

# SECTION 21

## VIDEO OUTPUT

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## SECTION 21

### VIDEO OUTPUT MODULE

#### 21.1 TECHNICAL DESCRIPTION

##### 21.1.1 General Description

The Video Output module amplifies the video signals for output to the cathode of each CRT. There is one Video Output module per CRT; each feeding the G1, G2 and heater voltages. The module consists of a push-pull output stage, driven by a driver stage and a pre-driver stage. The module also permits DC black level biasing of each CRT. The DC operating point is maintained by a keyed sync tip clamp circuit.

##### 21.1.2 Circuit Description

###### 21.1.2.1 Sync Tip Clamp Circuit

The sync tip clamp circuit is built around FET Q1. Resistors R4, R5, R6, R7, R8, R52 and TC3 set the source voltage of the FET. Specifically, trimpot R5 is adjusted to produce a source voltage between 1.3V and 1.6V at 25 °C.

The CLAMP input is fed by 10V peak amplitude, 1.8  $\mu$ s duration, clamp pulses, originating from the Video Control module. These clamp pulses cause capacitor C1 to charge to 8.5V, and gate voltage of Q1 to increase 0.6V above Q1 source voltage. Q1 turns ON and drain-to-source resistance drops to 2 ohms. This resistance drop allows input capacitor C4 to charge to a value between 1.1V and 1.4V.

During active line time, the zero volts on the CLAMP input keeps D2 reverse biased and gate voltage of Q1 at -8.5V. The FET is OFF and the dc voltage across C4 remains constant.

Other components in the clamp circuit function as follows:

- D1 protects the circuit against excessive input voltages,
- R2 provides a discharge path for C1,
- D4 and TC3 provide temperature compensation, and
- R3 compensates the video tilt.

###### 21.1.2.2 Input Amplifier

Input amplifier, Q1 and Q2, is a non-inverting, low output impedance stage. Q2 is a constant current source, Q3 is a varying current source. Q2 base voltage determines the current through R12 and R13, and the output voltage at the collector of Q3.

Zener diode ZD1 with R14, C5 and C7, set Q3's emitter voltage to 6V and base voltage to 5.4V. This sets the collector current of Q2 to a constant value.

The base voltage of Q2 is between 1.0V and 1.4V, its emitter voltage is between 0.5V and 0.8V. The current through R13 is between 5.0mA and 9.0mA. 1mA of this current is supplied by Q2. The output voltage at the collector of Q3, established by the voltage drop across R12, is between 0.8V and 1.3V.

Diode D14 protects the base-emitter junction of Q3. Series RC, R11 and C6, across the base and collector of Q3, prevents high frequency oscillations.

###### 21.1.2.3 Driver Amplifier

The driver stage consists of common emitter amplifier Q4, driving common base high voltage amplifier Q5. The base of Q5 is biased at 6V via ZD2. Its emitter voltage is 5.4V and the current through R18 is 16mA.

The base voltage of Q4 is between 0.8V and 1.3V. Its emitter voltage is between 0.2V and 0.6V. The emitter current through Q4 is between 17mA and 50mA. 16mA are supplied through R18. Up to 30.2mA are supplied by Q5. The voltage at the collector of Q5 is between 150V and 100V.

###### 21.1.2.4 Output Amplifier

The output amplifier is a push-pull stage. It consists of Q6 and Q7.

The stage is dc biased, just OFF, by diode D7. The load is the cathode of the CRT connected through beam current sensors, IC1 and IC2. Trimpot R5 sets the dc voltage on the cathode to 140V when BRIGHTNESS is set to 5 on the function bar graph.

###### 21.1.2.5 Response to Video Input

A video input increase to 0.8V causes the emitter voltage of Q2 to increase to 1.4V. This increases the current in Q5 to 130mA and decreases the voltage at the cathode to 20V.

A video input increase to 1.0V causes the driver stage to just enter saturation. This reduces the cathode voltage to a minimum.

The total voltage gain of all stages is 140.

