SERVICE MANUAL

SINGER MODEL 1501
PROCESSOR

SINGER
BUSINESS MACHINES

Edition Letter	Suffix	Description
None	00	Original Printing - April 1975

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SINGER MODEL 1501

PROCESSOR

23-0563-500
MARCH, 1975

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SECTION I

PRODUCT DESCRIPTION

1-1. SCOPE OF THIS MANUAL

This manual includes all information necessary for operation, preventive and corrective maintenance at field level on the Singer Model 1501 Intelligent Terminal; hereafter referred to as the "1501". (Differences between the 1501 and the 1533, an optional Dual-Tape-Drive device which can be connected to the 1501, are given, where this operation, preventive and corrective maintenance is affected.) Special attention is directed to Section III, Modular Maintenance, since familiarity and understanding of this section will aid in troubleshooting and maintenance. The maintenance discussed in this manual is limited to field level, i.e. that which is performed to a sub-assembly level only. A sub-assembly can be a printed circuit board, a mechanical/electrical assembly (such as the CRT Visual Display Unit). Preventive Maintenance inspections to be performed, step-by-step adjustment procedures for each applicable sub-assembly, and removal and replacement of sub-assemblies are included. A Table of Known Symptoms and Causes is provided to minimize equipment down-time.

Section V identifies the sub-assemblies and associated controls and adjustments, so that once a faulty function has been isolated (via the table of known symptoms and causes), the affected sub-assembly can be quickly replaced.

1-2. GENERAL DESCRIPTION

The Singer Model 1501 shown, in Figure 1-1, is a single desk top unit that provides all the functions of a mini-computer with a visual display. Input information is received from magnetic tape or by operator input via a keyboard. Operator controls other than the keyboard include system reset switches, program load and program interrupt switches. A solid state memory (4K or 8K byte) offers space to store a desired program of instructions for problem solving and processing.

The basic 1501 contains two tape drives that can serve as either input or output devices. Additional tape drives may be connected by application of the 1533 dual cartridge tape drive. Each unit contains two tape drives and a maximum of three units may be added to an individual 1501 system. Another option available is the 1530 numeric keypad offering numeric entries for those who are familiar with accounting machines rather than standard keypunch types.

1-3. SINGER MODEL 1501 CHARACTERISTICS

DC power within the 1501 system is supplied by conventional diode type rectifiers utilizing series type regulators, providing +5VDC, +12VDC, -12VDC, +19VDC, and +21.5VDC. Table 1 contains the electical and physical data of the 1501.

Figure 1-1. Singer, Model 1501 Intelligent Terminal

TABLE 1

Characteristics Of Singer Model 1501

Physical
 Overall dimensions Height 10" (25 CM), Width 18.5" (47 CM), Length 24" (60 CM)
 Weight (uncrated)   64 lb. (29 Kg)

Electrical
 Input Requirements
        Voltage----------- 100V RMS nominal, 50/60 Hz
        Range----------- 90V - 110V RMS
        Voltage----------- 115V RMS nominal, 50/60 Hz
        Range----------- 104V - 129V RMS
        Voltage----------- 230V RMS nominal, 50/60 Hz
        Range----------- 208V - 258V RMS
 Selection made by taps on the power supply by terminal jumpers.
 Protection rated at 2.5 times the full load RMS input.

 Output Requirements
        + 5VDC $\pm$3%   50 MV ripple
        +12VDC $\pm$3% 100 MV ripple
        -12VDC $\pm$3%   60 MV ripple
        +19VDC $\pm$3% 100 MV ripple
     +21.5VDC $\pm$5% 200 MV ripple
 Tolerances will correct for input variation, load variation from 0 to
 full load, short term drift over an 8 hr. period, 0 to peak of ripple.

 Protective Circuits
     +5V contains an overvoltage protection activated between 5.6VDC
     minimum and 6.2VDC maximum.
     +19V contains an overvoltage protection activated between 21VDC
     minimum and 22VDC maximum.

     The power supplies are fused as follows:
           +5VDC --- 20 amps
          +12VDC --- 6 amps
          -12VDC --- 6 amps
          +19VDC --- 3 amps

SECTION II

PRINCIPLES OF OPERATION

2-1.   GENERAL INFORMATION

Figure 2-1 illustrates the block diagram of the 1501 system. The 1501 system combines two magnetic tape transports, an input keyboard, a CRT visual display, I/O interfaces, a solid state memory and an arithmetic processor into a single desk top unit.

In this section the sub-units of the 1501 system will be discussed functionally. Reference to figure 2-1 should be made to facilitate the functional discussion.

2-2.   MEMORY BOARD (Figure 5-2)

The 1501 system memory is contained on a single card that plugs into the processor board. The memory is made up of MOS (metal oxide semi-conductor) chips and is available in 4K or 8K bytes (8-bit bytes) of random access storage. Both the processor and CRT have direct access to memory.

2-3.   PROCESSOR BOARD (Figure 5-2)

The processor board is the functional center of action within the 1501 system. All information to or from the solid state memory must be routed through it. It operates in conjunction with and is directly associated with the T/C/I board.

The processor board performs the following specific tasks; it provides timing signals for each instruction cycle, decodes each non-I/O instruction of the running program, generates proper control signals for the remainder of the processor logic, maintains an adder which performs arithmetic and logical operations on command from specific program instructions, contains the interrupt logic for the system and contains the Program Load ROM (read only memory).

2-4.   T/C/I BOARD (Figure 5-3)

The Tape/CRT/I/O board (T/C/I) provides an interface between the processor, the cartridge tape drives (including the tape amplifier with pre-amplifier and tape motion control board), the keyboard, the CRT visual display, the serial I/O devices, add-on cartridge tape drives, add-on numeric keypad and the add-on communication adapter boards.

The T/C/I board maintains an 8 bit Accumulator which is a functional part of the processor, controls the serial I/O functions, generates control signals for the peripheral devices, and selects the individual tape deck in accordance with internal program needs.

2-5.   CARTRIDGE TAPE DRIVES (Figure 5-7)

The 1501 system contains two independent cartridge tape drive units, which are functionally identical. Each tape cartridge contains computer-grade polyester magnetic tape. Each cartridge is equipped with a write-enable pin to prevent erasing or writing on the tape except when the pin is in place. A tape drive consists of a transport mechanism and a tape motion control circuit board.
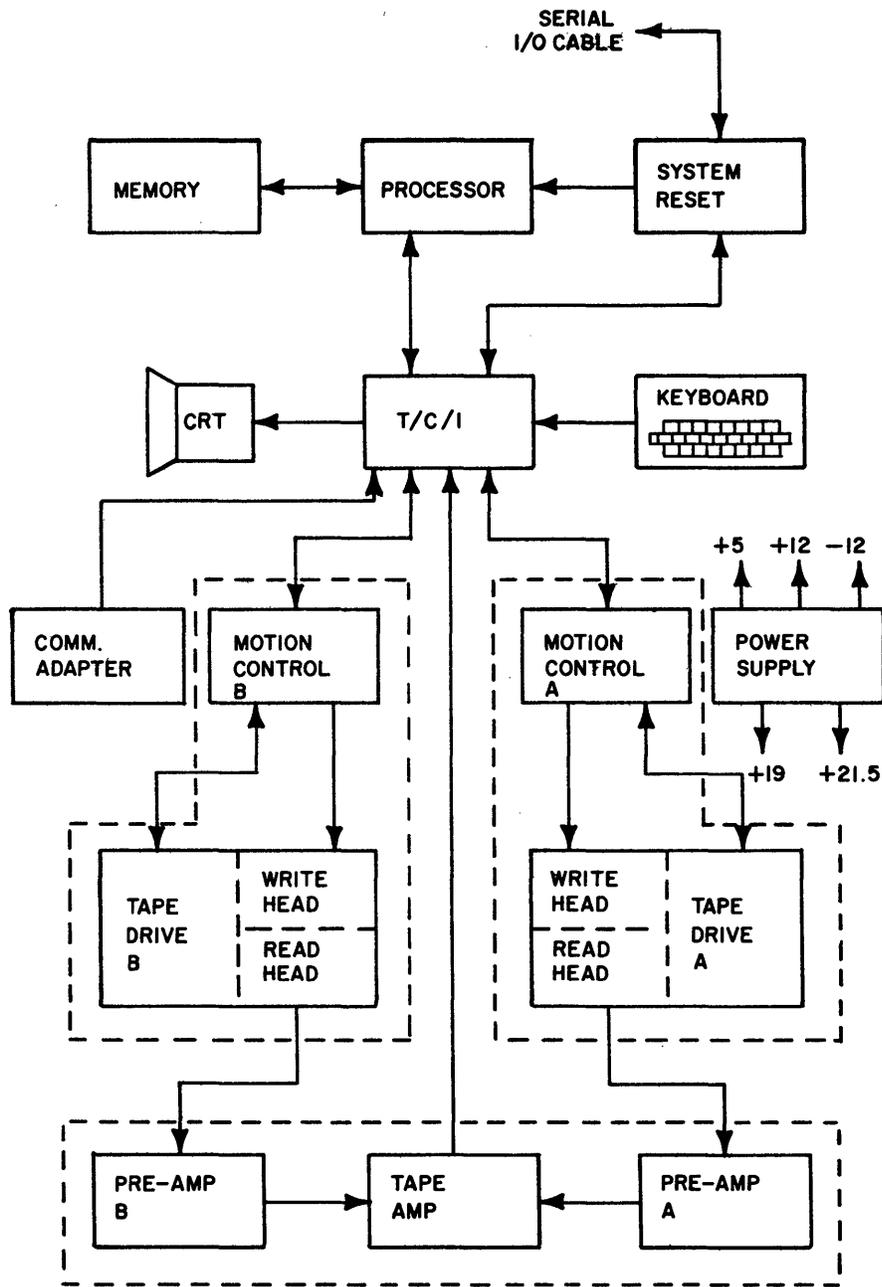
Figure 2-1. Model 1501 Intelligent Terminal Functional Block Diagram

The tape transport supplies a regulated capstan and the take-up and supply reels for the cartridge, a manual rewind switch; and checks for the tape status conditions; such as tape cartridge loaded, tape not fully rewound (tape must be fully rewound before the cartridge can be removed), end of tape and cartridge write enabled.

The Motion Control Board (paragraph 2-6) powers the motors of the tape transport and generally remains attached as an integral part of the whole tape drive assembly during its lifetime.

2-6.   TAPE MOTION CONTROL BOARD (Figure 5-13)

The Tape Motion Control Board provides the means of regulating cartridge tape travel. The speed is 10 inches per second during Read/Write operations and 40 inches per second during Search/Rewind operations (Search operations can be conducted in either direction of tape motion). Command signals from the T/C/I board in conjunction with status signals from the tape transport, cause the tape to operate in one of the speed modes mentioned above.

Tape format, read forward/backward, start/stop time delays, read/write checking, record size, inter-record gaps, and the number of retries are controlled by the internally stored program. The motion control board generates the end-of-tape status signal when the reflective marker on the tape is sensed.

2-7.   TAPE AMPLIFIER BOARD (Figure 5-8)

The tape pre-amplifiers amplify the signals from the read heads of the tape transports and sends these signals to the tape amplifier. The pre-amplifiers connect directly to read heads and are part of the tape amplifier board. The tape amplifier, amplifies and conditions the signals from the pre-amplifiers and sends them to the T/C/I board.

2-8.   CRT VISUAL DISPLAY (Figure 5-5)

The CRT Visual Display is equipped with a cathode ray type screen that can display up to 256 characters in 8 rows of 32 characters each. Each character is formed from a 5 x 7 dot matrix pattern. An eighth dot can be displayed for cursor, underscore, etc. and is a programmable function. The memory stores the dot matrix pattern for each character type. The CRT display is controlled and timed by the T/C/I board. Data and control signals that come from the T/C/I board are horizontal and vertical sweep, and data pulses.

2-9.   KEYBOARD (Figure 5-4)

The keyboard is the device by which an operator enters data or responds to instructions displayed on the CRT by depressing one or more keys. Depression of a key causes a code corresponding to the physical location of the key to be transmitted to the T/C/I board.

2-10.   SYSTEM RESET BOARD (Figure 5-6)

The system reset board serves two functions. When the system AC switch is turned on, an initial signal that is generated occurs during power supply stabilization. This is the general clear and insures that all logic conditions are in a ready state. The system reset board also amplifies serial I/O data transmitted on the Serial I/O cable. All serial I/O data is to or from the T/C/I board, via the system reset board.

2-11.   POWER SUPPLY (Figure 5-14)

The power supply provides the regulated DC operating voltages for the 1501 system; from 100VAC, 115VAC or 230VAC line source. Outputs are +12VDC @3A, -12VDC @3A, +5VDC @15A, +19VDC @2.5A, and +21.5VDC @50 ma. The +19VDC and +5VDC outputs are over-voltage protected.

2-12. WIRED MODULE (Figure 5-11)

The wired module is composed of five connectors mounted in a removeable panel located on the side of the 1501 system. The connectors are wired together supplying the interconnect wiring for the Processor, T/C/I, and communications adapter boards.

2-13. 1500 SERIES ACCESSORIES

Several options are offered as accessories to the 1501 system. The 1530 Keypad can be plugged into the 1501 Keyboard, and offers easy numeric entry for those operators who are familiar with accounting machine keyboards. Figure 2-2 illustrates the 1530 keypad.

Other options offered include the 1533 dual tape drives that can operate in conjunction with the 1501 system. The 1533 tape drives are identical to the tape drives housed in the 1501 unit.

The Model 1533 Dual Drive cartridge tape system is a peripheral device for the Model 1501 Intelligent Terminal. Cartridge tape drives of 1500 processors function under the 1501 controlling program in pairs; one pair is housed in the 1501, and 1533 Dual Drive units can provide as many as three extra pairs.

Via programming, the pair of drives to be used is selected, and either the first or second drive of the pair is activated. The two drives housed in the 1501 are Pair 1, the first 1533 unit connected houses Pair 2, and so on.

