WAVE-VECTOR™ EMI/RFI MATERIALS

铂韬新材

电子材料及创新应用整合服务的理想伙伴

Your Optimal Business Partner for
Electronic Material & Innovative Application

Website: www.wave-vector.com

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01. CHAPTER

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- ✓ The development course
- ✓ The patent certificates
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- ✓ Process capability
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Company profile

WAVE-VECTOR™ is a diversified technology manufacturing enterprise, co-founded by the domestic and foreign Master's & PhD teams team who have been deeply engaged in the semiconductor material industry for more than ten years. Relying on the "magnetic", "electric" and "thermal" technology platform, WAVE-VECTOR™ is committed to independent research and development, production and sales of new materials such as electromagnetic compatibility, shielding, thermal conductivity and semiconductor packaging.

NB S&P Car Com LED

Adhering to the mission of producing advanced materials and providing innovative solutions, We actively cooperate with our customers to minimize risks and create value for them through highly reliable innovative solutions, creating favorable conditions for customers to implement strategic priorities and achieve sustainable growth.

2017
Established in

120万 ㎡
Capacity

30+
National patent

6 条
Advanced production lines

4000+㎡
Factory area

100+
Cooperation partners

Development Course

Do not stick to the past experience, break through the limitations of the existing ability, dare to be the first, create value, reach the future.

- WAVE-VECTOR™ was established in Suzhou

- In 2019, awarded the Taicang Entrepreneurship Leading Talent Program
- In2019, built the first soft magnetic powder production line
- In2019, built the first wave absorbing film production line
- In 2019, completed 39 patent applications

- In 2020awardedGusuEntrepreneurship Leading Talent Program
- In 2020, recognized as a national high and new technology enterprise
- In 2020, won A round of tens of millions of financing

- In 2021,completed the third absorbing film production line
- In 2021,completed the first thermal conductivity and absorption production line
- In 2021,built the first millimeter wave product line
- In 2021, was successful in batch supply to many head enterprises

The Patent Certificates

The invention relates to a coating device for magnetic film material made of flake magnetic powder and a working method thereof

The invention relates to a composite material with thermal conductivity and electromagnetic shielding functions and a preparation method thereof

The invention relates to a novel sealing ring with noise reduction and wave absorption function and a preparation method thereof

The invention relates to a coating with rust-proof and wave-absorbing function and a preparation method thereof

The invention relates to a flame retardant soft magnetic composite with flexible magnetic properties

The company pays attention to the layout of intellectual property rights. We firmly believe that innovation and creation is the core competitiveness of sustainable development of enterprises. We take the advanced and complex technologies accumulated over a long period of time as the intangible assets of the company for inheritance and industrial transformation. In terms of equipment, process, formula, structure and application, a total of 39 patents were declared, including 8 authorized invention patents and 17 utility model patents.

Production capacity

Current capacity of powder 50t/ month

Current film production capacity 100,000 ㎡/ month

Build a one-stop production mechanism from materials to products, focus on medium - and long-term strategic development of diversified product matrix.

R&D Investment

We keep the commitment of continuous innovation, focus on personnel and technology investment, 10-15% of sales revenue into new products, new process, new equipment research and development

R&D equipment

With excellent testing equipment, experimental equipment and pilot production equipment a total of 89 sets.

university-enterprise cooperation

- With Suzhou University Industry-university-research cooperation
- Oriented talent delivery

R&D Investment

- Increase investment
- Training talents
- Encourage scientific research and innovation

Capacity expansion

- Six production lines have been mass-produced
- Employees 50 +

Testing equipment

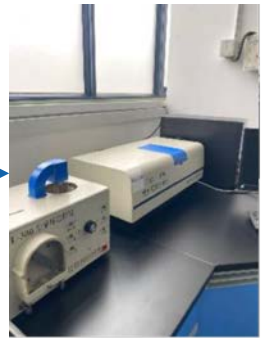
Magnetic detection Digital bridge

The thickness of the test Coating thickness gauge

Surface resistance test Daily resistance tester

Permeability test Agilent E4991

Test equipment



Powder particle size analyzer

Environmental test chamber
Hot and cold impact testing machine

Constant temperature and humidity tester

Salt spray test chamber

Production equipment

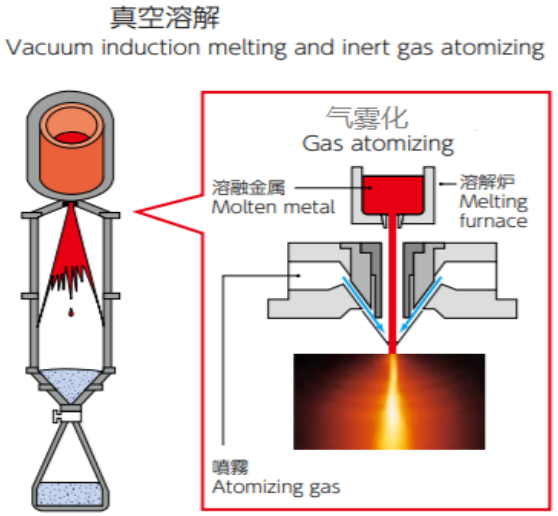
Coating production line

Vacuum heat treatment furnace

High energy mixer

According to the individual needs of different customers, design diversified product structure.

1



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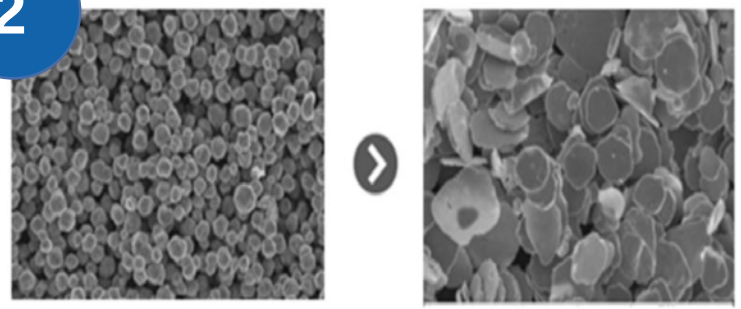
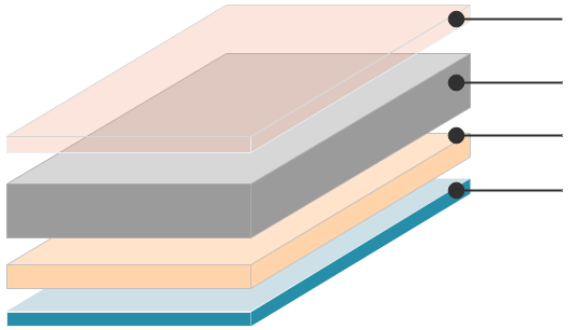
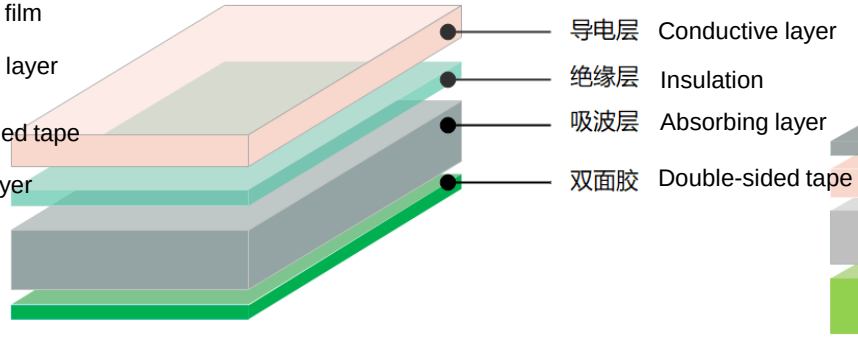


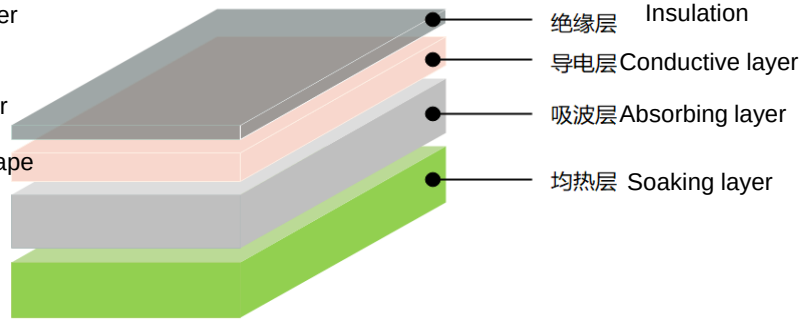
3

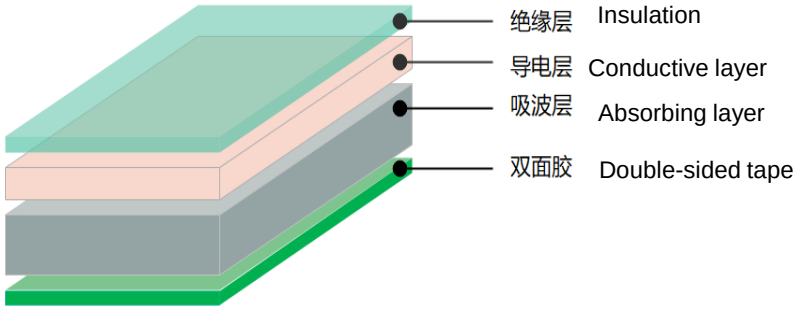
- **Absorbent + polymer material**
  - Carbonyl Iron、MPP, High Flux, Sendust, X-Flux …
    Amorphous, Nanocrystalline
  - NBR、CPE、TPU、PLA、ABS、PA,Epoxy, acrylic acid, silicone, etc.
- **Molding process**
  - **Dry forming**
    - Calendering, plate, extrusion, injection molding, 3D printing
  - **Wet molding**
    - Coating, flow delay, spraying, immersion etc.

