

ANSYS



仿真  
新时代

2017 ANSYS用户技术大会

中国·烟台

# PCB及机箱设备EMC辐射分析

张伟/ 高级应用工程师

ANSYS 中国

# 传统EMC设计弊端



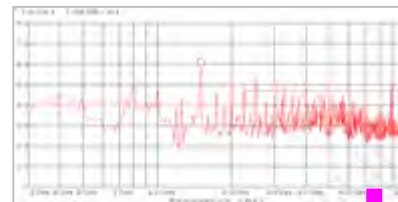
产品EDA开发



整机装配



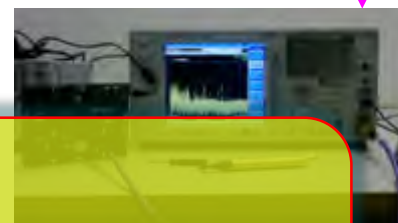
EMC测试



测试超标



整机装配

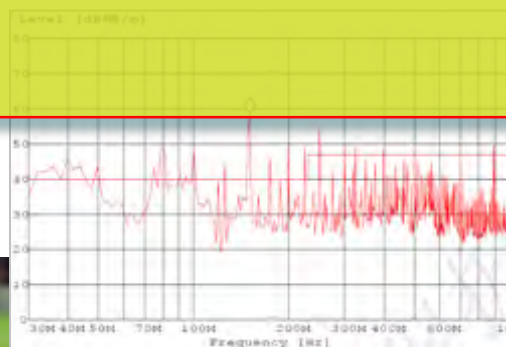


**重复多次整改, 无法满足性能要求, 严重耽误交付周期!**

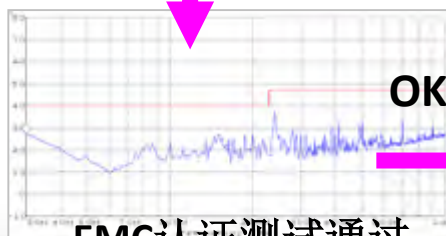
NO



EMC测试



EMC测试超标



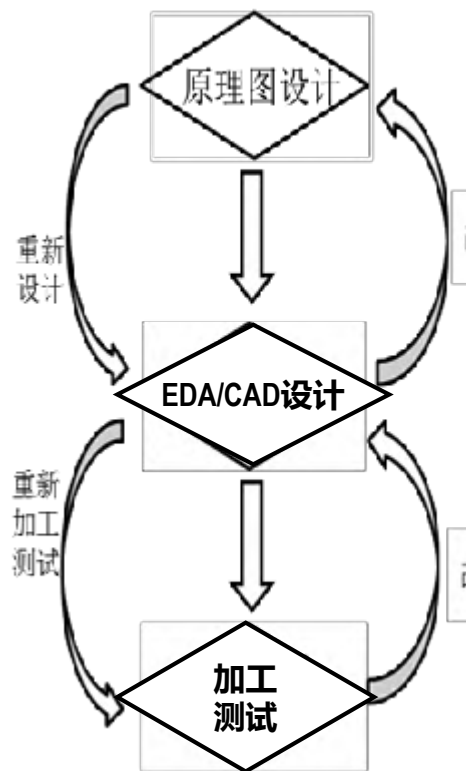
OK

EMC认证测试通过

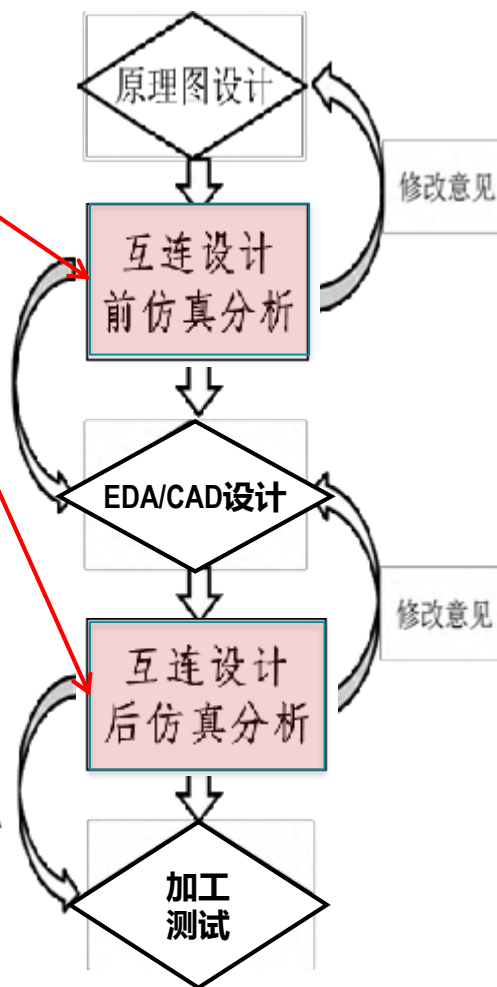


# EMC设计新流程

## 虚拟仿真技术！

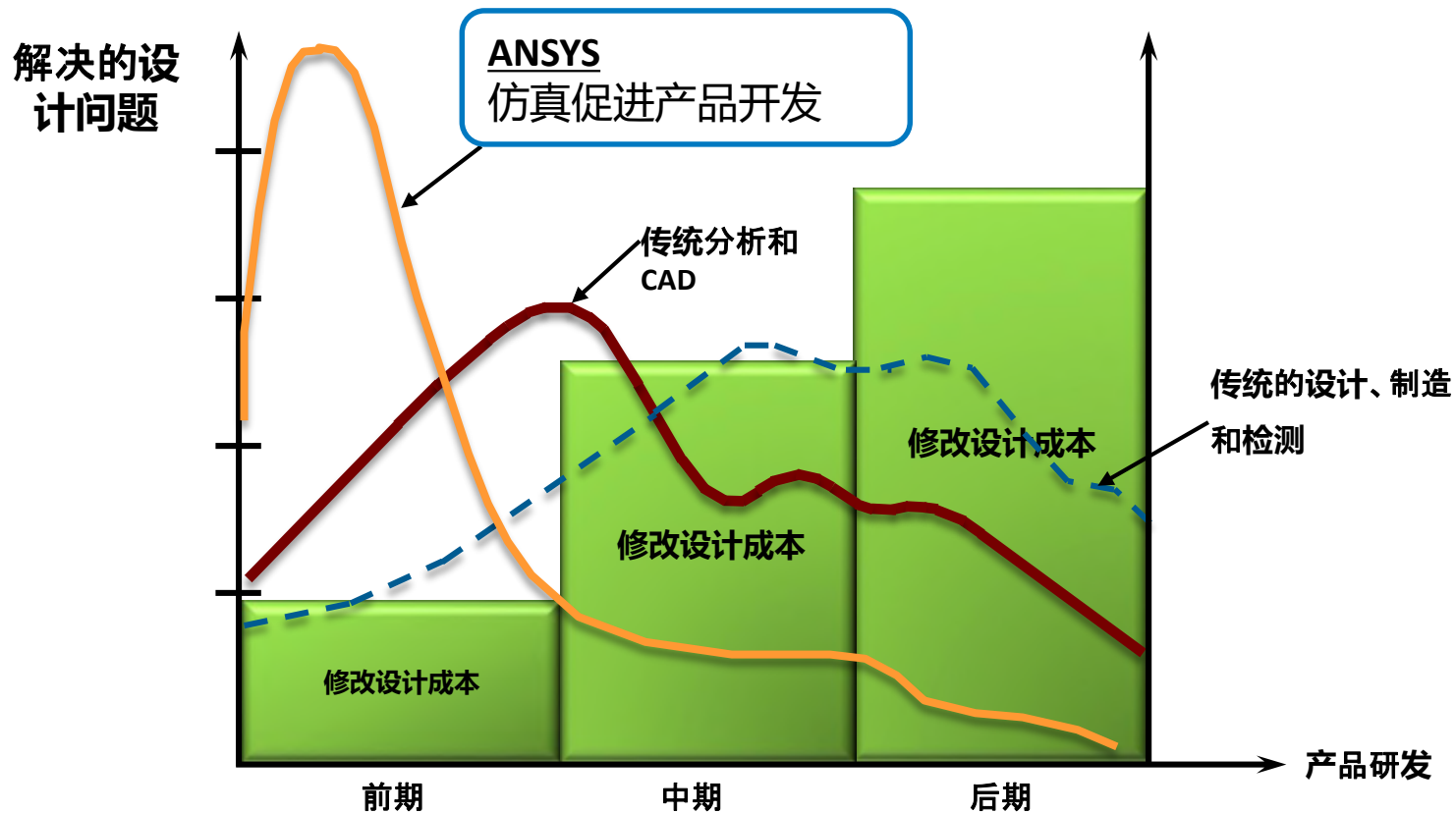


