Ultrasonic Air Transducer

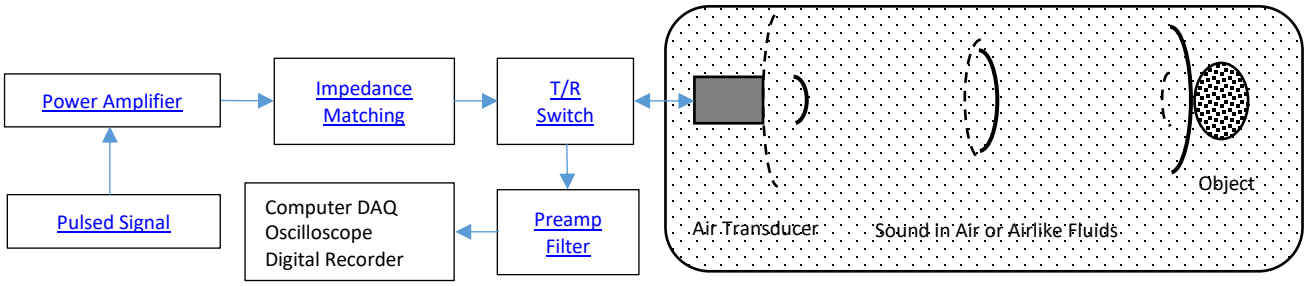
BII-7900 series air transducers featuring low to medium Q_m in air are for air-coupled NDT (Non-destructive Testing), navigation, ranging, measurement and control, and characterization of airlike fluids (gases) and materials such as woods, plastics, rubber, foam, and composites. Water-proofed transducers to withstand 50m water depth is available.

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

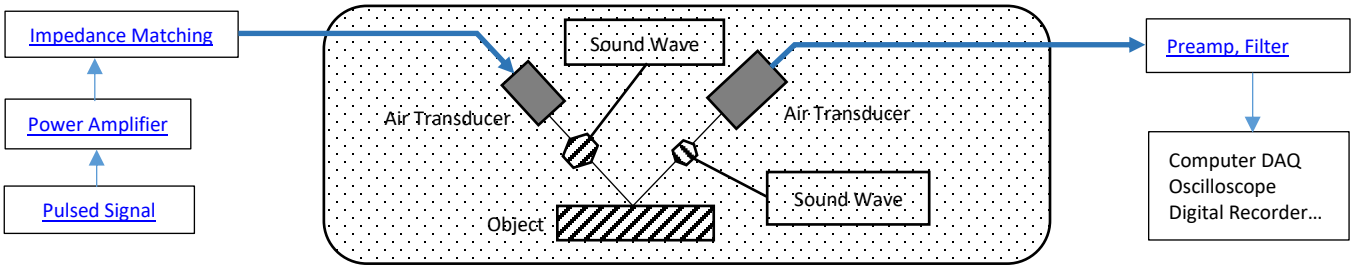
Absorption of Sound in Air at 20°C (68°F), Relative Humidity: 10%, 1 atm.

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

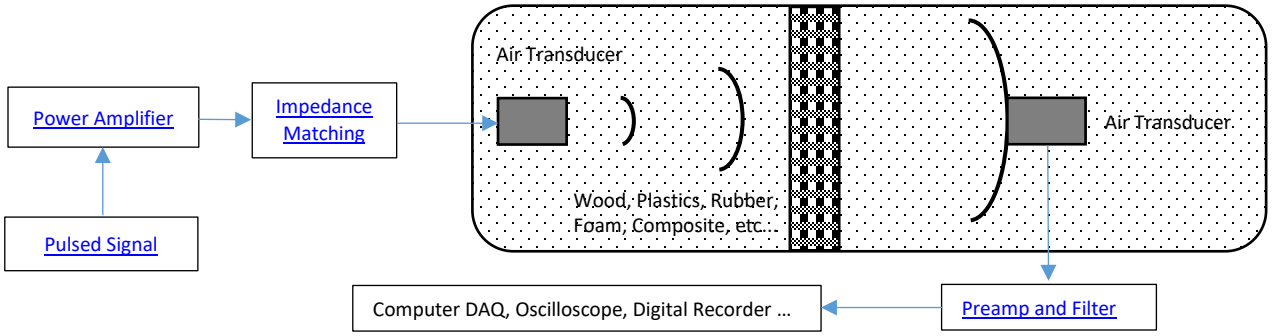
Pulse-Echo System: SONAR in Air and Airlike Fluids



Pulse-Reflection System in Air and Airlike Fluids



Pulse-Transmission System: Information Transmission through Air, Airlike Fluids, and DUT (Device Under Test).



