XFddt: Electromagnetic Simulation Software
Electromagnetic Simulation Solutions for Design Engineers and EM Professionals

Remcom provides innovative electromagnetic simulation software and consulting services. Our products simplify the analysis of complex EM problems and lead the market in FDTD-based modeling and simulation.

Cell phone antenna design, MRI coil analysis, antenna placement on vehicles and airplanes, and placement of wireless communication systems are made easier with Remcom’s EM simulation software and expertise.
XFdtd®: Fast and Accurate Has Never Been So Easy

Save Time and Streamline Your Work
As an FDTD simulation solver, XFdtd outpaces other methods in efficiency as the number of unknowns increases. Learn more on page 14.

Key benefits of XFdtd 3D EM Simulation Software include:

• Circuit Element Optimizer determines optimal values for lumped circuit elements connected directly into the EM simulation mesh.

• 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.

• Unlimited Memory support for problems exceeding 60 GB and billions of cells.

• XACT Accurate Cell Technology® resolves the most intricate designs with fewer computational resources.

• CAD Merge seamlessly integrates new versions of CAD and PCB designs into existing projects.

• XTend Script Library automates modeling and design with pre-loaded, customizable scripts for creating custom features.

• Guided modeling processes, editable modeling history, ability to edit imported CAD files.

• Intelligent, ultra-fast meshing expedites previewing of finished meshes prior to simulation.
**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 you 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
Simplified Workflow

XF streamlines your workflow by eliminating time-consuming, redundant tasks.

XF multiplies your productivity by allowing you to reuse almost anything you create. Any project can be turned into a template, the parts of your project can be stored in a shared library, and your simulations are saved and the results easily accessed for comparison purposes.

Key Features

- Custom project templates
- Simulation history with all results
- Shared libraries
- Shared component, sensor, and waveform definitions
- PCB Merge for importing layered PCBs in ODB++
- CAD Merge

Seamless Revisions with CAD Merge

If you work with frequently updated CAD files, you’ll only have to set up the hierarchy, material assignments and meshing priority once. XF preserves this information each time a new version of the file is imported, keeping your workflow as efficient as possible.

CAD Merge compares the new geometry with the original and automatically refreshes the project tree with the changes.
**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.

Key Features
- Represents small gaps and curved surfaces
- Increases accuracy of results
- Significantly improves simulation time by reducing unknowns

Comparisons show the dramatic improvement with XACT.
Results & Output

Complete result history.

XF was designed to support the way you work by keeping track of every simulation you do 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. The Results Browser in XF is completely customizable, and filtering and searching tools make it easy to find exactly what you’re looking for with a few clicks.

Visual Output

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

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) output types
- Dissipated Power Density

Approximate MR image and transmit efficiency visual output types.
### Circuit Element Optimizer (CEO)

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

Circuit Element Optimization is a new technology that is only available in XF – no other electromagnetic simulation tool offers it. It is unique because of its ability 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.

#### Component Values

- **L**: 1 nH to 10 nH
- **C**: 1 pF to 10 pF

#### S11 Threshold

- **GPS**: -6 dB
- **Bluetooth**: -15 dB

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![Diagram showing component values and S11 threshold](image-url)
**Parameters Everywhere**

XF helps you find the optimal solution.

In XF, parameters are part of the DNA of a project. Parts, components, waveforms, materials and just about everything else in your project can leverage the power of parameters. It’s simple enough for anyone to use, but with advanced capabilities that will make any power user happy.

**Key Features**

- Define nearly any value as a parameter, such as the length of a part or the frequency of a simulation
- Mathematical expressions using parameters
- Interface with scripts for parameter evaluation

Entire assemblies based on the same parameter can be modified by changing one value. Since parameters can be used almost anywhere in XF, you can automate more things and gain complete control of your projects.
Custom Scripted Features

XF allows you to create your own custom features with a powerful scripting API.

With XF, the power is in your hands to create time-saving, custom features that allow you to work faster. Nearly everything in the application can be controlled and accessed through a powerful scripting API. Whether you’re writing custom dialogs or designing custom optimization routines, the scripting API in XF breaks down the walls between what you have and what you need.

