TECHNICAL REPORT

Good news for those who are considering about process reduction and functionality improvement by realizing both decoration and electromagnetic wave shielding function!

Realization of both decoration and electromagnetic wave shielding function

Electromagnetic wave shielding ink (Conductive ink)

It is possible to add an electromagnetic wave shielding function during the decoration process. It contributes to strengthening EMC measures (against noise emission and intrusion) and cost reduction of electronic devices.

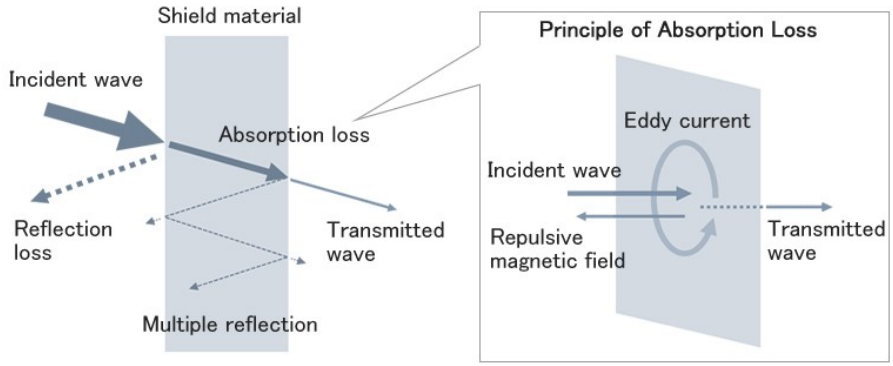
1. Mechanism of electromagnetic wave shield

Principle of blocking the incident electromagnetic waves by the electromagnetic wave shielding material

Electromagnetic wave shielding materials mainly use two principles to block incident electromagnetic waves. One is reflection loss that reflects the incident electromagnetic waves on the surface. The other is absorption loss that attenuates the incident electromagnetic waves inside the shield material.

This absorption loss is a loss due to the repulsive magnetic field that cancels the incident electromagnetic wave by the eddy current generated when the incident electromagnetic wave passes through the shield material and a loss due to the heat generated by the eddy current itself.

Also, to be precise, multiple reflections that electromagnetic waves repeatedly reflect inside the shield material also occur, but the value is small enough to ignore.



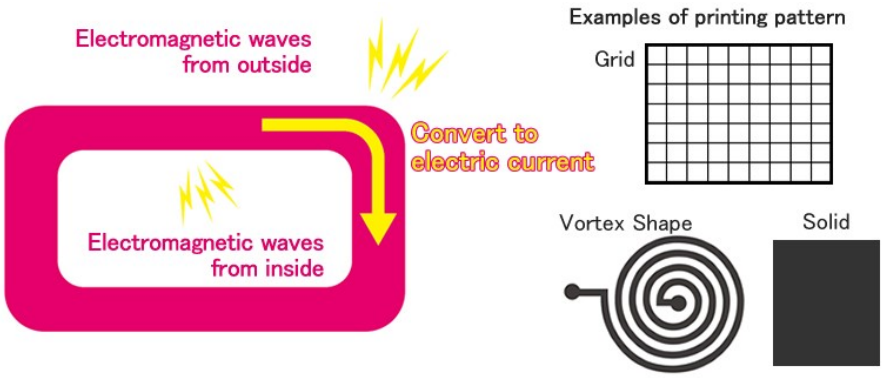
Principle	Details of Principle	Related variables
Reflection loss	Loss due to reflection that occurs at the boundary between the surface of the shield material and the space.	Conductivity of the shield material regardless of the thickness of the shield material.
Absorption loss	Loss due to repulsive magnetic field and heat due to eddy current generated when electromagnetic waves pass through the shield material.	Frequency of electromagnetic waves, thickness, magnetic permeability and conductivity of shield material
Multiple reflection	A phenomenon where electromagnetic waves are reflected multiple times inside the shield material. Some waves pass through the shield material and reduce the loss effect.	Normally, the value is small enough to ignore.

2. Electromagnetic wave shielding ink (Conductive ink)

Mechanism of ink for electromagnetic wave shield

Electromagnetic wave shielding ink can realize electromagnetic wave shielding function mentioned above by having a conductive function. This ink enables to reduce the leakage of electromagnetic waves which is generated inside electronic devices and the intrusion of external electromagnetic waves.

