

3M™ XYZ / Isotropic Electrically Conductive Adhesive Transfer Tape 9709S / 9709 SL

Product Description

3M™ Electrically Conductive Adhesive Transfer Tape 9709S is a pressure sensitive adhesive (PSA) transfer tape with isotropic electrical conductivity. The PSA matrix is filled with conductive fillers which allow interconnection between substrates through the adhesive thickness (the “Z-axis”) and also provides electrical conductivity in the plane of the adhesive (“X-Y Axis”). The PSA tack and adhesion properties allow for room temperature application and assembly processes. Tape 9709S has inherent EMI shielding capability.

Tape 9709S provides an electrical connection and adhesively bonds EMI/RFI shields and gaskets to metal frames and enclosures. The low contact resistance and tape construction result in good EMI performance. Tape 9709S can be applied as die cut parts or in roll form.

Tape 9709S offers good XYZ electrical conductivity performance with good adhesion. As Tape 9709S has inherent EMI shielding performance, it can enhance existing shielding solutions, offer new design options and improve Faraday cage designs.

Tape 9709S can offer lower contact resistance to “hard surfaces” or surfaces with oxide layers, such as to stainless steel as compared to the Tape 9709. As each application is unique, it is important for users of the Tape 9709S to evaluate which will work best given their product design. In some designs, Tape 9709 may perform effectively equivalently to Tape 9709S in EMI shielding as a final design is electromagnetic interference compatibility (EMC) tested as a completed assembly.

3M™ Electrically Conductive Adhesive Transfer Tape 9709SL is a premium low release liner version of Tape 9709S. The Tape 9709S standard release liners (PET/PET) offer good release properties from many common surfaces. In applications where very low liner release is desired, the Tape 9709SL version offers a set of premium low release liners (PET/PCK Paper).

As in all conductive PSA applications, stable electrical performance in any electrical connection application may require added mechanical reinforcement (clamping or compressing) in the bond area.

Construction

Property	Value
Adhesive Type	Filled Acrylic Pressure Sensitive
Release Liner	
Tape 9709S	Std PET/PET Liners
Tape 9709SL	Premium Low Release PET/PCK Paper Liner
Approximate Thickness	
Adhesive	2 mil (50 µm)
Tape 9709S Liner(s)	2 mil (50 µm) / 1.5 mil (35 µm)
Tape 9709SL Premium	2 mil (50 µm) PET /
Low Release Liner(s)	4 mil (100 µm) PCK Paper
Note: Tapes 9709S and 9709SL:	Tight Side / Easy Side Release



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Typical Physical Properties and Performance Characteristics

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Adhesive Properties:

Peel Adhesion to Stainless Steel: (Test Method is based on a modified ASTM D3330, 12 ipm peel rate, 1 in. width, 2 mil PET backing, 180 degree)		
Dwell Time @ Room Temperature 23°C	1 Hour 29 oz./in. (3.2 N/cm)	24 Hours 32 oz./in. (3.5 N/cm)
Note: Peel values will often be higher than noted above when using a non-PET backing. Different backing types effect the backing modulus, thickness and stiffness and these differences directly effect the peel test result value. As an example, a 2 mil aluminum backing will change the test value of the peel adhesion as the peel back angle at the interface will change due to the backing stiffness. A 2 mil aluminum backing would generally increase the peel values.		
Temperature Performance ¹	Application Use Temperatures: -40 to +85°C Varies with application design. See Note 1. See also the Application section of this document	
Shelf Life and Storage	Tape in roll form: Shelf life 24 months from the date of manufacture when stored in original cartons at 21°C (70°F) and 50% relative humidity.	

