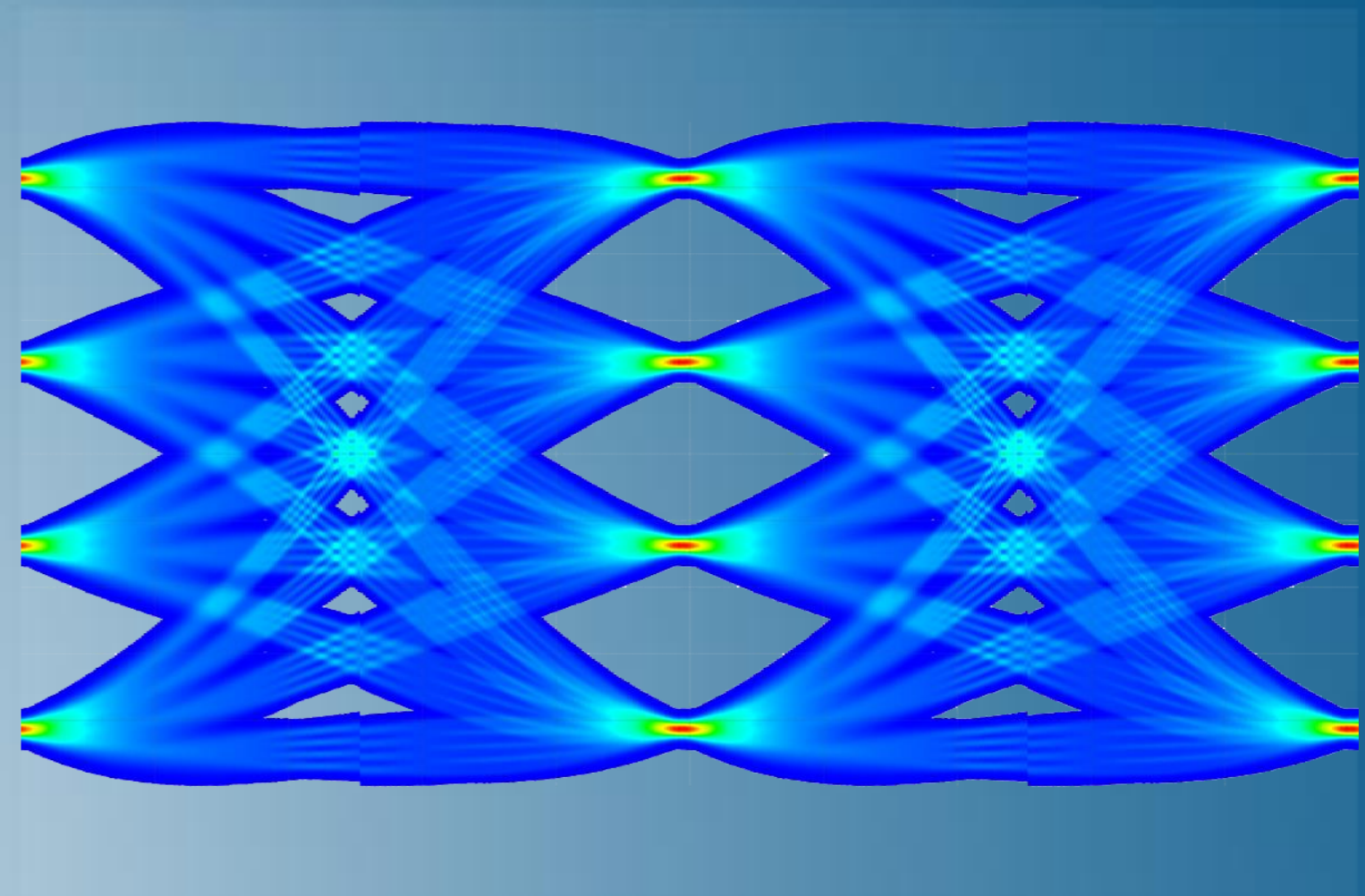


CST Studio Suite - EDA / SI-PI

2020



3DEXPERIENCE[®]



About this Course

Course objectives

Upon completion of the course you will:

- ▶ Be able to perform basic functions in terms of modeling, setup of simulation, importing layout boards and analyzing pre- and postprocessing results
- ▶ Get an overview on suitable solvers for specific SI/PI applications.
- ▶ Know how to set up and run the solvers and tools for different SI and PI.

Targeted audience

PCB layout engineers and SI/PI/EMC simulation analysts

Prerequisites

None (basic knowledge of SI, PI and EMC analysis)



2 days

Day 1

- ▶ Lesson 1 Introduction
- ▶ Lesson 2 Solver Overview

- ▶ Lesson 3 Circuit Simulation Overview
- ▶ Workshop 1 Circuit Simulation

- ▶ Lesson 4 EDA Workflow Integration
- ▶ Workshop 2 EDA Import and Export

- ▶ Lesson 5 Modeling Techniques
- ▶ Lesson 6 Materials, Ports and Boundaries

- ▶ Lesson 7 Result Handling and Postprocessing
- ▶ Workshop 3 Differential Via Pair (optional)
- ▶ Workshop 4 Connector

Day 2

- ▶ Lesson 8 DC IR Drop / Power Integrity Solution Overview
- ▶ Workshop 5 DC IR Drop / Power Integrity
- ▶ Workshop 6 Decoupling Capacitor Analysis

- ▶ Lesson 9 Signal Integrity Overview
- ▶ Workshop 7 SI TD Analysis
- ▶ Workshop 8 SI FD Analysis