Key Features

- Full-featured Script Editor
- Custom dialog creation through scripts
- Access to Result Data

The XTend Script Library helps adapt XF to your unique processes to extend the functionality of the tool. The scripts packaged with the application are available for you to modify and fit to your own needs. Remcom’s support team is also available to customize scripts for your specific use; contact Remcom for a quote.
High-Performance Computing Options for Every User

Improve EM simulation performance using the most modern high-performance computing technologies available.

Remcom’s industry-leading EM acceleration is a powerful tool to shorten your development time and release your products to market sooner.

Message Passing Interface (MPI) Technology for CPU and GPU Clusters

Distributing XF calculations among CPU and/or GPU clusters creates limitless potential.

Unlimited Memory Support

No memory limits! Simulate massive problems exceeding billions of cells.

Multiprocessor Technology

XF calculations are parallelized across all available processors within your computer, greatly speeding calculations.

See examples and learn more at www.remcom.com/no-limits
XStream GPU Acceleration

Built-in EM simulation acceleration via graphics processing units.

XStream tremendously improves EM simulation performance by leveraging the powerful NVIDIA graphics processing units (GPUs) available in modern video cards to make ultra-fast FDTD numerical computations. Leveraging NVIDIA's latest generation GPUs, XStream enables XF calculations to finish in minutes as compared to hours or even days using a CPU only.

Throughput Plot of XStream.

Throughput Plot of MPI + XStream.
Why Use the FDTD Method?

While many electromagnetic simulation techniques are applied in the frequency-domain, FDTD solves Maxwell’s equations in the time domain. This means that the calculation of the electromagnetic field values progresses at discrete steps in time. One benefit of the time domain approach is that it gives broadband output from a single execution of the program; however, the main reason for using the FDTD approach is the excellent scaling performance of the method as the problem size grows. As the number of unknowns increases, the FDTD approach quickly outpaces other methods in efficiency.

FDTD has also been identified as the preferred method for performing electromagnetic simulations for biological effects from wireless devices [1]. The FDTD method has been shown to be the most efficient approach and provides accurate results of the field penetration into biological tissues.

## Specifications & Versions

There are three versions of XF available: Limited, Professional, and Bio-Pro. Bio-Pro is a specialty version of XF that includes capabilities for bio-EM calculations. All versions include 64-bit analysis module, geometric modeler and postprocessor, as well as shared memory multiprocessor (MPM) capability. The following chart shows a comparison of available features in each version:

<table>
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<tr>
<th>XFdtd Versions Comparison</th>
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<th>Pro</th>
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<tr>
<td>XStream GPU Acceleration Tokens</td>
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<tr>
<td>MPM Tokens</td>
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<td>16</td>
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<tr>
<td>3D CAD Modeling</td>
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<td>Parameterization &amp; Scripting</td>
<td>*</td>
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<tr>
<td>CAD and PCB Import*</td>
<td>SAT, SAB, DXF, STL only</td>
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<td>XACT Accurate Cell Technology</td>
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<td>Specific Absorption Rate (SAR)</td>
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<tr>
<td>Birdcage Tool</td>
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<td>Floating Licenses</td>
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*Pro and Bio-Pro import types: ODB++, SAT/SAB, DXF, VDA-FS, STEP, IGES, Pro/E, CATIAv4, CATIAv5, Inventor, STL

XFdtd runs on Windows and Linux.

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.
A Sampling of Our Customers

3M  IBM  Toshiba
BAE Systems  LG  Toyota
Cobham  Lockheed Martin  U.S. Food and Drug Administration (FDA)
Dynetics  Mitsubishi  United States Air Force
Ericsson  Nokia  United States Army
GE  Samsung  United States Marines
General Motors  Siemens  United States Navy
Honda  Sony  Texas Instruments
Honeywell

▶ See www.remcom.com/customers for more.

Remcom has been leading the EM market with innovative simulation and wireless propagation tools for more than 20 years. Our family of products includes:

XFdtd®: 3D EM simulation software package that provides engineers with powerful and innovative tools for modeling and EM software simulation.

Wireless InSite®: A radio propagation analysis package for analyzing the impact of the physical environment on the performance of wireless communication systems.

XGtd®: A high frequency GTD/UTD based package for the design and analysis of antenna systems on complex objects such as vehicles and aircraft.