

# SECTION 13

## POWER DEFLECTION MODULE

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## SECTION 13

### POWER DEFLECTION MODULE

#### 13.1 TECHNICAL DESCRIPTION

##### 13.1.1 General Description

The Power Deflection module controls the flow of current through the deflection yokes (and the arising magnetic fields) on each CRT. Convergence amplifiers, which drive the horizontal and vertical convergence yokes, are located on this module. There is one Power Deflection module for each CRT.

##### 13.1.2 Circuit Description

###### 13.1.2.1 Convergence Amplifiers

The convergence yokes have a 60  $\mu\text{H}$  inductance and 0.3  $\Omega$  winding resistance. They are driven by current sensing, voltage feedback, transconductance type amplifiers.

**NOTE:** The vertical and horizontal amplifiers are similar. In the following paragraphs, component designations shown in brackets ( ) refer to the horizontal circuitry.

###### 13.1.2.2 Input Stage

Q1 and Q2 form the input stage. It is a differential input, single-ended output inverting amplifier. Bias current is 3mA. The DC operating current through matched pair Q14(Q4) and Q11(Q1) is 1.5mA when  $V_{in}=0$ . The DC operating voltage, measured after R46(R27), is -10.4 volts.

The stage has a voltage gain,  $A_v=67$ . Temperature stability is provided by R52(R35) and R53(R36). C19(C11) suppresses high frequency oscillations.

###### 13.1.2.3 Driver Stage

The driver consists of Q15(Q5), a transistor inverting amplifier. Gain is 27, DC emitter voltage is -11.5V, collector current is 5.6 mA and collector voltage is -0.5V.

The output of the stage is biased at 0 by D17(D11) and D21(D15). D20(D14) prevents the transistor from saturating. The parallel combination of C22(C15) and D16(D10) provide high frequency stability and reduce thermal drift.

###### 13.1.2.4 Output Stage

The output stage for each amplifier is a push-pull, super emitter follower. The output consists of Q13, Q16, Q19 and Q20 (Q3,Q6,Q9 and Q10). The stage has a gain of about 1. The average output current is kept below 1.88A by safety resistors R50 and R58 (R31 and R41) which cause Q12 and Q18 (Q2 and Q8) to limit the output stage. R44 (R32) is a current sense resistor. R8 (R9) provides damping.

###### 13.1.2.5 General

The equivalent circuit for the vertical and horizontal amplifiers is shown in Figure 13-1. NOTE: The pincushion input network appears on the vertical amplifier only.

The pincushion input voltage is the sum of the pincushion and bow voltages. It has a maximum value of 5.5 volts. Because it is AC coupled to the amplifier, the peak pincushion input voltage is 2/3 times 5.5 volts or 3.7 volts.

The peak amplitude of the convergence input voltage is 10 volts. The peak current in the vertical amplifier is 1.5 A maximum. The peak current in the horizontal amplifier is 0.7 A maximum.

With the pincushion input voltage= $V_p$  and convergence input voltage= $V_c$ , the closed loop output current of the vertical amplifier is:

$$I_v = 0.25V_p + 0.061V_c$$

The output current of the horizontal amplifier is:

$$I_h = 0.067V_c$$

Damping resistor, R8(R9), delays the yoke current by 13° at 50kHz. C37 causes the pincushion input voltage to lead approximately 10° at 50kHz.

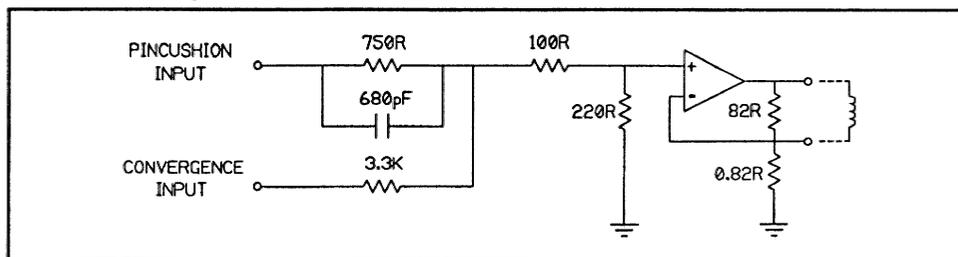


FIGURE 13-1. Convergence Amplifier Equivalent Circuit

## 13-2 MODULE SERVICING Power Deflection Module

### 13.2 SERVICING AND ALIGNMENT

#### 13.2.1 Disassembly and Access

##### Module Location:

- projection head

##### Tools & Equipment Required:

- Phillips screw driver
- 3/16" hex head socket

a) Refer to Section 5.2. Remove the top cover and lower casing to fully expose the Power Deflection modules (located at the rear of the projector).

b) If the Power Deflection module for the green (center) CRT is to be removed, remove the keypad assembly from the projection head as instructed per Section 5.2. NOTE: disconnection of the keypad cable from the Mother Board is not required.

