

# SECTION 20

## VIDEO CONTROL MODULE

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## SECTION 20

### VIDEO CONTROL MODULE

#### 20.1 TECHNICAL DESCRIPTION

##### 20.1.1 General Description

The Video Control module performs two primary functions. It amplifies video input signals by multiplying them by the gain signal from the Waveform module. It provides crosshatch and text generation.

Outputs of the Video Control module are fed to the Video Output module.

##### 20.1.2 Circuit Description

###### 20.1.2.1 Clamp Pulse Generator

The 5V HFB signal, generated by IC39, provides the clamp pulse. Q23 amplifies and inverts the HFB signal. C125 and R211 differentiate the collector pulse of Q23; this generates a negative-going spike coincident with the leading edge of the HFB signal. The spike signal feeds the trigger input of monostable multivibrator IC12. When triggered, the output of IC12 goes high for about 2  $\mu$ S. The pulse is distributed on the module. It is also sent to the video output modules via PA1<7.

###### 20.1.2.2 Clamping

In the video control module, the clamp pulse is AC-coupled to the gates of Q8, Q9, Q10, Q17, Q18 and Q19. During scan, the gate-to-source voltage of each FET is about -10V; the drain-to-source channel is open. AC-coupled video is allowed to pass unimpeded. During the clamp pulse the gate-to-source voltage goes positive, causing the drain-to-source channel to turn ON. Video AC-coupled capacitors charge or discharge accordingly to establish the proper black level bias point.

###### 20.1.2.3 Video Switch

IC11 is the video switch. It contains a 3 pole, double throw switch. Video signal levels at IC11's input are about 300 mV p-p. The ENABLE signal (TTL) controls the switch. The -12V supply and shunt regulator IC10 provide the -5V used to operate IC11.

###### 20.1.2.4 Multipliers

The 3 multipliers permit independent gain control of the red, green and blue video signals. Gain signals provided by the waveform module vary from 0 to 5V. Each

multiplier reduces the gain range to 0 to 2V at pin 4. A differential output current is provided between pins 2 and 14. The output current develops a signal across the resistor pairs connected to the filtered and regulated 10V supply (R135 & R136, R134 & R140 and R141 & R142). The small signal generated has to be amplified. Red, green and blue null (R113, R114 & R115) are set to zero contrast for an even raster.

###### 20.1.2.5 High Gain Video Amplifier

Wide band video amplifier, NE592, raises the signal generated across resistor pairs R135 & R136, R134 & R140 and R141 & R142 to 1V p-p. The input to NE592 is biased midway between ground and the 10V supply. The output of NE592 is internally biased.

###### 20.1.2.6 75 $\Omega$ Buffer

The output of NE592 is AC-coupled to a two transistor, emitter-follower output stage. This buffer has a gain of 1.5 when terminated with a 75  $\Omega$  load. The input to the buffer is clamped to prevent the video duty cycle from adversely affecting its bandwidth.

###### 20.1.2.7 Digital Section

The Video Control module generates all internal video. It also switches external and internal video.

The Video Control module contains two internal video generators, a test pattern generator and a character generator. The test pattern generator provides dot and crosshatch capabilities. These are used during projector set-up. The character generator is used to produce menus and bar charts.

###### Test Pattern Generator

The test pattern generator circuitry produces horizontal and vertical lines with a dot pattern superimposed.

Vertical line counter, IC32, divides the number of vertical field scan lines by 32. The resulting value is stored in IC34. It is used to load IC23 and IC33 (interval counter). The interval counter uses this value to count down the horizontal crosshatch lines generated by IC29. IC31 (a 74LS593 counter) divides HPLLCLK by 16. Its output is used by IC29 to generate the vertical lines of the crosshatch.

Character Generator

The character generator creates a 32 by 32 character display. The character set, stored in IC26 (a 1K x 8 bit ROM), contains 128 characters. The characters are based on the standard ASCII set. Characters are defined as 5 by 7 bit patterns in 8 by 8 matrices.

