# Temperature-Aware Design with SYMMIC™
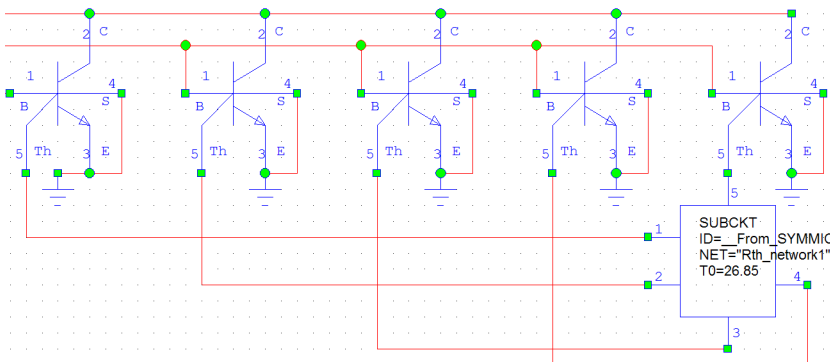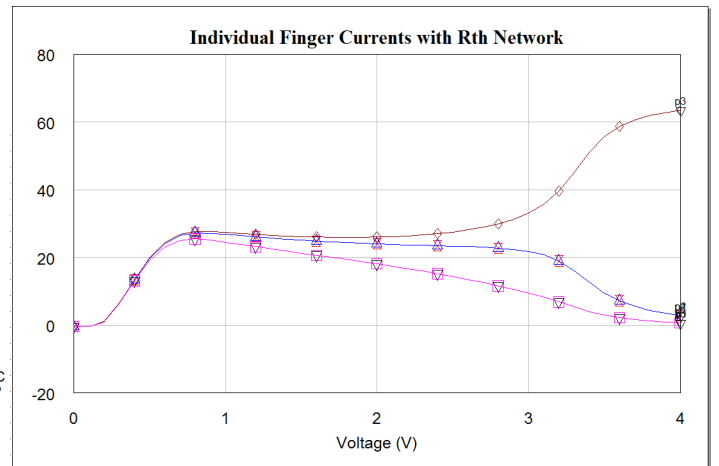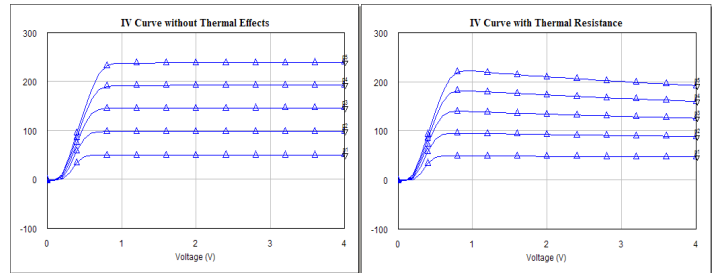
FEATURES AT A GLANCE

➢ SYMMIC is Microsoft Windows desktop software for design-stage thermal analysis

➢ SYMMIC eliminates defining meshes, setting up boundary conditions, and drawing part geometries

➢ Optimized 3D thermal models are automatically generated from parameterized templates

➢ Templates can be rapidly configured to match a large number of device geometries by changing parameters through the graphical user interface

➢ Multiple templates may be placed in a layout to create a thermal model of an entire MMIC, multiple MMICs mounted on a module, and multiple modules mounted on printed circuit boards or other subsystems

➢ Thermal analysis may be performed at every design stage, from the active device to the subsystem

➢ Proprietary computational algorithms ensure accurate calculation of junction temperature at every stage

➢ SYMMIC extracts from the 3D finite element model an equivalent RC thermal network that can be integrated into electrical simulations

