Planar Antennas for WLAN Applications

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Outlines

- **WLAN Mobile-Unit Antennas**
  - **Surface mountable antennas**
  - **Printed monopole antennas**
  - **Printed dipole antennas**
  - **Slot antennas, PIFAs**
- **WLAN Access-Point Antennas**
  - **Patch antennas for broadside radiation**
  - **Printed monopole antennas**
  - **Printed dipole array antennas**

Surface Mountable Antennas

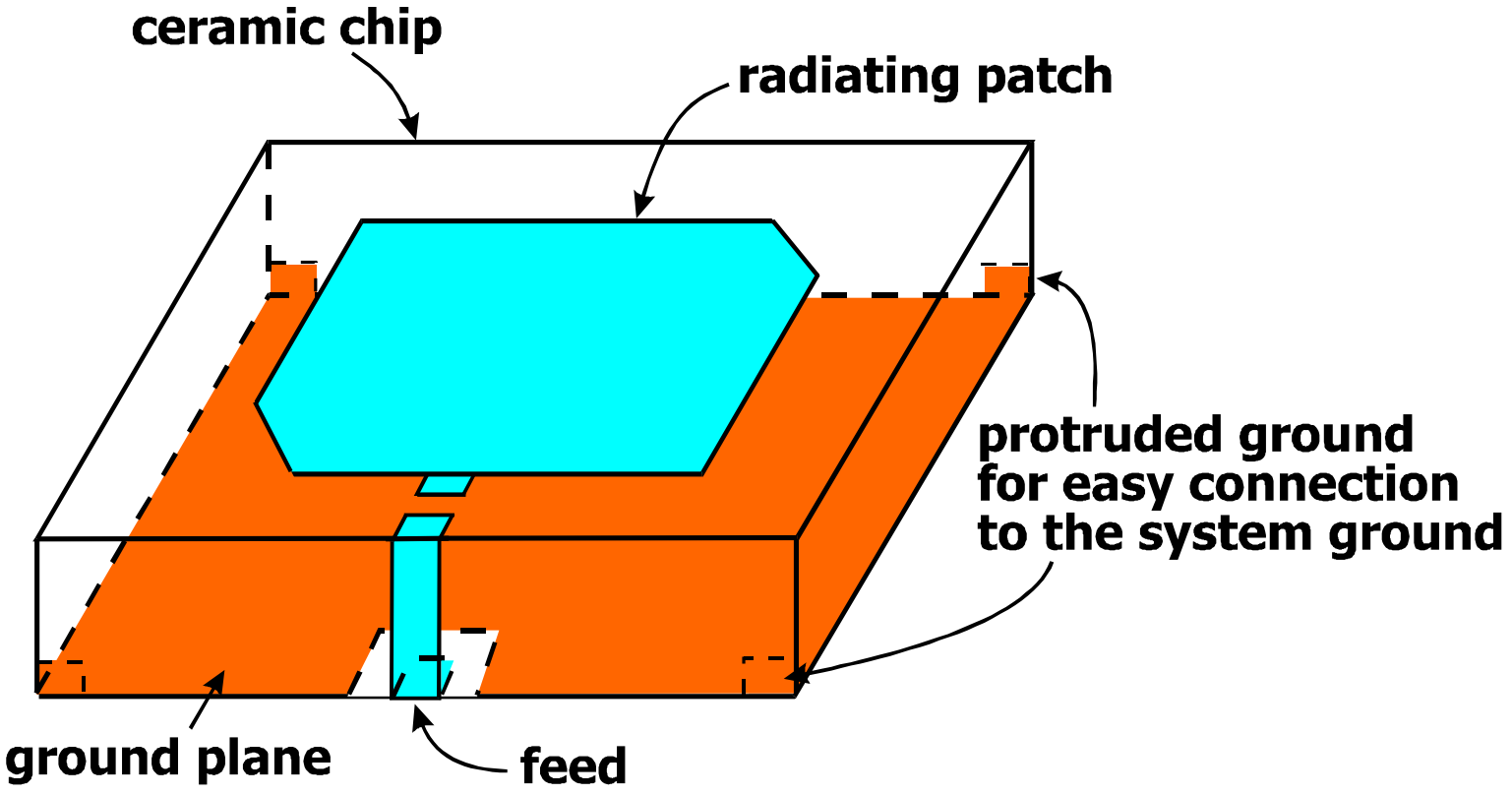
- **Ceramic chip antennas**
- **Plastic chip or Folded strip monopole antennas**
- **Dielectric resonator antennas**

SMA- Ceramic Chip Antennas

- **Regular patch antenna (ceramic chip as a substrate)**
- **PIFAs**
- **Monopoles (ceramic chip as a support for the monopole)**

SMA- Ceramic Chip Antenna (1)

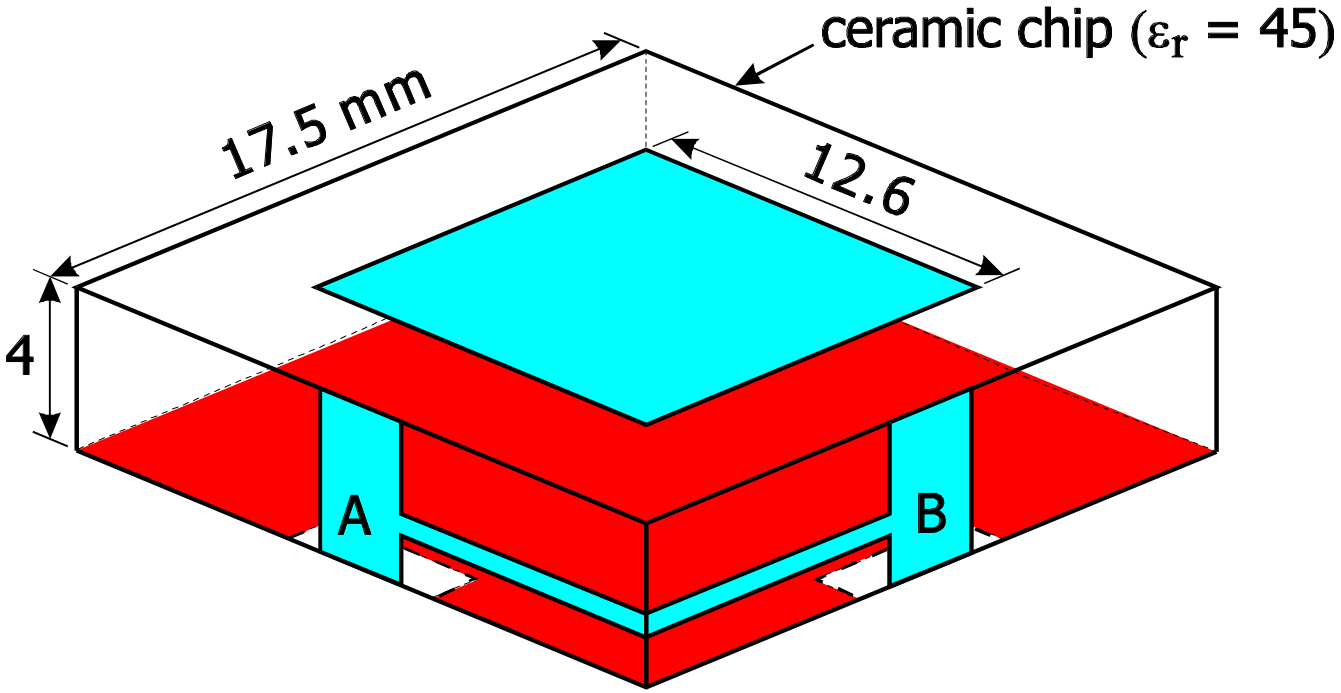
CP Design



US Patent 6140968

SMA- Ceramic Chip Antenna (2)

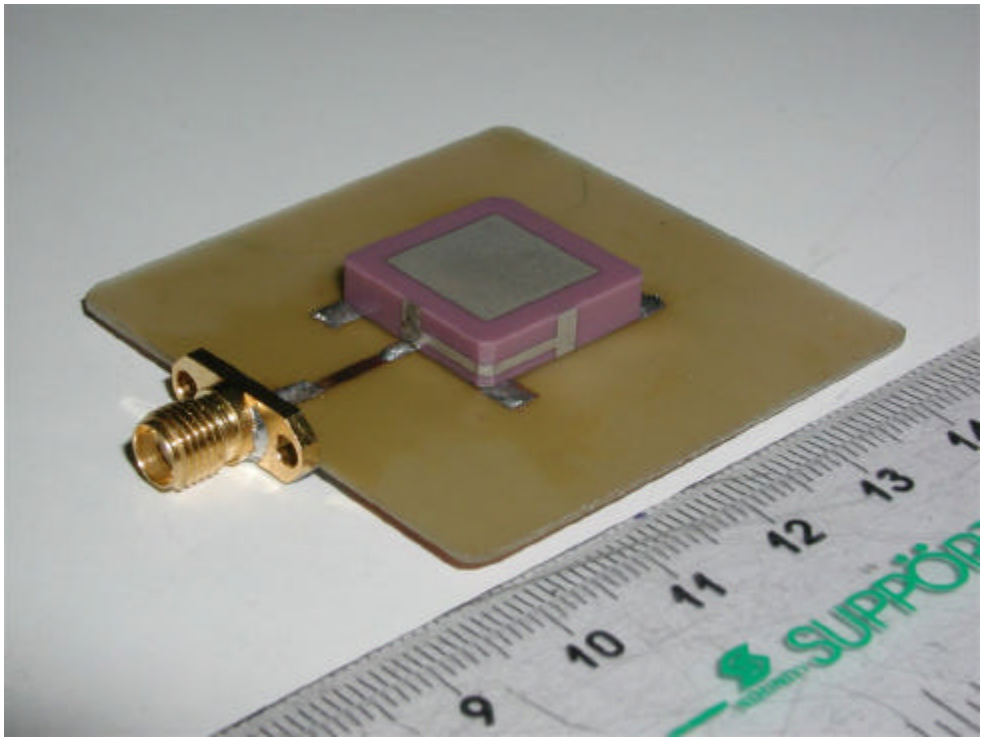
CP Design, dual side-feed, feed at A for RHCP, feed at B for LHCP



Patent pending

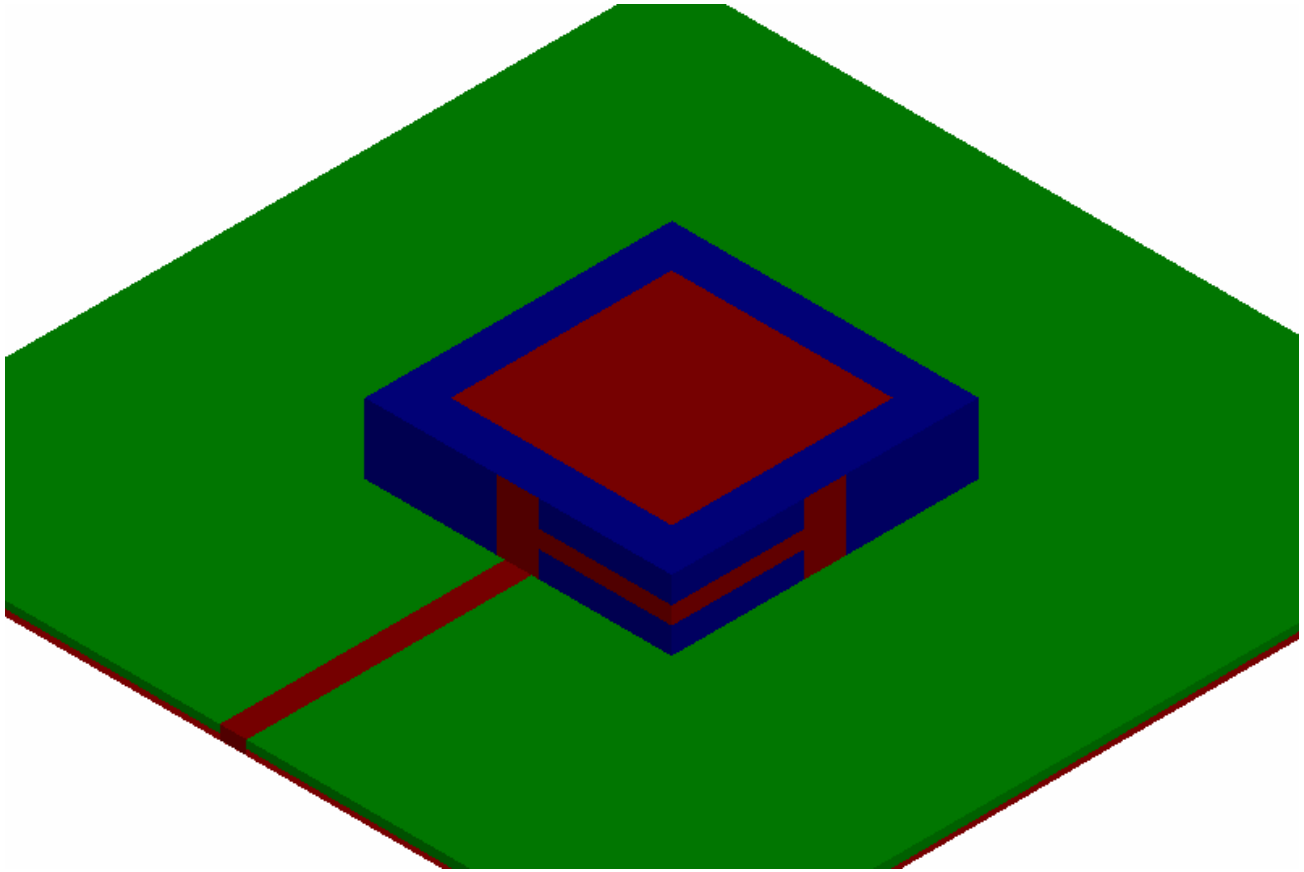
SMA- Ceramic Chip Antenna (2.2)

CP Design, dual side-feed ceramic chip antenna; Gain level about 3.0 dBic (test board 50 mm x 50 mm) for 1575 GHz GPS operation



