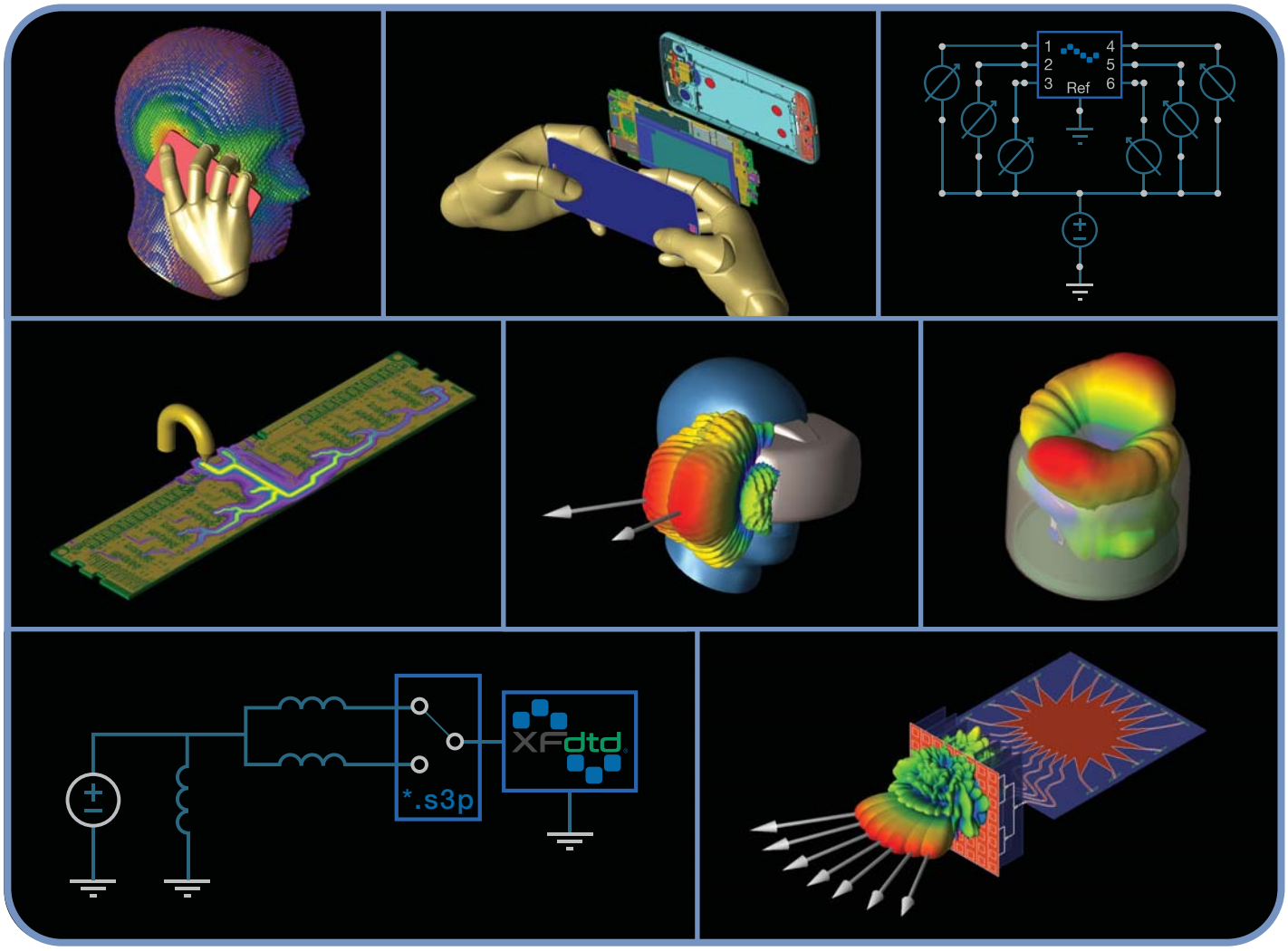
XFdtd® Electromagnetic Simulation Software



XFdtd®

REMCOM®

CONTENTS

Electromagnetic Simulation Solutions for Design Engineers and EM Professionals

Remcom provides electromagnetic simulation and site-specific radio propagation software for analyzing complex EM problems and antenna propagation. We empower design engineers with unique solutions for navigating today's rapidly changing technologies.

