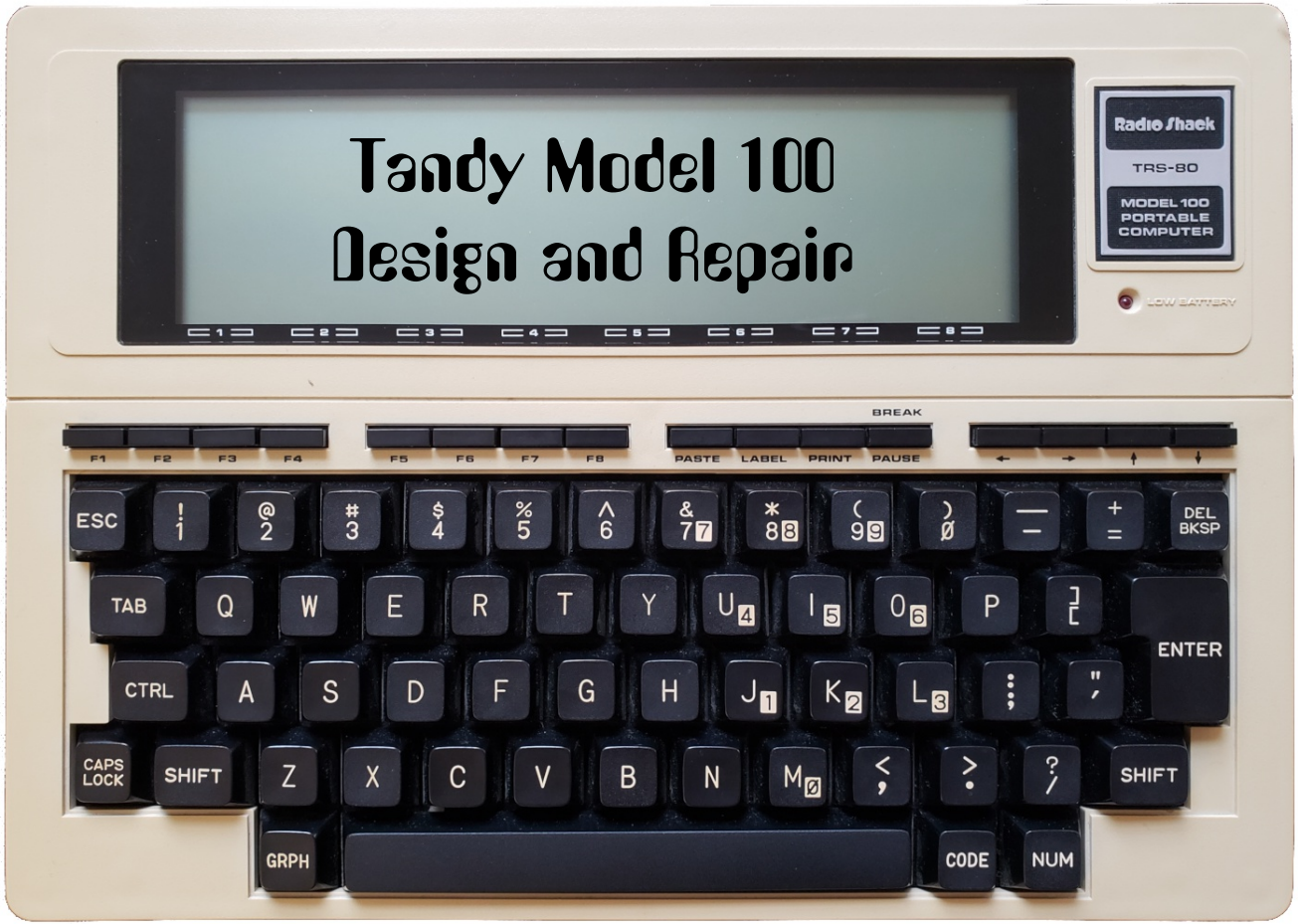

Josh Malone (@48kRAM)

Tandy Assembly 2019

Credits and Thanks

Thanks to all the members of the Club 100 list who have helped me over the years, including John Hogerhuis, Ken Pettit, Stephen Adolph, Brian White

Special thanks to Randy Kindig, Charles Peklenk and Comet <Com3t@Yahoo.Com> for reviewing these slides

Background

- Released in 1983 as the “TRS-80 Model 100 Portable Computer”
  - No architecture similarities to other TRS-80s
- Later advertised as the “Micro Executive Workstation”

Tandy Assembly 2019

Background

- Designed by Kyocera of Japan
- Sold as Kyotronic-85
- Licensed to other OEMs
  - Tandy
  - NEC
  - Olivetti

Variants

- NEC PC 8201a/8300
  - Highly expandable
  - Multi-bank RAM (int. and sidecar)
  - X-modem file transfer

- Olivetti M10
  - Flip-up screen
  - European or US keyboard

Images courtesy oldcomputers.net

Variants

- Tandy 102
  - Thinner, lighter
  - Cost-reduced (SMT)

- Tandy 200
  - Clamshell form-factor
  - 16-line screen
  - MS Multiplan in ROM
  - 3 banks of 24k RAM

Images courtesy oldcomputers.net

Background

- Operating system and built-in applications produced by Microsoft
  - Last major project written largely by Bill Gates himself
- Built-in applications:
  - BASIC - Microsoft floating-point Basic
  - TEXT - Text editor
  - TELCOM - Modem communication program
  - ADDRSS, SCHEDL - Address book and schedule programs based on text files

Menu

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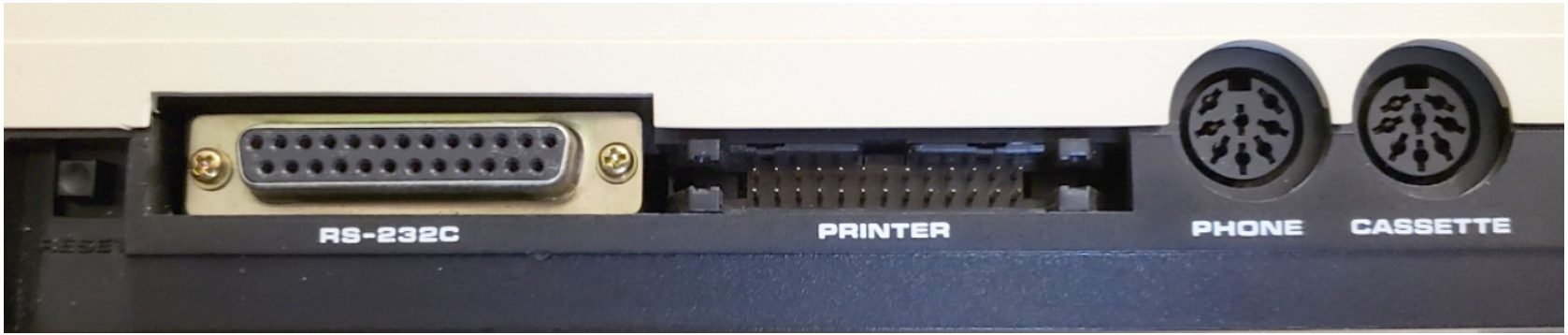
Connectors

