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TRS-80® Model III

Technical Reference Manual

For programmers and technicians

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IMPORTANT NOTICE

This Technical Reference Manual is written for owners of the TRS-80 Model III Computer, who have a thorough understanding of electronics and computer circuitry. It is not written to the beginner's level of comprehension.

This manual contains detailed schematics and theories of operation for each major part of the Model III. These tools will aid you with designing interfaces for your computer, repairing your own computer after its warranty has expired, or simply obtaining practical knowledge of your TRS-80 Model III operation.

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SECTION I

INTRODUCTION

SYSTEM OVERVIEW

The Radio Shack TRS-80 Model III Microcomputer is an enhanced version of Radio Shack's popular TRS-80 Microcomputer (Model I). The TRS-80 Model III is software compatible with the Model I so that owners of either system can take advantage of the large number of programs available.

Features of the TRS-80 Model III which are common to the TRS-80 Model I include:

- Availability of Level I or Level II BASIC in ROM
- Full size typewriter style keyboard
- A 12-inch video display
- Built-in cassette interface
- Character display of 16 lines of 64 characters
- Graphics under control of BASIC (128 H x 48 V)
- UL recognized construction

In addition, the Model III has the following standard features:

- 12-key numeric keypad for rapid entry of numbers
- Rugged cabinet housing keyboard, electronics, video display, and power supply
- Direct drive video monitor for improved resolution
- Internal power supply
- Parallel printer port for use with Radio Shack printers

Several other features are available when Level II BASIC is used; features such as: real time clock, upper and lower case characters, RAM internally expandable to 48K bytes, I/O port for peripheral expansion, and cassette interface available with 500 and 1500 baud rates.

Optional peripherals for the TRS-80 Model III include disk drives (two built-in, two external) with double density for increased storage capacity, and a built-in RS-232 serial interface for communications and peripheral interface.

The Block Diagram shows the various internal components and connections of the Model III Microcomputer.

FIGURE 1. TRS-80 MODEL III BLOCK DIAGRAM

SECTION II

DISASSEMBLY/REASSEMBLY

DISASSEMBLY

CASE:

1. Remove all cables from the bottom and rear of the Computer. Position the Computer on its rear panel to provide easy access to the case bottom. Remove the ten screws from the case bottom. Notice the different types and lengths of screws and note their positions. Set them aside in groups.

2. Position the Computer upright and remove the #6 screw and washer from the top of the back panel of the case.

3. Very carefully remove case top, lifting **striaght up** and setting it aside to the left (if facing video screen). Be careful not to exceed the length of the video cable.

4. Remove screws from the chassis shield and the ground connectors and remove the shield. **

CPU BOARD:

1. Remove all cables connecting the CPU Board (power supply cable, video, keyboard, and cassette cables, and if applicable, the RS-232 and FDC inter-connect cables).

2. Remove the five screws fastening the PC Board (two in upper right corner, three on bottom).

3. Remove the small PCB Mount Bracket and its two screws from atop the metal chassis bracket. **

4. Make sure all cables to the CPU Board have been disconnected then remove the Board. (If your unit uses plastic spacer mounts to hold the Board, press the small tabs on the mounts through the mounting holes in the PCB and gently pull the CPU Board off.)

FDC BOARD (optional):

NOTE: The CPU Board must be remove before removing the the FDC Board.

1. Be sure to disconnect all cables to the FDC Board.

2. Remove the screws holding the FDC Board to the metal chassis and remove the Board.

RS-232 BOARD (optional):

NOTE: The CPU Board must be removed before removing the RS-232 Board.

1. Be sure to remove all cables connecting the RS-232 Board.

2. Remove the screws connecting the PC Board to the chassis and remove the Board.

MAIN POWER SUPPLY:

1. Remove all interconnect cables to the Boards fastened on the metal chassis bracket (power supply cable, video, keyboard, and cassette cables, and if applicable, RS-232 and FDC power connectors and the Disk ribbon cable).

2. Remove the four screws fastening the metal chassis bracket to the case bottom.

3. Make sure all inter-connecting cables are removed, then carefully lift out chassis bracket and attached Boards.

4. Remove the four screws fastening the Power Supply to the Bracket (notice where the ground tab is fastened), then carefully remove the power supply.

DISK DRIVE POWER SUPPLY (optional):

1. Disconnect all cables and wires connecting to the Power Supply.

2. Remove the four screws fastening the Board to the Disk Mounting Bracket (notice where the ground tab is fastened), then carefully remove the Power Supply.

DISK DRIVES (optional):

1. To remove the Disk Drive in the top position, carefully remove the FDC inter-connect cable connected to the rear of the Drive.

2. Remove the four screws and washers (two on each side) which connect the Drive to the Disk Mounting Bracket.

3. Disconnect the power supply connector from the bottom of the top board in the Disk Drive and also remove the ground wire from the rear of the Drive.

**Not applicable to all units.

4. To remove the Disk Drive in the bottom position, **you must first remove the Disk Drive Power Supply.**

5. After removing the Power Supply, remove the FDC inter-connect cable from the rear of the Drive.

6. Remove the four screws and washers (two on each side) which connect the Drive to the Disk Mounting Bracket.

7. Disconnect the power supply connector from the bottom of the top board in the Disk Drive and also remove the ground wire from the rear of the Drive.

VIDEO MONITOR (CRT) AND VIDEO BOARD

1. Disconnect the four color coded wires with spade lugs from the CRT yoke. (Be sure to note their positions.)

2. Disconnect the connector on the rear of the CRT neck.

WARNING

There may be a high voltage charge on the high voltage anode. To discharge, connect one end of a wire to a known good ground and connect the other end of the wire to the blade of a common screwdriver. Insert the screwdriver blade under the suction cup and touch it to the clip holding the wire to the CRT.

3. Insert a common screwdriver under the suction cup on the high-voltage anode wire on the side of the CRT. Use the screwdriver to compress the clip holding the wire to the tube and pull the wire free.

4. Remove the ground wire fastened directly to the Video Board.

5. Remove the upper right and lower left nuts and washers which hold the CRT in place.

CAUTION

If dropped, the CRT may implode. To avoid this kind of accident, support the CRT while performing the next step.

6. Remove the remaining lower right and upper left nuts, and washers and carefully remove the CRT.

7. Disconnect the CPU cable connector from the Video Board.

8. Remove the two screws fastening the Video Board to the Case Top and carefully lift out Board.

REASSEMBLY

RS-232 BOARD (optional):

1. Install the PC Board using #6 x 3/8" screws. If applicable, press the PC Board onto the plastic spacer mounts then fasten with the screws.

2. Reconnect all cables to the RS-232 Board.

FDC BOARD (optional):

1. Install the PC Board using #6 x 3/8" screws and the plastic spacer mounts, if used.

2. Reconnect all cables to the FDC Board.

CPU BOARD:

1. Make sure good insulating washers are attached to the CPU Board (Rev. F boards only) then fasten the Board using #6 x 1/4" screws.

2. Reconnect all cables to the CPU Board (power supply cable, video, keyboard, and cassette cables, and if applicable, RS-232 and FDC inter-connect cables).

3. Attach the small PCB Mount Bracket (if used) to the metal chassis bracket with two #6 x 1/4" screws.

MAIN POWER SUPPLY:

1. Fasten the Power Supply to the metal chassis bracket using four #6 x 1/4" screws. Be sure the ground tab is fastened back in place.

2. Install the chassis bracket (with all Boards in place) in the case bottom using four #6 x 1/4" screws.

3. Reconnect all cables (power supply, video, keyboard, and cassette cables, and RS-232 and FDC power cables and Disk ribbon cable if necessary).

DISK DRIVE (optional):

1. Place the Disk Drive in the bottom position and reconnect the ground wire and power supply connector.

2. Fasten the Drive with four #6 x 1/2" screws and four flat washers (two on each side).

3. Reconnect the FDC inter-connect cable to the rear of the Drive.

4. Position the second Disk Drive in the top position and reconnect the ground wire and power supply connector.

5. Fasten with four screws and washers (two on each side).

6. Reconnect the FDC inter-connect cable to the rear of the Drive.

DISK DRIVE POWER SUPPLY (optional):

1. Before installing the Power Supply, be sure that the bottom Disk Drive is mounted in place and the Disk Shield is in positon on the Disk Mounting Bracket.

2. Reconnect all cables and wires to the Power Supply.

3. Fasten the Power Supply with four #6 x 3/8" screws. Be sure the ground tab is fastened back in place.

VIDEO MONITOR (CRT) AND VIDEO BOARD:

1. Position the CRT in the Case Top and install the upper left and lower right #10 washers and nuts.

2. Install the upper right and lower left #10 washers and nuts. Be sure to reconnect the ground wire from the CPU cable. It will require two nuts to fasten it.

3. Install the Video Board into the Case and fasten with two #6 x 1/4" screws.

4. Connect the ground wire with solder lug back to the Video Board.

5. Install the plug on the rear of the CRT neck.

6. Install the four color coded wires with spade lugs to their associated terminals (as determined by a colored dot on the yoke near each terminal).

7. Install the high-voltage anode wire on the side of the CRT. Use a screwdriver to compress the clip and insert it into the CRT. Press down on the suction cup to secure.

CASE:

1. Double-check to be sure all wires are connected correctly and all Boards are properly fastened.

2. Attach the chassis shield (if used) with #6 x 1/4" screws and reconnect the ground connectors.

3. Carefully place the Case Top over the Case Bottom. **Do not hit the CRT neck. It could implode or break off.**

4. Install the #6 x 3/8" sheet metal screw and flat washer in the top rear panel of the Case.

5. Carefully rest the Computer on its rear panel and replace the ten #8 screws; five 1" sheet metal toward rear, three 7/8" machine head along front, and two 1" machine head in remaining positions.

SECTION III

CPU CIRCUIT BOARD

TECHNICAL DESCRIPTION

The technical description of the Model III Computer CPU circuit board will be broken down into nine sections. These are:

1. Processor
2. RAM
3. Adress Decoding
4. Video
5. Video Sync Circuits
6. Keyboard
7. Cassette Interfaces
8. Line Printer and Real Time Clock
9. I/O Bus

This breakdown, which follows the partitioning of the schematic diagrams, will allow easy explanation and referencing.

VIDEO SYNC CIRCUITS

The video sync circuits are required to meet the pulse width and polarity requirements of the video monitor. It also allows adjustment in both the horizontal and vertical planes in discrete increments. The vertical sync pulse VSYNC is active low and approximately 693μsec in duration. The frame rate is either 50 or 60 Hertz. The horizontal rate is 15,840 Hz and the signal HSYNC is active high with a duration of approximately 8 μsec. The vertical plane adjustment covers a total of eight rows and is adjustable in increments of one row (R1, R2, R4). The horizontal plane adjustment increments by two characters for a total coverage of 16 character positions. Both adjustments are accomplished with the use of wired "AND" gates U22 and U38 (LS266).

PROCESSOR

The CPU chip is a Z-80 that runs at a clock speed of 2.02752 MHz. The CPU clock is derived by dividing the basic video clock (10.1376 MHz) by five. U62 performs this function and the clock is non-symmetrical with a 40 percent high duty cycle. The clock signal PQC is run through an active pull-up and becomes PCLOCK which has a full 5-volt swing with fast rise and fall times. The reset switch, which is located on the keyboard, is ORed with power on reset (R7, C54, U15) to provide a System RESET* signal. The Reset pin on the Z-80 is driven by RESET*. The address lines are buffered by LS244's (U91, U92), the data lines by an LS245 (U90), and control lines buffered by an LS367 (U76). The buffered control lines are combined in U89 and U86 to form memory and I/O port controls (RD*, WR*, IN*, OUT*).

See the CPU Timing Diagram for exact time relationships. U75 is used to switch the data bus buffer during INTAK* cycle or any read operation (I/O or Memory). Whenever one of the ROMs is being accessed, the data bus buffer is disabled by U108 since the ROMs data lines are located on the CPU data bus. BUSRQ*, HALT*, BUSAK*, and RFSH* are not used. The Model III has three sockets for the ROMs (U104, U105, U106. They are 64K bit, 32K bit, and 16K bit ROMs respectively.

RAM

The RAM consists of an array of up to twenty-four 16K dynamic memory chips with damping resistors located on all address and control lines (RP1, RP2, RP3). Chips U7 to U14 are addressed at 4000 to 7FFF, U25 to U32 are addressed at 8000 to BFFF and U43 to U50 are addressed at C000 to FFFF. The memory data is interfaced to the data bus by two 8T26s (U63, U64). Normally the data is driven into the memory array. However, on a read cycle U19 switches the direction of the transceivers and drives memory data onto the data bus. The - 5 volts required by the RAMs is supplied by a 3-terminal regulator (MC7905C) which takes −12 volts as its input. See the CPU Timing Diagram for the relationship between RAS*, MUX, CAS*.

FIGURE 1. CPU TIMING DIAGRAM

ADDRESS DECODING

The Address Decoding provides all the selects for the system I/O ports, the ROMs, Keyboard, Video, and RAM memory control. Refer to the Memory Map for exact locations of devices.

The two LS138 demultiplexers provide the INPUT and OUTPUT strobes for system I/O ports EØ to FF; U41 for OUTs and U40 for INs. Memory timing consists of U37 and U61 in a shift register configuration clocked at 10.1376 MHz to give the correct relationship between RAS*, MUX, and CAS*.

MUX provides the switch between Row address and Column address on the address multiplexers U24 and U42 for the memory array. The three CAS signals are generated by LS139 (U58), LS32s (U59, U107) and one CAS for each row of RAMs.

Note that the first row of RAMs is the only one suitable for 4K RAMs (jumper option U to T, N to P, GG to FF). The ROM strobes (ROMA*, ROMB*, and ROMC*) are generated by the remaining section of the LS 139 (U58), and part of the LS 145 (U60).

The combinational logic below U60 (U75, U73, U72, U86) deletes two addresses from ROMC* (37E8 and 37E9) which correspond to the line printer address; thus, ROMCP* is the actual strobe going to the 16K bit ROM. The result is that the line printer may be accessed for a read as either a memory address (37E8) or an I/O port (F8). See the I/O ports and address space map. The remaining strobes KYBD* and VID* are also generated by the LS145 (U60).

MEMORY MAP OF MODEL III

HEX ADDRESS	DESCRIPTION	DECIMAL SIZE (1K = 1024)
ØØØØ 1FFF	ROM A	8K
2ØØØ 2FFF	ROM B	4K
3ØØØ 37FF	ROM C	2K-2
37E8 37E9	Printer Status	2
38ØØ 3BFF	Keyboard	1K
3CØØ 3FFF	Video	1K
4ØØØ 7FFF	RAM	16K
8ØØØ BFFF	RAM	16K
CØØØ FFFF	RAM	16K

I/O PORT DESCRIPTION

Name: LPIN*
Port Address: ØF8H
Access: Read Only
Description: Read Line Printer Port Status

BIT 7 = BUSY
1=True
Ø=False

BIT 6 = OUTPAPER
1=True
Ø=False

BIT 5 = UNIT SELECT
1=True
Ø=False

BIT 4 = FAULT
1=True
Ø=False

Name: LPOUT*
Port Address: ØF8H
Access: Write Only
Description: Line Printer Output Data Port

BIT 7 thru BIT Ø = ASCII Byte to be Printed.

Name: RTCIN*
Port Address: ØECH
Access: Read Only
Description: Clear Real Time Clock Interrupt

BIT 7 thru BIT Ø = Don't Care

Name: DISKOUT*
Port Address: ØFØH to ØF3H
Access: Write Only
Description: Write to Disk Control Registers

Port ØFØH = Disk Command Register
Port ØF1H = Disk Track Register
Port ØF2H = Disk Sector Register
Port ØF3H = Disk Data Register

Name: DISKIN*
Port Address: ØFØH to ØF3H
Access: Read Only
Description: Read Disk Control Registers

Port ØFØH = Disk Status Register
Port ØF1H = Disk Track Register
Port ØF2H = Disk Sector Register
Port ØF3H = Disk Data Register

Name: RS232IN*
Port Address: ØE8H to ØEBH
Access: Read Only
Description: Read UART Registers

Port ØE8H = Modem Status
Port ØE9H = N.A.
Port ØEAH = UART Status Register
Port ØEBH = UART Receiver Holding Register, Resets D.R.

Name: RS232OUT*
Port Address: ØE8H to ØEBH
Access: Write Only
Description: UART Control, Data; Modem Control; BRG Control

Port ØE8H = UART Master Reset
Port ØE9H = Baud Rate Register Load
PortØEAH = UART Control register and Modem Control
Port ØEBH = UART Transmitter Holding Register

VIDEO

The Video section can be subdivided into four parts:

A. Video RAM with associated addressing and data buffer
B. Main oscillator and divider chain
C. Character generation logic
D. Wait logic

A. The video RAM consists of two 2114 static RAMs (U81, U82) which gives 1024 (1K) bytes of RAM. Addressing from the divider chain or the Z-80 CPU comes from the LS157 multiplexors (U69, U70, U71). The video data is buffered to the CPU data bus through an LS245 (U67), or to the character generator logic by the LS273 latch U68. Addressing control is determined by the signal RSVID* which is described in paragraph D.

B. The main oscillator consists of inverters from U2, crystal Y1, and discretes R1, R5, and C1. The oscillator runs in the fundamental mode at a frequency of 10.1376 MHz. This basic frequency is divided by two in U3 and becomes CLOCK/2. The CLOCK and CLOCK/2 signals are fed to mux U4 which provides the divider chain with the CHAIN signal (633.6 kHz) provides the shift register U52 with the SHIFT signal, and also supplies the signal LATCH (1/8 the rate of SHIFT) to various parts. MODSEL selects either the 64 character or 32 character mode. (Refer to the Video Timing diagram.) The main divider chain consists of two LS393s (U20, U56) and one LS74 (U1). This divider chain, connected as one long ripple counter, presents the character count, the line and row count, and the horizontal and vertical drive signals to the rest of the video section. The horizontal drive signal (HDRV) runs at 15.840 kHz and results in 80 characters per line; 64 displayed and 16 blanked. The line count (L1 to L8) runs modulo 12 (i.e., twelve horizontal lines per character block). The row counter (R1 to R8 and VDRV) runs modulo 22 (60 Hz), or modulo 26 (50 Hz) depending which jumper option, "A", or "B" or "C", has been selected.

C. The character generation logic consists of a latch (LS273-U68) to hold the ASCII data, a ROM which contains the dot pattern making up the characters, a shift register (LS166 - U52) which serializes the 8-bit data for display on the screen, and the associated timing and control signals provided by the divider chain and oscillator circuits. On the rising edge of LATCH the LS273 stores the ASCII byte from the video RAMs. This data is presented to the character generator ROM to form part of the address of the character to be displayed. The other addressing information comes from the divider chain (L1 to L4) to select the scan line of the character to be displayed. (There are twelve scan lines in each character block.) On the next LATCH pulse the data from the ROM is latched into the shift register and shifted out by the SHIFT clock. The SHIFT clock runs eight times faster than LATCH, hence there are eight horizontal dots per character line. The LATCH signal into the shift register is qualified by DLYBLANK so that during horizontal retrace, vertical retrace, and the last four scan lines of each character displayed, the shift register will shift out zeros.

FIGURE 2. VIDEO TIMING DIAGRAM

If VD7 is a one and VD6 is a zero, then a graphics character will be displayed which uses LS153 (U54) and LS244 (U53) to load the data into the shift register. Note that both U36 and U53 are tri-state devices and that the enables for these devices (DLYCHAR* and DLYGRAPHIC*) are the complements of each other. This means that either character data or graphics data will be loaded into the shift register depending of course on the state of VD7 and VD6. The signal ENALTSET and an LS00 (U37) allow the 64 characters that are masked by the graphics characters to be displayed from the ROM (U36). When ENALTSET is a one, the 64 standard characters are displayed. When ENALTSET is a zero, 64 alternate characters are displayed.

D. The wait logic forces the CPU into a wait state if the BLANK* signal is not present. This allows video RAM updates only during horizontal retrace, vertical retrace, and the blanking on the last four scan lines of a character since these are the conditions that form BLANK*. This will eliminate virtually all the "hashing" on the display. The logic consists of U17, U16, U18, U57, U39, and U1. When VID* is true, indicating the CPU wants access to the video RAM, and PBLANK* is false, both signals are combined in U16 to give PWAIT*. If PBLANK* is true, it is combined with VID* to give RSVID*, which is then granted access to the video RAM. This feature can be disabled through the DISWAIT input to U39 which is under software control.

KEYBOARD

The keyboard interface consists of open collector drivers (LS05) U34 and U35 which feed the 8 by 8 key matrix with addresses A0 through A7. The output of the matrix has the pullup resistors and CMOS receivers which give reliable key closure sensing even with key switches of up to 300 ohm resistance. The data from the CMOS buffer is driven onto the data bus by the LS240 (U66). The signal KYBD* strobes the octal data bus driver. The reset switch is also mounted on the keyboard assembly and the three lines required are routed in the twenty-pin keyboard cable to the reset circuit. Note that all electronic parts are mounted on the CPU Board; none are required on the PCB for the keyboard.

CASSETTE INTERFACE

There are two separate cassette circuits for 500 Baud and 1500 Baud. The 500 Baud Read circuitry is very similiar in principle to the Read circuitry on Model I. The MC1741 forms a two pole high pass active filter to filter out 60 Hz noise. The two amplifiers of the MC1458 (U80) form a full-wave active rectifier. Capacitor C94 acts to smooth out the rectified output which is then fed to a 339 comparator (U96). Resistors R48, R49, and R51 provide a fixed threshold of 0.5V at pin 5 of U96. This gives a minimum level with which the input signal at pin 4 may be compared against. Capacitor C93 provides a voltage equal to the average signal level, with R46 and CR9 providing fast charge and R48 providing a slow discharge. Capacitor C93 provides an equivalent AGC action since the comparator threshold becomes proportional to the signal level. The comparator outputs negative pulses corresponding to the input pulses which are then inverted by U2 and fed into the clock of a "D" flip-flop (U3). The "D" flip-flop will then be set and will stay set until cleared by CAS OUT* (equivalent to OUTSIG in Model I). CAS IN* will read the data stored in U3 and output it at pin 7 of the data bus.

