

SECTION 17

VERTICAL DEFLECTION & HORIZONTAL REGULATION MODULE

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17.1 TECHNICAL DESCRIPTION

17.1.1 General Description

The Vertical Deflection & Horizontal Regulation 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.

17.1.2 Circuit Description

17.1.2.1 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.

17.1.2.2 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 is adjusted until the oscillator frequency locks to incoming sync. In the event of sync failure, the oscil will run free, maintaining vertical deflection.

17.1.2.3 Vertical Ramp Circuit

IC3 (a TDA1170S differential amplifier) generates 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. control circuitry regulates the current generator. Capacitors C6 and C9 and resistors R111, R121, R21 and R107 use buffered RAMP GEN to produce a ramp curve. This curve is independent of height and size regulation. Series R107 and R21 adjusts linearity. Series R111 and R121 corrects tilt.

NOTE: The removal or absence of R111, R121, and R107 will result in a linear ramp. At impedance levels, this ramp will also appear at pin 12 of IC3.

17.1.2.4 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 IC10B 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, gain remains constant. R118 (size limit control) adjusts the gain of IC1D. Increased gain reduces ramp output level.

17.1.2.5 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 Q10 through C66 and R139. The negative-going transition of the ramp waveform are passed by C66. D28 limits

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Vertical Deflection and Horizontal Regulation Module

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 PA1-5 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.

17.1.2.6 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.

17.2 SERVICING AND ALIGNMENT

17.2.1 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 & Horizontal Regulation 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.

17.2.2 Alignment

The following procedure provides instructions for general setup of the Vertical Deflection & Horizontal Regulation Module.

Reference Figure 17-1.

Tools & Equipment Required:

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

STEP 1 – Remove Vertical Deflection & Horizontal Regulation Module

a) Hook the printed circuit board extractor into the hole in the bottom outside corner of the Vertical Deflection & Horizontal Regulation module. Pull the module out of its slot.

b) Insert the extender board into the Vertical Deflection & Horizontal Regulation module slot. Put the Vertical Deflection & Horizontal Regulation 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.