Our complementary products work together to provide complete end-to-end design and analysis of complex devices in real world scenarios, simplifying EM analysis for a wide variety of applications including:

- Mobile Device Design
- 5G and MIMO Applications
- Automotive Radar
- Radar and Scattering
- Microwave Devices and Waveguides
- Biomedical and SAR Validation
- Outdoor and Indoor mmWave Planning and Analysis
- WiFi Device Performance

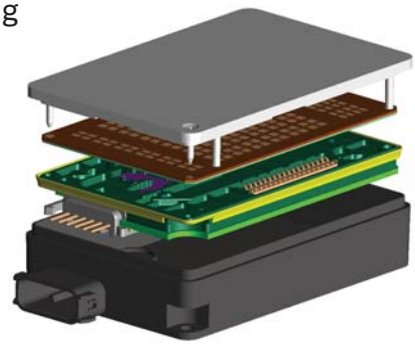
XFdtd®: Fast and Accurate Has Never Been So Easy

Save Time and Streamline Your Work

A full-featured EM simulation solver, XF outpaces other methods in efficiency as the number of unknowns increases. XF includes full-wave, static, bio-thermal, optimization, and circuit solvers to tackle a wide variety of applications.

Key benefits of XFdtd 3D EM Simulation Software include:

- Superposition Simulations and Array Optimization facilitate the use of beam steering, spatial diversity, and other techniques to maximize 5G device performance.
- The schematic editor enables advanced antenna matching network and corporate feed network analyses, including multi-state and multi-port devices.



- Circuit Element Optimizer determines optimal values for lumped circuit elements connected directly into the EM simulation mesh.
- Transient EM/Circuit Co-Simulation facilitates a realistic analysis of device performance by including TVS diodes and other nonlinear ESD mitigation components within the simulation.
- Dielectric Breakdown Prediction reveals locations and components at risk of suffering dielectric breakdown in a device design prior to hardware testing.
- Optenni Lab Integration makes it easy to generate a matching network topology and initial component values for your device.
- PrOGrid Project Optimized Gridding® simplifies grid creation by considering multiple aspects of a project to optimize the grid for both accuracy and runtime.
- XStream® GPU Acceleration for CPUs and GPU clusters enables calculations to finish in minutes as compared to hours.
- XACT Accurate Cell Technology® resolves the most intricate designs with fewer computational resources.
- Intelligent, ultra-fast meshing expedites previewing of finished meshes prior to simulation.

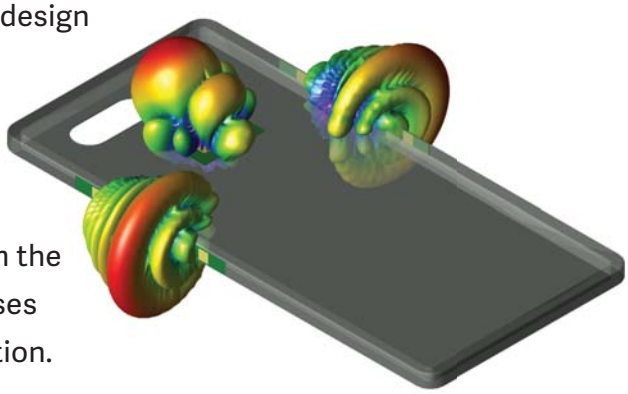
5G Array Analysis

In-depth analysis of 5G-capable devices.

Antenna engineers are developing advanced antenna systems capable of beam steering and multiple data stream transmission in order to meet throughput requirements for 5G. XF enables in-depth analysis of a device's stand-alone performance, with 5G device design features that support high-frequency array antennas and complex devices operating at millimeter wave frequencies.

