

# BABEL

A computer program  
to interface with  
the HP 8510  
network analyzer,  
to collect data  
to make calculations &  
to plot data

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## **Section I – Babel Documentation**

### **What is it?**

Babel is a program which enables IBM PC's and PC clones to communicate with the HP 8510 network analyzer. Babel collects data from the HP 8510 and writes it in an organized output file. The data can be converted to magnitude - phase (the HP 8510 communicates data only in real - imaginary pairs), with magnitude in either linear or decibel form. The user may also use Babel to calculate radiation loss or normalized load impedance. Babel performs many other small tasks, all of which aid in using the HP 8510 network analyzer and the 1-port or 2-port data it measures.

Babel was written and compiled with Microsoft QuickBasic version 4.5.

### **Convention used in this documentation:**

<key>        The greater-than and less-than brackets signify a key (on the keyboard) pushed.

### **How to use the program:**

Babel is a menu-driven program. Thus, to use the program, input the number of the choice on the list (menu) shown and hit <enter> at the menu prompts.

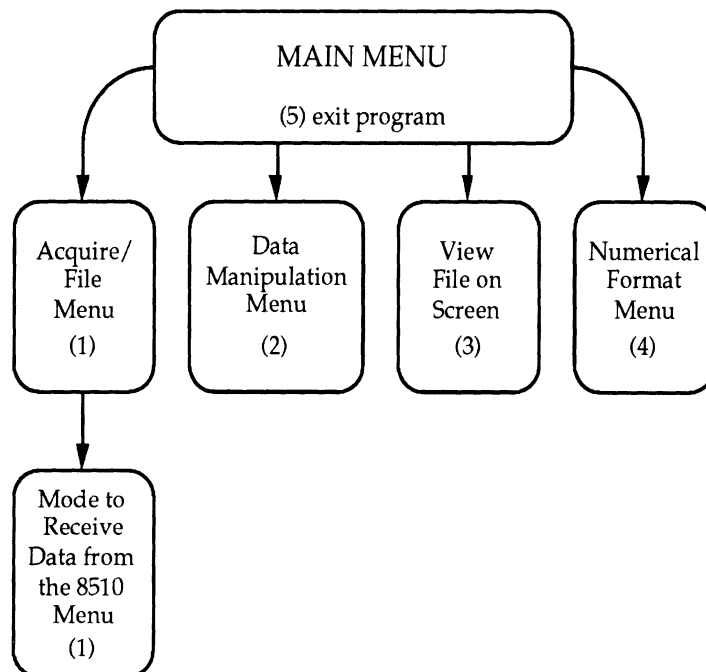
Non-menu inputs are entered the same way, with both uppercase and lowercase letters being acceptable. In answering yes/no questions, please realize that a "yes" response is not the same as a "y" and likewise "no" does not equal "n". The responses "y" and "n" should be used.

For all inputs: if the response given is not in the range of the menu, or incorrect in some other manner, the program will ask for the input until a correct response is given. Additionally, instructions are given where inputs are more complicated than just <number> + <enter>.

Note the instructions that frequently appear in the upper right corner:

- 1) <F1> transfers to a menu-driven help screen at most prompts. This menu is self-explanatory and will not be discussed further in the text.
- 2) In all menus except the main menu, <esc> will send the user to the previous menu. At most other inputs, <esc> will return the user to the previous menu.
- 3) At inputs requiring the user to give a file name or a comment line (inputs that involve a long string of characters), the input is typed in word processor style. The cursor can be moved through the line of input with the left and right arrow keys of the numeric keypad. The backspace key deletes the character to the left of the cursor and typing characters in in the middle of the input string inserts them, moving the characters under and to the right of the cursor to the right. All that appears to the left of the cursor when <enter> is pressed is taken as input. Hitting <F8> places the file name, directory or comments that existed before the input began into the input line so that the user can edit the string. Editing may be easier than re-typing a long string that is similar to the previous one. Be careful - hitting <F8> will erase any input currently in the line.

The Babel menus are set up as shown in the diagram. To go down one level, select the proper number at the menu just above. To go up one level, hit <esc> at the menu prompt.



Error messages/warning messages are printed on the screen beginning with ">>". After one of these messages, the program waits for the user to hit a key to continue. Other messages are printed on the screen followed by a brief pause after which the program continues.

