

Version
1.0.3

PRODUCT INFORMATION

Sitras Sidytrac Designer – Simulation of AC and DC traction power supply

siemens.com/rail-electrification

SIEMENS

Sitras Sidytrac Designer –
The simulation tool and its features

In the system design of railway electrification systems we combine the calculations of our simulation tool Sitras Sidytrac Designer with our extensive system know how.
By means of simulations with Sitras Sidytrac Designer the workflow is standardized and automated, sources of errors are reduced and the efficiency increased.

Features of the simulation tool

- Detailed design of new AC or DC traction systems with electrical dimensioning of substations and contact line systems:
  – Economical design of the entire system
  – Calculation of power reserves for further extensions
- Easy simulation and retrofit design of existing lines
- Detailed design of innovative electrical traction systems like eHighway
- Graphical user interface with visualization options for the railway network and components being designed
- Multi-train simulation with integrated electrical load flow calculation
- Short circuit calculation along defined line sections
- Induced voltage calculation in parallel conductors
- Magnetic field calculation along the line
- Highly automated comprehensive and customer-specific adaptable browser-enabled format of results in standardized tables and graphics for easy documentation
- Automatically processed predefined standard reports and special evaluations for e.g. induced voltages, magnetic fields, protection impedances, stray current, equivalent thermal loads, etc.
- Comprehensive possibility for variant calculations and results comparisons at a glance, e.g. variants of network switching states and feeding configurations, train schedules, fault conditions.



Benannte Stelle Interoperabilität Bahnsysteme
beim Eisenbahn-Bundesamt

EBC EISENBAHN-CERT
NOTIFIED BODY INTEROPERABILITY

Zertifikat

Certificate

Prüfbescheinigung gemäß der Europäischen Regelungen für Konformitätsbewertung (ERC)
Test certificate according to the European regulassessment (ERC)

EBC-ID 3519

Für das **Simulationsprogramm Sitras® Sidytrac® Designer**
For the **simulationstool Sitras® Sidytrac® Designer**

der Firma
of the company

Siemens Mobility GmbH
Otto-Hahn-Ring 6, 81739 Munich, Germany

wird durch die
is through the

Benannte Stelle Interoperabilität Bahnsysteme
beim Eisenbahn-Bundesamt – EISENBAHN-CERT
Heinemannstraße 6, D-53175 Bonn
- Kenn-Nummer der Europäischen Kommission: 0893 -

bestätigt, dass
die Validierung des Simulationsprogramms Sitras® Sidytrac® Designer
für alle DC- und AC-Energieversorgungssysteme den Anforderungen
der folgenden Norm entspricht:
approved, that the validation of the simulation Sitras® Sidytrac® Designer for all AC and DC voltage system meets the requirements of the following standard:

EN 50641:2020

Die Prüfung wurde nach Modul CB gemäß Beschluss der Kommission 2010/713/EU durchgeführt.
The test was carried out according to modul CB in accordance with Commission decision 2010/713/EU.

Die der Prüfung zugrunde liegenden Unterlagen sind der Anlage zu entnehmen.
The documents on which the test is basedcan be found in the appendix.

Dieses Zertifikat ist gültig bis 07.04.2027.
This certificate is alid until April 07th, 2027.

Bonn, den 08.04.2022

Systembereichsleiter
EISENBAHN-CERT

EISENBAHN-CERT EBC NOTIFIED BODY INTEROPERABILITY

Certification acc. to EN 50641

Areas of application – Design and calculation of traction power systems with Sitras Sidytrac Designer

With the help of Sitras Sidytrac Designer the system design and calculation of the complete traction power supply system is carried out.

Overall system design

- Simulated train operation and network calculation for AC and DC railways
- Simulation of innovative electrical traction systems like eHighway
- Optimization of feeding concepts
- Definition of substation locations
- Energy demand calculations for railway lines
- Calculation and assessment of contingency operation
- Current load of contact lines, cables, busbars, switchgears and transformers
- Calculation of line impedances, potentials and voltage along the line
- Assessment of controlled substations (inverter, double converter), energy storage units
- Calculation of current distribution of contact lines
- Dimensioning of rail active balancer Sitras RAB plus and mobile rail VAR compensator Sitras RVC plus.

