

Side-scan Transducer and Linear Transducer

BII7570 Series Linear, Side Scan, Interferometric (Phase-measuring) and Parametric Transducers: Sea-floor Mapping and Sub-bottom Profiling.

Linear Transducer: Bespoke fan-shaped beam provides wide view area in across-track plane and high spatial resolution in along-track plane. Sidelobe ≤ -21 dB.

Conventional Side Scan: BII's side scan transducers with fan-shaped beam are designed for use in underwater imaging, sea/river/lake-floor mapping, target location, mine hunting, fisheries... The beam covers wide across-track swath and provides high along-track spatial resolution in tens or hundreds meter range. Acoustic image of underwater bottom is achieved at grazing angles of incidence. High resolution image can be formed with the technique of **Synthetic Aperture Imaging**. Multiple frequencies are available in one transducer.

Interferometric (Phase-measuring) Side Scan: The phase differences of received signals are detected by multiple linear receive arrays paralleling to the linear transmit array. After ambiguity is removed with proper techniques, the direction of arrival (DOA) and location of the scatterer can be accurately determined.

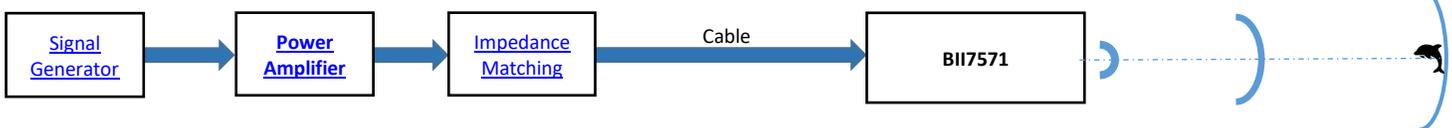
Parametric Side Scan: When two underwater sound waves of different primary frequencies f_{p1} and f_{p2} ($f_{p1} > f_{p2}$) propagate in the same direction, they interact with each other to create low frequency sound wave of secondary frequency f_{sec} . ($f_{sec} = f_{p1} - f_{p2}$). The directivity of secondary frequency is close to the ones of primary frequencies. This difference frequency sound is useful for practical applications in sediment profiling, depth sounding and communication. Parametric array gain or efficiency (generally $\leq 1\%$) is better as primary sound powers are higher, secondary frequency f_{sec} is higher, down shift ratio $(f_{p1} + f_{p2}) / (2f_{sec})$ is lower, and $(\alpha p * R)$ is lower (α : mean primary sound attenuation coefficient; R : rayleigh distance). Attenuation/absorption coefficient of sediments is frequency dependent around 0.06f to 0.6f (dB/(m*kHz)).

Typical Applications

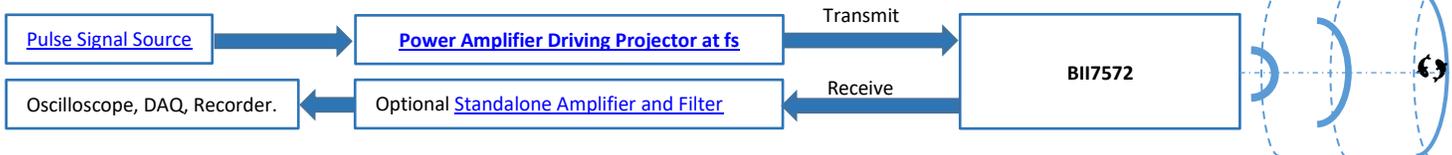
Sea/River/Lake-floor Mapping	Target Location Underwater	Fisheries	Direction of Arrival	Mine Hunting
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SYSTEM CONFIGURATION (Simplified Flow Charts: Control Signals, DC Power Supplies, etc. are NOT shown.)

