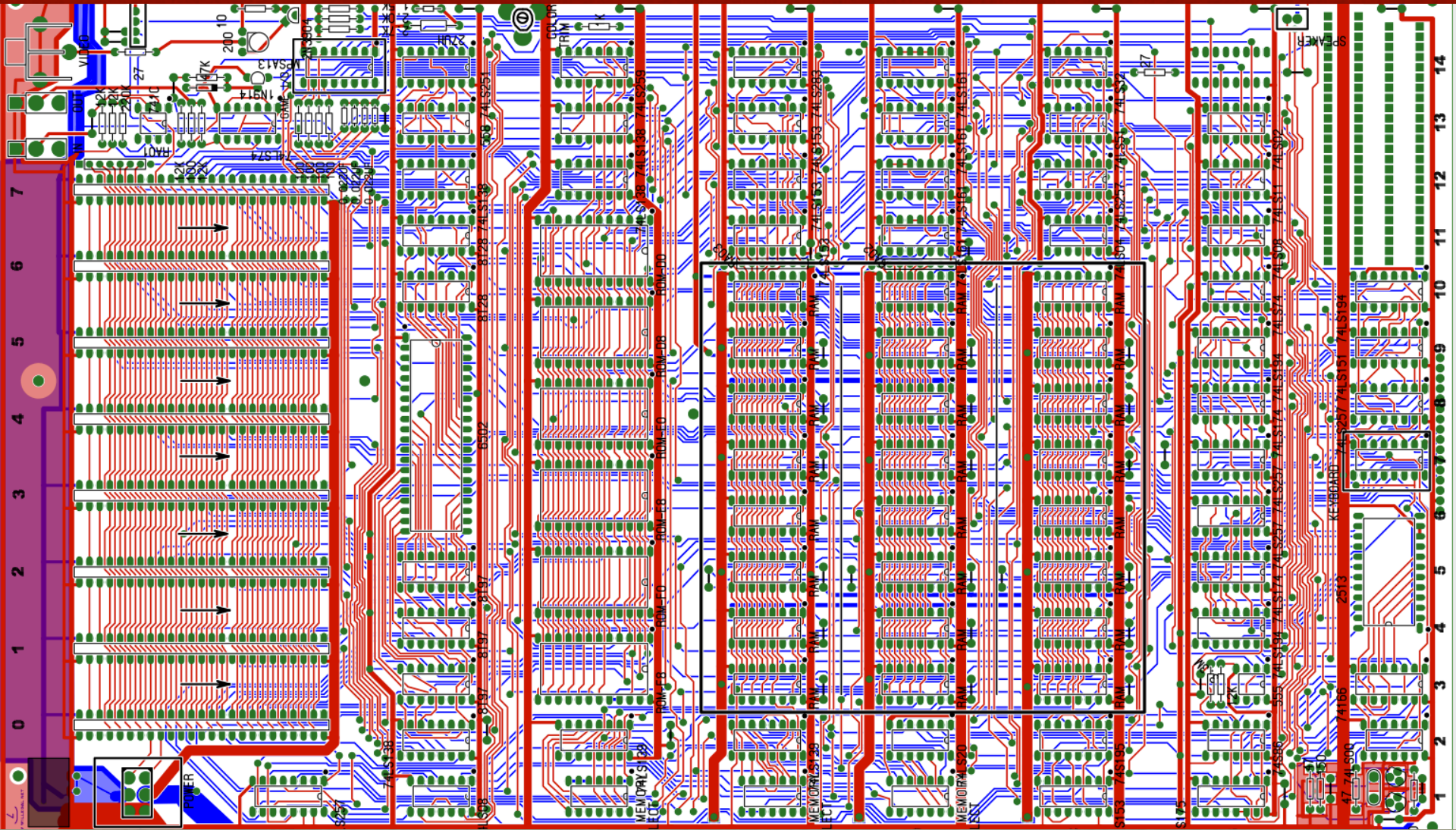


# APPLE II MAINTENANCE



# APPLE II MAINTENANCE

## INTRODUCTIONS

- Introductions
  - About Mike Willegal
  - Who are you?
- What systems
- What tools

# APPLE II MAINTENANCE OVERVIEW

- Cleaning
- Finding Vintage Components
- Maintenance
  - Enclosure
  - Motherboard
  - Power supply
  - Keyboard
  - Disk ][

# WHAT SYSTEMS

- Focus on Apple II/IIplus
- Some aspects applicable to IIe
- Less on IIc & IIGS
- Useful for other vintage micros and electronics

# WHAT TOOLS

- Screwdrivers
  - #1 phillips
  - #2 phillips
- Hex driver –motherboard nut
- Pliers - standoffs
- Chip extractor

# MORE TOOLS

- Multimeter
  - high impedance ohms function
- Soldering iron
  - temperature controlled tip
- Oscilloscope
  - minimum 2 probes
  - 100 MHZ or higher preferable
  - chip clips
  - leads with clips
- Schematics

# MORE TOOLS (CONT.)

- Contact Cement
- Paint Brush
- Solder
- Resin
- Cleaners
  - Isopropyl Alcohol
  - Gojo
  - Windex

# APPLE II/IIPLUS BASICS

- Base system made of up of
  - Enclosure – 3 piece plus speaker
  - Motherboard - 8.5”x14”
  - Power supply
  - Keyboard
  - Disk ][