The 500 Baud Write circuitry is identical to the write circuitry used in the Model I. This circuit is also used to provide the squarewave data for 1500 Baud. Data 00H gives 0.4V out, Data 01H gives 0.8V out, and Data 02H gives 0.0V out. The 1500 Baud uses 01H and 02H only. The 500 Baud output is a 250μsec pulse while the 1500 Baud output is a squarewave that varies in frequency between 1320 Hz and 2680 Hz.

The 1500 Baud cassette input consists of a zero crossing detector using U96. Diode CR8 is used to prevent the input signal from driving pin 10 of U96 negative. The output, pin 13 of U96, is normally high when the signal is applied and will provide a 50mV threshold at pin 11. R57 and R59 provide this 50mV of threshold and hysteresis. The output of the comparator is fed to the two 74LS74 "D" flip-flops which determine whether the rising or falling edge is detected and is also used to set an interrupt signal INT* using U18 and U35. ENCASINTF, pin 2, enables the falling edge interrupt latch and ENCASINTR, pin 12, enables the rising edge interrupt latch. Only one of the latches are enabled at any one time. CASIN* clears the interrupt latches and RDINTSTATUS* is used to read the data from the interrupt latch to tell which latch has been set. The cassette motor on relay is driven by U97.

LINE PRINTER AND REAL TIME CLOCK

The LS273 (U94) latches the data written to the Line Printer and the one-shot (U93) provides the data strobe. The printer status lines are buffered through the LS244 (U95). A full eight bits of data are buffered so that the Line Printer interface could be used for any general purpose parallel interface.

The Real Time Clock circuit provides either a 30 Hz or 25 Hz interrupt to the CPU if enabled. VDRV is divided by two at U83 (LS74) and latched in the other section of U83. This generates an interrupt through LS38 (U88) and the status can be read by strobing U84 (LS367) with RDINTSTATUS*. To clear the interrupt one must strobe RTCIN*.

IO BUS

The I/O Bus supports all the signals necessary to implement a device that is compatible with the Z-80's I/O structure. The LS245 (U101) buffers the data in both directions and is enabled by ENEXTIO. The direction is determined by LS244 (U102) and is also enabled by ENEXTIO. The control lines necessary for I/O operation are buffered by LS367 (U103) and they are also enabled also by ENEXTIO. External I/O waits and interrupts are also supported by the I/O bus via U87 and U88. Refer to the detailed I/O Bus description and timing diagram.

ADJUSTMENTS AND JUMPER POSITIONS

The jumper positions vary between 4K and 16K RAM models. Jumpers should be installed as described below.

4K RAM	U to T, N to P, GG to FF
16K RAM	S to T, R to P, EE to FF

The CRT positioning jumpers also very between the 50Hz and 60Hz models. Jumpers should be installed as described below. The Vertical and Horizontal Position jumpers are determined by the factory and depend on the frame rate and the monitor used.

The standard CRT jumper configurations for a 60 Hz computer are:

Vertical Frame Rate:

C to B

Vertical Position Adjustment:

D to E
K to L
J to H

Horizontal Position Adjustment:

V to W
CC to BB

The standard jumper configurations for a 50 Hz computer are as follows:

Vertical Frame Rate:

A to B

Vertical Position Adjustment:

D to E
M to L
G to H

Horizontal Position Adjustment:

V to W
CC to BB

There normally should be no need to change these jumper positions, however on some units the display may appear too far to the left. If this should occur, change the V to W jumper plug to W to X. This moves the display one character position to the right within the raster.

MODEL III I/O BUS

The Model III Bus was designed to allow easy and convenient interfacing of I/O devices to the Model III. The I/O Bus supports all the signals necessary to implement a device compatible with the Z-80s I/O structure. That is:

Addresses:

AØ to A7 allow selection of up to 256† input and 256 output devices if external I/O is enabled.

†Ports 8ØH to ØFFH are reserved for System use.

Data:

DBØ to DB7 allow transfer of 8-bit data onto the processor data bus if external I/O is enabled.

Control Lines:

a. IN* – Z-80 signal specifying that an input is in progress. Gated with IORQ.
b. OUT* – Z-80 signal specifying that an output is in progress. Gated with IORQ.
c. RESET* – system reset signal.
d. IOBUSINT* – input to the CPU signaling an interrupt from an I/O Bus device if I/O Bus interrupts are enabled.
e. IOBUSWAIT* – input to the CPU wait line allowing I/O Bus device to force wait states on the Z-80 if external I/O is enabled.
f. EXTIOSEL* – input to CPU which switches the I/O Bus data bus transceiver and allows an INPUT instruction to read I/O Bus data.
g. M1* – and IORQ* – standard Z-80 signals . . . .

The address line, data line, and control lines a to c and e to g are enabled only when the ENEXIO bit in EC is set to a one.

To enable I/O interrupts, the ENIOBUSINT bit in the CPU IOPORT EØ (output port) must be a one. However, even if it is disabled from generating interrupts, the status of the IOBUSINT* line can still read on the appropriate bit of CPU IOPORT EØ (input port).

See Model III Port Bit assignment for ports ØFF, ØEC, and ØEØ on pages 21 and 22.

The Model III CPU board is fully protected from "foreign I/O devices" in that all the I/O Bus signals are buffered and can be disabled under software control. To attach and use an I/O device on the I/O Bus, certain requirements (both hardware and software) must be met.

For input port device use, you must enable external I/O devices by writing to port ØECH with bit 4 on in the user software. This will enable the data bus address lines and control signals to the I/O Bus edge connector. When the input device is selected, the hardware will acknowlege by asserting EXTIOSEL* low. This switches the data bus transceiver and allows the CPU to read the contents of the I/O Bus data lines. See Figure 3 for the timing. EXTIOSEL* can be generated by NANDing IN and the I/O port address.

Output port device use is the same as the input port device in use, in that the external I/O devices must be enabled by writing to port ØECH with bit 4 on in the user software – in the same fashion.

For either input or output devices, the IOBUSWAIT* control line can be used in the normal way for synchronizing slow devices to the CPU. Note that since dynamic memories are used in the Model III, the wait line should be used with caution. Holding the CPU in a wait state for 2 msec or more may cause loss of memory contents since refresh is inhibited during this time. It is recommended that the IOBUSWAIT* line be held active no more than 500 μsec with a 25% duty cycle.

The Model III will support Z-80 mode 1 interrupts. A RAM jump table is supported by the LEVEL II BASIC ROMs and the user must supply the address of his interrupt service routine by writing this address to locations 4Ø3E and 4Ø3F. When an interrupt occurs, the program will be vectored to the user supplied address if I/O Bus interrupts have been enabled. To enable I/O Bus interrupts, the user must set bit 3 of Port ØEØH.

Input or Output Cycles.

"Inserted by Z80 CPU

Input or Output Cycles with Wait States.

"Inserted by Z80 CPU

†Coincident with IORQ* only on INPUT cycle.

FIGURE 3. I/O BUS TIMING DIAGRAM

MODEL III PORT BITS

Name: WRNMIMASKREG*
Port Address: ØE4H
Access: WRITE ONLY

Bit 7 = ENINTRQ; Ø disables Disk INTRQ from generating an NMI.
1 enables above.

Bit 6 = ENDRQ; Ø disables Disk DRQ from generating an NMI.
1 enables above.

Name: RDNMISTATUS*
Port Address: ØE4H
Access: READ ONLY

Bit 7 = Status of Disk INTRQ; 1 = False, Ø = True

Bit 6 = Status of Disk DRQ; 1 = False, Ø = True

Bit 5 = Reset* Status; 1 = False, Ø = True

Name: MOD OUT
Port Address: ØECH
Access: WRITE ONLY

Bit 7 = Undefined

Bit 6 = Undefined

Bit 5 = DISWAIT; Ø disables video waits, 1 enables

Bit 4 = ENEXTIO; Ø disables external IO Bus, 1 enables

Bit 3 = ENALTSET; Ø disables alternate character set,
1 enables alternate video character set.

Bit 2 = MODSEL; Ø enables 64 character mode,
1 enables 32 character mode.

Bit 1 = CASMOTORON; Ø turns cassette motor off,
1 turns cassette motor on.

Bit Ø = Undefined

Name: RDINTSTATUS*
Port Address: ØEØH
Access: READ ONLY

NOTE: A Ø indicates the device is interrupting.

Bit 7 = Undefined

Bit 6 = RS-232 ERROR INT

Bit 5 = RS-232 RCV INT

Bit 4 = RS-232 XMIT INT

Bit 3 = IOBUS INT

Bit 2 = RTC INT

Bit 1 = CASSETTE (1500 Baud) INT F

Bit Ø = CASSETTE (1500 Baud) INT R

Name: CASOUT*
Port Address: ØFFH
Access: WRITE ONLY

Bit 7 = Undefined

Bit 6 = Undefined

Bit 5 = Undefined

Bit 4 = Undefined

Bit 3 = Undfined

Bit 2 = Undefined

Bit 1 = Cassette output level

Bit Ø = Cassette output level

Name: WRINTMASKREG*
Port Address: ØEØH
Access: WRITE ONLY

Bit 7 = Undefined

Bit 6 = ENERRORINT; 1 enables RS-232 interrupts on parity error, framing error, or data overrun error.
Ø disable above.

Bit 5 = ENRCVINT; 1 enables RS-232 receive data register full interrupts,
Ø disables above.

Bit 4 = ENXMITINT; 1 enables RS-232 transmitter holding register empty interrupts,
Ø disables above.

Bit 3 = ENIOBUSINT; 1 enables I/O Bus interrupts,
Ø disables the above.

Bit 2 = ENRTC; 1 enables real time clock interrupt,
Ø disables above.

Bit 1 = ENCASINTF; 1 enables 1500 Baud falling edge interrupt,
Ø disables above.

Bit Ø = ENCASINTR; 1 enables 1500 Baud rising edge interrupt,
Ø disables above.

Name: CAS IN*
Port Address: ØFFH
Access: READ ONLY

Bit 7 = 500 Baud Cassette bit

Bit 6 = Undefined

Bit 5 = DISWAIT (See Port ØECH definition)

Bit 4 = ENEXTIO (See Port ØECH definition)

Bit 3 = ENALTSET (See Port ØECH definition)

Bit 2 = MODSEL (See Port ØECH definition)

Bit 1 = CASMOTORON (See Port ØECH definition)

Bit Ø = 1500 Baud Cassette bit

NOTE: Reading Port ØFFH clears the 1500 Baud Cassette interrupts.

Name: DRVSEL*
Port Address: ØF4H
Access: WRITE ONLY

Bit 7 = FM*/MFM; Ø selects single density,
1 selects double density.

Bit 6 = WSGEN; Ø = no wait states generated,
1 = wait states generated.

Bit 5 = PRECOMP; Ø = no write precompensation,
1 = write precompensation enabled.

Bit 4 = SDSEL; Ø selects side Ø of diskette,
1 selects side 1 of diskette.

Bit 3 = Drive select 4

Bit 2 = Drive select 3

Bit 1 = Drive select 2

Bit Ø = Drive select 1

FIGURE 4. CPU PRINTED CIRCUIT BOARD — COMPONENT SIDE

FIGURE 4. CPU PRINTED CIRCUIT BOARD — CIRCUIT SIDE

CPU MODULE PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	CAPACITORS		
C1	47pF, Ceramic Disc	830-0474	ACC470QJCP
C2	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C22	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C23	4.7μF, 16V, Electrolytic, Radial	832-5471	ACC4752DAP
C24	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C44	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C45	4.7μF, 16V, Electrolytic, Radial	832-5471	————
C46	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C53	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C54	22μF, 16V, Electrolytic, Radial	832-6221	————
C55	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C56	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C57	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C58	4700pF, Ceramic Disc	830-2473	————
C59	0.0047μF, Ceramic Disc	———	————
C60	33μF,	832-6331	ACC336QDAP
C61	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C71	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C72	4.7μF, 16V, Electrolytic, Radial	832-5471	ACC4752DAP
C73	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C79	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C80	33pF, Ceramic Disc	830-0334	ACC330QJCP
C81	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C82	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C83	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C84	0.001μF, Ceramic Disc	830-2104	ACC102QJCP
C85	0.001μF, Ceramic Disc	830-2104	ACC102QJCP
C86	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
↓	↓	↓	↓
C90	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C91	200pF, Ceramic Disc	830-1204	ACC201QJCP
C92	0.1μF, 50V, Monolithic	838-4104	ACC104QJAP
C93	4700pF, Ceramic Disc	830-2474	————
C94	0.1μF, Ceramic Disc	830-4104	ACC104QJAP
C95	0.01μF, Ceramic Disc	830-3104	ACC103QJCP

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
C96	0.1μF, 50V, Monolithic	830-4104	ACC104QJAP
↓	↓	↓	↓
C101	0.1μF, 50V, Monoithic	830-4104	ACC104QJAP
C102	10μF, Electrolytic, Radial	832-6101	ACC106QDAP
C103	10μF, Electrolytic, Radial	832-6101	ACC106QDAP
C104	0.1μF, 50V, Monolithic	830-4104	ACC104QJAP
C105	0.1μF, 50V, Monolithic	830-4104	ACC104QJAP
C106	0.01μF, Ceramic Disc	830-3104	ACC103QJCP
C107	27pF, Ceramic Disc	830-0274	————
C108	220pF, 50V, Z5P, Ceramic Disc	830-1223	ACC101QJCP
C109	100pF, 50V, Ceramic Disc	830-1104	ACC101QJCP
C110	100pF, 50V, Ceramic Disc	830-1104	ACC101QJCP
C111	0.022μF, Ceramic Disc	830-3224	————
↓	↓	↓	↓
C115	0.022μF, Ceramic Disc	830-3224	————
C116	100pF, 50V, Ceramic Disc	830-1104	ACC101QJCP
C117	0.022μF, Ceramic Disc	830-3224	————
C118	0.022μF, Ceramic Disc	830-3224	————
C119	0.022μF, Ceramic Disc	830-3224	————
C120	180pF, Ceramic Disc	830-1184	————
C121	220pF, Ceramic Disc	830-1223	————
C122	27pF, Ceramic Disc	830-0274	ACC470QJCP
C123	220pF, Ceramic Disc	830-1223	————
C124	0.022μF, Ceramic Disc	830-3224	————
C125	100pF, 50V, Ceramic Disc	830-1104	————
C126	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C127	0.022μF, Ceramic Disc	830-3224	————
C128	100pF, 50V, Ceramic Disc	830-1104	ACC0130QJCP
C129	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C130	0.022μF, Ceramic Disc	830-3224	————
↓	↓	↓	↓
C136	0.022μF, Ceramic Disc	830-3224	————
C137	220pF, Ceramic Disc	830-1223	————
C138	Not Used	———	————
↓	↓	↓	↓
C199	Not Used	———	————
C200	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C201	10μF, 16V, Electrolytic, axial	831-6101	————
C202	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
↓	↓	↓	↓
C207	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C208	10μF, 16V, Electrolytic, axial	831-6101	————
C209	10μF, 16V, Electrolytic, axial	831-6101	————
C210	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C211	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C212	10μF, 16V, Electrolytic, axial	831-6101	————
C213	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C214	10μF, 16V, Electrolytic, axial	831-6101	————
C215	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP
C216	10μF, 16V, Electrolytic, axial	831-6101	————
C217	10μF, 16V, Electrolytic, radial	832-6101	ACC106QDAP

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
C218	68pF, Ceramic Disc	830-0684	ACC680QJCP
C219	68pF, Ceramic Disc	830-0684	ACC680QJCP
C220	68pF, Ceramic Disc	830-0684	ACC680QJCP
	CONNECTORS		
J3	Right Angle Header Connector	851-9091	AJ6978
J4	4-pin Header Connector	851-9079	AJ6997
J5	6-pin Header Connector	851-9103	AJ6980
J6	20 position	851-9086	AJ6848
J7	20 position, straight connector	851-9101	AJ6979
J8	20 position, straight connector	851-9101	AJ6979
JP1A	DIP Strip, 8-position	851-9105	AJ6981
JP1B	DIP Strip, 8-position	851-9105	AJ6981
JP2A	DIP Strip, 8-position	851-9105	AJ6981
JP2B	DIP Strip, 8-position	851-9105	AJ6981
	CRYSTAL		
Y1	10.1376 MHz	840-9007	--------
	DIODES		
CR1	1N982	815-0982	ADX1103
CR2	1N982	815-0982	ADX-1103
CR3	1N4148	815-0148	ADX-1152
↓	↓	↓	↓
CR9	1N4148	815-0148	ADX-1152
	FERRITE BEADS		
L1	#2643000301	841-9014	--------
FB1	#2673000701	841-9019	--------
FB2	#2673000701	841-9019	--------
FB3	#2673000701	841-9019	--------
	INTEGRATED CIRCUITS		
U1	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558
U2	74LS04, Hex Inverter	802-0004	AMX3552
U3	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558
U4	74LS157, Quad 1-of-2 Data Selecter	802-0157	AMX3563
U5	74LS93, Binary (÷16) Counter	802-0093	AMX3560
U6	74LS10, Tripe 3-input NAND gate	802-0010	AMX3898
U7	416, RAM	804-1016	AXX3021
↓	↓ 4116	↓	↓
U14	416, RAM	804-1016	AXX3021
U15	74LS132, Quad 2-input NAND	802-0132	AMX3561
U16	74LS00, Quad 2-input NAND gate	802-0000	AMX3550
U17	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
U18	74LS00, Quad 2-input NAND gate	802-0000	AMX3550
U19	74LS08, Quad 2-input AND gate	802-0008	AMX3698
U20	74LS393,	802-0393	AMX3706
U21	74LS11, Triple 3-input AND gate	802-0011	AMX3554
U22	74LS246,	802-0266	————————
U23	74LS221, Dual One-Shot with Schmitt Trigger input	802-0221	AMX3810
U24	74157, Quad 2-Line to 1-Line Data Selecter/Multiplexer	802-0157	AMX3563
U25	416, RAM	804-1016	AXX3021
↓	↓	↓	↓
U32	416, RAM	804-1016	AXX3021
U33	74LS04, Hex Inverter	802-0004	AMX3552
U34	74LS05, Hex Inverter with Open Collecter	802-0005	AMX3553
U35	74LS05, Hex Inverter with Open Collecter	802-0005	AMX3553
U36	MCM68A316E, Character Generator	804-4316	AXX3040
U37	74LS00, Quad 2-input NAND gate	802-0000	AMX3550
U38	74LS266, Quad Exclusive NOR gate with Open Collecter Outputs	802-0266	AMX4660
U39	74LS08, Quad 2-input AND gate	802-0008	AMX3698
U40	74LS138, Decoder/De-multiplexer	802-0138	AMX4583
U41	74LS138, Decoder/De-multiplexer	802-0138	AMX4583
U42	74157, Quad 2-Line to 1-Line Data Selecter/Multiplexer	802-0157	AMX3563
U43	416, RAM	804-1016	AXX3021
↓	↓	↓	↓
U50	416, RAM	804-1016	AXX3021
U51	MC14050B	803-0050	AMX4584
U52	74LS166, 8-bit Parallel In/Serial Out Shift Register	802-0166	AMX3564
U53	74LS244, Line Driver	802-0244	AMX3864
U54	74LS153, Dual 4-line to 1-line Data Selecter/Multiplexer	802-1053	AMX3562
U55	74LS175, Hex/Quad "D" Flip-Flop with Clear	802-0175	AMX3566
U56	74LS393	802-0393	AMX3706
U57	74LS02, Quad 2-input NOR gate	802-0002	AMX3551
U58	74LS139, Decoder/De-multiplexer	802-0139	AMX3800
U59	74LS32, Quad 2-input OR gate	802-0032	AMX3557
U60	74LS145, BCD/Decimal Decoder/Driver	802-0145	AMX4659
U61	74LS175, Hex/Quad "D" Flip-Flop	802-0175	AMX3566
U62	74LS90, Decade, (÷12), Binary Counter	802-0090	AMX3804
U63	8T26, Bus Transceiver	806-0026	AMX4261
U64	8T26, Bus Transceiver	806-0026	AMX4261

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
U65	MC14050B	803-0050	AMX4584
U66	74LS240, Octal Buffer	802-0240	AMX4225
U67	74LS245	802-0245	AMX4470
U68	74LS273	802-0273	AMX4227
U69	74LS157, Quad 2-line to 1-line Data Selector/Multiplexer	802-0157	AMX3563
U70	74LS157, Quad 2-line to 1-line Data Selector/Multiplexer	802-0157	AMX3563
U71	74LS157, Quad 2-line to 1-line Data Selector/Multiplexer	801-0157	AMX3563
U72	74LS30, 8-input NAND gate	802-0030	AMX3556
U73	74LS27, Triple 3-input NOR gate	802-0027	AMX4658
U74	74LS04, Hex Inverter Quad 2-input	802-0004	AMX3552
U75	74LS08, Quad 2-input AND gate	802-0008	AMX3698
U76	74LS367, Tri-State Hex Buffer	802-0367	AMX3567
U77	Z-80, CPU	804-7080	AMX3586
U78	74LS74, Dual "D" Flip-Flop Positive Edge Triggered	802-0074	AMX3558
U79	MC1741, Operational Amplifier	805-0741	AMX4258
U80	MC1458	805-0458	AMX4661
U81	MCM2114, RAM	804-0004	AXX3038
U82	MCM2114, RAM	804-0004	AXX3038
U83	74LS74, Dual "D" Flip-Flop Positive Edge Triggered	802-0074	AMX3558
U84	74LS367, Tri-State Hex Buffer	802-0367	AMX3567
U85	74LS74, Dual "D" Flip-Flop Positive Edge Triggered	802-0074	AMX3558
U86	74LS32, Quad 2-input OR gate	802-0032	AMX3557
U87	74LS04, Hex Inverter	802-0004	AMX3552
U88	74LS38, Quad 2-input NAND Buffer with Open Collector Outputs	802-0038	AMX4328
U89	74LS32, Quad 2-input OR gate	802-0032	AMX3557
U90	74LS245	802-0245	AMX4470
U91	74LS244, Line Driver	802-0244	AMX3864
U92	74LS244, Line Driver	802-0244	AMX3864
U93	Not Used	———	———
U94	74LS273, Octal "D" Flip-Flop	802-0273	AMX4227
U95	74LS244, Line Driver	802-0244	AMX3864
U96	LM339	805-0339	AMX4200
U97	MC75452	805-0452	AMX3573
U98	74LS174, Hex Quad "D" Flip-Flop	802-0174	AMX3565
U99	74LS244, Line Driver	802-0244	AMX3864
U100	74LS174, Hex Quad "D" Flip-Flop	802-0174	AMX3565
U101	74LS245	802-0245	AMX4470
U102	74LS244, Line Driver	802-0244	AMX3864
U103	74LS367, Tri-State Hex Buffer	802-0367	AMX3567
U104	ROM A, MCM364	804-1364	AXX3039
U105	ROM B, MCM332	804-0332	AXX3037
U106	ROM C, MCM68A	804-0316B	AMX4642
U107	74LS32, Quad 2-input OR gate	802-0032	AMX3557
U108	74LS10, Triple 3-input NAND gate	802-0010	AMX3898