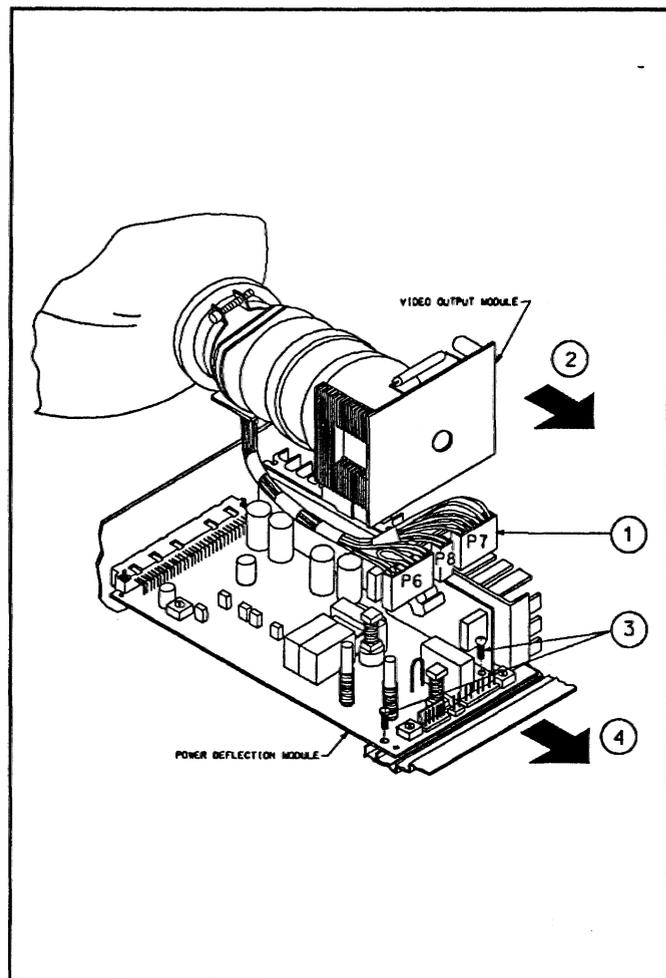


FIGURE 13-2. Power Deflection Module Removal

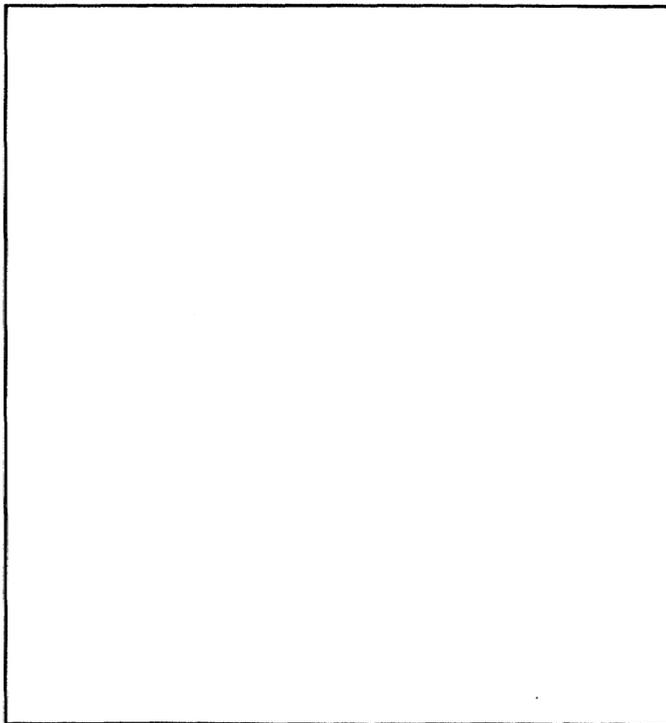
c) Locate the Power Deflection module to be removed. Disconnect the P6, P7, and P8 connectors from the module.

d) 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 without difficulty. Once free, rest the board above the CRT.

e) Remove the two Phillips screws securing the Power Deflection module to the upper rear extrusion as shown below.

e) Carefully pull the Power Deflection Module out from the projector. The side modules (red and blue) may exit from the side of the projector. The center module must exit from the back.

**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.



### 13.2.2 Alignment and Adjustments

The following procedures provide instructions for adjusting the vertical height preset, width preset and raster width on the Power Deflection module.

Reference Figure 13-3.

#### Tools & Equipment Required:

- video source (24 kHz)
- fine tip slot screwdriver
- 3/32" plastic or nylon Allen key
- oscilloscope and 100X probe

#### STEP 1 - Vertical Height Preset

- a) Press the # key on the keypad for a crosshatch pattern.
- b) Press CONVERGE, 5 , 1 to select zero the convergence, then press the 1 button to do it.
- c) Adjust R74 on the GREEN module to the mid-point of adjustment range if the green module was replaced.
- d) Adjust R74 on the RED and BLUE modules until the height of all colors matches.

#### STEP 2 - Width Preset

**NOTE: This procedure is to be used on the GREEN Power Deflection Module only.**

- a) Connect the 100X probe of the oscilloscope to the drain of Q4. Q4 is located on the MOSFET printed circuit board.
- c) Connect a 15.7 kHz source to the projector.
- d) Adjust the image for maximum horizontal size.
- e) Adjust R25 to produce 1260 V p-p at the drain of Q4 on the MOSFET PCB.

#### STEP 3 - Adjust Raster Width

- a) Connect the video source to the projector. Set the horizontal frequency to 15.75 kHz.
- b) Adjust L3 until raster width matches for all colors as close as possible.
- c) Set the horizontal frequency to 31.5 KHz. Adjust L1 to match widths.

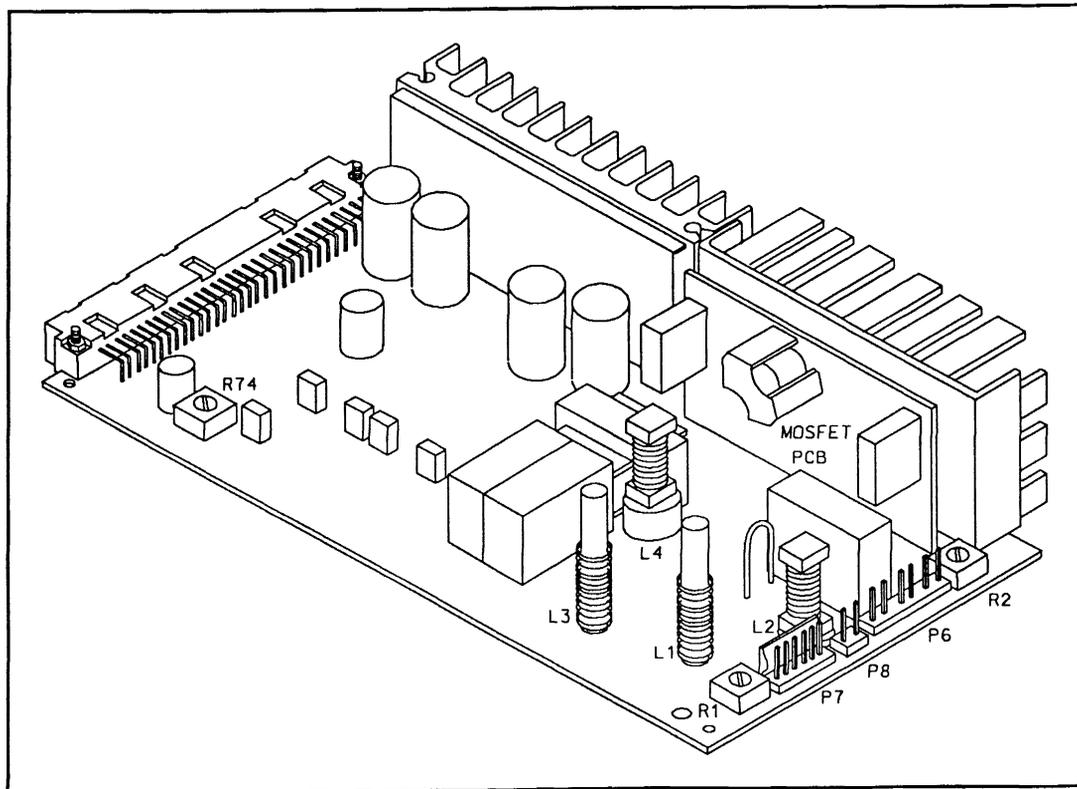
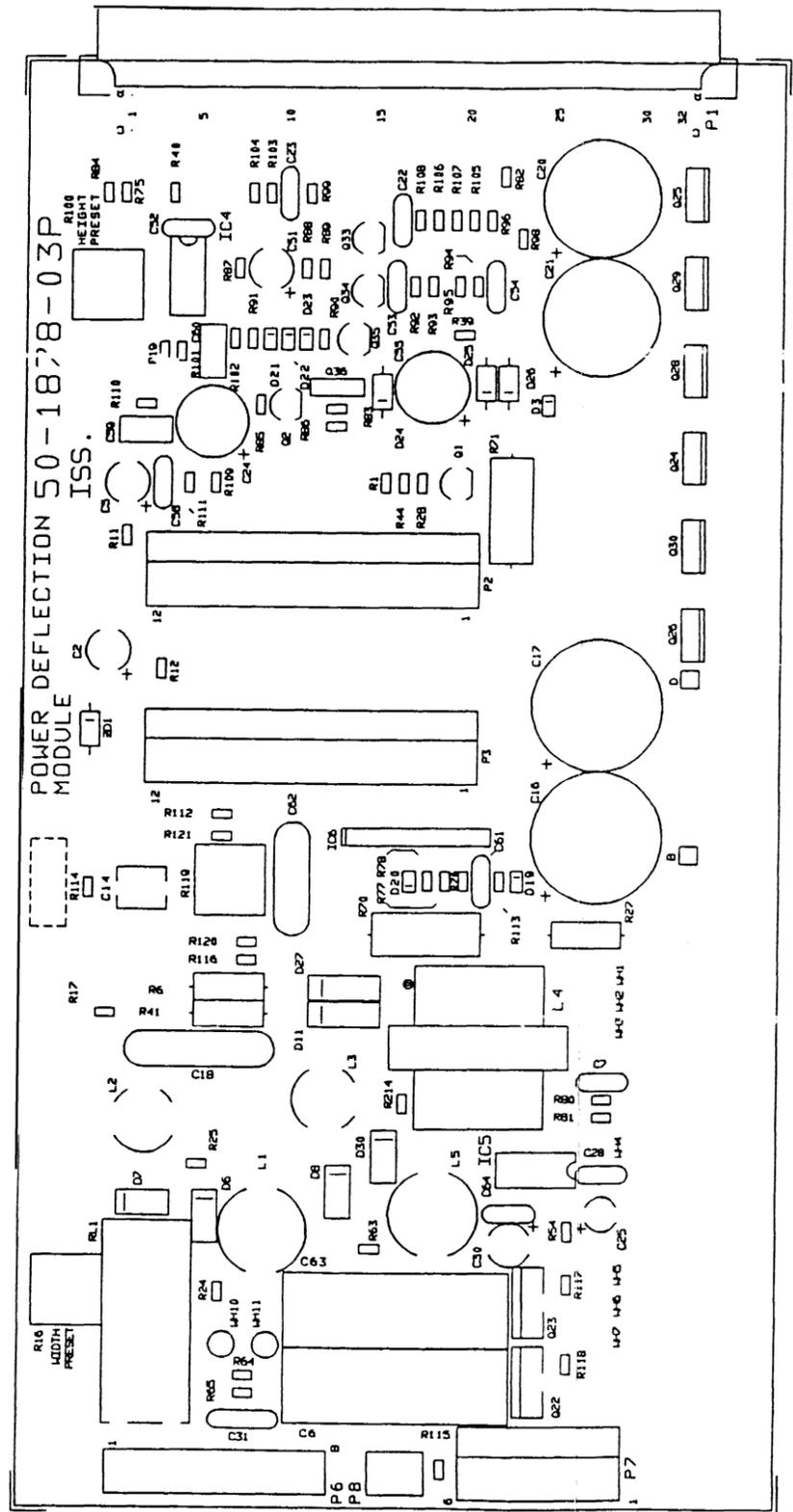