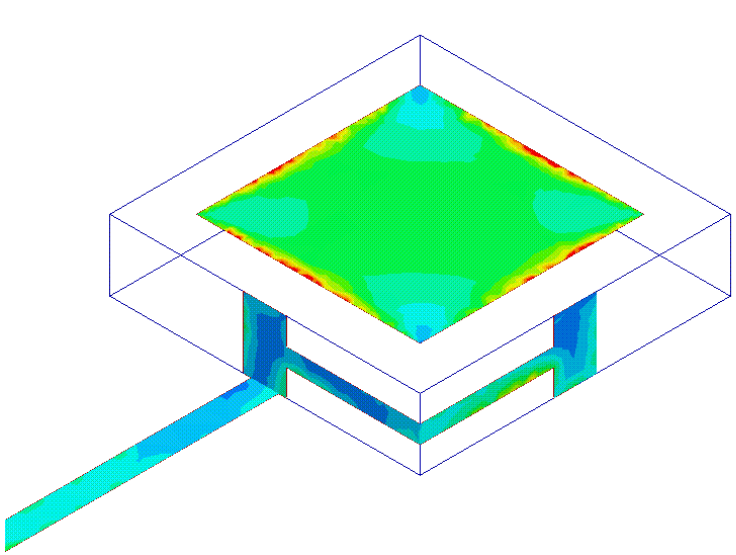
Patent pending

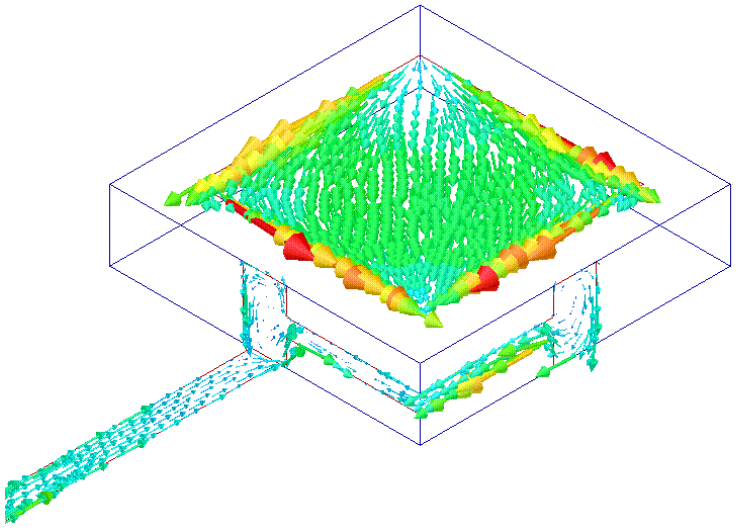
3D Model in Ansoft HFSS



Current Plot on Antenna

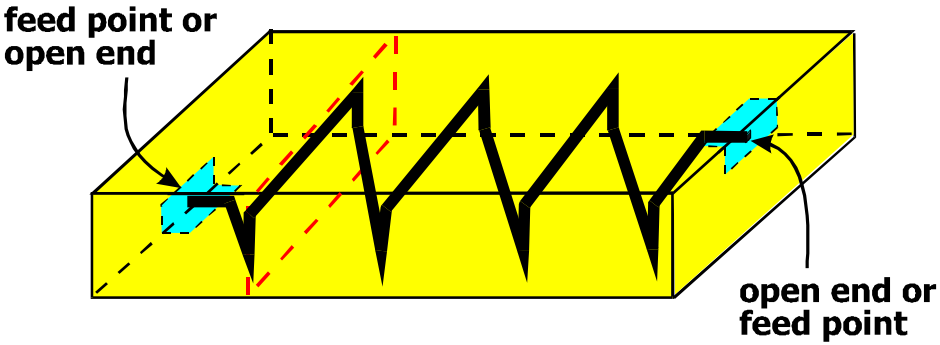
Ansoft HFSS

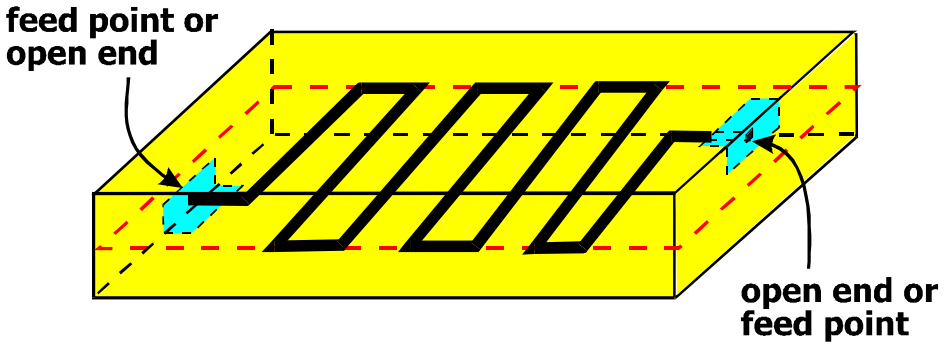




SMA- Ceramic Chip Antenna (3)

Helix monopole embedded within the ceramic chip





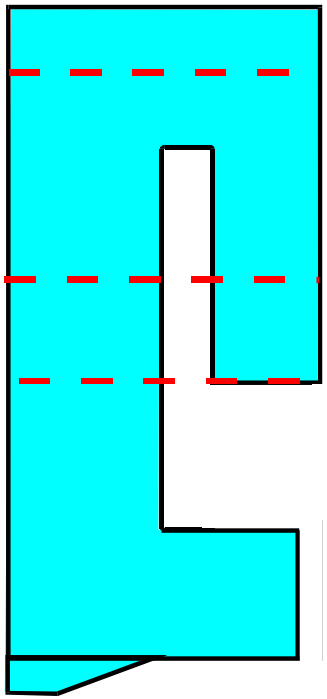
Meandered monopole embedded within the ceramic chip

US Patent 5977927, 5892490

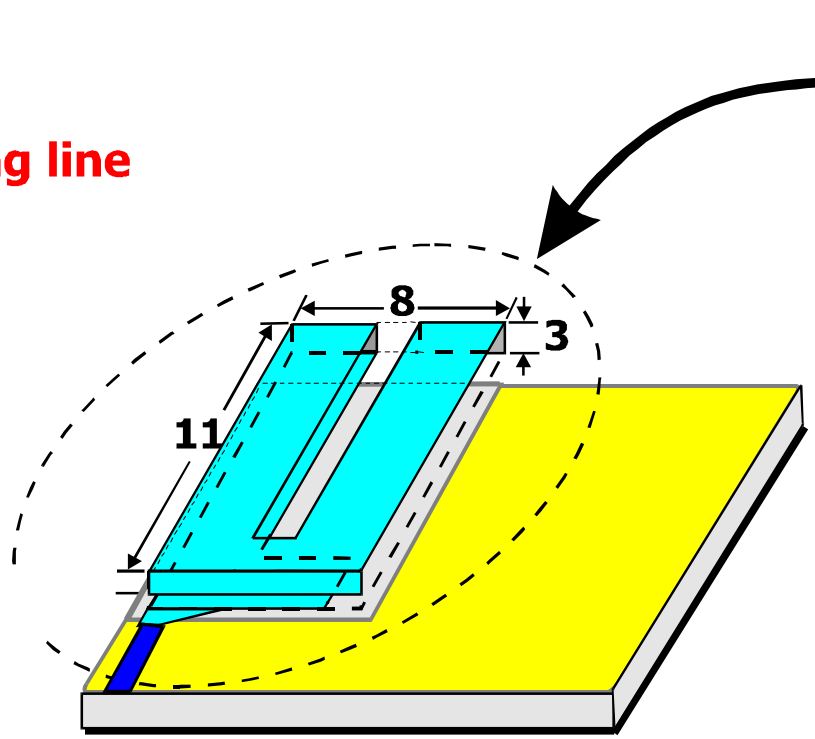
SMA- Plastic Chip or Folded Strip Monopole (1)

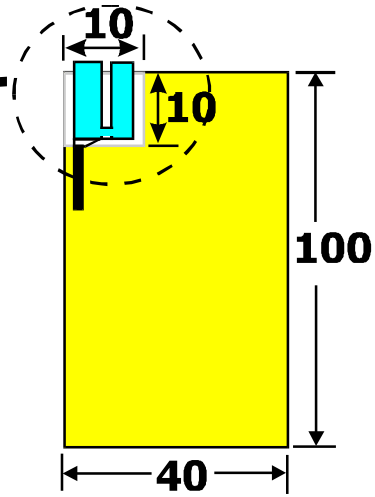
Dual-band operation in 2.4/5.2 GHz WLAN bands;
Antenna size: 12 x 8 x 3 mm³

planar structure



bending line



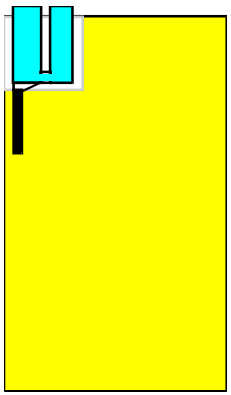


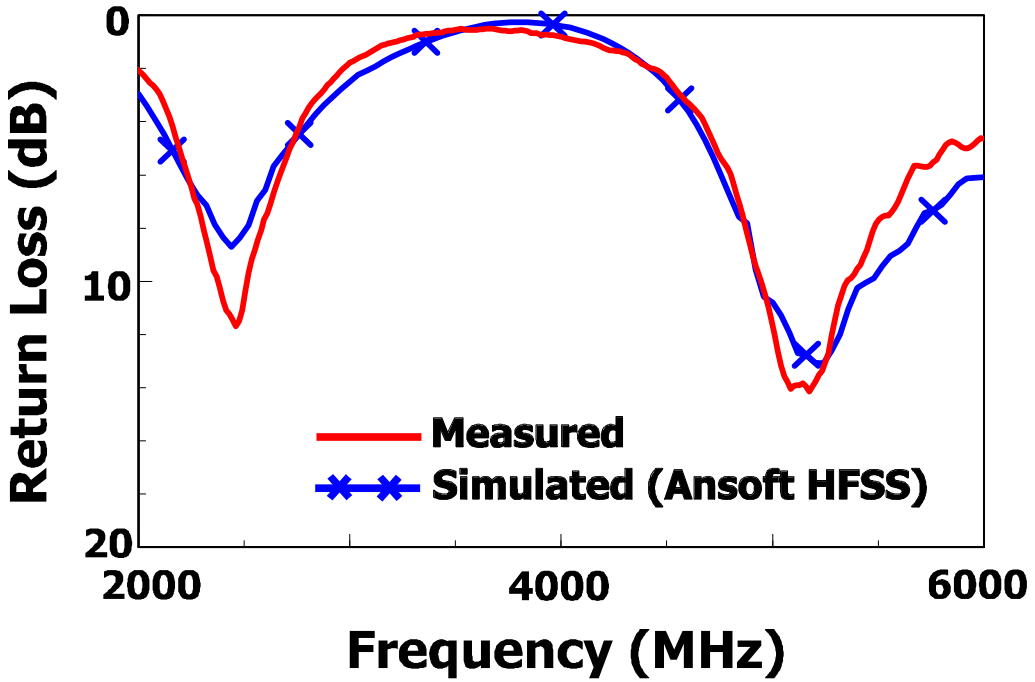
Patent pending

SMA- Plastic Chip or Folded Strip Monopole (1.1)

10 dB RL BW: 130 MHz for 2.4 GHz band, 418 MHz for 5.2 GHz band;

Gain level about 2 dBi in the 2.4 and 5.2 GHz bands





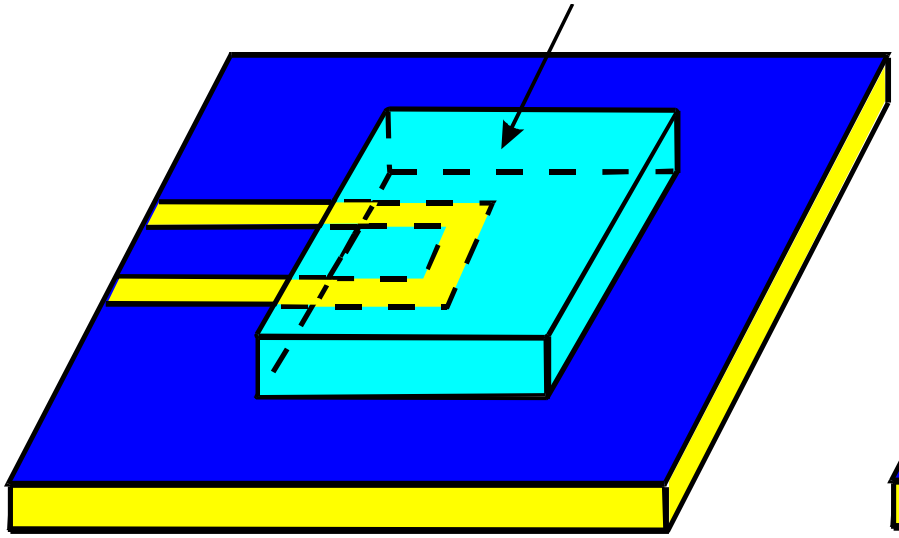
SMA- DR Antennas

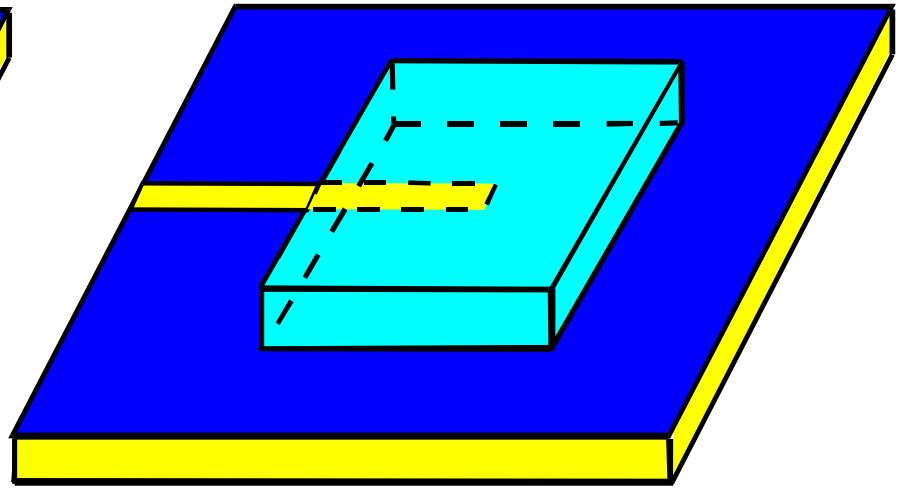
- **Dielectric constant = 20 ~ 100**
- **Compact size**
- **Very low dielectric loss**
- **No metallic loss, Suitable for higher-frequency operation**
- **Wider bandwidth than microstrip antennas**

