Multilayer chip antenna application guide

1. introduction

The chip antenna series is designed for the applications of ISM band 2.4GHz and CMMB, just like as Bluetooth、home RF,CMMB, etc. they have these features: compact、light weight、built-in application、proper gain and proper bandwidth、omni-directional and low cost. Of course, they can be mounted by normal SMT process.

as we known, the miniature chip antenna was sensitive with the application environment, such as the K value and thickness of FR4 board. So they need a proper matching circuit composed of L or C to work in a good state. That means you have to match the antenna in your final products to get the best performance. The characteristic you see on the specification was measured on our own evaluation board. Just like the bottom table.

Part No.	size (mm)	Resonant freq. (GHz)	Band width （MHz）	Average gain (dBi)	Peak gain （dBi）
SLDA31	3.2×1.6×1.0	2.80	100	-1.0	0.5
SLDA52	5.2×2.0×1.0	2.54	200	0.5	2.5
SLDA62	6.0×2.0×1.0	2.64	200	0.7	2.6
SLDA72	7.0×2.0×1.0	2.86	250	1.0	2.7
SLDA81	8.0×1.0×1.0	3.01	200	2.0	0.5
SLDA92	9.0×2.0×1.0	2.66	300	1.0	3.0
SLDA16030	16.0×3.0×2.0	0.433	20	1.0	3.0
SLDA35050	35.0×5.0×1.0	0.65	50	—	-2.0 dBi (710 MHz). -7.0 dBi (474 MHz)
SLDA50040	35.0×5.0×1.0	0.65	50	—	-6.0 dBi (862 MHz). -3.0 dBi (474 MHz)

After the adjusting process, the antenna's center frequency would be getting down to 2.45 GHz and CMMB. We offer several types which have different size and center frequency; therefore you can choose the most proper one according to your board condition.

2. Matching circuit & component

Chip antenna should be matched with the environment of final products.

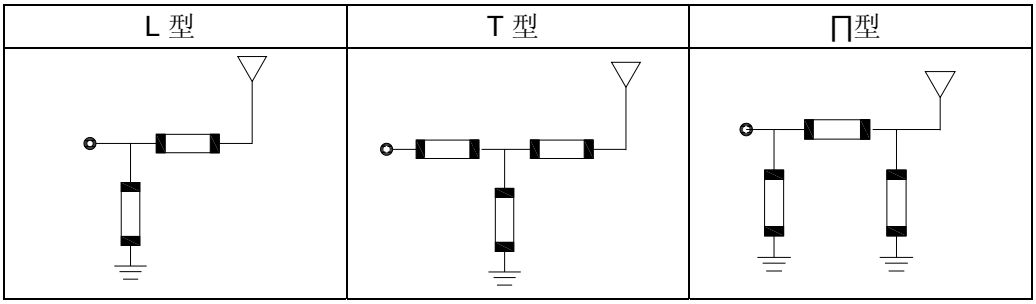
Normally this process can be done with capacitor or inductor as follows,

Component	Description	Value
Capacitor	*Series C	0.5 ~ 10 pF
	*Shunt C	33, 100 pF
Inductor	Series L	1.0 ~ 6nH
	Shunt L	1.0 ~ 6nH

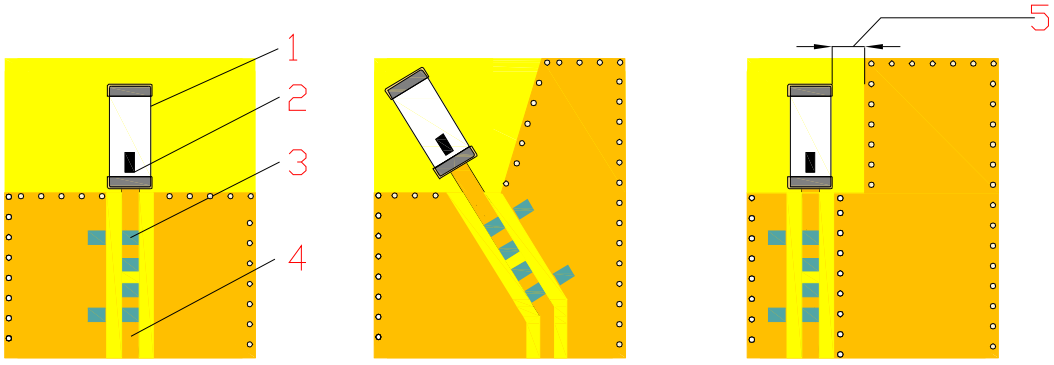
*Series: Connected between antenna and feeding line in series.