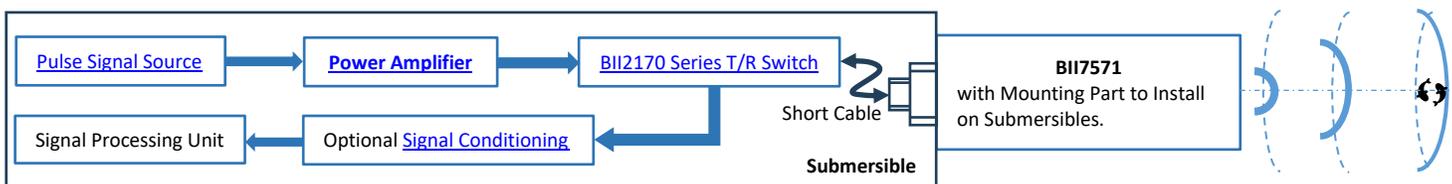
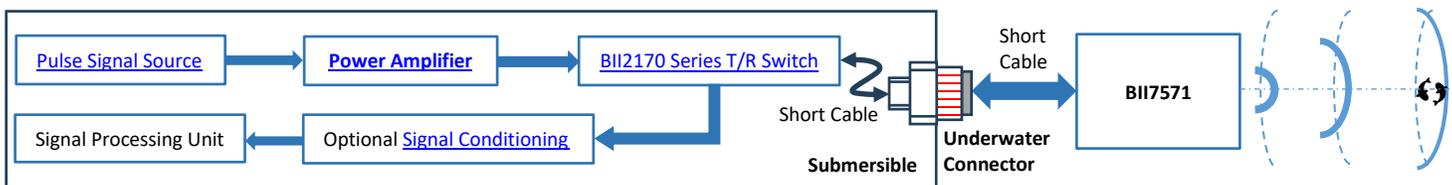
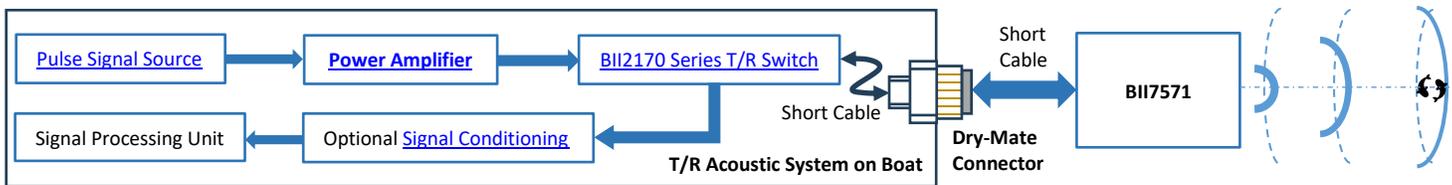
(a) Generation of Underwater Sounds with BII7571 (Only One Line Array).



(b) Transmitting and Receiving Underwater Sounds with BII7572 (First Line Array as Sound Projector, Second Line Array as Sound Receiver):



(c) Transmitting and Receiving Underwater Sounds with BII7571 (Only One Line Array): Cables (≤ 5 m) between Transducers and T/R Switch.



