

SECTION 19

POWER DEFLECTION MODULE

TABLE OF CONTENTS

Section	Page
19.1 Technical Description	19-1
19.2 Servicing and Alignment	19-2
19.3 Component Layout and Schematics	19-3
19.4 Parts List	19-13
19.5 Specifications	19-17

LIST OF ILLUSTRATIONS

Figure	Page
19-1 Convergence Amplifier Equivalent Circuit	19-1
19-2 Power Deflection Module Removal	19-2
19-3 Power Deflection Module Alignment	19-3
19-4 Power Deflection Module Component Layout	19-4
19-5 Power Deflection Module Schematic	19-5
19-6 MOSFET PCB Component Layout	19-7
19-7 MOSFET Assembly Schematic	19-8
19-8 Amplifier PCB Component Layout	19-10
19-9 Amplifier Assembly Schematic	19-11

LIST OF TABLES

No tables included in this section.

19.1 TECHNICAL DESCRIPTION

19.1.1 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.

19.1.2 Circuit Description

19.1.2.1 Convergence Amplifiers

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

19.1.2.2 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 Q1 and Q2 is 1.5mA when $V_{in}=0$. The DC operating voltage, measured after R13, is -10.4 volts.

The stage has a voltage gain, $A_v=67$. Temperature stability is provided by R30 and R31. C3 suppresses high frequency oscillations.

19.1.2.3 Driver Stage

The driver consists of Q3, a single transistor inverting amplifier. Gain is 27, DC emitter voltage is -11.5 volts, collector current is 5.6 mA and collector voltage is -0.5 volt.

The output of the stage is biased at 0 by D1 and D4. D2 prevents the transistor from saturating. The parallel combination of C5 and D3 provide high frequency stability and reduce thermal drift.

19.1.2.4 Output Stage

The output stage for each amplifier is a push-pull, super emitter follower. The horizontal output consists of Q4, Q26 and Q30, the vertical output is Q5, Q24 and Q28. The stage has a gain of about 1. The average output current is kept below 1.88A by safety resistors R15 and R16 which act as fuses, causing SCRs Q6, Q7, Q8 and Q9 to trigger. R18 is a current sense resistor. R17 provides damping.

19.1.2.5 General

The equivalent circuit for the vertical and horizontal amplifiers is shown in Figure 19-1. 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, R17, delays the yoke current by 13° at 50kHz. C11 causes the pincushion input voltage to lead approximately 10° at 50kHz.

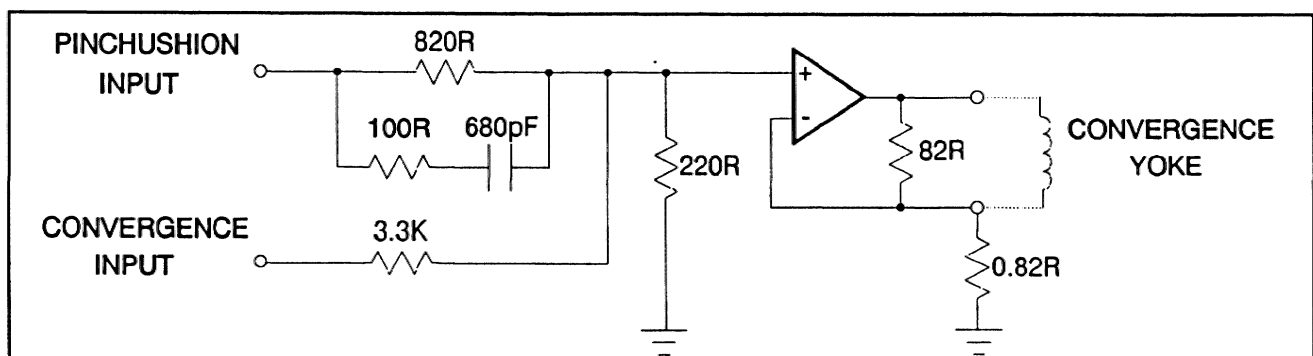


FIGURE 19-1. Convergence Amplifier Equivalent Circuit

19.2 SERVICING AND ALIGNMENT

19.2.1 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 following covers and panels:

- front top cover
- rear top cover
- lower case

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.

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.

f) 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.

