Ultrasonic Power Transducer: High Power, High Q_m

BII7580 Series Ultrasonic Power Transducer for High Power Ultrasonics.

BII7580 series are designed for ultrasonic power applications with continuous-wave and resonance techniques for sonic agitation, processing, and NDT (Non-destructive Testing). For example, the analysis of macroscopic and microscopic, physical and chemical properties, generation of 'quartz wind' and radiation pressure, etc.

Immersion transducers: The transducer is immersed in liquid in a tank or test tube. It is recommended that the temperature of the loading medium is monitored to avoid overheating transducers. Multiple transducers can operate in parallel to cover larger area to be agitated. Following sound fields in processing tank can be achieved: free wave, diffuse, standing wave, pressure, and acceleration fields.

Contact transducers: When the transducer is used in air, the couplant (water, gel, grease, oils and commercial couplant) is a necessary material to provide efficient acoustic coupling between the transducer face and the piece under test. Because of the low thermal conductivity of air, the transducer can only be used with low power CW signal or pulsed/burst/gated high-power signal.

50Ω Transducer Load: the transducers are 50Ω loads to power amplifiers. They are compatible to BII power amplifiers, RF power amplifiers, and 50Ω coax cablings among equipment.

Typical Applications

Sonic Agitation & Process	Physical, Mechanical, Chemical, Biological and Thermal Effects of Sound Energy
Material Study, Fluids Characterization	Transform from Voltage (Electrical Energy) to Force (Pressure)

Specification

fs: Resonance Frequency in Water. **MIPP**: Maximum Input Pulse Power. **MPW**: Maximum Pulse Width. **MCIP**: Maximum Continuous Input Power. **D**: Duty Cycle. **Z:** Transducer Impedance in water at fs.

Transducer	fs	Z in Water	MIPP (W) in Water at f_s	MPW (s) in Water at MIPP & f_s	MCIP (W) in Water at f_s	Size, mm, ΦDxH
BII7580H-7500IM	7.5 MHz	50 Ω	300	0.03	2	Φ21x30
BII7580Q-5000IM	5.0 MHz	50 Ω	690	0.03	5	Φ27x30
BII7580Q-3500IM	3.5 MHz	50 Ω	690	0.05	5	Φ27x30
BII7580H-3000IM	3.0 MHz	50 Ω	850	0.035	2.8	Φ21x30
BII7581-2250IM	2.25 MHz	50 Ω	1000	0.08	9.0	Φ33x30
BII7581-2000IM	2.0 MHz	50 Ω	3500	0.05	10.9	Φ33x30
BII7581-1000IM	1.0 MHz	50 Ω	540	1	15	Φ33x30
BII7581Q-900IM	900 kHz	50 Ω	3400	0.2	16.5	Φ42x35
BII7581Q-800IM	800 kHz	50 Ω	3400	0.22	16.0	Φ42x35
BII7581Q-700IM	700 kHz	50 Ω	3400	0.26	15.5	Φ42x35
BII7581H-600IM	600 kHz	50 Ω	3200	0.48	20	Φ48x30
BII7582-500IM	500 kHz	50 Ω	4300	0.8	33	Φ60x40
BII7582-400IM	400 kHz	50 Ω	4300	1.0	31	Φ60x40
BII7583-300IM	300 kHz	50 Ω	6300	2.3	60	Φ89x40
BII7584-200IM	200 kHz	50 Ω	9000	4.5	108	Φ114x60
BII7584-150IM	150 kHz	50 Ω	3800	7.5	95	Φ114x60
BII7584-100IM	100 kHz	50 Ω	4300	11	75	Φ114x65
BII7584-70IM	70 kHz	50 Ω	5100	16	68	Φ114x70
BII7584-60IM	60 kHz	50 Ω	4800	21	60	Φ114x75
BII7584-50IM	50 kHz	50 Ω	4900	26	55	Φ114x75
BII7584-35IM	35 kHz	50 Ω	5100	33	38	Φ114x100

Warning: the loading medium which the transducer is immersed in MUST be non-corrosive, non-flammable, non-explosive. Solvents shall not be used with transducers, such as hydrochloric acid, isopropyl alcohol, ethyl lactate, acetone, xylene, Iso hexanes, mineral spirits, etc.

