Tiny BASIC for the CPUville Z80 Computer

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Introduction

Early personal microcomputers, such as the Altair 8800, were programmed using assembly language and machine code. However, there was much interest in developing higher-level computer languages for these early machines. The BASIC programming language (Beginner's All-purpose Symbolic Instruction Code) was a natural target for these efforts. The original BASIC was developed in 1964 and ran on mainframe computers. Many computer science students wrote their first programs in BASIC. So, when personal computers appeared, there was a natural desire to develop a BASIC language interpreter that could run on these new machines.

Microcomputers where handicapped in the early years by the size of memory, which usually cost more than the microprocessors. Nonetheless, a number of BASIC interpreters were written that could run in small memory spaces of only a few kilobytes. One of the most influential was Palo Alto Tiny BASIC, written by Li-Chen Wang in 1976. This program is famous for the comment in its source file heading that read “@COPYLEFT ALL WRONGS RESERVED”. It was one of the early formal expressions of the free software philosophy.

Tiny BASIC was written for the Intel 8080 processor, and 8080 machine code will almost always run on the Z80[1]. This BASIC interpreter runs in 2K of ROM, and 2K of RAM is more than adequate for writing and running small programs. So, on first look it seems to be well suited for use in the CPUville Z80 computer with the serial interface. The original Tiny BASIC 8080 assembly language was written in a dialect for a mainframe assembler has since been lost. However, Roger Rauskolb in October of 1976 modified the assembly language so that it could be assembled by Intel's 8080 Macroassembler, also known as MAC-80. The source code for this assembler was written in Fortran 66. Most mainframe and minicomputers of the day had Fortran compilers, so this assembler was easy for most hobbyists to access. Eventually, the MAC-80 assembler was made available in 8080 code, and was one of the popular programs on early CP/M computers.

So, with the 8080 source code for Tiny BASIC, and an assembler source code available in Fortran, there was a chance I could get Tiny BASIC up and running on the CPUville Z80 computer.

First, I had to compile the MAC-80 assembler. Fortunately, the open-source Fortran compiler gfortran has the ability to compile obsolete Fortran dialects such as Fortran 66, and I was able to compile MAC-80 and run it on a PC, in the Linux environment. Next, I modified the Tiny BASIC code to match the CPUville Z80 computer hardware. Specifically, I had to change the status and data port addresses for the UART (called the ACIA in the Tiny BASIC comments), the test bits for UART status, and the UART initialization bytes. I changed the ORG statements at the end of the Tiny BASIC code to better match a system with 2K ROM and 2K RAM. And, that was it! Tiny BASIC assembled without errors. I loaded it onto a ROM, and it ran fine on the CPUville computer.

Tiny BASIC is quite limited in its capabilities. It is integer-only – no floating point numbers allowed. It can only initialize one array, and can use only 26 variables, named A to Z. It does not have higher

1 The Z80 was designed to be compatible with the 8080. The 8080 registers, flags, and machine code are a subset of Z80 registers, flags, and machine code. All 8080 machine instructions will work properly on the Z80, with the exception of instructions using the rarely used parity/overflow flag.

arithmetic functions, such as exponent. But surprisingly it has a random number generator function, so games with probabilities can be programmed. There is a full summary of the Tiny BASIC language in Appendix A.

Setting up Tiny BASIC on the CPUville Z80 computer

Tiny BASIC machine code has been loaded onto a 2K EPROM for use in the CPUville Z80 computer. It is intended for use in the computer with the serial interface attached, as a substitute for the v.7 EPROM. For details on using the serial interface, please consult the Serial Interface Instruction Manual. The Tiny BASIC EPROM can also be used in the computer with the disk and memory expansion interface, taking the place of the v.8 EPROM, but in its current form Tiny BASIC can only use 2K of RAM[2]. In the computer with the disk and memory expansion, one is able to install CP/M and use the much more powerful Microsoft BASIC.

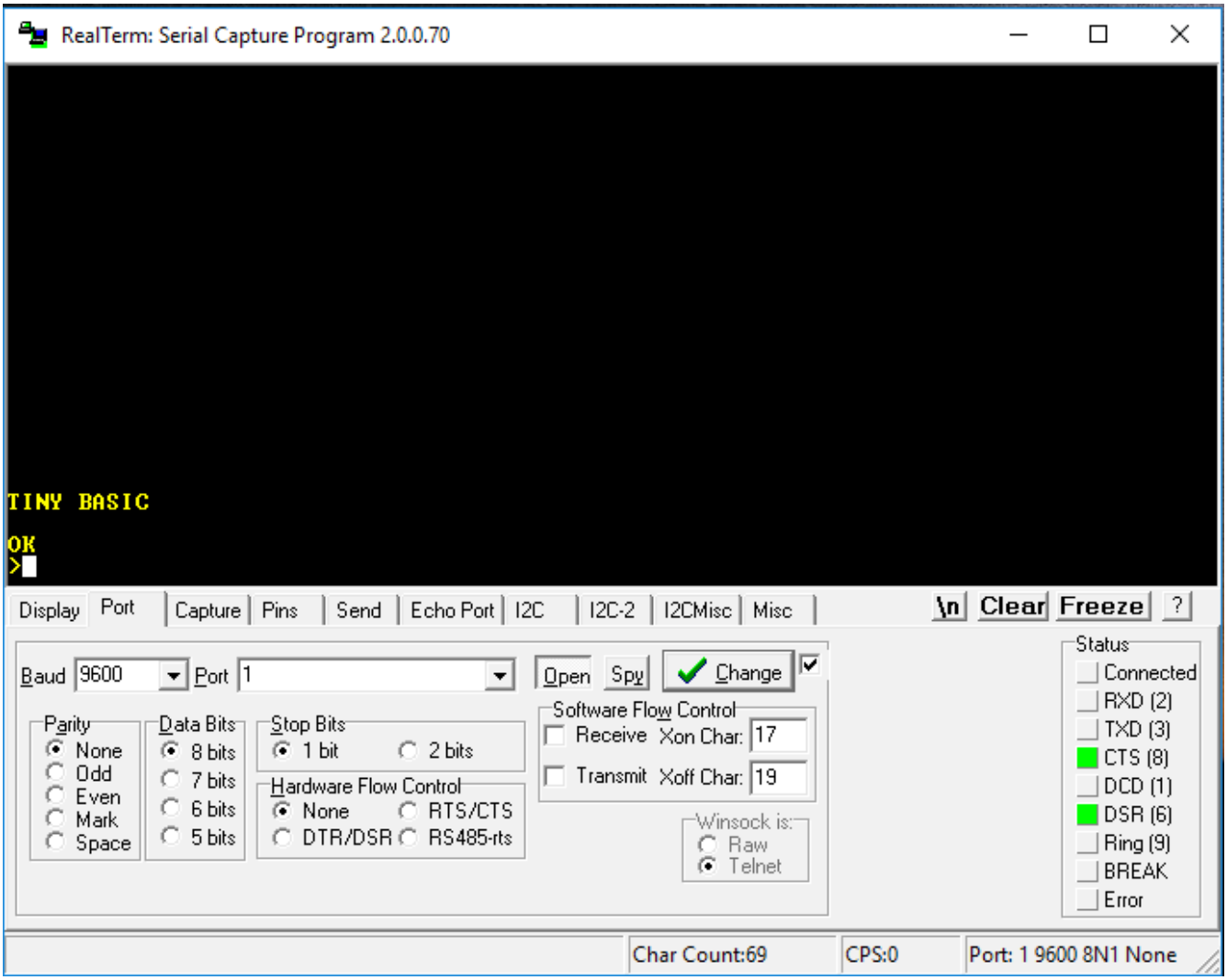
To set up the CPUville Z80 computer for Tiny BASIC, it should have the serial interface attached directly to it. Remove the v.7 EPROM and replace it with the Tiny BASIC EPROM. The computer needs to be set for the fast clock, and the jumpers need to be ON. It does not matter what is on the input port DIP switches.

The following sections describe in detail how to use Tiny BASIC in both Windows and Linux environments.

2 The Tiny BASIC code can easily be modified to use more RAM if this is desired.

Using Tiny BASIC with Realterm in Windows

Set the Realterm display to ANSI, 24 rows, and the port to 9600 baud with 8 data bits, one stop bit, and no parity – the usual settings when operating the CPUville Z80 computer with the serial interface. With the Tiny BASIC EPROM installed, connect the computer to power, and take it out of reset. The display will show the Tiny BASIC greeting:

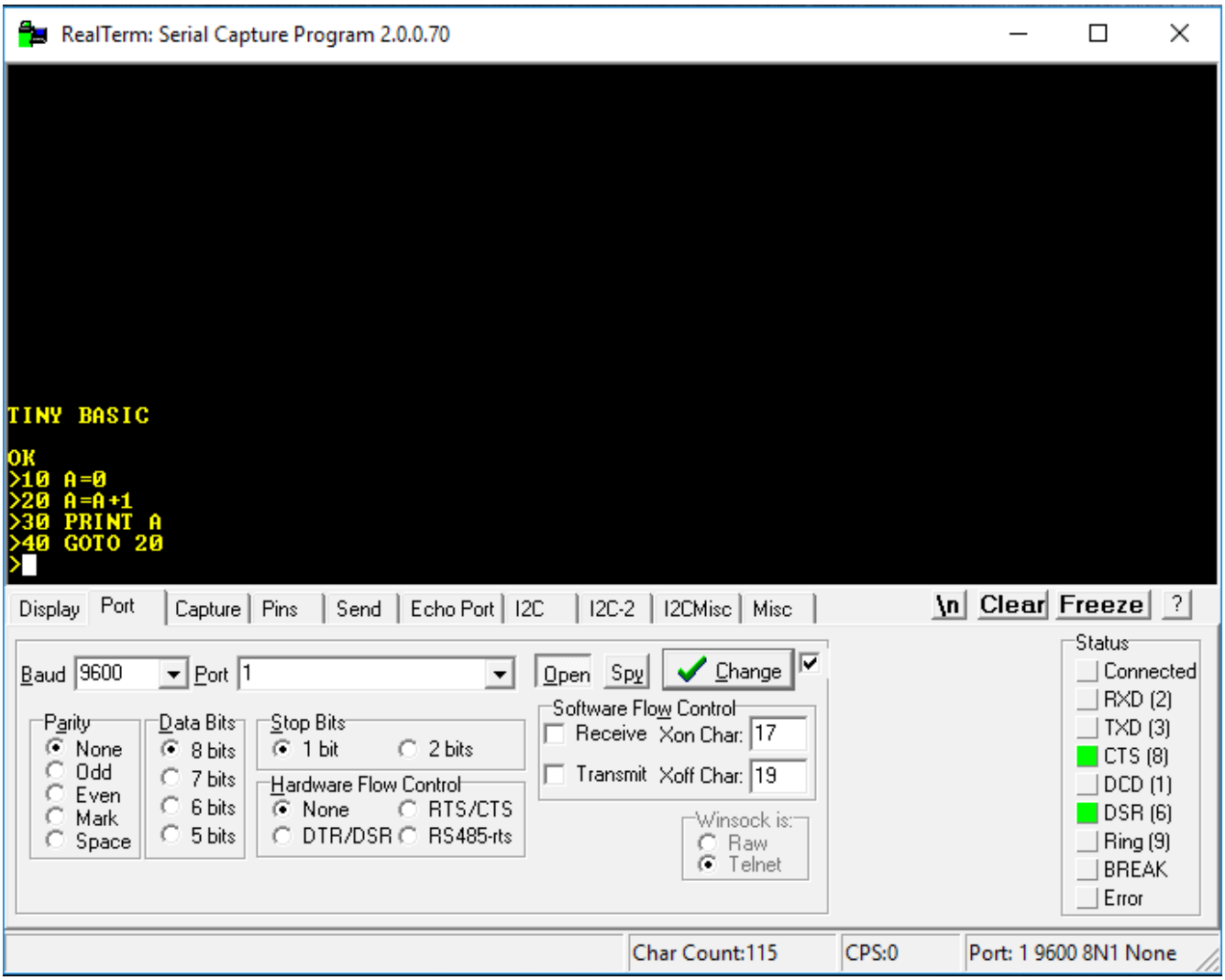


I will demonstrate Tiny BASIC programming, and how to save and load programs from the PC disk. A full description of the Tiny BASIC programming language can be found in Appendix A.

To enter program statements, at the > prompt, type a number between 1 and 32767, a space, then a program statement. When you have finished, hit return or enter. If you make a mistake, you can erase the line by entering the line number only, then re-enter the line. Using backspace does not seem to work

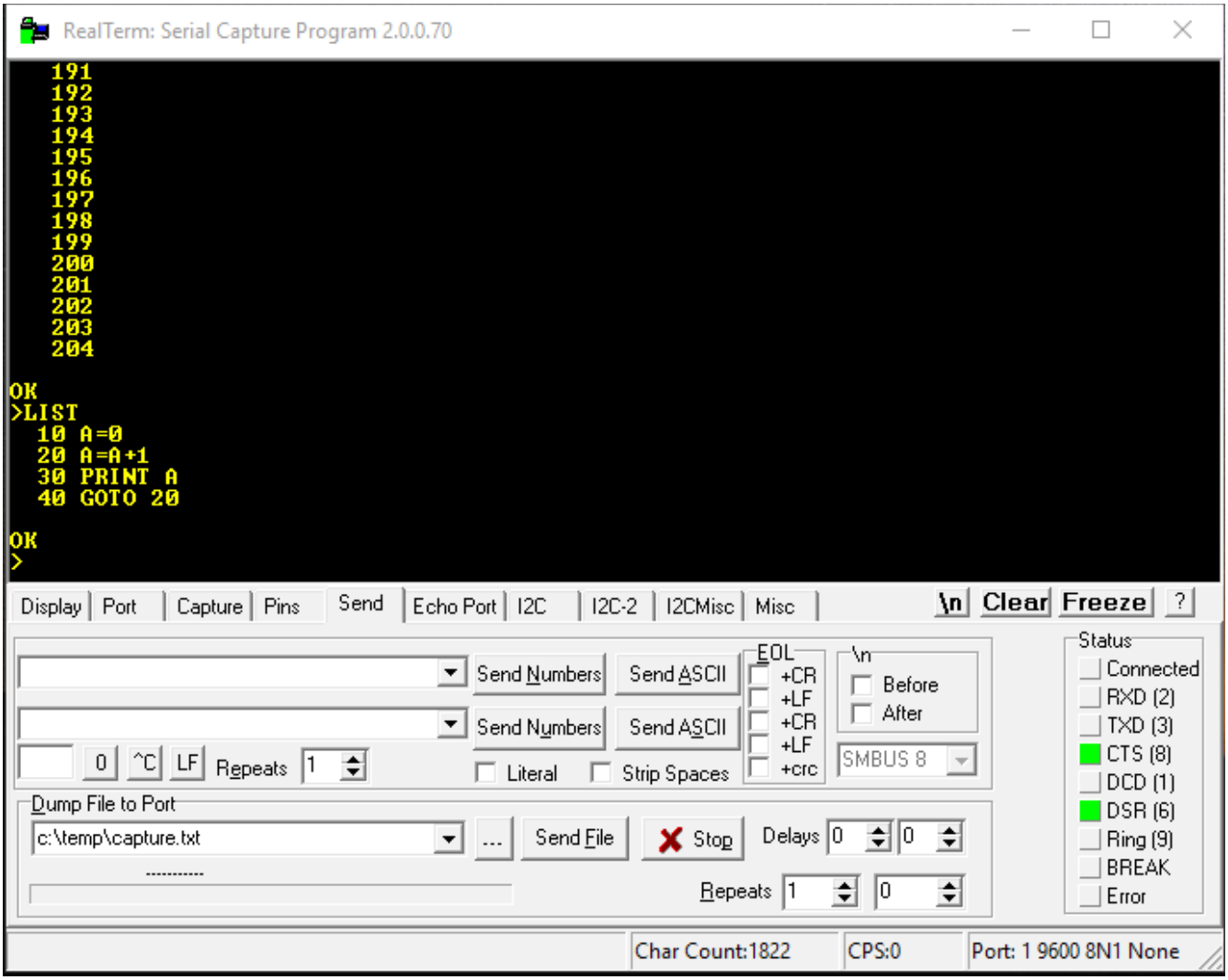
to erase your characters in the Realterm environment.

Here is a sample program, which prints consecutive integers starting at 1 :

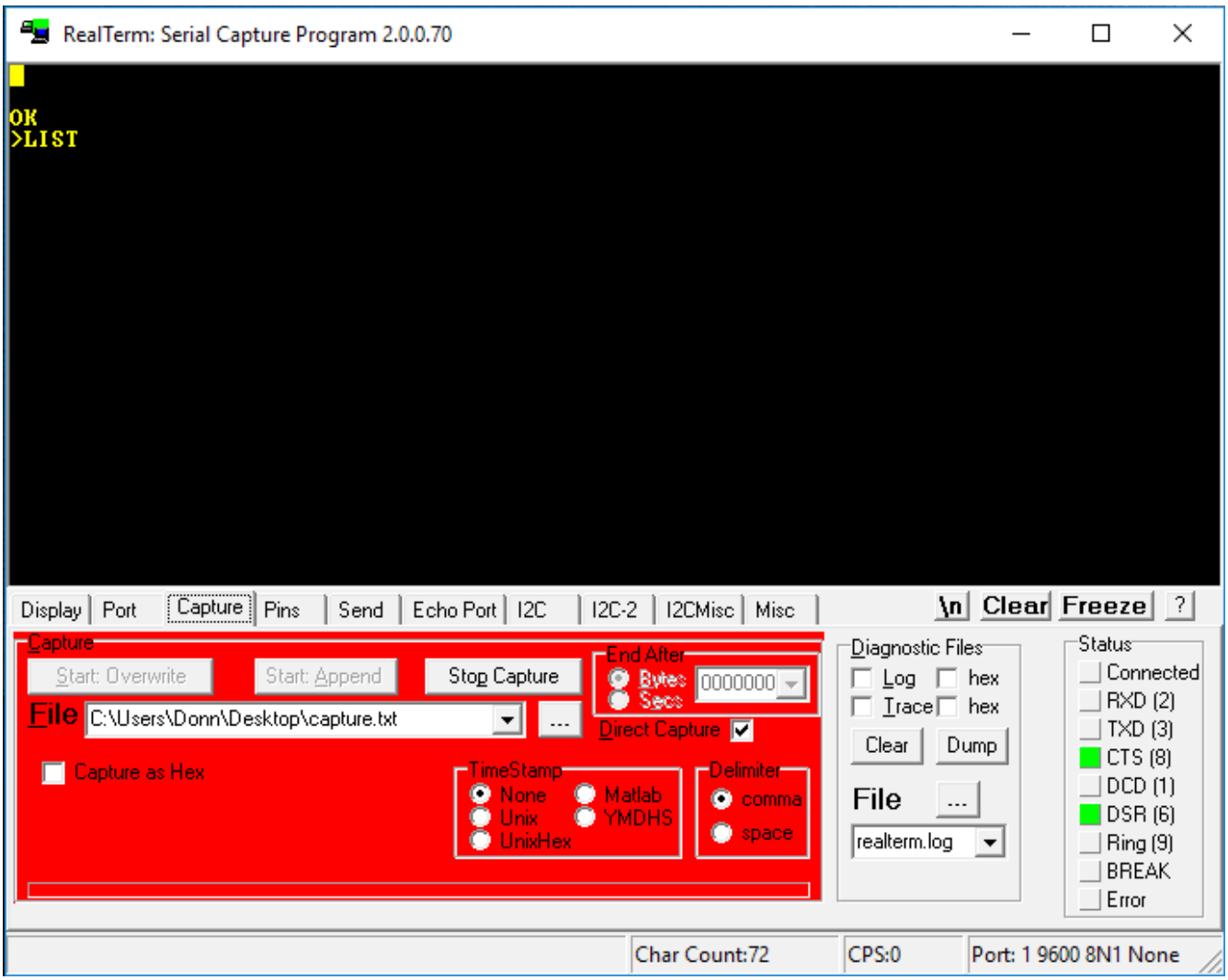


To run the program, type RUN at the prompt. The integers will scroll down the screen. To stop the program, go to the Send tab of Realterm and hit the control-C button (^C, shown by the red arrow):

