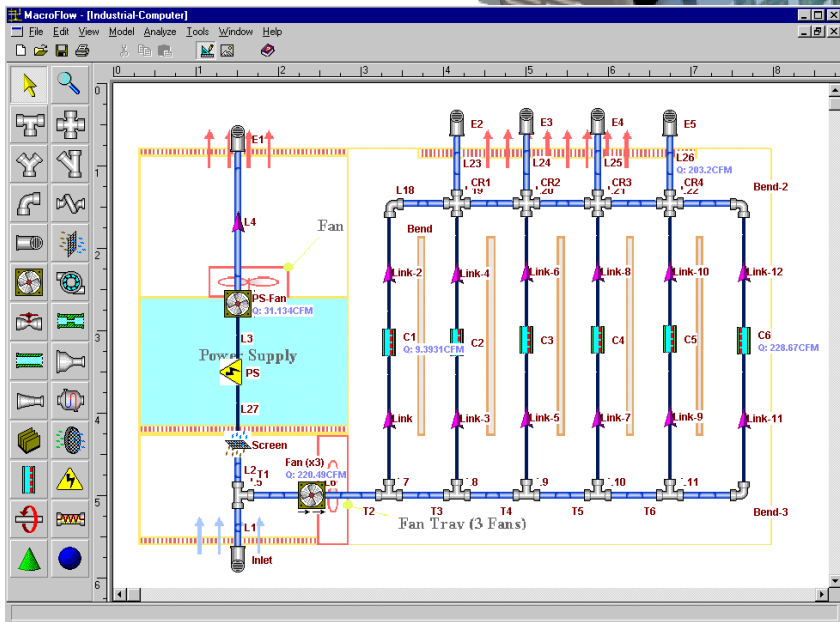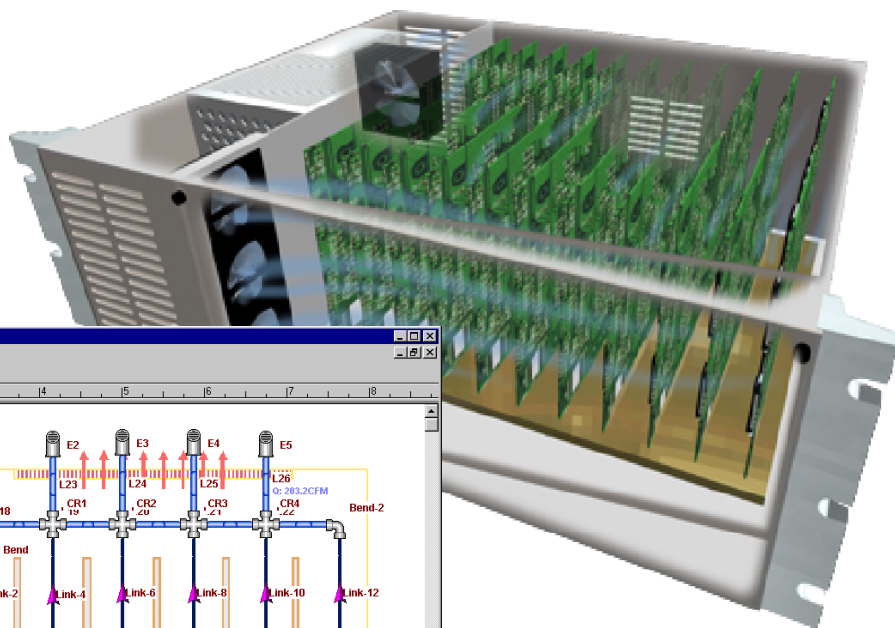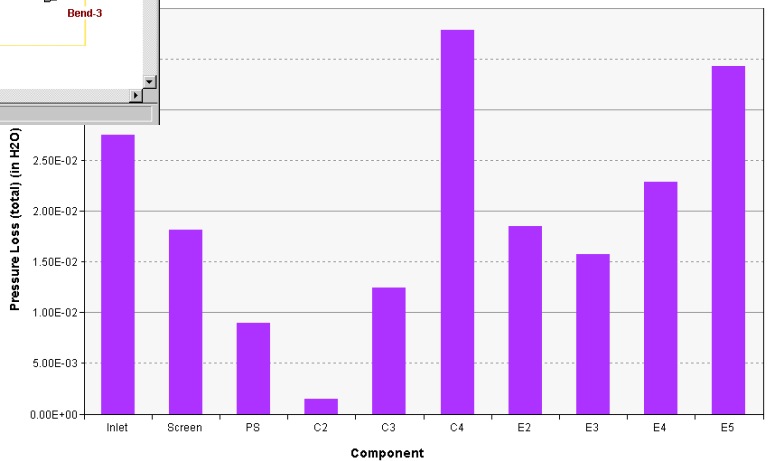# MacroFlow™

