USER GUIDE

UG025 | EMI Patch WE-EMIP

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Electronic designs, especially wireless and high frequency devices, challenge engineers with electromagnetic interferences (EMI) from different sources resulting in diminished performance. The development of advanced functionalities, miniaturization, and the aim of obtaining optimized performance in electronic devices significantly impacts their electromagnetic compatibility (EMC). As electronic components become more densely packed on a printed circuit board (PCB), unintended coupling between components can cause EMI. These requirements result in design restrictions that make using a board-level shield (BLS) essential in reducing EMI. It is challenging to reduce electromagnetic problems, such as undesired magnetic decoupling between two adjacent components or circuits. One innovative component solution is the EMI Patch, which has the advantage of providing a shielding option that does not require any electronic redesign.

1. WHAT IS THE EMI PATCH?

EMI Patch is a shielding solution that combines a conductive metal layer with a magnetic absorber material. An adhesive non-conductive layer fixes it to the EMI source (Figure 1).

Figure 1: EMI Patch layer distribution.

This combined solution provides higher attenuation levels than using only a noise suppression sheet (NSS) by combining the absorbing properties of the magnetic material and the reflective loss mechanism of the metal.

The attenuation of the EMI provided by the EMI Patch is determined by the interaction of its constituent materials. The magnetic material primarily causes attenuation through the losses determined by its magnetic properties, mainly defined by its permeability. On the other hand, the metal layer can reduce interferences through the reflection mechanism.

The use of magnetic material in the hybrid structure further prevents the occurrence of undesired stray field through the re-radiation mechanism (Figure 2).

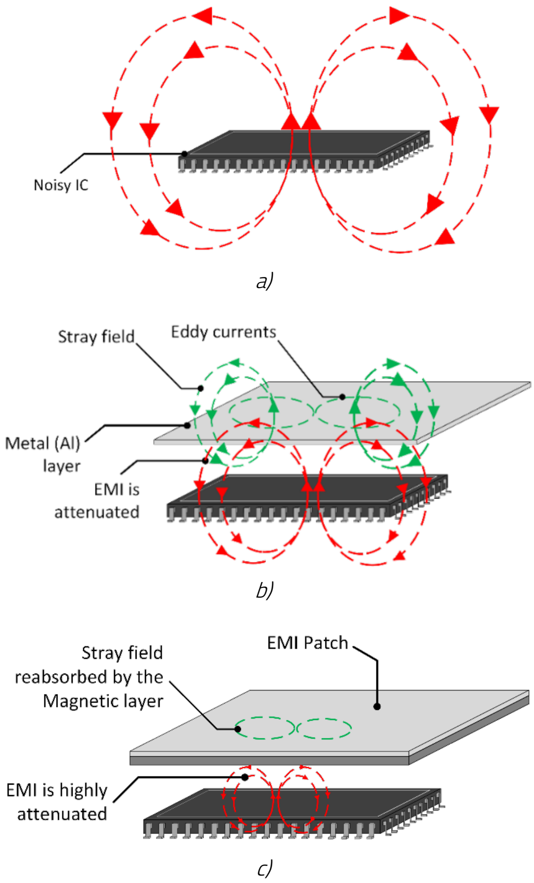
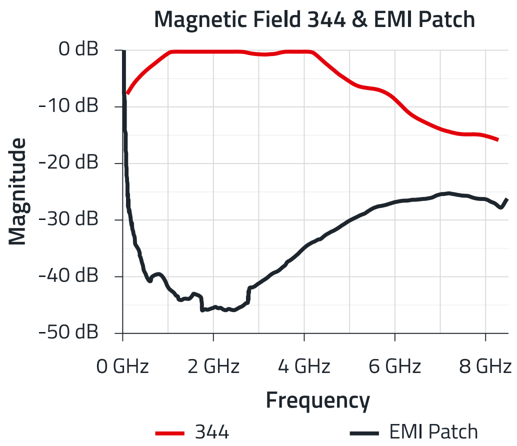


Figure 2: Magnetic field generated by (a) noisy IC, (b) when a metal foil is added and (c) when combining a conductive metal layer with a magnetic absorber material (EMI Patch).

Thereby, this structure may extend the working bandwidth of these materials and obtain a more significant attenuation than each of these materials could provide individually (Figure 3).