The projector display is memory mapped into a 1K address space in IC30 (video RAM). Text can be shown anywhere on the projector display. The generator can also switch external and internal video for any or all memory-mapped locations.

The microprocessor addresses the video RAM through buffers IC38 and IC39. The buffers isolate the external address (A(0) to A(9)) from the character generator address (B(0) to B(9)). IC31 generates the horizontal character count address, B(0) to B(4). IC32 divides the number of scan lines in a vertical frame by 256. The result is the vertical character count address, B(5) to B(9), in IC25.

The value is stored in IC28 and used to load IC22 (line width counter). Line insertion between character rows is performed by IC27 (a programmable logic device) to keep the display uniform. This operation is performed when the number of scan lines is not an integer multiple of 256.

IC30 receives cycling horizontal and vertical count addresses. It outputs the ASCII character code corresponding to the address. This code is latched by IC28. The latched code is the look-up address for IC26 (character PROM). Addresses C(0) to C(2) are the character row count. They select the row in the character's bit pattern. The row of the character's bit pattern is output from PROM storage to IC24 (parallel-in, serial-out shift register), and shifted out by HPLLCLK\*.

Video Selection

The test pattern generator and character generator are microprocessor selectable. Select functions are processed by writing data to the external data address (IOSEL2). See Table 20-1.

**TABLE 20-1. Video Selection**

DATA BIT			ACTION
D0	D1	D2	
—	0	0	test pattern/character generator disabled
—	0	1	character generator enabled
0	1	0	dot pattern enabled
0	1	1	dot pattern & char. generator enabled
—	0	0	test pattern/character generator disabled
—	0	1	character generator enabled
1	1	0	crosshatch enabled
1	1	1	crosshatch & char. generator enabled

**20.2 SERVICING AND ALIGNMENT****20.2.1 Disassembly and Access****WARNING**

**STATIC SENSITIVE COMPONENTS  
STATIC CONTROLLED WORK STATION REQUIRED**

**Module Location:**

- rear panel card rack

**Tools & Equipment Required:**

- Phillips screw driver

a) Remove the back panel as described in Section 5.2.

b) Locate the Video Output module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack as described in Section 5.2.

**20.2.2 Alignment and Adjustments**

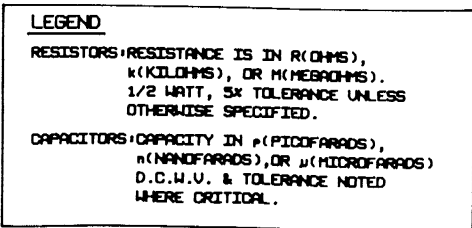
Refer to Section 7, *Alignment Procedures*, for Video Amplifier Alignment and Color Balance Set-up.

**20.3 COMPONENT LAYOUT AND SCHEMATICS**

Refer to the following pages for component layouts and schematics of the Video Control Module.