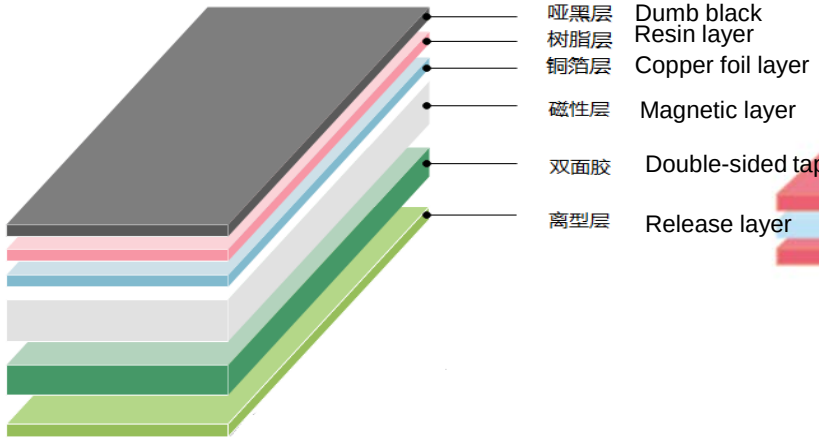
According to the individual needs of different customers, design diversified product structure.

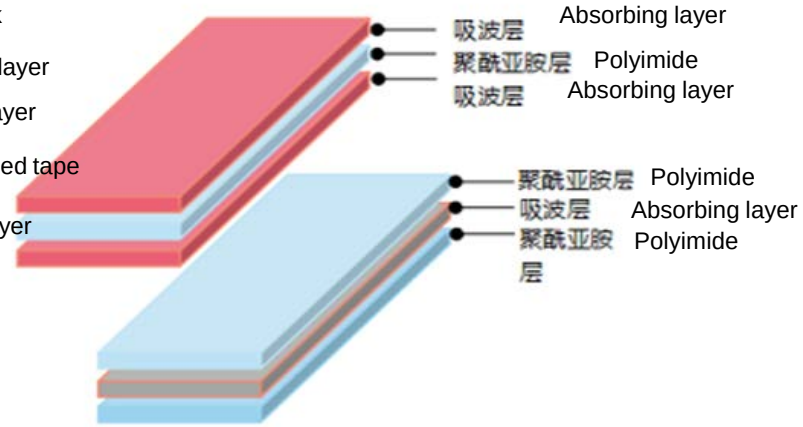












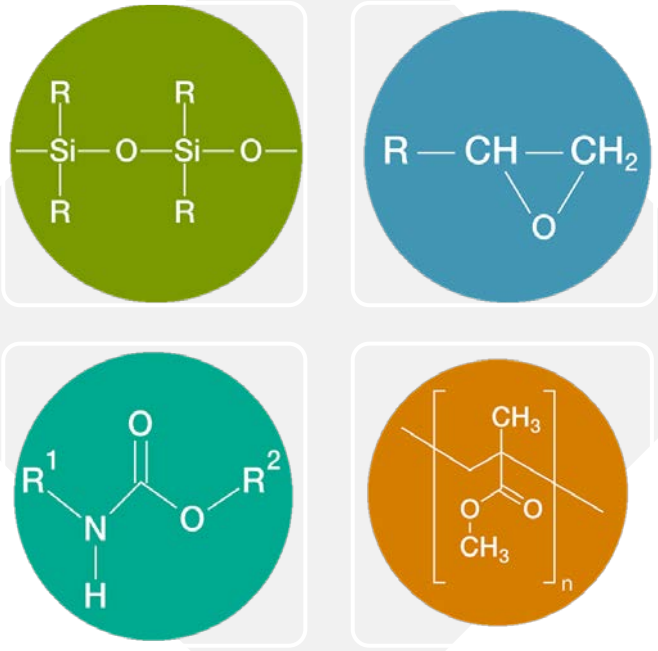
Leveraging the diversity of knowledge and experience, our technical team is good at applying the expertise and experience of successful cases to new scenarios, and has a deep understanding of customer innovation needs and excellent application knowledge to implement the strategic instructions of "from product thinking to system understanding".

R&D capability - Formula system

Diversified formula system to meet the individual needs of different customers

- When flame retardancy, high temperature resistance and permanent elasticity are primary requirements, silicone products are the best choice for protecting fragile electronic components and modules.

- Polyurethane formulations can be applied to electronic packaging materials and are known to work best in low temperature applications. It protects sensitive electronics and is water resistant.



- Epoxy resin formula has the advantages of high strength, wide use, high durability, strong adhesion, chemical corrosion resistance and high temperature resistance.

- Acrylic resin formulations can be cured at room temperature. In addition to providing high structural viscosity, acrylic resins provide impact resistance, low and high temperature properties, and good service fatigue life.

We listen to our customers and provide you with effective technical experts and team support. Our team is highly responsive and skilled in providing innovative products with soft magnetic powder, thermal powder and conductive powder in combination with polyurethane, epoxy, silicone and acrylic resins. Each product is developed with great enthusiasm and carefully manufactured for delivery to meet your performance, cost, and planned goals.

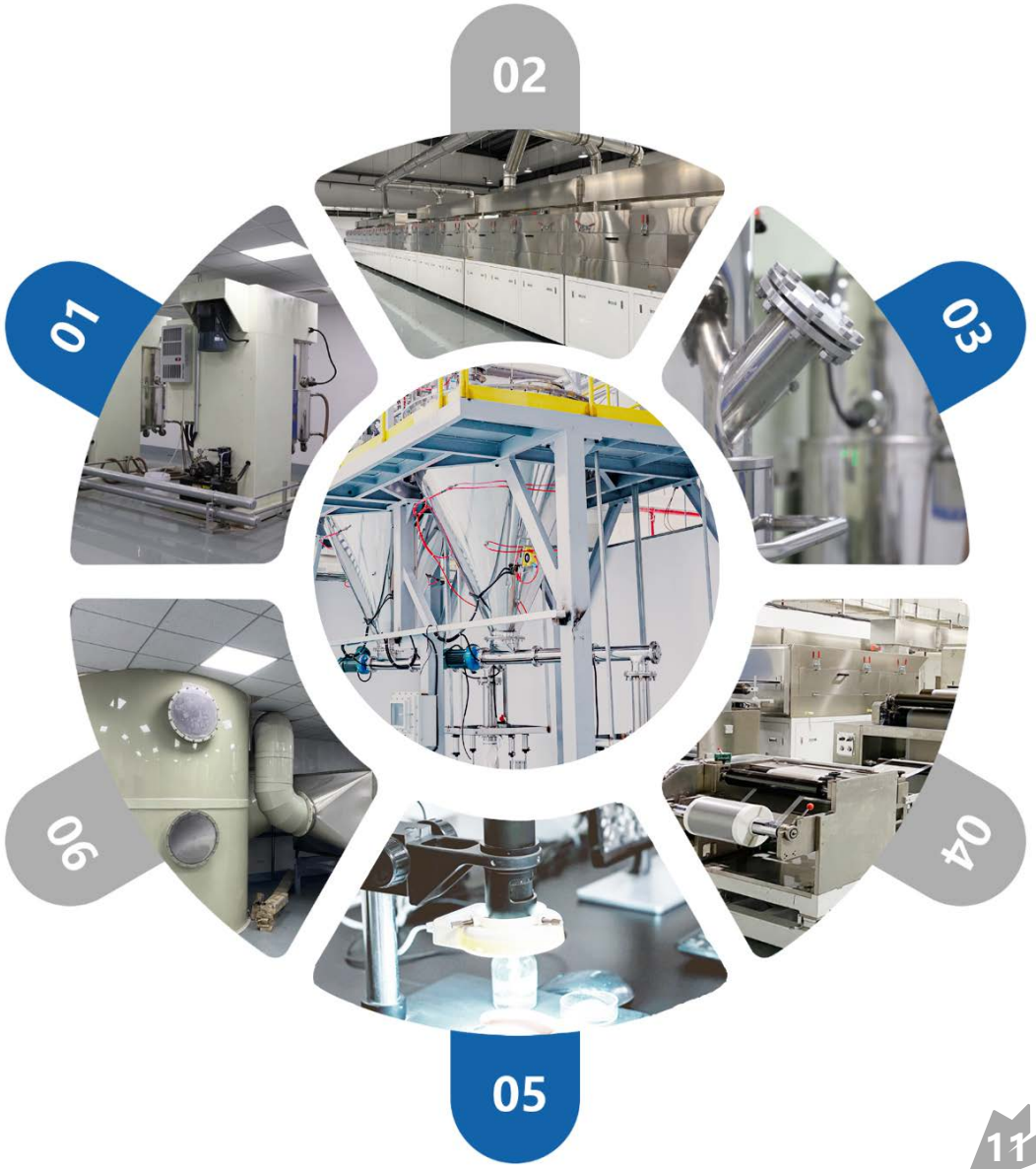
Process capability

Advanced manufacturing workshop	Standardized workshop, advanced production machines
Quality assurance	In 2018, the company passed ISO9001 quality management certification
Lean 6 s	Clean production workshop
Zero defect	Multiple monitoring Our goal is zero defects
High and new technology enterprise	Identified as a high-tech enterprise


管理体系认证证书


MANAGEMENT SYSTEM CERTIFICATE

Suzhou Botao New Materials Technology Co., Ltd.



Quality control

Stuff

Orientation
Mount guard training
Job skill training

Inspection

First qualified test release
Each process inspection, IPQC inspection
Process sampling testing, pre-packaging testing

Machine

Set up equipment files
Frequency of scheduled maintenance
Preventive maintenance
Emergency plan for unplanned shutdown of equipment

Environment

Plant is clean and bright
Regular factory 6S audit
Keep clean, material, fixture and fixture in order
Perform the requirements of the 6S

Material

Supplier qualification audit
Supplier management
Feed qualification test

Method

Standard operating guide
Identify key processes and quality control points
Standard process documents define production
Operation, process parameters set

02. CHAPTER

Main Products

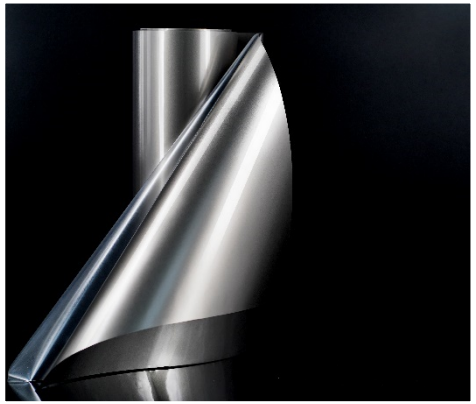
- ✓ Lineup
- ✓ Two dimensional soft magnetic powder
- ✓ Absorbing film
- ✓ Thermal conductive absorbing
- ✓ Millimeter wave products

