SHEET 1 OF 74

DRAWING NO. C061186

PROJECT SWEET - 16

TITLE SWEET - 16 Production Specification

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REV	DESCRIPTION	DATE	SIGN
1AX	Initial Release	9/29/82	

This sheet is an attachment to the design level drawing. This sheet will become history upon proper release.

ATARI SWEET 16 HOME COMPUTER

PRODUCT SPECIFICATION

(C061186)

Ajay Chopra

1.0 INTRODUCTION AND SCOPE

The purpose of this document is to detail the engineering design specifications and the engineering performance specifications for the Atari Sweet-16 Home Computer. This document is intended to be a major information transfer document for transfer of product information from the Hardware and Software Development groups to the Manufacturing, Design Assurance, and Application Software organization. This document will, therefore cover all aspects of the S-16 either directly or indirectly (by serving as a pointer to more detailed documents on specific aspects of the machine).

The S-16 is a low cost home computer. It is an enhanced version of the Atari 800 computer system and is reduced in size, lower in price and upward compatible with the Atari 800.

The S-16 is referred as the Z800 in certain sections of this document. The Z800 and the S-16 are one and the same produuct.

2.0 RELEVANT DOCUMENTS

[1] ATARI 800 HARDWARE MANUAL (C016555)

[2] SERIAL INPUT/OUTPUT INTERFACE USER'S HANDBOOK PART 1 AND 2

[3] DE RE ATARI

[4] SWEET-16 KEYBOARD (C060046)

[5] SWEET-16 SCHEMATICS (C060439)

[6] THE 6502 MICROPROCESSOR MANUAL

[7] MC68B21 (PIA) DATA SHEETS

[8] S-16 DOCUMENT TREE (C060290)

[9] 6502 SOFTWARE DESIGN MANUAL

[10] 6502 MODIFIED ELECTRICAL SPECIFICATIONS (C014806)

[11] MTBF CALCULATIONS FOR A800/400 BY STEVE ZYSKI (HCD QA DOCUMENT

[12] MONTHLY A800 WARRANTY RETURN REPORTS BY JIM NORTH (HCD QA)

[13] PRELIMINARY S-16 TEST PLAN (HCD QA DOCUMENT)

[14] POKEY SPECIFICATIONS (C012294)

[15] ANTIC SPECIFICATIONS (C012296)

[16] GTIA SPECIFICATIONS (C014805)

3.0 PRODUCT OVERVIEW

3.1 Product Design Goals

The S-16 Home Computer is deisgned for elegantly satisfy the following basic functionalities for the end user:

(1) Entertainment

(2) Education/Learning

(3) Information Services

(4) Transaction Services

(5) Personal Development

To meet the above functional requirements the S-16 supports high resolution graphics and sound generation capabilities. It has been designed to support a wide variety of peripherals. It also supports good communication facilities for accessing remote data bases and for conducting tranactions with remote intelligent devices.

The S-16 is an enhanced version of the Atari 800 and has been designed with the following goals in mind:

(1) Low Cost

(2) Reduced Size

(3) Compatibility With The Atari 800/400

(4) High Performance Peripheral Interface Mechanisms

(5) Better Human Interface

(6) Better Product Quality

3.2 S-16 In Comparison With A800

The S-16 external features differ from those of the A800 in the following areas:

(1) Lower profile than the Atari 800

(2) Changed keyboard including a HELP key and four new a application definable function keys

(3) A single cartridge slot instead of two

(4) Two controller parts instead of four

(5) The TV interface cable of an S-16 is detachable for the console

(6) Two status LEDs have been added in the 64K version of the S-16

(7) The 12 Vdc signal has been deleted from the SIO connector

(8) The console speaker has been removed

(9) The S-16 cartridge slot is on the left side instead of the top. No cartridge door or power interface switch is provided.

(10) The controller parts are located on the left side instead of the front

(11) The power on off switch is located on the left side instead of the right side.

(12) The monitor jack, the power jack and the S10 interface are located on the back of the S-16

Internally the S-16 integrates the A800 mother board,CPU board, RAM boards and the operating system board into a single logic board. No "personality card" slots are provided

The 64K version of the S-16 has 64K of dynamic RAMS

The compatibility issues arising from these features dealt with in Chapter 7.

3.3 S-16 Configurations

The S-16 has been designed in two configurations

(1) A 16K S-16 (an S-16 with 16K of system RAM)

(2) A 64K S-16 (an S-16 with 64K of system RAM)

The current manufacturing plans call for the manufacture of only the 64K version.
The 16K version of the machine shall not utilize, nor let the user utilize any add-on memory. A new Memory Management Unit (MMU) chip shall be required to upgrade 16K S-16s to 64K S-16s

Besides the memory size and O.S. differences, the two versions of the S-16 will have some cosmetic differences in the packaging. Details of these are in Sec 5.1

3.4 Architecture Overview

The architecture of the S-16 is similar to that of Atari 800. Figure 3.1 shows the basic functional blocks.

The 6502 microprocessor (Atari part #C014806) is used as the central processing unit (CPU). The CPU is the overall system manager. The memory, the 1/O processing circuitry, the display circuitry and the cartridge lie in the memory map of the CPU. The CPU can therefore address these functional blocks and exchange control/ status information and/or data with them. The memory map of the CPU is described in Section 5.2.1.3.1 See [6] for more details on the 6502. The operating system of the S-16 (described in Chapters 6) is responsbile for efficient information exchange between all entities on the CPU bus.

The Display Processing circuitry consists of the ANTIC Dispaly Processor, the GTIA Display interface chip and associated circuitry. ANTIC is custom microprocessor with an instruction set geared towards display processing (alphanumeric and graphic). This is the only entity in the S-16 that can halt the CPU and become a master on the CPU bus. The ANTIC does this to retrieve display commands from a shared data base in the CPU memory. The ANTIC translates the high-level CPU commands to a simple bit stream for the GTIA. The GTIA adds color and "player missile" graphics to the input bit stream and provides outputs suitable for display. The ANTIC and GTIA interface directly to the processor bus in addition to interfacing with each other. See [1], [3] and Section 5.2.1.3 for more details.

The I/O Processing Ciruitry consists of the POKEY 1/O chip, the 6520 Peripheral Interface Adapter (PIA) and miscellaneous circuitry. The POKEY and PIA together control the SIO interface and the controller interfaces.The POKEY also does the keyboard scan. Certain parts of the GTIA are also used for I/O control. This is described section 5.2.1.3.5.

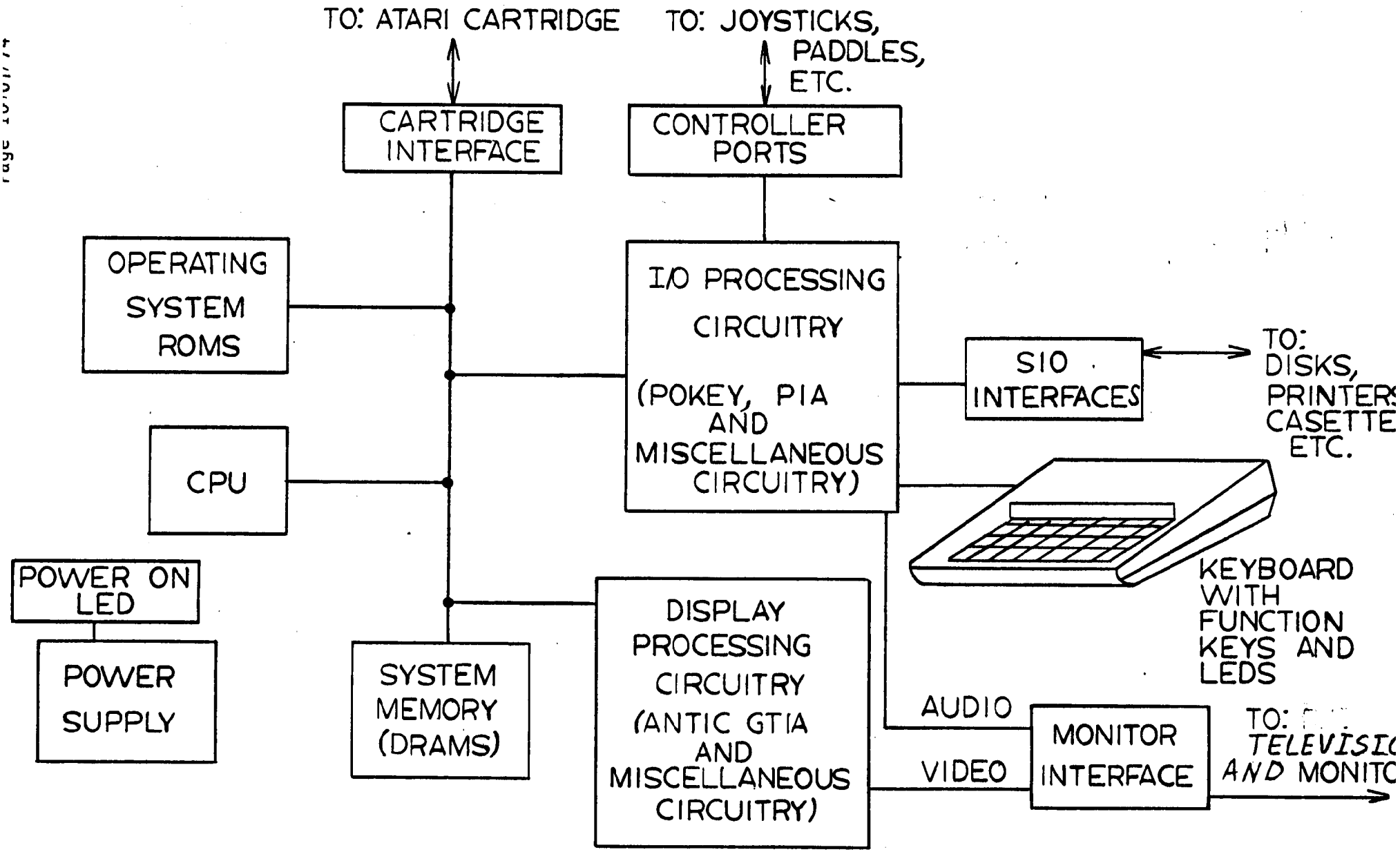


FIGURE 3.1

SWEET SIXTEEN FUNCTIONAL BLOCK DIAGRAM

The operating system ROMs house the S-16 operating system. Two 8K X 8 ROMs are used for this purpose. In a 64K system these ROMs can be disabled and a different O.S. can be loaded from peripherals (eg. disks).

