

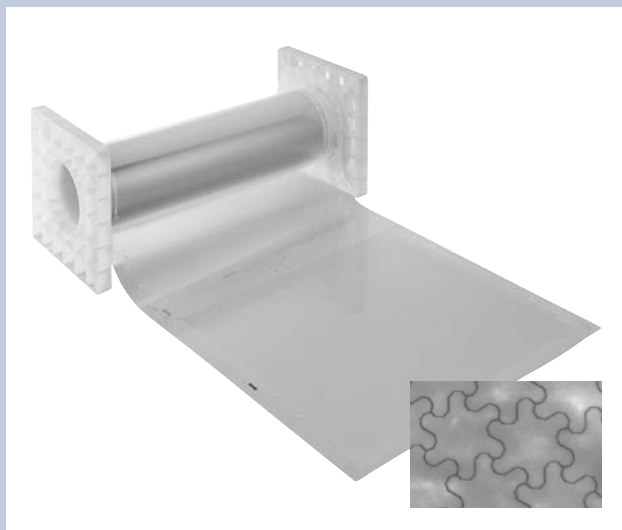
Transparent conductive film
Transparent Electromagnetic Wave Shield
Roll Type (with OCA)

Product Catalog

**IN Your
Future**

Roll type (with OCA)

Advanced EMC Solutions in Transparent Applications. Enabling efficient noise suppression with reduced component count and simplified integration



FEATURES

- High Transparency with Outstanding EMI Shielding Effective across a broad frequency range
- Ultra-Fine Copper Mesh Patterning Achieved with our proprietary microfabrication technology
- Pre-Applied OCA (Optical Clear Adhesive) Ensures convenient and clean installation
- Thin, Lightweight, and Flexible Film Format Maximizes design freedom and integration flexibility

MAIN APPLICATION

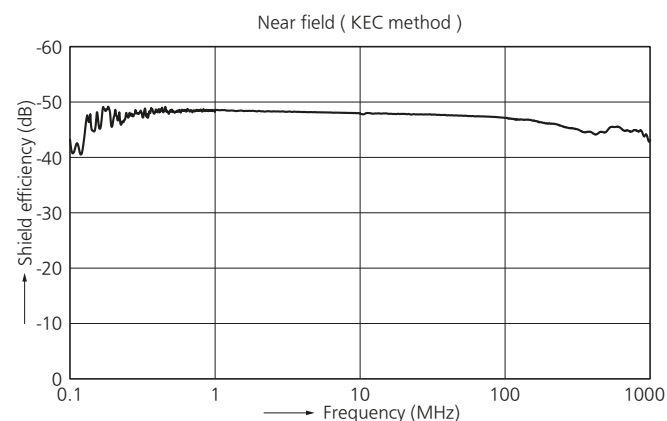
- Noise Shielding
 - Display / Monitor
 - Industrial Machinery, etc.
- Radio wave environment setup
 - RFID (restriction of radio wave area)
 - Wi-Fi (anti-interference) , etc.

DETAILED FEATURES

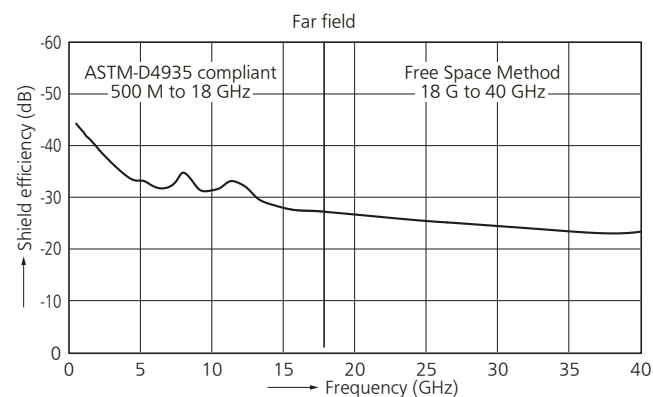
■ High Transparency Meets Broad-Spectrum EMI Shielding

Achieves both exceptional optical clarity and high electromagnetic shielding across wide frequency bands.

1. KEC method (100 k to 1 GHz) *



2. Coaxial tube method ASTM-D4935 compliant (500 M to 18 GHz) / Free space method (18 G to 40 GHz) *



*Data are for reference only and are not guaranteed.

Transparent conductive film Transparent Electromagnetic Wave Shielding

■ Proprietary Ultra-Fine Copper Mesh Technology

- Provides stable EMI shielding over a broad frequency range by
 - Copper lines: 2.4 μm width, 85 μm pitch on average*¹
 - Delivers low sheet resistance: Max. 2.6 $\Omega/\text{sq.}$ *²

*1: Typical values.

*2: Measured using 4-point probe method.

● Reduced Optical diffraction

By employing a unique mesh pattern, our design minimizes visual scatter and moiré, addressing a common drawback of conventional grid-type metal meshes.

PART NUMBER

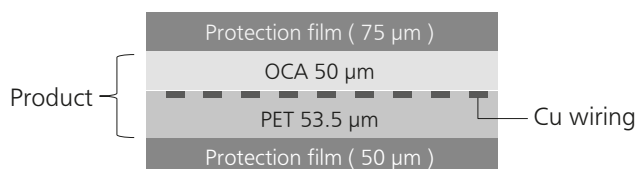
1	2	3	4	5	6	7	8	9	10	11	12
E	M	A	0	6	0	0	0	0	3	B	0

SPECIFICATIONS

This product is a transparent conductive film for Transparent electromagnetic wave shielding.