### 21.1.2.6 Beam Current Sensors

IC1 and IC2 monitor CRT beam current. They provide outputs I1 and I2 respectively. These outputs are the voltage equivalent of beam current and are used as inputs to the beam current limiter.

## WARNING

DO NOT repair the beam current circuitry. X-ray radiation may be emitted when excessive high voltage exists.

## 21.2 SERVICING AND ALIGNMENT

### 21.2.1 Disassembly and Access

#### Module Location:

- ▶ projection head

#### Tools & Equipment Required:

- ▶ Phillips screw driver
- ▶ 1/4" hex head socket

a) Remove the top cover as instructed in Section 5.2.

b) If the Video Output module for the green (center) CRT is to be removed, remove the keypad assembly from the projection head as instructed in Section 5.2.

NOTE: disconnection of the keypad cable from the Mother Board is not required.

c) Locate the Video Output module to be removed. Gently pull the Video Output module away from the CRT. Note: the Video Output module is secured to the CRT by a small amount of hot melt glue. The joint between the glue and the CRT should break from the CRT without difficulty.

d) Disconnect the following connectors and leads from the Video Output module:

- ▶ focus lead (to Bias module)
- ▶ P3 (ground)
- ▶ P10 (ground)
- ▶ G2 (to Bias module)
- ▶ P8
- ▶ P9 (video input)

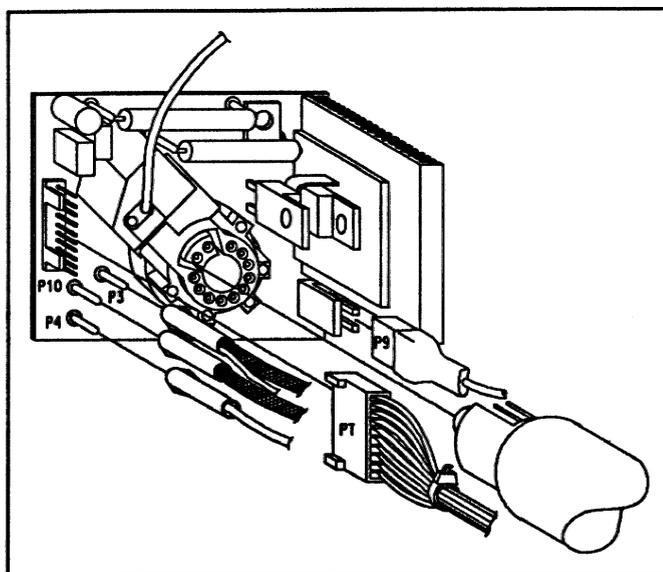


FIGURE 21-1. Video Output Module Removal

02060325

NOTE: Prior to reassembly, pull or scrape off the hardened hot melt glue from the Video Output Module CRT connector. Re-connect the Video Output module to the CRT and apply the same amount of hot melt glue between the CRT connector and the CRT connector terminals.

### 21.2.2 Alignment and Adjustments

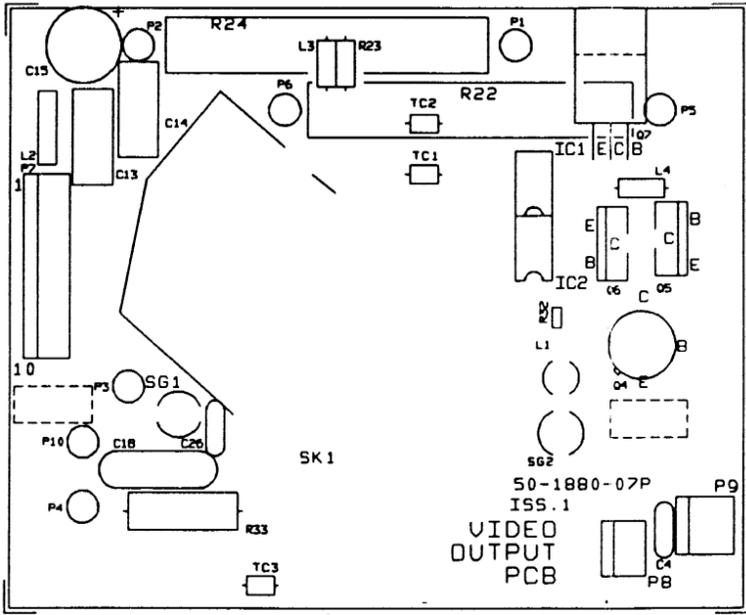
The Video Output module is adjusted during Color Balance Set-up. Refer to Section 7 for the Color Balance set-up procedure.

