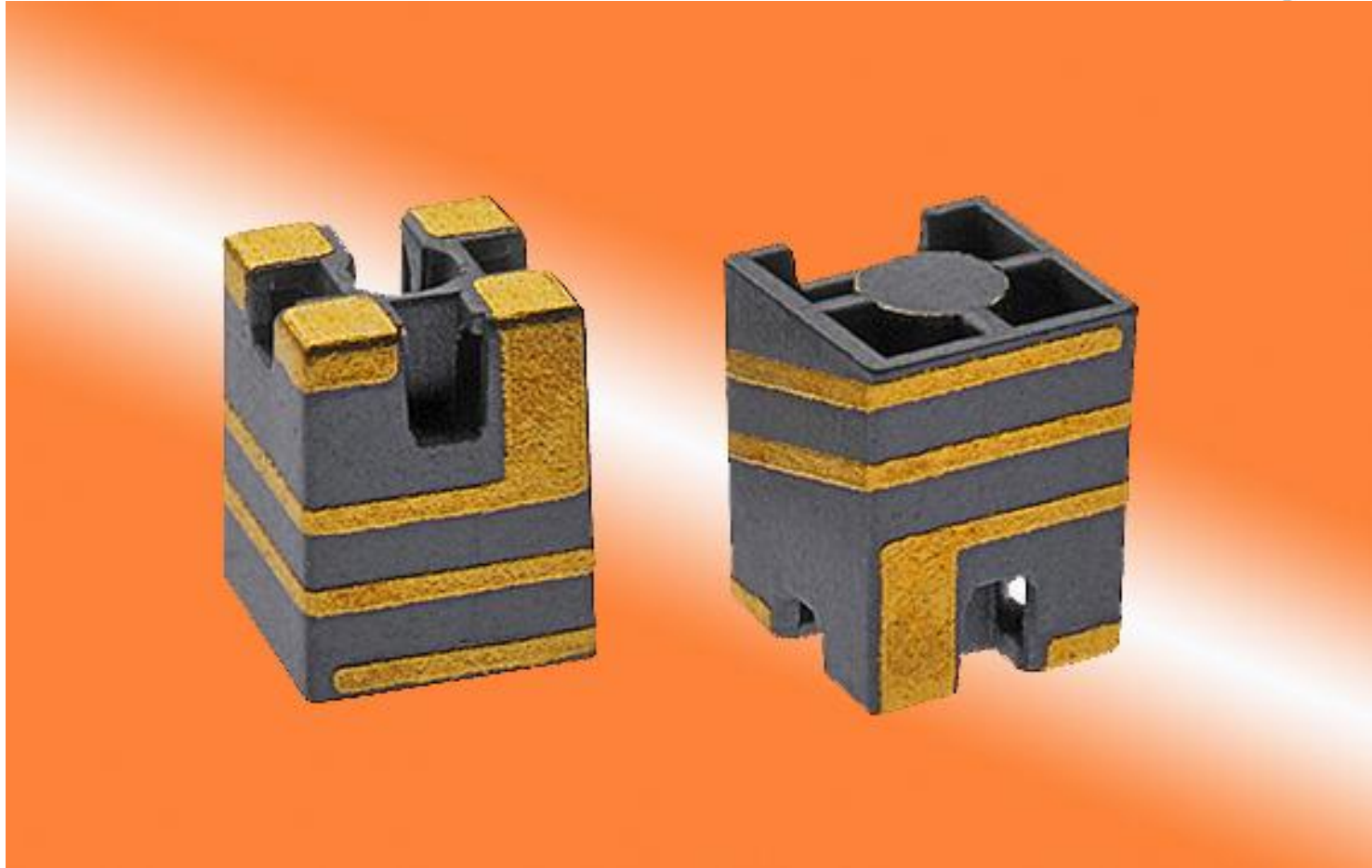




2.4 GHz SMD On-Ground Antenna

***Mads Sager
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Featuring high performance levels and easy integration to satisfy the demands of the wireless marketplace



