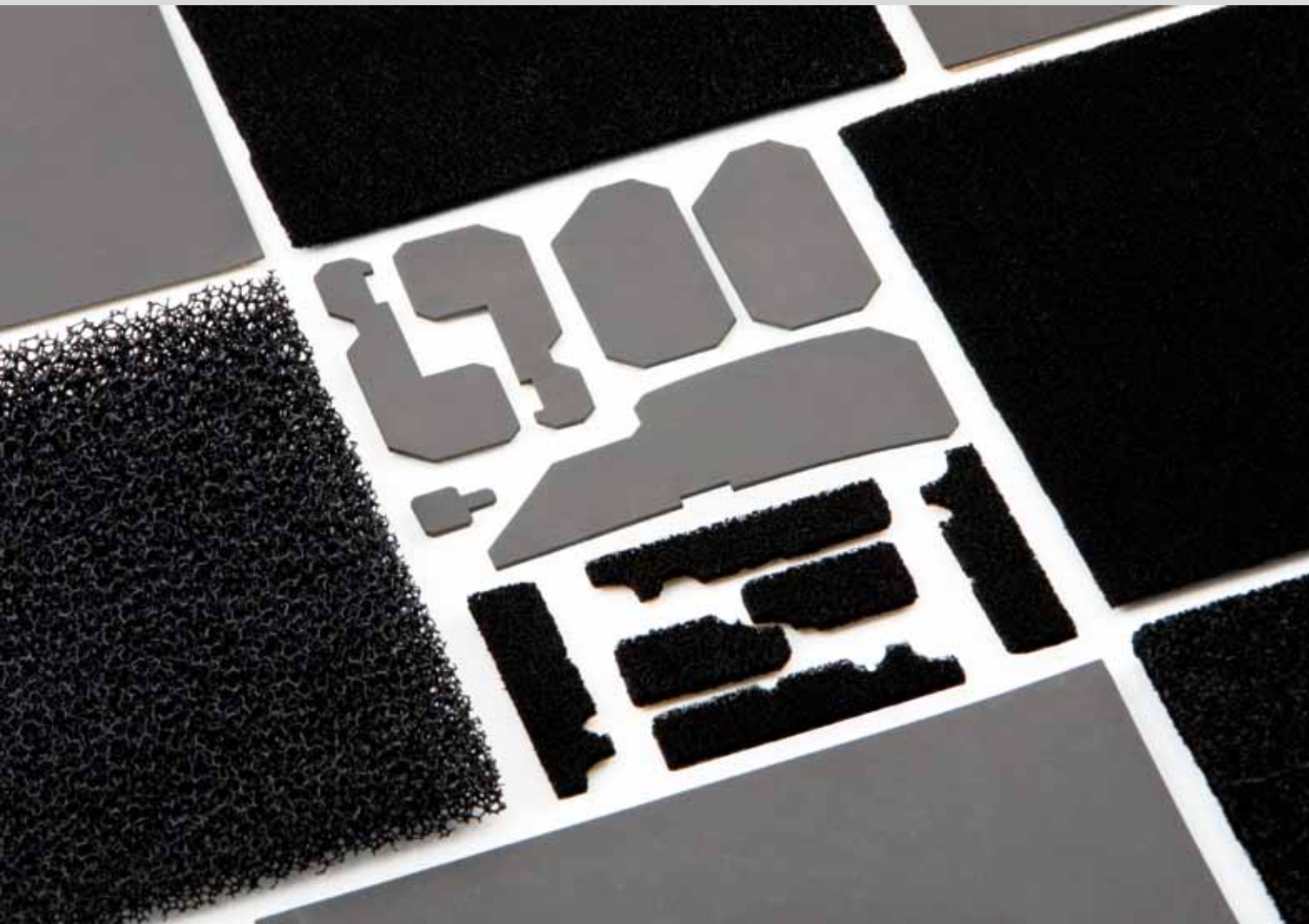


**17.**

**MICROWAVE  
ABSORBER.**



## GENERAL INFORMATION

Interest in microwave-absorbing material technology has been growing.

As the name implies, microwave-absorbing materials are coatings whose electrical and/or magnetic properties have been altered to allow absorption of microwave energy at discrete or broadband frequencies.

There are several techniques to achieve these properties. The goal of the absorber manufacturer is to balance electrical performance, thickness, weight, mechanical properties and cost.

### Customizations



## FEATURES AND BENEFITS

- Available in wide range of dimensions can easily be die-cut or supplied in kiss cut parts.
- Environmental friendly: Halogen - free and Rohs certified excellent performance at low, medium and Hi frequencies.
- Supplied with pressure sensitive adhesive for ease of installation.
- Fire retardant rating up to UL94 V0.
- Sheets are offered in nominal sizes 24" x 24" (609.6 x 609.6 mm), although custom sizes and moulded components are available upon request.

## PRINCIPLES OF OPERATION

Altering the dielectric and magnetic properties of existing materials will produce microwave absorbers.