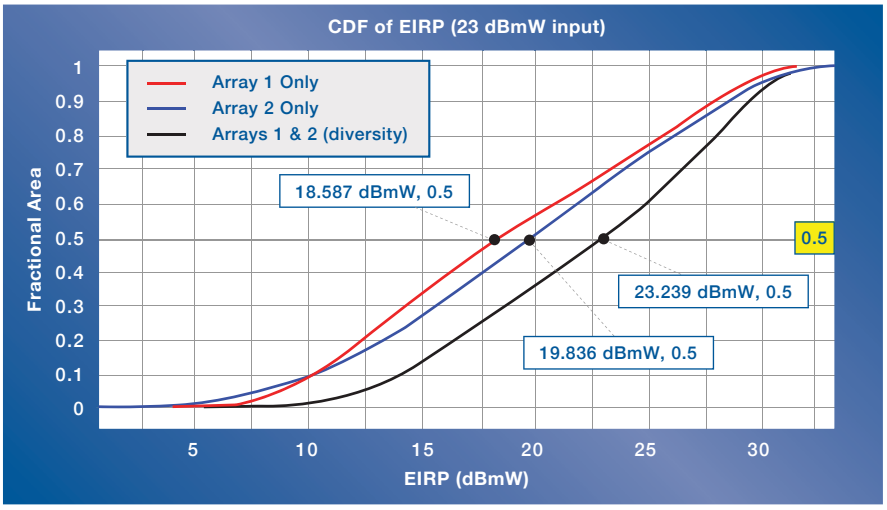
Superposition and Array Optimization

Determining the numerous beam states for a new design can be tedious due to the hundreds or thousands of port phase combinations. XF leverages the electromagnetic principle of superposition to quickly analyze these combinations with a single simulation. By combining steady-state results from the simulation, XF efficiently determines the port phases that maximize the far zone coverage in each direction.



CDF of EIRP

XF's full wave solver computes S-Parameters, efficiencies and far field for each of the elements in a device. The Array Analysis tool then optimizes the phases of the feeds for each element over a set of desired beam angles. A cumulative distribution function of effective isotropic radiated power (CDF of EIRP) plot is then generated for one or more arrays to provide a total metric of the performance of the device.



Powerful Flexible Modeling

Spend less time modeling and more time getting results.

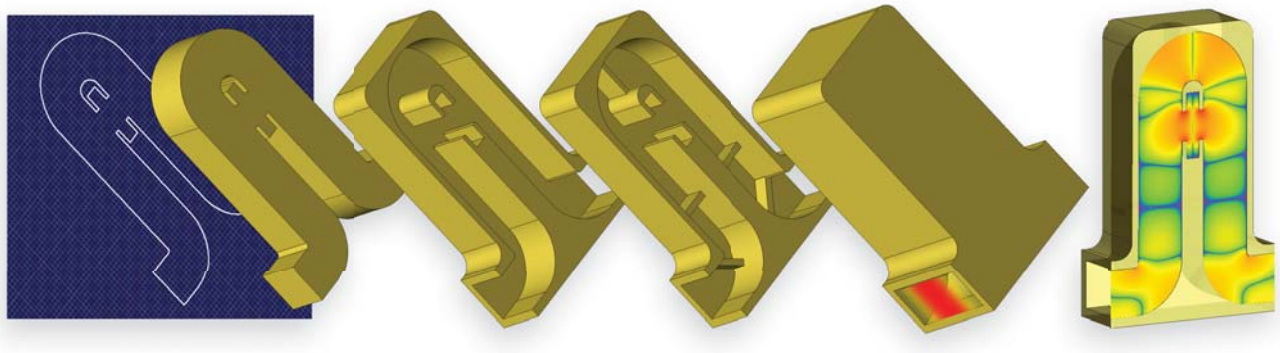
Whether you're importing CAD databases or building your own models, the sophisticated modeling tools in XF will make your job easier. The modeling engine in XF allows you to build complicated models from the ground up or modify imported CAD files. This reduces the amount of time you spend modeling, leaving more time to focus on your results.

Key Features

- 2D Sketcher with constraints: Intuitive grid/object snapping and a constraint system allow for quick creation of complex shapes.
- Feature history for objects: Modeling operations are chained together on each object, creating an editable history for each model in your project.

Importable CAD Formats

- ODB++
- SAT/SAB
- DXF
- VDA-FS
- STEP
- IGES
- Pro/E
- CATIAv4
- CATIAv5
- Inventor
- STL
- BRD



