LTCC Chip Antennas – How to maximize performance

深圳市卓联微科技有限公司
联系人:李毅波
电 话:0755-23956691
移动电话：+86-15815578918
EMAIL:Lee@jointwel.com.cn
WEB:https://www.jointwel.com.cn/
企业Q Q: 2850870988
地 址： 深圳市宝安区宝源路1009号宝安互联网产业基地A区5栋3B02/3B06

Outline

- Chip Antenna Characteristics
- Antenna Selection Considerations
- Circuit Design Constraints
- Layout Tips

Goal → To Maximize Performance

Motivation

- Chip Antenna an efficient means of “connectivity” to modern portable electronic devices.
- Miniature portable devices requires small antennas.
- Can be internalized – i.e. “Concealed” within device.

Pros

- Chip antennas are small, cheap and performs well.
- Bulky external "whip" type antenna thing of the past.

Cons

- *Must be accounted for during initial circuit design stage*
- *Interference, proximity de-tuning & degradation concerns.*

LTCC Chip Antenna

Chip Antenna Characteristics -1

- Features Ag radiating element encapsulated in ceramic.
- A quarter-wave （ λ/4 ）monopole system.
- Works with GND plane to form dipole system.
- Certain “No_GND” space necessary.
- Small form factor, thin profile & light weight

Chip Antenna Characteristics - 2

- Omni-directional diversity.
- Linear Polarization.
- Mounting configuration flexibility.
- Frequency range supported: 0.8 GHz thru 10 GHz.
- WiFi, BT, WiMAX, UWB, GSM, CDMA, GPS etc.
- Suitable for Pick & Place.

Antenna Selection Considerations -1

- Size
- Frequency Band
- Bandwidth
- Polarization
- Peak Gain
- Ave Gain
- Radiation Diversity Pattern

Antenna Selection Considerations -2

- Successful Antenna design means harmonious interaction of the “seven” parameters.

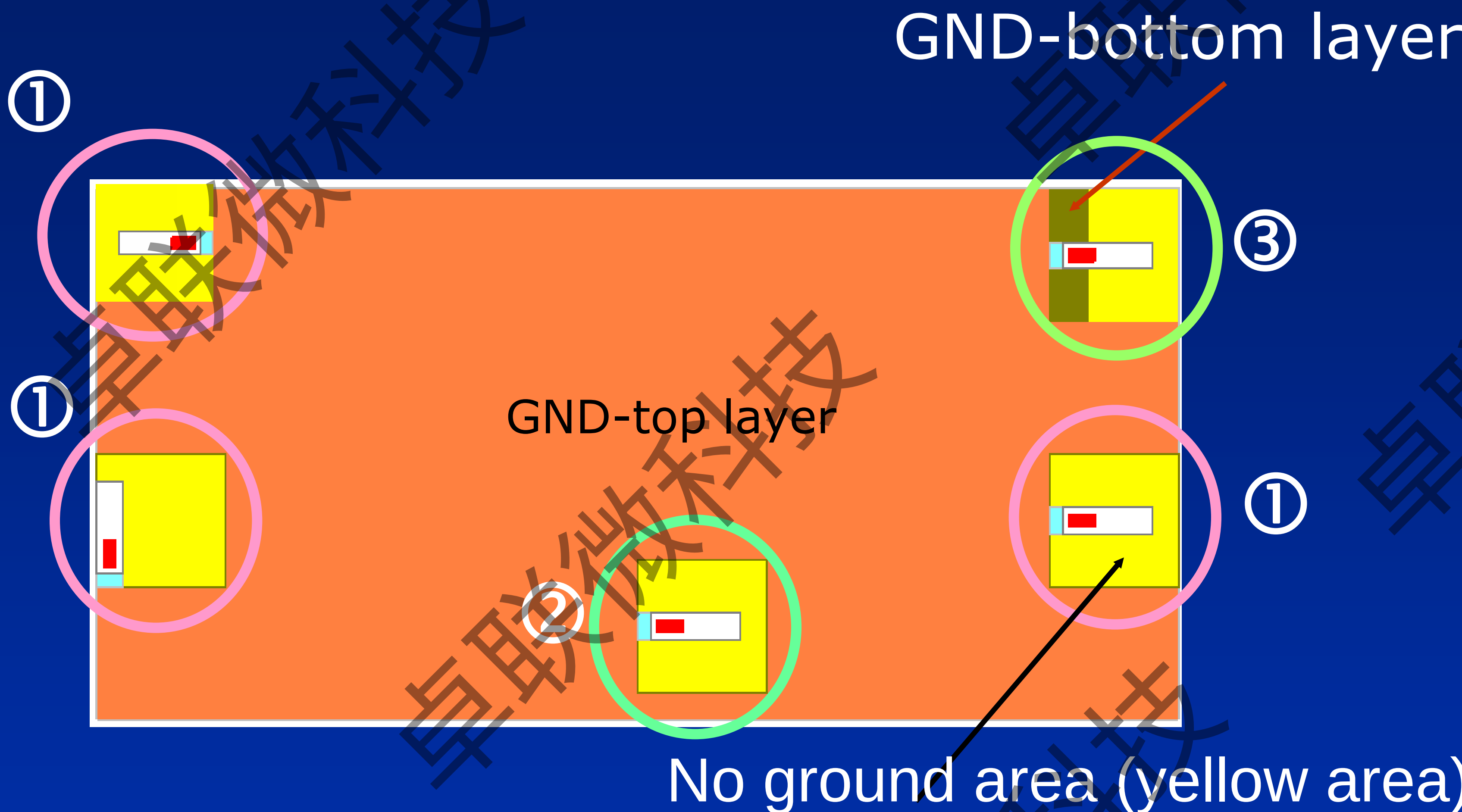
- Additional considerations for diversity systems – e.g. MIMO