2.4GHz SMD On-ground Antenna base showing SMD solder pads and plated traces (left picture) and pick-and-place area on the antenna top (right picture)

Development Background



- Project started out as a mobile phone Bluetooth antenna
- Requirements:
 - very limiting physical size constraints
 - device to work without the removal of any ground layer in PCB above which the antenna sits
- Goal:
 - a mechanically more robust Molded Interconnect Device (MID) chip antenna that delivered consistent RF performance
- Molex leveraged the power of Laser Direct Structuring (LDS) technology on molded plastic

Development Background (continued)

■ Molex's achievement:

- smallest on-ground antenna in the market, only 3.00 x 3.00 x 4.00 mm (0.118" x 0.118" x 0.157") in size, weighs a mere 0.03g
- is RoHS-compliant and halogen-free
- is fully SMD-compatible
- requires no ground clearance at all
 - PCB ground layers left intact for other uses
- great PCB real estate savings
 - reverse side of the PCB space is freed for component assembly

Product Features



This standard, general market antenna features:

- **monopole structure with an omni-directional radiation pattern**
- **simple strip-line matching on the PCB itself for easy antenna optimization, without the need for discrete components**
- **a single discrete series component can be used, however, to offset the antenna resonance frequency if the need exists, due to loading effects by components near the antenna**
- **full compatibility with SMD and reflow processes, enabling smooth and cost-effective product integration**
- **usability as a standalone device without the need for cable connection**

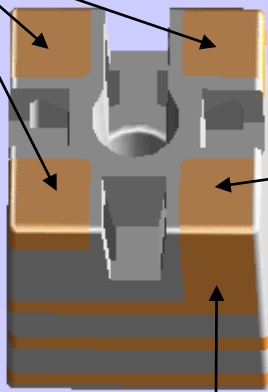


Product Features (continued)

■ In the left diagram below, four SMD pads are shown. Three dummy pads are to be attached to the PCB for strong mechanical bonding while the remaining signal SMD pad connects to the radio transceiver circuit on the PCB

■ In the right diagram below, the pick-and-place feature of the antenna works with a standard vacuum nozzle for component assembly operations

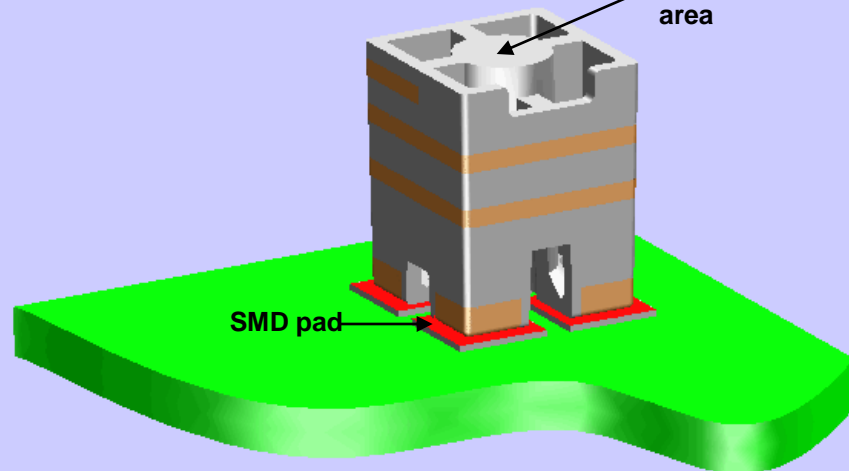
Dummy SMD pads
soldered to PCB
for strong
mechanical
bonding



Signal SMD pad
connecting to
transceiver via a
transmission line
on the PCB

Antenna radiator traces consisting of immersion
Gold (Au) over Nickel (Ni) and Copper (Cu)
under-plating

Pick-and-place
area



SMD pad

Illustration showing the plated SMD pads of
the 2.4GHz SMD On-ground antenna base