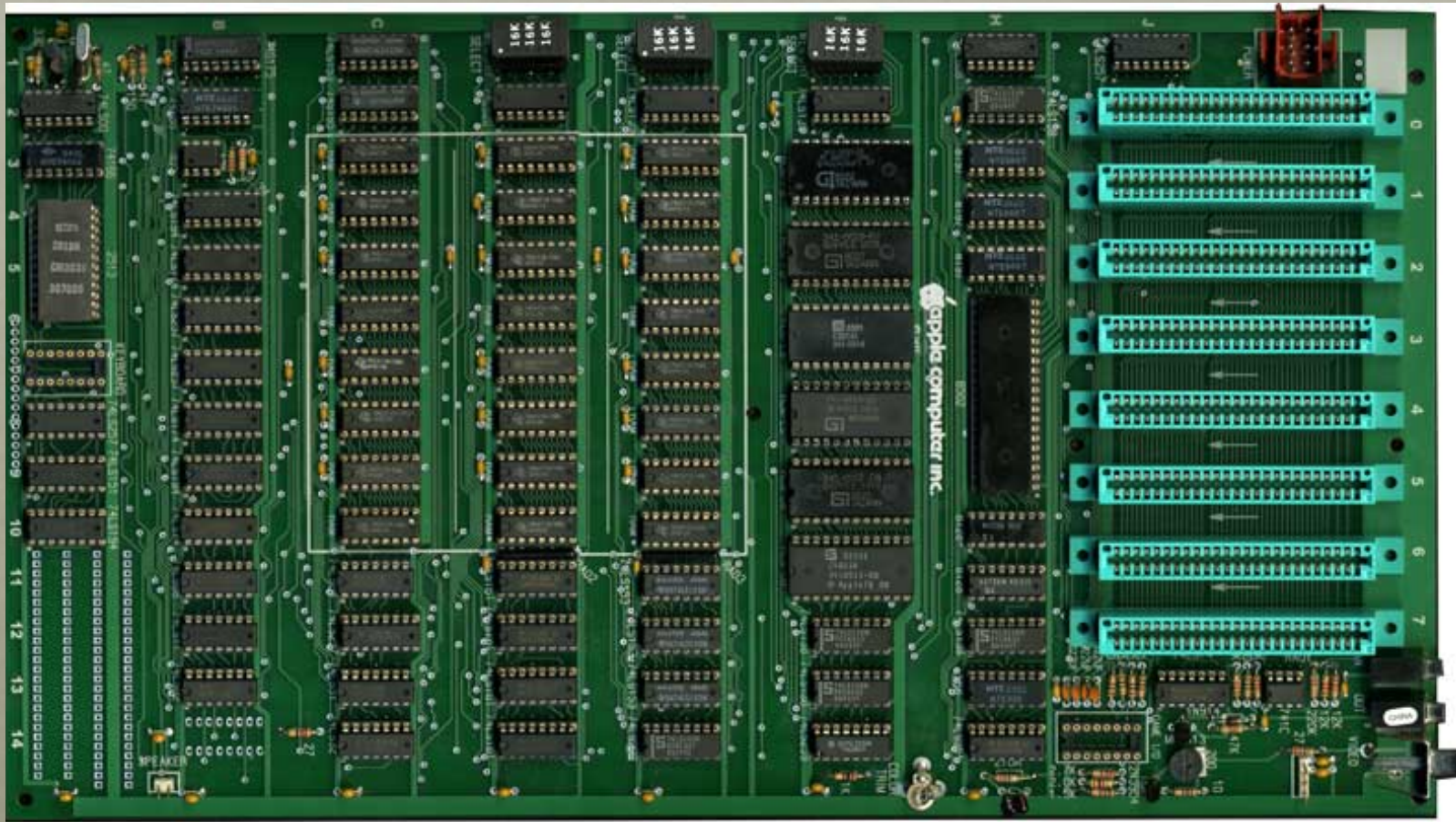
# CASE



# CASE MAINTENANCE

- Keep out of light
- Base held on with 10 Screws
- GoJo application followed by dishwasher (no soap) my preferred approach to dirt
- Holes can be repaired with Bondo
- Touch up paint manually matched
- Use contact cement to reattach headlock connectors or speaker

# MOTHERBOARD



# MOTHERBOARD CLEANING?

- If it works, don't fix it
- Cleaning
  - Static is a concern
  - Compressed air
  - Soft paint brush
  - Isopropyl alcohol & lint free cloth

# MOTHERBOARD REPAIRS

## PSEUDO-RANDOM CHIP SWAPPING

- Wear and tear on sockets
- Doesn't address non-IC issues
- Risk of introducing problems
- Apple service notes have guidelines about what causes typical faults

# MOTHERBOARD REPAIR

## REPAIR THROUGH DEBUG

- Check voltages
- Get video section working first
  - Work from output stage back toward DRAM
- Video working, but not booting
  - Work from CPU to memory, checking each bus signal
- Booting, but flakey
  - Memory or memory addressing likely culprit
  - Programmers PROM has memory test
  - Loadable memory tests are available (aptest)

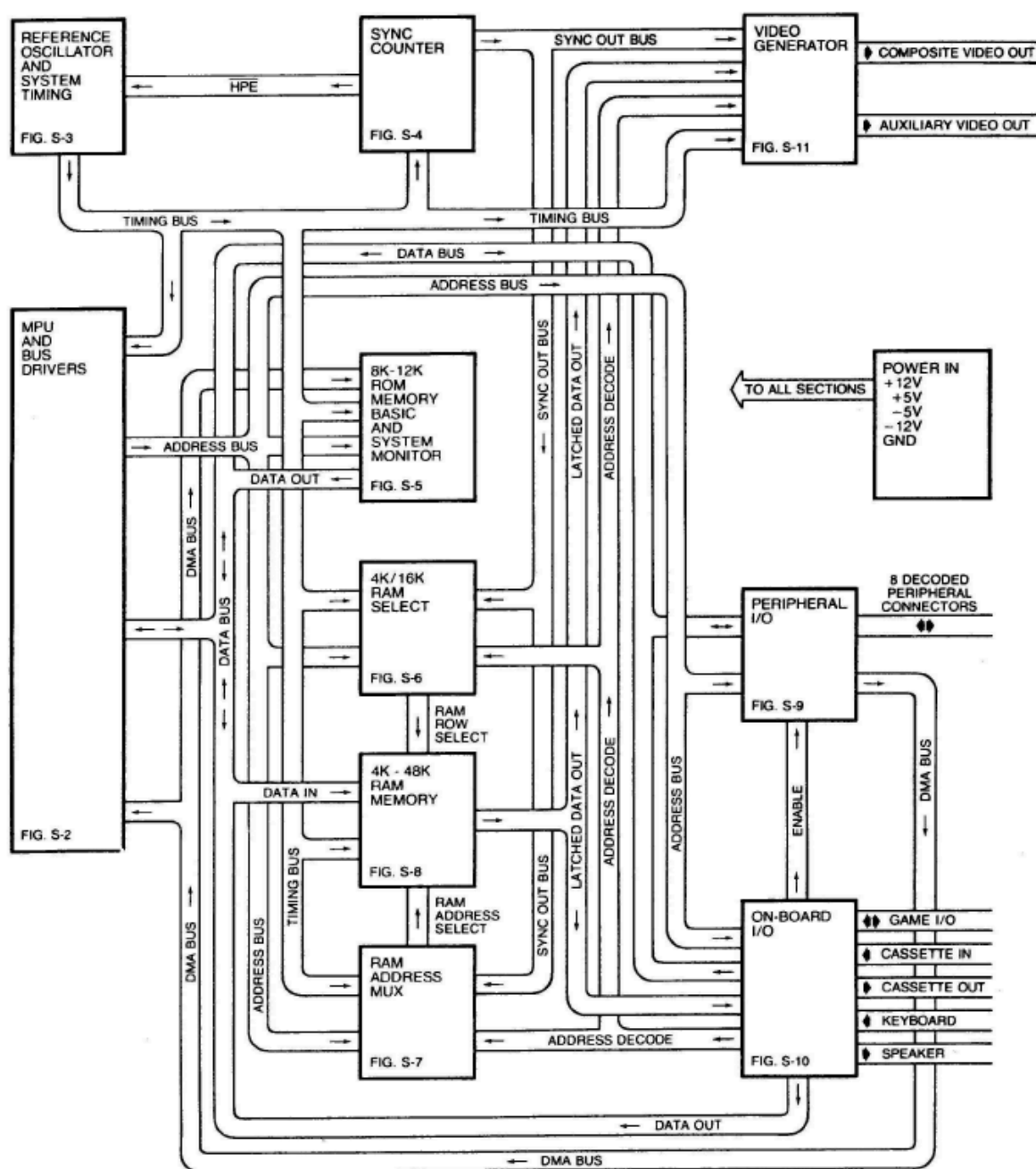


FIGURE S-1 APPLE II SYSTEM DIAGRAM

# MOTHERBOARD REPAIR

## COMPONENT EXTRACTION

- Two options
  - Use rework station
  - Cut up and remove 1 pin at a time.



# POWER SUPPLY



# POWER SUPPLY

- Know what you are doing
- On/Off switches are still obtainable
- Rivets
  - Drill out with 1/8" drill bit
  - Make sure any metal pieces are removed before reassembling
  - Replace with aluminum pop rivet

# KEYBOARD



# KEYBOARD

- Datanetics keyswitches
  - Restore
    - Add isopropyl alcohol with eyedropper
    - Work vigorously
    - Repeat
- MM5740/AAE encoder
  - Static sensitive
  - Expensive, if you can find them
  - Littlediode.com occasionally has them

# KEYBOARD

- Plugging in backwards
  - Will usually blow one of the 74LS04 inverters
  - Easy fix
- Worst case – I sell a kit to connect a PS/2 keyboard

# DISK II



# DISK II

- Speed
  - Remove cover
  - Run Aptest on scratch disk
    - Adjust 10 pot
- Head Cleaning
  - Remove cover
  - Isopropyl alcohol and lint free swab

