

INTRODUCTION

This Service Manual is organized in 8 Sections:

- 1 THEORY OF OPERATION- overview of 520ST architecture and how it works.
- 2 SCHEMATICS AND SILKSCREEN- electrical drawings and component layout.
- 3 TESTING- test equipment and overview of tests which can be performed.
- 4 DISASSEMBLY/ASSEMBLY- detailed instructions to take apart and reassemble the 520ST.
- 5 SYMPTOM CHECKLIST- quick reference for troubleshooting common problem areas.
- 6 DIAGNOSTIC FLOWCHARTS- detailed procedures for troubleshooting and repairing 520ST.
- 7 PARTS LIST- detailed breakdown of parts in the 520ST.
- 8 UPDATES- section to be used to hold Field Change Orders, Upgrade Bulletins, and Tech Tips.

This manual is designed for use by both the experienced and semi-experienced Service technician. The Diagnostics Flowcharts provide detailed diagnostics and repair procedures for technicians not completely familiar with the Atari 520ST Computer System. The Symptom Checklist provides a rapid reference for the more experienced technician.

SECTION ONE

THEORY OF OPERATION

CASE DESIGN

The 520ST is primarily designed as a keyboard computer with external video display, disk drives, and power supply. The top panel (Fig. 1.1) contains the keyboard, ventilation slots, and a power on indicator.

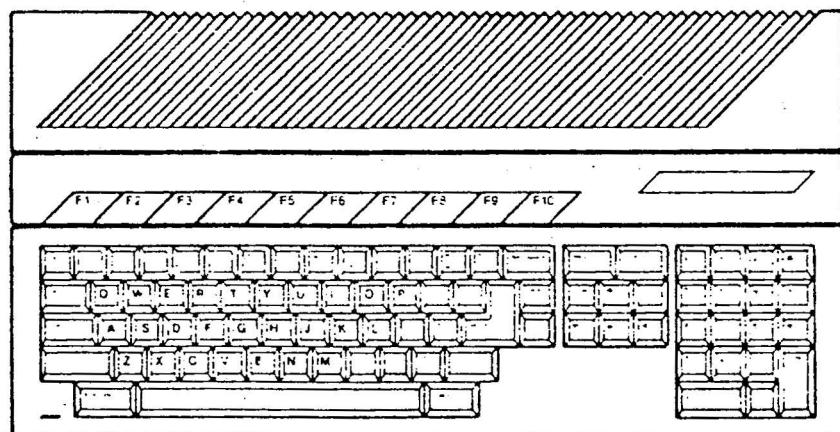


Figure 1.1
TOP PANEL

The side panels contain the expansion ROM slot and mouse/joystick ports.

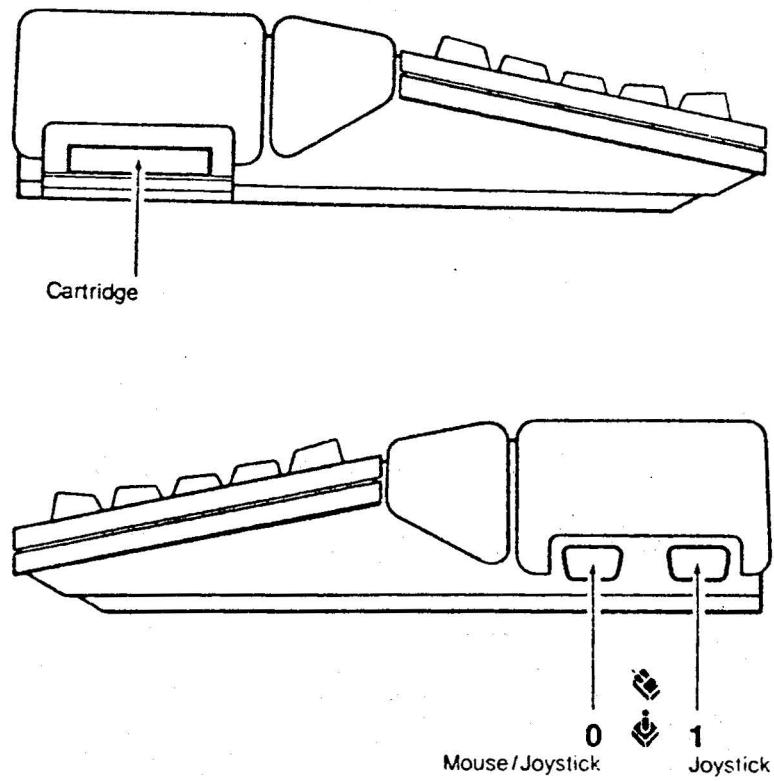


Figure 1.2
SIDE PANELS

The Back Panel (Fig. 1.3) contains the on/off switch, reset button, power connector, video connector, printer connector, RS232 connector, MIDI connectors, and disk drive connector.

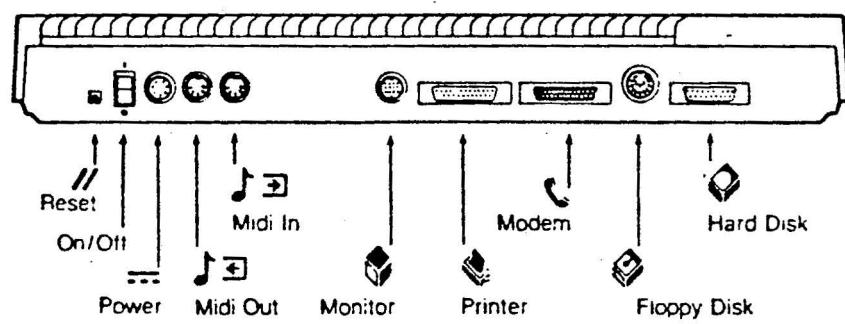


Figure 1.3
BACK PANEL

ARCHITECTURE

The 520ST Computing System is based on the Motorola MC68000 16 bit data/24 bit address microprocessing unit. The hardware architecture consists of a main system, a graphics subsystem, a music subsystem, and several device subsystems.

Main System

- * MC68000 running at 8MHz
- * 320 Kbyte Read Only Memory
- * 512 Kbyte Random Access Memory
- * Direct Memory Access support

Graphics Subsystem

- * 32 Kbyte BitMap video display
- * 320 x 200 pixel, 16 color palette from 512 selections
- * 640 x 200 pixel, 4 color palette from 512 selections
- * 640 x 400 pixel, monochrome

Music Subsystem

- * Programmable sound synthesizer
- * Musical instrument network communication

Device Subsystems

- * Intelligent Keyboard
- * 2 button mouse/joystick interface
- * Monitor interface
- * Parallel printer interface
- * RS-232C serial interface
- * Floppy disk controller & interface
- * Hard disk drive interface

MAIN SYSTEM

The main system includes the microprocessing unit, main memory (both ROM and RAM), and general purpose DMA controller.

Micropocessing Unit

The 520ST computing system is based on an 8 MHz Motorola MC68000 16 bit data/24 bit address microprocessing unit. Some features of the MC68000 are: eight 32 bit data registers, nine 32 bit address registers, a 16 Megabyte direct addressing range, 14 addressing modes, memory mapped I/O, five data types, and a 56 instruction set. The MPU is directly supported by a Mostek MK68901 Multi Function Peripheral providing general purpose interrupt control, system timers, and I/O.

Main Memory

The organization of main memory consists of five 64 Kbyte slots for ROM and one bank of 512 Kbyte RAM. The configuration of main memory ROM is ascertained through software identification. The configuration of main memory RAM is achieved via the programming of the Memory Configuration Register on the Memory Controller Chip.

Direct Memory Access

Direct main memory RAM access is provided to support both low speed (250 to 500 Kilobits/sec) and high speed (up to 8 Megabits/sec) 8 bit device controllers. The base address for the DMA read or write operation is loaded into the DMA Base Address and Counter Register located on the Memory Controller Chip. The DMA controller Chip performs the actual DMA through a 32 byte FIFO programmed via the DMA Mode Control Register and DMA Sector Count Register. The progress, success, or failure of the DMA operation is reported through the DMA Status Register which is cleared by toggling Write/Read in the DMA Mode Control Register. Bus accesses are granted to the DMA controller and the MC68000 MPU on an egalitarian first come, first served basis. The access remains in effect until an operation is complete or until control is otherwise relinquished.

GRAPHICS SUBSYSTEM

The graphics subsystem consists of the video display memory, and a graphics control chip (Video Shifter).

Video Display Memory

Video display memory is configured as n logical planes interwoven by 16 bit words into contiguous memory to form one 32 Kilobyte physical plane starting at a 256 byte half page boundary. The starting address of display memory is placed in the memory controller's Video Base Address Register which is then loaded into the Video Address Counter Register and incremented. Display memory is part of main memory with the physical screen origin located at the top left corner of the screen.

Video Configuration

The 520ST possesses three modes of video configuration: 320 x 200 resolution with 4 planes, 640 x 200 resolution with 2 planes, and 640 x 400 resolution with 1 plane. The modes are set through the Shift Mode Register on the Video Shifter Chip. A sixteen word color lookup palette is provided with nine bits of color per entry. The sixteen Color Palette Registers contain three bits of red, green, and blue aligned on low nibble boundaries. In 320 x 200 4 plane mode all sixteen palette colors can be indexed, while in 640 x 200 2 plane mode only the first four palette entries are applicable. In 640 x 400 monochrome mode the color palette is bypassed altogether. Instead provided with an inverter for inverse video controlled by bit 0 of palette color 0. Palette color 0 is also used to assign a border color in multi-plane mode and a white or black border in monochrome mode depending on bit 0.

MUSIC SUBSYSTEM

The 520ST music subsystem is composed of a programmable sound synthesizer and a musical instrument serial interface. The interface provides high speed serial communication of musical data to and from more sophisticated synthesizer type devices.

Sound Synthesizer

The General Instrument AY-8910 Programmable Sound Generator produces music synthesis, sound effects, and audio feedback (eg alarms and key clicks). With an applied clock input of 2 MHz and built-in digital to analog converters, the PSG is capable of providing a frequency response range between 30 Hz and 125 KHz. The generator places a minimal amount of processing burden on the main system (which acts as the sequencer) and has the ability to perform using three independent voice channels. The three sound channels are mixed and sent to the monitor speaker.

Musical Instrument Communication

The Musical Instrument Digital Interface (MIDI) allows the integration of the 520ST with music synthesizers, sequencers, drum boxes and other devices possessing MIDI interfaces. High speed (31.25 Kilobaud) serial communication of keyboard and program information is provided by two ports, MIDI OUT and MIDI IN (MIDI OUT also supports the optional MIDI THRU port).

DEVICE SUBSYSTEMS

The 520ST supports seven device subsystems: an intelligent keyboard, video interface, parallel interface, RS232C interface, MIDI interface, floppy disk interface, and hard disk interface.

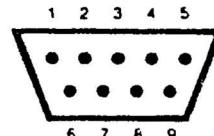
Intelligent Keyboard

The Intelligent Keyboard (ikbd) transmits encoded make/break key scan codes (with two key rollover), ASCII codes, mouse/trackball data, joystick data, and the time of day. The ikbd receives commands as well, with bidirectional communication controlled on the Main board side by an MC6850 Asynchronous Communications Interface Adaptor supplied with transmit and receive clock inputs of 500 KHz. All ikbd functions such as key scanning, mouse tracking, command parsing, etc. are performed by a 1MHz Hitachi HD6301 8 bit Microcomputer Unit. The 2 Button Mouse is an opto-mechanical device with the following characteristics: a resolution of 100 counts/inch, a maximum velocity of 10 inches/second and a maximum pulse phase error of 50 percent. The joystick is a 4 direction switch-type joystick with one fire button.