A Software Tool for Rapid Thermal Design of Electronics Cooling Systems

Pressure Loss Across Various Components in an Industrial Computer
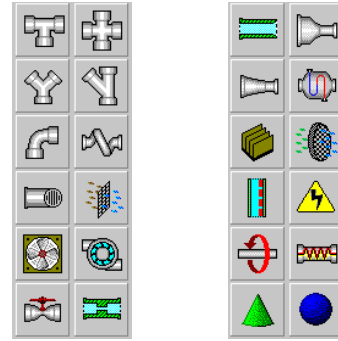
MacroFlow™

A Software Tool for Rapid Thermal Design of Electronics Cooling Systems

Addressing the Need for Fast Analysis

MacroFlow™ fills the gap between quick but limited spreadsheet calculations and detailed but time-consuming CFD analysis. It uses the technique of Flow Network Modeling (FNM) for a fast and accurate analysis of flow and temperature distributions in electronics systems.

With an easy-to-use interface, a comprehensive and customizable component library, and an efficient solution algorithm, MacroFlow™ provides a convenient, fast, and accurate tool for system-level thermal design. Hundreds of design options can be evaluated very quickly to select a few good designs early in the design process, shorten the design cycle, and reduce time to market.

Easy Construction of Network Models

The Graphical User Interface of MacroFlow™ facilitates quick setup of network models of practical electronics systems.

- Easy-to-use GUI allows construction of flow networks using components and links in an intuitive manner.

- Component characteristics are specified through meaningful dialogs.

- Productivity features such as Units Stencil and Global Editing make network construction quick and simple.

Extensive Component Library

MacroFlow™ provides an extensive and customizable library of components for analysis of practical air- and liquid-cooled electronics systems.

- Standard components such as Duct, Area Change, and Orifice allow representation of geometries of flow paths.

- Electronics cooling components such as Heat Sink, Filter, Fan/Pump, and Card Passage allow accurate representation of special aspects of electronics cooling systems.

- User-defined flow and heat transfer characteristics can be specified in various functional forms and stored in customized databases for subsequent reuse.

Quick and Robust Solution

MacroFlow™ incorporates a robust and efficient technique for the solution of the network equations for flow rate, pressure, and temperature. Even complex networks can be solved within a few seconds on a PC.
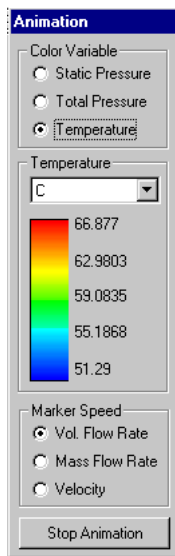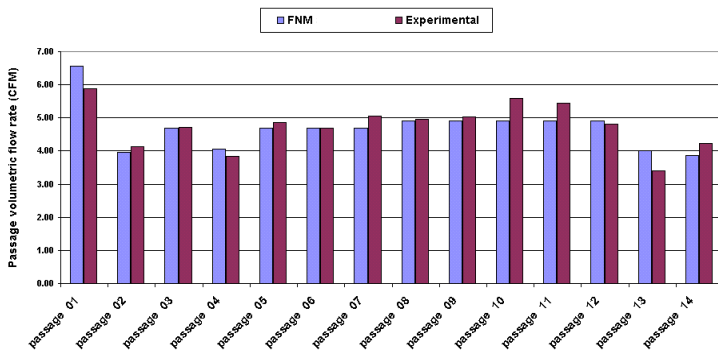