- ▶ Lesson 10 CST MWS Solver Overview
- ▶ Workshop 9 SerDes Channel Analysis

Additional Material

- ▶ Appendix 1 Waveguide Ports – Advanced

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SIMULIA Training

<http://www.3ds.com/products-services/simulia/services/training-courses/>

The screenshot shows the SIMULIA Services Training Courses page. At the top, there is a navigation menu with the following items: PRODUCTS & SERVICES, SIMULIA, SERVICES, TRAINING COURSES, and SCHEDULE & REGISTRATION. Below the navigation, the main heading is "SIMULIA SERVICES" with the subtext "PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE." A teal button labeled "CONTACT SALES" with an envelope icon is positioned in the top right. The main content area is titled "Training Schedule & Registration" and contains a paragraph: "We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer's prior specification. To view the worldwide course schedule and to register for a course, visit the links below." Below this text are three columns: "North American" with a map of North America, "International" with a globe, and "Live Online Training" with a computer monitor icon. Each column has two links: "> By Location" and "> By Course". The "Live Online Training" column has a link "> Full Schedule".

PRODUCTS & SERVICES ▾ SIMULIA ▾ SERVICES ▾ TRAINING COURSES ▾ SCHEDULE & REGISTRATION ▾

SIMULIA SERVICES


PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE.

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Training Schedule & Registration


We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer's prior specification. To view the worldwide course schedule and to register for a course, visit the links below.

North American




- > [By Location](#)
- > [By Course](#)

International



- > [By Location](#)
- > [By Course](#)

Live Online Training



- > [Full Schedule](#)

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Revision Status

Lesson 1	1/20	Updated for CST Studio 2020
Lesson 2	1/20	Updated for CST Studio 2020
Lesson 3	1/20	Updated for CST Studio 2020
Lesson 4	1/20	Updated for CST Studio 2020
Lesson 5	1/20	Updated for CST Studio 2020
Lesson 6	1/20	Updated for CST Studio 2020
Lesson 7	1/20	Updated for CST Studio 2020
Lesson 8	1/20	Updated for CST Studio 2020
Lesson 9	1/20	Updated for CST Studio 2020
Lesson 10	1/20	Updated for CST Studio 2020
Appendix 1	1/20	Updated for CST Studio 2020

Workshop 1	1/20	Updated for CST Studio 2020
Workshop 2	1/20	Updated for CST Studio 2020
Workshop 3	1/20	Updated for CST Studio 2020
Workshop 4	1/20	Updated for CST Studio 2020
Workshop 5	1/20	Updated for CST Studio 2020
Workshop 6	1/20	Updated for CST Studio 2020
Workshop 7	1/20	Updated for CST Studio 2020
Workshop 8	1/20	Updated for CST Studio 2020
Workshop 9	1/20	Updated for CST Studio 2020

Lesson 1: Introduction

Lesson content:

- ▶ The SIMULIA Brand
- ▶ SIMULIA Electromagnetics Product Portfolio
- ▶ Help Mechanisms



15 minutes

Lesson 2: Solver Overview

Lesson content:

- ▶ "Electromagnetic" SI Applications
- ▶ Solver Choice Overview
 - Power Integrity
 - Signal Integrity
- ▶ PCB Studio Solvers
 - 2D Transmission Line (TL) Modeling
 - 3D Partial Elements Equivalent Circuit (PEEC) Method
 - 3D Finite Elements Frequency Domain (FE/FD) Method
- ▶ CST Microwave Studio / Full-Wave Solvers
 - 3D Transient Solver
 - 3D Frequency Domain Solver
- ▶ Annex: Advanced 3D Modeling Techniques



30 min

Lesson 3: Circuit Simulation Overview

Lesson content:

- ▶ CST Design Studio
- ▶ I/O Buffer Information Specification (IBIS) Viewer
- ▶ Port Definition
- ▶ Circuit Simulation Tasks
 - S-Parameter Task
 - AC Task
 - Transient Task

- ▶ Annex: AC Task Combine Results / True Transient Co-Simulation



Workshop 1: Circuit Simulation

This workshop illustrates the capabilities of CST Design Studio and allows you to perform EDA-related simulations on the circuit level:

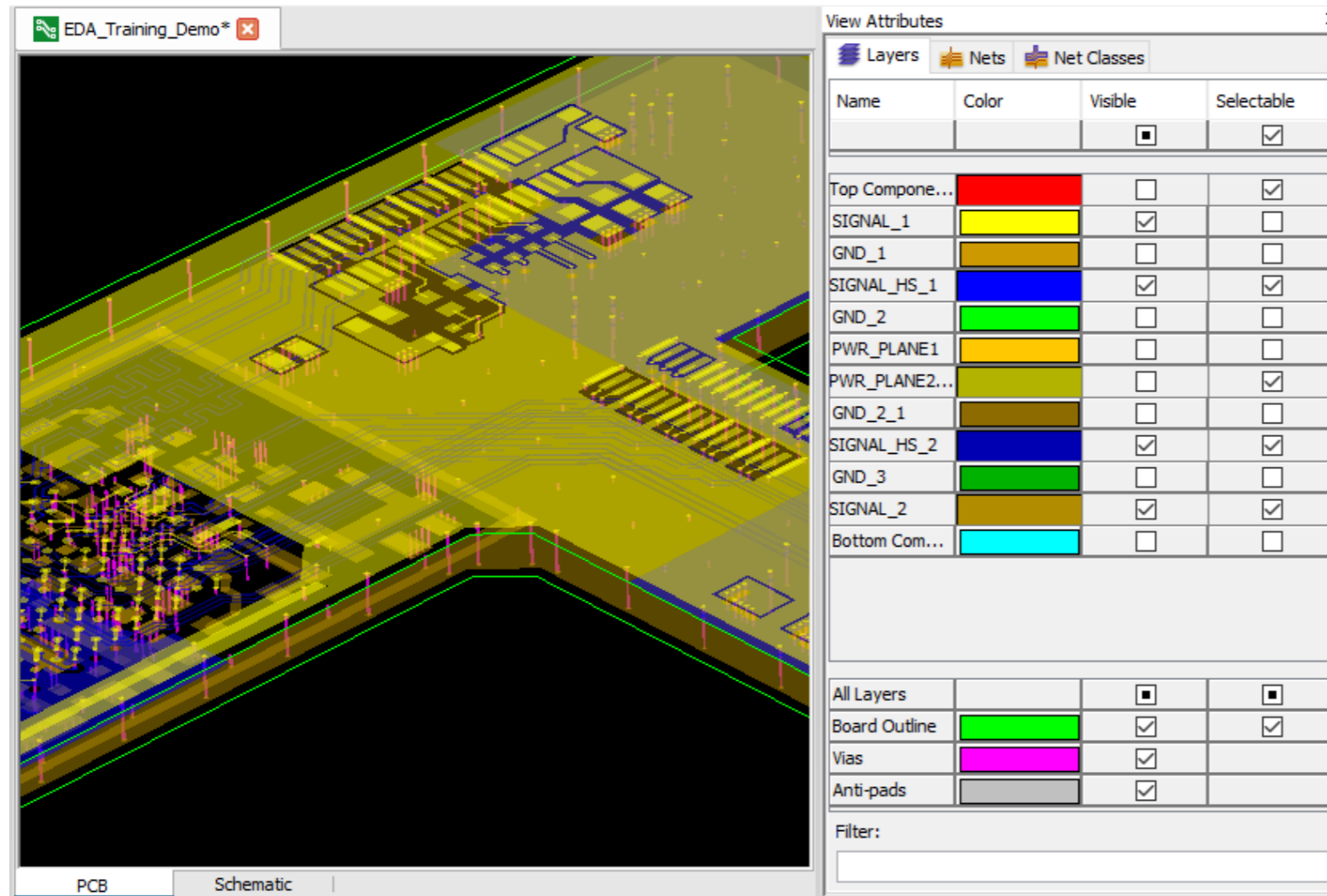
1. Create a **Coupled Microstrip Line** to serve as a model for subsequent simulations.
2. Perform a **Time Domain analysis** using a transient task on a serial termination resistor setup.
3. Study the **effect of different resistor values** on the voltage reflection in terms of signal integrity. Use parameter sweeps as well.
4. Include **IBIS files** in the model to perform a more realistic simulation. Analyze the effects of different ODTs (On Die Termination).
5. Apply **Crosstalk analysis** in the time and frequency domains.



