

ATARI
400/800

Service Manual

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CHAPTER 1 - GENERAL INFORMATION

1.1 INTRODUCTION

This 400/800 System Service Manual is a reference guide for the service technician. The information presented in this manual, when used in conjunction with ATARI training, will enable a service technician to install, operate, and maintain the ATARI 400/800 Computer Systems.

In addition to basic user operating instructions, this manual includes procedures that describe operating the ATARI 400/800 Computer Console in conjunction with peripheral equipment for maintenance purposes.

This manual further describes the functional operation of the 400/800 ATARI Computer Consoles and provides detailed procedures for its maintenance. This information will enable a service technician to troubleshoot and repair the ATARI 400/800 Computer Consoles to the replaceable integrated circuit level. None of the procedures included require special test equipment or tools. This manual also provides spare parts ordering information to replace expended units and/or assemblies, and the fault reporting procedures required.

1.2 ATARI 400/800 COMPUTER CONSOLE DESCRIPTION

The ATARI 400/800 Computer Consoles, see Figure 1-1, are personal microcomputers designed to provide entertainment, in the form of games; education, using interactive, audio-visual, education programs; information, providing a serious tool for home and business information management; plus perform all the functions of a fully programmable general purpose computer.

The ATARI 400 Computer Console contains the central processor unit (CPU) and memory in the form of the Operating System read-only-memory (ROM) and 8K (8 x 1 024 bytes) of user programmable random access memory (RAM), expandable to 16K (16 x 1024 bytes). The Console also holds the keyboard, cartridge slot, controller jacks, and a serial I/O port for connecting to peripheral devices.

The ATARI 800 Computer Console contains the central processor unit (CPU) and memory in the form of the Operating System read-only-memory (10K ROM) and 8K-16K (standard) of user programmable random-accessmemory (RAM), and two Expansion Sockets for additional RAM modules (maximun 48K). The Console also holds the keyboard, cartridge slots, controller jacks and a serial I/O port for connecting to peripheral devices.



Figure 1-1. The ATARI 400/800 Computer Consoles

1.3 HOW TO USE THIS MANUAL

This manual is organized into six chapters:

- Chapter 1 General Information
- Chapter 2 Installation
- Chapter 3 System Operation
- Chapter 4 Functional Description
- Chapter 5 Maintenance
- Chapter 6 Spare Parts List and Ordering/Reporting Information

Each chapter contains only the information needed to fulfill its function. If a given subject applies to more than one chapter, then the subject will be discussed in the chapter where it is most used; other chapters would then refer to the chapter and paragraph containing the subject.

First- and second-level paragraphs in the manual contain unique 2- and 3-digit numbers, respectively, in the paragraph heading. The first digit is always the same as the number of the chapter. Third- and fourth-level paragraphs contain lower case letters and numbers in parentheses, respectively, in the paragraph heading. Paragraphs are referenced in text by their number (e.g., 5.4.2 and 5.4.9c).

Figures and tables are numbered sequentially on a chapter basis. The first digit of a figure or table number is always the number of the chapter. Tables appear one time, following their first reference in text.

Figures also appear one time after their first reference in text, unless repeating the figure is easier than having the reader refer back.

1.3.1 General Information

This chapter contains a general description of the ATARI 400/800 Computer Consoles, a physical description of the system (dimensions, weights, and operating specifications), and a summary of the peripheral equipment used with the system. All system operating features and options are described.

This chapter also contains general information such as the scope of the manual and how to use the information in it. Also, it provides safety precautions unique to the ATARI 400/800 Computer Systems and a listing of related documents.

1.3.2 Installation

Chapter 2 contains detailed procedures for unpacking, system setup and initialization, checkout and repacking.

1.3.3 System Operation

Chapter 3 contains procedures for system power-up, using the keyboard and screen editor functions, using program cartridge system keys, and controllers and operating the program cassette recorder.

1.3.4 Functional Description

Chapter 4 provides a functional description of the ATARI 400/800 Computer Console systems. The functional description will be presented using a functional block diagram discussion to the integrated circuit level. This information is presented to familiarize the service technician with the ATARI 400/800 Computer Console as a system, thereby providing him/her with a basis for troubleshooting system faults.

1.3.5 Maintenance

Chapter 5 presents preventive maintenance, troubleshooting, and repair instructions. Preventive maintenance includes instructions for normal cleaning and inspection tasks. The troubleshooting portion of the chapter presents symptom probable-cause corrective action types of tables. The repair portion of the chapter provides instructions for replacing printed circuit assemblies, whole assemblies, and specific integrated circuits in keeping with the ATARI maintenance philosophy.

Chapter 6 provides ATARI part numbers for the field replaceable units of the 400/800 Computer Console system. The chapter also provides information for ordering the parts through the nearest ATARI parts distribution center. In addition chapter 6 provides information on how to use the Fault Reporting System.

1.4 CHANGES TO THIS MANUAL

This manual will periodically be updated or changed to keep it current with changes in the ATARI 400/800 Computer Console systems. Changes normally start with ATARI Customer Support issuing a "Tech Tips" that alerts the service technician to such things as changes in maintenance procedures and critical problem areas. After either a series of these Tech Tips are issued or one of an extremely critical nature is issued, service manual change pages are published. These pages are of the remove-the-old-and-insert-the-new type. A vertical bar in the margin of the changed page indicates the revised material. After about 20% of a manual's pages are changed, Customer Support Publications reissues the entire manual.

1.4.1 Notice of Changes Page

The Notice of Changes page, see Figure 1-2, contains instructions for changing this manual. It will come with pages intended to replace outdated pages in the manual. The Notice contains the affected page number and the action required to make the changes. After making the necessary changes, insert the Notice at the end of the manual to keep a current record of changes.

1.4.2 List of Effective Pages

The List of Effective Pages on the back of this manual's title page lists all the pages in this book, including the title page, the List of Effective Pages, deleted pages, added pages, and foldout pages.

1.4.3 Reader Comment Form

ATARI Customer Support Publications Department created the Reader Comment Form (at the back of this manual) to get feedback from the service technician about our manuals. If you are in any way dissatisfied with this publication, we want to hear from you. Tell us about technically inaccurate information, gross typographical errors, or missing information. If you know a way to improve a procedure, please let us know that, too. When filling out the form, be specific and give the page number and a line reference with paragraph number, if possible.

NOTICE OF CHANGES

NOTICE OF CHANGES

This NOTICE OF CHANGES contains instructions for changes required for an ATARI Personal Computer manual. The affected document title, ATARI number, issue number, and issue date are identified below.

The NOTICE OF CHANGES page indicates the affected page number and action required. The type of change may be specified as "add" or "delete".

Insert this NOTICE OF CHANGES at the end of the affected document to maintain a record of changes.

CHANGE INFORMATION

DOCUMENT TITLE _____

ATARI NUMBER _____ ISSUE _____ ISSUE DATE _____

NOTICE OF CHANGE NUMBER _____ DATE ISSUED _____ SHEET _____



 A Warner Communications Company

Figure 1-2. Sample Notice of Changes Page

1.5 SAFETY

As with any electronic equipment, precautions consistent with all standard industrial safety practices must be observed while maintaining the ATARI 400/800 Computer Console systems. A current of 10 mA can put the human heart in fibrillation and a current of only 100 mA can cause it to stop completely. Since human skin resistance is normally about 300 ohms, any voltage in excess of 30 volts can be lethal.

Notices are included throughout this manual to alert you to problem areas or dangerous situations.

A WARNING statement will precede the text of a procedure that, if not strictly observed, could result in injury or death of the service technician.

A CAUTION statement will precede the text of a procedure that, if not strictly observed, could result in damage to or destruction of equipment hardware or software.

A NOTE statement will highlight an essential operating or maintenance procedure, condition, or clarifying fact. Notes will also be used to provide information that, though not necessary, will be helpful to understanding a concept or completion of a procedure.

1.6 RELATED DOCUMENTATION

This service manual provides only that information necessary for a service technician to install, operate, and maintain the ATARI 400/800 Computer Console systems.

Other documents published by ATARI, other manufacturers, and publishing houses may be helpful to the service technician. The following documents apply directly to the ATARI 400/800 Computer Consoles systems:

ATARI 400 Operator's Manual	CO14768
ATARI 800 Operator's Manual	CO14769
ATARI 810 Disk Drive Operator's Manual	CO14760
ATARI 820 Printer Operator's Manual	CO14762
ATARI 400/800 Basic Reference Manual	CO15307
ATARI BASIC	CO14385

The ATARI 400 and 800 Computer Consoles are general purpose microcomputers based upon the 6502 microprocessor. The ATARI 400/800 Consoles, see Figure 1-3, are the central processing units (CPU) for their respective systems. Each console comes standard with a built in keyboard. 8K/16K of RAM, ROM operating systems, connector jacks for adding peripherals and hand controllers, and a 15 foot RF cable for connection to a user's television set.

The controller jacks on the front of both the 400 and 800 Consoles accept any of the three types of hand controllers available from ATARI.

The side panel of the 400 Console, see Figure 1-4, contains a peripheral jack, power ON/OFF switch, and a power jack. A channel 2/3 switch is located on the back of the console to switch the console to channel 2 or channel 3 transmission frequency.

The side panel of the 800 Console, see Figure 1-5, contains a monitor jack, a peripheral jack, a channel 2/3 switch, a power ON/OFF switch, and a power jack.

Both the 400 and 800 Console keyboards provide a full alphanumeric character set, cursor controls, and special purpose keys. The alphabet keys when used in conjunction with the CTRL (Control) key become special graphic symbols. To the right of the keyboard is the power ON light and four special control switches. From top to bottom they are:

SYSTEM RESET - Interrupts whatever the computer is doing and restarts the Operating System or Program Cartridge

OPTION - Interrupt used by the Program Cartridge to choose among the variations within a game or program

SELECT - Interrupt used to select one of several games or programs in the Program Cartridge

START - Interrupt used to Start the game or program selected from the Program Cartridge

The AC Power Adapter provides the 9 Vac used by the 400 and 800 Computer Consoles. The AC Power Adapter plugs into a standard wall outlet and converts the 110V ac line voltage to the 9V ac required by the Consoles. The power cord from the AC Power Adapter plugs into the power jack on either the 400 or 800 Console.

The TV Switch Box allows the 400/800 Computer Console to be connected to the normal 300 ohm RF antenna inputs on a typical television set.

The Program Cassette Recorder provides 400K bytes of storage (120



Figure 1-3. ATARI 400/800 Computer Console Systems

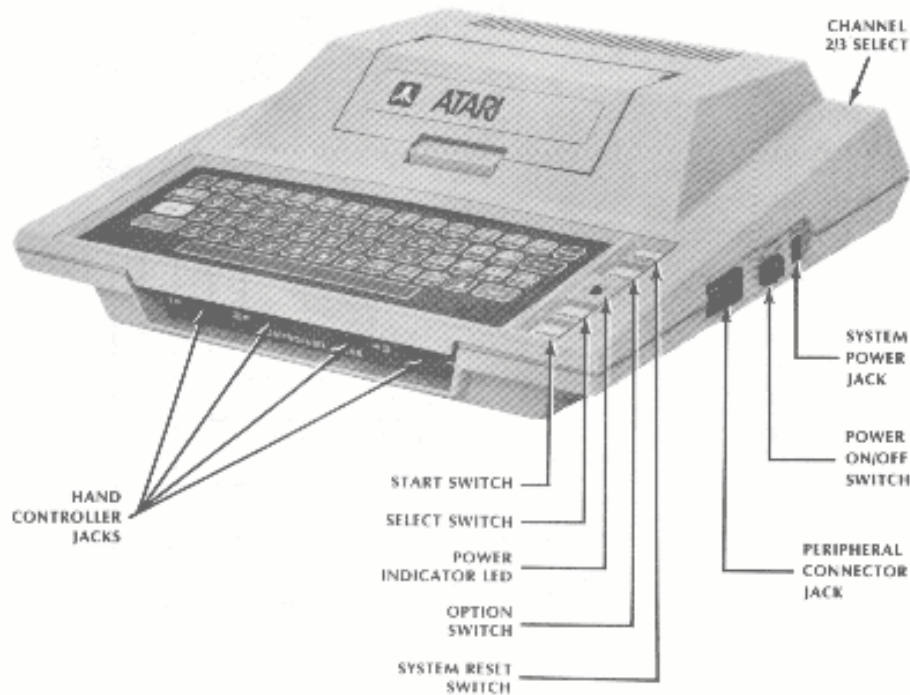


Figure 1-4. ATARI 400 Computer Console, Side View

minute cassette) for the Consoles. The Program Cassette Recorder plugs into the peripheral serial I/O port. The Program Cassette Recorder has two channels, a data channel for video display and an audio channel. Prerecorded tape contains an audio track that allows narration and music to accompany the tapes using the television speakers. Programs recorded by the user onto cassette tape can only record on the data channel. There are six control buttons on the Program Cassette Recorder, from left to right they are:

1. Record
2. Rewind
3. Play
4. Advance (fast forward)
5. Stop/Eject
6. Tape Counter Reset Button
7. Pause (Available on some models)

The "BASIC" Program Cartridge provided as a standard feature with both the 400 and 800 Computer Consoles contains the ATARI BASIC Interpreter. When plugged into the Console Cartridge Slot (one cartridge slot in the 400 Console, left cartridge slot in the 800 Console) the user can write programs in 'BASIC' programming language. Programs written by the user are stored in the Console's RAM memory and are erased when power is turned off. The BASIC Program Cartridge is marked 'LEFT CARTRIDGE' indicating insertion in the left cartridge slot only. An ATARI Educational System Program Cartridge and cassette tapes are

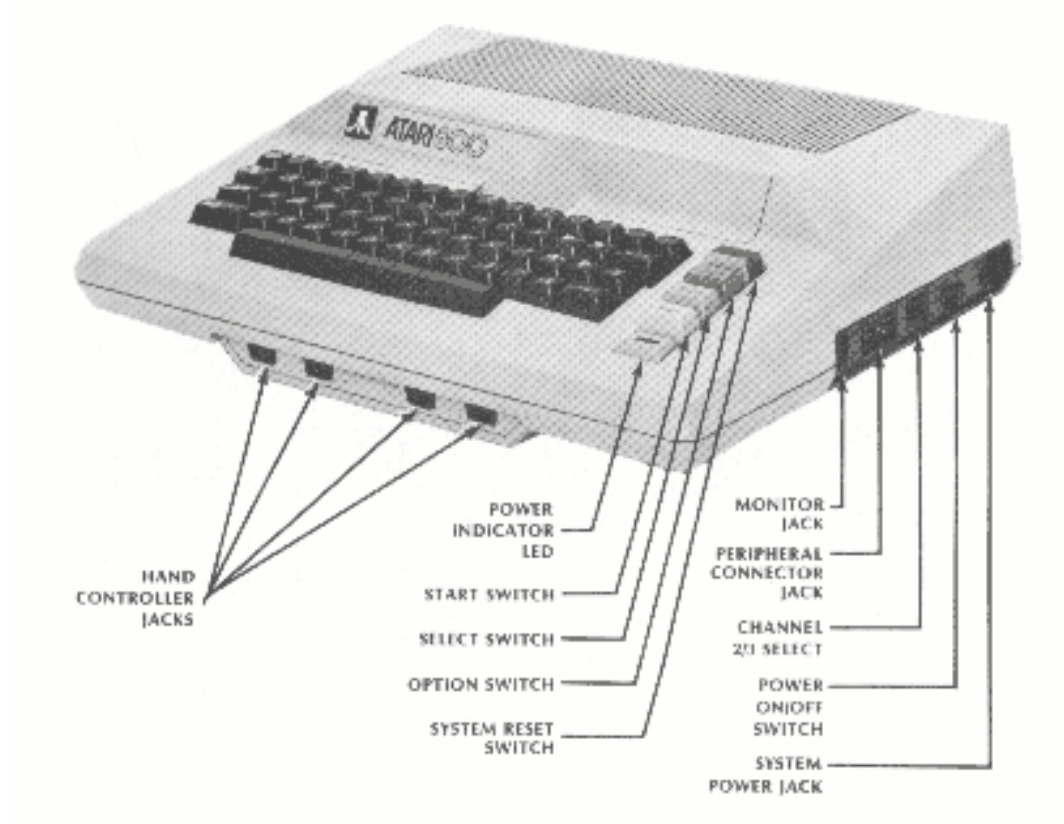


Figure 1-5. ATARI 800 Computer Console, Side View

provided as a standard feature with the 800 Computer Console. The Program Cartridge when inserted in the Computer Cartridge slot provides a self-paced learning tool. The Program prompts the student with instructions when to load additional information from the Program Cassette Recorder.

1.8 OPTIONAL EQUIPMENT

The list of optional equipment is broken up into two categories—optional peripheral devices and accessory units. The following is a list of the equipment in each of these categories, some items not yet available. call ATARI for details:

PERIPHERALS

- ATARI 410 Program Cassette Recorder
- ATARI 810 Disk Drive
- ATARI 815 Dual Disk Drive (Double Density)
- ATARI 820 Printer (40 Column Impact)
- ATARI 822 Thermal Printer (40 Column)
- ATARI 825 Printer (80 Column Impact)
- ATARI 830 Acoustic Modem
- ATARI 850 Interface Module

ACCESSORIES

CX852	8K RAM Memory Module
CX853	16K RAM Memory Module
CX70	ATARI Light Pen
CX30-04	Paddle Controller Pair
CX40-04	Joystick Controller Pair
CX81	ATARI I/O Data Cord (3 feet)
CX86	Printer Cable (included with ATARI 825)
CX87	Modem Cable (included with ATARI 830)
CX88	Interface Module Cable
CX89	Monitor Cable (Color Monitor)
CX82	Monitor Cable (B/W Monitor)
CA014746	TV Switch Box
CA014748	Power Adapter (included with ATARI 400, 800, 810, 850)
C014854	ATARI 8 20 Printer Ribbon
C014026	ATARI 820 Printer Paper (Roll Paper)
CX4100	ATARI 410 Digital Cassette (Blank)
CX8100	ATARI Blank Diskettes (5 per box)
CX8101	ATARI 810 Master Diskette (1 per box)
CX8104	ATARI 810 Master Diskette II (1 per box)
CX8111	ATARI 810 Formatted Diskettes II (5 per box)
CX8201	ATARI 815 Master Diskette (1 per box)

1.9 SPECIFICATIONS

This paragraph provides the operating characteristics and specifications useful to a service technician for maintaining the ATARI 400/800 Computer Console systems. All specifications and characteristics are presented in Tables 1-1 and 1-2.

Table 1-1. ATARI 400 Computer Console Specifications

Console:	FCC approved with built-in RF modulator.
CPU:	6502B Microprocessor; 1.78 MHz clock.
Color:	16 colors, each with 8 intensities.
Sound:	Four independent sound synthesizers for musical tones or game sounds, four octaves. Variable volume. Internal speaker (in addition to audio through television set).
Memory:	8K bytes of Random Access Memory (RAM) is included. The ATARI 400 may be expanded to 16K at your service center. 10K bytes ROM Operating System, expanded to 16K with user installed solid-state Program Cartridges.
Keyboard:	57 alphanumeric keys plus 4 function keys. Upper/lower case, Inverse video. Full screen editing. Four-way cursor control with 29 keystroke graphics.

Table 1-1. ATARI 400 Computer Console Specifications (continued)

I/O: Serial input/output port for simple connection to peripherals. Four controller jacks for joystick and paddle controllers.

Language: ATARI BASIC 8K ROM Program Cartridge is included.

Display: Highest graphics resolution 320x192, 24 lines of 40 characters.

Power: AC step-down transformer. UL approved.

Dimensions: 13.5 x 11.5 x 4.5 inches. 5.75 pounds.

Table 1-2. ATARI 800 Computer Console Specifications

Console: FCC approved, with built-in RF modulator. Connects to any television set.

CPU: 6502B Microprocessor, 1.78 MHz clock

Color: 16 Colors, each with 8 intensities.

Sound: Four independent sound synthesizers for musical tones or game sounds, four octaves. ; ; Variable volume. Internal speaker (in addition ; ; to audio through television set). ; ;

Memory : 8 or 16K bytes of Random Access Memory (RAM) is included. The ATARI 800 Console may be expanded to 48K RAM with user-installed 8K or 16K ATARI Memory Modules. The 800 Console includes a 10K ROM Operating System. ROM may be expanded to 26K with user-installed Program Cartridges.

Keyboard: 57 full-stroke alphanumeric keys plus 4 function keys. Upper/lower case. Inverse video. Full screen editing. Four way cursor control with 29 keystroke graphics.

I/O: Serial input/output port for simple connection to peripherals. Four controller jacks for joystick and paddle controller and light pen.

Language : ATARI BASIC 8K ROM Program Cartridge included.

Display: Highest graphics resolution 320 x 192. 24 lines x 40 characters. Three text modes.

Power: AC step-down transformer. UL approved

Dimensions: 16 x 12.5 x 4.5 inches. 9.75 pounds.

CHAPTER 2 - ATARI 400/800 COMPUTER CONSOLES INSTALLATION

2.1 INTRODUCTION

The following paragraphs provide instructions on unpacking, system set-up and check-out, adding peripheral devices, and repacking for shipment.

2.2 UNPACKING

The ATARI 400/800 Computer Systems are a series of components which function together with the user's television set to form a single computer system.

The basic system consists of the following:

- Computer Console
- TV Switch Box
- AC Power Adapter
- 2 Instruction Manual
 Operators Manual
 ATARI BASIC
- Program Cartridge
- ATARI Educational System ATAR I BAS IC La nguage
- Ring Binder and Warranty Registration

Other configurations of the "basic" system are being put together at ATARI. Call or write ATARI for the latest information.

Remove the accessory tray from the packing box and check that it contains all of the standard components, see above. Remove the Console with the foam end caps from the box. Remove the foam end caps and polyethylene bag from the console. Save all your ATARI Console packaging materials for repacking and storage.

Inspect the Console and the accessories for any obvious shipping

WARNING!!
Keep all polyethylene bags away from small children!

damages. If damage is found, note it on the waybill and require the delivery agent to sign the waybill. Notify the transfer company immediately and submit a damage report to the transfer company. Be sure to save the packing material for the transfer company's inspection.

2.3 CONNECTING THE TV SWITCH BOX

The TV Switch Box is designed to be permanently attached to the user's television set and has an adhesive backing to hold it in place on a smooth clean surface.

Disconnect the present antenna leads from the VHF terminals on the back of the television set. Notice whether the antenna cable is the round, 75 Ohm variety with a screw-on connector or the flat, twin-lead 300 Ohm cable. Attach it to the matching 75 or 300 Ohm connector labeled ANTENNA on the side of the TV Switch Box.

Attach the short, flat, twin-lead 300 Ohm cable labeled TV on the bottom of the TV Switch Box to the VHF screw terminals on the television. If the television antenna is of the 300 Ohm variety, the TV Switch Box is installed.

If the television antenna is 75 Ohms, convert the television to accept the 300 Ohm signal from the TV Switch Box. Refer to Figure 2-1 for instructions on how to convert the television to 300 Ohm antenna input impedance.

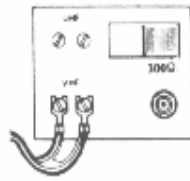
When the COMPUTER - TV switch on the TV Switch Box is in the COMPUTER position the television receives the RF signals from the ATARI Computer Console. Tune the television to channel 2 or 3, whichever is weaker in your area. When the switch in the TV position, signals come from the television antenna.

NOTE

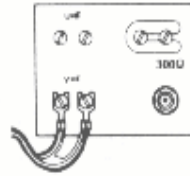
Federal Communications Commission Require that you:

- Avoid using any longer twin-lead wire from the TV Switch Box to the television than that supplied with the TV Switch Box.
- Avoid connecting the twin-lead wire from the TV Switch Box to any television antenna or cable TV outlet.
- Avoid attaching loose wires to the antenna terminals when the ATARI Personal Computer products.

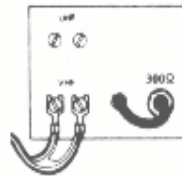
Any of the above may cause interference to nearby television sets and is against Federal Communications Commission (FCC) regulations.



If it looks like this? Push the switch to the **300 OHM (300Ω)** position.



If it looks like this, loosen the screws holding the U-shaped slider and move it to the position marked **300 OHM or 300Ω**.



If it looks like this? Screw the short round wire into the connector provided.

Figure 2-1. Conversion to 300 Ohm Antenna Input Impedance

2.4 CONNECTING THE PROGRAM CASSETTE RECORDER

The ATARI 410 Program Cassette Recorder resembles an ordinary audio cassette recorder. Its playback and recording levels have been permanently set at the correct volume for use with the ATARI Computer Consoles.

Carefully unpack the Program Cassette Recorder from its container, careful to save all packing material for storage and shipment.

Plug the data cord (permanently attached to the recorder) into the jack labeled PERIPHERAL on the side panel of the ATARI Console, see Figure 2-2.

ATARI Personal Computers 2-3

NOTE

When the Program Cassette Recorder is used in conjunction with other peripheral devices the Program Cassette Recorder has to be plugged into to the I/O Connector jack on the other peripheral device (daisy-chained).

Plug the recorder power cord into the jack labeled AC on the side of the recorder and into an ordinary wall socket.

2.5 CONNECTING THE AC POWER ADAPTER

The AC Power Adapter supplies low voltage (9V AC) required by the Main Power Switch on the side of the the Consoles. Check to see that the computer consoles is OFF. Plug the AC Power Adapter into any 115 Vac outlet (ordinary house current). Plug the end of the AC Power Adapter cable into the jack labeled POWER IN on the side panel of the computer console, see Figure 2-2.

2.6 INSERTING PROGRAM CARTRIDGES

ATARI Program Cartridges contain programs that are permanently stored in a ROM within the cartridge. To insert a Program Cartridge open the Cartridge Door by depressing the lever marked PULL OPEN on either the 400 or 800 Consoles, see Figure 2-3. The door is held under tension and should spring open. Hold the cartridge with the label toward you so that it can be read. Push it firmly, straight down, into the slot. It will snap gently into place. Single cartridges should always be inserted in the left slot. They will be labeled LEFT CARTRIDGE on the end opposite the opening. Double cartridges will be labeled LEFT CARTRIDGE and RIGHT CARTRIDGE. Insert them in the correct slot.

NOTE

The cartridge door contains a power interlock. In order to prevent damage to the computer or the program cartridge, the power is turned off whenever the cartridge door is opened.

When the Program Cartridge is inserted correctly, the cartridge door will close without touching the program cartridge.

2.7 CONNECTING TELEVISION MONITOR

The ATARI 800 Computer Console has the option of using a television Monitor without the standard RF input cable, contains a monitor jack, see Figure 2-2, which accepts the optional monitor cables available from ATARI. Refer to Chapter 1, para. 1.8, Optional Equipment for the model number of the monitor cables. Plug the monitor cable into both the Console and the television monitor.



Figure 2-2. ATARI 400/800 Computer Consoles, Side View



Figure 2-3. 400/800 Consoles, Cartridge Door Open

2.8 CONNECTING THE ATARI 810 AND 815 DISK DRIVE

The ATARI 810 and 815 Disk Drives may be used with many combinations of ATARI devices. However, the ATARI 800 Computer Console with 16K (minimum) of RAM memory is required to operate the disk system. Up to four disk drives may be connected to the system at a time.

Setting up the Disk Drive (Refer to Figure 2-4)

- First verify that all switches (computer power and disk drive) are OFF.
- Plug AC Power Adapter into the wall plug, and its small plug into the disk drive.
- Plug one end of the CX 81 Data Cord furnished with the disk drive into the plug labeled PERIPHERAL on the Console, and the other end into either of the I/O CONNECTOR jacks on the back of the disk drive unit.
- Additional peripheral devices can be connected by using the unused I/O CONNECTOR jack on the back of the disk drive.
- If only one disk drive is to be used, set the device code switch on the back of the disk drive to position number 1. (See diagram on back of drive).
- If more than one disk drive is to be used, the switches should be appropriately set. You may find it useful to label the disk drives by number for easy location of a particular unit.

NOTE

The device switch on each drive is normally set to 'position 1' before shipment.

2.9 CONNECTING THE ATARI 820 AND 822 PRINTER

The ATARI 820 and 822 Printers provide 40 column printouts for the ATARI 400 and 800 Personal Computer Systems.

Setting up the Printer (Refer to Figure 2-5)

- Plug the power cord (permanently connected to the printers) into a 110-115 Vac outlet (with the Power switch OFF).
- Plug the CX81 Data Cord in the serial I/O port, labeled PERIPHERAL on the Console, or if another peripheral is in use, into the jack labeled I/O CONNECTOR on that peripheral. Plug the data cord into either jack labeled I/O CONNECTOR on the printer.
- Inspect the ribbon (model 820) and paper for proper positioning and useability, refer to the operator's manual for the individual printer.

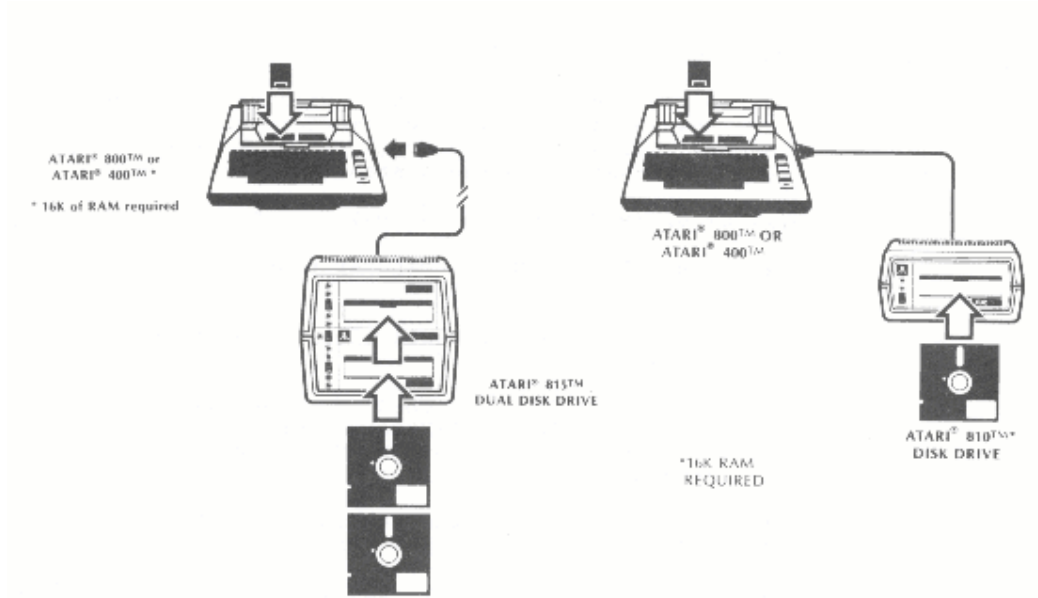


Figure 2-4. ATARI Disk Drive Cable Connections

CAUTION

Do not operate the printer without ribbon or paper or you may damage the printer mechanism.

2.10 USING THE ATARI 850 INTERFACE MODULE

The ATARI 850 Interface Module expands the interface capabilities of the ATARI Personal Computer Systems. The interface module connects to the ATARI 400 and 800 Computer Consoles via an I/O CONNECTOR port (two provided) and has four EIA RS232C compatible ports, an 8-bit parallel output interface for connection to the ATARI 825 80 Column Printer. Any of the serial ports can be used with the ATARI 830 Acoustic Modem. Refer to Figure 2-6 when connecting each of the following devices.

2.10.1 Connecting the ATARI 850 Interface Module

The following steps detail the connection of the ATARI 850 Interface Module to the ATARI 400/ 800 Computer Consoles :

- Verify that the Power switch is OFF.
- Plug the AC Power Adapter into an AC outlet (wall plug. 115Vac nominal) and then plug the other end into the power receptacle on the interface module.