Schedule

- Integration of real train operation
- Calculation of energy consumption for individual variants
- Speed restriction for various train types
- Integration of driving on sight, block system and signal points possible.

Safety of persons and protection of installations

- Calculation of rail potentials / touch voltages
- SCD positioning
- Assessment of stray currents for DC railways.

Protection design

- Short circuit calculations DC / AC railways
- Maximum operational currents of feeding sections
- Design parameters for relay coordination
- Contact line protection impedances
- Protection simulation for overcurrent and distance protection.

Power quality

- 3-phase unbalance because of single-phase railway loads
- 3-phase voltage fluctuation study
- Resonance behavior of railway lines.

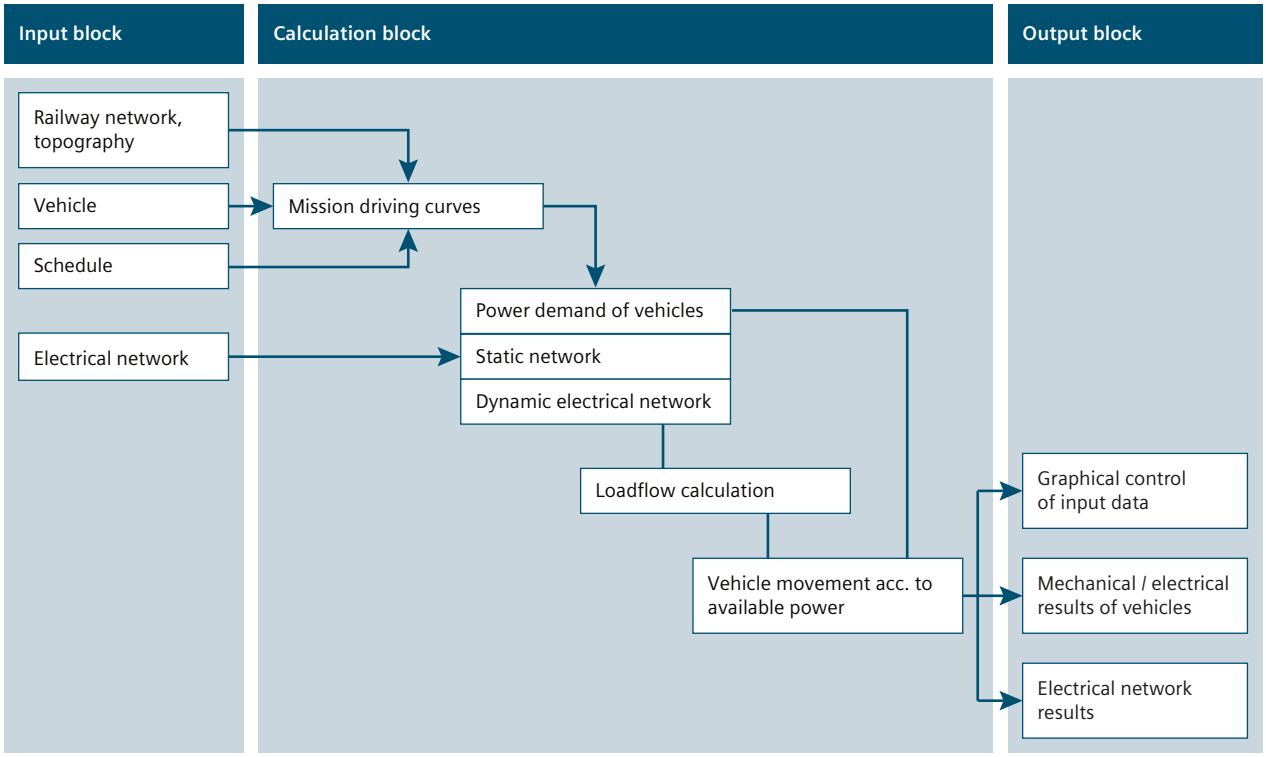
Interference, magnetic fields, electro-magnetic compatibility

- Studies and calculations of electric and magnetic fields of railway lines
- Calculation of psophometric interference in telecommunication cables, i. e. frequency analysis of the electro-magnetic interference
- Mutual interference between DC and AC railways
- Induced voltages in parallel conductors, e. g. cable screens and signal lines.

