

SECTION 19

VERTICAL DEFLECTION MODULE

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SECTION 19

VERTICAL DEFLECTION MODULE

19.1 TECHNICAL DESCRIPTION

19.1.1 General Description

The Vertical Deflection module generates vertical drive pulses for the Power Deflection modules and supplies regulated current to the deflection yokes. The module also includes vertical auto-lock circuitry and an EHT INHIBIT circuit.

19.1.2 Circuit Description

19.1.2.1 Vertical Frequency-to-Voltage Converter

The vertical frequency-to-voltage converter consists of an integrator, one shot multivibrator (IC2B) and op amp IC1C.

IC2B is triggered by incoming vertical pulses (VERT 1) at edge connector PC1-10. The 300 μ s (approximate) wide pulse leaving pin #10 of IC2B, is applied to the integrating network R69 and C25. The voltage at the junction of R69 and C25 is positive.

The integrated voltage produced is directly proportional to VERT 1 frequency and inversely proportional to vertical period, i.e., a shorter period or a higher frequency will produce a higher DC output. The voltage is applied to pin 10 of op amp IC1C. R122 (U.F. SET) presets a regulated negative voltage at its center tap. Feedback resistor R10 (L.F. SET), is the gain control for IC1C. The voltage at pin 10 should be 0 or higher. The voltage at pin 9 should be negative. The output at pin 8 should be positive.

19.1.2.2 Vertical Auto/Manual Switch

In the automatic mode, the sync pulse voltage appearing at edge connector PC1-15 is low. This makes the base of Q4 low and forces Q4's collector high. The output voltage, from Q4, is applied to pin 6 of IC7 (analog switch). A low voltage on pin 6 connects the output of IC1C to IC7 switch outputs, pins 3 and 4. A high voltage on pin 6 connects the output of IC1C to RC network R89 and C10. The network's output, combined with the output voltage of the analog switch, set the vertical oscillator frequency. In the event of an incoming sync pulse failure, voltage is applied to the oscillator network via R41. In the manual mode, the DC voltage appearing at edge connector PC1-15 is high. Q4 is turned ON and its collector goes low. The auto circuit is de-activated and the manual circuit becomes active.

V HOLD (IN), a variable, positive voltage present at edge connector PC1-2, is applied to the base of Q9. Q9's emitter voltage is set to 0.6 V above its base voltage. this alters the voltage at the junction of R63, R108 and R147. The voltage

is applied to the analog switch, via R147. It is adjusted until the oscillator frequency locks to the incoming sync. In the event of sync failure, the oscillator will run free, maintaining vertical deflection.

19.1.2.3 Vertical Ramp Circuit

IC3 (a TDA1170S differential amplifier) generates the vertical deflection ramp. In the auto mode, the ramp frequency is determined by the values of C10, R89 and the output voltage from IC7.

In the manual mode, the ramp frequency is determined by the values of C10, R89 and the effective resistance of R63, R108 and R147.

The ramp generator consists of a current generator and the capacitors between pin 12 of IC3 and ground. Size control circuitry regulates the current generator. Capacitors C6 and C9 and resistors R111, R121, R2 and R107 use buffered RAMP GEN to produce a ramp curve. This curve is independent of height and size regulation. Series R107 and R2 adjusts linearity. Series R111 and R121 corrects tilt.

NOTE: The removal or absence of R111, R121, R2 and R107 will result in a linear ramp. At low impedance levels, this ramp will also appear at pin 1 of IC3.

19.1.2.4 Vertical Height Control

The vertical ramp is fed to op amp IC10C. The output from IC10C goes to edge connector PA1-3. The output also drives the height control circuit. The output of IC1D is rectified. The resulting DC output is applied to the non-inverting input of IC1B.

An increase in the output of IC10C will increase the output of IC1D, the rectified DC voltage and the output of IC1B. This will produce an increase in the voltage at pin 7 (height adjust) of IC3 and decrease the gain, i.e., gain remains constant. R118 (size limit control) adjusts the gain of IC1D. Increased gain reduces ramp output level.

19.1.2.5 Vertical Boost Pulse

The vertical boost pulse is generated by IC10C. It triggers the vertical boost circuit. The leading edge of the pulse is also a reference in the convergence circuit.

The output of IC10C is coupled to the base of Q16 through C66 and R139. The negative-going transitions of the ramp waveform are passed by C66. D28 limits the negative values to -0.6V. Q16, which is normally ON, is cut-off by the negative-going pulse at its base.

A corresponding positive going pulse at the collector of Q16 is coupled to the positive trigger input of one shot IC2A. The positive going output pulse from IC2A is coupled to output PAI-5 via emitter follower Q15. The pulse width is approximately 200 μ S. R146 and C70 at IC10C pin 10, and R140 and C71 in the collector circuit of Q16, act as filters to reduce interference from the buck converter section.

19.1.2.6 Scan Fail

IC4 and IC5 (CA339 quad comparator), with open collector outputs, indicate scan failure and initiate EHT inhibit. The negative inputs of both ICs, except IC4D, are tied to reference ZD1 and D4. The non-inverting input of IC4D is also tied to this reference.

Pin D of IC5 senses the 200V supply level.