RELATED PRODUCTS

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

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; 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.									
Side Scan Transducer	BII7571			BII7572			BII757N (N=3, 4, 5, ...)		
Line Array Number:	One Line Array			Two Line Arrays in Parallel			N Line Arrays on Parallel		
f _s Options:	Operation frequency f _s : 45 kHz to 500 kHz, Bespoke. In-stock Array Elements: 45, 50, 60, 70, 100, 120, 150, 200, 250, 300, 400, 500 kHz. < 45 kHz, please consider Parametric Side Scan Transducer .								
	For example: a BII7572 with one 45 kHz line array and one 50 kHz line array to achieve 5 kHz side scan sounds.								
	1. Efficiency is low in the frequency range far from f _s , so it is NOT recommended to operate transducer at frequency far from f _s . 2. Transducer can operate in low power at frequency far from f _s , the input power P _i should be much less than 1% MCIP at f _s .								
Survey Range:	≤ 500 m, determined by source level, propagation loss, target strength, etc...								
	50 kHz	70 kHz	100 kHz	120 kHz	200 kHz	250 kHz	300 kHz	400 kHz	500 kHz
	400 m	380 m	350 m	320 m	200 m	160 m	135 m	110 m	100 m
Pulsed Driving Signal:	SONAR/Pulsing Signals: SINE Pulses, Bell-shaped Sine Pulse, Chirp/FM Pulses, Burst Pulse Train.								
Directivity Pattern:	Fan-shaped Beam								
Beamwidth (-3dB):	1. Bespoke Side-scan Transducer: Along-track: ≤ 2.0°. Across-track: ≤ 50°.								
	2. Bespoke Linear Transducer: Along-track: ≤ 20°. Across-track: ≤ 50°.								
Side Lobe Level:	1. Side-scan Transducer: ≤ -13.3 dB (One-Way).								
	2. Linear Transmit Transducer: ≤ -21 dB (Do NOT use this transducer to receive sound.)								
	3. Linear Receive Transducer: ≤ -21 dB. (Do NOT use this transducer to transmit sound.)								
Quality Factor Q _m :	3 ~ 4, -3 dB bandwidth = f _s /Q _m .								
TVR at f _s :	≥ 160 dB μPa/V@1m at f _s , 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} .								
Admittance (G and B):	TBD, to be determined, or refer to G-B Graph .								
Driving Voltage V _i at f _s :	Pulsed Driving Signal and Duty Cycle D ≤ 1%: Maximum V _i , V _{i,max} = v(MIPP/G _{max}) or 600, whichever is less, in V _{rms} .								
Input Power P _i :	P _i = V _i ² * G. Refer to G-B Graph : G is conductance, G _{max} is maximum G at f _s .								
MIPP at f _s :	Maximum Input Pulse Power at f _s : P _i = V _i ² * G _{max} or 500 to 2000 Watts, whichever is less. TBD, to be determined.								
MPW at MIPP and f _s :	0.02 Seconds, Maximum Pulse Width at MIPP and at f _s . TBD, to be determined.								
MCIP at f _s :	10 to 50 Watts, Maximum Continuous Input Power at f _s , TBD, to be determined.								
How to determine pulse width, duty cycle and off-time with input pulse power (peak power):									
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 PW ≤ (MIPP * MPW*(120°C-T)/103°C)/IPP, or PW ≤ 20 mS, whichever is less. T: Water Temperature in °C.									
3. Duty Cycle D ≤ MCIP*(120°C-T)/103°C)/IPP, or D ≤ 1%, Whichever is less.									
4. Off-time ≥ PW*(1-D)/D.									
FFVS at f _s :	-195 to -170 dB V/μPa at f _s , Free-field Voltage Sensitivity.								
	$Sensitivity\ Loss\ over\ extension\ cable\ at\ f_s\ (dB) = 20 * \log \left\{ \frac{(1 + 2\pi f_s C_c / B)}{\sqrt{[G^2 + (B + 2\pi f_s C_c)^2] / (G^2 + B^2)}} \right\}$ G: Conductance at f _s ; B: Susceptance at f _s ; 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} .								
Operating Depth:	300 m, maximum, and Limited by the cable length if the cable has wire leads or a non-waterproof connector.								
Mounting:	Two 3/8"-16 x 1.25" 316 SS Screw. Hex Nut and Split Lock Washer are included.								
Cable Options:	1. Shielded Cable (SC), Rubber Jacket. Two Conductors (AWG20, 600V, 4A.).								
	2. Unshielded Cable (USC), Rubber Jacket. Two Conductors (AWG18, 600V, 10A.).								
	3. 50 Ω RG58 Coax (RG58).								
	4. Shielded Cable, Twisted Pair, Teflon (PTFE) Jacket, ΦD=4.0 mm (SC40), up to 200°C, 600V, 4A, Not Water-proofed.								
	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: 0.6 m.								
	2. Custom.								
Connector:	1. Default: Wire Leads (WL). 2. 50 Ω BNC Male (BNC). 3. Underwater Mateable Connector (UMC). 4. MIL-5015 Style (5015). 5. Custom (custom). Note: Underwater Mateable Connector is for underwater uses. Other connectors and wire leads are for dry uses and are non-waterproof.								
Size (LxWxH):	TBD. Determined by beam angles.								
Weight in Air:	≥ 0.5 kg with 1 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.								
IM at f_s:	Bespoke BII6000 Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices.								
	Phase Angle θ of Complex Impedance ≤ 20° at f _s .								
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.

for 50Ω BNC Male connector, it is buyer's sole responsibility to make sure that the (female) 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. Cables will be labelled with #1, #2, #3, #4, #5 ...for multiple arrays inside a transducer.

