BII7716 Series Underwater Scanning Transducer for 360° View Field in Horizontal Plane

Scanning SONAR Transducer for 360° Search. Underwater Scanning Transducers are underwater 32-element cylindrical array transducers (Transmitting Sounds and Listening sounds), and directional beams are implemented with subarrays for scanning. Typical applications are acoustic positioning, tracking, echo locating, and navigation in horizontal plane in the ocean, rivers, and lakes.

The Scanning SONAR Transducers provide efficient solution to detect and locate fish schools and targets in the horizontal plane about hundreds and thousands meters with 360° searching. The transducers have superior performances for use in shallow water and near surface fishing.

The subarray that operator determines sends out a pulse of narrow beam sound in specific directions and receive the echo reflected from targets; or, in passive listening mode, it searches the sounds emitted from sound sources with highly directional beam.

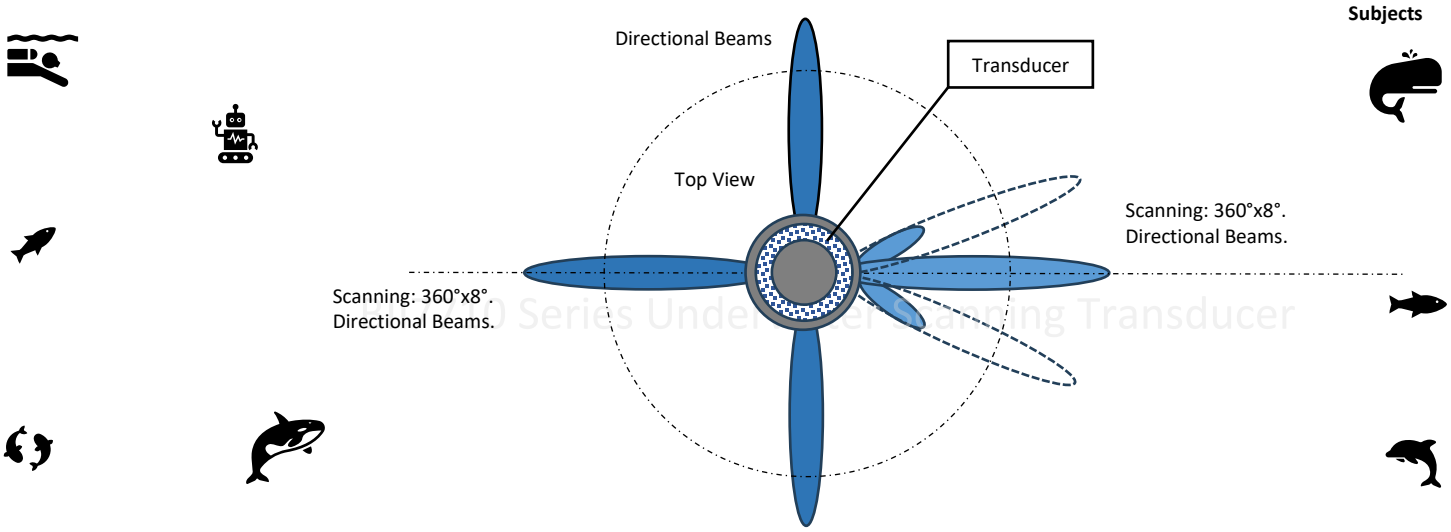
Besides one BII7716 transducer implements a pulsing-echo system with T/R switch modules BII2100, two BII7716 transducers can set up a Transmit and receive system with one transducer working as transmitter, another one working as receiver, this setup dos not need T/R switch modules.

