Benthowave Instrument Inc.

SE=SL-TL+AG-NL Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revised on 2026-6-30

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

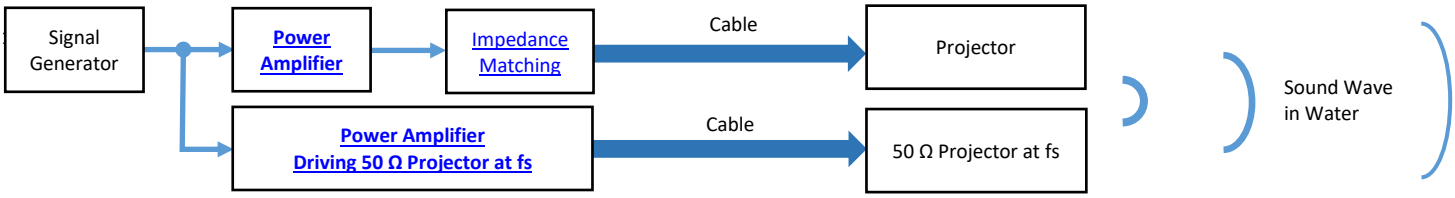
BII7590 series are low frequency broadband transducers (Low Q, Free Flooded Ring Transducers) with toroidal beam and ranging from 1 to 30 kHz for deep and shallow water communication, and as low frequency sound sources in water. BII7590 series is NOT recommended to detect underwater sounds.

Typical Applications

Deep Ocean Submergence Broadband Sound Source Long Range 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

SYSTEM CONFIGURATION

Transmitting Sounds.



RELATED PRODUCTS

Power Amplifier for SONAR, NDT, and HIFU	Impedance Matching between Transducers and Amplifiers

Specification

Transducers are tested in water at 20°C unless stated otherwise.

f_s: Resonant Frequency; **IM**: Impedance Matching; **η_{ea}**: Electroacoustic Efficiency; **PF**: Power Factor; **TVR**: Transmitting Voltage Response; **SL**: Sound Level; **FFVS**: Free-field Voltage Response, Receiving Voltage Response (**RVR**), or Voltage Sensitivity; **DRP**: Directional Response Pattern; **HxV:** Horizontal x Vertical Beam Angles. **SLL**: Sidelobe Level; **SRD:** Sound Ranging Distance along Axis of Main Lobe; **Z**: Complex Impedance; **|Z|**: Impedance Amplitude; **θ**: Impedance Phase; **Y**: Admittance; **G**: Conductance of Admittance; **B**: Susceptance of Admittance; **Q_m**: Mechanical Quality Factor; **Q_e**: Electrical Quality Factor; **MIPP**: Maximum Input Pulse Power; **MPW**: Maximum Pulse Width at MIPP and at fs; **MCIP**: Maximum Continuous Input Power. **TR:** Transmit and Receive; **TRSW**: Transmit and Receive Switch with built-in low noise preamp and bandpass filter. **BW**: -3dB Bandwidth or Beamwidth; **PND**: Pressure Noise Density, **LNR**: Low Noise Receiver, **SC**: Signal Conditioning, **OPL**: Overload Pressure Level. **Temp.**: Temperature.

Part Number:	**BII7591**	**BII7592**	**BII7593**	**BII7594**	**BII7596**	**BII7596IM**	**BII7598IM**
Applications:	Emit Sounds, NOT recommended to detect underwater sounds.						
IM for Emit:	Optional. TVR increases with built-in Impedance Matching Network. Refer to Impedance Matching at fs.						
f_s ±10%:	18 and 29 kHz	14 and 20 kHz	10 and 14 kHz	4 and 8 kHz	3.5 and 6.5 kHz	6.5 kHz	3 kHz
Signal Type:	**Pulsing Signals of SONAR and Communication**: Tone Burst (Sinusoidal) Excitation, Chirp Pulse, Square Wave Pulse, Spike (Shock) Pulse, Coded Excitation (Barker/Golay), etc.						
	Continuous Signals, Arbitrary Signals, Aquatic/Marine Animal Sounds, Ambient and Ship/Vehicle Noises, etc.						
DRP:	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**.						
SLL:	None						
Free C_f at 1kHz:	16 nF ±10%	20 nF ±10%	44 nF ±10%	115 nF ±10%	69 nF ±10%	N/A	N/A
Dissipation D:	0.005 at 1kHz						
Q_m at fs:	3.5	1.5 to 3				2.0	2.0
	-3dB bandwidth $\Delta f = fs/Q_m$. Q_m determines the transient response or the rise and fall rings of steady-state response.						
$\eta_{ea\ at\ fs}$ at f_s:	0.525	0.93	0.9 ± 5%				
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. Driving Transducer with Continuous Signals: (1). Electroacoustic Efficiency η_{ea} is quite low at $f << f_s$ and drops gradually at $f > f_s$. It is NOT recommended to apply high voltage to transducers to emit high power sounds at frequencies far from f_s. Otherwise, transducer may be damaged by over-voltage and/or 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 $f \le 0.8*f_s$ and $P_i \le 0.2$*MIPP at $f \ge 1.3*f_s$. **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 pulsing power sounds at frequencies far from f_s with **Pulsing Signals with Duty Cycle ≤ 10%, Pulse Length ≤ 10mS**. The applied voltage must be less than the rated safe voltage of the transducer. Otherwise, transducer will be damaged by overvoltage and/or overheating.						
PF at f_s:	0.185	0.123	0.21	0.36		≥ 0.94	≥ 0.94
TVR at f_s:	Refer to **TVR Graph** in Water, Transmitting Voltage Response. µPa/V at 1m.					147.7 dB	147.0 dB
Radiation SL:	SL = 20*logV_i + TVR, dB µPa@1m. Driving Voltage V_i is in unit of V_{rms}.						

