

**NCR**

**Personal  
Computer**

**PC4i  
Service Manual**

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# NCR PERSONAL COMPUTER PC 4i

## SERVICE MANUAL

### CONTENTS

#### Chapter 1 System Overview

NCR Personal Computer Hardware .....	1-1
Display Unit .....	1-1
Models .....	1-3
Model Numbers .....	1-5
Tools .....	1-6
Alternate Main Processor Board .....	1-8

#### Chapter 2 Basic Troubleshooting

Level 0 (Power-On) Diagnostics .....	2-1
Power On .....	2-2
Power Cords and Switches.....	2-2
Memory Test Messages .....	2-3
After First Attempt .....	2-6
After Second Attempt .....	2-7
Power Supply .....	2-9
Peripherals .....	2-17
Check Keyboard .....	2-17
Check for Diagnostic Errors .....	2-17
Restore Full Configuration .....	2-19
Test Total Memory .....	2-19
Test CRT and Disk Drives .....	2-20
Re-Installation .....	2-22

#### Chapter 3 Level 0 Diagnostics

Memory Test .....	3-1
Other MPB Tests .....	3-5
Keyboard Test .....	3-5
Initialization and Loading .....	3-5
Error Returns .....	3-6
Parallel Port Error Codes .....	3-7
Level 0 Loop Tests on Generic Processor Board ..	3-7
Error Messages of the Early-Type MPB .....	3-14
Suggested Action .....	3-15

## Chapter 4 Level 1 Diagnostics

How to Begin Testing .....	4-1
Load the Diskette .....	4-1
Main Menu .. .. .	4-2
Main Menu Help Screens .....	4-5
Test Completion Displays .....	4-6
Diagnostic Selections .....	4-8
Run all Tests Once .....	4-9
Automatic Completion .....	4-9
Memory (Main Menu Selection 1) .....	4-11
Memory Test Help Screens .....	4-12
RAM Pattern Test .....	4-12
RAM Address Test .....	4-13
RAM Parity Test .....	4-14
RAM Walking Ones Test .....	4-15
Firmware Checksum Test .....	4-16
Controllers (Main Menu Selection 2) .....	4-17
Controllers Test Help Screens .....	4-18
CPU Test .....	4-18
DMA Test .....	4-19
Flexible Disk Controller Test .....	4-20
Interval Timer Test .....	4-21
Interrupt Controller Test .....	4-22
CPU Controller Test .....	4-23
Monochrome Display Controller Test .....	4-24
Color Graphics Display Controller Test .....	4-23
Serial Synchronous Controller Test .....	4-26
Keyboard (Main Menu Selection 3) .....	4-26
Flexible Disk Drive (Main Menu Selection 4) .....	4-28
Flexible Disk Drives HELP Screens .....	4-28
Read Only Drive A Test .....	4-29
Read/Write Drive A Test .....	4-30
Fixed Disk Drive (Main Menu Selection 5) .....	4-31
Fixed Disk Drive Test HELP Screen .....	4-32
Read/Write Maintenance Track .....	4-32
Read Only Sector 0 .....	4-33
Read Only Entire Disk .....	4-34
Read/Write Entire Disk .....	4-35
Fixed Disk Controller .....	4-38
Monochrome Display (Main Menu Selection 6) .....	4-39
Color/Graphics Display (Main Menu Selection 7)..	4-41
Peripherals (Main Menu Selection 8) .....	4-47
Serial Port Loopback Test .....	4-48
Parallel Port Loopback Test .....	4-49

Printer Tests .....	4-50
Generic Printer Test .....	4-51
PC Compatible Printer Test .....	4-52
Utilities .....	4-53
Videotex Adapter Tests (Main Menu Selection)....	4-54
Local Test .....	4-55
Remote Test .....	4-55
Picture Test .....	4-57

## Chapter 5 Level 1 Diagnostic Error Returns

Repair Guidelines .....	5-1
Basic System Configuration .....	5-1
Preliminary Checks .....	5-2
Main Processor Board Components .....	5-3
Memory Addressing .....	5-5
Error Codes .....	5-8
Relationship between Detail Codes and	
Repair Procedures .....	5-8
Format of Displayed Error Codes .....	5-10
List of Major Error Codes .....	5-10
Memory Error Codes .....	5-12
Repair Procedure 01 .....	5-13
Repair Procedure 02 .....	5-18
Repair Procedure 03 .....	5-20
Repair Procedure 04 .....	5-21
Repair Procedure 05 .....	5-21
Flexible Disk Drive Error Codes .....	5-23
Repair Procedure 06 .....	5-25
Keyboard Error Codes .....	5-32
Repair Procedure 07 .....	5-32
Video Display Error Codes .....	5-34
Repair Procedure 08 .....	5-35
Repair Procedure 09 .....	5-37
Peripheral Error Codes .....	5-38
Repair Procedure 10 .....	5-40
Repair Procedure 11 .....	5-43
Repair Procedure 12 .....	5-46
Major System Controller Error Codes .....	5-39
Repair Procedure 13 .....	5-47
Repair Procedure 14 .....	5-48
Repair Procedure 15 .....	5-48
Repair Procedure 16 .....	5-49
Repair Procedure 17 .....	5-50

Repair Procedure 18 .....	5-51
Repair Procedure 19 .....	5-52
Repair Procedure 20 .....	5-52
Fixed Disk Controller Error Codes.....	5-53
Repair Procedure 21 .....	5-53
Repair Procedure 22 .....	5-54
Videotex Error Codes .....	5-56
Repair Procedure 23 and 24 .....	5-57
Repair Procedure 25 .....	5-57
Repair Procedure 26 .....	5-57

## **Chapter 6 Removal/Replacement**

Cabinet .....	6-1
Card Rack Assy .. ..	6-2
Printed Circuit Boards .....	6-4
Options PCBs .....	6-4
Main Processor Board .....	6-5
Disk Drives .....	6-7
ON/OFF Switch .....	6-9
Brightness and Volume Controls..	6-10
Monochrome CRT/Power Supply Assy .....	6-11
Complete Assembly .....	6-11
Power Supply .....	6-12
Monochrome Deflection Board .....	6-14
Monochrome CRT .....	6-15
Color CRT/Power Supply Assy .....	6-17
Power Supply .....	6-18
Color Deflection Board .....	6-19
Color CRT .....	6-21

## **Chapter 7 Adjustments**

Monochrome CRT .....	7-1
Display out of Focus .....	7-3
Display too Dim .....	7-3
Display Rolls .....	7-4
Display too Short/Long .....	7-4
Display Not Linear .....	7-5
Display too Wide/Narrow .....	7-5
Display Tilted .....	7-5
Character Field Size .....	7-6
Color CRT .....	7-6
Horizontal Deflection .....	7-8

Oscillator Alignment .....	7-8
Picture Width .....	7-9
Vertical Deflection .....	7-10
Video .....	7-11
Cutoff Adjustment .....	7-11
Whiteness .....	7-12
Sub-Brightness .....	7-12
Focus .....	7-13
Convergence .....	7-13
Convergence Adjustments .....	7-13
Adjustments for Videotex Monitor 008-0072370 ..	7-15
Adjustments for Videotex Monitor 008-0072196 ..	7-18

## **Chapter 8 Strapping Information**

Main Processor Board .....	8-1
Configuration Switches .....	8-1
Jumper Settings .....	8-5
Alternate Main Processor Board .....	8-1
Switch Settings .....	8-2
Jumper Settings .....	8-6
Early-type Main Processor Board .....	8-7
Switch Configurations of Early-type MPB .....	8-8
Switch Configurations of PCBs .....	8-10
Memory Expansion Board .....	8-10
Alpha Display Adapter .....	8-11
Graphic Controller Boards .....	8-12
In-House DLC Adapter .....	8-13
Videotex Adapter Board .....	8-14
Flexible Disk Controller Board 1.2 MB.....	8-16
Hard Disk Controller Boards .....	8-17
Flexible Disk Drive Jumpers .....	8-20

## **Appendix A Layouts and Schematics**





## System Overview

**NCR PERSONAL COMPUTER HARDWARE**

The NCR Personal Computer consists of a main Display Unit and a Keyboard. The computer is available in different models, and has a variety of options that can be added to each model. Expansion boards from non-NCR ("third party") manufacturers can be used with the NCR Personal Computer, as well as expansion boards offered by NCR.

**DISPLAY UNIT**

The standard Display Unit consists of the following parts:

- o Cabinet
- o Power Supply
- o 1 or 2 flexible disk drive(s) or one flexible disk drive and one hard disk drive
- o 12-inch monochrome CRT display or 12-inch color CRT display
- o Processor Board with:
  - o 8088 Microprocessor
  - o 256 KB Random Access Memory (RAM)
  - o 16K Read Only Memory (ROM)
  - o RS-232-C Serial Interface
  - o Centronics Parallel Interface (for printer)

# SYSTEM OVERVIEW

- o Plug-in board option expansion slots
- o Fixed disk drive controller plug-in board if the unit includes a fixed disk.
- o Video controller plug-in board.

A block diagram of the NCR Personal Computer Hardware is shown in Figure 1-1.

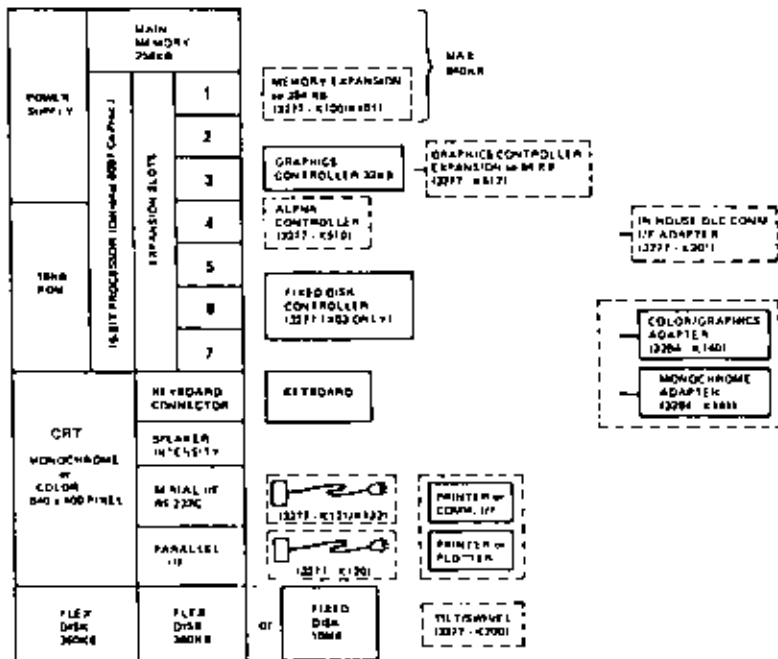


Figure 1-1 Hardware Block Diagram

The Main Processor Board and any option boards are

accommodated in an easily removable Card Rack Assembly, this assembly allows for a maximum of 7 option boards to be added to the system. The shape of the Card Rack Assembly imposes the following restrictions on the size of the option boards that may be installed:

The option boards must conform to the following dimensions:

3 Boards 334 mm x 107 mm (13.1 in. x 4.2 in.)

3 Boards 296 mm x 107 mm (11.6 in. x 4.2 in.)

1 Board 254 mm x 107 mm (10.0 in. x 4.2 in.)

#### **MODELS**

The NCR Personal Computer is available in various models. The standard internal RAM memory size for all models is 256KB. The models currently available are:

- o A 12-inch monochrome display, 1 flexible disk drive and 256KB memory
- o A 12-inch monochrome display, 2 flexible disk drives and 256KB memory
- o A 12-inch monochrome display, 1 flexible disk drive and 1 fixed disk drive, and a 256KB memory
- o A 12-inch color display, 1 flexible disk drive and 256KB memory
- o A 12-inch color display with 2 flexible disk drives and 256KB memory
- o A 12-inch color display with 1 flexible disk drive and a fixed disk drive, and 256KB memory
- o A 12-inch color display with Videotex , 1 flexible disk drive and 256KB memory
- o A 12-inch color display with Videotex , 2

## SYSTEM OVERVIEW

flexible disk drives and 256 KB memory

- o A 12-inch color display with Videotex, 1 flexible disk drive and 1 fixed disk drive, and 256KB memory

The Videotex systems are dual purpose systems, to be used either as a Videotex system, or as a normal personal computer. These systems are tailored to meet individual country requirements, for example Bildschirmtext for Germany, Teletel for France, and Prestel for Great Britain.

### WARNING

Disconnect the power cable before removing the cabinet. Dangerous voltages are present when working on the computer with the cabinet removed.

ONLY TRAINED ENGINEERS AND NCR TRAINED SERVICE PERSONNEL SHOULD ATTEMPT TO WORK ON THE COMPUTER WITH THE CABINET REMOVED AND THE POWER ON.

It is recommended that the first operation after removing the cabinet should be to discharge CRT anode voltage.

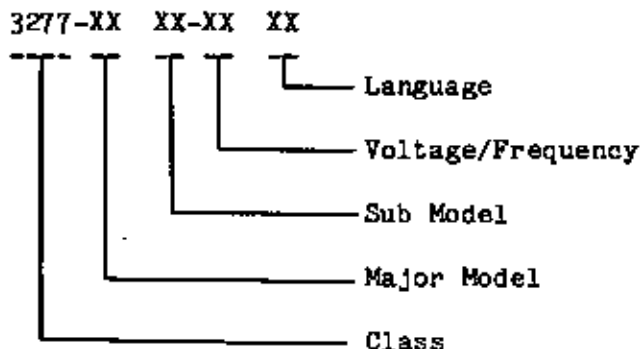
### CAUTION

Electrostatic discharge can cause damage to some components used in the computer. Where possible, work in a static free area and use special wrist-ground straps. Avoid touching the components and circuit paths, handle printed circuit boards by their edges. The construction technique (multi-layer) used on some PC boards makes the soldering components extremely difficult, therefore such work should only be undertaken by a field engineer who is experienced in repairing

PCBs, and using the special facilities that are available in NCR workshops.

### MODEL NUMBERS

The model number of the NCR PC 41 is shown on the plate at the back of the unit. The meaning of the model number is shown below:



The NCR model numbers are defined in Figure 1-2.

## SYSTEM OVERVIEW

Class	3277	NCR Class Number
Major Model	11	Monochrome CRT
	12	Color CRT
	13	Videotext CRT (Color)
Sub Model	01	Single Flexible Disk Drive
	02	Dual Flexible Disk Drives
	03	Fixed and Flexible Disk Drives
Voltage/ Frequency	71	120 Volts, 50/60 Hz. *)
	73	220/230/240 Volts, 50/60 Hz.
Language	00	U.S. English
	01	International English
	02	U.K. English
	03	Spanish
	05	French
	06	German
	09	Swedish
	10	Danish
	11	Norwegian
	12	Italian
20	Finnish	

Figure 1-2 Model Number Definition

\*) The monochrome version is strapped and can be used in the voltage range of 120/220 to 240 V.

### TOOLS

A normal set of hand tool for an electronic engineer is sufficient to service the computer. You also need an NCR Alignment Disk.

o For 48 TPI Drives - part no. 603-9009167

To enable the execution of the Level 0 Loop Test the following test adapters are available:

- o Turnaround Keyboard Test Adapter 017-0044311
- o Turnaround Parallel/Serial Test Adapter 017-0044320

To allow access to the Card Rack Assembly with power applied, an extension cable can be made locally. Figure 1-3 provides the information needed to make the cable.

Parts Required:

Receptacle Connector (Female)	007-2007711
Receptacle Connector (Male)	007-2007712
Cable 15 Wire, 18 AWG, Length approx. 700mm	Local Purchase

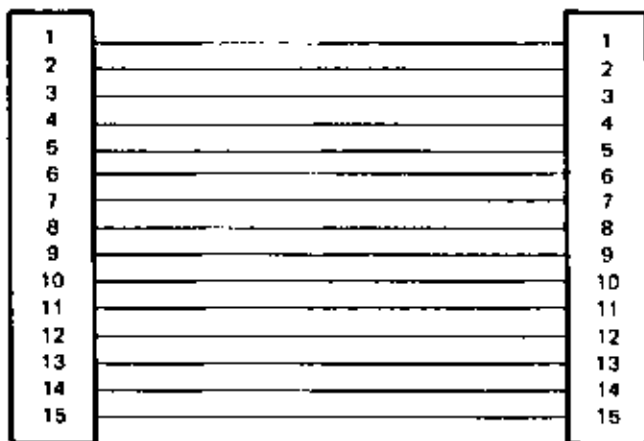


Figure 1-3 Extension Cable

## *SYSTEM OVERVIEW*

### **ALTERNATE MAIN PROCESSOR BOARD**

Since the introduction of the NCR Personal Computer PC4i a new style Main Processor Board, known as "Alternate" Main Processor Board (in this manual sometimes referred to as "Generic" Main Processor Board) has been introduced. Much of the information in this manual applies both to the "Alternate" Main Processor Board and to the two Early-type Main Processor Boards. The "Alternate" MPB is used in a variety of NCR computers. Distinguishing characteristics of this board are its 8 slots, 2 switch packs, VLSI ICs, RAM location and RAM accessibility. Computers with such a mainboard installed are marked with a "G" (which stands for "Generic") on the PC board rack.



## Basic Troubleshooting

This chapter is intended to help the engineer in either repairing the system, or bringing it to a partially operative state so that the diagnostic diskette may be used for further troubleshooting.

Presented here is a structured sequence of operations to follow when either the system is unable to run diagnostics, or the level 0 (power-on) diagnostics fail (see Fig. 2-1).

Generally faulty systems can be classified into two types:

- o Non-operative - a system where it is not possible to load a diagnostic diskette.
- o Partially operative - a system with sufficient working components to allow the loading of a diagnostic diskette.

### LEVEL 0 (POWER-ON) DIAGNOSTICS

The level 0 diagnostics are performed automatically each time the system is switched on.

These diagnostics check the following:

- o RAM memory (for memory size setting refer to Chapter 8 "Strapping Information")
- o 8088 CPU (CPU is used to test all the modules)
- o 27182 EPROM (containing BIOS)
- o 765 Flex Disk Controller

## *BASIC TROUBLESHOOTING*

- o 8237A DMA controller
- o 8253 Timer
- o 8259A Programmable Interrupt Controller
- o Keyboard Interface

### **STEP ONE**

#### **POWER ON**

##### **Power Cords and Switches**

1. Ensure that the power cord is plugged into the back of the computer
2. Ensure that the power cord is plugged into a properly grounded wall outlet. (Use a lamp that you know is in working order, and check that the outlet has power.)
3. Ensure that the power cords for any currently-attached external devices (printer, etc.) that have separate power cords are plugged into properly grounded wall outlets.
4. Insert the Service Diagnostic diskette into drive A. Use a working copy of the original diskette. Make a back-up copy on another computer, if necessary, but do not use a diskette that has no backup. The possibility exists that a problem could result in the loss of the software.
5. Turn ON any attached external devices that have separate power cords and switches (unless the device installation instructions specified that the device be turned on after the computer).
6. Turn ON the computer power. Turn the volume control and brightness to maximum.

7. Turn ON any currently-attached external devices that were specified to be turned on after the processing unit.

#### Memory Test Messages

1. In a properly operating system the turn-on procedure results in the display of Memory Test on the screen; quickly followed by steps through the increments of memory installed. An audible tone or beep is followed by the display of some introductory messages about the software. Then the prompt A> (or other) appears along with a blinking cursor.  
The following few steps treat anomalies of that sequence.
  - a. If the screen does not display a message, the tube may not have been warmed up in time. Wait approx. 30 seconds for the tube to warm up. Then turn the power OFF and ON for a retry.

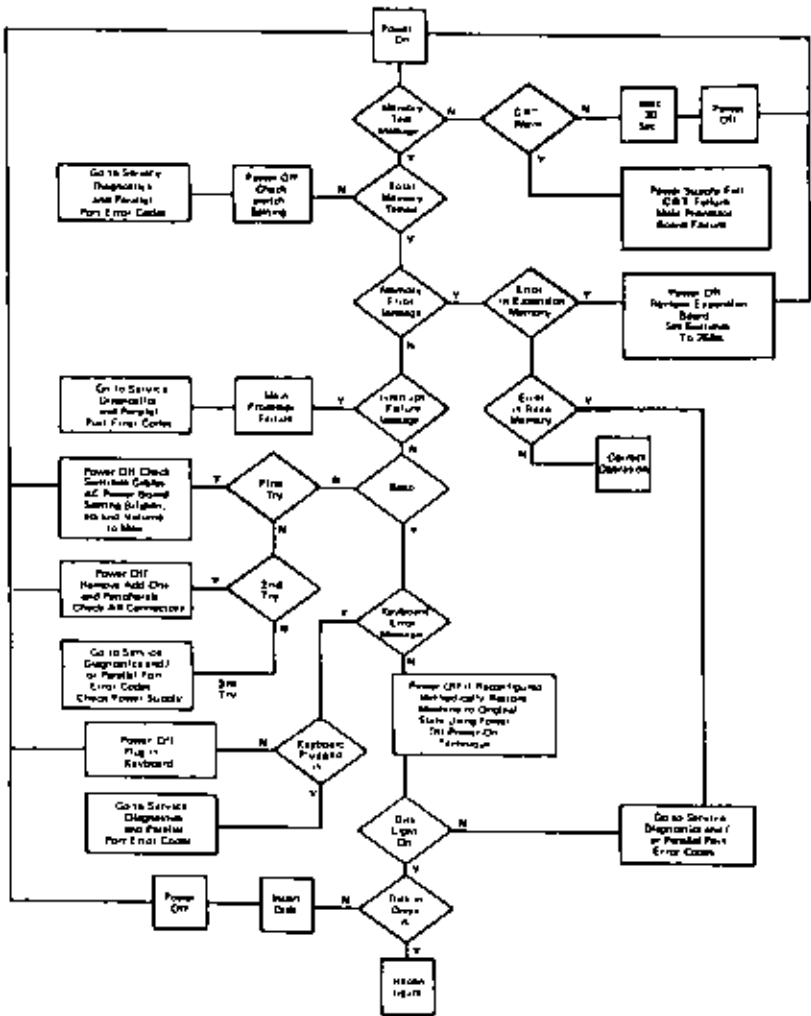


Figure 2-1 Troubleshooting Flowchart

b. If there is no display after the tube is warm, a display failure , a power supply failure, or main processor failure is suspected. Proceed to repair or replace as appropriate.

Make a check of the power supply voltage before disassembling the unit. The MPB Parallel Port Error Codes can be checked with

a turnaround test adapter (refer to "Tools" in Chapter 1).

If display failure is indicated, then review and observe the instructions for installation of the display (refer to Chapter 6 "Removal/Replacement").

2. The procedure of steps a and b should result in a display Memory Test. The installed amount of memory should be indicated by steps in increments of 64KB each.
3. If the correct amount of memory is not indicated, turn the power OFF and check the switch settings (see Chapter 8 "Strapping Information") for the correct positions.
4. Use the Service Diagnostics.

#### NOTE

The Power-ON diagnostics routines issue a set of codes (see Table 3-1 Error Codes, Chapter 3) to the parallel port which are applicable to the MPB. By plugging the test adapter (see "Tools" Chapter 1) or an oscilloscope to this port, these codes can be observed. This is of particular value if the video display is not working.

5. If Step 2 indicated that the correct amount of memory has been tested, a tone or beep is heard. The test procedure is cycling through the complete number of increments. A successful test is indicated by a screen message.
  - a.) If no beep is heard, proceed to step 6.
  - b.) If a **Keyboard Error** message is displayed, go to Check for Keyboard, Step 1.

## **BASIC TROUBLESHOOTING**

- c.) If a **Memory Error** is displayed, go to check for Diagnostics Errors, Step 1.
6. If this was the first attempt to power up, go to "After First Attempt", Step 1.  
If this was the second attempt to power up, go to "After Second Attempt", Step 1.

If this procedure fails to locate the problem after the third attempt, then disassemble the computer and check the power supply (see Chapter 6 "Removal/Replacement"). If there is no problem with the power supply, then the MPB is faulty. Replace MPB.

### **After First Attempt**

1. Turn OFF the power switches for any external devices (printer etc.).
2. Turn OFF the computer power switch.
3. Unplug the computer power cord, and any external device power cord, from the wall outlet.
4. Unplug the power cord from the back of the computer.
5. Remove any adapter board that interferes with access to the MPB configuration switch blocks SW1 and SWA. Refer to the instructions for installation and removal.
6. Check all configuration switch settings (refer to Chapter 8 "Strapping Information")
7. Check the attachment and condition of all cables.
8. Check the AC power source . (Use a lamp that you know is in working order, and check that the outlet has power).

9. Check the AC slow-blow power fuse, located in the power supply. For the available versions the following fuses have been inserted:  
Monochrome: 3 A  
Color: 6.3 A  
Videotex: 4 A
10. Ensure that the adapter boards edge connectors are correctly seated in the MPB board connector slots.
11. Turn the display brightness and the computer volume control knobs fully clockwise to their maximum settings.
12. Replace any adapter board removed.
13. Turn on the computer again.

**After Second Attempt**

1. Turn OFF power and unplug power cords.
2. Take out all expansion adapter boards for any features which had been added to the original basic machine.

Refer to Chapter 6 "Removal/Replacement" for instructions on removing the cabinet from the computer and on removing each pertinent adapter board.

The adapter boards that remain will be:

- a. The monochrome or color/graphics display adapter board.
  - b. The fixed disk drive controller board, if the computer has a fixed disk.
3. Disconnect each printer or other peripheral device which is connected to either the parallel or serial port connector on the rear of the computer.

## *BASIC TROUBLESHOOTING*

4. Take out any adapter board which interferes with access to the MPB configuration switches (see Chapter 8 "Strapping Information").
5. Set the configuration switches for the minimum 256 KB memory size (Refer to Chapter 8 for proper switch settings).

### **NOTE**

If any device is disconnected from the MPB serial port in step above, the serial port switches (see Chapter 8) must be changed to show the port disabled.

6. Check all internal and external connectors that are visible and reachable for the devices that remain installed on the computer. Ensure that the connections are tight and proper.
7. Replace the monochrome adapter card, if it was removed in Step 4. Follow the instructions for installing boards in Chapter 6 "Removal/Replacement".
8. Turn ON the computer again.



**POWER SUPPLY**

Since without a correctly functioning power supply no part of the system can function, therefore it should always be one of the first areas to be checked.

The power supply is a sub-assembly of the CRT assembly. Fig.2-2 shows the power supply connections. Three versions of the power supply are used:

- o for systems with a monochrome CRT
- o for systems with a color CRT
- o for systems with a Videotex

All power supply components are located on the power supply PBC. Except for replacing the fuse (F1) the power supply is not considered field repairable, however, some checks should be made before replacing the power supply.

Use a meter to monitor the +5V, -5V,+12V and -12V. These may be checked at the following points:

Connector J4	Pin 10	+5 Volts
	Pin 1	-5 Volts
	Pin 12	+12 Volts
	Pin 4	-12 Volts
	Pin 2	Ground

The flow-chart, Figure 2-3, and 2-4 will help to eliminate possible failures.

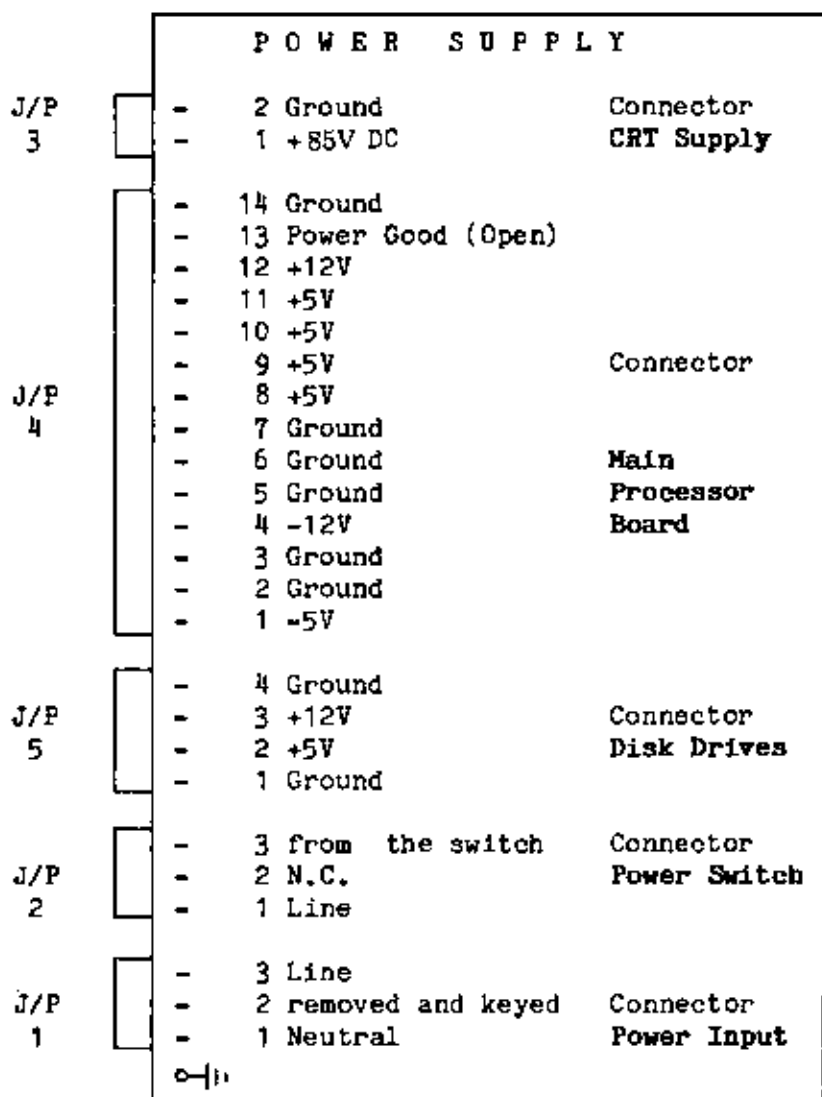


Figure 2-2 Power Supply Connections  
(Monochrome systems) (1 of 2)

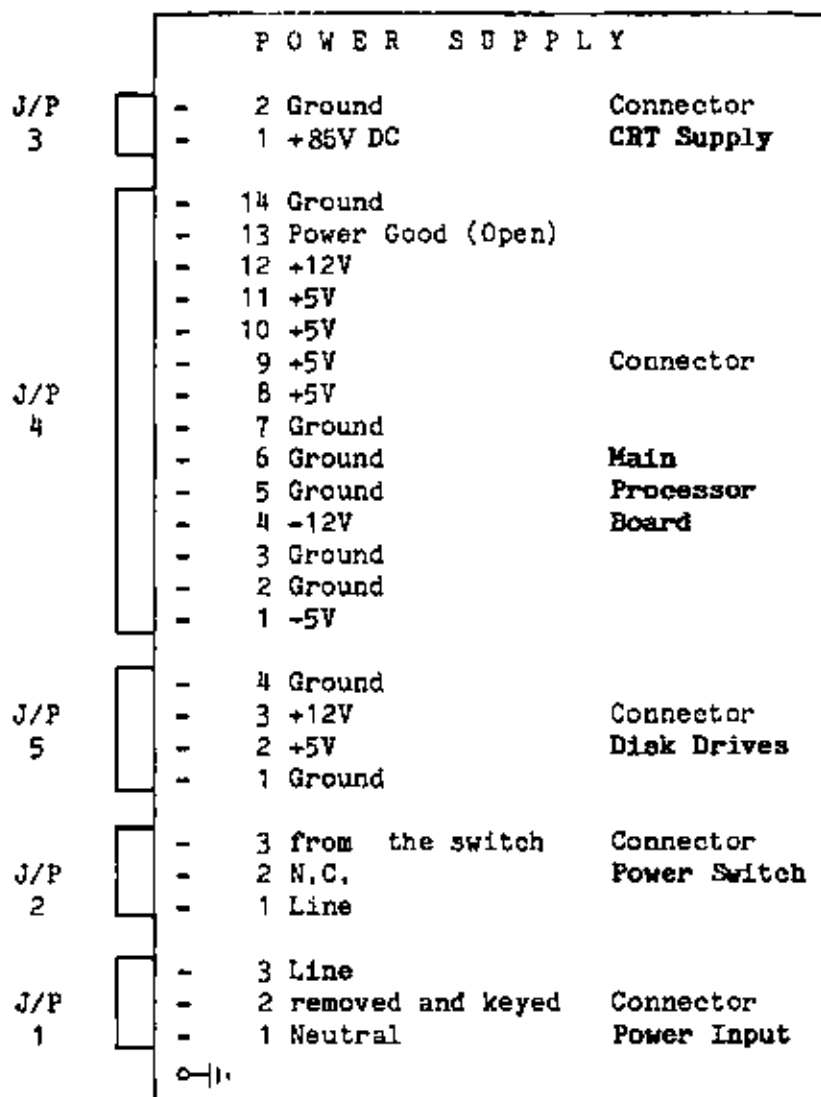


Figure 2-2 Power Supply Connections  
(Color Systems) (2 of 2)

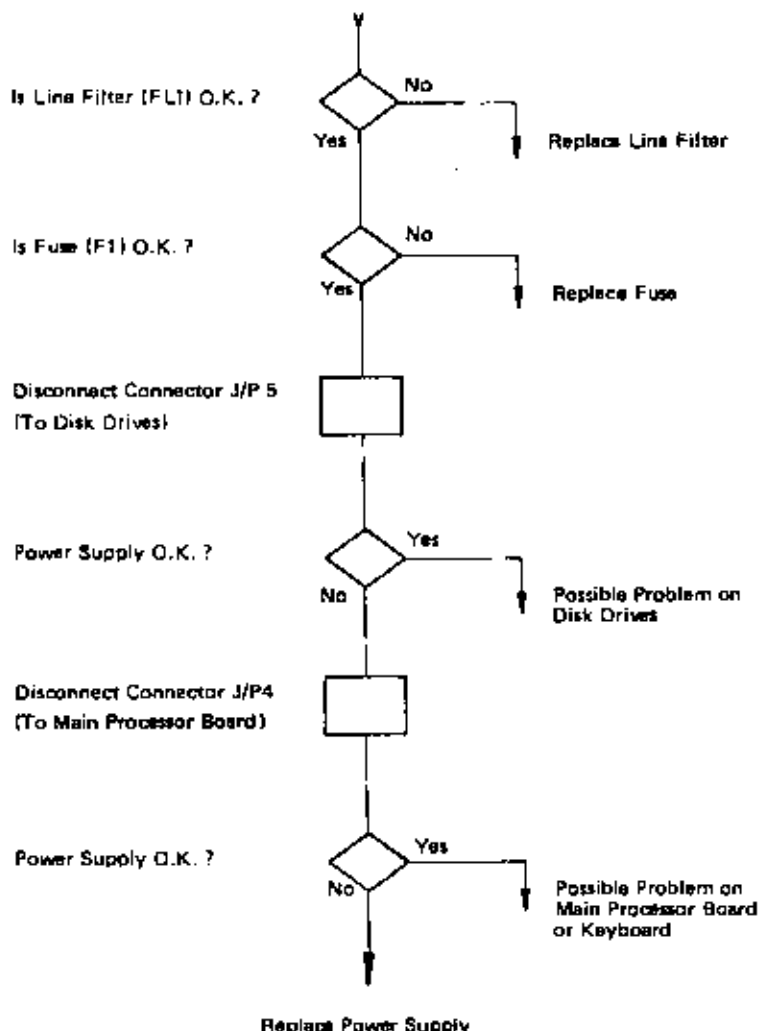


Figure 2-3 Troubleshooting Flow Chart PS (1 of 5)\*

\* This troubleshooting flow chart applies to the Power Supply 008-0072344 (Color).



# BASIC TROUBLESHOOTING

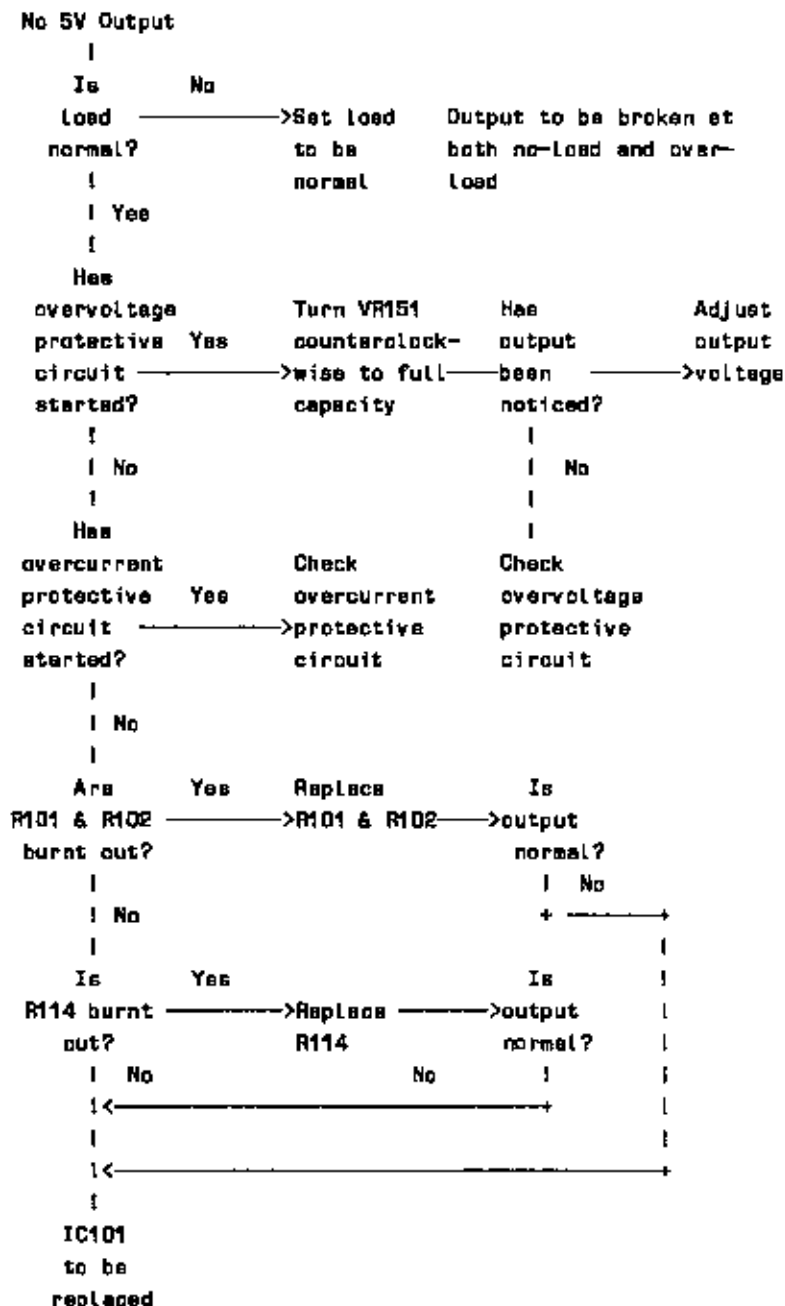


Figure 2-3 Troubleshooting Flow Chart PS (3 of 5)

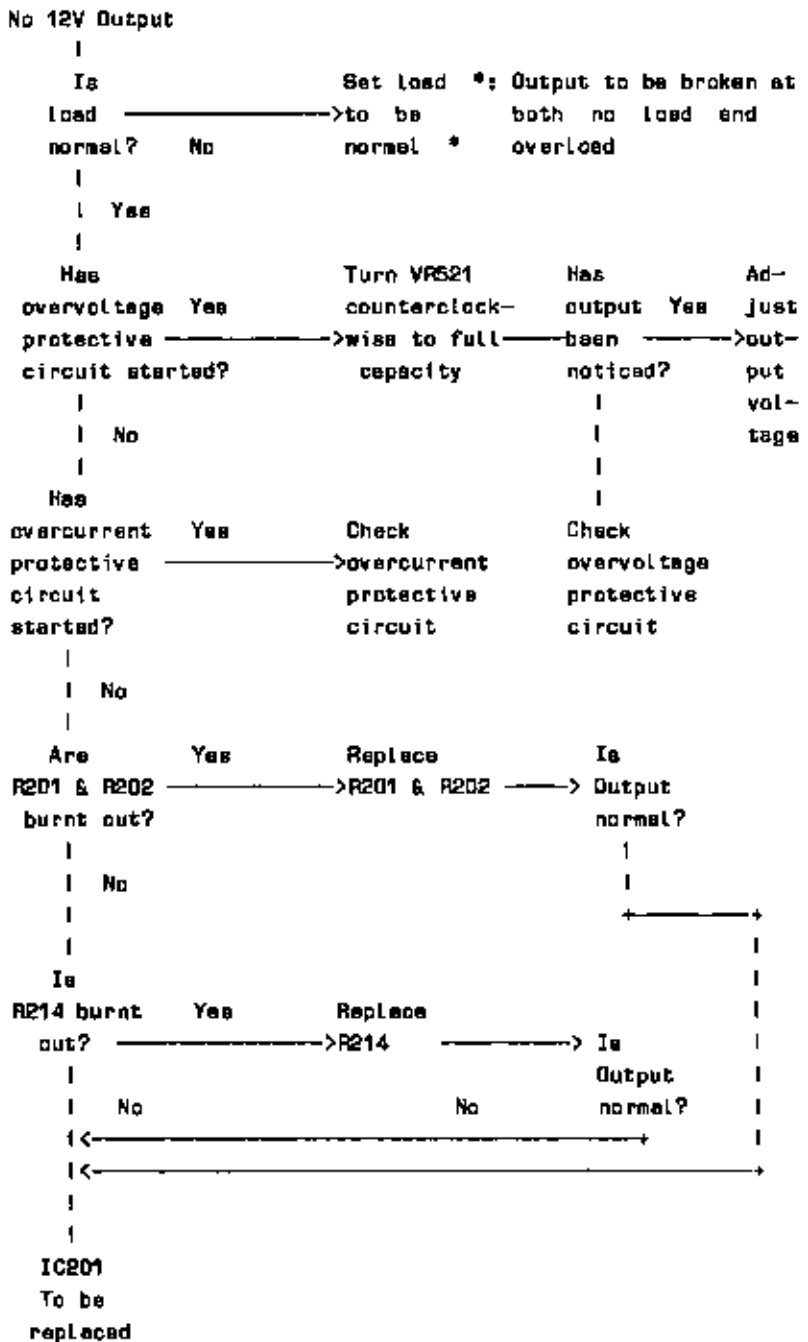


Figure 2-3 Troubleshooting Flow Chart PS [4 Of 5]





### **Peripherals**

Remove all peripherals that may be attached to the NCR Personal Computer, and their interface PC boards. If necessary, reset the configuration switches on the Main Processor Board to match the downgraded system configuration.

The pertinent switch configurations are shown in Chapter 8 "Strapping Information".

If the Level 0 Diagnostics now run correctly then replace the PC boards and reconnect the peripherals one at a time. Rerun the Level 0 Diagnostics after replacing each PC board, and after reconnecting each peripheral to determine which part of the system is causing the trouble.

### **CHECK KEYBOARD**

1. Check that the keyboard cable is properly plugged into the 5-pin connector on the back of the MPB. If it is, use either of the diskette-based sets of diagnostic routines to check the keyboard.

If the keyboard is not properly plugged in, go to Step 2.

2. Turn OFF the power as detailed in "After First Attempt".
3. Plug the keyboard cable connector into the keyboard connector on the MPB.
4. Turn ON the computer again.

### **CHECK FOR DIAGNOSTICS ERRORS**

1. Check the display screen to see whether the power-on diagnostics routines have detected and indicated the presence of any memory error.
  - a. If no memory error message is displayed, but there is an interrupt failure message, go to step 2.

## BASIC TROUBLESHOOTING

- b. If any other errors are indicated, go to step 2.
- c. If the computer has been reconfigured for the purpose of troubleshooting, it is necessary to restore the machine step by step to full configuration, retesting at each incremental buildup to determine whether the addition of any specific component causes any malfunction.
- d. The computer has been reconfigured if any of the following steps were performed:
  1. Configuration switch settings were changed as a result of the check in step 6 of "After the First Attempt".
  2. Expansion adapter boards were removed in step 2 "After Second Attempt".
  3. Parallel or serial port devices were disconnected in step 3 of After Second Attempt.
  4. Configuration switches were changed to restrict the memory test to the minimum 256KB in step 5 of "After Second Attempt".
- e. If the computer was reconfigured, and has not yet been restored and retested at full configuration, go to step 1 in the Restore Full Configuration section.
- f. If the computer was not reconfigured, or has been restored step by step to full configuration and retested, go to step 3.
  2. If the message "Interrupt Failure" is displayed, a MPB failure is indicated. See "Service Diagnostics" to continue diagnosing the condition.
  3. If the message Error in "Expansion Memory" is displayed on the screen, hardware parity must be checked by removing the expansion memory

board testing each increment separately.

4. If the message "Error in Base Memory" is displayed, an error in lower 128 RAM is indicated. This RAM is soldered into the main processor board; therefore, the board should be replaced to assure the problem has been corrected.
5. If the error message "1701" is displayed on screen an error in the fixed disk is indicated. This may be due to: fixed disk not connected, device defective, fixed disk controller defective or no power to device.
6. If the computer now appears to be operating properly in all respects at full configuration (the power-on diagnostics have displayed no error, the operating system is booted from the diskette, and the system prompt, A> (or other), is displayed), the procedure to recover from a nonoperative condition has been completed successfully.
7. If the computer is still not functioning properly, use either of the diskette-based sets of diagnostic routines to attempt identification of the problem.

## RESTORE FULL CONFIGURATION

### TEST TOTAL MEMORY

1. If the configuration switches indicating the amount of memory were set to the minimum 256 KB, raise the setting in minimum KB increments until the actual total amount of memory installed in this computer is indicated. Retest after each incremental setting to determine whether any problem exists with any specific bank of memory.

If the amount of memory indicated on the screen as tested is less than the total amount installed, go to step 2.

## **BASIC TROUBLESHOOTING**

If all memory installed in the computer has been successfully tested, go to Test CRT And Disk Drives.

2. Increase the amount of memory indicated by the configuration switches by minimum increments and retest by performing the following sequence of actions:
  - a. Turn OFF the power.
  - b. Take out any adapter board which interferes with access to the MPB configuration switches.
  - c. Set the configuration switches to indicate the next higher increment of memory (see Chapter 8 for proper switch settings).
  - d. Replace the adapter board, if removed for access to the switches.
  - e. Turn ON the computer again.

### **TEST CRT AND DISK DRIVES**

1. Observe whether any characters and/or the cursor are displayed on the screen. If they are not, use either of the diskette-based sets of diagnostic routines to attempt identification of the problem.

If the cursor and/or characters (other than a diagnostic error message) are displayed, go to Step 2.

2. If a fixed disk drive unit is installed, and currently attached (it might have been temporarily disconnected for an earlier test), listen for the whirring noise that the drive makes when it is rotating. The drive should be rotating all the time the processing unit is turned on.

If the fixed disk drive, installed and attached, is not active and running as it should be, check the fixed disk controller board switches to see if they are set correctly (see Chapter 8 for proper switch setting).

If the switch settings are correct, use either of the diskette-based sets of diagnostic routines to attempt identification of problem.

Disconnect the fixed disk if it is not operating properly. When all of the connections and switch settings are correct, proceed to step 3.

If no fixed disk drive is installed and attached, or if the drive is active and running properly, proceed to step 3.

3. Check whether a diskette was inserted in disk drive A, with the drive access lever turned to enable the drive, prior to the start of the current test pass. If so, observe whether the drive active light is on.

If the drive is loaded and active, proceed to step 5. If no diskette is in the drive, or if the drive or the drive active is not on, proceed to step 4.

4. Restart the test with the disk drive properly loaded by the following steps:
  - a. Turn the computer power switch OFF
  - b. Insert a backup copy of an NCR-DOS (or other) operating system diskette into drive A. The problem being diagnosed could destroy data on a diskette, so be sure to use a back-up copy.
  - c. Turn the drive lever clockwise to enable the drive.
  - d. Turn ON the computer again.

## **BASIC TROUBLESHOOTING**

5. Observe whether any indication of a problem exists, e.g. an error message on the screen or some other indication of error. At the conclusion of the power-on diagnostics, the operating system should be booted into the computer and the system prompt A> (or other) should be displayed.

If any problem is visible, or if the operating system is not properly booted in, proceed to step 6 to retry the process with the backup diskette.

If everything appears to be working properly, continue the process of restoring the machine to full configuration.

6. If this step has previously been performed (that is, the backup diskette has already been used), use either of the diskette-based sets of diagnostic routines to attempt identification of the problem.

If this step has not been done yet and a backup copy of the operating system diskette (or a diskette for a different operating system) is available, do the following:

- a. Turn OFF the computer power switch.
- b. Insert the backup (or alternate) operating system diskette into Drive A.
- c. Turn the drive lever clockwise to enable the drive.
- d. Turn ON the computer again.

## **REINSTALLING THE EXPANSION ADAPTER BOARDS AND PERIPHERALS**

To return the computer to full configuration step by step, reinstall one at a time the expansion adapter boards and peripherals removed or disconnected in tests. This procedure will isolate any problem which exists to one adapter board or peripheral device.

The technique requires reiteration of this and other steps as many times as there are expansion adapter cards or port-connected peripherals.

If some action taken during the procedure, such as making connections secure or correcting configuration switch settings, has cleared up the problem(s) which required this effort, the steps of the Check For Diagnostics Errors section will have completed the troubleshooting procedure.

A recommended Sequence for re-installing expansion adapter cards and/or peripheral devices is:

1. Memory Expander Board - If it was not re-installed in the memory test, follow the instructions in Test Total Memory for accessing the additional memory in 64 KB increments.
2. Flexible Disk Drive Expander Kit.
3. Fixed Disk Drive adapter board and connections to the drive(s).
4. Printer connected to the parallel port.
5. Printer or other device connected to the serial port - Note that this requires changing of the configuration switch settings to show the serial port enabled as COM1.
6. Asynchronous Communications Adapter Board and attached peripheral(s).
7. Any other expansion adapter board.

When re-installing an expansion adapter card or port-connected peripheral, follow the procedures outlined in the Chapter 6 "Removal/Replacement" of this manual.

If the configuration switches must be changed, see Chapter 8 "Strapping Information" for proper switch settings. Refer to the instructions in the Chapter 6

## *BASIC TROUBLESHOOTING*

"Removal/Replacement" for removing and replacing boards, if necessary, for access to switches.

Then turn ON the computer again.



**Level 0 Diagnostics**

This chapter details the tests that are performed during the execution of the automatic power-on diagnostic routines that are contained in the ROM of the NCR Personal Computer. These diagnostics are initiated before any other activity is attempted each time the computer is turned on.

Normal messages and error messages which may be displayed on the screen are shown. Error codes which are issued via the Main Processor Board (MPB) parallel port are also listed. These error codes are shown if the screen error messages are not displayed because of malfunction.

The action to take for each specific error condition is suggested.

It is recommended to log all tests that are running as soon as the computer is switched on.

**MEMORY TEST**

Each time the power is turned on, the ROM program performs a self-diagnosis that includes a check of the Dynamic Random Access Memory (DRAM) resident on the MPB and on the memory expansion board if present. Other MPB components and the keyboard are also tested. The following occurrences are normal:

1. A whirring motor noise from the disk drive is heard.
2. A blinking cursor appears on the screen.
3. The memory test is conducted in 64 KB increments.

## LEVEL 0 DIAGNOSTICS

In normal operation, the upper boundary of the bank of memory tested is displayed in the upper left-hand corner of the screen; at successful completion of the test of each bank, the following screens appear:

MEMORY TEST

64K

MEMORY TEST

128 K

MEMORY TEST  
192X

.See Note Following

MEMORY TEST  
256X

.See Note Following

**NOTE**

Memory banks on the "Alternate" MPB higher than 256KB are tested, and their upper boundaries displayed, only if the configuration switches (switch 1 and 2 of switch block A, SWA, on the MPB are set to indicate that a higher total amount of memory (640 KB) is present. The memory diagnostic routine tests up to the size set in the switches.

The early-type MPB contains one switch block including 8 switches 2 of them are for memory setting. The maximum size of memory to be set are 256 KB.

If a Main Processor Board error is found or a software memory error is identified in the first 64KB, the processor is looping in this test routine. If this occurs, refer to chapter 2 "Basic Troubleshooting" of this manual and follow the procedures detailed there.

If a software memory error is found above 64KB, the message MEMORY ERROR is displayed and the memory size in the diagnostic routine work area is set to the size of the error-free amount of RAM (to the nearest increment) and the next test in the diagnostic routines is started.

As soon as the processor is in the Level 0 Loop mode it does not continue the test run, but enters HOLD. If a Parity Error occurs in the first 64KB only one error message is issued as an LED code on the parallel port. An error occurring in the memory area of 64KB to 640KB is issued as an error message in the form of an LED code and additionally it is displayed on the screen (e.g. PARITY ERROR MAIN BOARD). The same message appears if the Level 0 Loop is run on the Memory Extension Board (PARITY ERROR EXTENSION BOARD).

### **OTHER MPB TESTS**

Other MPB components are tested. These include:

- o The 8088 Central Processing Unit (CPU) IC.
- o The 2764 Erasable-Programmable Read-Only Memory (EPROM) IC. This IC contains the Basic I/O System (BIOS). BIOS has two major sets of components: the power-on diagnostics/initialization routines; and the device handling routines. Since this is a ROM IC, testing cannot include writing to the IC. The test, therefore, consists of reading the IC, calculating a checksum, and comparing the checksum with that recorded on the IC when it was programmed.
- o The 8237A Direct Memory Access (DMA) Controller.
- o The 8253 Timer.
- o The 8259 Programmable Interrupt Controller.

### **KEYBOARD TEST**

The keyboard interface is tested to verify that a keyboard which can communicate with the processor is attached.

The speaker in the computer ( on the MPB) should sound a single audible tone ("beep") to indicate successful conclusion of the keyboard test and start of the initialization and booting phase.

If no beep is heard, refer to chapter 2 "Basic Troubleshooting" and follow the procedures given.

### **INITIALIZATION AND LOADING**

If all the above tests have been successfully completed, a beep and the message **LOADING** appears to signify the initialization portion of the power-on routines is begun. The initialization includes:

## *LEVEL 0 DIAGNOSTICS*

- o Zeroing of DRAM memory
- o Setting up in DRAM memory the tables and control information (flags, vectors) needed by the operating system.
- o Loading and (booting) the operative system from the diskette in drive A (normally) and transferring control to the operating system coding.

At the conclusion of the initialization and loading process, the operative system should display the system prompt A>. The computer is now ready to run any application or other software.

### **NOTE**

The message DISK ERROR, INSERT SYSTEM DISK AND PRESS ANY KEY TO TRY AGAIN is displayed if the boot disk is missing or improperly formatted.

### **ERROR RETURNS**

If no activity (disk drive motor noise, blinking cursor, memory test) occurs after the computer and the peripherals are turned on, try the following:

1. Turn OFF the power switch.
2. Check that your wall outlet is working properly (use a lamp that you know works).
3. Turn ON the computer again.
4. If the test is still not successful, turn to chapter 2 "Basic Troubleshooting" of this manual and follow the procedures detailed there.

If an audible tone ("beep") is heard after the memory test, and the system prompt is not displayed (or if the message KEYBOARD ERROR is displayed), go to the

"Check Keyboard" section of chapter 2 "Basic Troubleshooting".

#### **PARALLEL PORT ERROR CODES**

The power-on diagnostics/initialization routines also issue a set of two character hexadecimal codes to the MPB parallel port. These enable a technician to attach the Parallel/Serial Test Adapter (see "Tools", Chapter 1) and/or an oscilloscope to the parallel port and display these codes to obtain an indication of hardware problems and status. This technique is quite valuable when, for any reason, the programs are unable to display messages on the screen.

#### **LEVEL 0 LOOP TESTS ON GENERIC PROCESSOR BOARD**

After turning on the computer its hardware is tested in a sequence of test routines before booting the operative system. There exist two groups of tests, the first group is always run, whereas the second group is only executed when Level 0 Loop has been selected. After completion the test sequence is concluded by the booting procedure, if no Level 0 Loop mode has been chosen.

With the Keyboard Adapter (See "Tools", Chapter 1) plugged or the disk drives disconnected from the MPB the Level 0 Loop Diagnostics are selected. The Parallel/Serial Test Adapter (see "Tools", Chapter 1) is provided with 8 LEDs on which error messages are issued as error codes (see Fig. 1-3 "Table of Error Messages" Before selecting the Level 0 Loop Mode the jumpers 3 and 4 of the SWA switch block on the "Alternate" MPB have to be in ON position and the Parallel/Serial has to be plugged into the respective receptacle.

As soon as the Level 0 Loop Diagnostics encounters an error while running the test, the test procedure is repeated and the respective error message is issued on the LEDs or displayed and/or on screen.

# LEVEL 0 DIAGNOSTICS

Error Codes	Test Description	Screen Message	Notes	Corrective Actions
76543210				
0000000X	8088 Register Test	U8	Processor is entering HOLD	Replace U8 or MPB
0000000X	EPR0M Checksum Test	U14	See Note #1	Replace U14
0000000X0	System I/O Test	MPB	See Note #1	Replace MPB
00X0000X	DMA Controller Test	U31	See Note #1	Replace U31
00X0000X	Timer 0		See Note #1	
0000000X	Timer 1	U30	See Note #1	Replace U30 or MPB
0000000X0	Timer 2		See Note #1	
00000000X	Start Memory Refresh			No test, no actions
00X00000	Scan for TOP OF MEMORY			No test, no actions
00X0000X	RAM Test 00-64K		See Note #1	Replace RAMs in the resp. memory bank
00X0000X	Parity Error 00-64K		Processor is entering HOLD	Replace U59

Fig. 3-1 Error Messages \*) on Screen and LEDs (1 of 6)

\*) For PC41 with "Alternate" MPB installed only.



Error Codes	Test Description	Screen Message	Notes	Corrective Action
76543210				
00000000	Interrupt Test	INTERRUPT FAILURE	See Note #1	Replace U25
00000001	Wait for unexpected Interrupt	INTERRUPT FAILURE	See Note #1	Replace U25
00000002	Wait for expected Interrupt	INTERRUPT FAILURE	See Note #1	Replace U25
00000003	RAM Test 64-128KB	MEMORY TEST 64KB	See Note #2	Replace RAM acc. to memory configuration and error message or
00000004	128-196KB	128KB	" " #2	" "
00000005	196-256KB	196KB	" " #2	" "
00000006	256-320KB	256KB	" " #2	" "
00000007	320-384KB	320KB	" " #2	" "
00000008	384-448KB	384KB	" " #2	" "
00000009	448-512KB	448KB	" " #2	" "
0000000A	512-576KB	512KB	" " #2	" "
0000000B	576-640KB	576KB	" " #2	" "
0000000C	Parity Test	PARITY ERROR ON MAIN PROCESSOR BOARD	Processor is entering HOLD	Replace U68 U77, U86 or MPB

Fig. 3-1 Error Messages on Screen and LEDs [2 of 6]

## LEVEL 0 DIAGNOSTICS

Error Code	Test Description	Screen Message	Notes	Corrective Action
76543210				
00X000X	Parity Test	PARITY ERROR ON EXPANSION BOARD	Processor is enter- ing HOLD	Replace Expansion Board
XXXX0000	Clear RAM/Setup temporary/Stack for Boot			No test, no corr. action
00X0000	Flex Disk Con- troller Farady IC	FLOPPY DISK CONTROLLER FAILURE	U46	Replace U46
000000X	Serial Control- ler Test	SERIAL I/O TROLLER FAILURE	Switch 3 on SWA must be ON. This test is only run in the Level 0 Loop mode. See Note #1	Replace U1 or MPB
000000X	Serial Port Test	SERIAL PORT FAILURE	Switch on SWA must be ON. This test is only run in the Level 0 Loop mode. See Note1#	Replace MPB

Fig. 3-1 Error Messages on Screen and LEDs (3 of 8)

Error Codes	Test Description	Screen Message	Notes	Corrective Action
78543210				
0XXXX000	Parallel Port Test	PRINTER PORT FAILURE	Switch 4 on SWA must be ON This test is run in the Level 0 Loop mode. Processor is entering HOLD.	Replace MPB
0X00000X	Keyboard Test	KEYBOARD ERROR	In the Level 0 Loop mode the keyboard connector or test adapter must be plugged. Otherwise test run is continued	Replace MPB or keyboard
00X00000	Display Loading	LOADING		No Test
0X0X0000	Set Interrupt Controller			No Test
000X00X0	Configure Parallel Ports			No Test
000X000X	Configure Parallel Ports			No Test

Fig. 3-1 Error Messages on Screen and LEDs (4 of 8)

## LEVEL 0 DIAGNOSTICS

Error Codes	Test Description	Screen Message	Notes	Corrective Action
76543210				
XXXXXXXX	Enable Parity			No Test
00000000	Configure Keyboard			No Test
00000000	Configure Disk			No Test
00000000	Configure Game Card			No Test
0000000X	Determine if Coprocessor is present	SWITCH SETTING COPROCESSOR, BUT INDICATES NO COPROCESSOR IS DETECTED	U5	Replace U5 or MPB
00000000	Initialize ROM Drives (including fixed disk)			
0000000X	Hipo Test	(XP) EXTRA PERFORMANCE OPTION IS NON-FUNCTIONAL	In Level 0 Loop processor remains in this test; otherwise the following tests are run.	Replace MPB
00000000	Set up Drives	ADVANCED QUAD FLEX DISK CONTROLLER CARD INSTALLED	This message is displayed only with this controller installed	No Test

Fig. 3-1 Error Messages on Screen and LEDs (5 of 8)

Error Codes	Test Description	Screen Message	Notes	Corrective Action
76543210				
XXXXDDDD	Boot	DISK ERROR, INSERT SYSTEM DISK AND PRESS TO TRY AGAIN	This message is displayed if startup was tried with a non-system disk or no disk present.	

Fig. 3-1 Error Messages on Screen and LEDs (6 of 8)

Note #1 Processor is looping in the respective test

Note #2 The following format is additionally displayed on the screen:

```
MEMORY ERROR
  ADDRESS = XXXX:XXXX
  EXPECTED =XXXX
  ACTUAL  = XXXX
```

The error codes shown in Fig. 3-1 are valid for the ROM BIOS 3.5 (150-0002348) only. This ROM BIOS can also be contained in the early-type MPB.

## LEVEL 0 DIAGNOSTICS

### ERROR MESSAGES OF THE EARLIER-TYPE MPB \*

If a ROM.BIO 2.3 version 017-00xxxxx is concerned the Level 0 Loop mode is running when:

1. S1 on switch block is in ON position  
(refer to Chapter 8 "Strapping Information")
2. Fixed disk controller is disconnected

---

Error Code**	Test Description	Screen Message	Notes
78543210			
<hr/>			
X0X0X0X0	8088 Register Test		Processor entering HOLD
X0X0000X	EPROM Checksum Test		Processor entering HOLD
X0X000X0	DMA Controller Test		Processor entering HOLD
X0X0000X	8253 Timer Test		Processor entering HOLD
X0X0X000	RAM Test 00 - 64KB		Processor entering HOLD
	64 - 640KB	MEMORY TEST end/or MEMORY ERROR	Firmware not halted
X0X0X000	Parity Error	ERROR IN BASE MEMORY or ERROR ON EXPANSION BOARD	Processor entering HOLD

---

Figure 3-2 Error Codes on LEDs and Screen (1 Of 2)

\* Early-type Main Processor Board (017-0044046)

\*\* on the LEDs of the Test Adapter (Chapter 1 "Tools")

Error Code	Test Description	Screen Message	Note
78543210			
X000X0X	Interrupt Controller Test	INTERRUPT FAILURE	Processor entering HOLD
X000X0X	Keyboard Test	KEYBOARD ERROR	Firmware not halted
X000X0X	Display of Load	LOADING	No test
X000X0X	Configuration for Parallel Port		No test
None	Fixed Disk Test Error in Fixed Disk	1701	Fixed Disk not connected, device defective, controller defective

Fig. 3-2 Error Codes on LEDs and Screens (2 of 2)

**SUGGESTED ACTION**

For some of the error conditions which can occur during the automatic running of the power-on diagnostics routines, the indication has been given in this chapter to go to the Troubleshooting Nonoperative Generic Systems chapter of this manual.

This tactic is generally appropriate when the problem appears to be in the RAM memory, or if the problem may be in any component added to the original main computer either by addition of an expansion adapter card or by plugging a cable into either the parallel port or the serial port on the MPB.

## LEVEL 0 DIAGNOSTICS

The Troubleshooting Nonoperative generic systems chapter gives detailed instructions for removing add-on memory and/or other devices to return the computer to the original status, then for restoring the machine to full configuration one step at a time. This procedure can isolate problems to a specific device.

Where the problem is indicated to be in one of the key MPB ICs (Processor, EPROM, DMA controller, Timer, Interrupt controller), the procedures in the Troubleshooting Nonoperative Generic Systems chapter are not likely to help.

Rerun the power-on process from completely OFF as described in this chapter two or three additional times to ensure that the error indication is "hard", i.e., it consistently repeats the identical message, code, etc.

When a problem appears to be definitely located in one of the pluggable MPB ICs the next step is disassemble the unit by removing the cabinet as shown in the Removal/Replacement chapter of this manual. Read and heed all warnings and cautions in that chapter before working on the computer with the cabinet removed.

In some cases, more positive seating of the IC can be accomplished either by gently but firmly pushing on it (discharge static first by touching a finger to the frame or to a board support standoff) or by very carefully removing the IC concerned, inspecting and, if necessary, straightening the pins, and reinserting the IC in its socket. After reassembling the cabinet, retry the power-on procedure.

### NOTE

When handling ICs on boards observe ESD Precautions. Wrist straps (with 1Megohm resistor) are required when handling any unprotected IC or PCB or when working on equipment without cabinetry.



If the attempt to improve the IC seating does not help, or if a hard error is indicated in a soldered-in IC (Timer, Interrupt Controller), the MPB must be removed from the computer and either replaced or repaired.

Follow the instructions in the "Cabinet" and "MPB" sections of Chapter 6 "Removal/Replacement". When the MPB has been removed, it can be taken to an NCR service facility or NCR-authorized dealer for repair or replacement.

(Repair of the MPB can be successfully done only by a well-trained field engineer or technician, since it involves unsoldering the defective component from a multi-layer PC board, and then soldering the new component into the same location on the same multilayer PCB. The danger that the heat of the desoldering/soldering may damage the printed circuits is considerable).



**LEVEL 1 DIAGNOSTICS**

This chapter tells you how to use the SERVICE DIAGNOSTICS diskette which is in the back of this manual. These diagnostics, also referred to as Level 1 Diagnostics, are the most comprehensive set of test routines supplied and supported by NCR for the NCR PERSONAL COMPUTER Model 4i.

Following the instructions in this chapter, the field engineer or technician interacts with the SERVICE DIAGNOSTICS software to test all or selected components of the computer. The software presents a hierarchy of menu selection screens on the CRT to simplify the choice of tests to perform. For all menu screens, corresponding HELP screens are available to further explain the purposes of the tests which may be selected.

Each menu and HELP screen is shown in this chapter, along with the results of each selection path chosen (the next level menu screen, or a completion screen). How to begin the testing, and how to terminate it, are described.

**HOW TO BEGIN TESTING****LOAD THE DISKETTE**

1. Make certain the power cord is plugged into the back of the processing unit.
2. Make certain that the processing unit power cord is plugged into a properly grounded wall outlet.
3. Make certain that the power cords for any currently-attached external devices (printer, etc.) that have separate power cords are plugged into properly grounded wall outlets.
4. Insert the SERVICE DIAGNOSTICS diskette into drive A.

**NOTE**

Use a back-up copy of the diskette included in the manual; the possibility exists that a problem with the computer could destroy the data on the disk.

5. Turn the drive access lever clockwise to enable the drive.
6. Turn ON any currently-attached external devices that have separate power cords and switches (unless the device installation instructions specified that the device be turned on after the processing unit).
7. Turn the computer.
8. Turn ON any currently-attached external devices that were specified to be turned on after the computer.

The BIOS ROM power-on diagnostics/initialization routines perform the power-on testing that occurs each time the machine is turned on, then DOS is loaded and the date and time should be entered. The Diagnostics Shell is then loaded.

**MAIN MENU**

The main menu is displayed each time the SERVICE DIAGNOSTICS diskette is booted in, and each time the user chooses to return to the main menu at the completion of a specific test.

The main menu gives the operator the following categories of choices:

- o Run All Tests (Press <F7>)
- o Run All Tests Continuously (Press <F8>)
- o Test A Specific Component (or type) (Menu items 1 to 11)

- o Run Utilities (Press <F6>)
- o View Main Menu HELP screen (Press <F1>)
- o Initiate A Continuous Test Run (Press menu item number and <F8>)

The following diagram illustrates the structure of the diagnostic system:

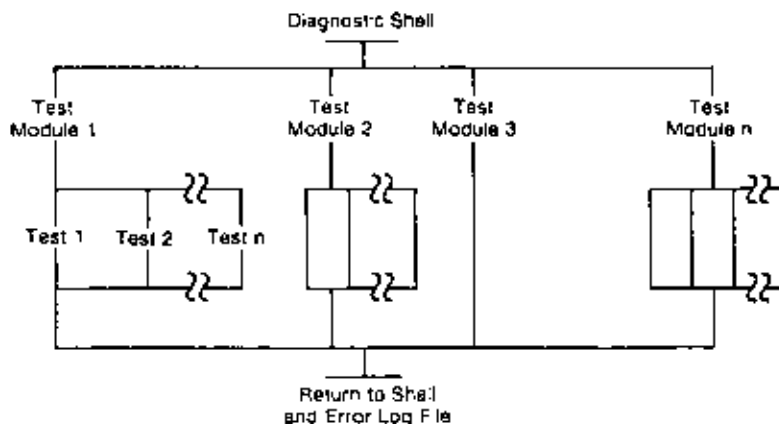


Fig. 4-1 Diagnostic Structure Diagram

The screens shown in this chapter may vary slightly depending on the version of diagnostics being used.

The Main Menu, as it appears on the display screen, is as shown:

The NCR Personal Computer  
Diagnostic Shell Version 1.0  
Copyright 1984,1985 NCR Corp.

Page 1 of 2

## MAIN MENU

## Available Tests

1	Memory	
2	Controller (Circuit Board)	PASSED
3	Keyboard	
4	380KB Flexible Disk Drive(s)	
5	Fixed Disk Drive	
6	Monochrome Display	FAILED
7	Color/Graphics Display	
8	Peripherals	

<F1>	Explanation of Tests	<F7>	Run All Tests Once
<F2>	Utilities	<F8>	Run All Tests Continuous
<F3>	Add/Delete Tests to Main Menu	<PgUp>	Previous Page
<F10>	Exit to DOS	<PgDn>	Next Page

Press selection and <Enter> for running test once OR  
Press selection and <F8> for continuous run of selection (<F4> to stop)  
SELECTION =>

Page 2 of the Main Menu, containing items 9 to 11, is accessed by pressing the <PgDn> key.

The NCR Personal Computer  
Diagnostic Shell Version 1.01  
Copyright 1984,1985 NCR Corp.

Page 2 of 2

## Available Tests

## MAIN MENU

09 High Speed (XP)  
10 Tape Drive  
11 BTX

<F1>	Explanation of Tests	<F7>	Run All Tests Once
<F2>	Utilities	<F8>	Run All Tests Continuous
<F9>	Add/Delete Tests to Main Menu	<PgDn>	Previous Page
<F10>	Exit to DOS	<PgDn>	Next Page

Press selection and <Enter> for running test once OR  
Press selection and <F8> for continuous run of selection (<F4> to stop)  
SELECTION =>

All highlighted tests except HIGH SPEED (XP) are available for your system.

To add/delete tests to/from the Main Menu, press the <F9> key.

If the <F7> key is pressed, each test (1 through 11) listed on the menu is automatically run in sequence, starting with the memory test. The test, for any device (fixed disk, color/graphics display, etc.) which is found by the diagnostic routines not to be present, is skipped.

To select any specific test, type the number for that test and press ENTER.

To run any test continuously, type the number and press the <F8> key. That will be run continuously until <F4> is pressed. If no test number is selected before the <F8> key is pressed, the series of tests 1 through 11 is repeated continuously until <F4> is pressed.

Press the <F6> key to access a set of utility routines. These utilities perform functions that are related to or needed during diagnostic or maintenance operations.

The utility functions available include:

- o Error Log Maintenance
- o Initialize Fixed Disk
- o Position Head For Relocation
- o Alignment Utilities (for video displays and fixed disk.)
- o Speed Check (for flexible disk drives)

#### **MAIN MENU HELP SCREENS**

To obtain more information about main menu choices without referring back to this chapter while running the diagnostics, press the <F1> key. The main menu HELP is displayed:

## LEVEL 1 DIAGNOSTICS

Memory - Test for RAM pattern, RAM address, RAM parity and FIRMWARE checksum.

Controllers - Tests for a CPU, DMA, interval timer, interrupt, CPU controller, CRT, and serial controller.

Keyboard - Tests the keyboard port, each keyboard key and its associated code.

Flexible disk drives - Tests for read only and read/write operation of each flexible disk drive.

Fixed disk drive - Tests for read only and read/write operation of the disk and for the fixed disk controller.

Monochrome display - Tests the CRT RAM, cursor addressing, the ASCII character set, the scroll register and various monitor attributes.

Color/Graphics display - Tests the CRT RAM, cursor addressing, the ASCII character set, the scroll register and various monitor attributes.

Peripherals - Tests the parallel and serial ports and an optional printer.

<F3> Return to previous menu

### TEST COMPLETION DISPLAYS

When a test is completed, the diagnostics routines display either a PASSED message or a detailed coded error message. Chapter 5 Level 1 Diagnostics Error Returns, explains all of the possible error messages and the suggested action to take for each.