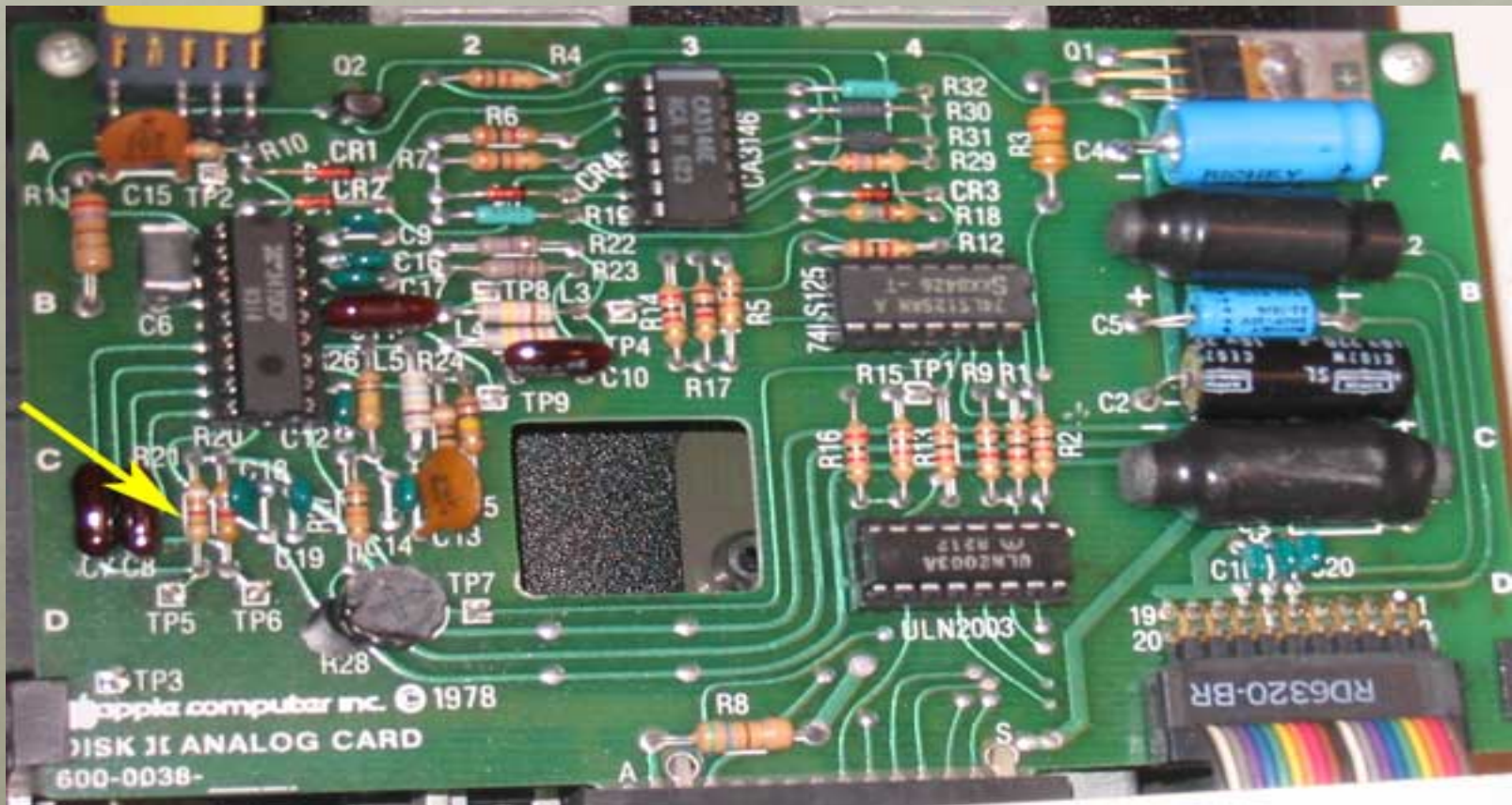
# DISK II

## ANCIENT CONTROLLERS

- The yellow arrow points to 9.1K resistor R-21 that controls a 2us delay between peak detection and read pulse output
- Later model drives, had this delay made adjustable by adding a 10k pot and reducing the value of the resistor to 7.2K
- Lift one leg of resistor and add 10K pot and adjust to 3us delay



# DISK II ANCIENT CONTROLLERS



- Lift one leg of resistor and add pot to adjust

# SCHEMATICS

- Red Book is presentation source
- Also found in
  - “Apple II Reference Manual”
  - “Understanding the Apple II”
- Be aware that HW changed as time went on