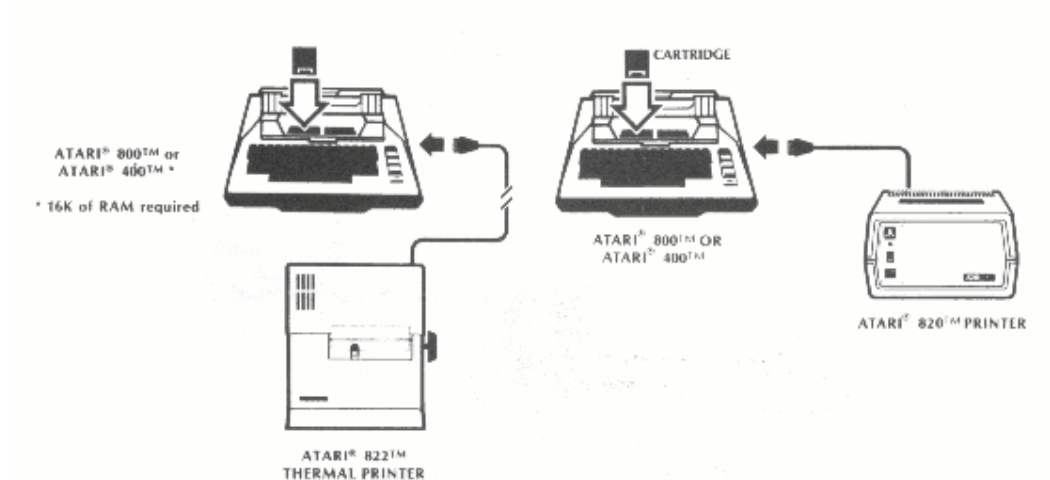


Figure 2-5. ATARI 40 Column Printer Cable Connections

- Plug one end of the CX81 Data Cord provided into the plug labeled PERIPHERAL on the Console and the other end into either of the jacks labeled I/O CONNECTOR on the side of the interface module.
- Disk drives or other peripheral devices that normally plug into the Console PERIPHERAL jack can now be plugged into the second I/O CONNECTOR port on the interface module.
- Proceed with the connection of additional peripheral devices before applying power (Power switch ON) to the interface module.

2.10.2 Connecting the ATARI 825 Printer

The ATARI 825 Printer is an 80 column dot matrix printer that must be connected to the ATARI 850 Interface Module. The printer connects to the 8 bit parallel output interface port on the interface module using the CX86 Printer Cable. Connect the printer as follows:
Check that the Power ON/OFF switch is in the OFF position.

- Plug the CX86 Printer Cable into the parallel I/O port labeled PARALLEL CONNECTOR on the interface module and the I/O CONNECTOR port on the back of the printer.
- Plug the Power Cord into a wall outlet (115 Vac nominal).
- Refer to ATARI 825 Operator's Manual for the proper power-up procedures.

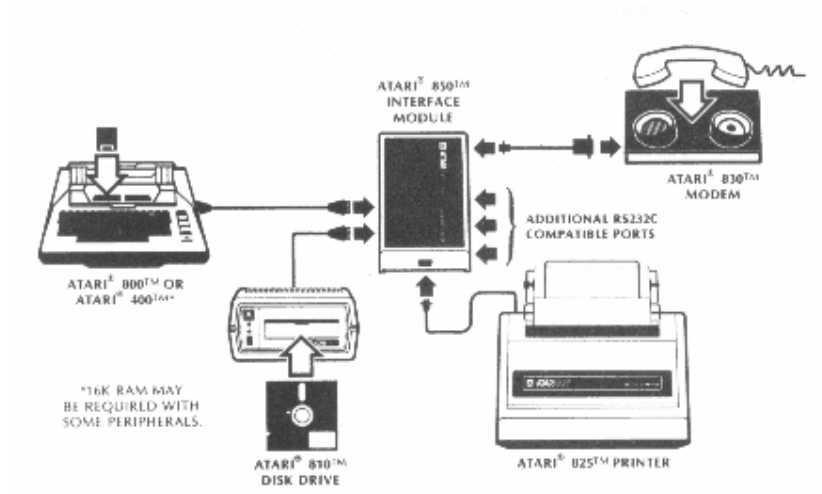


Figure 2-6. ATARI 850 Interface Module Cable Diagram

2.10.3 Connecting the ATARI 830 Acoustic Modem

The ATARI 830 Acoustic Modem is a stand-alone acoustically coupled, frequency shift keying (FSK) modem. It must be connected to the ATARI 400/800 Computer Consoles with the ATARI 850 Interface Module.

Connect the acoustic modem as follows:

- Check to see that the Power ON/OFF switch is in the OFF position.
- Plug the CX87 Modem Cable into one of the RS232C Interface ports on the ATARI 850 Interface Module, and into the I/O CONNECTOR port on the ATARI 830 Acoustic Modem.
- Plug the AC Power Adapter into a wall outlet (115 Vac nominal) and plug the power cable into the power receptacle on the acoustic modem.
- Refer to the ATARI 830 Acoustic Modem Operator's Manual for information on proper set-up and operation of the modem.

CHAPTER 3 - SYSTEM OPERATION

3.1 INTRODUCTION

This chapter will cover the procedures required for system power-up, using the keyboard and screen editor functions, using Program Cartridge system keys, operating the hand controllers, and operating the ATARI 410 Program Cassette Recorder.

3.2 SYSTEM POWER-UP

Two modes of system power-up exist for the ATARI 400/800 Personal Computer Systems; power-up with disk drives and power-up without disk drives. Before continuing with system power-up ensure that you have unpacked and set-up your system according to the instructions outlined in Chapter 2, System Installation.

3.2.1 System Power-Up Without Disk Drive

The following steps detail the procedures required to power-up an ATARI 400 or 800 Personal Computer System without an attached Floppy Disk Drive. These procedures assume that the system has been set-up according to the instructions contained in Chapter 2, System Installation.

Without Program Cartridge.

To power-up the system without a Program Cartridge requires only that the system be connected to all devices correctly, and the System Power-ON switch is set to ON. After a few seconds, the screen will display the "ATARI COMPUTER - MEMO PAD" logo. The Memo Pad Logo indicates that the system has run a self-test, with no failures, and is ready to accept information from the Keyboard.

With Program Cartridge.

To power-up the system with the Program Cartridge installed, requires only that the system be connected to all devices correctly, and the System Power-ON switch is set to ON. After a few seconds, the screen will display a prompt depending upon the Program Cartridge, ie., the BASIC Cartridge prompts you with a "READY" written on the screen. Some Program Cartridges might require you to press the START key or load a program from the Program Cassette Recorder. The screen display will prompt you with the correct action for you to take.

Before 'loading' the program contained on the Program Cartridge the Console Operating System, contained in ROM, has already run a self test and found the system to be operating properly.

Anytime the Cartridge Door is raised to change the Program Cartridge or add/remove a cartridge, the system Interlock switch shuts off power to the Console. The power automatically returns when the door is shut, and the system repeats the power-up sequence (in the process clearing all information stored in RAM Memory).

3.2.2 System Power-Up With Disk Drive

The system power-up sequence with an attached Floppy Disk Drive requires more attention to following the exact sequence of instructions. The following procedures assume that the system has been connected according to the instructions outlined in Chapter 2, System Installation.

Proceed as follows:

1. Connect the system devices according to the instructions outlined in Chapter 2.
2. Power-up the peripheral devices according to the instructions in their respective Operators Manuals.
3. When the Busy Light turns OFF, insert the Master Diskette (Disk File Manager) into the Floppy Disk Drive no. 1, and close disk door.
4. If applicable insert the Program Cartridge in the Cartridge slot. and close Cartridge door.
5. Set the System Power switch to ON. The system automatically 'boots' the program from the Master Diskette.
6. The prompt that appears on the screen will depend upon the Program Cartridge or lack of Program Cartridge. The BASIC Program Cartridge will display the 'READY' prompt. Entering 'DOS' on the Keyboard will display the Disk Operating System Menu.
8. Once the Disk File Manager has been read from the Master Diskette, the Master Diskette can be removed from the Floppy Disk Drive. The program now resides in RAM memory.

3.3 KEYBOARD AND SCREEN EDITOR FUNCTIONS

The ATARI Personal Computer Keyboard, see Figure 3-1, closely resembles an ordinary typewriter, but has been designed with additional flexibility to provide the ATARI user with the most efficient set of symbols for each Computer Console application. In addition, each key has the capacity

to be redefined by instructions from an individual - Program Cartridge or program.

The following paragraphs define the use and application of each of the keys.



Figure 3-1. The ATARI Keyboard

- CAPS/LOWR - Pressing this key once, puts the Keyboard in the uppercase/lowercase mode, requiring the use of the SHIFT key to get uppercase letters and special characters. Pressing the key once again, puts the Keyboard in the all uppercase mode.
- SHIFT - Pressing either of the SHIFT keys and holding it down (while in the lowercase mode) while pressing another key will produce the uppercase letters or the character shown on the upper half of the keytop on the actual keyboard. Figure 3-4 shows the characters that will be produced by the SHIFT and key combination
- ATARI LOGO - The ATARI Logo key switches characters into inverse video. Press it again to go back to normal display.
- CTRL - The control key CTRL functions as a second type of shift. When depressed in conjunction with another key a completely new set of graphics appears on the screen. Figure 3-2 shows what the combination of the CTRL key and other keys will produce on the screen.
- ESC - The ESC (escape) key disables the cursor control movements and prints a graphic character on the screen instead. Figure 3-3 shows what the combination of the ESC key and other keys displays on the screen.
- BREAK - The BREAK key interrupts the computer while it is busy following instructions.

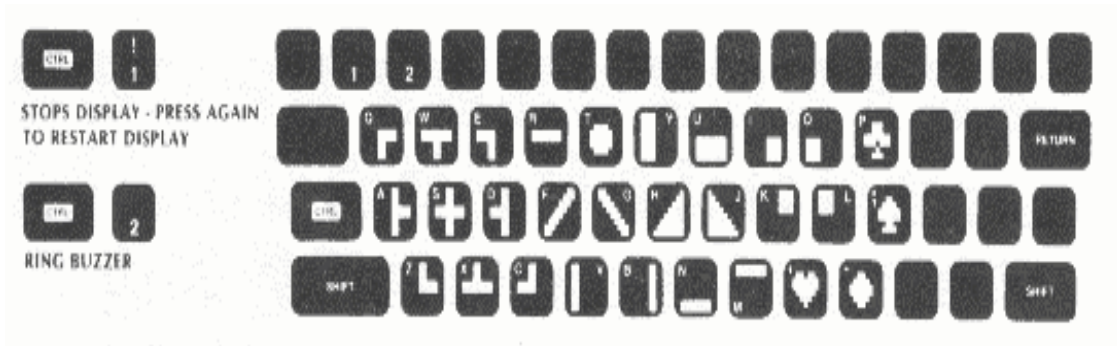


Figure 3-2. Special Graphics Using the CTRL Key

- RETURN - The RETURN key has three functions. First, it moves the cursor to the left margin and down one line on the screen. Second, RETURN marks the end of a logical line for the computer. Third, RETURN activates the computer. The specific action taken depends on the software.
- CLR-SET-TAB - This key operates much like the TAB key on a regular typewriter. SHIFT and CLR-SET-TAB set a TAB stop at the cursor position. CTRL and CLR-SET-TAB clear the TAB stop under the cursor. CLR-SET-TAB by itself spaces the cursor over to the next TAB stop. This key operates on logical lines so you can tab at any position up to the 116th character.

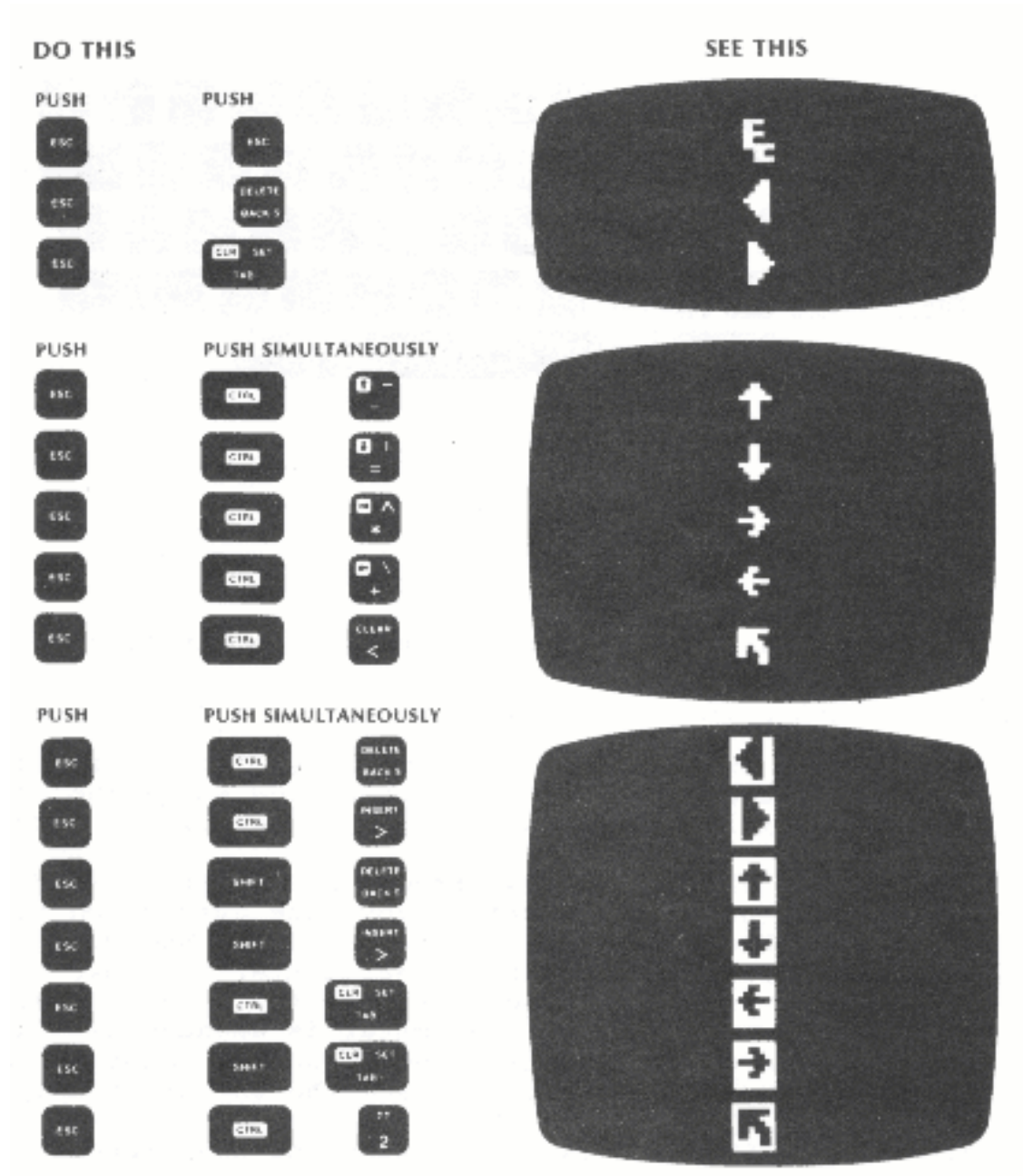


Figure 3-3. Special Graphics Using the ESC Key



Figure 3-4. SHIFT Keyboard and Key Combination

Screen Editing Functions

- SHIFT CLEAR or CTRL CLEAR - When held down simultaneously erases all characters on the screen and moves the cursor to the home position at the upper left corner of the screen.
- CTRL and the UP arrow, DOWN arrow, RIGHT arrow, LEFT arrow - These cursor control functions move the cursor on the screen in the direction shown by the arrows on the keytops. When you move the cursor over a letter, that letter is shown in inverse video on the screen. When you move the cursor away from it using the cursor controls the letter is unchanged. If you put the cursor over a character, and then push another character key, the new character will replace the one previously shown.
- SHIFT and INSERT - This combination of keys creates a space for a new line by moving the logical line containing the cursor and all lines below it down one line. The information on the bottom line of the screen that is pushed off will be lost.
- CTRL and INSERT - This combination of keys creates a space for a new character by moving the character under the cursor to the right. The rest of the line also shifts to the right. The cursor remains on the space which is now available for the new character.

- DELETE BACK S - This key erases each character as the cursor moves back one space at a time. The whole line stays the same length.
- SHIFT and DELETE BACK S - This combination of keys removes one whole logical line. If there are lines below the deleted line they will all move up one line leaving a new blank line at the bottom of the screen.
- CTRL and DELETE BACK S - This combination erases the character under the cursor by moving all the characters to the right of the cursor one space to the left. The line becomes shorter.

3.4 PROGRAM CARTRIDGE SYSTEM KEYS

The four keys to the right of the Keyboard allow the operator to select different starting positions within a Program Cartridge. Each starting position is the beginning of a game or application stored within a single Program Cartridge.

Push SYSTEM RESET to stop the computer and restart from the beginning of a Program Cartridge. Push SELECT to see the initial screen at the beginning of the next game or application. Push OPTION to choose among the variations possible within a game or application. After you have made your choices with the SELECT and OPTION keys, push START to begin the action.

3.5 OPERATION OF HAND CONTROLLERS

Many of the Program Cartridges available from ATARI use the Hand Controllers to move images on the display screen. All hand controllers are identical and can plug into any of the Controller jacks on the front of the Consoles. Each Hand Controller has one button and eight possible stick positions. The "stick" or "paddle" can be moved in a 360 degree circle and can be used by the program to position the screen.

3.6 ATARI 410 PROGRAM CASSETTE RECORDER

The ATARI 410 Program Cassette Recorder resembles an ordinary audio cassette tape recorder. Its playback and recording levels have been permanently set at the correct volume for use with the ATARI Personal Computers. Set up the 410 Program Cassette Recorder according to the instructions contained in Chapter 2, System Installation.

3.6.1 Operation of the Program Recorder

The following steps explain the use of each of the control keys on the program recorder.

- Press STOP EJECT to open the cassette door and disengage the cassette.
- Insert a cassette into the aperture, with the tape surface toward you and close door.
- Press REWIND to move to the beginning of the tape (the tape will stop automatically at end of tape, press STOP EJECT once to disengage REWIND).
- Press the tape COUNTER reset button until the counter shows 000. As the tape advances, this counter will show the approximate location on the cassette tape. Use this number to find programs stored in the middle of the tape. Before storing a program beyond the beginning of a tape, note the counter number for later reference.
- Press ADVANCE to move tape forward to the location of a program (indicated by the Tape Counter) if necessary, then press STOP EJECT.
- Press PLAY to ready the recorder for starting signal from computer.

NOTE

Do not press the ADVANCE key while rewinding the cassette tape, also do not press the REWIND key while advancing tape, either action will stretch the cassette tape.

3. 6. 2 Transfer a Program to Cassette Tape

The following steps detail the procedures required to transfer programs from the Computer Console RAM memory to the Program Recorder cassette tape. (Refer to the BASIC Reference Manual for additional command information):

1. Insert a blank cassette tape into the Program Recorder with the recording surface toward you and the label so that it can be read. (Side one of the cassette tape will now be recorded on, to record on side two of the cassette tape, turn tape over and reinsert).
2. Press REWIND and wait until the tape stops.
3. Press the Tape Counter Reset button until it reads 000.
4. Press STOP EJECT once (not hard enough to eject tape).
5. On the Computer Console Keyboard type: CSAVE, RETURN. You will hear two beeps.
6. Press RECORD and PLAY simultaneously on the Program Cassette

Recorder. Now press RETURN on the keyboard again. A series of tones indicates that the Program Recorder is under control of the Computer. The Program Recorder will erase the beginning of the tape surface for approximately eighteen seconds, and copy the program from RAM onto the cassette tape, then stop.

7. To record more than one program on a cassette tape repeat steps 5 and 6 until all programs are recorded. Be sure to record the starting tape counter number for each of the programs recorded.

NOTE

It is good programming technique to create a backup cassette tape for each of your recorded cassette tapes.

8. Press STOP EJECT on the Program Recorder.

3.6.3 Transfer a Program from Tape to Computer

The following steps detail the procedures required to transfer a program recorded on a cassette tape to the RAM memory of a Computer Console.

1. Insert the prerecorded cassette tape into the Program Recorder with the recording surface toward the front and the label so that it can be read.
2. Press REWIND and wait until the tape stops.
3. Press STOP EJECT once (not hard enough to eject cassette).
4. Press the Tape Counter Reset button until it reads 000.
5. Use the ADVANCE key to position the cassette tape at the beginning of the stored program (refer to record you made in step 7, above).
6. On the Computer Console keyboard type: CLOAD and press RETURN. You will hear one beep.
7. Press PLAY on the Program Recorder. Then press RETURN on the keyboard. A series of tones from the computer indicates that the program is being transferred.
8. When the tape stops, the program has been transferred from the cassette tape to the computer.
9. Press STOP EJECT on the Program Recorder.

CHAPTER 4. FUNCTIONAL DESCRIPTION

4.1 INTRODUCTION

The following paragraphs provide a functional block diagram discussion of the ATARI 400 and 800 Computer Console Systems. The first paragraphs will describe the overall system, using a simple block diagram discussion of the major functional modules. Later sections provide a more detailed discussion of each of these major functional modules.

For greatest convenience, all the Figures referred to in this Chapter have been placed together at the end of the Chapter.

4.2 The ATARI 400 and 800 Computer Console Systems

The ATARI 400 and 800 Computer Consoles are made up of seven major functional modules. Refer to Figure 4.1.

- Motherboard
- CPU Printed Circuit Board
- ROM Personality Printed Circuit Board (Operation System)
- RAM Memory Printed Circuit Board
- Keyboard
- Power Supply
- Program Cartridges

The printed circuit boards plug into sockets on the Motherboard, utilizing a common Address Bus, Data Bus, and clock lines. The various power requirements are routed from the Power Supply through the Motherboard to all the printed circuit boards. The Keyboard connects directly to the Motherboard through a ribbon connector. The sixteen-Line Address bus (A0-A15) allows the microprocessor to directly address 65,536 (64K) memory locations. The eight line Data bus (D0-D7) provides the communication and data path between the various functional modules.

4.2.1 Motherboard

The Motherboard performs the function of tying together all the various components of the computer system, as well as performing a variety of logic functions. All printed circuit boards, (pcb) and connector cables plug into the Motherboard to allow communication between the functional blocks of the 400 and 800 Computer Consoles. The Motherboard also does the following:

- Generates 3.58 MHz Master Clock for the CPU printed circuit board.
- Generates Power-On Reset for the CPU printed circuit board.
- Performs parallel/serial data conversion between the CPU printed circuit board and the peripherals.
- Provides driving circuitry for the Key-Press signal from the CPU printed circuit board to the Console Speaker.
- Converts signals from the various hand controllers into recognizable data for the microprocessor.
- Buffers and drives the data lines between the CPU printed circuit board, the RAM Memory pcb(s), and the remainder of the system.
- Performs the first Memory Map decoding of the possible 64K address locations to 8K blocks for the microprocessor.
- Generates control signals for the peripheral devices.
- Receives video data from the CPU printed circuit board, converts it to a composite video and routes it to the Power Supply pcb.
- Combines the sound from the computer system and the audio track of prerecorded cassettes.
- Develops the sound subcarrier for the television audio as part of the composite video.

4.2.2 Central Processing Unit

The Central Processing Unit (CPU) printed circuit board (pcb) performs the function of controller for the entire Console system. The CPU pcb contains the 6502 Microprocessor, the ANTIC chip (a specialized microprocessor) and the CTIA chip, which generates the video signals for the system. The CPU pcb controls the Console system and its peripheral devices through address lines (to select which device it needs to communicate with) and data lines (to transmit or receive data from a selected device) common to the entire system. Operating instructions for the microprocessor come from the ROM Operating System on the Personality pcb. Additional functions of the CPU pcb are:

- Receives Master Clock from Motherboard and generates Phase 1 (Φ 1 or Ph 1) and Phase 2 (Φ 2 or Ph 2) clocks used to synchronize the entire system.
- Transmits "Refresh" signal at least every 2 milliseconds to refresh the dynamic RAM memory chips on the RAM Memory pcb.
- Receives the four "trigger" lines from the fire button of the hand controller accessories.
- Receives the lines from the four control switches to the right of the Keyboard:

Option - Selects a variation of the Program Cartridge

Select - Selects a different portion of the Program Cartridge

Start - Starts a program (usually on the Program Cartridge)

System Reset - Resets the system

- Generates video signals to be processed by the Motherboard before being sent to R.F. Module on the Power Supply pcb.

4.2.3. ROM Personality pcb

The ROM Personality pcb contains in read-only memory (ROM), the program of operating instructions for the microprocessor. Two 4K ROMs contain the Operating System, and one 2K ROM contains arithmetic functions for use with BASIC programming. Information is retrieved from the ROMs by addressing a particular location on the ROM using the Address bus. The data contained in that location is placed on the Data Bus to be read by the microprocessor.

The ROM Personality pcb also provides the Chip Select signals used to select the various LSI chips throughout the Console system and for the bidirectional data buffers on the Motherboard.

4.2.4 RAM pcb

The RAM (Random Access or Read/Write Memory) pcb performs the function of temporary data storage for the System. The RAM is dynamic RAM, requiring refresh, and comes in 8K or 16K versions.

Each RAM chip on the RAM pcb has only seven address lines. To address 16K separate locations requires fourteen address lines. To accomplish this, a fourteen-bit address is sent to the address demultiplexer, which first passes the lower seven bits to the RAM chips as a Row Address.

After an appropriate delay, the highest seven bits are passed as a Column Address. Data is then either put in or taken out of the location selected. Direction of data flow is determined by the Read/Write line.

Refresh occurs at least every 2 milliseconds. The refresh signal is generated on the CPU printed circuit board.

4.2.5 Keyboard

The keyboard generates alphanumeric characters as well as special graphic symbols. The keyboard allows the operator to communicate with the Console system for writing programs or responding to preprogrammed cassettes or cartridges. The keyboard consists of fifty-seven normally open switches. They are scanned at a rapid rate and when a switch is found closed, that scan pattern is sent to the microprocessor for encoding.

4.2.6 Power Supply

The Power Supply printed circuit board receives 9 Vac from an external power adapter (transformer) and provides +5 Vdc, +12 Vdc, and -5 Vdc for the Console system. The Power ON/OFF switch is mounted on the Power Supply pcb and removes input power by opening the 9 Vac line. An additional interlock switch removes power from the system when the operator opens the top panel to install or remove Program Cartridges.

The RF Module also resides on the Power Supply pcb. The RF Module generates the RF output for the video screen from the composite video signals received from the Motherboard, and is switchable to television channel 2 or 3.

Voltages:

+5 Vdc A - Supply voltage for the logic pcbs

+5 Vdc B - Specially filtered for the video circuitry

+12 Vdc and -5 Vdc - Supply voltage for the dynamic RAM memory chips

4.2.7 Program Cartridge

The Program Cartridge performs the function of permanently storing the microprocessor instructions for a particular application, e.g., a game or

check book balancing program. It consists of two 4K ROM chips mounted on an enclosed printed circuit board. Information is retrieved from the ROM chips by addressing the memory locations assigned to the Program Cartridge slot(s). The data in the memory locations is then placed on the Data bus lines.

4.3 FUNCTIONAL BLOCK DIAGRAM DISCUSSION

The following paragraphs provide a detailed functional block diagram discussion of the 400 and 800 Console Systems.

4.3.1 Central Processing Unit Board (CPU Board)

The Central Processing Unit (CPU) pcb contains the 6502 CPU (or MPU) CHIP (A303), the CTIA chip (A301), the ANTIC chip (A302), tri-state address buffers (Z303 & Z304), and the Clock Generator (Z302A and Z302B). See Figures 4-2 and 4-3.

CPU 6502 Integrated Circuit. The 6502 microprocessor contains registers flags, interconnections, arithmetic logic, and control logic which recognize operation codes. The salient characteristics of the 6502 microprocessor are summarized as follows:

- Byte-oriented structure
- 151 opcodesDecimal or binary arithmetic modes
- Seven addressing modes
- True indexing
- Stack pointer
- Two interrupt levels
- 64K address range
- Integral clock circuit
- Single 5-volt dc power requirement

Figure 4-3 shows pin assignment of the 6502 microprocessor. The functions of the pins are given below.

AB0-AB15 Address Bus. The Address Bus signals on the 6502 MPU are push-pull drivers capable of driving one standard TTL load and 130 picofarads of capacitance. The address placed on the Address Bus is determined by the Program Counter in the 6502 MPU or a stored address in RAM memory, specified by the program instruction. The ANTIC chip also puts addresses on the system Address Bus, sharing control of the bus with the 6502 MPU.

DB0-DB7 Data Bus. Pins 26 through 33 are connected to the bidirectional Data Bus. Each of these pins is connected to both an input and an output buffer. The output buffer is in three-state high impedance (isolated) condition except when data transfer out takes place. All data transfers take place during the Phase 2 clock pulse. During Phase 1 the Data Bus is in the isolated high impedance condition. The Data Bus output buffer is a push-pull driver, like the Address Bus driver, and is capable of driving a TTL load. The data on this bus from an external support chip must be stable before the end of the Phase 2 clock pulse.

R/W Read/Write. The R/W Line allows the microprocessor to control the direction of data transfer among system components. When the voltage level is high the R/W line is reading from the Data Bus into the microprocessor. When the voltage level is low it is commanding an external device to write the present contents of the Data Bus into a peripheral support chip or memory. All transitions on this line occur during Phase 1, which allows control of data transfers during Phase 2.

RDY - Ready. The RDY input permits delay of execution of any machine cycle during which the RDY line is held low. If the Ready (RDY) line goes from high to low during a Write cycle the processor will execute that cycle and will stop in the next Read cycle.

SYNC - Synchronizing Signal. The SYNC signal is an output signal produced when the 6502 microprocessor is fetching an opcode. This line goes high during Phase 1, and stays high for the remainder of the cycle. If the RDY line is pulled low during Phase 1 of a SYNC high cycle, single-step operation of the 6502 microprocessor can be achieved.

SO - Set Overflow. The SO line is an output line that sets the Overflow bit in the Status Register. The Overflow bit is set to a logic one (high) on a high to low transition on this pin.

RES - Reset. The Reset line is used to initialize the microprocessor during power-up. As the Power Supply is turned on the RES line is held low, resetting internal registers. When the line goes high the processor will delay six Phase 1 to Phase 2 cycles. After the RES delay the processor will fetch instructions from memory locations FFFC and FFFD.

NMI - Non-maskable Interrupt. The Non Maskable Interrupt (NMI) input interrupts the processor after it has completed the instruction being executed when the NMI line was pulled low. The NMI interrupt cannot be masked by the processor to prevent recognition of this interrupt. The processor will not detect another NMI until this line has gone high and then back to low. The NMI signal must be low for at least two clock cycles in order to be recognized. The following steps take place when an NMI signal is recognized:

- The values in the Program Counter and the processor Status register are pushed on the stack into three successive locations determined by the value of the stack pointer when NMI is detected.
- Locations FFFA and FFFB will be read to vector the processor to a subroutine to handle the interrupt.
- The Interrupt mask in the processor Status register is set to a one, disallowing a maskable interrupt.

The microprocessor will be returned to its original condition upon reading a RTI instruction in the interrupt handler subroutine.

IRQ - Interrupt Request. The IRQ request input is similar to the NMI signal. Unlike the NMI signal, the IRQ input can be controlled by bit 2 of the Program Status register, the interrupt mask bit {I}. If the flag bit I is a logic one, signals on the IRQ input will be disregarded. The IRQ line is level-sensitive, not edge-sensitive. The processor will be interrupted as long the flag bit I is low and IRQ is low. The processor performs the same steps as an NMI operation, with different locations for the vector address (FFFE and FFFF). The processor will be returned to its original condition upon reading a RTI instruction in the interrupt handler subroutine.

