CUSTOM COMPUTER CENTER, INC.
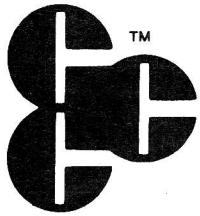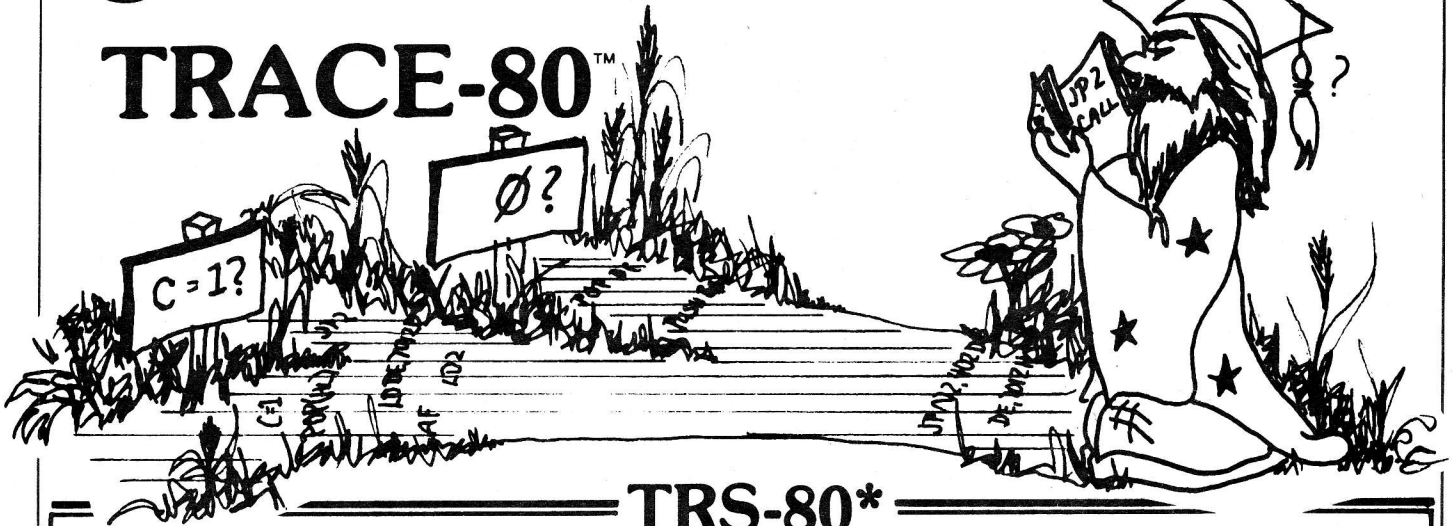
P.O. BOX 58042 ★ HOUSTON, TEXAS 77058

★ *Learn machine language and assembly language.*
★ *Dicipher machine language logic.*
★ *Dynamically debug your machine language routines.*

TRACE-80™

TRS-80*
MOD 1 Tape/Disk Version
$29.95

TRACE-80 is an interactive monitor that provides you the ability to dynamically analyze (or single step) machine language code in both ROM or RAM. This means you can run a step or freeze action with or without setting a breakpoint. During execution you can display and/or print the contents of the registers, the memory location, the machine code executed and the assembly language mnemonics.

With this capability, **TRACE-80** provides you the means for observing machine code execute because you can start or stop, run slow or fast and never miss a single action of the computer.

TRACE-80 gives the novice the tool to learn machine code by tracing programs written by others.

TRACE-80 provides the commercial programmer the software to dynamically test and debug his programs.

FEATURES:
★ For both beginner and advanced programmer.
★ More than 20 commands.
★ Trace-80 is written in machine language.
★ Traces both ROM and RAM.
★ Tape or Disk operation.
★ Model II Disk version available.
★ Optionally prints only "Transfer of Control" instructions.
★ Full speed, slow speed or freeze execution modes.
★ Memory can be displayed/modified.
★ Hex, ASCII and mnemonic display modes.
★ Printer optional.
★ Abreviated or full printer format.
★ Set breakpoint in ROM.
★ Serial printer output if desired.
★ Option of normal screen display, memory display, trace display or clear screen.