Any function which can be performed by a tape drive in the 1501 can be performed by a drive in a 1533 in normal processing of data. An operating program for
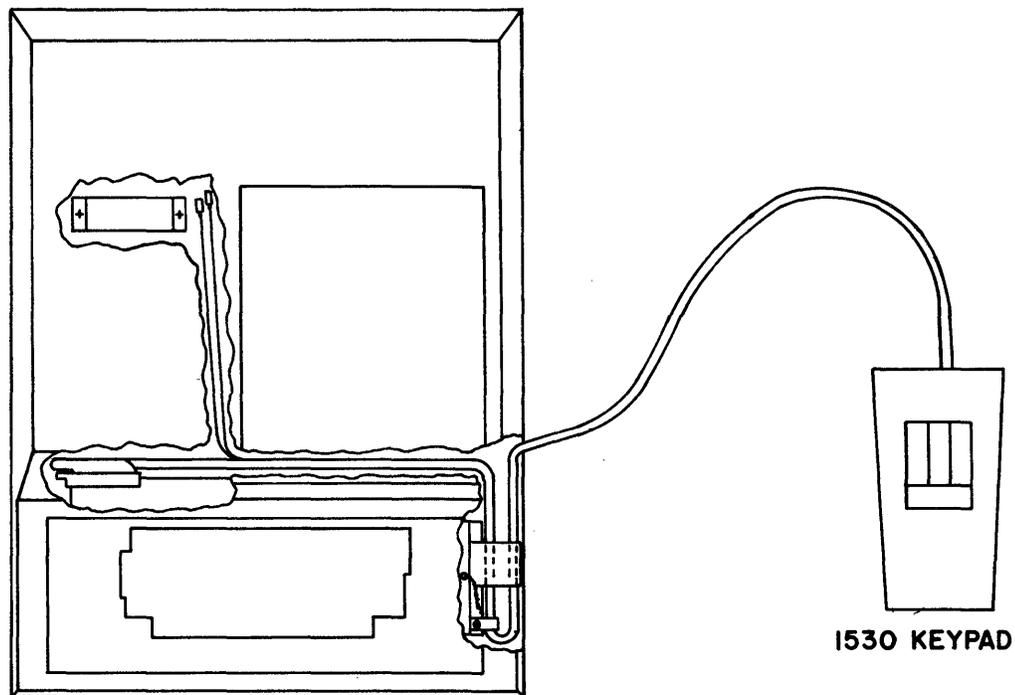

1530 KEYPAD

Figure 2-2. 1530 Numeric Keypad

the 1501, however, can not be loaded from a 1533 drive except as a subroutine of a program already running in the 1501. Drive 2 of Pair 1 (in the 1501) is the only tape drive capable of initial program loading in normal use.

Figure 2-3 illustrates the connections which add 1533 Dual Drives to a 1501 processor.

The +12 Volt and -12 Volt power supplies are separate removable components located at the rear of the 1533. They are available for either 110 V.A.C. or 220 V.A.C. operation, or a Field Engineer can modify them to accommodate either - but not both of these main levels.

Logic elements are supplied by a series regulator assembly which regulates the +12 Volt power supply output down to a +5 Volt level.

The Multiplex Board is the central element of the 1533. It accepts all inputs from the 1501 and transfers all 1533 outputs back to the 1501. It also provides signal transfer between the 1501 and the next 1533 Dual Drive connected into a system.

The Tape Amplifier processes data from tape drive read heads, converting the analog signal received to digital logic levels. It includes two preamplifiers which connect directly onto read heads and amplifies the tape signal detected.

Tape drives of the 1533 are identical to cartridge drives used in all 1500 Series hardware. They accept 1500 tape cartridges and employ electro-mechanical switches to monitor tape status and control the "write-protect" features. The drives are capable of detecting presence of a tape cartridge, detecting fully rewound conditions, and detecting the presence of write-enable pin inserted into the bottom side of a cartridge. They thread tape automatically onto reels and detect the upcoming end of available tape before the end of the reel is actually reached. All of these features are monitored by the 1501 operating program and operating results of their presence are wholly dependent on the program being used.

As shown in Figure 2-3, the first 1533 interfaces directly into a 1501 and each 1533 will interface to another like unit. Every 1533 includes this add-on capability, but the multiplexing circuitry of the 1501 processor can not support more than three 1533 Dual Drives.

There are seven main functional components in the 1533, as illustrated in figure 2-4. Comparison with Figure 2-1 shows a great deal of physical similarity between the 1501 and the 1533 units. The board descriptions are the same for both units. In the case of the 1533 unit the Multiplex board replaces the tape drive control portion of the T/C/I board and serves as an interface between the 1501 unit and the 1533 unit or adjacent 1533 unit.

2-14. COMMUNICATIONS ADAPTER BOARDS

The 1501 system accommodates optional communication adapter boards, that allow asynchronous or bi-synchronous communications. Only one of these boards may be plugged into the 1501 unit at a time.

TO
A.C. POWER

TAPE/CRT/IO
BOARD

1533
(PAIR 2)

1533
(PAIR 3)

1533
(PAIR 4)

MULTIPLEX BOARD

"D" CONN. ON T/C/I BOARD
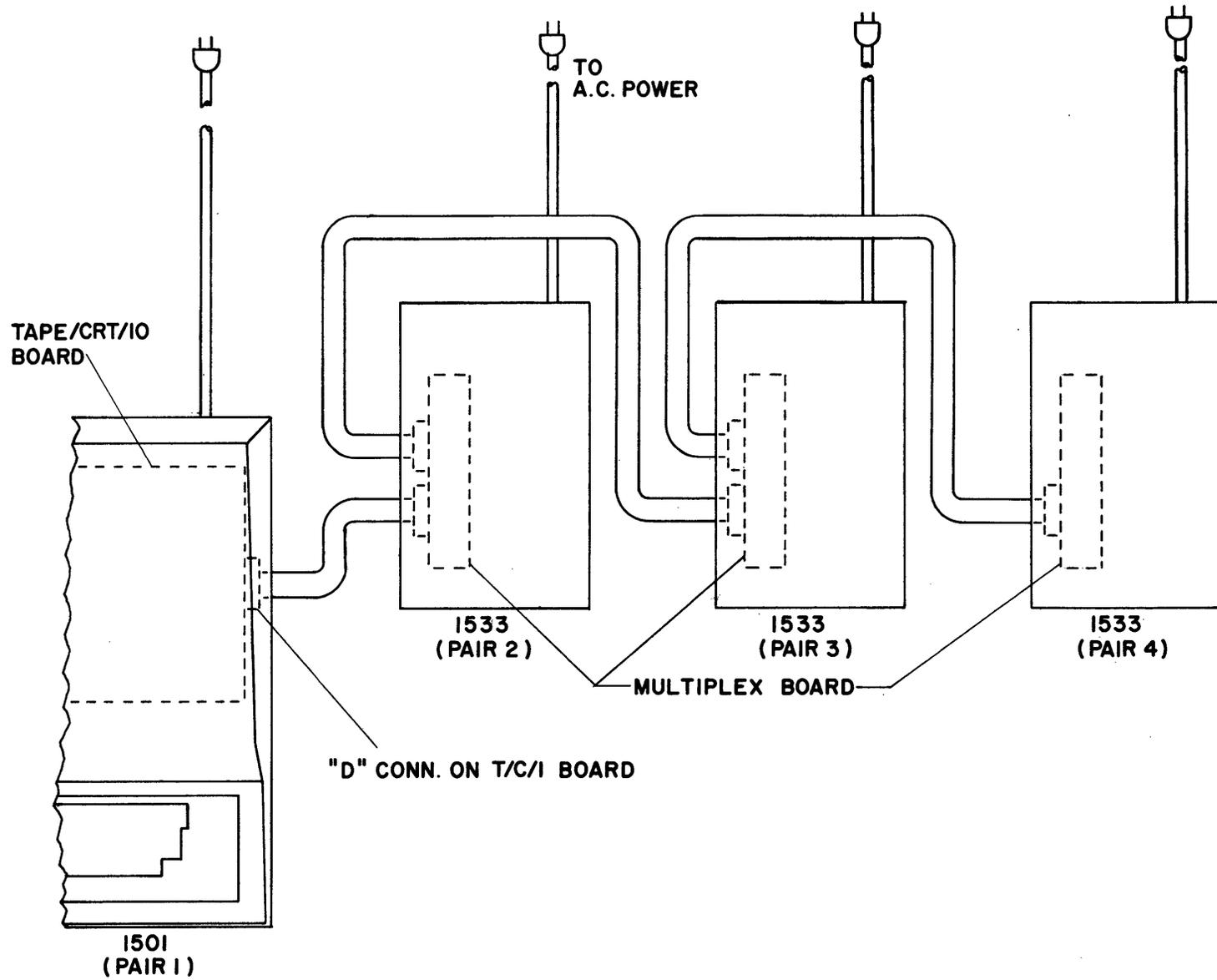
1501
(PAIR 1)

Figure 2-3. 1501/1533 Functional Diagram
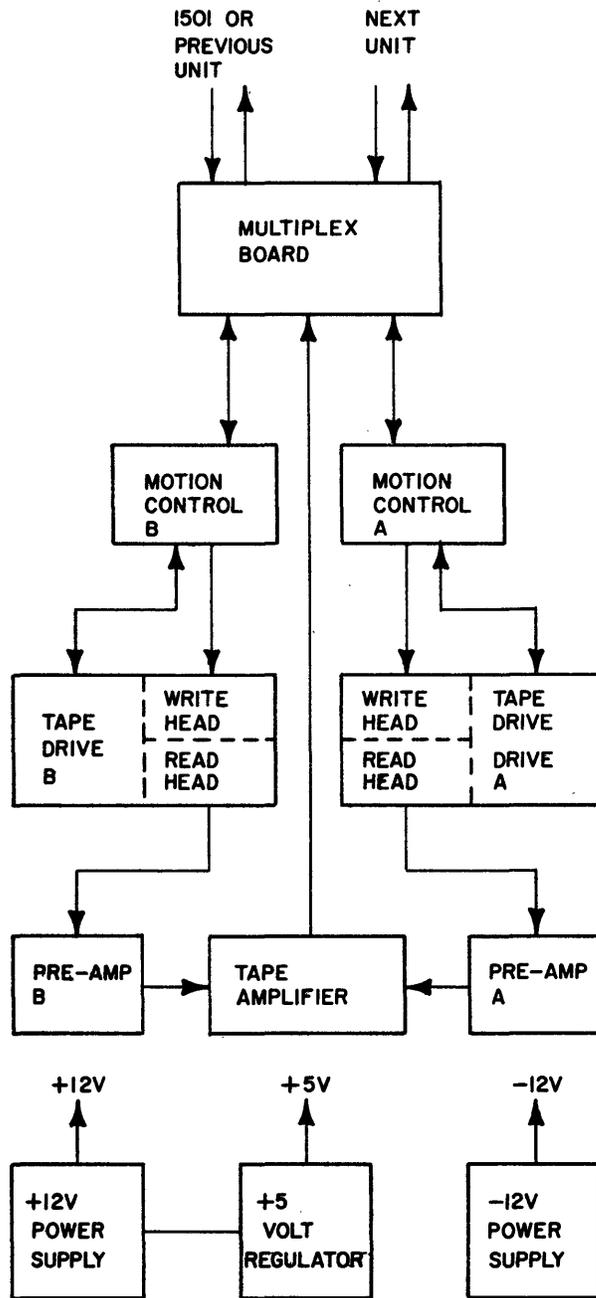
Figure 2-4. Model 1533 Block Diagram

The 1534 communications adapter board allows communication (with a modem) in asynchronous applications. The 1535 communications adapter board allows communication (with a modem) in synchronous applications. Both communications adapter boards contain transmitter, receiver, clock and control circuits required for communications. Both interfaces are in compliance with EIA RS-232-C and CCITT V24 standards.

2-15. OPERATOR CONTROLS

The 1501 system has relatively few operator controls aside from the keyboard. Figure 2-5 illustrates the control locations of the 1501 unit. The AC Power ON/OFF switch is located on the right side panel. A well located beneath the CRT display contains the Program Load/Program Interrupt, and System Reset Switches. For the 1501 Tape Drives, there is a manual rewind switch located on the top of each drive between the supply and take-up reels. There is also a cartridge lock lever which is used to lock the tape cartridge in place.

1. Program Load/Program Interrupt

2. System Reset

Figure 2-5. Model 1501 Control Locations

2-16. FUNCTIONAL FLOW OF OPERATING MODES (Figure 2-1)

The functional flow breaks down into several major modes of operation. These modes are broken down as to their relationship to two physical equipment areas; tape drive operations, and keyboard and CRT visual display.

2-17. 1501 TAPE FUNCTIONS

The processor board fetches instructions from the memory board and generates the proper control signals for tape operations. These control signals are then sent to the T/C/I board. The tape drive pair and deck selection is performed by the T/C/I board in accordance with associated program instructions. The first "pair" of drives are those on the 1501 unit, the second "pair" are those in the first 1533 and so on. Speed and direction of tape travel is controlled by the Tape Motion Control Board in accordance with the control signals from the T/C/I board.

The modes of operation are; read, write, search and rewind. After the proper tape deck is selected, the T/C/I board instructs the selected tape deck's Motion Control Board to move the tape in the forward direction at the rate of 10 inches per second.

If the read circuits are enabled after appropriate software delays, data may then be read from tape. The tape data is read by the read head of the selected deck. The data is then fed to the Tape Amplifier where it is converted to digital information. This data is then sent to the read circuits of the T/C/I board. The processor board then receives this data from the T/C/I board via the accumulator and places it in memory.

If the write circuits are enabled after appropriate software delays, data may then be written on tape. The data is fetched from the Memory Board by the Processor Board and then sent to the T/C/I Board via the accumulator. The T/C/I Board then sends the data to the selected tape deck. The Motion Control Board does not alter the Write data, except funnel it to the write head if the write enable pin has been placed in the associated tape cartridge.

