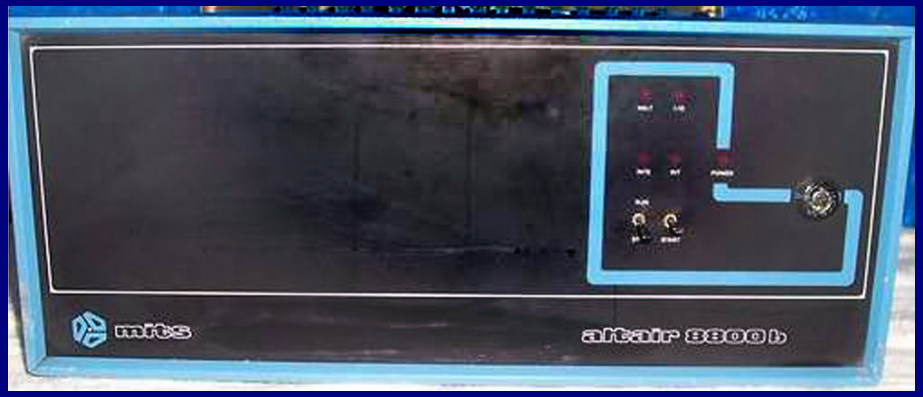
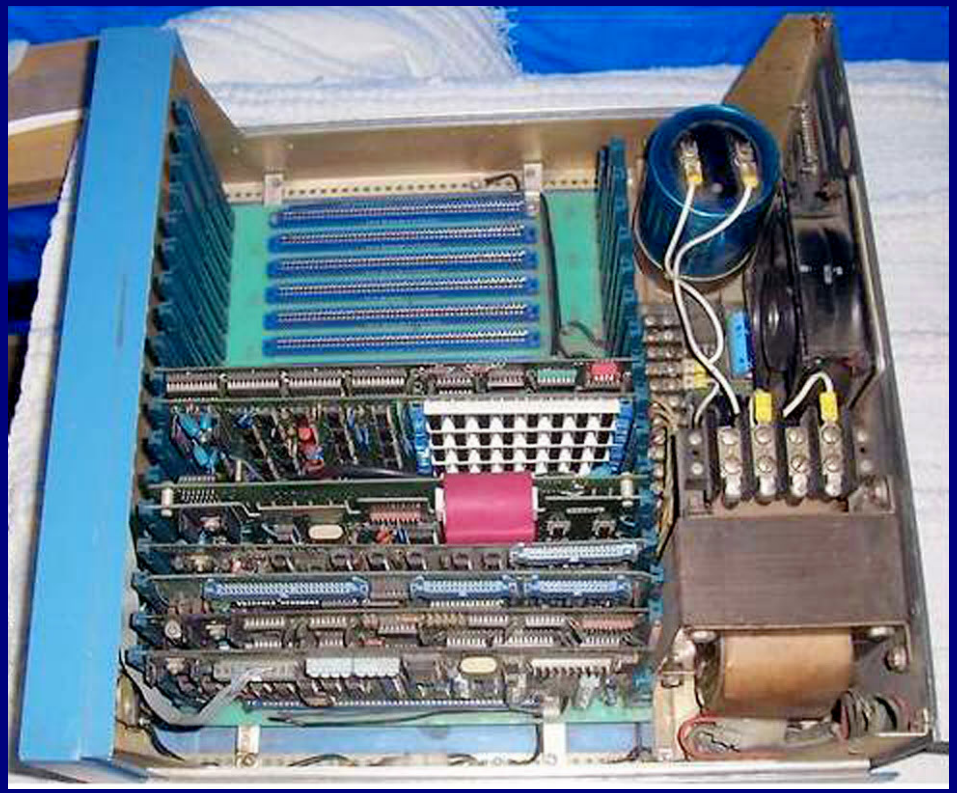
Restoring the Altair 8800bt