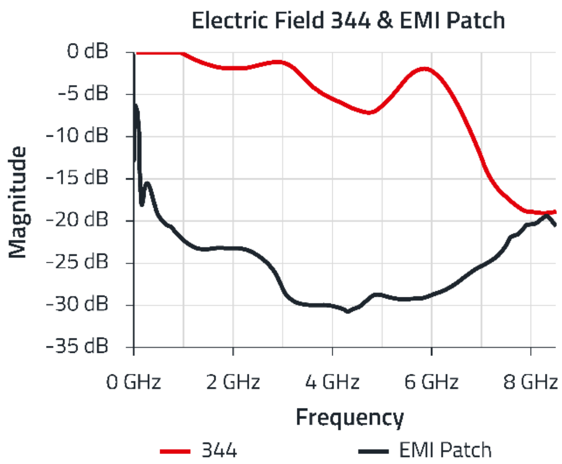


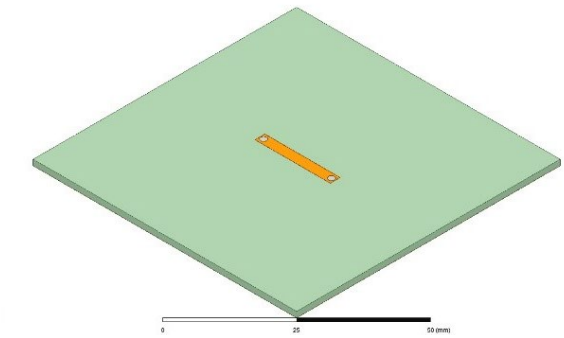
Figure 3: In these two graphs it can be seen how the EMI Patch performs better shielding to Magnetic field and to Electrical field than a sole ferrite absorber material (in this case measurements were made with 344 with WE-FAS EMI Flexible Absorber 0.1 mm thickness).

2. EMI PATCH PERFORMANCE

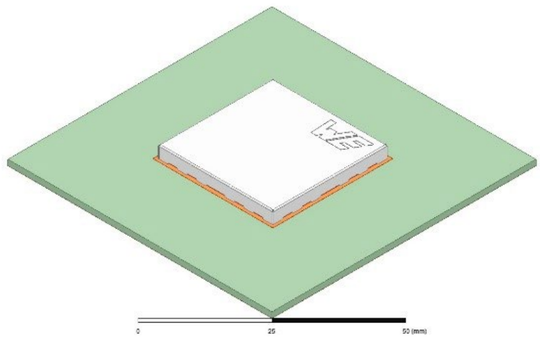
2.1 EMI Patch Performance in Near-Field Conditions

The EMI Patch's performance has been tested against other BLS options, such as a shielding cabinet with the same dimensions. Even when the EMI Patch is not a full replacement of a shielding cabinet, it can be a compromised solution to manage EMI levels avoiding PCB re-design as well as being cost effective. Three different scenarios corresponding to each of the measurements performed are shown.

The first scenario shows a microstrip line on a PCB, which is used as a source of electromagnetic interference (Figure 4a). A shielding cabinet of 30 x 30 mm is applied to reduce the interferences generated by the microstrip line in Figure 4b , including the necessary footprint. In Figure 4c an EMI patch with the same dimensions is applied on the microstrip line to analyze its emissions.



a)



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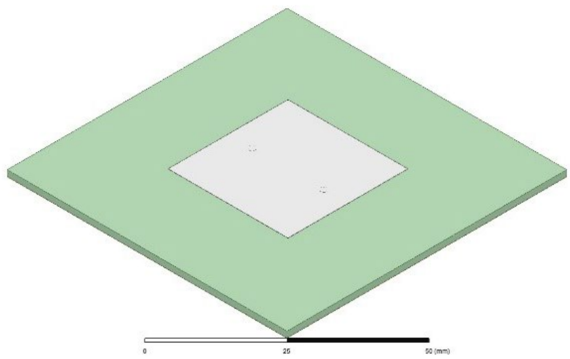
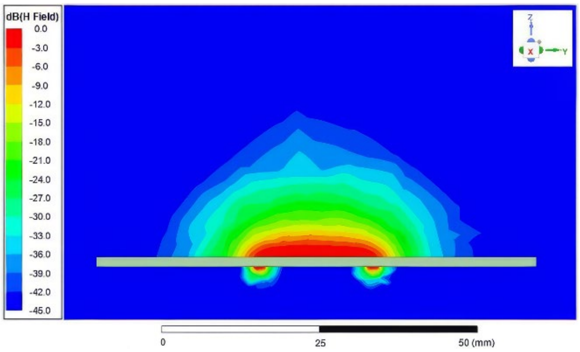