## 21.3 COMPONENT LAYOUT AND SCHEMATICS

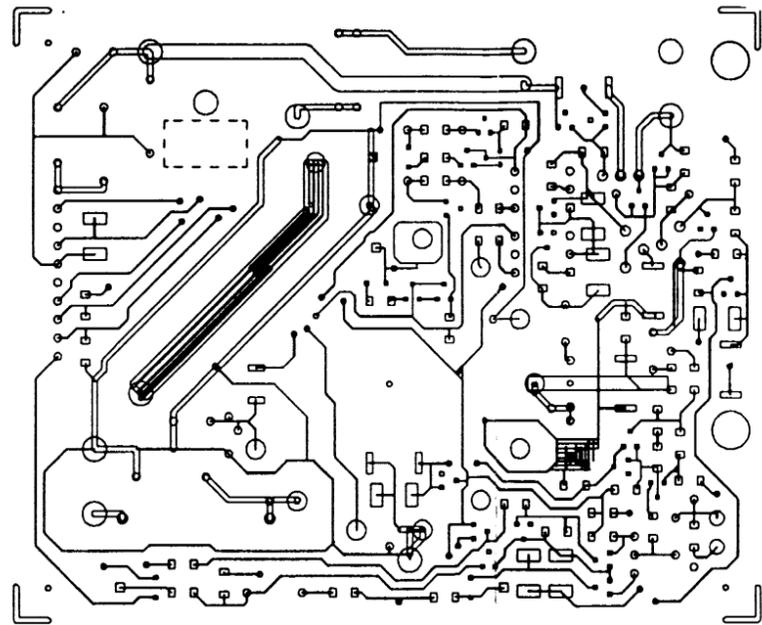
Refer to the following pages for component layouts and schematics of the Video Output Module.

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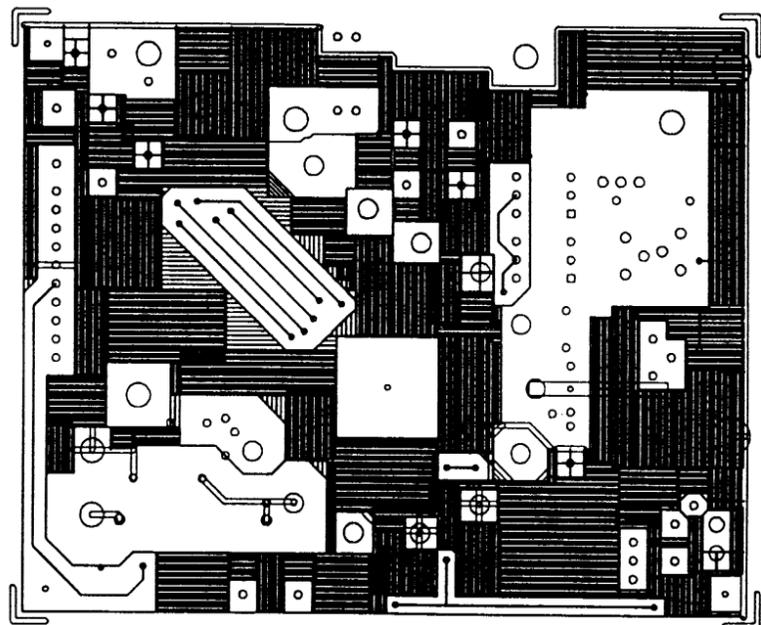
50-1880-07P ISS.1



Component Layout



Solder Side  
(Viewed from Component Side)