FIGURE 13-3. Power Deflection Module Alignment

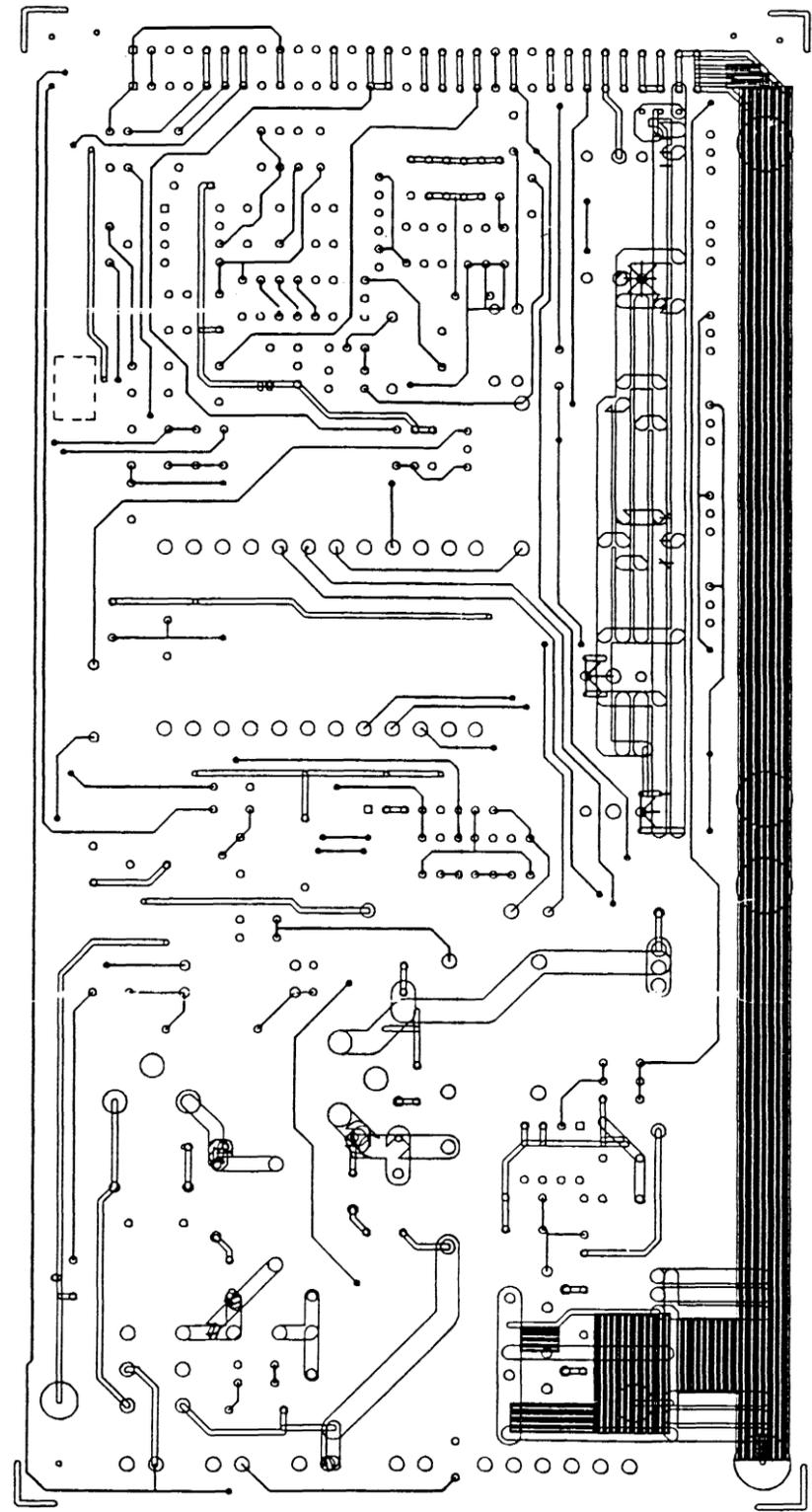
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### 13.3 COMPONENT LAYOUT AND SCHEMATICS