Mouse/Joystick

- 1 — Up/XB
- 2 — Down/XA
- 3 — Left/YA
- 4 — Right/YB
- 5 — Not Connected
- 6 — Fire/Left Button
- 7 — + 5VDC
- 8 — Ground
- 9 — Joy1 Fire/Right Button



Joystick

- 1 — Up
- 2 — Down
- 3 — Left
- 4 — Right
- 5 — Reserved
- 6 — Fire Button
- 7 — + 5VDC
- 8 — Ground
- 9 — Not Connected

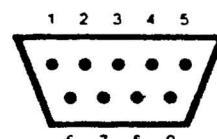


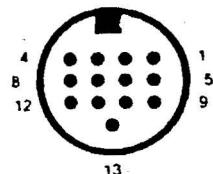
Figure 1.4
MOUSE/JOYSTICK PORTS

Video Interface

The video display interface supports a medium resolution Analog RGB monitor and a high resolution monochrome monitor. Major components of the video interface are the summer and buffer circuits. The video summer circuit consists of three 3 bit digital to analog converters with sync suppression diodes. It takes 3 weighed bits of red, green, and blue from the video shifter chip and generates eight discrete levels of red, eight discrete levels of green, and eight discrete levels of blue to produce a total of 512 possible colors. The video buffer circuits are impedance matching emitter follower amplifiers. There are four buffers in all; three for the video summer circuit output for red, green, and blue; and one for monochrome video output from the Video Shifter.



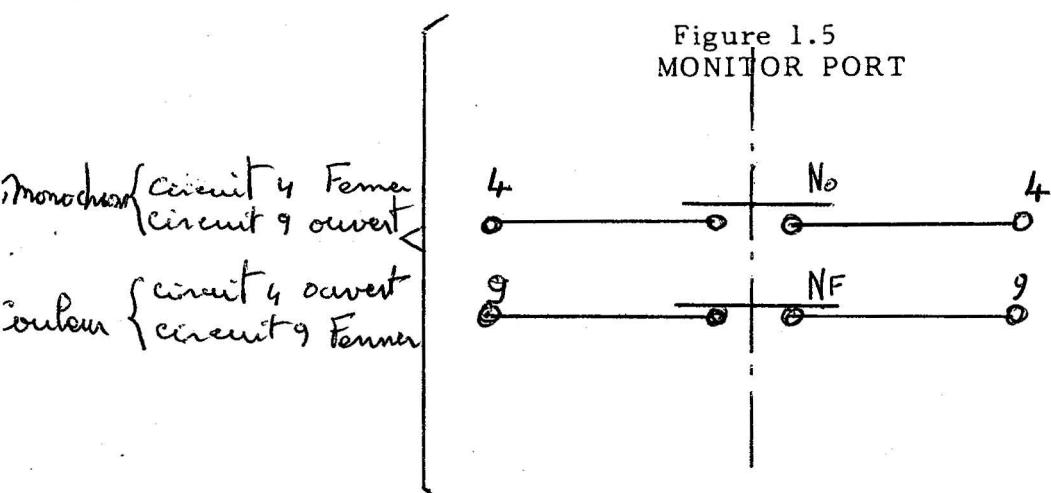
Monitor



+12V → 1,2K ← mode SW

- 1 — Audio Out
- 2 — Reserved Comp SYNC
- 3 — General Purpose Output
- 4 — Monochrome Detect
- 5 — Audio In
- 6 — Green
- 7 — Red
- 8 — Ground
- 9 — Horizontal Sync
- 10 — Blue
- 11 — Monochrome
- 12 — Vertical Sync
- 13 — Ground

Figure 1.5
MONITOR PORT



Parallel Interface

The 520ST parallel interface supports Centronics STROBE from the AY-3-8910 PSG for data synchronization and Centronics BUSY to the MK68901 MFP. Eight bits of read/write data are handled through I/O Port B on the PSG at a typical data transfer rate of 4000 bytes/second.

Printer

- 1 — STROBE
- 2 — Data 0
- 3 — Data 1
- 4 — Data 2
- 5 — Data 3
- 6 — Data 4
- 7 — Data 5
- 8 — Data 6
- 9 — Data 7
- 10 — Not Connected
- 11 — BUSY
- 12-17 — Not Connected
- 18-25 — Ground

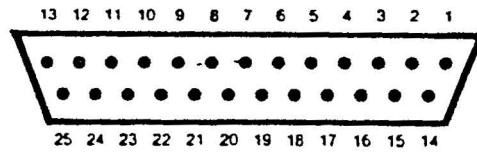


Figure 1.6
PRINTER PORT

RS232C Interface

The 520ST RS232C interface provides voltage level synchronous or asynchronous serial communication. Five EIA RS232C handshake control signals are supported: Request To Send and Data Terminal Ready are transmitted through the AY-3-8910 PSG I/O Port A; Clear To Send, Data Carrier Detect, and Ring Indicator are received through the MK68901 MFP. The MFP USART transmit and receive clock inputs are controlled by the Baud Rate Generator MFP Timer D which is supplied with 5 MHz and can support asynchronous data transfer rates from 50 to 19200 baud. One byte transmit and receive data buffers are managed by the MFP USART, which provides monitoring of buffer conditions and communication errors.

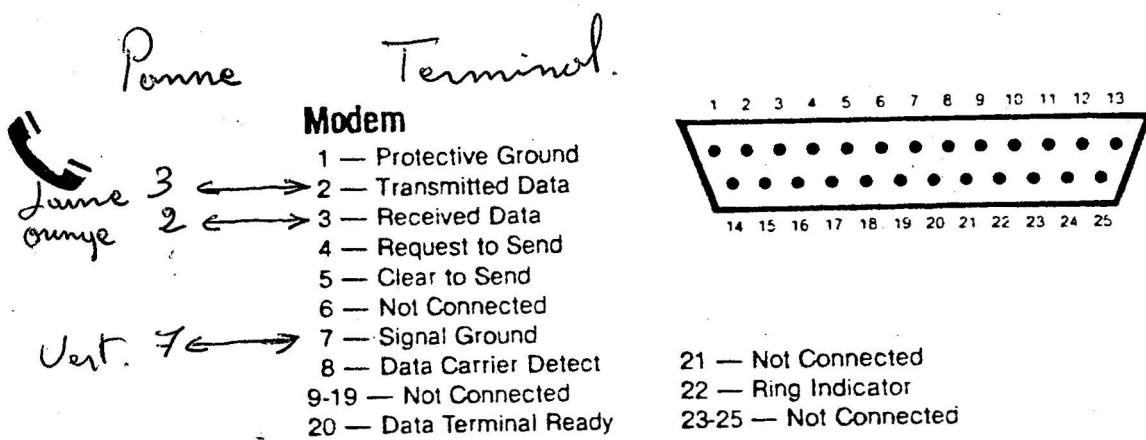


Figure 1.7
RS 232 PORT

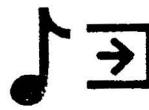
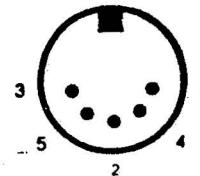
Midi Interface

The 520ST MIDI interface provides current loop asynchronous serial communication controlled by an MC6850 ACIA supplied with transmit and receive clock inputs of 500 KHz. The data transfer rate is 31.25 Kbaud. The MIDI specification calls for serial data to consist of eight data bits preceded by a start bit and followed by one stop bit.



Midi Out

- 1 — THRU Transmit Data
- 2 — Shield Ground
- 3 — THRU Loop Return
- 4 — OUT Transmit Data
- 5 — OUT Loop Return



Midi In

- 1 — Not Connected
- 2 — Not Connected
- 3 — Not Connected
- 4 — IN Receive Data
- 5 — IN Loop Return

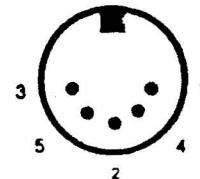


Figure 1.8
MIDI PORTS

Disk Drive Interface

The floppy disk drive interface is provided through the DMA controller to an on board Western Digital WD1772 Floppy Disk Controller. A total of two daisy chained floppy disk drives can be supported. Commands are sent to the FDC by first writing to the DMA Mode Control Register to select the FDC internal command register and then writing the desired one byte command to the Disk Controller Register.



Floppy Disk

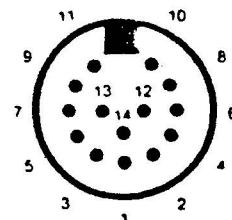
- | | |
|--------------------|--------------------|
| 1 — Read Data | 11 — |
| 2 — Side 0 Select | 10 — |
| 3 — Logic Ground | 8 — |
| 4 — Index Pulse | 6 — |
| 5 — Drive 0 Select | 4 — |
| 6 — Drive 1 Select | 3 — |
| 7 — Logic Ground | 2 — |
| 8 — Motor On | 1 — |
| 9 — Direction In | 12 — Write Gate |
| 10 — Step | 13 — Track 00 |
| 11 — Write Data | 14 — Write Protect |
- 
- A circular diagram representing a 14-pin connector. The pins are numbered around the perimeter: 11 at the top, 10 at the top-right, 8 at the right, 6 at the bottom-right, 4 at the bottom, 3 at the bottom-left, 2 at the left, 1 at the top-left, 9 at the top-right, 13 at the top, 12 at the top-right, 14 at the center, 5 at the bottom-left, and 7 at the bottom-right. The center of the circle is marked with a small square.

Figure 1.9
FLOPPY PORT

Hard Disk Interface

The 520ST hard disk drive interface is also provided through the DMA controller, however, the hard disk controller is off board and is sent commands via an SCSI-like command parameter block. The format of both floppy and hard disks is 512 byte data sectors.