RAM ADDRESS

PASSED

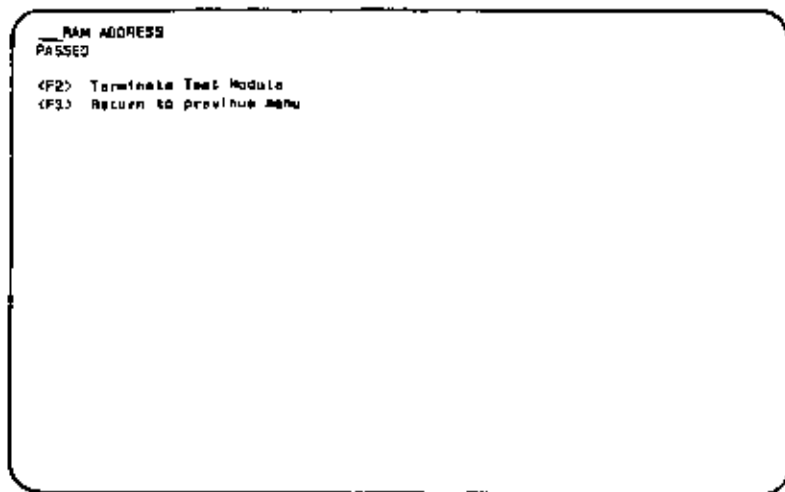
<F2> Terminate Test Module

<F3> Return to Previous Menu



Examples of completion displays are:

### Successful Completion



In the example shown, the RAM Address test, one of the memory tests included in selection 1 of the menu has run and that part of the memory has passed the test procedures.

If the selection was made and the Enter key pressed, a MEMORY menu is displayed and a test selection must be made pressing the Enter key pressed again. If the selection of memory was made and the <F8> key was pressed, the tests run continuously until the <F4> key is pressed.

## LEVEL 1 DIAGNOSTICS

### Unsuccessful Completion

```
FLEX:03:80  (data)  (time)
DV  RTY  STD  ST1  ST2  TRACK HEAD SECTOR DENSITY
6   00   XX   XX   XX   XX   XX   XX   XX   XX
```

In this example, flexible drive B failed the Write test, part of the Flexible Disk Drive test (selection 4 of the main menu). It failed because the flexible disk controller (FDC) failed to respond.

The major error codes (03 = flexible disk drive write error) and detail error codes (80 = FDC failed to respond), and the abbreviations and values on the next two lines, are explained in Chapter 5, Diagnostics Error Returns.

### DIAGNOSTIC SELECTIONS

The following sections describe the results of each selection chosen from the main menu. Specific device, or device type, menus, HELP screens accessed from the device menus, and each test chosen from a device menu, are shown. The display upon completion of each test or sub-test has the PASSED or FAILED messages which are clear from the screen as the next message is displayed. All error messages are retained in the Error log file for reference.

**RUN ALL TESTS ONCE (FUNCTION KEY <F7>)**

When the <F7> key is pressed from the main menu screen, the separate tests for specific devices (selections 1 through 11) are automatically run in sequence. The test for any device (fixed disk, color/graphics display, etc.) which is determined by the diagnostic routines to be not present is skipped.

**CAUTION**

The flexible disk diagnostic tests are destructive to the data on any diskette other than the diagnostic diskette. BEFORE CONTINUING, ensure that no diskettes other than the diagnostics diskette and/or formatted scratch diskette(s) are inserted in the flexible disk drive(s). If any other diskette is left in, data and/or program on it will be written over by test patterns. The program does not stop again after this point. If no formatted disks are available, and one or two are needed at this point, exit from the diagnostics routines (press <F10>), load the DOS diskette, and follow the instructions in the DOS manual to format as many diskettes as you need. When finished, return to the diagnostic routines and select the RUN All Tests selection (press <F7>).

**Automatic Completion**

The program displays the message PASSED after successful completion of each test or sub-test in the same format as with individual tests. The main menu does not remain on the screen.

The appropriate message is displayed after the test or sub-test during which the error is detected; however, the program does not stop. The program runs to successful or unsuccessful completion of all tests regardless of test results. The diagnostics will return to the main menu upon completion of the tests.

Upon completion the messages appear as shown in the sample screen below. In this sample, both the keyboard and the monochrome display failed in some aspect, and because there is no color display, there is no message for that menu selection.

```
The MCR Personal Computer                               Page 1 of 2
Diagnostic Shell Version 1.0
Copyright 1985 MCR Corp.

                                MAIN MENU

Available Tests

1  Memory                               PASSED
2  Controllers [Circuit Devices]        PASSED
3  Keyboard                             FAILED
4  380KB Floppy Disk Drive(s)           PASSED
5  Fixed Disk Drive                      PASSED
6  Monochrome Display                   FAILED
7  Color/Graphics Display
8  Peripherals                           PASSED

<F1>  Explanation of Tests              <F7>  Run All Tests Once
<F8>  Utilities                         <F8>  Run All Tests Continuous
<F9>  Add/Delete Tests to Main Menu    <PgUp> Previous Page
<F10> Exit to DOS                      <PgDn> Next Page

Press selection and <Enter> for running test once OR
Press selection and <F8> for continuous run of selection (<F4> to stop;
SELECTION =>
```

To see a record of any errors detected, select the utilities function (F6 key) and then select Error Log Maintenance ("3"). From the Error Log Maintenance Menu, select "1", Display Error Log, and press ENTER.

**MEMORY (MAIN MENU SELECTION 1)**

When selection number "1" is chosen from the main menu screen, the Memory tests menu screen is displayed:

```

The NCK Personal Computer                               Copyright 1985 NCK Corp.
                                                    MEMORY
                                                    Installed Memory - xxxx KB

Available Selections

1  RAM Pattern          - Writes and reads test Patterns to/from memory
2  RAM Address         - Verifies addressing in RAM
3  RAM Parity          - Checks the operation of RAM parity
4  RAM Walking Ones    - Writes and reads patterns of walking ones and zeros
5  FIRMWARE Checksum  - Performs a checksum test of the system FIRMWARE

<F1>  explanation of Selections
<F2>  Terminate Test Module

Press selection and <Enter> for running test once OR
Press selection and <F8> for continued run of selection (<F4> to stop)
SELECTION - >

```

Each of the five available tests is selected by entering the corresponding number (1 through 5). To run a specific test once, type the selection and press ENTER. To run the test continuously, type the selection and press the <F8> key. Press the <F4> key to stop a continuous run.

When the <F2> key is pressed, the program returns to the main menu.

**NOTE**

The Walking Ones Test will take considerably more time to run than the other tests. It will not be performed when the memory tests are run from the Main Menu (Selection 1, Function Key <F7> or <F8>). It must be selected from this menu.

## LEVEL 1 DIAGNOSTICS

### Memory Test HELP Screen

To obtain more information about the available memory tests, press <F1> to see the HELP screen:

RAM Pattern - Writes test patterns to check DRAM, data path and control circuitry.

RAM Address - Tests both segment addressing and low order addressing capabilities.

RAM Parity - Writes checkerboard patterns to all installed parity DRAM.

FIRMWARE Checksum - Verifies the firmware checksum

<F2> Return to previous menu

### RAM Pattern Test

If selection 1 of the Memory test menu is chosen, the RAM pattern test is run. The name of the test is displayed while the test is in progress:

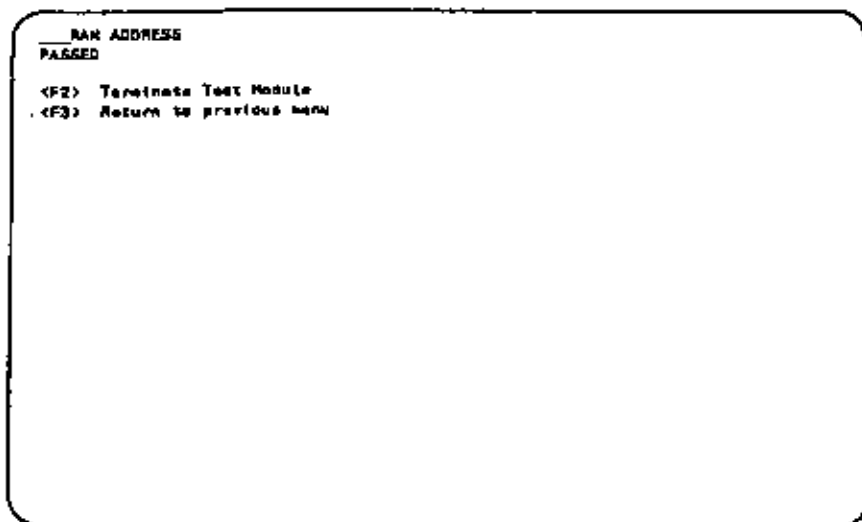
\_\_\_ RAM PATTERN  
PASSED

<F2> Terminate Test Module  
<F3> Return to previous menu

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 10 of this manual for a description of error messages and recommended corrective actions.

#### RAM Address Test

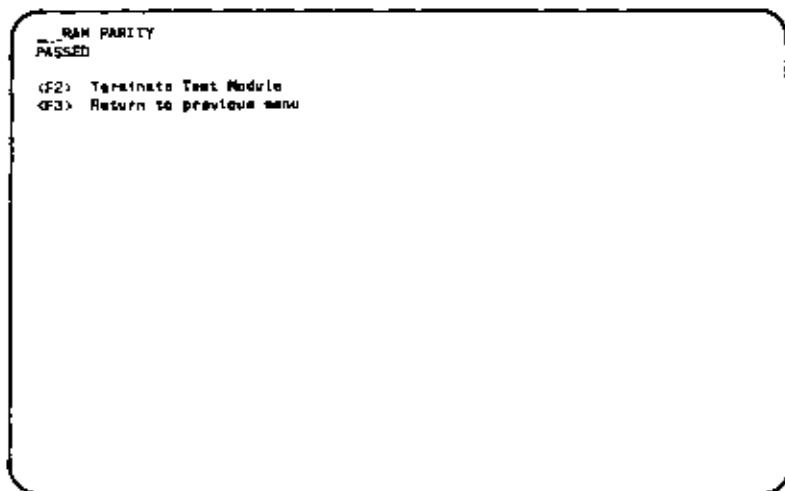
If selection 2 of the Memory test menu is chosen, the RAM Parity test is run. The name of the test is displayed while the test is in progress:



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### RAM Parity Test

If selection 3 of the Memory test menu is chosen, the Firmware Checksum test is run. The name of the test is displayed while the test is in progress:



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error message and recommended corrective actions.



**RAM Walking Ones Test**

If Selection 4 of the Memory Test Menu is selected, the RAM Walking Ones Test is run.

**NOTE**

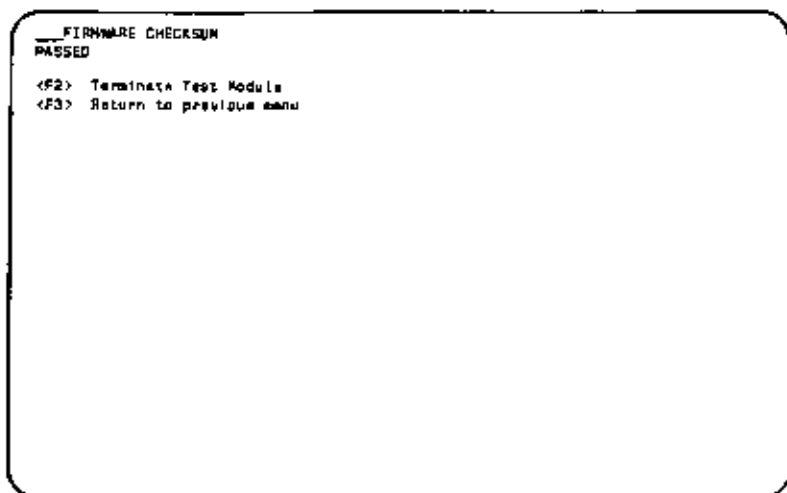
This test can only be run, after the three preceding RAM tests have been completed. Otherwise a warning is displayed.

A menu similar to the other memory test menus is displayed while the test is in progress. Upon completion of the test, either the passed message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of ERROR messages and recommended corrective actions.

IBM PC Personal Computer	Copyright 1984, 1985 IBM Corp.
MEMORY	
Installed Memory = 0256 KB	
___ RAM WALKING ONES	
PASSED	
[F2] Terminate Test Module	
[F3] Return to previous menu	

**FIRMWARE Checksum Test**

If selection 5 of the Memory test menu is chosen, the Firmware Checksum test is run. The name of the test is displayed while the test is in progress:



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

## CONTROLLERS (CIRCUIT DEVICES) (MAIN MENU SELECTION 2)

When selection number "2" is chosen from the main menu screen, the Controllers test menu screen is displayed:

The MCR Personal Computer		Copyright 1985 MCR Corp.
CONTROLLERS		
Available Selections		
1 CPU	- Tests the 8088-2 CPU chip	
2 DRAM	- Tests the Direct Memory Access controller	
3 Flexible Disk	- Tests the 8272 Flexible Disk controller	
4 Interval Timer	- Tests the 8253 timer and counter chip	
5 Interrupt	- Tests the 8259 interrupt controller	
6 CPU Controller	- Tests the VLSI CPU controller	
7 Monochrome CRT	- Tests the 6845 for monochrome operation	
8 Color CRT	- Tests the 6845 for color operation	
9 Serial	- Tests the 8250 serial controller	
<F1> Explanation of Selections <F2> Terminates Test Module		
Press selection and <Enter> for running test once OR Press selection and <F8> for continuous run of selection [<F4> to stop] SELECTION =>		

Each of the nine available controller tests is selected by entering the corresponding number, 1 through 9. If the F8 key is pressed after the number for a specific test is selected, that test is run continuously until <F4> is pressed. If the ENTER key is pressed after the number of a specific test is selected, the test will run once and stop. Press <F2> to return to the main menu.

## LEVEL 1 DIAGNOSTICS

### Controllers Test HELP Screen

To obtain more information about the available tests of the various Main Processor Board (MPB) and adapter card controller chips, press F1 to see the HELP screens:

CPU - Tests the execution of the instruction set

DMA - Verifies the DMA controller can be accessed and performs a partial functionality test.

Flexible Disk - Verifies the flexible disk controller can be accessed and performs a partial functionality test.

Interval Timer - Verifies the interval timer can be accessed and performs a partial functionality test.

Interrupt - Verifies the interrupt controller can be accessed and performs a partial functionality test.

CPU Controller - Verifies the VLSI CPU controller can be accessed by performing an internal test on the peripheral interface and the keyboard interface.

CRT - Verifies the CRT controller can be accessed and performs a partial functionality test.

Serial - Verifies the serial controller can be accessed and performs a partial functionality test.

<F3> Return to previous menu

### CPU Test

If selection 1 of the Controllers test menu is chosen, the CPU test is run. The name of the test is displayed while the test is in progress:

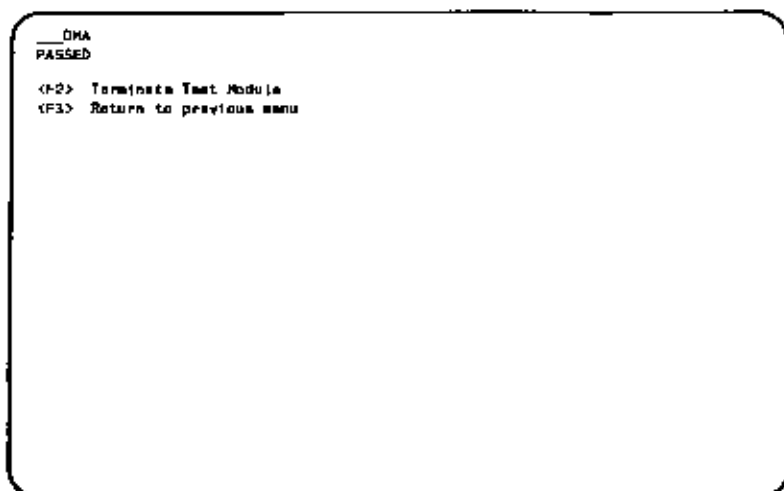
\_\_\_ CPU  
PASSED

<F2> Terminate Test Module  
<F3> Return to previous menu

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

#### DMA Test

If selection 2 of the Controllers test menu is chosen, the DMA Controller test is run. The name of the test is displayed while the test is in progress.



Upon completion of the test, either the PASSED message or an error message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### Flexible Disk Controller Test

If selection 3 of the Controllers test menu is chosen, the Flexible Disk Controller test is run. The name of the test is displayed as the test is in progress.

FLEXIBLE DISK

PASSED

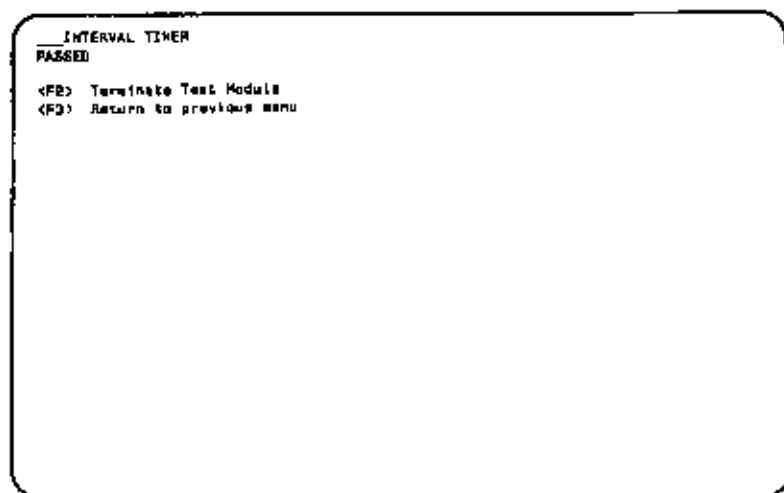
<F2> Terminate Test Module

<F3> Return to previous menu

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

**Interval Timer Test**

If selection 4 of the Controllers test menu is chosen, the Interval Timer test is run. The name of the test is displayed while the test is in progress.



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### Interrupt Controller Test

If selection 5 of the Controllers test menu is chosen, the Interrupt Controller test is run. The name of the test is displayed while the test is in progress.

```
INTERRUPT CONTROLLER  
PASSED  
  
<F2> Terminate Test Module  
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to chapter 5 of this manual for a description of error messages and recommended corrective actions.



**CPU Controller Test**

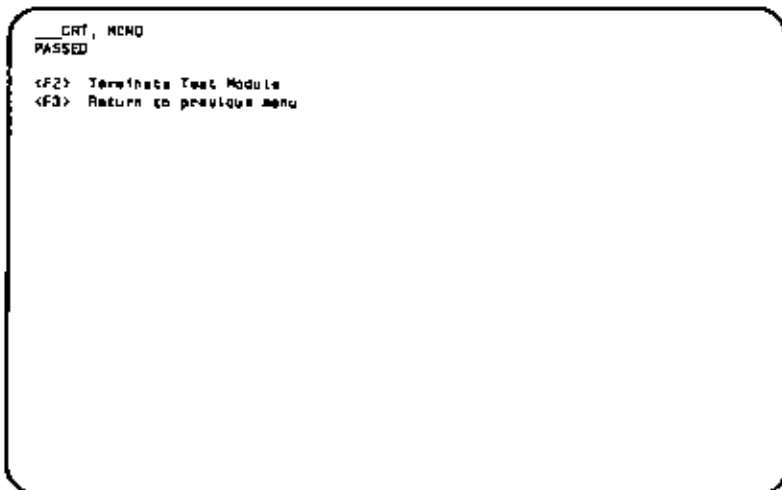
If selection 6 of the Controllers test menu is chosen, the CPU Controller test is run. The name of the test is displayed while the test is in progress.

```
___ CPU CONTROLLER  
PASSED  
  
<F2> Terminate Test Module  
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to chapter 5 of this manual for a description of error messages and recommended corrective actions.

### Monochrome Display Controller Test

If selection 7 of the Controllers test menu is chosen, the Monochrome Display Controller test is run, if the program senses the presence of a monochrome display adapter. If it does not sense the presence of a monochrome display adapter, the program redisplay the Controllers test menu. The name of the test is displayed while the test is in progress.



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

**Color/Graphics Display Controller Test**

If selection 8 of the Controllers test menu is chosen, the Color/Graphics Display Controller test is run, if the program senses the presence of a color/graphics display adapter. If it does not sense the presence of a color display adapter, the program redisplay the Controllers test menu. The name of the test is displayed while the test is in progress.

```
___ CRT, COLOR
PASSED

<F2> Terminate Test Module
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

## LEVEL 1 DIAGNOSTICS

### Serial Asynchronous Communications Controller Test

If selection 9 of the Controllers test menu is chosen, the Serial Asynchronous Communications Controller test is run. The name of the test is run. The name of the test is displayed while the test is in progress.

```
___SERIAL  
PASSED
```

```
<F2> Terminate Test Module  
<F3> Return to previous menu
```

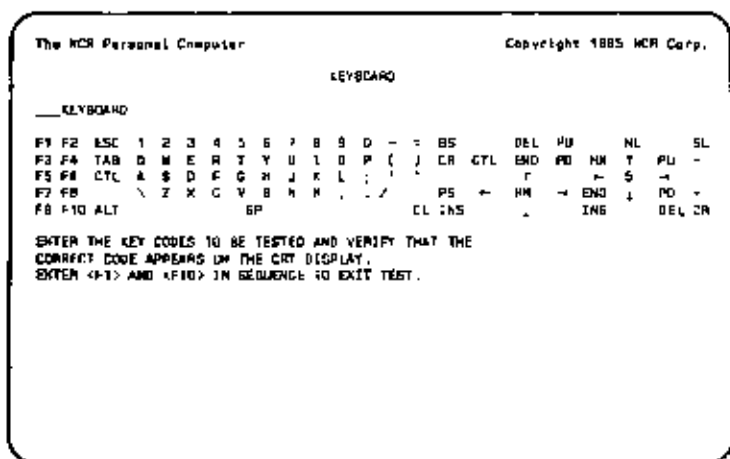
Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### KEYBOARD (MAIN MENU SELECTION 3)

When selection number "3" is chosen from the main menu screen, a message indicating a test of the keyboard port is displayed, followed by a line indicating a test of the keyboard and a pattern of rectangular blocks representing the positions of keys on the keyboard. The operator presses any or all keys while visually verifying that for each key the proper key value appears at the proper location in the pattern.

The last line in the display directs the operator to ENTER<F1>AND<F10>IN SEQUENCE TO EXIT TEST. Whether

any other keys have been pressed or not, pressing these two causes another message to be displayed. After all keys have been pressed, followed by the <F1>/<F10> entry, the display is similar to the screen shown:



An entry "Y" indicates a successful completion of the test and a message, PASSED, will be displayed. Press the <F2> key to return to the main menu.

An entry of "N" indicates unsuccessful completion and an ERROR message is displayed. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

## LEVEL 1 DIAGNOSTICS

### FLEXIBLE DISK DRIVE (MAIN MENU SELECTION 4)

When selection number "4" is chosen from the main menu screen, the Flexible Disk Drive test menu screen is displayed:

The MCR Personal Computer	Copyright 1984,1985 MCR Corp.
FLEXIBLE DISK DRIVE	
Number of Drives = 02	
Available Selections	
Read Only tests on available drives	Read/write tests on Available Drives
1 Drive A	5 Drive A
2 Drive B	6 Drive B
3 Drive C	7 Drive C
4 Drive D	8 Drive D
Note: To insure proper operation under all conditions, run the disk speed test in the utilities section of the Main Menu.	
<F1> Explanation of Selections	
<F2> Terminate Test Module	
Press selection and <Enter> for running test once OR	
Press selection and <F8> for continuous run of selection (<F4> to stop)	
SELECTION =>	

Each of the eight available tests is selected by entering the corresponding number (1 through 8). If the <F8> key is pressed after the number for a specific test is selected, that test is run continuously until <F4> is pressed. If the ENTER key is pressed after the number for a specific test is selected, the test runs one time and stops. When <F2> is pressed, the program returns to the main menu.

### Flexible Disk Drive Test HELP Screen

To obtain more information about the available flexible disk drive tests, press <F1> to see the HELP screen:

Read Only - Verifies an entire MCR PC standard format disk in one of the installed drives. To check disk rotational speed accuracy, execute the FLEETBLE DISK SPEED Utility.

Read/Write - Performs a format/write/read on selected sectors that are reserved by the diagnostic system in a DOS file. This is a destructive test on those reserved sectors. To check disk rotational speed accuracy, execute the FLEETBLE DISK SPEED Utility.

(F3) Return to previous menu

### Read Only Drive A Test

If selection 1 of the Flexible Disk Drive test menu is chosen, the Read Only test is run on drive A. The name of the test is displayed while the test is in progress:

```

READ ONLY, FLEETBLE DRIVE A
PASSED

(F2) Terminate Test Module
(F3) Return to previous menu

```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

## LEVEL 1 DIAGNOSTICS

### Read/Write Drive A Test

If selection 5 of the Flexible Disk Drive test menu is chosen, the Read/Write test is run on drive A:

```
___ READ/WRITE, FLEXIBLE DRIVE A  
PASSED
```

```
<F2> Terminate Test Module  
<F3> Return to previous menu
```

### CAUTION

The flexible disk diagnostics tests are destructive to data on any diskette other than the diagnostics diskette. BEFORE CONTINUING, ensure that no diskette other than the diagnostics diskette and/or a formatted scratch diskette is inserted in flexible disk drive A. If any other diskette is left in, data and/or programs on it will be written over by test patterns.

Press the space bar or any alphabetic or numeric key to continue.

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error message and recommended corrective actions.



**Other Flexible Disk Drives**

The selection of other tests on the Flexible Disk Drive menu causes the test selected to run in the same manner as the tests for Drive A. The messages are the same in all cases.

**FIXED DISK DRIVE (MAIN MENU SELECTION 5)**

When selection number "5" is chosen from the main menu screen, the Fixed Disk Drive test menu screen is displayed:

The NCR Personal Computer	Copyright 1985 NCR Corp.
FIXED DISK DRIVE	
Available Selections	
1 Read/Write Maintenance Track	- Destructive test to maintenance track
2 Read Only Sector Zero	- Read sector zero on each track
3 Read Only Entire Disk	- Read each sector on fixed disk
4 Read/Write Entire Disk	- Destructive test to entire fixed disk
5 Fixed Disk Controller	- Specific test to fixed disk controller
 <F1> Explanation of Selections	
<F2> Terminate Test Module	
 Press selection and <Enter> for running test once CR	
Press selection and <F8> for continuous run of selection [<F4> to stop]	
SELECTION ->	

Each of the five available tests is selected by entering the corresponding number (1 through 5). If the <F8> key is pressed after a specific test is entered, that test runs continuously until <F4> is pressed. If ENTER is pressed after the selection is made, the test runs once and then stops. Press <F2> to return to the main menu.

## LEVEL 1 DIAGNOSTICS

### Fixed Disk Drive Test HELP Screen

To obtain more information about the available fixed disk drive tests, press<F1>to see the HELP screen:

Prior to executing each specific test, the controller test is performed.

Read/Write Maintenance Track - Formats, writes, and reads the maintenance track.

Read Only Sector Zero - Verifies sector 0 of every track on disk.

Read Only Entire Disk - Performs a read only test on the entire fixed disk. This is a non-destructive test.

Read/Write Entire Disk - Writes and reads the entire disk. This is a destructive test; therefore, the NCR-DOS FDISK and FORMAT utilities must be run on the fixed disk before using the disk again.

Fixed Disk Controller - Performs a specific test on the Fixed Disk Controller.

<F3> Return to previous menu

### Read/Write Maintenance Track

If selection 1 of the Fixed Disk Drive test menu is chosen the Read/Write Maintenance Track test is run. The name of the test is displayed while the test is in progress:

The NCR Personal Computer

Copyright 1984,1985 NCR Corp.

#### FIXED DISK DRIVE

... READ/WRITE MAINTENANCE TRACK - DRIVE 00  
PASSED

<F2> Terminate Test Module

<F3> Return to previous menu

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### Read Only Sector 0

If selection 2 of the Fixed Disk Drive test menu is chosen, the Read Only Sector 0 test is run:

```
READ ONLY SECTOR 0 Drive XX  
PASSED
```

```
<F2> Terminate Test Module  
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

## LEVEL 1 DIAGNOSTICS

### Read Only Entire Disk

If selection 3 of the Fixed Disk Drive test menu is chosen. First a screen is displayed where you are requested enter the number of fixed disk to test.

```
The NCR Personal Computer                               Copyright 1984,1985 NCR Corp.

                               FIXED DISK DRIVE

    __ READ/WRITE ENTIRE DISK

Enter number of fixed disk to test
(0=First Fixed Disk, 1=Second Fixed Disk, etc.)
```

After selecting the number of the drive to be tested the Read Only Disk test is run:

```
                               FIXED DISK

    __ READ ONLY ENTIRE DISK
    (F4) Stop Testing

Drive__ 00                               Function__ READ
Head__ 00                                Cycle__ 0001
Track__ 0000
Sector__ 00

Surface errors:
Soft errors__ 0000
Hard errors__ 00

Total errors:
Soft errors__ 0000
Hard errors__ 00
```

In the above display, the drive number is 00 for the first integrated fixed disk drive or for the first external fixed disk drive if no integrated drive is present. Head number is increased by increments of 1 from 00 to 03 as the test proceeds. Track number for

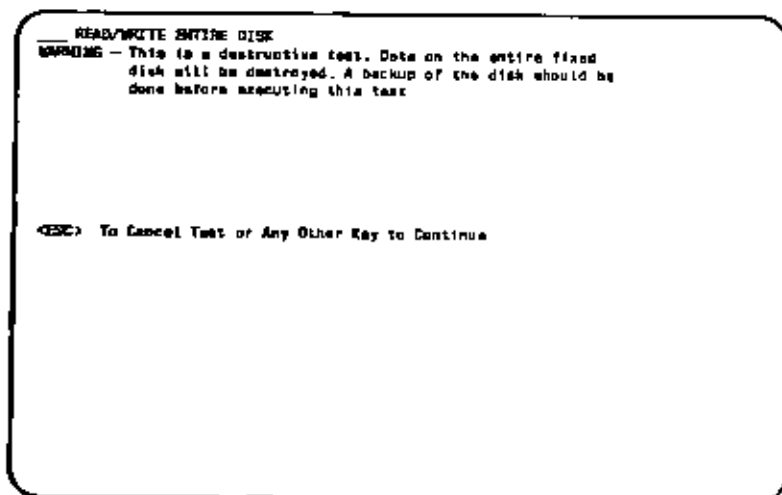
each head is increased by increments of 1 from 0000 to maximum track number (depending on whether 10MB or 20MB) then is reset to 0000 for the next head. The sector number is increased by increments of 1 from 01 to 17 for each track.

Cycle number is 0001 if this test is being run just once; if continuous run was chosen, cycle number begins at 0001 and is increased by 1 for each complete test cycle until <F4> is pressed to stop the test.

If "any key" (space bar or any alphabetic or numeric key or some special characters) is pressed, the Fixed Disk Test Summary screen is displayed.

#### Read/Write Entire Disk

When selection 4 of the Fixed Disk Drive test menu is chosen, the warning screen of the Read/Write test is displayed:



## LEVEL 1 DIAGNOSTICS

In the following screen you are requested to enter the number of the fixed disk to be tested.

```
The NEC Personal Computer                               Copyright 1984,1985 NEC Corp.

                                FIXED DISK DRIVE

                                READ/WRITE ENTIRE DISK

Enter number of fixed disk to test
10-First Fixed Disk, 1-Second Fixed Disk, etc.:
```

When "any" key is pressed again, the write pass of the test begins. The information displayed is almost identical to the Read Only Entire Disk test; the main difference is that the Function WRITE is indicated:

```
__ READ/WRITE ENTIRE DISK
<F> Stop Testing

Drive__ 00                                Function__ WRITE
Head__ 00
Track__ 0000                               Cycle__ 0001
Sector__ 00

Surface errors:
Soft errors__ 0000
Hard errors__ 00

Total errors:
Soft errors__ 0000
Hard errors__ 00
```

In the above display, the drive number is 00 for the first integrated fixed disk drive or for the first external fixed disk drive if no integrated drive is present. Head number is increased by increments of 1 from 00 to 03 as the test proceeds. Track number for each head is increased by increments of 1 from 0000 to maximum track number (depending on whether 10MB or 20MB) then is reset to 0000 for the next head. Sector number is increased by increments of 1 from 01 to 17 for each track.

After a complete WRITE cycle, the Function is changed to READ, and the complete READ cycle is begun. The display values start over at 00(00) or 01 and are increased to maximum values as above.

Cycle number is 0001 if this test is being run just once; if continuous run is chosen, cycle number begins at 001 and is increased by 1 for each complete test cycle (WRITE and READ) until <F4> is pressed to stop the continuous run, or until <F2> is pressed to return the program to the main menu.

If "any key" (space bar or any alphabetic or numeric key or some special characters) is pressed in response to the last line, the Fixed Disk Test Summary screen is displayed:

*** HARD DISK TEST SUMMARY					
Test cycles: 0001					
Hard errors: 00					
Soft errors: 0000					
Surface	Error	Track	Sector	Cycle	Soft errors
Surface: 00	NO ERROR				0000
	NO ERROR				
	NO ERROR				
	NO ERROR				
Surface: 01	NO ERROR				0000
	NO ERROR				
	NO ERROR				
	NO ERROR				
Surface: 02	NO ERROR				0000
	NO ERROR				
	NO ERROR				
	NO ERROR				
Surface: 03	NO ERROR				0000
	NO ERROR				
	NO ERROR				
	NO ERROR				

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### Fixed Disk Controller

When selection 5 of the Fixed Disk Drive test menu is chosen, the Fixed Disk Controller test screen is displayed.

```
The NCR Personal Computer                               Copyright 1984,1985 NCR Corp.

                               FIXED DISK DRIVE

... FIXED DISK CONTROLLER
PASSED

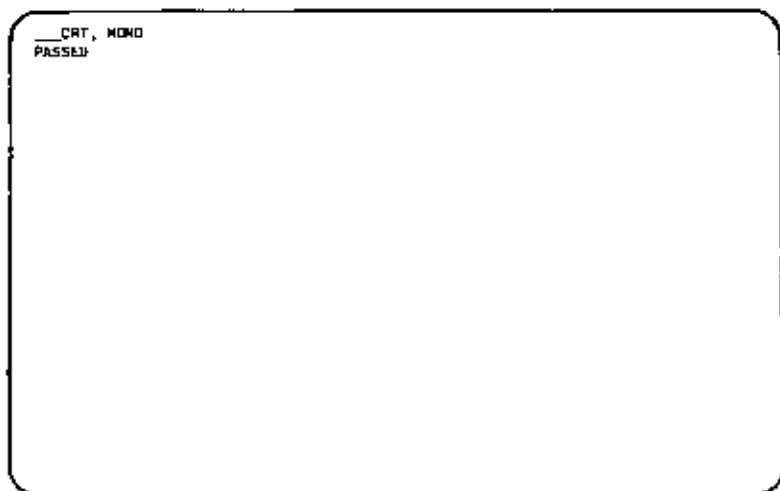
<F2> Terminate Test Module
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.



**MONOCHROME DISPLAY (MAIN MENU SELECTION 6)**

When selection number "6" is chosen from the main menu screen, the Monochrome Display test runs by briefly displaying the test name as it tests the controller:



\_\_CRT ATTRIBUTES

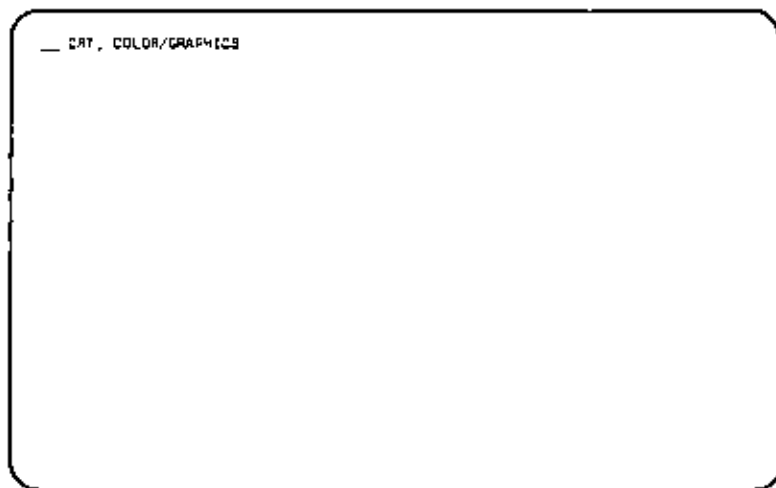
[Several lines, each demonstrating one or a combination of attributes such as normal video, inverse video, underlining, blinking and high intensity, are displayed.]

\_\_CHARACTER SET

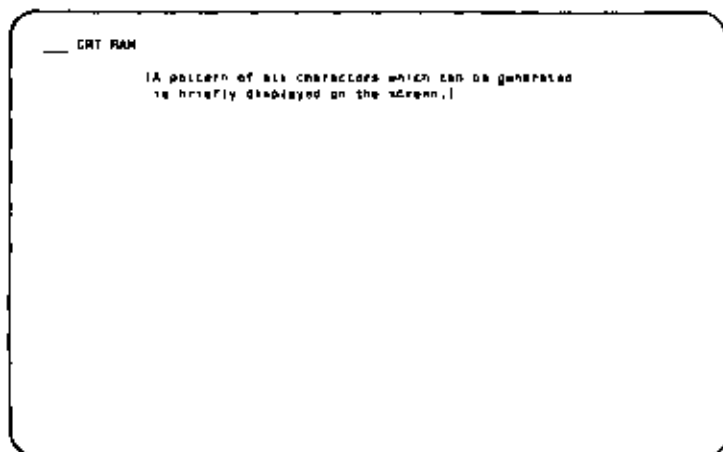
[A pattern of all characters which can be generated is briefly displayed on the screen.]

**COLOR/GRAPHICS DISPLAY (MAIN MENU SELECTION 7)**

When selection number "7" is chosen from the main menu screen, the Color/Graphics Display test begins by briefly displaying the test name as it tests the controller:



Then, without stopping, the test displays this screen:



## LEVEL 1 DIAGNOSTICS

Again without stopping, the test displays this screen asking for verification of the attributes shown:

### --- CRT ATTRIBUTES

[Several lines, each demonstrating one or a combination of attributes such as normal video, inverse video, blinking, high intensity, blue highlight, white on blue/red/green, blue/red/green on white, are displayed.]

Are the correct attributes displayed? (Y/N) \_

If "N" is entered, an ERROR message is displayed and choice similar to those described in the "Unsuccessful Completion" section of the "Test Completion Displays" section of this chapter are displayed.

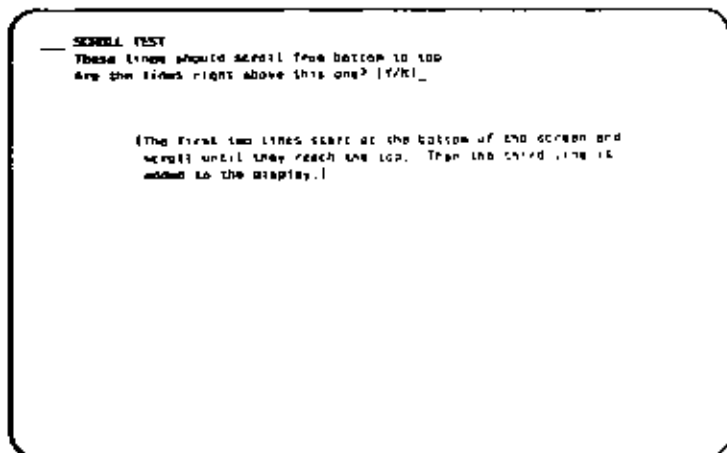
If "Y" is entered, the next screen is displayed:

### --- CHARACTER SET

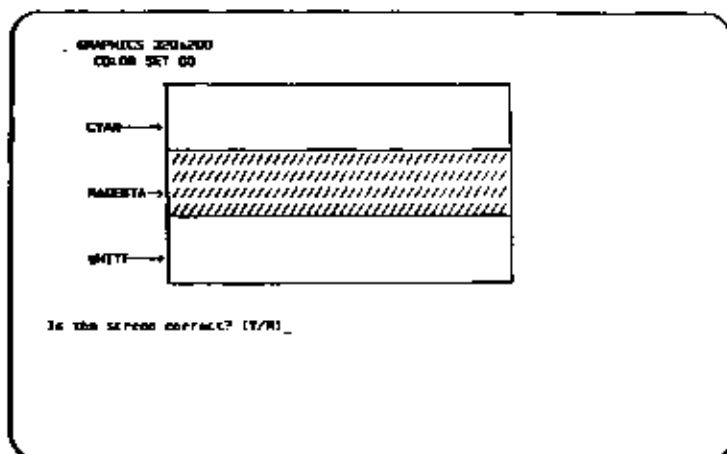
[A pattern of all characters which can be generated is briefly displayed on the screen.]

Is the character set correct? (Y/N) \_

If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:

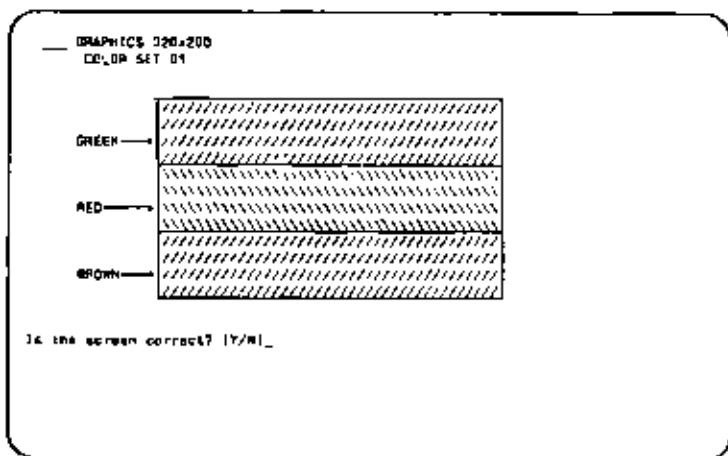


If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:

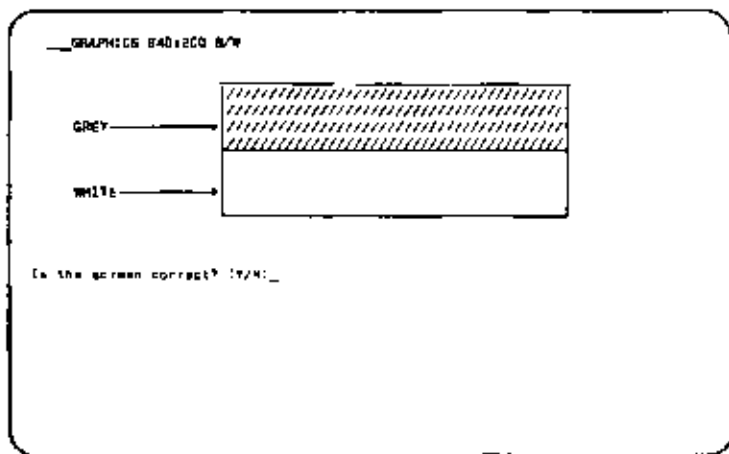


## LEVEL 1 DIAGNOSTICS

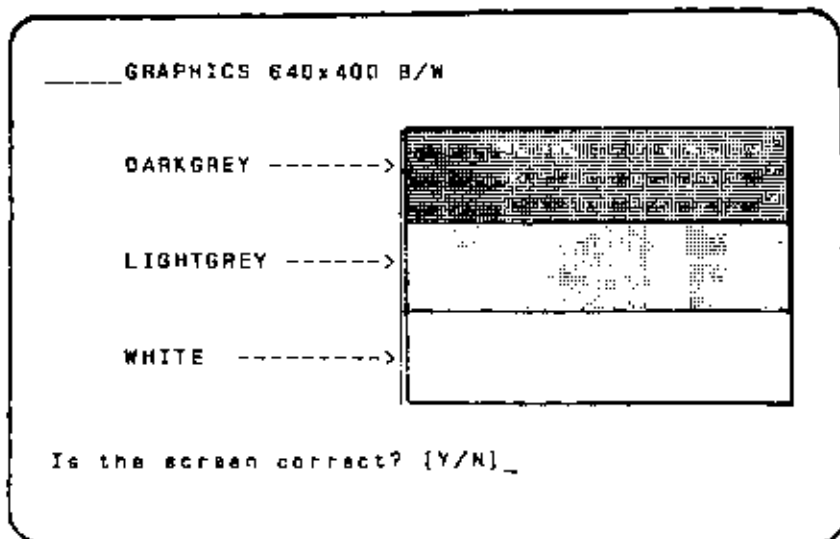
If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:



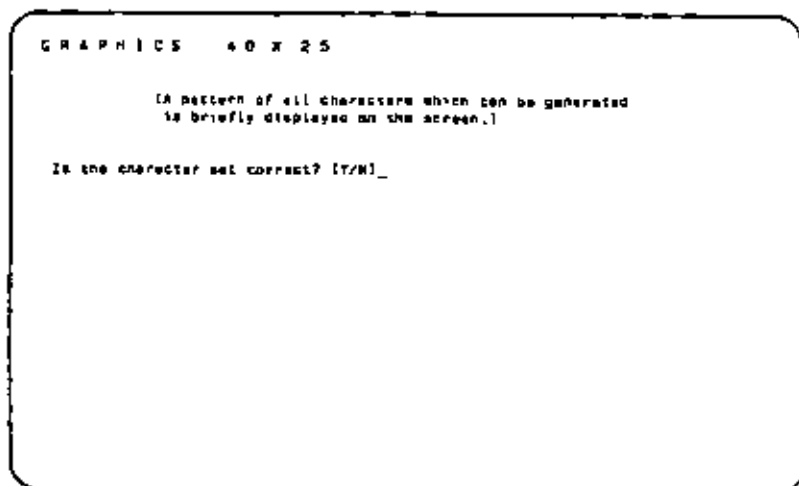
If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:



If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:



If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:



## LEVEL 1 DIAGNOSTICS

If "N" is entered, an ERROR message is displayed as before. If "Y" is entered, the next screen is displayed:

```
— LIGHT PEN
Is light pen attached? (Y/N)
```

If "N" is entered, the Color/Graphics Display test has been successfully completed and the program returns to the main menu. If "Y" is entered, additional lines for testing light pen performance are added to the display:

```
— LIGHT PEN
Is light pen attached? (Y/N)
Place light pen tip at center of
displayed block and activate light pen.
FA-NO RESPONSE FROM PEN.
```





If <F4> is pressed, an ERROR message is displayed as before.

The PASSED message is displayed upon successful completion of all the tests. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### PERIPHERALS (MAIN MENU SELECTION 8)

When selection number "8" is chosen from the main menu screen, the Peripherals Test Menu is displayed:

The NCR Personal Computer	Copyright 1985 NCR Corp.
PERIPHERALS	
Available Selections	
1 Serial Port Loopback	- Perform test on internal serial port
2 Parallel Port Loopback	- Perform test on internal parallel port
3 Generic Printer	- Test non-industry standard printer
4 PC-Compatible Printer	- Test industry standard printer
<F1> Explanation of Selections	
<F2> Terminate Test Module	
Press selection and <Enter> for running test once CR	
Press selection and <F8> for continuous run of selection (<F4> to stop)	
SELECTION =>	

### HELP Screen

To obtain more information about the available tests, press F1 to see the HELP screen:

**Serial Port Loopback** - Tests the serial port switch on the main processor board. Then, tests the port loopback. Requires a serial port loopback wrap plug for the port.

**Parallel Port Loopback** - Tests the parallel port switch on the main processor board. Then, tests the port loopback. Requires parallel port loopback for the port.

**Generic Printer** - Prints the ASCII character set on the parallel printer.

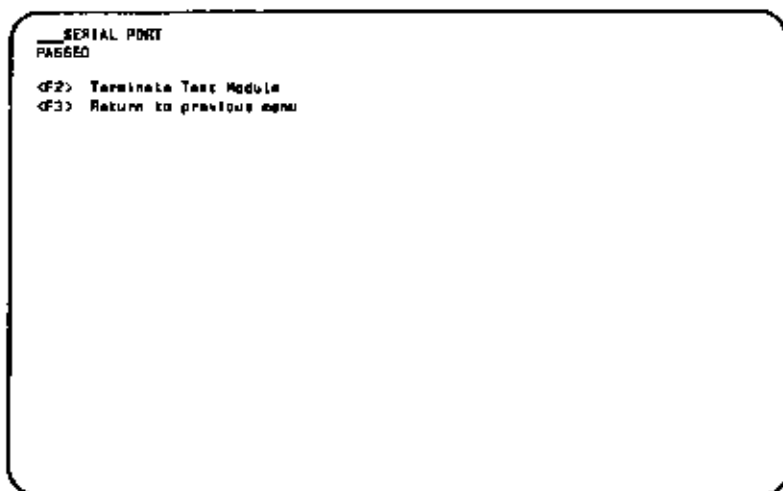
**PC-Compatible Printer** - Prints the ASCII character set and PC-specific control codes on a PC-compatible printer.

<F3> Return to previous menu

### **Serial Port Loopback Test (Peripherals Menu Line 1)**

When selection number "1" is chosen from the peripherals menu, the Serial Port Loopback test is performed. The name of the test is displayed while the test is in progress.

This test requires the use of a serial port Test Adapter (refer to Chapter 1 "Tools") for the test. For test run the Test Adapter (on screen displayed as "wrap plug") has to be plugged into the appropriate port.



Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

#### **Parallel Port Loopback Test (Peripherals Menu Line 2)**

When selection number "2" is chosen from the peripherals menu, the Parallel Port Loopback test is performed. The name of the test is displayed while the test is in progress.

This test requires the use of a parallel port loopback Test Adapter for the test (refer to Chapter 1 "Tools"). For the test run the Test Adapter (on screen displayed as "wrap plug") has to be plugged into the appropriate port.

\_\_\_ PARALLEL PORT  
PASSED

<F2> Terminates Test Module  
<F3> Return to previous menu

Upon completion of the test, either the PASSED message is added to the display. Refer to Chapter 10 of this manual for a description of error messages and recommended corrective actions.

## Printer Tests

### NOTE

These tests are for a printer attached to the printer (parallel) port of the computer. Any parallel printer can be tested using the "generic" printer test. Only a printer which is designed to respond to PC-specific control codes for additional functional capability can be tested using the "PC-Compatible" printer test.

Each of the two available tests is selected entering the corresponding number (3 or 4) of the Peripherals Menu. If the ENTER key is pressed after selecting the specific test, the test runs once and stops. If the <F8> key is pressed after selecting a specific test, that test is run continuously until <F4> is pressed.

When <F4> is pressed, the program returns to the peripherals menu.

### Generic Printer Test

If selection "3" of the Peripherals test menu is chosen, the Generic Printer test is run. The name of the test is displayed while the test is in progress:

```
__GENERIC PRINTER
PASSED

<F2> Terminate Test Module
<F3> Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to Chapter 5 of this manual for a description of error messages and recommended corrective actions.

### PC Compatible Printer Test

If selection "4" of the Peripherals menu is chosen, the PC Compatible Printer test is run. The name of the test is displayed while the test is in progress:

```
___PC-COMPATIBLE PRINTER
PASSED
(F2) Terminate Test Module
(F2) Return to previous menu
```

Upon completion of the test, either the PASSED message or an ERROR message is added to the display. Refer to chapter 5 of this manual for a description of error messages and recommended corrective action.

**UTILITIES (MAIN MENU F6 KEY)**

When the <F6> key is pressed from the main menu screen, the menu screen for the Utility functions available on the diagnostics diskette is displayed:

The NCR Personal Computer Copyright 1985 NCR Corp.		Page 1 of 1
<b>UTILITIES</b>		
<b>Available Selections</b>		
1 Initialize Fixed Disk	-Prepares Fixed Disk for DOS operations	
2 Position Head for Relocation	-Positions Fixed disk head for transportation	
3 Error Log Maintenance	-Provides utilities for error log maintenance	
4 Monochrome Alignment	-Screens for monochrome display alignment	
5 Color Alignment	-Screens for color display alignment	
6 Disk Alignment	-Utility for proper disk alignment	
7 Flexible Disk Speed Check	-Displays disk speed for adjustment	
<F3> Return to previous menu	<PgUp> Previous Page	<PgDn> Next Page
Press selection number and <Enter> to choose from Available Selections. SELECTION =>		

The Utilities Menu explains the function of each of the possible utilities that can be selected by typing the corresponding number and pressing the ENTER key. The selected utility runs once and stops.

During its run, appropriate screen and menus are displayed to prompt any actions on the user's part and to explain what operation is being done.

Pressing the <F3> key the program returns to the main menu.

**VIDEOTEK (BTX) ADAPTER TESTS (Main Menu Selection 11)**

This test routine enables the testing of the functional characteristics of

- the modem and video long player (VLP) interfaces (local loop test)
- the modem and VLP interfaces for remote operation (remote loop test)
- EUROM memory/controllers (test pictures)

When selection "11" is chosen from the main menu screen of the LEVEL 1 Diagnostics the BTX (Videotex) test menu screen is displayed:

```
The NCR Personal Computer                Copyright 1985 NCR Corp.

                                     BTX

Available Selections

1. UUART: local Test
2. Uuart: remote Test 12V
3. Uuart: remote Test 5V
4. Pictures

<F1> Explanation of Selections
<F2> Terminate Test Module

Press selection and <Enter> test once OR
Press selection and <F2> for continuous run of selection (<F4> to
stop)
SELECTION=>
```



**Local Test**

If selection "1" of the Videotex (BTX) test menu is chosen, the Local Test is run , the following screen is displayed:

```
The NCR Personal Computer          Copyright 1985 NCR Corp
                                     BTX

__ _USART Local Test
PASSED

<F2> Terminate test module
<F3> Return to previous menu
```

**Remote Test**

If selection 1 of the Videotext (BTX) test menu is chosen the following screen is displayed:

```
The NCR Personal Computer          Copyright 1985 NCR Corp.
                                     BTX

Insert Turnaround Plug 1 in Modem/VLP Interface and type <cr>
```

## LEVEL 1 DIAGNOSTICS

Remote testing is based on the comparison of characters. As seen on the screen displayed the test can only be carried out using two different turnaround plugs. These plugs are wired as shown in the table below:

Turnaround Plug 1	Turnaround Plug 2
J2-2 -> J2-1	J2-8 -> J2-9
J2-5 -> J2-3	J2-5 -> J2-3
J2-6 -> J2-4	J2-6 -> J2-4
J2-12 -> J2-13	J2-12 -> J2-13
J2-15 -> J2-14	J2-15 -> J2-14

Before remote loop testing is started you are requested to insert the proper turnaround plug in the modem/VLP interface on the Videotex (BTX) adapter board. After having plugged the turnaround plug the following screen is displayed:

```
The NCR Personal Computer                Copyright 1985 NCR Corp.
                                           BTX
_____USART remote test
PASSED

<F2> Terminate Test Module
<F3> Return to previous menu
```

**Picture Test**

If selection "4" in the Test Menu is chosen, test screen No.1 testing the character and attribute memory is displayed.

**Test Screen No.1- Testing the character and attribute memory**

The screen consists of white letters ("U") displayed on a red background; the border color is half intensity green.

Errors: characters other than "U"  
other colors for the foreground/background

This test does not permit to test DRCS characters.

Press any key to continue.

**Test Screen No. 2 - Testing the inverse character and attribute memory**

The screen display shows white "\*" characters blinking on a blue background.

Errors: characters other than "\*" intermittent blinking other colors

This test does not permit to test DRCS characters.

Press any key to continue.

**Test Screen No. 3 - DRCS Memory Test**

A bar pattern is displayed on the screen. The bars are displayed in half-intensity red, black, and white. The border color is half-intensity cyan.

Errors: irregularities in the pattern other colors

Press any key to continue

## LEVEL 1 DIAGNOSTICS

### Test Screen No. 4 - Inverse DRCS Character Test

A bar pattern is displayed on the screen. The bars are blue and red. The border color is half-intensity white.

Errors: irregularities in the pattern other colors

Press any key to continue.

Test Screen No. 5 - The screen display consists of a white area enclosed by a black border. The white area designates the area in which characters can be displayed.

This picture is useful for checking the screen setup and the position of the image on the screen.

Press any key to continue.

Test Screen No. 6 - "Video Test" is displayed in yellow letters on a transparent background. The display is positioned in the middle of the screen.

Checks for transparent background when merging input from a video long player.

Press any key to continue..

Next you are asked whether the screen displays were correct. Enter "Y" and press the (F2) key to return to the main menu.

**Level 1 Diagnostics Error Returns**

This chapter provides information needed to diagnose and repair the NCR PERSONAL COMPUTER Model PC 41. It is not the intent of this manual to educate the user in all aspects of computer operation. The material presented in this chapter is of a technical nature and the user should possess some experience with digital circuits before attempting any major repairs. However, this material can serve as a valuable tool in determining the most probable cause of system failure.

**REPAIR GUIDELINES**

Before any attempts are made to repair the computer system, some guidelines need to be established. It is considered good practice to reduce the system to a basic configuration before troubleshooting begins. This can help eliminate problems that are not machine dependent but exist in some piece of peripheral equipment. If such a problem is detected, the peripheral equipment may be re-installed a piece at a time (taking care to check the system for proper operation after each installation) until the defective equipment is found.

**WARNING**

Power should be turned off before removing or installing any system components.

**SYSTEM CONFIGURATION**

A system may have the following configuration:

1. Main processor board with controller and memory ICs installed and including configuration switches and connectors.
2. Power supply package with appropriate

## *LEVEL 1 DIAGNOSTICS ERROR RETURNS*

connectors and outlets.

3. One fixed disk drive installed in the computer housing.
4. Up to two flexible disk drives installed in the computer housing.
5. Fixed disk controller board.
6. Controller board for a video display, either color or monochrome, and the cables to connect the unit.

### **PRELIMINARY CHECKS**

After the system has been configured for troubleshooting, some checks should be performed:

1. Have all peripheral boards not needed for system operation been removed from the computer? Remove any excess equipment.
2. Are all cards remaining in the expansion slots correctly installed? Refer to the "After First Attempt" section of the Troubleshooting Non-Operative Systems chapter of this manual.
3. Check the switch settings on the main processor board; are they set properly for the system configuration? Refer to Chapter 8 if you need help with the switch settings.
4. Check all cables attached to the main processor board and cards in the expansion slots. Make sure that all cables are installed correctly.
5. Perform a visible inspection of the circuit components, checking for any obvious signs of damage: bad solder connections, shorts, missing or damaged resistors/capacitors etc.
6. Check the voltage levels to the Main Processor Board power connector. The system uses; 12V,-

12V, 5V, -5V and ground. Make sure that all installed peripherals are receiving the correct voltages (this includes the disk drives and video power connectors).

**MAIN PROCESSOR BOARD COMPONENTS**

For those not familiar with the Main Processor Board (MPB), it is recommended that some time should be taken to learn the location of the major board components. Figure 5-1 shows the placement of all the major components used by the NCR Personal Computer on the Alternate (Generic) Main Processor Board, whereas Fig. 5-2 shows the major components on the Early-type Main Processor Board.

LEVEL 1 DIAGNOSTICS ERROR RETURNS

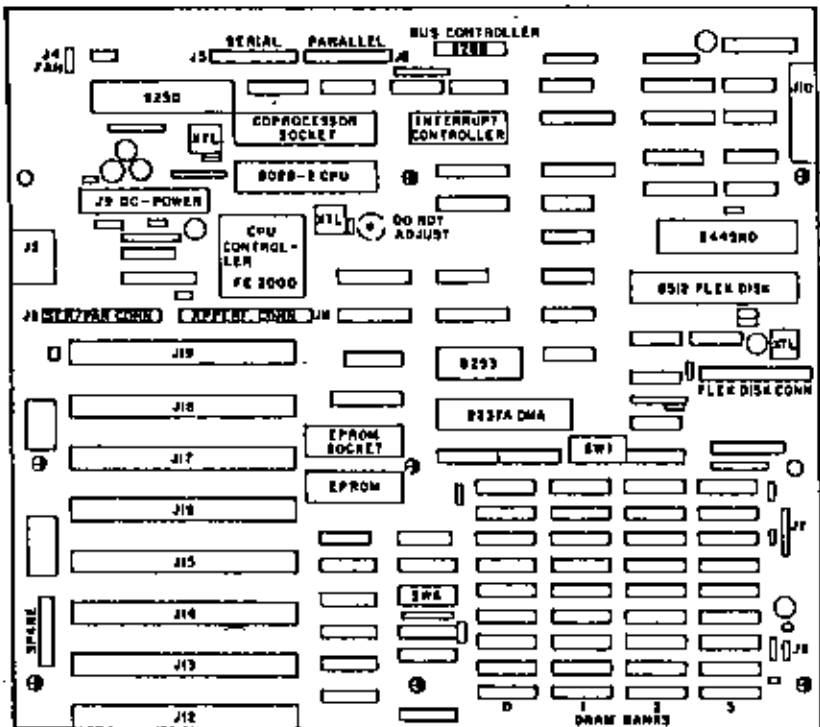


Figure 5-1 Alternate\* Main Processor Board

\* Also called "Generic"



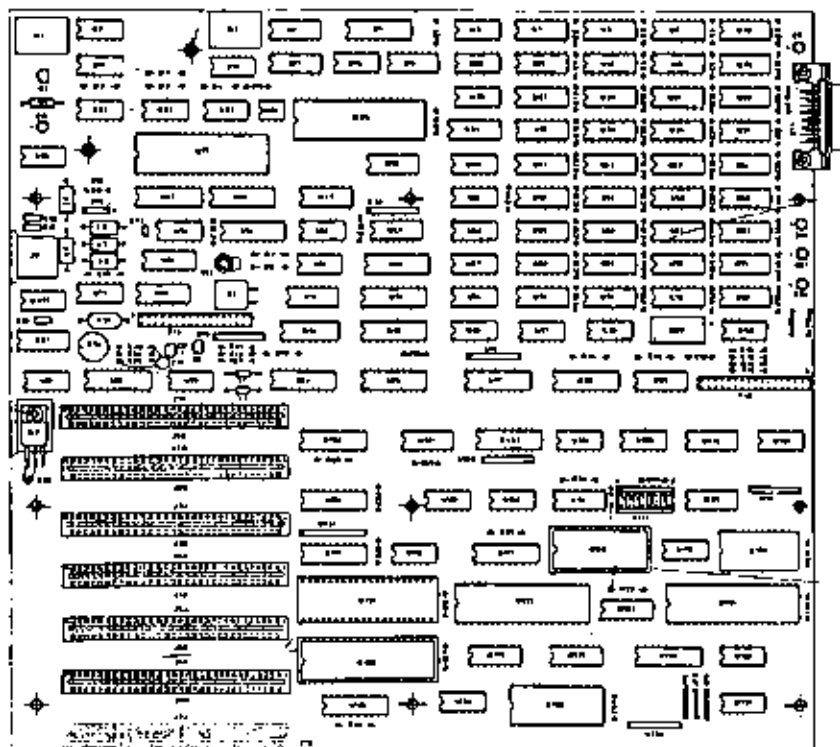


Figure 5-2 Early-type Main Processor Board

### MEMORY ADDRESSING

When using the diagnostic diskette, it is helpful to understand the method of memory addressing used by the 8088 microprocessor. The 8088 divides memory up into segments and allocates 64K bytes to each segment. Using this method of memory segmentation it is possible to address 1 MB of system memory. To address a memory location it is necessary to specify its segment base address and its segment offset value. A typical example of a segmented address specification is shown in Figures 5-3 and 5-4 for the two boards. Both segment code and offset value are given in hexadecimal notation.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

To construct the physical memory address it is necessary to place 0 to the right of the last digit in the segment base and add the offset value to form the 20 bit address. Figure 5-4 shows how the example in Figure 5-3 is converted to a 20 bit address. The address formed is the actual physical address of the memory location. A more thorough description of 8088 addressing can be found in one of the reference sources for the Intel 8088 microprocessor.

```

_____ most significant
|
20C2:010F
|   |_____ offset value
|_____ segment base
```

Figure 5-3 Segment Address

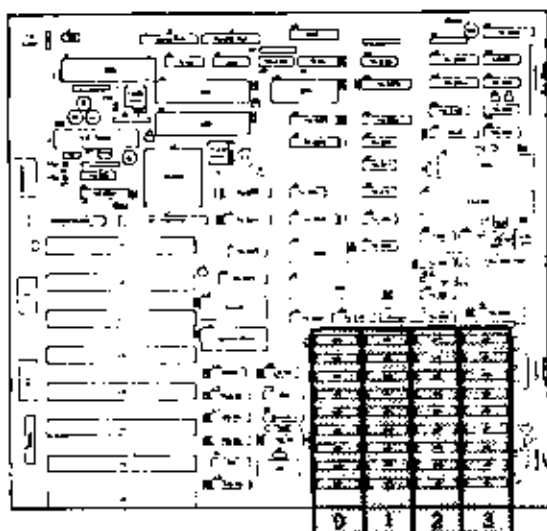
```

-----
|_____0 added to segment base
|
20C20 (segment)
+010F (offset)
-----
20D3F (20 bit physical address)
```

Figure 5-4 Physical Address Construction

Figure 5-5 shows the physical locations of the banks of memory ICs on the two main processor boards.

(1)



Bank

(2)

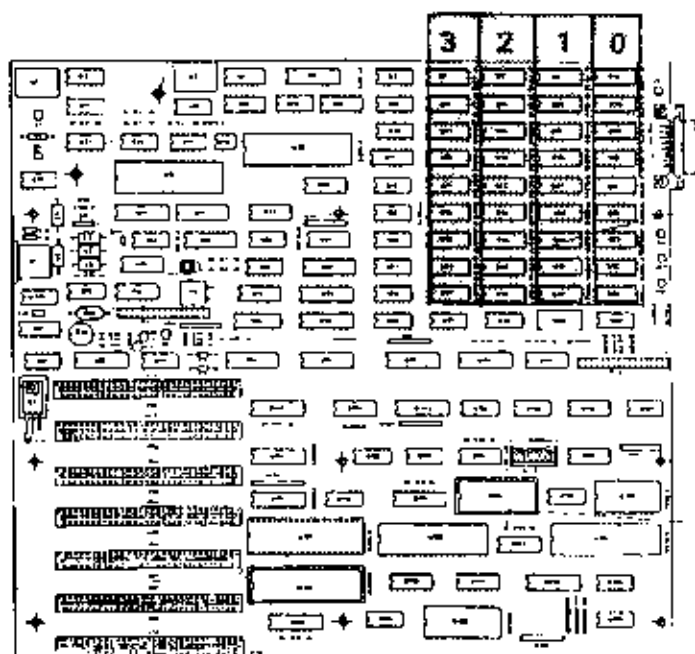


Figure 5-5 Memory Segment Locations for the Alternate(1) and Early-type MPB (?)

**ERROR CODES**

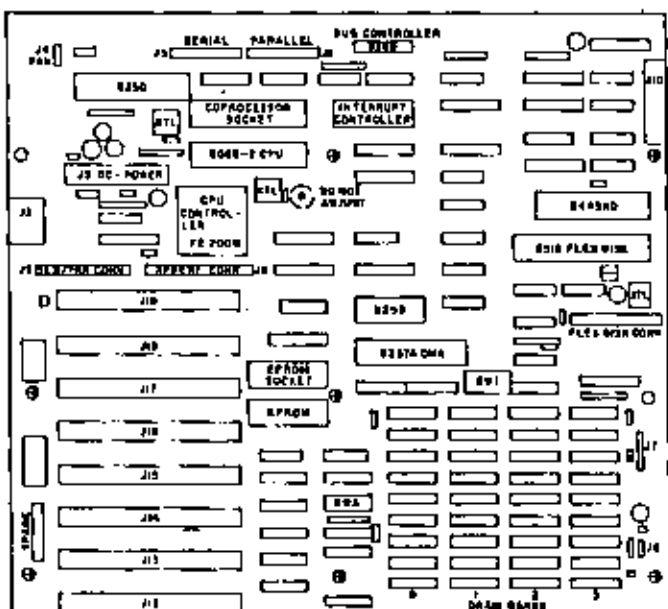
This section describes the error reports from the NCR Personal Computer SERVICE DIAGNOSTICS program. The reports from the diagnostics are in coded form. This reduces the large overhead of program code required for text. Codes are exemplified in the accompanying text.

**RELATIONSHIP BETWEEN MAJOR CODES, DETAIL CODES AND REPAIR PROCEDURES**

Error codes are broken down into MAJOR and DETAIL codes. In addition, ADDR(ess), EXP(ected) DATA, and OBS(erved) DATA information is also displayed where appropriate. The MAJOR codes are, in general, a description of the type of test being performed when an error was encountered. This code is a BCD value that is displayed on the CRT and also presented to the printer data port. Each MAJOR code may have several DETAIL codes associated with it. The DETAIL codes are specific descriptions of the error and are displayed as hex values on the CRT only. Data that is to be returned from a particular register or memory device is displayed in the EXP DATA and OBS DATA fields. If the OBS(erved) DATA does not match the EXP(ected) DATA then an error has been detected. The ADDR(ess) field is for memory related failures.

After every MAJOR CODE the "Repair Procedure" that is recommended to troubleshoot the faulty condition is presented. Additional "Repair Procedures" may follow specific DEVICE codes. On the Main Processor Board (MPB), each semiconductor component is identified by a "U" number. The repair procedures specify components on the MPB by the appropriate "U" number. Figure 5-6 shows the location of components on the MPB by "U" numbers. Equipment recommended for performing repairs includes: Multimeter, Digital Logic Probe.

(1)



(2)

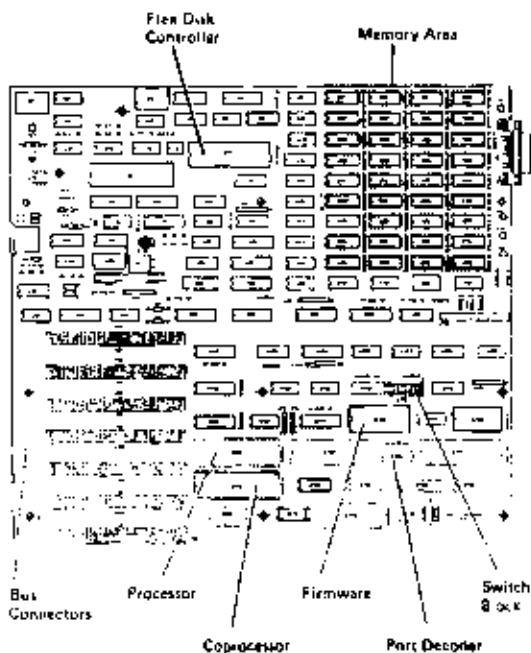


Figure 5-6 MPB Component Identification for Alternate (1) and Early-type MPB (2)

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### FORMAT OF DISPLAYED ERROR CODES

FILENAME: MAJOR CODE: DETAIL CODE    DATE    TIME  
ADDITIONAL MESSAGE

#### Examples:

FLEX:02:80Date Time

This code represents:

MAJOR: An error was returned while attempting  
to read a flexible disk drive.

DETAIL: FDC failed to respond, Time out on FDC.

NOTE: FDC is an abbreviation, used frequently in  
this chapter, for Flexible Disk Controller.

FLEX: 04:00Date Time

EXP DATA: AA, OBS DATA: A8

This code represents-

MAJOR: An error was encountered in comparing  
data read from the FDC subsystem.

DETAIL: No detail error.

EXP DATA: The data pattern AA was expected.

OBS DATA: The data pattern A8 was observed.

### LIST OF MAJOR ERROR CODES

Figure 5-7 is a list of the MAJOR CODES that are used  
and a brief description of each.

---

CODE	DESCRIPTION
System Memory Error Codes:	
MEMORY:01	RAM PARITY ERROR
MEMORY:02	RAM PATTERN ERROR
MEMORY:03	RAM ADDRESS ERROR
MEMORY:04	ROM CHECKSUM ERROR
MEMORY:05	RAM WALKING BIT ERROR

---

Figure 5-7 Major Error Codes (1 of 3)

LEVEL 1 DIAGNOSTICS ERROR RETURNS

CODE	DESCRIPTION		
<b>Flexible Disk Drive Error Codes:</b>			
FLEX:01	FDC RESET ERROR		
FLEX:02	FDC READ ERROR		
FLEX:03	FDC WRITE ERROR		
FLEX:04	FDC VERIFY ERROR		
FLEX:05	FDC FORMAT ERROR		
FLEX:06	FDC DATA ERROR		
FLEX:07	FDC RESET ERROR		
<b>Keyboard Error Codes:</b>			
KEYBRD:01	KEYBOARD ERROR		
<b>Video Monitor Error Codes:</b>			
MONO/COLOR:01	CRT ERROR		
<b>Peripheral Error Codes:</b>			
PERIPH:01	SERIAL COMMUNICATIONS ERROR		
PERIPH:02	PRINTER PORT ERROR		
PERIPH:03	PRINTER ERROR		
<b>Error Codes of Major System Controllers:</b>			
CONTROL:01	CPU ERROR	U6*	U125**
CONTROL:02	INTERRUPT CONTROLLER ERROR	U25	U132
CONTROL:03	INTERVAL TIMER ERROR	U30	U120
CONTROL:04	DMA CONTROLLER ERROR	U31	U122
CONTROL:05	CPU CONTROLLER ERROR	U7	-
CONTROL:06	SERIAL PORT	U1	U37
CONTROL:07	FLEXIBLE DISK CONTROLLER	U46	U25
CONTROL:08	CRT CONTROLLER (ON EXPANSION CARD)	-	-
* Component number for Alternate MPB			
** Component number for Early-type MPB			

Figure 5-7 Major Error Codes (2 of 3)

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

---

CODE	DESCRIPTION
Error Codes of the Fixed Disk Subsystem:	
FIXED:01	FIXED DISK CONTROLLER ERROR (ON EXPANSION BOARD)
FIXED:02	FIXED DISK NOT READY
FIXED:03	FIXED DISK RECALIBRATE ERROR
FIXED:04	FIXED DISK FORMAT ERROR
FIXED:05	FIXED DISK SEEK ERROR
FIXED:08	FIXED DISK WRITE ERROR
FIXED:07	FIXED DISK READ ERROR
FIXED:08	FIXED DISK DATA ERROR
FIXED:09	FIXED DISK VERIFY ERROR
FIXED:10	FIXED DISK ERROR [INTERNAL]

---

Figure 5-7 Major Error Codes (3 of 3)

### DETAIL ERROR CODES AND REPAIR PROCEDURES

Not every MAJOR error code will have associated DETAIL codes. The remainder of this chapter lists the MAJOR codes in sequence, followed by the DETAIL codes (if any) associated with each MAJOR code or group of MAJOR codes, followed by the recommended "Repair Procedures".

