TEST REPORT

SU-126, S/N: 002

2 MHz x 20 mm Active Diameter Unfocused Transducer

and

Fundamental Resonance Impedance Matching Network

Technischen Universität, München

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Overall Conformity

Date: 1/24/2014

Conformity: Yes

Jay Evered

I. Transducer Specifications

Center Frequency	2.000 MHz
Active Diameter	20.00 mm (0.787 inches)
Thru Opening	None
Geometric Focus	Unfocused (flat)
Pressure Focal Gain	2 (assumes 1 at the radiating surface and in a linear homogenous field)
Focal Depth	133 mm (see axial beam plot)
# of Elements	1
Environment	Immersible in water to a depth of 1 meter, 0 to 60 ^{o}C
Cable	1 meter custom high power cable, 25 Ohm coax, exits back of housing
Connector	UHF male on transducer cable; UHF female on transducer side, BNC female on driver side of matching network
Transducer Housing	Brass, 25.4 mm (1.00 inch) diameter x 25.4 mm (1.00 inch) long
Mounting Holes	None
RF Shielding	Transducer housing is RF shielded. Conductive transducer face and RF shield are connected to cable ground return.
Matching Network	A fundamental harmonic RF impedance matching network is supplied inside an external enclosure, intended for use with a 50 Ohm RF amplifier.

II. Measurement of the shape of transducer

Not applicable

III. Burn-in Test (if applicable)

Not applicable

IV. Electrical Impedance*

* Test is performed proceeding burn-in test (if applicable for this specific transducer).

An HP 4194A Impedance/Gain-Phase Analyzer was used to measure the electrical input impedance of the transducer. During these measurements, the transducer face was in room-temperature water with no reflectors. In the attached plots, the transducer impedance is shown at the fundamental with and without the RF matching network.

- Degassed water at 20 degrees Celsius
- Non-reflective environment
- Fundamental (Fo) plotted frequency range: 1 kHz to 4.0 MHz
- Magnitude (Z): Plotted from 0 to 100 Ohms
- Phase: Plotted from -90 to +90 degrees

<u>FUNDMENTAL RESONANCE (see Appendix for Figures)</u>

Operating Band down to -3 dB normalized to a perfect 50 Ohm / 0 degree match:
(See Power Transfer plot, Figure 2)

Center Frequency	2.00 MHz
Minimum Frequency	1.42 MHz
Maximum Frequency	2.71 MHz

Unmatched electrical impedance values @ Center Frequency:

	Magnitude (Ohms)	Phase (degrees)
@ Center Frequency	41.8	-63.7

Matched electrical impedance values over operating band:

	Magnitude (Ohms)	Phase (degrees)
@ Center Frequency	59.8	-0.3
Minimum	18.6	-59.0
Maximum	131.5	20.2