Signal Type:	Pulsed and burst SINE/Square/Chirp excitation, Continuous Signals.
Directivity Pattern:	Conical, refer to **Directivity Response Pattern**.
-3dB Beam Width:	Refer to **Directivity Response Pattern,** or in the datasheet with shipment.
Side Lobe Level:	No side lobes or ≤ -17.7 (dB) (-3dB Beam Width <50°).
Resonant Frequency f_s:	Refer to the table.
Transmitting Frequency:	f_s ± 25%*f_s. Minimum Transmitting Frequency: $f_s/2$. Operating Frequency < Minimum Transmitting 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.
Quality Factor Q_m at f_s:	3 to 15, load medium dependent. -3dB bandwidth Δf = fs/Q_m. Qm determines the transient response or the rise and fall rings of steady-state response.
Efficiency η at fs:	0.3 to 0.8, Load Medium Dependent. **Electroacoustic Efficiency η_{ea} is quite low at f << f_s and drops gradually at f > f_s, so it is NOT recommended for transducers to emit high power sounds at frequencies far from f_s. Otherwise, transducer may be damaged by overheating.**
Power Factor PF at f_s:	≥ 0.87 or **Phase Angle θ** of Complex Impedance of the transducer: |θ| ≤ 30°.
TVR at f_s:	Refer to **Transmitting Voltage Respons,** or in the datasheet with shipment.
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 < 100%:** V_{imax} = √(MIPP * |Z|), in V_{rms}. Z is impedance with Impedance Matching Unit at fs. **Continuous Operation at 100% Duty Cycle:** Maximum V_i, V_{imax} = √(MCIP * |Z|), in V_{rms}.

Input Power P_i:	$P_i = V_i^2 / Z$ at f_s. Z is impedance 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.	
FFVS at f_s:	-210 to -175 dB V/µPa, Transducer dependant, 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}.
Maximum Depth:	20 m or 0.2 MPa pressure in liquid, and Limited by the cable length if the cable has wire leads or a non-waterproof connector.
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. Bolt-Fastening Mounting with Free Hanging (**BFMFH)** 6. End-face Mounting (**EFM**) 7. Flange Mounting (**FGM**) 8. Flush Mounting (**FSM**)
	Please refer to online document **AcousticSystem.pdf** for a complete list of Mounting Options and more details.
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 (Not Water-proofed, ONLY for Dry Air Use). 6. Shielded Cable with Twisted Pair and Teflon (PTFE) Jacket, ΦD=4.0 mm (**SC40**), up to 200°C, AWG20 Conductors (Not Water-proofed, ONLY for Dry Air Use). 7. Two Conductor Unshielded Cable (**USC**)
	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-Out:	By default, the cable goes out of the device from the end face. To save space and have the device shorter, the cable can go out of the device from the side wall. Specify when ordering.
Cable Length:	1. Default: 1m. 2. Custom.
Connector:	1. Default: Wire Leads (**WL**) 2. Male BNC (**BNC**) (Max. Diameter Φ14.3 mm). **BNC with RG178 Coax**: Service Temperature up to 165°C or 329°F. 3. MIL-5015 Style (pin) (**MIL**) (Max. Diameter Φ30 mm with 3 contacts) 4. XLR Plug (**XLR**), Rating: 133 VRMS, 15A. (Max. Diameter Φ20.2 mm) 5. Underwater Mateable Connector (pin) (**UMC**) (Max. Diameter Φ21.5 to Φ35 mm)
	Note: Underwater Mateable Connector is for uses underwater. Other connectors and wire leads are for dry uses and are not waterproofed.
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.
Temperature Sensor:	1. Default: No built-in temperature sensor. 2. Built-in temperature sensor. Append **TS** to part number (BIIxxxxTS) for integrating a temperature sensor in the transducer.
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.
Potable Transmitter:	BII8030 series portable acoustic transmitters.
Cooling Transducer:	To avoid overheating transducers during high power applications, pulse driving signal should be used to allow transducers to cool down in water or liquid. Effective cooling is necessary by liquid circulation, and keep water/liquid in specified temperature range.
Remove Air Bubbles on Radiation Surface:	To increase power efficiency, the air bubbles on transducer radiation face developed during operation in liquid must be removed with soft cloth before driving the transducer. An flashlight is a useful aid to check the situation of the transducer surface in liquid. It is a good routine to rub the transducer radiation surface lightly with soft cloth before operating the transducer each time. Do NOT touch the water/liquid and transducer when the system is powered.
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.	

