Here follow 4 pages of an article focusing on microwave absorbers tests with kind permission of VHF Communications editorial office

VHF COMMUNICATIONS 4/2004

*Franco Rota, I2FHW*

# Franco's Finest Microwave Absorbers

**Franco Rota runs an RF component supply company in Italy called R F Elettronica. His main objective is to sell bulk components such as SMD parts to the electronics industry. He attends some radio rallies in Europe and often has interesting items for sale that can be used or adapted by radio amateurs for use on the amateur bands. This is the second article of a regular series that will describe one of Franco's products with details of its use by radio amateurs. If you require more details about the products you can contact VHF Communications or Franco – info@rfmicrowave.it**

## 1.0 Introduction – extract from R F Elettronica catalogue

Microwave absorbers, usually for RF applications, can be divided in two categories:

- For anechoic chambers, for antennas or free space, they usually work through a gradual impedance change and they are available in pyramidal shape for anechoic chambers. They are often used to attenuate the unwanted side lobes into the radar antennas, in this case they are multilayer with a thickness over 1cm.
- For cavities (metal boxes), every box behaves like a cavity excited by several secondary propagation modes, for higher frequencies or in medium size boxes the RF circuit will also have many self-oscillations at various frequencies. Since every box is different in size shape and operating frequency the calculation of secondary propagation modes is very difficult.

The absorber placed in the cavity will act to dampen the resonance in several different ways by changing the characteristic of the cavity. The microwave absorber will also lower the Q of the cavity. For best operation the absorber must be placed near a metallic surface (cover of the box). As a general rule, lower frequency cavity resonances would require a heavier loaded and thicker material for equivalent absorption, cost considerations point you towards a lighter thinner material. An additional desirable feature is their low conductivity so they will not short out circuits if they accidentally come into contact. MAS... and MAF-3A absorbers (see table 1) are used only in cavities (metal boxes) on a metal surface, they have an auto adhesive film to simplify the installation. MAF-1 0 and MAF-1 9, thanks to a big thickness, are

**Table 1: Microwave Absorbers from R F Elettronica catalogue.**

| | Microwave Silicone absorber | | Microwave foam absorber | | |
|---|---|---|---|---|---|
| | | | LS26 | AN73 | AN74 |
| Thickness | 0.8mm (0.030") | 2.6mm (0.100") | 3.1mm (1/8") | 10mm multiplayer | 19mm multilayer |
| Electrical conductivity | ~MΩ | | ~KΩ | ~MΩ | ~KΩ Black side ~MΩ White side |
| Temperature range | -50°C / +190°C | | -50°C / +120°C | -50°C / +130°C | -50°C / +90°C |
| Assembly | By acrylic transfer film adhesive | | By acrylic transfer film adhesive | By acrylic transfer film adhesive | --- |
| Reflection loss | >6dB >6GHz | >6dB >1.8GHz >10dB 2 – 4GHz | >6dB >8GHz | >10dB >5GHz ~18dB >7GHz | >10dB >2GHz >20dB >4GHz |
| Type | Flexible, carbonyl iron loaded silicone rubber | | Flexible low density carbon impregnated foam | | |
| Application | For cavity >4GHz | For cavity >1.5GHz | For cavity >5GHz | Both cavity and free space >3.5GHz | Both cavity and free space >1.5GHz |
| **Cod.** | **MAS-0.8A-5x10** 5 x 10cm **9.00€** | **MAS-2.6A-5x10** 5 x 10cm **15.00€** | **MAF-3A-10x20** 10 x 20cm **7.50€** | **MAF-10A-10x20** 10 x 20cm **12.00€** | **MAF-19-10x20** 10 x 20cm **8.00€** |
| **Cod.** | **MAS-0.8A-10x10** 10 x 10cm **17.00€** | **MAS-2.6A-10x10** 10 x 10cm **29.00€** | **MAF-3A-20x20** 20 x 20cm **14.00€** | **MAF-10A-20x20** 20 x 20cm **22.00€** | **MAF-19-20x20** 20 x 20cm **14.50€** |
| **Cod.** | **MAS-0.8A-15x30** 15 x 30.4cm **54.00€** | **MAS-2.6A-15x30** 15 x 30.4cm **92.00€** | **MAF-3A-30x60** 30 x 60.9cm **49.00€** | **MAF-10A-30x60** 30 x 60.9cm **75.00€** | **MAF-19-30x60** 30 x 60.9cm **50.00€** |
| **Cod.** Max size | **MAS-0.8A-30x30** 30.4 x 30.4cm **104.00€** | **MAS-2.6A-30x30** 30.4 x 30.4cm **176.00€** | **MAF-3A-60x60** 60.9 x 60.9cm **95.00€** | **MAF-10A-60x60** 60.9 x 60.9cm **140.00€** | **MAF-19-60x60** 60.9 x 60.9cm **94.00€** |