Illustration showing the 2.4GHz SMD On-ground
antenna mounted onto a PCB

Specifications

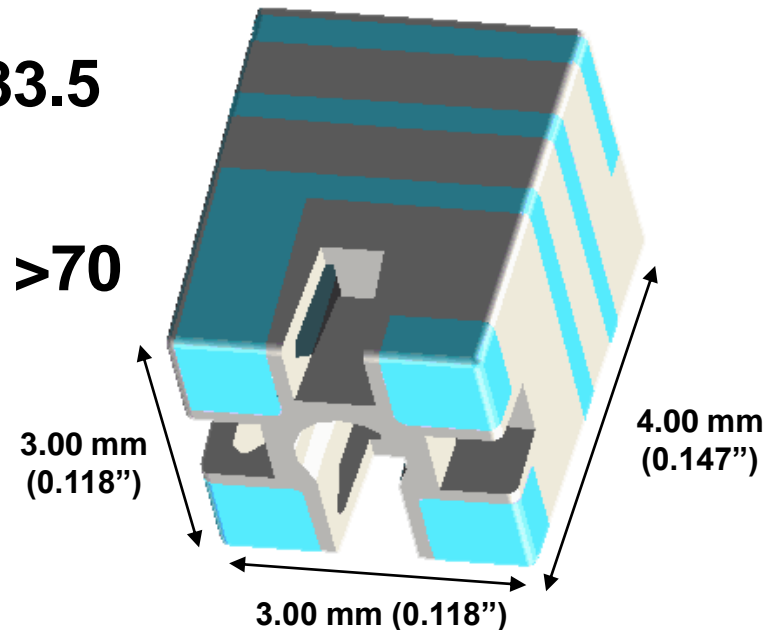


■ Reference platform:

- 100mm by 40mm test-board
- Works on different sized PCB's as well with modified electrical specifications

■ Electrical specifications:

- Frequency (MHz): 2400 to 2483.5
- Return Loss - S11 (dB): < -9
- Average Total Efficiency (%): > 70
- Peak Gain (dBi): 1.35
- Polarization: Linear
- Input Impedance (Ohms): 50



Markets and Applications



■ Telecommunication Applications

- Bluetooth devices
- Headsets
- Notebooks and netbooks
- Smart Phones
- Tablet PCs
- WiFi devices
- Wireless LAN (WLAN)
- IEEE 802.11b/g/n devices



Tablet PCs

■ Industrial Applications

- Machine-to-machine (M2M) communications
- Smart meters
- Lighting controls
- ZigBee IEEE 802.15.4 devices
- 2.4 GHz Industrial, Scientific and Medical (ISM) band systems and wireless devices



Smart meters



*Bluetooth is a registered trademark of Bluetooth SIG

**Wi-Fi is a registered trademarks of the Wi-Fi Alliance

†ZIGBEE is a registered trademark of trademark of ZigBee Alliance

Markets and Applications (continued)

■ Consumer Electronics (CE) Applications

- Cameras
- Mobile gaming devices
- Personal navigation devices
- Wireless internet TV and Audio



Wireless headsets

■ Automotive Applications

- Bluetooth devices
- Infotainment systems

■ Medical Applications

- Telemedicine- and Telehealth devices



Car infotainment systems

Features and Benefits



- **Smallest on-ground Molded Interconnect Device (MID) antenna in the market**
- **Offers valuable PCB real estate savings on the mounted side of the antenna**
- **No removal of ground layers from beneath the antenna needed**
- **Frees up PCB space behind the solder-mounted antenna for other component assembly or other uses**
- **Application of Laser Direct Structuring (LDS) chip antenna technology in manufacturing**
- **Ensures consistent antenna RF performance given the excellent laser structuring repeatability, precision and accuracy of LDS**
- **Fully SMD-compatible**
- **The high-temperature base material and the metal plating technology employed allows the antenna to endure reflow temperatures - an ideal condition for a standard SMT process**
- **RoHS-compliant**
- **Meets RoHS regulatory standards**