### MEMORY ERROR CODES

#### RAM PARITY TEST

Format of code:

MEMORY:01:ww            Date            Time  
ADDR: ssss:0000

Where,            ww            = Detail code  
                  ssss            = Segment address of error  
                  0000            = Offset address of error



## LEVEL 1 DIAGNOSTICS ERROR RETURNS

Detail code:

01	Parity error interrupt
02	Base RAM parity error
04	Expansion RAM error

These codes are logically "or"ed to present the final detail code.

Example: 03 Parity error & interrupt from the  
base RAM  
or: 04 Parity detected from expansion  
RAM with no interrupt.

### Repair Procedure 01

The detail code will give the location of a parity failure (base or extended memory). Use the most significant digit of the segment code to identify which bank contains the defective RAM IC. This can be done by using Figure 5-5. Refer also to Figures 5-3 and 5-4 shown earlier in this chapter.

Locate the segment number in the table and find the data bit(s) that failed the RAM PATTERN TEST. The junction of the row and column will intersect the IC that is suspect. The locations of the ICs are found on both MPBs, the Alternate and Early-Type MPB, all other RAMs are located on the Memory Expander Card. Memory bit IC locations on the MPB are shown in Figure 5-8 and Figure 5-9, respectively. If the test indicates a parity failure and the RAM PATTERN TEST passes, then suspect the parity IC within the faulty segment.

# LEVEL 1 DIAGNOSTICS ERROR RETURNS

SWITCH & (SWS) CONFIGURATION								DATA BIT POSITION								PARITY CMP POSITION
0		1		2		3		7	6	5	4	3	2	1	0	
Segment Code	Memory Range	Segment Code	Memory Range	Segment Code	Memory Range	Segment Code	Memory Range									
0000	64K	0000 111K 3000	32EK	0000	64K	0000 111K 3000	256K	U67	U66	U65	U64	U63	U62	U61	U60	U59
1000	128K			1000	128K	4000 no 7000	512K	U76	U75	U74	U73	U72	U71	U70	U69	U68
2000	192K			2000 no 3000	384K	6000	576K	U85	U84	U83	U82	U81	U80	U79	U78	U77
3000	256K			6000 no 8000	640K	9000	640K	U94	U93	U92	U91	U90	U89	U88	U87	U86
Segment Code	Memory Range															
4000	320K							U8	U6	U5	U4	U3	U2	U1	U0	U7
5000	384K							U7	U7	U7	U7	U7	U7	U7	U7	U7
6000	448K							U6	U6	U6	U6	U6	U6	U6	U6	U6
7000	512K							U5	U5	U5	U5	U5	U5	U5	U5	U5
8000	576K							U4	U4	U4	U4	U4	U4	U4	U4	U4
9000	640K							U3	U3	U3	U3	U3	U3	U3	U3	U3

0	1 2		BANK			
	<input type="checkbox"/> OFF	<input type="checkbox"/> OFF	0	1	2	3
	<input type="checkbox"/>	<input type="checkbox"/>	64	64	64	64
1	1 2		BANK			
	<input type="checkbox"/> OFF	<input checked="" type="checkbox"/> ON	0	1	2	3
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	256	256	256	256

Switch Bank A (SWS) Configuration

Figure 5-8 RAM Memory IC Locations for Alternate MP6

LEVEL 1 DIAGNOSTICS ERROR RETURNS

Segment Code	Memory Range		Data Bit Position								Parity IC Pos
			7	6	5	4	3	2	1	0	
0000	64KB		U10	U20	U30	U35	U44	U53	U62	U71	U80
1000	128KB	On	U9	U19	U29	U34	U43	U52	U61	U70	U79
2000	192KB	MPB	U8	U18	U28	U33	U42	U51	U60	U69	U78
3000	256KB		U7	U17	U27	U32	U41	U50	U59	U68	U77
4000	320KB		U63	U52	U51	U50	U49	U48	U47	U46	U54
5000	384KB	On	U44	U43	U42	U41	U40	U39	U38	U37	U45
6000	448KB	MEM.	U35	U34	U33	U32	U31	U30	U29	U28	U36
7000	512KB	EXP.	U26	U25	U24	U23	U22	U21	U20	U19	U27
8000	640kb	CARD	U8	U7	U6	U5	U4	U3	U2	U1	U9

Figure 5-9 RAM Memory IC Location for Early-type MPB.

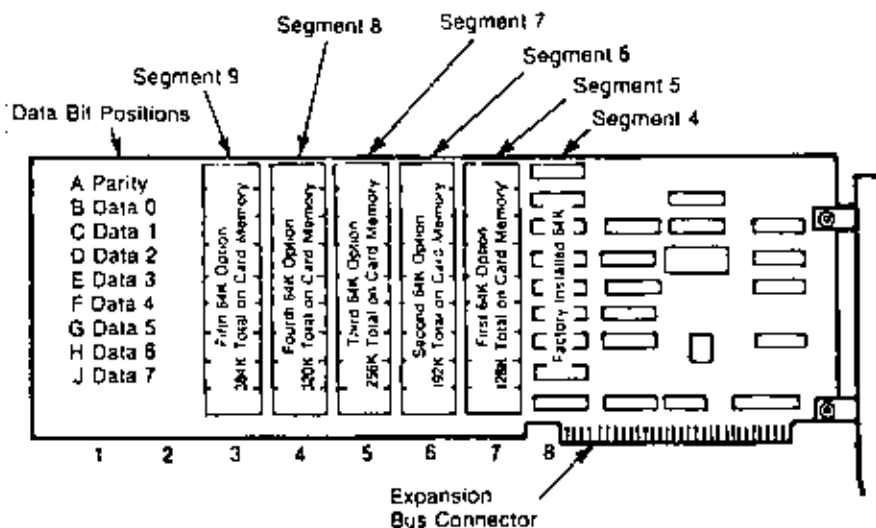


Figure 5-10 RAM Memory IC Locations on Expansion Board

# LEVEL 1 DIAGNOSTICS ERROR RETURNS

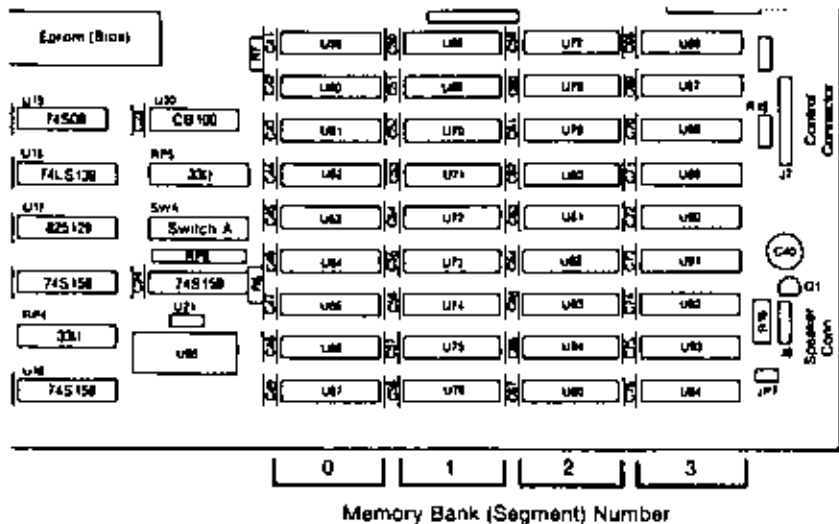


Figure 5-11 MPB Memory IC Locations for Alternate MPB

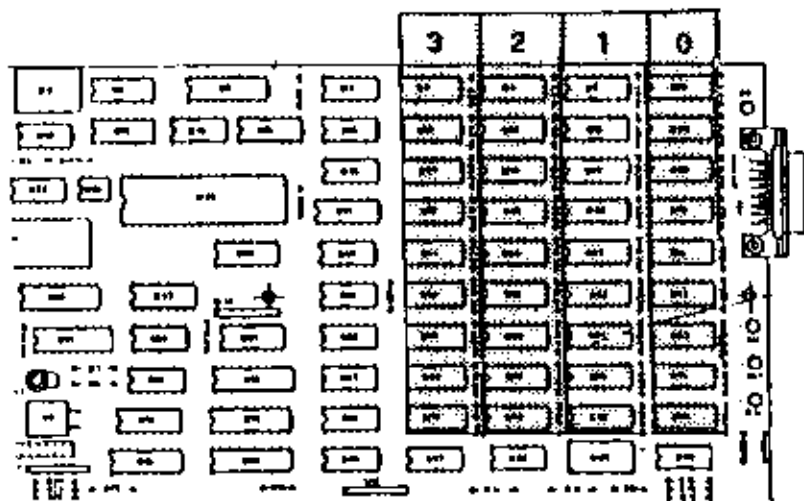


Figure 5-12 MPB Memory IC Locations for Early type MPB

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

To check errors reported on the Memory Expander Board remove the expander board and set the configuration switches for the maximum memory on the MPB. If the system passes the parity check, the problem is on the Memory Expander Board and diagnostics can proceed (with the expander board reinstalled) as described above. This technique can be used to isolate RAM failures within any segment of memory. Set the configuration switches for the next lower increment and run the diagnostics until the problem is no longer observed or the switches are set for only 256 K of MPB memory. This technique can be used to isolate RAM IC failures within specific segments of memory. Figures 5-11 and 5-12, respectively, show the location of segments on both Main Processor Boards and on the Memory Expansion Board as well. If the diagnostics report a PARITY ERROR after the suspect RAM memory IC has been replaced, then it is necessary to evaluate the hardware associated with parity generation. Figure 5-8 and Figure 5-9, respectively, shows the placement of all major RAM memory hardware components on the Main Processor Board. Check the parity generator for proper input/output conditions.

### RAM PATTERN TEST

Format of code:

```
MEMORY:02:ww,      Date      Time
ADDRR:   sssss:0000
EXP DATA: xxxx, OBS DATA: yyyy
```

Where,

ww	=	Detail code
ssss	=	Segment address of error
oooo	=	Offset address of error
xxxx	=	Expected data
yyyy	=	Observed data

Detail code:

- 01 Pattern Error Verified
- 02 Intermittent Error, Duplicated
- 04 Intermittent Error, Not Duplicated

These codes are NOT logically "or"ed.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### Repair Procedure 02

The RAM PATTERN TEST writes data patterns into memory and then reads the patterns back to verify that all the data bits in memory are functioning properly. This test will detect the presence of stuck data bits in a RAM or an intermittent bus driver. Comparing the expected data with the observed data will show the defective bit positions. If the segment address changes randomly with repeated execution of the RAM PATTERN TEST, then the problem is also associated with the addressing hardware and the RAM ADDRESS TEST should be used to provide further information. A pattern failure that reports a constant segment address can be checked using Repair Procedure. Intermittent failures that are reported as not Duplicated will require re-use of the RAM PATTERN TEST to determine if there is an actual problem. Intermittent failures reported as Duplicated could be the result of the RAM IC or the data bus to the RAM IC. Figures 5-13 and 5-14, respectively, show the location of RAM memory hardware on the Main Processor Board.

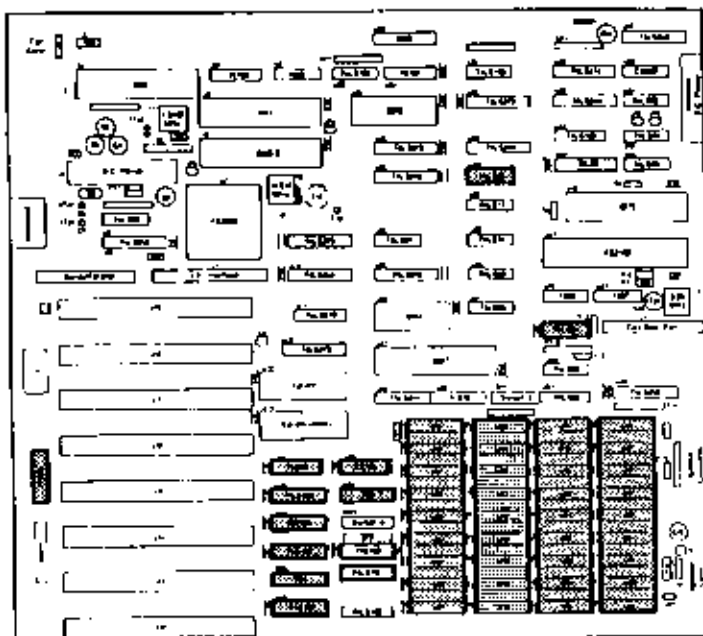


Figure 5-13 RAM Memory Components for Alternate MPB

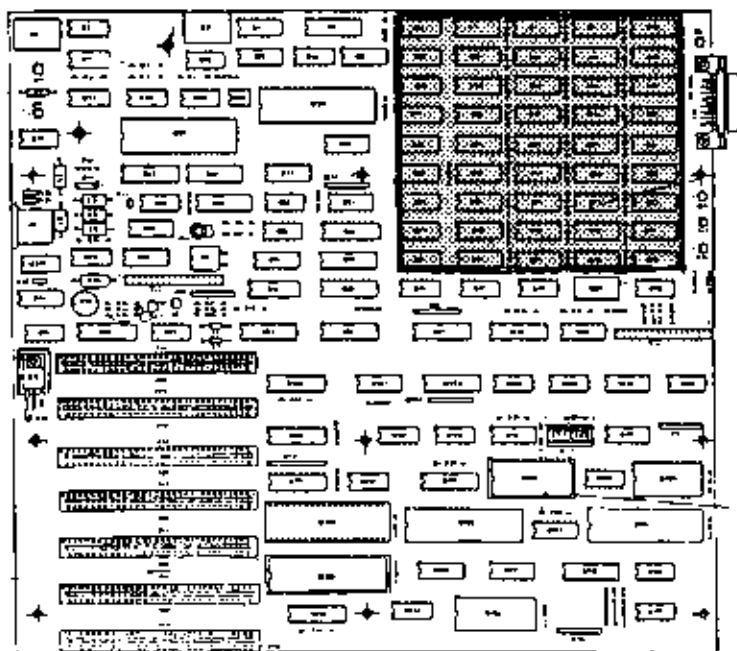


Figure 5-14 RAM Memory Components for Early-type MBD

# LEVEL 1 DIAGNOSTICS ERROR RETURNS

## RAM ADDRESS ERROR TEST

Format of code:

MEMORY:03:ww Date Time  
ADDR: ssss:oooo  
EXP DATA: xxxx, OBS DATA: yyyy

Where, www = Detail code  
for DETAIL 01,  
xxxx = Segment of expected address  
yyyy = Segment of observed address  
for DETAIL 02,  
ssss = Segment of address or error  
oooo = Always zero  
xxxx = Expected address (A8 - A15)  
yyyy = Observed address (A8 - A15)  
for DETAIL 03,  
ssss = Segment address of error  
oooo = Always zero  
xx = Expected address (A0 - A7)  
yy = Observed address (A0 - A7)

Detail code:

- 01 Segment conflict (A16 - 20A)
- 02 Upper address conflict (A8 - A15)
- 03 Low address conflict (A0 - A7)

### Repair Procedure 03

RAM ADDRESS ERROR will return Detail codes that help isolate problems with the system address bus. The ADDRESS PATH is checked in the hardware for integrity along isolated bus components. The ADDRESS PATH is hardware divided as low order address (8 bits), high order address (8 bits), and segment address (4 bits). Each address path has its own data latches and bus drivers. The Detail code returned by the RAM ADDRESS TEST specifies the ADDRESS PATH in the hardware that could be defective. Comparing the expected address with the observed can provide indications of which address line(s) are failing. Evaluation of bus driver input/output characteristics is recommended; suspect intermittent IC failure.



**RAM WALKING ONES TEST**

Format of code:

MEMORY: 05:00

ADDR: ssss:oooo

EXP DATA: xxxx, OBS DATA:yyyy

Where,            ww    = Detail code  
                   ssss = Segment address of error  
                   oooo = Offset address of error  
                   xxxx = Expected data  
                   yyyy = Observed

Detail Code:

00 ALWAYS ZERO

**Repair Procedure 04**

The RAM Walking Ones test writes walking one and zero patterns in memory, then reads the patterns back to verify that all data bits are functioning properly. This test is more extensive than the pattern test, with the exception that intermittent errors are not checked.

**ROM CHECKSUM ERROR TEST**

Format of code:

MEMORY:04:00

EXP DATA: xx, OBS DATA: yy

Where,            xx    = Expected checksum  
                   yy    = Calculated checksum

Detail code:

NONE

**Repair Procedure 05**

Make certain that the EPROM BIOS IC (shown in Figure 5-14 and 5-15, respectively, is correctly inserted in its socket (U13 (U118)). If the ROM CHECKSUM ERROR still occurs replace the EPROM BIOS IC. Should the

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

ROM test still report a checksum error the problem probably exists in an intermittent address or data bus component that connects the ROM to the 8088 microprocessor.

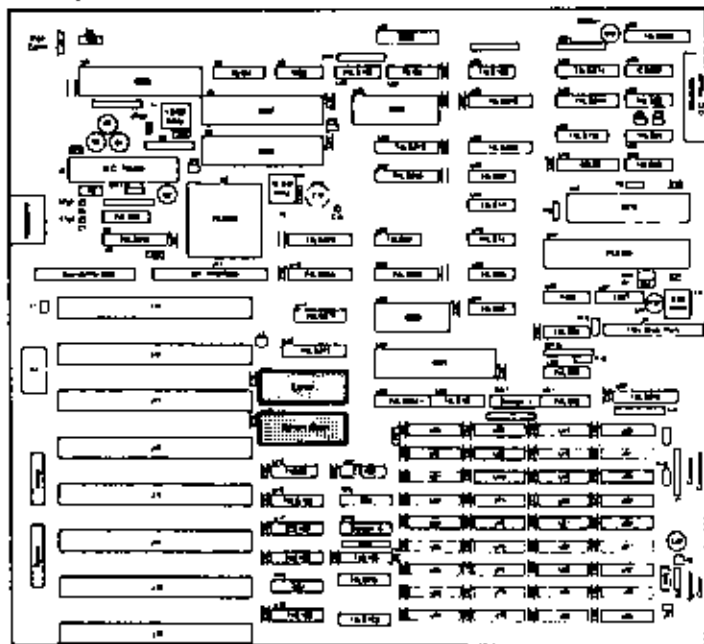


Figure 5-15 ROM Hardware Components  
for Alternate MPB

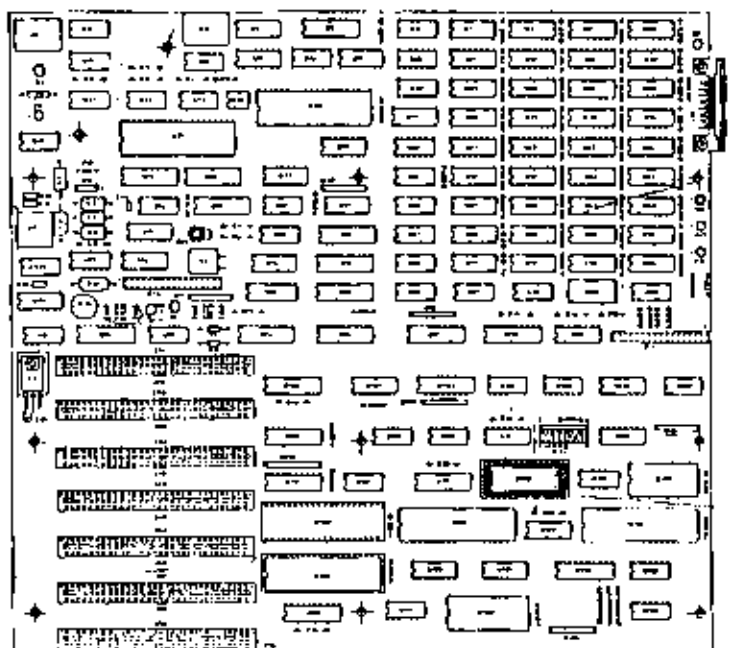


Figure 5-16 ROM Hardware Components  
for Early-type MPB

### FLEXIBLE DISK DRIVE ERROR CODES

FLEXIBLE DISK DRIVE ERRORS, FLEX:01 to 07  
(Refer to Figure 5-7)

Format of code:

FLEX:aa:ww,      Date          Time

EXP DATA: xx, OBS DATA: yy

aa      = Major code

ww      = Detail code

xx      = Optional expected data

yy      = Optional observed data

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

NOTE: The EXP DATA and OBS DATA fields are displayed on major code FLEX:06 only.

Detail code:

The following detail codes apply to major codes FLEX:01 through 05 and FLEX:07.

88	Disk drive not ready
80	FDC failed to respond
40	Seek operation failure
20	FDC failure
10	CRC error on reading
09	Attempt to read accross 64k boundry (internal error)
08	Data overrun error
04	Requested sector not found
03	Attempt to write a write protected disk
02	Address mark not found on track
01	Bad command (internal error)

Accompanying message:

NOTE: This message is not displayed for major code FLEX:06.

DV	RTY	ST0	ST1	ST2	TRACK	HEAD	SECTOR	DENSITY
xx	xx	xx	xx	xx	xx	xx	xx	xx

This data is the status returned from the FDC. Refer to Figure 5-17 for status code specifics.

	DV	= Drive number
	RTY	= Number of retry
STATUS CODE	ST0	= Status register 0 from FDC
STATUS CODE	ST1	= Status register 1 from FDC
STATUS CODE	ST2	= Status register 2 from FDC
	TRACK	= Track selected
	HEAD	= Head 1 (H=0) or 2 selected
	SECTOR	= Sector selected
	DENSITY	= Sector density

**Repair Procedure 06**

Failure in the Flexible Disk Drive system can be particularly hard to troubleshoot and repair. There is a general approach for solving disk drive problems that is applicable to most failures. Treatment of certain types of failures will follow the specified detail code.

Bit Number	Status Byte 0	Status Byte 1	Status Byte 2
07	07 and 06 0 Normal Command Termination	Logic Level 1 Indicates That FDC Tried to Access a Nonexistent Sector	Not Used Logic 0
	07 0 06 1 Abnormal Command Termination		
06	07 1 06 0 Invalid Command Issued	Not Used Logic 0	Logic 1 During Read by FDC in Deleted Data Address Mark was Encountered
	07 1 06 1 Abnormal Termination Ready Line Changed State During Command Execution		
05	Logic 1 Indicates Completion of the Seek Command	FDC Detected a Data Checksum (CRC) Error if Set to Logic 1	Logic 1 if CRC Error Found in Data Field (Bad Data)
04	Set to Logic 1 if Fault Signal Received From FDD or Track 00 Not Found After 17 Stop Pulses	Logic 1 Indicates That FDC Not Serviced by Main System During Data Transfer and the FDC Timed Out	Logic 1 if the Cylinder (Track) is Not Found
03	Set to Logic 1 if the FDD is Not Ready When a Ready/Write Command is Issued	Not Used Logic 0	Logic 1 if Scan Command is Satisfied (Equal)
02	Indicates State of Read/Write Head on FDD at Interrupt	Logic 1 Indicates No Data Returned for Sector Not Found or Bad Address ID Field	Logic 1 if Scan Command Does Not Find the Sector on a Track
01	Unit Select 1 Drive A 01 0 Drive B 01 1	Logic 1 if FDD Returns Write Protect During a Write Operation	Logic 1 Bad Track Information Detected
00	Unit Select 2 Drive A 00 0 Drive B 00 1	Logic 1 if FDC Does Not Find the Address Mark After Detecting Index Mark Twice	Logic 1 if Data Address Mark Can Not Be Found

FDC Flexible Disk Controller  
FDD Flexible Disk Drive

Figure 5-17 Flexible Disk Drive Status Codes

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

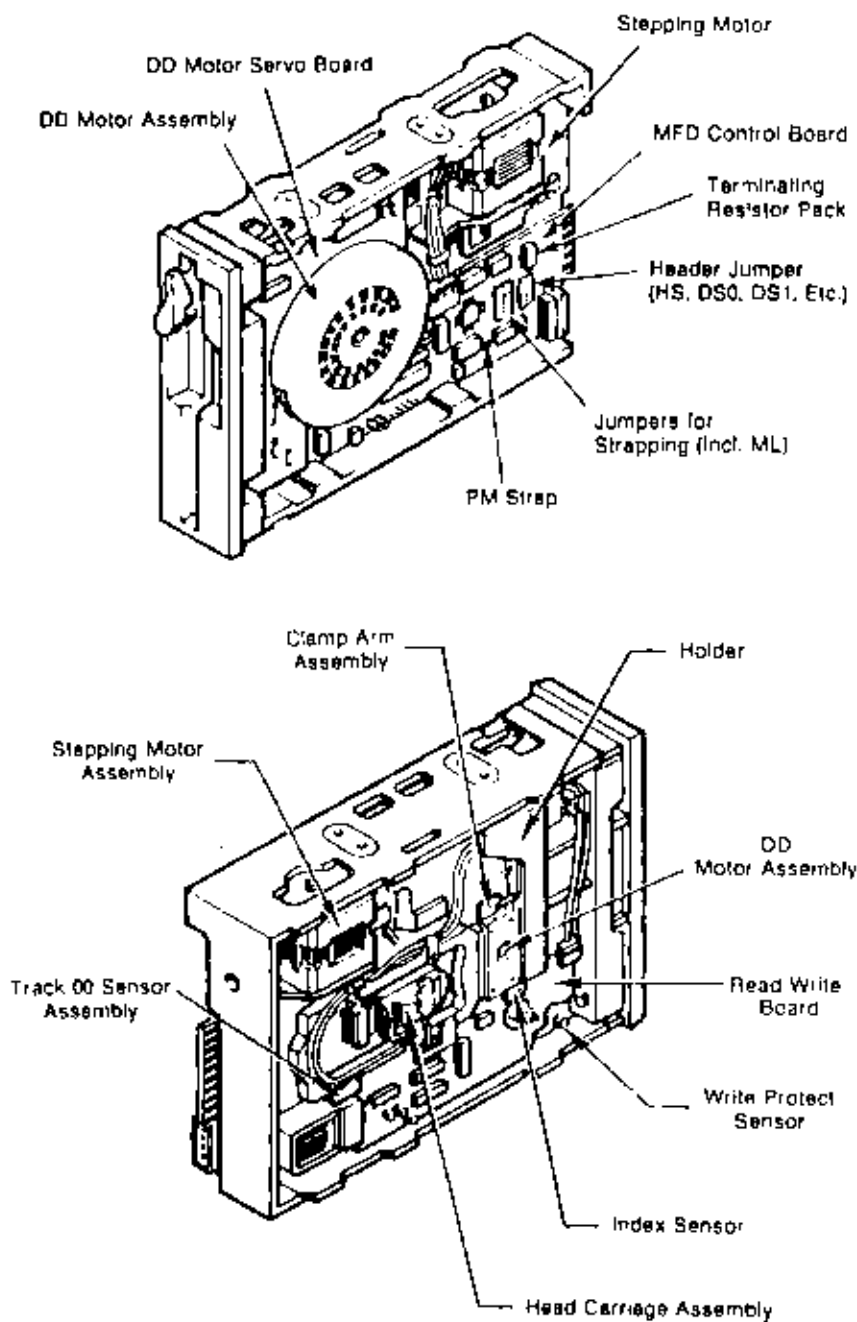


Figure 5-18 Flexible Disk Drive Components

There are two major subassemblies needed for correct disk drive operation. They are: Main Processor Board, disk drive unit. Refer to the "System Configuration" section in this chapter before starting the troubleshooting session. Figure 5-18 shows the placement of components on the Flexible Disk Drive. As a general method of isolating flexible disk drive failures the following technique can be used.

Because the computer uses drive A as the primary system drive, a failure of that drive (if there is a disk drive in that position) will prevent the computer from loading the operating system during any boot operation. For systems that have two flexible disk drives, the second drive can be strapped to be drive A. Figure 5-19 shows in detail the header jumper and other strapping blocks found on the disk drive (refer to Figure 5-18 for location). The NCR Personal Computer requires that two straps to be installed. They are the ML and one drive select strap. Disk drives are configured as drive A or B by installing a strap on DS0 or DS1, respectively.

NOTE: To change the strapping it is necessary to remove the Flexible Disk Drive from the computer.

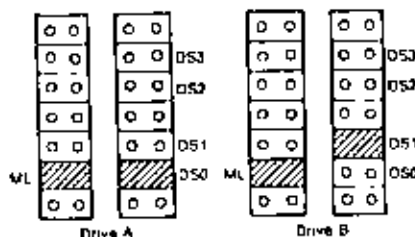


Figure 5-19 Disk Drive Strap Locations

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

To configure a different flexible disk drive to be drive A, remove the strap from DS1 and reinstall on DS0. Remove the strap from DS0 on drive A; this will prevent addressing conflicts.

NOTE: Do not install two disk drives that are both strapped as system drive A, address bus conflicts will result.

With a different drive reconfigured to operate as drive A attempt to restart the computer system. If the Flexible Disk Drive still fails to respond, the failure is not likely to be in the drive unit. Replace the straps as they were originally and insert the disk drives back into the computer cabinet. If switching the drives solves the problem then the specific detail code may provide information as to the cause of the failure. Should it be necessary to return the disk drive unit to a service center for repairs the operational disk drive (configured as drive A) can be used to provide a working computer system.

A terminating resistor pack must be installed on the disk drive attached to the last connected ribbon cable position. Figure 5-20 illustrates the ribbon cable; the location of the terminating resistor pack is shown in Figure 5-18. If only one flexible disk drive is installed, the resistor pack must be inserted in that drive. For systems with two flexible disk drives, only one resistor pack is used, i.e., on the drive at the end of the cable.

### CAUTION

Improper installation of the resistor pack will cause unexpected results in the operation of the disk drive.





Figure 5-20 Ribbon Cable Termination

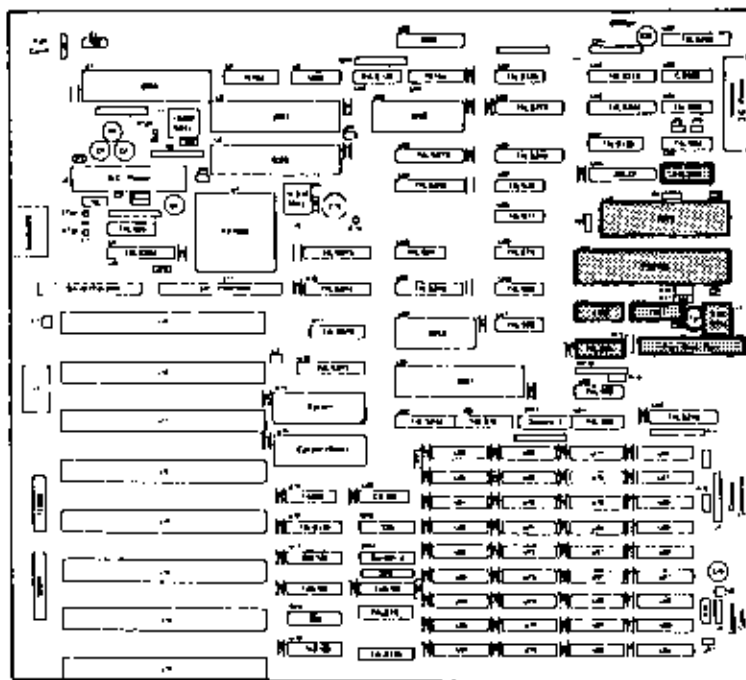


Figure 5-21 Flexible Disk Related Hardware, Alternate MPB

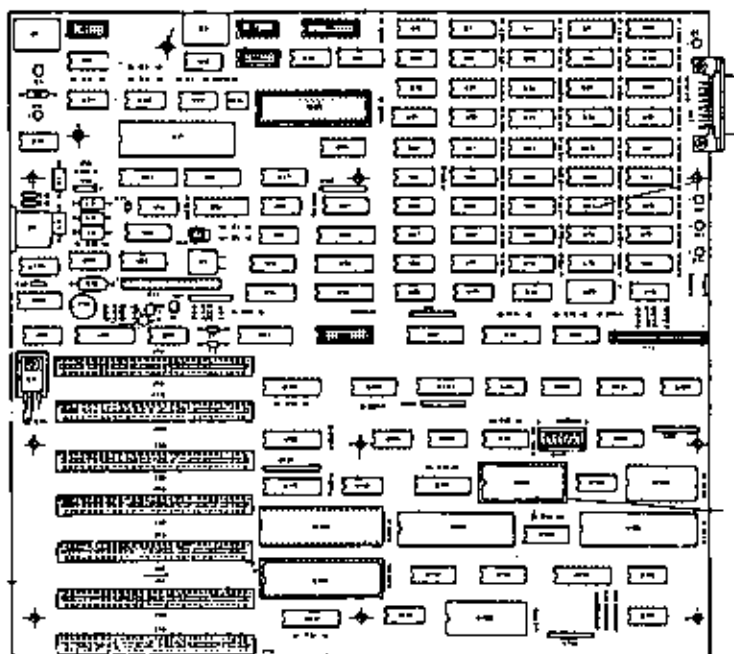


Figure 5-22 Flexible Disk Related Hardware,  
Early-type MPB

For more detailed information on troubleshooting the Flexible Disk Drive subassembly, refer to the specific detail code that was reported by system diagnostics.

**DETAIL CODE 88**

Suspect failure of disk drive unit. Refer to "Repair Procedure 05".

**DETAIL CODE 80**

Suspect intermittent failure of Flexible Disk Controller Card. Check control lines at the expansion slot. Recommend replacement of FDC.

**DETAIL CODE 40**

Suspect disk drive failure. Recommend Repair Procedure.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### DETAIL CODE 20

See device code 80.

### DETAIL CODE 10

Suspect disk drive unit out of alignment or defective. Perform data read/write test on alternate Flexible Disk Drive (if installed) to verify condition. If both drives fail CRC check then suspect the flexible disk drive controller.

### DETAIL CODE 09

DMA segment addressing error, probably the result of a diagnostic software error. Suspect that the diagnostic disk is defective.

### DETAIL CODE 08

Suspect Main Processor Board Failure. Check DMA channel 2 (DRQ 2) for intermittent operation.

### DETAIL CODE 04

Suspect disk drive failure. Check index sensor on drive (Figure 5-18) shows the location) for obstruction. Refer to Repair Procedure for verifying drive failure.

### DETAIL CODE 03

Suspect Defective write protect sensor on the disk drive unit (Figure 5-18) shows the location). Check sensor for obstruction. You can measure resistance from write protect sensor (photo resistor) with diskette installed that is write protected and then not write protected. Resistance should change from high to low if the sensor is operational. Refer to Repair Procedure.

### DETAIL CODE 02

Suspect defective drive; refer to Repair Procedure. If the drive is not defective then the problem is probably a bad flexible disk controller.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### DETAIL CODE 01

Software error. Reboot system and perform test again. Suspect bad diagnostics program disk.

## KEYBOARD ERROR CODES

### KEYBOARD ERROR TEST

Format of code:

ERROR:01:ww            Date            Time  
EXP DATA:xx, OBS DATA: yy

Where,    ww = Detail code  
          xx = Expected data from keyboard port  
          yy = Observed data from keyboard port

Detail codes:

- 01    Keyboard code will not reset
- 02    No interrupt on keyboard
- 03    Bad data on loopback of keyboard port
- 04    Bad data from keyboard

### Repair Procedure 07

Check that the keyboard is connected properly to the main processor board connector. The pins of the keyboard connector should be checked for damage.

### DETAIL CODE 01

Suspect that the CPU controller (U7 on the MPB) is defective.

### DETAIL CODE 02

The keyboard connector J3 should be checked for power to the keyboard. Pin 5 should read 5V and pin 4 should read 0V (ground). If the keyboard is receiving power the keyboard is either not sending data to the main processor board or the data path contains a defective component. Check the EXPAND OBS DATA fields. If the OBS DATA returns a code of 55 the keyboard is operational and the data path (to U7) is not

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

defective. Figures 5-23 and 5-24, respectively, shows the main processor board components that comprises the keyboard interrupt signal path.

### DETAIL CODES 03 and 04

These codes indicate an internal keyboard failure of the CPU controller. Check inputs to U7 (U125) and proper operation of the keyboard clock.

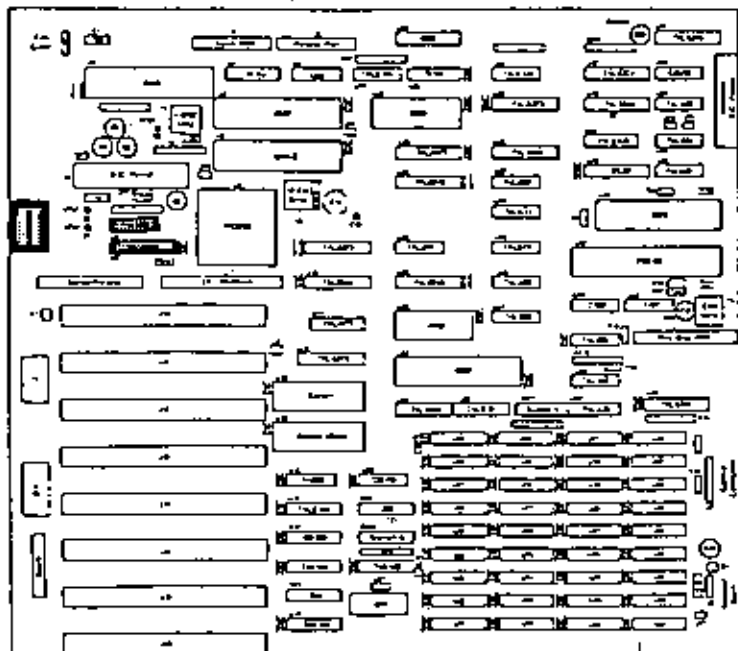


Figure 5-23 Keyboard Related Hardware,  
Alternate MPB

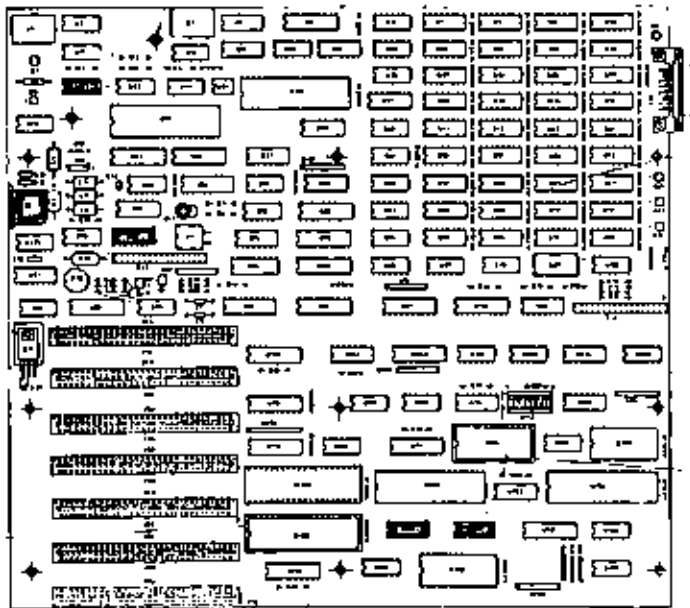


Figure 5-24 Keyboard Related Hardware,  
Early-type MPB

**VIDEO DISPLAY ERROR CODES**

**CRT ERROR TEST**

Format of code:

MONO:01:ww                      Date              Time  
 EXP DATA: xx,              OBS DATA: yy

OR

COLOR:01: ww                      Date              Time  
 EXP DATA: xx,              OBS DATA: yy

Where,              ww = Detail code  
                     xx = Expected data from register

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

yy = Observed data from register

DETAIL code:

- 01 Monochrome crtc register access error
- 02 Monochrome crtc cursor error
- 03 Monochrome crtc character set error
- 04 Monochrome crtc attribute error
- 06 Monochrome crtc scroll error
- 11 Color crtc register access error
- 12 Color crtc cursor error
- 13 Color crtc 80x25 character set error
- 14 Color crtc attribute error
- 15 Color 640x25 mode error
- 16 Color crtc scroll error
- 20 Color 320x200 graphics error - color set 0
- 21 Color 320x200 graphics error - color set 1
- 22 Color 640x300 graphics error
- 30 Color light pen test aborted (timeout)
- 31 Color light pen address failure

### Repair Procedure 08

Detail codes 01 through 06 refer to the errors that occur on systems that use a monochrome display. Detail codes 11 through 22 are associated with systems that use a color video display.

If you have another video display controller card, try to install it. Should this not solve the problem, remove the controller card from its expansion slot location and re-install it in another expansion slot location. This will correct a problem that is the result of a bad expansion slot connector. If the video display is operational and will perform some functions (such as inverting the display) then the character generator ROM on the controller card is probably defective. Errors that are reported for the monochrome/color video display are usually the result of a bad controller card. To check the possibility of a bad data path to the controller card from the Main Processor Board, a memory expander card can be placed into the expansion slot occupied by the video controller card and the diagnostics test for RAM failures can be executed. To use this technique a BCD display must be installed for error message output. or output should be redirected to a printer.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

If no error messages are generated, the data path to the expansion slot is functional. If the video display is operational, but the display does not stabilize, perform the necessary adjustments to the video display unit.

### WARNING

The video display adapter/controller board contains HIGH VOLTAGE elements.

If the problem is the result of a bad video display unit and not the digital circuitry, check for the proper voltages to the analog video circuits. If the display is out of alignment, refer to the Chapter 7 "Adjustments" of this manual for more information.

#### DETAIL CODES 01, 02, 06, 11, 12

Suspect a defective CRT Controller card, probably the CRT Controller chip.

#### DETAIL CODE 03, 13

Suspect defective character generator ROM on the CRT controller card or defective character code RAM. Perform CRT RAM test to verify CRT character code integrity.

#### DETAIL CODE 04, 14

Recommend use of the CRT RAM Error diagnostics test to check for possible defective attribute RAM IC.

#### DETAIL CODE 20, 21

Check the color adjustment to the CRT.

### CRT RAM ERROR TEST

Format of code:

MONO:02:ww                    Date            Time  
ADDR: ssss: oooo, EXP DATA: xxxx;    OBS DATA: yyyy  
OR  
COLOR:02:ww                    Date            Time



## LEVEL 1 DIAGNOSTICS ERROR RETURNS

ADDR: ssss: 0000, EXP DATA: xxxx, OBS DATA: yyyy  
Where, ww = Detail code  
      ssss = Segment address of error  
      0000 = Offset address of error  
      xxxx = Expected data  
      yyyy = Observed data

### Detail codes:

01	Monochrome pattern error
02	Monochrome address error
11	Color pattern error
12	Color address error

### Repair Procedure 09

Refer to Repair Procedure 08. Use the memory expansion board to test the CRT controller card data path. If the memory expansion board produces a RAM failure error, the hardware data path to the expansion slot is suspected to have failed. Otherwise suspect a defective RAM IC on the CRT controller card.

### DETAIL CODE 01 and 11

These codes refer to the monochrome and color units, respectively. They indicate an intermittent failure of a line driver to the RAM IC or a stuck data bit within the RAM. If the flexible disk drive controller or the memory expander card (if installed) do not produce an error in the diagnostics test the CRT RAM IC is most likely the cause of the error condition.

### DETAIL CODE 02 and 12

Suspect intermittent failure of an address latch. Check the address bus to the main Processor Board expansion slot for proper operation (particular attention should be given to address lines 18 and 19). The failure is probably the result of a defective component on the CRT controller card.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### PERIPHERAL ERROR CODES

#### SERIAL COMMUNICATIONS ERROR TEST

Format of code:

PERIPH:01:ww            Date            Time  
EXP DATA :xx, OBS DATA: yy

Where,        ww = Detail code  
              xx = Optional expected data  
              yy = Optional observed data

NOTE:        EXP DATA and OBS DATA are in reference to the registers in error. If a register is not in question these fields are not displayed.

#### Detail Code:

The detail code is a bit sensitive code. It is displayed on the CRT as a hex code with bit 7 as the MSB and bit 0 as the LSB. An "x" represents the "Don't Care State". The detail codes are to construct the error code for all serial communication failures. Block 1 codes represent failures of the 8250 serial communications chip or the line drivers used to transmit or receive data from the serial (RS 232) port: To form the error code the detail codes for block 1 diagnostics are logically "or" ed. Observe that the following bit designation is used.

bits 0,1	communications channel selected
bits 2,3	error during transmit or receive
bits 4	internal/external loop back test
bits 5,6	control/status errors
bits 7	time out or receive data error

NOTE:        See Figure 5-25 for status/control definitions

	(LSB)							(MSB)
	Bit #0	Bit #1	Bit #2	Bit #3	Bit #4	Bit #5	Bit #6	Bit #7
Receive Register (Read Only)	Data Bit 0	Data Bit 1	Data Bit 2	Data Bit 3	Data Bit 4	Data Bit 5	Data Bit 6	Data Bit 7
Transmit Register (Write Only)	Data Bit 0	Data Bit 1	Data Bit 2	Data Bit 3	Data Bit 4	Data Bit 5	Data Bit 6	Data Bit 7
Line Status Register	Logic 1 When Data is Ready	Overrun Error	Data Parity Error When Set to Logic 1	Logic 1 Indicates No Stop Bit Error	Break Interrupt	Transmit Hold Register Empty Flag	Transmit Shift Register Flag	
Modem Control Register	Reflects the State of DTR Control Line	Reflects the State of RTS Control Line	User Defined Output	User Defined Output	Logic 1 Indicates Internal Loop Back Diagnostics			
Modem Status Register	Defines Receipt of CTS Control Signal	Reflects DSR Control Line Status	Ring Indicator Control Line Status	Receive Line Signal Detector Status	Complement of CTS Input Signal	Complement of DSR Input Signal	Complement of Ring Indicator Input	Complement of Receive Line Signal Input
Interrupt Enable Register	Logic 1 Enables Data Available Interrupt	Logic 1 Enables Transmit Register Empty Interrupt	Logic 1 Enables Receive Line Status Interrupt	Logic 1 Enables Modem Status Interrupt				
Interrupt ID Register	Logic 1 = Interrupt Pending	Interrupt ID 0	Interrupt ID 1					

Figure 5-25 Serial Communications Status (1 of 2)

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

BLOCK 1	Bit	7	6	5	4	3	2	1	0
COM1 channel selected		x	x	x	x	x	x	0	1
Error on channel during transmit		x	x	x	x	0	1	x	x
Error on channel during receive		x	x	x	x	1	0	x	x
Channel loop back internal		x	x	x	1	x	x	x	x
Channel loop back external		x	x	x	0	x	x	x	x
LOOP MODEM CONTROL is status error		0	0	0	x	x	x	x	x
MODEM STATUS will not reset		0	0	1	x	x	x	x	x
MODEM STATUS will not set		0	1	0	x	x	x	x	x
LINE STATUS error		0	1	1	x	x	x	x	x
Channel time out error		1	0	0	x	x	x	x	x
Receive data error		1	0	1	x	x	x	x	x

BLOCK 2								
Detail codes associated with block 2 are indicative of serial communications interrupt failures or a failure to select the serial communications chip completely.								
Channel interrupt error on wrong channel.								
Interrupting channel indicated.	1	1	1	0	0	0	x	x
eg.								
No COM interrupt	1	1	1	0	0	0	0	0
Channel interrupt on COM1	1	1	1	0	0	0	0	1
Channel interrupt on COM2	1	1	1	0	0	0	1	0
Bad INTERRUPT ID status before interrupt	1	1	1	0	0	1	x	x
Bad INTERRUPT ID status after interrupt on COM1	1	1	1	0	1	0	x	x
						0	1	
Select error COM1	1	1	1	0	1	1	0	1

Figure 5-26 Serial Communications Status (2 of 2)

### Repair Procedure 10

Before starting to troubleshoot the communications channel it is recommended that the system configuration switches may be checked for the proper setting. It is also necessary to install a wrap plug or Turnaround Test Plug (Part No. 017-0044311) for the RS-232 port. If you do not have such a Test Plug construct one using an RS-232 female connector with the pins jumpered as in Figure 10-27. If you have not already done so, refer to the "System Configuration" section of this chapter. Most of the bit sensitive codes that are specified in the error message refer to the failure of the 8250 communications IC or one of the associated line drivers. This test can be used to determine a peripheral device (modem, printer, etc.) connected to the serial (RS-232) port is defective. Figure 5-25 shows the location of hardware used by the serial communications port. To test the data bus to the 8250 serial communications IC a printer can be attached to the computer's printer

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

port (J2) and diagnostics check run on the printer. If the printer fails the problem is probably an intermittent bus driver on the data bus. This test can be used since both printer and serial port use the data bus.

**NOTE:** Remove any equipment attached to the RS-232 port and install the loop-back connector **BEFORE** running the diagnostics test.

Connect: 2 to 3  
4 to 5 to 8  
5 to 20 to 22



Figure 5-27 Turnaround Test Adapter  
(Soldering Side)

### DETAIL CODE (BLOCK 1)

If an internal error is returned by the detail code (bit 4 at logic 1) then suspect a failure of the 8250 serial communications IC. Errors that occur during external loop back checks require that the line drivers from/to the 8250 be checked for proper operation. Figure 5-23 provides more information for determining the actual cause of an internal failure.

### DETAIL CODE (BLOCK 2)

The serial interrupt can be detected as the output of the tri-buffer U23 (U12). It is routed to the interrupt controller IC through switch block A on the main processor board. For interrupt failures check that the system switches are set for serial port enabled. If the switch is properly set, proceed from the output of U23

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

(U12) (pin 8) to determine if the interrupt signal is operational (refer to Figures 5-26 and 5-27, respectively)

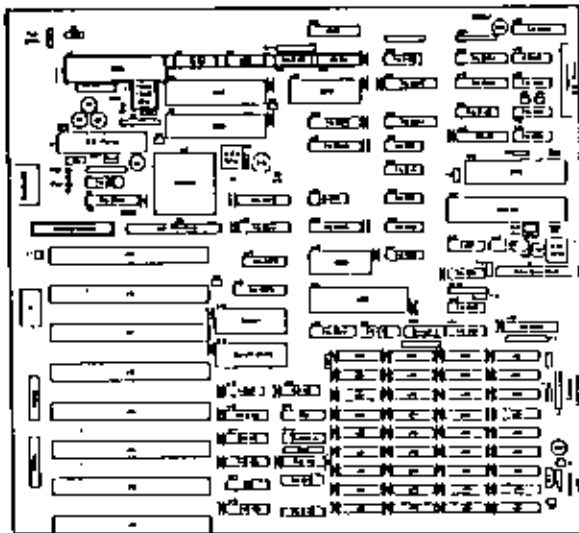


Figure 5-28 Serial Communications Port Hardware for Alternate MPB

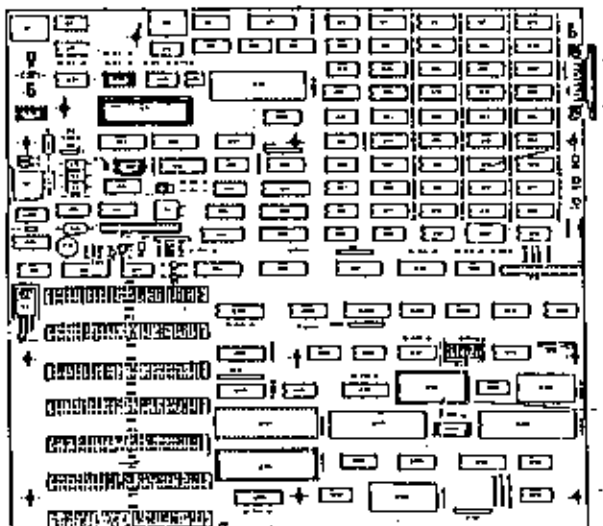


Figure 5-29 Serial Communications Port Hardware, Early-type MPB



## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### DETAIL CODE 01

If the printer data path is defective the diagnostics test with loop back connector installed will show the failure (invalid data) in the EXP DATA and OBS DATA fields. For valid data the expected and observed fields will be the same. Should the test fail then the problem is resident on the main processor board.

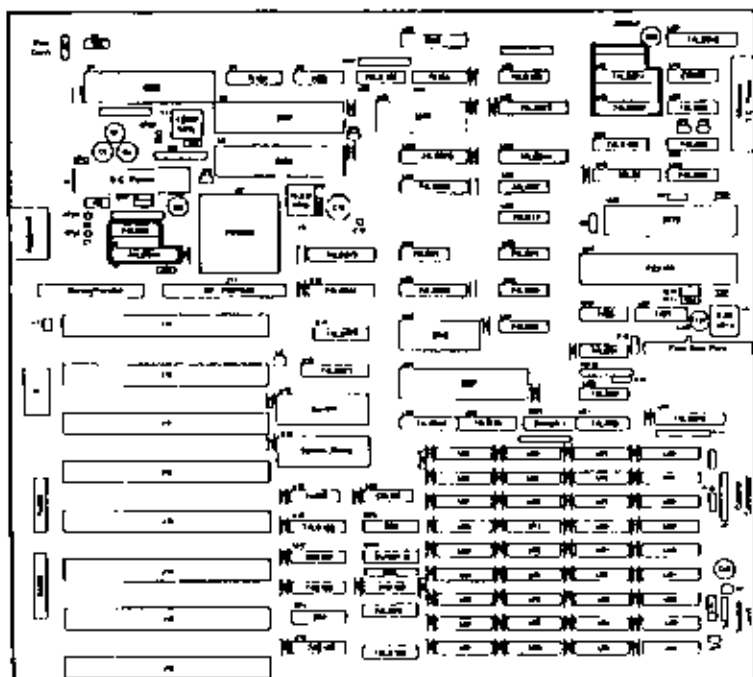


Figure 5-31 Printer Port Hardware Components  
Alternate MPB



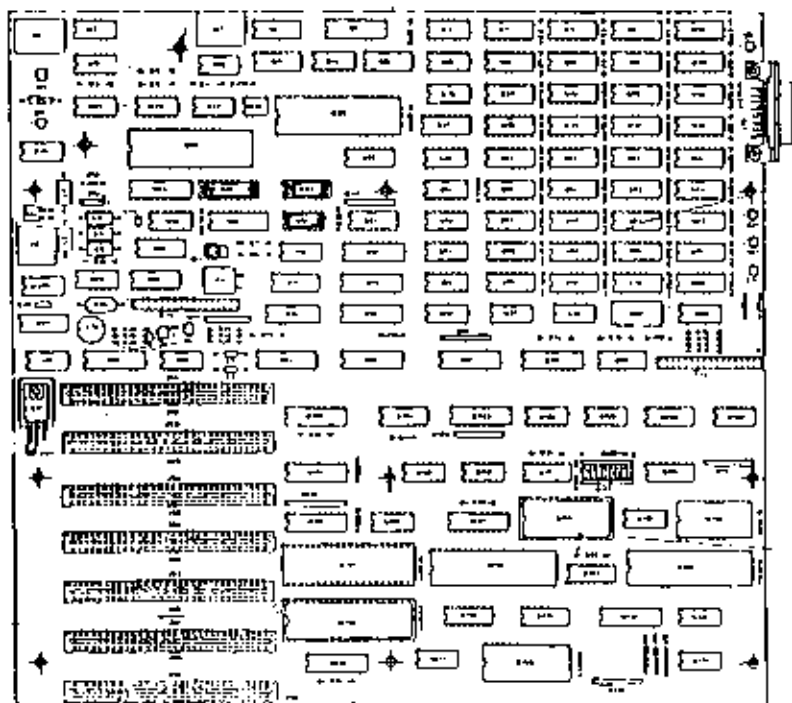


Figure 5-32 Printer Port Hardware Components  
Early-type MPB

To check the integrity of the data bus used to communicate with the printer port a loop back connector can be placed on the RS 232 SERIAL PORT (J10) and diagnostics performed on the serial port. If the serial port also fails the diagnostics test the problem is a bad bipolar ROM (U9, which generates chip selects for serial and printer ports) or a defective component on the data bus.

#### DETAIL CODE 02 and 03

Printer control and status is a Main Processor Board Failure and requires the analysis of printer port hardware. The problem might be a defective data bus line driver or data latch. Suspect the C data bus routed from the 8255

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

((PIO, U35 (U46)) through line driver U61 (U47) and data latch U69 (U56) to the printer port. Refer to Detail Code 01.

### DETAIL CODE 04

Suspect Interrupt #7 not operational at interrupt controller ((8259, U25 (U132)). Check the operation of -ACK from the printer port (J2 pin 5). Check U23 (U12\*) (tri-state buffer for interrupt 7) for proper operation.

## PRINTER ERROR TEST

Format of code:

PERIPH:03:ww            Date            Time

Where,    ww = Detail code

Detail code:

- D0 = 1 : Printer time out
- D3 = 1 : I/O error
- D4 = 1 : Printer select
- D5 = 1 : Out of paper
- D6 = 0 : Ack (internal)
- D7 = 0 : Printer busy

### Repair Procedure 12

Refer to previous Repair Procedure 11. Check the installation of the printer; suspect bad cable connection or printer switch settings.

## MAJOR SYSTEM CONTROLLER ERROR CODES

Diagnostic Error Codes 01, 03, 04, 05, 06, 07 are associated with failures on the main processor board.

To analyze the error condition requires the use of an oscilloscope. However, some of the components are installed in sockets and can be removed. Replacement of defective socketted components may alleviate the error condition.

**CAUTION**

Care should be used in removing any socketted IC component or damage to the component/socket may result.

**CPU ERROR (8088)**

Format of code:

CONTROL:01:00            Date            Time

Detail code:

NONE

**Repair Procedure 13**

Check the 8088 U6 (U125) for correct installation. Determine if the ready line of U6 (U125) is active; this will suspend operation of the microprocessor. If this condition is observed then check RDY and DMA wait inputs into the CPU VLSI (U7/125). If one of these two control lines is not active then suspect that the clock IC (U7) or the processor (U6)(U125) is defective.

NOTE: A control line attached to a defective input that is also attached to the inputs of other gates can produce unpredictable results and conditions that are difficult to troubleshoot.

**INTERRUPT CONTROLLER (8259) TEST**

Format of code:

CONTROL:02:ww            Date            Time  
EXP DATA: xx,    OBS DATA: yy

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

Where,                    ww = Detail code  
                          xx = Expected data from register  
                          yy = Observed data from register

Detail code:  
  10                    Failed read/write to mask register

### Repair Procedure 14

Check the bus connections to the 8259 Interrupt Controller IC.

#### DETAIL CODE 10

Suspect 8259 (U25)(U132\*) data bus to processor connection; check data bus. The 8259 may be internally damaged resulting in intermittent failure; replace U25 (U132\*).

### INTERVAL TIMER (8253) TEST

Format of code:

CONTROL:03:ww            Date            Time  
EXP DATA: xxxx,   OBS DATA: yyyy

Where,   ww   = Detail code  
          xxxx = Expected data from register  
          yyyy = Observed data from register

Detail code:

1x   Failed counter read/write test  
      x = counter 2  
2x   Timer too fast  
      x = counter 0,1,2  
3x   Timer too slow  
      x = counter 0,1,2  
5x   No output from timer 0  
      x = counter 1,2

### Repair Procedure 15

#### DETAIL CODE 1x

Suspect intermittent failure of the 8253 timer

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

IC U30 (U120). Recommend check of the B data bus for proper operation.

### DETAIL CODE 2x, 3x, 5x

Check the clock inputs to the 8253 U30 (U120)  
Suspect divide by 2 flip flop and the timer chip  
(U30)(120).

### DMA CONTROLLER (8237) TEST

Format of code:

for Detail 1x

CONTROL:04:1x            Date            Time  
EXP DATA: xx, OBS DATA: yy

Where,                    xx = Expected data from register  
                          yy = Observed data from register

for DETAIL 70,

CONTROL:04:70            Date            Time  
EXP DATA: xxxx, OBS DATA: yyyy

Where,            xxxx = expected segment  
                  yyyy = observed segment

Detail code:

- 1x    DMA controller failed internal register  
      read/write test  
      x = register 2 through 7
- 70    DMA failed addressing test.

### Repair Procedure 16

DETAIL CODE 1x

Suspect intermittent failure of 8237  
U31(U122).

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

### DETAIL CODE 70

DMA failed addressing test. Evaluate the EXP and OBS DATA fields to determine if the address failed along an eight bit address path. If the lower address bus (bits 0 - 7) has been altered then suspect line driver U32 (U75). For alterations of the high address bus (bits 8 - 15) suspect address latch U12 (U126). If Detail Code 70 is returned and the EXP and OBS data fields match then suspect U11.

### CPU CONTROLLER ERROR TEST (VLSI DEVICE)

Format of code:

CONTROL:05:ww            Date            Time

EXP DATA: xx, OBS DATA: yy

ww = Detail code

xx = Expected data from port

yy = Observed data from port

DETAIL code:

11    Port failed read/write test to PIO control register (Port B).

### Repair Procedure 17

The system PIO uses port B for the following control functions: control the speaker on the Main Processor Board, enable RAM parity, read the sense switches, and keyboard control.

Because port B is used to control several different devices, the diagnostics test for those devices should return an error if there is a failure on one of its control lines. Run RAM PARITY TEST and KEYBOARD TEST using the diagnostics. To test the speaker depress any printing character key on the keyboard and hold. When the end of line is reached the speaker will click repeatedly until the key is released. The speaker should emit a constant tone. Intermittent failure is indicated by a random break in the tone. All of these tests should be run repeatedly to check for intermittent component

failure. A failure detected by using this technique can isolate which line on the PIO is failing. Check CPU Controller.

**SERIAL PORT (8250) TEST**

**FAILED LINE CONTROL REGISTER READ/WRITE TEST**

Format of code:

CONTROL:06:ww            Date            Time  
EXP DATA: xx, OBS DATA: yy

Where,            ww = Detail code  
                  xx = expected data from register  
                  yy = observed data from register

Detail code:

- 01    Read/write to divisor latch high
- 02    Read/write to divisor latch low
- 03    Read/write to line control register
- 04    Read/write to modem control register

**Repair Procedure 18**

Suspect defective 8250 (U1, U37) or intermittent failure of data bus. Perform the PRINTER PORT TEST. The printer uses the C data bus to communicate with the microprocessor. If the printer port passes (several runs of the test) suspect the 8250 (U1)(U37) serial communications IC. A failure reported by the Printer Port Test indicates a failure of the data bus; check line driver U43 (U94) for intermittent failure. Refer to "Repair Procedure 07" for troubleshooting the serial communications port.

**FLEXIBLE DISK CONTROLLER (8272) TEST**

Format of code:

CONTROL:07:ww            Date            Time  
EXP DATA: xx, OBS DATA: yy

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

Where,                    ww = DETAIL code  
                          xx = Expected data from register  
                          yy = Observed data from register

Detail code:

- 10 No ready status from controller
- 11 Bad status returned after invalid command sent
- 12 Incorrect STATUS 0 returned from controller after invalid command sent

### Repair Procedure 19

Suspect defective flexible disk drive controller IC. Refer to "Repair Procedure 08" for more information on troubleshooting flexible disk drives.

## CRT CONTROLLER (6845) TEST

Format of code:

CONTROL:08:ww            Date            Time  
EXP DATA: xxxx, OBS DATA: yyyy

Where, ww = Detail code  
          xxxx = Expected data from register  
          yyyy = Observed data from register

Detail code:

- 0E Cursor address register read/write error - 14 (mono)
- 0F Cursor address register read/write error - 15 (mono)
- 1E Cursor address register read/write error - 14 (color)
- 1F Cursor address register read/write error - 15 (color)

### Repair Procedure 20

Suspect defective 6845 CRT Controller chip. Replace the 6845 Controller IC or the CRT Controller Card.



## LEVEL 1 DIAGNOSTICS ERROR RETURNS

Refer to "Repair Procedure 08" for more information on troubleshooting Video (CRT) systems.

### FIXED DISK CONTROLLER ERROR CODES

#### FIXED DISK CONTROLLER ERROR TEST (ON EXPANSION BOARD)

Format of code:

FIXED:01:ww	Date	Time	
HEAD	TRACK	SECTOR	CYCLE
xx	xxxx	xx	xxxx

Where,           ww = Detail code  
                  xx = location on disk related to error

Detail code:

01	Command error (internal)
02	Address error
04	Sector error
05	Reset error
07	Initialization error
09	DMA across 64K error (internal)
0B	Bad track
10	Uncorrectable data error
11	ECC soft error
20	Controller error
40	Seek error
80	Timeout error
BB	Undefined error (internal)
FF	Read status failed

#### Repair Procedure 21

Check the power and ribbon cable connectors to the fixed disk drive. Re-install the fixed disk controller card in a different Expansion slot. Perform diagnostics test on the flexible disk drive and the CRT unit. If both pass the diagnostic test then the problem is a defective fixed Disk or fixed disk controller card.

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

Some error conditions can be corrected by reformatting the fixed disk. If the fixed disk drive is reformatted all data previously stored on the drive is lost.

### FIXED DISK ERROR TEST

(Refer to Figure 5-7)

Format of code:

FIXED:aa:ww	Date	Time
HEAD TRACK SECTOR	CYCLE	
xx xxxx xx	xxxx	

NOTE: The additional messages do not appear for all error codes.

Where, aa = Major code  
ww = Detail code  
xx = location on disk related to error

Detail code:

01	Command error (internal)
02	Address error
04	Sector error
05	Reset error
07	Initialization error
09	DMA across 64K error (internal)
0B	Bad track
10	Uncorrectable data error
11	ECC soft error
20	Controller error
40	Seek error
80	Timeout error
BE	Undefined error (internal)
FF	Read status failed

### Repair Procedure 22

Major error codes FIXED:02 through FIXED:08 indicate failures that occur in the fixed disk drive assembly. (For failure of the fixed disk controller, a major error code of FIXED:01 is returned.) To verify the

## LEVEL 1 DIAGNOSTICS ERROR RETURNS

operation of the main processor board bus signals insert another controller card (CRT, memory expander) in the expansion slot occupied by the fixed disk controller card and perform diagnostics tests for the newly installed card. If the diagnostics tests pass then the problem resides on the fixed disk controller card or the fixed disk drive subassembly. Check the fixed disk drive for proper installation and strapping.

### DETAIL CODE 01

An invalid command was issued to the fixed disk. Check the cable connections to the drive unit. Suspect failure of the fixed disk controller card.

### DETAIL CODE 02

Probable failure of the fixed disk controller card.

### DETAIL CODE 04

Suspect failure of the fixed disk drive. Reformatting the drive might correct the condition.

### DETAIL CODE 05

Suspect failure of the fixed disk drive. Refer to "Repair Procedure 22" for checking the RESET signal to the expansion slot.

### DETAIL CODE 07

Suspect failure of the fixed disk controller card.

### DETAIL CODE 09

Software failure. Repeat the test; if the test fails again, try another diagnostics diskette.

### DETAIL CODE 0B

Suspect damage to fixed disk drive. Attempt to reformat the drive unit.

### DETAIL CODE 10

Refer to DETAIL CODE 0B.

**DETAIL CODE 11**

Refer to DETAIL CODE 0B.

**DETAIL CODE 20**

The fixed disk controller card failed while the diagnostics were testing the drive unit. Suspect defective fixed disk controller card.

**DETAIL CODE 40**

Refer to DETAIL CODE 0B.

**DETAIL CODE 80**

The fixed disk drive failed to respond to the fixed disk controller. Check the drive for correct installation.

**DETAIL CODE BB**

Perform the diagnostics test again. Suspect failure of fixed disk controller card or the diagnostics test diskette.

**DETAIL CODE FF**

Suspect failure of the fixed disk controller card.

**VIDEOYEX ERROR CODES**

**MODEM INTERFACE ERROR TEST**

\*\*\* ERR: 26:ww

**VLP INTERFACE ERROR TEST**

\*\*\* ERR: 26:ww

Where, ww = Detail Code

**Repair Procedure 23 and 24**

If detail codes 01 and 02 are returned, the Videotex controller board is defective. A new board must be installed.

**Repair Procedure 25**

Check for the installation of the Turnaround Test Plug (Part No. 017-0044311). If the error persists, a new Videotex controller board must be installed.

**TEST PICTURE ERROR**

\*\*\* ERR: 26:ww

Where, ww = DETAIL code

**Repair Procedure 26**

If detail code 10 is returned, the EUROM, Videotex controller board or the switchboard may be defective.



**Removal/Replacement**

This chapter describes how to remove and replace the major assemblies of the NCR Personal Computer PC 4i.

The description includes all assemblies that are used in the computer, therefore be sure that the correct procedure is used since not all features are in every system.

In some of the figures assemblies are not shown for reasons of clarity. It is only necessary to remove what is described in the text.

When a complete assembly is replaced, contact your supplier or NCR office for information concerning the possible repair of the defective assembly.

**WARNING**

Disconnect the power cord before removing the cabinet. Dangerous voltages are present when working with the covers removed. Only trained engineers should attempt to work on the computer with the covers removed.

Do not leave the computer unattended with power applied and the covers removed.

**CABINET**

To remove the cabinet, refer to Figure 6-1 and use the following procedure:

1. Be sure that the ON/OFF switch is in the OFF position
2. Disconnect the power cord (A).

## REMOVAL/REPLACEMENT

3. Remove the two retaining screws (B).
4. Slide the cabinet top backwards and upwards.

To re-assemble, use the above procedure in the reverse order.

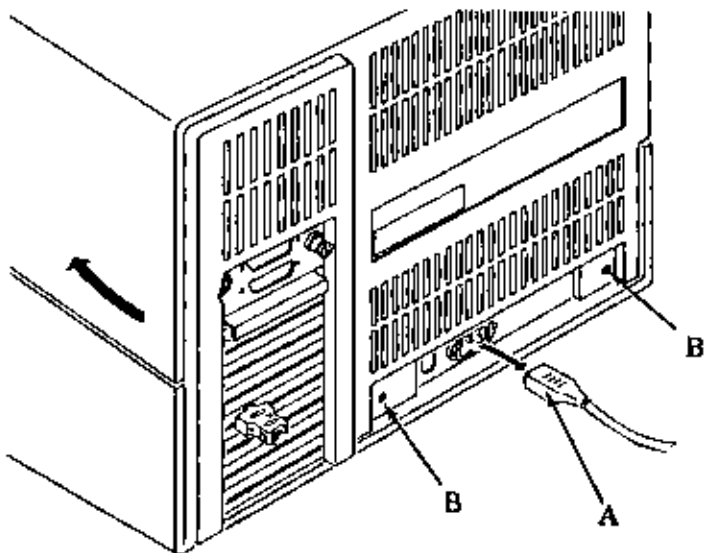


Figure 6-1 Cabinet Removal

## CARD RACK ASSEMBLY

To remove the card rack assembly, refer to Figure 6-2 and use the following procedure.

1. Be sure that the ON/Off switch is in the OFF position.
2. Make a note of their positions and disconnect the cables from the back of the card rack assembly.



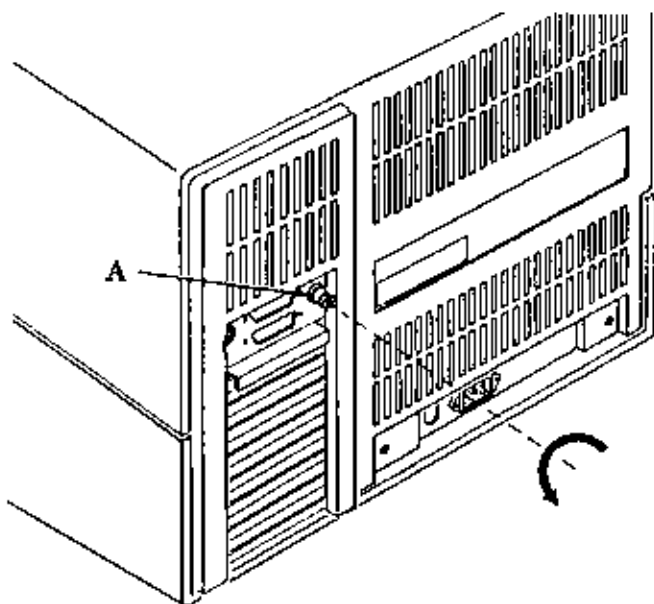


Figure 6-2 Card Rack Removal

3. Turn the securing screw (A) a quarter turn counter-clockwise.
4. Pull out the card rack assembly.

**NOTE**

The cable connecting the disk drives to the card rack assembly is long enough to allow complete withdrawal of the assembly and further work on the assembly.

5. To completely disconnect the card rack assembly, make a note of their positions and disconnect the broad ribbon cables from the disk drives.

To re-assemble, use the above procedure in the reverse order.

**NOTE**

The ribbon cable is color coded on the lower edge, be sure that the connectors to the disk drives are reconnected the correct way.

When adding option boards to a system the following limitations must be considered:

1. A maximum of seven boards may be installed into the card rack assembly.
2. The shape of the card rack assembly limits the installation to three full length boards in the upper slot positions; and four shorter length boards in the lower slot positions. You can install shorter length boards in the upper slot positions.

**PRINTED CIRCUIT BOARDS**

All printed circuit boards (except power supply and deflection board) are contained in the card rack assembly. To remove the PCBs, remove the card rack assembly and use the following procedures.