Electrical Properties:

Current Carrying Capacity ³	Estimated: 1.0 Amps/in ²
Z-Axis Resistance @ 1 Hr dwell, 2mm x 5mm contact area ^{1,2,4,5}	<0.5 ohms
Minimum Overlap Area	Application dependent

Thermal Performance:

Apparent Thermal Conductivity	0.6 - 0.7 W/mk
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- Application use temperature range of the 3M™ XYZ/Isotropic Electrically Conductive Adhesive Transfer Tape 9709S and 9709SL may be increased or have improved reliability with the use of a mechanical clamping system as determined by the end use customer. The temperature use range is dictated by two primary items: Temperature performance of the acrylic adhesive (generally in the range of -40°C to about 95°C depending on other environmental conditions) as it supports the conductive particles in the adhesive/particle matrix and the potential movement of the conductive fillers in the adhesive system in an end use application design. Items contributing to the good performance of the Tape 9709S and 9709SL for resistance level performance include, but are not limited to: assembled bond line force (constant force present across the bond line after assembly and over the life of the product), types of substrates bonding, surface features in bonded area, etc. (See section on mechanical clamping for added information).
- Two wire resistance measurement (a 4 wire test would generally be lower). The Z axis test uses a test PCB with gold traces or pads that are 2mm wide. The ECATT tape is laminated to a polyimide or PET flex with a gold plating. The ECATT is laminated to the flex to cover about 50% of the flex surface. The flex/ECATT is bonded to the PCB gold pad and the opposite (non-ECATT end) is placed into contact with another gold PCB trace to make an electrical contact. Contact R is measured between the two PCB pads of the flex to infer a relative contact R of the ECATT product based on this test method and surfaces used.
- Estimated. Customers are required to qualify the maximum current capability for their application.
- Minimum suggested conductor overlap area (pad area) in the interconnection of individual circuit lines to ensure Z-Axis conduction must be optimized for each application and environmental and mechanical design conditions.
- Z & XY conductivity end use and testing results will vary based on many factors such as, but not limited to: End use design, environmental conditions, aging environment, test methods, interface material types & compatibility, product lot to lot & with-in lot variability, XY span, surface features & topography, area, surface preparation, etc.

Available Sizes

Slit Tape Width 1.0 to 12 inch (25 mm to 354 mm)	Standard Length 36 yds. (32.9 m)	Maximum Length 108 yds. (98.8 m)
Normal Slitting Tolerance	0.065 in. (0.8 mm)	

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Application Techniques

Bonding

- To obtain maximum adhesion, the bonding surfaces must be clean and dry.
- Pressure must be applied to the bond line after assembly to wet the substrates with 3M™ XYZ/Electrically Conductive Adhesive Transfer Tape 9709S and to engage the conductive particles with the substrates to make electrical connection. Mechanical pressure (roller, metal bar) or finger pressure at 5 to 15 psi (0.03 to 0.10 Mpa) is suggested at 20°C (68°F) to 25°C (77°F). The end user may find through testing that a higher pressure could be more effective in their end use design to meet their specific design criteria. Heat may be applied simultaneously to improve wetting and final bond strength. **See Note A.**
- Tape 9709S is suggested to be applied at a maximum temperature range not to exceed 60°F - 158°F (15°C - 70°C). Tape application below 50°F (10°C) is not suggested because the adhesive will be too firm to wet the surface of the substrate, resulting in low adhesion. **See Note A.**
- Adhesion builds with time, up to 24 to 72 hours may be required to reach final adhesion values.

Note A) Regarding the application of Temperature, Pressure and Time (T-P-T) during assembly and/or lamination: Care must be taken by the end user during assembly as the modulus of the tape will be reduced with the application of heat.

- An application method with ranges of not more than: 5-15 psi @ 15-70°C for 2-30 seconds is suggested as a set of initial evaluation ranges. An example of initial T-P-T that may be evaluated is: 8 psi applied via an assembly fixture using an air actuated pressure pad (pad is a medium firm elastomer) for 5 seconds @ 23°C. The end user may find assembly T-P-T outside these limits works well in their unique application. The noted T-P-T is a suggested starting point of tape bonding criteria and will be influenced by Tape 9709S part size, substrate types, substrate modulus, surface features, flatness, assembly fixtures, etc.
- Final bond strength and conductive performance will be impacted by how Temperature-Pressure-Time interact in an end use assembly method to the desired substrates.
- Care must be used to minimize excessive “Temperature-Pressure-Time” assembly methods as they are applied to the tape during assembly so that the conductive filler/acrylic adhesive matrix is not damaged leading to poor performance (ie: excessive squeeze-out of tape, filler-interface damage, minimize over compression and conductive filler/adhesive matrix damage.)
- A Design of Experiments (DOE) is suggested to establish the optimum bonding conditions for each application assembly.