Transducer Wiring:	Shielded Cable	Coax, BNC.	UMC3P, Locking Sleeve: DLSA-M.	MIL3P	DIN3P	XLR3P
Signal:	White or Red	Center Contact	Pin 2	Pin C or G	Pin 3	Pin 2
Signal Common:	Black	Shield	Pin 1	Pin B	Pin 1	Pin 3
Shielding and Grounding	Shield	Shield	Pin 3	Pin A	Pin 2	Pin 1
Please contact us for bespoke wirings of differential transducers such as dipole, quadrupole, multimode rings, and flextensional sources.						
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				

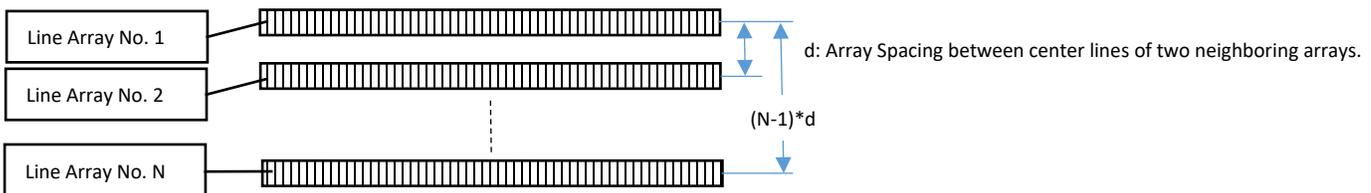
How to Order Side-scan Transducer:

BII757	N	-fs x d	-Beamwidth	-Cable type	-Cable Length	-Connector
	Number of Linear Arrays	fs, in kHz. d: Array Spacing in mm.	HxV in ° of Each Array		Refer to options.	
For examples:						
BII7571-100kHz-1°x50°-SC-1m-WL	BII7571 Transducer, Number of Linear Arrays: 1; One 100kHz Linear Array; Beamwidth: 1°x50°; Default Mounting: Two SS Screws; Shielded Cable; 1m, Wire Leads.					
BII7572-100kHz-1°x50°-SC-1m-WL	BII7572 Transducer, Number of Linear Arrays: 2; Two 100kHz Linear Arrays in Parallel (first one for transmit, second one for receive); Beamwidth of Each Array: 1°x50°; Default Mounting: Two SS Screws; Shielded Cable; 1m, Wire Leads.					
BII7572-45kHzx50kHzx35mm-1°x50°-SC-1m-WL	BII7572 Transducer, Number of Linear Arrays: 2; 45kHz and 50kHz Linear Arrays in Parallel with spacing 35mm; Beamwidth of Each Array: 1°x50°; Default Mounting: Two SS Screws; Shielded Cable; 1m, Wire Leads.					
BII7575-100kHzx18mm-1°x50°-SC-1m-WL	BII7575 Transducer, Number of Linear Arrays: 5; Five 100kHz Linear Arrays in Parallel with evenly spacing 18mm; Beamwidth of Each Array: 1°x50°; Default Mounting: Two SS Screws; Shielded Cable; 1m, Wire Leads.					