- Serial (RS-232)
- Printer
- Cassette
- Phone (300 baud modem)

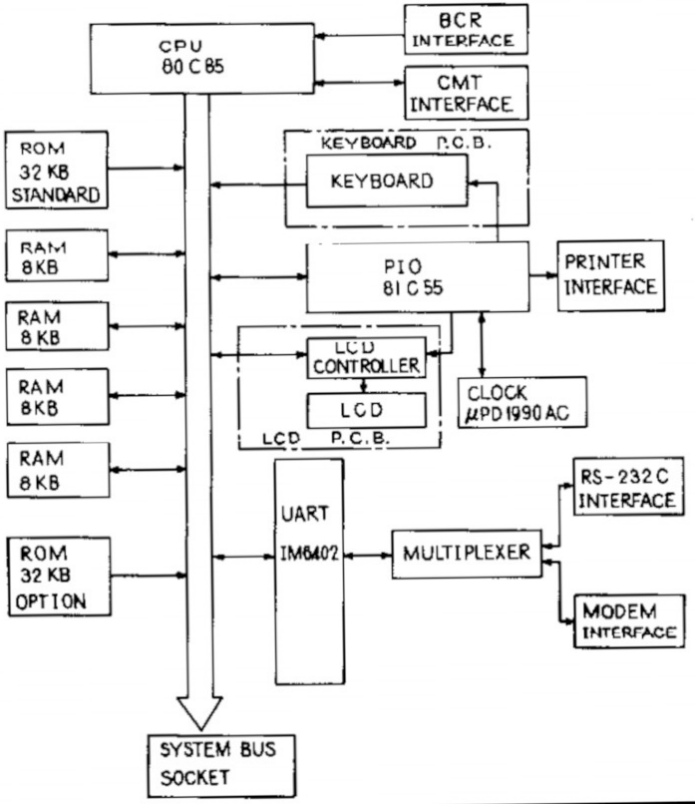


Connectors

- Bar-code reader
- Power (DC coaxial)

Architecture

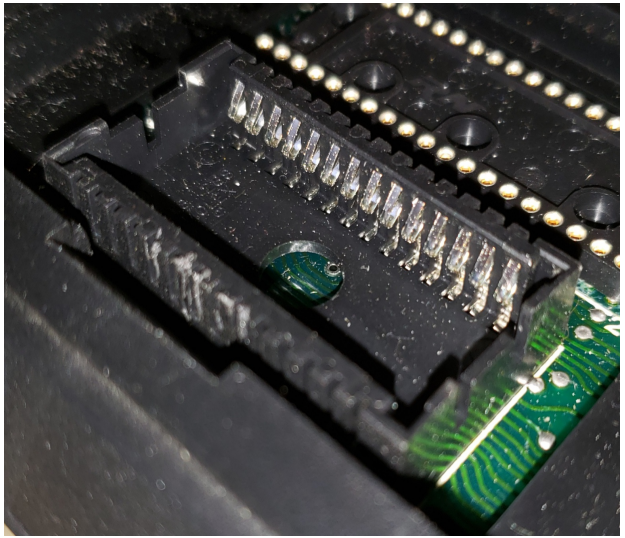
- Intel 80C85 CPU / 2.4MHz
  - 8080 but less support chips
  - Full CMOS - drew ~10mA
  - Multiplexed ADDR / DATA bus
- 32kB RAM / 32 kB ROM
- Bank-switched option ROM
- 8-line x 40-char LCD display
  - With graphic mode
- RS-232, 300bps modem, BCR



Option ROM

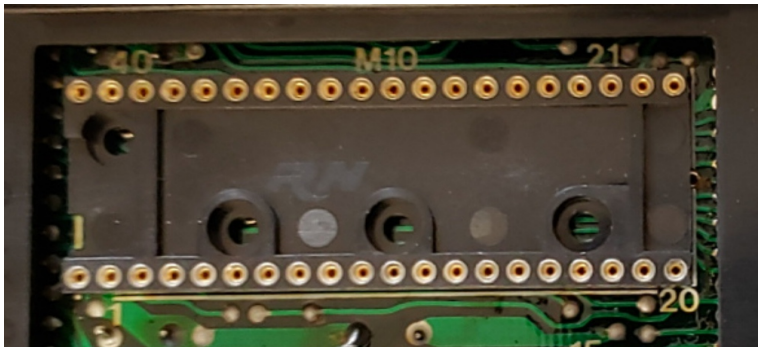
- Socket for optional ROM expansion was available under a “trap door” in the bottom case
- Option ROM allowed installation of additional software

-Multiplan (spreadsheet)
-Better word processors
-Financial packages
-Disk OS systems
-Forth
-BASIC tools



System Bus Connector

- The raw system bus was available on a DIP-40 connector behind trap door
  - 102 replaced this with 40-pin IDC connector
- Used by the Disk-Video Interface (DVI)
  - Gave one or two 5.25” floppy drives
  - Composite video
  - 80-column text