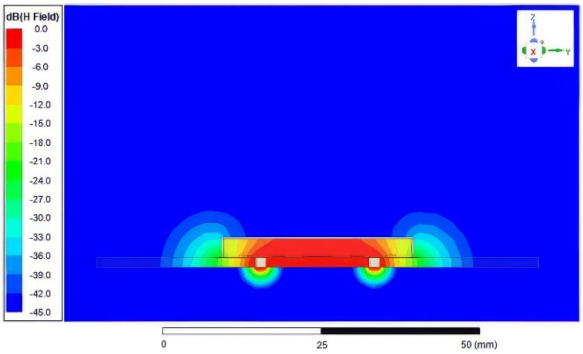
c)

Figure 4: Definition of the scenarios analyzed: (a) reference measurement (interference source), (b) shielding cabinet applied and (c) EMI Patch applied.

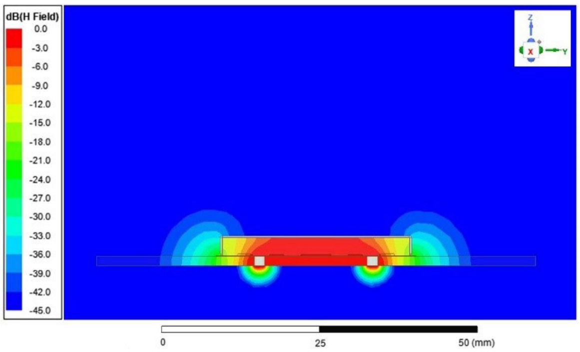
For each of the scenarios, the magnetic field distribution at 500 MHz is plotted (Figure 5).



(a)



(b)



(c)

Figure 5: Analysis of the near H-field (a) reference measurement (interference source), (b) shielding cabinet applied and (c) EMI Patch applied.

It is possible to observe that the near-field emissions generated by the EMI source are significantly reduced both when the shielding cabinet and EMI Patch are applied.

Figure 6 shows the comparison between the shielding effectiveness (SE) provided by both solutions when it is determined.

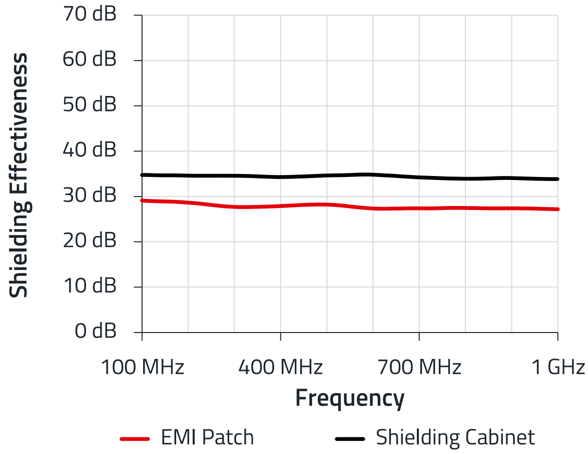


Figure 6: Comparison of shielding effectiveness for the EMI Patch compared to the shielding cabinet.

As can be seen in both studies, the shielding effectiveness provided by the shielding cabinet is slightly better than that offered by the EMI Patch.

2.2 EMI Patch Performance in Far-Field Conditions

To further understand the shielding capabilities of the EMI Patch, it is also important to consider how it behaves under far-field conditions. This approach allows to evaluate the performance in a wider frequency range, including bands relevant for modern communication systems such as 5G.

A specific test setup has been used to analyze the shielding effectiveness of the EMI Patch up to 18 GHz [9,10]. The setup is based on a controlled absorber box environment, where the sample is placed between two antennas, one transmitting and one receiving, inside a cavity lined with absorbing material (Figure 7). This configuration avoids external reflections and allows a stable measurement across a broad frequency range.

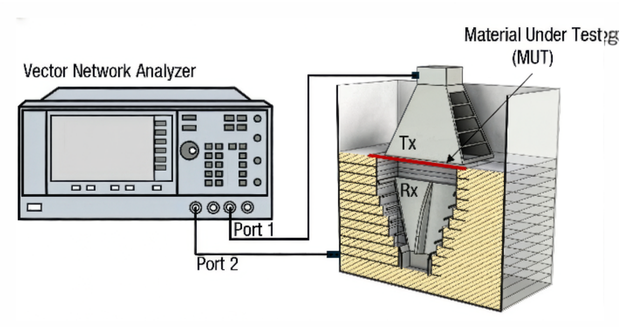


Figure 7: Absorber box measurement setup used for far-field analysis of the EMI Patch.