THIS PACKAGE CONTAINS:
• USER'S MANUAL
• CASSETTE TAPE CONTAINING:
    16K VERSION
    32K VERSION
    48K VERSION

EQUIPMENT REQUIRED:
• TRS-80, LEVEL II
• MINIMUM OF 16K MEMORY
• DISK DRIVES OPTIONAL
• PARALLEL or SERIAL PRINTER OPTIONAL

PARTIAL LIST OF COMMANDS: Load disk file, Trace, Slow motion execution, Full speed execution, Freeze action, Single instruction execution, Examine and/or modify memory, Examine and/or modify register contents, Enable/Disable screen, Enable/Disable printer, ASCII or Hex display, Full screen memory display, Line printer commands, etc.

CUSTOM COMPUTER CENTER, INC.

TRACE-80 - A DYNAMICALLY INTERACTIVE MONITOR
Release 1.0
September 1, 1980

CUSTOM COMPUTER CENTER, INC.

TRACE-80 - A DYNAMICALLY INTERACTIVE MONITOR

TABLE OF CONTENTS

I.   GENERAL DESCRIPTION AND PURPOSE OF TRACE-80

THE TRACE-80 program provides a powerful tool for debug of assembly language programs residing in ROM, PROM or RAM. It provides a slow motion execution with screen display and/or a printed record of an assembly language program execution.

TRACE-80 is designed to run under either Model I DOS or LEVEL II, or Model II DOS.

TRACE-80 is an invaluable tool for both the new programmer learning to program in assembly language as well as the expert programmer attempting to find a bug in his latest program. The programmer may easily see the exact execution sequence of his program along with the value of all flag bits and registers. Register contents and memory locations may be easily inspected in either hexidecimal or ASCII and modified. Memory may also be displayed in instruction mnemonic format.

The TRACE-80 trace printout includes memory location, instruction mnemonics and register contents. The screen display has this information plus data pointed to by the register contents. Traced programs are executed by relocating and executing each instruction one at a time except for jump group and call and return group instructions. These instructions are interpreted and appropriate transfer of control performed. This allows tracing routines residing in ROM or PROM since modification of the traced program memory is not required.

For each instruction executed or interpreted, the memory location is printed first. The instruction opcode is then interpreted and the correct instruction mnemonics are printed. Instructions which may be executed are then executed and transfer of control instructions (e.g. JP, JR, CALL, RET), are emulated (i.e. if the condition code is proper, the location counter is updated). After this controlled execution or emulation, the contents of each register of the active register set (including new PC) is printed. The CRT screen is then updated displaying the next instruction to be executed and the process is repeated until the end address is reached.

The TRACE-80 trace mode also causes execution of the program being traced to be considerably slower than real time. This makes it easy to quickly step through a program while watching each step. Subroutines such as disk or cassette read/write which require real time execution to maintain proper timing may not, however, be traced in slow motion due to the non-real time execution. The full speed mode of execution which uses a breakpoint concept must be selected for these sections of code.

An example of the screen display is shown in figure 1 and an example of the line printer output is shown in figure 2.

```
        AF = 0154 -Z-H-P--
        BC = 0000 : F3 AF C3 74 06 C3 00 40   C3 00 40 E1 E9 C3 9F 06
        DE = 4480 : 80 00 00 00 42 00 02 46   66 00 11 00 10 00 03 01
        HL = 431B : 0D 49 4C 0D 49 4E 4B 2F   50 43 4C 0D FF FF FF FF
        IX = FFFF : 00 F3 AF C3 74 06 C3 00   40 C3 00 40 E1 E9 C3 9F
        IY = AFFF : 11 FA A8 18 17 11 FE A8   18 12 11 32 A8 18 0D 11
        SP = 41FA : 2D 40 00 00 00 00 2C 23   C9 36 28 18 FA 36 29 18
        PC = 8724 : 3E 24 3E 4D 72 D8 F1 43   65 71 82 E5 E9 C3 8F 06
                    3E24      LD   A,24H
              0000 : F3 AF C3 74 06 C3 00 40   C3 00 40 E1 E9 C3 9F 06
              0010 : C3 03 40 C5 06 01 18 2E   C3 06 40 C5 06 02 18 26
              0020 : C3 09 40 C5 06 04 18 1E   C3 0C 40 11 15 40 18 E3
              0030 : C3 0F 40 11 1D 40 18 E3   C3 12 40 11 25 40 18 DB
              0040 : C3 D9 05 C9 00 00 C3 C2   03 CD 2B 00 B7 C0 18 F9
              0050 : 0D 0D 1F 1F 01 01 5B 1B   0A 1A 08 18 09 19 20 20
        T80 CMD.
```