A Search Tape enable and a selected tape deck causes the associated Tape Motion Control Board to move the tape in either the forward or reverse direction at the rate of 40 inches per second. The T/C/I Board then enables its read circuits to receive tape sprocket pulses. A tape sprocket pulse will be generated by the T/C/I board whenever a block of information on the tape is sensed going by the read head. When the program determines that approximately the correct number of blocks have passed the read head, it instructs a slowdown to a normal tape speed of 10 inches per second. A normal read and check sequence begins in order to locate the desired block of information.

Tape can be rewound in one of two ways. One way is by the rewind switch on the tape drive itself. The second is via a command issued by a running program. Once a rewind sequence is initiated, it cannot be interrupted until fully completed. During a rewind the tape drive is in the reverse direction at a rate of 40 inches per second. The tape motion stops when the tape is fully rewound.

The Program Load switch located in the switch well beneath the CRT visual display can be used to load a program. When the switch is pushed toward the CRT, it initiates a Memory Load from the ROM (read only memory) on the processor board. The ROM contains a small tape loading program. This program reads and loads the first record of tape into memory, then transfers control to that newly loaded program to load the rest of the tape.

2-18. KEYBOARD ENTRY AND CHARACTER DISPLAY

The Keyboard and CRT visual display are used by the running program to communicate with the operator in a conversational manner. The running program displays a question on the CRT visual display. The operator answers the question by depressing one or more keys on the Keyboard. When a character is depressed, a six bit code is generated by the keyboard hardware and sent directly to the accumulator on the T/C/I board. Two other bits (making a total of 8) are used to indicate if a function key (CTRL, NUM, and ALPH) has been depressed. It is important to remember that data is sent to the accumulator only when a character key is depressed, and not when a function key is depressed by itself. Thus a function key such as "CTRL" is depressed and held while a character key is depressed.

The CRT visual display is designed to display 256 characters in 8 rows of 32 characters each. Each character is formed by lighted dots within a 5 x 7 matrix. Each character displayed on the screen has an associated memory location that holds a code representing the character displayed. There are 16 possible memory display areas in an 8K memory all of which are in the lowest order 2K increment of memory. In addition, memory contains a table of dot patterns for each of the characters in a 64-character set. The dot pattern is inserted into the memory by the operating program and so may be changed to display characters which are appropriate to application or international locality.

The CRT control circuitry located on the T/C/I board contains the logic needed to access and buffer both the character code data and the dot pattern data. The CRT control circuitry also generates the horizontal and vertical sweep trigger pulses and the character video data used by the CRT to display the information.

SECTION III

MODULAR MAINTENANCE

3-1. INTRODUCTION

The 1501 system is a stable and conservatively designed equipment. Maintenance routines described here apply to optional equipment such as the 1533 unit, as well as the basic 1501 unit.

Maintenance of these units can be done in the field by replacement of entire modules. Conditions may arise whereby it is expedient to attempt minor repair of modules in the field. This should only be attempted where a high degree of certainty exists as to the success of the attempt and it is to everyone's advantage. Only modules that are whole and do not exhibit missing components will be accepted for repair at a module repair station. In the event any field troubleshooting of modules has been attempted with unsuccessful results, dismantled modules must be reassembled before they can be deemed acceptable for repair at a repair station.

A whole module is a complete tape drive, complete power supply, a complete printed circuit board, etc.

One of the most important parts of any maintenance program is the preventive portion. This section places emphasis on this phase as well as the usual maintenance procedures whenever an equipment malfunction is noted.

3-2. PREVENTIVE MAINTENANCE

Preventive maintenance is highly influenced by environmental conditions and the use to which the unit is subjected. Periodic checks, visual inspection, and cleanliness are the basis for good preventive maintenance.

The first step in any preventive maintenance schedule is careful and thorough visual inspection for signs of dirt, wear, cracks, binds, loose connections or loose hardware.

The second step in preventive maintenance is cleanliness. A clean environment will enhance equipment life and appearance. Excessive accumulation of dust and dirt in electronic circuits acts as an insulating blanket, and by preventing efficient heat dissipation, may cause overheating and component breakdown.

In addition to these primary considerations, the 1501 system should be maintained by following the preventive maintenance schedule given in table 2, preventative maintenance schedule.

3-3. CLEANING

General cleaning of the 1501 system is the responsibility of the operator and is limited to exterior cleaning and dusting. Internal cleaning requires more care and should only be attempted by personnel familiar with the equipment and would normally be completed during periods of required maintenance in accordance with recommended schedules.

TABLE 2

Preventive Maintenance Schedule

Task	Weekly	Every 3 mos.	Yearly	During Each Service Call
Check for worn tape leader		X		X
Clean tape path	X*			X
Check and (if necessary) adjust power supply		X		X
Check and (if necessary) adjust tape drive speed		X		X
Check Capstan				X Replace if worn or defective
Remove dust from inside the CRT implosion screen and face.			X	X

*Operator may find need to clean more often, depending on use of system, and the environment. Daily cleaning is not unusual in heavy daily use.

Cleaning of the tape module itself is not unlike that required by any highly sophisticated tape recorder of a commercial type. A tape path cleaning kit is available and only materials that are furnished in this kit may be used in the tape path cleaning function.

The tape path must be cleaned at least once every 40 hours of tape drive use in order to avoid contamination from dust and loose oxide. The tape path cleaning points are shown in figure 5-7. The following steps will ensure proper cleaning of the tape path.

a. Lift the Loader Carriage to the LOAD position and pull back on the carriage retainer clip to release the carriage.

b. Remove the Tape Leader Eyelet from the pull-pin on the take-up reel, and remove the leader out of the tape path. The other end of the leader will be held in place by the Locking Lever, in the OPEN position.

c. Clean the tape leader, using a cloth pad soaked in Freon.

d. Using a Q-tip applicator soaked in Freon, clean the tape Guides, the Write and Read Heads and the Capstan and Take-up Reel Hub.

e. Replace the Tape Leader Eyelet on the pull pin of the take-up reel, and reposition the tape along the proper tape path.

NOTE

Above procedure is to be performed by the operator.

CRT cleaning is a simple procedure and may be easily accomplished whenever the cabinet has been removed. The dust and dirt that accumulates between the plastic implosion screen and CRT face can be removed with a clean cloth. Both the CRT face and the implosion screen must be kept clean.

During this same interval whenever the cabinet is removed any excessive accumulation of dust, lint or dirt on any internal areas should be removed. Extreme care must be exercised in the handling of boards, cables, connections such as not to induce any future equipment malfunctions due to handling.

3-4.   SUB-ASSEMBLY REMOVAL AND REPLACEMENT

The 1501 system consists of 13 parts comprised of modular elements, power supply, CRT visual display and tape drives. Reference to section IV will provide a list of individual parts with corresponding part numbers, as well as the layout of each replaceable sub-unit of the 1501 system.

Modular maintenance consists almost exclusively of repairs of unit functional defects by replacement of entire modules. In the case of the power supply and the display unit, certain adjustments and measurements do apply. These adjustments are referenced in subsequent paragraphs and related to the appropriate figure in section V. Figure 5-1 provides an isometric drawing of the 1501 system, showing the locations of the major plug-in-modules.

3-5.   PROCESSOR/MEMORY BOARD REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-2 for Processor/Memory Board component locations.

a. Turn the AC Power switch off.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. The Processor and Memory boards are accessible on the right side of the machine, the Processor board is the second board from the bottom of the chassis.

d. To remove the Processor board, remove the board locks (located on each side of the board). Grasp board firmly and pull straight out. DO NOT bend board while removing.

e. To remove the Memory board, loosen the two Memory board retainer screws until the retainers can be rotated away from the board. Pull the board up slightly, then out of the Memory connector, taking care not to bend the board excessively.

f. Install the new memory in the Processor board, component side up. Put the Memory board retainers back in the lock position.

g. To re-insert Processor board, place board in board guides with memory facing up and towards back panel connector. Slide the board until it hits against back panel connector. Now place both thumbs on edge of Processor board, at the same time grasping cover cabinet. Push firmly with your thumbs until a very loud click is heard. The Processor board is now seated in back panel connector.

h. After board is inserted in machine, secure all boards by replacing the board locks.

i. Re-assemble by following step b then a.

3-6.   TAPE/CRT/IO BOARD REMOVAL AND REPLACEMENT

Procedure: Refer to Figure 5-3 for Tape/CRT/I/O component location.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. The Tape/CRT/I/O Board is accessible on the right side of the machine. The Tape/CRT/I/O Board is the first board from the bottom of the chassis.

d. Remove connector from the Tape/CRT/I/O Board.

e. To remove the Tape/CRT/I/O Board, remove the board locks (located on each side of the board). Grasp board firmly and pull straight out. DO NOT bend board up when removing.

f. To re-insert Tape/CRT/I/O Board, place board in board guides with component side facing up and deck switch on right side. Slide Tape/CRT/I/O board until it hits against back panel connector. Now place both thumbs on edge of Tape/CRT/I/O Board, at the same time grasping the lower cabinet, push firmly with your thumbs until a very loud click is heard. The Tape/CRT/I/O Board is now seated in the back panel connector. Make sure the Deck Select Switch is positioned toward the operator.

g. After board is inserted in machine, secure all boards by replacing the board locks.

h. Re-assemble by following steps d thru a in reverse order.

3-7.   KEYBOARD REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-4 for Keyboard component locations.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. Using $\frac{1}{4}$" nut driver, remove the 2 mounting screws on the left side of the Keyboard and loosen the 3 mounting screws on the right side.

d. Withdraw the Keyboard several inches and take the connector off the upper right corner of the keyboard assembly. The Keyboard is now free and can be withdrawn from the machine.

e. Before replacing the Keyboard, be certain the P.C. board will not be shorted to either the aluminized case or the program LOAD switch by applying insulating tape as required.

f. Re-assemble by following these procedure steps in reverse order. When re-assembling, the Keyboard may not be properly centered with respect to the opening in the cabinet top. It may be necessary to remove the cabinet top after re-assembly and shift the position of the Keyboard.

3-8. CRT VISUAL DISPLAY REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-5 for CRT Component location.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. Using the Phillips screw driver, remove the ground wire from the Power Supply chassis.

d. Using the $\frac{1}{4}$" nut driver, remove the four mounting screws.

e. Carefully lift the CRT Assembly several inches and disconnect the connectors of the cable harness. The assembly is now free to be removed.

f. To replace the CRT Display Unit, follow this procedure starting with Step e, working in the reverse order.

3-9. SYSTEM RESET BOARD REMOVAL AND REPLACEMENT

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. The Reset Card is located under the lower left corner of the Power Supply (see figure 5-1). Remove the hex-head screws holding down the BNC bracket.

d. Remove the two Reset board mounting screws and the connector plug.

e. Remove the BNC bracket and the Reset board from the system. Unsolder the signal wire from the BNC connector.

f. Remove the Ground Terminal from the BNC bracket.

g. Re-assemble by following these procedure steps in the reverse order.

3-10. CARTRIDGE TAPE DRIVE REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-7 for Tape Drive component locations.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. With a small phillips screwdriver, just loosen both Read/Write Head assembly retaining screws. Push the Pre-Amp retainer bracket away from the Pre-amp just far enough to remove the Pre-amp from the Read Head. Remove the Pre-amp cable from the clamp.

d. Remove the mounting screws from Tape Drive. Lift the Tape Deck several inches. You will notice that some green ground wires are secured to Tape Drive by a screw on the bottom of the Drive; loosen this screw and remove the wires.

e. Next, remove cable connector (plug J1, figure 5-13) from bottom center of the Motion Control board affixed to the tape drive. The tape drive is now free to be withdrawn from the system.

f. To replace the tape drive, follow this procedure starting with step e, and working in the reverse order.

3-11. TAPE AMPLIFIER BOARD REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-8 for Tape Amp Board component location.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 4-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. The Tape Amplifier Board is located directly beneath Tape Drive #2. To gain access to the Tape Amplifier Board, remove Tape Drive #2, following the procedure given in Section 3-10.

d. After Tape Drive #2 is removed, remove the pre-amp from Tape #1, following step C of Section 3-10.

e. Disconnect Cable from connector J3.

f. Using the $\frac{1}{4}$" nut driver, loosen and remove the four corner mounting screws. A ground lead will be secured by one of the screws and will be removed with the screw. Four insulating washers may be present between the Tape Amp Board and the cabinet.

g. Re-assembly: When replacing the part, the four insulating washers, if required, should be aligned above the screw holes. It is very important that the pre-amplifier assembly cables be crossed. Re-assemble by following these procedure steps in the reverse order.

3-12. CAPSTAN REMOVAL AND REPLACEMENT

A tape capstan can be removed by applying the Capstan Puller tool (T-19221) to the capstan and turning the tool's screw until the part has been lifted free of the deck.

Proper orientation of the new capstan should be determined as the motor shaft is tapered and the capstan will only fit one way. The new capstan should seat so that the motor shaft is not farther than 1/16-inch above or below the top surface of the capstan.

The new capstan (Singer Part No. 9009295-91) should seat with thumb pressure after applying Lok-tite quick-set 404 to the shaft.

Figure 5-9 shows the capstan being removed.

3-13. WIRED MODULE REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-11 for component location.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. Remove the board locks.

d. Remove the Processor Board and T/C/I Board and the communications option board, if applicable.

e. Now loosen and remove the 2 left supply mounting screws using the $\frac{1}{4}$" nut driver. Also remove the Keyboards.

f. Loosen the 3 rack mounting screws half-way (4 or 5 threads).

g. Using the long nose pliers, remove all the wires that attach the Wired Module to the DC Terminal block, the Reset Bd., and the Program Load/Reset Switch Assembly.

h. Remove the 4 Wired Module mounting screws.

i. While lifting the left side of the rack $\frac{1}{2}$ inch, remove the Wired Module.

j. To replace the Wired Module, follow steps h through a in the reverse order.