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	RESISTORS		
R1*	910 ohm, ¼W, 5%, Carbon Film	820-7191	AN0192EEC
R2	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R3	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R4	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R5*	910 ohm, ¼W, 5%, Carbon Film	820-7191	AN0192EEC
R6	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R7	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R8	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R9	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R10	2.7K, ¼W, 5%, Carbon Film	820-7227	AN0224EEC
R11	470 ohm, ¼W, 5%, Carbon Film	———	———
R12	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R13	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R14	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
R15	750 ohm, ¼W, 5%, Carbon Film	820-7175	———
R16	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R17	1.2K, ¼W, 5%, Carbon Film	820-7212	AN0199EEC
R18	22 ohm, ¼W, 5%, Carbon Film	820-7022	AN0078EEC
R19	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R20	220K, ¼W, 5%, Carbon Film	820-7422	AN0396EEC
R21	7.5K, ¼W, 5%, Carbon Film	820-7275	———
R22	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R23	7.5K, ¼W 5%, Carbon Film	820-7275	———
R24	220 ohm, ¼W, 5%, Carbon Film	820-7122	AN0149EEC
R25	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R26	82K, ¼W, 5%, Carbon Film	820-7382	———
R27	1.2K, ¼W, 5%, Carbon Film	820-7212	AN0199EEC
R28	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R29	75K, ¼W, 5%, Carbon Film	820-7375	———
R30	39K, ¼W, 5%, Carbon Film	820-7339	AN0330EEC
R31	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R32	220 ohm, ¼W, 5%, Carbon Film	820-7122	AN0149EEC
R33	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R34	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R35	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R36	100K, ¼W, 5%, Carbon Film	820-7410	AN0371EEC
R37	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R38	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R39	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R40	150 ohm, ¼W, 5%, Carbon Film	820-7115	AN0142EEC
R41	150 ohm, ¼W, 5%, Carbon Film	820-7115	AN0142EEC
R42	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R43	20K, ¼W, 5%, Carbon Film	820-7320	———
R44	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R45	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R46	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
R47	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
R48	51K, ¼w, 5%, Carbon Film	820-7351	AN0344EEC
R49	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
* May appear as 560 ohm		820-7156	

CPU MODULE PARTS LIST (cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
R50	4.7K, ¼W, 5%, Carbon Film	820-7247	AN0247EEC
R51	620K, ¼W, 5%, Carbon Film	820-7462	----------
R52	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
R53	8.2K, ¼W, 5%, Carbon Film	820-7282	AN0271EEC
R54	6.8K, ¼W, 5%, Carbon Film	820-7268	----------
R55	56K, ¼W, 5%, Carbon Film	820-7356	----------
R56	56K, ¼W, 5%, Carbon Film	820-7356	----------
R57	1.5M, ¼W, 5%, Carbon Film	820-7515	----------
R58	1K, ¼w, 5%, Carbon Film	820-7210	AN0196EEC
R59	15K, ¼W, 5%, Carbon Film	820-7315	AN0297EEC
R60	150 ohm, ¼w, 5%, Carbon Film	820-7115	AN0142EEC
R61	10K, ¼W, 5%, Carbon Film	820-7310	AN0281EEC
R62	220 ohm, ¼w, 5%, Carbon Film	820-7122	AN0149EEC
R63	4.7K, ¼w, 5%, Carbon Film	820-7247	AN0247EEC
R64	22K, ¼W, 5%, Carbon Film	820-7322	----------
R65	47 ohm , ¼W, 5%, Carbon Film	820-7047	AN0099EEC
R66	30 ohm, ¼W, 5%, Carbon Film	820-7030	----------
R67	Not Used	----------	----------
R68	Not Used	----------	----------
R69	220 ohm, ¼W, 5%, Carbon Film	820-7122	----------
RP1	27 ohm, Resistor Network	829-0009	----------
RP2	27 ohm, Resistor Network	829-0009	----------
RP3	27 ohm, Resistor Network	829-0009	----------
RP4	4.7K, Resistor Network	829-3247	----------
RP5	1.5K, Resistor Network	829-0015	----------
RP6	10K, Resistor Network	829-0010	----------
	RELAY		
K1	1 Form A, 5VDC	842-9102	AR8130
	TRANSISTORS		
Q1	2N3906	810-0906	AMX3584
VR1	MC7905C	805-1905	AMX4260
	MISCELLANOUS		
	Cable, 8-position, 3.75" (1)	845-9008	----------
	Cable, 8-position, 8.5" (1)	845-9108	AW2632
	Jumper Plugs (10)	851-9098	----------
	Socket, 40-pin (1)	850-9002	AJ6580
	Socket, 24-pin (4)	850-9001	AJ6579
	Socket, 20-pin (3)	850-9009	AJ6760
	Socket, 18-pin (2)	850-9006	AJ6701
	Socket, 16-pin (24)	850-9003	AJ6581

FIGURE 5. MODEL III CPU SCHEMATIC DIAGRAM — VIDEO AND HORIZONTAL SYNC. CIRCUITS

NOTES:

1. All capacitors are in micro farads and all resistors are in ohms unless otherwise noted.
2. On Revision F boards only, U62, pins 6 and 7 are connected and pin 6 is not at ground.

FIGURE 6. MODEL III CPU SCHEMATIC DIAGRAM – PROCESSOR SECTION

FIGURE 7. MODEL III CPU SCHEMATIC DIAGRAM – RAM SECTION

FIGURE 8. MODEL III CPU SCHEMATIC DIAGRAM – ADDRESS DECODING SECTION

FIGURE 9. MODEL III CPU SCHEMATIC DIAGRAM – VIDEO SECTION

FIGURE 10. MODEL III CPU SCHEMATIC DIAGRAM – KEYBOARD SECTION

FIGURE 11. MODEL III CPU SCHEMATIC DIAGRAM – CASSETTE INTERFACE SECTION

FIGURE 12. MODEL III CPU SCHEMATIC DIAGRAM – LINE PRINTER AND REAL TIME CLOCK SECTION

FIGURE 13. MODEL III CPU SCHEMATIC DIAGRAM – I/O BUS SECTION

FIGURE 14. MODEL III CPU SCHEMATIC DIAGRAM – RS-232-C INTERFACE AND FDC INTERFACE CONNECTORS

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SECTION IV

FLOPPY DISK INTERFACE

TECHNICAL DESCRIPTION

The TRS-80 Model III Floppy Disk Interface Board is an optional board which if incorporated provides a standard five inch floppy disk controller. The Floppy Disk Interface Board supports both single and double density encoding schemes. This feature, along with a special software package, allows the transfer of Model I disk files to the Model III system. This results in an upgrade to double density encoding for the Model III owner. Write precompensation can be software enabled or disabled beginning at any track, although the system software enables write precompensation for all tracks greater than twenty-one. The amount of write precompensation is continously variable from Ønsec to more than 500 nsec. The write precompensation is factory adjusted to 200 nsec. The data clock recovery logic incorporates a phase-locked loop oscillator which achieves state of the art reliablity. One to four drives may be controlled by the interface (two internal drives and two external). All data transfers are accomplished by CPU data requests. In double density operation, data transfers are synchronized to the CPU by forcing a wait to the CPU and clearing the wait by a data request from the FDC chip. The end of the data transfer is indicated by generating a non-maskable interrupt from the interrupt request output of the FDC chip. A hardware watchdog timer insures that error conditions will not hang the wait line to the CPU for a period long enough to destroy RAM contents.

CONTROL AND DATA BUFFERING

Refer to the Schematic Diagram.

The Floppy Disk Controller Board is an I/O port mapped device which utilizes ports E4H, F0H, F1H, F2H, F3H, and F4H. The decoding logic is implemented on the CPU board. (See the Decoding Logic section of the CPU discussion.) U4 of the Floppy Disk Controller Board is a non-inverting octal buffer which isolates and buffers the required control signals. Table 1 summarizes the port and bit allocation for the Floppy Controller Board. U2 of the Floppy Disk Controller Board is a bi-directional, 8-bit transceiver used to buffer data to and from the Floppy Controller Board. The direction of data transfer is controlled by the combination of control signals DISKIN* and RDNMIMASKREG*. If either signal is active (logic low), U2 is enabled to drive data onto the CPU board data bus. If both signals are inactive (logic high), U2 is enabled to receive data from the CPU data bus.

NONMASKABLE INTERRUPT LOGIC

A dual "D" flip-flop (U5) is used to latch data bits D6 and D7 on the rising edge of the control signal WRNMIMASREG*. The outputs of U5 control the conditions which will generate a non-maskable interrupt to the CPU. The NMI interrupt conditions are programmed by doing an OUT instruction to port E4H with the appropriate bits set. If data bit 7 is set, an NMI will be generated by an FDC interrupt request. If data bit 7 is reset, interrupt requests from the FDC are disabled. If data bit 6 is set, an NMI will be generated by Motor Time Out. If data bit 6 is reset, interrupts on Motor Time Out are disabled. An IN instruction from port E4H enables the CPU to question the Floppy Disk Controller Board to determine the source of the non-maskable interrupt. Data bit 7 indicates the status of FDC interrupt request (0 = true, 1 = false). Data bit 6 indicates the status of Motor Time Out (0 = true, 1 = false). Data bit 5 indicates the status of the front panel reset (0 = true, 1 = false). The control signal RDNMIMASKREG* when active (logic 0), gates this status onto the CPU data bus.

DRIVE SELECT LATCH AND MOTOR ON LOGIC

Selecting a drive prior to a disk I/O operation is accomplished by doing an OUT instruction to port F4H with the proper bit set. The following table describes the bit allocation of the Drive Select Latch.

DATA BIT	FUNCTION
D0	Selects Drive 0 when set *
D1	Selects Drive 1 when set *
D2	Selects Drive 2 when set *
D3	Selects Drive 3 when set *
D4	Side 0 selected when reset, Side 1 selected if set
D5	Write Precom. engaged when set, disabled if reset
D6	Generate waits if set, no waits if reset
D7	Selects MFM mode if set, FM mode if reset

*Only one of these bits should be set per output.

A hex "D" flip-flop (U6) latches the drive select bits, side select and FM*/MFM bits on the rising edge of the control signal IDRVSEL*. A dual "D" flip-flop (U18) is used to latch the Wait Enable and Precompensation enable bits on the rising edge of IDRVSEL*. The rising edge of IDRVSEL* also triggers a one-shot (1/2 of U15) which produces a Motor On to the disk drives. The duration of the Motor On signal is approximately two seconds. The spindle motors are not designed for continous operation, therefore the inactive state of the Motor On signal is used to clear the Drive Select Latch, which de-selects any drives which were previously selected. The Motor On one-shot is retriggerable by simply executing an OUT instruction to the Drive Select Latch.

WAIT STATE GENERATION AND WAITIMOUT LOGIC

As previously mentioned, a wait state to the CPU can be initiated by an output to the Drive Select Latch with D6 set. Pin 5 of U18 will go high after this operation. This signal is inverted by 1/6 of U1 and is routed to the CPU board where it forces the Z-80 into a wait state. The Z-80 will remain in the wait state as long as WAIT* is low. Once initiated, the wait state will remain until one of four conditions are satisfied. One half of U10 (a five input NOR gate) is used to perform this function. INTRQ, DRQ, RESET, and WAITIMOUT are the inputs to the NOR gate. If any one of these inputs are active (logic high), the output of the NOR gate (U10 pin 6) will go low. This output is tied to the clear input of the wait latch. This signal, when low, will clear the Q output (U18 pin 5) and set the Q* output (U18 pin 6). This condition causes WAIT* to go high and allows the Z-80 to exit the wait state. U20 is a 12-bit binary counter which serves as a watchdog timer to insure that a wait condition will not persist long enough to destroy dynamic RAM contents. The counter is clocked by a 1MHz signal and is enabled to count when its reset pin is low (U20 pin 11). A logic high on U20 pin 11 resets the counter ouputs. U20 pin 15 is the divide by 1024 output and is used to generate the signal WAITIMOUT. This watchdog timer logic will limit the duration of a wait to 1024μsec, even if the FDC chip fails to generate a data request or an interrupt request.

CLOCK GENERATION LOGIC

A 4MHz crystal oscillator and a divide by 2 and divide by 4 counter generate the clock signals required by the FDC board. The basic 4MHz oscillator is implemented with two invertors (1/3 of U25) and a quartz crystal (Y1). One half of U24 is used to divide the basic 4MHz clock by 2 to produce a 2MHz output at U24 pin 6. This output is again divided by 2 using the remaining half of U24 to produce a 1MHz output at U24 pin 8. The 1MHz clock is used to drive the clock input of the 1793 FDC chip and the clock input of the watchdog time (U20).

DISK BUS SELECTOR LOGIC

As mentioned previously, the Model III Floppy Disk Board supports up to four drives (two internal, two external). This function is implemented by using two disk drive interface buses, one for the internal drives and one for the external drives. J4 is the edge connector used for the internal drives and J1 is the edge connector for the external drives. U22 (a quad 2 to 1 data selector) is used to select which set of inputs from the disk drive buses are routed to the 1793 FDC chip. U22 pin 1 is the control pin for the data selector. If U22 pin 1 is low, the external inputs are selected, otherwise the internal inputs are selected. This control signal (labeled EXTSEL*) is derived from the outputs of the Drive Select Latch. If Drive 2 or Drive 3 is selected, U17 pin 1 will go low indicating that an external drive is selected. One half of U10 (a five input NOR gate) is used to detect when any of the four drives are selected. The output of this NOR gate (U10 pin 5) is inverted and is used as the head load timing and ready signal for the 1793 FDC chip. Therefore if any drive is selected, the head is assumed to be loaded and the selected drive is assumed to be ready.

READ/WRITE DATA PULSE SHAPING LOGIC

Two one-shots (1/2 of U15 and 1/2 of U23) are used to insure that the read and write data pulses are approximately 450nsec in duration.

DISK BUS OUTPUT DRIVERS

High current open collector drivers (U21, U9, and U1) are used to buffer the output signals from the Drive Select Latch and the FDC chip to the floppy disk drives. Note from the schematic that each output signal to the drives has two buffers associated with each signal, one set is used for the internal drive bus and the other set is used for the external bus. No select logic is required for these output signals since the drive select bits define which drive is active.

WRITE PRECOMPENSATION AND CLOCK RECOVERY LOGIC

The Write Precompensation and Read Clock Recovery logic is comprised of U11 (WD1691), U13 (WD2143) and U14 (LS629), along with a few passive components. The WD1691 is an LSI device which minimizes the external logic required to interface the 1793 FDC chip to a disk drive. With the use of an external VCO, U14, the WD1691 will derive the RCLK signal for the 1793, while providing an adjustment signal for the VCO, to keep the RCLK synchronous with the read data from the drive. Write precompensation control signals are also provided by the WD1691 to interface directly to the WD2143 (U13) clock generator. The Read Clock Recovery section of the WD1691 has five inputs: DDEN*, VCO, RDD*, WG, and VFOE*/WF. It also has three outputs: PU, PD*, and RCLK. The inputs VFOE*/WF and WG when both are low, enable the Clock Recovery logic. When WG is high, a write operation is in progress and the Clock Recovery circuits are disabled regardless of the state of any other inputs.

The Write Precompensation section of the WD1691 was designed to be used with the WD2143 clock generator. Write Precompensation is not used in single density mode and the signal DDEN* when high indicates this condition. In double density mode (DDEN* = 0), the signals EARLY and LATE are used to select a phase input (01 - 04) on the leading edge of WDIN. The STB line is latched high when this occurs, causing the WD2143 to start its pulse generation.

02 is used as the write data pulse on nominal (EARLY = LATE = 0), 01 is used for the early, and 03 is used for the late. The leading edge of 04 resets the STB line in anticipation of the next write data pulse. When TG43 = 0 or DDEN* = 1, precompensation is disabled and any transitions on the WDIN line will appear on the WDOUT line.

When VFOE*/WF and WG are low, the Clock Recovery circuits are enabled. When the RDD* line goes low, the PU or PD* signals will become active. If the RDD* has made its transition in the beginning of the RCLK window, PU will go from a high impedence state to a logic one, requesting an increase in VCO frequency. If the RDD* line has made it transition at the end of the RCLK window, PU will remain in the high impedence state while PD* will go to a logic zero, requesting a decrease in the VCO frequency. When the leading edge of RDD* occurs in the center of the RCLK window, both PU and PD* will remain in the high impedence state, indicating that no adjustment of the VCO frequency is required. By tying PU and PD* together, an adjustment signal is created which will be forced low for a decrease in VCO frequency and forced high for an increase in VCO frequency. To speed up rise times and stabilize the output voltage, a resistor divider using R7, R10, and R9 is used to adjust the tri-state level at approximately 1.4V. This adjustment results in a worst case voltage swing of plus or minus 1V, which is acceptable for the frequency control input of the VCO (U14). This signal derived from the combination of PU and PD* will eventually correct the VCO input to exactly the same frequency multiple as the FDD* signal. The leading edge of the RDD* signal will then occur in the exact center of the RCLK window, an ideal condition for the 1793 internal recovery circuits.

FLOPPY DISK CONTROLLER CHIP

The 1793 is an MOS LSI device which performs the functions of a floppy disk formatter/controller in a single chip implemetation. The 1793 is functionally identical to the 1791 used on the Model II FDC Printer Interface Board, except that the data bus is true as opposed to inverted. Refer to the appendix section for more information on the FD1793. The Model II Technical Reference Manual also contains a good presentation of the 1791 FDC chip as well as a discussion on Write Precompensation. The following port addresses are assigned to the internal registers of the 1793 FDC chip.

PORT #	FUNCTION
F0H	Command/Status Register
F1H	Track Register
F2H	Sector Register
F3H	Data Register

ADJUSTMENTS AND JUMPER OPTIONS

The Data Separator must be adjusted with the 1793 in an idle condition (no command currently in operation). Adjust R7 potentiometer for a 1.4V level on pin 2 of U14. Then adjust R6 potentiometer to yield a 2MHz square wave at pin 16 of U11.

The Write Precompensation must be adjusted while executing a continous write command on a track greater than twenty-one. Adjust R5 potentiometer to yield 200nsec wide pulses at pin 4 of U11. This results in a write precompensation value of 200nsec.

There are four jumper options on the Floppy Disk Controller Board. They are designated on the PC Board silkscreen and are referenced on the Schematic Diagram. The jumpers should be installed as described below.

JUMPER CONNECTIONS

A to B
E to G
L to M
H to J

FIGURE 1. FDC BOARD TO CPU BOARD SIGNAL DESCRIPTION

FIGURE 2. FLOPPY DISK INTERFACE PC BOARD – COMPONENT SIDE

FIGURE 2. FLOPPY DISK INTERFACE PC BOARD – CIRCUIT SIDE

FLOPPY DISK INTERFACE PC BOARD PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	CAPACITORS		
C1	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C2	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C3	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C4	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C5	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C6	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C7	75pF, 50V, ceramic disc	830-0754	————————
C8	33μF, 16V, electrolytic, radial	839-6331	ACC336QDAP
C9	100pF, 50V, ceramic disc	830-1104	ACC101QJCP
C10	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C11	0.47μF, 16V, mylar	835-4471	————————
C12	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C13	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C14	100pF, 50V, ceramic disc	830-1104	ACC101QJCP
C15	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C16	470pF, 50V, ceramic disc	830-1474	ACC471QJCP
C17	10μF, 16V, electrolytic, radial	832-6101	ACC106QDAP
C18	10μF, 16V, electrolytic, radial	832-6101	ACC106QDAP
C19	0.01μF, 16V, ceramic disc	830-3104	ACC103QJCP
C20	0.022μF, 50V, ceramic disc	830-3224	ACC223QJCP
↓	↓	↓	↓
C23	0.022μF, 50V, ceramic disc	830-3224	ACC223QJCP
C24	180pF, ceramic disc	830-1184	————————
C25	180pF, ceramic disc	830-1184	————————
C26	180pF, ceramic disc	830-1184	————————
C27	0.022μF, ceramic disc	830-3224	ACC223QJCP
C28	180pF, ceramic disc	830-1184	————————
C29	0.022μF, ceramic disc	830-3224	ACC223QJCP
C30	100pF, ceramic disc	830-1104	ACC101QJCP
	CONNECTORS		
J2	20 pos. right angle	851-9078	————————
J3	4 pin right angle header	851-9079	AJ6977
	CRYSTAL		
Y1	4 MHz	840-9010	AMX2804
	DIODES		
CR1	MZ4682	815-0682	ADX1518
	INTEGRATED CIRCUITS		
U1	7416, Hex Inverter/Buffer	800-0016	————————
U2	74LS245	802-0245	AMX4470
U3	74LS00, NAND gate	802-0000	AMX3550
U4	74LS244, Octal Buffer	802-0244	AMX3864
U5	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558

FLOPPY DISK INTERFACE PC BOARD PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	INTEGRATED CIRCUITS (cont'd)		
U6	74LS174, Quad "D" Flip-Flop	802-0174	AMX3565
U7	WD1793	850-9002	AXX3041
U8	74LS38, NAND Buffer	802-0038	AMX4328
U9	7416, Hex Inverter/Buffer	800-0016	----------
U10	74LS260, Dual NOR gate	802-0260	----------
U11	WD1691	850-9009	AMX4471
U12	MC140733, AND gate	803-0073	----------
U13	WD2143-01	850-9006	AMX4472
U14	74LS629. VCO	802-0629	AMX4663
U15	74LS123, Mono Multivibrator	802-0123	AMX3803
U16	74LS367, Hex Buffer	802-0367	AMX3567
U17	74LS02, NAND gate	802-0002	AMX3551
U18	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558
U19	74LS368, Hex Inverter/Buffer	802-0368	AMX3568
U20	MC14040B, Binary Counter	803-0040	AMX4666
U21	7416, Hex Inverter/Buffer	800-0016	----------
U22	74LS157, Quad Multiplexer	802-0157	AMX3563
U23	74LS123, Mono Multiplexer	802-0123	AMX3803
U24	74LS74, Dual "D" Flip-Flop	802-0074	AMX3558
U25	74LS04, Hex Inverter	802-0004	AMX3552
	RESISTORS		
R1	2.2K, 1/4W, 5%	820-7222	AN0216EEC
R2	150 ohm, 1/4W, 5%	820-7115	AN0142EEC
R3	150 ohm, 6 pin resistor network	829-0012	ARX0241
R4	2.2K, 1/4W, 5%	820-7222	AN0216EEC
R5	1K, Trim Pot	827-9210	AP0835
R6	50K, Trim Pot	827-9350	AP7168
R7	100K, Trim Pot	827-9410	----------
R8	10K, 1/4W, 5%	820-7310	AN0281EEC
R9	47K, 1/4W, 5%	820-7347	AN0340EEC
R10	47K, 1/4W, 5%	820-7347	AN0340EEC
R11	10K, 1/4W, 5%	820-7310	AN0281EEC
R12	10K, 1/4W, 5%	820-7310	AN0281EEC
R13	47 ohm, 1/4W, 5%	820-7047	AN0099EEC
R14	270K, 1/4W, 5%	820-7427	----------
R15	150 ohm, 10 pin resistor network	829-0013	ARX0242
R16	10K, 1/4W, 5%	820-7310	AN0281EEC
R17	910 ohm, 1/4W, 5%	820-7191	AN0192EEC
R18	910 ohm, 1/4W, 5%	820-7191	AN0192EEC
R19	2.2K, 1/4W, 5%	820-7222	AN0216EEC
R20	22K, 1/4W, 5%	820-7322	----------
	MISCELLANEOUS		
	Socket, 18 pin	850-9006	AJ6701
	Socket, 20 pin	850-9009	AJ6760
	Socket, 40 pin	850-9002	AJ6580
	FDC Board, complete assembly		AXX0510
	FDC Board, without major chips		AXX0509

NOTES:

1. All capacitor values are in micro-farads and all resistor values are in ohms unless otherwise stated.
2. On some boards, R5 may appear as a 1K resistor and R21 may appear as a 750 ohm resistor.