For purposes of analysis, the dielectric properties of a material are categorized as its permittivity and the magnetic properties as its permeability.

Both are complex numbers with real and imaginary parts. Common dielectric materials used for absorbers, such as foams, plastics and elastomers, have no magnetic properties, giving them permeability of 1.

Magnetic materials, such as ferrites, iron and cobalt-nickel alloys, are used to alter the permeability of the base materials.

High dielectric materials, such as carbon, graphite and metal flakes, are used to modify the dielectric properties.

When an electromagnetic wave, propagating through a free-space impedance of  $Z_0$ , is incident upon a semi-infinite dielectric or magnetic dielectric boundary of impedance  $Z_1$ , a partial reflection occurs.

The magnitude of the reflection coefficient is governed by the following equation:

## ABSORBER TYPES

### ELASTOMERIC ABSORBERS

These thin, flexible absorbers are best for outdoor use.

The method of application is adhesive bonding to a metal substrate. Adhesives vary with the type of elastomer chosen and include: epoxies, urethanes, contact adhesives and pressure-sensitive adhesives (PSA).

In general, nitrile are the easiest elastomers to bond and have a variety of compatible adhesive systems available. Bond strengths in excess of 10 pounds per inch are typical. In some cases, it is necessary to cover a tight radius or complex curvature.

An alternative to flat sheet material is conformally molded parts.

Conformal molds increase the ease of bonding and reduce the likelihood of applying any built-in stresses into the material.

For gasket applications, the elastomeric absorber may be extruded.

To improve weather resistance, the absorber is painted. Typically, an epoxy - or urethane-based paint is used.

To avoid gaps between sheets, absorptive gap fillers are used to minimize any impedance mismatches from sheet to sheet.

This technique also limits the formation of surface waves and reflections.

Newer non-corrosive fillers, such as iron silicide, are also available for corrosive environments.

### BROADBAND ABSORBERS

Open-cell foam absorbers are normally used in a protected environment, i.e. radomes or nacelles. Therefore, application becomes much less critical than for those on the exterior of a vehicle.

The typical method of application is adhesive bonding. Again, a wide class of adhesives may be used, including contact cements, epoxies and acrylic PSA. In general, cohesive failure of the material will result before adhesive failure. The front surfaces may be painted or coated to further protect the absorber.

**Euro Technologies** uses two methods to produce broadband absorbers for external use.

The first method involves taking broadband foam or netting absorber and encapsulating it in a reinforced coated fabric. The bagging material is completely enclosed around the absorber making it weather proof.

This radar-absorptive cover can then be used in external environments with no physical degradation to the absorbing medium. A second method uses a closed-cell foam filling technique to produce rigid structural absorptive panels.

The absorber, **MWA6**, is lightweight and may be molded to a variety of shapes. It has broadband absorptive characteristics similar to the flexible foam **MWA3** absorbers.

The rigid, closed-cell form may be painted and will be impervious to external environments. A variety of high-strength, lightweight, flexible fillers for **MWA6** are being developed. **MWA6** and absorptive honeycomb may be used as the inner core for structural panels.

The panel would consist of face sheets of fiberglass the radar and graphite or metal as the ground plane. These panels are lightweight and high strength and can be used as structure in certain applications.

## MWA1 - SINGLE BAND ABSORBERS

**MWA1** absorbers are resonantly tuned to discrete frequencies between 500 MHz and 100 GHz. They are designed to reduce energy reflections off of a conductive ground plane by > 99% (- 20 dB) at normal angles of incidence.

The performance is based upon the principle of phase cancellation by the incident energy reflection being out of phase with the ground plane reflection.

The materials are thin, flexible and easy to cut and install. They are elastomer based with a variety of choices available. For example, silicone is chosen for high-temperature applications, nitrile for fuel and oil resistance and natural rubber for commercial applications.

Several magnetic fillers are available; carbonyl iron powder is standard, but other materials such as iron silicide (FeSi) are used for corrosion-resistant applications. The density of the materials is based on the volume percentage of magnetic filler. The relationship between resonant frequency, weight and thickness.

### MATERIAL TYPES AVAILABLE

**R - Natural Rubber**

**S - Silicone**

**U - Urethane**

**N - Nitrile**

AVAILABLE IN STANDARD SHEET OF 24" x 24"

Code	Thickness (mm)	Freq (Ghz)	DB Loss
MWA1-R-040-1	1.0	18.200	- 20.0
MWA1-S-045-0	1.1	14.000	- 20.0
MWA1-R-055-1	1.4	11.200	- 20.0
MWA1-N-063-1	1.6	9.400	- 20.0
MWA1-R-075-1	1.9	6.500	- 20.0
MWA1-R-100-1	2.5	2.400	- 20.0
MWA1-N-115-0	2.9	3.000	- 20.0
MWA1-R-150-1	3.8	1.500	- 15.0

## MWA2 - SURFACE WAVE ABSORBERS

**MWA2** surface wave absorbers are thin, magnetically loaded elastomeric sheets designed to provide attenuation at high angles of incidence for surface wave attenuation. They are nominally manufactured in the thickness range of 0.015" to 0.125" (0.4 mm to 3.2 mm).