V. Power Input at Center Frequency

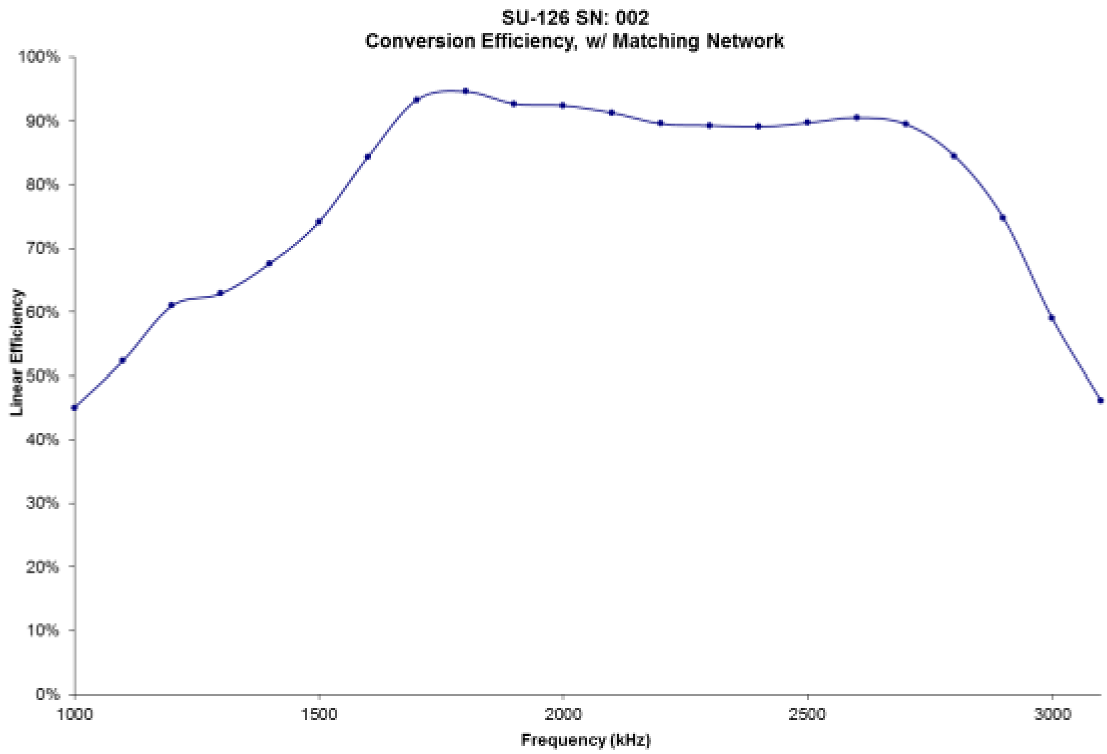
<u>FUNDAMENTAL RESONANCE</u>

	Watts Electrical	Pressure at Surface (kPa_peak)	Voltage (Vrms)	Current (Irms)
Max Pulsed	300	650	168	NA
Max Average	35	222	57.5	1.4

VI. Conversion Efficiency Test

Test Conditions:

- Acoustic Power Measurements: Radiation Force Balance SC PN: RFB-100, Synthetic Bristle Absorber
- With radiating field perpendicular to the absorber's face
- Degassed water at 20 degrees Celsius
- Excitation: Continuous wave for one-second duration
- Electrical Power Measurement: SC PN: 21A, 20 Watt scale, acquires Applied Electrical Power (Incident – Reflective Electrical Power)



Measured power conversion efficiency v. frequency for the SU-126 Sn 002 2.0 MHz transducer.

VII. Beam Pattern Measurements

Beam pattern measurements were made for this specific transducer and are presented in the appendix.

VIII. Usage Notes

The transducer is coated with a thin film of epoxy. The housing is brass. The transducer face, housing, and cable exit are water-tight.

The transducer face and housing are at RF ground potential. Due to the large RF present within the transducer during operation, an **electrical safety ground** connection to the transducer housing is highly recommended. If the transducer were broken during operation, the internal RF electrical wires could come into contact with the water, presenting an electrical shock hazard.

Permanent damage could result if the transducer is dropped, particularly if the face strikes a solid object. The transducer face is quite brittle. Use extreme care when handling the transducer.

Permanent damage could also result if the transducers are overheated. Internal temperatures to 80^{o}C should not cause permanent damage, but this is difficult to determine from external temperature measurements. Avoid driving the transducer at high power at frequencies far away from the center frequency, because the transducer is much less efficient at frequencies away from resonance.

Hazardous RF voltages also exist within the impedance matching network during operation. The network should not be driven at high power with the cover removed.

The matching network will only function correctly if it is connected **directly** to the transducer, with **no** added cable length. The cable length between the RF amplifier and the transducer should not have a significant effect on performance. Due to the high power levels, the current in the cable is fairly high and cable heating could be significant. During sustained high-power operation, the temperature of the cable between the matching network and transducer should be periodically checked. Operation at frequencies away from the center frequency may result in higher resonant currents in the cable, and thus higher cable heating.

The matching networks are fairly robust, but they could be damaged if dropped on a hard surface. If damage is suspected to either the matching network or the transducer, a simple test can be performed with your RF wattmeter. Simply drive the transducer at its center frequency (in water with no reflections) and check forward and reflected power. If the input impedance is still 50 Ohms and close to zero degrees, then there will be minimal reflected power. If damage has occurred, the impedance is likely to have changed.

