

BII-7910 Series Annular Array Air Transducer: Electronic Beam Focusing and Amplitude Shading/Weighting

BII-7910s air transducers featuring low to medium Q_m in air are for air-coupled NDT (Non-destructive Testing), navigation, ranging, measurement and control, and characterization of airlike fluids (gases) and materials such as woods, plastics, rubber, foam, and composites. Water-proofed transducers to withstand 50m water depth is available.

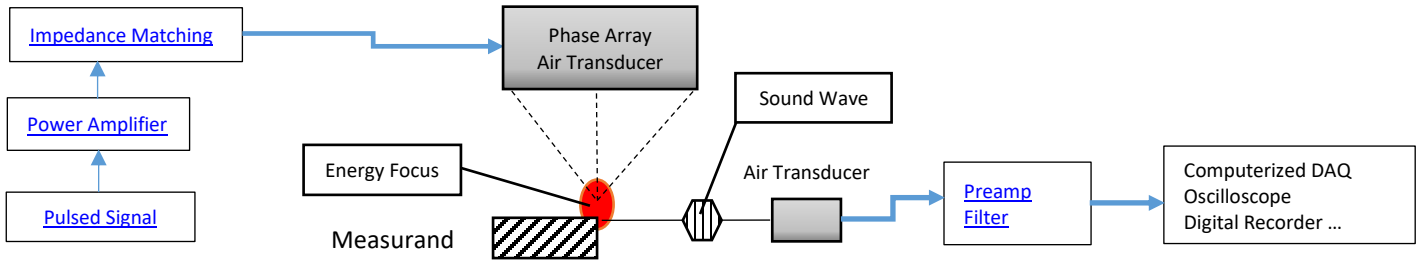
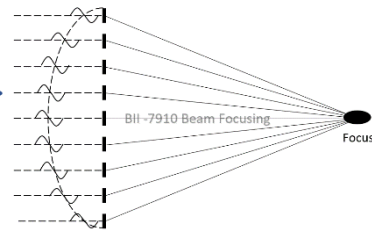
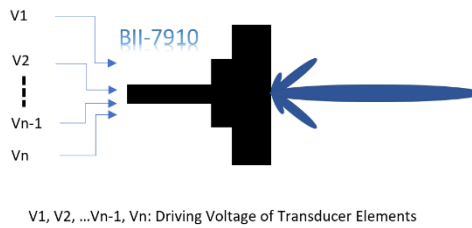
These annular array (ring-array) transducers have radially distributed symmetric ring elements on the circular radiation face. The elements are driven separately with voltage sources to support beam focusing (Phase Shift or Time Delay), amplitude shading (Weighting), and tune the best compromise between main-beam sharpness and the side-lobe suppression.

With proper phase shift of each signal applied to ring elements, the sound energy is concentrated on a small focal point in air, airlike liquids, or on the material under test for air-coupled NDT, measurement, and control. Improved performances comparing to planar air transducers are achieved such as higher signal to noise ratio, greater penetration depth into material, and better lateral resolution, etc...

Typical Applications													
Measurands influence propagation time, phase, and attenuation.							Measurands influence reflection, refraction, scattering and transmission.						
Robotics, Proximity Detection, Sound Ranging, Material Study Level Measurement, Speed Measurement, Leak Detection Edge Detection, Web Guiding System, Air-Coupled NDT							Counting, Monitoring, Remote Control, Alarming, Motion Detection Automatic Sizing, Sorting & Positioning of Parts, Ultrasonic Testing and Analysis Surface/Profile Characterization and Quick Scanning for Quality Control						
Absorption of Sound in Air at 20°C (68°F), Relative Humidity: 10%, 1 atm.													
Frequency (kHz)	30	40	50	70	100	120	150	200	250	300	400	500	1000
Absorption (dB/m)	0.3	0.4	0.5	0.7	1.8	2.5	4.0	6.5	10	16	28	43	200



- BII-7910 Annular Array:
1. Spherical Transducer Beam Focusing and Spreading
 2. Piston-type Transducer Amplitude Shading/Weighting Side-lobe Suppressing Dual Beam, Dual Frequency