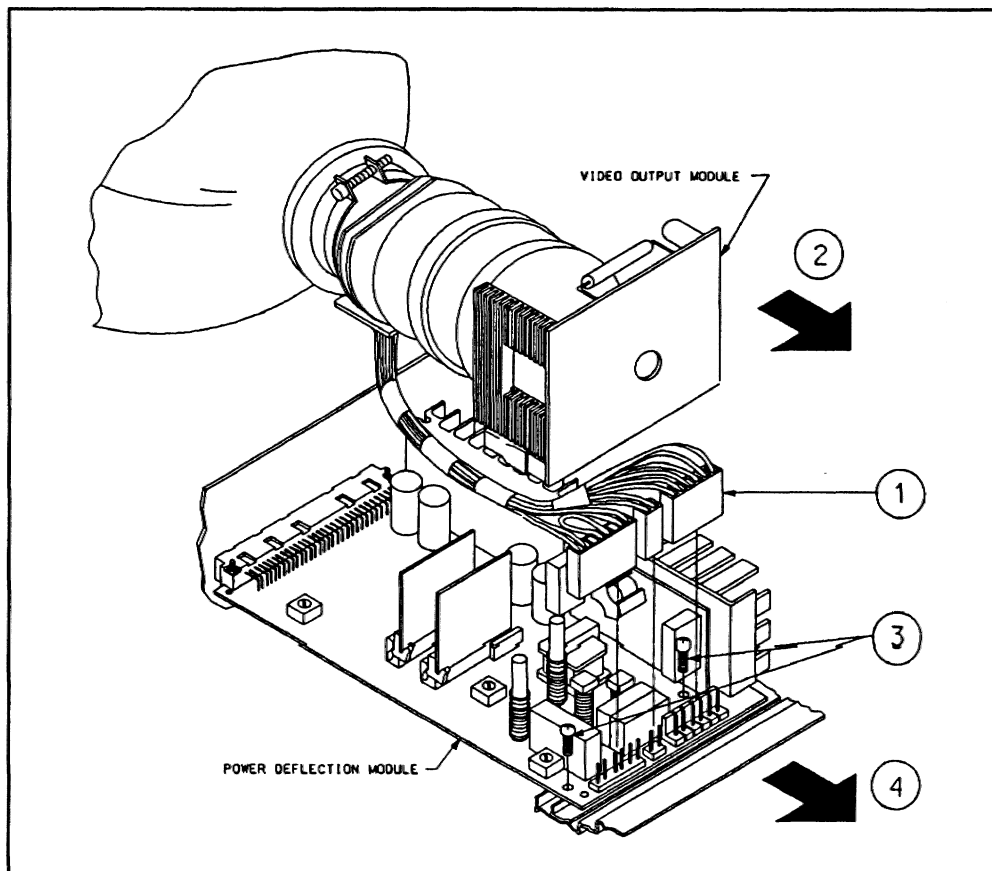


FIGURE 19-2. Power Deflection Module Removal

19.2.2 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 19-3.

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, 2, RESET. Converge, center only, red to green and blue to green. DO NOT press EXIT.
- c) Adjust R100 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 R16 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 24 KHz.
- b) Adjust L3 until raster width matches for all colors as close as possible.