ANTIC and CTIA Integrated Circuits.

The primary function of the ANTIC integrated circuit is to fetch data from memory, independent of the processor, for display on the video screen. Direct Memory Access (DMA), is used by the ANTIC chip to retrieve data from memory. The ANTIC chip requests the use of the Address Bus and the Data Bus by sending a HALT signal to the microprocessor, causing the processor to become "Tri-State" during the next computer cycle. The ANTIC then addresses and reads from memory the data for placement on the video screen. Once initiated, the DMA is completely and automatically controlled by the ANTIC chip without need for further microprocessor intervention.

In addition to the display DMA, the ANTIC chip also generates DMA addresses for the refresh (REF signal) of the system dynamic RAM memory. The ANTIC chip steals cycles from the 6502 processor to do memory refresh and fetch graphics data when needed. Each byte of data fetched from memory requires one machine cycle. Memory refresh takes nine cycles out of every video display line, unless pre-empted by a high resolution graphics mode. Memory refresh continues during vertical blank. Once memory refresh starts on a line, it occurs every four cycles unless pre-empted by DMA.

Graphics data retrieved from memory, via the ANTIC DMA process, is routed to the CTIA graphics registers. A color-luminance register is contained on the CTIA chip and as the serial graphic data passes through the CTIA chip it is "impressed" with color and luminance values contained in these registers, before being sent to the video display. Priority is assigned to all objects by the CTIA chip before the serial graphics data is sent to the video display.

4.3.2 Motherboard Console System (400)

The 400 Console Motherboard contains the POKEY chip (A101), the PIA chip (A102), the ROM Personality chips (A103, A104, A105), the Keyboard Key-In/Key-Out analog multiplexers, the Memory Map Decoder (Z103), the controller jacks (J101 through J104), the CPU connector jack (J110), and the Keyboard connector jack (J105). See Figures 4-4 and 4-5.

The POKEY integrated circuit provides the interface between the Keyboard, Serial I/O ports, and the microprocessor. Also contained within the chip are four semi-independent audio channels, each with its own frequency, noise, and volume control. Figure 4-6 shows pin assignments of the POKEY chip, and the functions of the pins are given below.

D0 - D7 Data Bus. The Data Bus lines (8 bits) are used to input and output information between the POKEY chip and the microprocessor. The Data Bus lines are routed to the processor through bidirectional tristate buffers.

CS0 Chip Select. This signal originates on the ROM Personality pcb, and is used by the microprocessor to select the POKEY chip. The POKEY chip is selected when this line goes low.

AUD Audio Signal. Four sound registers are located in the POKEY chip. The output of these registers are used to develop the audio signal.

A0 - A3 Address Bus. These address lines are used in conjunction with the Chip Select (CS0) line to address parts of the POKEY chip.

KR2. This input line is held low during the selection of certain keys. The keys that take this line to an active low are the Break, Control, and both shift keys.

KR1. This line goes low to indicate that a key has been found depressed during a Keyboard scan. The value on pins K0 - K5 when KR1 goes low is sent to the microprocessor to determine the key depressed.

K0 - K5. The value on these pins increments as the Keyboard is scanned.

The value indicates a Keyboard key position.

P0 - P7. Two lines correspond to each of the four connector ports on the front of the Console. Each line is an analog input into the POKEY chip which converts this analog signal into an eight-bit binary code.

R/W - Read/Write. When R/W goes low (logic 0) data is transferred from the microprocessor (Write operation) to the POKEY chip. When R/W goes high (logic 1) data is transferred from the POKEY chip (Read operation) to the microprocessor.

Ph 2 or Φ 2 - Clock Input. Phase 2 of Master Clock is used by the Pokey chip to generate its own internal timing.

SID - Serial Input Data. Serial Data from devices such as the Program Recorder and the Floppy Disk Drive are input on this line.

SOD - Serial Output Data. Data is output serially to peripheral devices on this line.

Clocks OCLK and BCLK. These clocks are used as timing control signals for the input and output of data.

IRQ Interrupt Request. The Interrupt Request line is used by the POKEY chip to initiate communication with the microprocessor. Setting this line low interrupts the processor and forces the processor to service the POKEY chip.

Peripheral Interface Adapter (PIA).

The Peripheral Interface Adapter (6520) has two 8-bit programmable I/O ports and two controller bits for each port, for a total of ten lines per port. The two control lines for each port are used to accomplish the handshaking during the exchange of data on the eight data lines. The external output lines are described in the following paragraphs :

D0-D7, Data Bus. The eight-bit bidirectional Data Bus transfers data to the PIA chip during an input operation, and to the peripheral ports A and B during an output operation.

PA0-PA7, Port A Lines. The eight-bit peripheral port A lines are programmed lines which can serve both input and output operations. The data direction register determines the direction data is transferred. A logic 1 (high) at pin CA2 specifies an output operation and a logic 0 (low) specifies an input operation.

PB0-PB7, Port B Lines. The eight-bit peripheral port B lines are programmed lines which can serve both input and output operations. The data direction register determines the direction of data transfer. A logic 1 (high) at pin CB2 specifies an output operation and a logic 0 (low) specifies an input operation.

VCC, VSS. VCC is the +5V dc supply, and VSS is ground for the integrated circuit.

Ph 2 or Φ 2 - Phase 2 Clock. This signal is the Phase 2 clock signal generated at the microprocessor. It is used to synchronize operations using the Data Bus.

RS0, RS1 - Register Select. The two Register Select lines, along with bit 2 of the Control Register and R/W bit, determine the data path and function. Selection combinations are shown in Table 4-1.

R/W - Read/Write. This line is high for a Read operation and goes low for a Write operation. R/W, together with 2, RS, and CS control the operation of the PIA chip.

CS0, CS1, CS2 - Chip Selects. These inputs are used to select the PIA chip. CS0 and CS1 must be high and CS2 low in order to select the PIA chip.

RS0	RS1	RwW	CRA2	CRB2	Function
0	0	X	0	X	Read or Write Data Direction Register A
0	0	0	1	X	Write into Peripheral interface Register A
0	0	1	1	X	Read from A-side input pins PA0 - PA7
0	1	X	X	X	Read or Write Control Register A
1	0	0	X	1	Write into Peripheral Interface Register B
1	0	X	X	0	Read or Write Data Direction Register B
1	0	1	X	1	Read from B-side input pins PB0-PB7
1	1	X	X	X	Read or Write Control Register B

IRQA - IRQB Interrupt Requests. These lines connect to the microprocessor IRQ line to provide interrupt requests. The IRQ lines are open-collector so that several can be connected together to the same input. When the PIA chip wants to communicate with the microprocessor this line is set low. Control of the IRQ lines is determined by the Control Registers A and B.

CA1 - CA2 Control lines. CA1 and CA2 are the control lines for the peripheral devices. CA1 is an input interrupt only from an I/O device. The interrupt can be set by a negative or positive transition of the input signal as determined by the Control Register A. Setting the interrupt request line IRQA by CA1 is also controlled by CRA. CA2 can be used either as an input or output control line. In one output mode CA2 generates a pulse each time data is read by the processor. The pulse can be used to input sequential data. In a second output mode CA2 is used in conjunction with CA1 to provide the "handshake" between the microprocessor and the peripheral device. The CA1 input is used to interrupt the microprocessor to indicate that data from a peripheral device is available. When the processor has finished reading the available data the CA2 output line is set low to signal the peripheral device that new data can be made available.

CB1, CB2 Control Lines. CB1 and CB2 are peripheral device control lines. CB1 is used as an input control line only. CB1 control line can set IRQB on a negative or positive transistion as determined by

Control Register B. CB2 can operate both as an input or output control line. CB2 can be used in conjunction with CB1 to provide the "handshake" between the microprocessor and a peripheral device. Each time the microprocessor writes data to the PIA output register, CA2 control line is set high to signal the peripheral device. When the data is read by the peripheral device it signals the microprocessor by setting CB1 control line high.

RESET. Setting this line low resets all the registers in the PIA. It also inhibits false outputs on the Port or Data Lines.

Input/Output Data Transfers.

The following paragraphs detail the procedures involved in typical Input/Output operations.

Transfer of data to a peripheral device is performed by first writing data to the PIA. The data is then put on the peripheral output line for use by the peripheral device. The "handshake" procedure for the output of data to a peripheral device is as follows:

- 1) The microprocessor signals the peripheral device that data is available on the Data Out line (SOD) by setting the CA1 control line high.
- 2) The peripheral device reads the data and signals the microprocessor that the data has been read by setting the CB 1 control line high.
- 3) The microprocessor can either make new data available to the peripheral device, and the cycle would be repeated, or the transfer of data can be terminated.

The peripheral input port on the PIA chip is used to transfer data to the microprocessor. The data from the peripheral device is made available on the input Data Bus.

- 1) The "handshake" procedure for the transfer of data from a peripheral device to the input port is as follows:
- 2) The CA1 line goes high to interrupt the microprocessor to indicate that data is available on the peripheral I/O port. The microprocessor reads the data on the input data line (SID) on the POKEY chip.
- 3) When the microprocessor has finished reading the available data it signals the peripheral device by setting the CS2 line low.

4.3.2.3 Key-IN Key-OUT Integrated Circuits. These two 4051 (Z101 and Z102) integrated circuits are used to scan the Keyboard for input

data on the 400 and 800 Computer Consoles. The 4051 integrated circuits are analog multiplexers controlled by the input lines A, B, C and X. A binary count between 0 and 7 is applied to the input lines A, B, and C (pins 9, 10, and 11) to select one of the output lines, X0 - X7. The eight possible inputs on each 4051 chip allows a maximum of 64 keys to be scanned (the 400 and 800 keyboards both contain 57 keys). When a key is scanned and found depressed, the output line X (pin 3) goes low to signal the POKEY chip to stop the count. The value present on lines K0 through K5 of the POKEY chip is sent to the microprocessor. The microprocessor uses a "look-up" table to determine the Keyboard character depressed.

4.3.2.4 Memory Map Decoder. The Memory Map Decoder integrated circuit (Z103) on the 400 Motherboard is a one-of-ten decoder. Four input lines (pins 12, 13, 14, and 15) determine which output line is selected. The 400 Console only uses three of the input lines (pin 12 being grounded) for a total of eight selected output lines (S0 - S7). Refer to Table 4-2 for the line selected for each input combination.
TABLE 4-2. Memory Map Select Lines

Signal/Pin				Active line	Device
GND12	A15/13	A14/14	A13/15		
L	L	L	L	1 - S0	8K RAM
L	L	L	H	2 - S1	8K RAM
L	L	H	L	3 - S2	8K RAM
L	L	H	H	4 - S3	8K RAM
L	H	L	L	5 - S4	8K RAM/CARTRIDGE L, R
L	H	L	H	6 - S5	8K RAM/CARTRIDGE L
L	H	H	L	7 - S6	2K ROM
L	H	H	L	7 - S6	I/O DECODER (Z105)
L	H	H	H	9 - S7	4K ROM "E" and "F"

4.3.2.5 I/O Decoder. The I/O Decoder integrated circuit (Z105) is a one-of-eight decoder/demultiplexer. The I/O Decoder is used to select

the different output devices, such as PIA chip, POKEY chip and the CTIA chip.

Only four of the possible output selections are used. (See Table 4-3.) The I/O Decoder is enabled by inputs on pins 4, 5, and 6; pin 4 input coming from the Memory Map Decoder (S6); pin 5 input coming the Address Bus and pin 6 input coming from the Chip Select (CS) line. The Binary Decode is provided by the Address Bus (A08, A09 and A10).

Table 4-3. I/O Decoder Select Lines

Enable/Pin			Binary Decode			Active Pin	Device Selected
A	A	S	A	A	A		
1	1	6	1	9	8		
2	1	4	0	2	1		
6	5		3				
H	L	L	L	L	L	Y0 - 15	CTIA
H	L	L	L	L	H	Y1 - 14	Not Used
H	L	L	L	H	L	Y2 - 13	POKEY
H	L	L	L	H	H	Y3 - 12	PIA
H	L	L	H	L	L	Y4 - 11	Not Used
H	L	L	H	L	H	Y5 - 10	External Select
						Y6 - 9	Not Used
						Y7 - 8	Not Used

The 800 Console Motherboard contains the POKEY chip (A101), the PIA chip (A102), the Keyboard Key-In/Key-Out analog multiplexers (Z103 and Z104), the I/O Decoder (Z101), Bidirectional Data Buffers (Z105 and Z106), the

controller jacks (J101 through J104), the Keyboard connector jack (J106), the left and right Program Cartridge jacks (J108 and J109), the CPU connector jack (J101), the ROM Personality connector jack (J107), and the

RAM Memory connector jacks (J102, J103, and J104). See Figures 4-7 and 4-8.

Refer to the descriptions provided in paragraph 4.3.2, Console Motherboard (400), for items similar in both the 400 and 800 Console Motherboards. The following paragraphs will describe those items unique to the 800 Console Motherboard.

4.3.3.1 Bidirectional Data Buffer

The Bidirectional Data Buffers (Z105 and Z106) are 74LS243 quad transceivers, commonly referred to as tristate buffers. Tristate refers to the three states that can occur in the device; the first state, pin 1

going high and pin 13 staying low, allows data to flow through the data buffer in the direction of the CPU; the second state, pin 13 going high and pin 1 staying low, allows data to flow through the data buffer in the direction of the POKEY chip, the PIA chip and the Personality pcb; the third state, with pin 1 and pin 13 both staying low, creates a high impedance condition in the data buffers and allows other devices to transmit data on the Data Bus lines. This high impedance state also isolates the CPU and the RAM pcbs from noise generated from a device using the Data Bus lines.

4.3.3.2 I/O Decoder

The I/O Decoder integrated circuit (Z1010) is a one-of-eight decoder/demultiplexer. Refer to the description provided in Section

4.3.2. The I/O Decoder is the same in the 400 and 800, but is labeled Z101 in the 800 console and Z105 in the 400 Console.

4.3.3.3 Composite Video

The 400 and 800 Motherboards route the Composite video signals (COMP CHROMA, COMP LUM, MOD, and COMP VIDEO) to the Power Supply to build the RF video output.

4.3.4 ROM Personality Board

The ROM Personality printed circuit board plugs into connector jack J107 and occupies memory locations D800 through FFFF. The Personality board contains the operating system on three ROM chips, two 4K chips and one 2K chip (See Figures 4-9 and 4-10). The two 4K ROM chips

(A401 and A403) contain the I/O subsystem, interrupt processing, initialization, Power-Up and Reset. The 2K ROM chip (A402) contains the floating point arithmetic package.

I/O Subsystem. The I/O subsystem contained in the ROM Operating System provides a high-level interface between the user programs and the Console and peripheral hardware. All peripheral devices capable of dealing with character data have symbolic names (such as K, D, P, E) and may be accessed using a Central I/O (CIO) routine.

Interrupt Processing. All hardware interrupts are handled by the interrupt subsystem in the Operating System. Vectored addresses contained in RAM memory point to subroutines in ROM to handle each type of interrupt.

Initialization. There are two levels of initialization provided by the system, Power-Up and Reset. Power-Up initialization is performed each time the system power is turned on, and Reset initialization is performed each time the Reset key is pressed.

Whenever system power is turned on, the Operating System examines and notes the configuration of the unit. The Operating System performs the following actions at Power-Up:

- Determines the highest RAM address
- Clears all RAM to zeroes
- Establishes all RAM interrupt vectors
- Initializes the ROM Cartridges
- Sets-up the video screen (24 x 40 text mode)
- Boots the cassette if desired
- Checks ROM Cartridge for disk boot instructions
- Boots the disk if desired and a disk drive is attached
- Transfers control to the ROM cartridge, booted program, or "blackboard" program.

Whenever the Reset key is pressed, the Operating System performs some, but not all, of the functions performed at Power-Up. The Operating System performs the following actions after the Reset key is pressed:

- Clears the Operating System portion of RAM memory
- Re-establishes all RAM interrupt vectors
- Formats the Handler Address table
- Initializes the ROM Cartridges

- Sets-Up the video screen for 24 x 40 text mode
- Transfers control to the ROM Cartridge, booted program, or "blackboard" program

The remaining 2K of Operating System ROM is a floating point program which is not used by the other parts of the Operating System itself, but is available to non-resident programs such as BASIC, Calculator, Pascal, etc. The floating point numbers are stored as ten BCD digits of mantissa plus a one-byte exponent. The following routines are among those found in the ROM program:

- ASCII to floating point and floating point to ASCII conversion
- Integer to floating point and floating point to integer conversion
- Floating point add, subtract, multiply, and divide
- Floating point log, exponent, and polynomial evaluation
- Floating point number clear, load, store and move

4.3.5 RAM Memory Boards

The ATARI 400 and 800 Computers come equipped with either 8K or 16K RAM memory boards. The 8K and 16K RAM memory boards are the same except for the 8K or 16K ememory chips and the addition of connector jumpers on the 8K RAM memory boards. (See Figures 4-11, 4-12, 4-13, and 4-14.) To address 8K of memory requires thirteen bits, and to address 16K of memory requires fourteen bits. The 8K RAM Memory board contains jumpers that are connected depending upon which RAM chip is installed on the board. The jumper makes up one bit of the thirteen-bit address. Figure 4-12 contains a jumper table detailing which connection to make for each type of RAM memory chip.

4.3.6 Power Supply

The 400 and 800 Power Supply have identical circuitry, with a few exceptions. (See Figures 4-15 through 4-18). The Console Power Supplies receive 9Vac (J204 and J206, 400 and 800 respectively) from the external power adapter (transformer) and provides +5Vdc, +12Vdc, and -5Vdc for the Console. Both the 400 and 800 Power Supplies have two power ON/OFF switches, S202 and S203 for the 400 Console, and S201 and S202 for the 800 Console. S202 and S201, respectively, are Power Interlock switches. Whenever the Program Cartridge door is opened the Power Interlock switch removes power from the system.

The RF signal is generated in both the 400 and 800 Power Supplies from the MOD signal received from the Motherboard. It is routed through the A203 integrated circuit to develop the RF output (J203).

A peripheral connector jack, J202 for the 400 Console and J204 for the 800 Console, provides the serial data-in/data-out port for the system. Devices are "daisy chained" together from this one output port. Each peripheral device is identified by a unique address, enabling all devices to reside on one output port.

Also contained on the 800 Power Supply board is the Monitor connector jack (J205). Present at J205 is the Composite video signals to drive a video monitor. The 800 Power Supply board also contains switches S204 through S207. These switches are the System Reset, Option Select, Game Select, and Game Start, respectively.

4.3.7 ROM Cartridge

The ATARI ROM Cartridge contains two ROM chips designed to provide a specific program application. See Figures 4-19 and 4-20. The 6502 microprocessor reads the information contained within the ROM chips by addressing memory locations BFFF through 8000. When the ROM Cartridges are inserted in the Motherboard they disable the RAM Memory address locations 8000 to BFFF, in 8K increments. The "left" ROM Cartridge overlays memory locations A000 to BFFF, and the "right" ROM Cartridge overlays locations 8000 to 9FFF.

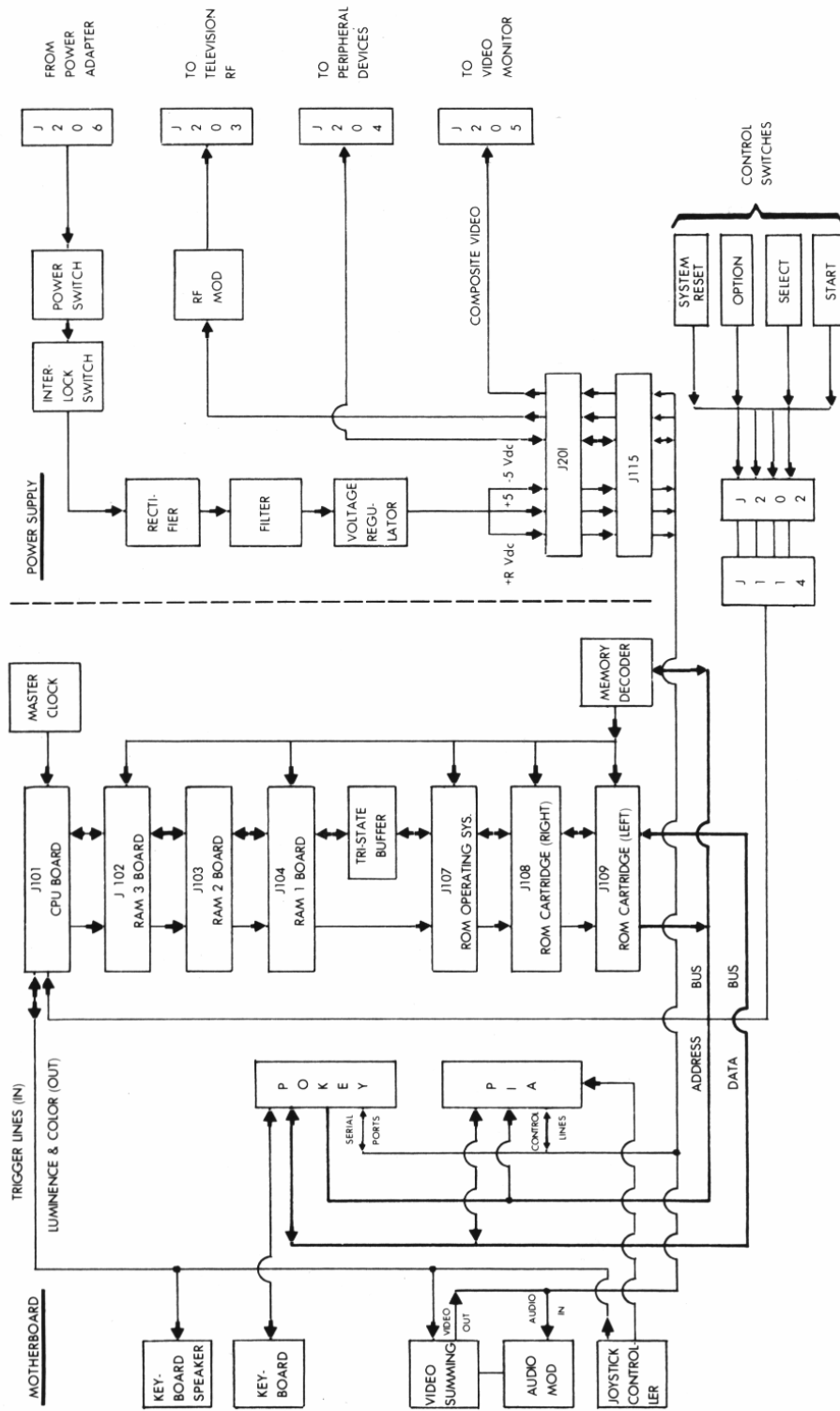


Fig 4-1

Figure 4-1 Major functional modules of the ATARI 400/800

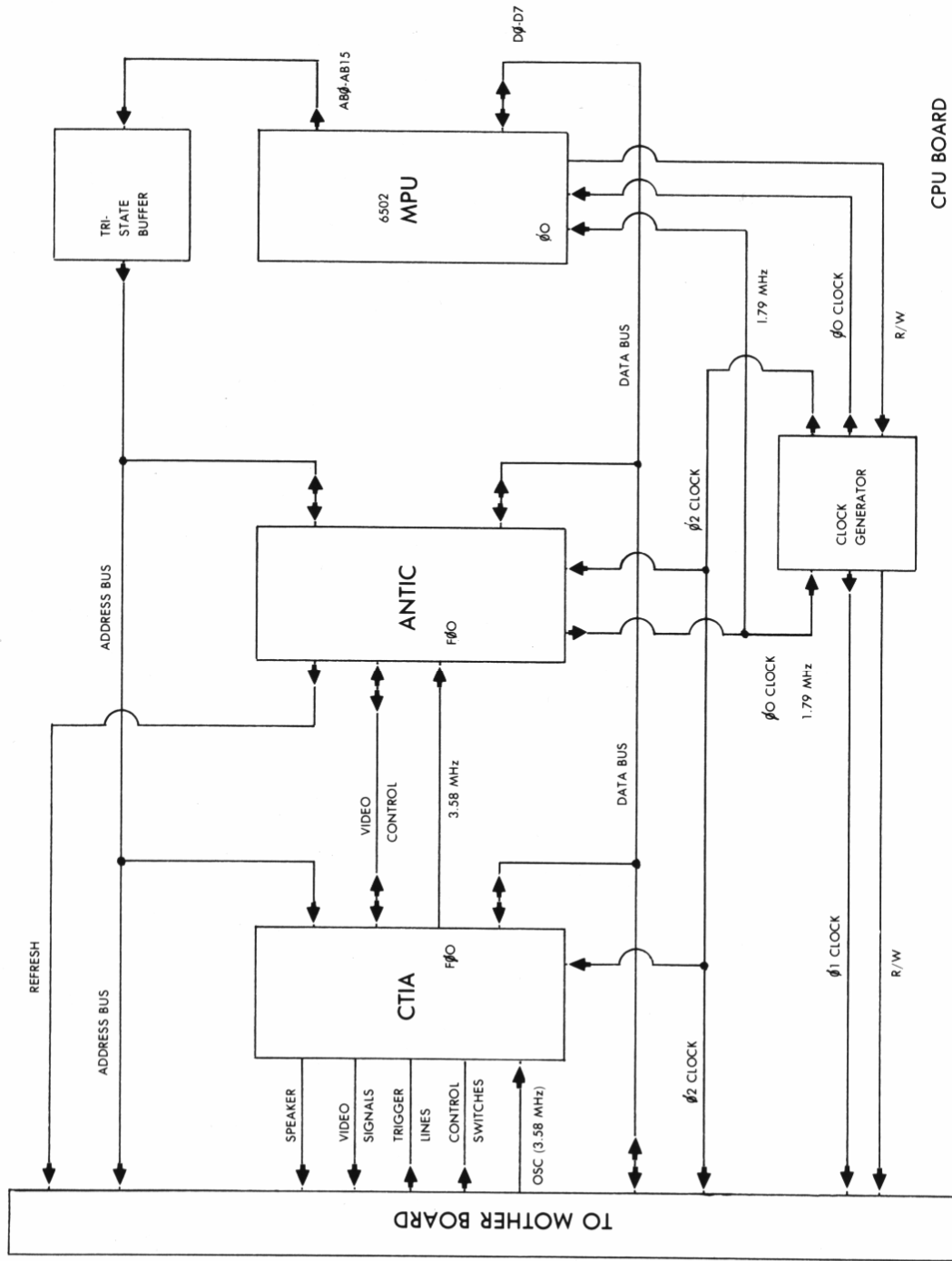


Fig 4-2

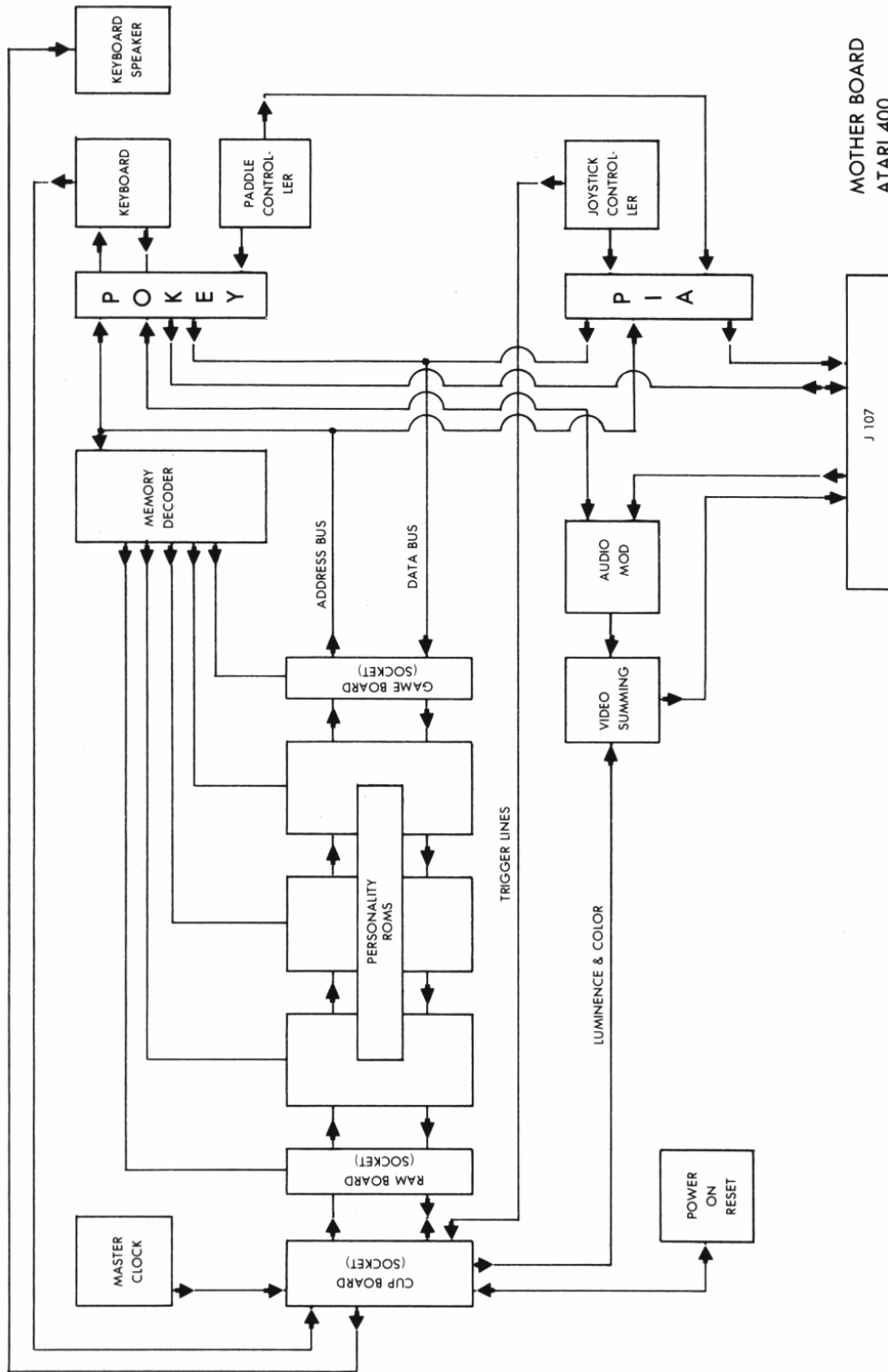


Fig 4-4

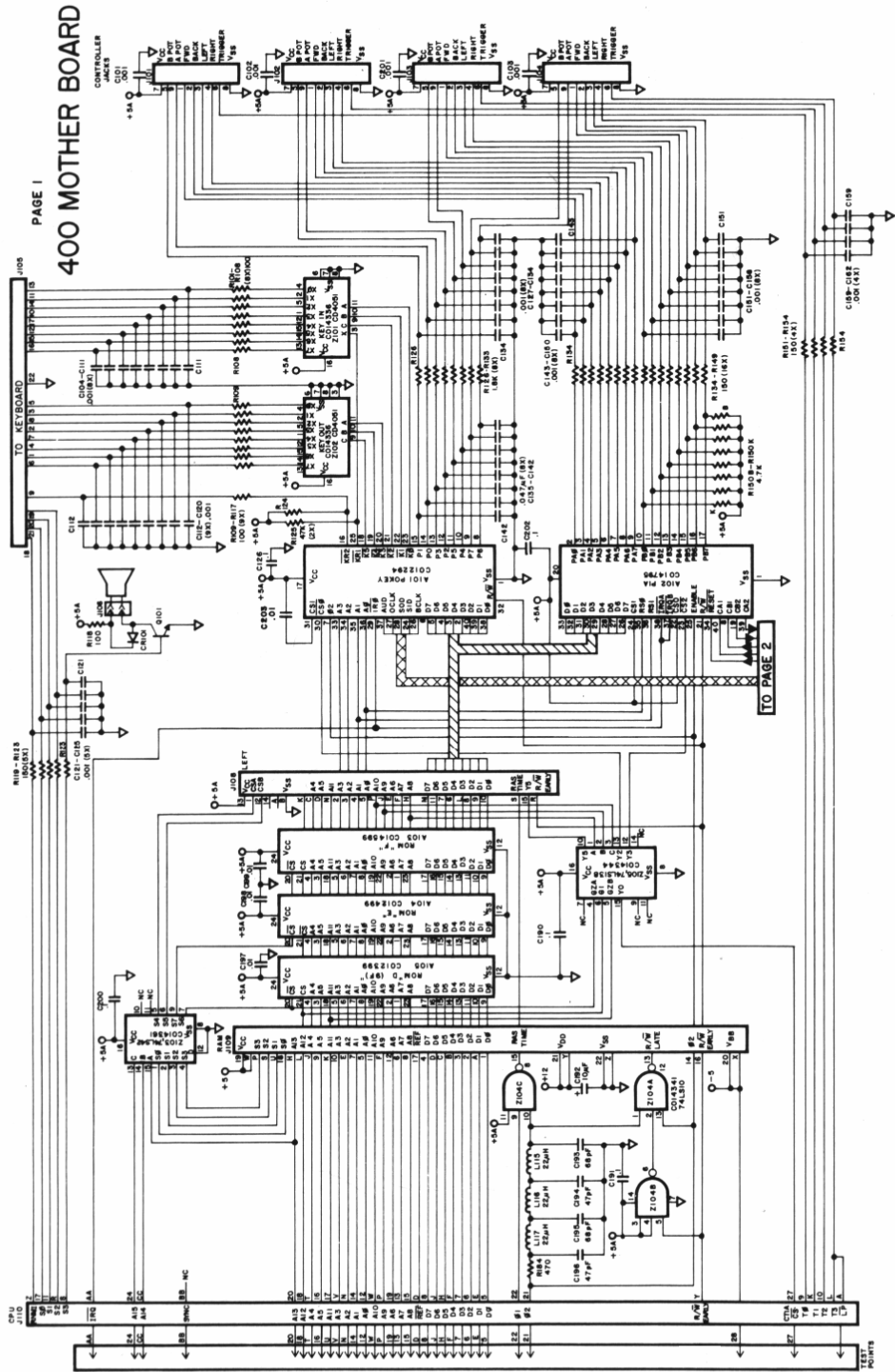


Fig 4-5a

Ground	VSS	1	POKEY	07	$\overline{K2}$	Keyboard Scan
Data Bus	D3	2		6E	$\overline{K1}$	Keyboard Scan
Data Bus	D4	3		8E	$\overline{K0}$	Keyboard Scan
Data Bus	D5	4		7E	SID	Serial Input Data
Data Bus	D6	5		9E	$\overline{KR1}$	Keyboard Scan
Data Bus	D7	6		5E	BCLK	Bidirection Clock
Phase 2 Clock	O2	7		4E	OCLK	Serial Output Clock
Pot Scan	P6	8		3E	SOD	Serial Output Data
Pot Scan	P7	9		2E	\overline{IRQ}	Interrupt Request
Pot Scan	P4	10		1E	$\overline{CS0}$	Chip Select
Pot Scan	P5	11		0E	CS1	Chip Select
Pot Scan	P2	12		6Z	R/W	Read/Write Control
Pot Scan	P3	13		8Z	A3	Address Bus
Pot Scan	P0	14		7Z	A2	Address Bus
Pot Scan	P1	15		9Z	A1	Address Bus
Keyboard Scan	$\overline{KR2}$	16		5Z	A0	Address Bus
5 V Power	VDD	17		4Z	AUDIO	Audio Out
Keyboard Scan	$\overline{K5}$	18		3Z	D0	Data Bus
Keyboard Scan	$\overline{K4}$	19		2Z	D1	Data Bus
Keyboard Scan	$\overline{K3}$	20		1Z	D2	Data Bus