Program structure –
Overview

The program consists of

- an intuitive GUI for data input,
- an iterative load flow simulation process, considering both, the power demand of vehicles based on the train operation and the available traction power based on the load flow calculation
- and a descriptive visualization of the simulation results.



Licenses –
Three license models available

Sitras Sidytrac Designer is available in three license editions. All three editions include a set of basic functions, which cover individual use cases.

The modular structure of the license editions offers further package options for either DC or AC electric traction systems or both and allows optimal customizable solutions for individual needs.

Data input and modeling environment with graphical user interface **Sidytrac Studio**

The graphical user interface Sidytrac Studio features data input, modeling, configuration and control of the complete simulation process including configration of output and results processing.

Input Data

Railway network, topography

- Railway network with sections, tracks, stations
- Topography with chainage, gradients, curve radii, location and type of tunnels
- Speed profiles, current limitations
- Speed restrictions for various train types, current limits.

Vehicle data

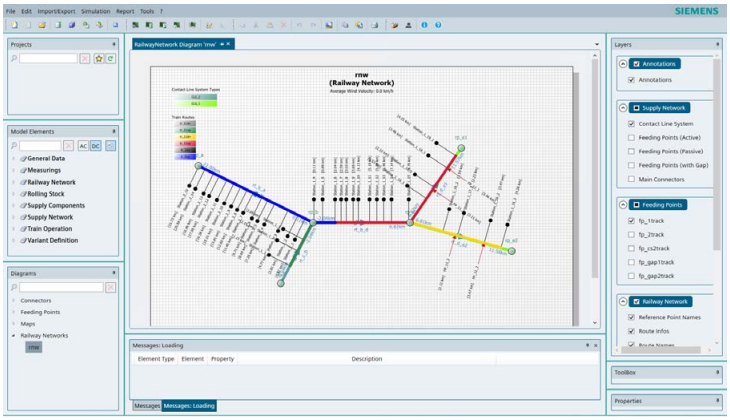
- Mass, maximum speed, acceleration, deceleration
- Efficiency, power factor, traction current limitations
- Traction and braking efforts, rolling resistances
- Auxiliaries, power consumption, onboard energy storages.

Schedule

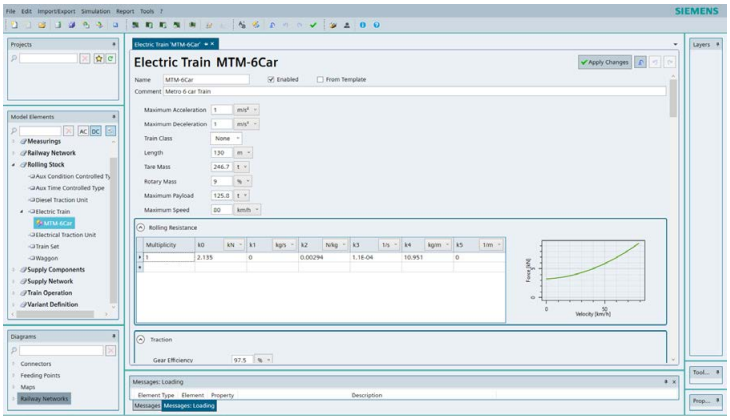
- Synchronized schedules, individual schedules
- Quasi-stochastic schedules.

Electrical network

- Network topology, feeding points and fault levels
- Substations, auto and booster transformers, rectifiers, inverters, energy storage units, reactive power compensation
- Switchgears, feeder conductors, resistors, reactors, capacitors, stationary consumers
- Contact line system (lumped impedance and multiconductor model).



