Free Flooded Ring Transducer: Broadband, Deep Ocean & Low Frequency

BII7590 series are low frequency broadband transducers (Low Q, Free Flooded Ring Transducers) with toroidal beam and ranging from 1 to 50 kHz for deep and shallow water communication, and as low frequency sound sources in water. BII7590 series is NOT recommended to detect underwater sounds.

Suggested Applications

Deep Ocean Submergence Broadband Sound Source Long Range Sound Transmission	Broadband Communication Underwater Telephone Voice Communication Underwater	Artificial Acoustic Target Echo-Repeater Target Active-Acoustic Target	Bioacoustic Stimuli Marine Animal Behavior Study Playback Marine Animal Voices/Calls

Specification

Part Number:	BII7591	BII7592	BII7593	BII7594	BII7596	BII7596IM	BII7598
Signal Type:	Pulsed SINE, Chirp, PSK, FSK, etc.; Pulsed Square Waveform; CW.						
Directivity Pattern:	Omnidirectional to Toroidal.						
f_{omni}:	13 kHz	9.7 kHz	6.5 kHz	4.8 kHz	3.2 kHz	3.2 kHz	2.3 kHz
	Omnidirectional at $f \le f_{omni}$.						
-3dB Beam Width:	Horizontal x Vertical, refer to **Directivity Response**.						
Side Lobe Level:	None						
Free Capacitance C_f at 1kHz:	15 nF ±10%	20 nF ±10%	40 nF ±10%	115 nF ±10%	69 nF ±10%	N/A	N/A
Dissipation D:	0.005 at 1kHz						
Resonant Frequency f_s:	17 and 25 kHz	13 and 20 kHz	8 and 12 kHz	4 and 8 kHz	3.5 and 6.5 kHz	6.5 kHz	3 kHz
Quality Factor Qm at fs:	1.5 to 3					2.0	2.0
	-3dB bandwidth $\Delta f = fs/Qm$. Qm determines the transient response or the rise and fall rings of steady-state response.						
$\eta_{ea\ at\ fs}$ at f_s:	≥ 0.85 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. **2. Transducer can emit low power sounds at frequencies far from f_s such as input power $P_i \le \eta_{ea}$ * MIPP at $f \le 0.8*f_s$ and $P_i \le 0.2$ * MIPP at $f \ge 1.3*f_s$.**						
Power Factor at f_s:	≥ 0.7					≥ 0.94	≥ 0.94
TVR at f_s in Water:	Refer to **TVR Graph** in Water, Transmitting Voltage Response. µPa/V at 1m.					147.7 dB	147.0 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 **Admittance Graph** in Water.					75Ω at f_s	80Ω at f_s
Driving Voltage V_i at f_s:	≤ 300 Vrms	≤ 400 Vrms	≤ 400 Vrms	≤ 400 Vrms	≤ 600 Vrms	≤ 220 Vrms	≤ 200 Vrms
	Pulsed Driving Signal and Duty Cycle D < 100%: Maximum V_i, $V_{imax} = \sqrt{(MIPP/G_{max})}$, in V_{rms}.						
	Continuous Operation at 100% Duty Cycle: Maximum V_i, $V_{imax} = \sqrt{(MCIP/G_{max})}$, in V_{rms}.						
	Combine maximum voltage above listed, the lowest maximum-drive-voltage is the driving voltage ratings of the transducer.						
Input Power P_i:	$P_i = V_i^2 * G$. Refer to **G-B Graph:** G is conductance.						
MIPP: Maximum Input Pulse Power, **MPW**: Maximum Pulse Width, **MCIP**: Maximum Continuous Input Power.							
MIPP at fs in Water:	17kHz: 80W 25kHz: 120W	13kHz: 150W 20kHz: 250W	8kHz: 230W 12kHz: 390W	4kHz: 400W 8kHz: 900W	3.5kHz: 200W 6.5kHz: 320W	600W	500W
MPW at MIPP & fs in Water:	17kHz: 40S 25kHz: 26S	13kHz: 60S 20kHz: 45S	8kHz: 200S 12kHz: 70S	4kHz: 20S 8kHz: 20S	3.5kHz: 200S 6.5kHz: 220S	20S	20S
MCIP at fs in Water:	17kHz: 58W 25kHz: 58W	13kHz: 110W 20kHz: 130W	8kHz: 230W 12kHz: 230W	4kHz: 100W 8kHz: 150W	3.5kHz: 160W 6.5kHz: 260W	260W	250W
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:	NOT recommended to detect underwater sounds.						
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ 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.						
Receiving Sound Level SL:	SL = 20*logV_o - FFVS, dB µPa. Receiving Voltage V_o is in unit of V_{rms}.						
Operating Depth: (Maximum)	900 m	800 m	700 m	500 m	300 m	300 m	200 m
	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. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-M8, BFM-FH-M10**). 5. Free-hanging with Male Underwater Connector (**FHUWC-3P**).						

