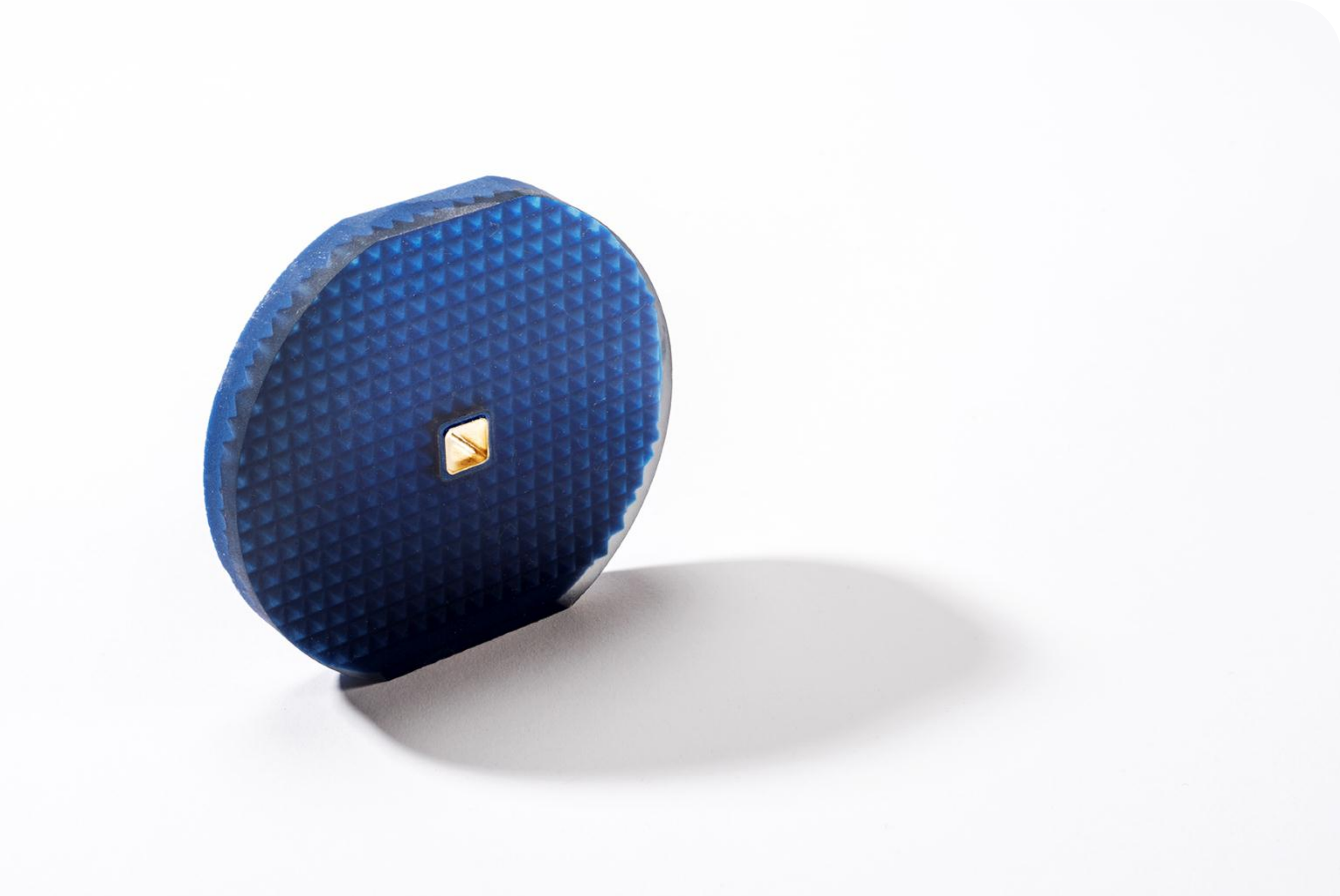
Bounded-square output mask



The Bounded-square output mask, from Precision Acoustics Ltd is designed to meet the measurement requirements of IEC 62359:2010 + AMD1:2017. When used in conjunction with a Radiation Force Balance (RFB) or a scanned hydrophone, the bounded output mask enables the evaluation of the power radiated through a 1 cm x 1 cm aperture for diagnostic ultrasound devices.