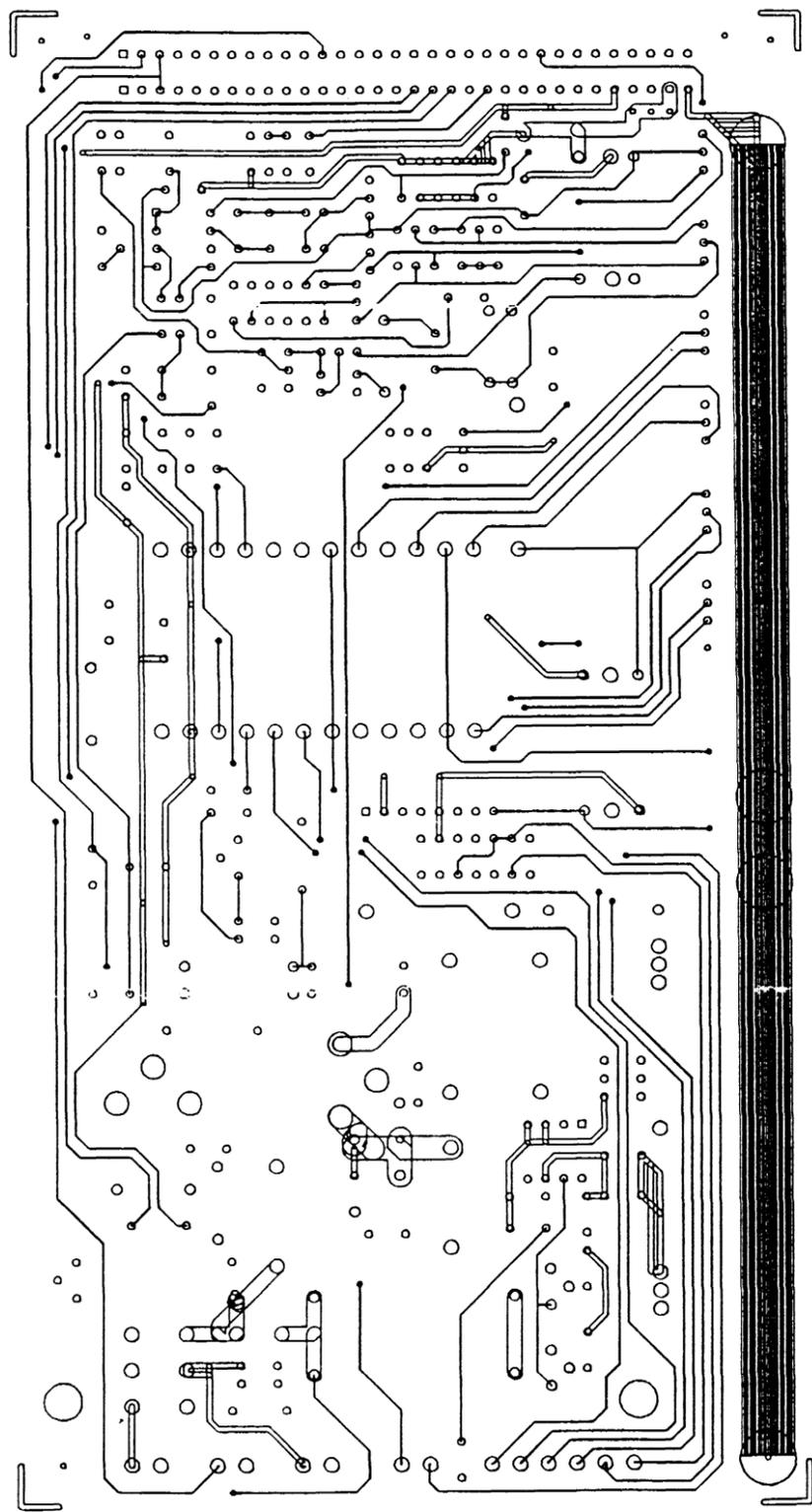
Refer to the following pages for component layouts and schematics of the Power Deflection Module.



Component Layout



Solder Side  
(Viewed from Component Side)