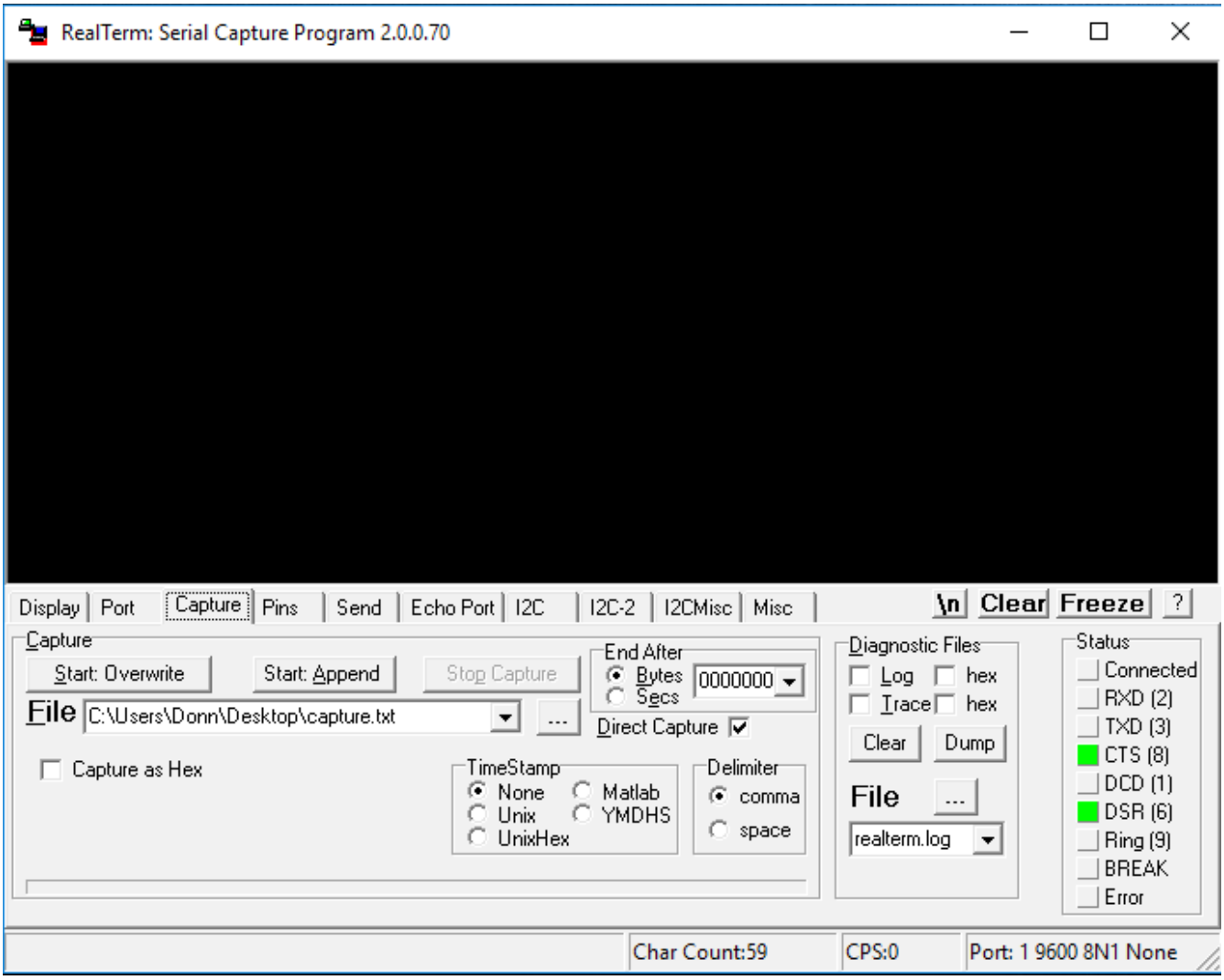
To see your program as it sits in Tiny BASIC's memory, type LIST:



We can use the LIST command, with the Realterm Capture function, to save a copy of the program to the disk on the PC. On the Realterm Capture tab, enter or navigate to a file to save the program. By default, the capture file, which is a text file, has the name capture.txt, but you can give it any name you like. Sometimes people use the .bas extension for BASIC program files. Once you have entered a file name and location, type LIST at the Tiny BASIC prompt <u>but do not hit Enter</u>. Then, hit the Start Overwrite button on the Realterm Capture tab. The capture area will turn red. Then, at the BASIC prompt, hit Enter:

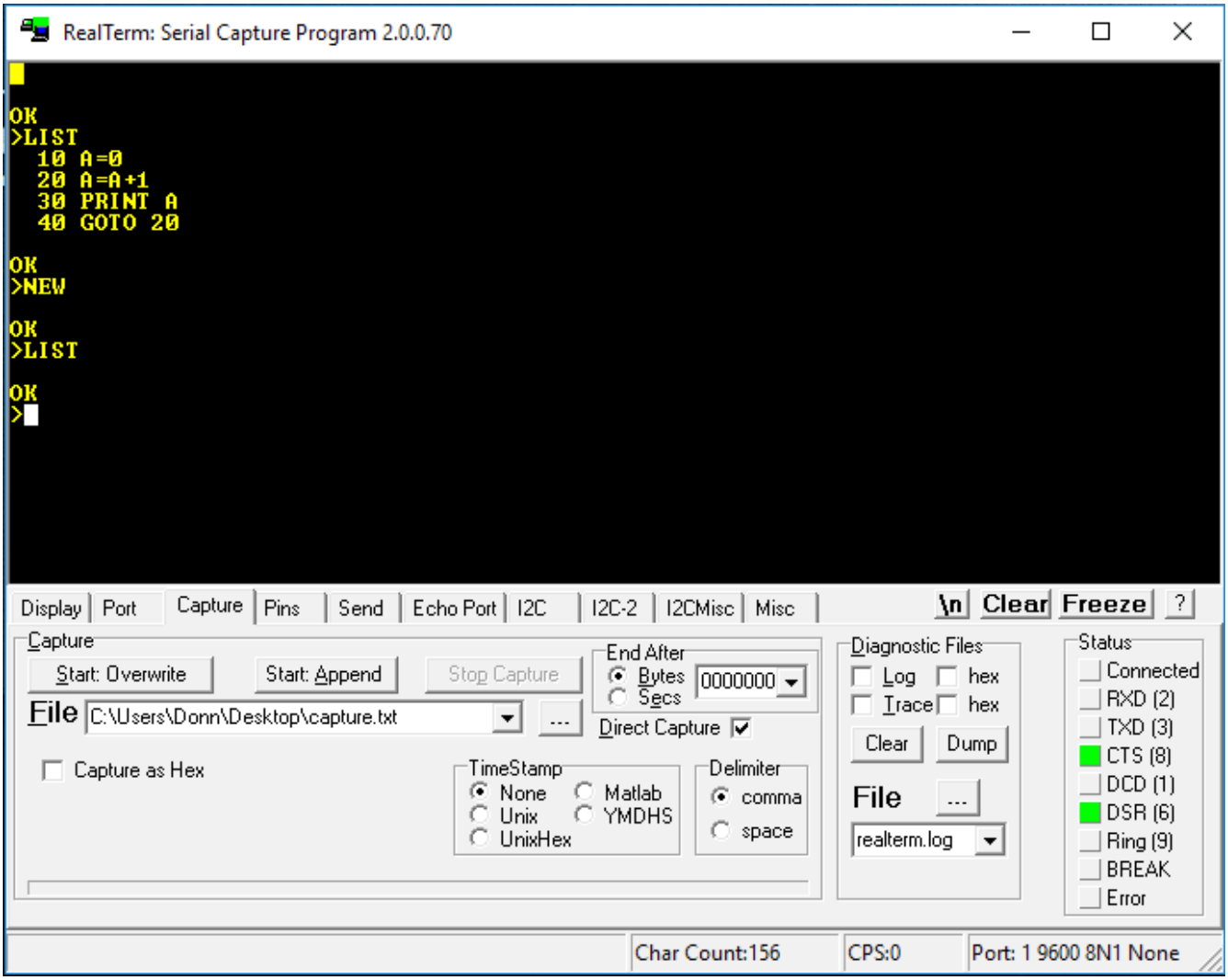


Next, hit the Stop Capture button. The screen will clear, and the capture area will turn back to its normal color:

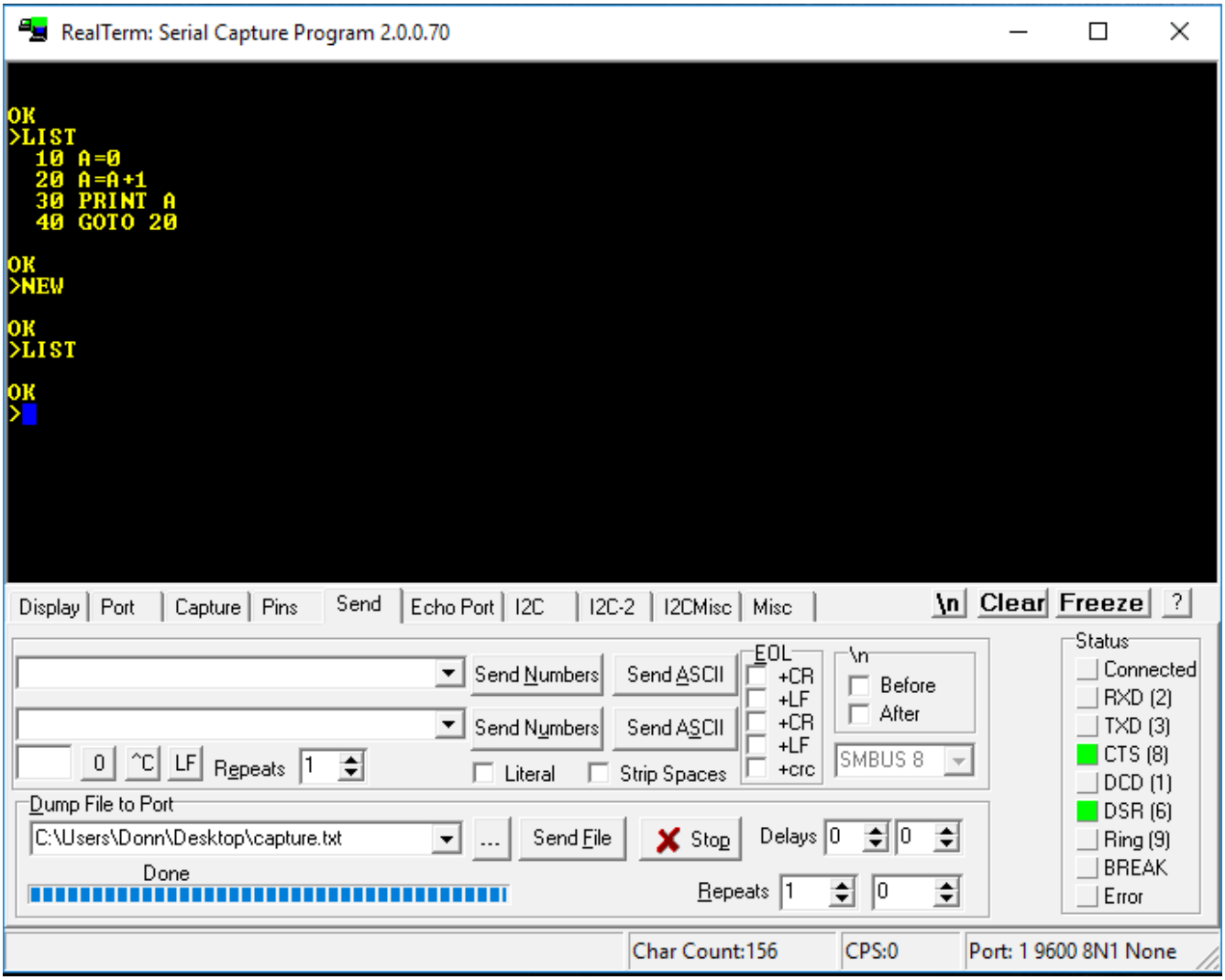


It looks like Tiny BASIC is lost, but click in the terminal screen area and hit Enter a few times and the Tiny BASIC prompt will re-appear.

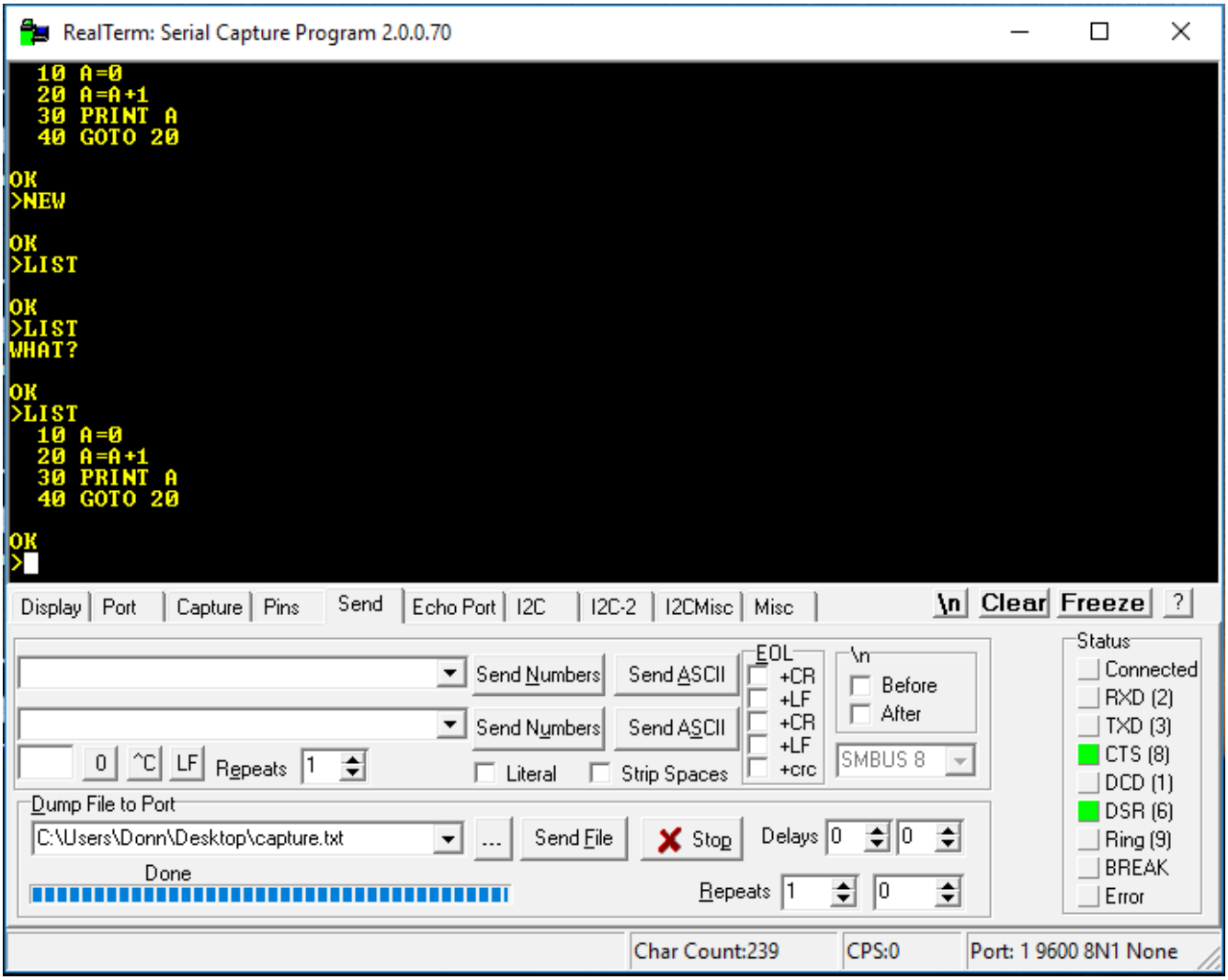
We will now load back the program we saved. First, type LIST to show the program is still in the Tiny BASIC memory. Then, type NEW to erase the program. After that, type LIST again to verify that the program is gone:



We will use the functions on the Realterm Send tab to load the program back into Tiny BASIC's memory area. In the terminal window, enter control-O. Nothing will happen, this just turns off Tiny BASIC's terminal output. This will prevent Tiny BASIC from echoing the characters in the file as we load them, which would mess up the screen. Then, in the Realterm Send tab, in the Dump File to Port area, enter or navigate to the program file. Then, hit the Send File button. The blue progress bar will show that the file has been sent. Then, hit the Stop button:



Now enter control-O again in the terminal window, to turn back on Tiny BASICs screen output. Type LIST or hit Enter. Tiny BASIC will have some garbage in its input buffer, because the capture file will have sent the “OK” and the prompt character from the LIST command output that we saved in the file, so it will produce a WHAT ? error message. If this bothers you, you can edit the capture file to remove them. But, if you hit Enter again, the error is cleared. Now enter LIST again, and you will see that the program is back in Tiny BASIC's memory:

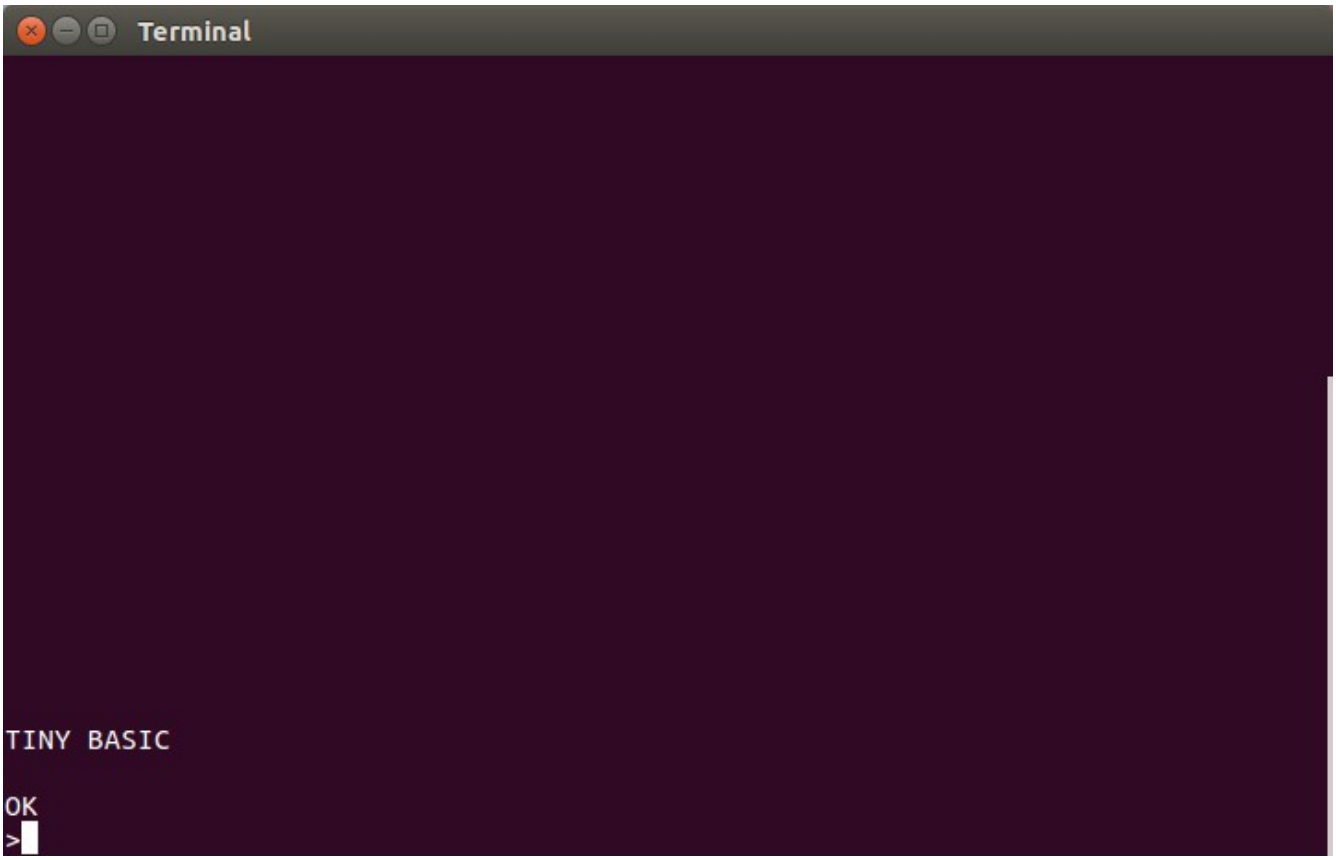


Use RUN to verify that the program works.

This concludes the discussion of running Tiny BASIC on the CPUville Z80 computer with Realterm in Windows.

Using Tiny BASIC with Minicom in Linux

Open a terminal window and start Minicom, with the port set to 9600 baud with 8 data bits, one stop bit, and no parity – the usual settings when operating the CPUville Z80 computer with the serial interface. With the Tiny BASIC EPROM installed, connect the computer to power, and take it out of reset. The terminal window will show the Tiny BASIC greeting:



I will demonstrate Tiny BASIC programming, and how to save and load programs from the PC disk. A full description of the Tiny BASIC programming language can be found in Appendix A.

To enter program statements, at the > prompt, type a number between 1 and 32767, a space, then a program statement. When you have finished entering a program statement, hit Enter. If you make a mistake, you can erase the line by entering the line number only at the Tiny BASIC prompt, then re-enter the line number with the corrected statement. Using backspace does not seem to work to erase your characters in the Minicom environment before you enter a line.