A spot kill signal enters at edge connector PCI-5 and feeds pin D of IC4. This signal is normally low. The comparator outputs will be high, provided all other sensing signals are higher than the reference voltage. All LED indicators will be OFF, diodes D17 and D18 will be back biased and Q1 (inhibit transistor) will be ON and the EHT will operate normally.

In the event of a decrease from the 12V supply, diode D16 keeps C28 from discharging until the 12V line drops sufficiently to keep Q1 OFF. The charging of C28 permits the inhibit transistor to fully shut OFF.

19.2 SERVICING AND ALIGNMENT

19.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:

- rear panel card rack

Tools & Equipment Required:

- Phillips screw driver

- Remove the back panel as described in Section 5.2.

- Locate the Vertical Deflection 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.

19.2.2 Alignment

The following procedure provides instructions for general setup of the Vertical Deflection module.

Reference Figure 19-1.

Tools & Equipment Required:

- printed circuit board extractor
- extender board, Vidikron Part #A- 03-230330-01P
- video source (45 to 120 Hz sync range)
- fine tip slot screwdriver
- oscilloscope

STEP 1 - Remove Vertical Deflection Module

- Hook the printed circuit board extractor into the hole in the bottom outside corner of the Vertical Deflection module. Pull the module out of its slot.

- Insert the extender board into the Vertical Deflection module slot. Put the Vertical Deflection module on the extender board. NOTE: The module may produce video noise when mounted on the extender board.

STEP 2 - LF & UF Set

- Connect the video source to the projector.
- Adjust R122 2/3 clockwise from its zero position.
- Set vertical sync on the source to 45 Hz. Adjust R10 for lock-in.
- Set vertical sync on the source to 120 Hz. Adjust R122 for lock-in.
- Repeat the c) and d) above until both frequencies automatically lock in.

STEP 3 - Size Limit

- Connect the oscilloscope to row A, pin 3 of the extender board (V DRIVE).
- Press **SIZE**, then press **U** on the keypad for maximum vertical size.
- Adjust R118 until the raster fills the face of the CRT.
- Make sure V DRIVE is not clipped.

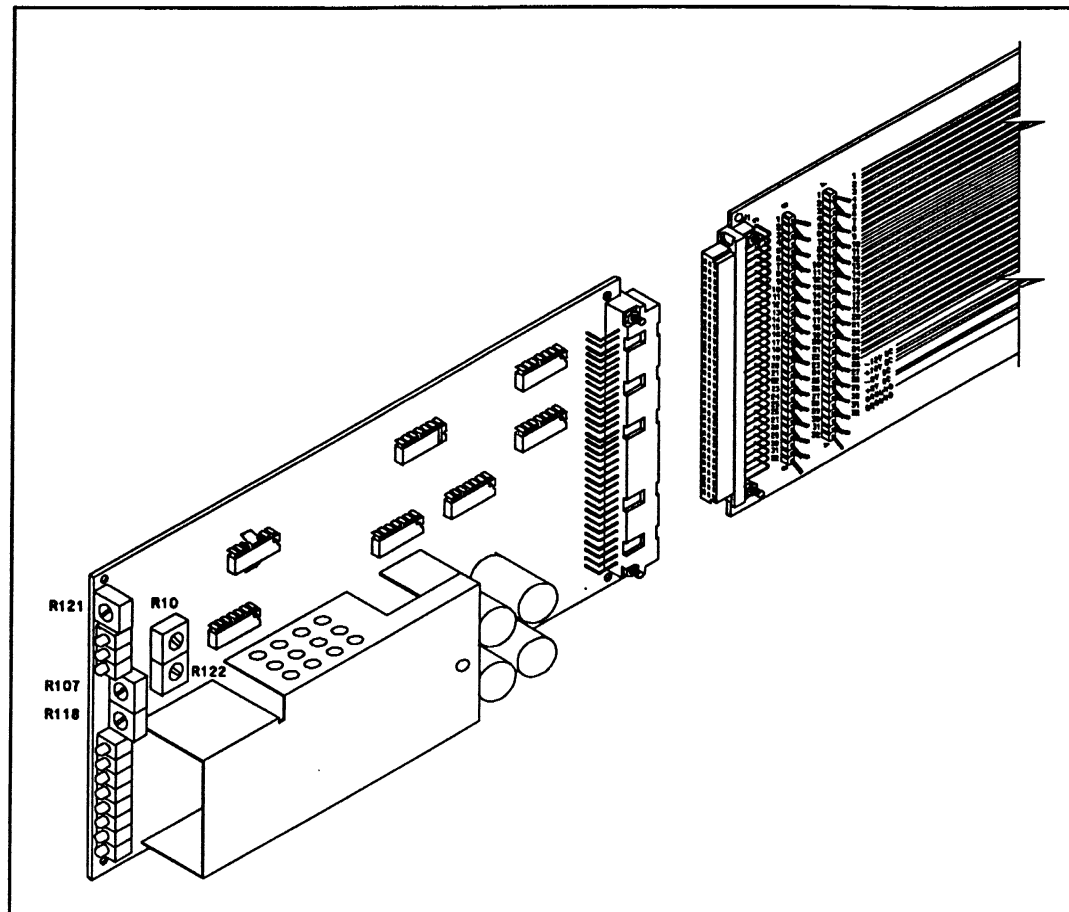


FIGURE 19-1. Vertical Deflection Module Alignment

02080826

STEP 4 - Vertical Linearity

- a) Press the # key on the keypad to produce a crosshatch.
- b) Adjust R107 and R121 until the top-to-bottom linearity looks good and the crosshatch lines appear evenly spaced.