■ Stack up

Please remove the protective film on both sides before use.



■ Performance

Item		Details	
Film substrate		PET (Polyethylene Terephthalate)	
Reference dimensions (1 sheet)	External shape	558.9 mm: MD (Machine Direction) 620.0 mm: TD (Transverse Direction)	
	Pattern area	477.3 mm: MD (Machine Direction) 531.5 mm: TD (Transverse Direction)	
Thickness (Reference Dimensions)		103.5 μm (excluding protection film) (Representative value) * ¹	
Wiring	Material	Copper	
	Wiring Width	2.4 μm (Representative value) * ¹	
	Average inter-wire pitch	85 μm (Representative value) * ¹	
Reference mass (weight)		92.5 g (External 1 sheet, Protective film is not included)	
Reference Characteristics	Total light transmission	Min. 80 %* ¹ , * ²	Light source irradiated from OCA side (ISO13468-1)
	Sheet resistance	Max. 2.6 $\Omega/\text{sq.}$ * ¹ , * ²	Probe Diameter: 20 mm Measurement Method: High-Frequency Eddy Current Method
Recommended Operating Conditions	Electromagnetic Wave Frequency Range	100 kHz to 40 GHz Near Field: 100 k to 1 GHz Far Field: 500 M to 40 GHz	
	Operating Temperature Range* ¹	−20 to +50 °C (Normal humidity, normal pressure, and no condensation)	
Quantity/Carton		128 Sheets (72 m) / 1 Roll	

Notes) 1: The unit of order must be the number of packaging boxes.

If you would like to cut the film or order less than the number of packaging boxes, please contact our sales representative.

2: Before using the product, please refer to "Precautions for Use of Transparent Electromagnetic Wave Shield" and "Requests to customers."

3: When using the product at temperatures and humidity other than the operating conditions, please check and evaluate the conditions of use for your company products.

4: The standard temperature and humidity for each characteristic measurement are normal temperature and normal humidity (Temperature +5 to +35 °C, humidity 45 to 85 % RH).

However, if the measurement result is questionable or if reproducibility is required, the test should be conducted in an environment where the product is left at +23 $\pm$ 5 °C and 65 $\pm$ 10 % RH for at least 24 hours.

5: Specifications for the appearance of the films shall be agreed separately.

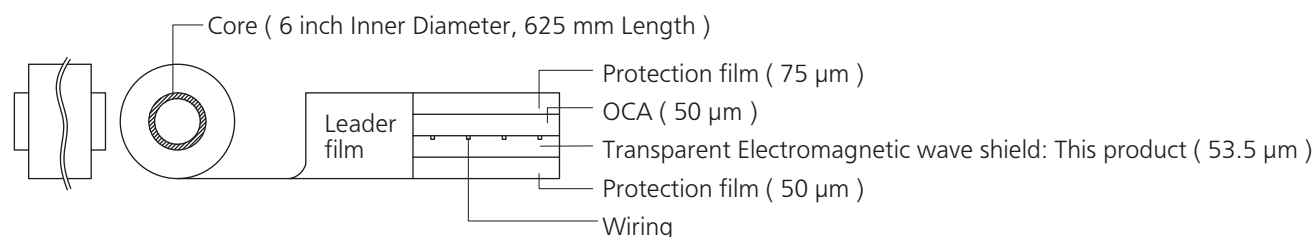
*1: These are not standard or guaranteed values.

*2: For details, contact your our company sales representative.

Transparent conductive film Transparent Electromagnetic Wave Shielding

DIMENSIONS (Unit: mm)

■ Product structure overview

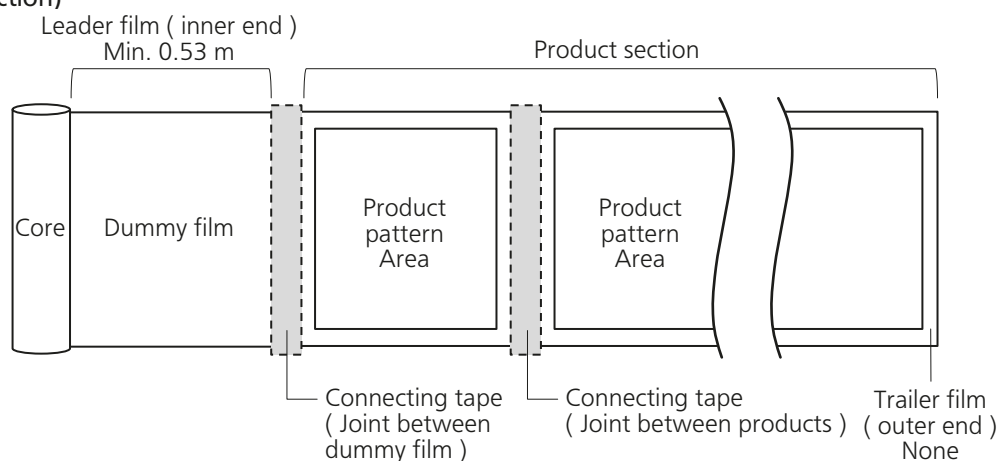


● Leader Film (Extra Length Section)

