



## 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

**f<sub>s</sub>:** 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 f<sub>s</sub>.

Transducer	f <sub>s</sub> ± 10%	Z in Water	MIPP (W) in Water at f <sub>s</sub>	MPW (s) in Water at MIPP & f <sub>s</sub>	MCIP (W) in Water at f <sub>s</sub>	Size, mm, ΦDxH
BII7580H-7500IM	7.5 MHz	50 Ω	300	0.03	2	Φ21x20
BII7580Q-5000IM	5.0 MHz	50 Ω	690	0.03	5	Φ27x20
BII7580Q-3500IM	3.5 MHz	50 Ω	690	0.05	5	Φ27x20
BII7580H-3000IM	3.0 MHz	50 Ω	850	0.035	2.8	Φ21x20
BII7581-2250IM	2.25 MHz	50 Ω	1000	0.08	9.0	Φ33x20
BII7581-2000IM	2.0 MHz	50 Ω	3500	0.05	10.9	Φ33x20
BII7581-1000IM	1.0 MHz	50 Ω	540	1	15	Φ33x20
BII7581H-600IM	600 kHz	50 Ω	3200	0.48	20	Φ48x20
BII7582-500IM	500 kHz	50 Ω	4300	0.8	33	Φ60x25
BII7582-400IM	400 kHz	50 Ω	4300	1.0	31	Φ60x25
BII7582H-300IM	300 kHz	50 Ω	3000	2	55	Φ73x25
BII7582H-200IM	200 kHz	50 Ω	1500	3	68	Φ73x25

**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 <b>Directivity Response Pattern</b> .
-3dB Beam Width:	Refer to <b>Directivity Response Pattern</b> , or in the datasheet with shipment.
Side Lobe Level:	No side lobes or ≤ -17.7 (dB) (-3dB Beam Width <50°).
Resonant Frequency f <sub>s</sub> :	Refer to the table.
Transmitting Frequency:	f <sub>s</sub> ± 25%*f <sub>s</sub> .
	Minimum Transmitting Frequency: f <sub>s</sub> /2.
	<b>Operating Frequency &lt; Minimum Transmitting Frequency:</b> 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 <sub>m</sub> at f <sub>s</sub> :	5 to 15, load medium dependent. -3dB bandwidth Δf = f <sub>s</sub> /Q <sub>m</sub> . Q <sub>m</sub> determines the transient response or the rise and fall rings of steady-state response.
Efficiency η at f <sub>s</sub> :	0.3 to 0.8, Load Medium Dependent. <b>Electroacoustic Efficiency η<sub>ea</sub> is quite low at f &lt;&lt; f<sub>s</sub> and drops gradually at f &gt; f<sub>s</sub>, so it is NOT recommended for transducers to emit high power sounds at frequencies far from f<sub>s</sub>. Otherwise, transducer may be damaged by overheating.</b>
Power Factor PF at f <sub>s</sub> :	≥ 0.87 or Phase Angle θ of Complex Impedance of the transducer:  θ  ≤ 30°.
TVR at f <sub>s</sub> :	Refer to <b>Transmitting Voltage Respons</b> , or in the datasheet with shipment.
Radiation Sound Level SL:	SL = 20*logV <sub>i</sub> + TVR, dB μPa@1m. Driving Voltage V <sub>i</sub> is in unit of V <sub>rms</sub> .
Admittance (G and B):	TBD, to be determined, or refer to <b>G-B Graph</b> .
Driving Voltage V <sub>i</sub> at f <sub>s</sub> :	<b>Pulsed Driving Signal and Duty Cycle D &lt; 100%:</b> V <sub>imax</sub> = √[(MIPP *  Z )], in V <sub>rms</sub> . Z is impedance with Impedance Matching Unit at f <sub>s</sub> .
	<b>Continuous Operation at 100% Duty Cycle:</b> Maximum V <sub>i</sub> , V <sub>imax</sub> = √[(MCIP *  Z )], in V <sub>rms</sub> .
Input Power P <sub>i</sub> :	P <sub>i</sub> = V <sub>i</sub> <sup>2</sup> / Z at f <sub>s</sub> . Z is impedance at f <sub>s</sub> , or 50Ω by default.

### How to determine pulse width, duty cycle and off-time with input pulse power (peak power) at f<sub>s</sub>:

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.