**Option PC Boards**

1. Remove the screw that secures the option PCB to the card rack assembly, see Figure 6-3.
2. Remove the plastic retaining strip
3. Carefully pull the PCB out of the card rack assembly.

To replace a PCB, use the above procedure in the reverse order. Be sure that the connector on the PCB is fully seated into the connector on the main processor board.

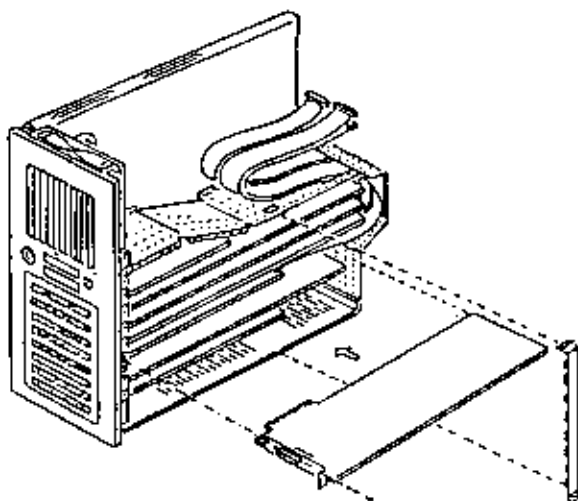


Figure 6-3 Option Board Removal

#### Main Processor Board

To remove the main processor board, remove all option PCBs, and use the following procedure. This procedure applies to both versions, to the Alternate and Early-type MPB as well.

1. Remove the 5 screws and lift off the metal cover (A) as shown in Figure 6-4. When removing an Alternate MPB the Speaker Connector JP7 has to be disconnected before removing the metal cover.
2. Disconnect all ribbon cables from the MPB.  
 Alternate MPB: Disconnect flexible disk drive connector from J1\*  
 Disconnect Serial/Parallel Connector from J2  
 Disconnect Fan Connector from JP7

## REMOVAL/REPLACEMENT

Early-type MPB: Disconnect Flexible Disk Drive connector from P12  
Disconnect Serial/Parallel connector from P13

\* marked on MPB

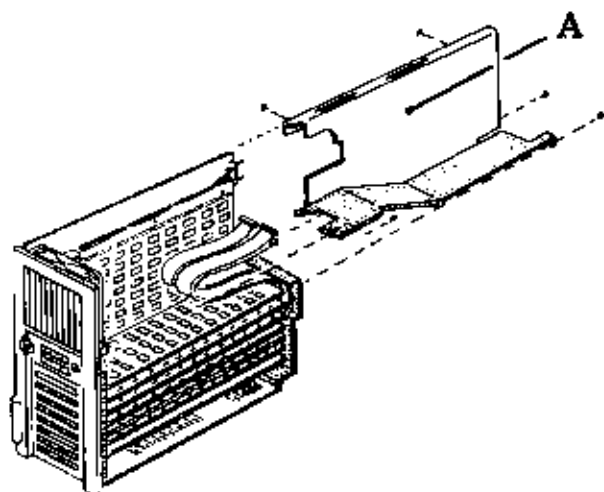


Figure 6-4 Main Board Cover Removal

3. Remove the two screws fastening the MPB to the rack.
4. Unscrew the power connector (A) on the top right of the MPB, see Figure 6-5.
5. Remove fan (B) on the front panel of the rack.
6. Using a small pair of pointed pliers, squeeze the lugs on each of the plastic stand-offs (C) together and carefully lift the board over the stand-offs, see Figure 6-5.
7. When the board has been lifted over the lugs of all stand-offs, then the board can be completely removed.

To replace the main processor board, use the above procedure in the reverse order.

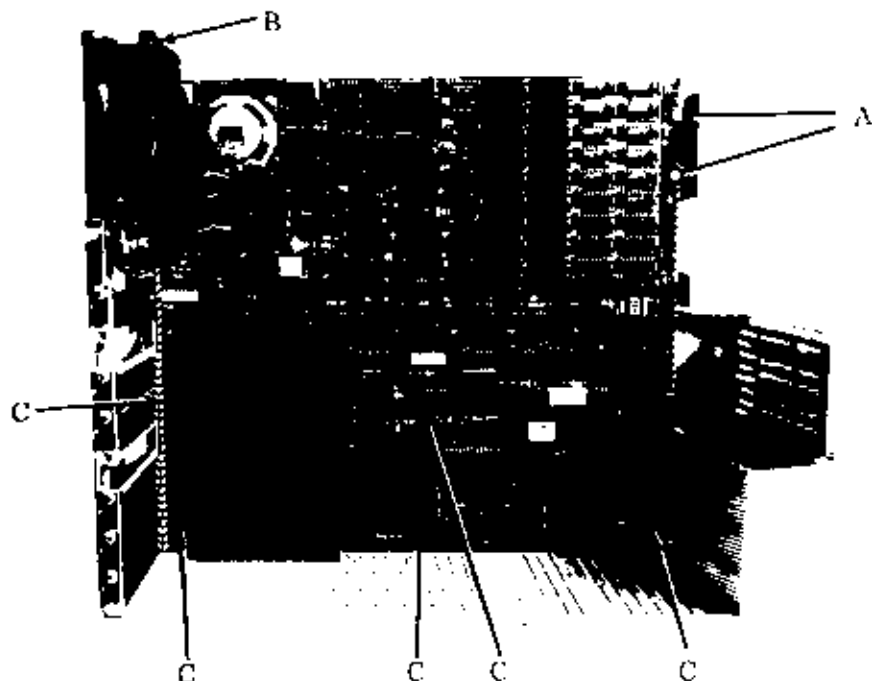


Figure 6-5 Board Removal

#### DISK DRIVES

To remove the disk drives, first remove the cabinet and card rack assembly, refer to Figure 6-6 and use the following procedure:

## REMOVAL/REPLACEMENT

1. If you have not already done so, disconnect the broad ribbon cable (A) from the disk drive (two cables on fixed disk drives).

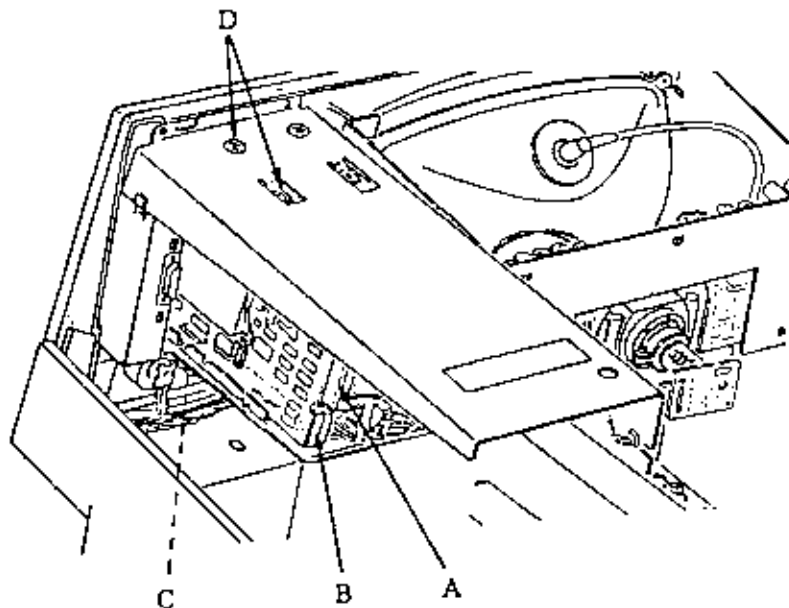


Figure 6-6 Disk Drive Removal

2. Disconnect the power cable (B) from the disk drive.
3. Remove the knurled screw (C).
4. Remove the two screws (D) from the top of the disk drive.
5. Slide the disk drive out through the front of the cabinet.

To replace a disk drive, use the above procedure in the reverse order.

NOTE: Unless the disk drive strapping is changed, flexible disk drives are not interchangeable. Always replace the drive into the original location.

If a replacement disk drive is being installed then this must be strapped correctly, refer to the Chapter 6 "Strappings".

### ON/OFF SWITCH

To remove the ON/OFF switch, remove the cabinet and card rack assembly, refer to Figure 6-7 and use the following procedure.

1. Be sure that the ON/OFF switch is in the OFF position, and that the power cord is disconnected.
2. Remove the two screws from the back of the ON/OFF switch.
3. Remove the switch cover the switch can now be pulled away from the back of the cabinet. Make a note of their positions and unsolder the wires.
4. Remove the ON/OFF switch.

To replace the switch, use the above procedure in the reverse order. Be sure that the wires are soldered onto the correct terminals.

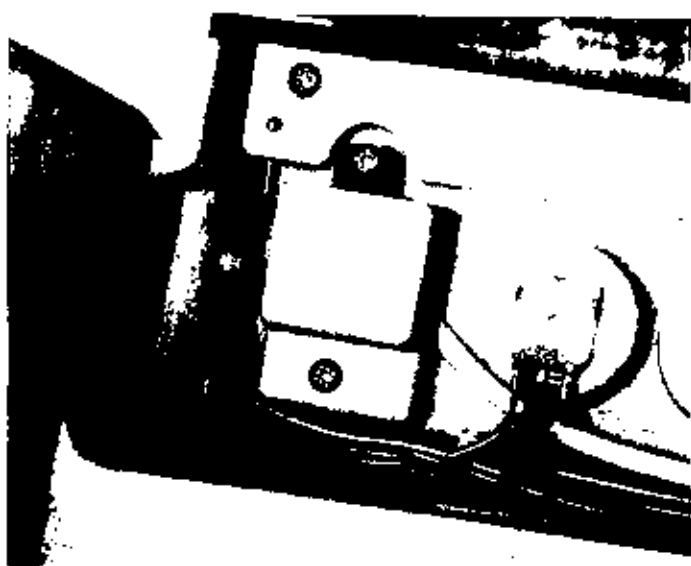


Figure 6-7 ON/OFF Switch Removal

#### BRIGHTNESS AND VOLUME CONTROLS

To remove either the Brightness or Volume controls, remove the cabinet and card rack assembly, use the following procedure:

1. Be sure that the ON/OFF switch is in the OFF position, and that the power cord is disconnected.
2. Using a small screwdriver push the control knob off the spindle as shown in Figure 6-8.
3. From the front of the computer unscrew the control knob securing nut.
4. The control knob can now be pulled away from the back of the cabinet. Make a note of their positions and unsolder the wires.
5. Remove the control knob.



To replace the control knob, use the above procedure in the reverse order. Ensure that the wires are soldered onto the correct terminals.

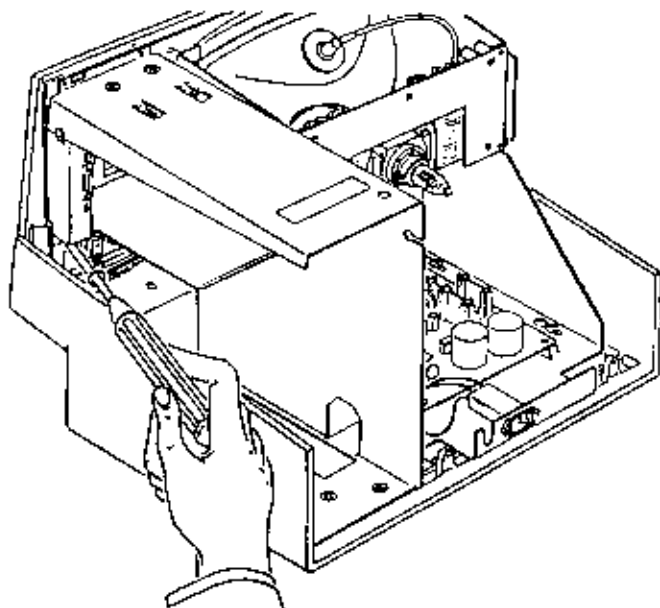


Figure 6-8 CRT Control Removal

### **MONOCHROME CRT/POWER SUPPLY ASSEMBLY**

This part of the computer may be removed as a complete assembly (CRT and power supply), or the power supply may be removed separately. Remove the cabinet, refer to Figure 6-9 and use the following procedure.

#### **COMPLETE ASSEMBLY**

1. Disconnect the three connectors J2,5,4 (A) from the left side of the power supply board.
2. Disconnect the CRT cable (B) from the back of the card rack assembly.
3. Loosen the 6 screws (C) and slide the assembly to the back, then lift out the complete assembly.

## REMOVAL/REPLACEMENT

To re-assemble the complete assembly into the computer, use the above procedure in the reverse order.

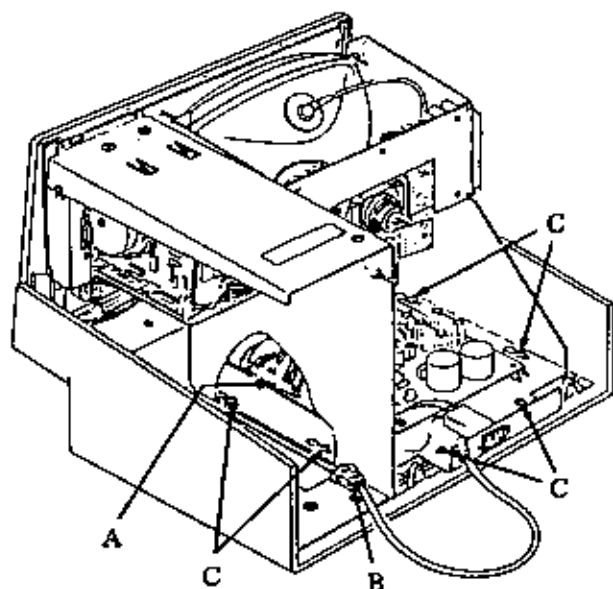


Figure 6-9 Monochrome CRT/Power Supply Removal

### POWER SUPPLY

The power supply may be removed from the CRT assembly either after the CRT assembly has been removed from the computer, or while it is still in the computer. To remove the power supply, refer to Figure 6-10 and use the following procedure.

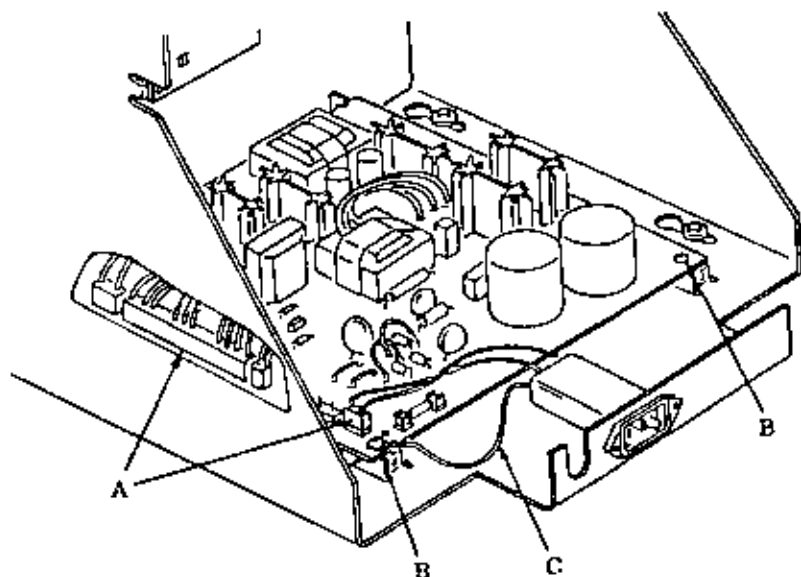


Figure 6-10 Monochrome Power Supply Removal

1. Disconnect all connectors (A) from the left side of the power supply board.
2. Remove the two screws (B) and disconnect the Ground wire (C).
3. Slide the power supply board towards the back of the CRT assembly and lift out.

To re-assemble the power supply into the CRT assembly use the above procedure in the reverse order. Be sure that the ground wire is reconnected and securely fastened.

MONOCHROME DEFLECTION BOARD

WARNING

Very high voltages are present when the unit is operating. Before removing the CRT High Tension lead, the CRT tube should be discharged by connecting a 1 megohm resistor between the high tension connector and ground for a minimum of ten seconds, see Figure 6-11.

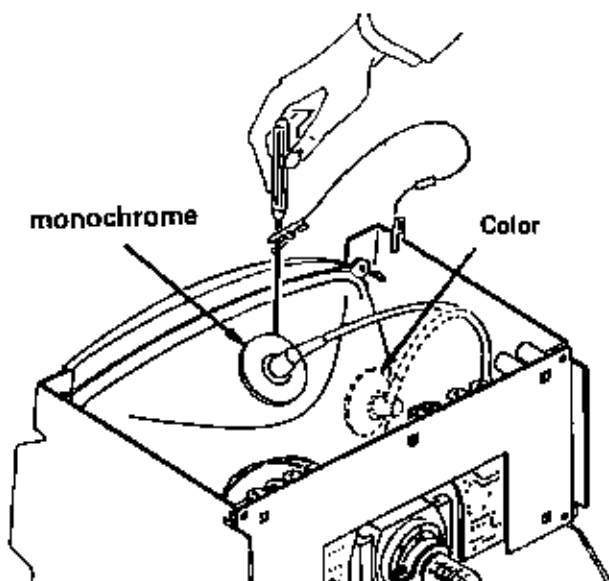


Figure 6-11 Discharging CRT

The monochrome deflection board can be removed with the CRT assembly still fitted into the computer, to do so refer to Figure 6-12 and use the following procedure.

1. Disconnect the high tension lead (A) from the back of the CRT tube.
2. Disconnect all connectors (B) from the deflection board.
3. Push the plastic clips (C) out of the frame, remove, and lift out the deflection board.
4. Remove small PCB from rear of CRT.

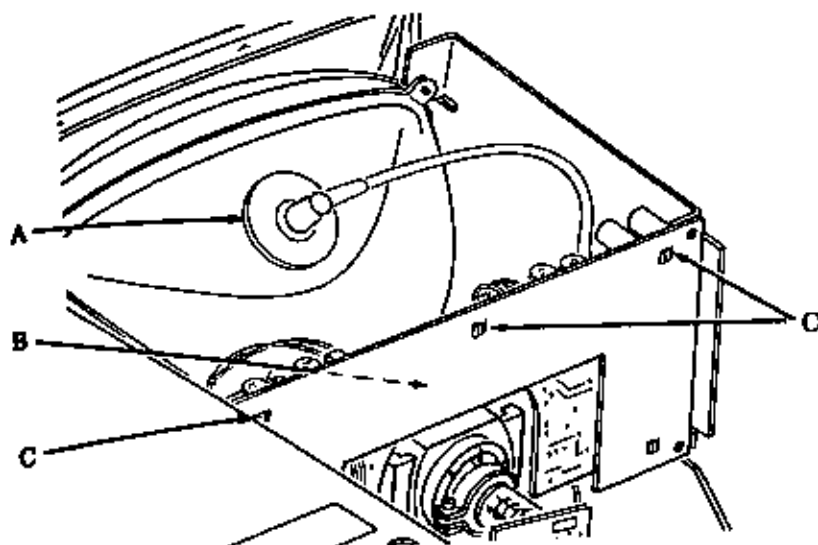


Figure 6-12 Monochrome Deflection Board Removal

To replace the deflection board, use the above procedure in the reverse order. Be sure that the high tension lead is fully seated into the CRT tube.

### MONOCHROME CRT

#### WARNING

Very high voltages are present when the unit is operating. Before removing the CRT High Tension lead, the CRT tube should be discharged by connecting a 1 megohm resistor between the high tension connector and ground for a minimum of ten seconds, see Figure 6-11.

## REMOVAL/REPLACEMENT

To remove the CRT, remove the cabinet, discharge the CRT tube, use the following procedure:

1. Remove the complete CRT/Power Supply assembly.
2. Disconnect the connector (A) from the deflection board, see Figure 6-13.

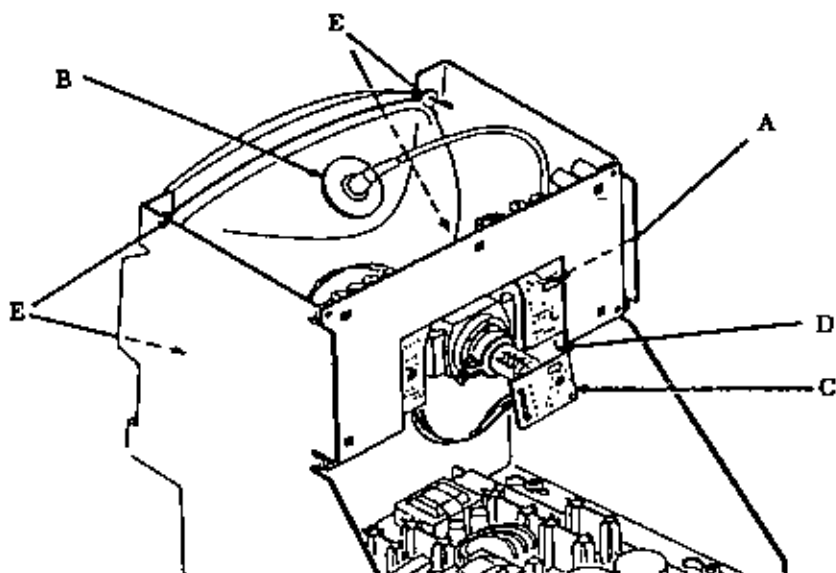


Figure 6-13 Monochrome CRT Removal

3. Disconnect the high tension lead (B) from the back of the CRT tube.
4. Disconnect the small PCB (C) from the end of the CRT tube.
5. Disconnect the ground wire (D) from the back of the CRT tube.
6. Support the CRT tube, remove the four screws (E) and carefully lift out the CRT tube.

To replace the CRT tube use the above procedure in the reverse order. Be sure that the high tension lead is fully seated into the CRT tube.

## COLOR CRT/POWER SUPPLY ASSEMBLY

To remove this assembly, remove the cabinet, and use the following procedure:

1. Disconnect the three connectors (A) from the left side of the power supply board (Figure 6-14) .
2. Disconnect the CRT cable (A) from the back of the card rack assembly, see Figure 6-15)

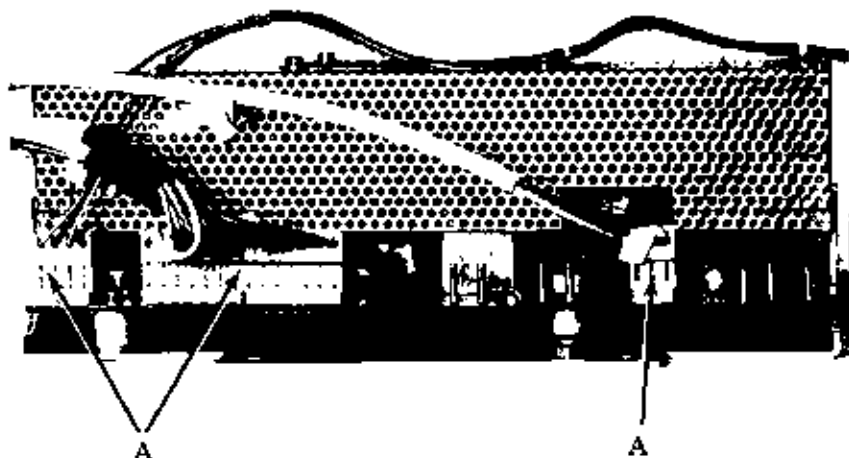


Figure 6-14 Color CRT/Power Supply Removal

3. Disconnect the connector (B) from the deflection board.
4. Remove the two screws (C)
5. Loosen the four screws (D) and slide the assembly to the back, then lift out the complete assembly.

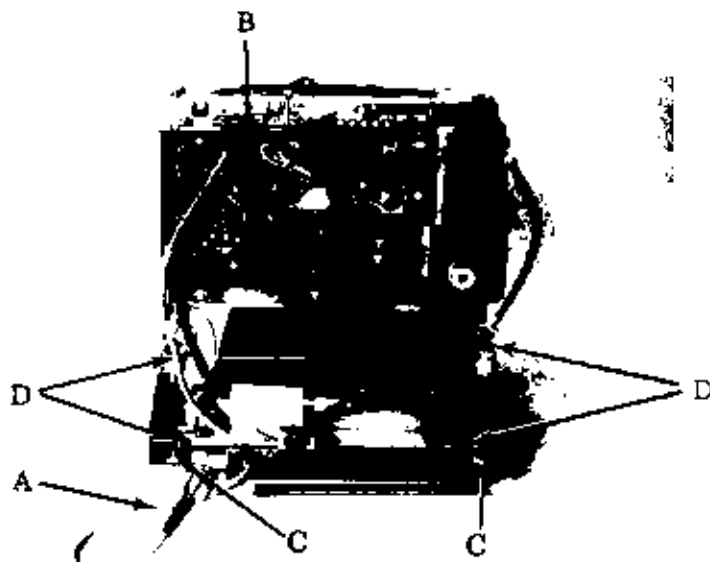


Figure 6-15 Power Supply Removal

To re-assemble the complete assembly into the computer, use the above procedure in the reverse order.

#### POWER SUPPLY

To remove the power supply, it is first necessary to remove the complete CRT/Power Supply assembly. Then, refer to Figure 6-16, and use the following procedure:

1. Disconnect the connectors (A) from the power supply board.
2. Disconnect connector (B) from the power supply.
3. Remove the four screws (C) that secure the power supply to the base of the assembly.
4. Slide the power supply out, under the front of the CRT tube.



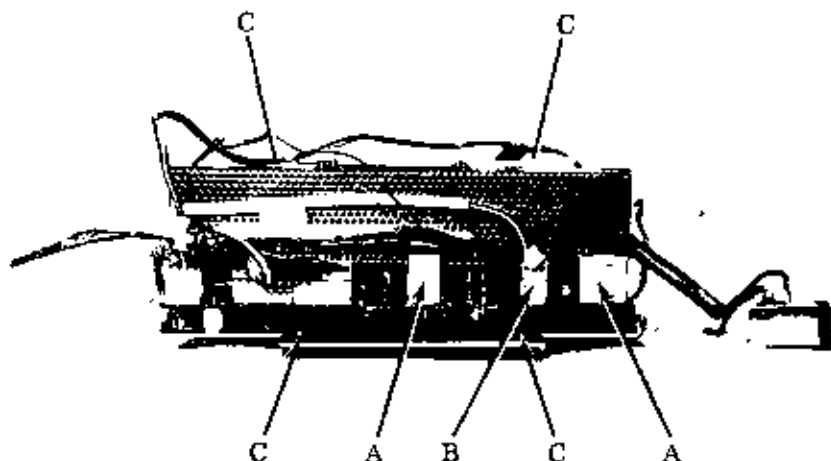


Figure 6-16 Color Power Supply Removal

To replace the power supply, use the above procedure in the reverse order.

#### COLOR DEFLECTION BOARD

##### WARNING

Very high voltages are present when the unit is operating. Before removing the CRT High Tension lead, the CRT tube should be discharged by connecting a 1 megohm resistor between the high tension connector and ground for a minimum of ten seconds, see Figure 6-11.

The color deflection board can be removed with the CRT assembly still fitted into the computer, to do so refer to Figure 6-17 and use the following procedure.

1. Disconnect the high tension lead from the back of the CRT tube.
2. Disconnect 4 connectors J1,2,3,115 (A) from the deflection board.
3. Disconnect connector (B) from the deflection board

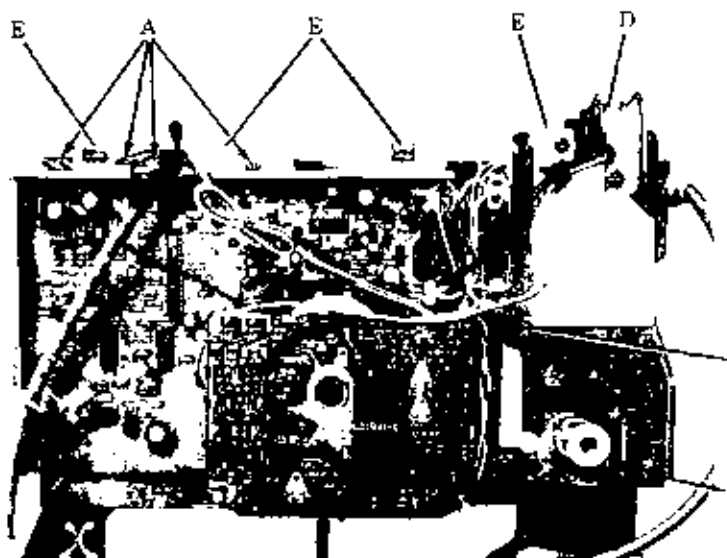


Figure 6-17 Color Deflection Board Removal

4. Remove the screw (C) from the lower right corner of the deflection board.
5. The deflection board is protected by a shielding grid which is attached by means of three screws.
6. Remove the two screws (D) from the bracket that secures the deflection board to the frame.
7. Break the adhesive bond (A) between the end of the CRT tube and the small PCB. disconnect the small PCB from the end of the CRT tube.
8. Push the plastic clips (E), see figure 6-17 out of the frame, remove, and lift out the deflection board.

To replace the deflection board, use the above procedure in the reverse order. Be sure that the high tension lead is fully seated into the CRT tube.

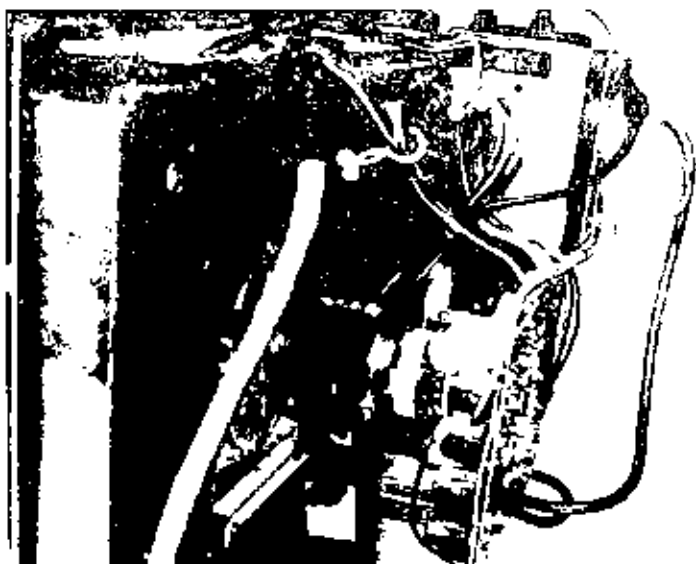


Figure 6-18 Color Deflection Board Removal

### COLOR CRT

#### WARNING

Very high voltages are present when the unit is operating. Before removing the CRT High Tension lead, the CRT tube should be discharged by connecting a 1 megohm resistor between the high tension connector and ground for a minimum of ten seconds, see Figure 6-11.

To remove the CRT, remove the cabinet, discharge the CRT tube, and use the following procedure:

1. Remove the complete CRT/Power Supply assembly.
2. Disconnect the connector (B) from the deflection board, see Figure 6-18.

## REMOVAL/REPLACEMENT

3. Disconnect the high tension lead from the back of the CRT tube.
4. Break the adhesive bond (A) from the end of the CRT tube and the small PCB, disconnect the small PCB from the end of the CRT tube.
5. Disconnect the single wire B from the back of the small PCB.
6. Disconnect connector B from Power Supply, see Figure 6-17.
7. Support the CRT tube, remove the four screws from the front of the CRT, and carefully lift out the CRT tube.

To replace the CRT tube use the above procedure in the reverse order. Be sure that the high tension lead is fully seated into the CRT tube.

### MONOCHROME CRT

The "Utilities" part of the Level 1 Diagnostics Disk contains a " Monochrome Alignment" phase. The screens provided in this phase can be used to help in adjusting the monochrome and color CRT display.

The positions of the adjustment controls are shown in Figure 7-1.

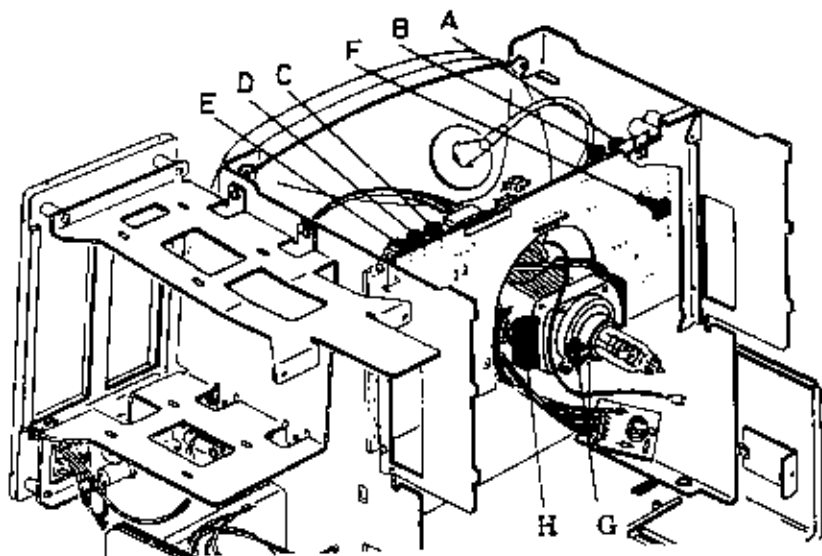


Figure 7-1 Positions of Adjustment Controls

**WARNING**

Very high voltages are present when the unit is operating. Although these voltages carry low current, extreme care should be used when performing adjustments when the unit is operating. All adjustments should be made with plastic adjusting tools. Before removing the CRT high tension lead, the tube should be discharged by inserting under the cap a screwdriver that is connected to ground through a 1 megohm resistor. To be sure that the CRT is fully discharged the connection to ground should be maintained for at least ten seconds, see Figure 7-2.

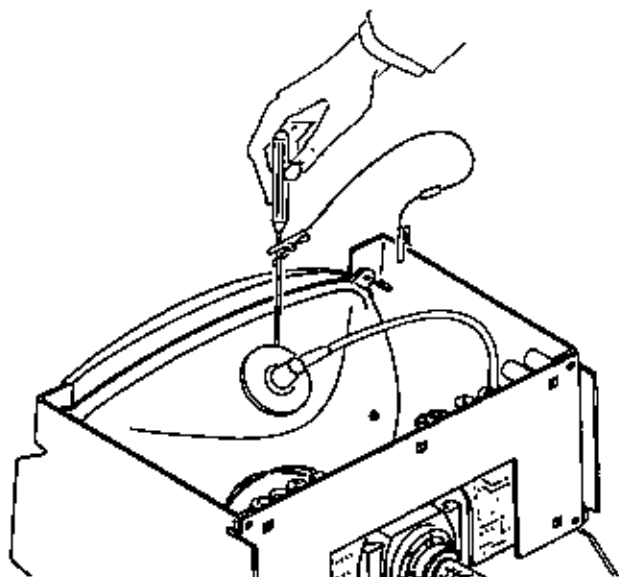
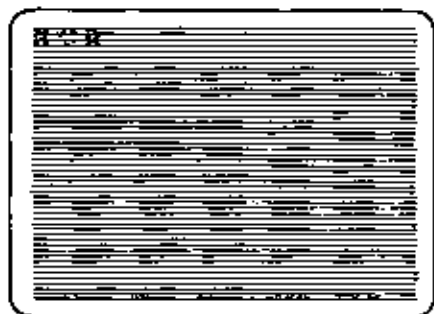


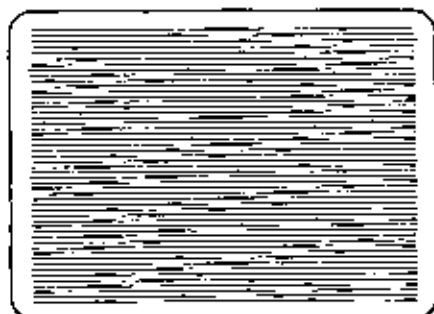
Figure 7-2 High-Voltage Discharge

DISPLAY OUT OF FOCUS



Adjust focus trimmer (A).

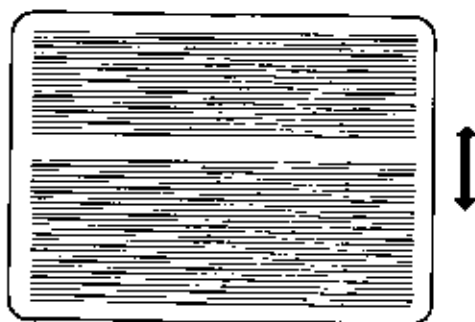
DISPLAY TOO DIM



Adjust brightness trimmer (B).

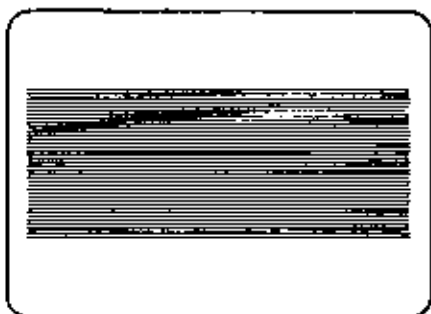
## ADJUSTMENTS

### DISPLAY ROLLS



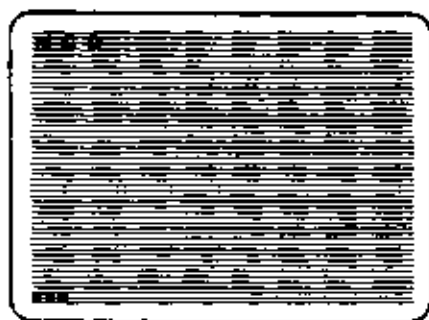
Turn trimmer (C) until display stops rolling, next turn trimmer in the opposite direction display just starts to roll in the opposite direction, now set the trimmer to the mid-point of these two positions.

### DISPLAY TOO SHORT/LONG

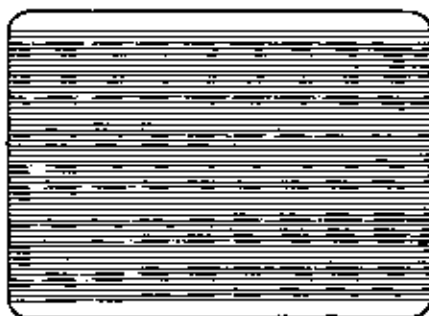


Adjust height trimmer (D), "Character Field Size".

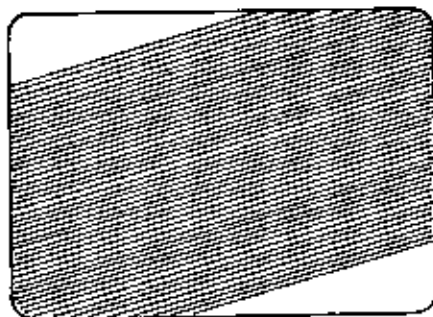


**DISPLAY NOT LINEAR**

Adjust linearity trimmer (E).

**DISPLAY TOO WIDE/NARROW**

Adjust coil (F), see "Character Field Size".  
**DISPLAY TILTED**



Loosen the locking screw (G) and rotate the yoke (H) assembly, tighten the locking screw, see Figure 7-1.

## ADJUSTMENTS

### CHARACTER FIELD SIZE

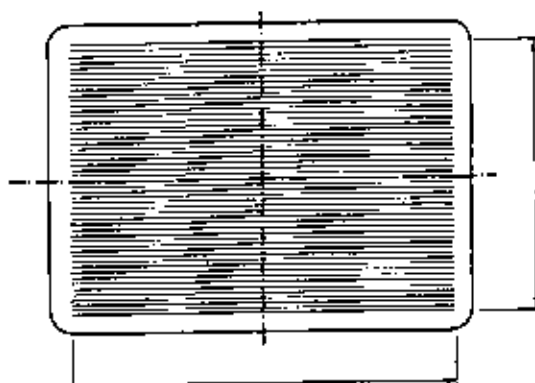


Figure 7-3 Character Field Size

With all adjustments correctly set, a full screen display of 25 lines each with 80 characters, occupies an area of 222 mm (8.7 in.) by 167 mm (6.6 in.), centered on the CRT screen as shown in Figure 7-3.

### COLOR CRT

#### NOTE

Before carrying out these adjustments, the CRT assembly must reach normal operating temperature. The unit should be switched on for at least half an hour with the brightness control turned to maximum.

To display the desired test screens, use the CRT Adjustment Routines of the Level 1 Diagnostics. With the <F6> key pressed in the Main Menu you enter the Utilities Menu (see Chapter 4). When selecting "5" in the Utility Menu you enter the Alignment Phase enabling you to perform your adjustments. The following screen is displayed:

The NCR Personal Computer  
Copyright 1985 NCR Corp.

Page 2 of 2

### COLOR ALIGNMENT

#### AVAILABLE SELECTIONS:

- 1 Linearity
- 2 Focus
- 3 Heater
- 4 Color Bars
- 5 Purity
- 6 Blank Screen

Note: After alignment screen is displayed press any key to continue.

<F8> Return to previous menu

Press selection number and <ENTER> to choose from Available Selections

SELECTION->

For any trimmer adjustments use only plastic tools.

### WARNING

Very high voltages are present when the unit is operating. Before removing the CRT High Tension lead, the CRT tube should be discharged by connecting a 1 megohm resistor between the high tension connector and ground for a minimum of ten seconds, see Figure 7-4.

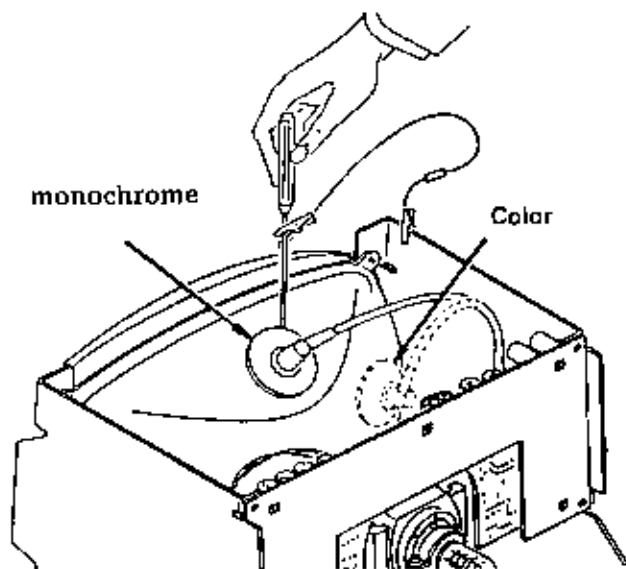


Figure 7-4 High-Voltage Discharge

## HORIZONTAL DEFLECTION

### OSCILLATOR ALIGNMENT

1. To enter the Color Alignment Utility proceed as previously described, then select "3", "4" and <F4> to obtain an all white picture to begin your adjustments (refer to Figure 7-5).
2. Turn H HOLD (VR502 in a clockwise direction until you see changes (overlapping) on the right edge of the white picture.  
Mark this position on the tube.
3. Turn H Hold in a counterclockwise direction until you see changes (overlapping) on the left edge of the white picture.  
Mark this position on the tube.
4. Position the white picture between these marks.

**PICTURE WIDTH**

1. Having obtained the Color Alignment Utility select "1" to obtain an all white test grid. Then begin your adjustments (refer to Figure 7-5).
2. Adjust H WIDTH (L552) until the width of the picture is 217mm  $\pm$  4mm (8.5in.  $\pm$  0.16in.).

NOTE: This coil reaches extremely high operating temperatures.

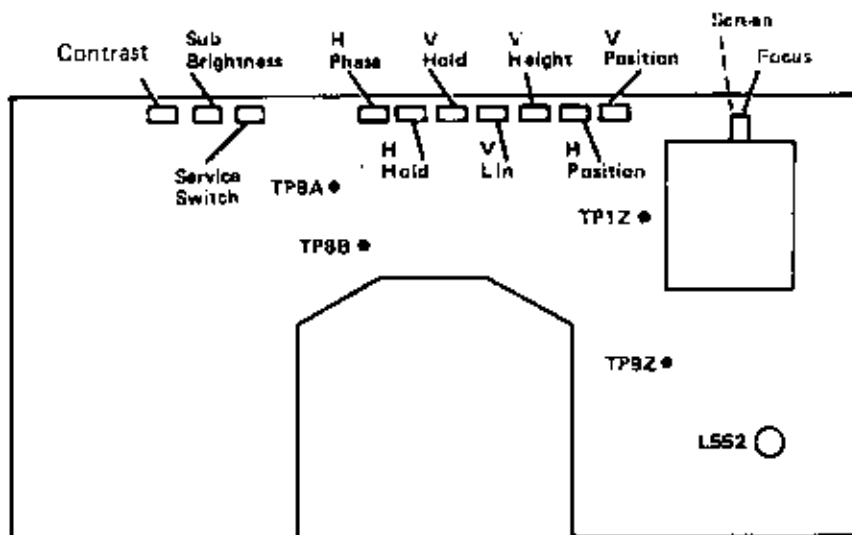


Figure 7-5 Deflector Board Adjustments and Test Points

**HORIZONTAL POSITION**

1. Having obtained the Color Alignment Utility select "1" to obtain an all white test grid. Then begin your adjustments (refer to figure 7-5).
2. Adjust H POSI (S591) and H PHASE (VR501) until the display is horizontally centered on the CRT screen.

## VERTICAL DEFLECTION

### OSCILLATOR ALIGNMENT

1. To enter the Color Alignment Utility proceed as previously described, then select "3", "4" and <F4> to obtain an all white picture to begin your adjustments (refer to Figure 7-5).
2. Turn the V HOLD (VR 401) counterclockwise until the picture starts to roll.
3. Now turn the V HOLD clockwise until the picture stops rolling, then continue turning in a clockwise direction for approximately 30 degrees.

### LINEARITY

1. To obtain a white test grid on the screen select "1" from the Alignment Utility and refer to Figure 7-5.
2. Adjust V HEIGHT (VR 403) until the picture height is approximately 150mm (5.9in.).
3. Adjust V LIN (VR 402) to obtain optimum linearity.

### PICTURE HEIGHT

1. To obtain a white test grid on the screen select "1" and refer to Figure 7-5.
2. Adjust HEIGHT (VR 403) until picture height is 163mm +/- 4mm (6.4in. +/- 0.16in.).

### VERTICAL POSITION

1. To obtain a white test grid on the screen select "1" and refer to Figure 7-5.
2. Adjust V POSITION (S491) until the display is vertically centered on the CRT screen.

NOTE: If necessary, repeat Linearity, Picture Height, and Vertical Position adjustments.

## VIDEO

## CUTOFF ADJUSTMENT

1. To enter the Color Alignment Utility proceed as previously described, then select "3", "4" and <F4> to obtain an all white picture to begin your adjustments (refer to Figure 7-6).

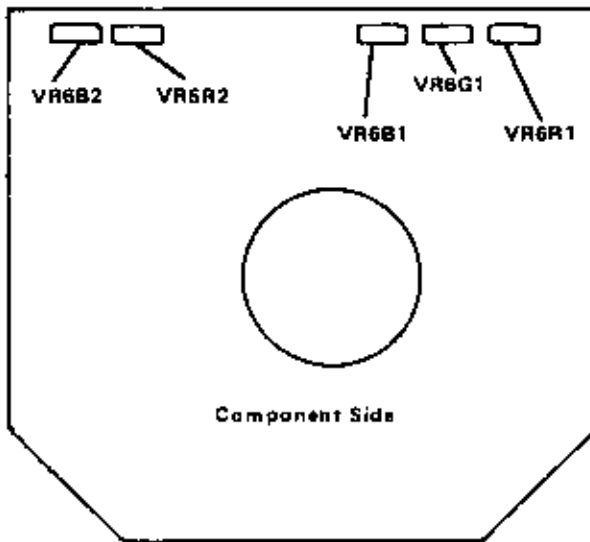


Figure 7-6 Video Adapter Board Adjustments

2. Turn VR6B1(blue),VR6G1(green), VR6R1(red), and SCREEN fully counterclockwise.
3. Turn VR6R2 and VR6B2 to their mid-positions.
4. Set the Sub-Brightness (VR201) and the external Brightness control to minimum.
5. Set the Service switch to the service position (left position).
6. Adjust SCREEN until one of the color lines is just visible.
7. Turn the potentiometer for the color that can be seen (VR6B1 for blue, VR6G1 for green, or VR6R1 for red) 1/4 turn clockwise.
8. Turn SCREEN counterclockwise until the line is just visible.

## ADJUSTMENTS

9. Adjust the two remaining color potentiometers until all colors have the same intensity and produce a white line.
10. Set the Service switch to the normal position (mid- position).
11. Turn external brightness control to maximum.
12. Adjust SCREEN clockwise until the background is just visible, then turn the screen counterclockwise until the background frame is just invisible.

## WHITENESS

1. To enter the Color Alignment Utility proceed as previously described, then select "3", "4" and <F4> to obtain an all white picture to begin your adjustments (refer to Figure 7-6).
2. Adjust VR6R2 and VR6B2 until a standard even whiteness is obtained.
3. Confirm that the white display does not change when the External Brightness control is turned.

## SUB-BRIGHTNESS

1. Select "6" from the Alignment Utility to obtain a blank (dark) screen. Write a dark screen, then set using potentiometer "screen" the background dark; no retrace lines shall be visible. (No frame visible on CRT).
2. To enter the Color Alignment phase proceed as previously described, then select "3", "4" and <F4> to obtain an all white picture to begin your adjustments (refer to Figure 7-5).
3. Set "external brightness" control and "subbrightness" control (VR 201) to maximum (fully counterclockwise).
4. Set "contrast" potentiometer (PZC)
5. Select "3", "4" and <F4> from the Alignment Utility to obtain an all white picture to begin your adjustments (refer to Figure 7-6).



4. Set meter to 1mA range and connect meter between Testpoints 1Z - 9Z.
5. Turn the "External Brightness" and Contrast (VR202) control to maximum.
6. Slowly turn Sub-Brightness (VR201) until the current is 400 microamperes.

#### FOCUS

1. Display a full screen (25 lines, 80 characters per line) of H's, and refer to Figure 7-10.
2. Set "External Brightness" control to maximum.
3. Adjust FOCUS for optimum focusing over the entire CRT screen. Pay particular attention to the focus of the middle H in the top row.

#### CONVERGENCE

These adjustments are factory set and are not normally required in the field. If making these adjustments, be sure that the system is not near any magnetic fields, and that the CRT screen faces either north or south.

The CRT is automatically degaussed on switch on. If necessary, switch off and wait at least fifteen minutes, then switch on again.

#### CAUTION

Do not touch the purity magnets.

#### CONVERGENCE ADJUSTMENTS

These adjustments are factory set, they are not normally necessary in the field and should only be made if absolutely necessary. Degauss the system before carrying out these adjustments.

## ADJUSTMENTS

1. To obtain a violet grid pattern, select "3", "4" and <F4> in the Color Alignment Utility and refer to Figure 7-6.
2. Loosen magnet lock ring.
3. Adjust D12 so that the red and blue vertical lines are superimposed on each other (violet lines).

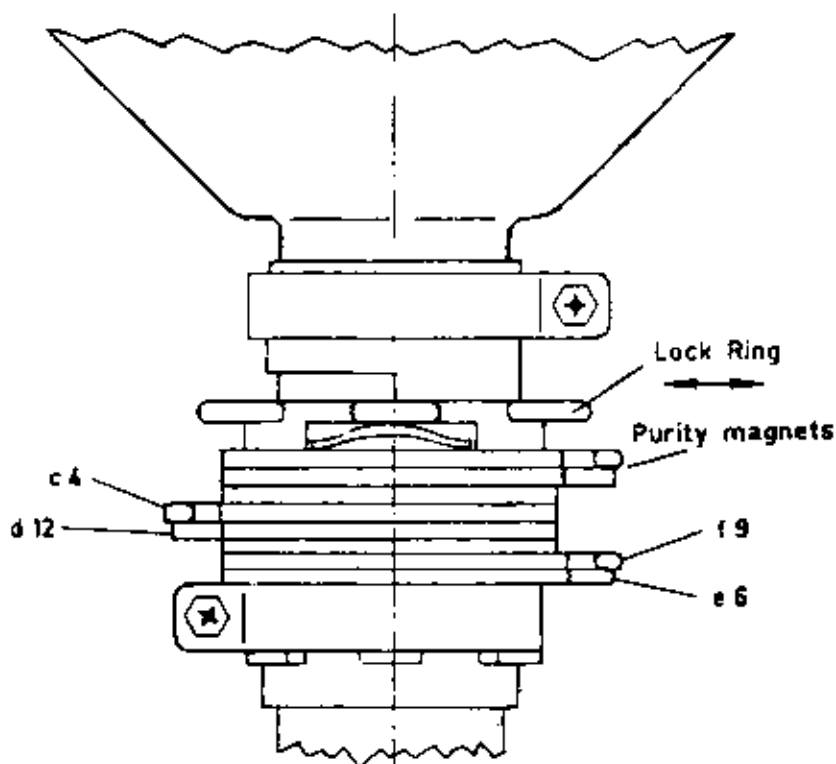


Figure 7-7 Convergence Adjustments

4. Adjust c4 and d12 together so that the horizontal red and blue lines are superimposed on each other (violet horizontal lines).
5. If necessary make minor adjustments to d12 to ensure that all grid lines are violet.

6. To obtain a white grid pattern on screen select "3", "2" and <F4> in the Alignment Utility.
7. Adjust e6 so that the vertical violet and green lines are superimposed on each other (white vertical lines).
8. Adjust f9 and e5 together so that the horizontal violet and green lines are superimposed on each other (white horizontal lines).
9. If necessary, make minor adjustments to e6 to ensure that all grid lines are white.
10. Retighten the lock ring.

### ADJUSTMENTS FOR VIDEOTEX MONITOR (BTX)

008-0072370

#### GENERAL

1. Pre-adjust the chassis
2. Perform only the adjustments here described.
3. Do not change all other adjustments.

#### TOOL AND TEST PROGRAM

Flexible disk with Service Diagnostic Test Program,  
HF adjustment tool

#### TEST PREPARATIONS

1. Set potentiometer VR601-603 on central position. Power on. (Heat-up time 10 minutes).
2. Check operating voltage at MP 101,  $U_b = 113V$
3. Load Diagnostic Test Program.
3. Bring brightness and contrast to maximum.
4. Short resistor R 131 against ground
5. Adjust for a nearly steady display using potentiometer VR 302 (horizontal hold) and/or VR 304 (vertical hold). Then remove short-circuited resistor: display must now synchronize.

Caution: Monitor automatically switches from 50 to 60 Hz.



focus at max. brightness and contrast.

### FBAS CHANNEL-R1.

1. Load videotex test program and switch on FBAS channel via keyboard.
2. Connect FBAS signal to socket. Check display geometry and display quality. If necessary, slightly adjust.

### ADJUSTMENTS FOR VIDEOTEX MONITOR (BTX) 008-0072370

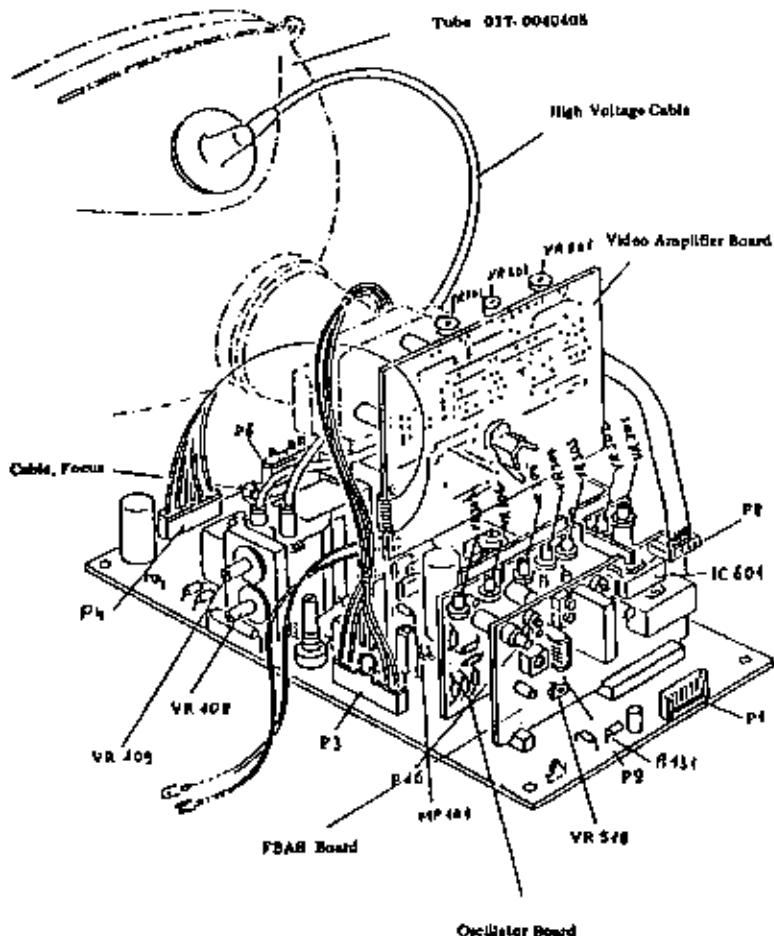


Figure 7-8 Adjustment Points

## **ADJUSTMENTS**

### **ADJUSTMENTS FOR VIDEOTEK MONITOR (BTX) 008-0072196**

#### **GENERAL**

1. Pre-adjust the chassis
2. Perform only the adjustments here described
3. Do not change all other adjustments.

#### **TOOL AND TEST PROGRAM**

Flexible disk with Service Diagnostic Test Program, HF adjustment tool.

#### **TEST PREPARATIONS**

Please don't readjust any potentiometer or coil not described in the present procedure.

Load disk with Diagnostic Test Program and select the monitor test for linearity.

#### **HORIZONTAL WIDTH IN 23KHZ MODE**

Adjust VR902 so that 105V is obtained at Test Point 99.

Adjust L552 to obtain 217 mm horizontal width.

Short circuit Test Point 8A and 8B

Adjust VR 505 so that an approximately stable picture is obtained.

#### **VERTICAL HEIGHT AND LINEARITY**

Adjust VR402 vertical height to 163 mm

Adjust VR 405 for vertical symmetry.

#### **FOCUS**

Select pattern for focus adjustment and adjust potentiometer for best average focus (positioned at FBT)

#### **CUTOFF AND BRIGHTNESS ADJUSTMENT**

Adjust VR6R1, VR6B1, VR6G1 which results in RGB Cutoff. Adjust these potentiometers with an approximately dark screen for dark grey. Display a full brightness white raster. Switch RGB signal off by removing signal connector. Switch S651 to RGB side, a central horizontal line is then displayed.

Adjust VR654, screen positioned at FBT, so that a

green line faintly brightens.

Adjust VR 652 and VR 653, VR 6R2, VR 6B2 so that the lines becomes white. Cancel S651 and switch RGB signal on.

Adjust VR 6R3 and VR 6B3 so that the raster becomes 6550 degrees K + 7 M.P.C.D white.

### **CONTRAST**

Turn external Contrast and Brightness potentiometer in maximum position.

### **SIZE**

Load VIDEOTEX System from operating system disk in drive A.

Load VIDEOTEX Diagnostic Program from disk in drive B.

The program concerned is named T1. Picture 1 could be used for size adjustment.

Display a picture by means of the 15KHz mode:

1. Adjust height by VR 404
2. Adjust H-phase by VR 503
3. Adjust H-Hold by VR 506
4. Adjust H-width by VR 904

Display a picture by means of the 18KHz mode

1. Adjust height by VR 403
2. Adjust H-phase by VR 502
3. Adjust H-Hold by VR 504
4. Adjust H-width by VR 903

Adjust all these potentiometers so that there is no difference between their mode.







## **STRAPPING INFORMATION**

### **Switch SW1**

This block of eight switches defines the following functions:

- o Switch 2 - Coprocessor
- o Switch 5 and 6 - type of display adapter
- o Switches 1,2,3,4 and 8 are not used in the PC 4i

### **Switch SWA**

This second block of eight switches defines the following functions:

- o Switches 1 and 2 - Memory capacity of the MPB.
- o Switch 3 - Serial port
- o Switch 4 - Parallel port
- o Switch 5 - HIPO feature
- o Switches 6, 7 and 8 - not used on the PC4i.

### **Switch Settings**

To set either switch SW1 or SWA, it is necessary to pull out the card rack assembly, see Figure 8-2.

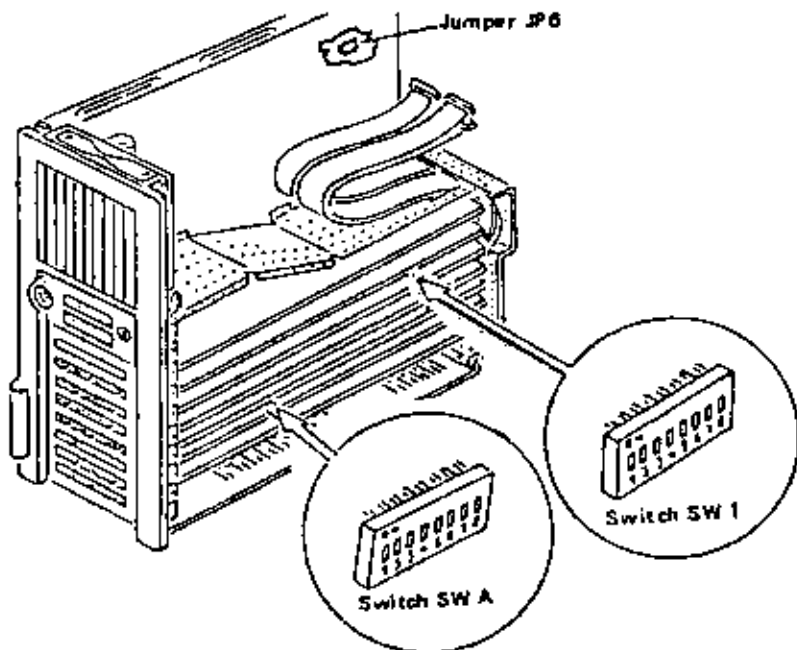


Figure 8-2 Locations of Switches

Depending on how many option boards are installed, it may also be necessary to temporarily remove some of these boards.

To set the switches press the end of the rocker switch which corresponds to the desired setting. Use a ball-point pen or similar object to set the switches, see Figure 8-3.

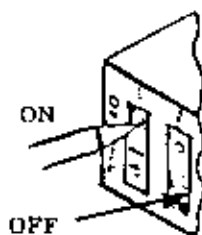


Figure 8-3 Setting the Switches

## STRAPPING INFORMATION

The settings for the switches block SW1 are shown in Figure 8-4.

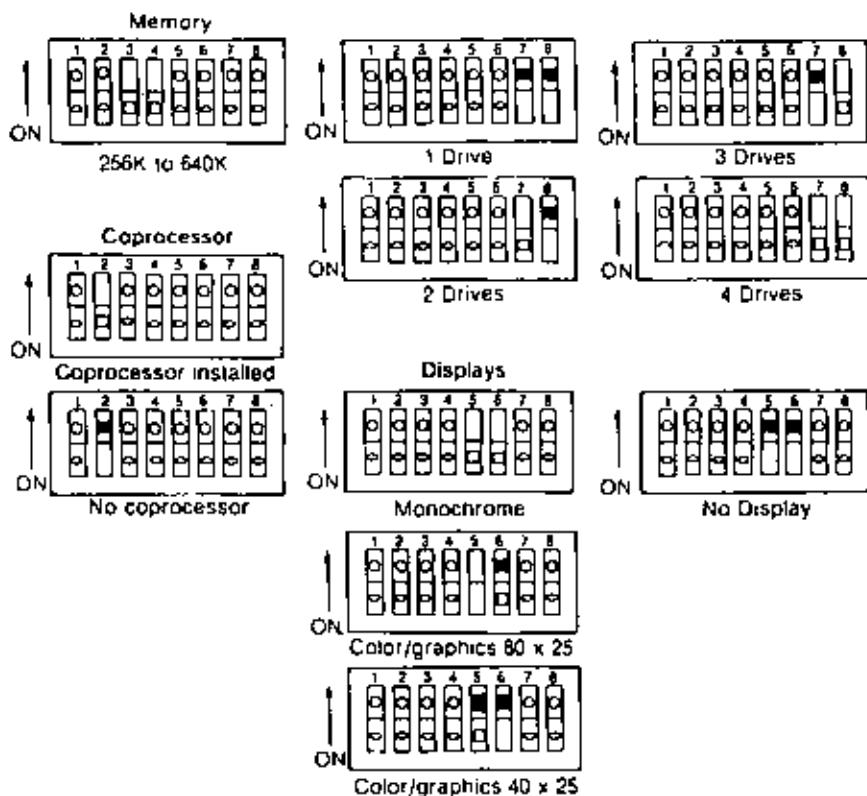
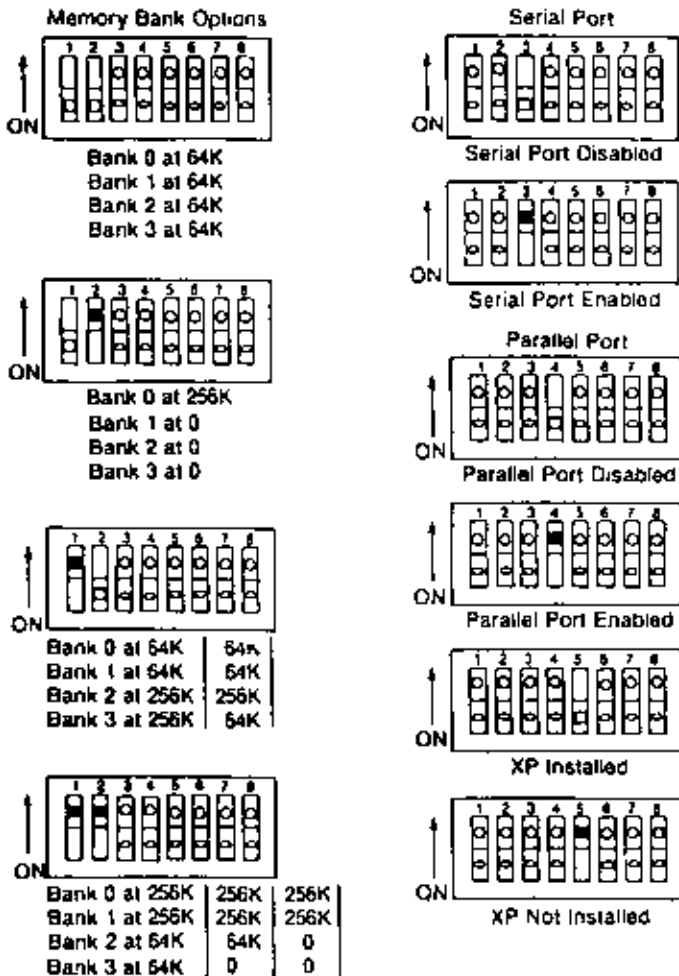


Figure 8-4 SW1 Switch Positions

The settings for switch block SWA are shown in Figure 8-5.



\* A Memory Expansion Board can be used with these settings.

Figure 8-5 SWA Switch Positions

## STRAPPING INFORMATION

### JUMPER SETTINGS

JUMPERS	FUNCTION
JP-1	Power good jumper 1. Open when no power good signal is available from power supply. 2. Closed when power supply has a power good signal
JUMPER	FUNCTION
JP-2	Factory set, has to remain in closed position
JP-3	Factory set, has to remain in closed position
JP-4	Test Input of 8088 processor. 1. Open conforms to normal operation. 2. Closed conforms to test operation.
JP-5	Factory set, has to remain in closed position.
JcP-6	Deselects the floppy disk controller on the Alternate MPB. 1. Open deselects the on-board floppy.
NOTE:	When a separate flexible disk controller board is installed (for example, when the system uses a 1.2MB flexible disk drive) then the jumper JP6 must be removed to disable the standard controller.
JP-7	Speaker header for Model 4i
JPX	Factory set, has to remain in closed position.
JPY	Factory set, has to remain in this position

**EARLY-TYPE MAIN PROCESSOR BOARD**

If your system does not contain an Alternate Main Processor Board either an Early-type MPB (1) or Early-type MPB (2) may have been installed into the system. Both main processor boards have one switch block and several jumpers on board. The two boards are similar in design and differ only slightly in their jumper locations.

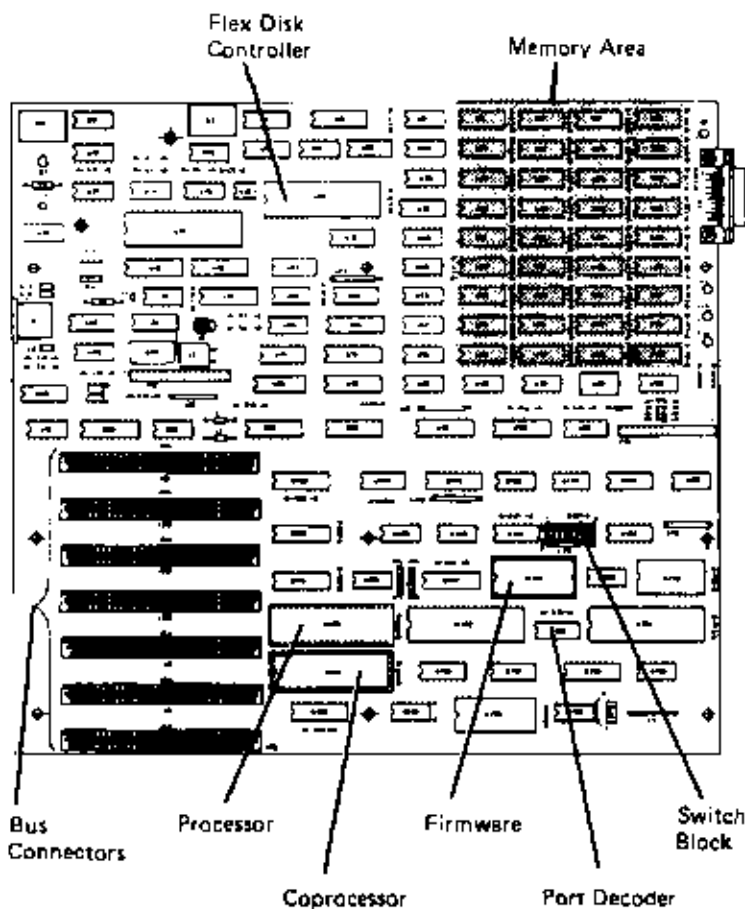


Figure 8-6 Early-type Main Processor Board

## SWITCH CONFIGURATIONS OF EARLY-TYPE MAINBOARDS

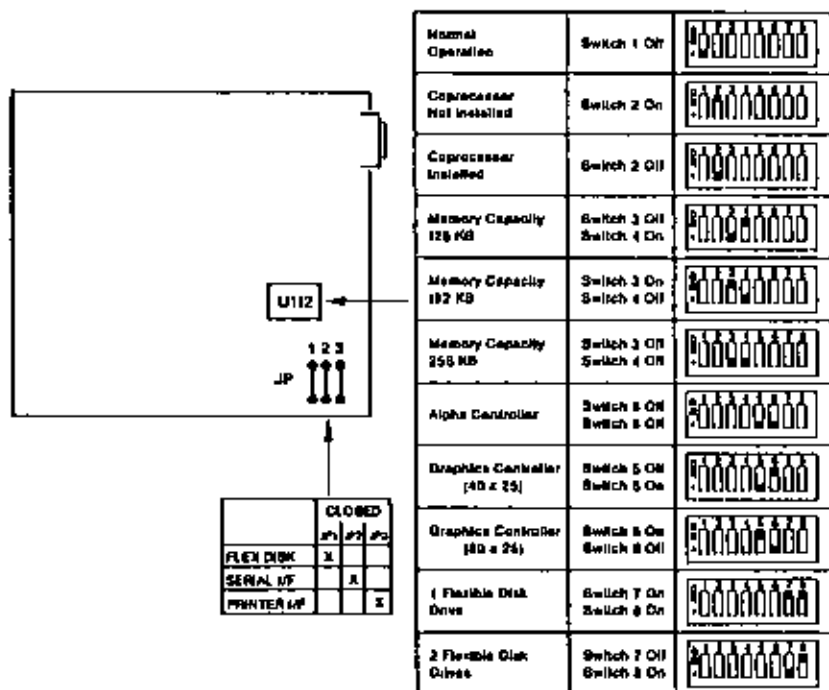


Figure 8-7 Switch Positions (Early-Type MPB1)



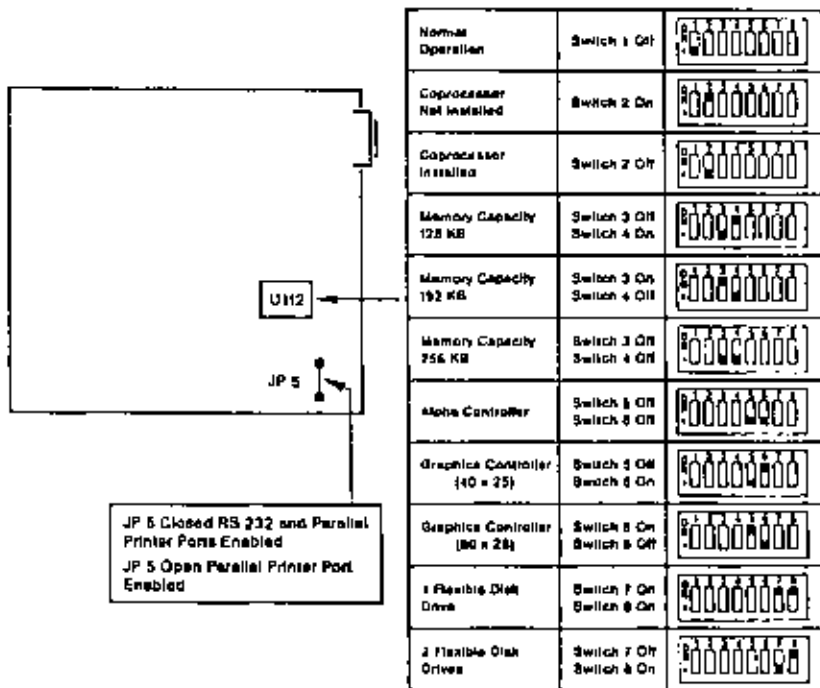


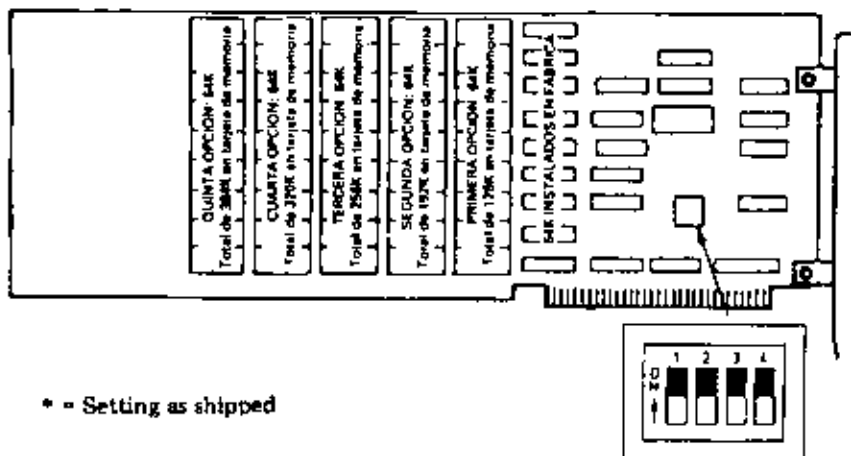
Figure 8-8 Switch Positions (Early-Type MPB2)

Some systems are delivered with a different strapping on the MPB. On these systems the strap J/P 5 is replaced by three straps - J/P1, J/P2, and J/P3.

