

FIVE DOLLARS

DAZZLER

instruction manual



Cromemco

i n c o r p o r a t e d

Specialists in computers and peripherals

2432 CHARLESTON RD., MOUNTAIN VIEW, CA 94043

DAZZLER

- **TECHNICAL INFORMATION**
- **TROUBLESHOOTING GUIDE**
- **SCHEMATIC and FOIL DIAGRAMS**
- **ASSEMBLY INSTRUCTIONS**

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Introduction

The TV DAZZLER color graphics module provides a general purpose interface between your computer and your color TV. The Dazzler can be used to generate games, animated displays, educational learning drills or even light shows, all in full color. The Dazzler is manufactured by Cromemco, 2432 Charleston Rd., Mountain View, CA 94043.

The Dazzler is built on two boards designed to plug directly into any computer using the S-100 microcomputer bus. The video output of the Dazzler can be connected directly to the video input of a color TV set. By using an optional RF modulator, the Dazzler can be conveniently connected to the antenna terminals of the TV set, rather than the input of the video amplifier.

With the Dazzler interface, TV games that are either unavailable, or available only in black and white, can now be programmed in full color. A football can now sail over a bright green playing field under the software control of your computer. Rocket ships can spew red-yellow flames against a brilliantly blue sky. Or perhaps you wish to challenge your computer to a game of checkers or chess on a red and black playing board—again generated on your TV screen by the TV Dazzler interface.

If you use your computer for business or accounting purposes, the Dazzler interface can be used to display multi-colored graphs of the data stored in your computer. Your computer can be used to process and format the raw data while histograms, charts or graphs of the data are displayed on your color TV.

The Dazzler interface can also turn your color TV into a TV terminal. Alphanumeric characters entered from a teletype or ASCII keyboard can be displayed directly on the screen of your TV using our Dazzlewriter software for character generation. Messages can also be generated internally in your computer and displayed—in full color. Alphanumeric messages, titles or comments can similarly be displayed in conjunction with Dazzler games or Dazzler graphic displays.

A new interface board from Cromemco, our D+7A I/O, is particularly useful for inputting analog signals for use in conjunction with the Dazzler. Analog signals from joysticks, for example, can be input to the computer with the D+7A module for use in controlling a Dazzler-generated display.

Another use of the Dazzler interface is in computerized instruction either at home or in the classroom. Word recognition tests, "flash card" arithmetic drills, and memory training can all be carried out with the excitement of a full-color display. Games can be interspersed with learning exercises to maintain student interest and enthusiasm. (For more information on the use of the Dazzler in the classroom see the December 1976 issue of BYTE magazine, "The Cybernetic Crayon," pp. 24-29, 138-141.)

Design

The Dazzler interface is a very advanced design using over 70 MOS and TTL integrated circuits on two printed circuit boards. Yet the Dazzler kit is easy to build. A special varnish or "solder mask" is used to guard against shorts during board construction. And a legend mask is silk-screened directly on the board to show precisely where each component is placed.

Only the highest quality parts are used in the Dazzler interface. The printed circuit boards are double-sided glass-epoxy with

plated-through holes and gold plated edge contacts. IC sockets are used for all dual-in-line ICs. And carbon film resistors are used for high-speed operation and temperature stability.

The two Dazzler boards may be plugged directly into two adjacent slots in your computer. A 16-conductor ribbon cable, with DIP plugs on each end, is used to interconnect the two boards. Alternatively Board 2 may be mounted "piggyback" on Board 1 so that only one slot is required. In this configuration, seven additional jumper wires must be used to interconnect Board 1 with Board 2.

Software

Cromemco provides software support for the Dazzler interface. We currently have 9 software packages available for purchase. Each package contains a punched paper tape listing along with complete documentation. The cost of each package is \$15. The 9 available software packages are:

- DAZZLEWRITER for alphanumeric generation
- LIFE, a colorful game by John Conway
- KALEIDOSCOPE for captivating colors displays
- TIC TAC TOE written in BASIC
- DAZZLEMATION for animated displays
- CHASE!, a two person game using two of our JS-1 joystick consoles
- TRACK, a one person game using our joystick console
- DAZZLEDOODLE allows you to draw in color on the TV screen using our JS-1 joystick console
- SPACEWAR, a two-person game using two of our JS-1 joystick consoles.

Operation

The Dazzler uses high-speed direct memory access (DMA) to read the memory of the host computer and translates the information in the memory into a color TV signal. The key advantage of using DMA is that the Dazzler can display a picture while at the same time the computer is executing either a related or unrelated program. Only a 15% slow-down of the computer execution is realized during the Dazzler operation.

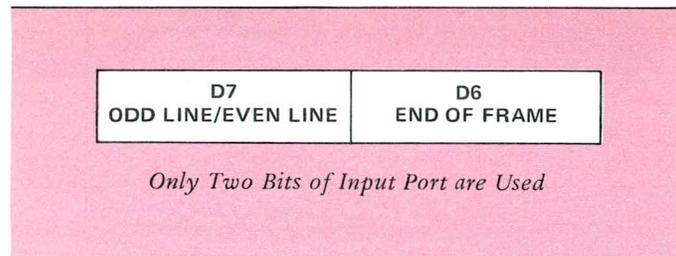
A functional block diagram of the Dazzler is shown on page 2. A 3.579545 MHz crystal oscillator is used to generate the color video subcarrier. The video output amplifier delivers a standard 1 V negative sync NTSC video signal into a 52 ohm load. A six foot length of 52 ohm coax cable is supplied with every Dazzler.

While the video output signal is generated by Board 1, Board 2 is used to communicate with the computer. A high speed (one million bytes per second) DMA controller is the heart of this board. The controller issues a "Hold" command when it is ready to access the computer memory. When the computer finishes the current machine cycle it issues a "Hold Acknowledge" signal to begin DMA.

