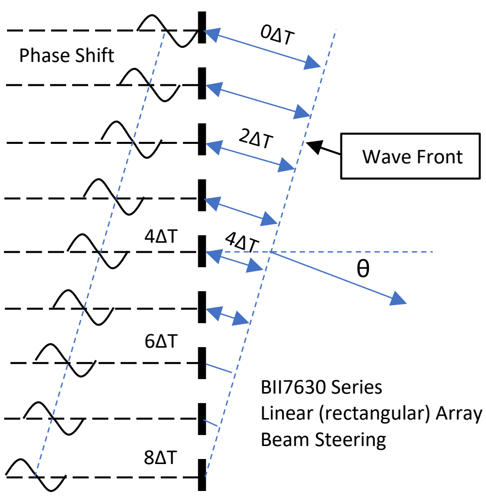
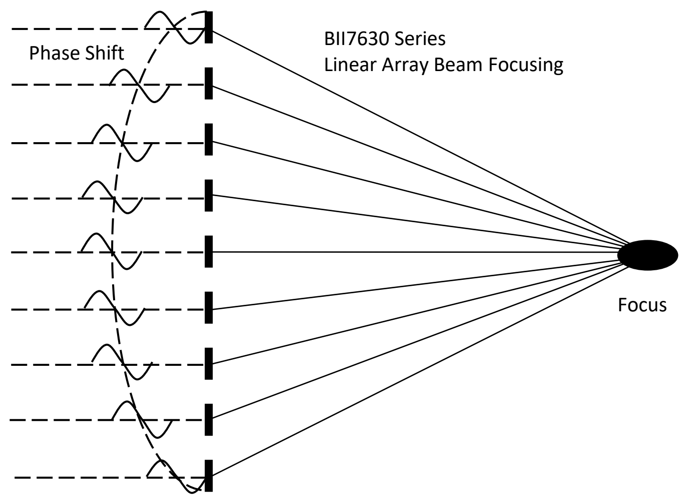
BII7630 Series Phased Array Transducer

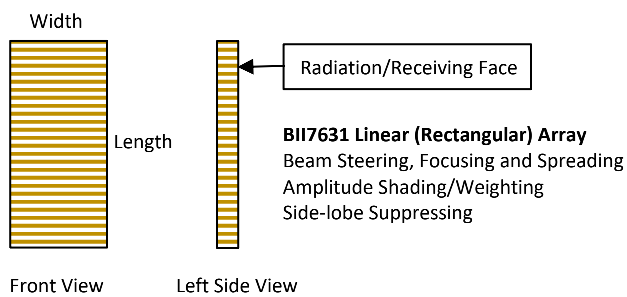
BII7630 Series Phased Array Transducer, Underwater Scanning: Positioning, Tracking, Navigation and Imaging

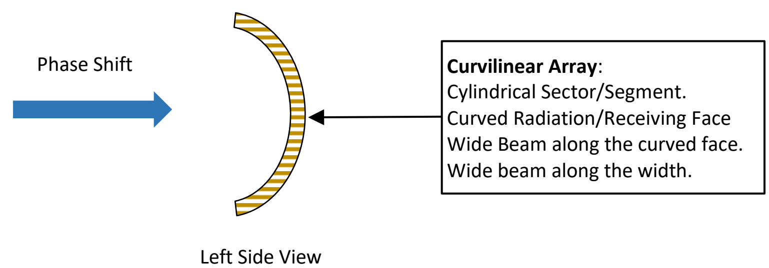
Beamforming and Total Focusing Method (TFM): Phased array transducers are rectangular (linear) array with custom-fit along-length beamwidth and cross-length beamwidth for uses in oceanography such as location, tracking and search of underwater sound sources in hundreds or thousands meter range, and in acoustical imaging and diagnosis in millimeter range such as biomedical study, NDT & AE, and material study. With dynamic focusing (Total Focusing Method TFM), both resolution and sensitivity are improved in detecting flaws or defects and acoustic imaging. Along-length beam can be steered and focused in ±75° range with array beamforming technology. Multiple beams at different directions can also be formed simultaneously with digital beamforming technology. The side lobes along length can be suppressed with amplitude shading or weighting.

Two or four array hydrophones can be used to set up "T" type cross array functioning as **Target Angle Estimation System** with Mills Cross technique. High resolution image can be formed with the technology of **Synthetic Aperture Sequential Imaging**. A phased line array transducer (projector) and a phased array hydrophone can work as a multibeam SONAR with Mills Cross technique. Multiple transducers can be wired in parallel electrically to set up a longer line array for reducing along-length beam width in low frequency range.