Component palette
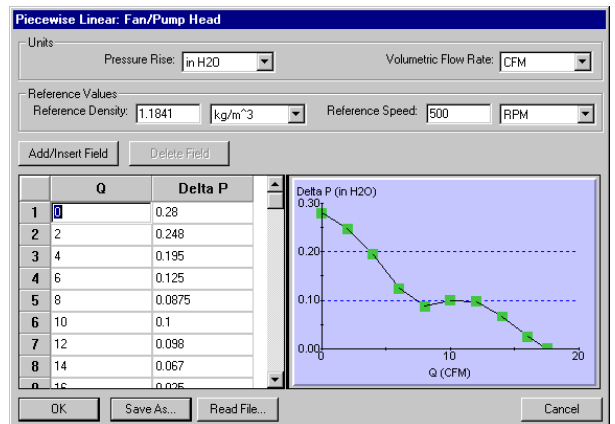
Dialog for fan head characteristics
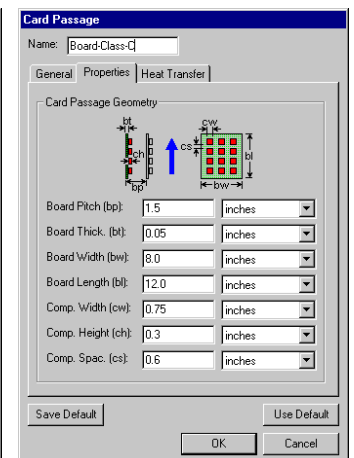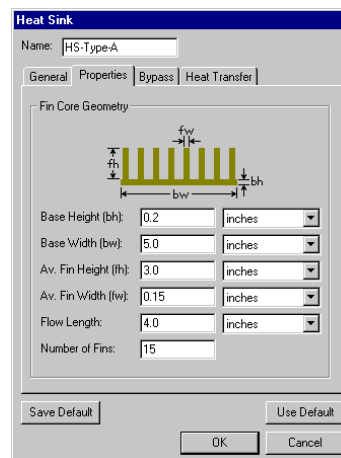
Dialogs for heat sink and card passage components

Volumetric Flow Rate Through Card Passages of a Telecom Cabinet
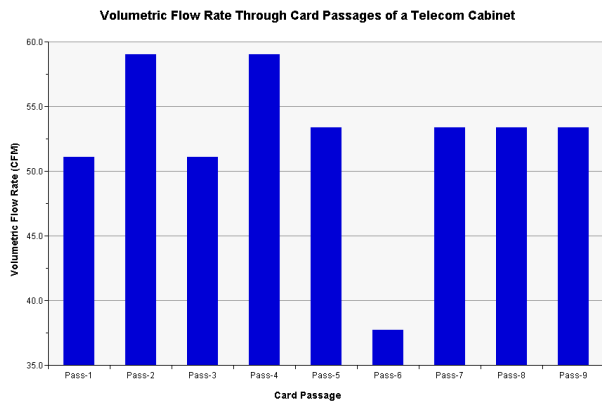
Bar chart showing the variation of volumetric flow rate

Dialog for flow animation

Comparison of predicted and measured flow rates

Comprehensive Postprocessing

Results for the flow and temperature distributions can be examined in the following manner:

- Bar charts for a comparative examination of the performance of various components
- Tabular output of calculated quantities with easy exporting to spreadsheets
- Display of results on the network model
- Animation of the flow using color-coded moving balls

A Well-Validated Product

MacroFlow^{TM} has been extensively validated using measurements on actual electronics systems as well as detailed CFD analysis. The calculated flow and temperature distributions obtained from MacroFlow^{TM} are typically within 10% of the measurements. Thus, MacroFlow^{TM} represents a reliable predictive tool.