- Overall performance is also system dependent .

Circuit Design Constraints

- Size of the Circuit board.
- Layout of the other board components.
- Complexity of circuit.
- Proper GND/No-GND dimensions.
- “Tuned” Matching Circuitry
- Shielding
- Suitable Enclosure (material)

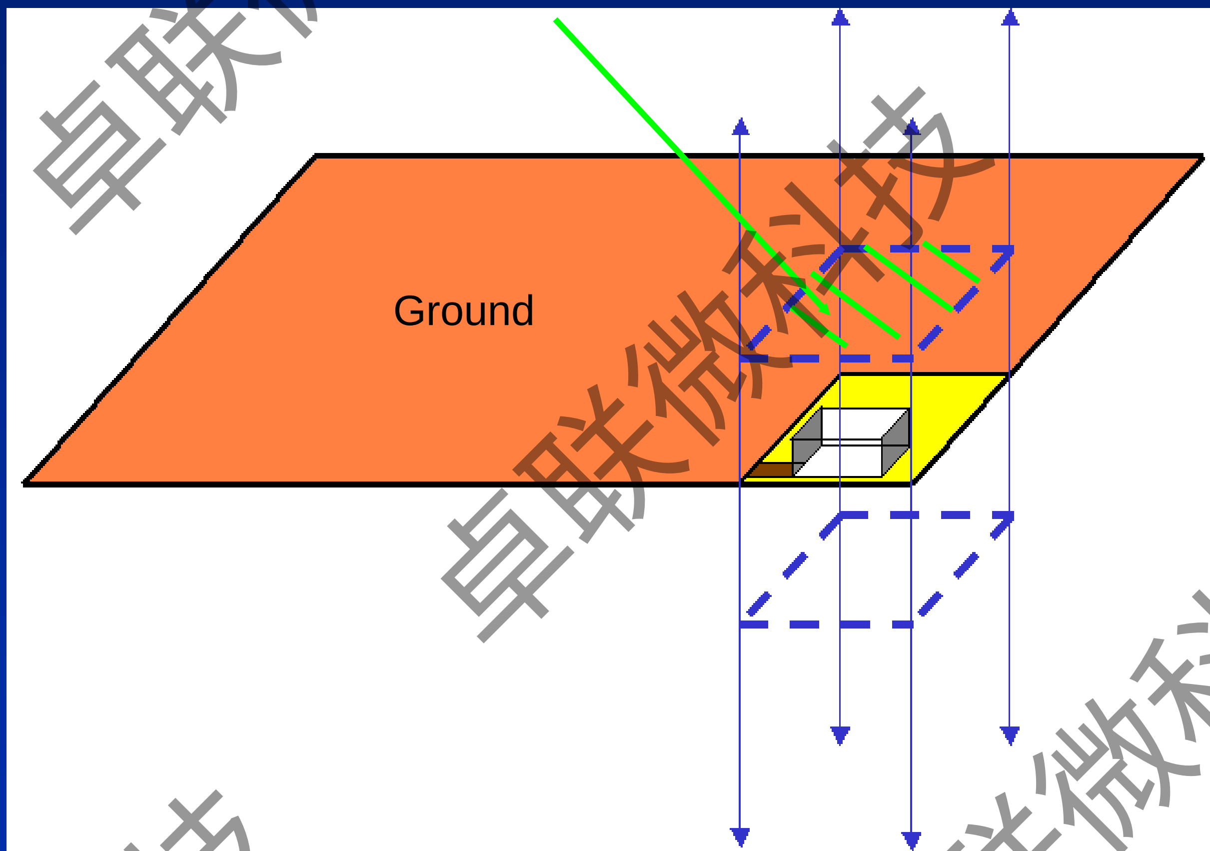
Layout Tips -1



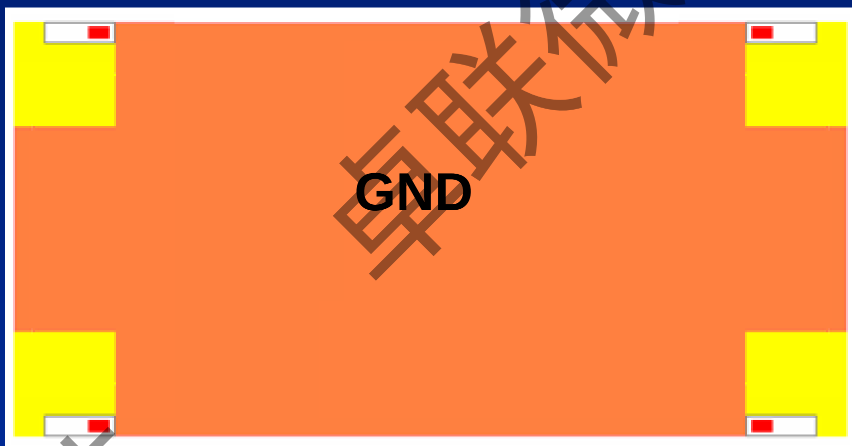
- Good Placements ①
- Bad Placements ② & ③

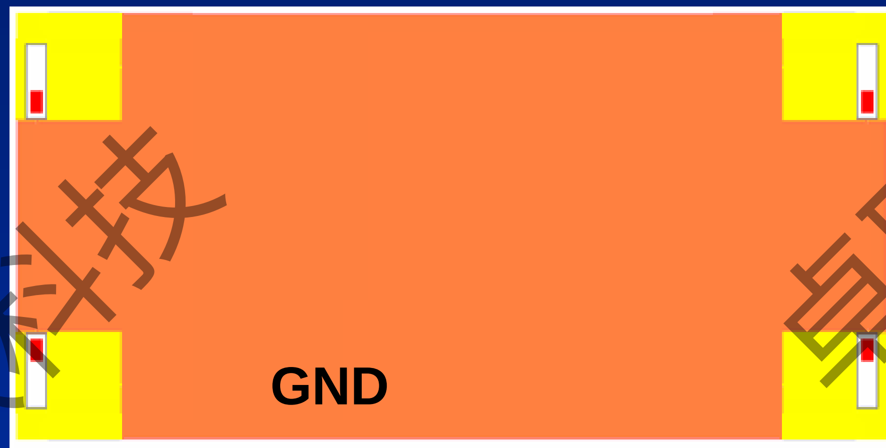
Layout Tips -2

Don't put the metal plate or battery above or below the yellow region
Keep away any other metals from clearance area.