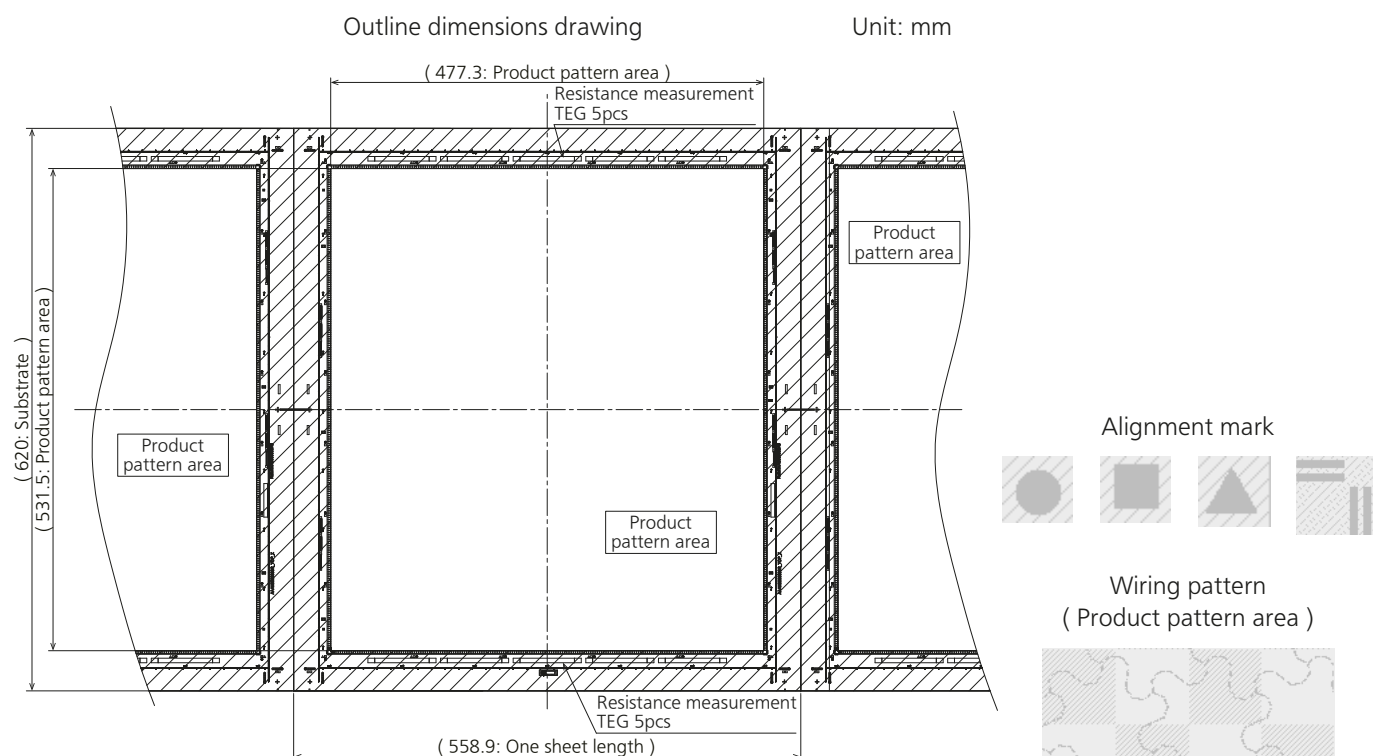
- Inner end: Min. 0.53 m
(Dummy area is
made as X)
- Outside end: None

Note)

A dummy film is connected to the product section with tape at the inner roll leader. Indentations or steps caused by the taped joint are not considered defects. When removing the tape, please take careful not to peel off the protective film.



■ Product pattern area



Notes) 1: The OCA (Optical Clear Adhesive) side is the surface where the part number " EMA0600003B0 " is clearly visible in the margin.

2: A margin area exists between each sheet.

Please refer to the CAD data to confirm the position of alignment marks during processing.

3: Curling of the film is not considered a defect.

4: The electrode color differs depending on the viewing side:

- OCA side: Copper
- PET side: Gray

$$\text{Average pitch} = \frac{a \text{ (the widest pitch)} + b \text{ (the narrowest pitch)}}{2}$$

Transparent conductive film Transparent Electromagnetic Wave Shielding

REFERENCE DATA

Reference data. This is not a guaranteed value.