STEP 5 - Current Shut Down

CAUTION

DO NOT USE THE EXTENDER BOARD FOR THIS PROCEDURE! THE R135 ADJUSTMENT REQUIRES REMOVAL AND INSERTION OF THE MODULE.

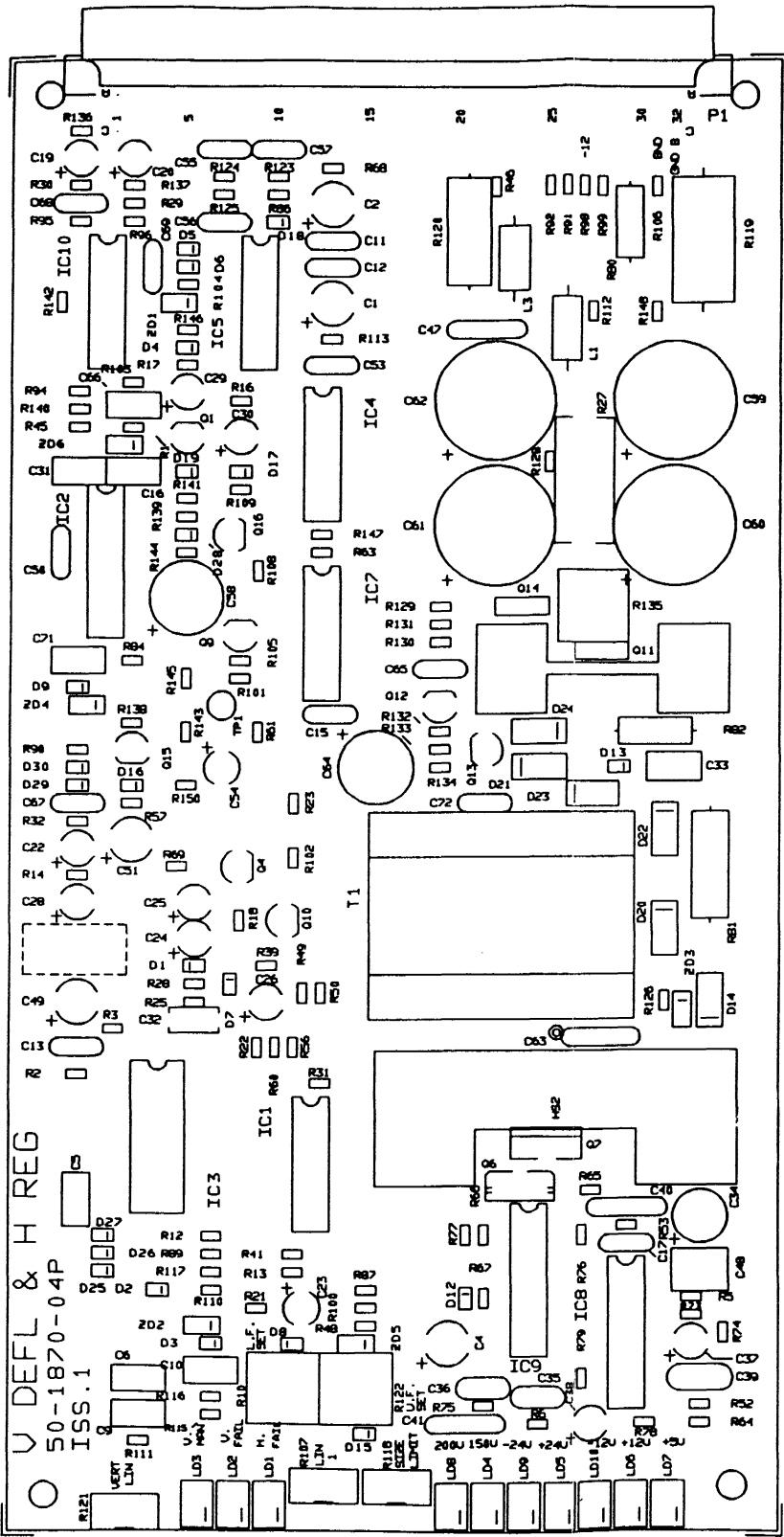
- a) Press the SIZE key on the keypad.
- b) Press the U key for maximum vertical size, then the R key for maximum horizontal size.

- c) Connect a 15.7 KHz source to the projector.
- d) Press KEY then press U on the keypad for maximum keystone.
- e) Turn the projector OFF.
- f) Turn the projector ON. Check the H INHIBIT LED. If the LED is OFF, then the procedure is complete. If the LED is ON, turn the projector OFF.
- g) Adjust R135 slightly clockwise.
- h) Repeat steps 6 and 7 until the LED is OFF.