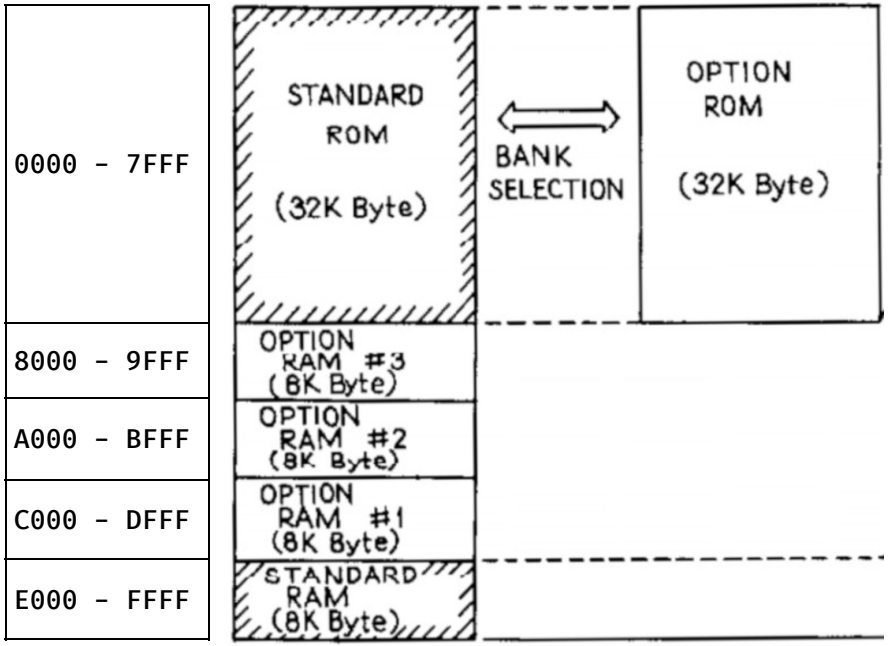
Power supply

- Powered by 4 AA batteries (16-20 hour runtime)
- External 6-volt “wall wart”
  - DC jack is ***center negative***
- Internal memory backup battery
  - 3.6v NiCd gives ~14 days memory backup
  - Recharged from AA or DC supply
- Internal switching PSU provides +5v, -5v
  - Allowed AA cells run down to ~1.2V or below
  - Software power control

On-board Peripherals

- 81C55 PIO
  - Printer, Keyboard, LCD, RTC, Buzzer
- Intersil 6402 UART
  - Shared to drive modem and RS-232 port
  - Rates up to 19200 in BASIC/TELCOM
- Bar-code Reader
- LCD display
  - Driven by ten Hitachi HD44102 driver ICs
  - Each driver controls ~50x32 area of screen

Memory / Address Space



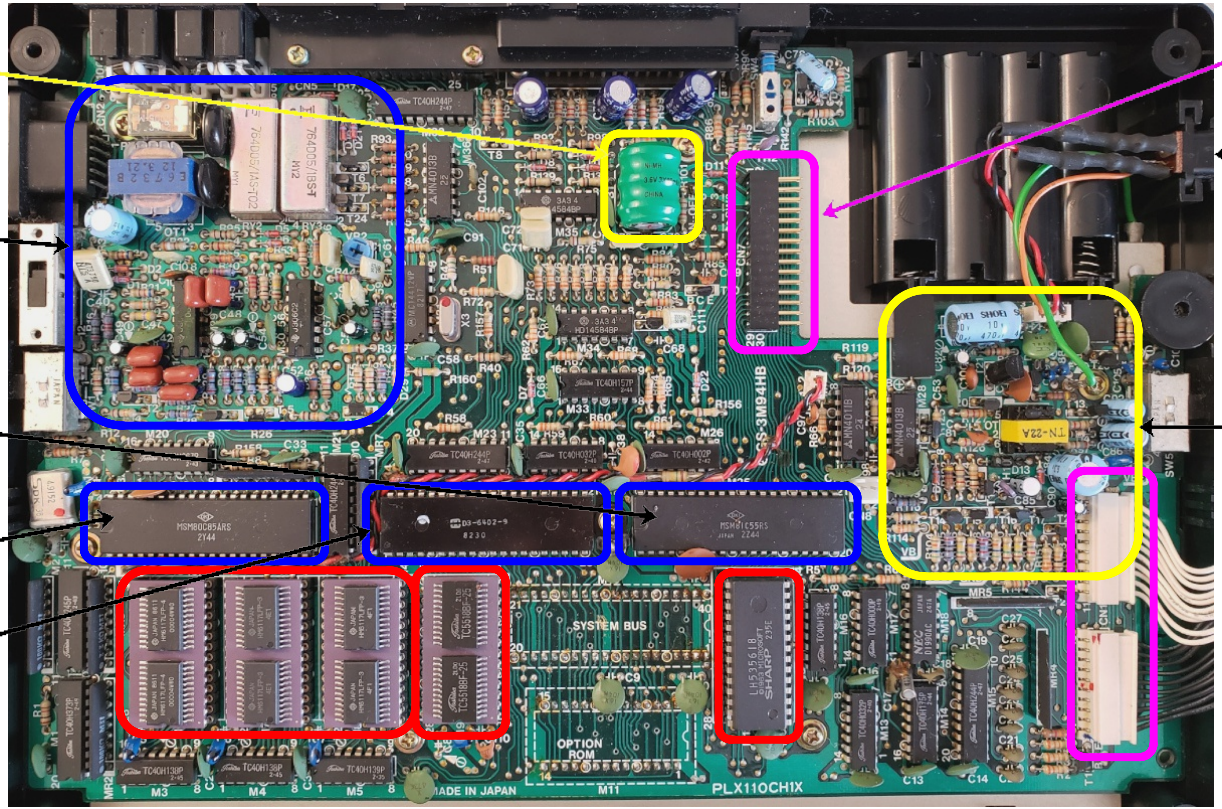
- Original units shipped with 8K, so all other RAM was optional
- Option ROM banked with main OS ROM
  - All one bank
  - BASIC / ROM apps can't directly access OPTROM

Memory Map

- Different types of files are stored in different regions of memory
- System Variables include pointers to region starts
- Regions get resized by OS as needed

Lower RAM (E000 to 8000)	BA Files
	DO Files
	CO Files
	BASIC Variables
	BASIC Arrays
	Free
	Stack
	User Programs
Upper RAM (FFFF)	System Variables