*Shunt: Connected between antenna and feeding line in parallel

you have to pre-place the π-type circuit layout before the antenna's, then you can chose one of the below circuit type with flexibility.



Layout example:



1# **2#** **3#**

If the space was big enough, the 1# layout was recommended.

1------chip antenna

2------feeding mark

3------layout pad of the matching circuit

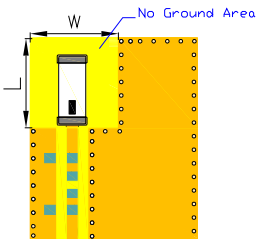
4------50omh transmission line (you can use the tool like ADS/APPCAD etc. to calculate the line width and space size)

For example, if we use the CPWG, you can use the parameter as below:

Thickness of board	Transmission line width	Space between the transmission line and ground
0.8	0.5	0.15
0.25	0.28	0.15

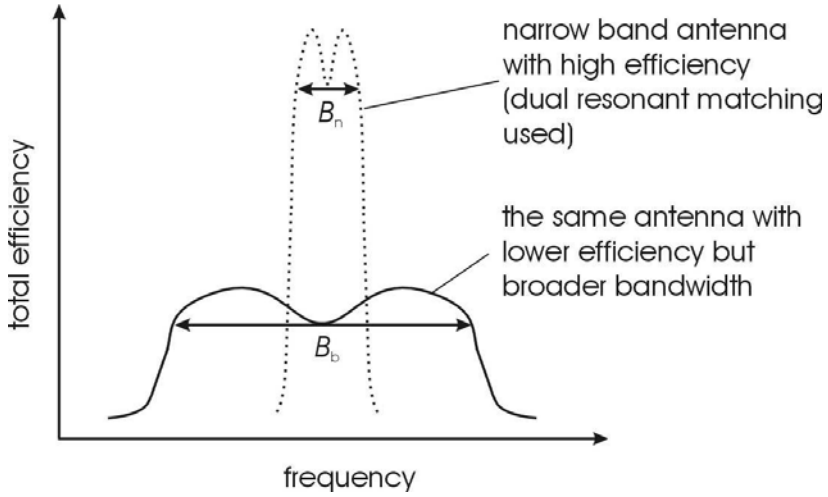
(unit: mm)

5-----the space between the antenna and ground. You can use the reference table as bellow.

P/N	Antenna size (mm)	No ground area size（min） L×W(mm)	Fig.
SLDA31	3.2×1.6	3.6×6.8	
SLDA52	5.2×2.0	5.6×6.8	
SLDA62	6.0×2.0	6.4×6.8	
SLDA72	7.0×2.0	7.4×6.8	
SLDA81	8.0×1.0	8.4×5.8	
SLDA92	9.0×2.0	9.4×6.8	
SLDA16030	16.0x3.0	18.0x10.0	
SLDA35050	35.0x5.0	39.0x15.0	
SLDA54040	50.0x4.0	55.0x12.0	

For SLDA35050 antenna, it was developed for moblie TV applicatoin, such as CMMB phone. Cause the CMMB operation frequency was 470M~870MHz, the small size chip antenna can't get the whole bandwidth, so we can use the method below to solve the problem:

1、take a trade-off between the efficiency and bandwidth



There are basically two options to decrease efficiency:

- resistive matching
- accept more mismatch between the antenna and the receiver

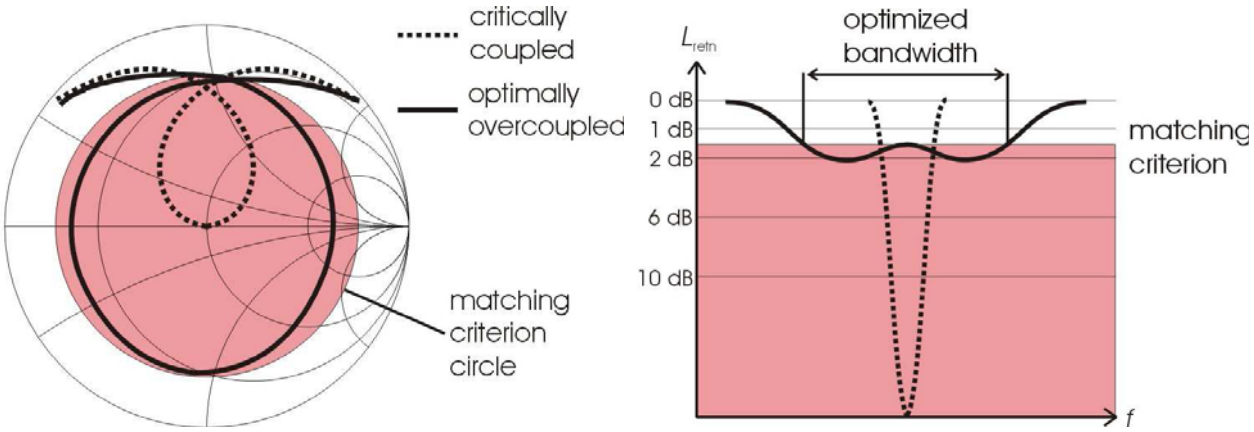
Resistive matching might be necessary in the case of a transmitting antenna to meet the requirements of the RF power amplifier, For a receiving antenna, such as CMMB antenna, this requirement is not needed.