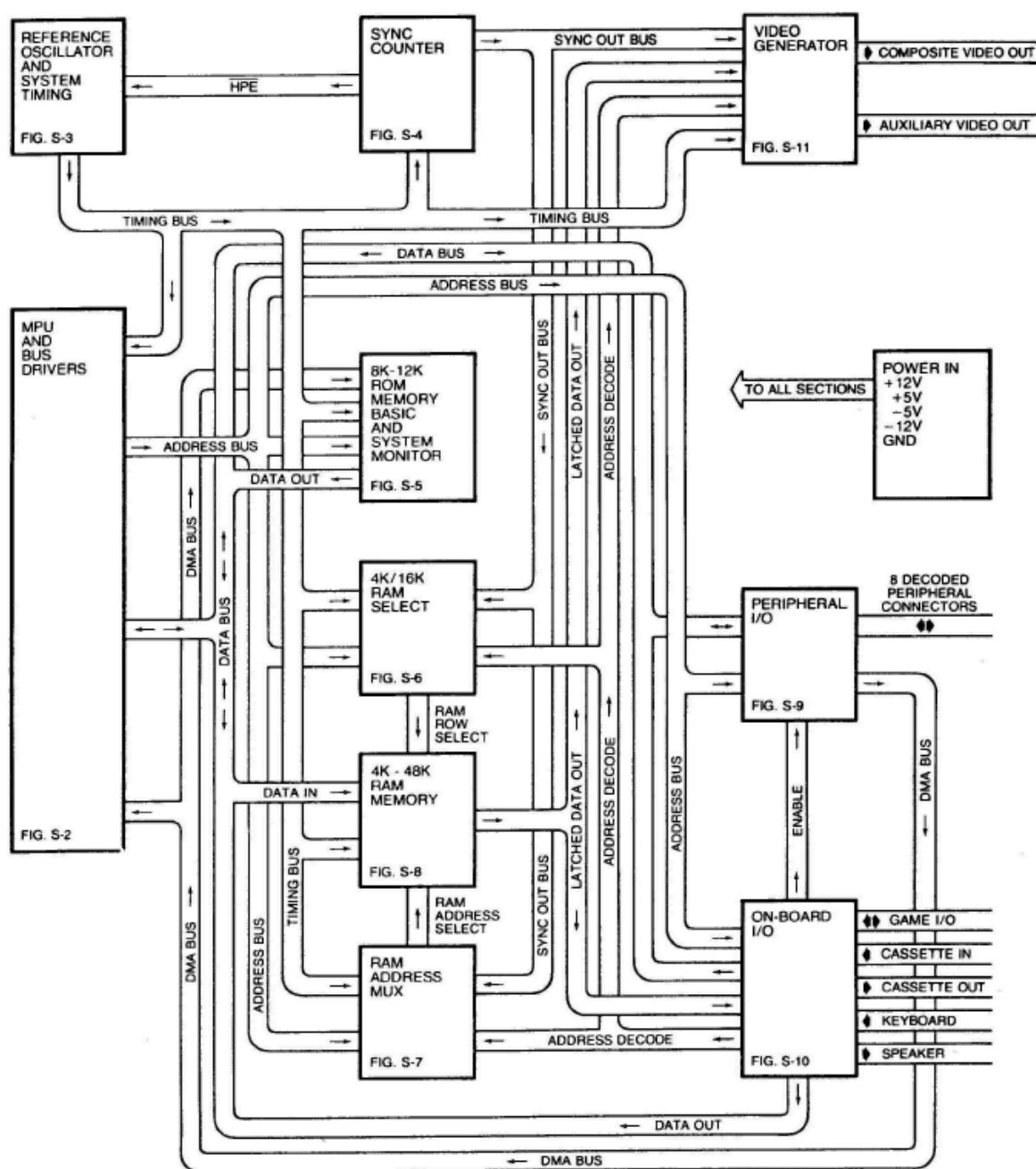


FIGURE S-1 APPLE II SYSTEM DIAGRAM

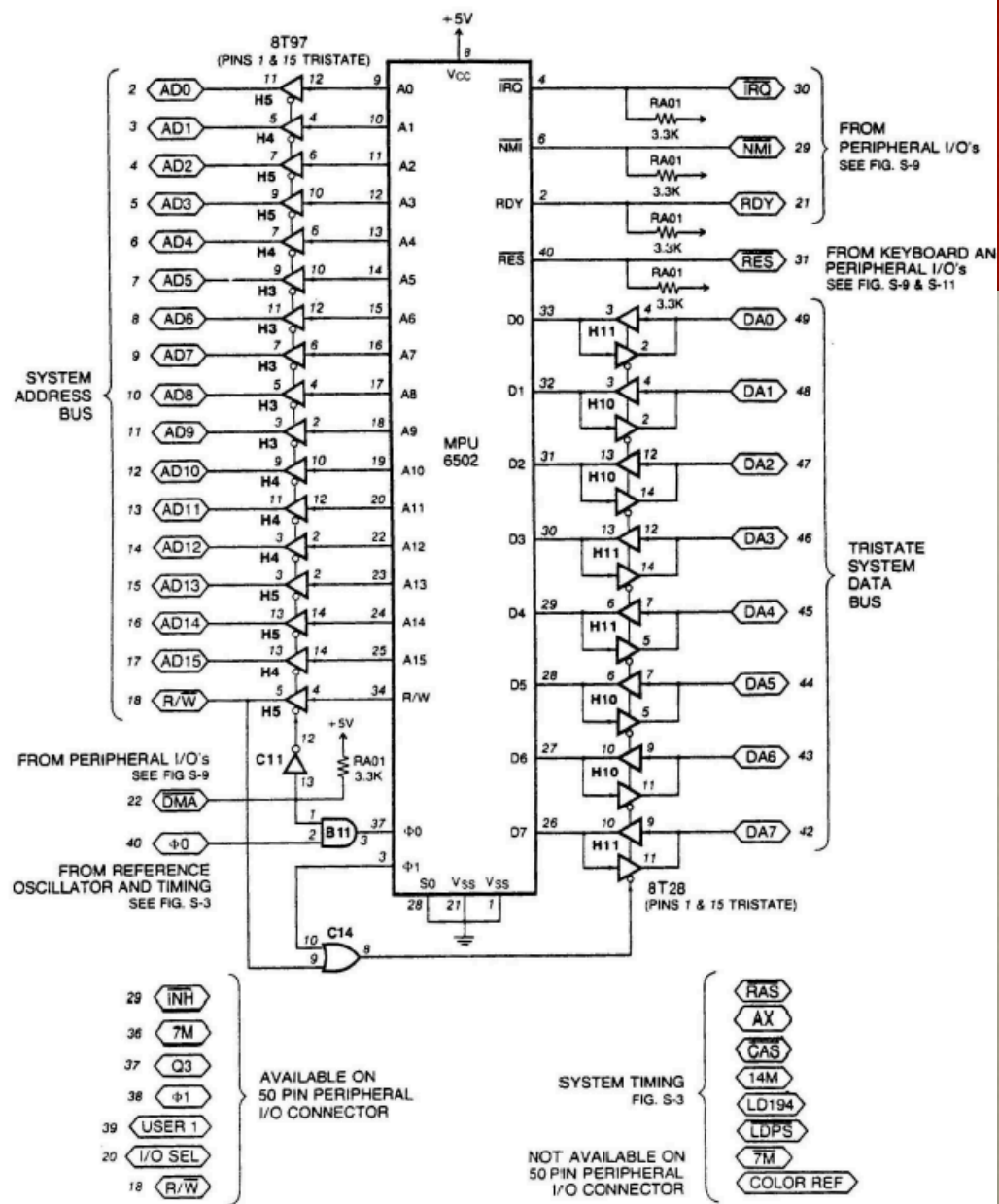


FIGURE S-2 MPU AND SYSTEM BUS

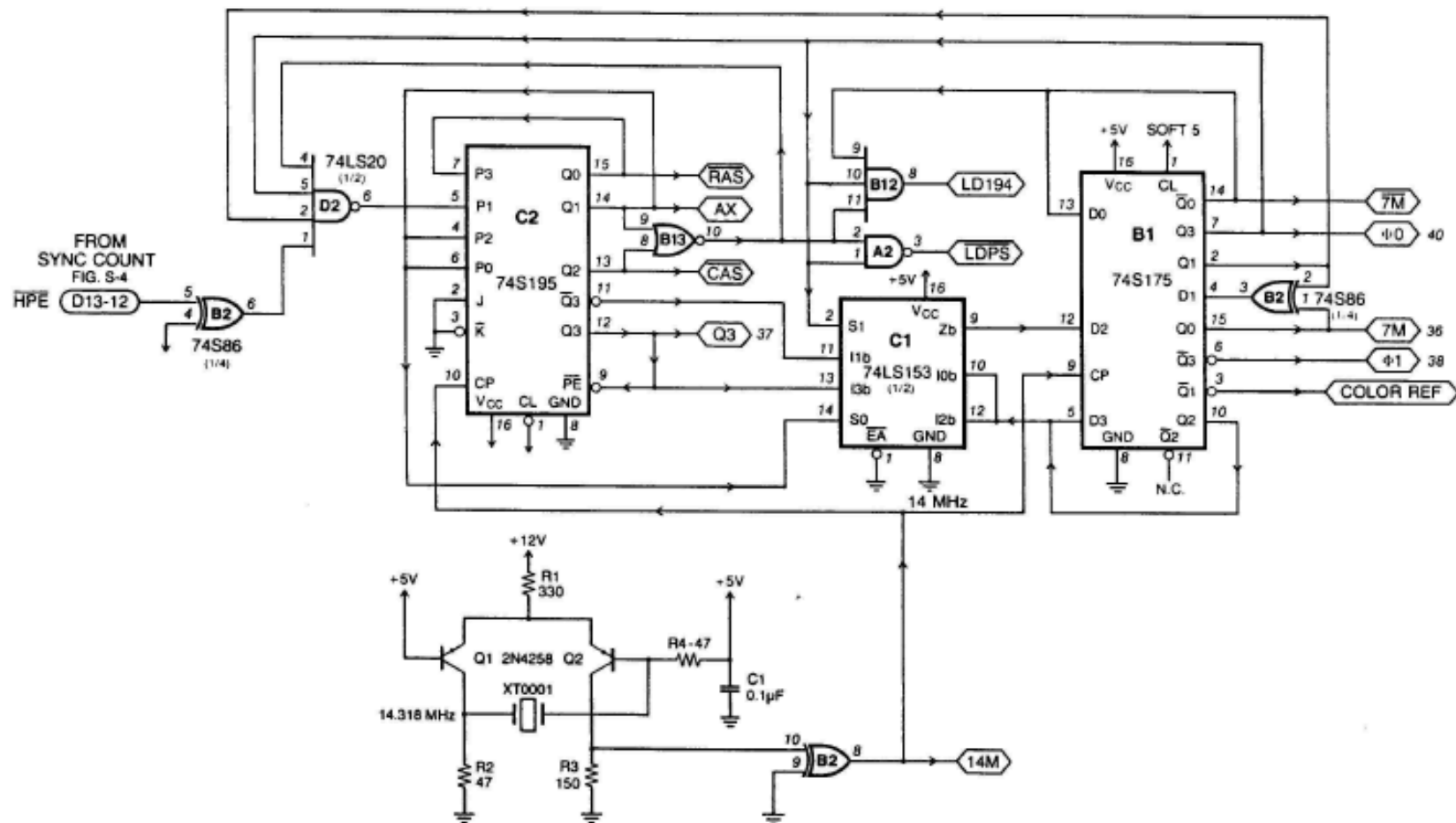