A Variety of Applications

MacroFlow^{TM} is useful for the analysis of open and closed, air- and liquid-cooled systems. It is being widely used for the design of cooling systems in the following applications:

- PCs, Servers, and Supercomputers
- Indoor and Outdoor Telecom Cabinets
- Power Electronics and Avionics
- Peripherals such as Projection and Storage Equipment
- Semiconductor Processing and Test Equipment

Productivity Gains in Thermal Design

The ease-of-use, the speed of calculation, and the accuracy of results make MacroFlow^{TM} a powerful tool for Conceptual and System-Level design. Its benefits include the following:

- Quick identification of performance-limiting components
- Exploration of many design options in a rapid manner
- Accurate sizing of fans, screens, heat sinks, and filters
- Evaluation of "what-if" scenarios
- Complementary use with focused CFD analysis

Use of MacroFlow^{TM} early in the design process leads to a significantly shortened design cycle and an improved quality of the final product.

MacroFlow™

Summary of Features and Benefits

Graphical User Interface

- Intuitive network construction
- Comprehensive component library
- User-definable component characteristics
- Customizable database for subsequent reuse
- Flexibility in unit specification
- Drawing bitmap as wallpaper

Computational Engine

- Direct solution technique for robust and efficient solution
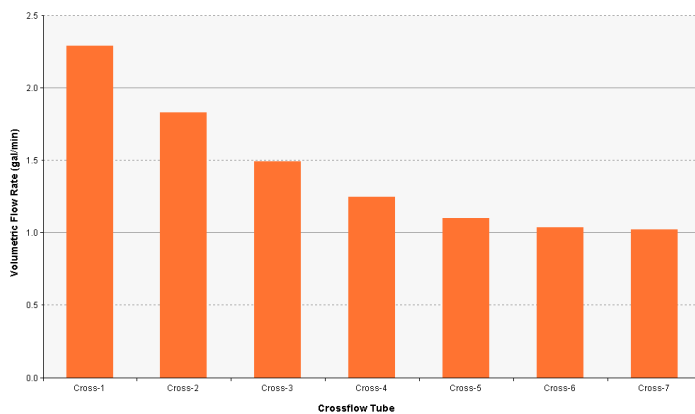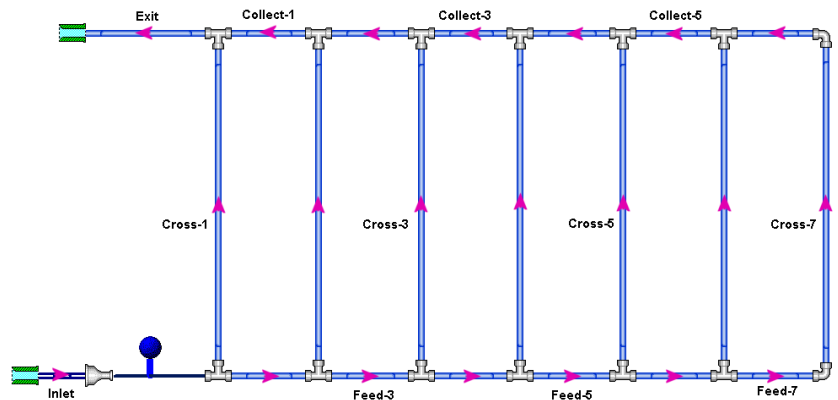
Presentation of Results

- Bar charts for comparisons
- Tabular output of numerical data
- Convenient display on network
- Animation of flow patterns

Engineering Benefits

- Analysis of many design options
- Identification of performance-limiting components
- Sizing of fans, screens, heat sinks
- Evaluation of failure scenarios
- Improved productivity and better product quality
- Reduced risk of late design changes
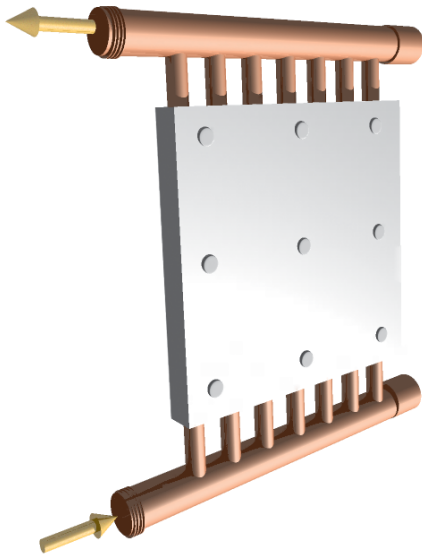
Volumetric Flow Rate in the Crossflow Tubes of a Cold Plate