The System Memory consists of up to 64K bytes of Dynamic Random Access Memories (DRAMs)

The Cartridge Interface accepts standard Atari cartridges.

The Controller interfaces host user input devices such as joysticks and paddles

The SIO interface provides an interface for intelligent serial peripherals like disks, cassettes and printers. Several peripherals can be daisy chainedd on this interface.

The Monitor interface is used to connect a color or black and white monitor to the S-16. A separate RF output is provided to connect the S-16 to a color or black and white TV

The keyboard is a 66 key full stroke QWERTY typewriter style keyboard with 10 function keys (including) a HELP key) and a RESET key

The S-16 Power Supply is a linear power supply. It takes 9 Vac as nominal input voltage and produces 5 V fully regulated DC for the S-16 electronics. An external step down transformer is provided to step down the AC voltage from line voltage (120 Vac) to 9 Vac

4.0 PRODUCT PERFORMANCE

This chapter will specify the projected performance requirements for the S-16. The environmental and reliability information included in this chapter is the targeted S-16 performance. The MTBF data has been derived from the A800/400 MTBF data (calculated and observed). [12], [13].

4.1 Environment

Operating Environment

Temperature =
- Maximum: 45 degrees C
- Minimum: 10 degrees C

Humidity =
- Maximum: 90% R H. (Non condensing)
- Minimum: 15% R.H.

Altitude =
- Maximum: 3000 Meters (9840 feet) (approx. 720 millibars pressure)
- Minimum: 60meters (-197 feet) below sea level

Non-Operating Environment

Temperature =
- Maximum: 60 degrees C
- Minimum: 30 degrees C

Humidity =

90% R.H. (max) 0% RH (min) (should condensation occur, unit is to be operational after drying)

Altitude =

Maximum:	3000 Meters (9840 feet) (approx 720 millibars pressure)
Minimum:	60meters (-197 feet) below sea level

4.2. Endurance Levels

Loading:

ESD Susceptiability:

No product damage or loss or data with a 10KV to 20 KV discharge at any point accessible to the user except electro-mechanical connectors

Design Life

Vibration:

Operating:	0.1g ± 10% 5 to 500 Hz
Resonance Search:	Sine scan 5-100 Hz dwell on resonances 1.0g for 10 minutes
Transportation:	100 to 300 cycles per minute, 2 directions 90 degrees apart, 30 minutes; each frequency to be such as to raise package from table 0.06 in., acceleration to be 1.0 g (min) (test recommended by National Safe Transit Com. for consumer products). No damage should result
Impact Test:	Free fall distance of 24 in. on corner, edge, and all 6 faces. No damage to a packaged S-16.

Freq. Variation:	Identical to the power adapter C017945)
Power Req: (Power adapter Consumption not included)	12.15 Watts with 115 volts R.M.S applied to the primary of the power adapter (C017945) with the Power-on Atari logo on the screen and no cartridge plugged in.
Ripple Rejection Ratio :	-64 dB.

4.5.2. Monitor Jack Performance

Composite video and composite luminance outputs will have the following characteristics with a 75 ohm termination:

SYNC TIP (MAX) 0.08 V
BLACK LEVEL 0.35 V ± 10%
WHITE LEVEL 0.7 V ± 15%

Audio outputs will have the following characteristics:

Frequency Range: 1Hz to 49KHz, -3db cutoff.

4.5.3. S10 Performance

MAX BAUD RATE 19.2K BAUD

Motor start line with 180 ohm load should pull up to (Vcc - 0.2) volts when "ON"

4.5.4. R.F. Modulator Performance

The R.F. Modulator will have the following characteristics with a 75 ohm termination at the S-16:

Maximum Voltage: 2mV
Minimum Voltage: 1mV

The Modulator output is selectable via a switch (on the back of the S-16) to Channel 2 or Channel 3.

	Band	Picture Carrier	Sound Carrier
Channel 2	54-60 (MHz)	55.25 MHz	59.75 Mhz
Channel 3	60-66 (MHz)	61.25 MHz	65/75 MHz

CHAPTER 5

HARDWARE DESIGN SPECIFICATIONS

TABLE OF CONTENTS

5.1 Package And Appearance

5.1.1 Dimensions and Weight

Height - 2.7-inches; Width - 15-inches; Depth - 12.5-inches; Weight - to be specified

See Figures 5.1.1, 5.1.2, 5.1.3, and 5.1.4

5.1.2 Package Description

5.1.2.1 Position Of Connector

See figures 5.1.3 and 5.1.4 for position of connectors.

5.1.2.2 Keyboard Description

The two configurations of the ATARI S-16 Home Computer have the same keyboards with 54 alphanumeric keys (including special characters and controls), a spacebar, and 11 function keys.

In addition to the alphanumeric keys, the board has a CONTROL key, for control functions, input of graphics characters and cursor Control. The board also has a CAPS lock key. A SHIFT key is located on each side of the board near the SPACE bar.

Above the typewriter pad is a series of 11 function keys. The tops of these keys are level with the bezel, but depress below the bezel to provide the same tactile feel as the alphanumeric keys.

Included in the function keys are START, SELECT, OPTION, the ATARI Logo key, and the BREAK key. At the far left of this strip of keys is the RESET key.

The four remaining Function Keys, F1 through F4, are user programmable.

There is a label panel directly above the Function Keys. This panel contains one LED (in the case of the 16K version) or three LEDs (in the case of the 64K version. It also contains the key labels for the Function Keys.

On the 16K version of the ATARI S-16 Home Computer, the strip is a continuation of the keyboard bezel and is made of the same material as the housing. There is one LED which is used as a POWER ON indicator.

The 64K version of the ATARI S-16 Home Computer has a translucent label strip made of high impact acrylic. There are three LEDS, one of which is the POWER ON indicator. The LED (L1) will light if the keyboard is disabled and the third LED (L2) lights if the international character set is selected. The key lables are hot stamped on the bezel underneath the strip.

The keyboard is connected to the mother board by a 15-conductor ribbon cable terminating in a Molex 22-01-2156 connector. This connector is polarized so that it can be connected in only one way. See "S-16 keyboard Electrical Requirements" (Atari P/N C060046) and keyboard Assembly Drawing (C040046) for complete details of electrical parameters.

5.1.3 Package Colors

The keyboard and bezel are dark brown (Borg Warner Cycolac T84816).

The translucent strip above the function keys on the 64K version is made of high impact acrylic and is translucent brown (Rohm & Hass (TR78017). The strip above the function keys on the 16K version is the same color as the housing.

The housing is beige (Borg Warner Cycolac (KJW86006)).

5.1.4 Package Materials

The keyboard and housing is made of ABS plastic.

The keytops of the Function Keys are brushed and formed aluminum nameplate material.

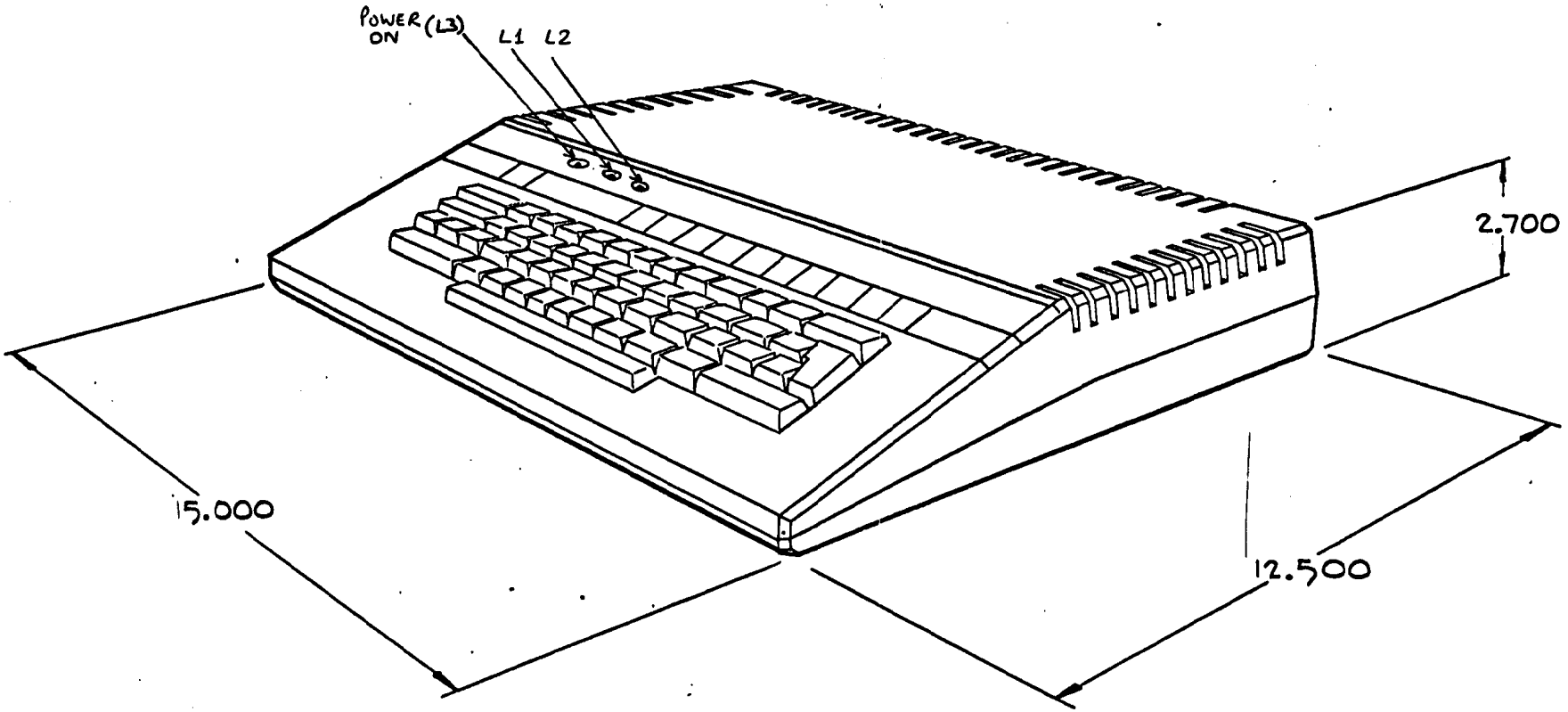


FIG 5.1.1 64 K S-16.