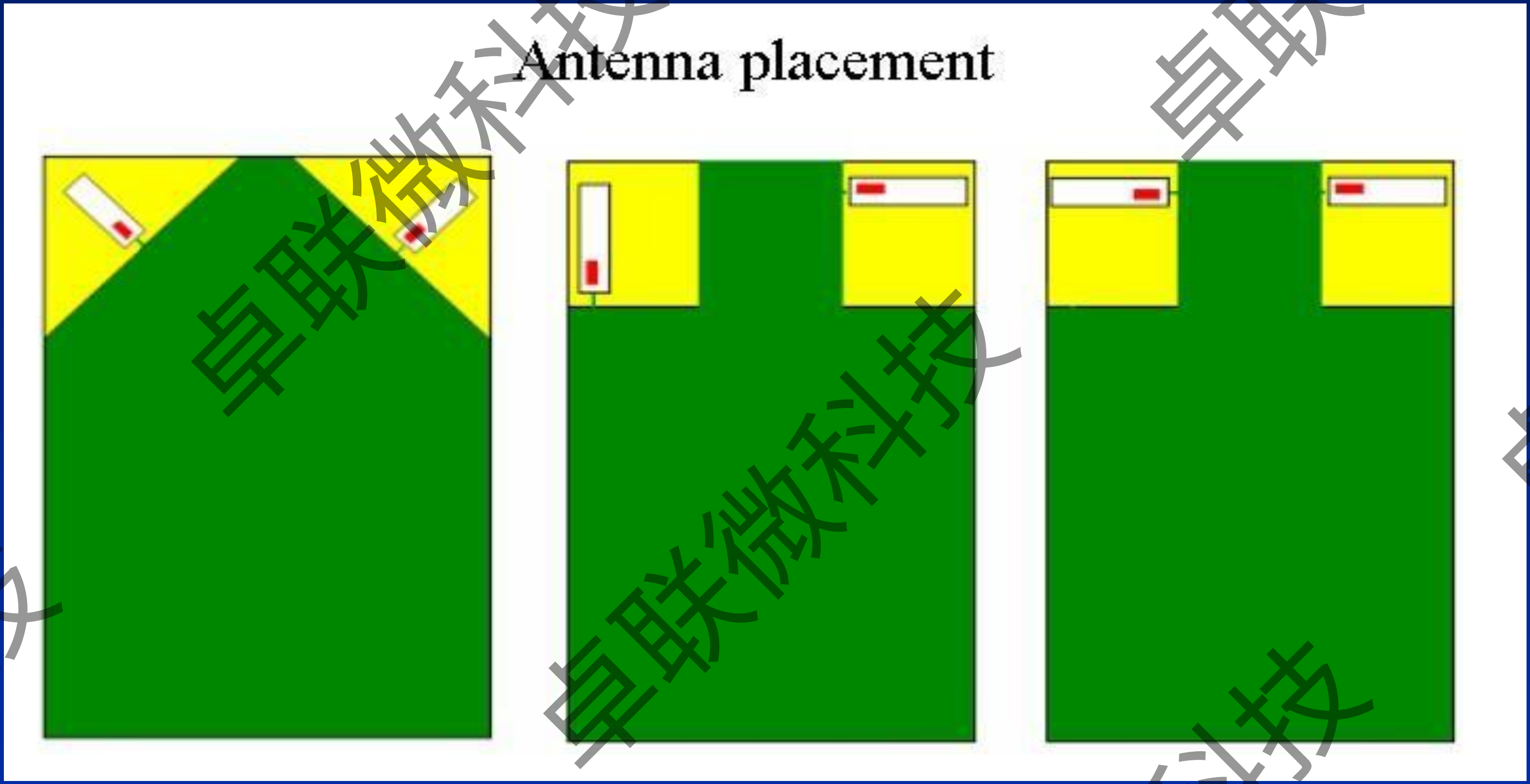
Layout Tips -3