also suitable for free space absorbing, for example to reduce lobes on antennas moreover these last two types give high attenuation if used in a cavity.

## 2.0 Laboratory tests

To examine the properties of the absorber material in my catalogue I carried out some tests in my laboratory.

- Step 1. I built a 50Ω line with the worlds best performance laminate (i.e. Rogers duroid RT5870 with εr 2,33 and 60mils thickness = 1.52mm) into a small box 26x36x16mm. This box, as you can see in Fig 1, was suitable only for the higher microwave frequency range. This small box was able to generate secondary propagation modes only at higher frequencies. The box was terminated at both ends with SMA connectors types, female + male, in order to avoid any further error due to the adapter. The p.c. board was soldered to the metal box all over its perimeter in order to ensure the best ground. The box was kept without any cover.
- Step 2. I did a measurement with a network analyser, Agilent 83640B plus 8757D, the result of this measurement is shown in Fig 2 (box without cover) The graph shows only the insertion loss of the p.c. board plus various little mismatches.
- Step 3. Then I put the original cover on the box and tested the new insertion loss, as you can see in Fig 2 there were secondary resonance modes at higher frequencies in the small box i.e. 17.5, 19, 20GHz etc. and a heavy insertion loss.

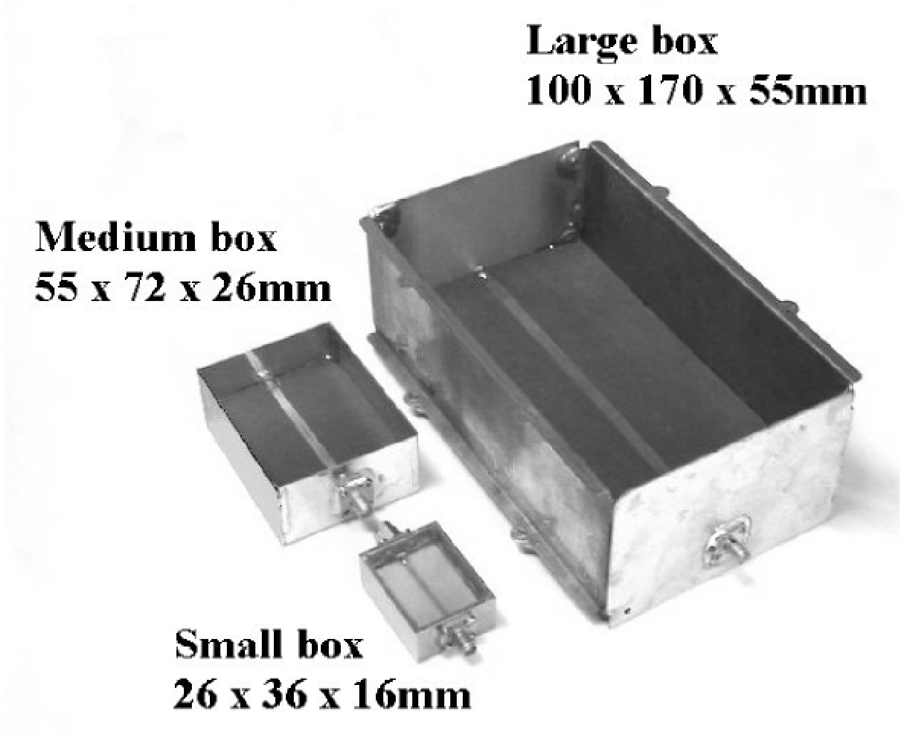


**Fig 1: Picture of the three boxes used for the laboratory tests.**

- Step 4. Then I fixed two different microwave absorbers on the internal side of the cover, as you can see in Fig 2 this is equal to the original condition (without cover), so it means that the condition with the cover plus absorber is equal to the condition without cover, in other words the 50Ω internal line "does not see" the cover.
- Step 5. Then I built a 50Ω line with the same laminate but into two bigger boxes, the purpose of building bigger boxes is to shift secondary modes at lower frequencies (see waveguide principle).
- Step 6. For the bigger box I had to change the microwave absorber because the absorber for higher frequencies was not able to work at lower frequencies (see specifications from catalogue). The results are shown in Fig 3 and Fig 4.