Here is a sample program the prints consecutive integers:

```
Terminal

TINY BASIC

OK
>10 A=0
>20 A=A+1
>30 PRINT A
>40 GOTO 20
>
```

To see your program as it sits in Tiny BASIC's memory, type LIST:

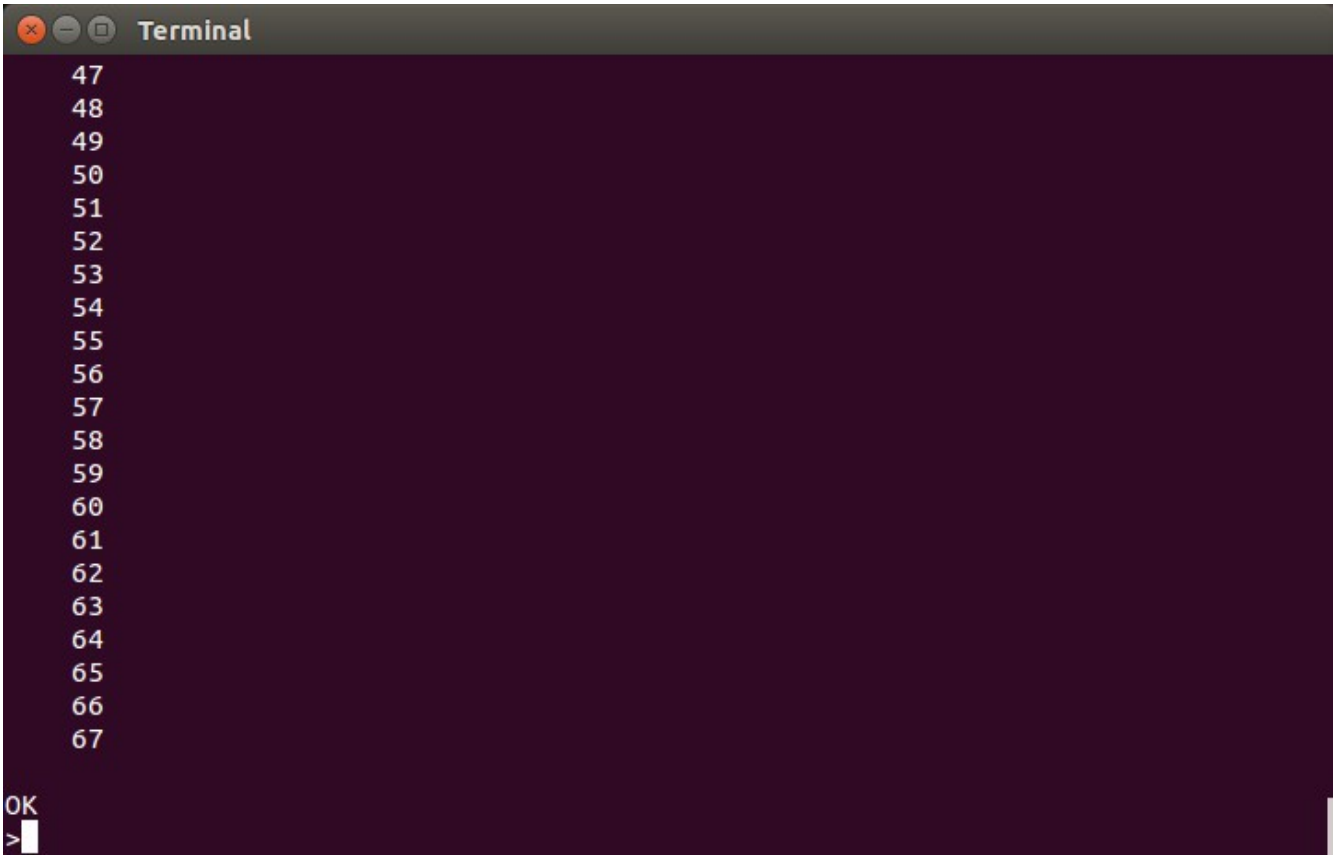
```
Terminal

TINY BASIC

OK
>10 A=0
>20 A=A+1
>30 PRINT A
>40 GOTO 20
>LIST
  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
>
```

To run the program, type RUN at the prompt. The integers will scroll down the screen. To stop the program, hit control-C:



We will use the LIST command, with the Minicom capture function, to save a copy of the program to the disk on the PC. Start by typing LIST at the Tiny BASIC prompt but do not press Enter. Hit control-A then Z to get the Minicom Command Summary window:

```
Terminal

     +-----------------------------------------------------------------+
     |                      Minicom Command Summary                    |
     |                                                                 |
     |               Commands can be called by CTRL-A <key>            |
     |                                                                 |
     |                Main Functions                  Other Functions  |
     |                                                                 |
     | Dialing directory..D  run script (Go)....G | Clear Screen.......C |
TINY | Send files.........S  Receive files......R | cOnfigure Minicom..O |
     | comm Parameters....P  Add linefeed.......A | Suspend minicom....J |
OK   | Capture on/off.....L  Hangup.............H | eXit and reset.....X |
>10 A| send break.........F  initialize Modem...M | Quit with no reset.Q |
>20 A| Terminal settings..T  run Kermit.........K | Cursor key mode....I |
>30 P| lineWrap on/off....W  local Echo on/off..E | Help screen........Z |
>40 G| Paste file.........Y  Timestamp toggle...N | scroll Back........B |
>LIST| Add Carriage Ret...U                                              |
  10 |                                                                 |
  20 |             Select function or press Enter for none.            |
  30 +-----------------------------------------------------------------+
  40 GOTO 20

OK
CTRL-A Z for help | 9600 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyS0
```

Hit the L key to designate and activate a capture file:

```
Terminal

TINY BASIC
                    +----------------------------------------+
OK                  |Capture to which file?                  |
>10 A=0             |> minicom.cap                           |
>20 A=A+1           +----------------------------------------+
>30 PRINT A
>40 GOTO 20
>LIST
  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
CTRL-A Z for help | 9600 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyS0
```

The default is minicom.cap, but you can use any name. Many people like to use the .bas extension for BASIC language program files. The Minicom capture function will append the capture file if it already exists, so for the purposes of saving a program you should either delete the old capture file first, or designate a new file. After you hit Enter the capture file is opened and the command summary closes. Now hit Enter to perform the LIST command in Tiny BASIC. The program listing will be captured by the file. Then, hit control-A then Z then L and close the capture file:

```
Terminal

TINY BASIC

OK
>10 A=0
>20 A=A+1
>30 PRINT A              +--------------------------------+
>40 GOTO 20              |          Capture file          |
>LIST                    |   Close    Pause      Exit    |
  10 A=0                 +--------------------------------+
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
>LIST
  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
CTRL-A Z for help | 9600 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyS0
```

Note you can go directly to the capture file dialog by entering control-A then L, bypassing the Minicom Command Summary.

Tiny BASIC sends text with carriage-return/linefeed characters at the end of each line (hex 0x0D, 0x0A). In Linux, which is derived from Unix, the convention is that lines in text files are terminated by a newline character only. In ASCII, this is the same as the linefeed character, 0x0A. When the Tiny BASIC program listing is saved, the Linux shell or the tty code strips out the carriage return characters. However, Tiny BASIC needs the carriage return characters when it reads back the file. So, they need to be put back into the capture file. There is a Linux utility that does this for us, called **unix2dos**[3].

Open a second terminal window. Enter the command **unix2dos** followed by the name of the capture file. To verify that you have the capture file, you can display it using the more command:

3 In Linux Debian-based system, the package that contains this utility is called **dos2unix**. It can be obtained from the repositories by the command **apt-get install dos2unix**.

```
Terminal
donn@donn-desktop:~$ unix2dos minicom.cap
unix2dos: converting file minicom.cap to DOS format ...
donn@donn-desktop:~$ more minicom.cap

  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
>
donn@donn-desktop:~$
```

Note that the capture file contains the “OK” and the Tiny BASIC prompt “>” after the program listing. These extra characters will cause Tiny BASIC to produce a WHAT error when you read back the file, but this won't interfere with getting the program back. You can now close the second terminal window.

To read back the program file, we will use the Minicom Paste File function from the Command Summary. But first, at the Tiny BASIC prompt, type NEW to erase the program from memory. Type LIST to verify that the program is gone. Then type control-O. This will prevent Tiny BASIC from echoing the incoming characters to the screen. Now type control-A then Z then Y, or just control-A then Y to get to the Minicom Paste File command. You can navigate to the file, or hit Enter to get a space to type in the name:

```
Terminal
  40 GOTO 20
  +------------------------[Select a file for upload]------------------------+
OK|Directory: /home/donn                                                      |
>L| [..]                                                                      |
  | [.adobe]                                                                  |
  | [.cache]                                                                  |
  | [.compiz]                                                                 |
  | [.config]                                                                 |
  | [.dbus]                                                                   |
OK| [.dropbox]                                                                |
>L| [.dropbox-dist]+----------------------------------------+                 |
  | [.eclipse]     |No file selected - enter filename:       |                |
  | [.gconf]       |> minicom.cap                            |                |
  | [.gimp-2.8]    +----------------------------------------+                |
  | [.gnome2]                                                                 |
  | [.gnome2_private]                                                         |
OK| [.gnupg]                                                                  |
>N| [.gnuradio]                                                               |
  |              ( Escape to exit, Space to tag )                             |
OK+---------------------------------------------------------------------------+
>LIST
                 [Goto]  [Prev]  [Show]   [Tag]  [Untag] [Okay]
OK
CTRL-A Z for help | 9600 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyS0
```

After the file name is entered, hit Enter to transfer the file. Now type control-O again to turn Tiny BASIC's output back on. Hit Enter or type LIST. Tiny BASIC will show the WHAT error because of the “OK” and “>” in the capture file, but just hit Enter again and you will get back to the Tiny BASIC prompt and clear the error. Then type LIST and you will see that the program has been read back into the Tiny BASIC memory:

```
Terminal
  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
>NEW

OK
>LIST

OK
>LIST
WHAT?

OK
>LIST
  10 A=0
  20 A=A+1
  30 PRINT A
  40 GOTO 20

OK
>
```

Enter RUN to verify that the program works.

This concludes the discussion of using Tiny BASIC with Minicom in Linux.

Appendix A: Tiny BASIC Language Description

What follows is the original description of the Tiny BASIC language taken from Li-Chen Wang's article published in *Dr. Dobb's Journal of Computer Calisthenics and Orthodontia*, vol. 1, number 5, May 1976, pages 12-15. This document can be found on-line at:

https://archive.org/details/dr_dobbs_journal_vol_01

The original text has been corrected in a few places for spelling and grammar errors. When procedures needed to be adapted for Tiny BASIC on the CPUville Z80 computer, I have added explanatory text in clearly marked boxes.

--Donn Stewart, November 2016

THE LANGUAGE

Numbers

All numbers are integers and must be less than 32767.

Variables

There are 26 variables denoted by letters A through Z. There is also a single array @(I). The dimension of this array is set automatically to make use of all the memory space that is left unused by the program. (i.e., 0 through SIZE/2, see SIZE function below.)

Functions

There are 3 functions:

```
     ABS(X) gives the absolute value of X.
     RND(X) gives a random number between 1 and x (inclusive).
     SIZE gives the number of bytes left unused by the program.
```

Arithmetic and Compare operators

```
     /    divide.
```

```
*    multiply.
-    subtract.
+    add.
>    greater than (compare).
<    less than (compare).
=    equal to (compare).
#    not equal to (compare).
>=   greater than or equal to (compare).
<=   less than or equal to (compare).
```

+, -, *, and / operations result in a value between -32767 and 32767. (-32768 is also allowed in some cases).
All compare operators result in a 1 if true and a 0 if not true.

Expressions

Expressions are formed with numbers, variables, and functions with arithmetic and compare operators between them. + and - signs can also he used at the beginning of an expression. The value of an expression is evaluated from left to right, except that * and / are always done first, and then + and -, and then compare operators. Parentheses can also be used to alter the order of evaluation. Note that compare operators can be used in any expression. For example:

```
10 LET A=(X>Y)*123+(X=Y)*456+(X<Y)*789
20 IF (U=1)*(V<2)+(U>V)*(U<99)*(V>3) PRINT "YES"
30 LET R=RND(100), A=(R>3)*(R>15)+(R>56)+(R>98)
```

In statement 10, A will be set to 123 if X>Y, to 456 if X=Y, and to 789 if X<Y. In statement 20, the "*" operator acts like a logical AND, and the "+" operator acts like a logical OR. In statement 30, Y will be a random number between 0 and 4 with a prescribed probability distribution of: 3% of being 0, 15-3=12% of being 1, 56-15=41% of being 2, 98-56=42% of being 3, and 100-98=2% of being 4.

Direct Commands

All the commands described later can he used as direct commands except the following three, they can only be used as direct commands and not as part of a statement:

RUN

will start to execute the program starting at the lowest statement number.

LIST

will print out all the statements in numerical order.

LIST 120

will print out all the statements starting at statement 120.

NEW

will delete all statements.

Abbreviations and blanks

You may use blanks freely, except that numbers, command key words, and function names can not have embedded blanks. You may truncate all command keywords and function names and follow them by a period. “P.", "PR.", "PRI.", and "PRIN." all stand for "PRINT". Also the word LET in LET command can be omitted. The "shortest" abbreviation for all keywords are as follows:

A.= ABS	F.= FOR	GOS.= GOSUB	G.= GOTO
IF = IF	IN.= INPUT	L.= LIST	N.= NEW
N.= NEXT	P.= PRINT	REM = REMARK	R.= RETURN
R.= RND	R.= RUN	S.= SIZE	S.= STEP
S.=STOP	TO=TO		
Implied = LET			

Statements

A statement consists of a statement number of between 1 and 32767 followed by one or more commands. Commands in the same statement are separated by a semi-colon ";". "GOTO", "STOP", and "RETURN" commands must be the last command in any given statement.

Commands

Tiny BASIC commands are listed below with examples. Remember that commands can be concatenated with semi-colons. In order to store the statement, you must also have a statement number in front of the commands. The statement number and the concatenation are not shown in the examples.

REM or REMARK Command

REM anything goes

This line will be ignored by TBI.

LET Command

LET A=234-5*6, A=A/2. X=A-100, @(X+9)=A-1

will set the variable A to the value of the expression 234-5*6 (i.e., 204), set the variable A (again) to the value of the expression A/2 (i.e., 102), set the variable X to the value of the expression A-100 (i.e., 2), and then set the variable @(11) to 101 (where 11 is the value of the expression X+9 and 101 is the value of the expression A-1).

LET U=A#B, V=(A>B) *X+(A<B)*Y

will set the variable U to either 1 or 0 depending on whether A is not equal to or is equal to B; and set the variable V to either X. Y or 0 depending on whether A is greater than, less than, or equal to B.

PRINT Command

PRINT

will cause a carriage-return (CR) and a line-feed (LF) on the output device.

PRINT A*3+1, "ABC 123 !@#", ' CBA '

will print the value of the expression A*3+1 (i.e., 307), the string of characters "ABC 123 !@#", and the string " CBA ", and then a CR-LF. Note that either single or double quotes can be used to quote strings, but pairs must be matched.

```
PRINT A*3+1, "ABC 123 !@#", ' CBA ',
```

will produce the same output as before, except that there is no CR-LF after the last item is printed. This enables the program to continue printing on the same line with another "PRINT".

```
PRINT A, B, #3, C, D, 2, #10, F, G
```

will print the values of A and B in 6 spaces, the values of C, D, and E in 3 spaces, and the values of F and G in 10 spaces. If there are not enough spaces specified for a given value to be printed, the value will be printed with enough spaces anyway.

```
PRINT 'ABC',-,'XXX'
```
[4]

will print the string "ABC", a CR without a LF, and then the string "XXX" (over the ABC) followed by a CR-LF.

INPUT Command

```
INPUT A, B
```

When this command is executed, Tiny BASIC will print “A:“ and wait to read in an expression from the input device. The variable A will be set to the value of this expression. Then "B:" is printed and variable B is set to the value of the next expression read from the input device. Note that not only numbers, but also expressions can be read as input.

```
INPUT 'WHAT IS THE WEIGHT' A, "AND SIZE"B
```

This is the same as the command above, except the prompt "A:" is replaced by "WHAT IS THE WEIGHT:“ and the prompt "B:" is replaced by "AND SIZE:". Again, both single and double quotes can be used as long as they are matched.

---

4 The minus sign '-' here and in the Input command description is intended to be a carriage return character, 0x0D, which would cause the cursor to return to the beginning of the line for overtyping. Most video display terminals, and PCs using terminal emulators, will not do true overtyping, just character replacement. Also, I have not found a way to enter a carriage return into a Tiny BASIC PRINT command on Realterm or Minicom.

```
INPUT A, 'STRING', -, "ANOTHER STRING", B
```

The strings and the "-" have the same effect as in "PRINT.

IF Command

```
IF A<B LET X=3: PRINT 'THIS STRING'
```

will test the value of the expression A<B. If it is not zero (i.e., if it is true), the commands in the rest of this statement will be executed. If the value of the expression is zero (i.e., if it is not true), the rest of this statement will be skipped over and execution continues at next statement. Note that the word "THEN" is not used.

GOTO Command

```
GOTO 120
```

will cause the execution to jump to statement 120. Note that GOTO command cannot be followed by a semi-colon and other commands. It must be ended with a CR.

```
GOTO A*10+B
```

will cause the execution to jump to a different statement number as computed from the value of the expression.

GOSUB and RETURN Commands

GOSUB command is similar to GOTO command except that: a) the current statement number and position within the statement is remembered; and b) a semi-colon and other commands can follow it in the same statement.

```
GOSUB 120
```

will cause the execution to jump to statement 120.

```
GOSUB A*10+B
```

will cause the execution to jump to different statements as computed from the value of the expression A*10+B.

RETURN

A RETURN command must be the last command in a statement and followed by a CR. When a RETURN command is encountered, it will cause the execution to jump back to the command following the most recent GOSUB command.

GOSUB can be nested. The depth of nesting is limited only by the stack space.

FOR and NEXT Commands

FOR X=A+1 TO 3*B STEP C-1

The variable X is set to the value of the expression A+1. The values of the expressions (not the expressions themselves) 3*B and C-1 are remembered. The name of the variable X, the statement number and the position of this command within the statement are also remembered. Execution then continues the normal way until a NEXT command is encountered.

The STEP can be positive, negative or even zero. The word STEP and the expression following it can be omitted if the desired STEP is +1.

NEXT X

The name of the variable (X) is checked with that of the most recent FOR command. If they do not agree, that FOR is terminated and the next recent FOR is checked, etc. When a match is found, this variable will be set to its current value plus the value of the STEP expression saved by the FOR command. The updated value is then compared with the value of the TO expression also saved by the FOR command. If this is within the limit, execution will jump back to the command following the FOR command. If this is outside the limit, execution continues following the NEXT command itself.

FOR can he nested. The depth of nesting is limited only by the stack space. If a new FOR command with the same control variable as that of an old FOR command is encountered, the old FOR will be terminated automatically.

STOP Command

STOP

This command stops the execution of the program and returns control to direct commands from the input device. It can appear many times in a program but must he the last command in any given statement. i.e., it cannot be followed by a semicolon and other commands.

Stopping the Execution

The execution of program or listing of program can be stopped by the Control-C key on the input device.

> To stop execution or listing of a program using Tiny BASIC on the CPUville Z80 computer with Realterm and Windows, you will need to press the control-C button (designated ^C) on the panel in the Send tab. In Minicom and Linux, control-C from the keyboard works fine.

Control of Output Device

The Control-O key on the input device can he used to turn the output device ON and OFF. This is useful when you want to read in a program punched on paper tape. To produce such a paper tape, type "LIST" without CR. Turn on the paper tape punch and type a few Control-Shift-P's and then a CR. When listing is finished, type more Control-Shift-P's and turn off the punch.

> To save a program to disk when running Tiny BASIC on the CPUville Z80 computer using Realterm in Windows, type LIST without the CR (that is, the Enter key), and under the Capture tab designate a file to capture the output. Hit Start Overwrite, then press Enter while in the terminal window. When the listing has stopped, press the Stop button to close the capture file.
> To save a program using Minicom in Linux, type LIST without the CR, and turn on a capture file using the Minicom Command Summary menu (ctrl-A-Z-L, or more directly by ctrl-A-L). Then press Enter. When the listing has stopped, use ctrl-A-L again to close the capture file. In Linux, the capture file will lack the carriage return characters, because these are stripped out by the Linux shell when creating a text file. To replace them (necessary when reading back the file into Tiny BASIC), open a second terminal window, and use the command **unix2dos** followed by the name of the capture file.

To read back such a paper tape, type "NEW", CR, and Control-O, then turn on the paper tape reader. When the paper tape is read, turn the reader off and type a Control-O again.

To read a program into Tiny BASIC running on a CPUville Z80 using Realterm in Windows, type “NEW”, Enter, and control-O. Then use the RealTerm Send File controls to send the file you captured before. When you have finished sending the file type control-O again.
To read in a program using Minicom in Linux, type “NEW”, enter, and control-O. Then use the Minicom Paste file function, accessed from the Minicom Command Summary menu (ctrl-A-Z-Y, or more directly, ctrl-A-Y), to paste in the file you captured before. Remember, you have to replace the carriage return characters in that file with the **unix2dos** command if you have not done so already. Files in both the Windows and Linux environments will have the “OK” and Tiny BASIC prompt characters in them from the capture, so Tiny BASIC will throw a WHAT? Error when you first hit Enter after loading a program, but this clears the error, and LIST will show the program to be intact.

Error Report

There are only three error conditions in Tiny BASIC. The statement with the error is printed out with a question mark inserted at the point where the error is detected.

(1) WHAT? means it does not understand you. Example:

```
WHAT?
210 P?TINT "THIS"        where PRINT is misstyped

WHAT?
260 LET A=B+3, C=(3+4?, X=4
```

(2) HOW? means it understands you but does not know how to do it.

```
HOW?
310 LET A=B*C?+2         where B*C is greater than 32767

HOW?
380 GOTO 412?            where 412 does not exist
```

(3)SORRY means it understands you and knows how to do it but there is not enough memory to do it.

