

RFID INLAY ASSEMBLY

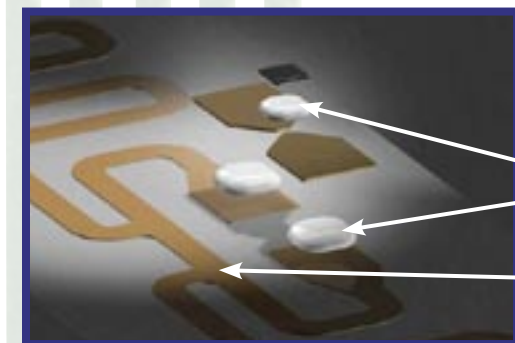


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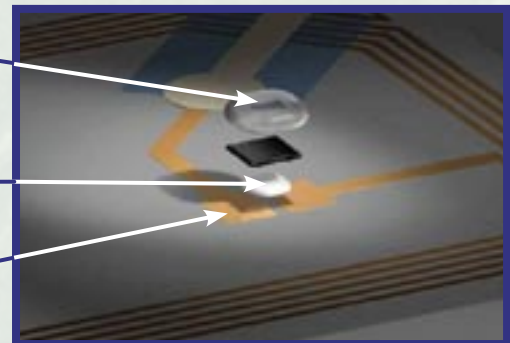
RFID SOLUTIONS Adhesives and Inks for RFID Assembly

Die Strap Attach



Encapsulant
Interconnect
Adhesive
Antenna Ink

Direct Die Attach



Overview

Used for everything from toll booths to department store inventory control to pet identification, Radio Frequency Identification (RFID) tags are devices capable of uniquely identifying an object via a pre-programmed response when queried by an external radio frequency wave.

Today's RFID tags consist of a graphic overlay and an inlay, with the inlay being the functional part of the tag and containing the die (used to carry the coded information) and the antenna (used to both transmit and receive RF signals). Critical to the assembly of the tags and their robust in-field performance is the selection of adhesives used to construct these devices.

Adhesive materials are used to attach dies onto antennae to build the inlays, which can be constructed in one of two ways:

1. An interconnect adhesive is used to attach a small bare die directly to an antenna. (See Direct Die Attach photo above.)
2. An interconnect adhesive is first used to build a much larger packaged die (interposer or die strap), which is then adhered onto an antenna. (See Die Strap Attach photo above.)

Both methods of assembly have been successfully employed to make active and passive RFID tags.

Direct Attachment of Bare Dies

The most common method of modern inlay assembly uses **Anisotropic Conductive Adhesives** to attach bare dies onto antenna substrates consisting of, but not limited to, etched aluminum and copper, stamped foil and printed conductive ink. Anisotropic conductive adhesives conduct in only one direction (along the z-axis) and are filled with small amounts of electrically conductive particles that have a tightly controlled size distribution.

When attaching small dies (0.8 mm x 0.08 mm on average) with flat bumps onto antennae, anisotropic conductive adhesives are the most suitable materials to use. It should be noted that during cure, anisotropic conductive adhesives do require pressure to establish a reliable connection.

Mechanical Support of Bare Dies

Another method of inlay assembly requires the use of **Non-Conductive Adhesives** to attach a small bare die onto an antenna. In this case, the die bumps are directly connected to the antenna pads using mechanical means. The purpose of the adhesive is then to provide structural support and increase tag reliability. Pressure is usually required during adhesive cure.