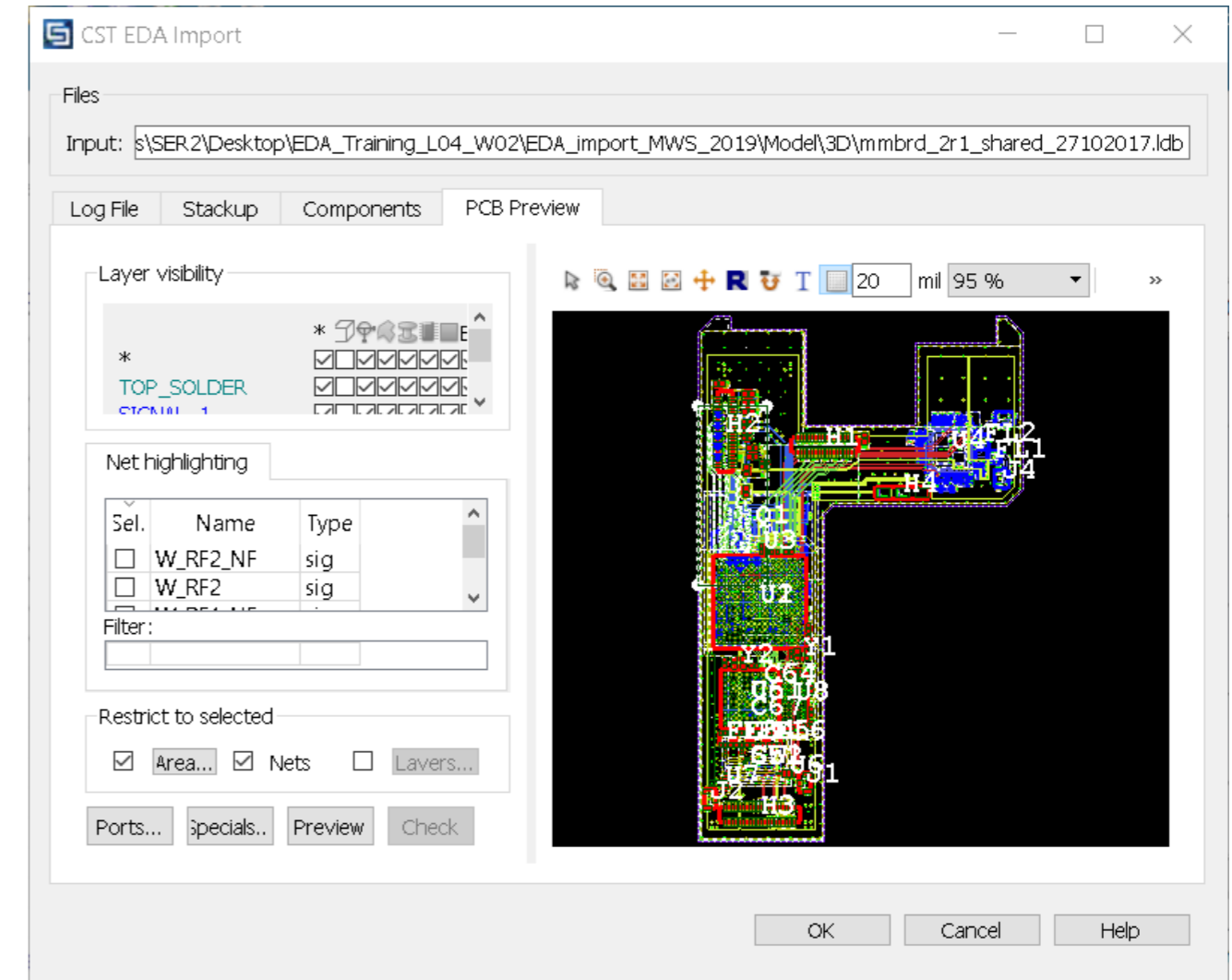
Lesson 4: EDA Workflow Integration

EDA Import/ Export

a. Via CST PCBS



b. Via CST MWS

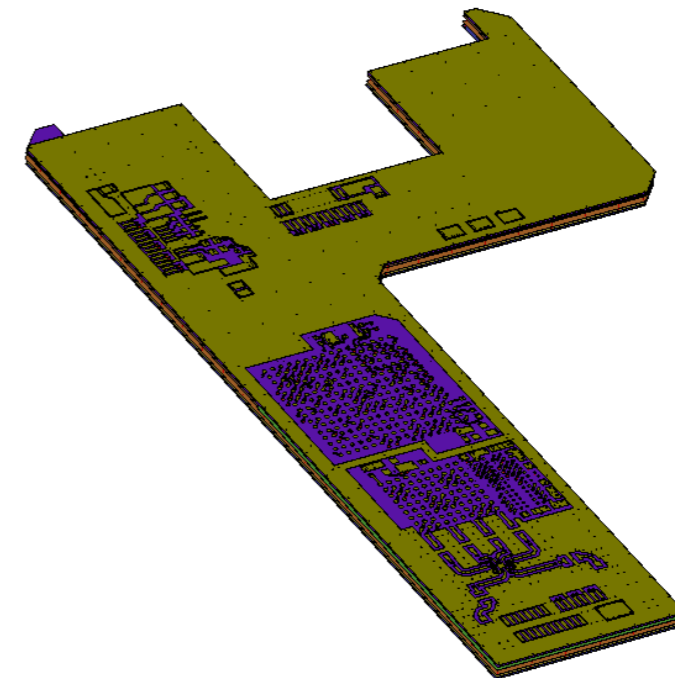


Workshop 2: EDA Import and Export

This workshop illustrates **EDA Import** and **Export**.

Tasks include:

1. Import a board file in ODB++ format.
2. Create a CST MWS project of LVDS nets along with a GND net such that all other nets are removed.
3. Use rectangular selection and port setup to limit the model to a rectangular area around the selected nets and construct ports for each signal.
 - a. Using CST PCBS
 - b. Using EDA Import of CST MWS



Lesson 5: Modeling Techniques

Lesson content:

- ▶ Basics
- ▶ View Options
- ▶ Short Exercise – Construct Objects
- ▶ Component Library
- ▶ Curves
- ▶ Moving & Copying
- ▶ Advanced Modeling Tools
- ▶ Short Exercise – Create Cone Structure
- ▶ Picks – Advanced
- ▶ EDA Modeling Features



1.5 hours

Lesson 6: Materials, Ports and Boundaries

Lesson content:

- ▶ Materials
 - ▣ Material Library
 - ▣ Basic Materials
 - ▣ Surface Impedance Models
- ▶ Advanced Materials
- ▶ Ports
 - ▣ Ports for S-Parameter Computation
 - ▣ Discrete Ports
 - ▣ Waveguide Ports
- ▶ Boundary Conditions
 - ▣ Boundary Types
 - ▣ Symmetry Planes
 - ▣ Boundaries for PCB Simulations



Lesson 7: Results Handling and Postprocessing

Lesson content:

- ▶ CST Microwave Studio Workflow
- ▶ Results Handling
- ▶ 1D Plot Options
- ▶ Result Navigator
- ▶ 2D/3D Plot Options
- ▶ Postprocessing Templates



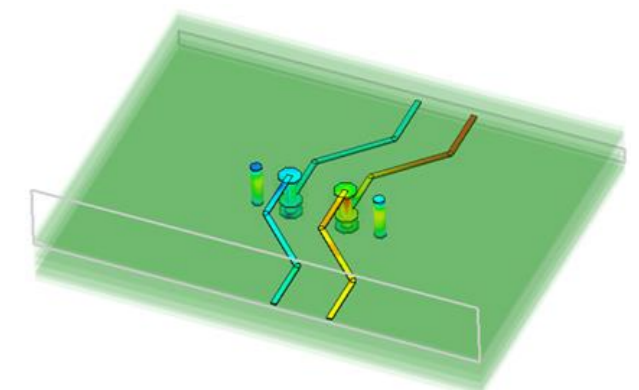
30 min

Workshop 3: Differential Via Pair (optional)

In this workshop you will learn how to use the Via Wizard to build realistic 3D via models for CST MWS simulation. Therefore, a predefined configuration of a differential stripline with vias connected will be used.