In addition to the high-speed DMA data link, two output ports and one input port are built into Dazzler Board 2 for the ex-

Bit D7 is not used. Bit D6 is used to set normal resolution (32 x 32 element picture for 512 bytes of 64 x 64 element picture for 2K bytes) or resolution X 4 (64 x 64 element picture for 512 bytes or 128 x 128 element picture for 2K bytes). Bit D5 sets the amount of computer memory (starting at the location given to output port 016) allocated to the picture. When D5 is "1", 2K Bytes of memory are used. When D5 is "0", 512 bytes are used. Bit D4 is used to select between a black-and-white display and a color display. Bits D3-D0 are used in resolution X 4 mode to set the color of a color picture or the intensity of a black-and-white picture. Bits D3-D0 are not used in normal resolution mode.

Only two bits of input port 016 are used. Bit D7 is low during odd lines and high during even lines. Bit D6 goes low for 4 ms between frames to indicate end of frame.

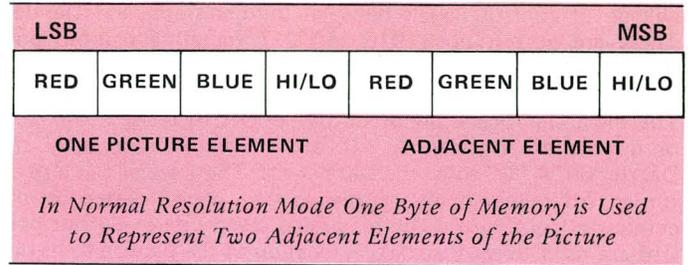


In order to generate a TV picture with Dazzler, the information that the Dazzler reads from the computer memory must be properly formatted. In resolution X 4 mode, each point on the TV screen is controlled by just one bit in the computer memory. When that bit is a "1" the corresponding element of the picture is on. When that bit is a "0" the picture element is off. In resolution X 4 mode, the color and intensity of the picture is set by bits D0 to D3 of the control word at output port 017. For full color in resolution X 4 mode, multiple frames of different colors must be interleaved.

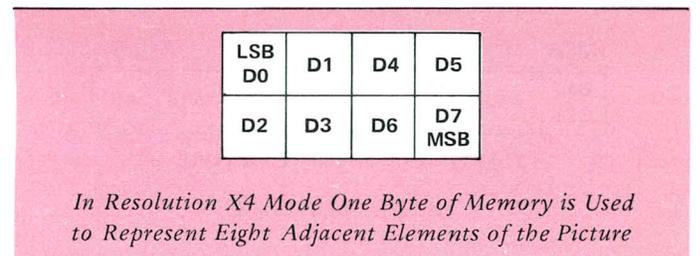
In normal resolution mode the color and intensity of each element of the TV picture are controlled by a four-bit "nybble" in the computer memory. Two elements of the picture are thus stored in each byte (8 bits) of memory. (For this reason a 64 x 64 picture in normal resolution mode requires 2K of memory.) The lowest order bit of each nybble (D0) determines whether the corresponding element of the picture contains red (1) or no red (0). Similarly, D1 controls green, D2 controls blue, and D3 sets either high intensity or low intensity color. In black-and-white mode these four bits are instead used to specify one of 16 levels of grey.

When writing programs for Dazzler displays it is important to remember that the TV picture is stored as a special coded sequence in the computer memory. The Dazzler simply interprets this code to form a TV picture. Two different codes are used depending on whether the Dazzler is used in normal resolution mode or in resolution X 4 mode (as set by the control word sent to output port 017).

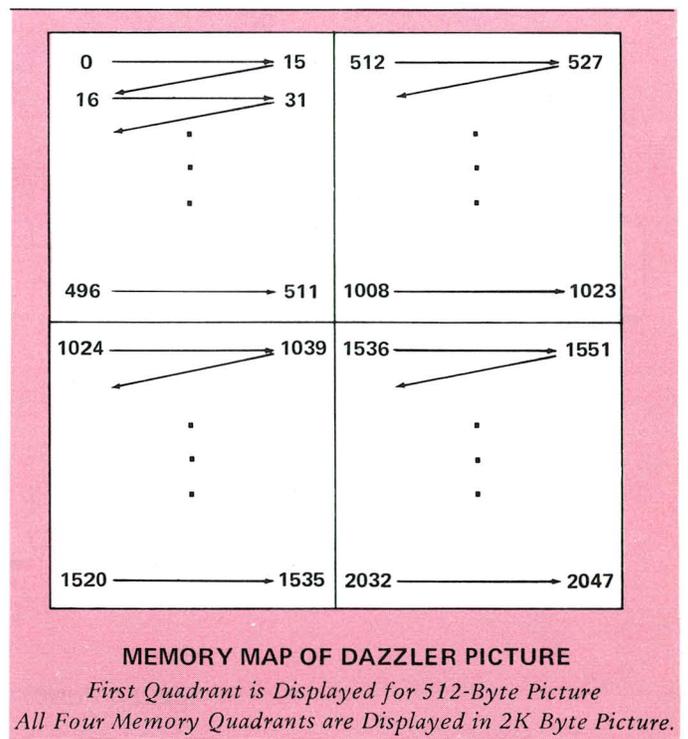
In normal resolution mode four bits of computer memory are used to code each element of the picture. A 32 x 32 picture requires 512 bytes of memory. A 64 x 64 picture requires 2K bytes of memory. The following diagram shows how the 4-bit code works:



In resolution X 4 mode each bit of the memory is used to either turn on or off a single element of the picture. The eight picture elements controlled by a single byte have the following geometric relationship:



The 2K byte Dazzler picture is stored in memory as four quadrants. Each quadrant of the picture occupies one 512-byte page of memory. Only one page of memory is displayed for a 512-byte picture. The sequence in which memory is scanned in making a 2K byte picture is shown below:



TV Connection

A length of RG174U coaxial cable is provided to connect the Dazzler to your TV. The center conductor of the cable should be soldered to the pad labelled "OUT" of Board 1. The shield of the cable should be soldered to the adjacent foil ground. The other end of this cable can be connected to the input of the video amplifier of a TV, being sure to terminate the cable in a 52-ohm impedance.

If you prefer to connect to the antenna terminals of the TV, rather than to the video amplifier input, a RF modulator is required. One such modulator is the Pixieverter Model PXV-2A available for \$8.50 from ATV RESEARCH, 13th and Broadway, Dakota City, Nebraska, 68731. If you use a Pixieverter you must also use a matching transformer between the output of the Pixieverter and the TV set. A standard 75 ohm to 300 ohm matching transformer, available at TV supply stores, will provide the required matching. (Radio Shack stores carry such a transformer for \$2.59, model 15-1140).

Servicing Your DAZZLER

Under normal operation your Dazzler should function for years without requiring service. Should you have to troubleshoot your Dazzler, the DAZZLER TROUBLESHOOTING GUIDE on the following pages provides a step-by-step procedure.

One common problem can occur when several boards are used simultaneously on the bus of the Altair 8800 computer. This problem is caused by the inability of the +8 V supply of the Altair to deliver an adequate supply voltage under load. This problem may show up as a series of dark bars of your DAZZLER picture. One cure to this problem we have found is to connect a very large filter capacitor (approximately 100,000 microfarads @ 10 V) across the Altair 8 V supply line.

Another common problem is caused by the inability of some dynamic memory boards to maintain memory integrity during DMA operation. Since the DAZZLER uses DMA to extract the picture from the computer's memory, we recommend that static memory boards be used for both picture and program storage during DAZZLER operation, such as the Cromemco model 4KZ static memory board.

Using Two DAZZLERS In Your Computer

If you wish to control two TV sets simultaneously, you can use two DAZZLERS in your computer at the same time. To synchronize the DAZZLERS remove the jumper wire connecting "SYNC IN" to "G" on Board 1 of one of the DAZZLERS. Now connect "SYNC OUT" from the other DAZZLER to the SYNC IN pad that used to be connected to "G". The two DAZZLERS are synchronized with this connection so that they may be operated simultaneously in the same computer.

Test Program

The following program is useful for testing the operation of the Dazzler and is useful for initial tune-up. To operate this program you must have 2K bytes of static memory beginning at location zero in memory.

This program begins by putting the bit sequence "10000000"

MEMORY LOCATION	MEMORY CONTENTS	COMMENTS
000 000	076	Move immediate into the accumulator
000 001	200	
000 002	323	Output to port number 016
000 003	016	
000 004	333	Input from the sense switches
000 005	377	
000 006	323	Output to port number 017
000 007	017	
000 010	303	Jump to memory location 000 000
000 011	000	
000 012	000	
000 012	000	

into the accumulator and outputting it to port 016. This turns on the Dazzler and tells it that the picture that it is to display begins at location zero in memory. Next the program uses the front panel sense switches to set the control word sent to output port 017. This allows the user to experiment with different output formats and appreciate the fantastic versatility of the Dazzler display. When sense switch A12 is raised the Dazzler goes into color mode, and a colorful quilt-like pattern will appear on the TV screen.

Tune Up

The tune up procedure for the Dazzler is straightforward. Begin by loading and running the above test program. Raise SSW A12. Adjust R 29 for a stable picture on your screen. Now raise SSWs 10, 11, 12, 13, 14. Adjust C17 for the brightest blue color on your screen. Now lower SSW A10 and raise A9. Adjust R28 for the brightest green. Finally lower SSW A9 and raise SSW A8. Adjust R27 for brightest red. The tune up of Dazzler is now complete.

Troubleshooting Procedure

Equipment Required

1. VTVM or VOM
2. Triggered sweep oscilloscope, preferably DC-5MHz or more, with an external sync input.
3. Frequency counter (optional)

Procedure

1. Measure the output of each regulator (IC1 & IC38) to be between +4.75 and +5.25 VDC, with less than 0.1VPP of 60 or 120Hz ripple. If low voltage or excessive ripple exists, check that primary power at regulator is always >7V, and check IC1 & 38.
2. Measure point "V" with oscilloscope and verify a ~3VPP square wave at 3.579545MHz. The counter can be used to set the frequency with the 7-25pf trimmer to an accuracy of ± 500Hz or better.
3. Measure IC7P4&6 to see ~3VPP square wave at 3.579MHz.
4. Measure point "W" to verify a 4.5 us wide pulse going from +3 to 0 or a 15.98 KHz rate. If not present, check IC's 32, 33, 21, 19, 31, 30, 36, and sync jumper.

5. Measure IC5P8 to verify a .25ms wide pulse going from +3 to 0 at a 31Hz rate. If not present, check IC's 3, 9, 18, 19, 11, 12, 5, 36, and sync jumper.
6. Measure "Sync Out" to verify a 62μs wide + pulse from 0 to +3 at a 31Hz rate. If not present, check IC6.
7. Measure IC23P9 to verify a 12ms wide + pulse at a 62Hz rate. If not present, check IC 2, 4, 8, 23.
8. Measure point "S" to verify a 35.8μs wide + pulse at a 15.98 KHz rate. If not present, check IC 19, 29.
9. Depress the "CLR" switch & verify IC63P8 is at 0 (or IC4P12 at +3). If does not clear, check IC 58, 63, 66.
10. Load the following test program into static RAM, starting at address 0 and start execution at 0 with the RAM protected.

```
loc 0 : 076      333      303
        200      377      000
        323      323      000
        016      017
```

11. Stop and run the program several times to verify that it stays in the address range 0 to 128.
12. With the program in (10) executing, the DAZZLER is enabled to display the first portion of memory, with the sense switches controlling output port 017. Verify the following switch control responses:

D0 to IC37P16	D4 to IC61P1
D1 to IC37P10	D5 to IC61P14
D2 to IC37P9	D6 to IC61P11
D3 to IC37P15	D7 to IC61P8

If not present, check IC's 37, 61, 72, 39, 48, 49, 45, 58, 59.

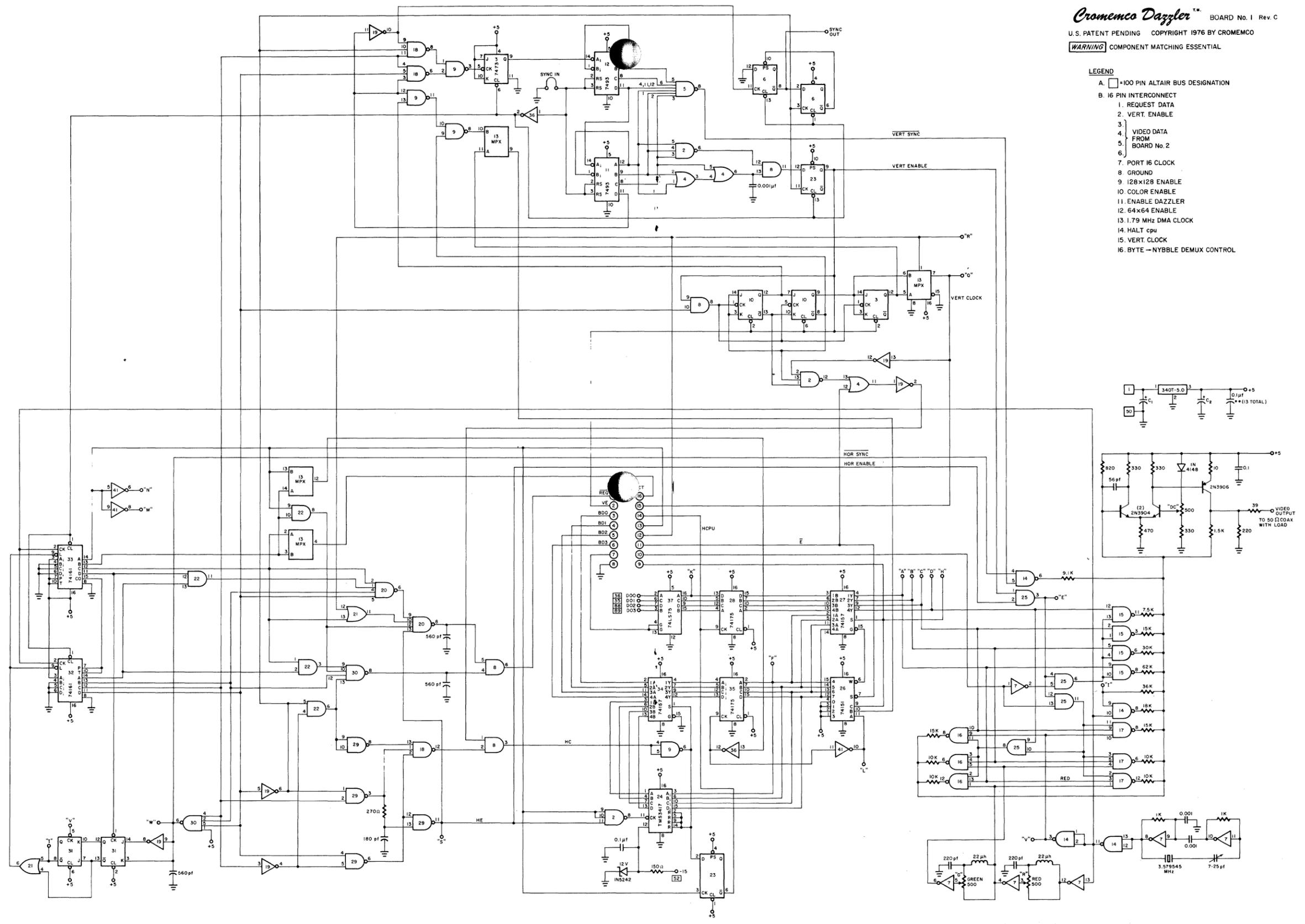
13. Verify that IC54P1, 14, 11, 8, and IC63P1, 14, 11 are at 0V and IC63P8 is +3V.
14. Temporarily change the instruction at loc 1 to 377 and execute. Verify that IC54P1, 14, 11, 8 and IC63P1, 14, 11 8 are +3. If not, check same IC's as in (13). Restore loc 1 to 200 & Run.
15. Stop execution. Verify IC63P8 is +3. Depress CLR switch and verify IC63P8 is now 0V. Put back in RUN. If does not clear, check IC's 58, 66.
16. Set sense SW D5=0. Verify IC60P9, 6, 2, 15 and IC62P9, 6, 2 are 0. Temporarily change instruction at loc 1 to 377 and execute. Verify IC60P9, 6, 2, 15 and IC62P9, 6, 2 are at +3. If incorrect action, check IC 52, 60, 62. Restore loc 1 to 200 & Run.
17. Measure IC18P12 and verify a 47μs wide + pulse with 62.5 μs period (15.98KHz). If not present, check IC 18, 21, 22 and 29.
18. Connect the scope for external + sync and obtain sync from IC23P9. Measure IC2P12 and verify a burst train of 313μs wide pulses from +3 to 0 at a 62.5Hz burst rate, for a total of 32 pulses/burst. Pulse leading edges are spaced 375μs. If not present, check IC's 2, 3, 8, 10, 13, 19.
19. Observe that setting sense SW D5=1 doubles the number of pulses. Leave D5=0. If not, check IC's 3, 13.
20. Measure IC23P6 and verify a burst train of 47μs wide + pulses with a 62Hz burst rate. The pulse leading edges should be spaced 250μs for a total of 32 pulses/burst, with pulses spaced 62.5μs between the bursts. If not present, check IC's 9, 23.
21. Observe that setting sense SW D5=1 doubles the number of pulses in the slower portion. Leave D5=0.
22. Measure point "T" to verify a + pulse train burst at a 62Hz

rate consisting the slower portion of the waveform in (20). If not, check IC 40.

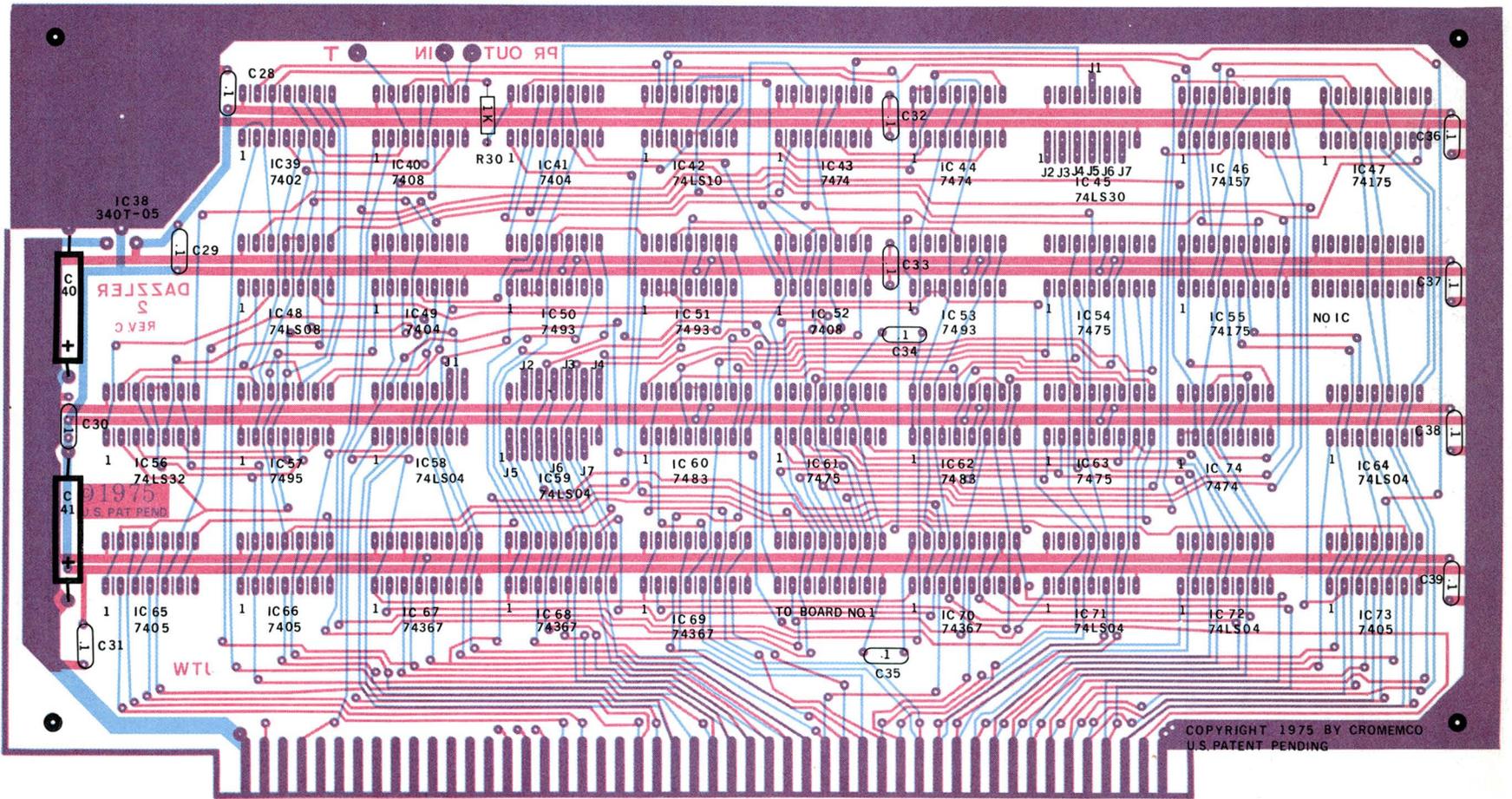
23. Connect the scope external + sync to point "T" and set the time base to 5μs/div so "T" is + during most of visible trace. Measure IC8P6 to verify a burst of pulses from +3 to 0 occurring while "T" is positive. For D5=0, there should be 33 pulses of width 280ns with 2.23μs between leading edges. For D5=1, there should be 65 pulses 280ns wide, spaced 1.11μs except for the first pair spaced 2.23μs. Leave scope sync on "T". If not correct, check IC's 8, 20, 21, 22, 30, 32, 33.
24. Measure IC57P12 to verify a + pulse each time pulse at "T" occurs, with a leading edge delay of 1-5μs and a trailing edge delay of .5-1μs. If not present, check IC's 39, 40, 47, 48, 49, 56, 66, 57. Also check for signals on PHOLD and PHLA, and priority input greater than +3.
25. Measure IC41P12 to verify a pulse train similar to IC41P1, except with the first pulse deleted for either position of D5. If not present, check IC's 41, 42, 43, 44, 49, 52, 58.
26. Measure IC50P12, 8, 11 to verify that the horizontal address counter operates in a binary fashion while "T" is high. IC51P12 operates only if D5=1. If not operating, check IC's 50, 51, 49.
27. Measure IC 51P9, 8, 11 and IC53P9, 8, 11 to verify Binary operation of the vertical address counter. IC53P11 operates only if D5=1. Use "T" for scope sync. If not correct, check IC's 51, 52, 53, 71, 13.
28. If the static RAM at 0 being read out by the DAZZLER was not cleared to 0 prior to loading and execution of the test program, it should contain a random pattern of 1's and 0's. Measure IC47P11, 6, 3, 14 and IC 55P11, 6, 3, 14 to verify random data reception while "T" is high. If not present, check IC's 47, 55, 64, 72.
29. Measure IC43P9 to verify presence of a square wave with period .5μs for D5=1 and 1.11μs for D5=0. If not present, check IC's 13, 43.
30. Measure IC46P4, 7, 9, 12 to verify the presence of random data when "T" is high. If not present, check IC's 41, 46.
31. Measure IC24P11 to verify bursts of 64 pulses from +3 to 0, pulses are a square wave of .56μs period, with bursts beginning every 62.5μs. If not present, check IC2.
32. Set D6=0. Verify point "H" is at 0. If not, check IC 61.
33. Measure points A, B, C, and D to verify presence of random data while "T" is high. If not present, check IC's 13, 34, 35, 36, 26, 49, 67, 70, 68, 69.
34. Measure points A, B, C, D to verify similar random data occur in the intervals when T is low. If not present, check for -12V ar IC24P12, and check IC 24, 34.
35. Set D4, D5, and D6=0 on sense switches. Measure IC25P6 to verify +3V. If not present, check IC's 7, 25, 61.
36. Set D4=1 and verify +3 at IC25P11 and 0 at IC25P6. If not, check IC's 7, 25.
37. With D4=0, measure IC15P3, 6, 8, 11 to verify presence of the random memory data. Set D4=1 and verify all IC 15 outputs are approximately +3.
38. With D4=1, measure IC16P6, 8, 12 and IC17P6, 8, 12 to verify presence of the random memory data modulated by the 3.58MHz color subcarrier. If not present, check IC's 16, 17, 25.
39. Measure IC14P6 to verify presence of a composite + sync pulse train containing 15.98KHz and 62Hz pulses. If not present, check IC 14.
40. Using point "W" for scope sync, verify presence of a 3.58MHz burst at IC14P8 occurring just after the horizontal sync pulses on IC14P6. If not present, check IC14.
41. Connect a 50 ohm load to the video output. Set D4=D5=D6=0. Adjust the 500 ohm "DC" pot in the video ampli-

- fiers so the most negative portion of the waveform (sync tips) is at +0.5VDC across the 50 ohm load. The more positive portions of the waveform may reach to +1.5VDC. If not possible, check the resistor values, transistors, and diode.
42. Connect the video output to a color TV direct video input through 50 ohm coax with a termination. An illuminated square consisting of a patchwork of many colors should fill the center of the screen if D4=1, with D4=0 producing a picture in shades of grey. D5 should control whether 32 or 64 squares are in each direction. Setting D6=1 will blank out the screen unless at least one of D0, D1, or D2 are ON.
 43. If only the first line of each square appears correct, check IC's 24, 34.
 44. If all or part of the squares in a line are duplicated from left to right, or lateral jitter appears in the image, check IC44.
 45. If some type of symmetry or duplication occurs in the display of a static RAM whose contents should be random, check IC's 49, 67, 68, 69, 70.
 46. If the memory doesn't read out, check IC's 67, 70.
 47. When measuring any particular signal, keep in mind the fact that a PCB short can cause extraneous added pulses.
 - a. Measure IC57P12 and verify it stays 0V. If not, check IC's 40, 47, 48, 56, and 57. If point "T" is staying at +3V, remove IC 40 and connect IC40P6 to ground. If IC57P12 is still not 0V, check for a 2MHz square wave at IC57P8, 9.
 - b. With IC57P12 at 0V, attempt steps 9, 10, and 11 again. If unsuccessful, check IC's 49, 65, 66, 67, 68, 69, 70, 73. Continue at (9). If IC 40 was left out, replace it between steps 21 and 22, and add a shorting jumper from IC57P12 to ground. Remove the shorting jumper before step 24.
 48. If two IC outputs are accidentally shorted together by the PCB, two important effects occur:
 - a. Since most gates have greater pull down capability than pull-up, the result is the logical OR of the two separate, desired signals.
 - b. At the times when one gate is pulling up and the other is pulling down, the logic signal will be in the range of 0.4 to 1.0V instead of the usual logic 0 range of 0 to 0.4V.
 49. Gate outputs are never exactly 0V or +5V unless there is a direct short.

- LEGEND**
- A. □ = 100 PIN ALTAIR BUS DESIGNATION
 - B. 16 PIN INTERCONNECT
 - 1. REQUEST DATA
 - 2. VERT. ENABLE
 - 3. VIDEO DATA FROM BOARD No. 2
 - 4. VIDEO DATA FROM BOARD No. 2
 - 5. BOARD No. 2
 - 6. BOARD No. 2
 - 7. PORT I6 CLOCK
 - 8. GROUND
 - 9. I28xI28 ENABLE
 - 10. COLOR ENABLE
 - 11. ENABLE DAZZLER
 - 12. 64x64 DAZZLER
 - 13. 1.79 MHz DMA CLOCK
 - 14. HALT CPU
 - 15. VERT. CLOCK
 - 16. BYTE -- NYBBLE DEMUX CONTROL

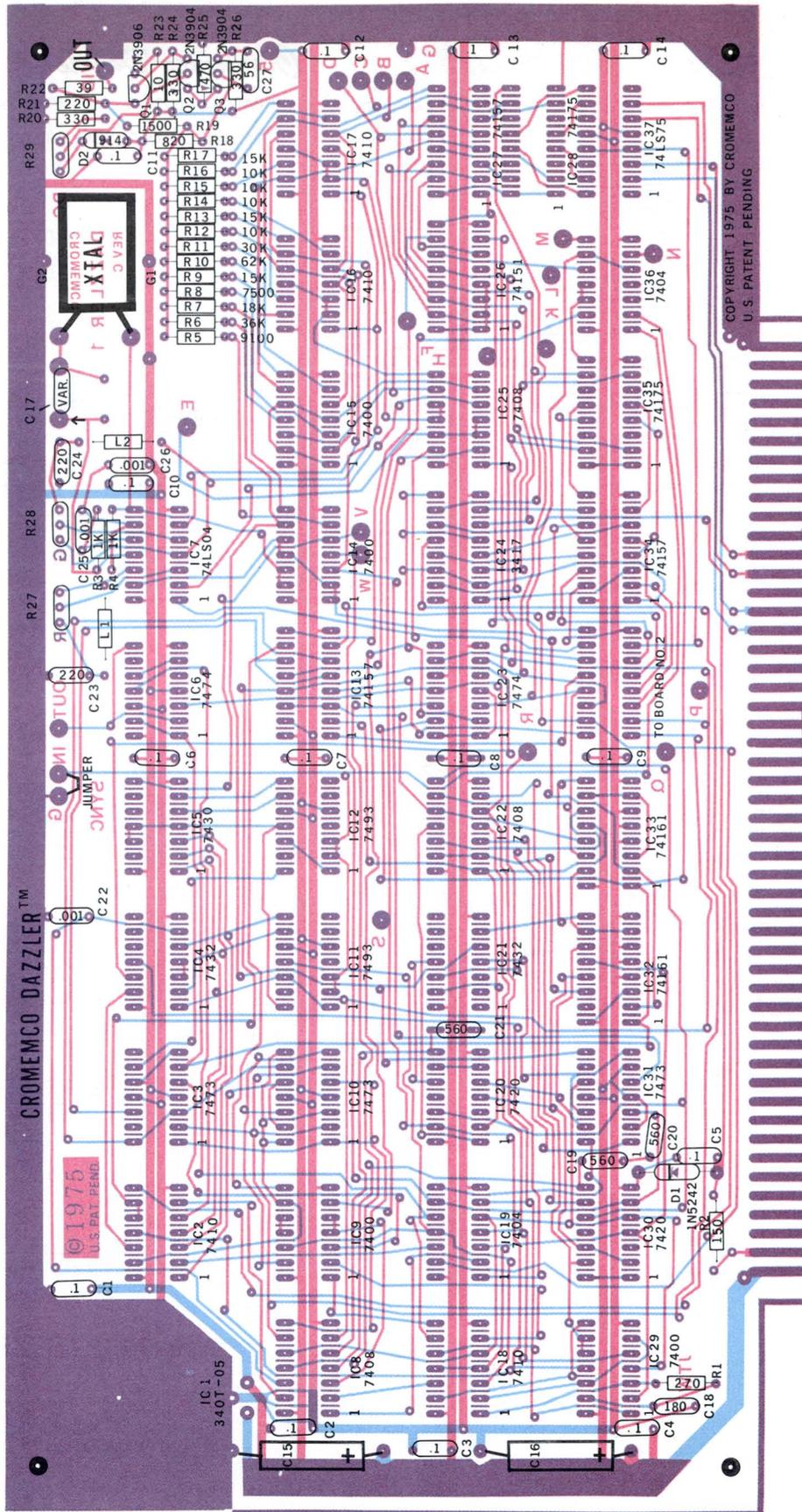


DAZZLER SCHEMATIC
Board No. 1



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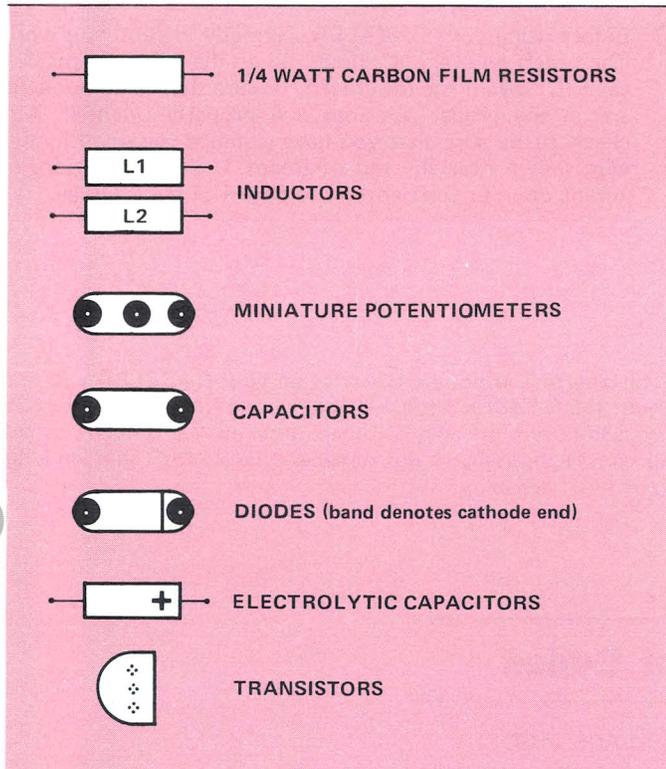
FOIL DIAGRAM
Board No. 1



FOIL DIAGRAM
Board No. 2

The assembly of the DAZZLER™ kit requires about one evening. All components are mounted on the component side of the pc boards and soldered to the foil on the opposite side. Be sure to use high-quality rosin core solder for the assembly and a fine-tipped low wattage soldering iron. IC sockets must be used for all ICs (except for the voltage regulators IC1 and IC38).

To facilitate the assembly of your DAZZLER kit, the part number of every component is printed in position on the component side of each pc board. The following symbols are used on the pc board:



Assembly of DAZZLER Board 1

- Solder in position IC sockets for ICs2 through 37. Solder a 16 pin IC socket in the position labeled "TO BOARD NO. 2".
- With a heatsink mounted between IC1 (LM340T-5.0 voltage regulator) and the pc board, secure this IC in position using 6-32 hardware. Solder the three leads in place.
- Solder in position capacitors C1-C14 (0.1µF disc ceramic capacitors).
- Solder in position filter capacitors C15 and C16 taking care to orient the positive (+) lead of each capacitor towards the bottom of the pc board.
- Solder in position the variable capacitor, C17. Note that the lead on the capacitor marked with an arrow goes in the hole location farthest from the XTAL. If the capacitor does not fit easily into its mounting holes, gently crimp the leads on

the capacitor with a pair of needle-nose pliers before inserting it.

- Solder in position the disc ceramic capacitors C18 (180pF); C19, 20, 21 (560 pF); C22 (.001); C23, 24 (220 pF); C25, 26 (.001); C27 (56 pF).
- Solder in place a small jumper wire, as shown, between the pads labeled "IN" and "G" on the opposite side of the board.
- Solder in place the 1N5242 Zener diode (D1) taking care to position the cathode end of the diode toward the top of the pc board. The cathode end of the diode is marked with a band.
- Solder in position diode D2 (1N914). Take care to orient the diode so that the cathode (banded) end is toward the top of the board.
- Solder in place the inductors L1 and L2. The inductors L1 and L2 are identical.
- Solder in position the ¼ watt 5% carbon film resistors R1-R26.
- Solder in position the three 500-ohm miniature potentiometers R27, R28, and R29. These three potentiometers are identical.
- Solder in position transistor Q1 (2N3906) taking care to position the flat face of the transistor toward the top of the pc board.
- Solder in position transistors Q2 and Q3 (2N3904) taking care to position the flat face of the transistors toward the bottom of the pc board.
- Solder in place the 3579.545 KC crystal (XTAL). The crystal should be mechanically secured in place by running a small piece of bare wire from the pad just under the crystal, over the top of the crystal to the pad just above the crystal. The wire should be pulled tight and soldered at each pad.
- Insert the ICs from envelope No. 1 into their sockets on Board 1. *Take special care to see that every IC is properly oriented in its socket and that each pin of every IC is properly engaged in the socket.*

Assembly of DAZZLER Board 2

- Solder in position IC sockets for ICs 39 through 74. Solder a 16 pin IC socket in the position labeled "TO BOARD NO. 1". **Do not** solder IC socket in the position labeled "NO IC".
- With a heatsink mounted between IC38 (LM340T-5.0 voltage regulator) and the pc board, secure this IC in position using 6-32 hardware. Solder the three leads in place.
- Solder in position capacitors C28-C39 (0.1 µF disc ceramics).

- Solder in position the filter capacitors C40 and C41 taking care to orient the positive (+) lead of each capacitor toward the bottom of the pc board.
- Solder in position R30, a 1K ¼-watt 5% carbon film resistor.
- Solder in position the seven port selection jumper wires. The jumper wires should connect pad J1 to J1; J2 to J2; J3 to J3, etc.
- Insert the ICs from envelope No. 2 into their sockets on Board 2. *Take special care to see that every IC is properly oriented in its socket and that each pin of every IC is properly engaged in the socket.*

Interboard connection

- A 16-conductor cable, with plugs on each end, is provided to connect Board 1 to Board 2. The cable should be plugged into the socket labeled "TO BOARD NO. 2" on the front of Board 1, be routed over the top of Board 1 down the front of Board 2 and into the socket on Board 2 labeled "TO BOARD NO. 1".

T.V. connection

- A length of RG174/U cable is provided to connect the Dazzler to your TV. The center conductor of the cable should be soldered to the terminal labeled "OUT" on

Board 1 (see Note below). The shield of the cable should be soldered to the adjacent foil ground. The other end of this cable can be coupled to the input of the video amplifier of a TV. If you prefer to connect to the antenna terminals of the set rather than to the video amplifier input, a RF modulator is required. The most cost-effective modulator that we know of is the Pixieverter available for \$8.50 from ATV Research, 13th and Broadway, Dakota City, Nebraska 68731.

NOTE: The TV "OUT" pad is located in the upper right corner of Board 1. Do not confuse this with the SYNC output near the center of the board.

- Before using your DAZZLER, carefully inspect your work. The notch on every IC should be on the left (with pin 1 of each IC toward the lower left). Be sure that all components are in the proper positions and properly oriented. Also check to be sure that you have installed the small jumper wire shown near the top of Board 1. For instructions on tuning up your Dazzler refer to page 4 of this manual.

Service

If for any reason you need service on your DAZZLER you may return the DAZZLER to Cromemco along with a check for \$35. The \$35 covers the cost of repair, tune-up, and return postage. We reserve the right to not repair any DAZZLER that we judge to be unserviceable.

Resistor Color Codes

10	BROWN – BLACK – BLACK – GOLD
39	ORANGE – WHITE – BLACK – GOLD
150	BROWN – GREEN – BROWN – GOLD
220	RED – RED – BROWN – GOLD
270	RED – VIOLET – BROWN – GOLD
330	ORANGE – ORANGE – BROWN – GOLD
470	YELLOW – VIOLET – BROWN – GOLD
820	GREY – RED – BROWN – GOLD
1K	BROWN – BLACK – RED – GOLD
1.5K	BROWN – GREEN – RED – GOLD
7.5K	VIOLET – GREEN – RED – GOLD
9.1K	WHITE – BROWN – RED – GOLD
10K	BROWN – BLACK – ORANGE – GOLD
15K	BROWN – GREEN – ORANGE – GOLD
18K	BROWN – GREY – ORANGE – GOLD
30K	ORANGE – BROWN – ORANGE – GOLD
36K	ORANGE – BLUE – ORANGE – GOLD
62K	BLUE – RED – ORANGE – GOLD

DAZZLER Kit-Packing List

**Envelope No. 1
ICs Board 1**

- 1 3417
- 1 LM340T-5.0
- 4 7400
- 2 7404
- 1 74LS04
- 3 7408
- 4 7410
- 2 7420
- 1 7430
- 2 7432
- 3 7473
- 2 7474
- 1 74LS75
- 2 7493
- 1 74151
- 3 74157
- 2 74161
- 2 74175

**Envelope No. 2
ICs Board 2**

- 1 LM340T-5.0
- 1 7402
- 2 7404
- 5 74LS04
- 3 7405
- 2 7408
- 1 74LS08
- 1 74LS10
- 1 74LS30
- 1 74LS32
- 3 7474
- 3 7475
- 2 7483
- 3 7493
- 1 7495
- 1 74157
- 2 74175
- 4 74367

**Envelope No. 3
Capacitors**

- 1 56 pF
- 1 180 pF
- 1 Variable
- 2 220 pF
- 3 560 pF
- 3.001 μ F
- 26 0.1 μ F
- 4 10 μ F

**Envelope No. 4
Resistors**

- 1 10 ohms
- 1 39
- 1 150
- 1 220
- 1 270
- 3 330
- 1 470
- 3 500 (pot)
- 1 820
- 3 1K
- 1 1.5K
- 1 7.5K
- 1 9.1K
- 4 10K
- 3 15K
- 1 18K
- 1 30K
- 1 36K
- 1 62K

**Envelope No. 5
Misc.**

- 2 Heatsinks
- 2 No. 6 screws
- 2 No. 6 nuts
- 1 2N3906
- 2 2N3904
- 1 1N914
- 1 1N5242
- 1 Crystal

**Envelope No. 6
Inductors**

- 2 22 μ H (L1, L2)

Other

- 1 16 conductor interconnect cable
- 1 6' length of RG174/U coax cable
- 1 DAZZLER Instruction Manual
- 25 16 pin IC Sockets (24 reqd)
- 50 14 pin IC Sockets (50 reqd)

WARRANTY

Your factory-built Dazzler is warranted against defects in materials and workmanship for a period of 90 days from the date of delivery. We will repair or replace products that prove to be defective during the warranty period provided that they are returned to Cromemco. No other warranty is expressed or implied. We are not liable for consequential damages.

Should your factory-built Dazzler fail after the warranty period it will be repaired, provided that it is returned to Cromemco, for a fixed service fee. We reserve the right to refuse to repair any product that in our opinion has been subject to abnormal electrical or mechanical abuse. The service fee is currently \$35 and is subject to change.

Your assembled Dazzler kit will be repaired, provided that it is returned to Cromemco, for a fixed service fee. We reserve the right to refuse repair of any kit that in our opinion has not been assembled in a workmanlike manner or has been subject to abnormal electrical or mechanical abuse. Payment of the service fee must accompany the returned merchandise. The service fee is currently \$35 and is subject to change.