传统设计流程



新型设计流程

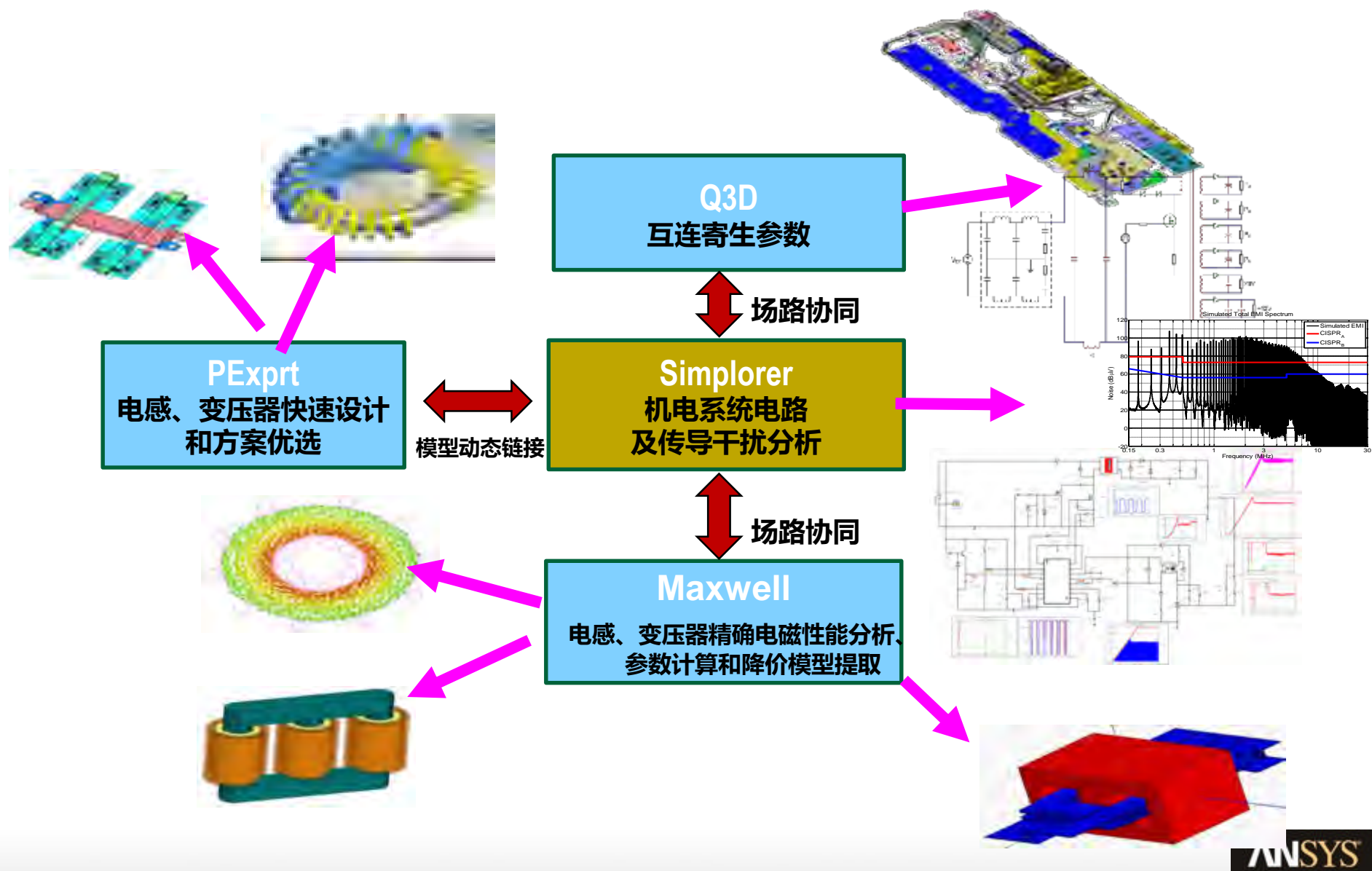
# 仿真技术对产品开发的影响



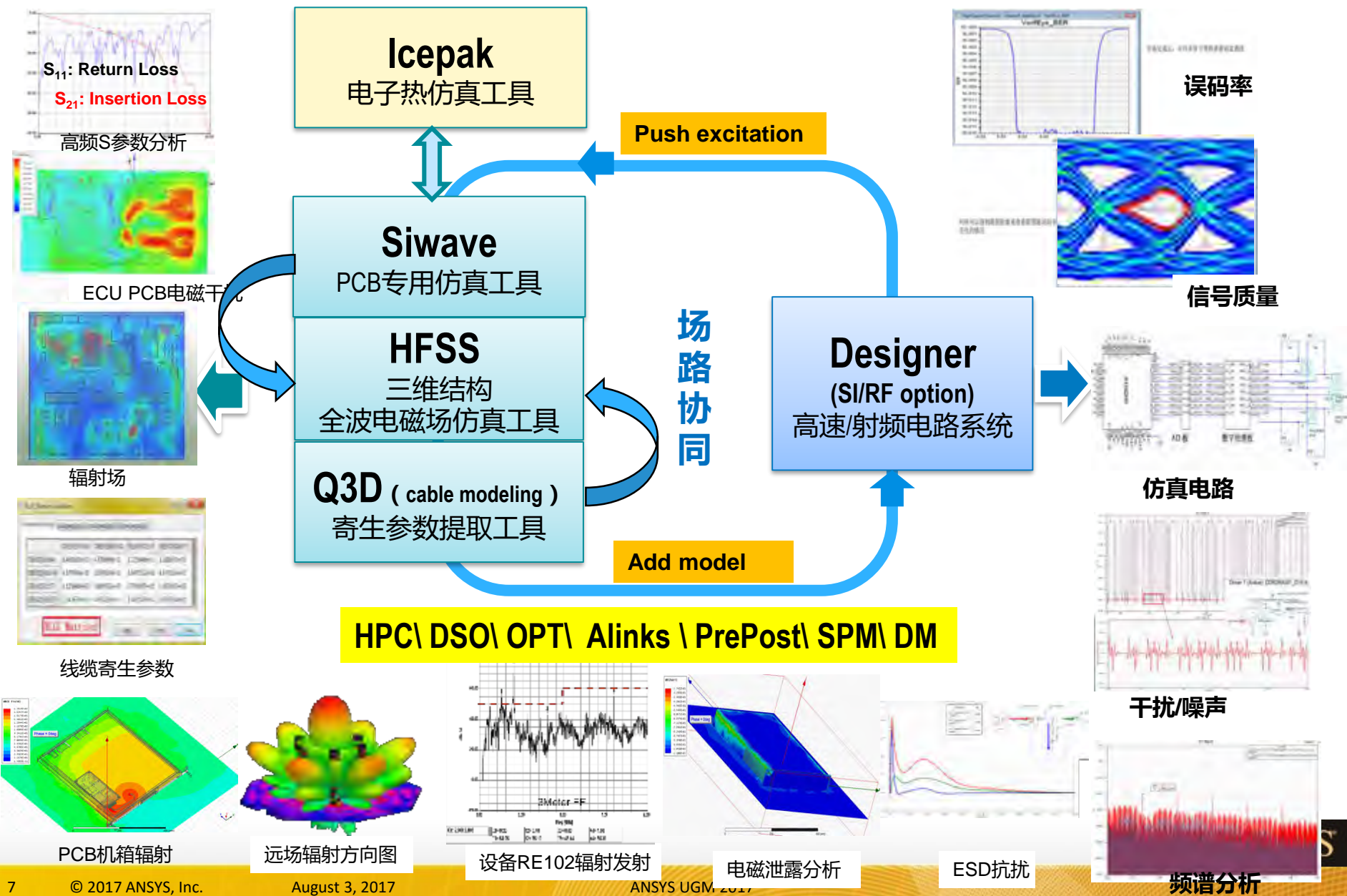
# ANSYS EMC 分析解决方案



# ANSYS 低频 EMC 传导解决方案



# ANSYS 高频EMC辐射解决方案

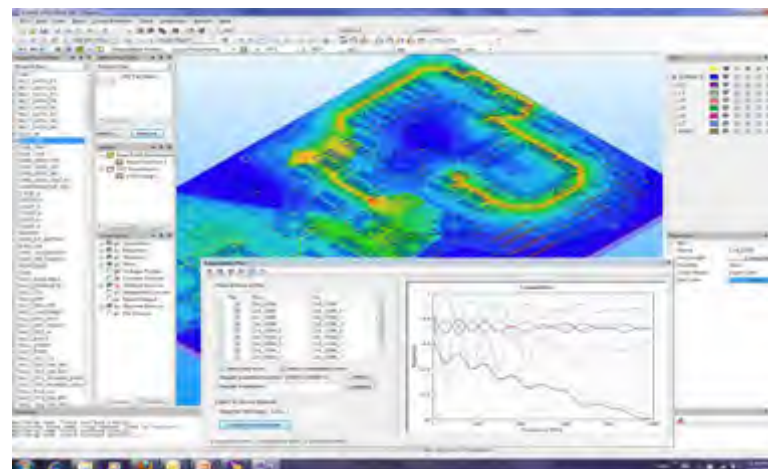


# 案例分析

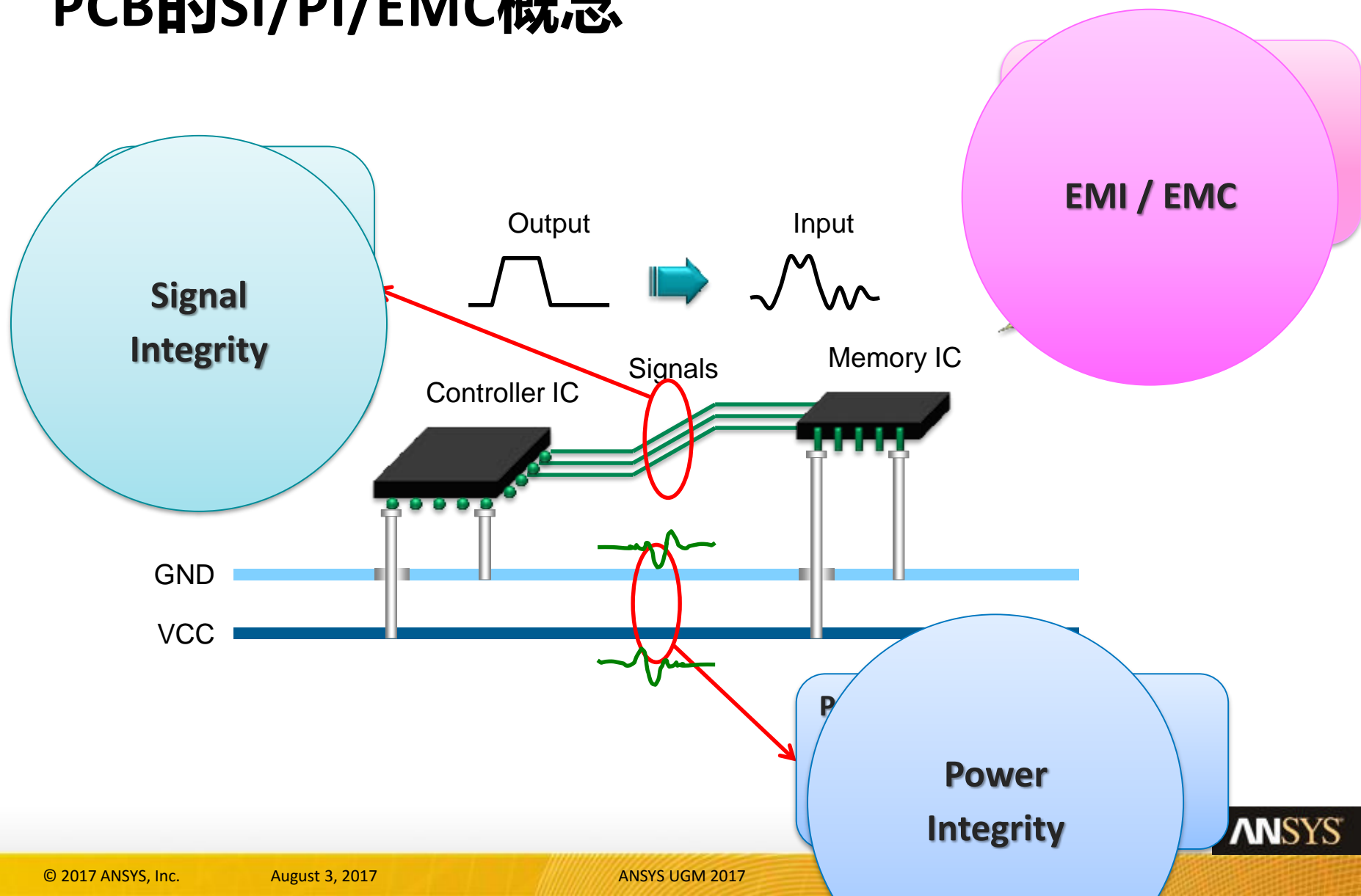
1. 电路板信号、电源噪声辐射仿真
2. PCB线缆机箱设备的辐射发射仿真
3. 外界强电磁环境下设备的辐射受扰仿真



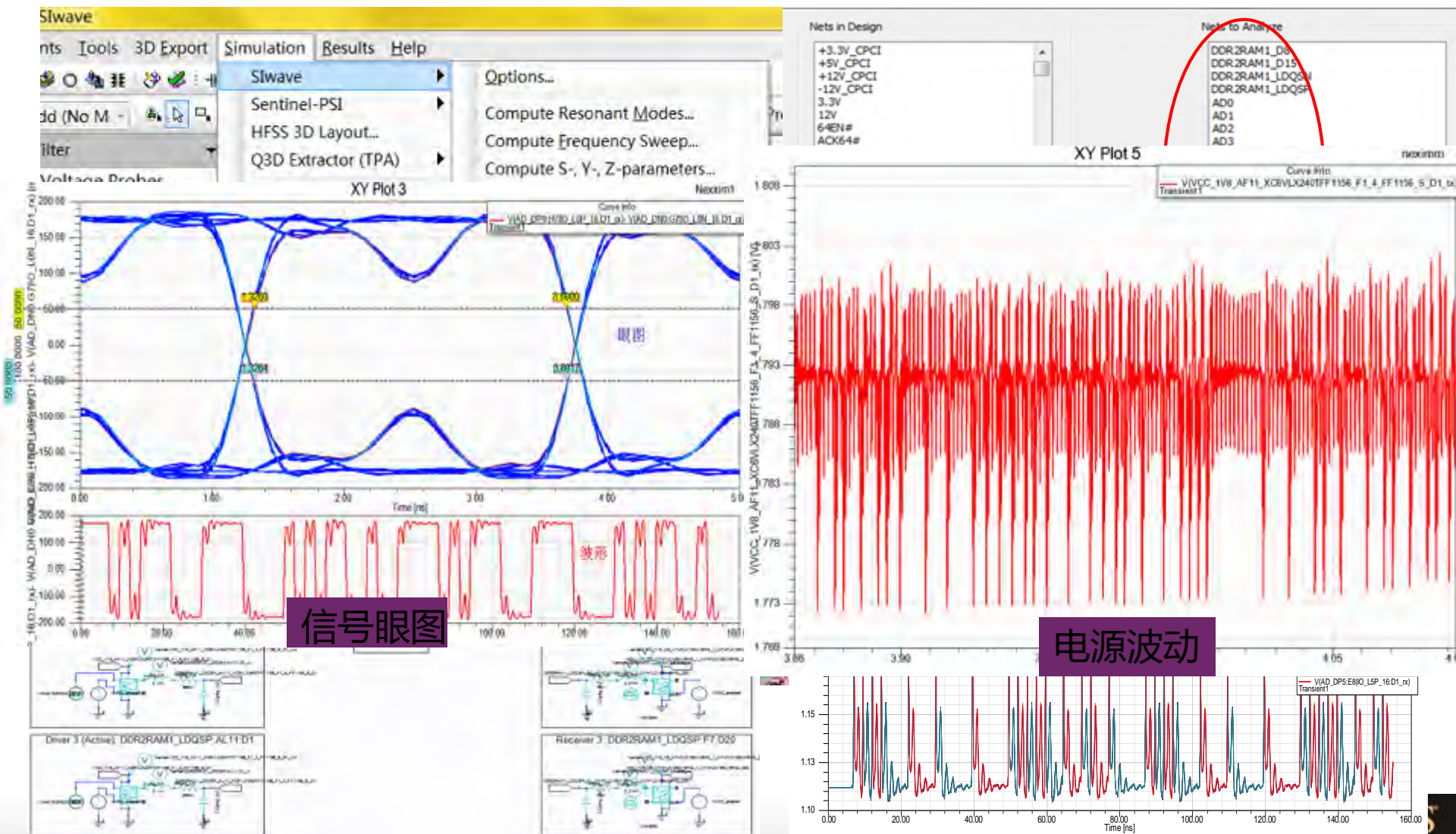
# 案例1：电路板信号电源噪声辐射



# PCB的SI/PI/EMC概念



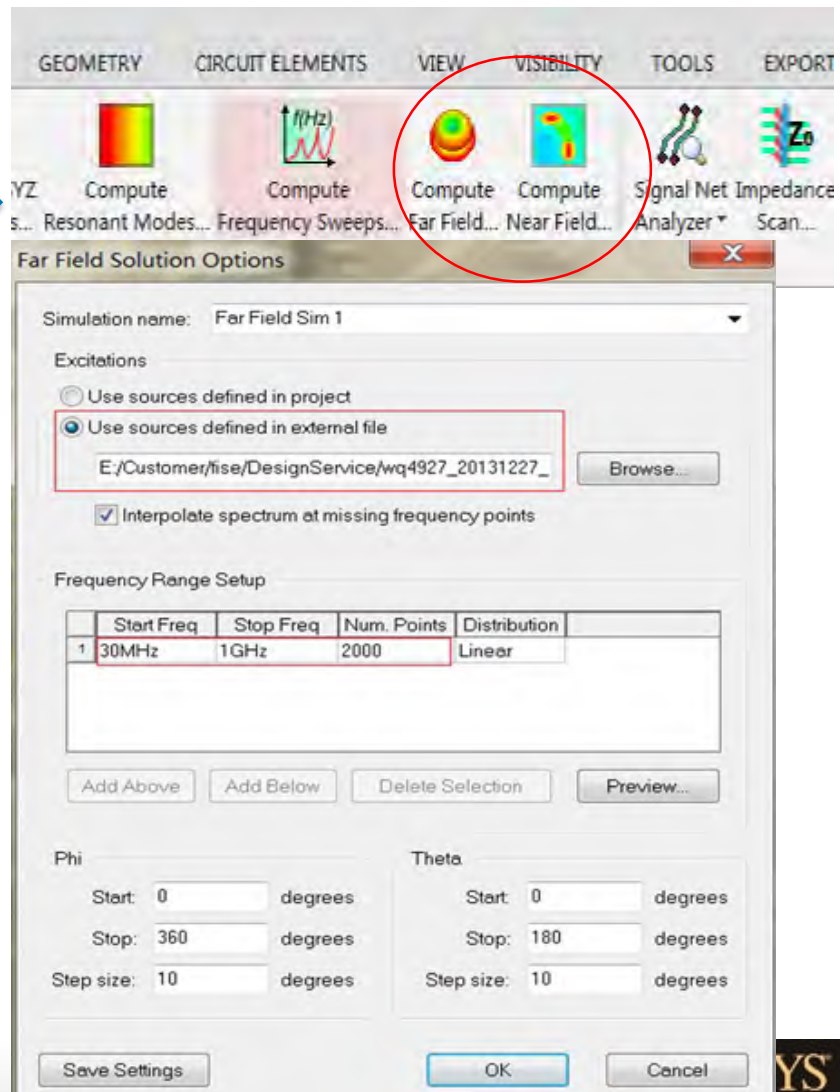
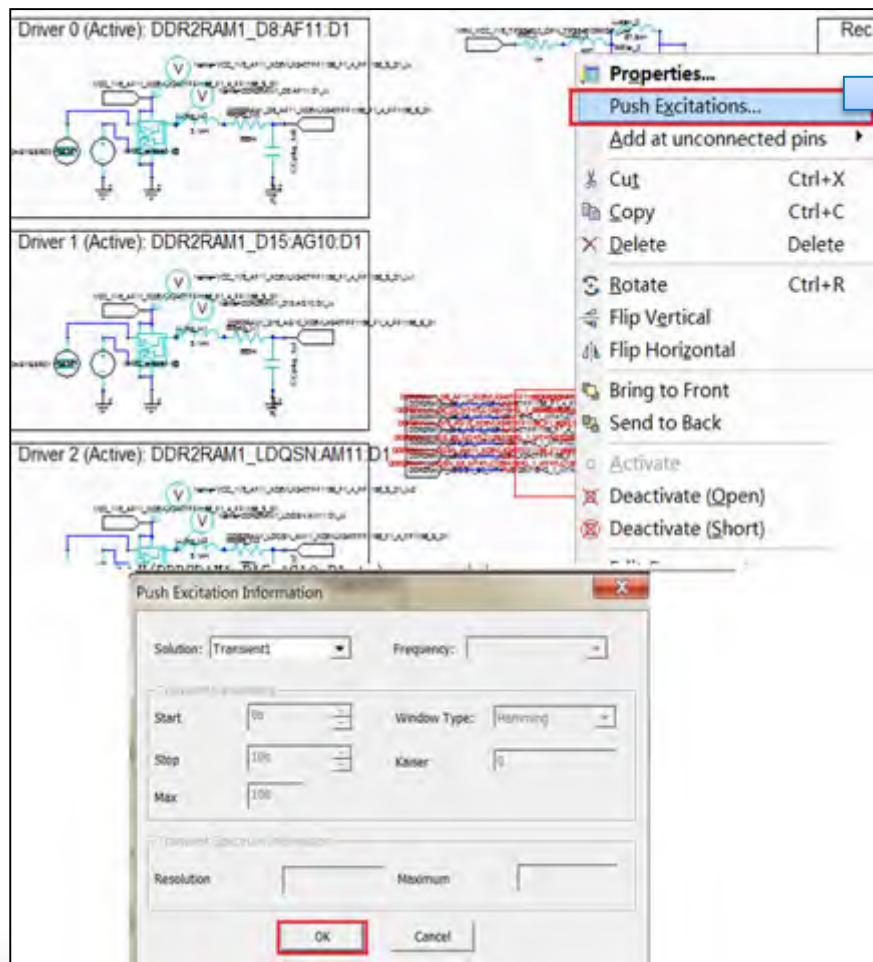
# ANSYS PCB SI/PI/EMC分析



