# Electronic Article Surveillance system

Electronic Article Surveillance system is also called“EAS”，Also known as electronic goods anti-theft system, is currently widely used in the retail industry, one of the commodity safety measures.EAS came into being in the United States in the mid-1960s. It was initially applied in the garment industry. Now it has been extended to more than 80 countries and regions in the world. It has also been applied to department stores, supermarkets, books, amusement parks and other industries, especially in supermarkets and clothing chains.

Catalog



EAS system is mainly composed of detector, decoder and electronic tag.Electronic labels are divided into soft labels and hard tags. Soft labels have low cost and can be directly attached to commodities. Soft labels can not be reused. Hard tags cost more than soft labels, but they can be reused. Hard tags must be equipped with special nail collectors for recycling, mostly for soft, penetrating clothing items. Decoders are mostly non-contact devices with a certain decoding (demagnetization) height. When the cashier checks in or bags, the tag can be decoded without touching the demagnetization area.There are also devices that combine the decoder and the laser bar code scanner, so that the receipt and decoding of goods can be completed at one time to facilitate the cashier's work. This method should cooperate with the laser bar code supplier to eliminate the mutual interference between them and improve the decoding sensitivity. Detectors are generally the detection system devices at the entrance and exit of shopping malls or at the checkout channel. After receiving the correct amount payable by a customer for the purchase of a commodity, the cashier can authorize the commodity to leave a designated area legally by demagnetizing and decoding the labels attached to the commodity. When uncoded goods are taken away from the mall, an alarm will be triggered when they pass through the detector device, thus reminding cashiers, customers and mall security personnel to deal with them in a timely manner.

**EAS classification**

EAS system is developing very fast. At present, it can be divided into single-bit system and multi-bit system.

Radio Frequency Identification (RFID) is a term used to describe any device that can be sensed by radio frequency. It usually refers to the use of radio

frequency to read information on a small device (called a tag).The RFID system consists of tag, decoder and antenna. Its working principle is as follows: after the tag enters the magnetic field, it receives the radio frequency signal from the reader, sends the product information stored in the chip (Passive Tag) by the energy obtained and the inductive current, or actively sends the signal of a certain frequency (Active Tag); After reading the information and decoding it, it is sent to the central information system for data processing.RFID tags allow us to read multiple tags in batches and over long distances using radio waves, which are far more meaningful than labels. In addition to the anti-theft function, the same tag can also be used to prove the ownership of goods, provide the anti-theft function of electronic goods that EAS system can achieve, and use RFID can achieve the purpose well.

With the unification of RFID standards, RFID tags have been widely recognized and applied, the breakthrough of identification rate and stability technology bottleneck, and the realization of low-cost tags, RFID will replace EAS to dominate the electronic goods anti-theft market.

The main technology of single bit identification system applied in EAS system can be divided into AM system, RF system and electromagnetic wave system. Since a single bit system has only two states, it can only report whether an item exists or not, but has no ability to report other details such as what the item is. EAS systems of different technologies have great differences in product price, reading distance and reliability.The RF labels used in electromagnetic strips and RF systems are relatively cheap; AM labels are more expensive. Both of them have soft labels (disposable labels permanently pasted on commodities) and hard tags (recyclable and reusable anti-theft labels).

AM system uses the resonance phenomenon produced by tuning fork principle to realize almost zero false alarm operation.When the frequency of the emission signal (alternating magnetic field) is the same as the oscillation frequency of AM tag, AM tag is similar to the tuning fork, which causes resonance signal (alternating magnetic field). When the receiver detects 4-8 consecutive (adjustable) resonance signals (once every fifty seconds), the receiving system will give an alarm. The characteristics of AM system are high anti-theft detection rate, almost zero false alarm, not shielded by tinfoil, good anti-interference and wide protection outlet (the maximum width of a single system can be protected by 4 meters).

