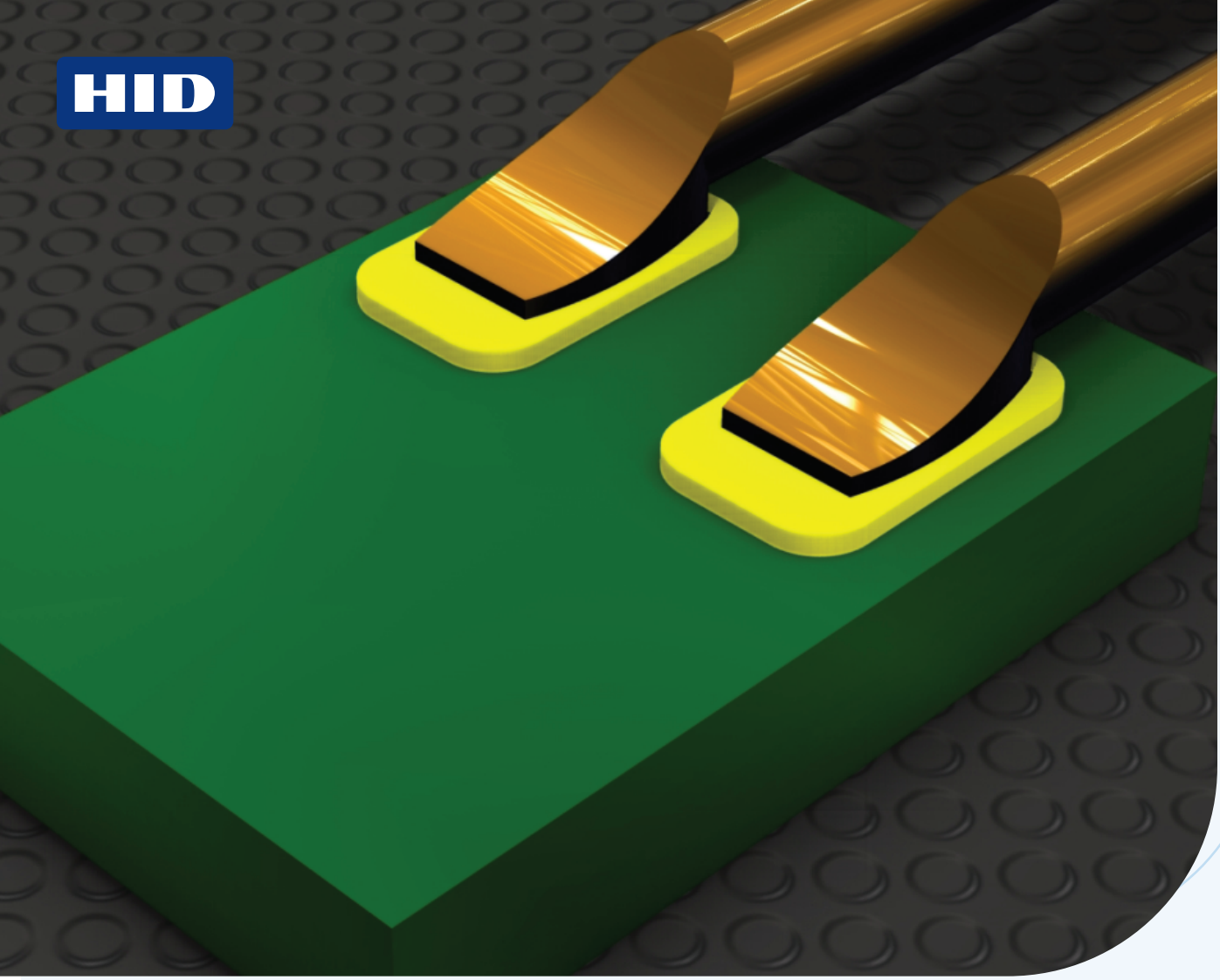


Advantages of DBond™ Technology for Cards, e-IDs & Industrial Applications

WHAT IS DBOND™ TECHNOLOGY?

DBond technology, also known as “Direct Bonding” is a means to directly connect an RFID wire antenna to a micro-sized chip without the need for bulky module housing and without additional soldering material.

DBond allows creation of smaller and thinner RFID-based products, which are more reliable and easier to process than standard RFID products. While low frequency (LF) Direct Bonding is well known and has been proven for years, high frequency (HF) Direct Bonding for card and industrial applications has not been available on the market before. HID Global is leveraging its years of experience and expertise to extend this technology to HF applications to create ultra-thin or -small products.

