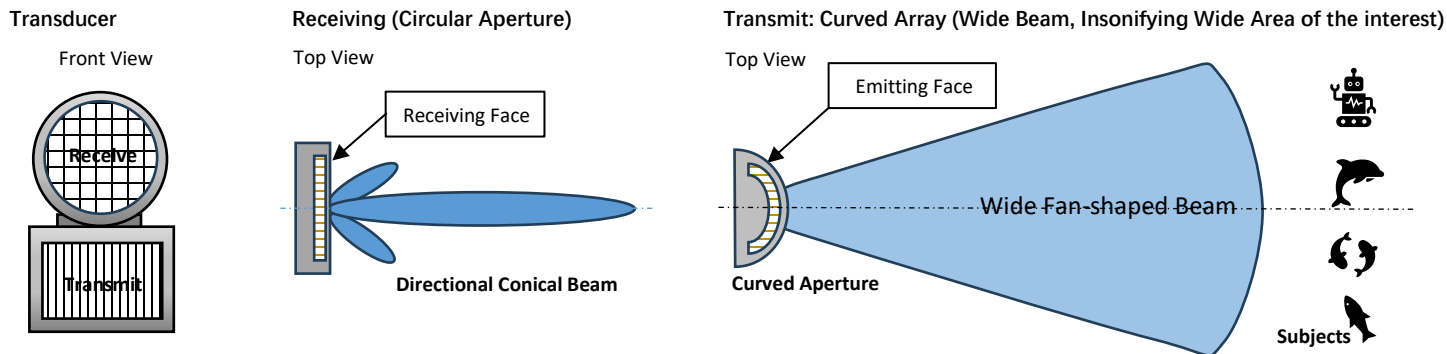


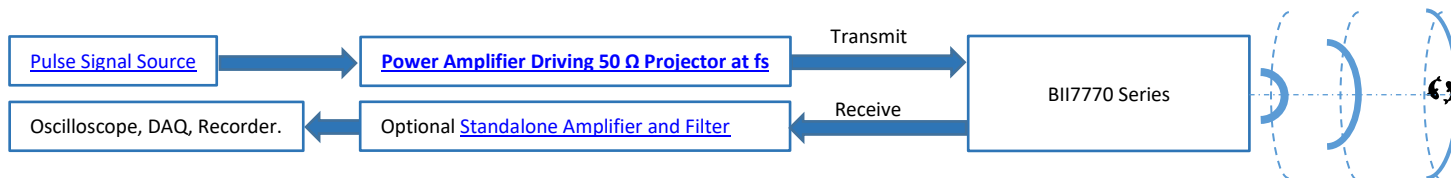
BII7770 Series Underwater Mechanical Scanning Transducer

The Underwater Scanning Transducer integrates a wide beam projector and a narrow beam low noise directional hydrophone for a portable mechanical or manual scanning SONAR. Typical applications are long range acoustic positioning, tracking, echo locating, navigation, communication, and artificial acoustic target in horizontal or vertical plane in the ocean, rivers, and lakes.



SYSTEM CONFIGURATION (Simplified Flow Charts: Control Signals, DC Power Supplies, etc. are NOT shown.)

Transmitting and Receiving Underwater Sounds:



Typical Applications

Artificial Acoustic Target: Echo-Repeater Target, Active-Acoustic Target
Underwater Telephone, Communication and Modem, Acoustic Release

Fish Finding, Underwater Acoustic Positioning: Transponder, Responder
Scanning SONAR, Tracking, Echo Locating and Navigation

Related Products

[BII5000](#) Power Amplifier
[BII6000](#) Impedance Matching for Transducers
[BII7630](#) Series Phased Array Transducer: Beamforming, Dynamic Focusing.