Error Corrections

If you notice an error in typing before you hit the CR, you can delete the last character by the Rub-Out key or delete the entire line by the Alt-Mode key. Tiny BASIC will echo a back-slash for each Rub-Out. Echo for Alt-Mode consists of a LF, a CR, and an up-arrow.

To correct a statement, you can retype the statement number and the correct commands. Tiny BASIC will replace the old statement with the new one.

To delete a statement, type the statement number and a CR only.

Verify the corrections by "LIST nnnn" and hit the Control-c key while the line is being printed.

Appendix B: Tiny BASIC Assembly listing

```
1
 8080 MACRO ASSEMBLER, VER 3.0        ERRORS = 0
+                                                  17:09  10/02/2016
+                                                                                    PAGE 1


                    ;
                    ;Modified Nov 1 2016 by Donn Stewart for use in CPUville Z80 computer
                    ;Changed UART (ACIA) port numbers to 3 for status, 2 for data in INIT, CHKIO, OUTC
                    ;Status bit for read in CHKIO changed to 0x02
                    ;Status bit for write in OUTC (actually OC3) changed to 0x01
                    ;Changed UART initialization parameters in INIT
                    ;Changed ORG statements at end of file to match system with 2K RAM
                    ;Changes shown in BOLD type
                    ;*************************************************************
                    ;
                    ;                 TINY BASIC FOR INTEL 8080
                    ;                       VERSION 2.0
                    ;                     BY LI-CHEN WANG
                    ;                  MODIFIED AND TRANSLATED
                    ;                    TO INTEL MNEMONICS
                    ;                     BY ROGER RAUSKOLB
                    ;                      10 OCTOBER,1976
                    ;                        @COPYLEFT
                    ;                  ALL WRONGS RESERVED
                    ;
                    ;*************************************************************
                    ;
                    ; *** ZERO PAGE SUBROUTINES ***
                    ;
                    ; THE 8080 INSTRUCTION SET LETS YOU HAVE 8 ROUTINES IN LOW
                    ; MEMORY THAT MAY BE CALLED BY RST N, N BEING 0 THROUGH 7.
                    ; THIS IS A ONE BYTE INSTRUCTION AND HAS THE SAME POWER AS
                    ; THE THREE BYTE INSTRUCTION CALL LLHH.  TINY BASIC WILL
                    ; USE RST 0 AS START AND RST 1 THROUGH RST 7 FOR
                    ; THE SEVEN MOST FREQUENTLY USED SUBROUTINES.
                    ; TWO OTHER SUBROUTINES (CRLF AND TSTNUM) ARE ALSO IN THIS
                    ; SECTION.  THEY CAN BE REACHED ONLY BY 3-BYTE CALLS.
                    ;
                    DWA     MACRO WHERE
        1                   DB   (WHERE SHR 8) + 128
        1                   DB   WHERE AND 0FFH
                            ENDM
                    ;
   0000                     ORG  0H
   0000   310010    START:  LXI  SP,STACK                   ;*** COLD START ***
   0003   3EFF              MVI  A,0FFH
   0005   C34206            JMP  INIT
                    ;
   0008   E3                XTHL                            ;*** TSTC OR RST 1 ***
   0009   EF                RST  5                          ;IGNORE BLANKS AND
   000A   BE                CMP  M                          ;TEST CHARACTER
   000B   C36800            JMP  TC1                        ;REST OF THIS IS AT TC1
                    ;
   000E   3E0D      CRLF:   MVI  A,CR                       ;*** CRLF ***
                    ;
   0010   F5                PUSH PSW                        ;*** OUTC OR RST 2 ***
   0011   3A0008            LDA  OCSW                       ;PRINT CHARACTER ONLY
   0014   B7                ORA  A                          ;IF OCSW SWITCH IS ON
```

```
0015   C36C06          JMP  OC2                    ;REST OF THIS IS AT OC2
                ;
0018   CD7103          CALL EXPR2                  ;*** EXPR OR RST 3 ***
001B   E5              PUSH H                      ;EVALUATE AN EXPRESSION
001C   C32D03          JMP  EXPR1                  ;REST OF IT AT EXPR1
001F   57              DB   'W'
                ;
0020   7C              MOV  A,H                    ;*** COMP OR RST 4 ***
0021   BA              CMP  D                      ;COMPARE HL WITH DE
0022   C0              RNZ                         ;RETURN CORRECT C AND
0023   7D              MOV  A,L                    ;Z FLAGS
0024   BB              CMP  E                      ;BUT OLD A IS LOST
0025   C9              RET
0026   414E            DB   'AN'
                ;
0028   1A       SS1:   LDAX D                      ;*** IGNBLK/RST 5 ***
0029   FE20            CPI  20H                    ;IGNORE BLANKS
002B   C0              RNZ                         ;IN TEXT (WHERE DE->)
002C   13              INX  D                      ;AND RETURN THE FIRST
002D   C32800          JMP  SS1                    ;NON-BLANK CHAR. IN A
                ;
0030   F1              POP  PSW                    ;*** FINISH/RST 6 ***
0031   CDB304          CALL FIN                    ;CHECK END OF COMMAND
0034   C3C604          JMP  QWHAT                  ;PRINT "WHAT?" IF WRONG
0037   47              DB   'G'
                ;
0038   EF              RST  5                      ;*** TSTV OR RST 7 ***
0039   D640            SUI  40H                    ;TEST VARIABLES
003B   D8              RC                          ;C:NOT A VARIABLE
003C   C25800          JNZ  TV1                    ;NOT "@" ARRAY
003F   13              INX  D                      ;IT IS THE "@" ARRAY
0040   CD1A04          CALL PARN                   ;@ SHOULD BE FOLLOWED
0043   29              DAD  H                      ;BY (EXPR) AS ITS INDEX
0044   DA9F00          JC   QHOW                   ;IS INDEX TOO BIG?
0047   D5              PUSH D                      ;WILL IT OVERWRITE
0048   EB              XCHG                        ;TEXT?
0049   CD5904          CALL SIZE                   ;FIND SIZE OF FREE
004C   E7              RST  4                      ;AND CHECK THAT
004D   DAF404          JC   ASORRY                 ;IF SO, SAY "SORRY"
0050   21000F          LXI  H,VARBGN               ;IF NOT GET ADDRESS
0053   CD7C04          CALL SUBDE                  ;OF @(EXPR) AND PUT IT
0056   D1              POP  D                      ;IN HL
0057   C9              RET                         ;C FLAG IS CLEARED
0058   FE1B     TV1:   CPI  1BH                    ;NOT @, IS IT A TO Z?
005A   3F              CMC                         ;IF NOT RETURN C FLAG
005B   D8              RC
005C   13              INX  D                      ;IF A THROUGH Z
005D   21000F          LXI  H,VARBGN               ;COMPUTE ADDRESS OF
0060   07              RLC                         ;THAT VARIABLE
0061   85              ADD  L                      ;AND RETURN IT IN HL
0062   6F              MOV  L,A                    ;WITH C FLAG CLEARED
```

```
0063   3E00            MVI  A,0
0065   8C              ADC  H
0066   67              MOV  H,A
0067   C9              RET
                ;
                ;TSTC:  XTHL                        ;*** TSTC OR RST 1 ***
                ;       RST  5                      ;THIS IS AT LOC. 8
                ;       CMP  M                      ;AND THEN JUMP HERE
0068   23       TC1:    INX  H                      ;COMPARE THE BYTE THAT
0069   CA7300           JZ   TC2                    ;FOLLOWS THE RST INST.
006C   C5              PUSH B                      ;WITH THE TEXT (DE->)
006D   4E              MOV  C,M                    ;IF NOT =, ADD THE 2ND
006E   0600            MVI  B,0                    ;BYTE THAT FOLLOWS THE
0070   09              DAD  B                      ;RST TO THE OLD PC
0071   C1              POP  B                      ;I.E., DO A RELATIVE
0072   1B              DCX  D                      ;JUMP IF NOT =
0073   13       TC2:    INX  D                      ;IF =, SKIP THOSE BYTES
0074   23              INX  H                      ;AND CONTINUE
0075   E3              XTHL
0076   C9              RET
                ;
0077   210000   TSTNUM: LXI  H,0                    ;*** TSTNUM ***
007A   44              MOV  B,H                    ;TEST IF THE TEXT IS
007B   EF              RST  5                      ;A NUMBER
007C   FE30     TN1:    CPI  30H                    ;IF NOT, RETURN 0 IN
007E   D8              RC                          ;B AND HL
007F   FE3A            CPI  3AH                    ;IF NUMBERS, CONVERT
0081   D0              RNC                         ;TO BINARY IN HL AND
0082   3EF0            MVI  A,0F0H                 ;SET B TO # OF DIGITS
0084   A4              ANA  H                      ;IF H>255, THERE IS NO
0085   C29F00          JNZ  QHOW                   ;ROOM FOR NEXT DIGIT
0088   04              INR  B                      ;B COUNTS # OF DIGITS
0089   C5              PUSH B
008A   44              MOV  B,H                    ;HL=10*HL+(NEW DIGIT)
008B   4D              MOV  C,L
008C   29              DAD  H                      ;WHERE 10* IS DONE BY
008D   29              DAD  H                      ;SHIFT AND ADD
008E   09              DAD  B
008F   29              DAD  H
0090   1A              LDAX D                      ;AND (DIGIT) IS FROM
0091   13              INX  D                      ;STRIPPING THE ASCII
0092   E60F            ANI  0FH                    ;CODE
0094   85              ADD  L
0095   6F              MOV  L,A
0096   3E00            MVI  A,0
0098   8C              ADC  H
0099   67              MOV  H,A
009A   C1              POP  B
009B   1A              LDAX D                      ;DO THIS DIGIT AFTER
009C   F27C00          JP   TN1                    ;DIGIT. S SAYS OVERFLOW
009F   D5       QHOW:   PUSH D                      ;*** ERROR "HOW?" ***
```

```
00A0   11A600   AHOW:   LXI  D,HOW
00A3   C3CA04           JMP  ERROR
00A6   484F573F HOW:    DB   'HOW?'
00AA   0D               DB   CR
00AB   4F4B     OK:     DB   'OK'
00AD   0D               DB   CR
00AE   57484154 WHAT:   DB   'WHAT?'
00B2   3F
00B3   0D               DB   CR
00B4   534F5252 SORRY:  DB   'SORRY'
00B8   59
00B9   0D               DB   CR
                ;
                ;*************************************************************
                ;
                ; *** MAIN ***
                ;
                ; THIS IS THE MAIN LOOP THAT COLLECTS THE TINY BASIC PROGRAM
                ; AND STORES IT IN THE MEMORY.
                ;
                ; AT START, IT PRINTS OUT "(CR)OK(CR)", AND INITIALIZES THE
                ; STACK AND SOME OTHER INTERNAL VARIABLES.  THEN IT PROMPTS
                ; ">" AND READS A LINE.  IF THE LINE STARTS WITH A NON-ZERO
                ; NUMBER, THIS NUMBER IS THE LINE NUMBER.  THE LINE NUMBER
                ; (IN 16 BIT BINARY) AND THE REST OF THE LINE (INCLUDING CR)
                ; IS STORED IN THE MEMORY.  IF A LINE WITH THE SAME LINE
                ; NUMBER IS ALREADY THERE, IT IS REPLACED BY THE NEW ONE.  IF
                ; THE REST OF THE LINE CONSISTS OF A CR ONLY, IT IS NOT STORED
                ; AND ANY EXISTING LINE WITH THE SAME LINE NUMBER IS DELETED.
                ;
                ; AFTER A LINE IS INSERTED, REPLACED, OR DELETED, THE PROGRAM
                ; LOOPS BACK AND ASKS FOR ANOTHER LINE.  THIS LOOP WILL BE
                ; TERMINATED WHEN IT READS A LINE WITH ZERO OR NO LINE
                ; NUMBER; AND CONTROL IS TRANSFERED TO "DIRECT".
                ;
                ; TINY BASIC PROGRAM SAVE AREA STARTS AT THE MEMORY LOCATION
                ; LABELED "TXTBGN" AND ENDS AT "TXTEND".  WE ALWAYS FILL THIS
                ; AREA STARTING AT "TXTBGN", THE UNFILLED PORTION IS POINTED
                ; BY THE CONTENT OF A MEMORY LOCATION LABELED "TXTUNF".
                ;
                ; THE MEMORY LOCATION "CURRNT" POINTS TO THE LINE NUMBER
                ; THAT IS CURRENTLY BEING INTERPRETED.  WHILE WE ARE IN
                ; THIS LOOP OR WHILE WE ARE INTERPRETING A DIRECT COMMAND
                ; (SEE NEXT SECTION). "CURRNT" SHOULD POINT TO A 0.
                ;
00BA   310010   RSTART: LXI  SP,STACK
00BD   CD0E00   ST1:    CALL CRLF                      ;AND JUMP TO HERE
00C0   11AB00           LXI  D,OK                      ;DE->STRING
00C3   97               SUB  A                         ;A=0
00C4   CD6005           CALL PRTSTG                    ;PRINT STRING UNTIL CR
00C7   21CE00           LXI  H,ST2+1                   ;LITERAL 0
```

```
00CA   220108          SHLD CURRNT                    ;CURRENT->LINE # = 0
00CD   210000   ST2:   LXI  H,0
00D0   220908          SHLD LOPVAR
00D3   220308          SHLD STKGOS
00D6   3E3E     ST3:   MVI  A,3EH                     ;PROMPT '>' AND
00D8   CDFA04          CALL GETLN                     ;READ A LINE
00DB   D5              PUSH D                         ;DE->END OF LINE
00DC   11370F          LXI  D,BUFFER                  ;DE->BEGINNING OF LINE
00DF   CD7700          CALL TSTNUM                    ;TEST IF IT IS A NUMBER
00E2   EF              RST  5
00E3   7C              MOV  A,H                       ;HL=VALUE OF THE # OR
00E4   B5              ORA  L                         ;0 IF NO # WAS FOUND
00E5   C1              POP  B                         ;BC->END OF LINE
00E6   CA3807          JZ   DIRECT
00E9   1B              DCX  D                         ;BACKUP DE AND SAVE
00EA   7C              MOV  A,H                       ;VALUE OF LINE # THERE
00EB   12              STAX D
00EC   1B              DCX  D
00ED   7D              MOV  A,L
00EE   12              STAX D
00EF   C5              PUSH B                         ;BC,DE->BEGIN, END
00F0   D5              PUSH D
00F1   79              MOV  A,C
00F2   93              SUB  E
00F3   F5              PUSH PSW                       ;A=# OF BYTES IN LINE
00F4   CD3805          CALL FNDLN                     ;FIND THIS LINE IN SAVE
00F7   D5              PUSH D                         ;AREA, DE->SAVE AREA
00F8   C20B01          JNZ  ST4                       ;NZ:NOT FOUND, INSERT
00FB   D5              PUSH D                         ;Z:FOUND, DELETE IT
00FC   CD5405          CALL FNDNXT                    ;FIND NEXT LINE
                                                      ;DE->NEXT LINE
00FF   C1              POP  B                         ;BC->LINE TO BE DELETED
0100   2A1508          LHLD TXTUNF                    ;HL->UNFILLED SAVE AREA
0103   CDE505          CALL MVUP                      ;MOVE UP TO DELETE
0106   60              MOV  H,B                       ;TXTUNF->UNFILLED AREA
0107   69              MOV  L,C
0108   221508          SHLD TXTUNF                    ;UPDATE
010B   C1       ST4:   POP  B                         ;GET READY TO INSERT
010C   2A1508          LHLD TXTUNF                    ;BUT FIRST CHECK IF
010F   F1              POP  PSW                       ;THE LENGTH OF NEW LINE
0110   E5              PUSH H                         ;IS 3 (LINE # AND CR)
0111   FE03            CPI  3                         ;THEN DO NOT INSERT
0113   CABA00          JZ   RSTART                    ;MUST CLEAR THE STACK
0116   85              ADD  L                         ;COMPUTE NEW TXTUNF
0117   6F              MOV  L,A
0118   3E00            MVI  A,0
011A   8C              ADC  H
011B   67              MOV  H,A                       ;HL->NEW UNFILLED AREA
011C   11000F          LXI  D,TXTEND                  ;CHECK TO SEE IF THERE
011F   E7              RST  4                         ;IS ENOUGH SPACE
0120   D2F304          JNC  QSORRY                    ;SORRY, NO ROOM FOR IT
```

```
0123   221508          SHLD TXTUNF                    ;OK, UPDATE TXTUNF
0126   D1              POP  D                         ;DE->OLD UNFILLED AREA
0127   CDEE05          CALL MVDOWN
012A   D1              POP  D                         ;DE->BEGIN, HL->END
012B   E1              POP  H
012C   CDE505          CALL MVUP                      ;MOVE NEW LINE TO SAVE
012F   C3D600          JMP  ST3                       ;AREA
                ;
                ;*************************************************************
                ;
                ; WHAT FOLLOWS IS THE CODE TO EXECUTE DIRECT AND STATEMENT
                ; COMMANDS.  CONTROL IS TRANSFERED TO THESE POINTS VIA THE
                ; COMMAND TABLE LOOKUP CODE OF 'DIRECT' AND 'EXEC' IN LAST
                ; SECTION.  AFTER THE COMMAND IS EXECUTED, CONTROL IS
                ; TRANSFERED TO OTHERS SECTIONS AS FOLLOWS:
                ;
                ; FOR 'LIST', 'NEW', AND 'STOP': GO BACK TO 'RSTART'
                ; FOR 'RUN': GO EXECUTE THE FIRST STORED LINE IF ANY, ELSE
                ; GO BACK TO 'RSTART'.
                ; FOR 'GOTO' AND 'GOSUB': GO EXECUTE THE TARGET LINE.
                ; FOR 'RETURN' AND 'NEXT': GO BACK TO SAVED RETURN LINE.
                ; FOR ALL OTHERS: IF 'CURRENT' -> 0, GO TO 'RSTART', ELSE
                ; GO EXECUTE NEXT COMMAND.  (THIS IS DONE IN 'FINISH'.)
                ;*************************************************************
                ;
                ; *** NEW *** STOP *** RUN (& FRIENDS) *** & GOTO ***
                ;
                ; 'NEW(CR)' SETS 'TXTUNF' TO POINT TO 'TXTBGN'
                ;
                ; 'STOP(CR)' GOES BACK TO 'RSTART'
                ;
                ; 'RUN(CR)' FINDS THE FIRST STORED LINE, STORE ITS ADDRESS (IN
                ; 'CURRENT'), AND START EXECUTE IT.  NOTE THAT ONLY THOSE
                ; COMMANDS IN TAB2 ARE LEGAL FOR STORED PROGRAM.
                ;
                ; THERE ARE 3 MORE ENTRIES IN 'RUN':
                ; 'RUNNXL' FINDS NEXT LINE, STORES ITS ADDR. AND EXECUTES IT.
                ; 'RUNTSL' STORES THE ADDRESS OF THIS LINE AND EXECUTES IT.
                ; 'RUNSML' CONTINUES THE EXECUTION ON SAME LINE.
                ;
                ; 'GOTO EXPR(CR)' EVALUATES THE EXPRESSION, FIND THE TARGET
                ; LINE, AND JUMP TO 'RUNTSL' TO DO IT.
                ;
0132   CDC204   NEW:    CALL ENDCHK                    ;*** NEW(CR) ***
0135   211708          LXI  H,TXTBGN
0138   221508          SHLD TXTUNF
                ;
013B   CDC204   STOP:   CALL ENDCHK                    ;*** STOP(CR) ***
013E   C3BA00          JMP  RSTART
                ;
0141   CDC204   RUN:    CALL ENDCHK                    ;*** RUN(CR) ***
```

```
0144   111708          LXI  D,TXTBGN                  ;FIRST SAVED LINE
                 ;
0147   210000   RUNNXL: LXI  H,0                       ;*** RUNNXL ***
014A   CD4005           CALL FNDLP                     ;FIND WHATEVER LINE #
014D   DABA00           JC   RSTART                    ;C:PASSED TXTUNF, QUIT
                 ;
0150   EB       RUNTSL: XCHG                           ;*** RUNTSL ***
0151   220108           SHLD CURRNT                    ;SET 'CURRENT'->LINE #
0154   EB               XCHG
0155   13               INX  D                         ;BUMP PASS LINE #
0156   13               INX  D
                 ;
0157   CD8406   RUNSML: CALL CHKIO                      ;*** RUNSML ***
015A   21BD06           LXI  H,TAB2-1                  ;FIND COMMAND IN TAB2
015D   C33B07           JMP  EXEC                      ;AND EXECUTE IT
                 ;
0160   DF       GOTO:   RST  3                         ;*** GOTO EXPR ***
0161   D5               PUSH D                         ;SAVE FOR ERROR ROUTINE
0162   CDC204           CALL ENDCHK                    ;MUST FIND A CR
0165   CD3805           CALL FNDLN                     ;FIND THE TARGET LINE
0168   C2A000           JNZ  AHOW                      ;NO SUCH LINE #
016B   F1               POP  PSW                       ;CLEAR THE PUSH DE
016C   C35001           JMP  RUNTSL                    ;GO DO IT
                 ;
                 ;*************************************************************
                 ;
                 ; *** LIST *** & PRINT ***
                 ;
                 ; LIST HAS TWO FORMS:
                 ; 'LIST(CR)' LISTS ALL SAVED LINES
                 ; 'LIST #(CR)' START LIST AT THIS LINE #
                 ; YOU CAN STOP THE LISTING BY CONTROL C KEY
                 ;
                 ; PRINT COMMAND IS 'PRINT ....;' OR 'PRINT ....(CR)'
                 ; WHERE '....' IS A LIST OF EXPRESIONS, FORMATS, BACK-
                 ; ARROWS, AND STRINGS.  THESE ITEMS ARE SEPERATED BY COMMAS.
                 ;
                 ; A FORMAT IS A POUND SIGN FOLLOWED BY A NUMBER.  IT CONTROLS
                 ; THE NUMBER OF SPACES THE VALUE OF A EXPRESION IS GOING TO
                 ; BE PRINTED.  IT STAYS EFFECTIVE FOR THE REST OF THE PRINT
                 ; COMMAND UNLESS CHANGED BY ANOTHER FORMAT.  IF NO FORMAT IS
                 ; SPECIFIED, 6 POSITIONS WILL BE USED.
                 ;
                 ; A STRING IS QUOTED IN A PAIR OF SINGLE QUOTES OR A PAIR OF
                 ; DOUBLE QUOTES.
                 ;
                 ; A BACK-ARROW MEANS GENERATE A (CR) WITHOUT (LF)
                 ;
                 ; A (CRLF) IS GENERATED AFTER THE ENTIRE LIST HAS BEEN
                 ; PRINTED OR IF THE LIST IS A NULL LIST.  HOWEVER IF THE LIST
                 ; ENDED WITH A COMMA, NO (CRLF) IS GENERATED.
```

```
                ;
016F   CD7700   LIST:   CALL TSTNUM                     ;TEST IF THERE IS A #
0172   CDC204           CALL ENDCHK                     ;IF NO # WE GET A 0
0175   CD3805           CALL FNDLN                      ;FIND THIS OR NEXT LINE
0178   DABA00   LS1:    JC   RSTART                     ;C:PASSED TXTUNF
017B   CDD205           CALL PRTLN                      ;PRINT THE LINE
017E   CD8406           CALL CHKIO                      ;STOP IF HIT CONTROL-C
0181   CD4005           CALL FNDLP                      ;FIND NEXT LINE
0184   C37801           JMP  LS1                        ;AND LOOP BACK
                ;
0187   0E06     PRINT:  MVI  C,6                        ;C = # OF SPACES
0189   CF               RST  1                          ;IF NULL LIST & ";"
018A   3B               DB   3BH
018B   06               DB   PR2-$-1
018C   CD0E00           CALL CRLF                       ;GIVE CR-LF AND
018F   C35701           JMP  RUNSML                     ;CONTINUE SAME LINE
0192   CF       PR2:    RST  1                          ;IF NULL LIST (CR)
0193   0D               DB   CR
0194   06               DB   PR0-$-1
0195   CD0E00           CALL CRLF                       ;ALSO GIVE CR-LF AND
0198   C34701           JMP  RUNNXL                     ;GO TO NEXT LINE
019B   CF       PR0:    RST  1                          ;ELSE IS IT FORMAT?
019C   23               DB   '#'
019D   05               DB   PR1-$-1
019E   DF               RST  3                          ;YES, EVALUATE EXPR.
019F   4D               MOV  C,L                        ;AND SAVE IT IN C
01A0   C3A901           JMP  PR3                        ;LOOK FOR MORE TO PRINT
01A3   CD6C05   PR1:    CALL QTSTG                      ;OR IS IT A STRING?
01A6   C3B601           JMP  PR8                        ;IF NOT, MUST BE EXPR.
01A9   CF       PR3:    RST  1                          ;IF ",", GO FIND NEXT
01AA   2C               DB   ','
01AB   06               DB   PR6-$-1
01AC   CDB304           CALL FIN                        ;IN THE LIST.
01AF   C39B01           JMP  PR0                        ;LIST CONTINUES
01B2   CD0E00   PR6:    CALL CRLF                       ;LIST ENDS
01B5   F7               RST  6
01B6   DF       PR8:    RST  3                          ;EVALUATE THE EXPR
01B7   C5               PUSH B
01B8   CD9205           CALL PRTNUM                     ;PRINT THE VALUE
01BB   C1               POP  B
01BC   C3A901           JMP  PR3                        ;MORE TO PRINT?
                ;
                ;*************************************************************
                ;
                ; *** GOSUB *** & RETURN ***
                ;
                ; 'GOSUB EXPR;' OR 'GOSUB EXPR (CR)' IS LIKE THE 'GOTO'
                ; COMMAND, EXCEPT THAT THE CURRENT TEXT POINTER, STACK POINTER
                ; ETC. ARE SAVE SO THAT EXECUTION CAN BE CONTINUED AFTER THE
                ; SUBROUTINE 'RETURN'.  IN ORDER THAT 'GOSUB' CAN BE NESTED
                ; (AND EVEN RECURSIVE), THE SAVE AREA MUST BE STACKED.
```

