EMC rešitve z Ansys orodji

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Ansys part of SYNOPSYS® ELITE CHANNEL PARTNER

Ansys part of SYNOPSYS®

Uvod Ansys EMC delavnice: Agenda

1. Vloga Ansysa EMC delavnice 2026 (Časovnica in cilji)
2. Simtec, Ansys part of Synopsys channel partner
3. Postopek EMC simulacije z Ansys Orodji - Dimitris Efsthathiou
4. Ostalo: Inštalacije, licence, logistika, ostala vprašanja…

Cilji delavnice Ansys EMC rešitev

1. Spoznati študente z Ansys orodji
2. Intro trening **Ansys HFSS, Circuit in SIwave orodij**
3. Predstavitev in prikaz postopka analize EMC simulacije (vključuje vsa zgoraj našteta orodja)
   - Konduktivne motnje
   - Sevalne motnje

Koliko poznate Ansys?
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Neki se mi sanja
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam
Neki se mi sanja
Pojma nimam
Pojma nimam

Koliko poznate Ansys?
Pojma nimam
Pojma nimam
Sem delal že simulacije HFSS in/ali SiWave
Pojma nimam
Pojma nimam
Pojma nimam
Sem delal že simulacije HFSS in/ali SiWave
Pojma nimam
Neki se mi sanja
Neki se mi sanja
Neki se mi sanja
Neki se mi sanja
Pojma nimam
Neki se mi sanja
Sem ga že uporabljal
Neki se mi sanja
Neki se mi sanja
Pojma nimam
Pojma nimam
Pojma nimam
Pojma nimam

Simtec srečanja

	Datum	Naslov	Agenda
1.	**2.4.2026**	Uvodna predstavitev	Predstavitev podjetjea Simtec, Intro predstavitev EMC simulacij
2.	**9.4.2026**	HFSS	Predstavitev orodja, “hands on” primer
	16.4.2026	PROSTO	
3.	**23.4.2026**	SIwave	Predstavitev orodja, “hands on” primer
4.	**30.4.2026**	EMC analiza	Praktičen primer

5 mednarodnih pisarn, podpora v 12 državah:

20 aplikativnih inženirjev simulacij

Ločene ekipe glede na fizikalne domene: CFD, FEA, Electronics & Optics.

25 let izkušenj

Preverjeno inudstrijsko znanje, grajeno na več kot 25 letih izkušenj iz prve roke.

Lokalna podpora v domačem jeziku

- **Grčija**
  - Ciper
  - Grčija
- **Slovenija**
  - Slovenija
- **Hrvaška**
  - Albanija
  - Bosna in Hercegovina
  - Hrvaška
  - Črna Gora
  - Makedonija
  - Srbija
- **Madžarska**
  - Madžarska
- **Romunija**
  - Romunija
  - Moldavija

Simtec storitve

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Oprema & tehnična podpora

- Lokalna tehnična podpora
- Pomagamo vam iskati najugodnejše rešitve

Uvajanje in usposabljanje uporabnikov

- Začetni treningi
- Napredni treningi
- Mentoriranje

Inženirske storitve

- Razvoj poteka analiz
- Avtomatizacija procesov in analiz
- Demokratizacija simulacijskih orodij
- Prenos tehnologije
- Definiranje in določanje materiala

Naše stranke

V podjetju Simtec smo zavezani k vzpostavljanju dolgoročnih partnerstev in napredku na področju tehnoloških mejnikov

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Aerospace & Defense	THEON INTERNATIONAL	PIPISTREL						
Appliances & Consumer Products	gorenjegroup	B/S/H/	Fotona choose perfection	Leone	IM Intelligent Mechatronics	HYLA	frigoglass	YASKAWA
Automotive & Transportation	ADRIA	YAZAKI	KOVIS good ideas create future	KAOUSSIS	RIMAC	Jajce Alloy Wheels d.o.o	AVL	
Construction	AVAX	EKME MECHANICAL ENGINEERING & CONSTRUCTION CONTRACTORS	TRIMO	Danfoss	IMP KLIMA	VENTURIA	EXANDAIR TEXTIL LÉGCSATORNA	Metlen Energy & Metals
Electronics	MAHLE	KONČAR D&ST	KOLEKTOR	KONČAR	INTRACOM TELECOM	PODKRIŽNIK group	Aviat NETWORKS	Emsiso POCLAIN
Energy	SUNLIGHT POWER IS KNOWLEDGE	iskraemeco	energy/ntel	KPT	encos			
Healthcare	Pharmathen Innovation inspired by life	ELPEN	bialoom					
Industrial Equipment & Rotating Machinery	Homa	DOMEL	KUKA	LITOSTROJ POWER	raymetrics	technosolar	VT TURBO	FLUID-LAB.HU FLOW TECHNOLOGY KFT
Marine & Offshore	asso subsea	ABS	HYDRUS	GAEAQUATIC	MACGREGOR	smed engineering	AFE structures	ABOARD NAVAL ARCHITECTS
Metals & other Materials	kronospan	CABLEL HELLENIC CABLES GROUP	TALUM	izoteh Construction of Industrial plants	ELKEME	DELTA		

Ansys part of SYNOPSYS®

EMI/EMC with Ansys HFSS, SIwave and Circuit

Dimitrios Efstathiou

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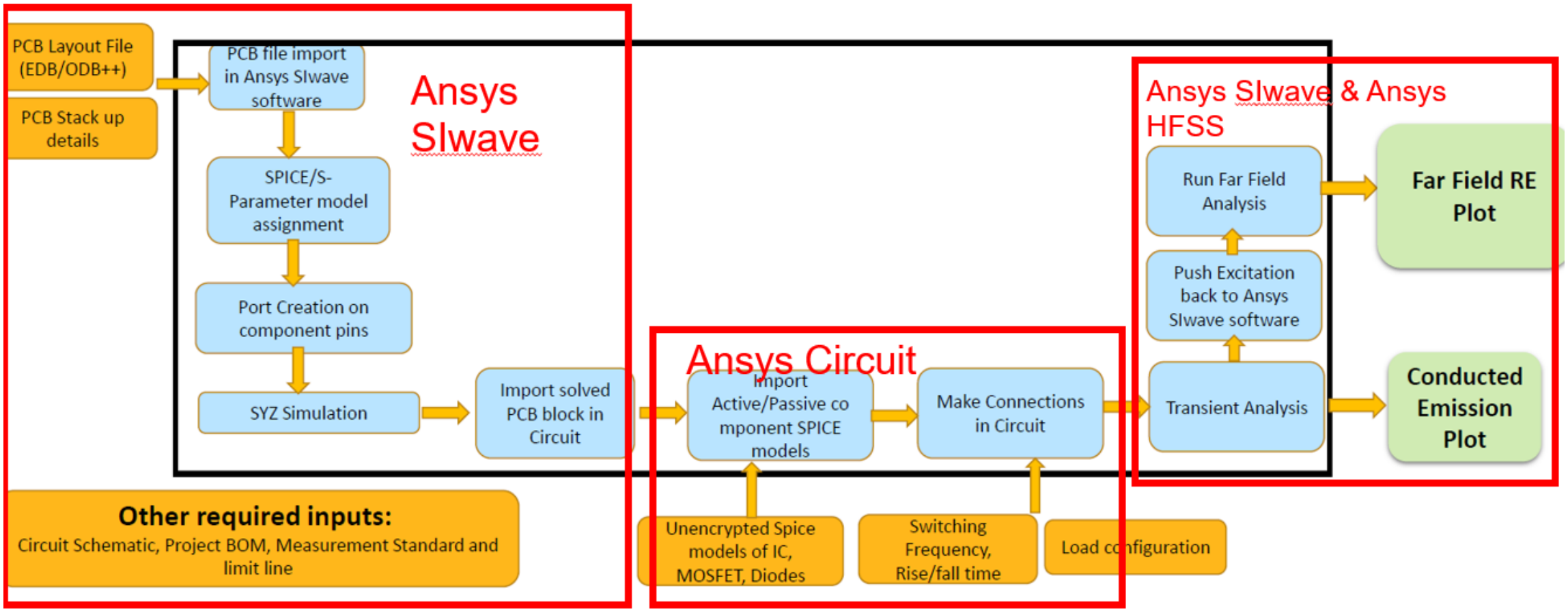
25 YEARS simtec 2001 - 2026 | Ansys part of SYNOPSYS® | SELECT CHANNEL PARTNER

Ansys part of SYNOPSYS®

PCB level CE/RE Simulation Workflow

- **Objective:** To analyse PCB for Conducted and Radiated Emission of PCB
- **Tools:** Ansys Slwave software, Circuit



Contents

- Analytical simulations versus Numerical simulations
- Ansys simulation platform
- Ansys Multi-physics
- Introduction to HFSS
- Introduction to SIwave
- Introduction to EMC

Analytical vs Numerical simulations for Electronics

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	Analytical Simulations	Numerical Simulations
Definition	Mathematical solutions derived using standard functions (calculus, differential equations) to obtain a precise answer	Approximate solutions derived using computational methods (FEM/MoM) that discretize a model into small elements to solve governing equations **Characteristics**: Approximate, iterative, and usually dependent on a specific set of parameters
Use case	Ideal for simple geometries, linear materials, and idealized boundary	Necessary for complex, non-linear, 3D, or dynamic problems where exact solutions do not exist
Pros	High accuracy, deep insight into the physics of the problem	Applicable to almost any problem, handles complex geometries and multi-physics simulations
Cons	Limited to simple, idealized cases; often impossible for complex, real-world engineering problems	Results are approximations (subject to discretization error), requires validation, and can have high computational costs
Tools	SPICE (Simulation Program with Integrated Circuit Emphasis): Ansys Circuit(Nexxim) LTspice, Qucs, TINA-TI e.t.c.	Ansys HFSS, Ansys SIwave, Ansys Q3D Extractor, Ansys Maxwell, Ansys Motor-CAD

Ansys offers a simulation platform with simulation across all major physics

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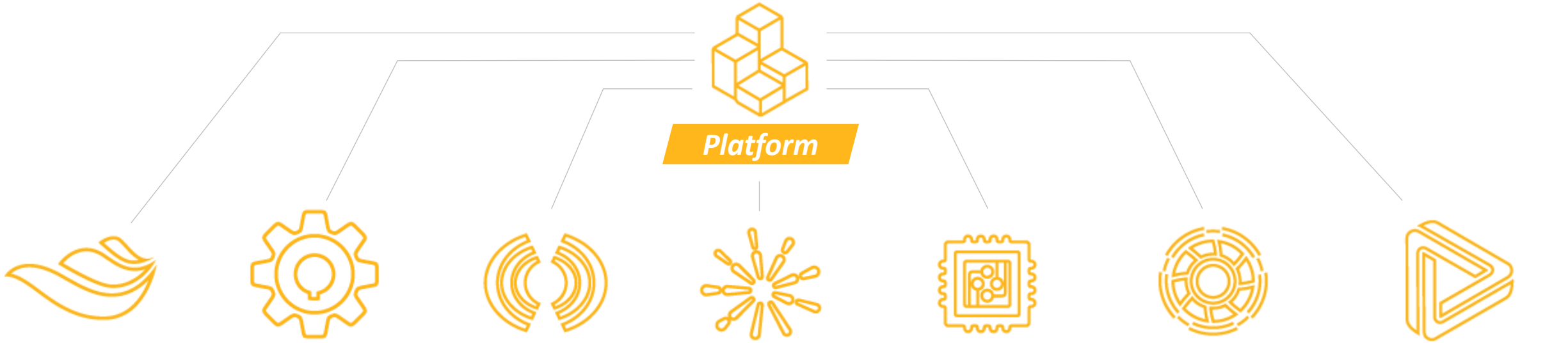