Mechanical Clamping

To assure electrical resistance stability of Tape 9709S in any flexible circuit interconnection application, or grounding application between various types of substrates, a mechanical clamp or other compressive force (i.e. foam strip held in compression over bond area.) should be considered in the design of the application. Any stress inherent in the assembly design (i.e. tensile, shear, cleavage) or temperature excursions (encountered through normal product use) applied to the bond area could result in an electrical open in the bonded circuit over time when no clamp or mechanism for maintaining a constant compressive forces is used. A well designed mechanical clamp will reduce the environmental stress on the bond line and improve the electrical reliability of the bond. In addition, the temperature operating range for the adhesive can be improved with a properly designed mechanical clamping system to ensure the conducting particles in the Tape 9709S maintain electrical contact. Several types of mechanical clamps have been used successfully including foam strips attached to lids or cases and screw-attached plastic clamps. Contact your 3M Technical Service Engineer for further information about mechanical clamping.

Temperature Performance

The electrical performance of Tape 9709S is more sensitive to environmental changes than is the peel adhesion performance. Contact resistance performance may be compromised, even if holding power is not significantly affected. See note 1 in “Electrical Properties” section. The user is responsible for the environmental performance qualification of Tape 9709S in their design.

Rework

Mechanically separate the parts using torque (for rigid parts) and peel (for flexible parts). Remove the adhesive by rubbing it off with a Scotch-Brite™ Hand Pad, clean up the site, and apply new adhesive. The force needed to separate the parts and/or remove the adhesive can be reduced by softening the adhesive by heating 158°F - 212°F (70°C - 100°C) or using solvents.*

***Note:** When using solvents, be sure to follow the manufacturer’s precautions and directions for use when handling such materials.

3M™ XYZ / Isotropic Electrically Conductive Adhesive Transfer Tape 9709S / 9709SL

General Application Guide

3M has a broad line of Electrically Conductive Adhesive Transfer Tapes (9703, 9705, 9706, 9707, 9709, 9709S, 9709SL, 9712, 9713, 9719, 9723, 7805, 7810) that vary in conductive filler types, filler loading design, adhesive chemistry, storage modulus of the conductive tape, adhesion to various surface types, thickness, conformability, etc. The reason that 3M provides a variety of tape products is that the multiple products provide for a range of product attributes that allow end users more options to optimize grounding, EMI shielding and interconnect solutions.

As each end use application has many variables unique to the design, it is suggested that 2 or more products be tested in a Design of Experiments (DOE) to identify the best performing product for the application along with the optimum assembly means (pressure, time, temperature, assembly fixtures, etc.) and final design configuration for desired end use performance.

End use substrate surfaces will vary for many unique characteristics as will the final assembly design specification, design configuration, assembly methods and end use environmental conditions. For example:

- a) End use design substrates to be evaluated with the 3M™ Tapes will vary in surface energy that can impact the adhesion strength of the tape to the surfaces (Stainless Steel vs. Polyimide vs. Gold vs. Nickel plating, etc.).
- b) Substrate surface hardness and inherent conductivity can affect potential filler/surface contact resistance (Stainless Steel vs. Gold vs. Silver Epoxy Ink vs. plated surfaces, etc.)
- c) Modulus or flexibility of the substrates can affect substrate interaction with the 3M™ Tape and environmental aging performance (Rigid PCB vs. Flex circuit vs. Metals vs. substrate thickness)
- d) Contact area for grounding on a substrate can impact the effective contact resistance level achieved in a design (Total contact area [3mm², 25mm², 100mm², etc.] and discrete sizes of individual contact areas (3mm², 10mm², 30mm², etc))
- e) Substrate surface topography or surface features can impact how the tape can “gap fill or conform to irregularities” and provide adhesion and conductivity between substrates.
- f) Bond line stress in the form of a tensile, cleavage, compression and shear can all affect 3M™ Tape performance in an application (Rigid to Rigid substrates, Multi-layer Flex to Rigid, Thin Flex to Rigid, etc.).
- g) Method of assembly & size of finished parts can affect tape selection (ease of converting and assembly based on die cut part shape and final assembly)
- h) Desired contact resistance level. For example, various applications specification may indicate a contact R <100ohms or R < 10ohms or R <1.0ohms target. Each design has its own resistance specification, and within a design, each area can have a different resistance level need.
- i) Environmental conditions (minimum and maximum temperatures, cycling, humidity, etc.)
- j) Assembly methods affect on final performance of the tape with the given substrates (tooling, fixtures, assembly pressure-temperature-time)
- k) Final Assembly configuration: Inherent bond line compression, clamping, stand-alone assembly, etc.