How the matching criterion 1 – 2 dB return loss can be accepted?

- Receiver antenna - there is no need to care about the oscillation in the RF power amplifier
- At the CMMB range the radio environment is noisy compared to the noise of the receiver and thus, the antenna performance is not very critical for the overall signal-to-noise ratio.

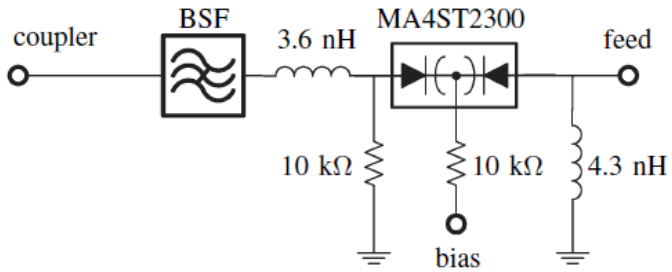
The impedance bandwidth can furthermore be increased by:

- Using dual resonant matching (as in the picture below)
- Using optimal overcoupling, i.e. the antenna is coupled so that the impedance bandwidth is maximized according to a certain matching criterion

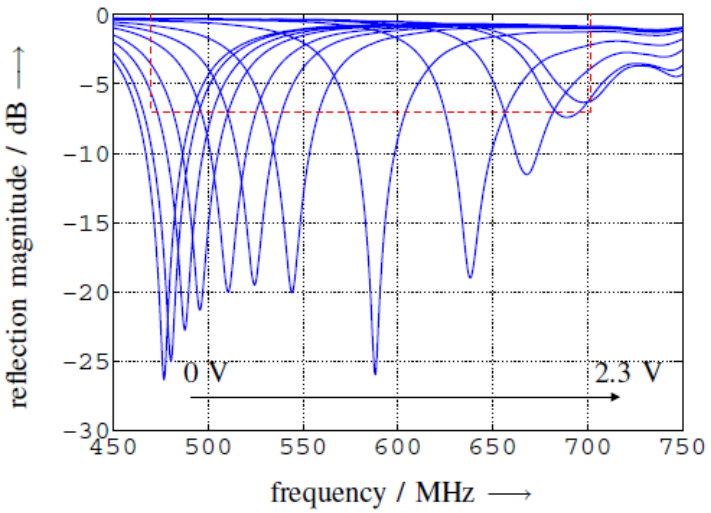


2、use the varing matching circuits

in the matching circuits, we can use the varing capacitor, such as Renesas's Varicap Diode, Implementing a tunable antenna to make the antenna operate on the whole band. For exmple:



tunable matching circuits



response with the tunning

3. Application recommendations

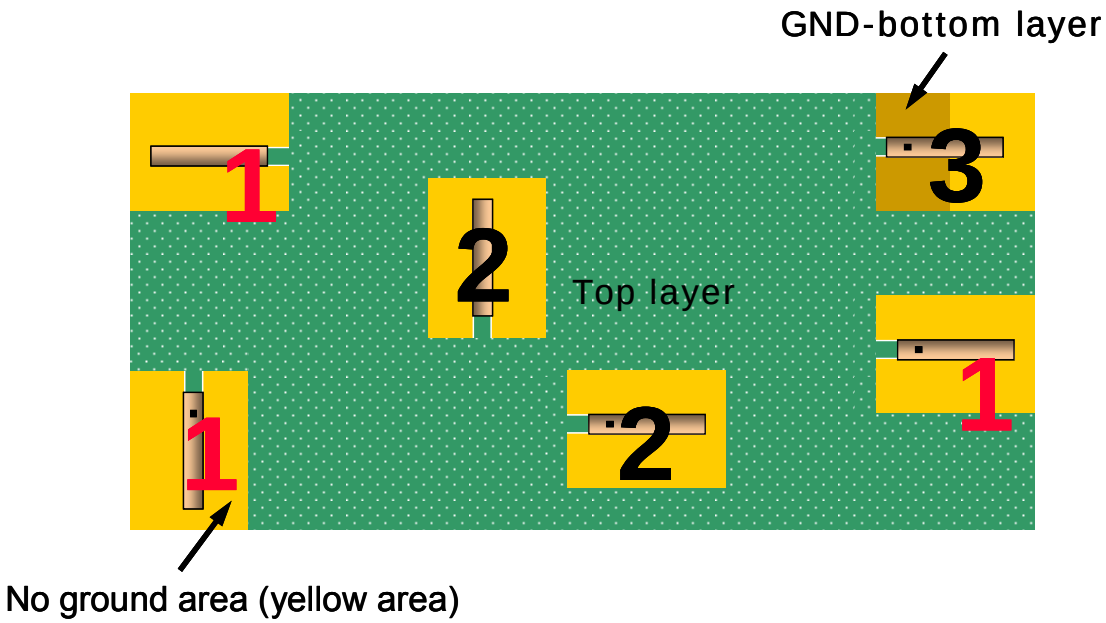
- It is often better not to reduce antenna size too much, if board space allows;
- It is also best to keep some clearance between the antenna and nearby objects. Or the tuning will be very difficult and radiation pattern can be heavily distorted;
- Never place ground plane or tracks underneath the antenna;
- Never place the antenna very close to metallic objects, such as batteries、LCD panel、speaker,

etc.

- Be careful about the wiring in the finalized product, not too close to the antenna;
- A monopole antenna should have a reasonable ground plane to be efficient;
- Do the final tuning in the end product, not in free air;
- Never install a chip antenna in a vastly different layout than the reference design, and expect it to work without tuning;
- Do not use a metallic enclosure or metallized plastic for the antenna;
- If possible, test the plastic casing for high RF losses, preferably before production;
- Never use low-Q loading components, or change manufacturer without retesting;
- Do not use very thin PCB tracks, the tracks should be fairly wide.

4. Layout Tips

Tips1:

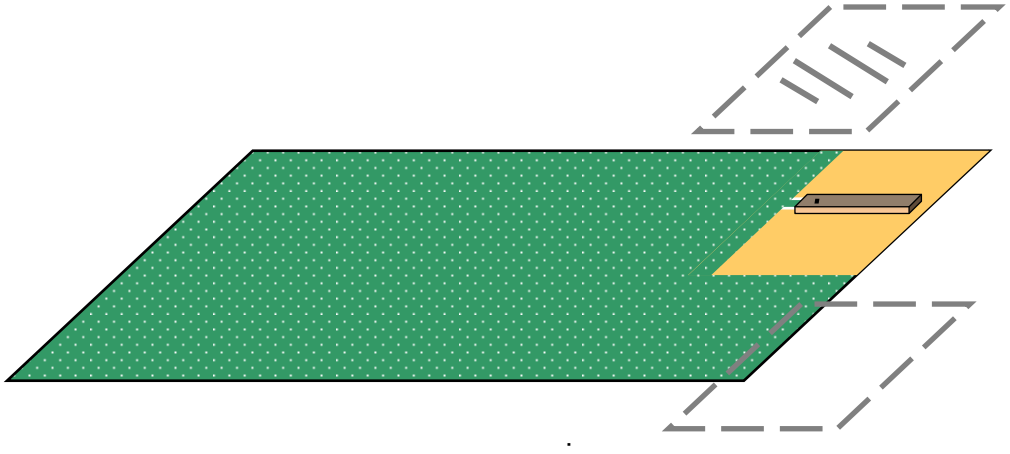


Good placement:1

Bad placement:2&3

Tips2:

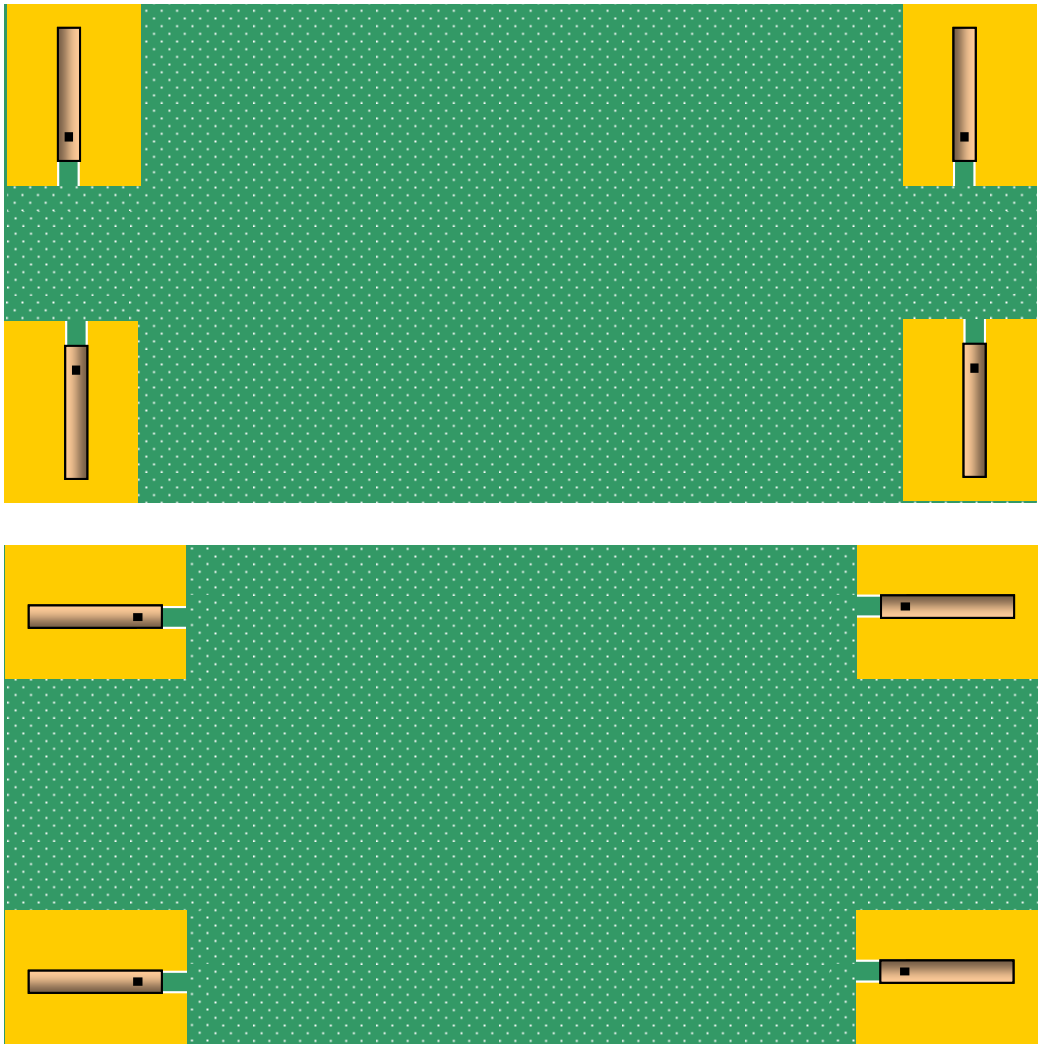
Don’ t put the metal plate or battery above or below the yellow region. Keep away any other metals from clearance area.



:

Tips3:

Further examples of good antenna placement schemes.