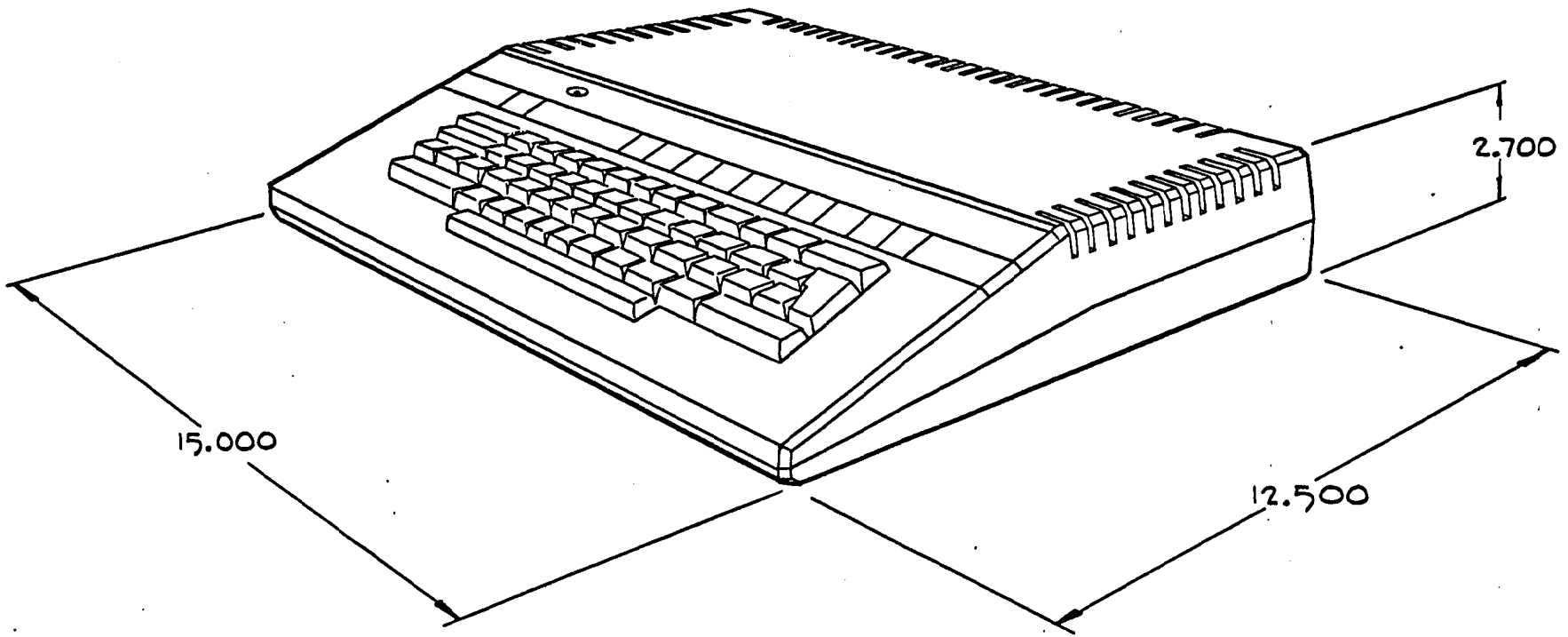


FIG 5.1.1 16K S-16.

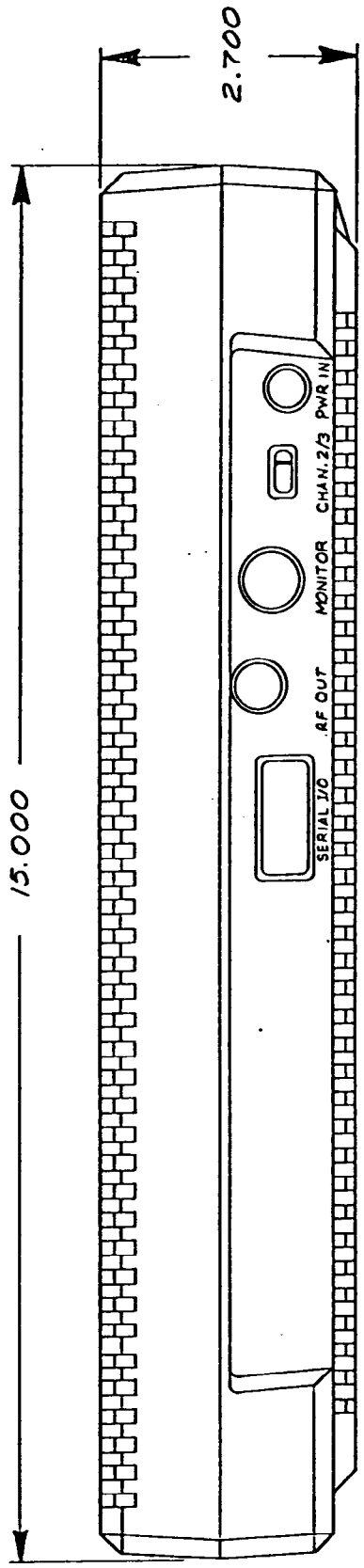


FIG. 5.1.3 S-16 BACK VIEW

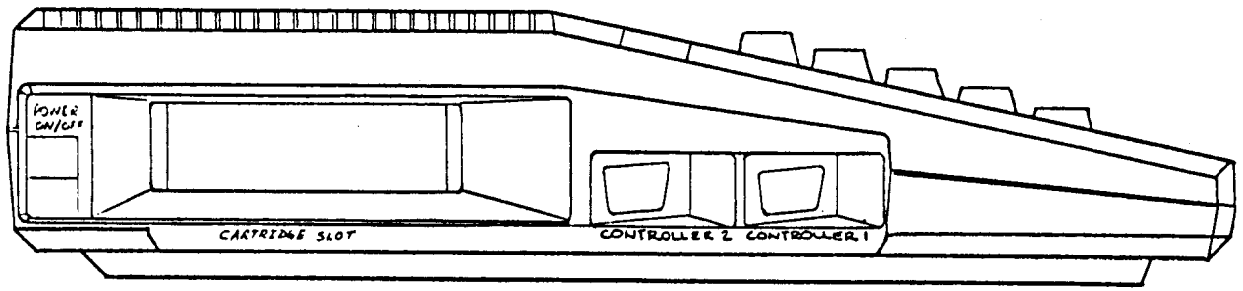
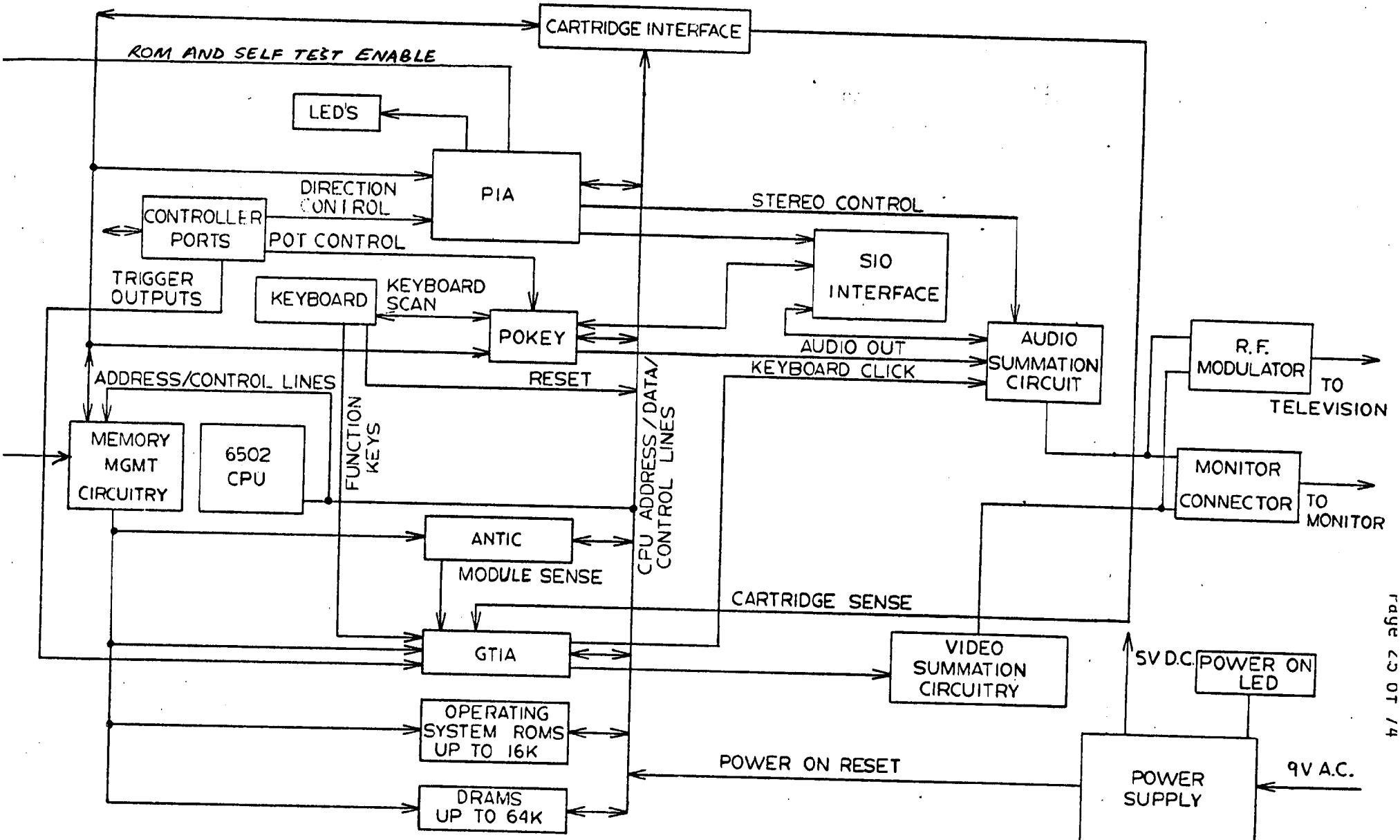


FIG 5.1.4. S-16 LEFT VIEW



SWEET SIXTEEN HARDWARE BLOCK DIAGRAM

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5.2.1.1 Mechanical Details

The CPU Board is 14.03" wide and 9" deep. The board is double sided and has a ground plane in both sides on which the upper and lower EMI shields rest. All connectors (except the keyboard & LED Board connectors) are mounted on the back or the left side of the board (see Figures 5.1.3. and 5.1.4.). The keyboard connector and the LED board connector are mounted the left front side of the board. All connectors are outside the EMI shield. The power supply electronics is located at the right rear corner close to a heat sink that runs half the length of the back side of the S-16.