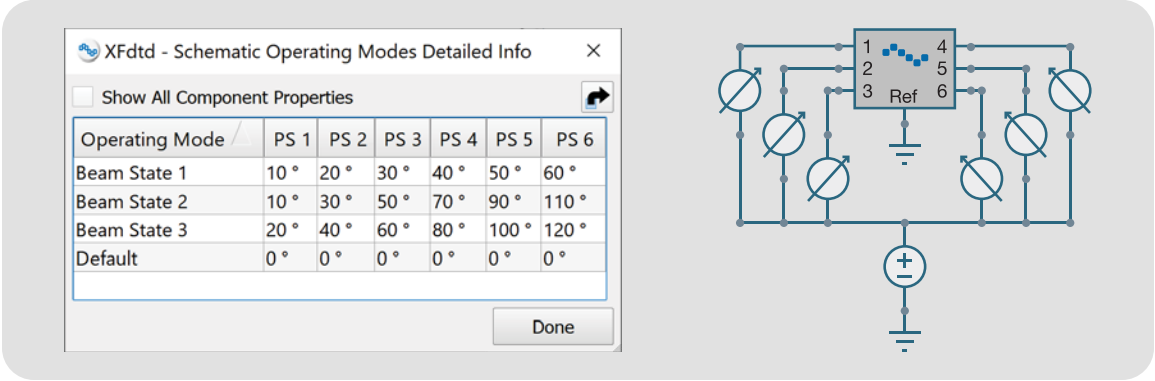
Frequency-Domain Circuit Solver and Schematic Editor

Build a matching network or corporate feed network and see its impact on full-wave results.

XF includes a schematic editor specially designed for antenna engineers who need to analyze matching networks and corporate feed networks. The S-parameters from an FDTD simulation are readily accessible for analysis. The associated frequency-domain circuit solver quickly solves the circuit layout and provides matched results. Once the matching network or corporate feed network analysis is complete, the schematic can be applied to the FDTD simulation where full-wave results can be inspected.

Supported Components and Operating Modes

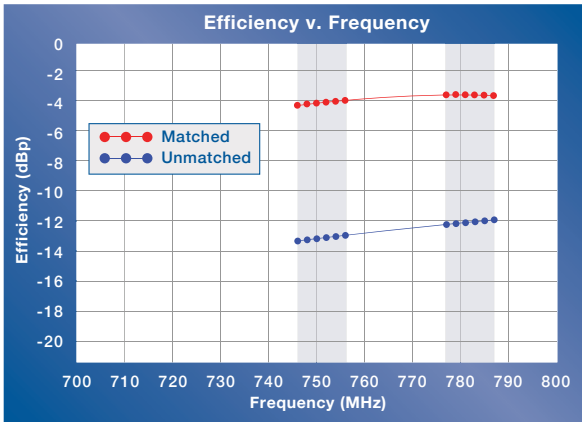
- Resistors
- Ideal and lossy inductors/capacitors
- Switches
- Phase shifters
- Netlist file import
- SnP file import
- FDTD block
- Voltmeter
- Ammeter



Steady-state Full-wave Results

When a schematic is applied to an FDTD simulation, the following results will update:

- Port data including S-parameters, VSWR
- System and radiation efficiencies
- Available, input, dissipated, and radiated powers
- Near field sensors
- Far field sensors



