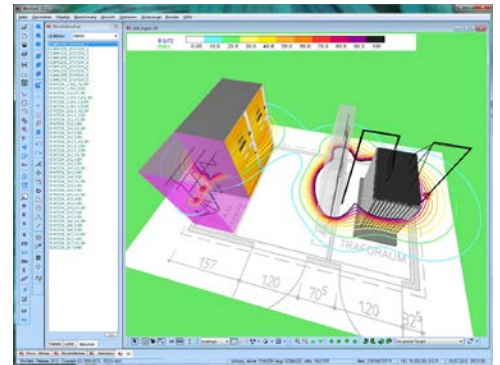


EFC-400[®] - Simulation Software

Computation of low frequency electric and magnetic fields

- ▲ Industry standard for low frequency simulation since 1995
- ▲ Maximum strength performance from calculation speed, ease of use, and the practically unlimited number of network elements
- ▲ Maximum cost-effectiveness in use, as users can create and import the necessary network elements themselves
- ▲ Principal users: Energy suppliers and their planning departments, consulting engineers, railroad companies and network regulation authorities
- ▲ Import and interpolation of measurement data
- ▲ All network elements are visible: 3D display → “What you see is what you get”
- ▲ Worldwide user references available from the Narda homepage



Product description

The EFC-400 software has been specially developed for computing the electric and magnetic fields around energy supply installations. The EFC-400ST version is the least expensive alternative for computing the magnetic fields of transformer stations or switching substations. The EFC-400LF version is capable of computing the electric field strength of overhead cables with up to 1000 sections as well as the magnetic flux density. EFC-400PS additionally allows computation of noise emissions and RF interference levels due to corona discharges.

General technical description

Compatibility between the different EFC-400 LF versions is 100% guaranteed at all times because the user interfaces of EFC-400 and "EFC-400 Station" use the same source text.

1. Secure investment

Users benefit from the fact that the application has been tried and tested over many years in practical use, so there is no risk in choosing "EFC-400". The wide distribution of the software ensures long-term development and technical support. Many power utility companies attest to the stability and effectiveness of the product, particularly since the two-year warranty includes a guarantee that EFC-400 delivers the advertised performance.

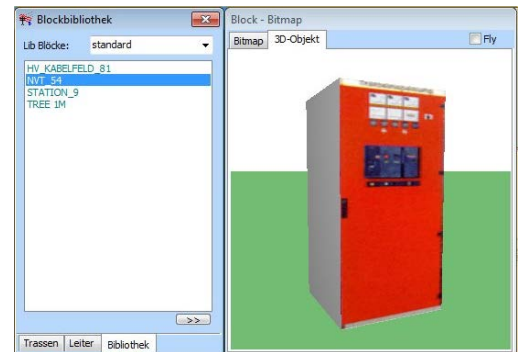
2. Individual network element construction

Users can adapt "EFC-400" to suit individual requirements without being dependent on services provided by the manufacturer. New elements can be added to the basic libraries within a few minutes if this becomes necessary, although the libraries contain more than 5,000 objects. Additional libraries can be accessed free of charge.

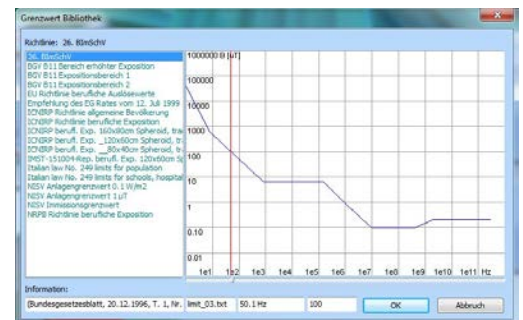
If a specific type of element is unavailable, it can be constructed using CAD and saved in the library for later use.