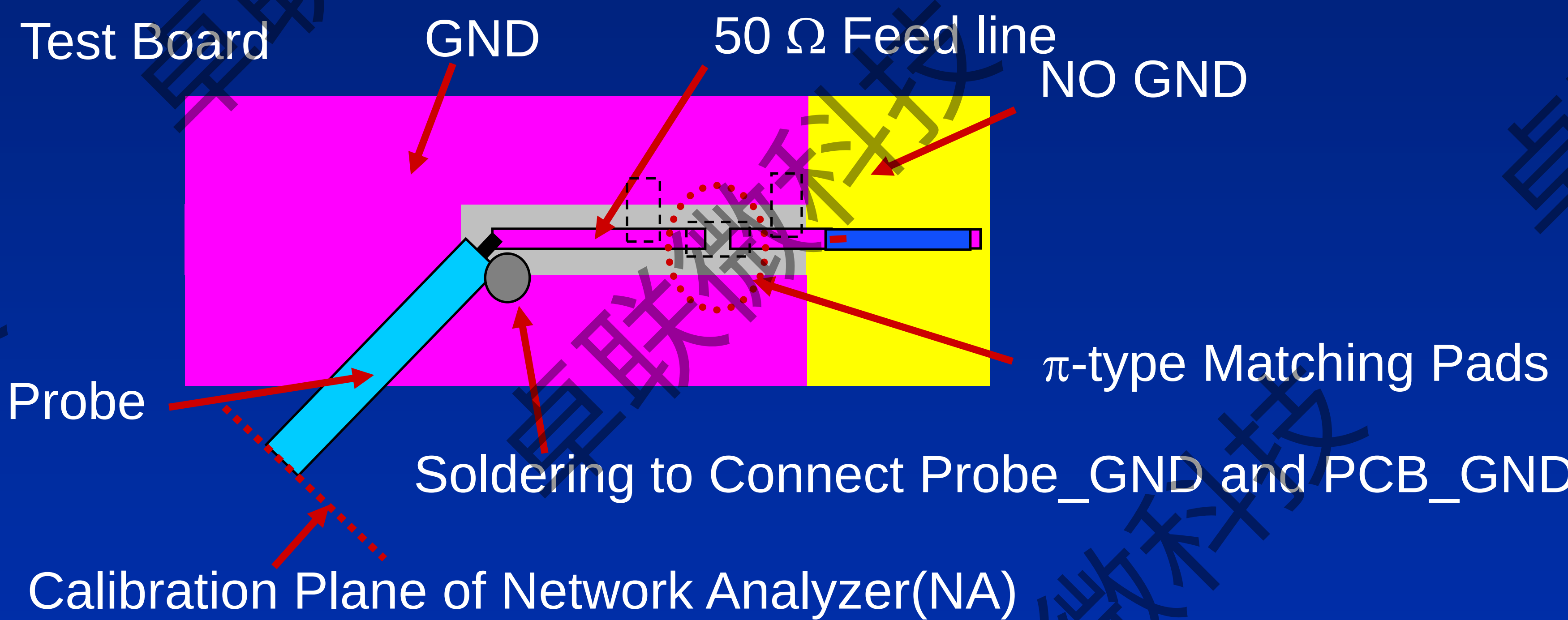
- Further examples of good antenna placement schemes