Typical Applications

Scanning Sonar, Obstacle Avoidance, Object/Target Detection and Tracking Fishery Sonar, Communication Underwater Robotic and Vehicle (ROV, AUV, UUV)

Related Products

BII5000 Power Amplifier BII6000 Impedance Matching BII7770 Scanning Transducer with Mechanical Gears BII7660 Multibeam Transducer: Imaging



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.		
Acoustic Transceiver	**BII7716-35**	**BII7716-50**
Frequency fs:	35 kHz ± 10%	50 kHz ± 10%
Array Geometry:	Cylinder, Curved Face of Cylindrical Sectors, 32 Array Elements around 360° perimeters.	
Acoustic Aperture:	**Transmit and Receive**: each element is a linear array evenly distributed in cylinder.	
Operation Mode:	Half-duplex.	
Scanning Mode:	1. Pulse-Echo. 2. Scanning horizontally with beam steering electrically in end user's digital beamformer.	
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 Elements:	End user determines emitting elements in end user's digital beamformer.	
Receive Elements:	End user determines Receiving elements in end user's digital beamformer.	
Digital Beamformer:	Necessary to achieve 2D underwater 360° field view, Not included. End users develop Digital Beamformer at end users' cost.	
IM at f_s:	Default: no built-in impedance matching devices.	
	End user determines the impedance matching.	
Signal Type:	**SONAR Pulsing Signals**: SINE Pulses, Bell-shaped Sine Pulses, Ricker Pulses, Chirp/FM Pulses, PSK/FSK, Burst Pulse Train.	
Beam Pattern:	Fan-shaped Directivity, refer to **Directivity Pattern**.	
Beam Width θ_{-3dB} (°):	**Single Array Element**: Horizontal x Vertical = 140° x 8°	**Single Array Element**: Horizontal x Vertical = 100° x 8°
	Horizontal: Along-Cylindrical Perimeter; **Vertical**: Along-Height of the Cylinder.	
	Horizontal Beam Width depends on Array Beamforming, end user determines the subarray being used to scan. When all array elements are active in parallel, it is 360° omnidirectional.	
Element Number N:	32	
Element Spacing:	360°/N = 11.25°	

Array Orientation:	Slot mark on housing: Receiving Channel# 1. Channel# 1, 2, 3, ... 31, 32 are sequential clockwise in bottom view of the transducer.	
Sidelobe Suppression:	No Sidelobe Suppression is applied to transducer.	
Side lobes:	a. Horizontal Sidelobe: depend on end user's digital beamformer. b. Vertical (along-height): ≤ -14 dB.	
Quality Factor Q_m:	2.5	2.2
	-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:	0.65 ± 0.5. in Water, Electroacoustic Efficiency.	
PF at f_s:	≥ 0.90	
Element TVR at fs:	143.0 ± 2, dB µPa/V at 1m	146.0 ± 2, dB µPa/V at 1m
	Refer to TVR Chart, Transmitting Voltage Response.	
Radiation SL:	Single Element: SL = 20*log V_D + TVR, dB µPa@1m. Driving Voltage V_D is in unit of V_{rms}.	
Admittance @ fs:	Each Array Element: G=0.375mS, B=0.572 mS.	Each Array Element: G=0.537mS, B=0.819 mS.
Driving Voltage V_D:	**Pulsing Signal:** Duty Cycle D ≤ 1%, Pulse Duration (Pulse Width) ≤ 100mS. Max. V_D = 600 V_{rms}.	
Input Power P_i:	$P_i = V_D^2 * G_{max}$ at f_s.	
MIPP at f_s:	Each Array Element: Maximum Input Pulse Power at f_s: $P_i = V_i^2 * G_{max}$ or 100 Watts, whichever is less.	
MPW at MIPP and f_s:	Each Array Element: ≤ 100 mS at Maximum Pulse Width at MIPP, at f_s and Duty Cycle D ≤ 1%.	
MCIP at f_s:	Each Array Element: 3 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 ≤ (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.		
Sensitivity at fs: (No Cable)	-181.5 ± 2, in dB V/µPa	-184.6 ± 2, in 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.	
FFVS:	Free-field Voltage Sensitivity, Refer to Graph of FFVS vs. Frequency.	
Receiving SL:	SL = 20*logV_o - FFVS, dB µPa. Receiving Voltage V_o is in unit of V_{rms}.	
Element Capacitance:	2.2 nF ± 10% at 1kHz	2.2 nF ± 10% at 1kHz
Element Dissipation:	0.01	0.01
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:	≤ 109 dB µPa/(m/s²)	≤ 112 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	
Mounting Options:	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 **End-face Mounting (EFMM)** for installation on submersibles.	
	Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.	
	Mounting part and cable are at top end face of the transducer for easy operation.	
	End user installs transducers on end user's positioning jigs for field deployment.	
Cable Orientation:	Perpendicular to end face of the housing.	
Cable Bundle:	each element has a cbale.	
	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 Length:	Default: 0.3 m (1 ft) for each array element.	
	≤ 20 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.	
Size (ΦDxH):	Φ168 x 300 mm.	Φ168 x 210 mm.