Current collapse in HBT investigated with SYMMIC™ and Microwave Office™
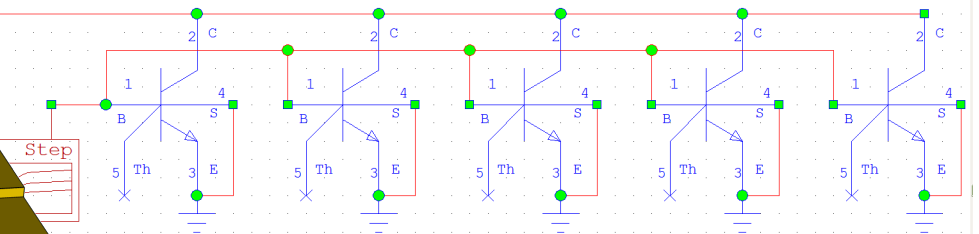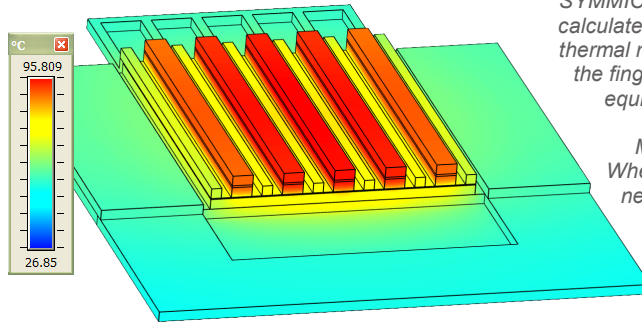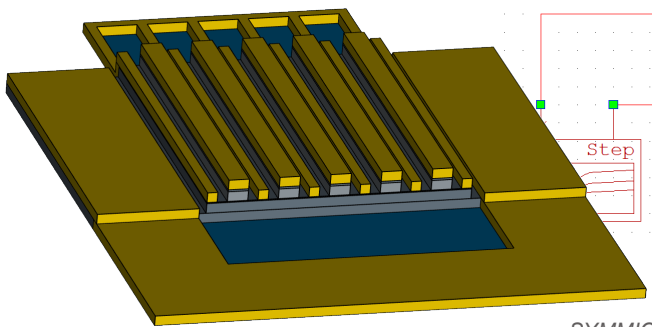
SYMMIC thermal analysis calculates the unbalanced thermal resistances within the fingers, supplying an equivalent resistance circuit for use in Microwave Office. When this resistance network is attached to thermal ports of the finger HBTs, one finger takes all of the current.

IV Curve without Thermal Effects

IV Curve with Thermal Resistance

Individual Finger Currents with Rth Network

SYMMIC™ thermal analysis integrates with Microwave Office™ to provide a complete electro-thermal analysis solution.

AWR Connected for CapeSym's SYMMIC is a unidirectional interface flow targeted at Monolithic Microwave Integrated Circuit (MMIC) designers. Scripts running in Microwave Office® export layouts to the SYMMIC software package for thermal analysis, and then import temperatures into the design.

Together, Microwave Office & SYMMIC provide MMIC designers with the ability to obtain optimal electrical performance with proper consideration given to thermal operating properties – resulting in more robust and reliable next-generation high-power amplifier designs.

SYMMIC and Microwave Office can interact in different ways to accommodate a variety of transistor models.

Non-Parametric Transistor Models

• For transistor models without temperature dependence, Microwave Office scripts export the device layout and dissipated powers to SYMMIC for both constant power (CW) and transient thermal analyses.

Transistor Models with Temperature Parameters

• Exporting the device layout and dissipated powers from Microwave Office lays a foundation for iterative electro-thermal analysis using SYMMIC in CW applications.

• SYMMIC can export device temperatures or thermal resistances back to Microwave Office.

• The thermal resistance model generated by SYMMIC can be incorporated into a circuit schematic as an equation for electro-thermal analysis in Microwave Office.

• Due to the temperature-dependent thermal properties of most semiconductors, increased accuracy can be realized by having Microwave Office run SYMMIC to update device temperatures after each iteration of the electrical simulation.
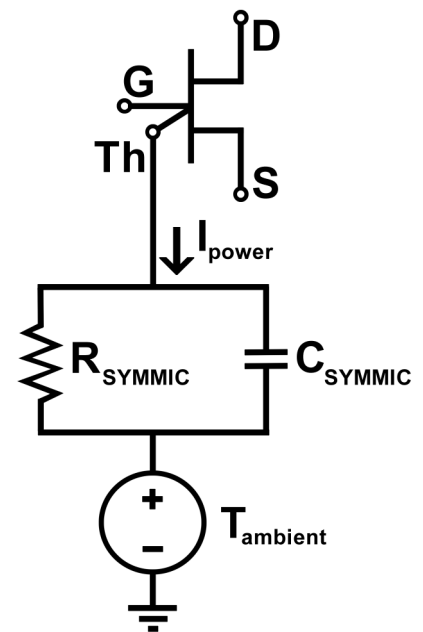
Transistor Models with Thermal Ports

• If the transistor model has a thermal port for attaching a thermal RC network, both CW and transient electro-thermal analyses are easily performed.

• The scripted equation generated by SYMMIC can be used to apply temperatures to the thermal port for an iterative CW electro-thermal analysis, if desired.

• SYMMIC can also export thermal impedances back to Microwave Office as a netlist circuit description.

• The thermal impedance network generated by SYMMIC includes thermal resistances and capacitances to accurately model dynamic coupling between devices in a MMIC at a particular operating point.

• When the thermal impedance network is attached to the thermal ports of the transistors in a MMIC, an accurate transient electro-thermal analysis is produced by Microwave Office's APLAC® transient simulator.

Contact us for a test drive
of the Microwave Office + SYMMIC integrated product.