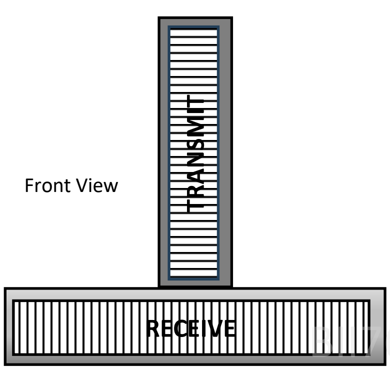




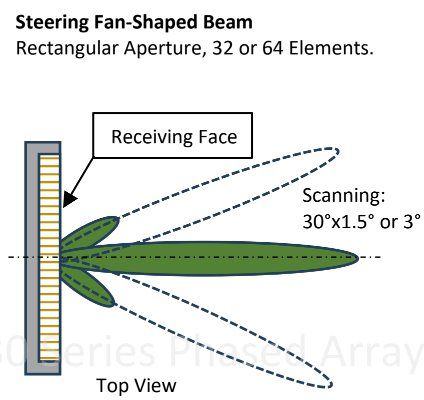




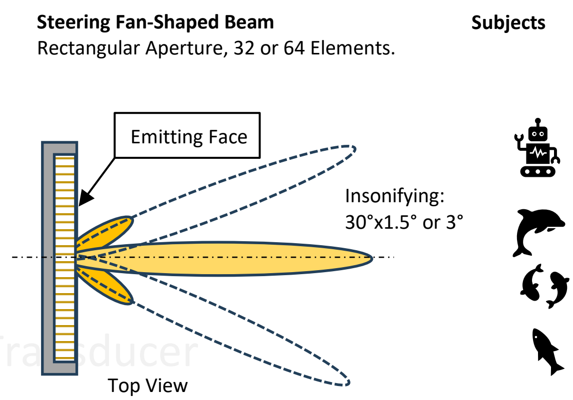
“T” Type Transducer Array



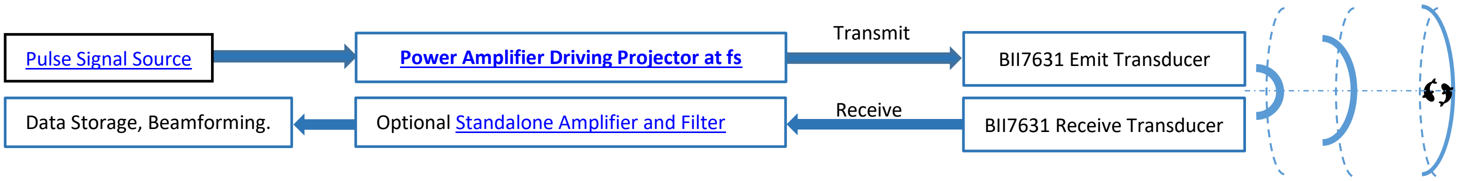
Receiving: Linear Aperture to Scan



Transmitting: Linear Array (Insonifying Area of the interest)



SYSTEM CONFIGURATION (Simplified Flow Charts: Control Signals, DC Power Supplies, etc. are NOT shown.):
Transmitting and Receiving Underwater Sounds:



Typical Applications

Acoustical Imaging: B-mode (2D) and Mechanical 3D, Diagnostic Ultrasound.	Underwater Floor/Bottom Mapping, Sector Scanning
Acoustic Pipeline Leak Detection, AE (NDT) and Material Study	Target Angle Estimation Systems, Direction-finding Sonar
Search & Tracking of Acoustic Tag, Pinger, Beacon/Transponder...	Navigation, Target Tracking, Obstacle Avoidance, Positioning, Object Detection

RELATED PRODUCTS

Power Amplifier for SONAR, NDT, and HIFU.	Impedance Matching between Transducers and Amplifiers.
BII7660 Series Multibeam (Scanning) Transducers.	BII7710 Scanning SONAR Transducer: 360° Search.

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; **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.	
Transducer:	**BII7631**
Applications:	Long Range Multibeam Transducers for 2D Imaging SONAR.
Acoustic Apertures:	**Transmit**: 6- or 64-element Linear Array. **Receive**: 6- or 64-element Linear Array.
Operation Mode:	Full-duplex and Half-duplex.
Scanning Mode:	Scanning in horizontal plane of linear array (**along Length**) with beam-steering electronically in end user's digital beamformer.
	If all elements of the linear array are in parallel as one element whose output signal is fed to a signal conditioner (not necessary), scanning along array Length mechanically or manually.
Sound Ranging **SRD**:	Pulse-Echo or Echo Sounding Ranging: refer to Maximum Echosounding Ranging vs Target Strength in Ocean.
	Passive Listening Range with Half-duplex mode is much greater than Echo Sounding Range and depends on the levels of sound sources.

Transmit (Projector) Module	
Array Geometry:	Linear Array
f_s:	**Available Options for Oceanography** : 30, 35, 40, 45, 50, 60, 70, 100, 120, 150, 200 kHz. TBD. To be determined with customization.
	Available Options for Acoustical Imaging and Diagnosis: 250, 300, 350, 400, 500 kHz. TBD. To be determined with customization.
	Minimum: 3.5 kHz. TBD. To be determined with customization.
	Operating Frequency < Minimum Transmit 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.
	For passive listening applications with $f_s \le 40$ kHz, a discrete array can be configured with hydrophones: BII7000, BII7010, BII7040, BII7070, BII7140, BII7180.
	For active SONAR applications with $f_s \le 40$ kHz, a discrete array can be configured with transducers: BII7500, BII7510, BII7520, BII7530, BII7700.
Transmit Element:	5 to 64, TBD. To be determined with customization.
	Array Element Number N: Custom-fit, N is determined by fs, d and -3dB along-Length or along-curve beamwidth. N = 76200/(fs*d*Along-Length Beamwidth) + 1.
Element Spacing d:	d: the distance among the center lines of two neighboring elements along the length of linear arrays.
	Minimum d = 1.5 mm, or maximum f_s which BII supports is 500 kHz.
	Default: d = λ/2
	Custom-fit: d = λ/2 ~ λ.
Digital Beamformer:	Necessary to achieve 2D underwater field view, Not included. End users develop Digital Beamformer at end users' cost.
IM at f_s:	1. Default: No Impedance matching devices.
	2. Bespoke: standalone IM devices and impedance matching to **50Ω**, Phase Angle |θ| of Complex Impedance ≤ **20°** at fs. Impedance $Z = 50^*e^{j\theta}$, in Ω, Phase Angle |θ| ≤ 20° at f_s.
Signal Type:	**SONAR Pulsing Signals**: SINE Pulses, Bell-shaped Sine Pulses, Ricker Pulses, Chirp/FM Pulses, PSK/FSK, Burst Pulse Train.
Directivity Pattern:	**Narrow Beam** along the length. Generally, 0.5° to 10°.
	Wide beam along the width. Generally, 10° to 50°.
Beam Width θ_{-3dB} (°):	Horizontal x Vertical = (0.5 ~ 5)° x (10 ~ 50)°; Typically, 1.5° x 30°. TBD. To be determined with customization.
	Horizontal: Along-curve Beamwidth (-3dB); **Vertical**: Along-Height Beamwidth (-3dB).
Beam Steering Range:	±75°
DRP:	Fan-shaped Directivity, refer to Directivity Pattern.
Side lobes SLL:	Refer to Graph of Directional Response Pattern.