8800b – June, 1976

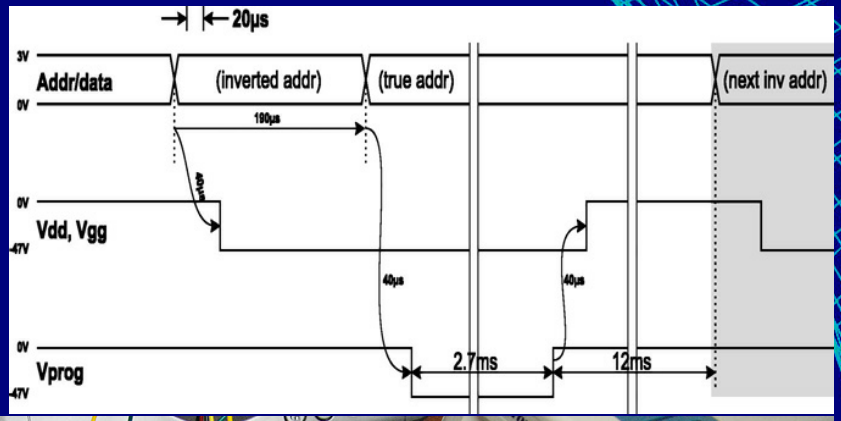
8800 – Dec, 1974

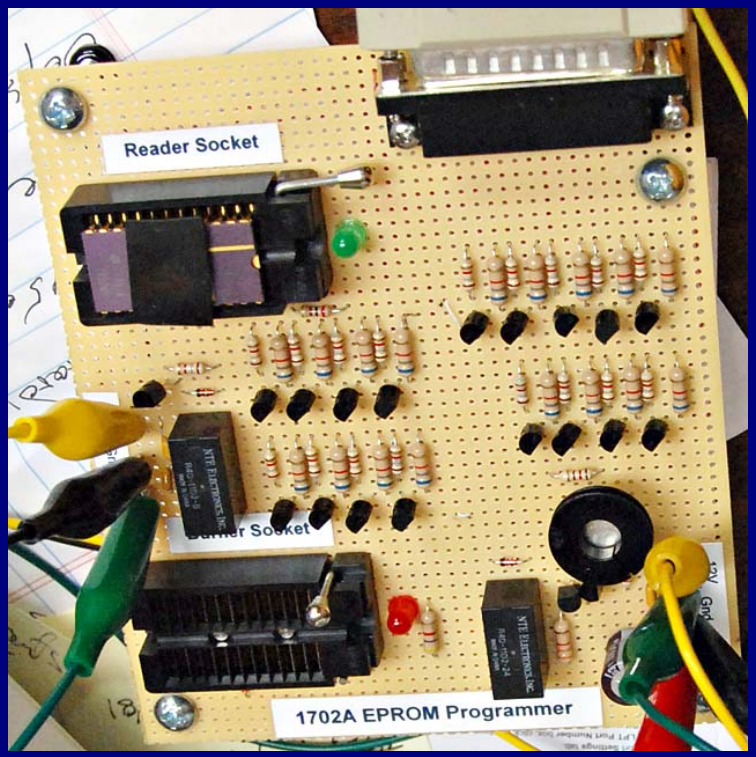


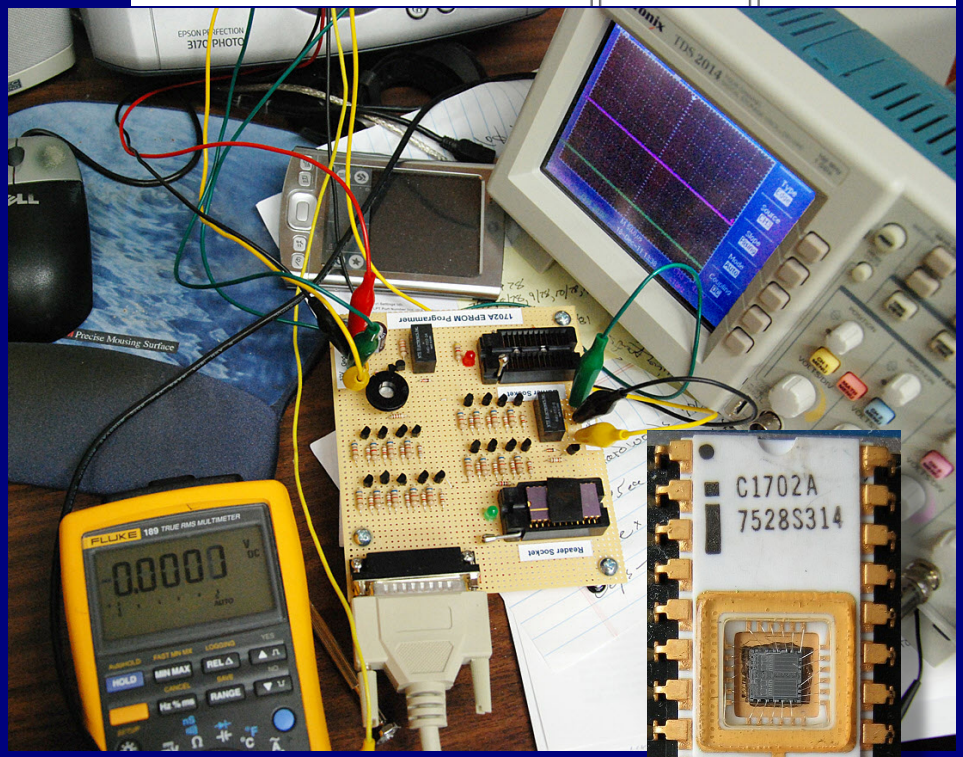
S. Lafferty Rev. 1

Burning a Monitor PROM (TURMON)

- **Uses Intel 1702A PROM**
- **Requires 59Volts at 200mA**
- **Weird timing sequence**
- **No DIY burner projects found**