The keyboard connects to the CPU board with a 15 wire flat cable. The LED board connects to the CPU board with a 5 wire flat cable, terminating in a 5 pin Molex type connector.

See "Sweet-16 Drawing Tree C060290" for a pointer to the detailed drawings on the S-16 mechanical sub-assemblies.

5.2.1.2 Interface Specifications

The CPU Board provides the following interfaces:

(1) The SIO Interface
(2) The Keyboard Interface
(3) The Controller Jack Interfaces
(4) The Cartridge Interface
(5) The Monitor Interface
(6) The Power Supply Interface
(7) The LED Board Interface

5.1.5 Package Subassemblies

The S-16 has the following major package subassemblies:

(1) Top Cover
(2) Bottom Cover
(3) Left Connector Panel
(4) Cartridge Guide
(5) Cartridge Retainer
(6) Keyboard Mask (bezel).
    (a) 16K and 64K Version - bezel
    (b) 64K version - acrylic indicator strip
(7) Two side trims (one at each end of function key row)
(8) Atari product lable next to left side trim
(9) FCC label on bottom covering dimple

5.2 Electromechanical Subassemblies

The S-16 has the following electromechanical subasemblies:

(1) The CPU Board
(2) The Keyboard
(3) The LED Board

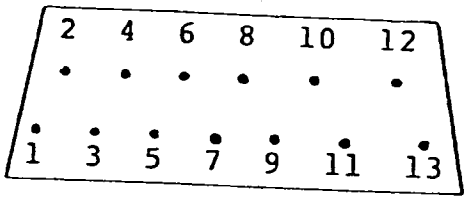
These subassemblies are described in the following sections.

5.2.1 The CPU Board

The CPU board is the heart of the S-16. It houses all the intelligent chips of the system and provides connectors for interfacing external modules (eg. printers) to the S-16. See figure 5.2.1. for a Hardware Block Diagram of the Sweet-16. All the functional blocks except the keyboard are resident on the CPU Board

5.2.1.2.1 The SIO Interface

See the SERIAL INPUT/OUTPUT USER's MANUAL PART 1" for a complete description of the SIO interface.



1. Clock Input
2. Clock Output
3. Data Input
4. Ground
5. Data Output
6. Ground
7. Command
8. Motor Control
9. Proceed
10. +5/Ready
11. Audio Input
12. Not Connected
13. Interrupt

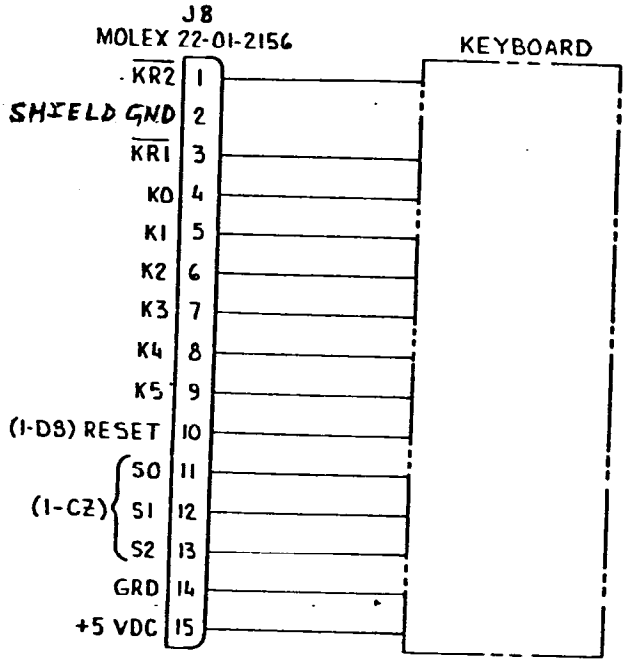
S-16 SIO CONNECTOR
(looking into the S-16 Jack)

NOTE: See SIO Users Manual Part 1 for a description of the signals.

5.2.1.2.2 The Keyboard Interface

See [4] for complete electrical environmental and functional specification of the S-16 keyboard. The key board interface is shown in Figure 5.1.5. The keyboard layout is shown in Figure 5.1.6. The mechanical details of the keyboard are given in KEYBOARD ASSEMBLY DRAWINGS (C060046).

A description of the Help and Function keys appear in Chpter 6.



CONNECTOR SCHEMATIC

KEYBOARD INTERFACE
FIG 5.1.5
(See C060046 for signal definitions)

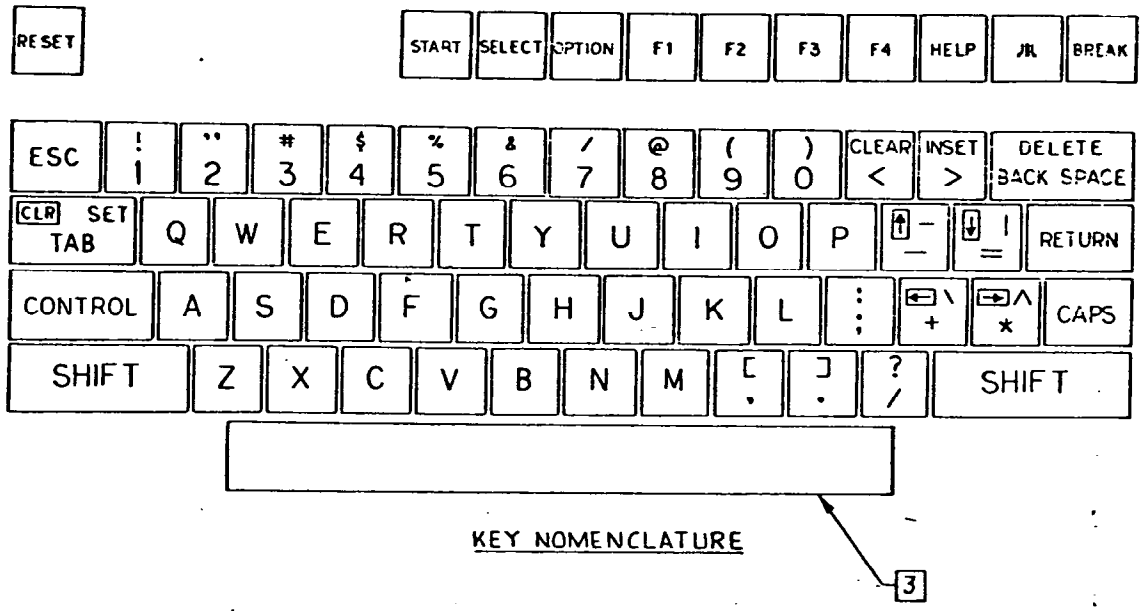

RESET
START
SELECT
OPTION
F1
F2
F3
F4
HELP
BREAK
ESC
CLEAR
INSET
DELETE BACK SPACE
CLR SET TAB
RETURN
CONTROL
CAPS
SHIFT
SHIFT
KEY NOMENCLATURE
3

FIG. 5.1.6

5.2.1.2.3 The Controller Jack Interfaces

The S-16 provides two controller jack interfaces. Both are functionally and electrically indentical. The controller jacks are 9 pin D type male connectors (see Figure 5.2.10) with the following signals:

PIN 1 thru PIN 4 are general purpose I/O lines. The direction of each of these lines is individually programmable by writing into the PIA internal registers. When a joystick is connected to the controller jacks these lines are the FWD (Forward), BACK, LEFT and RIGHT inputs respectively providing direction control inputs to the S-16. See [1] and [7] for discussion on the direction control mechanism for these lines. [1] also describes the configuration of these lines when other input devices such as paddles are connected to these lines.

PIN 5 and 9 are BPOT input and APOT input respectively. These inputs accept the outputs from the potentionmeters in the two paddles that can be connected to the controller interfaces.

PIN 6 is the "active low" TRIGGER input from the controllers (eg. joysticks, paddles). These inputs are also designed to accept the light pen signal. When this line goes low the GTIA LP (light Pen) input is pulled low. See section 5.2.1.3.3 and [1] for details.

PIN 7 is the Vcc output to the controllers. This ower output has a nominal value of 5 Vcc

PIN 8 is the GROUND reference for the controllers.

Electrical Levels

PINS 1 through PIN 4 are buffered inputs in parallel with ratioed outputs (with static protection circuitry) and have the following electrical characteristics:

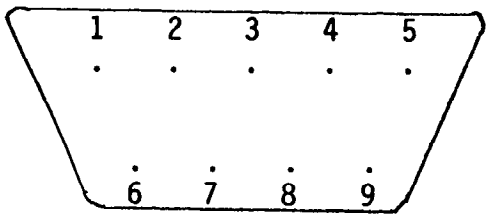
Input 0 level	-0.5Vdc(min):::0.8Vdc (max)
Input 1 level	2.0Vdc(min):::5.25Vdc (max)
Output 0 level at 1.6mA	0.0Vdc(min):::0.4Vdc (max)
Output 1 level at -100micro amp	2.4Vdc(min):::5.0Vdc (max)
Capacitance	15 pF (max)
Load Current at 2.4Vdc	100 microamps (min)

PINS 5 and 9 are Schmitt Trigger inputs with a low threshold of 1 Vdc (max) and a high threshold of 1.7 Vdc (min) and a hysteresis of 0.3 Vdc (min). The max input capacitance is 15 pF.