Weight in air:	≥ 10 kg with 1 m cable bundle.	≥ 8 kg with 1 m cable bundle.
	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.	
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.	
TR Switch:	BII2100 Transmitting & Receiving Switch Module with Built-in Preamp and Bandpass Filter. 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.		

Wiring Information.

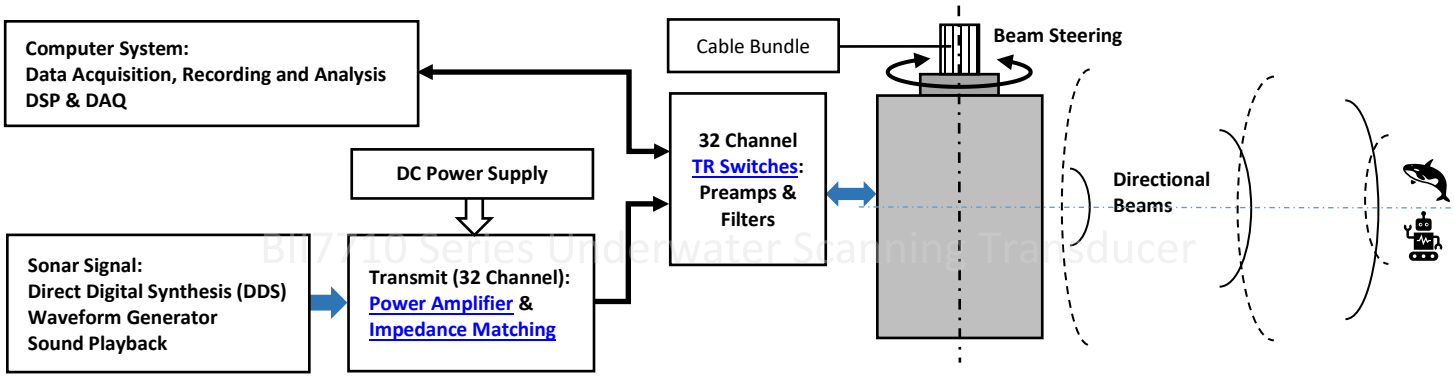
Array Element	**Coax, BNC.**
Signal:	Center Contact
Signal Common, Shielding and Grounding.	Shield

How to Order.

