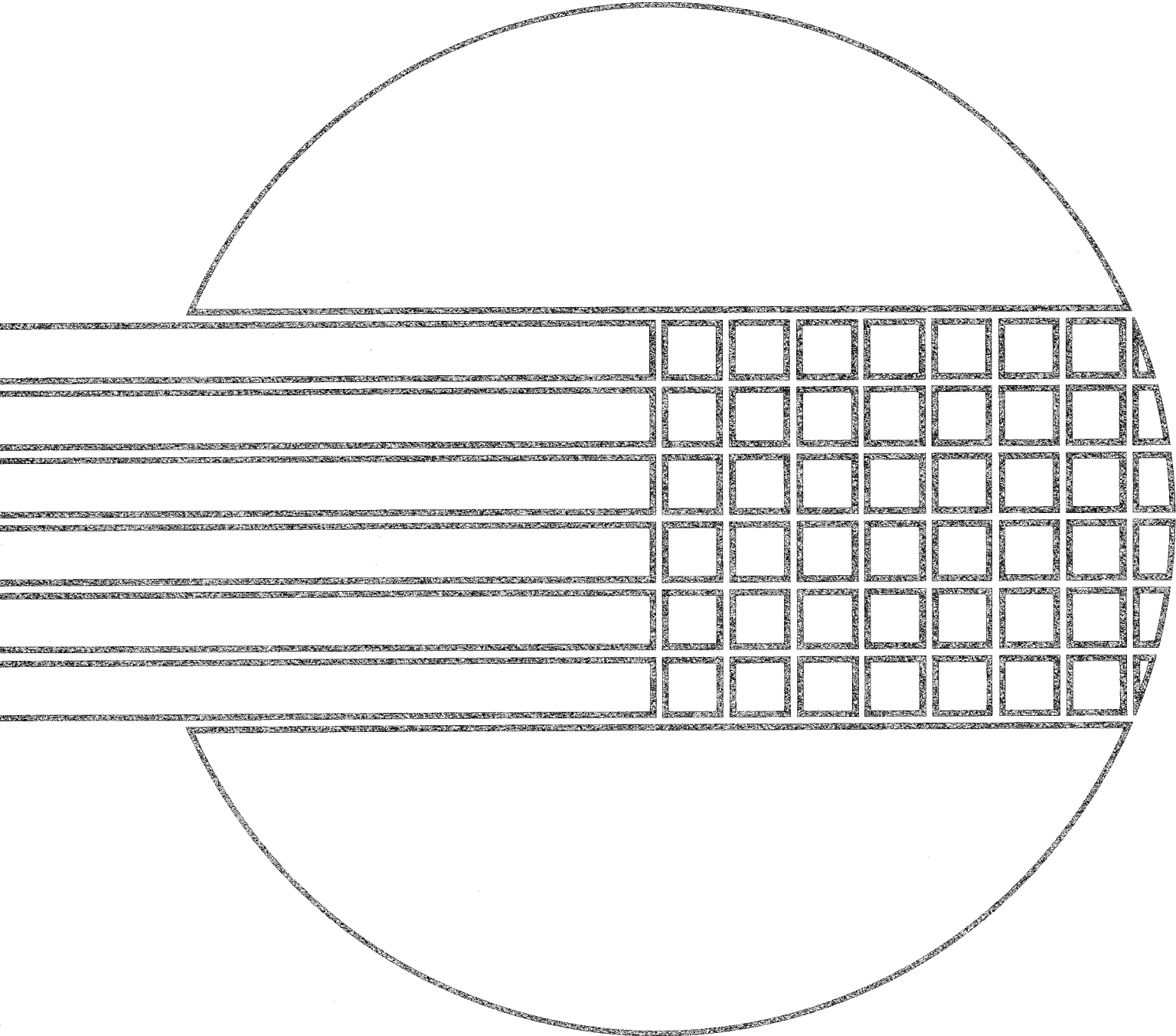


**SIGNETICS
SUPPORT SOFTWARE
FOR USE WITH
GE'S MARK III
TIMESHARING SYSTEM
SP54**



1. SUMMARY

A series of programs is described that provide the microprocessor application's design engineer with on-line support for the development of programs to be run on the Signetics 2650 microprocessor. These programs include a cross-assembler, a cross-simulator, and two tape utility programs that convert the object file produced by the assembler into either a "hex" format, suitable for loading into system memory by "PIPBUG," or into a format suitable for burning PROMs. The programs are accessed through a communications terminal connected to General Electric's Mark III Timesharing System via standard telephone lines.

