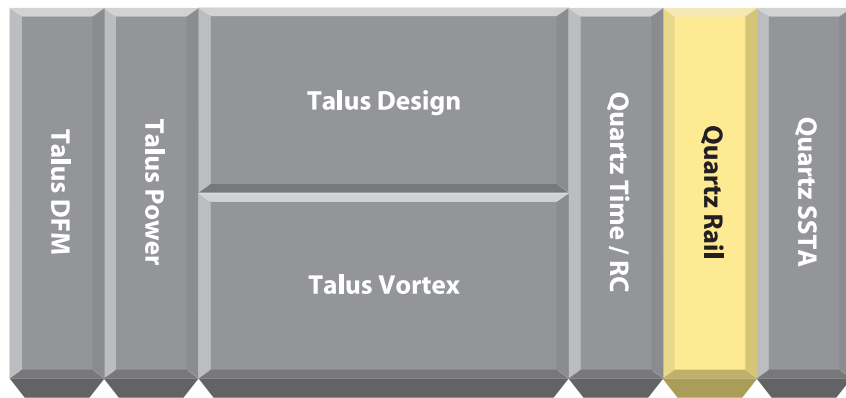


# Quartz™ Rail

- Complete methodology for power and rail analysis throughout the design flow minimizes power integrity problems and limits postlayout analysis and repair.
- Transient analysis accounts for sudden changes in power consumption by considering decoupling capacitors and package inductance.
- Embedded power analysis accounts for static, dynamic and short circuit power.
- Thermal analysis capability accounts for temperature impact on leakage power.
- Concurrent timing, IR-drop, power and thermal analysis minimize design iterations.
- Embedded characterization capability for switching-current waveform and intrinsic de-coupling capacitance increases accuracy.
- Accurate memory modeling enables full-chip, dynamic IR-drop analysis.
- Intelligent guidance for decap insertion based on transient analysis helps optimize leakage power and improve yield.
- GUI-based visualization and what-if analysis capabilities enable users to plan and define optimal power grid configurations.
- Accurate macromodeling and abstraction of intellectual property (IP) and soft macro blocks leverage Magma's unique GlassBox™ technology.
- Unified data model architecture provides increased speed and capacity along with instant access to analysis data that enables automatic correction
- Interfaces with industry-standard simulators and supports standard file formats including precharacterized power libraries.

Quartz Rail is a power sign-off solution for nanometer designs. With integrated power analysis and planning, voltage-drop analysis, voltage-drop-induced delay analysis and electromigration analysis on rail wires and vias, Quartz Rail enables designers to maintain power integrity in their designs. Quartz Rail is a standalone power integrity tool that can also be fully integrated with Magma's RTL-to-GDSII implementation flow for correct-by-construction rail design.



The increasing use of battery-powered portable electronic systems is driving the demand for digital integrated circuits (ICs) that consume the smallest possible amount of power. Implementing a reliable power network for large and complex SoCs with minimal power dissipation and without sacrificing performance is a major design challenge. As feature sizes shrink below 90 nanometers (nm), effects such as dynamic voltage (IR) drop and temperature become significant design considerations. These are also closely interdependent with timing and signal integrity (SI) issues such as crosstalk (both noise and delay).

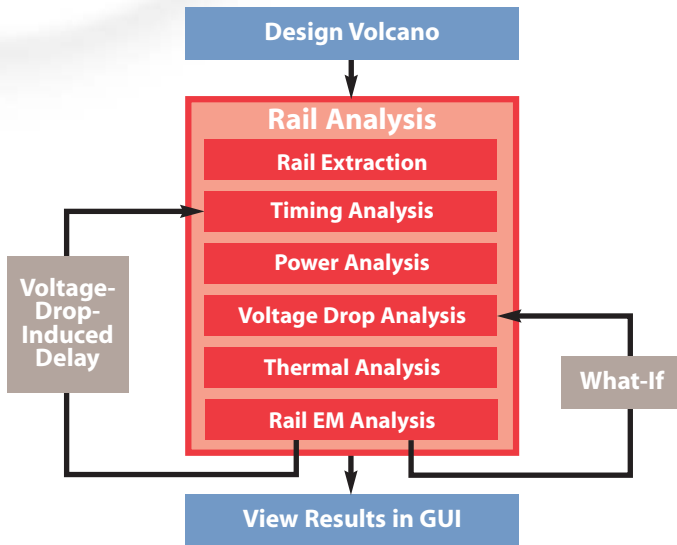
Conventional power and IR-drop analysis tools operate in different environments than implementation tools, often causing multiple and time-consuming design iterations after layout. Lack of accurate, in-context analysis capabilities can also lead to overdesign, which in turn can cause congestion problems and lead to suboptimal operation of the chip.