NOTE

Exercise care in rewiring the module; incorrect wiring could damage system components. The Program Load wires should be connected first (Table 11) followed by the Reset wires, and then the DC power (Table 12) wires.

3-14. COOLING FAN REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-12 for Cooling Fan component location.

a. Turn the AC Power switch to OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. Using the $\frac{1}{4}$" nut driver, remove the two mounting screws from the top corners of the Fan frame.

d. Move the Fan frame away from the system far enough so that the two A.C. input wires can be removed, using the long nose pliers, from the Fan terminals.

e. The Fan can now be completely withdrawn from the system.

f.   Before the replacement fan is secured to the system, check the air flow direction. Air flow must be toward the back of the system (its direction is illustrated by a small arrow on the side of the fan frame). Then follow this procedure starting with step d, working in the reverse order. Care should be taken in tightening down the fan mounting screws, if they are over-tightened the frame of the fan can be distorted and the fan blade will hit the frame.

3-15. POWER SUPPLY REMOVAL AND REPLACEMENT

Procedure: Refer to figure 5-14 for Power Supply component location.

a.   Turn the AC Power switch OFF.

b.   Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c.   Remove the pair of green ground wires from each side of the power supply using a Phillips screwdriver.

d.   Remove the four mounting screws using the $\frac{1}{4}$" nut driver.

e.   Disconnect the DC voltage connector from the power supply.

f.   Tilt Power Supply and disconnect the A.C. input wires. Extract the Power Supply from the work-station.

g.   To install a new Power Supply, attach the A.C. wires to pins 2 and 5* on the A.C. terminal block of the Power Supply.

h.   Check voltages (Ref. 3-21.b.).

i.   Perform steps e through a in reverse order.

*Terminal Jumpers are different for different A.C. Voltages.

Voltage	Jumper
90-110	1&2, 5&6
104-129	2&3, 4&5
208-258	3&4

3-16. TOOLS AND STANDARDS

The equipment required for maintenance consists of several common tools and measuring devices that are commercially available, and a few special tools as well as diagnostic test tapes and software. The following is a list of items necessary for proper modular maintenance and adjustments.

Digital Voltmeter
5/16" nutdriver
$\frac{1}{4}$" nutdriver
$\frac{1}{4}$" flat blade screwdriver
#1 Phillips screwdriver
miniature pot-adjust screwdriver
3-32" plastic or nylon screwdriver (for CRT adjustments)
Automatic Systems Test Tape (Tool #T19171)

Capstan Puller Tool (Tool #T19221)
Diagnostic Software (See "1500 Series Field Engr.
   Software Reference".)
Head Cleaning Kit (SBM #9012173-55)
"Loctite" Quick Set 404

3-17. SYSTEM ADJUSTMENT PROCEDURES

During troubleshooting of a failure or malfunction or preventive during a mainte-
nance inspection, it may be necessary to make some equipment adjustments. Subsequent
paragraphs explain the circumstances under which adjustments to the CRT visual display,
speaker volume, tape speed and power supply voltage levels should be made.

3-18. CRT DISPLAY ADJUSTMENTS

The CRT contains six different controls (see figure 5-10) that can be used to adjust
the display. The CONTRAST, BRIGHTNESS, and FOCUS controls effect the presentation
of the characters. VERTICAL SIZE effects the spacing between characters. VERTICAL
LINE effects the side-to-side positioning of the display. Rotating the Yoke makes the
display level.

The CONTRAST and BRIGHTNESS controls are fingertip-adjustable; FOCUS is
a screwdriver adjustment; VERTICAL SIZE and VERTICAL LINE are adjusted with a
plastic tuning wand. The following paragraph outlines a detailed procedure to be followed.

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape
    drive access door and lift the cabinet top straight up, while grasping its
    bottom side edges and pulling slightly outward.

c. Insert line cord into an AC outlet and turn power switch ON.

d. Obtain a CRT display by loading a program tape which would yield an
    appropriate display.

CAUTION

Hazardous voltages exist in certain portions of the display
circuitry. Personal contact with exposed circuits should
be avoided.

e. Adjust the BRIGHTNESS and CONTRAST controls on the rear of the CRT
    module.

f. To adjust VERTICAL SIZE, VERTICAL LINE or the YOKE, turn power off
    and remove the four screws that fasten the CRT to the Work station.

g. Loosen the Yoke screw enough so that the yoke can be rotated.

h. Turn the power switch ON and reload the Test Library tape.

i. Turn the Yoke with an insulated tool until the display is level.

j. Use the plastic wand to adjust VERTICAL SIZE and/or VERTICAL LINE, if
    required.

k. Turn the power off, retighten the Yoke screw and replace the CRT unit.

l.   Retest display for quality, if satisfactory, turn the power off.

m.   Carefully replace the cabinet top straight down and insert the screw fasteners.

3-19. SPEAKER VOLUME ADJUSTMENT

The speaker volume may be adjusted to the level desired by the operator. One program available for use in making this adjustment is the Keyboard Test (any program that uses a keyboard beep may be used). Load the program into the 1501 and follow the instructions on the CRT until the tone begins to pulsate.

a.   While the speaker is sounding, slide the front of the Terminal 3 inches past the edge of the table on which it is resting such that the speaker volume control is visible on the underside of the cabinet (see figure 5-10).

b.   Using a #1 Phillips screwdriver, adjust this control to achieve the desired volume level. Turn clockwise for increased volume, counterclockwise for decreased volume.

c.   Slide the Terminal back to its original location on the table.

3-20. TAPE SPEED ADJUSTMENT

Tape Drive speeds are adjustable and must be checked and/or adjusted when a Tape Drive is replaced. The Automatic System Test Software is employed for this purpose and its use to adjust tape speeds is described in this section.

The "1500 F E Software Reference" describes use of the automatic System Test Software, which allows a general evaluation of system performance, and may isolate many types of module failures. The following procedure describes completely tape speed adjustment.

Materials Required: 1-medium sized screwdriver, 1/8"
                     1-Automatic Systems Test Tape

a.   Load the Automatic Systems Test Tape and note the forward and reverse speeds.

b.   If the tape speed needs adjustment, turn the AC Power switch OFF.

c.   Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

d.   Turn system on.

e.   Locate the Motion Control Board on the left side of the tape deck. Refer to figure 5-10 for the location of pots that govern the forward and reverse speeds.

f.   To alter the speeds using the 1/8" screwdriver, turn the adjustable resistors as follows:

Forward Speed (Lower Pot, R19)
Faster - Clockwise
Slower - Counter-clockwise

Reverse Speed (Upper Pot, R24)
Faster - Counter-clockwise
Slower - Clockwise

g. Since the forward and reverse speeds are interdependent, it may be necessary to re-adjust the speeds until both the forward and reverse fall within the range displayed.

h. If proper speeds cannot be obtained, remove Tape Drive for subsequent troubleshooting.

3-21. POWER SUPPLY ADJUSTMENT PROCEDURE

a. Turn the AC Power switch OFF.

b. Remove the four cabinet top screw fasteners (see figure 5-1). Close the tape drive access door and lift the cabinet top straight up, while grasping its bottom side edges and pulling slightly outward.

c. Verify that the terminal block (TB-2) connections are as shown in Figure 5-14. Turn the system on and allow 15 minutes of warm-up before making any adjustments.

d. All DC voltage measurements will be made at the DC terminal block behind the CRT unit. The voltage levels should be as follows:

T.B. Ref.	Wire Color	Setting
+12	Red	+12.0V
-12	White/Red	-12.0V
+5	Orange	+ 5.0V
+10	Yellow	+19.0V
-7	White/Yellow	+21.5V

e. Set R11 (the +19.0V fine adjustment) in the midpoint of its swing. Adjust R10 (the +19.0V course adjustment) until the voltage is approximately +19.0V at the DC terminal block. Adjust R11 until the voltage is exactly +19.0V.

NOTE

If +19.0V cannot be obtained, it may be necessary to adjust the overvoltage pot R14. A clockwise adjustment of R14 will increase the voltage required to activate the overvoltage circuit.

f. Adjust R46 to obtain +5.0 V at the DC terminal block.

NOTE

If +5.0V cannot be obtained, it may be necessary to adjust the overvoltage pot R51. A clockwise adjustment of R51 will increase the voltage required to activate the overvoltage circuit.

g. Adjust R62 to obtain +21.5V at the DC terminal block.

If +21.5V cannot be obtained, it may be necessary to
re-adjust the +19.0V level. Increase the output volt-
age of the +19.0V course adjustment R10. Decrease
the fine adjustment pot R11 to reduce the voltage to
the correct value. This should give the needed volt-
age to obtain +21.5V with R62.

h. Adjust R30 to obtain +12.0V at the DC terminal block.

i. Adjust R31 to obtain -12.0V at the DC terminal block.

j. Turn the AC Power switch off and carefully replace the cabinet and insert
   the screw fasteners.

3-22. POWER SUPPLY OVERVOLTAGE ADJUSTMENT

The +5V overvoltage circuit is required to be activated between the ranges of
5.6V minimum and 6.2V maximum. Potentiometer R51 is used to adjust the circuit
to activate within the specified range.

The +19V has a similar overvoltage circuit. It may be adjusted using the same
procedure as the +5V circuit. The range for activation of this circuit is 21V minimum
to 22V maximum. R14 adjusts the overvoltage level for the +19V.

Procedure: +5V

a. Remove the two orange wires from the DC terminal block. These are the two
   +5V wires coming from the power supply. This is to adjust the +5V overvoltage
   circuit without damaging the circuit boards.

b. Turn R51 clockwise as far as it will go. This will set the overvoltage at its
   upper limit.

c. Using a DC voltmeter, monitor the +5V while adjusting R46. Adjust R46 so
   that the +5V level falls between 5.6V and 6.2V.

d. Turn R51 counter-clockwise until the overvoltage circuit activates and the
   +5V is shut down.

Procedure: +19V

a. Remove the yellow and white/yellow wires from the DC terminal block. These
   are the +19V and +21.5V wires from the power supply. Removal allows adjust-
   ment of the +19V overvoltage circuit without damage to the Memory Board.

b. Turn R14 clockwise as far as it will go. This will set the overvoltage at its
   upper limit.

c. Using a DC voltmeter, monitor the +19V (yellow wire) while adjusting R10
   (coarse) and R11 (fine); the +19V voltage level pots, so that the +19V level
   falls between 21V minimum and 22V maximum.

d. Turn R14 counter-clockwise until the overvoltage circuit activates and the
   +19V is shut down.

NOTE

After adjustment of the overvoltage circuit levels,
re-connect the wires to the DC terminal block and
adjust the power supply levels.

3-23. KNOWN SYMPTOMS AND CAUSES

Several known symptoms that indicate the existence of equipment failure and/or
malfunction and their related causes are listed in Tables 3 through 9. These tables will
serve as a troubleshooting aid in the repair of an equipment malfunction. To remove or
replace a specific module, refer to the appropriate section dealing with module removal
and replacement.

TABLE 3

AC Power Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. Cooling fan not rotating	1. AC Line fuse blown 2. Line Cord Loose 3. AC Switch defective 4. Cooling fan inoperative	Replace fuse Check line cord Replace switch Replace fan
b. Continually blows AC Line Fuse	1. Power Supply 2. Wiring	Replace Power Supply Locate wiring defect
c. No lights lit on tape drives and fan not rotating	1. AC line fuse blown 2. Line Cord Loose 3. AC switch defective	Replace fuse Check line cord Replace switch
d. Cooling fan rotating too slowly	1. System wired for 220V 2. 220V fan installed in 110V system	Notify sales representative Replace with 110V fan

TABLE 4

DC Power Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. Tape Drive E.O.T. light not lit on either deck	1. Power Supply 2. AC Power problem	Check power supply output. If not satisfactory replace power supply Refer to AC Power Symptoms
b. Tape drive EOT sensor light not lit on only one drive	1. Tape Drive 2. Loose cable connection	Replace Tape Drive Visually check connectors
c. Program does not load	1. Power Supply	Check Power Supply outputs. Replace if necessary. Refer to Program failure symptoms
d. Tape Drives rotate too slowly	1. Power Supply 2. Tape Drive	Check P.S. outputs. If not satisfactory, adjust or replace P.S. as necessary. Adjust Speed
e. Burning Odor	1. Power Supply burnt component 2. Other Subassemblies burnt component	Measure outputs. If outputs are okay, attempt to isolate source of odor. Attempt to isolate to a particular sub-assembly and replace it.