[BII7710](#) Scanning SONAR Transducer: 360° Search
[BII7660](#) Series Multibeam SONAR Transducers: 2D Imaging Sonar

Specification

Transducers are tested in water at 20°C unless stated otherwise.		
FG: Fixed Gain; PG: Programmable Gain; DF: Differential Output; SE: Single Ended Output; BPF: Band Pass Filter; HPF: High Pass Filter; LPF: Low Pass Filter.		
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; 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 f _s ; 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.		
Acoustic Transceiver	BII7771	BII7772
Acoustic Aperture:	Transmit: Cylindrical Segment. Receive: Circular Piston.	
Communication:	Full-duplex and Half-duplex.	
Sound Ranging SRD:	Communication: SRD ≈ 4.4 km.	Communication: SRD ≈ 3.6 km.
	Pulse-Echo or Echo Sounding Ranging: refer to Echosounding Ranging vs Target Strength in Ocean .	
IM for Emit:	Emit Element: Impedance Matching to 50 Ω.	
SC for Receive:	Built-in Fixed Gain Preamp and Filter.	
Operation Mode:	Scanning horizontally or vertically with mechanical rotation.	
Operating Depth:	300 m maximum and limited by the cable length if the cable has wire leads or a non-waterproof connector.	
Mounting Options:	1. Bolt-Fastening Mounting with Free Hanging (BFM-FH-3/8".)	
	2. End-face Mounting (EFMS)	
	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details. Mounting part and cable are at rear face of the transducer for easy rotation.	
Size:	Refer to outline drawings .	
Weight in air:	10.5 kg with 15 m cable.	9.6 kg with 15 m cable.
	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.	
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.		