PIN 6 has the following electrical characteristics:

Logic 0 Input level	0.8 Vdc (max)
Logic 1 Input Level	2.0 Vdc (min)
Input capacitance	25 Pf (max)

Controller Jack (Looking Into The S-16 Connector)



. (Joystick) Forward Input
. (Joystick) Back Input
. (Joystick) Left Input
. (Joystick) Right Input
. B Potentiometer, Input
6. Trigger Input
7. +5 volts
8. Ground
9. A Potentiometer Input

ig. 5.2.10

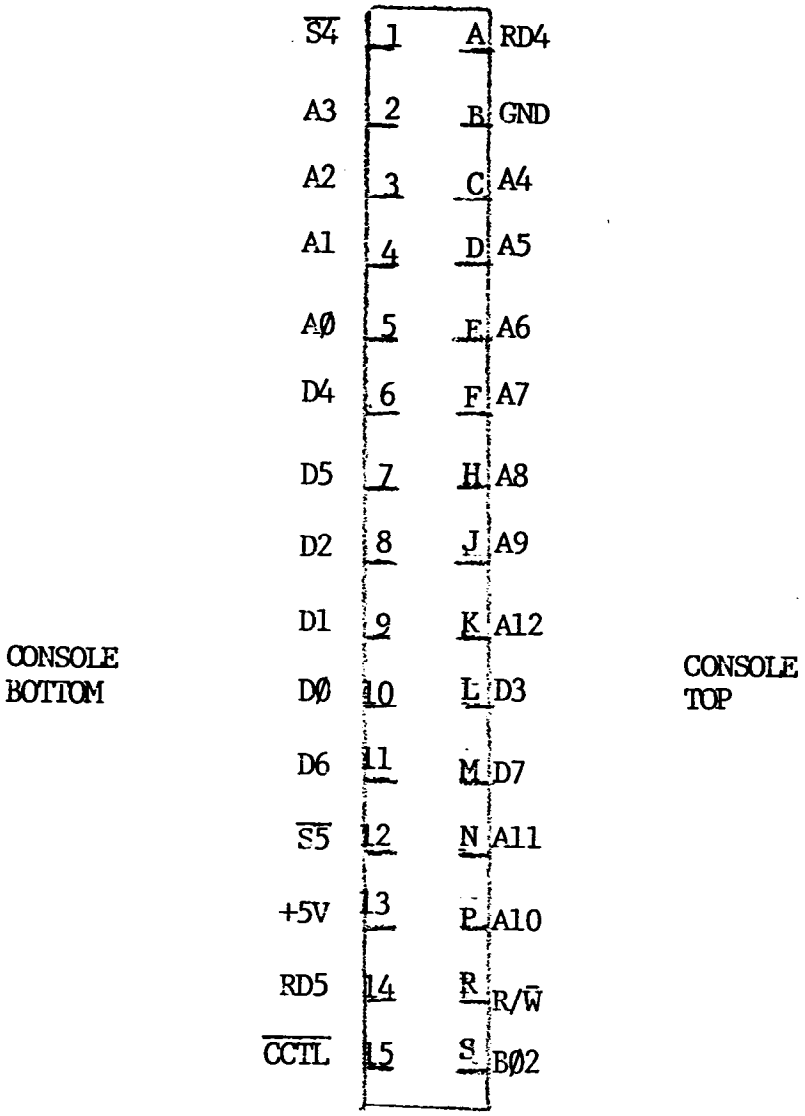


FIGURE 5.2.11 CARTRIDGE INTERFACE
(Looking into the Cartridge Slot)

5.2.1.2.5 The Monitor Interface

The monitor interface is a 5 pin DIN connector (see figure 5.2.11) with the following pin-out:

PIN 1 is the real time Composite luminance output. This signal has a voltage level between 0 and 1 volt AC. This output has an impedence of 75 ohms (looking into the pin). This output contains the luminance and sync information. It does not contain the chrominance information.

PIN 2 is the GROUND reference signal to the monitor.

PIN 3 is the real time monoaural audio output to the monitor. This signal has a peak to peak variation of 1 volt. This output has an impedence of 1.8K ohms (looking into the pin)

PIN 4 is the real time Composite Video output to the monitor. This signal has a variation between 0 and 1 volt. This output has an impedence of 75 ohms (looking into the pin). This output contains the luminance, chrominance and sync information.

PIN 5 is the no connect.

S-16
Monitor Jack (looking into the S-16 Jack)
D.I.N. 5 Jack

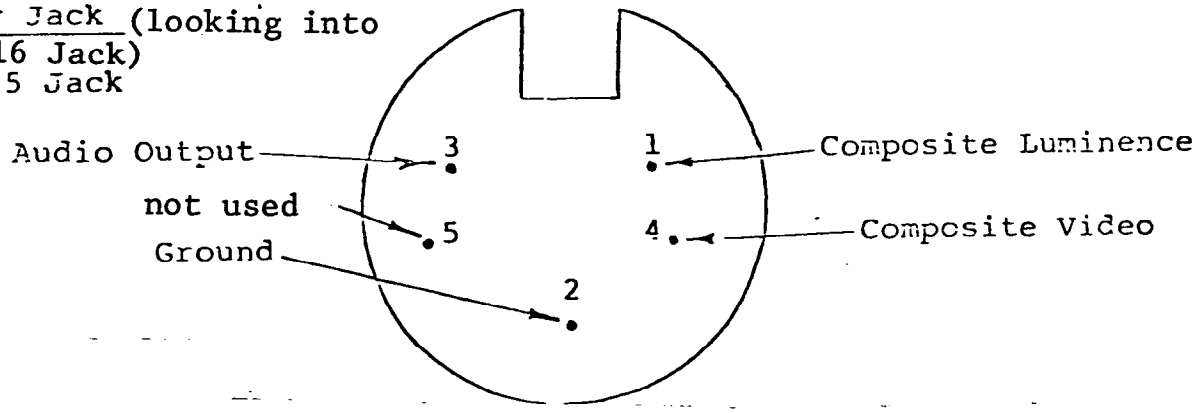


Figure 5.2.12

5.2.1.2.6 Power Input Interface

The power input to the S-16 is a 9 Volt AC input through a 2.5 mm pinned power jack. An external step-down transformer accepts 115VAC (nominal) from the power line and steps it down to 9VAC. The step-down transformer is electrically identical to the one used for the Atari 810 disk drive. (Atari Part (C017945).

5.2.1.2.7 Led Board Interface

The LED Board is connected to the CPU board with a 5 wire flat cable terminating in a 5 pin molex connector with the followig signals:

PIN	SIGNAL
1	LED 3 (Power on)
2	No connect (Keyway)
3	LED 2 (International character set)
4	LED 1 (keyboard Disable)
5	Ground

5.2.1.2.8 The T.V. Interface

The S-16 provides an R.F. Modulated output for direct connection to a T.V. set. The R.F. output is available through a phono plug located on the back of the S-16 (See figure 5.1.3.).

5.2.1.2.8 A channel selection switch is provided on the back side of the S-16 (See figure 5.1.4.). The user may use T.V. channels 2 or 3 with the S-16

5.2.1.3 Digital Hardware

The Digitial Hardware consists of the 6502 CPU, the Antic Display Processor, the GITA, the POKEY, the PIA chip, the Memory (RAM and ROM) and miscellaneous logic.

5.2.1.3.1 The 6502 CPU

The functional and electrical details of the 6502 are given in [6], electrical differences between the regular 6502 and the modified 6502, SALLY, (the 6502 used in S-16) is given in [10]. Software design details of the 6502 are given in [9]. This section will describe the 6502 pins with reference to how they re used in the S-16.

(1) The Address Line (A15 to A0): This is the processor addresses all devices that are in its memory map, using these lines. The memory map of the 6502 is shown in figure 5.2.8. The internal registers of ANTIC,GTIA,POKEY and PIA are addressed using the address lines together with certain control signals (e.g. 02 CLOCK,R/W etc.) and the cartridge. The memory map is described later in this section.

(2) The Data Line (D7 to D0): This is the processor data bus. The processor transmits and receives information over these lines. The data bus connects the major functional blocks of the S-16. This includes the ROM, RAM, ANTIC, GITA, POKEY, PIA, and the cartridge interface.

(3) Ø0 Clock Input. This is the processor clock input. There is only one source of all clocks in the S-16 and that is a 3.579545 MHz crystal. This clock is fed into the OSC pin of the GITA (See section 5.2.1.3.3 below). The GITA uses this clock internally, buffers it and outputs it to the ANTIC as FAST Ø0. The ANTIC uses FØ0) internally, divides it by 2 and outputs it as Ø0 Clock. This is the clock that the processor uses as input clock. The nominal frequency of this clock is 1.789772 MHz.

(4) Ø1 Clock Output: This clock is the same frequency as the Ø0 input clock but is inverted in phase. The S-16 uses this clock at various places in its logic for timing purposes. See [9] for details.

(5) Ø2 Clock Output: This clock is the same frequency as the Ø0 Clock but is delayed by 60 ns. with respect to the Ø0 Clock. This clock is used by the ANTIC, GTIA, POKEY and PIA to synchronize the CPU signals for the internal timing. This clock is also used for timing purposes at various places in the S-16 digital hardware. See [9] for details.

(6) $\overline{\text{NMI}}$ Input: This is the nonmaskable input of the processor. The ANTIC drives this input to implement "display list interrupts" and vertical blanking interrupts. See [3] for a description of Display List Interrupts.

(7) $\overline{\text{IRQ}}$ Input: This is the Interrupt Request input of the processor. The POKEY and the PIA pull down this line whenever they have information for transmittal to the processor from devices connected to their I/O parts, or whenever the I/O device requests information from the processor.

The PIA and POKEY outputs that drive this line are "open drain". This permits all interrupts lines to be tied together in a wire-OR configuration. For details on the interrupt handlers see Chapter 6.

(8) RST Input: This is the reset input to the processor. The effect of reset on the processor is decribed in [6]. The reset signal is generated under two circumstances: during power-up and whenever the RESET BUTTON on the keyboard is depressed. The RST signal is an input to the ANTIC and the PIA.

(9) R/W Output: This is the read/write output of the processor. This line is high for a read and low for a write. Certain sections of the memory map (eg. the ROM) are read only. Others are write only (eg. some internal registers of the custom chips). For details on these see [1].

(10) RDY Input: This input delays execution of any cycle during which the RDY line is pulled low. ANTIC pulls this input low to synchronize the CPU to ANTIC after a "wait for horizontal sync" command. See [3].