To deliver total design closure for area, power, timing and SI effects, a power integrity solution is required. Magma's Quartz Rail provides such a solution and can be integrated into Magma's RTL-to-GDSII implementation flow. It enables accurate analysis and management of power integrity throughout the design implementation flow, ensuring rapid convergence.

# Quartz™ Rail

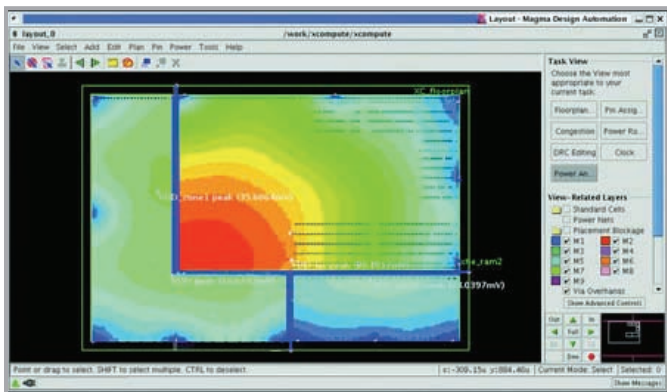
## Static and Dynamic Power Analysis

Quartz Rail provides complete static and dynamic power consumption analysis and visualization. This includes flexible specification of power data in the .lib file and switching activity specification using net-based switching factors or imported directly from switching activity files such as a VCD file.



## Transient Rail Analysis

Quartz Rail can perform transient rail analysis, where the circuit behavior is computed during a certain time interval, given any initial state and time-dependent stimuli during that interval. Transient analysis takes into account sudden changes in power consumption and overshoot and undershoot effects due to power surges. Transient analysis is performed by taking into consideration the on-chip resistive and capacitive effects. Package RLC information can be annotated to improve the accuracy



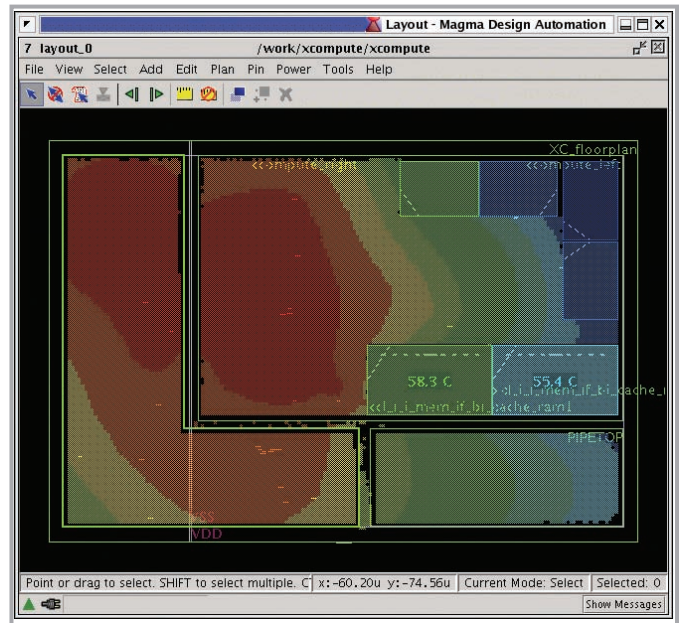
*Transient IR drop analysis enables intelligent decoupling capacitance insertion.*

of the transient analysis. Quartz Rail provides on-the-fly characterization to capture the switching-current waveform and intrinsic decap information using an embedded SPICE engine. This functionality significantly improves the accuracy of the dynamic IR-drop analysis.