They are elastomer-based with a variety of choices available. For example, silicone is chosen for high-temperature applications, nitrile for fuel and oil resistance and natural rubber for commercial applications. Several magnetic fillers are available; carbonyl iron powder is standard, but other materials such as iron silicide (FeSi) are used for corrosion resistant applications. The materials are available in UL fire retardant versions for use in commercial devices.

**Euro Technologies** can provide the material die-cut and with a pressure-sensitive adhesive for ease of installations.

Sheets are offered in nominal sizes of 24" x 24" (609.6 mm x 609.6 mm), although custom sizes and molded components are available.

### APPLICATIONS

The material can be used inside of microwave housings to reduce internal resonance and to lower the "Q" of the microwave cavity. They are also effective in isolating antennas from ground plane reflections.

**MWA2** can be used with board level shielding and other types of EMI shielding to enhance the shielding effectiveness at frequencies from 2-40 GHz.

Code	Thickness (mm)	Opt. Freq. Range (Ghz)
MWA2-S-030-1	0.8	12 - 18
MWA2-R-040-1	1.0	8 - 12
MWA2-S-040-1-FR	1.0	8 - 12
MWA2-N-050-1	1.3	8 - 12
MWA2-R-080-1	2.0	4 - 8
MWA2-S-100-1-FR	2.5	2 - 4
MWA2-R-180-1	4.6	< 2

### MWA3 - RETICULATED FOAM ABSORBERS

**MWA3** is a reticulated foam absorber. Reticulated foam is an urethane-based foam with a well-defined open-cell structure. The cell size can be chosen to optimize penetration of the conductive coating to which it is adhered.

**Euro Technologies** uses two separate processes to produce its reticulated foam absorber.

This unique spray process applies a coating that is graded through the thickness of the foam.

The grading of the coating also produces an electrical grading that results in a material with excellent broadband reflectivity reduction. **Euro Technologies** also uses a dip process to produce foam with uniform electrical properties.

**Euro Technologies** also dips **MWA3**, a convoluted egg-crate shaped foam. This shaping allows for graded impedance, which provides broadband reflectivity reduction. **MWA3** is produced in thicknesses from 1.5" to 4" (38.1 mm to 101.6 mm) and is used when broadband performance from 2 to 18 GHz is required.

The product can be supplied with a bonded-on ground plane and pressure-sensitive adhesive.

#### APPLICATIONS

**MWA3** broadband foam is commonly used around antennas to provide isolation or side lobe reduction. It can be die-cut into components for EMI reduction inside microwave cavities and is used to manufacture antenna hats and test boxes.

It can be encapsulated into a textile cover for use outdoors and fabricated into blankets, covers and other components. Recently, it has been used for a combination air/EMI filter in networking equipment.

THE PRODUCT CAN BE MADE UL94 HF1 FOR SUCH APPLICATIONS

Code	Thickness (mm)	Freq. Range (Ghz) 20 Db
MWA3-U-750-0	19.1	6 - 18
MWA3-U-1125-0	28.6	4 - 18
MWA3-U-1250-0	31.8	4 - 18
MWA3-U-2000-0-FR	50.8	2 - 18

## MWA4 - SINGLE LAYER "LOSSY" FOAM ABSORBERS

**MWA4** is a series of single layer "lossy" sheets produced by dipping lightweight open-celled urethane foam into a resistive solution. The end product is a uniform, lightweight, loaded sheet material with a specified insertion loss at a given frequency.

**MWA4** offers the lowest cost in microwave absorber products. Thickness of the sheets range from 0.125" to 1.5" (3.2 mm to 38.1 mm) and are generally 24" x 24" (609.6 x 609.6 mm).

Custom sizes and components can be fabricated. The insertion loss of the product is measured in an insertion tunnel over the 2 to 18 GHz frequency range. Specifications are generally given at 3 or 10 GHz.

**THE MATERIAL CAN BE DIE-CUT INTO COMPONENTS AND SUPPLIED WITH A PRESSURE-SENSITIVE ADHESIVE FOR EASE OF APPLICATION**

Code	Thickness (mm)	Insertion Loss per in at 3 Ghz (DB/IN)
MWA4-U-125-1	3.2	- 15.0
MWA4-U-250-0	6.4	- 2.5
MWA4-U-375-0	9.5	- 32.0
MWA4-U-500-1	12.7	- 25.0

## ORDERING INFORMATION

**MWA** - **1** - **S** - **040** - **0** - **FR**

- MWA** Product Family
- 1** Family Type
- S** Material: **S** = Silicone / **U** = Urethane / **R** = Nat. Rubber / **N** = Nitrile
- 040** Thicknes (inch)
- 0** 0 = No Adhesive / 1 = Adhesive
- FR** Flame Retardant