SMA- DR Antenna with a CPW feed or a microstrip-line feed

DR antenna can be easily excited by a CPW line or a microstrip line

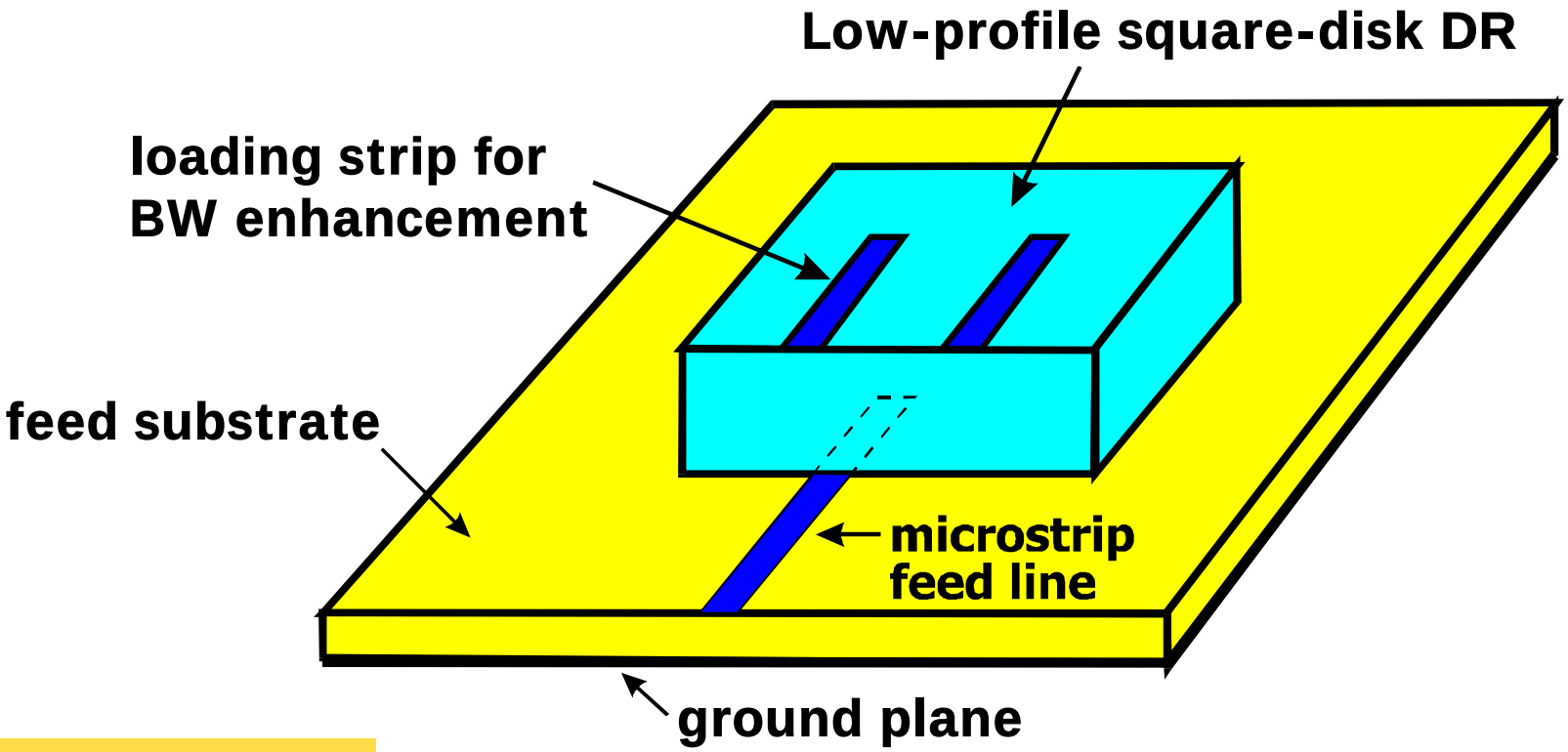
Low-profile square-disk DR





SMA- Broadband DR Antenna with a Microstrip Feed (1)

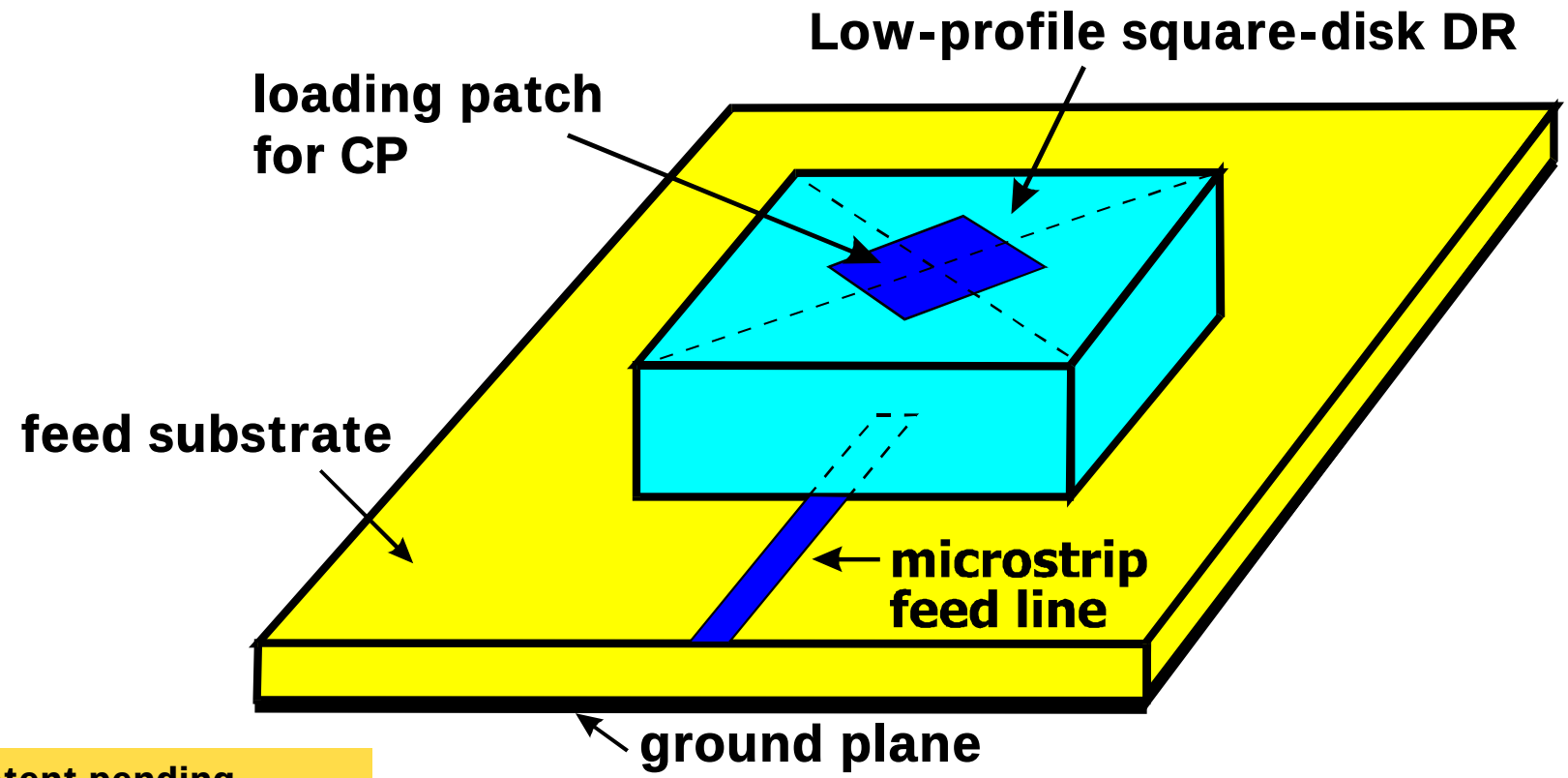
DRA with size 1.6 x 10 x 10 mm^3 and e_r = 90.5 has a 250-MHz BW for WLAN operation in the 5.2 GHz band



Patent pending

SMA- DR Antenna for CP Radiation (1) using a loading patch

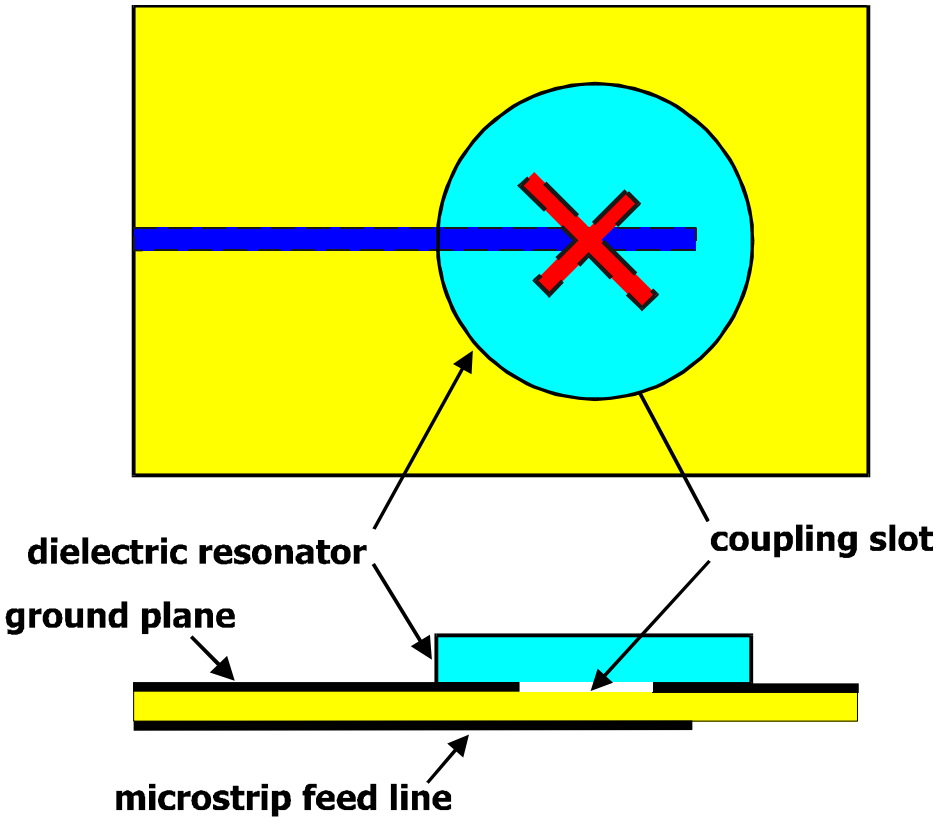
DRA with size 28 x 28 x 4.9 mm^3 and e_r = 79 has a 1.1 % CP BW@2 GHz



Patent pending

SMA- DR Antenna for CP Radiation (2) using a cross-slot-coupled feed

DRA with radius 14.7 mm, height 5.1 mm, and e_r = 79 has a 3.9 % CP BW@2 GHz

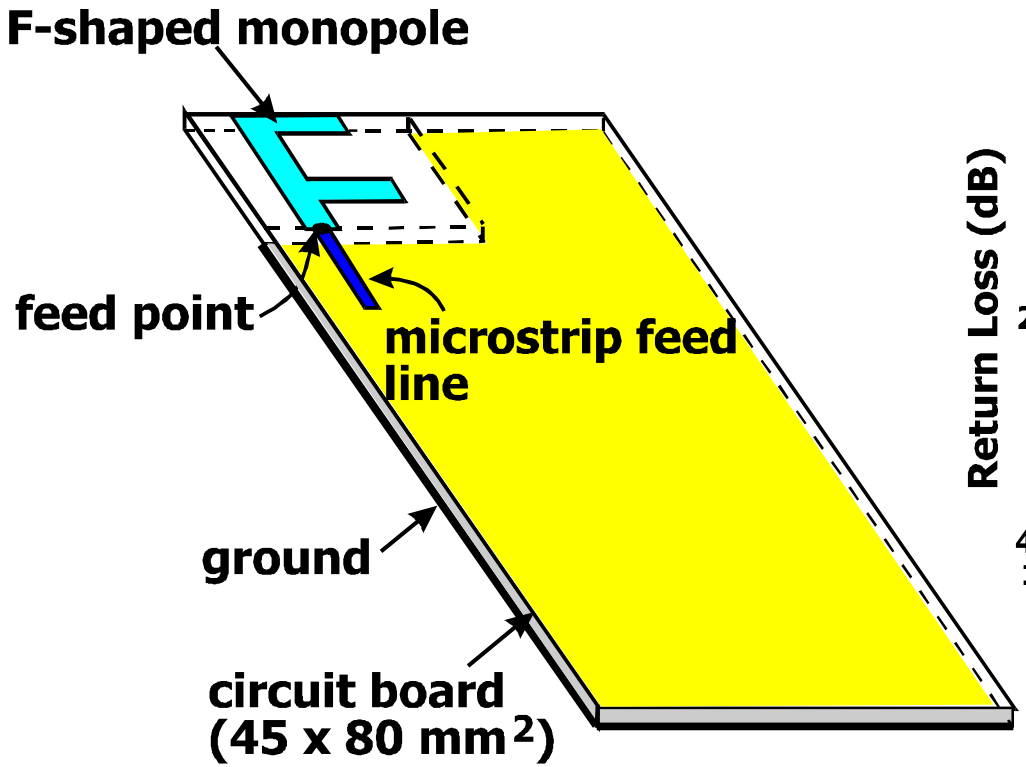


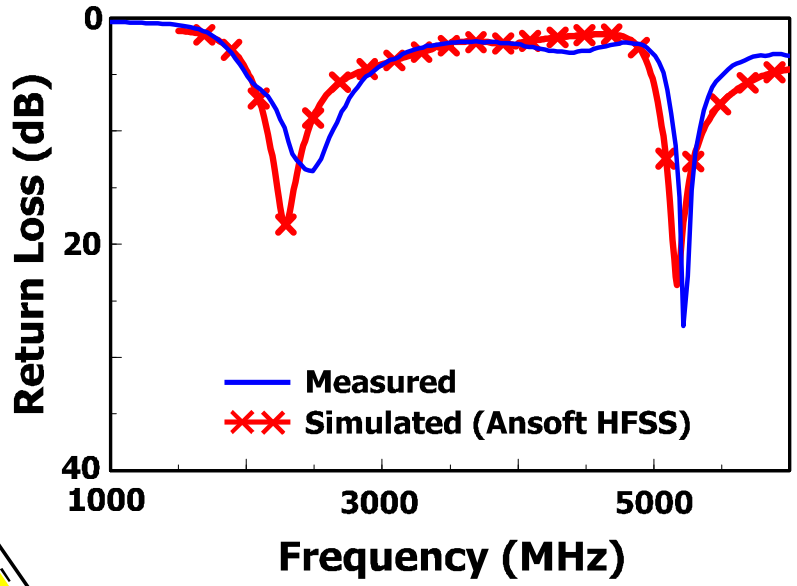
WLAN Printed Monopole Antennas

- **Integrated design with the system circuit board**
  - **Dual-band monopole antenna**
  - **Diversity monopole antenna**
  - **Diversity dual-band monopole antenna**
- **Printed monopole with a coaxial feed line**

WLAN Printed Monopole-Dual-band monopole (1)

