HAL DS2000 KSR VIDEO DISPLAY TERMINAL

CUSTOMER MAINTENANCE MANUAL

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DS2000 KSR CUSTOMER MAINTENANCE MANUAL

Preface:

This DS2000 Customer Maintenance Manual provides technical information about the circuitry of the DS2000 KSR terminal and presents a step-by-step troubleshooting guide. The DS2000 has been designed in a modular arrangement, and the troubleshooting guide is designed to isolate problems to specific boards whenever possible. When the defective module is located, please contact the factory (or authorized HAL distributor) so that arrangements can be made for repair of the module. This approach should expedite repairs of units and reduce the danger of shipping damage that might occur if the entire terminal were returned for repair. Since special test fixtures are required to test circuitry on each board, it is highly recommended that repair of the boards themselves be left to the factory or authorized-distributor technicians.

This manual is organized in six sections, presenting a discussion of the circuitry, disassembly procedures, specifications and limitations, trouble-shooting, adjustments and options, and schematic diagrams. It is recommended that you give all sections at least a cursory reading before beginning any tests or measurements.

The troubleshooting flow diagram has been prepared to utilize on-screen symptoms and I/O tests, minimizing the amount of external test equipment required. A good 20,000 ohms-per-volt VOM may be the only piece of test equipment you need! An oscilloscope is not required by the procedures given, but may prove useful.

Problems with the DS2000 can be placed in three general categories: those due to internal component failures, those due to a hostile environment, and those due to operator misunderstanding. As with all electronic equipment, some failure of internal circuitry may occur, particularly during the first few weeks of operation. However, the factory "burn-in" testing and the conservative design of the DS2000 have shown this mode of failure to be rare.

Equipment failures due to application of improper I/O connections or voltages, lightning strikes, or a hostile environment (water or excess heat), vary with the user. Experience has shown that the DS2000 problems can often be traced to these sources.

Experience has also shown that improper operator understanding of the many features of the DS2000 is often interpreted as an equipment malfunction. Please double check your operating procedures before "digging-into" the troubleshooting checks -- you may save yourself a lot of time and effort! If you discover a potentially confusing instruction in any of the manuals, please let us at the factory know so that future versions may be ammended. Use this DS2000 Customer Maintenance Manual in conjunction with your DS2000 Operator's Manual and Operator's Guide.

DS2000 KSR VIDEO DISPLAY TERMINAL

Customer Maintenance Manual

CONTENTS:

FIGURES:

THE DS2000 KSR COMMUNICATIONS TERMINAL

1. SYSTEM DESCRIPTION

Circuitry of the DS2000 KSR is contained primarily on three printed circuit boards (two, excluding the MR2000 option). These are the power supply board, the logic board, and the MR2000 Morse receive board. Fig. 1.1 shows the basic interconnections between these subassemblies. Each subassembly has a numerical designation, which is used to identify it. These designations appear on each pc board to help make identification easier.

1.1 System Block Diagram

Fig. 1.2 contains a functional block diagram of the entire KSR, including the MR2000 option. Like other HAL terminals, the DS2000 is designed around a dedicated microcomputer, the heart of which is a type Z-80 8-bit microprocessor IC. The Z-80, along with its associated ancillary devices, controls all KSR operations. The kinds of devices directly interfaced with the Z-80 in the DS2000 are as follows: Read-Only Memory (ROM), Random-Access Memory (RAM), Cathode-Ray-Tube Controller (CRT Controller or CRTC), Keyboard Matrix, Input/Output (I/O) Interface Circuitry, and the MR2000 Morse Receive Circuitry. Other devices, such as the line buffer, character generator, and video combining circuitry, are interfaced directly with the CRT controller, which can directly access memory, as necessary, during video display routines.

Communication between the Z-80 and its ancillary devices is through the bi-directional data bus, address bus, and control signals such as I/O Read/Write and Memory Read/Write. Operation of the Z-80 Central Processing Unit (CPU) requires that a multitude of commands, data and address information be communicated on a common multiconductor data bus. A system of tri-state buffer/driver devices actuated by commands from the Z-80 and CRT Controller, along with two types of interrupts, ensure that inter-device communications are carried out properly on this "party line". The two types of interrupts used on the Z-80 CPU are software maskable ($\overline{\text{INT}}$) and non-maskable ($\overline{\text{NMI}}$). Maskable interrupts can be "ignored" by the CPU if they happen at other than specific times during program execution, whereas non-maskable interrupts must be serviced by the CPU as soon as it completes the current program instruction being executed. Interrupts will be discussed in more detail when the circuitry that generates them is analyzed.

The DS2000 KSR operates differently than all previous HAL amateur terminals in that the Z-80 shares control of the address and control buses with the 8350 CRT Controller. In this system, the CRTC is said to be operating in Direct-Memory Access (DMA) mode when it takes control of the buses from the Z-80 CPU. How this system operates is explained in more detail in the sections of text that deal with the CPU and CRTC.

1.2 CPU/MEMORY SECTION

The CPU/Memory section of the KSR circuitry is shown in block-diagram form in Fig. 1.3, and schematically in Fig. 6.1.

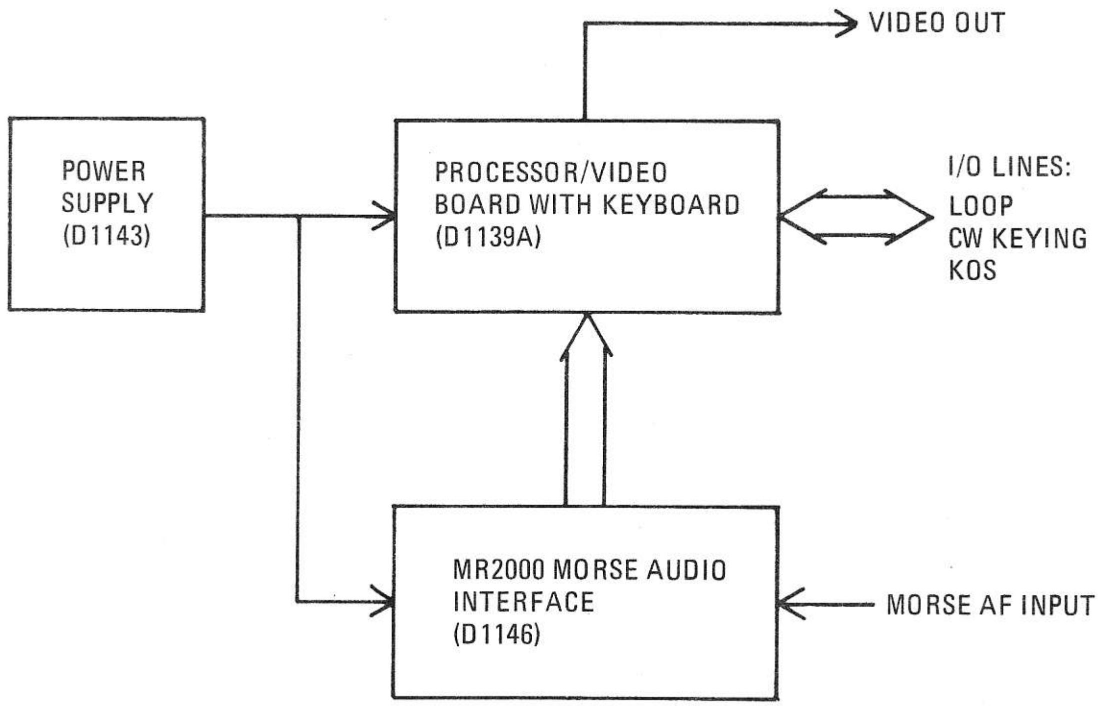


FIG. 1.1 -- Block diagram of pc-board interconnections in DS2000.

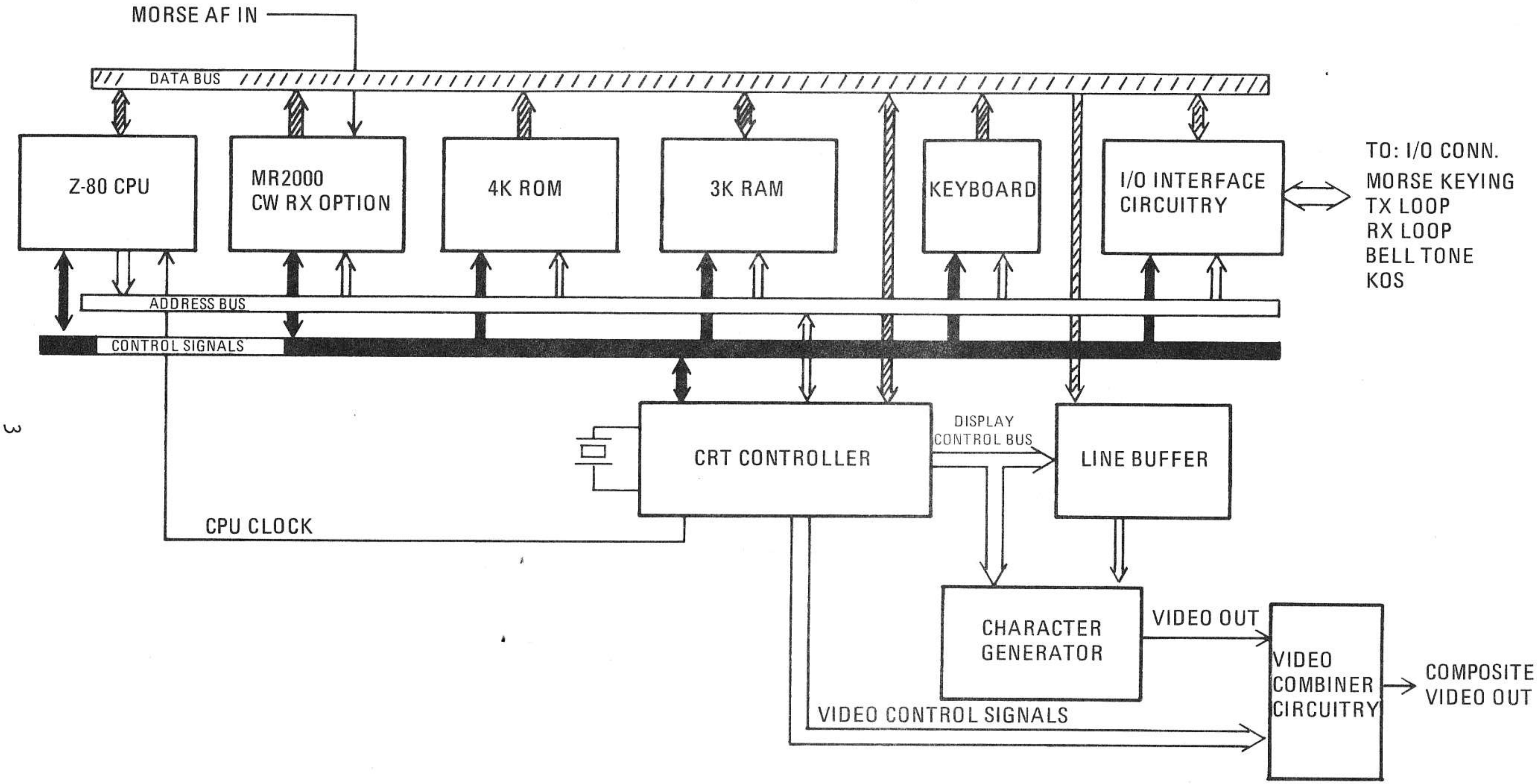


FIG. 1.2 -- DS2000/MR2000 block diagram (functional).

1. Program Memory

All operations performed by the DS2000 circuitry are determined by sequential steps in the system program. This program, which contains all necessary instructions for the microprocessor, is contained in Programmable Read-Only Memory (PROM). Early DS2000s contain four type 2708 Erasable PROMs, while the newest versions contain a single mask-programmable ROM. Typical subroutines that are stored in the KSR PROM are: keyboard decoding, character storage, speed change, code conversion, status processor, and test message generation. The program information stored in memory devices is often referred to as "software" to distinguish it from the hard-wired or "hardware" part of the system. The software in the DS2000 is installed in plug-in sockets, assuring simple replacement if future software updates are made available.

2. Text Storage Memory

The DS2000 KSR logic board contains 3 kilobytes of Random-Access Memory (RAM), which is used to store all text in the video buffer (1728 characters) along with the text in the hidden buffer. Six static RAM ICs (each 1k x 4 bits) are used to store all text, whether it is being displayed or stored in the hidden transmit buffer.

3. Z-80 CPU

The $\overline{\text{DOTCLK}}$ signal from the CRT Controller is divided down to generate the Z-80 clock and $\overline{\text{NMI}}$ signals. The frequency of the non-maskable interrupt is 2.1328 kHz, providing an interval of approximately 0.47 mS between NMIs. The DS2000 software program is interrupted each time an NMI occurs, providing a regular time-referenced "stopping point".

Two signals interface the Z-80 CPU with the CRT Controller: $\overline{\text{HOLD}}$ and $\overline{\text{BUSEN}}$. The $\overline{\text{HOLD}}$ signal is generated by the CRTC to request control of the buses. This signal goes to the $\overline{\text{BUSRQ}}$ input on the Z-80, which completes the instruction being performed and then removes itself from the buses by tri-stating (going to a high impedance) at all address- and data - bus connections. After the Z-80 has gone tri-state, it acknowledges the bus request with a $\overline{\text{BUSAK}}$ signal that is used to enable the CRTC as a BUS Enable ($\overline{\text{BUSEN}}$) signal.

Additional control signals from the Z-80 are used to create Memory Write ($\overline{\text{MEMWR}}$), Memory Read ($\overline{\text{MEMR}}$), I/O Write ($\overline{\text{IOWR}}$), and I/O Read ($\overline{\text{IORD}}$). These, along with another Z-80 control signal -- I/O Request ($\overline{\text{IORQ}}$) -- and address lines are used to enable or select all ancillary devices. The $\overline{\text{INTRP}}$ control line from the MR2000 board is connected to the maskable interrupt ($\overline{\text{INT}}$) on the Z-80.

1.3 INPUT/OUTPUT SECTION

(A block diagram depicting the I/O section circuitry in the DS2000 is contained in Fig. 1.4.)

1. Keyboard

In the DS2000 KSR, the keyboard is treated as a read-only type memory device. Performing a part of the main service routine in the system software, the Z-80 scans the keyboard matrix looking for a logic zero on one of the data lines, representing a key press on a specific key. If a key press

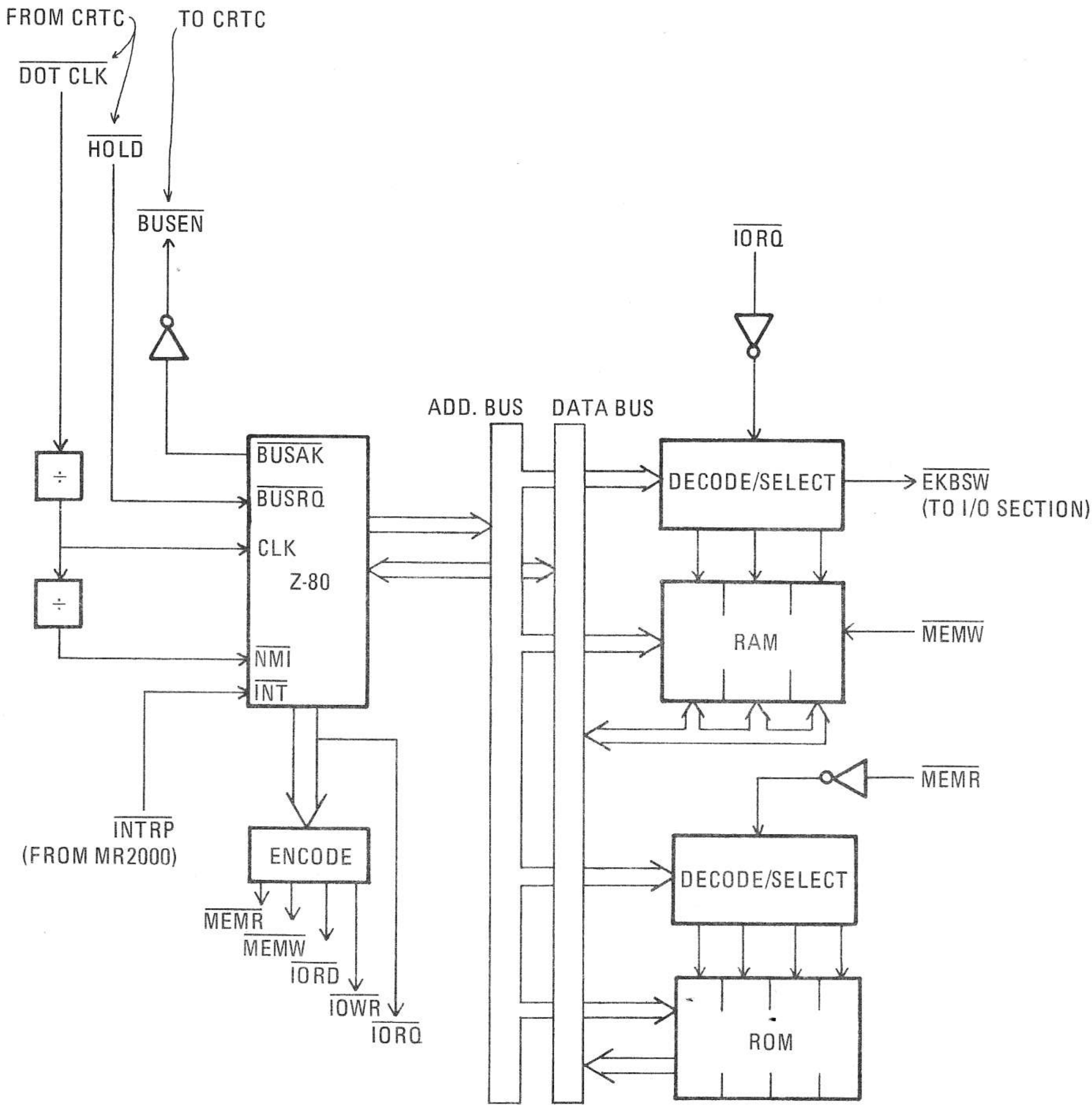


FIG. 1.3 -- CPU/Memory section of DS2000 circuitry.