(11) HALT Input: The HALT input stops the processor from executing bus cycles when pulled low. The address, data and read/write lines are tri-stated and are available for use by another bus mater. When the HALT input is pulled high the processor resumes execution from the cycle where it has interrupted. The ANTIC pulls the HALT line low whenever it needs to access the system memory for the display list or the display data. See [3].

(12) VSS and VCC Pins are the power connections to the processor. The supply voltage on Vcc should be 5v (+ or - 5%). The absolute maximum limit on Vcc is 7 volts.

CPU MEMORY MAP

The CPU memory map is shown in Figure 5.2.8 (a), (b) and (c), Fig. 5.2.3 (a) shows the memory map for a 16K S-16. Figure 5.2.8(b) shows the memory map for a 64K S-16, Figure 5.2.8(c) gives the details of the I/O mapped devices for both machines. For a description of the Cartridge interface, RD4 and RD5 see section 5.2.1.2.4. The mechanism for enabling Self Test and ROMENABLE is through a PIA part (See section 5.2.1.3.4).

This section will briefly describe the I/O map of the CPU. The region from D000H to D7FFH is the memory mapped I/O space. As shown in figure 5.2.8(c) the area from D000H to D0FFH is used to address the GTIA internal registers, the area from D200H to D2FFH is used to address the POKEY internal registers, the area from D300H to D3FFH is used to ddress the PIA registers and the area from D400H to D4FFH is used to address the ANTIC internal registers. The region from D500H to D5FFH is reserved for passing control information to the cartridges. When any address of the form D5XXH is invoked the Cartridge Conrol (CCNTL) line on the cartridge interface is enabled. The regions from D100H to D1FFH and D600H in D7FFH are not used.

Note that in when Self Test is invoked, the region from 5000H to 57FFH is used as the logical address space for the Self Test code. The actual physical location of the Self Test code is in the Operating System ROM from location D000H to location D7FFH and is shadowed by the 1/0 devices. See Chapter 6 for a description of the Self Test code.

MEMORY MAP 15K S-16

FFFF E000	Operating system if ROM ENABLE asserted. Not used if ROM ENABLE not asserted.
DFFF D800	Operating system if ROM ENABLE asserted. Not used if ROM ENABLE not asserted.
D7FF D000	Memory mapped I/O space (see Figure 5.2.8(c) or details) Self Test Code Space (physical) shadowed by I/O devices.
CFFF C000	Operating system if ROM ENABLE asserted. Not used if ROM ENABLE not asserted.
BFFF A000	Mapped to cartridge interface if RD5 asserted. Not used if RD5 not asserted.
9FFF 8000	Mapped to cartridge interface if RD4 asserted. Not used if RD4 not asserted.
7FFF 5800	Not used.
57FF 5000	Self Test Space (logic) if SELF TEST enabled and ROM ENABLE asserted. Not used if (SELF TEST disabled or ROM ENABLE not asserted).
4FFF 4000	Not used.
3FFF 0000	RAM

Figure 5.2.8 (a)

MEMORY MAP 64K S-16

FFFF E000	Operating system if ROM ENABLE asserted; RAM if ROM ENABLE not asserted.
DFFF D800	Operating system if ROM ENABLE asserted; RAM if ROM ENABLE not asserted.
D7FF D000	Memory mapped I/O space (see Figure 5.2.8(c) for details); Self Test Code Space (physical) shadowed by I/O devices.
CFFF C000	Operating system if ROM ENABLE asserted; RAM if ROM ENABLE not asserted.
BFFF A000	Mapped to cartridge interface if RD5 asserted; RAM if RD5 not asserted.
9FFF 8000	Mapped to cartridge interface if RD4 asserted; RAM if RD4 not asserted.
7FFF 5800	RAM
57FF 5000	Self Test Space (logical) if SELF TEST enabled and ROM ENABLE asserted; RAM if (SELF TEST disabled or ROM ENABLE not asserted).
4FFF 4000	RAM
3FFF 0000	RAM

Figure 5.2.8 (b)

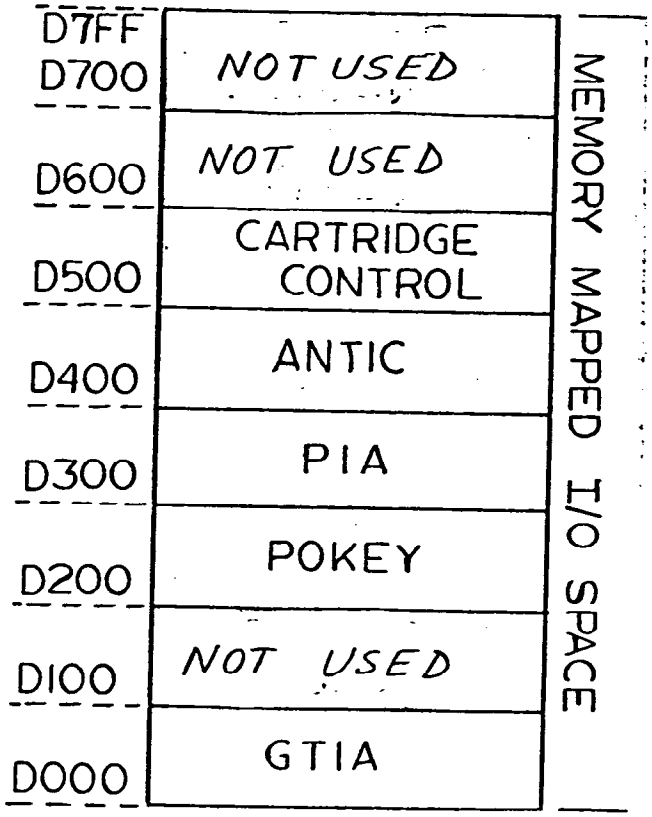

D7FF
D700
NOT USED
D600
NOT USED
D500
CARTRIDGE CONTROL
D400
ANTIC
D300
PIA
D200
POKEY
D100
NOT USED
D000
GTIA
MEMORY MAPPED I/O SPACE

FIG 5.2.8.(c).

5.2.1.3.2 The ANTIC Display Processor

The ANTIC is a custom display microprocessor with an instruction set customized for graphics generation. The functional detials including the internal registers are described in [1]. This section will describe how the ANTIC pins are used in the S-16 system. It will give references in the documents that describe the environmental and electrical characteristics of ANTIC.

ENVIRONMENTAL CHARACTERISTICS

The environmental characteristics of the ANTIC are described in "Electrical Specifications for Atari's ANTIC MOS/LSI" (Part #C012296).

ELECTRICAL CHARACTERISTICS

See the ANTIC data sheet for the electrical characteristics of the chip.

FUNCTIONAL DESCRIPTION OF PINS

(1) The Address Lines (A15 to A0): These lines are bidirectional. The CPU uses these lines to address the internal registers of the ANTIC. The ANTIC drives these lines (when it is the bus master) to access the system memory after acquiring the bus from the CPU. ANTIC addresses the system memory to access its display list and to access the display data. ANTIC also generates refresh addreses.

(2) The Data Lines (D7 to D0): This is the data bus of the S-16. All data between the CPU and the ANTIC is transferred over this bus. The ANTIC retrieves its display data over these lines, proceses it and passes it on to the GTIA.

(3) FØ0 Input: This is the fast Ø0 clock input from GTIA. This clock has a nominal frequency of 3.579545 MHz, and is used to clock the information on the AN0 to AN2 lines.

(4) The Ø0 Clock Output: The ANTIC generates this clock by dividing the FØ0 clock by 2. This clock is used by the CPU as its input clock. It has a nominal frequency of 1.789772 MHz.

(5) The Ø2 clock input: This is the CPU's Ø2 clock. The ANTIC uses this clock to synchronize signals on the CPU interface.

(6) RDY Output: ANTIC generates this signal whenever it needs to insert a "wait" state in the CPU read cycles. Insertion of a wait state delays the current CPU bus cycle to allow syncronization of the CPU to the ANTIC controlled display. See [3].

(7) $\overline{\text{HALT}}$ Output: The ANTIC pulls the line low whenever it needs to access the system memory. ANTIC waits for a fixed time after pulling this line low before it assures that the CPU is off the system bus. The ANTIC can then access the system memory.

(8) $\overline{\text{NMI}}$ Output: The ANTIC pulls this line low to issue a display list interrupt or a vertical blank interrupt to the CPU. See [3] for a description of display list and vertical blank.

(9) R/$\overline{\text{W}}$ Line: When the ANTIC is the system bus master, this line is its read/write output and is used to read data from the system memory. When the CPU is bus master, this line is the Read/Write input to the ANTIC.

(10) The $\overline{REF}$ output: This output is the DRAM refresh signal. The ANTIC has an internal 7-bit refresh counter that generates refresh addresses together with this signal to refresh the DRAM. This signal is generated atleast once every horizontal scan line and typically 8 times per scan line.

(11) AN0 to AN2 lines: These three lines are outputs to the GTIA chip. The ANTIC passes decompressed display data in real time to the GTIA on these lines.

(12) $\overline{RESET}$: This is the $\overline{RESET}$ input to the ANTIC. The reset input does not affect the generation of $\overline{REF}$ (refresh signal) and the refresh addresses. The data in the dynamic RAMs is therefore not lost if the $\overline{RESET}$ button on the keyboard is hit.

(13) $\overline{LP}$: This is the light pen input to the ANTIC. The light pen can be connected to either controller jacks of the S-16. If the trigger input on either controller jack is pulled low the $\overline{LP}$ line goes low. See [1] for the affect of the $\overline{LP}$ input on the internal registers of the ANTIC.

(14) Vcc and Vss: are the power connections to the processor. The supply voltage on Vcc should be 5 volts (+ or - 5%).

5.2.1.3.3 The GTIA Chip

The GTIA interfaces with the ANTIC processor on one side and with the video summation circuitry on the other. Its primary task is to generate color and luminance signals from the display information bit stream it receives from the ANTIC. In addition to this the GTIA provides 8 1/O pins that are used in the S-16 as described later in this section.

THE ENVIRONMENTAL SPECIFICATIONS

The environmental specifications of the GTIA are given in "ELECTRICAL SPECIFICATIONS OF THE ATARI GTIA MOS LSI PART (C014805).