3. Module clarity

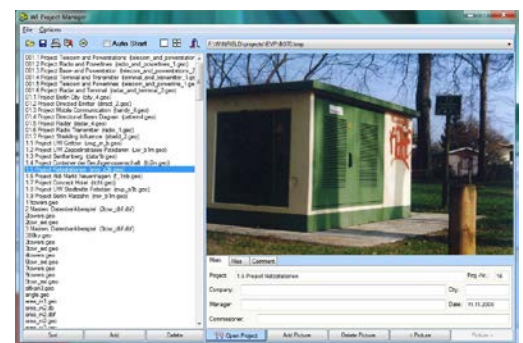
Because EFC-400 is a construction program, there are no "black boxes": Each element can be edited at will. This means that traceability is always possible for any third party, since they can check the construction and make printouts of the results using the license-free runtime version. EFC-400 does not use any modules that it does not generate itself or which it does not understand.



Component library



Integrated limit value evaluation



Project archiving

Description of Version EFC-400LF

1. Simulation of high-tension routes

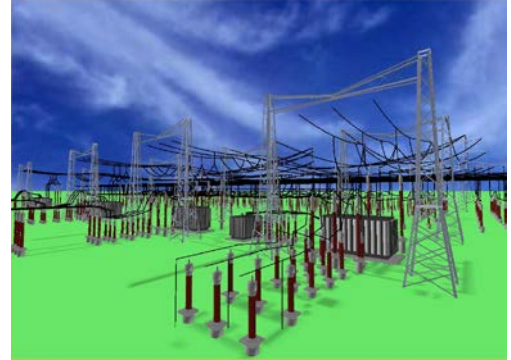
To simulate high-tension routes, users simply have to select masts and system configurations from a library. If the route is changed, e.g. by moving mast positions, the conductor path is automatically corrected.

2. Provision for phase and frequency

Field sources of different frequencies (0 - 30 kHz), such as the overhead wires for long-distance or urban railroads, can be processed with correct phase. Comparison with measured data is possible, with optional interpolation.

3. Dynamic memory

The number of simultaneous computation points is only limited by the capacity of the hard disk, and the fast computation speed provides performance that is otherwise only available from workstations. The program includes export interfaces for DXF format or ASCII tables to allow further processing of the data with presentation, statistics and CAD systems.



Magnetic field of a switching substation



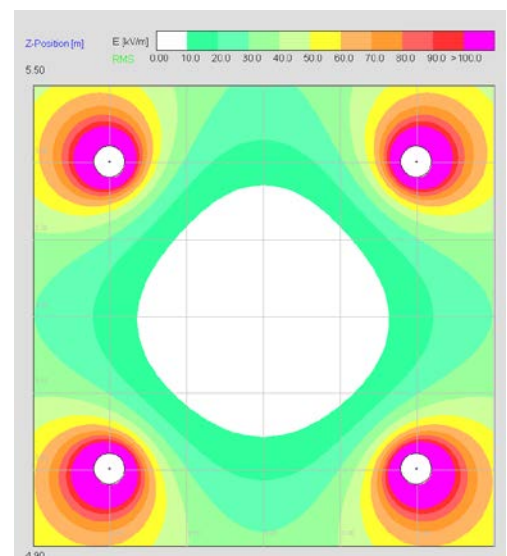
Field computation with interfering objects

Description of Version EFC-400PS

1. Computation of surface field strengths

In addition to computing the ground field strength, EFC-400PS also determines the surface field strengths at 100 points on the surface of every conductor or part conductor segment. These precise surface field strengths serve as the entry data for calculating the noise and RF levels, whereas traditional methods only estimate the surface field strengths using "rule of thumb" formulas.

The six methods used for computing levels correspond to different sources, all of which are based on empirical analysis, and can be user selected. The noise level is determined on the basis of the partial conductor method using the selected formula, in that the noise potential is calculated by scalar addition of the spatial distributions of all the individual segments.



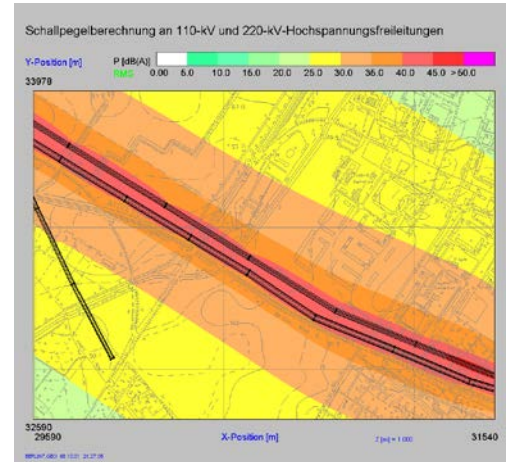
Four-conductor bundle surface field strength

2. Representation of noise level at any location

The method used can handle any arrangement of conductors, taking the slack span into account. The procedure is able to cope with the orientation, spacing and surface field strength of each individual segment.