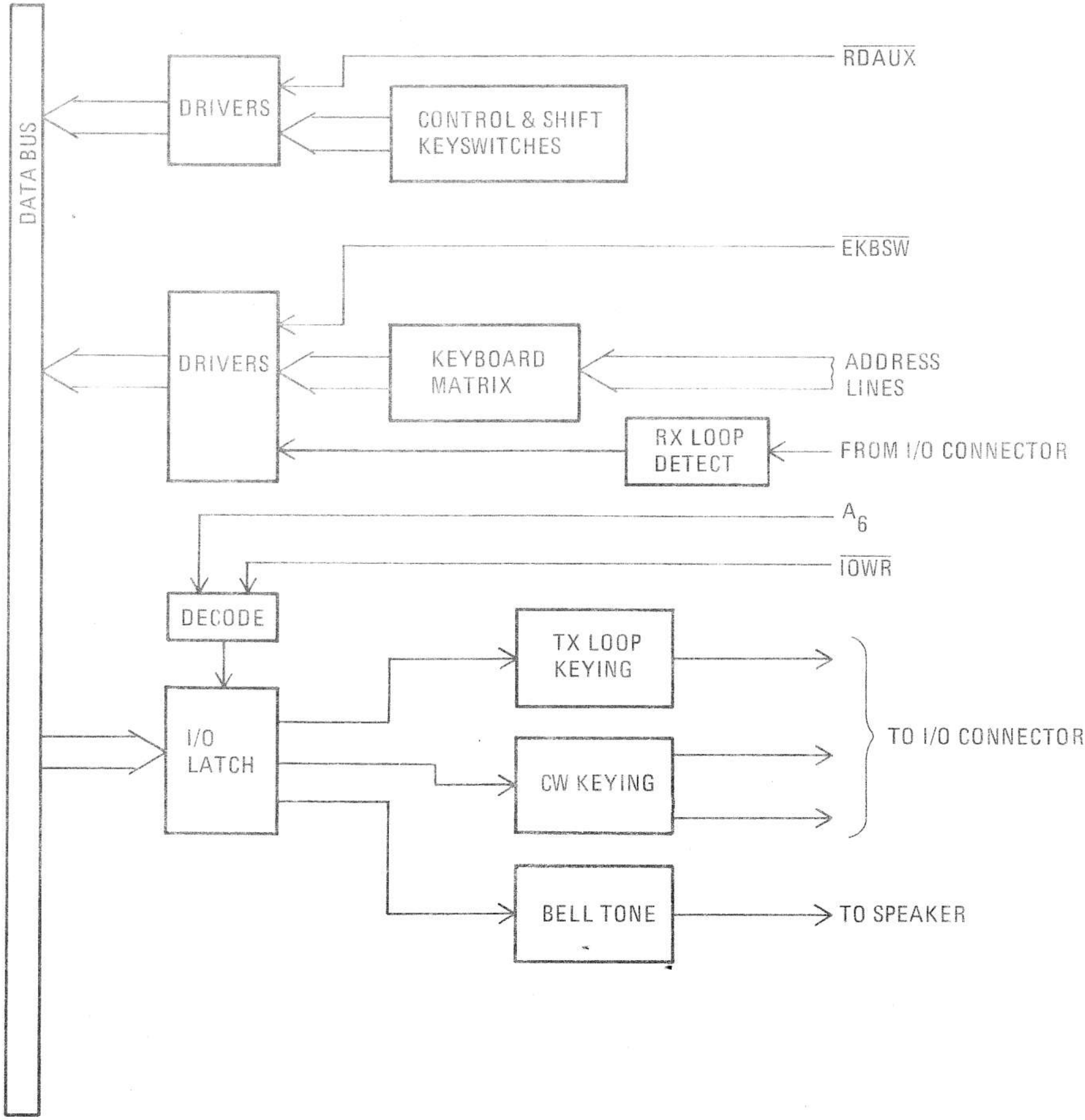


FIG. 1.4 -- I/O section of DS2000 circuitry.

is detected during the matrix scan, the program instructs the CPU to "read auxilliary" by enabling the RDAUX control line. When this line is enabled (active low), the SHIFT and CTRL key switches are I/O read via two of the data lines. The practical effect of this operation is that the keyboard is continually being scanned for keypresses, and that when one is detected, the CPU checks to see if it was combined with a SHIFT or CTRL keypress. The software keyboard-decoding routine then assembles this information to determine the desired character or function.

2. I/O Connections

The I/O Write (IOWR) signal is combined with address line CA6 to generate an enable for the I/O latch used to set the various I/O ports to the proper levels, as determined by the data received from the data bus. The bell-tone, cw-keying and TX-loop keying circuits are all driven by this latch.

3. Receive-Loop Detect

The output from the RX-loop detection circuit is fed to the same drivers that place the keyboard-matrix information on the data bus. Thus, the RX loop is read for high or low condition each time the keyboard is scanned.

1.4 VIDEO GENERATOR SECTION

Fig. 1.5 shows the video generator section of the DS2000 circuitry in block diagram form. The main component in the video circuitry is the 8350 CRT Controller, which is interfaced with the CPU through control signals such as HOLD and BUSEN (bus enable). Since the CRTC is capable of operating in Direct-Memory Access (DMA) mode, there must be some way to remove the Z-80 CPU from the address and data buses when the CRTC requires them to do its job. When the 8350 requires the next line of video information for storage in the line buffer, it sends a HOLD command to the CPU, which sees this as a bus request. After the Z-80 completes the instruction being performed, it tri-states effectively removing itself from the buses, and acknowledges CRT bus control by sending a bus enable (BUSEN) signal to the CRTC. The 8350 then accesses memory to obtain the necessary text for the line buffer. When it is finished using the address bus, the CRTC removes the HOLD command, returning control to the CPU. Since the CRTC and CPU use the HOLD and BUSEN commands to "agree" as to which device has control of the address bus, it might be said that they "shake hands" via these two lines. The HOLD and BUSEN commands are therefore referred to as "handshaking" signals.

When the CRTC addresses memory, the ASCII codes for the next character row to be TV scanned are loaded into the line buffer, which feeds display data to the character generator. The generator receives several timing signals from the CRTC, as well as the DOTCLK signal. When a new character row of codes has been loaded, the character generator outputs the dot patterns for the top scan line of the character row, followed by the patterns for the successive scan lines in the character row until the complete row is displayed. Then, the next character row is loaded, and displayed scan-line by scan-line as explained above. This continues until the entire contents of memory have been loaded and displayed, after which the process is repeated.

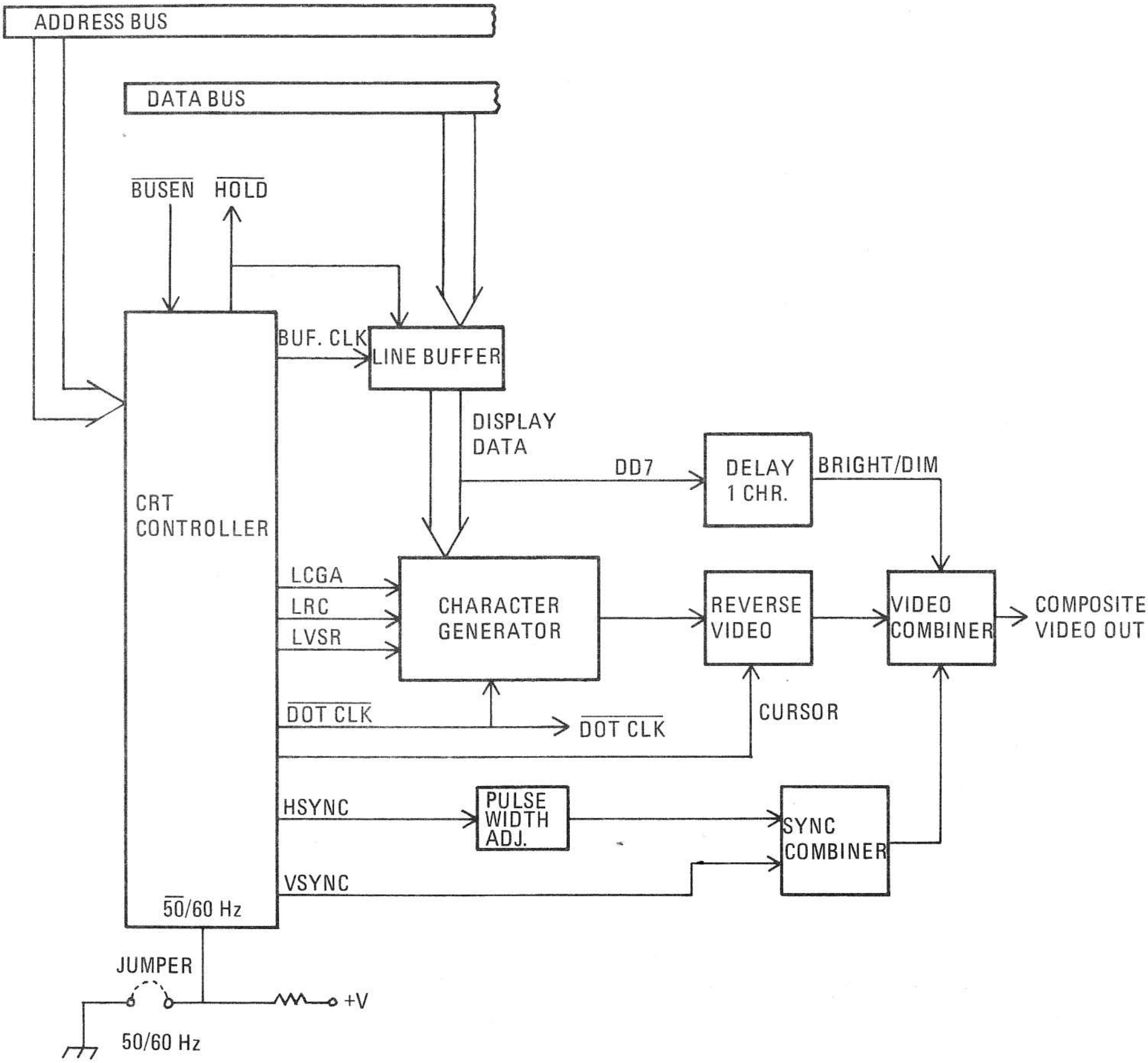


FIG. 1.5 -- Block diagram of video section of DS2000.

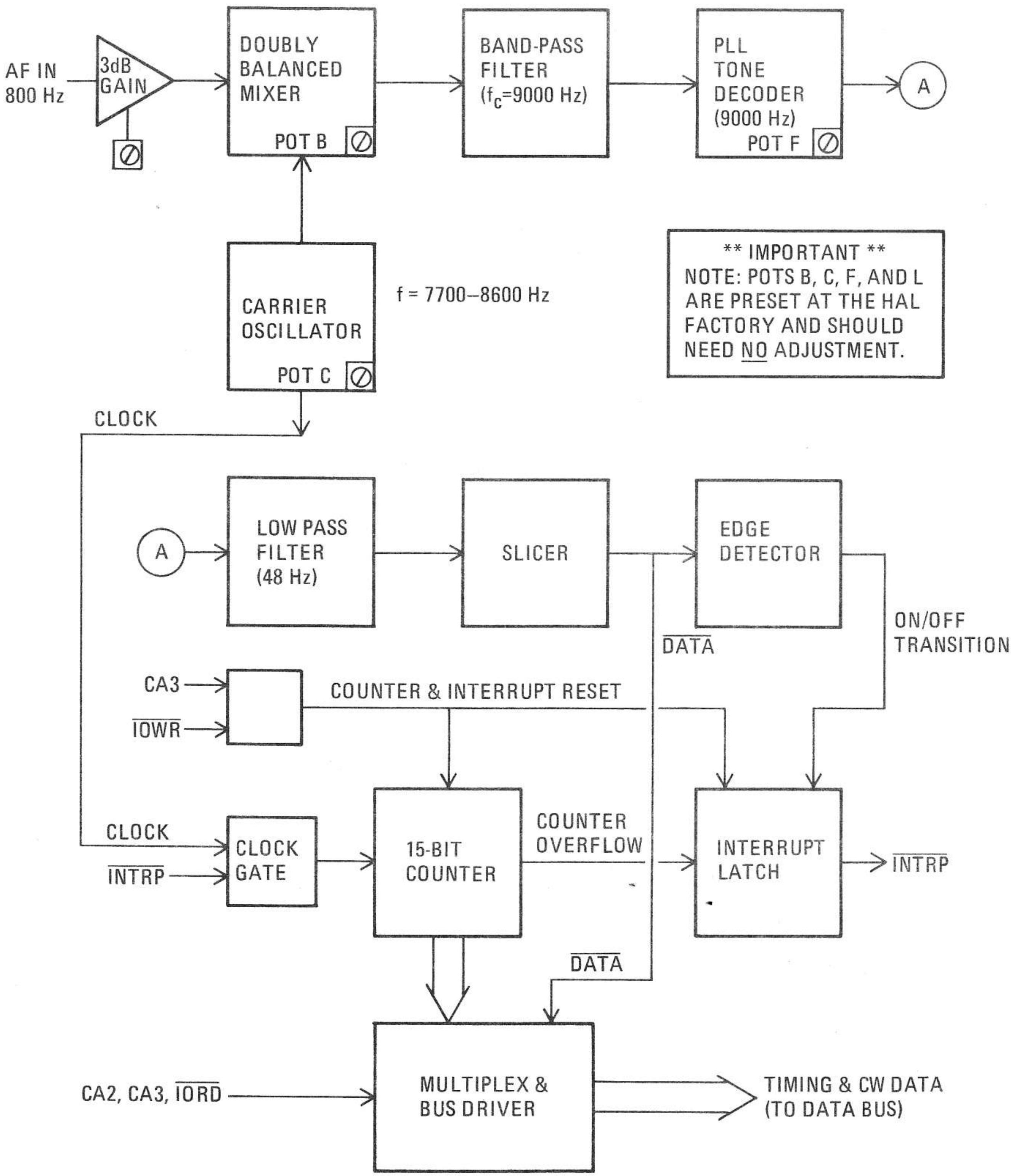


FIG. 1.6 -- Block diagram of MR2000 circuitry.

The serial stream of video (dot/no dot) information from the character generator is inverted when a CURSOR signal is present, providing a reversed character (black on white) at the position of the xmit cursor. Output video from this stage is combined with sync-signals in the video combiner, where bright/dim control is supplied, as derived from display data line seven (DD7). A delay in the bright/dim control line synchronizes the control with the video information.

A line-frequency control pin on the CRTC is connected through a "pull-up" resistor to +5 volts (logic one) for 60-Hz operation. For 50-Hz operation, this line should be jumpered to ground, providing a logic zero (jumper "B" -- see section 5.3).