Lineup

Absorbing powder BU

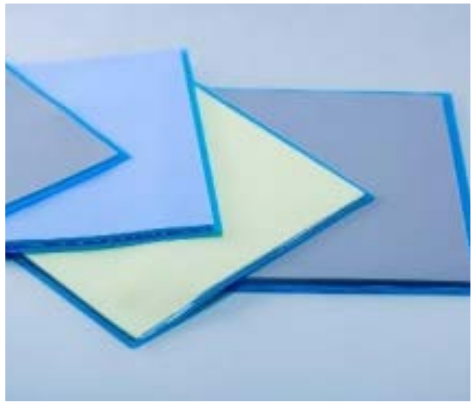
- Wireless charging WPC
- EMR technology
- RFID industry anti – metal solutions
- Power supply system

Absorbing film BU



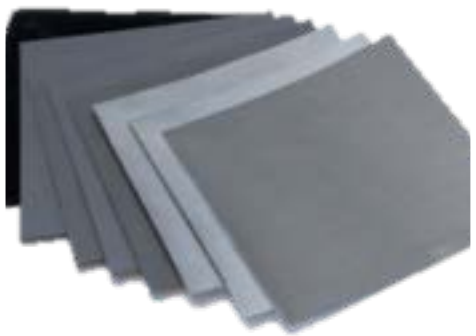
- CPU/GPU Noise countermeasure
- CCD Noise countermeasure
- PCB/FPC Noise countermeasure
- Communication module RFI countermeasures
- USB 3.0/TYPE C interfere with the contact

Thermal conductive absorbing BU



- High heat IC comprehensive countermeasures
- Multi-function solution
- EMI bonus for cooling modules
- EMI countermeasures for micro base stations

Millimeter wave products BU



- Base station sidelobe management
- AAU cavity resonant noise absorption
- EMI countermeasures for optical modules
- Surface wave absorption
- Millimeter wave radar noise

Absorbing powder

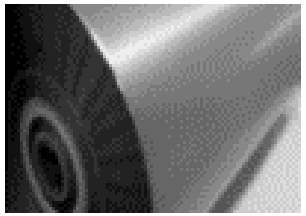
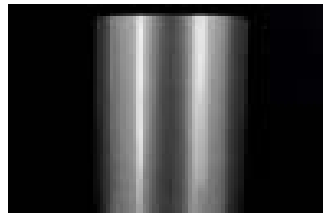
Features:

- Length to diameter ratio
- The thickness of homogeneous
- Particle concentration
- Rules of the morphology
- Loose than moderate
- Metallic luster

Application field

1. Thin film absorbing material
2. Absorbing coating
3. High frequency electronic devices
4. Wireless charging components
5. 5G device material
6. Frequency conversion chip inductor
7. Line noise filter, pulse transformer
8. Energy storage and filter inductor

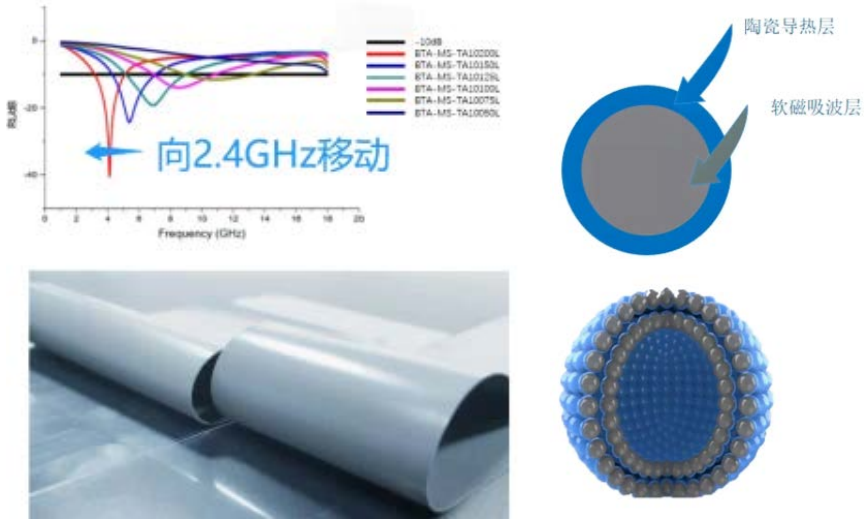
Absorbing film

	High performance ultra-thin Absorbing material	Composite Absorbing material	High frequency Absorbing material	Ultra high frequency Absorbing material	Coil Absorbing material	Flame retardant Absorbing material
Photos						
Chief application	Mobile phone、smart watches、laptops、Pad and other electronic products	RFID、Cable、IC, etc.	For 5G signal materials, 700MHz-6GHz band is used	Cell phone base station, vehicle radar, optical module, etc.	Mobile phone, TV, monitor and other terminal market	Automotive, PCB, vehicle-mounted radar, wiring harness, ADAS and other application requirements
Application fields	Goertek Apple Amazon	luxshare-ict Confidex TEConnectivity	HP DELL LENOVO	HUAWEI Hikvision FNSR	MI OPPO VIVO	Arcfox AION XIAOPENG

Integrated EMI and heat dissipation solution

Thermal potting glue
for absorption waveguide

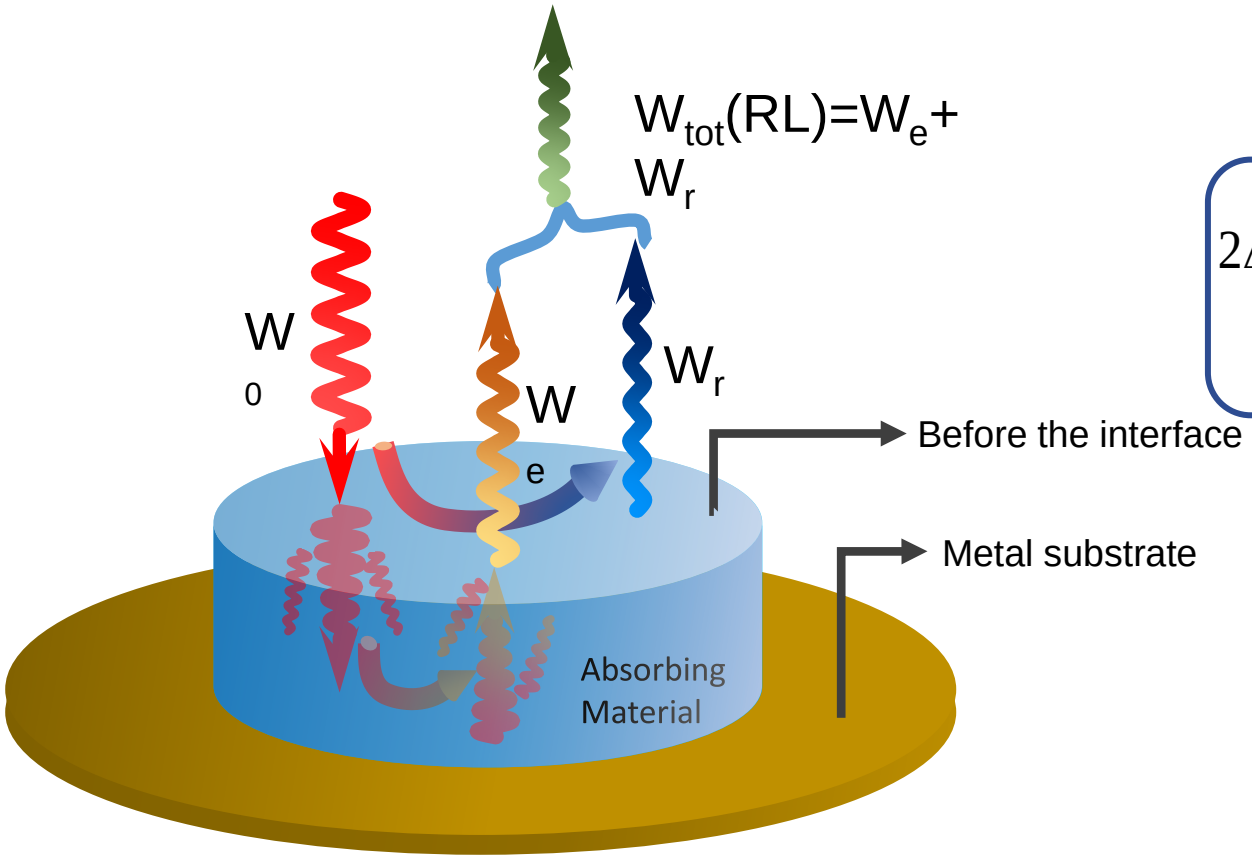
Thermal coating
for absorption waveguide



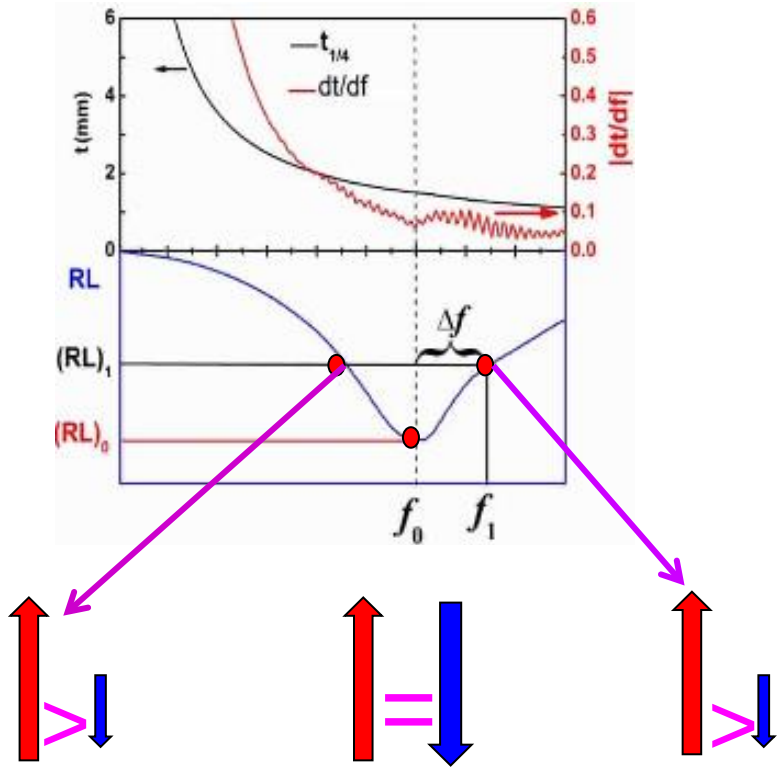
Thermal pad
for absorption waveguide

Each powder has two functions at the same time (magnetic conductivity + thermal conductivity), the thermal conductivity of the "coat" of the absorbing powder has a unique multi-layer core and shell structure, using this powder to make a variety of products, can have good thermal conductivity and absorption function.