RF Performance



Return Loss

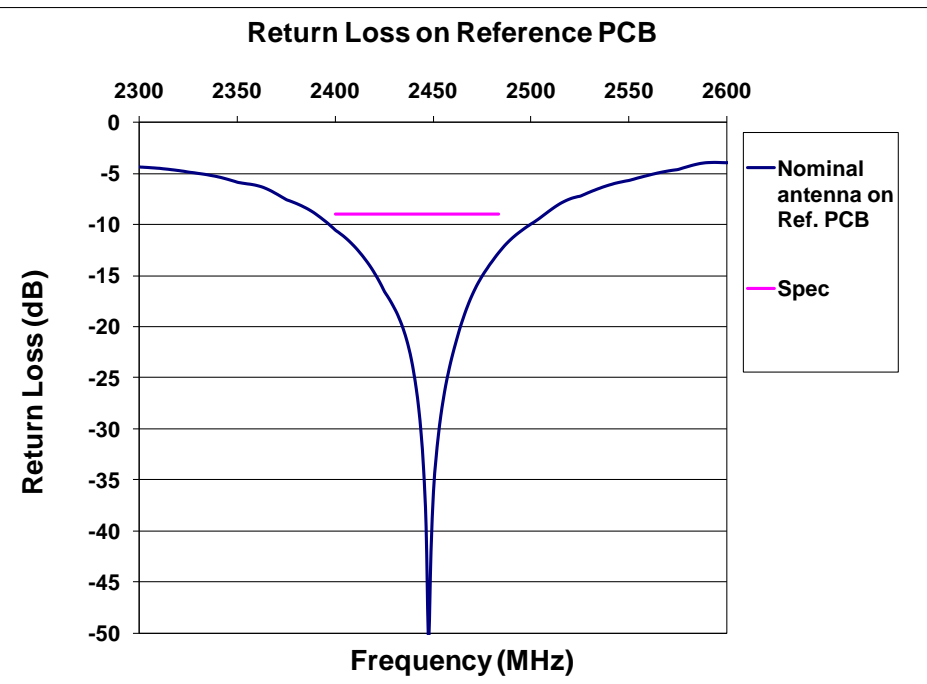


Figure 1: Return Loss (S11) as measured on reference board

Efficiency

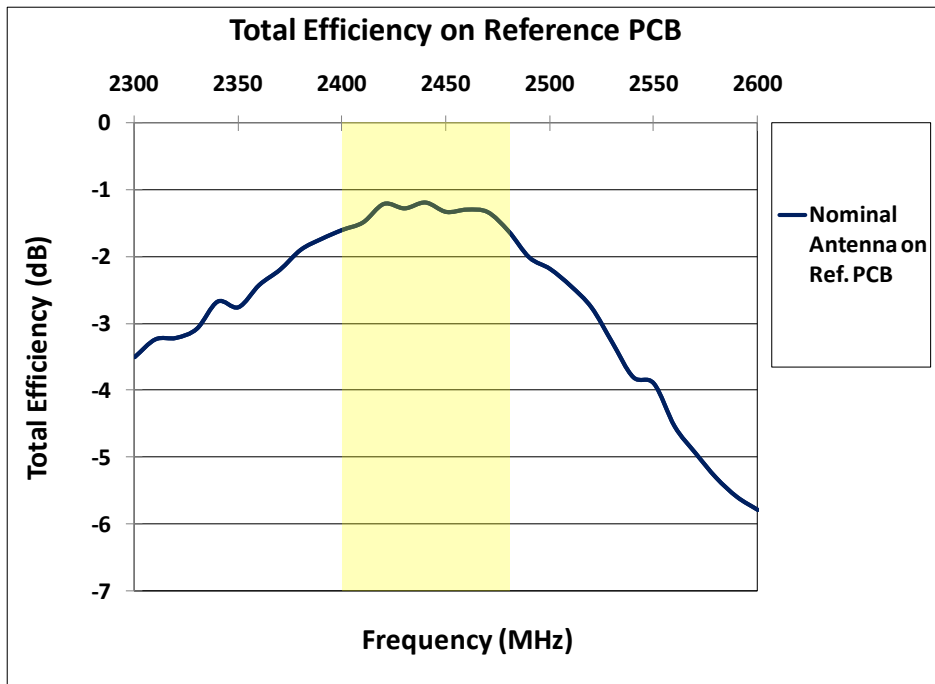


Figure 2: Total Efficiency (including Mismatch losses) as measured on reference board

RF Performance



Radiation Plots