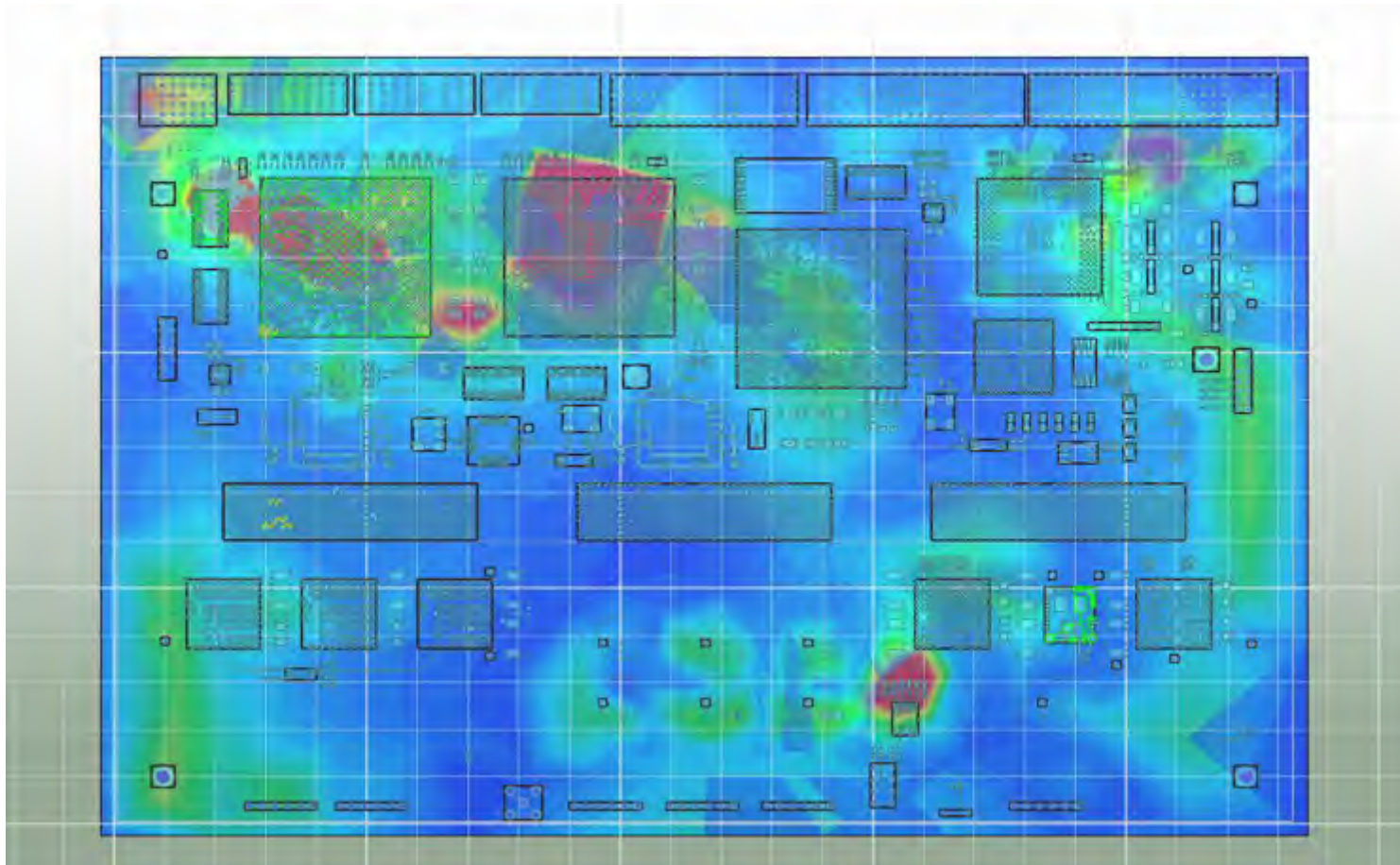


# PCB辐射分析

SIwave与designer的场路协同



# 噪声辐射分析

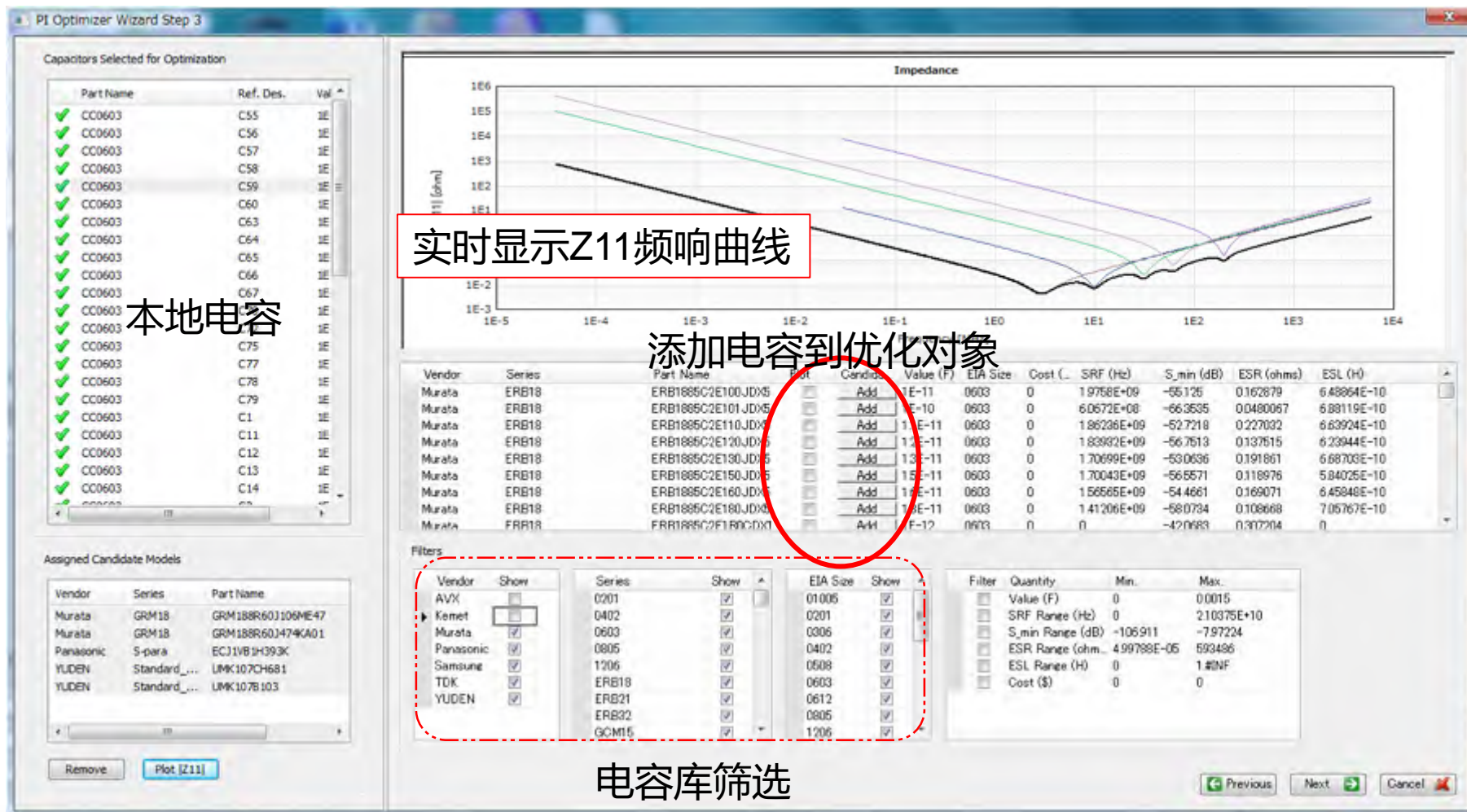


近场辐射分布

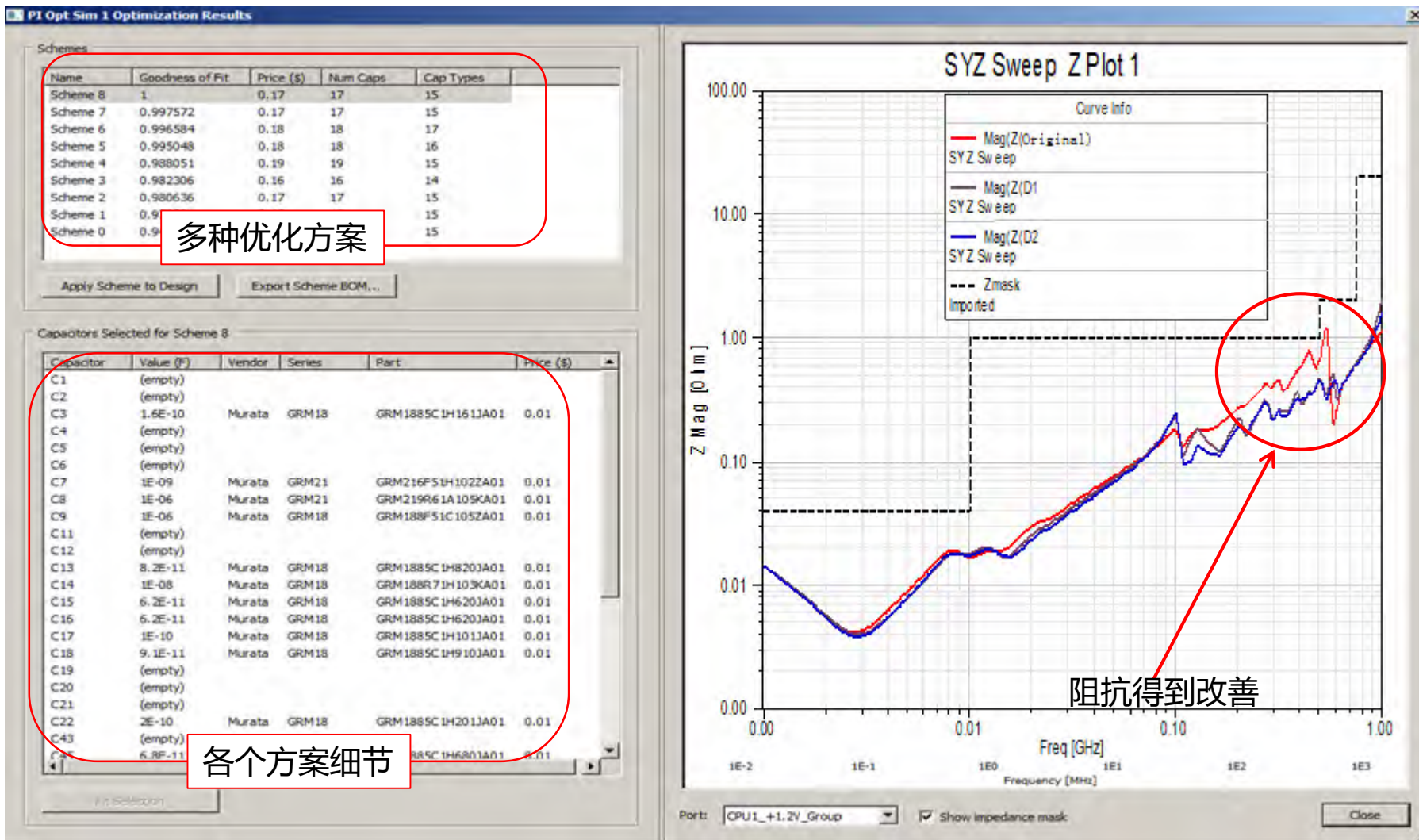


# 电源阻抗自动优化

电源去耦网络阻抗自动优化模块，考虑电容容值，布局位置，焊盘等细节影响

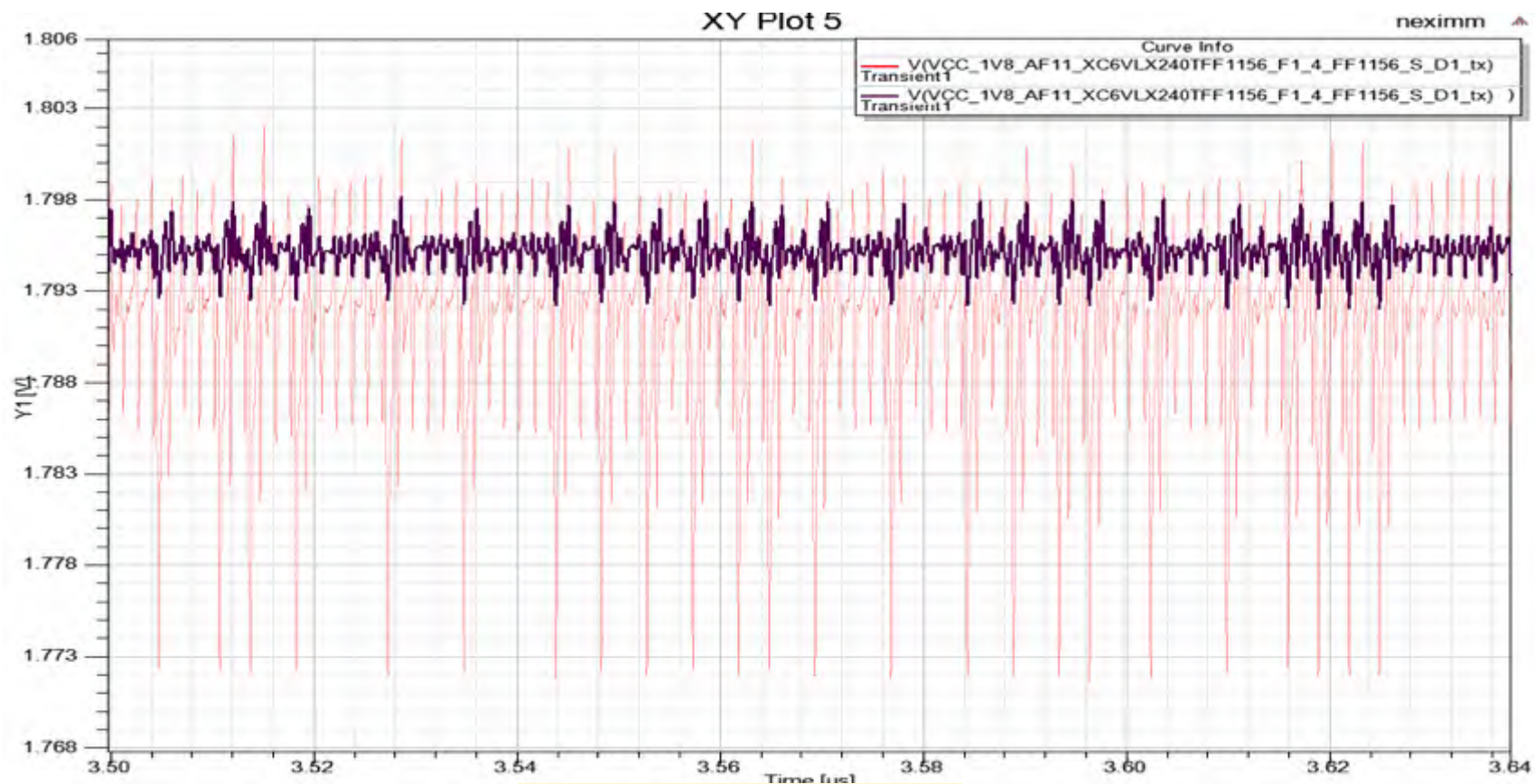


# 阻抗自动优化



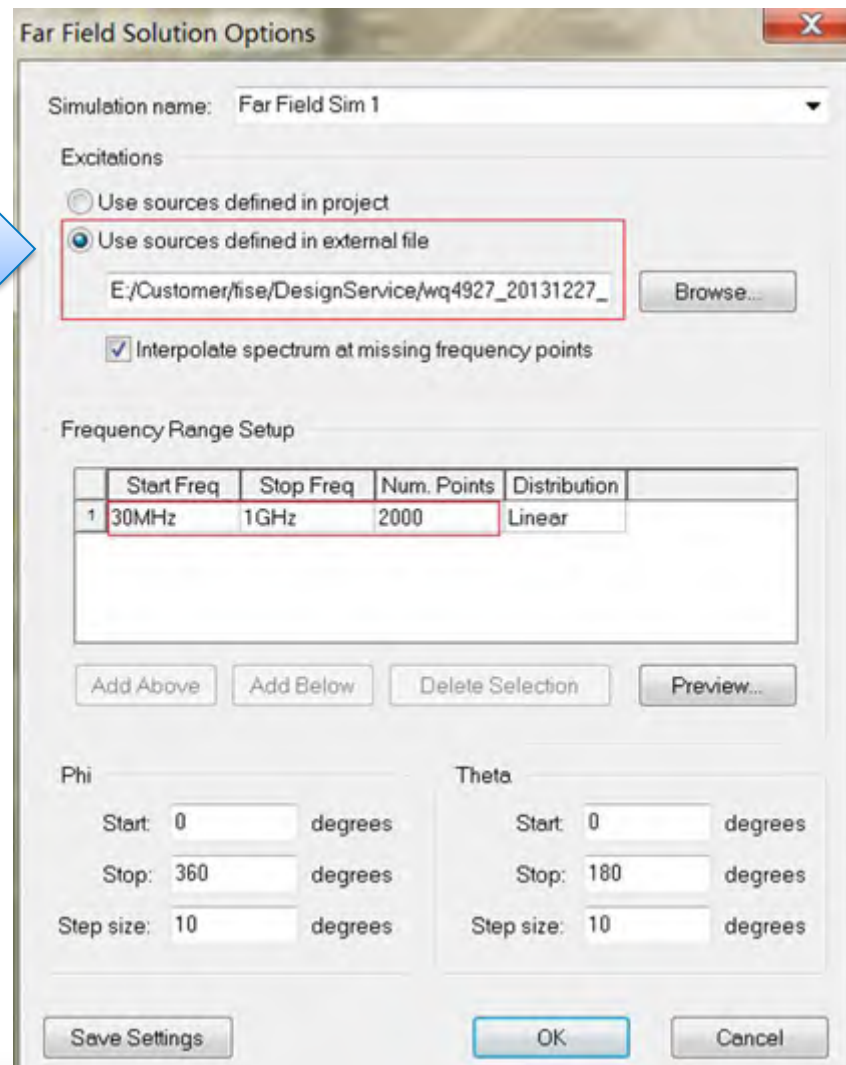
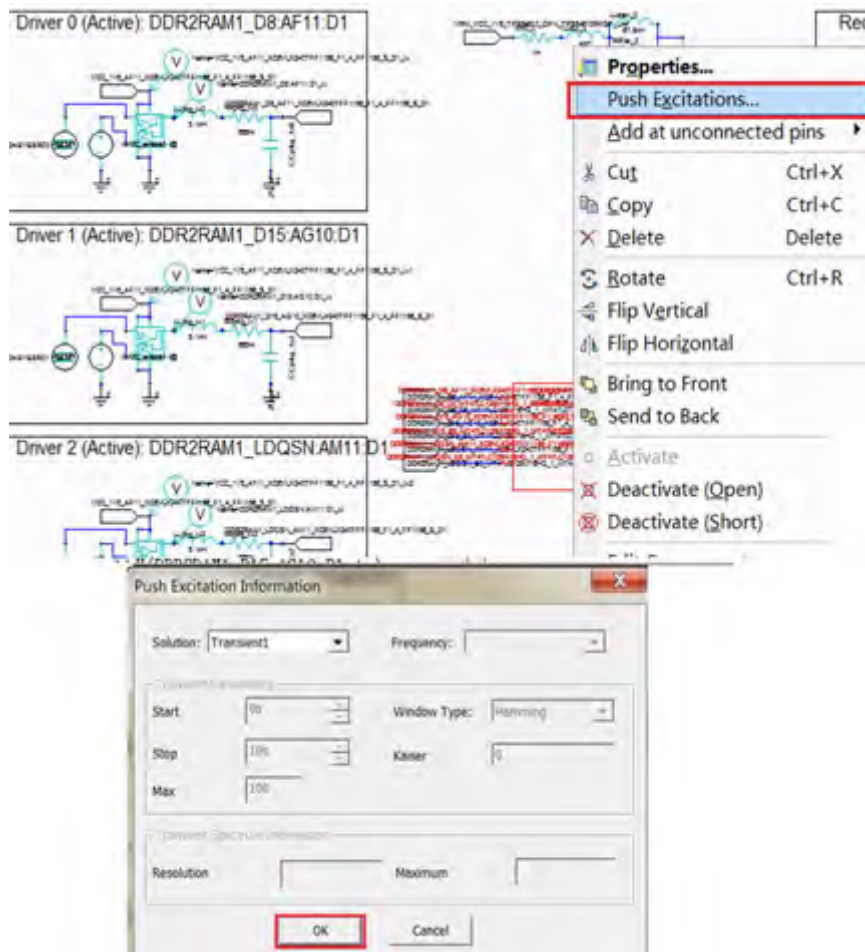