Component Side

FIGURE 19-4.  
Power Deflection Module Component Layout



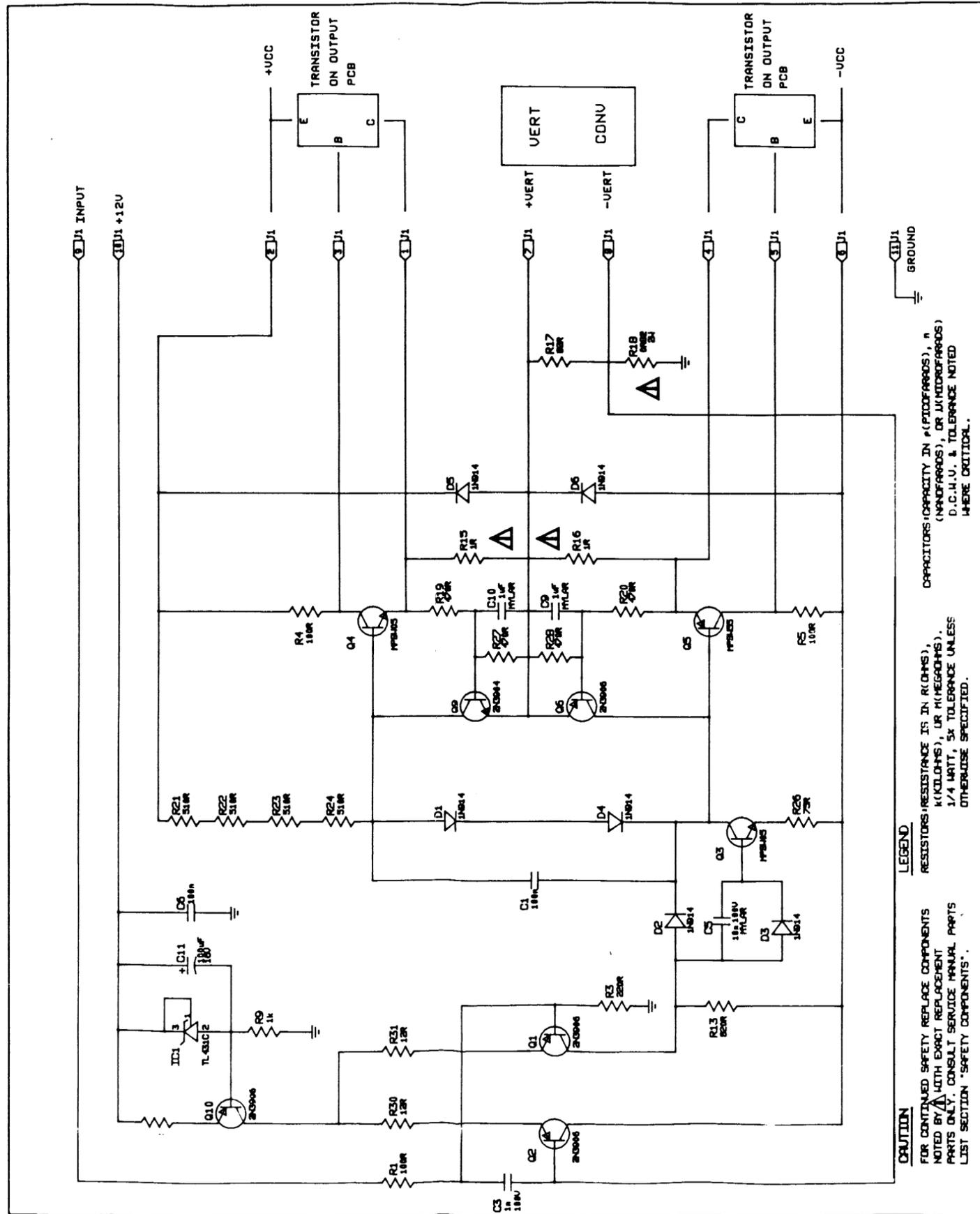
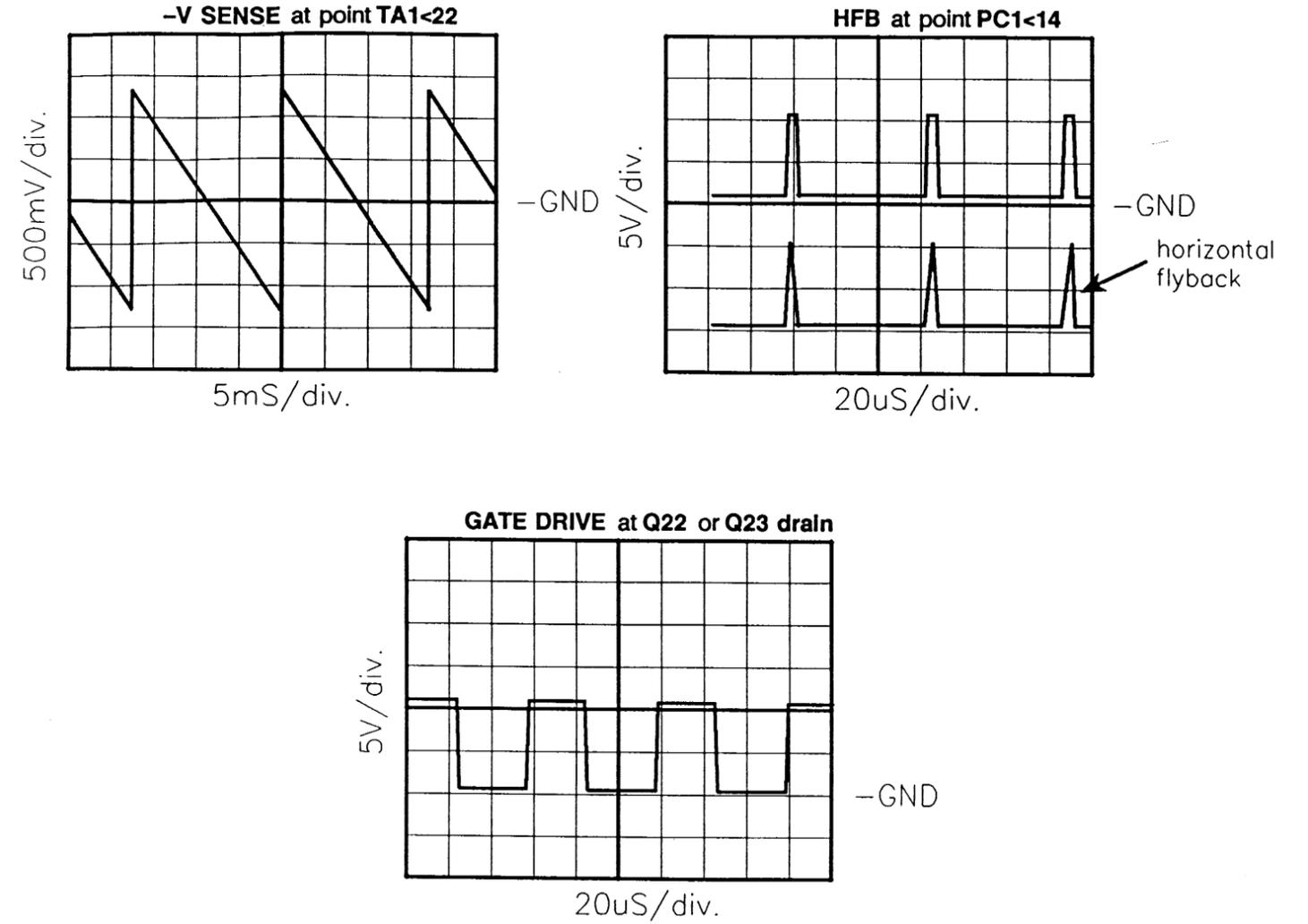
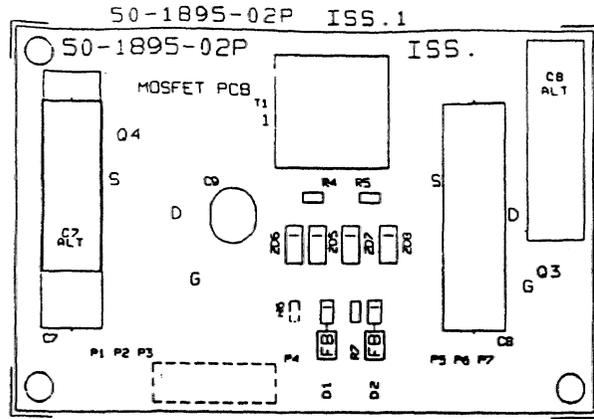


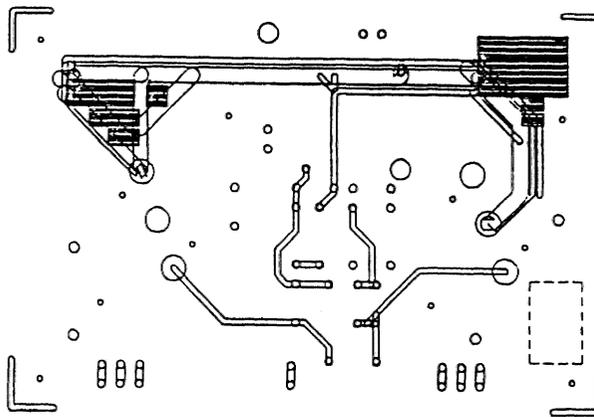
FIGURE 13-9. Amplifier Assembly Schematic

DEFLECTION PCB SCHEMATIC REFERENCE

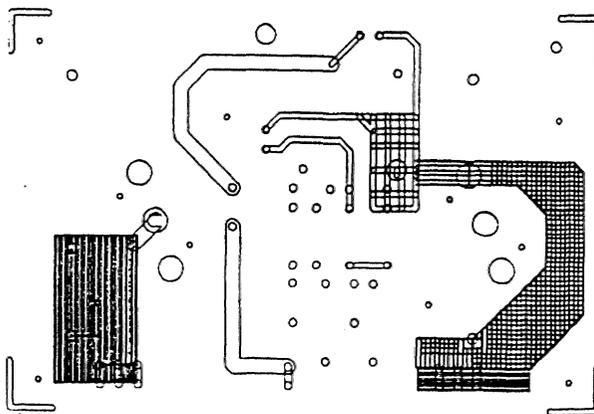




Component Layout



Solder Side  
(Viewed from Component Side)