Transmit (Projector) Module		
Transmitting Face:	Curved Face of Cylindrical Segment.	
DRP:	Fan-shaped Directivity, refer to Directivity Pattern .	
Beam Width θ_{-3dB} (°):	Horizontal x Vertical = H x V= θ_{-3dB} = 70° x 16°.	Horizontal x Vertical = H x V= θ_{-3dB} = 80° x13°.
Side lobes:	Refer to Graph of Directional Response Pattern .	
Transmit Frequency:	50 kHz $\pm$ 25%	60 kHz $\pm$ 25%
	Minimum 20 kHz.	Minimum 25 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.	
Signal Type:	SONAR/Communication/Pulsing Signals: SINE Pulses, Bell-shaped Sine Pulse, Chirp Pulse, PSK/FSK, Burst Pulse Train, Continuous Signals, Arbitrary Signals, etc.	
Q_m at f_s :	3.5 $\pm$ 0.5 in Water	3.8 $\pm$ 0.5 in Water
	-3dB bandwidth $\Delta f = f_s/Q_m$. Quality Factor Q_m determines the transient response or the rise and fall rings of steady-state response.	
η_{ea} at f_s :	0.89 $\pm$ 0.3 in Water, Electroacoustic Efficiency.	0.78 $\pm$ 0.3 in Water, Electroacoustic Efficiency.
PF at f_s :	≥ 0.96	≥ 0.96
TVR at f_s :	Refer to TVR Chart , Transmitting Voltage Response. Tolerance: ± 2 dB.	
Z at f_s :	$Z = 50 * e^{j\theta}$, in Ω , Phase Angle $ \theta \leq 20^\circ$ at f_s .	
Driving Voltage V_D :	Pulsing Signal: Duty Cycle $D \leq 10\%$. Pulse Width $\leq 50mS$. Max. $V_D = \sqrt{(MIPP * Z)}$, or 387 , in V_{rms} . Z is impedance at f_s .	Pulsing Signal: Duty Cycle $D \leq 10\%$. Pulse Width $\leq 50mS$. Max. $V_D = \sqrt{(MIPP * Z)}$, or 387 , in V_{rms} . Z is impedance at f_s .
	Continuous Operation: Max. $V_D = \sqrt{(MCIP * Z)}$, or 71 , in V_{rms} .	Continuous Operation: $V_D = \sqrt{(MCIP * Z)}$, or 71 , in V_{rms} .
Input Power P_i :	$P_i = V_D^2 / Z$ at f_s . Z is impedance at f_s .	$P_i = V_D^2 / Z$ at f_s . Z is impedance at f_s .
MIPP at f_s :	Maximum Input Pulse Power at f_s : $P_i = 3000$ Watts.	
MPW at MIPP and f_s :	0.05 Seconds, Maximum Pulse Width at MIPP and at f_s .	
MCIP at f_s :	100 Watts, Maximum Continuous Input Power 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 $\leq (MIPP * MPW * (120^\circ C - T) / 103^\circ C) / IPP$. T: Water Temperature in $^\circ C$. 3. Duty Cycle $D \leq MCIP * (120^\circ C - T) / 103^\circ C$. 4. Off-time $\geq PW * (1 - D) / D$.		
Cable:	1. Two Conductor Unshielded Cable (USC), Rubber, AWG18 Conductor, 600Vrms, 10A. 2. Two Conductor Shielded Cable (SC), Rubber or PVC Jacket, AWG20 Conductor, 600Vrms, 4A 3. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, $\Phi D = 4.0$ mm (SC40), up to 200 $^\circ C$, AWG20 Conductors. Handling: Do not use the cable to support transducer weight in air and water if the transducer has a mounting part.	
Cable Length:	1. Default: 15 m. 2. Custom up to 50 m.	
Transmit Connector:	1. Default: Wire Leads (WL), for Transmit, Receive Signal, and DC Power Supply. 2. Underwater Mateable Connector (2 pins) (UMC2P) (Max. Diameter $\Phi 35$ mm). Locking Sleeve: DLSA-M. Underwater Mateable Connector (3 pins) (UMC3P) (Max. Diameter $\Phi 35$ mm). Locking Sleeve: DLSA-M. Underwater Mateable Connectors (UMC) 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 $\Phi 19$ to $\Phi 30$ mm). Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.	
1. MIL: MIL-5015 Style Connectors, interconnection solution for high power signals. $-55^\circ C$ to $+125^\circ C$, Fastening Type: Threaded. Dry Uses. 2. UMC: Underwater Mateable Connectors, interconnection solution for high power or weak signals. Fastening Type: Threaded. Underwater Uses. 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.		
Receive Module		
Beam Pattern:	Conical	
Beam Width θ_{-3dB} (°):	12° at $f_s = 50$ kHz	10° at $f_s = 60$ kHz
Side lobes:	≤ -28 dB, refer to Directivity Pattern .	
Housing:	Circular Piston	
Sensitivity:	-184.0 + Preamp Gain ± 2 dB, in dB V/ μ Pa, at operating frequency f_s . Refer to Graph of FFVS vs. Frequency . Free-field Voltage Sensitivity.	
Preamp Gain:	1. Default: 24 dB. 2. Bespoke: 10 to 40 dB.	
Frequency Range:	Available: 1 Hz to 350 kHz	
Filters:	Band Pass Filter, 2nd order, 40 dB/Decade Roll-off.	
	1. Default -3dB Cut-off Frequencies: 0.1 to 350 kHz. 2. Bespoke. For example: 10 Hz to 350 kHz.	1. Default -3dB Cut-off Frequencies: 0.1 to 350 kHz. 2. Bespoke. For example: 10 Hz to 350 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 1 kHz, you may specify a high pass filter with -3dB cut-off frequency at 100 Hz 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.	
Signal Conditioning:	Additional Signal Conditioning is available such as PGA/AGC/VGA preamps with filters, which compensate the loss of sound propagation and spreading up to 90dB dynamic range depending on specific configuration. Order separately.	