4. Matching process

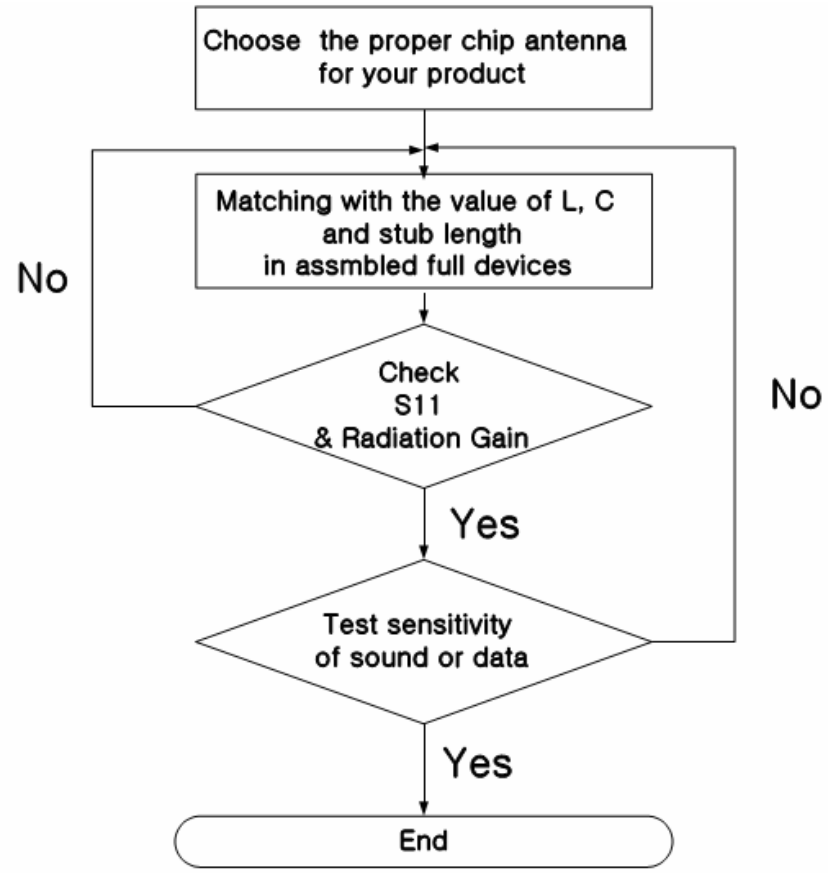


Fig. matching process

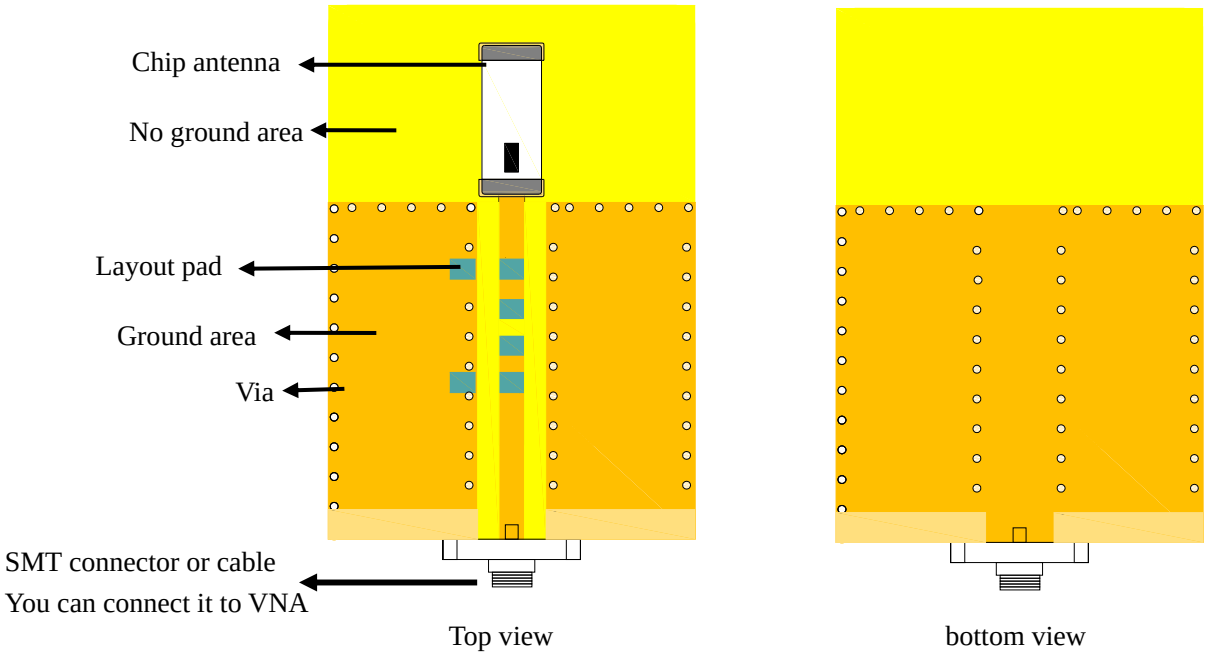
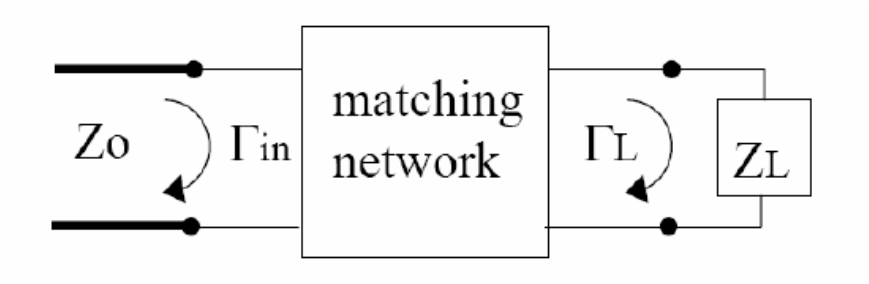