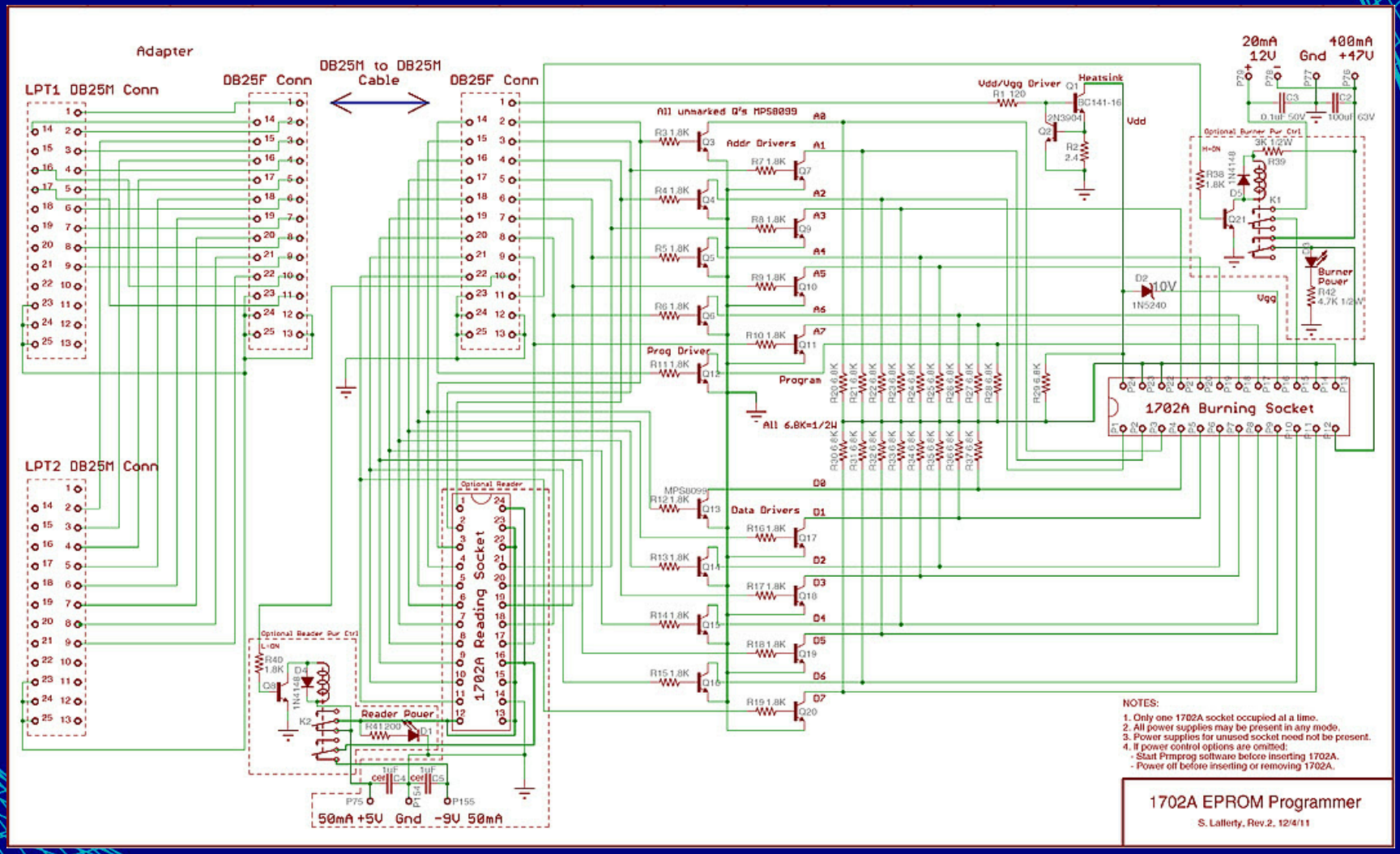






PROM Programmer Hardware

- **21-transistors, 2-relays**
- **22-resistors, 4-caps**
- **Lotsa itty bitty wires**



PROM Programmer Software

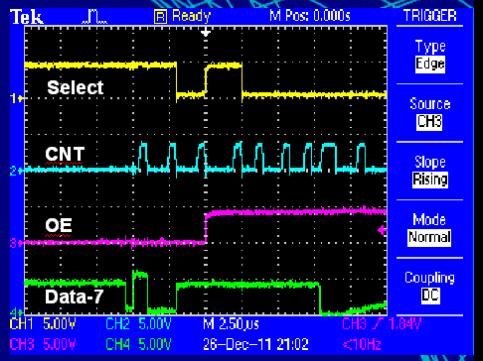
- **~700-lines of QuickBasic**

```
'
'       1702A PROM Programmer
'
'   - Reads a data file and burns a 1702A EPROM in attached hardware (PPHW).
'
ENDLOC% = 256                           'LAST LOCATION TO BURN
REBURN% = 32                            'NUMBER OF REPEATED BURNS
CALL DLYTIM(-1)                         'CALIBRATE THE DELAY
CALL DUMP(DUMPOFF) '********* INIT TEST DUMP BURN TO FILE
CALL TSTLIST(-2) '****** INIT TEST READIN LISTING TO FILE -2=OFF MODE, -1=INIT TST 0=OPER
'  PUT HARDWARE IN SAFE MODE:
OUT 890, 3                              'TURN OFF HW & INIT CTRL REG
CALL PORTMOD2("IN")                     'INP MODE AVOIDS CONTENTION
CALL SNDADDR(PWRDOWN)                   'INIT THE LPT1 DATA (ADDR) PORT
CALL SNDBYTE(PWRDOWN)                   'INIT THE LPT2 DATA PORT
CALL BURNPWR("OFF")                     'TURN OFF BURNER SOCKET POWER
CALL READPWR("OFF")                     'TURN OFF READER SOCKET POWER

CLS
PRINT "1702A EPROM Programmer"          'SIGNON MESSAGE
CALL PRESSANY                           'VIEW SIGNON
CHOOSE:
CLS
PRINT
PRINT "Please select function:"
PRINT
PRINT "    (B)urn an eprom"
PRINT "    (R)ead an eprom into a file"
PRINT "    (V)erify eprom is erased"
PRINT "    (O)ption settings"
PRINT "    [Esc] to quit"
PRINT
```