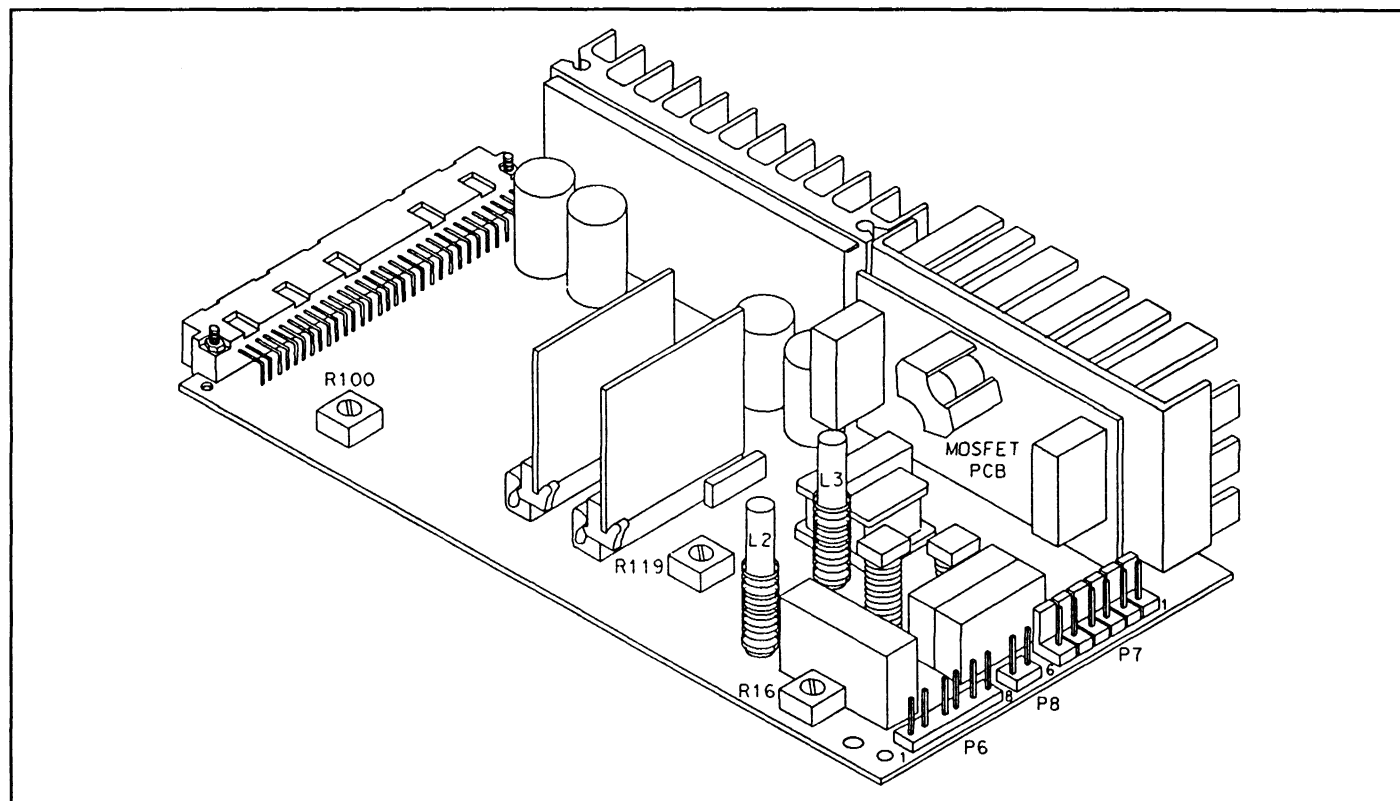


FIGURE 19-3. Power Deflection Module Alignment

19.3 COMPONENT LAYOUT AND SCHEMATICS

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