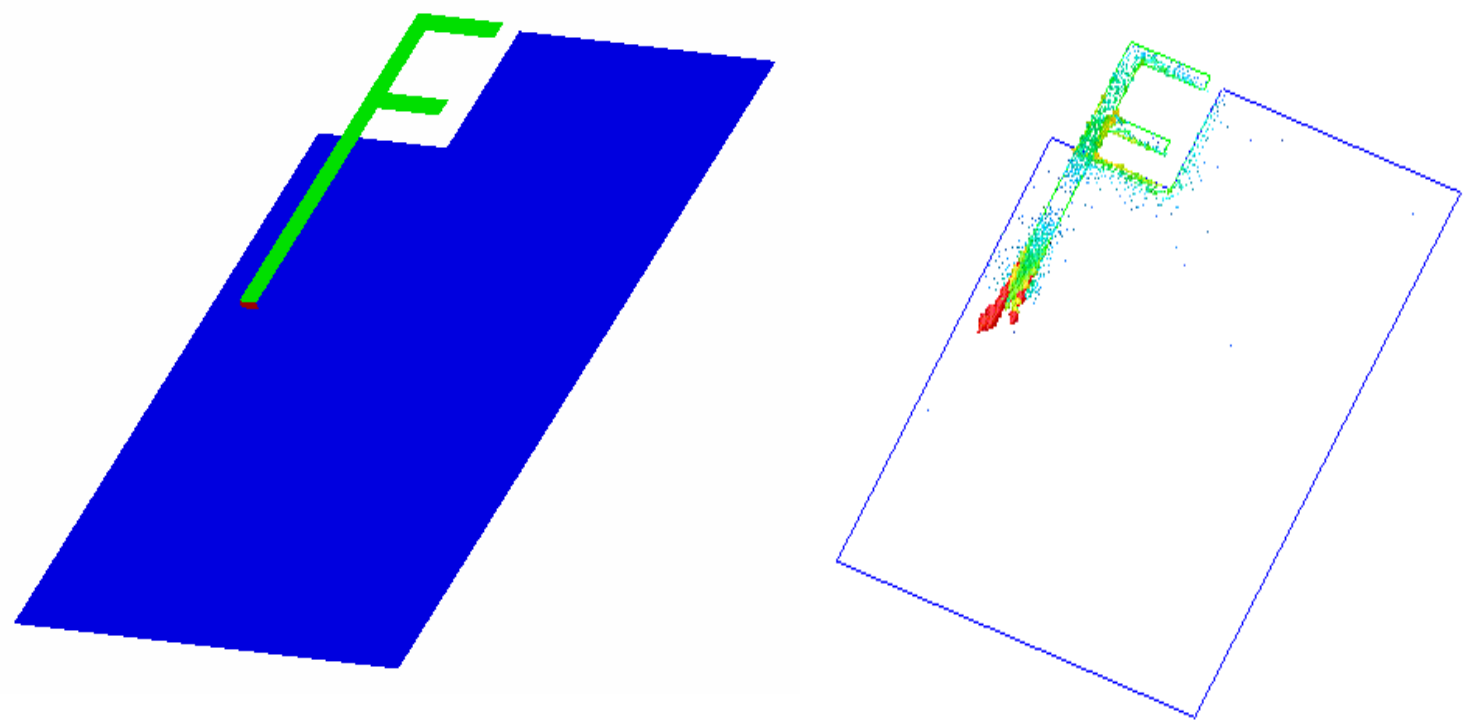
Dual-band F-shaped monopole for 2.4/5.2 GHz WLAN bands; antenna size: 10 x 15 mm²





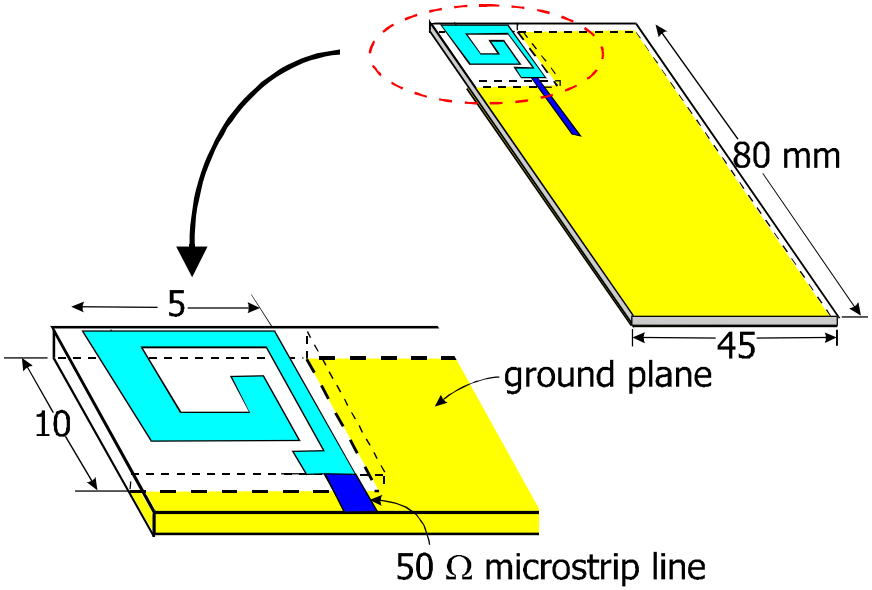
Patent pending

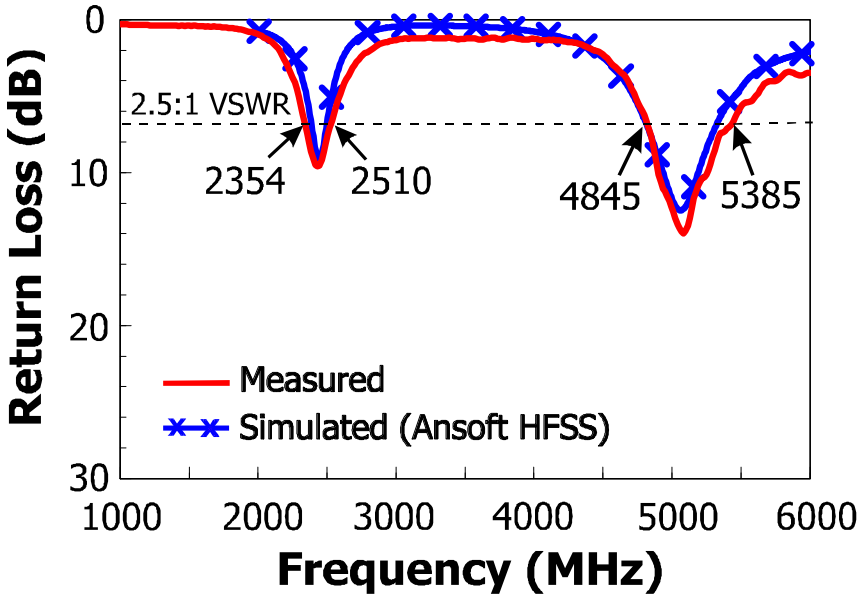
3D Model in Ansoft HFSS & Vector Current Plot



WLAN Printed Monopole-Dual-band monopole (2)

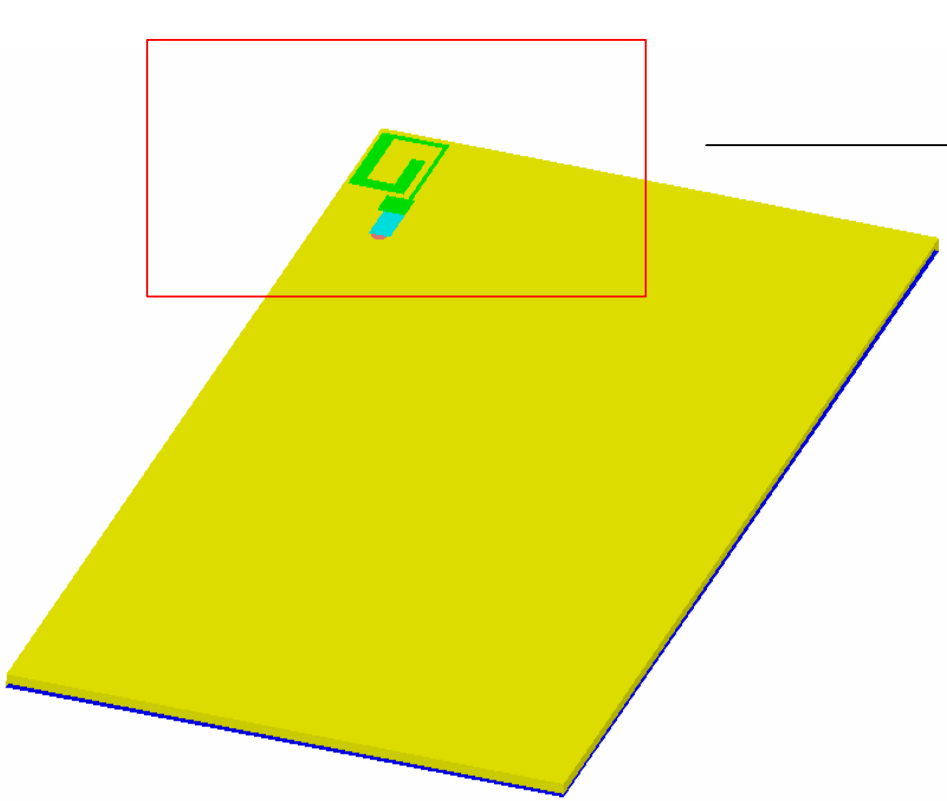
Dual-band spiral monopole for 2.4/5.2 GHz WLAN bands

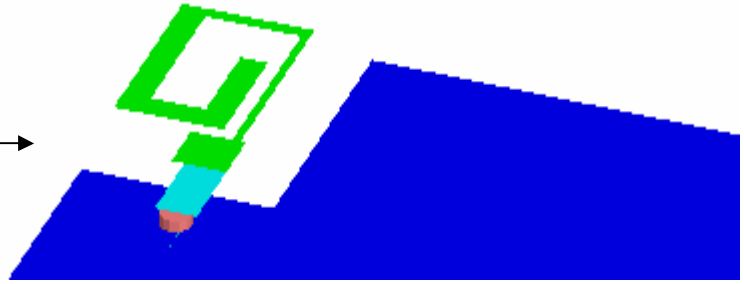




Patent pending

3D Model in Ansoft HFSS





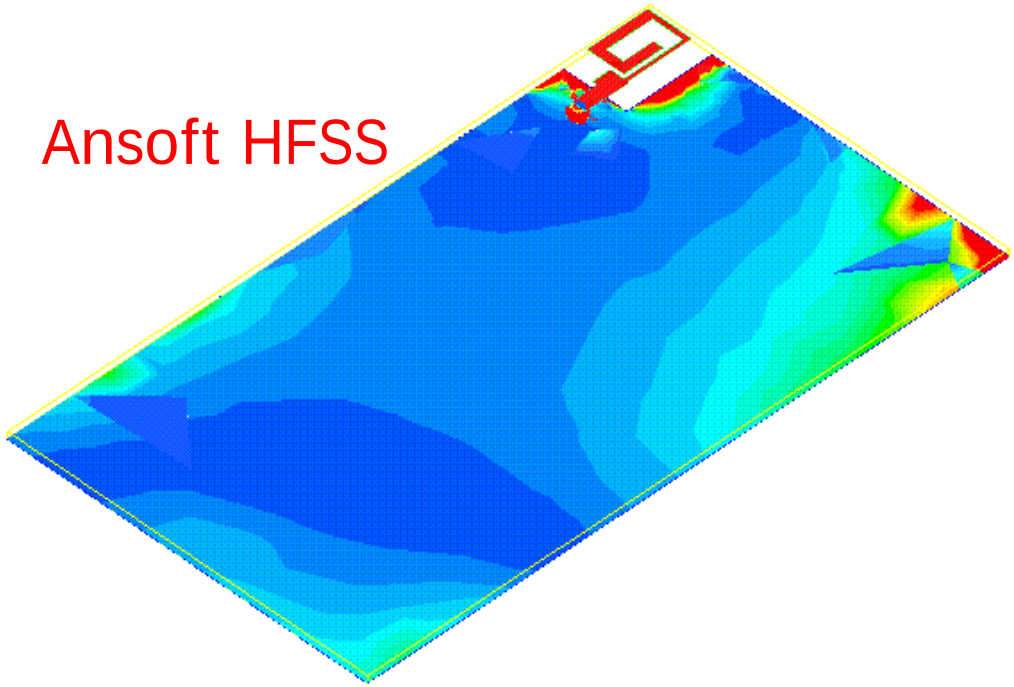
Without substrate

Ground plane

substrate

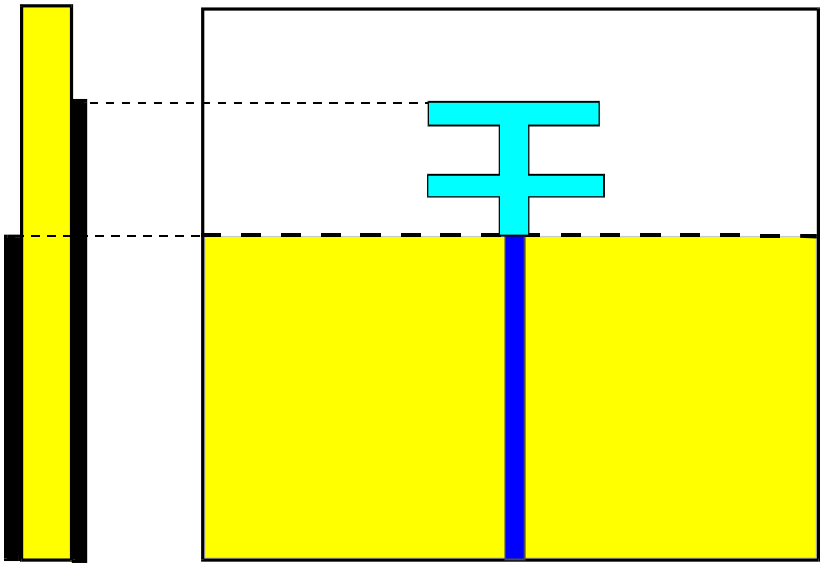
Magnitude Current Plot on Antenna

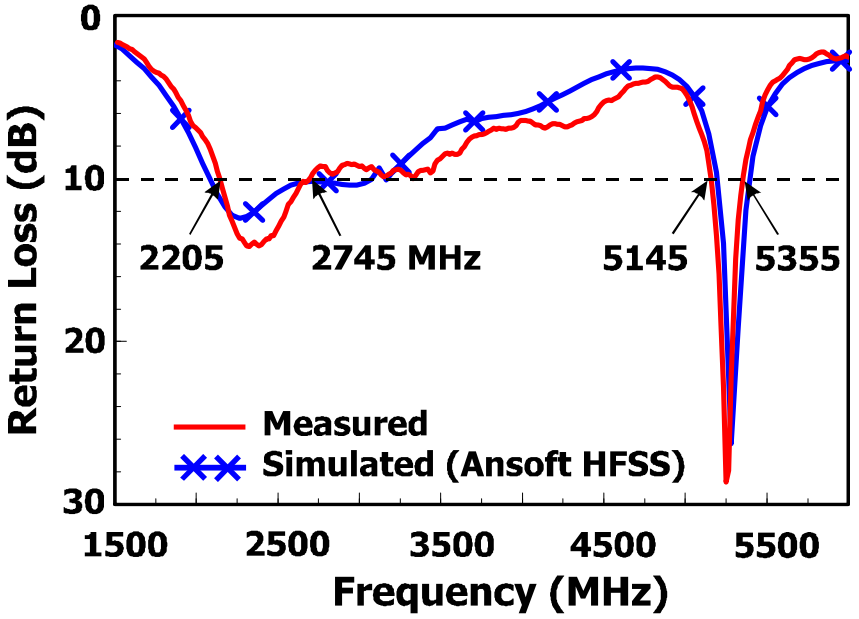
Ansoft HFSS



WLAN Printed Monopole-Dual-band design (3)