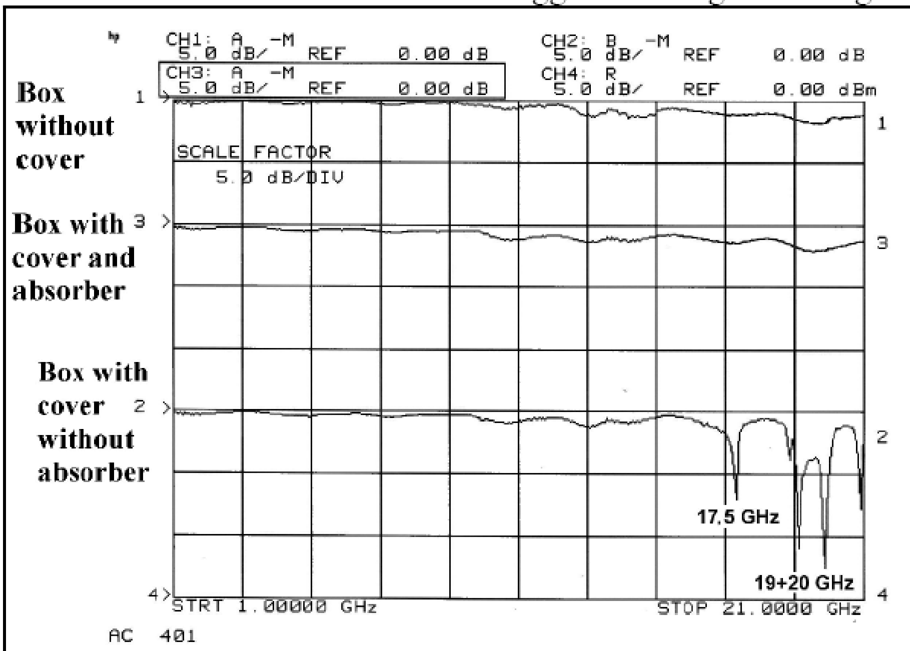


**Fig 2: Test results for the small box.**

**Microwave absorber types:**

**MAS-0.8A + MAF-3A**

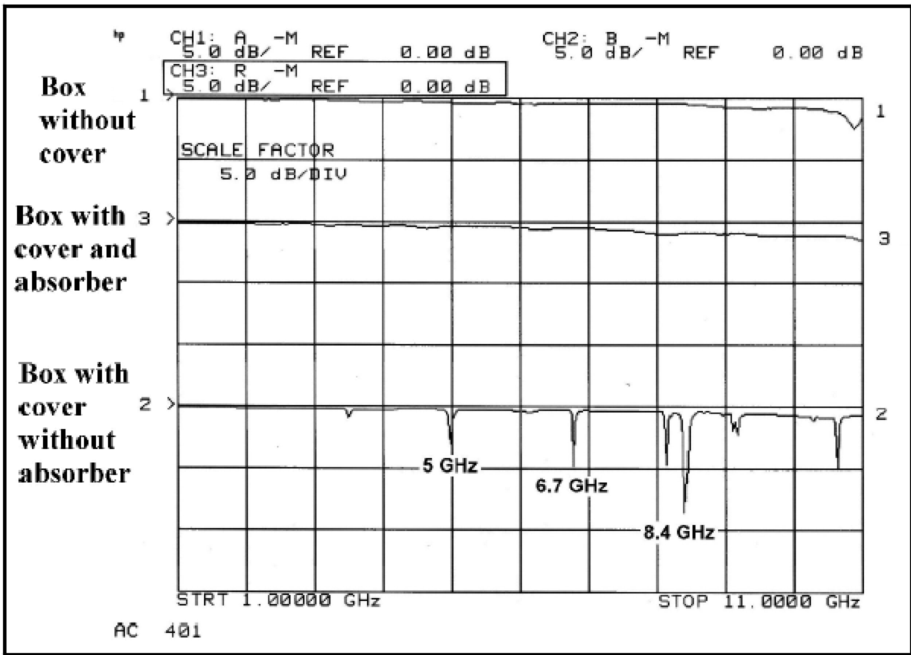


**Fig 3: Test results for the medium box.**

**Microwave absorber types:**

**MAS-0.8A + MAF-3A**

## 3.0 References

[1] Emerson & Cuming Microwave Products, Choosing the correct absorber. http://www.eccosorb.com/start.asp