The 3D model generated by the Via Wizard will be simulated in CST MWS in order to obtain its high frequency characteristics (S-parameters). You will learn how to set up CST MWS in terms of Boundary Conditions, Ports, Field Monitors, etc.

In a third step you will set up a circuit simulation which includes the S-parameter representation of the 3D Via Model connected to a stripline block in order to build a realistic transmission channel. In circuit simulation you will obtain a single-ended S-parameter and a mixed-mode S-parameter, as well as an eye diagram for the whole transmission channel.

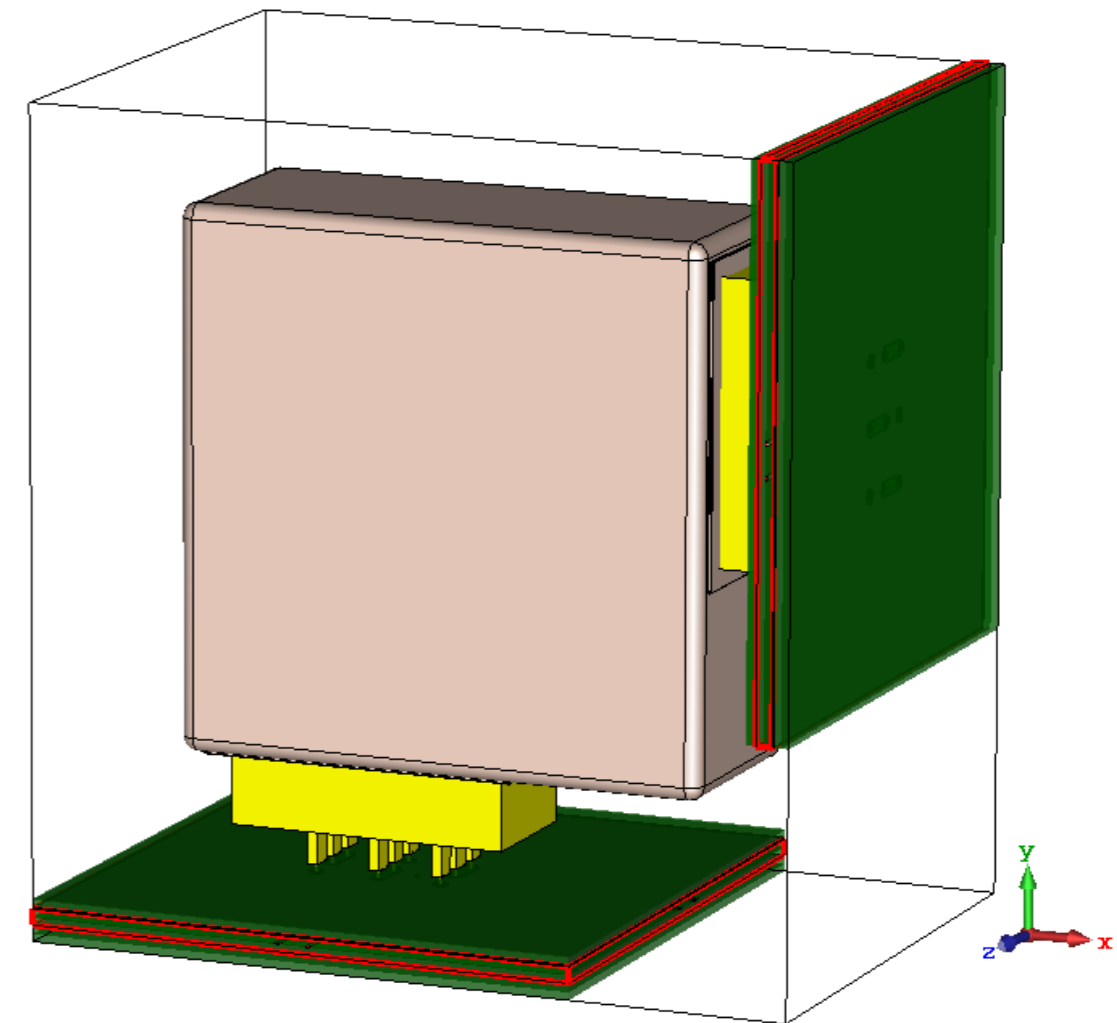


45 min

Workshop 4: Connector

This workshop considers the S-parameter and TDR analysis of a high-speed connector:

1. Setup
 - a. Project Template
 - b. Background Material
 - c. Import SAT file model
 - d. Define Waveguide Ports
 - e. Mesh
2. S-Parameters
3. TDR Analysis
 - a. Cross-probing
4. Sensitivity and Yield
5. Import PCB



Lesson 8: DC IR Drop / Power Integrity Solution Overview

Lesson content:

- ▶ Power Delivery Network (PDN)
- ▶ DC IR Drop Analysis
- ▶ AC PDN Impedance Analysis
 - Power Plane Impedance
 - Capacitance – Decaps & Mounting Inductance
- ▶ Power Integrity Workflow
- ▶ Power Integrity Setup
- ▶ IR Drop Analysis
- ▶ PI Analysis
- ▶ Decap Analysis Tool
- ▶ Decap Optimization [manually]



Workshop 5: DC IR Drop / Power Integrity

In this workshop you will perform a power integrity analysis of a smartphone motherboard.