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                  ; THE STACK POINTER IS SAVED IN 'STKGOS', THE OLD 'STKGOS' IS
                  ; SAVED IN THE STACK.  IF WE ARE IN THE MAIN ROUTINE, 'STKGOS'
                  ; IS ZERO (THIS WAS DONE BY THE "MAIN" SECTION OF THE CODE),
                  ; BUT WE STILL SAVE IT AS A FLAG FOR NO FURTHER 'RETURN'S.
                  ;
                  ; 'RETURN(CR)' UNDOS EVERYTHING THAT 'GOSUB' DID, AND THUS
                  ; RETURN THE EXECUTION TO THE COMMAND AFTER THE MOST RECENT
                  ; 'GOSUB'.  IF 'STKGOS' IS ZERO, IT INDICATES THAT WE
                  ; NEVER HAD A 'GOSUB' AND IS THUS AN ERROR.
                  ;
01BF   CD1906   GOSUB:  CALL PUSHA                      ;SAVE THE CURRENT "FOR"
01C2   DF               RST  3                          ;PARAMETERS
01C3   D5               PUSH D                          ;AND TEXT POINTER
01C4   CD3805           CALL FNDLN                      ;FIND THE TARGET LINE
01C7   C2A000           JNZ  AHOW                       ;NOT THERE. SAY "HOW?"
01CA   2A0108           LHLD CURRNT                     ;FOUND IT, SAVE OLD
01CD   E5               PUSH H                          ;'CURRNT' OLD 'STKGOS'
01CE   2A0308           LHLD STKGOS
01D1   E5               PUSH H
01D2   210000           LXI  H,0                        ;AND LOAD NEW ONES
01D5   220908           SHLD LOPVAR
01D8   39               DAD  SP
01D9   220308           SHLD STKGOS
01DC   C35001           JMP  RUNTSL                     ;THEN RUN THAT LINE
01DF   CDC204   RETURN: CALL ENDCHK                     ;THERE MUST BE A CR
01E2   2A0308           LHLD STKGOS                     ;OLD STACK POINTER
01E5   7C               MOV  A,H                        ;0 MEANS NOT EXIST
01E6   B5               ORA  L
01E7   CAC604           JZ   QWHAT                      ;SO, WE SAY: "WHAT?"
01EA   F9               SPHL                            ;ELSE, RESTORE IT
01EB   E1               POP  H
01EC   220308           SHLD STKGOS                     ;AND THE OLD 'STKGOS'
01EF   E1               POP  H
01F0   220108           SHLD CURRNT                     ;AND THE OLD 'CURRNT'
01F3   D1               POP  D                          ;OLD TEXT POINTER
01F4   CDFD05           CALL POPA                       ;OLD "FOR" PARAMETERS
01F7   F7               RST  6                          ;AND WE ARE BACK HOME
                  ;
                  ;*************************************************************
                  ;
                  ; *** FOR *** & NEXT ***
                  ;
                  ; 'FOR' HAS TWO FORMS:
                  ; 'FOR VAR=EXP1 TO EXP2 STEP EXP3' AND 'FOR VAR=EXP1 TO EXP2'
                  ; THE SECOND FORM MEANS THE SAME THING AS THE FIRST FORM WITH
                  ; EXP3=1.  (I.E., WITH A STEP OF +1.)
                  ; TBI WILL FIND THE VARIABLE VAR, AND SET ITS VALUE TO THE
                  ; CURRENT VALUE OF EXP1.  IT ALSO EVALUATES EXP2 AND EXP3
                  ; AND SAVE ALL THESE TOGETHER WITH THE TEXT POINTER ETC. IN
                  ; THE 'FOR' SAVE AREA, WHICH CONSISTS OF 'LOPVAR', 'LOPINC',
                  ; 'LOPLMT', 'LOPLN', AND 'LOPPT'.  IF THERE IS ALREADY SOME-
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                  ; THING IN THE SAVE AREA (THIS IS INDICATED BY A NON-ZERO
                  ; 'LOPVAR'), THEN THE OLD SAVE AREA IS SAVED IN THE STACK
                  ; BEFORE THE NEW ONE OVERWRITES IT.
                  ; TBI WILL THEN DIG IN THE STACK AND FIND OUT IF THIS SAME
                  ; VARIABLE WAS USED IN ANOTHER CURRENTLY ACTIVE 'FOR' LOOP.
                  ; IF THAT IS THE CASE, THEN THE OLD 'FOR' LOOP IS DEACTIVATED.
                  ; (PURGED FROM THE STACK..)
                  ;
                  ; 'NEXT VAR' SERVES AS THE LOGICAL (NOT NECESSARILLY PHYSICAL)
                  ; END OF THE 'FOR' LOOP.  THE CONTROL VARIABLE VAR. IS CHECKED
                  ; WITH THE 'LOPVAR'.  IF THEY ARE NOT THE SAME, TBI DIGS IN
                  ; THE STACK TO FIND THE RIGHT ONE AND PURGES ALL THOSE THAT
                  ; DID NOT MATCH.  EITHER WAY, TBI THEN ADDS THE 'STEP' TO
                  ; THAT VARIABLE AND CHECK THE RESULT WITH THE LIMIT.  IF IT
                  ; IS WITHIN THE LIMIT, CONTROL LOOPS BACK TO THE COMMAND
                  ; FOLLOWING THE 'FOR'.  IF OUTSIDE THE LIMIT, THE SAVE AREA
                  ; IS PURGED AND EXECUTION CONTINUES.
                  ;
01F8   CD1906     FOR:    CALL PUSHA                  ;SAVE THE OLD SAVE AREA
01FB   CDA004             CALL SETVAL                 ;SET THE CONTROL VAR.
01FE   2B                 DCX  H                      ;HL IS ITS ADDRESS
01FF   220908             SHLD LOPVAR                 ;SAVE THAT
0202   211307             LXI  H,TAB5-1               ;USE 'EXEC' TO LOOK
0205   C33B07             JMP  EXEC                   ;FOR THE WORD 'TO'
0208   DF         FR1:    RST  3                      ;EVALUATE THE LIMIT
0209   220D08             SHLD LOPLMT                 ;SAVE THAT
020C   211907             LXI  H,TAB6-1               ;USE 'EXEC' TO LOOK
020F   C33B07             JMP EXEC                    ;FOR THE WORD 'STEP'
0212   DF         FR2:    RST  3                      ;FOUND IT, GET STEP
0213   C31902             JMP  FR4
0216   210100     FR3:    LXI  H,1H                   ;NOT FOUND, SET TO 1
0219   220B08     FR4:    SHLD LOPINC                 ;SAVE THAT TOO
021C   2A0108     FR5:    LHLD CURRNT                 ;SAVE CURRENT LINE #
021F   220F08             SHLD LOPLN
0222   EB                 XCHG                        ;AND TEXT POINTER
0223   221108             SHLD LOPPT
0226   010A00             LXI  B,0AH                  ;DIG INTO STACK TO
0229   2A0908             LHLD LOPVAR                 ;FIND 'LOPVAR'
022C   EB                 XCHG
022D   60                 MOV  H,B
022E   68                 MOV  L,B                    ;HL=0 NOW
022F   39                 DAD  SP                     ;HERE IS THE STACK
0230   3E                 DB   3EH
0231   09         FR7:    DAD  B                      ;EACH LEVEL IS 10 DEEP
0232   7E                 MOV  A,M                    ;GET THAT OLD 'LOPVAR'
0233   23                 INX  H
0234   B6                 ORA  M
0235   CA5202             JZ   FR8                    ;0 SAYS NO MORE IN IT
0238   7E                 MOV  A,M
0239   2B                 DCX  H
023A   BA                 CMP  D                      ;SAME AS THIS ONE?
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```
023B   C23102          JNZ  FR7
023E   7E              MOV  A,M                    ;THE OTHER HALF?
023F   BB              CMP  E
0240   C23102          JNZ  FR7
0243   EB              XCHG                        ;YES, FOUND ONE
0244   210000          LXI  H,0H
0247   39              DAD  SP                     ;TRY TO MOVE SP
0248   44              MOV  B,H
0249   4D              MOV  C,L
024A   210A00          LXI  H,0AH
024D   19              DAD  D
024E   CDEE05          CALL MVDOWN                 ;AND PURGE 10 WORDS
0251   F9              SPHL                        ;IN THE STACK
0252   2A1108   FR8:   LHLD LOPPT                  ;JOB DONE, RESTORE DE
0255   EB              XCHG
0256   F7              RST  6                      ;AND CONTINUE
               ;
0257   FF       NEXT:  RST  7                      ;GET ADDRESS OF VAR.
0258   DAC604          JC   QWHAT                  ;NO VARIABLE, "WHAT?"
025B   220508          SHLD VARNXT                 ;YES, SAVE IT
025E   D5       NX0:   PUSH D                      ;SAVE TEXT POINTER
025F   EB              XCHG
0260   2A0908          LHLD LOPVAR                 ;GET VAR. IN 'FOR'
0263   7C              MOV  A,H
0264   B5              ORA  L                      ;0 SAYS NEVER HAD ONE
0265   CAC704          JZ   AWHAT                  ;SO WE ASK: "WHAT?"
0268   E7              RST  4                      ;ELSE WE CHECK THEM
0269   CA7602          JZ   NX3                    ;OK, THEY AGREE
026C   D1              POP  D                      ;NO, LET'S SEE
026D   CDFD05          CALL POPA                   ;PURGE CURRENT LOOP
0270   2A0508          LHLD VARNXT                 ;AND POP ONE LEVEL
0273   C35E02          JMP  NX0                    ;GO CHECK AGAIN
0276   5E       NX3:   MOV  E,M                    ;COME HERE WHEN AGREED
0277   23              INX  H
0278   56              MOV  D,M                    ;DE=VALUE OF VAR.
0279   2A0B08          LHLD LOPINC
027C   E5              PUSH H
027D   7C              MOV  A,H
027E   AA              XRA  D
027F   7A              MOV  A,D
0280   19              DAD  D                      ;ADD ONE STEP
0281   FA8802          JM   NX4
0284   AC              XRA  H
0285   FAAA02          JM   NX5
0288   EB       NX4:   XCHG
0289   2A0908          LHLD LOPVAR                 ;PUT IT BACK
028C   73              MOV  M,E
028D   23              INX  H
028E   72              MOV  M,D
028F   2A0D08          LHLD LOPLMT                 ;HL->LIMIT
0292   F1              POP  PSW                    ;OLD HL
```

```
0293   B7              ORA  A
0294   F29802          JP   NX1                      ;STEP > 0
0297   EB              XCHG                          ;STEP < 0
0298   CD9804   NX1:   CALL CKHLDE                   ;COMPARE WITH LIMIT
029B   D1              POP  D                        ;RESTORE TEXT POINTER
029C   DAAC02          JC   NX2                      ;OUTSIDE LIMIT
029F   2A0F08          LHLD LOPLN                    ;WITHIN LIMIT, GO
02A2   220108          SHLD CURRNT                   ;BACK TO THE SAVED
02A5   2A1108          LHLD LOPPT                    ;'CURRNT' AND TEXT
02A8   EB              XCHG                          ;POINTER
02A9   F7              RST  6
02AA   E1       NX5:   POP  H
02AB   D1              POP  D
02AC   CDFD05   NX2:   CALL POPA                     ;PURGE THIS LOOP
02AF   F7              RST  6
                ;
                ;*************************************************************
                ;
                ; *** REM *** IF *** INPUT *** & LET (& DEFLT) ***
                ;
                ; 'REM' CAN BE FOLLOWED BY ANYTHING AND IS IGNORED BY TBI.
                ; TBI TREATS IT LIKE AN 'IF' WITH A FALSE CONDITION.
                ;
                ; 'IF' IS FOLLOWED BY AN EXPR. AS A CONDITION AND ONE OR MORE
                ; COMMANDS (INCLUDING OTHER 'IF'S) SEPERATED BY SEMI-COLONS.
                ; NOTE THAT THE WORD 'THEN' IS NOT USED.  TBI EVALUATES THE
                ; EXPR. IF IT IS NON-ZERO, EXECUTION CONTINUES.  IF THE
                ; EXPR. IS ZERO, THE COMMANDS THAT FOLLOWS ARE IGNORED AND
                ; EXECUTION CONTINUES AT THE NEXT LINE.
                ;
                ; 'INPUT' COMMAND IS LIKE THE 'PRINT' COMMAND, AND IS FOLLOWED
                ; BY A LIST OF ITEMS.  IF THE ITEM IS A STRING IN SINGLE OR
                ; DOUBLE QUOTES, OR IS A BACK-ARROW, IT HAS THE SAME EFFECT AS
                ; IN 'PRINT'.  IF AN ITEM IS A VARIABLE, THIS VARIABLE NAME IS
                ; PRINTED OUT FOLLOWED BY A COLON.  THEN TBI WAITS FOR AN
                ; EXPR. TO BE TYPED IN.  THE VARIABLE IS THEN SET TO THE
                ; VALUE OF THIS EXPR.  IF THE VARIABLE IS PROCEDED BY A STRING
                ; (AGAIN IN SINGLE OR DOUBLE QUOTES), THE STRING WILL BE
                ; PRINTED FOLLOWED BY A COLON.  TBI THEN WAITS FOR INPUT EXPR.
                ; AND SET THE VARIABLE TO THE VALUE OF THE EXPR.
                ;
                ; IF THE INPUT EXPR. IS INVALID, TBI WILL PRINT "WHAT?",
                ; "HOW?" OR "SORRY" AND REPRINT THE PROMPT AND REDO THE INPUT.
                ; THE EXECUTION WILL NOT TERMINATE UNLESS YOU TYPE CONTROL-C.
                ; THIS IS HANDLED IN 'INPERR'.
                ;
                ; 'LET' IS FOLLOWED BY A LIST OF ITEMS SEPERATED BY COMMAS.
                ; EACH ITEM CONSISTS OF A VARIABLE, AN EQUAL SIGN, AND AN EXPR.
                ; TBI EVALUATES THE EXPR. AND SET THE VARIABLE TO THAT VALUE.
                ; TBI WILL ALSO HANDLE 'LET' COMMAND WITHOUT THE WORD 'LET'.
                ; THIS IS DONE BY 'DEFLT'.
```

```
                ;
02B0   210000   REM:    LXI  H,0H                    ;*** REM ***
02B3   3E               DB   3EH                     ;THIS IS LIKE 'IF 0'
                ;
02B4   DF       IFF:    RST  3                       ;*** IF ***
02B5   7C               MOV  A,H                     ;IS THE EXPR.=0?
02B6   B5               ORA  L
02B7   C25701           JNZ  RUNSML                  ;NO, CONTINUE
02BA   CD5605           CALL FNDSKP                  ;YES, SKIP REST OF LINE
02BD   D25001           JNC  RUNTSL                  ;AND RUN THE NEXT LINE
02C0   C3BA00           JMP  RSTART                  ;IF NO NEXT, RE-START
                ;
02C3   2A0708   INPERR: LHLD STKINP                  ;*** INPERR ***
02C6   F9               SPHL                         ;RESTORE OLD SP
02C7   E1               POP  H                       ;AND OLD 'CURRNT'
02C8   220108           SHLD CURRNT
02CB   D1               POP  D                       ;AND OLD TEXT POINTER
02CC   D1               POP  D                       ;REDO INPUT
                ;
02CD            INPUT:                               ;*** INPUT ***
02CD   D5       IP1:    PUSH D                       ;SAVE IN CASE OF ERROR
02CE   CD6C05           CALL QTSTG                   ;IS NEXT ITEM A STRING?
02D1   C3DB02           JMP  IP2                     ;NO
02D4   FF               RST  7                       ;YES, BUT FOLLOWED BY A
02D5   DA1503           JC   IP4                     ;VARIABLE?   NO.
02D8   C3EB02           JMP  IP3                     ;YES.  INPUT VARIABLE
02DB   D5       IP2:    PUSH D                       ;SAVE FOR 'PRTSTG'
02DC   FF               RST  7                       ;MUST BE VARIABLE NOW
02DD   DAC604           JC   QWHAT                   ;"WHAT?" IT IS NOT?
02E0   1A               LDAX D                       ;GET READY FOR 'PRTSTR'
02E1   4F               MOV  C,A
02E2   97               SUB  A
02E3   12               STAX D
02E4   D1               POP  D
02E5   CD6005           CALL PRTSTG                  ;PRINT STRING AS PROMPT
02E8   79               MOV  A,C                     ;RESTORE TEXT
02E9   1B               DCX  D
02EA   12               STAX D
02EB   D5       IP3:    PUSH D                       ;SAVE TEXT POINTER
02EC   EB               XCHG
02ED   2A0108           LHLD CURRNT                  ;ALSO SAVE 'CURRNT'
02F0   E5               PUSH H
02F1   21CD02           LXI  H,IP1                   ;A NEGATIVE NUMBER
02F4   220108           SHLD CURRNT                  ;AS A FLAG
02F7   210000           LXI  H,0H                    ;SAVE SP TOO
02FA   39               DAD  SP
02FB   220708           SHLD STKINP
02FE   D5               PUSH D                       ;OLD HL
02FF   3E3A             MVI  A,3AH                   ;PRINT THIS TOO
0301   CDFA04           CALL GETLN                   ;AND GET A LINE
0304   11370F           LXI  D,BUFFER                ;POINTS TO BUFFER
```