Y or Z:	Refer to **Admittance Graph** in Water.					50Ω at f_s	50Ω at f_s
Driving Voltage V_D 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:	120 W	270 W	480 W	480W	600 W	600 W	350W
MPW at MIPP & fs in Water: Duty Cycle D.	17 Seconds D ≤ 30%.	35 Seconds D ≤ 40%.	60 Seconds D ≤ 40%.	30 Seconds D ≤ 20%.	200 Seconds D ≤ 40%.	200 Seconds D ≤ 40%.	Continuous
MCIP at fs in Water:	50 W	100 W	200 W	110 W	260 W	260 W	350W
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.							
Operating Depth:	≤ 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. Bolt-Fastening Mounting with Free Hanging (**BFMFH-1/4", BFMFH-3/8"**). 3. Free-hanging with Male Underwater Connector (**FHUWC-3P**).						
	Please refer to online document **AcousticSystem.pdf** for a complete list of Mounting Options and more details.						
Cable:	1. Shielded Cable (**SC**), Rubber Jacket. Two Conductors (AWG20, 600V, 4A.). 2. Unshielded Cable (**USC),** Rubber Jacket. Two Conductors (AWG18, 600V, 10A.). 3. 50Ω RG58 Coax (**RG58**). Transmit Power of RG58 and BNC: (1) Continuous Power ≤ 300W at fs; (2) Pulse Power ≤ 1000W with D ≤ 10%, PD ≤ 100mS at fs.						
	Handling: Do not use cable to support transducer weight in air; Always use mounting part, if any; Do not bend the cable.						
Cable Length:	1. Default: (a) 15m (49.2ft) for Non-Underwater Connectors. (b) 0.6m (2 ft) with Underwater Mateable Connectors: (2 pins) (**UMC2P**) and (3 pins) (**UMC3P**). 2. Custom-fit Cable Length up to 152m (500 ft). Note: limited by power consumptions over the cable.						
Connector:	1. Default: Wire Leads (**WL**). 2. (1). Underwater Mateable Connector (2 pins) (**UMC2P**) (1.1). Transducer Power ≥ 800 W rms: IL2M + Locking Sleeve: DLSA-M, Max. Diameter Φ35.5 mm. (1.2). Transducer Power < 800 W rms: MCIL2M + Locking Sleeve: MCDLS-F, Max. Diameter Φ22 mm. (2). Underwater Mateable Connector (3 pins) (**UMC3P**) (2.1). Transducer Power ≥ 800 W rms: IL3M + Locking Sleeve: DLSA-M, Max. Diameter Φ35.5 mm. (2.2). Transducer Power < 800 W rms: MCIL3M + Locking Sleeve: MCDLS-F, Max. Diameter Φ22 mm. Note: Underwater Mateable Connectors (**UMC**) is from well-known global manufacturers. 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). 5. DIN Receptacle with 3 Male Pins (**DIN3P**), (Max. Diameter Φ17 mm). 6. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm), for Transmit Grounded Signal.						
	Underwater Mateable Connectors (UMCs) are rated for subsea submersion, whereas standard connectors and wire leads are rated for use only in dry, non-submerged environments.						
1. **BNC**: "Bayonet Neill–Concelman" is a miniature quick connect/disconnect radio/audio frequency connector used for coaxial cable. **Fastening Type: Bayonet Lock**. 2. **XLR**: Employed for balanced audio and DC or AC power signal interconnections, 3 to 7 contacts. **Fastening Type: Latch Lock**. 3. **MIL**: MIL-5015 Style Connectors, interconnection solution for high power signals. –55°C to +125°C, **Fastening Type: Threaded. Dry Uses**. 4. **UMC**: Underwater Mateable Connectors, interconnection solution for high power or weak signals. **Fastening Type: Threaded. Underwater Uses**. 5. **DIN**: Electrical cylindrical connectors, 3 to 14 contacts, Φ20mm diameter, used for audio, RF, digital, and DC or AC power signals. **Fastening Type: Threaded**.							
Physical Size (ΦDxH, mm):	Φ48x25	Φ60x26	Φ89x61	Φ114x90	Φ168x115	Φ168x170	Φ220x220
	Actual length depends on Mounting Parts.						
Weight in Air:	≥ 0.16 kg	≥ 0.28 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 Temp.:	-10 °C to +60 °C or 14 °F to 140 °F.						
Storage Temperature:	-20 °C to +60 °C or -4 °F to 140 °F.						
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 **highest fs**. For example, **BII7594-IM50Ω**: BII7594 transducer with built-in Impedance Matching unit as 50Ω load at its highest fs or 8 kHz.						
	Phase Angle |θ| of Complex Impedance ≤ 20° 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.							