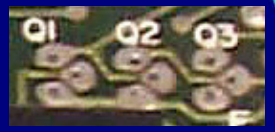
```
Burning pass   30  of        32
Burning pass   31  of        32
Burning pass   32  of        32
Programming complete.

Verify the burned data? (Y/N)
Move the EPROM to the reading socket.
Press any key to continue...
The PROM compares okay.

Press M for Main menu, B to Burn again or Esc to quit.
```

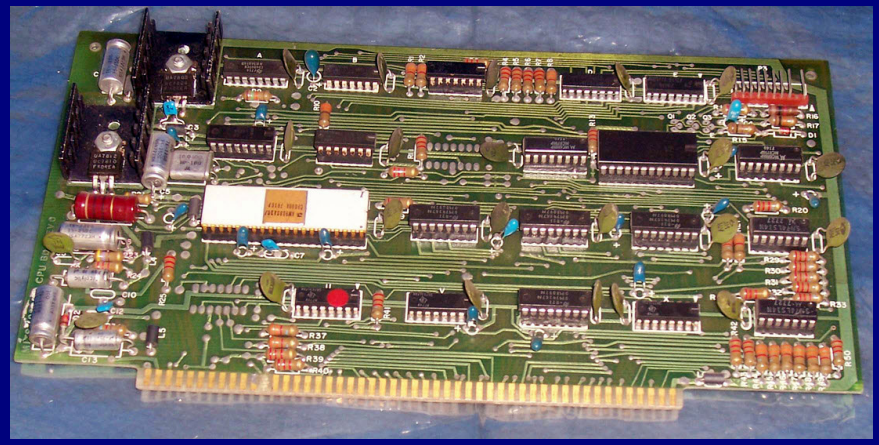
```
DO                                      'KEEP
  A$ = INKEY$                           'CHECKING AND
LOOP WHILE A$ = ""                      'LOOPING UNTIL KEY IS PRESSED

IF (A$ = "B") OR (A$ = "b") THEN GOTO BURN

IF A$ = "r" OR A$ = "R" THEN            'ENTERING "R" =>read eprom
  CALL READPRM                          '
  CALL PRESSANY                         'WAIT FOR USER TO SEE RESULT
  GOTO CHOOSE                           'THEN RETURN TO FILENAME INPUT
END IF

IF A$ = "v" OR A$ = "V" THEN            'ENTERING "V" =>check erase
  CALL CHKERASE                         'CHECK IF CHIP ERASED
  CALL PRESSANY                         'WAIT FOR USER TO SEE RESULT
  GOTO CHOOSE                           'THEN RETURN TO FILENAME INPUT
END IF

IF A$ = "o" OR A$ = "O" THEN            'ENTERING "O" =>OPTIONS MODE
  CALL OPTIONS(ENDLOC%, REBURN%)        'ASK USER TO SET OPTIONS
  GOTO CHOOSE                           'THEN RETURN TO FILENAME INPUT
END IF

IF ASC(A$) = 27 THEN GOTO FINISH

GOTO CHOOSE

BURN:
INPUT "Enter data filename or press [Enter] to cancel:", FILENAM$
IF FILENAM$ = "" THEN GOTO CHOOSE       'EMPTY LINE RETURNS TO MENU
INPUT "Choose format (A)SCII hex:, (B)inary, [Enter] to cancel:", A$
IF (A$ = "A") OR (A$ = "a") THEN
  CALL RDASC(FILENAM$, IERR%)           'READ THE ASCII DATA FILE
ELSEIF (A$ = "B") OR (A$ = "b") THEN
  CALL RDBIN(FILENAM$, IERR%)           'READ THE BINARY DATA FILE
ELSE GOTO CHOOSE                        'EMPTY LINE RETURNS TO MENU
END IF
CLOSE #1                                'MAKE SURE INP FILE CLOSED
IF IERR% = 1 THEN                       'IF THERE WAS AN ERROR READING
  CALL PRESSANY                         'PAUSE TO LET USER READ MSG
  GOTO CHOOSE                           'THEN RETURN TO THE MENU
END IF
CALL TSTLIST(0)
PRINT
PRINT "256 data bytes successfully read."   'IF SUCCESSFUL, REPORT OK
CALL SHOWPDAT                           'DISPLAY THE DATA

CALL CHKREAD(IERR%)                     'CHK FOR CHIP IN READ SOCKET
PRINT " "
PRINT "Press Esc to cancel or another key to start burning the PROM." 'WAIT
DO                                      'FOR
  A$ = INKEY$
LOOP WHILE A$ = ""                      'KEYPRESS TO START THE BURN.
IF ASC(A$) = 27 THEN GOTO CHOOSE        'CANCEL IF ESC PRESSED.
BURNAGAIN:
PRINT "Burning the PROM. Press ESC to abort..." 'ANNOUNCE WE ARE BURNING...

CALL PORTMOD2("OUT")                    'PUT LPT2 IN DATA OUTPUT MODE.
CALL BURNPWR("ON")                      'TURN ON BURNER SOCKET POWER
```

