



蓝牙天线设计指南

Latest Version: 1.0

2016-04-26

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2 版本历史

日期	版本号	注释	作者
2016-04-26	V1.0	建立初始版本	han
2016-05-25	V1.1	语句及错字更正	ChenZhiPing

3 RF 布局

- (1) 在 **PCB** 设计时优先考虑蓝牙 **RF** 布局及布线。
- (2) 为保证良好的天线性能，原则上天线周围 1cm 内不能有金属物体，金属物体包括：USB 接口、按键、焊接线等。蓝牙耳机空间小，但是也需要遵守天线远离金属物体的原则，在 PCB 设计时需要考虑这点，否则即使天线匹配好效果可能还是不理想。
- (3) 天线位置预留足够的净空区域。如图 (1) 中 $d1$ 约为 2mm。
- (4) 天线边上 GND 要完整，且每小于 100mil 的间隔就要有一个过孔，如图 (1) 所示。天线地要远离高频电路的地，如天线参考地避免靠近晶振 GND。

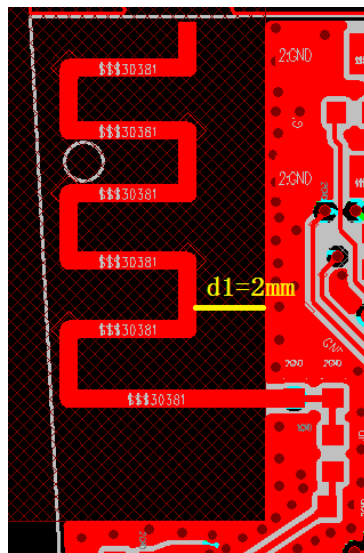
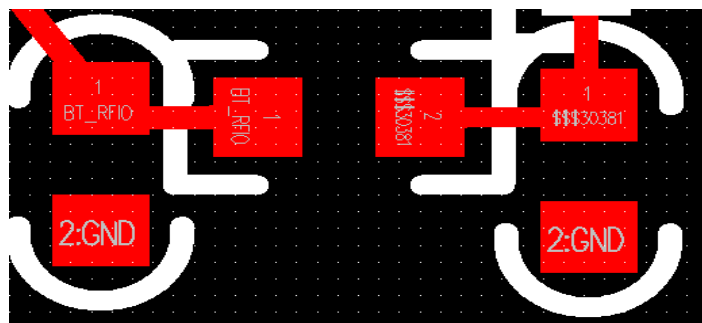


图 (1) 天线参考地

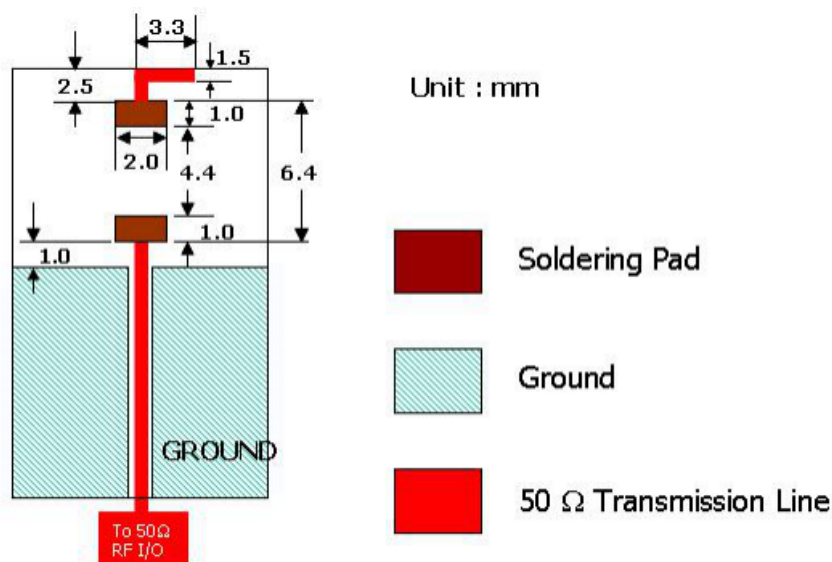
- (5) 匹配网络元件应尽量靠近天线放置，并且元件需紧靠，如图 (2) 所示。



5.1 陶瓷天线

(1) 陶瓷天线的选型需要考虑到天线的增益，一般来讲，面积越大增益和效率越好。反之，天线越小增益及效率越差，越容易受外围影响。综合体现出来的效果是方向性及距离差。