	No side lobes in Horizontal Plane or XY Plane; ≤ -14 dB side lobes in Vertical Plane or XZ Plane.
Sidelobe Suppression:	No Sidelobe Suppression is applied to transmit array.
Q_m at f_s:	3.6 ± 0.5, typically.
	-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:	0.5 ~ 0.65, ± 0.5. in Water, Electroacoustic Efficiency. TBD. To be determined with customization.
η_{ea} at $f << f_s$:	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 transmit high power sounds at frequencies far from f_s. Otherwise, transducer may be damaged by over-voltage and/or overheating.
PF at f_s:	≥ 0.96 with impedance matching unit.
TVR at f_s:	150.0 ~ 180.0, ± 2 dB µPa/V@1m. TBD. To be determined with customization.
	Refer to TVR Chart, Transmitting Voltage Response. Tolerance: ±2 dB.
Radiation SL:	SL = 20*log V_D + TVR, dB µPa@1m. Driving Voltage V_D is in unit of V_{rms}.
Driving Voltage V_D:	**Pulsing Signal:** Duty Cycle D ≤ 1%, Pulse Duration (Pulse Width) ≤ 100mS. Max. $V_D = \sqrt{(MIPP * \|Z\|)}$ = 316 V_{rms} ~ 600 V_{rms}. TBD. To be determined with customization. Z is impedance at fs.
Input Power P_i:	$P_i = V_D^2 / Z$ at f_s. Z is impedance at f_s or 50Ω.
MIPP at f_s:	Maximum Input Pulse Power at f_s: $P_i = V_D^2 * Z$ or **500 to 2000 Watts**. TBD. To be determined with customization.
MPW at MIPP and f_s:	≤ 100 mS at Maximum Pulse Width at MIPP, at f_s and Duty Cycle D ≤ 1%.
MCIP at f_s:	10 to 100 Watts, Maximum Continuous Input Power at f_s. TBD. To be determined with customization.
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:	300 m maximum and limited by the cable length if the cable has wire leads or a non-waterproof connector.
Mounting Options:	**For Underwater Uses and Large Transducer**: 1. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-3/8")** for portable applications on boats or shore. 2. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-3/8") and End-face Mounting (EFMM)** for installation on submersibles.
	For Aerial uses and Small Transducers: Bolt-Fastening Mounting with Free Hanging (**BFM-FH-1/4"**) or Free Hanging (**FH**).
	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 operation.
	End user installs transducers on end user's positioning jigs for field deployment.
Transmit Cable:	1. 50 Ω Coax RG174/U, ΦD=2.8 mm (**RG174**). 2. 50 Ω Coax RG316/U, ΦD=2.5 mm (**RG316**).
	Handling: (1) Do not use the cable to support transducer weight in air and water if the transducer has a mounting part. (2) Do not bend the cable.
Cable Orientation:	1. Default: Perpendicular to end face of the housing. 2. Customization: Perpendicular to side wall of the housing to reduce the overall length. Appending SW to the part number.
Cable Length:	Default: 0.3 m (1 ft) for each array element.
	≤ 15 m.
Connector Options:	1. Wire Leads (**WL**). 2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm).
	Note: wire leads and BNC are for dry aerial uses and are not waterproofed.
Physical Size:	TBD. To be determined with customization.
	Refer to outline drawings.
Weight in Air:	TBD. To be determined with customization.
	Actual weight depends on Mounting Parts, Cable Types and Length, 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.
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.	

Receive Module	
Array Geometry:	Linear Array
f_s:	**Available Options for Oceanography** : 30, 35, 40, 45, 50, 60, 70, 100, 120, 150, 200 kHz. TBD. To be determined with customization.
	Available Options for Acoustical Imaging and Diagnosis: 250, 300, 350, 400, 500 kHz. TBD. To be determined with customization.
	For passive listening applications with f_s ≤ 40 kHz, a discrete array can be configured with hydrophones: BII7000, BII7010, BII7040, BII7070, BII7140, BII7180.
	For active SONAR applications with f_s ≤ 40 kHz, a discrete array can be configured with transducers: BII7500, BII7510, BII7520, BII7530, BII7700.
Receiving Element:	Bespoke: 5 to 64.
	Array Element Number N: Custom-fit, N is determined by fs, d and -3dB along-Length or along-curve beamwidth. N = 76200/(fs*d*Along-Length Beamwidth) + 1.
Element Spacing d:	d: the distance among the center lines of two neighboring elements along the length of linear arrays.
	Minimum d = 1.5 mm, or maximum fs which BII supports is 500 kHz.
	Default: d = λ/2
	Custom-fit: d = λ/2 ~ λ.