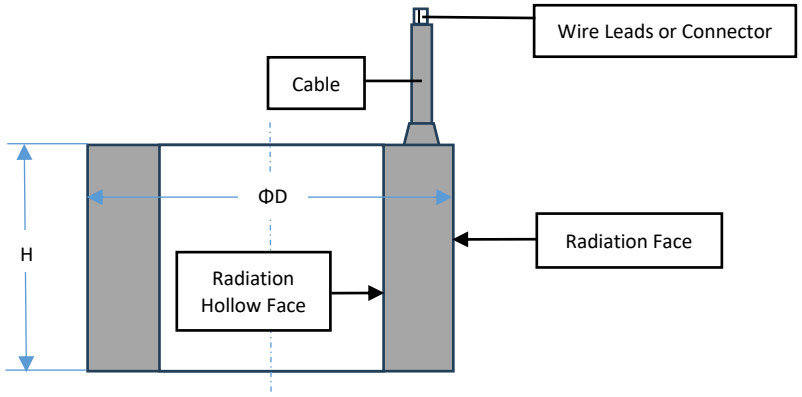
	6. Flange Mounting (**FGM-Φ220, etc.**)						
	Please refer to online document **AcousticSystem.pdf** for a complete list of Mounting Options and more details.						
Cable:	1. Two Conductor Shielded Cable (**SC**), Rubber or PVC Jacket. 2. 50 Ω RG58 Coax (**RG58**) 3. Two Conductor Unshielded Cable (**USC**)						
	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:	1. Default: Wire Leads (**WL**). 2. Underwater Mateable Connector (3 pins) (**UMC3P**) (Max. Diameter Φ21.5 to Φ35 mm). 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. 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 (ΦDxH, mm):	Φ48x21	Φ60x26	Φ89x48	Φ114x90	Φ168x115	Φ168x170	Φ220x220
	Actual length depends on Mounting Parts.						
Weight in Air:	≥ 0.105 kg	≥ 0.280 kg	≥ 0.6 kg	≥ 1.2 kg	≥ 2.2 kg	≥ 2.6 kg	≥ 6.0 kg
	Actual weight depends on Mounting Parts, Cable Types and Length.						
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:	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices.						
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 (BIIxxxx-TS) 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 of Shielded Cable:	**Wire Leads WL**		**UMC3P**	**MIL3P**		**BNC**	
Signal	White or Red		Contact 2	Contact C		Center Contact	
Signal Common	Black		Contact 1	Contact B		Shield	
Shielding and Grounding	Shield		Contact 3	Contact A		Shield	
Wiring of Unshielded Cable:	**Wire Leads WL**		**UMC3P**	**MIL3P**			
Signal	White		Contact 2	Contact C			
Signal Common	Black		Contact 1	Contact B			
N/A	N/A		N/A	Contact A (not used)			

