BII7720 Series Flush-Mounting Transducer: Flush-Mounting Transducer: SONAR, NDT, AE.

BII7720 series transducers mount through a hole or counterbore hole cut in the housing of SONAR/NDT/AE instruments, apparatus, vehicles (or towed streamlined body), pipes, or the wall of swimming pools. The flush-mounting design of these transducers minimizes surface discontinuity between the transducer and the mounting wall (or hull), and allows for smooth water flow over the surfaces, resulting in much lower induced acoustic noise (hydrodynamic noise, flow noise), less drag/resistance, avoidance of accidental collision and better acoustic performance for the underwater devices in motion such as towed fish/bodies, ROV/AUV/UUV, robots, etc... Low-profile flush installation protrudes only 4.75mm outside the housing with streamlined flange.
Transducers emit and receive conical beams, and are designed for use as components in communication/positioning, navigation, fishery, oceanography, Seafloor-mapping, Marine Animals research, NDT/AE, etc....
The housing can be mounted on different materials such as woods, plastics, fiber glass, ceramics and metals. Marine sealants shall be used for sealing, bedding and installation. The depth rating is limited by the sealing performance of the cured marine sealants.
In NDT and AE applications (as immersion transducers or contact transducers), the couplant (water, gel, grease, oils, commercial couplant, and shear-wave couplant) is a necessary material to provide efficient acoustic coupling between the transducer face and the subject (piece under test).

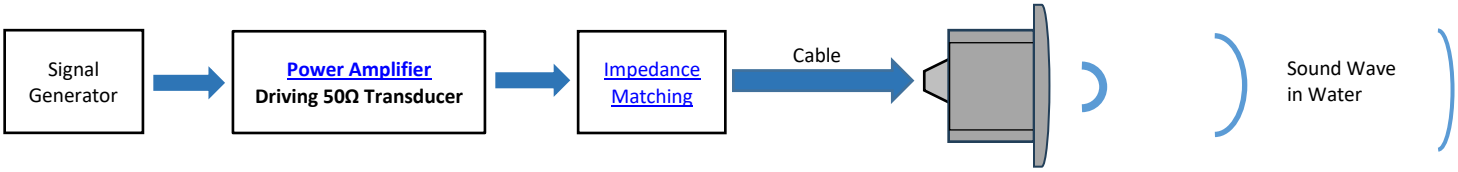
Typical Applications

Towed Sonar/Bodies, Vessels in Motion, Sonobuoy, Towfish.	Communication/Remote Control/Telemetry/Positioning.
Sonar Navigation, Inspection and Survey, NDT/AE Instruments.	Object Detection/Tracking/Avoidance, Fish finder.
Surface Continuity for Low Acoustic Perturbation.	Aquarium/Pool/Underwater Security, Alarm System.
Sound Velocity Profiler, Bathymetric Sounder, Depth Sounder.	Precision Distance Gage, Altimeter, Liquid Level.
Bioacoustics: Marine Animals, Fishery and Plankton.	Process Measurement and Control.

