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ELECTROMAGNETIC SHIELDING OF CABLES AND MATERIAL USED

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Abstract
This work focuses on shielding buried high-voltage (HV) cables, examining two possible screen topologies (open and closed) and various materials (conductive and ferromagnetic). In a closed Shield, the shield surrounds the cables.

Keywords: electromagnetic shielding, electrostatic shielding, magnetostatic, high frequency.

Introduction

Shielding is a technology that uses shielding to block or reduce the transmission of electromagnetic energy, and is one of the important means of suppressing electromagnetic interference. Electromagnetic shielding can generally be divided into three types: electrostatic shielding, magnetostatic shielding, and high frequency electromagnetic field protection. The purpose of the three types of shielding is to prevent the external electromagnetic field from entering a certain area that needs to be protected. The principle is to use the external field induction protection effect to counteract the effects of the external field. However, due to the different characteristics of the area to be protected, the requirements for the protective shell material and the shielding effect also differ.

There are two main types of cable protection materials. One of them is that we usually call a material with a certain degree of protection at a certain level of resistance a semi-permeable polymer material. The Classification Standard is the principle of permeability of the inner material. The material itself has electrical conductivity, called the structural type, while the shielding noise is called the composite type through the filler path. Both structural and composite semi-permeable polymer materials are the most important shielding materials used in cable structure. This is because semiconductor polymer materials can not only protect against electromagnetic interference, but can also offer strong resistance to other natural damage. In particular, the ability to resist lightning strikes can make it widely used in special application scenarios such as aircraft cables. The process of manufacturing semi-permeable polymer materials is relatively complex and the cost is relatively high. Therefore, semiconductor polymer materials require high costs. The second type is metal wire weaving, which mainly refers to the use of metal wire as the main material for forming a shielding network. Cable protection material for immunity against magnetic interference. In cables such as HDMI2.1 and USB4 that require protection, the metal wires used for the woven shielding material are mostly tinned copper wires. The method of choosing this material is mainly to improve the shielding performance of the cable. However, cables for different application scenarios the design structure of the current Wire Weaving also differ in the speed of weaving. In general, the effect of multilayer weaving is better than single-layer weaving, and the coating area is inversely proportional to the angle of weaving. That is, in order to improve the shielding

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work, we need to reduce the angle of weaving and increase the coating area. In short, the effective application of wire protection can play a good role in protecting electromagnetic parasites.

Literature review

In a certain sense, the wire and cable manufacturing industry is the industry of finishing and assembling the material. Firstly, the material consumption is very large, and the material cost of cable products is 60-90% of the total production costs; secondly, there are many types and types of materials used, and the performance requirements are especially high. For example, copper used for conductors, the purity of copper should be more than 99.95%. Some products use high purity copper without oxygen; Thirdly, the choice of materials has a decisive influence on the production process, the life of the product and the service life.

At the same time, the benefits of cable companies are also closely related to material selection, processing and production management. Therefore, the design of wire and cable products should be carried out simultaneously with the selection of materials. Typically, several types of materials are selected and identified through process and performance screening tests.

The materials used for cable products can be divided into conductive materials, insulation materials, protective materials, shielding materials, filler materials, etc.according to the state and function of use. But some materials are inherent in several structural parts, for example, protective copper wire and copper tape, as well as electrical copper for the conductor. Thermoplastic materials in particular, such as polychloroethylene, polyethylene, etc., can only be used in insulation or coating if some formula components are modified.

Due to the ever-changing use function, application environment and terms of use of cable products, while there are basic performance requirements (commonality) for certain types of materials, each series and product types will have some specific performance requirements (characteristics).). For example, the general requirement of the cable and cable of the energy system for the insulation layer is a high electrical insulation indicator.

For example, it should be noted that the material for high-voltage electrical cables can withstand high electric field strength, has high insulation resistance, requires small dielectric losses, and does not require almost any mixture (including air space) in the insulation layer. A medium-voltage power cable (6-35 kV) has these requirements, but it can be greatly reduced. As for low-voltage wires and cables, only a certain resistant tensile strength and insulation resistance are required. For economy and portability, the insulation layer must be resistant to good mechanical properties and weather, so it cannot use a protective layer in most cases (for example, PVC insulated wires).

Since materials play a very important role in the functioning of products, and many types of materials contain a wide range of knowledge areas, materials of the same name have many brands and formulas due to the different molecular structure and molecular weight distribution of the base. different proportions of materials, different mixtures and mixtures. As a result, the process conditions of materials of different brands are different, and the characteristics of finished products are very different. For this reason, cable companies must require production workers to familiarize themselves with the properties of materials that are widely used in this process, strictly follow the procedures for using the process, and require the inspection

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department to strengthen the strict quality control of incoming materials. materials prepared by themselves.

Low frequency cables make up the peak of cable production. If cables of different frequencies are exposed to multiple grounding points, they generate more noise current that does not correspond to the entire shielding layer in order to achieve a good anti-noise effect. If one-point grounding shielding is used, it is necessary to ensure that the current is self-coated in the shielding layer so that the noise current remains in the shielding layer and thus effectively avoids electromagnetic interference. Due to the influence of the external grounding method of the application components, the internal shielding method of some cables often adopts a two-point grounding. This is mainly because the two-point grounding shielding method can take the current returned by the inner magnetic field of the cable and thus reduce the current noise intensity. The problem of stray capacitance usually arises in high frequency cables, which seriously affects the normal current transmission in high frequency cables. However, one-point grounding and two-point grounding cannot effectively solve this problem. Therefore, multi-point grounding should be applied to the shielding method on high frequency cables. In high-frequency cable, the interference current inside the line has several frequencies and features surface concentration, which doubles the effect of direct interference, which does not contribute to the normal operation of the entire line, and the multi-point grounding method can reduce the impedance in the shielding layer. , Reducing interference from noise flow, thereby improving the overall shielding effect.