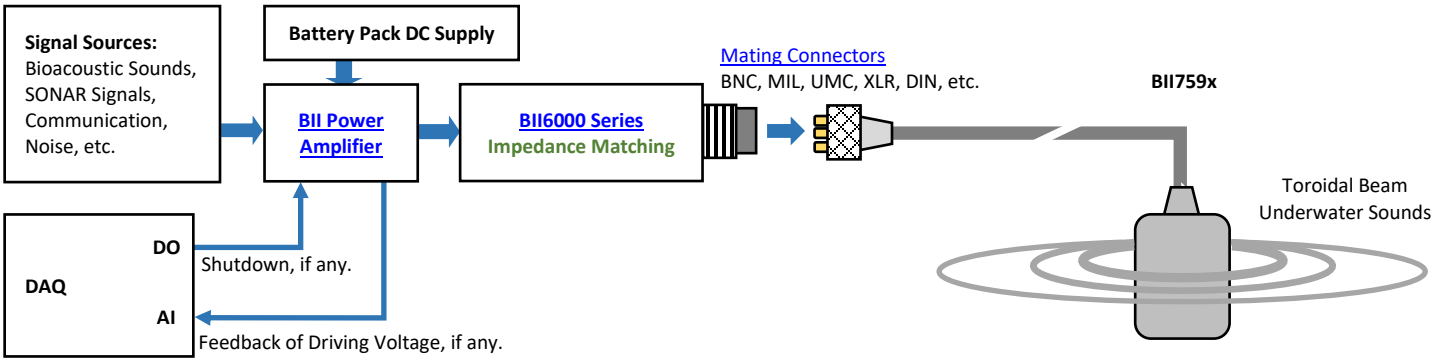
Wiring Information

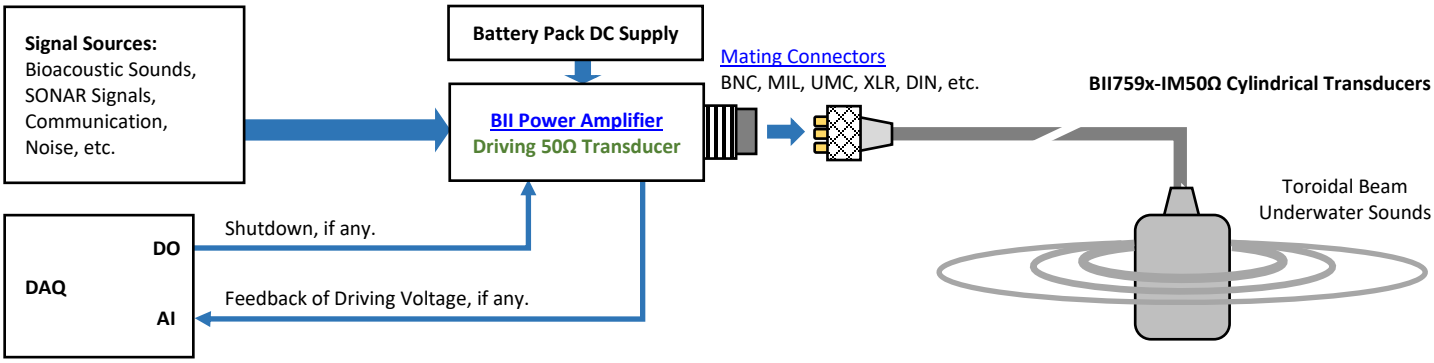
Wiring of Shielded Cable:	**Wire Leads WL**	**UMC3P, Locking Sleeve: DLSA-M.**	**MIL3P**	**BNC**
Signal	White or Red	Contact 2	Contact C	Center Contact
Signal Common	Black	Contact 1	Contact B	Shield
Shielding and Grounding	Shield	Contact 3	Contact A	Shield
Wiring of Unshielded Cable:	**Wire Leads WL**	**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		
N/A	N/A	N/A		

How to Order Transducers. The default options are for stock items which are regularly available.

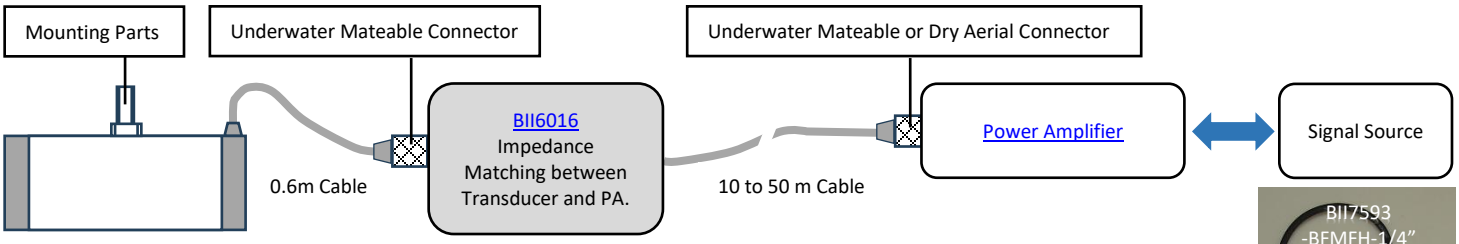
Part Number	**-Mounting**	**-Cable Length**	**-Cable Type**	**-Connector Type**
BII7591, BII7592, BII7593,	Default: **BFMFH-1/4"**.	Default: **15m, or 0.6m** for UMC2P Connector.	**SC** for MIL3P, WL. **USC** for UMC2P Connector. **Coax** for BNC.	Default: **WL**.
BII7594, BII7596, BII7596IM, BII7598IM.	Default: **BFMFH-3/8"**.			
Example:	**Description**			
BII7593-BFMFH-1/4"-30m-RG58-BNC	BII7593 Transducer, Bolt Fastening Mounting with Free Hanging: BFMFH-1/4", 30m RG58 Coax Cable, BNC Male.			
BII7596-FH-30m-SC-WL	BII7596 Transducer, Free Hanging, 30m Shielded Cable, Wire Leads.			
BII7596-BFMFH-3/8"-0.6m-USC-UMC2P	BII7596 Transducer, Bolt Fastening Mounting with Free Hanging: BFMFH-3/8", 0.6m Unshielded Cable, 2 pins Male Underwater Mateable Connector with Locking Sleeve: DLSA-M.			
BII7596-BFMFH-3/8"-30m-SC-WL	BII7596 Transducer, Bolt Fastening Mounting with Free Hanging: BFMFH-3/8", 30m Shielded Cable, Wire Leads.			

