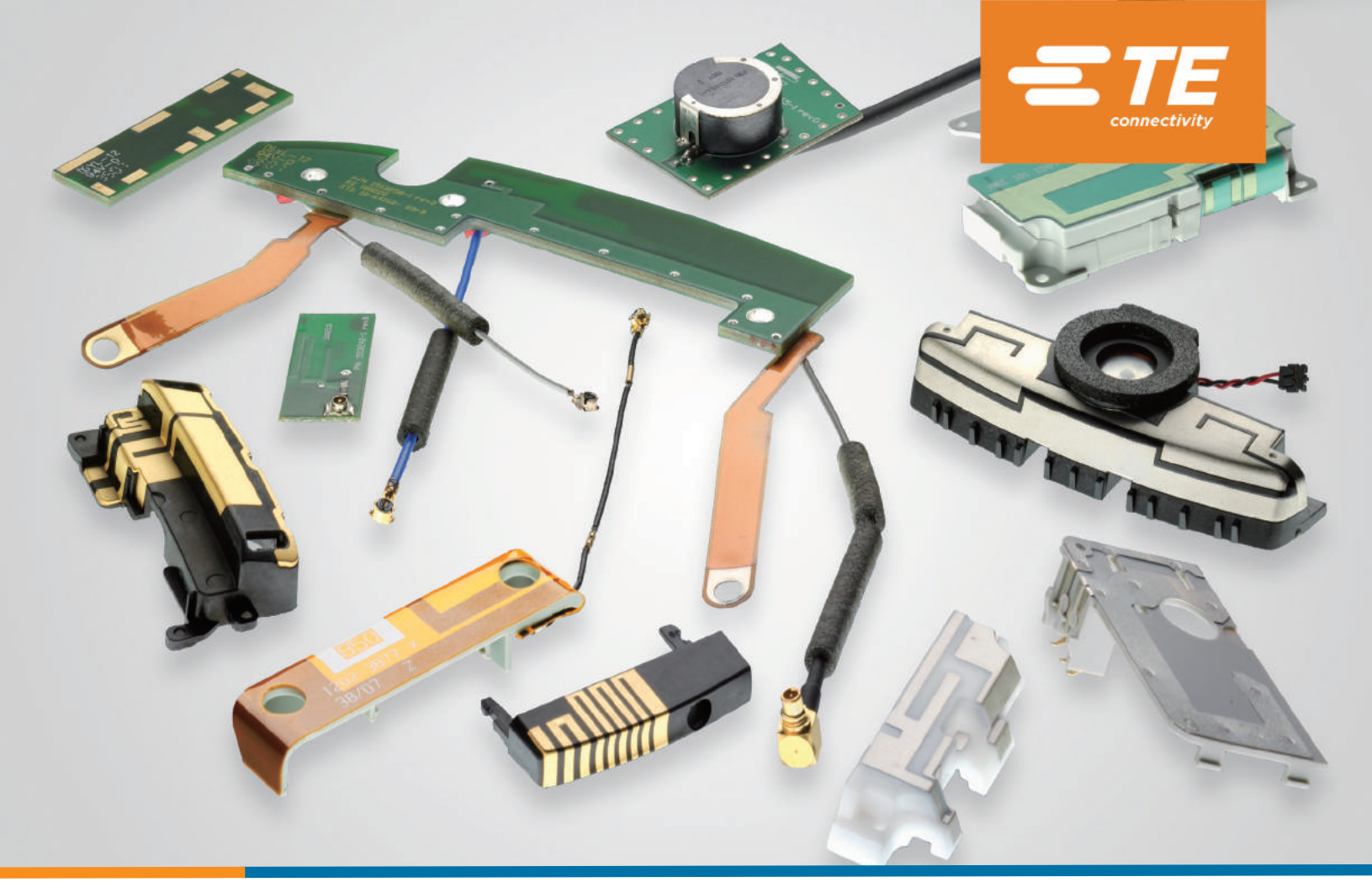


Antenna Products

Standard and Custom Solutions

TE Connectivity Antenna Benefits

- High performance and innovative products
  - High reliability: high performance and isolation
  - High efficiency: optimized throughput, minimal losses
- In-house testing and validation
- State-of-the art antenna laboratories and personnel, deployed globally
- Innovation leader with leading patent portfolio
- Quick-turn designs and prototypes
- World class manufacturing capabilities
- Thrive on opportunities to solve problems together with our customers
- Community leader listed on Dow Jones Sustainability Index and named one of World's Most Ethical Companies by Ethisphere® Institute