Fluids	Structures	Electromagnetics	Optics	Semiconductors	Software, Systems	Design & Additive
Ansys Fluent	Ansys Mechanical	Ansys HFSS	Ansys SPEOS	Ansys PathFinder	Ansys SCADE Architect	Ansys Discovery AIM
Ansys CFX	Ansys Autodyn	Ansys Maxwell	Ansys VRXPERIENCE	Ansys PowerArtist	Ansys SCADE Suite	Ansys Discovery Live
Ansys Chemkin-Pro	Ansys LS-DYNA	Ansys SI-Wave	Ansys Theia-RT	Ansys RedHawk	Ansys SCADE Display	Ansys SpaceClaim
Ansys TurboGrid	Ansys AQUA	Ansys Icepak	Ansys HIM	Ansys RedHawk-SC	Ansys medini Analyze	Ansys Exasim
Ansys FENSAP-ICE	Ansys ACT	Ansys Q3D Extractor	Ansys Genesis	Ansys Totem	Ansys Twin Builder	Ansys Flex
Ansys BladeModeler	Ansys nCode	Ansys Motor-CAD	Ansys Aesthetica	Ansys Variance FX		
Ansys Polyflow						

Multi-Domain: Multiple Physics using ANSYS tools

EM Fields
(HFSS, SIwave, Maxwell)

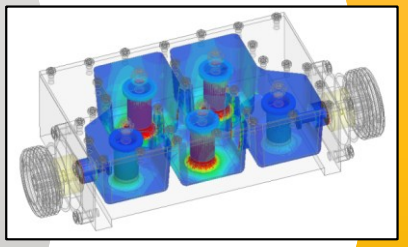
Thermal
(Icepak, Mechanical)

Stress
(Mechanical)

Adaptive Meshing

Temperature Dependent Materials

Full-Wave Finite-Element Method

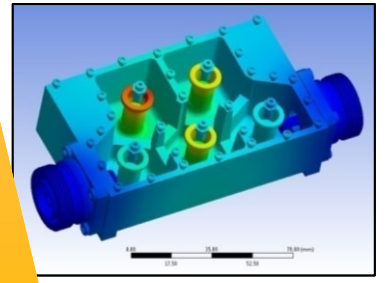


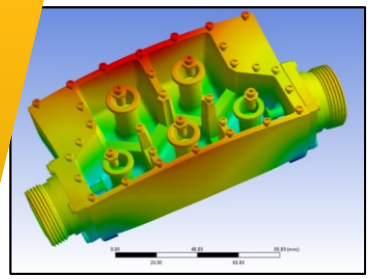
Power Loss Density as Thermal Source

Common Geometry Interface

Conformal Mesh

Transient and Steady-State Thermal





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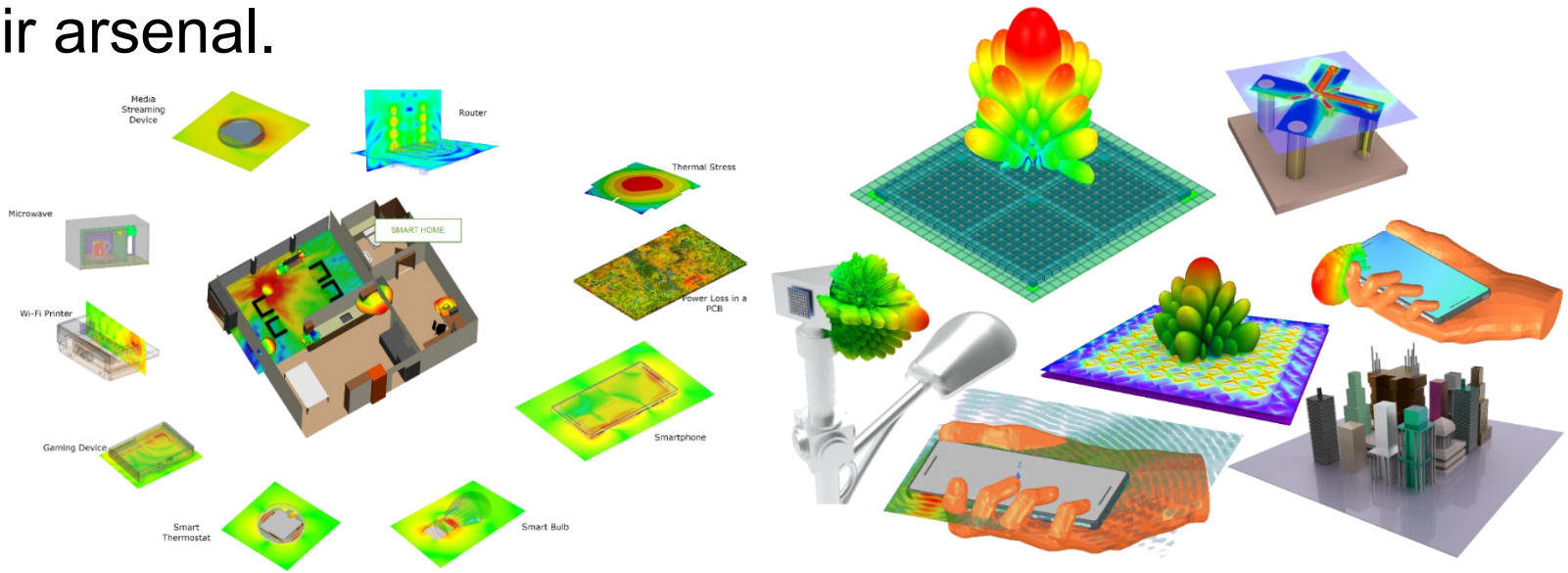
Electromagnetic simulation with Ansys HFSS

Ansys
part of SYNOPSYS®

What is HFSS?

- HFSS is a general-purpose full wave 3D electromagnetic design and simulation tool for antennas, ICs, chips, packages, PCBs and RF & microwave components.
- Renowned for its gold standard accuracy, workflow, speed, adaptability and capacity, HFSS is an indispensable EM simulation tool for electrical engineers to have in their arsenal.

Ansys HFSS – a versatile EM design and simulation tool



Full Assembly - ECAD + MCAD Mesh Assembly

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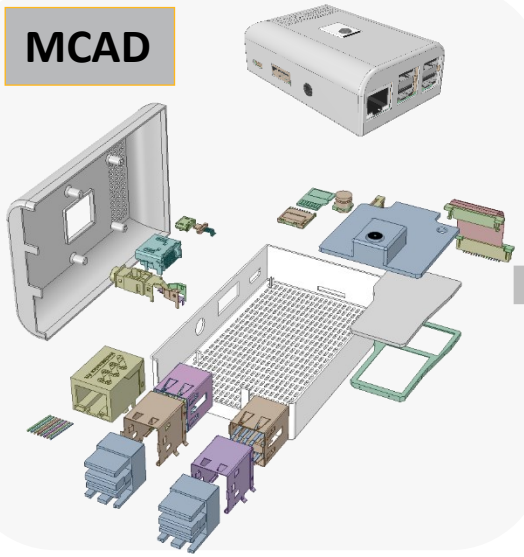
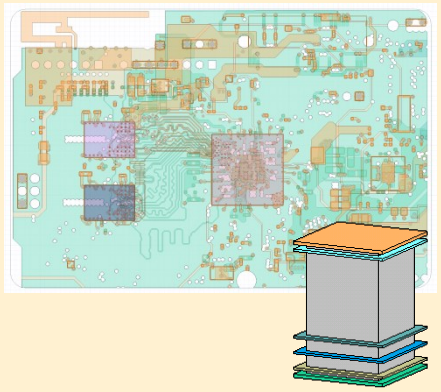
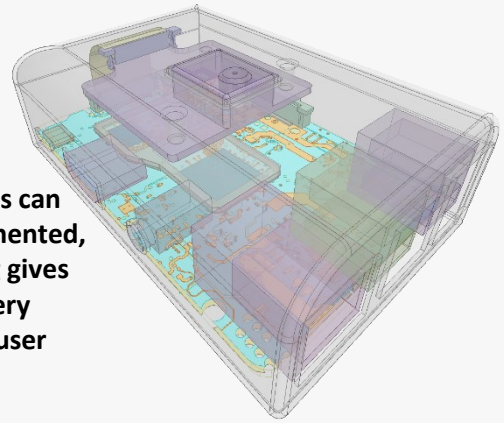
MCAD



3D Layout



3D Layout: Full Assembly



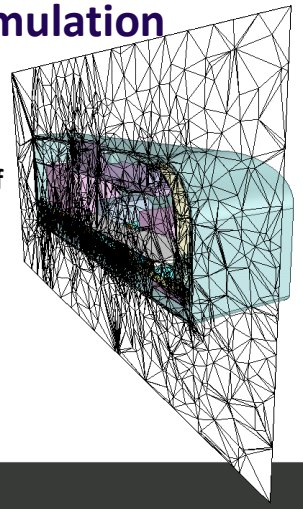
Geometry changes can quickly be implemented, adaptive meshing gives confidence on every solution without user interaction

EDT

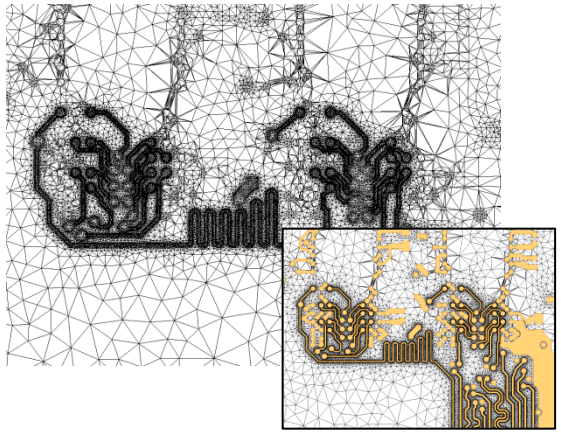
HFSS

Simulation

2D Cross section of mesh



Automatically generated mesh shown on PCB



- **Automated Mesh Creation**
  - Accurate
  - Efficient
- **Solve time independent of port count**
  - Capture full network parameters for all nets simultaneously with low computational overhead
- **Captures small and large features efficiently**
  - Small pitch traces, meandering traces, accurate coupling and isolation