RF uses radio wave as transmitting and receiving signal. The detection frequency ranges from 6 MHz to 10 MHz, and the international common frequency is 8.2 MHZ. The greatest advantage of the radio system is that the cost of the system is very low and the installation is convenient. However, its anti-theft label is circular coil type and its frequency is relatively high, the system is vulnerable to interference from some items, such as cash register, spotlight, coiled cable and other electronic products, metal objects, which may interfere with it, causing system false alarm or non-reporting. Electromagnetic

System uses electromagnetic wave as detection signal. The tag of electromagnetic wave system is small, the price of tag is cheap. It can repeat degaussing, but it is susceptible to the influence of magnetic or metal substances and produces false alarm. Electromagnetic wave and RF system are produced at the same time, but the price and technical reasons determine its low acceptance in the market. Because of its tag characteristics and price advantages, it is widely used in the domestic book market.

How to choose EAS system? How to distinguish the anti-theft system in supermarkets? How to judge the quality of clothing anti-theft system?

Every user has the characteristics of choosing the anti-theft system of commodities, which is generally considered from the aspects of product quality, product price, after-sales service, etc. If you are sensitive about price, we can only choose cheaper radio frequency anti-theft system and low-cost imitation AM system. There are many merchants of this kind of products, good and bad, quality and after-sales are difficult to guarantee. Of course, if you want better quality and after-sales service at a low price, you can choose some companies with good reputation in China, which have been in operation for a long time and have guaranteed service, just come to us, Nanjing Bohang Electronics.

First of all, considering the quality of products, the performance indicators of EAS system include system detection rate, system false alarm, anti-environmental interference ability, shielding degree by metal objects, protection width, protection commodity types, anti-theft label performance/size, degaussing equipment and so on.

Detection rate refers to the number of alarms per unit number of valid labels passing through different locations of the detection area in different directions. Because of the directionality of the label of the anti-theft system, the concept of detection rate should be based on the average detection rate in all directions.As far as the three most commonly used principles in the market are concerned, the detection rate of AM system is the highest, generally more than 95%; the detection rate of RF system is between 75-95%; and the detection rate of electromagnetic wave is generally between 50-70%. The system with low detection rate is likely to miss the report when the goods are brought out, so the detection rate is one of the main performance indicators to evaluate the anti-theft system. Of course, the detection rate is based on the better quality of the system. Different manufacturers of EAS system will have different detection rates, and installation spacing will also affect the detection rate.

System false alarm refers to the alarm of non-anti-theft label triggering system. If the alarm is triggered by non-labeled items, it will bring difficulties to the judgement and processing of staff, and even cause conflicts between customers and shopping malls. Due to the limitation of the principle, the common EAS systems can not completely eliminate false alarm, but there will be differences in performance. The key to choose the system is to look at the false alarm rate.

When the equipment is disturbed (mainly by power supply and

surrounding noise), the system will send an alarm signal when no one passes by or no trigger alarm items pass by. This phenomenon is called false alarm or self-alarm. RF systems are susceptible to environmental interference and often self-resonate, so some systems are equipped with infrared devices, which is equivalent to an electric switch. Only when people pass through the system and block the infrared rays, the system starts to work. When no one passes by, the system is in standby state. Although this method solves the self-satisfaction when no one passes by, it still can't solve the self-satisfaction when someone passes by.

Electromagnetic wave system is also vulnerable to environmental interference, especially the interference of magnetic media and power supply, which affects the performance of the system.

Because of its unique resonance distance and intelligent technology, the AM system is controlled by computer and driven by software. It can automatically detect ambient noise, so it can adapt to the environment well and has better anti-interference ability.

Many commodities in shopping malls and supermarkets contain metal articles, such as foil-packed foods, cigarettes, cosmetics, pharmaceuticals, etc., as well as their own metal products, such as batteries, CD/VCD discs, hairdressing products, hardware tools, etc. In addition, shopping carts and shopping baskets provided by shopping malls are also included. The influence of metal-containing articles on EAS system is mainly the shielding effect of induction tags, which makes the detection device of the system unable to detect the existence of effective tags or greatly reduces the detection sensitivity, leading to no alarm from the system.