For operation at sustained high-power levels, airflow should be supplied to the matching network. The built-in fan operates at 12 VDC. Reduced voltages may be used while operating at intermediate power levels or moderate duty cycles, due to reduced cooling requirements.

Appendix

Figure 1.a. Unmatched electrical impedance.

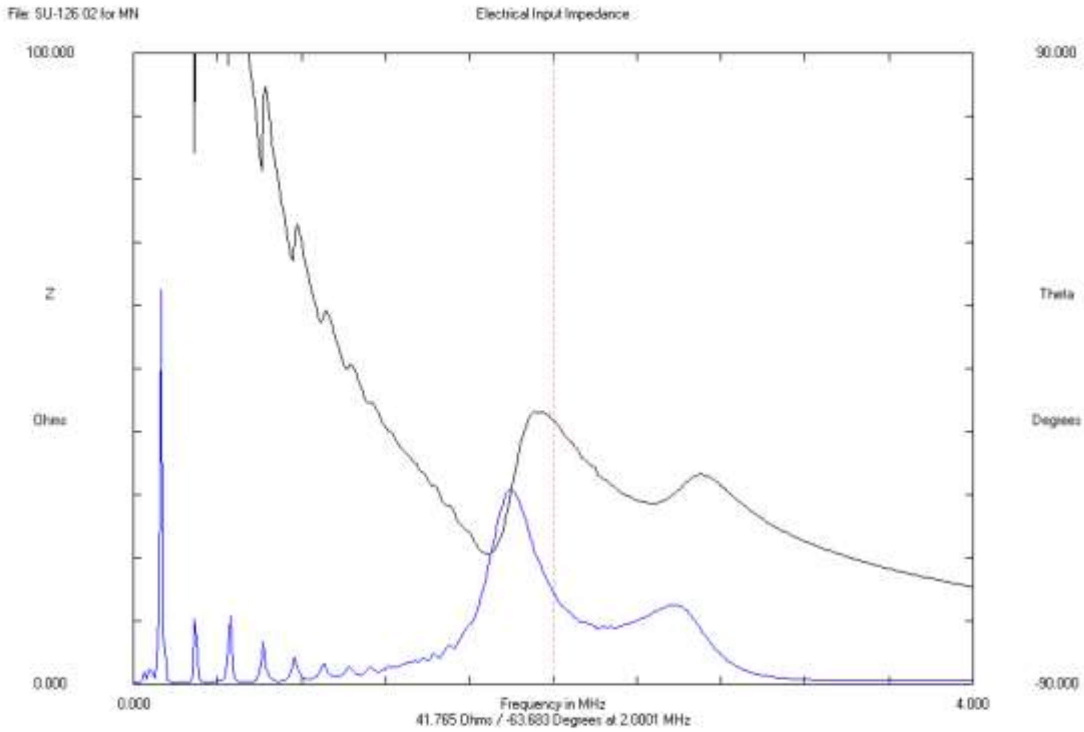


Figure 1.b. Matched electrical impedance.