Input Noise Density:	Refer to Pressure Noise Density (RTI, referred to the input).
Overload Pressure Level:	$20 \cdot \log(V_{\text{max}}/2.828)$ – Sensitivity, in dB μPa .
Output Type:	Differential
Maximum Output:	$V_{\text{max}} = (\text{Supply Voltage } V_s - 1.0)$, in Vpp.
Cable:	Four Conductor Shielded Cable (SC), AWG24 or AWG26/28.
Cable Length:	1. Default: 15 m. 2. Custom up to 50 m.
Receive Connector:	1. Default: Wire Leads (WL). 2. Underwater Mateable Connector (4 pins) (UMC4P) (Max. Diameter $\Phi 22$ mm). Locking Sleeve: MCDLS-F. Underwater Mateable Connectors (UMC) is from global manufacturers of underwater connectors. Its part number is listed in quote in detail. 3. XLR Receptacle with 3 Male Pins (XLR3P), (Max. Diameter $\Phi 20.2$ mm). XLR Receptacle with 4 Male Pins (XLR4P), (Max. Diameter $\Phi 20.2$ mm). 4. DIN Receptacle with 3 Male Pins (DIN3P), (Max. Diameter $\Phi 17$ mm). DIN Receptacle with 4 Male Pins (DIN4P), (Max. Diameter $\Phi 17$ mm). 5. Male BNC (BNC) (Max. Diameter $\Phi 14.3$ mm). Two BNCs for differential signals.
	6. +9VDC Battery Snap (BS), +9VDC or +18VDC power supply.
	7. 4mm Banana Plug Pair (Red and Black Color) (BP), DC power supply.
	Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.
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. DIN : Electrical cylindrical connectors, 3 to 14 contacts, $\Phi 20\text{mm}$ diameter, used for audio, RF, digital, and DC or AC power signals. Fastening Type: Threaded. 4. UMC : Underwater Mateable Connectors, interconnection solution for high power or weak signals. Fastening Type: Threaded. Underwater Uses. 5. 3.5mm TRS stand for Tip, Ring, and Sleeve, miniature, quick connect/disconnect, audio frequency connector used for shielded cable. Fastening Type: None.	
Supply Voltage Vs:	+4.5 to +32 VDC.
	+9, +12 or +18 VDC is recommended. Warning: DC supply voltage exceeding the +32 VDC damages preamplifier module beyond repair.
Suggested DC Supply:	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included. DO NOT use variable power supply whose maximum supply voltage is higher than the rated voltage. DO NOT use switching mode DC power supply.
Current (Quiescent):	1.45 mA

How to Order

Transducer	-Mounting	-Transmit and Receive Cable Length	-Transmit Connector	-Receive Connector
BII7771, BII7772.	Default: BFM-FH-3/8"	2 x 15m for free hanging. 2 x 0.6m (2 ft) for Underwater Connector.	Default: Wire Leads. UMC3P	Default: Wire Leads. UMC4P
Example of Part Number:		Description		
BII7771-BFM-FH-3/8"-15m-WL-WL		BII7771, 50kHz transducer, Bolt-Fastening Mounting with Free Hanging (BFM-FH-3/8"), Cable: two x 15m, Transmit Connector: Wire Leads; Receiver Connector: Wire Leads.		
BII7772-BFM-FH-3/8"-0.6m-UMC3P-UMC4P		BII7772, 60kHz transducer, Bolt-Fastening Mounting with Free Hanging (BFM-FH-3/8"), Cable: two x 0.6m, Transmit Connector: UMC3P; Receiver Connector: UMC4P.		

Transmit Wiring Information.

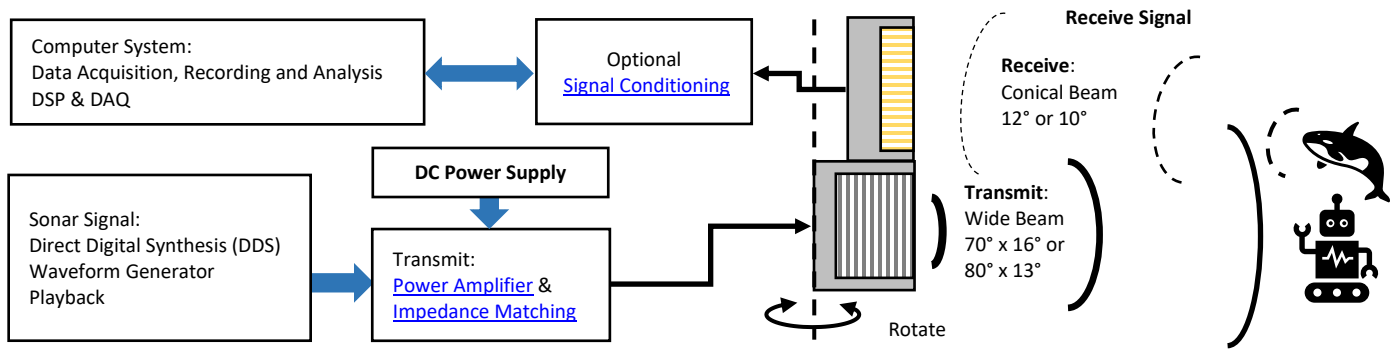
Transducer Wiring:	Shielded Cable	Unshielded Cable	UMC2P, Locking Sleeve: DLSA-M.	UMC3P, Locking Sleeve: DLSA-M.	MIL3P
Signal:	White or Red	White	Pin 2	Pin 2	Pin C or G
Signal Common:	Black	Black	Pin 1	Pin 1	Pin B
Shielding and Grounding	Shield	N/A	N/A	Pin 3	Pin A