The Bounded-square output mask is based upon HAM A (also available from Precision Acoustics Ltd) which is a two-layer absorbing tile with an impedance matching front layer on top of a micro-bubble filled, pre-cast polyurethane absorbing layer. The interface between the two layers has a pyramidal wedge structure to reduce specular reflections and provide geometrical acoustic impedance matching between the two materials. Within the tile there is a precision cut 1 cm^2 aperture, which has a reflective metal lining. This lining ensures that ultrasonic signals that are obliquely incident upon the sides of the aperture are not absorbed and are transmitted through.

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TYPICAL PROPERTIES

Appearance	Two-layer polyurethane sheet: Clear upper layer acoustic impedance matched to water; Blue highly absorbing lower layer.
Dimensions of standard tile	250 mm X 200 mm X 14 mm
Aperture internal dimension	1 cm X 1 cm
Density	1010 ± 20 kg / m3
Average wave speed (1-10 MHz)	1500 ± 30 m / s
Acoustic impedance	1.5 MRayls
Resistant to	Isopropyl Alcohol (IPA) Tricholethylene
Affected by	Ketones (MEK, Acetone) – Swell Dichloromethane – Swell and break down
Avoid prolonged exposure to	Ozone UV
Stability	Very stable due to cross-linked nature of polymer
Coefficient on Thermal Expansion	200 ppm/°C

BOUNDED-SQUARE OUTPUT MASK AND THE MEASUREMENT OF ULTRASONIC POWER

Ultrasonic power is a key quantity required for acoustic output measurements of medical ultrasonic equipment. This is conventionally made using the radiation force principle and the operation of RFBs is described in detail within IEC 61161. The recently amended standard of IEC 62359:2010 + AMD1:2017 stipulates that the output power from diagnostic ultrasound machines in both scanning and non-scanning modes is evaluated in terms of that transmitted through a 1 cm x 1 cm aperture. One way of achieving this is to place a mask in between the source of ultrasound and the RFB target. This mask should have a reflection coefficient that is below -30 dB and a loss of 45 dB/cm at 3.5 MHz. Furthermore the mask's inside walls should be lined with a reflective materials to minimize loss in the walls. All of these features can be found in the Bounded-square output mask from Precision Acoustics Ltd. Data to illustrate the echo reduction and insertion loss is provided below.

INSERTION LOSS

Insertion loss (IL) is defined as

$$IL = -20\log_{10}\left(\frac{P_t}{P_i}\right)$$

where P_t is the amplitude of the acoustic pressure transmitted through a sample and P_i is the amplitude of the acoustic pressure incident upon it.

This has been experimentally determined for the absorbing section of a 14mm thick Bounded-square output mask, and this is shown in Figure 1.

The dynamic range of IL measurement is approximately 60 dB and values higher than this cannot be guaranteed.

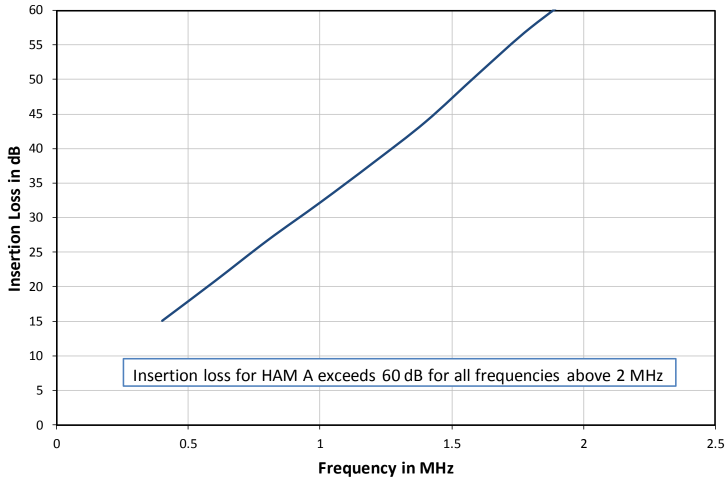

Figure 1 – Insertion loss vs Frequency for Bounded-square output mask

ECHO REDUCTION

Echo Reduction (ER) is defined as

$$ER = -20\log_{10}\left(\frac{P_r}{P_i}\right)$$

where P_r is the amplitude of the acoustic pressure reflected from a sample and P_i is the amplitude of the acoustic pressure incident upon it.