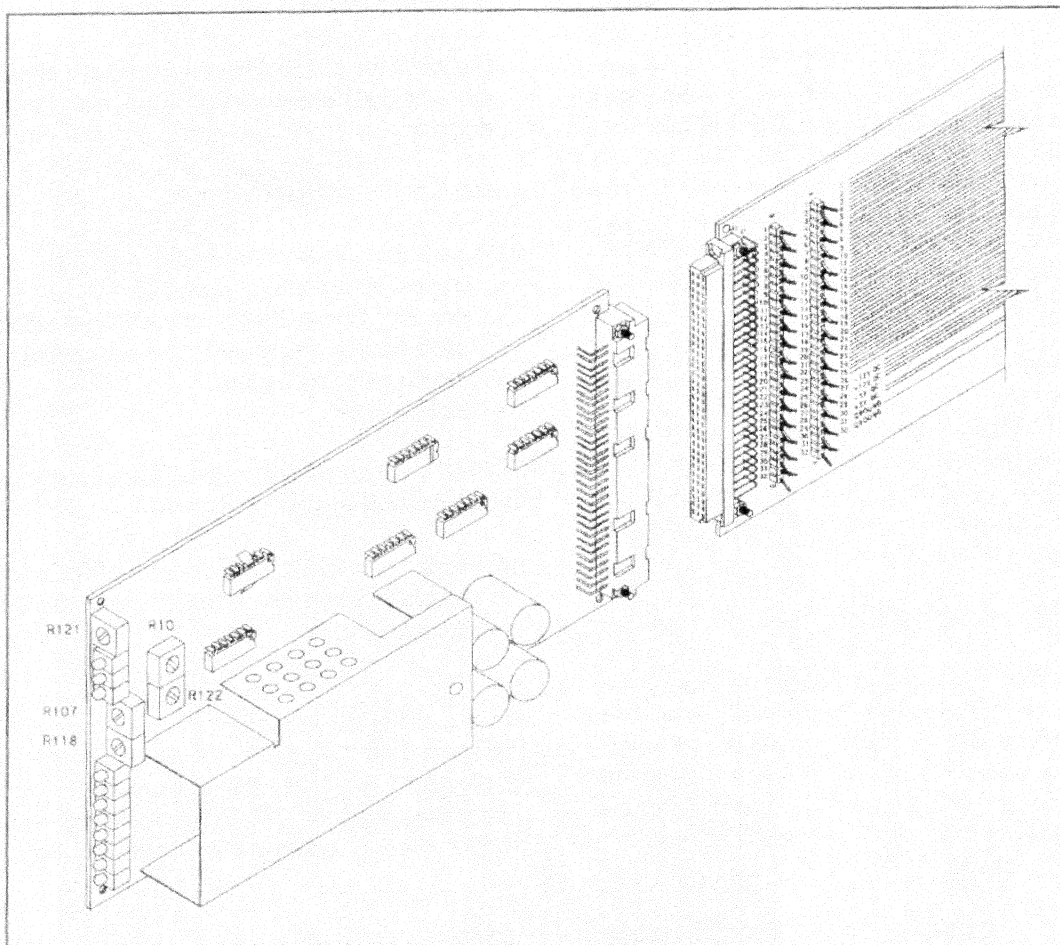


FIGURE 17-1. Vertical Deflection & Horizontal Regulation Module Alignment

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! R135 adjustment will require physical 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.

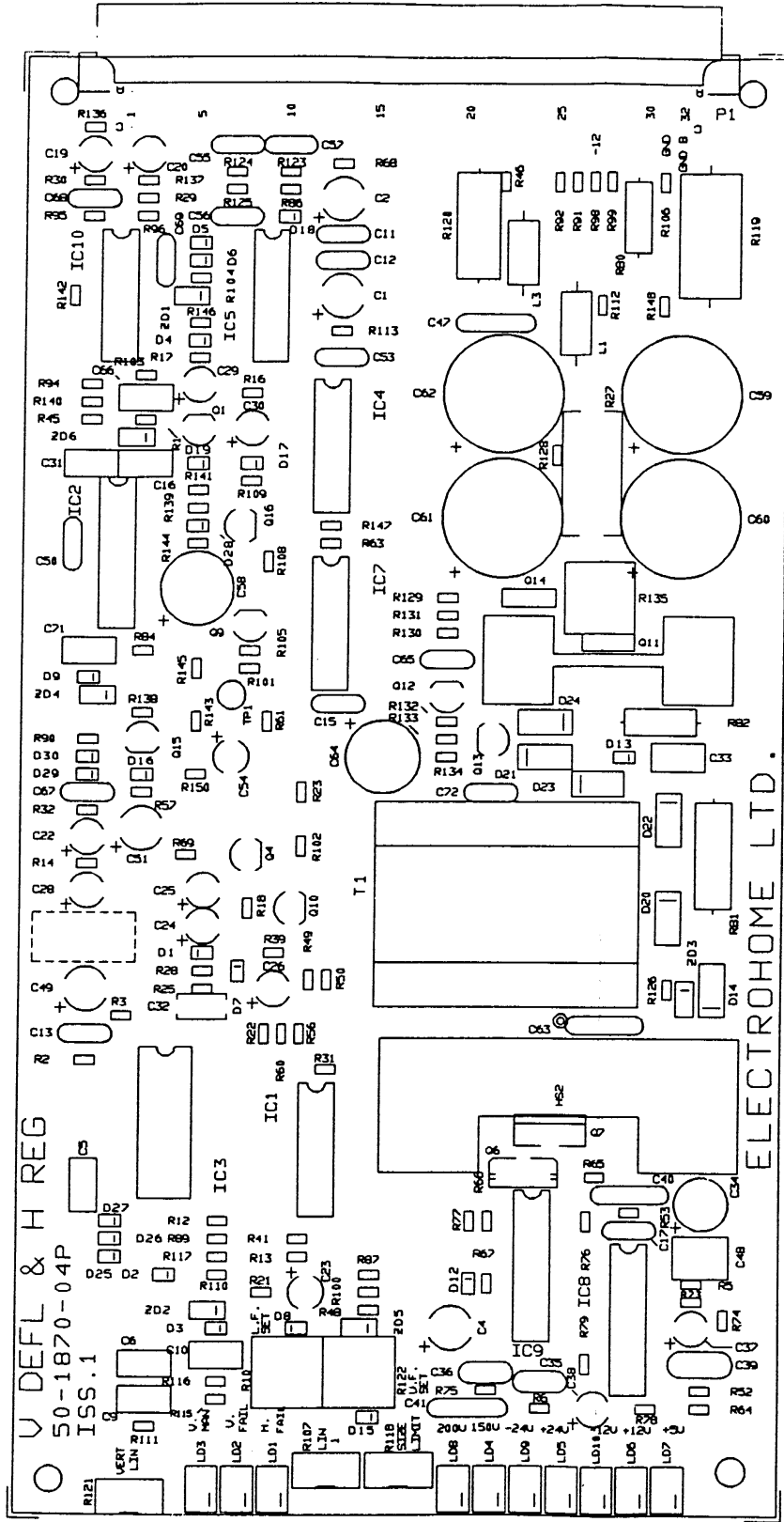
g) Adjust R135 slightly clockwise.

h) Repeat steps 6 and 7 until the LED is OFF.