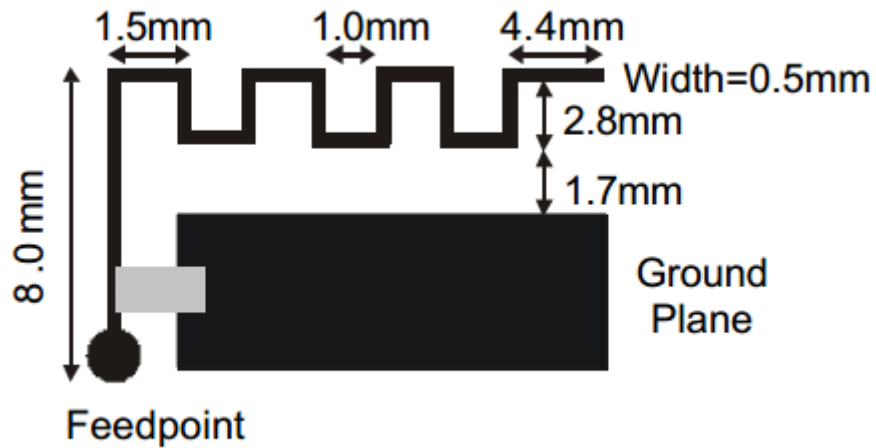
(2) 使用陶瓷天线设计时应根据规格书要求来设计。图（4）是某一陶瓷天线的设计要求，其要求在陶瓷天线后还要走一段线，这些地方都需要注意。



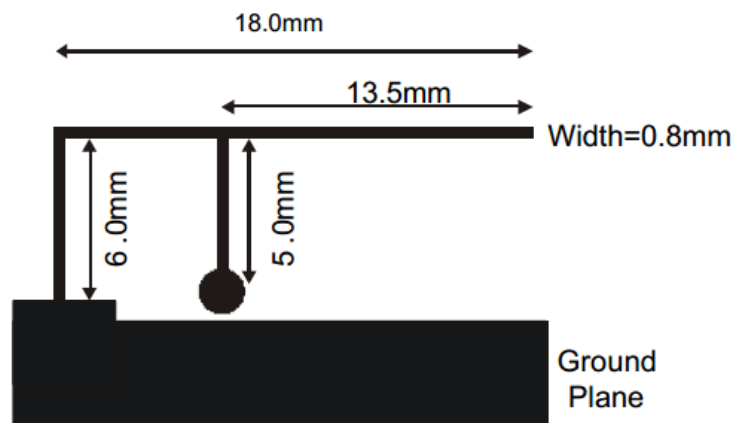
图（4）某陶瓷天线设计规格

5.2 板载 PCB 天线

(1) 蛇形天线，天线的参考规格如下图所示，注意天线参考地需完整，该天线可使用在有足够净空区的 PCB 上。

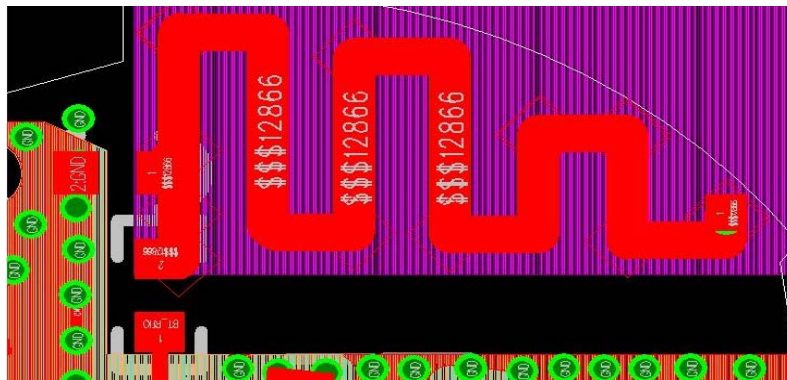


图（5）蛇形天线

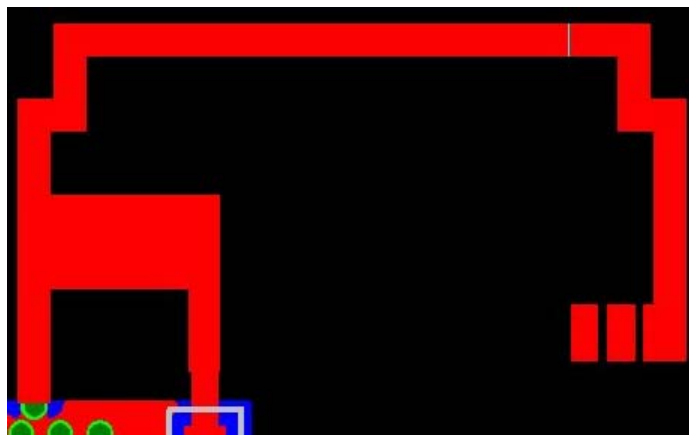


图（6）倒 F 天线

对于空间有限的 PCB，可以对天线做变形处理，但要尽量满足 $1/4$ 波长的要求，长度为 32mm。如图（6）所示。如果天线长度不够，RF 性能会变差。变形后的天线增益及方向性需要实测样机调试，通过不断调整达到最好增益及效率。