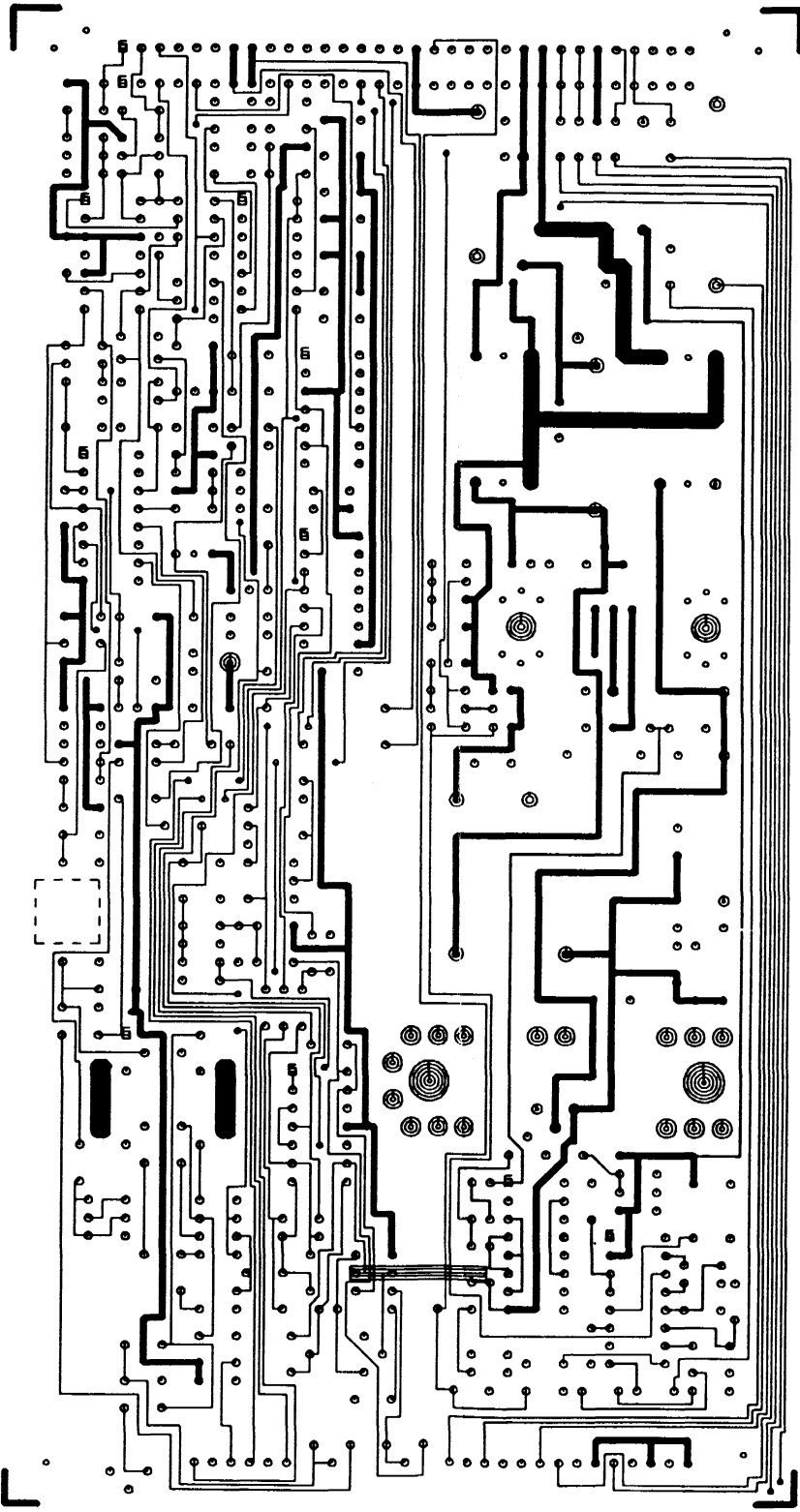
19.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Vertical Deflection module.