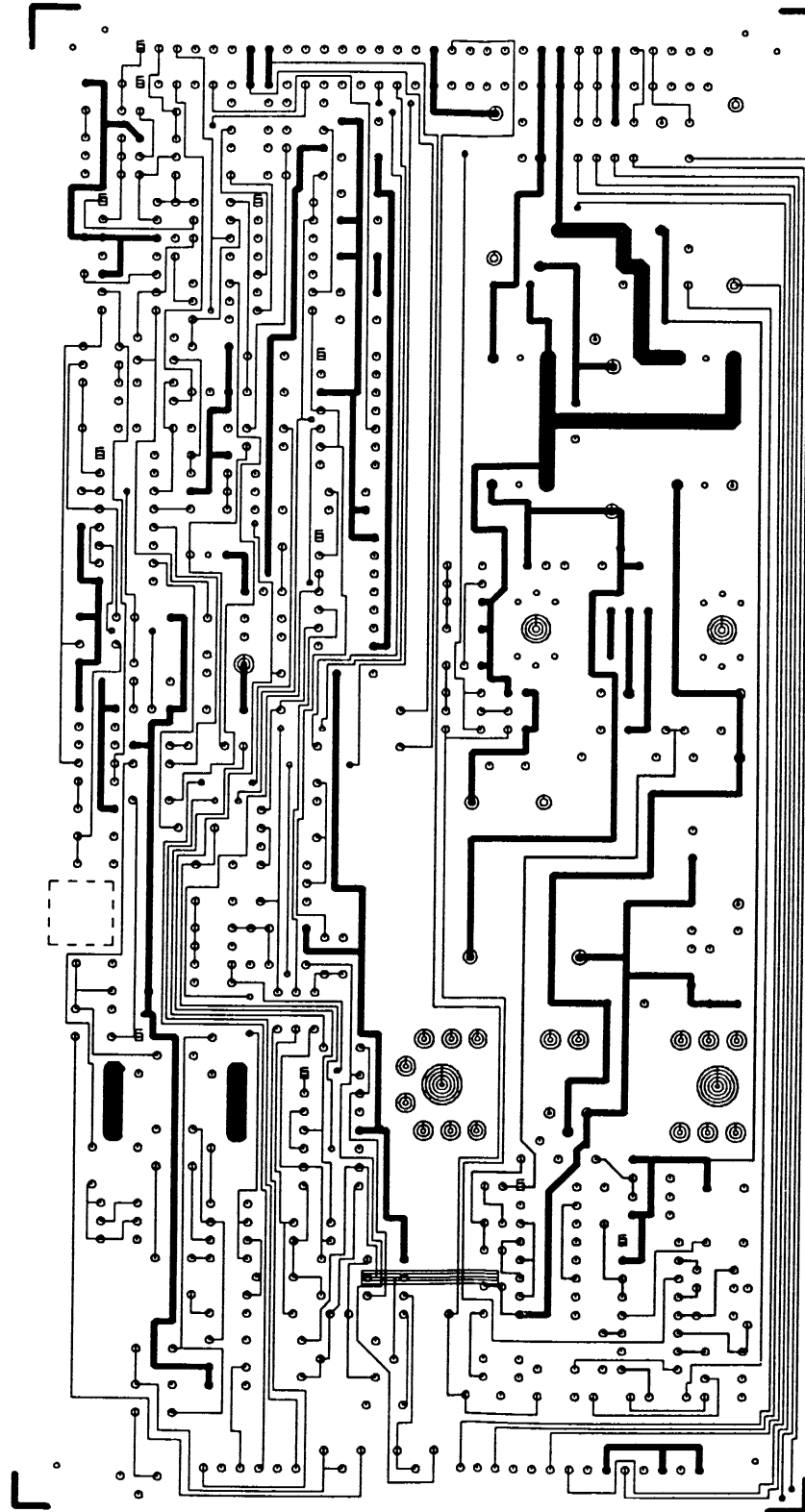
17.3 COMPONENT LAYOUT AND SCHEMATICS

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

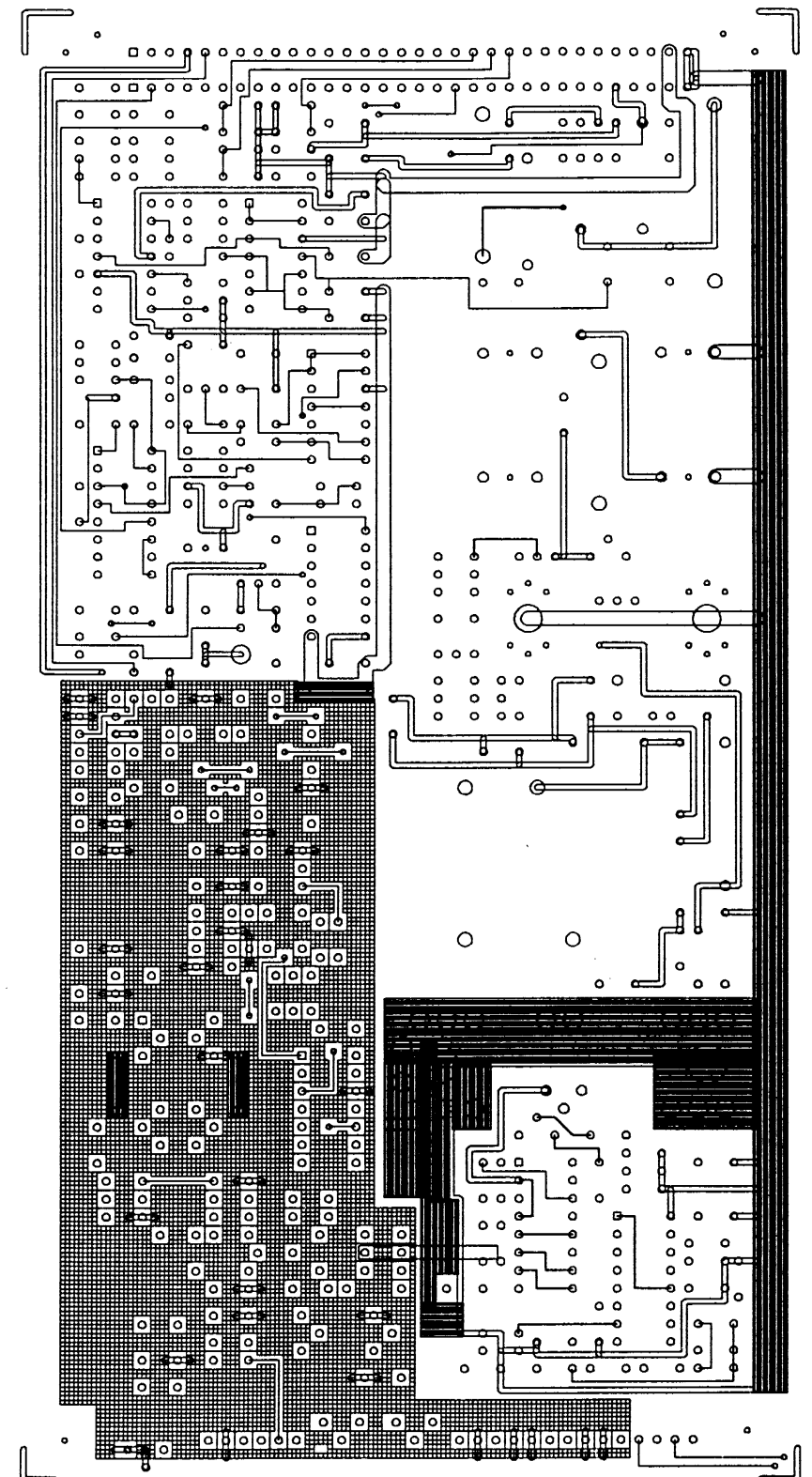
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Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 17-2.
Vertical Deflection & Horizontal
Regulation Module Component Layout