FIGURE S-3 REFERENCE OSCILLATOR AND SYSTEM TIMING

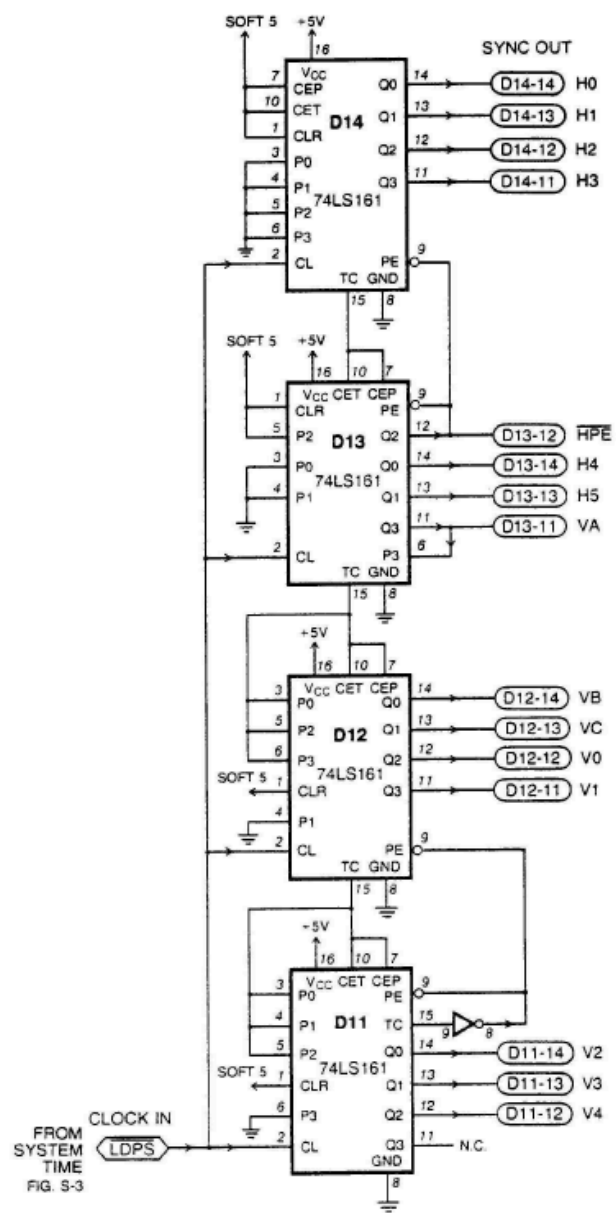


FIGURE S-4 SYNC COUNTER

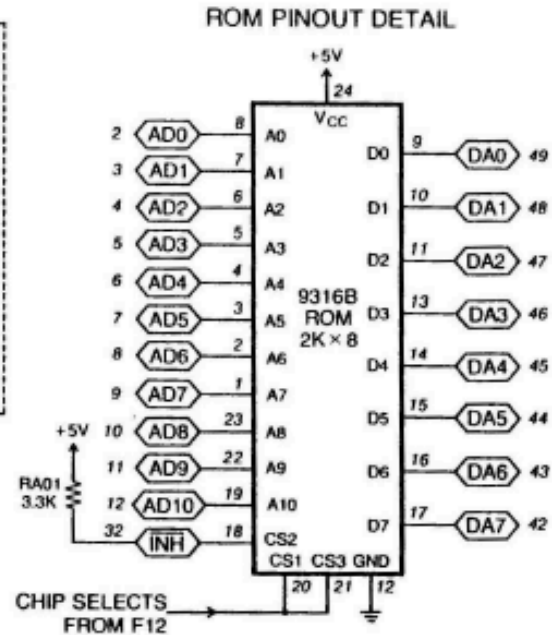
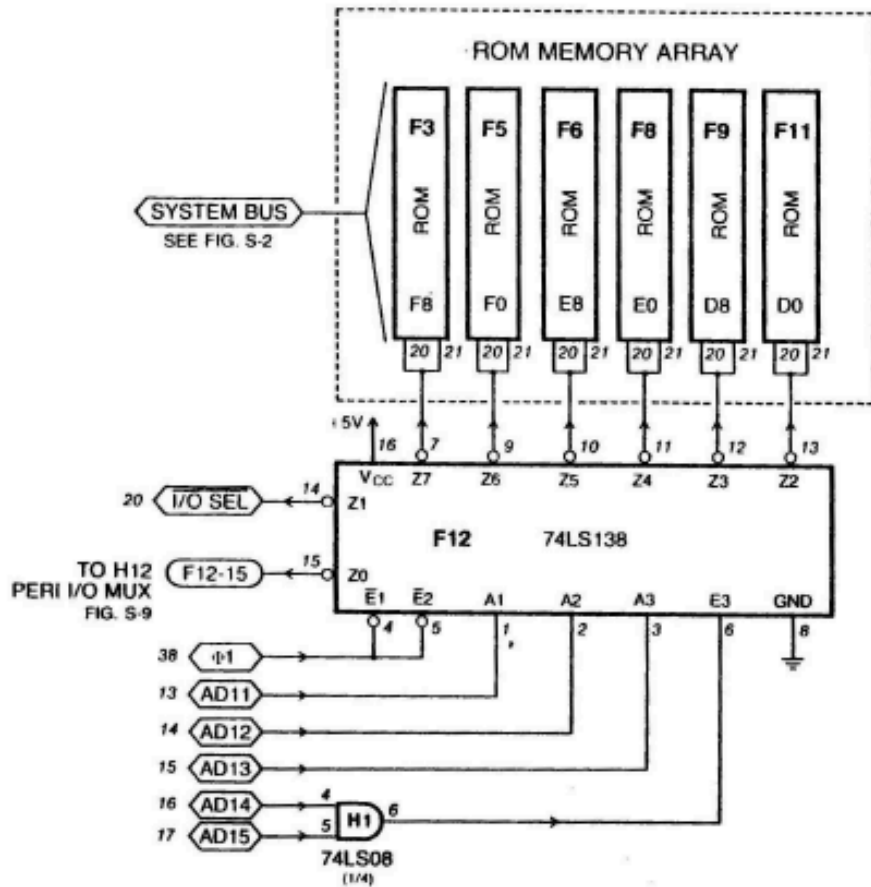