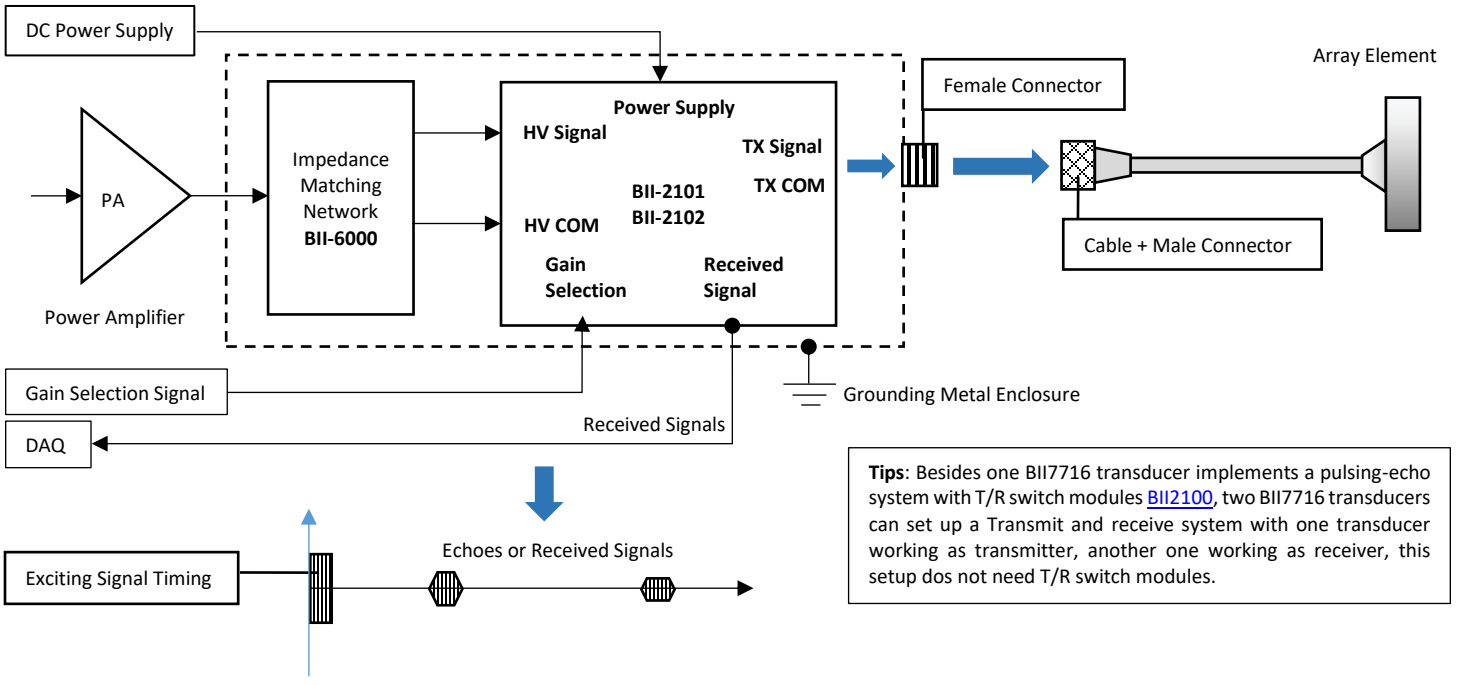
Transducer	**-Mounting**	**-Cable Length**	**-Cable Type**	**-Connector**
BII7716-35, BII7716-50.	Refer to Options.			

Example of Part Number:	**Description**
BII7716-35-BFM-FH-3/8"-20m-RG174-BNC	BII7716-35 transducer, Bolt-Fastening Mounting with Free Hanging (BFM-FH-3/8"), 20m RG174 coax, BNC.
BII7716-35-EFMM-1m-RG174-WL	BII7716-35 transducer, End-face Mounting EFMM, 1m RG174 coax, BNC.

Tracking, Locating and Navigation:



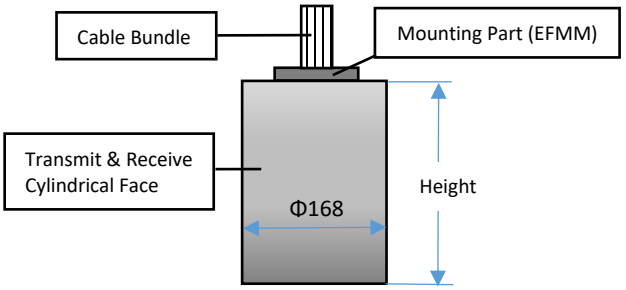
System Block Diagram (Refer to WARNING about the insulation and grounding for operating safety before wiring and assembling the devices.)
HV: High Voltage Source from a Signal Generator, Power Amplifier, or Impedance Matching Unit. **TX**: Driving Signal to a Transducer.