Quartz Rail supports vector-free transient analysis, automatically deriving internal activities within the timing windows by running a Monte Carlo simulation based on boundary conditions and activity propagation. Quartz Rail supports domain-based power and IR-drop analysis for multi-Vdd designs.

## Embedded Thermal Analysis

Quartz Rail has built-in temperature analysis that accurately calculates temperature distribution on the die that results from the power dissipation of the gates and the heat conductivity of the substrate. Analyzing thermal effects is critical because it impacts device reliability, leakage current and switching performance. Quartz Rail can concurrently address timing, crosstalk, power, IR drop and thermal effects to minimize the number of design iterations



*Thermal map analysis accounts for temperature effects on leakage power.*

## GUI and Incremental Analysis

Quartz Rail provides various views for power and current density, as well as thermal and IR-drop maps. Designers can use the feedback from these maps to make necessary changes to the power grid and via structures, and ensure optimal power distribution.

Leveraging Magma's unified data model, Quartz Rail enables direct crossprobing of hot spots or IR drop from a power map or a report into the layout section causing the problems. This allows users to incrementally find and fix power and IR drop problems on the fly.

### **Abstraction and Macromodeling**

Quartz Rail includes advanced and accurate macro-modeling technology to model the rail networks that represent various design components such as IP and soft macro blocks. Models of the associated current and power characteristics are automatically extracted from the .lib file.

Quartz Rail also leverages Magma's powerful and unique GlassBox abstraction technology for modeling soft macros. This provides massive data reduction of up to 90 percent, enabling rapid analysis and convergence of large (more than 20 million gates) hierarchical designs.

### **Streamlined Rail Analysis Flow Enables Reliable and Rapid Convergence**

Quartz Rail includes built-in extraction capabilities for accurately extracting parasitic networks needed for static and dynamic IR-drop analysis. This forms a linear system of equations comprising current and voltage sources that can be accurately and quickly analyzed for IR-drop effects. Users can modify and analyze this network to locate floating nets or power pad pins, as well as query currents at various nodes on the network.

Quartz Rail is also tightly integrated with Talus™ Power to help minimize and optimize power throughout the design flow. Magma's unique architecture, based on a patented unified data model, allows various analysis engines to access design and analysis data from a single, in-memory representation. This allows designers to analyze the complex, interdependent effects of IR-drop, timing, temperature and power at any stage of the design, and empowers them to take the necessary steps to avoid these problems at an early stage. Quartz Rail is also a standalone product. It can be used in third-party flows to provide sign-off power and IR-drop analysis.

### **TECHNOLOGY FEATURES:**

#### **Accurate, Embedded Power Analysis**

- Static and dynamic analysis
- Easy, flexible setup from .lib file
- Switching activity setup on nets or from VCD, GAF files
- Multiple operating mode analysis
- Activity propagation

#### **Fast, Accurate Rail Analysis**

- Static, dynamic and transient IR-drop analysis
- Automatic rail extraction
- Accurate macromodeling of power network
- Embedded SPICE engine for higher accuracy
- Decoupling capacitance analysis and guidance for insertion

#### **Early Feasibility Analysis**

- What-if analysis to evaluate multiple power grids
- Analysis of partially placed designs
- Analysis of partial grids

#### **Electromigration**

- Average, peak and RMS current density limit analysis for layers and vias
- EM-based wire widening
- EM-based double via creation

#### **Voltage-Drop-Induced Delays**

- Instance-specific derating
- Static and transient incremental timing to ensure convergence

#### **Thermal Analysis**

- Analysis of substrate power generation and self-heating in the interconnects
- Helps accurately determine device reliability, leakage power and switching performance

#### **High Capacity, Hierarchical Analysis (> 20M gates)**

- GlassBox technology enables accurate abstraction and massive data reduction
- Support for IP using black boxes

#### **Visualization/Reporting**

- Detailed report on power consumption
- Detailed report on IR drop identifies problem nodes and locations
- GUI-based visualization of power (power, power density, current, current density)

MAGMA DESIGN AUTOMATION

# Quartz™ Rail



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