Power Deflection Module Component Layout

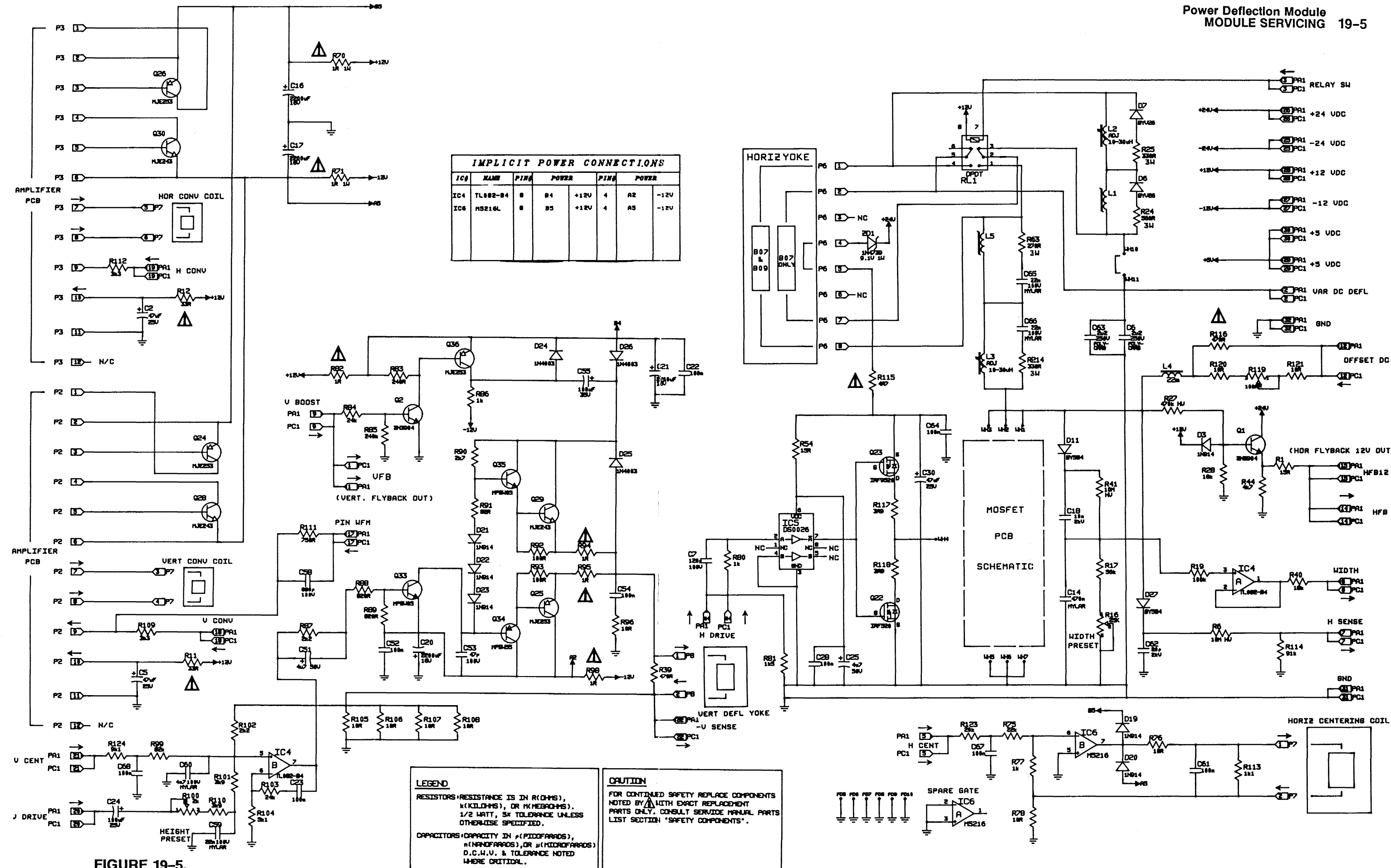
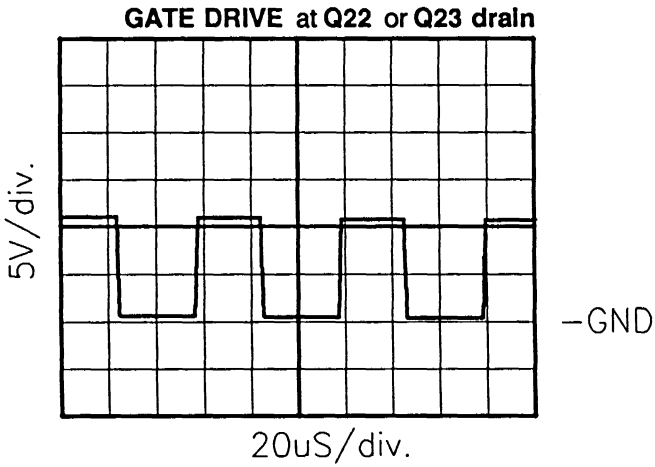