Flexible Disk Drives Enabled - J/P 1 Closed  
 Serial Port Enabled - J/P 2 Closed  
 Parallel Port Enabled - J/P 3 Closed

## SWITCHING CONFIGURATIONS OF PCBs

## MEMORY EXPANSION BOARD



64 KB *		256 KB	
128 KB		320 KB	
192 KB		384 KB	

Figure 8-9 Switch Position on Memory Expansion Board

## ALPHA DISPLAY ADAPTER

English	Closed	Danish	Open
French		Finnish	
German		Norwegian	
Italian		Swedish	
Spanish			

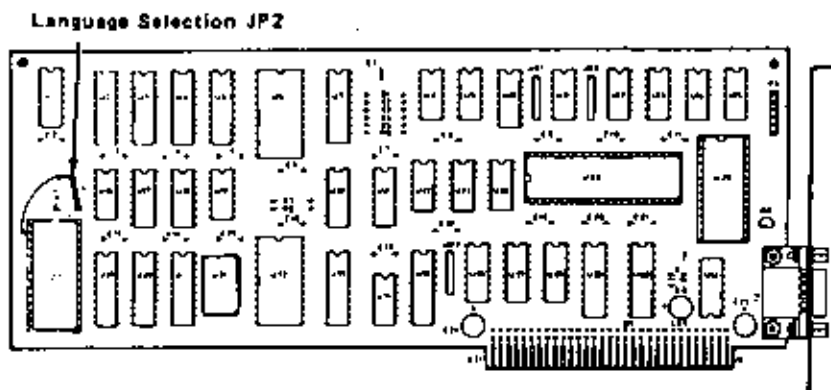


Figure 8-10 Location of Jumpers

## STRAPPING INFORMATION

### GRAPHIC CONTROLLER BOARD

Set J1 open for color CRT and set J1 closed for monochrome CRT. For jumper location and language selection see figure below:

Strapping for Graphic Controller Board 017-0044063:

English	Closed	Danish	Open
German			
French			
Italian			
Spanish			
		Finnish	
		Norwegian	
		Swedish	

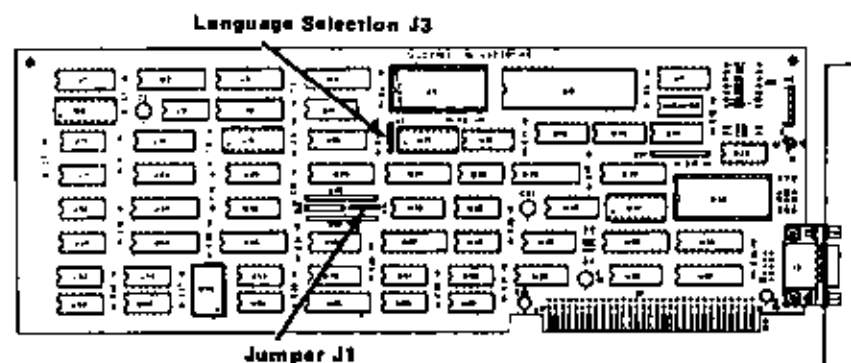


Figure 8-11 Locations of Jumpers

## Strappings for Graphic Controller Board 017-0043980

Language	Jumper	
	J3	J5
U.S. English	Closed	Open
Scandinavian	Open	Closed
Other Languages	Closed	Closed

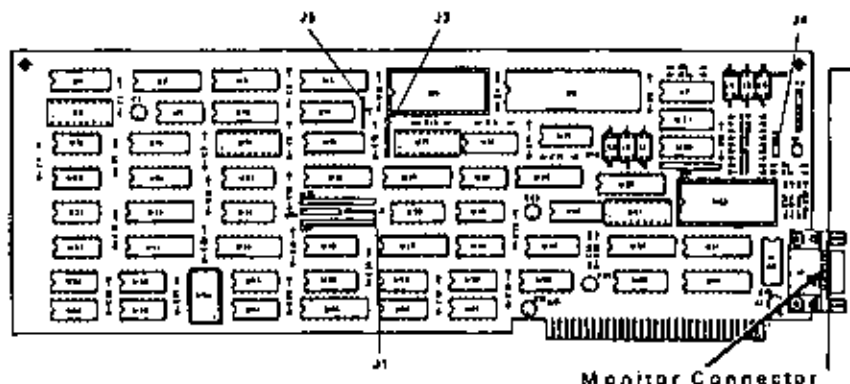


Figure 8-12 Locations of Jumpers

**IN-HOUSE DLC ADAPTER**

The Jumpers W1 and W2 are used to select Interrupt Request lines as shown below:

Jumper		Selection
W1	W2	
A - B	A - B	IRQ3 Interrupt Vector 11
B - C	B - C	IRQ2 Interrupt Vector 10

The jumpers W1 and W2 are factory installed between A and B.

## STRAPPING INFORMATION

### VIDEOTEK ADAPTER BOARD

Before installing these boards ensure that the strapping is set correctly as shown in the following tables:

Strappings for Videotex Adapter Board 017-0040364C

X1	1-2	2K RAM (factory set)
	2-3	8K RAM
X2	1-2	2K RAM (factory set)
	2-3	8K RAM
X3	DCD.A/	Jumper always installed
X4	DSR.B/	Jumper always installed
X5	CTS.A/	Jumper always installed
X6	1-12	IRQ2 (factory set)
	2-11	IRQ3
	3-10	IRQ4
	4- 9	IRQ5
	5- 8	IRQ6
	6- 7	IRQ7
X7	DCD.B/	Jumper always installed (part of artwork)
X8	Jumper not installed - Video Long Player	
	Jumper installed - Videorecorder	

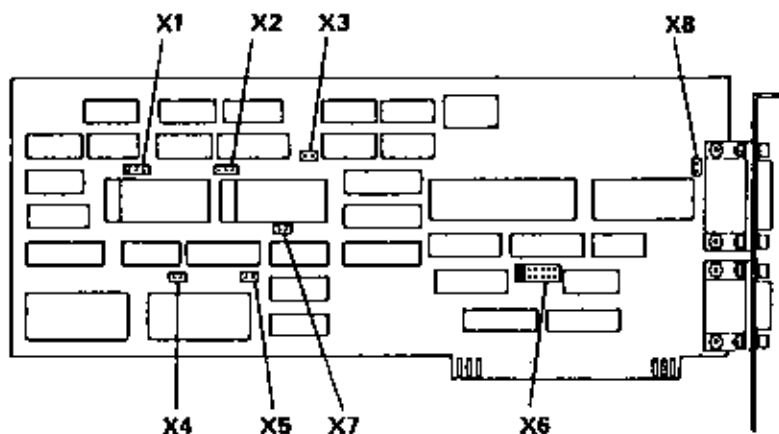


Figure 8-13 Locations of Jumpers

## Strappings for Videotex Adapter Board 017-0044050

X1	1-2	2K RAM
	2-3	8K RAM (factory set)
X2	1-2	2K RAM
	2-3	8K RAM (factory set)
X8	1-12	IRQ 2 (factory set)
	2-11	IRQ 3
	3-10	IRQ 4
	4- 9	IRQ 5
	5- 8	IRQ 6
	6- 7	IRQ 7
X8	1-2	Phase Lock Loop filter, switching over without strapping for VLP, whereas using strapping for video recorder
X9	1-5	A19 Address strapping
	2-8	A18
	3-7	A17 (factory set)
	4-8	A16

# STRAPPING INFORMATION

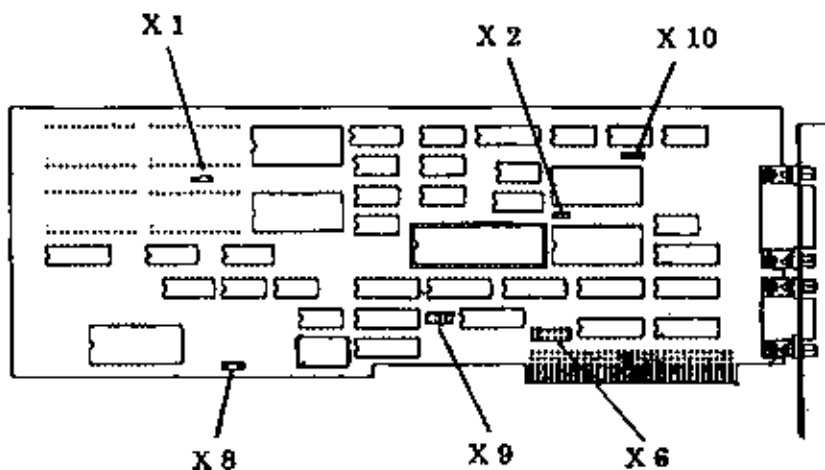
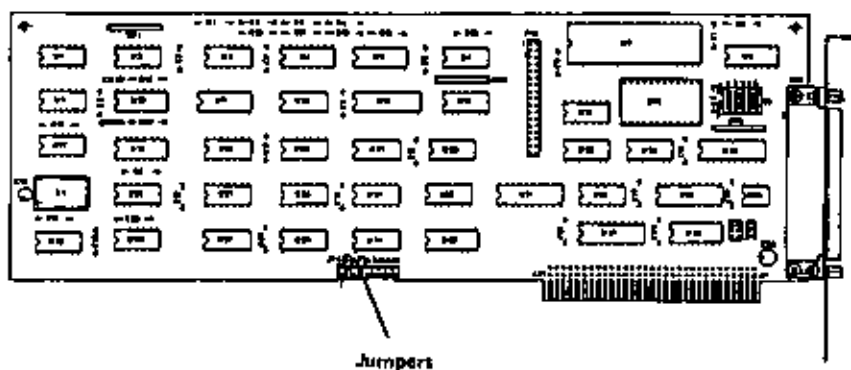


Figure 8-14 Location of Jumpers

## FLEXIBLE DISK CONTROLLER BOARD 1.2MB



	JP 12	JP 11
PC/LPC/IBM PC/XT	OFF	ON
PC/8, IBM AT	ON	OFF

ADDRESS	JP 18	JP 8
3F8 ... 3F7, 1F7	OFF	ON
378 ... 377, 177	ON	OFF

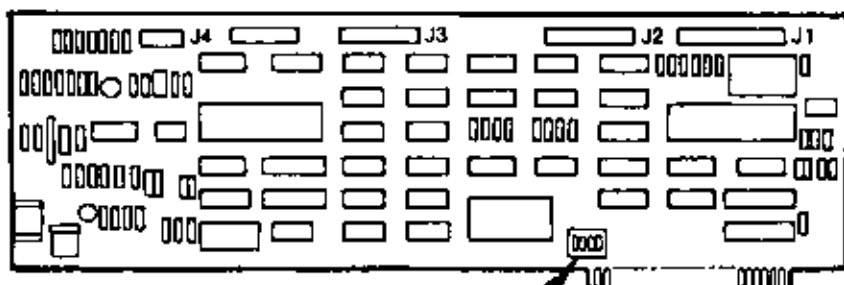
Figure 8-15 Locations of Jumpers



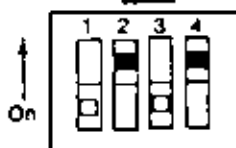
## HARD DISK CONTROLLER BOARDS

The following Controller Boards are available:

008-0072640:



J1 Disk Drive Control Signals  
 J2 Disk Drive 1 Read/Write Data  
 J3 Disk Drive 2 Read/Write Data  
 J4 Test



Switch Settings

		Drive C Switch 1 and 2		Drive 0 Switch 3 and 4	
Seagate	10 MB	ON	ON	ON	ON
	20 MB	OFF	ON	OFF	ON
Miniscribe	20 MB	OFF	OFF	OFF	OFF
NEC	20 MB	ON	OFF	ON	OFF

Figure 8-16 Location of switches

# STRAPPING INFORMATION

008-0072641:

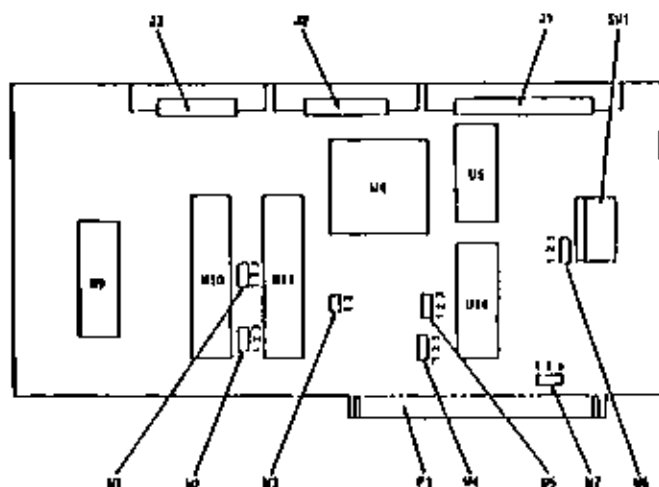


Figure 8-17 Location of switches

## Switch Settings:

W1	1-2	W5	--
W2	1-2	W6	2-3
W3	1-3	W7	--
W4	2-3		

## SW1 Jumper Block Description

Position		
1 2	1 1	Drive
Drive C	Drive D	Type
1 1	1 1	ST 225
		MITSUBISHI
1 0	1 0	NEC D 5126
0 0	0 0	ST 212
		NEC D 5124
		BASF 6188

008-0072642:

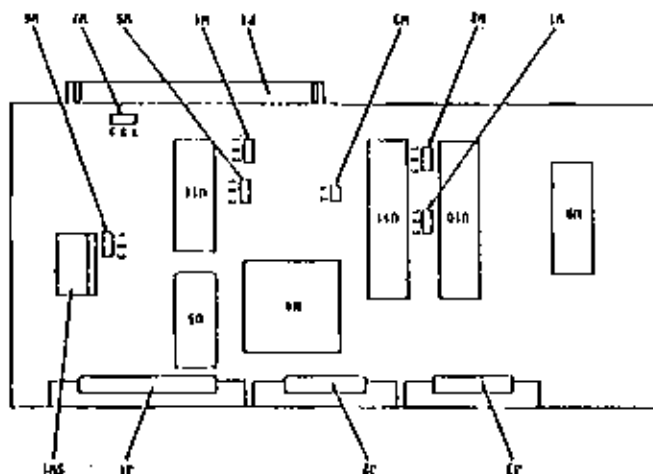


Figure 8-18 Location of Switches

## Switch Settings:

W1	1-2	W5	--
W2	1-2	W6	2-3
W3	1-3	W7	--
W4	2-3		

## SW1 Jumper Block Description

Position		
1 2	1 1	Drive
Drive C	Drive D	Type
1 1	1 1	Miniscribe
		3425 TEAC SD 250
0 1	0 1	ST 225
1 0	1 0	NEC D 5126
0 0	0 0	ST 212
		NEC 55124
		BASF 6188

## STRAPPING INFORMATION

Legend: 0 = Jumper = Switch closed  
1 = No Jumper = Switch open

Two jumpers must be set on the Jumper block SW1 see Figure below.

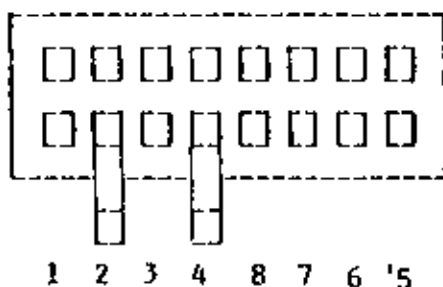


Figure 8-19 Jumper Block

## FLEXIBLE DISK DRIVE JUMPERS

The flexible disk drives of the system are selected by connecting a jumper between certain contacts of the header jumper. The following diagram illustrates the location of the header jumper on the flexible disk drive unit, and the labels of the various jumper connections

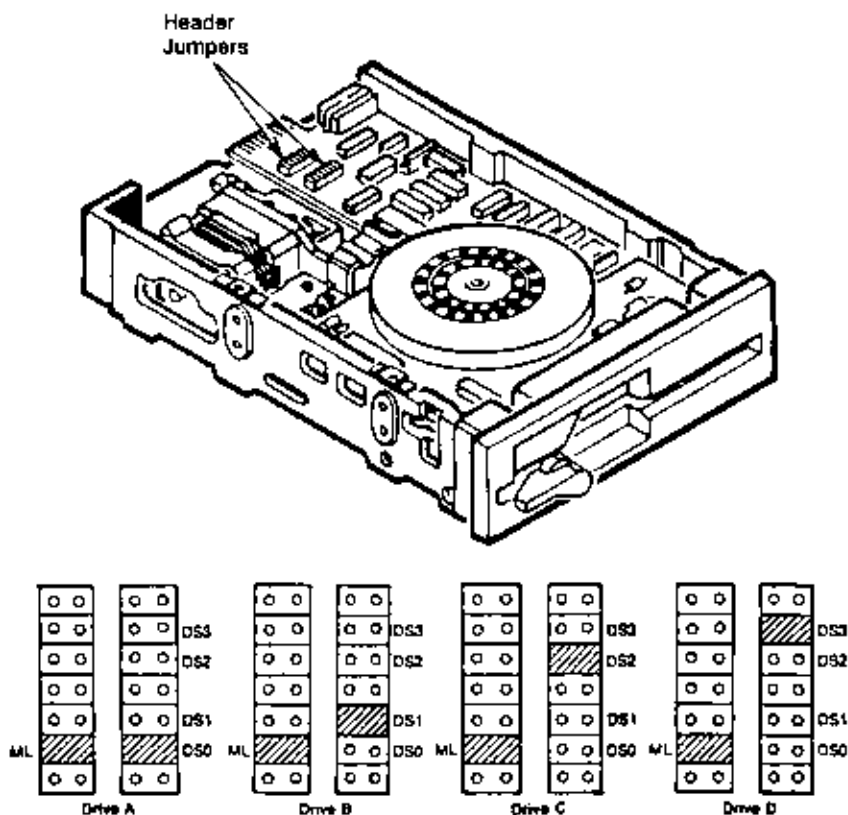


Figure 8-20 Jumper Header Configurations for Flexible Disk Drives



## LAYOUT AND SCHEMATICS

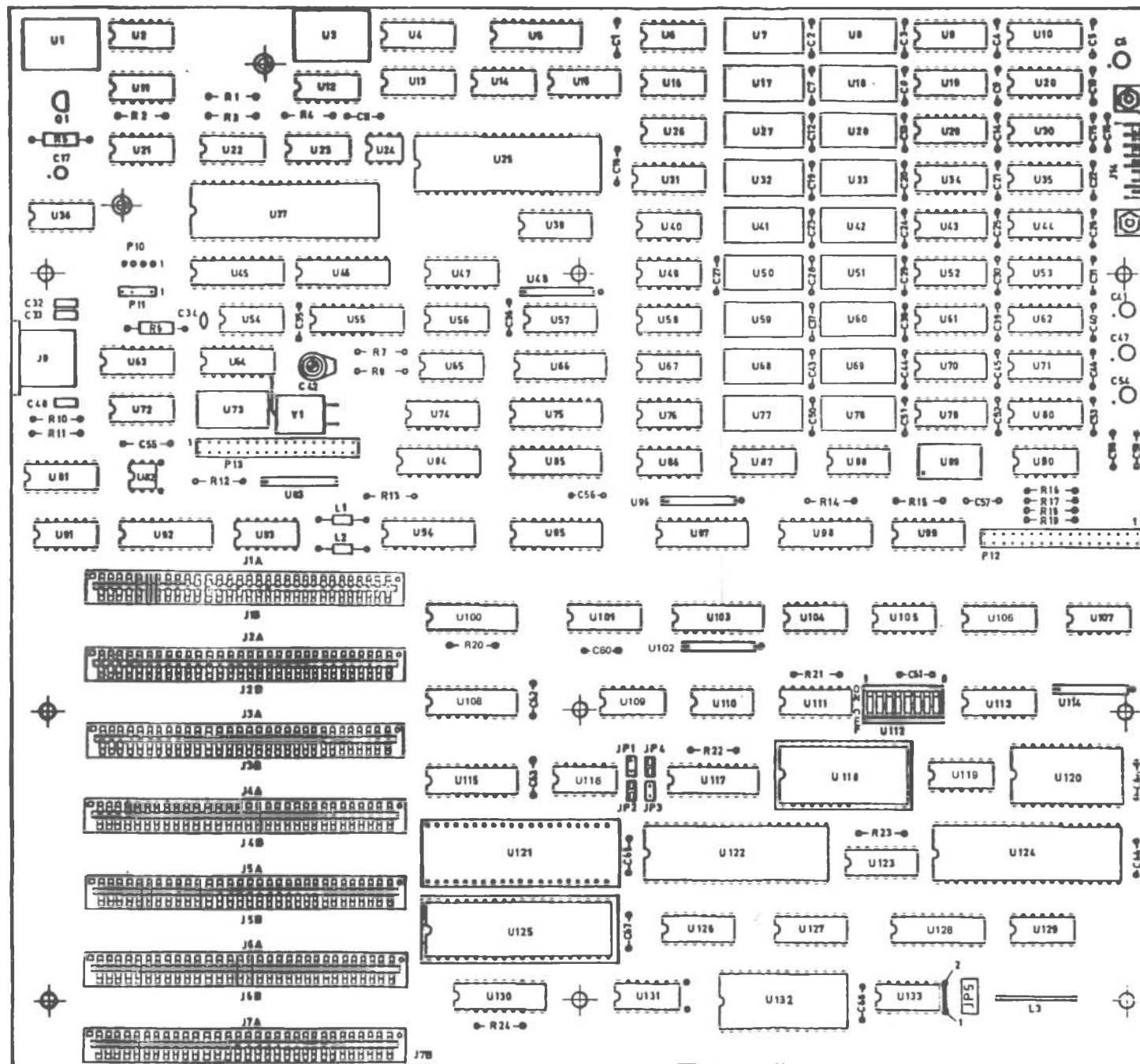
## CONTENTS

Early-type Main Processor Board .....	A-1
Alternate Main Processor Board .....	A-16
Wiring Diagram .....	A-31
Graphics Controller Board .....	A-34
Alpha Controller Board .....	A-40
Flexible Disk Drive .....	A-45
Flexible Disk Drive 1.2 MB .....	A-53
Fixed Disk Drive .....	A-54
Monochrome CRT .....	A-56
Monochrome Power Supply .....	A-57
Color CRT .....	A-58
Color Power Supply .....	A-59
External Monochrome Monitor .....	A-60
External Color Monitor .....	A-64
Memory Expansion Board .....	A-70
DLC Inhouse I/F Board .....	A-75
Videotex Adapter Board .....	A-79
Videotex Switch Board .....	A-85
Wiring Diagram Videotex .....	A-87
Keyboard .....	A-90



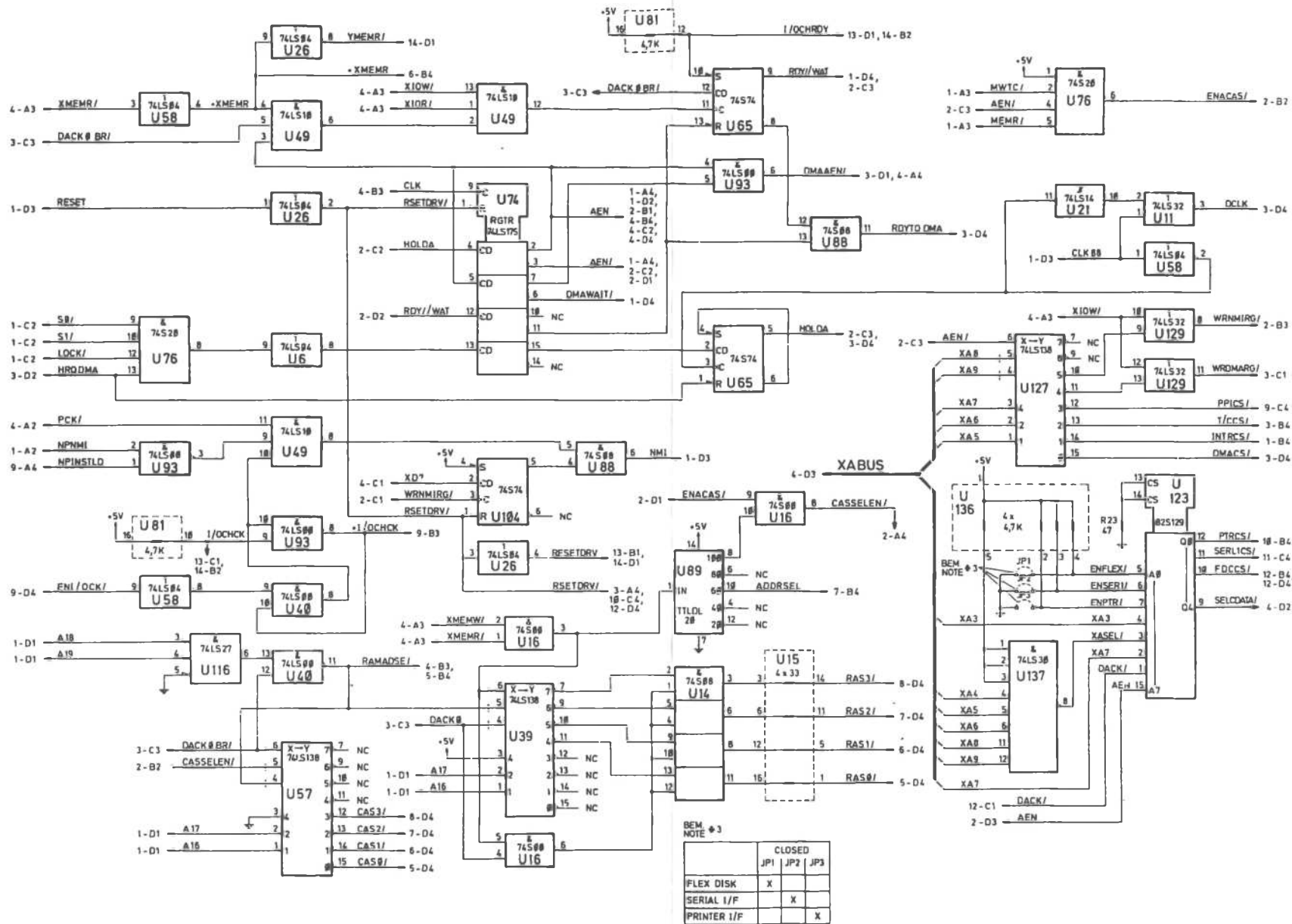


Early-type Main Processor Board

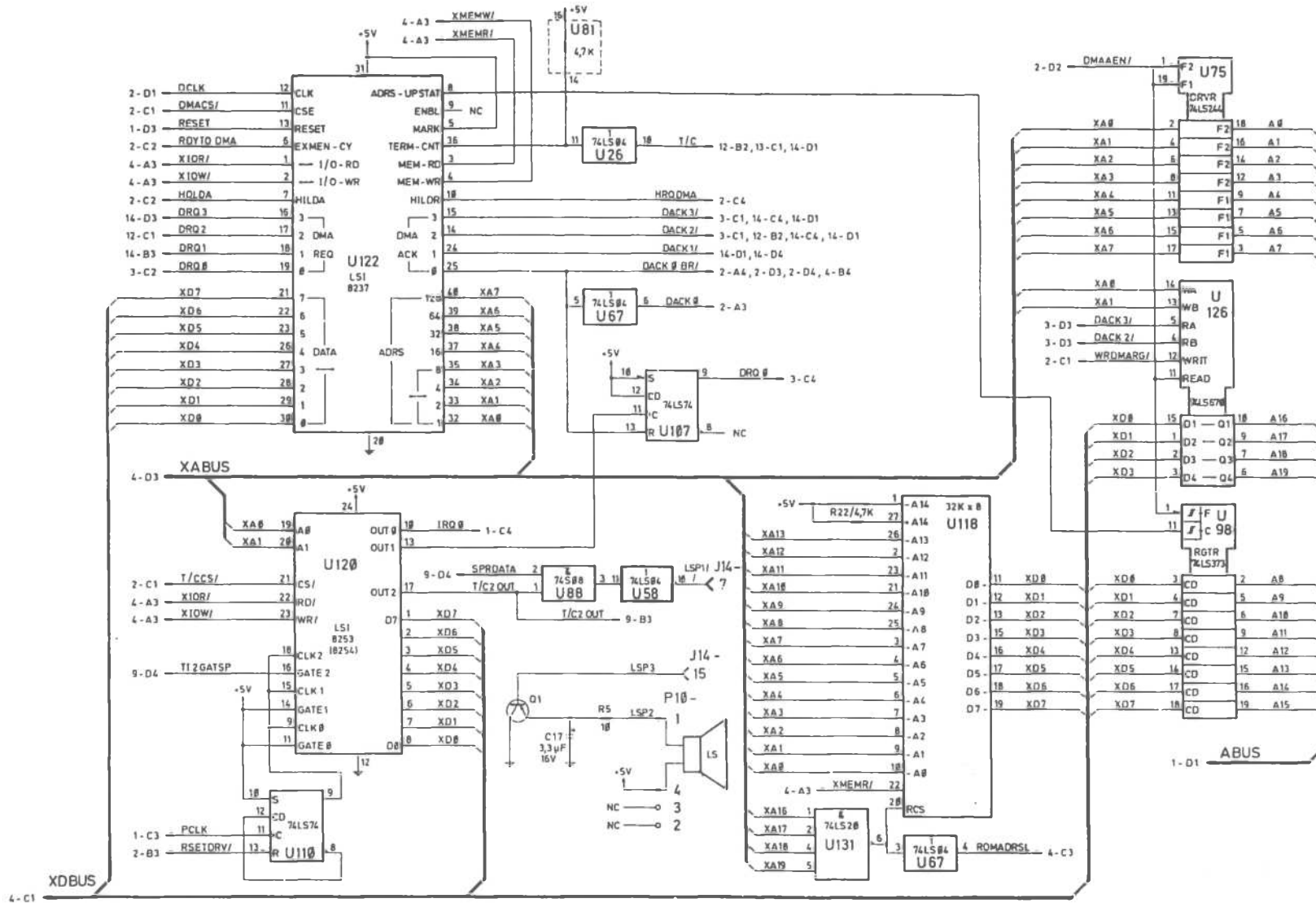




LAYOUTS AND SCHEMATICS

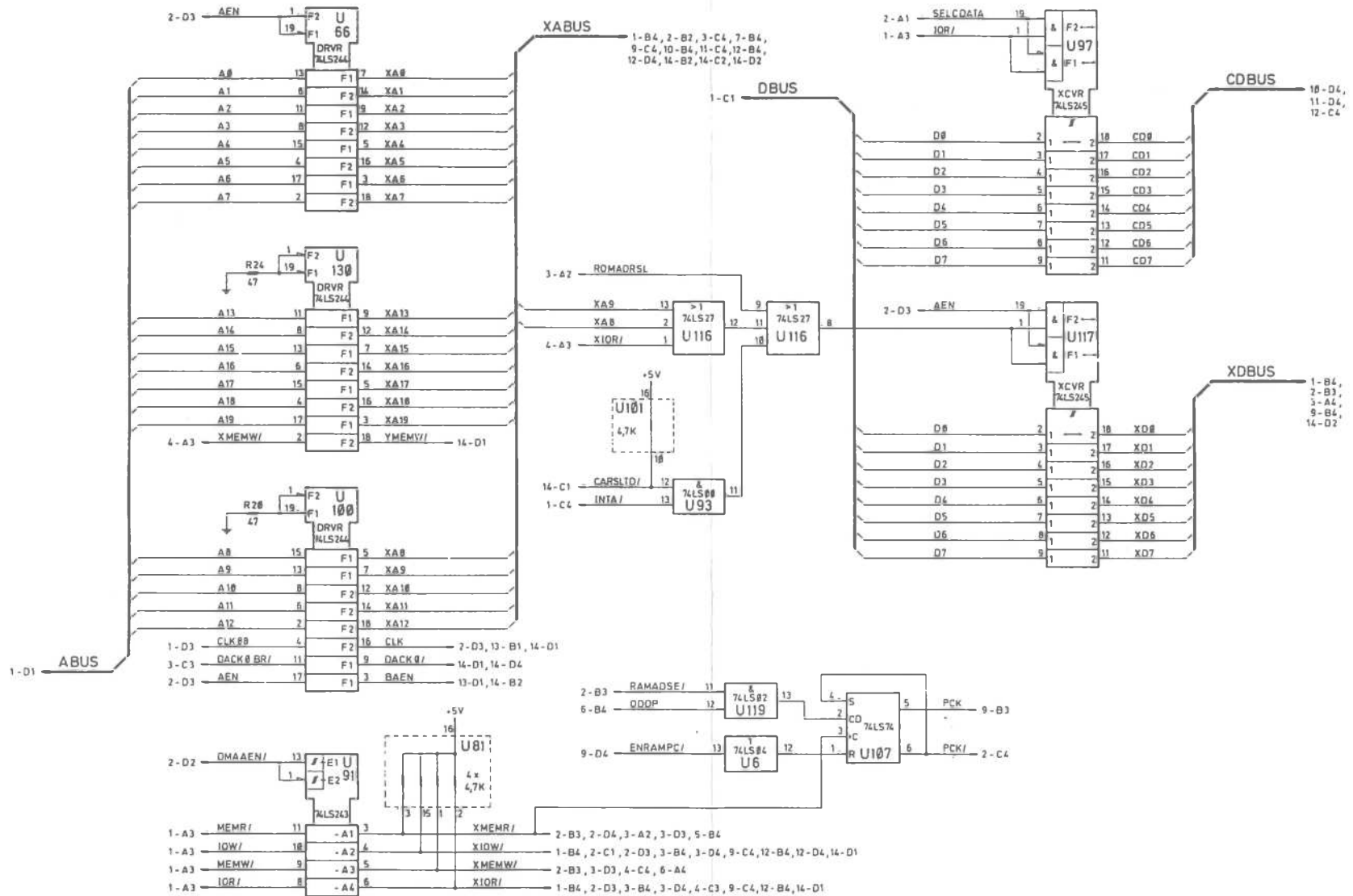


Early-type Main Processor Board (2 of 14)



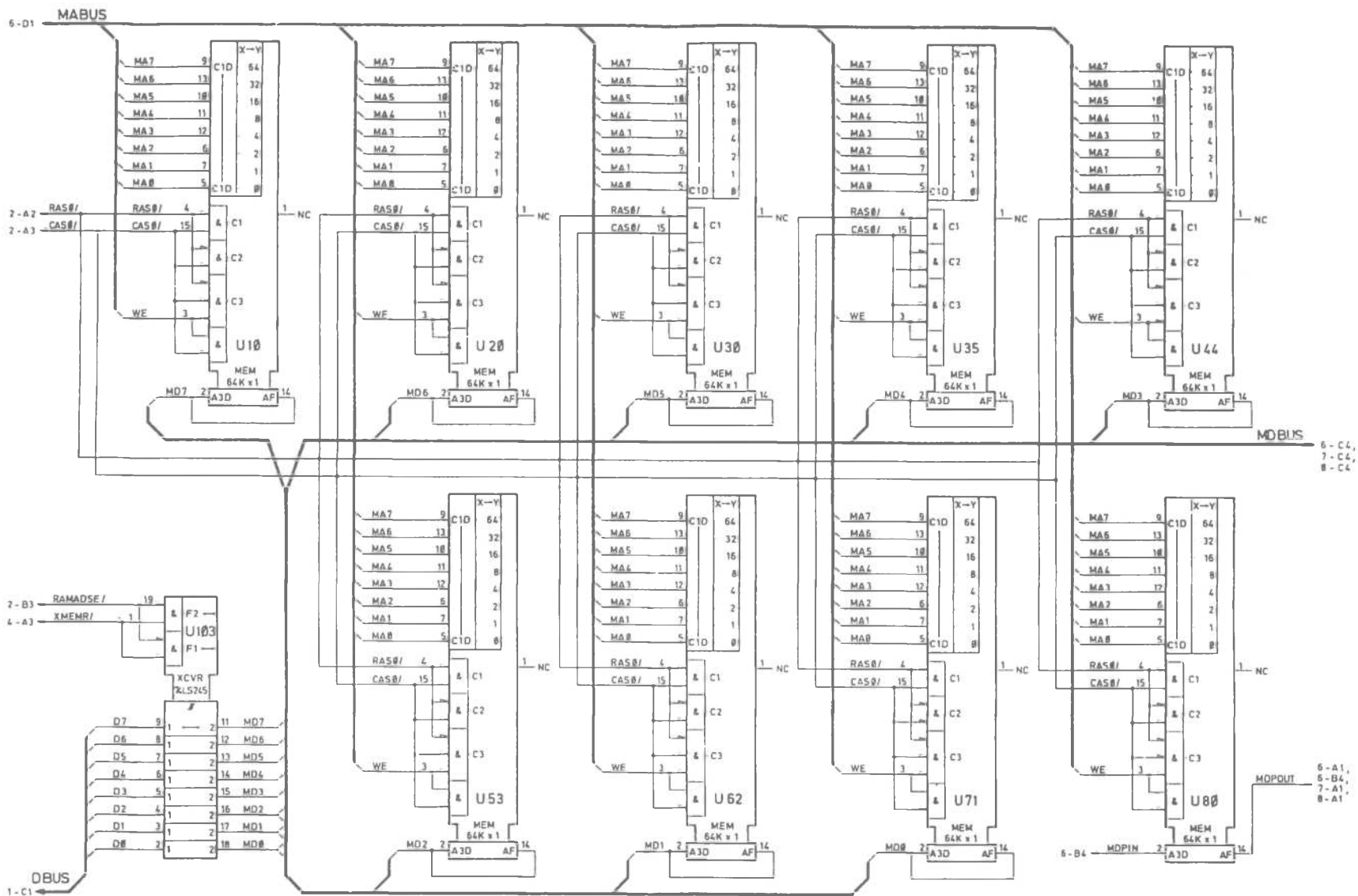
Early-type Main Processor Board (3 of 14)

LAYOUTS AND SCHEMATICS



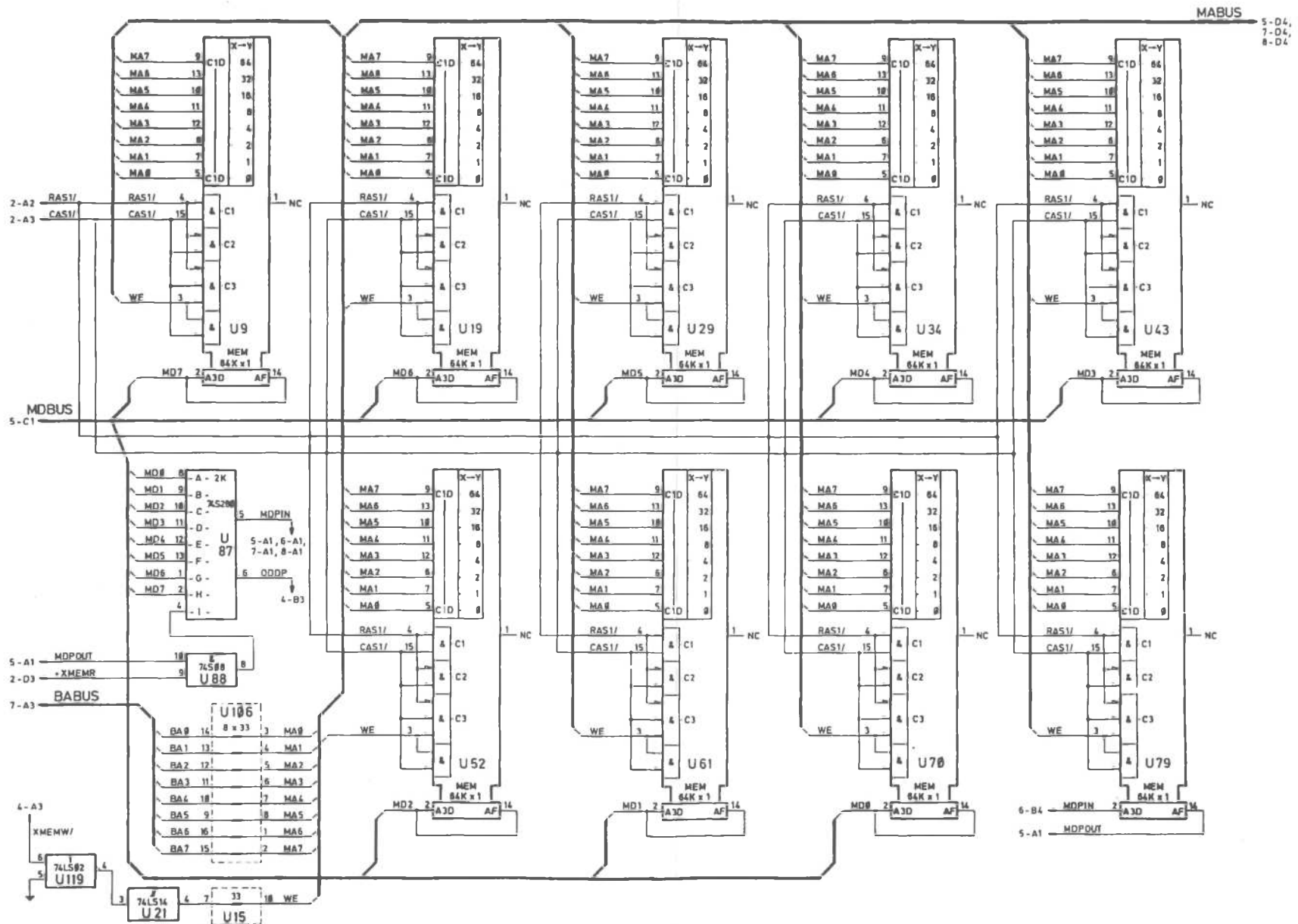
Early-type Main Processor Board (4 of 14)

LAYOUTS AND SCHEMATICS

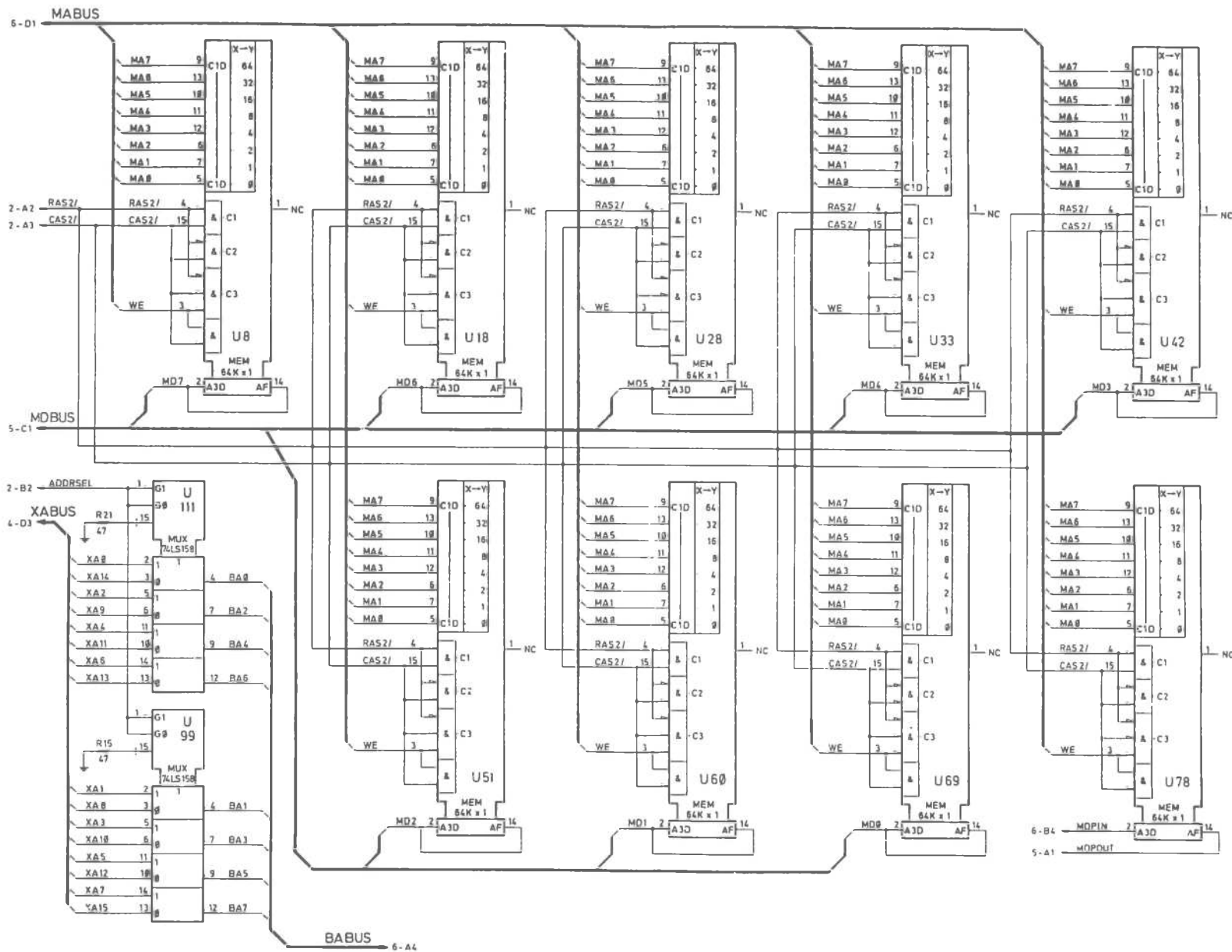


Early-type Main Processor Board (5 of 14)

LAYOUTS AND SCHEMATICS



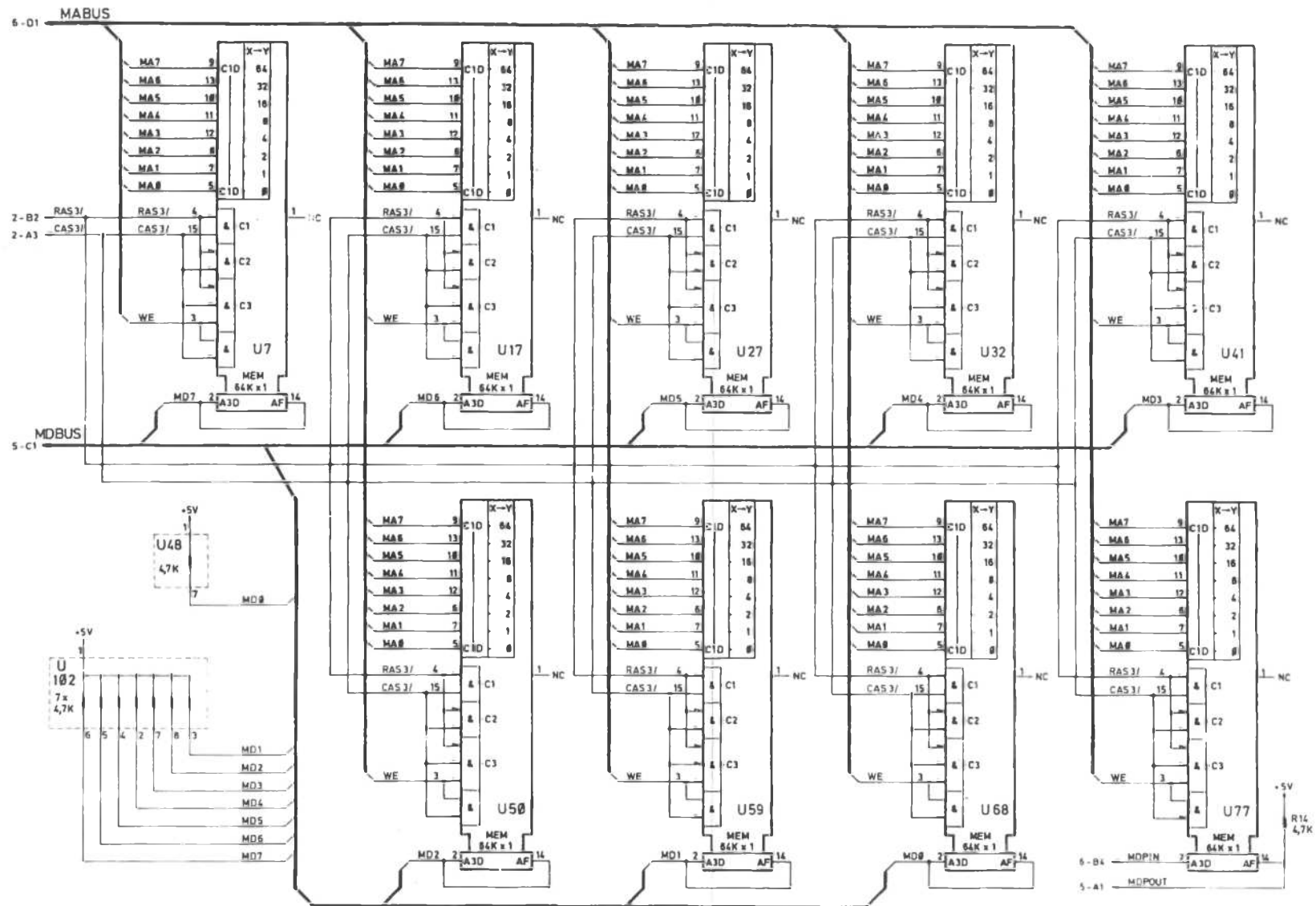
Early-type Main Processor Board (6 of 14)



Early-type Main Processor Board (7 of 14)

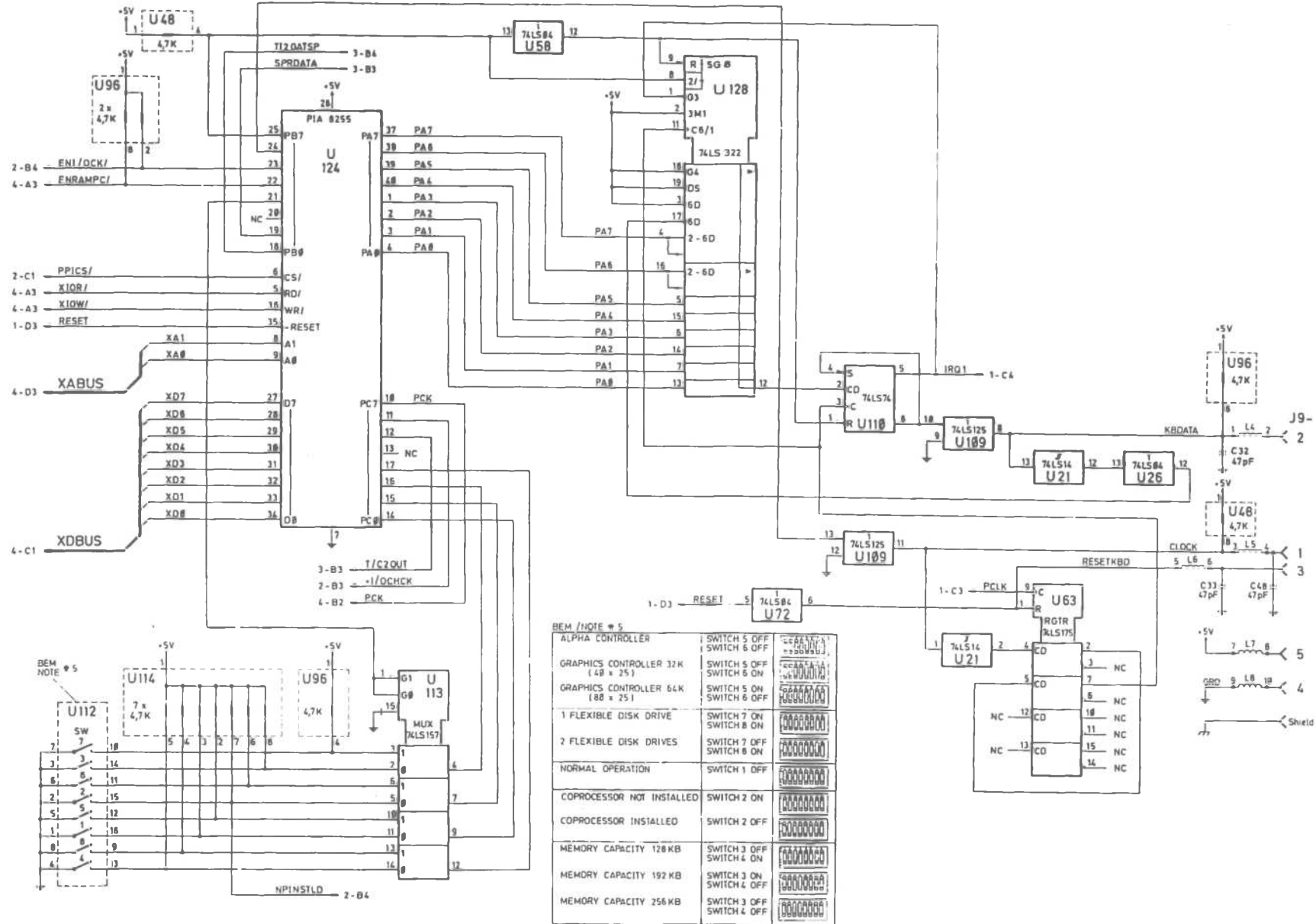


LAYOUTS AND SCHEMATICS



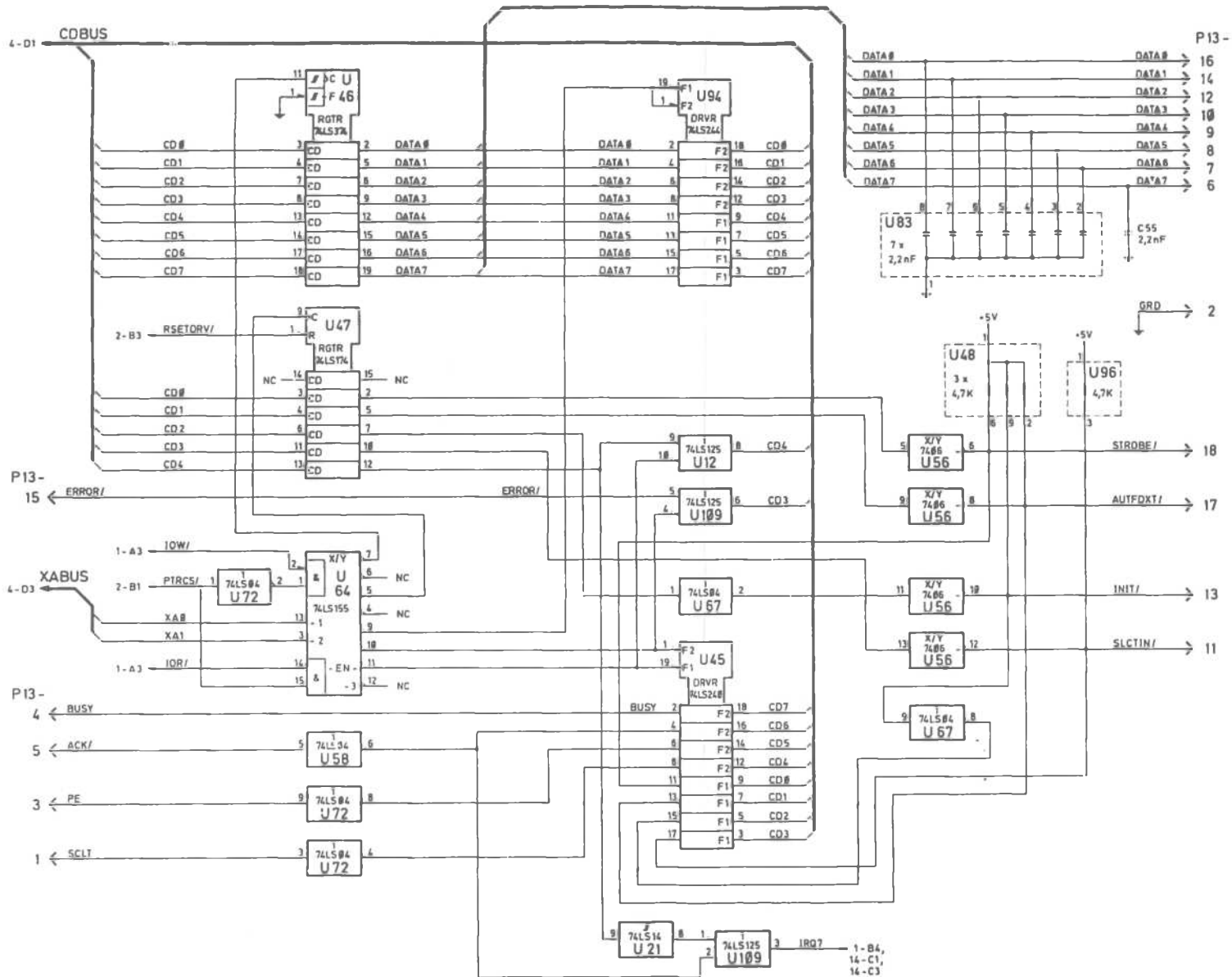
Early-type Main Processor Board (8 of 14)

LAYOUTS AND SCHEMATICS

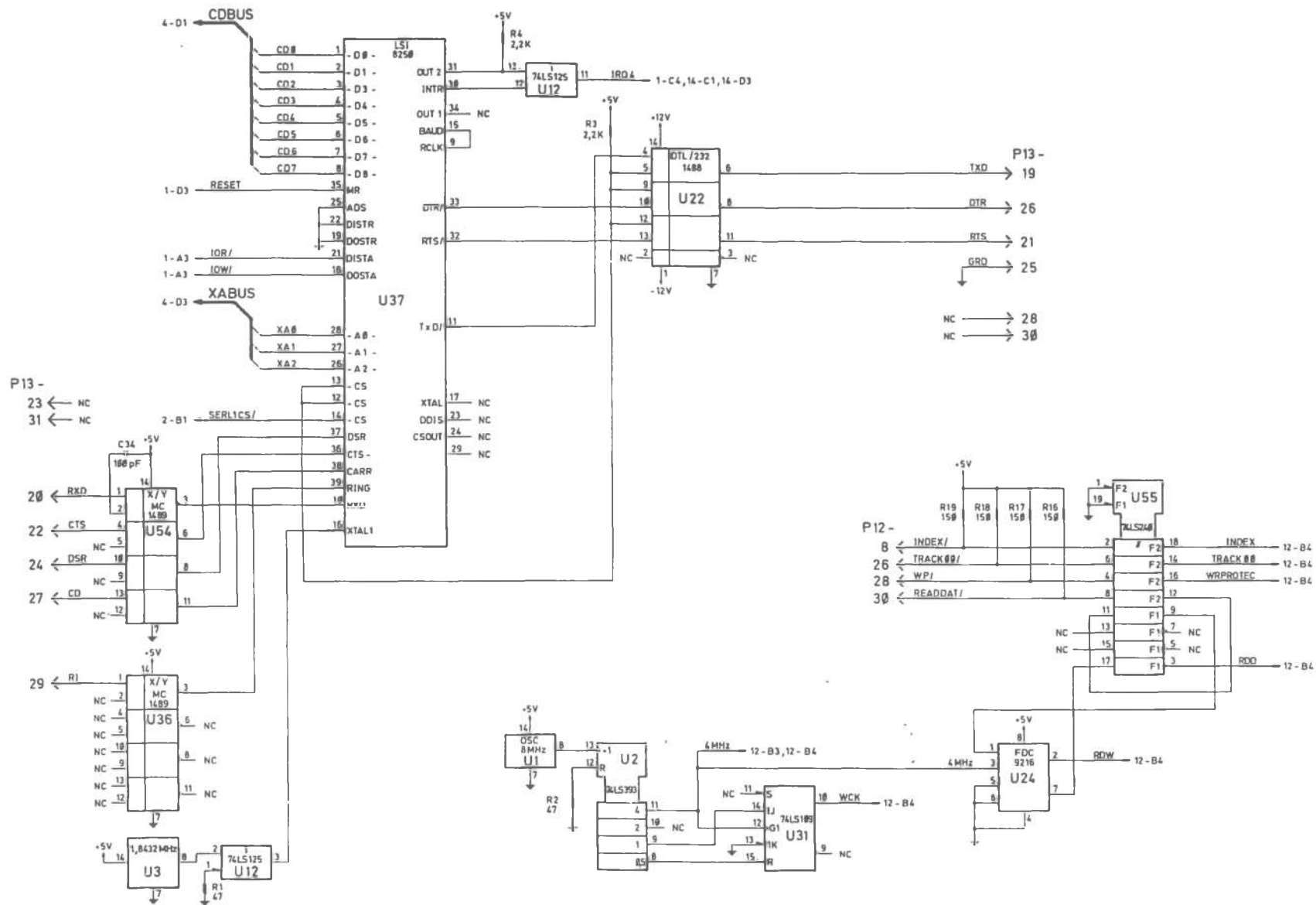


Early-type Main Processor Board (9 of 14)

LAYOUTS AND SCHEMATICS

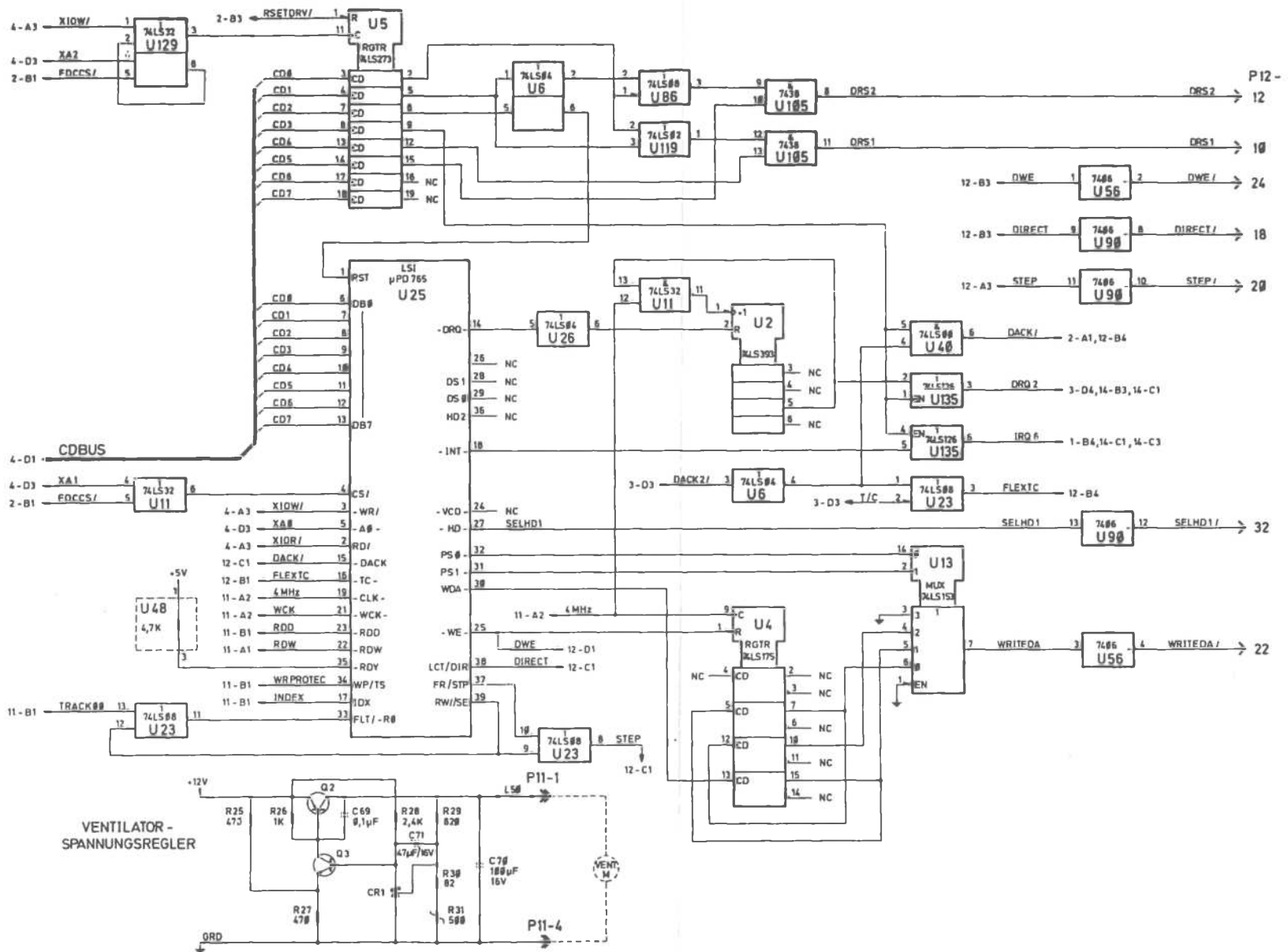


Early-type Main Processor Board (10 of 14)



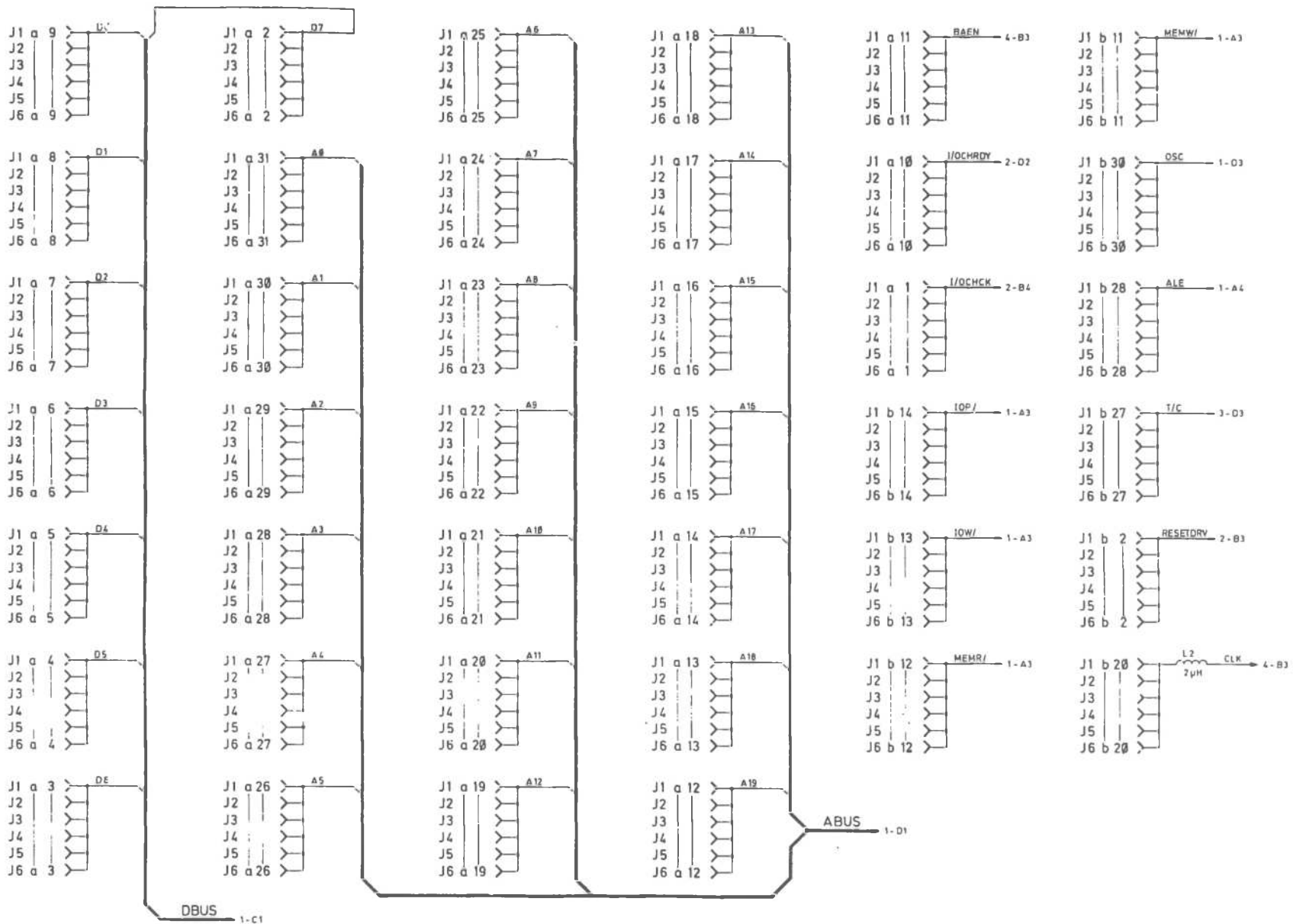
Early-type Main Processor Board (11 of 14)

LAYOUTS AND SCHEMATICS



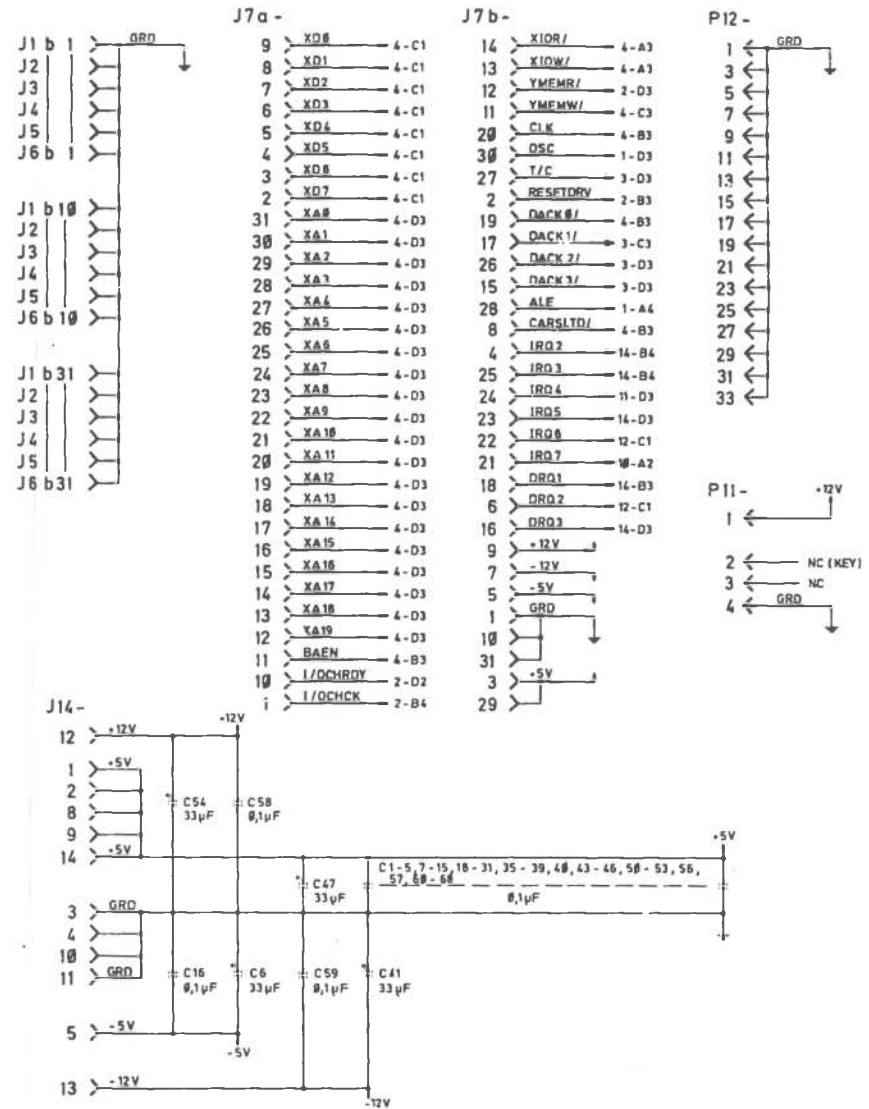
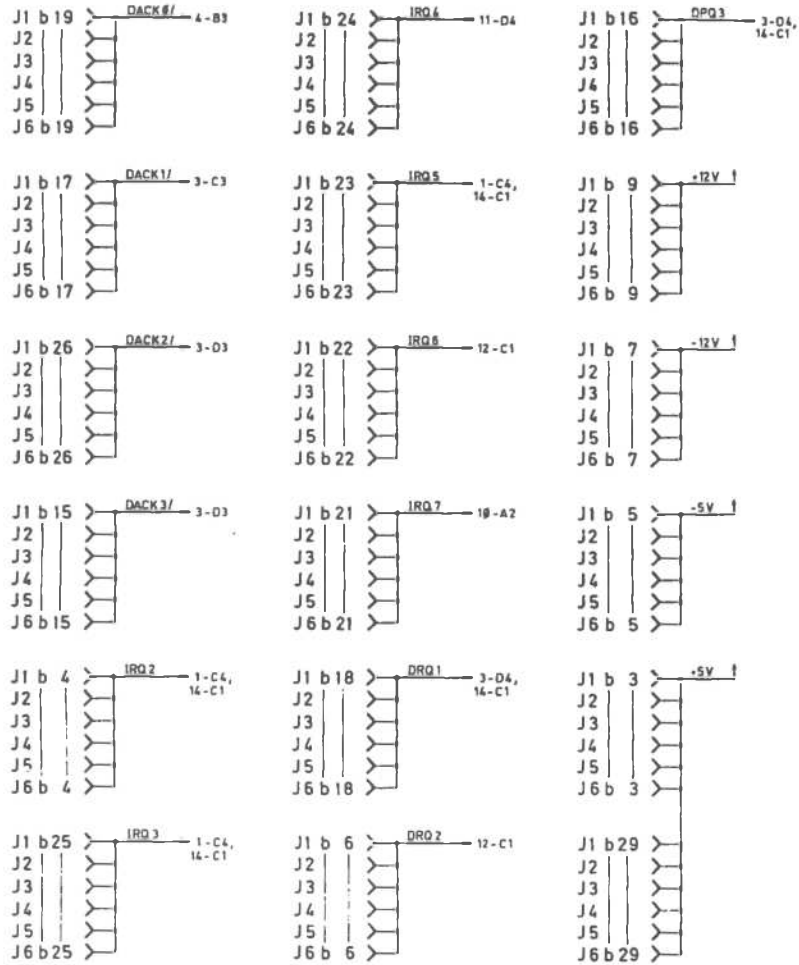
Early-type Main Processor Board (12 of 14)