A setup file is read by the program which includes basic file information such as number of points, start and stop frequencies, default directory, form of data, and some other information. If the user would like to change the information in the setup file, the order of the information must be undisturbed and the quotation marks must be included. The possibilities for change and their restrictions are:

*number of points* - must be 51,101,201 or 401

*start and stop frequencies* - must be > 0 and start < stop

*default directory* - must be an already created directory, with a "\" at the end

*default form of data* - must be "DB", "LN" or "CX", and in all capitals

*angle range flags* - listed as S parameter, impedance with 1 = 0 to 360, 0 = complex and -1 = -180 to 180

*radiation loss form* - must be "dB" or "linear" and upper/lower case important

*parameters of data taken* - must be "all", "S11", "S21", "S12" or "S22"

*position of labels in the output file* - must be "top" or "bottom"

*cursor blink duration* - any number, the bigger the number the slower the cursor blink speed

## Main Menu:

```
HP 8510 Network Analyzer Data Handler          F1 for help
* current file: c:\folder\filename.DB

      MAIN MENU

      1) Go to Acquire/File menu
      2) Go to Data Manipulation menu
      3) View file on screen
      4) Set numerical formats
      5) Exit program

      What would you like to do?
      .
```

The menu selections and where they send the user are:

- 1) *Go to Acquire/File menu* - puts acquire/file menu on screen.
- 2) *Go to Data Manipulation menu* - puts data manipulation menu on screen.
- 3) *View file on screen* - displays current data on screen.
- 4) *Set numerical formats* - puts numerical format specification menu on screen.
- 5) *Exit program* - ends execution of program, returning to DOS, after a possible message and a question. The message that is printed indicates the status of the file in memory, if a file is currently in memory. The question asks if it is OK to quit. A "y" response exits, anything else returns to main menu.

### Acquire/File menu:

```
HP 8510 Network Analyzer Data Handler          F1 for help
* current file: c:\folder\filename.DB         F8 to edit
                                              <esc> for main menu

      DATA ACQUISITION / FILE MENU

1) Receive from HP 8510
2) Take inventory of files on disk
3) Load file from disk
4) Save current file to disk
5) Trash current file (dump from memory, no save)
6) Delete file from disk
7) Rename current file
8) Make/remove directory

What would you like to do?
```

The menu selections and their functions are:

- 1) *Receive from HP 8510* - transfers the user to the mode to receive from the 8510 menu.
- 2) *Take inventory of files on disk* - allows user to see a list of files in a directory on the hard disk or on a disk in a drive. The user is asked to give a path to look in. Inputting only <enter> checks the current file's directory (usually printed at top of screen). To see what is in the directory, a "\" must be entered at the end of the path. If the "\" is not at the end of the path, the only output is the name of the directory. The list of files is printed on a blank screen, with the path printed at the top. The program returns to the acquisition/file menu when the user strikes a key. An error (such as "file not found") also returns the program to the acquisition/file menu. <F8> puts the current path into the input line.
- 3) *Load file from disk* - allows user to read a previously saved data file to review or recalculate. A warning message is printed if a current file is not saved, but still allows the user to load a new file (which will take the place of and erase the current file). The user is asked to input the file name, which may be in upper or lower case (DOS works only in upper case, but treats upper and lower equally). If the file is in the same directory as the current file, simply the name and extension will load the file. To change directories, the name must be typed in with an entire path specified. <esc> or <enter> get back to the acquisition/file menu without loading. <F8> puts the current path and file name into the input line.

File names: The maximum length for file names is 8 characters, as required by DOS. Longer names are cut off after the first 8 characters by the program. All data files dealt with in this program must have "CX", "DB" or "LN" as an extension. No problem should arise since the program takes care of them in all cases except for loading. While loading, the program checks to make sure that the extension is "CX", "DB" or "LN". If not, the user is prompted to give a file name again. If so, the program makes sure that the path is viable, i.e. checks for a ":" in the second character and for "\" characters (if any) to designate path and file name. WARNING: Files not created by Babel but with correct extensions

should not be loaded in because of errors that may arise if the text of the file is not exactly as Babel would read or write them.