RF system is the most seriously affected by metal shielding, which may be one of the main limitations of RF in practical use. Electromagnetic wave system will also be affected by metal objects. When large pieces of metal enter the detection area of electromagnetic wave system, the system will appear "stop" phenomenon. When metal shopping carts and shopping baskets pass by, even if the goods inside have valid labels, there will be no alarm because of shielding. In addition to the impact on pure iron products such as iron pans, AM systems can work normally for other common items in supermarkets, such as metal goods/tinfoil, metal shopping carts/shopping baskets.

Shopping malls need to consider the protection width of EAS system, so as not to narrow the width between supports, affecting customer access. Besides, shopping malls all want more spacious entrances and exits.

Commodities in supermarkets can generally be divided into two categories. One is "soft" goods, such as clothing, shoes and hats, knitwear, which are generally protected by hard tags and can be reused; the other is "hard" goods, such as cosmetics, food, shampoo, etc., which are protected by soft labels, demagnetized at the cash register and generally used once.

Anti-theft label is an important part of the whole EAS system. The performance of anti-theft label affects the performance of the whole anti-theft

system. Some labels are susceptible to humidity; some can't bend; some can be easily hidden in the packaging of goods; some can cover useful instructions on goods and so on.

Reliability and operability of degaussing equipment are also important factors in selecting anti-theft system. At present, the more advanced degaussing equipment is non-contact type, which produces a certain height of degaussing area. When the effective tag passes through, it completes the degaussing of the tag instantaneously without touching the degaussing device, which facilitates the cashier's operation and speeds up the cash register.

## Single Bit Label

Labels left on the merchandise and neutralized by salesmen are considered deactivated. One of the types of deactivating tags is an electronic circuit consisting of inductors and capacitors that resonate at a certain radio frequency.

The magnetic label is composed of a magnetic strip of soft magnetic material. The magnetic label can be magnetized or demagnetized by interacting with ferromagnetic elements made of hard magnetic materials. Under the action of magnetic field with a certain frequency, the soft magnetic strip will resonate and produce harmonics. This enables tag recognition. Hard ferromagnetic elements are magnetized or demagnetized, which also activates or deactivates the label.

AM label is composed of a strip magnetostrictive material and a strip magnetic material with high coercivity. The magnetic field with a specific frequency will cause the resonance of the coercive magnetic strip. This resonance can be detected by a receiver sensitive to the magnetic field generated by the magnetostrictive material of mechanical resonance. The label can be deactivated by changing the magnetic bias of the magnetic strip.

For Radio Frequency Identification (RFID) technology, EAS is only a simple additional function. Compared with other traditional ESA, RFID has the following advantages:It can not only announce the existence of an item by triggering an alarm system, but also announce what the item is; it can make all sites of the same label system on the whole distribution channel from the manufacturer to the retailer close or turn on EAS function at the same time by command; it can be conveniently controlled by the read-write protocol of the label. Labels, instead of using a bulky magnetic block to remove information from all kinds of messy credit cards as some retailers do today.

When the system uses wireless communication, the label can be encapsulated in the goods, which avoids leaving the traditional label box behind the store when the goods are taken out of the package. Without additional cost, EAS functions and identification and tracking systems can be integrated.

## Multi-bit Tags

The traditional EAS tag is a single bit device, and it can not be switched between on and off by programming signals.
Resonance circuit is to minimize the reactance of the circuit at resonance frequency by selecting suitable values of resistance R, capacitance C and inductance L.

One of the methods is to arrange the resonant circuit on a thin insulating dielectric substrate to form a tag that can be used in EAS system.Generally, the resonant circuit coil consists of a closed loop of conductive elements with specific impedance and inductance values. The capacitive element in the closed ring consists of two thin metal conductive films placed on two opposite surfaces of the dielectric substrate. This kind of label should be pasted on the goods, which can play a role in anti-theft. The RF signal transmitted from the base station is on or near the resonance frequency. Once the tag enters the RF signal field, the absorption of the tag to the RF signal will lead to the change of the oscillating current in the base station resonance circuit, and the power in the receiving coil will decrease. These two effects can be used to detect the existence of the tag, and then the items pasted with the tag can be detected. Therefore, once either of the above two effects is detected by a pickup coil or amplifier, an alarm sound can be issued indicating that a commodity has been illegally moved.To deactivate the label, a relatively high power RF pulse can be provided at the checkout counter. The high power RF pulse can break down a weak part of the capacitor or fuse coil in the circuit. In either case, the circuit is no longer resonant and no longer responds to RF signals from base stations. Therefore, customers who normally pay at the checkout counter can pass through the anti-theft detection door without any difficulty.