PCB Overview



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Failure Modes

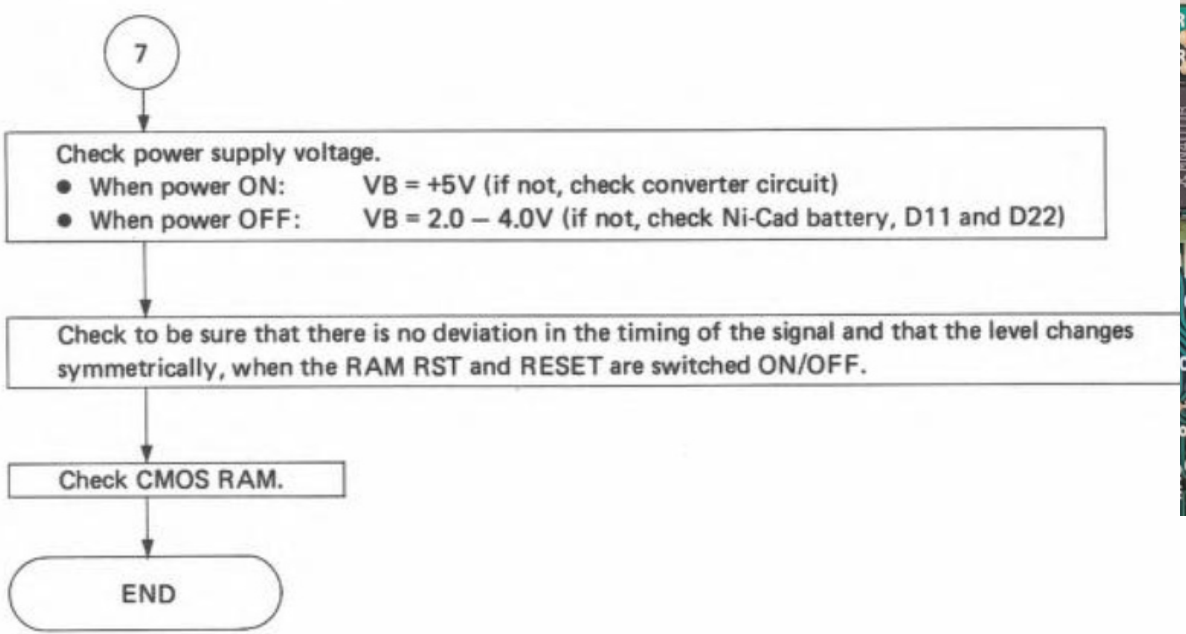
(and what to do about them)

Service Manuals

- Tandy created some EXCELLENT service and technical manuals for the M100 line
  - Theory of operation for all subsystems
  - Troubleshooting flowcharts
  - Schematics, timing diagrams, etc.
- Available online, but beware of bad scans
  - https://archive.org/details/TandyM100ServiceManual

Service Manuals

7. Memory protection doesn't function



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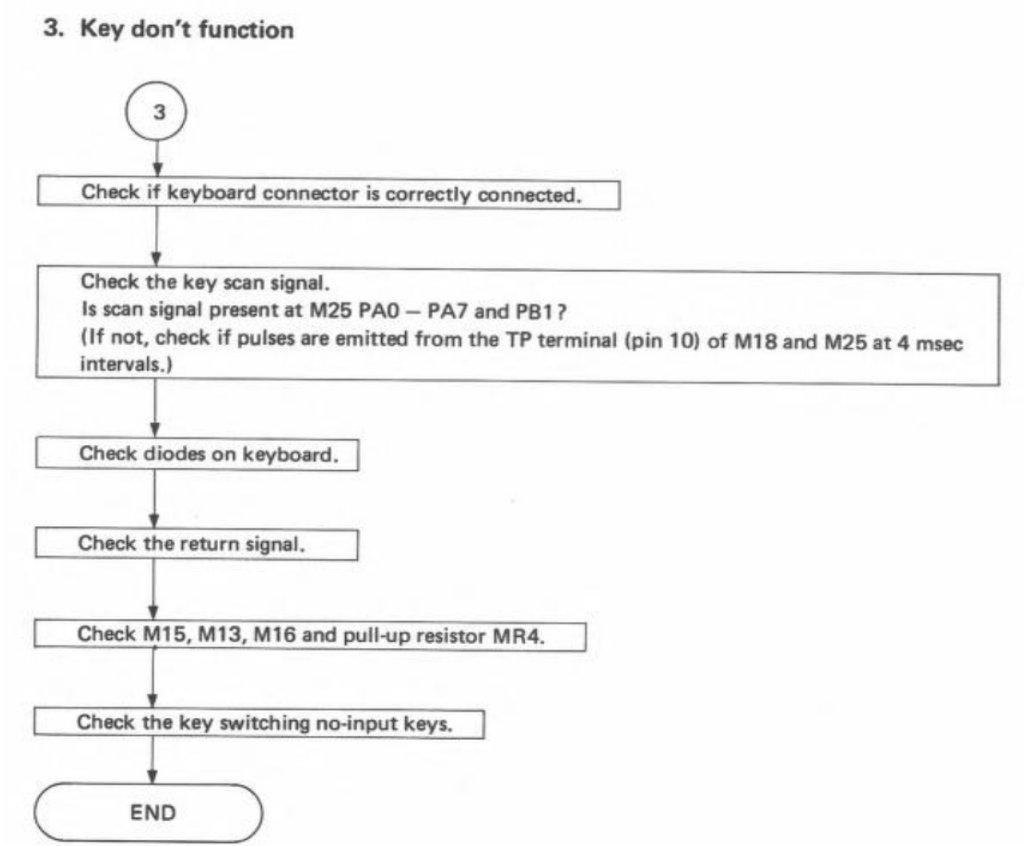
Service Manuals