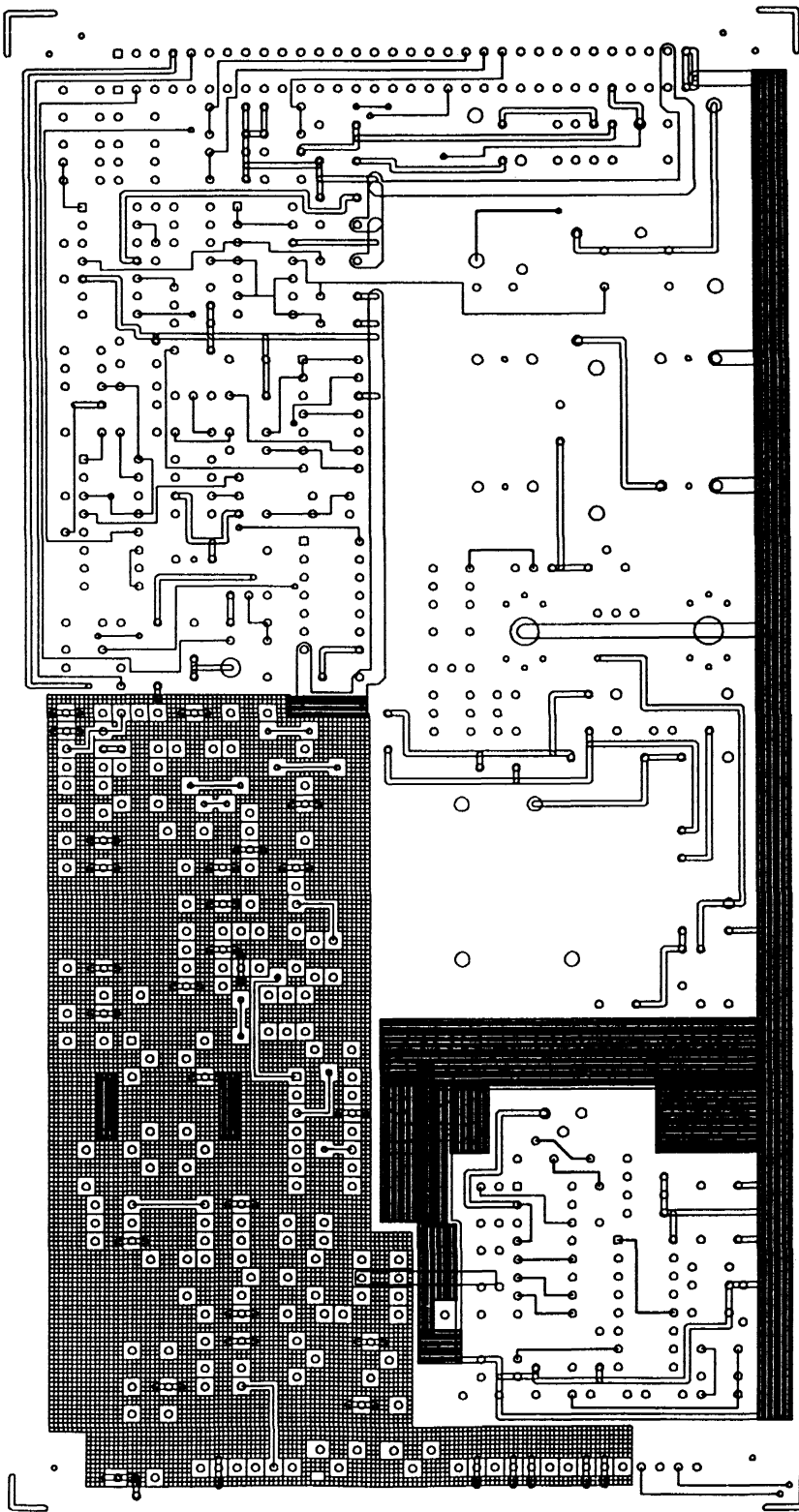
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Component Layout



Solder Side
(Viewed from Component Side)