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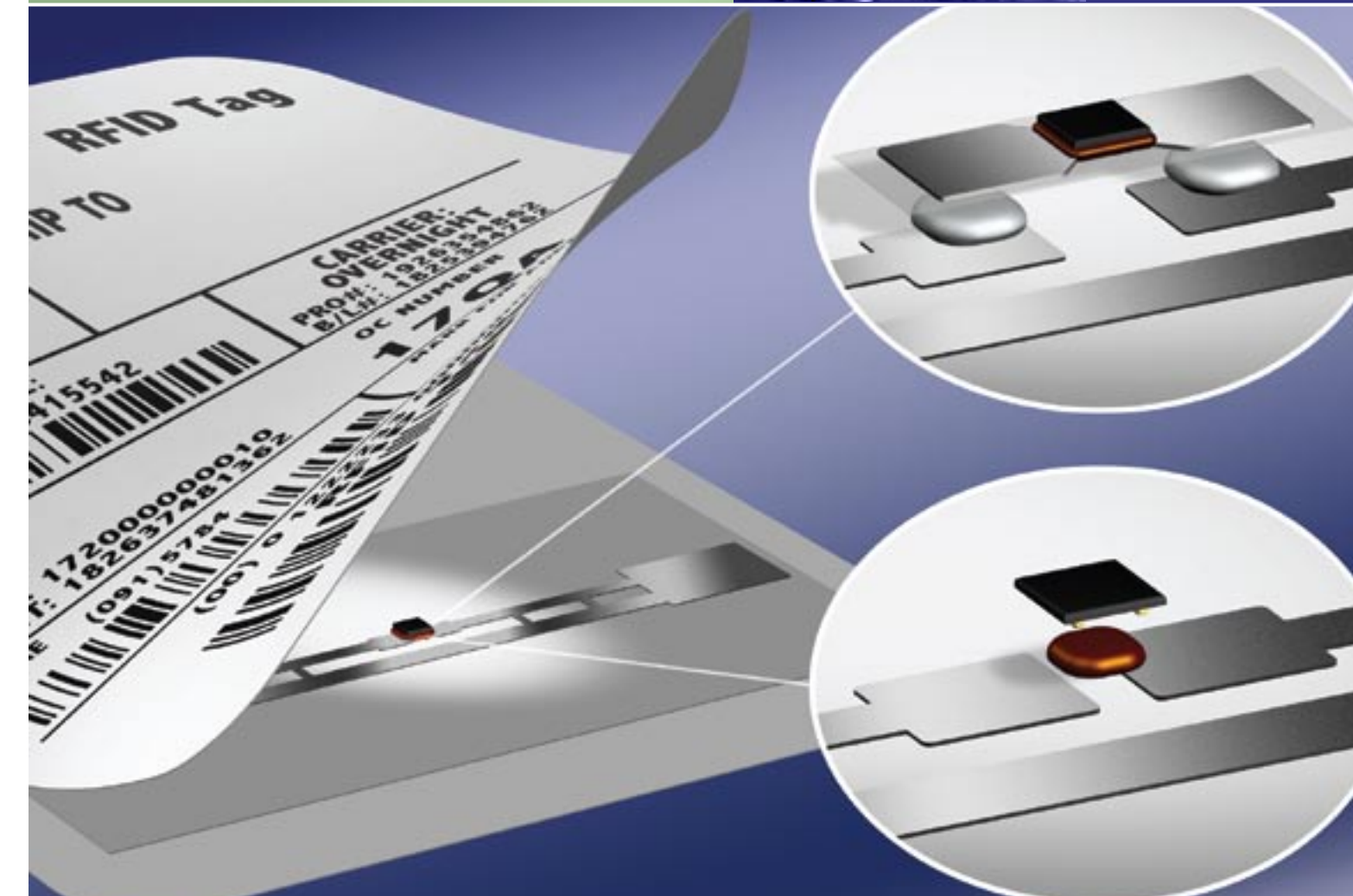
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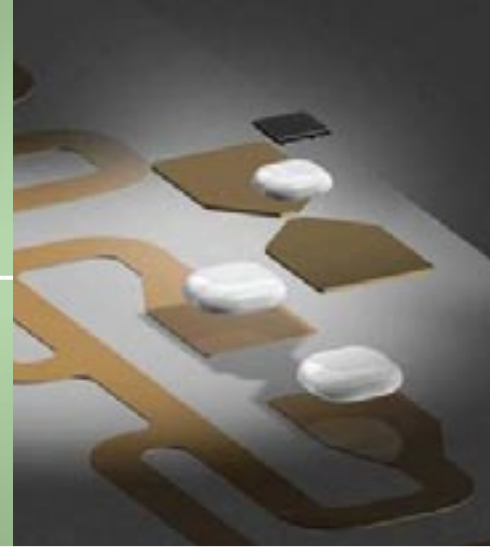
