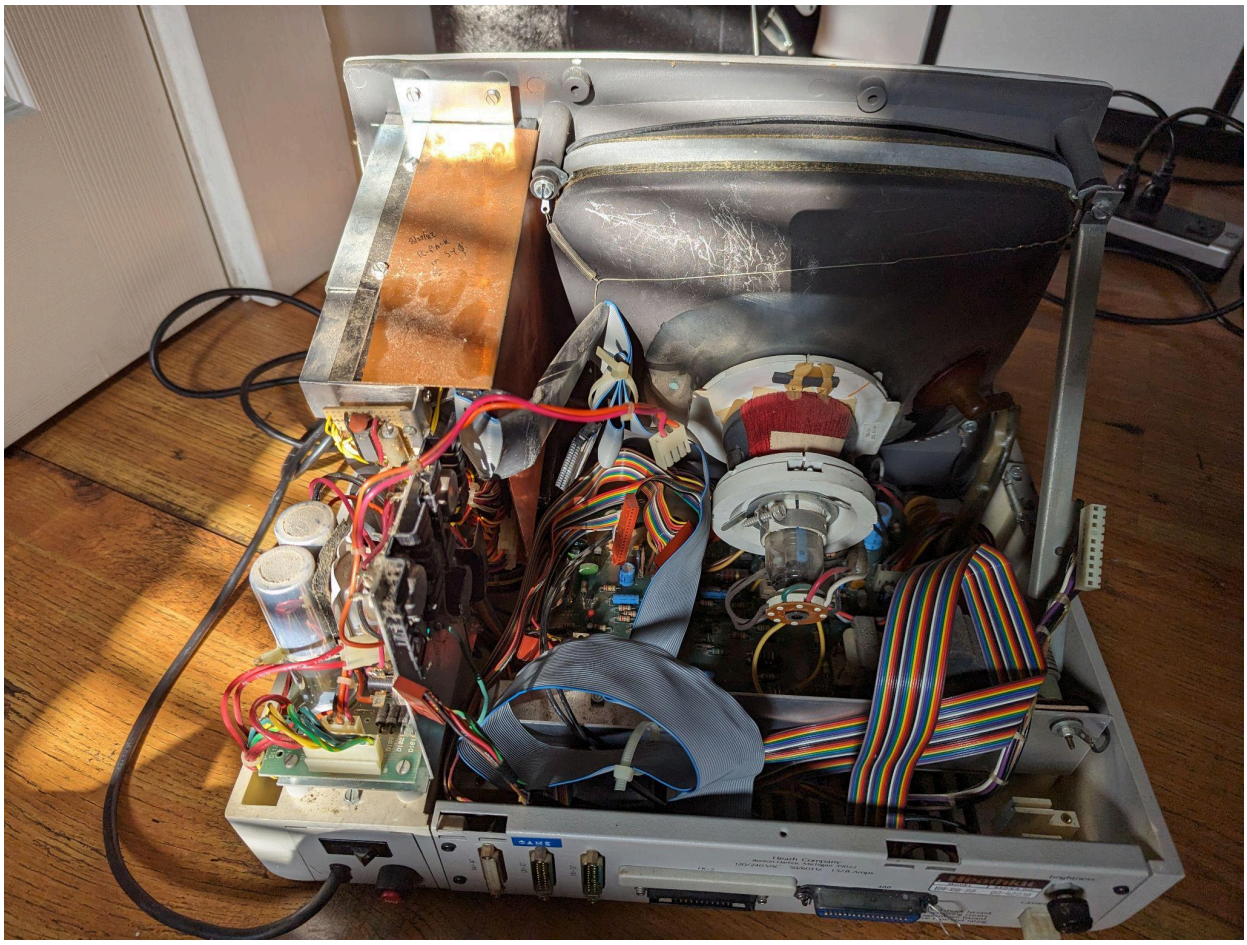
J.B.'s Heathkit H89

J.B.’s Heathkit H89

My first computer, circa age 7, was an H89 that my dad had used to run his pharmacy. After he upgraded to a PC at work, he brought the H89 home and taught me how to run games and educational software on CP/M. He also had the 10MB Winchester add-on with an 8" floppy drive. Sadly he sold that off many years before I became interested in vintage computers.

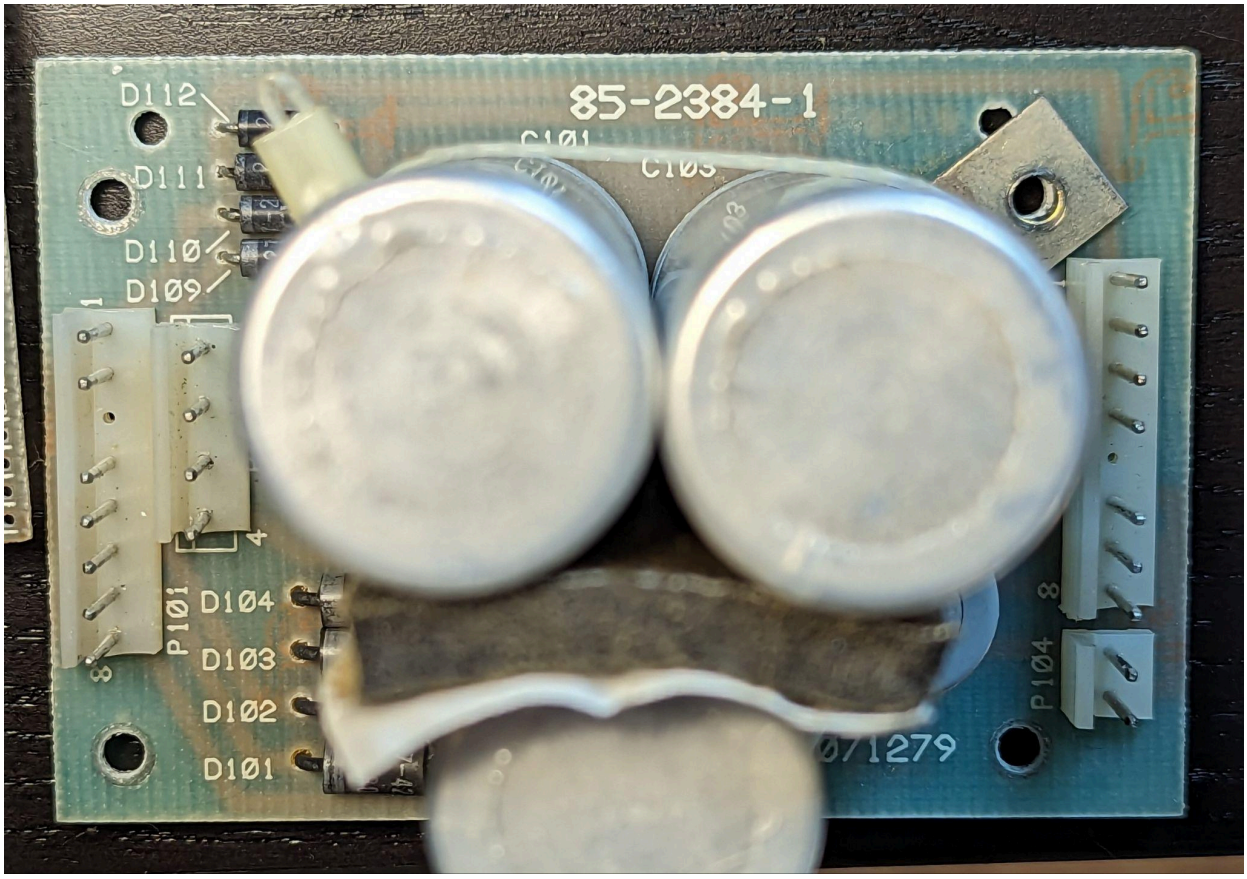
Fast forward almost 40 years, and as fate would have it, I ran into my first boss at VCFSW in Dallas. He wanted to part with an H89 with a lot of manuals and disks included. I made him an offer and now it’s mine. Sadly, it is in need of some repairs, but I guess it wouldn’t be a Heathkit if it wasn’t a project, huh?

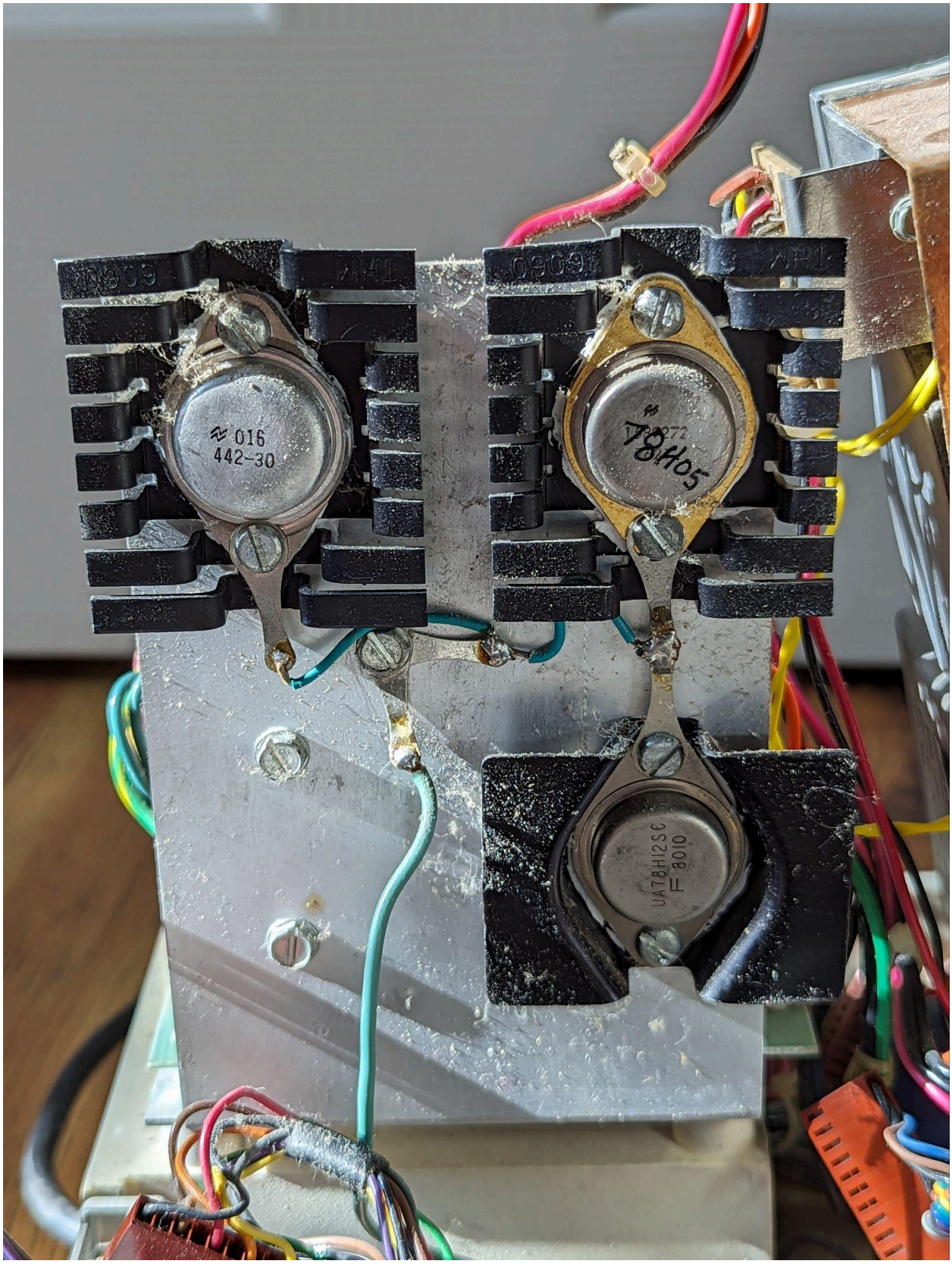
Hardware



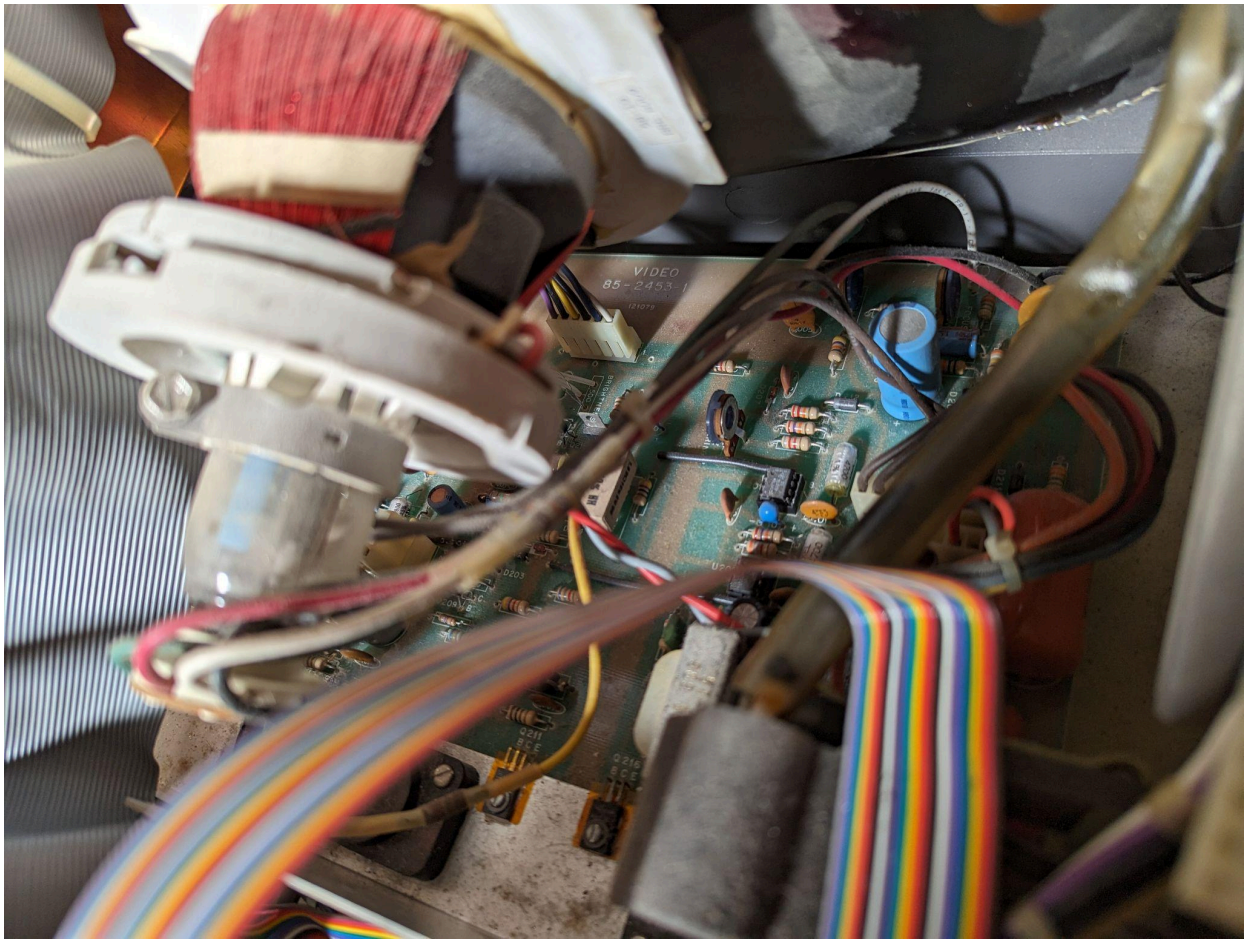

Heath Company
Benton Harbor, Michigan 49022
120/240 VAC 50/60 Hz 1.5/.8 Amps
Heathkit
MODEL
SERIES NO.
HN-88-99
02-42239
488