Restoration Phase-I Run Monitor–TURMON



- Mainframe power supply – reforming main cap.
- Lab power on CPU board and Turnkey board.
- Fireup – no dot prompt (first of many).
- Fixing problems:
  - (Jumpers to setup RS232. New internal serial cable.)
  - Microswitch bypass for bad contacts and lost key.
  - CPU CD4009 replaced. Tied floating inputs to gnd.
  - CPU Q1,2,3 missing. Installed new transistors. Fixed POC.
  - CPU two solder/etch bridges lines run between pins.
  - MITS docs had pins 2,3 swapped for the RS232 connector.
  - Wrong (modified) TURMON version, with the stack wrongly placed.
- Finally a dot prompt! TURMON works! Can examine/change memory and jump!



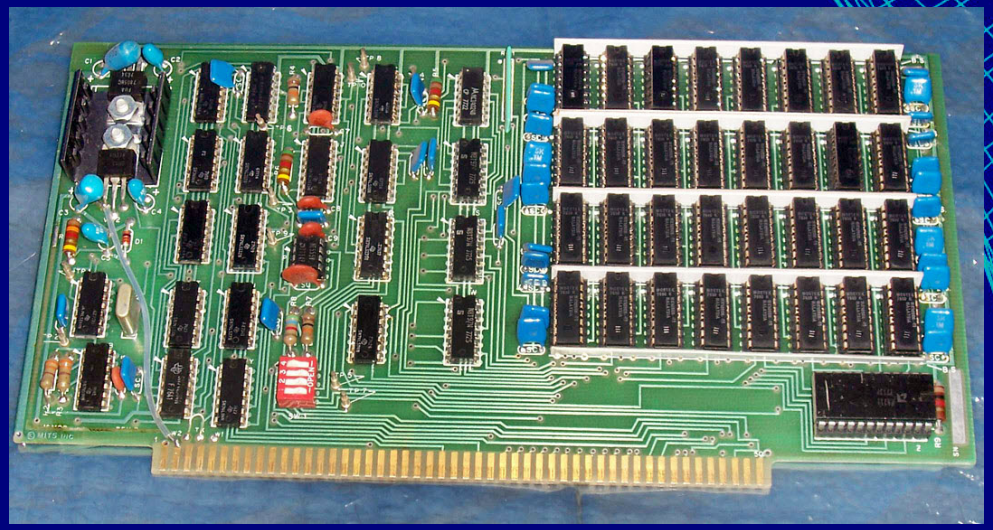


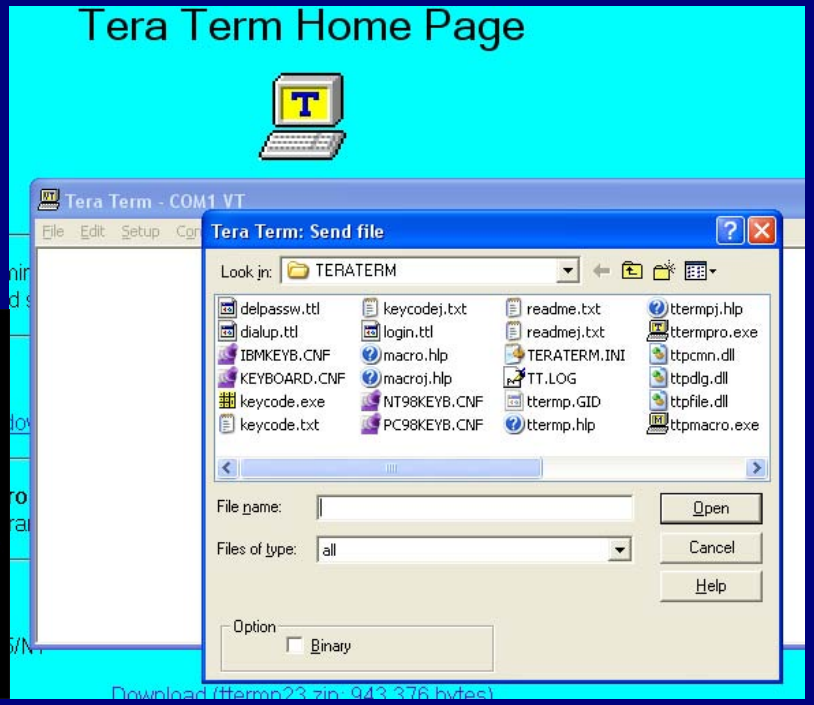
CPU had never worked!

Restoration Phase-II Run Programs in RAM

- Burned multiboot loader prom (MBL).
- Manual tests 16K dynamic memory board work.
- (Static memory board seems rough.)
- Tera Term to work as terminal and paper tape reader.
- Errors loading BASIC.
- Paper tape image file mod'ed for other loaders. MBL needs leader.
- Usual serial I/F confusion–stop bits, data bits, HW ctrl lines.