```
0307   DF              RST  3                        ;EVALUATE INPUT
0308   00              NOP                           ;CAN BE 'CALL ENDCHK'
0309   00              NOP
030A   00              NOP
030B   D1              POP  D                        ;OK, GET OLD HL
030C   EB              XCHG
030D   73              MOV  M,E                      ;SAVE VALUE IN VAR.
030E   23              INX  H
030F   72              MOV  M,D
0310   E1              POP  H                        ;GET OLD 'CURRNT'
0311   220108          SHLD CURRNT
0314   D1              POP  D                        ;AND OLD TEXT POINTER
0315   F1       IP4:   POP  PSW                      ;PURGE JUNK IN STACK
0316   CF              RST  1                        ;IS NEXT CH. ','?
0317   2C              DB   ','
0318   03              DB   IP5-$-1
0319   C3CD02          JMP  IP1                      ;YES, MORE ITEMS.
031C   F7       IP5:   RST  6
                ;
031D   1A       DEFLT: LDAX D                        ;***  DEFLT ***
031E   FE0D            CPI  CR                       ;EMPTY LINE IS OK
0320   CA2C03          JZ   LT1                      ;ELSE IT IS 'LET'
                ;
0323   CDA004   LET:   CALL SETVAL                   ;*** LET ***
0326   CF              RST  1                        ;SET VALUE TO VAR.
0327   2C              DB   ','
0328   03              DB   LT1-$-1
0329   C32303          JMP  LET                      ;ITEM BY ITEM
032C   F7       LT1:   RST  6                        ;UNTIL FINISH
                ;
                ;*************************************************************
                ;
                ; *** EXPR ***
                ;
                ; 'EXPR' EVALUATES ARITHMETICAL OR LOGICAL EXPRESSIONS.
                ; <EXPR>::<EXPR2>
                ;         <EXPR2><REL.OP.><EXPR2>
                ; WHERE <REL.OP.> IS ONE OF THE OPERATORS IN TAB8 AND THE
                ; RESULT OF THESE OPERATIONS IS 1 IF TRUE AND 0 IF FALSE.
                ; <EXPR2>::=(+ OR -)<EXPR3>(+ OR -<EXPR3>)(....)
                ; WHERE () ARE OPTIONAL AND (....) ARE OPTIONAL REPEATS.
                ; <EXPR3>::=<EXPR4>(* OR /><EXPR4>)(....)
                ; <EXPR4>::=<VARIABLE>
                ;           <FUNCTION>
                ;           (<EXPR>)
                ; <EXPR> IS RECURSIVE SO THAT VARIABLE '@' CAN HAVE AN <EXPR>
                ; AS INDEX, FUNCTIONS CAN HAVE AN <EXPR> AS ARGUMENTS, AND
                ; <EXPR4> CAN BE AN <EXPR> IN PARANTHESE.
                ;
                ;EXPR:  CALL EXPR2                   ;THIS IS AT LOC. 18
                ;       PUSH H                       ;SAVE <EXPR2> VALUE
```

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032D   212107   EXPR1:  LXI  H,TAB8-1                  ;LOOKUP REL.OP.
0330   C33B07           JMP  EXEC                      ;GO DO IT
0333   CD5C03   XP11:   CALL XP18                       ;REL.OP.">="
0336   D8               RC                             ;NO, RETURN HL=0
0337   6F               MOV  L,A                       ;YES, RETURN HL=1
0338   C9               RET
0339   CD5C03   XP12:   CALL XP18                       ;REL.OP."#"
033C   C8               RZ                             ;FALSE, RETURN HL=0
033D   6F               MOV  L,A                       ;TRUE, RETURN HL=1
033E   C9               RET
033F   CD5C03   XP13:   CALL XP18                       ;REL.OP.">"
0342   C8               RZ                             ;FALSE
0343   D8               RC                             ;ALSO FALSE, HL=0
0344   6F               MOV  L,A                       ;TRUE, HL=1
0345   C9               RET
0346   CD5C03   XP14:   CALL XP18                       ;REL.OP."<="
0349   6F               MOV  L,A                       ;SET HL=1
034A   C8               RZ                             ;REL. TRUE, RETURN
034B   D8               RC
034C   6C               MOV  L,H                       ;ELSE SET HL=0
034D   C9               RET
034E   CD5C03   XP15:   CALL XP18                       ;REL.OP."="
0351   C0               RNZ                            ;FALSE, RETURN HL=0
0352   6F               MOV  L,A                       ;ELSE SET HL=1
0353   C9               RET
0354   CD5C03   XP16:   CALL XP18                       ;REL.OP."<"
0357   D0               RNC                            ;FALSE, RETURN HL=0
0358   6F               MOV  L,A                       ;ELSE SET HL=1
0359   C9               RET
035A   E1       XP17:   POP  H                         ;NOT .REL.OP
035B   C9               RET                            ;RETURN HL=<EXPR2>
035C   79       XP18:   MOV  A,C                       ;SUBROUTINE FOR ALL
035D   E1               POP  H                         ;REL.OP.'S
035E   C1               POP  B
035F   E5               PUSH H                         ;REVERSE TOP OF STACK
0360   C5               PUSH B
0361   4F               MOV  C,A
0362   CD7103           CALL EXPR2                     ;GET 2ND <EXPR2>
0365   EB               XCHG                           ;VALUE IN DE NOW
0366   E3               XTHL                           ;1ST <EXPR2> IN HL
0367   CD9804           CALL CKHLDE                    ;COMPARE 1ST WITH 2ND
036A   D1               POP  D                         ;RESTORE TEXT POINTER
036B   210000           LXI  H,0H                      ;SET HL=0, A=1
036E   3E01             MVI  A,1
0370   C9               RET
               ;
0371   CF       EXPR2:  RST  1                         ;NEGATIVE SIGN?
0372   2D               DB   '-'
0373   06               DB   XP21-$-1
0374   210000           LXI  H,0H                      ;YES, FAKE '0-'
0377   C39B03           JMP  XP26                      ;TREAT LIKE SUBTRACT
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037A   CF       XP21:   RST  1                        ;POSITIVE SIGN? IGNORE
037B   2B               DB   '+'
037C   00               DB   XP22-$-1
037D   CDA503   XP22:   CALL EXPR3                    ;1ST <EXPR3>
0380   CF       XP23:   RST  1                        ;ADD?
0381   2B               DB   '+'
0382   15               DB   XP25-$-1
0383   E5               PUSH H                        ;YES, SAVE VALUE
0384   CDA503           CALL EXPR3                    ;GET 2ND <EXPR3>
0387   EB       XP24:   XCHG                          ;2ND IN DE
0388   E3               XTHL                          ;1ST IN HL
0389   7C               MOV  A,H                      ;COMPARE SIGN
038A   AA               XRA  D
038B   7A               MOV  A,D
038C   19               DAD  D
038D   D1               POP  D                        ;RESTORE TEXT POINTER
038E   FA8003           JM   XP23                     ;1ST AND 2ND SIGN DIFFER
0391   AC               XRA  H                        ;1ST AND 2ND SIGN EQUAL
0392   F28003           JP   XP23                     ;SO IS RESULT
0395   C39F00           JMP  QHOW                     ;ELSE WE HAVE OVERFLOW
0398   CF       XP25:   RST  1                        ;SUBTRACT?
0399   2D               DB   '-'
039A   86               DB   XP42-$-1
039B   E5       XP26:   PUSH H                        ;YES, SAVE 1ST <EXPR3>
039C   CDA503           CALL EXPR3                    ;GET 2ND <EXPR3>
039F   CD8604           CALL CHGSGN                   ;NEGATE
03A2   C38703           JMP  XP24                     ;AND ADD THEM
               ;
03A5   CD0504   EXPR3:  CALL EXPR4                    ;GET 1ST <EXPR4>
03A8   CF       XP31:   RST  1                        ;MULTIPLY?
03A9   2A               DB   '*'
03AA   2D               DB   XP34-$-1
03AB   E5               PUSH H                        ;YES, SAVE 1ST
03AC   CD0504           CALL EXPR4                    ;AND GET 2ND <EXPR4>
03AF   0600             MVI  B,0H                     ;CLEAR B FOR SIGN
03B1   CD8304           CALL CHKSGN                   ;CHECK SIGN
03B4   E3               XTHL                          ;1ST IN HL
03B5   CD8304           CALL CHKSGN                   ;CHECK SIGN OF 1ST
03B8   EB               XCHG
03B9   E3               XTHL
03BA   7C               MOV  A,H                      ;IS HL > 255 ?
03BB   B7               ORA  A
03BC   CAC503           JZ   XP32                     ;NO
03BF   7A               MOV  A,D                      ;YES, HOW ABOUT DE
03C0   B2               ORA  D
03C1   EB               XCHG                          ;PUT SMALLER IN HL
03C2   C2A000           JNZ  AHOW                     ;ALSO >, WILL OVERFLOW
03C5   7D       XP32:   MOV  A,L                      ;THIS IS DUMB
03C6   210000           LXI  H,0H                     ;CLEAR RESULT
03C9   B7               ORA  A                        ;ADD AND COUNT
03CA   CAF703           JZ   XP35
```

```
03CD   19       XP33:   DAD  D
03CE   DAA000           JC   AHOW                    ;OVERFLOW
03D1   3D               DCR  A
03D2   C2CD03           JNZ  XP33
03D5   C3F703           JMP  XP35                    ;FINISHED
03D8   CF       XP34:   RST  1                       ;DIVIDE?
03D9   2F               DB   '/'
03DA   46               DB   XP42-$-1
03DB   E5               PUSH H                       ;YES, SAVE 1ST <EXPR4>
03DC   CD0504           CALL EXPR4                   ;AND GET THE SECOND ONE
03DF   0600             MVI  B,0H                    ;CLEAR B FOR SIGN
03E1   CD8304           CALL CHKSGN                  ;CHECK SIGN OF 2ND
03E4   E3               XTHL                         ;GET 1ST IN HL
03E5   CD8304           CALL CHKSGN                  ;CHECK SIGN OF 1ST
03E8   EB               XCHG
03E9   E3               XTHL
03EA   EB               XCHG
03EB   7A               MOV  A,D                     ;DIVIDE BY 0?
03EC   B3               ORA  E
03ED   CAA000           JZ   AHOW                    ;SAY "HOW?"
03F0   C5               PUSH B                       ;ELSE SAVE SIGN
03F1   CD6604           CALL DIVIDE                  ;USE SUBROUTINE
03F4   60               MOV  H,B                     ;RESULT IN HL NOW
03F5   69               MOV  L,C
03F6   C1               POP  B                       ;GET SIGN BACK
03F7   D1       XP35:   POP  D                       ;AND TEXT POINTER
03F8   7C               MOV  A,H                     ;HL MUST BE +
03F9   B7               ORA  A
03FA   FA9F00           JM   QHOW                    ;ELSE IT IS OVERFLOW
03FD   78               MOV  A,B
03FE   B7               ORA  A
03FF   FC8604           CM   CHGSGN                  ;CHANGE SIGN IF NEEDED
0402   C3A803           JMP  XP31                    ;LOOK FOR MORE TERMS
               ;
0405   210107   EXPR4:  LXI  H,TAB4-1                ;FIND FUNCTION IN TAB4
0408   C33B07           JMP  EXEC                    ;AND GO DO IT
040B   FF       XP40:   RST  7                       ;NO, NOT A FUNCTION
040C   DA1404           JC   XP41                    ;NOR A VARIABLE
040F   7E               MOV  A,M                     ;VARIABLE
0410   23               INX  H
0411   66               MOV  H,M                     ;VALUE IN HL
0412   6F               MOV  L,A
0413   C9               RET
0414   CD7700   XP41:   CALL TSTNUM                   ;OR IS IT A NUMBER
0417   78               MOV  A,B                     ;# OF DIGIT
0418   B7               ORA  A
0419   C0               RNZ                          ;OK
041A   CF       PARN:   RST  1
041B   28               DB   '('
041C   05               DB   XP43-$-1
041D   DF               RST  3                       ;"(EXPR)"
```

```
041E   CF              RST  1
041F   29              DB   ')'
0420   01              DB   XP43-$-1
0421   C9       XP42:  RET
0422   C3C604   XP43:  JMP  QWHAT                    ;ELSE SAY: "WHAT?"
                ;
0425   CD1A04   RND:   CALL PARN                     ;*** RND(EXPR) ***
0428   7C              MOV  A,H                      ;EXPR MUST BE +
0429   B7              ORA  A
042A   FA9F00          JM   QHOW
042D   B5              ORA  L                        ;AND NON-ZERO
042E   CA9F00          JZ   QHOW
0431   D5              PUSH D                        ;SAVE BOTH
0432   E5              PUSH H
0433   2A1308          LHLD RANPNT                   ;GET MEMORY AS RANDOM
0436   116907          LXI  D,LSTROM                 ;NUMBER
0439   E7              RST  4
043A   DA4004          JC   RA1                      ;WRAP AROUND IF LAST
043D   210000          LXI  H,START
0440   5E       RA1:   MOV  E,M
0441   23              INX  H
0442   56              MOV  D,M
0443   221308          SHLD RANPNT
0446   E1              POP  H
0447   EB              XCHG
0448   C5              PUSH B
0449   CD6604          CALL DIVIDE                   ;RND(N)=MOD(M,N)+1
044C   C1              POP  B
044D   D1              POP  D
044E   23              INX  H
044F   C9              RET
                ;
0450   CD1A04   ABS:   CALL PARN                     ;*** ABS(EXPR) ***
0453   1B              DCX  D
0454   CD8304          CALL CHKSGN                   ;CHECK SIGN
0457   13              INX  D
0458   C9              RET
                ;
0459   2A1508   SIZE:  LHLD TXTUNF                   ;*** SIZE ***
045C   D5              PUSH D                        ;GET THE NUMBER OF FREE
045D   EB              XCHG                          ;BYTES BETWEEN 'TXTUNF'
045E   21000F          LXI  H,VARBGN                 ;AND 'VARBGN'
0461   CD7C04          CALL SUBDE
0464   D1              POP  D
0465   C9              RET
                ;
                ;*********************************************************
                ;
                ; *** DIVIDE *** SUBDE *** CHKSGN *** CHGSGN *** & CKHLDE ***
                ;
                ; 'DIVIDE' DIVIDES HL BY DE, RESULT IN BC, REMAINDER IN HL
```

```
                  ;
                  ; 'SUBDE' SUBSTRACTS DE FROM HL
                  ;
                  ; 'CHKSGN' CHECKS SIGN OF HL.  IF +, NO CHANGE.  IF -, CHANGE
                  ; SIGN AND FLIP SIGN OF B.
                  ;
                  ; 'CHGSGN' CHECKS SIGN N OF HL AND B UNCONDITIONALLY.
                  ;
                  ; 'CKHLDE' CHECKS SIGN OF HL AND DE.  IF DIFFERENT, HL AND DE
                  ; ARE INTERCHANGED.  IF SAME SIGN, NOT INTERCHANGED.  EITHER
                  ; CASE, HL DE ARE THEN COMPARED TO SET THE FLAGS.
                  ;
0466   E5         DIVIDE: PUSH H                          ;*** DIVIDE ***
0467   6C                 MOV  L,H                        ;DIVIDE H BY DE
0468   2600               MVI  H,0
046A   CD7104             CALL DV1
046D   41                 MOV  B,C                        ;SAVE RESULT IN B
046E   7D                 MOV  A,L                        ;(REMINDER+L)/DE
046F   E1                 POP  H
0470   67                 MOV  H,A
0471   0EFF       DV1:    MVI  C,0FFH                     ;RESULT IN C
0473   0C         DV2:    INR  C                          ;DUMB ROUTINE
0474   CD7C04             CALL SUBDE                      ;DIVIDE BY SUBTRACT
0477   D27304             JNC  DV2                        ;AND COUNT
047A   19                 DAD  D
047B   C9                 RET
                  ;
047C   7D         SUBDE:  MOV  A,L                        ;*** SUBDE ***
047D   93                 SUB  E                          ;SUBSTRACT DE FROM
047E   6F                 MOV  L,A                        ;HL
047F   7C                 MOV  A,H
0480   9A                 SBB  D
0481   67                 MOV  H,A
0482   C9                 RET
                  ;
0483   7C         CHKSGN: MOV  A,H                        ;*** CHKSGN ***
0484   B7                 ORA  A                          ;CHECK SIGN OF HL
0485   F0                 RP                              ;IF -, CHANGE SIGN
                  ;
0486   7C         CHGSGN: MOV  A,H                        ;*** CHGSGN ***
0487   F5                 PUSH PSW
0488   2F                 CMA                             ;CHANGE SIGN OF HL
0489   67                 MOV  H,A
048A   7D                 MOV  A,L
048B   2F                 CMA
048C   6F                 MOV  L,A
048D   23                 INX  H
048E   F1                 POP  PSW
048F   AC                 XRA  H
0490   F29F00             JP   QHOW
0493   78                 MOV  A,B                        ;AND ALSO FLIP B
```

```
0494   EE80            XRI  80H
0496   47              MOV  B,A
0497   C9              RET
                ;
0498   7C       CKHLDE: MOV  A,H
0499   AA              XRA  D                        ;SAME SIGN?
049A   F29E04          JP   CK1                      ;YES, COMPARE
049D   EB              XCHG                          ;NO, XCH AND COMP
049E   E7       CK1:   RST  4
049F   C9              RET
                ;
                ;*************************************************************
                ;
                ; *** SETVAL *** FIN *** ENDCHK *** & ERROR (& FRIENDS) ***
                ;
                ; "SETVAL" EXPECTS A VARIABLE, FOLLOWED BY AN EQUAL SIGN AND
                ; THEN AN EXPR.  IT EVALUATES THE EXPR. AND SET THE VARIABLE
                ; TO THAT VALUE.
                ;
                ; "FIN" CHECKS THE END OF A COMMAND.  IF IT ENDED WITH ";",
                ; EXECUTION CONTINUES.  IF IT ENDED WITH A CR, IT FINDS THE
                ; NEXT LINE AND CONTINUE FROM THERE.
                ;
                ; "ENDCHK" CHECKS IF A COMMAND IS ENDED WITH CR.  THIS IS
                ; REQUIRED IN CERTAIN COMMANDS.  (GOTO, RETURN, AND STOP ETC.)
                ;
                ; "ERROR" PRINTS THE STRING POINTED BY DE (AND ENDS WITH CR).
                ; IT THEN PRINTS THE LINE POINTED BY 'CURRNT' WITH A "?"
                ; INSERTED AT WHERE THE OLD TEXT POINTER (SHOULD BE ON TOP
                ; OF THE STACK) POINTS TO.  EXECUTION OF TB IS STOPPED
                ; AND TBI IS RESTARTED.  HOWEVER, IF 'CURRNT' -> ZERO
                ; (INDICATING A DIRECT COMMAND), THE DIRECT COMMAND IS NOT
                ; PRINTED.  AND IF 'CURRNT' -> NEGATIVE # (INDICATING 'INPUT'
                ; COMMAND), THE INPUT LINE IS NOT PRINTED AND EXECUTION IS
                ; NOT TERMINATED BUT CONTINUED AT 'INPERR'.
                ;
                ; RELATED TO 'ERROR' ARE THE FOLLOWING:
                ; 'QWHAT' SAVES TEXT POINTER IN STACK AND GET MESSAGE "WHAT?"
                ; 'AWHAT' JUST GET MESSAGE "WHAT?" AND JUMP TO 'ERROR'.
                ; 'QSORRY' AND 'ASORRY' DO SAME KIND OF THING.
                ; 'AHOW' AND 'AHOW' IN THE ZERO PAGE SECTION ALSO DO THIS.
                ;
04A0   FF       SETVAL: RST  7                        ;*** SETVAL ***
04A1   DAC604          JC   QWHAT                    ;"WHAT?" NO VARIABLE
04A4   E5              PUSH H                        ;SAVE ADDRESS OF VAR.
04A5   CF              RST  1                        ;PASS "=" SIGN
04A6   3D              DB   '='
04A7   08              DB   SV1-$-1
04A8   DF              RST  3                        ;EVALUATE EXPR.
04A9   44              MOV  B,H                      ;VALUE IS IN BC NOW
04AA   4D              MOV  C,L
```

```
04AB   E1              POP  H                    ;GET ADDRESS
04AC   71              MOV  M,C                  ;SAVE VALUE
04AD   23              INX  H
04AE   70              MOV  M,B
04AF   C9              RET
04B0   C3C604   SV1:   JMP  QWHAT                ;NO "=" SIGN
                ;
04B3   CF       FIN:   RST  1                    ;*** FIN ***
04B4   3B              DB   3BH
04B5   04              DB   FI1-$-1
04B6   F1              POP  PSW                  ;";", PURGE RET. ADDR.
04B7   C35701          JMP  RUNSML               ;CONTINUE SAME LINE
04BA   CF       FI1:   RST  1                    ;NOT ";", IS IT CR?
04BB   0D              DB   CR
04BC   04              DB   FI2-$-1
04BD   F1              POP  PSW                  ;YES, PURGE RET. ADDR.
04BE   C34701          JMP  RUNNXL               ;RUN NEXT LINE
04C1   C9       FI2:   RET                       ;ELSE RETURN TO CALLER
                ;
04C2   EF       ENDCHK: RST 5                    ;*** ENDCHK ***
04C3   FE0D            CPI  CR                   ;END WITH CR?
04C5   C8              RZ                        ;OK, ELSE SAY: "WHAT?"
                ;
04C6   D5       QWHAT: PUSH D                    ;*** QWHAT ***
04C7   11AE00   AWHAT: LXI  D,WHAT               ;*** AWHAT ***
04CA   97       ERROR: SUB  A                    ;*** ERROR ***
04CB   CD6005          CALL PRTSTG               ;PRINT 'WHAT?', 'HOW?'
04CE   D1              POP  D                    ;OR 'SORRY'
04CF   1A              LDAX D                    ;SAVE THE CHARACTER
04D0   F5              PUSH PSW                  ;AT WHERE OLD DE ->
04D1   97              SUB  A                    ;AND PUT A 0 THERE
04D2   12              STAX D
04D3   2A0108          LHLD CURRNT               ;GET CURRENT LINE #
04D6   E5              PUSH H
04D7   7E              MOV  A,M                  ;CHECK THE VALUE
04D8   23              INX  H
04D9   B6              ORA  M
04DA   D1              POP  D
04DB   CABA00          JZ   RSTART               ;IF ZERO, JUST RESTART
04DE   7E              MOV  A,M                  ;IF NEGATIVE,
04DF   B7              ORA  A
04E0   FAC302          JM   INPERR               ;REDO INPUT
04E3   CDD205          CALL PRTLN                ;ELSE PRINT THE LINE
04E6   1B              DCX  D                    ;UPTO WHERE THE 0 IS
04E7   F1              POP  PSW                  ;RESTORE THE CHARACTER
04E8   12              STAX D
04E9   3E3F            MVI  A,3FH                ;PRINT A "?"
04EB   D7              RST  2
04EC   97              SUB  A                    ;AND THE REST OF THE
04ED   CD6005          CALL PRTSTG               ;LINE
04F0   C3BA00          JMP  RSTART               ;THEN RESTART
```

```
                ;
04F3   D5       QSORRY: PUSH D                          ;*** QSORRY ***
04F4   11B400   ASORRY: LXI  D,SORRY                    ;*** ASORRY ***
04F7   C3CA04           JMP  ERROR
                ;
                ;*************************************************************
                ;
                ; *** GETLN *** FNDLN (& FRIENDS) ***
                ;
                ; 'GETLN' READS A INPUT LINE INTO 'BUFFER'.  IT FIRST PROMPT
                ; THE CHARACTER IN A (GIVEN BY THE CALLER), THEN IT FILLS
                ; THE BUFFER AND ECHOS.  IT IGNORES LF'S AND NULLS, BUT STILL
                ; ECHOS THEM BACK.  RUB-OUT IS USED TO CAUSE IT TO DELETE
                ; THE LAST CHARACTER (IF THERE IS ONE), AND ALT-MOD IS USED TO
                ; CAUSE IT TO DELETE THE WHOLE LINE AND START IT ALL OVER.
                ; CR SIGNALS THE END OF A LINE, AND CAUSE 'GETLN' TO RETURN.
                ;
                ; 'FNDLN' FINDS A LINE WITH A GIVEN LINE # (IN HL) IN THE
                ; TEXT SAVE AREA.  DE IS USED AS THE TEXT POINTER.  IF THE
                ; LINE IS FOUND, DE WILL POINT TO THE BEGINNING OF THAT LINE
                ; (I.E., THE LOW BYTE OF THE LINE #), AND FLAGS ARE NC & Z.
                ; IF THAT LINE IS NOT THERE AND A LINE WITH A HIGHER LINE #
                ; IS FOUND, DE POINTS TO THERE AND FLAGS ARE NC & NZ.  IF
                ; WE REACHED THE END OF TEXT SAVE AREA AND CANNOT FIND THE
                ; LINE, FLAGS ARE C & NZ.
                ; 'FNDLN' WILL INITIALIZE DE TO THE BEGINNING OF THE TEXT SAVE
                ; AREA TO START THE SEARCH.  SOME OTHER ENTRIES OF THIS
                ; ROUTINE WILL NOT INITIALIZE DE AND DO THE SEARCH.
                ; 'FNDLNP' WILL START WITH DE AND SEARCH FOR THE LINE #.
                ; 'FNDNXT' WILL BUMP DE BY 2, FIND A CR AND THEN START SEARCH.
                ; 'FNDSKP' USE DE TO FIND A CR, AND THEN START SEARCH.
                ;
04FA   D7       GETLN:  RST  2                          ;*** GETLN ***
04FB   11370F           LXI  D,BUFFER                   ;PROMPT AND INIT.
04FE   CD8406   GL1:    CALL CHKIO                      ;CHECK KEYBOARD
0501   CAFE04           JZ   GL1                        ;NO INPUT, WAIT
0504   FE7F             CPI  7FH                        ;DELETE LAST CHARACTER?
0506   CA2305           JZ   GL3                        ;YES
0509   D7               RST  2                          ;INPUT, ECHO BACK
050A   FE0A             CPI  0AH                        ;IGNORE LF
050C   CAFE04           JZ   GL1
050F   B7               ORA  A                          ;IGNORE NULL
0510   CAFE04           JZ   GL1
0513   FE7D             CPI  7DH                        ;DELETE THE WHOLE LINE?
0515   CA3005           JZ   GL4                        ;YES
0518   12               STAX D                          ;ELSE SAVE INPUT
0519   13               INX  D                          ;AND BUMP POINTER
051A   FE0D             CPI  0DH                        ;WAS IT CR?
051C   C8               RZ                              ;YES, END OF LINE
051D   7B               MOV  A,E                        ;ELSE MORE FREE ROOM?
051E   FE77             CPI  BUFEND AND 0FFH
```