How to Order

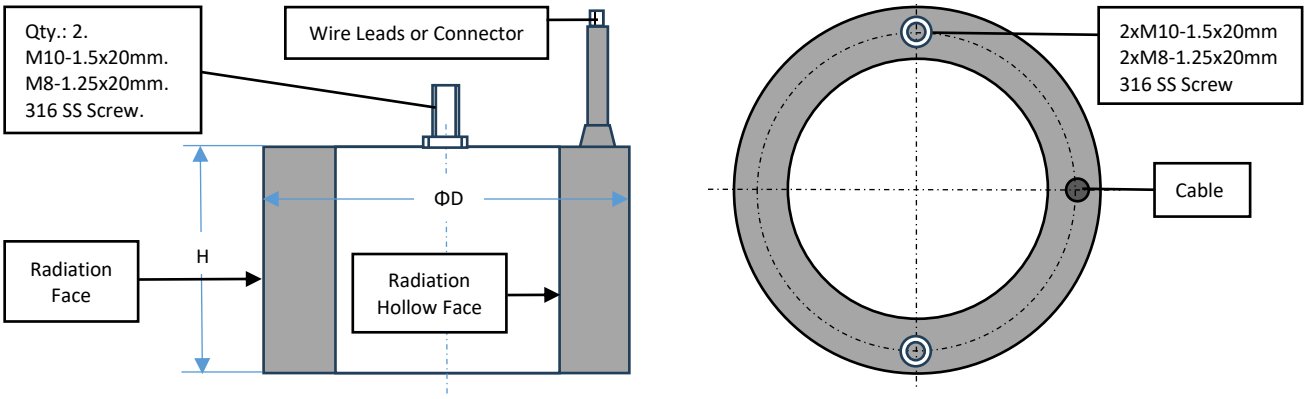
Part Number	**-Mounting Part**	**-Cable Length in Meter**	**-Cable Type**	**-Connector Type**
Example:	Description			
BII7593- BFM-FH-M10-30m-RG58-BNC	BII7593 Transducer, Bolt Fastening Mounting with Free Hanging: BFM-FH-M10, 30m RG58 Coax Cable, BNC Male.			
BII7596-FH-30m-SC-WL	BII7596 Transducer, Free Hanging, 30m Shielded Cable, Wire Leads.			
BII7596-BFM-5/8”-0.6m-SC-UMC	BII7596 Transducer, Bolt Fastening Mounting: BFM-5/8”, 0.6m Shielded Cable, Male Underwater Mateable Connector.			
BII7596-BFM-FH-M10-30m-SC-WL	BII7596 Transducer, Bolt Fastening Mounting with Free Hanging: BFM-FH-M10, 30m Shielded Cable, Wire Leads.			

Outline Drawings

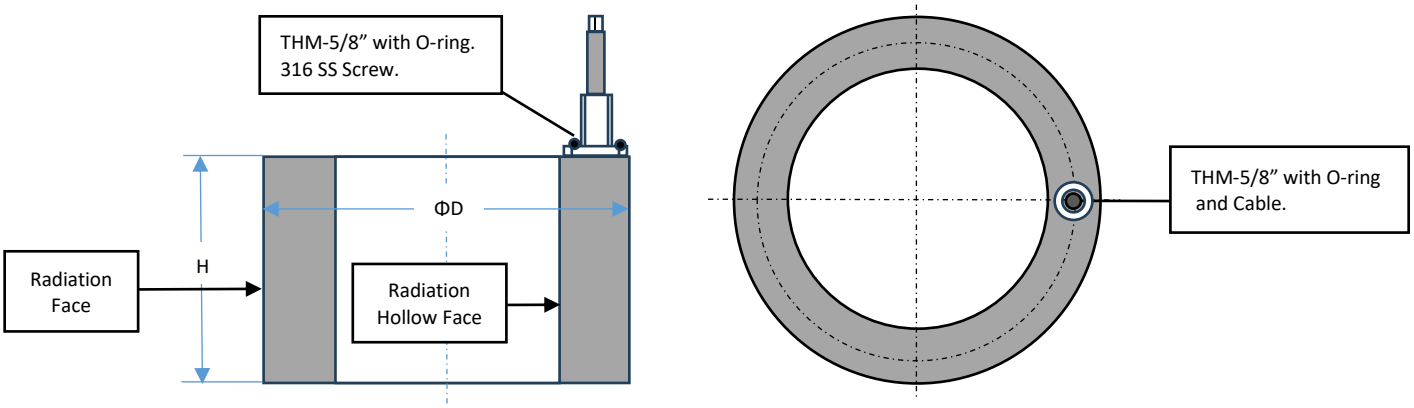
1. Free Hanging **(FH).**



2. Bolt-Fastening Mounting with Free Hanging **(BFM-FH-M8 for BII7591, BII7592, or BFM-FH-M10 for BII7593, BII7594, BII7596.)**