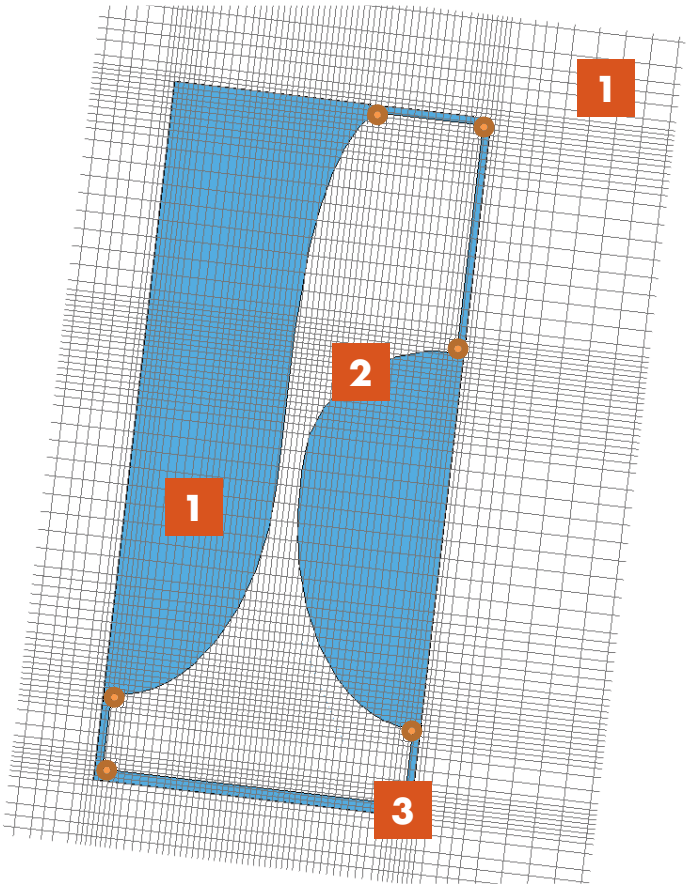
Fast, Intelligent Meshing

XF makes it easier to generate more accurate and efficient meshes with less work.

XF allows you to see the finished mesh with materials before the simulation ever starts. This provides the confidence that the simulation will not fail due to a meshing error. XF's intelligent and ultra-fast mesh updating capabilities make this process even more seamless than before.

PrOGrid Project Optimized Gridding®

Additionally, XF's Project Optimized Gridding algorithm, PrOGrid, streamlines the process of generating an efficient grid. By considering a combination of geometry features, operating frequency, and material parameters, PrOGrid intelligently creates a grid that is optimized for high accuracy and short run times.



PrOGrid Logic

1. Guarantee cells per wavelength in free space and in dielectrics where the wavelength is shorter.
2. Reduce cell size around curved geometry.
3. Apply boundary refinement at the edges of conductors where electric fields are strongest.

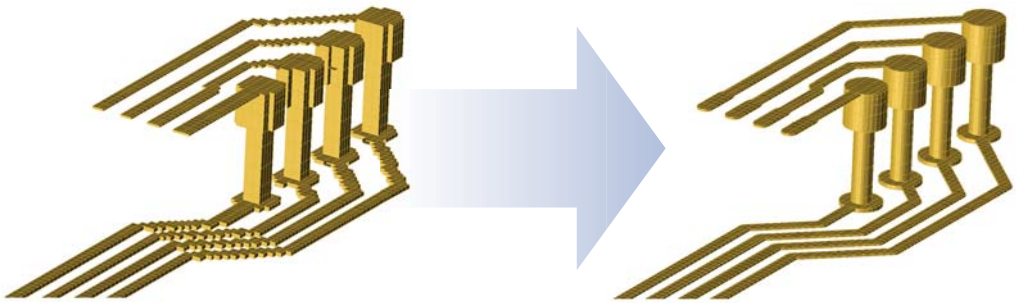
Identify geometric features like vertices [●] and snap grid lines to them.

XACT Accurate Cell Technology®

Accurate meshing of curved geometry.

With XF, there is no need to choose performance over accuracy. XACT mesh reduces simulation time while improving the accuracy of even the most intricate designs. Using an advanced sub-cellular conformal method, XF reduces computing resources while maintaining the accuracy of a full wave solver. Faster, more accurate simulations improve the throughput of your designs from start to finish.

Traditional FDTD Mesh **XACT Mesh**

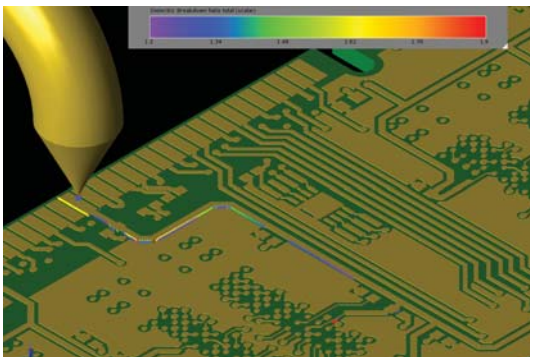


Comparisons show the dramatic improvement with XACT.

Dielectric Breakdown Prediction

Predict locations at risk of dielectric breakdown.

XF has a collection of features for electrostatic discharge (ESD) testing, enabling engineers to identify potential locations of dielectric breakdown and components at risk of damage in their device designs. For less obvious damage this pre-prototype insight is especially valuable, as it minimizes the chance of undetected weaknesses and reveals areas of concern prior to hardware testing.