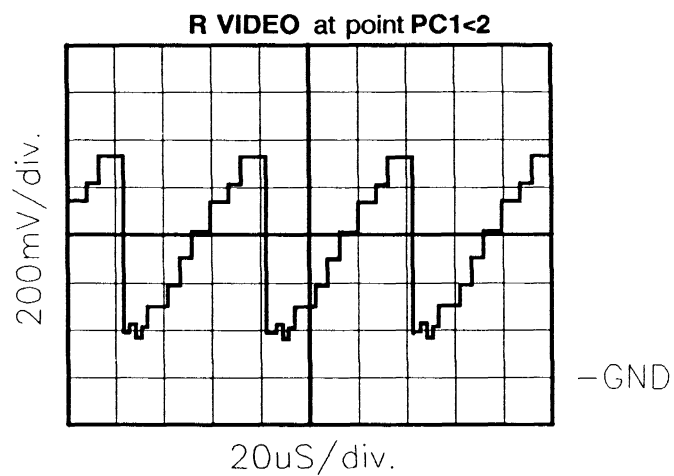
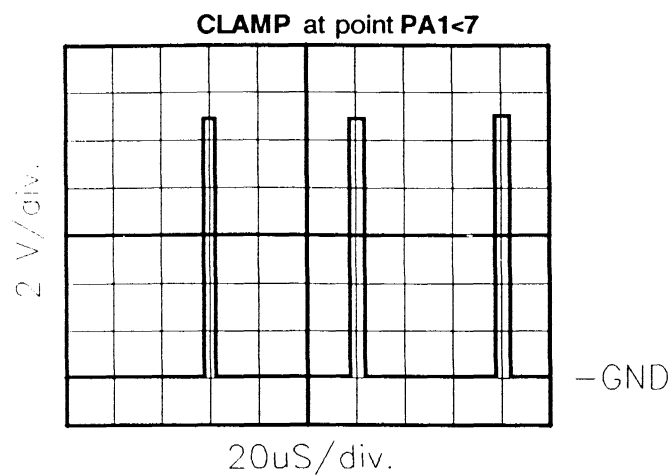