85-2384-1 Power Supply Board

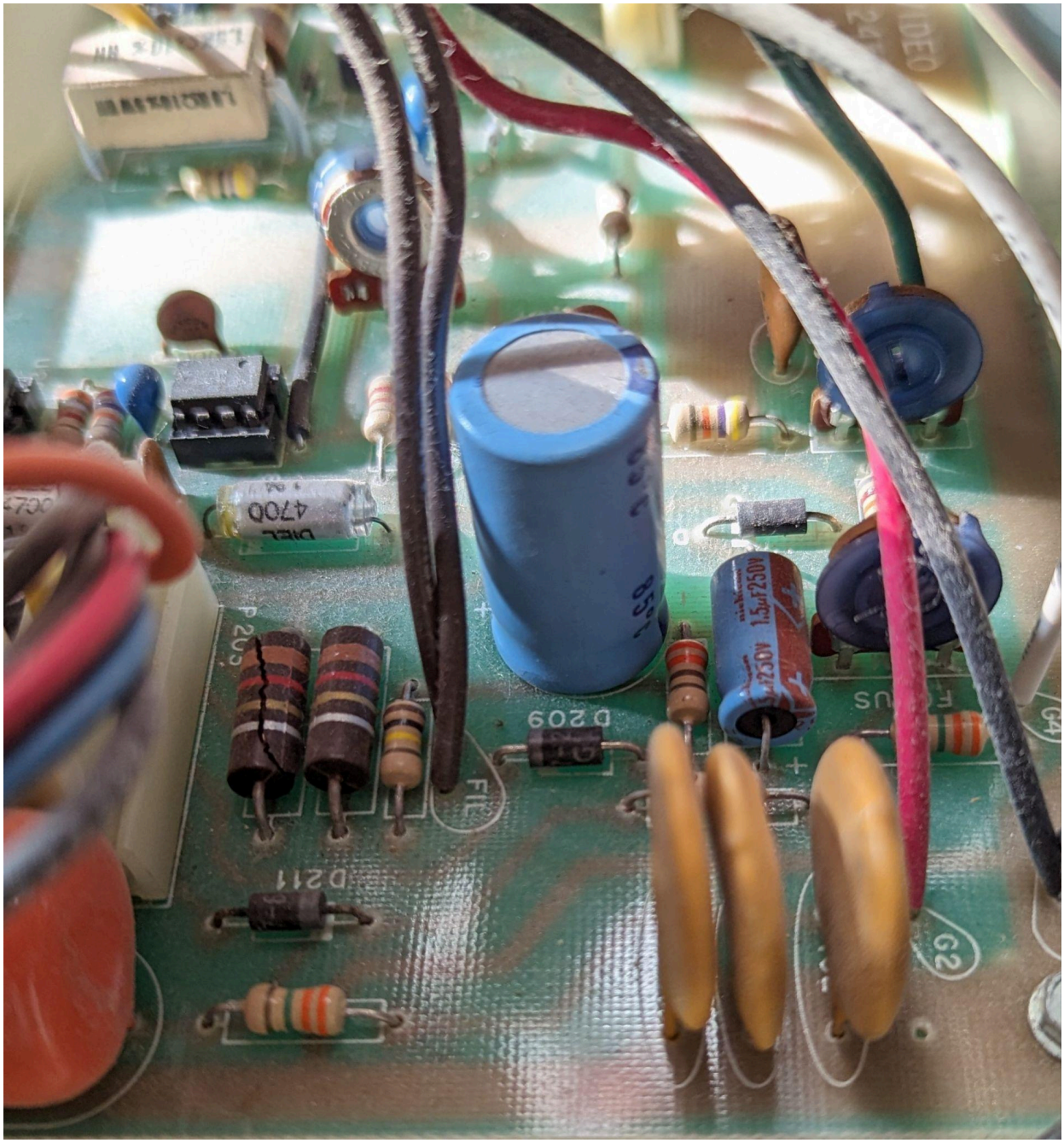



0909
016
442-30
0909
UA78H12SC
F 8010

85-2453-1 Video Board

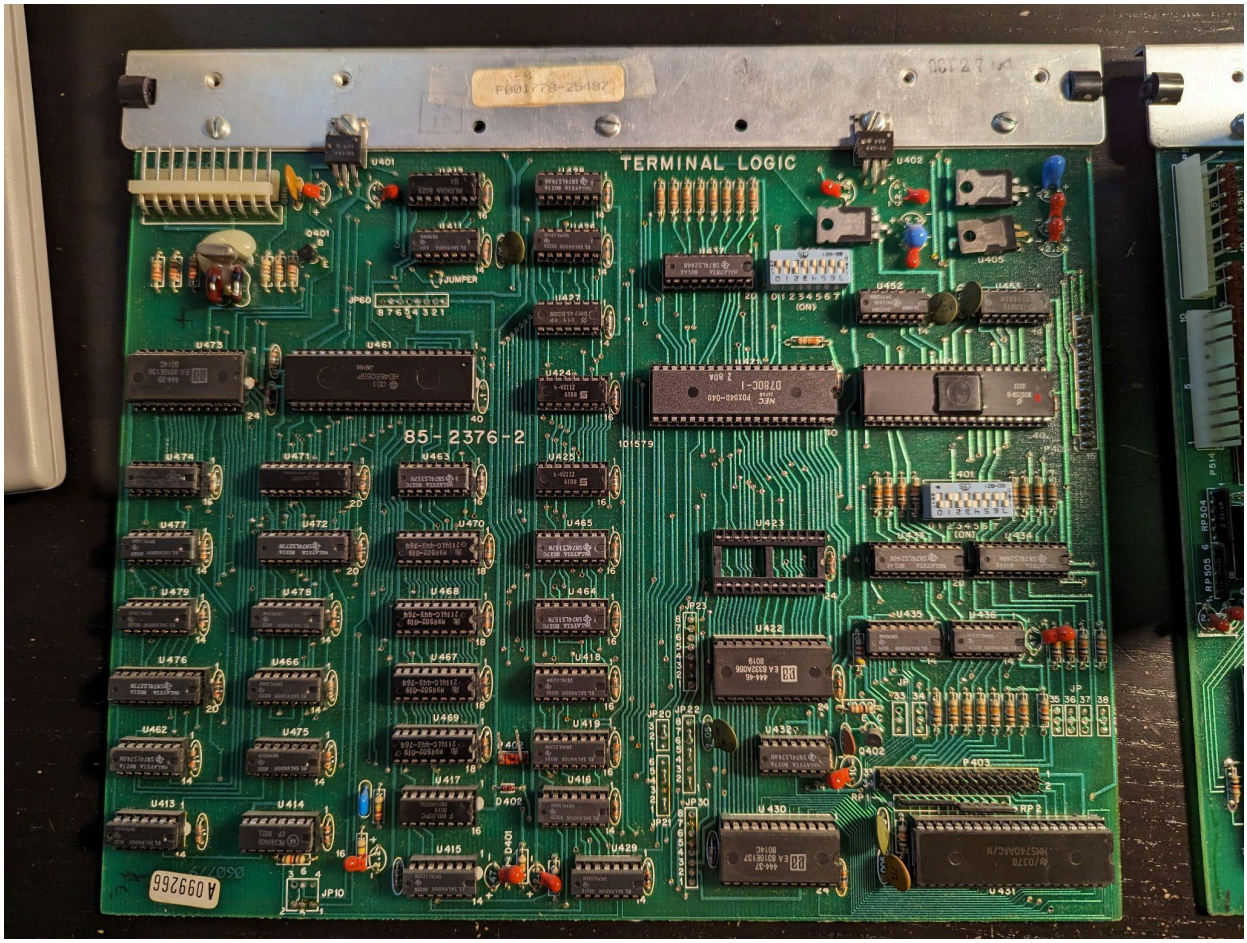


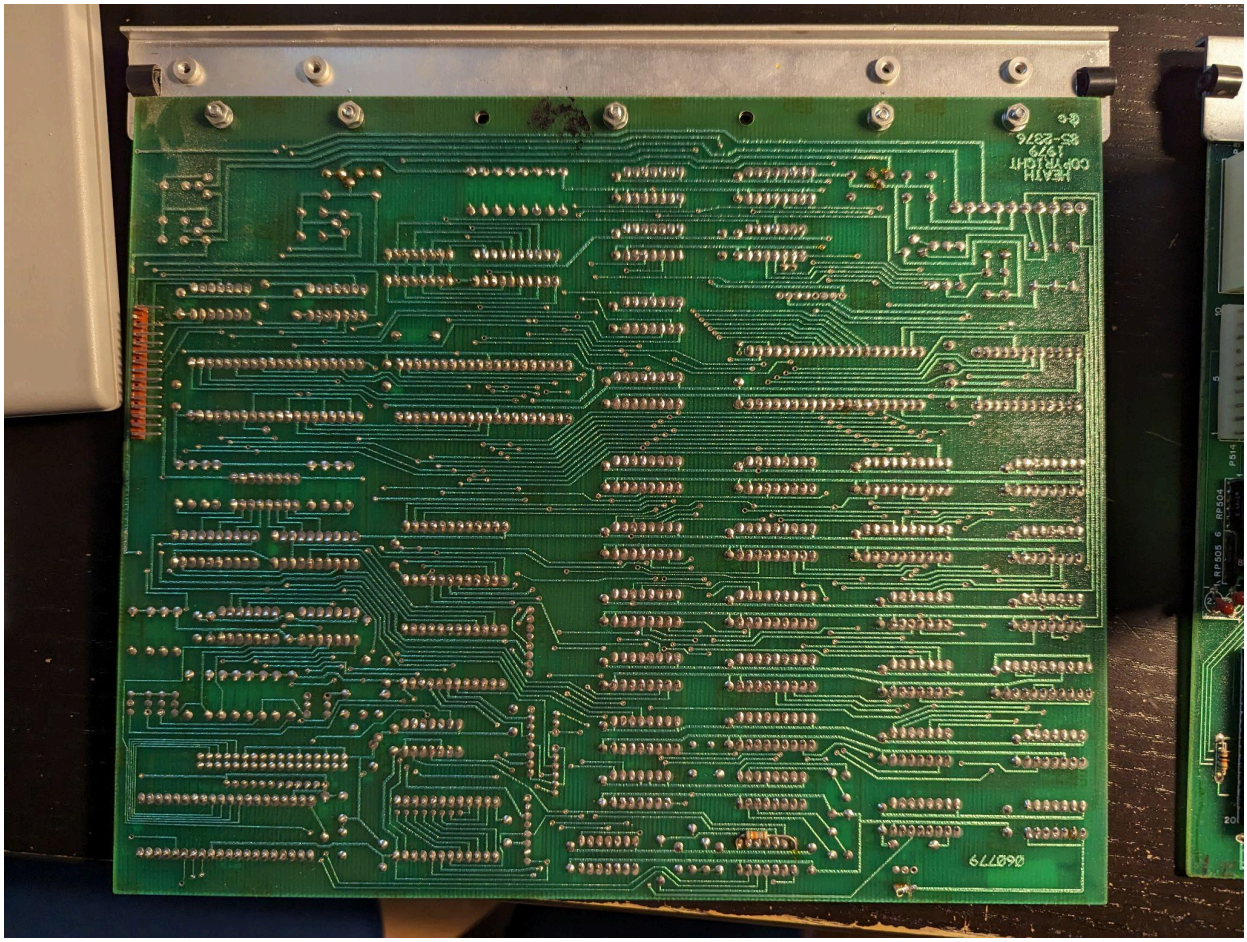
Cracked R263: 1.2Ω 2 watt 10% resistor


4700
D209
D211
1.5µF250V

D215
D207
D20
CRYSTAL
CENTERI

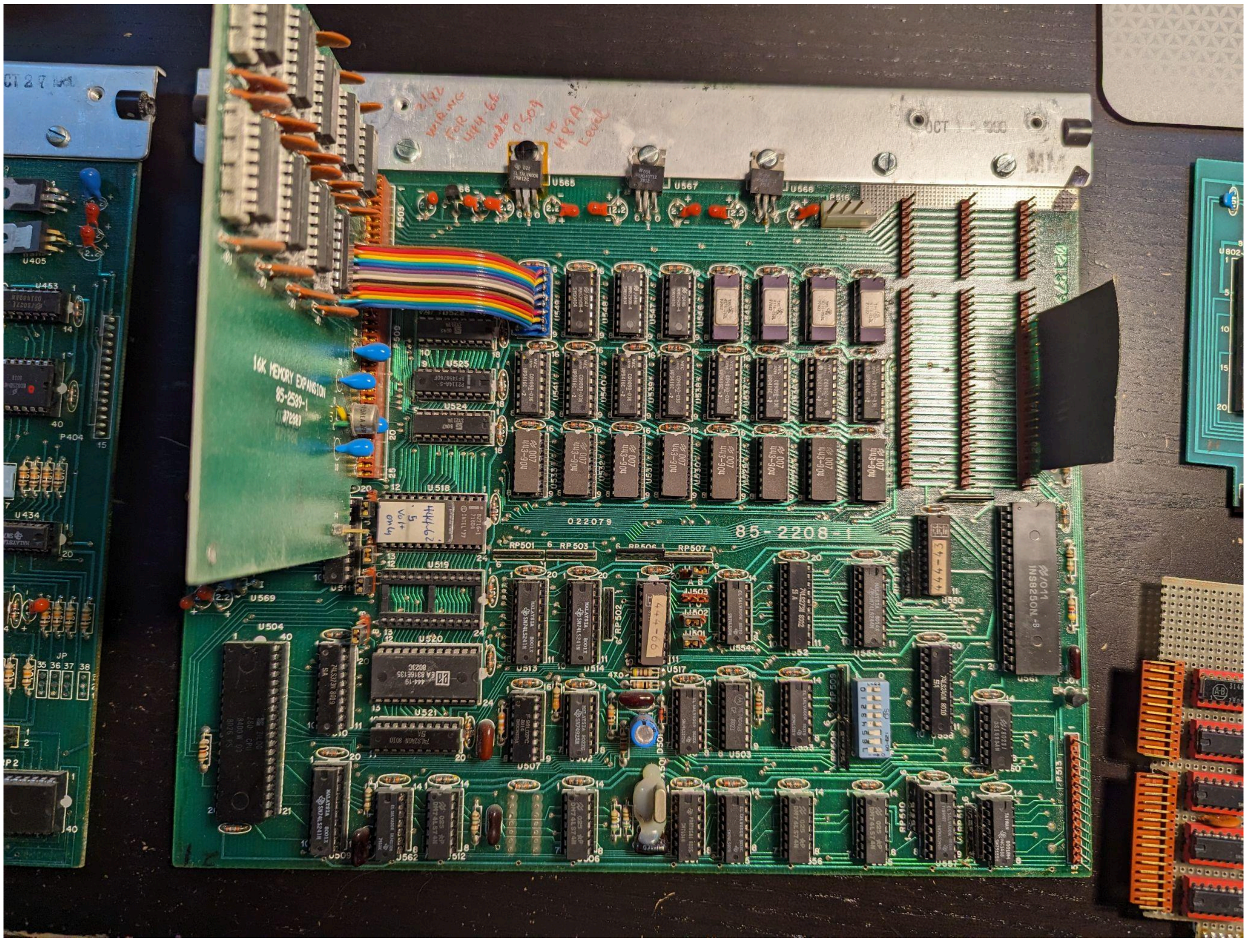
85-2376-2 Terminal Logic Board

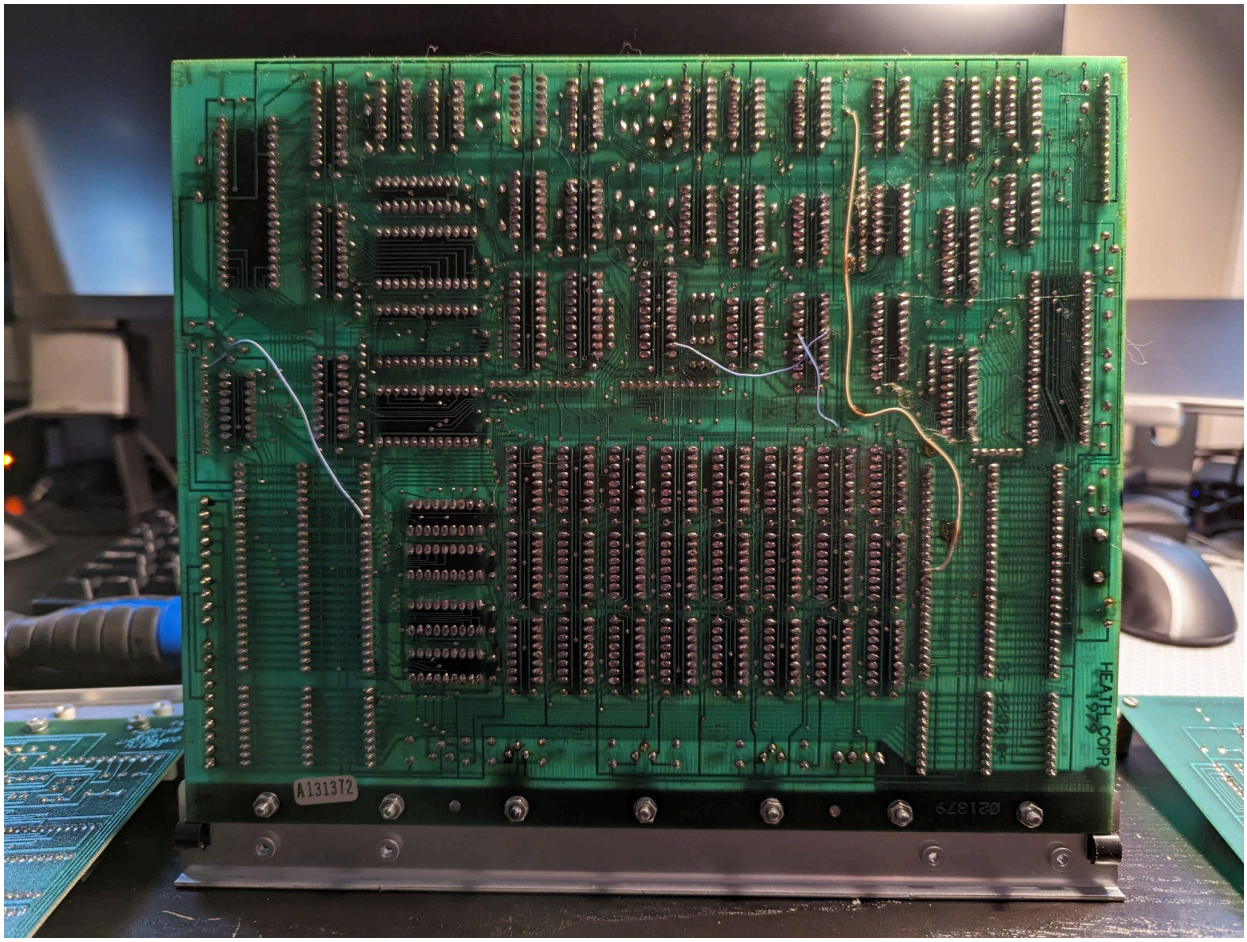




85-2208-1 CPU Board

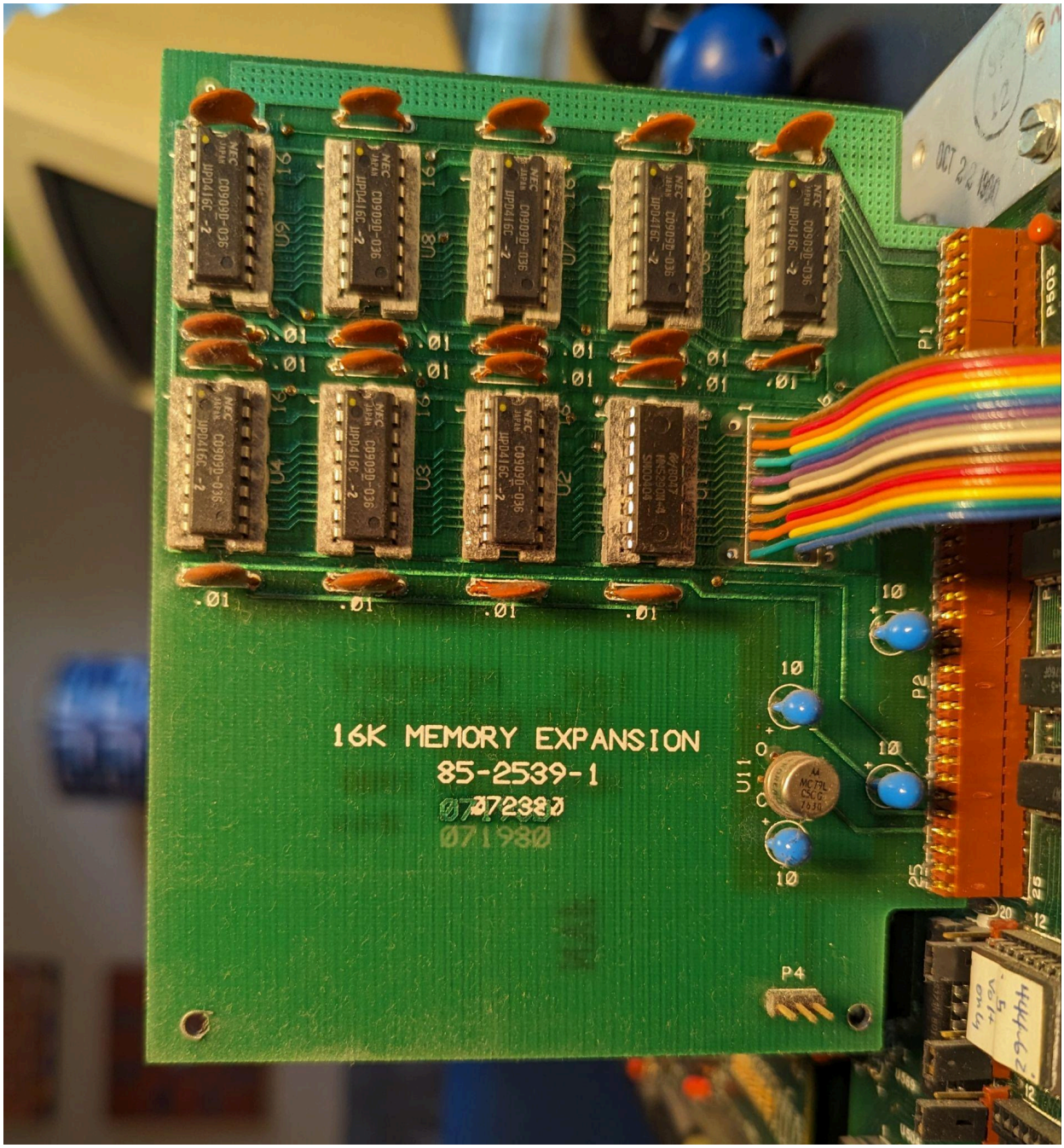
Oct 1980 date code on CPU board heat sink