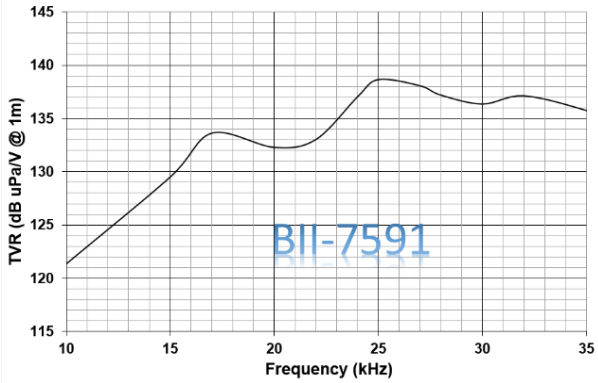
3. Thru-hole Mounting with O-ring Sealing **(THM-5/8")**

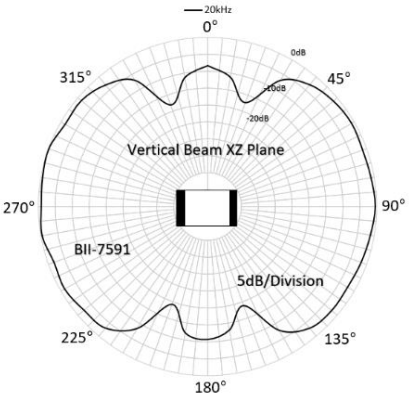


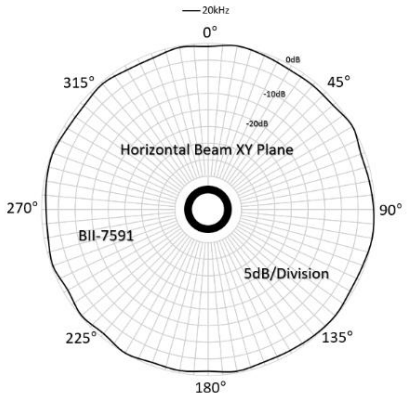
TVR Transmitting Voltage Response in Water