www.te.com/antennas

GLOBAL ANTENNA FOOTPRINT

TE Connectivity is a leading developer and manufacturer of high performance embedded and external antennas for diverse wireless applications in various industries. TE has a global presence with manufacturing and design locations around the world.

Antenna Laboratory & Design Locations:

- Harrisburg, Pennsylvania USA
- Aptos, California USA
- Fremont, California USA
- Auburn Hills, Michigan USA
- Hertogenbosch, Netherlands
- Stuttgart, Germany
- Taipei, Taiwan
- Kawasaki, Japan
- Seoul, Korea
- Kunshan, China

Manufacturing Locations:

- Qingdao, China
- Shenzhen, China

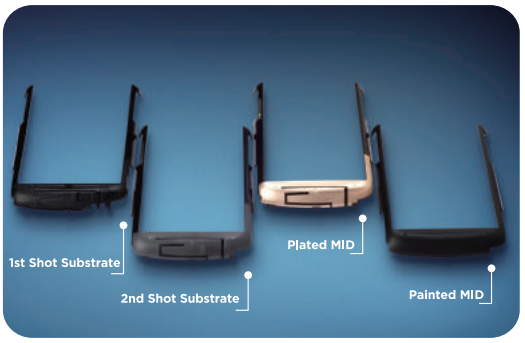
MANUFACTURING TECHNOLOGIES

Molded Interconnect Device (MID) Technology

TE is one of the leading providers of molded interconnect device (MID) technology with more than 25 years mass production experience. In its most basic form, MID technology is defined as a process that results in selectively plated plastic parts. This technology is most often used in three basic ways: electro-mechanical (signal or current carrying traces), RF technology (antennas), and shielding applications. MID technology can integrate electrical and mechanical elements into almost any shape of interconnect device allowing entirely new functions to be created while facilitating the miniaturization of products.
TE utilizes two different technologies to manufacture MID antennas: Two Shot molding and laser direct structuring (LDS).

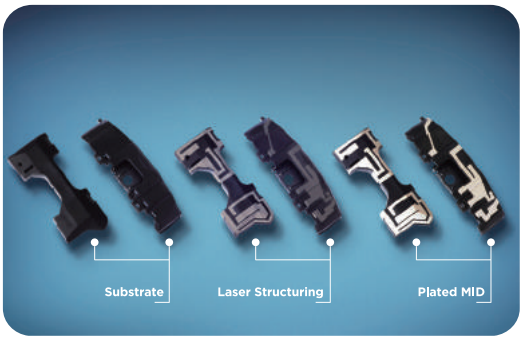
Two Shot Molding

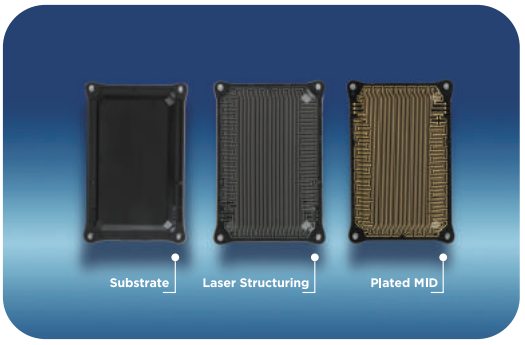
Two shot molding is a mature and well understood process that remains viable for cost effective and repeatable production of MIDs. The basic process has only two steps, injection molding of two distinct thermoplastic polymers and the electroless plating process, resulting in a selectively plated component. In order to achieve the selectivity during plating, a catalyst doped "plateable" resin is molded in conjunction with a standard non-plateable resin to define the desired area to be plated. This area is metalized initially with copper, followed by nickel and, optionally, gold plating. The following are just a few of the several advantages that MID two shot technology delivers compared to alternative technologies:



- Design flexibility for complex 3D geometries
- Ability to integrate multiple functions into one component
- Tightest tolerance for pattern registration to carrier
- Fewest manufacturing steps and processes
- Higher yields
- Improved scalability

Laser Direct Structuring (LDS)





LDS is an exciting technology used to create MIDs. Through the use of a dedicated laser system and resins, LDS opens up many possibilities to create 3 dimensional MIDs with finer line width and spacing than what is possible with the conventional MID processes. The LDS is a three-step process. First, the part is molded in a standard single shot mold using one of the LDS resins. Second, the desired pattern is directly structured onto the part by the 3D laser system. Finally, the pattern is plated using the industry-standard methods where the plating adheres only to the plastic that has been activated by the laser, thus creating a conductive pattern. LDS offers the same advantages as the two shot technology mentioned above plus additional ones:

- Ability to produce thin (0.15 mm) traces
- Flexibility for pattern changes during production
- Simple/fastest/lowest cost tooling

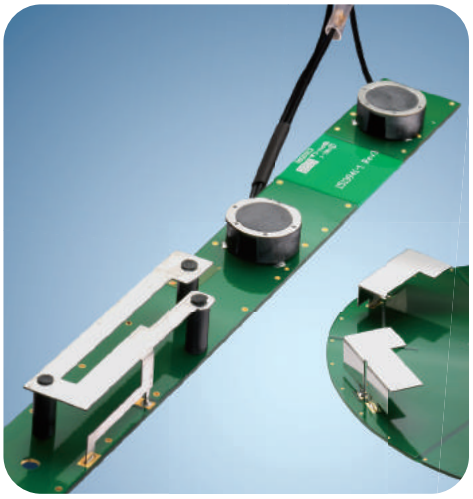
TE is leading the market in new LDS Thin Film technology process and product development. Contact us for more details on this latest manufacturing technology.

MANUFACTURING TECHNOLOGIES

Stamped Metal, Printed Circuit Board (PCB) and Flexible Printed Circuit (FPC) Technology

TE has significant experience in antenna design and manufacturing and provides customized antenna solutions, accommodating the wireless industry's move towards increased complexity and demand for miniaturization. Our manufacturing technologies deliver optimal and well-proven solutions for a variety of wireless applications. In addition to MID technology, TE most commonly utilizes stamped metal, printed circuit board (PCB) and flexible printed circuit (FPC) technology for its antenna products.

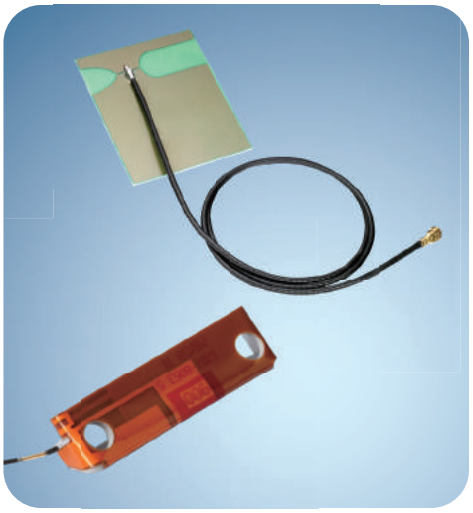
Stamped Metal Antennas



TE has developed a standard line of low profile, high performance stamped metal antenna solutions, and we can provide custom designs as well. Stamped metal antennas offer customers a low cost and highly repeatable manufacturing solution with a number of standard "off the shelf" or customized antenna designs. Stampings are a proven solution with several advantages such as:

- Lowest cost
- Integrated contacts
- High volume production dies
- Rapid prototyping capability

Flexible Printed Circuit (FPC) and Printed Circuit Board (PCB) Antennas



Flexible printed circuits (FPCs) and printed circuit boards (PCBs) are suitable for multi-band antennas, allowing virtually any wireless device to operate at different frequencies without the need for multiple antennas.