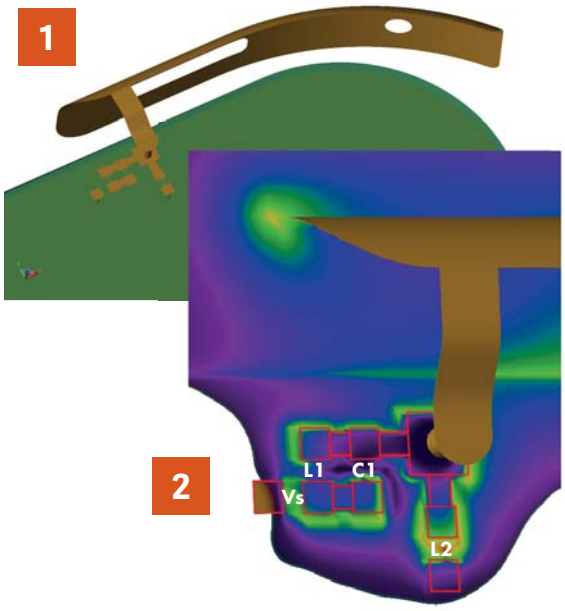


Cell edges which exceeded their dielectric strength during a simulation can be examined with the Dielectric Breakdown Sensor and Dielectric Breakdown Ratio result type.

Circuit Element Optimizer (CEO)

Determine component values for Full-Wave Matching Circuit Optimization (FW-MCO).

Circuit Element Optimization is a technology unique to XF, and is able to consider electromagnetic field interactions between the components and the surrounding environment. This makes it easier than ever to find the optimal set of components and achieve the desired performance with a matching network or filter.



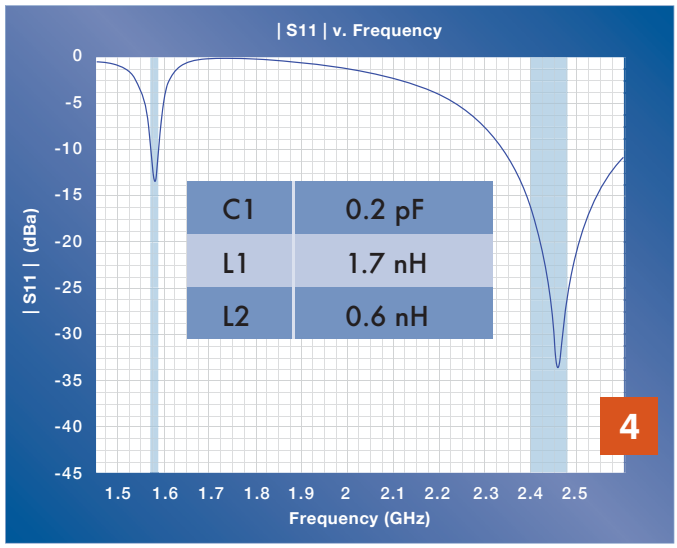
Design Flow with CEO

1. Set up the XF project including copper traces, component locations, materials, grid, etc.
2. Create a Response Matrix which uses FDTD simulations to characterize field interactions affecting the components.
3. Perform a Circuit Optimization that uses S-Parameter and/or efficiency goals to select the optimal set of component values.
4. Verify that the matching network or filter performs as desired with the selected component values.