Digital Beamformer:	Necessary to achieve 2D underwater field view, Not included. End users develop Digital Beamformer at end users' cost.
Side lobes SLL:	refer to Directivity Pattern.
Sidelobe Suppression:	No Sidelobe Suppression in Horizontal Plane or XY Plane. End user should do digital beamforming in buyers' application software.
	Sidelobe Suppression to -21 dB in Vertical Plane or XZ Plane.
Directivity Pattern:	**Narrow Beam** along the length. Generally, 0.5° to 10°.
	Wide beam along the width. Generally, 10° to 50°.
Beam Width θ_{-3dB} (°):	Horizontal x Vertical = (0.5 ~ 5)° x (10 ~ 50)°; Typically, 1.5° x 30°. TBD. To be determined with customization.
	Horizontal: Along-length Beamwidth (-3dB); **Vertical**: Along-width Beamwidth (-3dB).
Beam Steering Range:	±75°
Q_m at f_s:	3.5 ± 0.5, Typically.
	-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.
FFVS at f_s:	-181 to -190.0 + Preamp Gain ± 2dB, in dB V/µPa, at operating frequency fs. TBD. To be determined with customization.
	Refer to Graph of FFVS vs. Frequency. Free-field Voltage Sensitivity.
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log\{(1+2\pi f_s C_c/B)/\sqrt{[G^2+(B+2\pi f_s C_c)^2]/(G^2+B^2)}\}$ **G**: Conductance at f_s; **B**: Susceptance at f_s; $\mathbf{C_c}$: 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:	Not Recommended.
Frequency Range:	**Available Options for Oceanography** : 10Hz to 250 kHz. TBD. To be determined with customization.
	Available Options for Acoustical Imaging and Diagnosis: 10 to 600 kHz. TBD. To be determined with customization.
Receiving SL:	SL = 20*logV_o - FFVS, dB µPa. Receiving Voltage V_o is in unit of V_{rms}.
Capacitance $\mathbf{C_f}$: Each Array Element.	0.5 to 5.0 nF ± 10% @ 1 kHz. TBD. To be determined with customization.
	C_f increases if there is extension Cable, Cable **C** ≈ Cable Length * 0.1nF/meter.
Dissipation:	0.004 to 0.01 @ 1 kHz. TBD. To be determined with customization.
Input Noise Density:	Refer to Pressure Noise Density (RTI, referred to the input).
Filters:	**A High Pass Filter** is formed with C_f of transducers and R_i of Preamps. -3dB High Pass Frequency: $f_{-3dBH} = 1/(2\pi R_i C_f)$. R_i: Input Resistance or Impedance of Preamp. C_f: Capacitance of transducer at 1 kHz (non-resonance measurement) or fs (resonance measurement such as NDT pulsing system). For example: 2nF of a array element at 1kHz and preamp Ri 1MΩ constitute high pass filter with -3dB frequency at 80 Hz.
	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 35 kHz, you may specify a high pass filter with -3dB cut-off frequency at 3.5 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.
Signal Conditioning:	Additional Low Noise 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.
	Signal Conditioning of Receive for Each Element: (1) Standalone PCB with wire bundles to be installed in end user's submersibles. (2) standalone devices with BNC connectors for dry aerial uses.
V_{omax} (Vpp):	N/A
OPL (dB µPa):	≤ 220 dB µPa. Overload Pressure Level.
Acceleration Sensitivity:	≤ 100 ~ 115 dB µPa/(m/s²).
Output Type:	Each Element outputs Single-ended Signal.
Output Z:	Z ≈ -j/(2*π*f*C_f)
Operating Depth:	300 m maximum and limited by the cable length if the cable has wire leads or a non-waterproof connector.
Mounting Options:	**For Underwater Uses and Large Transducer**: 1. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-3/8")** for portable applications on boats or shore. 2. Bolt-Fastening Mounting with Free Hanging (**BFM-FH-3/8") and End-face Mounting (EFMM)** for installation on submersibles.
	For Aerial uses and Small Transducers: Bolt-Fastening Mounting with Free Hanging (**BFM-FH-1/4"**) or Free Hanging (**FH**).
	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.
	End user installs both transducers on end user's positioning jigs for field deployment.
Receive Cable Bundle:	1. **Default**: 50 Ω Coax RG174/U, ΦD=2.8 mm (**RG174**). 2. 50 Ω Coax RG316/U, ΦD=2.5 mm (RG316). 3. Shielded Cable with Twisted Pair and PVC Jacket, ΦD=3.6 mm (**SC36**).
	Cables Bundles. Each element has one cable.
	Handling: (1) Do not use the cable to support transducer weight in air and water if the transducer has a mounting part. (2) Do not bend the cable.
Cable Orientation:	Perpendicular to rear face of receiving units.
Orientation of Receiving Array:	1. in default: First Element is located at the most right position of the array with Front View or Receiving Face View Last Element (32nd or 64th) is located at the most left position of the array in Front View or Receiving Face View 2. If the orientation of the linear array is not in default, BII shall specify the orientation in data sheet.
Cable Length:	Default: 0.3 m (1 ft) for each array element.
	≤ 15 m.
	Preamp close to the receiving element is necessary to avoid signal loss over the cable.
Connector Options:	1. Wire Leads (**WL**).

	2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm).
	Note: wire leads and BNC are for dry aerial uses and are not waterproofed.
Physical Size:	TBD. To be determined with customization.
Weight in Air:	TBD. To be determined with customization.
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.
Impedance Matching:	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately.

Wiring Information. Cables will be labelled with #0, #1, #2, #3, … #N-1 for array elements.