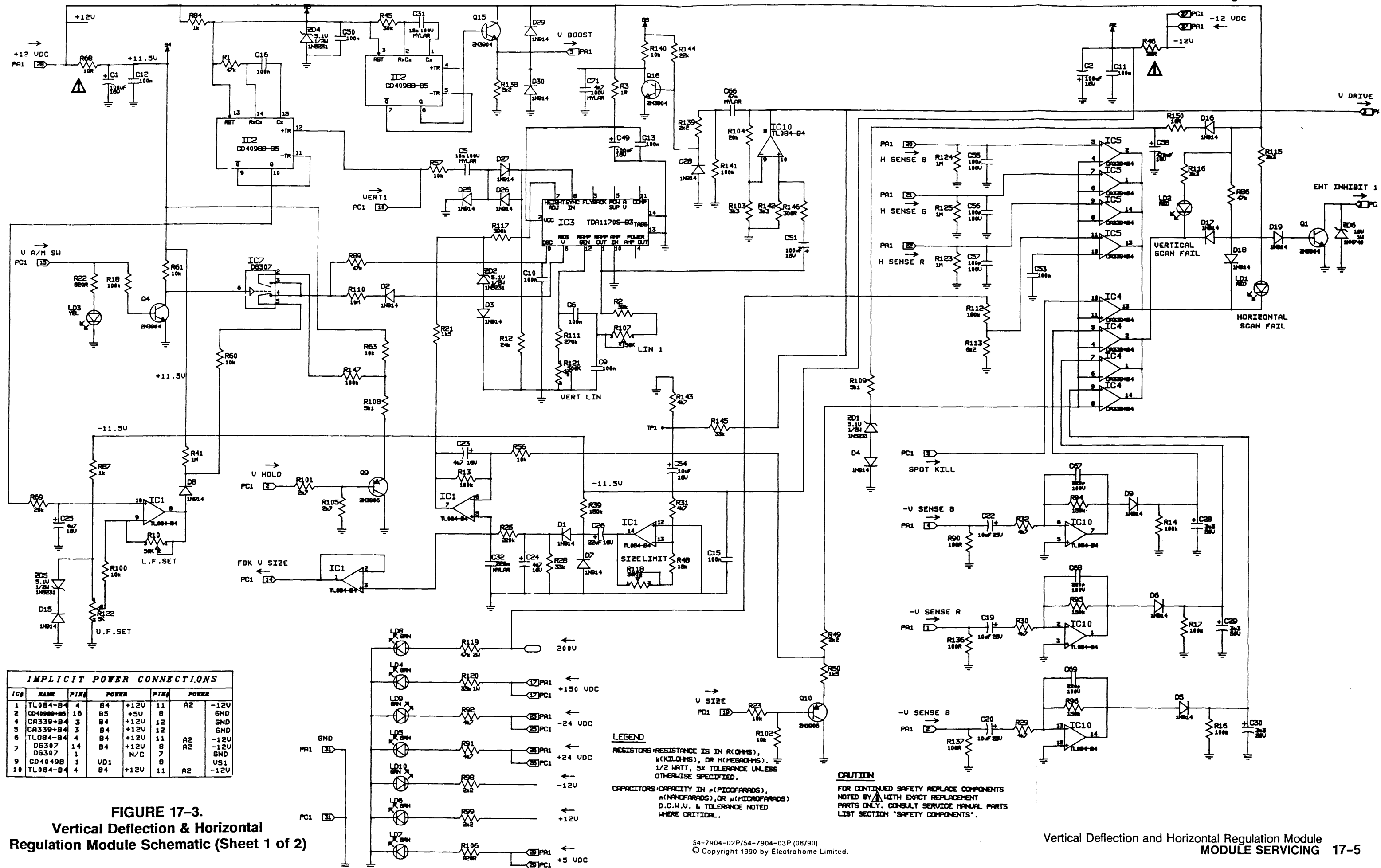
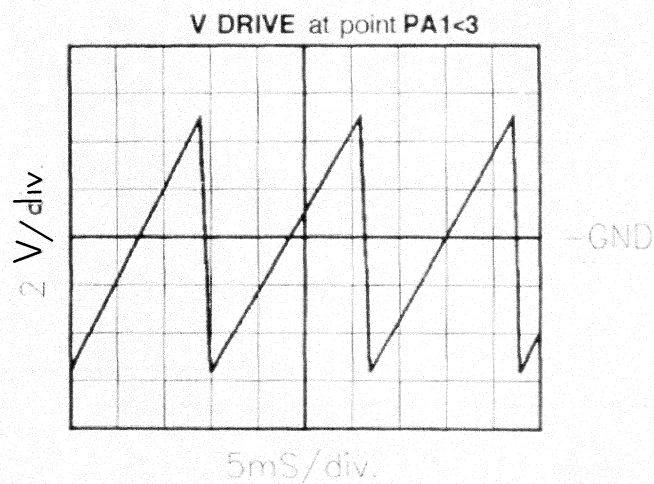
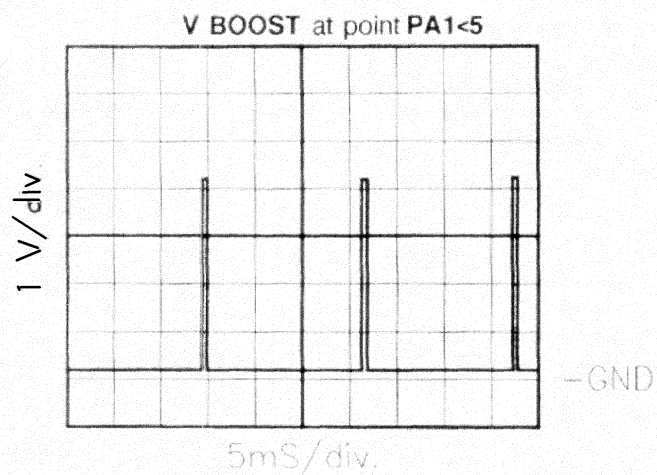