THE ELECTRICAL SPECIFICATIONS

The electrical specifications of the GTIA are given in the GTIA data sheet.

FUNCTIONAL DESCRIPTION OF THE PINS

A general description of the GTIA pins is in the data sheet. This section will describe the pins as they are used in the S-16 system.

(1) A0 to A4 are the address inputs to the GTIA. The CPU uses these to address the internal registers of the GTIA.

(2) D0 to D7 are the GITA data lines. The CPU writes data in the GITA and reads status information from the GTIA registers using these lines.

(3) FØ0 is the Fast Phase 0 clock output from the GITA. This is a buffered version fo the OSC clock input to the GTIA and is used to clock the ANTIC-GTIA display data lines (AN0 to AN2).

(4) AN0 to AN2 are the real time display data input lines from the ANTIC.

(5) Ø2 is the Phase 2 clock input from the CPU. This clock is used by GTIA to Synchronize the CPU-ANTIC interface and for its internal timings.

(6) OSC input is the oscillator input into the GTIA The oscillator has a nominal frequency of 3.579545 MHz, (+or-0.01%). There is only one oscillator in the S-16 and all timings are derived from this oscillator.

(7) R/$\overline{W}$ is the Read/Write input from the CPU.

(8) $\overline{CS}$ is the Chip Select input from the address decoder circuitry. The GTIA needs this because it uses only 5 of the 16 CPU address lines to as inputs for internal register addressing.

(9) HALT is an input from the ANTIC. This input goes low when the ANTIC requests the system bus from the CPU

(10) LUMO to LUM3 are the real time luminnce outputs of the GTIA. These signals are fed into the video summation circuitry to product the composite luminance signal for the display.

(11) COLOR is the real time color output of the GITA. The color signal line generates the color burst signal to provide a color reference to the monitor or the T.V. The different colors are encoded in the phase variations (with reference to the burst signal) of the instentaneous signals on this line.

(12) CSYNC is the composite synch signal. This signal supplies the horizontal and vertical synch pulses for the timing of the composite video signal generated in the video summation circuitry.

(13) The $\overline{S0}$ input pin is used to sense the OPTION key. This input goes low when the key is depressed. This input has to be polled periodically by the application software.

(14) The $\overline{S1}$ input is used to sense the START key. When the key is depressed this input goes low. This input has to be polled periodically by the application software.

(15) The $\overline{S2}$ input is used to sense the SELECT key. This input goes low when the key is depressed. This input has to be polled periodically by the application software.

(16) The $\overline{S3}$ is the Keyboard Click Signal. The GTIA generates this signal whenever a key is depressed on the keyboard and the keyboard click is enabled. This signal goes to the audio summtion circuitry.

(17) The $\overline{T0}$ input is used to sense the trigger input from controller jack #1. This line goes low when the trigger is pressed. This line has to be polled periodically by software.

(18) The $\overline{T1}$ input is used to sense the trigger input from controller jack #2. This line goes low when the trigger is pressed. This line has to be polled periodically by application software.

(19) The $\overline{T2}$ input is not used.

(20) The $\overline{T3}$ input is used to sense the presense of the cartridge in the cartridge interface. This input has to be polled periodically in software.

(21) The CADJ input is the color adjust input of the GITA. The color adjust input can be varied from 1 volt to 10 volts with an external potentionmeter. This variation in voltage varies the delays of the internal transistors in the GTIA. This delay, in turn, controls the hue of the COLOR output of the GTIA. The 10 volt signal is generated by passing the 5 Vdc through a voltage doubler circuit. The color adjustment is necessary because the hue outputs of different GTIA chips are not identical. A color adjustment will therefore be done on each S-16 before it shipped out.

(22) Vcc and Vss are the power supply pins of the GTIA. The power requirements of the GTIA are 5 Volts (+ or -5%).

5.2.1.3.4 The PIA Chip

The PIA is a general purpose I/O chip and is used in the S-16 to control the Controller Interfaces and the S10 interface. A Motorola MC68B21 PIA or equivalent is used as the S-16 Peripheral Interface Adapter. The electrical, environmental and function characteristics of the PIA are discussed in MC68B21 Data Sheet [7].

This section will describe how the pins of the PIA are used in the S-16.

(1) RS0 and RS1 inputs are connected to the CPU address lines A0 and A1 respectively. The CPU selects the internal registers of the PIA using these lines and the chip select inputs.

(2) D0 through D7 are connected to the CPU data lines.

(3) R/W is connected to the CPU read/write line.

(4) $\overline{IRQA}$ and $\overline{IRQB}$ are "open drain" interrupt request outputs. The outputs are connected in a wire-or configuration and are input to the CPU IRQ pin.

(5) ENABLE input is connected to the CPU buffered Phase 2 (BØ2) clock. The PIA uses this for its internal timings and to synchronize the CPU interface.

(6) PA0 to PA7 are the PIA port A pins are used as follows:

PA1 = Controller 1 Forward (FWD) Input
PA1 = Controller 1 Back Input
PA2 = Controller 1 Left Input
PA3 = Controller 1 Right Input
PA4 = Controller 2 Forward (FWD) Input
PA5 = Controller 2 Back Input
PA6 = Controller 2 Left Input
PA7 = Controller 2 Right Input

Each of these lines is programmable as an input or an output by changing the contents of the direction register in the PIA. The above configuration is the O.S. default and it allows a joystick to be connected.

(7) PB0 is PB7 are the PIA port B pins and are used as follows in the S-16.

PB1: O.S. ROM Enable/Disable Output
PB1: Not Used.
PB2: Output to LED1 (keyboard Disable Indicator)
PB3: Output to LED2 (International Character Set Indicator)
PB4: Not used
PB5: Not used
PB6: Not used
PB7: Self Test Mode Enable Output

(8) CA1 is connected to the $\overline{\text{PROCEED}}$ input (Pin 9) from the SIO connector.

(9) CB1 is connected to the $\overline{\text{INTERRUPT}}$ input (Pin 13) from the SIO connector

(10) CA2 is the MOTOR CONTROL output to the SIO connector.

(11) CB2 is the $\overline{\text{COMMAND}}$ Output to the SIO connector.

(12) CS2 (chip select) input is connected to the PIA output of the S-16 decoder.

(13) Vcc and Vss are the power inputs to the PIA. Vcc should be 5 volts ($\pm$ 5%).

NOTE: See [2] for a description of the signals in items 8,9,10 and 11.

5.2.1.3.5 The POKEY Chip

The POKEY is a custom LSI chip and is used in the S-16 for Audio Generation, S10 Control, Controller Interface scan and keyboard scan.

ENVIRONMENTAL CHARACTERISTS

The Environmental Characteristics of POKEY are given in ELECTRICAL SPECIFICATIONS for Atari's POKEY MOS LSI P/N C012294.

ELECTRICAL CHARACTERISTICS

The Electrical Characteristics of POKEY are specified in the POKEY Data Sheet

FUNCTIONAL DESCRIPTION

A Functional Description of POKEY's internal registers is given in [1)] This section will describe how the POKEY pins are used in the S-16

(1) The Address Inputs (A0 thru A3) are connected to the CPU address lines A0 to A3 respectively. The CPU uses these to address the internal registers of POKEY.

(2) The Data Lines (D0 thru D7) are connected to the CPU; Data Bus.

(3) The $\overline{CS}$ (chip select) Input is connected to the POKEY output from the S-16 decoder.

(4) Ø2 Input in connected to the BØ2 clock.

(5) $\overline{R/W}$ Input is connected to the CPU R/$\overline{W}$ lines

(6) IRQ Output is activated by POKEY whenever a POKEY port needs service from the CPU. This is an "open drain" output and is connected to the CPU's IRQ Input.

(7) P0 thru P7 are the POKEY Pot Port pins and are used as follows:

P0 = APOT input from Controller Jack #1
P1 = BPOT Input from Controller Jack #1
P2 = APOT Input from Controller Jack #2
P3 = BPOT Input from Controller Jack #2
P4 = is an option strap: GND = Run Power on self test
+5 = don't run power on self test.
P5 = thru P7 are not used and are connected to ground.

(8) ADD is the audio output from POKEY. This output goes to the monitor jack through the audio summation circuitry and is the primary sound output of the S-16.

(9) ACLK, BCLK, SID and SOD are connected to SIO connector pins CLOCK OUT, CLOCK IN, DATA IN and DATA OUT respectively.

See [2] for more details on the functionality of these signals.

(10) $\overline{K0}$ thru $\overline{K5}$ are the keyboard scan outputs to the keyboard connector

(11) $\overline{KR1}$ and $\overline{KR2}$ are the keyboard scan response inputs from the keyboard connector.

(12) Vcc and Vss are the POKEY power pins. Vcc should be 5 volts ($\pm$ 5%).

5.2.1.3.6 The S-16 Memory

The O.S. ROMs

The S-16 O.S. is resident in two 8Kx8 ROMs that are located in address space C000H to FFFFH in the CPU Memory Map. The ROMs input CPU address lines A0 through A12 and the chip selects from the Address Decoding Circuitry and generate data on CPU data lines. (D0 thru D7). The ROMS require a power input of 5V($\pm$ 5%).

The S-16 DRAMS

The S-16 Random Access Memories consist of eight 16K x 1 DRAMS (in the 16K S-16) or eight 64K x 1 DRAMS (in the 64K S-16). The DRAMS in a 16K S-16 reside in addresses 0000H through 3FFFH. The DRAMS in the 64K S-16 physically occupy the whole address space of the CPU.

Generation of ROW and COLOMN addresses is done with the help of external multiplexers. The select input to multiplexers and the RAS and CAS strobes to the DRAMS are generated by delaying the Ø2 Clock signal using a tapped delay line.

.2.1.3.7 Miscellaneous Logic

(1) Memory Management (or Address Decoding) circuitry:

The Memory Management Circuitry consist of a PAL, one 3 to 8 decoder and a few gates. The input to this circuitry are the Address Lines A8 thru A15 and control signals like ROM ENABLE (from PIA), $\overline{REF}$, etc. The outputs of this circuitry are GTIA chip select. POKEY chip select, PIA chip selsct O.S ROM selects, RAM selects, and Cartridge select.