Dual-band double-T monopole for 2.4/5.2 GHz WLAN bands



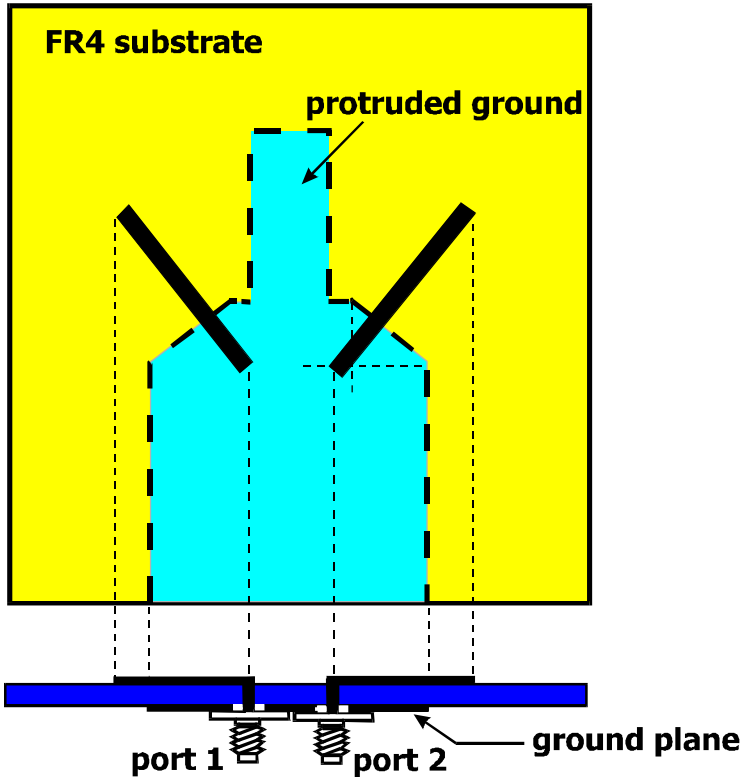


Patent pending

WLAN Printed Monopole-Diversity monopole design (1)

Spatial/polarization diversity in the 2.4 GHz band

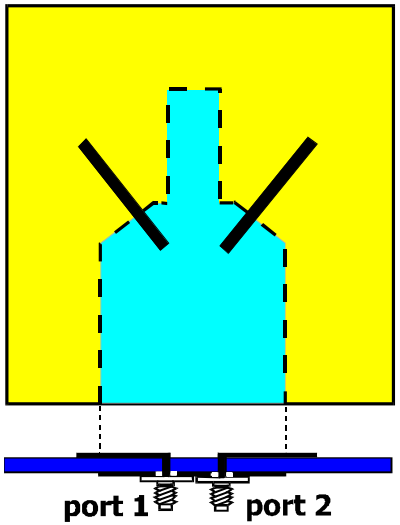
Protruded ground plane improves port decoupling between ports 1 and 2

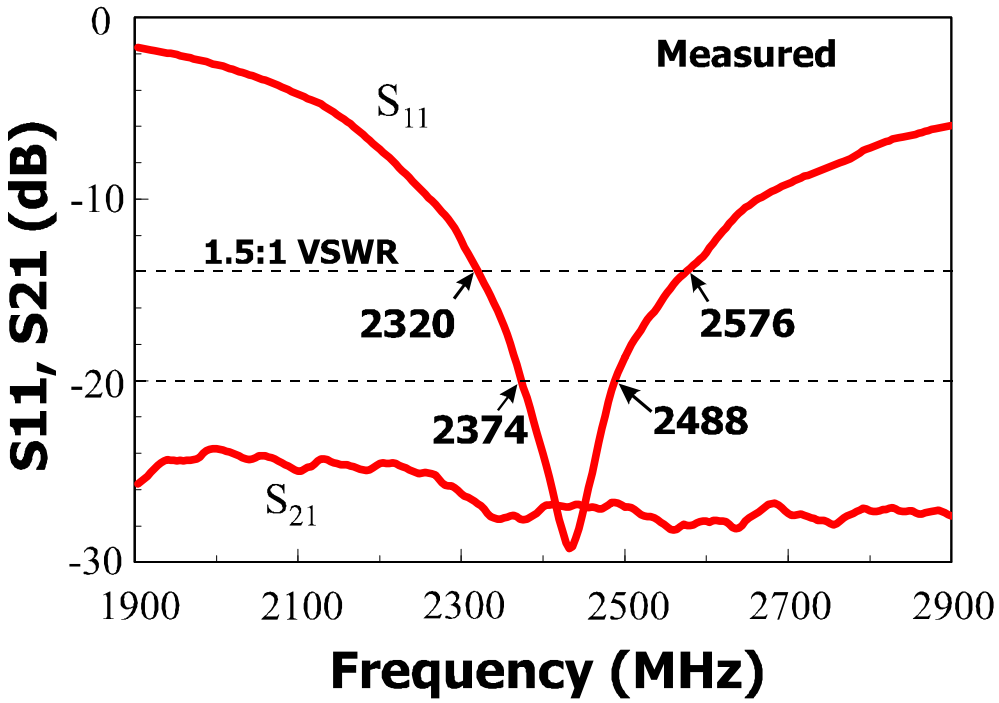


Patent pending

WLAN Printed Monopole-Diversity monopole design (1.1)

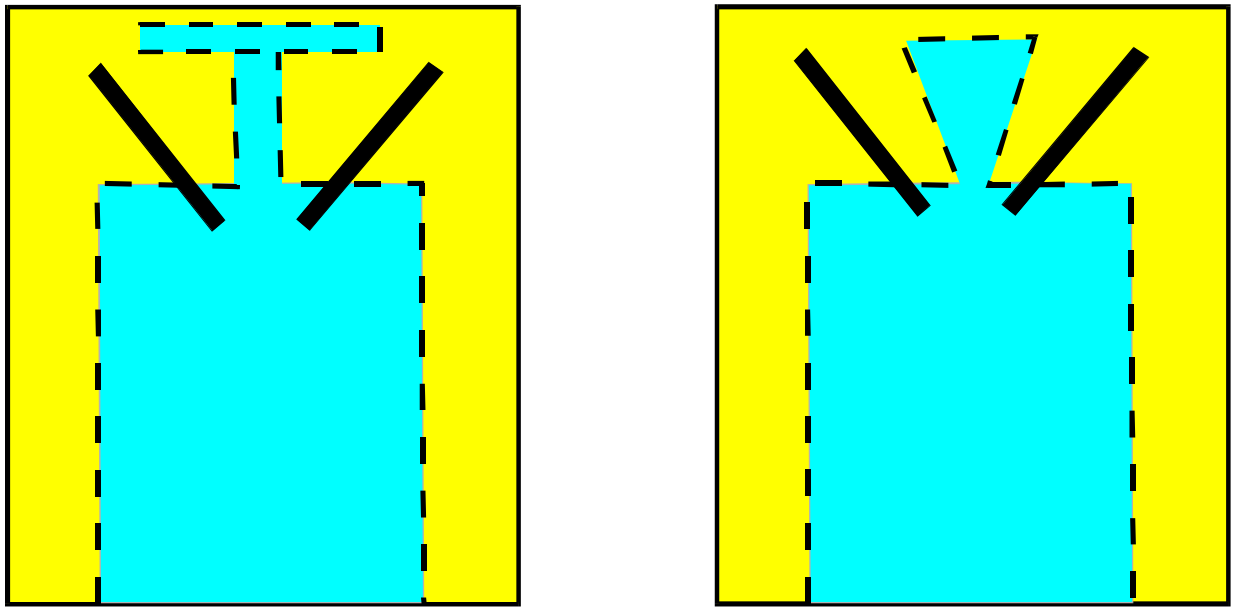
Gain level ~ 1.8 dBi for ports 1 and 2





WLAN Printed Monopole-Diversity monopole design (1.3)

Other promising diversity monopole antennas with highly decoupled feeding ports

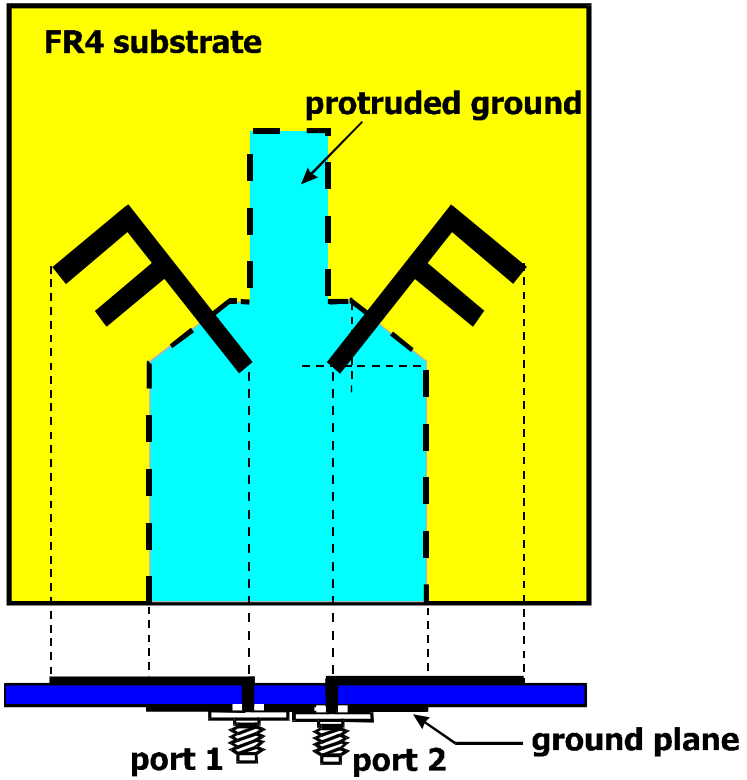


Patent pending

WLAN Printed Monopole-Diversity dual-band monopole (1)

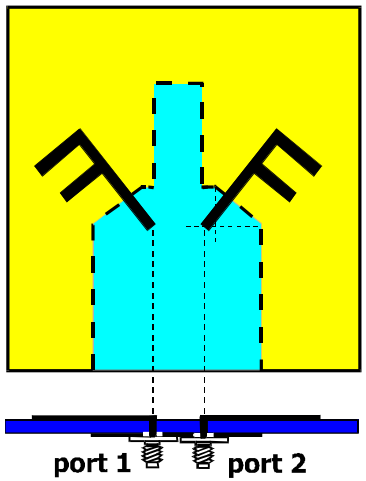
Diversity monopole antenna for 2.4 and 5.2 GHz dual-band operations

Protruded ground plane improves port decoupling between ports 1 and 2

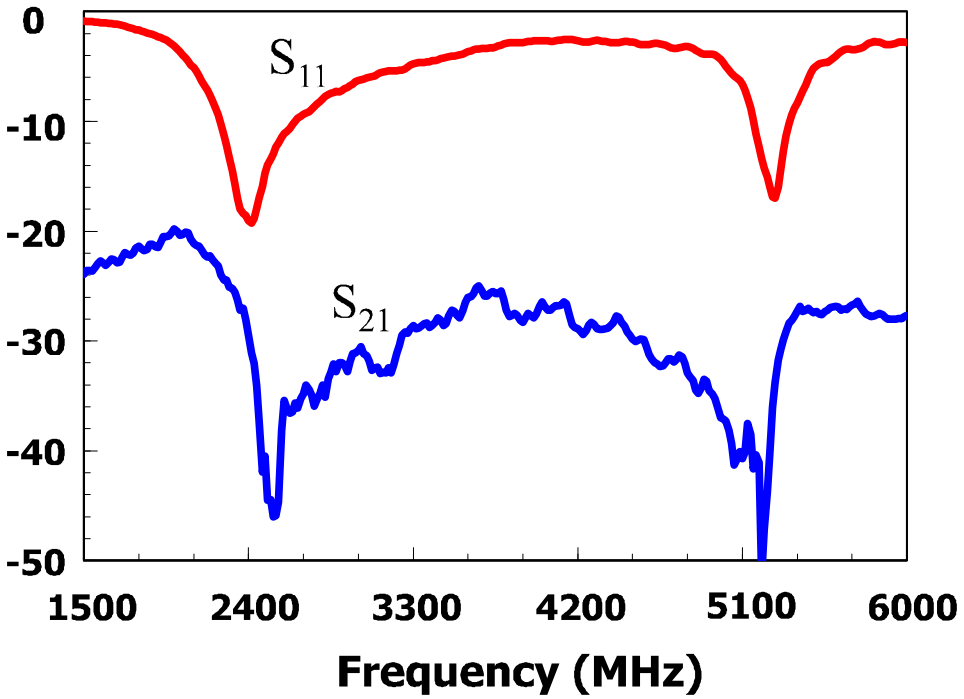


Patent pending

WLAN Printed Monopole- Diversity dual-band monopole (1.1)