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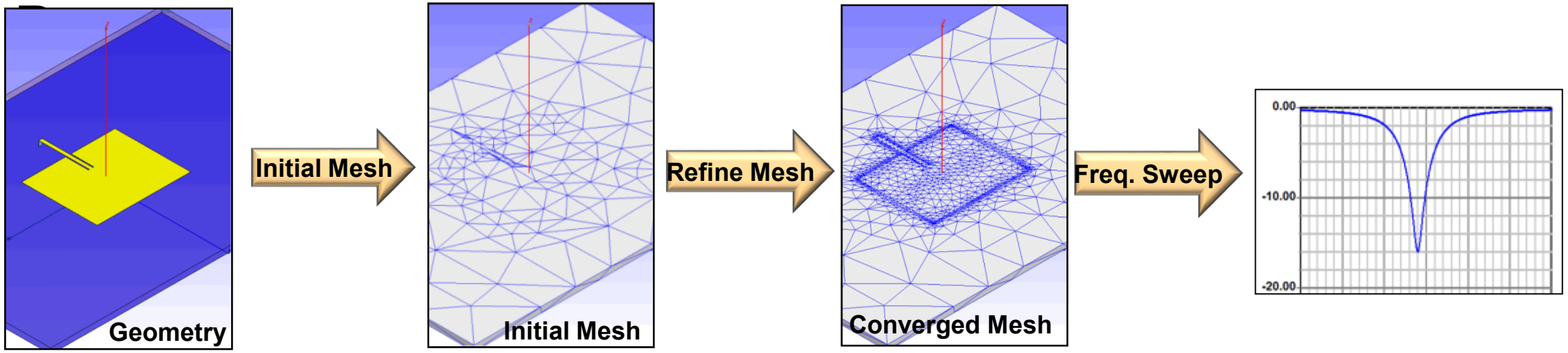
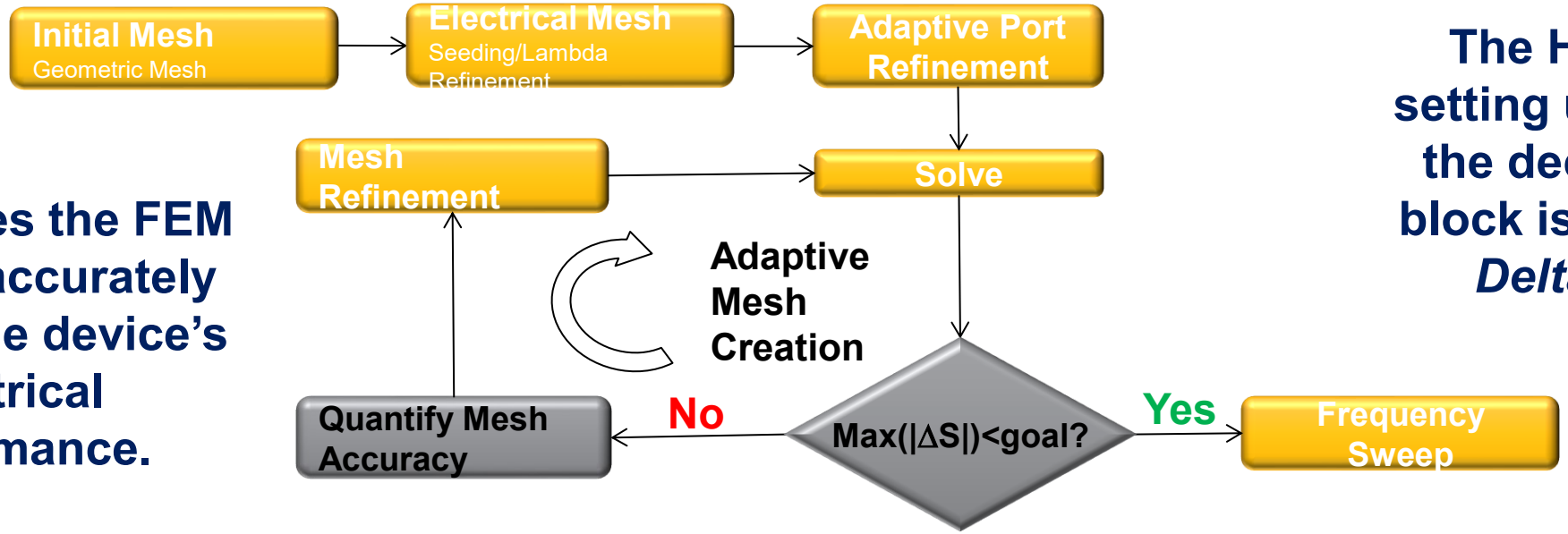
HFSS FEM Automated Solution Adaptive Meshing





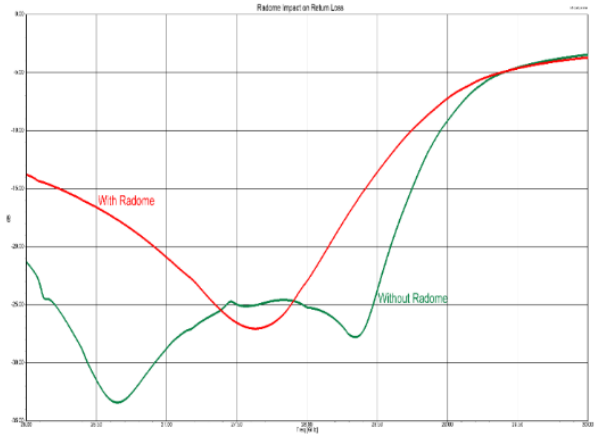
HFSS tunes the FEM mesh to accurately capture the device's electrical performance.

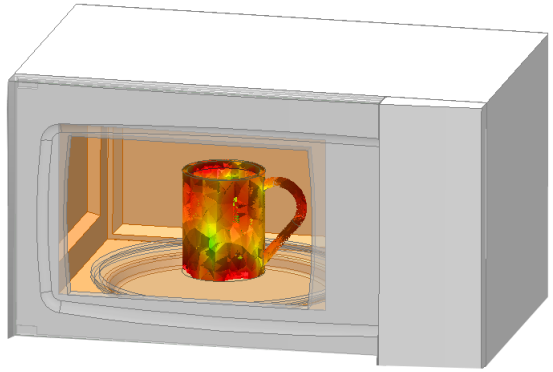
The HFSS setting used in the decision block is called *Delta S.*

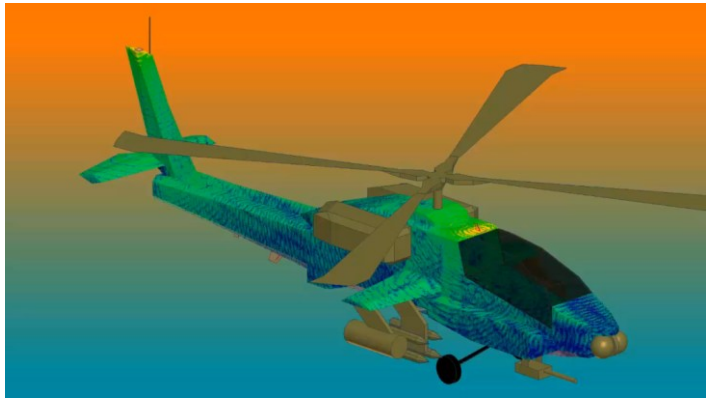
Outputs from HFSS

- S-parameters
- Electromagnetic Fields
  - Electric
  - Magnetic
  - Current
- Conductor and Substrate Losses
- Radiated Fields and Efficiency
- Far Field Antenna Pattern & Gain
- Thermal Loads for Multiphysics Analysis

Return Loss







Scattering parameters (S-parameters) (1/2)

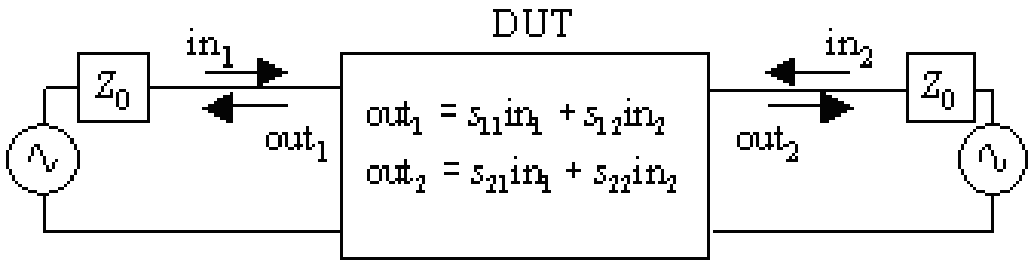
- S-parameters refer to the elements in a mathematical matrix describing the behavior of an electrical network (or circuit) when it is being stimulated by an electrical signal.
- S-parameters describe how electromagnetic energy propagates through a device/system at a specific frequency. It is a measure of how much RF energy is transmitted, reflected or lost in a device/system.

$$Input\ Return\ Loss(dB) = 10 \cdot log_{10}\left(\left|\frac{1}{S_{11}^2}\right|\right) = -20log_{10}(|S_{11}|)$$

$$Output\ Return\ Loss\ (dB) = 10 \cdot log_{10}\left(\left|\frac{1}{S_{22}^2}\right|\right) = -20log_{10}(|S_{22}|)$$

$$Insertion\ Loss\ (dB) = -20log_{10}(|S_{21}|)$$

$$Reverse\ Loss\ (dB) = -20log_{10}(|S_{12}|)$$



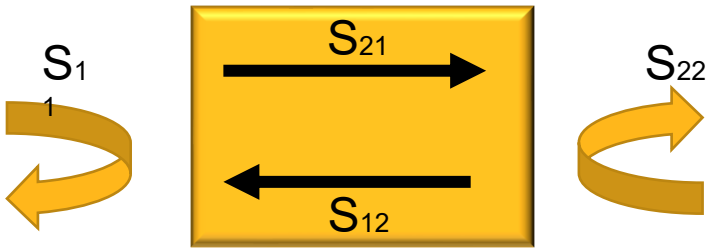
$$s_{11} = \left.\frac{out_1}{in_1}\right|_{in_2=0} \qquad s_{12} = \left.\frac{out_1}{in_2}\right|_{in_1=0}$$

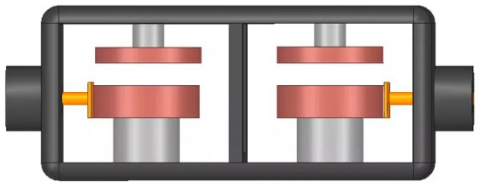
$$s_{21} = \left.\frac{out_2}{in_1}\right|_{in_2=0} \qquad s_{22} = \left.\frac{out_2}{in_2}\right|_{in_1=0}$$

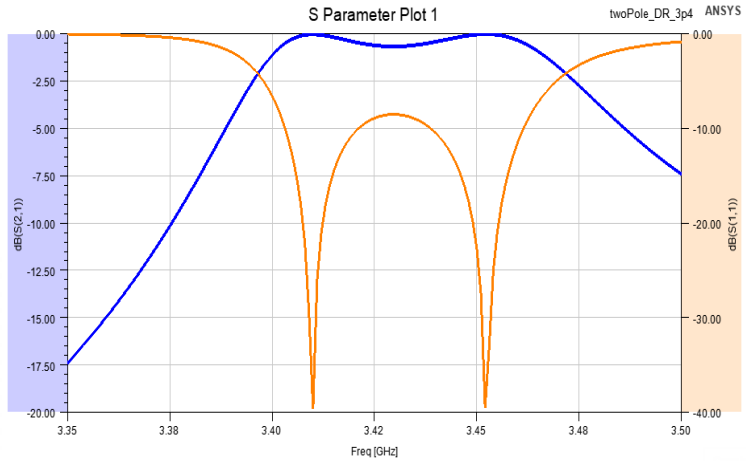
https://www.everythingrf.com/community/what-are-s-parameters

Scattering parameters (S-parameters) (2/2)

- Electrical engineers can apply S-parameters to a wide range of engineering designs, including communication systems, integrated circuits and printed circuit boards (PCBs), microwave circuits, and radio frequency (RF) circuits.
- An RF system or a PCB can be made up of many different parts where each part can potentially be represented by their S-parameters and cascaded together to characterize the response of the full system.
- However, when different parts of a system electromagnetically couple to one another or to their environment, they have to be simulated together.