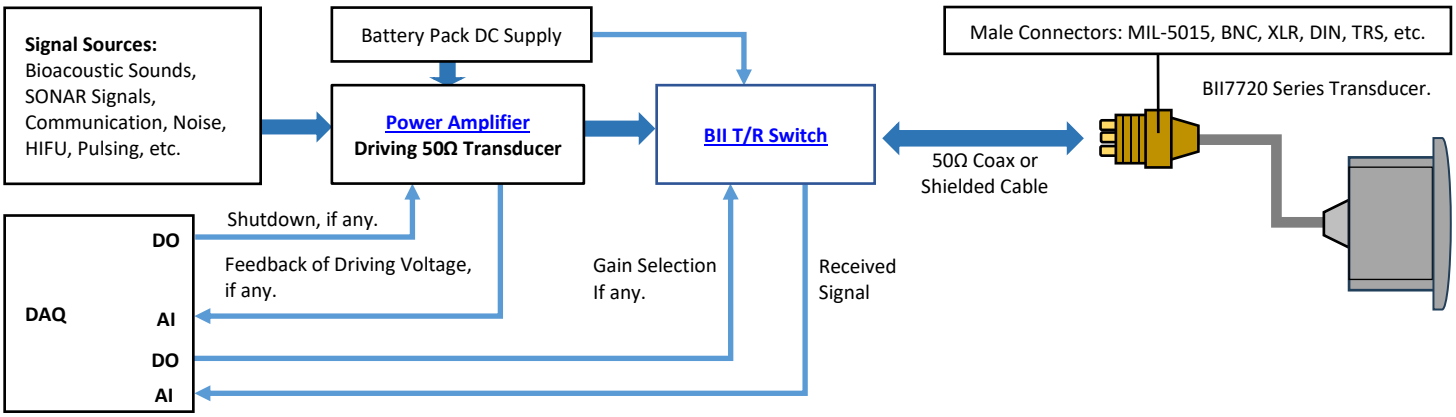
RELATED PRODUCTS

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

SYSTEM CONFIGURATION
(a) Transmitting Sounds.



(b) Transmitting and Receiving Sounds.



TRANSDUCER SPECIFICATIONS

TVR: Transmitting Voltage Response (dB µPa/V at 1m); **FFVS**: Free-filed Voltage Sensitivity (dB V/µPa); **θ**: Beamwidth at -3dB; **fs**: Resonant Frequency (kHz); **Qm**: Quality Factor, -3dB Bandwidth=fs/Qm; **ΦD**: Flange Diameter; **L**: Body Length. **MIPP**: Maximum Input Pulse Power; **MCIP**: Maximum Continuous Input Power; **MPW**: Maximum Pulse Width at MIPP. **C_h**: Transducer Capacitance, **D**: Dissipation at 1kHz, **G**: Conductance at fs.

Transducer	fs (kHz)	TVR	FFVS	θ	Qm	C_h (nF)	MIPP	MCIP	MPW	G @ fs	Size ΦDxL	Mounting Thread[1]
BII7723/22	22	121	-177	160°	15	0.131	225W	2.0W	65s	0.014mS	Φ59x80	M35x1.5
BII7723/25	30	122	-176	140°	15	0.094	244W	2.0W	58s	0.018mS	Φ59x80	M35x1.5
BII7723/45	45	139	-177	78°	7	0.270	222W	2.5W	34s	0.196mS	Φ59x50	M35x1.5
BII7723/50	50	136	-182	70°	5	0.188	240W	2.6W	29s	0.110mS	Φ59x50	M35x1.5
BII7723/70	70	140	-184	50°	3.5	0.174	200W	4.0W	28s	0.220mS	Φ59x40	M35x1.5
BII7723/100	100	147	-187	35°	3.5	0.272	220W	4.6W	20s	0.255mS	Φ59x40	M35x1.5
BII7723/120	120	151	-189	29°	3.5	0.340	230W	5.2W	16s	0.405mS	Φ59x30	M35x1.5
BII7723/150	150	155	-191	23°	3.5	0.442	238W	6.0W	13s	0.702mS	Φ59x30	M35x1.5
BII7723/200	200	160	-193	17.5°	3.0	0.570	230W	6.2W	10s	1.300mS	Φ59x30	M35x1.5
BII7723/300	300	166	-196	12°	3.0	0.760	205W	6.7W	6.6s	2.500mS	Φ59x30	M35x1.5
BII7723/400	400	171	-199	8.7°	3.0	0.958	184W	7.0W	5.0s	4.240mS	Φ59x30	M35x1.5
BII7723/500	500	171	-196	7.0°	3.0	0.622	420W	4.3W	2.0s	4.890mS	Φ59x30	M35x1.5
BII7723/1000	1000	181	-200	3.5°	4.5	1.037	420W	4.5W	1.1s	13.58mS	Φ59x30	M35x1.5
BII7723/2000	2000	193	-206	1.8°	4.5	2.074	420W	4.7W	0.6s	54.34mS	Φ59x30	M35x1.5
BII7725/45	45	145	-184	47°	6	0.757	620W	7W	34s	0.286mS	Φ80x50	M56x4
BII7725/50	50	144	-182	42°	5	0.530	680W	7W	30s	0.215mS	Φ80x50	M56x4
BII7725/70	70	150	-184	30°	3.5	0.527	600W	10W	28S	0.345mS	Φ80x40	M56x4
BII7725/100	100	156	-187	21°	3.5	0.777	620W	13W	20S	0.729mS	Φ80x40	M56x4
BII7725/120	120	159	-189	17.6°	3.5	0.914	600W	14W	16S	1.064mS	Φ80x30	M56x4
BII7725/150	150	163	-191	14°	3.5	1.113	600W	15W	13S	1.695mS	Φ80x30	M56x4
BII7725/200	200	168	-193	11°	3.0	1.435	580W	17W	10S	3.101mS	Φ80x30	M56x4
BII7725/300	300	175	-197	7.0°	3.0	1.920	500W	18W	6S	5.910mS	Φ80x30	M56x4
BII7725/400	400	180	-200	5.2°	3.0	2.413	460W	19W	5S	10.11mS	Φ80x30	M56x4
BII7725/500	500	179	-196	4.7°	3.0	1.500	946W	10W	2.0s	12.00mS	Φ80x30	M56x4