Layout Tips -4



- Antenna placement schemes for Diversity systems

A. Antenna Matching Setup



B. Measuring Steps

1. One port calibration for NA
   Open-Short-Load

2. Mount probe onto PCB and connect to NA

3. Measure S11 of test board without antenna
   →S11_open →save trace to memory of NA

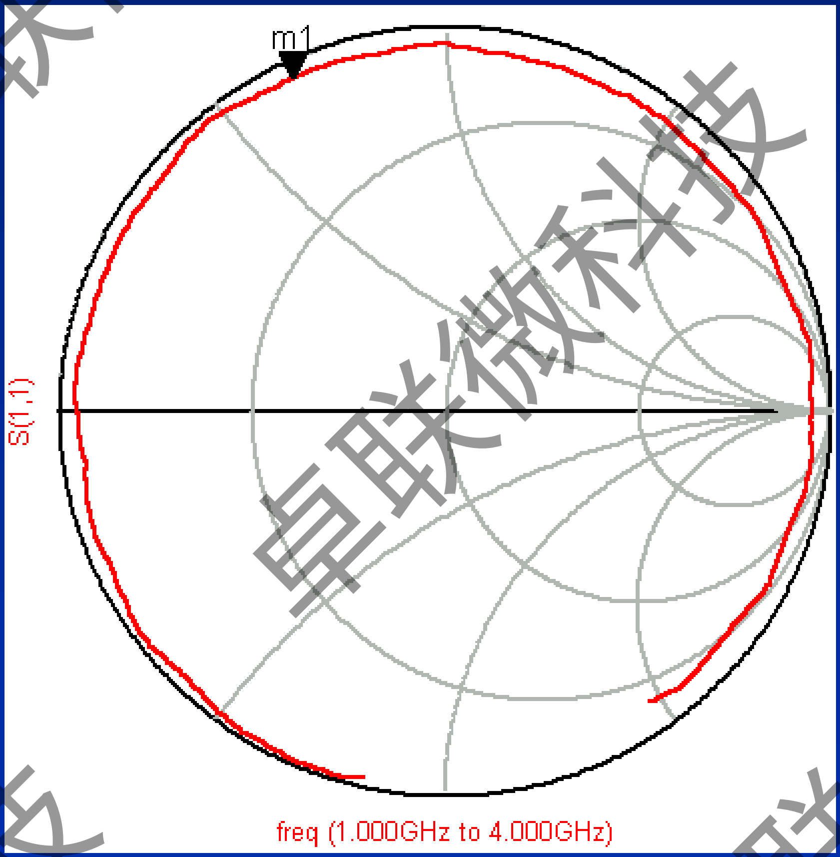
4. Measure S11 of test board with antenna and 0 Ω R mounted
   →S11_antenna