The above end use application variables make it difficult to predict which 3M™ Tape may work “best” to a desired level of performance in an application. Thus, 3M has a broad and unique line of conductive tapes to provide a blend of performance characteristics to evaluate for each application.

3M™ XYZ / Isotropic Electrically Conductive Adhesive Transfer Tape 9709S / 9709SL

General Application Guide (continued)

Following are some general, basic, comparative tape attributes that might influence end use performance and suggest what products are potential options to be tested for an application:

Product: Adhesive Type, Thickness, Conductive Filler type, Conductivity attributes

3M™ Electrically Conductive Adhesive Transfer Tapes 9703 & 9705: Acrylic Adhesive Type 1A, 50um, Silver Coated Particles Type A, Z-Axis Design

- Tape 9703 is a lower out-gassing version of the Tape 9705. Tape 9703 is typically used in aerospace type applications or where lower out-gassing is a benefit. Tapes 9703/9705 are particle based products that can be evaluated for modest pitch type Z-axis (anisotropic) interconnection. Tape 9705 may provide good contact resistance to hard surfaces (Stainless Steel, Nickel plated surfaces) or medium soft surfaces (gold) for grounding of EMI shields.

3M™ Electrically Conductive Adhesive Transfer Tapes 9706: Acrylic Adhesive Type 1SS, 50um, Silver Coated Particles Type A, Z-Axis Design

- Tape 9706 is a more surface aggressive ECATT on many substrates which will allow a higher level of adhesion build as measured via a peel adhesion test method and as compared to the 3M™ Electrically Conductive Adhesive Transfer Tapes 9703 or 9705. As Tape 9706 is a more aggressive ECATT tape, it is generally not compatible with Indium Tin Oxide (ITO) coatings or other easily corroded surfaces. Tape 9706 is a particle based product that can be evaluated for modest pitch type z-axis (anisotropic) interconnection. Tape 9706 may provide good contact resistance to hard surfaces (stainless steel, nickel plated surfaces) or medium soft surfaces (gold) for grounding of EMI shields.

3M™ Electrically Conductive Adhesive Transfer Tape 9707: Acrylic Adhesive Type 1SS, 50um, Silver Coated Particles Type C, Z-Axis with variable path length XYZ plus inherent EMI Shielding

- Tape 9707 is a more surface aggressive ECATT on many substrates which will allow a higher level of adhesion build as measured via a peel adhesion test method as compared to the Tape 9709S. As Tape 9707 is a more aggressive ECATT tape, it is generally not compatible with Indium Oxide (ITO) coatings or other easily corroded surfaces. Tape 9707 is designed to have improved contact resistance vs. the Tape 9709 to hard surfaces, such as stainless steel. Tape 9707 has excellent inherent EMI shielding and also good contact resistance to soft surfaces (gold, etc.). The inherent EMI shielding of these products provide for improved EMI shields and shielding effectiveness in an end use design.

3M™ Electrically Conductive Adhesive Transfer Tape 9709: Acrylic Adhesive Type 2A, 50um, Silver Coated Particles Type B, Z-Axis with variable path length XYZ plus inherent EMI Shielding

- Tape 9709 works well on soft surfaces (gold to gold, certain plated surfaces, etc.), but will provide higher contact resistance levels on harder surfaces, such as stainless steel. The inherent EMI shielding of these products provide for improved EMI shields and shielding effectiveness in an end use design as compared to many other types of conductive adhesives tapes.