Figure 4-6 Pin Assignments of
ATARI Custom Chips POKEY, ANTIC and CTIA
(page 1 of 3)

Ground	VSS	1	04	VDD	5V Power
CTIA Data	AN \emptyset	2	05	A11	Address Bus
CTIA Data	AN1	3	06	A9	Address Bus
Light Pen	LP	4	07	A8	Address Bus
CTIA Data	AN2	5	08	A7	Address Bus
Interrupt Input	RNMI	6	09	A6	Address Bus
Interrupt Output	NMI	7	10	A5	Address Bus
Refresh	REF	8	11	A4	Address Bus
Halt	HALT	9	12	Ph2	Phase 2 Clock
Address Bus	A3	10	13	D \emptyset	Data Bus
Address Bus	A2	11	14	D1	Data Bus
Address Bus	A1	12	15	D2	Data Bus
Address Bus	A \emptyset	13	16	D3	Data Bus
Read/Write	R/W	14	17	Ph \emptyset	Phase 0 Clock
Ready	RDY	15	18	FPh \emptyset	Fast Phase 0 Clock
Address Bus	A10	16	19	RES	Reset
Address Bus	A12	17	20	D7	Data Bus
Address Bus	A13	18	01	D6	Data Bus
Address Bus	A14	19	02	D5	Data Bus
Address Bus	A15	20	03	D4	Data Bus

Figure 4-6 Pin Assignments of
ATARI Custom Chips POKEY, ANTIC and CTIA
(page 2 of 3)

Address Bus	A1	1	CITA	40	COL	Color
Address Bus	A \emptyset	2		39	LUM \emptyset	Luminance 0 Output
Ground	VSS	3		38	LUM 1	Luminance 1 Output
Data Bus	D3	4		37	LUM 2	Luminance 2 Output
Data Bus	D2	5		36	<u>CSYNC</u>	Output Sync
Data Bus	D1	6		35	<u>HALT</u>	HALT
Data Bus	D \emptyset	7		34	VDD	Power
Trigger 0	T \emptyset	8		33	OSC	Oscillator Input
Trigger 1	T1	9		32	FPHO	Clock out
Trigger 2	T2	10		31	PH2	Phase 2 Input
Trigger 3	T3	11		30	<u>CS2</u>	Chip Select 2
Console Sw 0	S \emptyset	12		29	<u>CS1</u>	Chip Select 1
Console Sw 1	S1	13		28	R/W	Read/Write
Console Sw 2	S2	14		27	D7	Data Bus
Console Sw 3	S3	15		26	D6	Data Bus
PAL Colr Delay	PAL	16		25	D5	Data Bus
Color Delay	DEL	17		24	D4	Data Bus
Alphanum. Data 0	AN0	18		23	A4	Address Bus
Alphanum. Data 1	AN1	19		22	A3	Address Bus
Alphanum. Data 2	AN2	20		21	A2	Address Bus

Figure 4-6 Pin Assignments of
ATARI Custom Chips POKEY, ANTIC and CTIA

(page 3 of 3)

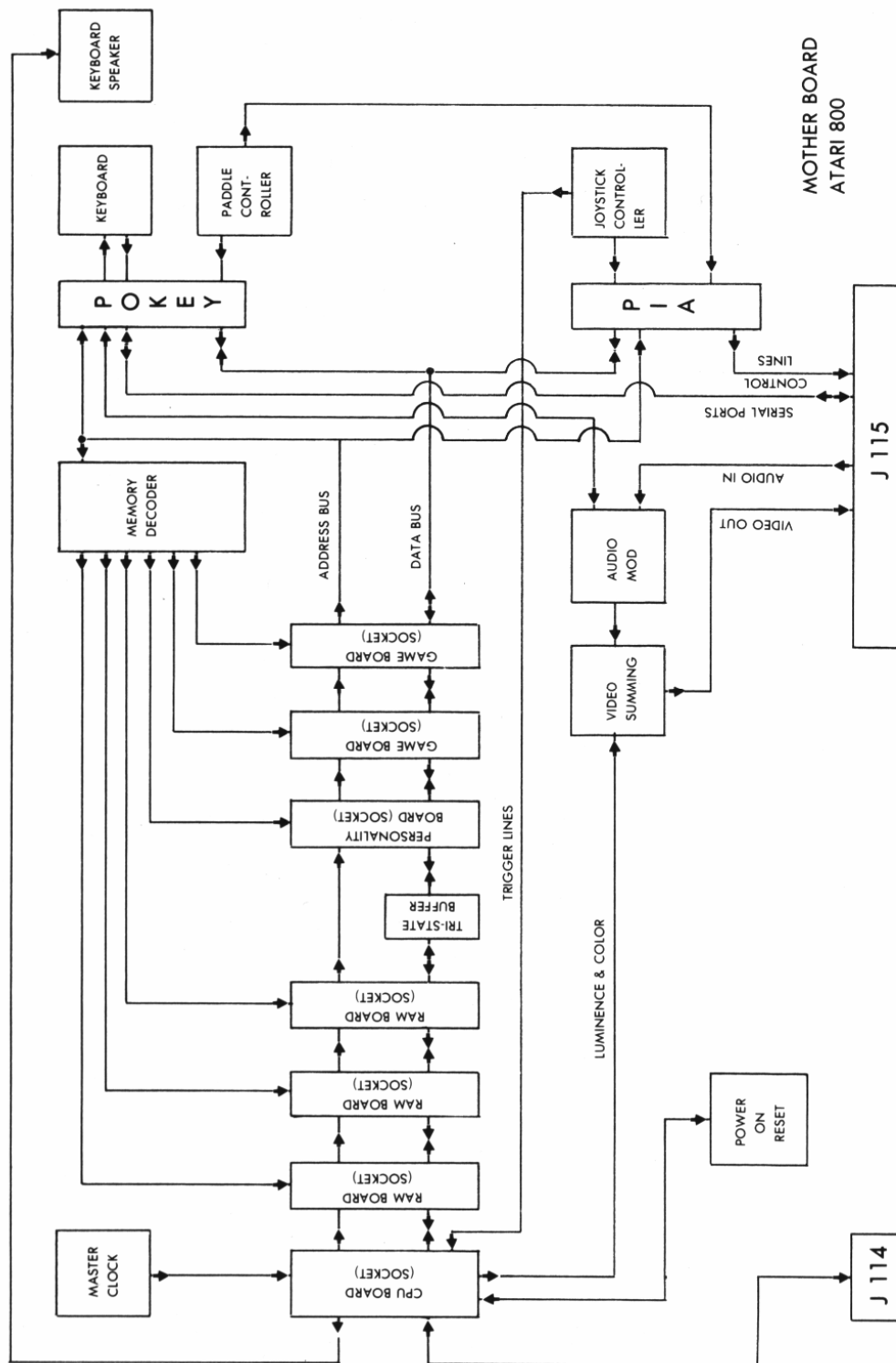


Fig 4-7

800 MOTHER BOARD

PAGE 1

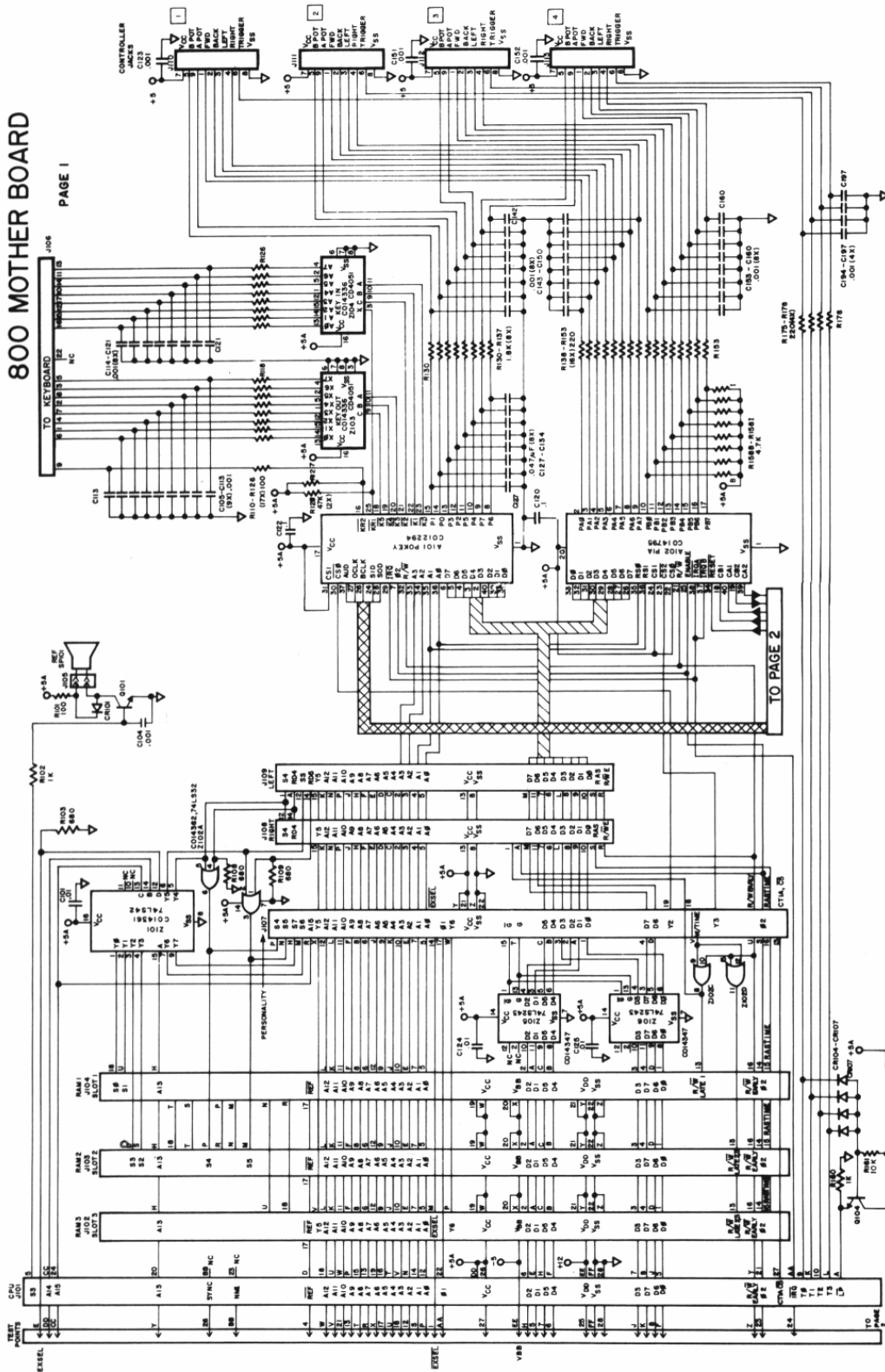


Fig 4-8a

800 MOTHER BOARD

PAGE 2

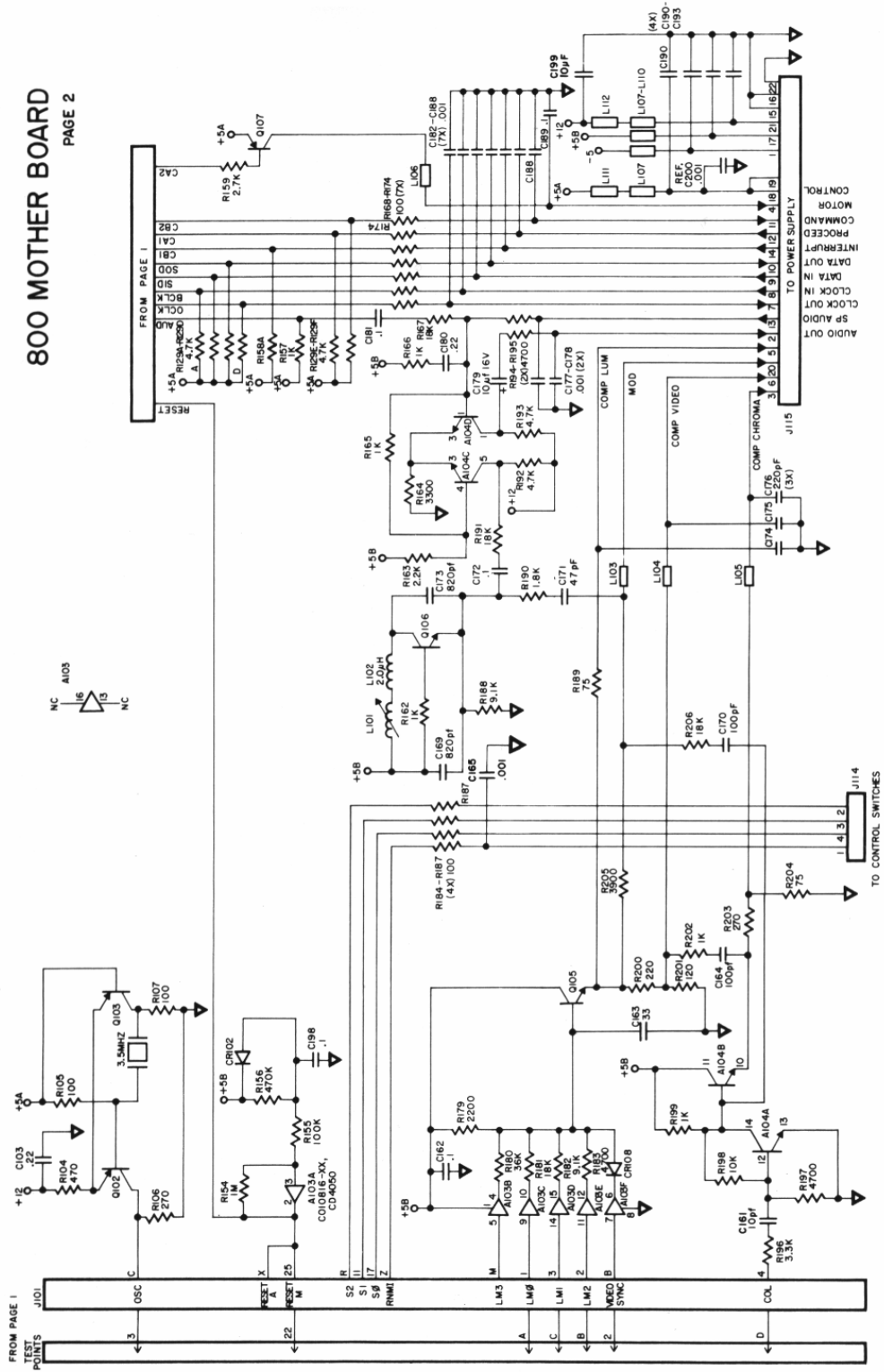
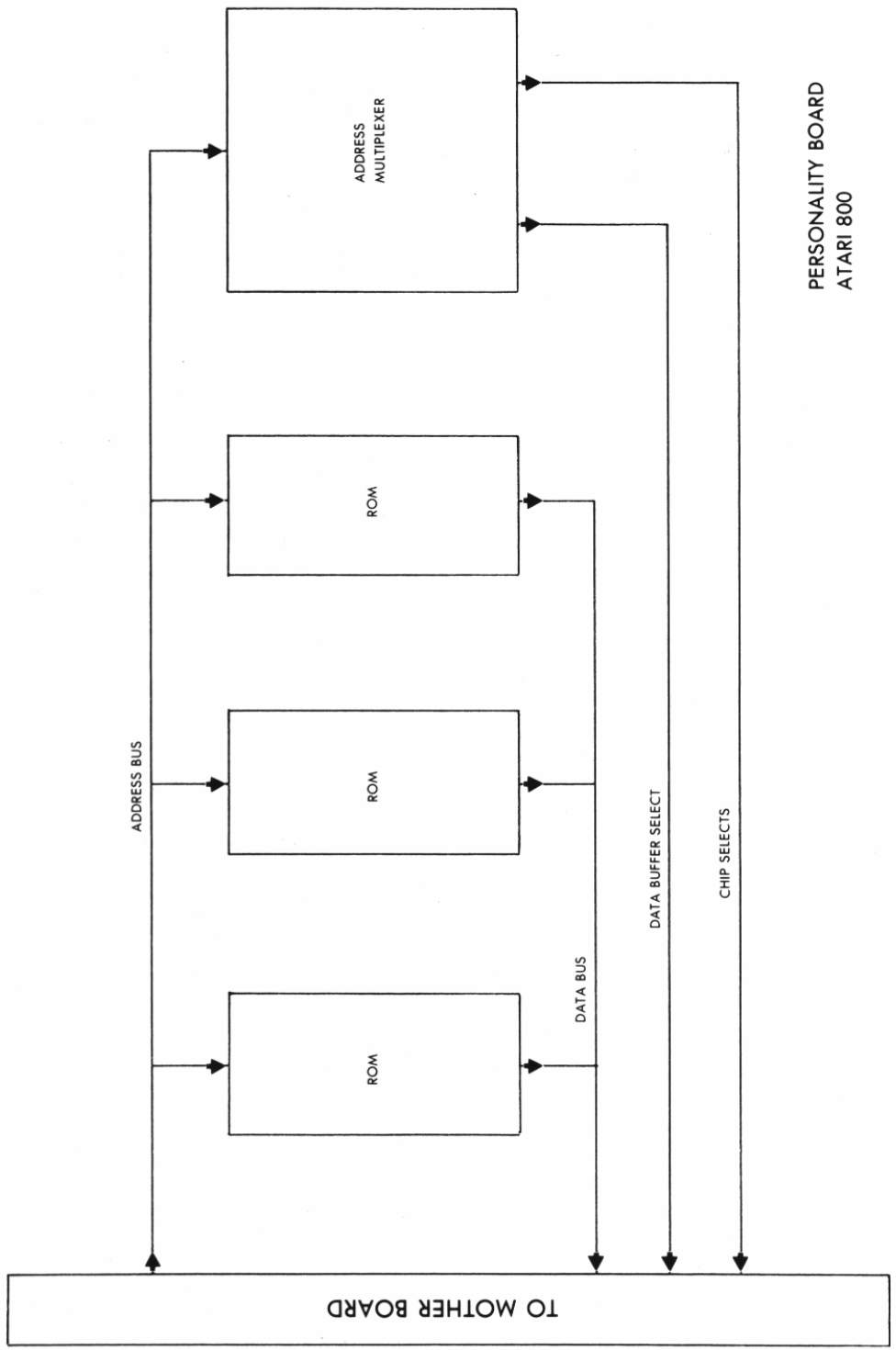


Fig 4-8b



PERSONALITY BOARD
ATARI 800

Fig 4-9

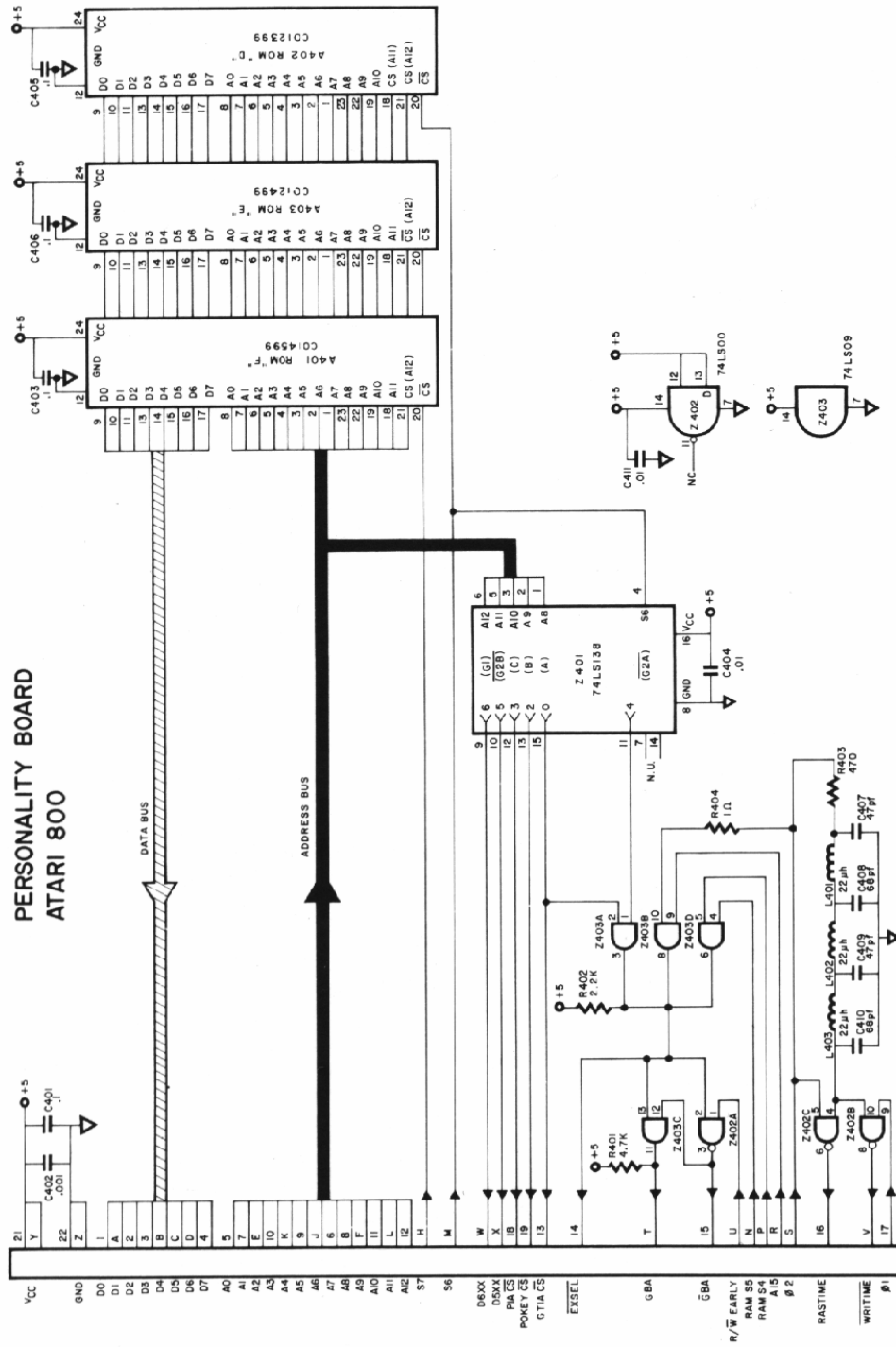
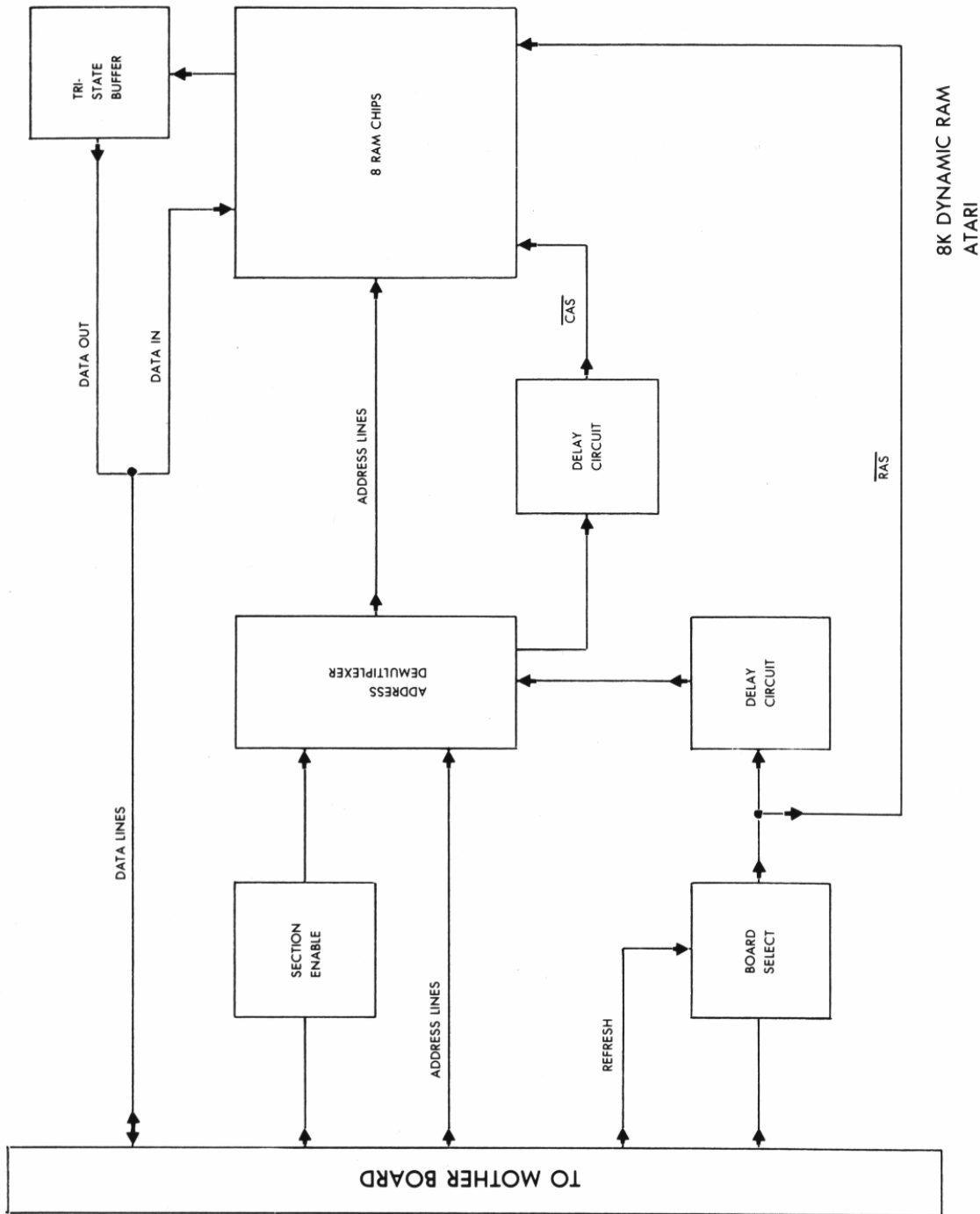