5. Set NA to data/memory mode (S11_antenna/S11_open)
   →S11_match

6. Match the trace of S11_match to 50Ω
   (center of Smith chart at the desired frequency)

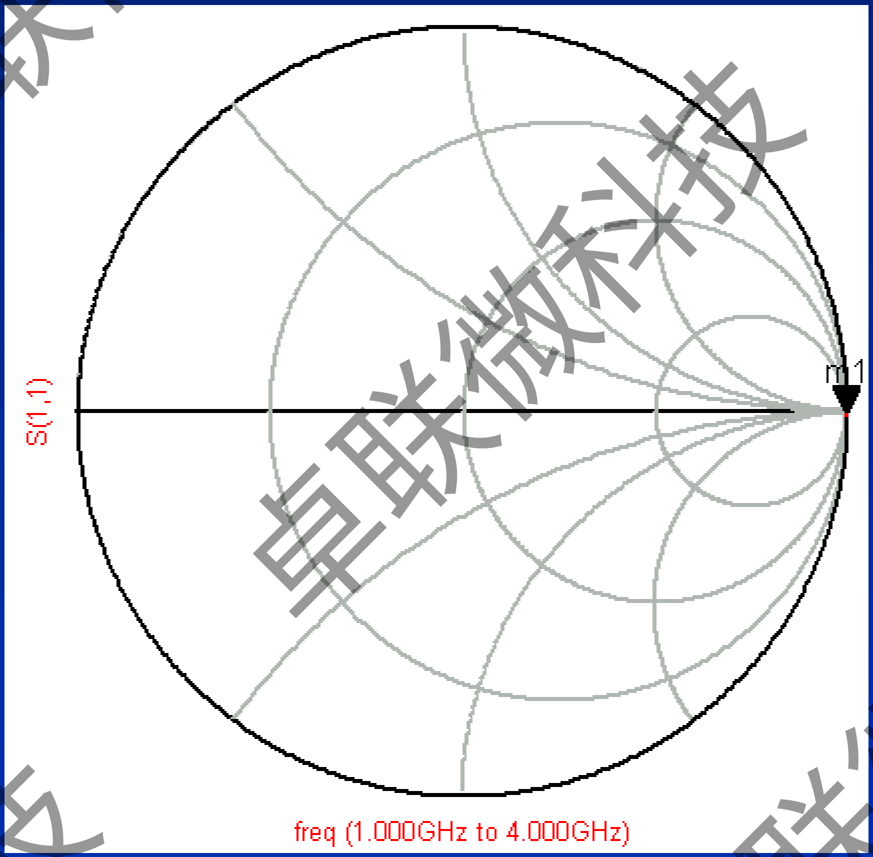
Antenna Matching Example

1. Probe+Feed Line