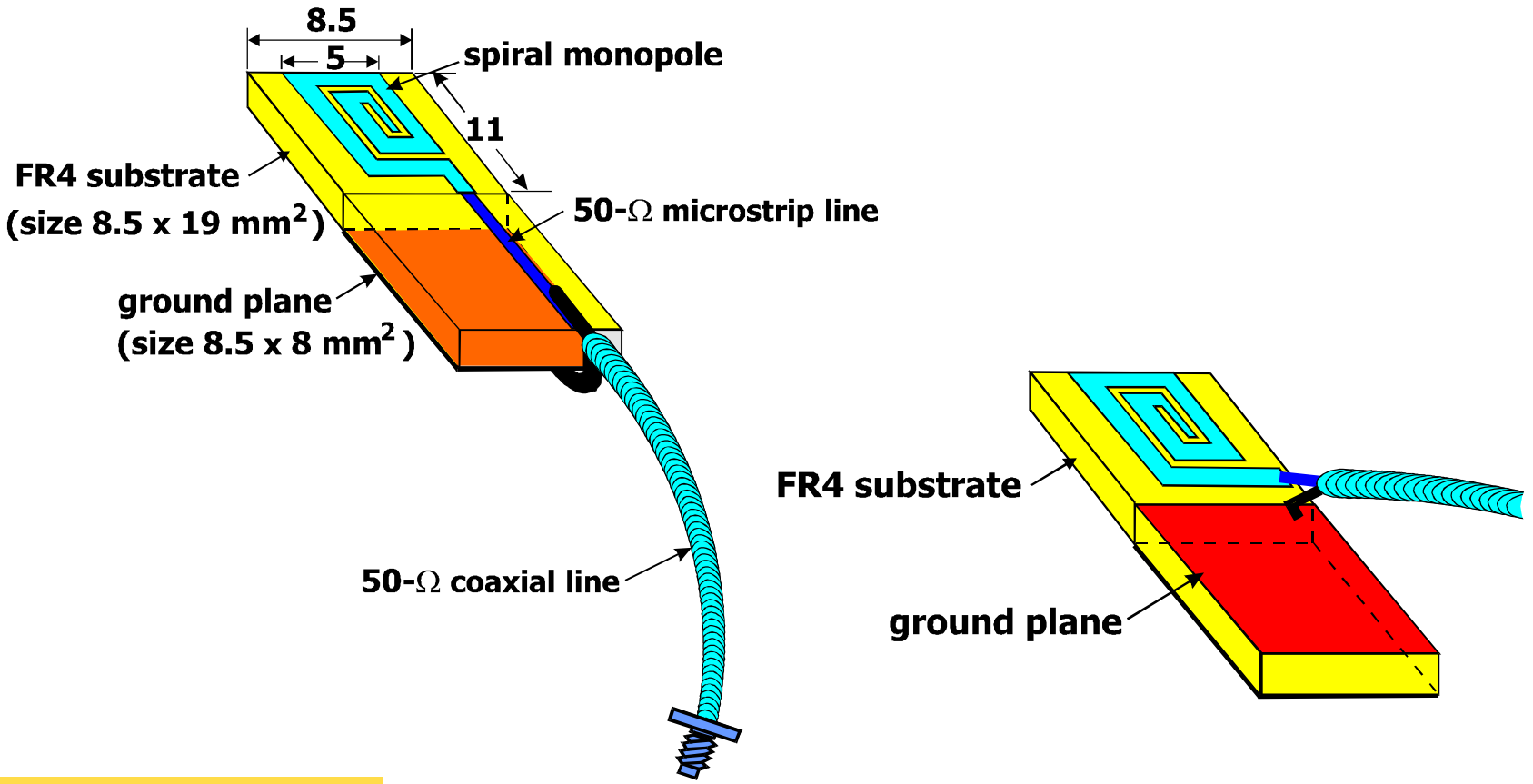


Within the 2.4 and 5.2 GHz bands, S_{11} < -10 dB and S_{21} < -28 dB



WLAN Printed Monopole-using a coaxial feed line

Dual-band spiral monopole for 2.4/5.2 GHz WLAN bands

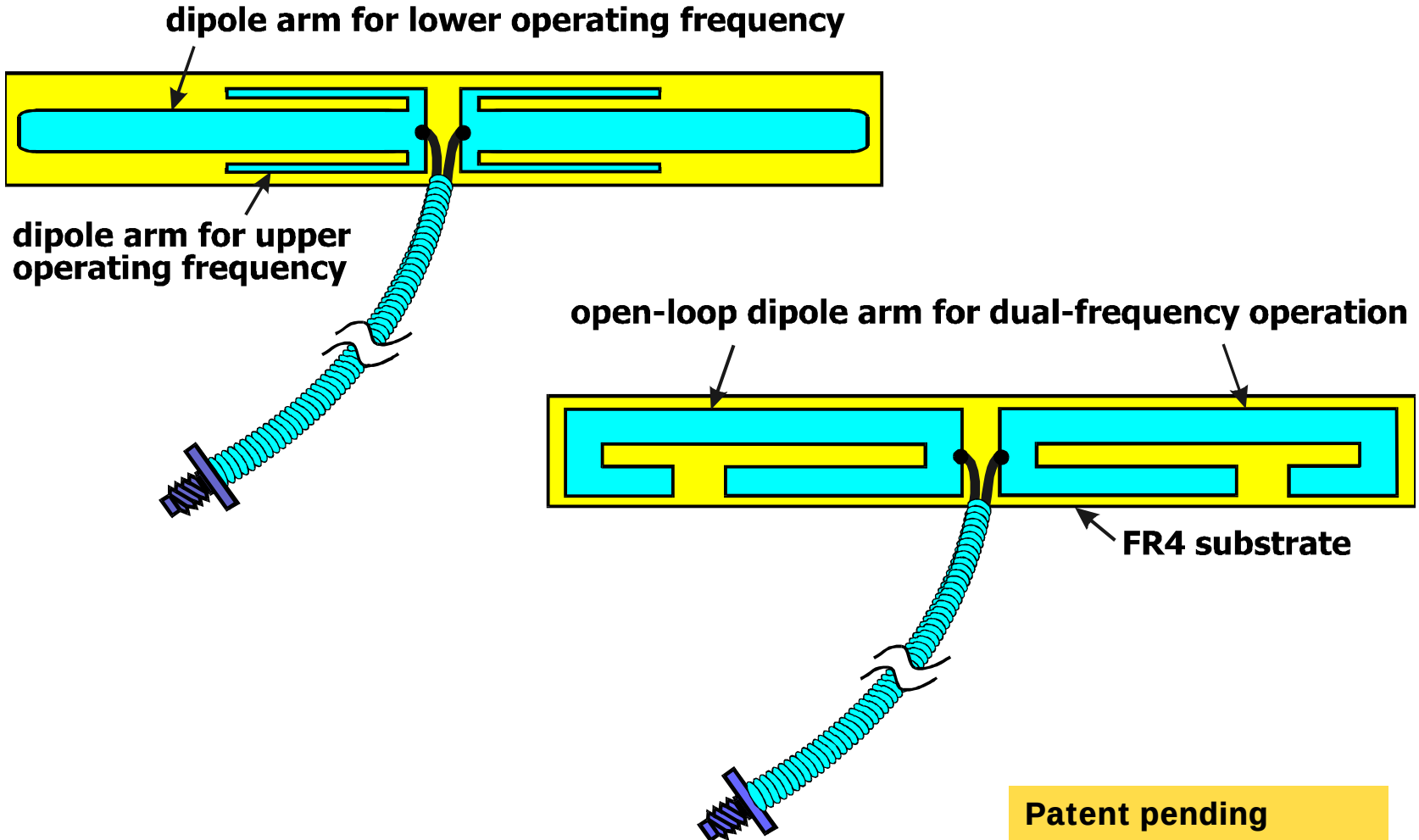


Patent pending

Dual-Band Printed Dipole Antennas

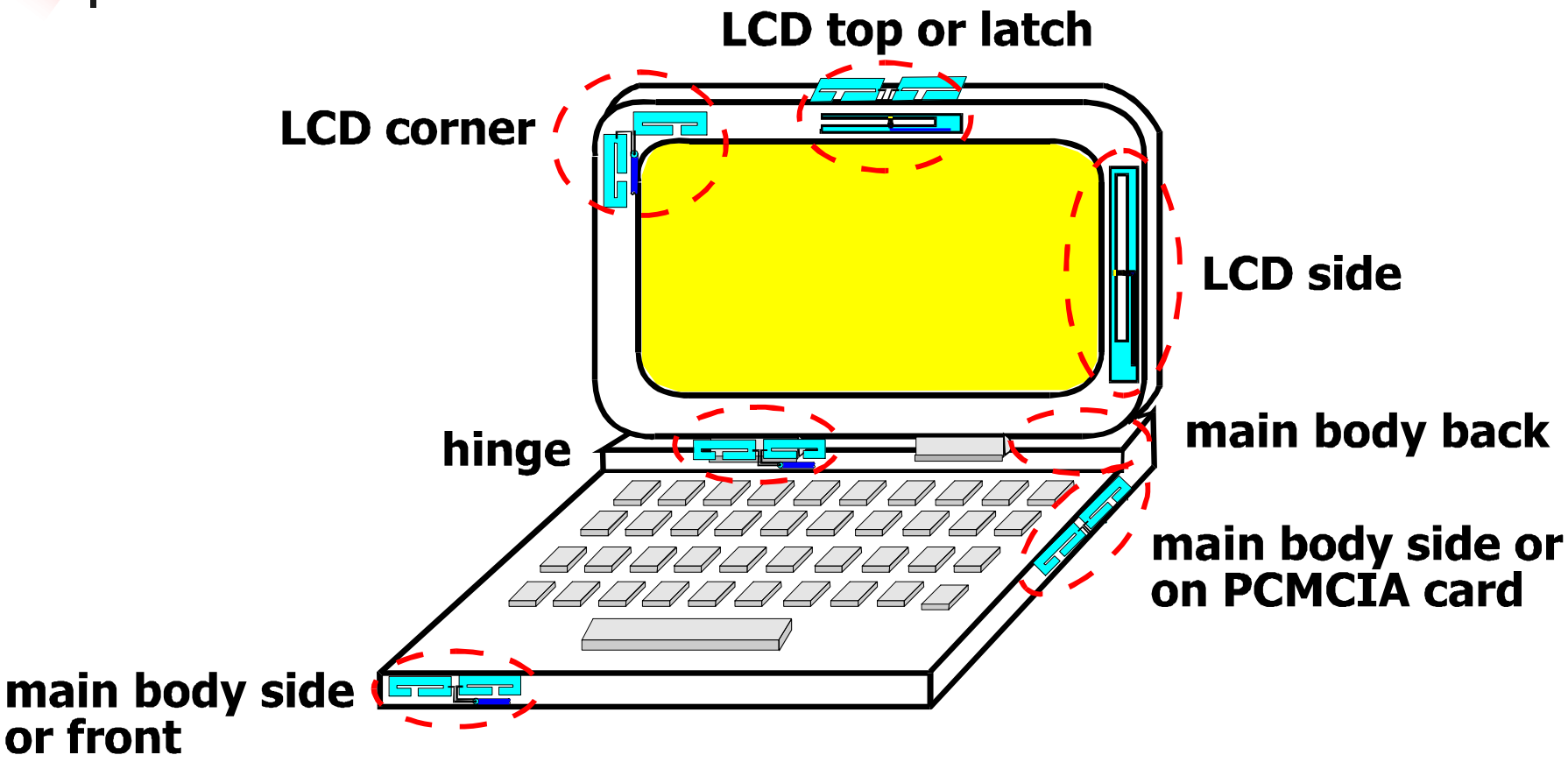
- **With trident arms**
- **With open-loop arms**
- **With L-slit-loaded arms**
- **With U-slotted arms**
- **With folded arms**

Dual-Band Printed Dipole-Fed by a Coaxial Line (1)



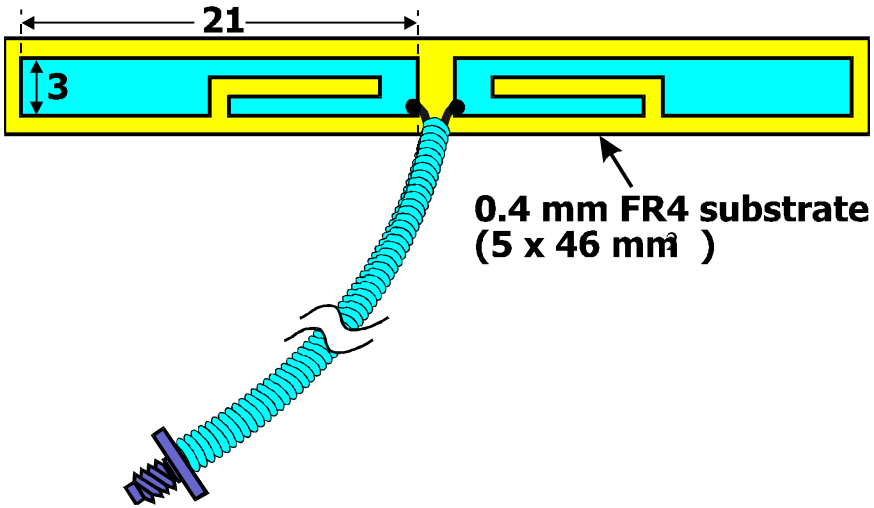
Patent pending

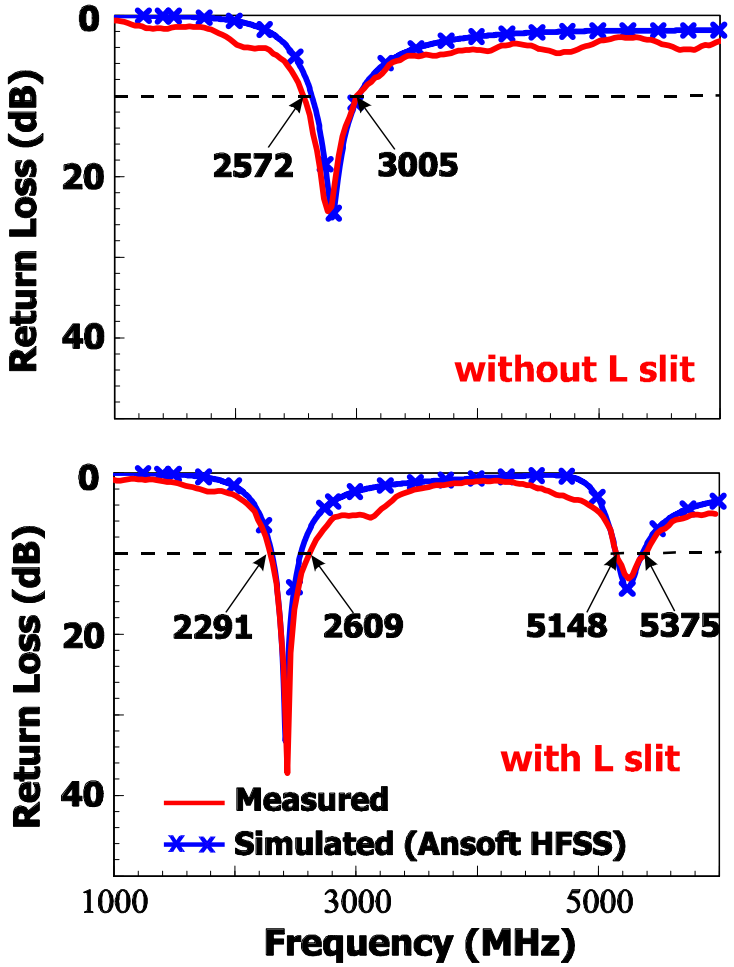
Printed Dipoles/Monopoles/Slot Antennas/ PIFAs Applied to Notebook Computer



US Patents 6344825, 6297779, 6008774, 6295029, 6339400, 2001/0040529, 2002/0021250

Dual-Band Printed Dipole-Fed by a Coaxial Line (2)