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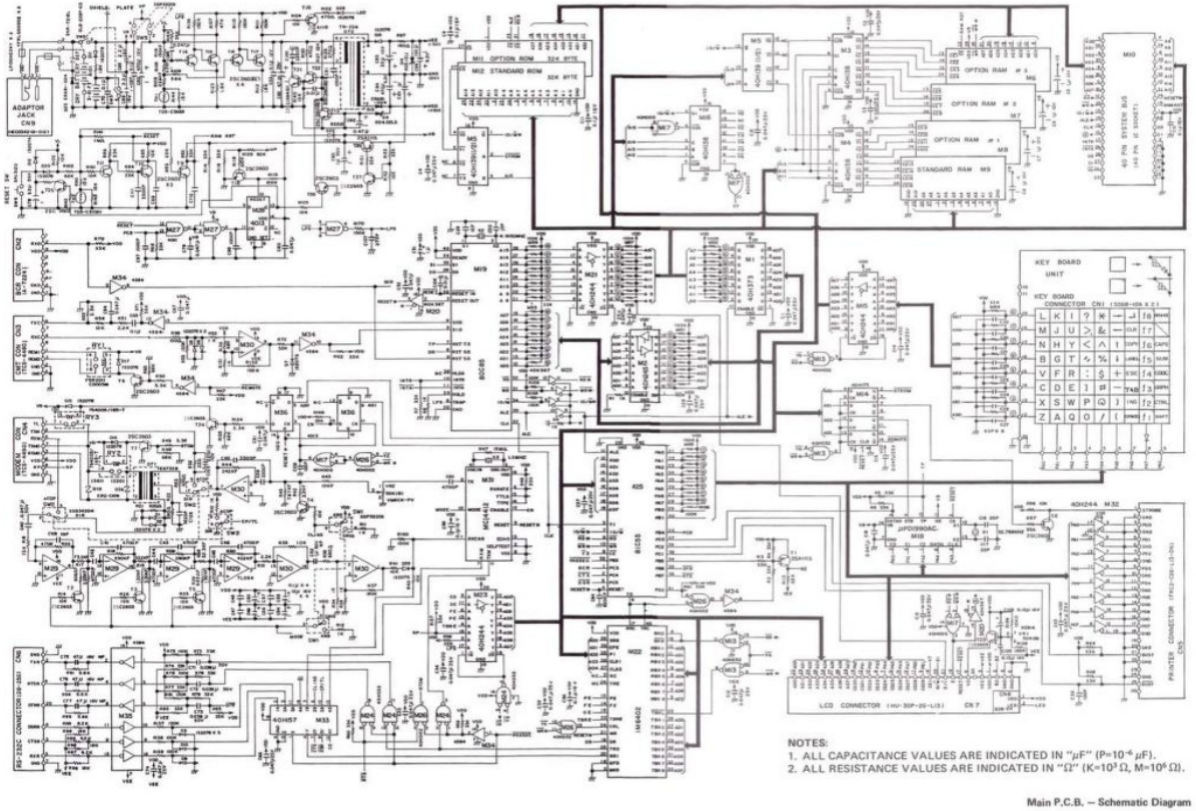
Service Manuals



Main P.C.B. — Schematic Diagram

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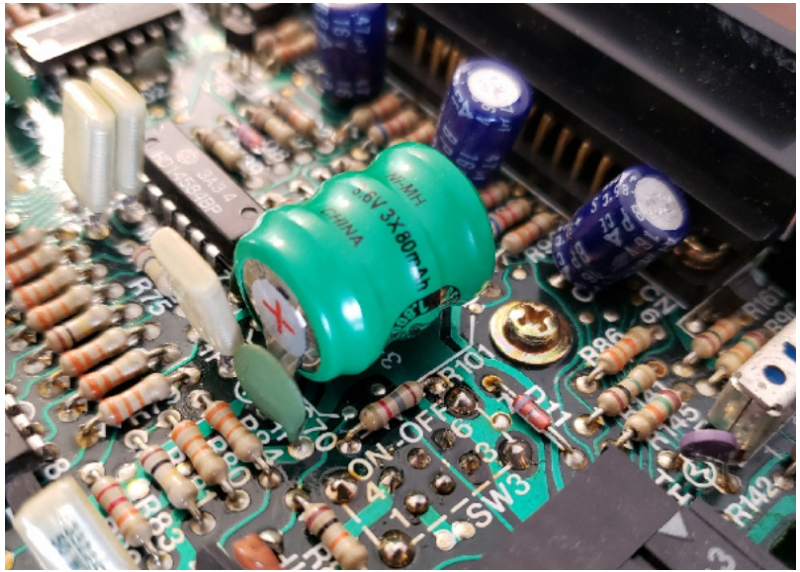
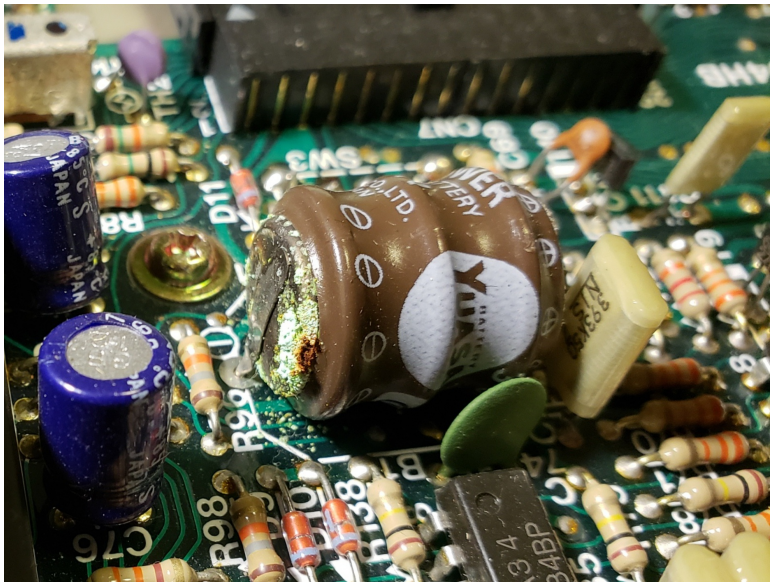
Memory Backup Battery

- Absolute #1 thing to worry about in Kyo slab!
- It should look like this:



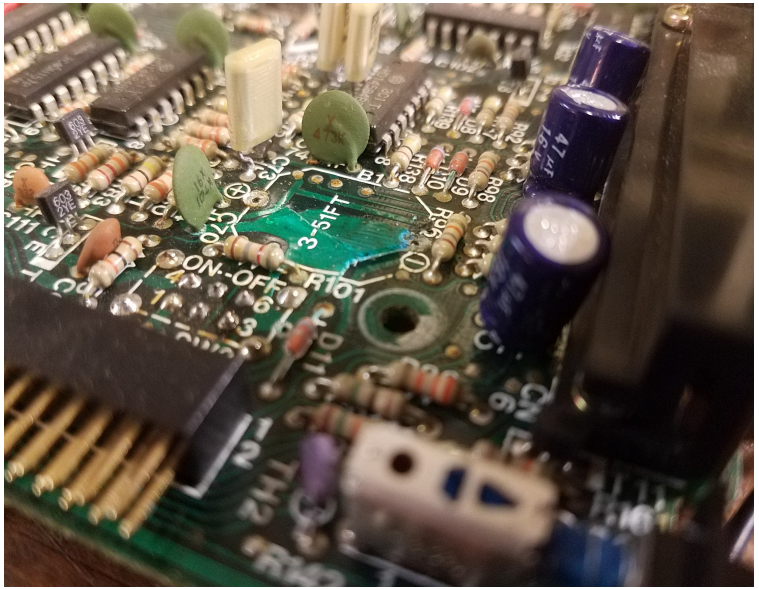
Memory Backup Battery

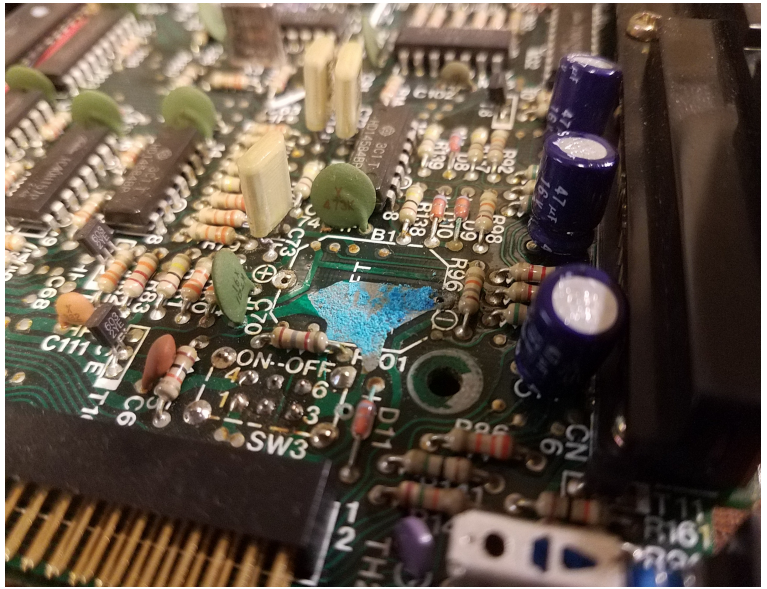
- Absolute #1 thing to worry about in Kyo slab!
- It often looks like this:



Battery Leak Damage

- Battery leakage can spread to other components and even get under the solder mask



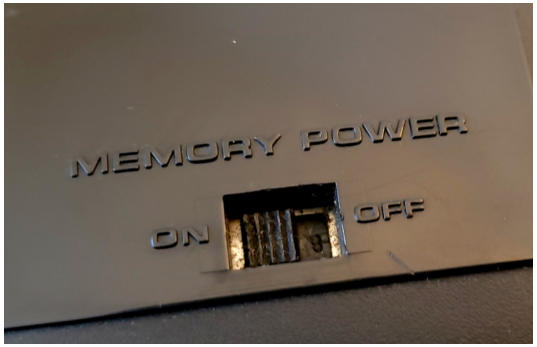


Repairing Battery Damage

- Battery leakage is actually alkali
  - Clean with a mild acid
    - Lemon juice, or white vinegar - diluted 50%
    - Duracell recommends “one tablespoon of boric acid in one gallon of water”
- Replace corroded components
- Repair corroded traces with jumper wires
  - 30-gauge “Kynar” wire
- Final wash with distilled water or 99% isopropanol

Other Memory Power Issues

- The “Memory Power” switch must be On or the system will not boot.
  - Dirty or faulty mem power switch will prevent the system booting.
  - Clean w/ alcohol or DeOxIt D5



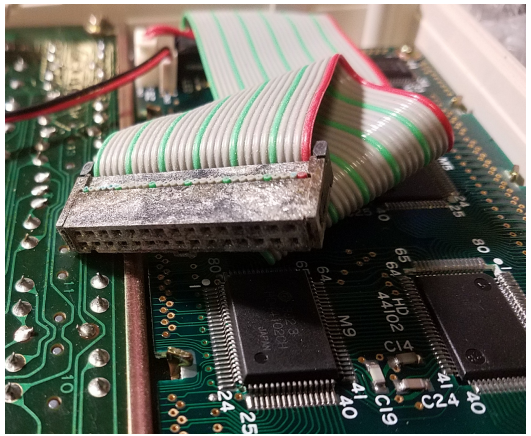
- Discharged memory battery can prevent boot-up
  - Charge memory batt. overnight on AA or ext. power
    - Memory Power switch must be on

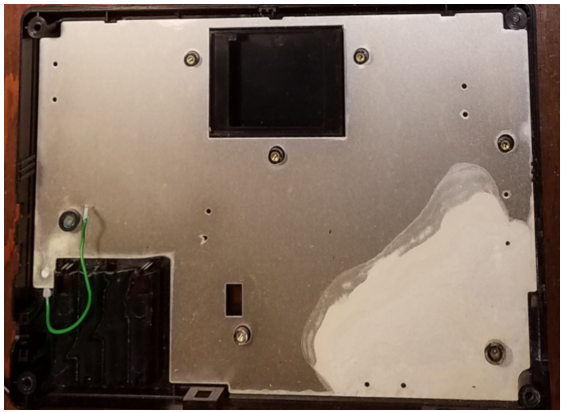
Memory Battery Alternatives

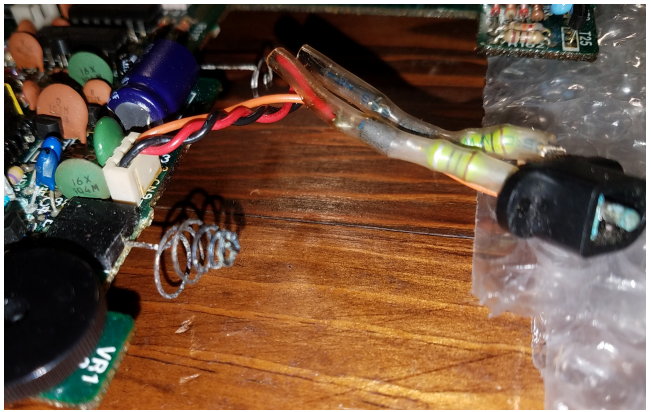
- Supercap
  - Can cause issues with power-down circuit
  - Can still leak under the right circumstances
- No memory backup at all
  - You can run a Tandy 100/102/200 without the memory battery installed.
  - Be sure to backup your data regularly (get a REX ☺)
  - Memory power rail no longer regulated properly - watch out for over-voltage external DC supplies

Primary Battery Leakage

- Clean and repair as before. Or throw it out and buy a new one!