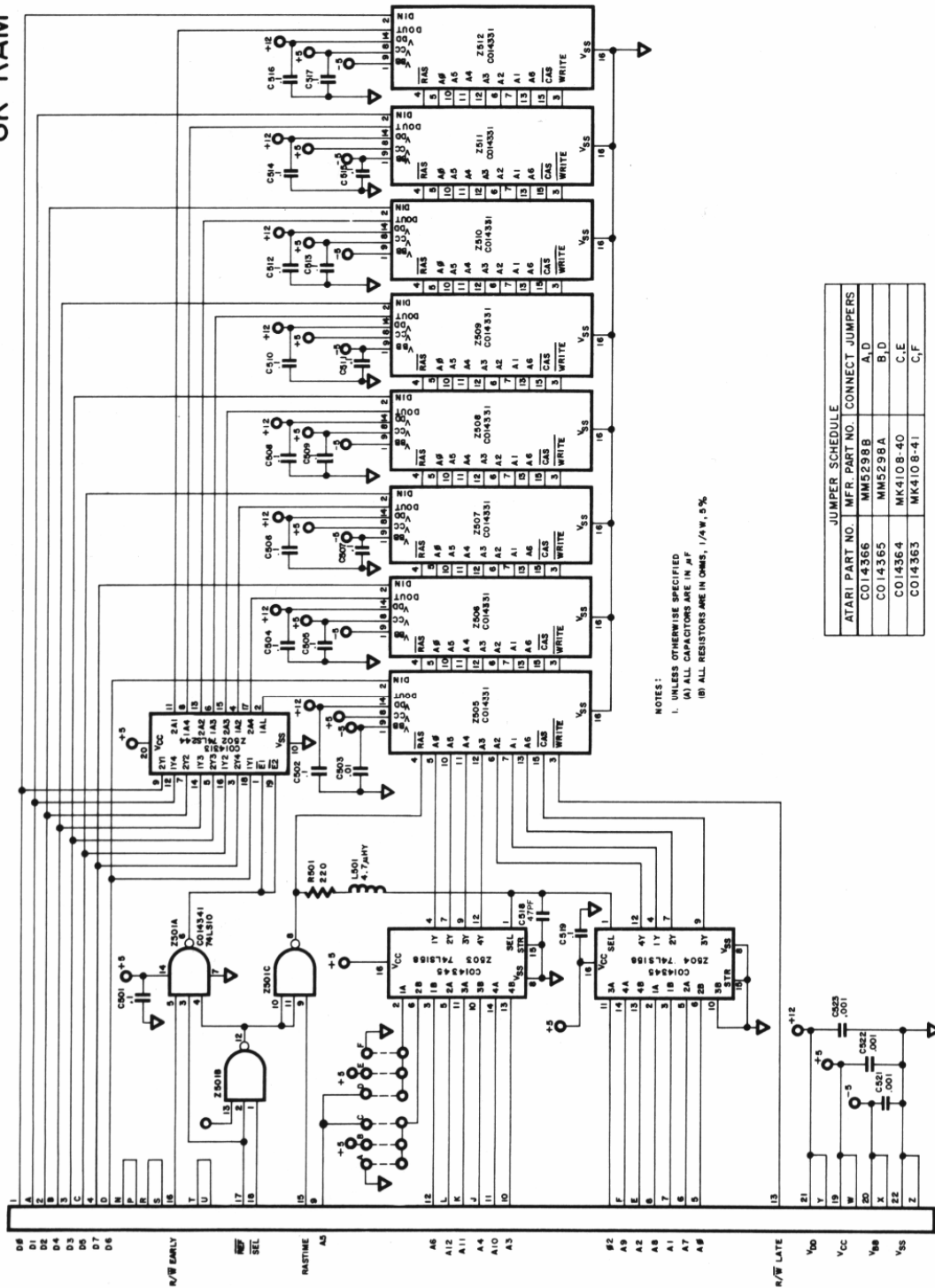
Fig 4-10



8K DYNAMIC RAM
ATARI

Fig 4-11

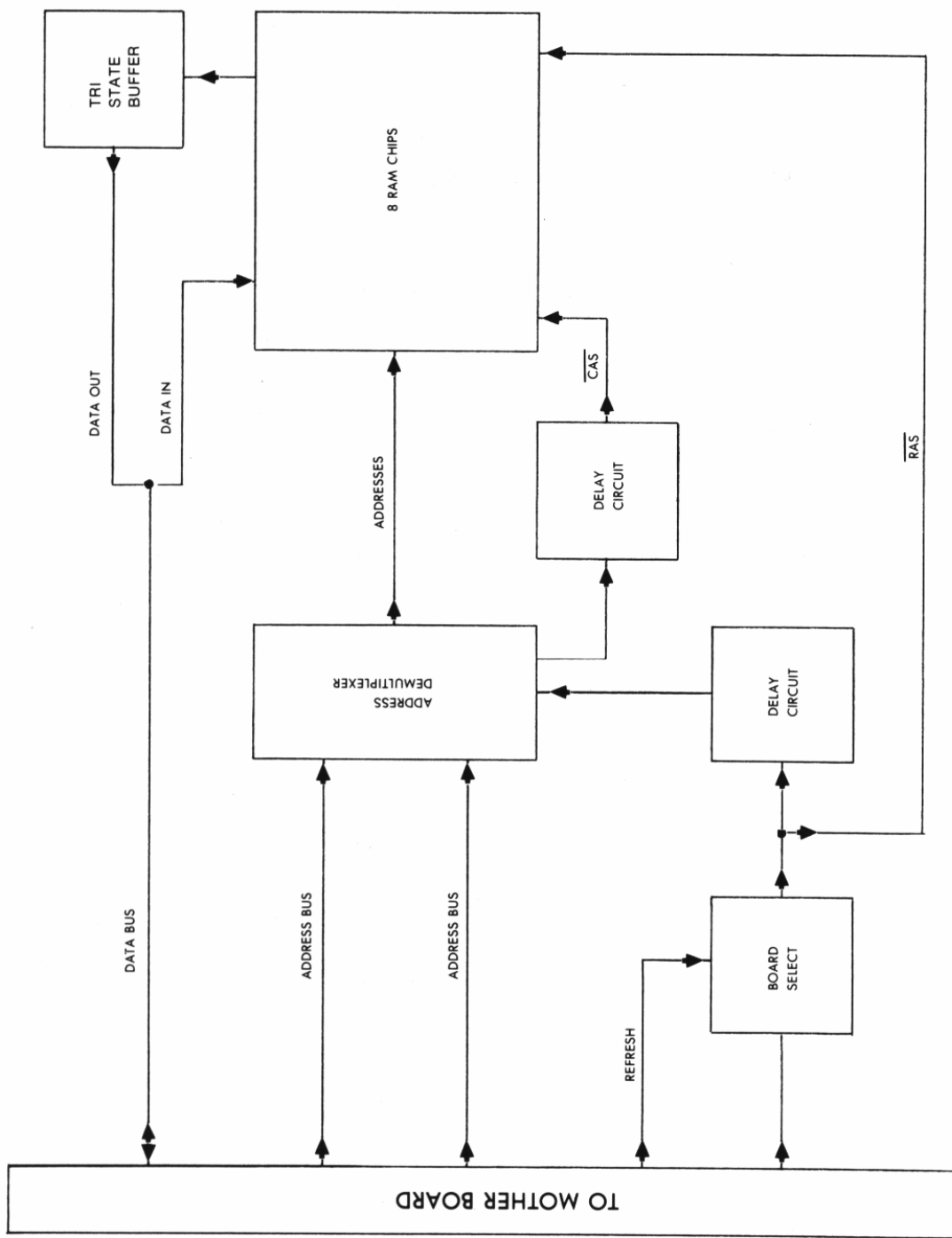
8K RAM



NOTES:
 1. UNLESS OTHERWISE SPECIFIED
 (A) ALL CAPACITORS ARE IN μ F
 (B) ALL RESISTORS ARE IN OHMS, 1/4W, 5%.

JUMPER SCHEDULE		
ATARI PART NO.	MFR PART NO.	CONNECT JUMPERS
C014366	MM5298 B	A,D
C014365	MM5298 A	B,D
C014364	MK4108-40	C,E
C014363	MK4108-41	C,F

Fig 4-12



16 K DYNAMIC RAM
ATARI

Fig 4-13

16K RAM

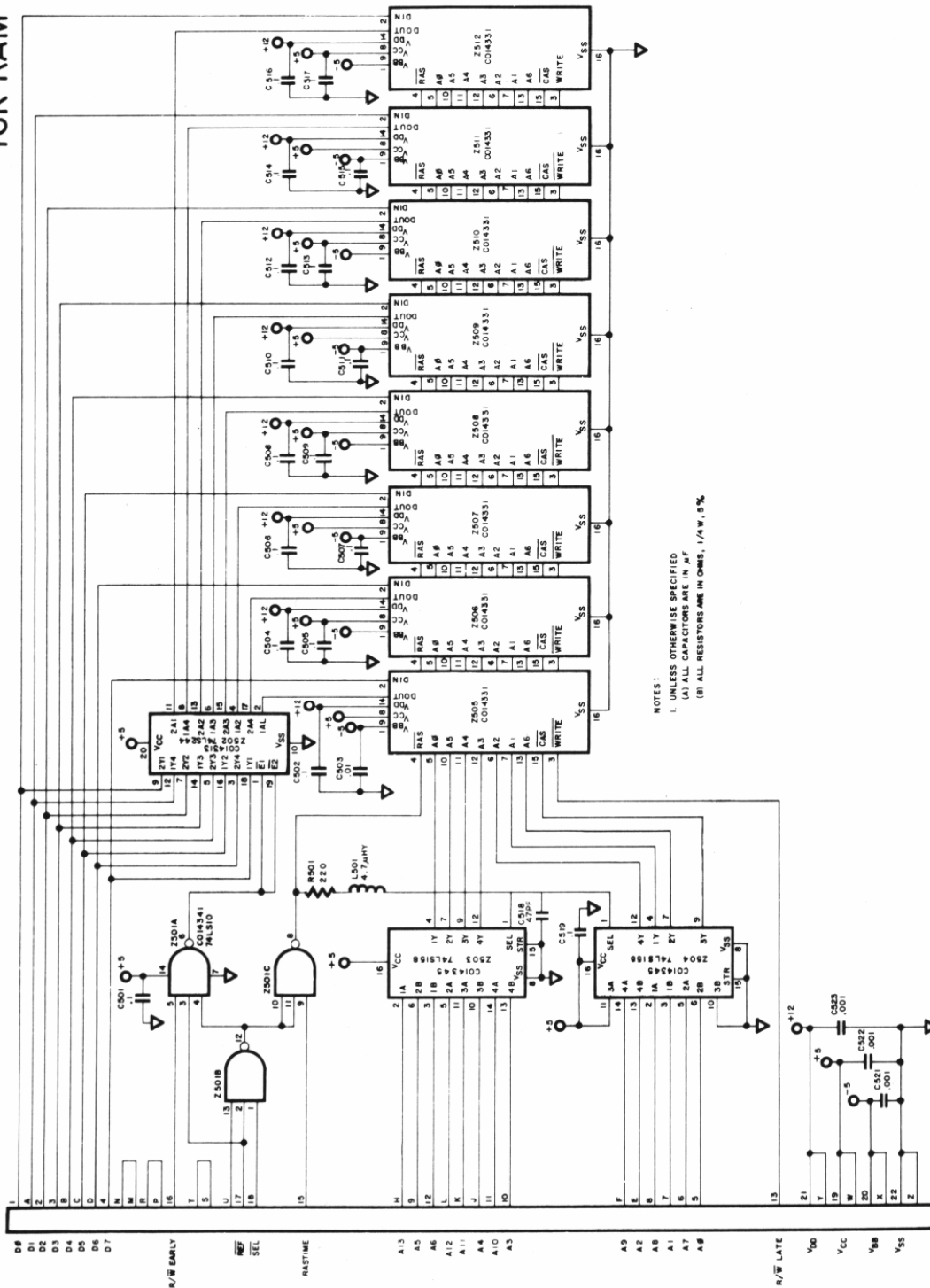


Fig 4-14

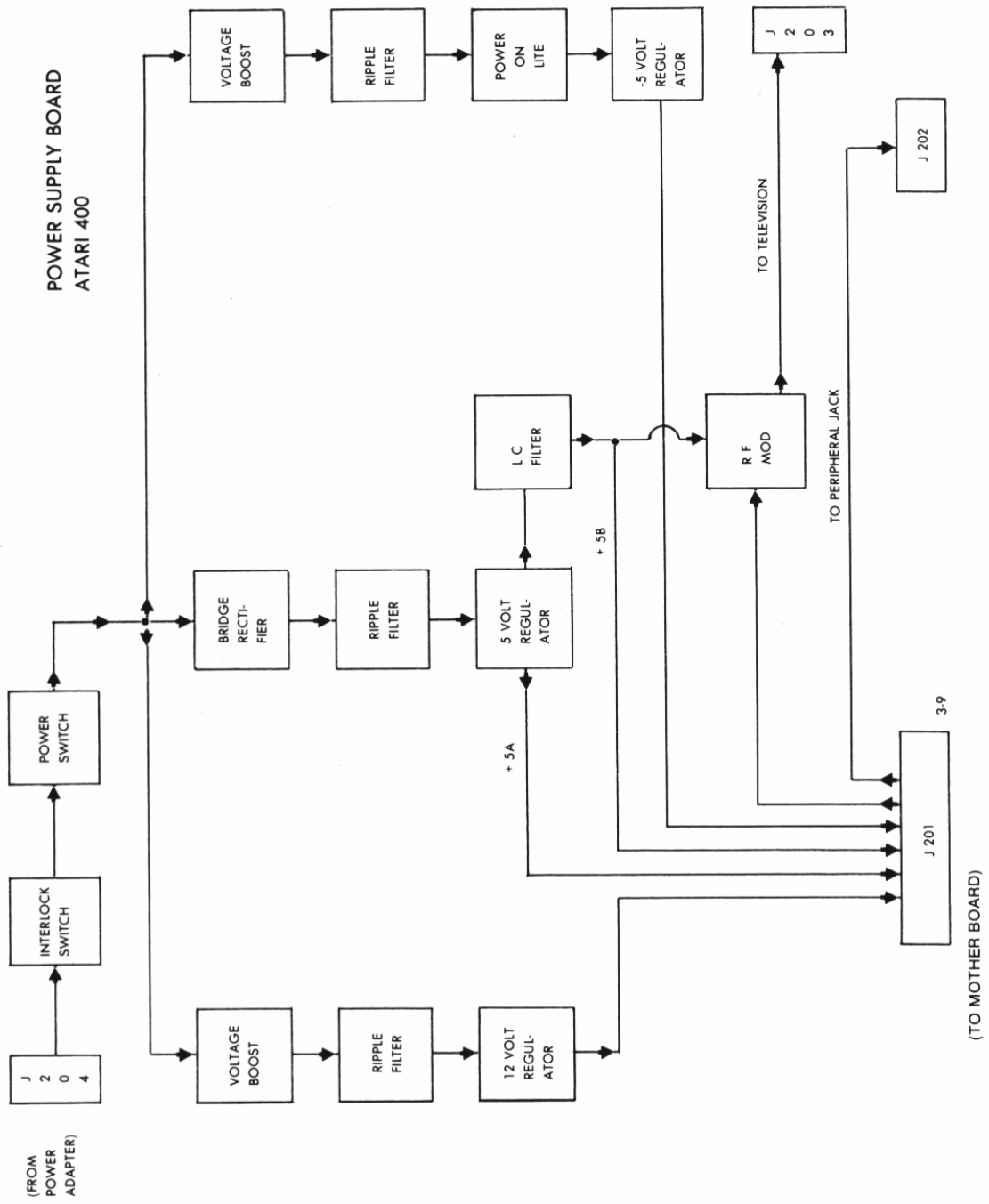


Fig 4-15

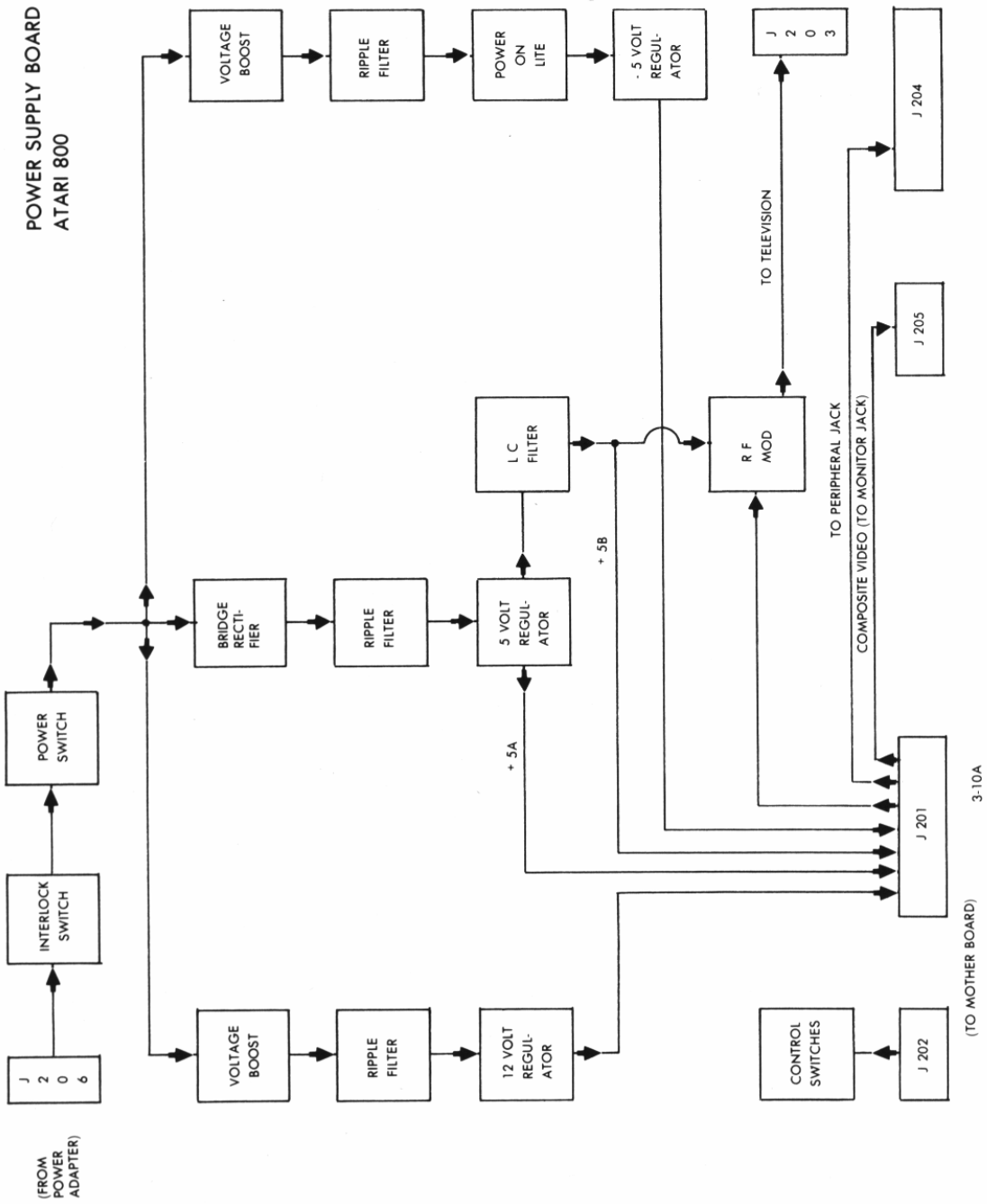
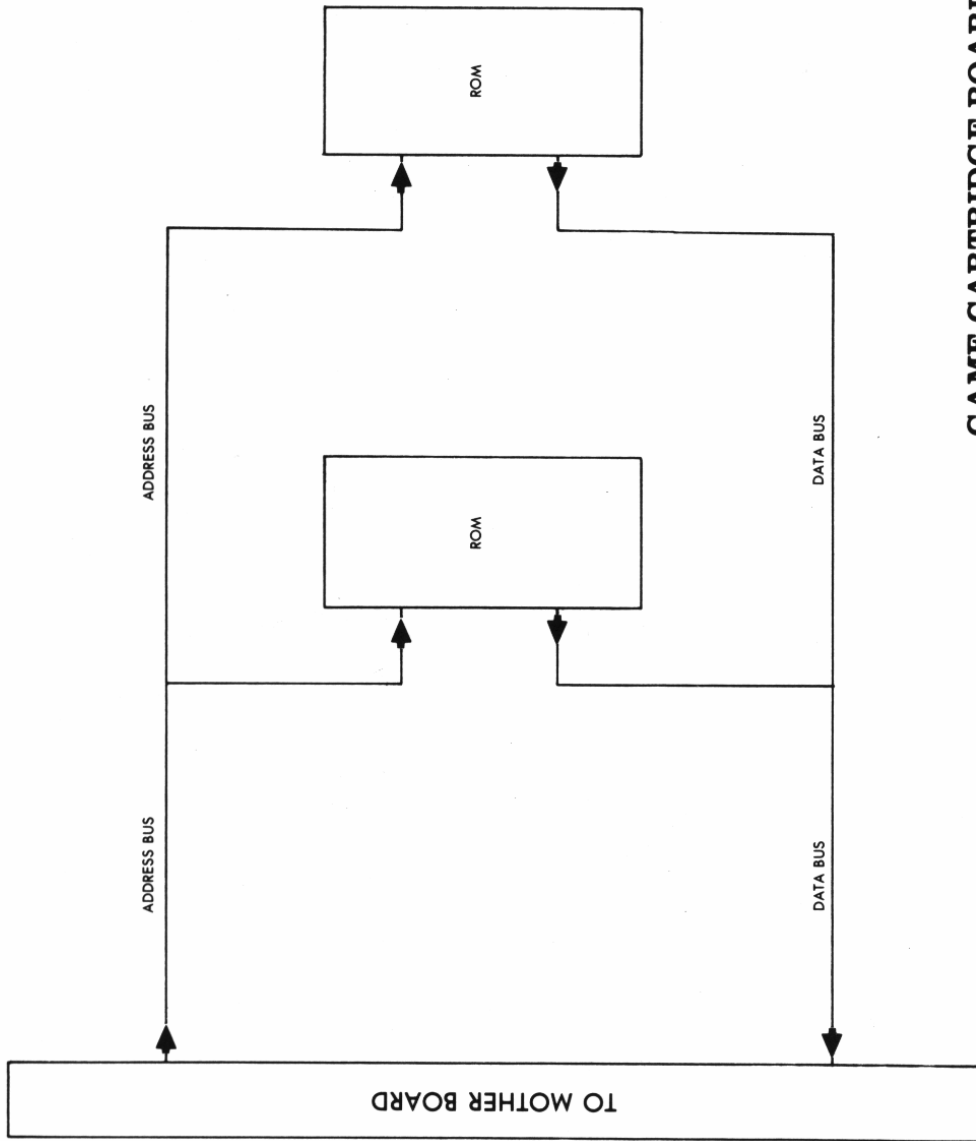


Fig 4-17



GAME CARTRIDGE BOARD

Fig 4-19

SCHEMATIC ROM CARTRIDGE

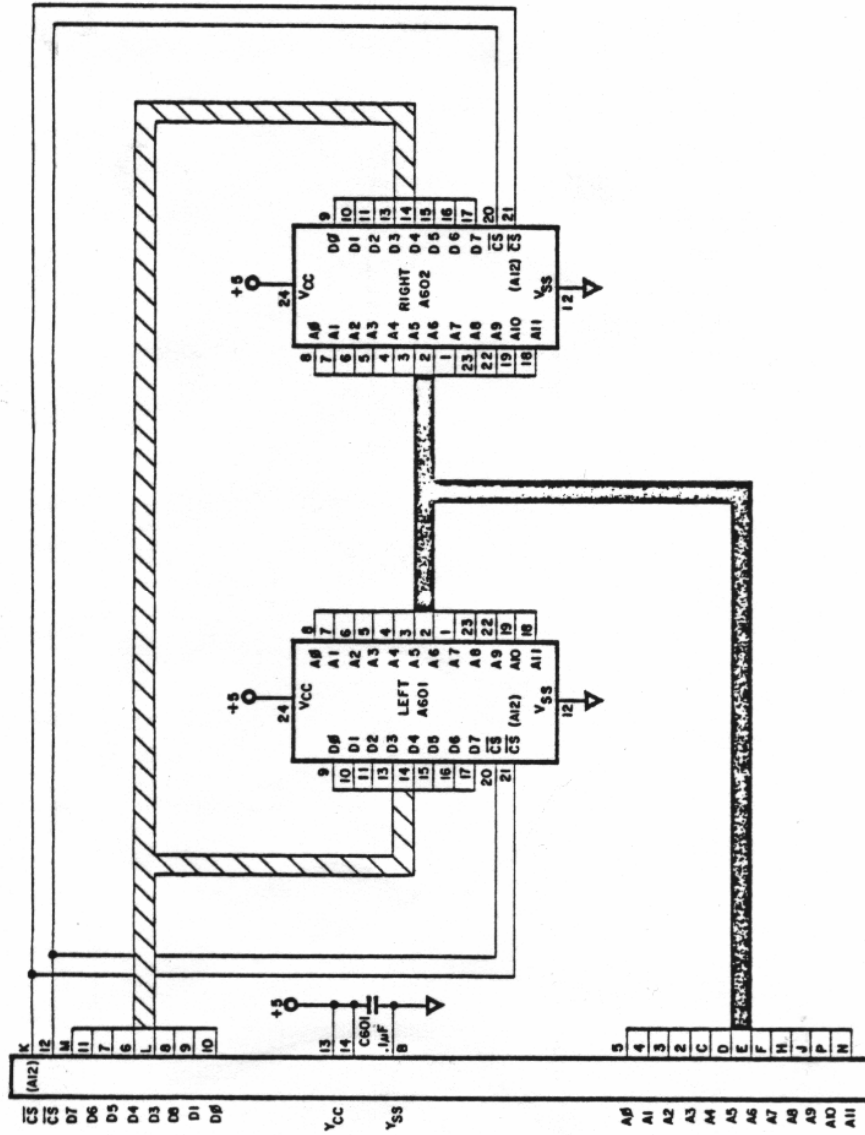


Fig. 4-20

CHAPTER 5 - MAINTENANCE

5.1 INTRODUCTION

The following paragraphs provide instructions on the proper care and maintenance of the 400/800 Consoles. Included will be a section on preventive maintenance, covering normal cleaning and inspection; a section on troubleshooting the 400/800 Consoles to detect an error causing component; and a section containing disassembly and assembly instructions.

NOTE

Printed circuit boards containing integrated circuits can be damaged by static charges in their plastic packaging or by handling in normal work environments. It is necessary to establish a static free work station. A work station for assembling static-sensitive materials should consist of an anti-stat poly table cover that is grounded to the metal on the table. In addition, the worker at the station should also be grounded, with a wrist strap, to the metal portion of the table. Note that the wrist grounding straps affect only the body of the service person, not the clothing. Therefore, short sleeves are preferred. If long sleeves are worn, they should be covered by an antistat gauntlet.

On static-sensitive work surfaces, all plastics except anti-static ones should be forbidden. Vinyl or mylar shop carriers pulled from a stack and laid casually on a board can destroy it. Styrene desoldering devices generate large static charges, particularly when triggered. Practically all plastic and plastic related materials generate tremendous charges and should not be permitted in the same room where static-sensitive devices are being assembled or stored.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance on both the 400 and 800 Computer Consoles consists of maintaining a dust free environment for the Consoles when not being used (wrapped in packaging material) and cleaning and lubricating the printed circuit board (PCB) contacts.

Many of the troubles encountered with both the 400 and 800 Consoles consist of loose or corroded contacts on both the CPU and memory (ROM and RAM) printed circuit boards.

5.2.1 PCB Contact Cleaning and Lubrication

The following steps detail the procedures required to clean and lubricate the PCB contacts on the CPU and memory PCBs once they have been removed from the motherboard. Refer to paragraphs 5.5 and 5.6 for disassembly instructions and paragraphs 5.7 and 5.8 for assembly instructions.

Tools Required

- o Board Cleaning Brush
- o Lubriplate (DS-ES Lubricant)
- o ZEP Safety Solvent or Isopropyl Alcohol
- o Dust Free Cloth
- o Acid Brush

Procedure

1. Inspect the PCB contacts for flux, dirt, foreign material and deeply serrated contact fingers.
2. Moisten the dust free cloth in the ZEP solvent and clean the finger contacts on the PCB, ensure that both sides of the contacts are clean of residual lubricant.

N O T E

Avoid touching the contacts on the PCB after cleaning.

3. If corrosion or residue remains on the contacts it will be necessary to clean the contacts further using the board cleaning brush. The proper procedure is as follows:
 - o After moistening the board cleaning brush with ZEP cleaning solvent firmly brush the contacts on the PCB, four to six strokes will do. Care must be taken to avoid contact between the brush and any other portion of the printed circuit board.
 - o Again clean the finger contacts of the PCB with the dust-free cloth.
4. Dip acid brush in lubriplate.
5. Apply even coating of lubriplate to contact fingers on both sides of PCB. The coating of lubriplate should be thick enough to obscure visibility of contact fingers. Avoid spreading lubriplate on areas other than the contact fingers.
6. The printed circuit board is now ready to be firmly seated back in the Console motherboard.

5.2.2 Visually Inspecting the Computer Consoles

As part of the preventive maintenance procedures visually inspect the Computer Consoles for damage and abuse.

1. Inspect the Controller jacks and Peripheral jacks for broken or bent pins.
2. Check RF cable for cracks in the insulation or bare (pinched) areas.
3. Open Cartridge Door and check cover closed Interlock switch. With a small blade screwdriver press the plunger down. Release plunger and observe return to normal position.
4. Inspect Cartridge slot for foreign objects or damage.
5. Inspect power jack for bent or damaged pin.

If any damage is found repair the defective unit according to the instructions outlined in the disassembly and assembly paragraphs of this chapter.

5.3 SYSTEM CHECK-OUT

The following paragraphs detail the standard check-out procedures used to determine the operational status of the 400/800 Computer Consoles. Refer to Figure 5-1, System Check-Out Flowchart, which depicts the typical paths followed by a service person. Figure 5-1 can be used as a guide in interpreting maintenance on the 400/800 Computer Consoles.

5.3.1 Memo Pad Test

This test is performed everytime the 400/800 Computer Console is either powered up (turned ON) or when the System Reset switch is depressed. This is a Console Self-Test contained in the Operating System (10K ROM) of the 400/800 Computer Consoles.

After the Power ON/OFF switch is set to ON, the Operating System performs a self-test and displays the "ATARI COMPUTER - MEMO PAD" logo to indicate a passing condition. If the system fails to respond with the correct indication, repeat the System Power-Up sequence for a second time, refer to Chapter 2 for instructions. If the system still fails to display the Memo Pad Logo or if the screen displays any of the following symptoms, refer to paragraph 5.4, Troubleshooting, for instructions.

- o Green Screen
- o Black Screen (Power Indicator ON)
- o Power Indicator NOT ON.
- o Random Characters appear on Screen
- o Character begins scrolling across Screen
- o Unit 'Locks-Up'. Memo Pad Logo does not appear, Screen correct color shade (not green, not black).

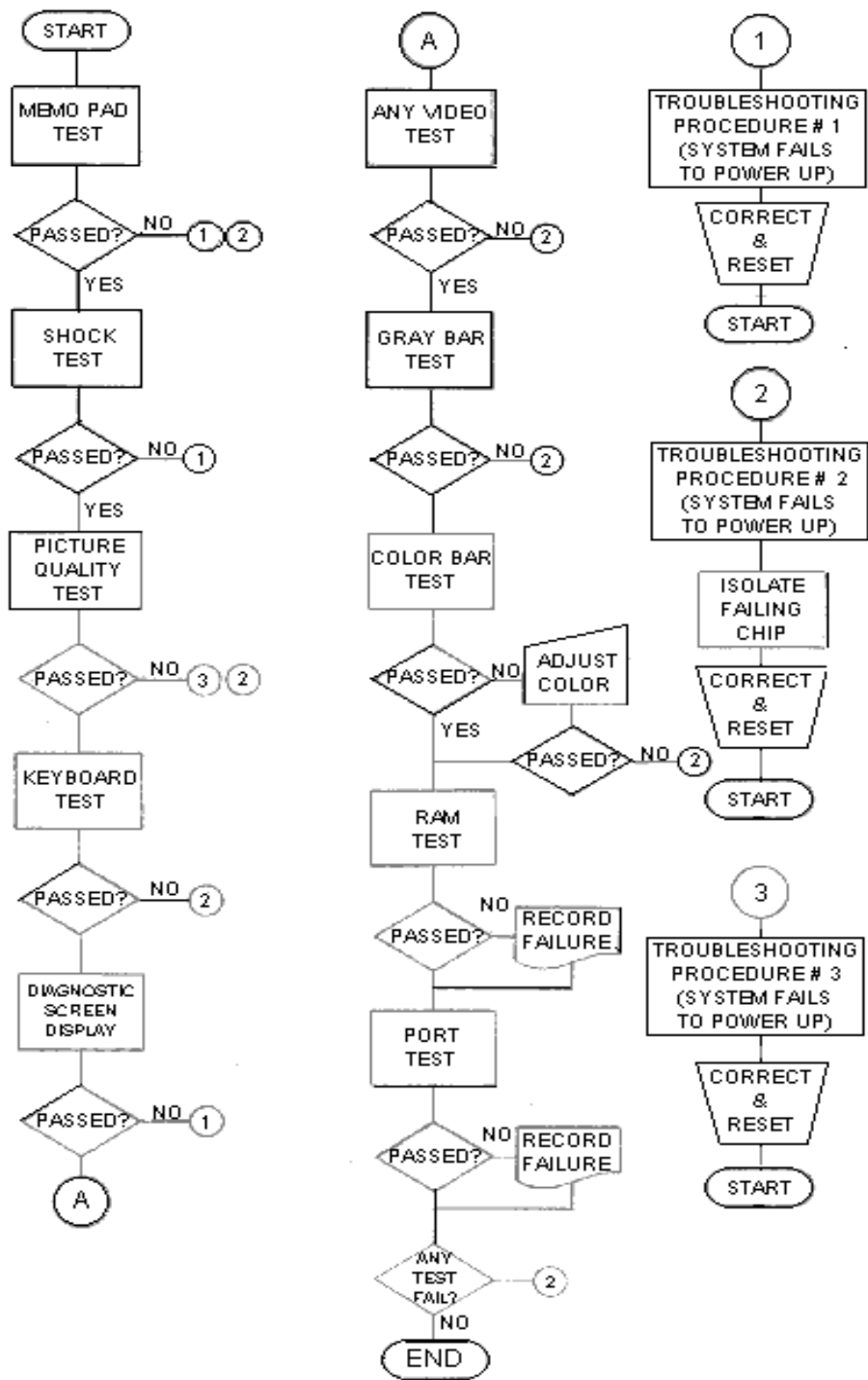


Figure 5-1. System Check-Out Flowchart

If the system displays the correct Memo Pad Logo and appears correct according to the preceeding criteria, continue to the Shock Test.