TE offers a broad range of low profile, high performance FPC and PCB antennas. Similar to our stamped metal antennas, FPC and PCB antennas offer OEMs a low cost and highly repeatable manufacturing solution in a number of "off the shelf" or customized antenna designs. FPC and PCB antennas address the needs of a variety of wireless applications and offer several advantages such as:

- Low cost tooling investment
- Flexibility for pattern changes during production
- Shortest lead time for tool build
- Patented material and patterns for optimal efficiency and performance

APPLICATIONS

TE Connectivity (TE) designs and manufactures antennas that comply with the most stringent operating requirements. TE has extensive experience providing customized embedded antenna solutions to accommodate the wireless industry's move towards increased complexity and demand for miniaturization combined with the need to integrate a multi-radio environment into one component.
Our antennas utilize diverse technologies and offer optimal solutions for each of the following examples:

Applications by Protocol

WLAN / Wi-Fi

- 802.11 (a/b/g/n/ac): 2400 - 2483.5 & 4900 - 5875 MHz
- Single band, Dual band, MIMO, Wave2, MU-MIMO embedded and ground plane independent antennas

Cellular / WWAN

- 2G, 3G, 4G, 5G from single to all band antennas
- LTE: 698 - 787; 2500 - 2690 & 3410 - 3600 MHz
- GSM/CDMA 850: 824 - 894 MHz
- GSM 900: 880 - 960 MHz
- GSM 1800: 1710 - 1880 MHz
- GSM/CDMA 1900: 1850 - 1990 MHz
- IMT-2100 (3G, UMTS): 1920 - 2170 MHz
- WiMAX: 2300 - 2700 & 3300 - 3800 MHz

Others

- ISM 900/ZigBee: 902 - 928 MHz
- Bluetooth: 2400 - 2483.5 MHz
- ZigBee: 2400 - 2483.5 MHz
- UWB: 3168 - 10560 MHz
- GPS: 1565 - 1585 MHz
- DVB-H: 1670 - 1675 MHz
- LoRa, Z-Wave, BTLE (Bluetooth low energy)
- GPS, Glonass, GNSS

Product Applications

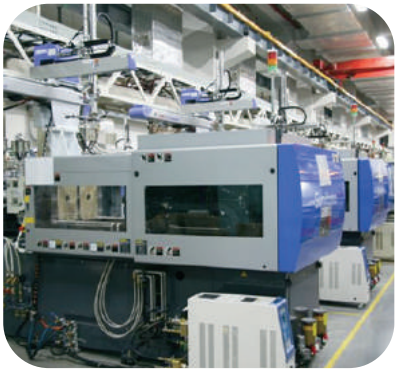
- Wireless Routers
- Smart Home Products
- Access Points & Mini Cells
- Point of Sale (POS) Terminals
- Security & Monitoring Systems
- Smart Meters & Smart Lighting
- Small & Large Home Appliances
- Industrial & Smart Grid Products
- IoT & M2M
- Set Top Boxes
- Televisions & Wireless Audio
- Desktop & Notebook Computers
- Mobile Phones & Handheld Products
- Printers & Business Equipment
- Medical Equipment
- Vehicle Tracking & OBD Products
- Wearables (Smart Watch, Cameras, etc.)
- Distributed Antenna Systems (DAS)
- Most High-Volume Wireless Products

VALUE-ADDED INTEGRATION

TE has manufacturing and design locations around the world, providing a full range of value-added production processes on-site. We also have state of the art measurement capabilities ensuring all of our antennas satisfy today's most discriminating performance and quality requirements.

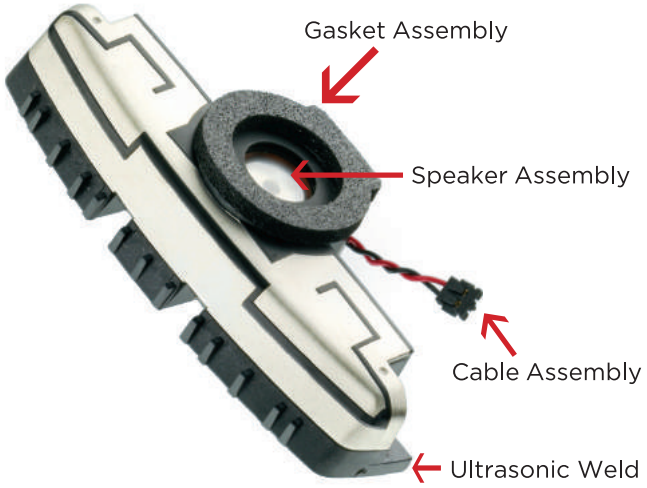
Enhanced Value Through On-Site Manufacturing Processes