FIGURE 3. MODEL III FLOPPY DISK INTERFACE SCHEMATIC

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SECTION V

RS-232C CIRCUIT BOARD

RS-232C TECHNICAL DESCRIPTION

The RS-232C option board for the Model III computer supports asynchronous serial transmissions and conforms to the EIA RS-232C standards at the input - output interface (P1). The heart of the board is the TR1602 Asynchronous Receiver/Transmitter. It performs the job of converting the parallel byte date from the CPU to a serial data stream including start, stop, and parity bits. For a more detailed description of how this LSI circuit performs these functions, refer to the TR1602 data sheets and application notes. The transmit and receive clock rates that the TR1602 needs are supplied by the Baud rate generator (BR19411). This circuit takes the 5.0688 MHz supplied by the CPU board and the programmed information received from the CPU over the data bus and divides the basic clock rate to provide two clocks. The rates available from the BRG go from 50 Baud to 19200 Baud. See the BRG table for the complete list.

BRG PROGRAMMING TABLE

NIBBLE LOADED	TRANSMIT OR RECEIVE BAUD RATE	16X CLOCK FREQUENCY	SUPPORTED BY SETCOM
ØH	50	0.8 kHz	yes
1H	75	1.2 kHz	yes
2H	110	1.76 kHz	yes
3H	134.5	2.1523 kHz	yes
4H	150	2.4 kHz	yes
5H	300	4.8 kHz	yes
6H	600	9.6 kHz	yes
7H	1200	19.2 kHz	yes
8H	1800	28.8 kHz	yes
9H	2000	32.081 kHz	yes
AH	2400	38.4 kHz	yes
BH	3600	57.6 kHz	yes
CH	4800	76.8 kHz	yes
DH	7200	115.2 kHz	yes
EH	9600	113.6 kHz	yes
FH	19,200	316.8 kHz	yes

The RS-232C board is a port mapped device and the ports used are E8 to EB. Following is a description of each port on both input and output.

PORT	INPUT	OUTPUT
E8	Modem status	Master Reset, enables UART control register load
EA	UART status	UART control register load and modem control
E9	Not Used	Baud rate register load enable bit
EB	Receiver Holding register	Transmitter Holding register

Interrupts are supported on the RS-232C option board by the Interrupt mask register (U10) and the Status register (U9) which allows the CPU to see which kind of interrupt has occurred. Interrupts can be generated on receiver data register full, transmitter register empty, and any one of the errors — parity, framing, or data overun. This allows a minumum of CPU overhead in transferring data to or from the UART. The interrupt mask register is port EØ (write) and the interrupt status register is port EØ (read). Refer to the IO Port description for a full breakdown of all interrupts and their bit positions.

The Model III RS-232C board is functionally identical to the Model I RS-232 board with the following exceptions: Interrupts are supported, there are no sense switches for configuring the interface, there is no COM/TERM switch for reversing the function of pins 2 and 3 on the DB-25, and the DC to DC converter is not required since +12V and -12V are provided by the internal power supply. Other differences include three additional interface outputs and no crystal for the BRG. All Model I software written for the RS-232 interface is compatable with the Model III RS-232C option board, provided that the software does not use the sense switches to configure the interface. The programmer can get around this problem by directly programming the BRG and UART for the desired configuration or by using the SETCOM command of the disk operating system to configure the interface. The TRS-80 RS-232C Interface hardware manual has a good discussion of the RS-232C standard and specific programming examples (Catalog Number 26-1145).

The following list is a pinout description of the DB-25 connector (P1).

PIN#	SIGNAL
1	PGND (Protective Ground)
2	TD (Transmit Data)
3	RD (Receive Data)
4	RTS (Request To Send)
5	CTS (Clear To Send)
6	DSR (Data Set Ready)
7	SGND (Signal Ground)
8	CD (Carrier Detect)
20	DTR (Data Terminal Ready)
22	RI (Ring Indicate)

PORT AND BIT ASSIGNMENTS

PORT E8H
OUTPUT: MASTER RESET
INPUT: MODEM STATUS REGISTER

An output to this port (and data), performs a master reset to the UART and enables the control register load enable bit. The following table details the bit definitions for an input from port E8H.

DATA BIT	FUNCTION
D7	Clear To Send, Pin 5 DB-25
D6	Data Set Ready, Pin 6 DB-25
D5	Carrier Detect, Pin 8 DB-25
D4	Ring Indicator, Pin 22 DB-25
D3	Not Used
D2	Not Used
D1	Not Used
DØ	Receiver Input, UART Pin 20 DB-25

PORT E9H
OUTPUT: BAUD RATE LOAD
INPUT: NOT USED

An output to this port loads the Baud rate generator with a code which corresponds to the desired receive and transmit Baud rate as outlined in the BRG Programming Table. The low order nibble of the data output to this port determines the receiver Baud rate, while the high order nibble determines the transmit Baud rate.

PORT EAH
OUTPUT: UART AND MODEM CONTROL
INPUT: UART STATUS

An output to this port loads the UART Control register if the enable bit for this function is set (D1 port E8H = 1). The UART Control register is five bits wide (D7 - D3) leaving three bits for modem control (D2 - DØ). Three more modem control bits were added by allowing software to enable or disable the UART Control register. The tables below summarize the bit allocations with the UART Control register enabled and disabled.

PORT EAH OUTPUT BITS WITH UART CONTROL REGISTER ENABLED

DATA BIT	FUNCTION
D7	Even Parity Enable, 1 = even, Ø = odd
D6	Word Length Select 1
D5	Word Length Select 2
D4	Stop Bit Select, 1 = two stop bits, Ø = one stop bit
D3	Parity Inhibit, 1 = disable parity
D2	Break Ø = disable transmit data (continous space)
D1	Data Terminal Ready, Pin 20 DB-25
DØ	Request To Send, Pin 4 DB-25

PORT EAH OUTPUT BITS WITH UART CONTROL REGISTER DISABLED

DATA BIT	FUNCTION
D7	Not Used
D6	Not Used
D5	Secondary unassigned, Pin 18 DB-25
D4	Secondary Transmit Data, Pin 14 DB-25
D3	Secondary Request To Send, Pin 19 DB-25
D2	Break Ø = disable Transmit Data (continous space)
D1	Data Terminal Ready, Pin 20 DB-25
DØ	Request To Send, Pin 4 DB-25

PORT EAH INPUT BITS

DATA BITS	FUNCTION
D7	Data Received, 1 = condition true
D6	Transmitter Holding register empty, 1 = condition true
D5	Overrun error, 1 = condition true
D4	Framing error, 1 = condition true
D3	Parity error, 1 = condition true
D2	Not Used
D1	Not Used
DØ	Not Used

PORT EBH
OUTPUT: TRANSMITTER HOLDING REGISTER
INPUT: RECEIVER HOLDING REGISTER

An output to this port loads the UART Transmitter Holding register with a word to be transmitted, as soon as the last word loaded in the holding register is transmitted. This register should never be loaded until the Transmitter Holding register empty bit (port EAH) is true. An input from this port reads the last word received from the UART received data holding register. This register should not be read until the data received bit (port EAH) is true.

FIGURE 1. RS-232 BOARD TO CPU BOARD SIGNAL DESCRIPTION

FIGURE 2. RS-232C PC BOARD – COMPONENT SIDE

FIGURE 2. RS-232C PC BOARD – CIRCUIT SIDE

RS-232C PC BOARD PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	CAPACITORS		
C1	10μF, 16V, radial (optional)	832-6101	ACC106QDAP
C2	10μF, 16V, radial (optional)	832-6101	ACC106QDAP
C3	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C4	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C5	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C6	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C7	0.1μF, 50V, monolithic, radial	838-4104	ACC104QJAP
C8	10μF, 16V, radial	832-6101	ACC106QDAP
C9	10μF, 16V, radial	832-6101	ACC106QDAP
	CONNECTORS		
P1	DB-25 Connector	851-9030	----------
P2	20 pos. right angle	851-9078	----------
P3	4 pos. right angle	851-9079	AJ6977
	INTEGRATED CIRCUITS		
U1	BR1941-L, Dual Baud C	804-6941	AMX3921
U2	TR1602B, UART	804-5602	AMX3865
U3	74LS244, Octal Buffer	802-0244	AMX3864
U4	74LS367, Hex Buffer	802-0367	AMX3567
U5	74LS367, Hex Buffer	802-0367	AMX3567
U6	74LS174, Quad "D" Flip-Flop	802-0174	AMX3565
U7	7404, Hex Inverter	-----	AMX3655
U8	74LS139, Dual Decoder	802-0139	AMX3800
U9	74LS368, Hex Buffer	802-0368	AMX3568
U10	74LS174, Quad "D" Flip-Flop	802-0174	AMX3565
U11	MC1489, Quad Line Driver	805-0189	AMX3868
U12	MC1488, Quad Line Driver	805-0188	AMX3867
U13	74LS27, NOR gate	802-0027	----------
U14	74LS38, NAND Buffer	802-0038	AMX4328
U15	MC1489, Quad Line Driver	805-0189	AMX3868
U16	MC1488, Quad Line Driver	805-0188	AMX3867
	RESISTORS		
R1	4.7K, 1/4W, 5%	820-7247	AN0247EEC
R2	4.7K, 1/4W, 5% (optional)	820-7247	AN0247EEC
R3	6.2K, 1/4W, 5% (optional)	-----	AMX4658
R4	4.7K, 1/4W, 5%	820-7247	AN0247EEC
	MISCELLANEOUS		
	Cable, 20 pos., 4.5", flat	845-9020	AW2631
	Socket, 18 pin	850-9006	AJ6701
	Socket, 40 pin	850-9002	AJ6580

FIGURE 3. MODEL III RS-232C SCHEMATIC DIAGRAM

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SECTION VI

POWER SUPPLY

GENERAL

The power supply used in the Model III is a switch mode power supply utilizing the flyback method of power conversion. This supply has built-in EMI filter and has over-voltage and over-current protection as well as regulation over line and load variations.

THEORY OF OPERATION

PRIMARY

Power is taken from a 115 volt AC line. A UL approved fusable resistor, R25, limits inrush current as well as acting as a system fuse. The AC current is taken through an EMI filter which suppresses power supply and system noise that would otherwise be reflected back into the power lines.

After the EMI filter, the signal goes to a full-wave bridge rectifier (DB1) then into a capacitive input filter. The combination of these last two items produces a 165 volt DC B+ line from which is run a DC-DC converter.

The DC-DC converter consists of a transistor (Q2) which is used to chop the B+ line at approcimately 20 kHz. D2, R9, C8, C9, and D3 are all part of a snubber network designed to protect Q2 as well as supress ringing which would contribute to line conducted EMI.

SECONDARY

When the power transistor (Q2) is 'ON', energy is stored in the core of the power transformer (T2). The secondary windings are polarized so that the output rectifiers do not conduct while Q2 is ON. When Q2 turns 'OFF', it causes the transformer to 'flyback' which causes the polarity on the output windings of T2 to reverse, allowing the output rectifiers to conduct and deliver energy to the output and output capacitors.

A pi-filter consisting of capacitors on either side of a series filter choke is used to smooth the output waveform, deliver energy during the ON time, and reduce ripple.

FEEDBACK AND CONTROL

On this power supply the only regulated voltage is the +5 volt output. The +12 volt and -12 volt outputs are simply additional secondary windings stacked on top of the +5 volt winding. They track the +5 voltage close enough to provide sufficient regulation to run the circuitry requiring +12 or -12 volts.

The +5 volt output is fed into an error amplifier which compares it to a reference voltage. The output of this amplifier is fed into a control circuit which is magnetically coupled through T1 to the turn-off circuit. This output also controls the ON time of Q2 providing voltage regulation by variations of the duty-cycle.

OVERVOLTAGE PROTECTION

If a failure in the power supply causes the outputs to rise uncontrolled past a specified voltage limit, the power supply will automatically shut down. This is done by sensing the +5 volt output via a Zener diode. When the voltage limit is reached, the SCR is triggered and shorts the +12 volt output to ground. A short on any output will cause the supply to foldback and shut down.

POWER SUPPLY COMPONENT VALUES

SYMBOL	DESCRIPTION
	CAPACITORS
C1	2200pF, 250VAC, metallized paper
C2	0.01μF, 1KV, ceramic
C3	2200pF, 250VAC, metallized paper
C4	0.22μF, 100V, polyester
C5	47μF, 250V, electrolytic
C6	100μF, 250V, electrolytic
C7	220μF, 10V, electrolytic
C8	4500pF, 1KV, ceramic
C9	0.01μF, 1KV, ceramic
C10	0.22μF, 100V, polyester
C11	1000μF, 25V, electrolytic
C12	1000μF, 25V, electrolytic
C13	1000μF, 25V, electrolytic
C14	330μF, 16V, electrolytic
C15	2200μF, 16V, electrolytic
C16	330μF, 16V, electrolytic
C17	470μF, 25V, electrolytic
C18	0.022μF, 50V, polyester
C19	0.22μF, 100V, polyester
C20	3900pF, 400VAC, ceramic
C21	0.1μF, 250VAC, metallized
	DIODES
D1	RGP10A, rectifier
D2	RGP10D, rectifier
D3	RGP10J, rectifier
D4	Rectifier assembly
D5	Rectifier assembly
D6	Rectifier assembly
D7	RGP15B, rectifier
D8	1N4606, silicon
D9	1N4606, silicon
D10	1N4606, silicon
DB1	W06, bridge rectifier
Z1	5.6V, 5%, 1W, zener
	INDUCTORS
L1	Common mode choke assembly
L2	Base choke
L3	1.5mH, choke
L4	Choke coil assembly
L5	Choke coil assembly
L6	Choke coil
	INTEGRATED CIRCUIT
IC1	Regulator
	RESISTORS
R1	47 ohm, 5%, metal oxide film
R2	150K, 5%, carbon film
R3	1K, 5%, carbon film
R4	Not used
R5	82 ohm, 5%, carbon film
R6	27 ohm, 5%, carbon film
R7	3.3 ohm, 5%, carbon film
R8	10 ohm, 5%, carbon film
R9	27 ohm, 5%, metal oxide film
R10	75 ohm, 5%, 1W, metal film
R11	270 ohm, 5%, carbon film
R12	82 ohm, 5%, carbon film
R13	270 ohm, 5%, carbon film
R14	8.2 ohm, 5%, carbon film
R15	560 ohm, 5%, carbon film
R16	56 ohm, 5%, carbon film
R17	56 ohm, 5%, carbon film
R18	12K, 5%, carbon film
R19	12 ohm, 5%, carbon film
R20	470 ohm, 5%, carbon film
R21	2.7K, 2%, metal film
R22	2.7K, 2%, metal film
R23	68K, 5%, carbon film
R24	220 ohm, 5%, 1W, metal oxide film
R25	2 ohm, 5%, fusing metal film
R26	22K, 5%, carbon film
SCR1	SCR C122F
	TRANSFORMERS
T1	Control assembly
T2	Power assembly
	TRANSISTORS
Q1	PE8050B
Q2	Transistor assembly
Q3	PE8550B

FIGURE 1. POWER SUPPLY SCHEMATIC DIAGRAM

SECTION VII

VIDEO MONITOR

FUNCTIONAL SPECIFICATIONS

The video monitor is a 12-inch solid state monitor designed for display of alphanumeric dot characters. The monitor is designed for a 12-volt DC power input with an average power consumption of 12 watts. The monitor accepts separate video, and vertical drive TTL level inputs.

SPECIFICATIONS

Cathode Ray Tube:	12" diagonal, 90° deflection angle, 4 x 5 aspect ratio, P4 phosphor, integral implosion protection.
Enviroment:	Operating Temperature: 41°F to 131°F (5°C to 55°C) ambient Humidity: 95% non-condensing at 41°F to 104°F (5°C to 40°C) Operating Altitude: 10,000 ft. (3046 meters) maximum
Power Input:	+12 VDC at 1 amp nominal
TTL Level Input Signals:	4 volts ± 1.5 volts Horizontal: 4 to 25μsec, positive going Vertical: 100 to 1400μsec, negative going Video: positive white
Video Response:	Bandwidth: 15 MHz, 3 dB Pulse rise time less than 30nsec
Scanning Frequency:	Horizontal: 15,600 Hz ± 500 Hz Vertical: 50/60 Hz
Horizontal Retrace:	10.5μsec maximum
Vertical Retrace:	850μsec maximum

FIGURE 1. VIDEO MONITOR PRINTED CIRCUIT BOARD

SERVICE ADJUSTMENTS

NOTE: Measurements should be made using 12.0 VDC input. Measurements with kine (CRT) attached will require the ground strap from kine be connected to chassis to prevent transistor failures in the event of kine arcing.

FOCUS

Adjust focus control F524 (Figure 1, Zone 2-A) for best overall focus.

VERTICAL SIZE

Adjust vertical size control R617 (Figure 1, Zone 3-B) to produce vertical scan of approximately 6 inches.

HORIZONTAL LINEARITY

Loosen deflection yoke clamp and slide linearity sleeve forward or backward to equalize character spacing on left side of to match character spacing on right side of screen (See Figure 2 for location of linearity sleeve).

WIDTH

Note: Check horizontal linearity prior to width adjustment. Adjust width control to produce horizontal scan of approximately 8 inches.

CENTERING

Adjust centering rings on deflection yoke assembly to center display on screen top to bottom and left to right.

HORIZONTAL HOLD

Horizontal Hold is accomplished by adjustment of the horizontal oscillator coil (Figure 1, Zone 4-D).

FIGURE 2. DEFLECTION YOKE ASSEMBLY

REPLACEMENT PARTS

PRODUCT SAFETY NOTE—Components marked with a (★) have special characteristics important to safety. Replacement of components marked with a (★) with anything other than the manufacturer's recommended replacement part may result in a safety hazard. Do not degrade the safety of the set through improper servicing or parts replacement.