Hard Disk

- | | |
|------------------------|-------------------|
| 1 — Data 0 | 14 — Acknowledge |
| 2 — Data 1 | 15 — Ground |
| 3 — Data 2 | 16 — A1 |
| 4 — Data 3 | 17 — Ground |
| 5 — Data 4 | 18 — Read/Write |
| 6 — Data 5 | 19 — Data Request |
| 7 — Data 6 | |
| 8 — Data 7 | |
| 9 — Chip Select | |
| 10 — Interrupt Request | |
| 11 — Ground | |
| 12 — Reset | |
| 13 — Ground | |

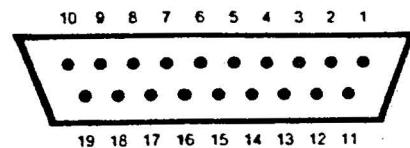
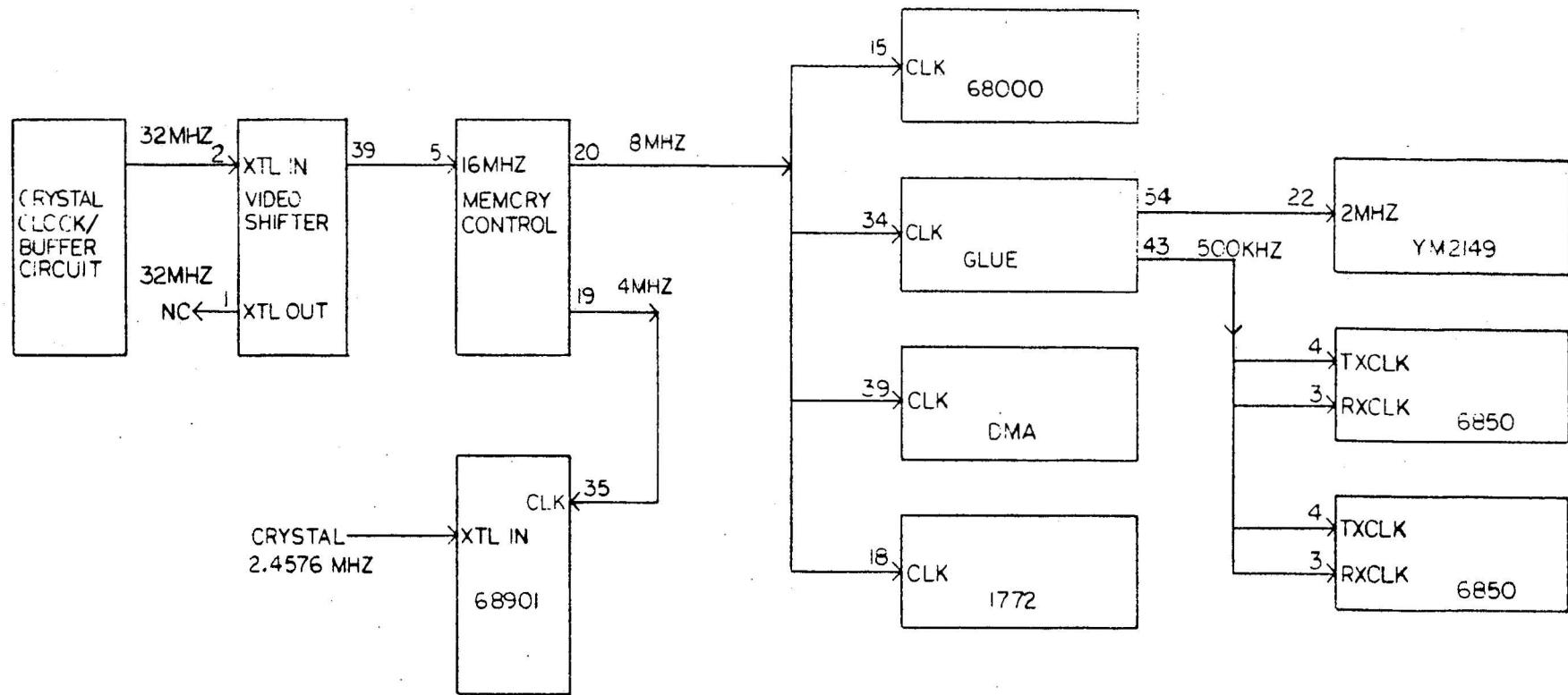


Figure 1.10
HARD DISK PORT

SECTION TWO

SCHEMATIC AND SILKSCREEN

The following pull-out drawings contain a representative schematic and silkscreen of the 520ST Computer. Minor variations in design may be encountered depending upon the production date of the computer. These drawings along with the Theory of Operation found in section one of this manual should provide all details required for an in-depth understanding of the 520ST.



520ST
SYSTEMCLOCKS

SECTION THREE

TESTING

OVERVIEW

This section pertains to the test equipment, diagnostic software, and test procedures required to verify correct operation and analyze failures of the 520ST Computer.

TEST EQUIPMENT

As a minimum, the following pieces of equipment are required to properly test and troubleshoot the 520ST:

- * 100MHz Oscilloscope
- * 50MHz Frequency Counter
- * Atari SM124 Monochrome Monitor
- * Atari SC122 RGB Monitor
- * Atari SF354 Floppy Disk Drive
- * Atari SF314 Floppy Disk Drive
- * ST Test Fixture
- * RS232 Loop-Back Connector
- * MIDI Loop-Back Cable
- * ST Test Diagnostic Cartridge
- * TOS/GEM System Disk
- * 2 Blank Disks
- * Small Hand Tool Kit
- * Spare Parts

POWER UP TEST

The power up test is a quick way to determine how much of the system is operating correctly. Once you know what's working you can concentrate on the trouble areas. If the test is sucessful then the following areas have a more than reasonable chance of operating correctly:

- * +5 Volts on Power Supply
- * System Clocks
- * Reset Circuitry
- * MC68000 MPU
- * ROM
- * Video Display RAM
- * Memory Controller
- * Glue Chip
- * Video Shifter Chip
- * Mouse Port
- * Keyboard
- * One of the two MC6850s
- * MK68901 MFP

Start the test by making sure the power switch is in the off position and there is no cartridge present. Connect the power supply, RGB monitor, and mouse to the computer.

Turn power switch ON

The monitor should now be displaying many Atari logos in a diagonally moving rainbow effect. Also on the screen, you should see a bee pointer.

Move the mouse around.

The bee should move in the same direction you moved the mouse. After 10 seconds or so, a window should open up with a picture of a disk drive, a floppy, and a message asking you to insert System Disk in Drive.

Hit the Return Key

The window should now disappear and the rainbow return. After a few seconds the window should reappear.

If you got as far as the second window, the test was successful. Go on to the ST Diagnostics Cartridge. If not, refer to the Power up Test in the Diagnostic Flowcharts section of this manual.

ST DIAGNOSTIC CARTRIDGE

The ST Diagnostic Cart. is a powerful and exhaustive test facility for diagnosing problems with the 520ST Computer System.

Setting Up Test

Before beginning the test, you will require the following:

- * Test Cartridge
- * ST Test Fixture
- * RS 232 Loopback Connector
- * MIDI Loopback Cable
- * RGB Monitor
- * Monochrome Monitor
- * Monitor Switchbox (optional)
- * SF314 & SF354 Disk Drives
- * Two 3.5" blank Diskettes

Start the test by making sure the power switch is in the off position. Connect the power supply, RGB Monitor, Drive Cable, RS232 Connector, and MIDI Cable to the 520ST. Now connect the Joystick Cables, the 25 pin Printer Cable, and the 19 pin Hard Disk Cable from the ST Test Fixture to the 520ST Computer. If properly hooked up, your test setup should look like Drawing CO26110 (Rev 2).

Turn power switch ON

If on power up, a red screen is displayed, refer to the Start Up Sequence in the Diagnostic Flowcharts section of this manual.

Main Menu

The program, if successful in its initialization, should display a blue screen with Type of Test Cartridge, Revision Number, and a Menu of TESTS.

Type the number of the test needed

Each test will startup in a blue screen. If the test passes, the screen will turn green. A failure will turn the screen red. If the test cannot proceed for some reason, the screen stays blue. The various error numbers displayed on the screen will indicate where the failure occurred. Reference the Master Error List for descriptions of the error numbers, and/or refer to the Diagnostic Flowchart for the particular test.

RAM Test

After selecting the RAM test the screen displays "Testing RAM". If RAM is working properly, the screen displays "Pass" on a green background. If a problem is found the error code, address at which error occurred, data written, and data read are displayed with a red background. Press any key to exit to main test Menu.

Keyboard Test

Displays "Keyboard Test" and 15 keyboard keys in reverse video. Press the keys that are shown on the screen one at a time in any order. As they are pressed, the displayed keys will change to normal video. When all the keys have been pressed "Pass" will be displayed with a green background. If a wrong key is pressed or the keyboard is malfunctioning, the screen will go red and the wrong key pressed will be shown at the bottom of the screen. Press (ESC) to restart test. Press any key to exit to the main Menu.

Color Test

The Color Test displays seven horizontal color bars across the screen. Each bar is dark on top and progressively gets brighter towards the bottom. Near the right edge of the screen the colors should be shifted up one line.

RS232 and MIDI Test

This test will first display "Testing RS232" while testing the RS232 port. If any errors occur, the error codes will be displayed on the preceding lines. Next it will display "Testing MIDI" while looping data back and forth thru the MIDI ports. Again, if any errors are found, the error codes will be displayed. If no errors are found in BOTH the RS232 and MIDI sections of the computer, the screen will display "Pass" and have a green background color. Press any key to exit this test.

DMA Port Test

This test will first display "DMA Port Test" while testing the port. If the test is sucessful it will display "Pass" and turn the screen green. If there is an error, it will display "Fail" along with the error code(s) and turn the screen red. Press any key to exit to Main Menu.

Printer/Joystick Ports Test

This test will first display "Printer/Joystick Port Test" while testing the port. If the test is successful it will display "Pass" and turn the screen green. If there is an error, it will display "Fail" along with the error code(s) and turn the screen red. Press any key to exit to Main Menu.

Monochrome Monitor Test

This test will display "Connect Monochrome Monitor" on a blue screen. Disconnect the RGB monitor and connect the Atari SM324 Monochrome monitor. The screen should be filled with a pattern of alternating black and white vertical lines. Now, turn up the volume on the monitor, a sound of changing frequency should be heard from the monitors speaker. To exit from this test, remove the monochrome monitor plug and replace it with an RGB monitor.

ROM Test

This test calculates the checksum of the ROMs installed in the computer and displays the value found. This test can be useful in determining the Revision level of the ROMs in the unit. As Atari Corp. issues new updates to the ROM code, Authorized Service Centers will be provided with the new checksums.

Disk Drive Port Test

For the Floppy test you will need two 3.5" diskettes. Insert a write protected, formatted diskette in Drive A; and a write enabled, double sided "scratch" diskette in Drive B. The test reads side 0 of Drive A, and formats, writes, and reads both sides of Drive B. Reading Drive A takes approximately 1 second, operations on Drive B will take 5 seconds. The screen will turn green and display "Pass" if all the tests prove successful. Any error will cause testing to stop, the screen to turn red, and an error code to be displayed. It may be helpful to have replacement diskettes on hand to verify that errors are not caused by bad or worn-out media. Hitting any key will return you to the Main Menu.

ST TEST CARTRIDGE MASTER ERROR CODE LIST

REV. 3.0

STARTUP SEQUENCE

00 Low address RAM error
01 No Timer A interrupt
02 No Timer B interrupt
03 No Timer C interrupt
04 No Timer D interrupt
05 Keyboard time-out
06 Keyboard error
07 Auto-Vector error
08 DTACK/VPA error
09 68000 error
0A Bad instruction fetch
0B Bus error
0C Address error
0D Priviledge violation

DMA PORT TEST

51 DMA Timed-out
52 DMA counter error
53 Data Mismatch error
54 DMA status = not responding

PORTS TEST

61 Printer
62 CBUSY
63 Trigger
64 Joy 0
65 Joy 1

RAM TEST

10 System RAM error
11 Memory device error
12 Address error
13 64K block addressing error

FLOPPY DISK TEST

90 Drive A not selected
91 Seek error
92 Read error
93 Drive A is not write protect
94 Drive B not selected
95 Format error, Drive B, Side 0
96 Write error, Drive B
97 Drive B is write protected
98 Data mismatch error
99 Format error, Drive B, Side 1
9A DMA status error
9B DMA count error
9C CRC error
9D Record not found (could not
read sector I.D. on disk)
9E Side select error
9F Error on read multiple sectors

RS232 TEST

41 Input data overrun
42 Input parity error
43 Input frame error
44 Write/Read data mismatch
45 Data not received
46 No IRQ
47 RI - DTR not connected
48 DCD - DTR not connected
49 RTS -CTS not connected

MIDI TEST

4A Input date overrun
4B Input parity error
4C Input frame error
4D Write/Read data mismatch
4E Data not received

SECTION FOUR

DISASSEMBLY/ASSEMBLY

The following describes the procedures required to disassemble the 520ST Computer.