- 4) *Save file to disk* - stores current file on hard drive or floppy disk. Comments and labels will be written as is currently specified (top or bottom - above or below the data) - no change from when the file was originally created. To change the position of the comments (top or bottom), go to the Receive From the HP8510 Menu, change the position and hit <esc> to return to the Acquire/File Menu, then save. Comments and labels refers to information like file name, date, comments and start/stop frequencies as well as the column labels and a key to columns. The reason for the option to put comments and labels at the bottom is that it is easier to load a file with data at the top into other software packages (like a workstation graphics program) than it is to load a file with a section of text at the top. With a bottom comment save, there will be one line of text above the data containing the number of points. Saving a file does not remove a file from the memory of the program. <enter> at the prompt returns the program to the acquire/file menu.

Column label examples are: frequency, S11 magnitude, radiation loss and normalized load impedance real. Name, date, comments, frequencies and column labels are shown on the top half of the View File on Screen screen.

Key to columns tells which data is in which column.

Example:

1=frequency

2=S11 magnitude

This indicates that frequency values occupy the first column and the values of magnitude for the S11 parameter are in the second column.

- 5) *Trash file (dump from memory, no save)* - enables user to clear file from memory without saving it. This menu selection is intended to enable the user to avoid warnings when trying to exit, load a file or receive new data from the HP 8510 without first taking care of the current file. All 3 of



these options effectively trash the file without a save. Entering anything except "y" at the prompt returns the program to the acquire/file menu.

- 6) *Delete file from disk* - lets user delete any file from disk. The deleted file does not have to be the current file (although it may be). The user is asked to input the path, filename and extension. <esc> or <enter> at the prompt return the program to the acquire/file menu. Once a name is input, it is reprinted and the user asked if it is OK to delete the file. Only a response of "y" will execute the delete. Any other response will return the program to the acquire/file menu. <F8> puts the current path and file name into the input line.
- 7) *Rename current file* - gives user option to change the name (or path) of the current file. To change only the name (remain in same directory), the user needs to type only the new name. To change paths, the entire new path must be specified, including the file name. <esc> or <enter> at the prompt return the program to the acquire/file menu. <F8> puts the current file name into the input line.
- 8) *Make/remove directory* - allows user to create or delete directories from within Babel. Collecting many sets of data can get to be a confusing mess unless the files are kept well organized. This option is available to allow the user to keep fairly well organized. The user is prompted to choose between making a new directory and removing a directory, then must input the directory name. The first prompt must be answered with a 1 or 2. At the second prompt, <esc> or <enter> will get back to the acquire/file menu. <F8> puts the current path (directory) into the input line.

## Data manipulation menu:

```
HP 8510 Network Analyzer Data Handler          F1 for help
* current file: c:\folder\filename.DB         <esc> for main menu

      DATA MANIPULATION MENU
S parameters: dB, 0 to 360
  1) Change to complex
  2) Change to magnitude(dB) - phase
  3) Change to magnitude(linear) - phase
  4) Change angle range
Normalized load Z: mag-phase, 0 to 360
  5) Change to complex
  6) Change to magnitude(linear) - phase
  7) Change angle range

  8) Determine Radiation Loss
  9) Change Radiation Loss from dB to linear
 10) Calculate Normalized Load Impedance

What would you like to do?
```

Calculations and conversions that can be made with the data are listed in the menu. To remind the user, the current forms and angle ranges of the S parameters and impedance are printed on the screen. Making a calculation or conversion sets the file to unsaved status. Help is only available at the menu prompt. The menu selections and formulas used in their calculations are:

- 1) *Change to complex* - changes the form of the S parameters to complex form, that is, to a form with real and imaginary parts.

$$\begin{aligned} \text{real} &= \text{magnitude} \cos(\text{phase}) \\ \text{imaginary} &= \text{magnitude} \sin(\text{phase}) \end{aligned}$$

- 2) *Change to magnitude(dB)-phase* - changes the S parameters to magnitude-phase form, with the magnitude in decibels. If changing from complex form, a small menu is printed and the user is asked to choose an angle range. A range must be chosen because <enter> will not return the user to the data manipulation menu.

$$\begin{aligned} \text{dB} &= 20 \log (\text{linear magnitude}) \\ \text{phase} &= \arctan\left(\frac{\text{imaginary}}{\text{real}}\right) \end{aligned}$$

Note: if Babel cannot calculate a dB value (due to bad data - such as a negative value, the log of which Babel cannot calculate), it sets the value to the default of -100 dB and prints a message to that effect on the screen.