# PCB时域电源抖动的改善



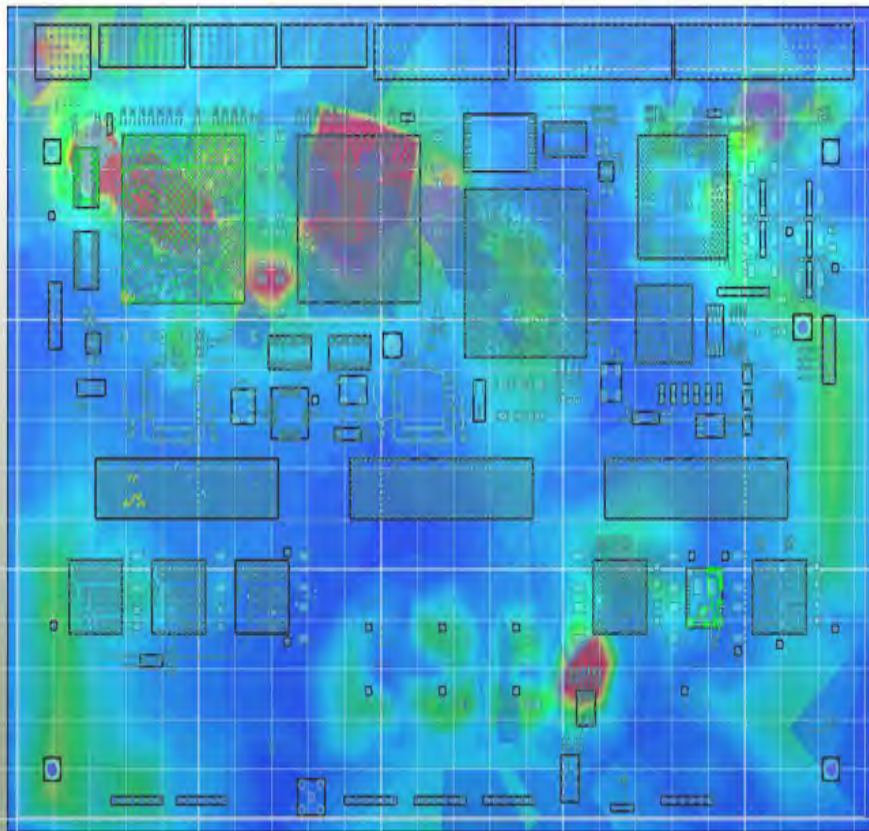
电源波动-优化前后

# PCB对外辐射分析

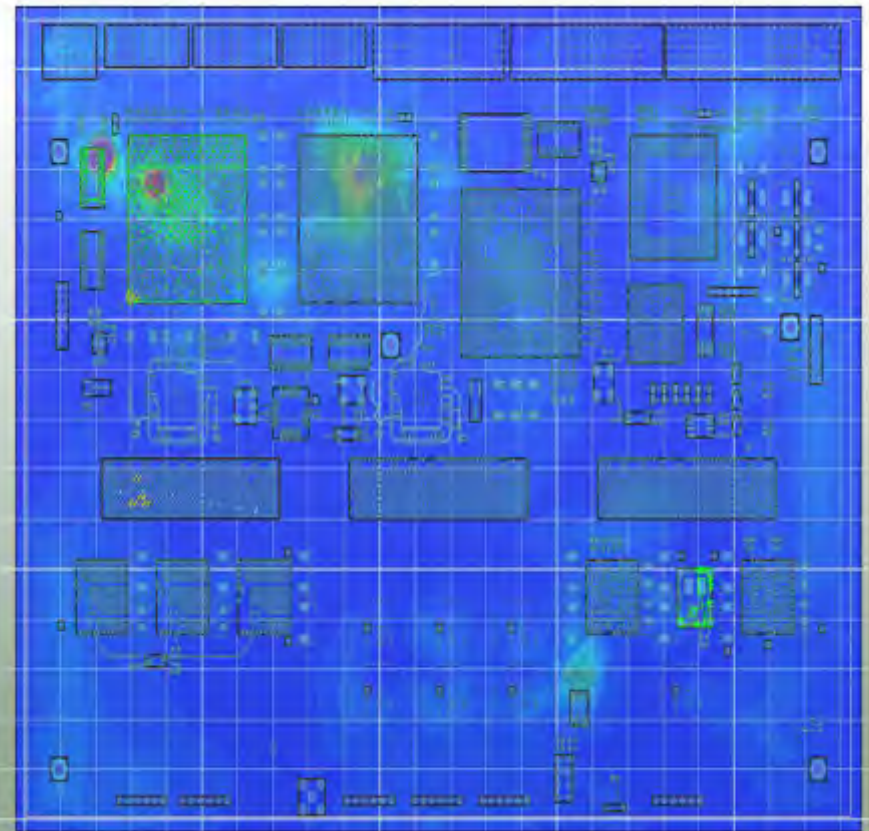




# PCB近场优化对比



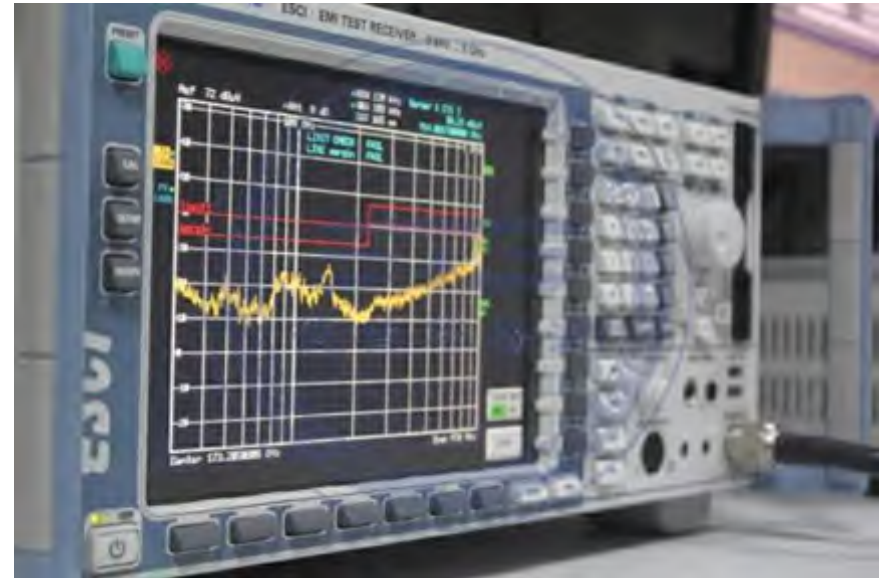
PCB电源优化前



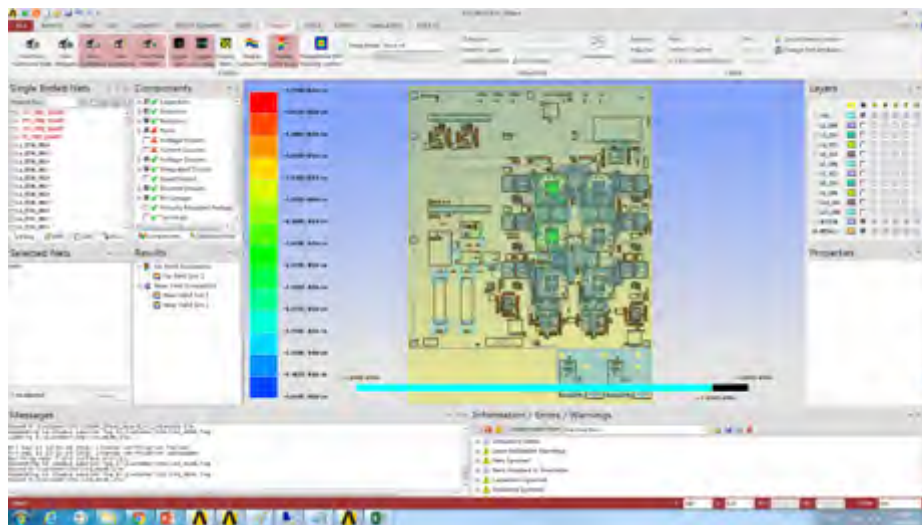
PCB电源优化后



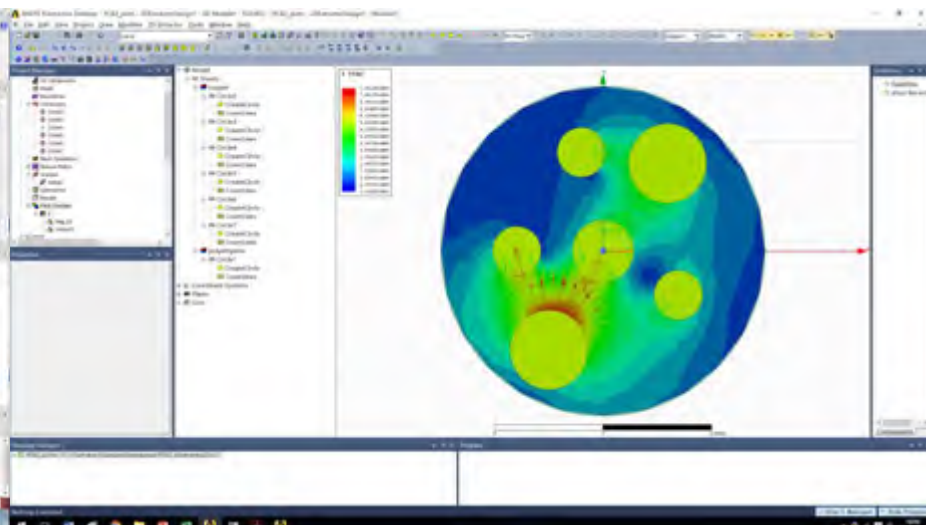
## 案例2：设备级（PCB线缆机箱）辐射发射



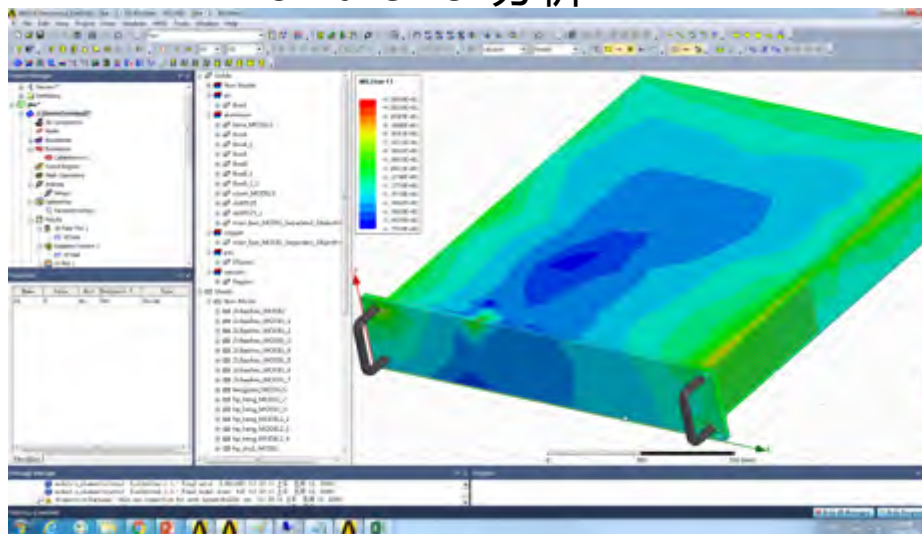
# 机箱联合PCB线缆的辐射分析



Siwave PCB分析



Q2D 线缆截面场



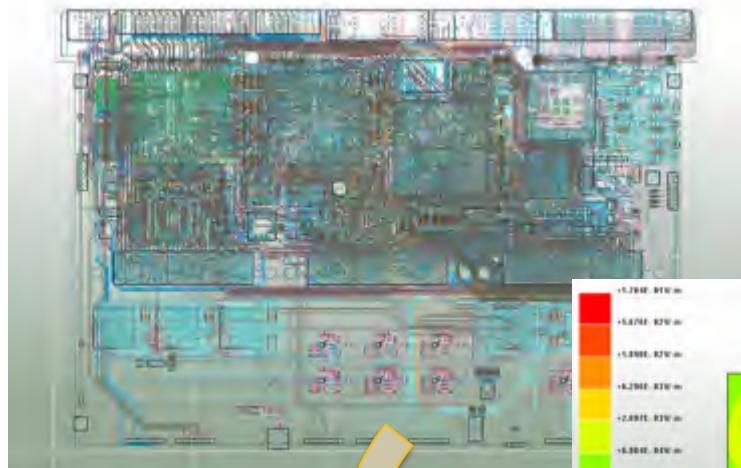
HFSS 设备三维电磁场



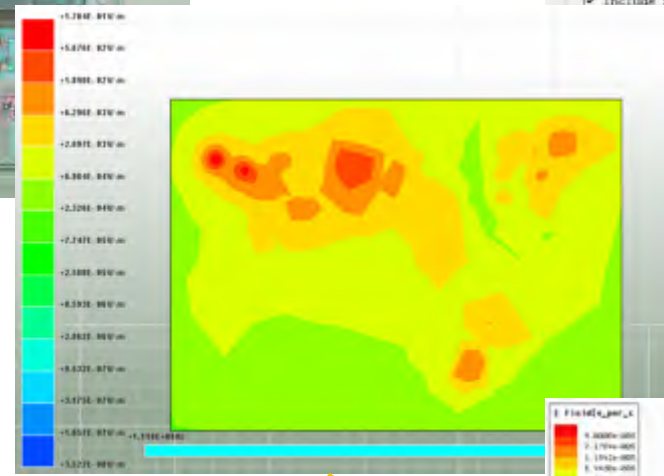
circuit 电路分析