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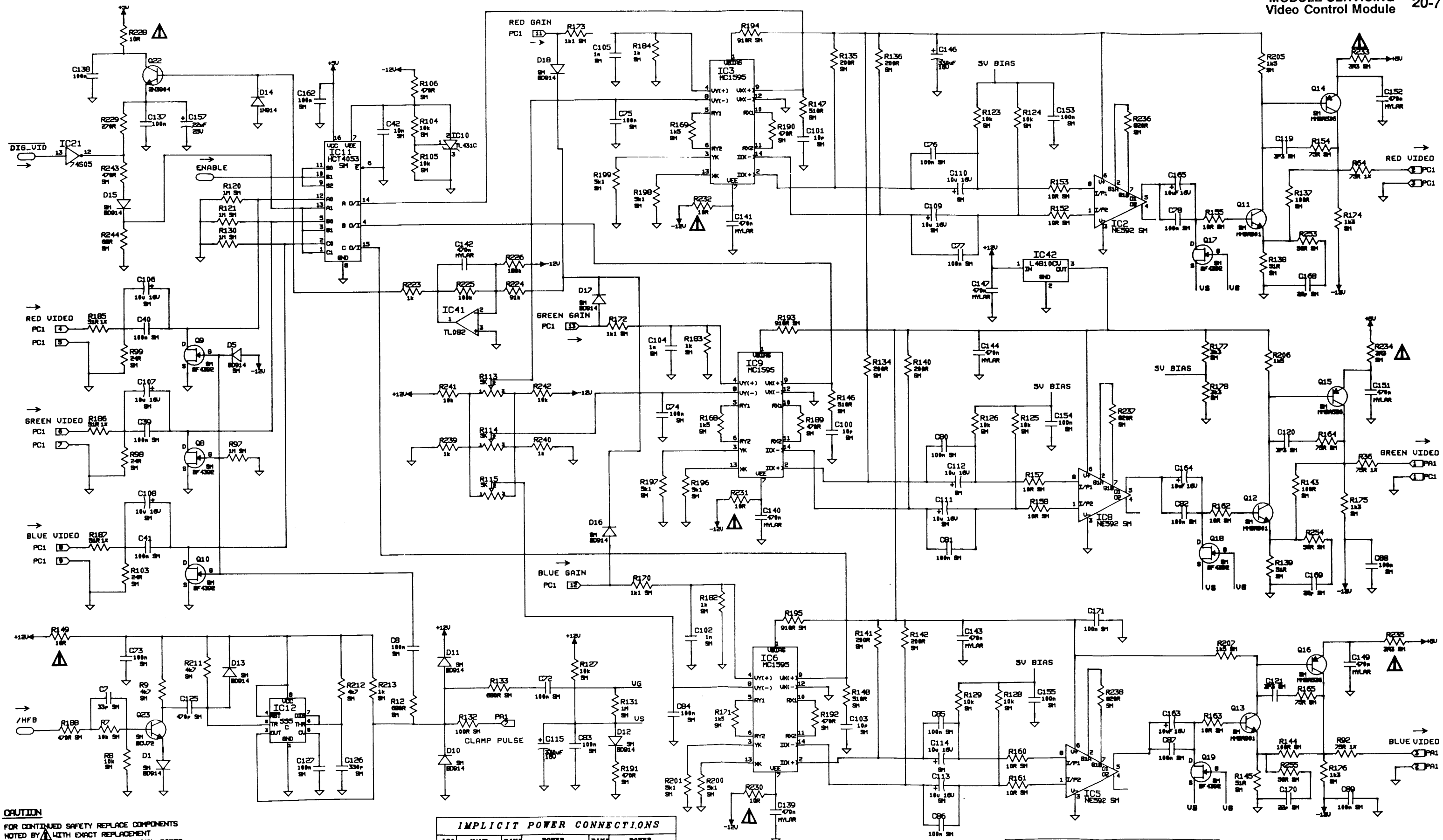