FIGURE 1 - EXAMPLE OF SCREEN PRINTOUT

```
LOCN INSTRUCT  MNEMONICS      A  FLAG-REG  BC   DE   HL   IX   IY   SP
                              02 -Z----N- 0001 0000 03DD 401D AFFF 41F0
0033 111D40    LD   DE,401DH  02 -Z----N- 0001 401D 03DD 401D AFFF 41F0
0036 18E3      JR   001BH     02 -Z----N- 0001 401D 03DD 401D AFFF 41F0
001B C5        PUSH BC        02 -Z----N- 0001 401D 03DD 401D AFFF 41EE
001C 0602      LD   B,02H     02 -Z----N- 0201 401D 03DD 401D AFFF 41EE
```

FIGURE 2 - EXAMPLE OF LINE PRINTER OUTPUT

TRACE-80   A Monitor with Dynamic Control   PAGE 4

II.   OPERATING INSTRUCTIONS FOR TAPE SYSTEMS

TRACE-80 is loaded from cassette tape by the following standard technique:

```
  . SYSTEM     ,Enter.    -  Transfer to system loader
  ? Filename   ,Enter.    -  Load program to be traced
  ? T8016K     ,Enter.    -  Load TRACE-80 routine from tape
  ? /          ,Enter.    -  Transfer control to TRACE-80
```

TRACE-80 will identify itself and ask the type of printer interface to be used. When this question is answered, TRACE-80 will then enter the command mode and request a command by typing "T80 CMD.". TRACE-80 must be in command mode in order for the user to enter a command.

TRACE-80 operating instructions under LEVEL II are the same as under DOS except certain commands will not work properly. Do not attempt to use the following commands under LEVEL II.

```
  L      -  Load disc file
  B      -  Go to DOS
```

The operation of each of the commands is explained below in the Command Input section.

All address and byte values are expressed in hexidecimal.

Note - There are three versions on each tape. They are t8016k, t8032k & t8048k. They are recorded in that order and a second set of three recordings follow the first on the same side of the tape

CUSTOM COMPUTER CENTER, INC.

III.   OPERATING INSTRUCTIONS FOR DOS SYSTEMS

TRACE-80 is loaded at the DOS command level in the standard way:

        T80   - LOADS AND EXECUTES TRACE-80

TRACE-80 will identify itself and ask for instructions on the type of
printer to be used. When this question is answered, TRACE-80 will then
enter the command mode and request a command by typing "T80 CMD.".
TRACE-80 must be in command mode in order for the user to enter a
command.

All address and byte values are expressed in hexidecimal.

The program to be traced must be loaded either by use of the DOS load
command or by use of the TRACE-80 load command. In either case, care
should be taken to avoid using the same area of memory as used by DOS or
TRACE80.

IV.   COMMAND INPUTS

L   - Load a disc file under TRACE-80 control. A
                     filespec must be provided in response to a
                     TRACE-80 request. The disc file will be loaded
                     by calling a DOS load routine. An error
                     message will be given if an error is detected.

Txxxx,yyyy   - Trace from starting address xxxx to ending
                     address yyyy. Output to screen and line
                     printer if they are enabled.

T   - Trace from current address to last specified
                     ending address. Output to screen and line
                     printer if they are enabled.

Cxxxx,yyyy   - Trace from starting address xxxx to ending
                     address yyyy and print only "transfer of
                     control" instructions if the printer is
                     enabled and if the transfer of control is
                     performed. The screen output is performed on
                     every instruction if the screen is enabled.

C   - Trace from current address to last specified
                     ending address and print only "transfer of
                     control" instructions if the printer is
                     enabled and if the transfer of control is
                     performed. The screen output is performed on
                     every instruction if the screen is enabled.

Gxxxx,yyyy   - Trace from starting address xxxx to ending
                     address yyyy with no print output or screen
                     output.

G   - Trace from current address to last specified
                     ending address with no print output or screen
                     output.

Exxxx,yyyy   - Execute at full speed from location xxxx to
                     location yyyy. Since a breakpoint will be
                     stored at location yyyy, it must be located in
                     RAM.