1.5 AUDIO INPUT INTERFACE SECTION (MR2000)

A block diagram depicting the Morse audio processing circuitry in the MR2000 is contained in Fig. 1.6. The circuitry is shown schematically in Fig. 6.5. Incoming audio is heterodyned with the local oscillator, with the sum of the two frequencies going through band-pass filtering centered at 9000 Hz. Band-pass filter output is fed to a phase-locked loop (PLL) tone decoder that is designed to detect 9 kHz input signals. PLL output is low-pass filtered before passing through a slicer stage, where the on-off keying information is "squared up" for use by the microprocessor. An edge detector generates an output for each transition (leading edge or trailing edge). These transitions are used to generate interrupts ($\overline{\text{INTRP}}$) to the processor. When the processor receives an $\overline{\text{INTRP}}$ command, it generates $\overline{\text{IORD}}$ and selects address lines two and three. These enable a multiplexer/dus driver used to place cw key-on/key-off information ($\overline{\text{DATA}}$) and timing bits on the data bus. The local oscillator generates a clock signal that is gated to a 15-bit counter that provides the timing bits to the data bus. $\overline{\text{IOWR}}$ combined with address line three resets both the interrupt latch and the counter, while overflow from the counter generates an $\overline{\text{INTRP}}$ command to the processor.

The balance of the KSR circuitry is contained on the power supply board and in the cabinet wiring. This portion of the DS2000 is shown schematically in Fig. 6.4.

2. DISASSEMBLY OF THE DS2000

2.1 In the event that you need to open the KSR cabinet to check voltages, check connectors, or perform any other servicing function, BE SURE TO READ THE FOLLOWING INFORMATION FIRST:

```
*************************************
*                                   *
*            WARNING !              *
*                                   *
*  ALWAYS UNPLUG THE POWER CORD     *
*  FROM THE AC POWER SOURCE BEFORE  *
*  OPENING THE KSR CABINET FOR      *
*  SERVICING.                       *
*************************************
```

Before beginning any disassembly of the DS2000 KSR, first disconnect all external equipment by unplugging the I/O connector, Morse AF input connector (if MR2000 is installed) and the coaxial connector attached to the video output. Turn off the KSR power switch and disconnect the captive line cord from AC power source. Place the KSR on a protected work surface and remove the four phillips-head screws that secure the KSR top section to the bottom chassis. Each of these screws should have an internal-star lockwasher on it (early version KSRs may be missing these lockwashers -- contact the factory or your distributor to obtain these if your unit does not have them). Set the hardware aside and lift the KSR top section straight up and off of the bottom chassis and lay it keyboard-side down on the protected work surface. Use caution to ensure that none of the interconnecting cables are strained during this operation.

2.2 Removal of the MR2000 Morse Receive Board

To remove the MR2000 from the KSR, set the bottom chassis of the DS2000 on its side with the bottom facing away from you (see Fig. 2.1). Unplug the ribbon-cable DIP header plug from the socket on the DS2000 logic board, and disconnect the power connectors (six-pin Molex) connecting the MR2000 to the power supply board. Next, remove the 6-32 hardware (four sets of screw, spacer, lockwasher and locknut) that secure the board to the DS2000 bottom chassis. Now the MR2000 board can be removed from the DS2000.

2.3 Removal of the Power Supply Board

To remove the power supply board from the DS2000, unscrew the four phillips-head screws that attach the board to the four stand-off spacers on the bottom chassis. Then disconnect the two cables going to the MR2000 and KSR logic boards, disconnect the cable going to the transformer, and disconnect the cable going to the pass transistor mounted on the rear panel. The power supply board should now be free of the DS2000 bottom chassis.

2.4 Removal of the Logic Board

To remove the KSR logic board from the DS2000 top cover, unplug the DIP header plug from the socket on the logic board, and unplug the power supply cable.

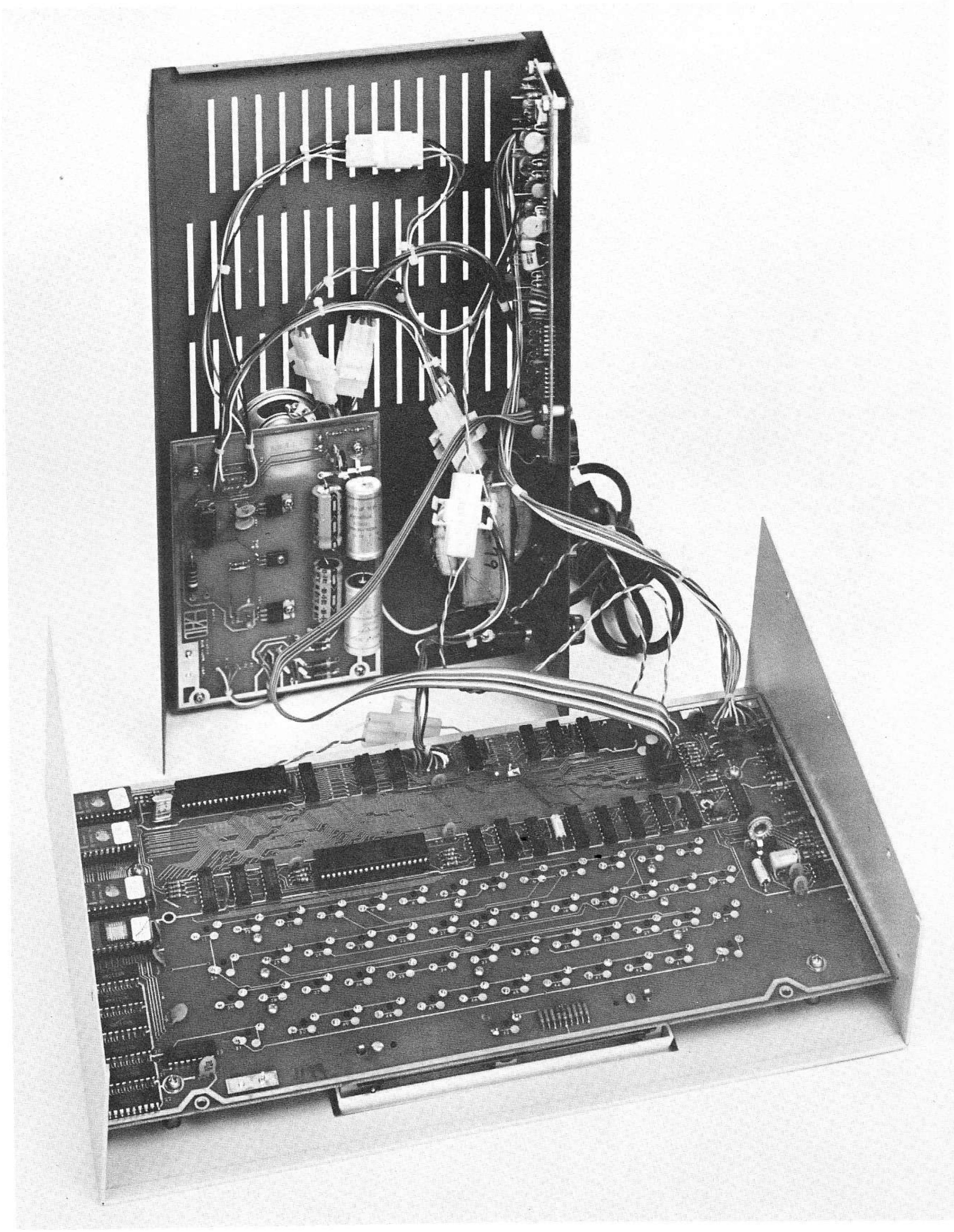


FIG. 2.1 -- Chassis position for installation/removal of MR2000.

Next, remove the I/O connector from the DS2000 rear panel by pressing the retaining flaps in (toward the connector shell) so that the connector shell pops out through the hole in the chassis. Then fold the retaining flaps back the other direction and feed the cable and connector back through the back-panel hole to the inside. Now the top cover should be completely disconnected from the bottom chassis. Remove the four screws that attach the logic board to the top cover. Put them aside along with the four internal-star lockwashers used between the pc board and stand-off spacer at each screw location.

2.5. Reassembly of the DS2000 KSR

In general, any subassembly of the KSR that has been removed can be reinstalled in the KSR chassis by following the above instructions in reverse order. The following are special instructions concerning installation of certain subassemblies.

1. When installing the MR2000, use caution when plugging the DIP header into the DIP socket on the logic board. Be sure that all of the pins are lined up with the socket holds before pressing the header into place. Also be sure that the header is oriented properly with respect to the socket (match the colored dots, or align the beveled corners).

2. When installing the logic board in the KSR top cover, initially do not tighten the four retaining screws all the way. Turn the top cover over and inspect the key tops to ensure that they all actuate freely. If some of the key tops rub against the edges of the keyboard cut-out, adjust the spacing by moving the keyboard assembly slightly. When the proper spacing is achieved, tighten the four retaining screws completely. Check key tops again to ensure that they do not bind against the metal cover cut-out edges when they are depressed.

3. I/O SPECIFICATIONS AND LIMITATIONS

Before making any connections to the DS2000 KSR (other than standard RTTY or CW interfacing as outlined in the Owner's Manual) review the following specifications.

```
******************************
*                            *
*          CAUTION!          *
*                            *
* IMPROPER CONNECTIONS MADE  *
* TO KSR I/O PORTS MAY CAUSE *
* DAMAGE TO INTERNAL PARTS.  *
******************************
```

Input/Output Data: (See Fig. 3.1)

Loop current input (pins 1 and 4 on I/O connector)

200 V maximum.

120 mA maximum, 18 mA minimum.

Morse audio input (pins 1 and 2 on audio connector)

10 V RMS maximum; 0.5 to 1.0 V P-P optimum.

Morse keying outputs (pins 7 and 9 on I/O connector)

Transistor switches to ground, keying positive (cathode) and negative (grid-block) voltage circuits simultaneously.

Rating: $\pm$150 VDC; 150 mA maximum.

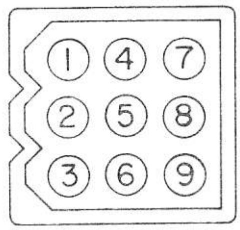
KOS output (pin 6 on I/O connector)

Transistor switch to ground, keying positive voltage circuits.

Rating: +200 VDC; 100 mA maximum.

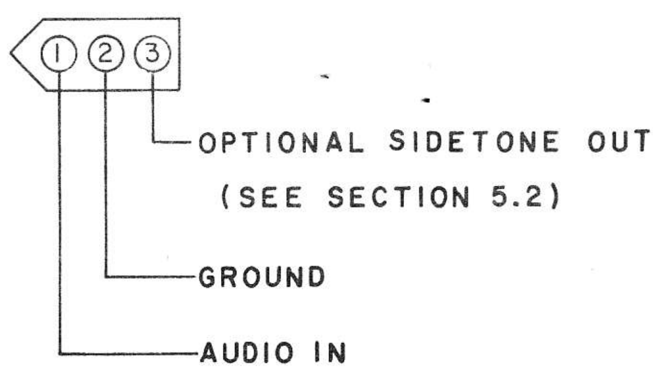
Video output (SO-239 UHF connector)

75-ohm, 1.0 V P-P composite video output, compatible with EIA RS-170 standards; peak video bandwidth = 6.1 MHz (8-MHz video bandwidth monitor recommended for good resolution).



1	+	TRANSMIT LOOP	BAUDOT OR ASCII
2	−		
3	+	RECEIVE LOOP	
4	−		
5	GND		
6	KOS		
7	CATHODE KEY OUT (POSITIVE)		
8	GND		
9	GRID-BLOCK KEY OUT (NEGATIVE)		

INPUT/OUTPUT CONNECTOR



MORSE AUDIO CONNECTOR

FIG. 3.1 -- DS2000 I/O connections.

4. TROUBLESHOOTING PROCEDURES FOR THE DS2000 KSR

As explained in the preface to this manual, it is important for the operator to rule out "cockpit error" as a possible problem before trying to troubleshoot the KSR. In the event that your DS2000 KSR develops a malfunction, the first step to take toward getting the unit repaired is to carefully note all of the symptoms of the problem. This suggests that a logic-based flow chart should be used to determine as closely as possible what portions of the circuitry are working, and at what point there seems to be a "breakdown" in system operation. This section contains sufficient information to allow the operator to verify proper operation of portions of the DS2000, and through simple checks and the process of elimination narrow down the anomaly to a single section of the KSR circuitry.

4.1 Initial Connector Check

```
****************************
*                          *
*        IMPORTANT!        *
*                          *
* ALWAYS UNPLUG EQUIPMENT  *
* BEFORE OPENING CABINET.  *
* LETHAL VOLTAGES INSIDE!  *
****************************
```

The first thing you should do if a problem occurs is open the KSR cabinet (see section 2) and verify that all connectors are in place. This includes all molex-shell connectors, and the ribbon-cable DIP header if an MR2000 is installed. Inspect the KSR interior visually for any loose hardware or dangling wires.

4.2 Returning Equipment

The following flow chart indicates specific subassemblies that should be returned to the factory when problems are encountered in KSR operation.[1] Always obtain prior authorization from the factory before sending any equipment (complete unit or any subassemblies) back for repair. Refer to section 4 of the KSR Owner's Manual if any difficulties are experienced with the DS2000. Part 4.3 specifically covers repair and return procedures. IMPORTANT: Any KSR problem that is suspected to be the result of lightning damage may involve more than one subassembly. The entire DS2000 KSR -- including MR2000 if installed -- should be returned to the factory for servicing if lightning damage is suspected.

[1]For units purchased from a HAL distributor, all references to the "the factory", when used in context with returning equipment or getting technical assistance or replacement parts, should be interpreted as "the distributor where purchased."

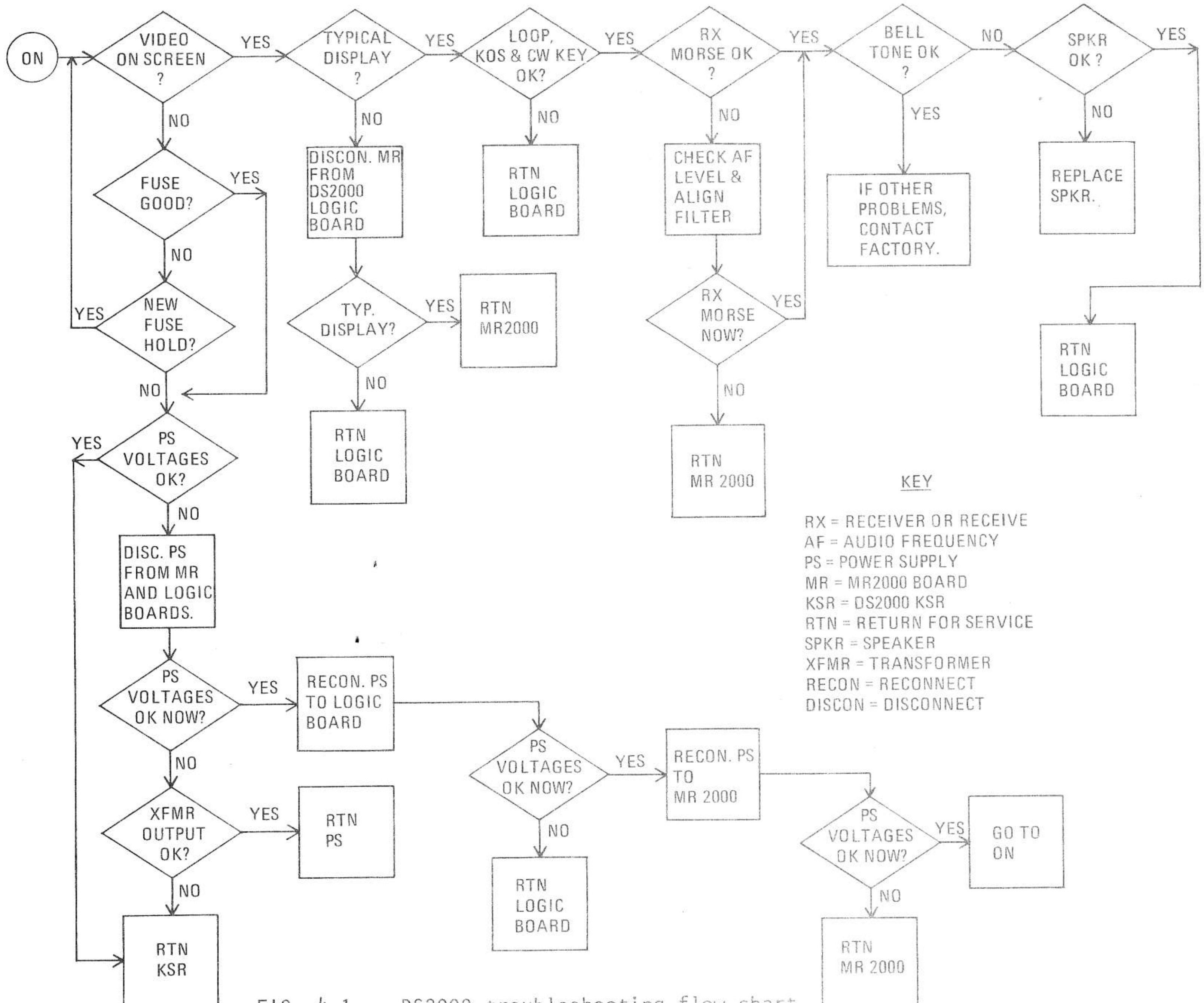


FIG. 4.1 -- DS2000 troubleshooting flow chart.