00-270011-03P

SCHEMATIC REFERENCE





**CAUTION**  
FOR CONTINUED SAFETY REPLACE COMPONENTS  
NOTED BY WITH EXACT REPLACEMENT  
PARTS ONLY. CONSULT SERVICE MANUAL PARTS  
LIST SECTION "SAFETY COMPONENTS".

IMPLICIT POWER CONNECTIONS					
IC#	NAME	PIN#	POWER	PIN#	POWER
21	74S05	7	CIRCUIT GND	14	+5V(A)
35	74HC14	7	GND	14	UCC
41	TL082	4	-11.5V	8	+12V

**LEGEND**  
RESISTORS: RESISTANCE IS IN (OHMS),  
K(KILOHMS), OR M(MEGAHMS).  
1/2 WATT, 5% TOLERANCE UNLESS  
OTHERWISE SPECIFIED.  
CAPACITORS: CAPACITY IN P(PICOFARADS),  
n(NANOFARADS), OR μ(MICROFARADS)  
D.C.W.V. & TOLERANCE NOTED  
WHERE CRITICAL.

FIGURE 20-3. Video Control Module Schematic (2 of 2)  
00-270011-03P



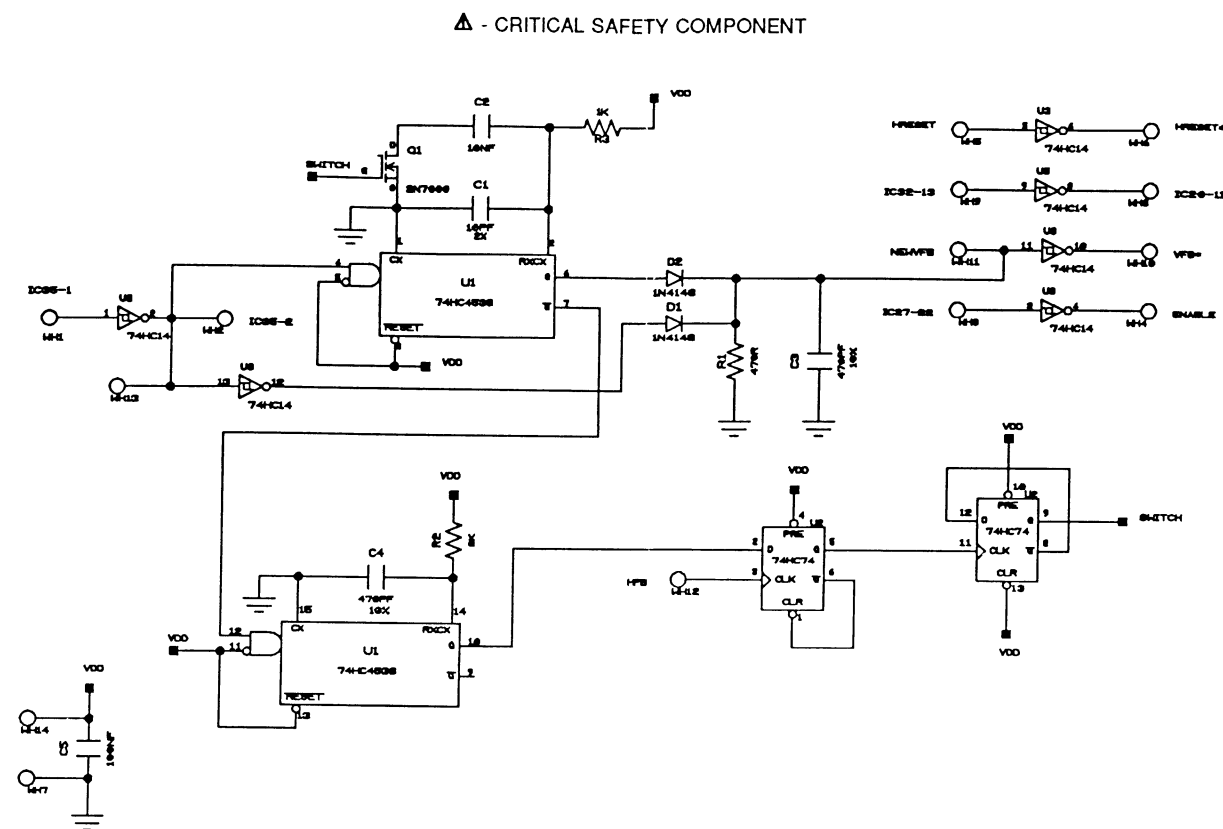
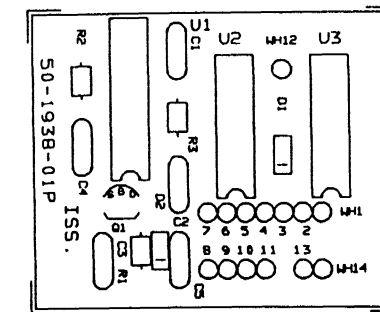
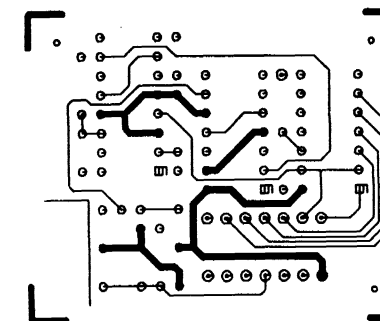


