DESK-TOP COMPUTING POWER FOR THE DESIGNER

Hewlett-Packard offers a broad line of calculating equipment and software packages for the electrical designer. Hand calculations, time consuming coding and card punching, and big computer problems are things of the past. Today you can solve your design problems on an easy-to-use desk-top calculator without compromising accuracy and capability.

For those circuit designs where you want to verify hardware performance prior to committing to expensive prototype fabrication (without getting tangled up on breadboard debugging and testing), you have the less expensive alternative of verifying network results at your desk. And for designs where you may want to alter component values, you will find the HP plotter a great convenience. With it, you can actually see the effects on circuit performance as you alter values. For example, you can change the capacitor value in the feedback loop of an op-amp circuit and watch phase and gain change with frequency variations.

THE HP 9815

The HP 9815 gives you power and flexibility at an economical price. The built-in, high-speed data cartridge provides fast storage and retrieval of data. The 16-character, alphanumeric thermal printer gives you quiet, readable results at 2.8 lines per second.

The 9815's simplified programming language, along with its powerful editing features, permits you to dedicate it to exactly the calculations you need. In addition, an extensive software offering is available from HP.

9815 ELECTRICAL ENGINEERING SOFTWARE

The HP 9815 Electrical Engineering, Vol. 1, Software Package (HP Part Number 09815-12500) contains eleven programs:

1. Circuit Network Analysis Program (CNAP)
2. Active Filter Design with Plot
3. Active Filter Design with Cascaded Sections
4. Band Pass Filter Design
5. Attenuator Network Design
6. Transfer Function Analysis
7. Quine-McClusky Minimization
8. S-, Z-, Y-, H-Parameter Conversion
9. Combining Two-Ports
10. Two-Port Configuration Conversion
11. S-Parameter Impedance Base Conversion

This software package requires an expanded memory 9815 (2025 steps) and optionally uses a HP 9862 Plotter.

CNAP for Analog Circuit Analysis

The Circuit Network Analysis Program (CNAP) was patterned after the well known ECAP circuit analysis program written by IBM. Features of CNAP are:

- Up to 6 nodes and 21 components can be analyzed concurrently.
- Components allowed are resistors, capacitors, inductors, and voltage controlled current sources.
- The precision and dynamic range of the 9815 make it possible to transform other active elements, such as op-amps, into the required form.
- Data input is simplified: all that is required is the specification of element values and node interconnections.
- Analysis is available in the swept frequency mode with either log or linear sweep.
- For each frequency, the magnitude of the output voltage (in dB) and the phase may be printed and/or plotted (Figure 1).

Faster Filter Design

If you need more capability in designing active or passive filters, three programs are available for the synthesis and analysis of modern network filters.

The first filter program designs either a low pass, high pass, or band pass filter. Some features include:

- Butterworth response.
- Calculation of component values, given a 3 dB frequency specification.
- Automatic drawing of circuit schematic with the plotter.

The second program will also design a Butterworth filter, but against a different set of specifications. The input information required by the user is:

- Cutoff frequency (3 dB point).
- Discrimination frequency and attenuation.

The output data consists of a listing of calculated component values, the order of the filter, and the complex poles.

The third program eliminates manual calculations from the classical passive network synthesis. Given the center frequency, terminal impedance, 3 dB bandwidth, pass band ripple, and low pass prototype order (number of poles), this program calculates the element values for a band pass filter with Butterworth, Tchebycheff, or user-defined response. The plotter then prints a schematic of the synthesized circuit. From this information, you can proceed directly to a breadboard verification with all network values neatly documented in printed format.

Transfer Function Design

The commonly used block-diagram approach to the analysis and synthesis of control systems, active filters, or analog computer circuits involves the determination of the overall transfer characteristics. If you need to design from the S domain into realizable circuit elements, try our solution with short-circuit transfer impedance functions. If you can express your system or circuit by

$$H(s) = \frac{Z_f(s)}{Z_i(s)}$$

where Z_f and Z_i are short-circuit transfer impedance functions, then this software will assist you in getting the right design solutions faster, with less pencil work.

This program allows you to determine either the circuit component values from a short-circuit transfer impedance function or

Circuit Design and Network Analysis on the HP 9815

HEWLETT hp PACKARD

the values for the transfer function from an actual circuit. Fifteen transfer functions are available via the program. The short-circuit transfer impedance functions are expressed in both the time constant form and the pole-zero form for your convenience. There are 39 unique circuit configurations that are realizable from the transfer functions. In some cases, more than one circuit is available for a particular transfer function. That's flexibility.

Logic Minimization

The logic design software contains a logic minimization program capable of handling problems with up to 6 variables. Using the Quine-McClusky technique, the program first requires all the P-terms as input data. The program then finds the prime implicants by a matching process and finally chooses from the prime implicants to form the minimized function.

You no longer need to depend on lengthy annotation techniques and guesswork to get all the redundant gates out of your design. Using this program, you can assure minimum hardware design costs with a few keyboard strokes. A 6-variable expression was minimized in less than 5 minutes with the 9815; the output is shown in Figure 2.

Microwave Design

Combining Two Ports

This program allows you to analyze a complex network by combining components and other two-port networks into one equivalent two-port configuration.

The elements of the network may be lumped constant components or devices whose S-parameters are known.