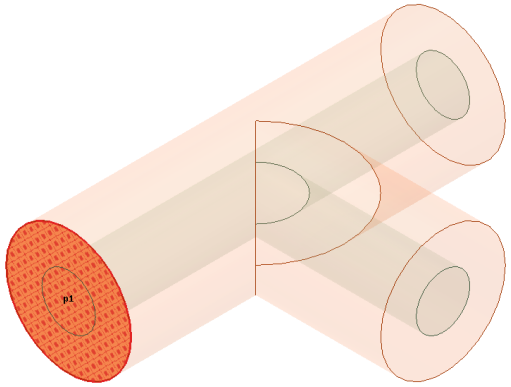


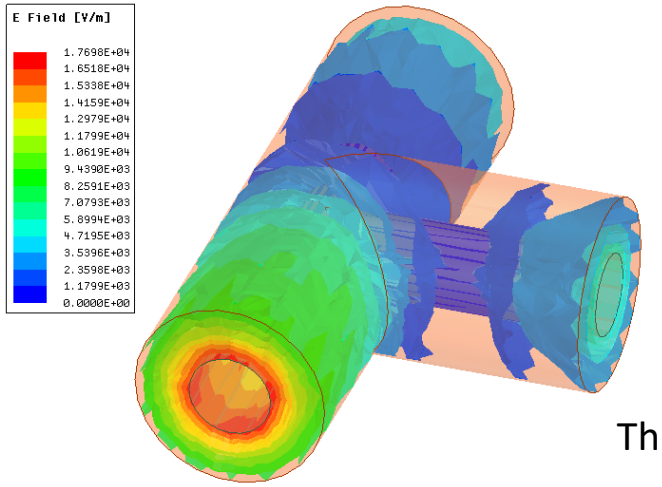


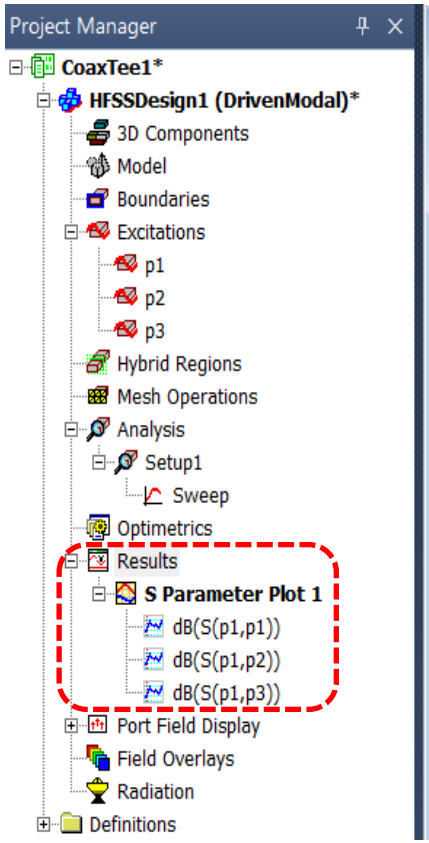


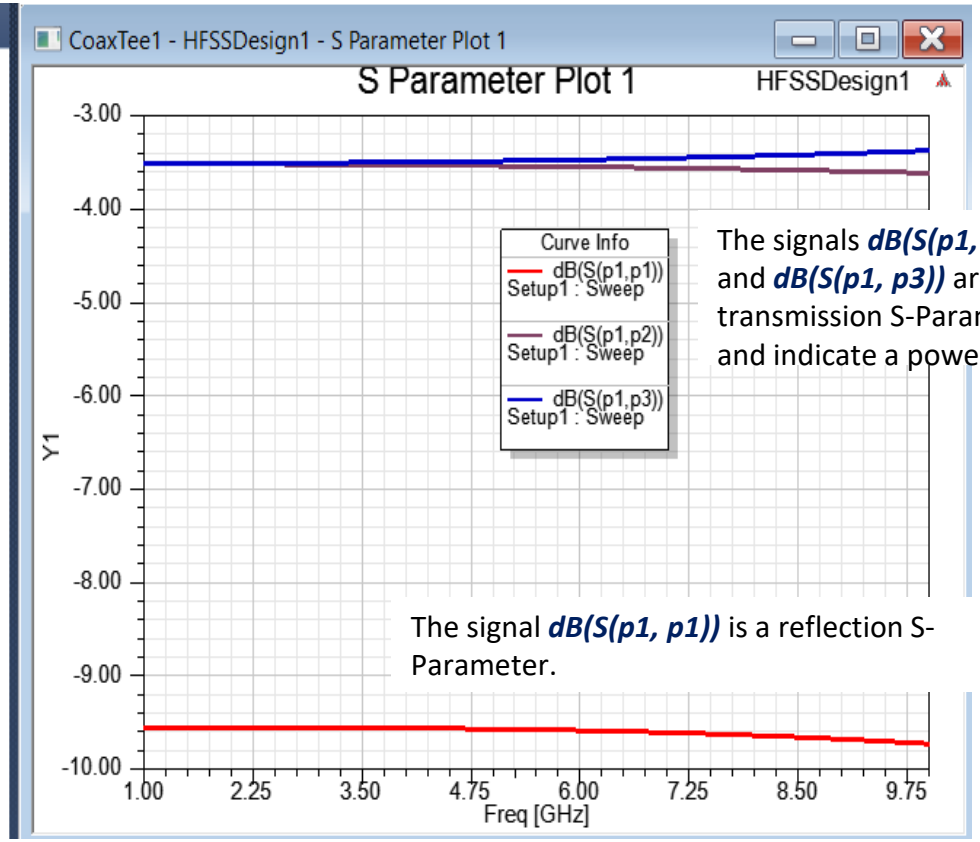
S-Parameters and Electric field on a Coaxial Tee

This is a splitter. Power from any port gets split between the other two ports.









The signals ***dB(S(p1, p2))*** and ***dB(S(p1, p3))*** are transmission S-Parameters and indicate a power split.

The signal ***dB(S(p1, p1))*** is a reflection S-Parameter.

This is the E-field magnitude plot, where the the ***scale is linear***.

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Electromagnetic simulation for PCB with SIwave

Ansys
part of SYNOPSYS®

Virtual System Analysis with SIwave & HFSS

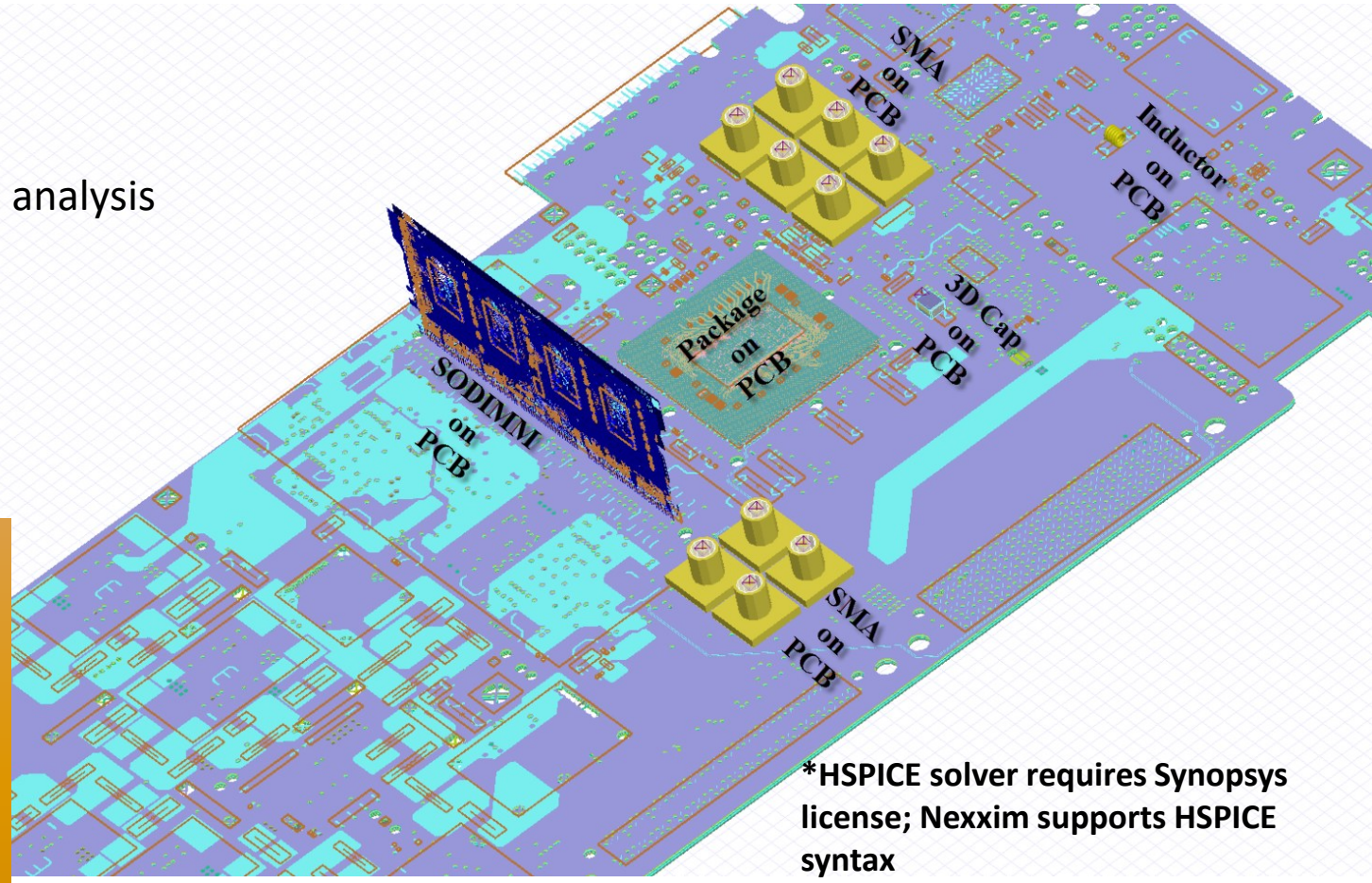
Assemble ECAD & MCAD

- Select appropriate solver
  - **SIwave** or **HFSS**
- Connect TX/RX within **AEDT Circuit** schematic circuit analysis
  - IBIS models
  - QuickEye
  - HSPICE*
  - PSPICE**

SIwave is a hybrid EM solver that complements HFSS full-wave extraction due to its speed & capacity.

SIwave enables full Package and PCB Analyses with a high fidelity hybrid solver.

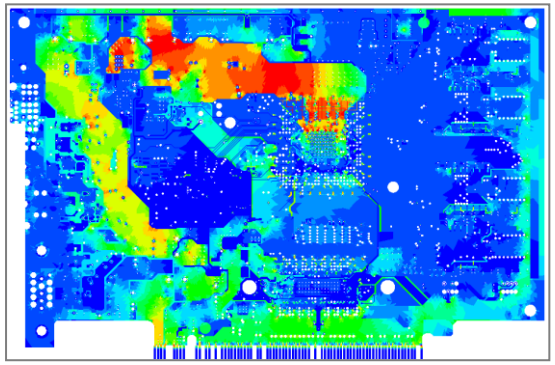
SIwave includes Nexxim (AEDT Circuit Design) PI/SI/EMI circuit capabilities to provide end-to-end solutions and workflows.



***HSPICE solver requires Synopsys license; Nexxim supports HSPICE syntax**

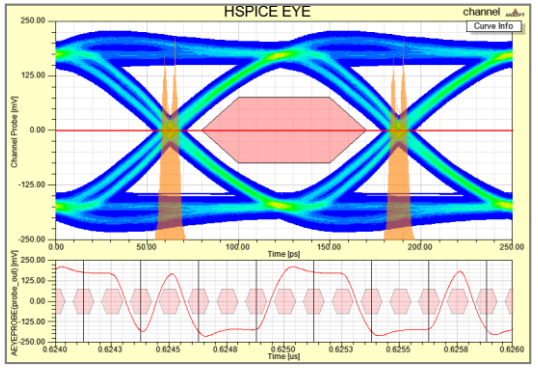
****** Uses Nexxim solver with PSPICE syntax**

What is ANSYS SIwave?