Note[1]: Metric Mounting Thread M36x4mm replacing M35x1.5mm will be used in BII Flush-mount Transducers in future production, and not available now.

Please refer to BII7690 series transducer for 0.1 to 7.5 MHz flush mounted NDT Transducers.

Resonant Frequency f_s:	f_s ± 10%	
Transmitting Frequency:	f_s ± 20%*f_s	
Impedance Matching:	None. Order impedance matching device separately as standalone device.	
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:	Conical Beam. Refer to Graph of Directivity Pattern.	
-3dB Beam Width:	Listed in the table above.	
Side Lobes:	No Side Lobes at Beamwidth ≤ 50°; -17.7dB at Beamwidth > 50°.	
Free Capacitance C_f:	Listed in the table above. With cable, C_f increases by (Cable Length * 0.1nF/meter).	
Dissipation D:	≤ 0.015 @ 1 kHz	
Quality Factor Q_m at f_s:	Listed in the table above.	
	-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:	0.3 to 0.7 in Water, Electroacoustic Efficiency, Load Medium Dependent.	
η_{ea} at f << f_s:	at f << fs, $\eta_{ea} / \eta_{ea\ at\ fs} \approx 0.1225*(k*\Phi D)^2$. 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:	0.44 to 0.6	
TVR at f_s:	Refer to TVR Chart, 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}.	
Impedance Matching?	None	**1. Working with 50Ω Impedance Matching Device.** **2. Working with BII T/R Switch: Impedance Matching to 50Ω.**
Admittance or Impedance at fs:	Refer to G-B Chart.	Z = 50*$e^{i\theta}$, in Ω, and Phase Angle |θ| ≤ 20° at fs.
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%:** $V_{imax} = \sqrt{(MIPP * \|Z\|)}$, 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:** $V_{imax} = \sqrt{(MCIP * \|Z\|)}$, in V_{rms}.
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:	$V_i^2 * G_{max}$ or MIPP listed in table, whichever is less.	
MPW at MIPP and f_s:	Refer to the table.	
MCIP at f_s:	Refer to the table.	