Directional Response Pattern in Water

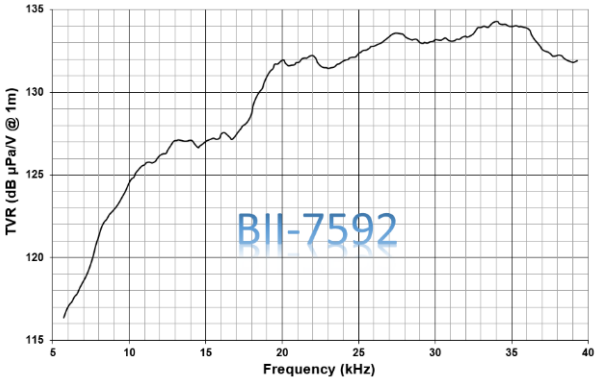
BII-7591 Transducer

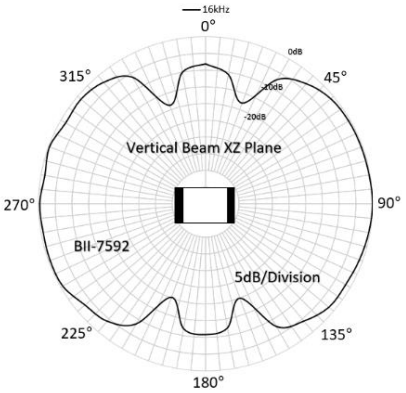


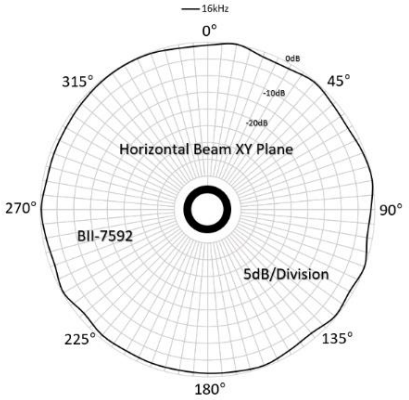




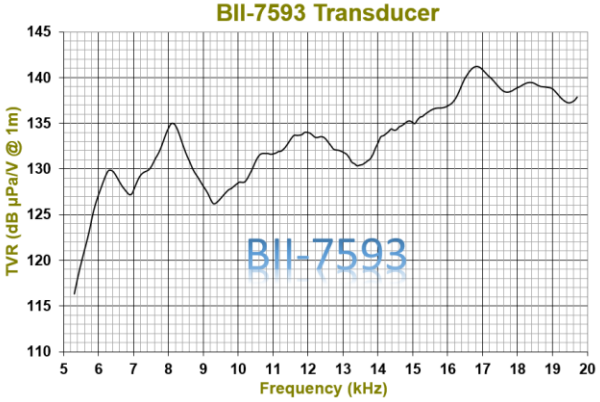
BII-7592 Transducer

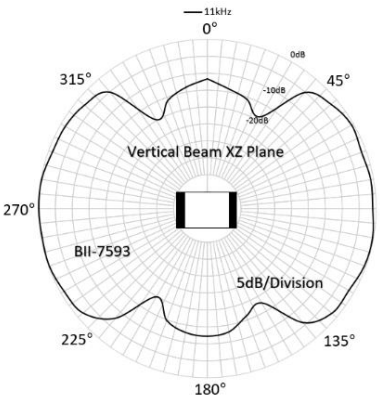


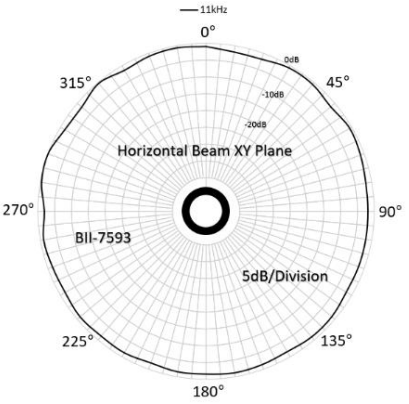