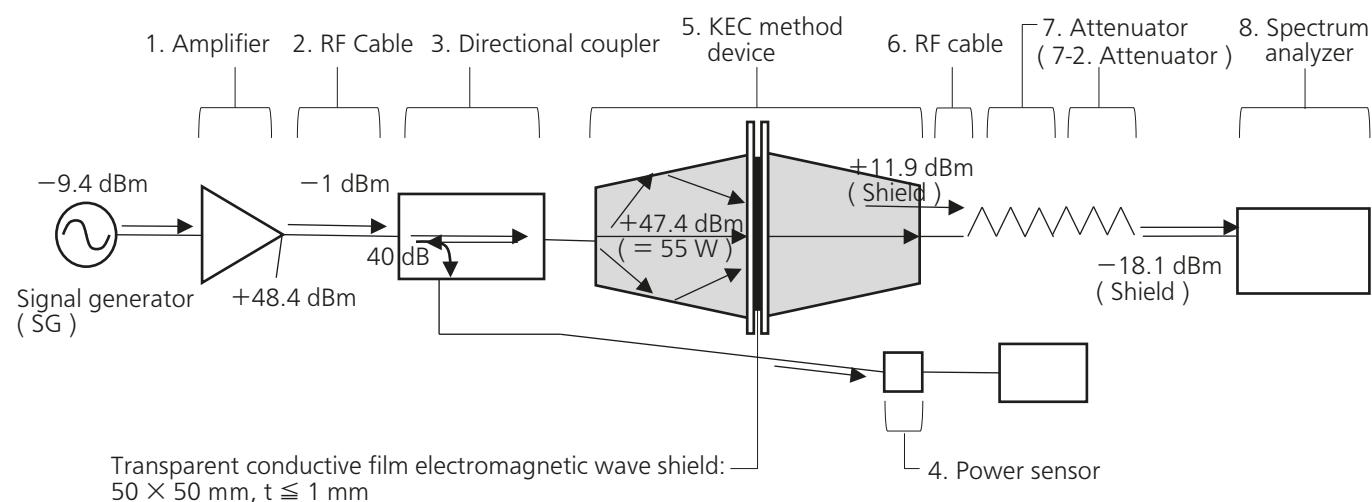
■ OCA characteristics

	Adhesion surface	Adhered duration	Measurement result [N/25 mm]	Test setup and measurement method
Adhesive force [N/25 mm]	Glass	1 minute	12.3	• Test sample stack up is OCA with PET#25 as substrate. • Test condition is referring to JIS Z 1528 • Adhered by rolling once with 2 Kg Rubber roller • Adhered to Glass and PET material • 180° peel/peel off speed: 300 mm/min • Bonding temperature: +23 °C 50 %RH • Measurement temperature: +23 °C 50 %RH
		24 hour	14.6	
	PET	1 minute	11.3	
		24 hour	12.7	

■ Power resistance evaluation

● Evaluation equipment setup

Purpose: Measuring power resistance by electromagnetic wave irradiation under ideal environment



1. Amplifier [NA1GF6G200]

Gain: +56.0 dB (min.)
Pout: 200 W (typ.),
150 W (min.) @P3dB/CW
100 W (min.) @P1dB/CW
Pin Resistance: +3.0 dBm (max.)
Pout Resistance: When the output reflected power exceeds 60 W, protection is applied.

2. RF Cable

SUCOFLEX_106 (3 m)
Loss value Approx. 1 dB (Spec: 0.328 dB/1 m @4 GHz)

3. Directional coupler [C10761R-727]

1000 to 6000 MHz 600 W 40 dB
Connector Shape
RF_IN: 7/16 (m) *
RF_OUT: 7/16 (f) *
FWD,REV: N (f)
*N conversion is used

4. Power sensor [NRP6A]

Average power sen
8 k to 6 GHz
100 pW to 200 mW
(-70 dBm to +23 dBm)

5. KEC method device

6. RF cable

SUCOFLEX_106 (3 m or 5 m product)
Spec: 0.328 dB/1 m @4 GHz

7. Attenuator: 20 dB, 100 W

7-2. Attenuator: 10 dB, 10 W

8. Spectrum analyzer [ESCI]

Pin Resistance: 30 dBm

● Evaluation conditions

- Evaluation device: KEC method device
- Electromagnetic wave frequency: 2.5 GHz
- Irradiation power: 55 W
- Irradiation time: 1 hour

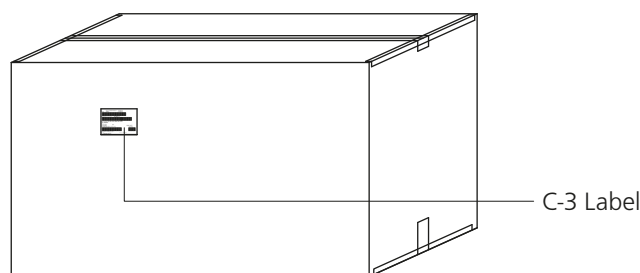
● Evaluation results

	Sheet resistance value (Ω /sq.)	Effect on fine wiring
Irradiation from substrate side	1.0	No effect
Irradiation from OCA side	1.0	No effect

Resistance value and fine wiring are not affected.

PACKAGING SPECIFICATIONS

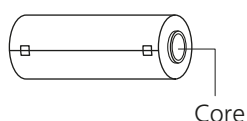
■ Exterior packaging Box



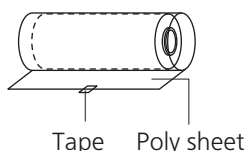
Note) For details on labels, please refer to "Label Specifications."

■ Inner Roll Packaging

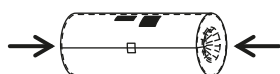
1) Fixing sheet with tape



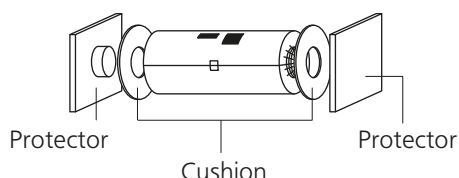
2) Covering entire roll with poly sheet and fixing it with tape.



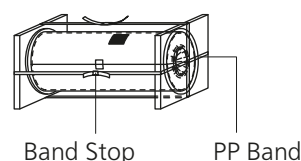
3) Folding both end of the wound poly sheet into the core.
Affixing labels onto the poly sheet.