Input railway network



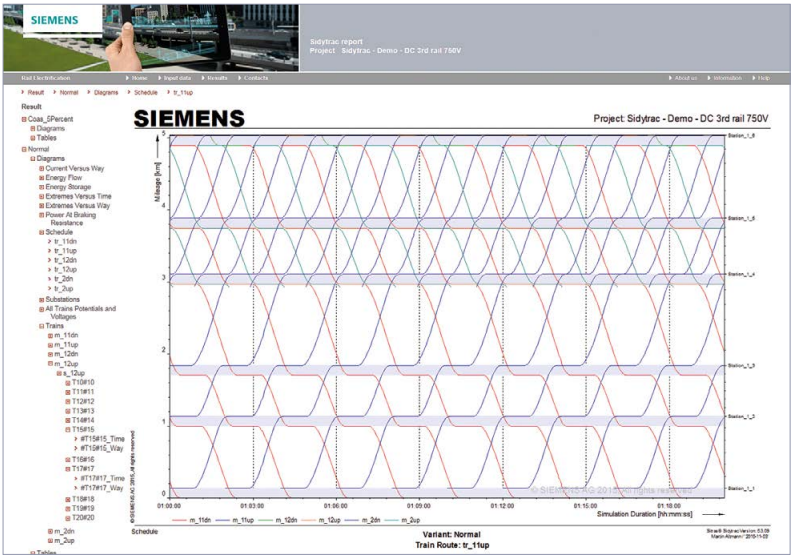
Input electric train

Calculation –
Multitrain simulation and load flow calculation

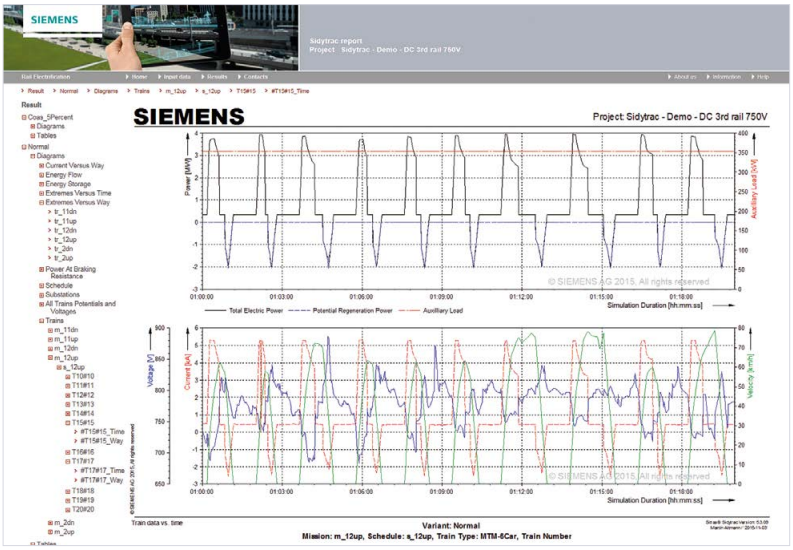
The calculation runs in the time step method, where two processes are carried out for each step.

First, the dynamic drive cycle calculation solves the kinematic equations, computes the operation of the trains in the network and determines the required propulsion power for the next time step. The train model accepts various train and motor data as well as the definition of different driving modes, such as all out running or coasting, so that a broad variety of electric traction systems can be modeled. Depending on various train run parameters, e.g. driving curves and state, topography, line side limitations, etc. the time step will automatically be reduced to increase the accuracy.

Next, the resulting electrical train loads are integrated into the static electrical network forming a common dynamic electrical network, with the trains representing time-dependent and movable power sinks and sources. For this common electrical network the electrical load flow is solved, i.e. the complex currents, voltages and available power for all nodes and branches of the network are determined at fundamental frequency.



Multitrain simulation: Schedule



Multitrain simulation: Power, train voltages and currents

The contact line system can either be modeled in sections with lumped impedance or with a multiconductor model considering full magnetic and capacitive coupling. Additionally Sidytrac features a customizable automatic pre-process for multiconductor to lumped model conversion, which allows a very fast, simplified calculation without the need for pre-calculation of the individual lumped impedances.