Receive Wiring Information with Fixed Gain Preamp.

Differential Output:	Wire Leads	UMC4P/XLR4P	DIN4P	DIN3P/XLR3P + 9V BS	TRS + 9V BS
+VDC	Red	Pin 3	Pin 4	Battery Female Snap	Battery Female Snap
Common	Black	Pin 1	Pin 1	Battery Male Snap	Battery Male Snap
Signal+	White	Pin 2	Pin 3	DIN Pin3	TRS Tip
Signal-	Blue, Green, or Yellow	Pin 4	Pin 2	DIN Pin1	TRS Ring
Signal Common	N/A	Pin 1	Pin 1	DIN Pin2	TRS Sleeve
Shielding	Shield	Metal Shell	Metal Shell	Metal Shell	N/A

Optional DC Supply Connector: 4mm Banana Plug Pair, Red Plug for +VDC, Black Plug for Common of the DC power supply.

Tracking, Locating, Navigation, Communication, and Artificial Acoustic Target:



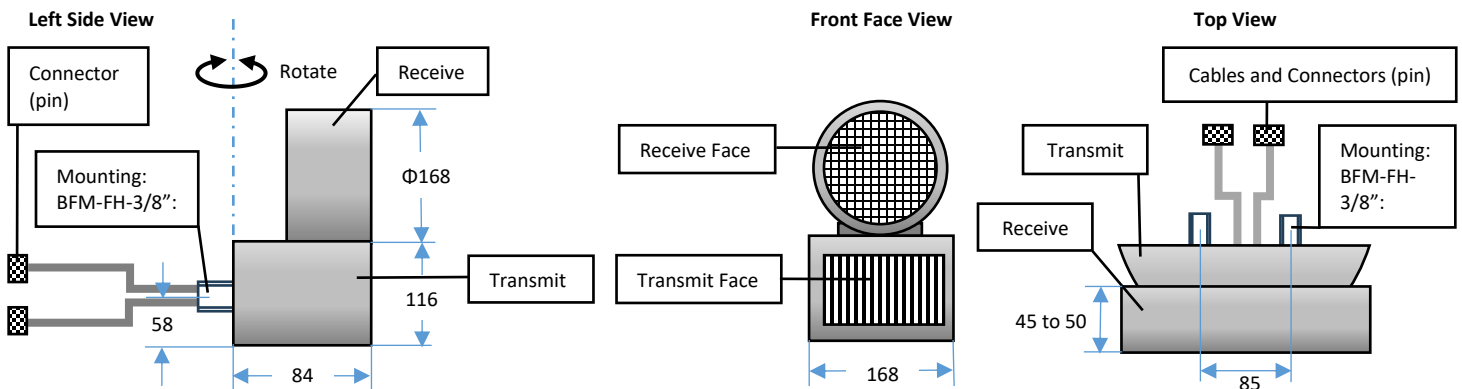
Application Notes:

Target strength of a 10"-length (0.25m) fish is about -35 dB. Echo Ranging of BII7771 and BII7772 to this fish is around 310 m.
 Target strength of a dolphin is about -20 dB. Echo Ranging of BII7771 and BII7772 to this dolphin is around 1.1 km.
 Target strength of a whale is about 0 dB. Echo Ranging of BII7771 and BII7772 to this whale is around 1.8 km.
 Target strength of seamounts is from +30 to +60 dB, say 30dB, Echo Ranging of BII7771 and BII7772 to seamounts is around 3.0 km.
 Sound Ranging of a Full-duplex and/or Half-duplex Communication system is around 4.0 km.