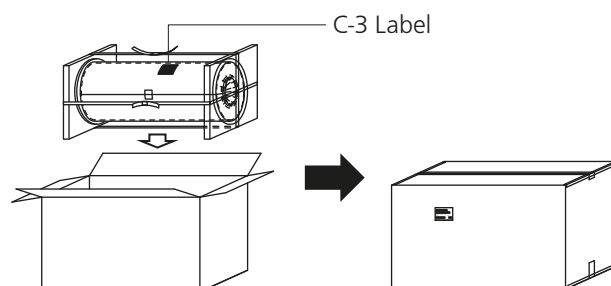
4) Placing cushions in between both ends of the roll and protector.



5) Tying up the roll with two pieces of PP band and fixing with band stop.



6) Store the roll in the packaging box and seal it.



Notes) 1: After opening the package, please repack and store it in accordance with the specifications.
2: To enhance the reliability of the product for actual use, please check the quality of the product in actual use.
3: Please be care not to scratch the product with a blade.
4: Do not place the product or roll directly on the floor or table etc.
5: For details on labels, please refer to "Label Specifications."

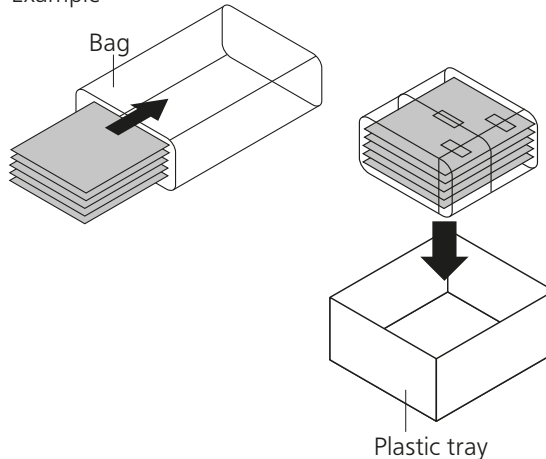
■ Individual Packaging for sheet condition products.

When you package this product individually, please check its performance before using.
Please store the product away from humidity, sulfide gas, external load, in order to maintain the product quality.

● Recommendation for packing material.

- Please use a bag such as PE. If the product is directly packed in cardboard, corrosion might occur due to sulfate from the cartonboard.
- Please use a plastic tray to protect the sheet from bending.

Example

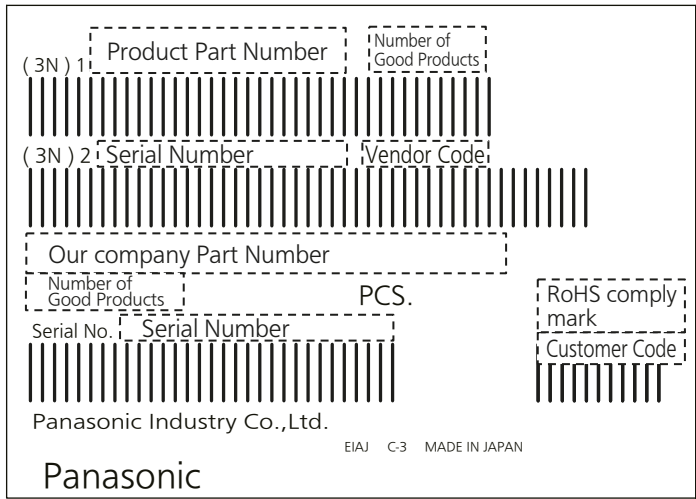


Transparent conductive film Transparent Electromagnetic Wave Shielding

Label specifications

C-3 Label

Affixing to the exterior (packaging box) and interior (roll packaging) 1 piece each. Please refer to the " Packaging Specifications " for the affixed areas.



Example) Serial Number
Label Issued date: August 1, 2025

T 5 8 0 1 E 0 0 0 0 1

Serial Number *
Printing machine number
Label Issued: Day
Label Issued: Month
Month 1 to 9: Month
Month 10 to 12:
0: October, N: November, D: December
Label issue date: Last one
digit of the year
Base code

Note) Please refer to " Precautions for Use of Transparent Electromagnetic Wave Shield " for identifying NG products.

* The serial number differs between the exterior package (outer box) and interior package (roll packaging) .

PRECAUTIONS

Before using the product, please refer to " Precautions for Use of Transparent Electromagnetic Wave Shield " and " Requests to customers. "

Precautions for Use of Transparent Electromagnetic Wave Shield

USE OF THIS PRODUCT

This product is a transparent conductive film for Transparent electromagnetic wave shielding purpose.

This product is designed and manufactured for general electronic equipment.
When considering the use of this product in applications where higher reliability and safety are required, such as where a failure or malfunction of this product could harm human life or property, it is necessary to exchange agreement on specifications for the application.

Regardless of the application, when the product is to be used in equipment that requires high safety, be sure to install protective circuits or redundant circuits to ensure the safety of the equipment and conduct safety tests.

PRECAUTIONS FOR USE

■ **This product is designed for indoor use of Transparent electromagnetic wave shielding.**
Please note that performance cannot be guaranteed in the following situations.

- 1) Since there is a risk of fire, please use after carefully evaluating the degree of heat generation by the power of the irradiated radio wave.
Also, do not use this product in a microwave oven as a home appliance.
(Reference Data: Power Resistance Evaluation)
- 2) Even in the indoor environment described in this specification, if the product is used in a place with high concentration of corrosive gas, or in extremely high temperature and humidity, or if the product is used in water, malfunction may occur.
Discoloration such as cloudiness or discoloration may occur.
- 3) Do not use the product outdoors or in an environment exposed to sunlight even indoors.
Discoloration such as cloudiness or discoloration may occur.