Using this method, the EMI Patch demonstrates consistent shielding effectiveness over the full range, confirming its ability to reduce EMI not only in near-field situations but also when far-field emissions are present. As shown in Figure 8, the EMI Patch provides attenuation values suitable for applications where high-frequency operation or wireless communication technologies are present, including parts of the frequency spectrum used in modern 5G systems.

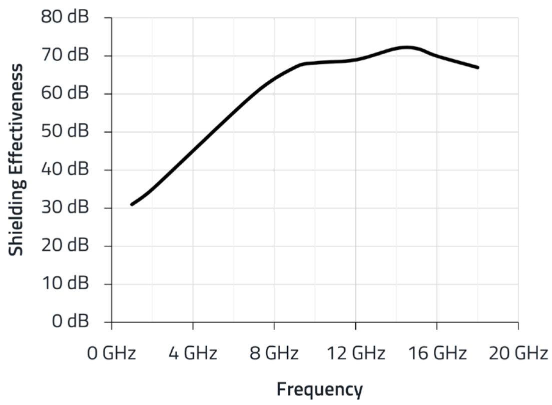


Figure 8: Shielding effectiveness of the EMI Patch measured using the absorber box method from 1 GHz to 18 GHz.

These results confirm that the EMI Patch is a valid solution to reduce radiated emissions over a wide frequency range, reinforcing its suitability in high-frequency and wireless environments, including those where 5G or similar communication technologies are involved.

3. SO WHY USE EMI PATCH?

The EMI Patch is an interesting and flexible alternative solution to shielding cabinets as there is no need to redesign the layout and it is able to achieve high levels of shielding effectiveness.

The EMI Patch shows a better performance in insertion loss than the FAS alone and the metal foil alone. The presence of the metal layer on the absorber improves its attenuation performance at lower frequencies, allowing same absorption results with a lower thickness of the magnetic layer. Therefore, the final design of the EMI Patch and its composition shows a better performance than the individual shielding effectiveness of the standalone independent layers on their own, this behavior is explained by the interaction of the layers between themselves that is explained in section 1 of this document.

The EMI Patch has an advantage over a shielding cabinet as it can be easily attached to the source of interference without requiring the electronics to be redesigned by introducing a footprint. It is easy to incorporate in the production stage, and it can be implemented as a final solution for a product.

Other advantage of EMI Patch is that they can be adapted to complex shapes and are easily assembled with adhesive onto a specific component or surface. It can be conveniently affixed over the EMI source, whether it be an IC or a certain area of the PCB that causes EMI problems. Additionally, it is lightweight, devoid of temperature-related issues, and avoids problems associated with cavity resonance, as it does not form a complete Faraday cage.

4. WHAT OPTIONS DO I HAVE?

There are two different part numbers for the EMI Patch, 371 0 and 371 1. Both part numbers are identical in terms of the materials used, magnetic absorber material and aluminum foil. The difference is that part number 371 0 includes a PET layer above the upper aluminum foil to provide electrical isolation. Therefore, in the case of using part number 371 1, it is possible to remove the removal film and connect the aluminum foil to a conductive part of the system. With the part number 371 0 this is not possible (Figure 9).

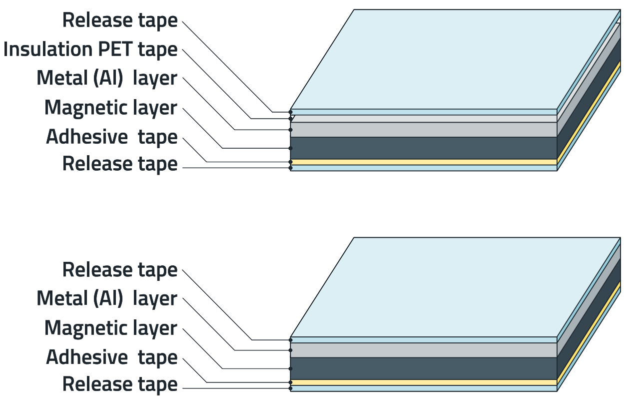


Figure 9: Part number features: 371 0 above and 371 1 below.

The following sections describe why to connect to the ground or a reference signal and how it should be done.

5. WHAT ARE THE MAIN ASPECTS OF EMI PATCH?

When using the EMI Patch, two basic aspects must be taken into account. The first is the size of the sample and the second is the connection of the aluminum top layer to the ground.

When the EMI Patch is applied, it is possible to increase the SE if the aluminum layer is connected to the reference plane using part number 371 1 and aluminum or copper tape.