WHITE PAPER

Two Decades of DBond™ Experience

In the low frequency area, DBond is a well-known technology used in producing ultra-thin or small products. Nearly 20 years ago, HID Global (formerly Sokymat) pioneered this technology and holds several patents. HID Global today produces over 60 million transponders per year, including Animal ID, automotive and more than 100 million RFID products for access control cards and keyfobs using LF DBond technology.

HID Global continues to develop innovations to the process and applications of DBond technology.

The following picture illustrates an important innovation enabling the bonding of the latest chip generations of NXP (Hitag µ) and EM Microelectronic (EM 4200), which are extremely small - only 0.5 x 0.5 mm. HID Global's specially designed, automated production equipment makes it possible to hold a chip of this tiny size in position while welding two wires to it that are thinner than a hair.

FIGURE 2: DIRECT BONDED NXP HITAG µ ON LEFT, COMPARED TO HITAG-S ON RIGHT

In order to weld the wires to the chip through LF Direct Bonding, special versions of the chip with customized bumps for connection are needed (see golden pads on the chips in Figure 1 above).

While this process is well established for LF environments, to date HF Direct Bonding has remained an industry-wide challenge. HID Global is the first company to successfully address this challenge due to its in-house expertise of building specialized production equipment.

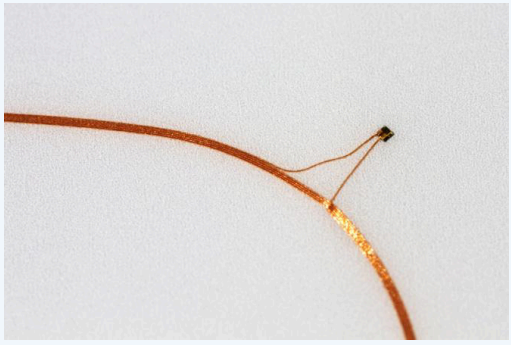
The main challenges encountered by using Direct Bonding in the HF RFID field are:

- Thick wires
- Thin chips
- Large (microcontroller) or very small chips (like memory chip) have to be carefully handled

Advantages of DBond™ Technology

WIDE RANGE OF FORM FACTORS

Depending on the application, the antenna is welded directly to a micro controller chip (0.5x0.5 mm or 3x3mm) instead of a module (~5x8 mm). This not only allows building smaller products such as the Glass Tag Mini of Æ1.4x8 mm, miniaturized disc shape Piccolino e-units or Logi Tag™ industrial tags, but also provides significant advantages for bigger products such as ISO cards or passports:



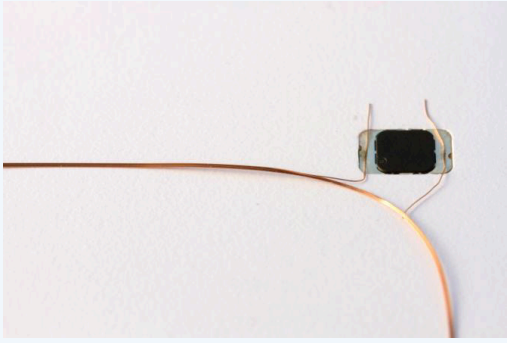
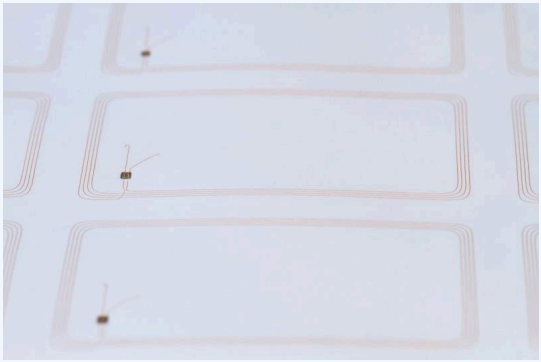


FIGURE 3: MIFARE® CHIP CONNECTED WITH DBOND™ TECHNOLOGY (LEFT) COMPARED TO A TRADITIONAL MODULE (RIGHT)

EXCELLENT PRINTABILITY OF ISO CARDS

When it comes to embedding a module into an ISO card, the size and thickness of the module may cause the surface of the card to become uneven which is a problem when the card is later printed on a desktop printer. A chip connected with DBond technology is so small and thin that the card surface remains perfectly flat to support printing after lamination with excellent results.