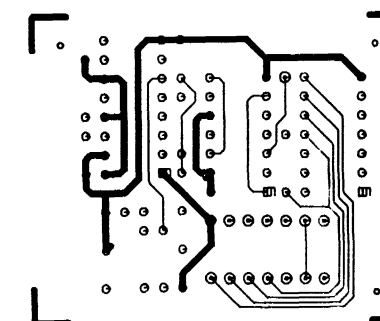
FIGURE 20-5. *Hysteresis PCB Schematic*  
00-250011-03P



Component Layout



Solder Side  
(Viewed from Component Side)



Component Side

FIGURE 20-4. *Hysteresis PCB Component Layout*

(REPLACE WITH IDENTICAL PART)

## 20.4.1 Video Control PCB

Item Ref.	Part No.	Description
<b>Integrated Circuits</b>		
IC2,IC5,IC8	IC-72-002002-02P	NE592D8, differential video amplifier
IC3,IC6,IC9	IC-14-002095-01P	MC1595L, linear arithmetic 4-quad multiplexer
IC10	IC-14-002833-01P	TL431C, precision shunt regulator
IC11	IC-72-A04001-01P	74HC4053, high speed logic
IC12	IC-14-A04069-01P	TLC555C, CMOS digital timer
IC20,IC34	IC-14-A04067-01P	74HC590, 8 bit binary counter
IC21	IC-14-004696-01P	74S05, hex inverter
IC22,IC23,IC33	IC-14-A04066-01P	74HC191, 4 bit sync up/down counter
IC24	IC-14-A04043-02P	74AHCT165, 8 bit shift register
IC25,IC31	IC-14-004689-01P	74LS593, 8 bit counter
IC26	IC-14-P01126-01P	CY7C281, 1024X8, PROM, programmed, V3.1
IC27	IC-14-P01127-02P	20L8A, PAL, digital TTL, prog, video control
IC28	IC-14-A04011-01P	74HC374, octal flip flop
IC29	IC-14-P01129-02P	PALCE16V8, prog
IC30	IC-14-A05037-02P	CY7C128 2Kx8 CMOS static ram
IC32	IC-14-A04040-01P	MM74HC4040, CMOS ripple counter
IC36	IC-14-A04047-01P	74HC174, hex D flip flops
IC37,IC38	IC-14-A04042-01P	74HC245, octal bus transceiver
IC39	IC-14-A04078-01P	74HC125, digital quad bus buffer
IC41	IC-14-002813-09P	TL082BC, linear op amp
IC42	IC-14-002845-01P	L4810CV, regulator, 10V
<b>Transistors and Diodes</b>		
Q8-Q10,Q17-Q19	TR-72-000701-01P	MMBF4392, N channel FET, surface mount
Q11-Q13	TR-72-000561-02P	MMBR901, RF NPN transistor, surface mount
Q14-Q16	TR-72-000561-01P	MMBR536, RF PNP transistor, surface mount
Q22	TR-14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q23	TR-72-000561-04P	BCV72, surface mount
D1,D5,D10-D13,D15-D18	D-72-000513-01P	MMBD914, switching diode, surface mount
D14	D-14-000513-01P	1N914, diode, 0.075A, 75V
<b>Capacitors</b>		
C7	C-66-433031-05P	33pF, 50V, 2% NPO, surface mount
C8,C39-C41,C72-C78, C80-C89,C127,C153- C155,C162,C171	C-66-310411-05P	100 nF, 50V, 10%, X7R, surface mount
C42	C-66-310311-05P	10nF, 50V, 10%, surface mount
C45,C47-C54,C56-C61, C64,C65,C67,C68,C137, C138,C156	C-89-000032-03P	100 nF, 50V, 20%, ceramic, multi layer
C70,C133,C163-C165	C-84-410004-01P	10 $\mu$ F, 25V, electrolytic
C100,C101,C103	C-66-410041-05P	10 pF, 50V, 5%, NPO, surface mount
C102,C104,C105	C-66-410231-05P	1 nF, 50V, 2%, NPO, surface mount
C106-C114	C-64-210134-11P	10 $\mu$ F, 16V, tantalum, surface mount
C115,C146	C-44-433103-05P	330 $\mu$ F, 16V, electrolytic
C119-C121	C-66-433801-05P	3.3 pF, 50V, surface mount