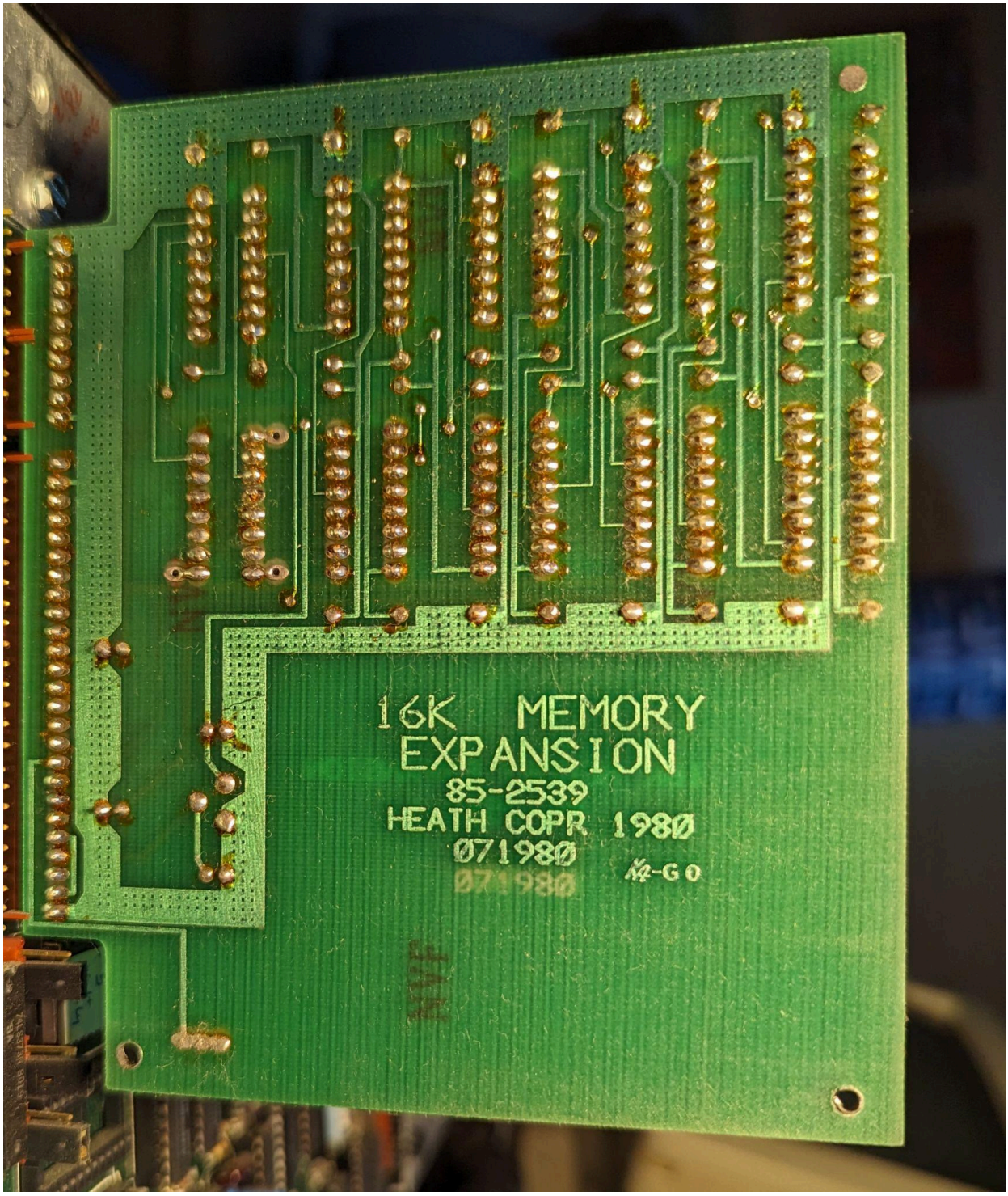

16K MEMORY EXPANSION
85-2208-1



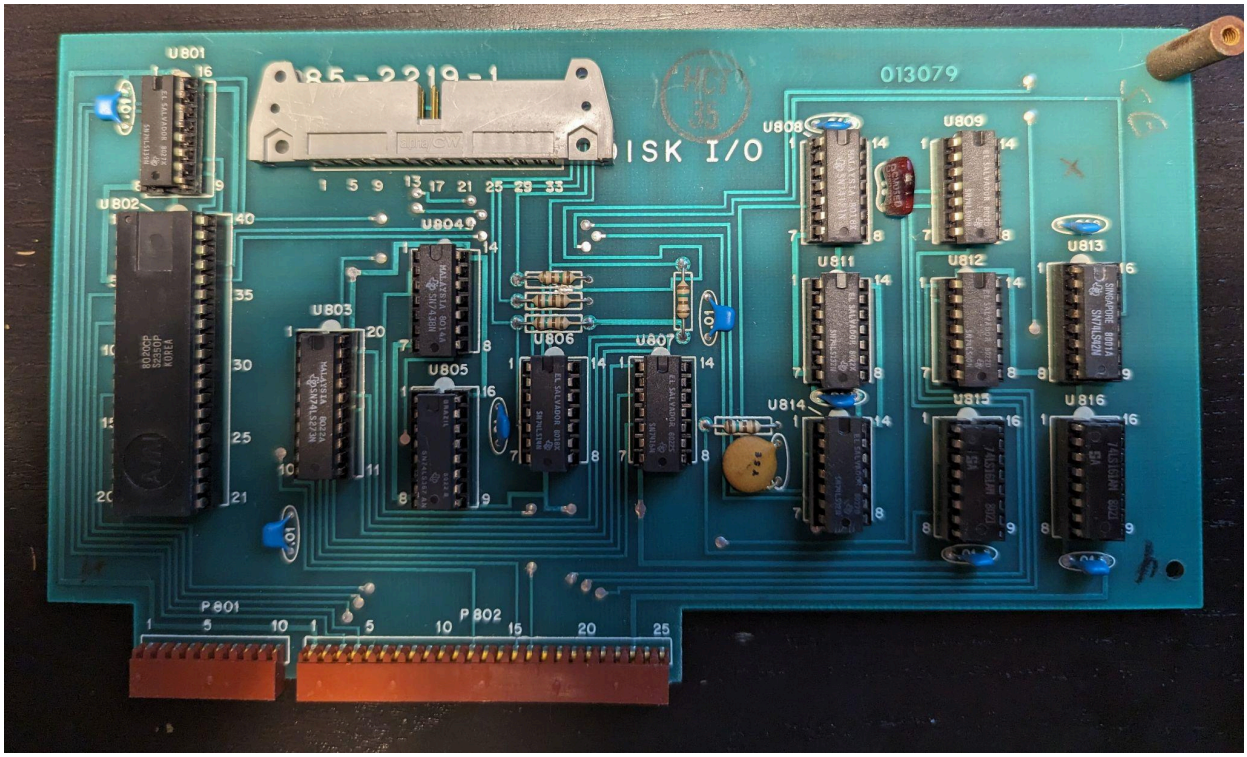
Note on heatsink: 2/82 Wiring for 444-66 and to P509 to H89A level