Physical image: Interface reflection model



$$2\Delta f = \frac{2Ct_m}{\frac{dt_m}{df}}$$



Absorption peak bandwidth adjustment

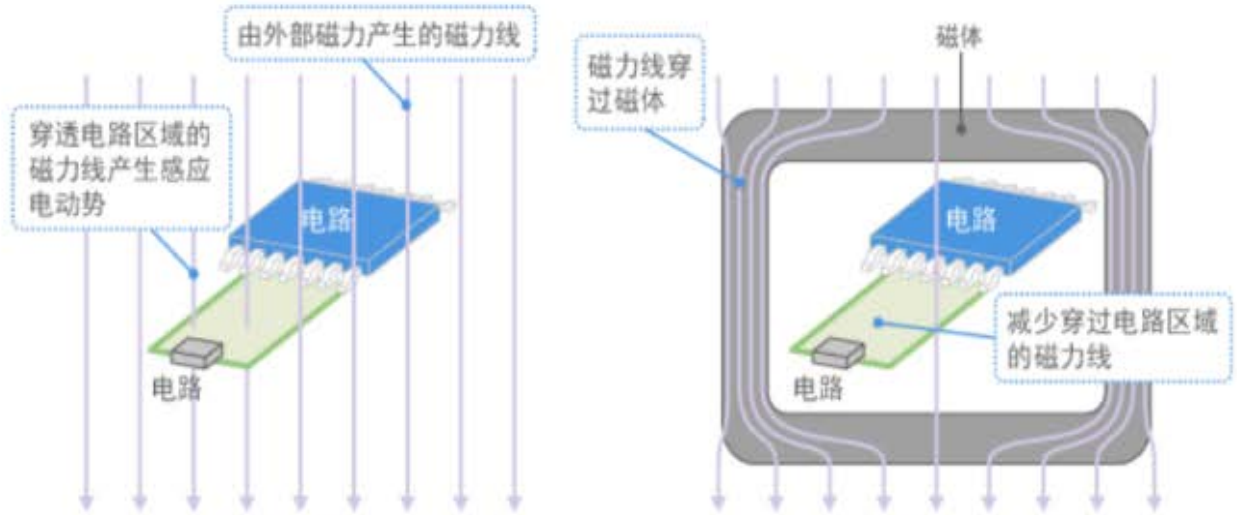
$$\Delta = 2\Delta f = \left[2\left(1-\left(1-\frac{R_1-R_0}{W_e}\right)^{1/2}\right)\right]^{1/2} \cdot \frac{2t_m}{\pi} \Big/ \left|\frac{dt_m}{df}\right|$$

03. CHAPTER

Product Application

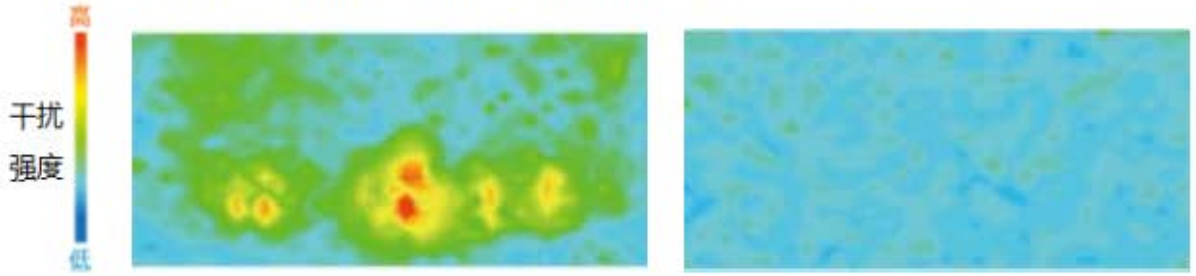
- ✓ Application principle
- ✓ Application example
- ✓ Application fields
- ✓ Application selection

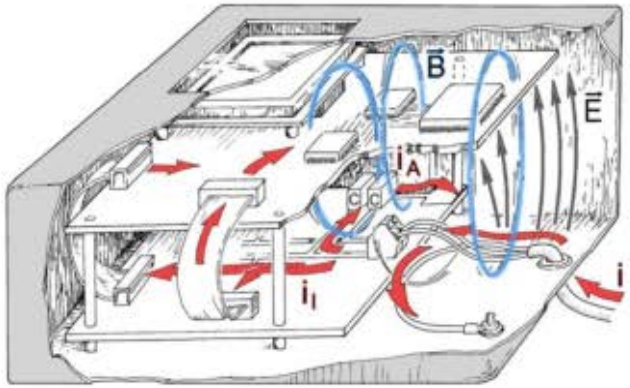
Application principle

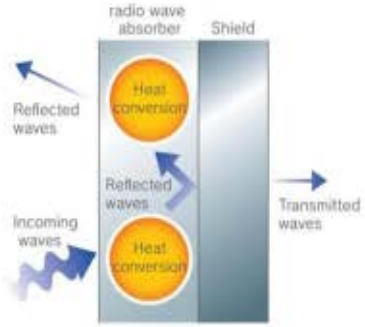


(a) 无吸波材料情形　　(b) 加吸波材料对策的电路

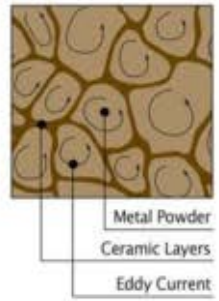
吸波材料可将磁力线（能量）引至磁体内，从而降低了目标对象周围的磁场，进而减少或消除电磁干扰。
磁导率越高对电磁波引导作用越强，越容易做到EMI/RFI的防护。







二维软磁金属粒子对电磁微波进行耗散转化为其他形式的能比如热能



磁损耗：$t_m = \frac{c}{2\pi f_m \mu''}$　　[Y.Naito , K. Suetake (1971)]

After the electromagnetic wave enters the two-dimensional soft magnetic powder, it will be transmitted along the direction of easy magnetization, that is, the direction of the powder. The thinner the powder is, the more difficult it is for the electromagnetic wave to break free of the constraint. On this principle, its transmission path can be planned.

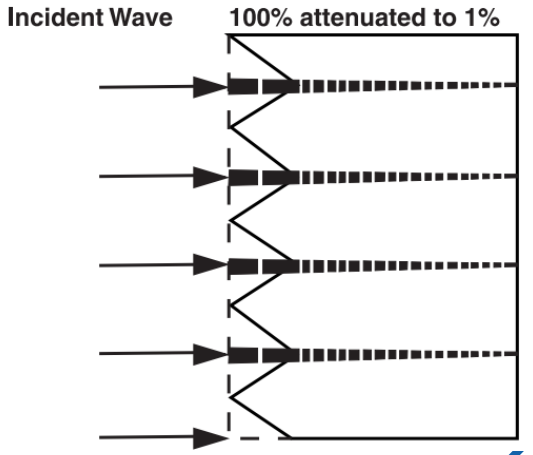
Application principle

- EMC related market access certification to protect the electromagnetic environment in the region, as follows:

  FCC and NEBC certification in North America, CE certification in Eu, VCCEI certification in Japan,

  C-TICK certification in Australia, and 3C certification in China

- Radio frequency and microwave electromagnetic wave frequency coverage range of 300KHz ~ 300GHz, is a limited band of radio waves for short. Wave-vector ™ is designed for near-field applications, and has been developed to meet customers' specific application needs. The principle is to achieve electrical, magnetic and dielectric loss of electromagnetic waves.



- Distinguish from frequency band: there is suitable for high frequency

  and low frequency absorbing materials;

- Application: there are absorbing materials suitable for reflection loss and insertion loss;

- In terms of loss types, there are absorbing materials suitable for electric field loss

  and magnetic field loss;

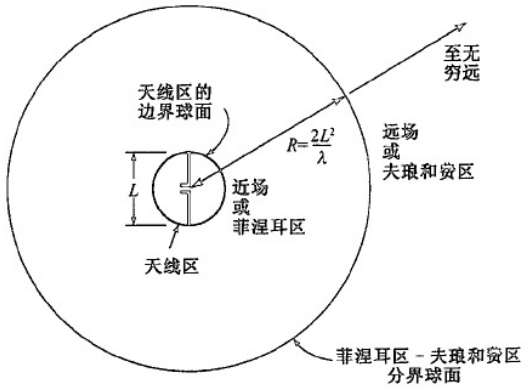
- Distinguish from the structure type: there are absorption materials for thin and light products.

Application principle

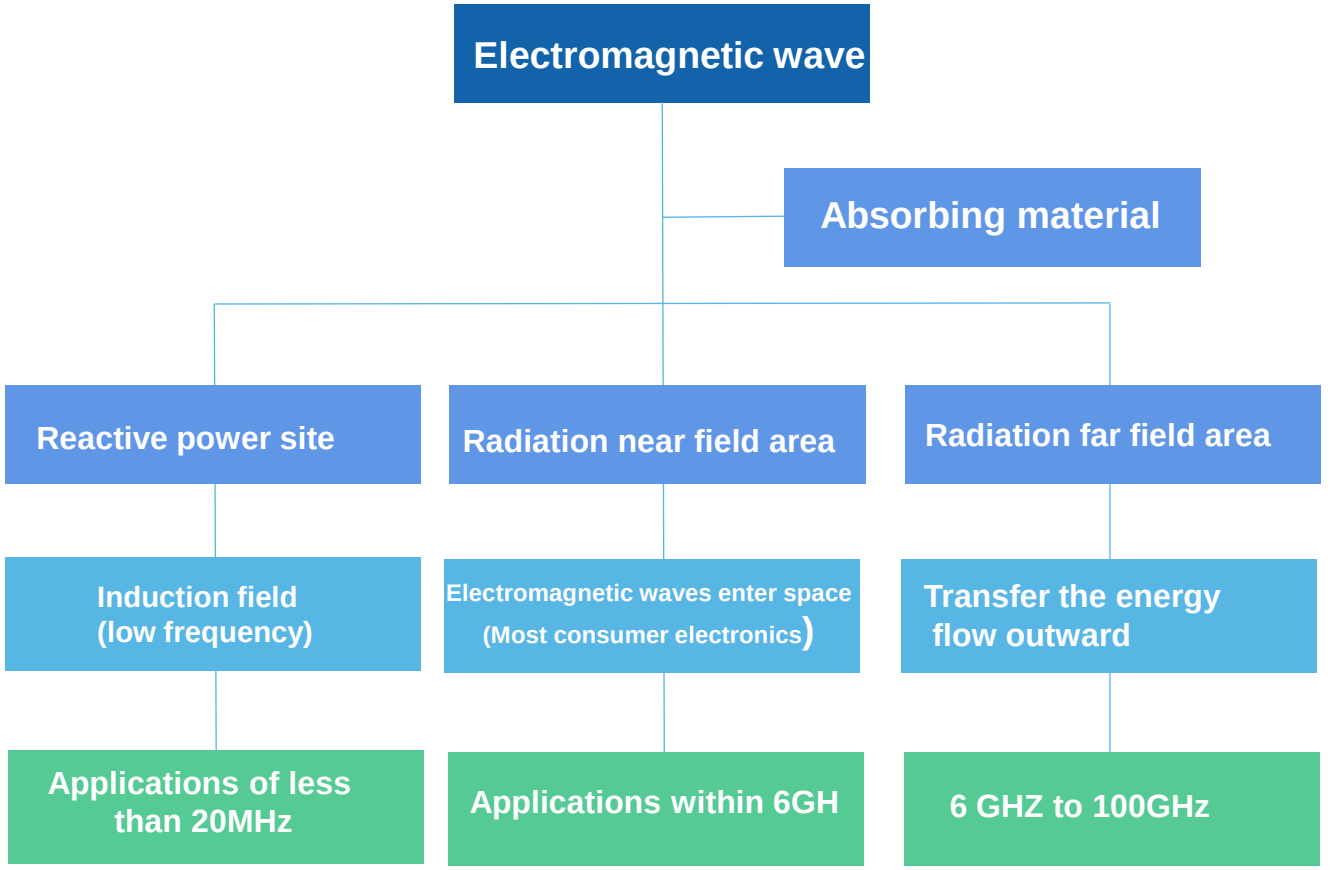
- Electromagnetic field: The field around the antenna can be divided into two main areas:

1. The area near the antenna is called the near field or Fresnel region,
2. The area farther away from the antenna is called the far field or Fraunhofer region.

Refer to the following figure:



- The dividing line between the two zones should be the radius R=2L2/λ (m).
- Where, L is the maximum size m of the antenna, λ is the wavelength m
- In order to facilitate understanding, the field around the antenna is usually divided into three finer regions:



Low frequency induction field product frequency: kHz

Android ecosystem

Mac OS ecosystem

Windows ecosystem

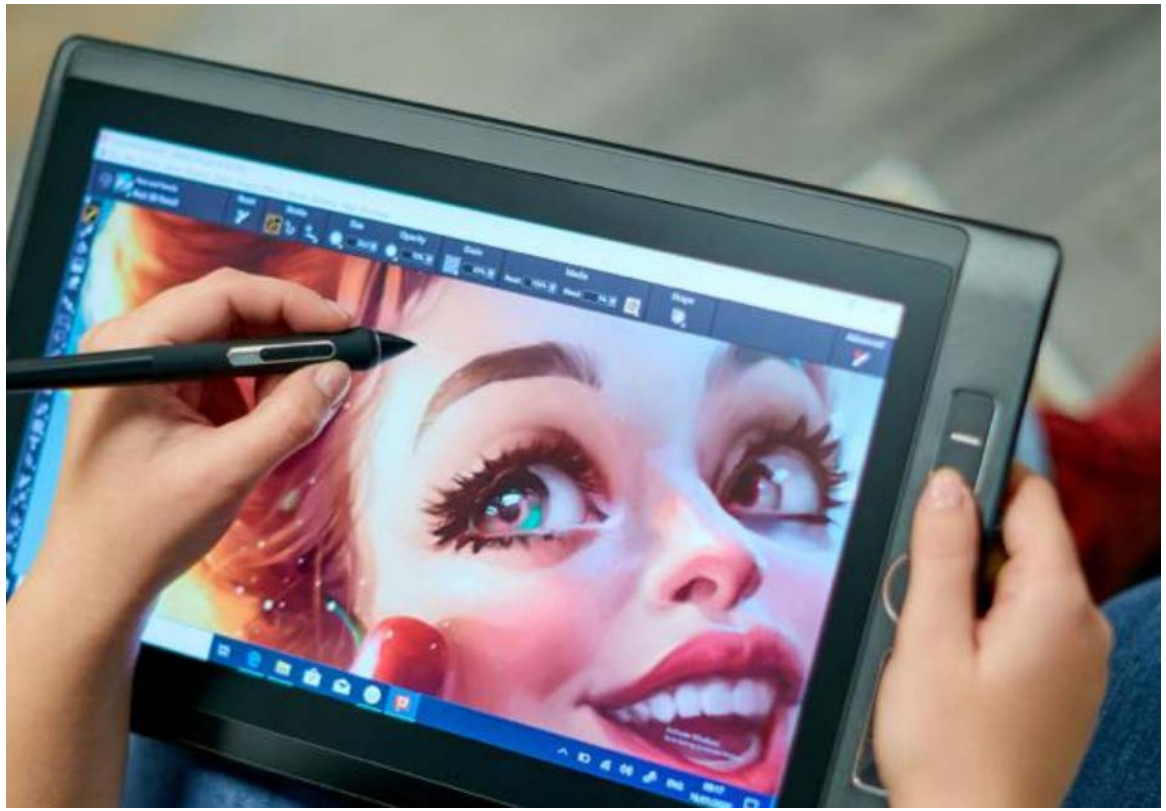
As a high induction driving raw material, the three operating systems to guide the promotion.

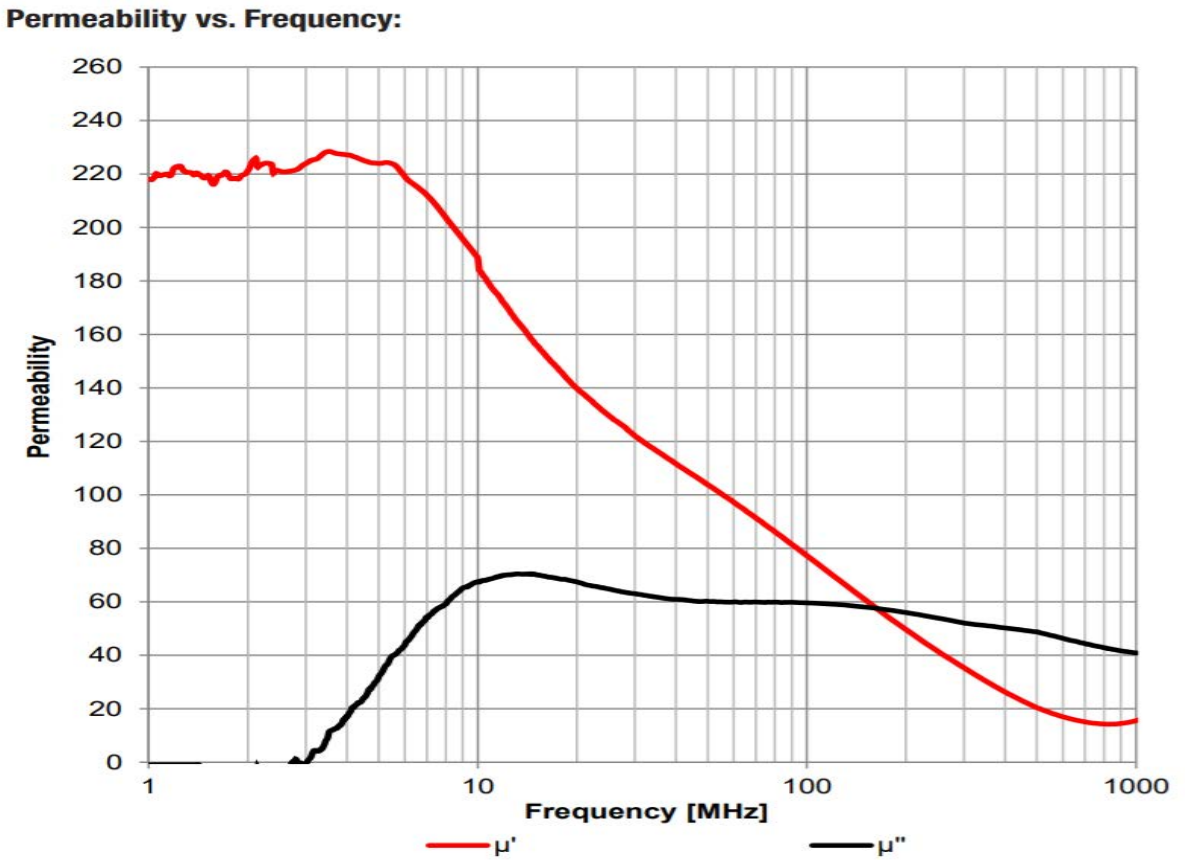
Industries

Banking & Finance | Healthcare | Hospitality & Tourism | Insurance | Telecommunications | Public Sector | Services | POS Retail | Meeting Rooms

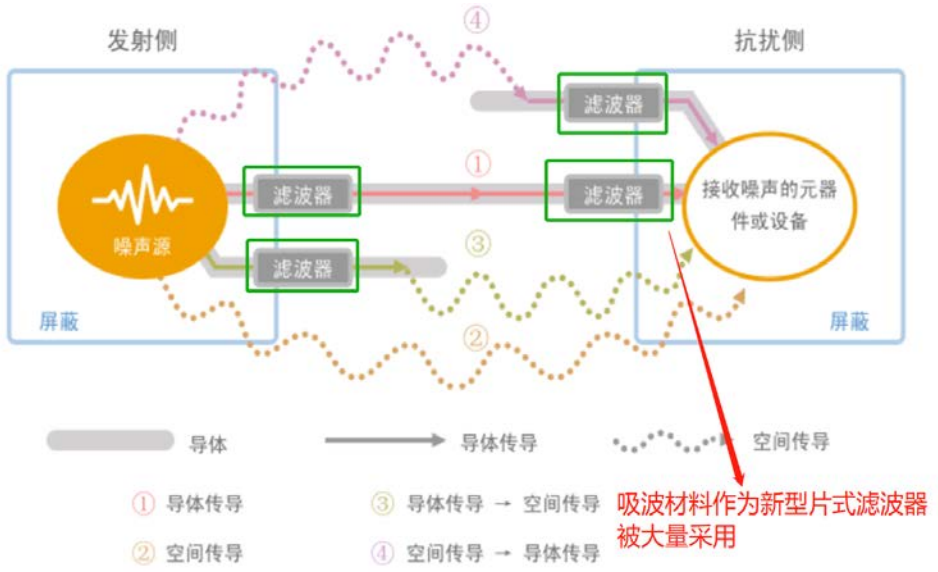
Low frequency induction field product frequency: khz-20mhz