Power Issues

- Internal switching power supply is prone to failure
  - Discrete component oscillator has multiple transistors, diodes, capacitors, etc. than can fail from rough handling, corrosion, or just life span (esp. *C82* and *C85*)
  - “Shotgun” replace all electrolytic caps in P.S. section
- Check service manual diagnostic flowchart for specific components to test / replace
- You will need an oscilloscope or freq counter to check crystal and PSU oscillation

RAM Issues

- M100 auto-detects installed RAM size
  - Tests first 256 bytes of each 8kB RAM chuck
  - Double: Read / complement / write
  - Save lowest RAM address to system variable
- A failed RAM module will prevent detection of modules “below” it.

RAM Issues

- Memory power rail
  - Memory power provided by V_B
  - V_B is ~0.4V less than battery voltage
  - Failed memory battery can drag V_B even on AC power
- Decoder circuit
- RAM modules
- BASIC RAM test - RAMTST.BA

LCD Problems

- LCD problems break down into three major categories
  - No image, or contrast issues
  - Columns or rows out
  - Sections out

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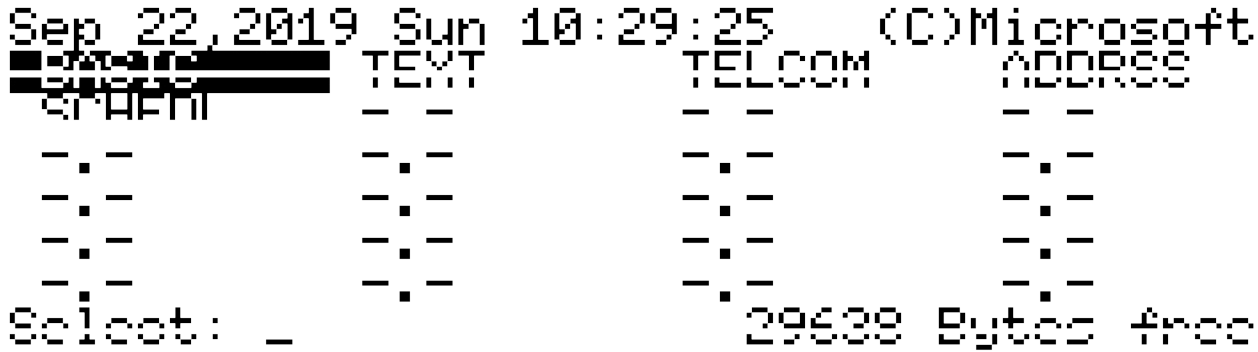

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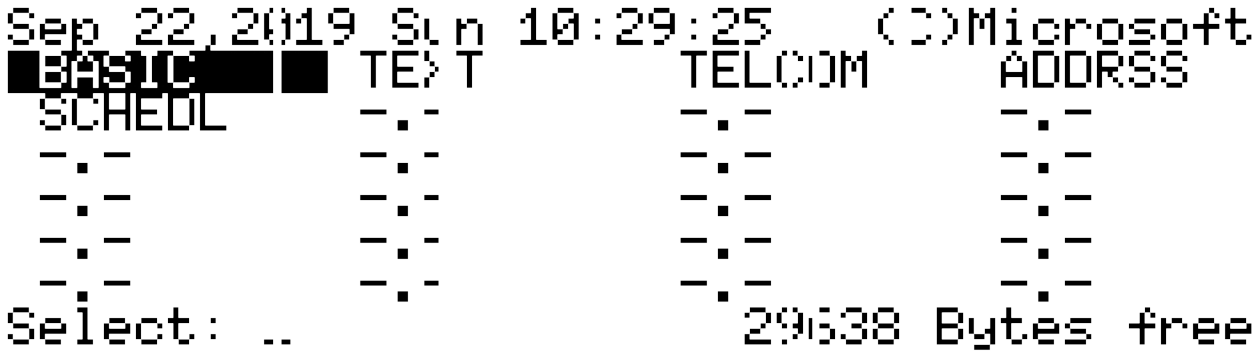

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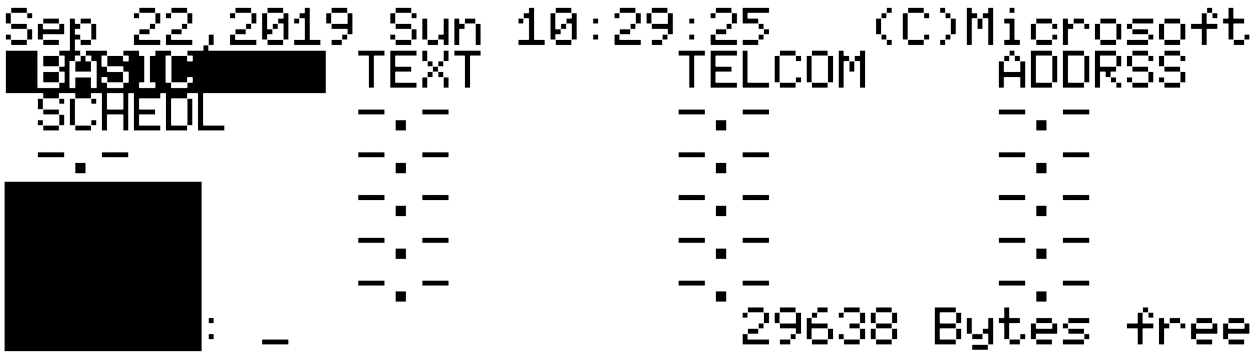


LCD Problems

- No image, or contrast issues
  - LCD requires -5V VEE rail
    - Poor contrast voltage swing can indicate poor VEE
  - Refer to power supply diagnosis
  - Check ribbon cable and connectors
  - LCD contrast (viewing angle) pot can get too dirty to provide proper contrast voltage.
    - Voltage should swing from ~0.5V to ~4V (LCD *C3*)

LCD Problems

- Lines or rows out
  - Caused by connection issues to LCD glass
  - Cleaning may help, but use solvents sparingly
  - Failed elastomeric connector
    - A.k.a Zebra strip
    - Can we find someone to maufacture new Zebra strips?