Exxxx,0   - Execute at full speed from location xxxx with
                     no return

E,yyyy   - Execute at full speed from current location to
                     location yyyy.

E   - Execute at full speed all instructions until
                     the instruction immediately following the
                     current instruction is reached. For example,
                     if the current instruction is CALL SUBR, then
                     all instructions will be executed until a RET
                     returns control to the instruction following
                     the CALL SUBR.

/   - Stop tracing at the current location. Trace
                     may be resumed at this location by entering a
                     T command.

I   - Trace single instruction only.

RIGHT ARROW - Trace single instruction only. If the next
               instruction is a conditional transfer of
               control instruction (e.g. JP NZ,7000H), the
               instruction will be forced to execute as
               though the condition is true (e.g. JP 7000H).
               The converse of this is the Skip command
               below. The TAB KEY is the equivalent of the
               right arrow on the Model II.

SPACE BAR   - Skip the next instruction. Do not execute the
               next instruction. Advance the program counter
               to the following instruction.

R   - Zero registers AF, BC, DE, HL, IX & IY.

Rkk   - Zero register kk where kk is registers AF, BC,
               DE, HL, IX, IY, SP OR PC.

Rkkxxxx   - Set register kk (where kk is register AF, BC,
               DE, HL, IX, IY, SP OR PC) to the value xxxx.

Dxxxx   - Set memory display address to xxxx

;   - Increment memory display address

-            - Decrement memory display address

M   - Enter memory modify mode using last modify
               address

Mxxxx   - Enter memory modify mode using xxxx as the
               new modify address. When current memory
               contents are displayed, a new value may be
               typed if desired to modify memory. If this
               is the last location to be examined/modified,
               press ENTER. If subsequent locations are to
               be examined/modified, press SPACE.

Nxxxx   - Display a mnemonic memory dump starting at
               location xxxx. If xxxx is not specified, the
               current location will be used.

O   - Disable screen outputs and clear screen.

X   - Enable screen in register & hex format.

H   - Change screen format from ASCII to hex.

A   - Change screen format from hex to ASCII.

S   - Change screen format from register format to
               full screen memory display.

P   - Line printer on in long format (print
               location, instruction in hex, instruction
               mnemonics, and register contents after
               instruction execution.

PS   - Line printer on in short format (print only
               location, instruction in hex, and instruction
               mnemonics.

PO   - Line printer off.

B   - Go to DOS (location 402DH)

V.   PRINTERS

Trace-80 is setup to work with either a standard parallel printer or a
serial printer working on a RS-232C interface. The user must select the
type printer after starting TRACE-80 by answering a question. All line
printer output on the model I is via the line printer DCB at location
4025H using a call to ROM at location 003BH. All output on the Model II
is via standard SVC calls.

TRACE-80 internal serial printer software is set up to work as follows:

        300 Baud
        No parity
        8 Bits per word
        1 Stop bit
        No null characters after a carriage return
        One line feed after a carriage return (Mod I only)
        A form feed is converted to line feed
            characters for a 66 line page (Mod I only)
        No check of CTS or DSR is made (Mod I only)

T R A C E - 8 0   S C R E E N S

TRACE SCREEN

```
AF = 0100 --------            T R A C E - 8 0
BC = FF00 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DE = 4480 :  80 00 00 00 42 00 00 23   F2 00 13 00 13 00 09 03
HL = 06D2 :  C3 96 1C C3 78 1D C3 90   1C C3 D9 25 C9 00 00 C9
IX = 4015 :  01 78 43 00 00 00 4B 49   07 58 04 2F 3D 00 44 4F
IY = 0000 :  F3 AF C3 74 06 C3 00 40   C3 00 40 E1 E9 C3 9F 06
SP = 41FA :  2D 40 12 E0 12 E0 20 20   20 00 3A 25 B1 B7 20 21
PC = 0683 :  20 EF 06 27 12 13 10 FC   3A 40 38 E6 04 C2 75 00
             20EF      JR    NZ,0674H
      7000 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7010 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7020 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7030 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7040 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7050 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
T80 CMD. _
```