The load flow calculation is performed using the node potential method. For optimizing the calculation speed of large networks with many nodes advanced numerical solving methods are available, automatically adapting depending on the convergence of the iteration.

Thanks to this iterative method the interdependencies between the traction power supply performance and the requirements of electric traction are calculated most realistically, such as the effect on the running time of the individual trains, the actual regeneration power as well on the network and component loads.

Output and data processing – Data base and reporting

The simulation results and input data are stored and automatically processed in a database, which allows comfortable and advanced individual post processing.

Furthermore Sidytrac Designer offers a predefined browser-enabled report format. This Sidytrac Report comprises of manifold diagrams and tables for evaluation of the electrical key data of the individual simulation variants, as well of variant comparisons for currents, voltages, power and energy.
System analysis and energy optimization are ideally supported.

Output Data

Graphical control of input data

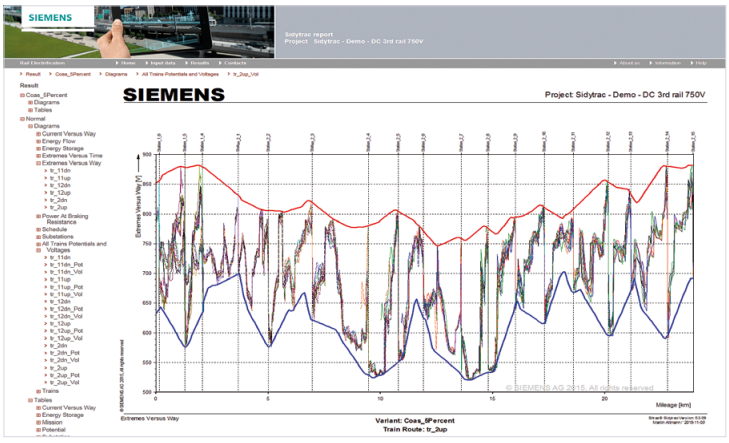
- Railway network, topography, electrical network topology
- Vehicle characteristics and limitations
- Graphical schedule, calculated.

Vehicle results

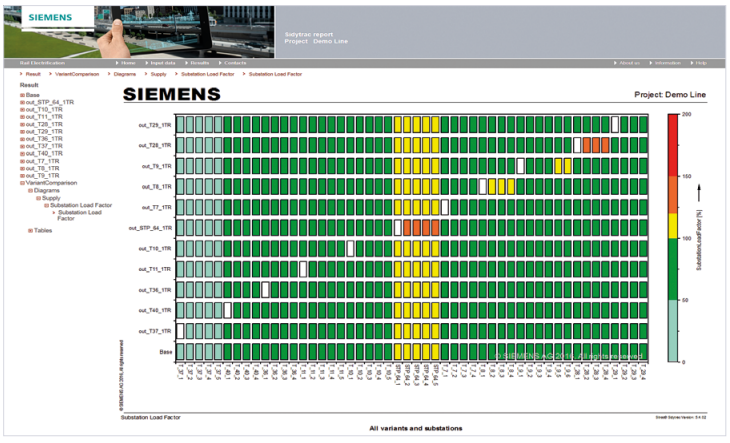
- Currents, Voltages
- Total power, recuperated power
- Traction power and energy, auxiliary demand, power at wheel, losses
- Power factor, efficiencies
- Position, speed, acceleration
- Traction effort, braking effort.

Electrical network results

- Conductor currents in network branches, supply voltages
- Power in the substations
- Power overview for individual variants
- Extreme values of train voltage, rail potential
- Total power, active power, losses
- Power factor, unbalance, flicker
- Energy balance
- Conductor currents along the line
- Short circuit currents
- Stray currents
- Induced voltages
- Impedance for protection relay settings
- Magnetic fields.



Output train voltages



Output variant comparison of substation power

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Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously main-tain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

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