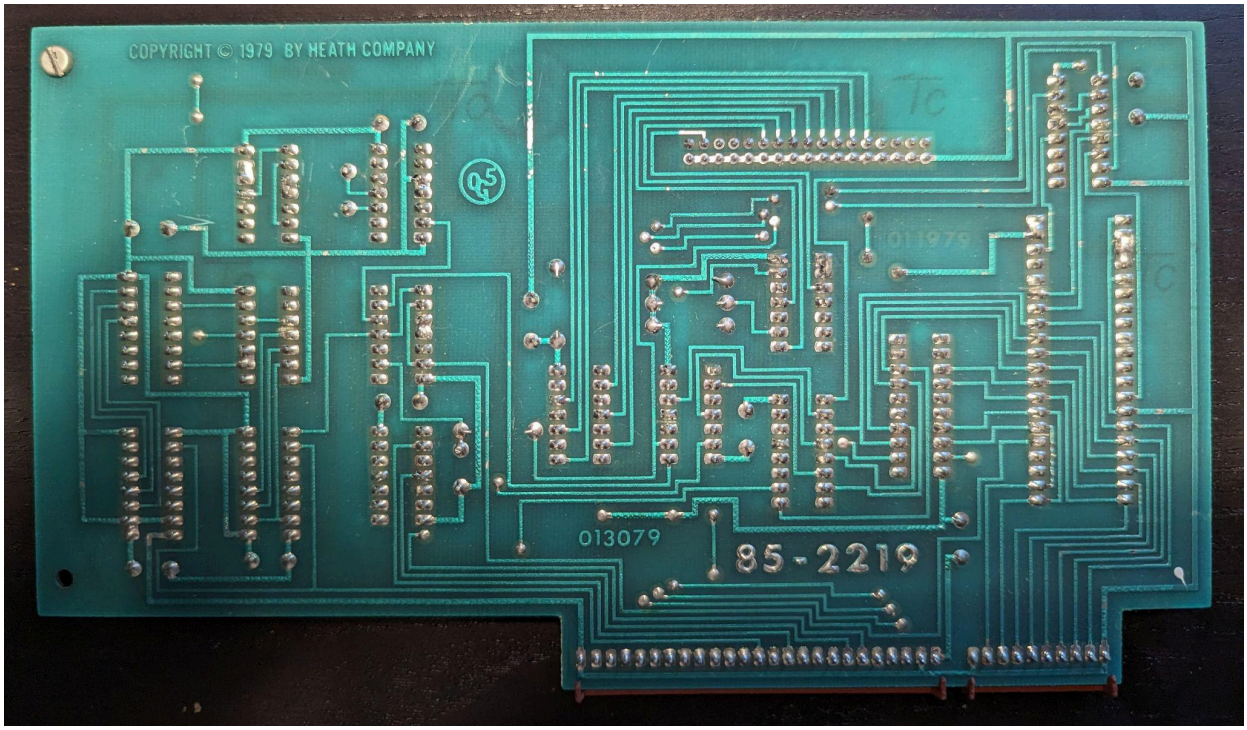
85-2539-1 16K Memory Expansion Board




16K MEMORY
EXPANSION
85-2539
HEATH COPR 1980
071980
071980
M4-G0

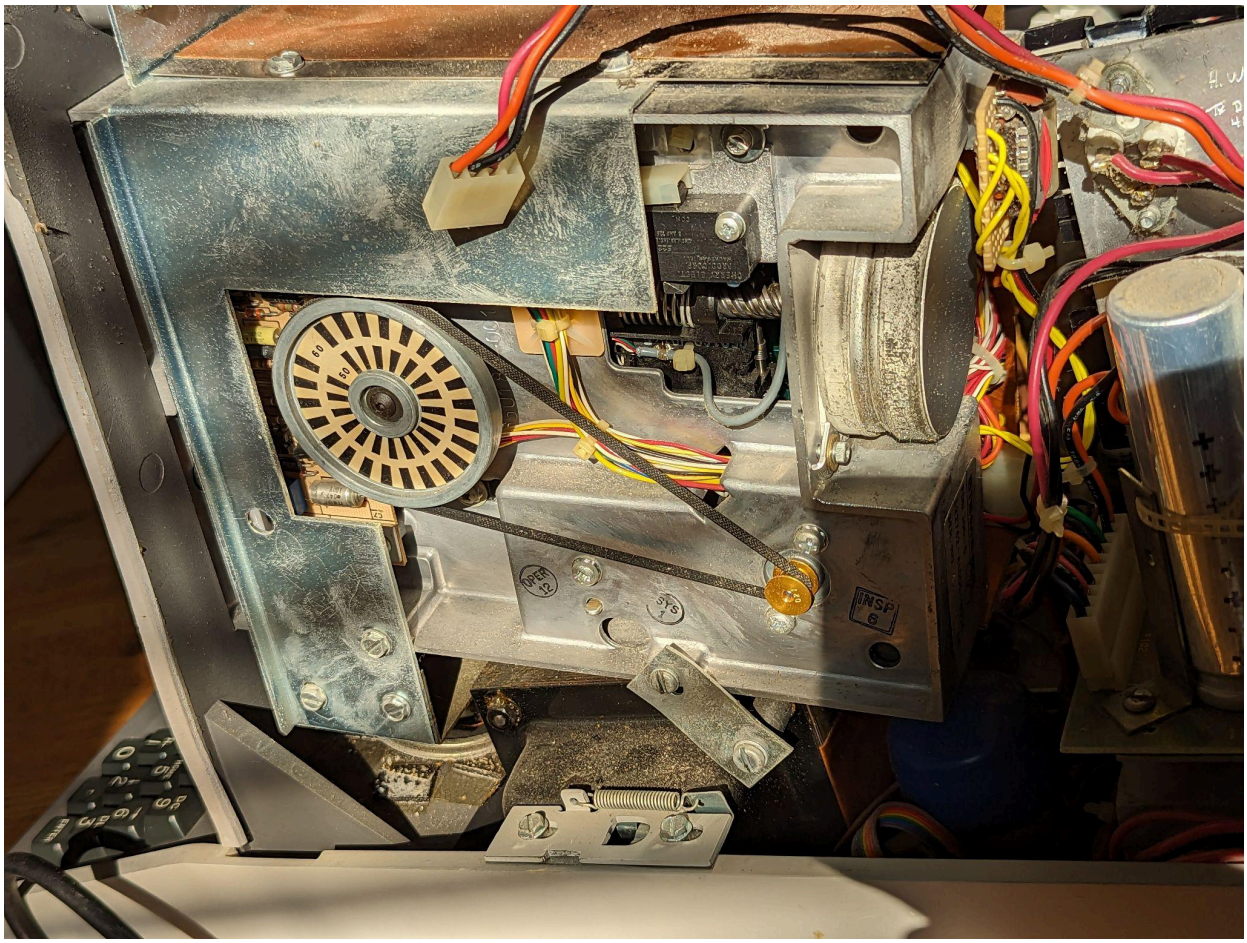
85-2219-1 Hard Sectored Disk I/O Board

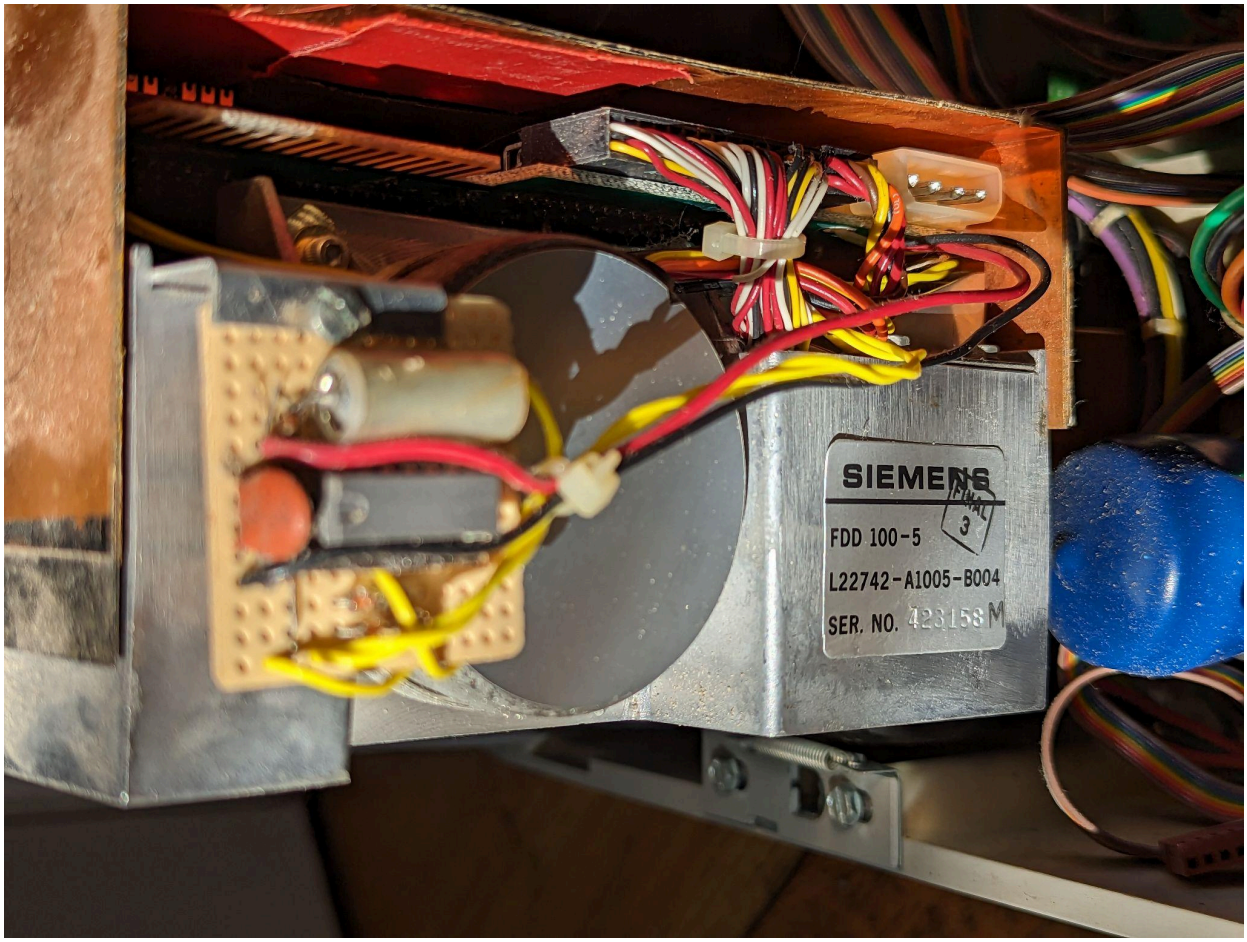


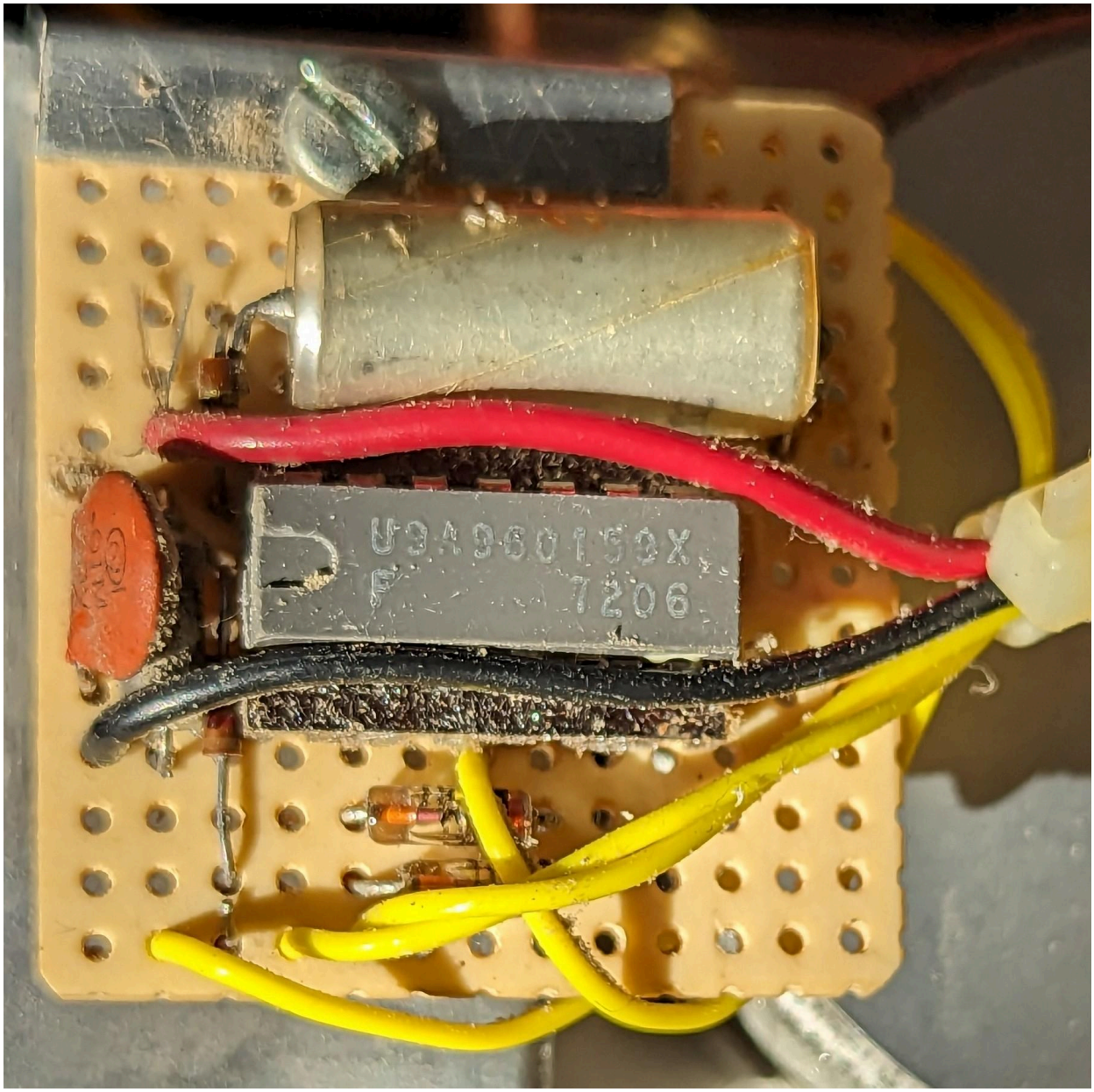


Siemens FDD 100-5

Note on copper shielding: 8/27/82 R-pack in SY0:

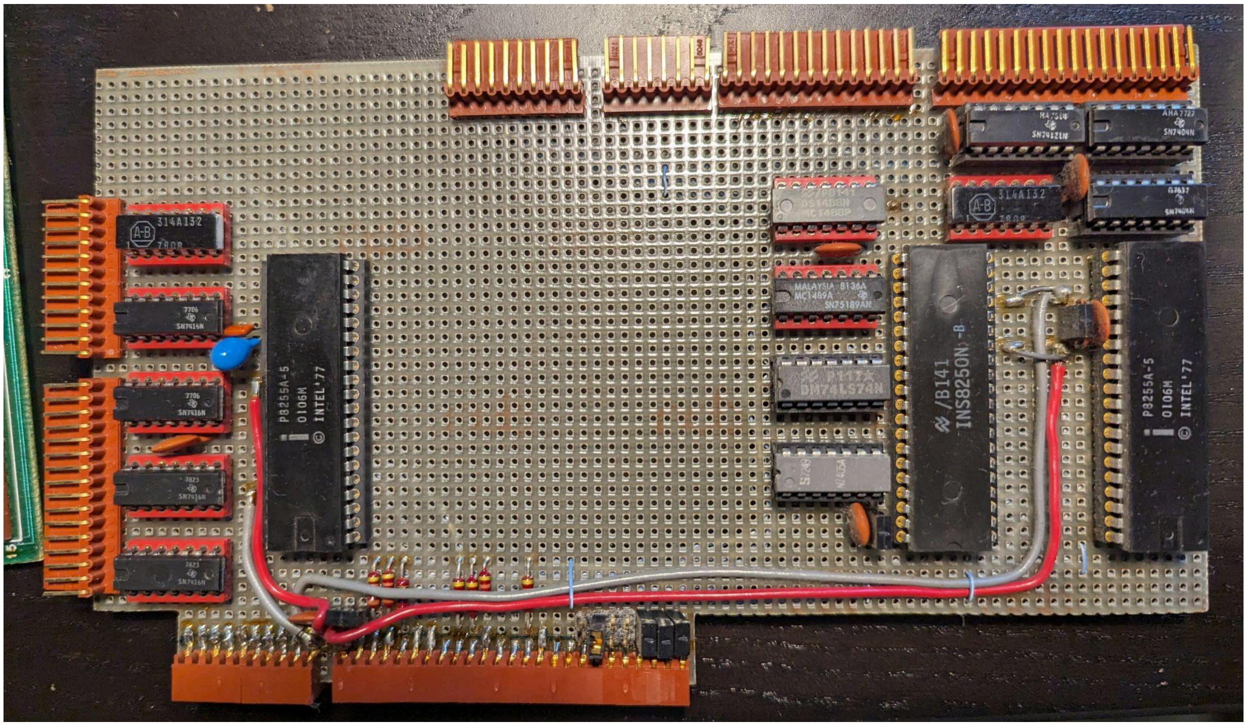


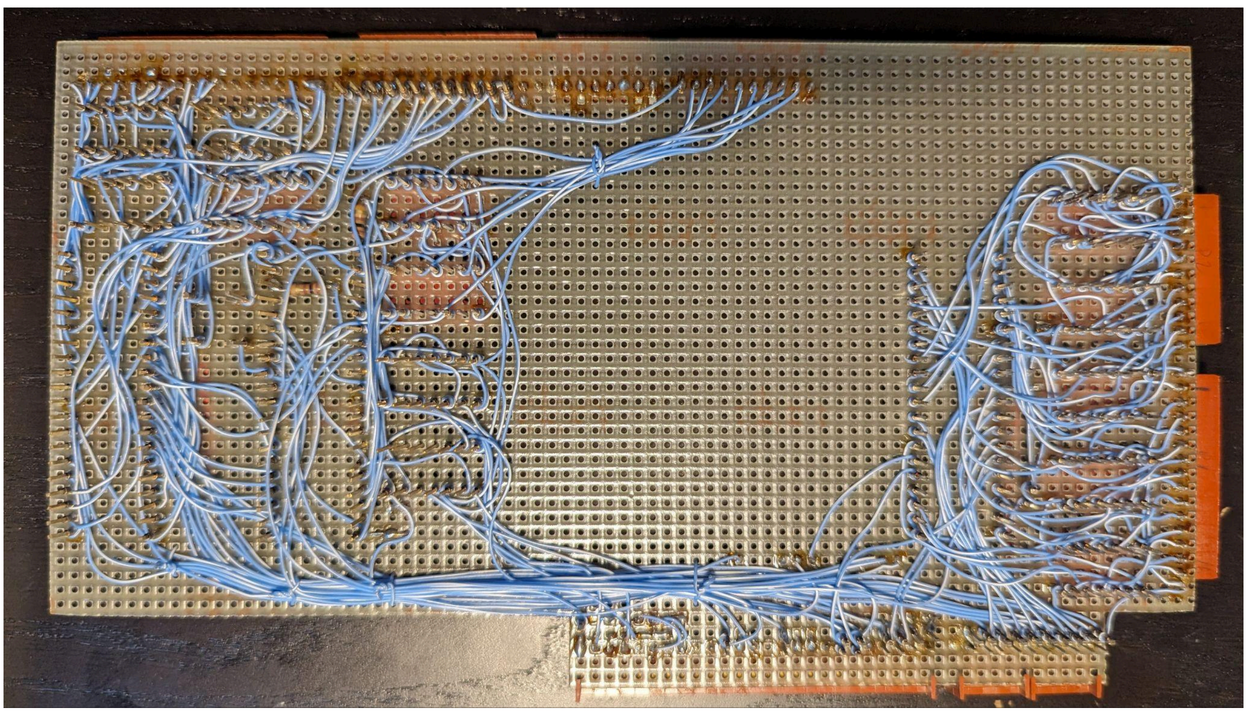

SIEMENS
FDD 100-5
L22742-A1005-B004
SER. NO. 423158

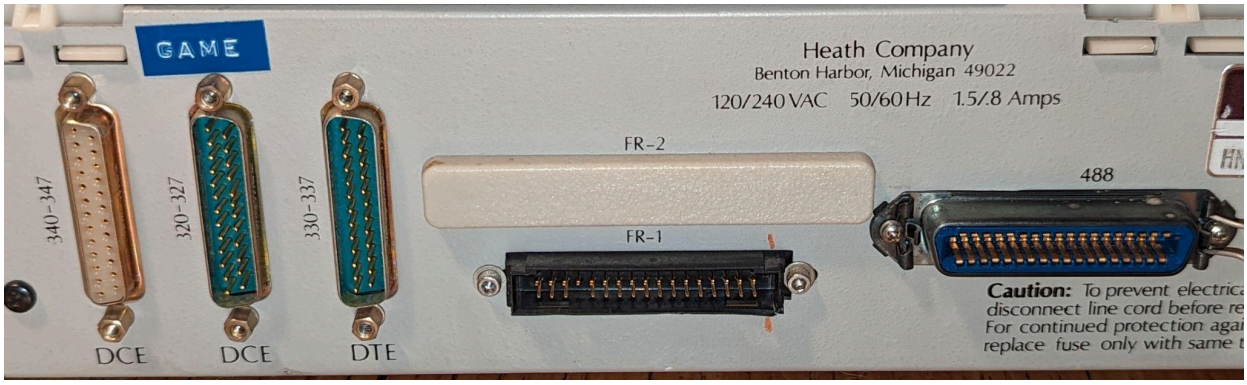


DIY Wire-wrapped Comm Board

2x P8255A-5 Programmable Peripheral Interface
1x INS8250N UART


P8255A-5
0106M
INTEL'77
INS8250N-B
DM74LS74N
MALAYSIA 8136A
MC1489A
SN75189AN
P8255A-5
0106M
INTEL'77





Documentation

Heath Software Docs

Mostly what it says on the spine… mystery volumes on the right contain:

- Benton Harbor Basic (Continued from HDOS 1.6 volume)
- H88/WH89 Computer Monitor MTR-88
- H8 Computer Front Panel Monitor PAM-8
- Edit 19 version 2 & 3, Edit 89


heath computer systems
reference manual
HDOS
heath computer systems
reference manual
Microsoft™
FORTRAN-80
heath computer systems
reference manual
cassette systems software
IBM
CP/M 2.2.03
BASIC-80
Operating Procedures Manual
Volume I
SUPERCALC
IBM
HDOS 1.4
IBM

Continuing Education: BASIC Programming & Assembly listings

So many listings…


HEATH Zenith
HDOS
Volume 1
HEATH Zenith
H19 ROM
HEATH Zenith
HDOS
Volume 2
HEATH Zenith
H17 ROM
HEATH Zenith
HDOS
Volume 3
BIOS LISTING
for
CP/M 2.2.03
HEATH Zenith
HDOS
Volume 4
EDIT19
VERSION 3
FOR HDOS AND
H89 OR H8/H19
Copyright (c) 1982 by
Steven and Kay A. Dubbins
4610 Spotted Oak Woods
San Antonio, Texas 78249

Hardware Manuals and Magazines

Documentation Inventory

I've included Heathkit part numbers if they were printed on the documents. If the part number doesn't have the last two digits, I added -00 to make it line up with the others.