Component Side

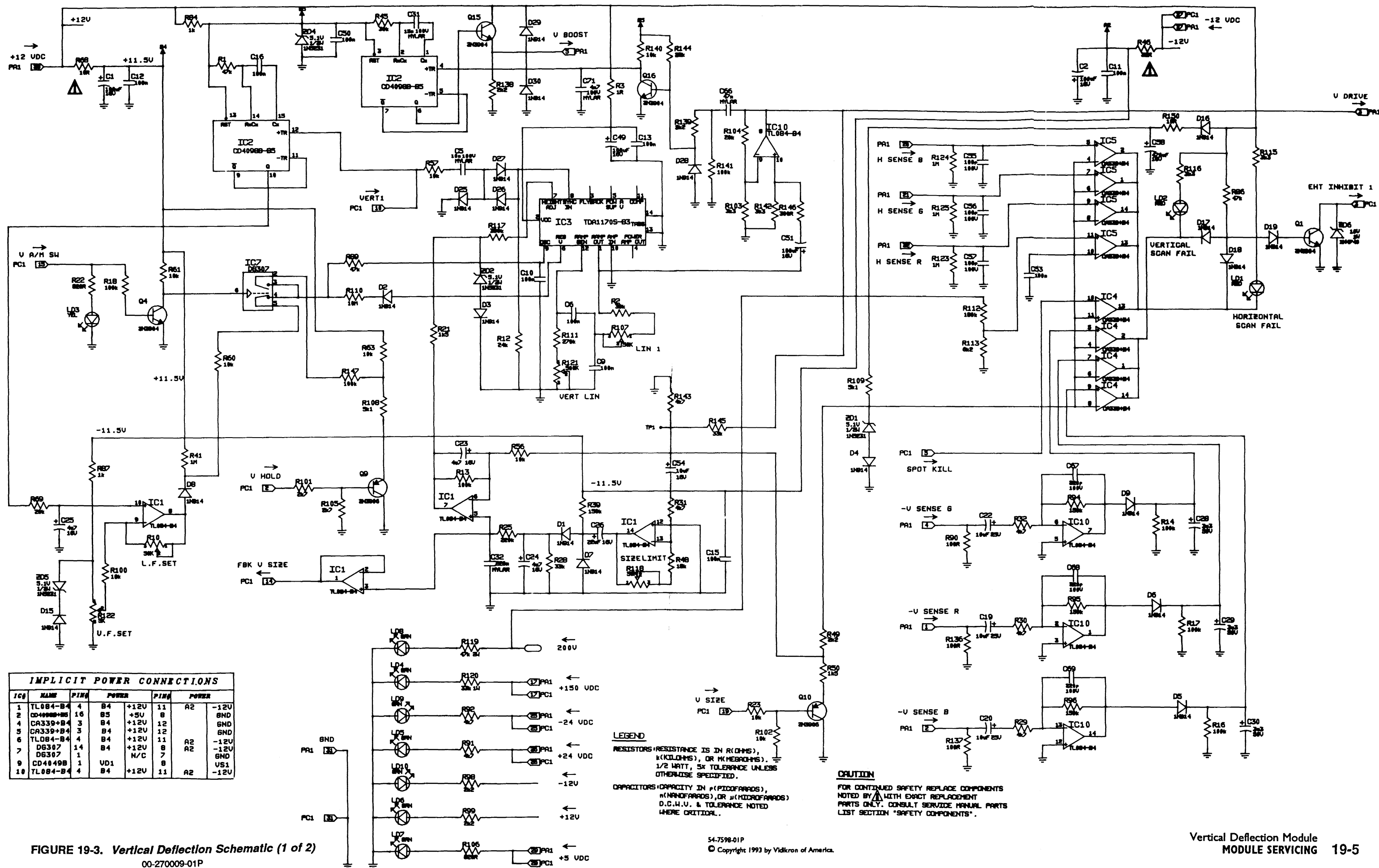
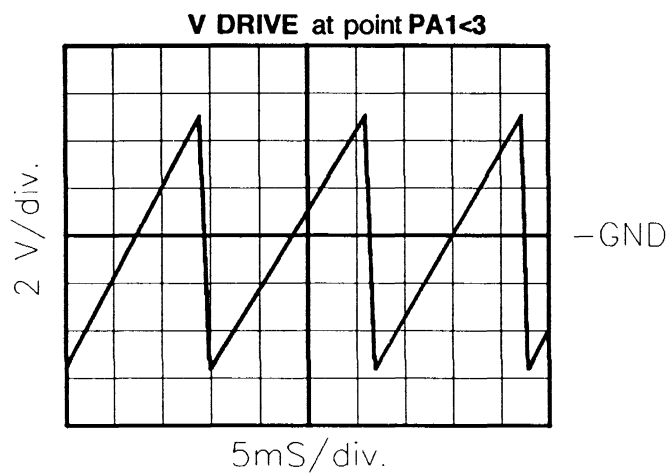
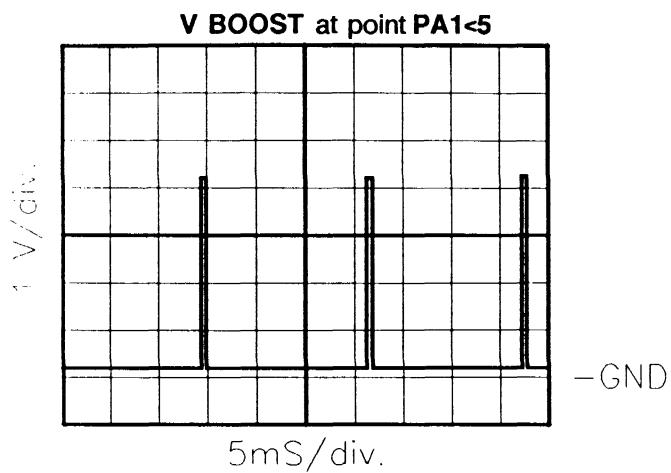


FIGURE 19-3. Vertical Deflection Schematic (1 of 2)
00-270009-01P

19-6 MODULE SERVICING
Vertical Deflection and Horizontal Regulation Module

SCHEMATIC REFERENCE



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19.4 PARTS LIST

▲ - CRITICAL SAFETY COMPONENT
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
Integrated Circuits		
IC1,IC10	IC-14-002104-01P	TL084CN, quad biFET linear op amp
IC2	IC-14-A04021-01P	CD4098BE, CMOS dual mono multivibrator
IC3	IC-14-002084-02P	SGS TDA1170S, linear vertical deflector
IC4,IC5	IC-14-002154-01P	CA339, quad linear voltage comparator
IC7	IC-14-A03009-01P	DG307CJ, I/F analog CMOS gate switch
IC8	IC-14-002830-01P	TDA4716A, SMPS controller
IC9	IC-14-A03014-01P	MC14049UB, I/F logic CMOS buffer
Transistors & Diodes		
Q1,Q4,Q13,Q15,Q16	TR-14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q6	TR-14-000982-14P	MPSU10, NPN, 300V, 0.5A, 1W
Q7	TR-14-A00704-01P	1RF731, hex FET, 350V
Q9,Q10	TR-14-000873-82P	2N3906, PNP, small signal
Q11	TR-14-000986-03P	MJE340, NPN, 300V, 0.5A, 20W
Q12	TR-14-000566-01P	2N5061, SCR thyristor
Q14	TR-14-000986-04P	MJE350, PNP, 300V, 0.5A, 20W
D1-D9,D12,D13	D-14-000513-01P	1N914, diode, 0.075A, 75V
D15-D19,D25-D30		
D14,D20	D-14-000525-07P	BYV26, rectifier, 0.5A, 350V, T
D21-D24	D-14-000533-02P	1N5817, Schottky barrier diode
LD1,LD2	LED-14-001016-02P	LED, 3V, 0.09A, red
LD3	LED-14-001016-03P	LED, 3V, 0.06A, yellow
LD4-LD10	LED-14-001016-01P	LED, 3V, 0.09A, green
ZD1,ZD2,ZD4,ZD5	DZ-14-000515-98P	1N5231, zener diode, 5.1V, 1/2W, 2%, T
ZD3	DZ-14-000531-35P	1N5242, zener diode, -12V, 5%
ZD6	DZ-14-000515-83P	1N4740, zener diode, 10V, 1W, 2%, T
Capacitors		
C1,C2,C4,C49,C51	C-84-410104-03P	100 μ F, 25V, electrolytic
C5	C-88-171030-02P	10 nF, 50V, 10%, mylar
C6,C9,C10,C16	C-88-171041-02P	100 nF, 100V, 10%, mylar
C11-C13,C15,C17,C50, C53,C72	C-89-000032-03P	100 nF, 50V, 20%, ceramic, multi layer
C19,C20,C22,C54	C-84-410004-01P	10 μ F, 25V, electrolytic
C23-C25	C-84-447506-01P	4.7 μ F, 50V, electrolytic
C26,C37,C38	C-84-422004-01P	22 μ F, 25V, electrolytic
C28-C30	C-84-433506-01P	3.3 μ F, 50V, electrolytic
C31	C-88-171531-01P	15 nF, 100V, mylar
C32,C33	C-88-172240-02P	220 nF, 50V, 10%, mylar
C34	C-84-422104-03P	220 μ F, 25V, electrolytic
C35,C36	C-89-000033-02P	1.0 nF, 50V, 1%, ceramic, multi layer
C39	C-89-000032-02P	0.47 μ F, 50V, \pm 20%, ceramic, multi layer
C40,C41	C-86-310213-02P	1 nF, 500V, 10%, Z5P
C47	C-46-310327-11P	10 nF, 500V, 20%
C48	C-88-173340-02P	330 nF, 63V, 10%, mylar
C55-C57,C65	C-86-610134-04P	100 pF, 100V, NPO, ceramic
C58	C-44-447103-06P	470 μ F, 16V, electrolytic

19.4 PARTS LIST (cont.)

▲ - CRITICAL SAFETY COMPONENT
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
Capacitors (cont.)		
C59-C62	C-44-422010-08P	22 μ F, 250V, electrolytic
C63	C-86-339113-02P	390 pF, 500V, 10%, ceramic disc
C64	C-44-447102-05P	470 μ F, 10V, electrolytic
C66	C-88-174730-02P	47 nF, 10%, mylar
C67-C69	C-86-622151-02P	220 pF, 100V, 10%, ceramic
C71	C-88-174721-02P	4.7 nF, 100V, 10%, mylar
Resistors		
R1	R-80-162025-11P	62K, 1/2W, 5%, metal film
R2	R-80-139025-11P	39K, 1/2W, 5%, metal film
R3	R-82-310085-29P	1R, 1/3W, 5%
R5,R84,R87,R148	R-80-110015-11P	1K, 1/2W, 5%, metal film
R6	R-80-116015-11P	1.6K, 1/2W, 5%, metal film
R10	VR-41-000344-13P	50K, carbon trim pot.
R12	R-80-124025-11P	24K, 1/2W, 5%, metal film
R13,R14,R16-R18,R141, R147	R-80-110035-11P	100K, 1/2W, 5%, metal film
R21,R50,R126	R-80-115015-11P	1.5K, 1/2W, 5%, metal film
R22,R76,R106	R-80-182005-11P	820R, 1/2W, 5%, metal film
R23,R56,R57,R60,R61, R63-R67,R100,R102, R131,R140	R-80-110025-11P	10K, 1/2W, 5%, metal film
R25	R-80-122035-11P	220K, 1/2W, 5%, metal film
▲ R27	R-42-000134-01P	0.82R, 2W, 5%
R28,R145	R-80-133025-11P	33K, 1/2W, 5%, metal film
R29-R32,R91,R92,R143	R-80-147015-11P	4.7K, 1/2W, 5%, metal film
R39,R94-R96	R-80-115035-11P	150K, 1/2W, 5%, metal film
R41,R123,R124,R125	R-80-110045-11P	1M, 1/2W, 5%, metal film
R45	R-80-130025-11P	30K, 1/2W, 5%, metal film
R46	R-80-122095-11P	22R, 1/2W, 5%, metal film
R48	R-80-118025-11P	18K, 1/2W, 5%, metal film
R49,R53,R98,R99,R138, R139	R-80-122015-11P	2.2K, 1/2W, 5%, metal film
R52	R-80-139015-11P	3.9K, 1/2W, 5%, metal film
R68,R150	R-80-110095-11P	10R, 1/2W, 5%, metal film
R69,R104	R-80-120025-11P	20K, 1/2W, 5%, metal film
R73,R101,R105	R-80-127015-11P	2.7K, 1/2W, 5%, metal film
R74	R-80-130015-11P	3K, 1/2W, 5%, metal film
R75	R-80-115005-11P	150R, 1/2W, 5%, metal film
R77	R-80-122005-11P	220R, 1/2W, 5%, metal film
R78	R-40-123955-31P	3.9M, 1/4W, 5%, metal film
R79	R-80-112025-11P	12K, 1/2W, 5%, metal film
▲ R80	R-42-000125-10P	10R, 1/4W, 5%, TC
▲ R81	R-42-000108-03P	22K, 1W, 5%
▲ R82	R-42-000125-11P	390R, 1/4W, 5%, TC
R86,R89	R-80-147025-11P	47K, 1/2W, 5%, metal film
R90,R136,R137	R-80-110005-11P	100R, 1/2W, 5%, metal film
R103,R115,R116,R142	R-80-133015-11P	3.3K, 1/2W, 5%, metal film