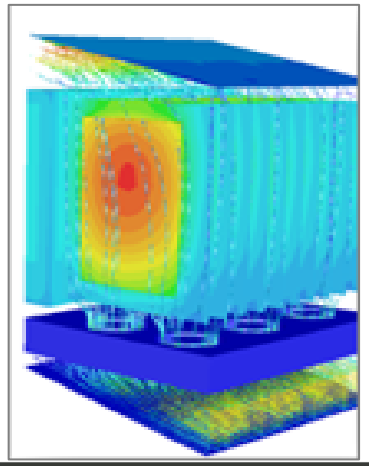
SIwave is an EM Simulator

- Hybrid full wave solver (2.5D)
- Mixture of simulation approaches
- 3D FEM solver with HFSS Regions



SIwave is a PCB Design Analysis Tool

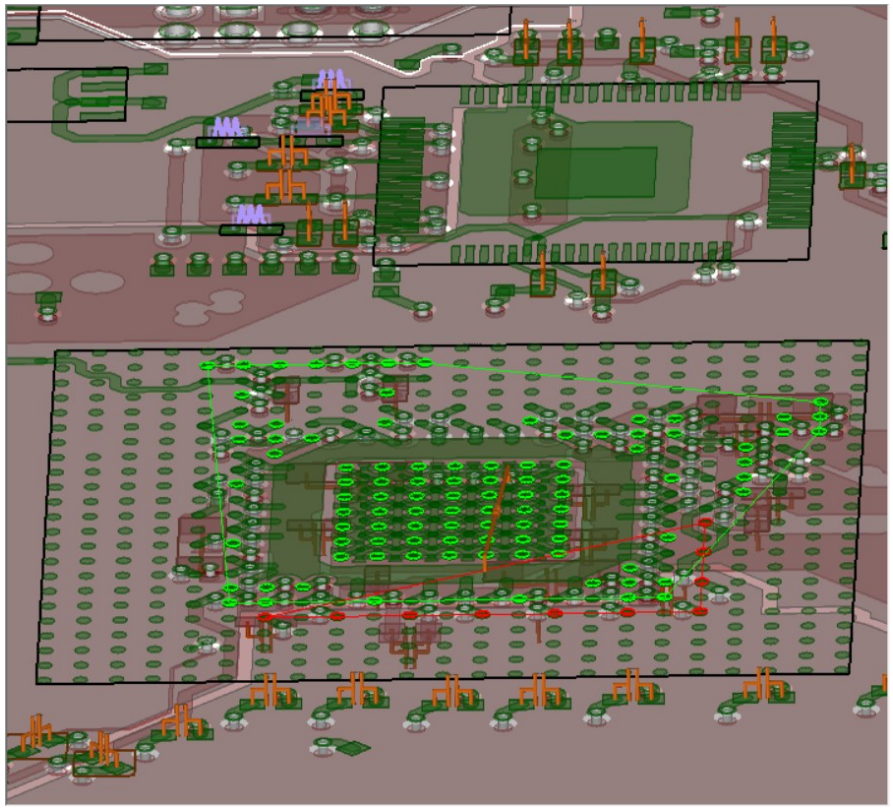
- SIwave imports many PCB layout formats
- SIwave has a layer stackup
- SIwave has PCB Signal Integrity design analyses and workflows.
- SIwave has Power Integrity design analyses and workflows



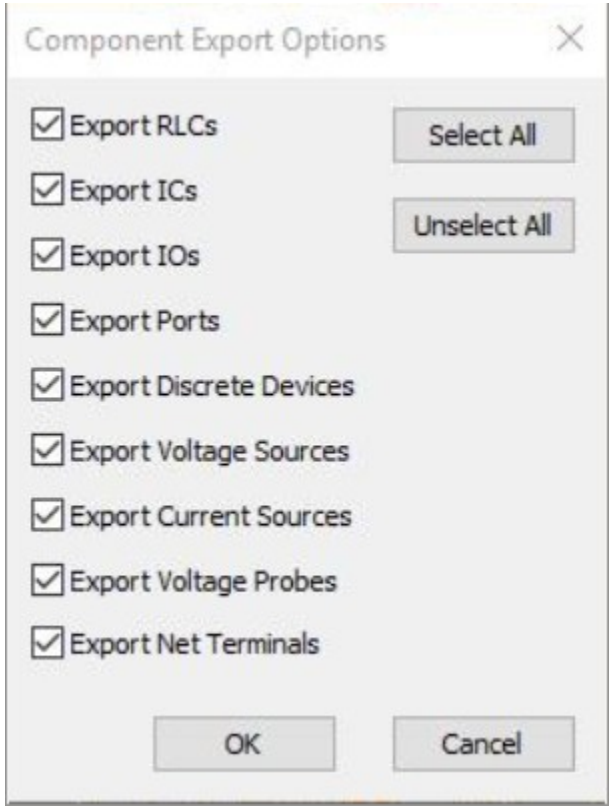
SIwave Integrates with other tools for Multiphysics analysis

- SIwave integrates with ANSYS Icepak for thermal analysis
- SIwave integrates into ANSYS Electronics Desktop (AEDT)
- SIwave solvers are available in HFSS 3D Layout
- SIwave simulation results can be exported to Ansys Electronics Desktop (AEDT)

SIwave - An Entire PCB Perspective



SIwave works with an entire PCB, the geometry, the materials, the stackup, and the whole bill of materials (BOM).

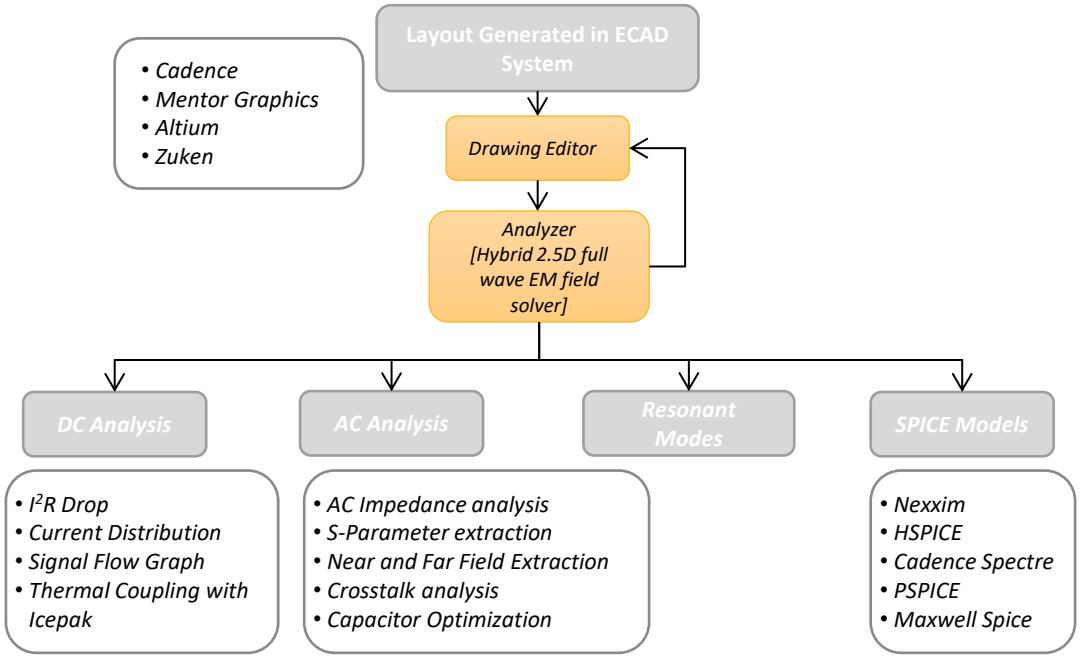


SIwave is an Electromagnetic Simulator that analyzes imported PCB structures, like this printed circuit board layout shown above.

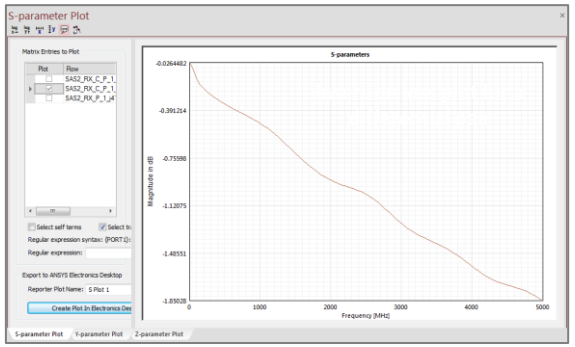
ECAD Translations – Supported Versions

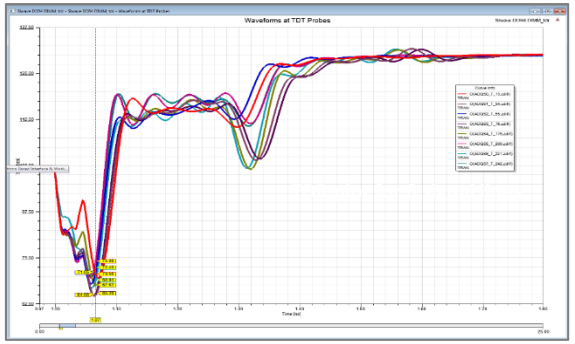
- Cadence
  - Allegro ⇒ 16.6 & 17.2
  - APD ⇒ 16.6 & 17.2
  - SiP Digital/RF ⇒ 16.6 & 17.2
  - Virtuoso ⇒ 5.10, 6.14, 6.15, & 6.16 (Linux only)
- Zuken (Sold by Zuken)
  - CR5000 ⇒ 10 and higher (Zuken translator for .anf & .cmp)
  - CR8000 ⇒ 2013 and higher (Zuken translator for .aedb, .anf & .cmp)
- ODB++
  - Altium Designer ⇒ R10 and greater
  - Mentor Expedition ⇒ EE7.9.1, EEVX.1, and greater
  - Mentor PADS ⇒ 9.4 and greater
  - Zuken Cadstar ⇒ 12.1 and greater
- IPC-2581
  - Pulsonix ⇒ Revision 8.5 build 5905 and greater
- Other ECAD Formats
  - .anf ⇒ ANSYS neutral file format
  - .gds ⇒ IC Chip format (added net-tracing for net naming)
  - .xfl ⇒ Apache Sentinel format
  - .dxf ⇒ AutoCad drawing format
    - Added Lead Frame Editor capability to SIwave and ANSYS Electronics Desktop
- Gerber
  - RS-247X ⇒ i.e. Autodesk Eagle, KiCad EDA, …

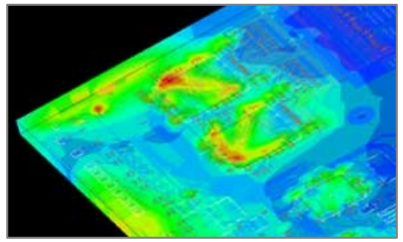
SIwave Analysis Capabilities



Hybrid solver technology enables simulation of entire system (PCB and Package)



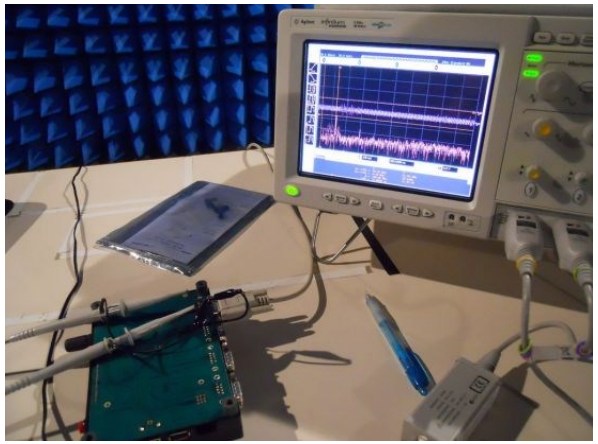




Prediction of EMI on a dual-processor quad-core PCB. Plot depicts near-field magnetic field at 778 MHz