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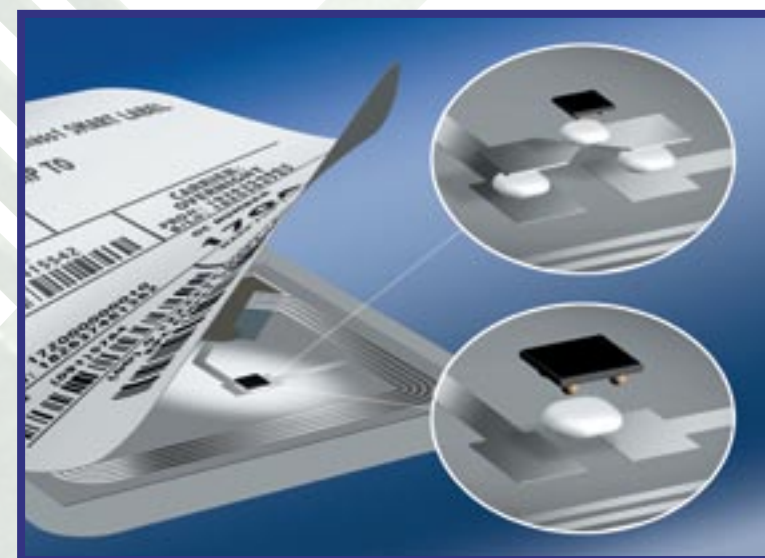
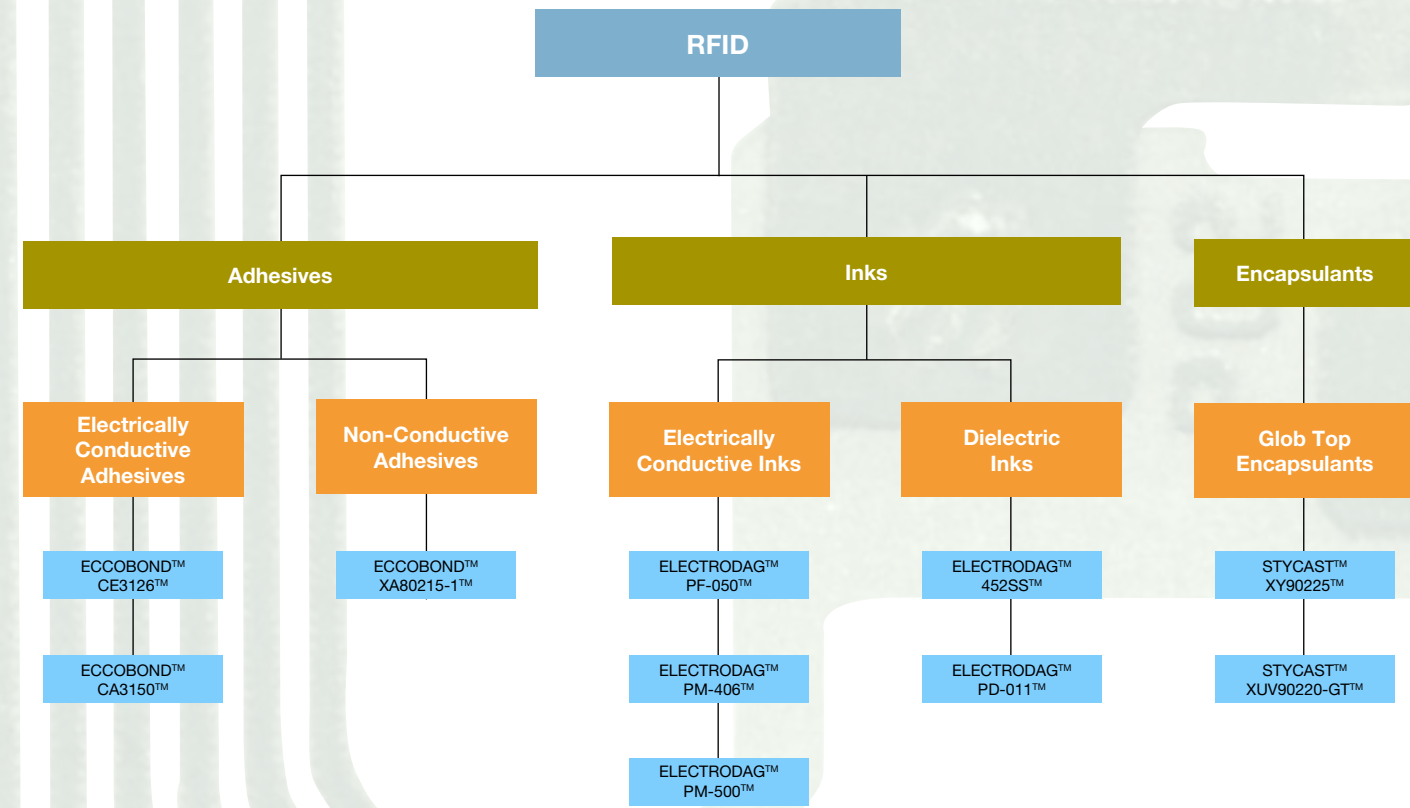
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RFID INLAY ASSEMBLY