Heathkit

Hardware

595-2667-04 Heathkit Manual for the Digital Computer Model H88 Assembly
595-2267-04 Illustration Booklet Main Pack Parts Pictorial
595-2268-04 Heathkit Manual for the Digital Computer Model H88 Operation
595-2268-04 Illustration Booklet H88 Operation
595-2268-04 Schematic of the Heathkit Digital Computer H88/WH89 Part 3 of 3
595-2716-00 Heathkit Manual for the 48 TPI 5-1/4" Floppy Disk Drive Model H-17-1
595-2766-00 Schematic of the Heathkit Digital Computer H-89A (3 of 3)
597-2190-02 Instructions for the Heath Floppy Disk Accessory Model H88-4
597-2191-00 Memory Expansion Accessory Model H88-2
597-2209-00 Heathkit Wire-Wrapping Card Model H88-10
597-2387-00 Heath Anti-Glare CRT Filter Models HCA-3 and HCA-4

HDOS

595-2340-00 HDOS 1.6 Chapter 0: Configuration for the H89-17
595-2335-00 HDOS 1.6 Chapter 1: Operating Instructions
595-2336-00 HDOS 1.6 Chapter 2: Console Debugger DBUG
595-2337-00 HDOS 1.6 Chapter 3: Heath Text Editor EDIT
595-2338-00 HDOS 1.6 Chapter 4: Heath Assembly Language ASM
595-2339-00 HDOS 1.6 Chapter 5: Extended Benton Harbor Basic

595-2474-00 HDOS 2.0 Chapter 1: System Configuration
595-2475-00 HDOS 2.0 Chapter 2: General Operations
595-2476-00 HDOS 2.0 Chapter 3: Console Debugger DBUG
595-2477-00 HDOS 2.0 Chapter 4: Heath Text Editor EDIT
595-2478-00 HDOS 2.0 Chapter 5: Heath Assembly Language ASM
595-2479-00 HDOS 2.0 Chapter 6: Extended Benton Harbor Basic
591-3466-00 HDOS Important Software Update
595-2466-01 HDOS Listing (Volumes 1-4)

Cassette System

595-2342-00 Cassette System H88-18 Introduction
595-2343-00 Console Debugger BUG-8
595-2344-00 Heath Assembly Language HASL-8
595-2345-00 Heath Text Editor TED-8
595-2349-00 H88/WH89 Computer Monitor MTR-88
595-2437-00 Benton Harbor Basic

Misc Software

595-2348-00 H8 Computer Front Panel Monitor PAM-8
595-2349-00 Monitor MTR-88 Software Reference Manual
595-2464-00 H17 ROM Listing (2 Copies)
595-2465-01 H19 ROM Listing (3 Copies)
595-2508-00 Monitor MTR-89 Operation Manual
597-2571-00 H-88/H-89/Z-89/Z-90 Configuration Guide (2 Copies)
597-2663-00 Introduction to SuperCalc by Sorcim

Continuing Education

595-2045-01 Heathkit Continuing Education BASIC Programming
595-2046-00 Heathkit Continuing Education BASIC Programming Workbook

Microsoft

595-2435-00 Microsoft Fortran-80 Manual Chapter 1-12
595-2286-00 Microsoft Macro-80 Assembler Manual
595-2286-00 Microsoft Link-80 Loader
595-2793-00 Microsoft BASIC Compiler
595-2538-01 Microsoft BASIC-80
595-2663-00 Microsoft Utilities HDOS Version [MACRO-80/CREF/LIB/LINK]
595-2285-01 Microsoft BASIC Model H8-21 for the Heath 8-bit Digital Computer Systems

Microsoft BASIC-80 CP/M Version Reference Guide

CP/M

Heathkit

CP/M 2.2 for the Heath and Zenith 8-Bit Computer Systems (dated 1980, no part number)
595-2776-00 CP/M Version 2.2 for the Heath/Zenith 8-bit Computer Systems (dated 1981)

Digital Research

An Introduction to CP/M Features and Facilities (dated 1978)
CP/M 2.0 Alteration Guide (dated 1979)
ED: A Context Editor for the CP/M Disk System (dated 1978)
CP/M Dynamic Debugging Tool (DDT) (dated 1978)
CP/M 2.0 Interface Guide (dated 1979)
CP/M 2.0 User's Guide for CP/M 1.4 Owners

Siemens Disk Drive

Digital Research CP/M 2.2 Quick Reference Guide
Siemens OEM Floppy Disk Drive FDD 100-5B Installation/Operation Manual (2 copies)
Siemens OEM Floppy Disk Drive FDD 100-5B Operation/Maintenance Manual
630322-100 Schematic Diagram Motor Drive PCB
650284-100 Schematic Diagram

Magazines

Original

HUG Software Catalog (Undated, P/N 885-4500)
Heath Users' Group Cross Reference (REMark 36)
REMark Issues 38-41 (March-June 1983)

Photocopies

BUSS #75-79 (Sept-Nov 1983)
REMark #9-35 (Feb 1980-Dec 1982)
Unknown HUG Software Catalog pp. 91-127

Building the H-89 by Martin Moore (Microcomputing, March 1981)
Firm Up Your Floppy with 800K by Peter A Stark (Microcomputing, August 1981)
Othello Tournament by Stephen Kimmel (Creative Computing, July 1981)

National Technical Schools

Ad Poster from Jan 1982
Video Terminal K-2291 thru 2299 Instructions

Additional binder full of information, still to be cataloged.

Misc

Printouts

Heath Computer Notes April 1982 - HDOS modifications?
H89 4MHz Modification Notes by George Najatian
HDOS 2.0 Patches from BUSS #33 March 1981
4MHz H89 CPU from BUSS #45 Dec 1981
H89 Old Memory Map PROM U517 (444-42)
H89 New Memory Map PROM U517 (444-66)
H89 Old I/O Map PROM U550 (444-43)
H89 New I/O Map PROM U550 (444-61)

Photocopies

Intel AP-16: Using the 8251 USART
Unknown Heathkit Manual Page 4-3 to 4-8 (setting baud rate, memory map, etc.)
Terminal escape codes (Heath/Zenith and ANSI Modes)
“Submit” Documentation
DUP - Disk Duplicator

Original Manuals?

Touch Typist by Newline Software
Ladders by Jerry A. Phelps
Mail-Mate by Sunflower Software

Space Odyssey 1 by Joe Gargiulo (Evryware)
Y-Wing Fighter by Dave Murry (Evryware)
Y-Wing II by Dave and Barry Murry (Evryware)
ZenCalc by The Software Toolworks
Query! by Hoyle and Hoyle Software
Report Writer by Hoyle and Hoyle Software
Edit-19 Version 3 for HDOS and H89
Edit-19 Version 2 for HDOS and H89

Original Owner's Notes

Heath/Epson Printer I/O Adapter Schematics - 2/81-4/3/81
Heathkit Disc Drive Modification: Anti-Bang and "Reset SY" release - 6/6/81
Construction Details: Heath Second Drive Enclosure/Power Supply - 7/2/81
Heath Second Drive Power Supply - 7/2/81
Notes on Pin Forming - 9/11/81
H-89 Information (Changes to terminal processor card, logic card, power supply) - 12/20/81
IBM/Tandon TM-100-1 Drive Modification/Comments - 2/13/82
CP/M Org-0 Modifications - 2/28/82
Notes on Printer Port Placement on Left Accessory Sockets P507-P509 - Undated
Misc receipts, invoices, and warranty info

5.25” Diskettes

Originals

HDOS Operating System

890-64 HDOS Heath Disk Operating System ©1980
890-104 HDOS Device Drivers ©1980
890-103 HDOS Software Tools ©1980

Microsoft Development Tools

HMS-817-4 Microsoft BASIC Compiler for HDOS Disk 1 & 2
830-49 HDOS Microsoft Fortran
890-8 Heath HDOS Microsoft Fortran June 10, 1980
890-60 Microsoft Fortran-80 Sample Programs for HDOS June 9, 1980

S. & K. Robbins

EDIT19 Version 2 for HDOS ©1981
EDIT19 Version 3.0 for HDOS ©1982

The Software Toolworks

205-H5 REACH Modem and File Transfer Program for HDOS ©1980 Walter Bilofsky
213-H5 RATFOR Preprocessor and Runtime Library for HDOS ©1980 William Person
214-D5 INVADERS Action Video Game for HDOS and CP/M ©1981 Robert Wesson
215-H5 SPOOL-N-GO Printer Spooler for HDOS ©1981 Barnard Software
215-H5 SUPER ZAP Screen Disk Dump and Patch for HDOS ©1981 Darvey Lavender
223-C5 ZENCALC Electronic Spreadsheet for CP/M ©1982 Knowledge Engineering

Hoyle and Hoyle Software

#53 REPORT for HDOS ©1982
#138 QUERY! for HDOS ©1982
#403 QUERY! 2 for HDOS ©1983

Evryware

Space Odyssey I for CP/M and HDOS ©1982 Joe Gargiulo
Y-Wing Fighter for CP/M and HDOS ©1981 Dae Murry

Heath Users' Group

885-1071 A Small Business Package III Program Disk
885-1071 B Small Business Package III Data Disk I
885-1061 C Small Business Package III Data Disk II
885-1092 Relocating Debug Tool
885-1109 A HDOS Retriever Documentation & Programs
885-1109 B HDOS Retriever Programs & Sample Data
885-1109 C HDOS Retriever Source Code Files
885-1120 HDOS "WHEW" Utilities
885-8009 Galactic Warrior

Misc

Pack 1.4 & Crypt 1.0 for HDOS ©1980 James J. Gillogly
SF-9004 Softstuff General Ledger for HDOS

The Keyboard Studio

I'm actually not sure if these are for CP/M or HDOS as the label doesn't indicate.

Database
CTRL 'P'atch
Graphic Subroutines

CP/M Operating System

HOS-8917-2 Digital Research CP/M 2.2 Distribution Disk 1-3
HSC-817-1 SuperCalc Program and Utilities Disk

Copies

These have mostly handwritten labels. A few are typewritten but obviously copies.

HDOS

HDOS 2.0 Disk Operating System Distribution Disk
HDOS 2.0 Device Drivers Distribution Disk
HDOS 2.0 Software Tools Distribution Disk
HDOS 2.0 Disk New Products Update Dist Disk
HDOS 1.6 Distribution Diskette (front); HDOS 1.6 (MOD) master (back)

HDOS Mods

I believe the original owner made his own customizations to HDOS, possibly related to the hardware mods he made to the disk drive and CPU board. Multiple disks appear to be sysgen/init for customized versions.

HDOS 1.6 Work Disk
HDOS System Disk
New Init for HUG, SY.DVD; front: init w/ 6 sectors; back: init w/ 4 sectors
HDOS min sysgen; front: 4 sector directory; back: min sysgen w/ reduce
Sysgen + Init: rel 2.0 modified 3/81
HDOS 2.0 sysgen + init
Sysgen + init w/ modified sysgen & pip; new init & SY.DVD
New drive init (both sides)
QUME DVD

HDOS Utilities (Likely HUG Disks)

Util + Mailpro (new)
Util 2
Util 3
HUG 885-1082; Util 4
Utilities #5; Reach
Utilities #6
HUG 885-1060; Disk 7: HDOS utility pkg
HUG 885-1064; Disk 9: Misc software ABS/ASM
Ed-a-sketch; Load-n-go; database manager

HUG SY: 885-1095

HDOS Development Tools

BASIC-80 Compiler (HDOS); dist disk #1 (front) #2 (back)
BASIC Compiler (HDOS) Disk #1; BASCOM, BASLIB
BASIC Compiler (HDOS) Disk #2; L80, M80, CREF, ETC.
Benton Harbor Basic (Non-Bootable)
Fortran 80 System Master Distribution Diskette
Fortran 80 System Master (front); Sample programs (back)

HDOS Business Apps

Label Plus; Label Plus Util
Label Plus; Label Plus Util Dist Disk Copy
Touch Typist
MailPro + MBASIC + HDOS 1.6; Auto City Feature; SY1 assumed for data
CWE Flippy Test; Pass-around menu, drawit
Query DBMS (Front); Report (Back)
Query DBMS
Query II & Writer (Epson)
Query 2 + Report (for Qume printer)
Menu + Text Editor using HDOS 2.0, NEW SY.DVD; CP/M Copy
Electronics Programs (front & back)

CP/M Operating System

CP/M 1.4 master work diskette
CP/M 2.2.0.3 Dist Disk #1
CP/M 2.2.0.3 Distribution Disk I
CP/M 2.2.0.3 Distribution Disk II
CP/M 2.2.0.3 Distribution Disk III
CP/M Distribution Disk I
CP/M Distribution Disk II
Microsoft BASIC-80

CP/M Development Tools

BASIC Compiler Dist Disk I
BASIC Compiler Dist Disk II
Super Calc Program Disk

CP/M Utilities

890-158 HDOS CPM & CPM-copy Dual Format
CP/M 2.2 Utilities

CP/M Business Apps

CP/M DB, CP/M CAT
ZenCalc CP/M
Magic Wand CP/M

Games

This is a set of numbered game disks that apparently have a menu to start them:

Menu for Games; HDOS 2.0 bootable; ASM, ABS
0: Games Disk 1 (non-bootable); MBASIC
1: MBASIC Games Disk #3
2: MBASIC Games Disk #4
3: MBASIC Games Disk #5
4: Adventure (HDOS 2.0)
5: Munchkin, Pirates, Invaders, Airport, Reversi
6: Assembly Lang Games #2

There are also several other non-numbered games disks:

Munchkin, Pirates, Reversi, Wumpus, Vegas
Mychess, Ywing 2 (HDOS)
Dungeons & Dragons (HDOS 2.0; HUG 885-1093)
DND Master (HUG 885-1093)
Ladders
Y-wing, Odyssey, Othello (HDOS front; CPM back)
Munchkin, Pirates CP/M

Editor Disks

Edit 19 V2 w/ Various Device Driver/Print Style Options (Qume)
Edit 19, Airport
Edit 19 Version 3 Distribution Disk (Thompson sys disk on back)
Edit 19 Version 3 Work Disk (not bootable)
Edit 19 Version 3 (both sides; boot)
Edit 19 Version 3 (boot)
Text Editor
Text Editor Files

Editor Files Backup

Modem-Related

Modem (2 disks)
Modem programs; Reach
Modem Pkg (HDOS; new SY.DVD)
HDOS Files: modem, editor, etc.

Mystery/Personal Contents

Troop 48 scout records
Disks with people's names on them
CP/M Files 1 & 2: SC, Text
Assembler Prep
GED, ASM Prep
Assem Prep II, SUP DUP PIP
Documentation; LP:SOURCE
LP Source (HDOS 1.6 level, asm etc.)
CDOS
Unlabelled disks, possibly blank

Repair Log

Initial Power Up

I'm kicking myself for not buying a variac to bring up my H89, but what's done is done now. When I first turned it on, the fan spun and I got two beeps but no picture, then the fuse blew a few seconds later. A whiff of magic smoke was in the air, and on closer inspection, I found that **R263** (1.2Ω 2 watt 10% resistor) on the video board had cracked. No other obvious signs of damage were present.