Top Cover/Keyboard Removal (Fig 4.1)

- 1) Turn unit upside down.
- 2) Remove the 6 screws on Bottom Cover, note that the front screws are different from the rear ones.
- 3) Turn unit upright and remove Top Cover.
- 4) Remove Keyboard from Main Board and Shield Assembly by unplugging keyboard harness connector located in opening on right front of shield. (Fig 4.2)

Bottom Cover Removal (Fig 4.1)

- 1) Remove the 3 screws along front of Main Board and Shield Assembly.
- 2) Locate and remove the 3 rear screws which are accessed thru holes along the rear of Top Shield.
- 3) The Main Board and Shield Assembly should now lift out from Bottom Cover.

Shield Removal (Fig 4.3)

- 1) Locate twisted tabs rising thru slots in Top Shield along perimeter of Main Board.
- 2) Untwist the tabs with long nosed pliers until they clear the slots in Top Shield.
- 3) Remove Top Shield from Main Board. This may require realigning a few of the tabs such that they clear the slots on Top Shield.
- 4) The Bottom Shield and insulator panel can now be removed by pushing the tabs down and thru the slots on the Main Board.

If the above instructions were followed correctly, you should now have a Printed Circuit Board loaded with components ready to be worked on. It is strongly recommended when testing and troubleshooting that the Main Board (without the shield and mounting screws) be put back in its Bottom Cover so the Keyboard may rest against the ribs of the Bottom Cover.

RE-ASSEMBLY

The following outlines the steps required to re-assemble the 520ST Computer.

- 1) Place insulation panel on Bottom Shield.
- 2) Place Main Board on top of Bottom Shield and insulator panel.
- 3) Align tabs from Bottom Shield such that they fit thru slots on Main Board. Press Main Board down to Bottom Shield making sure the insulator panel is properly in place.
- 4) Place Top Shield thru tabs. Make sure all tabs have come thru both Main Board and Top Shield before proceeding.
- 5) With long nosed pliers twist each tab to hold Top Shield securely to Main Board.

IT IS EXTREMELY IMPORTANT THAT THE TOP SHIELD MAKE A GOOD CONTACT TO THE MAIN BOARD'S GROUND PLANE.

- 6) Insert Main Board and Shield Assembly into Bottom Cover.
- 7) Screw in the 3 front screws in place.
- 8) Using a magnetic screwdrive secure the 3 rear mounting screws into place thru the Top Shield. Make sure that the Main Board is now securely in place and no loose objects are lodged inside the Shield.
- 9) Connect Keyboard Harness to Main Board thru opening in Top Shield.
- 10) Place Keyboard on Supporting ribs of Bottom Cover, with a small amount of pressure the Keyboard should snap snugly into place.
- 11) Place Top Cover over Keyboard and Bottom Cover.

- 12) Turn unit upside down and insert the 6 bottom screws into place.

WORD OF CAUTION

It is strongly recommended that the computer be retested once in plastic to make sure that the re-assembly was done correctly and there are no shorts to Shield.