2. USAGE OVERVIEW

The user creates the source file for his assembly language program by using the editing facility or his program may be punched onto cards and read into the system. Once the source file resides in the system, the user executes the assembler, which translates symbolic source statements into machine language instructions, and generates both an assembled listing of the source file and an object file. If the assembler reports any errors in the source file, the user may again invoke the editing facility to correct the errors. The corrected source file is then resubmitted to the assembler. Once the assembler reports no errors, the user may input the object file to the simulator which simulates execution of the program.

The simulator provides the following capabilities:

- 1) Establishes initial program conditions.
- 2) Monitors execution sequences.
- 3) Modifies the program until it operates as desired.

Once the program operates correctly, the user may repeat the entire cycle: correct his source file, reassemble, and test the new program using the simulator. When the program is fully tested and debugged, it may be punched onto tape in a format for loading into system memory and/or for burning PROMs.

3. PROGRAM DESCRIPTIONS

The next few sections describe the available programs and provide detailed instructions for using them. All available usage options are included as reference information. A final section, called "Operating Instructions," provides step-

by-step procedures for generating, editing, assembling, simulating, and punching Signetics 2650 programs. These procedures explain some of the more commonly used features of both the General Electric Timesharing System and the Signetics facilities and demonstrate how to use them.

A. PIPHASM – SIGNETICS 2650 PIP ASSEMBLER (HEX TAPE FORMAT)

PIPHASM supports the 2650 assembler language as specified in the basic manual set (2650 BM 1000). It outputs a hexadecimal object module in a format acceptable to the two tape-punching programs, PIPHTAP and PIPSTAP, and to the simulator, PIPSIM.

To execute the assembler, enter the command:

```
/PIPHASM
```

The assembler will start executing and will request the following information:

- The name of the input (source) file.
- The name assigned to the assembler-produced object file. It is suggested that some naming convention be adopted; e.g., always name the object file with the first four letters from the name of the source file followed by ".OBJ".
- The width of your terminal carriage. Enter "0" if your terminal carriage has 120 characters; otherwise, enter "1".

To assemble your program, the assembler creates a scratch file on your user ID. If the assembly runs to completion, this file will be purged. But if the assembly is aborted, the file may remain on your user ID. You may collect up to ten of these scratch files before the assembler will be unable to assemble because it cannot find a scratch file name. The scratch file names that must be purged are referred to as: A 00, A 01, . . . , A 09.

B. SIGNETICS 2650 SIMULATOR

The 2650 simulator, a program written in FORTRAN IV, simulates the execution of a 2650 program without using the 2650 processor. The simulator executes a 2650 program by maintaining its own internal FORTRAN storage registers to describe the 2650 program, the microprocessor registers, the ROM/RAM memory configuration, and the input data to be read dynamically from I/O devices. The user may

request traces of the processor status, dumps of the contents of memory, and program timing statistics. Multiple simulations of the same program with different parameters may be executed during one simulation run.

The simulator requires as input both the program object module produced by the 2650 assembler and a file of user commands. It produces a listing of the user's commands, executes the program, and prints ("displays") both static and dynamic information as requested by the user's commands.

The Signetics Basic Manual Set (2650 BM 1000) contains a description of the user commands and the general operation of the simulator.

To execute the simulator, enter the command:

```
/PIPSIM
```

The simulator starts executing and requests the following information:

- The name of the object module produced by the assembler for your program.
- The name of the file of simulator commands.

C. PAPER TAPE UTILITIES

The two paper tape utility programs, PIPHTAP and PIPSTAP, complete the series of programs discussed in this memo.

1) PIPHTAP

PIPHTAP punches the "hex" object file onto tape in a format acceptable as input to the 2650 Prototyping Card (2650 PC 1001). Refer to Signetics Applications Memo SS51 for the tape format specifications.