TABLE 5

Program Failure Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. Program does not load on deck #2	1. Undetermined 2. Tape Deck 3. Tape Amp Bd.	Change Deck address switch. Mount program tape on drive 1 and retry Program Load. If Program does not load, go to symptom B. Replace Tape Drive Replace Tape Amp Bd.
b. Program does not load on deck #1	1. Power Supply 2. Processor Memory Bd. 3. Tape/CRT/I/O Board	Check Power Supply voltages. If not satisfactory, replace P. S. Reseat or replace Remove. Reseat or replace
c. Failure during program operation	1. Processor Memory Bd. 2. Power Supply 3. Tape/CRT/I/O Bd.	Reseat or replace Reseat or replace. Check outputs. If not satisfactory, replace. Same as above.
d. Intermittent vibration dependent	1. Processor Memory Bd. 2. T/C/I Bd. 3. Loose PC Bds. 4. Loose Cables 5. Bent Wired Module Pin	Replace Processor/ Memory Board. Replace T/C/I Bd. Reseat PC Bds. Check and reseat connectors Check and replace Wired Module if necessary.
e. Intermittent program loading on both drives	1. Processor Memory Bd. 2. Power Supply	Replace Replace

TABLE 6

Keyboard Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. Key sticks	1. Keyboard 2. Keyboard Alignment	Remove Key top and clean switch with freon. Re-align keyboard
b. Key is unacceptable	1. Keyboard 2. T/C/I Board	Replace Keyboard Replace
c. Intermittent characters from Keyboard	1. Keyboard	Check for "short-circuits" against chassis, etc., or replace
d. No keys accepted	1. Tape/CRT/I/O Bd. 2. Keyboard 3. Loose connector	Replace Replace Check
e. Group of keys malfunction	1. Keyboard 2. T/C/I board	Replace Replace
f. Wrong character from keyboard	1. Keyboard 2. T/C/I board	Replace Replace

TABLE 7

CRT Symptoms

Symptom	Possibly Faulty Module	Action to be taken
a. Display is blank	1. Tape/CRT/I/O Bd. 2. CRT Module 3. Cable Connector 4. Processor/Memory Bd.	Reseat or replace Replace Check Reseat or replace either, as necessary
b. Characters are incorrect	1. Tape/CRT/I/O 2. Processor/Memory Bd.	Reseat or replace Reseat or replace either as required
c. Display lack of clarity	1. CRT Module 2. T/C/I Board	Adjust or replace if necessary Replace
d. Display narrows from top to bottom	1. CRT Module 2. Loose Connector 3. Power Supply	Replace Check Check

TABLE 7 (Cont)

CRT Symptoms

Symptom	Possibly Faulty Module	Action to be taken
e. Top row compressed	1. T/C/I board 2. CRT Module	Replace Replace
f. Display not centered	1. CRT Module	Replace
g. Erroneous dot pattern for one character	1. Memory Bd.	Replace Memory Bd.
h. CRT Jitters	1. Power Supply	Replace
i. CRT Jitters while a tape drive is in motion	1. Tape Drive 2. Power Supply	Replace Replace

TABLE 8

Tape Drive Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. Program does not load	1. Undetermined 2. Tape Amp Bd. 3. Tape Deck	Change Deck Address switch. Mount Program tape on other drive and retry program load. If program does not load, restore deck address switch to desired position. Replace Replace
b. Program does not load from either deck.	1. Processor/ Memory Bd. 2. Tape/CRT/I/O Bd. 3. Power Supply 4. Tape Amp Bd. 5. Program Load Switch 6. Reset Board	Reseat or replace. Reseat or remove. Check Power Supply voltages. If not satisfactory, replace P. S. Replace Replace Replace
c. Read retries on good records	1. Tape Deck-read head 2. Power Supply 3. Tape Amp. Bd.	Clean or, if necessary replace Measure Outputs Replace
d. Intermittent program	1. Processor/Memory Bd. 2. Tape/CRT/I/O Bd. 3. Tape Drive 4. Tape Amp. Bd.	Replace if necessary Replace Replace Replace

TABLE 8 (Cont)

Tape Drive Symptoms

Symptoms	Possibly Faulty Sub-Assembly	Action to be taken
e. Does not read or write	1. Tape/CRT/I/O Bd. 2. Tape Amp. Bd.	Replace Replace
f. Writes unreadable records (Write Errors)	1. Tape Deck 2. Dirty write head 3. Memory	Replace Clean write head Replace
g. Gives TAPE RUNAWAY STATUS	1. Tape/CRT/I/O Bd. 2. Tape Deck	Reseat or Replace Replace
h. Slack in take-up leader when lock arm is closed with a cartridge in	1. Power Supply 2. Tape Drive-lock arm switch/activator	Check Power Supply outputs. Replace if necessary. Replace Tape Drive
i. One drive will not rewind	1. Tape Drive-clip-in switch 2. Tape/CRT/I/O Bd.	Replace Tape Drive Replace
j. Neither drive will rewind, or neither drive will move forward	1. Power Supply 2. T/C/I Board	Check outputs. If necessary, replace Replace
k. Deck will not run at slow speed (only high speed is possible)	1. Tape Drive Tachometer bad 2. Broken wire from Tachometer	Replace Tape Drive Repair
l. Drive Speed Wrong or not constant	1. Tape Drive (Tachometer)	Clean Tachometer Replace Tape Drive
m. Rewinding causes program to fail	1. Power Supply 2. Tape Drive	Replace Replace
n. EOT not sensed	1. EOT Sensor 2. Tape Drive	Replace Replace
o. Noisy or erratic motion	1. Tape Drive	Replace
p. Worn Capstan (visible groove)	1. Capstan 2. Clip-in Switch	Replace Replace Tape Drive
q. Leader has trouble returning to "home" position	1. Dirty Capstan 2. Faulty Leader	Clean Capstan Replace leader

TABLE 9

Serial I/O Symptoms

Symptom	Possibly Faulty Sub-Assembly	Action to be taken
a. No data output or no data input	1. Tape/CRT/I/O Bd. 2. Terminator 3. System Reset Bd.	Reseat or replace Check for proper Termination Replace

SECTION IV

CONDENSED PARTS LIST

This section lists, with parts numbers, the parts which are required for maintenance of the Singer Model 1501 as described by this Service Manual.

TABLE 10

1501 MODULES

Module	Singer Part No.
Memory Board (8K)	9011813-33
(4K)	9012367-30
Processor Board	9012099-87
T/C/I Board	9012752-96
*Cartridge Tape Drive	9011142-74
Motion Control Board	9011142-75
Tape Amplifier Board	9009295-20
Power Supply	9012474-16
CRT Display	9009295-17
Keyboard	9009424-75
Systems Reset Board	9009295-31
Communications Adapter Bd.	
Model 1534	9013634-38
Model 1535	9012115-82
Wired Module	9012752-98
Cooling Fan (115 VAC)	9011540-85
Cooling Fan (230 VAC)	9011080-29
AC Fuse (for 115VAC)	9014666-48
AC Fuse (for 230VAC)	
AC Fuse Holder	9012115-36
Tape Deck Cover	9011079-40
Reset Switch	9011080-36
Prog. Load Switch	9011080-38
Power Supply Fuses:	
20 Amp	9012716-08
6 Amp	9012716-07
3 Amp	9001931-91
Capstan	9009295-91
Speaker	9011079-31
AC Power Cord (115VAC)	9011079-23
AC Power Cord (230VAC)	9012093-89
91 ohm Coax. Cable Term.	9011079-33
BNC Outlet	9011080-30
Tape Drive Leader-Link	
Assembly	9009424-78
EOT Sensor	9011079-21
Keyboard Overlay	9012093-98
Top Cover Screw	9012606-10
Read/Write Head Ass'y.	9009424-86
BNC "T" Adapter	9011080-30

*Includes Motion Control Board.

SECTION V

REFERENCE

This section contains material that is referenced in other sections of this manual.

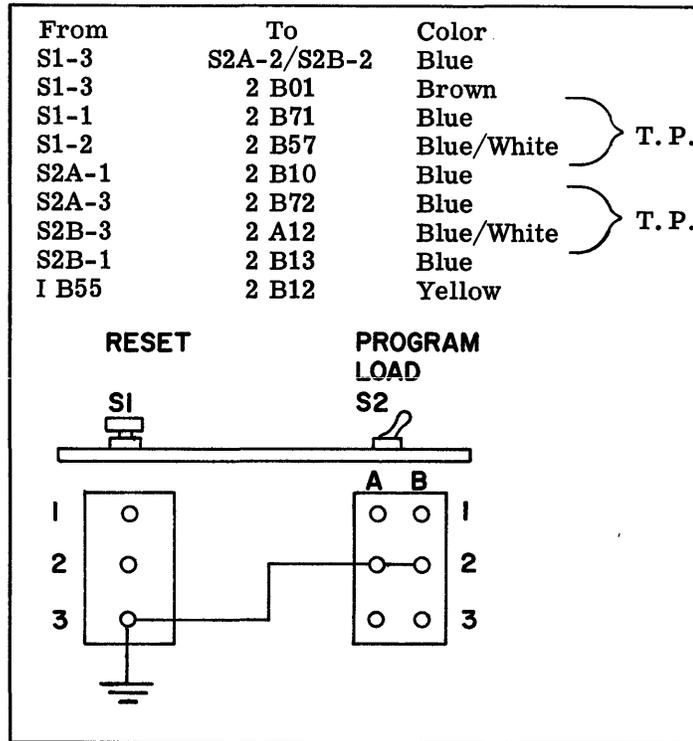## TABLE 11

WIRED MODULE CONNECTIONS TO PROG LD ASSEMBLY

From	To	Color
S1-3	S2A-2/S2B-2	Blue
S1-3	2 B01	Brown
S1-1	2 B71	Blue
S1-2	2 B57	Blue/White
S2A-1	2 B10	Blue
S2A-3	2 B72	Blue
S2B-3	2 A12	Blue/White
S2B-1	2 B13	Blue
I B55	2 B12	Yellow

S1-3/S1-3/S1-1/S1-2 group: T.P.
S2A-3/S2B-3 group: T.P.

TABLE 12

WIRED MODULE CONNECTIONS TO D.C. POWER AND RESET

D.C. Terminal Block			Reset Board		
Wire #	To	Color	Wire #	To	Color
1	Buss 1	Brown	5	1A03	Red
2	Buss 2	Orange	12	1A80	Orange
3	Buss 3	Red	7	1A81	Brown
12	2A24	White/Violet	8	1B51	Blue/White
11	2A26	Yellow	9	1B63	Blue
4	Buss 4	Orange	10	1B01	Blue/White
5	Buss 5	Brown	11	1B53	Blue
6	Buss 6	Brown	1	1B05	Blue
7	Buss 7	Orange	6	2B07	Blue
15	3A28	Red/White	2	1B79	Red/White
13	3A30	Red			
8	Buss 8	Red/White			
9	Buss 9	Orange			
10	Buss 10	Brown			

TAPE DECK #2   TAPE DECK #1

SPEAKER VOLUME CONTROL

CRT UNIT

POWER SUPPLY

KEYBOARD

BOARD LOCK

POWER ON/OFF SWITCH

SCREW FASTENERS (4)