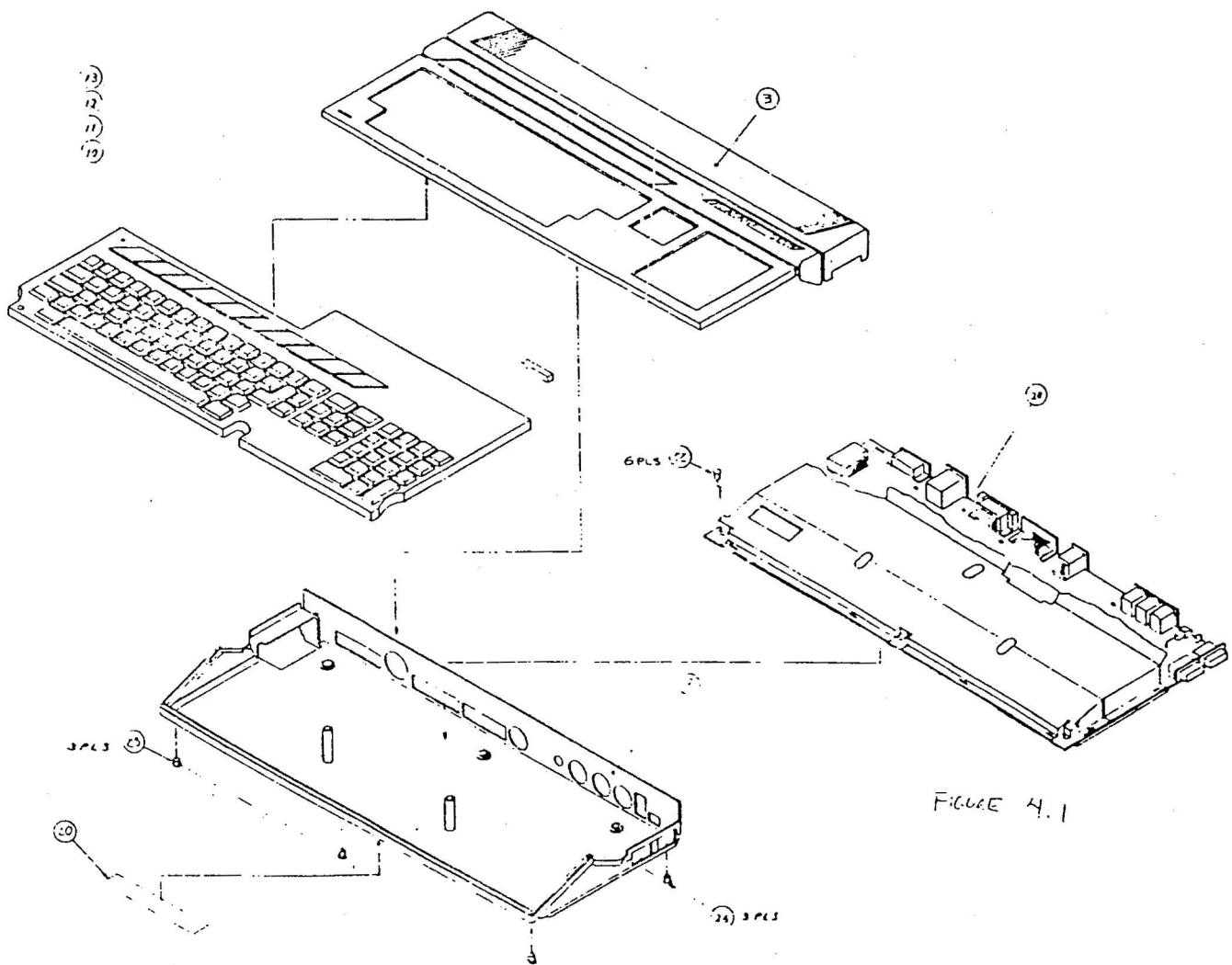


FIGURE 4.1

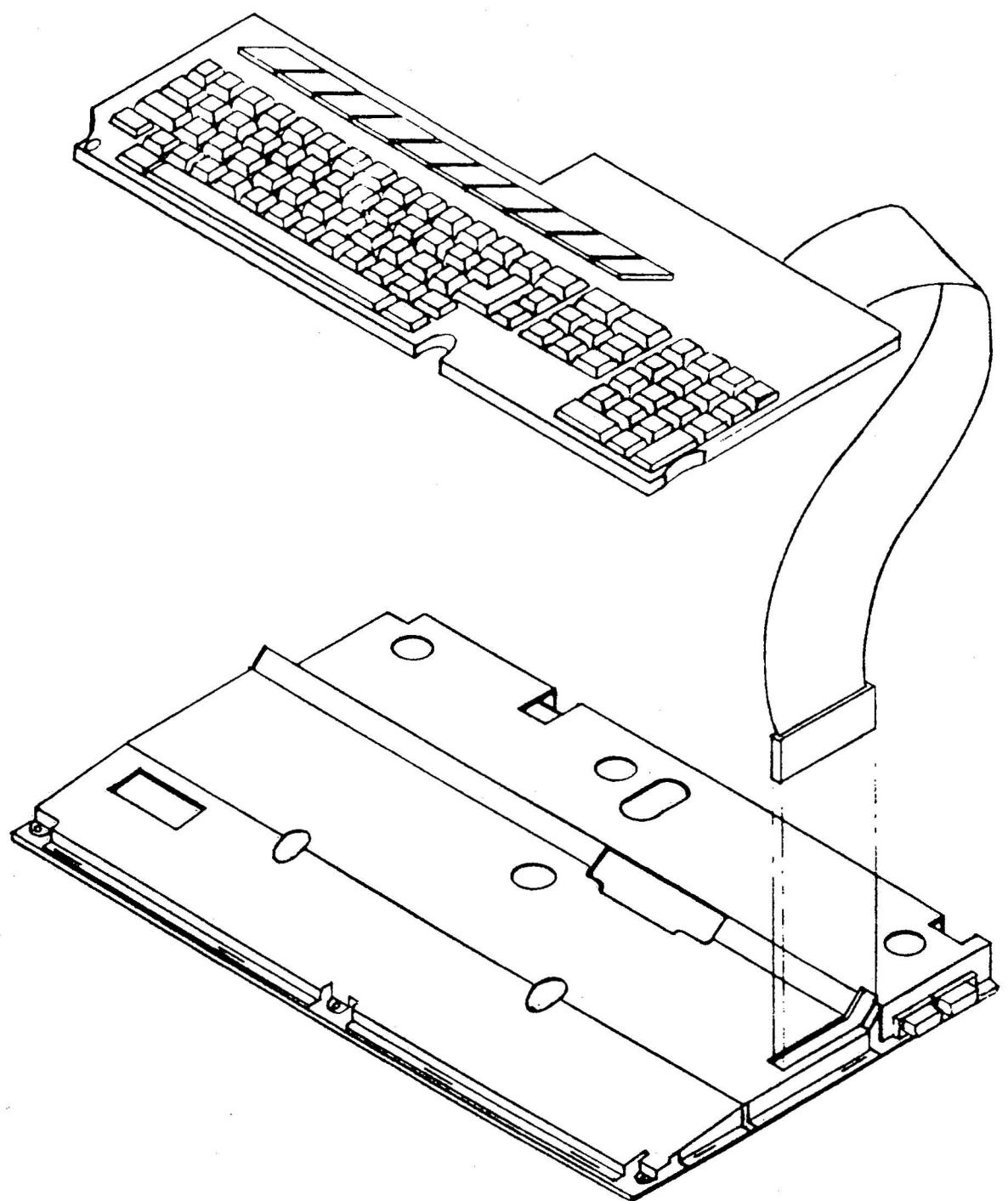


Figure 4.2

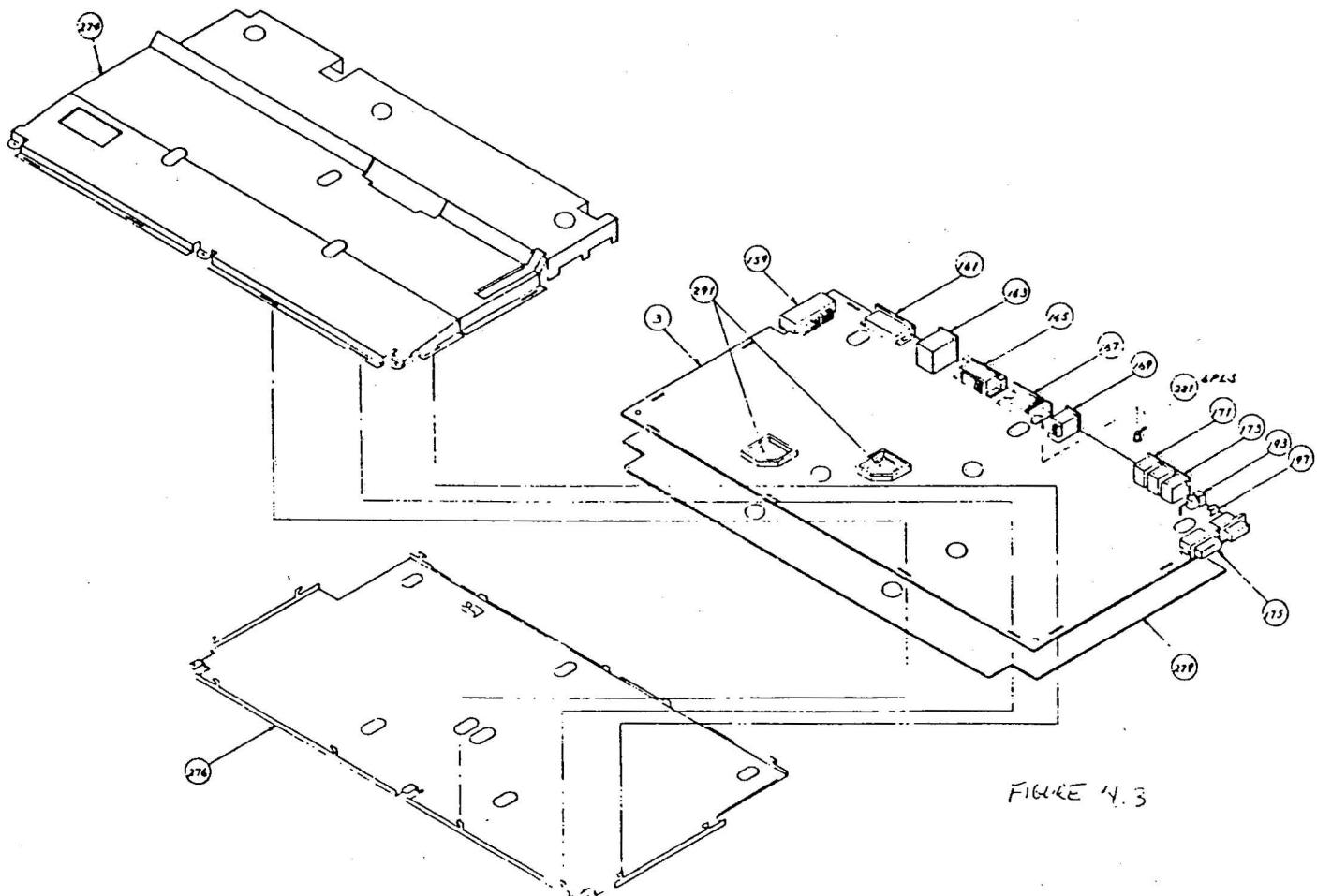


FIGURE 4.3

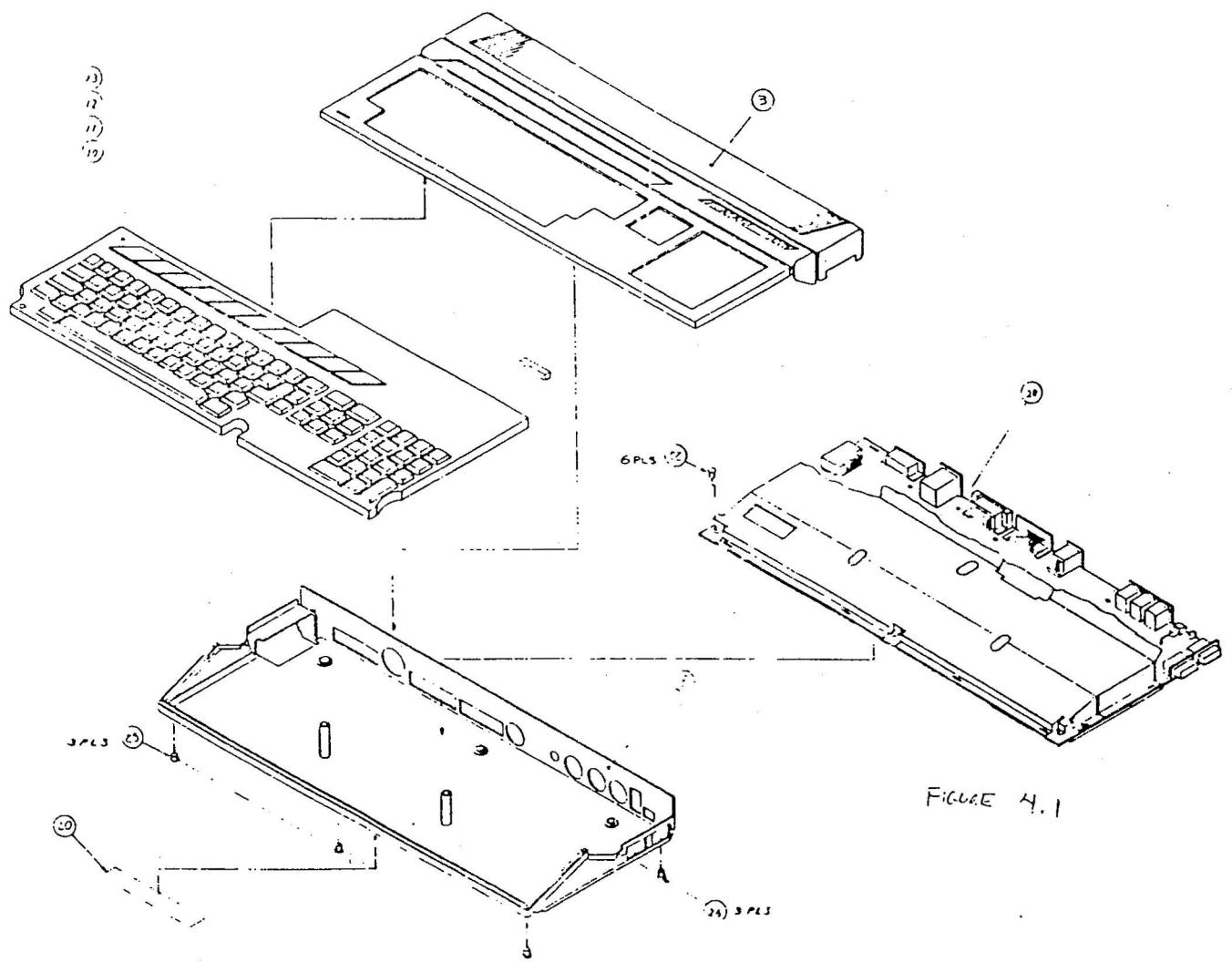


FIGURE 4.1

SECTION FIVE

SYMPTOM CHECKLIST

The Symptom Checklist is designed to help the experienced technician arrive at a rapid diagnosis of problems with the 520ST Computer.

DISPLAY PROBLEMS

Symptom	Probable Cause(s)
Black Screen	Bad power supply; bad GLUE chip; bad Shifter chip; shield shorting main board
White Screen	Address bus problem; bad Shifter chip.
Random Dots/Bars On Screen	Bad Memory Controller chip; bad DRAM; bad Shifter chip
One Color Missing (Red, Green or Blue)	Bad video summer/buffer; bad Shifter chip
Scrambled Screen	Bad GLUE chip; bad vertical/horizontal sync buffer circuit; clock problem; bad Memory Controller

DRIVE INTERFACE PROBLEMS

Symptom	Probable Cause(s)
Disk Doesn't Boot	Bad WD 1772 chip; bad DMA chip; bad sound chip; bad buffer chip; shield shorting to main board.
Busy Light Won't Light Up	Bad sound chip
Busy Light Stays On	Bad WD 1772 chip; bad sound chip
Double Sided Drive Won't Work	Bad sound chip
Drive Won't Format	Bad WD 1772 chip; bad DMA chip

MIDI PROBLEMS

Bad opto-isolator chip; bad 6850 chip; bad buffer chip; bad connector.

RS232 Port Problems

Bad buffers, bad +12 or -12 volts on power supply; bad 68901; bad sound chip; bad connector.

Printer Port Problems

Bad sound chip; bad 68901 chip; bad connector.

Keyboard/Mouse Problems

Bad 6850 chip; bad 68901 chip; bad Keyboard Assembly; bad joystick/mouse connector.

Hard Disk Port Problems

Bad DMA chip; bad WD 1772 chip; bad Memory Controller chip; bad connector.

ST DIAGNOSTIC CARTRIDGE
ERROR CODE QUICK REFERENCE

ERROR CODE	PROBABLE CAUSE(S)
START UP SEQUENCE	
00	Bad Memory Controller; bad DRAM
01,02,03,04	Bad 68901 MFP Chip
05	Bad keyboard assembly; bad 6850 ACIA
06	Bad keyboard assembly.
07	Bad 68000
08	Bad 68901; bad glue chip
09	Bad 68000
0A	Bad glue; bad ROM; bad memory controller address/data base problem
0B	Bad glue; bad ROM; bad memory controller address/data bus problem
0C	Address bus problem
0D	Bad 68000

ERROR CODE

PROBABLE CAUSE(S)

RAM TEST

- 10 Bad Memory Controller; bad DRAM
- 11 Data Bus short; bad DRAM
- 12 Bad Memory Controller; bad DRAM
- 13 Bad Memory Controller

RS232 TEST

- 41,42,43,44 Bad 68901
- 45 Bad buffer (U14, U13); bad 68901
- 46 Bad 68901, Glue chip
- 47, 48, 49 Bad 68901; bad sound chip

MIDI TEST

- 4A,4B,4C,4D,4E Bad 6850, buffer chip U35,U36,U39

ERROR CODE	PROBABLE CAUSE(S)
------------	-------------------

DMA PORT TEST

- | | |
|----------|--------------------------------|
| 51 | Bad DMA, bad memory controller |
| 52,53,54 | Bad DMA chip |

PORTS TEST

- | | |
|-------|---------------------------------|
| 61 | Bad sound chip |
| 62 | Bad 68901 chip |
| 64,65 | Keyboard assembly, shorted port |

FLOPPY DISK TEST

- | | |
|----|--|
| 90 | Bad sound chip |
| 91 | Bad WD 1772, bad buffer |
| 92 | Bad WD 1772; bad DMA, bad buffer (U8) |
| 93 | Diskette not write protected; bad WD 1772 chip |
| 94 | Bad sound chip |
| 95 | Bad WD 1772 |

ERROR CODE	PROBABLE CAUSE(S)
------------	-------------------

FLOPPY TEST (cont.)

96	Bad WD 1772, DMA, buffer
97	Diskette write protected
98	WD 1772; DMA
99	Single sided drive setup as Drive B
9A	DMA chip
9B	DMA chip, memory controller
9C	WD 1772, bad media
9D	WD 1772, bad media
9E	Sound chip
9F	DMA, WD 1772

SECTION SIX

DIAGNOSTIC FLOWCHARTS

This section was written to aid the Service Technician in the trouble shooting and repair of the 520ST Computer. When used along with Section Five, Diagnostic Checklist, finding the malfunction, isolating it and repairing it should be a straightforward process.