FIGURE S-5 ROM MEMORY

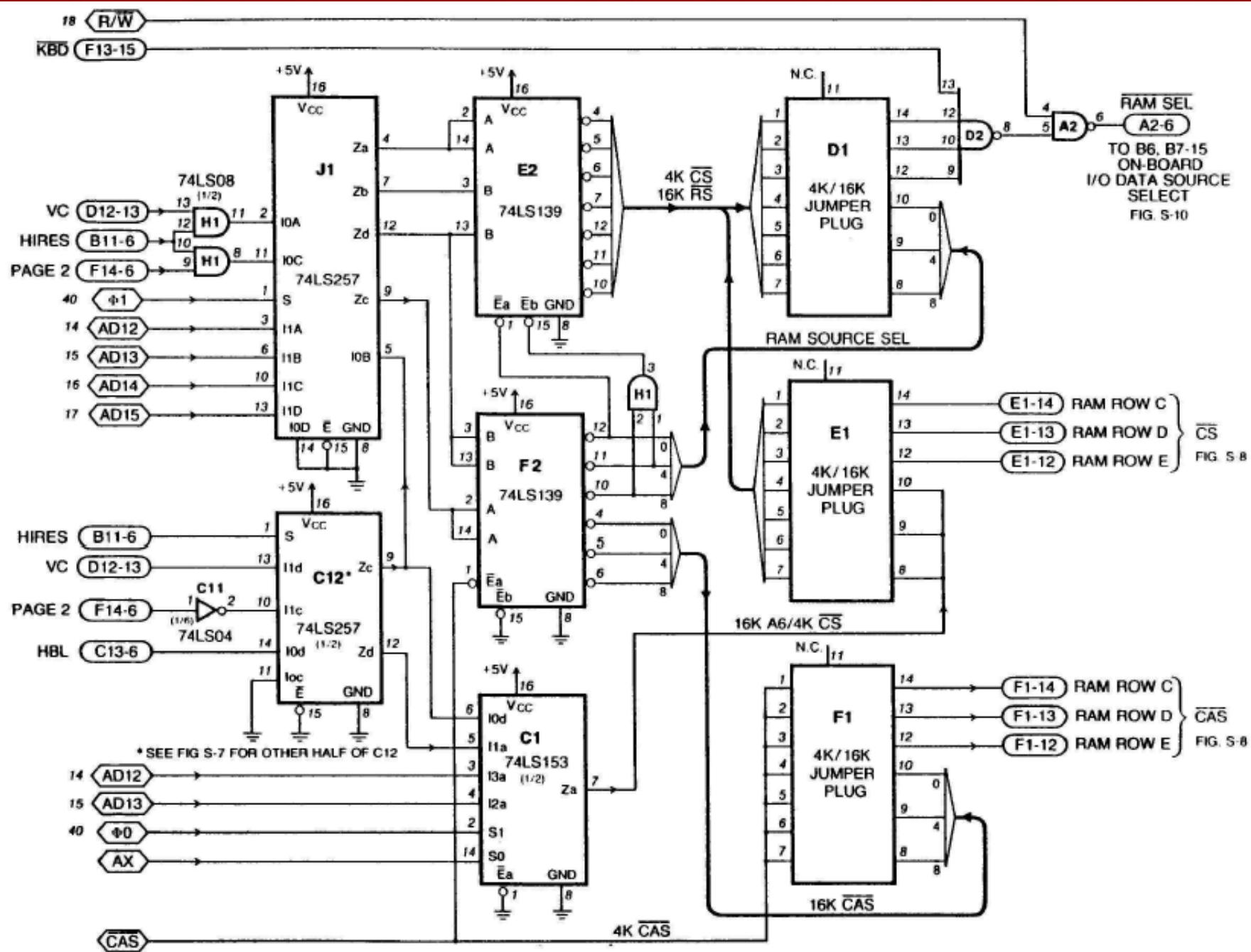


FIGURE S-6 4K/16K RAM SELECT



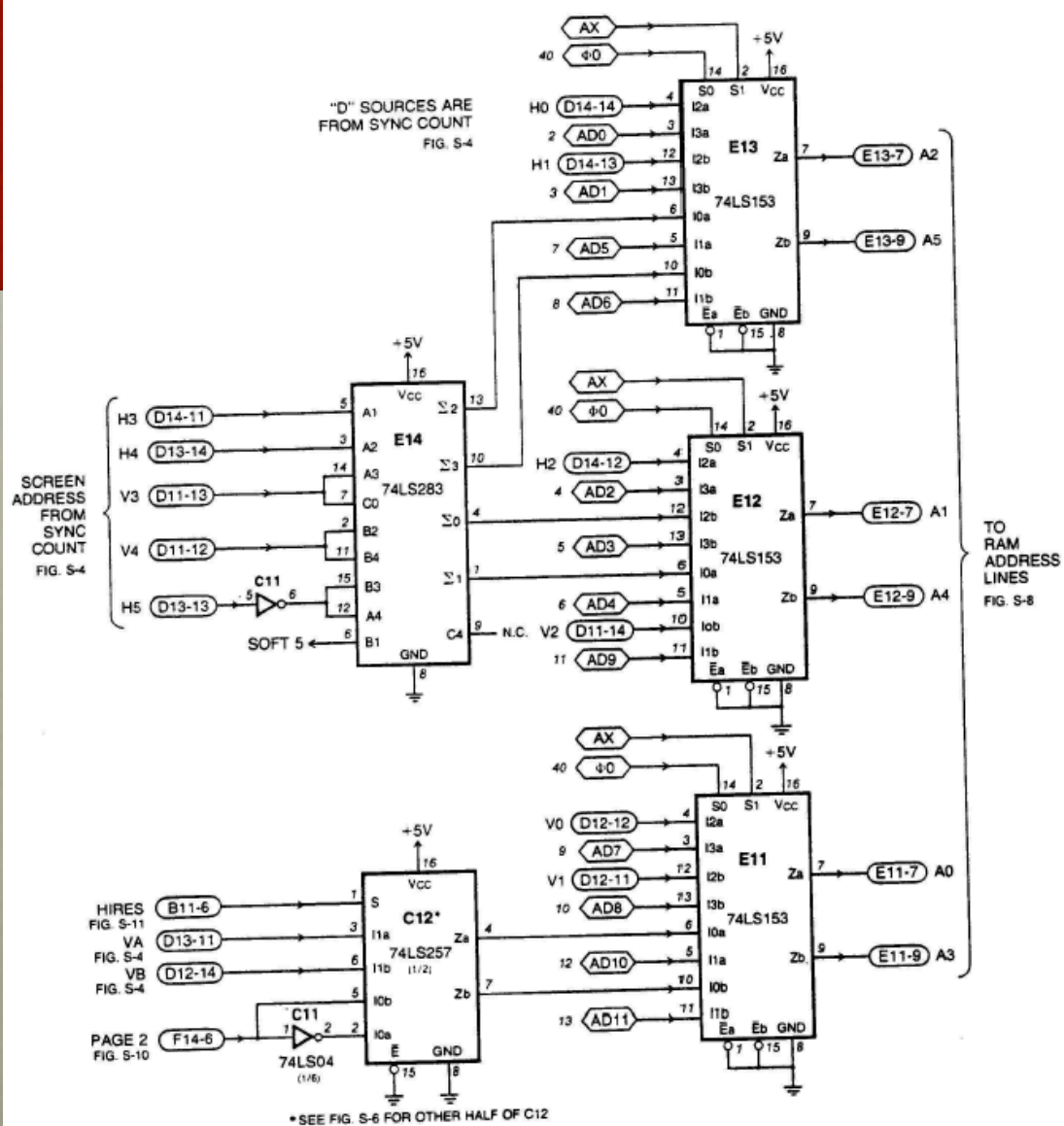


FIGURE S-7 RAM ADDRESS MUX

FROM 4K/16K SELECT  