The results are shown as contour lines, just like the electric field strength. The noise level can be read off for every point beneath an overhead cable or within a transformer substation. The results converge towards a limit value as the number of segments increases in the same way as the computation of electric field strength.

The method is implemented for AC and DC.



Noise level computation 1 m above ground

COMPARISON TABLE

Product description	EFC-400EP Enterprise	EFC-400LF Low frequency	EFC-400ST Station	EFC-400PS Plus sound	EFC-400TC Telecom
Computation methods	E, H, B, S, dB(A)	E, B	B	E, B, dB(A)	E, H, S
Frequency range	0 - 300 GHz	0 - 30 kHz	50 - 60 Hz	0 - 30 kHz	1 kHz - 300 GHz
Computational area ¹⁾	Unlimited	Unlimited	150 m x 150 m	Unlimited	Unlimited
Limit value evaluation in % ²⁾	•	•	•	•	•
Measurement data processing	•	•	•	•	•
Phase optimization	•	•		•	

1) Maximum 32,000 x 32,000 computation points

2) Limit value evaluation not possible for dB(A)

Computation of electric and magnetic fields

Computation according to EN 50413, 26. BImSchV, ICNIRP and EU standards

Power supply lines – according to VDE 0848

Specifications
Magnetic field computation
Calculation of RMS and peak values and components
Time-dependent field components
Automatic computation of ground conductor currents
Slack span height by classification of segments
Frequency range 0 to 30 kHz
Geometric objects
Maximum 2,000,000 conductors
Maximum 100 power supply and overhead lines
Maximum 1,000 masts
Maximum 100 isolated masts
Maximum 200,000 buildings
Maximum 200,000 blocks
Computation types
Maximum 32,000 x 32,000 points
Computation along a straight line in space
Computation across an area in space
Z axis profile series
Dynamic interpolation of data points
Test according to Kirchhoff's law
Object editing
Clear, simple entry of geometric data
Move, rotate, and insert functions for geometric data
Reusable conductor sections
Poly-line elements, coils, etc.
Library with mast and railroad profiles
Data display
X, Y, Z axis diagrams
2D contour line diagrams
3D surface diagrams
Conductor representation
Statistics, histograms
Average, L05, L50, and L95 values
Zoom function
Support for power supply lines
Mast library
User defined masts
Automatic mast segmentation
Replacement of masts in lines
Editing of mast types in lines
System voltage or individual phase voltage
Entry of AL/St/CU conductors
Phase optimization
Conductor temperature taken into account

Integrated tools
Editor, calculator
Paint tool
DXF object filter
Computation of electric field
Up to 100,000 load segments
Ground effects
Gauss-Jordan or Sparse Matrix Inversion
Effects of masts and buildings
System requirements
500 MB RAM, HD 20 GB free space
WIN XP™ / WIN VISTA™ / WIN 7™
Performance
Maximum 3.000.000 points/sec (Pentium™, 3 GHz)
32-bit runtime version for external computation
Batch job available
Integrated data compression
User interface configuration
User defined colors
Supports True Color graphics
Data interface
Upload of terrain profiles
Import of experimentally determined data
Import of maps in DXF, PCX, JPEG, BMP and TIFF formats
DXF export of contour lines, shadings and geometric bodies
ASCII export (EXCEL™ readable format)
Export of 4D color surfaces
Export / import of dBase™ and Paradox™ files
Bitmap, WMF, JPG, html and CD export