ALLOWS ULTRA-THIN INLAYS



When associated with a thin chip (today 75 µm, but thinner tomorrow), an inlay with DBond technology can become as thin as 175µm, whereas a standard inlay produced with a module is typically 300 µm thick. Today's thinnest modules are already ~200 µm. So DBond technology allows >30% thinner inlays.

Inlay thickness is an important criterion for some applications, such as e-government applications, where organizations are requesting more and more security features on cards. An ultra-thin polycarbonate (PC) inlay gives additional room to ID card manufacturers to apply additional PC security layers in their card construction.

IMPROVED DURABILITY

Due to the smaller surface occupied by the DBond connection, products with DBond technology are much less susceptible to bending and torsion than module technology. In addition, there are only two connection points to the chip, whereas with module technology there are in total six connection points, which imply three times as many potential failure points. The image below shows the external antenna connections to a module (1, 6) and internally within a module (2, 3, 4 and 5). DBond technology would weld the external antennae (1, 6) directly to the chip (3, 4), removing the need for any others connections.

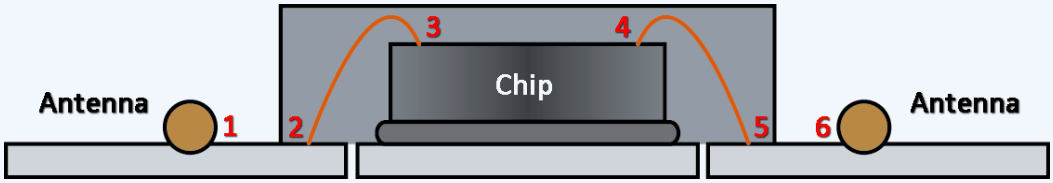


FIGURE 4: ANTENNA CONNECTIONS FOR MODULE TECHNOLOGY

PROVEN, HIGHLY RELIABLE COPPER WIRE ANTENNA

DBond technology works with copper wire antennas that are truly welded to the chip. This is the best solution in terms of RFID performance as well as robustness and long term reliability.

Today with more than 90% of RFID e-documents manufactured using copper wire antenna. The reliability of the copper wire antenna is proven.

DBond™ vs. Flip-Chip Technologies in HF Applications

When a module is not required in the development of ultra-thin products, some manufacturers use Flip Chip technologies as an alternative to DBond. The long term reliability of the Flip Chip connection remains to be proven. Although this may not be an issue for applications like single-use public transport ticketing, long term reliability is a key criteria for some applications such as e-government documents that require 10 or more years of lifespan.

The Flip Chip concept is not new; it was commercially introduced by IBM in the 1960's for individual transistors and packaged diodes.

The traditional solder bump Flip Chip process may be considered as four sequential steps: (1) preparing the wafer for solder bumping, (2) forming or placing the solder bumps, (3) attaching the bumped die to the board, substrate or carrier and (4) completing the assembly with an adhesive under-fill.

Based on this concept, various companies have developed the Flip Chip for use in thousands of different applications in an effort to take advantage of the size and cost benefits offered by this assembly method. RFID applications are no exception to this approach and several companies have developed an "alternative" Flip Chip method. Due to the temperature limitation of the manufacturing process however, the traditional Flip Chip technology with solder bumps is not always a feasible approach and cannot be used in the packaging of contactless smart cards.

Solder bumps have been replaced by other material (primarily gold bumps) such that the Flip Chip connection is no longer considered a legitimate welding process. The Flip Chip technology may use different types of adhesive technologies such as ACF (Anisotropic Conductive Film), ACP (Anisotropic Conductive Paste) or NCP (Non Conductive Paste).

For all these Flip-Chip technologies, the chip is glued to the substrate and the electrical connection is completed by a "physical" and "rigid" contact instead of being welded, thus creating a less reliable and more breakable connection.

Flip Chip technology is also associated with different types of antennas such as printed antenna or etched antenna, but not to copper wire antenna.

The image below illustrates a typical Flip-Chip mounting via glue on a PET or Polycarbonate substrate and a printed or etched aluminum or copper antenna. The glue will float aside as the chip is pressed down to allow the contacts to touch the antenna.