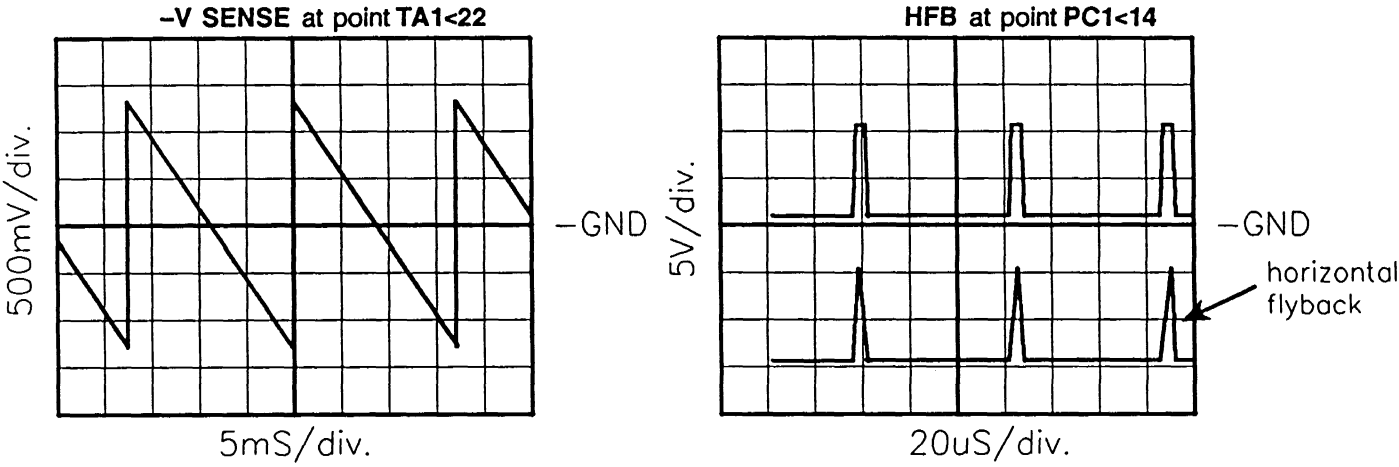
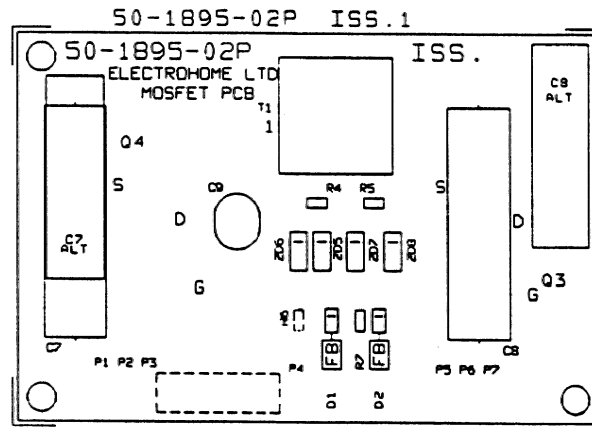


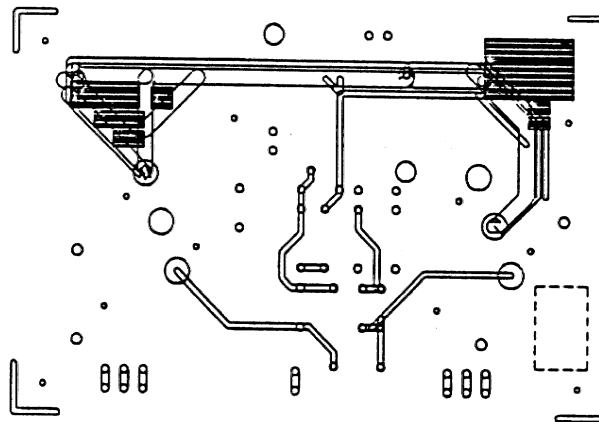
FIGURE 19-5.
Power Deflection Module Schematic