Component Side

FIGURE 13-6. MOSFET PCB Component Layout

-  Silk Screen
-  Bottom Foil
-  Top Foil

FIGURE 13-6. MOSFET PCB Component Layout

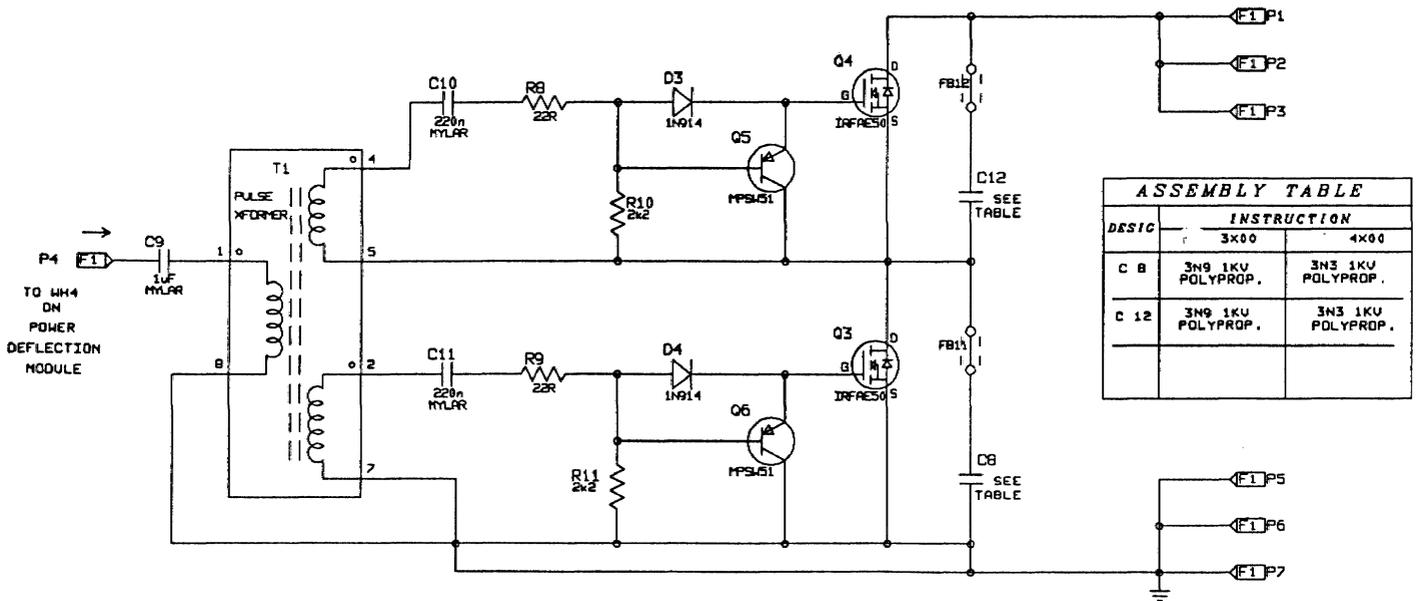
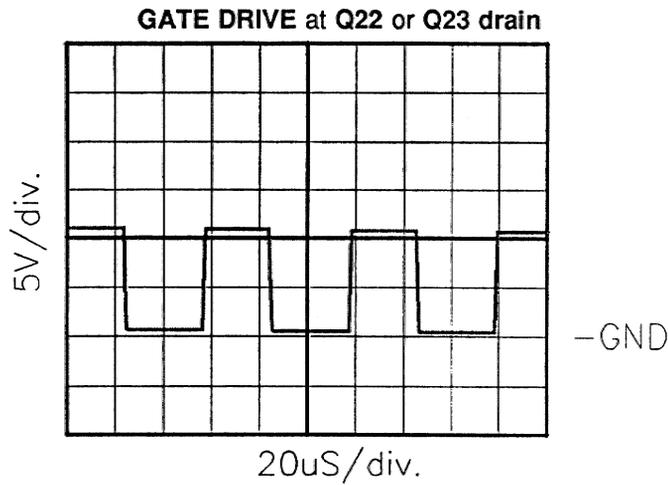
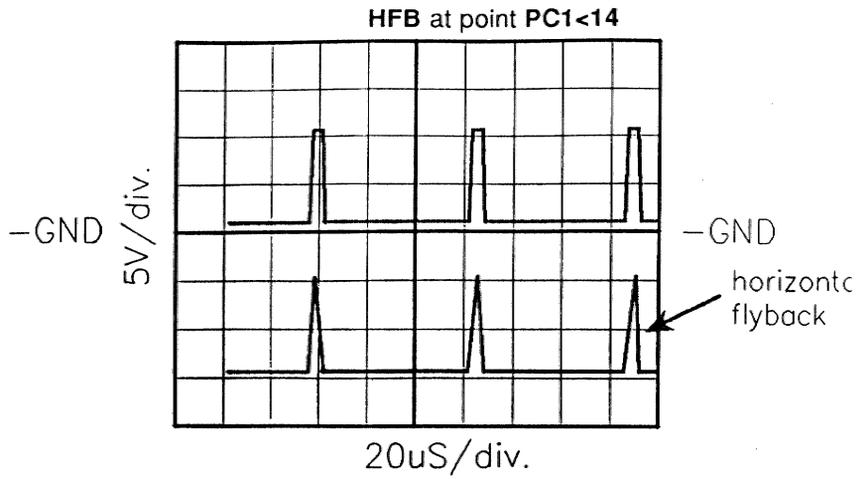
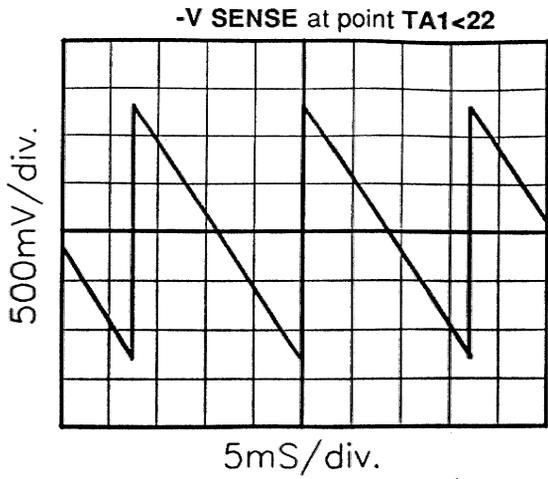
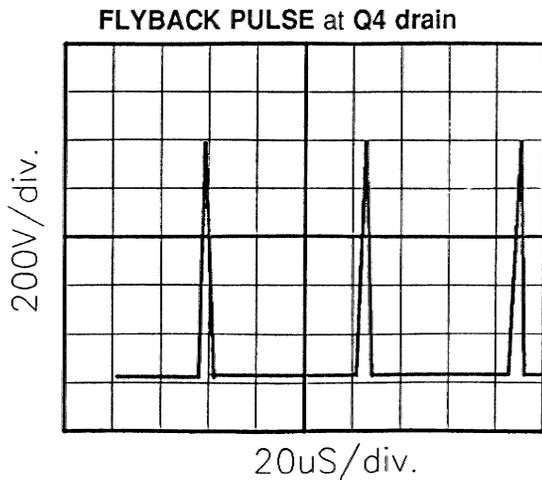