Electromagnetic wave shielding ink has a great flexibility, both decoration and shielding function and also it is easy to be introduced because it provides a shielding function by printing. Moreover, it contributes to process reduction, lightweight and thinner, etc., by substituting with other methods (details will be described later).



Excellent features of electromagnetic wave shielding ink

Excellent functionality	Details
Inexpensive and simple process	• Printing enables to add function with simpler process than other electromagnetic wave shielding technologies. • Not increasing much processes, without care about weight and thickness, the shield function can be added.
Achieve both shield function and decoration	• Colors compatible with electromagnetic wave shielding ink can realize both shielding function and decoration. • If the color is not compatible with electromagnetic wave shielding ink, it can get a shielding function when it is overprinted with decorative ink.
Free adjustment of print pattern and ink layer thickness	• Solid, pattern and ink layer thickness can be freely adjusted to internal devices. • Grid pattern makes it possible to be compatible with the parts which require light transmission such as displays.
Resistance to humidity and less time deterioration	• It is more resistant to humidity and its performance less deteriorates over time than metal foil and metal vapor deposition.
Also applicable to antistatic	• Ink with a surface resistance value (2000Ω) that cannot be seen in other conductive materials can also be set (described later). • It is applicable to prevent disturbance caused by electrostatic and electrification.

Fields of application of electromagnetic wave shielding ink

Two measures: today's electronics strictly require prevention of malfunction by noise emission (EMI or emission) and noise intrusion (EMS or immunity), that is, EMC measures (EMI measures + EMS measures).

However, due to increase use scene of electronic devices owing to the miniaturization and higher performance of them, the noise issues are not solved by only one absolute measure, but being solved by integrating multiple measures.

Under such circumstances, this electromagnetic wave shielding ink has become an excellent technology to realize relatively easily reinforcing EMC countermeasures.

Fields of application	Obtainable effect
Touch panel	• Print on the touch panel in a grid pattern. Enables both visibility and reinforcement of shield function • Solid printing on window frames. Adds a shield effect in the decoration process
Electronic device housing	• Shield function can be reinforced with addition of minimum process.
Antistatic measures for electronic devices	• Compatible with electrical resistance value (surface resistance 2000Ω) not seen in other conductive materials • Applicable to electronic devices that require anti-static and anti-electrification measures

3. Basic performance value of electromagnetic wave shielding ink

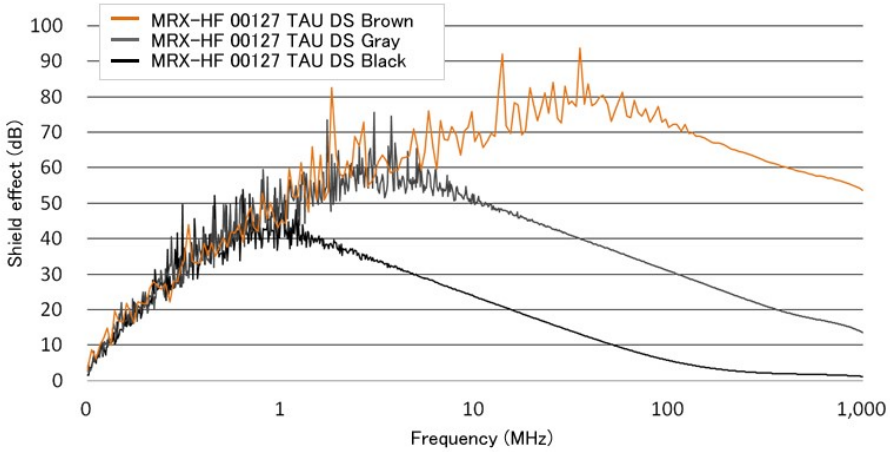
Conductive performance of electromagnetic wave shielding ink

The following is the reference values of the ink layer thickness value and surface resistance value when printing the electromagnetic wave shielding ink under the recommended conditions.