LAYOUTS AND SCHEMATICS

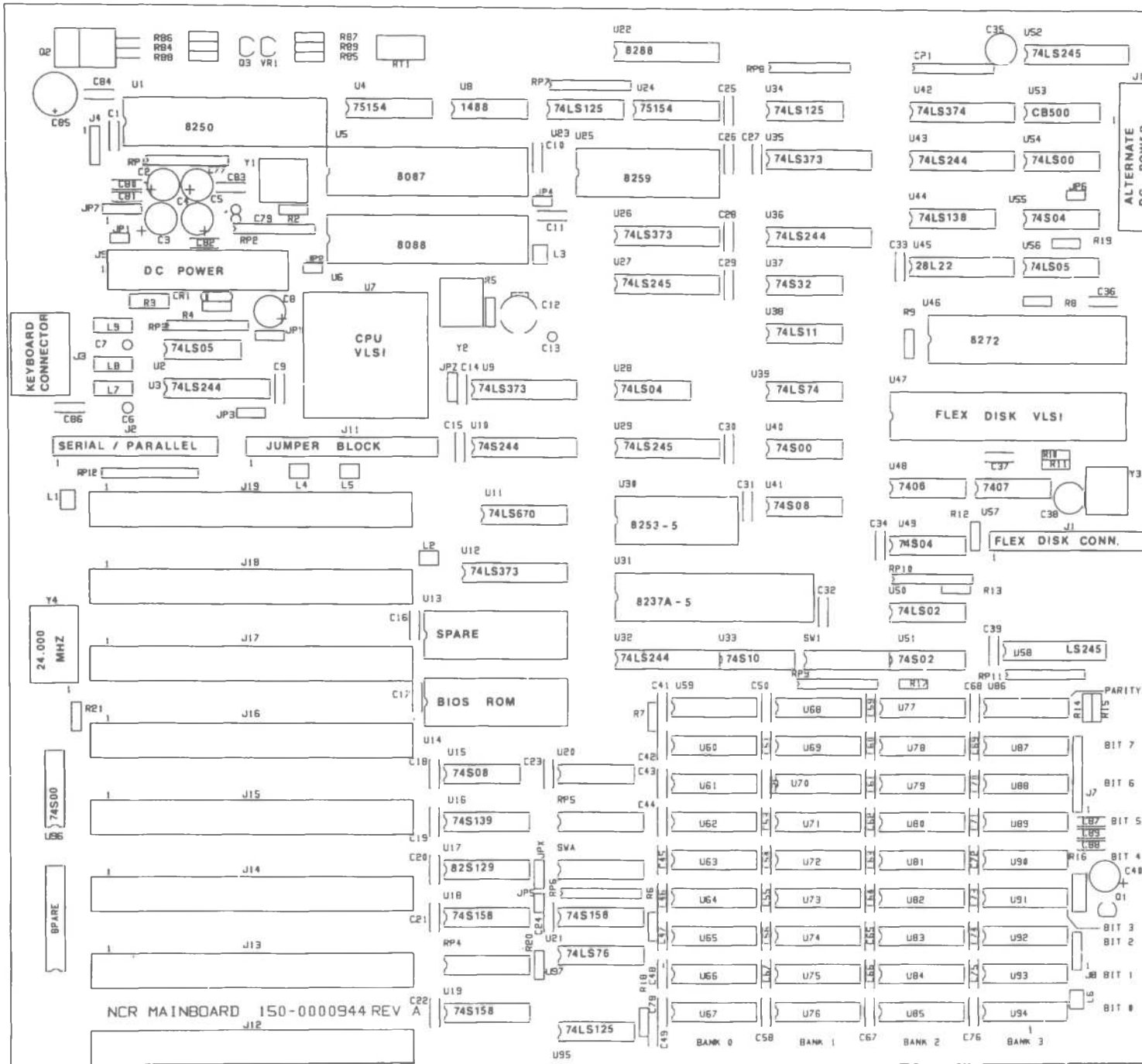


Early-type Main Processor Board (13 of 14)

LAYOUTS AND SCHEMATICS



Alternate Main Processor Board



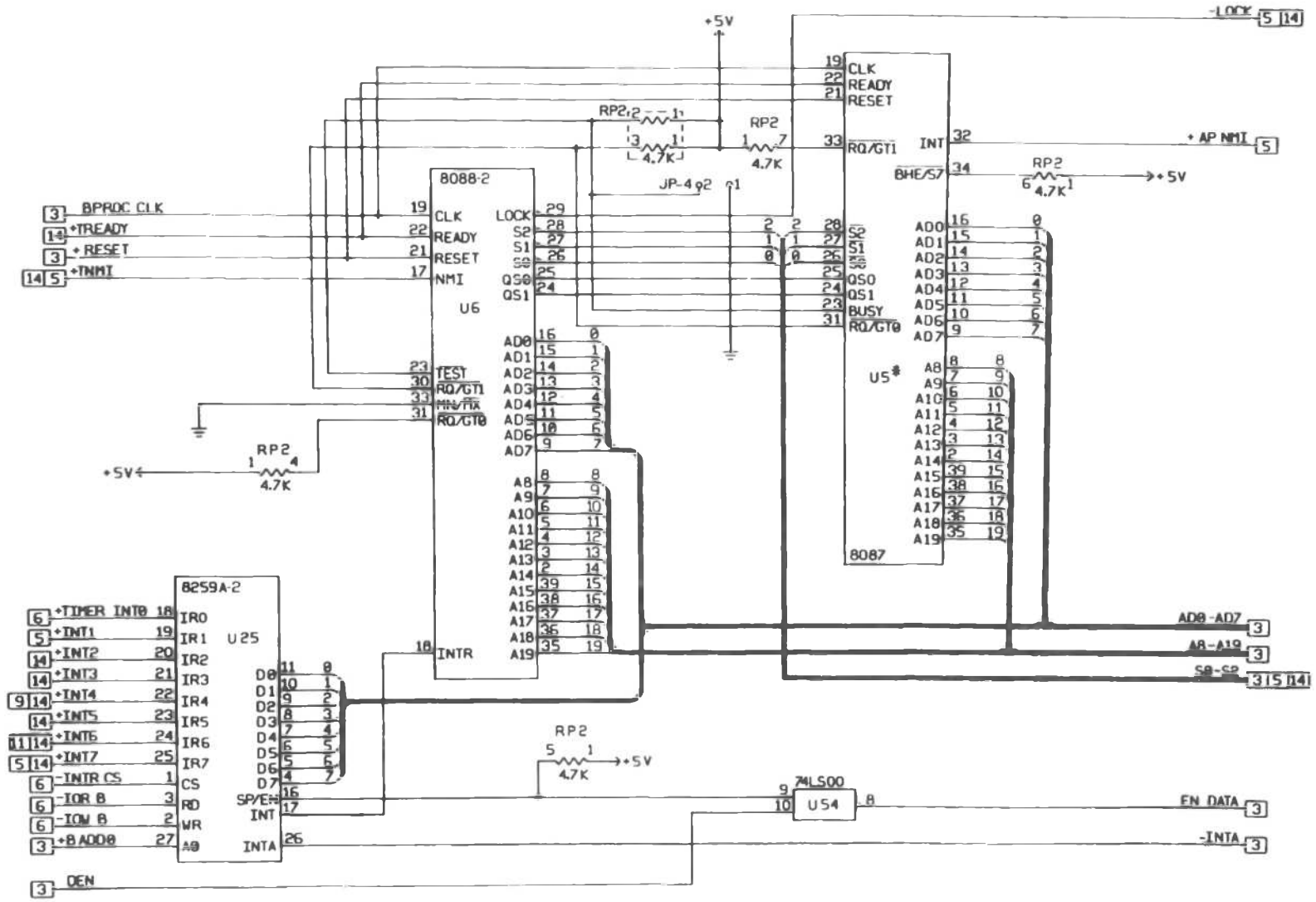


LAYOUTS AND SCHEMATICS

LOGIC DIAGRAMS

PIN NUMBERS				PIN NUMBERS				PIN NUMBERS				PIN NUMBERS				PIN NUMBERS			
U NUMBER	+5	GND	UNUSED	U NUMBER	+5	GND	UNUSED	U NUMBER	+5	GND	UNUSED	U NUMBER	+5	GND	UNUSED	U NUMBER	+5	GND	UNUSED
1	40	20		37	14	7		73	8	15		109				145			
2	14	7		38	14	7		74				110				146			
3	20	10		39	14	7		75				111				147			
4	15	8		40	14	7		76				112				148			
5	40	1,20		41	14	7		77				113				149			
6	40	1,20		42	20	10		78				114				150			
7	30 59	26,9,43		43	20	10		79				115				151			
8			-12V - PIN 14 -12V - PIN 1	44	15	8		80				116				152			
9	20	10		45	20	10		81				117				153			
10	20	10		46	40	20		82				118				154			
11	14	7		47	19	42		83				119				155			
12	20	10		48	14	7		84				120				156			
13	20	14		49	14	7		85				121				157			
14	20	14		50	14	7		86				122				158			
15	14	7		51	14	7		87				123				159			
16	15	8		52	20	10		88				124				160			
17	16	8		53	14	7		89				125				161			
18	16	8		54	14	7		90				126				162			
19	16	8		55	14	7		91				127				163			
20	14	7		56	14	7		92				128				164			
21	15	8		57	14	7		93				129				165			
22	20	10		58	20	10		94	8	15		130				166			
23	14	7		59	8	15		95	14	7		131				167			
24	15	8		60				96	14	7		132				168			
25	20	14		61				97	5	13		133				169			
26	20	10		62				98				134				170			
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36	20	10		72	8	15		108				144				180			

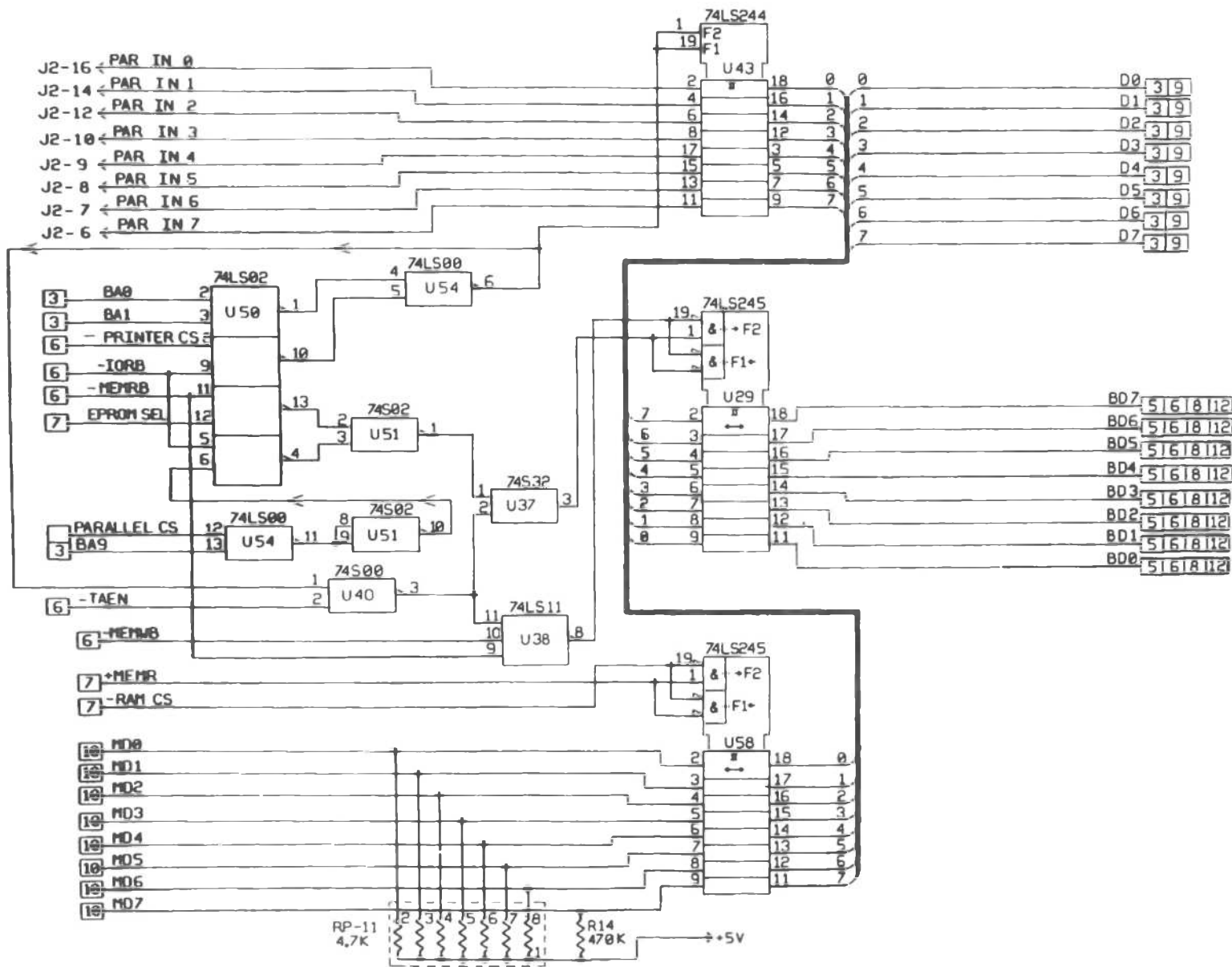
Logic Diagram



Alternate Processor Mainboard (2 of 14)



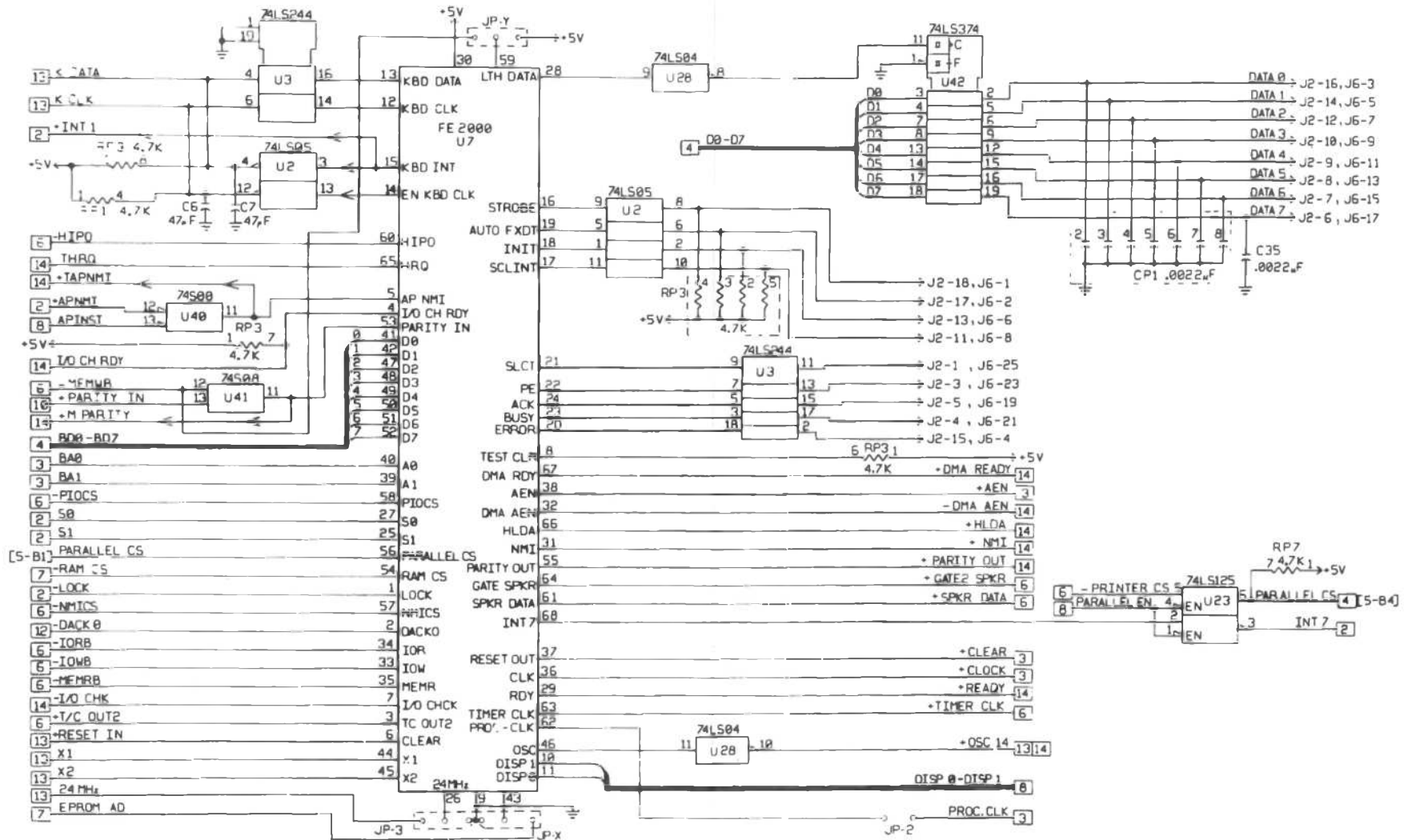
Logic Diagram



Alternate Main Processor Board (4 of 14)

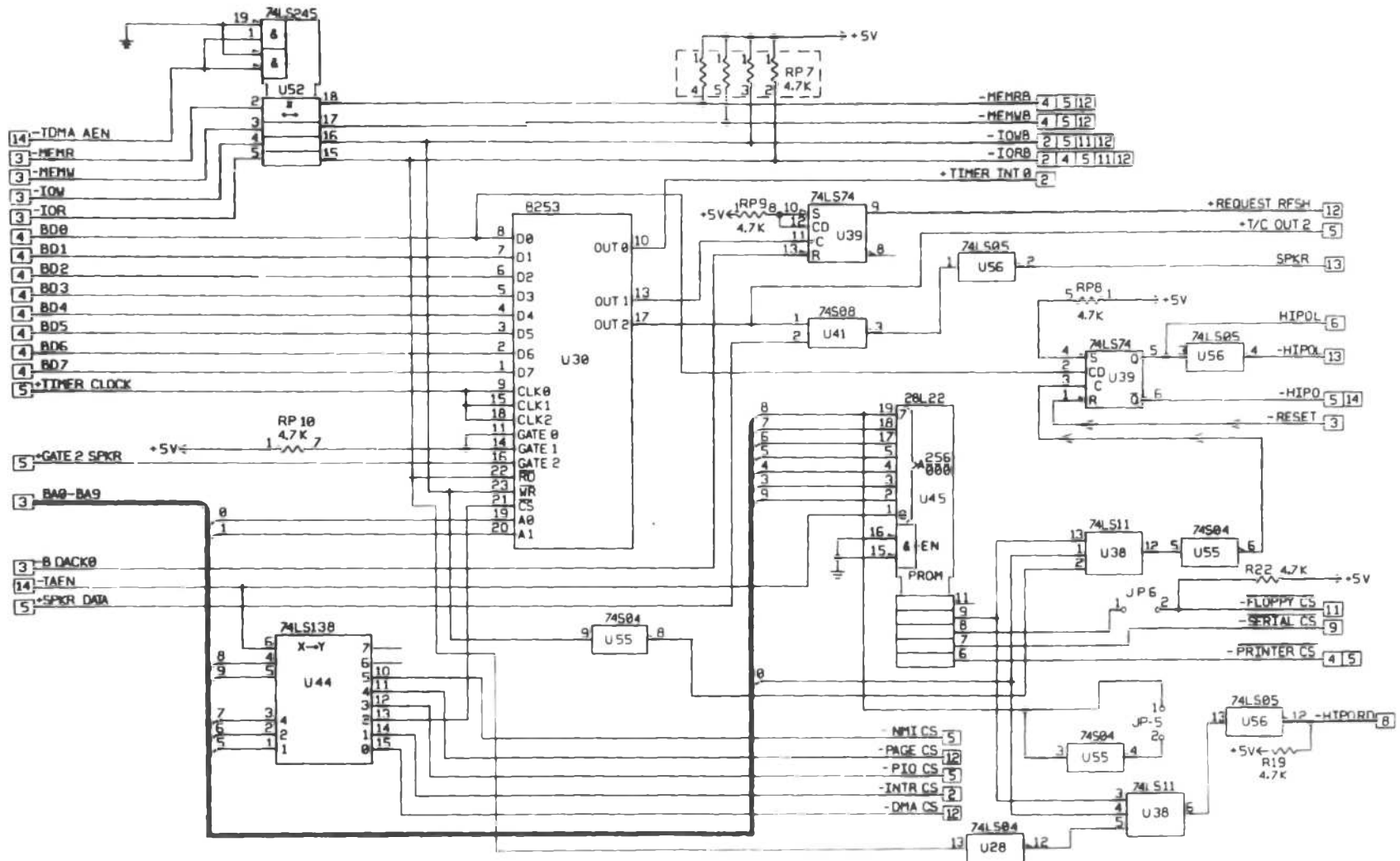
LAYOUTS AND SCHEMATICS

Logic Diagram



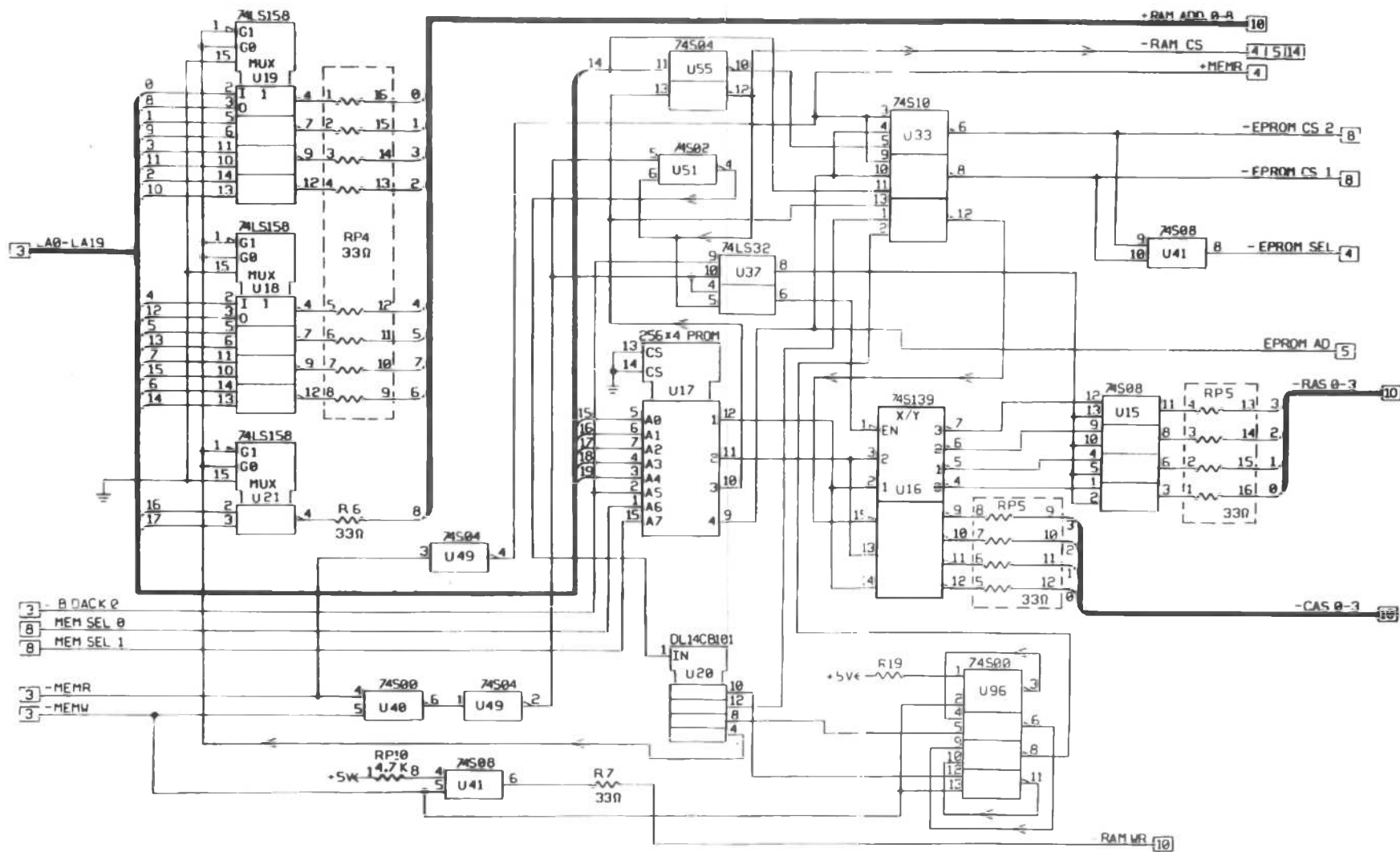
Alternate Main Processor Board (5 of 14)

Logic Diagram

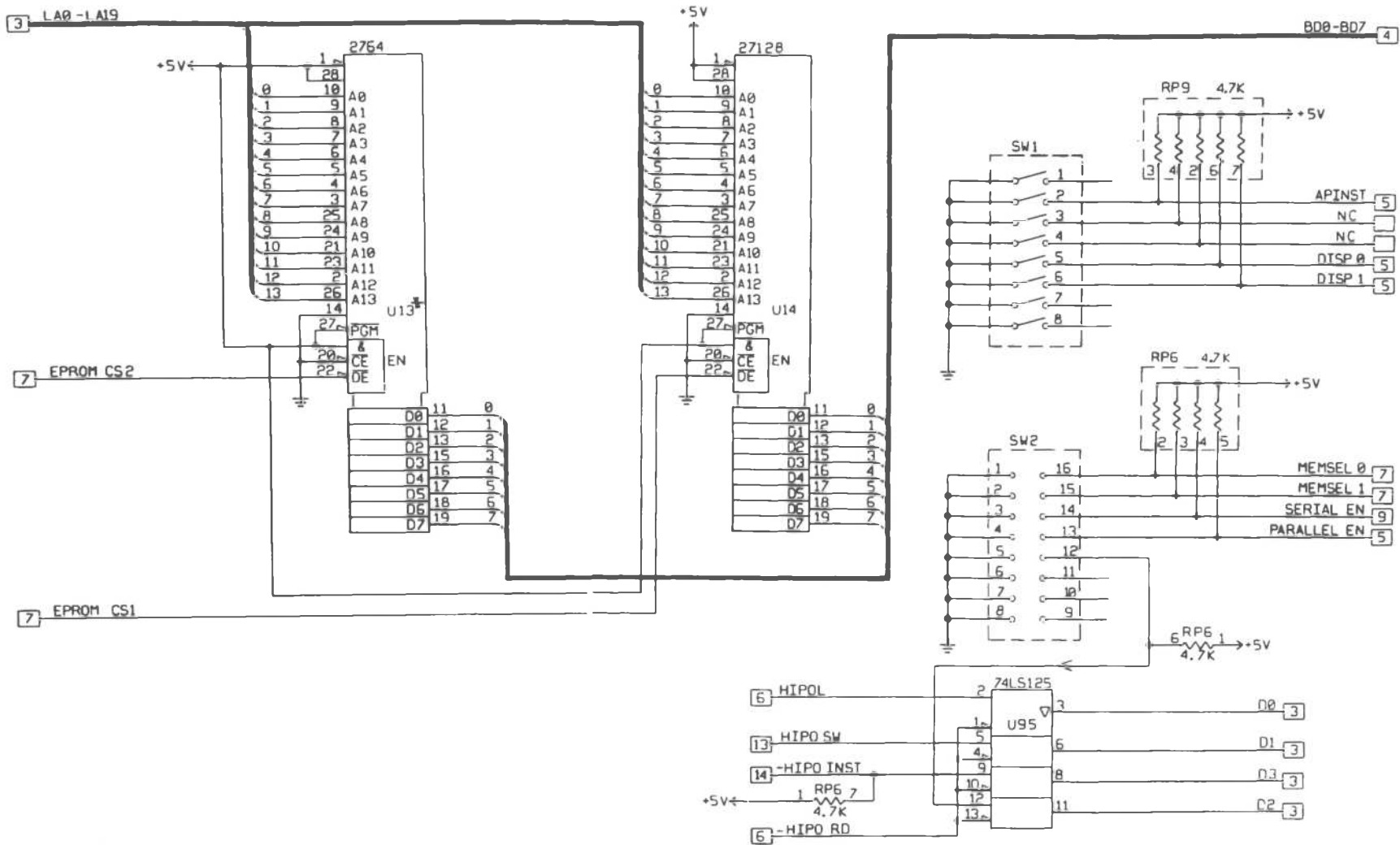


Alternate Main Processor Board (6 of 14)

Logic Diagram

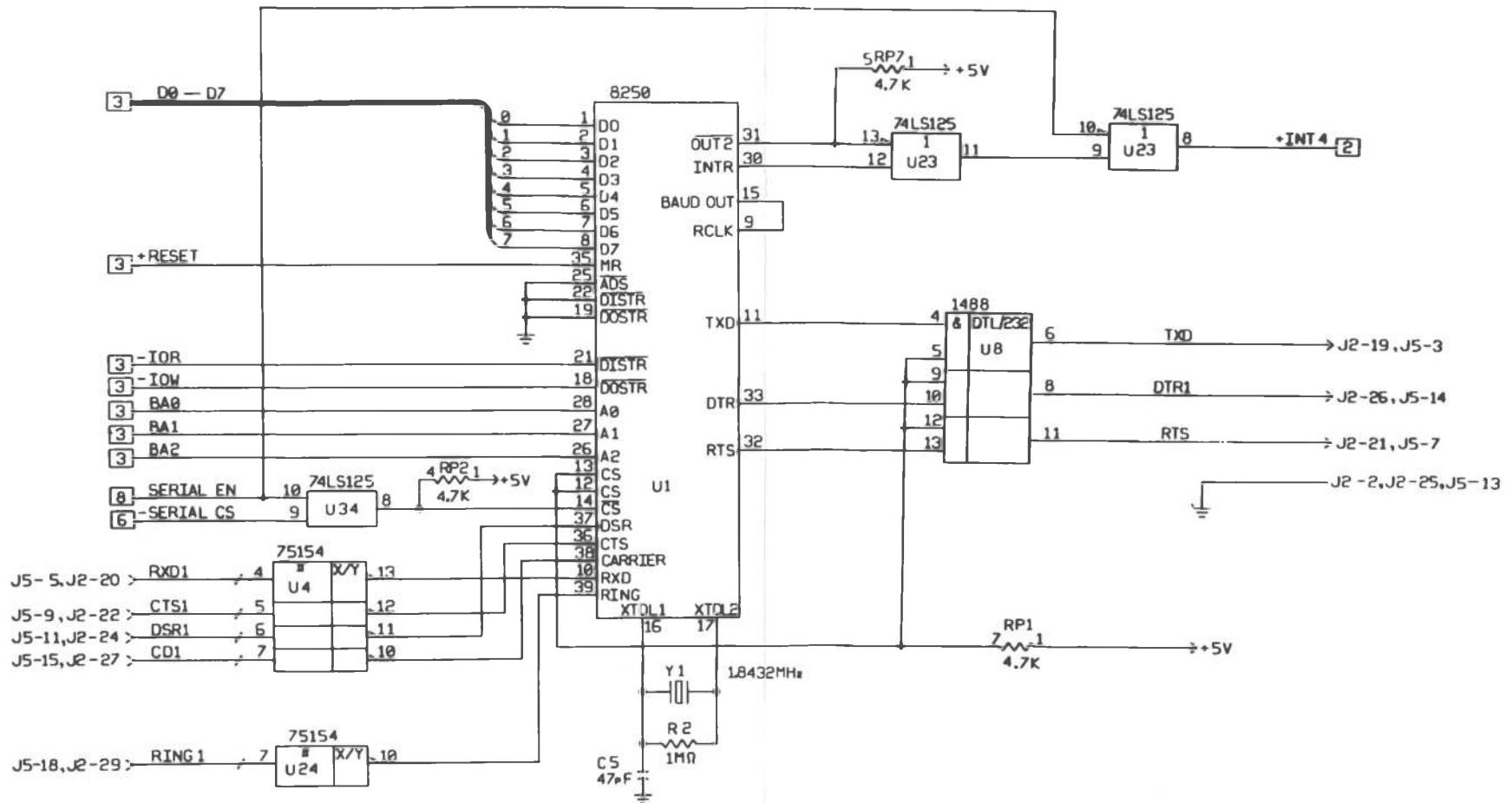


Logic Diagram



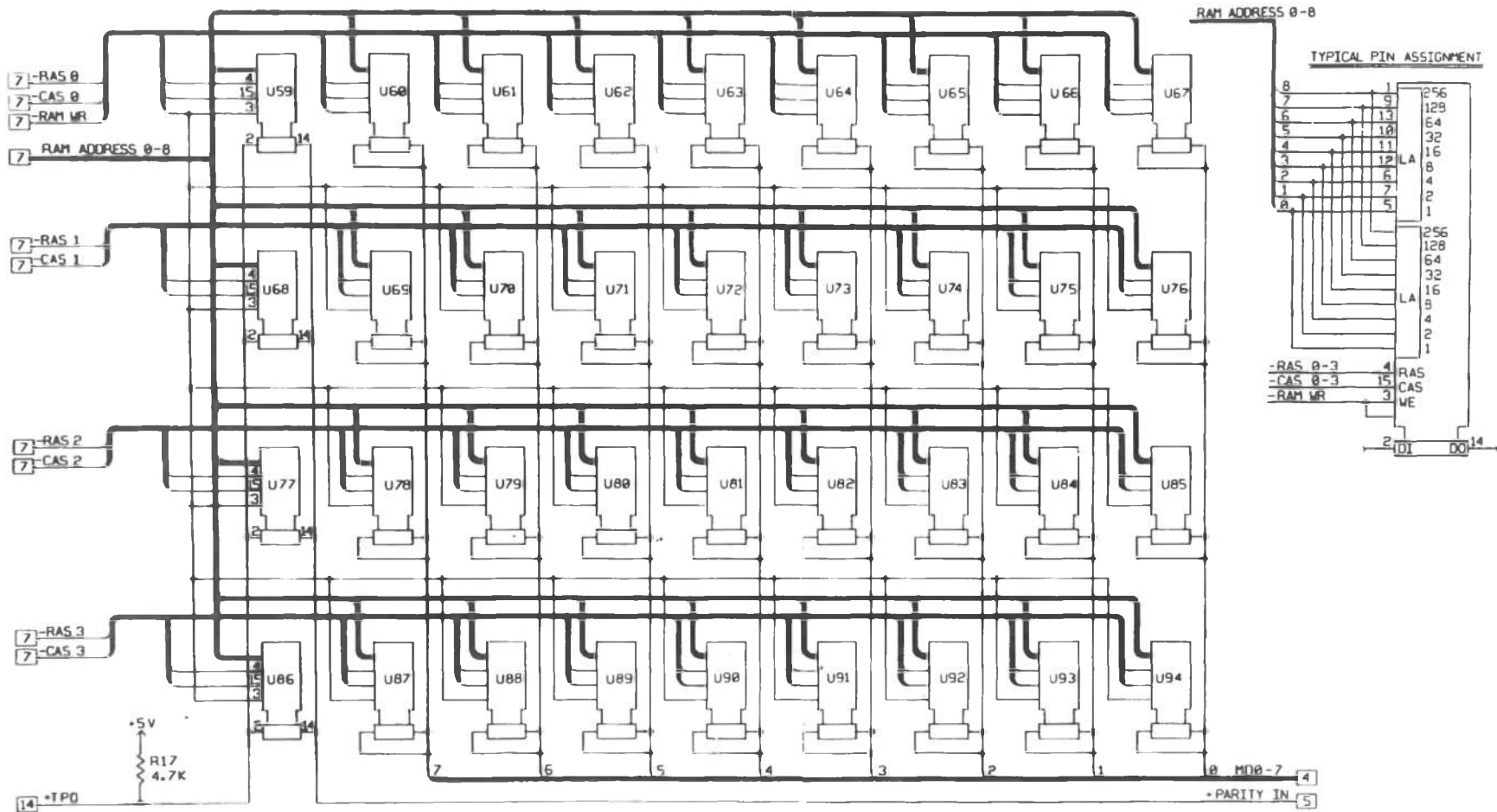


Logic Diagram



Alternate Main Processor Board (9 of 14)

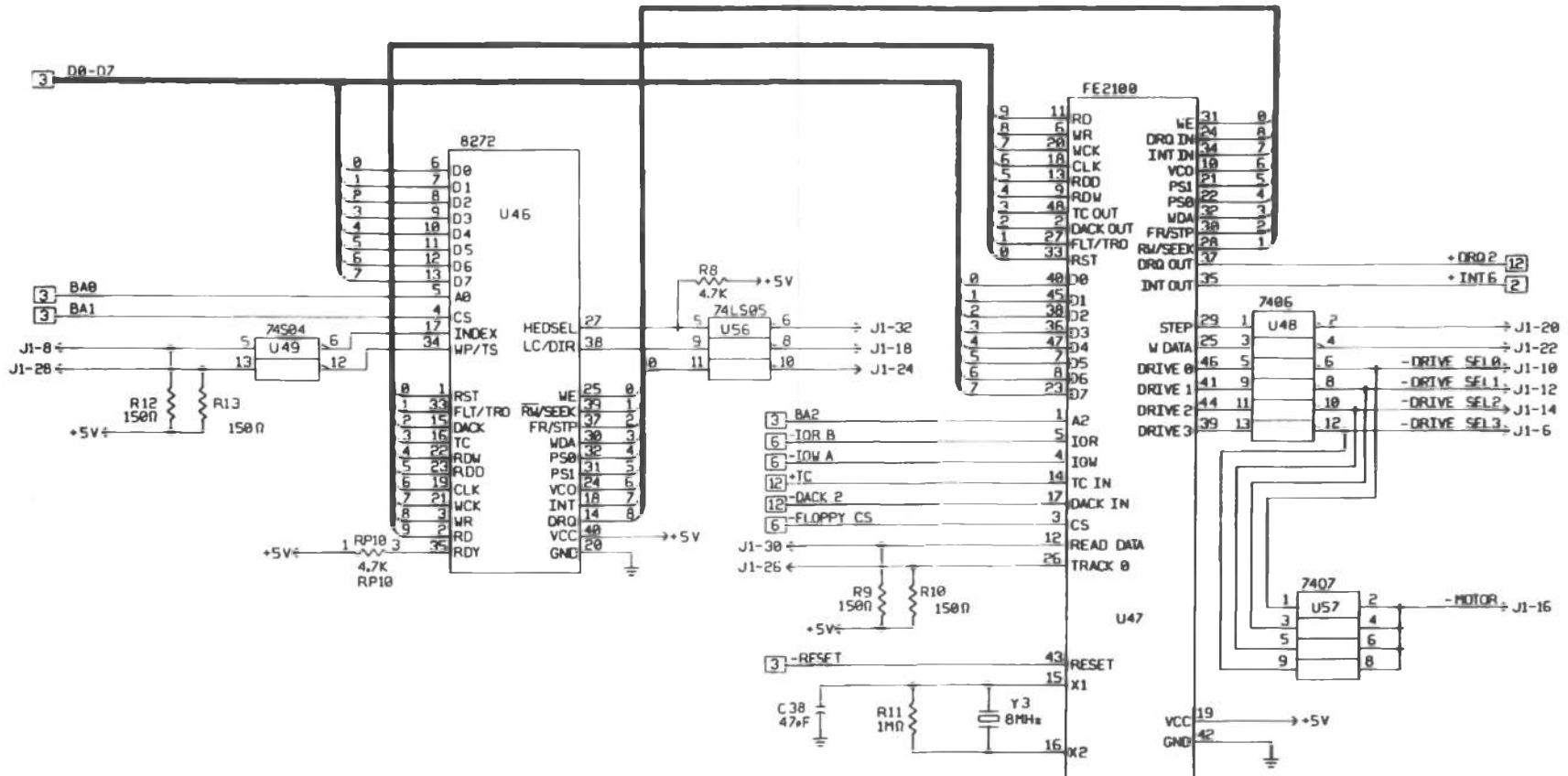
Logic Diagram



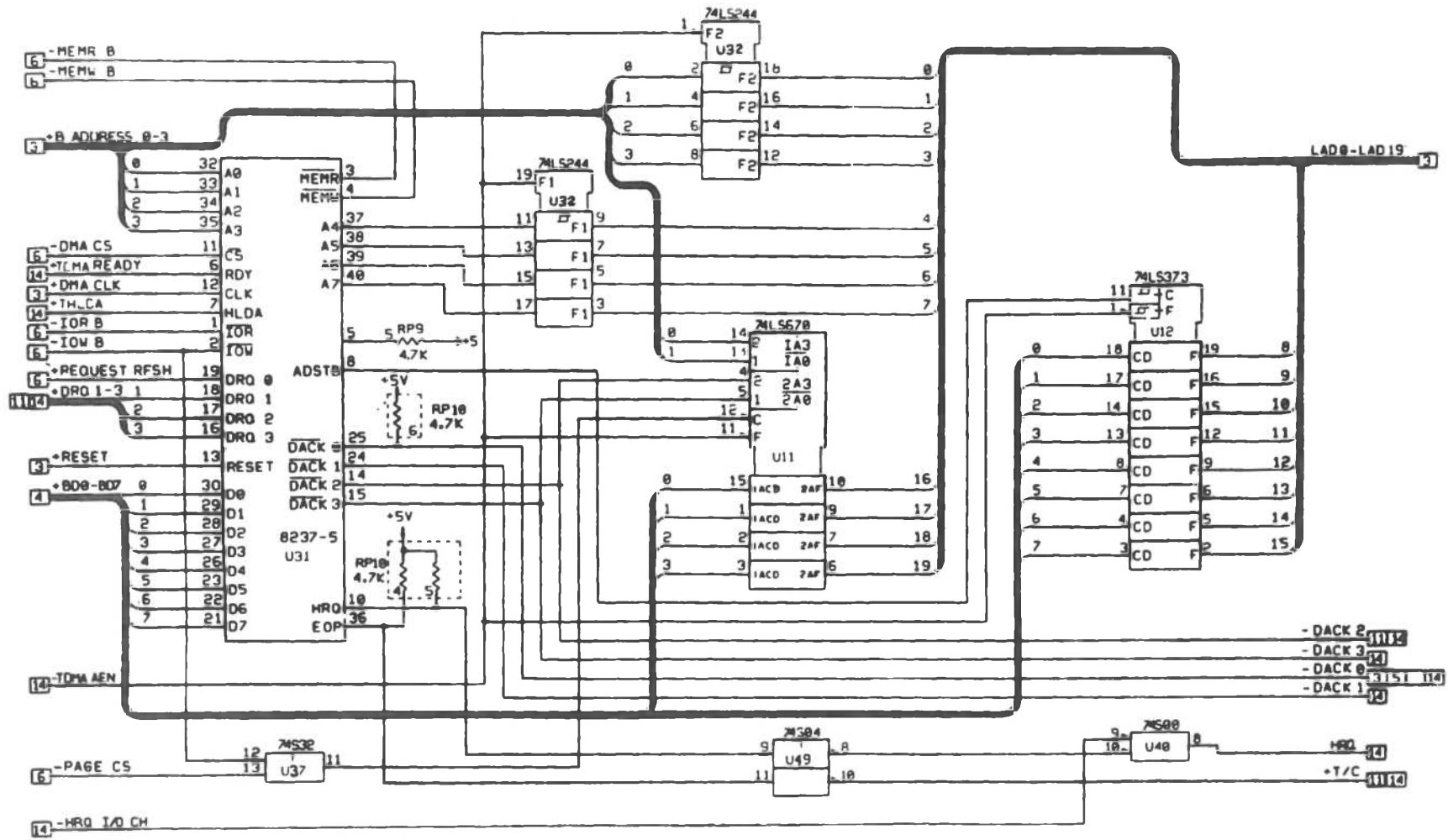
Alternate Main Processor Board (10 of 14)

LAYOUTS AND SCHEMATICS

Logic Diagram



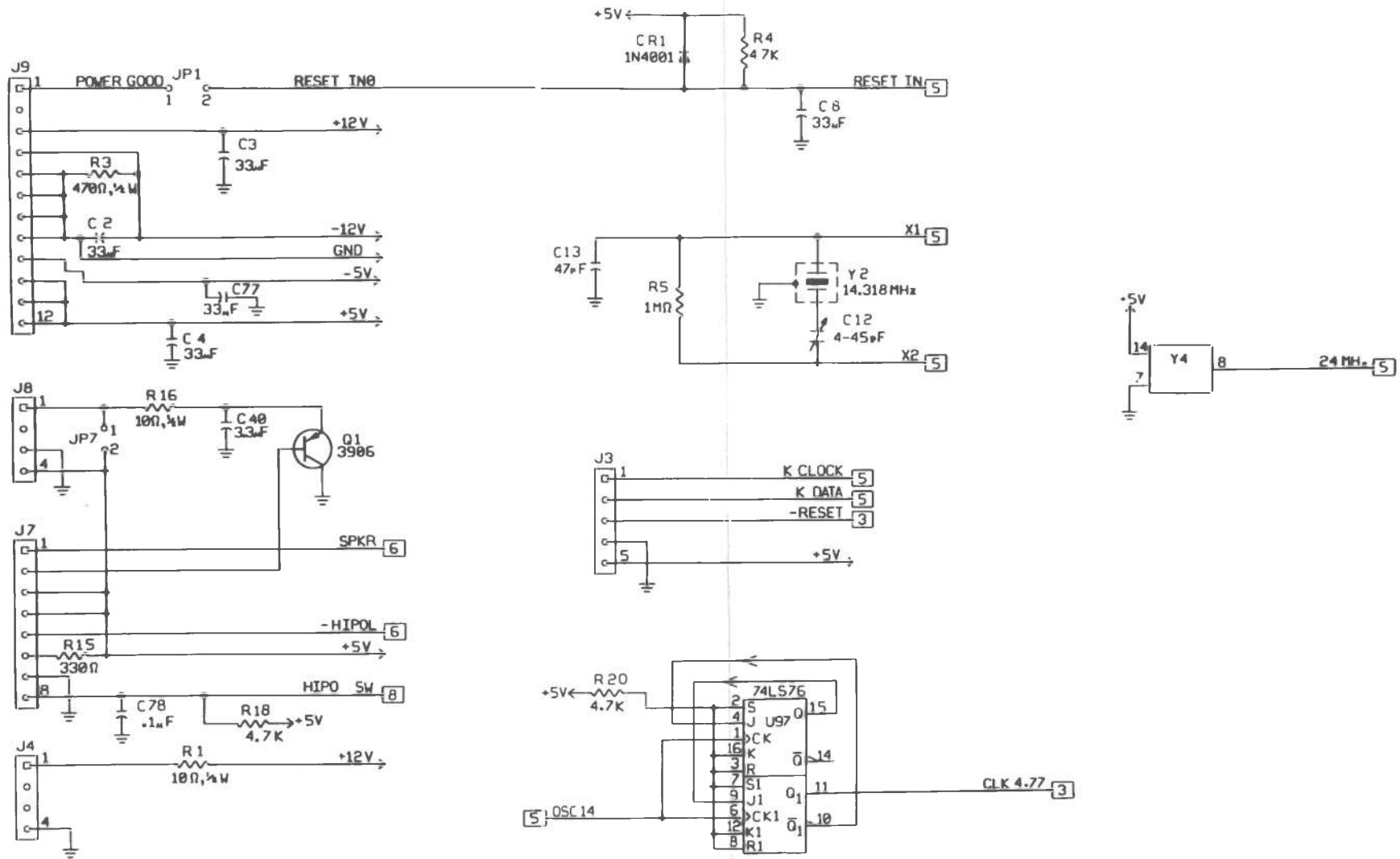
Logic Diagram



DO NOT POPULATE

LAYOUTS AND SCHEMATICS

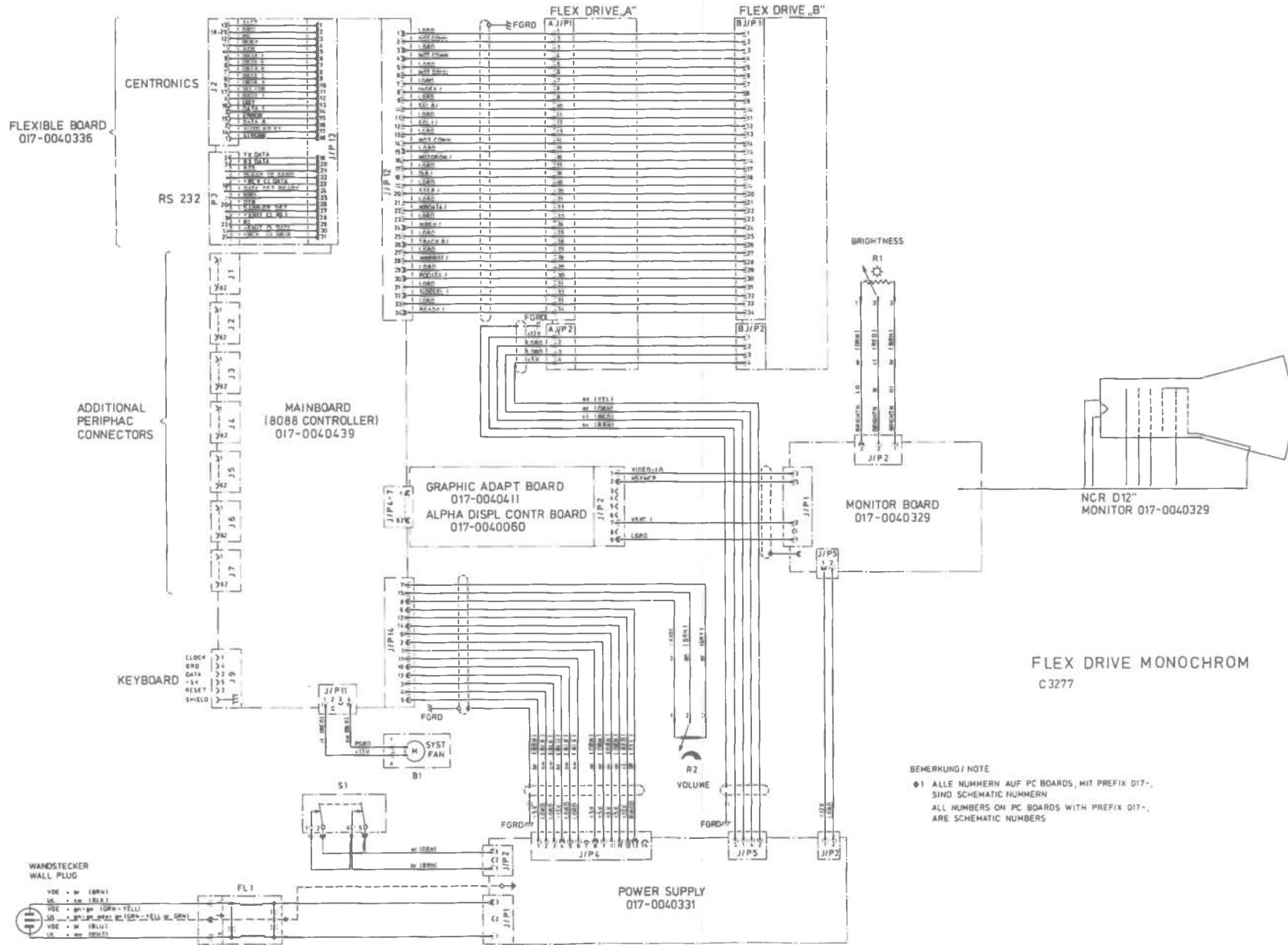
Logic Diagram





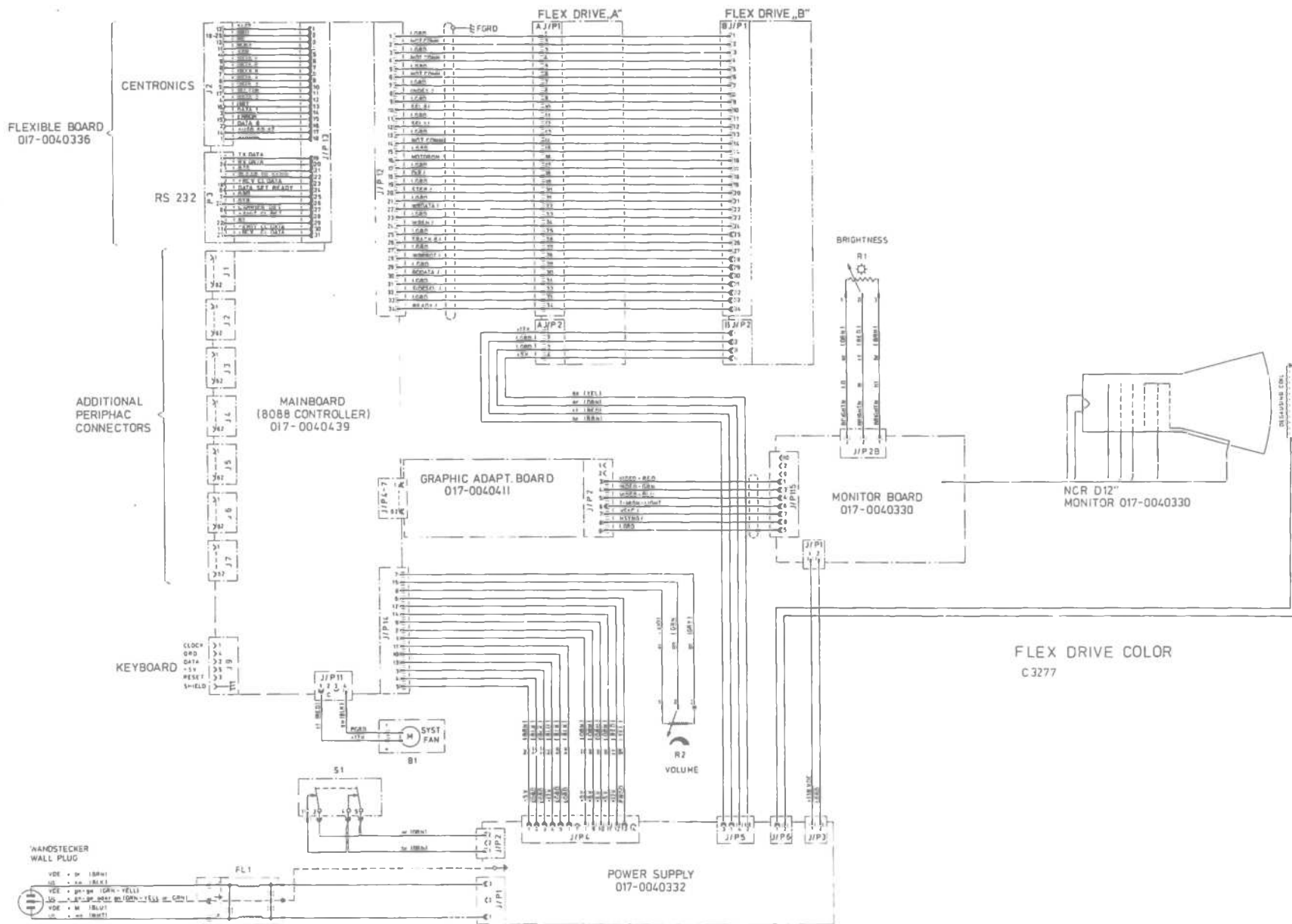
# LAYOUTS AND SCHEMATICS

## Wiring Diagram



Wiring Diagram (1 of 3)

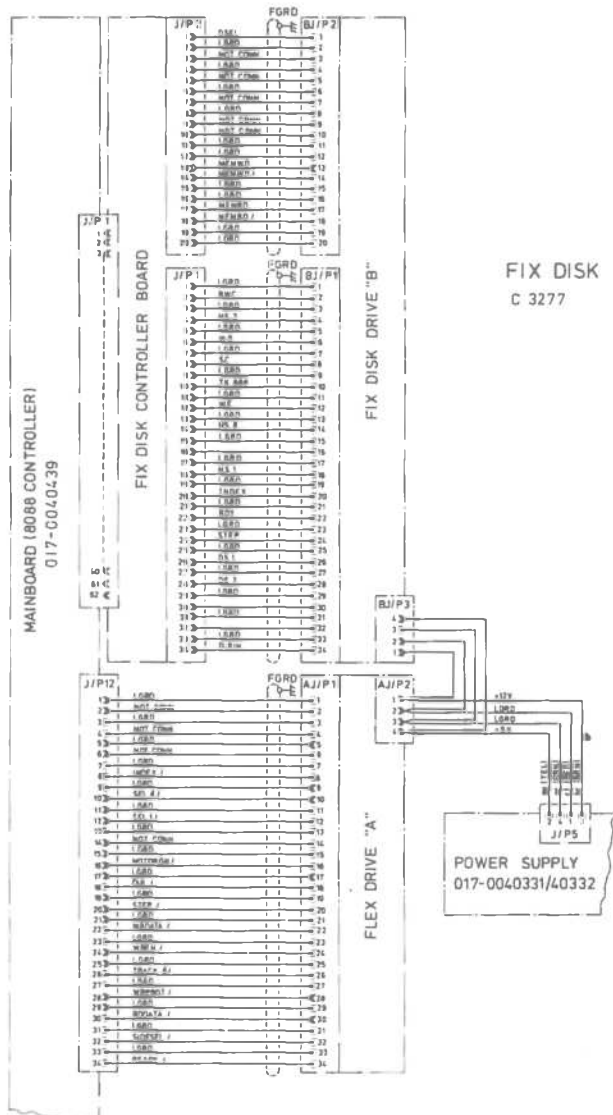
# LAYOUTS AND SCHEMATICS



Wiring Diagram (2 of 3)

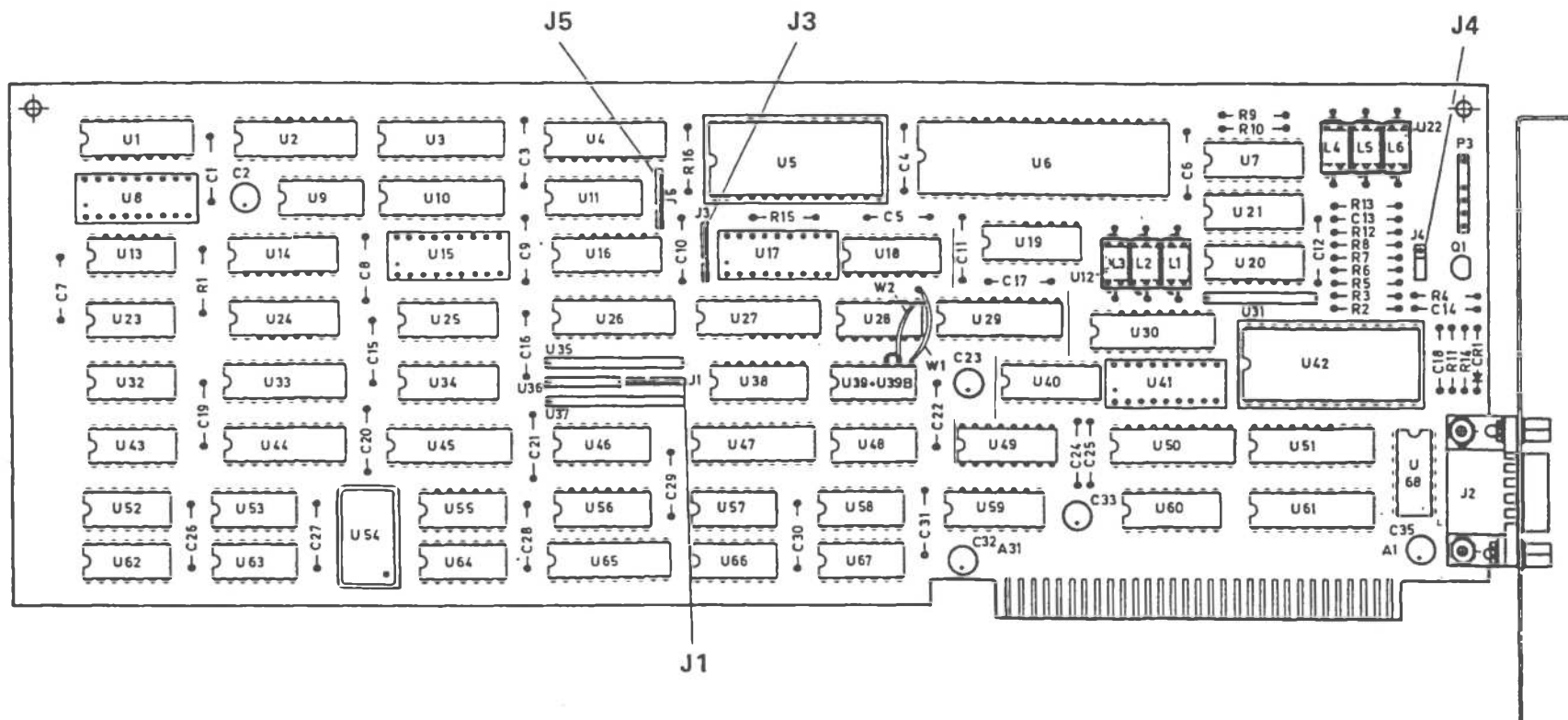


LAYOUTS AND SCHEMATICS

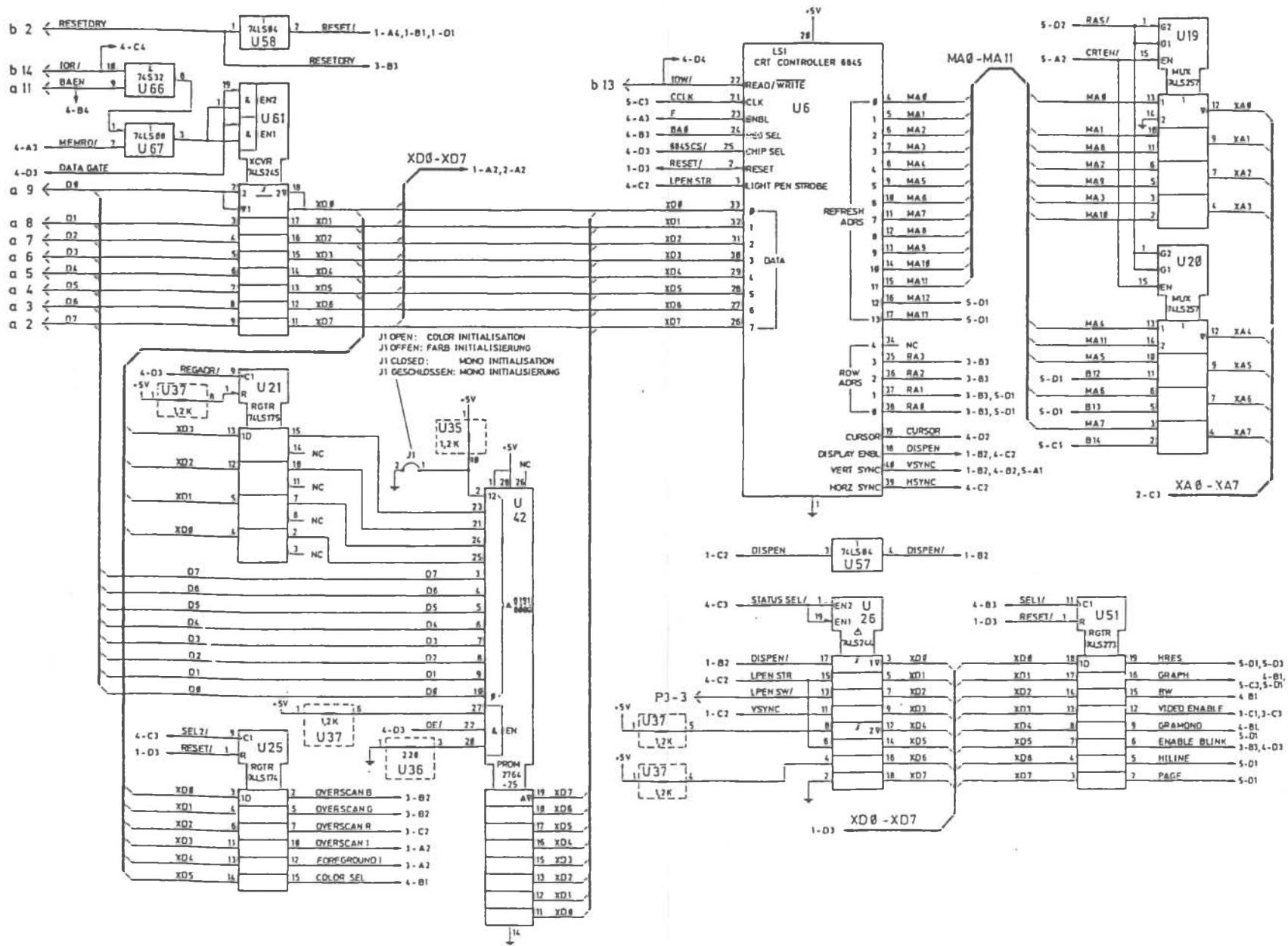


Wiring Diagram [3 of 3]

Graphics Controller Board

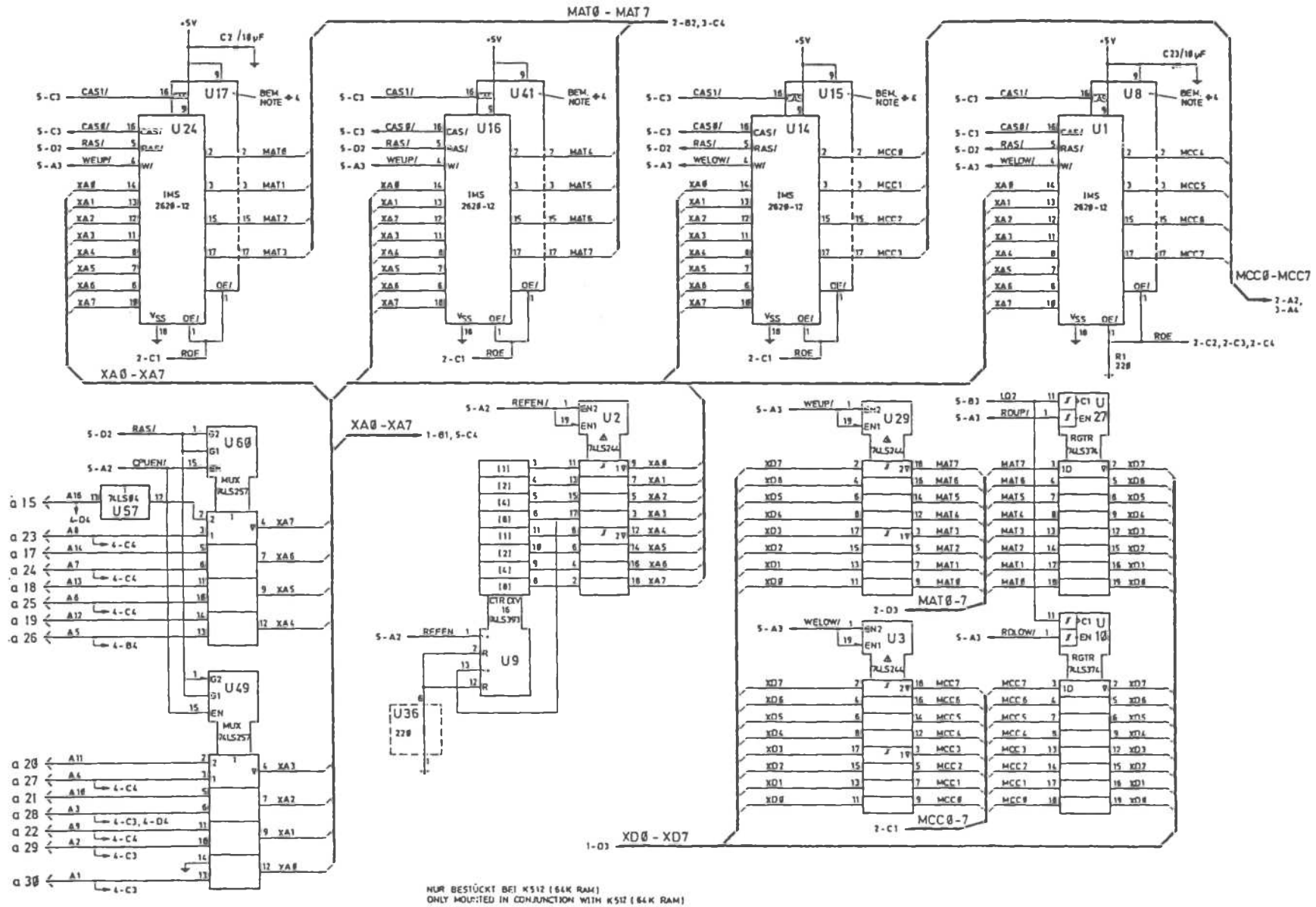


# LAYOUTS AND SCHEMATICS



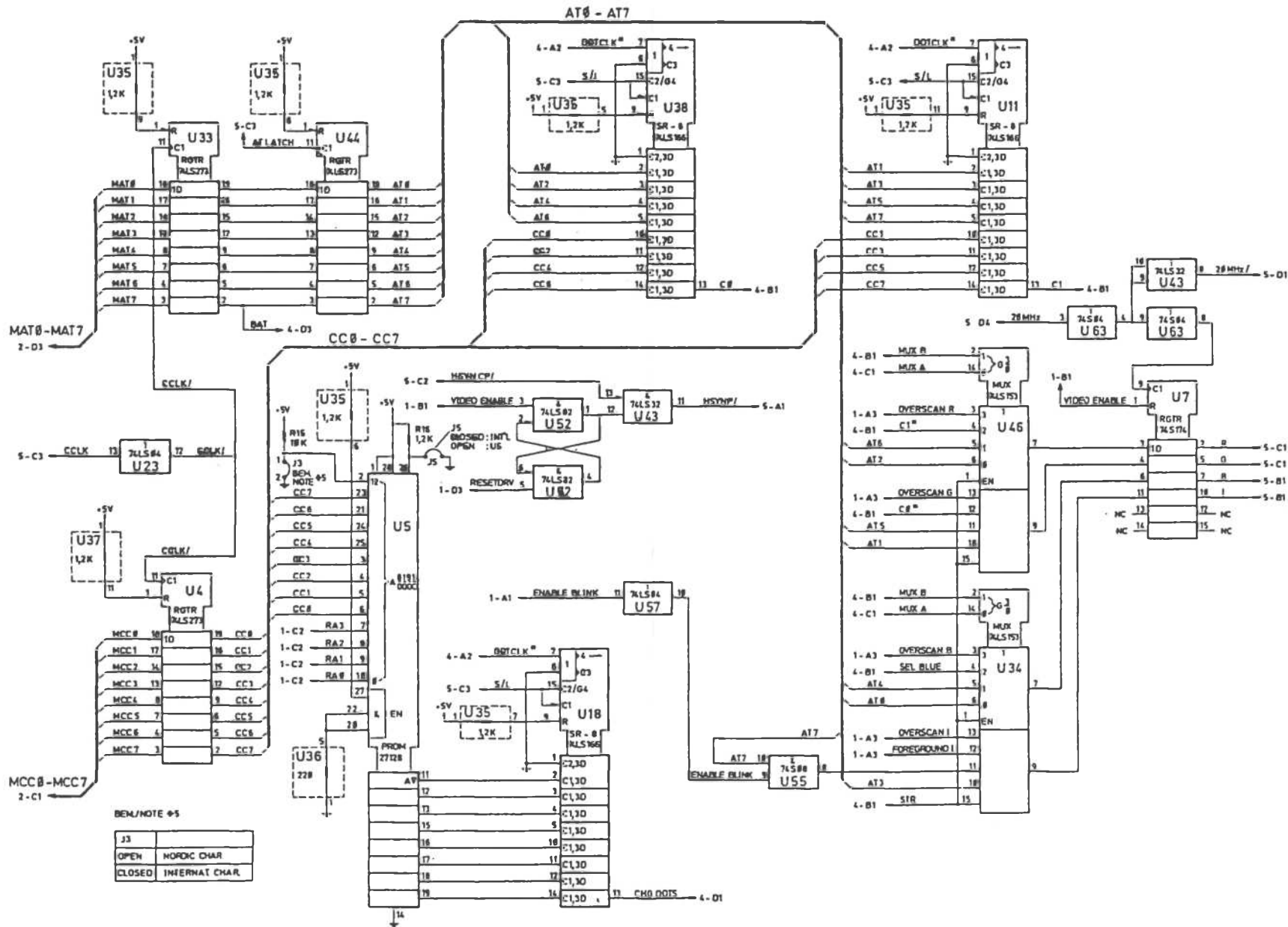
Graphics Controller Board (1 of 5)