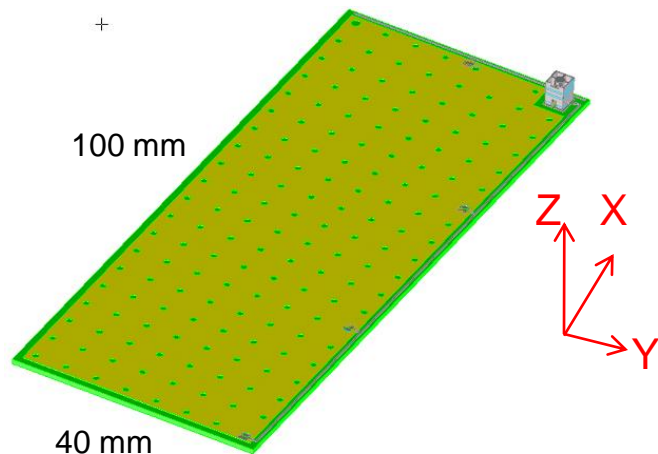


Figure 3a: Antenna on a 100mm by 40 mm reference board with full ground on the reverse side of the board

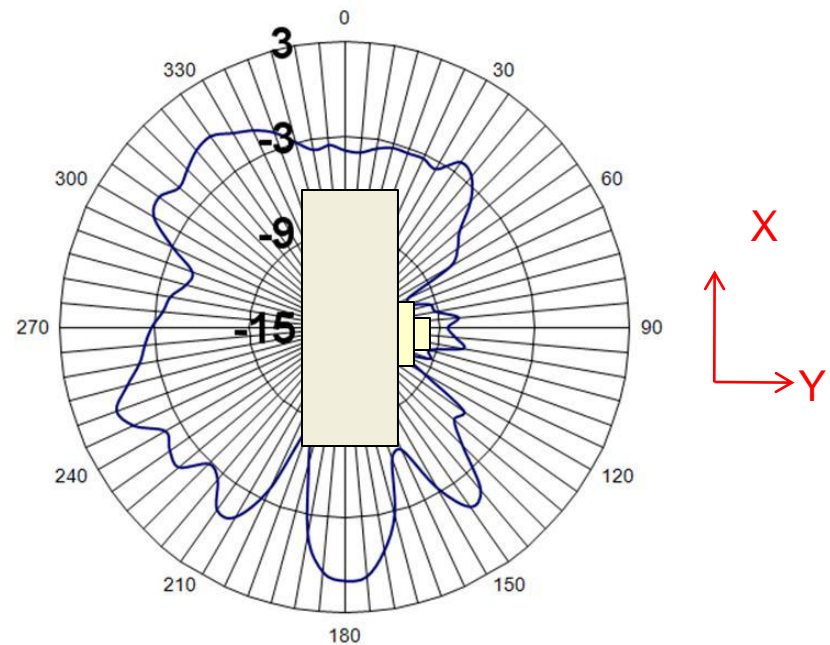


Figure 3b: Radiation diagram of X-Y plane shows combined polarizations as measured on reference board