4.3 Using The Flow Chart

The chart in Fig. 4.1 generally flows from left to right, and top to bottom. A key provides identification of symbols and abbreviations used in the chart. In most cases this diagram should narrow down KSR problems to a specific subassembly, eliminating the necessity of returning the entire unit. However, some malfunctions cannot be isolated in this fashion. In these cases, where pc-board circuit tracing or other specialized troubleshooting techniques are required to affect repairs, <u>the customer should NOT attempt to repair the KSR.</u> <u>In any instance, do not perform troubleshooting beyond the scope of that indicated in the flow chart.</u> Any damage that is determined by the factory to be the result of unauthorized troubleshooting will not be repaired under warranty, and may void the warranty.

4.4 Troubleshooting Guide

The following text is provided to supplement the information contained in the flow chart. Each vertical flow section -- where a problem is indicated, causing a branch-off from the main flow -- is explained in sequence. Until you become familiar with Fig. 4.1, use this text in conjunction with the flow chart when doing troubleshooting.

1. Video On Screen?

If no video appears on the monitor screen when the DS2000 is first turned on, there are several obvious possible causes that should be checked out. Is the DS2000 KSR power cord plugged into a "hot" (active) ac power outlet? Is the monitor also connected to ac power? Is the video cable properly connected to the video output connector on the DS2000, and terminated properly (proper impedance) at the monitor video-input connector? Are the contrast and brightness controls on the monitor set to the proper levels? Be sure to check the video cable for continuity and short also. After these things have been checked, continue with the decisions on this branch of the flow chart. If possible, verify that the monitor is operating properly by testing with another video input. If another monitor is available, connect the DS2000 video output to it. A good display indicates that the original monitor is at fault.

If a bad fuse is replaced and continues to blow, DO NOT keep replacing. Under no circumstances should the fuse be replaced with one that has a higher rating than stated in the Owner's Manual. Power supply voltages should be checked next.

```
********************************
*                              *
*           CAUTION!           *
* LETHAL VOLTAGES ARE EXPOSED  *
* IN REAR SECTION OF KSR NEAR  *
* POWER TRANSFORMER AND FUSE.  *
********************************
```

All power supply voltages can be tested at the 6-pin Molex connectors on the power supply cables. Refer to section 2 (assembly/disassembly) before attempting any troubleshooting INSIDE the KSR cabinet. Check the plus and minus 12-volt and plus and minus 5-volt supplies at the Molex connector on each power supply cable.[1] Pin identification is supplied in Fig. 6.4, as well as wire color codes.

[1]Some later production versions containing a single 52132 ROM instead of four 2708 EPROMs may not have minus 5-volt regulator circuitry in the power supply. In these units, test $\pm$12-volt and +5-volt supplies only.

The regular circuits in the KSR power supply are designed to "shut down" when excessive current is drawn. A short circuit or defective component on the logic board or MR2000 board could cause this to happen. Verify proper power supply operation by disconnecting the power supply Molex connectors and testing the power supply outputs with no load attached. By the process of elimination, the power-hungry area (if any) can be isolated. This is done by testing voltages with individual boards connected.

2. Typical Display?

An atypical video display may be caused by a misadjustment of one or more circuits in the video monitor. This should be checked before continuing. First, check to see that the video-input impedance switch is in the proper position: 75-OHM, NOT the HI-Z position. Set the brightness and contrast controls while the screen contains both transmit and receive text (some bright characters and some dim) for reference. Adjust the brightness first, reducing it until the raster (scan lines that cover the entire picture area of the tube) just disappears but so that both bright and dim characters are still visible. Then adjust the contrast control for optimum resolution and minimum "blossoming" of the bright characters.

A display that looks skewed and unreadable may be the result of a misaligned horizontal hold control. A video picture that rolls or flips along its vertical axis is probably the result of an out-of-adjustment vertical hold control. If text lines at the top of the screen are either smaller or larger in height than those closer to the bottom of the screen, an adjustment of the vertical linearity control is indicated. If the vertical linearity control is moved from the factory setting, an adjustment of the vertical size control may be necessary. All of the above controls, along with the focus control are located on the rear panel of the ESM-914 monitor. Thus, it should not be necessary to open the cabinet to perform any of the above adjustments. Refer to the Operator's Manual included with your ESM-914 (or other monitor) when making any adjustments.

If the DS2000 KSR video display is abnormal (irratic behavior, such as characters appearing and disappearing without reason, or the cursor jumping randomly) the software program may not be executing properly. A failure of the program execution may also cause a partial or complete lack of response to the keyboard, or an inability to receive properly. Usually this type of problem is caused by a defective part on the DS2000 logic board. However, it is possible that a problem on the MR2000 Morse receive board is disturbing the data and address lines on the logic board. Disconnect the DIP header connecting the MR2000 to the KSR logic board. If the difficulty persists, the defective part is probably on the logic board. If the trouble clears up when the MR2000 board is disconnected, then it should be returned for service.

3. Loop KOS and CW Lines Key OK?

The DS2000 logic board contains the microprocessor and support circuitry as well as all video generation, loop sensing, sidetone generation, CW keying and loop keying circuitry. Problems that are encountered in any of these areas would therefore indicate a possible malfunction on the logic board.

4. RX Morse OK?

Morse receive problems are usually caused by a defective component on the MR2000 board. Before you decide that the MR2000 board is the cause of a Morse receive problem, check your CW RX cabling and audio source (receiver audio output). Also inspect the MR2000 ribbon cable to ensure that the DIP header is properly mated with the socket on the KSR logic board. Test the MR2000 audio input signal with an oscilloscope or ac voltmeter to see that the level is proper. The receiver audio going to the MR2000 should be between 0.5 and 1.0 volts peak-to-peak, and should not exceed 10 volts in any case.

Proper tuning of the signal and alignment of the MR2000 circuitry with the available audio from the receiver are also necessary for optimum CW reception. Tuning of CW signals is covered in the KSR Operator's Guide and in the Owner's Manual.

As discussed in section 1.5, the audio input interface circuitry for Morse reception heterodynes the incoming audio with a local oscillator and the sum of the two frequencies is fed to a bandpass filter centered at approximately 9000 Hz. The local oscillator is set at the factory so that an 800-Hz audio input provides a mixer output that is centered in the band-pass filter. The 800-Hz note is chosen because it matches the audio frequency available from most receivers when a signal is tuned to the center of the receiver i-f filter pass band. For receivers that provide other center-frequency audio notes (i.e. 900 or 1000 Hz), the MR2000 circuitry can be adjusted so that the center frequency provided by the station receiver will heterodyne up to the frequency required to pass through the center of the bandpass filter. This is done by varying the local oscillator (LO) frequency.

To obtain proper alignment of the MR2000 pass band and center-frequency audio note from the receiver, follow the procedure below:

1) Turn on receiver xtal calibrator or other stable, constant-level AØ emission and tune receiver for maximum S-meter reading on the signal. (This centers the signal in the i-f filter pass band.)

2) Turn on DS2000/MR2000 and select Morse mode. Be sure to type a RETURN key to put the DS2000 back in the receive mode.

3) Increase audio level to MR2000 input until asterisks (***) appear on DS2000 video in bottom right corner.

4) Decrease audio level until asterisks just disappear, then increase slightly until they reappear.

5) Adjust the small potentiometer (accessable through MR2000 connector hole at rear of DS2000 cabinet) to determine the range over which asterisks remain visible. Then set control to center of this range.

6) Repeat steps 4 and 5 until no appreciable change in potentiometer results. The center of the MR2000 pass band is now aligned with the audio note that results when a signal is tuned to the center of the receiver i-f pass band (optimum condition).

5. Bell Tone Okay?

An intermittant or inactive sidetone or Bell signal can be caused by defective wiring, speaker, or Bell-Tone circuitry. To determine the problem area, check the audio output from the Bell-Tone current amplifier located on the logic board to see if a signal is present at that point. (See Fig. 6.2 for schematic diagram of the Bell Tone circuitry.) If no signal is detected at this point, check for a defective potentiometer by testing for audio prior to the pot (i.e. at the negative end of the 10 μF capacitor).

The sidetone audio is routed to the speaker through cables connected to the power supply board. Check for audio at the foil pads where the brown wires are soldered. If sidetone audio is present at all points up to the speaker, test the speaker with an alternate source of audio to verify operation.

6. Other Problems

If problems not specifically covered in the troubleshooting section develop, contact the Customer Service Dept. at the factory for assistance. Be sure to obtain prior authorization from factory personnel before returning any equipment to HAL for service.

4.5 RF-Induced Problems

The DS2000 KSR is designed to operate in close proximity to radio frequency transmitting and receiving equipment. Particular attention has been paid to the shielding of the KSR circuitry through the use of an all-steel enclosure and good common grounds. However, under certain conditions in an rf-saturated environment, the DS2000 KSR may be susceptable to rf-induced interference. This may manifest itself in any of a number of ways, such as partial or complete lack of response to the keyboard, or erratic behavior of the video display.

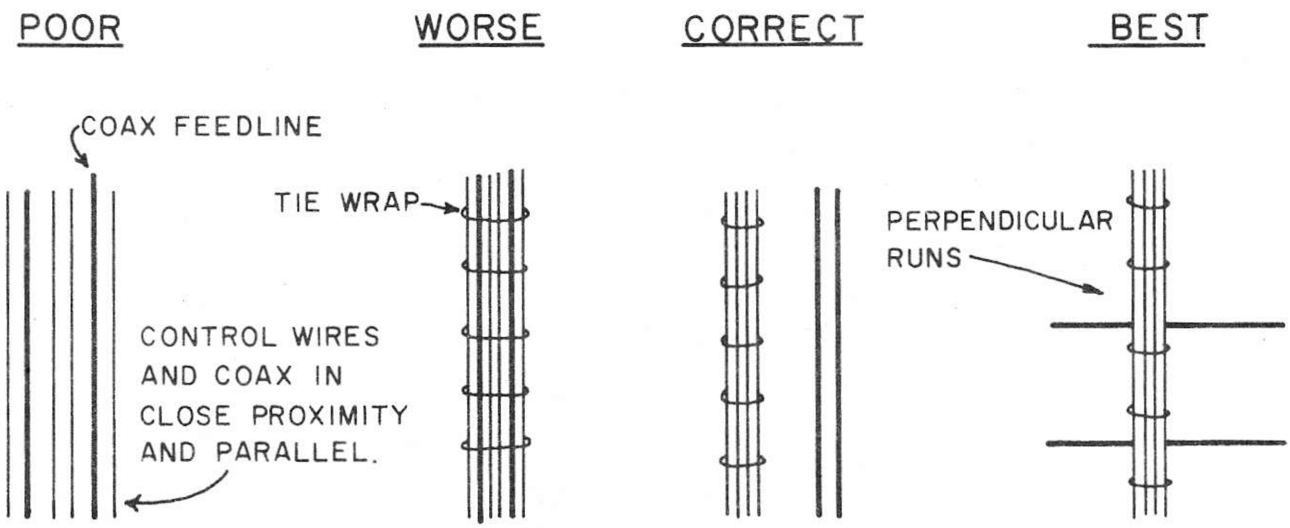
The first thing that should be checked if rf problems are suspected is the ground system. The transmitter should be properly grounded for rf (in addition to electrical ground) and all other station equipment grounds should be connected to the transmitter chassis. The rf ground should consist of a short length of heavy copper wire or braid terminated at a good earth ground (ground rod or copper cold-water pipe). If a water-system ground is used, be sure that the pipes are 100 percent metal from the point of connection to the water mains -- plastic plumbing will break the ground path. If the distance between your transmitter and ground rod or water-main ground is more than a quarter wavelength at the highest operating frequency, make the ground wire a half-wavelength, or a multiple of a half wavelength long. If you plan to operate on 10 and 15 meters you may need to run a separate ground wire for each band if the distance requires the use of half-wavelength wires. For example, if the distance from the ground point exceeds about 8 to 10 feet, a 10-meter half-wave ground wire (16 feet long) and 15-meter half-wave ground wire (22 to 23 feet long) would be used. Consult any of the amateur handbooks or antenna books for a more in-depth discussion of grounding techniques.

The best way to confirm that a problem is being caused by rf induction is to temporarily eliminate the source. This may be done in stages, starting with a partial reduction in exciter drive, and ending with transmitter shut-off. Since rf energy can be induced in the DS2000 circuitry through several different paths, connecting the transmitter to a dummy load may not eliminate all rf related problems, although this is an excellent first step in verifying rf problems.

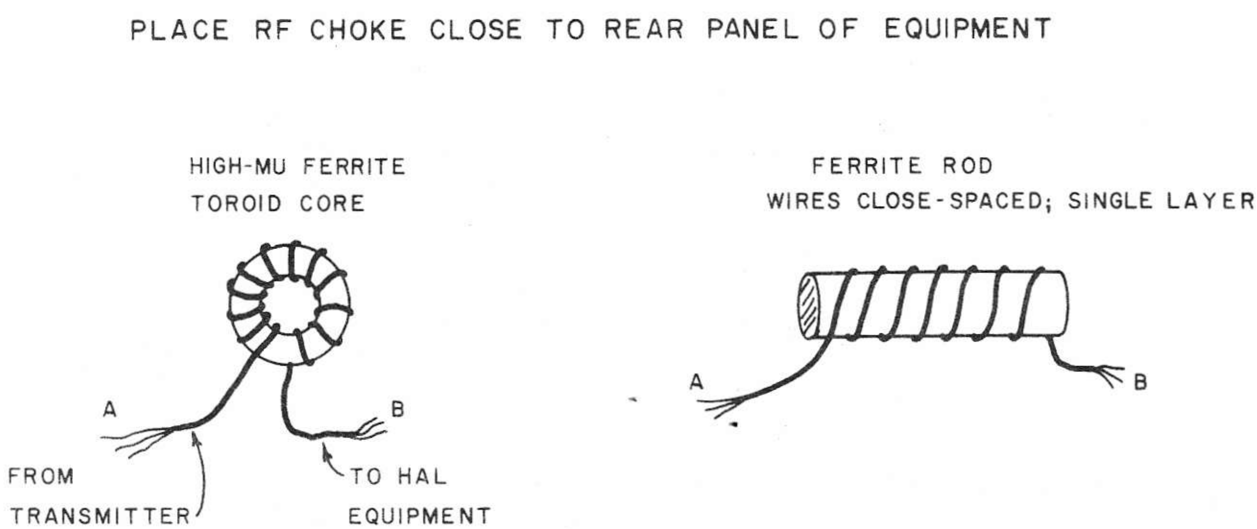
Radiation of rf energy from linear amplifiers, antenna tuners, coaxial switches, monitor scopes, and interconnecting coax-cable jumpers is also possible. In fact, it is this type of radiation that is most likely to be coupled into nearby I/O and power cables going to the DS2000 KSR. To locate the point or points of radiation, experiment with different cable arrangements to see if the rf-induced problem can be eliminated by reducing coupling between any of the DS2000 cables and nearby coaxial lines carrying rf power. Fig. 4.2A contains several cable arrangements, both bad and good, showing how to keep rf coupling to a minimum. The drawing in Fig. 4.2B shows the use of high-mu (950 or 2000) ferrite toriods or rods to choke the flow of rf on audio and control lines.

If cable rearrangement doesn't yield positive results, then begin eliminating pieces of equipment and sections of coaxial cable until the transmitter is connected directly into a shielded dummy load. As each piece of equipment is removed from the transmission line, check to see if the rf-related problems have diminished or disappeared. If the rf problem persists with the exciter connected directly to a dummy load reduce the drive level to see if that eliminates the problem.

If operation into a dummy load does not significantly reduce the rf-related problems, disconnect all I/O cables from the KSR. Test the DS2000 operation while it is connected only to ac power and a video monitor. At the same time, enable the transmitter so that it sends a CW signal into a dummy load. If rf problems are still present, then rf energy is probably being introduced to the DS2000 through the power cord by means of the common ac

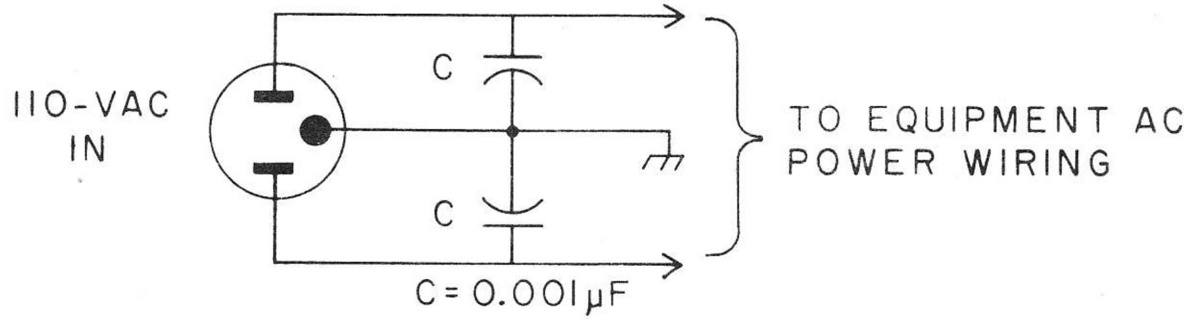


(A)

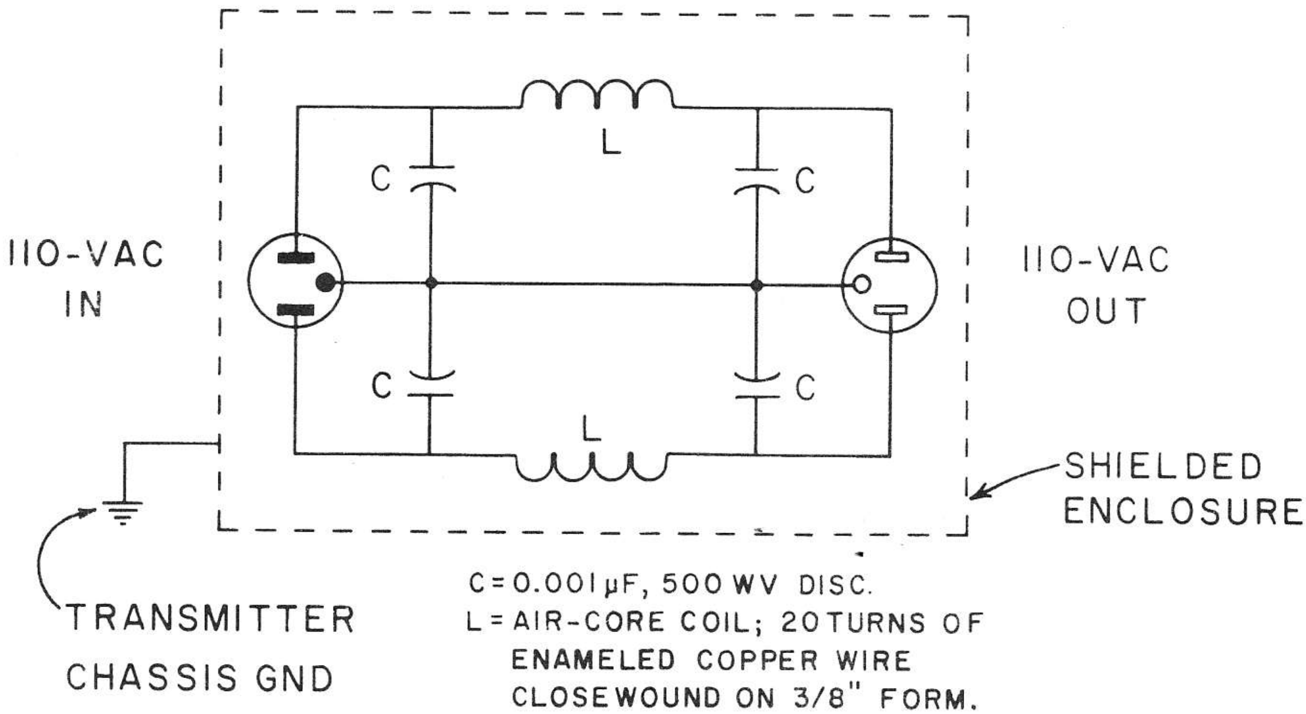


(B)

FIG. 4.2 -- (A) Cable arrangements, showing ways to reduce rf coupling.
(B) Use of high-mu toroids and rods to choke the flow of rf on audio and control lines.



(A)



(B)

FIG. 4.3 -- (A) Simple rf-bypass method used in many transmitters.

(B) Brute-force ac-line filter that can be added to reduce or eliminate the flow of rf on power lines.

power line. This is usually indicative of poor ac-line filtering in the radio transmitter power supply section. Fig. 4.3A shows a common bypass-filter method used in many transmitters. The drawing in Fig. 4.3B depicts a brute-force ac-line filter that can be added to transmitters or other equipment to eliminate the flow of rf on ac power lines.

Rf-induced problems that cannot be cured, or ones that appear not to be the fault of inadequate transmitter filtering should be referred to HAL factory Customer-Service personnel. In cases where this is not feasible, or where station rearrangement is necessary to affect complete elimination of the rf problems, the information in the following section may be of some help.

4.6 Minimizing Rf-Related Problems Through Antenna Selection & Deployment

In addition to the liberal use of rf bypassing capacitors on station equipment, the use of certain antennas will offer reduced levels of rf in the radio room in many cases. Whenever possible, use resonant Yagi, quad, dipole or vertical antennas, and try to achieve a good impedance match at the antenna instead of relying on an antenna tuner. Random-length wire antennas and others that require tuning from the shack are more likely to create high levels of rf within the vicinity of the operating position.

The location of the transmitting antenna with respect to the radio room also has an effect on the rf energy that is coupled into interconnecting cables. Apartment dwellers may have the most difficulty achieving a good installation since many times an indoor antenna is the only type allowed. Where outdoor antennas are allowed, they should be placed as high as practicable. Not only will this provide for better reception, but it will also reduce the level of rf in the shack. Excellent antenna-installation information can be found in many radio & electronics handbooks, antenna theory/construction booklets as well as in articles published in electronics periodicals.

In most situations, coaxial cable feed line is preferred over open-wire, twin-lead, or single-wire type feed systems as its self-shielding property reduces the chance of rf coupling.

Rf energy may also be conducted back to the station by coupling of rf between the antenna and the outside shield braid of the coaxial cable. The use of a balun on a center-fed dipole fed with coaxial cable may also help reduce coupling, and therefore reduce RFI. An rf choke constructed by winding five or six turns of coaxial cable in a coil approximately six inches in diameter may also help reduce the flow of rf currents on the outside of the coaxial-cable braid. If such a choke is used, it should be wrapped with electrical tape to hold the windings together, and be secured as close as possible to the feed-point of the dipole (or driven element if a beam antenna is used).

Try to dress coaxial cable feed lines so that they drop perpendicular to the dipole wire and not parallel to the radiating wire. In some cases, it may be necessary to run the coaxial cable straight to the ground and bury it for the run to the transmitter to reduce the coupling between the outside shield braid of the coaxial cable and the antenna. If there is a moderate SWR on the line, try adjusting the coaxial cable length so that a low impedance (high feed current) is presented to the transmitter. This may help reduce the level of rf in the vicinity of the transmitter.

5. ADJUSTMENTS AND OPTIONS

The following are adjustments that can be made and options that can be selected by the KSR operator. Read all of this information carefully before attempting to make an adjustment or select an option on the KSR, as physical damage or improper KSR operation may result from placing a jumper in the wrong location, or turning the wrong potentiometer.

```
****************************
*                          *
*         CAUTION!         *
*                          *
* DISCONNECT KSR FROM AC   *
* POWER BEFORE OPENING     *
* CABINET.                 *
****************************
```

5.1 Sidetone Adjustments

Sidetone volume can be adjusted by turning the potentiometer provided on the logic board. (See Fig. 5.1) All KSRs leave the factory with the volume pot set for maximum audio output. If a lower level is desired, adjust the potentiometer until the required level is reached. To monitor the sidetone during adjustments, hold down the "TUNE" key to generate a continous sidetone output. (The TUNE key is located between the RETURN and SHIFT keys.)

Sidetone frequency is not adjustable in the DS2000 KSR. However, if the frequency must be changed, the values of two resistors and one capacitor may be changed to alter the frequency of the oscillator. See Fig 5.1 for the location of these parts, and Fig. 5.2 for suggested values that would provide different sidetone frequencies. The sidetone oscillator circuit is shown in schematic diagram form in Fig. 6.2.

5.2 Optional Sidetone Output

If an auxilliary sidetone audio output is required, a wire jumper can be added between the speaker terminal on the power supply board and an unused pin on the MR2000 audio connector. Solder one end of a 10-inch length of insulated hook-up wire to the speaker terminal (marked "S") on the power supply board. See Fig. 5.3 for location of this circuit board pad. Solder the other end of the 10-inch wire to the unused pin (pin 3) circuit pad on the MR2000 pc board. Fig. 5.4 shows the location of this pad. The audio level available at pin three of the MR2000 audio connector after this modification has been made can be adjusted via the sidetone level pot.

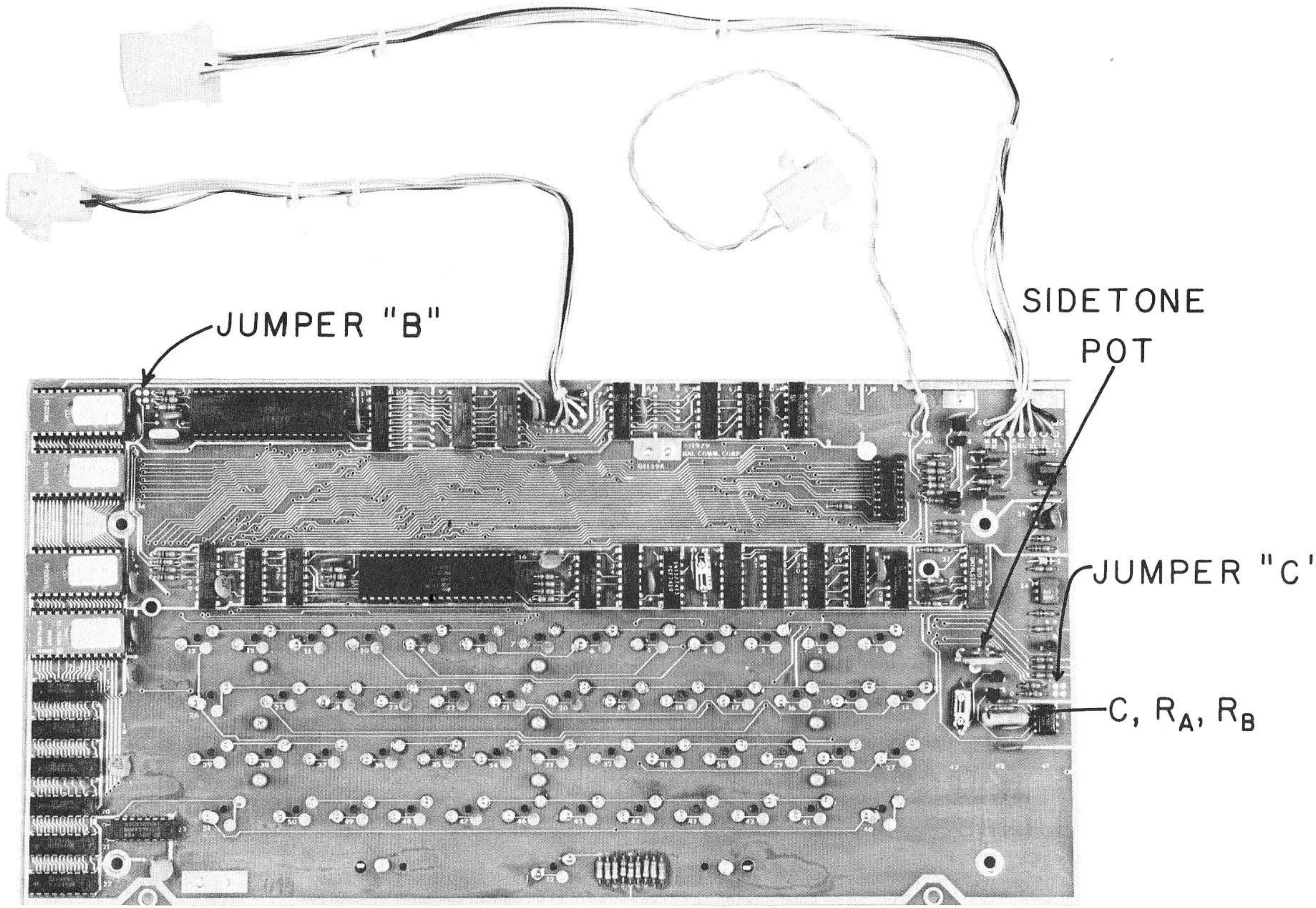


FIG. 5.1 -- Location of jumpers, sidetone volume pot and C, R_A, R_B.

DS2000 KSR SIDETONE FREQUENCY DETERMINING COMPONENTS

APPROXIMATE FREQUENCY (Hz)	R_A (OHMS)	R_B (OHMS)	C (µF) **
500	6.8 K	27 K	0.047
600	2.2 K	120 K	0.01
700	5.6 K	100 K	0.01
800*	2.2 K	18 K	0.047
1000	8.2 K	68 K	0.01
1200	6.8 K	56 K	0.01
1400	8.2 K	47 K	0.01

* As set at factory. ** Use mylar or polystyrene cap.

Fig. 5.2 -- 555 oscillator component selection chart.

5.3 Modification for Operation with 50-Hz Line Frequency

The DS2000 KSR can be operated at 110-V/220-V and 60-Hz/50-Hz. Operating voltages are selected by changing the transformer wiring, as described in the Owner's Manual, section 3.5. Operation on 50-Hz line frequency requires the insertion of a wire jumper on the DS2000 logic board at location "B". Jumper location "B" is indicated in Fig. 5.1. This is the only modification that is required to operate the DS2000 with 50-Hz line frequency.

5.4 Modification for Operation with 69-Character Video Line

The DS2000 KSR video line can be selected either for 72 characters or 69 characters in length. Line length is selected by changing the jumper at location "C" as indicated in Fig. 5.1. The absence of a jumper at this location provides the DS2000 video at 72 characters per line, and the addition of a jumper will provide 69 characters per line. Jumper location "C" is also shown in the schematic diagram of Fig. 6.3, near the 8350 CRTC.

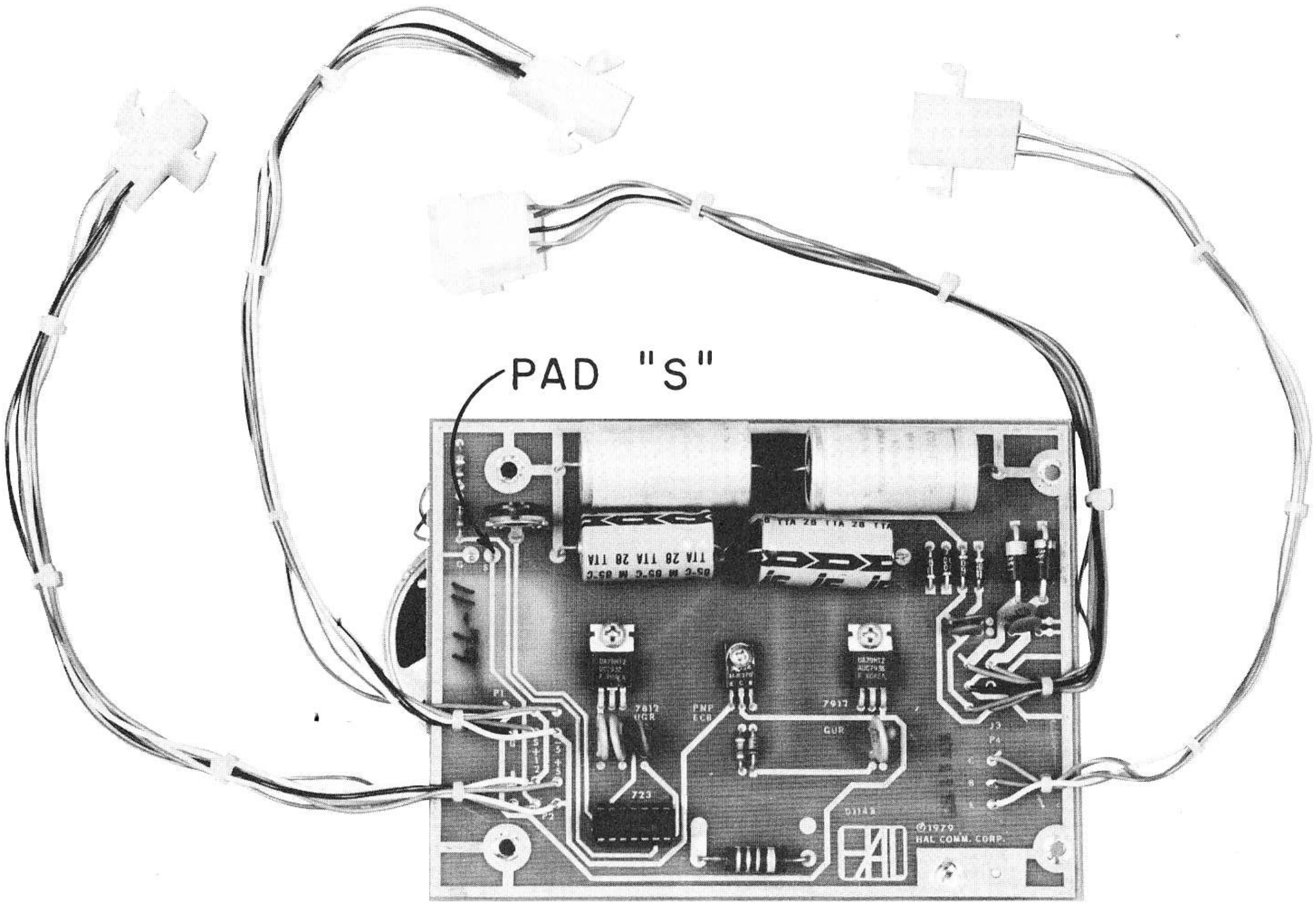


FIG. 5.3 -- Location of optional sidetone-output circuit pad "S".

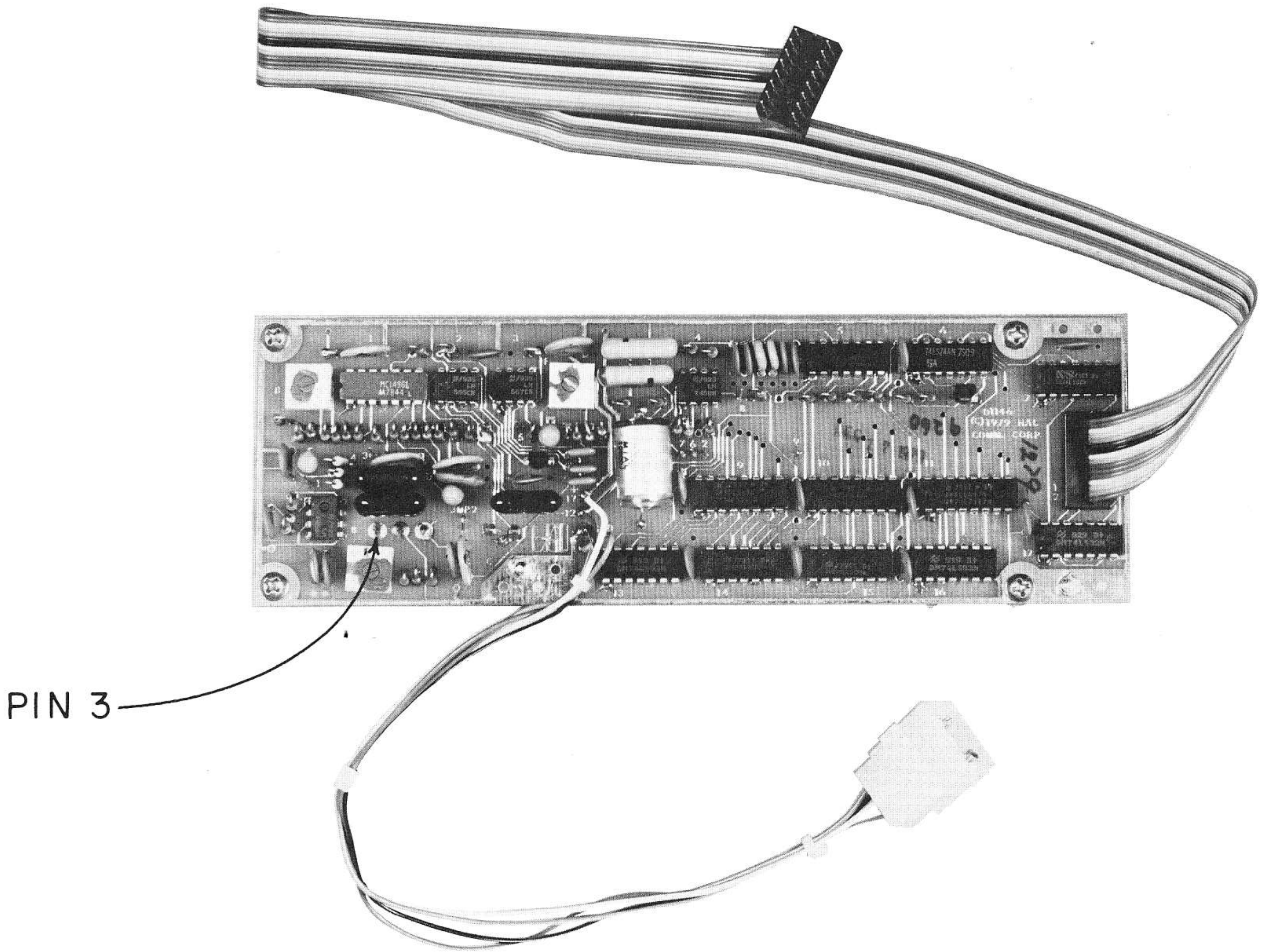
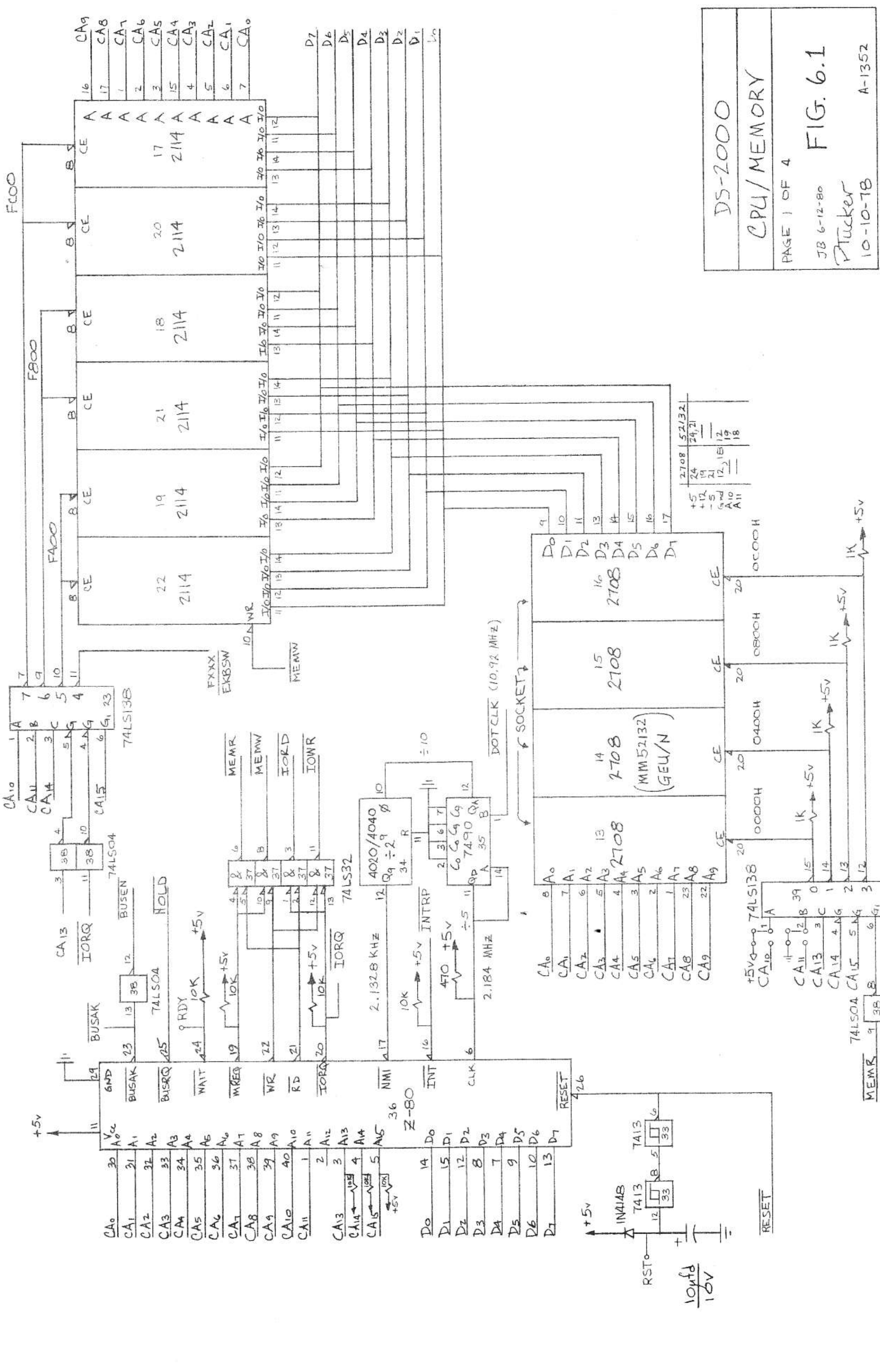
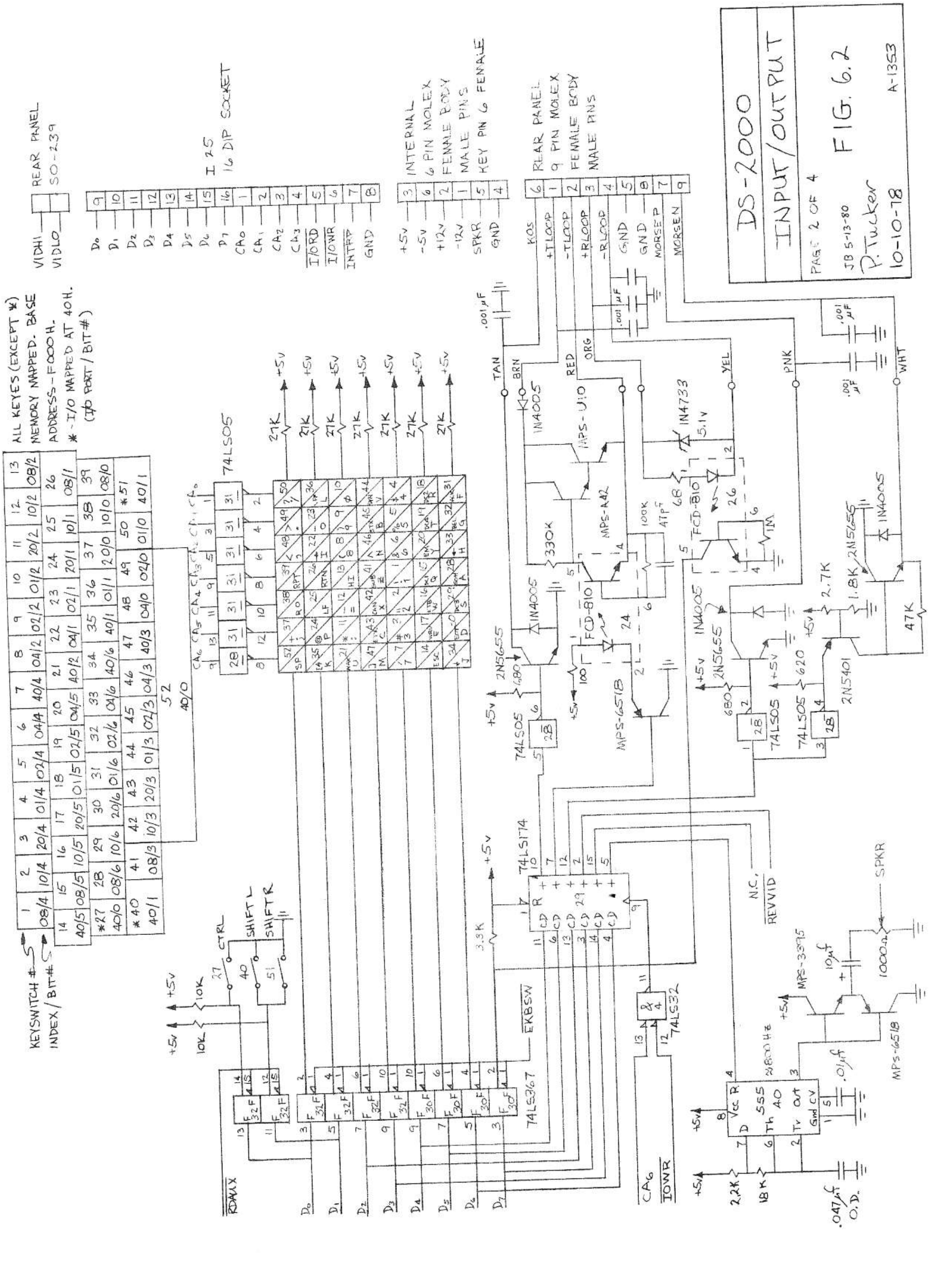


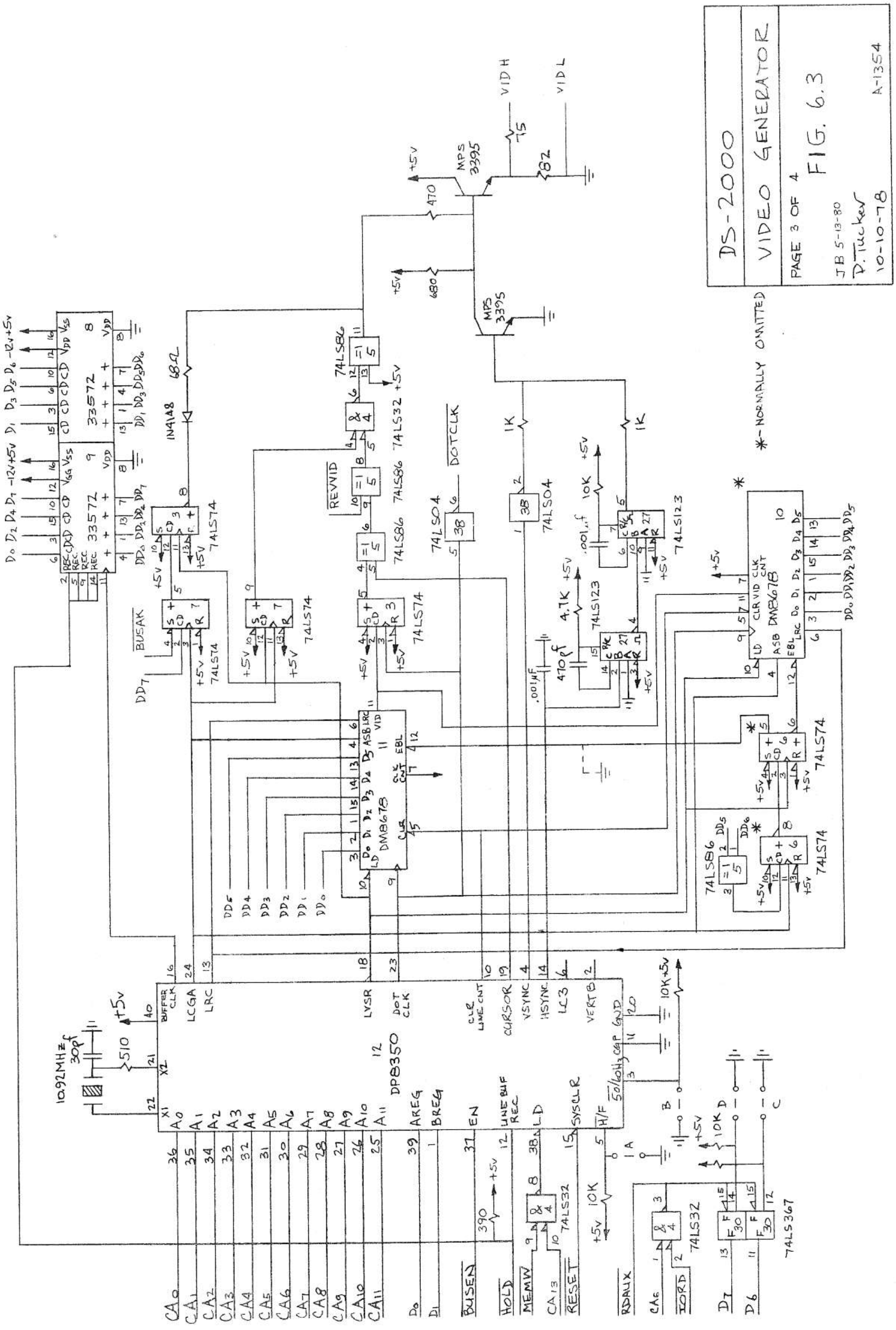
FIG. 5.4 -- Location of optional sidetone-output connector pin 3.