3M™ Electrically Conductive Adhesive Transfer Tapes 9709S and 9709SL: Acrylic Adhesive Type 2A, 50um, Silver Coated Particles Type C, Z-Axis with variable path length XYZ plus inherent EMI Shielding

- Tapes 9709S and 9709SL are similar with the exception of the release liners used. The Tape 9709SL has premium, low force release liners for applications that require very low liner release. Tapes 9709S/9709SL are designed to have improved contact resistance vs. the Tape 9709 to hard surfaces, such as stainless steel. Tapes 9709S/ 9709SL have excellent inherent EMI shielding and also good contact resistance to soft surfaces (gold, etc.). The inherent EMI shielding of these products provide for improved EMI shields and shielding effectiveness in an end use design. Tapes 9709S/9709SL can be used in a laminate format (Tape 9709S/metal layer/Tape 9709S) to bridge wider gaps or have very robust EMI shielding performance.

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General Application Guide (continued)

3M™ Electrically Conductive Adhesive Transfer Tapes 9712 and 9713: Acrylic Adhesive Type 3A, 75um to 100um, Carbon Scrim Type 1 or Nickel Plated Carbon Scrim Type 2, XYZ-Axis

- Tapes 9712 and 9713 use the same type 3A acrylic adhesive. The key differences are: Tape 9712 is slightly thicker than the Tape 9713 and uses a carbon scrim that generally leads to a higher surface contact resistance vs. the Tape 9713's Nickel plated carbon scrim (a more conductive scrim). As the Tape 9712 is thicker, adhesion can be higher. The Tapes 9712 and 9713 can provide good contact resistance to hard and soft surfaces. But in general, both Tapes 9712 and 9713 will have resistances that are somewhat higher than found with a particle based 3M tape. Tapes 9712 and 9713 also provide excellent die cutting and converting capability as the scrim adds to adhesive support and ease of use.

3M™ Electrically Conductive Adhesive Transfer Tape 9719: Silicone Adhesive Type 1S, 70um, Nickel Plated Carbon scrim Type 2, XYZ-Axis

- Tape 9719 is a silicone version of the Tape 9713 product. The benefits of the silicone based Tape 9719 are: Higher temperature performance, improved adhesion to very low surface energy materials vs. the Tape 9713 (such as silicone based EMI shielding gaskets, etc.)

3M™ Electrically Conductive Adhesive Transfer Tape 9723: Acrylic Adhesive Type 3SS, 55um, Nickel/Copper Plated PET Scrim, XYZ-Axis Design

- Tape 9723 is a more surface aggressive ECATT on many substrates which will allow a higher level of adhesion build as measured via a peel adhesion test method and as compared to the 3M™ Electrically Conductive Adhesive Transfer Tape 9713. As Tape 9723 is a more aggressive ECATT tape, it is generally not compatible with Indium Tin Oxide (ITO) coatings or other easily corroded surfaces. Tape 9723 is a conductive scrim based product that can be evaluated for EMI shielding and grounding. Tape 9723 may provide good contact resistance to hard surfaces (stainless steel, nickel plated surfaces) or medium soft surfaces (gold) for grounding of EMI shields.

3M™ Electrically Conductive Adhesive Transfer Tape 7805: Acrylic Adhesive Type 4A, 150um, Silver Coated Particles Type D, Z-Axis and XYZ.

- Tape 7805 has been designed to provide a thicker conductive tape. The increased Tape 7805 thickness is achieved through a unique particle concentration design that may allow good resistance levels in a thicker product. The added thickness allows improved conformability, bridging wider gaps, increased tolerance stack-up, etc. Tape 7805 has a degree of inherent EMI shielding that will depend on the end use design. Tape 7805 may work well on soft surfaces (gold to gold, certain plated surfaces, etc.), but will provide higher contact resistance on harder surfaces, such as stainless steel.