LAYOUTS AND SCHEMATICS

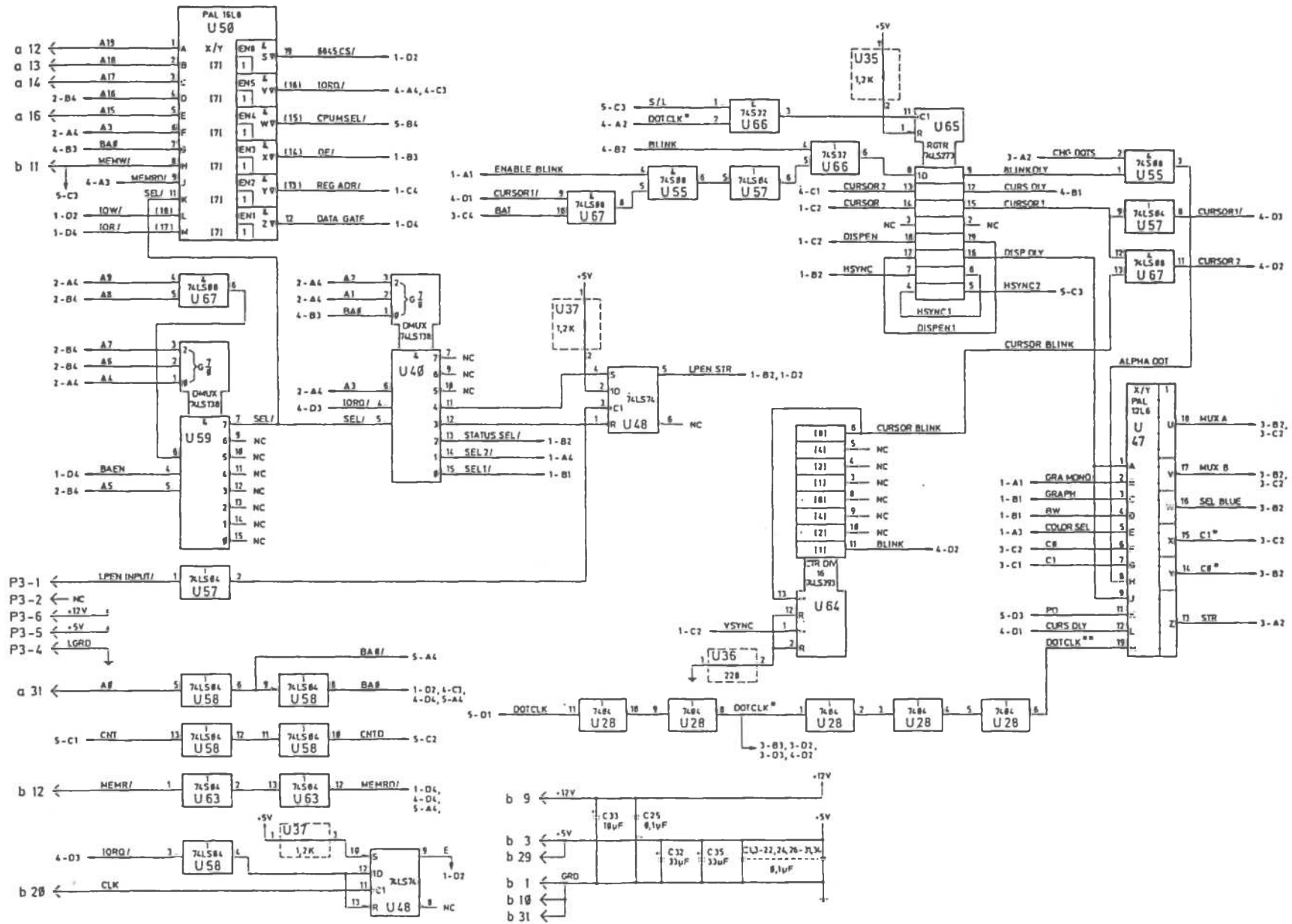


Graphics Controller Board (2 of 5)

LAYOUTS AND SCHEMATICS



LAYOUTS AND SCHEMATICS

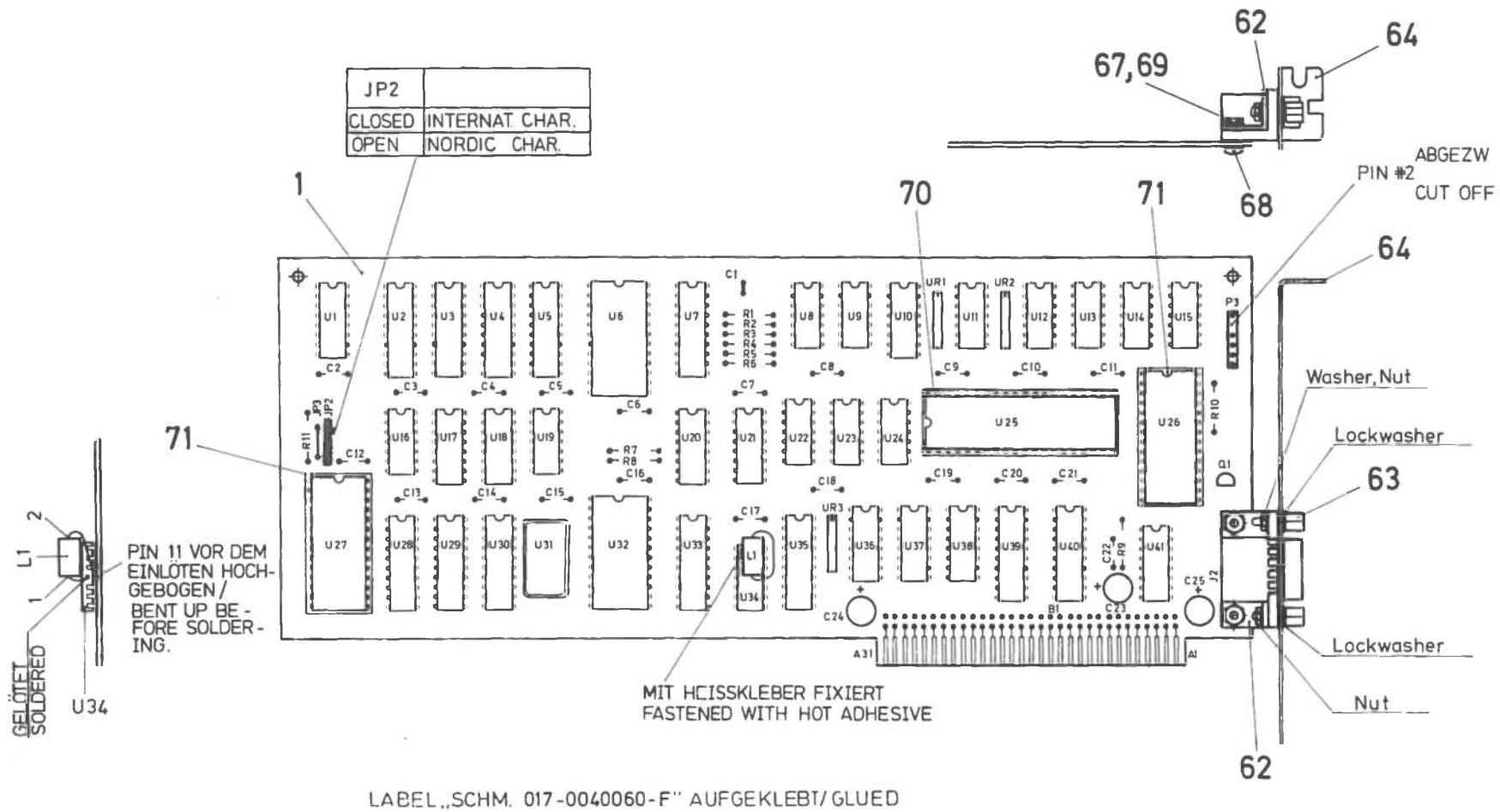


Graphics Controller Board (4 of 5)



LAYOUTS AND SCHEMATICS

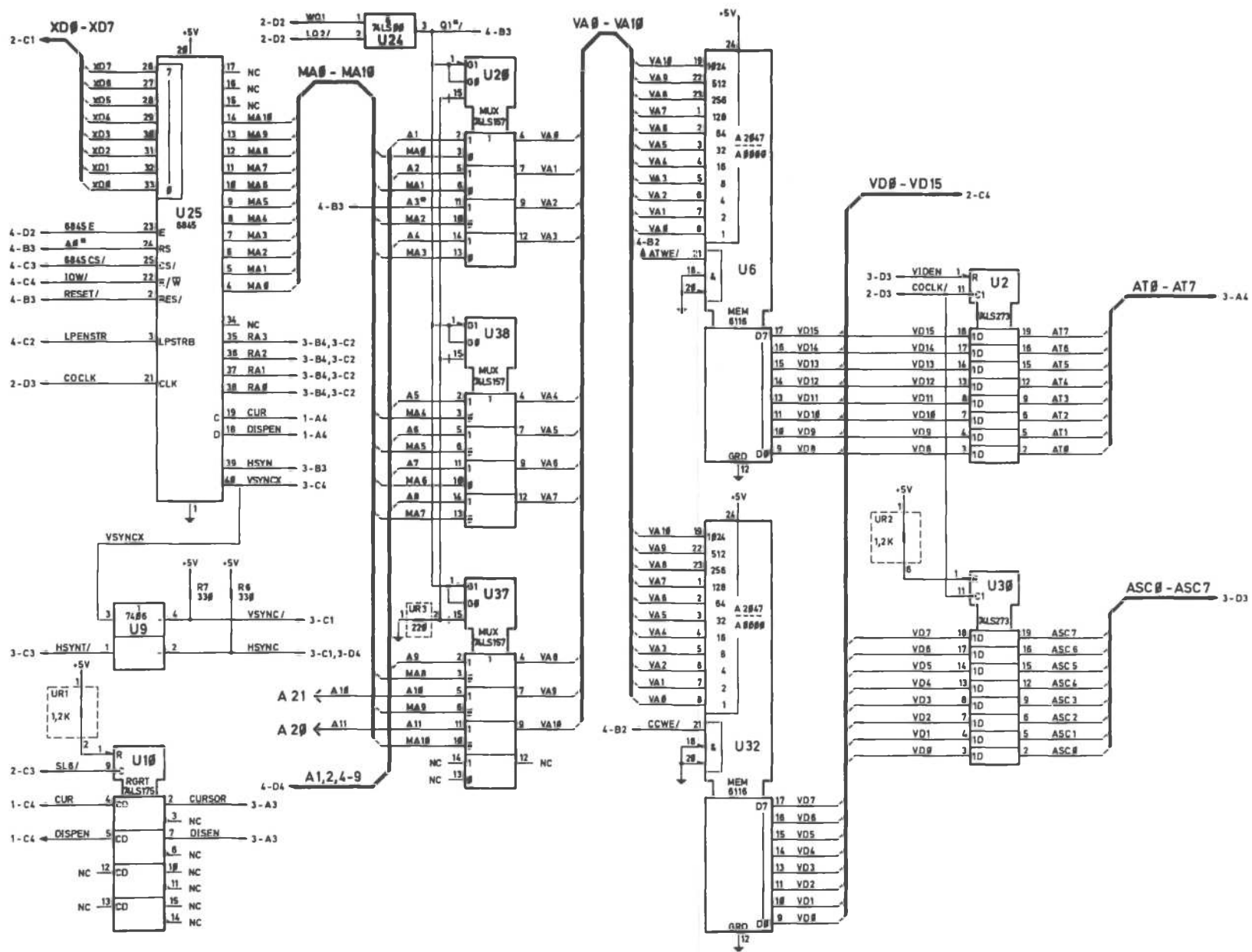
Alpha Controller Board



- \* 3 ITEM 77 GLUED ON SOLDERSIDE
- \* 2 NICHT BESTÜCKT : C1, JP1, JP3, P2  
NOT MOUNTED : C1, JP1, JP3, P2
- \* 1 SCHEMATIC NO.: 017-0040060 -F

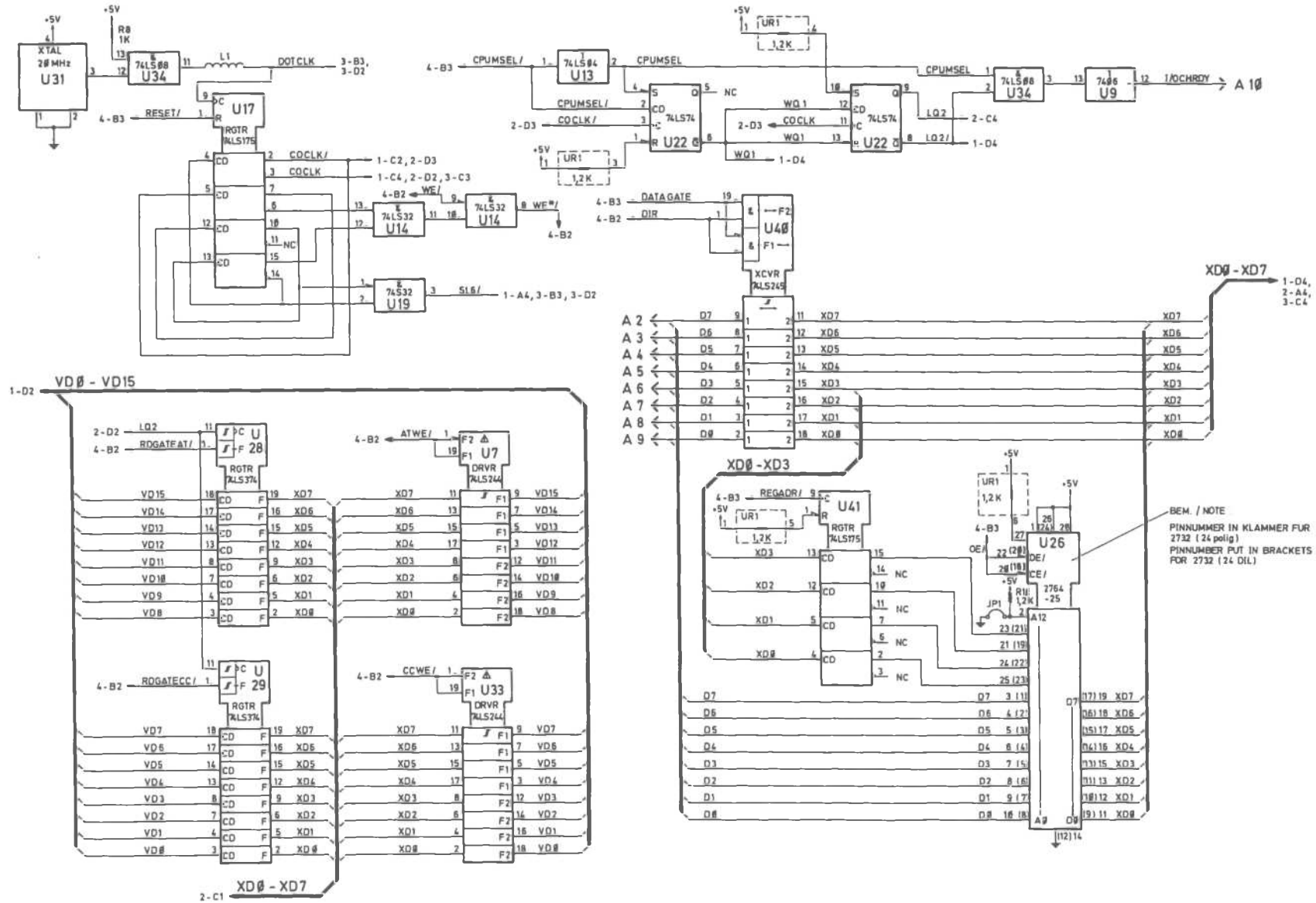


LAYOUTS AND SCHEMATICS



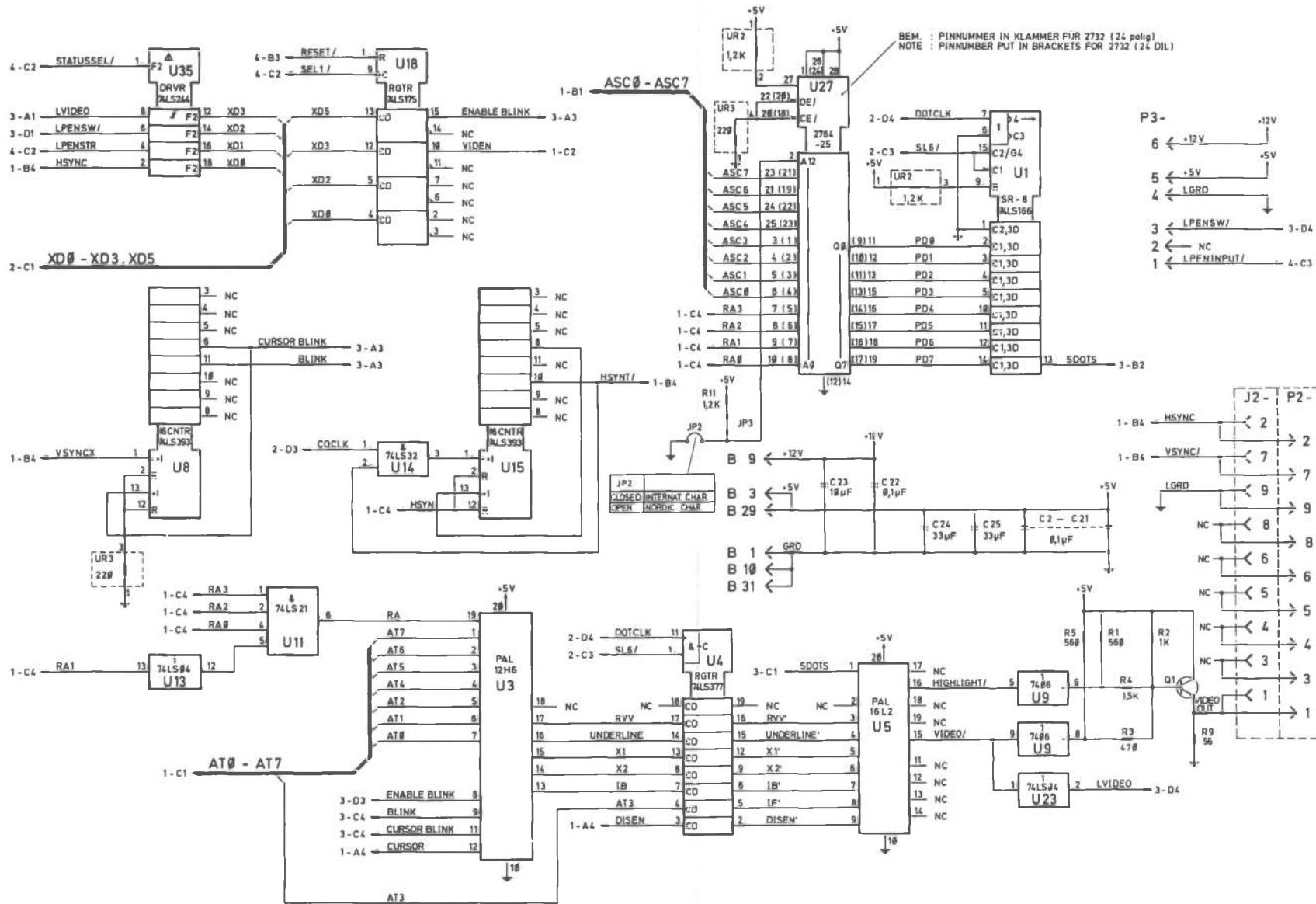
Alpha Controller Board (1 of 4)

LAYOUTS AND SCHEMATICS



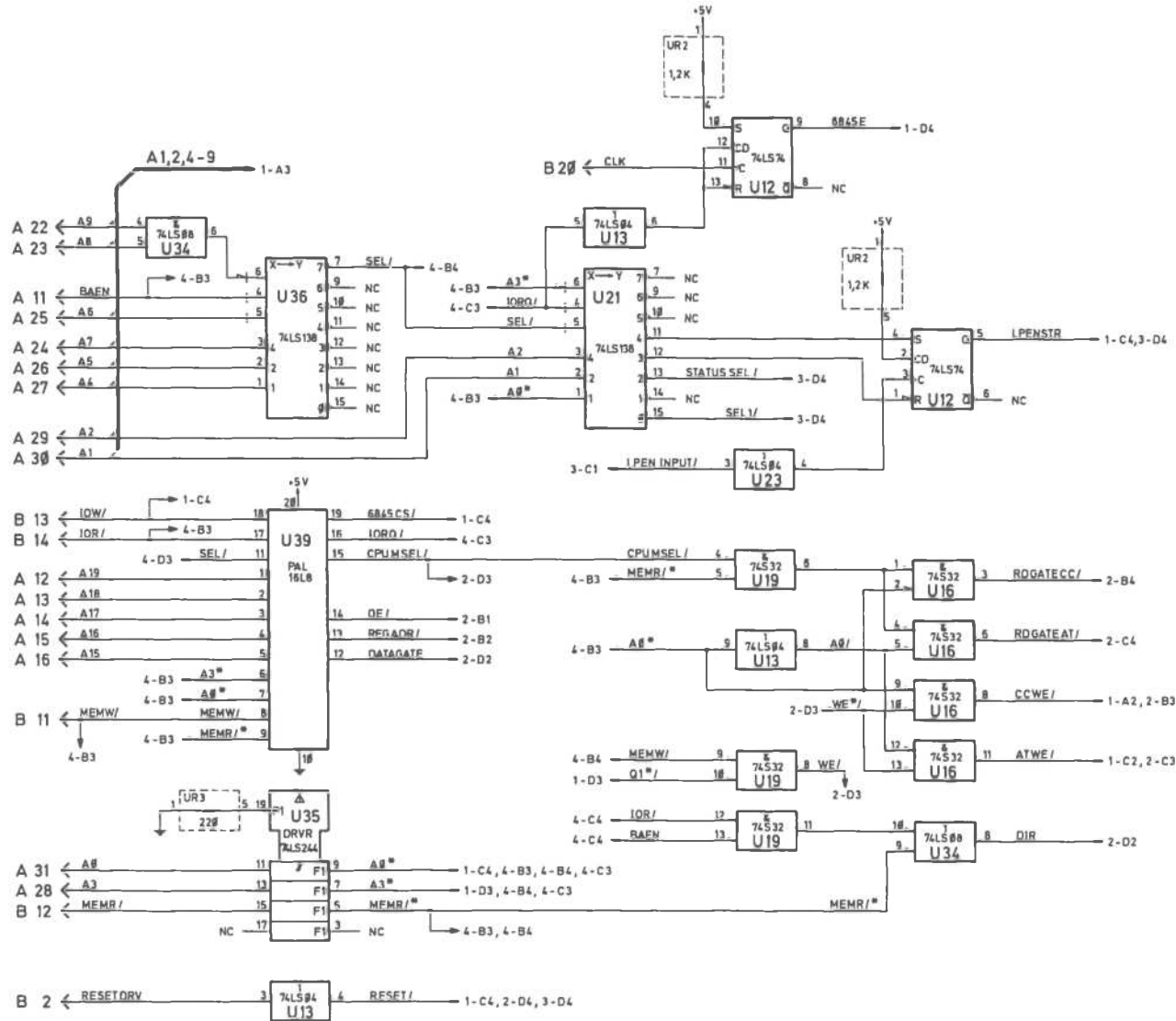
Alpha Controller Board (2 of 4)

# LAYOUTS AND SCHEMATICS



Alpha Controller Board (3 of 4)

LAYOUTS AND SCHEMATICS

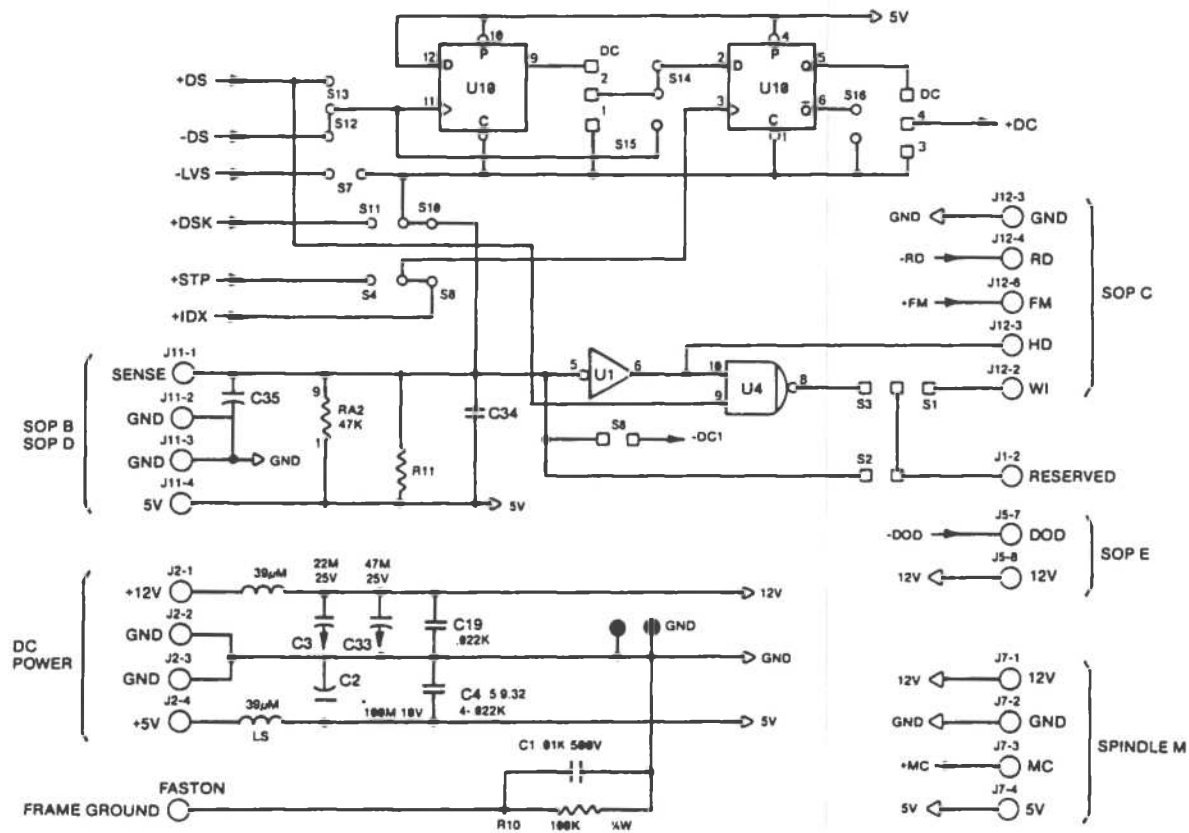


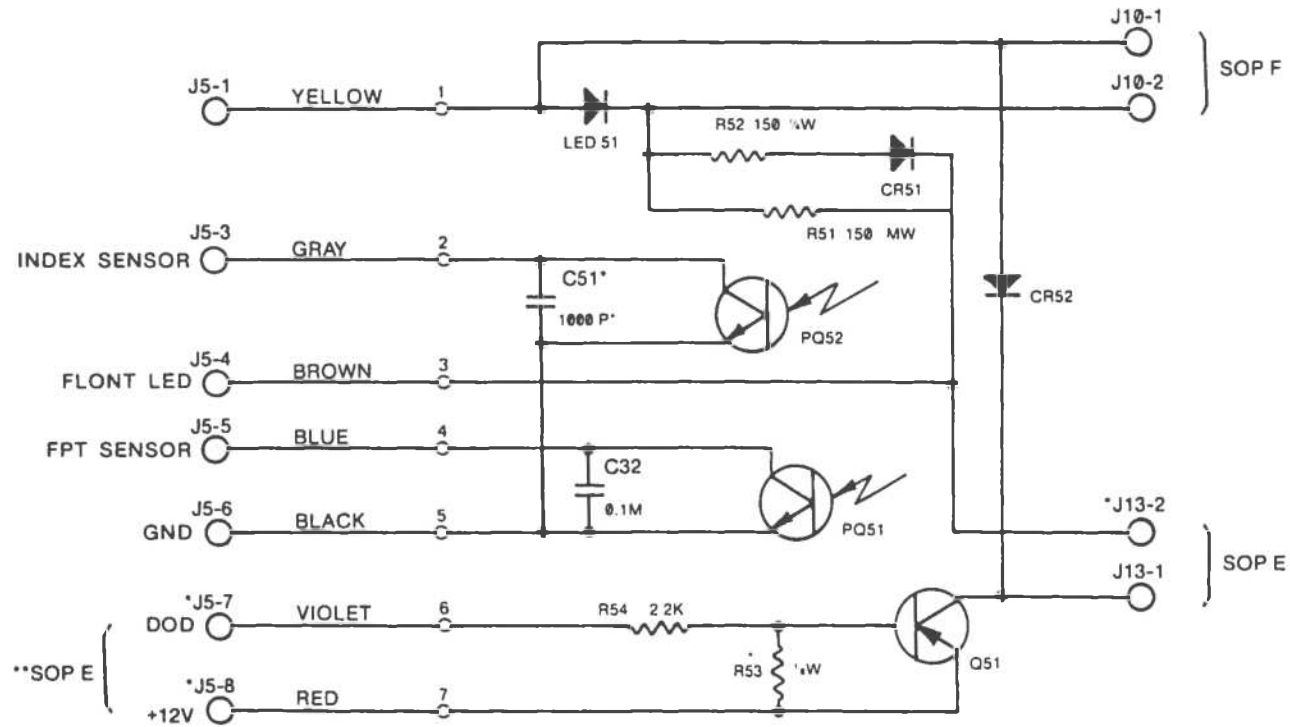
♦ 2 ALLE WIDERSTANDSWERTE SIND IN OHM  
ALL RESISTANCE VALUES ARE IN OHM

♦ 1 ASSY-NO.: 017-0040424 - E

LAYOUTS AND SCHEMATICS

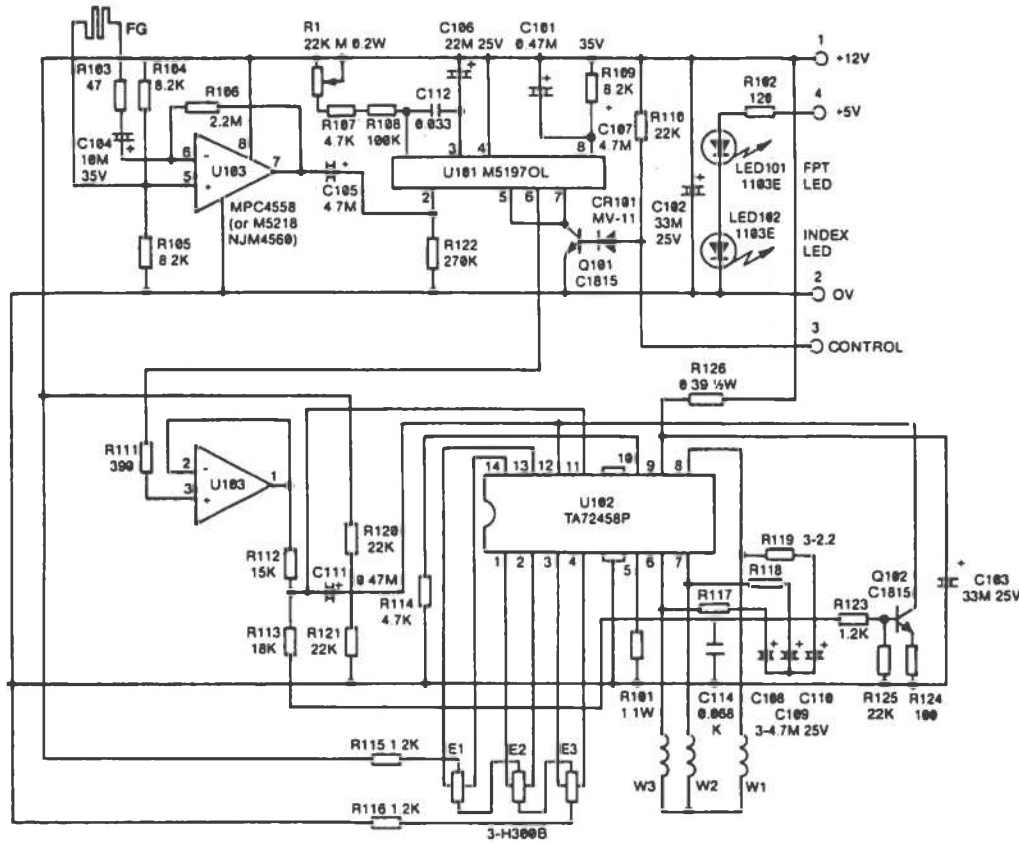
Flexible Disk Drive

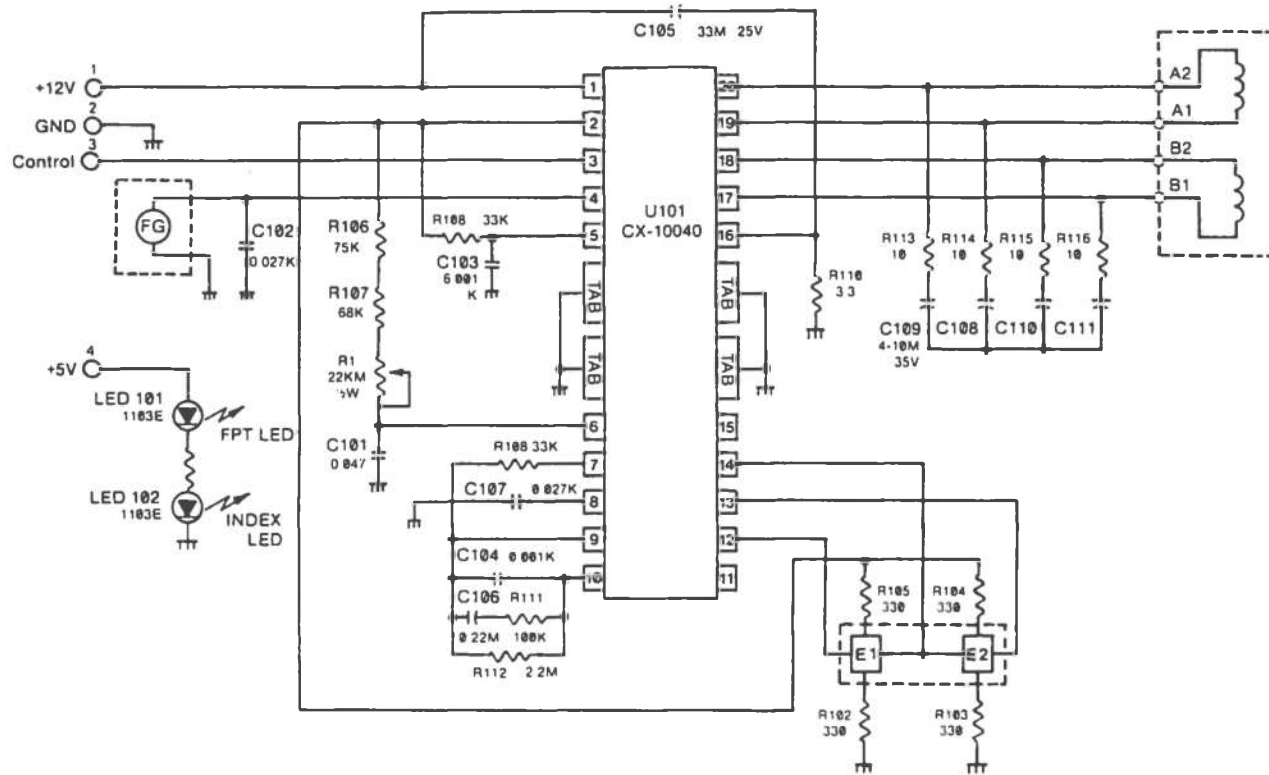




Flexible Disk Drive (2 of 8)

LAYOUTS AND SCHEMATICS

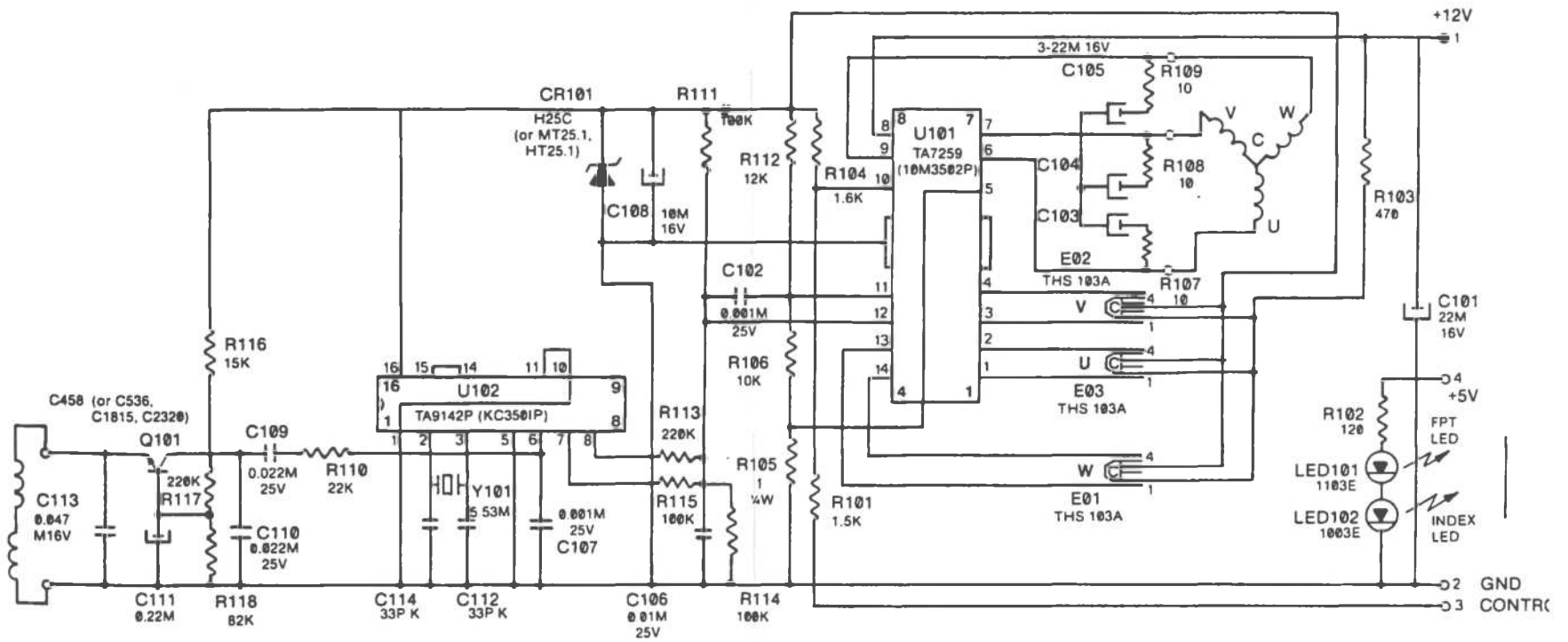


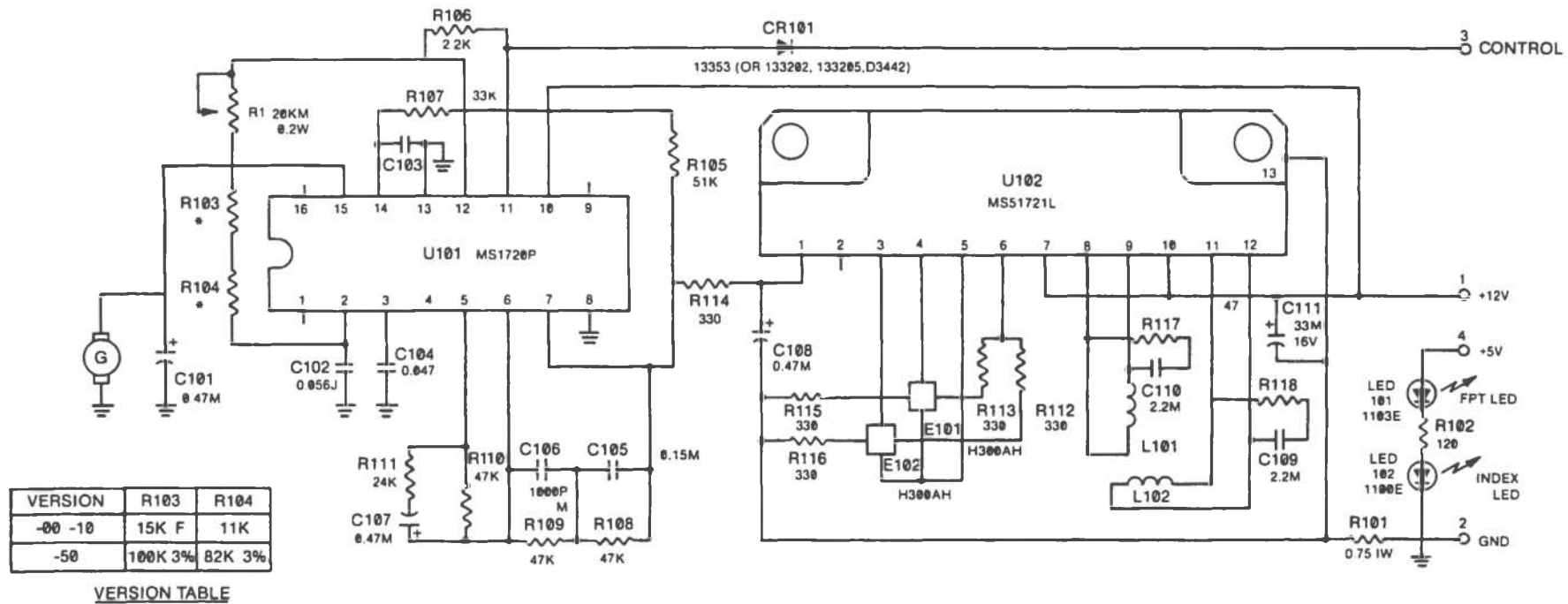


Flexible Disk Drive [ 4 of 8 ]



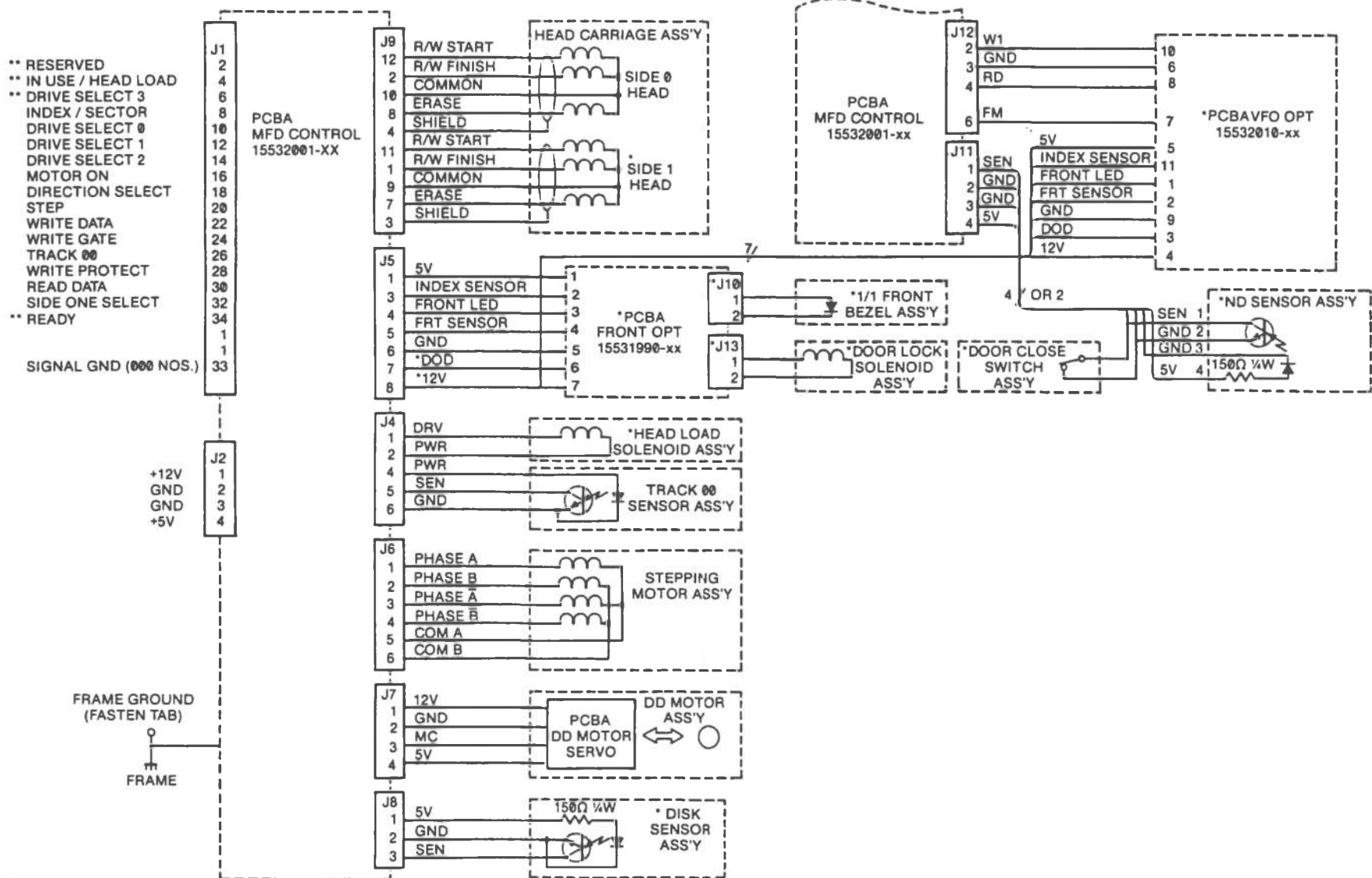
LAYOUTS AND SCHEMATICS

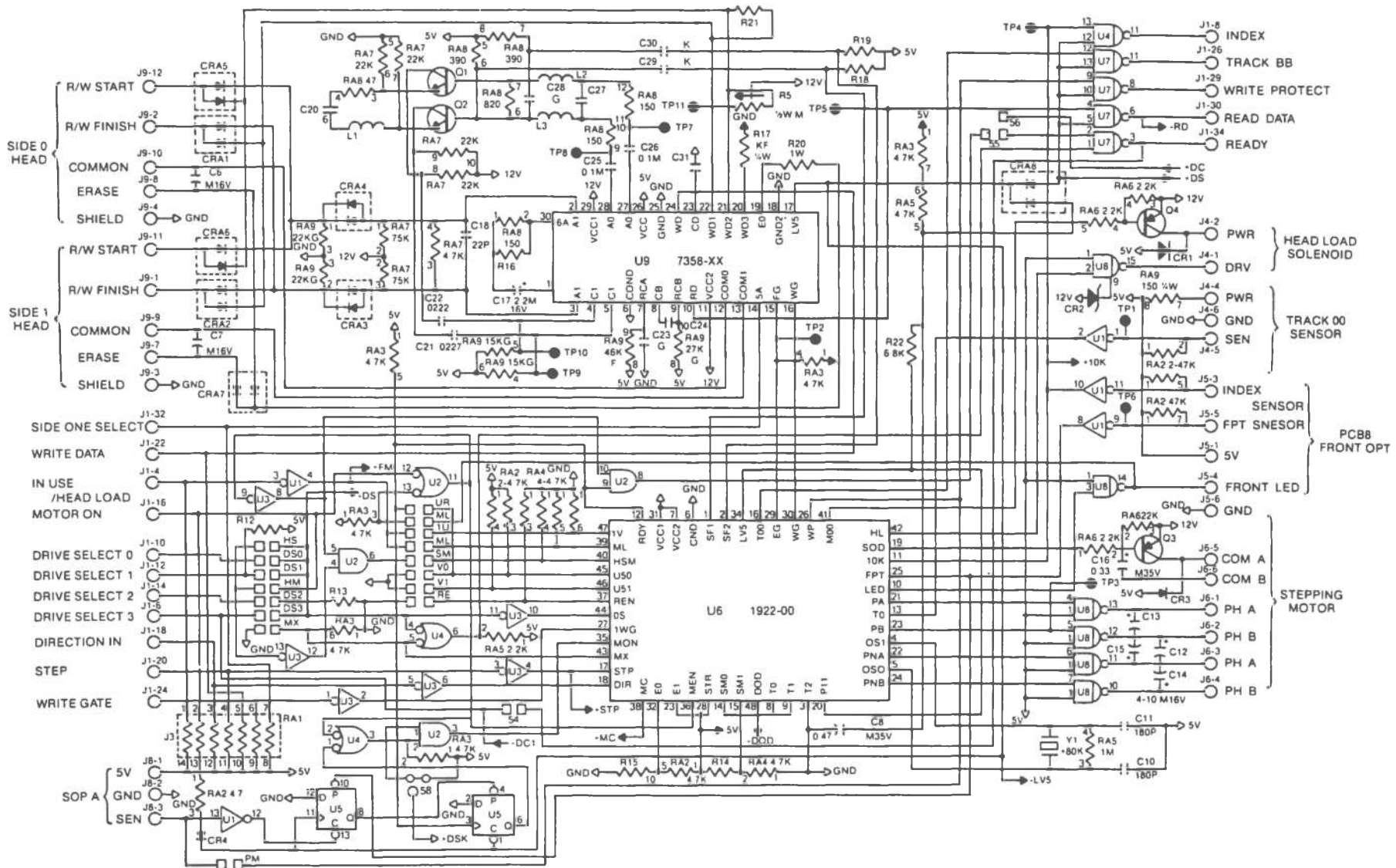




NOTE: RESISTORS ARE 1/4W, UNLESS OTHERWISE SPECIFIED.

LAYOUTS AND SCHEMATICS

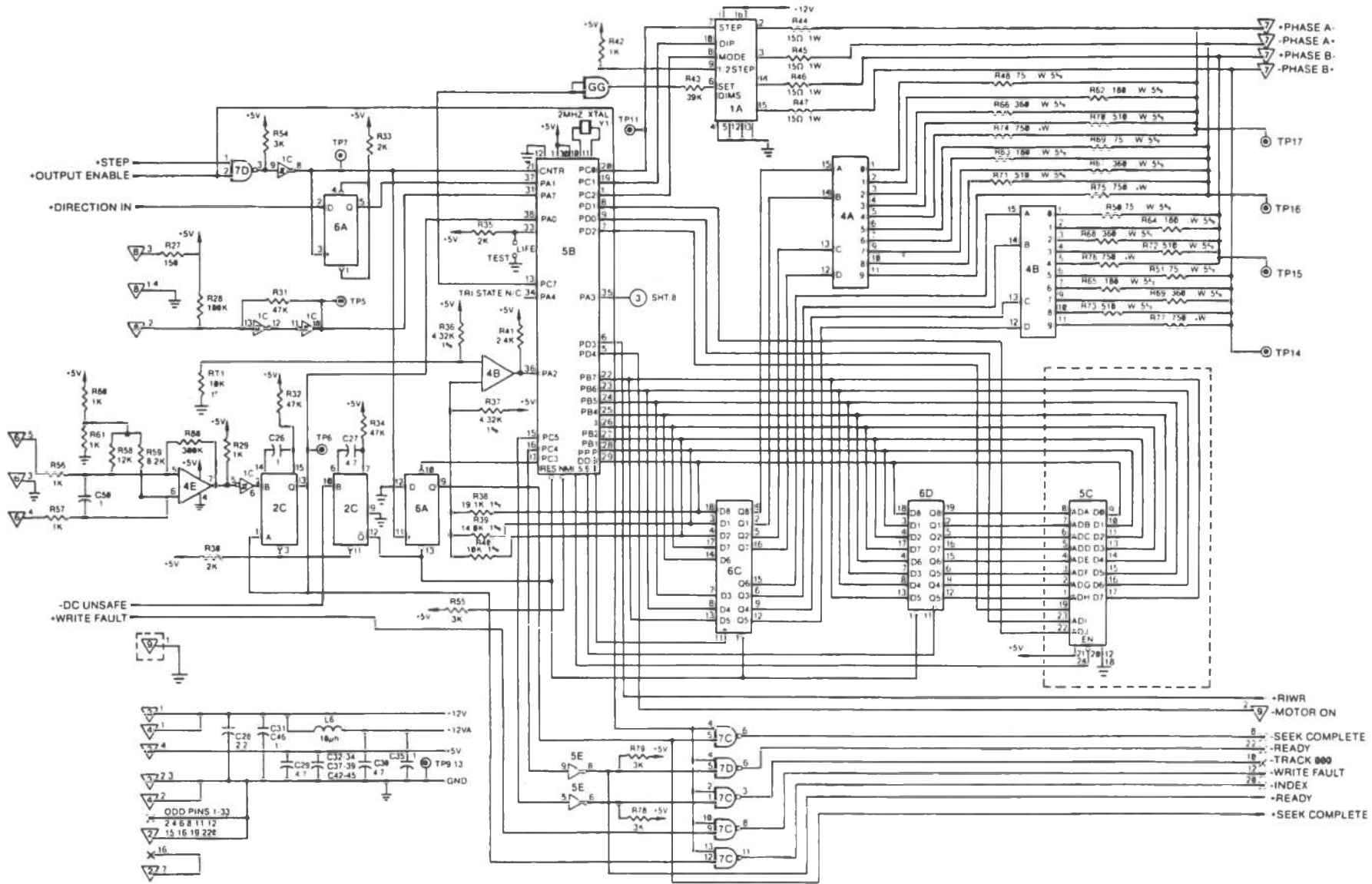




Flexible Disk Drive (8 of 8)

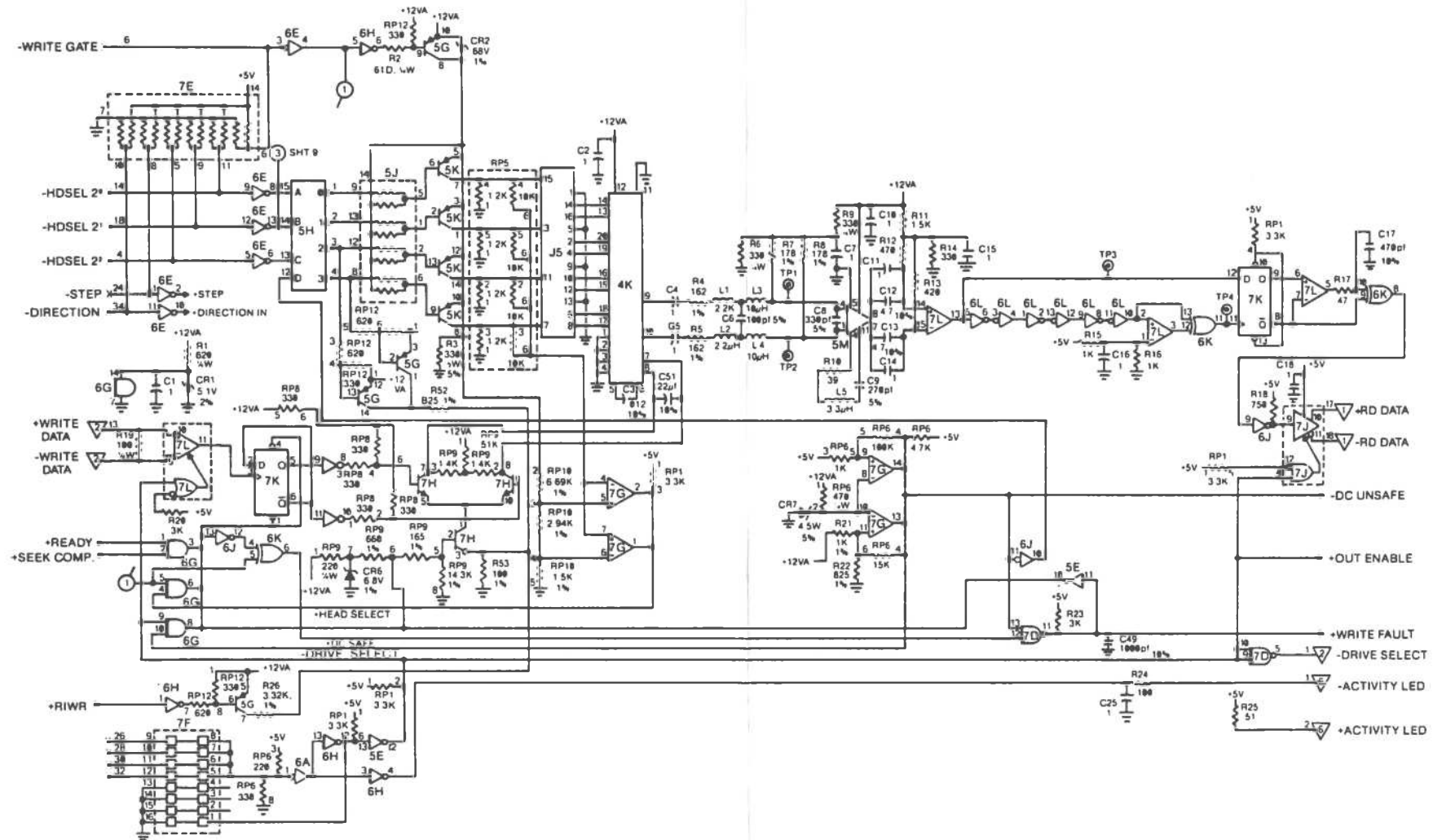


Fixed Disk Drive



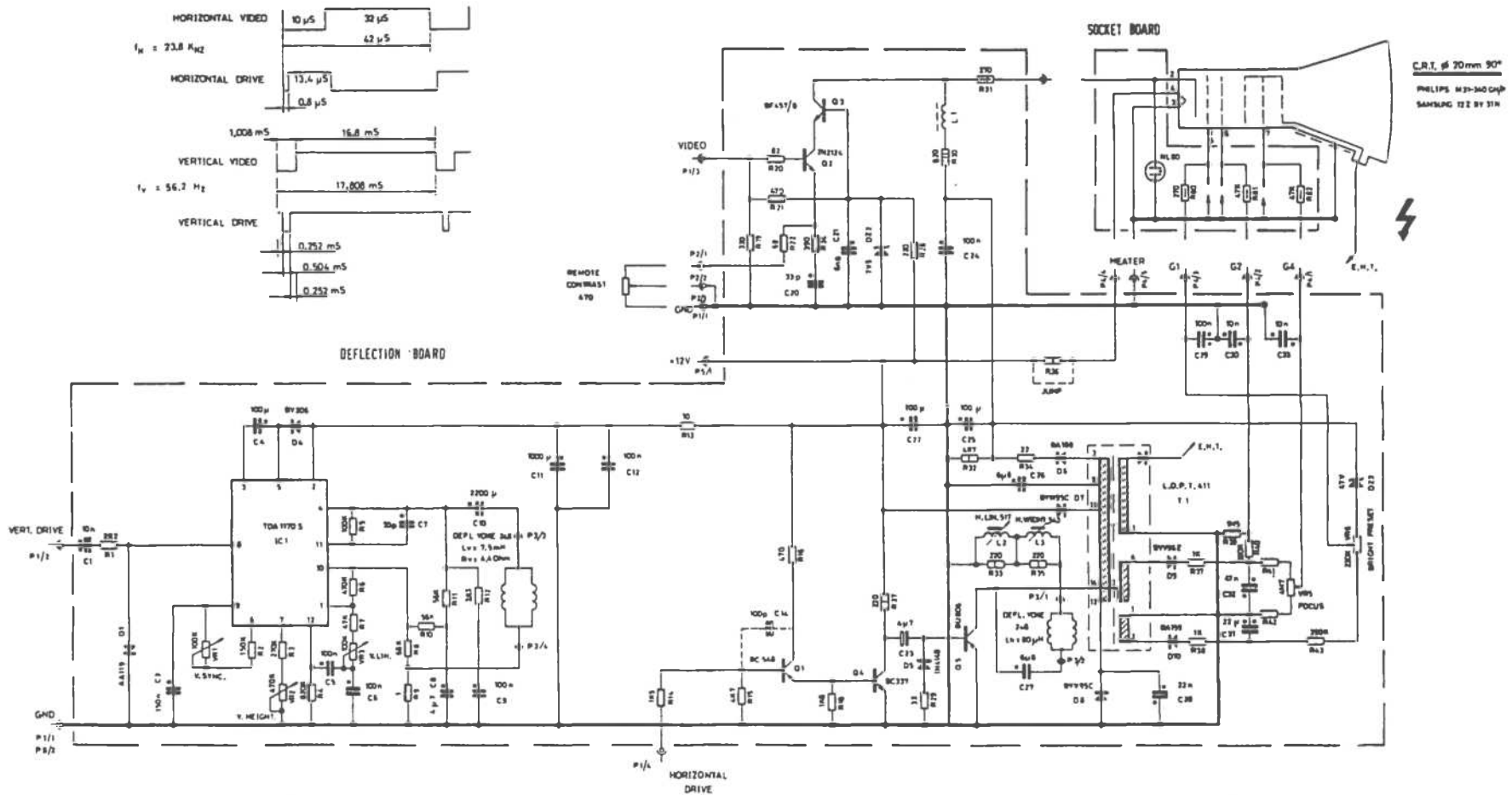
Fixed Disk Drive (1 of 2)

LAYOUTS AND SCHEMATICS



Fixed Disk Drive (2 of 2)

Monochrome CRT



C.R.T. # 20mm 90"  
 PHILIPS M31-360 CxP  
 SAMPLING 12.2 BY 5TH

WOUND COMPONENTS

TYPE	CODE
L.O.P.T.	411
LINEARITY COIL	517
AMPLITUDE COIL	563
DEFLECTION YOKE	248

P.1

- 3 = C
- 4 = HORIZONTAL DRIVE
- 3 = VIDEO INPUT
- 2 = VERT. DRIVE
- 1 = GND

P.2

- 3 = REMOTE CONTR. LG
- 2 = REMOTE CONTR. WP
- 1 = REMOTE CONTR. HI

P.5

- 2 = GND
- 1 = -12V

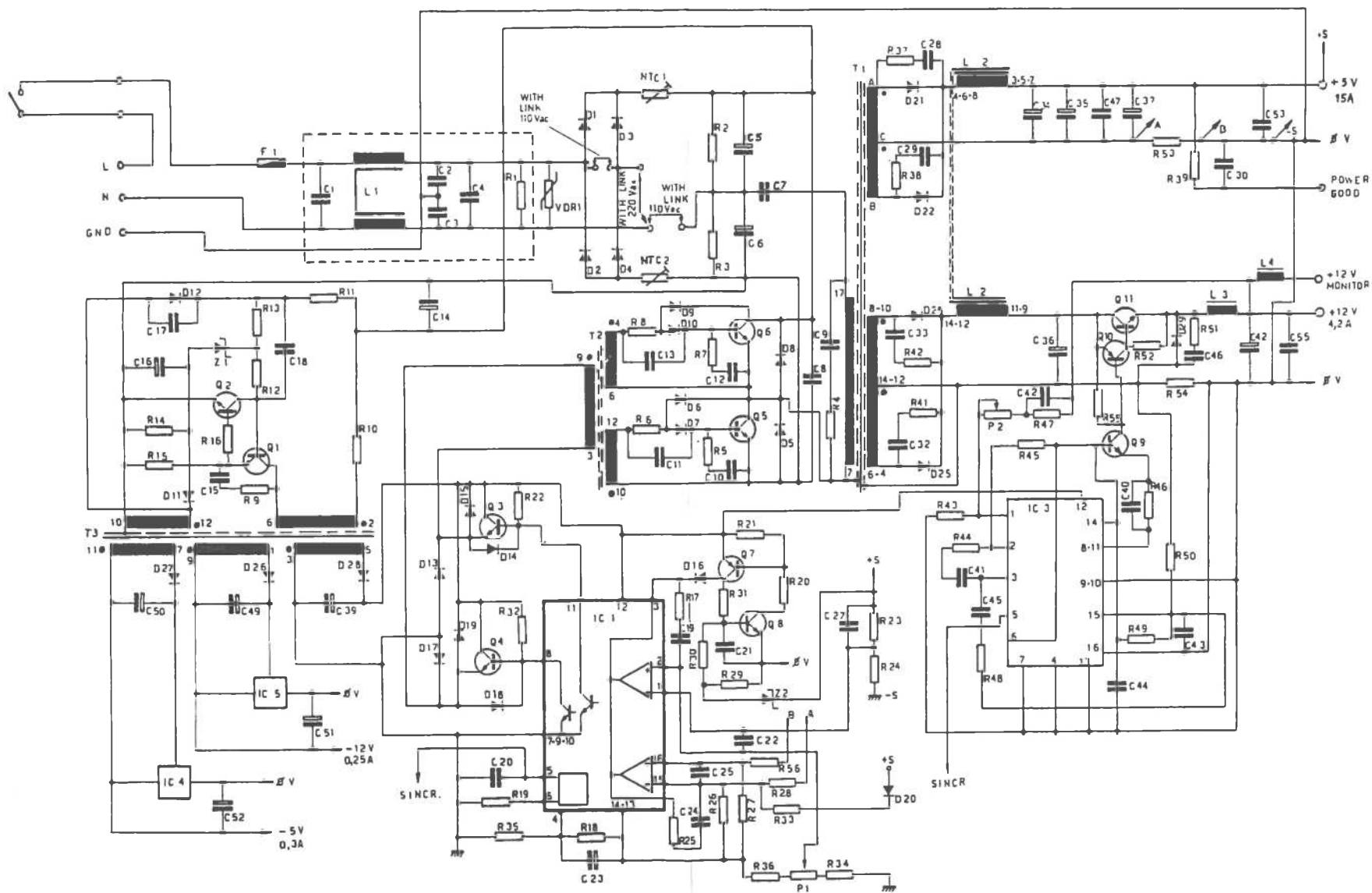
	C.R.T.	
	PHILIPS	SAMPLING
R 36	0	0
R 61	1M5	2M7
R 62	1M 2	100M

VOLTAGE	CAPACITORS				RESISTORS	
	ELECTROLYTIC	POLYESTER	POLYPROP.		WATT	
100 V					1/4	
150 P 750					1	
100-200					3	
1000 V					3	
					4	
					5	

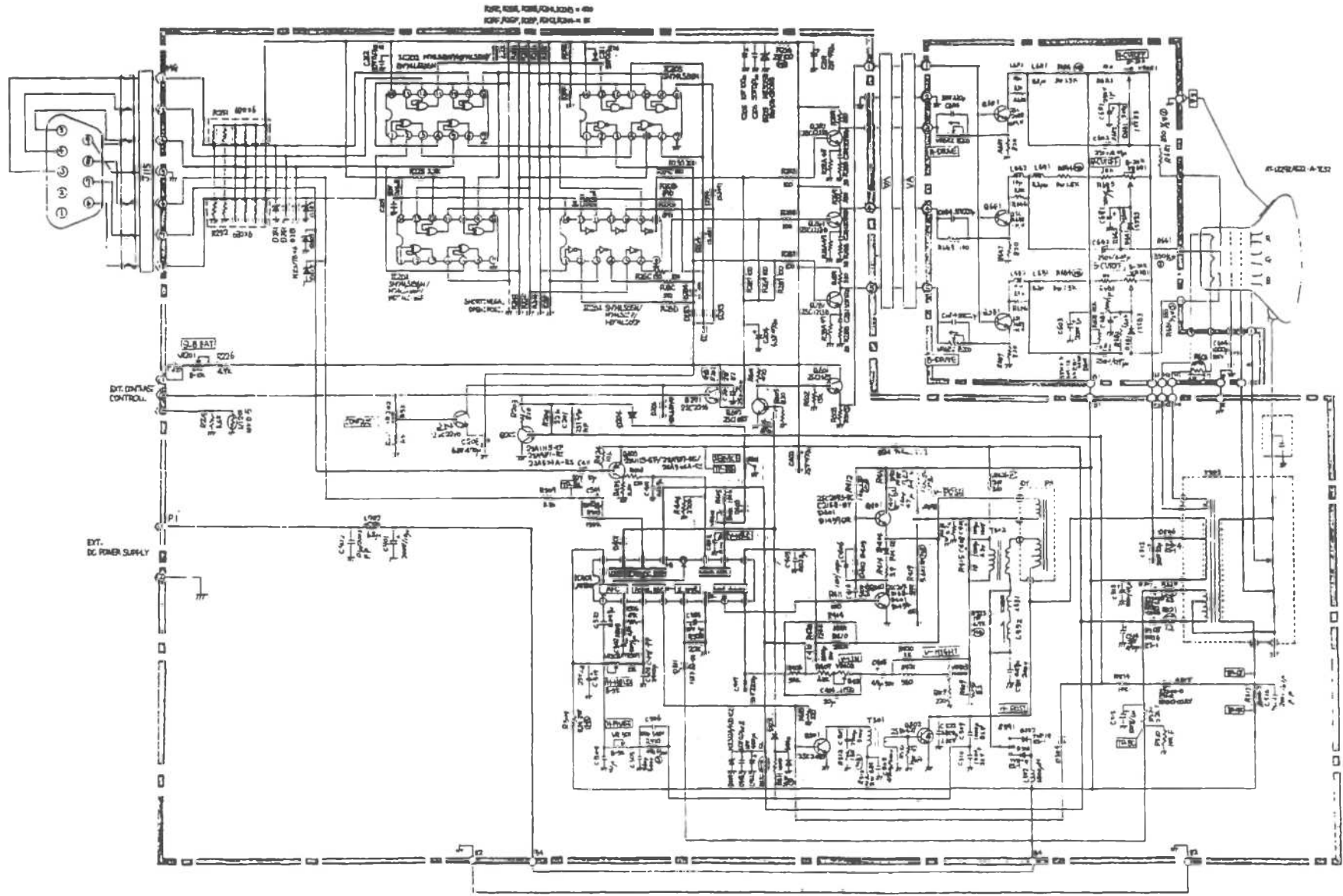


LAYOUTS AND SCHEMATICS

Monochrome Power Supply

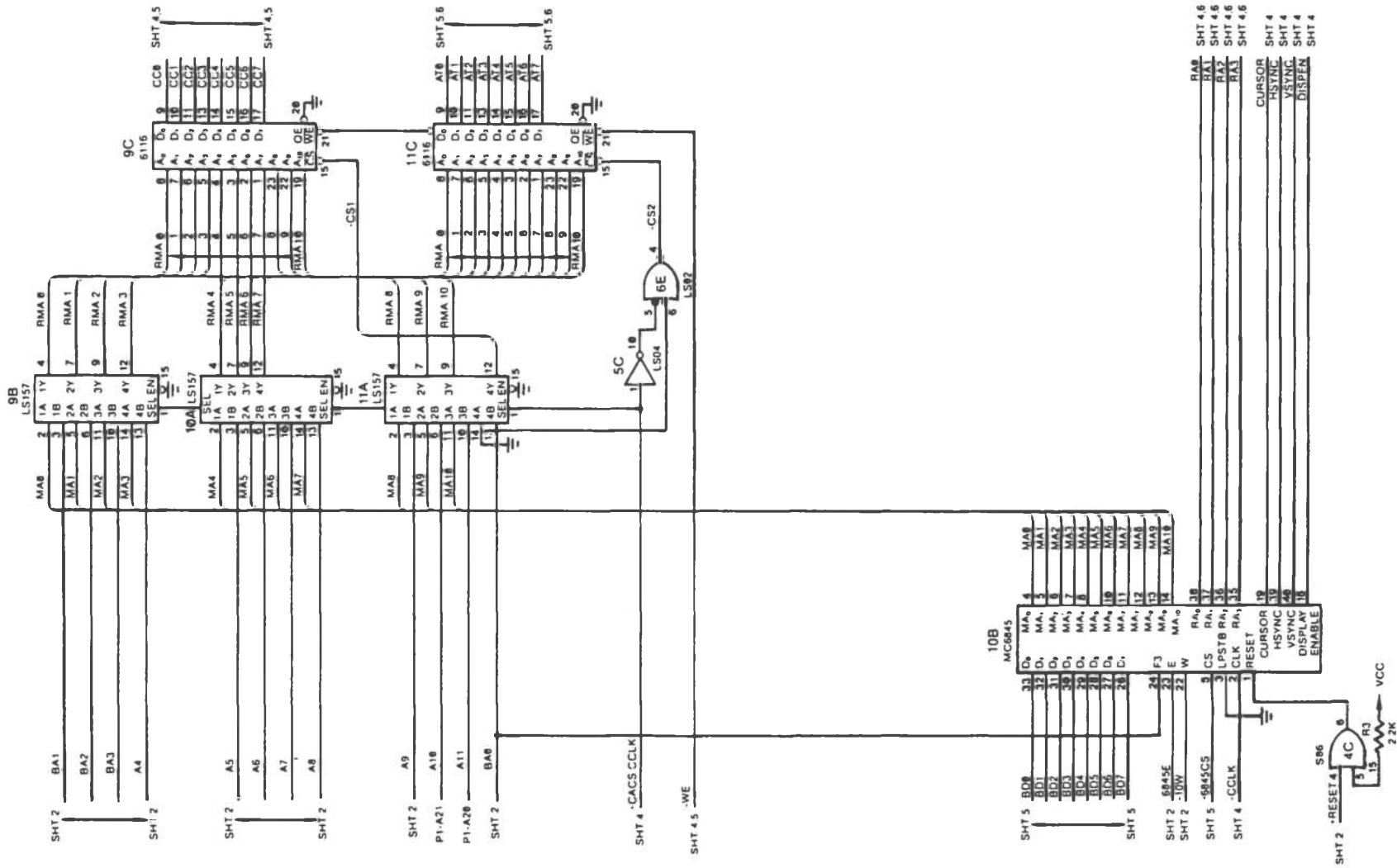


Color CRT



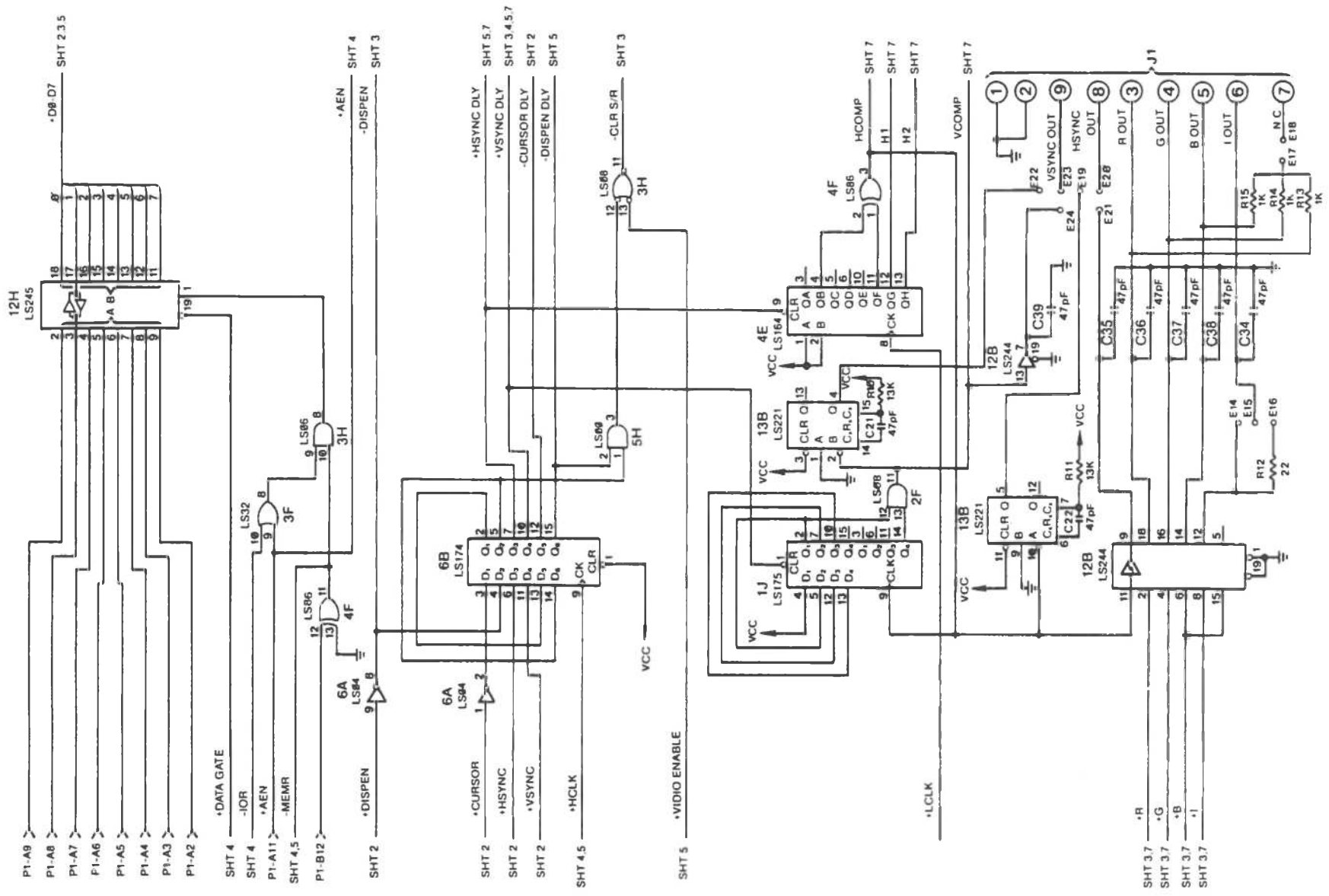


External Monochrome Monitor Controller



CRT CONTROLLER CHARACTER SET





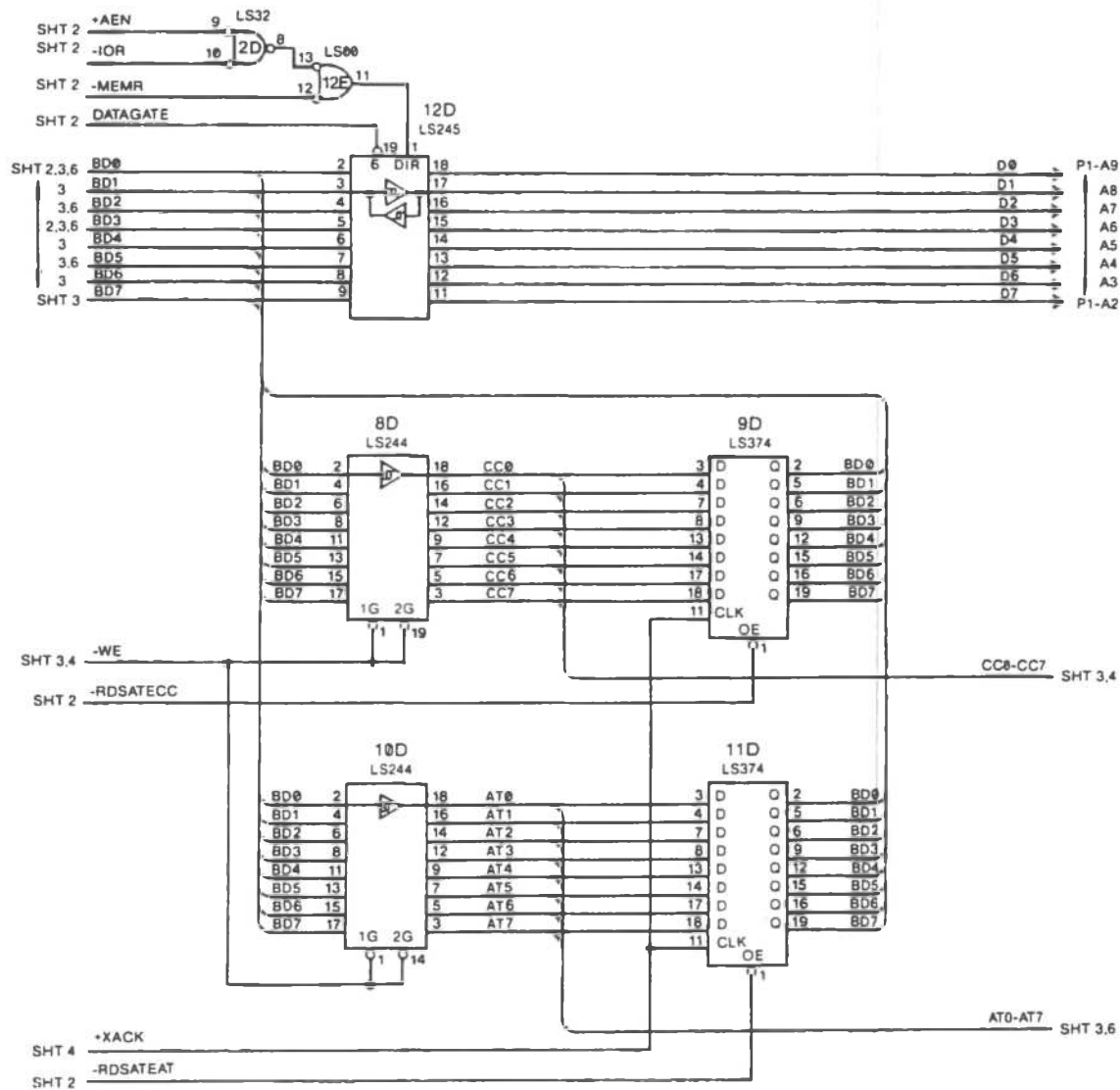
External Monochrome Monitor Controller (3 of 4)







