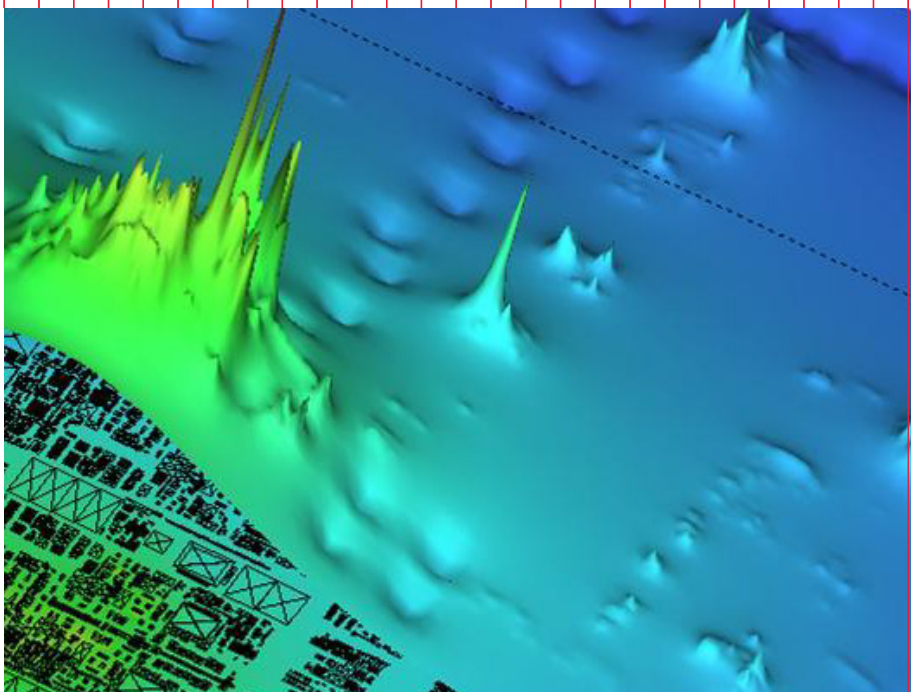
Keysight Technologies
HeatWave Electro-Thermal Simulator
Temperature-enabling your simulations

Data Sheet



What if you knew the temperature profile inside your chip–before tape out? High performance ICs have areas with very high power density, causing temperature to rise unevenly within the die. Smaller form factors make it harder to remove the heat.

HeatWave is a device-level electro-thermal simulator for ICs and stacked-die SiP. It is used by leading semiconductor vendors worldwide to improve their circuit performance and reliability. HeatWave is the only electro-thermal simulator that combines full-chip capacity with device-level resolution. It computes a 3-D temperature profile of your chip, and annotates the device temperatures into your circuit simulator, making it thermal-ly accurate.

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Benefits to IC Designers

- HeatWave enables your circuit simulator to show how temperature affects your circuit's performance, helping you to neutralize adverse temperature effects before committing to fabrication.
- By computing an accurate operational temperature profile within the IC, HeatWave reveals hotspots and excessive temperature variations in precision circuitry.
- HeatWave enhances your ability to detect reliability and wear out/lifetime issues, using accurate and realistic temperature data.

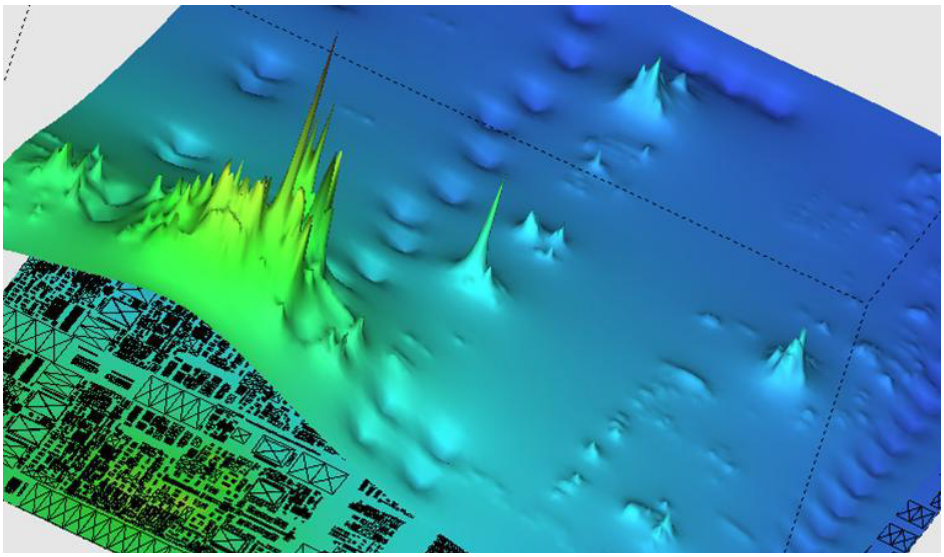


Figure 1. Temperature surface plot showing peaks, calculated from the actual power dissipated by each device, and temperature troughs, caused by heat conduction of the solder bumps.