Power Supply Repairs

Based on recommendations from the SEBHC mailing list I decided to recap the power supply in addition to replacing the blown fuse. I also decided to buy spare tantalum capacitors in all of the common values used in the Heathkit in case any of them needed to be replaced. I ordered the replacement caps, resistor, and fuses from Mouser.

I got the power supply caps and fuse replaced and verified voltages on my power supply, then disconnected the Video Board from the power supply. With the Terminal Logic and CPU Logic

boards powered, I was able to get two beeps once again. Keys on the keyboard generated a software click, so it seemed that the power supply and computer boards were working.

Video Board Repairs

Resistor and Capacitor Replacements

I replaced the cracked **R263** along with **R264** next to it, and all of the electrolytic capacitors on the video board. When I powered on the video board again to check the voltages, **R244** (15 ohm, ½ watt) flamed out. I replaced the resistor and powered up the video board again, and the same resistor burned again immediately, so it was obvious something else on the board was shorted.

Transistor Replacements

After checking the specs on all the transistors, I came up with the following. The NTE238 is available from NTE Parts Direct and the rest are available from Mouser:

- The following parts are still readily available:
    - MJE172 (Q208, Q211)
    - MJE182 (Q207)
    - MJE340 (Q216)
    - MPSA56 (Q203)
    - MPSA06 (Q204)
    - 2N3906 (Q212)
    - 2N3904 (Q215)
- MJ2841(Q213) can be replaced with MJ15001G
- MPSU06 (Q205, Q206) can be replaced with CEN-U06 or CEN-U07
- MPSU10 (Q214) can be replaced with CEN-U10
- MPSL01 (Q209) can be replaced with 2N5551
- MPSA65 (Q202) can be replaced with BC516
- BU500 (Q217) can be replaced with NTE238

Once the transistors came from Mouser, I replaced all the transistors on the board. I kept any old transistors that still tested OK out of circuit as spares. I soldered the BU500 back into the board since I did not have a replacement. When I powered on the board and repeated the voltage checks, the power supply was now at 53V and no components burned.

Shorted Transistors

I removed the flyback from the board so that soldering was less awkward and the sticky red goo on the anode cap would not get all over me.

I looked at what was connected to **R244** on the schematic and started checking diode drops and resistance between the legs of the nearby transistors with my multimeter. Initially I suspected **Q205** and **Q206** (both NSDU06), but they tested OK out of the circuit. I found a .58-.59 voltage drop and 22M resistance from base to emitter and base to collector of both transistors, and infinite resistance in the other direction. The culprits turned out to be **Q207** (MJE182) and **Q208** (MJE172). All 3 legs of **Q208** were dead shorts, and **Q207** was shorted from base to emitter. With these transistors removed from the board, I was able to power it on long enough to check voltages without anything else catching on fire.

When performing the voltage checks on page 65 of the H88 assembly manual, I found the voltage at **TP13** to be close to 70V instead of 53V, while the voltage at **TP14** was 6.2V as expected. This indicated that the 53V supply was not being regulated. I powered down the board and performed the resistance tests on page 63, and everything checked out except for TP2, which was supposed to be greater than 5000 ohms, but my multimeter showed only 3600 ohms. **Q211** (MJE172), **Q212** (2N3906), and **Q213** (MJ2841) were listed as possible problems when the resistance at TP2 is too low. I tested the diode drops and resistance on all 3 in-circuit and found that **Q213** was the most likely suspect, so I removed it from the board too. With **Q213** removed from the circuit, I confirmed that its emitter was shorted to its collector.

Q217 (BU500) was not shorted but I am not sure whether it is good or not based on the lower than expected resistance readings. The table below shows the diode drops and resistances measured on the original transistor and the NTE238 replacement that I ordered. Since the transistor was already out of the board I decided to replace it.

	BU500 Diode Drop	NTE238 Diode Drop	BU500 Resistance	NTE238 Resistance
B->E	0.498V	0.504V	4M	11M
B->C	0.419V	0.456V	400K	5M
E->B	OL	OL	OL	OL
E->C	OL	OL	OL	OL
C->B	OL	OL	5M	OL
C->E	OL	OL	9M	OL

CRT Checkout

Unfortunately I still did not get any heater or anode voltage, and incorrectly concluded that my CRT's heater was burned out. It turns out I was checking continuity between the wrong pins of the CRT. Later I realized that the pin connectors are slightly skewed from where the pin numbers

are printed on the tube socket and that there are little lines pointing from the number to the corresponding hole. After checking the correct pins, my CRT heater does have continuity.

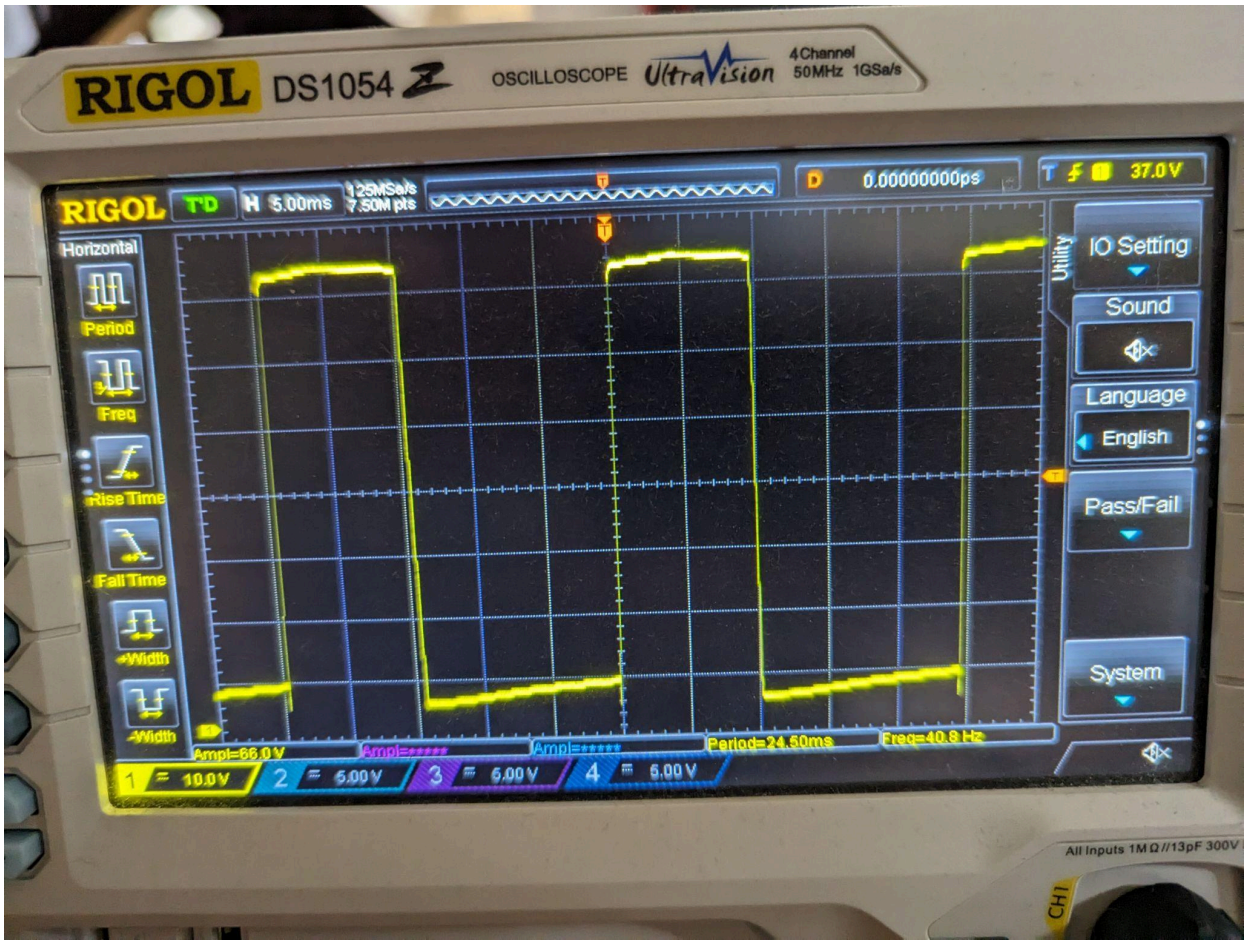
Flyback Checkout

I checked for continuity on the flyback transformer. I got continuity on the orange/red primary and the yellow/blue and brown/brown secondaries. I got an open circuit on the HV secondary in either direction, but this is most likely due to the high voltage diode that is in series with the HV lead. The multimeter diode tester does not put out enough voltage to overcome the HV diode drop.

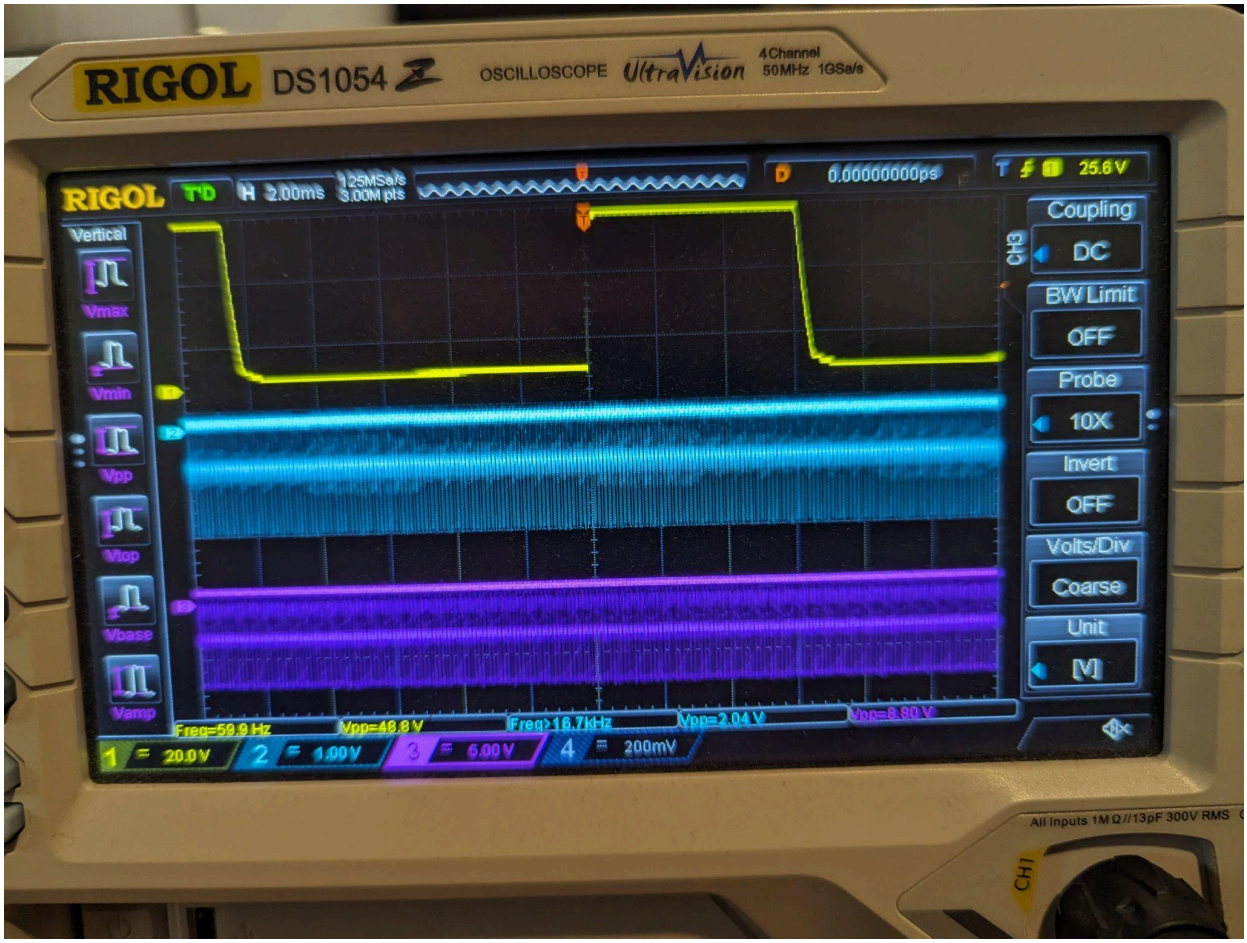
Signal Checkout

With the flyback still disconnected, I hooked up my oscilloscope and traced the vertical and horizontal sync signals through the circuit.

With the TLB disconnected, I got a ~40Hz vertical sync signal which is generated by **Q201** (MPU131, programmable unijunction transistor).