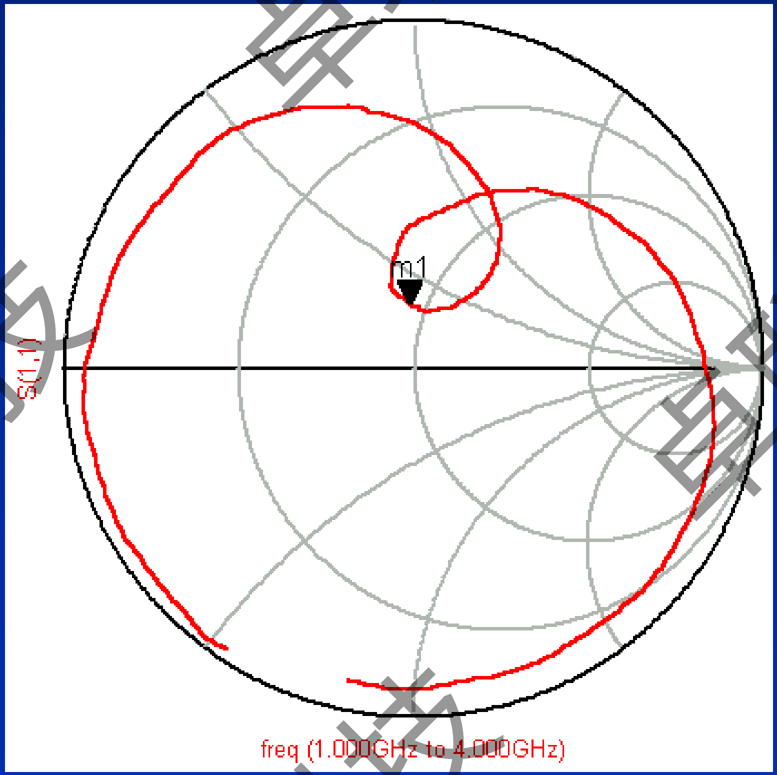
Antenna Matching Example

2. Probe+Feed Line (normalized)

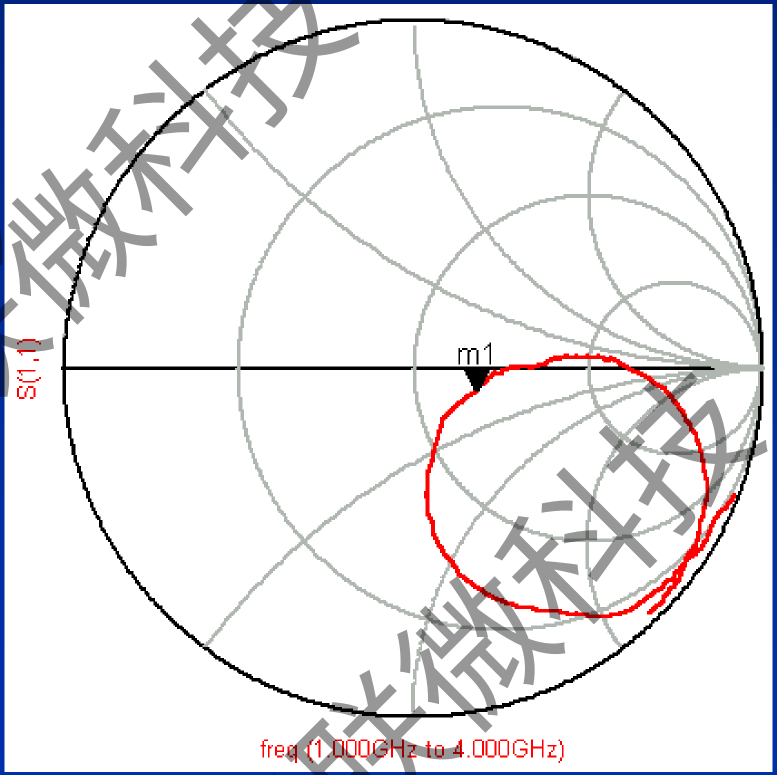


3. Antenna

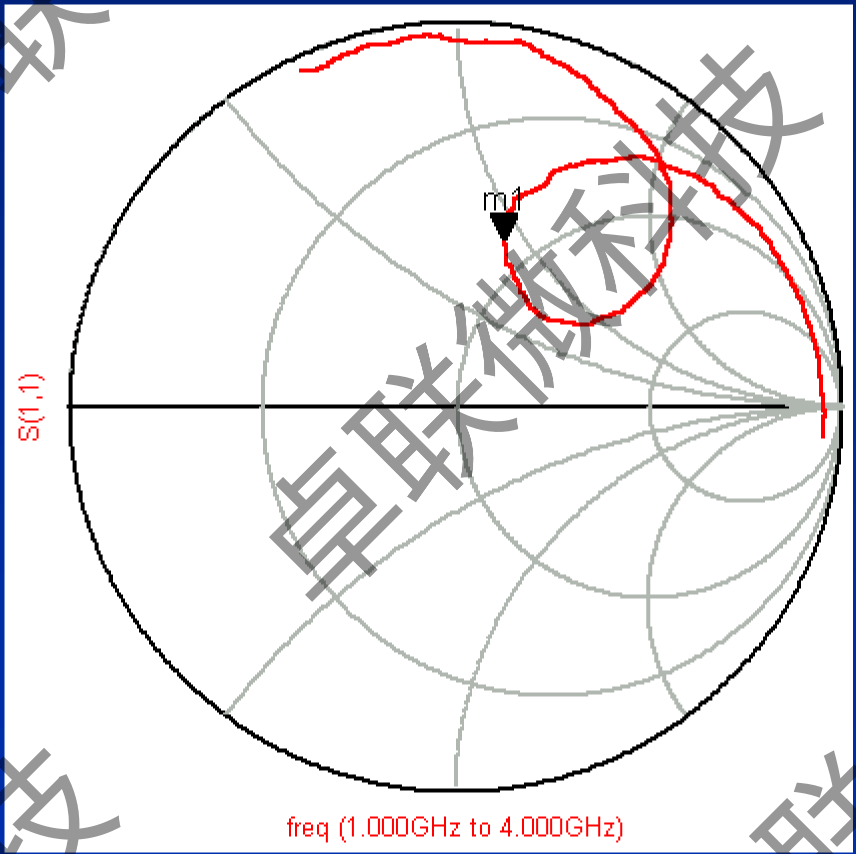
(not normalized)



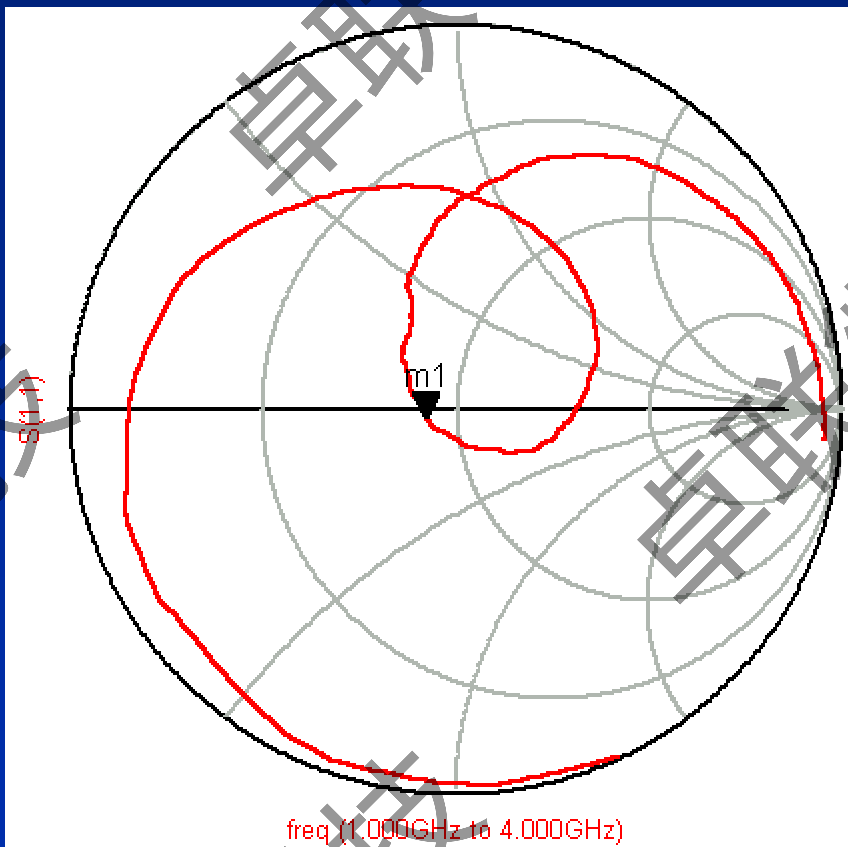
(normalized)