SPEAKER

POWER-IN CONNECTOR

COMMUNICATIONS BOARD

A.C. FUSE

PROCESSOR MEMORY BOARD

FAN

TAPE CRT AND I/O BOARD

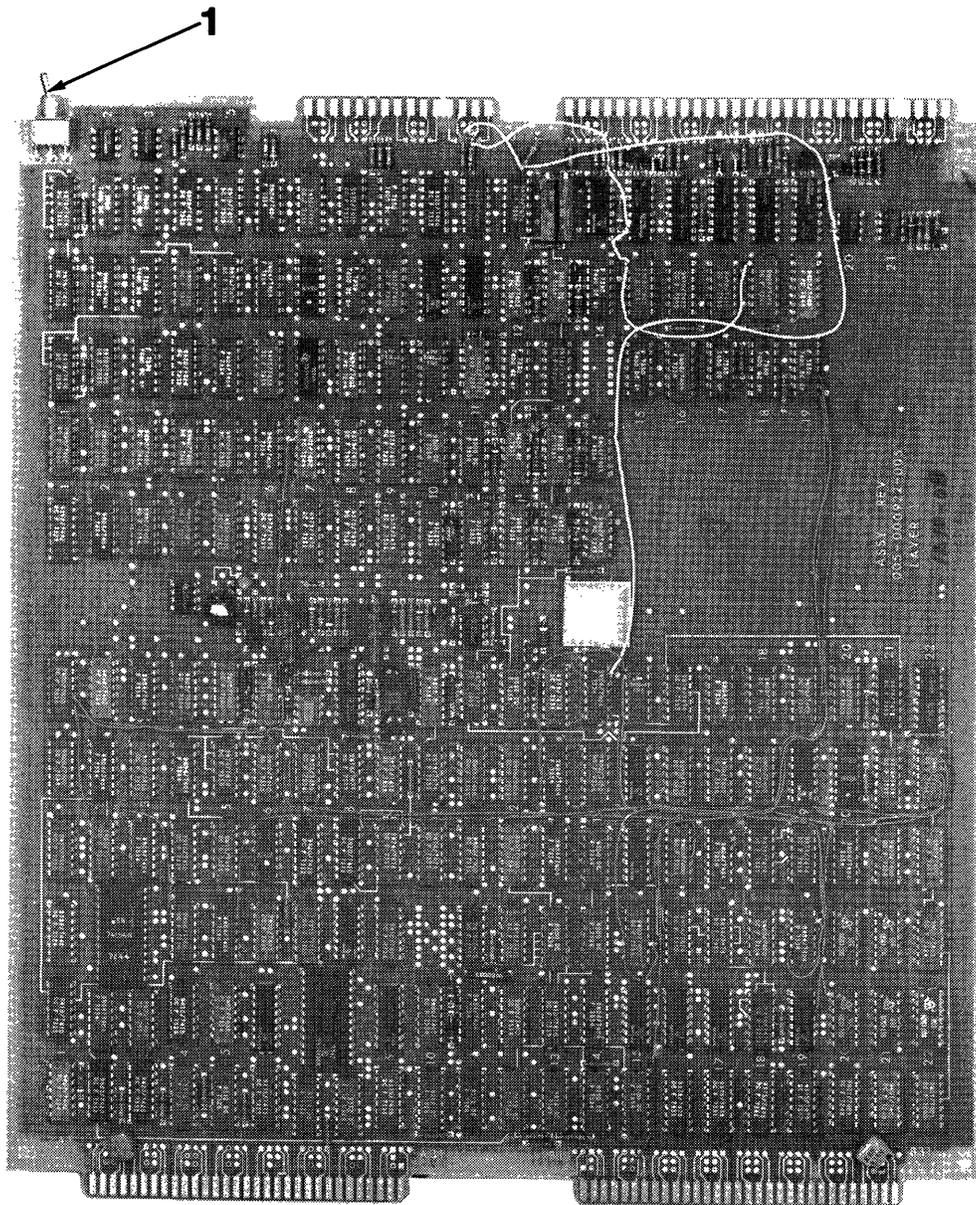I/O CONNECTOR

VOLTAGE TERMINAL BLOCK

RESET BOARD
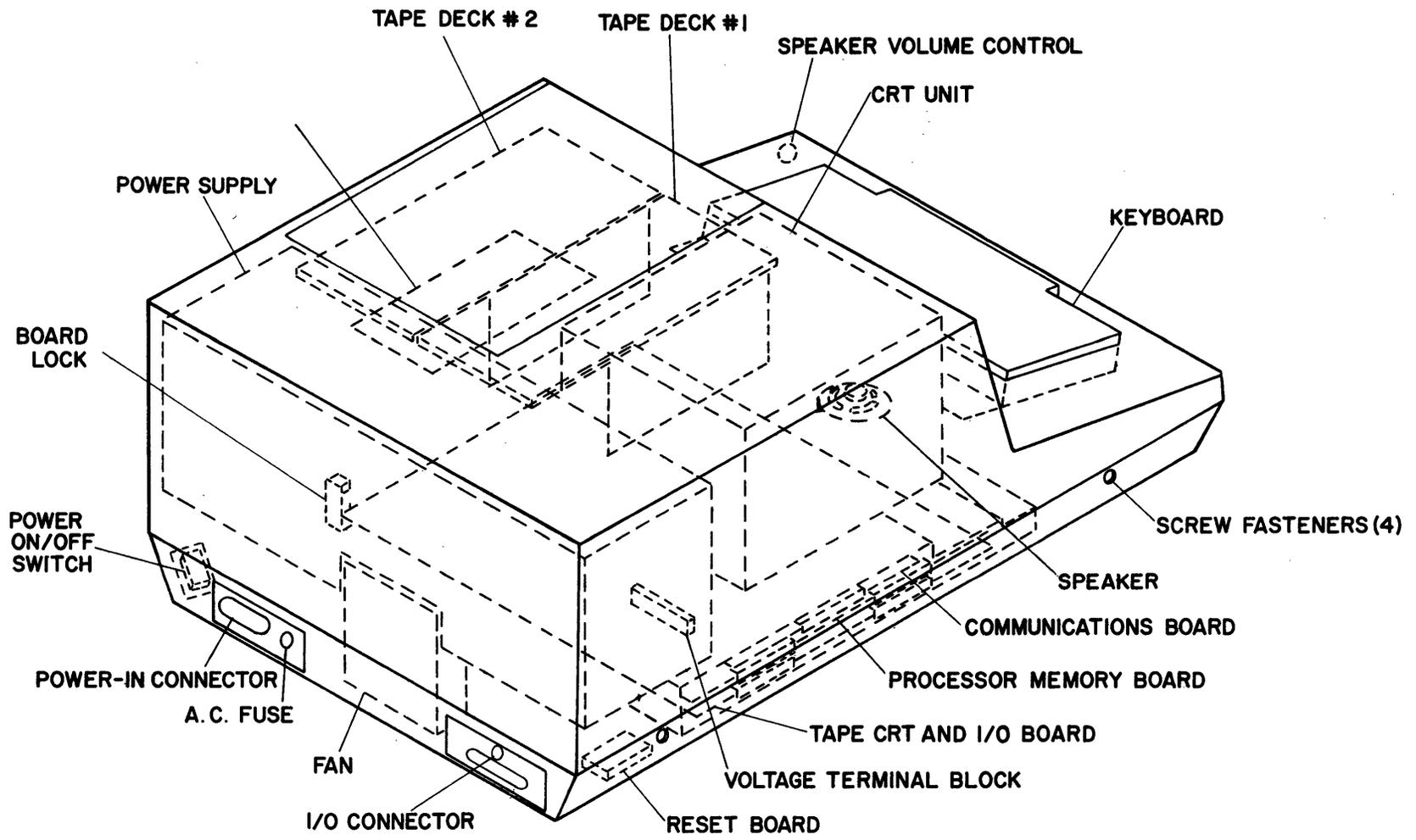
Figure 5-1.   Singer Model 1501 Isometric
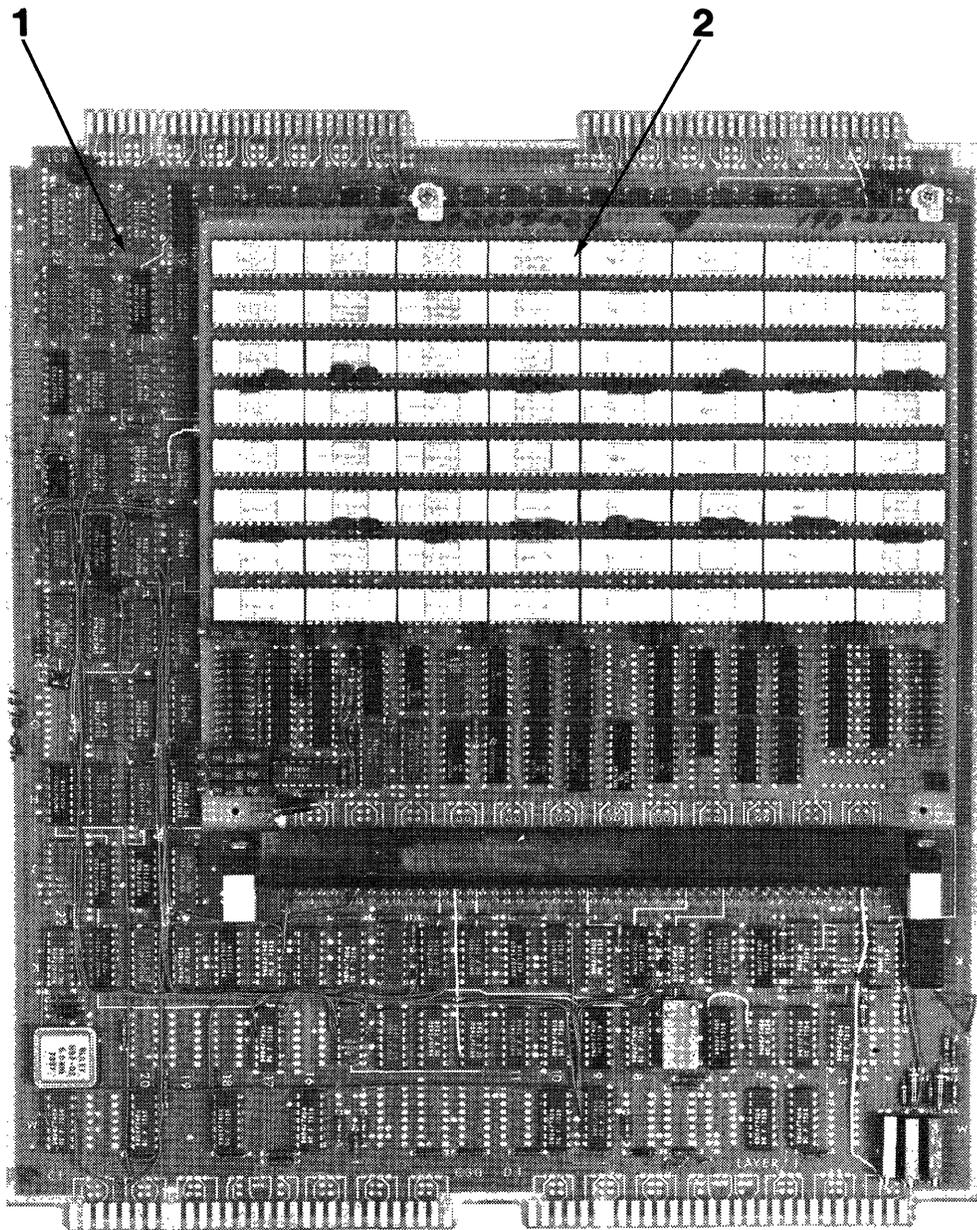
1. Processor Board
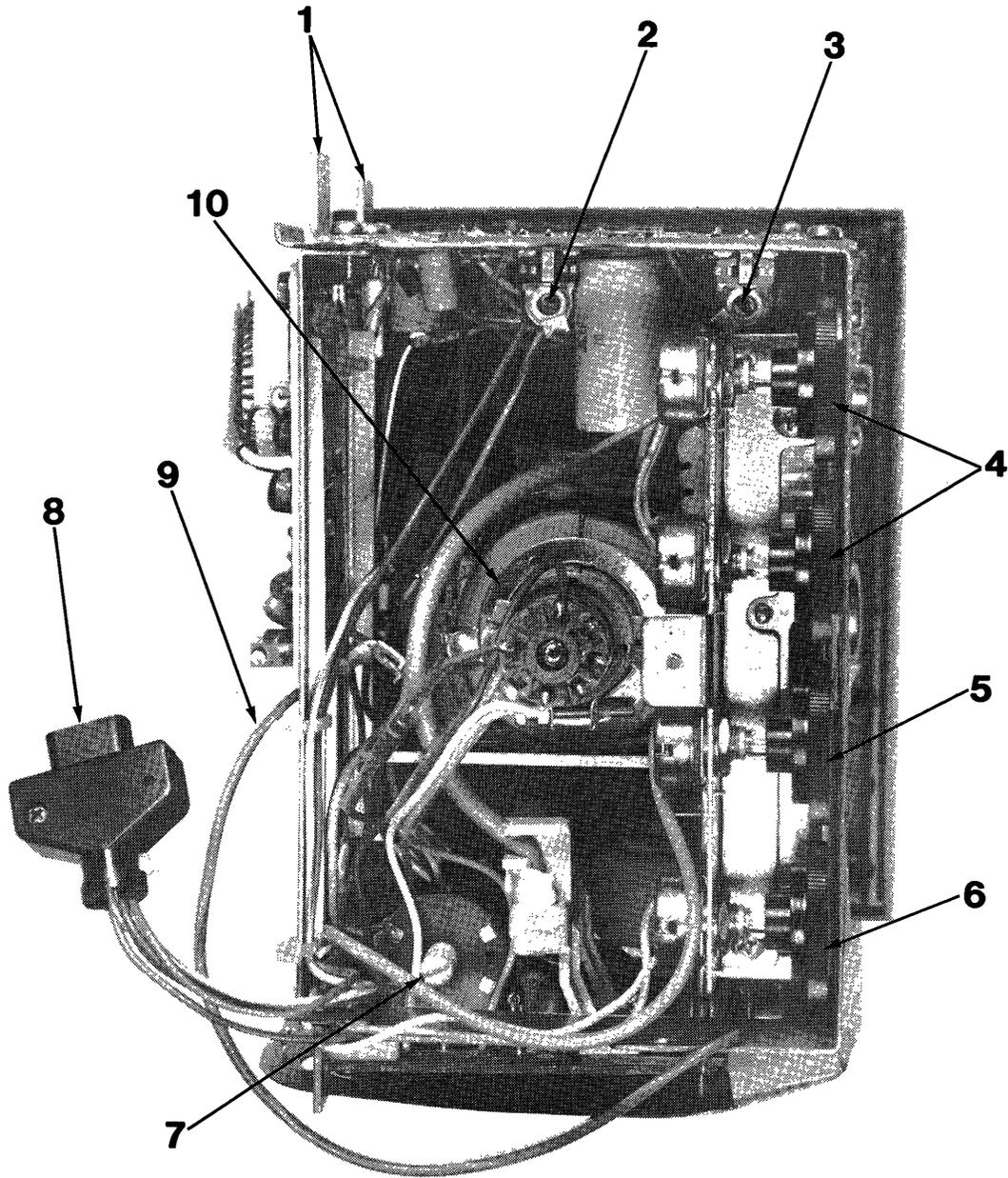
2. Memory Board

Figure 5-2. Processor/Memory Board
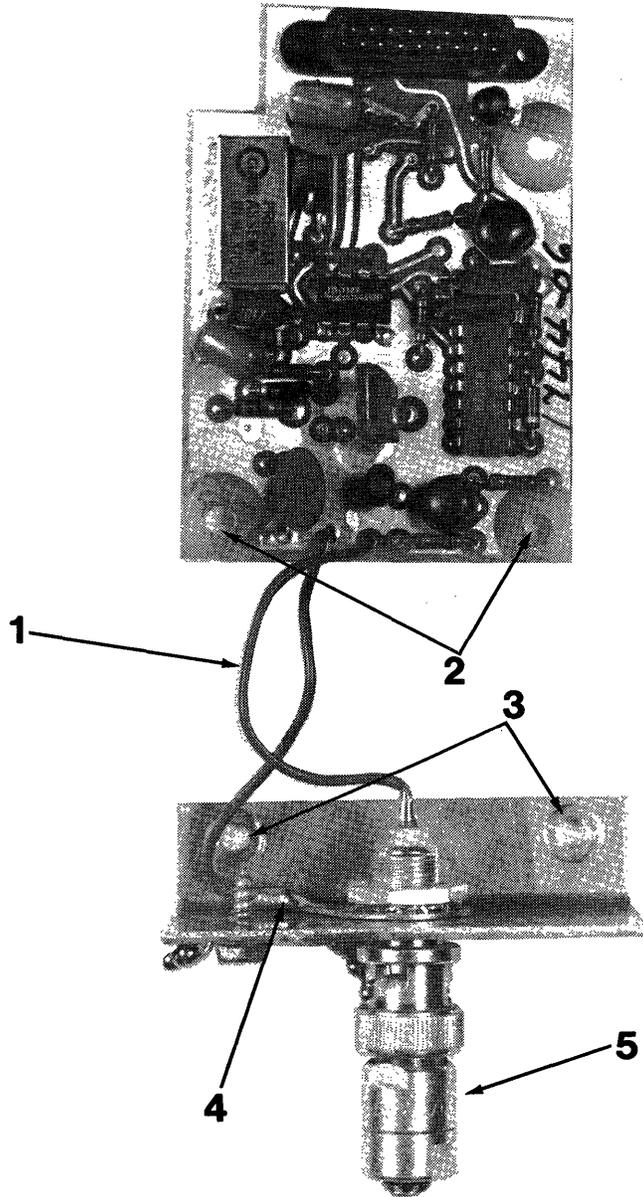
1. Deck Address Switch