To execute PIPHTAP, enter the command:

```
/PIPHTAP
```

PIPHTAP responds with a request for the name of your object (input) file; it then requests that the punch be turned on and that the carriage return key be depressed. PIPHTAP punches about 50 frames of leader before it punches the object module. When the system responds with "READY," turn the punch off.

2) PIPSTAP

PIPSTAP punches the "hex" object file onto tape in a form suitable for burning a PROM. To execute PIPSTAP, enter the following command:

```
/PIPSTAP
```

PIPSTAP responds with a request for the following information:

- The name of the object file.
- The value (two hexadecimal digits) representing the unburned state of your PROM.
- The size in bytes (four decimal digits) of the PROMs to be burned.
- Up to eight pairs of START/END addresses (four hexadecimal digits). Each address pair identifies an area of code in the object module.

NOTE: All numbers entered must contain leading zeros; e.g., when entering the size of a PROM as 256, you must enter 0256.

A START address larger than 7FFF, e.g., 8000, terminates the input mode.

Once the input mode is terminated, PIPSTAP requests that the punch be turned on. It then punches and prints a record for each PROM specified.

START/END addresses are rounded down/up to the limits of the affected PROM. Thus if:

```
INITIAL PROM VALUE = FF,
PROM SIZE           = 0256,
START ADDR         = 0040
```

and

```
END ADDR           = 0240,
```

PIPSTAP punches three records: 0000 - 00FF, 0100 - 01FF, and 0200 - 02FF. Each of the records is preceded by its initial address (0000, 0100, 0200) punched into the tape so that it is visible. This enables the tape to be separated into individual strips for each PROM. The areas 0000 - 003F and 0241 - 02FF are filled with FFs.

Each record is punched in exactly the order in which its START/END address was entered so that multiple records may be punched for the same PROM. When the system types "READY," turn the punch off.

4. OPERATING INSTRUCTIONS

This section provides a synopsis of operating instructions for using the GE Mark III Timesharing Service to generate, edit, assemble, simulate, and punch Signetics 2650 programs. For more detailed information on the capabilities of the GE Mark III Timesharing Service, refer to the following manuals available from General Electric's Information Services Business Division:

- 1) *Command System* — Mark III Foreground Reference Manual No. 3501.01J.
- 2) *Editing Commands* — Mark III Foreground Reference Manual No. 3400.01F.

When using high-speed terminals (120 cps and up) or in the event of any difficulty, contact your local General

Electric Sales Office. A list of General Electric Sales Offices is provided at the end of this document.

A. LOGGING IN

- Set the terminal to "LINE" mode.
- Select the half-duplex mode, using the HALF/FULL duplex switch (if necessary).
- When you hear the high-pitched tone (indicating that you have established communication with the computer), place the telephone receiver in the modem coupler.

NOTE: In the following examples data typed by the user is underlined to distinguish it from data printed by the computer.

Log in as follows:

H carriage return

Depressing the carriage return key terminates all input lines. Some General Electric personnel recommend that four Hs, HHHH, be entered instead of one. The timesharing system determines the speed of your terminal from the speed at which these characters are received.

The computer will respond to your H carriage return entry with:

U#=#

At this point enter your user ID (3 alphabetic characters and 5 numeric characters) and press the carriage return:

U#=# AAANNNNN

The system responds

PASSWORD

XXXXXXXX

providing a blocked-out area in which you may enter your password. Type the password on top of the blocked-out area and press the carriage return. At this point the system may send an informative message to your terminal. Some user IDs are equipped with a short log-on sequence. If this is true, the system responds with

READY

If this is not true, the system responds with

ID:

This is a request for accounting information. If you do not wish to enter any accounting information, simply press the carriage return:

ID: carriage return

The computer will respond with:

SYSTEM:

Specify FORTRAN IV

SYSTEM: FIV

since both the assembler and the simulator are written in FORTRAN IV. The system will respond with:

NEW OR OLD

This is the same as the READY message. The system is now ready to perform any task you request.