Wiring Information

Transducer Wiring:	**Shielded Cable**	**Coax, BNC.**	**Underwater Connector**	**MIL-5015 Connector**	**XLR Plug**
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 2
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 3
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 1
Please contact us for bespoke wirings of differential transducers such as dipole, quadrupole, multimode rings, and flextensional sources.					

Wiring Information of Temperature Signal.

Temperature Sensor Wiring:	**Shielded Cable**	**Coax, BNC, SMC, SMA**	**Underwater Connector**	**XLR Plug**	**TRS Plug**
Signal:	White or Red	Center Contact	Contact 2	Pin 2	Tip
Signal Common:	Black	Shield	Contact 1	Pin 3	Ring
Shielding and Grounding	Shield	Shield	Contact 3	Pin 1	Sleeve

How to Order Underwater Transducer (Projector), HIFU & Ultrasonic Power Transducer

Part Number	-Mounting Part	-Cable Length in Meter	-Cable Type	-Connector Type
Example:	Description			
BII7581-1000IM-FH-2m-RG58-BNC	BII7581-1000IM Transducer, Free Hanging, 2m RG58 Coax, Male BNC Connector.			

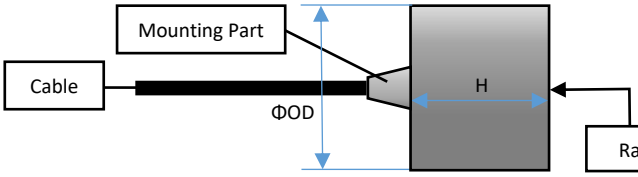
Question:

What if the mating connector of my power amplifier device is NOT available from BII?

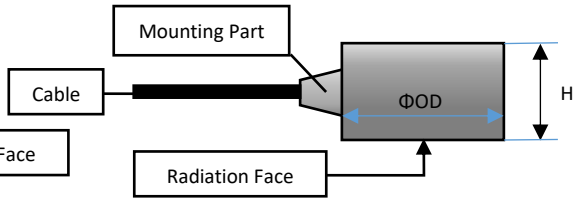
1. Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
2. A connector adaptor might be assembled by BII by customization, and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations.
3. Many adaptors for standard connectors are available in worldwide electronic suppliers such as BNC to SMA, BNC to SMC, XLR to TRS, etc. Check out your local suppliers.

Physical Size (Dimensional Unit: mm): The overall length varies with mounting parts.

a. General Size information.



b. Size information of Customized Cable Orientation: Side Wall.

