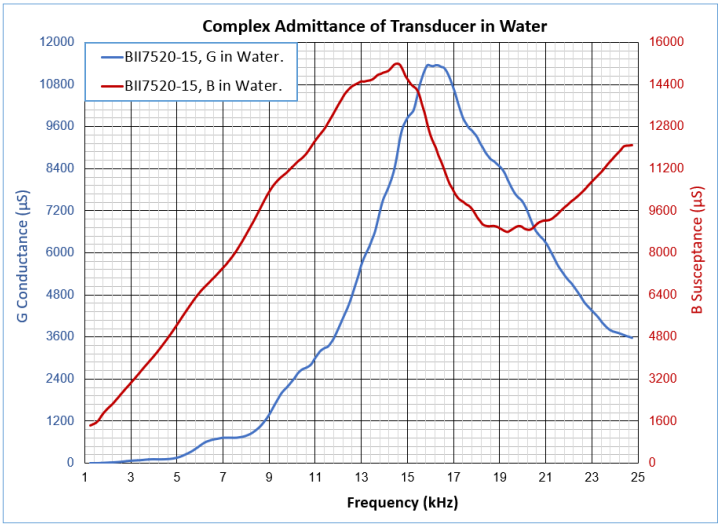


5. More Mounting/Installation Options: Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and details.

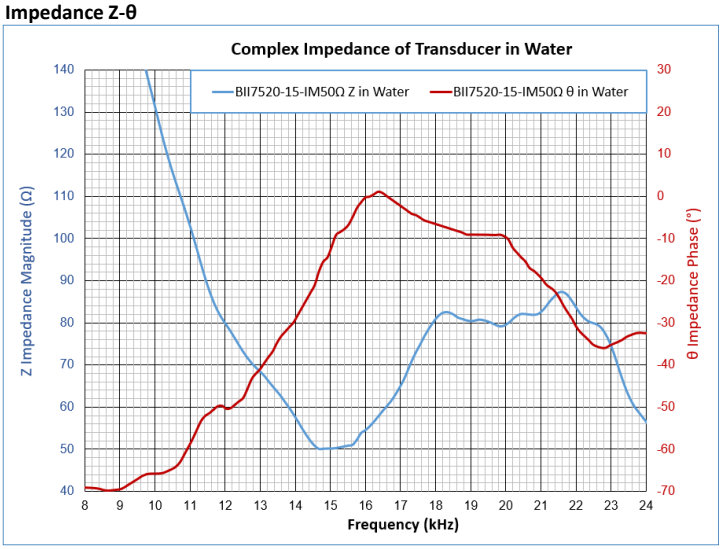
TVR and FFVS



Admittance G-B



Impedance Z-θ



Directivity