DEFLECTION PCB SCHEMATIC REFERENCE

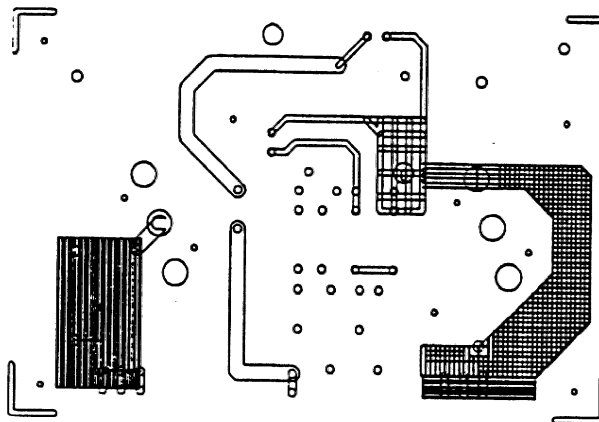




Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 19-6. MOSFET PCB Component Layout

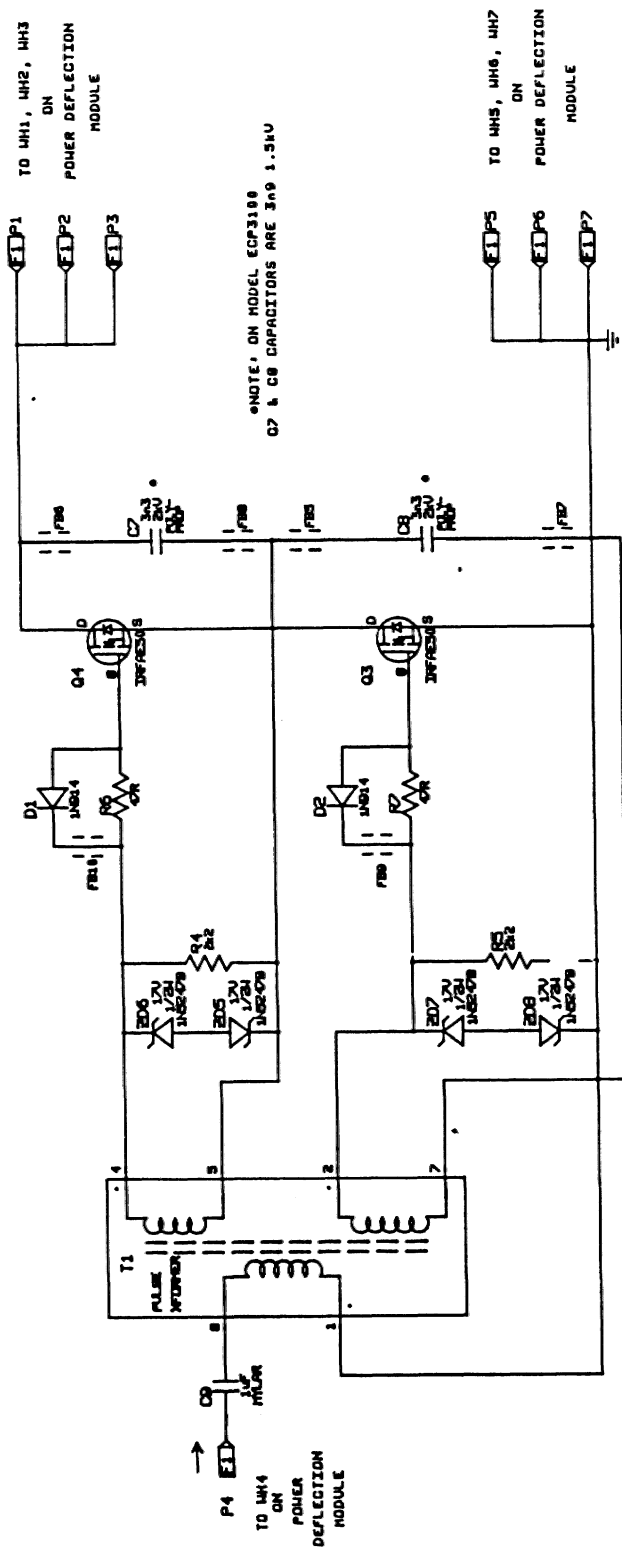
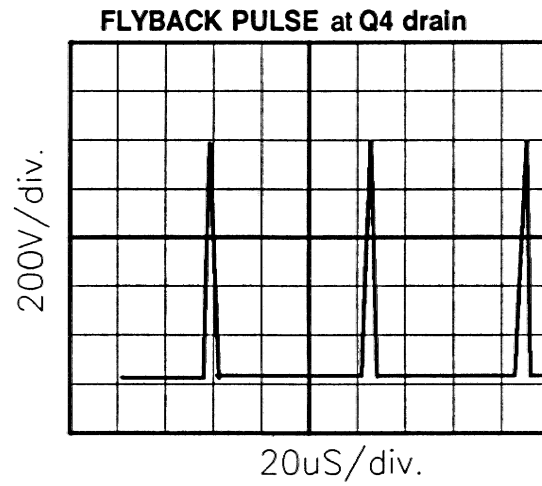
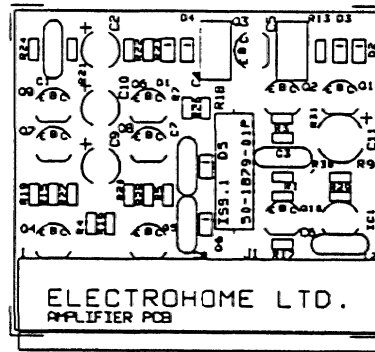