MEMORY SCREEN

```
      7000 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7010 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7020 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7030 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7040 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7050 :  00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
      7060 :  00 0A 76 B7 CA 2F 59 F1   C9 4F 06 07 3A 0A 76 B7
      7070 :  C8 0E 00 C9 3E 1B CD 33   00 C3 74 5E FE 61 D8 D6
      7080 :  20 FE 5B D8 C3 36 58 3A   0A 76 B7 CA 93 02 C9 3A
      7090 :  0A 76 B7 CA 84 02 C9 3A   3F 3C EE 0A 32 3F 3C C9
      70A0 :  3A 0A 76 B7 CA 35 02 CD   42 6F CD AE 70 C9 2A 36
      70B0 :  76 3A 38 76 BD 20 27 3A   39 76 BC 20 21 11 5F 72
      70C0 :  CD 36 44 C2 18 72 DD 34   04 CD 36 44 21 7F 74 28
      70D0 :  04 25 DD 35 0A 22 38 76   DD 35 04 21 7F 72 7E 23
      70E0 :  22 36 76 C3 4E 6F F5 3A   0A 76 B7 20 04 F1 C3 64
MODIFY LOC 0000 : F3 - _
```

MNEMONIC SCREEN

```
0683     20EF      JR    NZ,0674H
0685     0627      LD    B,27H
0687     12        LD    (DE),A
0688     13        INC   DE
0689     10FC      DJNZ  0687H
068B     3A4038    LD    A,(3840H)
068E     E604      AND   04H
0690     C27500    JP    NZ,0075H
```

TRACE 80   Printer Output

Screen Contents to be traced

T R A C E - 8 0

```
AF = 0100  ------
BC = FF00 :  00  00  00  00  00  00  00  00  00  00
DE = 4480 :  80  00  00  42  00  21  F2  00  13  00  0B  01
HL = 431E :  00  50  00  49  4C  47  00  43  40  0D  E0  12  E0
IX = 4015 :  01  23  23  00  00  00  4B  49  07  53  04  2F  00  44  4F
IY = B18D :  20  00  02  00  02  00  04  00  74  06  00  32  30  45  46  20
SP = 41FA :  2D  40  12  E0  01  57  00  70  21  00  3C  01  00  04
PC = 12E0 :  C5  E5  21  1D  41  CD  B1  00  18  0C  C5  E5  CD  0  07  3C
             PUSH BC
7000  ::  21  00  3C  01  00  04  36  20  23  0B  78  B1  20  F3  21  26
7010  ::  70  DD  21  00  3E  7E  FE  00  28  09  DD  77  00  23  DD  23
7020  ::  C3  15  70  C3  23  70  54  48  49  53  20  49  53  20  54  48
7030  ::  45  20  4D  45  53  53  41  47  45  20  54  20  42  45  20
7040  ::  50  52  49  4E  54  45  44  20  4F  4E  20  54  48  45  20  56
7050  ::  49  44  45  4F  00  00  00  00  00  00  00  00  00
```

T80 CMD

Long Printer Output
Trace of 12e0

LOCN	INSTRUCT	MNEMONICS		A	FLAG-REG	BC	DE	HL	IX	IY	SP
12E1	E5	PUSH HL		01	--------	FF00	4480	431E	4015	B18D	41F8
12E2	211D41	LD HL,411Dx		01	--------	FF00	4430	431E	4015	B18D	41F6
12E5	CDB109	CALL 09B1		01	--------	FF00	4480	411D	4015	B18D	41F6
09B1	CDC209	CALL 09C2H		01	--------	FF00	4480	411D	4015	B18D	41F4
09C2	5E	LD E,(HL)		01	--------	FF00	4480	411D	4015	B18D	41F2
09C3	23	INC HL		01	--------	FF00	44E0	411D	4015	B18D	41F2
09C4	56	LD D,(HL)		01	--------	FF00	44E0	411E	4015	B18D	41F2
09C5	23	INC HL		01	--------	FF00	12E0	411E	4015	B18D	41F2
09C6	4E	LD C,(HL)		01	--------	FF00	12E0	411F	4015	B18D	41F2
				01	--------	FFE0	12E0	411F	4015	B18D	41F2

Long Printer Output
Page of 700

LOCN	INSTRUCT	MNEMONICS		A	FLAG-REG	BC	DE	HL	IX	IY	SP
7000	21003C	LD HL,3C00H		01	--------	FFE0	12E0	411F	4015	B18D	41F2
7003	010004	LD BC,0400H		01	--------	0400	12E0	3C00	4015	B18D	41F2
				01	--------	0400	12E0	3C00	4015	B18D	41F2