FIGURE 17-3.
Vertical Deflection & Horizontal
Regulation Module Schematic (Sheet 1 of 2)

SCHEMATIC REFERENCE



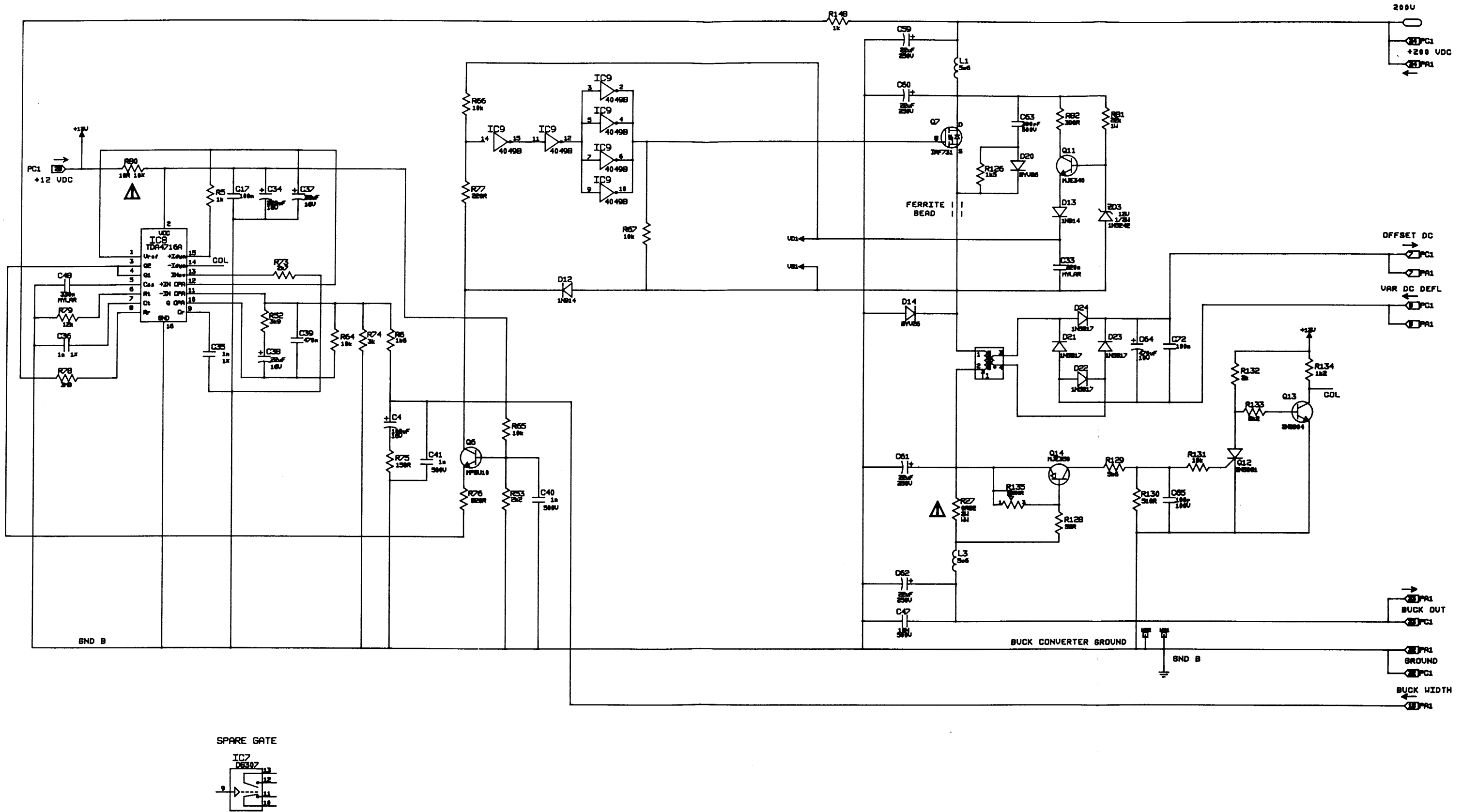


FIGURE 17-4.
Vertical Deflection & Horizontal
Regulation Module Schematic (Sheet 2 of 2)