This has been experimentally determined for the Bounded-square output mask, and this is shown in Figure 2.

The dynamic range of ER measurement is approximately 60 dB and values higher than this cannot be guaranteed.

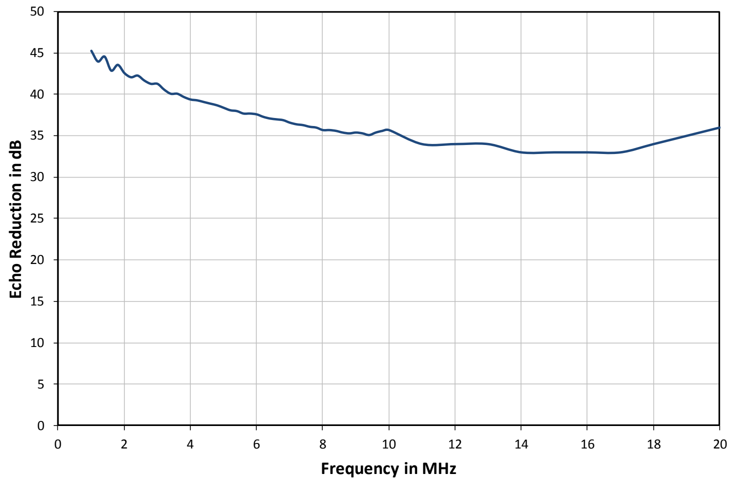

Figure 2 – Echo Reduction vs Frequency for Bounded-square output mask

All data relating to the ER and IL of Bounded-square output mask has been provided by the NPL (London).

FRACTIONAL POWER DISSIPATION

Fractional power dissipation (FPD) is defined as

$$\mathrm{FPD} = 1 - \left(\frac{P_r}{P_i}\right)^2 - \left(\frac{P_t}{P_i}\right)^2$$

where P_r is the acoustic pressure reflected from the sample, P_t is the acoustic pressure transmitted through the sample and P_i is the acoustic pressure incident upon the sample. This has been derived from the ER and IL measurements for Bounded-square output mask, and this is shown in Figure 3.

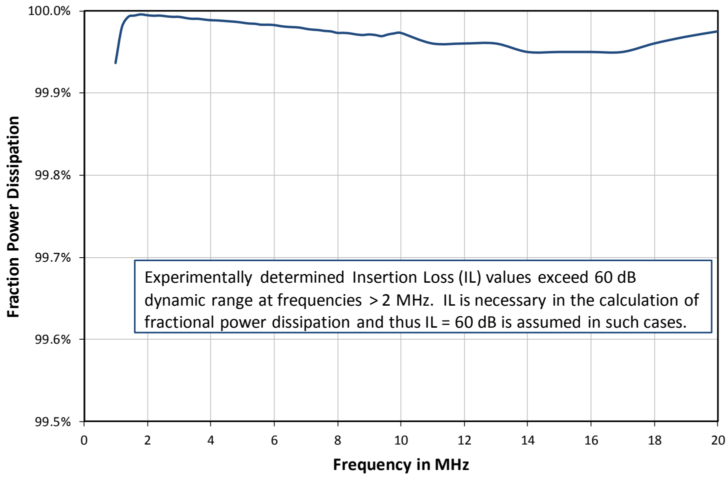

Figure 3 – Fraction Power dissipation vs Frequency for Bounded-square output mask

All information is based on results gained from experience and tests, and is believed to be accurate but is given without acceptance of liability for loss or damage attributable to reliance thereon as conditions of use lie outside the control of Precision Acoustics Ltd.