Transducer Wiring:	**Shielded Cable**	**Coax, BNC.**
Signal:	White or Red	Center Contact
Signal Common:	Black	Shield
Shielding and Grounding	Shield	Shield

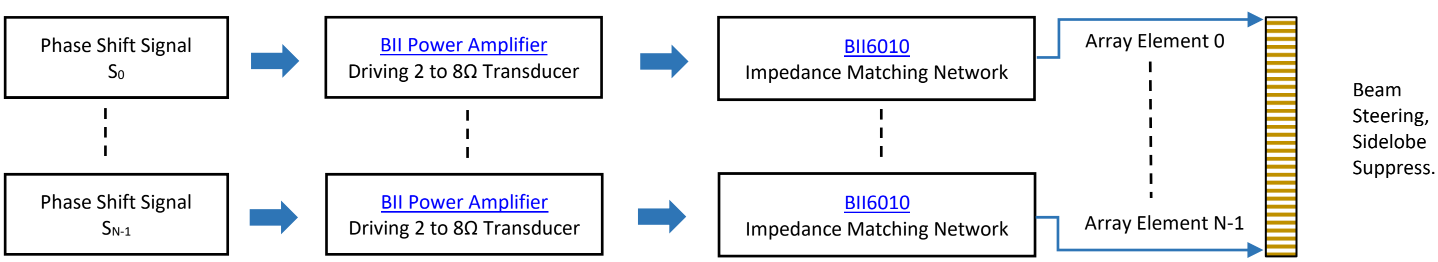
How to Order

Array Spacing d: the distance among the center lines of two neighboring elements.
Beam Width: The angle of main lobe at -3dB when driving signals to all array elements are identical (f, phase and amplitude are same.).
Array Element Number N: calculation with fs, Spacing of Elements d and -3dB beam width of H (Horizontal Beam Width).

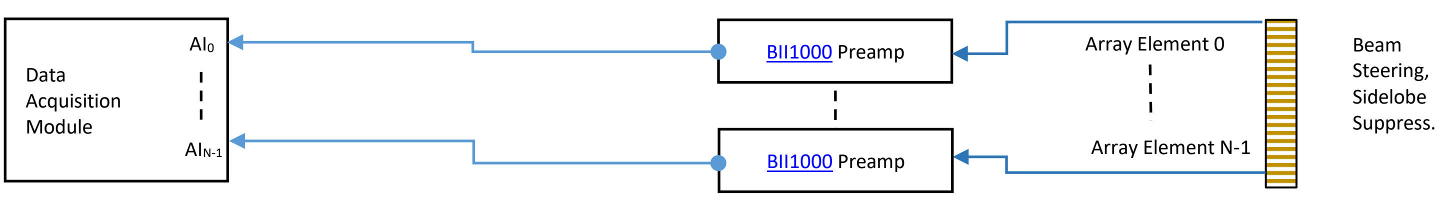
Transducer	**-fs**	**-Transmit or Receive**	**-d Spacing of Elements**	**-Beam Width**	**-Mounting**	**-Cable Length**	**-Cable Type**	**-Connector**
BII7631	in kHz	Transmit or Receive Module.	Default: λ/2, or Bespoke, in mm.	H°xV° at fs	Refer to Options	for Each Element, in meter.	Refer to specs.	

Example of Part Number:	Description
BII7631-35kHz-Transmit-λ/2-2°x30°-BFM-FH-3/8”-15m-RG174-BNC	BII7631 transducer, fs: 35kHz; Transmit Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-3/8”; 15m RG174 Coax for each element, BNC Male.
BII7631-35kHz-Receive-λ/2-2°x30°-BFM-FH-3/8”-15m-RG174-BNC	BII7631 transducer, fs: 35kHz; Receive Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-3/8”; 15m RG174 Coax for each element, BNC Male.
BII7631-35kHz-Transmit-λ/2-2°x30°-BFM-FH-3/8”-EFMM-15m-RG174-WL	BII7631 transducer, fs: 35kHz; Transmit Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-3/8” and EFMM; 15m RG174 Coax for each element, Wire Leads.
BII7631-35kHz-Receive-λ/2-2°x30°-BFM-FH-3/8”-EFMM-15m-RG174-WL	BII7631 transducer, fs: 35kHz; Receive Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-3/8” and EFMM; 15m RG174 Coax for each element, Wire Leads.
BII7631-500kHz-Transmit-λ/2-2°x30°-FH-1m-RG174-BNC	BII7631 transducer, fs: 500kHz; Transmit Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: Free Hanging; 1m RG174 Coax for each element, BNC Male.
BII7631-500kHz-Receive-λ/2-2°x30°-FH-1m-RG174-BNC	BII7631 transducer, fs: 500kHz; Receive Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: Free Hanging; 1m RG174 Coax for each element, BNC Male.
BII7631-500kHz-Transmit-λ/2-2°x30°-BFM-FH-3/8”-1m-RG174-BNC	BII7631 transducer, fs: 500kHz; Transmit Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-1/4”; 1m RG174 Coax for each element, BNC Male.
BII7631-500kHz-Receive-λ/2-2°x30°-BFM-FH-3/8”-1m-RG174-BNC	BII7631 transducer, fs: 500kHz; Receive Module, Array Element Spacing: λ/2; -3dB Beamwidth at fs: 2°x30°; Mounting: BFM-FH-1/4”; 1m RG174 Coax for each element, BNC Male.