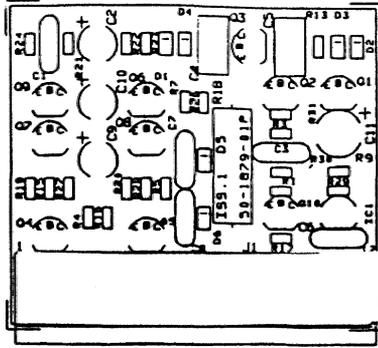
FIGURE 13-7. MOSFET Assembly Schematic  
00-250002-04P

**DEFLECTION PCB SCHEMATIC REFERENCE**

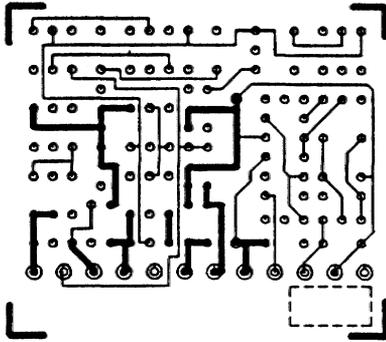


**MOSFET PCB SCHEMATIC REFERENCE**

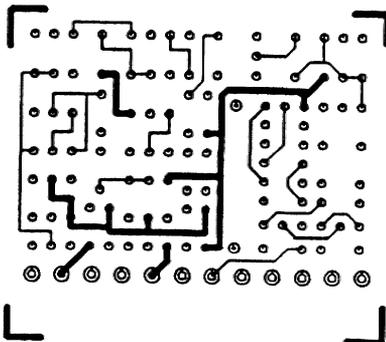




Component Layout



Solder Side  
(Viewed from Component Side)



Component Side

FIGURE 13-8. Amplifier PCB Component Layout

13.4 PARTS LIST

▲ - CRITICAL SAFETY COMPONENT  
(REPLACE WITH IDENTICAL PART)

13.4.1 Power Deflection PCB

Item Ref.	Part No.	Description
<b>Integrated Circuits</b>		
IC1	IC-14-002836-01P	M5216L, dual large current op amp
IC2	IC-14-002833-01P	TL431C, precision shunt regulator
IC3	IC-14-003050-01P	DS0026, 5 MHz 2 phase MOS (closed) driver
IC4	IC-14-002813-09P	TL082BC, linear op amp
<b>Transistors and Diodes</b>		
Q1,Q4,Q7,Q8,Q11,Q14, Q17,Q18	TR-14-000873-82P	2N3906, PNP, small signal
Q2,Q12,Q22,Q23	TR-14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q3,Q5,Q13,Q15,Q24, Q25	TR-14-000887-01P	MPSW05, NPN
Q6,Q16,Q21,Q28	TR-14-000988-02P	MJE253, PNP
Q9,Q19,Q26	TR-14-000889-02P	MPSA55, PNP
Q10,Q20,Q27	TR-14-000988-01P	MJE243, NPN
D1,D2,D5,D6	D-14-000525-07P	BYV26, rectifier, 0.5A, 350V, T
D3,D4	D-14-000513-03P	BY184, diode, 0.002A, 1800V
D7-D23,D25	D-14-000513-01P	1N914, diode, 0.075A, 75V
D24,D26,D27	D-14-000525-53P	1N4003, rectifier, 1A, 200V
ZD1	D-14-000531-39P	1N4739A, zener diode, 9.1V, 1W
<b>Capacitors</b>		
C2,C7,C8,C14,C18,C24, C26,C28,C30,C35,C38	C-89-000032-03P	100 nF, 50V, 20%, ceramic, multi layer
C3	C-46-500003-01P	10 nF, 2000V, 20%, Z5U, ceramic disc
C4	C-46-500005-01P	20 pF, 2KV, ceramic disc
C5,C6	C-49-000019-38P	2.2 μF, 250V, 10%, polycarbonate
C9,C11,C19	C-86-610252-02P	1 nF, 100V, ceramic
C10	C-86-612132-04P	120 pF, 100V, 2%, NPO, ceramic
C12,C17,C20,C23	C-88-171053-12P	1 μF, 50V, mylar
C13,C27	C-84-447506-01P	4.7 μF, 50V, electrolytic
C15,C22	C-88-171031-12P	10 nF, 100V box type, mylar
C16,C21,C32,C39	C-44-422203-08P	2200 μF, 16V, electrolytic
C25	C-88-174740-13P	470 nF, 63V, 5%, mylar
C29	C-86-647033-04P	47 pF, 100V, NPO, ceramic
C31	C-84-410105-04P	100 μF, 35V, electrolytic
C33	C-88-174721-02P	4.7 nF, 100V, 10%, mylar
C34	C-88-172231-02P	22 nF, 100V, mylar
C36	C-84-410104-03P	100 μF, 25V, electrolytic
C37	C-86-668151-02P	680 pF, 100V, 10%, 45ppm/ °C, ceramic
C40,C41	C-86-647711-04P	47 pF, 100V, NPO, ceramic

# 13-12 MODULE SERVICING

## Power Deflection Module

### 13.4 PARTS LIST (cont.)

▲ - CRITICAL SAFETY COMPONENT  
(REPLACE WITH IDENTICAL PART)

#### 13.4.1 Power Deflection PCB (cont.)

Item Ref.	Part No.	Description
<b>Resistors</b>		
R1	VR-41-000344-12P	25K, carbon trim pot
R2	VR-41-000344-04P	100R, carbon trim pot
R4	R-80-247035-23P	470K, 1/2W, 5%, high voltage
R5,R15	R-42-000143-05P	330R, 3W, 5%
R6	R-42-000143-06P	560R, 3W, 5%
R8,R9,R66	R-80-182095-11P	82R, 1/2W, 5%, metal film
R10,R27,R46	R-80-111015-11P	1.1K, 1/2W, 5%, metal film
R11	R-42-000143-04P	270R, 3W, 5%
R12,R16	R-80-210055-23P	10M, 1/2W, 5%, high voltage
R13,R17,R25,R26,R79, R90-R93	R-80-110095-11P	10R, 1/2W, 5%, metal film
R14,R23,R67	R-80-110015-11P	1K, 1/2W, 5%, metal film
R18	R-80-162025-11P	62K, 1/2W, 5%, metal film
R19	R-80-122025-11P	22K, 1/2W, 5%, metal film
R20,R72	R-80-151015-11P	5.1K, 1/2W, 5%, metal film
R21	R-80-147085-11P	4.7R, 1/2W, 5%, metal film
R22	R-80-115015-11P	1.5K, 1/2W, 5%, metal film
R24,R29,R30,R39,R40, R48,R49,R56,R57,R100	R-80-147005-11P	470R, 1/2W, 5%, metal film
R28,R47,R62,R89	R-80-122015-11P	2.2K, 1/2W, 5%, metal film
R31,R41,R50,R58, R68,R81,R82,R101	R-80-110085-11P	1R, 1/2W, 5%, metal film
▲ R32,R44	R-42-000134-01P	0.82R, 2W, 5%
R33,R45	R-80-122005-11P	220R, 1/2W, 5%, metal film
R34,R51	R-80-168005-11P	680R, 1/2W, 5%, metal film
R35,R36,R52,R53	R-80-112095-11P	12R, 1/2W, 5%, metal film
R37,R54	R-80-175095-11P	75R, 1/2W, 5%, metal film
R38,R55	R-80-127005-11P	270R, 1/2W, 5%, metal film
R42,R43,R59,R71, R80,R84,R102	R-80-110005-11P	100R, 1/2W, 5%, metal film
R60	R-80-110035-11P	100K, 1/2W, 5%, metal film
R61,R83	R-80-124025-11P	24K, 1/2W, 5%, metal film
R63,R73	R-80-182005-11P	820R, 1/2W, 5%, metal film
R64	R-80-124005-11P	240R, 1/2W, 5%, metal film
R65	R-80-116025-11P	16K, 1/2W, 5%, metal film
▲ R69,R70	R-42-000108-02P	1R, 1W, 5%
R74	VR-41-000344-08P	2K, carbon trim pot
R75,R77	R-80-139015-11P	3.9K, 1/2W, 5%, metal film
R76	R-80-182025-11P	82K, 1/2W, 5%, metal film
R78	R-80-127015-11P	2.7K, 1/2W, 5%, metal film
R85	R-80-124035-11P	240K, 1/2W, 5%, metal film
R86	R-80-120025-11P	20K, 1/2W, 5%, metal film
R87	R-80-118025-11P	18K, 1/2W, 5%, metal film
R88	R-80-111035-11P	110K, 1/2W, 5%, metal film
R94	R-80-147015-11P	4.7K, 1/2W, 5%, metal film
R95	R-80-115095-11P	15R, 1/2W, 5%, metal film
R96	R-80-175005-11P	750R, 1/2W, 5%, metal film
R97,R98	R-80-133015-11P	3.3K, 1/2W, 5%, metal film
R99	R-80-191015-11P	9.1K, 1/2W, 5%, metal film