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 ( <b>THSO</b> ) 3. Bolt Fastening Mounting (Stainless Steel) ( <b>BFMSS</b> ) 4. End-face Mounting ( <b>EFM</b> ) 5. Flange Mounting ( <b>FGM</b> ) 6. Flush Mounting ( <b>FSM</b> ) Please refer to online document <a href="#">AcousticSystem.pdf</a> for a complete list of Mounting Options and more details.
Cable:	1. Two Conductor Shielded Cable ( <b>SC</b> ), Rubber or PVC Jacket. 2. 50 $\Omega$ RG58 Coax ( <b>RG58</b> ) 3. 50 $\Omega$ RG174/U Coax ( <b>RG174</b> ) 4. <b>50 <math>\Omega</math> RG178/U Coax (RG178) (Operating Temperature Range: -70°C To +200°C)</b> 5. Two Conductor Unshielded Cable ( <b>USC</b> ) <b>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.</b>
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 ( <b>WL</b> ) 2. Male BNC ( <b>BNC</b> ) (Max. Diameter $\Phi 14.3$ mm). <b>BNC with RG178 Coax: Service Temperature up to 165°C or 329°F.</b> 3. Underwater Mateable Connector (pin) ( <b>UMC</b> ) (Max. Diameter $\Phi 21.5$ to $\Phi 35$ 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. <a href="#">Built-in temperature sensor</a> . Append <b>TS</b> to part number (BIIxxxxTS) for integrating a temperature sensor in the transducer.
Power Amplifier:	<b>BIIS000</b> Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.
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.
<b>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.</b> <b>for 50<math>\Omega</math> 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.</b>	

#### Wiring Information

<b>Transducer Wiring:</b>	<b>Shielded Cable</b>	<b>Coax, BNC.</b>	<b>Underwater Connector</b>	<b>MIL-5015 Connector</b>	<b>XLR Plug</b>
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.

<b>Temperature Sensor Wiring:</b>	<b>Shielded Cable</b>	<b>Coax, BNC, SMC, SMA</b>	<b>Underwater Connector</b>	<b>XLR Plug</b>	<b>TRS Plug</b>
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

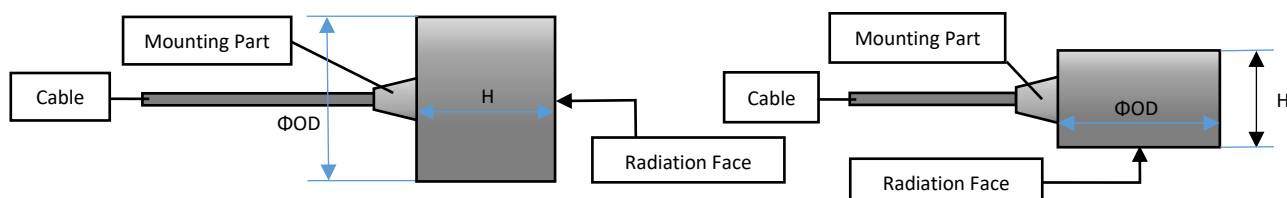
#### How to Order Underwater Transducer (Projector), HIFU & Ultrasonic Power Transducer

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.			

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/cm <sup>2</sup>	3.5 W/cm <sup>2</sup>
50 kHz	0.6 W/cm <sup>2</sup>	5 W/cm <sup>2</sup>
70 kHz	0.8 W/cm <sup>2</sup>	8 W/cm <sup>2</sup>
100 kHz	1 W/cm <sup>2</sup>	9 W/cm <sup>2</sup>
150 kHz	5 W/cm <sup>2</sup>	12 W/cm <sup>2</sup>
200 kHz	7 W/cm <sup>2</sup>	50 W/cm <sup>2</sup>
300 kHz	10 W/cm <sup>2</sup>	70 W/cm <sup>2</sup>
500 kHz	30 W/cm <sup>2</sup>	90 W/cm <sup>2</sup>
1 MHz	500 W/cm <sup>2</sup>	500 W/cm <sup>2</sup>
2 MHz	1000 W/cm <sup>2</sup>	1000 W/cm <sup>2</sup>

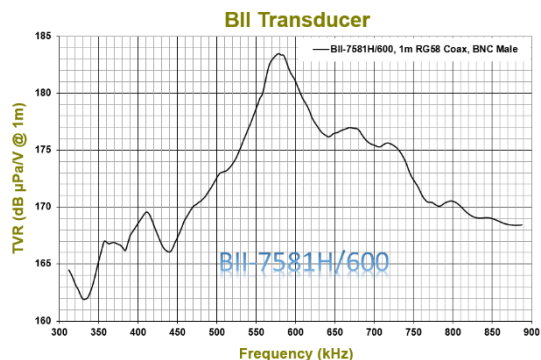
### Question:

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

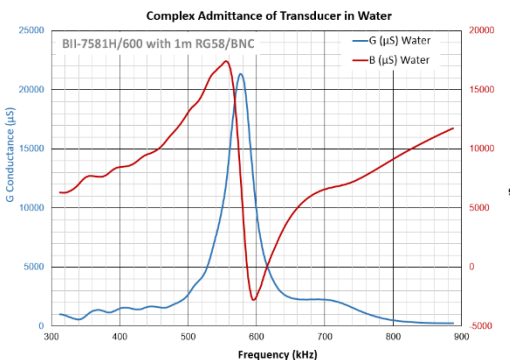
1. Buyer may order BII products with wire leads, and buyer assembles the mating connector to the cable end.
2. A connector adaptor might be assembled by BII by customization, and BII ships the adaptor to buyer as accessory of the device. Please contact BII for customizations.
3. Many adaptors for standard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

Following technical data are for non-50Q transducers.

### TVR (Transmitting Voltage Response)



### Admittance



### Directivity Response Pattern in Water