S-, Z-, Y-, H-Parameter Conversion

Are you more familiar with, say, Y-parameters than S-parameters? No problem. Your Y-parameters can be converted to equivalent S-parameters for program inputs, and S-parameter outputs can be converted back to Y-parameters.

With this program, conversions can be made from a given parameter set (S, F, Y, H) to any or all of the three remaining sets of two-port parameters.

Two-Port Configuration Conversion

This program converts two-port S-parameters for any transistor configuration (common emitter, common base, common collector) to two-port S-parameters for either or both of the remaining configurations.

S-Parameter Impedance Base Conversion

This program converts S-parameters measured with a given characteristic impedance (typically 50 ohms) to generalized S-parameters referred to arbitrary generator and load impedances.

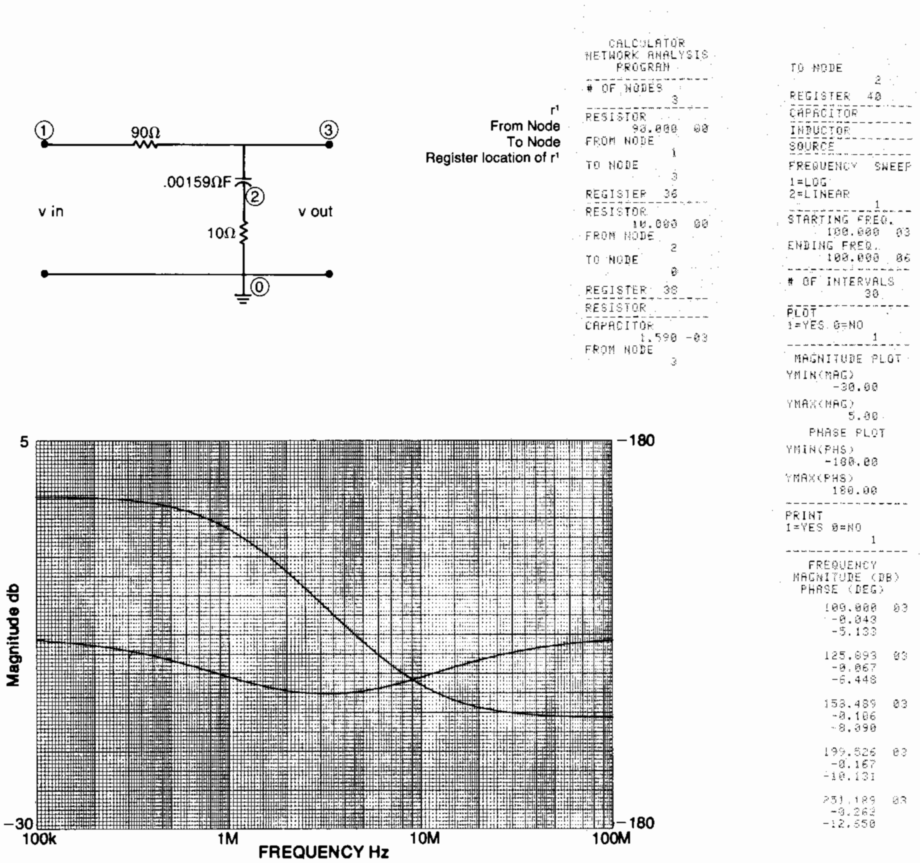

Figure 1. CNAP Analysis of RC Network

CAD — THE TIME SAVER

If your design problem is too troublesome for manual analysis, but does not warrant the time and expense of a computer, try the HP Calculator-Aided Design solution. It can save you time and money and give you hands-on accessibility and accurate answers in a few minutes. HP can help you take the drudgery out of your work and give you more design time.

The 9815 Electrical Engineering, Vol. 1, Software Package can be ordered through your local HP sales office. Ask for the following Part Number: 09815-12500.

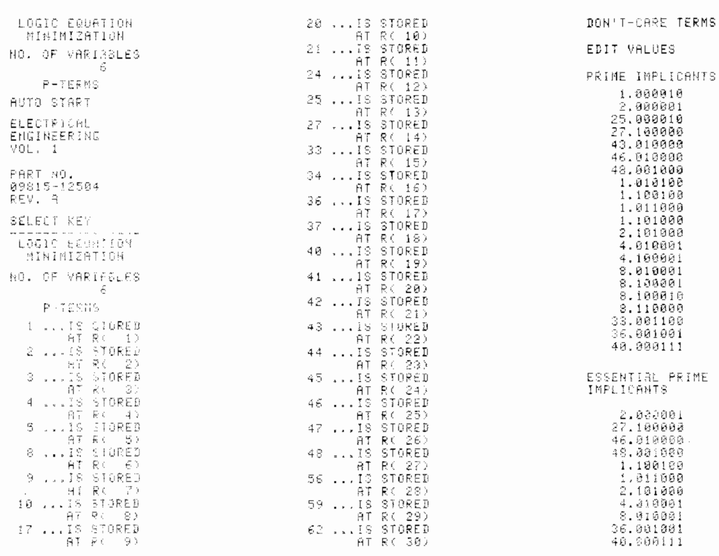

Figure 2. Quine — McClusky Minimization.

Printed in U.S.A.
(11/75) 10M

5952-9020 (40)