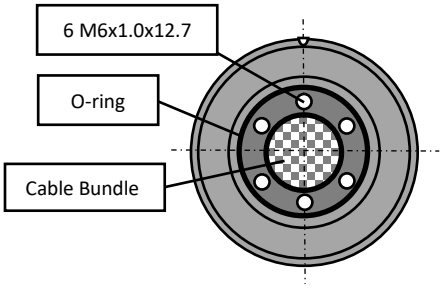
Tips: Besides one BII7716 transducer implements a pulsing-echo system with T/R switch modules BII2100, two BII7716 transducers can set up a Transmit and receive system with one transducer working as transmitter, another one working as receiver, this setup dos not need T/R switch modules.

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

Side View



Top View



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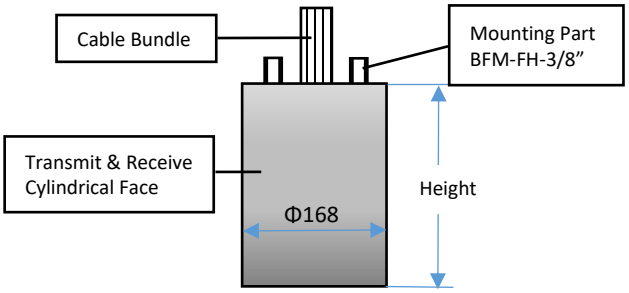

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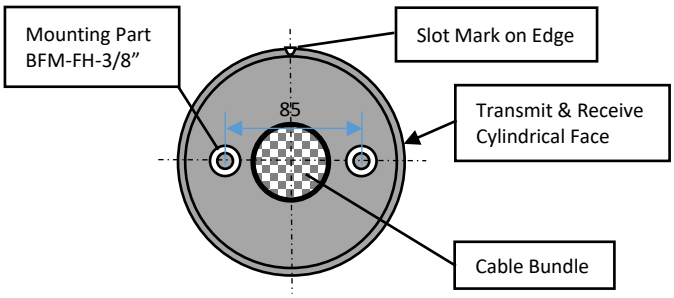
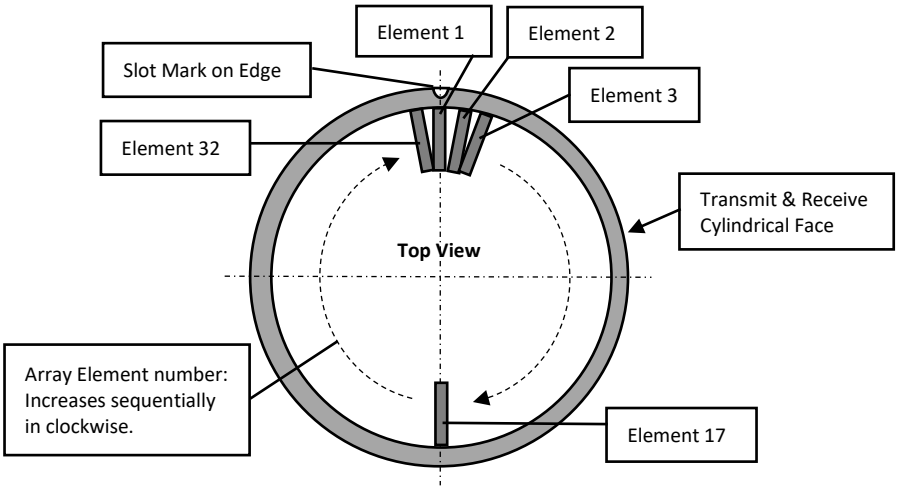
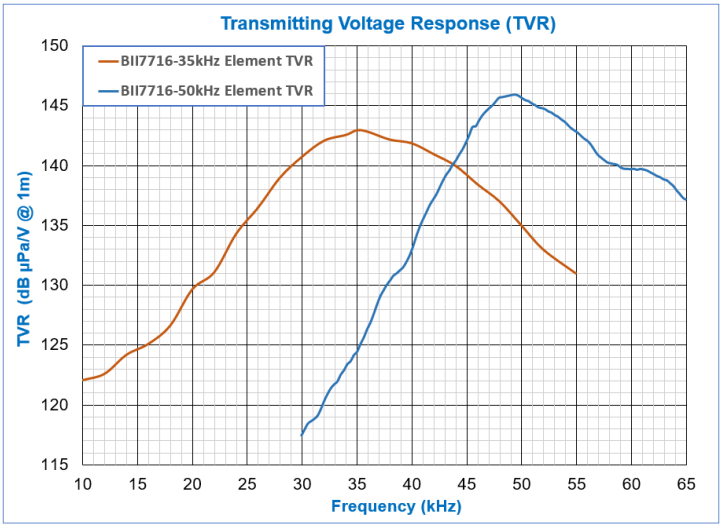