SYMBOL NO.	STOCK NO.	DRAWING NO.		DESCRIPTION
				VIDEO MONITOR KIT
				KTR-131
				CHASSIS ASSEMBLY
				VDC-1
				CAPACITORS
C301	146763	1442134-66		.1 uf 10% 100V film
C302	147957	1491407-12m		220 pf 10% 50V Z5P disc
C303	137583	945304-125		.01 uf 20% 1000V disc
C501	145315	1491408-52m		2700 pf 10% 50V Z5P disc
C502	143879	1491407-91m		1000 pf 20% 50V Z5P disc
C503	134778	1472442-69		.033 uf 10% 100V film
C504	126425	1472442-66		.018 uf 10% 200V film
C505	142023	942966-224		36 pf 5% 500V N750 disc
C506	141028	1446666-151		5.6 uf 20V electrolytic
C507	134778	1472442-69		.033 uf 10% 100V film
C508	146012	1472442-65		.015 uf 10% 200V film
C509	126343	1472442-68		.027 uf 10% 100V film
C510	139441	1472442-63		.01 uf 10% 200V film
C511	138891	973991-83	★	
C512	143879	1491407-91m		1000 pf 20% 50V Z5P disc
C513	137583	945304-125		.01 uf 20% 1kV disc
C514	425666	945304-159	★	
C515	425666	945304-159	★	
C516	143029	945304-154	★	
C517	146113	984655-38		1 uf 150V electrolytic
C518	146113	984655-38		1 uf 150V electrolytic
C519	148889	1490001-17		1 uf 350V electrolytic
C520	141002	945802-37		390 pf 10% 500V N1500 disc
C521	141285	1446667-481		56 uf 10% 50V electrolytic
C522	120832	1420193-63		1000 pf 10% 500V disc
C523	141432	1490306-541		470 uf 25V electrolytic
C524	141163	1490306-441		330 uf 25V electrolytic
C525	120832	1420193-63		1000 pf 10% 500V disc
C527	137583	945304-125		.01 uf 20% 1kV disc
C528	142776	1490304-561		4.7 uf 50V electrolytic
C603	143879	1491407-91m		1000 pf 20% 50V Z5P disc
C604	134778	1472442-69		.033 uf 10% 100V film
C605	139285	1446668-241		220 uf 15V electrolytic
C606	139285	1446668-241		220 uf 15V electrolytic
C607	145359	1472442-60		5600 pf 10% 200V film
C608	137331	1446657-321		47 uf 6V electrolytic
C609	139444	1472442-75		.1 uf 10% 100V film
C610	145307	984655-42		.68 uf 80V electrolytic
C611	104205	1420193-69		3300 pf 10% 500V disc
C702	145740	1491407-21m		270 pf 20% 50V Z5P disc
				DIODES
CR501	119597	1471872-6		Horiz AFC
CR502	119597	1471872-6		Horiz AFC
CR504	140972	1476171-34		Damper
CR505	140971	1476171-33		+12V run
CR506	142569	1476171-31		+10V rectifier
CR606	119597	1471872-10		Silicon
CR607	119597	1471872-6		Silicon
CR608	119597	1471872-6		Silicon
CR609	119597	1471872-6		Silicon
CR610	119597	1471872-6		Silicon
F101	148886	1479891-6	★	Fuse — 2 amp
				BEADS
FB501	119971	1443391-2		Ferrite
FB502	119971	1443391-2		Ferrite
FB503	119971	1443391-2		Ferrite
FB504	119971	1443391-2		Ferrite
FB505	119971	1443391-2		Ferrite
FB506	119971	1443391-2		Ferrite
FB601	116761	1443391-1	★	Ferrite
				COILS
L301	137224	973966-54		39 uf
L302	140080	973966-65		22 uh
L501	148888	1474738-3		Horiz. hold
L502	145567	1479981-502		Choke bead
L504	148887	1478648-4		Width
				TRANSISTORS
Q302	141295	1417362-3		Video out
Q501	148907	1417346-3		Horizontal oscillator
Q503	140977	1417335-1		Horizontal output
Q601	142711	1417306-8		Vertical integrator
Q602	132830	1471112-8		Vertical oscillator
Q603	132830	1471112-8		Pre amp
Q604	139268	1417318-2		Vertical driver
Q606	141008	1417349-2		Vertical output top
Q607	137340	1417303-1		Vertical output bottom
Q701	142711	1417306-7		Horizontal sync separator
				RESISTORS
R303	149441	993260-157		2200 ohm 5% 3W ww
R516	512510	90496-231		1 meg ohm 5% 1W
R517	830147	993273-389	★	
R519	146774	993273-337	★	
R520	830010	993273-349	★	
R522	830A68	993273-345	★	
R523	430227	993218-469		1 meg ohm 5% 1/4W
R524	139062	1473359-26		control focus
R526	140983	946023-332	★	
R527	830010	993273-349	★	
R609	830033	993273-361	★	
R612	148892	1496161-10		control vertical hold
R613	148893	993218-483		3.9 meg ohm 5% 1/4W
R617	149178	1473359-47		control vertical size
R703	147588	993218-173		1.5 meg ohm 10% 1/4W
T501	148908	1465974-505	★	Transformer — high voltage rectifier assembly
T502	146777	1479977-3		Transformer — horizontal driver
	121134	1442419-4		Clamp — yoke
	148349	1465916-513		Socket — kine assembly
	148894	1463734-506	★	Yoke — deflection
				PICTURE TUBE
		12VCLP4	★	Picture tube

FIGURE 3. VIDEO MONITOR ASSEMBLY SCHEMATIC DIAGRAM

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SECTION VIII

ILLUSTRATED PARTS CATALOG

FIGURE 1. OUTER CASE ASSEMBLY

FIGURE 2. CASE TOP ASSEMBLY

FIGURE 3. BASE PLATE ASSEMBLY

FIGURE 4. METAL CHASSIS ASSEMBLY

FIGURE 5. DISK DRIVE ASSEMBLY

ILLUSTRATED PARTS CATALOG
PARTS LIST

FIGURE 1. OUTER CASE ASSEMBLY

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
101	Case Feet	8590098	AF0297
102	Screw, #8 x 3/4", plastite	8569060	--------
103	Screw, #8 x 1", PH, machine	8569084	AHD2308
104	Screw, #8 x 3/4", sheet metal	8569083	AHD1620
105	Power Switch	8489030	AS0693
106	Screw, #6 x 3/8", sheet metal	8569088	AHD1621
107	Washer, #6, flat	8589017	AHD8514
108	Power Cord	8709138	AW2540

FIGURE 2. CASE TOP ASSEMBLY

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
111	Video Board Assembly	8492002	AXX8010
	Screw, #6 x 1/4", plastite	8569077	AHD1618
	Shield, mylar	859014	--------
112	Video Display, CRT	8492002	AXX8010
113	Washer, #10, flat	8589038	AHD8548
114	Nut, hex, #10-24	8579021	AHD7180
115	Tab, ground, CRT	8529020	AHC0329
117	Case Top	8719104	AZ5689

FIGURE 3. BASE PLATE ASSEMBLY

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
116	Screw, #6 x 1/4", plastite	8569077	AHD1618
120	Knob, Thumbwheel	8719112	AK4298
121	Video Control Bracket	8729040	ART3081
123	Label, RAM size, 16K	8789261	AHC0321
124	Keyboard, 65-key	8790511	AXX0205
	Screw, #6 x 1/2", plastite	8569079	AHD1619
125	Keyboard, Bezel	8719101	AZ5688
126	Keyboard Header, right angle	8519107	AJ6909
*127	Mylar Shield	8539015	--------
128	Metal Chassis	Not Stocked	Not Stocked
129	Power Supply, main	8790021	AXX6005
	Fastex, 16404-08	8559022	AHC0075
	Screw, #6 x 3/8"	8569108	--------
*132	Fastex Ground Clip	8182-67-04	--------
*133	Tinnerman clip	8559029	AHC0782

NOTE: *items many not appear on earlier version units.

FIGURE 4.METAL CHASSIS ASSEMBLY

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
*134	Chassis Shield	Not Stocked	Not Stocked
135	CPU Board Assembly	8858006	AXX0507
*136	Insulating Washers	8539013	AHC0787
*137	Screw, #6 x 5/8", PPH	8569013	--------
138	Connector Bracket	8729039	ART3082
*139	Ground Bracket	8729055	--------
	Screw, #6 x 1/4"	8569098	--------
	Washer, #6, star	8589043	--------
	Nut, #6	8579014	AHD7168
140	RS-232 Board Assembly	-----	AXX0511
141	FDC Board Assembly	8858029	AXX0510

NOTE: If your computer is earlier the Rev. F, the following hardware may be used on your unit instead of the starred (*) items.

	PCB Mount Bracket	729042	ART3080
	Screw, #6 x 1/4", plastite	8569077	AHD1618
	Clip, RICHCO, LCBS-20R	8559017	AHC0070
	Fastex, 16404-08	8559022	AHC0075
	Clip, RICHCO, LCBS-4R	8559018	AHC0071
	Fastex, 16402-04	8559020	AHC0073

FIGURE 5. DISK DRIVE ASSEMBLY

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
145	Power Supply Disk	8790021	AXX6005
146	RF Shield	8729041	ART3085
147	Disk Mounting Bracket, left	8719106	ART3083
148	Disk Mounting Bracket, right	8719105	ART3086
149	Disk Drive	8790112	AXX5019
1	Screw, #6 x 1/4", PPH	8569077	--------

MISCELLANEOUS

DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
Cable Clamp	8729054	--------
Cable Mount	8559028	AHC0358
Cable Tie, 4"	8559027	AW2214
Ground Tab, CPU	8529024	--------
Ground Tab, Keyboard (0.130)	8529026	--------
Ground Tab, Keybaord (0.171)	8519062	--------

CABLES

AC Power Harness	8709151	AW2531
Cassette I/O Internal	8709156	AW2538
CRT Wire Harness	8709153	AW2356
DC Pwer Harness, Disk	8709155	AW2532
DC Power Harness, Main	8709178	AW2537
Ground Harness, Disk	8709204	--------
Ground Harness, Keyboard	8709194	--------
Ground Harness, Main	8709161	AW2591
Ground Harness, Secondary Disk	8709195	--------
Keyboard/CPU, shielded	8709182	--------

SECTION IX

MINI DISK DRIVE

SECTION I

GENERAL DESCRIPTION

A. INTRODUCTION

The Disk Drive is a "MINI" Disk Memory designed for random access data entry, storage, and retrieval applications. These applications typically, are intelligent terminal controllers, micro-computers, word processing systems, data communications systems, error logging, micro-program loading and point-of-sale terminals. The Disk Drive is capable of recording and reading digital data using FM, MFM or M^2FM techniques.

IMPORTANT NOTICE

A redesigned Logic PC Board has been incorporated into this Manual. Refer to the supplement that follows the Illustrated Parts Catalog section of this book. The supplement contains only the affected paragraphs, illustrations and Parts List.

B. PHYSICAL DESCRIPTION

The electronic components are mounted on two PC Boards: the Logic Board and the Servo Board. There are two versions of the Logic Board, as shown in Figure 2. The Logic Board is located above the chassis, and the Power and Interface signals are connected directly to that Board. The Servo Board (shown in Figure 3) may be mounted in one of two ways, depending on the version of the Servo Board and the type of Disk Drive. The older version, Non-linear Servo Board, is mounted to the rear of the Disk Drive on internal and external units. The newer version, Linear Servo Board, is mounted to the bottom of the Disk Drive on internal units and to the rear of the Drive (the same as the Non-linear Boards) on the external units.

The spindle is belt driven by a DC motor with an integral tachometer. The servo control circuit, pulleys and the tachometer control the speed of the spindle. The read/write/erase head assembly is positioned by means of a stepper motor, split band and a pulley.

C. FUNCTIONAL DESCRIPTION

The Disk Drive is fully self-contained. It consists of a spindle drive system, a head positioning system, and read/write/erase system.

When the front latch is opened, access is provided for the insertion of a 5.25 inch (133.4 mm) standard diskette. The diskette is positioned in place by plastic guides, the front latch and a back stop.

Closing the front latch activates the cone/clamp system which centers and clamps the diskette to the drive hub. The drive hub is driven at a constant speed of 300 rpm by a servo controlled DC motor. In operation, the magnetic head is loaded into contact with the recording medium whenever the front latch is closed.

A 4-phase stepper motor/band assembly and its associated electronics position the magnetic head over the desired track. This positioner employs a one-step rotation to cause a 1-track linear movement. When a write-protected diskette is inserted into the Drive, the write-protect sensor disables the write electronics of the Drive and an appropriate signal is applied to the interface. (When performing a write operation, a 0.013-inch (0.33 mm) [nominal] data track is recorded.)

Data recovery electronics include a low-level read amplifier, differentiator, zero-crossing detector and digitizing circuits. No data decoding facilities are provided in the basic Drive.

The Drive is also supplied with the following sensor systems;

1. A track ØØ switch which senses when the Head/Carriage assembly is positioned at Track ØØ.
2. The index sensor (an LED light source and a phototransistor) is positioned so that when an index hole is detected, a digital signal is generated. The index sensor used is a high resolution device which can distinguish holes placed close together, i.e., index-sector holes in a hard sectored diskette.
3. The write-protect sensor disables the Disk Drive electronics whenever a write-protect tab is applied to the diskette.

D. INTERFACE CONNECTIONS

Signal connections for the external Disk Drive are made via a user-supplied 34-pin flat ribbon connector. The internal Drive uses a Radio Shack connector, Part Number AW2535. Both of these connectors mate directly with the PC Board connector (J1) at the rear of the Drive. The DC power connector is a four-pin connector (J2) on the Logic PC Board on the top rear of the Drive.

The signal connector harness should be of the flat ribbon or twisted pair type with the following characteristics:

1. Maximum length of 10 feet (3 M).
2. 22 - 24 gauge conductor compatible with the connector to be used.

Power connections for external Drives should be made with 18 AWG cable. Internal Drives use the Disk DC Power Harness, Radio Shack Part Number AW2532.

Media	Industry-compatible 5-1/4 inch (133.4 mm) diskette
Tracks per inch	48
Number of Tracks	40
Read/Write Track Width	9.912 inches (252 mm)
Dimensions	
Height	3.38 inches (85.85 mm)
Width	5.87 inches (149.10 mm)
Depth	8.0 inches (203.2 mm)
Weight	4.5 lbs (2.04 Kg
Temperature (Exclusive of Media)	
Operating	10°C to 43°C (50°F to 110°F)
Non-operating	–40°C to 71°C (–40°F to 160°F)
Relative Humidity (Exclusive of Media)	
Operating	20% to 80%
Non-operating	5% to 95% (non-condensing)
Vibration	6 to 600 Hz 0.5g peak
Seek Time	5 msec track to track
Head Settling Time	15 msec (last track addressed)
Error Rate	1 per 10^9 recoverable 1 per 10^{12} non-recoverable
Head Life	20,000 hours (normal use)
Media Life	3 million passes on a single track
Disk Speed	300 rpm ±1.5% (long term)
Instantaneous Speed Variation	±3.0%
Start/Stop Time	250 msec (maximum)
Transfer Rate	125/250K bits/sec
Bits/Disk (unformatted)	1.75 million (FM)
Recording Modes (typical)	FM, MFM, MMFM
Power	+12 V dc ±0.6 V, 900 ma maximum 5 V dc ±0.25 V, 600 ma maximum

TABLE 1. MINI-DISK DRIVE MECHANICAL AND ELECTRICAL SPECIFICATIONS.

E. PHYSICAL CHECKOUT

Before applying power to the unit, the following inspection should be performed:

1 Front latch. Check that the front latch opens and closes. Note that when the door is opened, the head arm raises.
2. Ensure that the front panel is secure.
3. Manually rotate the drive hub. The hub should rotate freely.
4. Check that the PC boards are secure. Check that the connectors are firmly seated. Also, check the location of the Servo Board for type (Linear or Non-linear).

LOGIC BOARD (COMPONENT SIDE)

FIGURE 1. LOGIC PC BOARD COMPONENT LOCATIONS

NON-LINEAR SERVO BOARD (COMPONENT SIDE)

LINEAR SERVO BOARD (COMPONENT SIDE)

FIGURE 2. SERVO PC BOARD COMPONENT LOCATIONS

5. Check for debris or foreign material between the heads and remove same.

6. Check plastics for broken or cracked pieces, e.g., write protect lever, guide rails, etc.

NOTE: To ensure proper operation of the Drive, the chassis should be connected to earth ground. The 3/16-inch (4.76 mm) male QC lug, located at the rear of the chassis, is provided for this connection.

F. MOUNTING THE DISK DRIVE

The Drive can be mounted in any plane, i.e., upright, horizontal or vertical. However, when it is mounted horizontally, the Logic PC board side of the chassis must be the uppermost side. Tapped holes are provided in various locations for the attachment of user-supplied hardware.

G. RESISTOR TERMINATION
(See Figure 3)

1. The Resistor Termination in IC socket (2F) is used only in the last Drive in the system. It must be removed for Drive 2 when two external drives are used.

NOTE: The internal Drives in the Model III Computer are not terminated.

FIGURE 3. RESISTOR TERMINATION

H. FLAT RIBBON CABLE ASSEMBLY
(See Figure 4)

Pins must be removed from Drive connectors on the Cable Assembly as follows and as illustrated:

1. Connector for the first internal drive (Drive 0) and the first external drive (Drive 2) pins 12, 14 and 32.

2. Connector for the second internal drive (Drive 1) and the second external drive (Drive 3), pins 10, 14 and 32.

INTERNAL DRIVES

DRIVE NUMBER ZERO	DRIVE NUMBER ONE
12	10
14	14
32	32

EXTERNAL DRIVES

DRIVE NUMBER TWO	DRIVE NUMBER THREE
12	10
14	14
32	32

FIGURE 4. CABLE ASSEMBLY – CONNECTOR PIN REMOVAL CHART

SECTION II

THEORY OF OPERATION

A. INTRODUCTION

The Disk Drive consists of the mechanical and electrical components necessary to record and read digital data on a diskette. DC power at ±12V and +5V (provided by the user for the external drives) is required for operation.

B. ORGANIZATION OF THE DISK DRIVE

All electrical subassemblies in the Disk Drive are constructed with leads which terminate in 4 or 5 pin connectors, enabling the individual assemblies to be removed.

The magnetic head is connected to the PC board via a cable terminating in a 5-pin female connector and its associated male socket which is located in close proximity to the read/write data electronics.

Interface signals and power are provided via connectors at the rear of the Drive. A detailed description of these signals is presented in Section III of this manual.

C. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

Figure 5 is a functional block diagram of the Disk Drive and should be referred to in conjunction with the following discussion:

The Disk Drive consists of the following functional groups:

- ★ Index Pulse Shaper
- ★ Write Protect Sensor
- ★ Track ØØ Sensor
- ★ Spindle Drive Control
- ★ Carriage Position Control
- ★ Write/Erase Control
- ★ Read Amplifier and Digitizer

D. INDEX

An index pulse is provided to the user system via the INDEX PULSE interface line. The index circuitry consists of an Index LED, Index Phototransistor and a Pulse Shaping Network. As the index hole in the disk passes the Index LED/Phototransistor combination, light from the LED strikes the Index Phototransistor causing it to conduct. The signal from the Index Phototransistor is passed to the Pulse Shaping Network which produces a pulse for each hole detected. This pulse is presented to the user on the INDEX PULSE interface line.

E. WRITE PROTECT

A Write Protect signal is provided to the user system via the WRITE PROTECT interface line. The write protect circuitry consists of a Write Protect Sensor and circuitry to route the signal produced.

When a write protected diskette is inserted in the drive, the sensor is activated and the logic disables the write electronics and supplies the status signal to the Interface.

F. TRACK ØØ SWITCH

The level on the TRACK ØØ interface line is a function of the position of the magnetic head assembly. When the head is positioned at Track ØØ and the stepper motor is at the home position, a true level is generated and sent to the user.

G. SPINDLE DRIVE

The Spindle Drive system consists of a spindle assembly driven by a DC motor-tachometer combination through a drive belt.

Associated with the spindle drive motor are the servo electronics required for control.

The control circuitry also includes a current limiter and an interface control line. When the DRIVE MOTOR ENABLE interface line is true, the drive motor is allowed to come up to speed. When the current through the drive motor exceeds 1.3 A, the current limit circuitry disables the motor drive.

H. POSITIONER CONTROL

The Head Positioning system utilizes a four-phase stepper motor drive which changes one phase for each track advancement of the Read/Write carriage. In addition to the logic necessary for motion control, a gate is provided as an element for inhibiting positioner motion during a write operation.

FIGURE 5. FUNCTIONAL BLOCK DIAGRAM

I. DATA ELECTRONICS

Information can be recorded on the diskette using a double-frequency code. Figure 6 illustrates the magnetization profiles in each bit cell for the number sequence shown.

The erase gaps provide an erased guard band on either side of the recorded track. This accommodates the tolerances in track positioning.

All signals required to control the data electronics are provided by the user system and are shown in the Block Diagram (Figure 5). These control signals are:

- ★ SELECT
- ★ WRITE ENABLE
- ★ WRITE DATA

The READ DATA composite signal is sent to the user system via the interface.

FIGURE 6. FM RECORDING

J. DATA RECORDING

Referring to Figure 5, it can be seen that the Write Electronics consists of a Write/Erase Current Source and Write Waveform Generator, Erase Current Source, and Trim Erase Control Logic.

The read/write winding on the magnetic head is center-tapped. During a write operation, current from the Write Current Source flows in alternate halves of the winding under control of the Write Waveform Generator.

Before recording can begin, certain conditions must be satisfied. The conditions required for recording (i.e., unit ready) must be established by the user system as follows:

(1) Drive speed stabilization. This condition will exist 250 mSec after starting the drive motor.

(2) Subsequent to any step operation, the positioner must be allowed to settle. This requires 20 mSec total after the last step pulse is initiated, i.e., 5 mSec for the step motion and 15 mSec for settling.

NOTE: All of the foregoing operations can be overlapped, if required.

Figure 7 shows the relevant timing diagram for a write operation. At t = Ø when the unit is ready, the WRITE ENABLE interface line goes true; this enables the Write Current source.

Since the trim erase gaps are behind the read/write gap, TRIM ERASE control goes true 390μSec after the WRITE ENABLE interface line. It should be noted that this value is optimized between the requirements at Track ØØ and Track 40 so that the effect of the trim erase gaps on previous information is minimized.

Figure 7 also shows the information on the WRITE DATA interface line and the output of the Write Waveform Generator which toggles on the leading edge of every WRITE DATA pulse.

Note that a minimum of 4 μSec and a maximum of 8 μSec between WRITE ENABLE going true and the first WRITE DATA pulse is only required if faithful reproduction of the first WRITE DATA transition is significant.

At the end of recording, at least one additional pulse on the WRITE DATA line must be inserted after the last significant WRITE DATA pulse to avoid excessive peak shift effects.

The TRIM ERASE signal must remain true for 800μSec after the termination of WRITE ENABLE to ensure that all recorded data are trim erased. This value is again optimized between the requirements at Tracks ØØ and 40.

The duration of a write operation is from the true-going edge of WRITE ENABLE to the false-going edge of TRIM ERASE. This is indicated by the internal WRITE BUSY waveform shown.

K. DATA REPRODUCTION

The Read Electronics consists of the following:

- ★ Read Switch
- ★ Read Amplifier
- ★ Filter
- ★ Differentiator
- ★ Comparator and Digitizer

The Read Switch is used to isolate the Read Amplifier from electrical signals across the magnetic head during a write operation.

Before reading can begin, the Drive must be in a ready condition. As with the data recording operation, this ready condition must be established by the user system. In addition to the requirements established in the paragraph, DATA RECORDING, a 100 μSec delay must exist from the trailing edge of the TRIM ERASE signal to allow the Read Amplifier to settle after the transient caused by the Read Switch returning to the Read mode.

