

EMC Coatings

Technical Data Sheet



What are EMC coatings?

Electromagnetic compatibility (EMC) issues and the interference created by this, is a major concern with reference to 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 including mobile phones and gas meters. The coatings fulfil demanding design requirements and are often a quick and inexpensive solution to a problem caused by electromagnetic fields.

It is important when deciding upon a suitable coating to know the attenuation of the field to which an item is susceptible.

Silver coatings, correctly applied, work by reflecting signals, whereas nickel coatings tend to absorb radiation.

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 electromagnetic radiation.

The shielding performance of different coating materials can easily be compared but various factors affect the degree of shielding each coating will give in 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 shapes and sizes.

Test pieces are used to give guidance about relative performance of different coatings. They are also used as a "quick" test for quality control purposes.

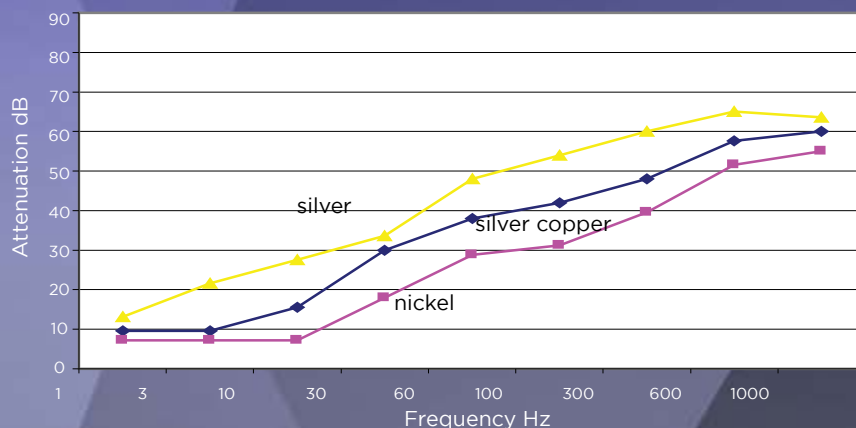
Types of EMC coating

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 electrically conductive coatings are generally used on the outside of enclosures for antistatic purposes. A 30µm coating is typically applied and, being based on carbon, is normally black in colour. The material will give a typical performance range of surface resistance of 10 to 100 ohms per 10mm. Nickel coatings are typically 30-50µm thick and are particularly good at absorbing low frequency radio waves.

Silver coated copper or copper-silver hybrid coatings are used rather than pure copper coatings. The former impart improved conductivity, compared with the latter, whilst keeping the costs at a competitive level. 30µm Copper-silver hybrid coatings are used in a wide variety of applications. Improving formulations are giving performance levels that are akin to those of silver only coatings.

Silver coatings have very high conductivity and hence good levels of shielding. The high cost of silver can limit its use, especially on larger components, however when applied correctly, silver is a very effective coating. With a typical film thickness of 6-12µm this allows complex parts to be protected 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 coatings on an acrylonitrile butadiene styrene (ABS)



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Coating Range



Physical properties						
Paint type	Silver	Silver	Silver/ Copper	Nickel	Antistatic	Antistatic
Sheet resistance Ω	0.03@25 μ m	0.035@25 μ m	0.1@30 μ m	0.5@50 μ m	<10@30 μ m	<5x10 ⁶ @40 μ m
Adhesion ASTM D3359-93	Yes	Yes	Yes	Yes	Yes	Yes
Diluent	methyl ethyl ketone	alcohol	methyl ethyl ketone	methyl ethyl ketone	methyl ethyl ketone	n/a
Normal coating thickness	10 μ m	15 μ m	30 μ m	50 μ m	15 μ m	20 μ m
Underwriters Laboratories Approved	yes	no	no	yes	no	no
Appearance	bright silver	silver	copper	mid grey	semi black	clear (82%)

Anotec provides a complete range of electromagnetic 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 silver and copper-nickel series of coatings will coat vertical and horizontal surfaces, giving excellent adhesion to substrates such as Polycarbonate (PC), Acrylonitrile Butadiene Styrene (ABS), Polystyrene and ABS/PC blends.



Testing EMC coatings

Correctly applied coatings will have a fairly 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 an applied coating. Normally the test is made across the longest track on the component i.e. end to end or across complex internal surfaces. 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 from 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 finish may reduce the probe contact area considerably compared with a smooth surface. Obviously, this condition can give misleading values and difficulty in confirming a manufacturer's quoted results for a specific shielding material. To accommodate this problem a strategically placed surrogate glass slide is normally used as a comparison.

Although shielding is part dependent as a rough guide to the relationship between coating conductivity and the level of shielding, a value of approximately 0.1 Ω would normally indicate a corresponding shielding performance of around 50 dB, this will rise in effectiveness to greater than 70 dB if the resistance 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 squares, 10mm apart.

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Glossary

Antistatic

A chemical agent used by 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 antistatics 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.

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

A material made from different substances

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. The scale is base 10 logarithmic; so an increase of 3 decibels corresponds to a doubling of the arithmetical value.

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 compatibility (EMC)

Electrical energy created by electromagnetic fields that are 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 as well as during thunderstorms. Typical sources include radio transmitters, computers, television 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 are often sensitive to discharges of lower than 100 volts.

Electrostatic Discharge

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

Insulator

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

Ohms (Ω)

The basic unit of measurement for electrical resistance.

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, broadcasting equipment, lighting, and spark from an electrical discharge.

Resistance

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

Resistivity

The relative 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 per centimetre or other unit of length.

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 one 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 ohms per unit volume.