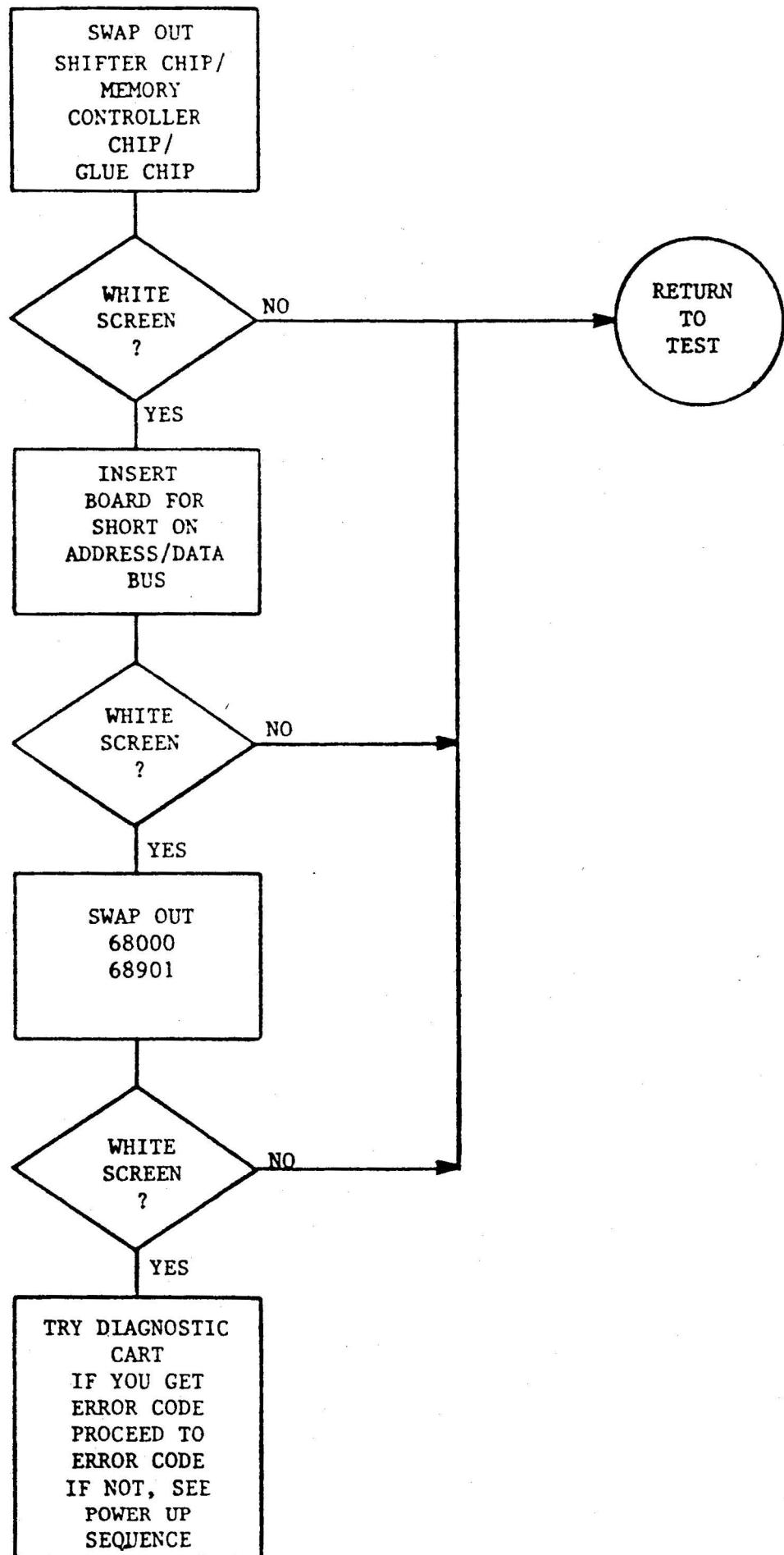
Swap-Out Procedures

At many places in the diagnostic flowchart a box tells you to "swap-out" a chip or a number of chips in a particular order. The "swap-out" instruction means that you should replace the indicated components (one at a time) with a known good component of the same type. The computer should then be tested with the new, known good component in place to see whether the "swap-out" solved the problem being checked. If the new component didn't fix the problem, the new component should be removed and the original component reinserted. In this way, you avoid needlessly replacing good components.

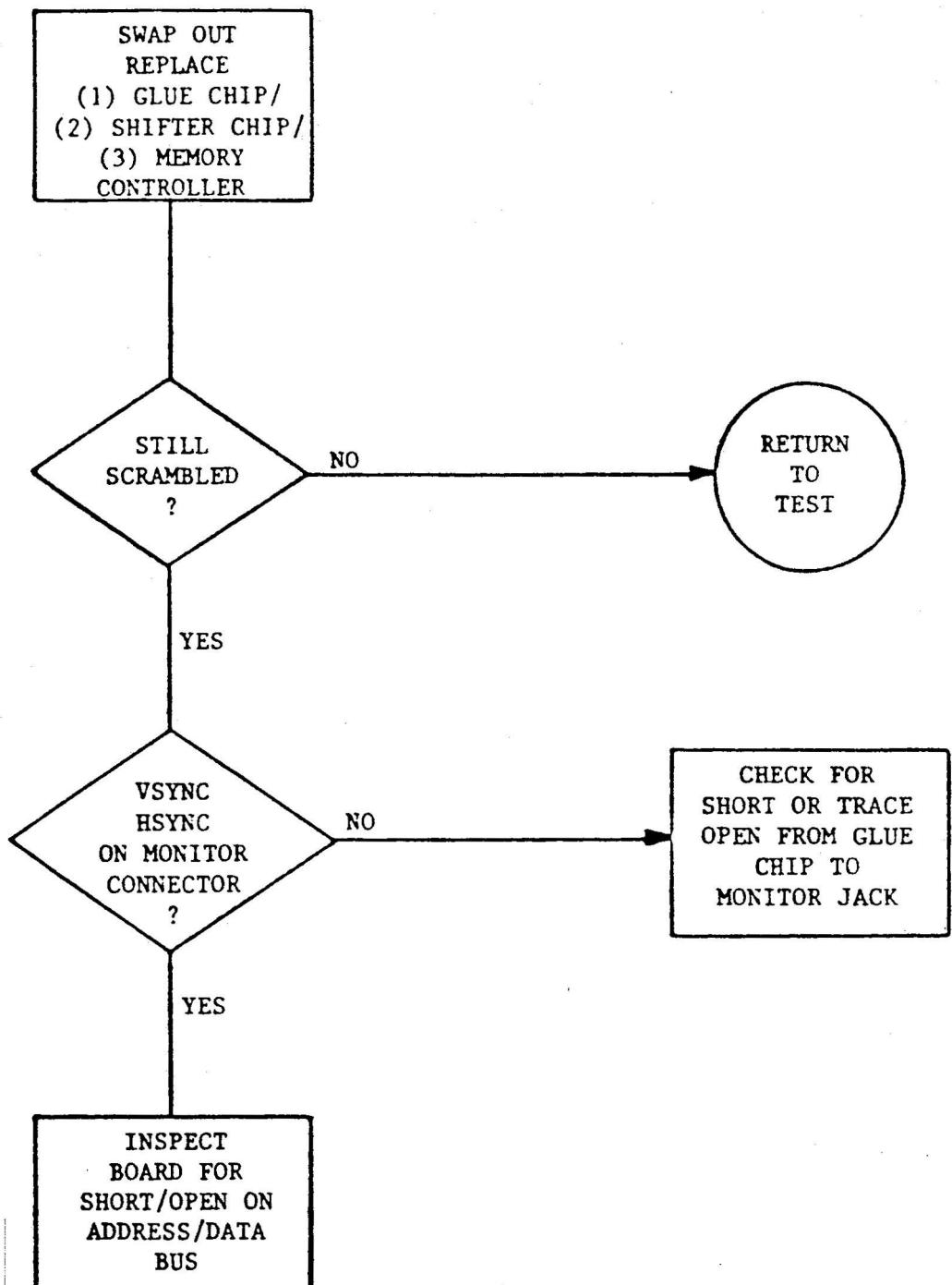
Handling of Integrated Circuits

Extreme care should be taken when handling the integrated circuit chips. They are all very sensitive to static electricity and can easily be damaged by careless handling. Always keep the chip in their plastic carrier tube or on conductive foam when not in use.

