EMC coatings

What are EMC coatings ?

Electromagnetic compatability (EMC) issues and the interference created through this, is a major concern on electrical and electronic products particularly in the fields of communications, information technology, transportation, safety and medical applications.

Conductive coatings have been successfully used for many years on applications from mobile phones to gas meters. The coatings lend themselves to demanding design requirements and are often a quick and inexpensive solution to an EC conformance problem.

It is important when deciding upon a suitable coating to know the attenuation that the product is susceptible to. Silver coatings, when correctly applied, work by reflecting signals, whereas nickel coatings tend to absorb signals. The effectiveness of a conductive coating is dependent upon its electrical impedance and conductivity. Plastics are generally non-conductive and are transparent to electromagnetic waves and therefore offer no protection against EMR.

The shielding performance of different coating materials can easily be compared but various factors affect the degree of shielding each coating will give on any particular application. Flat test pieces can be used to give comparative performances between different coating types but they are not representative of fully assembled enclosures with differing degrees of geometric complexity. These are used to give some idea as to the relative performance of different coatings. They are also used as a "quick" test for quality control.

Types of EMC coating

The degree of absorption and reflection of signals is dependent upon the coating thickness, the thinner the coating the less absorbent it will be.

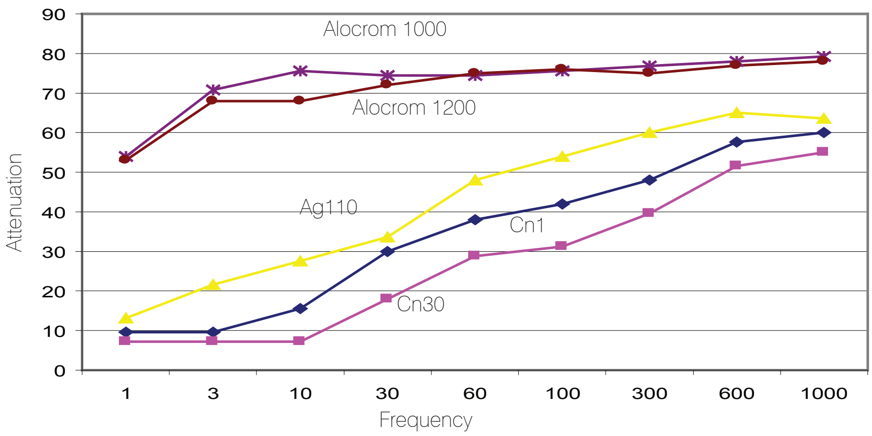
At the lowest level of performance ESD coatings are generally used on the outside of enclosures for anti static purposes. A 30μm coating is applied and being carbon loaded is normally black in colour. The material will give a typical performance range of surface resistance of 10 to 10 Ω^2.

Nickel coatings are typically 30-50μm thick and are particularly good at absorbing RF at the lower frequency range.

Silver coated Copper or Copper/Silver hybrid coatings are used rather than a pure copper coating. The advantages being improved conductivity, whilst keeping the costs at a competitive level. 30μm Copper /Silver hybrid coatings are commonly used as a general purpose coating. Improving paint technology is giving performance levels that are close to that of silver coatings.

Silver coatings produce very high conductivity and hence high levels of shielding. The high cost of Silver can limit the economic size coated, however when applied correctly, Silver is a very effective coating. With a typical low film thickness of 6-12μm this allows for complex parts to be coated with minimal loss of detail.

The chart below shows typical attenuation levels against frequency carried out by an Independent test facility, as a comparison between the commonly used paints on an ABS enclosure and Alocrom on an Aluminium enclosure.



All these finishes are available from Anochrome Technologies

Anochrome Group

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Coating Range

Physical properties	Ag110	Ag215	Cn1	Cn30	Cn4	Cn4c
Paint type	Silver	Silver	Silver/Copper	Nickel	Antisatic	Antistatic
Sheet resistanceΩ	0.03@25µm	0.035@25µm	0.1@30µm	0.5@50µm	<10$^{@}$30µm	<5x10^{6}@40µm
Adhesion ASTM D3359-93	Yes	Yes	Yes	Yes	Yes	Yes
Diluent	MEK	Alcohol	MEK	MEK	MEK	n/a
Normal coating thick-ness	10µm	15µm	30µm	50µm	15µm	20µm
UL approval	Yes	No	No	Yes	No	No
Appearance	Bright Silver	Silver	Copper	Mid grey	Semi Black	Clear 82%
Approx cost from Cn1	x10	x9	1	x.8	x0.5	x3

Anotec Ag, and Cn series of coatings provide a complete range of Elecrtro Magnetic Compatible EMC coatings for all requirements, they are air drying systems which can be easily applied and are compatible with plastics commonly used for all sizes of electronic enclosures.
The Ag and Cn series of coatings will coat vertical and horizontal surfaces, giving excellent adhesion to substrates such as Polycarbonate, ABS, Polystyrene and ABS/PC blends.

