

# NASA TECH BRIEF

## *Manned Spacecraft Center*



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### Chrysler Improved Numerical Differencing Analyzer for Third Generation Computers CINDA-3G

#### The problem:

To develop a new and versatile method to supplement or replace use of the original CINDA thermal analyzer program in order to take advantage of the improved systems software and the machine speeds of third generation computers.

#### The solution:

CINDA-3G, developed for third generation computers, is virtually identical to the original CINDA, but it has been almost completely rewritten to take advantage of the improved systems software and third generation computers.

#### How it's done:

CINDA-3G provides a complete update to handle the job. Whereas CINDA was virtually a self-contained program having its own Update, Monitor, and Compiler, the CINDA-3G foundation consists of a preprocessor which accepts the same user input data and converts it to advanced FORTRAN subroutines and block data input which is then passed on to the system FORTRAN Compiler. While this requires a double pass on data where previously only one was required, the increased speed and improved software of the 3rd generation machines more than compensate.

The CINDA-3G program options offer the user a variety of methods for solution of thermal analog models presented to it in a network format. The network representation of the thermal problem is unique in that it has a one-to-one correspondence to both the physical model and the mathematical model. This analogy enables engineers to quickly construct mathematical models of complex thermophysical problems and prepare them for program input. In addition, the program contains numerous subroutines for handling interrelated complex phenomena such as sublimation, diffuse radiation within enclosures, and simultaneous

1-D incompressible fluid flow, including valving and transport delay effects. The optional combination of these capabilities in conjunction with the model size allowable (greater than 4000 nodes for a linear 3-D system on 65 K core) makes CINDA-3G an extremely potent analytical tool for thermal systems analysis.

The program is virtually identical to its predecessor (CINDA) which was a dimensionless multi-option systems compiler program. It constructs and analyzes a mathematical model of any one, two, or three dimensional, lumped parameter representation of a physical system governed by a set of diffusion equations; e.g., the Fourier equation with an additional source term. To utilize the program, a user must construct a thermal analog network representation of the physical system, uniquely number all of the elements, and input the information in the required format. Nonlinear material properties and boundary conditions may be calculated simultaneously as a function of one or more independent variables. Nonlinear transfer functions may be treated as effective nonlinear transfer properties and handled in the above manner.

#### Notes:

1. The program is written in FORTRAN V and SLEUTH II assembly language for use on the UNIVAC 1108 computer.
2. This program is an update of and ultimately replaces the original CINDA program, Tech Brief Number 67-10278.
3. Inquiries concerning this innovation may be directed to:

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(continued overleaf)

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