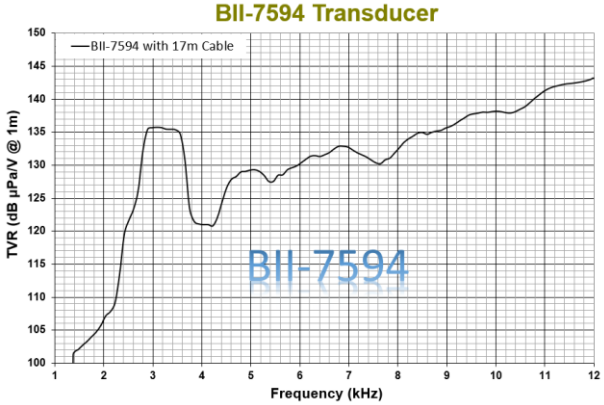
BII-7593 Transducer

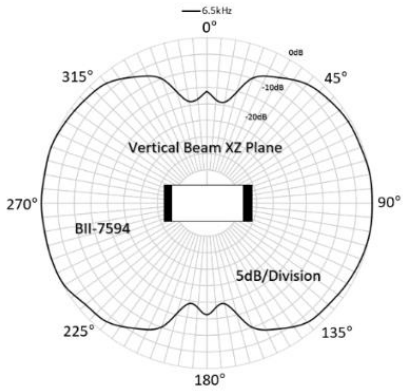


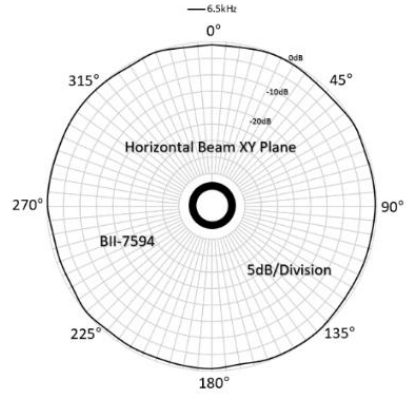


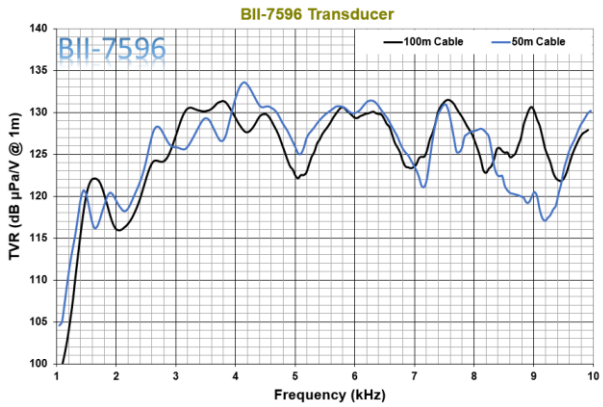


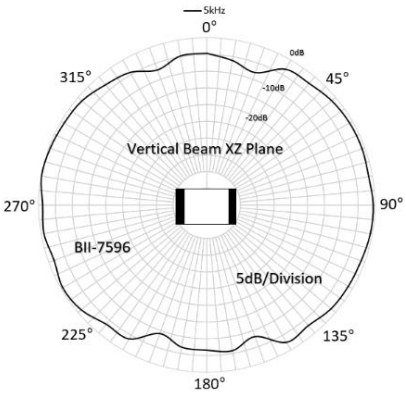
BII-7594 Transducer

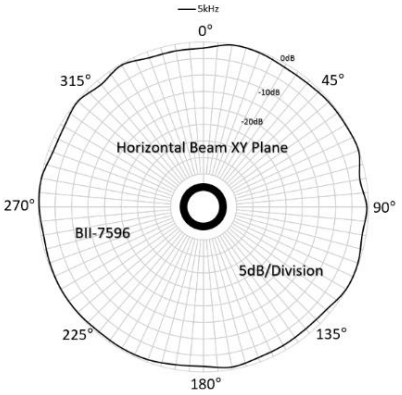




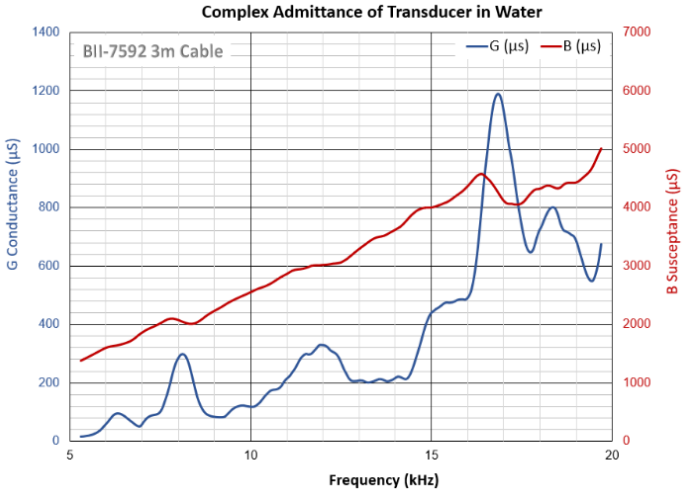




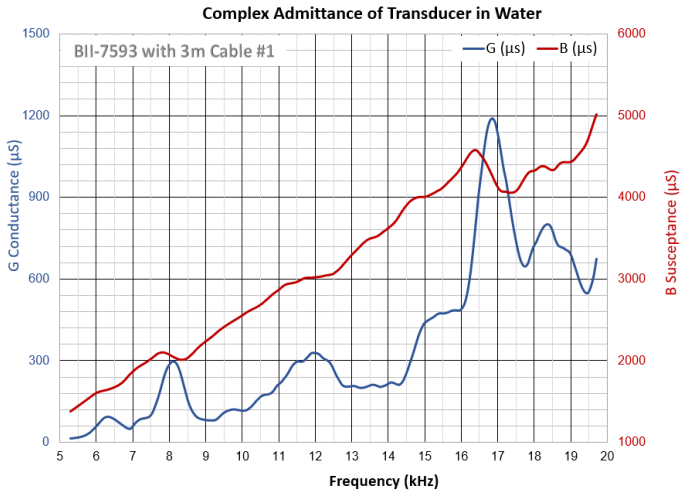