Component Side

FIGURE 21-2. Video Output Module Component Layout

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

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

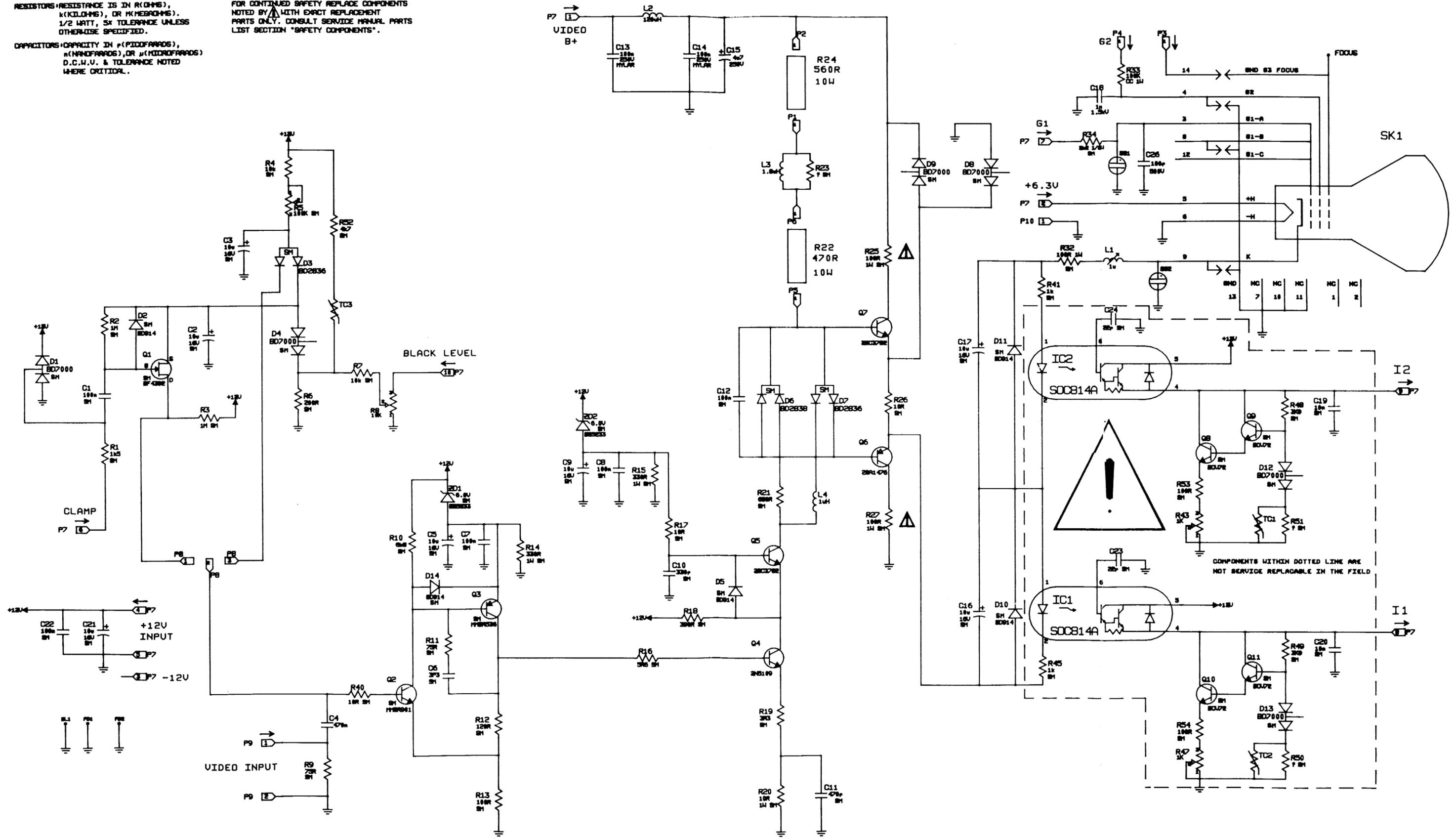
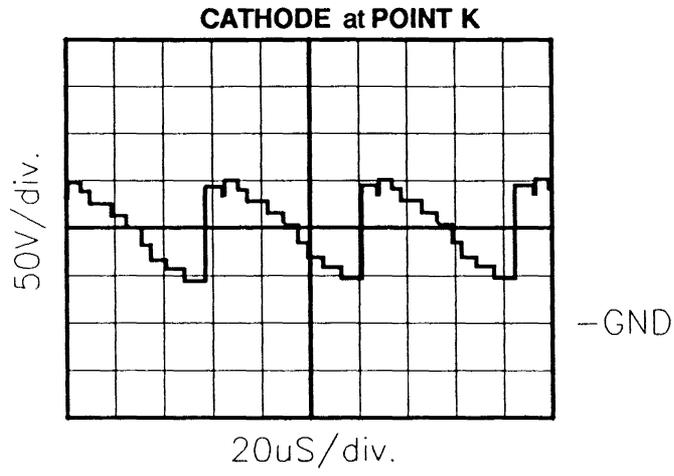