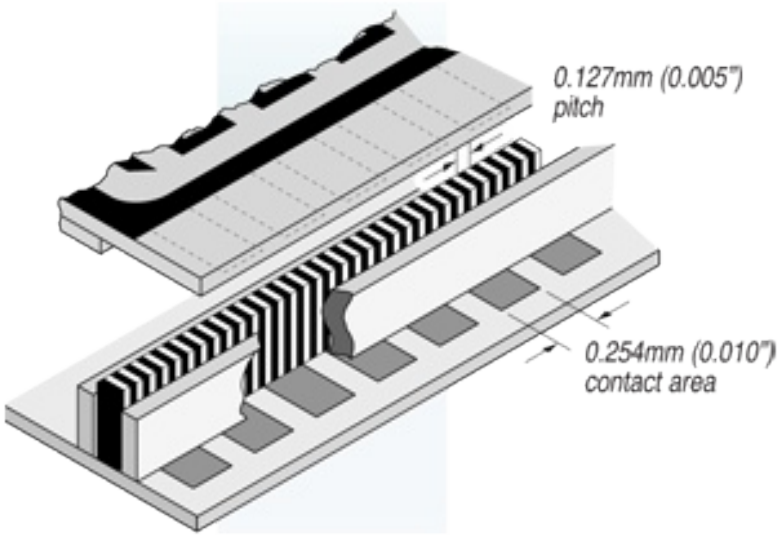


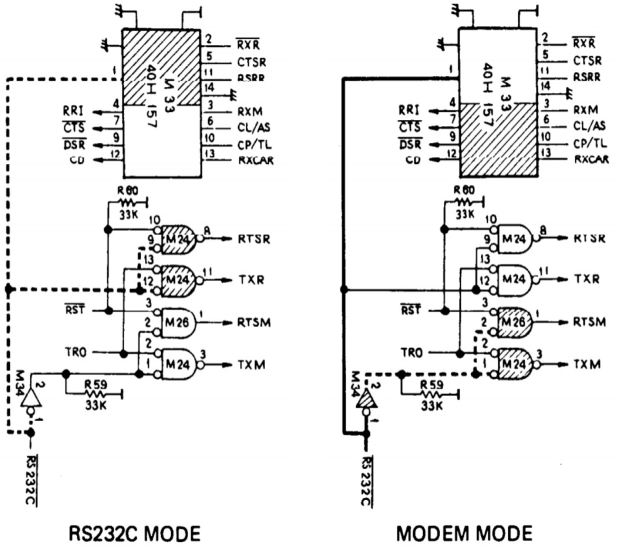
Image from fujipoly.com

LCD Problems

- Sections out
  - A black or non-present rectangular section indicates failure of one of the HD44102 LCD driver ICs
  - Do ***NOT*** remove failed chips from a good LCD module using hot air; cut out failed chip and drag off legs with a hot iron and bevel tip

Serial Comm Failures

- 6402 UART feeds both RS-232 and modem
  - Cassette is not fed by UART
  - If problem only occurs on RS-232 or modem, but not both, check switching circuit
  - Otherwise, check UART
  - For modem-only issues, check phone line transformer OT1



Keyboard Issues

- Keyboard is driven by 8155 PIO
- Check connections to board
- Individual key failure
  - Mechanical? Check with ohm meter
  - Failed diode on keyboard PCB
- Cracked traces
  - Esp. if PCB support between PIO and UART is missing

Field Diagnosis

Quick-and-dirty assessment techniques

Initial Inspection

- Check for corrosion
  - Battery compartment and DC power jack
- Install AA batteries
- Turn on memory power switch
- Turn on main power switch
- Check for power-on / boot

Initial Inspection

- If it shows any signs of life:
- Perform cold-start (<Ctrl>+<Break>+<Reset>)
- Check reported “Bytes free”
- Test functionality of MENU, BASIC and TEXT
- Test soft-power circuit
  - Start BASIC and type “POWER OFF<Enter>”

Garbage In Memory

- Memory is corrupt but no hardware faults
- Can indicate no faults or memory problems
  - Corrupt RAM can be result of software crash
  - Failing VB or memory battery can corrupt RAM
  - Further diagnosis needed but often system is fine
- Screen garbled, MENU not responsive, etc.
  - Power on
  - Cold-start system (<Ctrl>+<Break>+<Reset>)
  - Look for functional menu, working BASIC, etc.

Running Blind

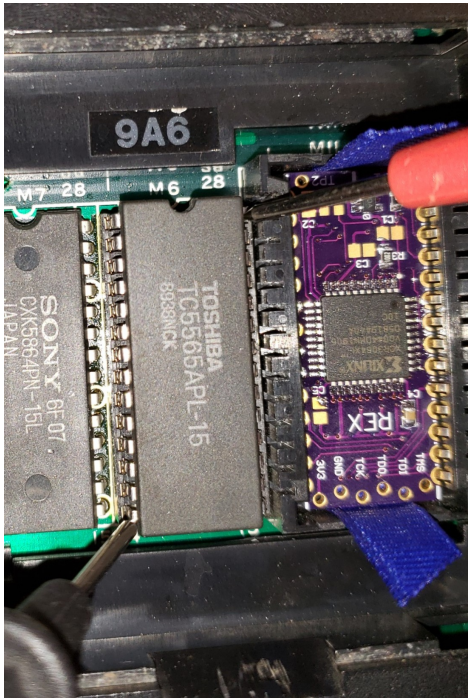
- System is mostly functional, but LCD out
  - Power on
  - Cold-start system (<Ctrl>+<Break>+<Reset>)
  - <Enter>
  - <B><E><E><P><Enter>
  - Listen for speaker beep to indicate running system
- Indicates: VEE supply, LCD connector

Failed DC Jack

- System runs only on external power, not on AAs
  - Install AAs
  - Switch power on - observe no activity
  - Connect external DC supply - observe system booting
- Indicates: DC power jack switch dirty or failed
  - DC power jack has a switch to select external or internal power source
  - Failure of this component can lead to AA supply not being connected to internal power supply

No Memory Power (102 only)

- Failed memory power rail
  - Open Option ROM trap door
  - Measure voltage across pins 14 and 28
  - Should read nominal for 3.6v NiCd
- Indicates dirty/failed memory power switch or failed memory battery



Thank you!

- Slides will be posted at www.vintageboot.net
- Twitter: @48kRAM
- www.club100.org