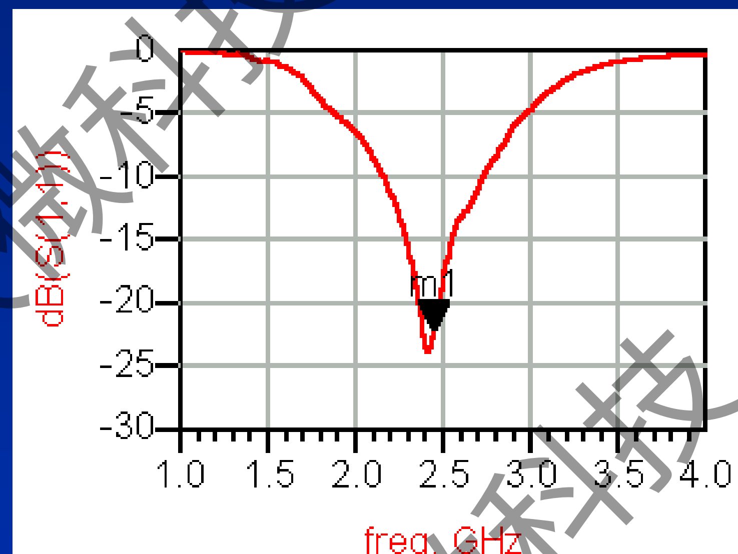


4. Ant+shunt 3.9nH (normalized)

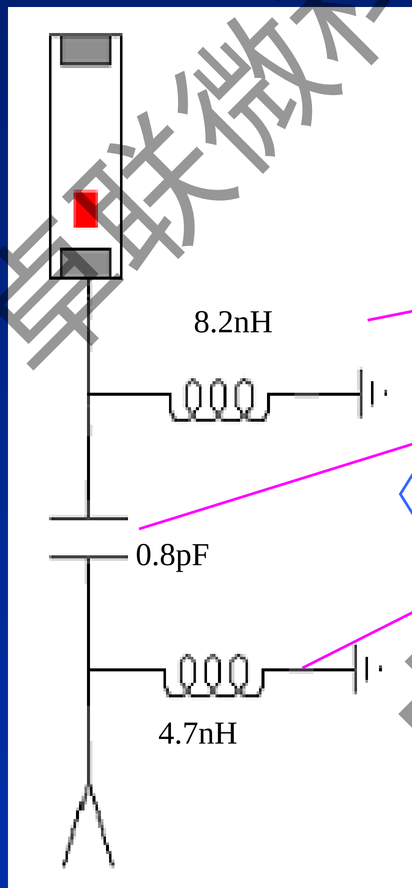


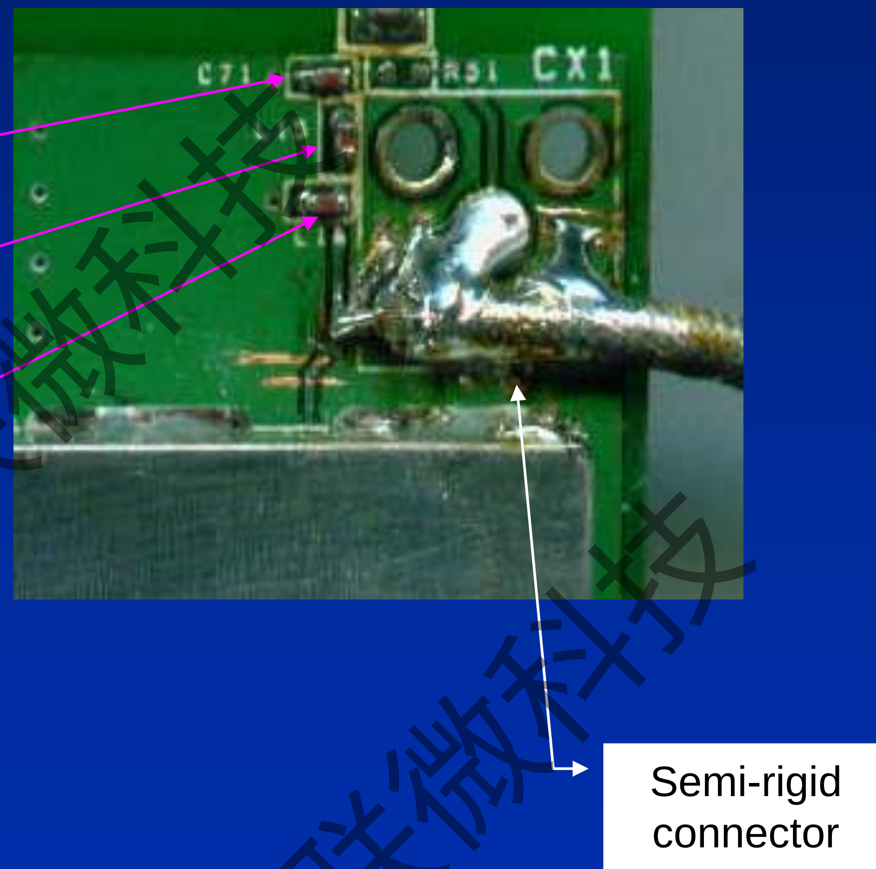
4. Ant+shunt 3.9nH+series 1.5pF (normalized)





Matched Antenna Example





Conclusion – How to design

- 1^{st} – Determine the antenna location on board
- 2^{nd} – Select the most appropriate antenna model
- 3^{rd} - Implement antenna in conformance with design rules