16K dynamic RAM

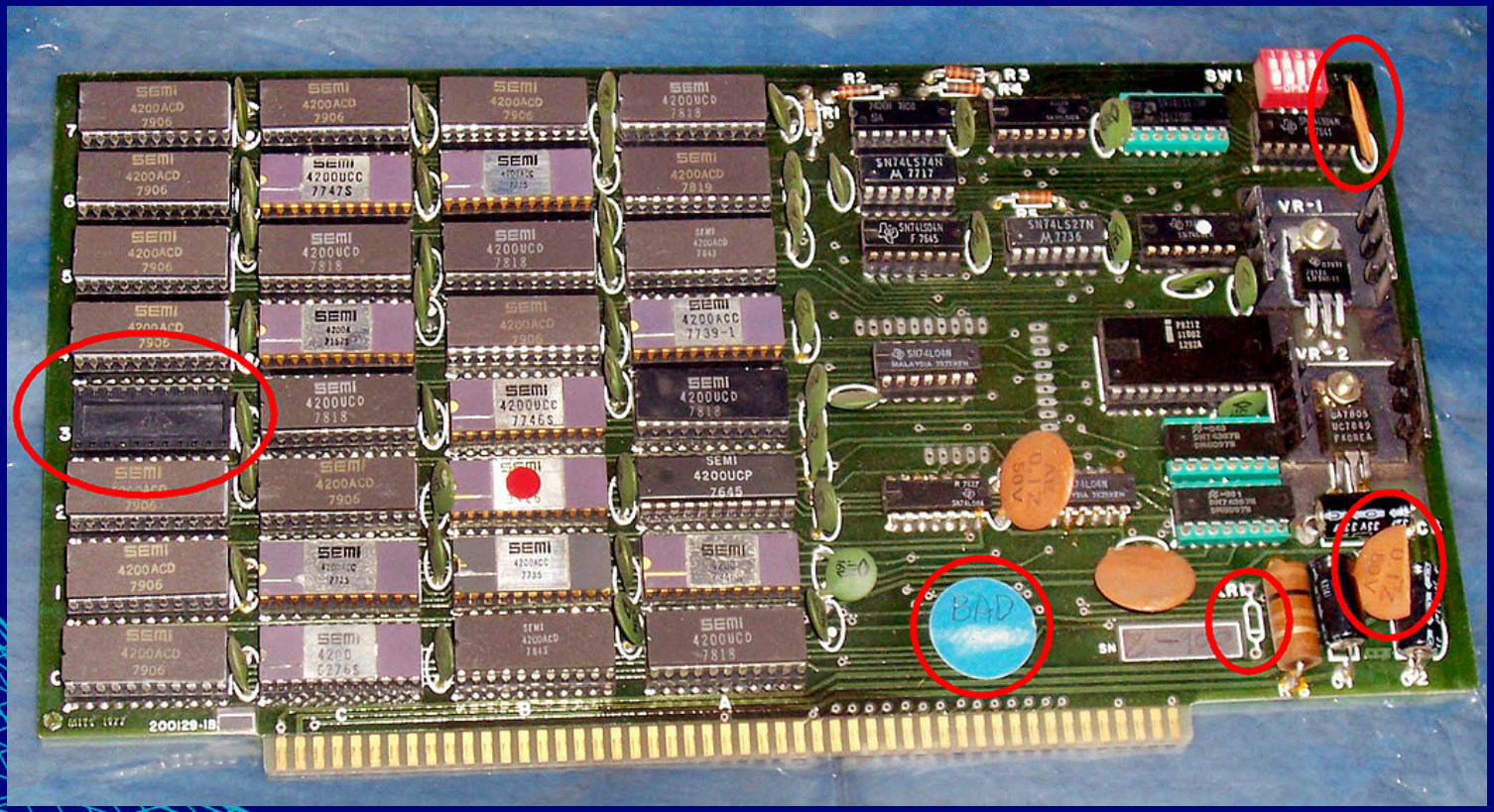




Bill Gates' tape of BASIC 1.0

Restoration Phase-II (cont'd)

- **Trying loopback test of Tera Term (TT), keying-in an echo routine on the 8800. Needed binary option in TT. But...**
- **Now the dynamic memory goes bad, causing errors.**
- **16K static memory: Replaced missing memory chip (Ebay) and broken caps. Added Zener which was never installed.**
- **Tried the loopback echo test in the static ram and it worked!**



16K static RAM board could never have worked reliably without the Zener

- **Tried loading Extended Basic 4.1 (the only one with a decent leader) and it worked! Got the sign-on routine! (trick question)**
- **Loaded a small BASIC game (Rock Paper Scissors). It beat my pants off!**

```
180 PRINT "YOU HAVE WON"A"GAME(S)."
185 PRINT "AND"G-1-(C+H)"GAME(S) ENDED IN A TIE.
190 PRINT:PRINT "THANKS FOR PLAYING!!"