Transducer Specification

BII-7910	Annular Array Air Transducer, refer to How to Order to specify array parameters.
Signal Type:	Pulse and burst SINE/Square/Chirp/FM. Warning: ONLY pulsed signals can be used to drive these transducers. Please determine the pulse width, duty cycle and input pulse power before putting the transducer in service. Otherwise, the transducer shall be damaged beyond repair.
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 $\leq (MIPP * MPW * (120^\circ C - T) / 103^\circ C) / IPP$, or Pulse Width ≤ 100 mS, whichever is less. T: Air or Airlike Fluids Temperature in °C.	
3. Duty Cycle $D \leq MCIP * (120^\circ C - T) / 103^\circ C / IPP$, or $D \leq 1\%$, whichever is less.	
4. Off-time $\geq PW * (1 - D) / D$.	
Resonant Frequency fs:	Available from 30 to 300 kHz, customized. In-Stock Elements: 30, 40, 50, 60, 70, 100, 120, 150, 200, 250, and 300 kHz.
Orientation:	Plane Circular Piston at Center: #1. Numbering of Array Elements: Outward Sequentially.
Circular Piston at Center:	Diameter ΦD in mm, Customized. Array Number: #1.
Ring Elements:	All ring elements has identical radial length. Radial Length of ring elements: L in mm, customized. Contact BII for availability (frequency dependent).
Ring Element Spacing d:	Centric Spacing d among Ring Elements in mm: $d = L + T$; Customized, generally, $d \leq \lambda / 2$. λ : Wavelength of Underwater Sound. d : Distance between central lines of two neighboring ring elements excluding Circular Piston at Center. L : Radial Length of a ring element. T : Radial length of pressure release materials among the ring elements.
Number of Elements N:	Customized. The number includes circular piston at center and is confined by sizes of housings and mounting parts.
TVR:	115.0 to 140.0 dB $\mu Pa / V @ 1m$ at fs, all rings are tied together. Transmitting Voltage Response.
FFVS:	-190.0 to -170.0 dB $V / \mu Pa$ at fs, all rings are tied together. Free-field Voltage Sensitivity.
Quality Factor Q_m :	3 to 8 (typical 5). -3 dB bandwidth of TVR = fs / Q_m .
Beam Pattern:	Conical
-3dB Beam Width:	One Way: $20203^\circ kHz * mm / (f * \Phi ID)$ without amplitude shading/weighting, all rings are tied together.

	Two Way: 14546°kHz*mm/(f*ΦID) without amplitude shading/weighting, all rings are tied together.
Side Lobe Level:	One Way: ≤ -20 dB without amplitude shading/weighting, all rings are tied together. Two Way: ≤ -40 dB, without amplitude shading/weighting, all rings are tied together.
Maximum Driving Voltage:	300 to 600 Vrms, or voltage rating of cables, whichever is less.
MIPP at fs:	Maximum Input Pulse Power: 100W to 2000W RMS, Transducer dependent.
MCIP at fs:	Maximum Continuous Input Power: 1W to 5W RMS, Transducer dependent.
MPW @ MIPP and fs:	Maximum Pulse Width: ≤ 100 mS, Transducer dependent.
Capacitance (nF@1kHz):	Transducer dependent.
Dissipation @ 1kHz:	Transducer dependent.
Admittance @fs:	Transducer dependent.
Waterproof:	Water-proofed for 50 m water depth.
Mounting Options:	<ol style="list-style-type: none"> 1. Default: Free Hanging (FH) 2. Thru-hole Mounting with Single O-ring (THSO) 3. Thru-hole Mounting with Double O-ring (THDO) 4. Bolt Fastening Mounting (Stainless Steel) (BFMSS) 5. End-face Mounting (EFM) 6. Flange Mounting (FGM) 7. Flush Mounting (FSM) Please refer to online document AcousticSystem.pdf for a complete list of Mounting Options and more details.
Cable:	<ol style="list-style-type: none"> 1. Two Conductor Shielded Cable (SC), Rubber or PVC Jacket. 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. 6. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, ΦD=4.0 mm (SC40), up to 200°C, AWG20 Conductors. 7. Custom Handling: Do not use the cable to support transducer weight in air if the transducer has a mounting part. Do not bend the cable.
Cable Length:	<ol style="list-style-type: none"> 1. Default: 1 m for each channel. 2. Customs, Specify when ordering.
Connector:	<ol style="list-style-type: none"> 1. Default: Wire Leads (WL) 2. Male BNC (BNC) (Max. Diameter Φ14.3 mm) 3. SMA (Plug, Male Pin) (SMA), Voltage Rating: 335 VRMS Continuous. (Max. Diameter Φ9.24 mm) 4. SMC (Plug, Female Socket) (SMC), Voltage Rating: 335 VRMS Continuous. (SMC) (Max. Diameter Φ6.4 mm) 5. MIL-5015 Style (pin) (5015) (Max. Diameter Φ30 mm with 3 contacts) 6. LEMO (Plug Male Pins) (LEMO) (Max. Diameter Φ9.5 mm with 3 contacts) 7. Underwater Mateable Connector (pin) (UMC) (Max. Diameter Φ21.5 to Φ35 mm) 8. Customized, buyer specifies the connector. (Custom) Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.
Housing Diameter:	Inner diameter for active material ΦID ≤ 153 mm; Outside diameter ΦOD ≤ 168 mm.
Weight:	> 1 kg in air. 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.
Power Amplifier:	BII-5000 Series Power Amplifier, Order Separately, or Third-party's power amplifiers such as 50Ω RF power amplifiers.
Impedance Matching:	BII-6000 Bespoke, Standalone, Impedance Matching between transducers and power amplifiers. Order Separately.
T/R Switch:	BII-2100 Transmitting & Receiving Switching, Not Included, Order Separately. Append TR to part number for integrating a T/R Switch in the transducer. This is available ONLY for large transducers whose housing diameter ≥ Φ60mm.
Temperature Sensor:	<ol style="list-style-type: none"> 1. Default: No built-in temperature sensor. 2. Built-in temperature sensor. Append TS to part number (BII-xxxxTS) for integrating a temperature sensor in the transducer.