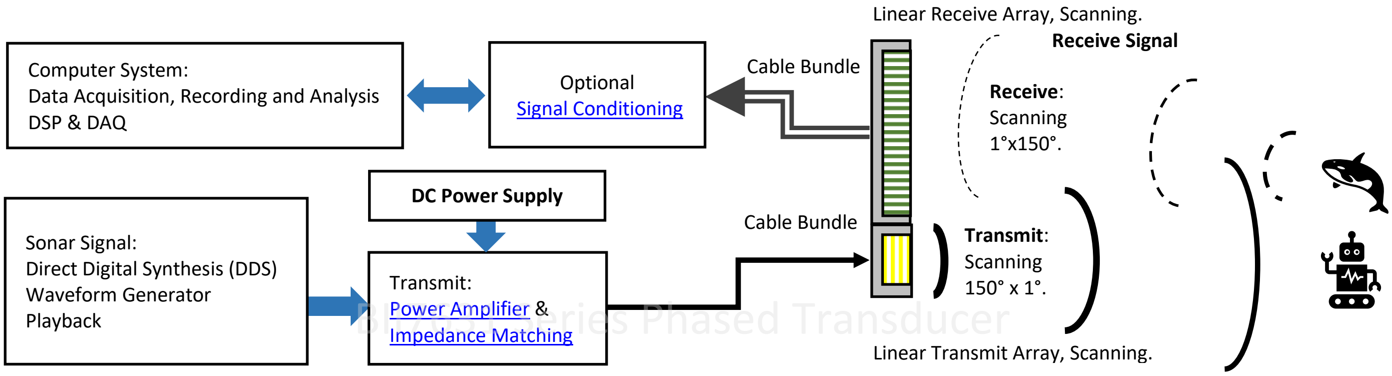
Emitting Sound



Receiving Sound



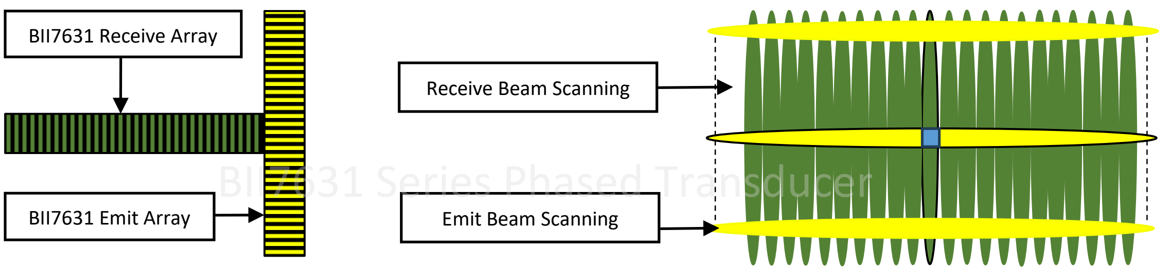
Tracking, Locating, Navigation, Communication, and Artificial Acoustic Target:



Application Notes:

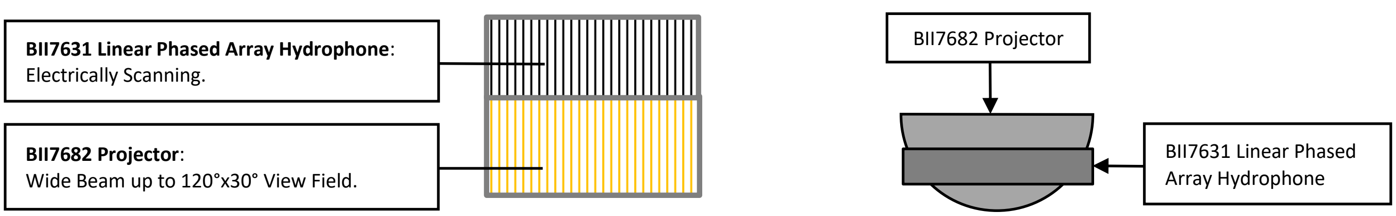
Target strength of a 10"-length (0.25m) fish is about -35 dB. Target Strength of a Fish Shoal with 1000 fish is about -5 dB.
Target strength of a dolphin is about -20 dB. Target strength of a whale is about 0 dB. Target strength of seamounts is from +30 to +60 dB.
Refer to **Maximum Echo-Sounding Ranging vs Target Strength** in Ocean for sounding ranges.

Dual Transducer Application.
3D "T" Type Imaging Multibeam Transducer: Two BII7631 Linear Phased Array (Rectangular Aperture).



Echo intensity of blue intersection area of a emit beam (yellow colour) and a receive beam (green colour) provides the average depth and backscattering information of the intersection area. Hundreds of tightly spaced echoes can be implemented from a single acoustic ping.

2D Imaging Multibeam Transducer: one BII7631 Linear Phased Array (Rectangular Aperture) and one BII7682 (Curvilinear or Cylindrical Sector Aperture).

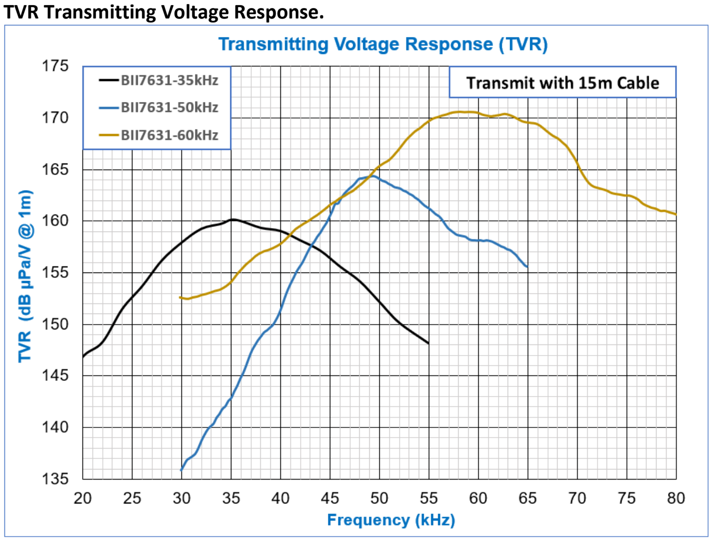


Front View: Acoustic Window

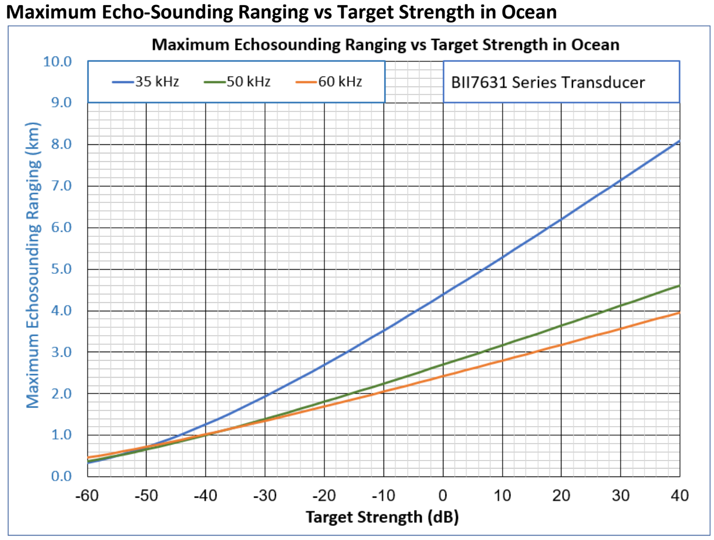
Top View

Typical Parameters, TBD. To be determined with customization.