HANDLING

- 1) In consideration of the critical importance of transparency as a functional attribute of the Product, the handling of the Product shall be conducted in a manner that prevents the adhesion of fingerprints, stains, or other contaminants. To this end, personnel shall cleanse their hands prior to handling and shall wear finger cots, gloves, masks, and other appropriate protective equipment. The Product shall be handled exclusively by non-patterned areas to avoid damage or contamination.
- 2) We recommend processing this product in a clean room.
- 3) During implementation, assembly, or any other handling procedures, care shall be taken to avoid the application of excessive mechanical stress to the Product.
- 4) When removing the protective film, appropriate electrostatic discharge (ESD) countermeasures, such as the use of ionizers, shall be employed to mitigate the risk of electrical disconnection. The removal speed of the protective film shall not exceed 10 cm/sec, corresponding to a surface charge of approximately 400–600 V. Furthermore, care shall be taken to avoid folding or applying undue stress to the film during removal.
- 5) During transportation and storage, the Product shall be protected from impact, abrasion, and other physical damage. Particular caution shall be exercised during transport in rainy conditions to prevent exposure to moisture.
- 6) Condensation on the Product may result in degradation of performance; therefore, appropriate environmental controls shall be maintained.
- 7) The Product shall not be cleaned using solvents or similar chemical agents. Cleaning with such substances may adversely affect the characteristics of the Product, and no warranty shall be provided for any resulting defects. In cases where the substrate is exposed and contact such as cleaning is anticipated, the Customer shall verify abrasion resistance and hardness under its own usage conditions.
- 8) Depending on the cutting method employed, there exists a potential risk of pattern or OCA (Optical Clear Adhesive) delamination from the edge surfaces. Accordingly, it is strongly recommended that the Customer conduct prior validation of process conditions.
- 9) It is recommended that the cut edges of the Product be sealed following the cutting process. In rare cases, discoloration may occur around the cut edge area.
- 10) The Product may exhibit defects depending on the materials to which it is laminated. The Customer shall evaluate the compatibility between the Product and the assembly components, including reliability testing, under post-lamination conditions prior to use.

Precautions for Use of Transparent Electromagnetic Wave Shield

- 11) When applying the Product to curved surfaces, usage shall be limited to surfaces with a curvature radius of R30 or greater and within a bending angle of 90°. If the edge of the Product is positioned near a curved surface, there is a risk of delamination. Sufficient validation shall be conducted prior to use. The Product shall not be used in areas subject to repeated bending stress.
- 12) The Product is not designed for application to three-dimensional curved surfaces. Application to such surfaces may result in wrinkling, disconnection, or other defects.
- 13) The Product incorporates adhesive materials that do not support repositioning. Reapplication is strictly prohibited. Additionally, the OCA (Optical Clear Adhesive) layer shall not be removed under any circumstances.

STORAGE

■ Store the film in the following environments and conditions.

- 1) The Product shall not be stored in environments containing corrosive gases, including but not limited to sea breeze, chlorine (Cl_2), hydrogen sulfide (H_2S), ammonia (NH_3), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).
- 2) The Product shall not be stored in locations subject to direct sunlight or prolonged exposure to ultraviolet radiation.
- 3) The Product shall be stored in its original packaging, without the application of mechanical stress, and must be wrapped in a polyethylene sheet to prevent contamination or damage.
- 4) The Company has verified that, under storage conditions of 0 to +35 °C and relative humidity 50 % or less, the sheet resistance values of the Product remain within specified parameters. Based on this evaluation, the Customer is advised to consider appropriate storage conditions accordingly.
- 5) To prevent misalignment or deformation of the film roll, the Product shall not be stored in a vertical orientation.

■ Storage guarantee period

The warranty period shall be one (1) year from the date of shipment (i.e., the date of outgoing inspection) , provided that the storage conditions specified in Clauses 1 through 5 above are strictly observed.

In the event that storage under conditions other than the aforementioned temperature and humidity is required, the Customer shall be solely responsible for conducting the necessary verification and evaluation prior to storage.

UNPACKING

- 1) Prior to unpacking, confirm the correct orientation (top and bottom) of the package.
The use of sharp instruments such as knives or cutters is strictly prohibited.
- 2) Carefully remove the Product from the corrugated cardboard container.
- 3) Remove any bands, protectors, or other securing materials from the Product.
- 4) Remove the Product from the polyethylene sheet in which it is wrapped.

● Precautions

Care shall be taken to ensure that no damage is inflicted upon the product by sharp instruments or other objects that may cause scratching or surface defects.