RFID TAG ASSEMBLY



ADHESIVES - ANISOTROPIC CONDUCTIVE ADHESIVES

PRODUCT	ANTENNA TYPE	DESCRIPTION	FILLER	PARTICLE SIZE	RECOMMENDED CURE CONDITION	WORK LIFE AT 25°C
ECCOBOND™ CE3126™	Al and Cu, both Etched and Vapor-Deposited	Snap curable anisotropic adhesive is especially suited in applications where throughput is critical. This product is typically used for very fine pitch flip chip interconnections where electrical conductivity is desired in only one direction.	Nickel Particle	2-3 microns (µm)	8 sec. @ 170°C	2 days

ADHESIVES - ISOTROPIC CONDUCTIVE ADHESIVES

PRODUCT	ANTENNA TYPE	DESCRIPTION	FILLER	PARTICLE SIZE	RECOMMENDED CURE CONDITION	WORK LIFE AT 25°C
ECCOBOND™ CA3150™	Stamped Al, Vapor-Deposited Cu or Conductive Ink	Snap curable, low temperature cure, electrically conductive adhesive with excellent adhesion and reliability of Cu and Al substrates.	Silver	10-15 microns (µm)	10 sec. @ 130°C	2 days

ADHESIVES - NON-CONDUCTIVE ADHESIVES

PRODUCT	ANTENNA TYPE	DESCRIPTION	FILLER	PARTICLE SIZE	RECOMMENDED CURE CONDITION	WORK LIFE AT 25°C
ECCOBOND™ XA80215-1	Conductive Ink or Etched Aluminum	Low temperature fast cure, good mechanical strength.	Silica	1 microns (µm)	10 sec. @ 150°C	1 day