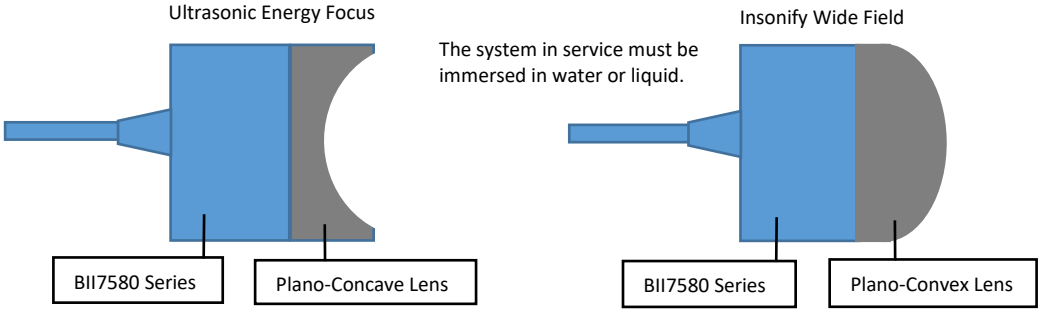


General Operating Guide of BII Ultrasonic Power Transducer

To produce the cavitation in liquids, please choose carefully the liquid (surface tension, viscosity, temperature), hydrostatic pressure, pulse length, operating frequency and driving voltage level or driving power. As a general guide, the cavitation threshold of the liquid increases as the operating frequency increases.

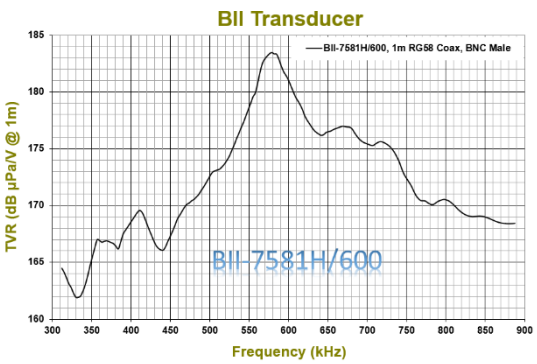
Frequency	Aerated (tap) Water: Cavitation Threshold.	Degassed Water: Cavitation Threshold.
35 kHz	0.3 W/cm²	3.5 W/cm²
50 kHz	0.6 W/cm²	5 W/cm²
70 kHz	0.8 W/cm²	8 W/cm²
100 kHz	1 W/cm²	9 W/cm²
150 kHz	5 W/cm²	12 W/cm²
200 kHz	7 W/cm²	50 W/cm²
300 kHz	10 W/cm²	70 W/cm²
500 kHz	30 W/cm²	90 W/cm²
1 MHz	500 W/cm²	500 W/cm²
2 MHz	1000 W/cm²	1000 W/cm²

Application Extension of BII7580 Ultrasonic Power Transducers (BII does NOT provide the Lens.)

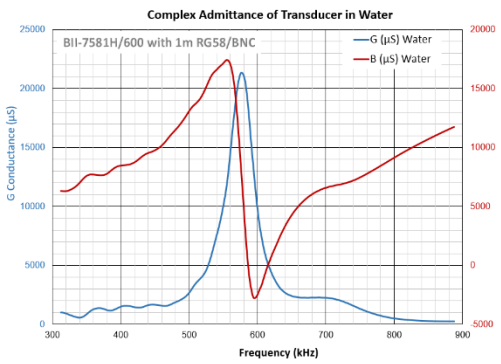


Following technical data are for non-50Ω transducers.

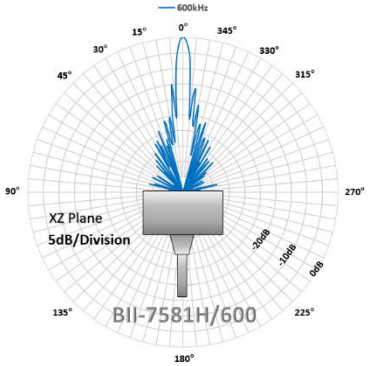
TVR (Transmitting Voltage Response)