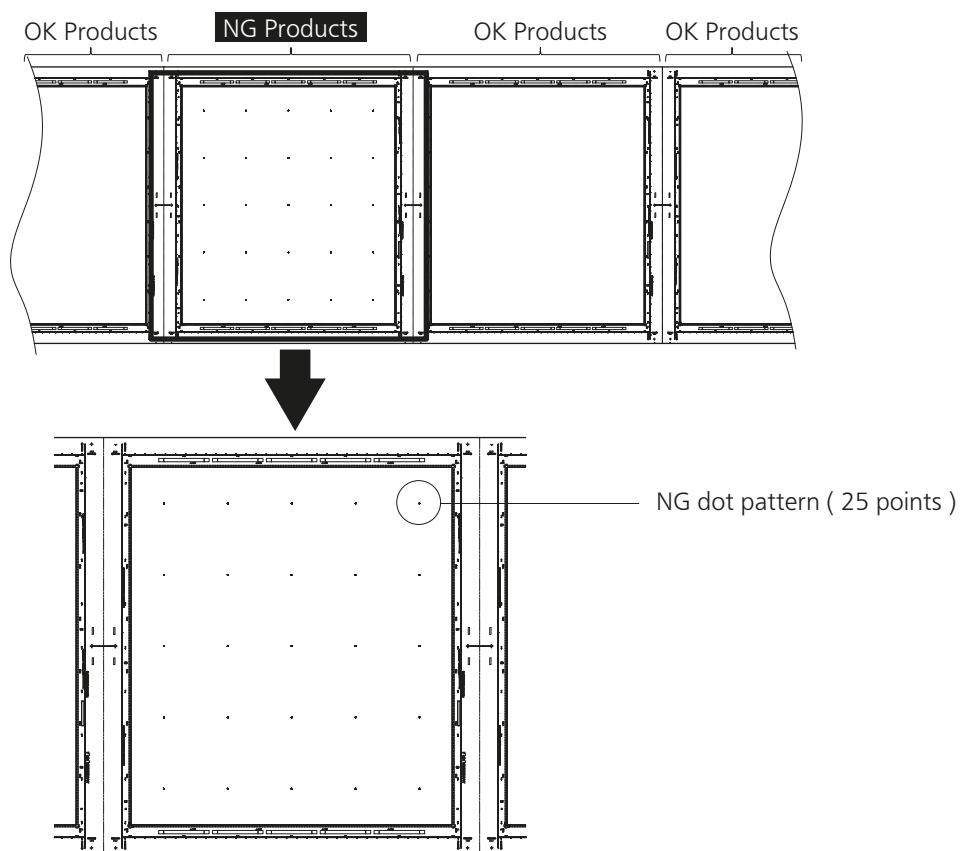
The Product shall not be placed directly onto any surface after removal from its packaging. Appropriate protective measures shall be taken to prevent contamination or physical damage.

Precautions for Use of Transparent Electromagnetic Wave Shield

IDENTIFICATION OF NG PRODUCTS

NG products are indicated with ink dots as shown below.

Not be used for the intended application. Use of such non-conforming products is strictly prohibited.



Requests to customers

This section applies to " Transparent Electromagnetic Wave Shield. "

BASICS

■ Handling of the catalog

● Application of the catalog

This catalog document (including the contents published on the website and associated data) describes the quality and performance of the Product as a standalone item. It defines the scope and terms of warranty applicable solely to the Product in isolation, and such warranty shall be limited exclusively to the matters expressly stated herein.

● Changes to this catalog

Modifications to the design, materials, manufacturing methods, or other aspects of the Product or its use that relate to technical know-how or other intellectual property rights owned by the Panasonic Industry Co., Ltd. Electromechanical Control Business Division (hereinafter referred to as " the Company ") or its corporate group (including the Company, its parent company, subsidiaries, and affiliated entities) may be implemented without prior notice to the Customer.

Prior to conducting mass production design reviews or placing purchase orders for the Product, the Customer is advised to contact the Company to confirm that the information contained in this catalog document represents the most current version available.

SAFETY COMPLIANCE

While the Company endeavors to enhance the quality and reliability of the Product, it is acknowledged that electrical components and devices may fail with a certain probability, and their durability may vary depending on the operating environment and usage conditions. Accordingly, the following provisions shall be observed when using the Product:

- 1) Prior to use, the Customer shall conduct evaluation and verification of the Product under actual usage conditions and in its mounted state, in accordance with the intended application.
- 2) Continued use of the Product in a degraded condition—such as when the Product no longer meets the quality or performance standards specified in this catalog document—may result in insulation breakdown, abnormal heat generation, smoke emission, or fire. In the event of performance degradation, use of the Product shall be discontinued immediately.
- 3) To prevent personal injury, fire, or other societal harm resulting from Product failure or end-of-life, the Customer shall implement appropriate safety measures, including but not limited to redundant design, flame-retardant design, and malfunction prevention design, and shall conduct safety testing accordingly.

Should any doubt arise regarding the safety of the Product, the Customer shall immediately cease use and promptly notify the Company.

LIMITATION OF USE

Our company classifies the use of its products as follows:

Standard use	This Product is intended for use in general-purpose applications such as computers, office automation equipment, communication devices, audiovisual equipment, consumer electronics, machine tools, personal devices, and industrial robots. This excludes components, devices, or systems requiring a high level of safety, or those used in such applications.
Special use	This Product is not intended for use in transportation equipment such as automobiles, trains, ships, or other vehicles; traffic signaling systems; security and disaster prevention devices; power generation or distribution equipment; various safety-related devices; or medical equipment, devices, or systems not directly intended for life support. Furthermore, the Product shall not be used in any other applications that, although not specifically designated, require a high level of safety due to the nature of their function or potential impact
Specific Use	This Product shall not be used in, or incorporated into, any of the following applications: Aircraft systems or equipment Aerospace systems or equipment Submarine communication systems Nuclear control systems Medical devices, equipment, or systems intended for life support Military devices, equipment, or systems Any applications that may be directly or indirectly associated with criminal activity Use of the Product in any of the above-mentioned applications is strictly prohibited.