FIG. S-6

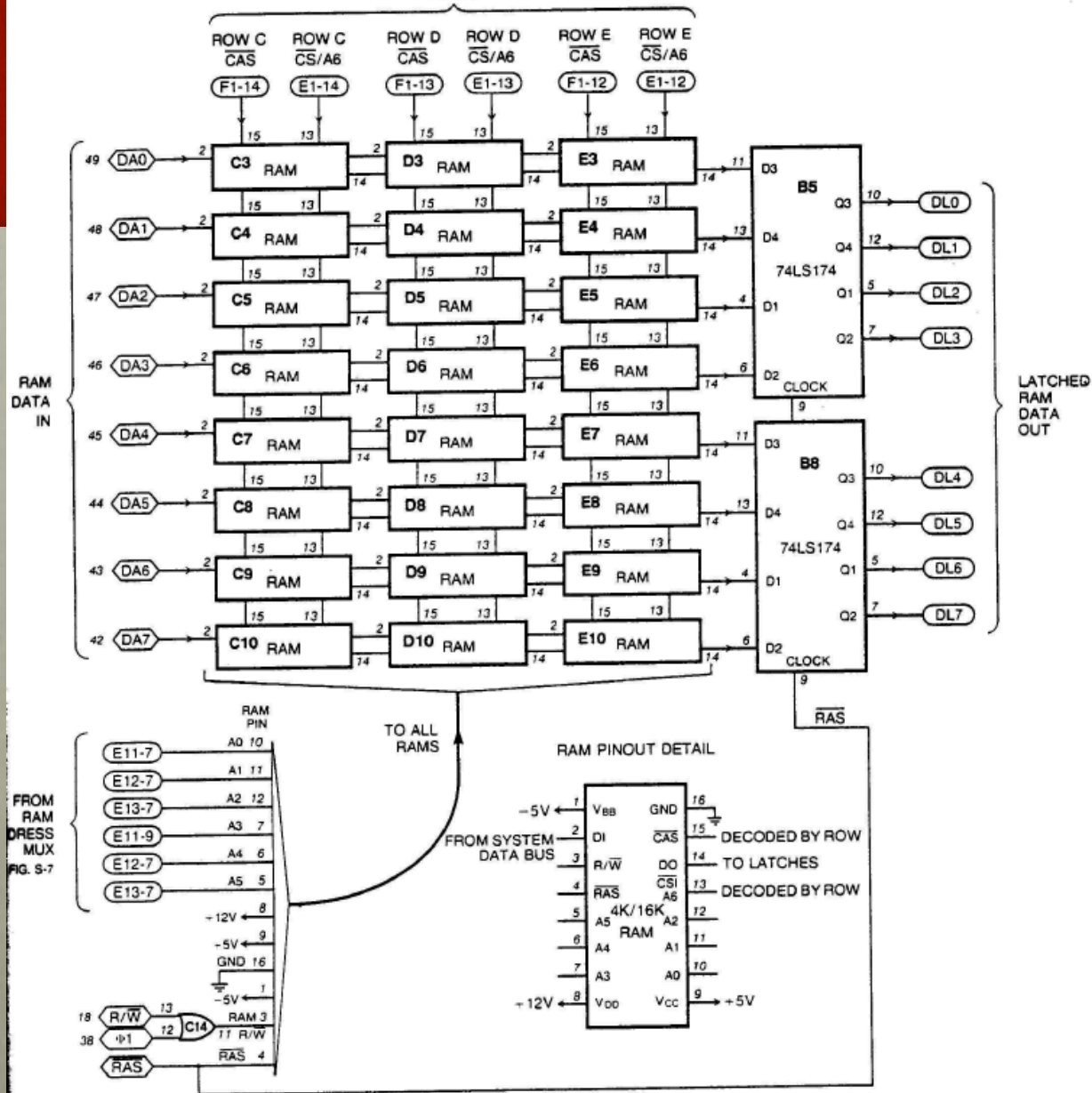


FIGURE S-8 4K TO 48K RAM MEMORY WITH DATA LATCH

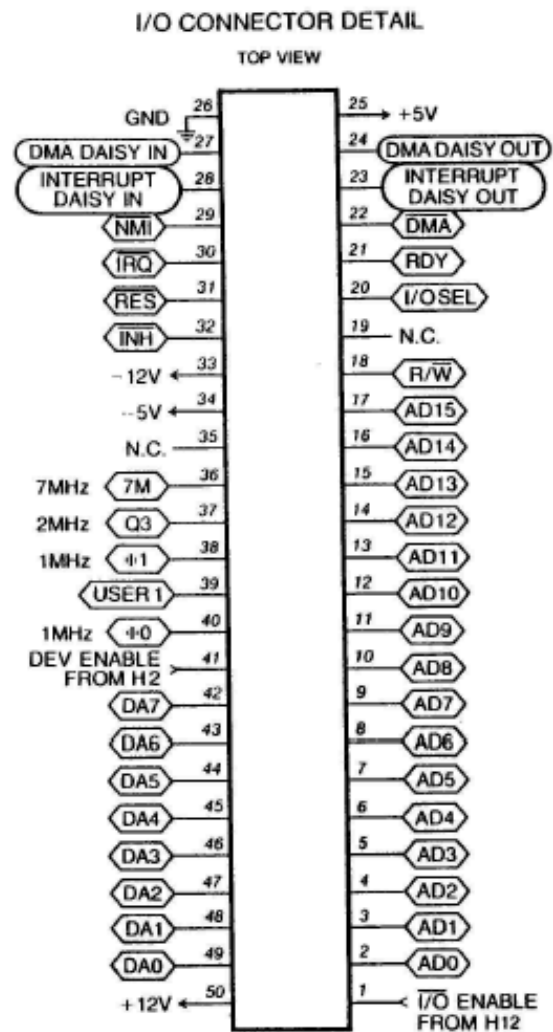
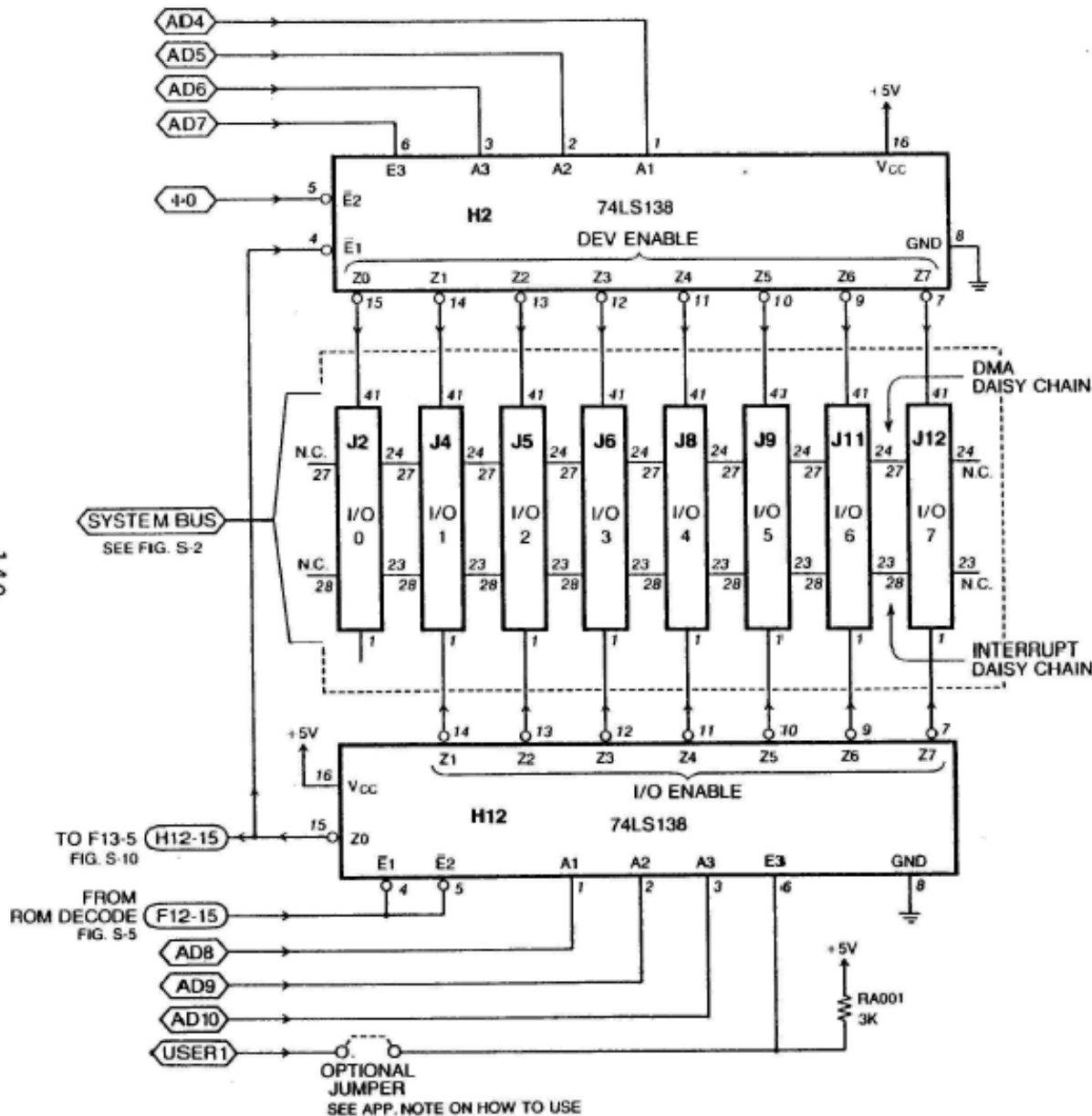