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.		
Working With T/R Switch?	None	**Working with BII T/R Switch: Impedance Matching to 50Ω.**
FFVS at f_s:	Refer to the table.	Element FFVS + Preamp Gain, Refer to the table.
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1 + 2\pi f_s C_c/B)/\sqrt{[G^2 + (B + 2\pi f_s C_c)^2]/(G^2 + B^2)}\}$ **G**: Conductance at f_s; **B**: Susceptance at f_s; **C_c**: Capacitance of Extension Cable. Cable is of 100 pF/meter roughly. **FFVS**: Free-field Voltage Sensitivity. Please refer to online document **AcousticSystem.pdf** for conversion between G-B and Z-θ, if necessary.	
FFVS at f << f_s:	Refer to the table. Variation: ± 3 dB V/µPa.	Element FFVS + Preamp Gain, Refer to the table. Refer to the table. Variation: ± 3 dB V/µPa.
	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:	1 Hz to 1.5*f_s.	2 kHz to 1.5*f_s.
Built-in Filters:	**High Pass Filters** are formed with Ch of transducers and R_i of Preamps. -3dB High Pass Frequency: f_{-3dBH} = 1/(2πRiCh). R_i: Input Resistance or Impedance of Preamp. C_h: Capacitance of transducer at 1 kHz (non-resonance measurement) or fs (resonance measurement such as NDT pulsing system). For example: A transducer 10nF at 1kHz and preamp Ri 100MΩ constitute high pass filter with -3dB frequency at 0.159Hz.	Bespoke HPF, or BPF. Minimum high pass filter f_{-3dB} is 2 kHz. 1. Reduce Noise. Both ocean ambient noises and the self-noises of electronic devices decrease when frequency increases. It is recommended to choose a built-in high pass filter to reject noises in low frequency range. For example, if you are interested in the signals greater than 50 kHz, you may specify a high pass filter with -3dB cut-off frequency at 5 kHz to improve signal to noise ratio of the signals of the interest. 2. Avoid Saturation. When there are strong low frequency noises, disturbances, and/or vibrations, resulting from rough surface waves and/or mechanical movements of the platform, it is recommended to specify a high pass filter to avoid hydrophone saturation in these low frequency ranges.
Amplitude Shading:	1. Default: None. 2. Bespoke, side lobes ≤ 30 dB is available upon request for BII7725/150, BII7725/200, BII7725/300, BII7725/400, BII7725/500. Note: -3dB beam angle of the main lobe increases with amplitude weighting/shading.	
Marine Sealants or Gasket:	**NOT supplied by BII.** Buyer can purchase them from buyer's local stores of adhesives, boats, automobiles, and industry suppliers.	
Operating Depth:	≤ 100 m or 1 MPa Pressure.	
	Limited by the performance of the sealing materials (such as marine sealants or gasket) over the mounting hole.	
	For deeper underwater deployment (maximum 300m) with **BII7723/xxx series (NOT BII7725/xxx series)**, one option is that O-ring grooves are cut on the mounting wall and O-rings are used besides marine sealants or casting sealants. The surface finish of the flange against the mounting wall: 50.8 microns Ra, Linear tolerance +/-0.12mm, or better.	
Mounting Options:	Refer to Table.	
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. 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). 6. 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: 0.15 m (6"). 2. Custom-fit.	
Connector Options:	1. Default: Wire Leads (**WL**). 2. MIL-5015 Style (3 pin) (**MIL3P**) (Max. Diameter Φ19 to Φ30 mm). 3. XLR Receptacle with 3 Male Pins (**XLR3P**), (Max. Diameter Φ20.2 mm). 4. DIN Receptacle with 3 Male Pins (**DIN3P**), (Max. Diameter Φ17 mm). 5. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm).	
Weight:	≥ 0.2 kg with 0.15 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.	
Impedance Matching at f_s:	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices.	
	Phase Angle |θ| of Complex Impedance ≤ 20° at fs.	
TR Switch Module:	BII2100 Transmitting & Receiving Switch Module with Built-in Preamp and Bandpass Filter. 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.	
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.	
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.
The TVR of the transducer is NOT affected with the cable length. Receiving Sensitivity Loss Over Extension Cable (dB) = 20*log[Ch/(Ch+Cc)]; Ch - Transducer Capacitance; Cc - Extension Cable Capacitance. Array directivity function = (directivity function of array element) * (directivity function of array pattern).

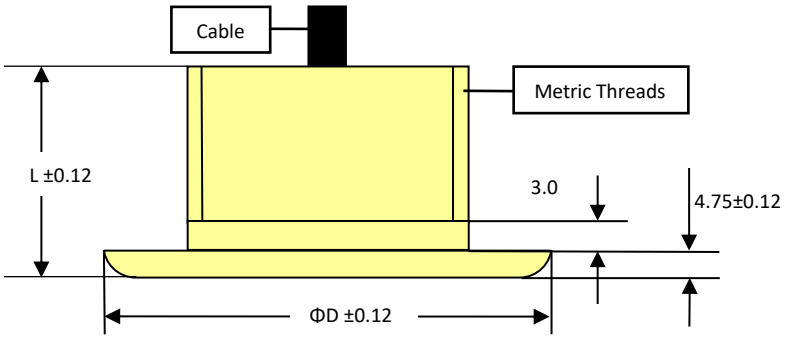
Wiring Information

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

Table 1. Flush Mounting (Marine Sealant or Gasket) (FSM)