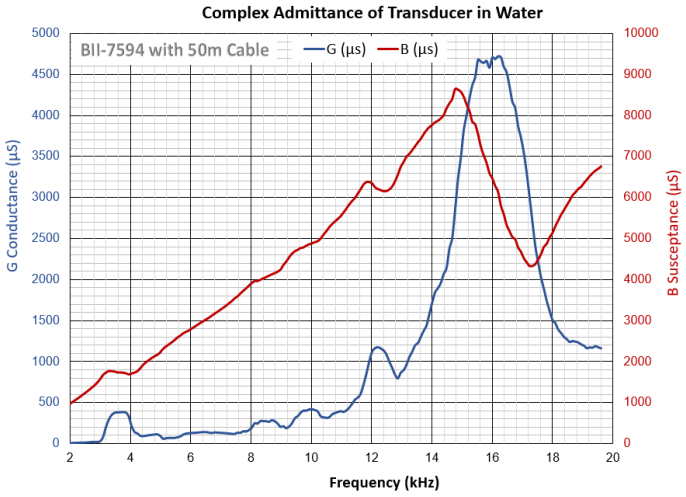
BII7592 (3m Cable) in Water



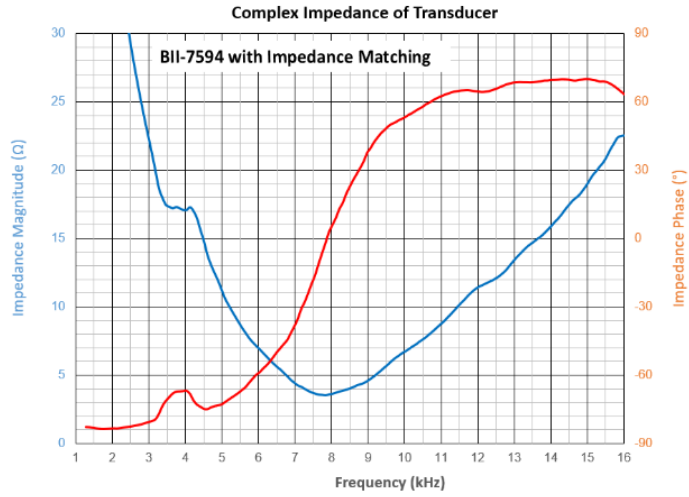
BII7593 (3m Cable) in Water



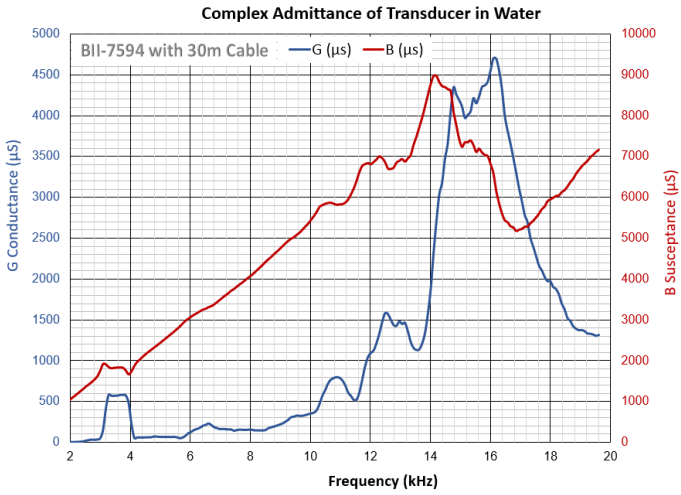
BII7594 (50m Cable) in Water



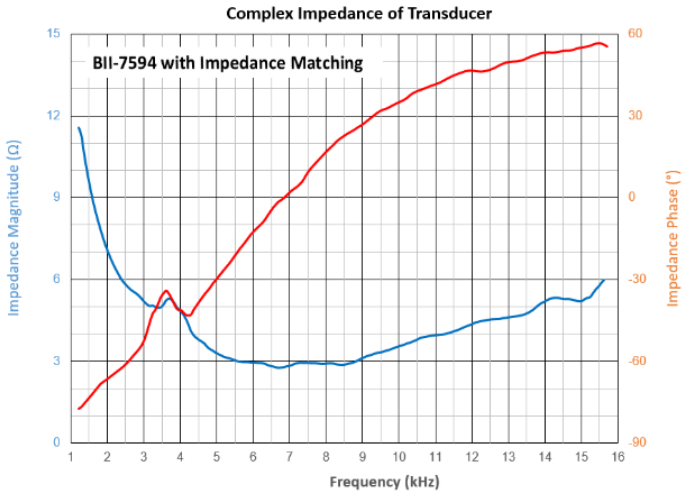
BII7594 (50m Cable) with Bespoke BII6010 Impedance Matching in Water