200 END
RUN
THIS PROGRAM ALLOWS YOU TO PLAY THE OLD GAME OF
ROCKS, PAPER, AND SISSORS AGAINST THE COMPUTER.
HOW MANY GAMES DO YOU WANT ? 3

GAME NUMBER 1
3=ROCK...2=SISSORS...1=PAPER
1....2....3....WHAT'S YOUR CHOICE ? 3
THIS IS MY CHOICE...
...PAPER
WOW!  I WIN!!

GAME NUMBER 2
3=ROCK...2=SISSORS...1=PAPER
1....2....3....WHAT'S YOUR CHOICE ? 3
THIS IS MY CHOICE...
...PAPER
WOW!  I WIN!!

GAME NUMBER 3
3=ROCK...2=SISSORS...1=PAPER
1....2....3....WHAT'S YOUR CHOICE ? 2
THIS IS MY CHOICE...
...PAPER
YOU WIN!!!

HERE IS THE FINAL SCORE:
I HAVE WON 2 GAME(S).
YOU HAVE WON 1 GAME(S).
AND 0 GAME(S) ENDED IN A TIE.

THANKS FOR PLAYING!!
OK
```

Tera Term - COM1 VT

File Edit Setup Control Window Help

```
.J17700
MEMORY SIZE?
LINEPRINTER? C
WANT SIN-COS-TAN-ATN? Y

1550 BYTES FREE
ALTAIR BASIC REV. 4.1
[EXTENDED VERSION]
COPYRIGHT 1977 BY MITS INC.
OK
```