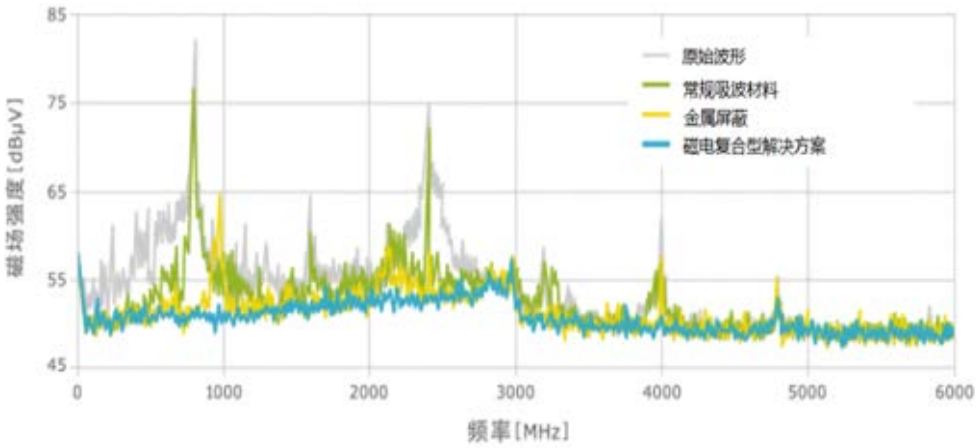
As a high induction driving raw material, the three operating systems to guide the promotion.





Near-field EMI/RFI frequency: MHz-GHz



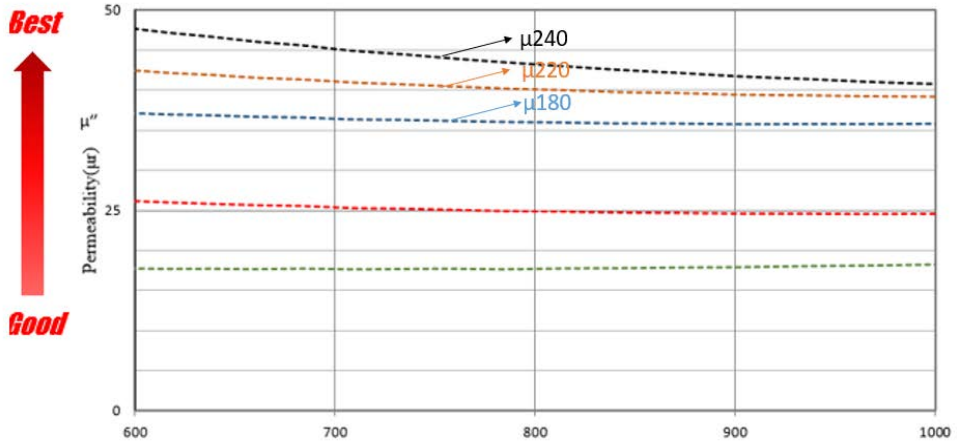


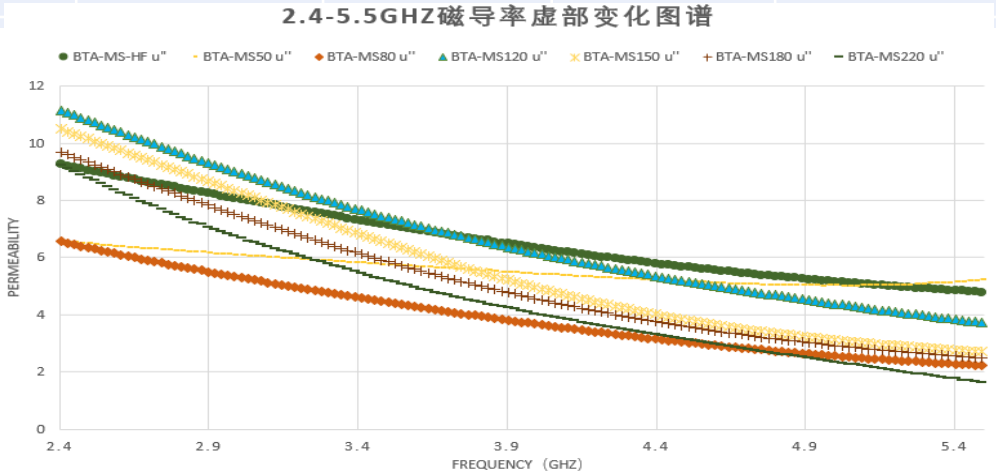
Near field environment, Consumer electronics Electromagnetic interference solutions

Near-field EMI/RFI frequency: 20MHz-6GHz

Product application selection guide(version2.0)	★★★★★	Particularly recommended	u.e.:	Assessment of
	★★★	Recommended		Recommended to use in combination with shielding materials (conductive cloth, copper aluminum foil)
	★	Apply		Recommended to use in combination with thermal management materials

Product categories		Near field EMI/RFI countermeasure material					
Application spectrum		20MHz～1GHz			1GHz-6GHz		
Application field	Material model	μ180	μ220	μ260	μ50	μ120	μ150
Notebook	CPU Noise countermeasures	★	★	★	★★★	★★★	★★★★★
	GPU Noise countermeasures	★★★	★★★★★	★★★	★	★	★★★
	DDR Noise countermeasures	★	★	★	★★★★★	★★★	★★★
	USB 3.0 Interfere with the lift	★	★	★	★	★★★	★★★★★
	SSD Noise countermeasures	★	★	★	★★★	★★★★★	★★★
	LCM Noise countermeasures	★★★	★	★	★	★★★	★★★★★
	Write electromagnetic screen in original handwriting	★	★★★	★★★★★	★	★	★
	Noise elimination in shielding cover	★	★★★	★	★	★★★	★★★★★





mm Wave product frequency: GHz-THz





➢ **Remote field environment solutions for 5G communication and other high frequency devices**

The ISSUE solving principle of high frequency far-field electromagnetic environment is different from that of near field. We use high frequency absorbing material, and its effects are as follows:

- **Reduce free space reflection;**
- **Suppression of cavity resonance;**
- **Reduce surface traveling waves.**

- **Its terminal application market is:**

1. Commercial communication: antenna, base station, optical module, router, switch, etc.
2. Millimeter wave applications: 5G communications, millimeter wave radar.

- **Industrial electronics: automotive electronics, drones, etc.**

1. Instrument measurement: power amplifier, filter, test system.
2. Security and defense: radar system, aerospace, etc.

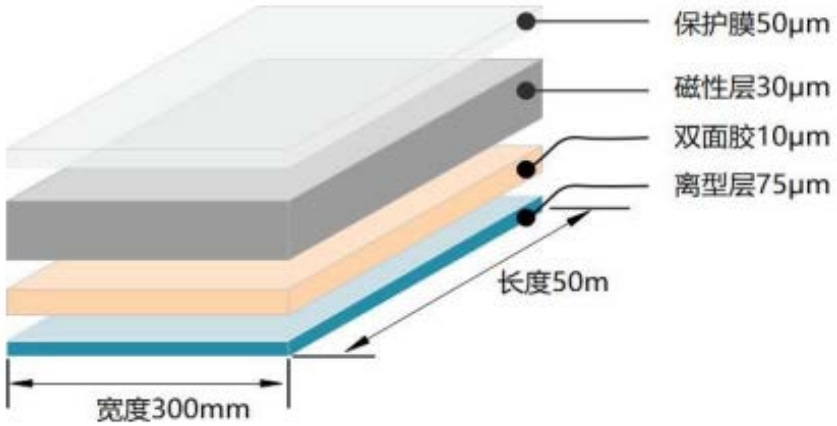


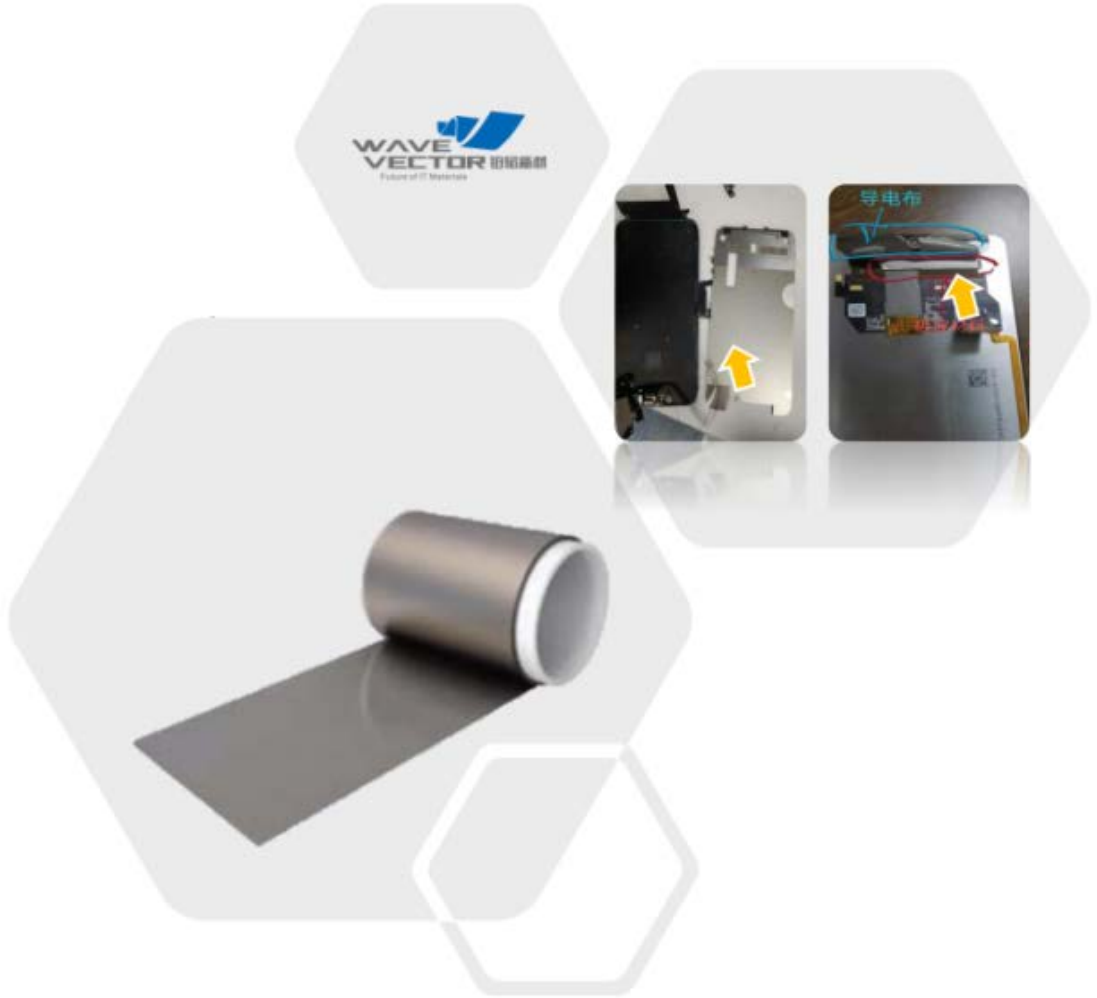



OLED application scenarios

With the increase of screen resolution and refresh frequency, the power consumption increases, and the interference of electronic devices will affect the display effect.