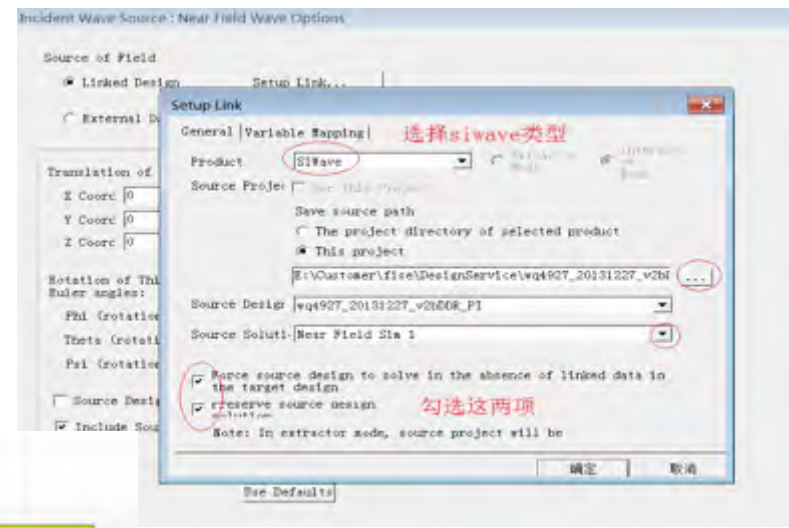
# PCB机箱联合



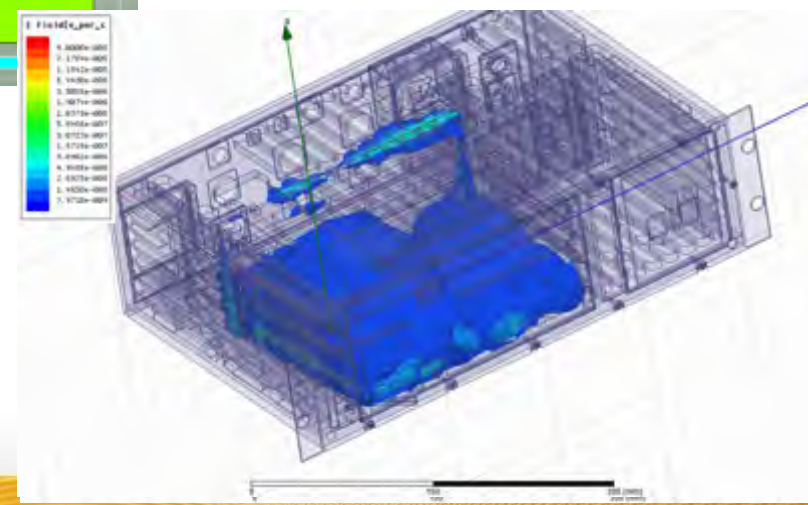
Siwave完成近场分析



HFSS连接Siwave近场数据



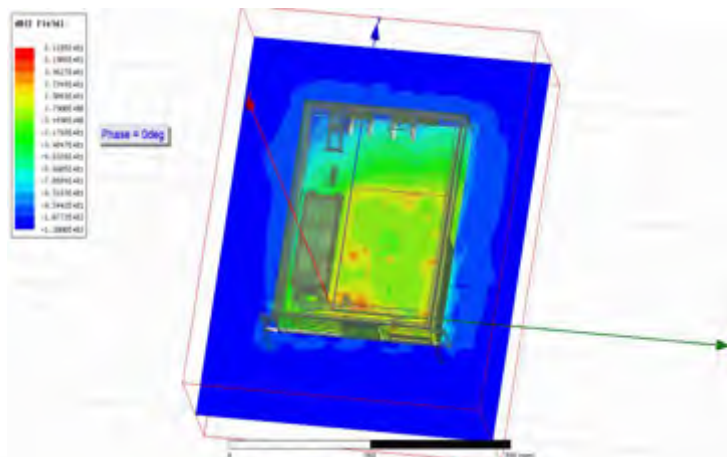
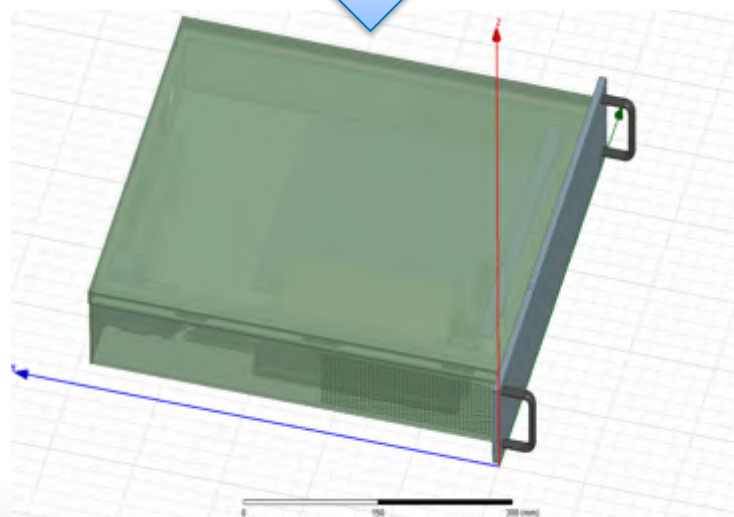
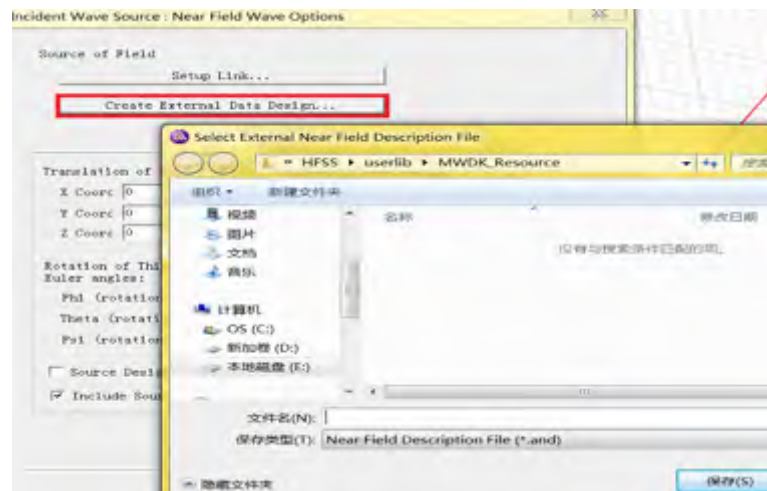
联合三维电磁场工具HFSS,可完成整设备的EMI分析



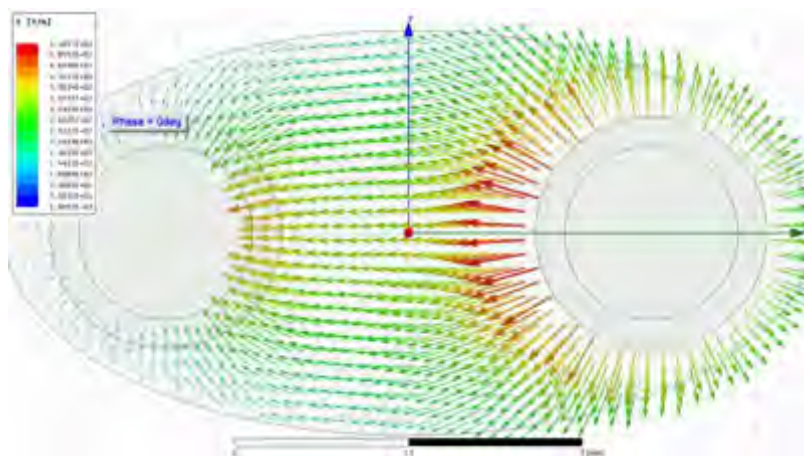
# 辐射数据多样化接口



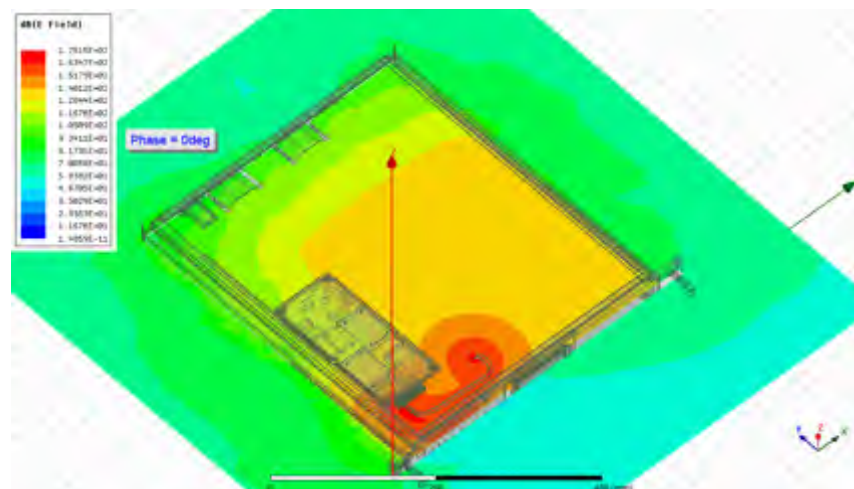
测试获得的辐射数据



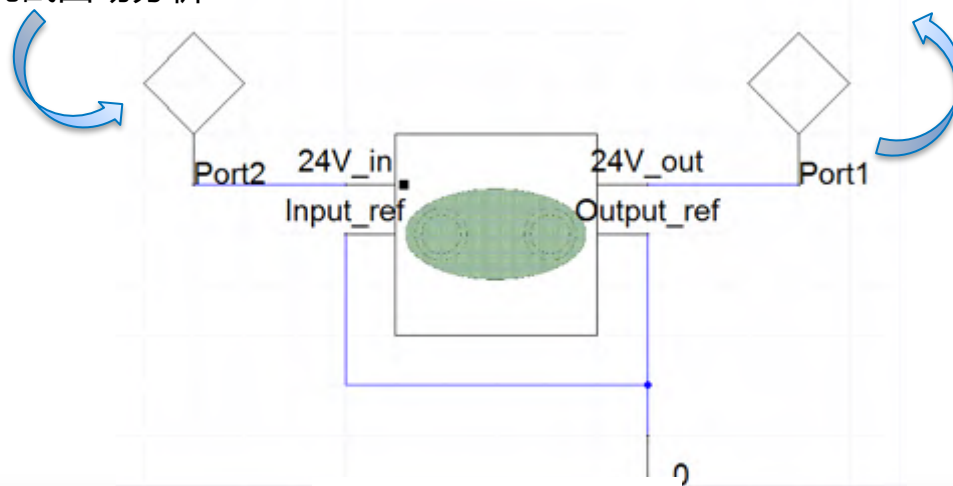
# 电缆辐射cable modeling技术



Q3D线缆截面场分析



HFSS线缆敷设场



Circuit电路噪声分析



# PCB 线缆机箱联合场分析

jike\_pcb\_cable

1 (DrivenTerminal)