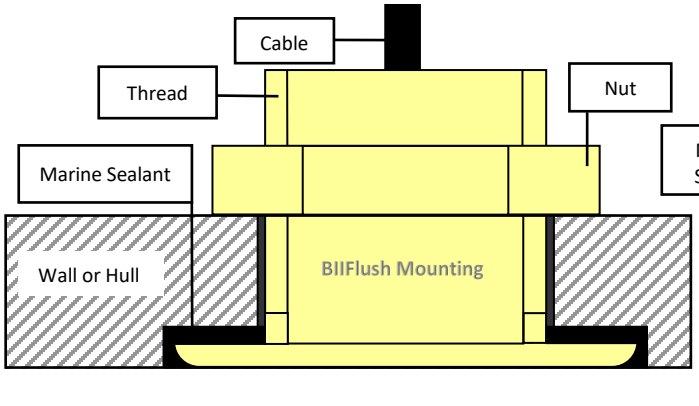
Acoustic Aperture	**Thread**	**Housing Length L (mm)**	**Flange Diameter ΦD**	**Hex Nut**	**Mounting Wall Thickness**	**Fastening Torque**
≤ Φ5 mm	M10x1.5	24.75	Φ18	Included	≤ (L – 14)	≤ 14 Nm
≤ Φ10 mm	M14x1.5	26.75	Φ22	Included	≤ (L – 16)	≤ 14 Nm
≤ Φ27 mm	M35x1.5	29.75, 40, 50, 80.	Φ59	Included	≤ (L – 13)	≤ 14 Nm
~~≤ Φ27 mm~~	~~M36x4~~	~~29.75, 40, 50, 80.~~	~~Φ59~~	~~Included~~	~~≤ (L – 13)~~	~~≤ 14 Nm~~
≤ Φ46 mm	M56x4	29.75, 40, 50.	Φ80	Included	≤ (L – 13)	≤ 14 Nm
Counterbored Mounting Hole is the best.						
Maximum Operating Depth:	**M10x1.5, M14x1.5**: 500m (5MPa), and limited by the performance of the sealing materials.					
	M35x1.5, ~~M36x4~~: 100m (1MPa) to 300m (3MPa), and limited by the performance of the sealing materials.					
	M56x4: 100m (1MPa), and limited by the performance of the sealing materials.					
Sealing Materials:	BII does NOT provide sealing materials such as marine sealants and gaskets.					
	Buyer can buy these materials from buyer's local stores of adhesives, boats, automobiles, and industry suppliers.					
Threadlockers are recommended to prevent threaded fasteners from loosening due to shock and vibration. NOT provided by BII.						

Physical Size (Dimensional Unit: mm): Nut is included with shipment.

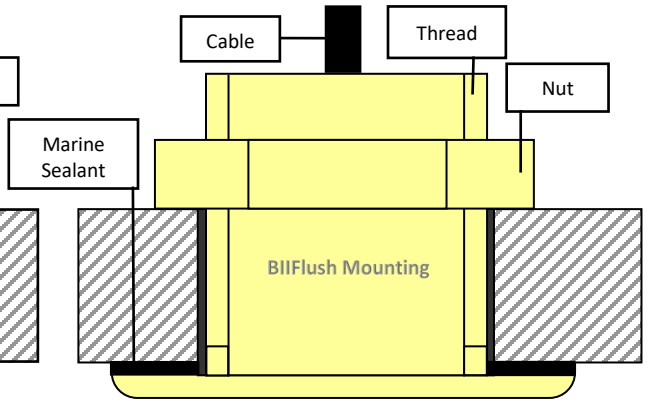


Installation/Mounting

Flush Mounting with Counterbore Hole.