FIGURE S-9 PERIPHERAL I/O CONNECTOR PINOUT AND CONTROL LOGIC

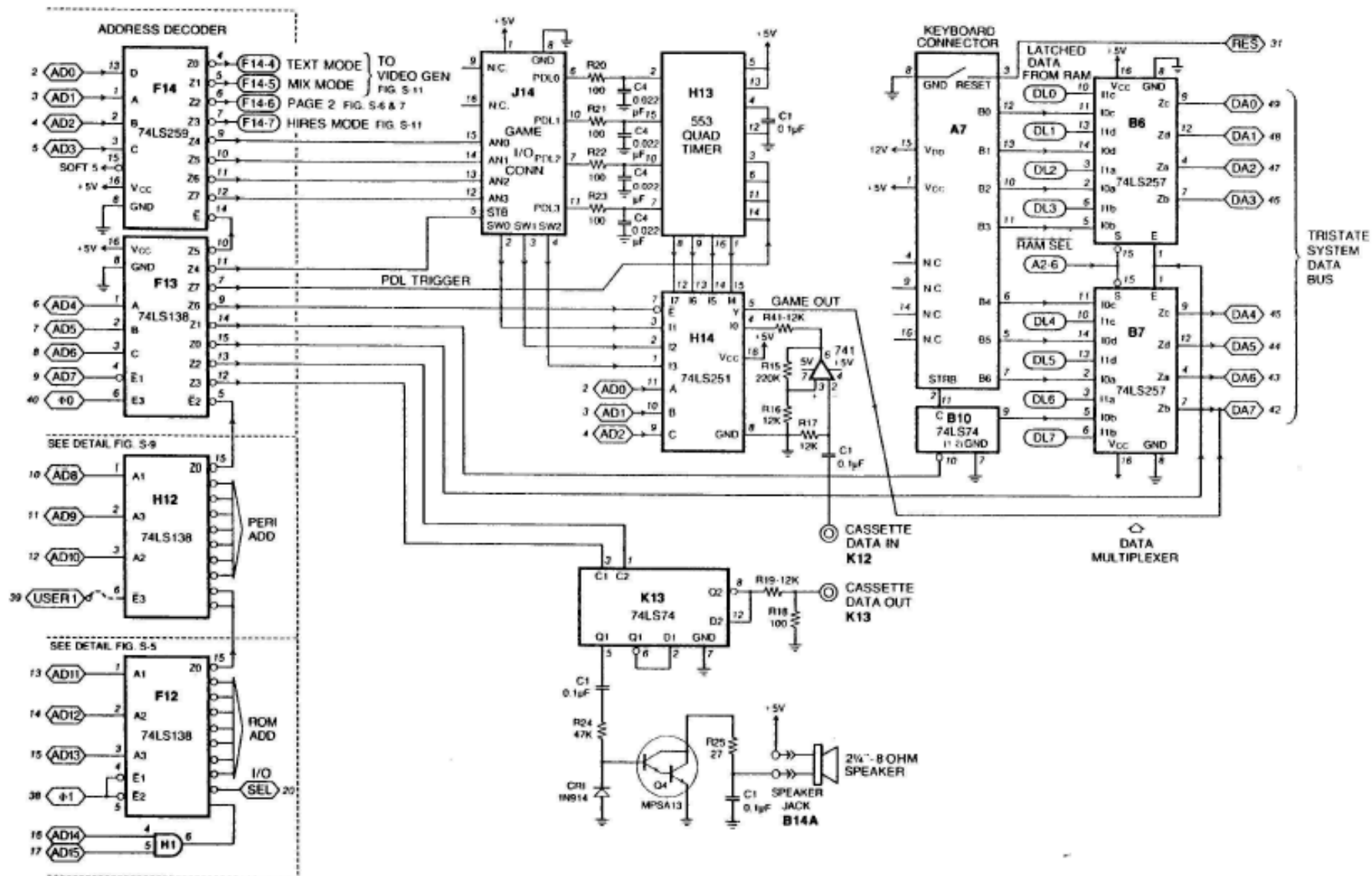
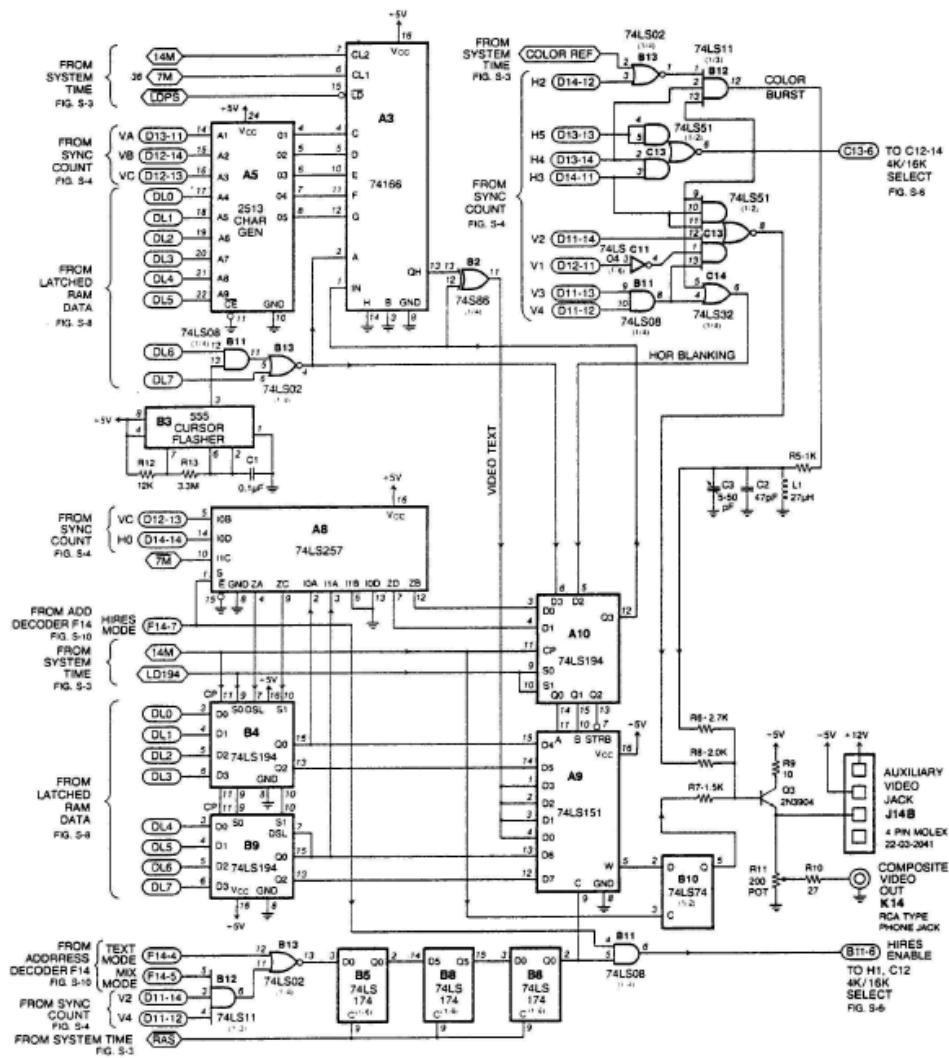


FIGURE S-10 ON-BOARD I/O



# REFERENCES

“Understanding the Apple II” – Jim Sather

“Red Book” – Apple

“Apple II Reference Manual” – Apple

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