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0520   C2FE04          JNZ  GL1                        ;YES, GET NEXT INPUT
0523   7B       GL3:   MOV  A,E                        ;DELETE LAST CHARACTER
0524   FE37             CPI  BUFFER AND 0FFH            ;BUT DO WE HAVE ANY?
0526   CA3005           JZ   GL4                        ;NO, REDO WHOLE LINE
0529   1B               DCX  D                          ;YES, BACKUP POINTER
052A   3E5C             MVI  A,5CH                      ;AND ECHO A BACK-SLASH
052C   D7               RST  2
052D   C3FE04           JMP  GL1                        ;GO GET NEXT INPUT
0530   CD0E00   GL4:    CALL CRLF                       ;REDO ENTIRE LINE
0533   3E5E             MVI  A,05EH                     ;CR, LF AND UP-ARROW
0535   C3FA04           JMP  GETLN
                ;
0538   7C       FNDLN:  MOV  A,H                        ;*** FNDLN ***
0539   B7               ORA  A                          ;CHECK SIGN OF HL
053A   FA9F00           JM   QHOW                       ;IT CANNOT BE -
053D   111708           LXI  D,TXTBGN                   ;INIT TEXT POINTER
                ;
0540           FNDLP:                                   ;*** FDLNP ***
0540   E5       FL1:    PUSH H                          ;SAVE LINE #
0541   2A1508           LHLD TXTUNF                     ;CHECK IF WE PASSED END
0544   2B               DCX  H
0545   E7               RST  4
0546   E1               POP  H                          ;GET LINE # BACK
0547   D8               RC                              ;C,NZ PASSED END
0548   1A               LDAX D                          ;WE DID NOT, GET BYTE 1
0549   95               SUB  L                          ;IS THIS THE LINE?
054A   47               MOV  B,A                        ;COMPARE LOW ORDER
054B   13               INX  D
054C   1A               LDAX D                          ;GET BYTE 2
054D   9C               SBB  H                          ;COMPARE HIGH ORDER
054E   DA5505           JC   FL2                        ;NO, NOT THERE YET
0551   1B               DCX  D                          ;ELSE WE EITHER FOUND
0552   B0               ORA  B                          ;IT, OR IT IS NOT THERE
0553   C9               RET                             ;NC,Z:FOUND, NC,NZ:NO
                ;
0554           FNDNXT:                                  ;*** FNDNXT ***
0554   13               INX  D                          ;FIND NEXT LINE
0555   13       FL2:    INX  D                          ;JUST PASSED BYTE 1 & 2
                ;
0556   1A       FNDSKP: LDAX D                          ;*** FNDSKP ***
0557   FE0D             CPI  CR                         ;TRY TO FIND CR
0559   C25505           JNZ  FL2                        ;KEEP LOOKING
055C   13               INX  D                          ;FOUND CR, SKIP OVER
055D   C34005           JMP  FL1                        ;CHECK IF END OF TEXT
                ;
                ;*************************************************************
                ;
                ; *** PRTSTG *** QTSTG *** PRTNUM *** & PRTLN ***
                ;
                ; 'PRTSTG' PRINTS A STRING POINTED BY DE.  IT STOPS PRINTING
                ; AND RETURNS TO CALLER WHEN EITHER A CR IS PRINTED OR WHEN
```

```
                ; THE NEXT BYTE IS THE SAME AS WHAT WAS IN A (GIVEN BY THE
                ; CALLER).  OLD A IS STORED IN B, OLD B IS LOST.
                ;
                ; 'QTSTG' LOOKS FOR A BACK-ARROW, SINGLE QUOTE, OR DOUBLE
                ; QUOTE.  IF NONE OF THESE, RETURN TO CALLER.  IF BACK-ARROW,
                ; OUTPUT A CR WITHOUT A LF.  IF SINGLE OR DOUBLE QUOTE, PRINT
                ; THE STRING IN THE QUOTE AND DEMANDS A MATCHING UNQUOTE.
                ; AFTER THE PRINTING THE NEXT 3 BYTES OF THE CALLER IS SKIPPED
                ; OVER (USUALLY A JUMP INSTRUCTION.
                ;
                ; 'PRTNUM' PRINTS THE NUMBER IN HL.  LEADING BLANKS ARE ADDED
                ; IF NEEDED TO PAD THE NUMBER OF SPACES TO THE NUMBER IN C.
                ; HOWEVER, IF THE NUMBER OF DIGITS IS LARGER THAN THE # IN
                ; C, ALL DIGITS ARE PRINTED ANYWAY.  NEGATIVE SIGN IS ALSO
                ; PRINTED AND COUNTED IN, POSITIVE SIGN IS NOT.
                ;
                ; 'PRTLN' PRINTS A SAVED TEXT LINE WITH LINE # AND ALL.
                ;
0560   47       PRTSTG: MOV  B,A                        ;*** PRTSTG ***
0561   1A       PS1:    LDAX D                          ;GET A CHARACTER
0562   13               INX  D                          ;BUMP POINTER
0563   B8               CMP  B                          ;SAME AS OLD A?
0564   C8               RZ                              ;YES, RETURN
0565   D7               RST  2                          ;ELSE PRINT IT
0566   FE0D             CPI  CR                         ;WAS IT A CR?
0568   C26105           JNZ  PS1                        ;NO, NEXT
056B   C9               RET                             ;YES, RETURN
                ;
056C   CF       QTSTG:  RST  1                          ;*** QTSTG ***
056D   22               DB   '"'
056E   0F               DB   QT3-$-1
056F   3E22             MVI  A,22H                      ;IT IS A "
0571   CD6005   QT1:    CALL PRTSTG                     ;PRINT UNTIL ANOTHER
0574   FE0D             CPI  CR                         ;WAS LAST ONE A CR?
0576   E1               POP  H                          ;RETURN ADDRESS
0577   CA4701           JZ   RUNNXL                     ;WAS CR, RUN NEXT LINE
057A   23       QT2:    INX  H                          ;SKIP 3 BYTES ON RETURN
057B   23               INX  H
057C   23               INX  H
057D   E9               PCHL                            ;RETURN
057E   CF       QT3:    RST  1                          ;IS IT A '?
057F   27               DB   27H
0580   05               DB   QT4-$-1
0581   3E27             MVI  A,27H                      ;YES, DO THE SAME
0583   C37105           JMP  QT1                        ;AS IN "
0586   CF       QT4:    RST  1                          ;IS IT BACK-ARROW?
0587   5F               DB   5FH
0588   08               DB   QT5-$-1
0589   3E8D             MVI  A,08DH                     ;YES, CR WITHOUT LF
058B   D7               RST  2                          ;DO IT TWICE TO GIVE
058C   D7               RST  2                          ;TTY ENOUGH TIME
```

```
058D   E1              POP  H                    ;RETURN ADDRESS
058E   C37A05          JMP  QT2
0591   C9      QT5:    RET                       ;NONE OF ABOVE
               ;
0592   0600    PRTNUM: MVI  B,0                  ;*** PRTNUM ***
0594   CD8304          CALL CHKSGN               ;CHECK SIGN
0597   F29D05          JP   PN1                  ;NO SIGN
059A   062D            MVI  B,'-'                ;B=SIGN
059C   0D              DCR  C                    ;'-' TAKES SPACE
059D   D5      PN1:    PUSH D                    ;SAVE
059E   110A00          LXI  D,0AH                ;DECIMAL
05A1   D5              PUSH D                    ;SAVE AS A FLAG
05A2   0D              DCR  C                    ;C=SPACES
05A3   C5              PUSH B                    ;SAVE SIGN & SPACE
05A4   CD6604  PN2:    CALL DIVIDE               ;DIVIDE HL BY 10
05A7   78              MOV  A,B                  ;RESULT 0?
05A8   B1              ORA  C
05A9   CAB405          JZ   PN3                  ;YES, WE GOT ALL
05AC   E3              XTHL                      ;NO, SAVE REMAINDER
05AD   2D              DCR  L                    ;AND COUNT SPACE
05AE   E5              PUSH H                    ;HL IS OLD BC
05AF   60              MOV  H,B                  ;MOVE RESULT TO BC
05B0   69              MOV  L,C
05B1   C3A405          JMP  PN2                  ;AND DIVIDE BY 10
05B4   C1      PN3:    POP  B                    ;WE GOT ALL DIGITS IN
05B5   0D      PN4:    DCR  C                    ;THE STACK
05B6   79              MOV  A,C                  ;LOOK AT SPACE COUNT
05B7   B7              ORA  A
05B8   FAC105          JM   PN5                  ;NO LEADING BLANKS
05BB   3E20            MVI  A,20H                ;LEADING BLANKS
05BD   D7              RST  2
05BE   C3B505          JMP  PN4                  ;MORE?
05C1   78      PN5:    MOV  A,B                  ;PRINT SIGN
05C2   B7              ORA  A
05C3   C41000          CNZ  10H
05C6   5D              MOV  E,L                  ;LAST REMAINDER IN E
05C7   7B      PN6:    MOV  A,E                  ;CHECK DIGIT IN E
05C8   FE0A            CPI  0AH                  ;10 IS FLAG FOR NO MORE
05CA   D1              POP  D
05CB   C8              RZ                        ;IF SO, RETURN
05CC   C630            ADI  30H                  ;ELSE CONVERT TO ASCII
05CE   D7              RST  2                    ;AND PRINT THE DIGIT
05CF   C3C705          JMP  PN6                  ;GO BACK FOR MORE
               ;
05D2   1A      PRTLN:  LDAX D                    ;*** PRTLN ***
05D3   6F              MOV  L,A                  ;LOW ORDER LINE #
05D4   13              INX  D
05D5   1A              LDAX D                    ;HIGH ORDER
05D6   67              MOV  H,A
05D7   13              INX  D
05D8   0E04            MVI  C,4H                 ;PRINT 4 DIGIT LINE #
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```
05DA   CD9205          CALL PRTNUM
05DD   3E20            MVI  A,20H                    ;FOLLOWED BY A BLANK
05DF   D7              RST  2
05E0   97              SUB  A                        ;AND THEN THE NEXT
05E1   CD6005          CALL PRTSTG
05E4   C9              RET
                ;
                ;*********************************************************
                ;
                ; *** MVUP *** MVDOWN *** POPA *** & PUSHA ***
                ;
                ; 'MVUP' MOVES A BLOCK UP FROM WHERE DE-> TO WHERE BC-> UNTIL
                ; DE = HL
                ;
                ; 'MVDOWN' MOVES A BLOCK DOWN FROM WHERE DE-> TO WHERE HL->
                ; UNTIL DE = BC
                ;
                ; 'POPA' RESTORES THE 'FOR' LOOP VARIABLE SAVE AREA FROM THE
                ; STACK
                ;
                ; 'PUSHA' STACKS THE 'FOR' LOOP VARIABLE SAVE AREA INTO THE
                ; STACK
                ;
05E5   E7       MVUP:  RST  4                        ;*** MVUP ***
05E6   C8              RZ                            ;DE = HL, RETURN
05E7   1A              LDAX D                        ;GET ONE BYTE
05E8   02              STAX B                        ;MOVE IT
05E9   13              INX  D                        ;INCREASE BOTH POINTERS
05EA   03              INX  B
05EB   C3E505          JMP  MVUP                     ;UNTIL DONE
                ;
05EE   78       MVDOWN: MOV  A,B                     ;*** MVDOWN ***
05EF   92              SUB  D                        ;TEST IF DE = BC
05F0   C2F605          JNZ  MD1                      ;NO, GO MOVE
05F3   79              MOV  A,C                      ;MAYBE, OTHER BYTE?
05F4   93              SUB  E
05F5   C8              RZ                            ;YES, RETURN
05F6   1B       MD1:   DCX  D                        ;ELSE MOVE A BYTE
05F7   2B              DCX  H                        ;BUT FIRST DECREASE
05F8   1A              LDAX D                        ;BOTH POINTERS AND
05F9   77              MOV  M,A                      ;THEN DO IT
05FA   C3EE05          JMP  MVDOWN                   ;LOOP BACK
                ;
05FD   C1       POPA:  POP  B                        ;BC = RETURN ADDR.
05FE   E1              POP  H                        ;RESTORE LOPVAR, BUT
05FF   220908          SHLD LOPVAR                   ;=0 MEANS NO MORE
0602   7C              MOV  A,H
0603   B5              ORA  L
0604   CA1706          JZ   PP1                      ;YEP, GO RETURN
0607   E1              POP  H                        ;NOP, RESTORE OTHERS
0608   220B08          SHLD LOPINC
```

```
060B   E1              POP  H
060C   220D08          SHLD LOPLMT
060F   E1              POP  H
0610   220F08          SHLD LOPLN
0613   E1              POP  H
0614   221108          SHLD LOPPT
0617   C5       PP1:   PUSH B                        ;BC = RETURN ADDR.
0618   C9              RET
                ;
0619   21780F   PUSHA: LXI  H,STKLMT                 ;*** PUSHA ***
061C   CD8604          CALL CHGSGN
061F   C1              POP  B                        ;BC=RETURN ADDRESS
0620   39              DAD  SP                       ;IS STACK NEAR THE TOP?
0621   D2F304          JNC  QSORRY                   ;YES, SORRY FOR THAT
0624   2A0908          LHLD LOPVAR                   ;ELSE SAVE LOOP VAR'S
0627   7C              MOV  A,H                      ;BUT IF LOPVAR IS 0
0628   B5              ORA  L                        ;THAT WILL BE ALL
0629   CA3F06          JZ   PU1
062C   2A1108          LHLD LOPPT                    ;ELSE, MORE TO SAVE
062F   E5              PUSH H
0630   2A0F08          LHLD LOPLN
0633   E5              PUSH H
0634   2A0D08          LHLD LOPLMT
0637   E5              PUSH H
0638   2A0B08          LHLD LOPINC
063B   E5              PUSH H
063C   2A0908          LHLD LOPVAR
063F   E5       PU1:   PUSH H
0640   C5              PUSH B                        ;BC = RETURN ADDR.
0641   C9              RET
                ;
                ;*************************************************************
                ;
                ; *** OUTC *** & CHKIO ***
                ;
                ; THESE ARE THE ONLY I/O ROUTINES IN TBI.
                ; 'OUTC' IS CONTROLLED BY A SOFTWARE SWITCH 'OCSW'.  IF OCSW=0
                ; 'OUTC' WILL JUST RETURN TO THE CALLER.  IF OCSW IS NOT 0,
                ; IT WILL OUTPUT THE BYTE IN A.  IF THAT IS A CR, A LF IS ALSO
                ; SEND OUT.  ONLY THE FLAGS MAY BE CHANGED AT RETURN. ALL REG.
                ; ARE RESTORED.
                ;
                ; 'CHKIO' CHECKS THE INPUT.  IF NO INPUT, IT WILL RETURN TO
                ; THE CALLER WITH THE Z FLAG SET.  IF THERE IS INPUT, Z FLAG
                ; IS CLEARED AND THE INPUT BYTE IS IN A.  HOWEVER, IF THE
                ; INPUT IS A CONTROL-O, THE 'OCSW' SWITCH IS COMPLIMENTED, AND
                ; Z FLAG IS RETURNED.  IF A CONTROL-C IS READ, 'CHKIO' WILL
                ; RESTART TBI AND DO NOT RETURN TO THE CALLER.
                ;
                ;OUTC:  PUSH PSW                      ;THIS IS AT LOC. 10
                ;       LDA  OCSW                     ;CHECK SOFTWARE SWITCH
```