This scenario involves the modification of the PCB design to incorporate a pathway or footprint that facilitates the connection of the EMI Patch solution to the ground or a reference signal (Figure 12).

6. WHERE CAN I USE EMI PATCH?

There are many applications where it is useful to use EMI Patch to reduce EMC problems.

It can be used during the EMC pre-compliance phase as a troubleshooting solution since it is applicable for addressing unforeseen EMI occurring at the board level.

The solution can be applied to systems where the EMI source and the victim are on the same PCB (intra-decoupling) or to systems where the victim and the EMI source are on different systems (inter-decoupling).

A practical case in which the EMI Patch can be used is to shield interference generated by integrated circuits (ICs) (Figure 10).

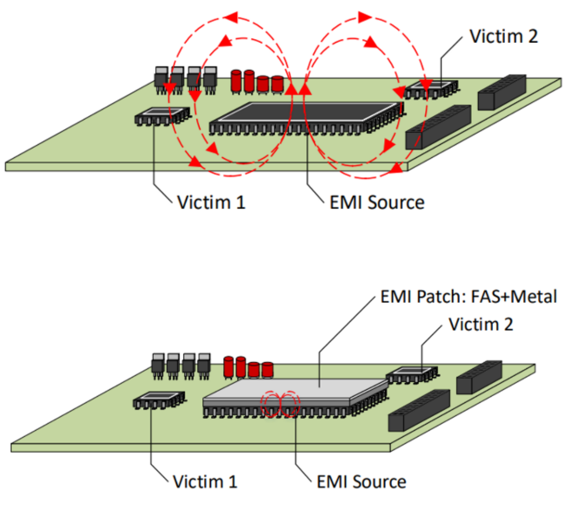


Figure 10: EMI Patch applied on a noisy IC that is interfering with the rest of the components.

Another practical case of the EMI Patch is in circuits where there is a wireless communication technology nearby. This increases the risk of the PCB components and tracks picking up interferences (Figure 11).

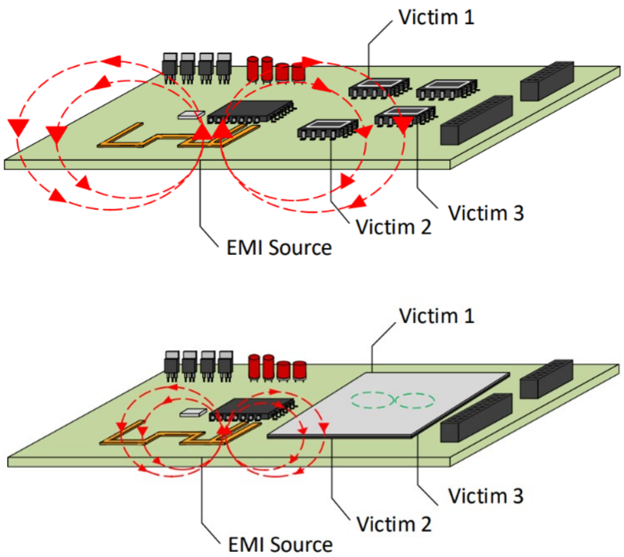


Figure 11: EMI Patch applied on ICs, which are affected by a wireless communication technology.

It is also possible to use the EMI Patch, in its non isolated version, together with aluminum or copper tape for those applications where a connection between the aluminum foil and the reference plane is required. For example, the top of the EMI Patch can be set in direct contact with the metallic housing which acts as a reference ground plane (Figure 12).

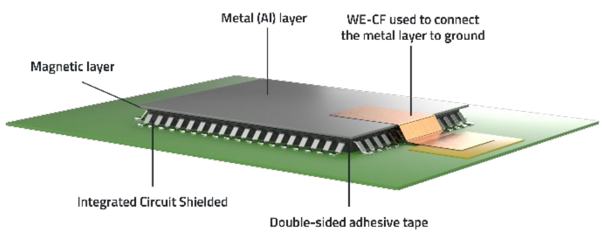


Figure 12: EMI Patch shorted to ground signal with copper tape.

The isolated version will ease the manipulation of the board when no ground connection is needed, with this version, the top PET layer provides high electrical insulation and breakdown voltage to the component and allows the EMI Patch to be close to conductive surfaces and provide the necessary electrical isolation when these conductive surfaces need to be separated.

In summary, the isolated version is recommended for use when it is necessary to have an insulated part to avoid short-circuits and undesired connections, while the non-isolated version is recommended when even more shielding effectiveness is desired and/or the designer wants to connect the EMI Patch to ground references.

A APPENDIX

A.1 Literature

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