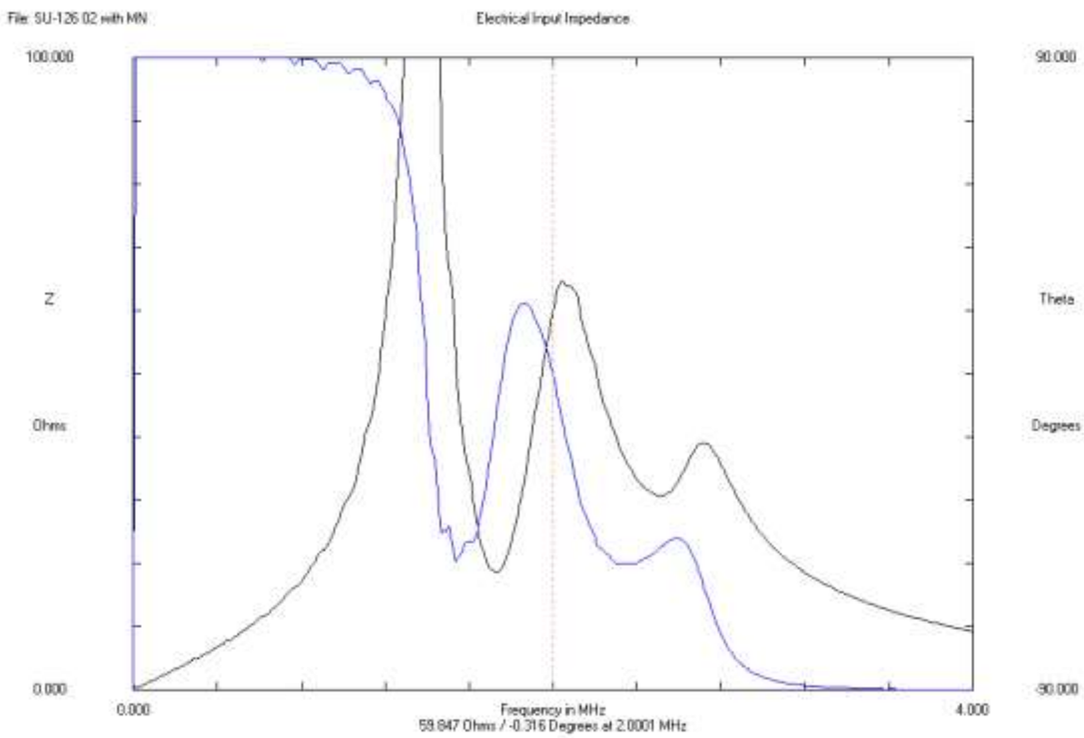


Figure 2. Matched power transfer to 50 Ohms real.

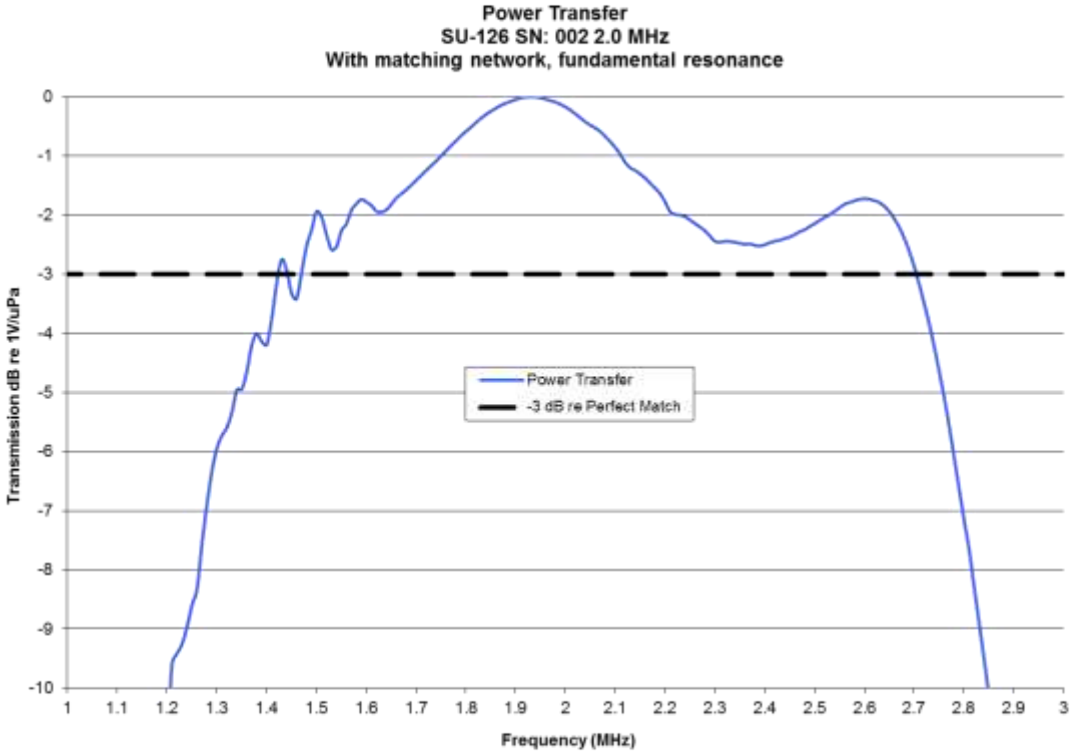
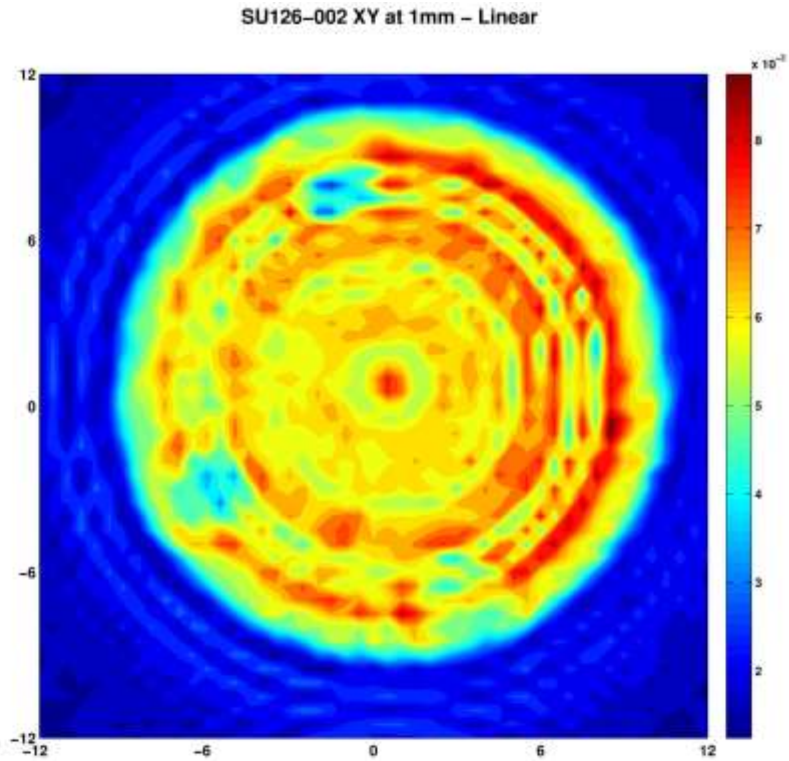