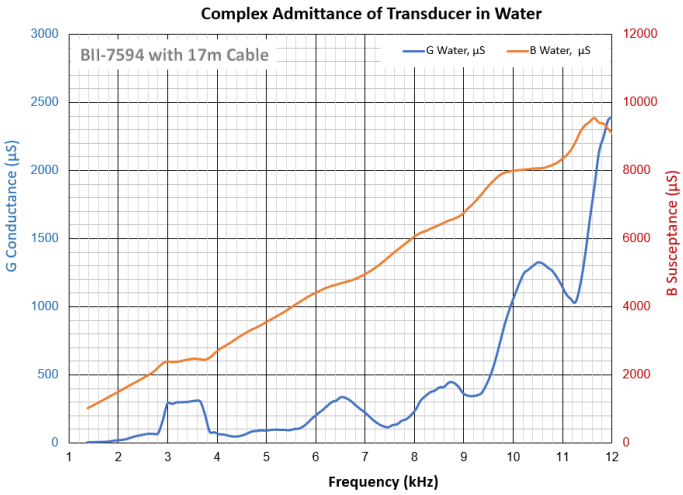
BII7594 (30m Cable) in Water



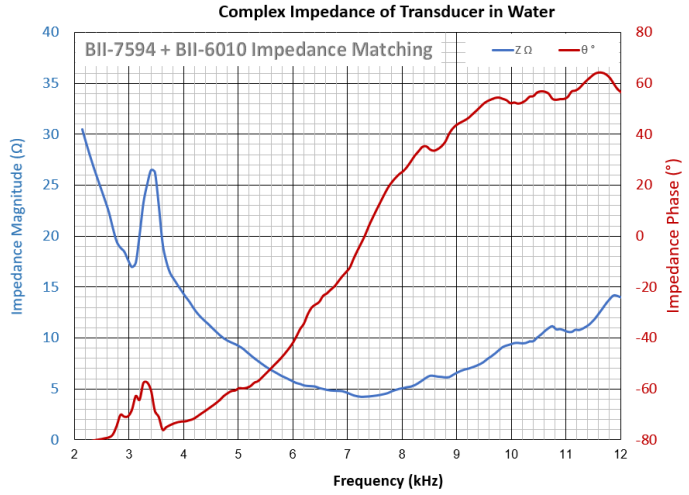
BII7594 (30m Cable) with Bespoke BII6010 Impedance Matching in Water



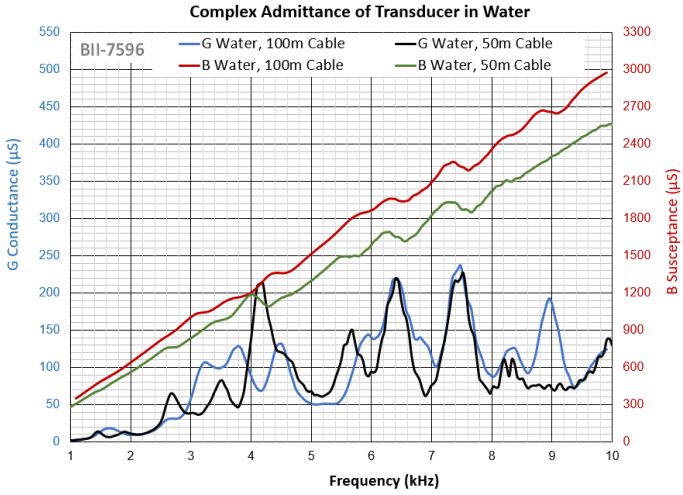
BII7594 (17m Cable) in Water



BII7594 (17m Cable) with Bespoke BII6010 Impedance Matching in Water



BII7596 in Water



BII7596 with Bespoke BII6010 Impedance Matching in Water