**20.4 PARTS LIST (cont.)**

**▲ - CRITICAL SAFETY COMPONENT**  
**(REPLACE WITH IDENTICAL PART)**

**20.4.1 Video Control PCB (cont.)**

<b>Item Ref.</b>	<b>Part No.</b>	<b>Description</b>
<b>Capacitors (cont.)</b>		
C125	C-66-447141-05P	470 pF, 50V, NPO, surface mount
C126	C-66-433141-05P	330 pF, 50V, 5%, NPO, surface mount
C139-C141,C143,C144, C147,C149,C151,C152	C-88-174740-12P	470 nF, 63V, 10%, mylar
C142	C-88-171031-02P	10 nF, 100V, 10%, mylar
C157	C-84-410506-01P	1 $\mu$ F, 50V, electrolytic
C166	C-86-622151-02P	220 pF, 100V, 10%, ceramic
C167	C-86-610252-02P	1 nF, 100V, ceramic
C168-C170	C-66-422041-05P	22 pF, 50V, 5%, NPO, surface mount
<b>Resistors</b>		
R7,R8,R104,R105, R123-R129	R-70-710023-21P	10K, 1/4W, 5%, surface mount
R9,R211,R212	R-70-747013-21P	4.7K, 1/4W, 5%, surface mount
R12,R133	R-70-768003-21P	680R, 1/4W, 5%, surface mount
R36,R64,R92	R-82-375091-29P	75R, 1/3W, 1%, metal film
R97,R120,R121,R130, R131	R-70-710043-21P	1M, 1/4W, 5%, surface mount
R98,R99,R103	R-70-724093-21P	24R, 1/4W, 5%, surface mount
R106,R188-R192,R243	R-70-747003-21P	470R, 1/4W, 5%, surface mount
R113-R115	VR-41-000345-05P	5K trimpot, 20 turn
R132,R137,R143,R144	R-70-710003-21P	100R, 1/4W, 5%, surface mount
R134-R136,R140-R142	R-70-720003-21P	200R, 1/4W, 5%, surface mount
R138,R139,R145	R-70-751093-21P	51R, 1/4W, 5%, surface mount
R146-R148	R-70-751003-21P	510R, 1/4W, 5%, surface mount
▲ R149,R152,R153,R155, R157,R158,R160-R163	R-70-710093-21P	10R, 1/4W, 5%, surface mount
R154,R164,R165	R-70-775093-21P	75R, 1/4W, 5%, surface mount
R168,R169,R171,R205- R207	R-70-715013-21P	1.5K, 1/4W, 5%, surface mount
R170,R172,R173	R-70-711013-21P	1.1K, 1/4W, 5%, surface mount
R174-R176	R-70-713013-21P	1.3K, 1/4W, 5%, surface mount
R177,R178	R-70-733013-21P	3.3K 1/4W, 5%, surface mount
R182-R184,R213	R-70-710013-21P	1K, 1/4W, 5%, surface mount
R185-R187	R-82-351191-29P	51.1R, 1/3W, 1%
R193-R195	R-70-791003-21P	910R, 1/4W, 5%, surface mount
R196-R201	R-70-751013-21P	5.1K, 1/4W, 5%, surface mount
R219	R-80-122015-11P	2.2K, 1/2W, 5%, metal film
R220	R-80-115015-11P	1.5K, 1/2W, 5%, metal film
▲ R221,R222,R228,R230- R232	R-80-110095-11P	10R, 1/2W, 5%, metal film
R223,R239,R240	R-80-110015-11P	1K, 1/2W, 5%, metal film
R224	R-80-191025-11P	91K, 1/2W, 5%, metal film
R225	R-80-110035-11P	100K, 1/2W, 5%, metal film
R226	R-80-118035-11P	180K, 1/2W, 5%, metal film
R229,R251	R-80-127005-11P	270R, 1/2W, 5%, metal film
▲ R233-R235	R-70-733083-21P	3.3R, 1/4W, 5%, surface mount
R236-R238	R-70-782003-21P	820R, 1/4W, 5%, surface mount

## 20.4 PARTS LIST (cont.)

▲ - CRITICAL SAFETY COMPONENT  
(REPLACE WITH IDENTICAL PART)

## 20.4.1 Video Control PCB (cont.)

Item Ref.	Part No.	Description
<b>Resistors (cont.)</b>		
R241,R242	R-80-110025-11P	10K, 1/2W, 5%, metal film
R244	R-70-768093-21P	68R, 1/4W, 5%, surface mount
R252	R-80-110005-11P	100R, 1/2W, 5%, metal film
R253-R255	R-70-756093-21P	56R, 1/4W, 5%, surface mount
RN1	R-43-000053-04P	1K resistor network

## 20.4.2 Hysteresis PCB

**Note: The Hysteresis PCB mounts in the IC35 socket on the Video Control PCB.**

Item Ref.	Part No.	Description
<b>Integrated Circuits</b>		
U1	IC-14-A04041-01P	MM14538B, CMOS, precision dual monostable
U2	IC-14-A04007-01P	74HC74, H-CMOS dual flip-flop
U3	IC-14-A04073-01P	74HC14, hex schmitt trigger inverter
<b>Transistors and Diodes</b>		
Q1	TR-14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
D1,D2	D-14-000513-01P	1N914, diode, 0.075A, 75V
<b>Capacitors</b>		
C1	C-86-610031-04P	10 pF, ceramic
C2	C-89-000032-04P	10 nF, 50V, 20%, ceramic, multi layer
C3,C4	C-86-647135-11P	470pF, 100V, 2%, ceramic
C5	C-89-000032-03P	100 nF, 50V, 20%, ceramic, multi layer
<b>Resistors</b>		
R1	R-80-147005-11P	470R, 1/2W, 5%, metal film
R2	R-80-120015-11P	2K, 1/2W, 5%, metal film
R3	R-80-110015-11P	1K, 1/2W, 5%, metal film