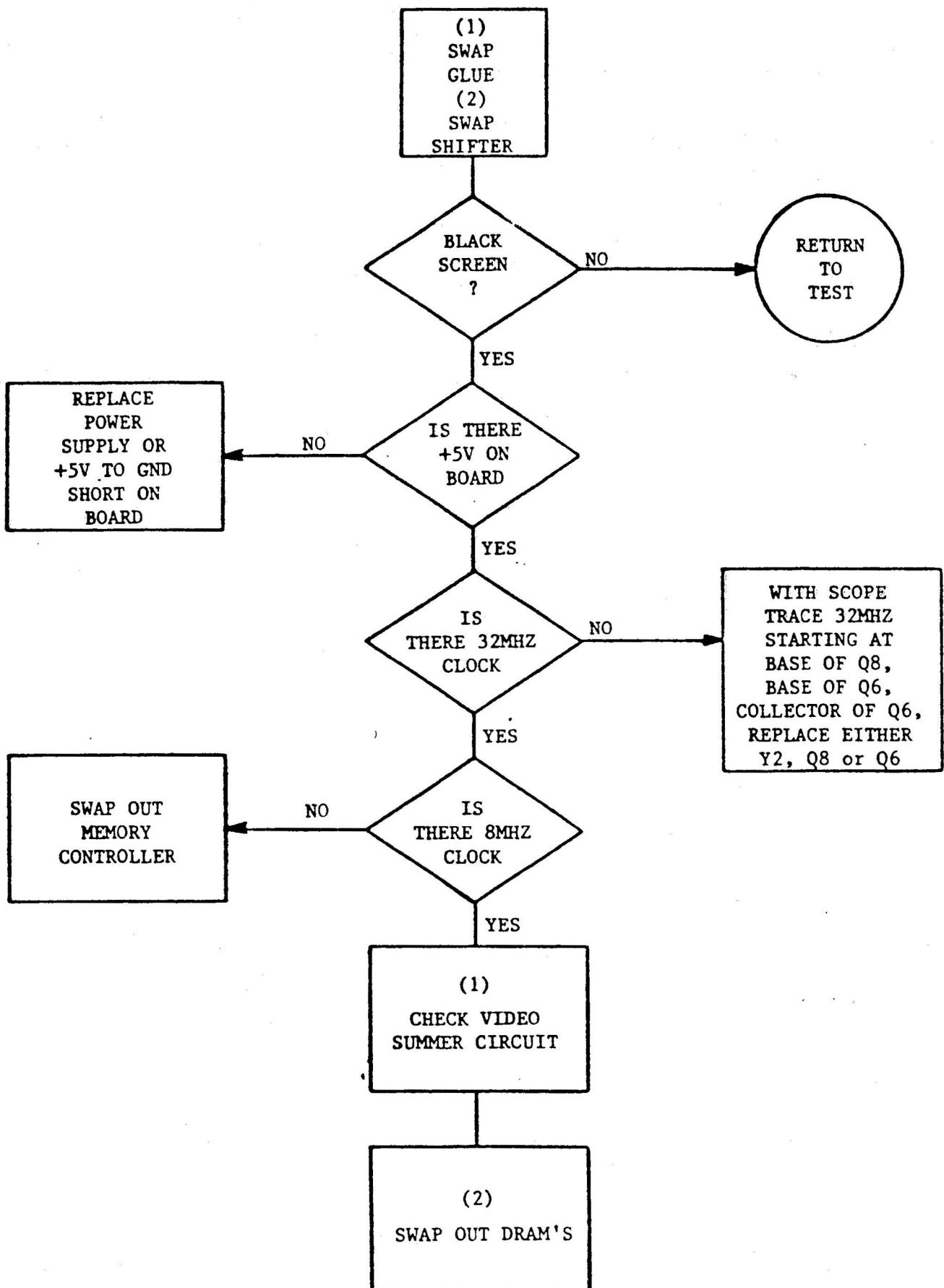
WHITE SCREEN

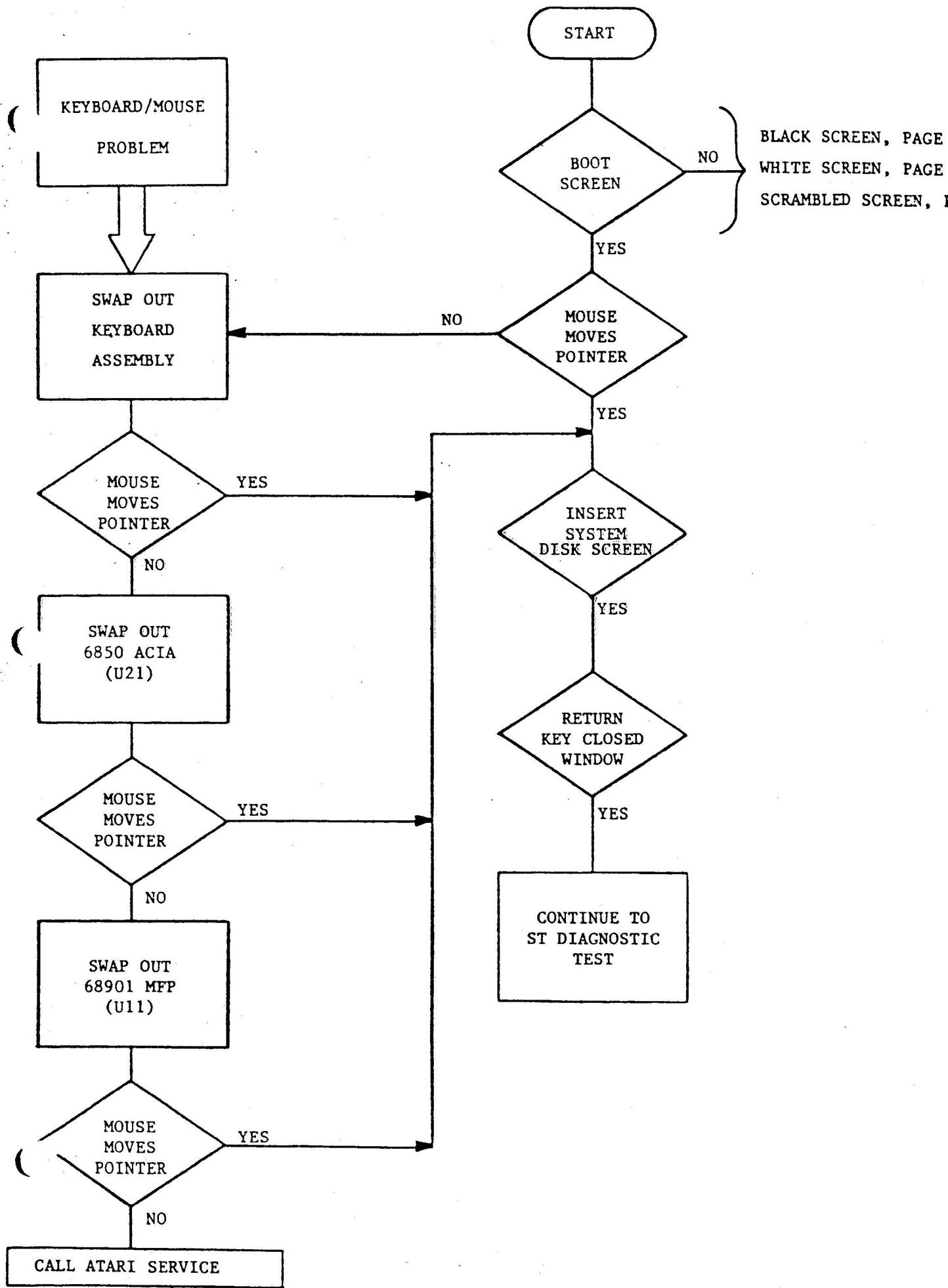


SCRAMBLED SCREEN



BLACK SCREEN





SECTION SEVEN

PARTS LIST

This section contains a complete listing of all parts used in the Atari 520ST Computer.

520ST SERVICE REPAIR KIT

REV A

<u>PART NUMBER</u>	<u>DESCRIPTION</u>	<u>KIT QTY</u>	<u>UNIT COST</u>	<u>EXTENSION</u>
CO25912	IC, Custom MMU	2	38.34	76.68
CO25913	IC, Custom DMA	2	30.12	60.24
CO25914	IC, Custom VIDEO	2	37.41	74.82
CO25915	IC, Custom GLUE	2	27.45	54.90
CO25944	Crystal 32.0424 MHZ	1	1.09	1.09
CC25978-001	Res: Network 10K OHM	1	.16	.16
CO25982	IC, 68000-8 CPU	1	23.10	23.10
CO25983	IC, Custom SOUND	2	4.89	9.78
CO25984	IC, 68901 MFP	2	16.92	33.84
CO25985	IC, 6850 ACIA	1	2.21	2.21
CO25988	IC, PC-900 Photocoupler	2	1.38	2.76
CO25993	Crystal 2.4576 MHZ	1	1.68	1.68
CO26028	IC, WD1772 FFD Contrl	1	17.85	17.85
CO26034	IC, 64K ROM	2	3.15	6.30
CO26035	IC, 64K ROM	2	3.15	6.30
CO70006	Power Switch	1	3.30	3.30
CO70099	Power Supply	2	39.46	78.92
CO70129	Conn. 40-Pin Right	1	1.26	1.26
CO70130	Conn. DB-19-Pin	1	1.80	1.80
CO70131	Conn. 14-Pin, DIN	1	.71	.71
CO70132	Conn. DB-25P	1	1.68	1.68
CO70133	Conn. DB-25S	1	1.68	1.68
CO70134	Conn. 13-Pin, DIN	1	1.02	1.02
CO70135	Conn. 7-Pin, Din	1	1.02	1.02
CO70242	Line Filter	2	1.45	2.90
CA070016-001	Bottom Housing	1	3.40	3.40
CA070020-001	Top Housing	1	3.10	3.10
CA070052-001*	PCB Assembly	1	350.00	350.00
CA070022-001	Keyboard Assembly	1	43.80	43.80
CA070025	Mouse	1	29.78	29.78
CO70258	Keycap Kit	2	7.13	7.13
CO26051-001	Owners Manual	1	3.90	3.90
TOTAL KIT COST				914.24

*Special Kit only cost

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

EFFECTIVE DATE 07/05/85

520ST PARTS PRICE LIST

Page 1 of 2

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>PRICE</u>	<u>MINIMUM ORDER</u>	<u>EXT.</u>
Res; 1/4W 100 OHM	14-5101	0.01	100	1.00
Res; 1/4W 1K OHM	14-5102	0.01	100	1.00
Res; 1/4W 10K OHM	14-5103	0.01	100	1.00
Res; 1/4W 12K OHM	14-5123	0.01	100	1.00
Res; 1/4W 150 OHM	14-5151	0.01	100	1.00
Res; 1/4W 15K OHM	14-5153	0.01	100	1.00
Res; 1/4W 200 OHM	14-5201	0.01	100	1.00
Res; 1/4W 220 OHM	14-5221	0.01	100	1.00
Res; 1/4W 2.4K OHM	14-5242	0.01	100	1.00
Res; 1/4W 27 OHM	14-5270	0.01	100	1.00
Res; 1/4W 3K OHM	14-5302	0.01	100	1.00
Res; 1/4W 33 OHM	14-5330	0.01	100	1.00
Res; 1/4W 33K OHM	14-5333	0.01	100	1.00
Res; 1/4W 3.6K OHM	14-5362	0.01	100	1.00
Res; 1/4W 47 OHM	14-5470	0.01	100	1.00
Res; 1/4W 4.7K OHM	14-5472	0.01	100	1.00
Res; 1/4W 560 OHM	14-5561	0.01	100	1.00
Res; 1/4W 5.6K OHM	14-5562	0.01	100	1.00
Res; 1/4W 6.8K OHM	14-5682	0.01	100	1.00
Res; 1/4W 7.5K OHM	14-5752	0.01	100	1.00
Res; 1/4W 820 OHM	14-5821	0.01	100	1.00
Res; 1/4W 8.2K OHM	14-5822	0.01	100	1.00
Diode: 1N914	31-1N914	0.15	10	1.50
Transistor; 2N3904	34-2N3904	0.11	10	1.10
Cap; Ceramic Axial 22PF 50V	CO14179-01	0.04	25	1.00
Cap; Ceramic Axial 33PF 50V	CO14179-04	0.03	50	1.50
Cap; Ceramic Axial 68PF 50V	CO14179-10	0.04	25	1.00
Cap; Ceramic Axial 680PF 50V	CO14179-17	0.03	50	1.50
Cap; Ceramic Axial 15PF 50V	CO14179-18	0.04	25	1.00
Cap; Ceramic Axial 100PF 50V	CO14179-19	0.03	50	1.50
Cap; Ceramic Axial 30PF 50V	CO14179-30	0.03	50	1.50
Cap; Ceramic Axial 8.2PF 50V	CO14179-33	0.03	50	1.50
Cap; Ceramic Axial 4700PF 50V	CO14180-08	0.04	25	1.00
Cap; Ceramic Axial .01UF 25V	CO14180-18	0.09	25	2.25
Cap; Ceramic Axial 0.1UF 25V	CO14181-03	0.08	25	2.00
Cap; Ceramic Axial 0.22UF 25V	CO14181-05	0.24	10	2.40
Cap; Ceramic Axial 0.47UF 25V	CO14181-07	0.09	25	2.25
IC, 74LS244	CO14313	1.18	2	2.36
IC, 74LS02	CO14340	0.63	2	1.26
Inductor, Axial 1OHU 5%	CO14381	0.10	10	1.00
Inductor, Ferite Bead Axial	CO14384	0.04	25	1.00
IC, 74LS04	CO17096	0.29	4	1.16
IC, 74LS05	CO17242	0.29	4	1.16
Inductor, Axial 1UH 10%	CO17948-05	0.11	10	1.10
Conn. DB-9 Pin (Joy/Mouse)	CO19062	0.41	4	1.64
IC, CUSTOM MMU	CO25912*	38.34	1	38.34
IC, CUSTOM DMA Controller	CO25913*	30.12	1	30.12
IC, CUSTOM Video Shifter	CO25914*	37.41	1	37.41
IC, CUSTOM Glue Chip	CO25915*	27.45	1	27.45
Crystal 32.0424 MHZ	CO25944*	1.09	1	1.09
Res; NETWORK 10K OHM X 9	CO25978-001*	0.16	5	0.80
IC, 68000-8 CPU	CO25982*	23.10	1	23.10