Specifications

Q: Lumped System Quality Factor; **λ**: Wavelength; **D**: Aperture Diameter.	Best Axial Resolution ≈ 0.95Q*λ.	Near Field Length N = $D^2/(4\lambda)$.
Rayleigh Distance = $\pi D^2/(4\lambda)$.	Fraunhofer Zone Distance = $2.3D^2/(4\lambda)$.	Angle of Divergence = $\sin^{-1}(1.22\lambda/D)$.

TVR (transmitting Voltage Response) unit: dB µPa/V@1m; **FFVS** (Free Field Voltage Sensitivity) unit: dB V/µPa. **BW**: Beamwidth. **SR**: Sensing Range of echoes, a distance range along the acoustic axis of the transducer. **f_s**: Series (Motional) Resonance Frequency where the maximum efficiency and greatest TVR exist. **MIPP**: Maximum Input Pulse Power; **MCIP**: Maximum Continuous Input Power; **MPW**: Maximum Pulse Width; **Gp**: Conductance in Parallel.

Air Transducer	**f_s (kHz)**	**D (mm)**	**BW (-3dB)**	**SR (m)**	**TVR**	**FFVS**	**MIPP (W)**	**MPW (Second)**	**MCIP (W)**	**Gp (mS)**	**Size: mm ΦODxH**
BII-7900H/500	500	Φ12	4.5°	0.16 to 1.0	126.5	-195.0	65	0.6	0.2	0.870	Φ21x20
BII-7900H/400	400	Φ12	5.6°	0.13 to 1.0	127.2	-193.0	70	0.8	0.2	0.620	Φ21x20
BII-7900H/300	300	Φ12	7.5°	0.10 to 1.0	129.0	-190.5	80	1.0	0.2	0.280	Φ21x22
BII-7900H/250	250	Φ12	9.0°	0.11 to 1.2	128.0	-183.8	120	0.7	0.2	0.110	Φ21x25
BII-7900H/200	200	Φ12	9.4°	0.10 to 1.5	126.9	-182.5	290	0.8	0.2	0.071	Φ21x30
BII-7900Q/150	150	Φ18	8.5°	0.15 to 2.0	128.0	-181.3	780	0.58	0.28	0.300	Φ27x35
BII-7901/120	120	Φ23	8.3°	0.19 to 2.5	126.8	-182.2	1200	0.684	0.36	0.603	Φ33x37
BII-7901Q/100	100	Φ32	7.3°	0.28 to 3.0	127.9	-183.6	2400	0.770	0.50	0.711	Φ42x40

BII-7901H/70	70	Φ37	8.8°	0.26 to 5.0	123.2	-184.6	3700	0.950	0.56	0.392	Φ48x45
BII-7902/50	50	Φ49	9.2°	0.31 to 10.0	121.6	-187.5	7500	1.100	0.74	0.285	Φ60x55
BII-7903/40	40	Φ74	7.8°	0.55 to 13.0	118.5	-182.7	18000	1.282	1.13	0.353	Φ89x60
BII-7904/30	30	Φ99	7.8°	0.72 to 20.0	115.6	-180.2	26000	2.046	1.50	0.291	Φ114x75

1. Reference standard of Decibel Scales is 1 μPa rms.
2. SR (Sensing Range) listed above is measured at BII laboratory with low noise T/R Switch, low noise 40/60dB gain preamp and stainless-steel plate at 17°C, 60% humidity and no air current. SR varies with field conditions such as humidity, temperature, air currents, target strength, etc...
3. Transducer length listed above is water-proofed for with 50m depth underwater. The length of a bespoke transducer without waterproof is 15mm shorter.

Loading Medium:	The loading medium which the transducer is immersed in MUST be non-corrosive and/or non-flammable.
Pulse Driving Signal:	Voltage Spike (Negative or Positive), pulsed and burst SINE/Square/Chirp excitation, pulsed communication signals. 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) 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, and Pulse Width ≤ 100 mS, whichever is less. T: air and airlike fluids temperature in °c.
3. Duty Cycle D ≤ MCIP*(120°c-T)/103°c)/IPP, and Duty Cycle D ≤ 1%, whichever is less.
4. Off-time ≥ PW*(1-D)/D.