System Block Diagram of Generate Sounds with BII759x. DO: Digital Outputs**, AI:** Analog Inputs**.**
This setup is a compact and low-cost solution for end users' acoustic system by integrating BII's Power amplifier (PCB form factor) and Impedance Matching device (PCB or small-enclosure form factor) into end users' grounded enclosures.

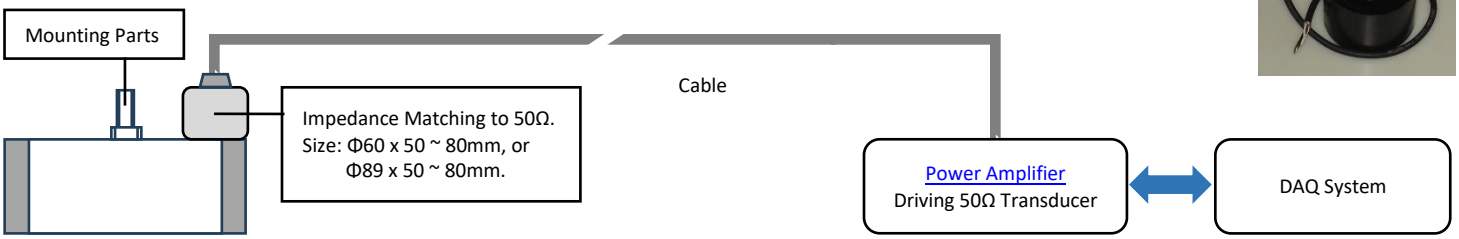




Block Diagram of BII7591, BII7592, BII7593, and BII7594 with Standalone Submersible Impedance Matching Device

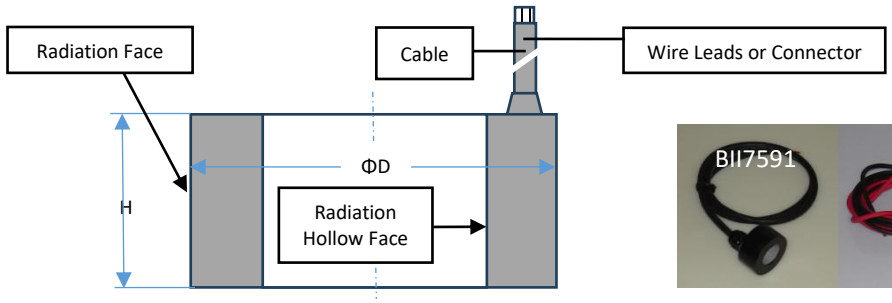


BII7596IM and BII7598IM Setup

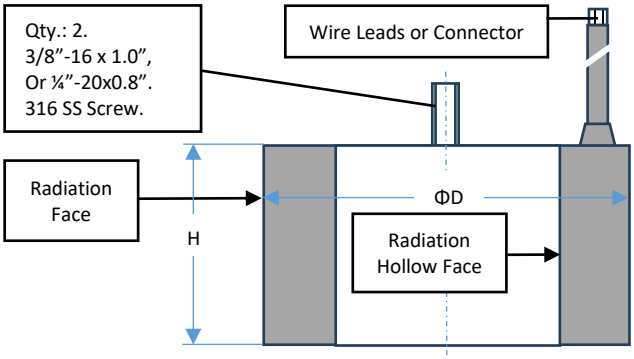


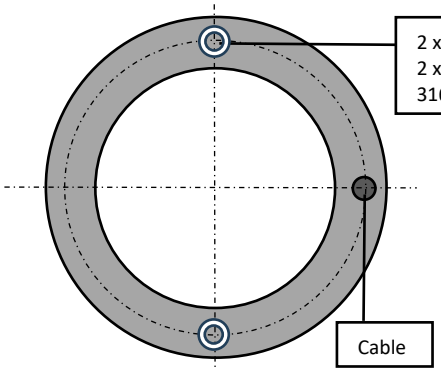
Outline Drawings

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

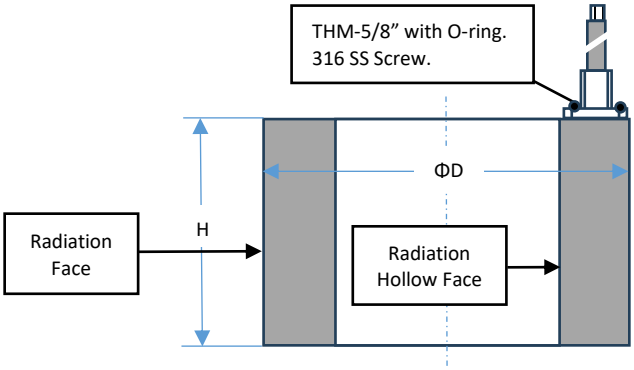


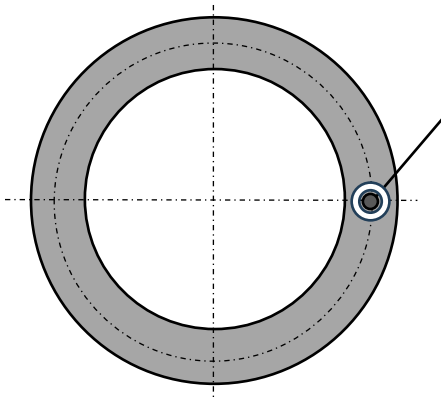
2. Bolt-Fastening Mounting with Free Hanging **(BFMFH-1/4” for BII7591, BII7592, or BFMFH-3/8” for BII7593, BII7594, BII7596, BII7596IM, BII7598IM.)**