Referring to Figure 8, the output signal from the read/write head is amplified by a read amplifier and filtered to remove noise by a Linear Phase Filter. The linear output from the Filter is passed to the Differentiator which generates a waveform whose zero crossovers correspond to the peaks of the read signal. This signal is then fed to the Comparator and Digitizer circuit.

The Comparator and Digitizer circuitry generates a 1 μSec READ DATA pulse corresponding to each peak of the read signal. This Composite Read Data signal is then sent to the user system via the READ DATA interface line.

NOTES:

1. t = Ø = 25Ø MILLISECONDS AFTER DRIVE MOTOR STARTS, OR 2Ø MILLISECONDS AFTER LAST STEP PULSE (WHICHEVER IS THE LATEST TIME).
2. UNSYNCHRONIZED
3. 8.5 MA PEAK TO PEAK
4. 4 μSECONDS MINIMUM. 8 μSECONDS MAXIMUM

FIGURE 7. WRITE TIMING DIAGRAM

NOTES:
t = Ø = 25Ø MILLISECONDS AFTER DRIVE MOTOR STARTS, OR 2Ø MILLISECONDS AFTER STEP COMMAND, OR 1ØØ μSECONDS AFTER TERMINATION OF WRITE BUSY (WHICHEVER IS THE LATEST TIME)

FIGURE 8. READ TIMING DIAGRAM

SECTION III

OPERATION

A. INTRODUCTION

This section contains the interface description and the electrical adjustments necessary for the Disk Drive.

B. INTERFACE ELECTRONICS SPECIFICATIONS

All interface signals are TTL compatible. Logic true (low) is +0.4 V (maximum). Logic false (high) is +2.4 V (minimum). Figure 9 illustrates the interface configuration.

FIGURE 9. INTERFACE CONFIGURATION

It is recommended that the interface cable be a flat ribbon cable, with a characteristic impedance of 100 ohms. (or equivalent twisted pairs). Maximum interface cable length is 10 feet (3 M).

Interface connector pin assignments and power connector pin assignments are given in Table 2 and Table 3.

C. INPUT CONTROL LINES
(See Table 2)

D. SELECT LINES (DS1* - DS4*)

The SELECT lines provide a means of selecting and deselecting a Disk Drive. These four lines (DS1* - DS4*) select one of the four Disk Drives attached to the controller. When the signal logic level is true (low), the Disk Drive electronics are activated and the Drive is conditioned to respond to step or read/write commands. When the logic level is false (high) the input control lines and output status lines are disabled.

A SELECT line must remain stable in the true (low) state until the execution of a step or read/write command is completed.

The Disk Drive address is determined by SELECT lines 1 through 4 (or a DIP Shunt in the 1E position) on the PC board. These lines provide a means of daisy-chaining a maximum of four Disk Drives to a controller. Only one line can be true (low) at a time. An undefined operation might result if two or more units are assigned the same address or if two or more SELECT lines are in the true (low) state simultaneously.

E. DRIVE MOTOR ENABLE (MOTORON)

When this signal line logic level goes true (low), the drive motor accelerates to its nominal speed of 300 rpm and stabilizes in less than 250 mSec. When the logic level goes false (high), the Disk Drive decelerates to a stop.

F. DIRECTION AND STEP (DIR*) (STEP*)

When the Disk Drive is selected, a true (low) pulse with a time duration greater than 200 nSec on the STEP line initiates the access motion. The direction of motion is determined by the logic state of the DIRECTION line when a STEP pulse is issued. The motion is towards the center of the disk if the DIRECTION line is in the true (low) state when a STEP pulse is issued. The direction of motion is away from the center of the disk if the DIRECTION line is in the false (high) state when a STEP pulse is issued. To ensure proper positioning, the DIRECTION line should be stable 0.1 μSec (minimum) before the trailing edge of the corresponding STEP pulse and remain stable until 0.1 μSec after the trailing edge of the STEP pulse. The access motion is initiated on the trailing edge of the STEP pulse.

G. COMPENSATED WRITE DATA (CWD)

When the Disk Drive is selected, this interface line provides the bit-serial WRITE DATA pulses that control the switching of the write current in the head. The write electronics must be conditioned for writing by the WRITE ENABLE line (refer to the WRITE ENABLE paragraph below).

For each high-to-low transition on the WRITE DATA line, a flux change is produced at the head write gap. This causes a flux change to be stored on the disk.

When the double-frequency type encoding technique is used (in which data and clock form the combined Write Data signal), it is recommended that; when writing all zeroes, the repetition rate of the high-to-low transitions be equal to the nominal data rate, ±0.1%. The repetition rate of the high-to-low transitions, when writing all ones, should be equal to twice the nominal data rate, ±0.1%.

H. WRITE GATE (WG*)

When this signal is true (low), the write electronics are prepared for writing data (read electronics disabled). This signal turns on write current in the read/write head. Data is written under control of the WRITE DATA input line. It is generally recommended that changes of state on the WRITE ENABLE line occur before the first WRITE DATA pulse. However, the separation between the leading edge of WRITE ENABLE and the first significant WRITE DATA pulse should not be less than 4 μSec and not greater than 8 μSec. The same restrictions exist for the relationship between the least significant WRITE DATA pulse and the

Controller-to-Disk Drive		
Ground	Signal	Description (Mnemonic)
1	2	Connector clamp
3	4	(Spare)
5	6	(Spare)
9	10	SELECT 1 (NDS1)
11	12	SELECT 2 (NDS2)
13	14	SELECT 3 (NDS3)
15	16	DRIVE-MOTOR ENABLE (NMOTORON)
17	18	DIRECTION
19	20	STEP (NSTEP)
21	22	WRITE DATA (NWRITEDATA)
23	24	WRITE GATE (NWRITEGATE)
31	32	SELECT 4 (NDS4)

Disk Drive-to-Controller		
Ground	Signal	Description (Mnemonic)
7	8	INDEX (NINDEX/SECTOR)
25	26	TRACK ØØ (NTRKØØ)
27	28	WRITE PROTECT (NWRITEPROTECT)
29	30	READ DATA (NREADDATA)
33	34	Connector Clamp

TABLE 2. DISK DRIVE EDGE CARD PIN ASSIGNMENTS – J1.
(J2 on the Redesigned Logic/Servo P C Board)

Pin	Supply Voltage
1	+12 V DC
2	Return (+12 V DC)
3	Return (+5 V DC)
4	+5 V DC

TABLE 3. POWER CONNECTOR PIN ASSIGNMENTS

termination of the WRITE ENABLE signal. When the WRITE ENABLE line is false (high), all write electronics are disabled.

When a write protected diskette is installed in a Disk Drive, the write electronics are disabled irrespective of the state of the WRITE ENABLE line.

I. OUTPUT STATUS
(See Table 2)

J. INDEX PULSE (IP*)

The INDEX PULSE signal is provided once each revolution (200 mSec, nominal) to indicate to the controller the beginning of a track. The INDEX PULSE line remains in the true (low) state for the duration of the INDEX PULSE (The duration of an INDEX PULSE is nominally 4.0 mSec).

The leading edge of an INDEX PULSE must always be used to ensure diskette interchangeability between Disk Drives.

K. TRACK ØØ (TRKØ*)

When the Disk Drive is selected, the TRACK ØØ interface signal indicates to the controller that the read/write head is positioned at Track ØØ. The Track ØØ remains true (low) until the head is moved away from Track ØØ.

L. WRITE PROTECT (WPRT*)

When the Disk Drive is selected, this signal line logic level goes true (low) when the diskette is write protected. The write electronics are internally disabled when the diskette is write protected.

NOTE: It is recommended that the write data line be inactive whenever Write Enable is false (i.e., read state).

When the level on this line is false (high), the write electronics are enabled and the write operation can be performed. It is recommended that the controller not issue a write command when the WRITE PROTECT signal is true (low).

M. READ DATA (RD*)

This interface line transmits the readback data to the controller when the Drive is selected. It provides a pulse for each flux transition recorded on the medium. The READ DATA output line goes true (low) for a duration of 1 μSec for each flux change recorded.

The leading edge of the READ DATA output pulse represents the true positions for the flux transitions on the diskette surface.

SECTION IV

MAINTENANCE

A. PHYSICAL DESCRIPTION OF THE PC BOARD

The Logic PC board is approximately 6 inches (152 mm) long by 5.5 inches (139 mm) wide. Figure 10 illustrates the placement of test points and connectors.

B. CIRCUIT BOARD TEST POINTS

The following test point description assumes that the Logic and Servo P.C. boards are installed in the Drive and that the Drive is in an operational mode with a diskette installed:

Logic Ground (TP6)
Digital Logic ground is referenced at TP6.

Differentiated Read Signal (TP3, TP4)
These test points are provided to observe the differential output of the second stage amplifier and differentiated read signal.

Read Data Single Shot (TP5)
The output of the single shot used in the read section is nominally 1.0 μsec for each flux transition detected.

Index Pulse (TP7)
With a standard soft sectored diskette installed, the signal is a high going pulse, nominally 4.0 msec in duration every 200 msec.

Amplified Read Signal (TP1, TP2)
These test points are provided to observe the differential output of the first stage of read signal amplification.

Motor On (TP13)
This signal is low true for the "motor on" condition.

Track ØØ (TP8)
This signal is low true when the carriage is positioned at track ØØ and the step motor phase is correct.

Analog Ground (TP10)
The analog ground reference point is provided for measuring read/write waveforms.

Step Pulse (TP12)
When stepping in or out, the signal is a high going pulse for each step of the carriage.

Write Protect Switch (TP9)
When a write protected diskette is installed in the Drive, the signal is high.

C. OPTION SELECT

Input Line Terminations

The Disk Drive has been provided with the capability of terminating the input lines listed below:

- ★ Motor On
- ★ Direction Select
- ★ Step
- ★ Write Data
- ★ Write Gate

These lines are terminated through a 150 ohm resistor pack installed in a DIP socket located at IC location 2F.

In a multiple drive system, only the last drive on the interface is to be terminated. All other drives on the interface must have the resistor pack removed. Catalog Numbers 26-1160 and 26-1164 are shipped with the termination resistor installed. Catalog Numbers 26-1161/1162/1163 are shipped without a resistor pack.

COMPONENT SIDE

FIGURE 10. LOGIC PC BOARD TEST POINTS AND CONNECTOR LOCATIONS

NON-LINEAR SERVO BOARD (COMPONENT SIDE)

LINEAR SERVO BOARD (COMPONENT SIDE)

FIGURE 11. SERVO PC BOARD CONNECTOR LOCATIONS

D. PREVENTIVE MAINTENANCE

To ensure that the Disk Drive operates at its design potential, the only scheduled preventive maintenance required is periodic cleaning of the magnetic recording head.

Mechanical and electrical adjustment details are provided for further service as a result of disassembly or repair.

E. CLEANING THE HEAD

To clean the magnetic head, we recommend using Radio Shack's Universal Disk Drive Head Cleaning Kit, catalog number 26-407. This kit comes with complete instructions for safely cleaning the disk drive heads.

CAUTION: Rough or abrasive cloth should not be used to clean the magnetic recording head. Use of cleaning solvents other than 91% Isopropyl alcohol may damage the head.

Extreme care must be exercised to prevent the heads from being damaged (i.e., scratching, banging together, etc.).

F. ALIGNMENT AND ADJUSTMENT

To perform the alignment and adjustment procedures, you will require the following equipment:

- ★ 30 MHz Dual Trace Triggered Sweep Scope
- ★ 5 1/4" Alignment Diskette
- ★ 5 1/4" Blank "scratch" Diskette

G. DRIVE MOTOR MAINTENANCE

Long Term Motor Speed Adjustment

1. Check power to unit. (+12 VDC ± Ø.6V, and +5 VDC ± Ø.25V.)

2. Insert a blank diskette and activate the drive.

3. Under fluorescent lighting, observe the speed disk on the spindle pulley. For 6Ø Hz operation the outer ring on the speed disk should appear stationary. For 5Ø Hz operation the inner ring should appear stationary.

4. If the speed disk does not appear stationary, adjust R4, located on the Servo PCB, until the disk appears stationary.

5. If motor speed cannot be adjusted, repair Servo PCB or motor as required.

Instantaneous Speed Variation Check/RAW Data Check

1. With a blank diskette inserted, write a 2F pattern on any track.

2. Connect scope to TP 5 with:

   Vert. to 2 volts/div.
   Time Base to 1 μsec/div.
   Trigger internal/positive

3. Observe the waveform. Measure jitter on the leading edge of the third pulse. The leading edge of the pulse should start 8 μsec ±24Ø nsec from the trigger pulse. The third pulse jitter should be less than 48Ø nsec (edge to edge).

4. If jitter is excessive, repair or replace: the drive belt, the motor; the Servo PC Board; or the spindle and bearings as necessary.

H. CARRIAGE MOVEMENT CHECK

1. Step between tracks ØØ and 34/4Ø.

2. Check carriage movement. Be certain that carriage is moving freely and not binding at any point. Repair if necessary.

I. HEAD RADIAL ALIGNMENT/CE ALIGNMENT

1. Insert a 5 1/4" alignment diskette.

2. Connect Scope:
   Channel A to TP 1
   Channel B to TP 2
   Ground to TP 10
   Ext. Sync to TP 7

   Set mode to add (A + B) Invert B
   Vert. to 50 MV/div
   Trigger external - loosely.

3. Read track 16 and verify the "cat eyes" pattern as shown in Figure 12. The smaller of the two "eyes" should not be less than 75% amplitude of the other. % = (small lobe/larger lobe) x 100.

FIGURE 12. "CAT EYES" PATTERN

4. Step to track ØØ. Return to track 16 and re-verify the pattern.

5. Step to track 34/4Ø and return to track 16. Re-verify the "cat eyes" pattern.

If Radial Needs Adjustment:

a. Loosen the two retaining screws on back of the unit and the retaining screw on the carriage assembly.

b. Turn the Adjustment Cam until the "cat eyes" pattern is within 75%. If the pattern does not come within spec, loosen the hex head screw on the collar of the stepper motor and rotate the stepper motor shaft until the "eyes" are to the 75% level. Tighten the hex head screw and return to step a.

c. Tighten all screws and recheck adjustment.

FIGURE 13. RADIAL ADJUSTMENT

J. TRACK ØØ ALIGNMENT

Track ØØ Switch Adjustment

1. Connect Scope:
   Channel A to pin 1 of Plug 11
   Vert. to 2 volts/div.
   Time Base to 10 msec.
   Trigger internal channel A, DC coupled

2. Step between tracks Ø2 and Ø3.

3. Loosen track ØØ switch mounting screw and adjust until switch activates between tracks Ø2 and Ø3. Tighten the mounting screw.

Track ØØ Stop Adjustment

1. Connect the scope as in Head Radial alignment.

2. Insert alignment diskette and read track ØØ.

3. Back off the track ØØ stop screw two turns. Slowly turn the track ØØ stop screw in until the output amplitude shown on the scope starts to decrease. Back the track ØØ stop screw out until the amplitude stops increasing. Back the track ØØ stop screw out one-half turn from this point.

FIGURE 14. TRACK ØØ STOP ADJUSTMENT

K. INDEX SECTOR ADJUSTMENT

1. Set Scope:
   Vert. at Ø2 volts/div.
   Time Base 5Ø μsec/div.

2. Insert alignment diskette and read track Ø1. Scope display should show Ø volts AC trace for 2ØØ μsec ±5Ø μsec. If the waveform is outside of spec., loosen the index sector light mounting screw and adjust to spec.

3. Open and close the Drive door and re-verify the index sector timing.

TIME SCALE = 50μsec/DIV

FIGURE 15. INDEX SECTOR TIMING

FIGURE 16. INDEX ADJUSTMENT

L. HEAD AMPLITUDE/COMPLIANCE CHECK

1. Insert a blank diskette and write a pattern to track 34.

2. Set Scope:
   Time Base to 10μsec/div.
   Read the amplitude.

3. Apply an additional 15 grams of pressure to the head load arm. (15 grams is approximately equal to the weight of a 25 cent piece.)

4. Observe the amplitude. If it increases more than 10%, the compliance needs to be adjusted.

5. To adjust the compliance, loosen the two nuts that hold the head load arm in place. While monitoring the amplitude, move the arm until output is highest. Hold the arm in this position and tighten the nuts.

6. Re-verify compliance. If compliance cannot be adjusted properly, replace the head load arm.

M. FINAL CHECK

1. Use the drive to format and backup a blank diskette.

2. Check the diskette in a known good drive.

FIGURE 17. UPPER ARM AND CARRIAGE

DISK CONTROLLER BOARD
PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	CAPACITORS		
C1	2.2μF, 35V, Tantalum, Axial	839-5223	ACC225MGTA
C2	470pF, 50V, Monolithic	838-1474	ACF2124
C3	68pF, 50V, Monolithic	838-1684	ACF2125
C4	0.47μF, 50V, Monolithic	838-4474	ACF2126
C5	0.47μF, 50V, Monolithic	838-4474	ACF2126
C6	0.01μF, 50V, Monolithic	838-3104	ACF2130
C7	0.47μF, 50V, Monolithic	838-4474	ACF2126
C8	0.47μF, 50V, Monolithic	838-4474	ACF2126
C9	4700pF, 50V, Monolithic	838-2474	ACF2123
C10	0.01μF, 50V, Monolithic	838-3104	ACF2130
C11	270pF, 50V, Monolithic	838-1274	ACF2128
C12	470pF, 50V, Monolithic	838-1474	ACF2124
C13	470pF, 50V, Monolithic	838-1474	ACF2124
C14	1200pF, 50V, Monolithic	838-2124	ACF2127
C15	0.1μF, 20V, Tantalum, Radial	839-4102	ACC104KETP
C16	0.1μF, 20V, Tantalum, Radial	838-4102	ACC104KETP
C17	4.7μF, 20V, Electrolytic, Axial	831-5472	ACC475MEAA
C18	0.01μF, 50V, Monolithic	838-3104	ACF2130
↓	↓	↓	↓
C23	0.01μF, 50V, Monolithic	838-3104	ACF2130
C24	Not Used	———	———
C25	0.01μF, 50V, Monolithic	838-3104	ACF2130
C26	6.8μF, 35V, Tantalum	838-5683	ACC685MGTP
C27	0.01μF, 50V, Monolithic	838-3104	ACF2130
C28	0.01μF, 50V, Monolithic	838-3104	ACF2130
C29	0.01μF, 50V, Monolithic	838-3104	ACF2130
C30	6.8μF, 35V, Tantalum	838-5683	ACC685MGTP
C31	0.01μF, 50V, Monolithic	838-3104	ACF2130
↓	↓	↓	↓
C35	0.01μF, 50V, Monolithic	838-3104	ACF2130
C36	4.7μF, 20V, Electrolytic, Axial	831-5472	ACC475MEAA
C37	4.7μF, 20V, Electrolytic, Axial	831-5472	ACC475MEAA
C38	6.8μF, 35V, Tantalum	838-5683	ACC685MGTP
C39	6.8μF, 35V, Tantalum	838-5683	ACC685MGTP
C40	330pF, 50V, Monolithic	838-1334	ACF2129
C41	330pF, 50V, Monolithic	838-1334	ACF2129
	DIODES		
CR1	1N4446	815-0446	ADX1364
CR2	1N4446	815-0446	ADX1364
CR3	1N4446	815-0446	ADX1364
CR4	1N4446	815-0446	ADX1364
CR5	Not Used	———	———
↓	↓	↓	↓
CR10	Not Used	———	———
CR11	1N4446	815-0446	ADX1364
↓	↓	↓	↓
CR21	1N4446	815-0446	ADX1364

DISK CONTROLLER BOARD
PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	INDUCTORS		
L1	390μh	841-9003	ACA8058
L2	390μh	841-9003	ACA8058
L3	680μh	841-9004	ACA8057
	INTEGRATED CIRCUITS		
3A	MC1733	805-0733	AMX4326
4A	NE592A	805-0592	AMX3688
2B	7406, Buffer and Interface gate	801-0406	AMX3675
3B	74LS20, Positive NAND gate	802-0020	AMX3555
4B	74LS20, Positive NAND gate	802-0020	AMX3555
5B	MSM311EL Precision Comparator	805-3011	AMX4327
2C	75463, Dual Peripheral Positive OR Driver	805-0463	AMX4329
3C	74123, Retriggerable Monostable Multivibrator	800-0123	AMX3955
4C	74LS74, Flip-Flop	802-0074	AMX3558
5C	74LS74, Flip-Flop	802-0074	AMX3558
3D	74LS04, Positive NAND gate	802-0004	AMX3552
4D	75462, Dual Peripheral Positive NAND Driver	805-0462	AMX4321
5D	74LS86, Quadruple 2-input Exclusive OR gate	802-0086	AMX3701
1E	DIP Shunt, 16-pin	848-9001	AL0907
2E	74LS14, Schmitt-Trigger Positive NAND gate	802-0014	AMX3716
3E	7407, Buffer and Interface gate	801-0407	AMX3684
4E	75462, Dual Peripheral Positive NAND Driver	805-0462	AMX4321
5E	74LS221, Dual Monostable Multi-vibrator w/ Schmitt-Trigger inputs	802-0221	AMX3810
1F	7438, Buffer and Interface Gate	8000038	AMX-3683
2F	8-Resistor Network	829-0007	ARX0181
4F	7438, Buffer and Interface Gate	8000038	AMX-3683
	RESISTORS		
R1	8.2K,¼W, 5%	820-7282	AN0271EEC
R2	8.2K, ¼W, 5%	820-7282	AN0271EEC
R3	8.2K, ¼W, 5%	820-7282	AN0271EEC
R4	27K, ¼W, 5%	820-7327	AN0316EEC
R5	27K, ¼W, 5%	820-7327	AN0316EEC
R6	3.6K, ¼W, 5%	820-7236	AN0235BEC
R7	1K, ¼W, 5%	820-7210	AN0196EEC
↓	↓	↓	↓
R12	1K, ¼W, 5%	820-7210	AN0196EEC
R13	1.2K, ¼W, 5%	820-7212	AN0199EEC
R14	150 ohms, ¼W, 5%	820-7115	AN0142EEC
R15	Not Used		
R16	1K, ¼W, 5%	820-7210	AN0196EEC
R17	1K, ¼W, 5%	820-7210	AN0196EEC