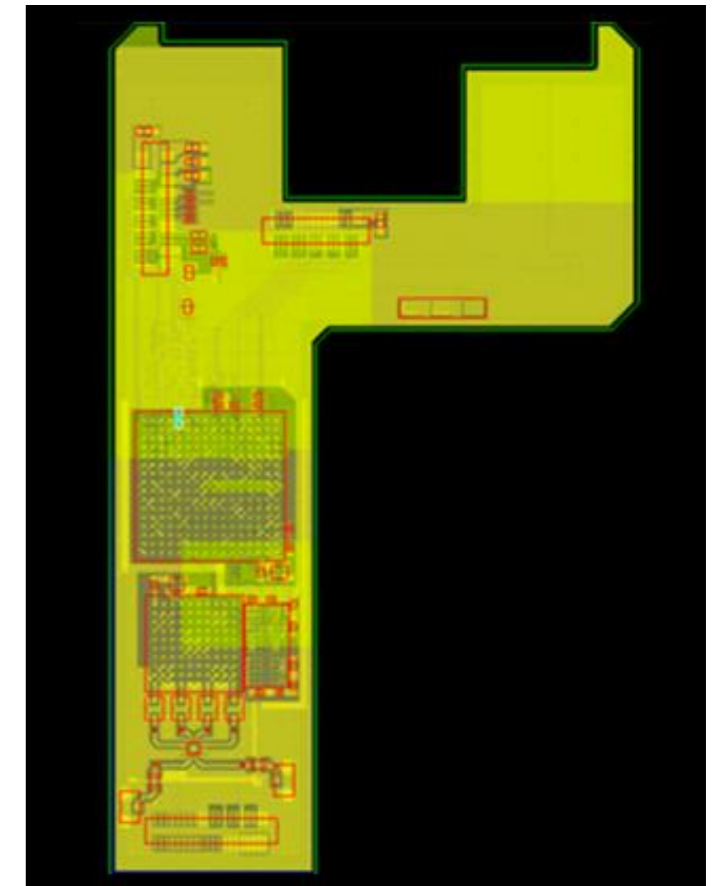
During the workshop you will import, prepare and perform an analysis on the 1.5V power net. It is important from the high-speed design point of view, because it provides power to the DDR3 interface.

Power Integrity (PI) analysis will be conducted in the following steps:

1. IR Drop (DC analysis to ensure that power losses do not exceed given thresholds).
2. PI Analysis (AC analysis to evaluate and improve net impedance behavior at higher frequencies).



This model will also be used in Workshop 6.

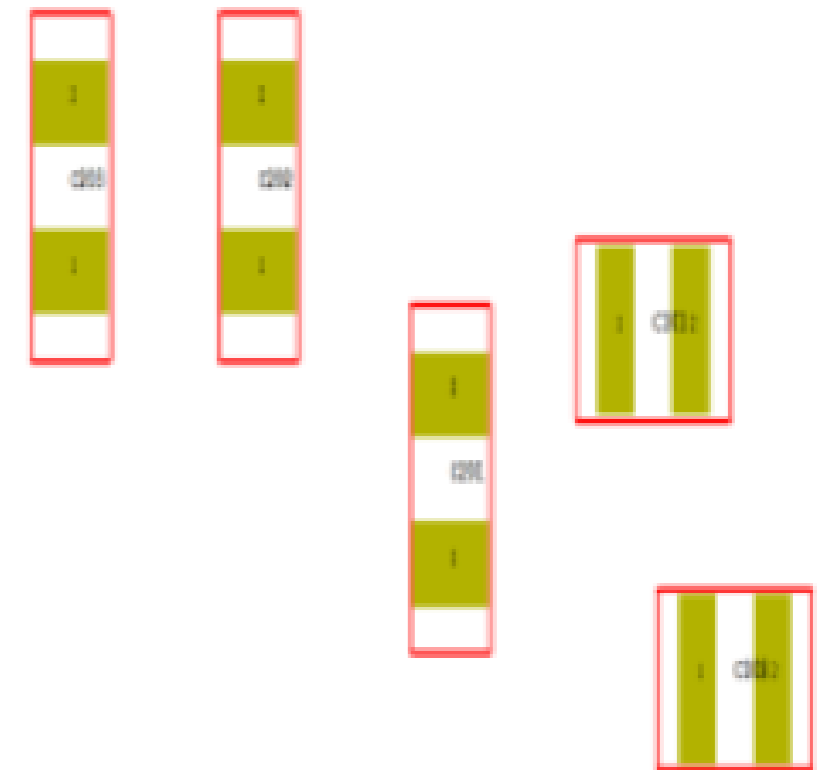


60 min

Workshop 6: Decoupling Capacitor Analysis

This workshop illustrates a common technique to reduce the AC noises of the PDN (power distribution network) by using decoupling capacitors between the power net and GND net. The goal is to find the least or cheapest amount of capacitors to be mounted while still meeting the target impedance.