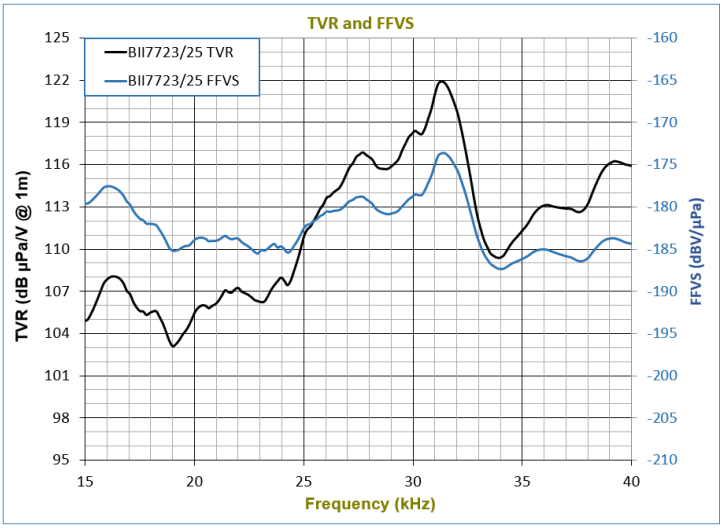


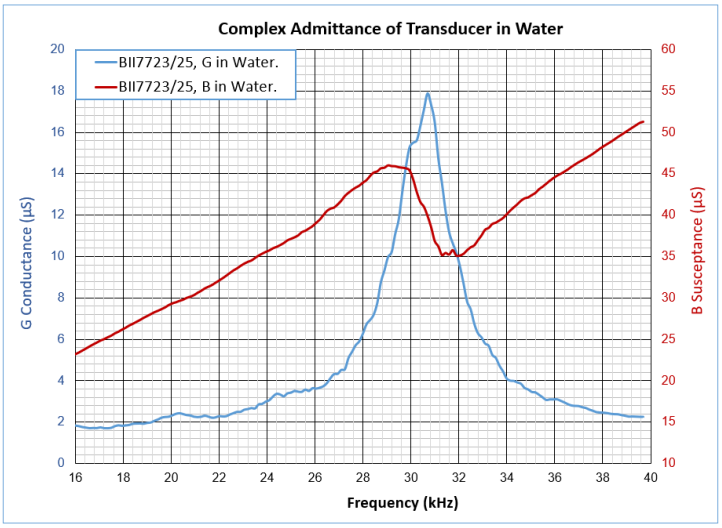
Low-profile Flush Mounting

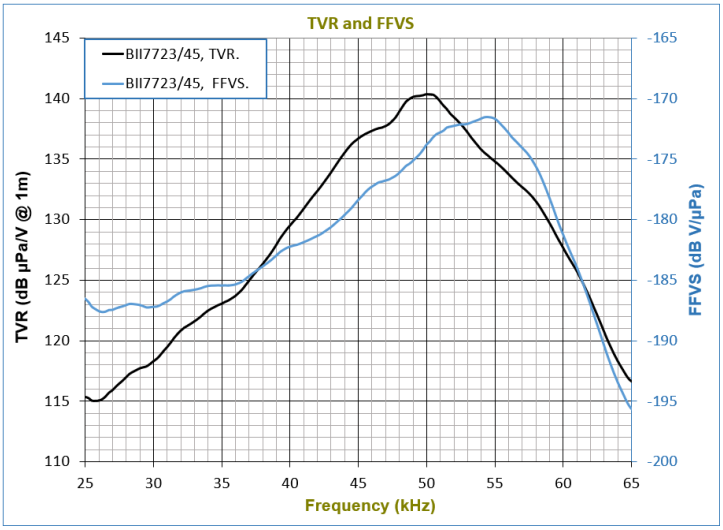


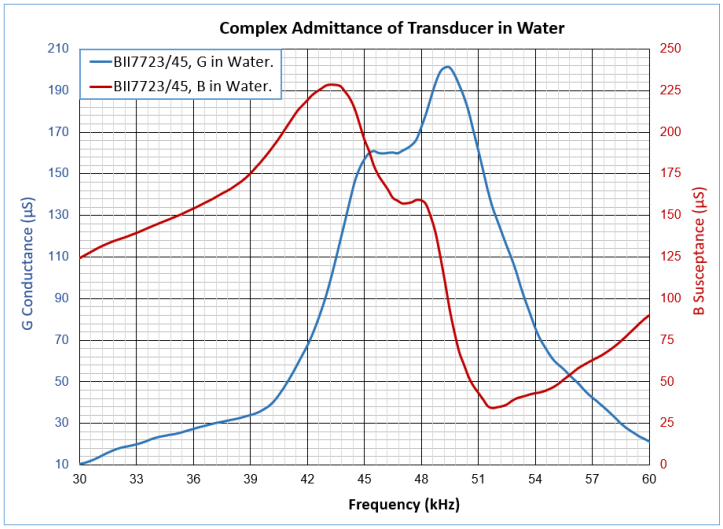
TVR Transmitting Voltage Response and FVS Free Field Voltage Response.