Fig. measurement method



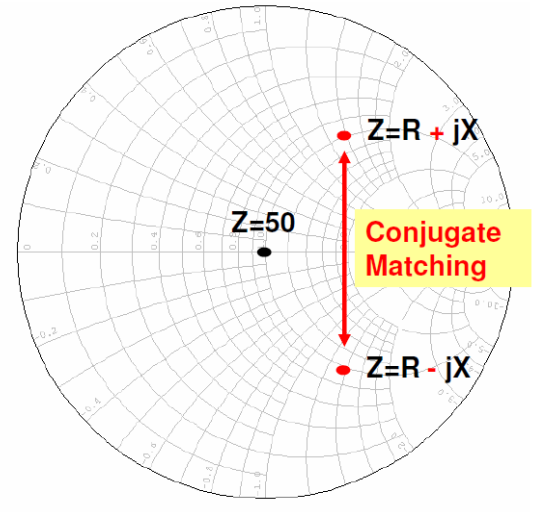


Fig. the target of antenna matching

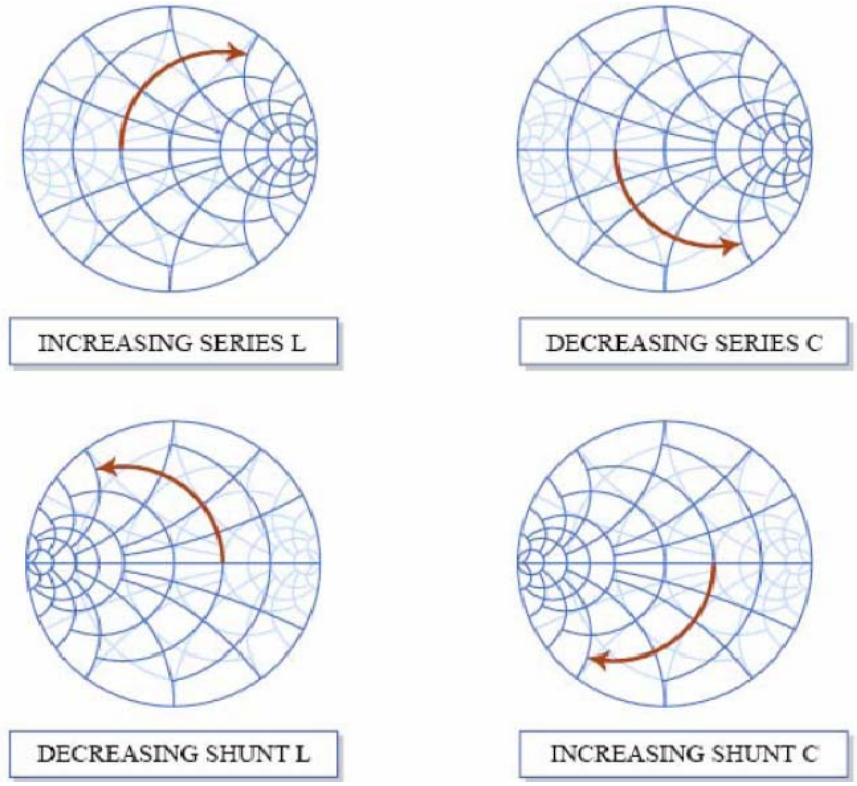
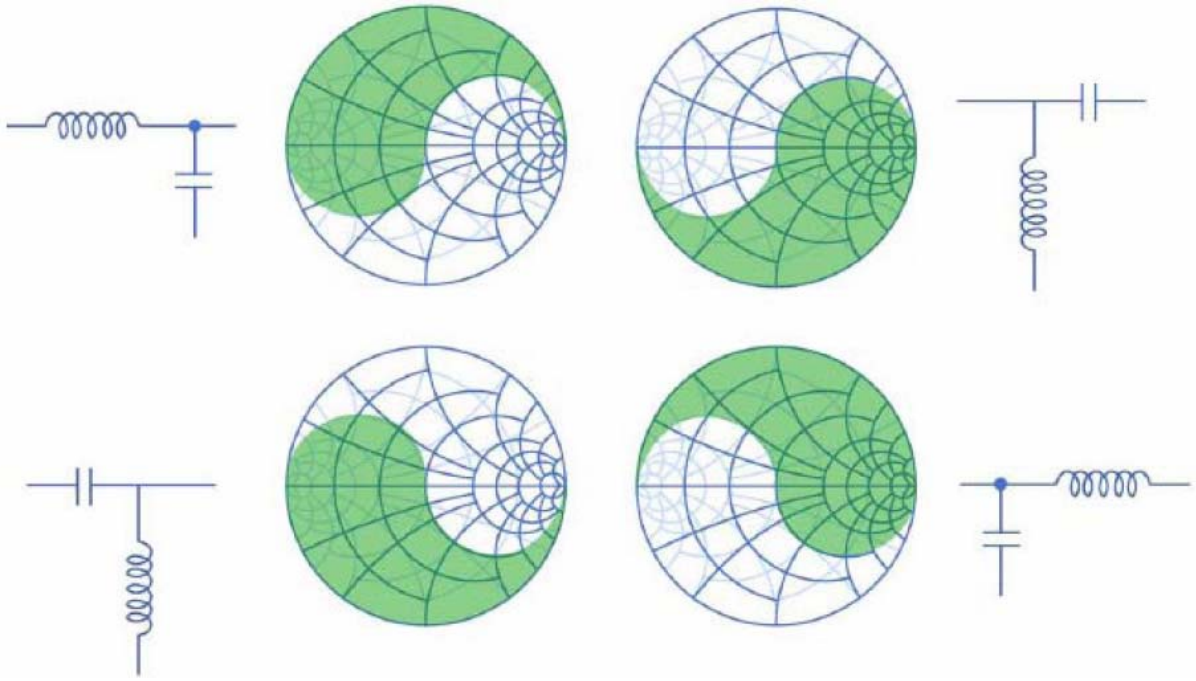