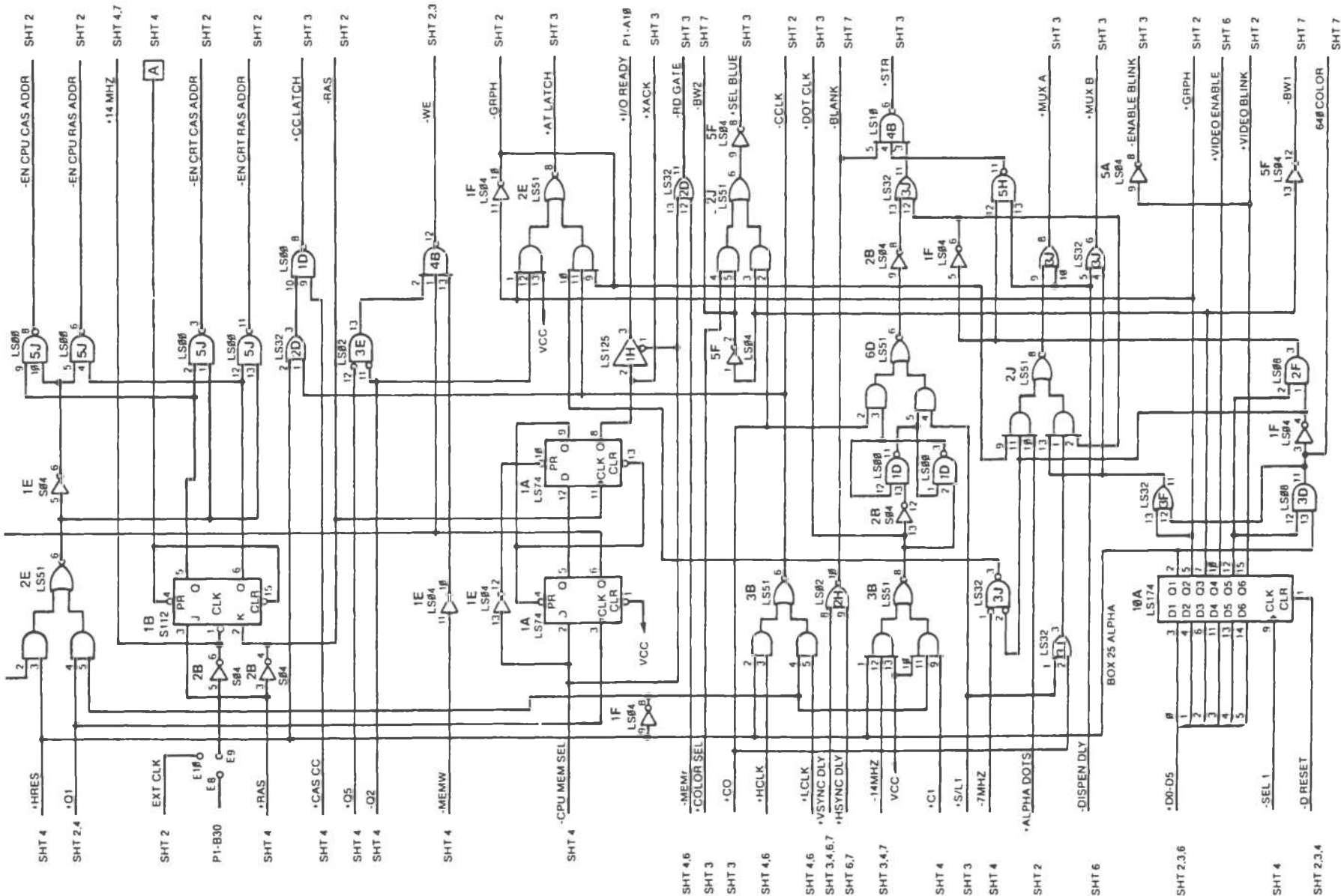
LAYOUTS AND SCHEMATICS



External Color Monitor Controller (2 of 6)

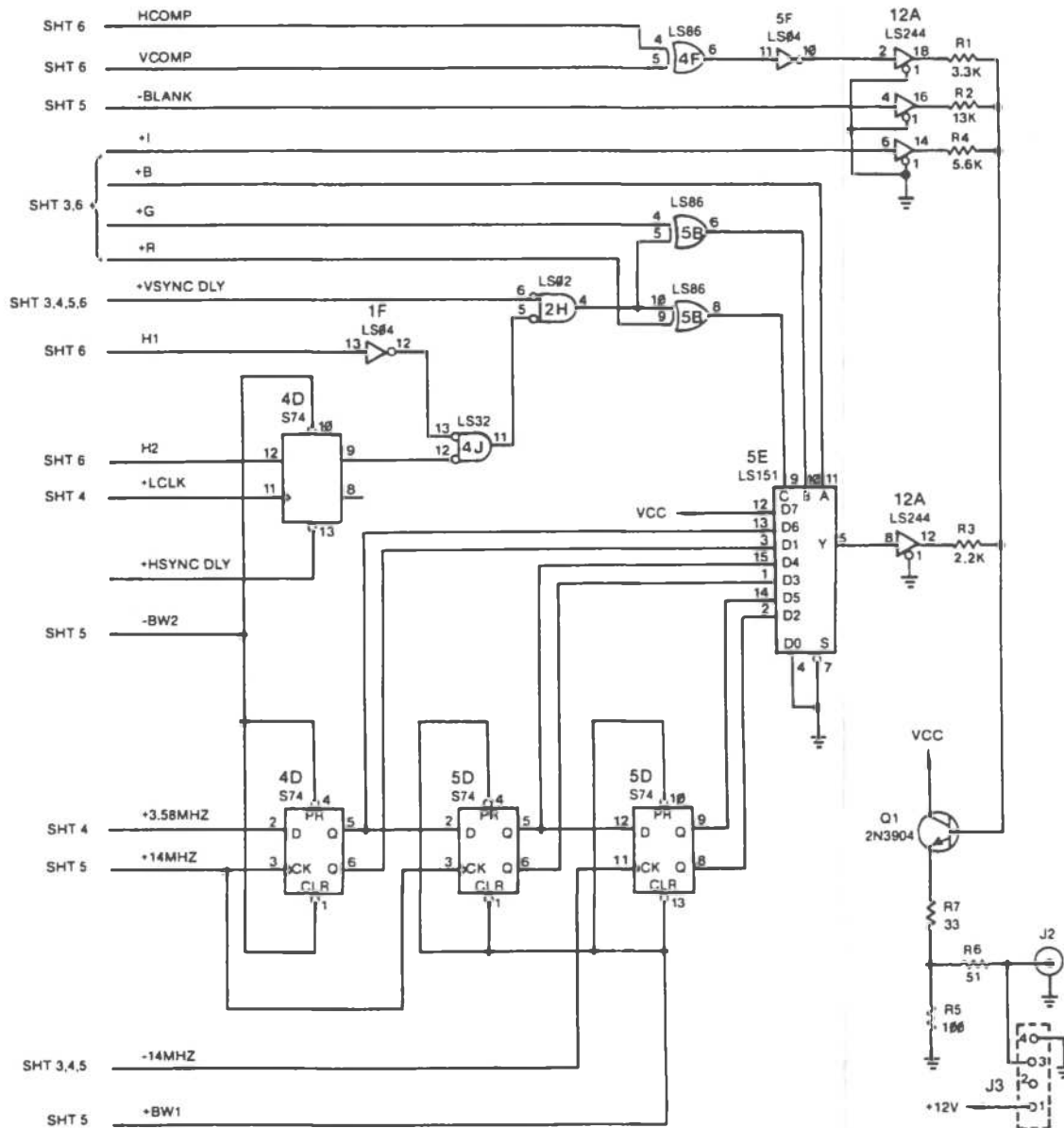






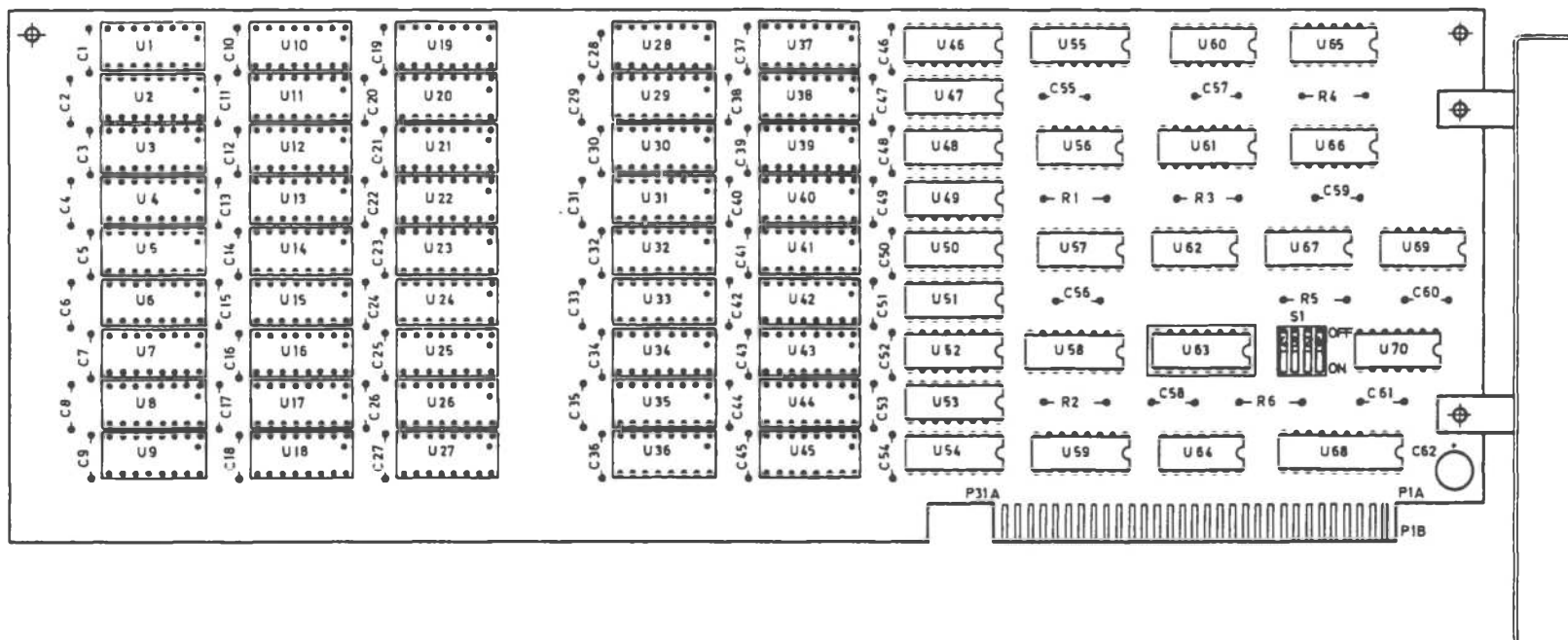
External Color Monitor Controller (5 of 6)

LAYOUTS AND SCHEMATICS

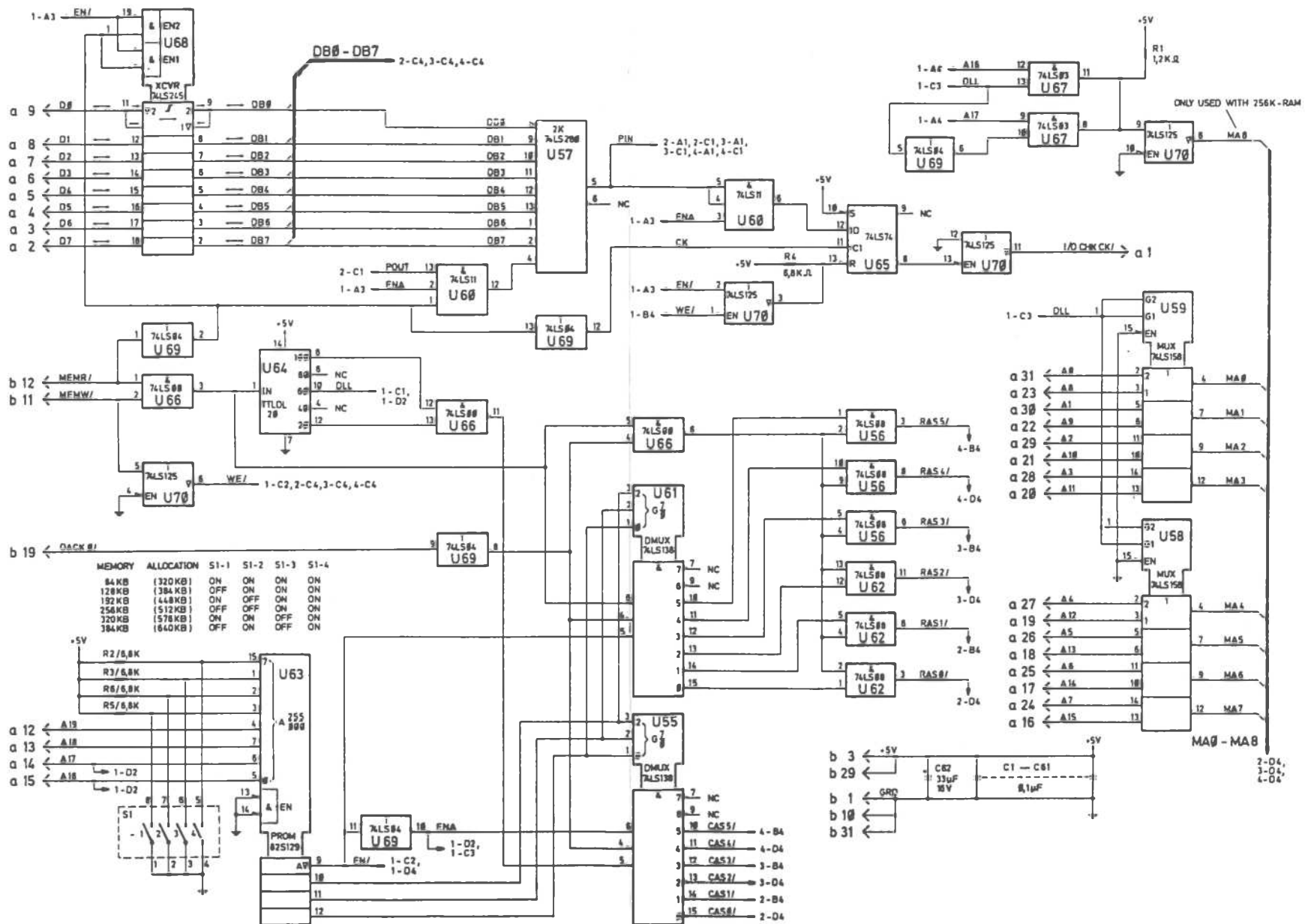


External Color Monitor Controller (6 of 6)

Memory Expansion Board

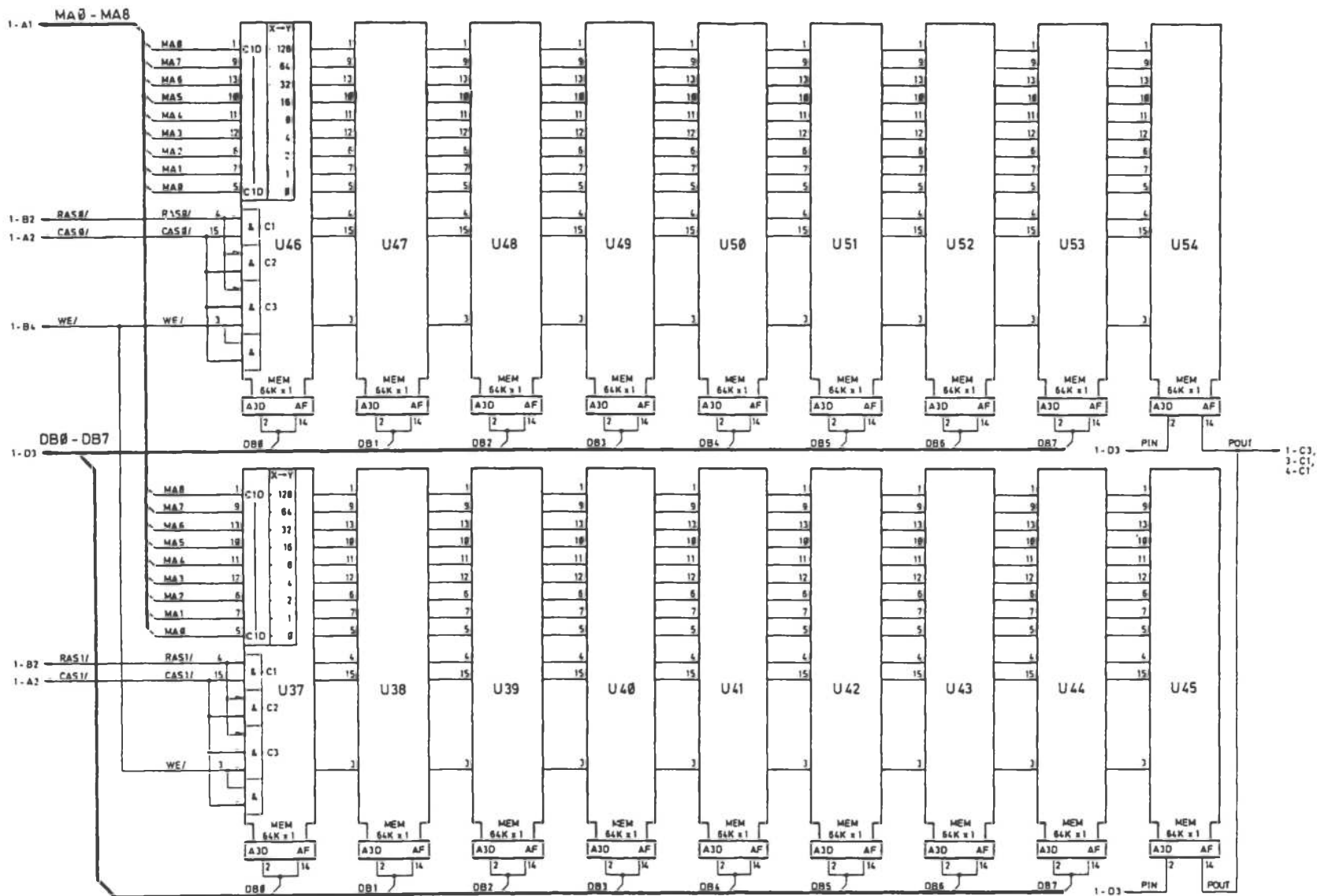


LAYOUTS AND SCHEMATICS



Memory Expansion Board <1 of 4>

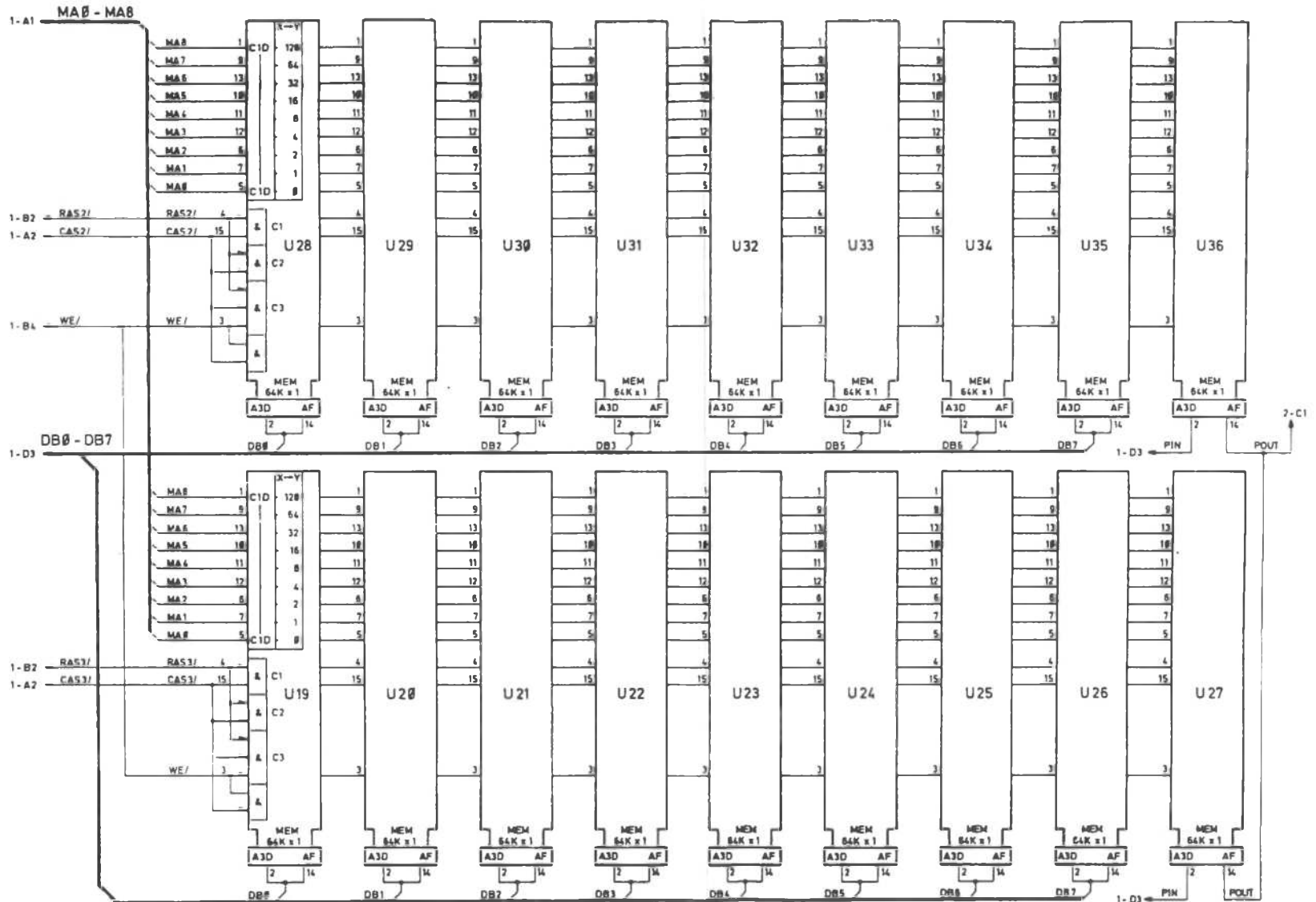
LAYOUTS AND SCHEMATICS



Memory Expansion Board (2 of 4)

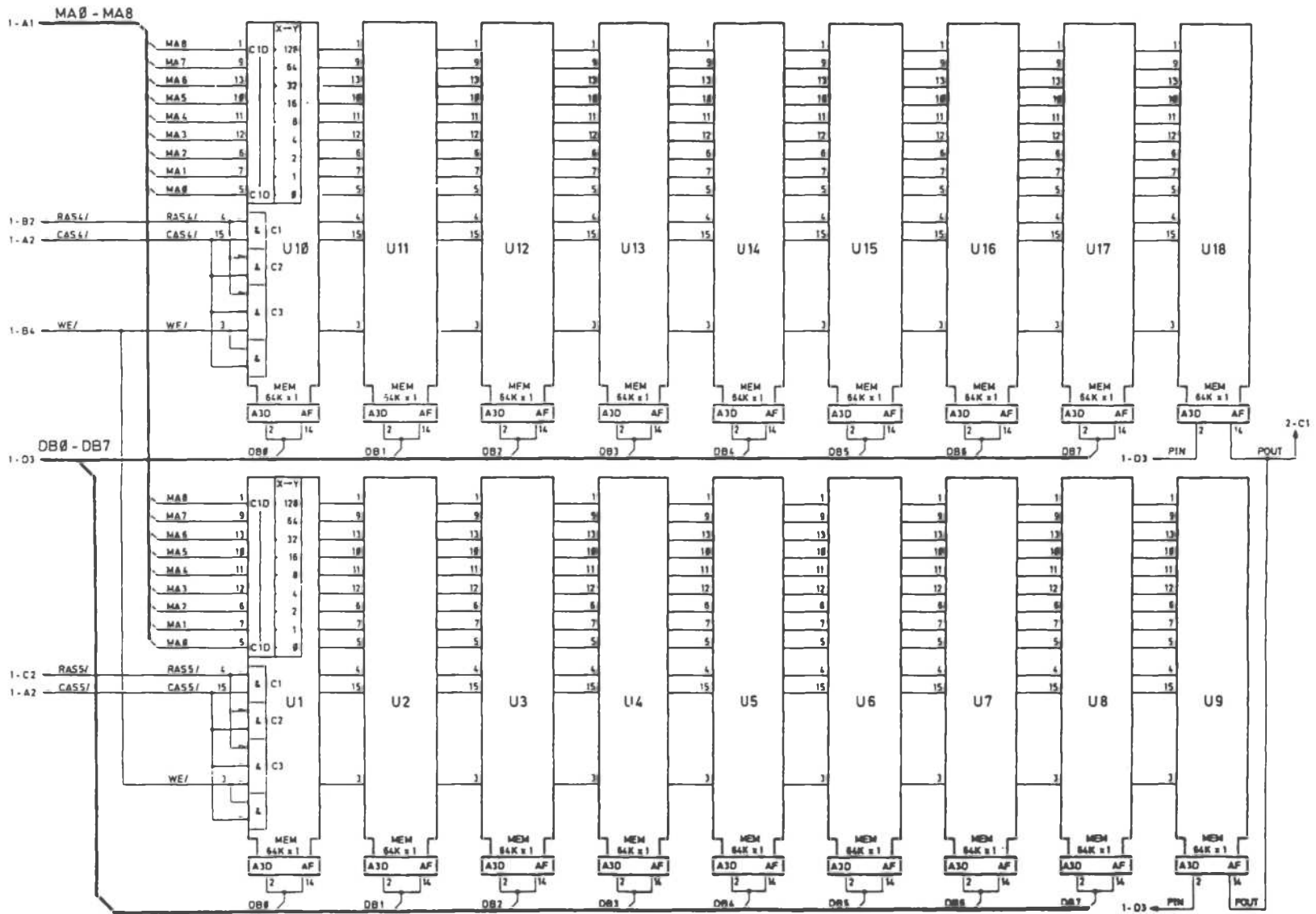


LAYOUTS AND SCHEMATICS



Memory Expansion Board (3 of 4)

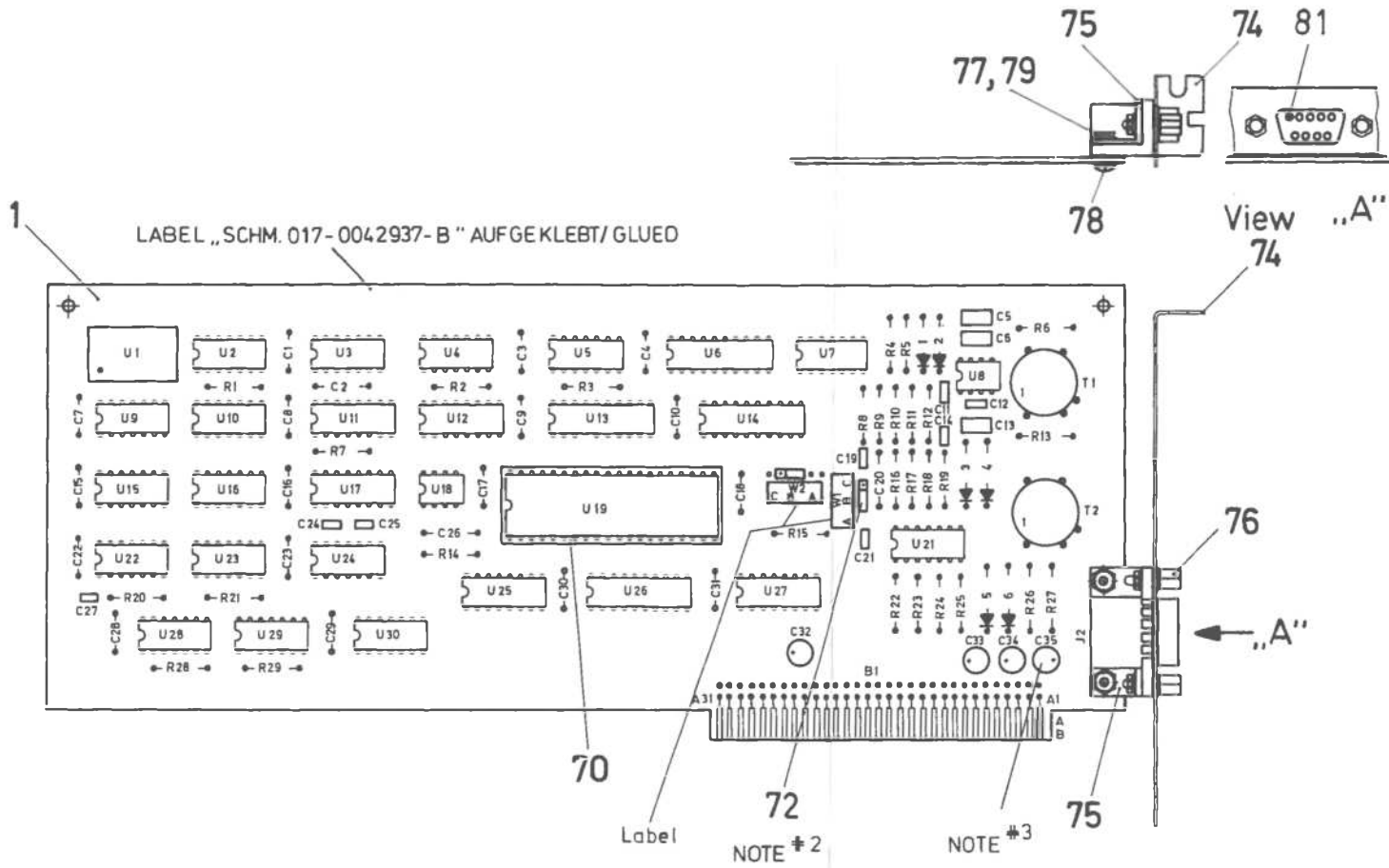
LAYOUTS AND SCHEMATICS



Memory Expansion Board (4 of 4)

LAYOUTS AND SCHEMATICS

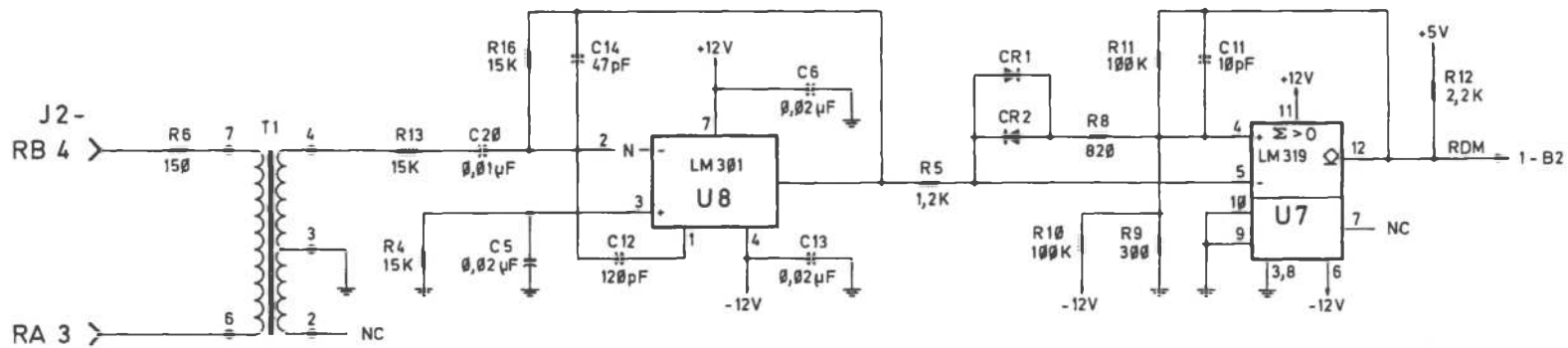
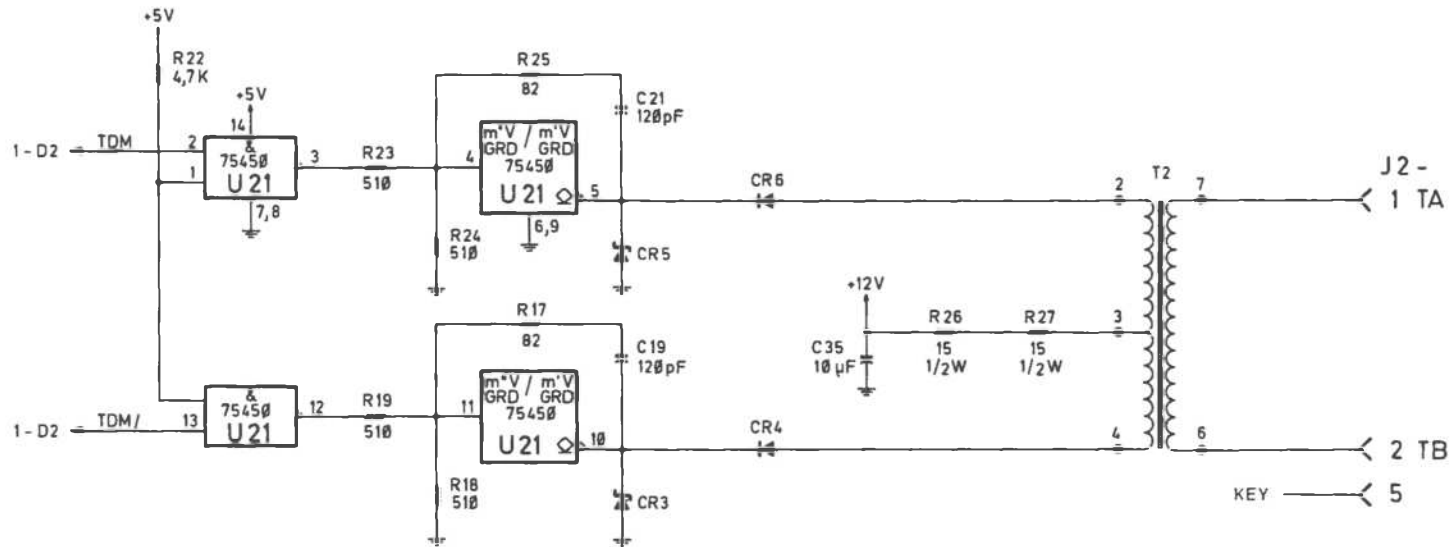
DLC Inhouse I/F Board







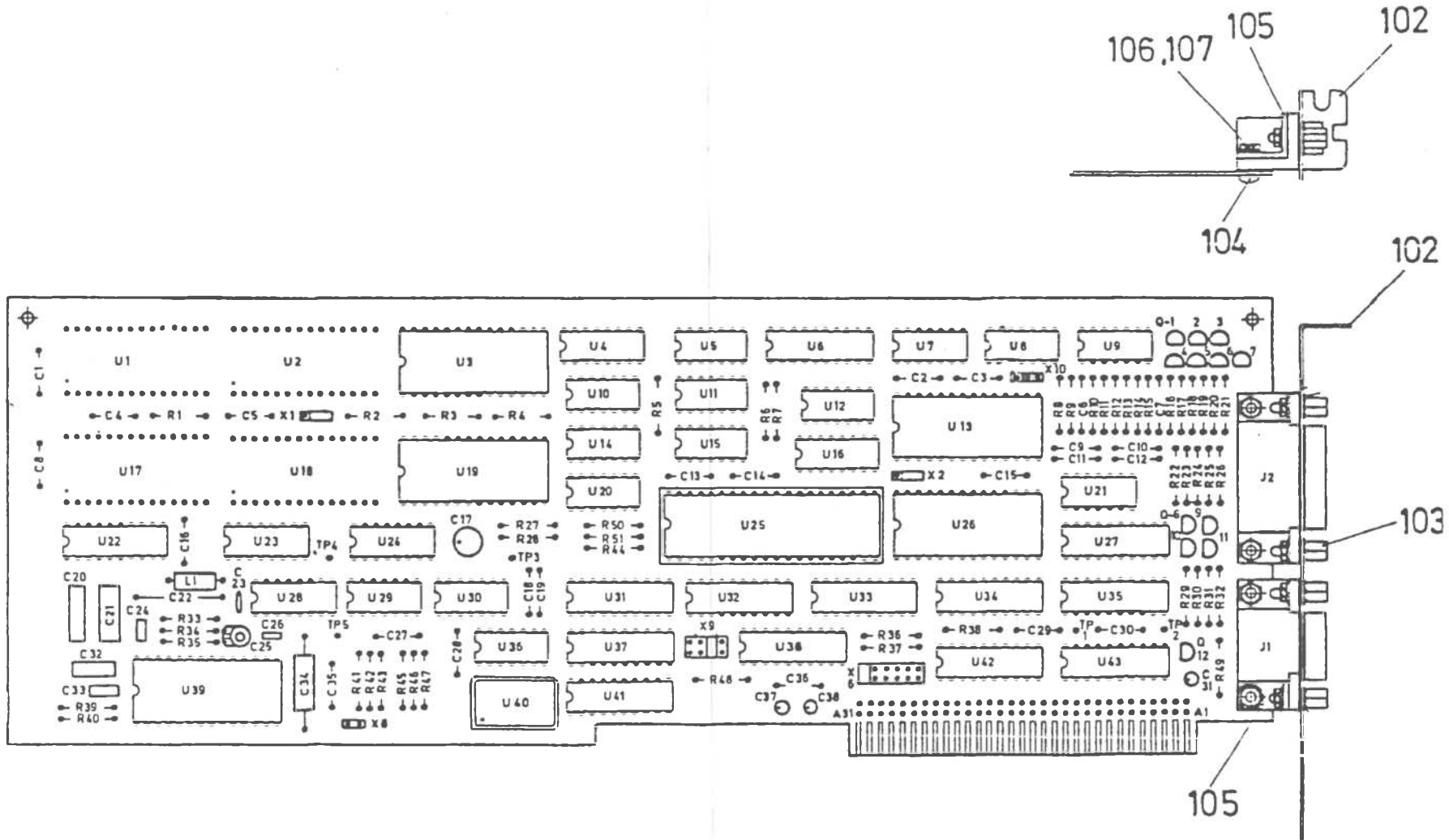
LAYOUTS AND SCHEMATICS



DLC Inhouse I/F Board (3 of 3)

LAYOUTS AND SCHEMATICS

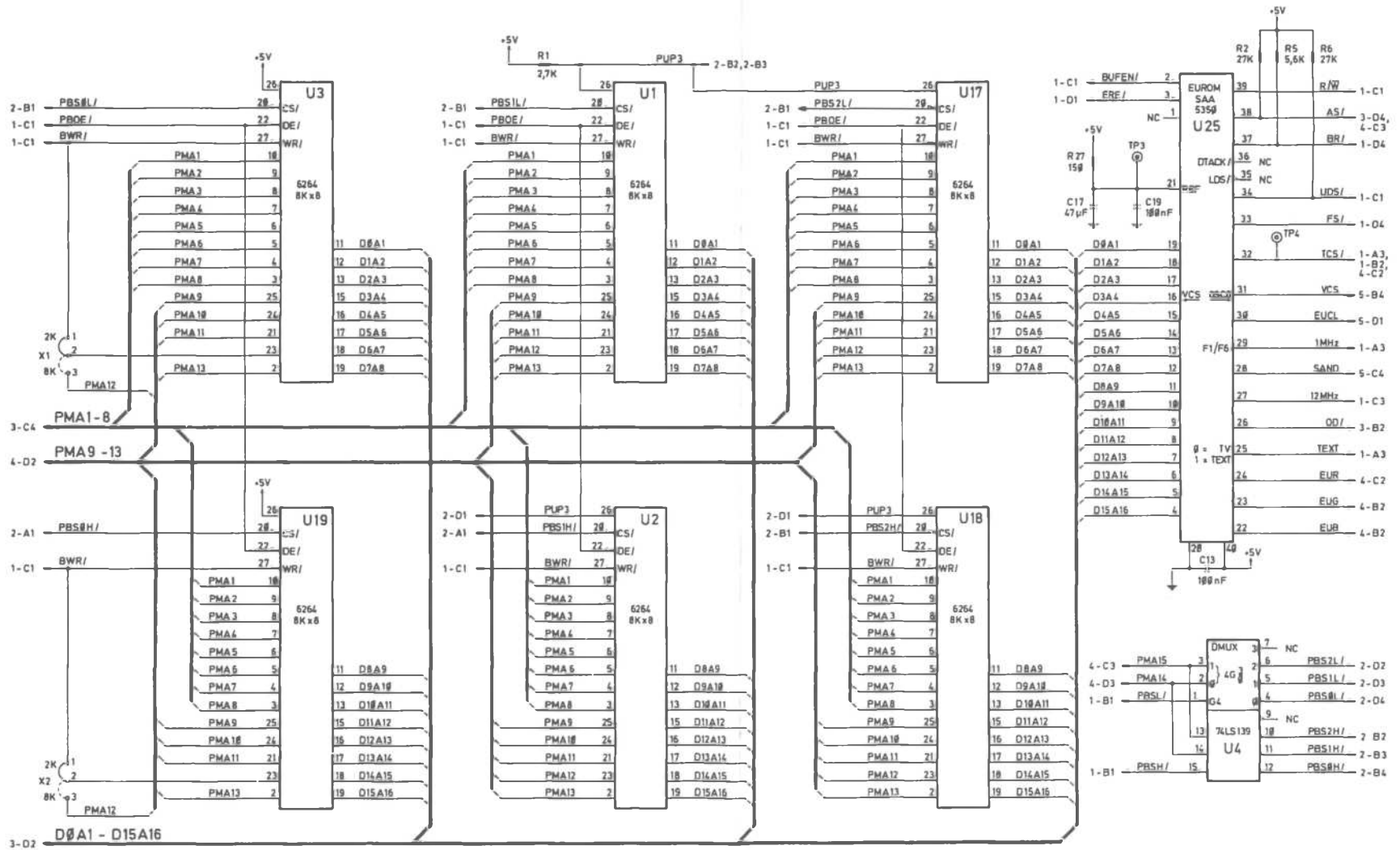
Videotex Adapter Board





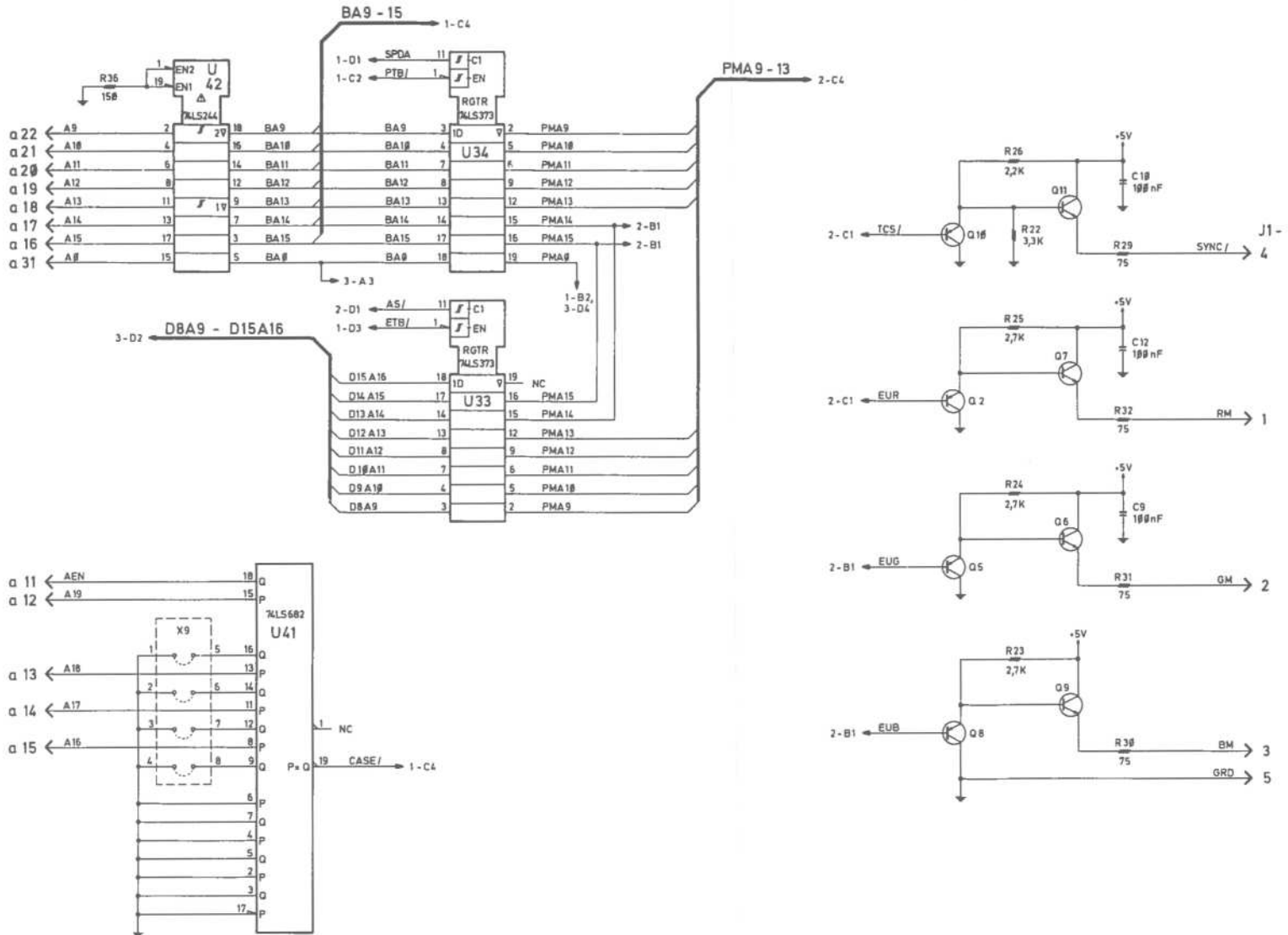


# LAYOUTS AND SCHEMATICS





LAYOUTS AND SCHEMATICS

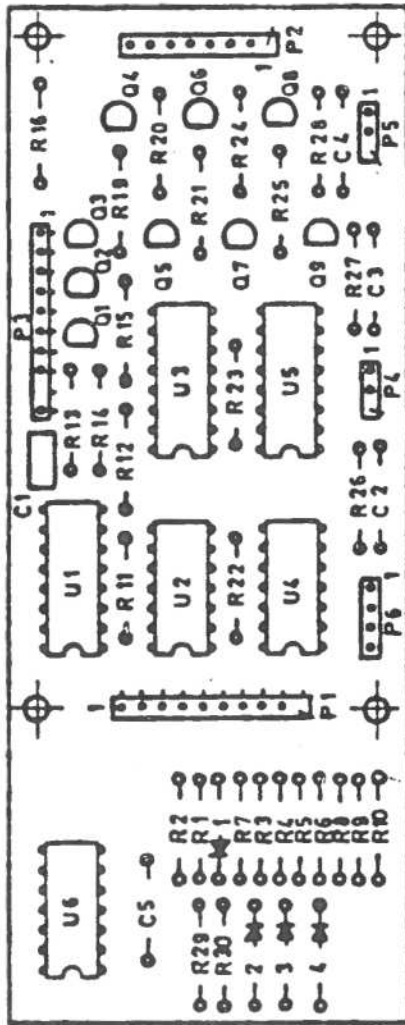


Videotex Adapter Board (4 of 5)

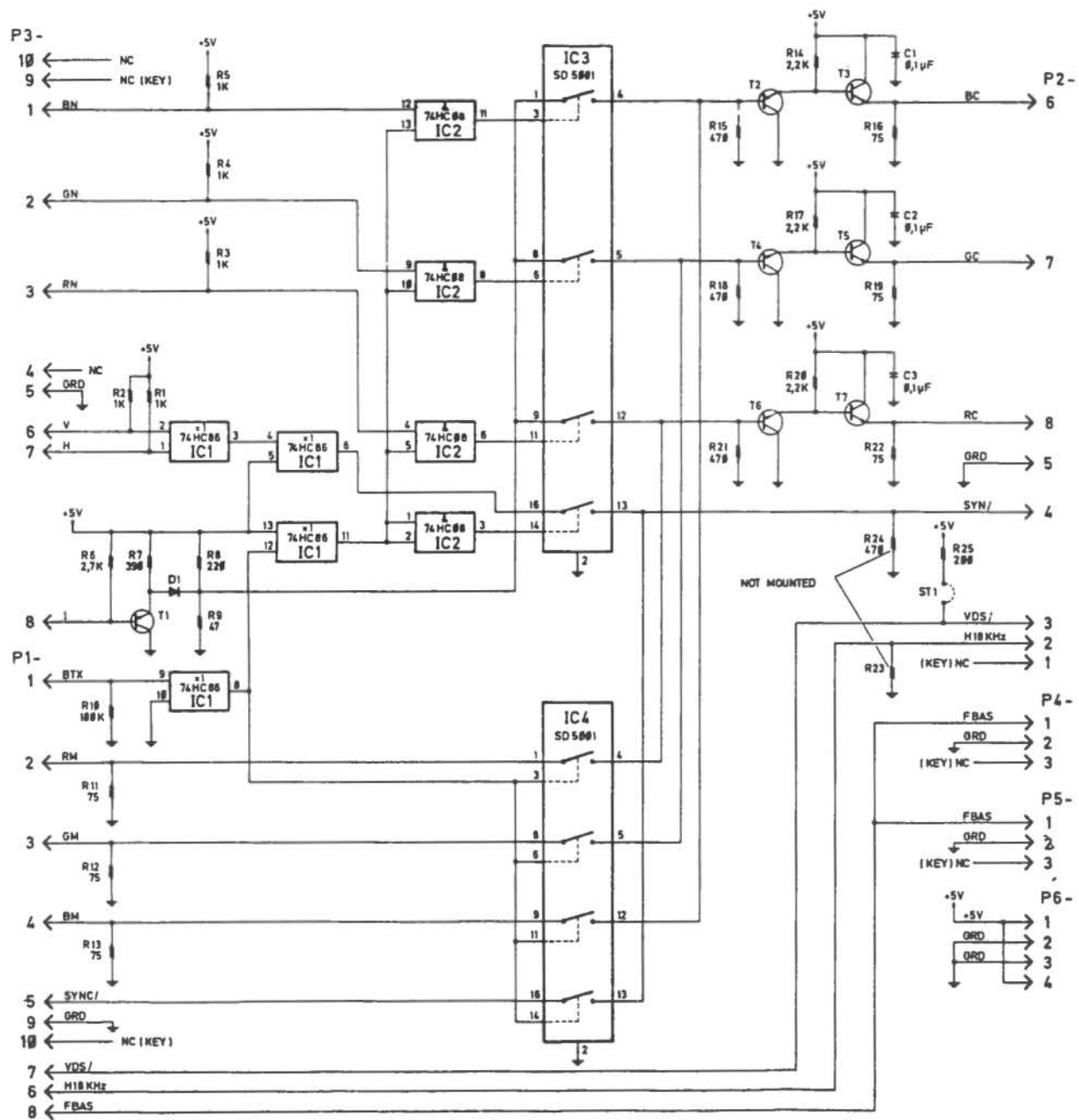


LAYOUTS AND SCHEMATICS

Videotex Switchboard



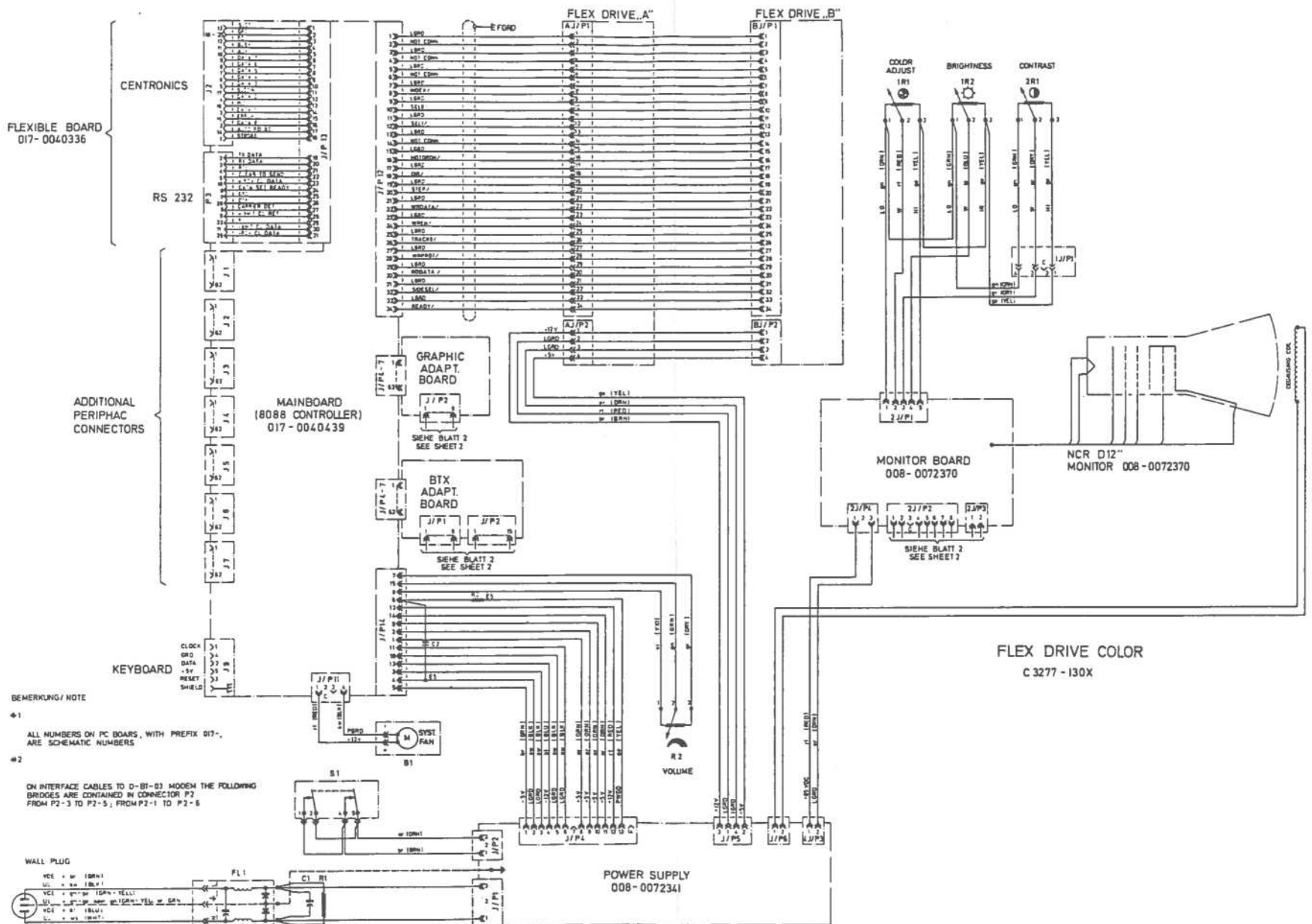
LAYOUTS AND SCHEMATICS



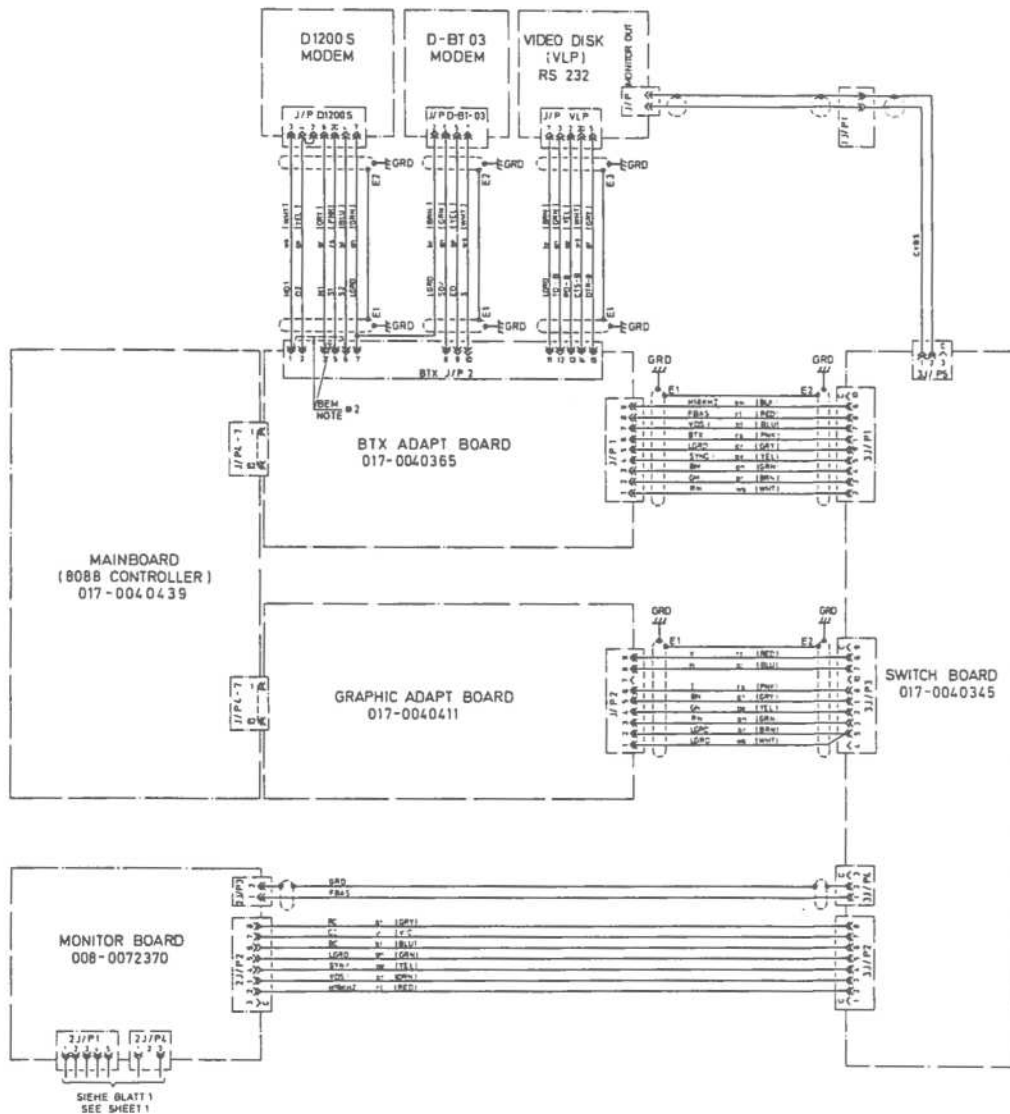
Videotex Switchboard

# LAYOUTS AND SCHEMATICS

## Wiring Diagram Videotex



Wiring Diagram Videotex (1 of 3)

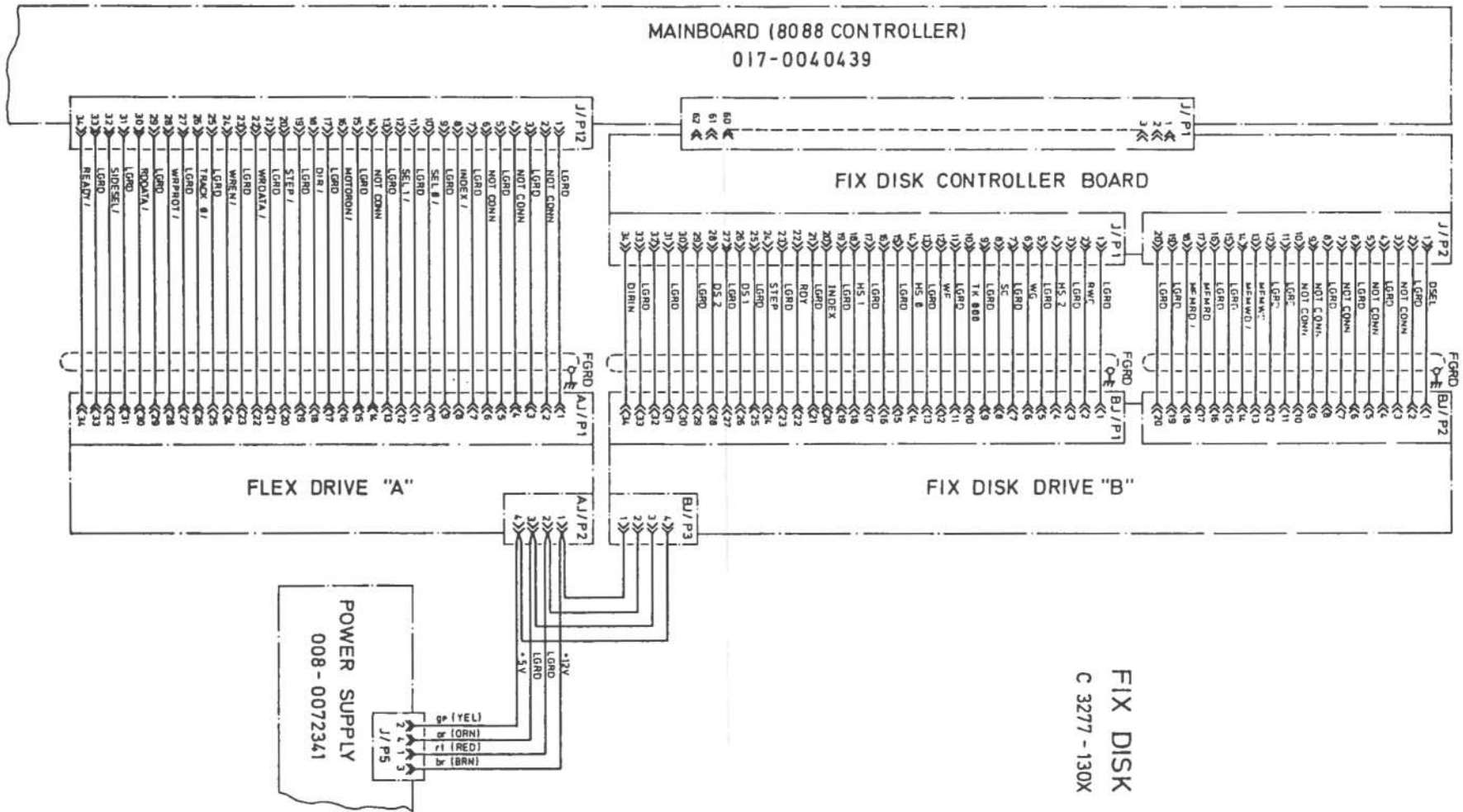


MODEM D1200 S; MODEM D-BT 03; VIDEO, DISK (VLP);  
C-3277-130X

Wiring Diagram Videotex [2 of 3]

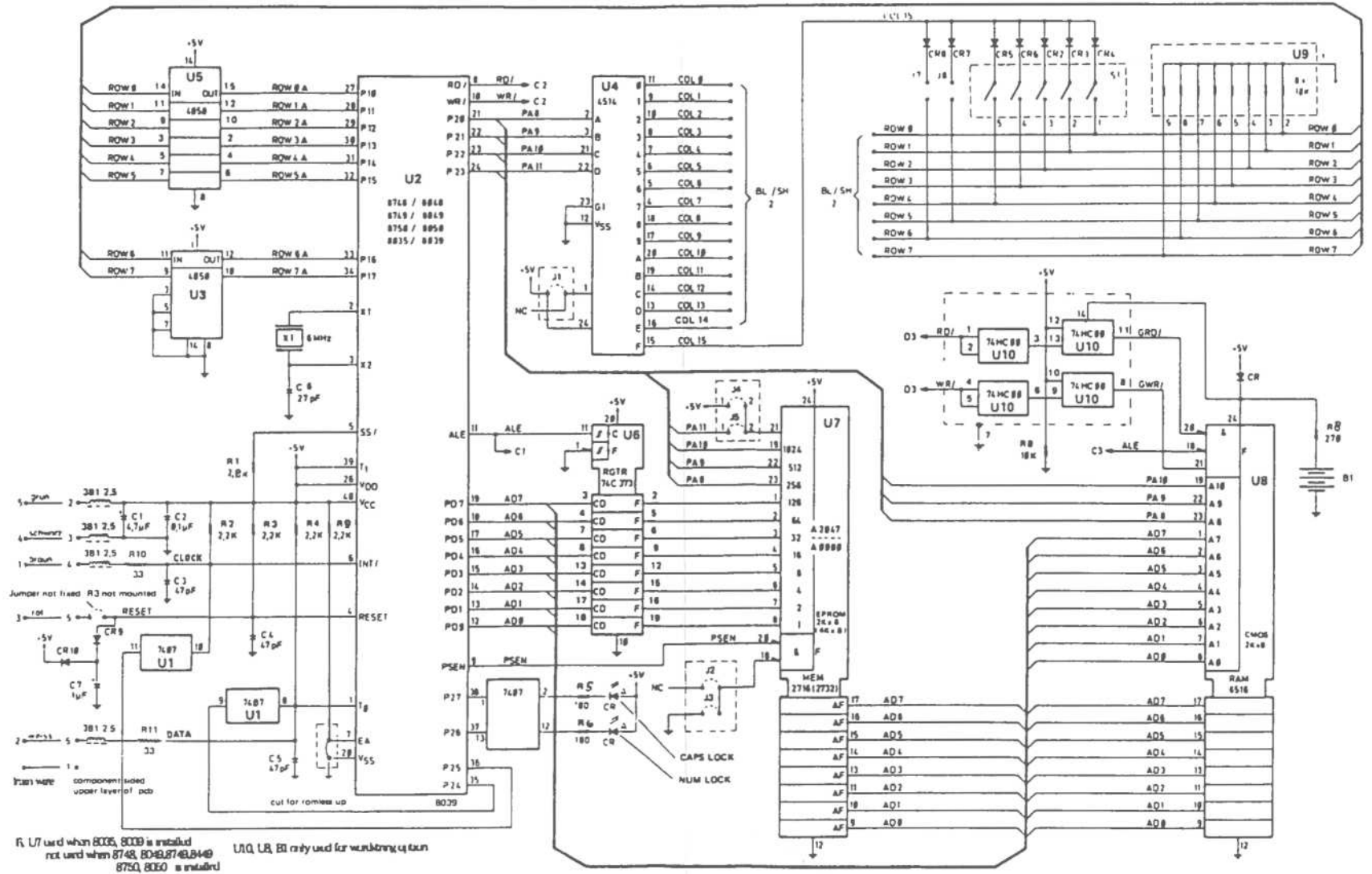


LAYOUTS AND SCHEMATICS





LAYOUTS AND SCHEMATICS



Keyboard Schematic