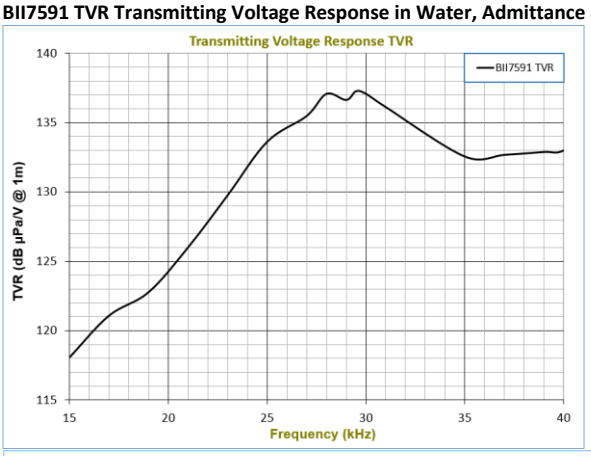


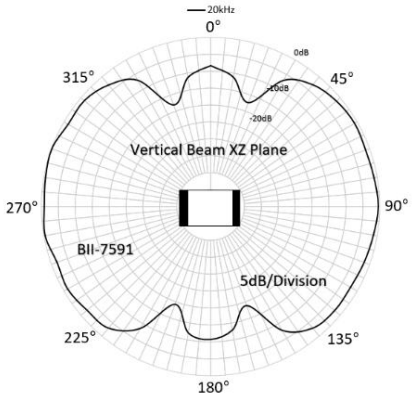
3. Thru-hole Mounting with O-ring Sealing **(THM-5/8”)**

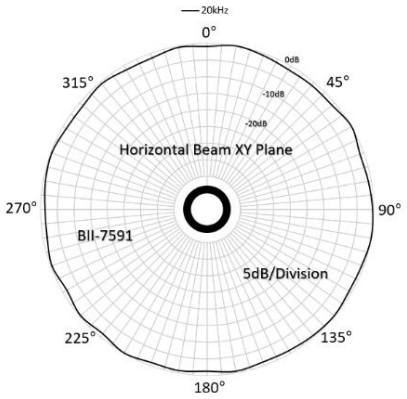


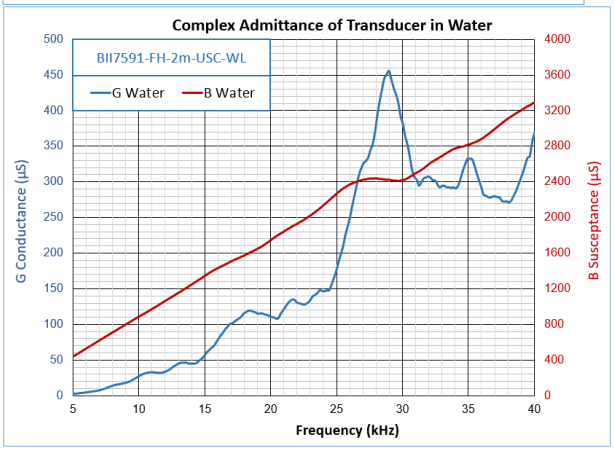


BII7591 TVR Transmitting Voltage Response in Water, Admittance and Impedance in Water, Directional Response Pattern in Water.