DISK CONTROLLER BOARD
PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	RESISTORS (cont'd)		
R18	1K, ¼W, 5%	820-7210	AN0196EEC
R19	1K, ¼W, 5%	820-7210	AN0196EEC
R20	750 ohms, ¼W, 5%	820-7175	AN0185EEC
R21	390 ohms, ¼W, 5%	820-7139	AN0162EEC
R22	10K, ¼W, 5%	820-7310	AN0281EEC
R23	390 ohms, ¼W, 5%	820-7139	AN0162EEC
R24	3.09K, ¼W, 5%	820-1230	AN0575BEC
R25	768 ohms, ¼W, 1%	820-1176	AN0572BEC
R26	3.9K, ¼W, 5%	820-7239	AN0237EEC
R27	1K, ¼W, 5%	820-7210	AN0196EEC
R28	47K, PW, 5%	820-7347	AN0340EEC
R29	2.2K, ¼W, 5%	820-7222	AN0216EEC
R30	2.2K, ¼W, 5%	820-7222	AN0216EEC
R31	768 ohms, ¼W, 1%	820-1176	AN0572BEC
R32	820 ohms, ¼W, 5%	820-7182	AN0187EEC
R33	390 ohms, ¼W, 5%	820-7139	AN0162EEC
R34	1.54K, ¼W, 1%	820-1215	AN0573BEC
R35	768 ohms, ¼W, 1%	820-1176	AN0572BEC
R36	Not Used	———	———
↓	↓	↓	↓
R41	Not Used	———	———
R42	1K, ¼W, 5%	820-7210	AN0196EEC
R43	1K, ¼W, 5%	820-7210	AN0196EEC
R44	3K, ¼W, 5%	820-7230	AN0226EEC
R45	10K, ¼W, 5%	820-7310	AN0281EEC
R46	Not Used		
R47	1K, ¼W, 5%	820-7210	AN0196EEC
R48	300 ohms, ¼W, 5%	820-7130	AN0158EEC
R49	1K, ¼W, 5%	820-7210	AN0196EEC
R50	Not Used	———	———
R51	Not Used	———	———
R52	150 ohms, ¼W, 5%	820-7115	AN0142EEC
R53	1K, ¼W, 5%	820-7210	AN0196EEC
R54	13.3K, ¼W, 1%	820-1313	AN0574BEC
R55	28.7K, ¼W, 1%	820-1328	AN0318BEC
R56	Not Used	———	———
R57	Not Used	———	———
R58	150 ohms, 2W, 5%	824-7115	AN0142EHC
R59	1K, ¼W, 5%	820-7210	AN0196EEC
R60	1K, ¼W, 5%	820-7210	AN0196EEC
R61	1K, ¼W, 5%	820-7210	AN0196EEC
R62	150 ohms, ¼W, 5%	820-7115	AN0142EEC
R63	10K, ¼W, 5%	820-7310	AN0281EEC
R64	1K, ¼W, 5%	820-7210	AN0196EEC
R65	750 ohms, ¼W, 5%	820-7175	AN0185EEC
R66	390 ohms, ¼W, 5%	820-7139	AN0162EEC
R67	Not Used	———	———
R68	1K, ¼W, 5%	820-7210	AN0196EEC
R69	1K, ¼W, 5%	820-7210	AN0296EEC

DISK CONTROLLER BOARD
PARTS LIST (Cont'd)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	TRANSISTORS		
Q1	2N4124, NPN	811-0124	AMX4178
Q2	2N4124, NPN	811-0124	AMX4178
Q3	2N4124, NPN	811-0124	AMX4178
Q4	2N4124, NPN	811-0124	AMX4178
Q5	2N4125, PNP	810-0125	AMX4330
Q6	Not Used	———	———
Q7	Not Used	———	———
Q8	2N4124, NPN	811-0124	AMX4178
	MISCELLANEOUS		
	16-pin IC Socket (2)	850-9003	AJ6581
	16-pin DIP Shunt Socket	848-9001	AL0907
	5-pin Right Angle Header	851-9054	AJ6815
	14-pin Right Angle Header (2)	851-9060	AJ6816
	Staking Pin (13)	852-9014	AHB9682
	Resistor, Ø ohm vlaue – Jumper (2)	829-0000	AJ6814
	4-position, PC Mount Housing	851-9056	ART2738

SERVO (MOTOR CONTROL) BOARD PARTS LIST

(NON-LINEAR SERVO BOARD)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	PRINTED CIRCUIT BOARD, SERVO (MOTOR CONTROL)	8709096	————
	CAPACITORS		
C1	1.0 μF, 35V, 20%, Tantalum	8335103	ACC105MGTA
C2	1.0 μF, 35V, 20%, Tantalum	8335103	ACC105MGTA
C3	1.0 μF, 35V, 20%, Tantalum	8335103	ACC105MGTA
C4	1.0 μF, 35V, 20%, Tantalum	8335103	ACC105MGTA
C5	0.047 μF, 80V, 10%, Tantalum	8393474	ACC473KKTA
C6	0.47 μF, 35V, 20%, Tantalum	8394473	ACC474MGTA
	DIODE		
CR1	1N4002, Rectifier, Low Power	8150002	ADX1148
	INDUCTOR		
L1	3.3 μh, 10%	8419005	ACA8059
	INTEGRATED CIRCUIT		
U1	LM2917N, Frequency to Voltage Converter	8050917	AMX4181
	RESISTORS		
R1	20K, 1/4 W, 5%,	8207320	AN0306EEC
R2	1M, 1/4 W, 5%	8207510	AN0445EEC
R3	1K, 1/4 W, 5%	8207210	AN0196EEC
R4	1K, Trim Potentiometer	8289210	AP7058
R5	1K, 1/4 W, 5%	8207210	AN0196EEC
R6	43.2K, 1/4 W, 1%	8201343	AN0576BEC
R7	470 ohms, 1/4 W, 5%	8207147	AN0169EEC
R8	470 ohms, 1/4 W, 5%	8207147	AN0169EEC
R9	18 ohms, 1/4 W, 5%	8207018	AN0075EEC
R10	1K, 1/4 W, 5%	8207210	AN0196EEC
R11	1 ohm, 1/2 W, 5%	8217001	AN0022EFC
R12	2.2K, 1/4 W, 5%	8217222	AN0216EEC
R13	2.2K, 1/4 W, 5%	8217222	AN0216EEC
	TRANSISTORS		
Q1	TIP110, Power	8110110	AMX4331
Q2	2N4124, NPN	8110124	AMX4178
	MISCELLANEOUS		
	10-pin, Right Angle Header	8519057	AJ6817
	Screw, 4-40 x 1/4" (6.35 mm)	8569032	AHD1541
	Nut, Hex, 4-40	8579001	AHD7165

SERVO (MOTOR CONTROL) BOARD
PARTS LIST (Cont'd)

(LINEAR SERVO BOARD)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
	PRINTED CIRCUIT BOARD, SERVO (MOTOR CONTROL)	8709169	AXX0316
	CAPACITORS		
C1	47 μF, 16V, Electrolytic	8326471	———
C2	47 μF, 16V, Electrolytic	8326471	———
C3	0.1 μF, 50V, Axial	8374109	———
C4	1.0 μF, 35V, Tantalum	8335103	ACC105MGTA
C5	0.01 μF, 80V, Axial	8393104	———
C6	0.022 μF, 50V, Axial	8373224	———
	INDUCTOR		
L1	3.3 μh, 10%	8419005	ACA8059
	INTEGRATED CIRCUIT		
U1	LM2917N, Frequency to Voltage Converter	8050917	AMX4181
	RESISTORS		
R1	20K, 1/4 W, 5%	8207320	AN0306EEC
R2	1M, 1/4 W, 5%	8207510	AN0445EEC
R3	1K, 1/4 W, 5%	8207210	AN0196EEC
R4	1K, Trim Potentiometer	8289210	AP7058
R5	1K, 1/4 W, 5%	8207210	AN0196EEC
R6	150K, 1/4 W, 5%	8200415	AN0142EEC
R7	470 ohm, 1/4 W, 5%	8207147	AN0169EEC
R8	1K, 1/4 W, 5%	8207210	AN0196EEC
R9	470 ohm, 1/4 W, 5%	8207147	AN0169EEC
R10	1K, 1/4 W, 5%	8207210	AN0196EEC
R11	1 ohm, 1/2 W, 5%	8217001	AN0022EFC
R12	2.2K, 1/4 W, 5%	8217222	AN0216EEC
R13	2.2K, 1/4 W, 5%	8217222	AN0216EEC
R14	1M, 1/4 W, 5%	8207510	AN0445EEC
	TRANSISTORS		
Q1	TIP110, Power	8110110	AMX4331
Q2	1N4124, NPN	8110124	AMX4178
	MISCELLANEOUS		
	10-pin, Right Angle Header	8519057	AJ6817
	Screw, 4-40 x 1/4" (6.35 mm)	8569032	AHD1541
	Nut, Hex, 4-40	8579001	AHD7165

FIGURE 18. ILLUSTRATED PARTS – EXPLODED VIEW

PARTS LIST
ILLUSTRATED PARTS CATALOG

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
1	Front Panel	8852025	AZ5380
2	LED Assembly (Panel)	8852020	AL1127
3	Front Panel Bushing	8852026	AHB9684
4	Left Hand Guide	8852024	ART2743
6	Write Protect Switch Assembly	8852017	AS2587
7	Index Assembly, Type I	8852019	ART2739
	Type II*	8852043	ART2895
8	Detector Holder	8852048	ART3003
9	Module Bias Spring Assembly	———	———
10	SSR Spring	8852060	ARB6845
11	SSR Spring Housing	8852059	ART3006
12	Lower Bearing	8852028	ART2745
13	Drive Belt	8852018	AB6443
14	Drive Motor Assembly	8852015	AM4545
15	Servo Board, non-linear	7000008	AXX0316
	linear	7000006	———
16	Track ØØ Screw	8852057	AHD1601
17	E-ring, large (cam)	8852049	AHE0029
18	E-ring, small (Track ØØ)	8852051	AHE0031
19	Track ØØ Switch Assembly	8852016	AS2586
20	Upper Bearing	8852027	ART2744
21	Hub Retainer	8852055	AHB9985
22	Hub Retainer Screw	8852056	AHD1600
23	Machined Hub Assembly	———	ART2740
24	Cone Assembly (2 pcs.)	8852021	ART3511
25	E-ring, medium (cone)	8852050	AHE0030
26	Latch Assembly	8852022	ADA0303
27	Foam Cone Lever Pad	8852063	AHB9986
29	Right Hand Guide	8852023	ART2742
30	Crimp Pin (tin)	8852045	AHB9982
	(gold)	8852046	AHB9983
	(inside Head Plug)		
31	Upper Arm Assembly	8852044	ART3002
32	Carriage Shaft	8852065	ART3050
33	Head Carriage Assembly	8852031	AH4403
34	Shaft Mounting Clamp	8852064	AHC0048
35	Drive Band, (Stepper)	8852032	ART2746
36	Collar, (Stepper)	8852047	AHB9984
37	Track ØØ Stop Kit	8852052	ART3004
38	Module Cam Screw	8852058	AHD1602
39	Logic PC Board	7000007	AXX0317
not shown	Module Cover, clear plastic	8852062	ART3007
	Cone Lever Assembly	8852053	ART3005
	includes: cone assembly, E-ring, med., latch assembly, and foam cone lever pad		
	Module Assembly SSR	8852029	AXX0318
	includes: upper arm assembly, carriage shaft, head carriage assembly, shaft mounting clamp, drive band, collar, track ØØ stop kit, and module cam screw		

*Type II Assemblys have a gold band around the photo transistor.

NOTES:
1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

FIGURE 19. MINI-DISK DRIVE SCHEMATIC DIAGRAM (Sheet 1)

NOTES:
1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

FIGURE 19. MINI-DISK DRIVE SCHEMATIC DIAGRAM (Sheet 2)

NOTES:
1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

NON-LINEAR SERVO BOARD

NOTES:
1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

LINEAR SERVO BOARD

FIGURE 20. SERVO PC BOARD SCHEMATIC DIAGRAM

SUPPLEMENT TO

SECTION IX

THIS SUPPLEMENT APPLIES TO ALL DISK DRIVES (26-1160 TO 26-1164) THAT USE THE NEW SINGLE (LOGIC/SERVO) BOARD DRIVE CIRCUITRY. THE CIRCUITRY HAS BEEN UPDATED AND NEW TEST POINTS ARE USED, ALTHOUGH ALL MECHANICAL ADJUSTMENTS WILL REMAIN THE SAME AS THE PREVIOUS TWO BOARD SYSTEMS.

SECTION I

GENERAL DESCRIPTION

A. INTRODUCTION

The main difference is in the PC Board (there is only one board, the Servo Motor circuitry has been incorporated onto the Logic Board and the DIP Resistor Termination and IC Socket have been replaced by a SIP Resistor Termination package and Socket). A changed paragraph is indicated by a vertical line in the margin adjacent to that paragraph. The Figure numbers in this section correspond to the Figures in the Manual.

B. PHYSICAL DESCRIPTION

The electronic components are mounted on the Logic/Servo Board. The Logic/Servo Board is located above the chassis, and the Power and interface signals are connected directly to that Board.

The spindle is belt driven by a DC motor with an integral tachometer. The servo control circuit, pulleys and the tachometer control the speed of the spindle. The read/write/erase head assembly is positioned by means of a stepper motor, split band and a pulley.

C. FUNCTIONAL DESCRIPTION

The Disk Drive is fully self-contained. It consists of a spindle drive system, a head positioning system, and read/write/erase system.

When the front latch is opened, access is provided for the insertion of a 5.25 inch (133.4 mm) standard diskette. The diskette is positioned in place by plastic guides, the front latch and a back stop.

Closing the front latch activates the cone/clamp system which centers and clamps the diskette to the drive hub. The drive hub is driven at a constant speed of 300 rpm by a servo controlled DC motor. In operation, the magnetic head is loaded into contact with the recording medium whenever the front latch is closed.

A 4-phase stepper motor/band assembly and its associated electronics position the magnetic head over the desired track. This positioner employs a one-step rotation to cause a 1-track linear movement. When a write-protected diskette is inserted into the Drive, the write-protect sensor disables the write electronics of the Drive and an appropriate signal is applied to the interface. (When performing a write operation, a 0.013-inch (0.33 mm) [nominal] data track is recorded.)

Data recovery electronics include a low-level read amplifier, differentiator, zero-crossing detector and digitizing circuits. No data decoding facilities are provided in the basic Drive.

The Drive is also supplied with the following sensor systems:

1. A track ØØ switch senses when the Head/Carriage assembly is positiond at Track ØØ.
2. The index sensor (an LED light source and a phototransistor) is positioned so that when an index hole is detected, a digital signal is generated. The index sensor used is a high resolution device which can distinguish holes placed close together, i.e., index-sector holes in a hard sectored diskette.
3. The write-protect sensor disables the Disk Drive electronics whenever a write-protect tab is applied to the diskette.

D. INTERFACE CONNECTIONS

Signal connections for the external Disk Drive are made via a user-supplied 34-pin flat ribbon connector. The internal Drive uses a Radio Shack connector, Part Number AW2535. Both of these connectors mate directly with the PC Board connector (J2) at the rear of the Drive. The DC power connector is a four-pin connector (J4) on the PC Board at the top rear of the Drive.

The signal connector harness should be of the flat ribbon or twisted pair type with the following characteristics:

1. Maximum length of 10 fee (3 M).
2. 22 - 24 gauge conductor compatible with the connector to be used.

Power connections for external Drives should be made with 18 AWG cable. Internal Drives use the Disk DC Power Harness, Radio Shack Part Number AW2532.

E. PHYSICAL CHECKOUT

Before applying power to the unit, the following inspection should be performed:

1. Front latch. Check that the front latch opens and closes. Note that when the door is opened, the head arm is raised.
2. Ensure that the front panel is secure.
3. Manually rotate the drive hub. The hub should rotate freely.
4. Check that the PC Board is secure. Check that the connectors are firmly seated.
5. Check for debris or foreign material between the heads and remove same.
6. Check plastics for broken or cracked pieces, e.g., write-protect lever, guide rails, etc.

NOTE: To ensure proper operation of the Drive, the chassis should be connected to earth ground. The 3/16-inch (4.76 mm) male QC lug, located at the rear of the chassis, is provided for this connection.

LOGIC BOARD (COMPONENT SIDE)

FIGURE 2. LOGIC/SERVO PC BOARD COMPONENT LOCATIONS

F. MOUNTING THE DISK DRIVE

The Drive can be mounted in any plane, i.e. upright, horizontal or vertical. However, when it is mounted horizontally, the Logic PC board side of the chassis must be the uppermost side. Tapped holes are provided in various locations for the attachment of user-supplied hardware.

G. FLAT RIBBON CABLE ASSEMBLY

The Flat Ribbon Cable Assembly that is used with the redesigned P.C. Board can be used with either the Model I or Model III Computers. Refer to Section I, General Description FLAT RIBBON CABLE ASSEMBLY for Connector pin configuration.

H. RESISTOR TERMINATION
(See Figure 3)

The Resistor Termination in the SIP socket (R51) is used only in the last drive in the system. Remove all other Resistor Terminations.

NOTE: The internal drives in the Model III Computer are not terminated.

FIGURE 3. RESISTOR TERMINATION

J. DATA RECORDING

Referring to Figure 5 it can be seen that the Write Electronics consists of a Write/Erase Current Source and Write Waveform Generator, Erase Current Source, and Trim Erase Control Logic.

The read/write winding on the magnetic head is center-tapped. During a write operation, current from the Write Current Source flows in alternate halves of the winding under control of the Write Waveform Generator.

Before recording can begin, certain conditions must be satisfied. The conditions required for recording (i.e., unit ready) must be established by the user system as follows:

(1) Drive speed stabilization. This condition will exist 250 mSec after starting the drive motor.

(2) Subsequent to any step operation, the positioner must be allowed to settle. This requires 20 mSec total after the last step pulse is initiated, i.e., 5 mSec for the step motion and 15 mSec for settling.

NOTE: All of the foregoing operations can be overlapped, if required.

Figure 7 shows the relevant timing diagram for a write operation. When t = Ø, the unit is ready and the WRITE ENABLE interface line goes true thus enabling the Write Current Source.

Since the trim erase gaps are behind the read/write gap, TRIM ERASE control goes true 390μSec after the WRITE ENABLE interface line. It should be noted that this value is optimized between the requirements at Track ØØ and Track 40 so that the effect of the trim erase gaps on previous information is minimized.

Figure 7 also shows the information on the WRITE DATA interface line and the output of the Write Waveform Generator which toggles on the leading edge of every WRITE DATA pulse.

Note that a minimum of 4 μSec and a maximum of 8 μSec between WRITE ENABLE going true and the first WRITE DATA pulse is only required if faithful reproduction of the first WRITE DATA transition is significant.

At the end of recording, at least one additional pulse on the WRITE DATA line must be inserted after the last significant WRITE DATA pulse to avoid excessive peak shift effects.

The TRIM ERASE signal must remain true for 800μSec after the termination of WRITE ENABLE to ensure that all recorded data are trim erased. This value is again optimized between the requirements at Tracks ØØ and 40.

The duration of a write operation is from the true-going edge of WRITE ENABLE to the false-going edge of TRIM ERASE. This is indicated by the internal WRITE BUSY waveform shown.

K. DATA REPRODUCTION

The Read electronics consists of the following:

- ★ Read Switch
- ★ Read Amplifier
- ★ Filter
- ★ Differentiator
- ★ Comparator and Digitizer

The Read Switch consists of two FETs that are used to isolate the Read Amplifier from electrical signals across the magnetic head during a Write operation.

The remaining functions of the Read circuitry are contained in the MC 3470 I C.

Before reading can begin, the Drive must be in a ready condition. As with the data recording operation, this ready condition must be established by the user system. In addition to the requirements established in the paragraph, DATA RECORDING, a 100 μSec delay must exist from the trailing edge of the TRIM ERASE signal to allow the Read Amplifier to settle after the transient caused by the Read Switch returning to the Read mode.

Referring to Figure 8 the output signal from the read/write head is amplified by a read amplifier and filtered to remove noise by a linear phase Filter. The linear output from the Filter is passed to the Differentiator which generates a waveform whose zero crossovers correspond to the peaks of of the read signal. This signal is then fed to the Comparator and Digitizer circuit. Variable Resistor R22 is used to balance the Comparator and Differentiator by adjusting out any circuit imbalances and reducing peak shift.

The Comparator and Digitizer circuitry generates a 1 μSec READ DATA pulse corresponding to each peak of the read signal. This Composite Read Data signal is then sent to the user system via the READ DATA interface line.

SECTION III

OPERATION

A. INTRODUCTION

This section contains the interface description and the electrical adjustments necessary for the Disk Drive.

B. INTERFACE ELECTRONICS SPECIFICATIONS

All interface signals are TTL compatible. Logic true (low) is +0.4 V (maximum). Logic false (high) is +2.4 V (minimum). Figure 9 illustrates the interface configuration.

FIGURE 9. INTERFACE CONFIGURATION

It is recommended that the interface cable be a flat ribbon cable, with a characteristic impedance of 100 ohms. (or equivalent twisted pairs). Maximum interface cable length is 10 feet (3 M).

C. INPUT CONTROL LINES

Interface connector pin assignments and power connector pin assignments are given in Table 2 and Table 3 in Section III of the Manual.

D. SELECT LINES (DS1* - DS4*)

The SELECT lines provide a means of selecting and deselecting a Disk Drive. These four lines (DS1* - DS4*) select one of the four Disk Drives attached to the controller. When the signal logic level is true (low), the Disk Drive electronics are activated and the Drive is conditioned to respond to step or read/write commands. When the logic level is false (high) the input control lines and output status lines are disabled.

A SELECT line must remain stable in the true (low) state until the execution of a step or read/write command is completed.

The Disk Drive address is determined by SELECT lines 1 through 4 on the PC Board. These lines provide a means of daisy-chaining a maximum of four Disk Drives to a controller. Only one line can be true (low) at a time. An undefined operation might result if two or more units are assigned the same address or if two or more SELECT lines are in the true (low) state simultaneously.