It is clear from the above description that once such tags are deactivated, they will no longer be reused.In addition, as described above, such tags can only carry one bit of information. Therefore, they can not give any information about identifying items, and can only be used in anti-theft situations. Usually these tags can be classified as single-bit tags.

Some RF tags consist of a resonance coil, i.e. two bilateral coils consisting of two thin film flat capacitors on both sides of the dielectric substrate. Such tags can be used as source tags and have an initial frequency different from that used by retailers to prevent theft. For example, such tags can be designed to be deactivated at the beginning until the first capacitor is broken down by a high-power RF pulse at the resonance frequency. The resonant frequency of the circuit is shifted to the resonant frequency of the retailer's anti-theft detection system by the first capacitor. When the customer pays for the goods he wants to buy, the second breakdown pulse at the cashier's desk is the failure of the second capacitor. At this point, the label can no longer be reused, and the label is permanently destroyed.
In some other labeling systems, two or more frequencies can be obtained on

an RF coil label by changing the circuit capacitance. In one case, the equivalent permittivity of capacitors is changed by a strong DC electric field. Therefore, the circuit has two resonance frequencies depending on the applied DC field strength. Due to the characteristics of ferroelectric hysteresis, the tag can be deactivated by DC electric field. However, the tag can also be re-activated by a DC electric field with opposite polarity for reuse. In another case, a group of capacitors can be connected in parallel to an inductor, and the dielectric thickness of each capacitor varies. In this way, a series of resonance frequencies can be obtained by applying different voltages. Under different electric field intensity, each capacitor can change its capacitance value according to its dielectric thickness. Another approach is to form an array of capacitors connected in parallel to the inductor. The resonance can be changed by selectively breaking down one or more capacitors, thus changing the resonance frequency of the final circuit. In this way, a set of frequency coding can be established by selectively breaking down capacitors or invalidating capacitors during interrogation. Once scanned, the tag can no longer be used because the frequency code depends on the capacitor that is broken down during the scan and the observed frequency changes. So once the tag is asked, its capacitive components become irreversible short circuits and can no longer be scanned again. The reusable label contains two ferromagnetic elements, one is soft ferromagnetic and the other is hard ferromagnetic. The two ferromagnetic elements cover the RF coil in most parts physically. By applying a bias field on the soft ferromagnetic material and saturating it, a ferromagnetic element with high coercivity can be magnetized. In this state, the RF field produces a very small hysteresis loss, resulting in a relatively high Q value of the tag circuit. On the other hand, when the hard ferromagnetic element is degaussed, the RF field produces a hysteresis loss in the soft ferromagnetic material, which lowers the Q value of the tag circuit.The reading device used to inquire and detect RF resonance tags has been put into practice, where the inquiry frequency is scanned near a central frequency. Generally, only very small tags are often emitted unless they appear in the middle of the emitter's field. Therefore, when there is no tag in the antenna field, there is only a very small loss of antenna circuit. When the scanning frequency is consistent with the resonance frequency of the active tag in the field, the energy is absorbed, and the detection circuit detects a drop in the voltage in the query antenna oscillation circuit. In a complete scan cycle, tag absorption occurs twice, resulting in a negative down-ward drop in the oscillating circuit. The negative descent causes pulse modulation, which can be filtered, demodulated and amplified, and alarm signals are sent to show that someone has stolen goods. The basic detection is achieved by changing the frequency of the inquiry carrier to match the frequency of the resonant tag.