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Vertical Deflection and Horizontal Regulation Module



17.4 PARTS LIST

Item Ref.	Part No.	Description
Integrated Circuits		
IC1,IC10	14-002104-01P	TL084CN, quad biFET linear op amp
IC2	14-A04021-01P	CD4098BE, CMOS dual mono multivibrator
IC3	14-002084-02P	SGS TDA1170S, linear vertical deflector
IC4,IC5	14-002154-01P	CA339, quad linear voltage comparator
IC7	14-A03009-01P	DG307CJ, I/F analog CMOS gate switch
IC8	14-002830-01P	TDA4716A, SMPS controller
IC9	14-A03014-01P	MC14049UB, I/F logic CMOS buffer
Transistors & Diodes		
Q1,Q4,Q13, Q15,Q16	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q6	14-000982-14P	MPSU10, NPN, 300V, 0.5A, 1W
Q7	14-A00704-01P	1RF731, hex FET, 350V
Q9,Q10	14-000873-82P	2N3906, small signal
Q11	14-000986-03P	MJE340, NPN, 300V, 0.5A, 20W
Q12	14-000566-01P	2N5061, SCR thyristor
Q14	14-000986-04P	MJE350, PNP, 300V, 0.5A, 20W
D1-D9,D12,D13, D15-D19,D25-D30	14-000513-01P	1N914A, diode, 0.075A, 75V, T
D14,D20	14-000525-07P	BYV26, rectifier, 0.5A, 350V, T
D21-D24	14-000533-02P	1N5817, Schottky barrier diode
LD1,LD2	14-001016-02P	LED, 3V, 0.09A, red
LD3	14-001016-03P	LED, 3V, 0.06A, yellow
LD4-LD10	14-001016-01P	LED, 3V, 0.09A, green
ZD1,ZD2,ZD4,ZD5	14-000515-98P	1N5231C, zener diode, 5.1V, 1/2W, 2%, T
ZD3	14-000531-35P	1N5242, zener diode, -12V, 5%
ZD6	14-000515-83P	1N4740, zener diode, 10V, 1W, 2%, T
Capacitors		
C1,C2,C4,C49,C51	84-410104-03P	100 μ F, 25V
C5	88-171030-02P	10 nF, 50V, 10%, mylar
C6,C9,C10,C16	88-171041-02P	100 nF, 100V, 10%
C11-C13,C15,C17, C50,C53,C72	89-000032-03P	100 nF, 50V
C19,C20,C22,C54	84-410004-01P	10 μ F, 25V
C23-C25	84-447506-01P	4.7 μ F, 50V
C26,C37,C38	84-422004-01P	22 μ F, 25V
C28-C30	84-433506-01P	3.3 μ F, 50V
C31	88-171531-01P	15 nF, 100V, mylar
C32,C33	88-172240-02P	220 nF, 50V, 10%
C34	84-422103-03P	220 μ F, 16V
C35,C36	89-000033-02P	1.0 nF, 50V, 1%
C39	89-000032-02P	0.47 μ F, 50V, \pm 20%
C40,C41	86-310213-02P	1 nF, 500V, 10%, Z5P

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Vertical Deflection and Horizontal Regulation Module