1. Guidance on workflow: Background and Pre-requisite setup
2. DeCap Workflow Part 1:
 - a. Follow-on from PI Analysis
3. Info Only: DeCap GUI
4. DeCap Workflow Part 2:
 - a. Define target impedance
 - b. Define the parts price and size code
 - c. Group available parts, optimize impedance
 - d. Reload optimized configuration, export list of parts
5. Info Only: Manually Reduce Impedance
6. Standalone DeCap Tool



Lesson 9: Signal Integrity Overview

Lesson content:

- ▶ Purpose of SI Analysis
- ▶ SI in Time Domain
- ▶ SI in Frequency Domain
- ▶ When to Run 2D (TL) or 3D Full Wave Analysis
- ▶ 3D Solver Characteristics
- ▶ SI Simulation Analysis Dialog
- ▶ IBIS Models
- ▶ Eye Diagram
- ▶ TDR Analysis



Workshop 7: SI TD Analysis

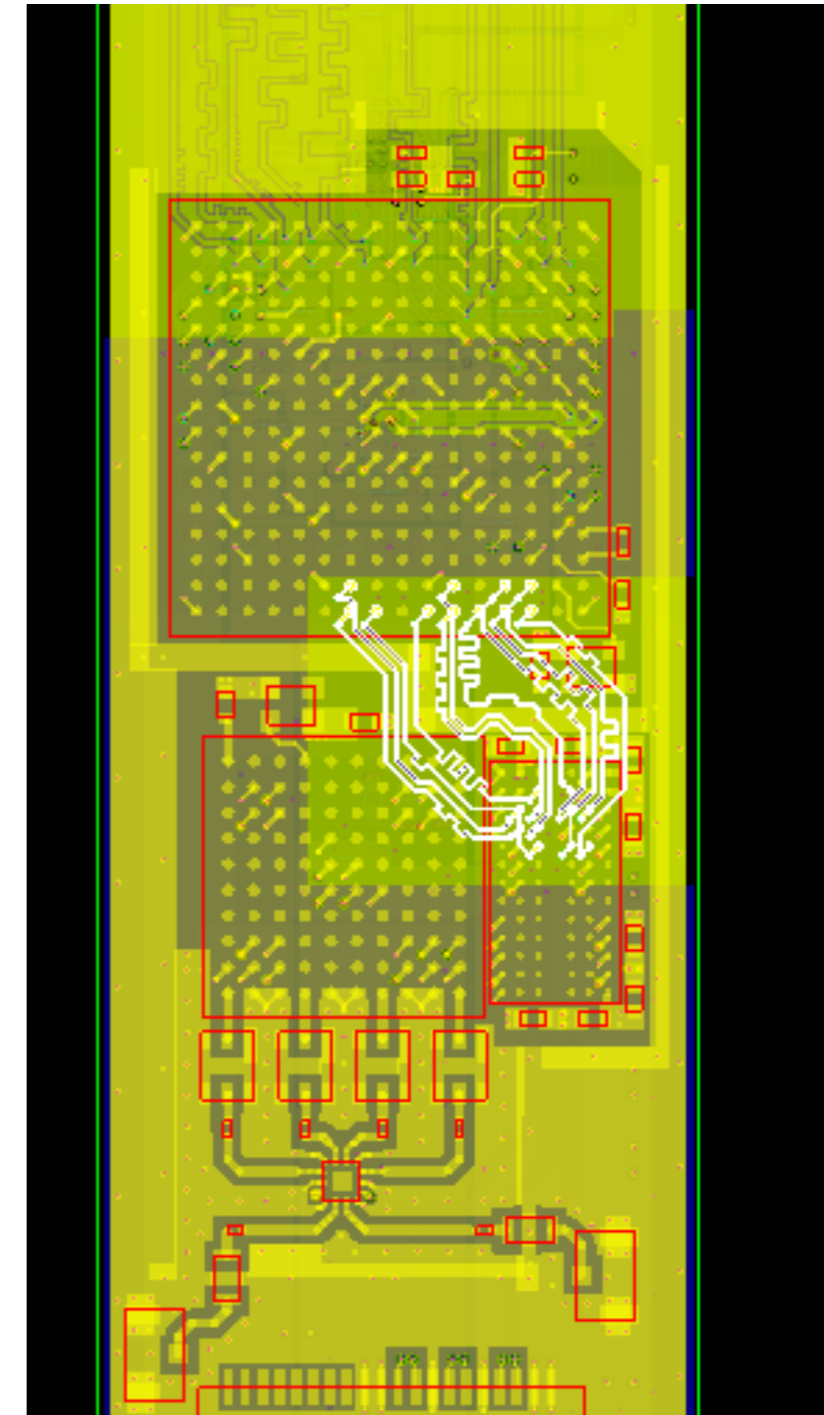
In this workshop you will investigate the signal integrity of a DDR3 bus on a mobile phone motherboard:

1. Application of the SI-TD workflow will be applied to set up a time domain analysis on this bus.
2. IBIS models of the CPU and the memory block will be assigned to drive an eye diagram analysis on the data lanes.
3. Then a 3D model of the bus will be exported to CST Microwave Studio in order to prepare a fullwave analysis.