EAS signal transmission mode is mostly analog, but in the global digital wave, whether it is acoustic, magnetic or radio frequency, inevitably, are closely following the pace of digitization, and have developed a series of products of

DSP (Digital Signal Processor). Analog technology is easy to be disturbed by various electromagnetic fields, especially when the distance between detection gates is large, there are many false alarms and missed alarms caused by electromagnetic field interference, and the accuracy of digital products in signal acquisition and processing is improved, which avoids many environmental and human factors interfering with EAS equipment and greatly improves the detection width of EAS. But DSP collects and processes all kinds of signals in real time by software. Because of some unavoidable problems in the process of software design, all kinds of DSP products on the market are not perfect. Therefore, although DSP is the future direction of EAS development, users can not blindly superstition. With the passage of time, the technology of DSP will become more perfect. We can directly understand the types, quantities, inventory of products sold through EAS decoding process, which is the direction of EAS technology efforts.

The function of the current EAS system is relatively single, mainly for the consideration of commodity theft prevention, and it is also installed as a single system settings and wiring. The next development of EAS will inevitably jump out of the existing single commodity management mode, organic integration with the CCTV monitoring and anti-theft alarm system, to achieve the collection of commodity theft, access control, attendance, etc. Logistics management, monitoring and other functions in one. With the popularity of EAS system and the maturity of many chain retailers'concept of commodity protection, commodity labeling will become more and more popular among many businesses. The so-called commodity labeling, that is, the manufacturer in the production process, the electronic label will be made in the goods or commodity packaging. For retailers, the labeling of goods saves the trouble of labeling manually, and the electronic label is hidden in the sandwich of cardboard or in the label of goods (this kind of hidden electronic label is also called source label). It is not easy to be detected and destroyed, which can better prevent the occurrence of internal and external theft. At the same time, open-shelf sales improve unit sales. Sale area and profit. For manufacturers and packers, adding a label on the production line will not affect the performance of the product; open-shelf sales will significantly increase the supply of goods; at the same time, it can avoid the external electronic label covering the original product instructions, maintaining the integrity of the original packaging graphics and commodity information. Although the source label increases the cost of the manufacturer, it also increases the market competitive advantage of the product because of its anti-theft label characteristics.Security industry has always advocated the organic combination of technology and air defense, and EAS, which is mainly used in the commercial field, is no exception. EAS has not been able to overcome the problem of false alarm and false alarm. The retail industry is facing customers who are shopping. When the equipment alarms, the handling is particularly important and sensitive. As an EAS supplier, when providing training for users,

it should explain all kinds of possible accidents to users, so that the merchants have a good idea of handling alarms; as a retailer, the quality training of employees should be further improved, and all kinds of alarms should be handled as humanely as possible, so as to alleviate the feelings of customers caused by false alarms. As customers, they need to understand the limitations of science and technology, cooperate with businesses to check, reduce unnecessary disputes and troubles.

Bit: Bit is a computer term, a unit of information, transliterated from English BIT. At the same time, it is also the bit in binary digits, the measure unit of information quantity, and the smallest unit of information quantity. Single bit: A single bit consisting of only two states of "1" and "0". Multi-bit: It consists of multiple bits. Binary numbers such as 01, 0100, etc.

## Acousto-magnetic principle

1. Magnetostrictive effect: Under the external magnetic field, the size of ferromagnetic material changes; after removing the external magnetic field, it restores its original length. Under the action of magnetic field, the length of magnetostrictive material changes linearly and displaces; or the effect of alternating magnetic field changes repeatedly, resulting in vibration or sound wave; this material can convert electromagnetic energy into mechanical energy or sound energy, on the contrary, mechanical energy into electromagnetic energy; the former is called magnetostrictive effect, and the latter is called magnetostrictive effect. It is called piezomagnetic effect.Under the action of a certain magnetic field intensity, the length of ferrite magnetic metal changes, which can be understood as a result of the small change of atomic spacing caused by magnetization. In an alternating magnetic field, a magnetostrictive metal bar can be seen oscillating at the frequency of the alternating magnetic field. If the frequency of alternating magnetic field is consistent with the resonance frequency of metal strip, the amplitude of alternating magnetic field is the largest, that is, resonance. This effect is especially obvious for Permalloy (or ferronickel alloy). On the other hand, the magnetostrictive effect is reversible, that is, piezomagnetic effect. Therefore, when the frequency of alternating magnetic field coincides with the resonant frequency of the metal strip in the acoustic magnetic label, the permalloy strip begins to vibrate. When the alternating magnetic field is turned off, the acoustic-magnetic tag will maintain a certain time of damped vibration like a tuning fork, and generate resonance signal, which can be detected by the receiver as the spatial extension of the alternating magnetic field. Magnetostrictive effect is described by magnetostrictive coefficient lambda. Lambda=(LH-L0)/L0, L0 is the original length of matter, and LH is the length of matter changed under external magnetic field. Because of the high magnetostrictive coefficient of permalloy, such as: Ni50 permalloy lambda=25*10-6, Ni80 permalloy lambda=(0.1"0.5)*10-6, the magnetostrictive