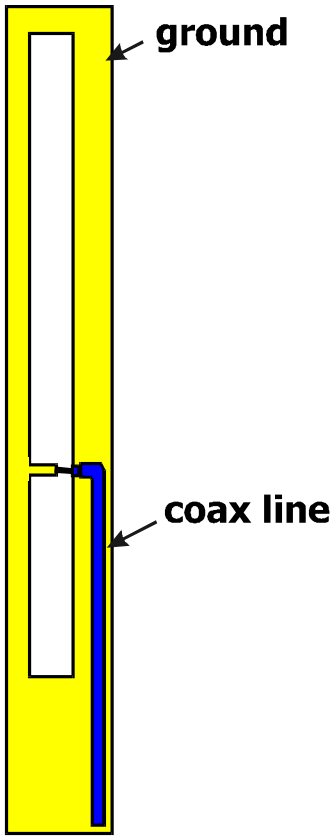




Radiation patterns across the 2.4 and 5.2 GHz bands are stable and close to those of a simple dipole antenna

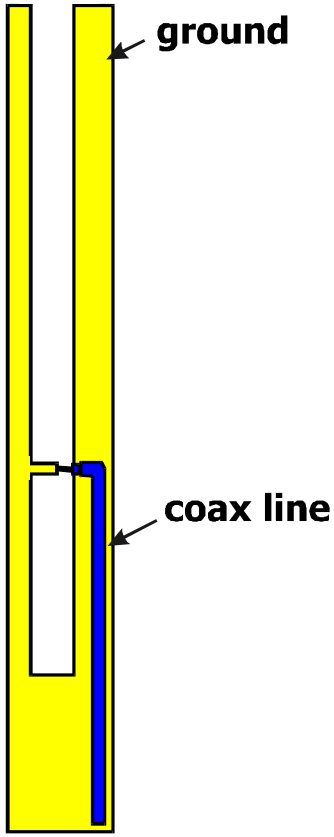
Patent pending

WLAN Slot Antenna/PIFA Applied to Notebook Computer



slot antenna

0.5 wavelength in length

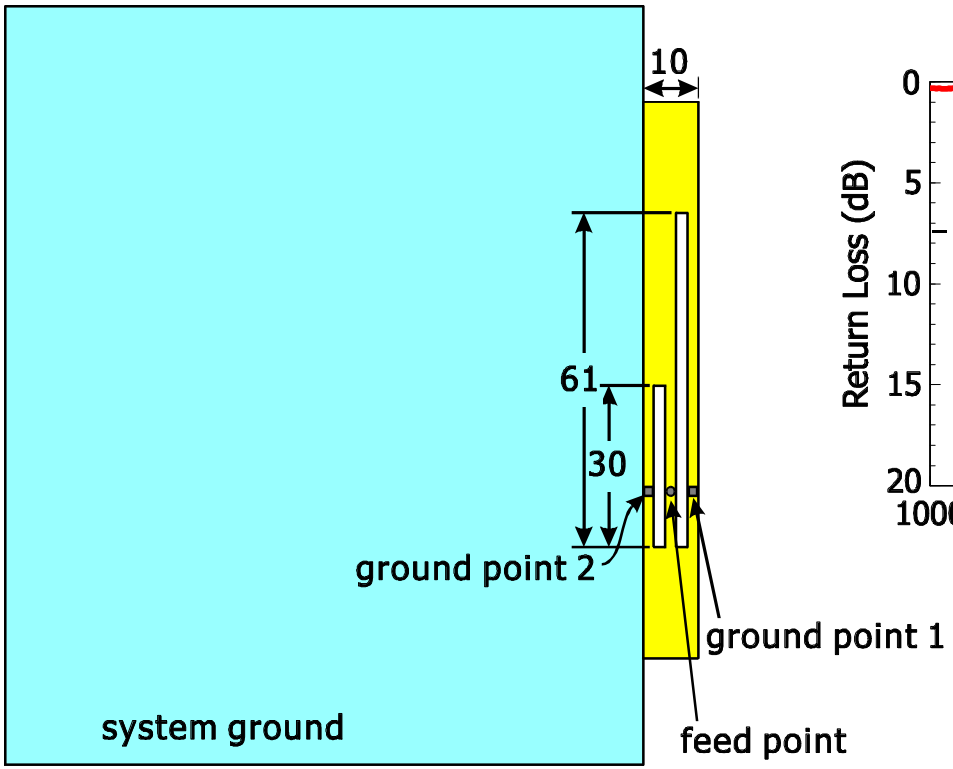


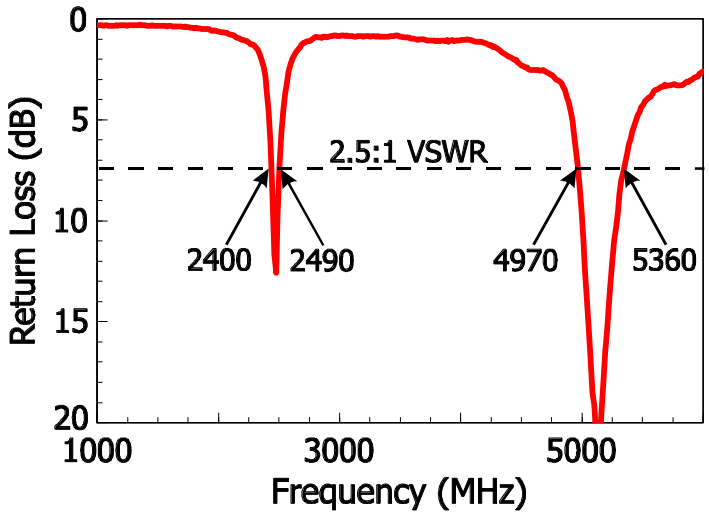
PIFA

0.25 wavelength in length

WLAN 2.4/5.2 GHz Dual-Band Slot Antenna

Antenna gain level in both the 2.4 and 5.2 GHz about 6.0~7.0 dBi

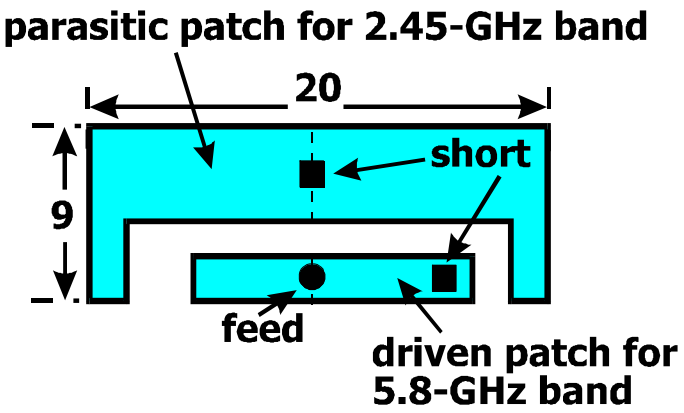




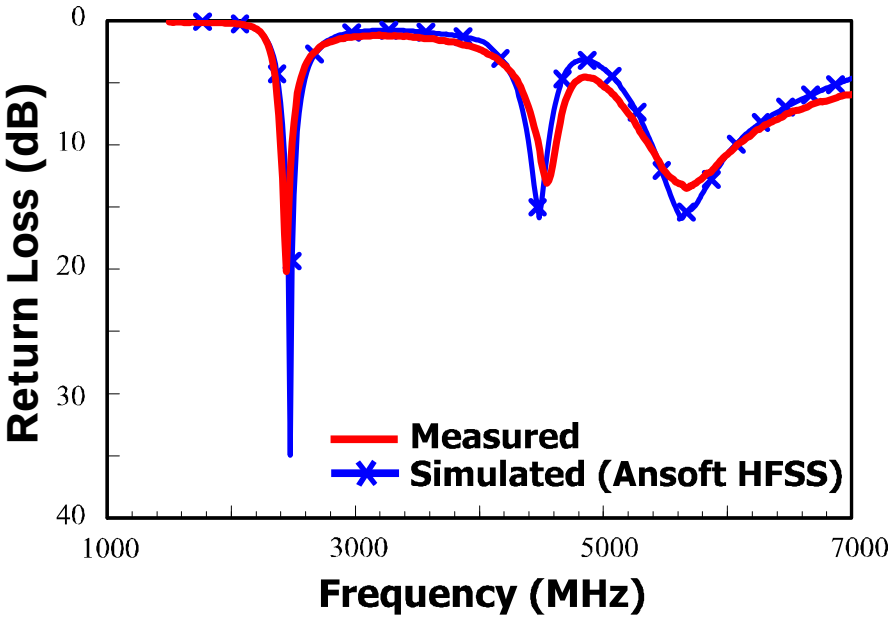
Patent pending

PIFAs for WLAN Operation- PIFA with a parasitic shorted patch

Antenna operates at the first resonant frequency of the driven and parasitic patches (2.4/5.8 GHz dual band)



Patch 5 mm above ground



Patent pending

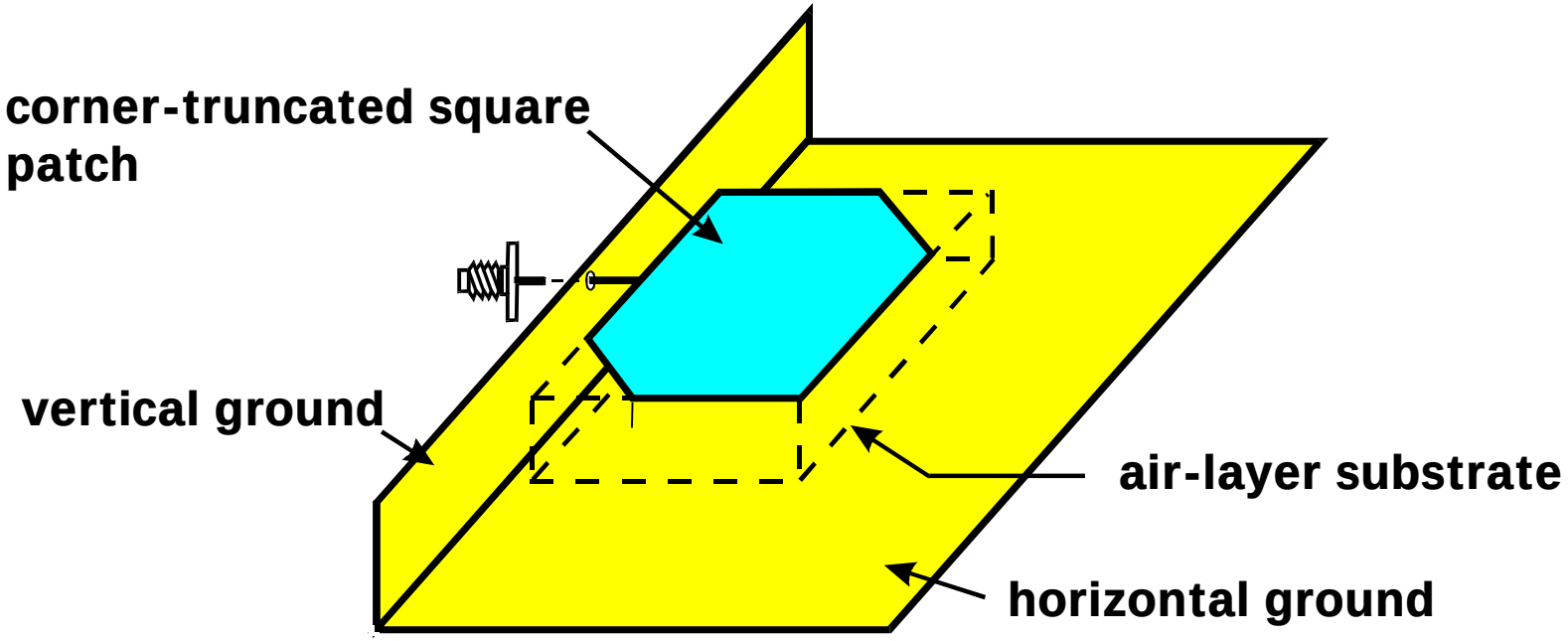
WLAN AP Antennas

- **Broadband CP design**
- **Dual-polarized design**
- **Dual-band design**
- **Printed dipole array for omnidirectional radiation**

WLAN AP Antenna-Broadband CP design (1)

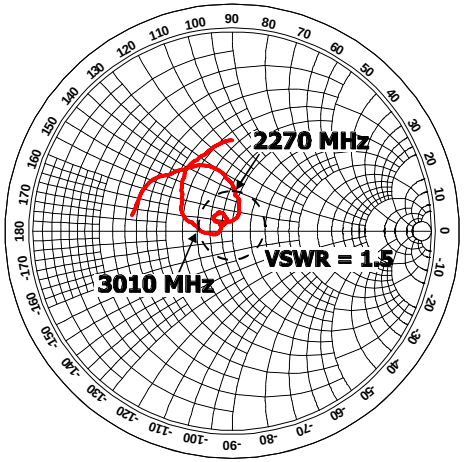
- Single-feed design with low cost in construction

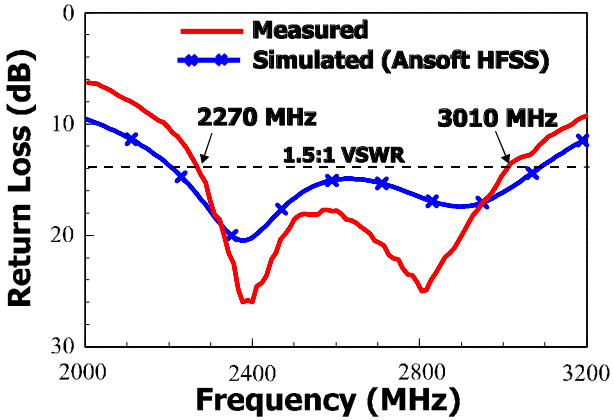
3dB AR CP bandwidth > 10 %@2.45 GHz, gain level ~ 8.5 dBi

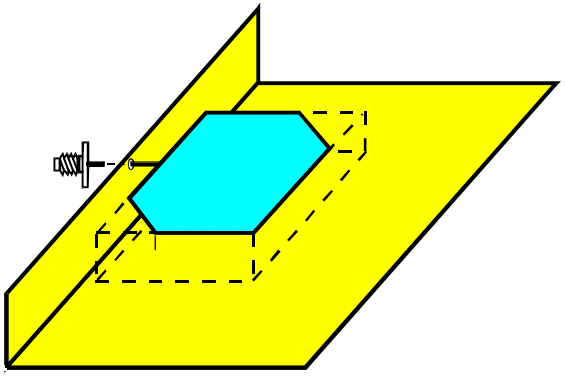


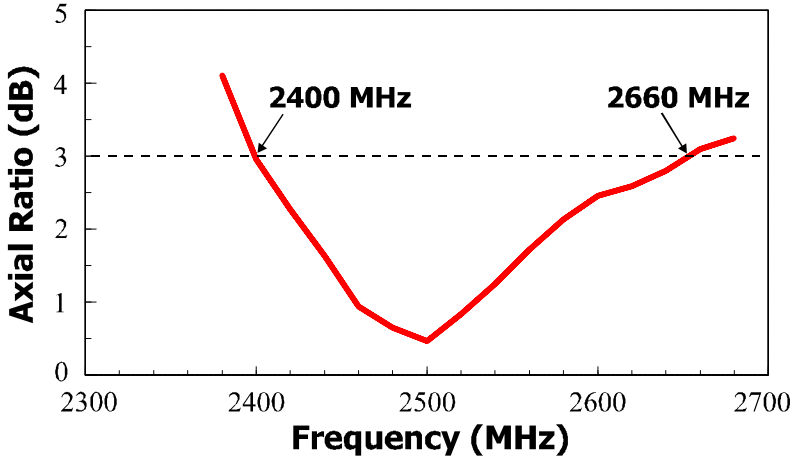
Patent pending

WLAN AP Antenna-Broadband CP design (1.1)