17.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Capacitors (cont.)		
C47	46-310313-11P	10 nF, 500V, 10%, Z5P
C48	88-173340-02P	330 nF, 63V, 10%
C55-C57, C65	86-610134-04P	100 pF, NPO
C58	44-447103-06P	470 μ F, 16V
C59-C62	44-422010-09P	22 μ F, 250V
C63	86-339113-02P	390 pF, 500V, 10%
C64	44-447102-05P	470 μ F, 10V
C66	88-174730-02P	47 nF, mylar
C67-C69	86-622151-02P	220 pF, 100V, 10%
C71	88-174721-02P	4.7 nF, 100V, 10%, mylar
Resistors		
R1, R86, R89	80-147025-11P	47K, 1/2W, 5%, metal film
R2	80-139025-11P	39K, 1/2W, 5%, metal film
R3	82-310085-29P	1R, 1/3W, 5%
R5, R84, R87, R148	80-110015-11P	1K, 1/2W, 5%, metal film
R6	80-116015-11P	1.6K, 1/2W, 5%
R10	41-000344-13P	50K, carbon trim pot
R12	80-124025-11P	24K, 1/2W, 5%, metal film
R13, R14, R16-R18, R141, R147	80-110035-11P	100K, 1/2W, 5%, metal film
R21, R50, R126	80-115015-11P	1.5K, 1/2W, 5%, metal film
R22, R76, R106	80-182005-11P	820R, 1/2W, 5%, metal film
R23, R56, R57, R60, R61, R63-R67, R100, R102, R131, R140	80-110025-11P	10K, 1/2W, 5%, metal film
R25	80-122035-11P	220K, 1/2W, 5%
 R27	42-000134-01P	0.82R, 2W, 5% SAFETY COMPONENT
R28, R145	80-133025-11P	33K, 1/2W, 5%, metal film
R29-R32, R91, R92, R143	80-147015-11P	4.7K, 1/2W, 5%, metal film
R39, R94-R96	80-115035-11P	150K, 1/2W, 5%, metal film
R41, R123, R124, R125	80-110045-11P	1M, 1/2W, 5%, metal film
R45	80-130025-11P	30K, 1/2W, 5%
 R46	80-122095-11P	22R, 1/2W, 5%, metal film SAFETY COMPONENT
R48	80-118025-11P	18K, 1/2W, 5%, metal film
R49, R53, R98, R99, R138, R139	80-122015-11P	2.2K, 1/2W, 5%
R52	80-139015-11P	3.9K, 1/2W, 5%, metal film

17.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Resistors (cont.)		
⚠ R68,R150	80-110095-11P	10R, 1/2W, 5%, metal film SAFETY COMPONENT
R69,R104	80-120025-11P	20K, 1/2W, 5%, metal film
R73,R101,R105	80-127015-11P	2.7K, 1/2W, 5%, metal film
R74	80-130015-11P	3K, 1/2W, 5%, metal film
R75	80-115005-11P	150R, 1/2W, 5%, metal film
R77	80-122005-11P	220R, 1/2W, 5%, metal film
R78	40-123955-31P	3.9M, 1/4W, 5%
R79	80-112025-11P	12K, 1/2W, 5%, metal film
⚠ R80	42-000125-10P	10R, 1/4W, 5%, TC SAFETY COMPONENT
R81	42-000108-03P	22K, 1W, 5%
R82	42-000125-11P	390R, 1/4W, 5%, TC
R90,R136,R137	80-110005-11P	100R, 1/2W, 5%, metal film
R103,R115,R116, R142	80-133015-11P	3.3K, 1/2W, 5%, metal film
R107,R118	41-000344-43P	50K, carbon trim pot
R108,R109	80-151015-11P	5.1K, 1/2W, 5%, metal film
R110	40-121065-31P	10M, 1/4W, 5%
R111	80-127035-11P	270K, 1/2W, 5%, metal film
R112	80-118035-11P	180K, 1/2W, 5%, metal film
R113	80-162015-11P	6.2K, 1/2W, 5%, metal film
R117	80-139035-11P	390K, 1/2W, 5%, metal film
R119	40-624735-01P	47K, 2W, 5%
R120	40-423335-01P	33K, 1W, 5%
R121	41-000344-47P	500K, carbon trim pot
R122	41-000344-09P	5K, carbon trim pot
R128	80-156095-11P	56R, 1/2W, 5%, metal film
R129	80-156015-11P	5.6K, 1/2W, 5%, metal film
R130	80-151005-11P	510R, 1/2W, 5%, metal film
R132	80-120015-11P	2K, 1/2W, 5%, metal film
R133	80-182015-11P	8.2K, 1/2W, 5%, metal film
R134	80-112015-11P	1.2K, 1/2W, 5%, metal film
R135	41-000344-06P	500R, carbon trim pot
R144	80-122025-11P	22K, 1/2W, 5%, metal film
R146	80-130005-11P	300R, 1/2W, 5%, metal film
Coils & Transformers		
L1	21-001400-09P	5.6 μ H, RF choke
L3	21-001400-24P	5.6 μ H, choke
T1	24-161012-01P	deflection choke power supply

17-12 MODULE SERVICING

Vertical Deflection and Horizontal Regulation Module

17.5 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