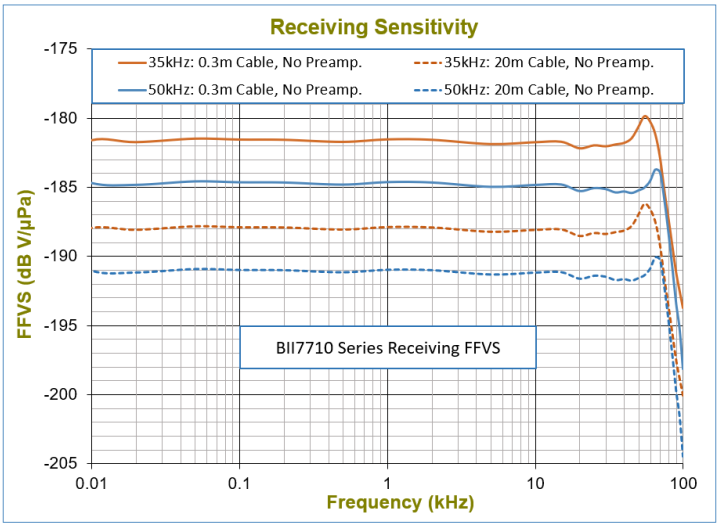
Orientation of Array Element from Top View



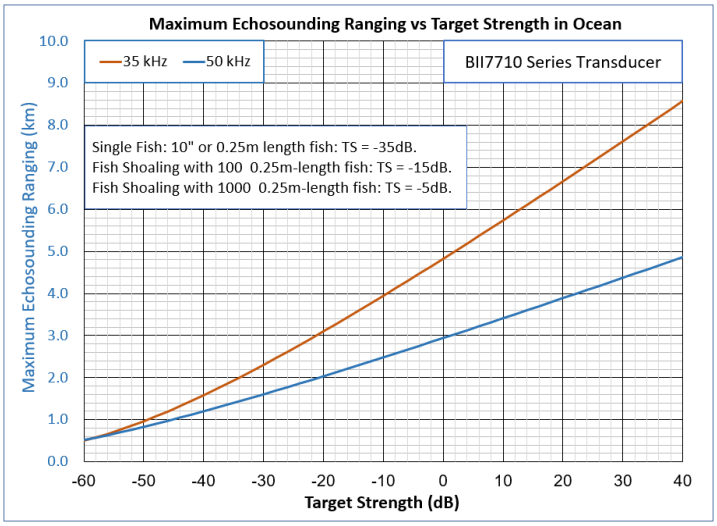
TVR (Transmitting Voltage Response)



FFVS (Free-field Voltage Response)



Maximum Echo-Sounding Ranging vs Target Strength in Ocean



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