5.3.2 Shock Test

The Shock Test is intended to verify the correct seating of RAM, ROM and CPU PCBs in the motherboard. If incorrectly seated the system could act irratically.

This test is to be run after successfully completing the hiemo Pad Test.

NOTE

Ensure that no Program Cartridge is in the cartridge slot. This can give you invalid failure indications.

Proceed as Follows:

1. With System Power switch ON, lift Console unit approximately two to three inches above the table.
 2. Release Console unit allowing it to free fall to the table.
 3. Repeat steps 1 and 2, three times observing the television screen for any of the failure conditions listed below. If failure indications do occur, set the System Power ON/OFF switch to OFF and refer to paragraph 5.4, Troubleshooting, for instructions.
- Green Screen
 - Random characters appear on Screen
 - Screen changes color

If the system displays none of the preceeding faults, continue to the Picture Quality Test.

5.3.3 Picture Quality Test

The Picture Quality Test is a visual inspection of the television screen to determine picture quality. Adjust the fine tuning on the television screen (automatic fine tuning must be OFF) for channel 2 or 3, whichever channel the Console is switched.

Observe the television screen, in the Memo Pad mode, for any of the following conditions:

- Herringbone pattern
- Snowy Picture

- Picture blurred
- White dot patterns on screen, usually appear as vertical dotted lines.

If any of the preceding conditions are observed refer to paragraph 5.4, Troubleshooting.

5.3.4 Keyboard Test

This test verifies the proper operation of the system Keyboard. To conduct this test, the preceding tests, Memo Pad Test and Shock Test, should have been successfully run and the system should be displaying the Memo Pad Logo.

The following steps constitute the Keyboard Test:

1. Type each of the character keys and observe their correct display on the television screen.
2. Press the RETURN and BREAK keys observing the carriage return and line feed.
3. Press the TAB key observing the cursor advancing ten (10) spaces.
4. Press the 'ESC' key twice to display "Ec" on the television screen.
5. Press the spacebar to move cursor right one space.
6. Press 'DELETE /BACK S' to move cursor left one space.
7. Press 'CAPS/LOWER', then type alphabet to display lower case alphabet on television screen.
8. Hold 'SHIFT' key down and press any alphabet character to display upper case alphabet character on television screen.
9. Press the inverse video key (key with ATARI logo) then type any character to check inverse video feature.
10. Hold down 'CTRL' (Control) key and press '↓' key and observe that the cursor moves down on the television screen. Use the 'CTRL' key and the cursor control keys to move the cursor up, right and left.
11. Press the 'SYSTEM RESET' key to clear the television screen and display the Memo Pad Logo.

If any of the above keyboard tests fail refer to paragraph 5.4, Troubleshooting. If the system displays none of the preceding faults, continue to the Stand Alone Test.

5.3.5 Stand Alone Test (Diagnostic)

The Stand Alone Test uses ATARI supplied diagnostic software (Program Cartridge) to check system operation and integrity. Complete all of the previous individual System Check-Out tests before preceeding with the Stand Alone Test. Complete the entire Stand Alone Test, logging all failure conditionst before attempting to repair any failure. Refer to paragraph 5.4, Troubleshooting, for the correct procedure to repair any detected failure.

Special Tools Required (Refer to Figure 5-2)

- Stand Alone Test Program Cartridge
- Controller Port Jumper Assembly
- Peripheral Port Jumper Assembly
- Screwdriver flat-blade no. 1

Test Procedures:

1. Set System Power ON/OFF switch to OFF.
2. Open Program Cartridge door and insert Stand Alone Test Program Cartridge in left cartridge slot (800 Console only, 400 Console only has one cartridge slot). Close Program Cartridge door.
3. Plug the Peripheral Port Jumper Assembly into the side peripheral port.
4. Plug the Controller Port Jumper Assembly into the front controller ports.
5. Set the System Power switch to ON. The diagnostic program Contained in the Program Cartridge will be executed and the diagnostic screen display will appear. If the Console fails to execute the diagnostic program and displays a System Error and a buzzer sounds, turn the System Power switch to OFF and reinsert the Program Cartridge. Repeat System Power-Up, if the Console fails to execute the diagnostic program after three attempts refer to paragraph 5.4, Troubleshooting, for further instructions.
6. Each diagnostic test contained on the Program Cartridge is selected by a 'command letter'. The following is a list of the 'command letters'.

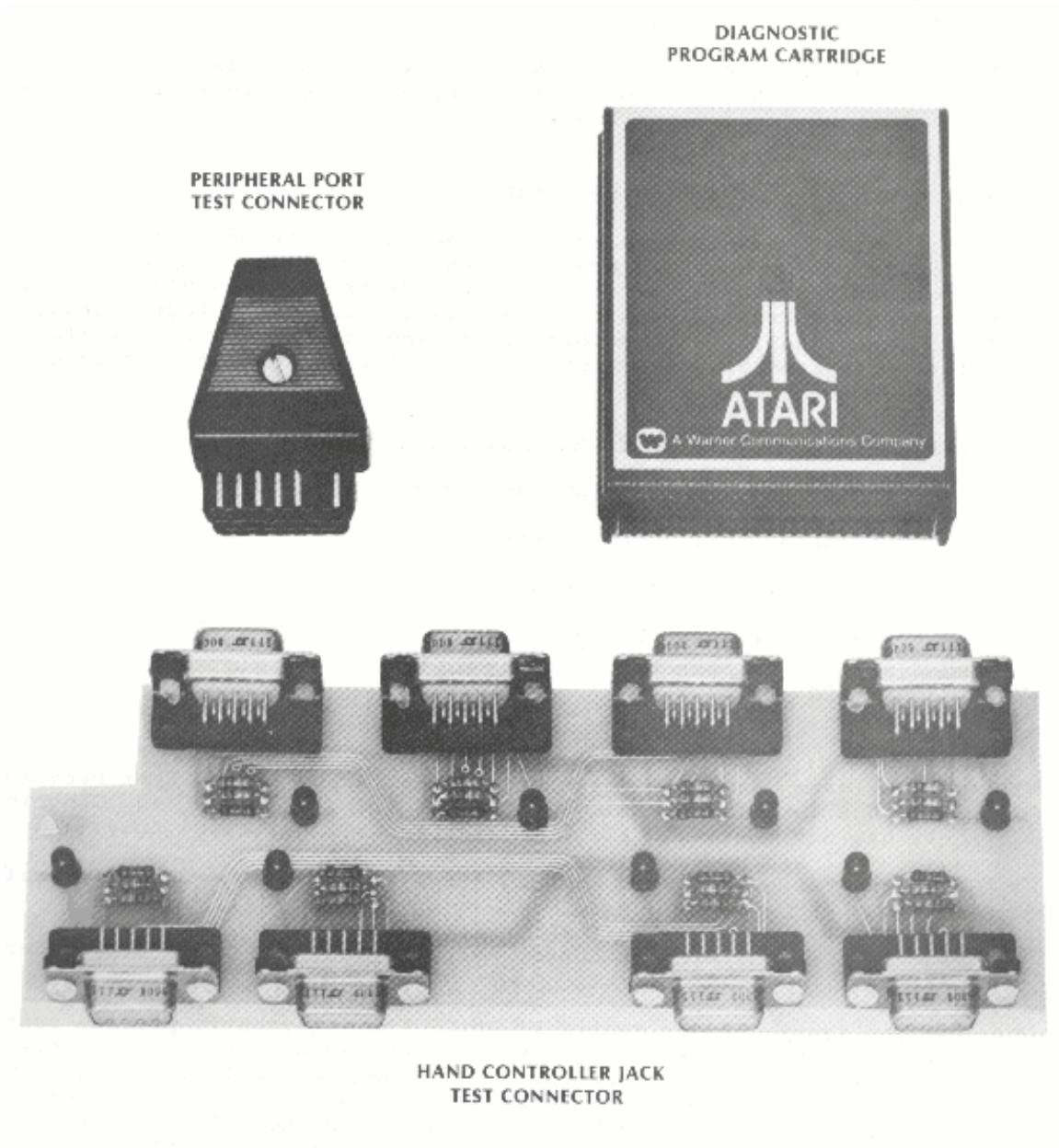


Figure 5-2. Stand Alone Test Special Tools

- D = Display Options
 - P = Pass/Fail
 - E = Display Error Table
 - S = Single Run of Test
 - C = Continuous Run of Test
- A = Any Video Test
- G = Graybar Test
- C = Colorbar Test
- R = RAM Test (Tests Up to 32K)
- P = Port Test (Used in Conjunction with Port Jumpers)
- T = Tone Test (4 Registers - 8 Tones each)

Proceed with each of the following tests, noting any errors that occur.

Display Option

The test procedures and results can be varied by entering Display Option commands. To enter the commands you must first type 'D' and carriage return (or spacebar) to enter the Display Option Mode. Once in the Display Option Mode the screen will prompt you to enter the test format, either a PASS/FAIL indication or an ERROR TABLE display.

```
Enter:
      P = PASS/FAIL Indication
      E = ERROR TABLE Display
```

Next the screen will prompt you to enter the test mode either SINGLE TEST or CONTINUOUS TESTING.

```
Enter:
      S = SINGLE TEST
      C = CONTINUOUS TESTING
```

These special options are only used with the RAM Memory and Port Tests.

VIDEO TESTS

The video test consists of a series of three tests designed to check video display, color adjustment, and screen luminosity.

```
A = ANY VIDEO TEST
```

2. Refer to Figure 5-3, for correct screen display.
- Check the V's in the upper right of the screen to be sure they are not inverted.
 - Observe if any of the vertical bars are missing or appear in a different sequence than Figure 5-3

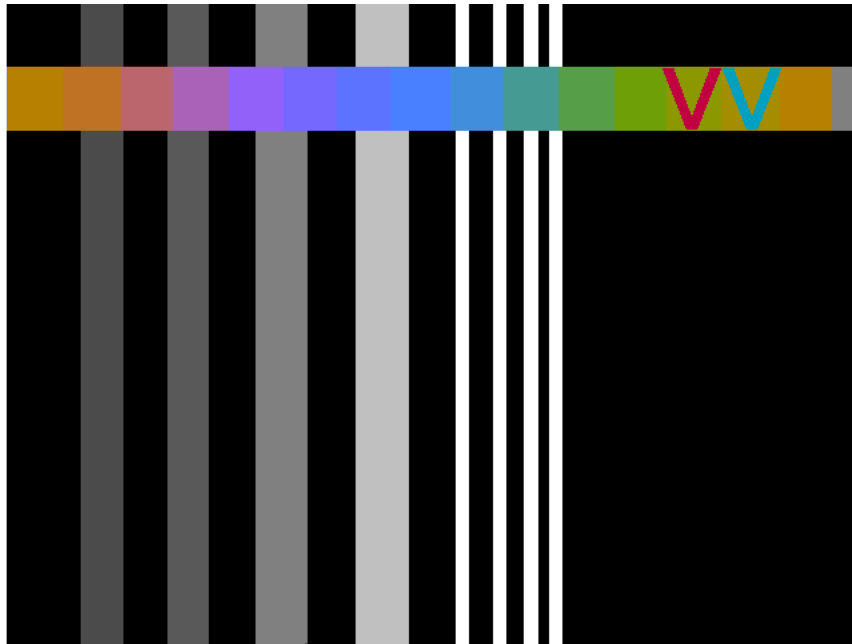


Figure 5-3. Any Video Test Screen Display

G = GRAYBAR TEST

1. Enter Command Letter 'G', carriage return (or spacebar).
 1. Refer to Figure 5-4 for screen display appropriate to this test.
- Screen is divided into eight equal horizontal bars.
 - The shading begins with the horizontal bar at the top of the screen being black and increments gradually to the bottom horizontal bar being white. The top four horizontal bars can be noticeably different in color shade than the bottom four horizontal bars.

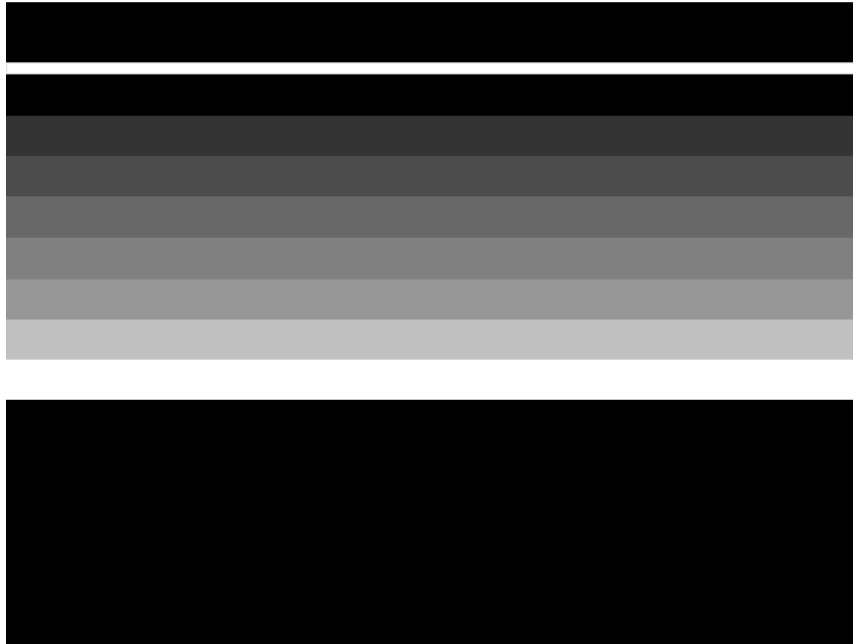


Figure 5-4. Graybar Test Screen Display

COLORBAR TEST

1. Enter Command Letter 'C', carriage return (or spacebar)
2. Refer to Figure 5-5 for the correct screen display for the Color Bar Test.
 - Between the top gray bar on the screen and the reference gray bar near the bottom of the screen are fifteen color bars developing a rainbow effect.
 - The color bars directly above and below the gray reference bar should be identical both bars green tint.
3. If the color bars directly above and below the reference bar are not identical proceed with the Color Bar Adjustment procedures that follow. If the color bars are identical then the Video Test is Complete and proceed to the RAM TEST.

Colorbar Adjustment Procedure

1. The 400 Console should remain powered-up and the Color Bar Test entered.
2. The 800 Console must be powered down and the Cartridge Door assembly removed, proceed as follows:

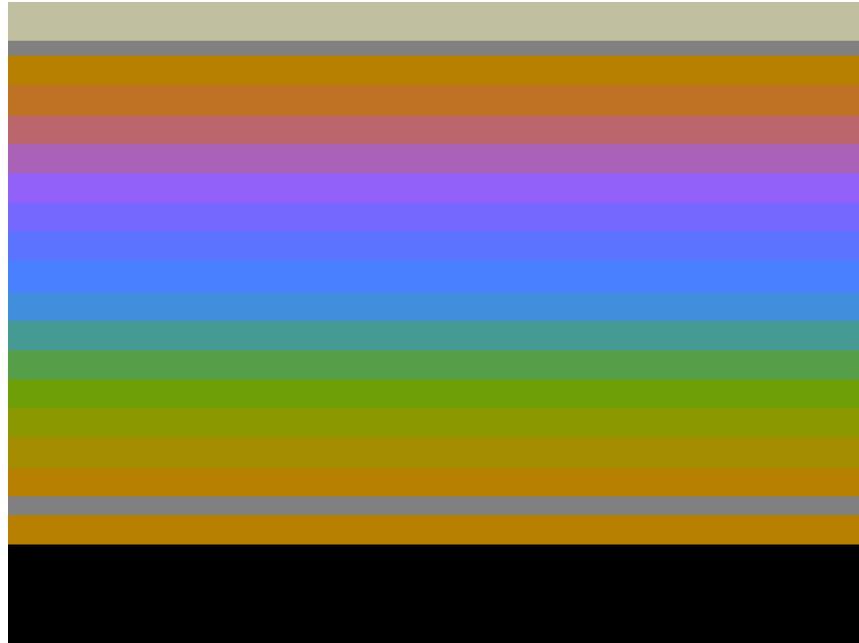


Figure 5-5. Color Bar Test Screen Display

- Set System Power ON/OFF switch to OFF.
 - Open Cartridge Door
 - Rotate Cartridge door clamps to the outside
 - Raise Cartridge Door assembly 1/4 inch, then pull towards you and lift off
 - Use small flat-blade screwdriver to depress Interlock switch
 - Set System Power ON/OFF switch to ON
 - Initialize Color Bar test to display screen format
3. Turn the Console 180 degrees to provide access to the back of the Console.
 4. Refer to Figure 5-6 for the 400 ConsoleT and to Figure 5-7 for the 800 Console when performing the following steps.
 - Insert a small (No. 1) flat-blade screwdriver or an electronic adjustment tool into the plastic grating of the 400 Console, or into the access hole of the 800 Console until it contacts the variable resistor.

- Adjust the variable resistor until the two color bars are identical.
5. Once adjusted, reassemble the 800 Console and proceed to the RAM Test. If unable to adjust the color bars refer to paragraph 5.4, Troubleshooting.

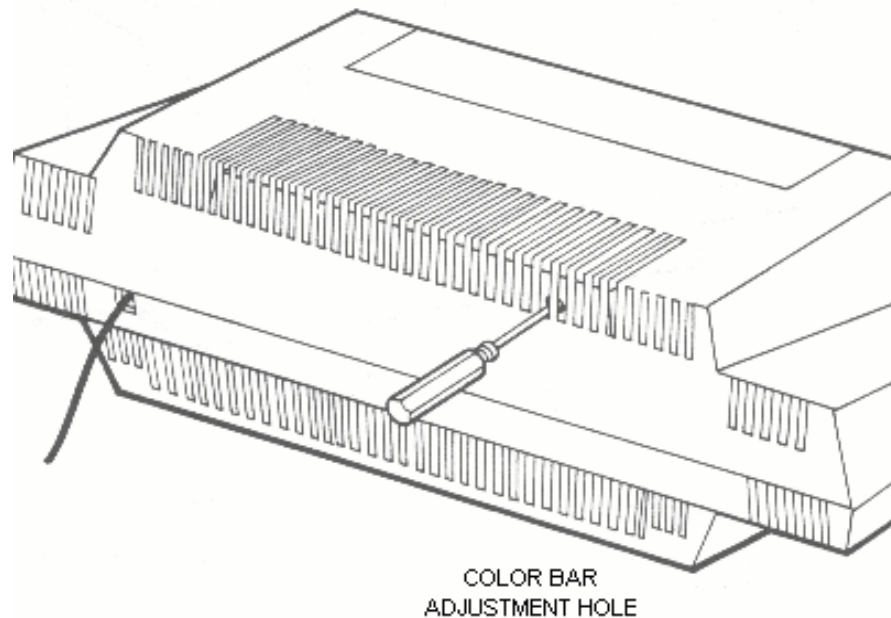


Figure 5-6. 400 Console Color Adjustment

RAM TEST

The RAM Test utilizes six different tests to verify the operation of the RAM Memory boards. The RAM Test checks the RAM memory in 8K blocks. The number of 8K blocks is entered as part of the command sequence. If you enter a number indicating less memory than actually installed the diagnostic program will only check the memory indicated. A maximum of 32K of RAM memory can be checked. In order to check additional memory it will be necessary to swap tested memory with untested memory.

Before running the RAM Test it is necessary to determine the type of display format and mode for the test. Default setting for the display format is a PASS/FAIL indication. Default setting for the test mode is a single test. RAM Memory boards should pass three complete series of diagnostic tests before acceptance. Typically a RAM Test is run as follows :

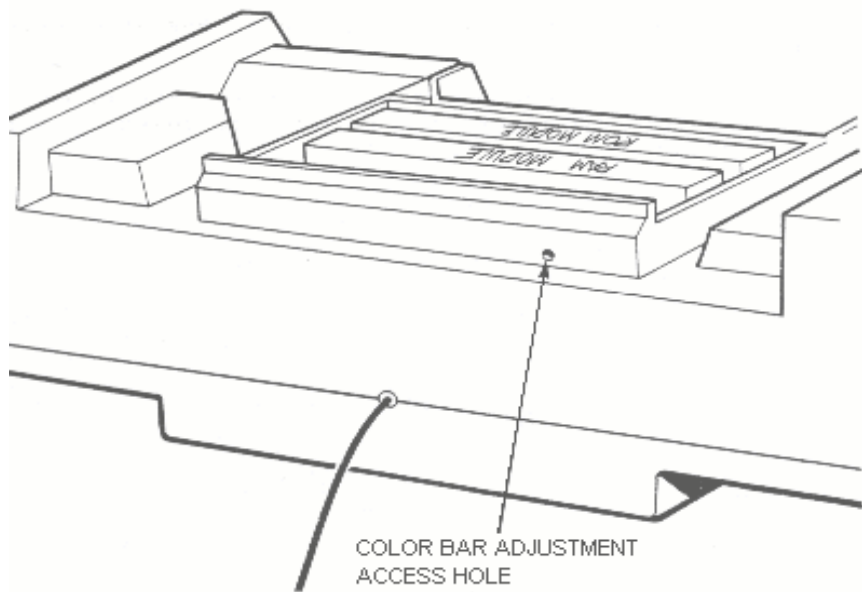


Figure 5-7. 800 Console Color Adjustment

1. Enter Command Letter 'D', carriage return (or spacebar), to Display Options.
3. Enter Command Letter 'E', carriage return (or spacebar), to display Error Table.
3. Enter Command Letter 'C', carriage return (or spacebar), to enable continuous testing.
4. Enter Command Letter 'C', carriage return (or spacebar), to select RAM Test.
5. Enter number of 8K memory blocks; 1 = 8K, 2 = 16K, 3 = 24K, 4 = 32K, carriage return (or spacebar).

In approximately ten seconds a matrix similar to Figure 5-8 will be displayed on the screen. In the lower four video lines on the screen, outlined in reverse video, will appear the prompt RAM TEST, indicating one complete test sequence. To continue testing, do nothing. To stop the test, hit carriage return (or spacebar) and the testing will stop at the completion of the present test.

Observe rows D and E for '1' indicators signifying a RAM failure. Also observe if the failure indication occurs in the same column each test or if it moves about. If a failure does occur record the failing location and rerun the RAM Test in its entirety making sure that the

RAM 8K memory block size was correctly specified. If the failure still exists refer to paragraph 5.4, Troubleshooting.

Repeat the RAM Test for each of the 8K or 16K RAM memory boards or modules, in excess of 32K.



Figure 5-8. RAM Test Matrix Screen Display

PORT TEST

This is a test of the ability of the 400/800 Computer Consoles to communicate with the outside world through the Hand Controller ports and the Peripheral port.

Check to see that the Peripheral Port Jumper Assembly and the Controller Port Jumper Assembly are securely inserted in their respective ports. Before running the PORT Test it is necessary to determine the type of display format and test mode desired. Default setting for the display format is a PASS/FAIL indication. Default setting for the test mode is a single test. (If the Display Options have already been changed from the default settings, ie., RAM Test, they need not be reestablished). Typically a PORT Test proceeds as follows:

1. Enter Command Letter 'D', carriage return (or spacebar), to Display Options.

2. Enter Command Letter 'E', carriage return (or spacebar), to display Error Table on screen.
4. Enter Command Letter 'C', carriage return (or spacebar), to initiate continuous testing.
2. Enter Command Letter 'P', carriage return (or spacebar), to initiate PORT Test.

Almost immediately a matrix similar to Figure 5-9 will be displayed on the screen. In the lower four video lines on the screen outlined in reverse video, will appear the prompt PORT TEST, indicating one complete test sequence. To continue testings do nothing. To stop the test, hit carriage return (or spacebar) and the testing will stop at the completion of the present test.

The Error Table displayed should be all zeroes, if a one (1) appears in any portion of the matrix an error condition exists. Record the error location and refer to paragraph 5.4, Troubleshooting.

NOTE

A blinking one (1) in position A-5 of the Error Table may not signify an error condition. A software error exists in the Stand Alone Test Program. The signal in question is the motor control line and will be more thoroughly tested in the Program Cassette Recorder Test.

TONE TEST

The TONE Test checks the sound generation Circuits of the Consoles and each of the four sound registers for tone and volume control. The volume on the television set should be set in the middle of the range for this test. The TONE Test must be run in its entirety for each of the four sound registers.

Proceed as follows:

1. Enter Command Letter 'T', carriage return (or spacebar), to initiate TONE Test.
2. Enter sound register number (1 to 4) to be tested when prompted by the screen display.

Eight tones are generated in succession, starting with the highest pitch down to the lowest. The first three tones are very high frequencies and may be inaudible to some people. Each tone starts at maximum volume and 'fades' to minimum volume.

The complete TONE Test, steps 1 and 2, should be run for each of the four sound registers.

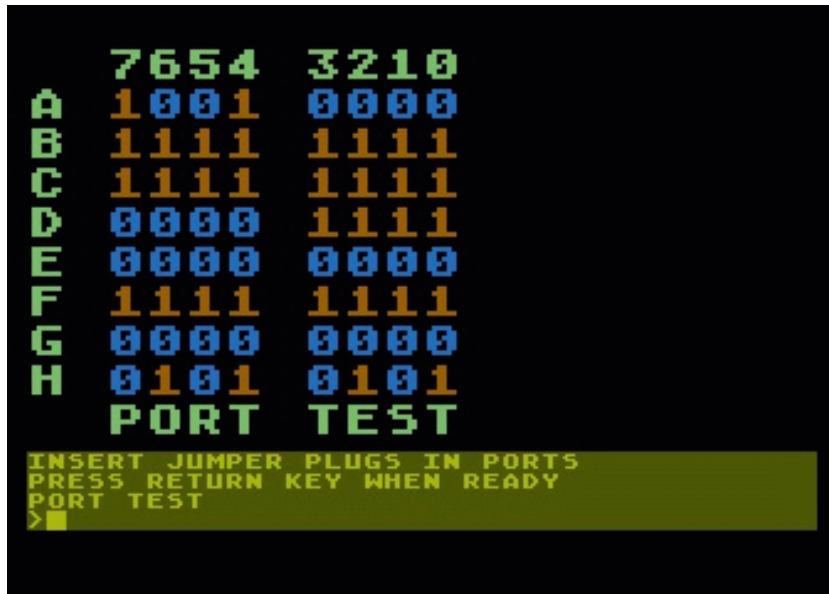


Figure 5-9. PORT Test Error Table Screen Display

5.4 TROUBLESHOOTING GUIDE

The following table provides a list of possible failures at different points in the power-up sequence and preceding test procedures. The table will list the failure, probable cause and the appropriate test procedure to isolate the problem to a printed circuit board or integrated circuit.

Table 5-1. Troubleshooting Guide

Description	Possible failure	Test Procedure
<p>MEMO PAD TEST</p> <ul style="list-style-type: none"> • Green Screen • Black Screen • Random Characters on Screen • Unit Locks Up • Character begin scrolling across screen 	<p>Loose or dirty contacts with RAM or CPU boards</p> <p>Motherboard</p>	<p>1</p> <p>2</p>
<p>VISUAL INSPECTION</p> <ul style="list-style-type: none"> • Damaged or bent pins • Cover Closed switch will not work properly • RF Cable cut or badly damaged • Bare or pinched area on RF cable 	<p>Replace damaged board</p> <p>Plunger or Power Supply</p> <p>Replace RF Cable</p> <p>Replace RF Cable</p>	<p>2</p> <p>2</p> <p>Replace immediately</p> <p>Replace immediately</p>
<p>KEYBOARD TEST</p> <ul style="list-style-type: none"> • Key depressed not displayed • Key depressed not same key that appears on screen • Characters begin scrolling across screen 	<p>Motherboard</p> <p>Or</p> <p>Keyboard</p>	<p>2</p>
<p>STAND ALONE TEST</p> <ul style="list-style-type: none"> • System Error (can not power-up with Stand Alone Test Cartridge inserted) • Fails Any Video Test • Fails Color Bar test • Fails Gray Bar test 	<p>Cartridge Guide</p> <p>RAM Memory Board</p> <p>CPU Board</p>	<p>2</p> <p>2</p>

<ul style="list-style-type: none"> • Fails Port test 	Motherboard	2
<ul style="list-style-type: none"> • Fails RAM Test 	RAM Memory Board	2
<ul style="list-style-type: none"> • Fails Tone Test 	Motherboard	2
PICTURE QUALITY TEST		
<ul style="list-style-type: none"> • Herringbone screen 	Power Supply	3
<ul style="list-style-type: none"> • Snowy picture or no picture 	RF Cable	3
<ul style="list-style-type: none"> • Blurred picture 	Power Supply	3
<ul style="list-style-type: none"> • White Dot Pattern on screen (usually vertical pattern) 	RAM Memory Board	3
<ul style="list-style-type: none"> • Picture upside-down when running programmed software. (Program Cartridge) 	CPU Board	3
<ul style="list-style-type: none"> • Power LED not ON and no picture 	Power Supply	2
<ul style="list-style-type: none"> • Screen oscillation wgen using Paddle Controller 	Motherboard needs Engineer fix	2
<ul style="list-style-type: none"> • Will not perform math calculations 	CPU Board	2

5.4.1 Troubleshooting -- Procadure Number One

This troubleshooting procedure is intended to be followed when the Console System fails to power-up correctly. Symptoms include Green Screen, Black Screen, Random Characters on Screen, or Unit Lock-Up.

This procedure assumes that the System Power ON LED is lit and the screen exhibits some symptom of Console control. If these two conditions do not exist proceed to Troubleshooting - Procedure Number Two.

Proceed with the following steps to troubleshoot the system:

1. Disassemble the Console using the instructions outlined in paragraph 5.5 for the 400 Console, and paragraph 5.6 for the 800 Console.
2. Clean the RAM Memory PCB and CPU PCB contact fingers per the instructions outlined in paragraph 5.2.1, PCB Contact Cleaning and Lubrication.
3. Assemble the individual boards to operate the system out of the casting, see Figures 5-10 and 5-11. Refer to paragraphs 5.7 and 5.8 for assembly instructions. Plug low voltage power adapter into the System Power jack.
4. Perform System Check-Out, refer to paragraph 5.3.

NOTE

Television screen interference is normal when the system is operated without the aluminum casting.