With the TLB connected, the vertical sync frequency increases to 59.9Hz 48 Vpp:



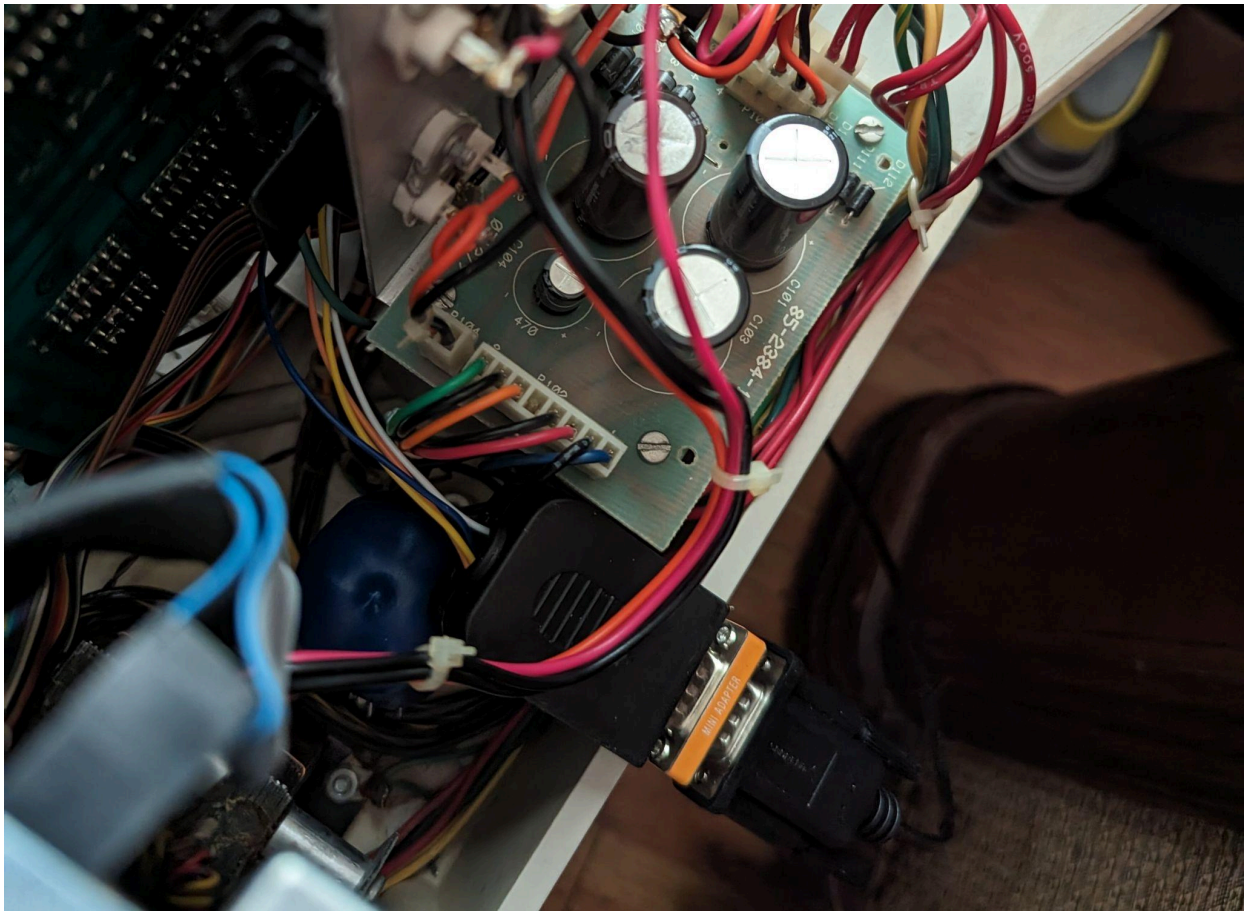
I also checked the horizontal sync signal at several points in the signal path:

- Yellow was on the vsync signal from the leg of **R238** connected to the base of **Q205**.
- Light blue was hsync on the leg of **R249** coming in from the TLB.
- Pink was on hsync on the leg of **R262**, which is connected to the base of **Q217**.
- Dark blue was on hsync on the red input to the flyback on **P203**, coming from the collector of **Q217**.

The output of **Q217** (BU500) seems too low at 2 Vpp when the H19 service manual suggests it should be close to 500 Vpp.

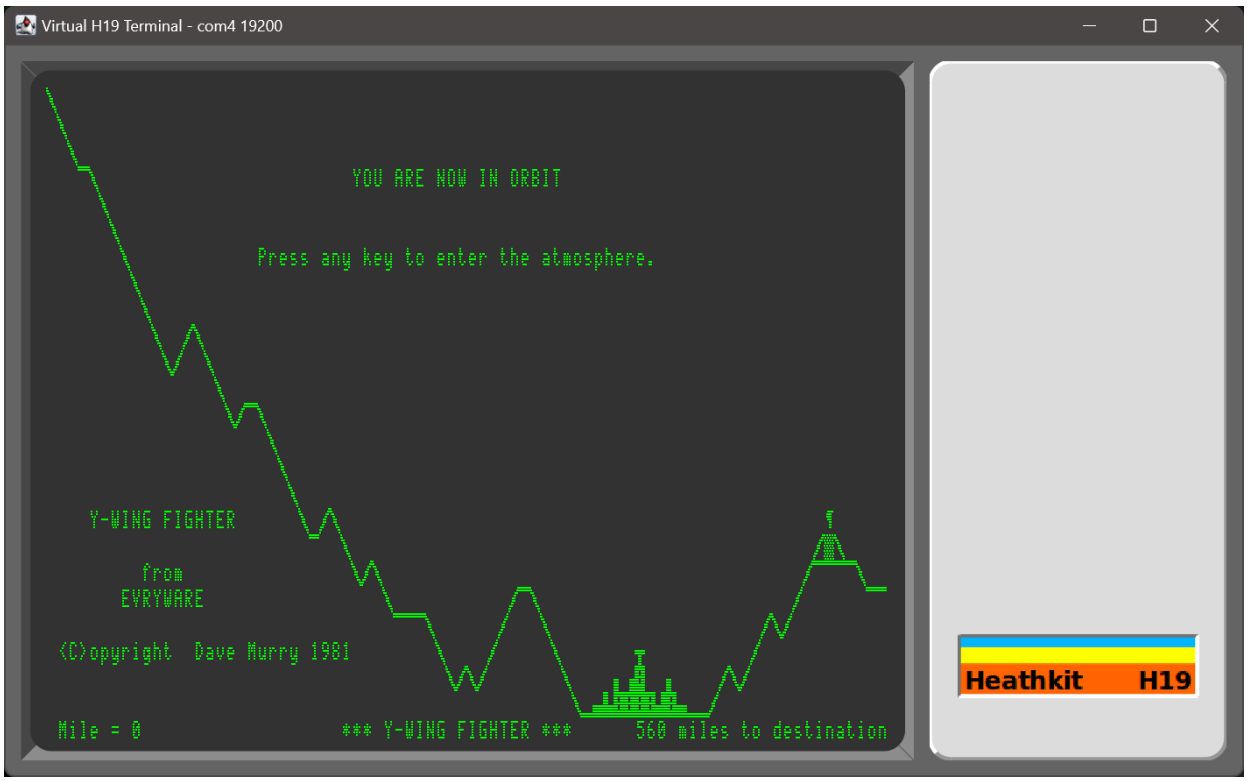
Serial Connector

I built an adapter cable that has a DE-9 connector on one end and a pin header connector on the other end to connect to P513. I hooked this up to my desktop PC using a null modem and USB to RS-232 adapter:



With this connected, I am able to interact with the H89 using Douglas Miller's [H19serial terminal]:


Virtual H19 Terminal - com4 19200
SYSTEM HAS 48K OF RAM
Volume 010, Mounted On SY0:
Label: HDOS 1.6
HDOS Version 1.6
Issue # 50.05.00
Date: 28-May-79
>dismount sy0:
Volume 010, Dismounted from SY0:
Label: HDOS 1.6
>mount sy0:
Volume 030, Mounted on SY0:
Label: EVRYWARE--YWING ODYSSEY--HDOS (CP/M ON BACK)
>ywing
Heathkit H19


Virtual H19 Terminal - com4 19200
YOU ARE NOW IN ORBIT
Press any key to enter the atmosphere.
Y-WING FIGHTER
from
EVRYWARE
(C)opyright Dave Murry 1981
Mile = 0
*** Y-WING FIGHTER ***
560 miles to destination
Heathkit H19

Bad DRAM

When I entered the Boot command, the drive showed no signs of life.

I tried entering the test program on page 3-4 of the H88 Operation Manual, and verified the program was stored to memory, but when I ran it, it would just hang:

```
  H: Substitute 40100
040100 076 076
040101 000 011
040102 337 315
040103 337 302
040104 000 003
040105 000 074
040106 337 376
040107 377 155
040110 000 312
040111 000 100
040112 337 040
040113 377 303
040114 000 102
040115 000 040
040116 377 337
  H: Substitute 40100
  H: Program Counter 040100
  H: Go
```

Next I flipped the memory test dip to 0 to run the memory test. It reports the last working address (LWA) in Heathkit's split-octal notation. 040021 is equivalent to 0x2011 (just over 8k):

```
Dynamic RAM test

         LWA = 040021
     Pass =015
```

Since my system had 64K of RAM, the LWA should have been 377377 or 0xFFFF if all the RAM was working. I tried swapping out the first bank for the second and the LWA moved to 140021 or 0x6011 (just over 24K) and then I replaced the second bank with the RAM from the expansion board, and the LWA moved to 277377 or 0xBFFF (48k). I let it run for a full 256 passes successfully.

After flipping the memory test dip switch back to 1 so it would boot normally, I was able to re-enter the test program and this time it produced the expected result, printing the following lines repeatedly:

```
123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijkl
```

With 48K working RAM, the drive light came on when entering the Boot command, but it still could not boot due to problems with the disk drive.

I still need to order some replacement 4116 16Kx1bit DRAMs from Jameco to repopulate the RAM expansion board.

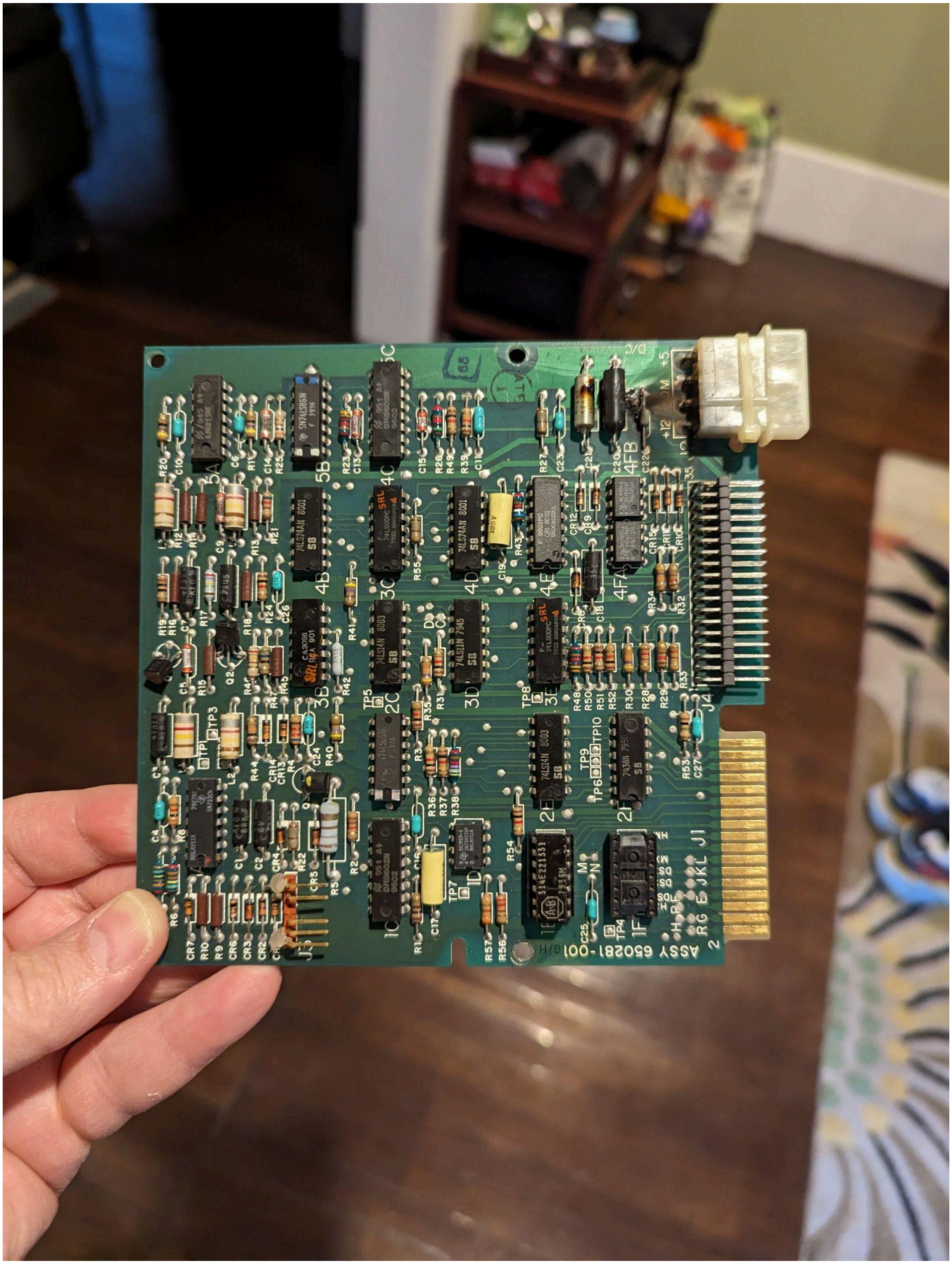
Drive Repair

The computer came with a Siemens FDD 100-5 drive. Since I was not able to get it working with the FC5025 when I was imaging the disks, I knew it probably needed some work. I tried lubricating the bearings in the spindle and the screw drive for the stepper motor with spray lithium grease. The drive would now spin but not at the correct RPM, and it was still not able to successfully boot from any disks.

I had a spare 5.25" 360K disk drive in my PCjr, which I borrowed to test the computer. After hooking it up to the H-17 controller and setting the jumper to DS2 (which makes it the first drive, SY0, since Heathkit's hard sector controller assigns the drives in reverse order). With this drive, I was able to successfully boot. The PCjr drive is half-height and it is too long to fit in the drive cage in the H89, so it is not a permanent solution.

My dad brought me his H77 external disk enclosure with two Siemens FDD 100-5 drives from his H89. I cleaned and lubricated the spindle bearings on all 3 drives. First, I removed the bearings from the spindle and the pressure clips and soaked them in 99% IPA. After soaking, I put them on a paper towel and observed a lot of discolored fluid coming from the bearings, probably from dried grease. I soaked them a second time in fresh IPA, dried them again on a paper towel, and then lubricated them using lithium grease. I put them back into the drives and also lubricated the stepper motor screw gear.

When powering up both of my dad's drives, C20 blew up on the analog boards of both drives. This is a 15V tantalum filter cap across the 12V line. The analog board from the original drive powered up without any fireworks, so the next step is to install this analog board on one of my dad's drives and see if it works. Before connecting the third board, I will also double check the 12V line to make sure it is not delivering overvoltage. I checked this once when I recapped the power supply but it may have gone out of spec since then.


ASSY 650281-001
J1
J4

I am also planning to add a CompactFlash adapter that Norberto Collado designed.