3D Components

Model

Boundaries

Excitations

CableNetwork1

IncNFWave1

Hybrid Regions

Mesh Operations

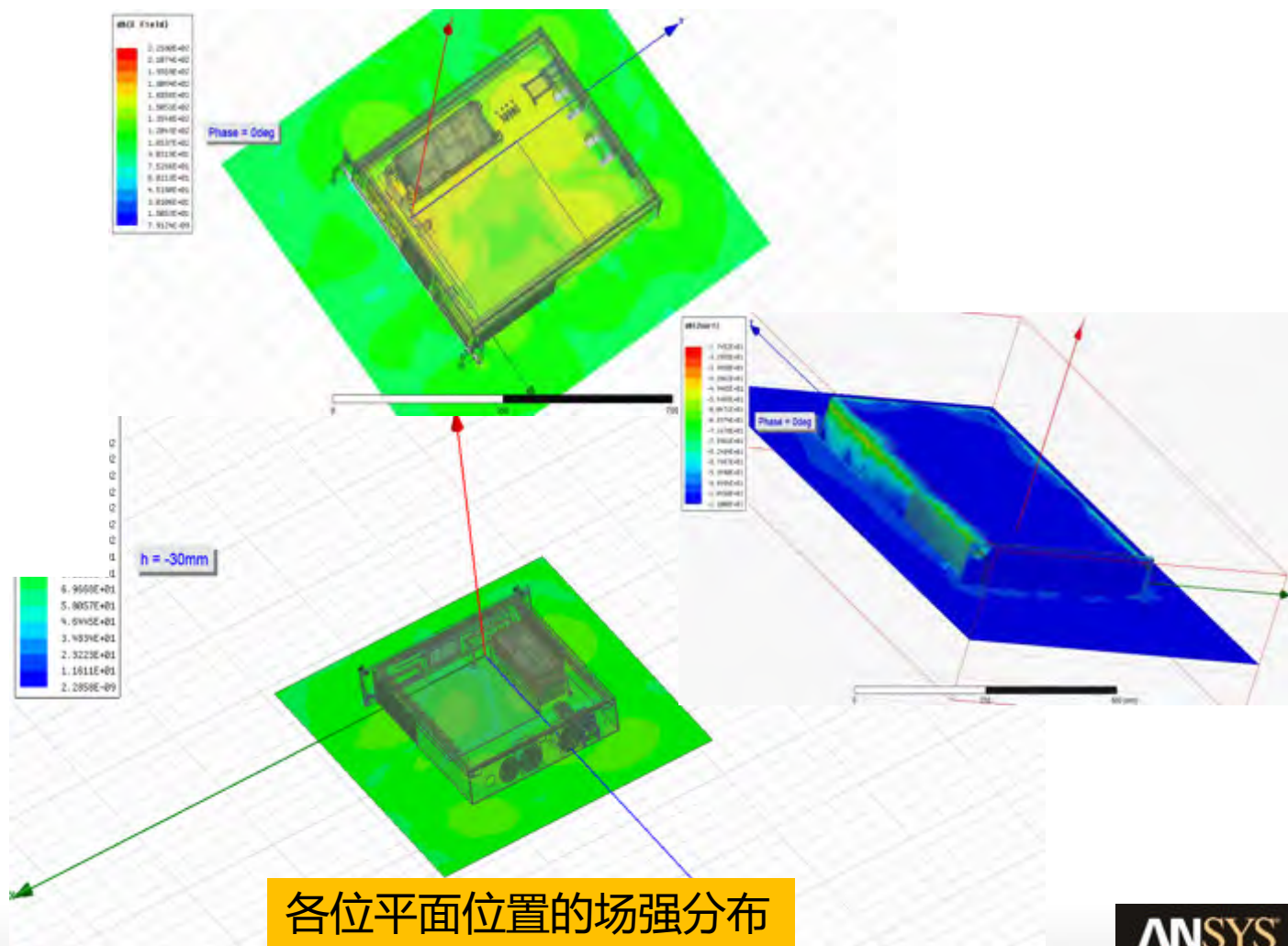
Analysis

Optimetrics

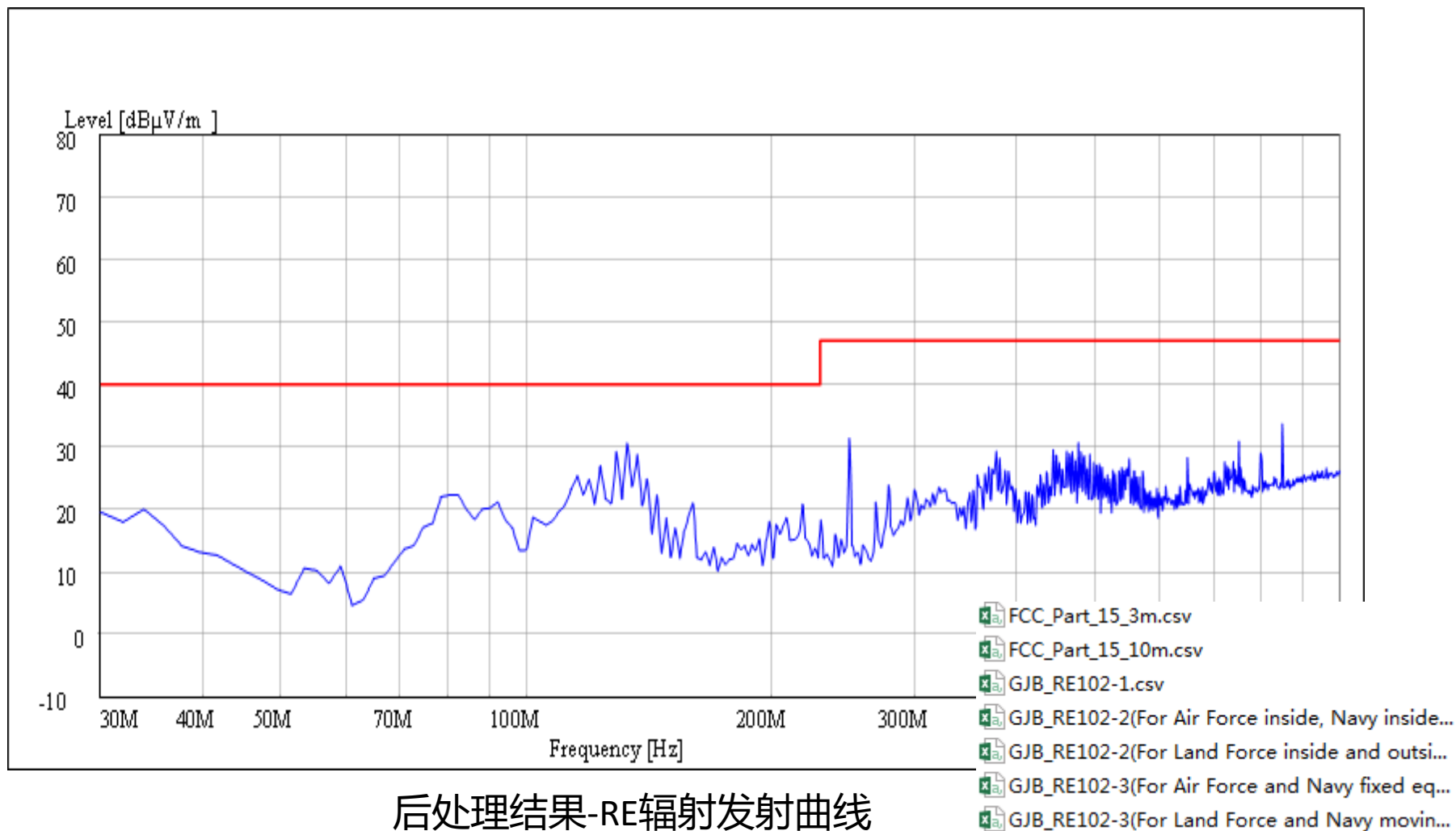
Results

Port Field Display

Field Overlays



# 设备RE102辐射

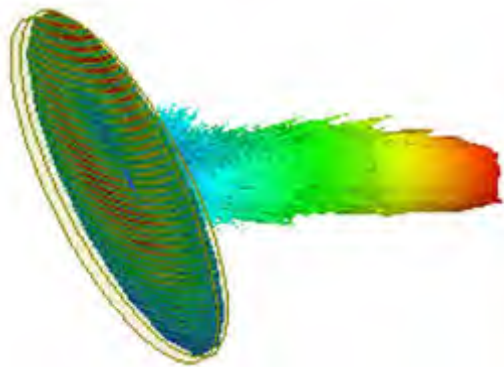


后处理结果-RE辐射发射曲线

## 案例3：外界强电磁环境下设备的辐射受扰



噪声源



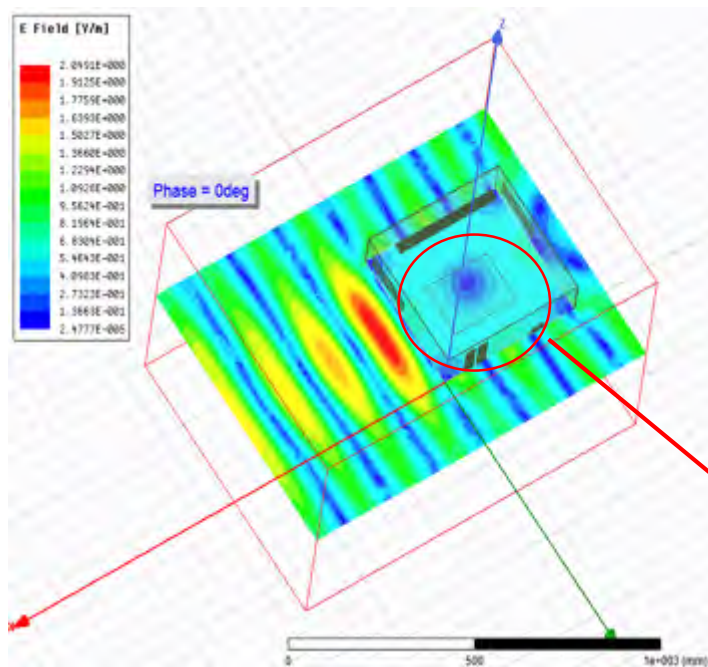
空间辐射



敏感设备

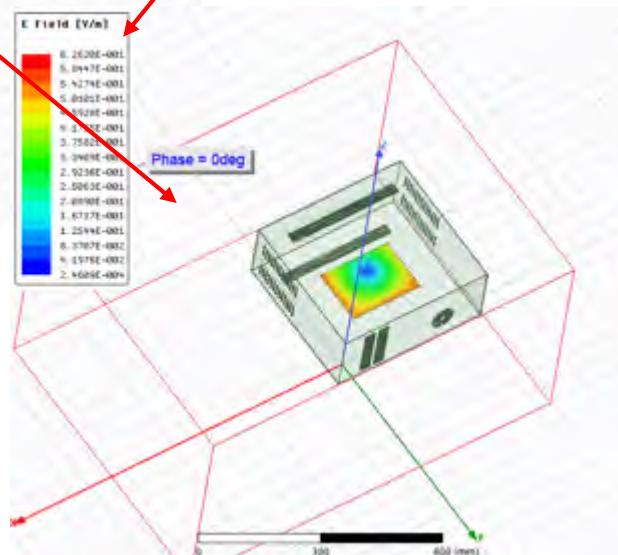
PCB电路耦合？ 线缆耦合？ 机箱屏蔽泄露？

# A: 通过PCB耦合噪声



HFSS建立机箱的电磁泄露分析

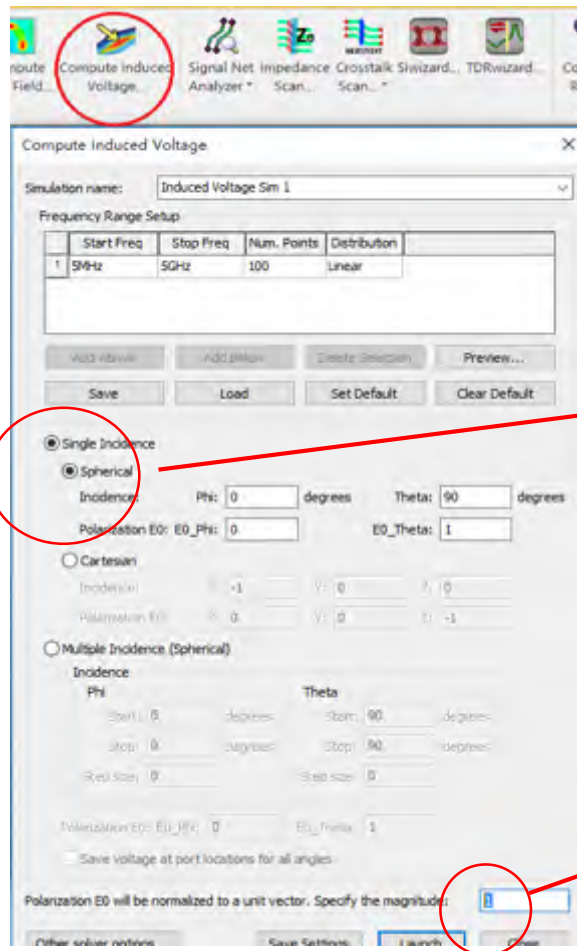
最强电场强度E<sub>max</sub>



PCB面电场强度

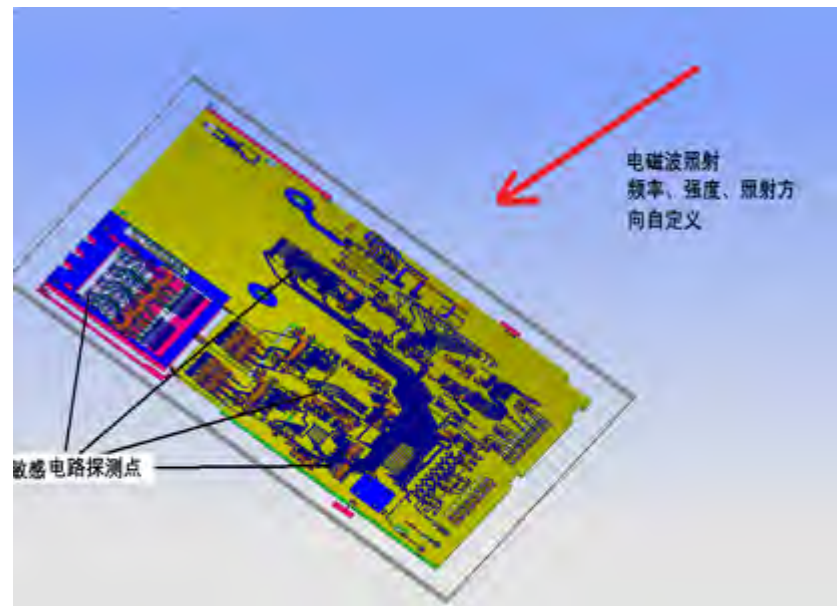


# SIwave平面波照射分析



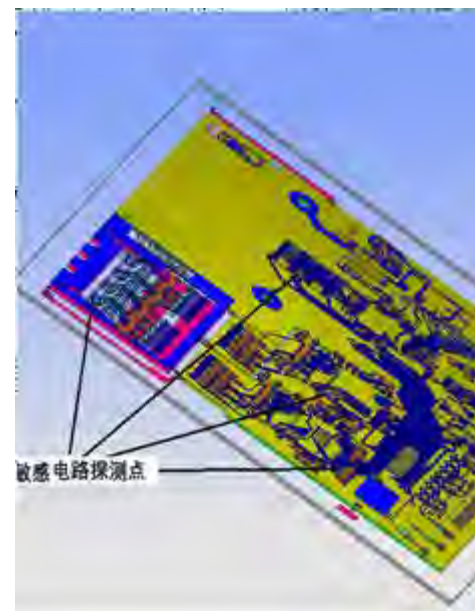
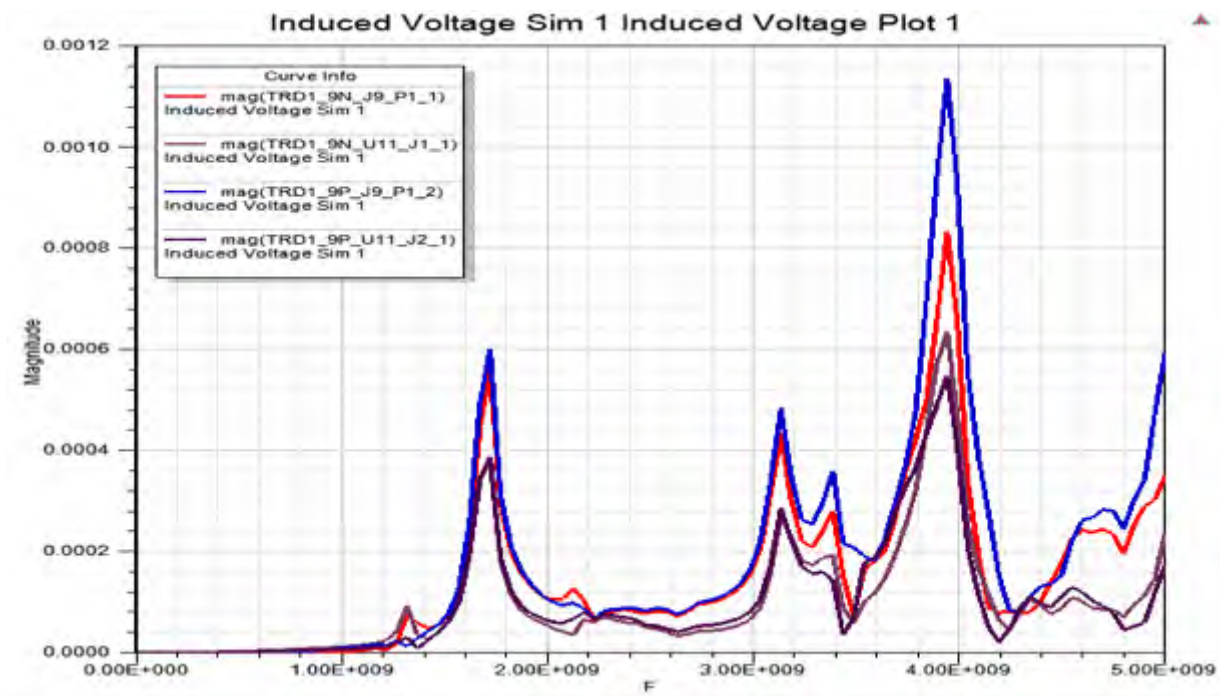
照射方向