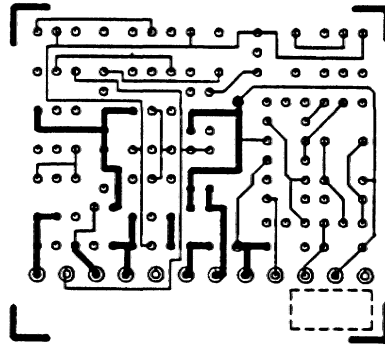
FIGURE 19-7. MOSFET Assembly Schematic

MOSFET PCB SCHEMATIC REFERENCE

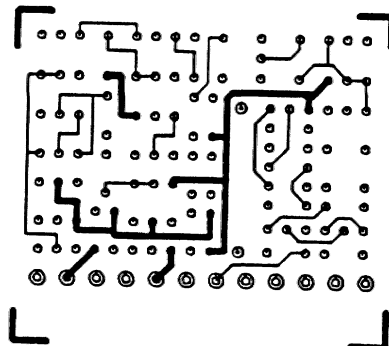




Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 19-8. Amplifier PCB Component Layout

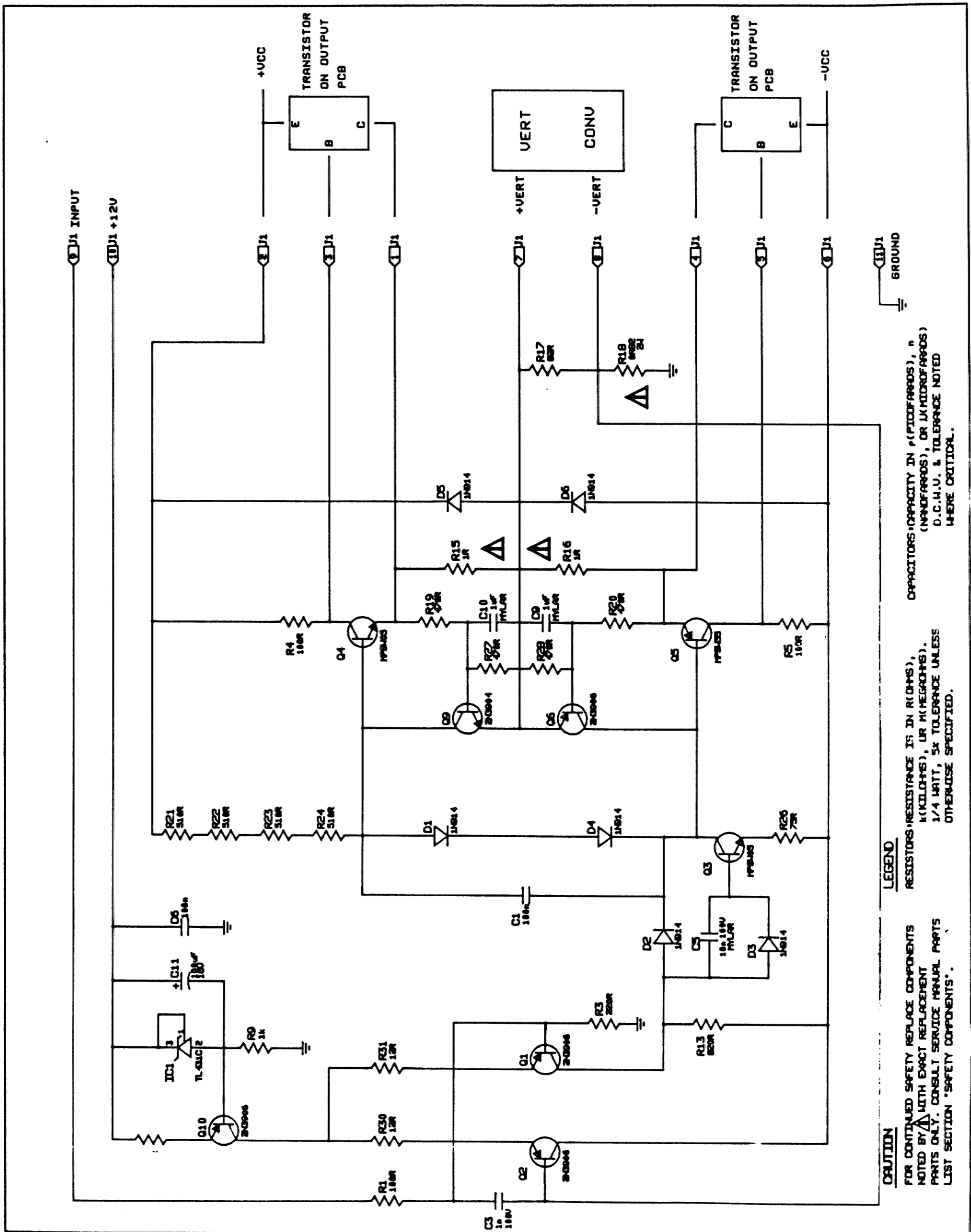


FIGURE 19-9. Amplifier Assembly Schematic

19.4 PARTS LIST

19.4.1 Power Deflection PCB

Item Ref.	Part No.	Description
Integrated Circuits		
IC4	14-002813-09P	TL082BC, linear amplifier
IC5	14-003050-01P	DS0026, 5 MHz 2 phase MOS (closed) driver
IC6	14-002836-01P	M5216L, dual large current op amp
Transistors and Diodes		
Q1,Q2	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q22	14-A00701-01P	1RF520, hex FET, 100V
Q23	14-A00703-01P	1RF9520, hex FET, 100V
Q24-Q26,Q36	14-000988-02P	MJE253, PNP
Q28-Q30	14-000988-01P	MJE243, NPN
Q33,Q35	14-000887-01P	MPSW05, NPN
Q34	14-000887-02P	MPSW55, PNP
D3,D19-D23	14-000513-01P	1N914, diode, 0.075A, 75V
D6,D7	14-000525-07P	BYV26, rectifier, 0.5A, 350V
D11,D27	14-000513-03P	BY184, diode, 0.002A, 1800V
D24-D26	14-000525-53P	1N4003, rectifier, 1A, 200V
ZD1	14-000531-39P	1N4739A, zener diode, 9.1V, 1W
Capacitors		
C2,C5,C30	84-447004-02P	47 μ F, 25V
C6,C63	49-000019-38P	2.2 μ F, 250V, 10%, polycarbonate
C7	86-612132-04P	120 pF, 2%, NPO
C14	88-174740-13P	470 nF, 63V, 5%, mylar
C16,C17,C20, C21	44-422203-09P	2200 μ F, 16V
C18	46-500003-01P	10 nF, 2000V, 20%, Z5U
C22,C23,C28, C52,C54,C61, C64,C67,C68	89-000032-03P	100 nF, 50V
C24	84-410104-03P	100 μ F, 25V
C25,C51	84-447506-01P	4.7 μ F, 50V
C53	86-647033-04P	47 pF, 100V, NPO
C55	84-410105-04P	100 μ F, 35V
C58	86-668151-02P	680 pF, 100V, 10%, 45ppm/ $^{\circ}$ C
C59, C65, C66	88-172231-02P	22 nF, 100V, mylar
C60	88-174721-02P	4.7 nF, 100V, 10%, mylar
C62	46-520012-30P	20 pF, 2KV