Figure 3a. Beam Plots, Radial – 1mm from transducer face



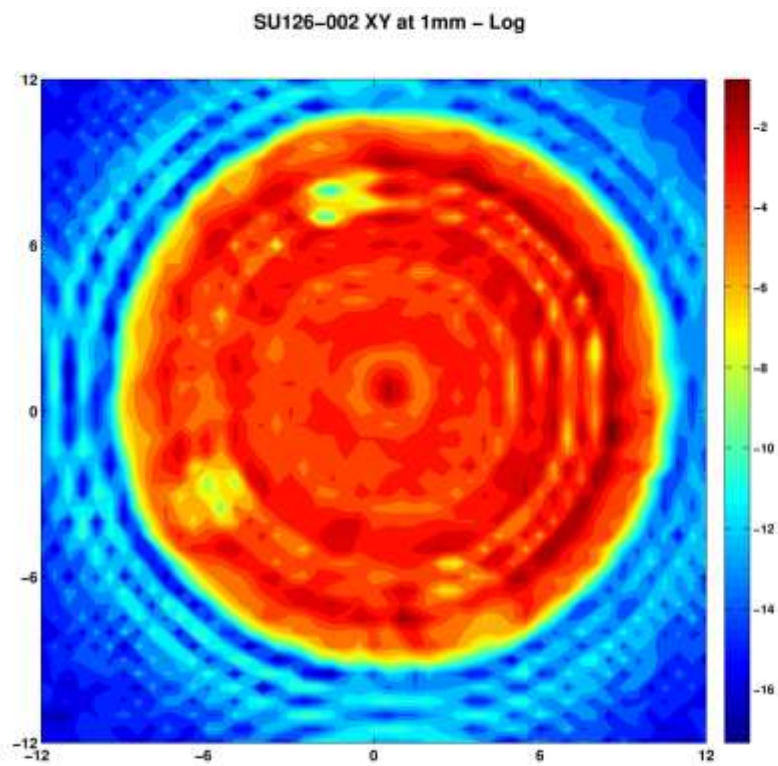


Figure 3b. Beam Plots, Axial Z=0 at transducer face