Testing EMC coatings

Due to the nature of the coating and the relative complexity of parts ,a reliable and accurate coating thickness test is difficult to achieve. Correctly applied coatings will normally have a consistent thickness. Since the surface resistance is affected by the coating thickness, the product's shielding performance in a production environment can be checked against historic data or previously validated samples of the parts. Two methods are used for testing coating resistance.

Point to point test
The objective of the test is to confirm the uniformity and degree of coverage of the applied coating. Normally the test is made across the longest track on the component i.e. end to end or across complex internal walls. Lower than expected results normally indicate poor coverage at the base of a wall or a difficult recess. If failure does occur, but no lightly coated areas are apparent the paint itself can be tested under controlled conditions using a flat panel to ensure its performance before continuing with production.
There is no recommended value, as each part is different. However from experience a value can be suggested, from known readings off a similar shaped/complex part.

Ohms Square test
The object of this test is to check paint shielding performance, not the integrity of the coating on the part.The probe's contact footprint must be clean and flat. Firm but even pressure should be applied. Surface texture of the component can dramatically affect readings, a rough or heavy spark finish may reduce the probe contact area by up to 75%. Obviously this condition can give misleading values and difficulty in reproducing the manufacturers recommended figures for the shielding material. To overcome this problem a strategically placed surrogate glass slide is normally used as a solution.
Although shielding is part dependent as a rough guide to the relationship between coating conductivity and the level of shielding, a value of approximately 0.1Ω^2 would normaly indicate a corresponding shielding performance of around 50 dB, this will rise in effectiveness to greater than 70 dB if Ω^2 reading is below 0.05. Provided they are square in footprint and are placed the same distance apart as their width, the probes do not have to be 10mm square. For example on small intricate components a 5mm square bar 5mm apart can be just as accurate. However it has become the industry's norm to use 10mm square 10mm apart.

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Glossary

Antistatic
A chemical agent used for blending, spraying or dipping to give material antistatic properties. Frequently it functions by attracting moisture from the surrounding environment to create a conductive layer of surface moisture on the material. Many antistats require a relative humidity of at least 15% for effective performance. Thus, their applications are often limited, and, because they gradually lose their effectiveness through evaporation and physical wear, they are best suited for component packaging and other short- term applications.

Antistatic Property
A material's ability to resist triboelectric charge generation. The term "antistatic" no longer refers to a material's resistivity range.

Attenuation
Reduction of a signal's strength by an EMI/RFI shield or housing. Usually expressed in decibels (dB), the degree of attenuation provided by a shield is determined by the absorption and reflection characteristics of the material being used, the thickness of the shield, and the manufacturing tolerances of the shield or housing.

Composite
Another word for "compound".

Conductivity
The ability of a material to carry an electrical current. A good conductor is a poor insulator and vice versa.

Decibel (dB)
A unit of measurement that shows the relative difference in power between two signals. A decibel measurement is equal to 10 times the common logarithm of the ratio between the signal strengths.

Electromagnetic Shield
A screen or other housing placed around a device or circuit to reduce the effects from both electric and magnetic fields.

Electromagnetic Interference (EMI) Electromagnetic compatability (EMC)
Electrical energy created by electromagnetic fields that is radiated or picked up by electronic equipment circuits that interferes with the normal operation of the electrical or electronic equipment. Energy can emanate from any circuit or man-made device that carries electric current. Typical sources include radio transmitters, computers, TV sets, fluorescent lamps, electric motors, and automobile ignition systems.

Electrostatic Charge
An electrical potential or voltage on a surface of a material. Such charges can reach several thousand volts and can seriously damage electronic components that often are sensitive to discharges of less than 100 volts.

Electrostatic Discharge
The transfer of electrostatic charge between two bodies at different electrostatic potentials.

Insulator
A material such as ceramic, glass, or plastic that resists the passage of electrical current.

Ohm
The basic unit of measurement for electrical resistance. Symbolised as Ω

Radio Frequency Interference (RFI)
A form of EMI, generally electrical energy in the radio frequency range that is capable of interfering with the proper operation of electrical or electronic equipment. Sources of RFI include computers, broadcast equipment, lighting, and the spark from an electrostatic discharge.

Resistance
The opposition to the flow of electricity. It is expressed in ohms.

Resistivity
The inability of a material to carry an electrical current.

Surface Resistivity
A mathematical representation of a material's ability to resist the passage of electricity across its surface. It is expressed in ohms/square.

Thermoplastic or Thermoplastic Resins
Modern synthetic plastics that do not undergo chemical changes during heating and cooling. These plastics are normally formed by injection moulding or extrusion.

Triboelectric Charge
The generation of electrostatic charge when two pieces of material in intimate contact are separated, where on or both are insulators. Substantial generation of static electricity can be caused by contact and separation of two materials, or by rubbing two materials together.

Volume Resistivity
A mathematical representation of a material's ability to resist the passage of electricity internally through its bulk. It is expressed in ohm-centimetre.

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