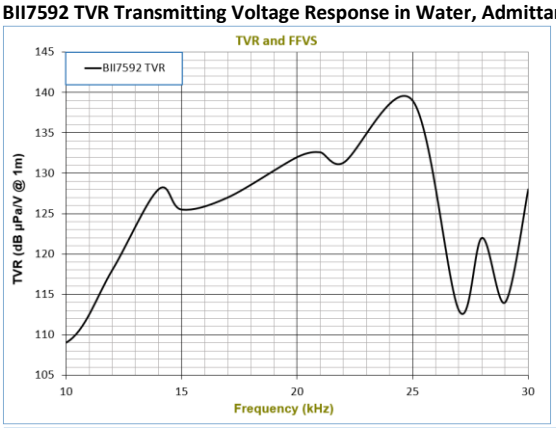


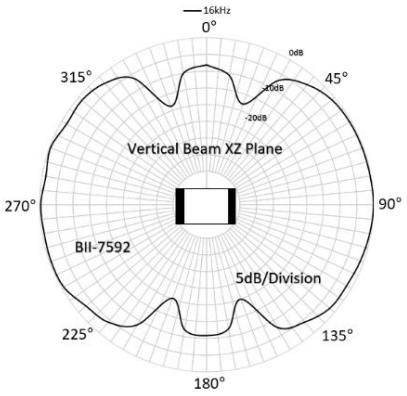


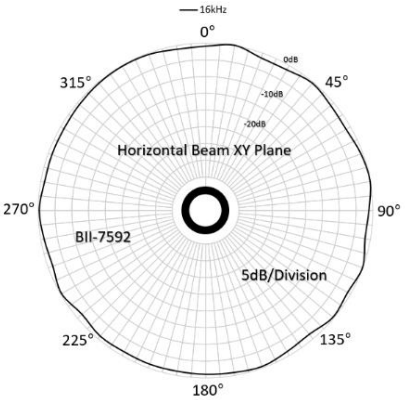


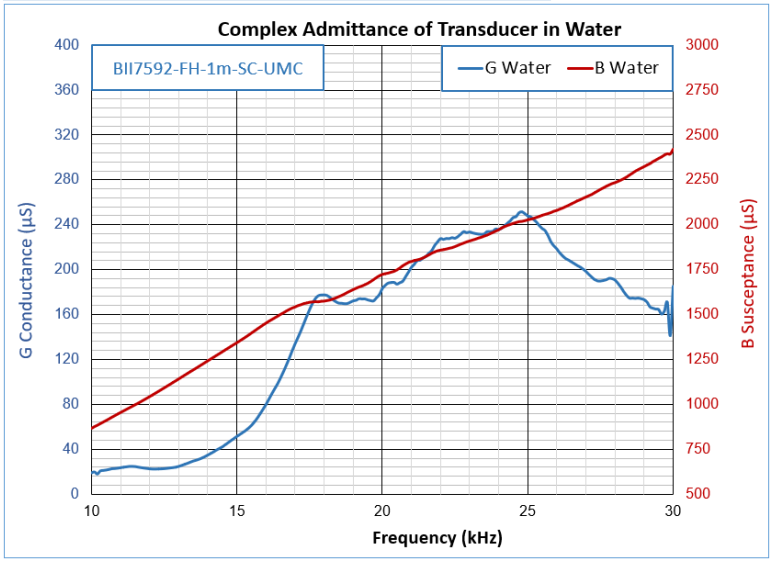


BII7592 TVR Transmitting Voltage Response in Water, Admittance and Impedance in Water, Directional Response Pattern in Water.

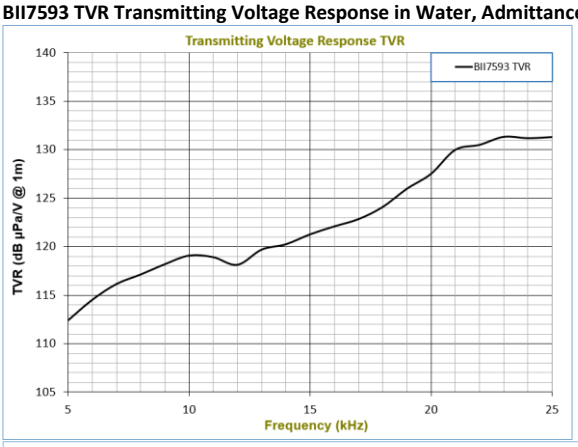


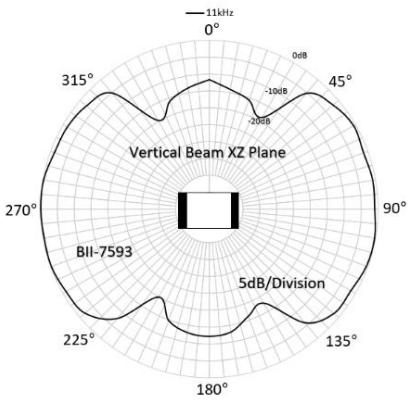


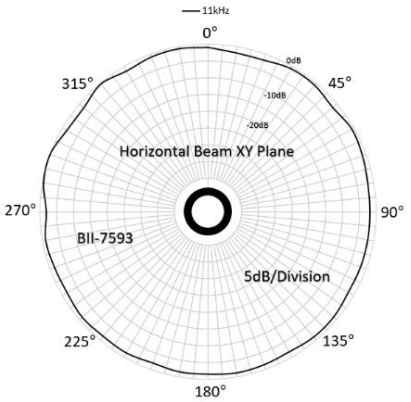


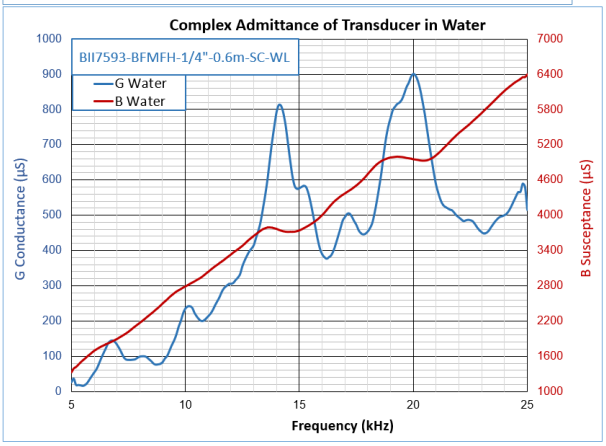


BII7593 TVR Transmitting Voltage Response in Water, Admittance and Impedance in Water, Directional Response Pattern in Water.