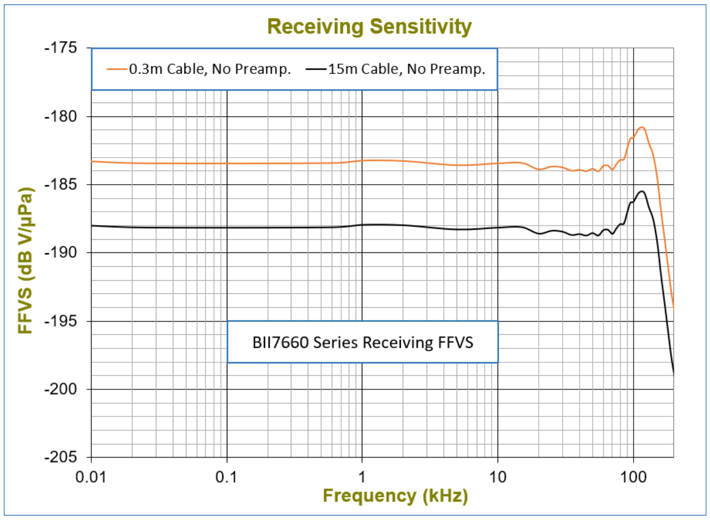
TVR Transmitting Voltage Response.



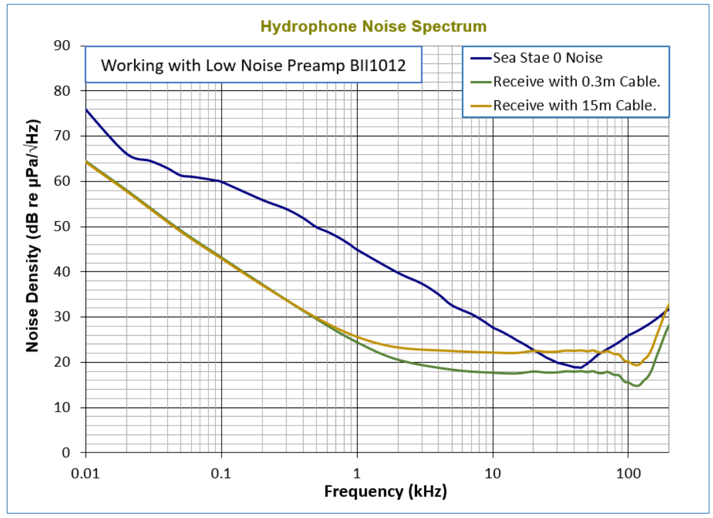
Maximum Echo-Sounding Ranging vs Target Strength in Ocean



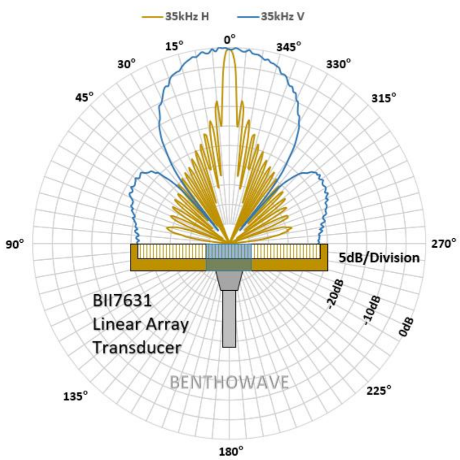
Free-field Voltage Sensitivity (FFVS):

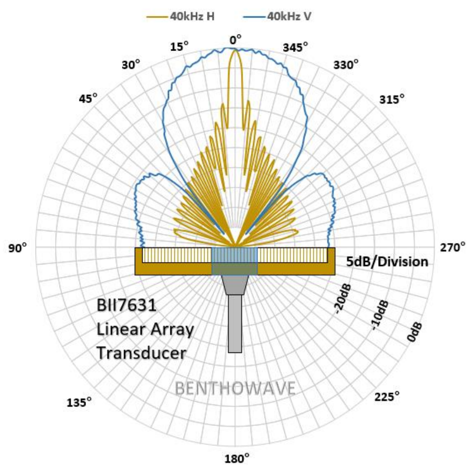


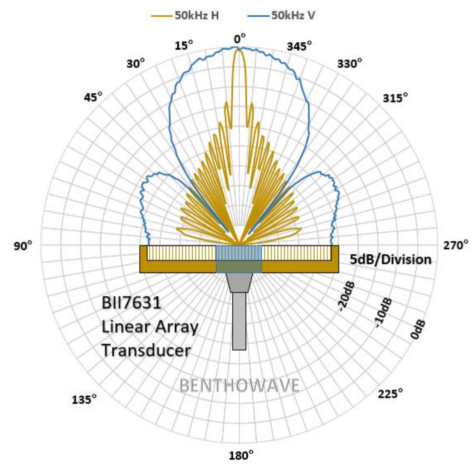
Pressure Noise Density of Receive (RTI, referred to the input):