Workshop 8: SI FD Analysis

1. The purpose of this workshop is to illustrate the use of the SI FD approach in CST PCB Studio for signal integrity analysis
2. The study will be focused on the DDR3 signal traces between the CPU and memory IC
3. Detailed steps are as follows
 - a. Import the PCB design into CST PCB Studio
 - b. Update the component definitions with IBIS files
 - c. Select the pins for the SI FD simulation
 - d. Define the frequency range
 - e. Run the simulation



30 min

Lesson 10: CST MWS Solver Overview

Lesson content:

- ▶ CST Microwave Studio Solver Overview
- ▶ Selecting the Most Appropriate Solver
- ▶ Time Domain Simulation
- ▶ Time Domain vs. Frequency Domain
- ▶ Frequency Domain Simulation
- ▶ Hybrid Solver Task

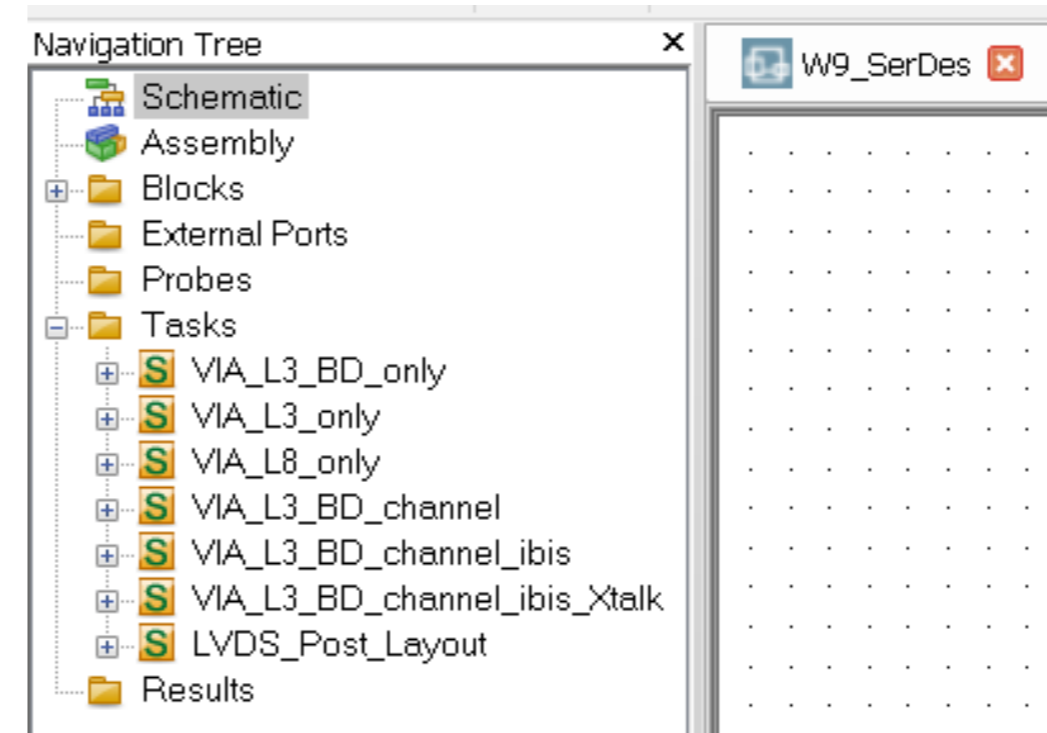
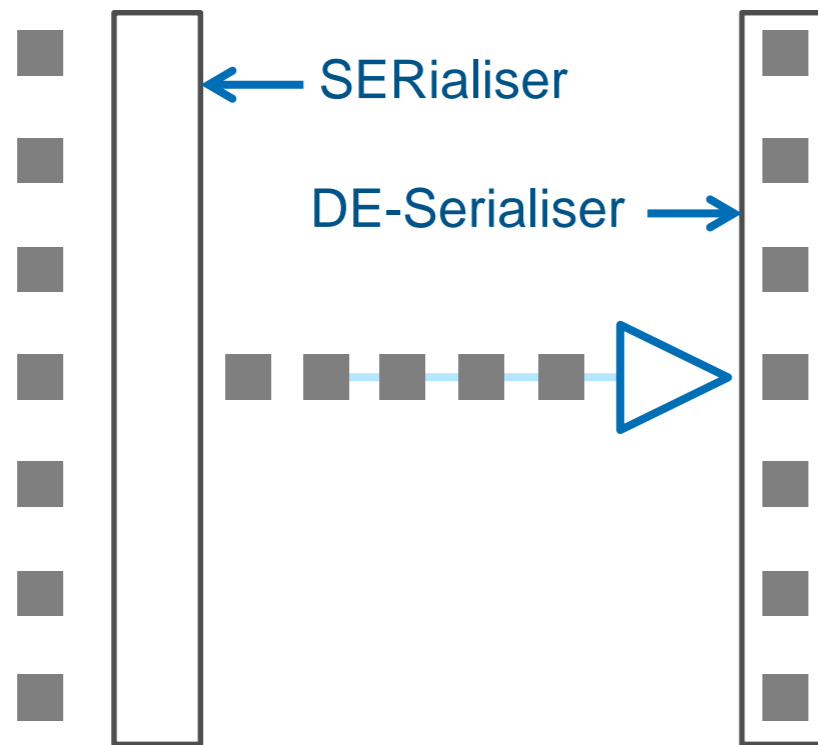


40 minutes

Workshop 9: SerDes Channel Analysis

Objectives

1. When you complete this workshop you will be able to:
 - a. Make use of the **Via Wizard** for SerDes Pre-Layout analysis.
 - b. Understand task management in CST Design Studio.
 - c. Use the parametric **Eye Diagram Tool**.
 - d. Understand the advantages of the T-Solver for Post-Layout analysis.



60 min

Appendix 1: Waveguide Ports – Advanced

Appendix content:

- ▶ Waveguide Port Basics
- ▶ Frequency-dependent Modes
- ▶ Mode Polarization
- ▶ Reference Plane
- ▶ Boundary Conditions of Waveguide Port Edges
- ▶ Hexahedral Meshing
- ▶ Multipin Waveguide Ports