FIGURE 21-3. Video Output Module Schematic  
00-270012-02P

54-7598-01P  
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SCHEMATIC REFERENCE



## 21.4 PARTS LIST

▲ - CRITICAL SAFETY COMPONENT  
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
<b>Integrated Circuits</b>		
IC1,IC2	IC-14-001012-01P	SOC814A, optocoupler
<b>Transistors and Diodes</b>		
Q1	TR-72-000701-01P	MMBF4392, N channel FET, surface mount
Q2	TR-72-000561-02P	MMBR901, RF NPN transistor, surface mount
Q3	TR-72-000561-01P	MMBR536, RF PNP transistor, surface mount
Q4	TR-14-000562-02P	2N5109, NPN, 20V, .4A, 2.5W
Q5,Q7	TR-14-000564-06P	2SC3782, NPN
Q6	TR-14-000564-07P	2SA1476, PNP
Q8-Q11	TR-72-000561-04P	BCV72, surface mount
D1,D4,D8,D9,D12,D13	D-72-000513-04P	MMBD7000, switching diode, surface mount
D2,D5,D10,D11,D14	D-72-000513-01P	MMBD914, switching diode, surface mount
D3,D7	D-72-000513-02P	MMBD2836, switching diode, surface mount
D6	D-72-000513-03P	MMBD2838, switching diode, surface mount
ZD1,ZD2	DZ-72-000531-01P	MMBZ5233, SOT-23, zener diode, 6V, 5%, 1/2W
<b>Capacitors</b>		
C1	C-66-422241-05P	2.2 nF, 50V, +-5%, NPO, surface mount
C2,C3,C5,C9,C16,C17, C21	C-64-210134-11P	10 $\mu$ F, 16V, tantalum, surface mount
C4	C-89-000032-02P	0.47 $\mu$ F, 50V, $\pm$ 20%, ceramic, multi layer
C6	C-66-433801-05P	3.3 pF, 50V, surface mount
C7,C8,C12,C22	C-66-310411-05P	100 nF, 50V, 10%, X7R, surface mount
C10	C-66-433141-05P	330 pF, 50V, 5%, NPO, surface mount
C11	C-66-447141-05P	470 pF, 50V, NPO, surface mount
C13,C14	C-48-171042-02P	100 nF, 200V, 10%, mylar
C15	C-44-447510-06P	4.7 $\mu$ F, 250V, electrolytic
C18	C-46-510112-30P	100 pF, 2KV, ceramic disc
C19,C20	C-66-310311-05P	10nF, 50V, 10%, surface mount
C23,C24	C-66-422041-05P	22 pF, 50V, 5%, NPO, surface mount
C26	C-46-310113-02P	100 pF, 500V, 10%, Z5P, ceramic disc
<b>Resistors</b>		
R1	R-70-715013-21P	1.5K, 1/4W, 5%, surface mount
R2,R3	R-70-710043-21P	1M, 1/4W, 5%, surface mount
R4	R-70-756013-21P	5.6K, 1/4W, 5%, surface mount
R5	R-71-011043-02P	100K, 25%, pot surface mount
R6	R-70-720003-21P	200R, 1/4W, 5%, surface mount
R7,R52	R-70-747013-21P	4.7K, 1/4W, 5%, surface mount
R8	R-71-011033-02P	10K, 25%, trim pot., surface mount
R9,R11	R-70-775093-21P	75R, 1/4W, 5%, surface mount
R10	R-70-768013-21P	6.8K, 1/4W, 5%, surface mount
R12	R-70-712003-21P	120R, 1/4W, 5%, surface mount
R13,R53,R54	R-70-710003-21P	100R, 1/4W, 5%, surface mount
R14,R15	R-70-933003-24P	330R, 1W, 5%, surface mount
R16	R-70-756083-21P	5.6R, 1/4W, 5%, surface mount
R17,R26,R40	R-70-710093-21P	10R, 1/4W, 5%, surface mount