- 3) *Change to magnitude(linear)-phase* - changes the S parameters to linear magnitude-phase form. (Angle range as above.)

$$\begin{aligned}\text{linear magnitude} &= \sqrt{(\text{real})^2 + (\text{imaginary})^2} \\ &= 10^{(\text{dB magnitude}/20)}\end{aligned}$$

- 4) *Change angle range* - allows the user to change the range of angles for the S parameters if they are in magnitude-phase form. (Angle range menu as above.)
- 5) *Change to complex* - changes the form of the normalized load impedance data to complex form.
- 6) *Change to magnitude(linear)-phase* - changes the normalized load impedance to linear magnitude-phase form. (Angle range menu as above.)
- 7) *Change angle range* - allows user to change range of normalized load impedance phase values. (Angle range menu as above.)
- 8) *Determine Radiation Loss* - calculates radiation loss from the S parameter data, one value per frequency.

$$\text{radiation loss} = 1 - |S_{11}|^2 - |S_{21}|^2$$

If the user has chosen to take 1-port measurements, radiation loss becomes:

$$\text{radiation loss} = 1 - |S_{11}|^2$$

or:

$$\text{radiation loss} = 1 - |S_{22}|^2$$

To convert to dB, the following equation is used:

$$\text{dB} = 10 \log (\text{radiation loss})$$

Note: if Babel cannot calculate a dB value (due to bad data - such as a negative value, the log of which Babel cannot calculate), it sets the value to the default of -100 dB and prints a message to that effect on the screen.

- 9) *Change Radiation Loss from dB to linear* - choosing this option executes the calculations to convert to the new form.

10) *Calculate Normalized Load Impedance* - performs the calculations involved with finding the normalized load impedance. The derivation begins with the identity for reflection coefficient (which is equal to the S11 parameter):

$$\rho \text{ (or } \Gamma \text{)} = \frac{Z_L - Z_0}{Z_L + Z_0}$$

Dividing top and bottom of the right hand side by  $Z_0$  (characteristic impedance of transmission line) converts  $Z_L$  (load impedance) into  $Z$  (normalized load impedance).

$$\rho = \frac{Z - 1}{Z + 1}$$

Solving for  $Z$  yields:

$$Z = \frac{1 + \rho}{1 - \rho}$$

The program makes the following calculation because it does not know complex math and  $Z$  is complex:

$$|Z| = \sqrt{\frac{(1+\text{Re}[\rho])^2 + \text{Im}[\rho]^2}{(1-\text{Re}[\rho])^2 + \text{Im}[\rho]^2}}$$

$$\angle Z = \arctan\left(\frac{\text{Im}[\rho]}{1+\text{Re}[\rho]}\right) - \arctan\left(\frac{\text{Im}[\rho]}{1-\text{Re}[\rho]}\right)$$

If the user has selected complex notation of  $Z$ , these conversions take place:

$$\text{Re}[Z] = |Z| \cos(\angle Z)$$

$$\text{Im}[Z] = |Z| \sin(\angle Z)$$

### Numerical formats menu:

```

HP 8510 Network Analyzer Data Handler                               F1 for help
* current file: c:\folder\filename.DB                               <esc> for main menu

NUMERICAL FORMAT SPECIFICATION MENU

                                form of data
piece of data                    current      standard
-----
1) frequency                      12.34567      12.34567
2) S parameter real                1.234567E+89  1.234567E+89
3) S parameter imaginary           1.234567E+89  1.234567E+89
4) radiation loss                  123.4567      123.4567
5) norm load Z magnitude           1.234567E+89  1.234567E+89
6) norm load Z phase               123.4567      123.4567

7) return to standard forms

What would you like to do?

```

Allows specification of what data looks like when viewed on screen or written to an output file. Three things can be formatted: a) scientific notation or fixed-length decimal; b) number of digits preceding the decimal point; c) number of digits following the decimal point.

The data that may be formatted is listed in the menu, along with the current settings and the standard settings. To change a setting, select the number corresponding to it, hit <enter> and respond to the 3 prompts that come up (corresponding to a,b and c above). Please note that hitting <enter> at one of the 3 prompts is interpreted by the computer to be an input of 0. After the 3 prompts have been answered, the total number of digits specified for data storage is displayed and the user must hit a key to continue back to this menu. The other option is to return to standard forms. If selected, the program changes all current settings to match the standard settings. <esc> at the prompt displays the main menu.