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/SMA/SMC connector, it is buyer's sole responsibility to make sure that the BNC/SMA/SMC shield of the signal source is firmly grounded for operating safety before hooking up transducer/hydrophone to the signal source. Coax with BNC/SMA/SMC is not intended for hand-held use at voltages above 30Vac/60Vdc.

Maintenance and Operations of BII Air Transducers.

Cooling Transducer: Forced air cooling is NOT necessary. It is not needed but would be helpful to mount the transducer with good thermal conductive metals.

Cleaning Surface: The dust and moisture on transducer radiation face must be removed with soft cloth before driving the transducer.

Characteristics of Temperature Sensor: -40 °C to 250 °C NTC Temperature Sensor: Resistance Vs. Temperature

Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	204.7	35	6.944	110	0.7483	185	0.1439
-35	154.4	40	5.830	115	0.6603	190	0.1313
-30	117.6	45	4.918	120	0.5840	195	0.1202
-25	90.44	50	4.166	125	0.5176	200	0.1103
-20	70.15	55	3.545	130	0.4598	205	0.1015
-15	54.87	60	3.028	135	0.4093	210	0.0937
-10	43.27	65	2.596	140	0.3651	215	0.0868
-5	34.39	70	2.234	145	0.3263	220	0.0807
0	27.53	75	1.929	150	0.2923	225	0.0754
5	22.2	80	1.671	155	0.2624	230	0.0706
10	18.02	85	1.451	160	0.2361	235	0.0665

15	14.72	90	1.265	165	0.2128	240	0.0628
20	12.10	95	1.105	170	0.1923	245	0.0597
25	10.00	100	0.9679	175	0.1742	250	0.0570
30	8.311	105	0.8500	180	0.1581		

Wiring:	Two Conductor Shielded Cable	Coax/BNC/SMA/SMC	Underwater Connector	MIL-5015 Connector
Signal	White or Red	Center Contact	Contact 2	Contact C
Signal Common	Black	Shield	Contact 1	Contact B
Shielding and Grounding	Shield	Shield	Contact 3	Contact A

How to Order									
BII-7910	/fs	-ΦD	-L	-d	-N	-Mounting	-Cable Length	-Cable	-Connector
Transducer	in kHz	Diameter of Circular Piston at center, in mm	Radial Length of Ring Elements, in mm	Centric Spacing of Ring elements, in mm	Number of Elements	Refer to specs.	of Each Element, in meter	Refer to specs.	
Example of Part Number:			Description						
BII-7910/70kHz-Φ20mm-7mm-10mm-8-FH-10m-SC-WL			BII-7910 transducer, 70kHz, Diameter of Circular Piston at center: Φ20mm, Radial Length of Ring Elements: L=7mm, Centric Spacing of Ring Elements: 10mm, 8 Array Elements, Free Hanging, 8x10m Shielded Cable, Wire leads.						
BII-7910/70kHz-Φ20mm-7mm-10mm-8-FGM-10m-WCB-WL			BII-7910 transducer, 70kHz, Diameter of Circular Piston at center: Φ20mm, Radial Length of Ring Elements: L=7mm, Centric Spacing of Ring Elements: 10mm, 8 Array Elements, Flange Mounting, 8x10m Wire/Cable Bundle, Wire leads.						
BII-7910/200kHz-Φ3mm-3mm-3.8mm-6-FH-5m-RG174 Coax-BNC:			BII-7910 transducer, 200kHz, Diameter of Circular Piston at center: Φ3mm, Radial Length of Ring Elements: L=3mm, Centric Spacing of Ring Elements: 3.8mm, 6 Array Elements, Free Hanging, 6 x 5m RG174 Coax, BNC Male.						

Structure:

