

## 6.22 CRT DRIVE PC BOARD (U24)

This PC board receives separate video signals, amplifies them, and drives a CRT.

### 6.22.1 Equipment Required

- . Oscilloscope : VP5511A
- . Digital Voltmeter : 3478A

### 6.22.2 Preparation

#### CAUTION:

Be sure to turn off the power before disassembly.

- (1) Remove the left side cover according to the description in paragraph 8.1.
- (2) Remove the heat sink (2) according to the description in paragraph 8.5.

#### WARNING:

To avoid serious electric shocks and possibly death, do not remove protective cover (1). It shields a high voltage circuit.

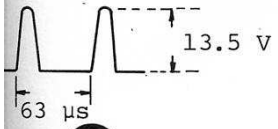
To avoid serious electric shocks and possibly death, do not touch any components on this PC board.

### 6.22.3 Troubleshooting

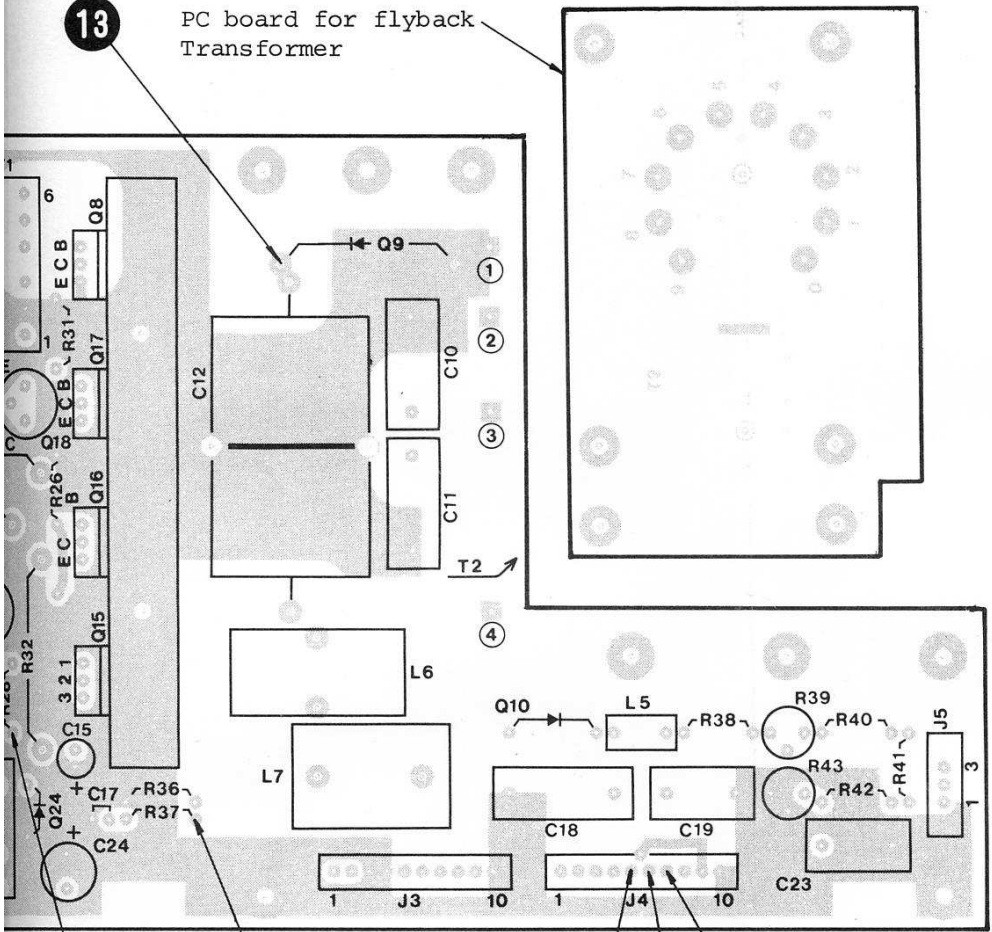
- (1) Check the signals shown in the COMPONENTS LAYOUT OF CRT DRIVE.

If the signal is abnormal, find the defective components by referring to the CIRCUIT DISGRAM OF CRT DRIVE.

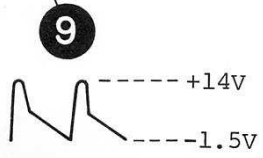




13 PC board for flyback Transformer



10 -8.4 V

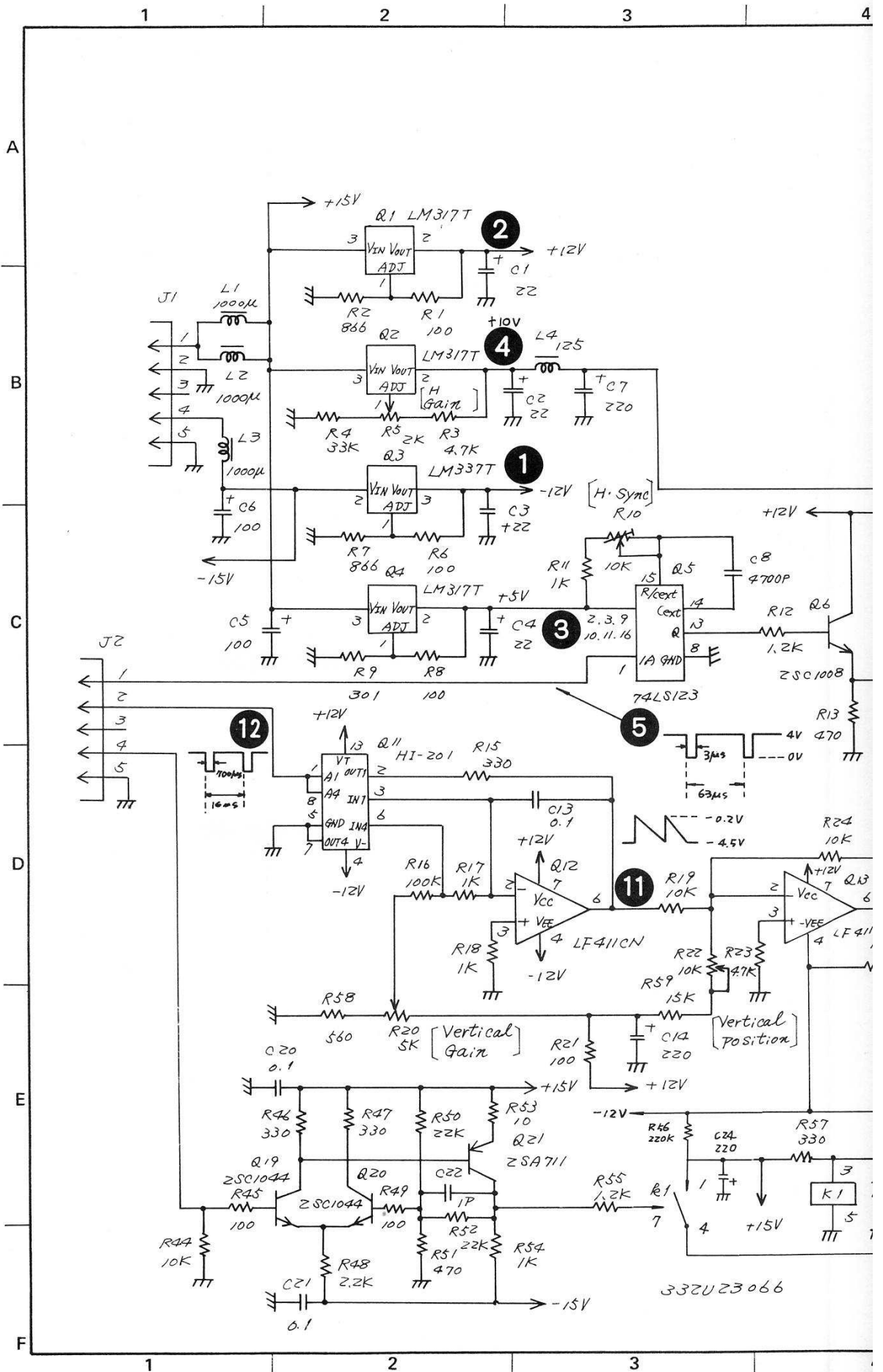


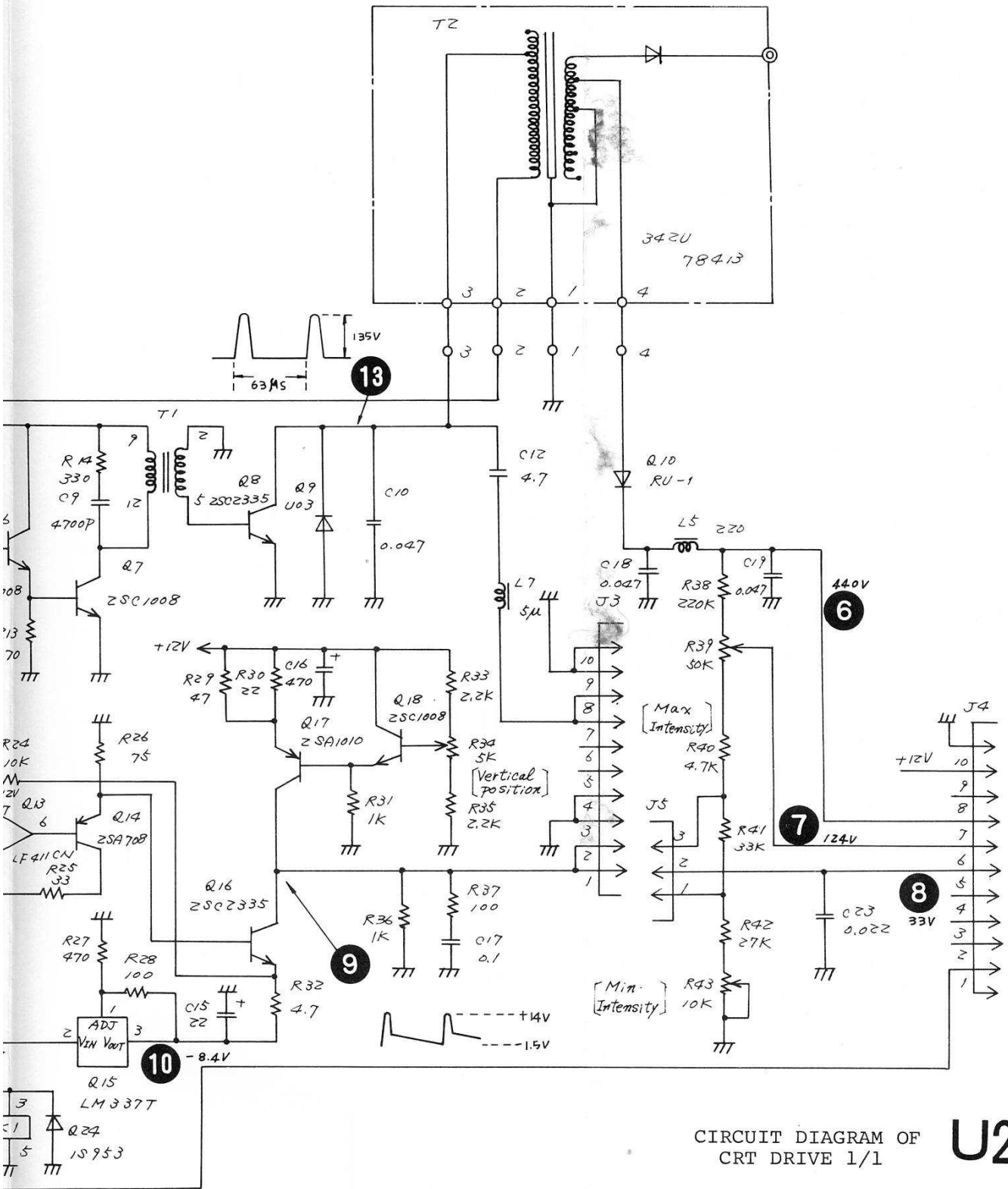
8 33 V  
7 124 V  
6 440 V

Note:

- The signal levels shown above are approximate value.

COMPONENTS LAYOUT OF CRT DRIVE **U24**





CIRCUIT DIAGRAM OF CRT DRIVE 1/1

U24

6-293/(6-294 blank)

## 6.19 DISP CPU PC board

This PC board consists of a microprocessor, its peripheral components, and CRT control circuit.

### 6.19.1 Equipment Required

- Troubleshooter : 9010A
- Oscilloscope : VP5511A
- Digital Voltmeter : 3478A

### 6.19.2 Preparation

**CAUTION:**

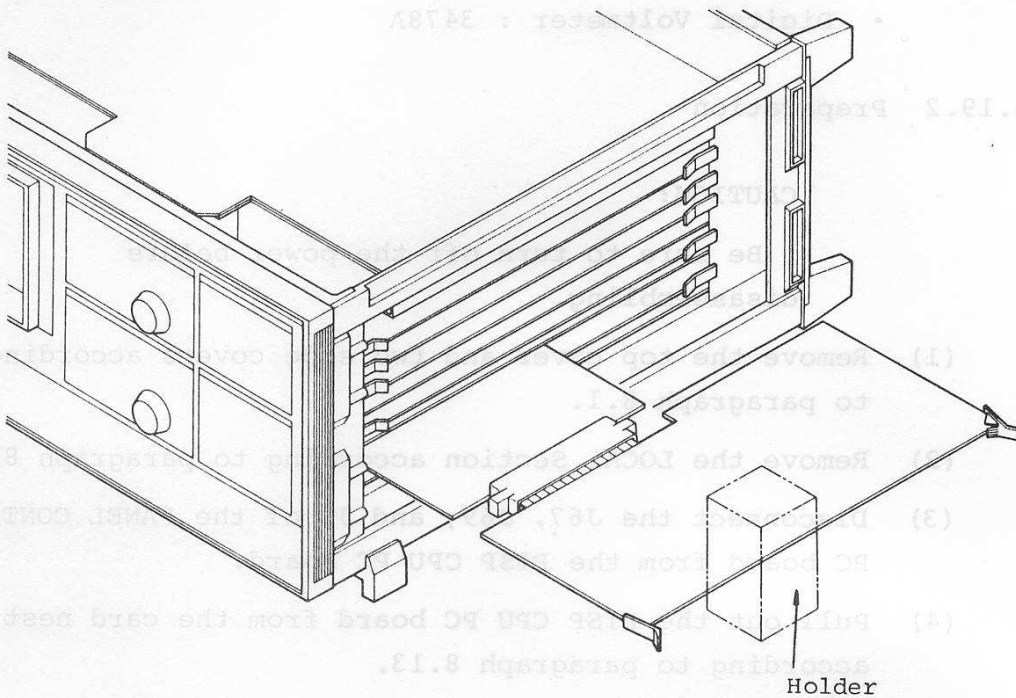
Be sure to turn off the power before disassembling.

- (1) Remove the top cover and two side covers according to paragraph 8.1.
- (2) Remove the LOCAL Section according to paragraph 8.3.
- (3) Disconnect the J67, J69, and J3 of the PANEL CONTROL PC board from the DISP CPU PC board.
- (4) Pull out the DISP CPU PC board from the card nest according to paragraph 8.13.

Hold the PC board as explained in the note.

Note:

When the DISP CPU, MAIN CPU, INTERFACE, IF SECTION, or SIGNAL PROCESSOR PC board is connected to Extender board, be sure to hold the PC board with a holder shown in the following figure.



(5) Reconnect J67 to the DISP CPU PC board through the Extension Cable-D.

**Note:**

Be sure to reconnect J67, J69, and J3 of PANEL CONTROL after reassembling.

**6.19.3 Troubleshooting**

**Notes:**

- Be sure to read appendix 1 before using the troubleshooter.
- Troubleshoot the DISP CPU PC board referring to the COMPONENTS LAYOUT OF DISP CPU.

Troubleshoot the DISP CPU PC board according to the following table.

If the results of these checks are abnormal, the trouble can be assumed to be as shown in Table 6.24.

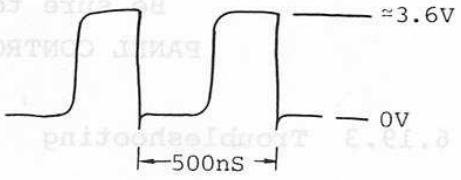
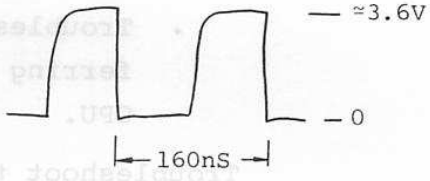
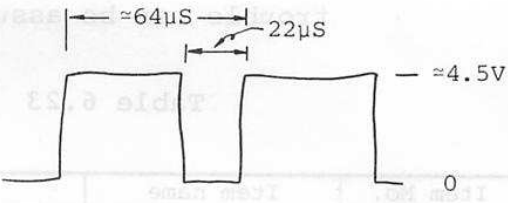
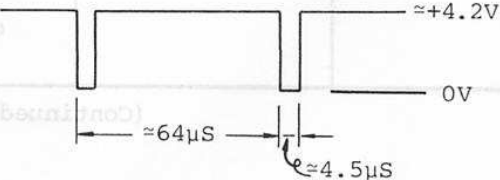
Table 6.23 Troubleshooting

Item No.	Item name	Check and test method
D1	+5 V Power Supply Check	Voltage between the +5VL and GNDL should be: +5 ±0.25 V +5VL : P.C. board edge connector 8R, 8L, 9R, 9L GNDL : P.C. board edge connector 42R, 42L, 43R, 43L

(Continued on page 6-228)

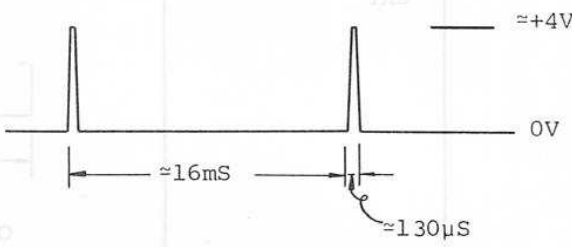
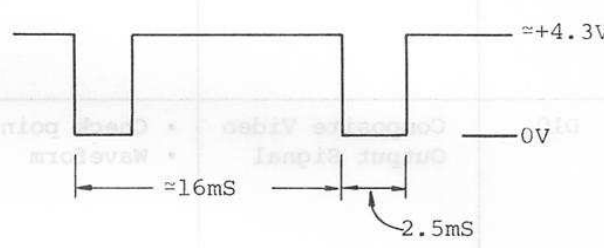
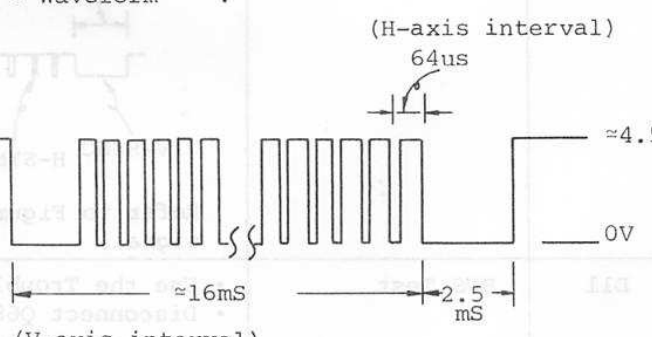


Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D2	CPU CLOCK (TP1) Check	<ul style="list-style-type: none"> <li>• Check point: TP1 (Q71 pin 9)</li> <li>• Frequency : 2 MHz (cycle 500 ns)</li> <li>• Waveform :</li> </ul> 
D3	CRT DISPLAY CLOCK Check	<ul style="list-style-type: none"> <li>• Check point : Q6 pin 8</li> <li>• Crystal Oscillator: X1</li> <li>• Frequency : 6.25 MHz (Cycle 160 ns)</li> <li>• Waveform :</li> </ul> 
D4	CRT Line Blanking Signal (TP20)	<ul style="list-style-type: none"> <li>• Check point: TP20</li> <li>• Waveform :</li> </ul> 
D5	CRT Horizontal axis Synchroni- zied Signal (TP17)	<ul style="list-style-type: none"> <li>• Check point: TP17</li> <li>• Waveform :</li> </ul> 

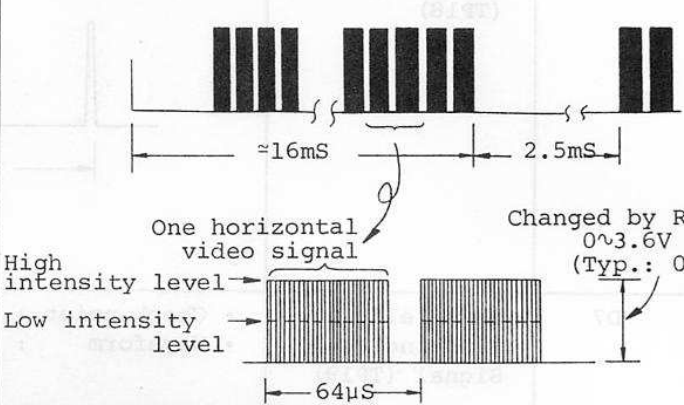
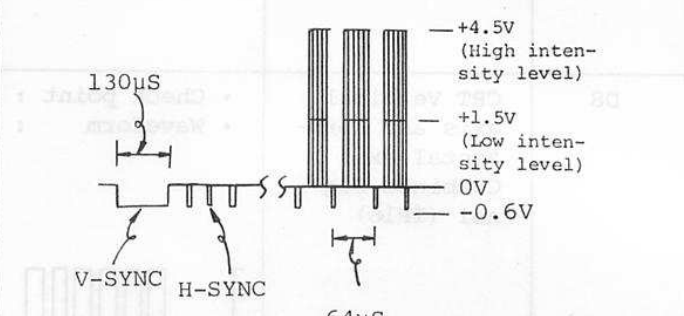
(Continued on page 6-229)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D6	CRT Vertical axis Synchronized Signal (TP18)	<ul style="list-style-type: none"> <li>• Check point : TP18</li> <li>• Waveform :</li> </ul> 
D7	CRT Field Blanking Signal (TP19)	<ul style="list-style-type: none"> <li>• Check point : TP19</li> <li>• Waveform :</li> </ul> 
D8	CRT Vertical axis and Horizontal axis Combined Signal (TP16)	<ul style="list-style-type: none"> <li>• Check point : TP16</li> <li>• Waveform :</li> </ul> 

(Continued on page 6-230)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D9	Video Signal for Internal CRT	<ul style="list-style-type: none"> <li>• Check point : J1 pin 4</li> <li>• Waveform :</li> </ul> 
D10	Composite Video Output Signal	<ul style="list-style-type: none"> <li>• Check point : J2 pin 3 (C1 (-))</li> <li>• Waveform :</li> </ul>  <p>Refer to Figure 6.5 for composite video signal.</p>
D11	BUS Test	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• Disconnect Q68 (R6502) from the socket, connect the interface pod of the Troubleshooter to the socket and perform the BUS test.</li> </ul> <p>(MAIN CPU is installed so that the CPU reset signal is generated in the MAIN CPU.)</p> <p>If message "BUS TEST OK" is displayed, it indicates normal operations.</p>

(Continued on page 6-231)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																																						
D12	ROM Test	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• Disconnect Q68 (R6502) from the socket, connect the interface pod of the Troubleshooter to the socket, and perform the ROM test. (MAIN CPU is installed so that the CPU reset signal is generated in the MAIN CPU.) If message "M TEST @ aaaa - aaaa SIG ssss OK" is displayed, it indicates normal operations.</li> <li>• The following table shows the location and normal signatures of each ROM.</li> </ul> <p style="text-align: center;">DISP CPU ROM SIGNATURE DATA</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 15%;">ROM No.</th> <th rowspan="2" style="width: 10%;">Part No.</th> <th colspan="2" style="width: 30%;">LOCATION (HEX)</th> <th rowspan="2" style="width: 15%;">SIGNATURE</th> <th rowspan="2" style="width: 10%;">REVISION</th> </tr> <tr> <th style="width: 15%;">START</th> <th style="width: 15%;">STOP</th> </tr> </thead> <tbody> <tr> <td>ROM 0</td> <td>Q22</td> <td>F000</td> <td>FFFF</td> <td>3620</td> <td>D-2</td> </tr> <tr> <td>ROM 1</td> <td>Q23</td> <td>C000</td> <td>CFFF</td> <td>E37A</td> <td>D-2A</td> </tr> <tr> <td>ROM 2</td> <td>Q30</td> <td>D000</td> <td>DFFF</td> <td>FDB9</td> <td>D-2A</td> </tr> <tr> <td>ROM 3</td> <td>Q31</td> <td>E000</td> <td>FFFF</td> <td>8C01</td> <td>D-2A</td> </tr> <tr> <td>ROM 4</td> <td>Q38</td> <td>1800</td> <td>27FF</td> <td>1F6B</td> <td>D-2A</td> </tr> </tbody> </table>	ROM No.	Part No.	LOCATION (HEX)		SIGNATURE	REVISION	START	STOP	ROM 0	Q22	F000	FFFF	3620	D-2	ROM 1	Q23	C000	CFFF	E37A	D-2A	ROM 2	Q30	D000	DFFF	FDB9	D-2A	ROM 3	Q31	E000	FFFF	8C01	D-2A	ROM 4	Q38	1800	27FF	1F6B	D-2A
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ROM 3	Q31	E000	FFFF	8C01	D-2A																																			
ROM 4	Q38	1800	27FF	1F6B	D-2A																																			
D13	RAM Test	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• Disconnect Q68 (R6502) from the socket, connect the interface pod of the Troubleshooter to the socket, and perform the RAM test. (MAIN CPU is installed so that the CPU reset signal is generated in the MAIN CPU.)</li> <li>• The LOCATION of the RAM in hexadecimal notation is shown below.</li> </ul> <p style="text-align: center;">0000 to 07FF (2K bytes)</p>																																						
D14	MAIN MEMORY ACCESS Test	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• This test checks if DISP CPU can read/write the MAIN MEMORY on the MAIN CPU board through the MAIN MEMORY BUS.</li> <li>• Disconnect Q68 (R6502) from the socket and connect the interface pod of the Troubleshooter.</li> <li>• Perform <b>WRITE</b> <input type="text" value="7"/> <input type="text" value="7"/> <b>F</b> <input type="text" value="8"/> <b>ENTER/YES</b> <input type="text" value="0"/> and <b>ENTER/YES</b>.</li> <li>• After performing the above, perform the RAM test at the LOCATION below.</li> </ul> <p style="text-align: center;">0800 to 17FF</p>																																						

(Continued on page 6-232)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																																																																																																																																																											
D15	FRONT PANEL BUS Test	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• Disconnect Q68 (R6502) from the socket and connect the interface pod of the Troubleshooter. (MAIN CPU is installed so that the CPU reset signal is generated in the MAIN CPU.)</li> <li>• FRONT PANEL ADDRESS BUS (FPA0 to FPA10) Test               <ol style="list-style-type: none"> <li>1. Synchronize the probe of the troubleshooter to the address.                    PROBE <input type="checkbox"/> SYNC <input type="checkbox"/> A</li> <li>2. The test is performed by "TOGGLE ADDR" of the TROUBLESHOOTING function. By operating the <input type="checkbox"/> TOGGLE ADDR <input type="checkbox"/> 0 and <input type="checkbox"/> ENTER/YES keys, the display changes to "A TOG @ 0 BIT-" and the Troubleshooter requests the toggle bit number. Then, input each number from 0 to 10, and press the <input type="checkbox"/> ENTER/YES and <input type="checkbox"/> LOOP keys, check each test point with the probe, and verify that the results conform to the table below. The probe is to be used in DATA mode (that is, without pressing the PULSE button).</li> </ol> </li> </ul>																																																																																																																																																											
TOGGLE TEST TABLE OF FRONT PANEL ADDRESS BUS																																																																																																																																																													
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Q77 pin 9	G	G	G	R/G	G	G	G	G	G	G	G																																																																																																																																																		
Q77 pin 11	G	G	G	G	R/G	G	G	G	G	G	G																																																																																																																																																		
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Q77 pin 17	G	G	G	G	G	G	G	R/G	G	G	G																																																																																																																																																		
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(Continued on page 6-233)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																																																																																									
D15	FRONT PANEL BUS Test	<p>Note: G : The green probe indicator lights. R/G : Both the red and green probe indicators light.</p> <ul style="list-style-type: none"> <li>FRONT PANEL DATA BUS (FPD0 to FPD7) Test</li> </ul> <ol style="list-style-type: none"> <li>Synchronize the probe of the Troubleshooter to the data. PROBE <input type="button" value="SYNC"/> <input type="button" value="D"/></li> <li>The test is performed by "TOGGLE ADDR" of the TROUBLESHOOTING function. By operating the <input type="button" value="TOGGLE DATA"/> <input type="button" value="7"/> <input type="button" value="8"/> <input type="button" value="0"/> <input type="button" value="0"/> <input type="button" value="ENTER/YES"/> <input type="button" value="0"/> and <input type="button" value="ENTER/YES"/> keys, the display changes to "D TOG @ 7800 = 0000 BIT-" and the Troubleshooter request toggle bit number. Then, input each number from 0 to 7, and press the <input type="button" value="ENTER/YES"/> and <input type="button" value="LOOP"/> keys, test each test point with the probe, and verify that the results conform to the table below.</li> </ol> <p>TOGGLE TEST TABLE OF FRONT PANEL DATA BUS</p> <table border="1" data-bbox="703 1160 1353 1597"> <thead> <tr> <th rowspan="2">TEST POINT</th> <th colspan="8">Toggle bit</th> </tr> <tr> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> </tr> </thead> <tbody> <tr> <td>Q79 pin 18</td> <td>R/G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 17</td> <td>G</td> <td>R/G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 16</td> <td>G</td> <td>G</td> <td>R/G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 15</td> <td>G</td> <td>G</td> <td>G</td> <td>R/G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 14</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>R/G</td> <td>G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 13</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>R/G</td> <td>G</td> <td>G</td> </tr> <tr> <td>Q79 pin 12</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>R/G</td> <td>G</td> </tr> <tr> <td>Q79 pin 11</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>G</td> <td>R/G</td> </tr> </tbody> </table> <p>Note: G : The green probe indicator lights. R/G : Both the red and green probe indicators light.</p>	TEST POINT	Toggle bit								0	1	2	3	4	5	6	7	Q79 pin 18	R/G	G	G	G	G	G	G	G	Q79 pin 17	G	R/G	G	G	G	G	G	G	Q79 pin 16	G	G	R/G	G	G	G	G	G	Q79 pin 15	G	G	G	R/G	G	G	G	G	Q79 pin 14	G	G	G	G	R/G	G	G	G	Q79 pin 13	G	G	G	G	G	R/G	G	G	Q79 pin 12	G	G	G	G	G	G	R/G	G	Q79 pin 11	G	G	G	G	G	G	G	R/G
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Q79 pin 15	G	G	G	R/G	G	G	G	G																																																																																			
Q79 pin 14	G	G	G	G	R/G	G	G	G																																																																																			
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Q79 pin 12	G	G	G	G	G	G	R/G	G																																																																																			
Q79 pin 11	G	G	G	G	G	G	G	R/G																																																																																			

(Continued on page 6-234)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																				
D15	FRONT PANEL BUS Test	<p>3. Data read Test The test is performed by "READ" of the TROUBLESHOOTING function and the stimulus probe. Press the PULSE <input type="button" value="LOW"/> key. (The low level stimulus pulse is generated.) By operating the <input type="button" value="READ"/> <input type="button" value="7"/> <input type="button" value="8"/> <input type="button" value="0"/> <input type="button" value="F"/> <input type="button" value="ENTER/YES"/> and <input type="button" value="LOOP"/> keys, the display changes to "READ @ 780F = FF OK" and data is continuously read from port address 780F of the FRONT PANEL BUS. In this state, input the pulse from the probe into each test point, and verify that the READ DATA conforms to the table below.</p> <p>READ TEST TABLE OF FRONT PANEL DATA BUS</p> <table border="1" data-bbox="598 907 1093 1377"> <thead> <tr> <th>TEST POINT (STIMULUS POINT)</th> <th>READ DATA</th> </tr> </thead> <tbody> <tr> <td>OPEN</td> <td>FF</td> </tr> <tr> <td>Q79 pin 18</td> <td>FE</td> </tr> <tr> <td>Q79 pin 17</td> <td>FD</td> </tr> <tr> <td>Q79 pin 16</td> <td>FB</td> </tr> <tr> <td>Q79 pin 15</td> <td>F7</td> </tr> <tr> <td>Q79 pin 14</td> <td>EF</td> </tr> <tr> <td>Q79 pin 13</td> <td>DF</td> </tr> <tr> <td>Q79 pin 12</td> <td>BF</td> </tr> <tr> <td>Q79 pin 11</td> <td>7F</td> </tr> </tbody> </table>	TEST POINT (STIMULUS POINT)	READ DATA	OPEN	FF	Q79 pin 18	FE	Q79 pin 17	FD	Q79 pin 16	FB	Q79 pin 15	F7	Q79 pin 14	EF	Q79 pin 13	DF	Q79 pin 12	BF	Q79 pin 11	7F
TEST POINT (STIMULUS POINT)	READ DATA																					
OPEN	FF																					
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Q79 pin 14	EF																					
Q79 pin 13	DF																					
Q79 pin 12	BF																					
Q79 pin 11	7F																					
D16	Link Test of MAIN CPU to Operational CPU	<ul style="list-style-type: none"> <li>• Use the Troubleshooter.</li> <li>• Disconnect Q68 (R6502) from the socket and connect the interface pod of the Troubleshooter.</li> <li>• Multiplication test</li> </ul> <p>1. SET the MAIN MEMORY ACCESS FLAG.</p> <p><input type="button" value="WRITE"/> <input type="button" value="7"/> <input type="button" value="7"/> <input type="button" value="F"/> <input type="button" value="8"/> <input type="button" value="ENTER/YES"/> <input type="button" value="0"/> <input type="button" value="ENTER/YES"/></p> <p>2. Input a 2-byte multiplicand (MAIN MEMORY)</p> <p><input type="button" value="WRITE"/> <input type="button" value="1"/> <input type="button" value="5"/> <input type="button" value="F"/> <input type="button" value="1"/> <input type="button" value="ENTER/YES"/> <input type="button" value="F"/> <input type="button" value="ENTER/YES"/></p> <p>... Low Byte</p> <p><input type="button" value="WRITE"/> <input type="button" value="1"/> <input type="button" value="5"/> <input type="button" value="F"/> <input type="button" value="2"/> <input type="button" value="ENTER/YES"/> <input type="button" value="0"/> <input type="button" value="ENTER/YES"/></p> <p>... High Byte</p>																				

(Continued on page 6-235)

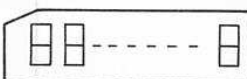
Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D16	Link Test of MAIN CPU to Operational CPU	<p>3. Input a 2-byte multiplier (MAIN MEMORY).</p> <p>WRITE 1 5 F 3 ENTER /YES 2 ENTER /YES            ... Low Byte</p> <p>WRITE 1 5 F 4 ENTER /YES 0 ENTER /YES            ... High Byte</p> <p>4. Set to multiply the above numeric data.</p> <p>WRITE 1 5 F 0 ENTER /YES 1 ENTER /YES</p> <p>5. Reset the MAIN MEMORY ACCESS FLAG.</p> <p>WRITE 7 7 F 9 ENTER /YES 0 ENTER /YES</p> <p>6. SET the ARITHMETIC FLAG.</p> <p>WRITE 7 7 F A ENTER /YES 0 ENTER /YES</p> <p>7. Wait for the calculation CPU to finish the operation.</p> <p>READ 7 7 F B ENTER /YES LOOP</p> <p>If the read DATA is C0, it indicates that the operation has ended. Then, read the answer as follows.</p> <p>8. SET the MAIN MEMORY ACCESS FLAG.</p> <p>WRITE 7 7 F 8 ENTER /YES 0 ENTER /YES</p> <p>9. Read the two-byte answer (MAIN MEMORY).</p> <p>READ 1 5 F 5 ENTER /YES .. Low Byte</p> <p>In this case, if the read DATA is 1E, operation is normal.</p> <p>READ 1 5 F 6 ENTER /YES .. High Byte</p> <p>In this case, if the read DATA is 00, operation is normal.</p> <ul style="list-style-type: none"> <li>For division, perform the above changing the DATA of Item 4 to 0.</li> </ul> <p>WRITE 1 5 F 0 ENTER /YES 0 ENTER /YES</p>

(Continued on page 6-236)



Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D18	Verification of Main Bus Handshake Circuit Operations	<p>(2) Turn on only L41 of the dip switches on the Extender Board-A, leaving all other dip switches.</p>  <p>(3) Disconnect Q68 (R6502) from the socket and plug in the interface pod of the troubleshooter instead.</p> <p>(4) Press the <b>RUN UUT</b> <b>F 0 0 0</b> <b>ENTER /YES</b> keys. In this case, the following message may be displayed: "POD TIMEOUT - ATTEMPTING RESET"</p> <p>(5) Press the <b>SET UP</b> key and then repeatedly press the <b>MORE</b> key. The following message will be displayed: "SET - TRAP ACTIVE FORCE LINE ? YES" Then press the NO key. Also, press the NO key if the following message is displayed: "SET - ENABLE RDY ? YES"</p> <p>(6) Perform the following operations while observing TP4 with the probe of the troubleshooter or an oscilloscope: <b>WRITE 7 7 F 8</b> <b>ENTER /YES</b> <b>0 0</b> <b>ENTER /YES</b> At this time, the level of TP4 will change from high to low.</p> <p>(7) Verify that the level of pin 6 of Q18 changes as follows: When pin 8 of Q26 is connected to GND → High When open → Low</p> <p>(8) Perform the following operations while observing TP4 again: <b>WRITE 7 7 F 9</b> <b>ENTER /YES</b> <b>0 0</b> <b>ENTER /YES</b> The level of TP4 will change from high to low.</p>

(Continued on page 6-237)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
D17	Write test of CRT buffer memories	<p>(1) Use the Troubleshooter.</p> <p>(2) Disconnects Q68 (R6502) from a socket, and inserts the interface pod of the troubleshooter into the socket (keeping the MAIN CPU mounted, which generates reset signals of CPU.)</p> <p>(3) Performs data-write-tests to the CRT buffer memory by the following operation:</p> <div style="text-align: center;"> </div> <p>(4) Refer to Figures 6.2 and 6.3 for the address of CRT buffer memory and the dot position on CRT.</p> <p>(Reference)</p> <p>An example of programming this test into the troubleshooter and writing display pattern continuously into the CRT buffer is shown below:</p> <pre> REG 0 = 8000 ←-- CRT buffer start address REG 1 = FF ←-- Write pattern LABEL 0 WRITE @ REG0 = REG1 INCR REG 0 IF REG 0 = 9FD9 GOTO 1                     CRT buffer stop + 1 address GOTO 0 LABEL 1 STOP </pre> <p>Note: Execution time is about 6 minutes and 30 seconds.</p>
D18	Verification of Main Bus Hand-shake Circuit Operations	<p>Note: Execute this test only when an error occurs during a D14 main memory access test.</p> <p>(1) Use the troubleshooter for this test.</p>

(Continued on page 6-238)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																																																																																																																																																																																																																																				
D19	CRT Memory Bus Control Signal Check	<p>(1) Use the troubleshooter and an oscilloscope.</p> <p>(2) Disconnect Q68 (R6502AP) from the socket and plug in the interface pod of the troubleshooter instead with the power supplies for both the troubleshooter and the TEST INSTRUMENT turned off.</p> <p>(3) Turn on the power supply of the troubleshooter, and then turn on the power supply of the TEST INSTRUMENT when "POWER - UP OK" is displayed. Next, perform the following key operations to initiate the CPU:</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; text-align: center;"> <table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">RUN</td> <td style="border: 1px solid black; padding: 2px;">F</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">UUT</td> <td></td> <td></td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> </tr> </table> </div> <p>(4) Writing the Check Program. The bus control signal varies from the read cycle (when the CPU read the CRT memory) and the write cycle (when the CPU writes data to the CRT memory). Check the bus control signal for both cycles.</p> <p>(a) Read cycle.</p> <table style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="border: 1px solid black; padding: 2px;">WRITE</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> <td style="border: 1px solid black; padding: 2px;">A</td> <td style="border: 1px solid black; padding: 2px;">D</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">WRITE</td> <td style="border: 1px solid black; 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padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">8</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> <td style="border: 1px solid black; padding: 2px;">F</td> <td style="border: 1px solid black; padding: 2px;">D</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">WRITE</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">9</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> <td style="border: 1px solid black; padding: 2px;">4</td> <td style="border: 1px solid black; padding: 2px;">C</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">WRITE</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">A</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> <td style="border: 1px solid black; padding: 2px;">O</td> <td style="border: 1px solid black; padding: 2px;">O</td> <td style="border: 1px solid black; padding: 2px;">ENTER</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="border: 1px solid black; padding: 2px;">/YES</td> <td></td> <td></td> <td style="border: 1px solid black; 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Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method																																																																																																												
D19	CRT Memory Bus Control Signal Check	<p>Execute the CPU by the following operation.</p> <p style="text-align: center;"> <input type="button" value="RUN"/> <input type="button" value="F"/> <input type="button" value="0"/> <input type="button" value="0"/> <input type="button" value="0"/> <input type="button" value="ENTER"/> <input type="button" value="UUT"/> <input type="button" value="/YES"/> </p> <p>(b) Write cycle</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">8</td> <td style="text-align: center;">D</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">2</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">A</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">3</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">A</td> <td style="text-align: center;">2</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">4</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">0</td> <td style="text-align: center;">A</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">5</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">E</td> <td style="text-align: center;">A</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">6</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">C</td> <td style="text-align: center;">A</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">7</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">D</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">8</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">F</td> <td style="text-align: center;">D</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">9</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">4</td> <td style="text-align: center;">C</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">A</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ENTER /YES</td> </tr> <tr> <td style="text-align: center;">WRITE</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">B</td> <td style="text-align: center;">ENTER /YES</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">ENTER /YES</td> </tr> </table> <p>A read operation is executed for the CRT memory (A) during the read cycle. To execute a read operation for the CRT memory (B), change 80 in line 3 to AO. Similarly, a write operation is executed for the CRT memory (B) during the write cycle.</p> <p>To execute a write operation for the CRT memory (A), change AO in line 3 to 80.</p> <p>(5) Verification of Output Waveforms. If the following key operations are performed, the Vend (write) cycle will be repeated in approximately 30 μS. Observe the waveforms of various sections with an oscillo-</p>	WRITE	0	1	0	0	ENTER /YES	8	D	ENTER /YES	WRITE	0	1	0	1	ENTER /YES	0	0	ENTER /YES	WRITE	0	1	0	2	ENTER /YES	A	0	ENTER /YES	WRITE	0	1	0	3	ENTER /YES	A	2	ENTER /YES	WRITE	0	1	0	4	ENTER /YES	0	A	ENTER /YES	WRITE	0	1	0	5	ENTER /YES	E	A	ENTER /YES	WRITE	0	1	0	6	ENTER /YES	C	A	ENTER /YES	WRITE	0	1	0	7	ENTER /YES	D	0	ENTER /YES	WRITE	0	1	0	8	ENTER /YES	F	D	ENTER /YES	WRITE	0	1	0	9	ENTER /YES	4	C	ENTER /YES	WRITE	0	1	0	A	ENTER /YES	0	0	ENTER /YES	WRITE	0	1	0	B	ENTER /YES	0	1	ENTER /YES
WRITE	0	1	0	0	ENTER /YES	8	D	ENTER /YES																																																																																																						
WRITE	0	1	0	1	ENTER /YES	0	0	ENTER /YES																																																																																																						
WRITE	0	1	0	2	ENTER /YES	A	0	ENTER /YES																																																																																																						
WRITE	0	1	0	3	ENTER /YES	A	2	ENTER /YES																																																																																																						
WRITE	0	1	0	4	ENTER /YES	0	A	ENTER /YES																																																																																																						
WRITE	0	1	0	5	ENTER /YES	E	A	ENTER /YES																																																																																																						
WRITE	0	1	0	6	ENTER /YES	C	A	ENTER /YES																																																																																																						
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WRITE	0	1	0	8	ENTER /YES	F	D	ENTER /YES																																																																																																						
WRITE	0	1	0	9	ENTER /YES	4	C	ENTER /YES																																																																																																						
WRITE	0	1	0	A	ENTER /YES	0	0	ENTER /YES																																																																																																						
WRITE	0	1	0	B	ENTER /YES	0	1	ENTER /YES																																																																																																						

(Continued on page 6-240)

Table 6.23 Troubleshooting (Cont'd)

Item No.	Item name	Check and test method
		scope and check the waveforms shown in the timing chart (see Figure 6.5)
		<div style="display: flex; justify-content: center; gap: 10px;"> <div style="border: 1px solid black; padding: 2px;">RUN</div> <div style="border: 1px solid black; padding: 2px;">UUT</div> <div style="border: 1px solid black; padding: 2px;">0</div> <div style="border: 1px solid black; padding: 2px;">1</div> <div style="border: 1px solid black; padding: 2px;">0</div> <div style="border: 1px solid black; padding: 2px;">0</div> <div style="border: 1px solid black; padding: 2px;">ENTER</div> <div style="border: 1px solid black; padding: 2px;">/YES</div> </div>
		(6) Turn off the troubleshooter after turning off the TEST INSTRUMENT.

Table 6.24 Cause of Trouble

Item No.	Cause of trouble
D1	POWER SUPPLY 1 PC board
D2	Q72, Q71, Q68 X2 R16, R17, R19
D3	Q6, Q54, Q46, Q45, Q34, Q42, Q33, Q35, Q47 X1 R4, R6, R7, R8 C52
D4	Q54, Q46, Q45, Q32, Q17 The same as shown in D3
D5	Q24, Q32, Q53, Q25, Q54, Q46 The same as shown in D4
D6	Q15, Q5, Q41, Q32, Q42, Q34, Q1, Q53, Q32, Q25 The same as shown in D4
D7	Q15, Q26, Q6, Q1, Q41, Q32, Q5, Q34, Q42 The same as shown in D3
D8	Q26, Q2, Q7 The same as shown in D7 and D4
D9	Q2, Q7, Q47, Q35, Q33, Q17 R1, R3, R5, R20, R21 C2, C3 The same as shown in D8
D10	Q7, Q16, Q24, Q32, Q35, Q33 R2, R9, R11, R22 C1, C2 The same as shown in D5 and D6
D11	lines (A0 to A15), lines (D0 to D7), R/W line Q59, Q50, Q22, Q23, Q30, Q31, Q38, Q39, Q77, Q78 Q12, Q13, Q51, Q76, Q67, Q73, Q17, Q16, Q74, Q75 Q10, Q79, Q14 R12, R13

(Continued on page 6-241)

Table 6.24 (Cont'd)

Item No.	Cause of trouble
D12	Q22, Q23, Q30, Q31, Q38, Q50, Q58, Q59, Q60, Q51, Q69
D13	Q39, Q51, Q10, Q17, Q18, Q4, Q78
D14	D18 Q51, Q60, Q26, Q17, Q59, Q11, Q9, Q4, Q3, Q18, Q8, Q72 Q40, Q12, Q13, Q14, Q10
D15	Q77, Q78, Q79, Q51, Q17
D16	DISP CPU PC board Q4, Q3, Q18, Q17, Q8, Q10, Q9, Q11, Q51, Q59
D17	MAIN-CPU PC board Q13, Q8, Q12, Q6, Q20, Q28, Q5, Q7, Q37, Q29, Q21 Q5, Q7, Q52 R11, R18, R16, R17
D18	Q28, Q36, Q48, Q56, Q57, Q29, Q37, Q49, Q19, Q21 Q76, Q67, Q74, Q75, Q65, Q66, Q20, Q73, Q72, Q16 Q64, Q52, Q44, Q40, Q62, Q63, Q61, Q70, Q33
D19	Q73, Q72, Q16, Q64, Q63, Q44, Q52, Q40, Q62, Q61 Q70, Q63, Q52, Q33, Q54, Q6, Q18, Q76, Q74, Q67, Q75 Q65, Q66, Q43, Q55, Q20

bit 7,6,5,4,3,2,1,0

9FD8	8000	8100	8200			9C00	9D00	9E00
9F00	8001	8101	8201			9C01	9D01	9E01
9F01	8002	8102	8202			9C02	9D02	9E02
9F02	8003	8103	8203			9C03	9D03	9E03
-----								
9FD4	80D5	81D5	82D5			9CD5	9DD5	9ED5
9FD5	80D6	81D6	82D6			9CD6	9DD6	9ED6
9FD6	80D7	81D7	82D7			9CD7	9DD7	9ED7
9FD7	80D8	81D8	82D8			9CD8	9DD8	9ED8

Fig. 6.2 CRT Buffer Memory address  
(For high intensity)

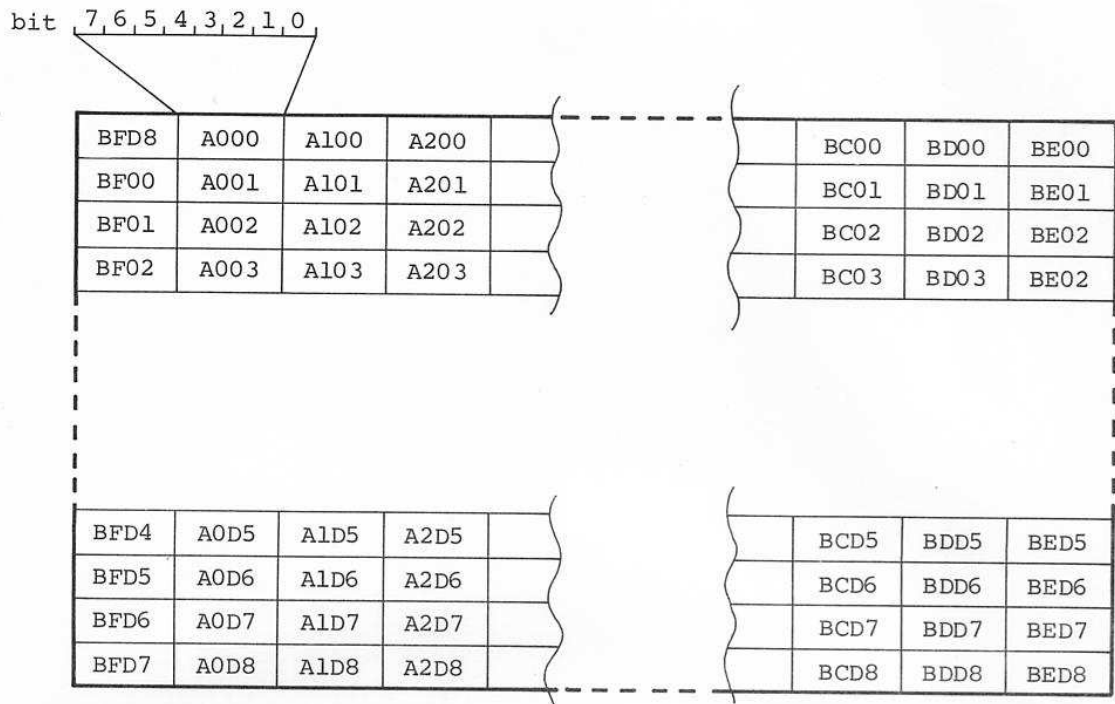
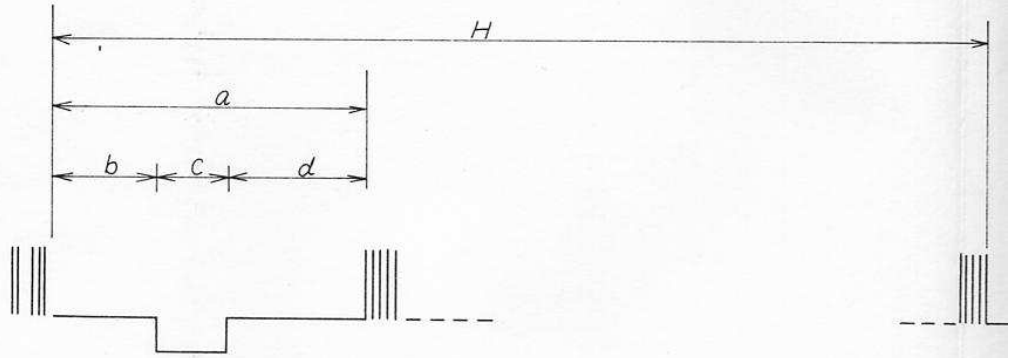


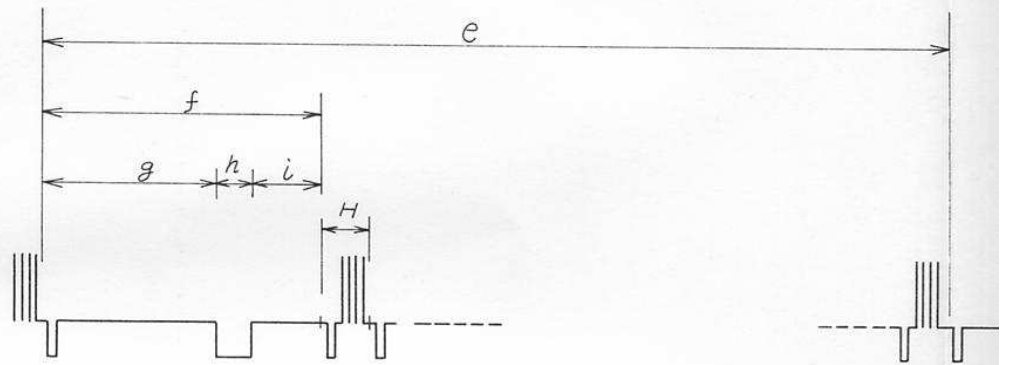
Fig. 6.3 CRT Buffer Memory address  
(For low intensity)



Horizontal  
line period



Field period



Characteristics of Composite Video Signal

Number of lines per frame	256 (note 1)
Field frequency [Hz]	62.3
Line frequency [kHz]	15.94

note 1: non-interlace

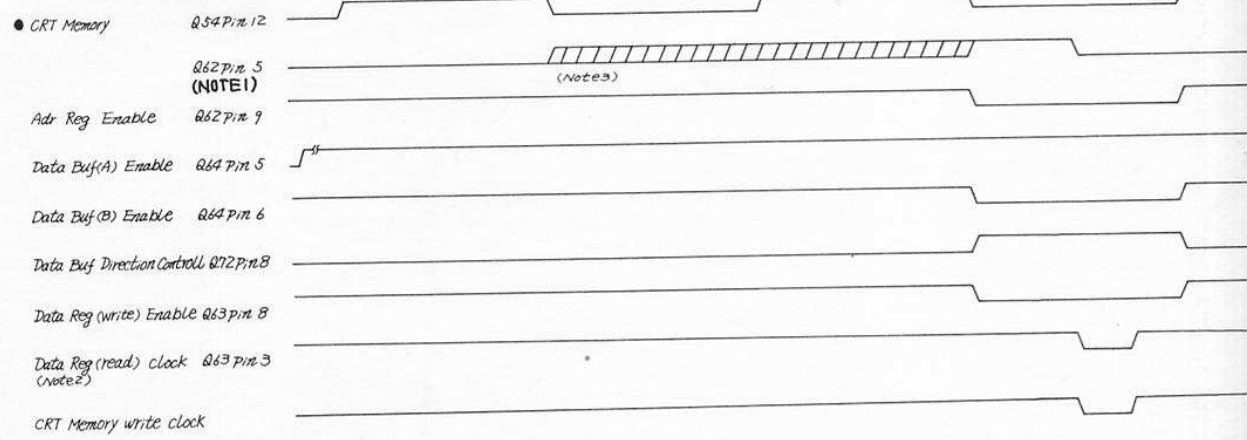
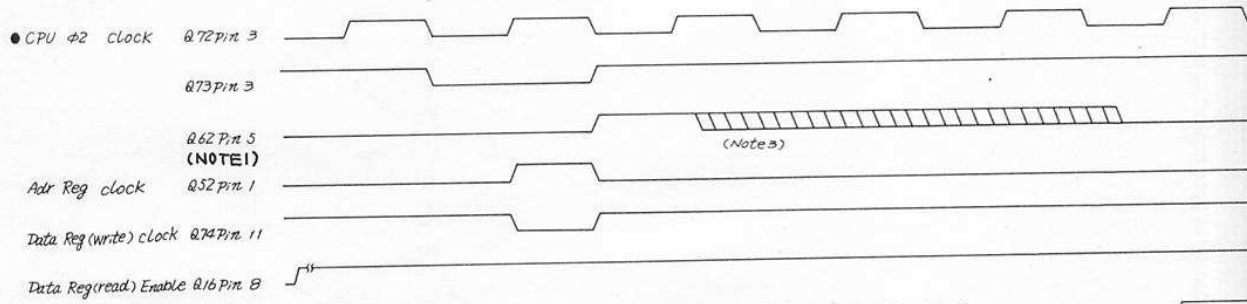
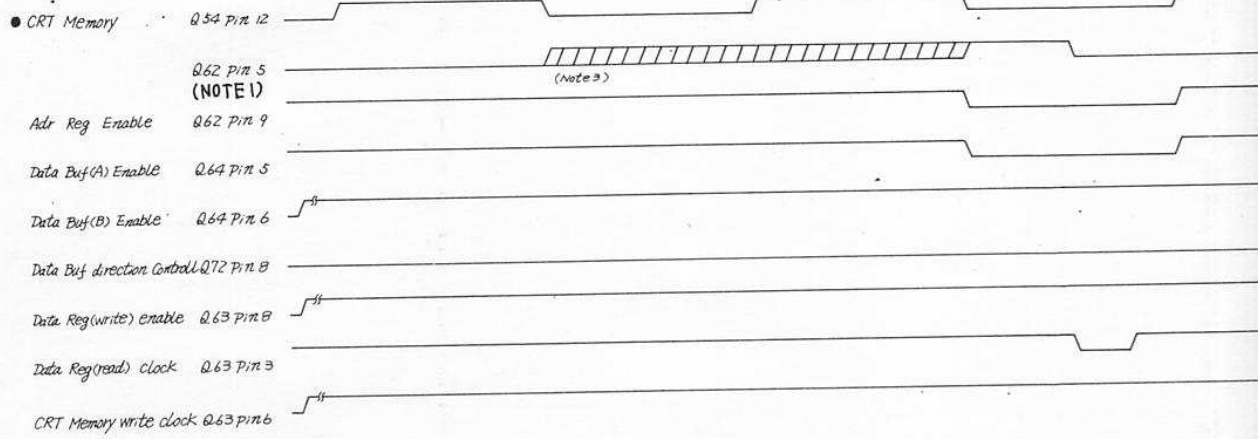
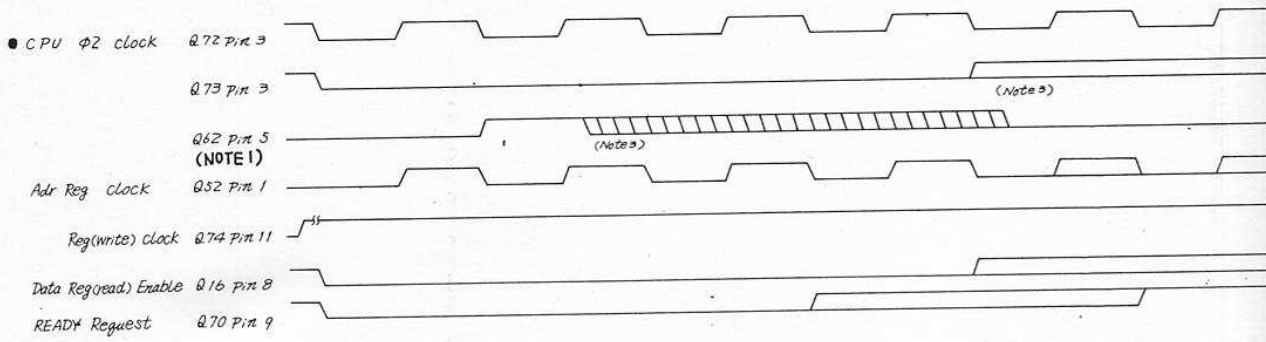
Details of line/field synchronizing signal

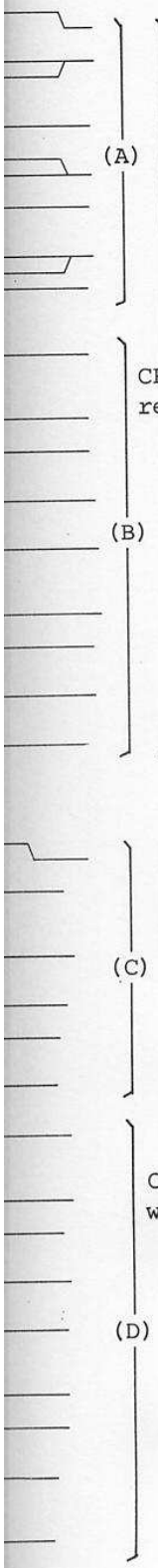
Symbol	Characteristics	
H	Line period ( $\mu\text{s}$ )	62.72
a	Line-blanking interval ( $\mu\text{s}$ )	21.76
b	Front porch ( $\mu\text{s}$ )	6.72
c	Synchronizing pulse ( $\mu\text{s}$ )	4.48
d	( $\mu\text{s}$ )	10.56
e	Field period (ms)	16.06 (note 2)
f	Field-blanking period (H)	39
g	(H)	24
h	Field-synchronizing pulse (H)	2
i	(H)	13

note 2: 256H

Fig. 6.4 Composite Video Signal Waveform


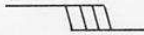

6-245/(6-246 blank)





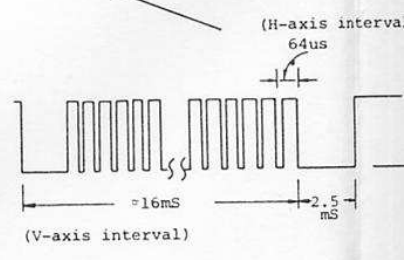
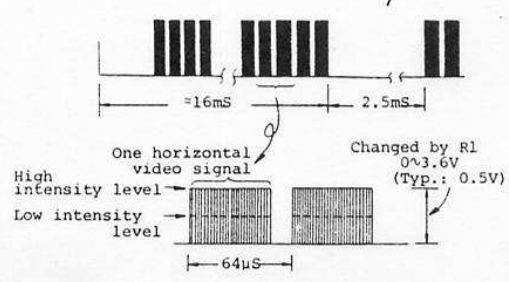
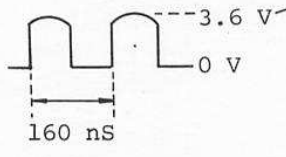
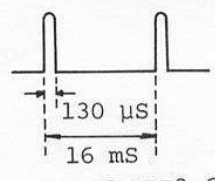
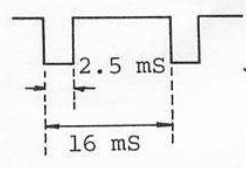
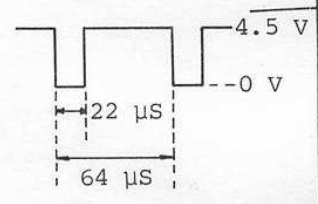
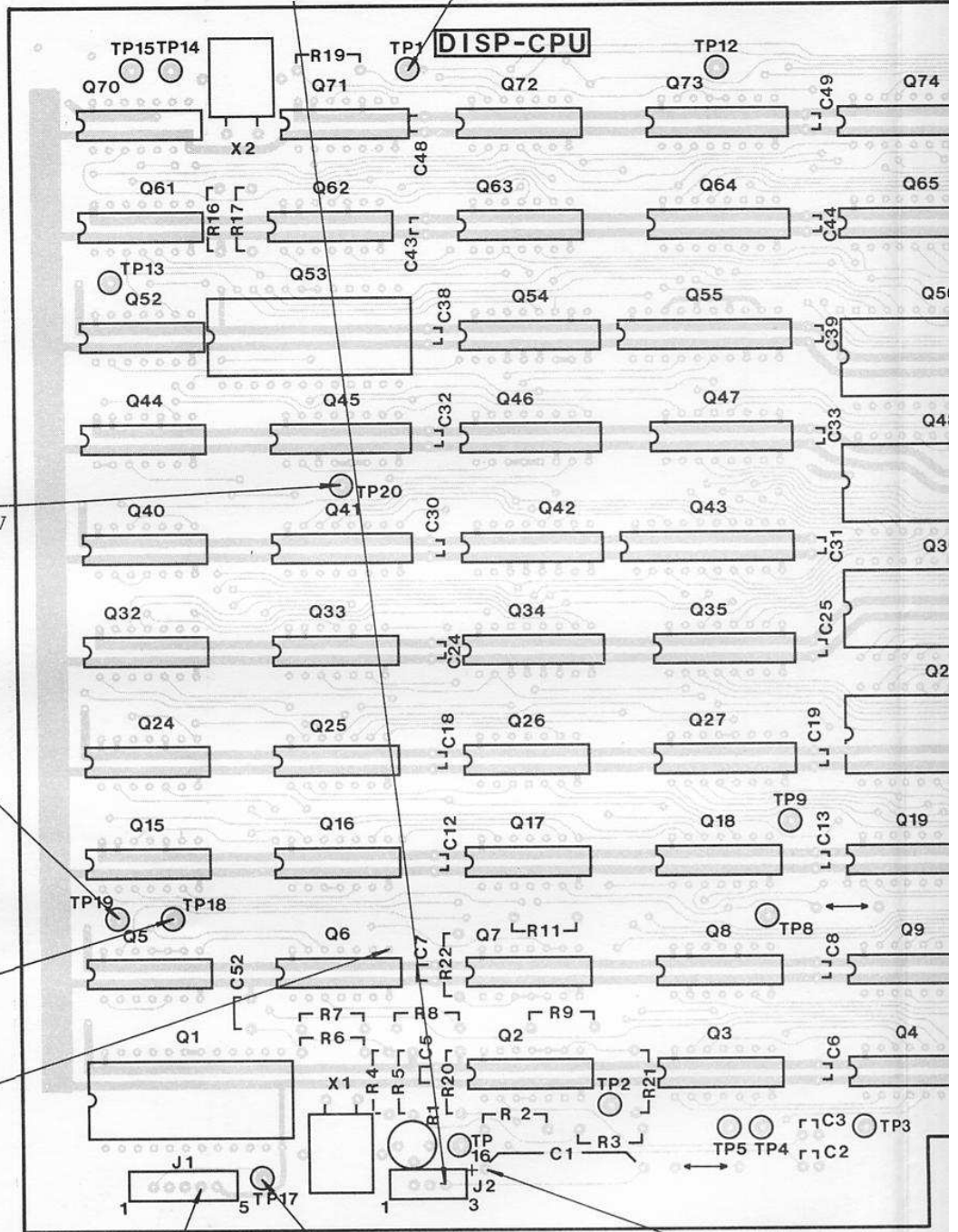
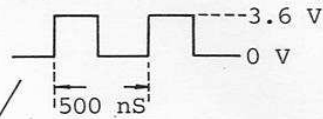
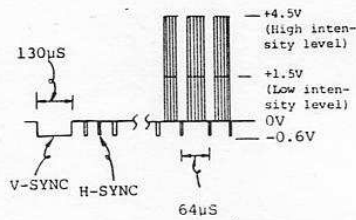
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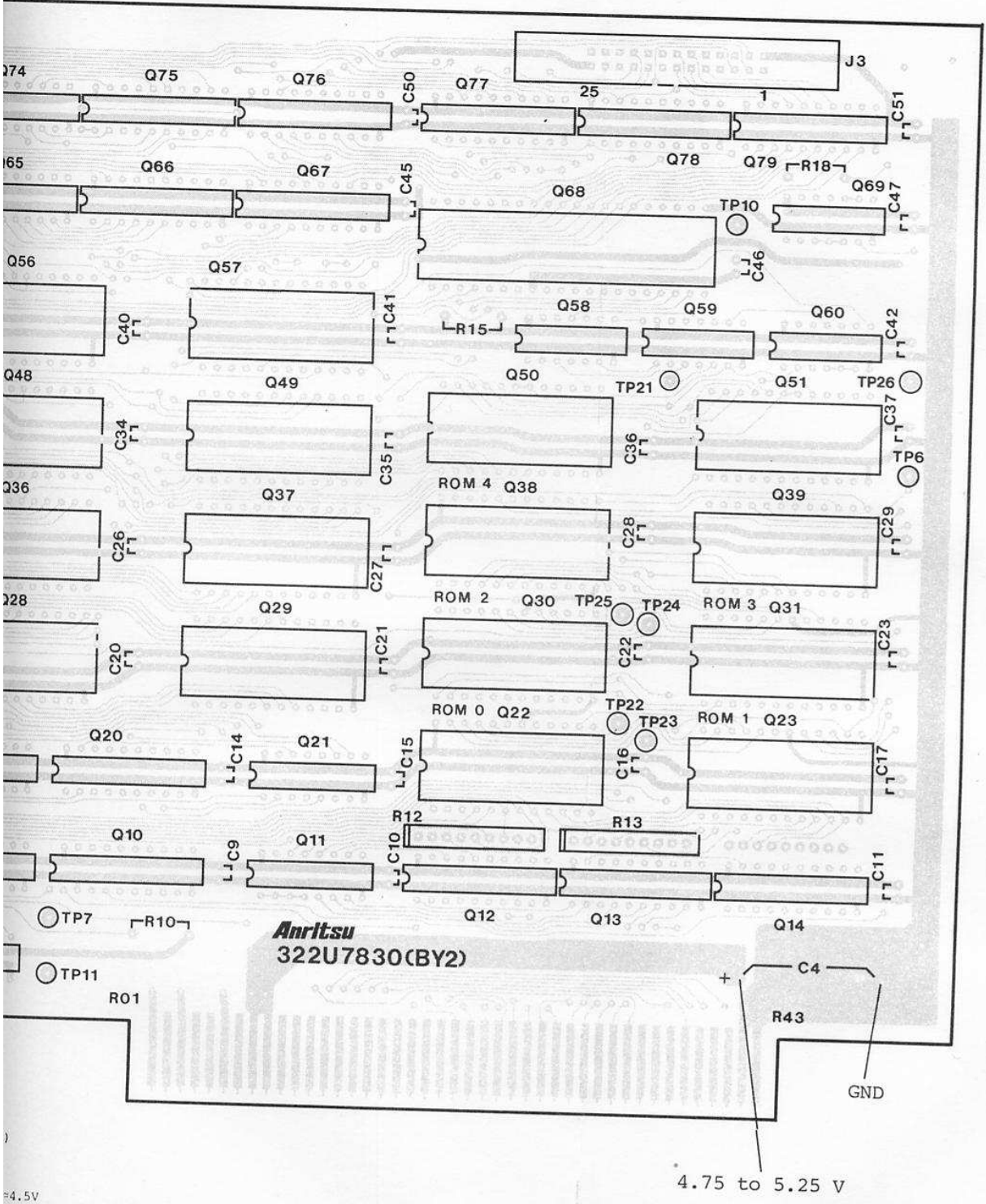
1. The CRT memory bus control signal consists of the CRT memory switching signal and a 02 clock as reference. Since these two signals are asynchronous, the length of the signal obtained by combining both signals (pin 5 of Q62 and pin 3 of Q73) is not defined.
2. Although the Data Reg (vend) clock should not appear, it does not affect operations of the circuit if it does.
3. Waveform representations

Waveform	State
	will be steady
	will be changing from high to low
	will be changing from low to high

4. These time charts can be observed when CPU 02 clock or CRT Memory signal is used as trigger, respectively.

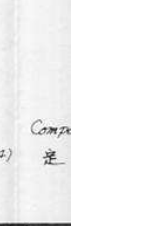
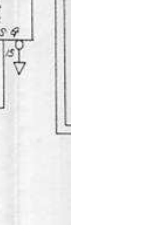
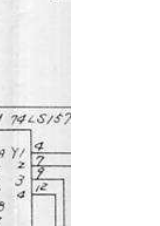
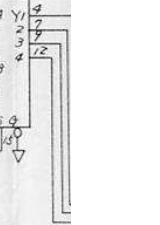
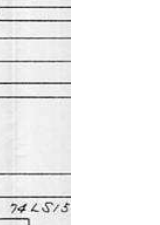
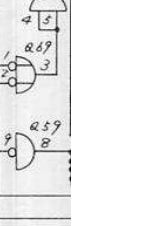
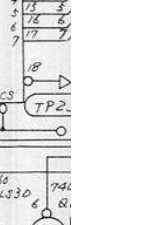
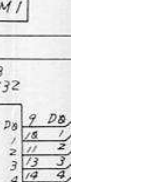
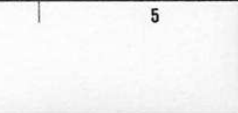
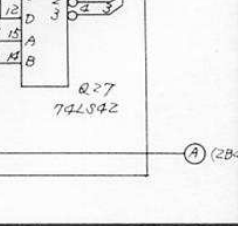
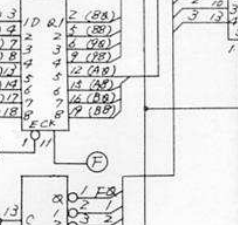
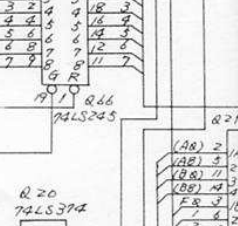
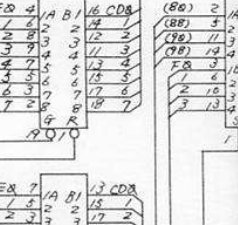
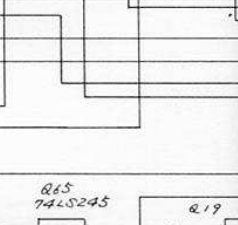
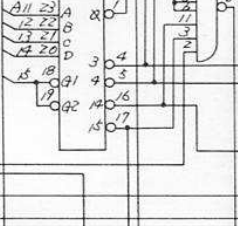
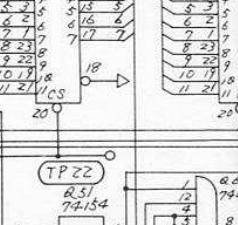
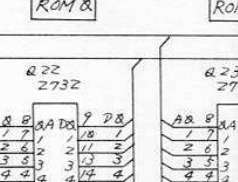
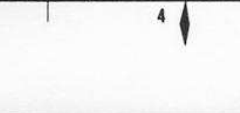
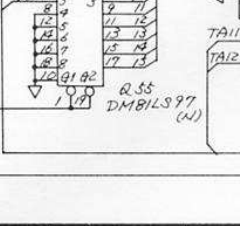
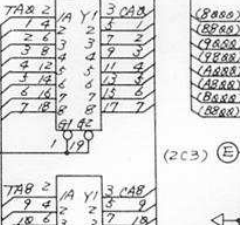
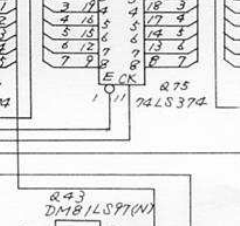
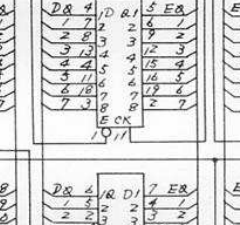
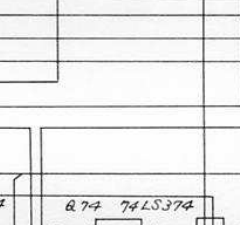
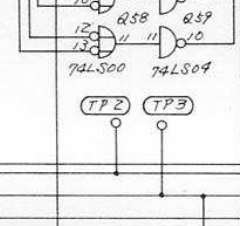
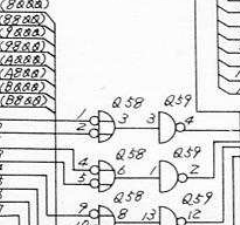
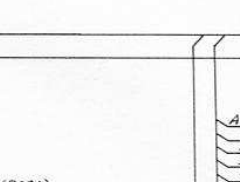
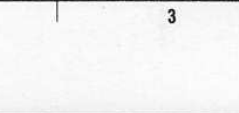
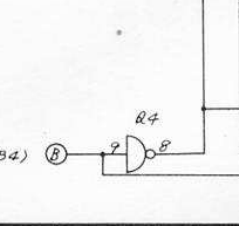
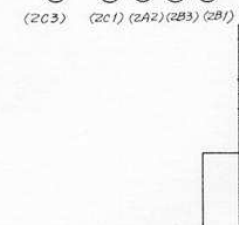
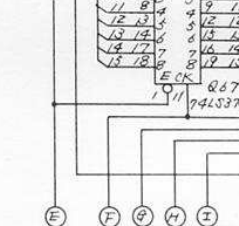
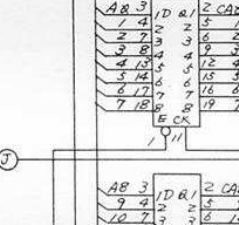
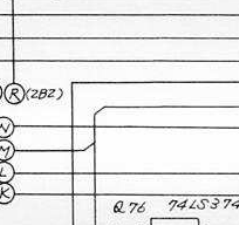
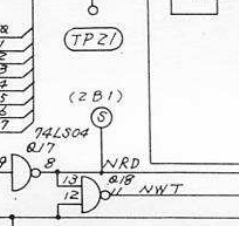
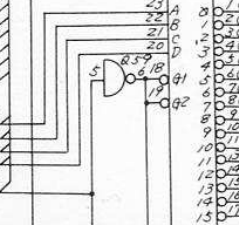
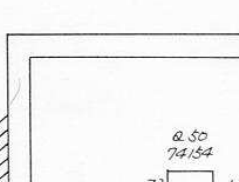
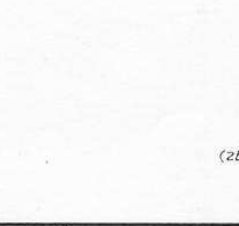
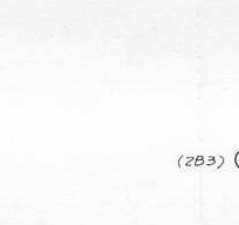
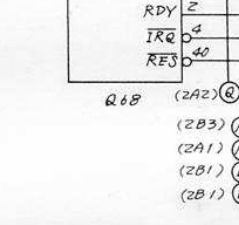
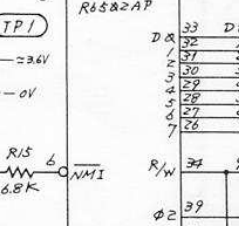
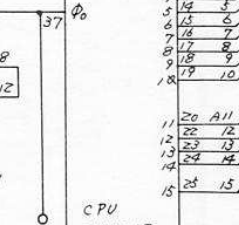
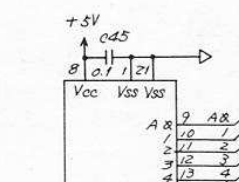
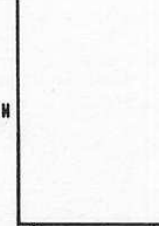
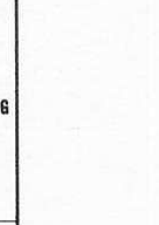
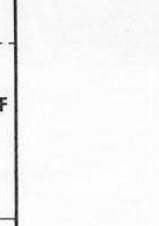
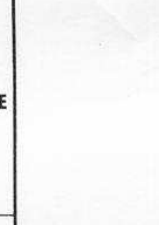
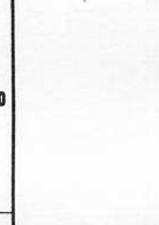
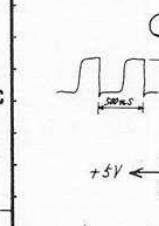
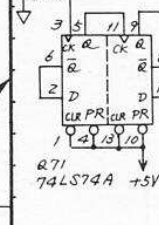
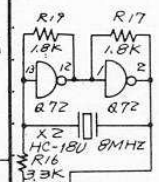
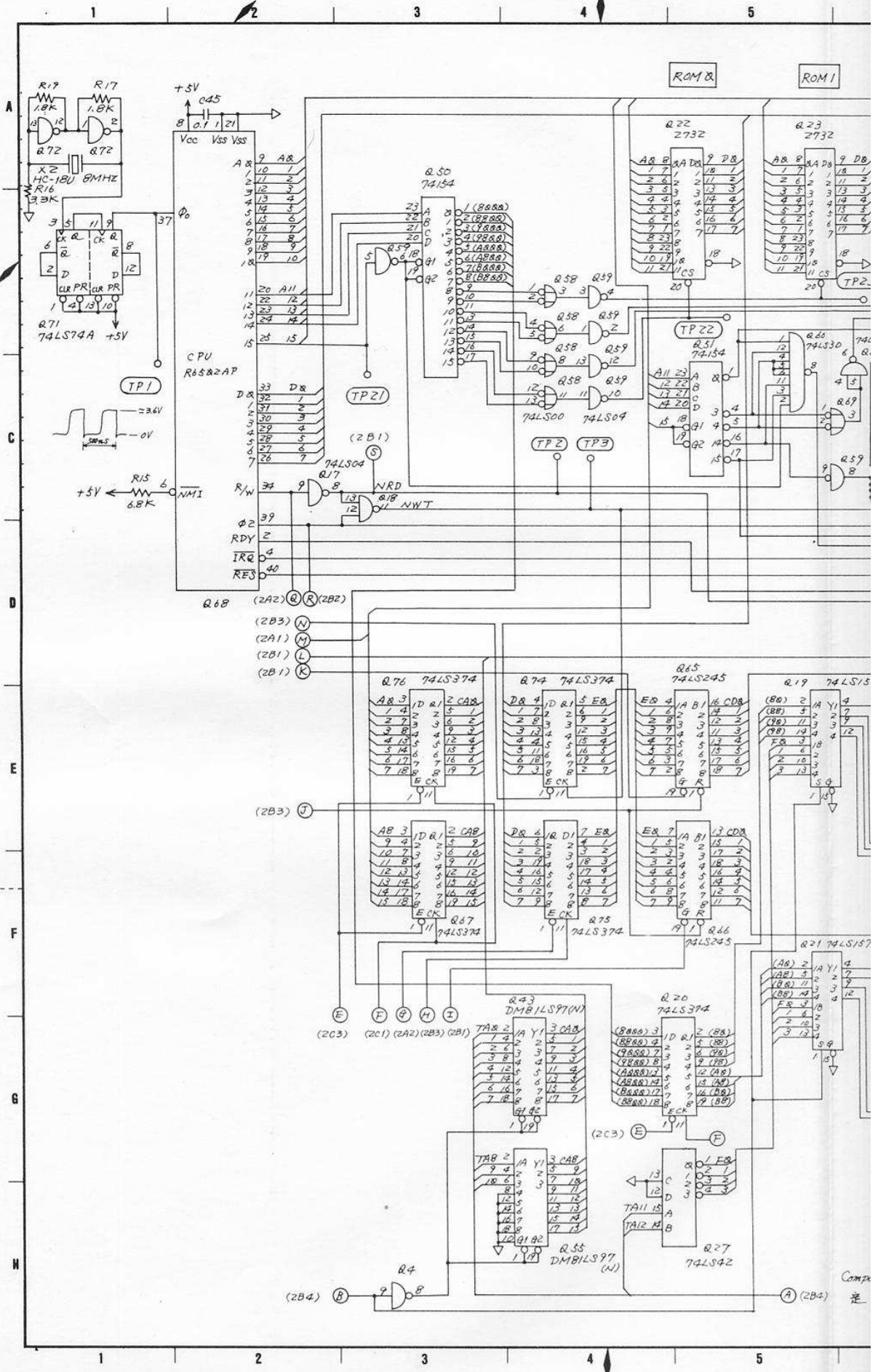
Fig. 6.5 CRT Memory READ/WRITE Cycle

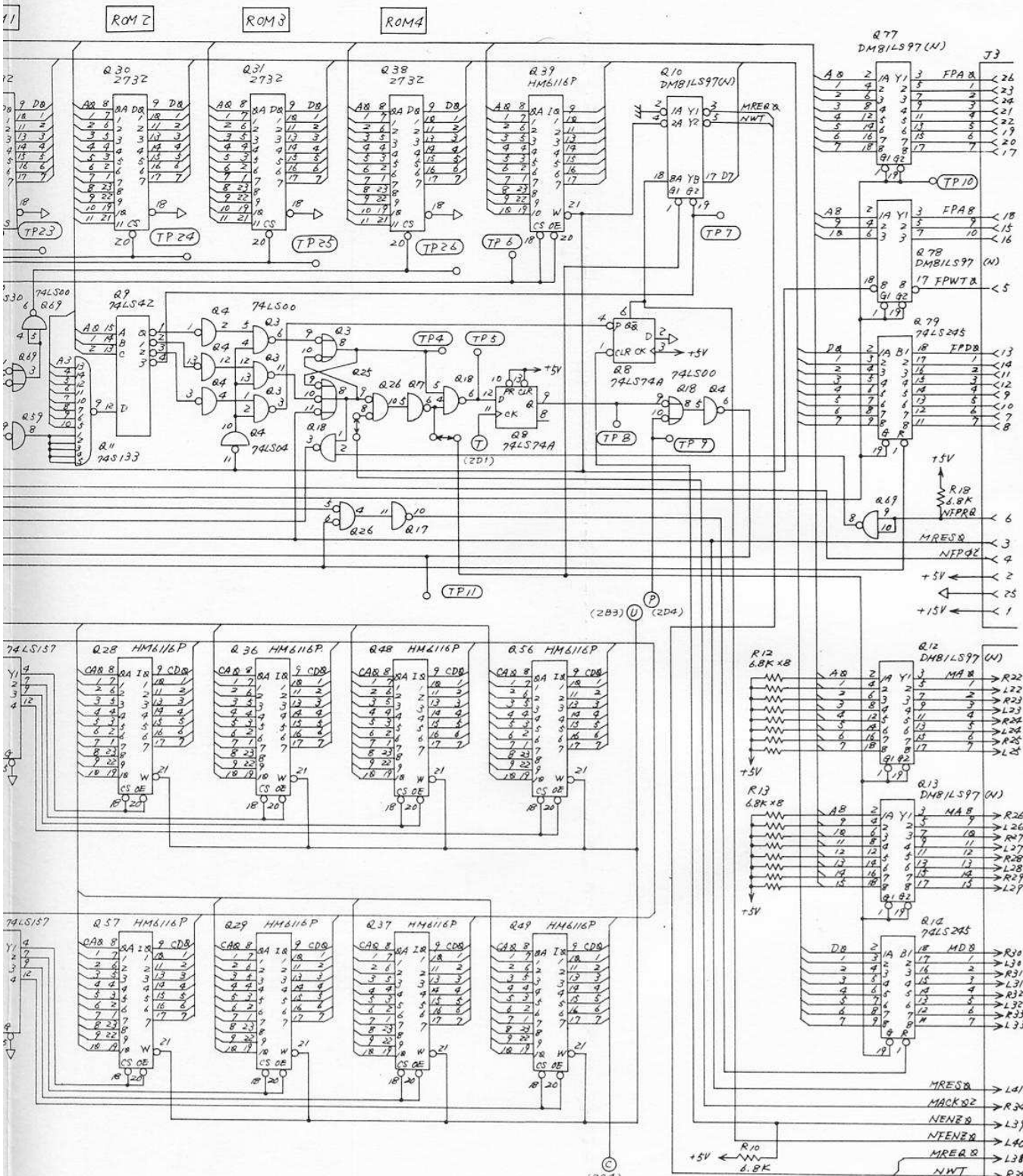




4.75 to 5.25 v  
 COMPONENTS LAYOUT OF DISP-CPU **U19**

6-249/(6-250 blank)





FRONT PANEL INTERFACE

MAIN MEMORY BUS

Component List

Japanese	English
37W74626	37W7487

- +5V ← CS
- R88, L88
- R89, L89
- R92, L92
- R93, L93
- +15V → R23, L83
- 15V → R26, L86
- GND → R81, L81

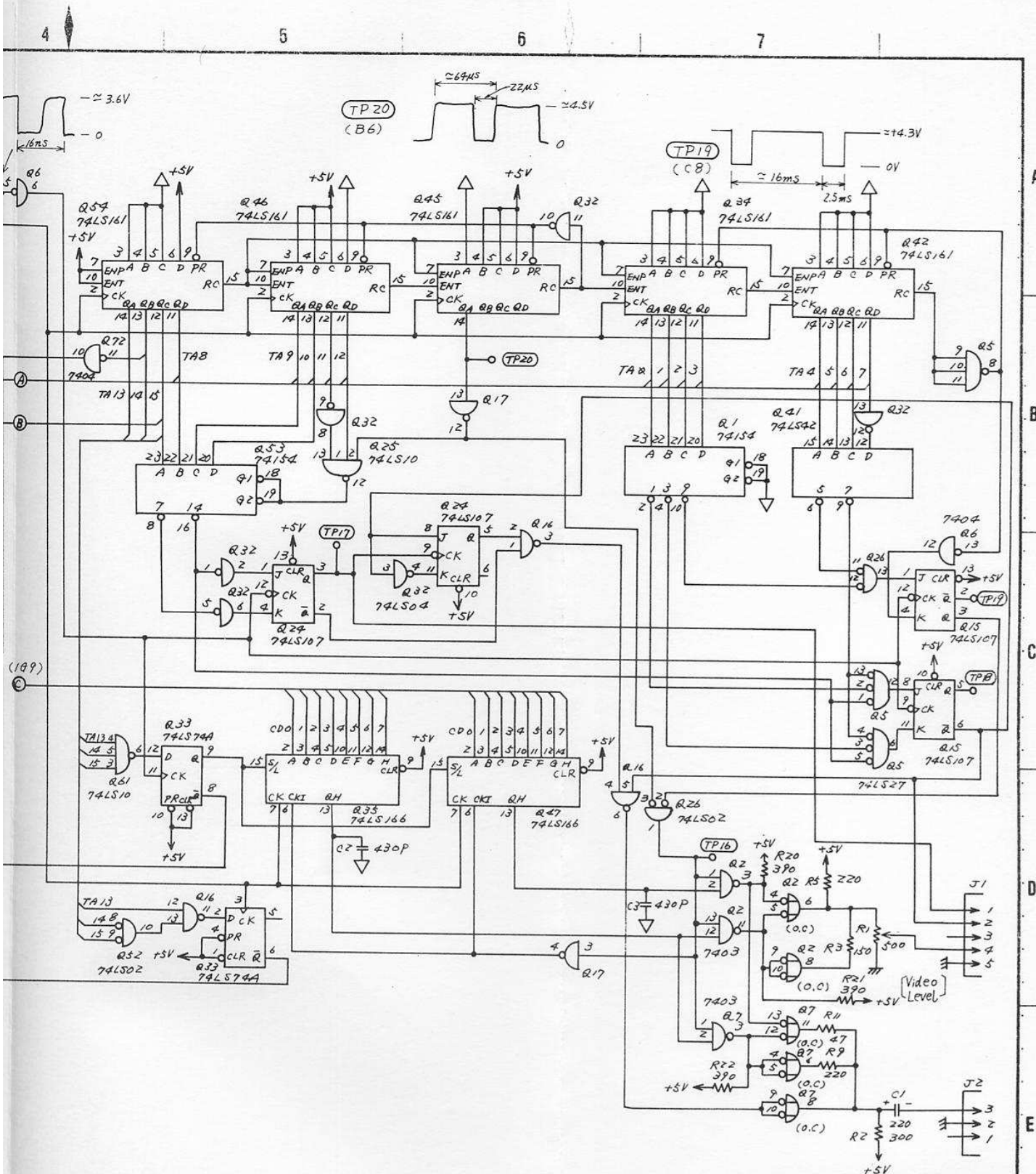
# CIRCUIT DIAGRAM OF DISP-CPU U19

1/2

6-251/(6-252 blank)







CIRCUIT DIAGRAM OF DISP-CPU **U19**  
2/2

6-253/(6-254 blank)