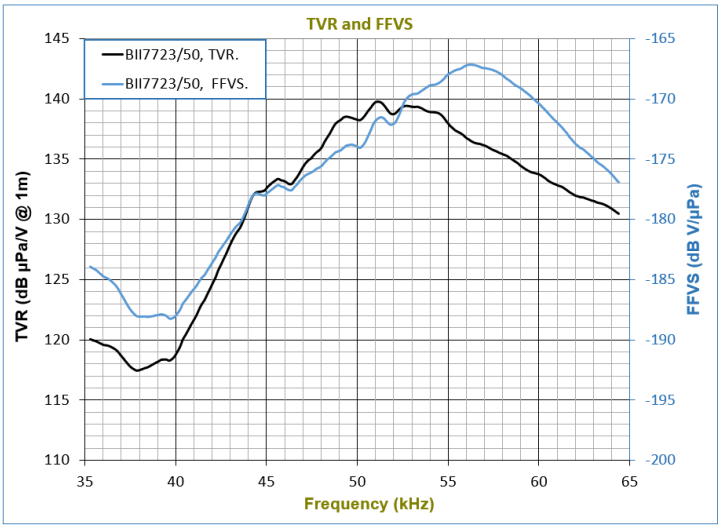
Admittance in Water

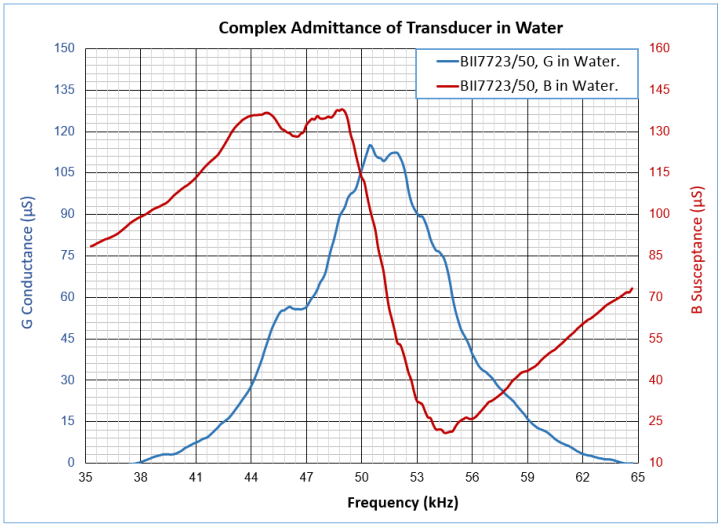




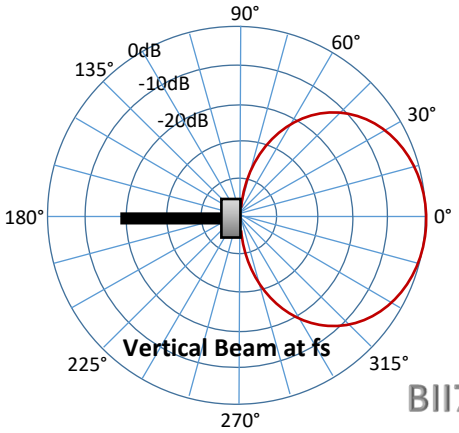


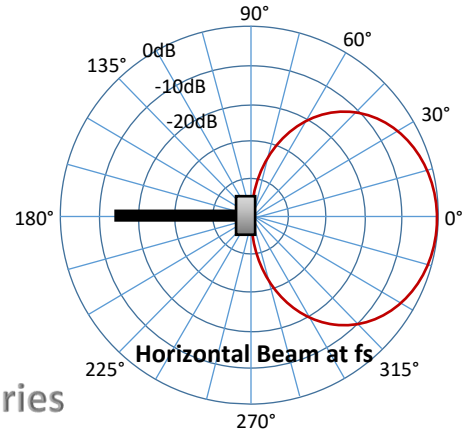






Directivity Pattern: illustration ONLY. Please refer to -3 dB beam width and side lobes of a specific transducer.





BII7720 Series