Research methodology

The protective layer of the data line is mainly made of copper, aluminum and other non-magnetic materials, usually a rolled copper mesh (aluminum-magnesium woven mesh) or a copper pillow (aluminum pillow, etc.), the thickness of which is very thin, very plentiful. Skin depth smaller than the frequency of use of metal materials. One point to explain is that one end of it must be connected to the circuit of the contacts, since the effect of the protective layer is not caused by the reflection and absorption of the electric field and magnetic field of the metal. , but from the grounding of the shielding layer. Different shapes directly affect the shielding effect. The future development trend of electromagnetic shielding materials is to develop in the direction of high shielding efficiency, wider shielding frequency and more comprehensive operation. The innovative application of various new materials in electromagnetic shielding leads to more development. In future technological development, electromagnetic shielding develops in terms of good electrical conductivity, simple processing technology, high cost performance and suitable for mass production.

Aluminum foil Mylar: aluminum foil Mylar uses soft aluminum foil and polyester film as raw materials and is added with an engraving coating. After the Mylar is baked in aluminum foil, it is cut and rolled up. It can be shaped and glued, and aluminum foil Mylar can be used for shielding and grounding Assembly after cutting the mold. Aluminum foil Mylar tape is mainly used in the noise screen of communication cables. Aluminum foil Mylar includes: one-way aluminum foil, two-way aluminum foil, winged aluminum foil, hot melt aluminum foil, aluminum foil tape, aluminum-plastic composite tape; aluminum layer provides excellent permeability, protection efficiency and corrosion resistance can adapt to different

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requirements, the shielding range is mainly 100k-3GHz, and then Mylar hot melt aluminum foil is covered with hot melt adhesive layer. on the surface where aluminum foil and Cable come into contact. When preheated to high temperature, the hot melt adhesive can be tightly wrapped with cable core insulation, which is useful for the shielding performance of the cable, ordinary aluminum foil is not sticky, just wrapped in the cable core. insulation, cable protection performance is poor.

Features and areas of application:aluminum foil Mylar is mainly used to protect high-frequency electromagnetic waves, to prevent high-frequency electromagnetic waves from coming into contact with the conductors of cables, and then generate induced currents and increase correlation. When a high-frequency electromagnetic wave touches an aluminum foil, according to Faraday's law of electromagnetic induction, an electromagnetic wave tends to the surface of an aluminum foil and produces an induced current. At this time, a conductor is needed to direct the induction current to the ground to prevent the induced current from interfering with the signal being transmitted. Wires that use aluminum foil as a protective layer usually require that the aluminum foil repeat rate is not lower than 25 percent. The largest number of applications currently belong to network wires. This type of network cable is mainly used in hospitals, factories and other places with strong electromagnetic radiation or a large number of powerful electrical equipment; in addition, it is also used in government and other industries with high requirements for network security.

Results

Copper / aluminum-magnesium gold wire and other winding nets (metal shielding): metal shielding is achieved by winding metal wires through a weaving equipment in a particular weaving structure. Protective materials are usually copper wires (canned copper wires), aluminum alloy wires, copper coated aluminum, copper tape (copper-plastic tape), aluminum tape (aluminum-plastic tape), steel tape and other materials suitable for metal weaving. , different structural parameters have different shielding properties, and the shielding efficiency of the rolled layer is not only different from that of the metal itself. Related to structural parameters such as electrical conductivity and magnetic conductivity, and the more layers, the larger the coating, the smaller the winding angle, the better the shielding performance of the winding layer, the winding angle must be controlled between {4}. } the degree is higher than 80 percent of the coating level for single-layer weaving, so it can be converted to thermal energy, potential energy, and other forms of energy through mechanisms such as loss of hysteresis, dielectric loss, loss of resistance, etc.

Conclusion

To consume unnecessary energy and achieve the effect of protecting and absorbing electromagnetic waves. Woven mesh is usually woven with canned round copper wire or aluminum-magnesium gold wire, mainly to prevent interference from low-frequency electromagnetic waves, and its principle of operation is the same as aluminum foil. A shielded network cable using a Mesh Mesh Mesh usually requires a mesh density of at least 80 percent. This type of winding mesh is mainly used where a large number of network cables are laid in the same slot, which can reduce the external interconnection that forms between a large

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number of network cables. It can also be used for shielding between Wire pairs to increase the winding length of wire pairs and reduce the requirements for the winding length of cables.

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The protective layer of the data line is mainly produced from non-magnetic materials such as copper and aluminum, usually rolled copper mesh (aluminum-magnesium rolled mesh) or copper bonding (aluminum bonding, etc.), and their thickness is very thin, much smaller than metal materials in terms of frequency of use. skin depth. One point to explain is that one end of it must be connected to the circuit of the contacts, since the effect of the protective layer is not mainly due to the reflection and absorption of the electric and magnetic field by the metal. by itself, but due to the grounding of the shielding layer. Different shapes directly affect the shielding effect. The future development trend of electromagnetic shielding materials will develop in the direction of high shielding efficiency, wider shielding frequency and more comprehensive performance. In electromagnetic shielding, the innovative application of various new materials is further developed. In future technological development, electromagnetic shielding develops in terms of good conductivity, simple processing technology, high cost performance and suitable for mass production.

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