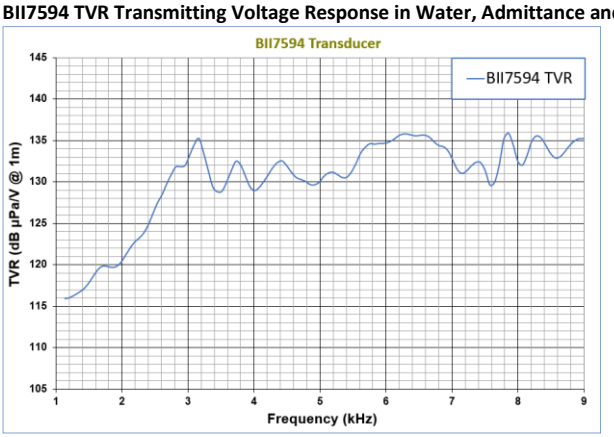


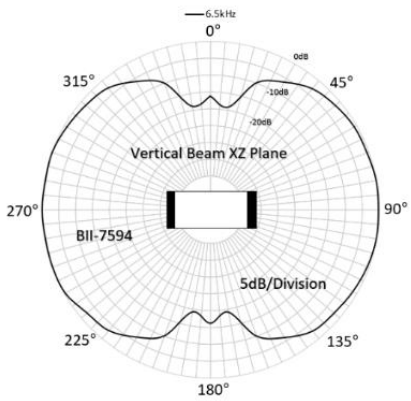


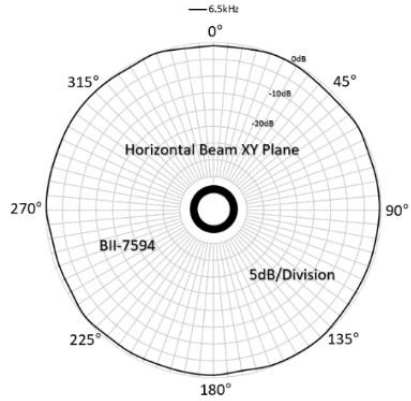




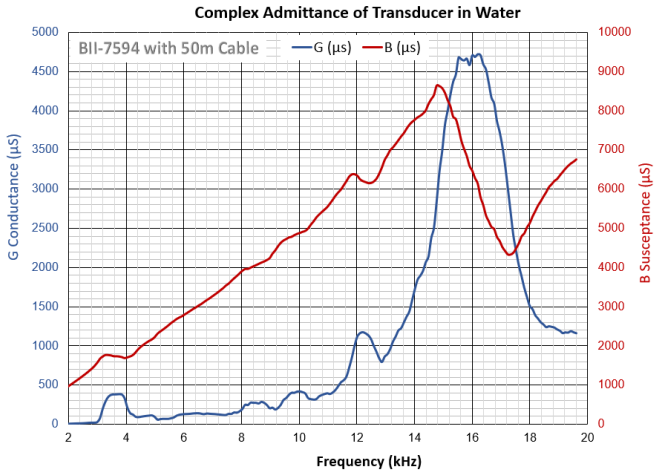
BII7594 TVR Transmitting Voltage Response in Water, Admittance and Impedance in Water, Directional Response Pattern in Water.



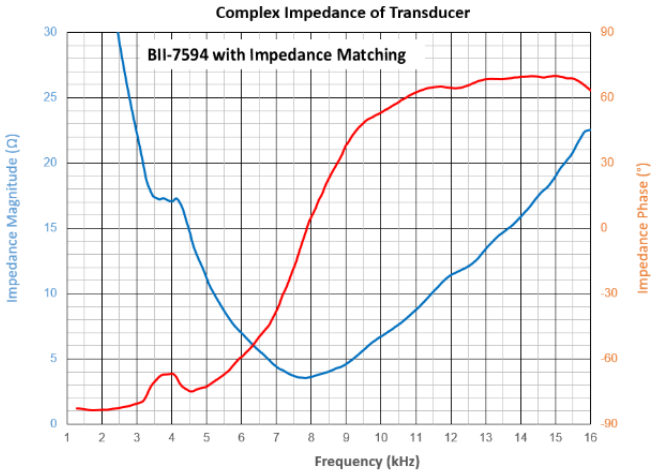




BII7594 (50m Cable) in Water

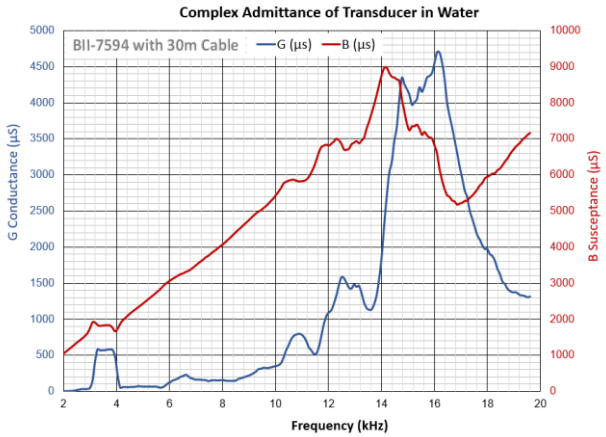


BII7594 (50m Cable) with Bespoke BII6010 Impedance Matching in Water

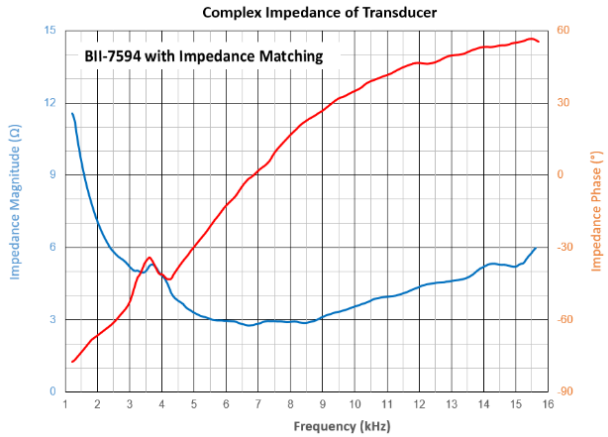


Benthowave Instrument Inc.