5.2.1.4 Analog Circuitry

The Analog Circuitry on the CPU Board consists primarily of the Video Summation Circuitry, the Audio Summation Circuitry, the R.F. modulator and the power supply.

5.2.1.4 Video Summation Circuitry

The Video Summation Circuitry takes the following signals as inputs:

(1) Luminance Outputs (LUM 0 thru LUM 3) from GTIA
(2) Color Output from GTIA
(3) Composite Synch Output (CSYNC) from GTIA

It produces the following outputs:

(1) Composite luminance output to the Monitor Jack. This signal has the following characteristics with a 75 OHM termination:

SYNC TIP MAX 0.08V
BLACK LEVEL 0.35 $\pm$ 10%
WHITE LEVEL 0.70 $\pm$ 15%

This signal is generated by summing the luminance outputs (LUM 0 to LUM 3) of the GTIA with a resistive summation network and adding timing information to it.

(2) Composite Video Output to the Monitor Jack. This signal has the following characteristics with 75 OHM termination:

SYNC TIP MAX 0.08V
BLACK LEVEL 0.35 ± 10%
WHITE LEVEL 0.70 ∓ 15%

This signal is generated by adding color information to the Composite Luminance Signal

5.2.1.4.2 The Audio Summation Circuitry

The Audio Summation network has been designed to provide a common summation mode for audio signals from POKEY, GITA (keyboard click), and the S10 interface. The resulting real-time audio signal is available as output on the S10 audio line and the Monitor Jack.

5.2.1.4.3 The R.F. Modulator

The R.F. Modulator inputs the composite video and the monoaural audio signals from the video summation circuitry and produces a modulated signal suitable for the television. A channel selection switch is provided to allow the user to use either T.V. channel 2 or channel 3 with the S-16.

The modulated signal will have the following characteristics with a 75ohm termination:

Maximum Voltage: 2mV
Minimum Voltage: 1mV

5.2.1.4.4 Power Supply

The S-16 has a linear power supply. The power supply electronics is resident on the CPU board. The power supply accepts a 9VAC input through a 2-5 mm pinned power jack. An external step-down transformer accepts 115 VAC from the power line and steps it down to 9VAC for the S-16. The 9VAC input is rectified by a bridge rectifier and then regulated by two separated voltage regulators. The regulated power outputs from the regulators are bussed on separate power rails to power distinct sections of the CPU Board. Both power rails have a common ground.

The D.C. output of each regulator is 5V + 5%. The maximum D.C. requirements for the S-16 electronics are 5V, 1.7 amps

The external step down transformer is electrically identical to the one used for the Atari 810 disk drive (Atari part # C017945)

5.2.2 The Keyboard

The keyboard layout is shown in figure 5.1.4. The electrical and functional details of the keyboard are speciffied in (4). The mechanical details are specified in "S-16 keyboard assembly drawings" (Atari P/N C060046).

5.2.3 The LED Board

5.2.3.1 Mechanical Details

The LED Board is 3" wide X 0.75" deep single sided PCB and it snaps onto the top cover. There are holes in the top cover through which the tops of the LEDS show. There is a 5 pin molex connector on the LED Board for the flat cable that connects the LED Board to the CPU Board.

5.2.3.2 Functional Details

The LED Board houses 3 LEDS:

(1) LED 1 lights up when the keyboard is disabled.
(2) LED 2 lights up when the International character set enabled.
(3) LED 3 is POWER - ON Indicator

See Section 5.2.1.2.7 for LED Board's interface to the CPU Board.

The 16K S-16's LED board is populated with only one LED, the POWER-ON Indicator. The 64K S-16's LED Board is populated with all three LEDS.

5.3 EMI AND HEAT MANAGEMENT

All the electronics on the CPU board (with the exception of the power supply electronics and the connectors) are enclosed in an EMI shield. The EMI shield is made up of two parts - the top shield and the bottom shield. Both shields are made of tin plated cold rolled steel. A ground plane is etched on both sides of the CPU board PCB along foot print of the EMI shields. The two shields rest on this plane and are held in place by the top and bottom plastic covers. See C060290 for details.

The S-16 plastic has louvres cut horizontally on the bottom cover. This allows for convection cooling. The EMI shield also help to dissipate heat efficiently because of its large surface area. In addition to this the S-16 has a heat sink that runs about half the length of the back side. Bolted on to this heat sink are the two power supply regulators and the full wave rectifier. The heat sink is made of thick aluminum.

7 COMPATIBILITY WITH EXISTING ATARI PRODUCTS

The ATARI S-16 Home Computer is designed to be compatible as possible with all existing ATARI 400/800 Home Computer Hardware and software products. This chapter will either resolve the apparent incompatibilities or flag the real incompatibilities.

This chapter is divided into four sections. Section 1 examines the ATARI S-16 Home Computer hardware as it affects the existing ATARI 400/800 Home Computer hardware products; Section 2 takes a look at how the ATARI S-16 Home Computer hardware affects existing ATARI 400/800 Home Computer software. Sections 3 and 4 discuss how ATARI S-16 Home Computer software affects existing ATARI 400/800 Home Computer hardware and software respectively.

7.1 Effects of ATARI S-16 Home Computer Hardware on existing ATARI 400/800 Home Computer Hardware Products.

7.1.1

The existing ATARI 800 personality card will not plug into the ATARI S-16 Home Computer. The Operating System (OS) personality card is unnecessary, because the S-16 DS is resident in the ATARI S-16 Home Computer main CPU card.

7.1.2

RAM expansion in discrete steps of 8K is not possible in the ATARI S-16 Home Computer. Only two configurations will be available: 16K and 64K. The 16K to 64K upgrade is not user installable, because it involves changing 16K DRAM chips to 64K chips and the replacement of the address decoding MMU.

7.1.3

Pin 12 of the ATARI 400/800 SIO connector is 12-volts, 300 ua of direct current. This voltage source has been eliminated on the S16 connector. Pin 12 is not connected on the S16 SIO connector. No existing ATARI 400/800 Home Computer peripheral device makes use of this voltage source.

7.1.4 The ATARI S-16 Home computer contains only one cartridge slot. This is compared to two in the ATARI 800 Home Computer.

The ATARI S-16 Home Computer will accept all ATARI 400/800 Home Computer left cartridges. ATARI 400/800 Home Computer right hand cartridge will not auto-run with the ATARI S-16 Home Computer. There curently are no Atari developed right hand cartridges.

7.1.5 There is a pin for pin compatibility between the ATARI 800 Home Computer and the ATARI S16 interfaces, except for Pin 5. Pin 5 is the Composite Chroma signal in the ATARI 800 Home Computer. Pin 5 is not connected in the ATARI S-16 Home Computer monitor interface. Therefore, any monitor using the Composite Chroma signal will not work with the ATARI S-16 Home Computer.

7.1.6 The RAS output to the Cartridge Interface is an ATARI 400/800 Home Computer has been changed to Ø2 clock in the ATARI S-16 Home Computer. This should not have any affect on existing cartridges, since none of them use the RAS input.

7.2 Effects of ATARI S-16 Home Computer Hardware on Existing ATARI 400/800 Home Computer Software Products.

7.2.1 The 64K version of the ATARI S-16 Home Computer has two function LEDs at the top of the keyboard. These LEDS show keyboard status. LED 1, if on, shows that the keyboard is disabled. LED2, if on, shows that the international character set is enabled. Existing software does not effect the state of these LEDs

7.2.2 There are four programmable Function Keys and a HELP key at the top of the ATARI S-16 Home Computer keyboard. Existing software is not affected by these keys.

7.2.3 The ATARI S-16 Home Computer has no inboard speaker. Those sounds normally generated by the ATARI 400/800 Home Computer inboard speaker (key clicks, bell, etc.) are directed to the television speaker by the ATARI 400/800 Home Computer software. All sounds generated by existing applications software are audible on ATARI S-16 Home Computer

7.2.4 Game controller jacks 3 and 4 do not exist on the ATARI S-16 Home Computer. A maximum of two joystick Controllers or two pairs of Paddle Controllers can be used at any one time; therefore games, such as ATARI BASKETBALL, having 4-player options in the ATARI 400/800 Home Computer will not have 4-player options in the ATARI S-16 Home Computer.

The PIA and POKEY ports used by the ATARI 400/800 Home Computer to interface with Controller Jacks 3 and 4 have been assigned to other tasks within the ATARI S-16 Home Computer. Those ports not having tasks assigned have been left unconnected; the S-16 OS does not attempt to read these unassigned ports.

7.2.5 The right hand cartridge slot has been eliminated from the ATARI S-16 Home Computer. The S-16 Operating System makes no check for its presence. Any existing software that uses an auto-run right hand cartridge slot will not function on the S-16.

7.3 Effects of ATARI S-16 Home Computer Software on Existing ATARI 400/800 Home Computer Hardware Products.

The ATARI S-16 Home Computer Operating System (OS) will interface with all ATARI 400/800 Home Computer game controllers, serial I/O peripheral devices are cartridges The OS will support all ATARI Home Computer language processors, applications programs and games.

7.4 Effects of ATARI S-16 Home Computer Software on Existing ATARI 400/800 Home Computer Software Products.

The compatibility issues in this category are documented in the SWEET 16 OPERATING SYSTEM EXTERNAL REFERENCE SPECIFICATION. Chapter 6.

7.5 EFFECTS OF EXISTING SOFTWARE ON THE S-16

(1) If an A800 application program that uses A800 controller ports 3 and 4 is loaded in the S-16 it will turn the PIA port B into an input port. Since the PIA port B is used as an output port in the S-16 (See section 5.2.1.3.4 for a description of the PIA port B), this change of port direction will have the following affect on the PIA pins.

PB0 (ROM ENABLE) will be set to enable the O.S. ROM

PB1 is not used.

PB2 and PB2 (LED ENABLE outputs) will be set so that the LEDs go OFF.

PB4, PB5 and PB6 are not used.

PB7 (SELF TEST ENABLE output) will default to Self Test Disabled.

These defaults are assured by S-16 hardware. Thus even if an application turns the direction of the PIA port around, the S-16 will default to a determinate and meaningful state.

8.0 PRODUCTION IDENTIFICATION

The preliminary marketing titles for the S-16 are as follows:

16K S-16: "ATARI 1200"

64K S-16: "ATARI 1200X"