**13.4 PARTS LIST (cont.)**

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

**13.4.1 Power Deflection PCB (cont.)**

Item Ref.	Part No.	Description
<b>Coils and Transformers</b>		
L1,L3	L-21-001429-02P	10 μH - 30 μH, width coil
L2,L4	L-21-001430-01P	linearity coil
L5	L-24-161007-03P	choke, SMPS, 22mH, 5%
<b>Miscellaneous</b>		
RL1	RL-25-000113-01P	DPDT relay, 12VDC

**13.4.2 MOSFET PCB (included as part of Power Deflection module)**

Item Ref.	Part No.	Description
<b>Transistors and Diodes</b>		
Q3,Q4	TR-14-A00603-01P	IRFAE50, power MOSFET
Q5,Q6	TR-14-000887-04P	MPSW51, PNP, 30V, 1W
D3,D4	D-14-000513-01P	1N914, diode, 0.075A, 75V
<b>Capacitors</b>		
C8,C12	C-49-000038-16P	3.9 nF, 1000V
C9	C-88-171053-12P	1 μF, 50V, mylar
C10,C11	C-88-172240-12P	220 nF, 63V, 10%, mylar
<b>Resistors</b>		
R8,R9	R-80-122095-11P	22R, 1/2W, 5%, metal film
R10,R11	R-80-122015-11P	2.2K, 1/2W, 5%, metal film
<b>Coils and Transformers</b>		
T1	T-24-170004-01P	transformer, horiz pulse

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**13.5 SPECIFICATIONS**

**Connector P1, Rows A & C:**

Pin 1 ..... analog output **VFB**  
 signal level ..... 5V peak  
**NOTE: vertical boost signal from V Deflection & H Regulation module**

Pin 2 ..... input **VAR DC DEFL**  
**NOTE: see Keystone module**

Pin 3 ..... analog input **RELAY SW**  
**NOTE: from open collector output**  
 measured in low band ..... 12VDC min

Pin 5 ..... analog input **H CENT**  
 signal level ..... -10 to 10VDC  
**NOTE: from Remote Control module**

Pin 6 ..... analog output **WIDTH**  
**NOTE: width control voltage**

Pin 7 ..... output **H SENSE**  
**NOTE: VDC proportional to scan size**

Pin 9 ..... input **V BOOST**  
 signal level ..... to 5V  
**NOTE: vertical boost signal from V Deflection & H Regulation module**

Pin 12 ..... **OFFSET DC**  
 measure with respect to:  
 VAR DC DEFL ..... 3.5 to 4.5VDC

Pin 14 ..... digital output **HFB**  
**NOTE: horizontal flyback pulse**  
 amplitude ..... peak  $\pm 10\%$   
 leading edge of HFB pulse coincident with trailing edge of flyback pulse to within 250 ns

Pin 15 ..... digital output **HFB12**  
**NOTE: same as HFB**

Pin 17 ..... analog input **PIN WFM**  
**NOTE: see Waveform module**

Pin 18 ..... analog input **V CONV**  
 vert. convergence waveform -8 to 8V peak

Pin 19 ..... analog input **H CONV**  
 hor. convergence waveform -8 to 8V peak

Pin 20 ..... analog input **V DRIVE**  
**NOTE: from Vertical Deflection & Horizontal Regulation module**  
 vertical sawtooth ..... 6 to 13V p-p

Pin 21 ..... analog input **V CENT**  
**NOTE: from Remote Control module**  
 vertical DC voltage ..... -10 to 10VDC

Pin 22 ..... analog output **-V SENSE**  
 vertical sawtooth ..... yoke current x 2.5

Pin 24 ..... analog input **H DRIVE**  
**NOTE: see Horizontal Deflection module**

Pin 25 ..... -24V power supply **-24 VDC**

Pin 26 ..... +24V power supply **+24 VDC**

Pin 27 ..... -12V power supply **-12 VDC**

Pin 28 ..... +12V power supply **+12 VDC**

Pin 29 ..... +5V power supply **+5 VDC**

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

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

Pin 32 ..... connected to Pin 32 **GND**

**Connector P6:** ..... Horizontal Yoke

**NOTE: Yoke 21-000160-01P or equivalent. Measure current with current probe.**

Pin 8  
 H SIZE @ 10VDC, R16 @ full deflection  
 signal level ..... 4.5A p-p min  
 H SIZE @ 0VDC, R16 @ minimum deflection  
 signal level ..... 3.7A p-p max  
 retrace pulse amplitude ..... 1200V peak  
 frequency ..... 50kHz  
 retrace time (AC-coupled) ..... 3.7  $\mu$ s  $\pm 5\%$

**Connector P7:** ..... Horizontal Centering Yoke  
**NOTE: Yoke 21-000160-01P or equivalent. Measure current with current probe.**

Pin 2  
 H CENT set to ..... 10V  
 signal level ..... 19mA min  
 H CENT set to ..... -10V  
 signal level ..... 19mA min

# 13-16 MODULE SERVICING Power Deflection Module

**Connector P7:** ..... Convergence Yoke

Pin 4 ..... vertical  
V CONV ..... 0 to 1.2A p-p max  
H CONV ..... 0 to 0.6A p-p max

Pin 6 ..... horizontal  
V CONV ..... 0 to 1.2A p-p max  
H CONV ..... 0 to 0.6A p-p max

**Connector P8:** ..... Yoke

**NOTE:** Yoke 21-000160-01P or equivalent. Measure current with current probe.

Pin 2  
R100 shorted, V DRIVE @ ..... 11V p-p  
signal level ..... 1.2A p-p  
retrace time ..... 300  $\mu$ s min