4. If the system will not power-up properly, proceed to Troubleshooting Procedure Number Two.

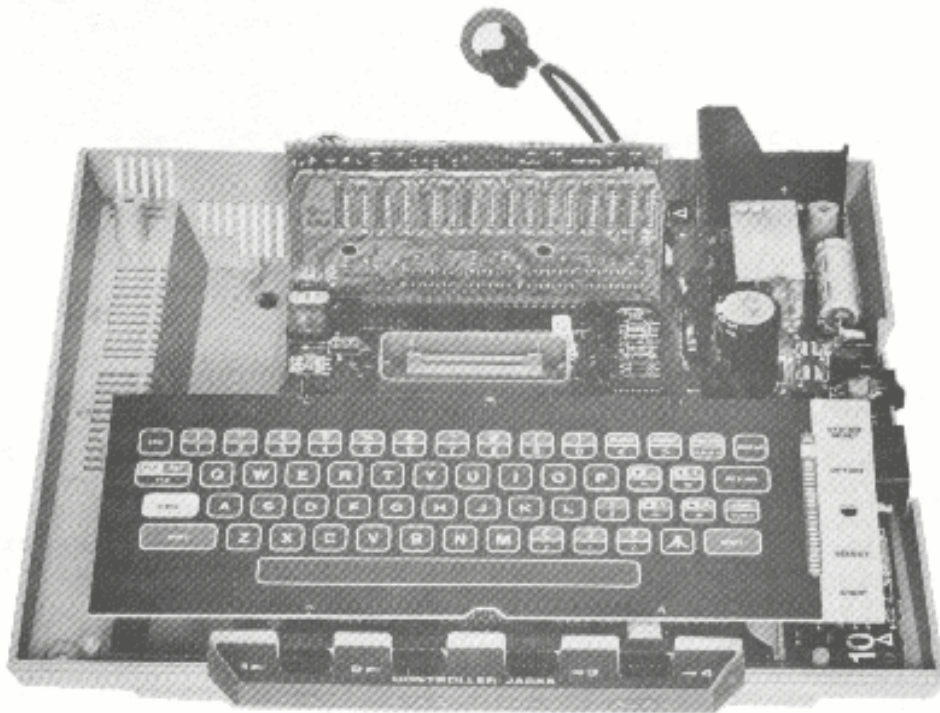


Figure 5-10. 400 Console, Assembled Without Casting

5.4.2 Troubleshooting - Procedure Number Two

This procedure in conjunction with Table 5-1, Troubleshooting Guide, is used to isolate the failure to a specific printed circuit board. Table 5-1, provides the most probable failing PCB for the described problem. This procedure will help isolate the failing PCB if the suggested faulty PCB is not the problem.

Proceed with the following steps to isolate the faulty PCB:

1. Disassemble the Console using the instructions outlined in ATARI Personal Computers 5-21, paragraph 5.5 for the 400 Console and paragraph 5.6 for the 800 Console.
2. Clean the RAM Memory PCB and CPU PCB contact fingers per the instructions outlined in paragraph 5.2.1, PCB Contact Cleaning and Lubrication.
3. Assemble the individual boards to operate the system out of the casting, see Figures 5-10 and 5-11. Refer to paragraphs 5.7 and 5.8 for assembly instructions. Plug low voltage power adapter into the System Power jack.
4. Perform System Check-Out, refer to paragraph 5.3. Continue from this point if the system fails System Check- Out.

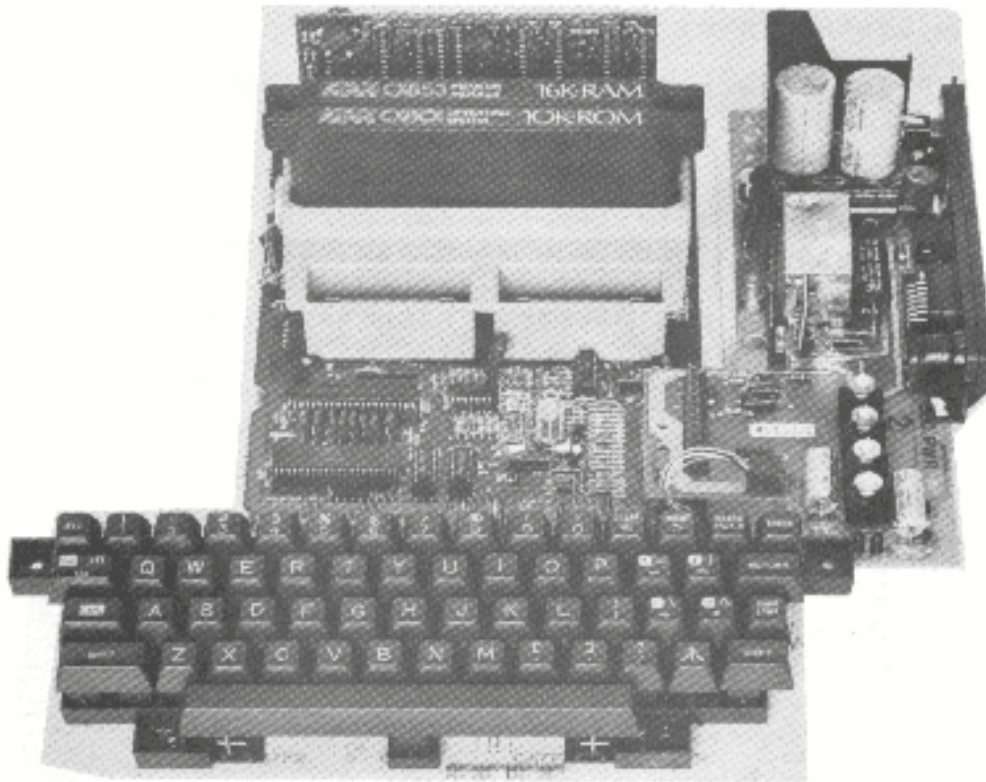


Figure 5-11. 800 Console, Assembled Without Casting

The following is a list of guidelines to aid in the troubleshooting of faulty printed circuit boards:

- Use only known good spares for substitution.
 - After each printed circuit board is substituted, retest system to determine if the problem has been corrected.
 - Leave the substituted printed circuit board in the system until the defective part is identified.
 - Ensure that the System Power is OFF before substituting printed circuit boards.
 - Place defective part back into system and recheck to verify failure detection.
5. Replace the printed circuit board listed in the Possible Failure column of Table 5-1, and run System Check-Out to determine if the problem still exists.

If the problem is corrected by replacing the suggested printed circuit board, refer to paragraph 5.4.4, Integrated Circuit Replacement Procedures. If the problem has not been eliminated, leave the substituted board in the system, identify the removed board for future replacement, and proceed to step 6.

6. Use the following replacement sequence to 'shot-gun' the problem if the suggested failing printed circuit board did not eliminate the problem.
- Power Supply Printed Circuit Board
 - CPU Printed Circuit Board
 - RAM Memory Board
 - ROM Operating System Board (800 System only)
 - Motherboard
 - Keyboard

If the problem is corrected by replacing the suggested printed circuit board, refer to paragraph 5.4.4, Integrated Circuit Replacement Procedures. If the problem has not been eliminated, leave the substituted board in the system, identify the removed board for future replacement, and proceed to the next suggested replacement board.

5.4.3 Troubleshooting - Procedure Number Three

This paragraph describes the procedures required to correct 'poor' picture quality. Poor picture quality is usually a result of a damaged RF Cable, defective power supply or motherboard. If the Aluminium Casting has been removed it is necessary test, refer to paragraphs 5.7 and 5.8 for the correct replacement procedures.

REPLACE RF CABLE

1. Remove top cover per Disassembly instructions, refer to paragraphs 5.5 and 5.6.
2. Unplug the RF Cable from the Power Supply jack and the TV Switch Box.
3. Plug spare RF Cable in Power Supply jack and the TV Switch Box.
4. Perform System Check-Out procedure, paragraph 5.3, to determine if problem has been corrected.

If replacing the RF Cable has corrected the problem, install the new RF Cable according to the instructions outlined in paragraphs 5.7 and 5.8. If the RF Cable was not the problem, leave the substituted RF Cable in the system, tag the existing RF Cable for future replacement, and proceed to Power Supply Replacement.

POWER SUPPLY REPLACEMENT

1. Remove Power Supply from the system using procedures outlined in paragraphs 5.5 and 5.6. If it was necessary to remove the Keyboard during the removal of the Power Supply reinstall the Keyboard before replacing the Power Supply.
2. Install new Power Supply in the system using procedures outlined in paragraphs 5.7 and 5.8.
3. Run the System Check-Out procedures to determine if the problem still exists: refer to paragraph 5.3.
4. If the problem has been eliminated, leave the substituted Power Supply in the system, reconnect the original RF Cable and run the System Check-Out procedures again to determine if the problem has been entirely corrected.

If replacing the Power Supply did not correct the 'poor' picture quality problem, refer to Troubleshooting - Procedure Number Two.

5.4.4 Integrated Circuit Replacement Procedures

The results recorded during the System Check-Out procedures can pinpoint a failing integrated circuit on a printed circuit board. Indications from the System Check-Out can point to failing integrated circuits on three

separated printed circuit boards, the motherboard, the CPU PCB, and the RAM Memory PCB. Previous Troubleshooting paragraphs, Procedures One, Two, and Three have already isolated a failing printed circuit board. The following paragraphs will provide additional information to isolate the failing integrated circuit (Chips).

RAM MEMORY BOARD

The test results and chip replacement procedures are the same for either the 8K or 16K RAM Memory boards. Chip replacement for both the 8K board and 16K board will be the same, all boards will be repaired with 16K chips.

This procedure assumes that the RAM Memory board has already been cleaned and lubricated according to the procedures outlined in paragraph 5.2.1. If this has not been done do so at this time, and rerun the System Check-Out to verify a failing RAM Memory board.

Before beginning to replace chips, check both 74LS158 chips (Z503 and Z504) to ensure that they are identical, refer to Figures 5-12 and 5-13 for reference:

- Same Date Codes
- Same Manufacturer

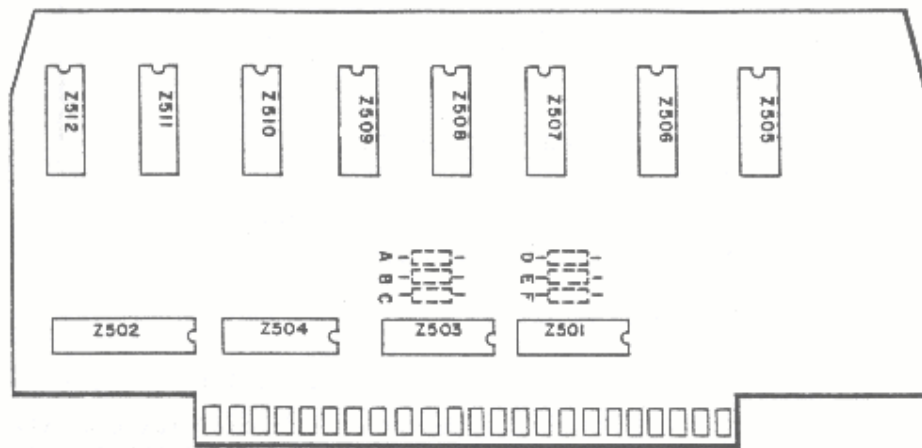


Figure 5-12. RAM Memory Board Locations, 8K

Review the notes you made during the RAM TEST, rows D and E of the test indicate which RAM chip was failing during the test, for example:

Memory Bits	7	6	5	4	3	2	1	0
Row D	1	0	0	0	0	0	0	0
Row E	0	0	0	0	0	0	0	0
Replace Chip	Z506	Z505	Z507	Z509	Z508	Z510	Z511	Z512

The above example would indicate that chip Z505 is failing the RAM Test and should be replaced. Before replacing any chips on the RAM Memory board the following troubleshooting hints should be read.

- When a failed RAM Memory board exhibits constantly changing failures the demultiplexing chips (Z503-Z504) are probably defective. Both chips must be the same manufacturer and the same date.

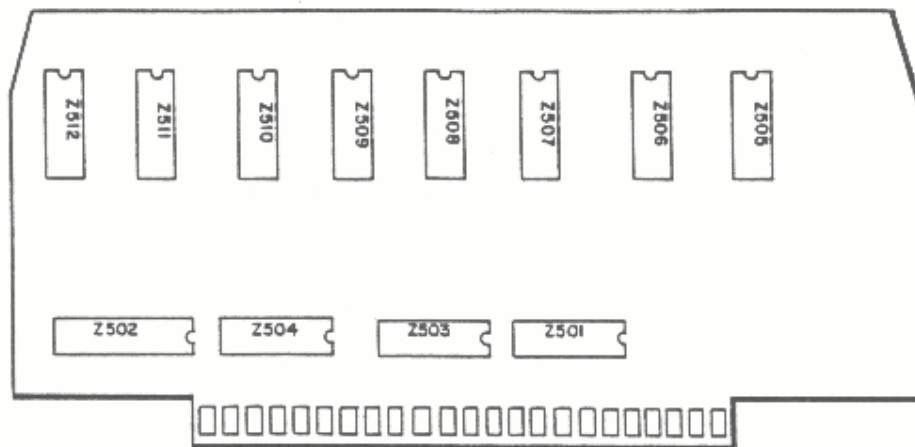


Figure 5-13. RAM Memory Board Locations, 16K

- When a failed RAM Memory board exhibits a 'Solid' failure (the failure does not change when the unit is tested in the continuous mode), probably that particular RAM chip is defective. (Second choice, the Data Buffer chip Z502).
- If the test fails at address hexadecimal 4000 (Rows B and C: 0100 0000 0000 0000) and the data read back is hexadecimal 40 (Rows D and E: 0100 0000), the same as the high order address byte, the board under test is probably never being enabled. The Board Select chip, Z501, could be defective.
- If the RAM Memory board being tested crashes the system (Green Screen) probably the Data Buffer chip Z502, is defective. Second choice, Board Select chip, Z501, as this also handles the refresh signal.
- Use only known good chips and leave substituted chips in the printed circuit board until the failing chip is identified.

- Test printed circuit board in system after each chip is replaced to determine if failure continues.
- Before a chip is changed or a board is added or removed to/from the system, power the system down.

CPU Printed Circuit Board

The CPU printed circuit board contains seven chips that provide the 'brains' of the system, see Figure 5-14. Each of the chips is explained briefly to enable selecting the correct chip to replace. If the selection of a chip does not correct the problem, then replace the chips in the order that they are presented.

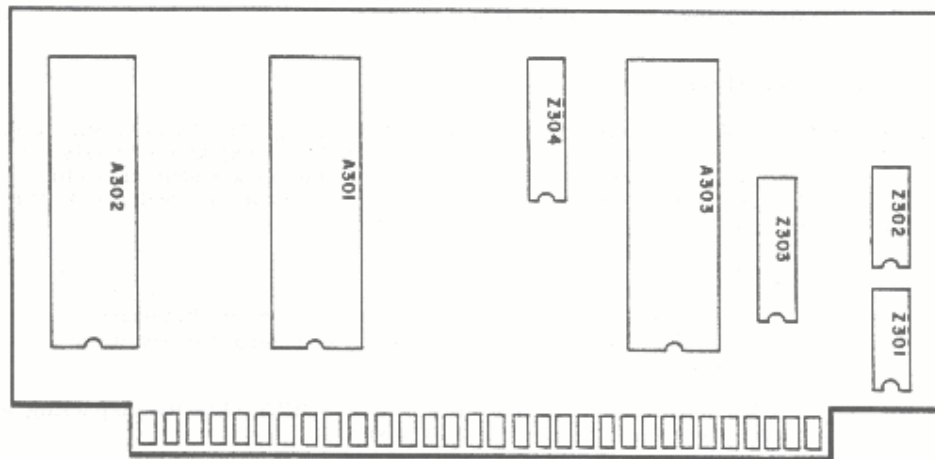


Figure 5-14. CPU Printed Circuit Board, Locations

- A303 - This is the 6502B Microprocessing Unit.
- A301 - This is the CTIA chip, which is used to generate all video and sync signals for the television screen. The PORT Test indicates a defective CTIA chip by displaying a '1' in Row F, any position.
- A302 - This is the ANTIC chip, which is used for both control of the CTIA and refresh operations on the dynamic RAM memory.
- Z303, Z304 - These are 74LS244 chips used as one direction tri-state buffer for MPU address lines.
- Z302 - This is a 7474 chip used to generate phase 1 and 2 clocks as well as processing HALT commands.
- Z301 - This is a 74LS02 chip used to help in the generation of the phase 1 and 2 clocks, helps with the processing of HALT commands and Read/Write signals.
- Use only known good chips and leave substituted chips in the printed circuit board until the failing chip is identified.
- Test printed circuit board in system after each chip is replaced to determine if failure continues.

- Before a chip is changed or a board is added to or removed from the system, power the system down.

5.4.5 Motherboards

The 400 and 800 Motherboards contains several integrated circuits with many diverse functions. Each of the integrated circuits is explained briefly, to let you choose the correct chip to replace. If the replacement of a chip does not correct the problem, then replace the chips in the order that they are presented. Refer to Figures 5-15 and 5-16.

400 Motherboard

- A101 - Used to control POT lines, audio signal, keyboard information lines as well as printer and floppy control lines (POKEY chip).
The PORT Test indicates a defective POKEY chip by displaying a '1' in Rows G, H, I, or J in any position.
- A102 - Used to control joystick lines, and Program Cassette Recorder control lines (PIA chip).The PORT Test indicates a PIA chip by displaying a '1' in Rows A, B, C, D, or E in any position.
- Z102 - Used to receive data from POKEY chip, translate the information and send it to the keyboard.
- Z101 - Used to receive data from the keyboard, translate the information, and send it to the POKEY chip.
- Z104 - Used to decode RASTIME and R/'4V Late signals.A111 - Used as buffers for video and lum lines. Also part of the Power ON Reset Circuit.
- Z103, Z015 - Used to decode Memory Map for computer.
- A103, A104, A105 - Used to hold Operating System and some BASIC Language programs.Use only known good chips and leave substituted chips in the printed circuit board until the failing chip is identified.
- Test printed circuit board in system after each chip is replaced to determine if failure continues.
- Before a chip is changed or a board is added or removed to/from the system, power the system down.

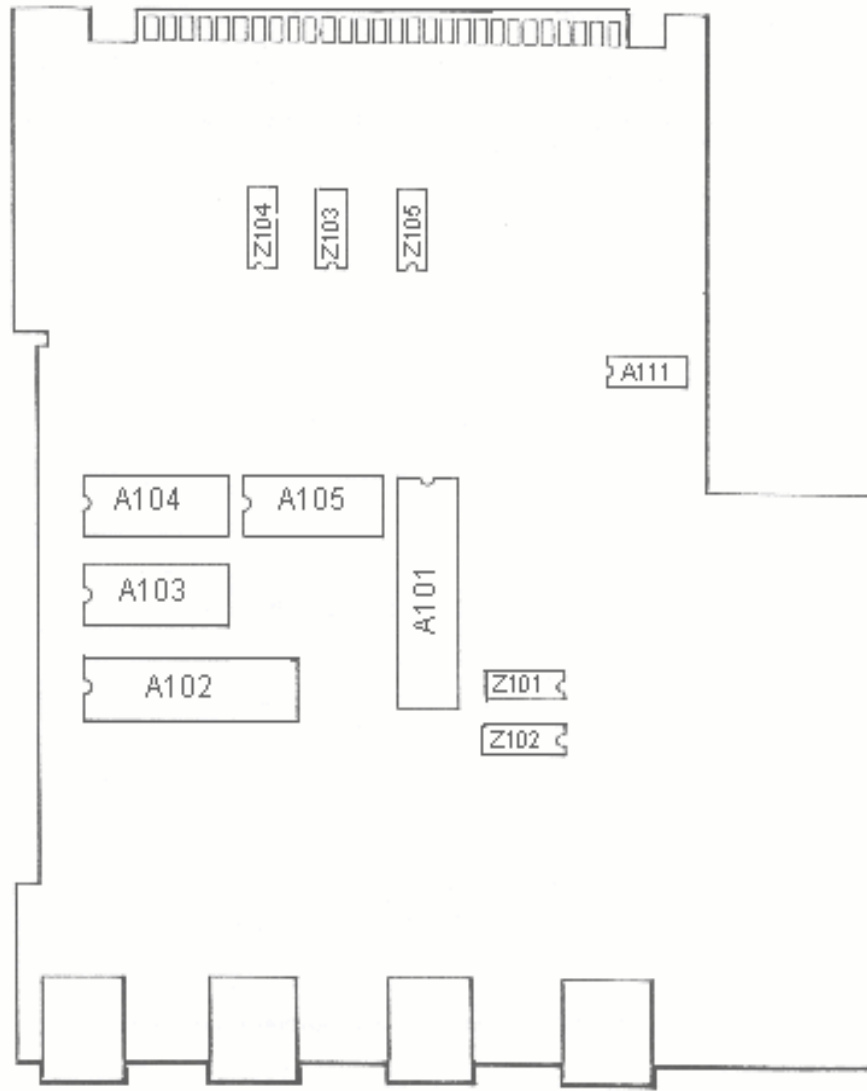


Figure 5-15. 400 Console Motherboard Locations

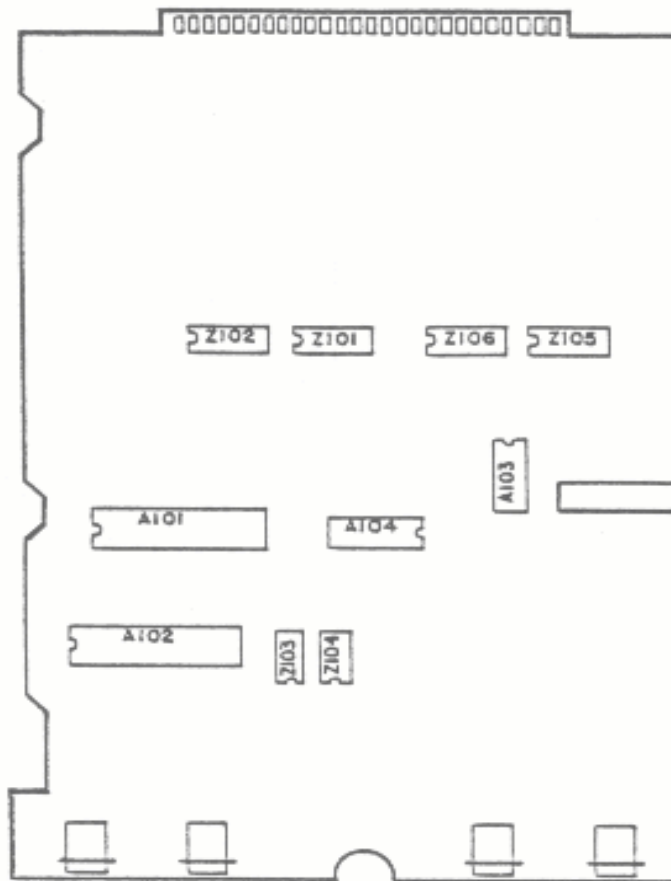


Figure 5-16. 800 Console Motherboard, Locations

800 Motherboard

- A101 POKEY chip - Used to control POT lines, audio signal, keyboard information lines as well as printer and floppy control lines. The PORT Test indicates a defective POKEY chip by displaying '1' in Rows G, H in any position.
- A102 PIA chip - Used to control joystick lines, and Program Cassette Recorder control Lines. The PORT Test indicates a PIA chip by displaying a '1' in Rows, A, B, C, D, or E in any position.

- Z103 - Used to receive data from POKEY chip, translate the information, send data to keyboard (Outputs from POKEY).
- Z104 - Receive data from keyboard, translate data, send data to POKEY chip (Inputs to POKEY).
- Z102 - Used to develop READ/WRITE early and late signals. Used to decode MEMORY MAP for computer.
- A103, A104 - Buffer for video and lum lines - Part of POWER-RESET circuit.
- Z101 - Develop MEMORY MAP for computer. Z105, Z106 - Bi-directional buffers for data lines.

5.5 DISASSEMBLY, 400 COMPUTER CONSOLE

This paragraph describes the procedures required to disassemble the 400 Computer Console. Proceed after reading the following notes.

1. Be very careful about mixing screws. The Plastic and aluminum parts will easily strip if the wrong size screw is used.
2. Excessive torque on screws will strip the plastic and aluminum parts:
 - Plastic - 6 inch pounds torque maximum.
 - Aluminum - 10 inch pounds torque maximum.
3. Protect the plastic surfaces of the console by working on a soft surface when the console is turned over, bottom up.
4. Use all static control precautions when handling any printed circuit board.

Access to Keyboard and Power Supply:

1. Top cover removal, refer to Figures 5-17 and 5-18
 - Set unit on its back
 - Remove 4 screws (no. 6 20x1/2) from bottom cover
 - Set unit upright
 - Unhook Top Cover from Keyboard
 - Open Cartridge Door o Lift Top Cover off

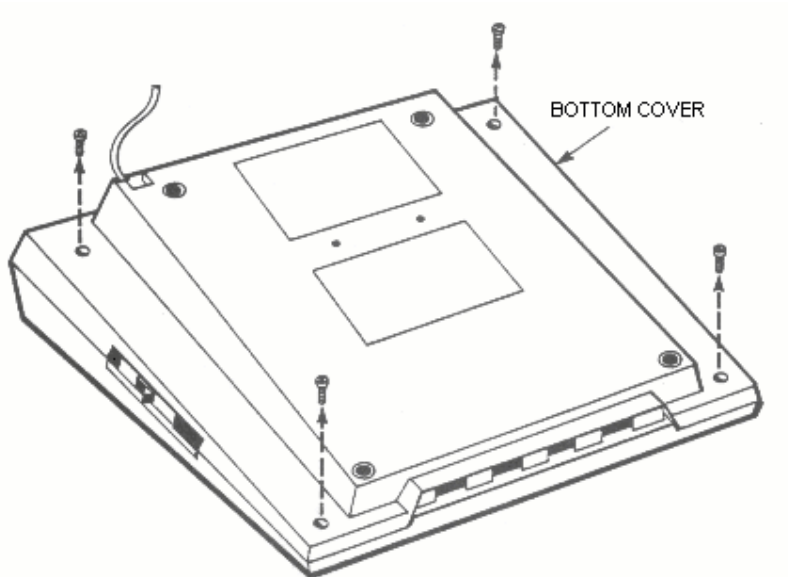


Figure 5-17. 400 Console, Bottom Cover Screw Location

2. Keyboard removal, refer to Figure 5-19

- Remove single Keyboard screw (no. 6 32x1/4)
- Raise left end of Keyboard and disconnect Keyboard Ribbon Cable

3. Power Supply Removal, refer to Figure 5-20 o Disconnect RF Cable from Power Supply

- Remove two screws (no. 6 32x3/8) from Power Supply
- Gently pull Power Supply away from casting 1/4 inch and lift out the Interlock Switch plunger
- Lift Power Supply straight up off the Motherboard connector pins.

Access to CPU, RAM, and Motherboard:

1. Module Assembly removal, refer to Figure 5-21

- Disconnect and remove Speaker assembly
- Lift Module Assembly out of Bottom Cover

2. CPU and RAM Printed Circuit Board Removal

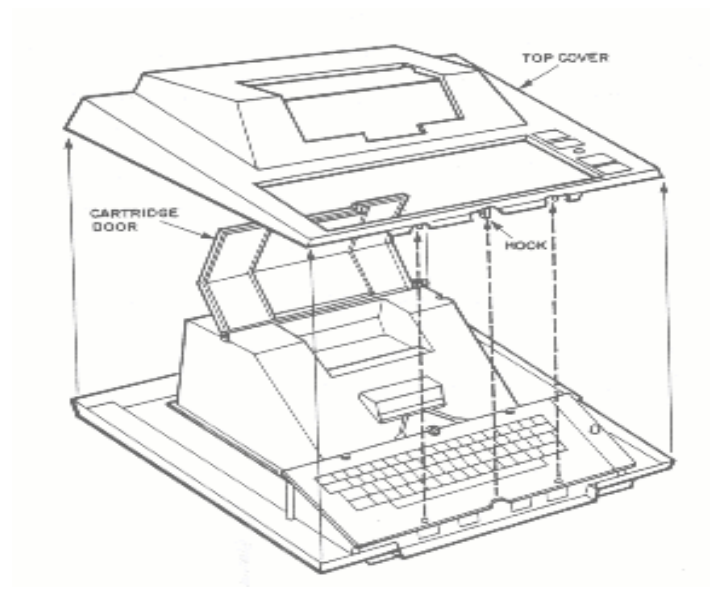


Figure 5-18. 400 Console, Top Cover Removal

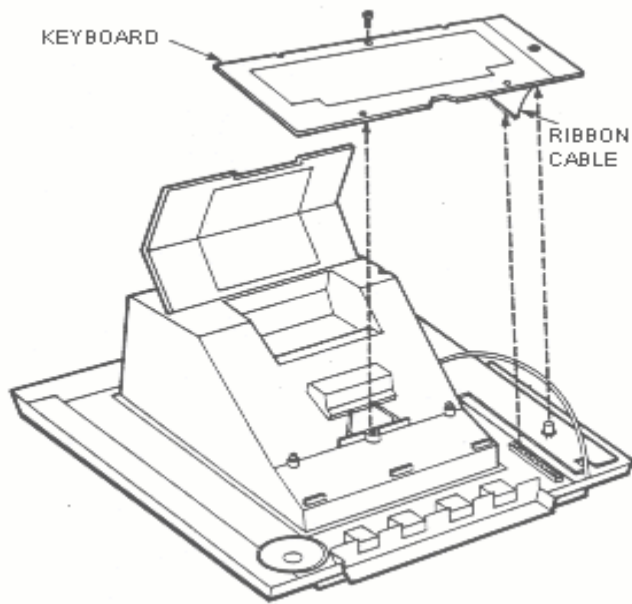


Figure 5-19. 400 Console, Keyboard Removal

- Close and latch Cartridge Door
- Set Module Assembly on its back
- Remove eight screws (no. 6 32x3/8) from Bottom Shield and lift off

4. Lift Motherboard assembly out of Aluminum Casting

- Gently unplug CPU and/or RAM Memory board
- Unhook and remove plastic Cartridge Guide

5.6 DISASSEMBLY, 800 Computer Console

This paragraph describes the procedures required to disassemble the 800 Computer Console. Proceed after reading the following notes.

COMPUTER CONSOLE

1. Be careful about mixing screws. The plastic and aluminum parts if the wrong size screw is used.
2. Excessive torque on screws will strip the plastic and aluminum parts.
 - Plastic - 6 inch pounds torque maximum
 - Aluminum - 10 inch pounds torque maximum
3. Protect the plastic surfaces of the console by working on a soft surface when the console is turned over on its back.
4. Use all static control precautions when handling any printed circuit board.

Access to RAM Memory boards and ROM Memory board

1. Cartridge Door assembly removal, refer to Figure 5-22
 - Set System Power switch to OFF.
 - Open Cartridge Door
 - Rotate Cartridge Door clamps to the outside
 - Raise Cartridge Door assembly 1/4 inch, then pull towards you and lift off

2. RAM Memory Module and ROM Memory Module removal

Lift out RAM Memory Modules

Lift out ROM Memory Modules

Access to Power Supply and Keyboard Assembly

1. Bottom Cover removal refer to Figure 5-23 o Set system on its back

- Remove the five screws (no. 6 32x3/8) from Bottom Cover
- Tilt back-end of Bottom Cover up and toward you to remove

2. Printed Circuit Board Removal, refer to Figure 5-25

3. Keyboard removal, refer to Figure 5-24

- Remove four screws (no. 6 32x5/8) from four corners of Keyboard
- Lift Keyboard out of Top Cover

NOTE

Use all static protection precautions when handling printed circuit boards.