S11 Threshold
GPS: -6 dB
Bluetooth: -15 dB

3

Component Values
L: 1 nH to 10 nH
C: 1pF to 10 pF

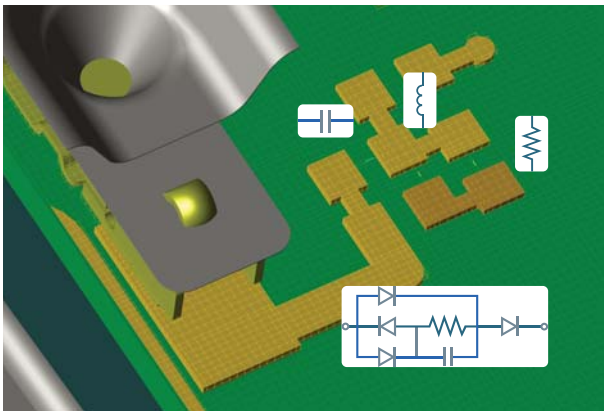


Transient EM/Circuit Co-Simulation

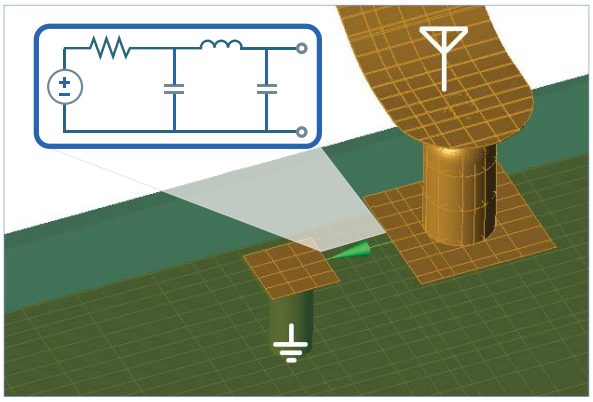
A SPICE-based circuit solver and full-wave FDTD solver are computed simultaneously.

TVS Diodes

TVS diodes are often used to protect sensitive circuitry from an ESD event. Manufacturers provide an equivalent SPICE model consisting of diodes, resistors, capacitors, and inductors to model the VI characteristics of the physical diode. XF's nonlinear circuit solver is able to handle unidirectional diodes, bidirectional diodes, and other ESD mitigation devices which are represented as an equivalent SPICE circuit.



Chip Components and Matching Networks



XF improves chip component and matching network analysis using a combined time-domain circuit solver and full wave electromagnetic solver. Import the schematic for a desired component via a netlist file, including SPICE elements such as resistors, capacitors, inductors, coupled inductors, and subcircuits. Netlist components can also be assigned as a matching circuit embedded within a feed, further simplifying matching network design.

Key Features

- Improve the analysis of transient-voltage-suppression (TVS) diodes, chip components and matching networks
- Simulate realistic chip performance using measured data from manufacturers such as Murata, Coilcraft, and Taiyo Yuden
- Define a matching network as a SPICE model and include in a voltage source

Versions

	Standard	Pro	MIMO		Standard	Pro	MIMO
HPC Tokens (Workstation)	1	2	4	Power Density		•	•
3D CAD Modeling	•	•	•	Biological Thermal Sensor		•	•
Parameterization & Scripting	•	•	•	VariPose® Mesh Repositioning		•	•
CAD and PCB Import	•	•	•	Birdcage Tool		•	•
XACT Accurate Cell Technology®	•	•	•	Schematic Editor			•
Electrostatic Solver (ESS)	•	•	•	Superposition			•
Rotman Lens Designer®	•	•	•	Array Optimization			•
Specific Absorption Rate (SAR)		•	•	Circuit Element Optimization			•

High performance computing packages are also available, including Cluster and Enterprise bundles for very large GPU, MPI, and MPM distributed memory installations. Please contact Remcom for pricing.

Results & Output

XF keeps track of every simulation for each project. Results from other projects or past simulations can be added to graphs, viewed in 3D, post-processed, or exported to text files. In addition, the fully customizable Results Browser makes it easy to filter and search.

Visual Output

- Planes, surfaces and volumes of output shown with input geometry
- E/H/B, conduction current, rotating B near fields, dissipated power density
- 3D far field patterns of E, gain, realized gain, axial ratio, radar cross section, EIRP
- Hearing aid compatibility, SAR, MR transmit efficiency, and approximate MR image outputs
- Biological temperature rise
- Dielectric Breakdown Prediction

Graphical Output

- Near zone fields/currents vs. time
- Impedance, S-Parameters vs. frequency, VSWR, active VSWR
- Polar plot antenna patterns
- Smith chart impedance plots
- FFT of transient results
- Group Delay output type
- Time Domain Reflectometry (TDR) and Time Domain Transmission (TDT)
- Dissipated Power Density
- Cumulative Distribution Function

Remcom has been leading the EM market with innovative simulation and wireless propagation tools for over 25 years.

Our Family of Products

Remcom Simulation Platform

Remcom's Simulation Platform unites WaveFarer® and XFdtd® for seamless analysis of radar returns and full-wave simulation in a common user interface.

XFdtd®

General purpose 3D EM simulation solver that simplifies analysis of a wide variety of applications.

WaveFarer®

High-fidelity radar simulator for drive scenario modeling at frequencies up to and beyond 100 GHz.

Wireless InSite®

Suite of ray-tracing models and high-fidelity EM solvers for analyzing site-specific radio wave propagation and wireless communication systems.

XGtd®

High frequency GTD/UTD software for analyzing antenna systems on complex objects such as vehicles and aircraft.

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