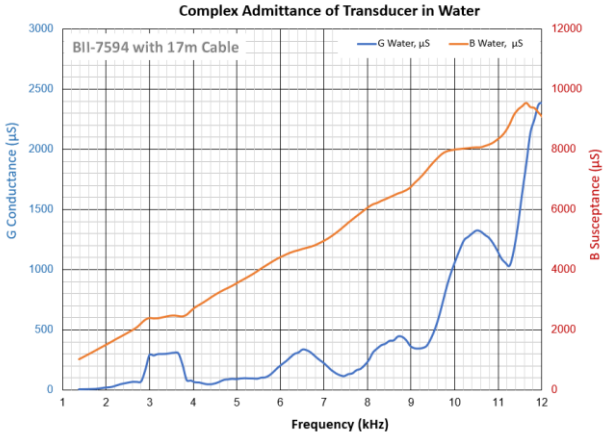
BII7594 (30m Cable) in Water



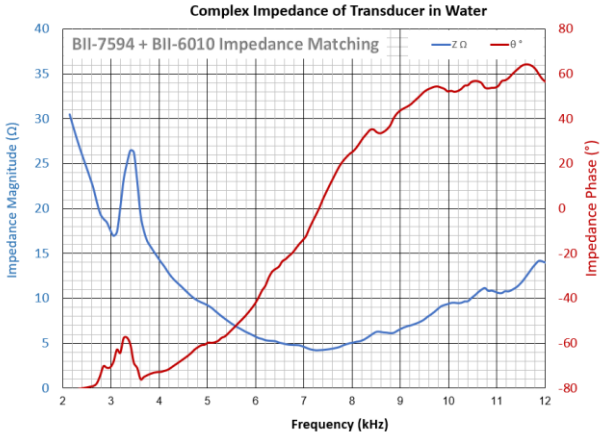
BII7594 (30m Cable) with Bespoke BII6010 Impedance Matching in Water



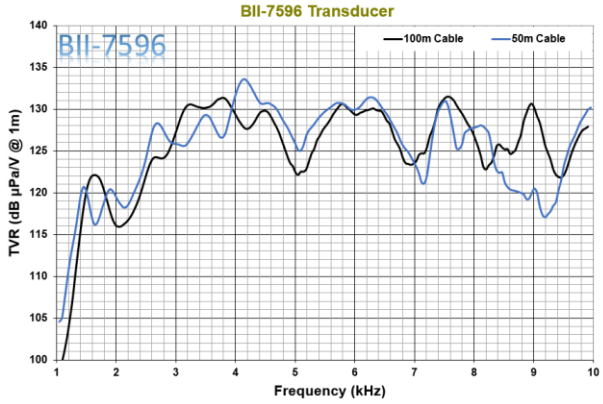
BII7594 (17m Cable) in Water

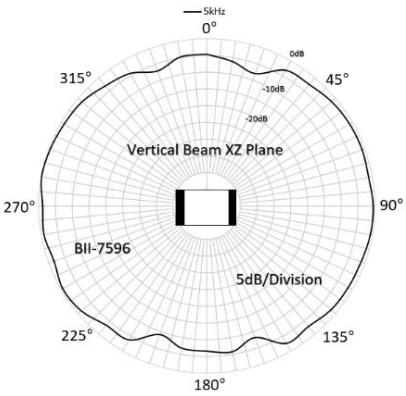


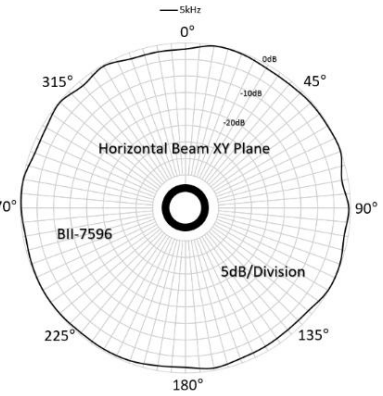
BII7594 (17m Cable) with Bespoke BII6010 Impedance Matching in Water



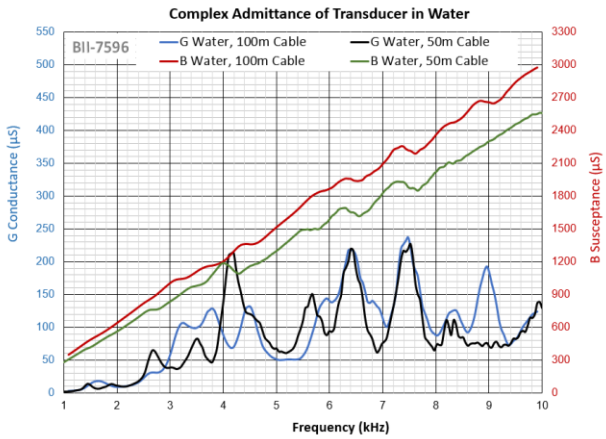
BII7596 TVR Transmitting Voltage Response in Water, Admittance and Impedance in Water, Directional Response Pattern in Water.







BII7596 in Water



BII7596 with Bespoke BII6010 Impedance Matching in Water