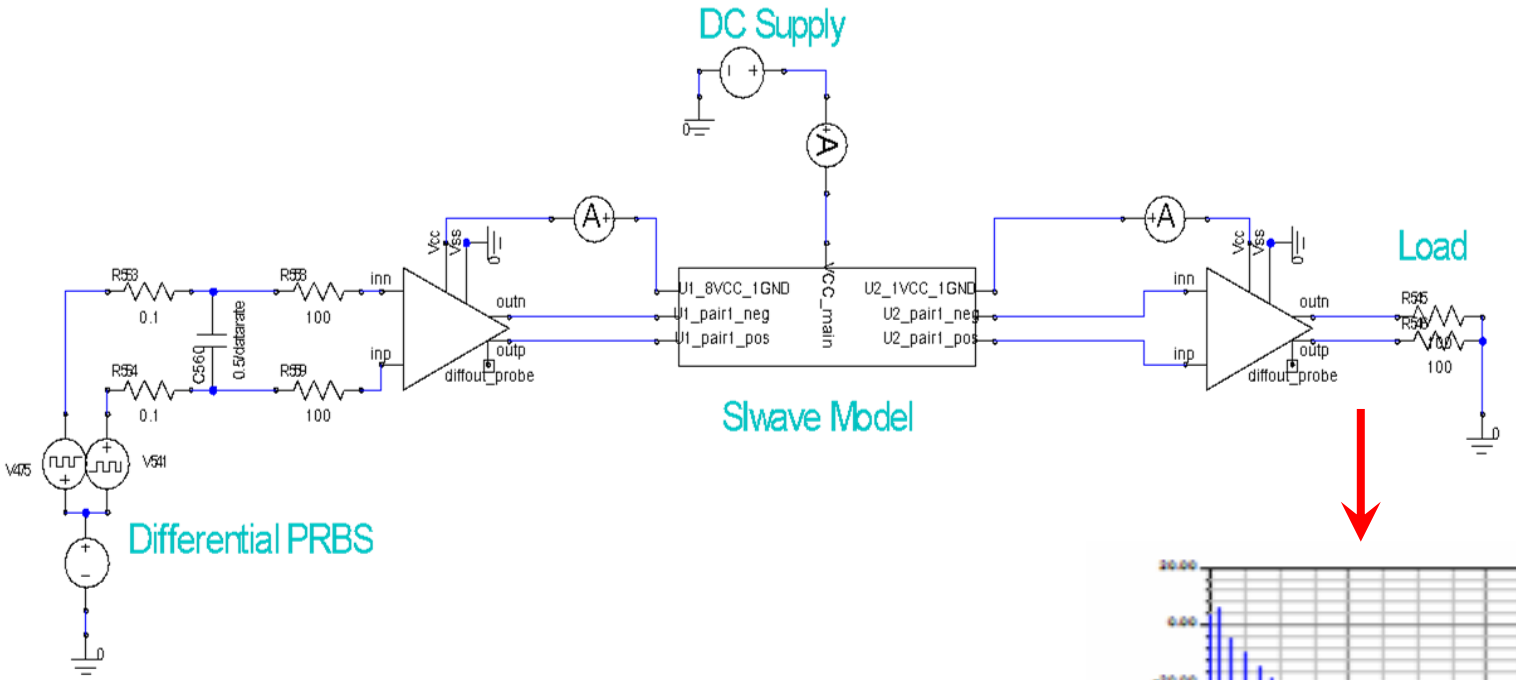
EMI/EMC Analysis

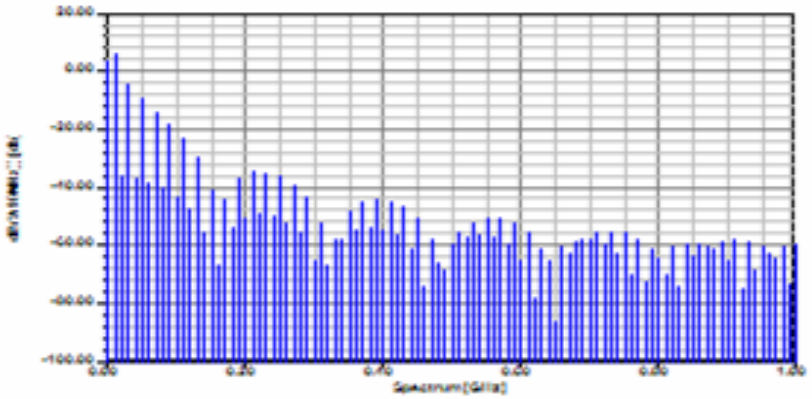
- First design and optimize Power Delivery Network (PDN) with Ansys SIwave to achieve:
  - Low plane impedance
  - Minimal resonances
- SIwave S-parameter model of simulated nets are imported to Circuit in Ansys Electronics Desktop
- Perform FFT of transient waveforms
  - The time domain source is modeled in Ansys Circuit in ANSYS Electronics Desktop
  - Measure Near/Far fields in Frequency band of interest in SIwave
  - The calculated field is the input to Ansys HFSS for shielding



ANSYS SIMULATION ADVANTAGES:
- Fast and Accurate
- EMC Normative testing in few minutes
- No physical prototype and expensive anechoic chamber needed

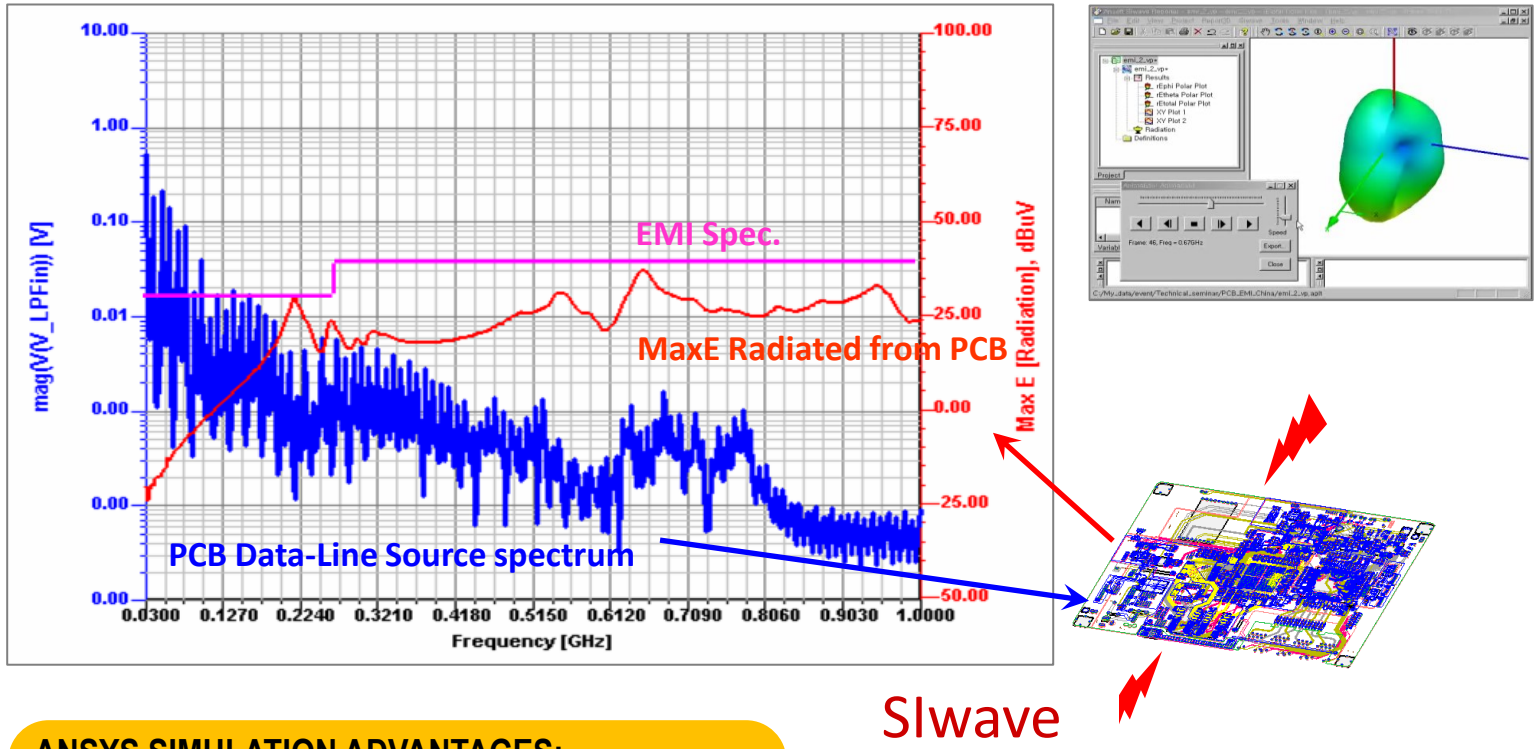
Generate Noise Sources





Use spectrum from SI analysis as noise source in SIwave

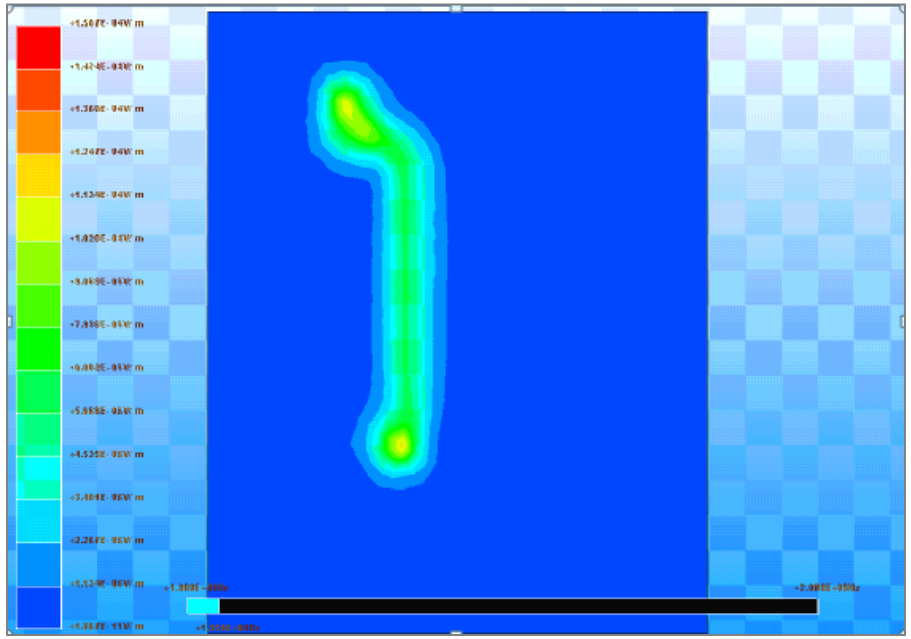
Plotting Far-Field



ANSYS SIMULATION ADVANTAGES:

- **Fast and Accurate**
- **EMC Normative testing in few minutes**
- **No physical prototype and expensive anechoic chamber needed**

Plotting Near-Field



ANSYS SIMULATION ADVANTAGES:

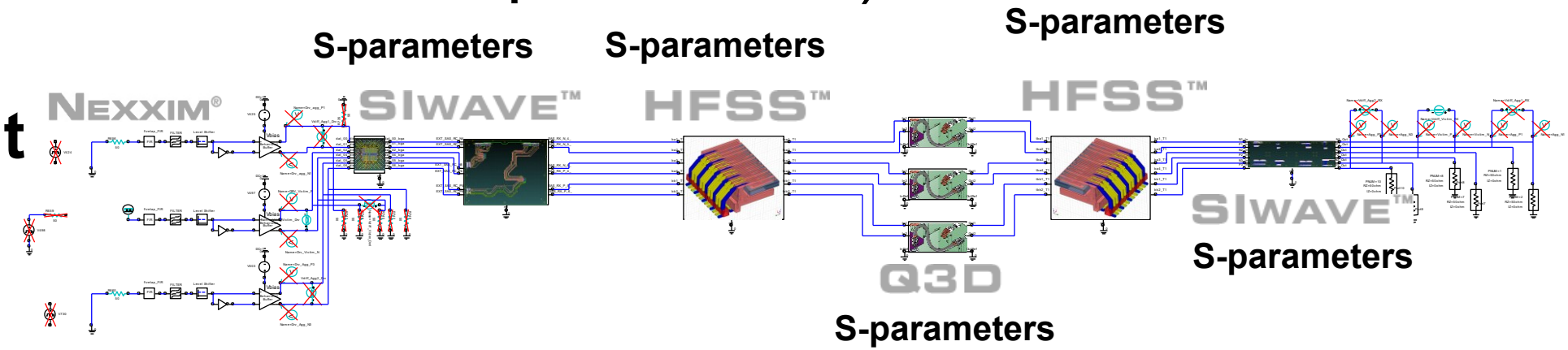
- **Fast and Accurate**
- **Recognize critical areas on the PCB**
- **No physical prototype and expensive anechoic chamber needed**

System simulation with Ansys Circuit (Nexxim)

ANSYS Circuit System Simulator (cascaded S-parameters)