RF Performance



Radiation Plots

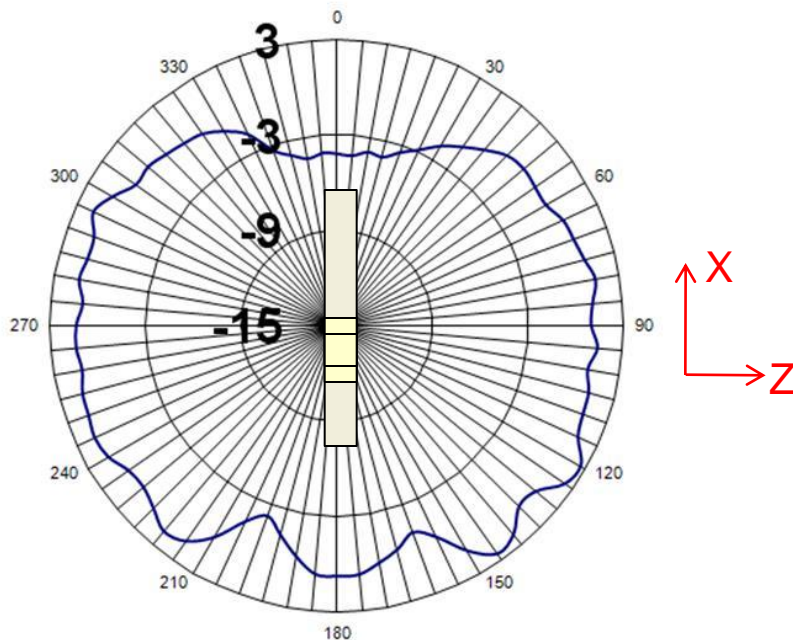


Figure 3c: Radiation diagram of X-Z plane shows combined polarizations as measured on reference board

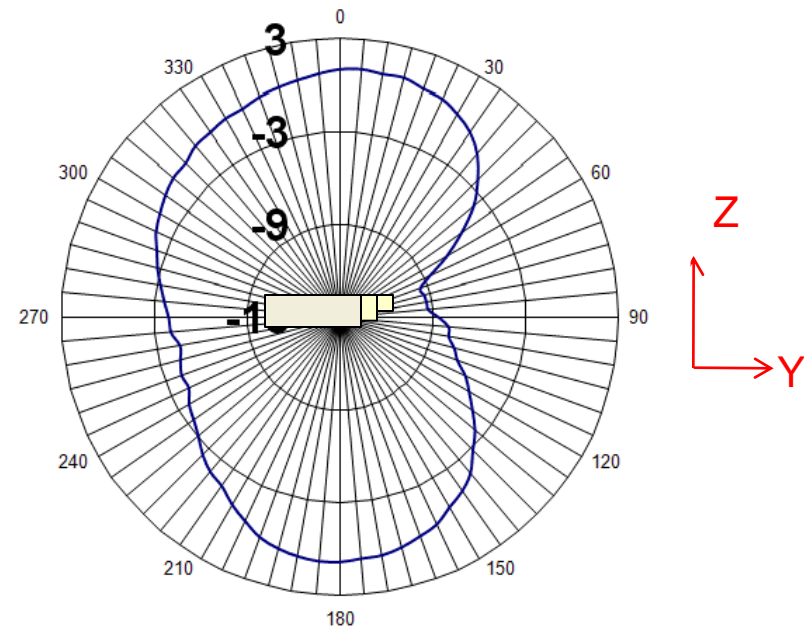


Figure 3d: Radiation diagram of Z-Y plane shows combined polarizations as measured on reference board

Competitive Information



Key Selling Benefits – Molex vs. Competing Product

- Most small ceramic antennas require some degree of ground clearance in the PCB to achieve the required radiation properties
- Molex's miniature 2.4GHz SMD on-ground antenna do not require any ground clearance and is suitable for use on PCBs of various sizes
- Customers can realize greater PCB real estate savings since the PCB ground layers can be left intact for other uses and the space on the reverse side of the PCB can be used for component assembly and other purposes



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one company > a world of innovation



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