This Product is intended to be used solely for standard applications and for the specific purposes described under " Applications " on the cover page of this catalog document (hereinafter referred to as the " Intended Use ") . The Product shall be used only within the scope of the specifications, requirements, instructions, environmental conditions, and other parameters set forth herein (collectively, the " Conditions ") .

Requests to customers

If the use of the Product is likely to fall under any of the following categories, the Company reserves the right to decline the provision of the Product. In such cases, the Customer shall consult with the Company in advance and enter into a written agreement regarding the applicable specifications, based on the intended use, Conditions, and the specific Product involved:

- 1) Use of the Product for any purpose other than the Intended Use.
- 2) Use of the Product for the Intended Use, but in violation of or without satisfying the Conditions, or under any conditions not specified in this specification document, or where such use is reasonably suspected.

ACCEPTANCE INSPECTION

Upon delivery of the Product, the Customer shall promptly conduct an incoming inspection.

Prior to or during such inspection, the handling and storage of the Product shall be conducted in accordance with the storage conditions specified in this catalog, and in compliance with the duty of care of a prudent manager.

WARRANTY PERIOD

The warranty period for this Product shall be one (1) year from the date of shipment.

Matters relating to replacement parts and end-of-production support are excluded from the scope of this catalog document and shall be subject to separate consultation.

If the Customer fails to provide the Company with written notice, within the warranty period, substantiated by reasonable grounds, that the Product does not conform to the specifications set forth in this catalog, the Company shall bear no liability whatsoever in relation to the Product.

SCOPE OF WARRANTY

■ Description of Warranty

In the event that the Product fails to conform to the usage specifications set forth in this catalog (hereinafter referred to as a " Nonconformity ") , and such Nonconformity is attributable to the Company, the Company shall, at its sole discretion, fulfill its warranty obligations under this catalog by either:

- 1) Providing, free of charge, replacement units in a quantity equal to that of the nonconforming Product; or
- 2) Refunding the purchase price of the nonconforming Product.

■ Exceptions to Warranty

Notwithstanding any other provisions of this catalog or any other agreement, the Company shall bear no liability whatsoever for any Nonconformity or damage arising from or in connection with any of the following circumstances, or in the event the Product is resold, transferred, or otherwise disposed of to any third party other than the Customer:

- 1) Use of the Product in accordance with instructions or specifications provided by any party other than the Company.
- 2) Any modification, alteration, or repair of the Product's structure, performance, or specifications conducted after shipment by the Company.
- 3) Events that could not have been foreseen using technologies available at the time of shipment.
- 4) Use, storage, or handling of the Product that does not comply with, or violates, the Conditions, including but not limited to: Use under conditions not specified in this specification document.
- 5) Continued use of the Product despite knowledge or reasonable awareness of performance degradation.
- 6) Failure to implement appropriate safety designs, such as redundant systems, flame-retardant measures, or malfunction prevention mechanisms.
- 7) Events arising from other products into which the Product is incorporated, or resulting from such incorporation.
- 8) Events arising from other materials, components, circuits, devices, or software combined with the Product, or resulting from such combinations.
- 9) Acts of God or other force majeure events.
- 10) Use of the Product for any purpose other than the Intended Use.
- 11) Any other cause not attributable to the Company.

Requests to customers

■ Non-Warranty Regarding Conformity, etc.

Notwithstanding the provisions set forth under "Warranty Coverage" and "Warranty Exclusions," the Company makes no warranties whatsoever with respect to any matters not expressly stated in this catalog. Accordingly, the Customer shall bear sole responsibility for determining the suitability of the Product for its intended use, including but not limited to the following:

1) In cases where the Product is incorporated into or used in combination with other products:

- (i) Compatibility with such other products;
- (ii) Operational functionality;
- (iii) Non-infringement of third-party intellectual property rights.

2) Compliance with applicable laws and regulations.

3) Conformity with various standards and certifications.

■ Scope of Warranty

1) The Company's warranty obligations in relation to any Nonconformity shall be limited exclusively to its direct contractual counterparty (including, in the case of sales through distributors or agents, such distributors or agents) . The Company shall bear warranty responsibility only in accordance with the terms of its agreement with said counterparty. Absent a separate written agreement regarding warranty obligations, the Company shall not be liable for any warranty claims made by any party other than its direct contractual counterparty under this catalog.

2) In the event that the Company is held liable for any damages arising from a Nonconformity, regardless of the legal basis of such claim, the scope of the Company's liability shall be limited to direct and actual damages incurred by its direct contractual counterparty. The total amount of the Company's liability, including warranty obligations as set forth under "Warranty Coverage," shall not exceed the amount paid by the direct contractual counterparty to the Company for the relevant Product.

OTHER MATTERS

■ Intellectual Property Matters

The technical information contained in this catalog, including representative characteristics of the Product and example application circuits, is provided for reference purposes only. Such information shall not be construed as granting any license or rights under any intellectual property owned by the Company, its affiliated entities, or any third party.

Accordingly, the Company shall bear no liability for any issues arising in connection with third-party intellectual property rights resulting from the use of the aforementioned technical information.

■ Handling of Information

Any specification documents, technical materials, evaluation results, samples, or other information provided by the Company to the Customer in connection with the Product shall constitute the Company's confidential information. Such information shall not be used for any purpose other than the use of the Product, and shall not be disclosed or provided to any third party without the Company's prior written consent.

■ Governing Law and Dispute Resolution

This catalog shall be governed by and construed in accordance with the laws of Japan.

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