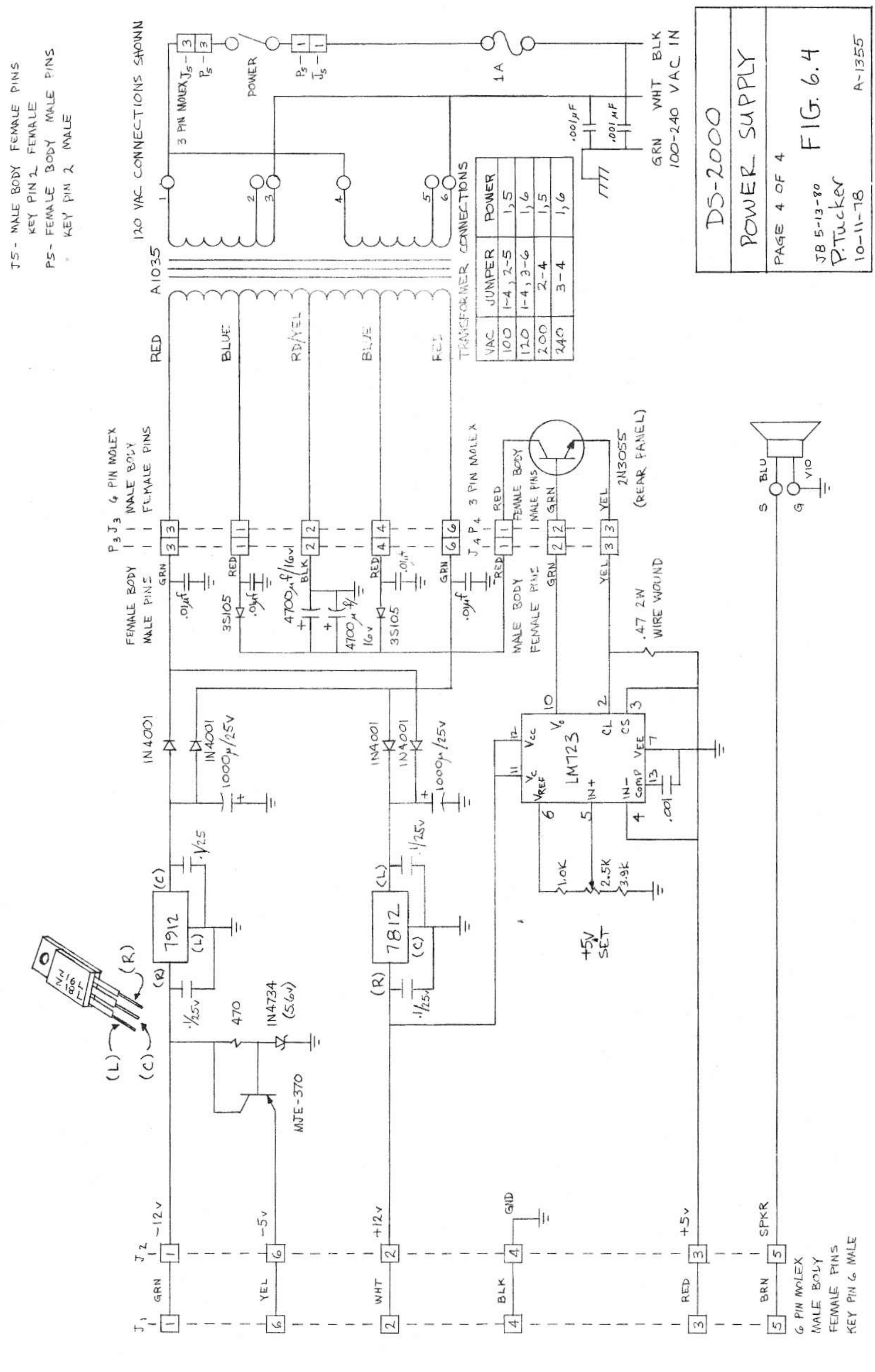
6. ILLUSTRATIONS - TABLE OF CONTENTS

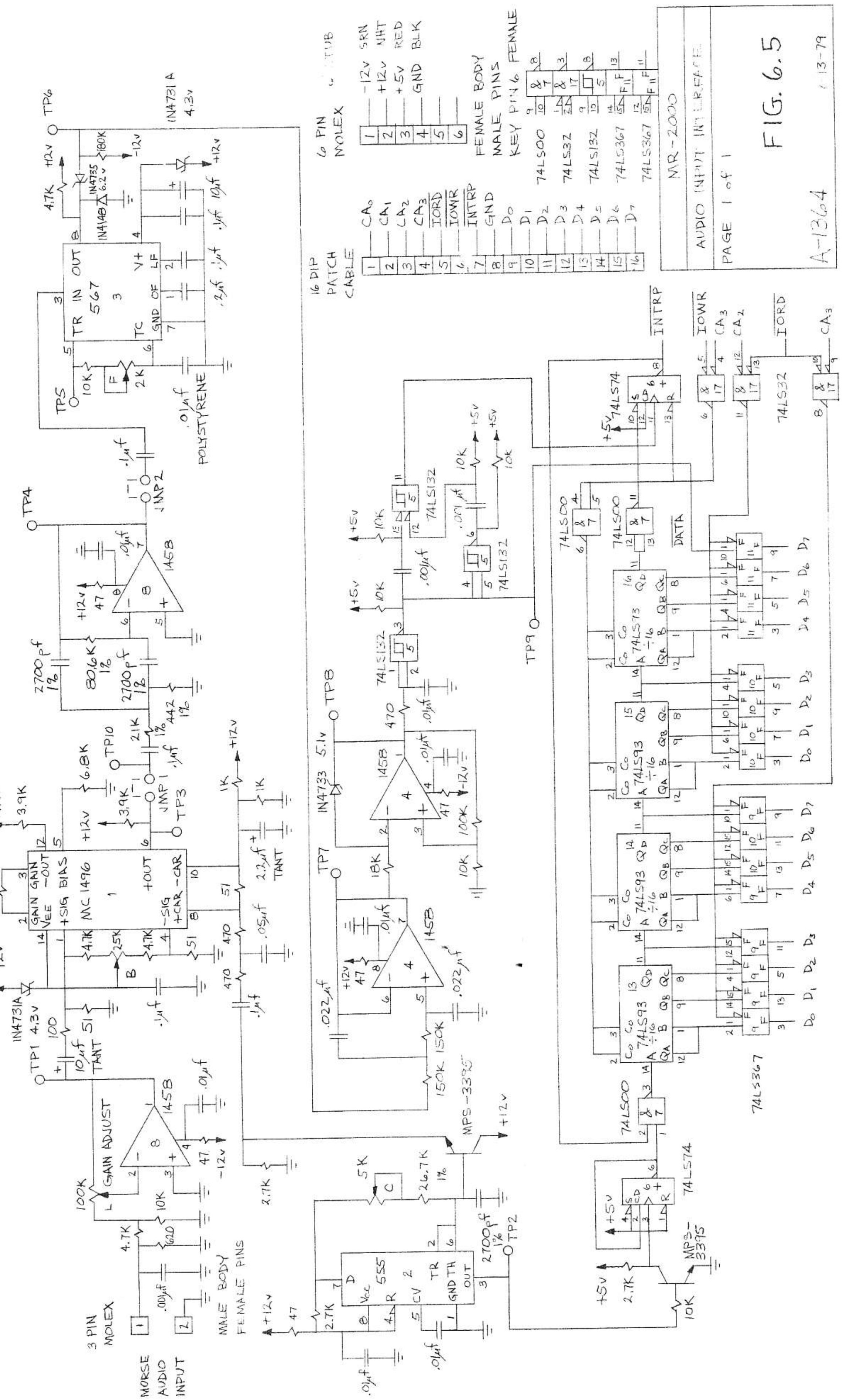
FIGURES:


DS-2000
CPU/MEMORY
PAGE 1 OF 4
JB 6-12-80
FIG. 6.1
PTucker
10-10-78
A-1352


DS-2000
INPUT/OUTPUT
FIG. 6.2
PAGE 2 OF 4
JB 5-13-80
P. Tucker
10-10-78
A-1353


DS-2000
VIDEO GENERATOR
PAGE 3 OF 4
FIG. 6.3
JB 5-13-80
D. Tucker
10-10-78
A-1354
*- NORMALLY OMITTED
DP8350
DM8678
33572
74LS74
74LS86
74LS04
74LS123
74LS32
74LS367
MPS 3395
IN4148
10.92MHz
VIDH
VIDL


DS-2000
POWER SUPPLY
PAGE 4 OF 4
FIG. 6.4
JB 5-13-80
P.Tucker
10-11-78
A-1355
120 VAC CONNECTIONS SHOWN
J5 - MALE BODY FEMALE PINS
KEY PIN 2 FEMALE
P5 - FEMALE BODY MALE PINS
KEY PIN 2 MALE
3 PIN MOLEX
POWER
1A
GRN WHT BLK
100-240 VAC IN
.001µF
A1035
RED
BLUE
RD/YEL
TRANSFORMER CONNECTIONS
VAC | JUMPER | POWER
100 | 1-4, 2-5 | 1,5
120 | 1-4, 3-6 | 1,6
200 | 2-4 | 1,5
240 | 3-4 | 1,6
6 PIN MOLEX
MALE BODY
FEMALE PINS
FEMALE BODY
MALE PINS
3S105
4700µf/16v
.01µf
3 PIN MOLEX
2N3055
(REAR PANEL)
.47 2W
WIRE WOUND
1N4001
1000µ/25V
LM723
7912
7812
1N4734
(5.6V)
470
MJE-370
1.0K
2.5K
3.9K
+5V
SET
-12V
-5V
+12V
GND
+5V
SPKR
GRN
YEL
WHT
BLK
RED
BRN
6 PIN MOLEX
MALE BODY
FEMALE PINS
KEY PIN 6 MALE


MR-2000
AUDIO INPUT INTERFACE
PAGE 1 of 1
A-1364
FIG. 6.5
MORSE AUDIO INPUT
3 PIN MOLEX
16 DIP PATCH CABLE
6 PIN MOLEX
FEMALE BODY MALE PINS
KEY PIN 6 FEMALE

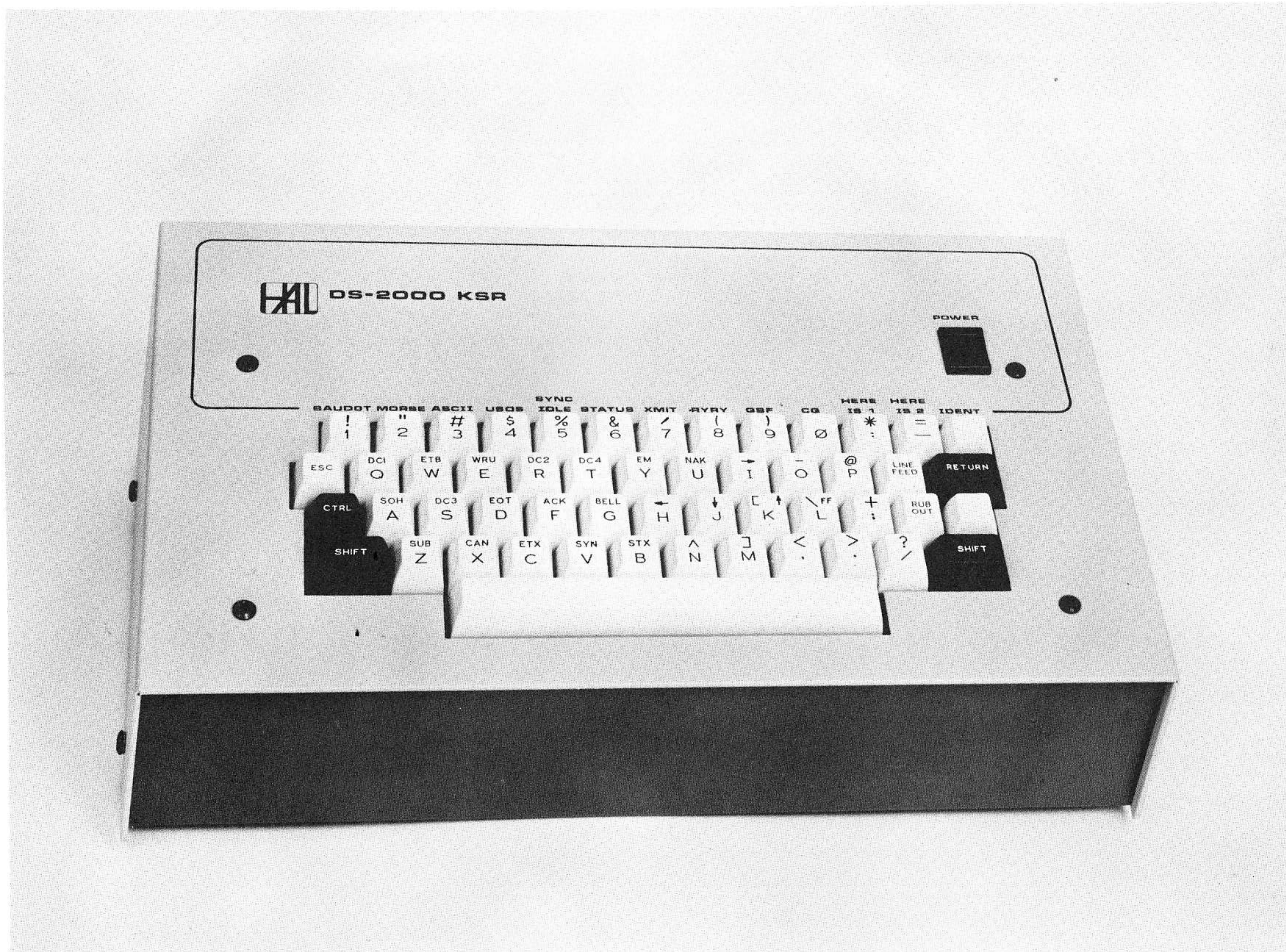


FIG. 6.6 -- DS2000: External view of complete unit.

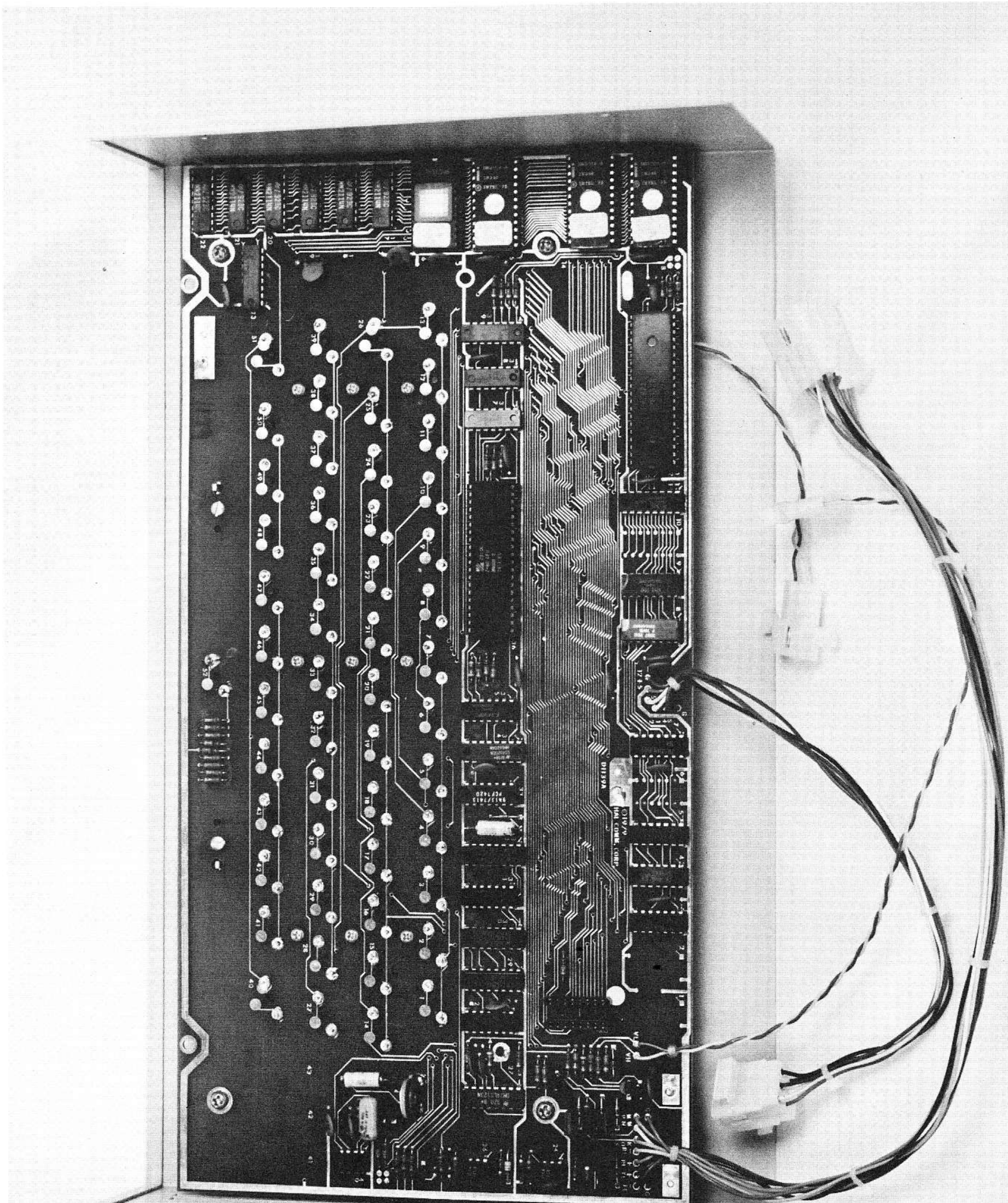


FIG. 6.7 -- Cabinet top removed from lower chassis.