电场强度

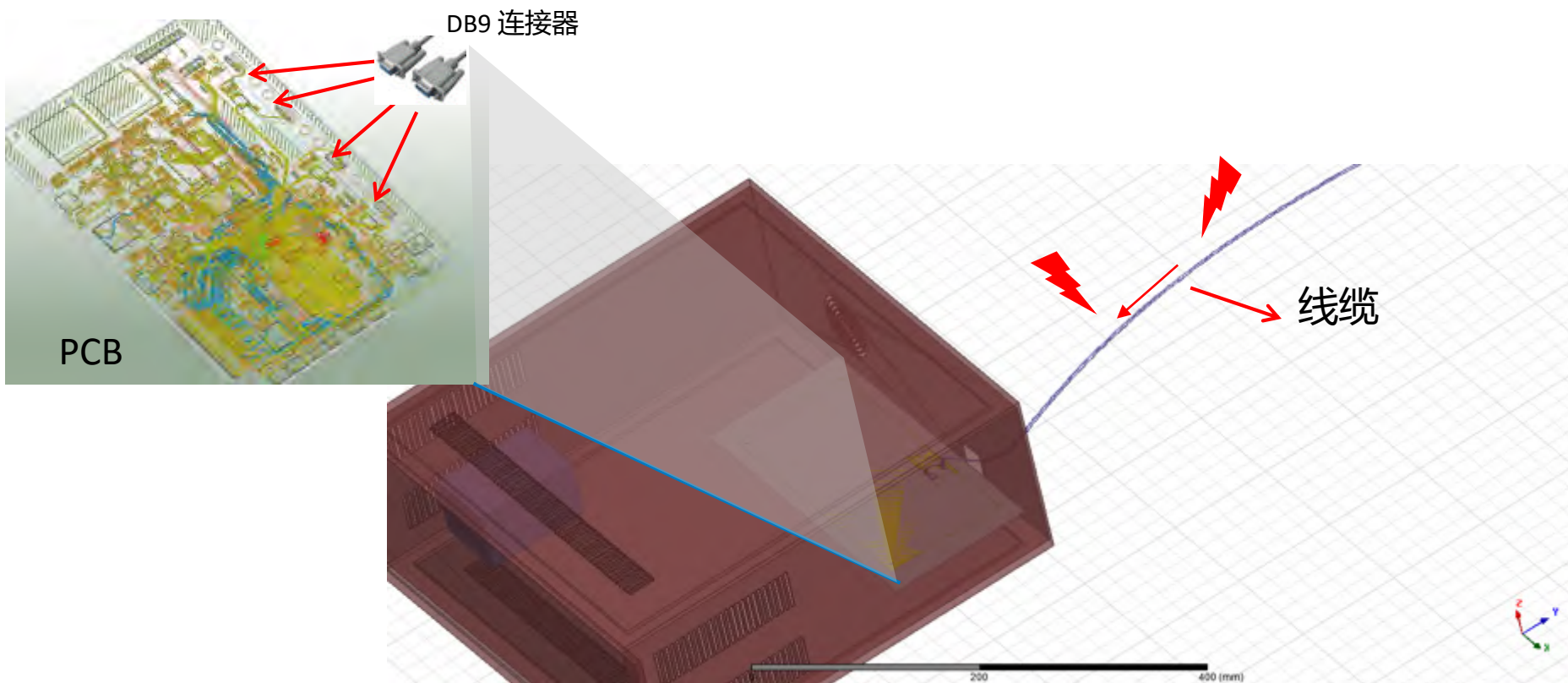




# 关键电路感应电压噪声



## B: 通过线缆耦合噪声

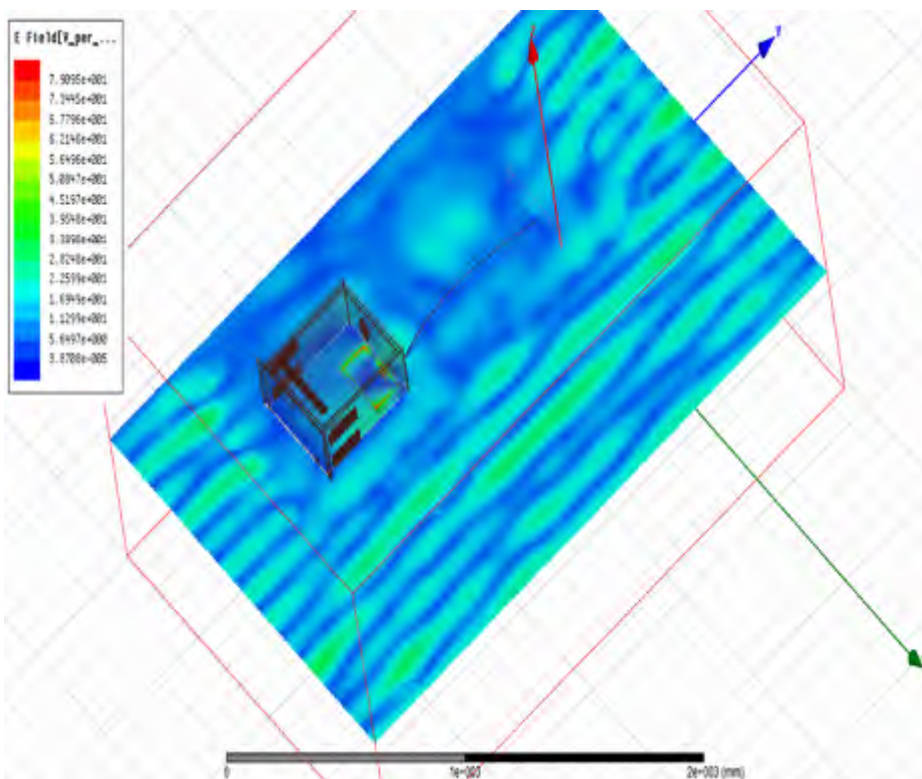


当在外界电磁波干扰的环境之下，线缆易形成天线效应，将不需要的电磁波能量接收下来，形成辐射干扰。

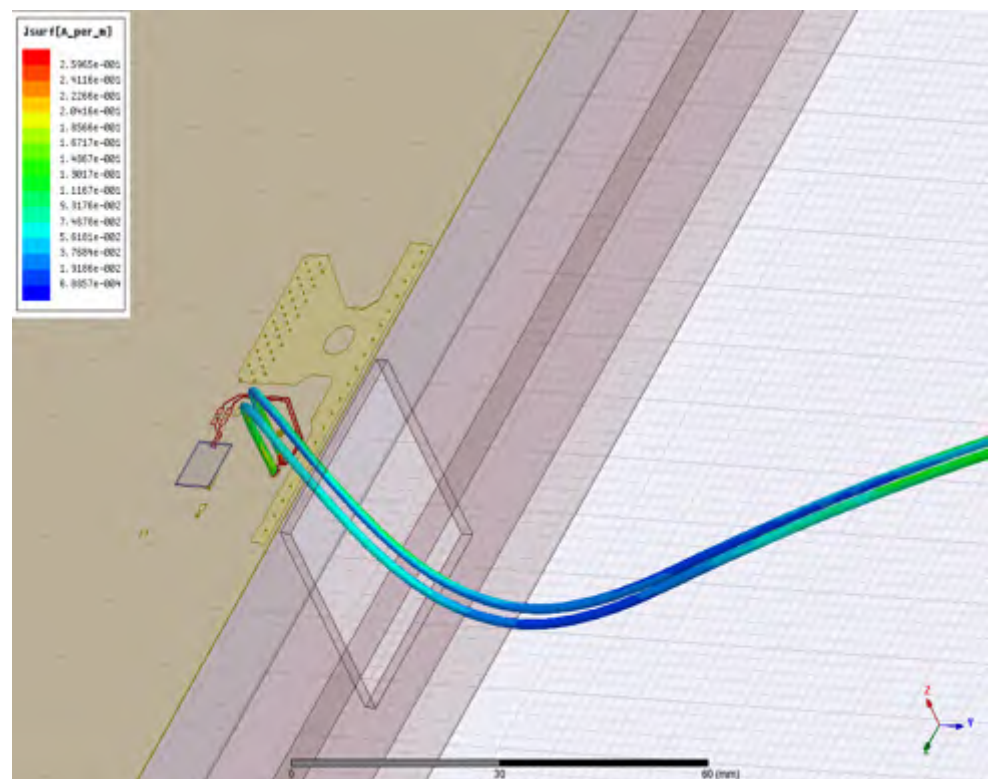




# 电磁波辐射场图

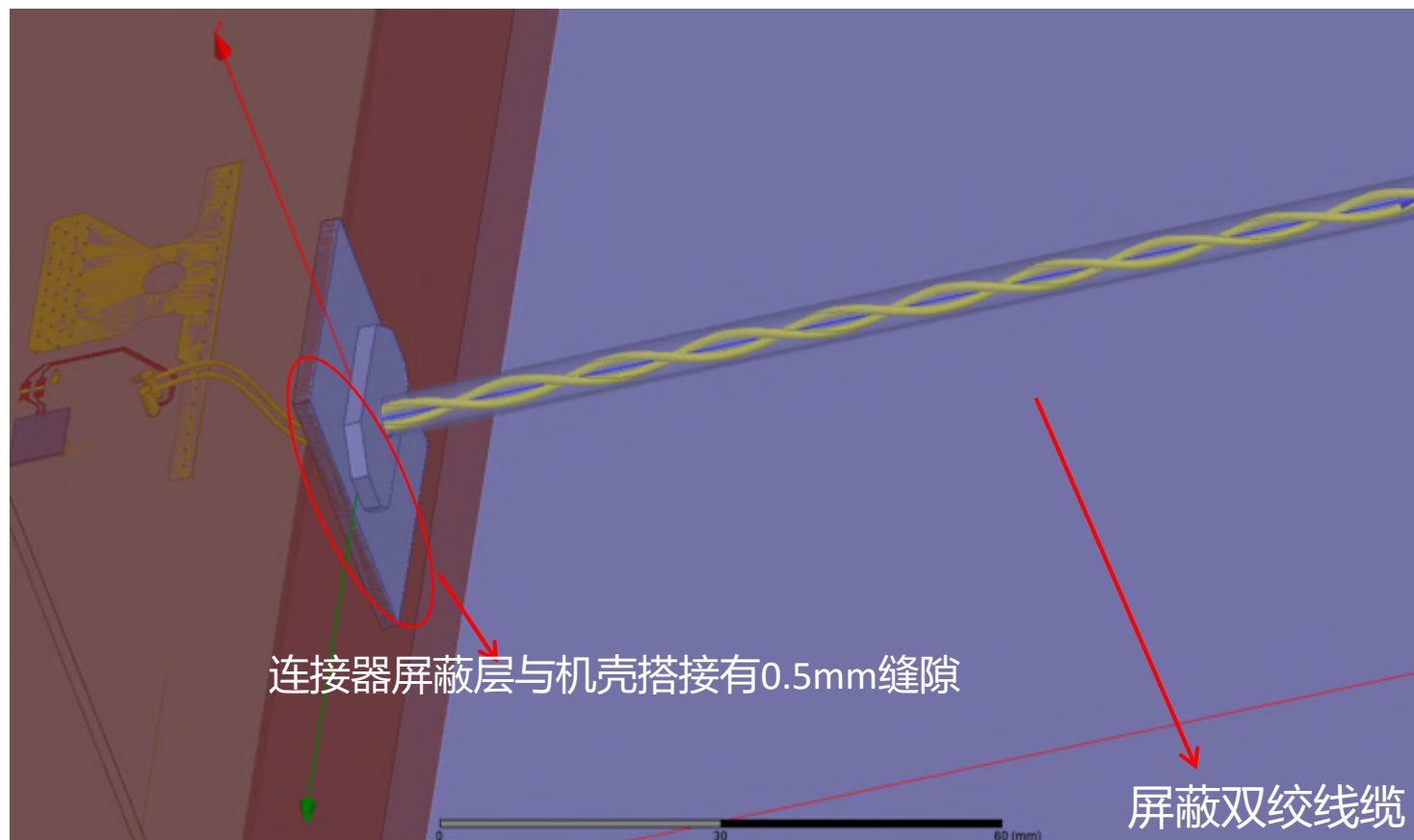


空间场分布



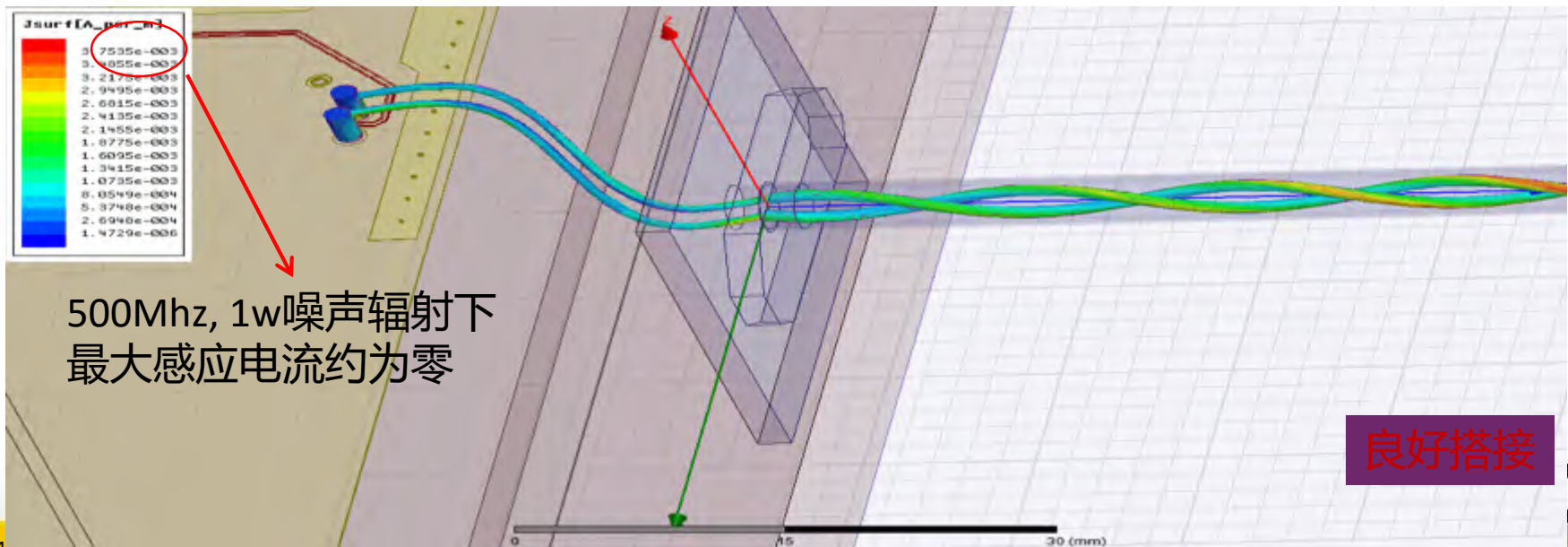