- Molding
- Plating
- Cable and Acoustic Assembly
- Ultrasonic Welding and Heat Staking
- Reflow Soldering
- Wave Soldering
- Hand Soldering
- Press Fit
- Painting



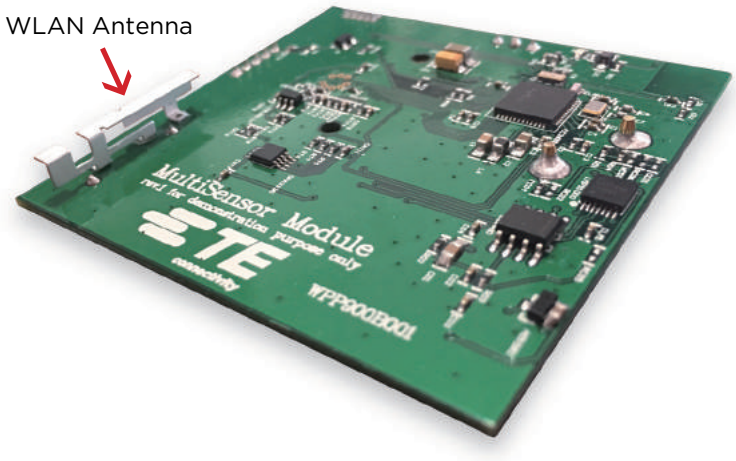
Example: Mid 2-Shot Antenna Assembly

Speaker Acoustic Module with Gasket & Wire Assembly



Example: Antenna Integration with Sensor

Stamped Antenna on Multi-Sensor Module



100% RF Performance Verification
100% Acoustic Performance Verification

EXTERNAL ANTENNAS

Most TE external antenna assemblies are designed to support WiFi and WiMAX enabled products and applications, while exhibiting excellent performance through 6 GHz. These external antennas can be provided with a wide variety of cable and connector types, with one option being an innovative 3-port connector eliminating the need for three separate SMA (or other interface) connectors.

Additionally, TE offers an external antenna that includes a 3-port omni-directional antenna assembly designed to support both in-door and outdoor cellular type of applications, such as distributed antenna systems.

Applications

- Wireless Routers
- Smart Home Products
- Access Points & Mini Cells
- Point of Sale (POS) Terminals
- Safety & Security Systems
- Set Top Boxes
- Televisions & Wireless Audio
- Desktop Computers
- Distributed Antenna Systems (DAS)

ASSOCIATED PRODUCTS AND RESOURCES

Antennas
Landing Page: www.te.com/antennas
Catalog: 4-1773459-7

Board Level Shields (BLS)
Landing Page: www.te.com/bls
Quick Reference Guide: 9-1773700-1

Grounding (Spring Fingers)
Landing Page: www.te.com/products/spring-fingers
Quick Reference Guide: 6-1773460-8

Discrete Wire Connectors
Landing pages: www.te.com/products/ct
www.te.com/products/minict
www.te.com/products/hpi
www.te.com/lowpowerdrawer
Quick Reference Guides: 1-1773455-8, 6-1773454-5, 1-1773713-2, 1-1773888-2

RF & Coax Connectors
Landing page: www.te.com/rf
Catalog: 1307191

High Frequency Relays
Landing page: www.te.com/relays
Datasheet: 5-1773450-5

Battery Connectors
Landing Pages: www.te.com/products/mobile-battery-connector
www.te.com/products/batterypack
Quick Reference Guides: 1-1773839-5, 1-1773839-4

Flexible Printed Circuit (FPC) Connectors
Landing page: www.te.com/products/fpc
Quick Reference Guides: 5-1773461-0, 8-1773459-2

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