- Remove two screws (no. 6 32x3/8) from aluminum casting flange.
- Remove single screw (no. 6 32x3/8) from Power Supply board (lower left hand corner)
- Disconnect Speaker cable and set Speaker aside.
- Raise front-end of Module Assembly one inch out of Top Cover and disconnect Keyboard cable.
- Rotate Cartridge Door latches to the inside to clear Top Cover.
- Lift Module Assembly out of Top Cover

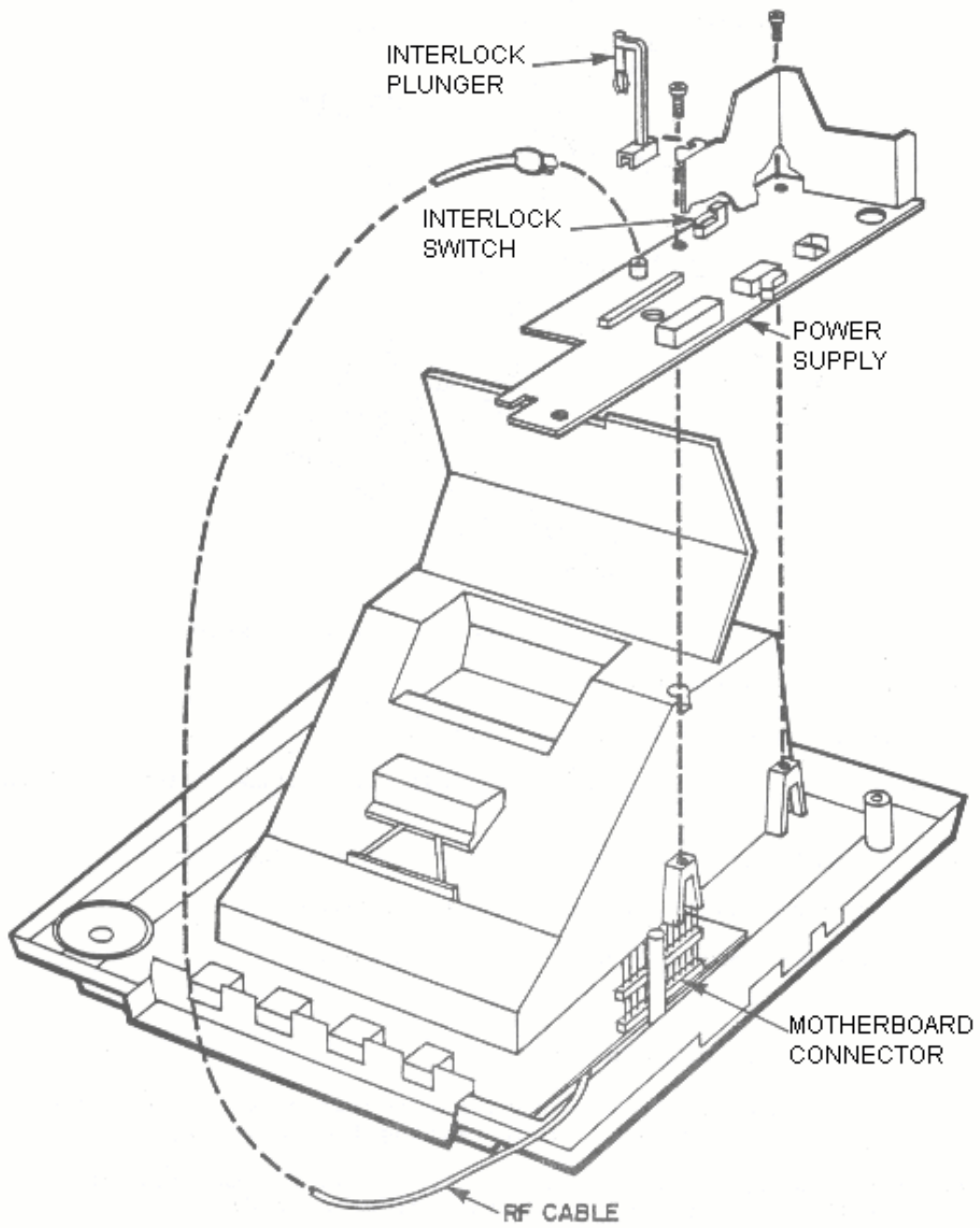


Figure 5-20. 400 Console, Power Supply Removal

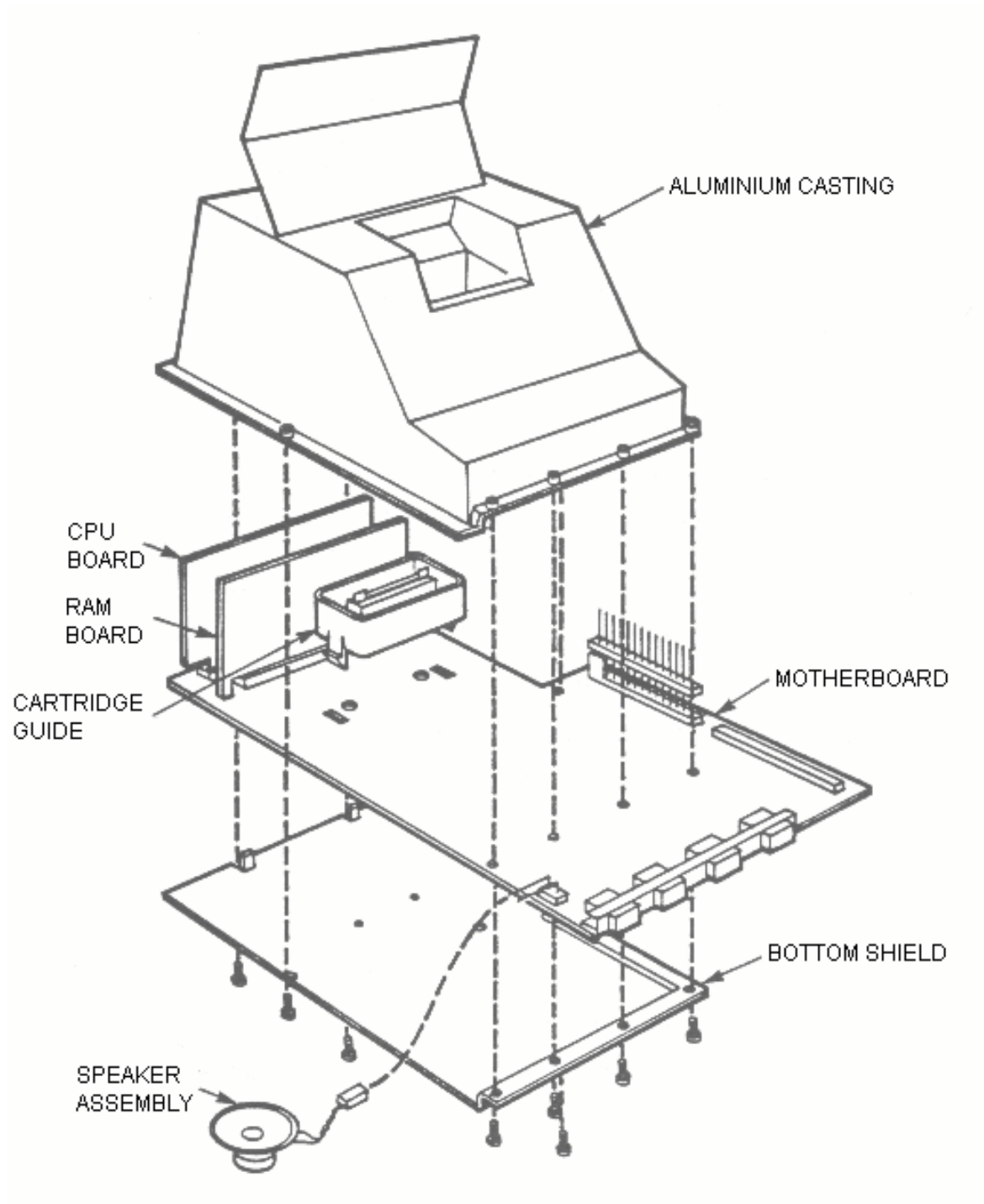


Figure 5-21. 400 Console, Bottom Cover Removal

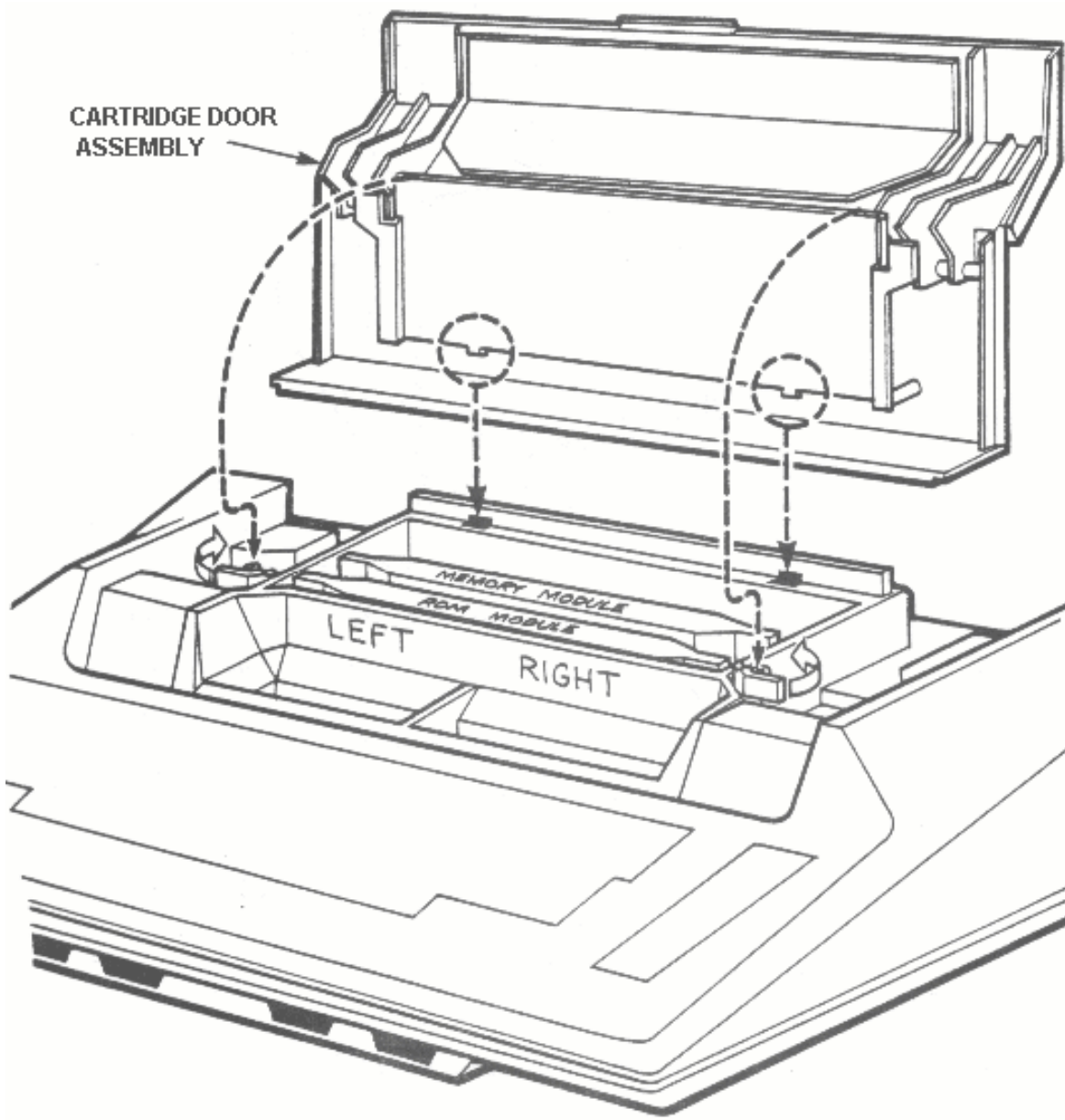


Figure 5-22. 800 Console, Cartridge Door Assembly Removal

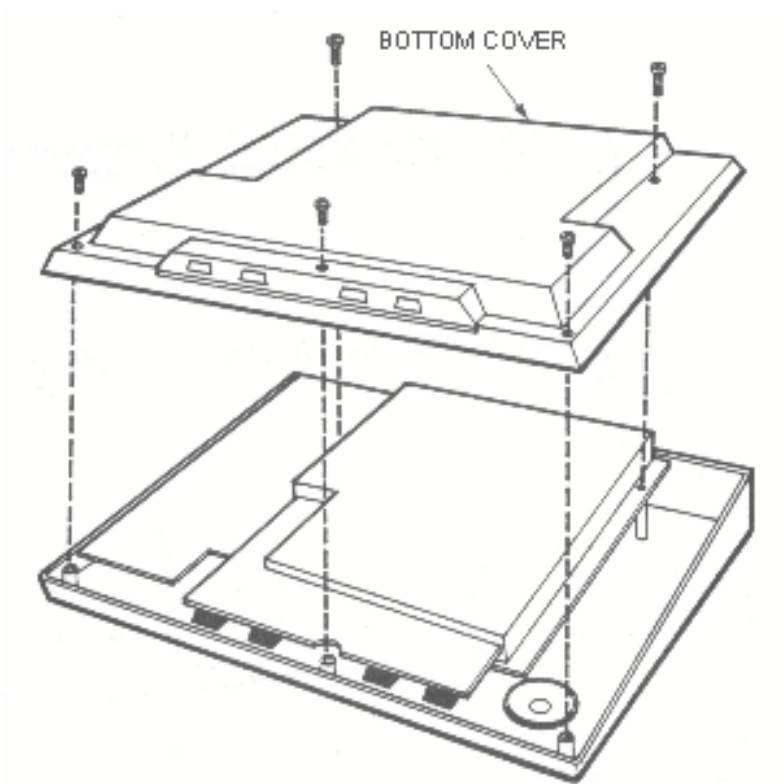


Figure 5-23. 800 Console, Bottom Cover removal

4. Power Supply removal, refer to Figure 5-26

- Unplug RF Cable from Power Supply board
- Unplug Power Supply Harness
- Remove three screws (no. 6 32x5/16) from Power Supply board
- Lift Power Supply board straight up

CAUTION

Be careful not to bend pins of Keyboard Cable

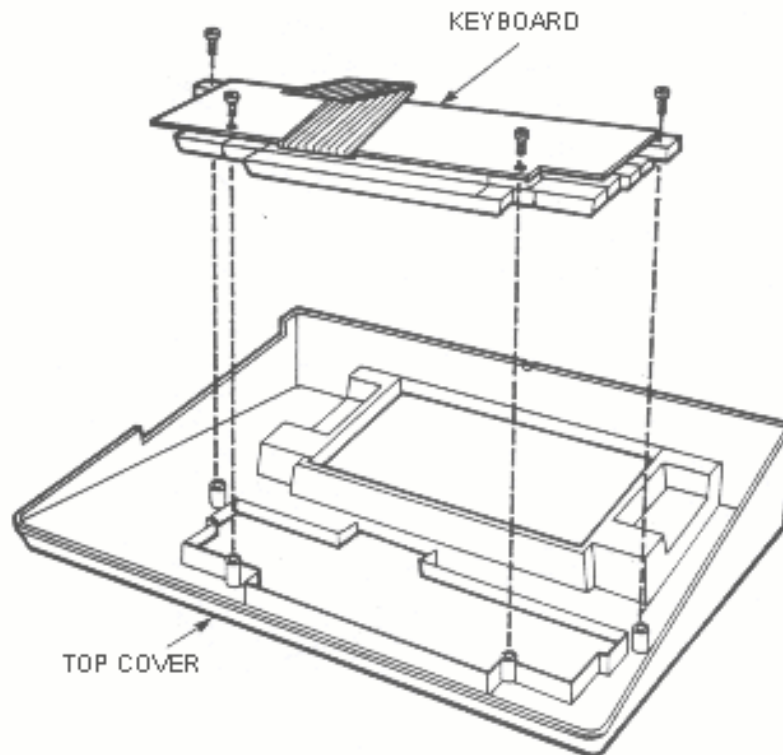


Figure 5-24. 800 Console, Keyboard Removal

5. Access to CPU Printed Circuit Board, refer to Figure 5-27

- Set Module Assembly on its back
- Remove nine screws (no. 6 32x5/8) from Lower Shield
- Lift Motherboard and Lower Shield out of aluminum casting
- Remove CPU printed circuit board

6. Access to Motherboard, refer to Figure 5-28

- Carefully slide screwdriver underneath Motherboard next to nylon clip. Gently raise handle of screwdriver, prying off. Repeat operation for other three nylon clips.
- Lift Motherboard off Lower Shield

CAUTION

Be careful not to bend any of the pins on the Motherboard Connector

- Remove the plastic Cartridge Guide by unhooking the four latches from bottom side of Motherboard.

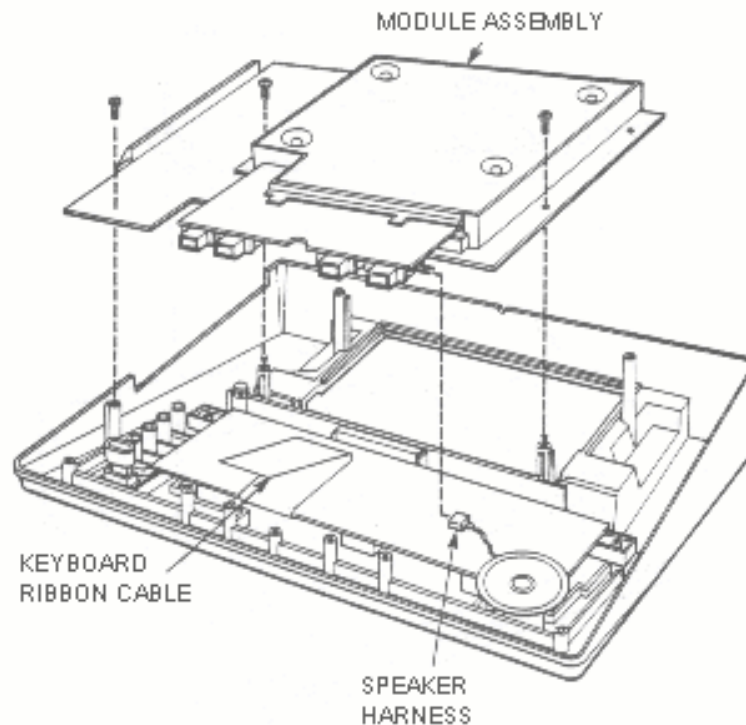


Figure 5-25. 800 Console, Module Assembly Removal

5.7 ASSEMBLY, 400 COMPUTER CONSOLE

The following paragraphs outline the steps required to re-assemble the 400 Computer Console and its related printed Circuit boards.

1. Module Assembly re-assembly, refer to Figure 5-21

- Snap Cartridge Guide into Motherboard (only goes one way)
- Insert RAM Memory board and CPU printed circuit board into Motherboard with component side of PCB to the rear. Before re-assembling PCBs be sure that they have been cleaned and lubricated refer to paragraph 5.2.1.

CAUTION

Do not allow tip of screwdriver to damage traces

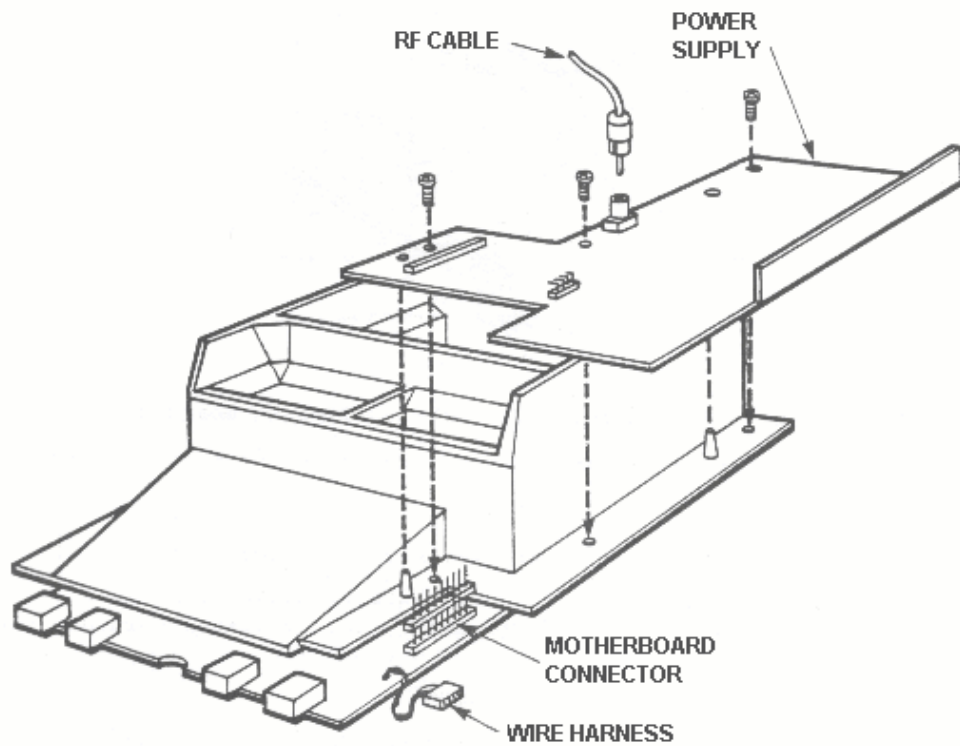


Figure 5-26. 800 Console, Power Supply Removal

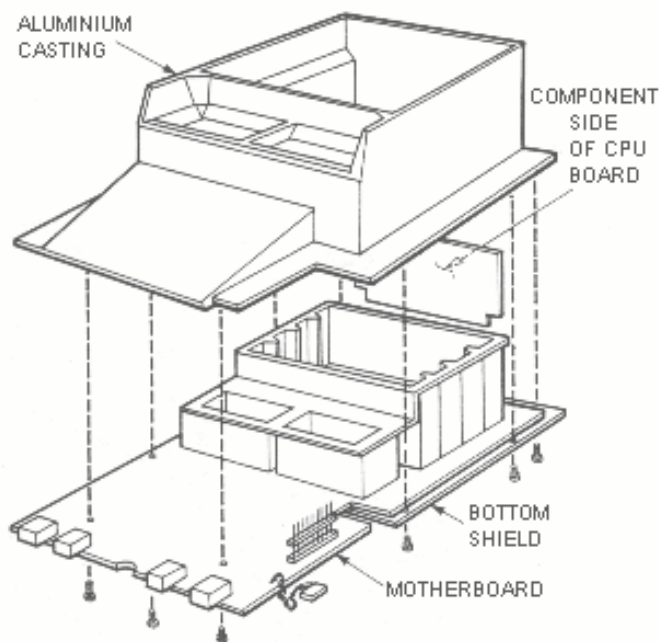


Figure 5-27. 800 Console, CPU Printed Circuit Board Removal

- Set Aluminum Casting on its back, invert Motherboard and gently lower into Casting.

NOTE

CPU PCB must fit into guides in the Aluminum Casting

- Install Lower Shield with eight screws (no. 6 32x3/8)
- Install Module Assembly in Bottom Cover

2. Keyboard Installation, refer to Figure 5-19

- Plug Speaker cable into Motherboard (no polarity) and set Speaker in Bottom Cover
- Plug Keyboard ribbon cable into connector on Motherboard
- Gently lower Keyboard over the Power-ON LED and guide posts on Aluminium Casting

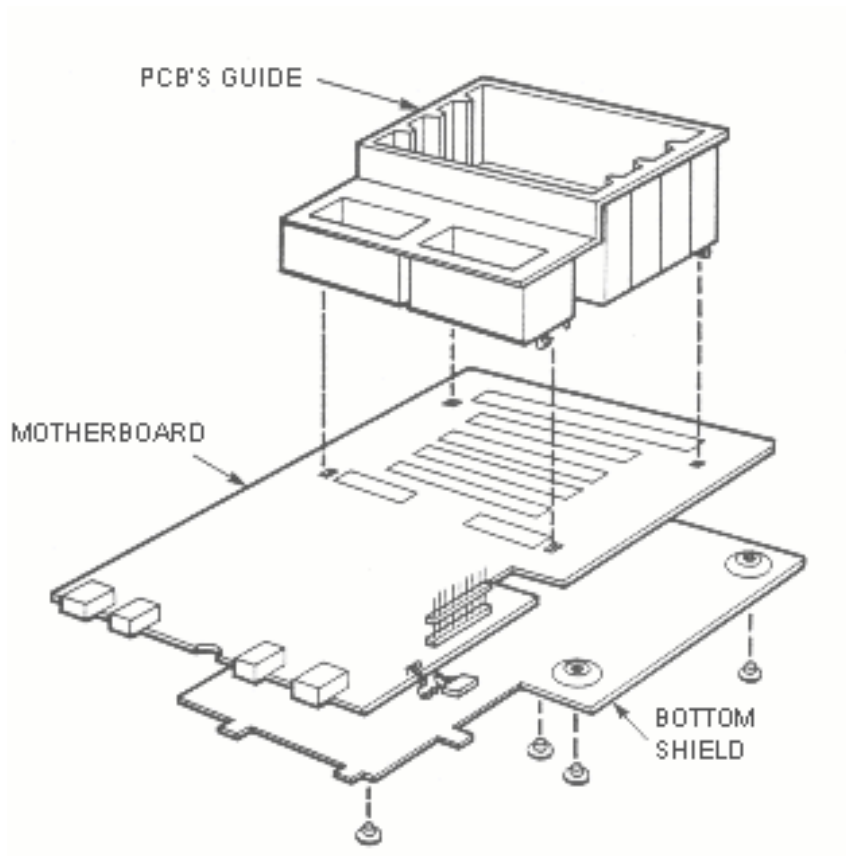


Figure 5-28. 800 Console, Motherboard Removal

3. Power Supply installation, refer to Figure 5-20

- Align Power Supply over Motherboard connector pins and Bottom Cover guide posts and gently press down.
- Install Interlock Switch Plunger into Aluminum Casting. Make sure the lower end of the Plunger is positioned over the Interlock switch and the Plunger shaft rides in its' notch in the Power Supply Heat Sink.
- Install two Power Supply mounting screws (no. 6 32x3/8)

CAUTION

Ensure that the RF Cable is not trapped under the Module Assembly

- Route the RF Cable through its' slot in the Power Supply board and plug into Power Supply jack.

Install single Keyboard mounting screw (no. 6 32x1/4)

4. Top Cover installation, refer to Figures 5-17 and 5-18.

- Open Cartridge Door
- Slide Top Cover down over the open Cartridge Door and Power-On LED.
- Guide the Top Cover locator pins into the Keyboard holes and snap the Top Cover hook under the Keyboard.
- Close the Cartridge Door and set system on its' back
- Align Top and Bottom Covers and install four screws (no. 6 20x1/2) into Bottom Cover.

5.8 ASSEMBLY, 800 COMPUTER CONSOLE

The following paragraphs detail the procedures required to re-assemble the 800 Computer Console and its' associated printed circuit boards.

1. Keyboard installation~ refer to Figure 5-24

- Lay Top Cover on its' back with Keyboard in Top Cover o
Install four mounting screws (no. 6 32x5/8)

NOTE

Check spacebar and keys to make sure they are not binding before proceeding to next step

2. Motherboard installation, refer to Figure 5-28

- Snap plastic Cartridge Guide into top side of Motherboard
- With Motherboard right side up, snap onto four nylon clips on Lower Shield. Make sure all four clips are firmly seated.

3. CPU Printed Circuit board installation refer to Figure 5-27

- Plug in CPU printed circuit board. Make sure component side of board faces away from plastic Cartridge Guide and is firmly seated.
- Set Aluminum Casting on its' back
- Turn Motherboard upside down, set Motherboard and Lower Shield into Aluminum Casting

CAUTION

Ensure CPU printed circuit board sits in its slot in the Aluminium Casting

- Install nine screws (no. 6 32x5/8) in Lower Shield
- Set system on its feet.

4. Power Supply installation, refer to Figure 5-26

- Carefully line up Motherboard pins to Power Supply connector
- Set Power Supply over guide pins on Aluminum Casting and gently press down
- Insert three screws (no. 6 32x5/16) in Power Supply board
- Reconnect Power Supply harness

CAUTION

Plug in Power Supply harness cable with orange or purple wire towards Aluminium Casting

- Plug RF Cable, short tipped end, into Power Supply jack.

5. Module Assembly installation into Top Cover, refer to Figure 5-25

- Set Top Cover on its back
- Invert Module Assembly and lower into Top Cover. Rotate Cartridge Door latches to the inside to clear Top Cover.

CAUTION

Make sure RF Cable is not trapped between Power Supply board and Top Cover standoff (upper left screw hole)

- Raise Motherboard one inch out of Top Cover and plug in Keyboard harness
- Install two screws (no. 6 32x3/8) in Aluminium Casting into Top Cover front holes only
- Set Speaker into receptacle, foam side down
- Connect speaker cable to jack (no polarity)

6. Bottom Cover installation, refer to Figure 5-23

- Align Bottom Cover with four Hand Controller Ports
- Seat Firmly all the way aroundr making sure RF Cable exits through its' hole and is not trappPd between the covers.
- Install five screws (no. 6 32x3/8) in Bottom Cover
- Set sytem on its' feet

7. RAM Memory and ROM Memory Modules installation

- Install ROM Memory Module, in slot closest to Keyboard
- Install RAM Memory Modules (maximum of three)

8. Cartridge Door assembly installation, refer to Figure 5-22

- Set Cartridge Door assembly down on Top Cover and slide to the rear to engage tcm slots in the Aluminum Casting
- Lock Cartridge Door assembly down with the two clamps next to the Program Cartridge slots.

CHAPTER 6

SPARE PARTS LIST AND ORDERING/REPORTING INFORMATION

6.1 INTRODUCTION

The following paragraphs will provide a list of the minimum spare parts kits that are to be maintained at an authorized Service Center. Also provided will be information for ordering additional parts through the nearest ATARI parts distribution center. Information will also be presented to explain the procedures required to correctly fill out the Part Repair Tag, for both Warranty work and Non-Warranty work.

6.2 SPARE PARTS LIST

The following is a list of the minimum spare parts that are to be maintained at an authorized Service Center:

Description	Part No.	Quantity
<u>Modules</u>		
800 Motherboard	CA014829	1
400 M otherboard	CA014807	1
800 Power Supply	CA014171	2
400 Power Supply	CA014155	2
CPU Printed Circuit Board	CA014800	2
10K ROM Printed Circuit Board	CA014090-01	1
16K RAM Printed Circuit Board	CA014802	2
8K RAM Printed Circuit Board	CA014802	1
<u>Components - Integrated Circuits</u>		
6502 MPU	CO14377	4
CTIA	CO12295	2
ANTIC	CO12296	2
Custom ROM	CO12499	2
Custom ROM	CO12599	2
Custom ROM	CO12399	2
POKEY	CO12294	2
6520	CO14795	4
16K RAM	CO14331	6
74LS42	CO14361	4
CD4051	CO14336	6
CD4050	CO10816	4
74LS10	CO14339	4
74LS138	CO14344	4
74LS02	CO14340	4
7474	CO14311	4

ATARI Personal Computers 6-1			
Description		Part No.	Quantity
<u>C omponents - Integrated Circuits (Cont.)</u>			
74LS244		CO14313	4
74LS158		CO14345	4
74LS00		CO14341	4
74LS09		CO14341	4
Transistor Array		CO10174	4
74LS243		CO14347	4
74LS32		CO14362	4
<u>Components - Other</u>			
Operators Manual	800	CO14769	2
Operators Manual	400	CO14768	2
Keyboard	800	CA012952-01	1
Keyboard	400	CA014031	1
RF Cable		CA014851	5
Speaker Assembly		CA011840	4
Power Adapter		CA014748	2
C rystal	3.579575	CO10177	2
Switch, Interlock		CO14387	10
Voltage Regulator	(5V)	CO14349	5
Voltage Regulator	(12V)	CO14348	5
Module RF ' B'		CA012174	5
400 Miscellaneous	Parts Kit		
800 Miscellaneous	Parts		1
410 Program Cassette Recorder			2
<u>Diagnostic Test</u>			
Stand Alone Test Cartridge		TE15644	1
Serial Port Jumper Assembly		TE15639	1
Controller Port Jumper Assembly		TE15638	1
<u>Supplies</u>			
Board Cleaning Brush			1
Aud Brush			1
Lubriplate DS-ES			1
Dust Free Cloth			1
Torque Seal			1

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