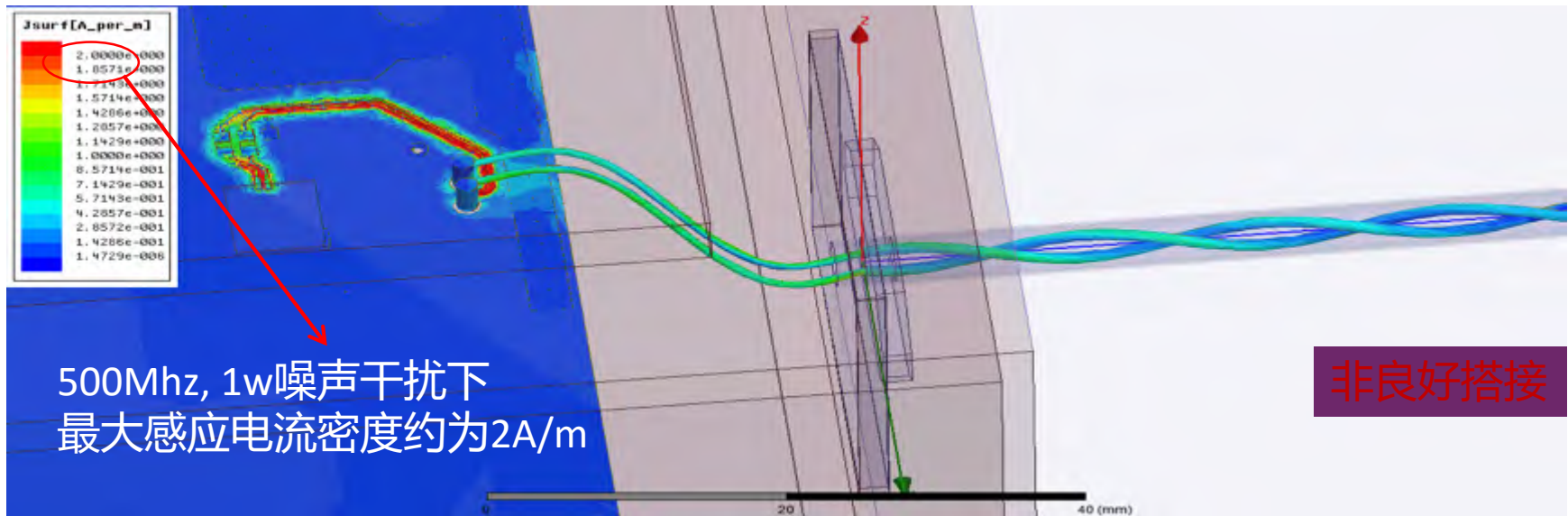
线缆感应电流

# 屏蔽线缆RS分析



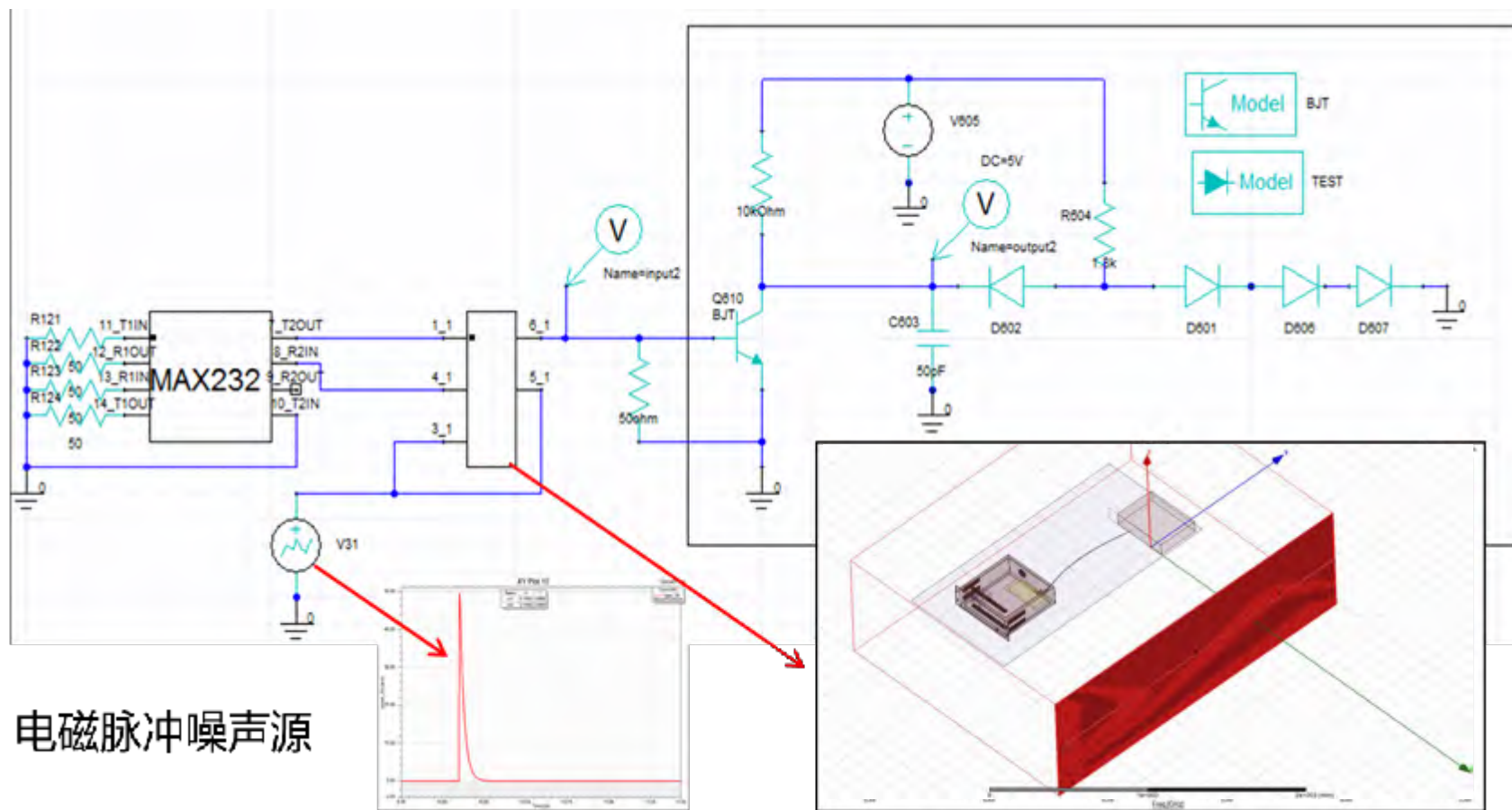
当屏蔽双绞线缆的屏蔽层没有和机壳形成良好搭接，将影响整个电路的抗干扰特性

# RS485线缆感应电流



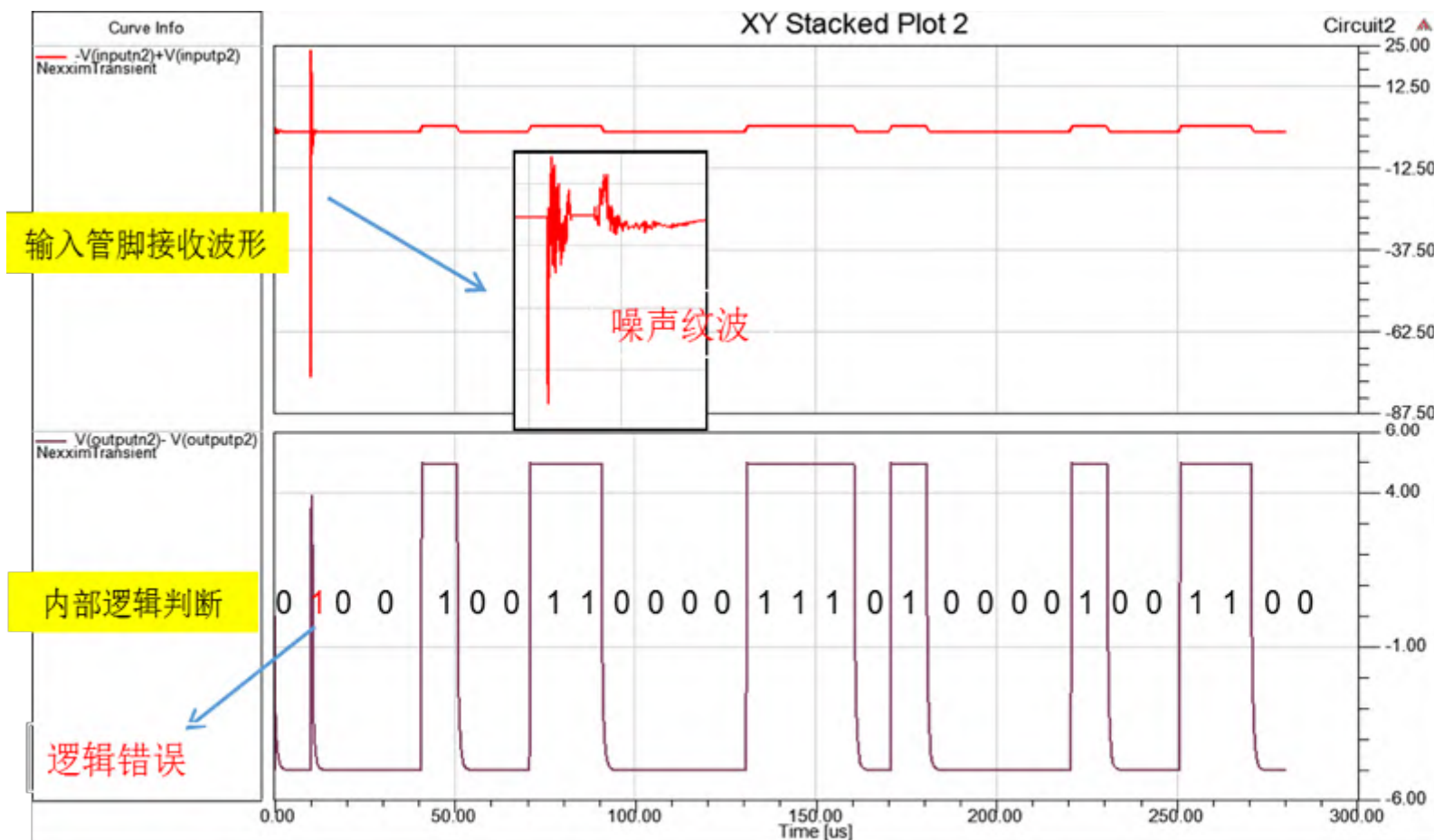


# 电路分析时域特征



电磁脉冲噪声源

# 时域干扰波形



由此可见，没有良好接地的双绞屏蔽线缆，收到外界高脉冲噪声的严重干扰，出现错误的逻辑判断；

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