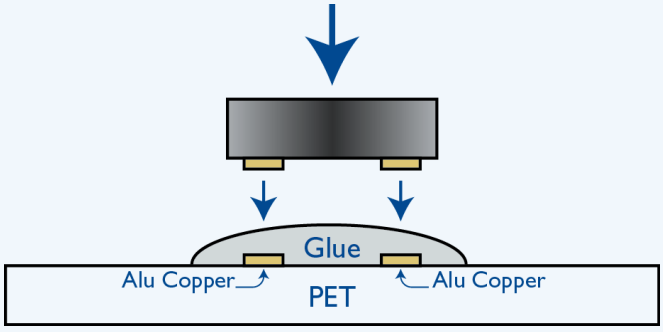


FIGURE 5: FLIP-CHIP MOUNTING VIA GLUE

HID Global's Vigo™ Technology

HID Global is working with major chip vendors to constantly increase the number of DBond enabled HF technologies that is available for Genuine HID® products. The first technology for industrial use is called Vigo™ and has the following main characteristics.

- ISO 15693 / ISO18000-3 standard compliant at 13.56 MHz
- 64 bit UID and 1 Kbit, 1.6 Kbit or 2 Kbit user programmable memory
- 32 bit password protection for functionality and data
- Privacy mode option, when the privacy mode is enabled the tag remain silent until a login command is received
- 60 years data retention

A range of small industrial products is available with this technology for use on- or off-metal. E.g. LogiTag 121, Glass Tag, Piccolino Tag or Brick Tag. Then image below shows an example of Vigo utilizing DBond technology that can for example either be used to create very small e-units or larger ones where the chip is very close to the antenna so that a big hole is possible in the tag e.g. to run a pipe through.

FIGURE 6: CLEARDISC VIGO™ WITH HOLE (LEFT) AND PICCOLINO TAG VIGO™ (MIDDLE)

Conclusion

When high quality is requested in applications, such as industrial, access or government eIDs applications, that demand many years of reliable function and excellent performance, DBond™ is the preferred choice.

HID Global pioneered and successfully established production of hundreds of millions of tags per year based on LF DBond technology. Now the experienced engineering and automation team at HID Global has enabled DBond technology for HF products.

The HF DBond capabilities enable HID Global's customers across a wide range of business segments to match products to their needs, based on the latest technology.

HID Global currently supports DBond technology in LF and HF for industrial tags and also for Government ID, ISO cards and prelaminates with a constantly increasing number of chip types.

For questions or availability information, please contact your HID Global sales representative.

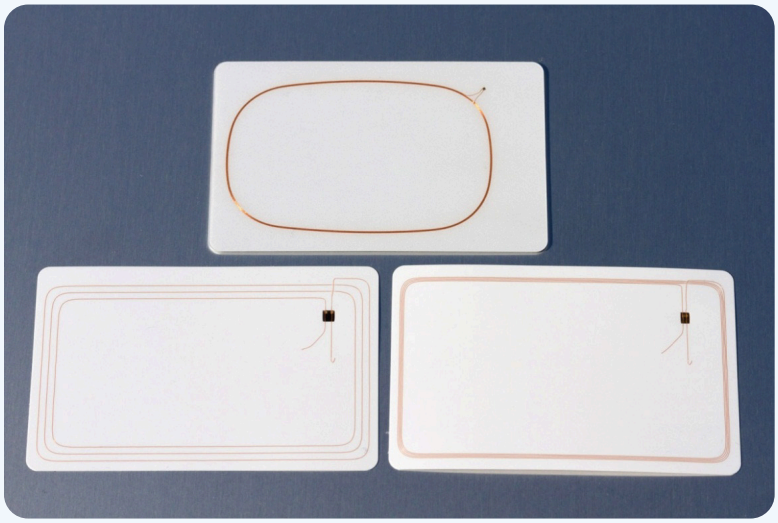


FIGURE 7: EXAMPLES FOR ISO CARD WITH DBOND™ TECHNOLOGY: COIL WINDING (TOP), WIRE EMBEDDING (BOTTOM)

ABOUT HID GLOBAL

HID Global is the trusted source for innovative products, services, solutions, and know-how related to the creation, management, and use of secure identities for millions of customers around the world. The company's served markets include physical and logical access control, including strong authentication and credential management; card printing and personalization; visitor management systems; highly secure government and citizen ID; and identification RFID technologies used in animal ID and industry and logistics applications. The company's primary brands include ActivID®, EasyLobby®, FARGO®, IdenTrust®, LaserCard®, Lumidigm®, Quantum Secure and HID®. Headquartered in Austin, Texas, HID Global has over 3,200 employees worldwide and operates international offices that support more than 100 countries. HID Global® is an ASSA ABLOY Group brand. For more information, visit www.hidglobal.com

To learn more about RFID Solutions from HID Global, please visit: http://www.hidglobal.com/rfid

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