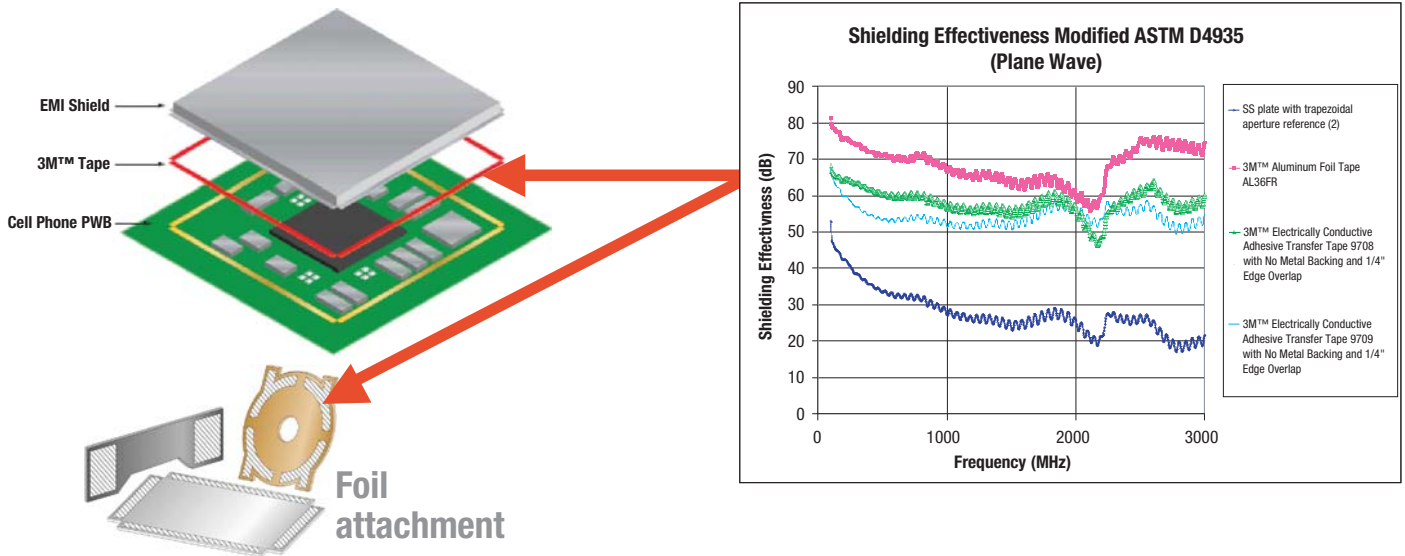
3M™ Electrically Conductive Adhesive Transfer Tape 7810: Acrylic Adhesive Type 5A, 150um, Nickel Coated Carbon Fibers Type F1, Z-Axis and XYZ.

- Tape 7810 has been designed to provide a thicker conductive tape. The increased Tape 7810 thickness is achieved through a unique particle concentration design that may allow good resistance levels in a thicker product. The added thickness allows improved conformability, bridging wider gaps, increased tolerance stack-up, etc. Tape 7810 has a degree of inherent EMI shielding that will depend on the end use design. Tape 7810 may work well on soft surfaces (gold to gold, certain plated surfaces, silver ink traces or contact pads, etc.).