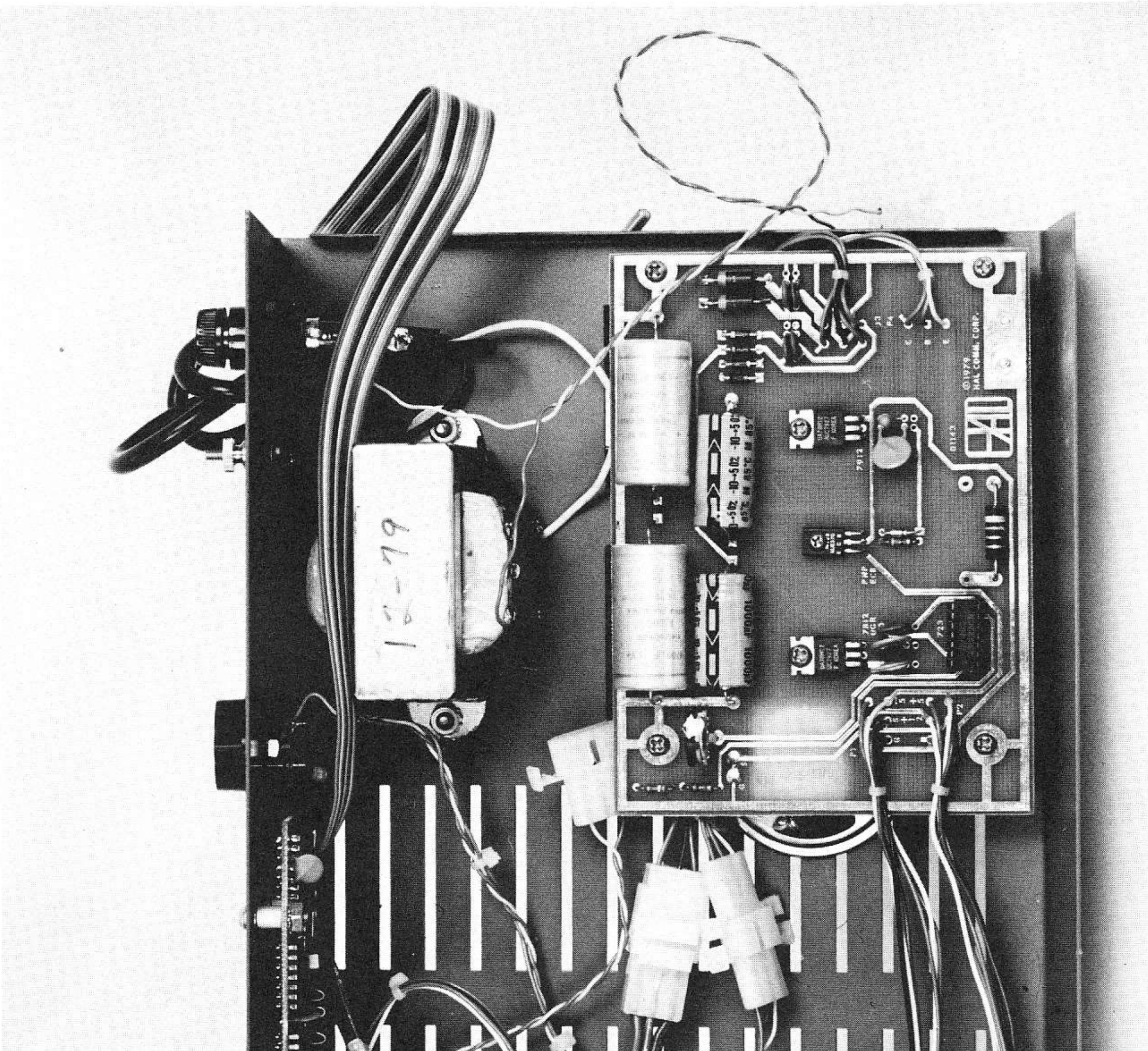


FIG. 6.8 -- Lower chassis with top section (logic board) removed.

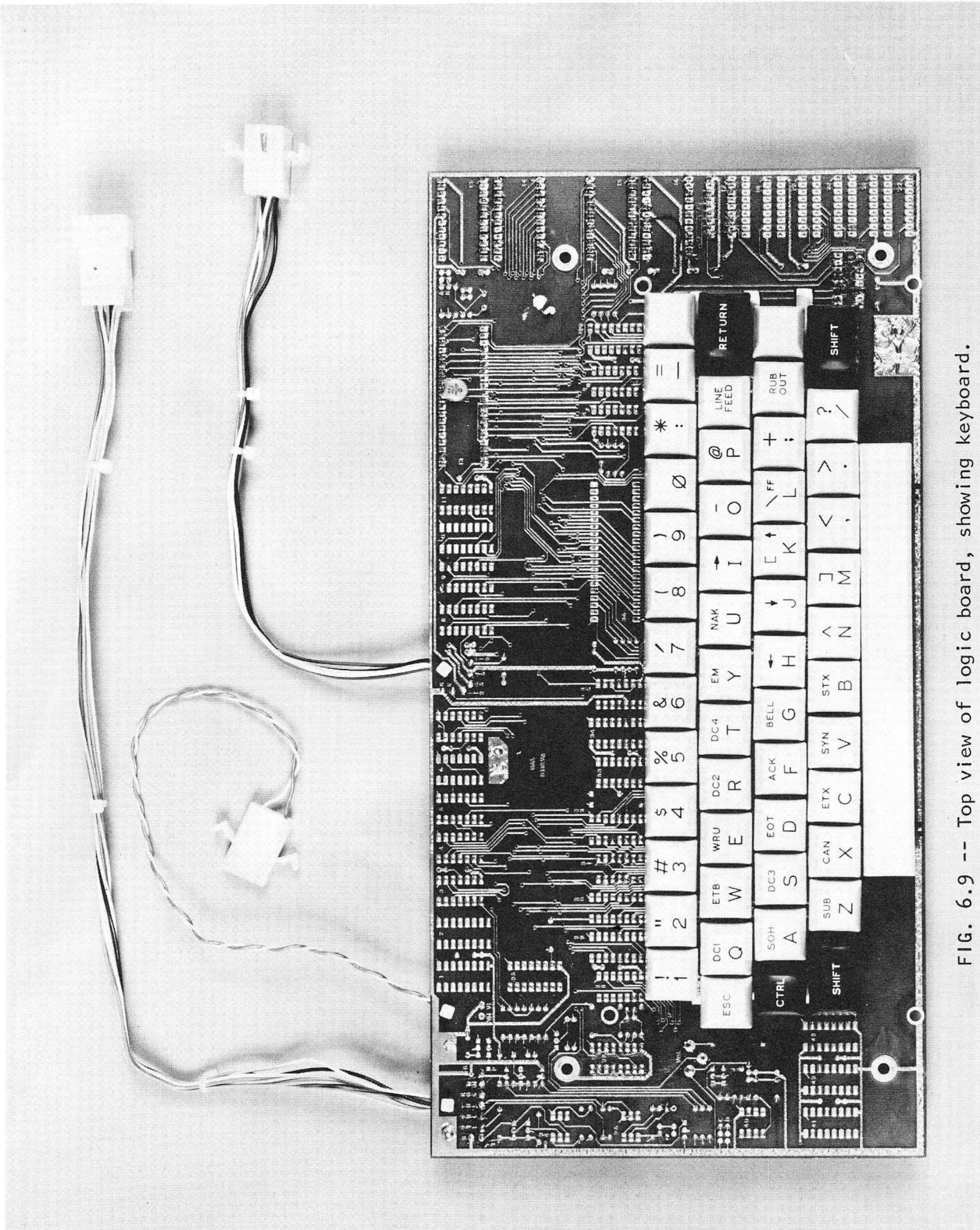


FIG. 6.9 -- Top view of logic board, showing keyboard.

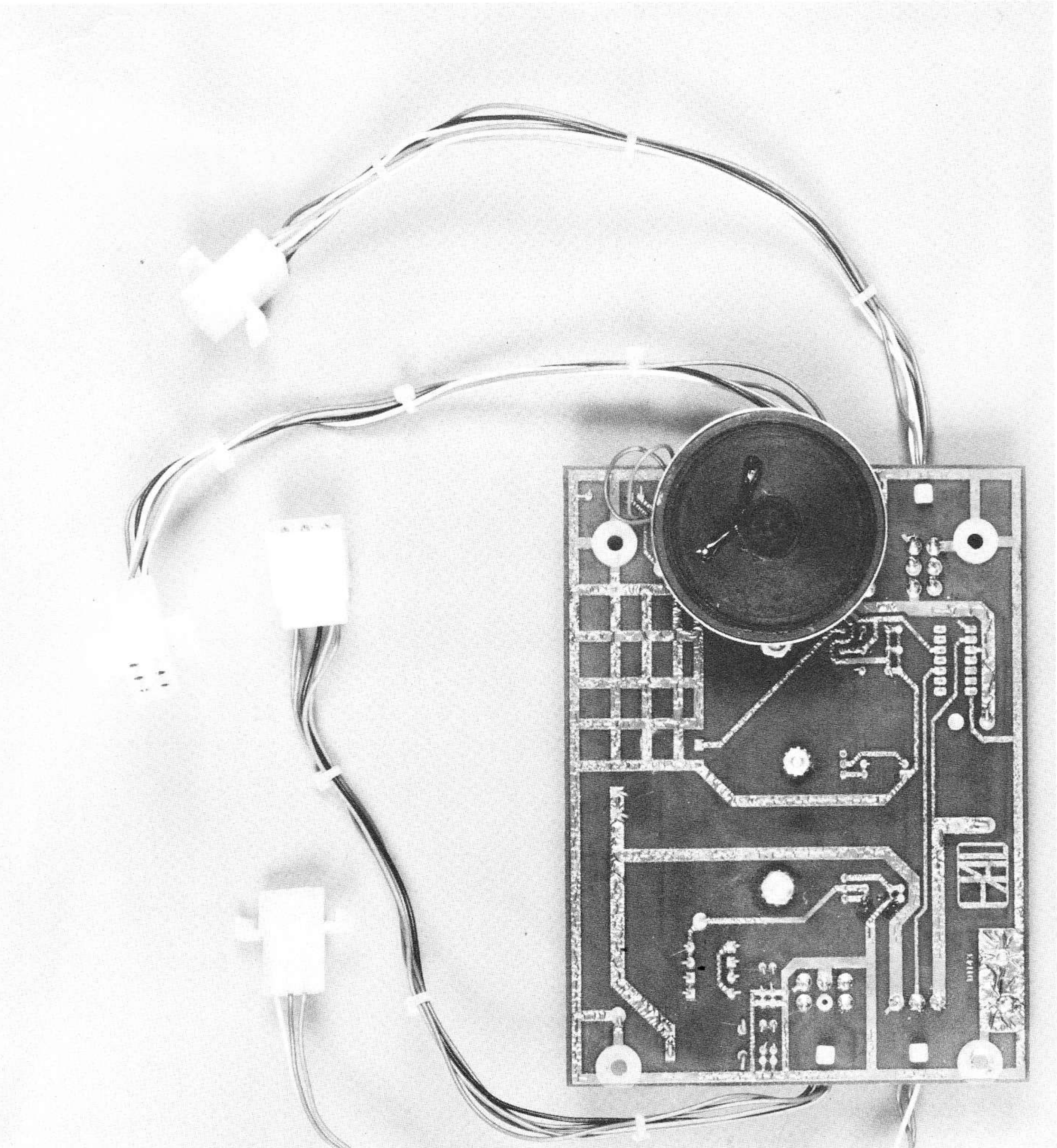


FIG. 6.10 -- Bottom view of power supply board.

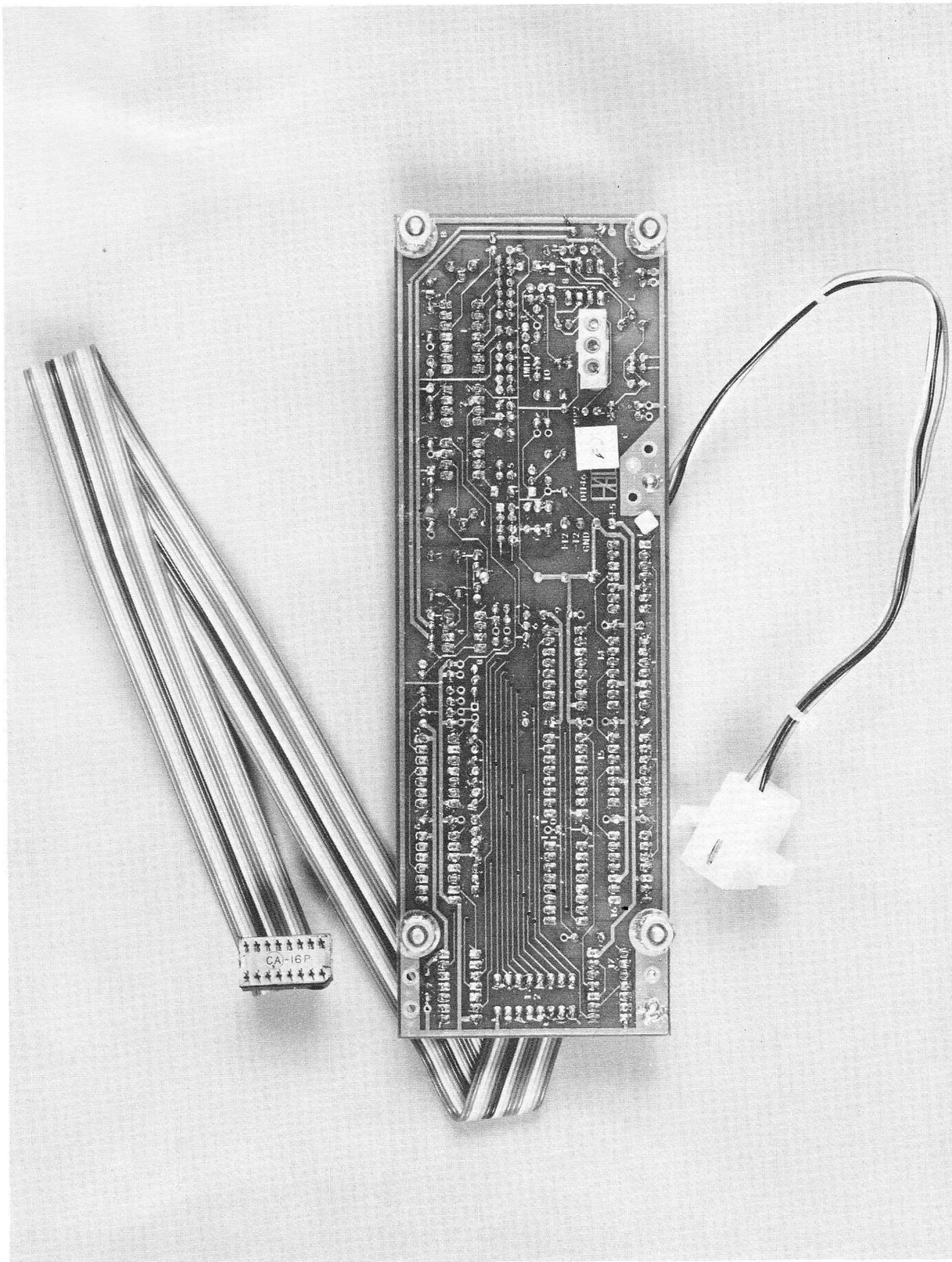


FIG. 6.11 -- View of back side of MR2000 board, Pot C and connector.