1. At present, it is mainly used in FPC in COF package to solve THE EMC of FPC devices. Generally, strip absorbing materials or flake absorbing materials for IC devices are used on one side.
2. COP sealing bag to absorb the application of materials, the change of single machine 2PCS. The protection of the rear screen area is mostly used in strip form.

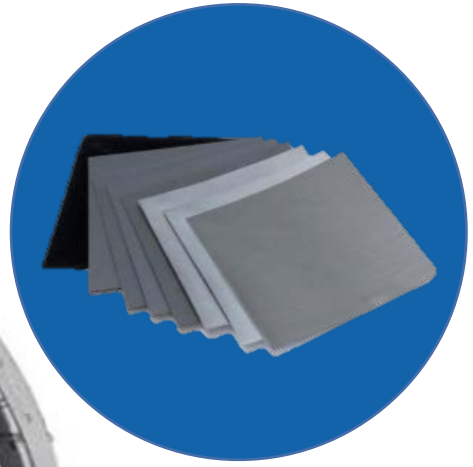


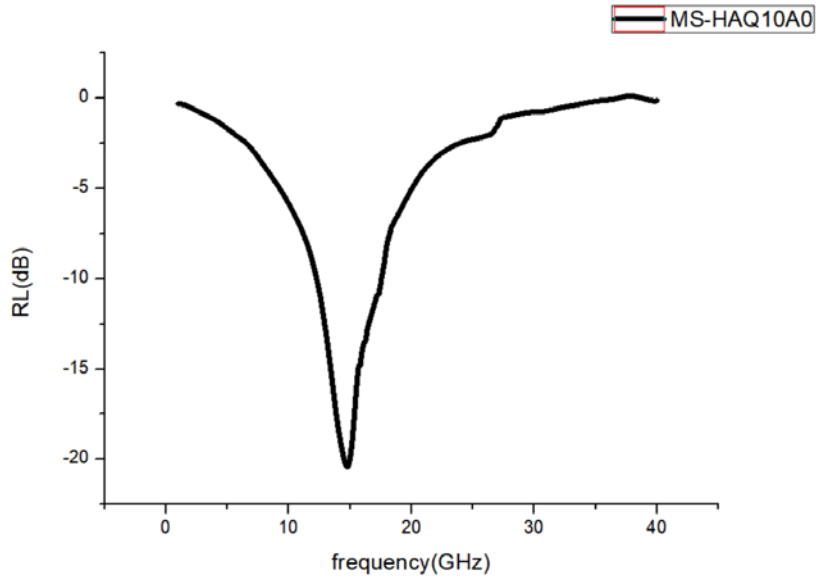


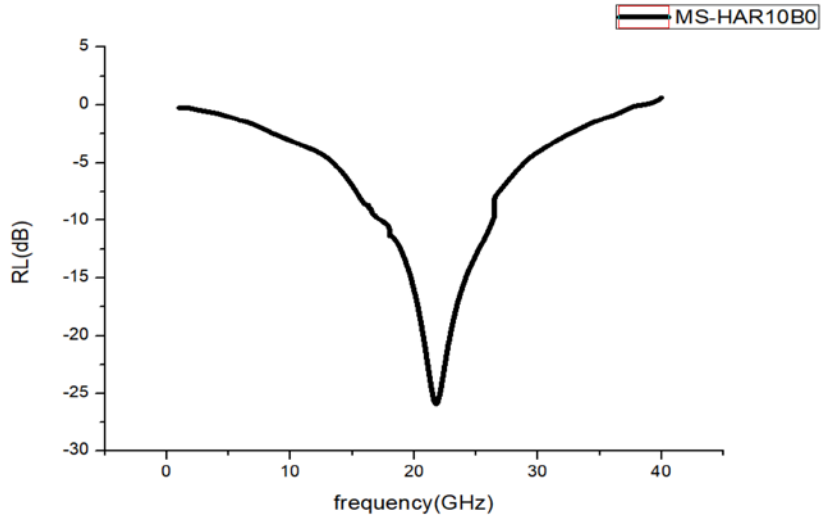
mm Wave product Frequency：6GHz-THz

Remote field environment solutions for 5G communication and other high frequency devices

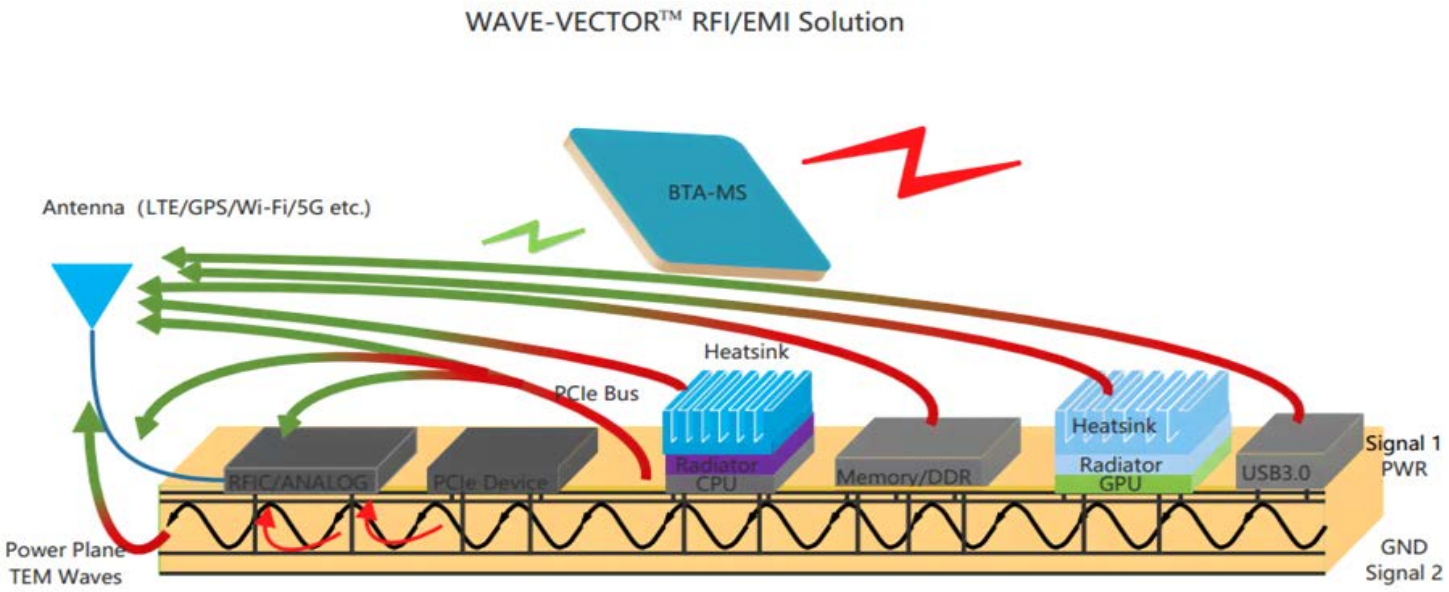
- Reflection Loss(Far field indicator)





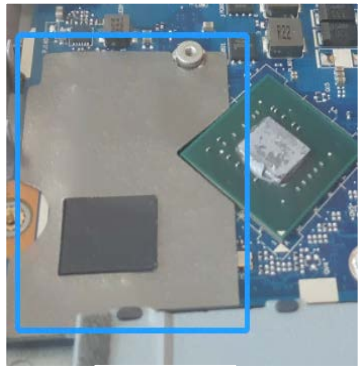


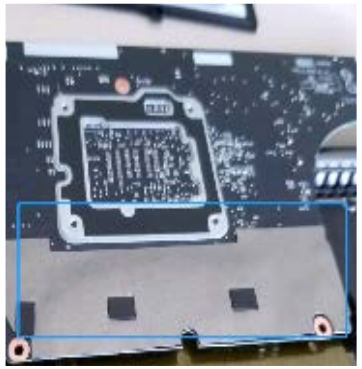
Application example

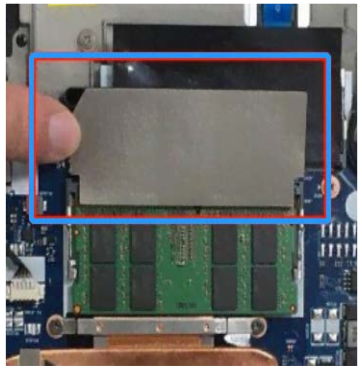


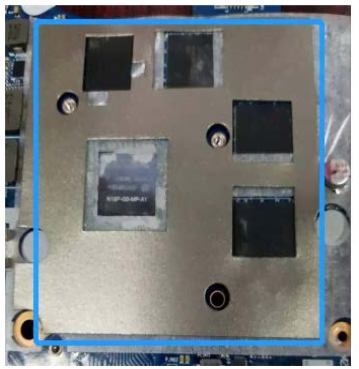
使用对象	作用原理	使用方法
柔性电路板，FPC排线	相当于一个高频下的磁环电感，抑制设备的纹波及尖峰	环型缠绕
高速CPU芯片	直接吸收电磁波，衰减耦合噪声	贴覆于芯片表面
图像处理芯片	直接吸收电磁波，衰减耦合噪声	贴覆于芯片表面
振荡芯片	直接吸收电磁波，衰减耦合噪声	贴覆于芯片表面
储存芯片	直接吸收电磁波，衰减耦合噪声	贴覆于芯片表面
高速信号线束	吸波与屏蔽作用，降低线束EMI干扰，降低线束本身因联结而导致的耦合干扰	贴覆于芯片表面
应用于屏蔽罩内壳	吸波，将杂波转化为低热散发出去，解决罩内腔穴共振及PCB或金属壳体缝隙闭合，降低电磁波对内部敏感器件的干扰	贴在屏蔽罩内壁及辐射源上