19.4 PARTS LIST (cont.)

▲ - CRITICAL SAFETY COMPONENT
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
Resistors (cont.)		
R107,R118	VR-41-000344-43P	50K, carbon trim pot.
R108,R109	R-80-151015-11P	5.1K, 1/2W, 5%, metal film
R110	R-40-121065-31P	10M, 1/4W, 5%, metal film
R111	R-80-127035-11P	270K, 1/2W, 5%, metal film
R112	R-80-118035-11P	180K, 1/2W, 5%, metal film
R113	R-80-162015-11P	6.2K, 1/2W, 5%, metal film
R117	R-80-139035-11P	390K, 1/2W, 5%, metal film
R119	R-40-624735-01P	47K, 2W, 5%
R120	R-40-423335-01P	33K, 1W, 5%
R122	VR-41-000344-09P	5K, carbon trim pot.
R128	R-80-156095-11P	56R, 1/2W, 5%, metal film
R129	R-80-156015-11P	5.6K, 1/2W, 5%, metal film
R130	R-80-151005-11P	510R, 1/2W, 5%, metal film
R132	R-80-120015-11P	2K, 1/2W, 5%, metal film
R133	R-80-182015-11P	8.2K, 1/2W, 5%, metal film
R134	R-80-112015-11P	1.2K, 1/2W, 5%, metal film
R135	VR-41-000344-06P	500R, carbon trim pot.
R144	R-80-122025-11P	22K, 1/2W, 5%, metal film
R146	R-80-130005-11P	300R, 1/2W, 5%, metal film
Coils & Transformers		
L1	L-21-001400-09P	5.6 μ H, RF choke
L3	L-21-001400-24P	5.6 μ H, choke
T1	T-24-161012-01P	choke, deflection power supply

19.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 analog input **-V SENSE R**
NOTE: see Power Deflection module

Pin 2 analog input **-V SENSE B**
NOTE: see Power Deflection module

Pin 3 analog output **V DRIVE**

no load, V SIZE = 5V
 adjust R118 such that the minimum to
 maximum voltage is 6 to 21V p-p $\pm 10\%$

adjust R118 to produce 10V p-p
 set V SIZE = 10V
 signal level **12V p-p $\pm 10\%$**

set V SIZE = 0V
 signal level **7V p-p $\pm 10\%$**

Pin 4 analog input **-V SENSE G**
NOTE: see Power Deflection module

Pin 5 analog output **V BOOST**
 vertical pulse, +ve going **5V peak $\pm 10\%$**
 pulse width **300 μ s $\pm 10\%$**

Pin 7 analog **OFFSET DC**

Pin 8 analog **VAR DC DEFL**

Pin 17 +150V power supply **+150 VDC**
 LED (LD4) indicator **5 mA max**

Pin 18 analog input **BUCK WIDTH**
NOTE: see Power Deflection module

Pin 20 analog input **H SENSE B**
NOTE: see Power Deflection module

Pin 21 analog input **H SENSE G**
NOTE: see Power Deflection module

Pin 22 analog input **H SENSE R**
NOTE: see Power Deflection module

Pin 23 analog output **BUCK OUT**
 Horizontal Regulator output, measure with pin A-18 adjusted
 for output current of:
 203 mA **115V $\pm 2\%$**
 308 mA **152V $\pm 2\%$**
 760 mA **47V $\pm 2\%$**

Pin 24 +200V power supply **+200 VDC**
 current range **128 to 300 mA**

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

(for LD9) current level **5 mA max**

Pin 26 +24V power supply **+24 VDC**
 (for LD5) current level **5 mA max**

Pin 27 -12V power supply **-12 VDC**
 current level **45 mA max**

Pin 28 +12V power supply **+12 VDC**
 current level **160 mA**

Pin 29 +5V power supply **+5 VDC**
 (for LD7) current level **5 mA 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 2 analog input **V HOLD**
 signal level **0 to 10VDC**
 vertical oscillator lock-in range
 manual mode @ SW = 5V
 lock-in range **45 to 120 Hz**
 pull-in range **+10/-0 Hz min**
 auto mode @ SW = 0V
 lock-in range **45 to 120 Hz**

Pin 3 analog output **EHT INHIBIT 1**
NOTE: collector output is open when inhibit is active

Pin 5 analog input **SPOT KILL**
NOTE: see Horizontal Deflection module

Pin 7 **OFFSET DC**
NOTE: connected to Row A, Pin 7

Pin 8 **VAR DC DEFL**
NOTE: connected to Row A, Pin 8

Pin 10 analog input **VERT1**
 positive vertical sync **0 to 5V**

Pin 14 analog output **FBK V SIZE**
 measure with no load on V DRIVE, V SIZE set to 5V
 R118 @ min **4VDC $\pm 10\%$**
 R118 @ max **3.6VDC $\pm 10\%$**

Pin 15 analog input **V A/M SW**
 vertical auto/manual switch **0 to 5VDC**

Pin 19 analog input **V SIZE**
 vertical size control **0 to 10VDC**
NOTE: from Remote Control module