Physical Size (Dimensional Unit: mm), Illustration only, scale is not 1:1.

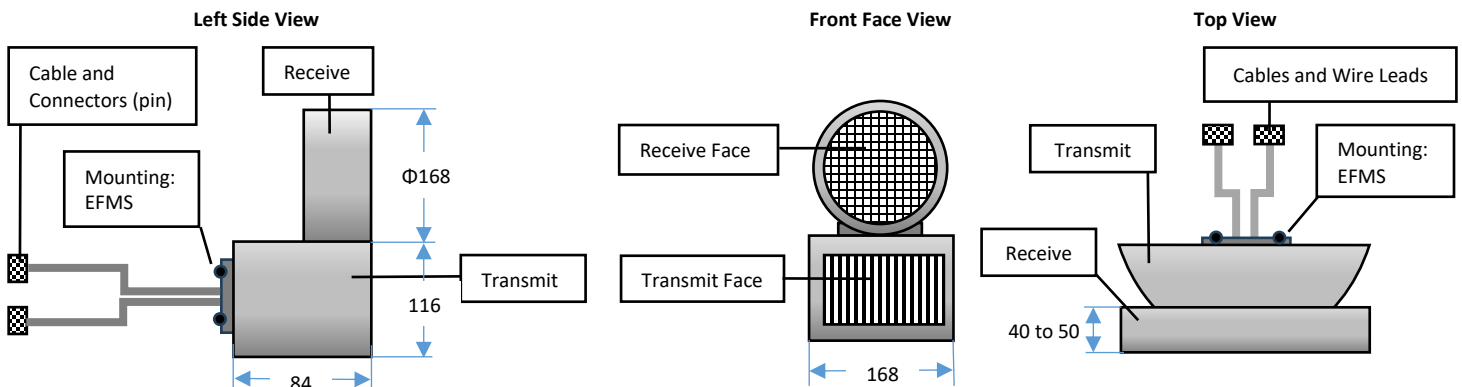
Installation with BFM-FH-3/8":

Two 3/8"-16 bolts are on the rear face of the transducer and two nuts are included. End user needs to prepare rotary device to rotate the transducer mechanically or manually for locating, searching and/or tracking the targets. Besides, the transducer can be installed on end user's underwater vehicles such as submersibles, UUVs (ROVs, AUVs.) etc. working as a forward looking SONAR transducer for obstacle avoidance, tracking, navigation, etc.



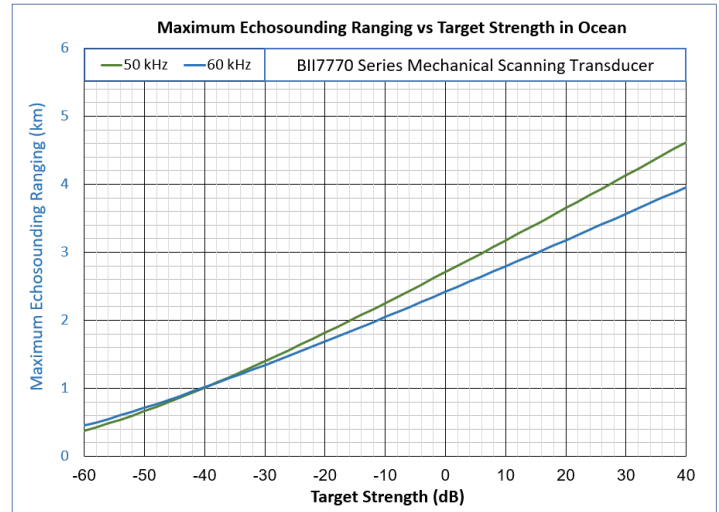
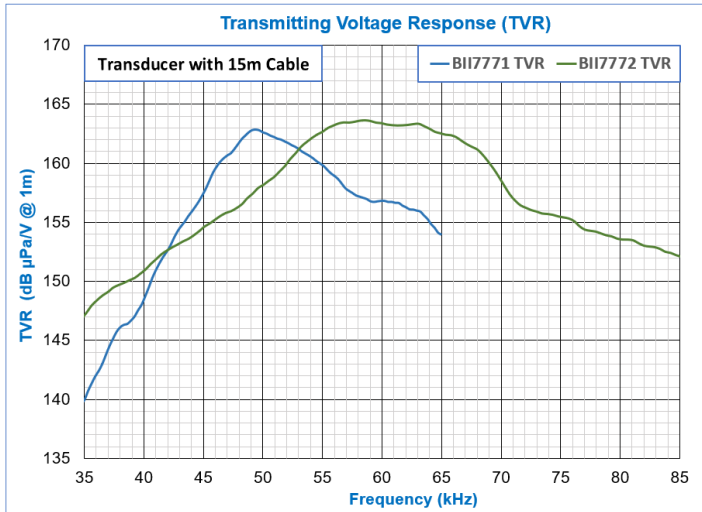
Installation with EFMS (O Ring Sealing):