Bespoke Transducers:	The -3dB beam width and operation frequency can be customized. Contact BII for details.
fs Tolerance:	± 5% Typical.
Third Harmonic:	2.8 fs ~ 3.2 fs; Transducers can operate at 3 fs and an impedance matching network at 3 fs should be ordered.
Quality Factor Q_m:	3 to 8. Note: -3dB bandwidth Δf = fs/Q_m.
Aperture:	Circular Plane
Beam Pattern:	Conical
Side Lobes:	≤ -20 dB for one way, ≤ 40 dB for two-way (pulse-echo).
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):	Listed in the datasheet of a specific transducer.
Driving Voltage V_i at fs:	Maximum V_i, V_{imax} = √(MIPP/G_{max}) or 600, whichever is less, in V_{rms}.
Input Power P_i:	$P_i = V_i^2 * G$. G is conductance.
FFVS at f_s:	Refer to the table, in dB V/μPa, 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; 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}.
Free Capacitance:	Listed in the datasheet of a specific transducer.
Dissipation:	Listed in the datasheet of a specific transducer.
Housing:	1. **Plastics for -40°C to +75°C (-40°F to +167°F)**: resists attack by acids, alkalis, salt solutions and most other chemicals. There is no risk of corrosion when exposed to naturally corrosive conditions. They will not rust or corrode from electrochemical and galvanic environment. Solvents shall not be used with air transducers, such as hydrochloric acid, isopropyl alcohol, ethyl lactate, acetone, xylene, Iso hexanes, mineral spirits, etc... 2. **316 Stainless Steel for -40°C to 140°C (-40°F to 284°F)**.
EMI Shielding:	The active element is NOT shielded inside housing. When the transducer works as a sound receiver, its signal conditioning circuit should have high-pass or band-pass filters to reject EMI noise.
Waterproof:	1. Water-proofed for 50 m water depth for standard transducer of -40°C to +75°C (-40°F to +167°F). 2. No water-proofed for high temperature transducer -40°C to 140°C (-40°F to 284°F).
Mounting Options:	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-Out:	1. By default, the cable goes out of the device from the end face. 2. To save space and have the device shorter, the cable can go out of the device from the side wall. Specify when ordering.
Cable:	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:	1. Default: 1 m. 2. Custom.
Connector:	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.
Size:	Listed in the datasheet of a specific air transducer.
Weight:	≥ 0.05 kg with 1 m cable. Actual weight depends on Mounting Parts, Cable Types and Length.
Service Temperature:	1. Default: -40°C to +75°C (-40°F to +167°F). 2. Bespoke: -40°C to 140°C (-40°F to 284°F) are available. Append **HT** to part number. Contact BII for details.
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 Impedance Matching between transducers and power amplifiers. Order Separately. Append **IM** to the part number for integrating BII-6000 in the transducer, and specify impedance in Ω. For example, BII-xxxxIM50Ω: BII-xxxx transducer with built-in Impedance Matching unit as a 50 Ω load.
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:	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

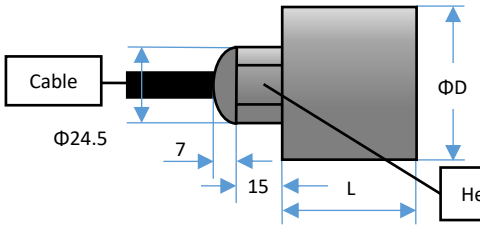
Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	204.7	35	6.944	110	0.7483	185	0.1439
-35	154.4	40	5.830	115	0.6603	190	0.1313
-30	117.6	45	4.918	120	0.5840	195	0.1202
-25	90.44	50	4.166	125	0.5176	200	0.1103
-20	70.15	55	3.545	130	0.4598	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

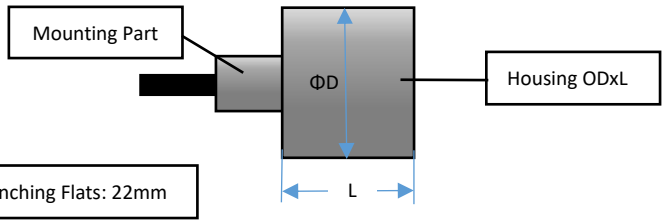
Physical Size (Dimensional Unit: mm): The overall length varies with the length of mounting parts. Please refer to online information of mounting options.

1. Cable goes out of the device from the end face.

a. Size information of Free Hanging.

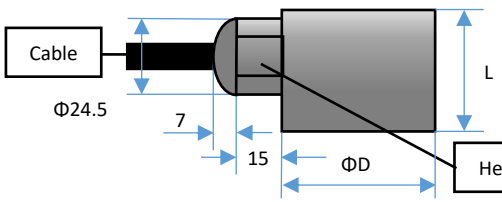


b. General Size information.



2. Cable goes out of the device from the side wall.

a. Size information of Free Hanging.



b. General Size information.