屏蔽罩内测


CPU


DDR

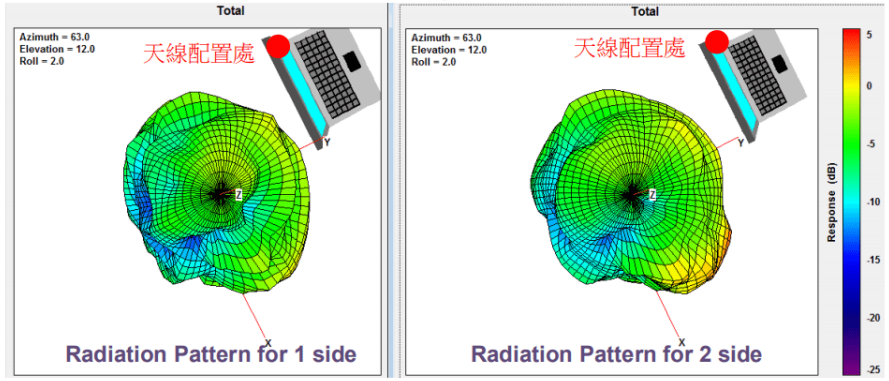

Memory


GPU


USB3.0

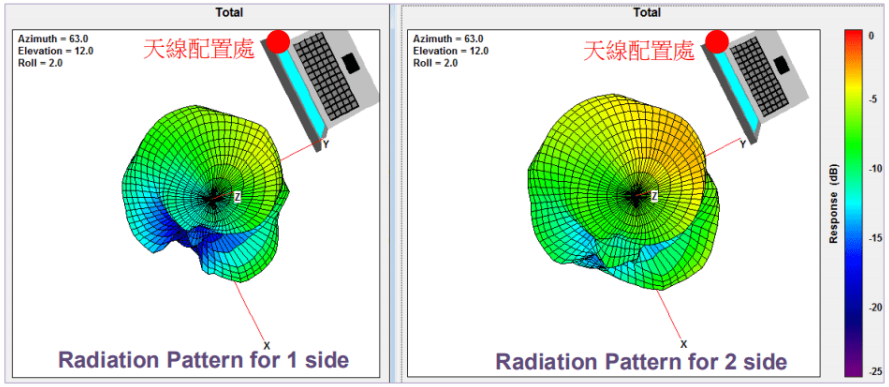
Application case: Wi-Fi antenna directly on the metal plate application

5.0GHz Radiation Pattern Comparison



由於5.0GHz天線路徑無法延伸至A件外觀面; 故幅射效率差異不大, 且場型變化變化也不多。

2.4GHz Radiation Pattern Comparison



左邊場型為天線配置於筆電右側(A件工模面)，右側為天線延伸至A件外觀面的場型;
由場型看出右邊輻射場型已有明顯改善.

In this application, the two-dimensional soft magnetic material shielding the impact of the backplane on the antenna is a key component to improve the communication efficiency of the antenna.

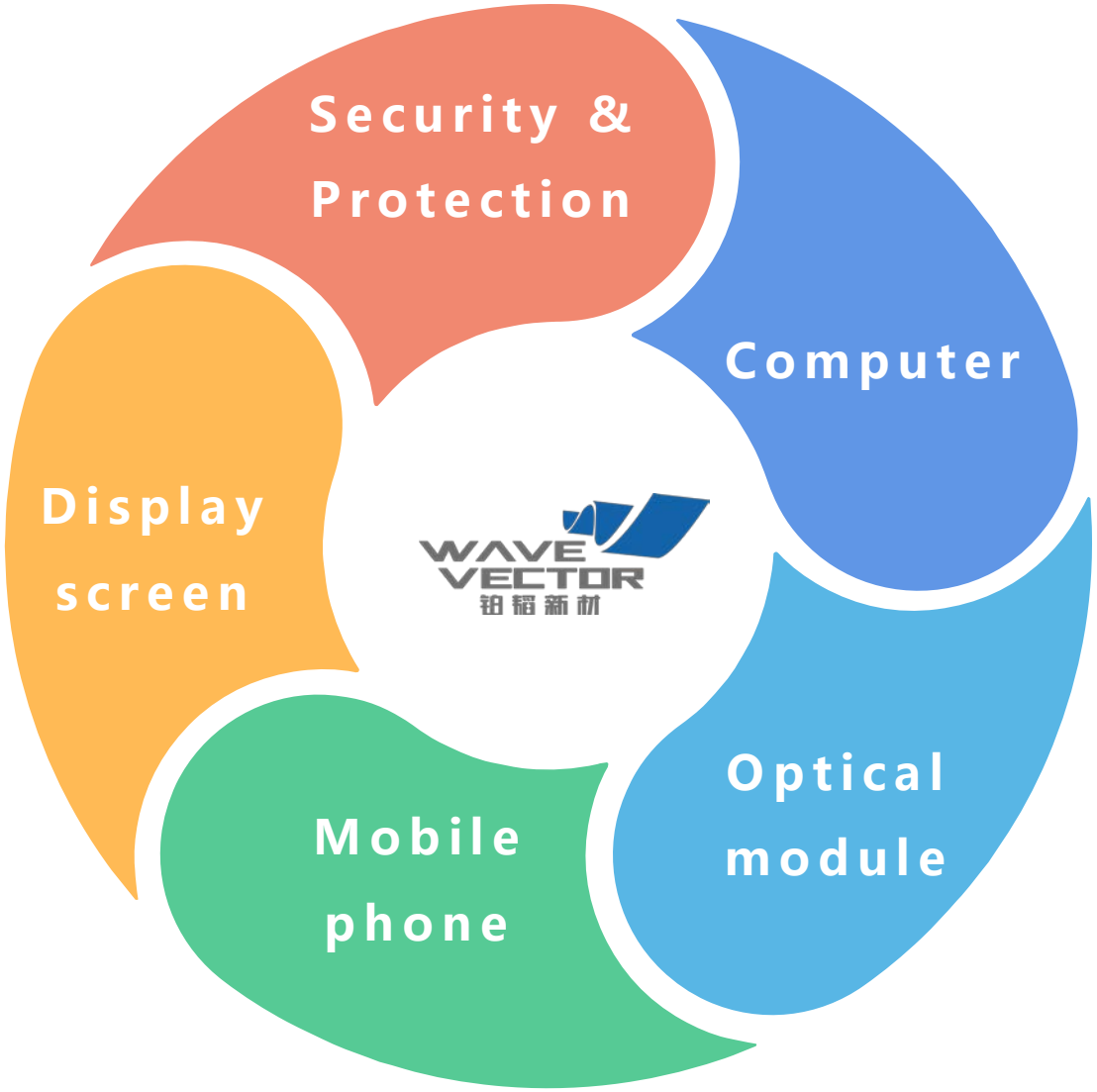
Application example

The EMI problem is becoming more prominent as next-generation communications technologies become "more powerful" and "more integrated."

Comparison of AAU/RRU Average Power consumption of 4G and 5G Devices (W)		
Business load	4G	5G
100%	289.68	1127.28
50%	273.58	892.32
30%	259.1	762.43
no-load	222.59	633

- The AAU, which stands for "active antenna unit" in Chinese, converts baseband digital signals into analog signals, and then modulates them into high-frequency radio frequency signals, which are then amplified to sufficient power by PA (power amplifier up to 400W), and then emitted by the antenna.
- The transistors in 5G circuits get smaller and smaller, which leads to higher leakage current and power loss. The leakage current of the chip will change with the temperature. When the chip temperature increases, the static power consumption will increase exponentially, and the leakage interference of influenza magnetic leakage will increase.
- Therefore, the introduction of advanced thermal absorption technology to ensure that the base station work in a reasonable temperature range, can greatly reduce the power consumption and electromagnetic leakage of the base station.

Application fields



Application selection

Product application selection guide(version2.0)

★★★	Particularly recommended	u.e.: Assessment of
★★	recommended	Recommended to use in combination with shielding materials
★	Apply	Recommended to use in combination with thermal management materials

Product categories		Induction field driving material		Near field EMI/RFI countermeasure material						Far field absorbing material				Multi-functional integrated solution		
Application spectrum		KHz ~ 15MHz		15MHz ~ 1GHz			Sub 6GHz			1 ~ 4GHz	4 ~ 8GHz	8 ~ 12GHz	12 ~ 40GHz	Broad spectrum acting materials		
Application field	material type	E180	C40	FR180	S220	S260	E50/110/150	FR70/110/150	T70/90/150	MS-LS	MS-C	MS-X	MS-K	TA10	TA20	TA30
Mobile phone	CPU Noise countermeasures	★★	★	★★	★★	★★	★★	★★	★★★	u.e.						
	OLED IC EMS defense	★★	★	★	★★★	★★	★★★	★	★★							
	CCD Noise countermeasures	★★	★	★	★	★	★★★	★★	★★							
	TYPE C interference cleared	★		★	★	★	★	★★★	★★							
	Improved communication stability	★	★★	★	★	★	★	★								
	Original handwriting electromagnetic screen application	★★★		★	★★	★	★	★	★★							
Notebook	CPU Noise countermeasures	★	★	★	★	★	★★★	★★	★							
	GPU Noise countermeasures	★★		★★	★★	★★★	★	★★	★							
	DDR Noise countermeasures	★		★	★	★	★★	★★★	★★							
	USB 3.0 Interfere with the lift	★		★	★	★	★★	★★★	★★							
	SSD Noise countermeasures	★		★	★	★	★★	★★★	★★							
	LCM Noise countermeasures	★		★★★	★	★	★★	★	★							
	Write electromagnetic panel in original handwriting	★★★		★	★	★	★★	★	★							
	Noise elimination in shield	★★		★	★★★	★	★★	★★★	★★							
Light module	Laser emitting module harmonic elimination										u.e.					
	PCB/FPC Noise countermeasures				★★★		★★		★★				★★		★★★	
Security equipment	Communication module RFI countermeasures										★★			★★★		
	PCB/FPC Noise				★★★		★★									

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