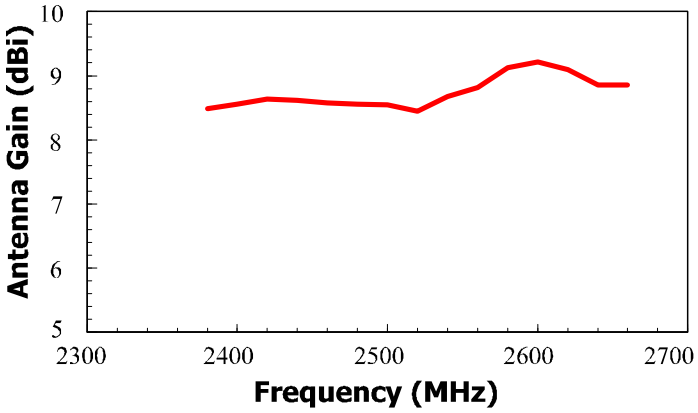


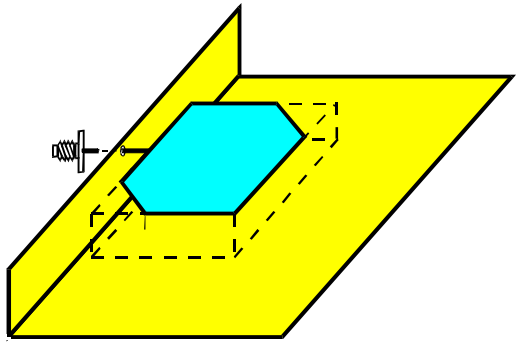


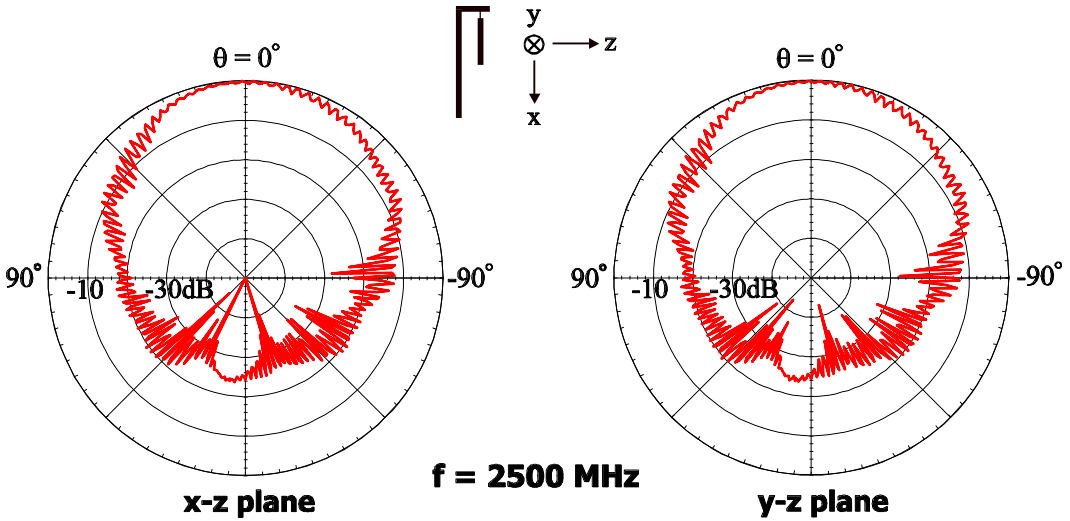




WLAN AP Antenna-Broadband CP design (1.2)

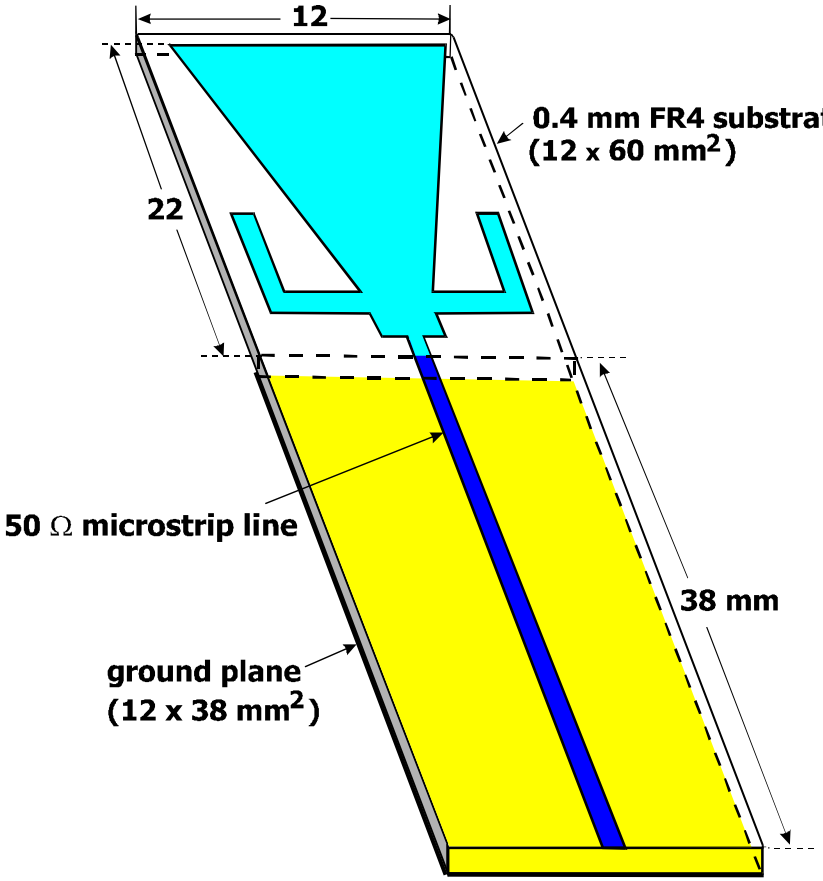






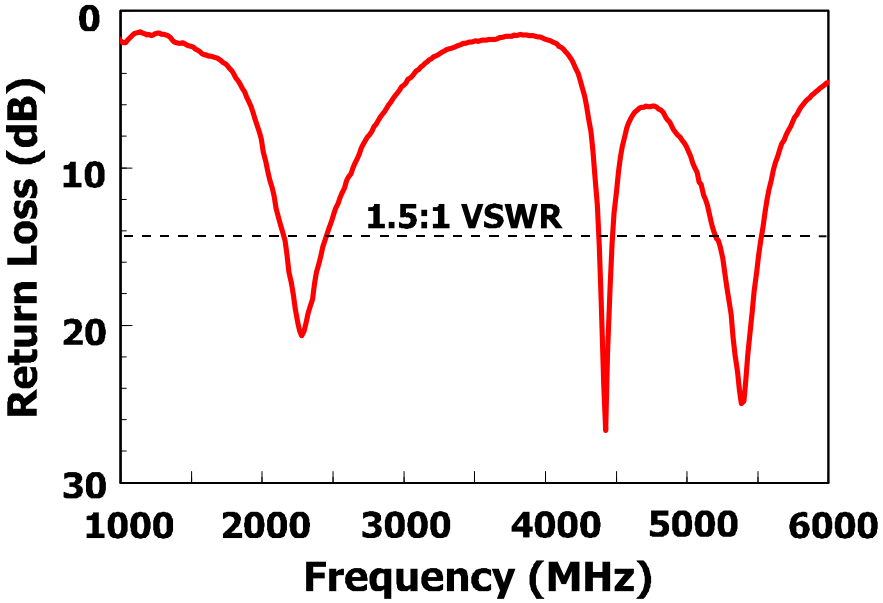
Spinning linear radiation patterns

WLAN AP Antenna- Dual-Band design- Printed monopole



2.4 GHz band: 3.5-4.0 dBi
5.2 GHz band: 4.0-5.5 dBi

Omnidirectional radiation



Patent pending

WLAN AP Antenna-
Omnidirectional printed dipole array (1)

5 GHz AP dipole array:

1.5:1 VSWR: 5.15-5.35 GHz

Peak gain: > 5.5 dBi

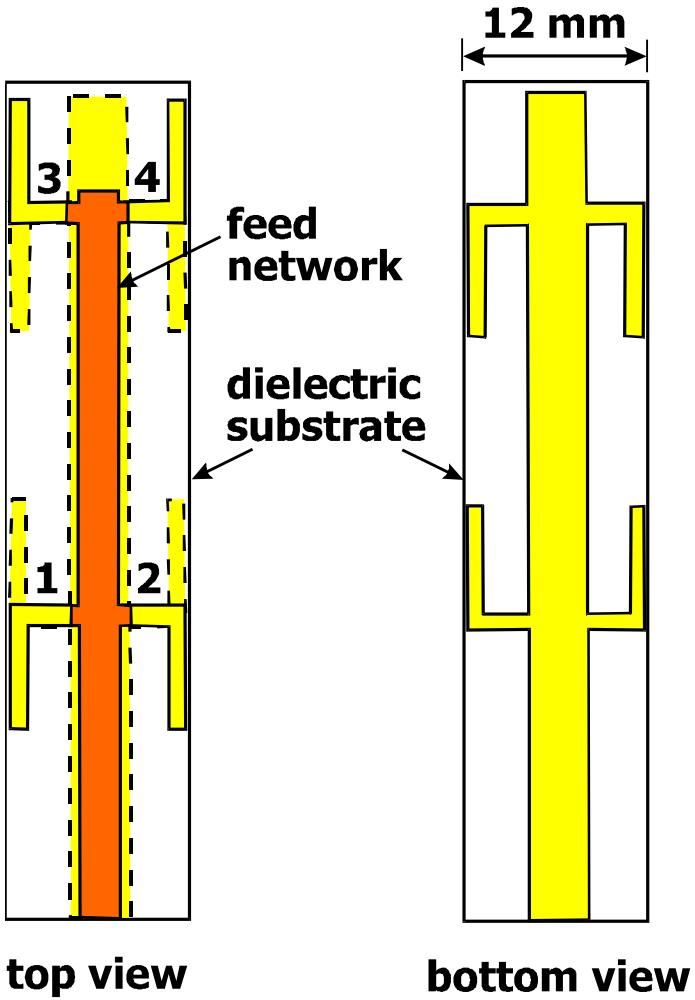
Omnidirectional ripple: < 2 dBi

Size: 12 mm x 90 mm

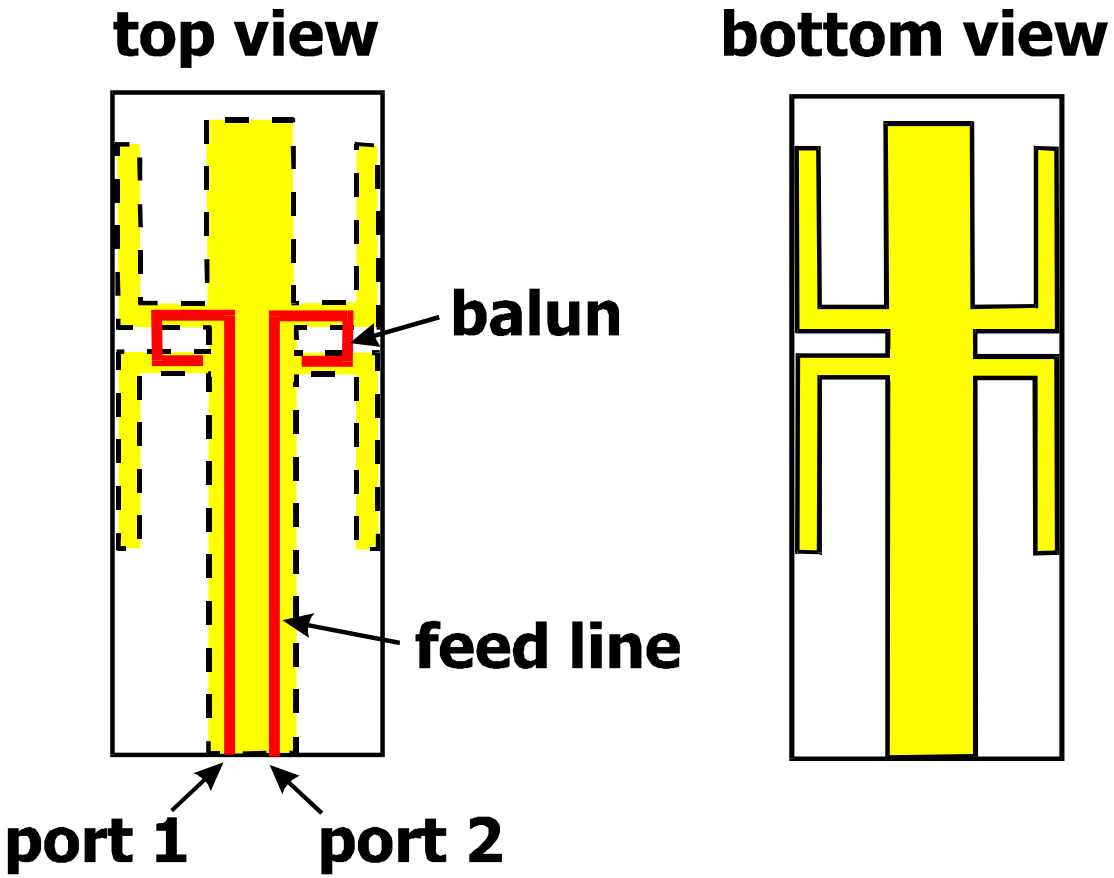
Omnidirectional pattern

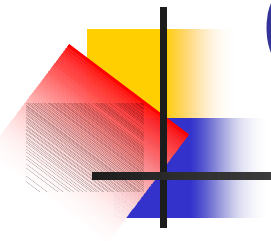
Ports 1, 2: 0°, 1/4 power

Ports 3, 4: 180°, 1/4 power



WLAN AP Antenna-Diversity printed dipole





Conclusions

- **Planar antennas are good candidates for WLAN applications**
- **More promising planar antenna designs and applications are in progress**