21.4 PARTS LIST (cont.)

⚠ - CRITICAL SAFETY COMPONENT  
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
<b>Resistors (cont.)</b>		
R18	R-70-739003-21P	390R, 1/4W, 5%, surface mount
R19	R-70-733083-21P	3.3R, 1/4W, 5%, surface mount
R20	R-70-910093-24P	10R, 1W, 5%, surface mount
R21	R-70-768003-21P	680R, 1/4W, 5%, surface mount
R22	R-42-144715-02P	470R, 10W, 5%
⚠ R24	R-42-145615-02P	560R, 10W, 5%
R25,R27	R-70-910003-24P	100R, 1W, 5%, surface mount
R32	R-40-221015-37P	100R, 1/2W, 5%, carbon
R33	R-40-421045-07P	100K, 1W, 5% carbon
R34	R-70-822013-23P	2.2K, 1/2W, 5%, surface mount
R41,R45	R-70-710013-21P	1K, 1/4W, 5%, surface mount
R43,R47	R-71-011023-02P	1K, 25%, trim pot., surface mount
R48,R49	R-70-739013-21P	3K9, 1/4W, 5%, surface mount
<b>Coils and Transformers</b>		
L1	L-21-001512-01P	0.5 $\mu$ H - 1.1 $\Omega$ H tunable coil
L2	L-21-011212-02P	120 $\mu$ H, 10%, peaking coil
L3	L-21-001185-16P	1.8 $\mu$ H inductor
L4	L-21-001185-13P	1 $\mu$ H inductor
<b>Miscellaneous</b>		
SG1,SG2	LM-27-000011-09P	lamp, argon
TC1-TC3	TH-42-000079-08P	100K, precision thermistor

## 21.5 SPECIFICATIONS

**contact K:** ..... CRT cathode  
 (measured with 1 Vpp input @ 1 MHz ..... 130V min.  
 High frequency response (-3dB) ..... 55 Mhz  
 Step response rise/fall time ..... 8nS max.

### Connector P7:

Pin 1 ..... **150 VDC** supply  
 current range ..... 0 to 140mA  
 typical current ..... 90mA

Pin 2 ..... Heater supply  
 signal level ..... 6.3VDC min.

Pin 3 ..... **-12 VDC** supply  
**NOTE: not used**

Pin 4 ..... **+12 VDC** supply  
 current level ..... 80mA max  
 typical current ..... 60mA

Pin 5 ..... **+12 VDC** supply  
 current level ..... 80mA max  
 typical current ..... 60mA

Pin 6 ..... analog input **CLAMP**

Pin 7 ..... **G1**

**NOTE: see Bias module**

Pin 8 ..... analog output I1  
 signal level ..... 5.94 to 6.06 VDC

Pin 9 ..... analog output I2  
 signal level ..... 5.94 to 6.06 VDC

Pin 10 ..... analog input **BLK LEVEL**  
 signal level ..... 0 to 7.2 VDC

### Connector P9:

Pin 1 ..... analog input **VIDEO INPUT**  
**NOTE: 1V p-p Into 75 $\uparrow$  max**

### Connector P4:

Pin 1 ..... **G2**

**NOTE: see Bias module**

**NOTES**