图（6）蛇形天线变形

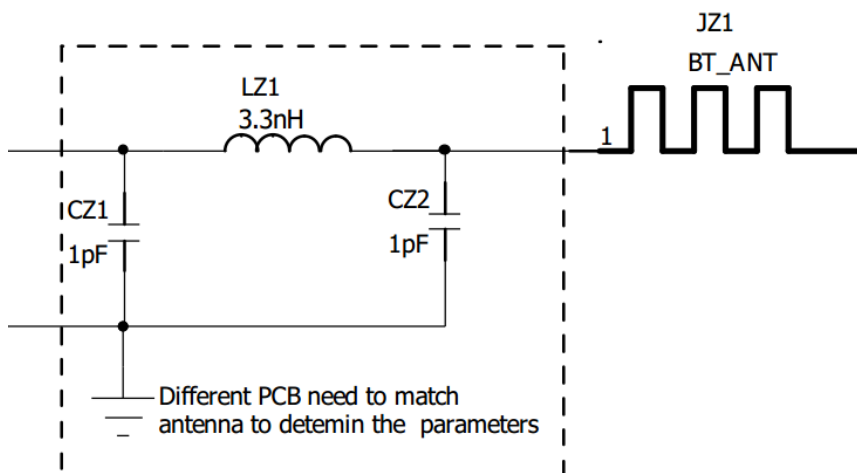


图（7）倒 F 天线变形

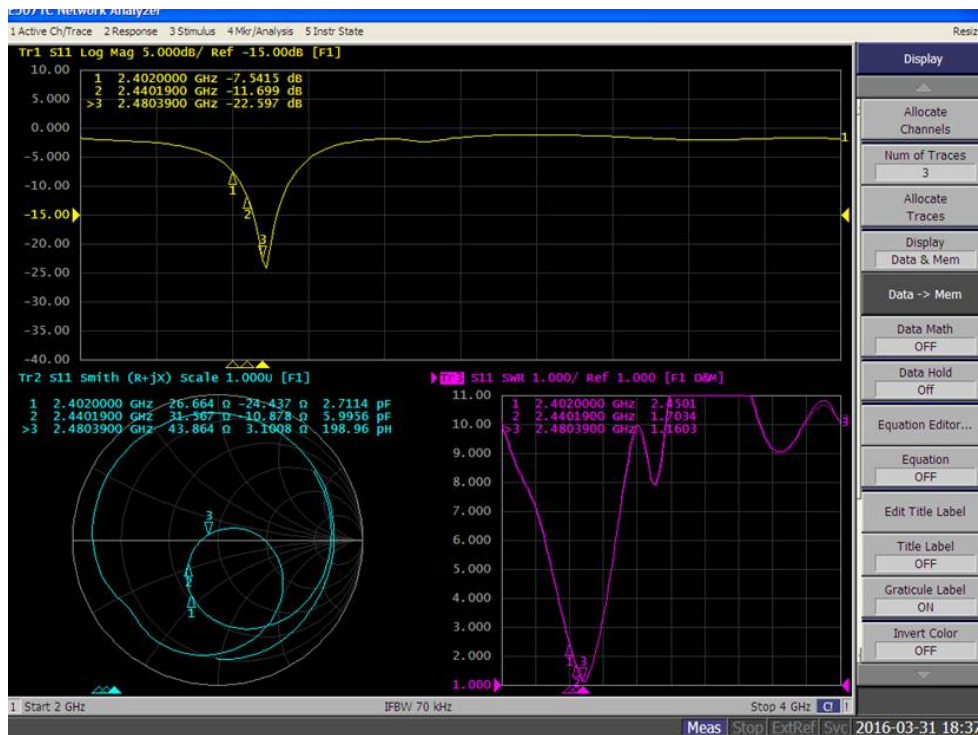
6 天线匹配

天线匹配的的目的是使天线的特征阻抗接近 50 欧姆，减小插入损耗。

天线匹配可通过调整匹配网络的参数，例如改变匹配网络中的电感和电容值，使 **S11** 驻波比 **VSWR** 小于 2，**S11** 回波损耗小于 -10dB。天线匹配需要考虑 **PCB** 外围器件、机壳对天线的影响，入耳式耳机还需要考虑人体对天线谐振点的影响。天线匹配需要在产品的真实使用环境中调试，这样调试的结果才有实际的应用意义。



图（8）匹配网络



图（9）天线 S11 参数

S11 参数需要使用网络分析仪去调试。如果没有设备就只能通过改变匹配网络参数，然后实际测试通讯距离来衡量匹配程度。良好的天线匹配可以提高通讯距离。

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