Fig. the tuning laws



L-type circuit forbidden region

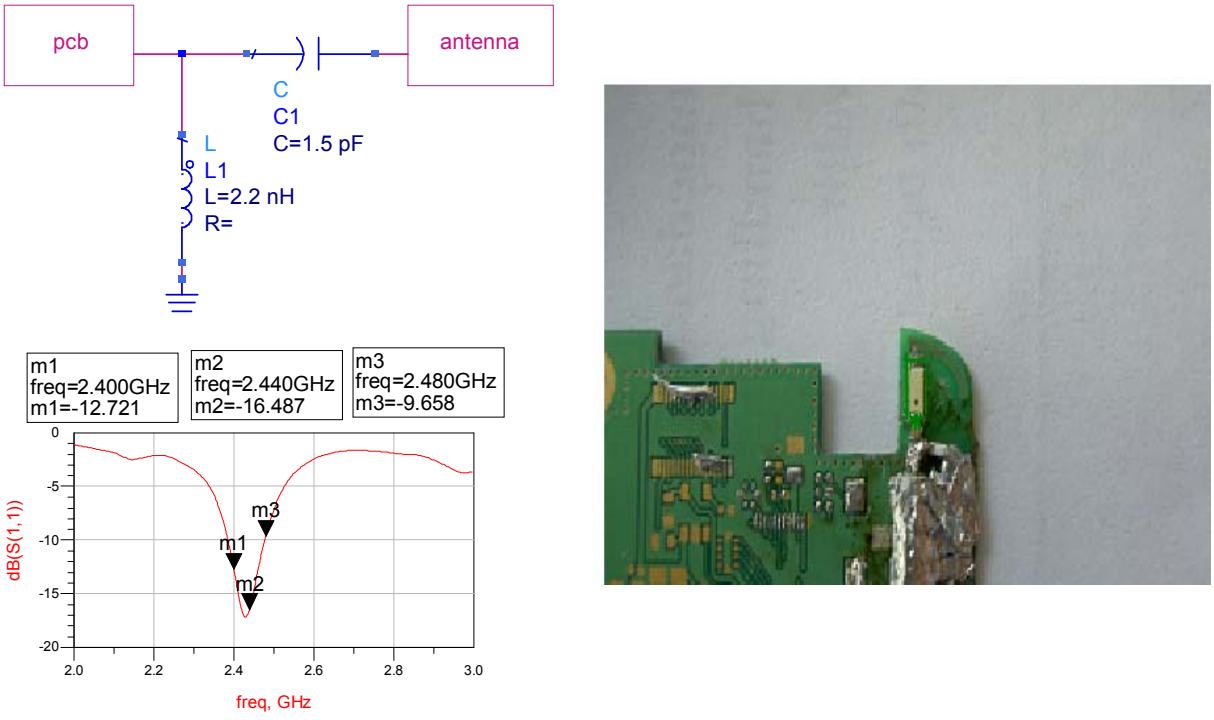


Fig. tuning example

Update:2012.11