B. ERROR RECOVERY

Prior to issuing any commands, it is essential to know how to delete an unwanted command.

- *Character Delete:* To delete the last character typed, hold down the shift key and depress zero (0) (ASCII decimal code 95). The ASCII decimal code is included since the actual key used may differ from terminal to terminal.
- *Line Delete:* To abort a line before the carriage return key is depressed, hold down the control key and depress "X" (ASCII decimal code 24).
- *Break:* To abort a command while it is being executed (e.g., stop printing a long file), depress the BREAK or interrupt key twice.

C. CREATING AND/OR EDITING A SOURCE FILE

Both the assembler and the simulator expect you to identify a source file that you have created. The assembler expects the 2650 program source file and the simulator expects the user's command source file. To create the source file, the name of the file must be specified:

NEW FILENAME

This command assigns the name, FILENAME, to the temporary working file. At this point, the file is empty. Notice that the file name, FILENAME, is eight characters long. We recommend that the first four characters be meaningful. Acceptable file names are 1-to-8 characters long using only the letters A through Z, numerals 0 through 9, and the period (.).

At this point enter each line of the source file into the temporary buffer:

```

100 *PROCESSOR SYMBOLS
110 R0 EQU 0
120 R3 EQU 3
130 *PROGRAM VARIABLE STORAGE
140 ORG H'100'
150 TLEN EQU 3 TABLE LENGTH
160 TBLA RES TLEN TABLE A
170 TBLB RES TLEN TABLE B
180 *MOVE DATA IN TBLA TO TBLB. TLEN MUST
185 *BE LESS THAN 256 BYTES

```

```

190      ORG      0
200      LODI,R3  TLEN
210 LOOP  LODA,R0  TBA-1,R3
220      STRA,R0  TBB-1,R3
226      NOP
228      NOP
230      HALT
240      END

```

Note that each line starts with a line number followed by a space and then the source data itself. Lines may be entered out of order, since the system will sort the source lines by line number. Once the data is entered, this temporary file must be saved in permanent storage using the following command:

SAVE

The system responds with a READY message, and the temporary file remains intact.

To list the contents of your temporary file, type:

LIST

The system responds by printing your file.

Should you want to change your source file, bear in mind that the only file that can be modified (or edited) is the temporary working file. At this point your source program still resides in the working file; however, if your source program resided in a permanent rather than a working file, enter the following command:

OLD FILENAME

The OLD command reads the contents of the permanent file, named FILENAME, into the temporary file and assigns the name, FILENAME, to the temporary file.

The source file is now ready for editing.

To add a line, simply type the line with a new line number:

225 BDRR,R1 LOOP

To change a line, retype the line using the same line number:

225 BDRR,R3 LOOP

To change all occurrences of the letters "TB" to "TBL" from lines 210 through line 220, enter the following command:

CHAVC 210/TB/TBL/220

This command changes the following two source lines:

```

210 LODA,R0 TBLA-1,R3
220 STRA,R0 TBLB-1,R3
READY

```

Lines 226 and 228 may be deleted with either one of the following two commands:

EDI DEL 226-228

or

EDI DEL 226,228

The first command deletes lines 226 through 228, while the second command deletes lines 226 and 228.

List your temporary file and verify all changes:

LIST

The system prints your file here and then prints:

READY

Save your file in the permanent file that was created with the SAVE command:

REPLACE

READY

The SAVE command creates a permanent file with the same name as the one assigned to the temporary file. The REPLACE command takes the content of the temporary file and stores it in the already existing permanent file that has the same file name.

NOTE: Most system commands may be shortened to the first three letters; e.g., REPLACE = REP.

D. ASSEMBLING THE PROGRAM TO CREATE AN OBJECT MODULE

The editing facility assumes that each line of your source program has a line number at the beginning. Since neither the assembler nor the simulator will accept these line numbers, the following command must be executed to remove them:

EDI DES FILENAME

READY

The assembler is now ready to be executed. Enter the command:

/PIPHASM

The assembler responds with a request for the name of your source program:

INPUT FILENAME? FILENAME

The assembler then requests the name of your object module:

OBJECT FILENAME? FILE.OBJ

This is a file that the assembler generates. Your file must be assigned a name. One useful technique is to use the first four letters of the name of the source program with .OBJ concatenated onto the end.