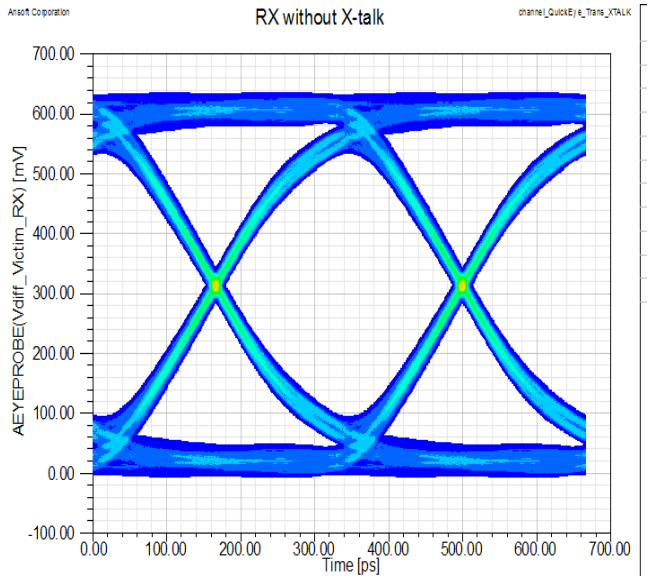
simtec

Circuit



Dynamic Link

QuickEye



Model courtesy of

intel

Ansys part of SYNOPSYS®

simtec

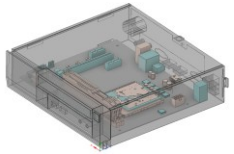
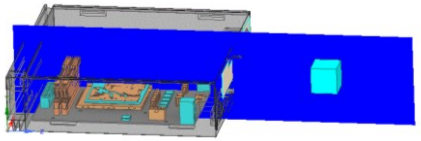
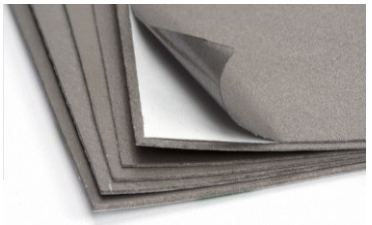
EMI/EMC with Ansys simulation tools

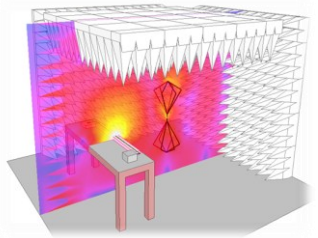
Ansys
part of SYNOPSYS®

EMI/EMC Development Process for Consumer Electronics

Simulation Allows Design Changes Early to Reduce Risk and Cost During Testing and Production Phases

Device Design → **EMC Simulation** → **EMC Mitigation** → **Prototype Fabrication** → **EMC Compliance Testing** → **Device Production**

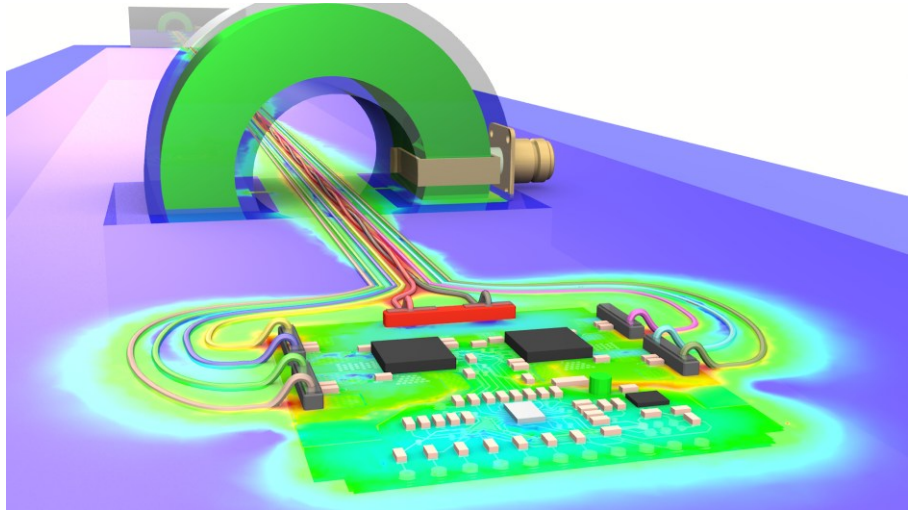


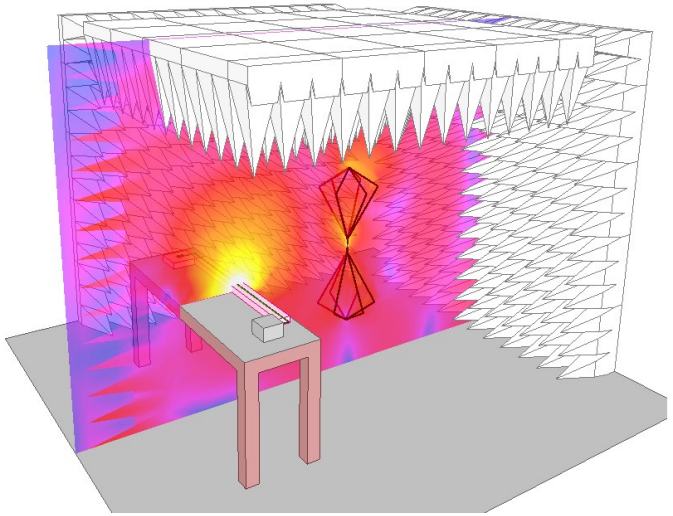

Simulation Allows Ability to Resolve EMC Issues During This Phase

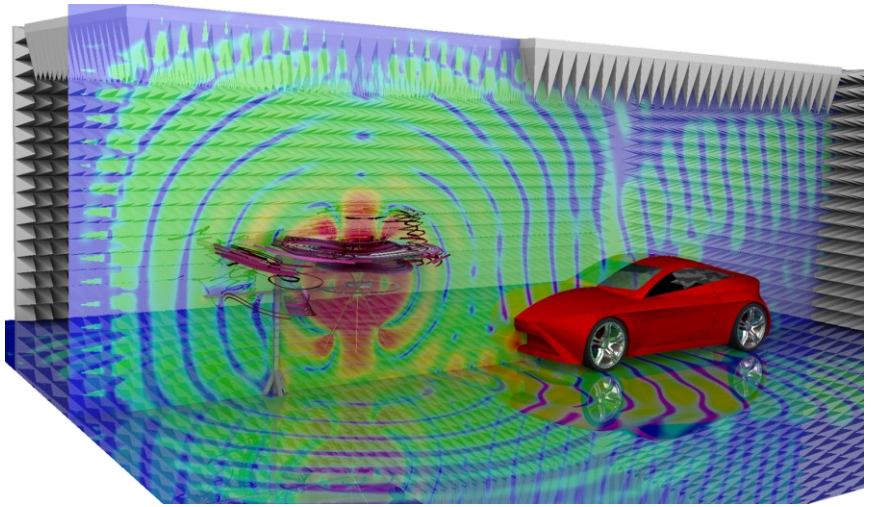
Changes to Product Design Are Expensive During This Phase

Background: EMC lab testing

EMC tests are expensive and can only be performed with a physical prototype







Pre compliance bench test platform test

Anechoic chamber

Full

COST OF RESPIN

Ansys Electronics Tools Address Many EMC Requirements

Radiated Immunity

Electrostatic Discharge (ESD)

Signal/Power Integrity (SI/PI)

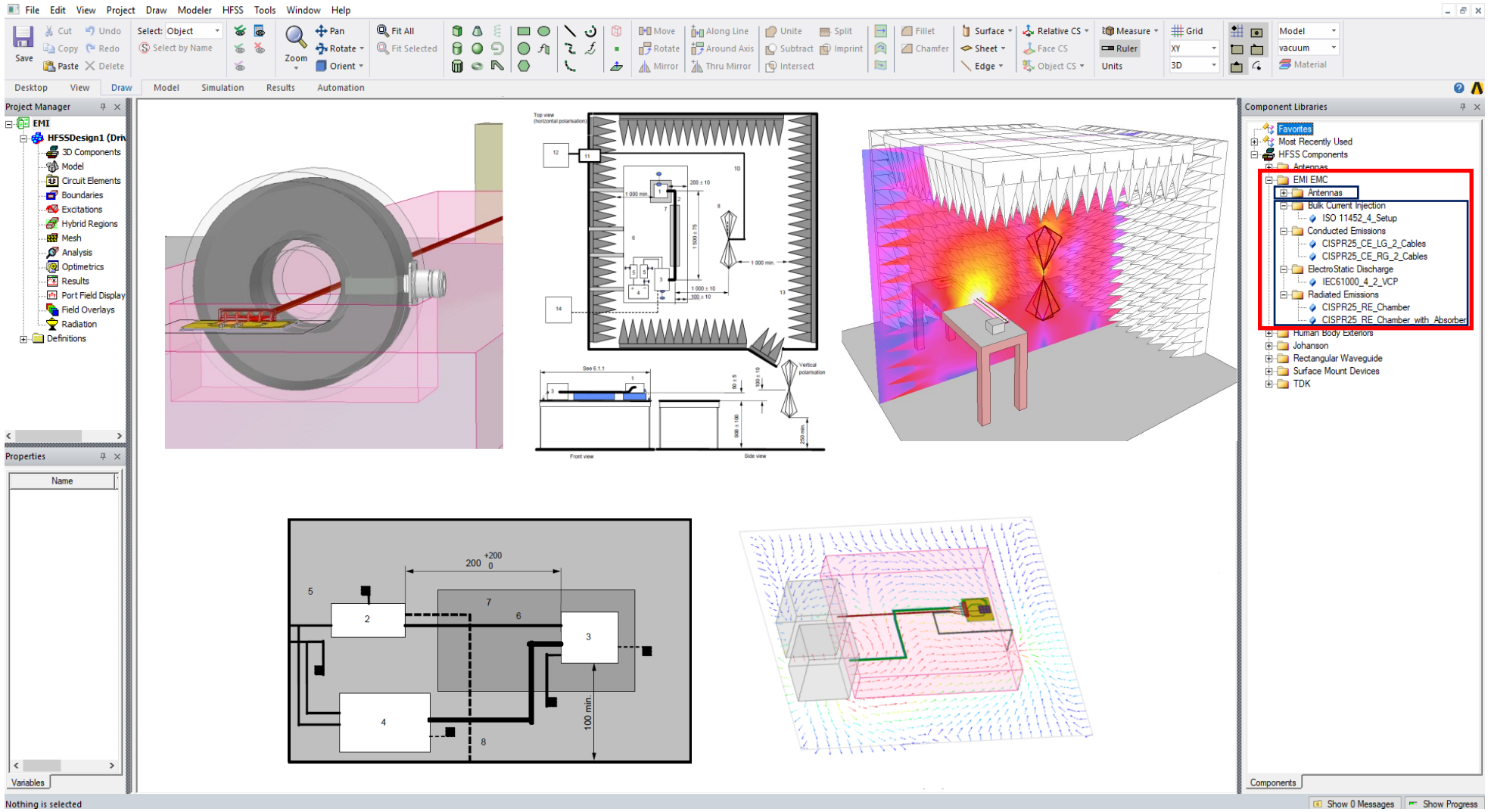
Radiated Emissions

Conducted Emissions

Transfer Impedance

Conducted Immunity

EMI/EMC 3D Components



EMI/EMC Examples

ELECTROSTATIC DISCHARGE

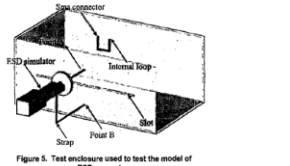
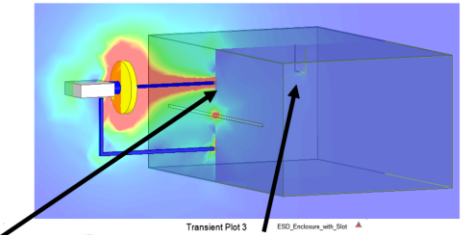
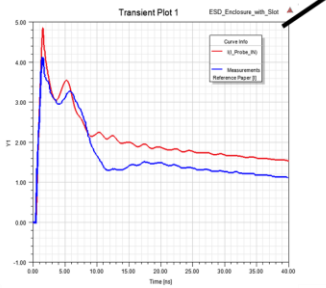
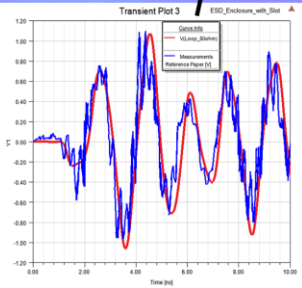


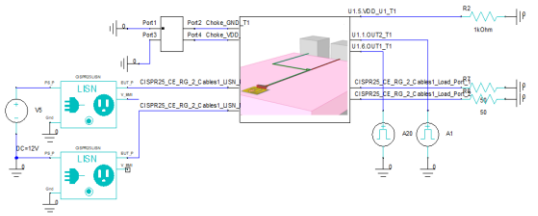
Figure 5. Test enclosure used to test the model of ESD generator.