coefficient of permalloy is larger, and the resonance signal produced by the label is larger.2. Magneto-mechanical coupling coefficient K When permalloy thin strip is stimulated by alternating magnetic field under biased magnetic field, alternating transformation between magnetic energy and mechanical energy occurs in the thin strip due to magnetostrictive effect and piezomagnetic effect. This energy conversion is called magneto-mechanical coupling, and its magnitude is measured by magneto-mechanical coupling coefficient K. The following are used: The K value is determined by the method. The core component of acoustic magnetic label is permalloy ribbon. According to phenomenological theory, the magnetomechanical coupling coefficient K is expressed as: FR is the resonance frequency and FA is the antiresonance frequency in the formula above. According to the resonance curve measured by the acoustic magnetic label, as shown in Figure 2. When the frequency of the excitation signal is 57.9 kHz, the resonance curve reaches the maximum value, that is fr=57.9 kHz; when the frequency of the excitation signal is 59.7 kHz, the resonance curve reaches the minimum value, that is, fa=59.7 kHz. Therefore, the magnetomechanical coupling coefficient k = 0.251 is calculated. Obviously, there are resonance and anti-resonance points in the acoustic-magnetic tag. Under the action of a small exciting magnetic field, it can produce a larger resonance signal, and the voltage difference between the two points is large, which indicates that the tag has a larger magneto-mechanical coupling coefficient. The sharp resonance curve shows that the tag has higher Q value, narrower bandwidth and stronger selectivity. Therefore, if a proper bias magnetic field is set up to make it work in a region with better characteristics, a higher resonance signal and a stronger frequency stability can be obtained.3Tuning fork effect acoustic magnetic label is composed of small plastic boxes, about 40 mm long, 8 "14 mm wide and 1 mm thick (existing thinner). In the small box, there are two kinds of metal bars which are similar to tuning fork. One is hard magnetic metal bars fixed on the plastic box, the other is soft magnetic permalloy bars which can vibrate freely. According to the special material and structure of the tag, it has a certain resonance frequency; when the frequency of the applied alternating magnetic field is consistent with the resonance frequency of the tag, it will produce resonance. Because of the magnetostrictive effect and piezomagnetic effect, when the external alternating magnetic field disappears, the tag will still produce damped oscillation, forming alternating mode of magnetic energy and mechanical energy, generating attenuated resonance signal, which is a kind of acousto-magnetic composite signal. Typical acoustic and magnetic labels work at 58 kHz, and tuning fork resonance signal is similar to ultrasonic wave. Therefore, the anti-interference ability and penetration force are very strong, which is the greatest advantage different from other labels. In the process of tuning fork effect recognition, electromagnetic energy and mechanical energy are actually converted to each other. However, due to the low energy conversion efficiency of magnetic sensor, strong transmitting power is needed,