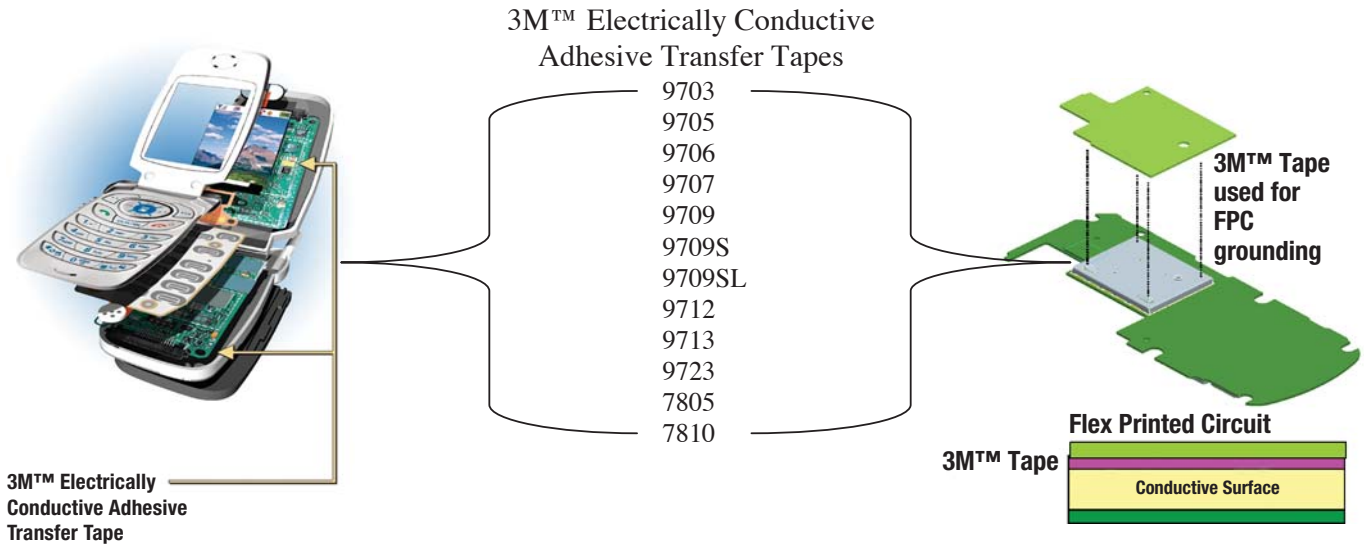
3M™ XYZ / Isotropic Electrically Conductive Adhesive Transfer Tape 9709S / 9709SL

3M™ Tape Application Benefits

3M™ Electrically Conductive Adhesive Transfer Tapes 9707, 9709, 9709S and 9709SL provide grounding and EMI Shielding through the bond line thickness leading to improved product EMI Shielding performance. 3M™ Electrically Conductive Adhesive Transfer Tapes 7805 and 7810 may provide EMI shielding in the bond line, but actual performance depends on the final design tape width.



3M™ Electrically Conductive Adhesive Transfer Tapes 9703, 9705, 9706, 9709, 9709S, 9709SL, 9712, 9713, 9723, 7805 and 7810 can provide FPC grounding and tapes 9707, 9709, 9709S, 9709SL, 7805 and 7810 can increase the effective EMI Shielding through the bond line thickness leading to improved product EMI Shielding performance of the FPC.



3M™ XYZ / Isotropic Electrically Conductive Adhesive Transfer Tape 9709S / 9709SL

Application Ideas

3M™ Electrically Conductive Adhesive Transfer Tape 9709S is ideal for EMI/RFI shield and gasket attachment applications, grounding application and larger Z-axis connections where Tape 9709S is die cut for each Z-axis connection. Applications include EMI shields for displays and gasket attachment to EMI/RFI cabinets and enclosures.

Certification/Recognition

MSDS: 3M has not prepared a MSDS for this product which is not subject to the MSDS requirements of the Occupational Safety and Health Administration's Hazard Communication Standard, 29 C.F.R. 1910.1200(b)(6)(v). When used under reasonable conditions or in accordance with the 3M directions for use, the product should not present a health and safety hazard. However, use or processing of the product in a manner not in accordance with the directions for use may affect its performance and present potential health and safety hazards.

TSCA: This product is defined as an article under the Toxic Substances Control Act and therefore, it is exempt from inventory listing requirements.

RoHs Complaint/REACH Compliant: 3M™ Electrically Conductive Adhesive Transfer Tape 9709S complies with the European Union's "Restriction of Hazardous Substances" (RoHs) initiative and with European REACH regulations 2002/95/EC and 2005/618/EC.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-251-8634. Address correspondence to: 3M, Electronics Markets Materials Division, 3M Center, Building 225-3S-06, St. Paul, MN 55144-1000. Our fax number is 651-778-4244 or 1-877-369-2923. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone: 1-787-750-3000. In Mexico, phone: 52-70-04-00.

Important Notice

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