[2] Emerson & Cuming Microwave Products, Circuit board housing cavity resonances. http://www.eccosorb.com/cavity_resonance.asp

[3] Eccosorb LS material. http://www.eccosorb.com/catalog/eccosorb/LS.pdf

[4] Absorber Principles. http://www.eccosorb.com/principles/modeabsorption5.asp

[5] R F Elettronica web site http://www.rfmicrowave.it

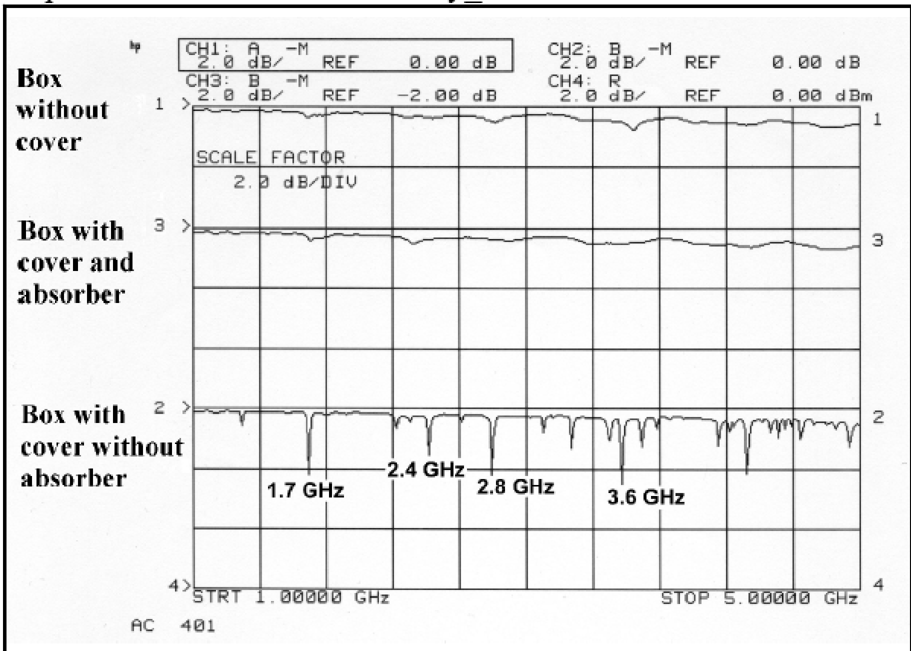


**Fig 4: Test results for the large box.**

**Microwave absorber types:**

**MAF-19 + MAS-2.6A**