Figure 5-3. Tape/CRT/I/O Board

1. Mounting Screw Slots (Left Side)

2. Mounting Screw Slots (Right Side)

Figure 5-4. Keyboard

|	
1. Mounting Screw Brackets	6. Brightness
2. Horizontal Width	7. Focus
3. Horizontal Linearity	8. Connector
4. Not Used	9. Ground Wire
5. Contrast	10. Yoke

Figure 5-5. CRT Display

1. Signal Wire

2. Mounting Screw Holes

3. Hex Head Screw Holes

4. Ground Terminal

5. Terminator

Figure 5-6. Reset Board/Relay Type
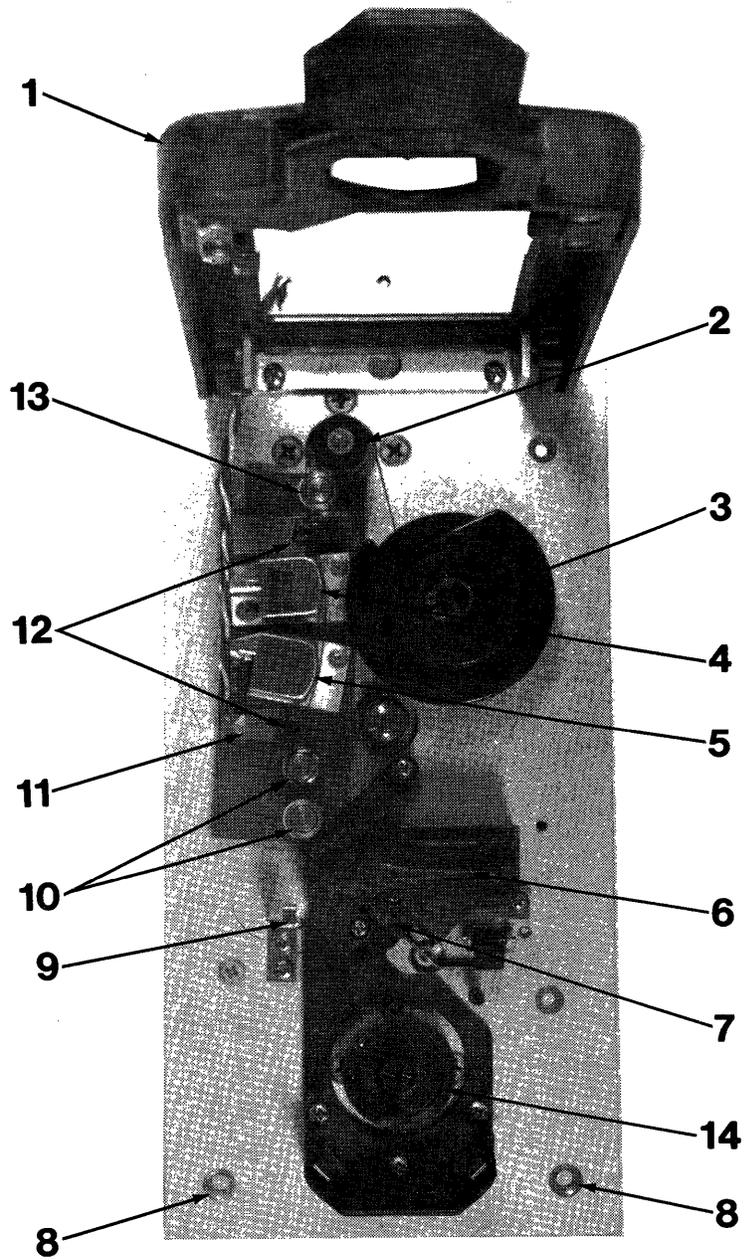
1. Loader Carriage	8. Mounting Screw Holes
2. Capstan	9. Carriage Retainer Clip
3. Take up Reel Hub	10. Tape Guides
4. Read Head	11. Pre-Amp Retainer Bracket
5. Write Head	12. Read-Write Head Retaining Screws
6. Locking Lever	13. Tape Guide
7. Tape Loader Clip (in home position)	14. Supply Reel Hub

Figure 5-7. Cartridge Tape Drive
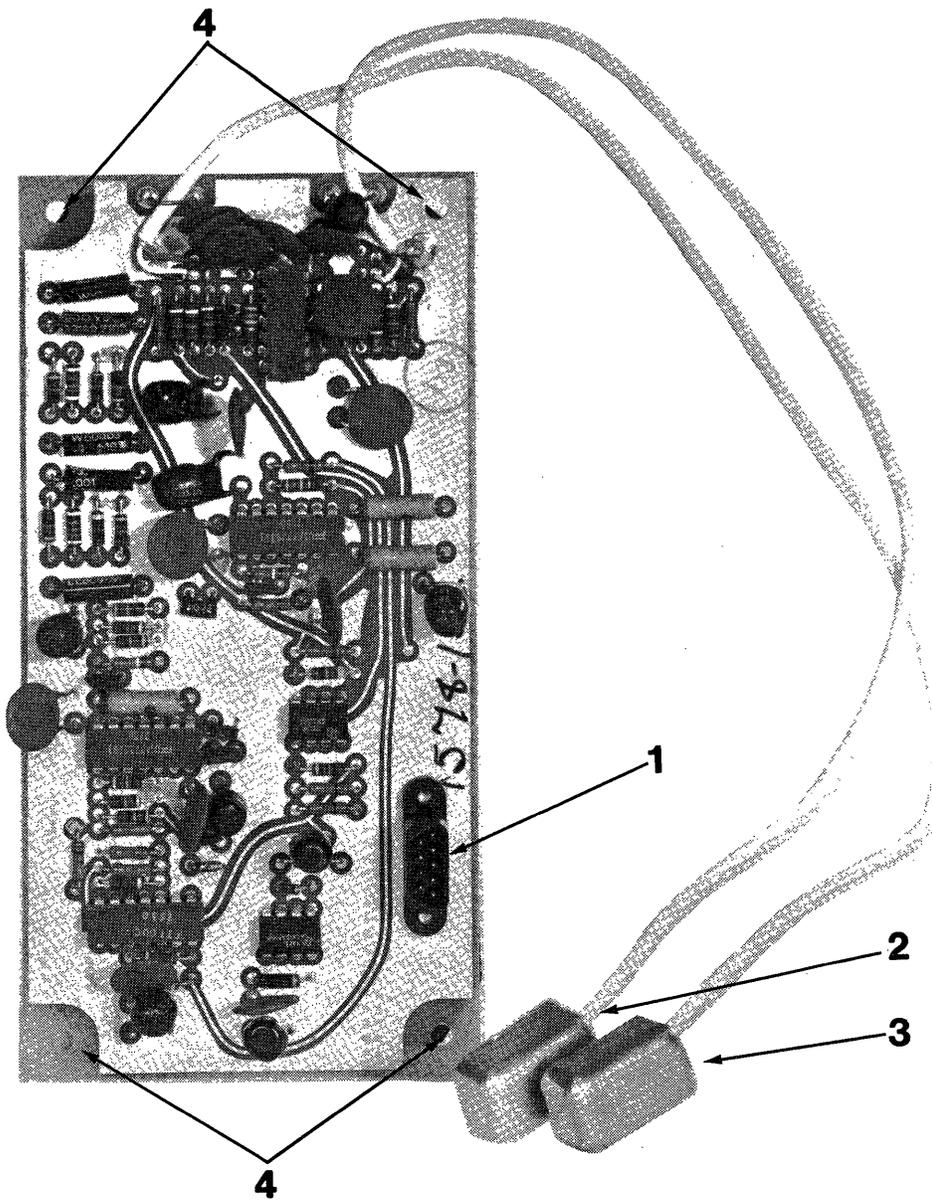
1. Plug J3

2. Tape Drive #1 Preamplifier

3. Tape Drive #2 Preamplifier

4. Mounting Screw Holes

Figure 5-8   Tape Amplifier Board
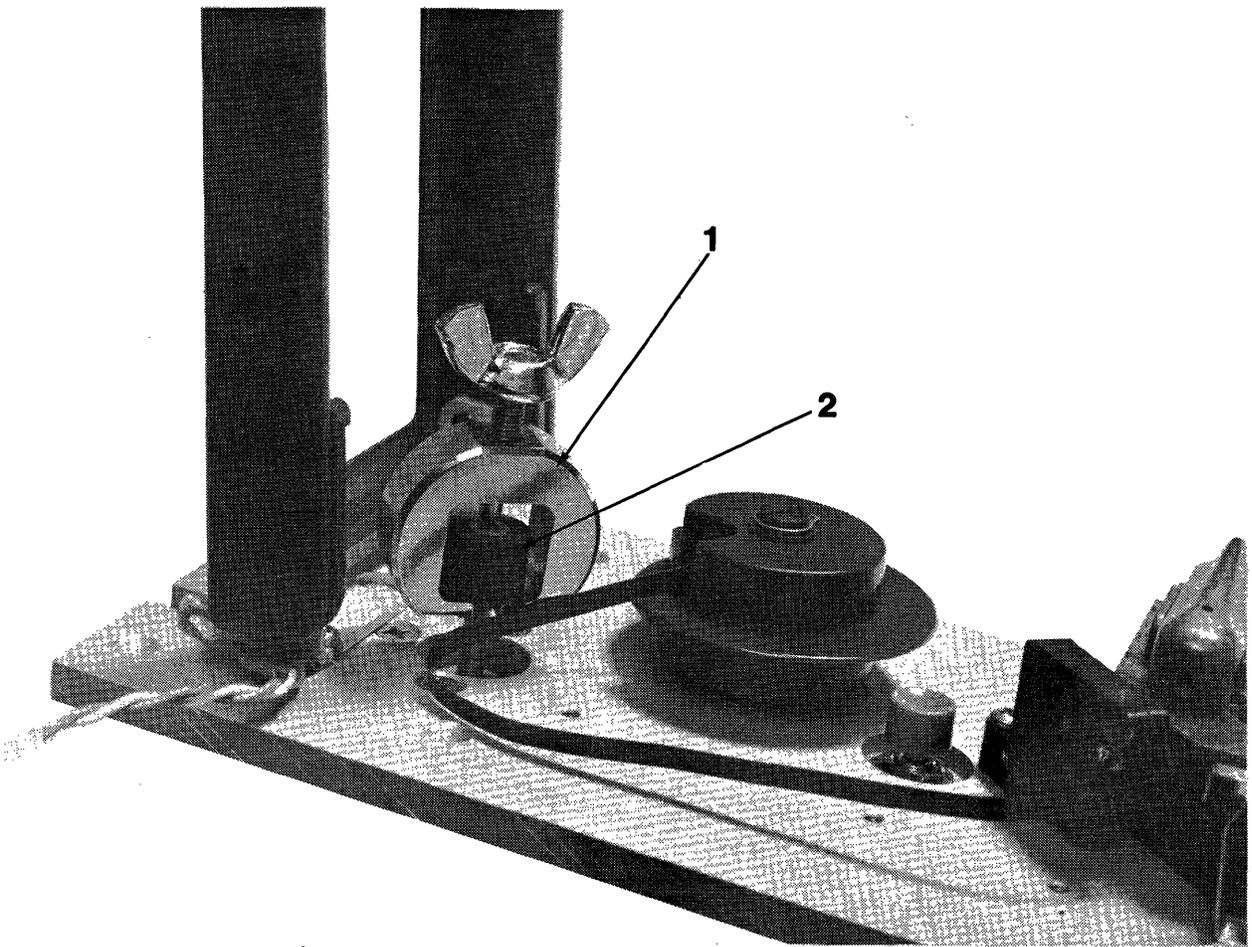
1. Capstan Removal Tool #T19221