End-face Mounting with O-ring sealing is installed on end user's underwater vehicles such as submersibles, UUVs (ROVs, AUVs.) etc. working as a forward-looking SONAR transducer for obstacle avoidance, tracking, navigation, etc.



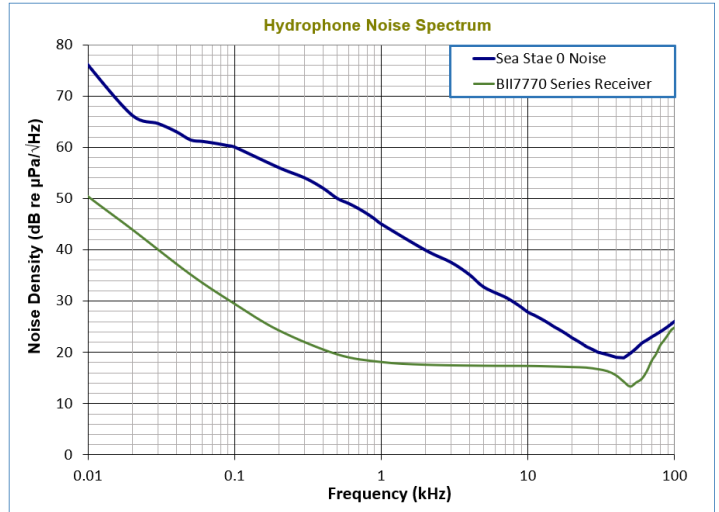
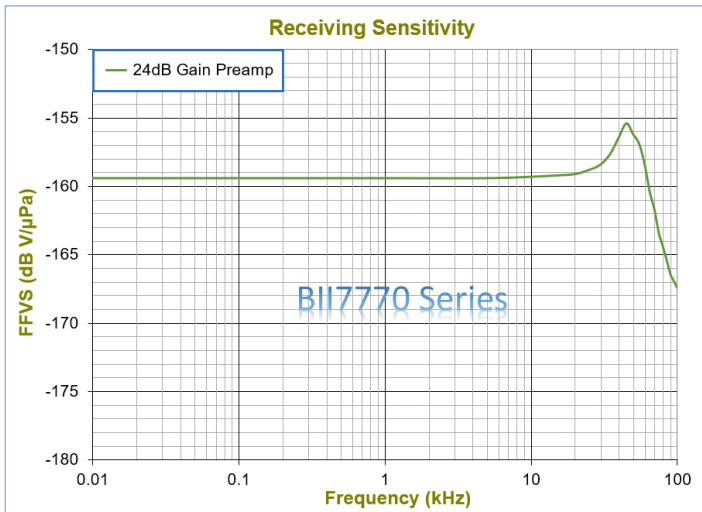
TVR Transmitting Voltage Response.

Echo-Sounding Ranging vs Target Strength in Ocean



Free-field Voltage Sensitivity (FFVS):

Pressure Noise Density of Receive (RTI, referred to the input):



Transmit Directivity Pattern

Receive Directivity Pattern