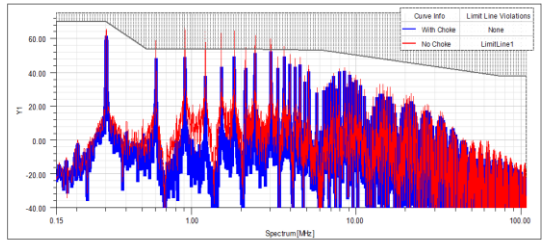






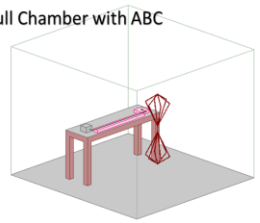
CONDUCTED EMISSIONS – CISPR25:2008

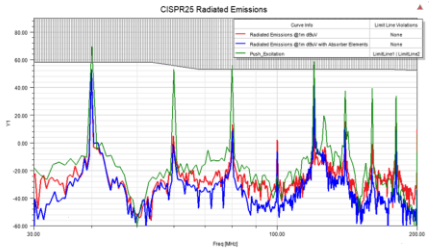




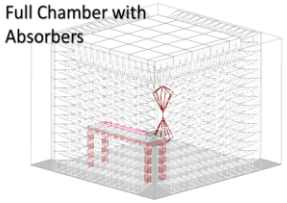
RADIATED EMISSIONS – CISPR25:2008

Full Chamber with ABC

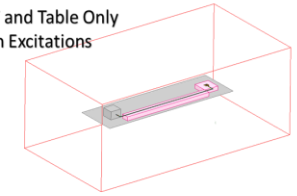




Full Chamber with Absorbers

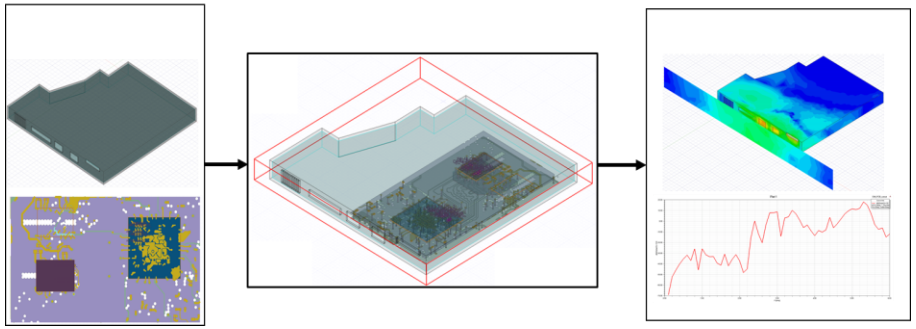


DUT and Table Only Push Excitations



RADIATED EMISSIONS – HFSS 3D LAYOUT

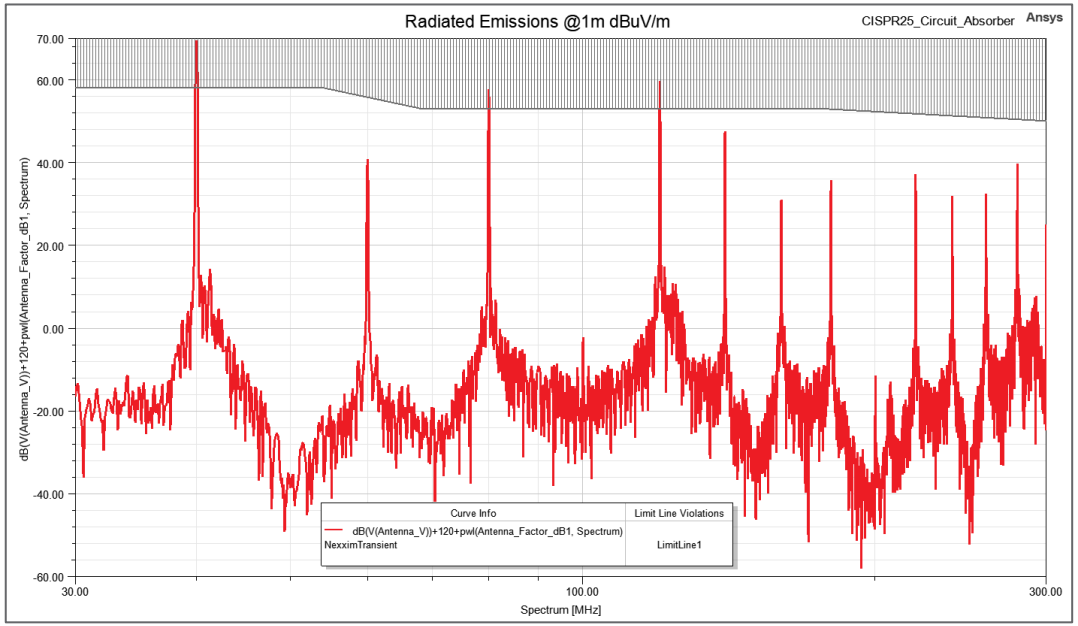
Open Design → Import and Place IBIS Models → Place Chassis Around PCB → Setup and Run S-parameter and Transient Circuit Analysis → View Emissions Results



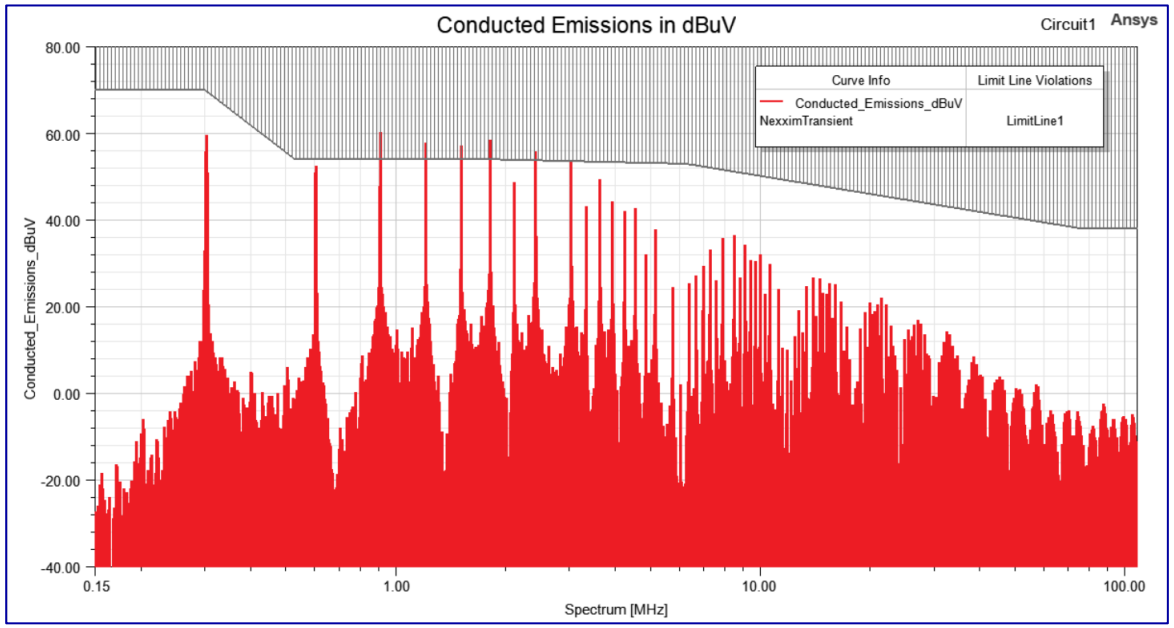
CISPR25 EMI EMC Context and Links

CISPR is the Comité International Spécial des Perturbations Radioélectriques
(English: International Special Committee on Radio Interference)
There are multiple CISPR standards and CISPR25 applies to vehicles and engines.

Both these emissions plots include CISPR25 limits overlaid in the plot.



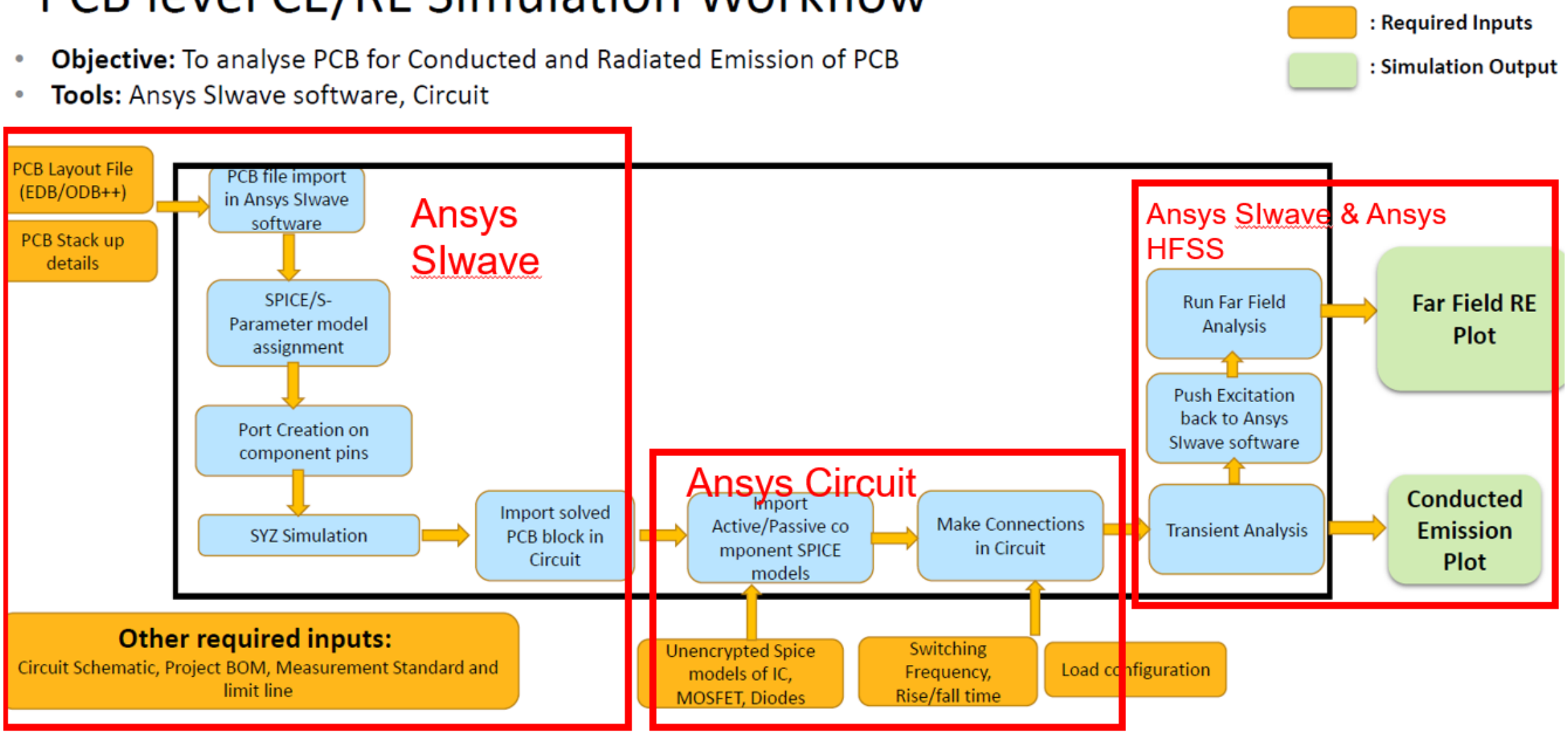
Radiated Emissions - RE



Conducted Emissions - CE

PCB level CE/RE Simulation Workflow

- **Objective:** To analyse PCB for Conducted and Radiated Emission of PCB
- **Tools:** Ansys Slwave software, Circuit



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