520ST PARTS PRICE LIST

Page 2 of 2

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>PRICE</u>	<u>MINIMUM ORDER</u>	<u>EXT.</u>
IC, CUSTOM Sound Chip	CO25983*	4.89	1	4.89
IC, 68901 MFP	CO25984*	16.92	1	16.92
IC, 6850 ACIA	CO25985*	2.21	1	2.21
IC, 1488 RS-232 Driver	CO25986	0.63	2	1.26
IC, 1489 RS-232 Receiver	CO25987	0.63	2	1.26
IC, PC-900 Photocoupler	CO25988*	1.38	2	2.76
IC, 556 Dual Precision Timer	CO25989	0.74	2	1.48
IC, 256K X 1 DRAM 150ns	CO25991	11.40	1	11.40
IC, 74LS373	CO25992	1.08	1	1.08
Crystal 2.4576 MHZ	CO25993*	1.68	1	1.68
IC, WD1772 FFD Controller	CO26028*	17.85	1	17.85
IC, 64K ROM	CO26034*	3.15	1	3.15
IC, 64K ROM	CO26035*	3.15	1	3.15
Owners Manual	CO26051-001*	3.90	1	3.90
Diode; 1N4148	CO60607	0.04	25	1.00
Power Switch SPDT Rocker	C061022	1.15	1	1.15
Power Switch SPDT Rocker	C070006*	1.28	1	1.28
Conn. 5 Pin, DIN MIDI	C070033	0.30	5	1.50
Shield Cap	C070071	0.25	4	1.00
Shield Box	C070076	0.38	3	1.14
Bottom Shield	C070077	1.54	1	1.54
Power Supply	C070099*	39.46	1	39.46
Push Switch	C070119	0.42	4	1.68
Conn. 40 Pin Right Angle	C070129*	1.26	2	2.52
Conn. DB-19 Pin (Hard Disk)	C070130*	1.80	2	3.62
Conn. 14 Pin, DIN	C070131*	0.71	2	1.42
Conn. DB-25P, RS-232C	C070132*	1.68	2	3.36
Conn. DB-25S, Parallel	C070133*	1.68	2	3.36
Conn. 13 Pin DIN, Video	C070134*	1.02	2	2.04
Conn. 7 Pin DIN, Male/Power	C070135*	1.02	2	2.04
Conn. 18 Pin SIL, Keyboard	C070136	0.25	4	1.00
Cap; Ceramic Axial 100PF 50V	C070149-008	0.03	50	1.50
Cap; Elec. Radial 22UF 16V	C070157-002	0.06	25	1.50
Cap; Elec. Radial 47UF 16V	C070157-004	0.10	25	2.50
Cap; Elec. Radial 1UF 50V	C070158	0.11	10	1.10
Res: NETWORK 4.7K OHM X 9	C070159-007	0.16	10	1.60
Inductor; Axial 0.27UH 20%	C070205	0.02	50	1.00
IC, 7406	C070210	0.46	4	1.84
Noise Filter; ZJS5101-02	C070241-002	0.20	5	1.00
Line Filter; SNH19L-0601-4	C070242*	1.45	1	1.45
Bottom Housing	CAO70016-001*	3.40	1	3.40
Top Housing	CAO70020-001*	3.10	1	3.10
Keyboard Assembly	CAO70022-001*	43.80	1	43.80
MOUSE	CAO70025*	29.78	1	29.78
PCB Assembly	CAO70052-001*	400.00	1	400.00
Keycap Kit (94 keys)	C070258*	7.13	1	7.13
520ST Service Kit (All *'s)	T/B/A	914.24	1	914.24

PRICE SUBJECT TO CHANGE WITHOUT NOTICE
EFFECTIVE DATE 7/05/85

520ST DOMESTIC (NTSC)

PARTS LIST (Page 1 of 4)

<u>LOCATOR</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
R43	14-5101	Res; 1/4W 100 OHM
R3,5,7,13-15,30,31 R44,45,74,103,105, R107,111	14-5102	Res; 1/4W 1K OHM
R9,10,12,93	14-5103	Res; 1/4W 10K OHM
R82,83	14-5123	Res; 1/4W 12K OHM
R109	14-5151	Res; 1/4W 150 OHM
R55,58,61	14-5153	Res; 1/4W 15K OHM
Alt/for R16	14-5201	Res; 1/4W 200 OHM
R16,41,76-80	14-5221	Res; 1/4W 220 OHM
R62-64	14-5242	Res; 1/4W 2.4K OHM
R42	14-5270	Res; 1/4W 27 OHM
R39	14-5302	Res; 1/4W 3K OHM
R118-126	14-5330	Res; 1/4W 33 OHM
R67	14-5333	Res; 1/4W 33K OHM
R53,56,69	14-5362	Res; 1/4W 3.6K OHM
R100,101	14-5470	Res; 1/4W 47 OHM
R1,2,4,6,11,29, R32,75,81,86,102	14-5472	Res; 1/4W 4.7K OHM
R84	14-5561	Res; 1/4W 560 OHM
R85	14-5562	Res; 1/4W 5.6K OHM
R68	14-5682	Res; 1/4W 6.8K OHM
R54,57,60	14-5752	Res; 1/4W 7.5K OHM
R40	14-5821	Res; 1/4W 820 OHM
R38	14-5822	Res; 1/4W 8.2K OHM
CR1,2,3,7	31-1N914	Diode: 1N914
Q1,2,6,8	34-2N3904	Transistor; 2N3904
C76	CO14179-01	Cap; Ceramic Axial 22PF 50V
C52	CO14179-04	Cap; Ceramic Axial 33PF 50V
C56	CO14179-10	Cap; Ceramic Axial 68PF 50V
C72,101,103	CO14179-17	Cap; Ceramic Axial 680PF 50V
C67	CO14179-18	Cap; Ceramic Axial 15PF 50V

520ST DOMESTIC (NTSC)
PARTS LIST (Page 2 of 4)

<u>LOCATOR</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
C18,19,20,21 Alt/for CO70149-008	CO14179-19	Cap; Ceramic Axial 100PF 50V
C10,11	CO14179-30	Cap; Ceramic Axial 30PF 50V
C63	CO14179-33	Cap; Ceramic Axial 8.2PF 50V
C74	CO14180-08	Cap; Ceramic Axial 4700PF 50V
C48,49	CO14180-18	Cap; Ceramic Axial .01UF 25V
C1-9,12-17,22-25,29, C32,35,40,46,47,54, C59,60,70,71,90-92, C95,100,102	CO14181-03	Cap; Ceramic Axial 0.1UF 25V
C26-28,30,36-39,41, C42,44,45,57,78-80	CO14181-05	Cap; Ceramic Axial 0.22UF 25V
C73	CO14181-07	Cap; Ceramic Axial 0.47UF 25V
U26,27	CO14313	IC, 74LS244
U40	CO14340	IC, 74LS02
L29	CO14381	Inductor, Axial 1OUH 5%
L17,21,23-28,30,31	CO14384	Inductor, Ferite Bead Axial
U35	CO17096	IC, 74LS04
U36	CO17242	IC, 74LS05
L19,22	CO17948-05	Inductor, Axial 1UH 10 %
J10,11	CO19062	Conn. DB-9 Pin (Joy/Mouse)
U15	CO25912	IC, CUSTOM MMU
U1	CO25913	IC, CUSTOM DMA Controller
U31	CO25914	IC, CUSTOM Video Shifter
U12	CO25915	IC, CUSTOM Glue Chip
Y2	CO25944	Crystal 32.0424 MHZ
PR1,2,3,5,6	CO25978-001	Res; NETWORK 10K OHM X 9
U10	CO25982	IC, 68000-8 CPU
U19	CO25983	IC, CUSTOM Sound Chip
U11	CO25984	IC, 68901 MFP
U20,21	CO25985	IC, 6850 ACIA
U14	CO25986	IC, 1488 RS-232 Driver
U13	CO25987	IC, 1489 RS-232 Receiver
U39	CO25988	IC, PC-900 Photocoupler

520ST DOMESTIC (NTSC)
PARTS LIST (Page 3 of 4)

<u>LOCATOR</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
U37	C025989	IC, 556 Dual Precision Timer
U16-18,24,25,28,29,30, U32,33,34,38,42,43,44,45	C025991	IC, 256K X 1 DRAM 150ns
U22,23	C025992	IC, 74LS373
Y1	C025993	Crystal 2.4576 MHZ
U9	C026028	IC, WD1772 FFD Controller
U4	C026034	IC, 64K ROM
U7	C026035	IC, 64K ROM
	C026051-001	Owners Manual
-Alt/for 31-IN914	CO60607	Diode; IN4148
SW1	C061022	Power Switch SPDT Rocker
Alt/for CO61022	C070006	Power Switch SPDT Rocker
J7,8	C070033	Conn. 5 Pin, DIN MIDI
PCB	C070071	Shield Cap
PCB	C070076	Shield Box
PCB	C070077	Bottom Shield
	C070099	Power Supply
SW2	C070119	Push Switch
J1	C070129	Conn. 40 Pin Right Angle
J2	C070130	Conn. DB-19 Pin (Hard Disk)
J3	C070131	Conn. 14 Pin, DIN
J4	C070132	Conn. DB-25P, RS-232C
J5	C070133	Conn. DB-25S, Parallel
J6	C070134	Conn. 13 Pin DIN, Video
J9	C070135	Conn. 7 Pin DIN, Male/Power
J12	C070136	Conn. 18 Pin SIL, Keyboard
C18-21	C070149-008	Cap; Ceramic Axial 100PF 50V
C50,55	C070157-002	Cap; Elec. Radial 22UF 16V
C33	C070157-004	Cap; Elec. Radial 47UF 16V
C31,34	C070158	Cap; Elec. Radial 1UF 50V

520ST DOMESTIC (NTSC)
PARTS LIST (Page 4 of 4)

<u>LOCATOR</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
RP4	CO70159-007	Res: NETWORK 4.7K OHM X 9
L20	CO70205	Inductor; Axial 0.27UH 20 %
U8	CO70210	IC, 7406
L5-15,12-16,55,83,91,92	CO70241-002	Noise Filter; ZJS5101-02
L3	CO70242	Line Filter; SNH19L-0601-4
Console	CAO70016-001	Bottom Housing
Console	CAO70020-001	Top Housing
Keyboard	CAO70022-001	Keyboard Assembly
	CAO70025	MOUSE
	CAO70052-001	PCB Assembly
Keyboard	CO70258	Keycap Kit (94 keys)
	T/B/A	520ST Service Kit

FIELD UPDATE

No. 1

The following is a list of problems found in initial computers shipped that have since been corrected. Should you encounter an early unit, its problems may be one of the following:

Problem: Sticky tape under 68 pin square chips; if incorrectly installed, the tape will cause intermittent contact on pins.

Solution: Remove tape altogether.

Problem: Component leads are too long causing shorts to bottom shield or shorts between two leads.

Solution: Cut leads if they are too long.

Problem: Power supply cable on computer and floppy not meeting correctly.

Solution: Cut approximately 1/8 inch ring from edge of plastic shroud on the metal portion of power supply connector.

Problem: Shields shorting near joystick or RS 232 port.

Solution: Realign leg and bend tab outward keeping leg straight.

Problem: Bottom shield insulator.

Solution: If insulator holes are same size as shield holes, replace insulator. If no new insulator is available, install 4 pieces of 1/4 inch thick styrofoam between insulator and solder side of PCB, strategically placed such that shield is pushed away from leads at hold edges.

Problem: Long leads on noise filter (L55-L66)(L67-L73)(L74-L83) are shorting if improperly inserted in board.

Solution: Cut excess lead length and resolder to board.