Standard settings:

|                   |              |
|-------------------|--------------|
| frequency         | 12.34567     |
| real or imaginary | 1.234567E+89 |
| linear magnitude  | 1.234567E+89 |
| dB magnitude      | 123.4567     |
| angle             | 123.4567     |

The S parameters, radiation loss and normalized load impedance are set to match the form of the current data. Examples: Complex S's have scientific form, 1 digit before the decimal and 6 after for both real and imaginary. Radiation loss in dB is not in scientific form with 3 before and 4 after.

The maximum number of total digits allowed is 7. Babel will allow input to reach no more than 7. Babel will also allow the user to choose 0 digits total (but 0 digit information is not useful).

Special care must be taken when not using scientific notation because if a data point is larger than the format allows, the program will write it (to screen/file) completely, but with a % appended to the beginning of the number. This will misalign the columns of output, and the extra % character may be unwanted (and error-causing) in the output file (if the output file will be read by this or another program).

## Receive menu:

```
HP 8510 Network Analyzer Data Handler          F1 for help
                                                F8 to edit
MODE TO RECEIVE DATA FROM THE 8510  <esc> for acquire menu

Current Settings:
 1) File name: c:\filepath\filename.CX
 2) Number of points: 201
 3) Starting frequency: 10
 4) Stopping frequency: 18
 5) Date: 12-25-1992
 6) Form of data: CX
 7) Comments: Whatever comments that are input to describe
              the experiment are placed in these two lines.
 8) Gather parameters: all
 9) Label position: top
10) Sweep and gather data from HP 8510

What would you like to change/do?
```

Note, Problem and Solution: be careful that the options match the HP 8510 settings, or else the data will be inaccurate, as the program and the HP 8510 do not communicate these options. If the number of points is correct but some other settings in this menu are not the same as the HP 8510 settings when the data was collected, that problem can be corrected. Load the file into the program and come to this menu, ignoring the warning that a file is in memory, and correct the settings. Then return to the acquire menu and save the file. Example: the user took data, but later realized that the start/stop frequencies are not matching the HP 8510 settings when the data was taken. Instead of losing the data, the user can fix the problem by changing the frequencies and re-saving the file. This works because the program always takes what the HP 8510 sends it, so the data is correct, just the frequencies assigned to the data is wrong.

The menu selections are: (<esc> returns to the menu from any of the options)

- 1) *File name:* - allows user to change or add a file name (acquire/file menu choice 7), or to change the path. The current path is printed here, with the file name if it exists. Whether or not the file name exists, the extension is printed as the last part of the name. The extension will

change only if the form of data is changed (menu choice 6). Edit option is available.

- 2) *Number of points:* - gives user option to modify the number of points that the HP 8510 takes. The options are 51,101,201 and 401. If the inputted value is not equal to one of the options, the program rounds to the nearest option. This is because the HP 8510 will only take these numbers of points, and any other values will yield incorrect data.
- 3) *Starting frequency:* - lets the user change the starting frequency. If the starting frequency specified is  $\leq 0$  then a message is issued and the user asked to re-do the input. Note: this program does not control the HP 8510 so the user must be careful to set the frequencies in Babel just as they are set on the HP 8510 (See Note, Problem and Solution above).
- 4) *Stopping frequency:* - lets the user change the stopping frequency. If the stopping frequency is less than the starting frequency, a message is printed and the user is asked to input the stopping frequency again.
- 5) *Date:* - allows user to change the date. The program assigns the date to the computer's internal date. <esc> leaves the date as is and returns to the menu.
- 6) *Form of Data:* - gives the user the selection of S parameter data type: complex or magnitude - phase (linear or decibel). A small menu is printed and the user asked to select one of the three.
- 7) *Comments:* - enables the user to attach some comments to the file which can be much more descriptive than the 8-character file name. The maximum length is 90 characters. The prompt asks for the user to type the comments. <enter> makes the comments blank (no comments whatsoever) and returns to the receive menu. Edit option is available.
- 8) *Gather parameter(s):* - gives the user the option of taking one S parameter or all S parameters. A small menu is printed and the user is asked to

input the parameter to collect. Taking only one parameter will minimize file space on disk.