INKS - ELECTRICALLY CONDUCTIVE INKS

PRODUCT	ANTENNA TYPE	DESCRIPTION	BINDER	SHEET RESISTIVITY AT 25 µm (ohms/sq mil)	RECOMMENDED CURE CONDITION	ANTENNA FREQUENCY
ELECTRODAG™ PF-050™	Screen-Printing	Screen printable silver ink for plastic film and paper substrates. Highly conductive, superior fine line printability.	Solvent	<0.010	3 min. @ 140°C	HF
ELECTRODAG™ PM-406™	Screen-Printing	Low temperature cure, excellent adhesion on paper and polyethylene terephthalate.	Solvent	<0.015	15 min. @ 120°C	HF
ELECTRODAG™ PM-500™	Flexography	Water-based silver ink for flexographic printing on paper and plastic film.	Water	<0.020	1 min. @ 120°C	UHF

INKS - DIELECTRIC INKS

PRODUCT	ANTENNA TYPE	DESCRIPTION	BINDER	SHEET RESISTIVITY AT 25 µm (ohms/sq mil)	RECOMMENDED CURE CONDITION	SHELF LIFE
ELECTRODAG™ 452SS™	Screen-Printing	Screen printable, UV curable dielectric ink for plastic film and paper substrates. Excellent flexibility.	100% UV	<2 x 10 ⁹	UV dose of 500 mJ/cm ²	12 months
ELECTRODAG™ PD-011™	Rotogravure/Flexography	Rotogravure/Flexography printable, UV curable dielectric ink for plastic film and paper substrates.	100% UV	<2 x 10 ⁹	UV dose of 500 mJ/cm ²	12 months

ENCAPSULANTS - GLOB TOP ENCAPSULANTS

PRODUCT	ANTENNA TYPE	DESCRIPTION	CURE METHOD	RECOMMENDED CURE CONDITION	WORK LIFE AT 25°C
STYCAST™ XY90225™	Thermal Cure	Low temperature cure, good reliability.	Thermal	90 sec. @ 120°C	1 day
STYCAST™ XUV90220GT™	UV Cure	Fast cure, good reliability.	UV	UV dose of 1000 mJ/cm ²	2 weeks

Attachment of Die Straps

While inlay assembly using direct bare die attach is suitable for many tag applications, this approach requires high-precision equipment and a clean manufacturing environment to successfully achieve high-speed assembly. Die straps, however, are much larger in size (5 mm x10 mm on average) and, therefore, greater latitude in placement is possible. For these applications, **Isotropic Conductive Adhesives** are the preferred interconnect solution. Isotropic conductive adhesives conduct in all directions and, unlike anisotropic conductive adhesives, pressure is not required during cure. These materials are not ideal for the direct attachment of small dies to antennae (due to the high likelihood of shorting) but, rather, are best suited for high-speed assembly of die straps to antennae.

Encapsulation of Bare Dies

In some applications, die encapsulation may be necessary to provide additional protection against the environment or to increase data security. A **Glob Top Encapsulant** is the most conductive material for this requirement, as it completely encases the die in a protective coating.

Criteria for Adhesive Selection

A material's adhesion to certain bonding surfaces is critical, as the reliability of the inlay is dictated by the adhesive's robust attachment to all surfaces with which it comes in contact. These surfaces may include the antenna (copper, aluminum or conductive ink), the die or die strap metallization (copper, aluminum, silver, gold, palladium, conductive ink or die passivation layer), and the substrate (PET, paper or PVC).



For more details on proper adhesive selection, please contact the materials specialists at Henkel.

Printed Conductive Inks for RFID Antennae

With over 50 years of experience in the development and formulation of high performance **Conductive Inks**, Henkel's Acheson™ line of conductive inks delivers robust performance for today's RFID antennae. Compatible with various deposition techniques, Henkel's portfolio of conductive inks for RFID antenna production support a wide range of printing methodologies, including the high-speed approaches of flexographic and rotogravure printing, and provides the fine-line resolution required for today's RFID products.

Ensuring a complete, compatible material solution between the conductive adhesive used for die attachment and the conductive ink used for antenna manufacture is critical. Henkel's expertise with both of these material classes ensures proven compatibility and provides for reliable in-field RFID performance.

For more information on Henkel's printed conductive ink product line, please contact our technical specialists.