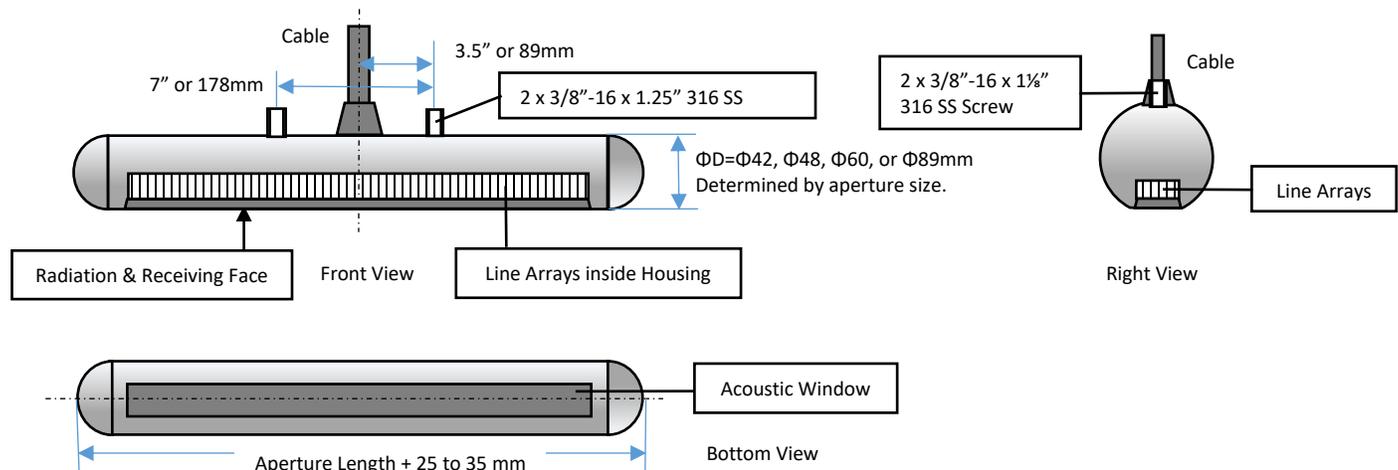
How to Order Linear Transducer BII7571:

BII7571	T or R	-SLL	-Beamwidth	-Cable type	-Cable Length	-Connector
	T: Transmit; R: Receive.	Side Lobe Level: -21dB	HxV in °		Refer to options.	
For examples:						
BII7571T-21dB-100kHz-10°x50°-SC-0.6m-UMC3P	BII7571 Transmit Transducer, Side Lobe Level: -21dB; One 100kHz Linear Array; Beamwidth: HxV=10°x50°; Default Mounting: Two SS Screws; Shielded Cable: 0.6m, Underwater Connector UMC3P.					
BII7571R-21dB-100kHz-10°x50°-SC-10m-XLR3P	BII7571 Receive Transducer, Side Lobe Level: -21dB; One 100kHz Linear Array; Beamwidth: HxV=10°x50°; Default Mounting: Two SS Screws; Shielded Cable: 10m, Connector XLR3P.					

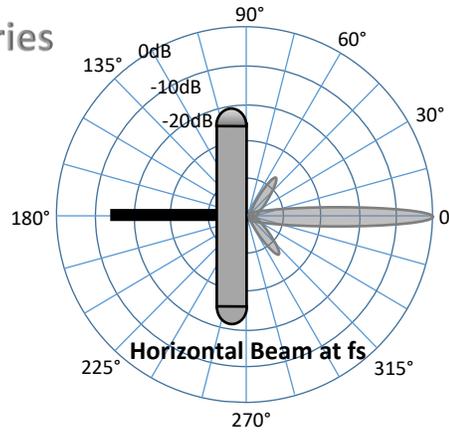
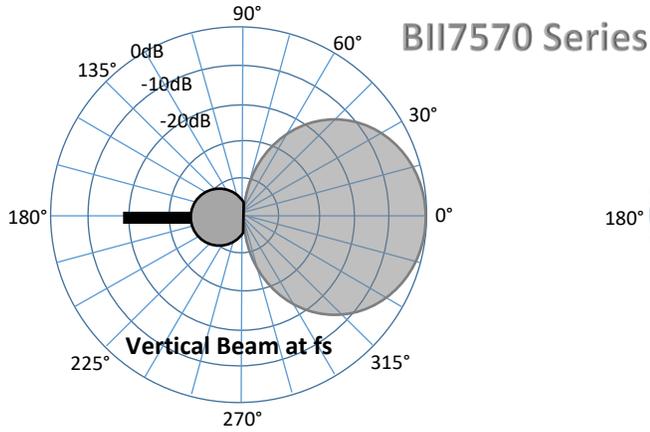
N Line Arrays in Parallel



Physical Size (Dimensional Unit: mm). following transducer structures are for illustration ONLY.



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



Admittance