such as the typical value of minimum activated magnetic field intensity is greater than 16A/m, so the antenna detector of acoustic-magnetic system is Principle of acousto-magnetic system: The transmitter of the detection system emits 58 kHz low frequency magnetic wave intermittently in 1/75 seconds, forming a detection area around it. When a tag consisting of two special amorphous metal sheets enters the detection area, the signal will be received by the matching receiver because of interference to the electromagnetic field or other forms of induction, i.e. resonance signal, which will cause the system alarm. Fig. 3 Acoustic-magnetic anti-theft system is composed of 1. Acoustic-magnetic system is composed of three parts as shown in Fig. 3. One is that the detector is located on the left and right sides of the graph. It includes transmitter and receiver. The basic principle is to use the transmitting antenna to transmit the alternating magnetic field, and form an induction zone between the transmitting antenna and the receiving antenna. The resonance principle of electromagnetic wave is used to search for the existence of valid labels in a specific range (i.e. labels that have not been decoded by decoder), and the alarm is triggered when the valid labels appear. Secondly, the acoustic and magnetic labels are located in the middle of the picture. It is a disorderly arrangement of amorphous metals that are cut into 58 kHz size accurately. It resonates with the magnetic bias sheet and reflects to the receiving support by entering the detection area. Thirdly, the unclassified decoder in the figure is a non-contact device with soft label decoding failure. When a cashier checks in, the tag can be decoded without touching the degaussing area, or the device that integrates the decoder and the laser barcode scanner can complete the collection and decoding of the goods at one time2. Acoustic-magnetic identification principle Acoustic-magnetic anti-theft system belongs to single-bit radio frequency identification system, which adopts digital modulation method of amplitude keying (ASK). The alternating magnetic field transmitted by the antenna is shown in the dotted line part of Fig. 4. The modulation signal is a binary coded signal, consisting of a single bit sequence of 0 and 1 states. The pulse duration is 0. The pulse duration is 20 ms, and the pulse amplitude required is large. The carrier signal is 58 kHz (or 60 kHz, 68 kHz) low frequency positive. Chord signal; the modulated signal is the ASK signal whose amplitude modulation coefficient is 100%. When the acoustic magnetic tag enters the ASK excitation alternating magnetic field (detection area) and the resonance frequency of the tag is consistent with the carrier frequency, the resonance phenomenon will occur in the tag because of magnetostrictive effect. When the alternating magnetic field is turned off, according to the piezomagnetic effect of the tag, the resonance signal will be maintained for a period of time, resulting in the damped oscillation in Fig. 4. In addition, because the mechanical energy and magnetic energy are alternately converted, the resonance signal is an acousto-magnetic composite signal, which is the meaning of the acousto-magnetic system. The resonance signal not only acts as the spatial extension of the exciting magnetic field, but also

has the characteristics of ultrasonic wave. Therefore, the induction coil in the receiver can easily detect the resonance signal, thus driving the alarm device of the system. Fig. 4 Acousto-magnetic identification principle of alternating magnetic field of acousto-magnetic tag: First, the center frequency of the signal is 58 kHz, the bandwidth is 57.8 kHz to 58.2 kHz (0.4 kHz), which is the narrowest in all electronic anti-theft systems at present, so it is extremely unlikely to be disturbed and cause false alarm. The second is the process of determining the label signal systematically. When the transmitting signal is turned off, the receiver receives six (adjustable) resonance signals in succession. If the power and frequency of each resonance signal are the same, it will be identified as a label signal. If it is impossible to produce six identical signals in one second for external interference signal, the label signal can be accurately determined by repeating the above recognition process, and almost achieved. Zero false alarm operation.

Application of AM system

When export companies get orders from Europe and the United States, they usually use anti-theft labels; especially in the top 100 supermarket chains in Europe and the United States, most of them use 58 kHz acoustic and magnetic anti-theft system. Only by placing DR anti-theft labels on commodities can they enter supermarkets in Europe and America. Acoustic magnetic system has two kinds of anti-theft labels, soft and hard. The first one is composed of two vibrating plates and one substrate. The second one is composed of one vibrating plate and one substrate. It is suitable for clothing, shoes and hats, bags and daily necessities/food with packaging. There are few acoustical and magnetic systems in China. Bohang Electronics in Nanjing is one of the most successful manufacturers in developing acoustical and magnetic systems independently. No need for grounding wires is the biggest highlight of its acoustical and magnetic systems.