ORDERING INFORMATION

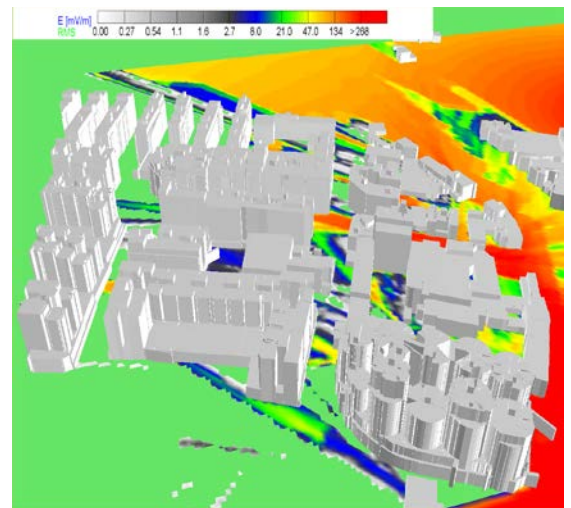
EFC-400 Simulation Software	
Model and article names	Order number P/N
EFC-400EP ENTERPRISE – includes all low frequency and high frequency modules (see separate data sheet)	2900/101/*
EFC-400LF LOW FREQUENCY – computes transformer station and high tension lines	2900/102/*
EFC-400ST STATION – LOW FREQUENCY – Limited to transformer station computation	2900/103/*
EFC-400PS PLUS SOUND – Version LF additionally with "corona" noise simulation	2900/104/*
EFC-400TC TELECOM – High frequency module	2900/105/*
(* Add suffix for language version: /E Spanish, /F French, /GE German, /I Italian, /UK English	/*
Annual update and upgrade on request only	2900/201 /202 /203 /204

EFC-400® – Telecommunications – Computation of electromagnetic fields

Computation according to:

- EN 50413, 26. BImSchV,
- IEC 62232, ICNIRP & EU standards

- ▲ The industry standard since 1995.
- ▲ Worldwide client references.
- ▲ Maximum strength performance from calculation speed, ease of use, and the practically unlimited number of building and antenna elements.
- ▲ Users: Network operators, local government environmental departments, engineering consultants, and regulatory authorities.
- ▲ Maximum cost-effectiveness in use, as users can create and import the necessary network elements themselves.
- ▲ Measurement data import and interpolation.
- ▲ All network elements are visibly displayed. Users can see the simulation results clearly just as they are computed.



Technical description

"EFC-400 Telecommunication" is the solution designed for computing the radiation exposure due to transmitting and telecommunications equipment emitting at high frequencies.

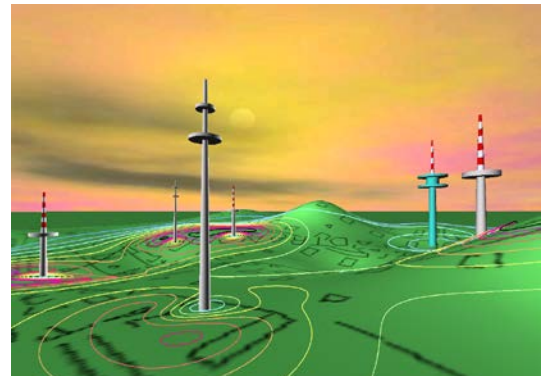
The main performance features are:

- E and H field, power flux density
- Radiation pattern based on antenna specifications
- Import of radiated beam diagrams (Kathrein, PowerWave)
- Attenuation due to buildings
- Plot as a percentage of the limit value
- Development of HF field registers

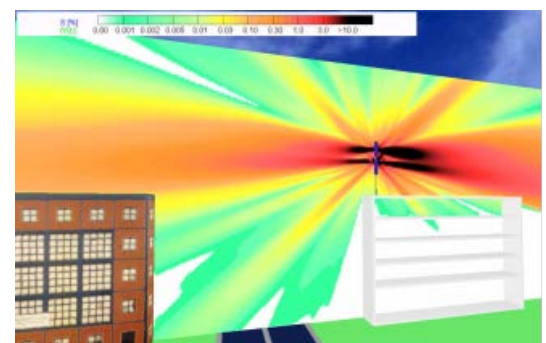
"EFC-400 Telecommunications" computes field strengths and power flux densities according to EN 50413, taking the directional characteristic into account by means of the normalized spherical harmonic.