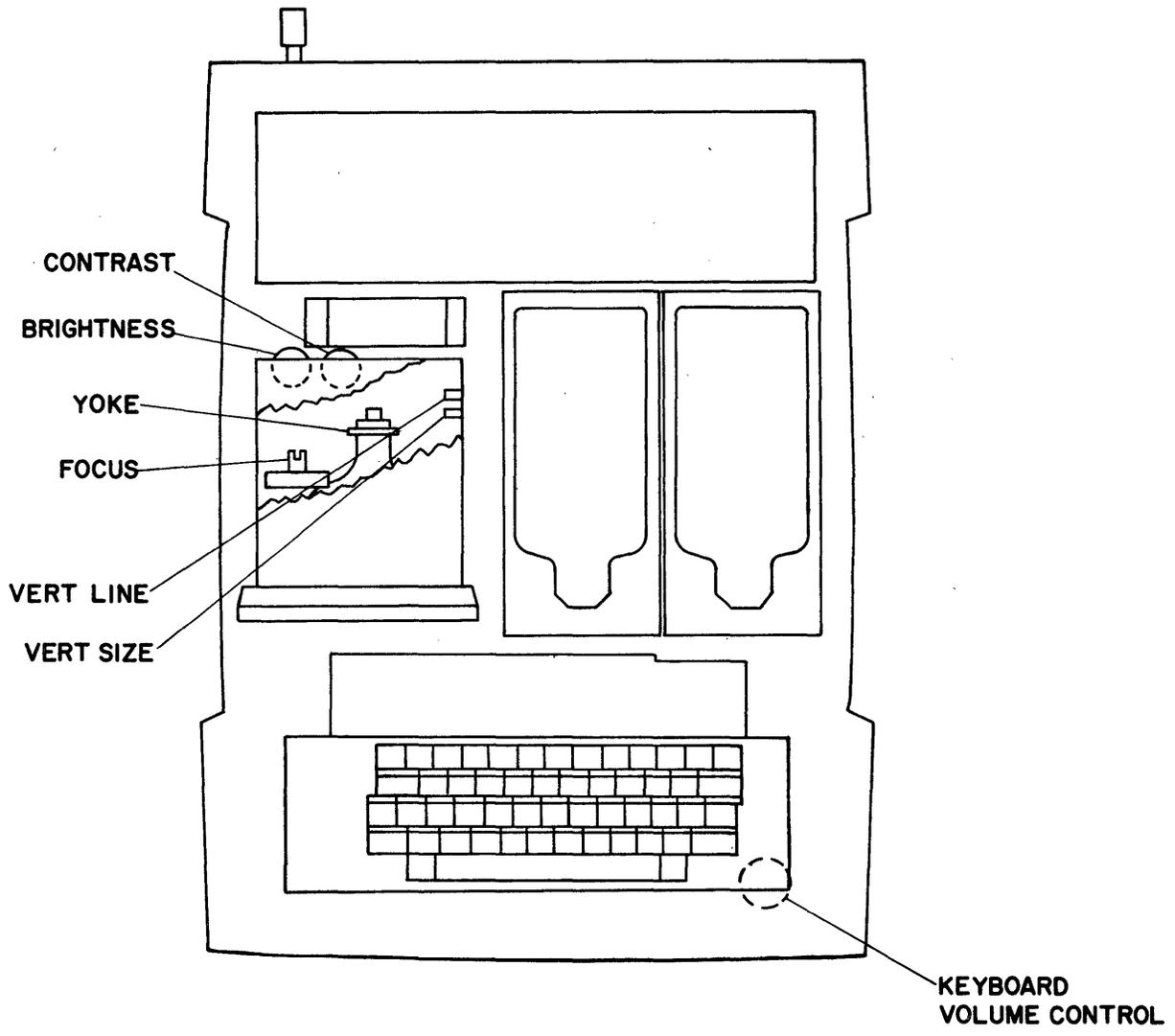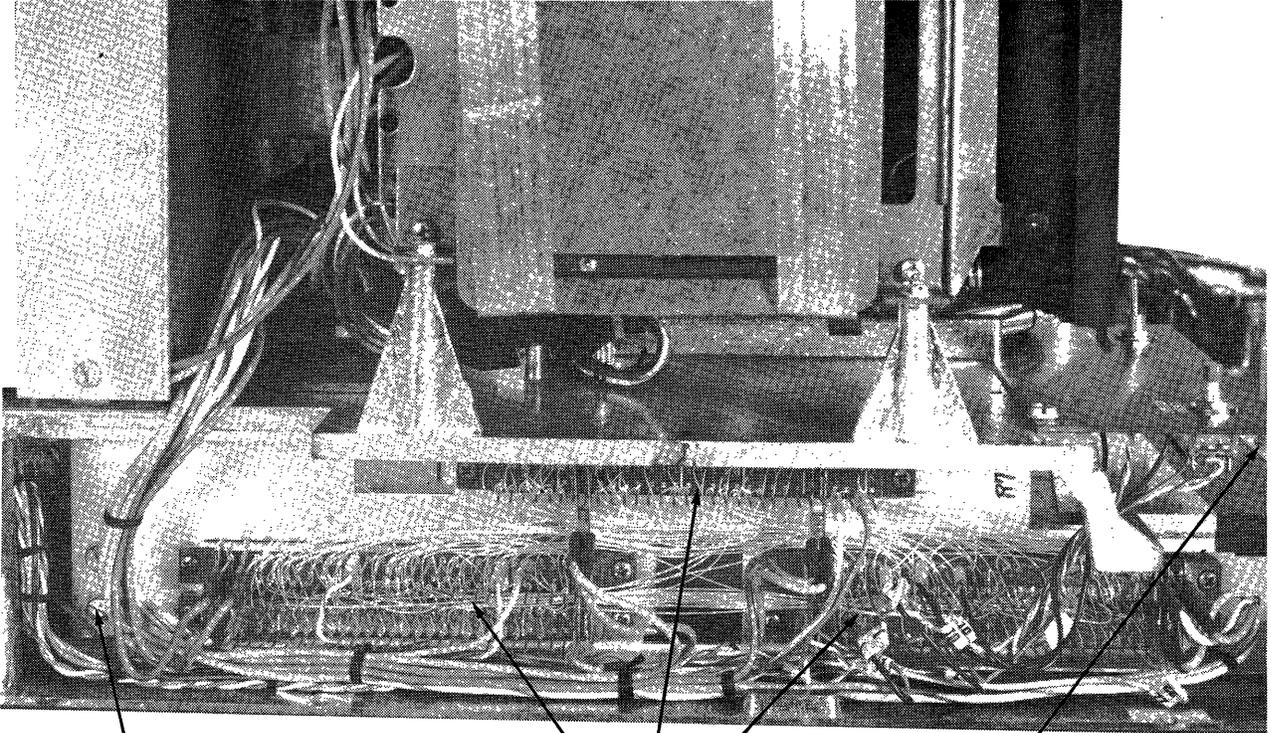2. Capstan

Figure 5-9. Capstan Removal
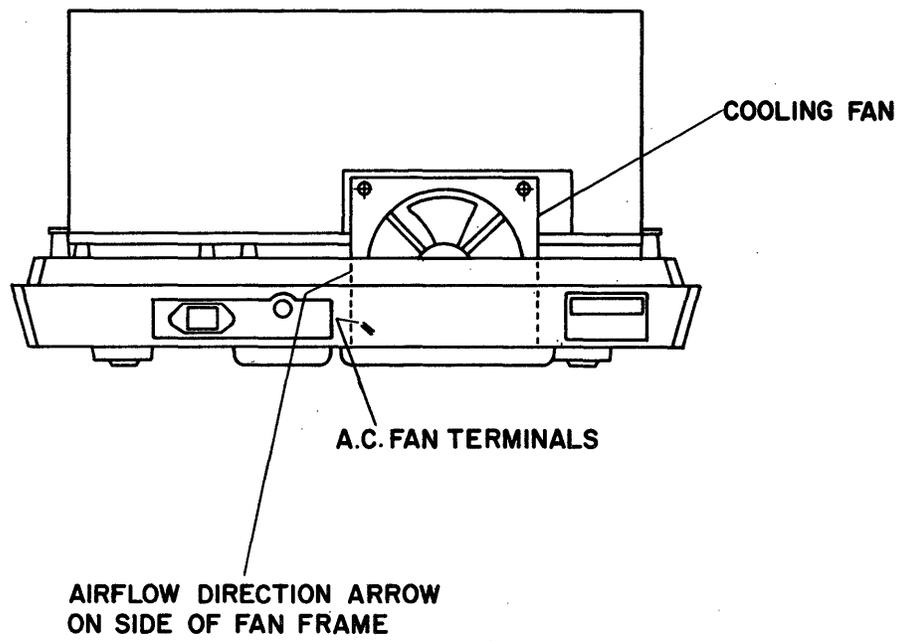
Figure 5-10. CRT/Speaker Adjustments

1. Mounting Screw
2. Inter-Wire Connectors
3. Rack Mounting Screw

Figure 5-11. Wired Module

COOLING FAN

A.C. FAN TERMINALS
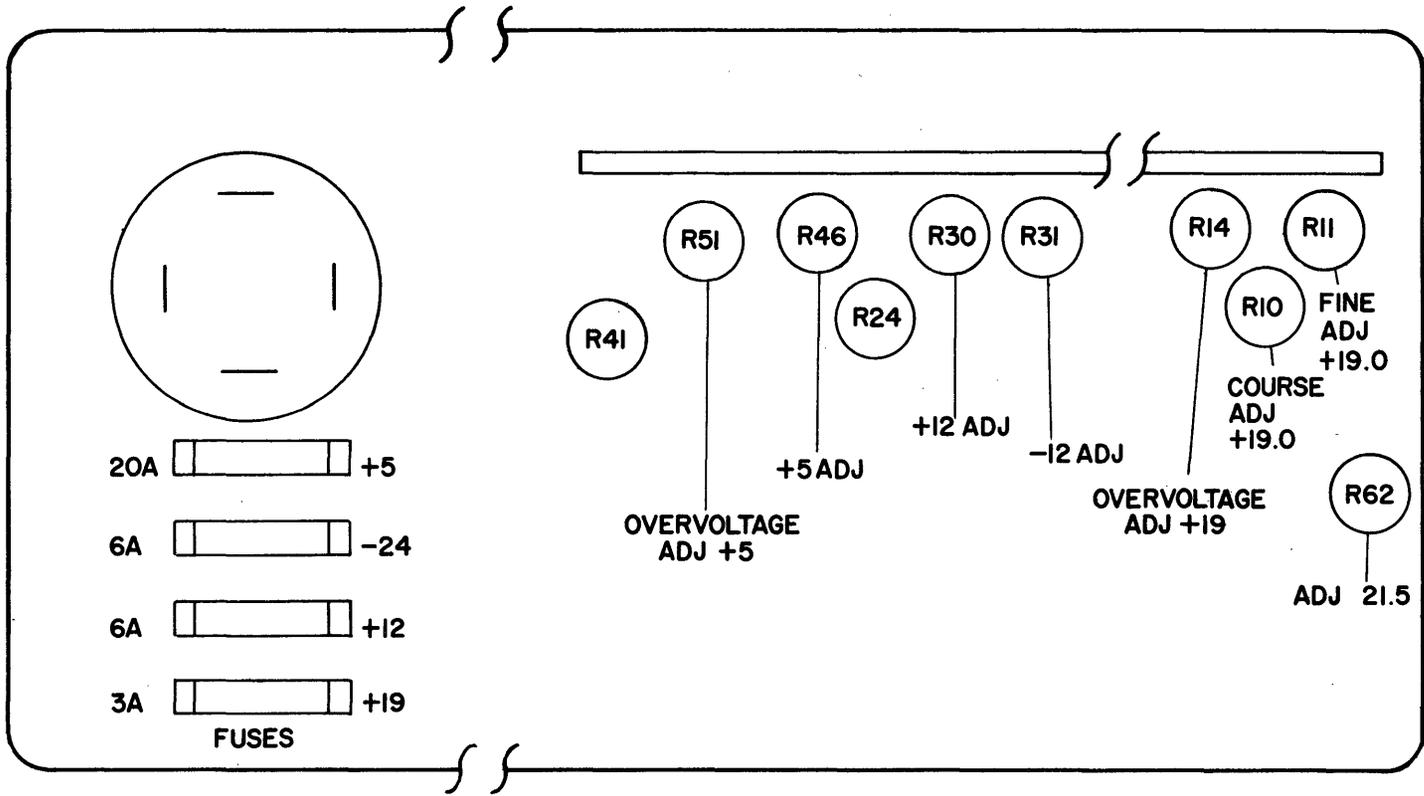
AIRFLOW DIRECTION ARROW
ON SIDE OF FAN FRAME

1501— REAR VIEW

Figure 5-12. Cooling Fan

Figure 5-13. Motion Control Board
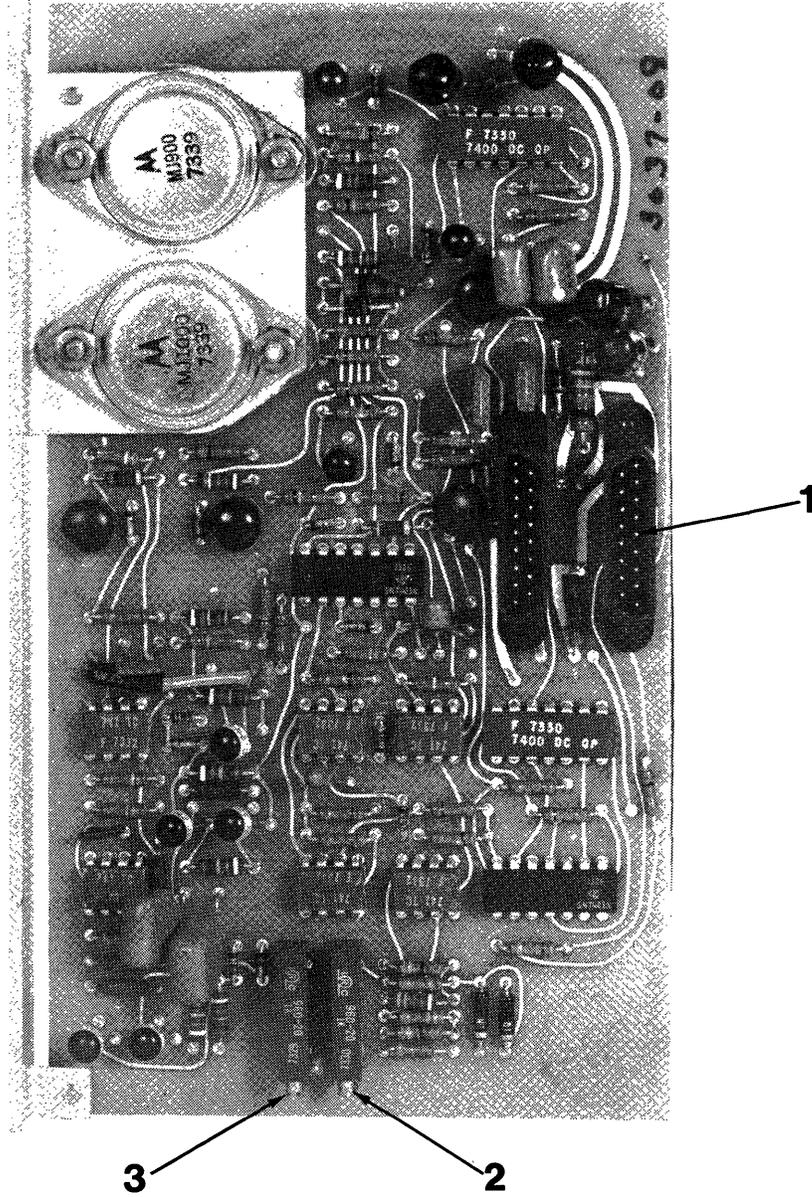
1. J1

2. Forward Speed Control

3. Reverse Speed Control

Figure 5-14. Acme Power Supply Adjustment Locations

SINGER MODEL 1501 PROCESSOR

SERVICE MANUAL

Publication No. 23-0563-500

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