The computer prints:

TYPE '0' FOR WIDE CARRIAGE or
TYPE '1' FOR NARROW CARRIAGE 1

If your terminal prints 120 characters per line, type '0'.
If your terminal prints less than 120 characters per line,
type '1'.

The assembler responds by printing your listing. When the
listing is complete, the system prints:

READY

Now that your listing is complete, you may restore the line
numbers to your file by entering the following command.
This is only necessary if you plan to edit your file.

EDI RES FILENAME

E. LOGGING OFF

Log off the GE Timesharing System and review your pro-
gram for logical and syntactical errors.

BYE
00024.11 CRU 0000.41 TCH 0009.74 KC
OFF AT 16:20PDT 10/15/75

**F. USING THE SIMULATOR TO TEST AND DEBUG
YOUR PROGRAM**

1. Log onto the system using the procedures outlined in
step A.
2. Create a file containing the simulator commands. As
with the object module, you could name this file by
concatenating .TST onto the first four letters of FILE-
NAME.

NEW FILE.TST
READY
100 PATCH 100,01 101,02 103,03
120 DUMP A, 100 - 105
130 FEND
SAVE

3. Request a simulator run.

First, you must remove the line numbers from the
command file:

EDI DES FILE.TST
READY
REP
READY

Then execute the simulator by entering the following
command:

/PIPSIM

The simulator responds with a request for the following
information:

OBJECT MODULE NAME? FILE.OBJ

Enter the name of the object module generated by the
assembler.

COMMAND FILE NAME? FILE.TST

Enter the name of the simulator command file.

The simulator prints its output at this time.

*Log off the General Electric Timesharing system and
review the simulator listing to determine if any program
corrections are required.*

BYE

**G. PUNCHING A PAPER TAPE FOR DEBUGGING ON
THE PROTOTYPE CARD SYSTEM**

Check to see that the punch is off, and log onto the system
using the procedures outlined in step A.

When the system responds with

READY

enter the command:

/PIPHTAP

PIPHTAP responds with a request for the name of your
input file:

ENTER INPUT FILE NAME? FILE.OBJ

When the input file name is entered, PIPHTAP prints the
following instructional message:

TURN ON PUNCH AND HIT CARRIAGE RETURN.

When the carriage return key is depressed, PIPHTAP punches
50 frames of leader and then punches your object module.
The object module is also printed.

When punching is complete, the system responds with

READY

Turn the punch off, and log off the system.

H. PUNCHING A PAPER TAPE FOR BURNING PROMS

Check to see that the punch is off, and log onto the system
using the procedures outlined in step A.

When the system responds with

READY

enter the command:

/PIPSTAP

PIPSTAP responds with a request for the name of your input file:

ENTER OBJECT FILE NAME? FILE.OBJ

PIPSTAP then requests that you enter the unburned state of your PROM. (Since PIPSTAP punches data into each location of the PROM, PIPSTAP requires a value that can be used for the other locations):

INITIAL PROM VALUE? 00

This value must be entered as two hexadecimal digits.

PIPSTAP then asks for the size of your PROM (in bytes) which must be entered in four decimal digits. The maximum allowable size is 1024.

PROM SIZE? 0256

PIPSTAP requests both a START and an END address for the code you want punched. Use four hexadecimal digits for each address as shown below. Don't forget the leading zeros.

START ADDR? 0000

END ADDR? 000A

PIPSTAP will request up to eight pairs of START/END addresses. Enter a number larger than 7FFF, e.g., 8000, when you have completely described the object module:

START ADDR? 8000

PIPSTAP prints the following message:

TURN ON PUNCH AND HIT CARRIAGE RETURN

When you press

Carriage Return

PIPSTAP punches 50 frames of leader followed by the PROM record specified by your START and END addresses. The START address of your PROM, 0000, is punched into the tape so that it is visible. Part of the object module will be printed.

When punching is complete, the system responds with:

READY

Turn the punch off, and log off the system.

5. GENERAL ELECTRIC SALES OFFICES

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