The form of the spherical functions is determined numerically from the specifications such as the aperture angle, or is read in as a radiated beam diagram. "EFC-400 Telecommunication" normalizes the spherical harmonic by integrating it over the surface area as a function of the radial component. The radiation flux through every surface above the terrain from the near-field to the far-field is therefore constant assuming that the ground is conductive. Since energy conservation is presumed, the method is superior to other procedures for computing undistorted fields with respect to its speed and accuracy, and the influence of buildings can be taken into account by specifying an attenuation factor.

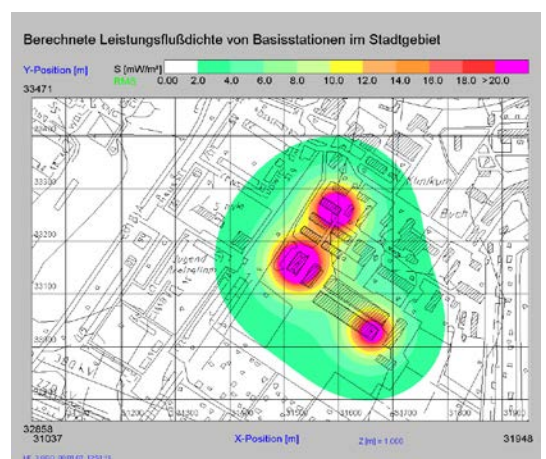
You only need to know the location of the antenna and the manufacturer's specifications for it. Since the locations are determined on the topographical map, it is possible to develop a field register straight away.



Power flux density of base stations



Mobile telecoms antenna on a building



Power flux density in an urban area

Computation of electric and magnetic fields

High frequency transmitters and telecommunications: EN 50413, IEC 62232, 26. BImSchV, ICNIRP and EU standards

Specifications
Magnetic field computation
3D computation of power flux density and field strength
Calculation of RMS and peak values
Harmonic angle data
Normalization by application of energy conservation set
Geometric segmentation
Frequency range 1 KHz to 300 GHz
Data display
X, Y, Z plot
2D contour line display
3D surface display
3D virtual reality interface
Radio transmitters taken into account
Statistics and histogram functions
Average value, L05, L50, L95 values
Zoom functions
Proportionality display
Object editing
Facilities for checking and entering geometric data
Move, rotate, and insert functions for geometric data
Grouping functions
Polygonal envelopes, circles, etc.
Radiation characteristics can be uploaded from manufacturers' libraries
Computation
Maximum 32,000 x 32,000 data points
Computation along a straight 3D line
Computation within the confined free space
Z axis field strength profile
Dynamic interpolation of data points
Geometric objects
Maximum 2,000,000 transmitter objects
Maximum 200,000 buildings
Maximum 2,000,000 geometric blocks
Integrated tools
Editor, Calculator
Project manager
Paint tool
Video wizard and Help function
DXF object filter
Data interface
Upload of terrain profiles
Import of experimentally determined data
Import of maps in DXF, PCX, JPEG, BMP and TIFF formats
DXF export of contour lines, shadings and geometric bodies
ASCII export and import / Excel text format
Creation of database reports and logs
Bitmap, WMF, JPG, HTML and CD export

Special computing features

- Use of antenna directional characteristic diagrams from data sheets
- Import of antenna directional characteristic diagrams (*.msi, *.txt)
- Interpolation of antenna directional characteristic diagrams
- Smoothing of of antenna directional characteristic diagrams via the side lobes
- Ground profile and vegetation taken into account
- Screening and reflections due to buildings taken into account

Performance features

- Maximum 3,000,000 points/second (with 3 GHz CPU)
- Data compression built-in
- User interface configuration
- User-defined settings for colors and contour lines
- Support for 256 colors and True Color graphics

Hardware requirements

- 500 MB RAM, HD 20 GB free space
- WINDOWS XP™ / WINDOWS VISTA™ / WINDOWS 7™

ORDERING INFORMATION

EFC-400 Simulation Software

Model and article names

	Order number P/N
EFC-400EP ENTERPRISE – includes all low frequency and high frequency modules (see separate data sheet)	2900/101/*
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