E. DRIVE MOTOR ENABLE (MOTORON)

When this signal line logic level goes true (low), the drive motor accelerates to its nominal speed of 300 rpm and stabilizes in less than 250 mSec. When the logic level goes false (high), the Disk Drive decelerates to a stop.

F. DIRECTION AND STEP (DIR*) (STEP*)

When the Disk Drive is selected, a true (low) pulse with a time duration greater than 200 nSec on the STEP line initiates the access motion. The direction of motion is determined by the logic state of the DIRECTION line when a STEP pulse is issued. The motion is towards the center of the disk if the DIRECTION line is in the true (low) state when a STEP pulse is issued. The direction of motion is away from the center of the disk if the DIRECTION line is in the false (high) state when a STEP pulse is issued. To ensure proper positioning, the DIRECTION line should be stable 0.1 μSec (minimum) before the trailing edge of the corresponding STEP pulse and remain stable until 0.1 μSec after the trailing edge of the STEP pulse. The access motion is initiated on the trailing edge of the STEP pulse.

G. COMPENSATED WRITE DATA (CWD)

When the Disk Drive is selected, this interface line provides the bit-serial WRITE DATA pulses that control the switching of the write current in the head. The write electronics must be conditioned for writing by the WRITE ENABLE line (refer to the WRITE ENABLE paragraph below).

For each high-to-low transition on the WRITE DATA line, a flux change is produced at the head write gap. This causes a flux change to be stored on the disk.

When the double-frequency type encoding technique is used (in which data and clock form the combined Write Data signal), it is recommended that: when writing all zeroes, the repetition rate of the high-to-low transitions be equal to the nominal data rate, ±0.1%. The repetition rate of the high-to-low transitions, when writing all ones, should be equal to twice the nominal data rate, ±0.1%.

H. WRITE GATE (WG*)

When this signal is true (low), the write electronics are prepared for writing data (read electronics disabled). This signal turns on write current in the read/write head. Data is written under control of the WRITE DATA input line. It is generally recommended that changes of state on the WRITE ENABLE line occur before the first WRITE DATA pulse. However, the separation between the leading edge of WRITE ENABLE and the first significant WRITE DATA pulse should not be less than 4 μSec and not greater than 8 μSec. The same restrictions exist for the relationship between the least significant WRITE DATA pulse and the

SECTION IV

MAINTENANCE

A. PHYSICAL DESCRIPTION OF THE PC BOARD

The Logic/Servo board is approximately 6 inches (152 mm) long by 5.5 inches (139 mm) wide. Figure 10 illustrates the placement of test points and connectors.

INSTALLATION

To replace the Logic P.C. Board and the Servo P.C. Board with the newer Logic/Servo P.C. Board, the following steps should be taken:

1. Discard the jumper cable that goes from P13 on the Logic P.C. Board to P20 on the Servo P.C. Board.
2. Disconnect all cables that connect the two Boards.
3. Remove both the Logic and the Servo P.C. Boards and the Servo P.C. Board mounting hardware.
4. Connect all cables except the Drive Motor Cable that was connected to P21 on the Servo P.C. Board.
5. Connect the Drive Motor Cable to P13 on the Logic/Servo P.C. Board.
6. Go through the maintenance checks again. Pay particular attention to Part H., DRIVE MOTOR MAINTENANCE and Part N., PEAK SHIFT COMPENSATION ADJUSTMENT.

B. CIRCUIT BOARD TEST POINTS

The following test point description assumes that the Logic/Servo P.C. Board is installed in the Drive and that the Drive is in an operational mode with a diskette installed:

Analog Ground (TP1)
The analog ground reference point is provided for measuring read/write waveforms.

Amplified Read Signal (TP2, TP3)
These test points are provided to observe the differential output of the first stage of read signal amplification.

Logic Ground (TP4)
Digital Logic ground is referenced at TP4.

Track ØØ (TP5)
This signal is low (true) when the carriage is positioned at track ØØ and the step motor phase is correct.

Step Pulse (TP6)
When stepping in or out, the signal is a high-going pulse for each step of the carriage.

Read Data One Shot (TP7)
The output of the one shot used in the read section is nominally 1.0 μsec for each flux transition detected.

Write Protect Switch (TP8)
When a write protected diskette is installed in the Drive, the signal is low (true).

Index Pulse (TP9)
With a standard soft sectored diskette installed, the signal is a high going-pulse, nominally 4.0 msec in duration every 200 msec.

Motor On (TP11)
This signal is low (true) for the Motor On condition.

C. OPTION SELECT

Input Line Terminations

The Disk Drive has been provided with the capability of terminating the input lines listed below:

- ★ Motor On
- ★ Direction Select
- ★ Step
- ★ Write Data
- ★ Write Gate

These lines are terminated through a 150 ohm resistor pack that is installed in a SIP socket (R51), located adjacent to J2.

In a multiple drive system, only the last drive on the interface is to be terminated. All other drives on the interface must have the resistor pack removed. Catalog Numbers 26-1160 and 26-1164 are shipped with the termination resistor installed. Catalog Numbers 26-1161/1162/1163 are shipped without a resistor pack.

FIGURE 10. LOGIC/SERVO PC BOARD TEST POINTS AND CONNECTOR LOCATIONS

D. PREVENTIVE MAINTENANCE

To ensure that the Disk Drive operates at its design potential, the only scheduled preventive maintenance required is periodic cleaning of the magnetic recording head.

Mechanical and electrical adjustment details are provided for further service as a result of disassembly or repair.

E. CLEANING THE HEAD

To clean the magnetic head, we recommend using Radio Shack's Universal Disk Drive Head Cleaning Kit, catalog number 26-407. This kit comes with complete instructions for safely cleaning the disk drive heads.

CAUTION: Rough or abrasive cloth should not be used to clean the magnetic recording head. Use of cleaning solvents other than 91% Isopropyl alcohol may damage the head.

Extreme care must be exercised to prevent the heads from being damaged (i.e., scratching, banging together, etc.).

F. ALIGNMENT AND ADJUSTMENT

To perform the alignment and adjustment procedures, you will require the following equipment:

- ★ 30 MHz Dual Trace Triggered Sweep Scope
- ★ 5 1/4" Alignment Diskette
- ★ 5 1/4" Blank "scratch" Diskette

G. DRIVE MOTOR MAINTENANCE

Long Term Motor Speed Adjustment

1. Check power to the unit. (+12 VDC ±0.6 V, and +5 VDC ±0.25 V.)

2. Insert a blank diskette and activate the drive.

3. Under fluorescent lighting, observe the speed disk on the spindle pulley. For 60 Hz operation, the outer ring on the speed disk should appear to be stationary. For 50 Hz operation, the inner ring should appear stationary.

4. If the speed disk does not seem to be motionless, adjust R54 (located in the upper right corner of the PC Board) for the desired effect.

5. If motor speed cannot be adjusted, repair the PC Board or the motor as required.

Instantaneous Speed Variation Check/RAW Data Check

1. With a blank diskette inserted, write a 2F pattern on any track.

2. Connect the 'scope to TP7 with:

   Vert. to 2 volts/div.
   Time Base to 1 μsec/div.
   Trigger internal/positive

3. Observe the waveform. Measure jitter on the leading edge of the third pulse. The leading edge of the pulse should start 8 μsec ±240 nsec from the trigger pulse. The third pulse jitter should be less than 480 nsec (edge to edge).

4. If jitter is excessive, repair or replace the drive belt, motor, PCB, or spindle as necessary.

H. CARRIAGE MOVEMENT CHECK

1. Step between tracks 00 and 34/40.

2. Check carriage movement. Be certain that carriage is moving freely and not binding at any point. Repair if necessary.

I. HEAD RADIAL ALIGNMENT/CE ALIGNMENT

1. Insert a 5 1/4" alignment diskette.

2. Connect Scope:
   Channel A to TP2
   Channel B to TP3
   Ground to TP1
   Ext. Sync. to TP9

   Set mode to add (A + B) Invert B
   Vert. to 20 mV/Div
   Trigger external - loosely.

3. Read track 16 and verify the "cat eyes" pattern as shown in Figure 12. The smaller of the two "eyes" should not be less than 75% amplitude of the other. (% = small lobe/larger lobe x 100)

FIGURE 12. "CAT EYES" PATTERN

4. Step to track ØØ. Return to track 16 and re-verify the pattern.

5. Step to track 34/4Ø and return to track 16. Re-verify the "cat eyes" pattern

If Radial Needs Adjustment:

a. Loosen the two retaining screws on back of the unit and the retaining screw on the carriage assembly.

b. Turn the Adjustment Cam until the "cat eyes" pattern is within 75%. If the pattern does not come within spec, loosen the hex head screw on the collar of the stepper motor and rotate the stepper motor shaft until the "eyes" are to the 75% level. Tighten the hex head screw and return to step a.

c. Tighten all screws and recheck adjustment.

FIGURE 13. RADIAL ADJUSTMENT

Refer to SECTION IV, MAINTENANCE, in the main body of this manual for the two procedures listed below:

J. TRACK ØØ ALIGNMENT

K. INDEX SECTOR ADJUSTMENT

L. HEAD AMPLITUDE/COMPLIANCE CHECK

1. Insert a blank diskette and write a pattern to track 34.

2. Set Scope:
   Time Base to 1Øμsec/div.
   Read the amplitude.

3. Apply an additional 15 grams of pressure to the head load arm. (15 grams is approximately equal to the weight of a 25 cent peice.

4. Observe the amplitude. If it increases more than 1Ø%, the compliance needs to be adjusted.

5. To adjust the compliance, loosen the two nuts that hold the head load arm in place. While monitoring the amplitude, move the arm until output is highest. Hold the arm in this position and tighten the nuts.

6. Re-verify compliance. If compliance cannot be adjusted properly, replace the head load arm.

PEAK SHIFT COMPENSATION ADJUSTMENT

R22 is adjusted as follows:

1. With a blank diskette inserted, write a 2F pattern on the innermost track (track 39).

2. Connect the 'scope to TP7 with:

   Vert. to 2 volts/div.
   Time Base to 1 μsec/div.
   Trigger internal/positive

3. The waveform should look like this:

4. Adjust R22 to center the second pulse between the first and third pulses with a maximum jitter of 240 nanoseconds.

M. FINAL CHECK

1. Use the drive to format and backup a blank diskette.

2. Check the diskette in a known good drive.

FIGURE 17. UPPER ARM AND CARRIAGE

PARTS LIST
Logic/Servo Controller Board
(Redesign)

Symbol	Description	Manufacturer's Part Number	Radio Shack Part Number
	PC Board (Rev C)	————	105050-001
	CAPACITORS		
C1	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C2	0.1 μF, 100 VDC, Polyester	ACC302KLGP	250001-233
C3	0.1 μF, 100 VDC, Polyester	ACC302KLGP	250001-233
C4	Not Used	————	————
C5	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C6	0.47 μF, 50 V, Z5U, Radial	ACC474ZJCP	250001-647
C7	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C8	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C9	0.47 μF, 50 V, Z5U, Radial	ACC474ZJCP	250001-647
C10	68 pF, 50 V, Radial	ACC680KJCP	250001-068
C11	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C12	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C13	330 pF, 50 V, Radial	ACC331KJCP	250001-133
C14	0.47 μF, 50 V, Z5U, Radial	ACC474ZJCP	250001-647
C15	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C16	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C17	470 pF, 50 V, Radial	ACC471KJCP	250001-147
C18	3300 pF, 100 V, Polyester	ACC302KLGP	250001-233
C19	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C20	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	251002-410
C21	470 pF, 50 V, Radial	ACC471KJCP	250001-147
C22	0.01 μF, 63 V, Axial	ACC103KJHA	250102-210
C23	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C24	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C25	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C26	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C27	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C28	0.022 μF, 50 V, Axial	ACC223KJCA	250002-722
C29	0.1 μF, 100 VDC, Polyester	ACC104JLGP	251002-610
C30	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C31	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C32	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C33	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C34	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C35	100 μF, 16 V, Electrolytic, Axial	ACC107WDAA	261002-310
C36	100 μF, 16 V, Electrolytic, Axial	ACC107WDAA	261002-310
C37	10 μF, 16 V, Electrolytic, Axial	ACC106WDAA	261002-410
C38	0.1 μF, 50 V, Z5U, Radial	ACC104ZJCF	250002-610
C39	330 pF, 50 V, Radial	ACC331KJCP	250001-133
	CONNECTORS		
J1	Header, 5-pin, Right Angle	AJ6815	312000-005
J2	On PC Board	————	————
J3	Header, 23-pin Right Angle	AJ7049	312000-023
J4	Housing, 4-pin, PC Mount, Power	ART2738	313000-004
J5	Header, 5-pin, Right Angle	AJ6815	312000-005

PARTS LIST (Cont'd)
Logic/Servo Controller Board
(Redesign)

Symbol	Description	Manufacturer's Part Number	Radio Shack Part Number
	DIODE		
CR1	1N5240B, 10%, Zener	ADX1582	600008-001
	INDUCTORS		
L1	390 μH, 10%, Axial	ACA8058	461391-010
L2	390 μH, 10%, Axial	ACA8058	461391-010
L3	5.6 μH, 10%, Axial	ACA8194	461506-010
L4	5.6 μH, Axial	ACA8194	461506-010
	INTEGRATED CIRCUITS		
U1	74LS123	AMX3803	610002-123
U2	MC3470	AMX4467	610010-470
U3	74LS74	AMX3558	610002-074
U4	74LS26	AMX4522	610002-026
U5	7438	AMX3683	610002-038
U6	74LS11	AMX3554	610002-011
U7	74LS86	AMX3701	610002-086
U8	LM2917	AMX4181	610020-917
U9	74LS14	AMX3716	610002-014
U10	74LS14	AMX3716	610002-014
U11	74LS74	AMX3558	610002-074
U12	ULN2003A	AMX4513	610010-413
	RESISTORS		
R1	62 ohms, 1/2 W, 5%	AN0110EFC	550003-062
R2	11 K, 1/4 W, 2%	AN0285CEE	540300-113
R3	24 K, 1/4 W, 2%	AN0526CEE	540300-243
R4	10 K, 1/4 W, 5%	AN0281EEC	550001-310
R5	2.2 K, 1/4 W, 5%	AN0216EEC	550001-222
R6	2.2 K, 1/4 W, 5%	AN0216EEC	550001-222
R7	4.7 K, 1/4 W, 5%	AN0247EEC	550001-247
R8	475 ohms, 1/4 W, 1%	AN0627BEE	540104-750
R9	330 ohms, 1/4 W, 2%	AN0159CEE	540303-303
R10	475 ohms, 1/4 W, 1%	AN0627BEE	540104-750
R11	768 ohms, 1/4 W, 1%	AN0572BEE	540107-680
R12	768 ohms, 1/4 W, 1%	AN0572BEE	540107-680
R13	Not Used	———	———
R14	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R17	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R18	470 ohms, 1/4 W, 5%	AN0169EEC	550001-147
R19	470 ohms, 1/4 W, 5%	AN0169EEC	550001-147
R20	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R21	1.8 K, 1/4 W, 2%	AN0210CEE	540300-182
R22	50 K, Trimmer, 20%	AP7211	560150-302
R23	10 K, 1/4 W, 5%	AN0281EEC	550001-310

PARTS LIST (Cont'd)
Logic/Servo Controller Board
(Redesign)

Symbol	Description	Manufacturer's Part Number	Radio Shack Part Number
R24	Not Used	————	————
R25	10 K, 1/4 W, 5%	AN0281EEC	550001-310
R26	240 ohms, 1/4 W, 5%	AN0151EEC	550001-124
R27	240 ohms, 1/4 W, 5%	AN0151EEC	550001-124
R28	Not Used	————	————
R29	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R30	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R31	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R32	0 ohms	AJ6814	550000-001
R33	3.3 K, 1/4 W, 2%	AN0230CEE	540300-332
R34	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R35	150 K, 1/4 W, 2%	AN0384CEE	540301-503
R36	470 ohms, 1/4 W, 5%	AN0169EEC	550001-147
R37	1 M, 1/4 W, 5%	AN0445EEC	550001-510
R38	3.3 K, 1/4 W, 2%	AN0230CEE	540300-332
R39	470 ohms, 1/4 W, 5%	AN0169EEC	550001-147
R40	1 M, 1/4 W, 5%	AN0445EEC	550001-510
R41	10 K, 1/4 W, 5%	AN0281EEC	550001-310
R42	1.5 K, 1/4 W, 5%	AN0206EEC	550001-215
R43	150 ohms, 1/4 W, 5%	AN0384CEE	540301-503
R44	10 ohms, 1/4 W, 5%	AN0063EEC	550001-010
R45	1 ohm, 1/2 W, 5%	AN0022EFC	550003-001
R46	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R47	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R48	2.2 K, 1/4 W, 5%	AN0216EEC	550001-222
R49	1 K, 1/4 W, 5%	AN0196EEC	550001-210
R50	20 K, 1/4 W, 5%	AN0306EEC	550001-320
R51	150 ohms, 6-pin SIP	ARX0241	570004-001
R52	56 ohms, 1/4 W, 5%	AN0013EEC	550001-056
R53	150 ohms, 1/4 W, 5%	AN0142EEC	550001-151
R54	1 K, Trimmer, 10%	AP7210	561501-301
R55	2.2 K, 1/4 W, 5%	AN0216EEC	550001-222
R56	150 ohms, 1/4 W, 5%	AN0142EEC	550001-151
	TRANSISTORS		
Q1	MPS3906	AMX3584	630007-001
Q2	MPS3906	AMX3584	630007-001
Q3	MPS3906	AMX3584	630007-001
Q4	MPS2907	AMX4187	630008-907
Q5	2N5460, FET	AMX4782	630006-001
Q6	2N5460, FET	AMX4782	630006-001
Q7	TIP110, Power	AMX4331	630003-110
Q8	2N4124	AMX4178	630002-001
Q9	2N4124	AMX4178	630002-001

PARTS LIST (Cont'd)
Logic/Servo Controller Board
(Redesign)

Symbol	Description	Manufacturer's Part Number	Radio Shack Part Number
	MISCELLANEOUS		
TP1	Staking Pin	AHB9682	310024-001
TP2	Staking Pin	AHB9682	310024-001
TP3	Not Used	———	———
TP4	Not Used	———	———
TP5	Staking Pin	AHB9682	310024-001
TP11	Staking Pin	AHB9682	310024-001
(Q7)	Heat Sink, TO220	———	405351-001
(Q7)	Screw, 4-40 x 3/8", Phillips	AHD2249	411351-406
(Q7)	Nut, 4-40	AHD7227	410020-001
(R51)	Socket, 6-pin, SIP	AJ7048	311500-006

FIGURE 18. ILLUSTRATED PARTS — EXPLODED VIEW

PARTS LIST
ILLUSTRATED PARTS CATALOG

ITEM NUMBER	DESCRIPTION	MANUFACTURER'S PART NUMBER	RADIO SHACK PART NUMBER
1	Front Panel	8852025	AZ5380
2	LED Assembly (Panel)	8852020	AL1127
3	Front Panel Bushing	8852026	AHB9684
4	Left Hand Guide	8852024	ART2743
6	Write Protect Switch Assembly	8852017	AS2587
7	Index Assembly, Type I	8852019	ART2739
	Type II*	8852043	ART2895
8	Detector Holder	8852048	ART3003
9	Spring Module	———	ARB7167
10	SSR Spring	8852060	ARB6845
11	SSR Spring Housing	8852059	ART3006
12	Lower Bearing	8852028	ART2745
13	Drive Belt	8852018	AB6443
14	Drive Motor Assembly	8852015	AM4545
15	Not Used	———	———
16	Track ØØ Screw	8852057	AHD1601
17	E-ring, large (cam)	8852049	AHE0029
18	E-ring, small (Track ØØ)	8852051	AHE0031
19	Track ØØ Switch Assembly	8852016	AS2586
20	Upper Bearing	8852027	ART2744
21	Hub Retainer	8852055	AHB9985
22	Hub Retainer Screw	8852056	AHD1600
23	Machined Hub Assembly	———	ART2740
24	Cone Assembly (2 pcs.)	8852021	ART3511
25	E-ring, medium (cone)	8852050	AHE0030
26	Latch Assembly	8852022	ADA0303
27	Foam Cone Lever Pad	8852063	AHB9986
29	Right Hand Guide	8852023	ART2742
30	Crimp Pin (tin)	8852045	AHB9982
	(gold)	8852046	AHB9983
	(inside Head Plug)		
31	Upper Arm Assembly	8852044	ART3002
32	Carriage Shaft	8852065	ART3050
33	Head Carriage Assembly	8852031	AH4403
34	Shaft Mounting Clamp	8852064	AHC0048
35	Drive Band, (Stepper)	8852032	ART2746
36	Collar, (Stepper)	8852047	AHB9984
37	Track ØØ Stop Kit	8852052	ART3004
38	Module Cam Screw	8852058	AHD1602
39	Logic/Servo PC Board	———	———
not shown	Module Cover, clear plastic	8852062	ART3007
	Cone Lever Assembly	8852053	ART3005
	includes: cone assembly, E-ring, med., latch assembly, and foam cone lever pad		
	Module Assembly SSR	8852029	AXX0318
	includes: upper arm assembly, carriage shaft, head carriage assembly, shaft mounting clamp, drive band, collar, track ØØ stop kit, and module cam screw		

*Type II Assemblys have a gold band around the photo transistor.

NOTES:

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3. REFERENCE DESIGNATORS NOT USED: R13, R24, R28 AND C4
4. LAST NUMBERS USED: R56 AND C39

FIGURE 19A. MINI-DISK DRIVE (REDESIGNED) SCHEMATIC DIAGRAM (Sheet 1)

FIGURE 19A. MINI-DISK DRIVE (REDESIGNED) SCHEMATIC DIAGRAM (Sheet 2)

RADIO SHACK A DIVISION OF TANDY CORPORATION

U.S.A.: FORT WORTH, TEXAS 76102
CANADA: BARRIE, ONTARIO L4M 4W5

TANDY CORPORATION

AUSTRALIA	BELGIUM	U. K.
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