## 20.5 SPECIFICATIONS

### Connector P1, Row A:

Pin 1 ..... analog output **G VIDEO**  
amplitude into 75Ω ..... 1V p-p ±10%  
frequency response ..... 100 MHz - 3 dB

Pin 2 ..... ground **GND**

Pin 3 ..... analog output **B VIDEO**  
amplitude into 75Ω ..... 1V p-p ±10%  
frequency response ..... 100 MHz - 3 dB

Pin 4 ..... ground **GND**

Pin 7 ..... analog input **CLAMP**  
back porch clamping pulse ..... 10 to 12V peak  
pulse width ..... 1.8 to 2.1 μS  
delay from rising edge HFB ..... 200 ns min.

Pin 9 ..... digital input, address line **A(0)**  
Pin 10 ..... digital input, address line **A(1)**  
Pin 11 ..... digital input, address line **A(2)**  
Pin 12 ..... digital input, address line **A(3)**  
Pin 13 ..... digital input, address line **A(4)**  
Pin 14 ..... digital input, address line **A(5)**  
Pin 15 ..... digital input, address line **A(6)**  
Pin 16 ..... digital input, address line **A(7)**  
Pin 17 ..... digital input, address line **A(8)**  
Pin 18 ..... digital input, address line **A(9)**

Pin 19 ..... digital in/output, data line **D(0)**  
Pin 20 ..... digital in/output, data line **D(1)**  
Pin 21 ..... digital in/output, data line **D(2)**  
Pin 22 ..... digital in/output, data line **D(3)**  
Pin 23 ..... digital in/output, data line **D(4)**  
Pin 24 ..... digital in/output, data line **D(5)**  
Pin 25 ..... digital in/output, data line **D(6)**  
Pin 26 ..... digital in/output, data line **D(7)**

Pin 27 ..... -12V power supply **-12 VDC**  
current ..... 90mA max.

Pin 28 ..... +12V power supply **+12 VDC**  
current ..... 140mA max.

Pin 29 ..... +5V power supply **+5 VDC**  
current ..... 600mA max.

Pin 30 ..... connected to pin 29 **+5 VDC**

Pin 31 ..... ground **GND**

Pin 32 ..... connected to pin 31 **GND**

### Connector P1, Row C:

Pin 1 ..... ground **GND**

Pin 2 ..... analog output **R VIDEO**  
amplitude into 75Ω ..... 1V p-p min.  
frequency response ..... 100 Mhz - 3 Db

Pin 3 ..... ground **GND**

Pin 4 ..... analog input **RED VID**  
amplitude ..... 0.5 to 2V p-p  
frequency response ..... 100 Mhz - 3 Db

Pin 5 ..... ground **GND**

Pin 6 ..... analog input **GRN VID**  
amplitude ..... 1 V p-p typ.

Pin 7 ..... ground **GND**

Pin 8 ..... analog input **BLU VID**  
amplitude ..... 1V p-p

Pin 10 ..... digital input **VFB**  
signal level ..... 0 to 12V

Pin 11 ..... analog input **R GAIN**  
contrast control voltage ..... 0 to 4.2V

Pin 12 ..... analog input **B GAIN**  
contrast control voltage ..... 0 to 4.2V

Pin 13 ..... analog input **G GAIN**  
contrast control voltage ..... 0 to 4.2V

Pin 17 ..... digital input **SEL1**  
input/output select 1 ..... TTL

Pin 21 ..... digital input **HFB**  
horizontal flyback pulse ..... 0 to 12V

Pin 22 ..... digital input **RD**  
read signal ..... TTL

Pin 23 ..... digital input **SEL2**  
input/output select 2 ..... TTL

Pin 24 ..... digital input **WR**  
write signal ..... TTL

Pin 25 ..... digital input **HPLLCLK**  
horizontal phase lock loop ..... 0 to 5V

Pin 26 ..... digital input **HRESET**  
horizontal reset pulse ..... 0 to 5V