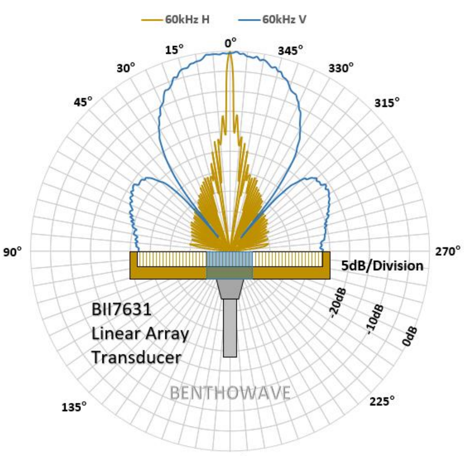


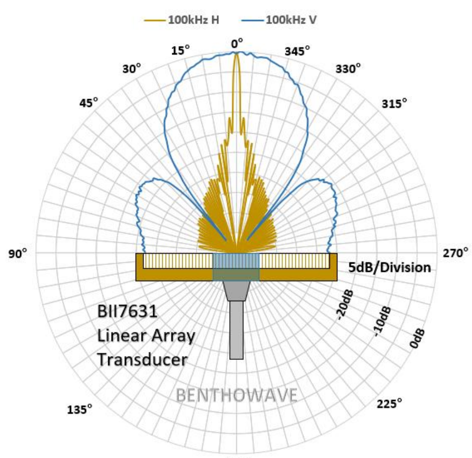
Directivity Pattern





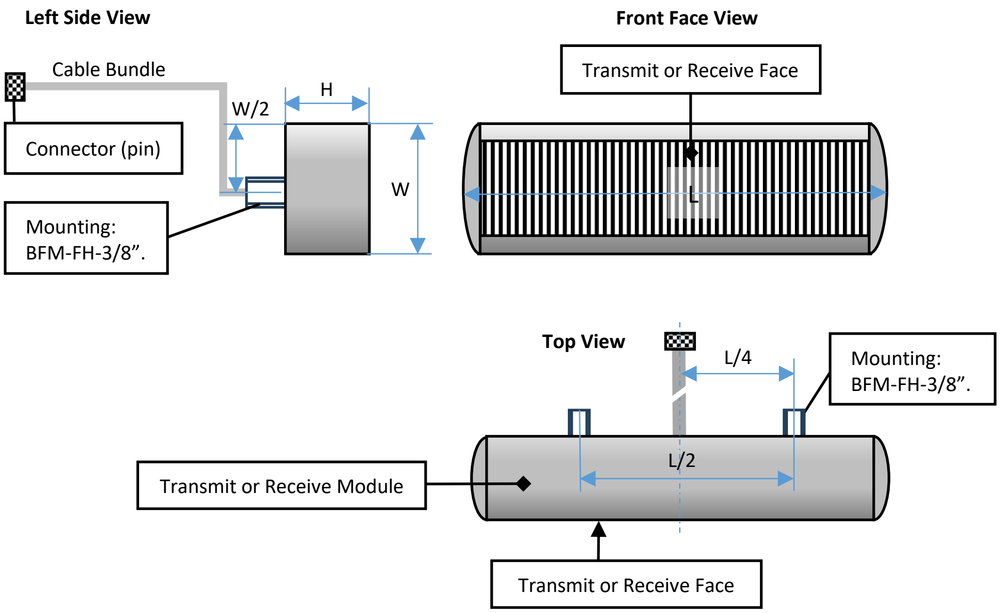






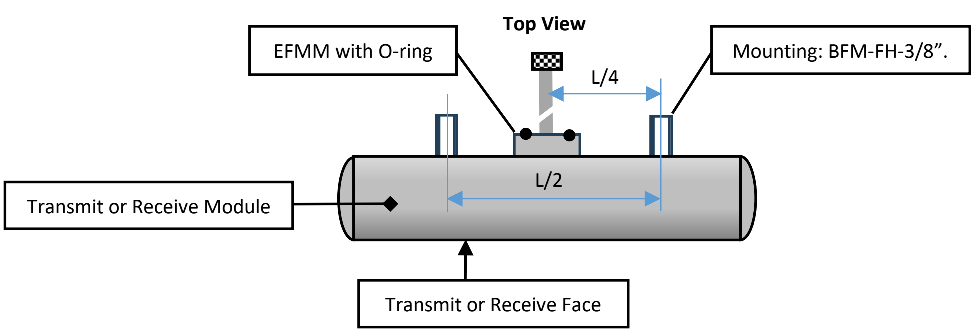
Physical Size (Dimensional Unit: mm), **Illustration only, scale is not 1:1.**

1. Installation with BFM-FH-3/8" on portable fixtures for application on boats and shore: Two 3/8"-16 bolts are on the rear face of the transducer and two nuts are included. End user needs to prepare mounting jigs to position the transducer securely for locating, obstacle avoidance, navigation, and/or tracking targets.



2. How to extend cable into submersibles (underwater vehicles) such as UUVs (ROVs, AUVs.)?

1. Ordering transducer with Mounting Parts of BFM-FH-3/8" and EFMM.
2. Besides two mounting parts BFM-FH-3/8", a End-face Mounting Part (EFMM with O-ring Sealing, refer to Acoustic System for more info.) is on the rear face for cable bundle going through. End users should prepare mounting holes on submersibles to install EFMM and its O-ring.



3. Installation with BFM-FH-1/4" or Free Hanging (FH) for aerial uses such as NDT/AE, Acoustical Imaging and diagnosis of Material: One or Two 1/4"-20 bolts are on the rear face of the transducer and two nuts are included, or Free Hanging (no any mounting part on transducer.). End user needs to prepare mounting jigs to position the transducer securely for locating and Searching the flaws and/or sounds sources in materials.

The couplant such as water, gel, grease, oils, commercial couplant is a necessary material for efficient acoustical energy transfer between transducer face and subject.