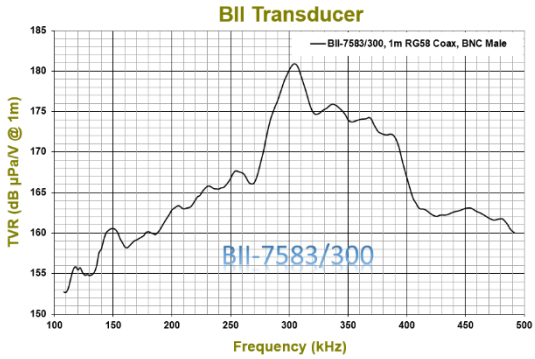


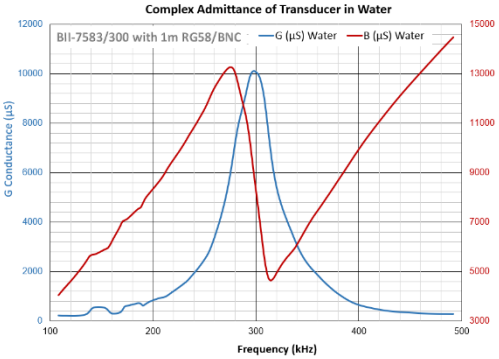
Admittance

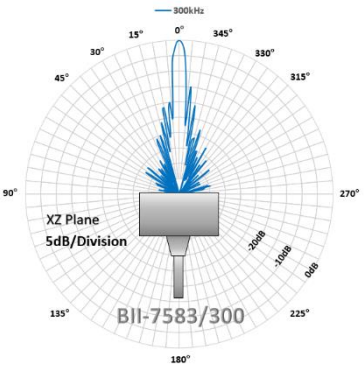


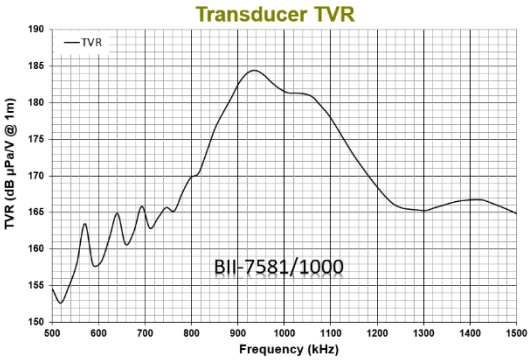
Directivity Response Pattern in Water

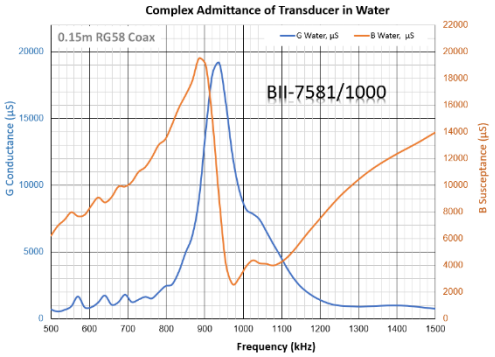


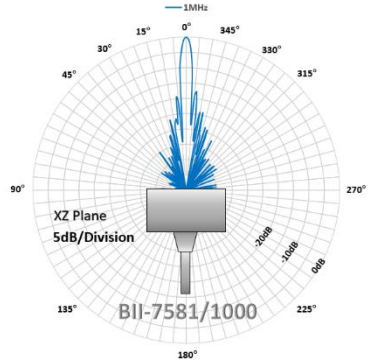

BII Transducer
BII-7583/300, 1m RG58 Coax, BNC Male
TVR (dB µPa/V @ 1m)
Frequency (kHz)
BII-7583/300


Complex Admittance of Transducer in Water
BII-7583/300 with 1m RG58/BNC
G (µS) Water
B (µS) Water
G Conductance (µS)
Frequency (kHz)


300kHz
XZ Plane
5dB/Division
BII-7583/300


Transducer TVR
TVR
TVR (dB µPa/V @ 1m)
BII-7581/1000
Frequency (kHz)


Complex Admittance of Transducer in Water
0.15m RG58 Coax
G Water, µS
B Water, µS
BII-7581/1000
G Conductance (µS)
B Susceptance (µS)
Frequency (kHz)


1MHz
XZ Plane
5dB/Division
BII-7581/1000