- 9) *Label position* - lets the user choose where Babel places the comments and strings within the data file. The options are above data (top) and below data (bottom).
  
- 10) *Sweep and gather data from HP 8510* - tells the program to communicate with the HP 8510. Gathering data consists of waiting for the HP 8510 sweep once, then collecting S11, S21, S12, S22 data (in that order) or just the single S parameter specified to be gathered and finally returning to the acquire menu. All data is taken from a single sweep. The HP 8510 screen should display some commands and change between the S parameter screens as if someone were pushing the S parameter buttons. A lockout of the HP 8510 is activated during the data collection, so the front panel buttons will not respond. After the data is collected, the HP 8510 is returned to local mode, and the user can operate the front panel buttons by pushing the "LOCAL" button. The data is saved to disk after it is taken and the HP 8510 returned to local. Babel returns to the acquire/file menu after gathering and saving the data.



## View File on screen:

Current data is displayed on the monitor, looking like:

```
File name: c:\filepath\folder\name.CX          F1 for help
Date: 12-25-1992
Comments regarding the data, or no comments.
Number of points: 201
Lower frequency limit: 12
Upper frequency limit: 42

          S11          S21
FREQUENCY  REAL    IMAGINARY  REAL    IMAGINARY
12.00000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.15000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.30000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.45000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.60000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.75000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
12.90000  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Hit a key to continue (q to quit viewing, n for next set of data).
```

The data is displayed in 3 sets, the first being the S11 and S21 parameters, the second being the S12 and S22 parameters, the third being the radiation loss and the normalized load impedance arrays. All 3 sets are displayed with frequency as the leftmost column. The first 6 lines (information basic to the file - name, date, start/stop frequency, etc.) always remain on the screen while the data scrolls underneath. The data is displayed from start frequency to stop frequency, increasing incrementally. When the screen is full (13 lines), the program waits for the user to hit a key to see another full screen of data. Thus, all data can be seen and examined. Entering <q> exits the view file mode and returns to the main menu. Entering <n> sends the view to the next set of data, not showing the remaining data in the set. Entering <n> from the third set sends view to the first set. Also, when all data in a set has been shown, hitting a key begins viewing the next set (first and second sets) or returns to the main menu (third set). <esc>, like <q> reverts to the main menu.

## Section II – Bablplot Documentation

### What is it?

Bablplot is a program that runs on IBM PC's and PC clones. It is a supplement to Babel - it will load the data files recorded by Babel and plot them as scattering parameters on a Smith Chart and in a linear or logarithmic plot of magnitude versus frequency. Bablplot will also graph phase versus frequency. However, Bablplot will plot from only one data file at a time.

Bablplot was written and compiled with Microsoft QuickBasic version 4.5.

### How to use the program:

Bablplot is a menu-driven program that operates in the same way as Babel. Again, <F1> transfers to a menu-driven help screen at most prompts and <esc> sends the user back to the main menu. Editing is available at the file name prompts and <F8> will display the default value in the line. Error and warning messages are treated just as in Babel. The same setup file is read by the program.

### Main Menu:

```
HP 8510 Network Analyzer Data Plotter          F1 for help
* current file: c:\folder\filename.DB

      MAIN MENU

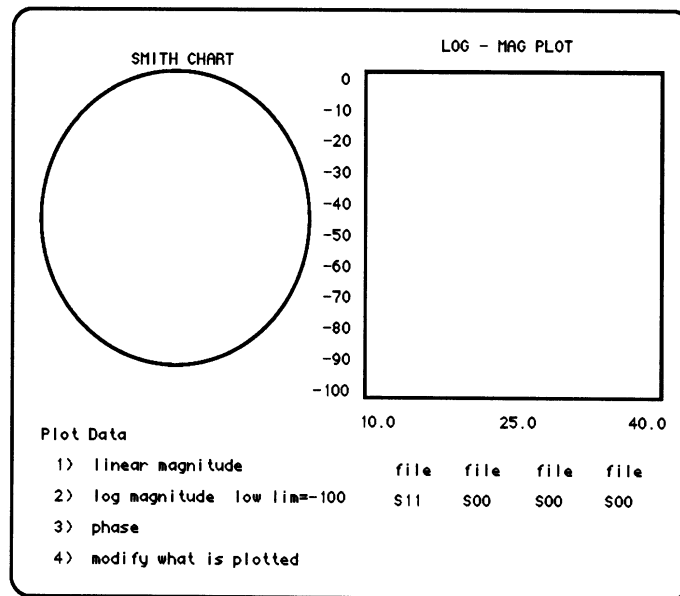
      1) Take inventory of files
      2) Load a file
      3) Plot data
      4) Exit Program

      What would you like to do?
```