19-14 MODULE SERVICING **Power Deflection Module**

19.4 PARTS LIST (cont.)

19.4.1 Power Deflection PCB (cont.)

Item Ref.	Part No.	Description
Resistors		
R1,R54	80-115095-11P	15R, 1/2W, 5%, metal film
R6,R41	80-210055-23P	10M, 1/2W, 5%, high voltage
△ R11,R12	80-133095-11P	33R, 1/2W, 5%, metal film
		SAFETY COMPONENT
R16	41-000344-12P	25K, carbon trim pot
R17	80-156025-11P	56K, 1/2W, 5%, metal film
R19	80-110035-11P	100K, 1/2W, 5%, metal film
R24	42-105615-01P	560R, 3W, 5%
R25,R214	42-103315-01P	330R, 3W
R27	80-247035-23P	470K, 1/2W, 5%, high voltage
R28	80-116025-11P	16K, 1/2W, 5%, metal film
△ R39,R116	80-147005-11P	470R, 1/2W, 5%, metal film
		SAFETY COMPONENT
R40	80-118025-11P	18K, 1/2W, 5%, metal film
R44	80-147015-11P	4.7K, 1/2W, 5%, metal film
R63	42-102715-01P	270R, 3W, 5%
△ R70,R71	42-000108-02P	1R, 1W, 5%
		SAFETY COMPONENT
R76,R78,R96, R105-R108,R120, R121	80-110095-11P	10R, 1/2W, 5%, metal film
R75	80-122025-11P	22K, 1/2W, 5%, metal film
R77,R80,R86	80-110015-11P	1K, 1/2W, 5%, metal film
R81	80-115015-11P	1.5K, 1/2W, 5%, metal film
△ R82,R94,R95,R98	80-110085-11P	1R, 1/2W, 5%
		SAFETY COMPONENT
R83	80-124005-11P	240R, 1/2W, 5%
R84,R103	80-124025-11P	24K, 1/2W, 5%, metal film
R85	80-124035-11P	240K, 1/2W, 5%, metal film
R87,R102	80-122015-11P	2.2K, 1/2W, 5%
R88,R89	80-182005-11P	820R, 1/2W, 5%, metal film
R90	80-127015-11P	2.7K, 1/2W, 5%, metal film
R91	80-182095-11P	82R, 1/2W, 5%, metal film
R92,R93	80-110005-11P	100R, 1/2W, 5%, metal film
R99	80-182025-11P	82K, 1/2W, 5%, metal film
R100	41-000344-08P	2K, carbon trim pot
R101,R110	80-139015-11P	3.9K, 1/2W, 5%, metal film
R104	80-151015-11P	5.1K, 1/2W, 5%, metal film
R109,R112	80-133015-11P	3.3K, 1/2W, 5%, metal film
R111	80-175005-11P	750R, 1/2W, 5%, metal film
R113	80-111015-11P	1.1K, 1/2W, 5%
R114	80-191025-11P	91K, 1/2W, 5%, metal film
△ R115	80-147085-11P	4.7R, 1/2W, 5%, metal film
		SAFETY COMPONENT
R117,R118	80-139085-11P	3.9R, 1/2W, 5%, metal film

19.4 PARTS LIST (cont.)

19.4.1 Power Deflection PCB (cont.)

Item Ref.	Part No.	Description
Resistors (cont.)		
R119	41-000344-04P	100R, carbon trim pot
R123	80-120025-11P	20K, 1/2W, 5%, metal film
R124	80-191015-11P	9.1K, 1/2W, 5%, metal film
Coils and Transformers		
L1,L5	21-001430-01P	linearity coil
L2,L3	21-001429-02P	10 to 30 μ H width coil
L4	24-161007-03P	SMPS choke
Miscellaneous		
RL1	25-000105-01P	DPDT relay, 12V coil


19.4.2 MOSFET PCB (Included as part of Power Deflection module)

Item Ref.	Part No.	Description
Transistors and Diodes		
Q3,Q4	14-A00603-01P	1RFAE50, power MOSFET
D1,D2	14-000513-01P	1N914, diode, 0.075A, 75V, T,
ZD5-ZD8	14-000531-37P	1N5247, zener diode, 17V, 5W, 5%
Capacitors		
C7,C8	49-000038-03P	3.9 nF, 1500V
C9	88-171053-12P	1 μ F, 50V, mylar
Resistors		
R4,R5	80-122015-11P	2.2K, 1/2W, 5%
R6,R7	80-147095-11P	47R, 1/2W, 5%, metal film
Coils and Transformers		
T1	24-161005-01P	64KHz pulse transformer

19-16 MODULE SERVICING **Power Deflection Module**

19.4 PARTS LIST (cont.)

19.4.3 Amplifier PCB (Included as part of Power Deflection module)

Item Ref.	Part No.	Description
Integrated Circuits		
IC1	14-002833-01P	TL431C, precision shunt regulator
Transistors and Diodes		
Q1,Q2,Q6,Q10	14-000873-82P	2N3906, PNP, small signal
Q3,Q4	14-000887-01P	MPSW05, NPN
Q5	14-000887-02P	MPSW55, PNP
Q9	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
D1-D6	14-000513-01P	1N914, diode, 0.075A, 75V,
Capacitors		
C1,C6	89-000032-03P	100 nF, 50V
C3	46-610252-02P	1 nF, 100V
C5	88-171031-02P	10 nF, 100V, 10%
C9,C10	84-422004-01P	22 μ F, 25V
C11	84-410104-03P	100 μ F, 25V
Resistors		
R1,R4,R5	80-110005-11P	100R, 1/2W, 5%, metal film
R3	80-122005-11P	220R, 1/2W, 5%, metal film
R9	80-110015-11P	1K, 1/2W, 5%, metal film
R13	80-111015-11P	1.1K, 1/2W, 5%
 R15,R16	80-110085-11P	1R, 1/2W, 5%
SAFETY COMPONENT		
R17	80-182095-11P	82R, 1/2W, 5%, metal film
R18	42-000134-01P	0.82R, 2W, 5%
R19,R20	80-147015-11P	4.7K, 1/2W, 5%, metal film
R21-R24	80-151005-11P	510R, 1/2W, 5%, metal film
R26	80-175095-11P	75R, 1/2W, 5%, metal film
R27,R28	80-122015-11P	2.2K, 1/2W, 5%
R29	80-168005-11P	680R, 1/2W, 5%, metal film
R30,R31	80-112095-11P	12R, 1/2W, 5%

19.5 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 $\times 2.5$

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

19-18 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 μ s min