Applications

- Thermally-Accurate Circuit Simulation
  HeatWave provides your circuit simulator with instance-specific temperatures that are computed using the full knowledge of the layout geometry, layer material properties, power dissipation, and package.
- Reliability and Lifetime Analysis
  Temperature is a strong driver of most IC failure mechanisms, such as electro-migration, NBTI/PBTI, TDDB, etc. HeatWave computes the actual temperature of each device and wire segment, to enable accurate reliability and failure rate estimates.
- Thermal Simulation with Incomplete Layout
  HeatWave can be used as a thermal floor-planning tool, to help avoid thermal hazards early in the design cycle. HeatWave can provide accurate thermal simulations of one or more defined regions on a chip, while only using layout and power abstractions for the remainder of the partially designed chip.

HeatWave Features

- HeatWave fits into the standard electronic design automation (EDA) ecosystem and makes use of existing IC design data, such as layout and power-source values & geometries. Its integration with the analog design flow automates device level computer aided design (CAD) data exchange, so that you can simulate the full chip temperature, without laborious data preparation.
- The output includes a full-chip temperature profile at the resolution of the IC layout feature sizes, provided as a graphically viewable 3-D database, and a temperature annotated netlist for circuit simulation. This gives you thermally-aware circuit simulation which shows the impact of temperature on your circuit performance and reliability.
- HeatWave provides commands to automatically monitor temperature values and variations, to help you detect thermal hazards for your design.
- HeatWave can be run in interactive graphical user interface (GUI) mode, enabling you to navigate in 3 dimensions throughout the chip and to visually inspect the temperatures on devices, metal layers, and other design objects.
- HeatWave can also be run from a script, enabling integration of results into other analysis tools.

Inputs

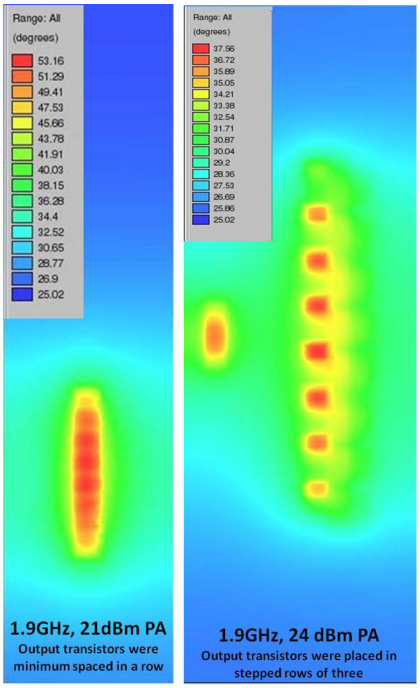
- Design layouts
- Package data
- Power sources
- Technology file

Outputs

- Temperature-aware circuit simulation results and a temperature-annotated netlist.
- List of converged temperatures and power values of all power-sources.
- Temperature profile saved as an archive, viewable as surface (2-D) and volume (3-D) plots.

Product Versions:

- Heatwave: Transient and steady state thermal analysis
- HeatWaveSS Analog: Steady state thermal analysis for analog designers
- Available on 64 bit Linux



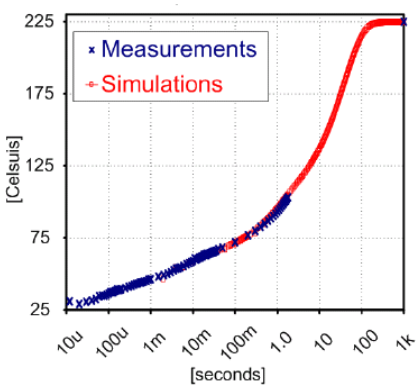


Figure 2. Max. temperature in a 50V N-type vertical DMOS driver transistor. Measured and simulated thermal impulse response. Note the last data-point measured separately at 1000 s.

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