The menu selections and where they send the user are:

- 1) *Take inventory of files* - displays all files in a directory on screen.
- 2) *Load a file* - puts data from a file into memory.
- 3) *Plot data* - goes to the graphics screen with Smith Chart and linear/log/phase plot.
- 4) *Exit program* - returns to DOS if a "y" is the user's answer to the "OK to quit?" prompt.

**Plot Screen:**



The rectangular plot x-axis is always frequency, with the limits being the start and stop frequencies. The options and their functions are:

- 1) *Linear magnitude* - changes the rectangular plot to linear magnitude versus frequency. The y-axis is fixed from 0.0 to 1.0.
- 2) *Log magnitude* - changes the rectangular plot y-axis to log magnitude. The upper limit is fixed at 0, but the lower limit can be specified by the user down to -250 dB.

- 3) *Phase* - changes the rectangular plot to phase angle versus frequency. The y-axis can be either -180 to 180 or 0 to 360.
- 4) *Modify what is plotted* - puts a menu on the screen that enables the user to choose what parameters of the loaded file are plotted. The menu looks as follows (this is the modify box):

```

Things to change:                                <esc> for previous screen
      filename.DB      filename.DB      filename.DB      filename.DB
1)  S11      3)  S11      5)  S11      7)  S11
2)  color    4)  color    6)  color    8)  color
9)  low lim { current = -100 }
10) angle range { current = -180 to 180 }
What would you like to modify?
```

Using this menu, the following choices can be made:

- 1,3,5&7) *S11* - this parameter is plotted. They can be S11, S21, S12, S22 or S00. S00 indicates that no plot is made. A small menu is printed in the modify box and the five choices made available.
- 2,4,6&8) *color* - the parameter directly above the word color will be plotted in the color that the two menu choices are printed in. Selecting one of these options gives the user the ability to choose one of the 15 colors (listed in a box above the modify box) to plot each parameter in. The choice is made by then entering the number that corresponds to the desired color.
- 9) *low lim* - lets the user input a value for the lower limit of the log magnitude plot. The value must be between -1 and -250 dB.
- 10) *angle range* - choosing this option toggles the angle range specification for the y-axis of the phase plot. The two ranges that are toggled between are 0 to 360 and -180 to 180.

<esc> returns control to the plot screen.

## Glossary:

directory - The name of the "folder" that a file is in. Two files in the same directory are in the same folder, and must have the same paths.

extension - File names may be followed by a . and a short (up to 3 letters) code revealing information about the file. Common extensions are: .EXE (executable file) and .DAT (data file). Extensions used by this program are: .CX (complex data file), .LN (linear data file) and .DB (decibel data file).

file name - The one-level, 8-letter name associated with an IBM computer file.

folder - On IBM computers, files are organized into levels. The first level is disk drive and it is compulsory. Then come one or more levels, the last of which is the file name. Levels between file name and disk drive are called folders.

path - The complete set of levels up to the file name, specifying the file's exact location. Babel allows 40 characters before the file name (from c: to last \). In DOS, c:filename is accepted (and filename put in current directory) but in Babel, c: is not an acceptable file name. The path must begin with c:\. (The drive may be any letter - c is just an example here.)

prompt - When the user is presented with a question printed on the screen and a blinking cursor to give keyboard input with, this is a prompt.

## Glossary Examples:

| <u>Name:</u>             | <u>Path:</u>      | <u>Directory:</u> | <u>File name:</u> | <u>Extension:</u> |
|--------------------------|-------------------|-------------------|-------------------|-------------------|
| C:\HPC\CIRCUITS\DATA1.DB | C:\HPC\CIRCUITS\  | CIRCUITS          | DATA1             | .DB               |
| C:\DATA1.CX              | C\                | (none)            | DATA1             | .CX               |
| A:\DATA\HPJUNE23\RUN.LN  | A:\DATA\HPJUNE23\ | JUNE23            | RUN               | .LN               |