```
                ;       ORA  A
0642   320008   INIT:   STA  OCSW
0645   3E4E             MVI  A,4EH          ;Initialize 8251A UART -- 3 is status port
0647   D303             OUT  3              ;1 stop bit, no parity, 8-bit char, 16x baud
0649   3E37             MVI  A,37H          ;enable receive and transmit
064B   D303             OUT  3
064D   1619             MVI  D,19H
064F           PATLOP:
064F   CD0E00           CALL CRLF
0652   15               DCR  D
0653   C24F06           JNZ  PATLOP
0656   97               SUB  A
0657   11A306           LXI  D,MSG1
065A   CD6005           CALL PRTSTG
065D   210000           LXI  H,START
0660   221308           SHLD RANPNT
0663   211708           LXI  H,TXTBGN
0666   221508           SHLD TXTUNF
0669   C3BA00           JMP  RSTART
066C   C27106   OC2:    JNZ  OC3            ;IT IS ON
066F   F1               POP  PSW            ;IT IS OFF
0670   C9               RET                 ;RESTORE AF AND RETURN
0671   DB03     OC3:    IN   3              ;Check status
0673   E601             ANI  1H             ;STATUS BIT
0675   CA7106           JZ   OC3            ;NOT READY, WAIT
0678   F1               POP  PSW            ;READY, GET OLD A BACK
0679   D302             OUT  2              ;Out to data port
067B   FE0D             CPI  CR             ;WAS IT CR?
067D   C0               RNZ                 ;NO, FINISHED
067E   3E0A             MVI  A,LF           ;YES, WE SEND LF TOO
0680   D7               RST  2              ;THIS IS RECURSIVE
0681   3E0D             MVI  A,CR           ;GET CR BACK IN A
0683   C9               RET
                ;
0684   DB03     CHKIO:  IN   3              ;*** CHKIO ***
0686   00               NOP                 ;STATUS BIT FLIPPED?
0687   E602             ANI  2H             ;MASK STATUS BIT
0689   C8               RZ                  ;NOT READY, RETURN "Z"
068A   DB02             IN   2              ;READY, READ DATA
068C   E67F             ANI  7FH            ;MASK BIT 7 OFF
068E   FE0F             CPI  0FH            ;IS IT CONTROL-O?
0690   C29D06           JNZ  CI1            ;NO, MORE CHECKING
0693   3A0008           LDA  OCSW           ;CONTROL-O FLIPS OCSW
0696   2F               CMA                 ;ON TO OFF, OFF TO ON
0697   320008           STA  OCSW
069A   C38406           JMP  CHKIO          ;GET ANOTHER INPUT
069D   FE03     CI1:    CPI  3H             ;IS IT CONTROL-C?
069F   C0               RNZ                 ;NO, RETURN "NZ"
06A0   C3BA00           JMP  RSTART         ;YES, RESTART TBI
                ;
06A3   54494E59 MSG1:   DB   'TINY '
```

```
06A7   20
06A8   42415349         DB   'BASIC'
06AC   43
06AD   0D               DB   CR
                ;
                ;*************************************************************
                ;
                ; *** TABLES *** DIRECT *** & EXEC ***
                ;
                ; THIS SECTION OF THE CODE TESTS A STRING AGAINST A TABLE.
                ; WHEN A MATCH IS FOUND, CONTROL IS TRANSFERED TO THE SECTION
                ; OF CODE ACCORDING TO THE TABLE.
                ;
                ; AT 'EXEC', DE SHOULD POINT TO THE STRING AND HL SHOULD POINT
                ; TO THE TABLE-1.  AT 'DIRECT', DE SHOULD POINT TO THE STRING.
                ; HL WILL BE SET UP TO POINT TO TAB1-1, WHICH IS THE TABLE OF
                ; ALL DIRECT AND STATEMENT COMMANDS.
                ;
                ; A '.' IN THE STRING WILL TERMINATE THE TEST AND THE PARTIAL
                ; MATCH WILL BE CONSIDERED AS A MATCH.  E.G., 'P.', 'PR.',
                ; 'PRI.', 'PRIN.', OR 'PRINT' WILL ALL MATCH 'PRINT'.
                ;
                ; THE TABLE CONSISTS OF ANY NUMBER OF ITEMS.  EACH ITEM
                ; IS A STRING OF CHARACTERS WITH BIT 7 SET TO 0 AND
                ; A JUMP ADDRESS STORED HI-LOW WITH BIT 7 OF THE HIGH
                ; BYTE SET TO 1.
                ;
                ; END OF TABLE IS AN ITEM WITH A JUMP ADDRESS ONLY.  IF THE
                ; STRING DOES NOT MATCH ANY OF THE OTHER ITEMS, IT WILL
                ; MATCH THIS NULL ITEM AS DEFAULT.
                ;
06AE            TAB1:                                ;DIRECT COMMANDS
06AE   4C495354         DB   'LIST'
                        DWA  LIST
06B2 1 81      +        DB   (LIST SHR 8) + 128
06B3 1 6F      +        DB   LIST AND 0FFH
06B4   52554E           DB   'RUN'
                        DWA  RUN
06B7 1 81      +        DB   (RUN SHR 8) + 128
06B8 1 41      +        DB   RUN AND 0FFH
06B9   4E4557           DB   'NEW'
                        DWA  NEW
06BC 1 81      +        DB   (NEW SHR 8) + 128
06BD 1 32      +        DB   NEW AND 0FFH
                ;
06BE            TAB2:                                ;DIRECT/STATEMENT
06BE   4E455854         DB   'NEXT'
                        DWA  NEXT
06C2 1 82      +        DB   (NEXT SHR 8) + 128
06C3 1 57      +        DB   NEXT AND 0FFH
06C4   4C4554           DB   'LET'
```

```
                        DWA  LET
06C7 1 83      +        DB   (LET SHR 8) + 128
06C8 1 23      +        DB   LET AND 0FFH
06C9   4946             DB   'IF'
                        DWA  IFF
06CB 1 82      +        DB   (IFF SHR 8) + 128
06CC 1 B4      +        DB   IFF AND 0FFH
06CD   474F544F         DB   'GOTO'
                        DWA  GOTO
06D1 1 81      +        DB   (GOTO SHR 8) + 128
06D2 1 60      +        DB   GOTO AND 0FFH
06D3   474F5355         DB   'GOSUB'
06D7   42
                        DWA  GOSUB
06D8 1 81      +        DB   (GOSUB SHR 8) + 128
06D9 1 BF      +        DB   GOSUB AND 0FFH
06DA   52455455         DB   'RETURN'
06DE   524E
                        DWA  RETURN
06E0 1 81      +        DB   (RETUR SHR 8) + 128
06E1 1 DF      +        DB   RETUR AND 0FFH
06E2   52454D           DB   'REM'
                        DWA  REM
06E5 1 82      +        DB   (REM SHR 8) + 128
06E6 1 B0      +        DB   REM AND 0FFH
06E7   464F52           DB   'FOR'
                        DWA  FOR
06EA 1 81      +        DB   (FOR SHR 8) + 128
06EB 1 F8      +        DB   FOR AND 0FFH
06EC   494E5055         DB   'INPUT'
06F0   54
                        DWA  INPUT
06F1 1 82      +        DB   (INPUT SHR 8) + 128
06F2 1 CD      +        DB   INPUT AND 0FFH
06F3   5052494E         DB   'PRINT'
06F7   54
                        DWA  PRINT
06F8 1 81      +        DB   (PRINT SHR 8) + 128
06F9 1 87      +        DB   PRINT AND 0FFH
06FA   53544F50         DB   'STOP'
                        DWA  STOP
06FE 1 81      +        DB   (STOP SHR 8) + 128
06FF 1 3B      +        DB   STOP AND 0FFH
                        DWA  DEFLT
0700 1 83      +        DB   (DEFLT SHR 8) + 128
0701 1 1D      +        DB   DEFLT AND 0FFH
                 ;
0702             TAB4:                                  ;FUNCTIONS
0702   524E44           DB   'RND'
                        DWA  RND
0705 1 84      +        DB   (RND SHR 8) + 128
```

```
0706 1 25      +        DB   RND AND 0FFH
0707   414253           DB   'ABS'
                        DWA  ABS
070A 1 84      +        DB   (ABS SHR 8) + 128
070B 1 50      +        DB   ABS AND 0FFH
070C   53495A45         DB   'SIZE'
                        DWA  SIZE
0710 1 84      +        DB   (SIZE SHR 8) + 128
0711 1 59      +        DB   SIZE AND 0FFH
                        DWA  XP40
0712 1 84      +        DB   (XP40 SHR 8) + 128
0713 1 0B      +        DB   XP40 AND 0FFH
                ;
0714            TAB5:                                  ;"TO" IN "FOR"
0714   544F             DB   'TO'
                        DWA  FR1
0716 1 82      +        DB   (FR1 SHR 8) + 128
0717 1 08      +        DB   FR1 AND 0FFH
                        DWA  QWHAT
0718 1 84      +        DB   (QWHAT SHR 8) + 128
0719 1 C6      +        DB   QWHAT AND 0FFH
                ;
071A            TAB6:                                  ;"STEP" IN "FOR"
071A   53544550         DB   'STEP'
                        DWA  FR2
071E 1 82      +        DB   (FR2 SHR 8) + 128
071F 1 12      +        DB   FR2 AND 0FFH
                        DWA  FR3
0720 1 82      +        DB   (FR3 SHR 8) + 128
0721 1 16      +        DB   FR3 AND 0FFH
                ;
0722            TAB8:                                  ;RELATION OPERATORS
0722   3E3D             DB   '>='
                        DWA  XP11
0724 1 83      +        DB   (XP11 SHR 8) + 128
0725 1 33      +        DB   XP11 AND 0FFH
0726   23               DB   '#'
                        DWA  XP12
0727 1 83      +        DB   (XP12 SHR 8) + 128
0728 1 39      +        DB   XP12 AND 0FFH
0729   3E               DB   '>'
                        DWA  XP13
072A 1 83      +        DB   (XP13 SHR 8) + 128
072B 1 3F      +        DB   XP13 AND 0FFH
072C   3D               DB   '='
                        DWA  XP15
072D 1 83      +        DB   (XP15 SHR 8) + 128
072E 1 4E      +        DB   XP15 AND 0FFH
072F   3C3D             DB   '<='
                        DWA  XP14
0731 1 83      +        DB   (XP14 SHR 8) + 128
```

```
0732 1 46      +        DB   XP14 AND 0FFH
0733   3C               DB   '<'
                        DWA  XP16
0734 1 83      +        DB   (XP16 SHR 8) + 128
0735 1 54      +        DB   XP16 AND 0FFH
                        DWA  XP17
0736 1 83      +        DB   (XP17 SHR 8) + 128
0737 1 5A      +        DB   XP17 AND 0FFH
                 ;
0738   21AD06   DIRECT: LXI  H,TAB1-1                  ;*** DIRECT ***
                 ;
073B            EXEC:                                  ;*** EXEC ***
073B   EF       EX0:    RST  5                         ;IGNORE LEADING BLANKS
073C   D5               PUSH D                         ;SAVE POINTER
073D   1A       EX1:    LDAX D                         ;IF FOUND '.' IN STRING
073E   13               INX  D                         ;BEFORE ANY MISMATCH
073F   FE2E             CPI  2EH                       ;WE DECLARE A MATCH
0741   CA5A07           JZ   EX3
0744   23               INX  H                         ;HL->TABLE
0745   BE               CMP  M                         ;IF MATCH, TEST NEXT
0746   CA3D07           JZ   EX1
0749   3E7F             MVI  A,07FH                    ;ELSE SEE IF BIT 7
074B   1B               DCX  D                         ;OF TABLE IS SET, WHICH
074C   BE               CMP  M                         ;IS THE JUMP ADDR. (HI)
074D   DA6107           JC   EX5                       ;C:YES, MATCHED
0750   23       EX2:    INX  H                         ;NC:NO, FIND JUMP ADDR.
0751   BE               CMP  M
0752   D25007           JNC  EX2
0755   23               INX  H                         ;BUMP TO NEXT TAB. ITEM
0756   D1               POP  D                         ;RESTORE STRING POINTER
0757   C33B07           JMP  EX0                       ;TEST AGAINST NEXT ITEM
075A   3E7F     EX3:    MVI  A,07FH                    ;PARTIAL MATCH, FIND
075C   23       EX4:    INX  H                         ;JUMP ADDR., WHICH IS
075D   BE               CMP  M                         ;FLAGGED BY BIT 7
075E   D25C07           JNC  EX4
0761   7E       EX5:    MOV  A,M                       ;LOAD HL WITH THE JUMP
0762   23               INX  H                         ;ADDRESS FROM THE TABLE
0763   6E               MOV  L,M
0764   E67F             ANI  7FH                       ;MASK OFF BIT 7
0766   67               MOV  H,A
0767   F1               POP  PSW                       ;CLEAN UP THE GABAGE
0768   E9               PCHL                           ;AND WE GO DO IT
                 ;
0769            LSTROM:                                ;ALL ABOVE CAN BE ROM
                 ;       ORG  1000H                    ;HERE DOWN MUST BE RAM
0800                    ORG  0800H
0800            OCSW:   DS   1                         ;SWITCH FOR OUTPUT
0801            CURRNT: DS   2                         ;POINTS TO CURRENT LINE
0803            STKGOS: DS   2                         ;SAVES SP IN 'GOSUB'
0805            VARNXT: DS   2                         ;TEMP STORAGE
0807            STKINP: DS   2                         ;SAVES SP IN 'INPUT'
```

```
0809            LOPVAR: DS   2                        ;'FOR' LOOP SAVE AREA
080B            LOPINC: DS   2                        ;INCREMENT
080D            LOPLMT: DS   2                        ;LIMIT
080F            LOPLN:  DS   2                        ;LINE NUMBER
0811            LOPPT:  DS   2                        ;TEXT POINTER
0813            RANPNT: DS   2                        ;RANDOM NUMBER POINTER
0815            TXTUNF: DS   2                        ;->UNFILLED TEXT AREA
0817            TXTBGN: DS   2                        ;TEXT SAVE AREA BEGINS
                ;       ORG  1366H
                ;       ORG  1F00H
0F00                    ORG  0F00H                    ;for 2K RAM
0F00            TXTEND: DS   0                        ;TEXT SAVE AREA ENDS
0F00            VARBGN: DS   55                       ;VARIABLE @(0)
0F37            BUFFER: DS   64                       ;INPUT BUFFER
0F77            BUFEND: DS   1                        ;BUFFER ENDS
0F78            STKLMT: DS   1                        ;TOP LIMIT FOR STACK
                ;       ORG  1400H
                ;       ORG  2000H
1000                    ORG  1000H                    ;for 4K system -- 2k ROM, 2K RAM
1000            STACK:  DS   0                        ;STACK STARTS HERE
                ;
000D            CR      EQU  0DH
000A            LF      EQU  0AH

                        END
NO PROGRAM ERRORS
```

SYMBOL TABLE

* 01

A	0007	ABS	0450	AHOW	00A0	ASORR	04F4
AWHAT	04C7	B	0000	BUFEN	0F77	BUFFE	0F37
C	0001	CHGSG	0486	CHKIO	0684	CHKSG	0483
CI1	069D	CK1	049E	CKHLD	0498	CR	000D
CRLF	000E	CURRN	0801	D	0002	DEFLT	031D
DIREC	0738	DIVID	0466	DV1	0471	DV2	0473
DWA	06CB	E	0003	ENDCH	04C2	ERROR	04CA
EX0	073B	EX1	073D	EX2	0750	EX3	075A
EX4	075C	EX5	0761	EXEC	073B	EXPR1	032D
EXPR2	0371	EXPR3	03A5	EXPR4	0405	FI1	04BA
FI2	04C1	FIN	04B3	FL1	0540	FL2	0555
FNDLN	0538	FNDLP	0540	FNDNX	0554	FNDSK	0556
FOR	01F8	FR1	0208	FR2	0212	FR3	0216
FR4	0219	FR5	021C *	FR7	0231	FR8	0252
GETLN	04FA	GL1	04FE	GL3	0523	GL4	0530
GOSUB	01BF	GOTO	0160	H	0004	HOW	00A6
IFF	02B4	INIT	0642	INPER	02C3	INPUT	02CD
IP1	02CD	IP2	02DB	IP3	02EB	IP4	0315
IP5	031C	L	0005	LET	0323	LF	000A
LIST	016F	LOPIN	080B	LOPLM	080D	LOPLN	080F
LOPPT	0811	LOPVA	0809	LS1	0178	LSTRO	0769
LT1	032C	M	0006	MD1	05F6	MSG1	06A3
MVDOW	05EE	MVUP	05E5	NEW	0132	NEXT	0257
NX0	025E	NX1	0298	NX2	02AC	NX3	0276
NX4	0288	NX5	02AA	OC2	066C	OC3	0671
OCSW	0800	OK	00AB	PARN	041A	PATLO	064F
PN1	059D	PN2	05A4	PN3	05B4	PN4	05B5
PN5	05C1	PN6	05C7	POPA	05FD	PP1	0617
PR0	019B	PR1	01A3	PR2	0192	PR3	01A9
PR6	01B2	PR8	01B6	PRINT	0187	PRTLN	05D2
PRTNU	0592	PRTST	0560	PS1	0561	PSW	0006
PU1	063F	PUSHA	0619	QHOW	009F	QSORR	04F3
QT1	0571	QT2	057A	QT3	057E	QT4	0586
QT5	0591	QTSTG	056C	QWHAT	04C6	RA1	0440
RANPN	0813	REM	02B0	RETUR	01DF	RND	0425
RSTAR	00BA	RUN	0141	RUNNX	0147	RUNSM	0157
RUNTS	0150	SETVA	04A0	SIZE	0459	SORRY	00B4
SP	0006	SS1	0028	ST1	00BD *	ST2	00CD
ST3	00D6	ST4	010B	STACK	1000	START	0000
STKGO	0803	STKIN	0807	STKLM	0F78	STOP	013B
SUBDE	047C	SV1	04B0	TAB1	06AE	TAB2	06BE
TAB4	0702	TAB5	0714	TAB6	071A	TAB8	0722
TC1	0068	TC2	0073	TN1	007C	TSTNU	0077
TV1	0058	TXTBG	0817	TXTEN	0F00	TXTUN	0815
VARBG	0F00	VARNX	0805	WHAT	00AE	XP11	0333
XP12	0339	XP13	033F	XP14	0346	XP15	034E
XP16	0354	XP17	035A	XP18	035C	XP21	037A

SYMBOL TABLE

XP22	037D	XP23	0380	XP24	0387	XP25	0398
XP26	039B	XP31	03A8	XP32	03C5	XP33	03CD
XP34	03D8	XP35	03F7	XP40	040B	XP41	0414
XP42	0421	XP43	0422				

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SYMBOL TABLE

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Appendix C: Intel Hex Code for Tiny BASIC

What follows is the hex file output from the assembly of the Tiny BASIC code in Appendix B. This can be copied and pasted into a text file. Some EPROM programmers will accept Intel hex files for programming EPROMs, so you can make your own Tiny BASIC EPROM that way. There are also utilities in both Windows (hex2bin) and Linux (objcopy) to convert an Intel hex file into a binary file.

```
:100000003100103EFFC34206E3EFBEC368003E0D61
:10001000F53A0008B7C36C06CD7103E5C32D03574D
:100020007CBAC07DBBC9414E1AFE20C013C3280054
:10003000F1CDB304C3C60447EFD640D8C25800136D
:10004000CD1A0429DA9F00D5EBCD5904E7DAF40480
:1000500021000FCD7C04D1C9FE1B3FD81321000F16
:1000600007856F3E008C67C923CA7300C54E060022
:1000700009C11B1323E3C921000044EFFE30D8FE61
:100080003AD03EF0A4C29F0004C5444D2929092955
:100090001A13E60F856F3E008C67C11AF27C00D5FB
:1000A00011A600C3CA04484F573F0D4F4B0D574888
:1000B00041543F0D534F5252590D310010CD0E0097
:1000C00011AB0097CD600521CE0022010821000070
:1000D0002209082203083E3ECDFA04D511370FCD80
:1000E0007700EF7CB5C1CA38071B7C121B7D12C597
:1000F000D57993F5CD3805D5C20B01D5CD5405C1C1
:100100002A1508CDE5056069221508C12A1508F1F0
:10011000E5FE03CABA00856F3E008C6711000FE749
:10012000D2F304221508D1CDEE05D1E1CDE505C30A
:10013000D600CDC204211708221508CDC204C3BAC7
:1001400000CDC204111708210000CD4005DABA0025
:10015000EB220108EB1313CD840621BD06C33B0738
:10016000DFD5CDC204CD3805C2A000F1C35001CD0A
:100170007700CDC204CD3805DABA00CDD205CD84E2
:1001800006CD4005C378010E06CF3B06CD0E00C359
:100190005701CF0D06CD0E00C34701CF2305DF4D1C
:1001A000C3A901CD6C05C3B601CF2C06CDB304C3E2
:1001B0009B01CD0E00F7DFC5CD9205C1C3A901CDCE
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