Ink name	Surface resistance value	Ink layer thickness	Compatible base material
MRX-HF 00127 TAU DS Brown	≤ 1Ω	14μm	PET、PC etc
MRX-HF 00127 TAU DS Gray	≤ 200Ω	14μm	Same as above
MRX-HF 00127 TAU DS Black	≤ 2000Ω	10μm	Same as above
GLS-HF 00127 TAU DS Gray	≤ 10Ω	10μm	Glass, Polyamide
GLS-HF 00127 TAU DS Black	≤ 2000Ω	8μm	Same as above

Shielding effect of electromagnetic wave shielding ink against electric field

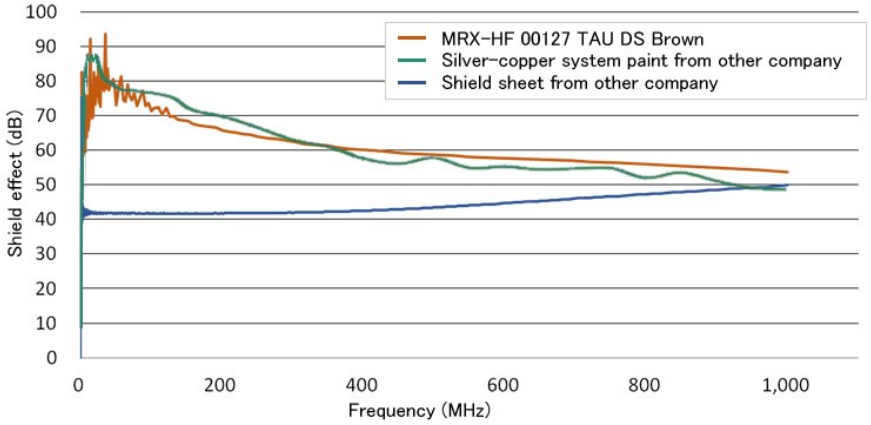
The shielding effect of MRX-HF 00127 DS against the electric field is as follows. (Substrate: PC, ink layer thickness of solid printing: brown and gray 14μm, black 10μm) In addition, more complicated shield effect adjustment is possible, as adjustment of ink layer thickness and partial printing by multi-layer printing are also possible.



Comparison of shielding effect with other companies' products

This is a comparison of MRX-HF 00127 DS Brown, with silver-copper shield paint from other company and shield mesh sheet using copper from other company.

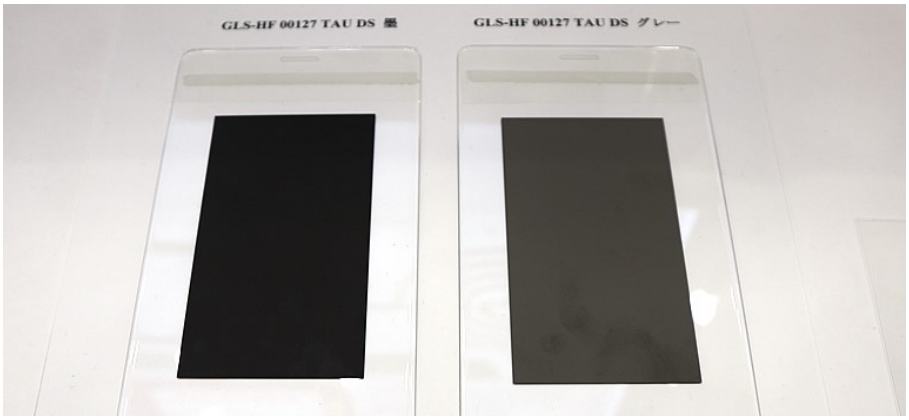
(Note: The frequency display shows in lines for comparing high frequencies. (Above comparison in black and gray shows in logarithm)) MRX-HF 00127 DS Brown has the same or better effect in the high frequency range, despite the ink layer thickness of 14 μm for single layer printing.



4. Example of using ink for electromagnetic wave shielding

Example of solid printing of electromagnetic wave shielding ink

This is printing example of GLS-HF 00127 TAU DS Black and Gray (substrate: glass) Because these can realize beautiful black or gray only by itself, it is possible to add a shield function and anti-static function simply by switching the decorative ink of the same color.



This is a printing example of MRX-HF 00127 TAU DS Black, Gray and Brown (substrate: PC) Because these can be printed in multiple layers, it is also possible to pursue both shielding function and designability by using MRX-HF 00127 TAU DS Brown, which has a high shielding effect.

Example of compatibility between electromagnetic wave shield and other functions (application to display)

This is an application example for a display of MRX-HF 00127 TAU DS Black that has both the electromagnetic wave shielding function and transmission of light (substrate: PC). Owing to the high degree of freedom of printing, electromagnetic wave shielding inks are effective when applied to special parts that require fine adjustment.

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