

SERVICE MANUAL

17" HIGH - RESOLUTION
COLOR DISPLAY MONITOR
MODEL TFS6705

≡ VC-7

MITSUBISHI ELECTRIC CORPORATION

APR. 1992

X-RADIATION WARNING

The surface of picture tube may generate X-Radiation. Precaution during servicing, and if possible use of a lead apron or metal for shielding is recommended. To avoid possible exposure to X-Radiation and electrical shock hazard, the high voltage compartment and the picture tube shield must be kept in place whenever the chassis is in operation. When replacing picture tube use only designated replacement part since it is a critical component with regard to X-Radiation as noted above.

CRITICAL COMPONENT REPLACEMENT WARNING

- The components marked "△" are critical components for X-ray radiation. When replacing these parts, use exactly the same one indicated in parts list.
- Please do not remove the seal of sealed potentiometer.
- The components stated below are no field serviceable parts. If broken, please contact with qualified personnel of Mitsubishi Electric Corp. or the distributor which indicated on name plate.
VR601 (HV-ADJ) VR602 (HV-PROTEC) T601 (FBT)

CAUTION

" In the product, metal plates and heatsinks located near fan are used for connection of safety ground. Same type of screw and washer must be used for safety connection, and should confirm for providing them."

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1. SPECIFICATION

1.1 FEATURES

(1) HIGH RESOLUTION IMAGE

1280 x 1024 pixel resolution image in non-interlace mode comes out. Flicker free image is enabled by non-interlace operation.

(2) AUTO TRACKING FUNCTION

Input signals which have 30 KHz~64 KHz as horizontal scanning freq., and 50 Hz~130 Hz as vertical scanning freq. can be displayed correctly in the screen of this monitor by the auto tracking function without any adjustment.

Display image size and position of 4 different signal sources are memorized by user and that of 6 different signal sources are preset at factory.

(3) EASY RE-ADJUSTMENT

Adjustment points of display image size and position are easily accessed through the front lid of the standard plastic cabinet, and push buttons.

(4) WIDE - BAND - VIDEO AMPLIFIER

Wide-band-analog video amplifier can display the fine-grained picture with unlimited colour.

NOTE:

In case of horizontal freq. around 62 - 64 KHz and vertical refresh rate of 74 - 76 Hz, should be applied as resolution 1024 x 768.

1.2 RATING / SPECIFICATION

(1) AC Power Voltage: 90-132 and 180-264VAC

(2) AC Power Frequency: 50/60 Hz

(3) Power Consumption: 130 W (nominal)

(4) Input Signal

(a) Video Signal: Analog RGB 0.7 Vp-p (typ)
(Positive bright)

(b) Sync Signal:

Composite sync on Green video 0.3Vp-p (typ)

Composite sync 1.5 Vp-p - 5.0 Vp-p (Negative)

Separate sync 1.5 Vp-p - 5.0Vp-p
(HD/ VD) (Negative / Positive)

(5) Interface

(a) Video Signal: Shrink D-SUB 15p
& 13W3 Connector

(b) Input Impedance: 75ohm for video signal
1Kohm for Sync. Signal

(6) Scanning Frequency:

Horizontal 30KHz - 64KHz

Vertical 50Hz - 130 Hz

(7) Warm Up Time: More than 30 minutes

(8) Effective Display Area: 300(W) x 225(H) mm

(9) Brightness: 100 nits (typ) with B22 phosphor

(10) Operater Controls:

Power SW (Front panel)

Degauss SW (Front panel)

Contrast control (Front panel)

Bright control (Front panel)

Horizontal width control

Horizontal position control

Vertical height control

Vertical position control

H-static convergence control

V-static convergence control

(11) Service Controls (Front lid):

R, G, B Video gain controls

PCC-AMP

PCC-PHASE

KEY-BALANCE

PIN-BALANCE

Horizontal width control

Horizontal position control

Vertical height control

Vertical position control

H-static convergence control

V-static convergence control

(12) Video Amplifier:

50Hz - 100 MHz \pm 3dB

Tr / Tf 6 nsec (typ)

(13) Retrace Time: Horizontal 4.0 μ sec
(Recommended) Vertical 600 μ sec

(14) Linearity: 7 % (max)

(15) Raster Distortion: 2.0 % (max)

(16) Raster Size Regulation: 0.5 % (max)

(17) Misconvergence:

* Center 0.35mm (max)
(within 225 mm diameter circle)

* Other Area 0.45mm (max)

(18) High Voltage: 27.0 KV (typ)

(19) Temperature: 0~40 °C (with standard cabinet)

(20) Outline Size: 410(W) x 406.5(H) x 440(D) mm
(Incl. T/S)

(21) Weight: Approx. 22 kg (Incl. T/S)

2. CIRCUIT DESCRIPTION

2.1 GENERAL

This display monitor is composed of eight blocks as shown in BLOCK DIAGRAM (Schematics).

- (a) Power supply and deflection block(PCB-MAIN)
- (b) Control block (PCB-CONTROL)
- (c) Deflection block (PCB-DEFL-SUB)
- (d) Video block (PCB-VIDEO)
- (e) Sync block (PCB-SYNC-SUB)
- (f) Power supply block (PCB-POWER-SUB)
- (g) HV-REG block (PCB-HV-SUB)
- (h) Distortion block (PCB-SINE)

Every blocks will be explained in detail in following chapters. In this chapter, the auto-tracking function will be explained generally.

Input sync signals whose horizontal scanning frequency of 30KHz-64KHz and vertical scanning frequency of 50Hz-130Hz can be automatically locked on without adjusting H-HOLD/V-HOLD.

This automatic lock on function is performed by the circuits in PCB-CONTROL.

To maintain optimum operation of circuits over wide frequency range, some elements in circuits are switched according to horizontal frequency of input sync signal. The circuit in PCB-CONTROL judges the frequency of input sync signal, and generates changing signals.

PCB-CONTROL also maintains the other control signals to adjust picture sizes, positions, etc. electronically.

2.2 POWER SUPPLY BLOCK

2.2.1 GENERAL

- (1) Dual input voltage 100~200 VAC and 220~240VAC (automatically) are supported.
- (2) The output lines of this power supply are shown in Table 2-1 with their main loads.
- (3) The power supply works as switched mode operation with RCC (Ringing Choke Converter) configuration. Output voltages are regulated by 3 of primary circuit feed back signal through photo coupler (IC902). The switching frequency is corresponding to load currents.
The 60V-140V line is regulated by the DC chopper method from 168V line whose switching frequency is corresponding to H-Sync input.

OUTPUT LINE	MAIN LOAD
6.3 V	CRT Heater
24 V	H / V Deflection IC, H - Drive
27 V	V - Deflection
5 V	CPU
12 V	Video Circuit
80 V	Video Circuit
168 V	Video Circuit, HV Circuit
60~140 V	H - Deflection
- 12 V	DAC Pre-Amp. for S - PCC Circuit for B, G, B - Gain

Table 2-1

2.2.2 RECTIFY AND FILTER CIRCUIT

- (1) The AC input voltage is rectified by the diode bridge D901.
The rectified voltage is filtered by charging C911 and C912.
- (2) The thermistor RT901 & RT902 are equipped to suppress the inrush current when switch on.
A triac Q901 shunts RT901 to eliminate the power loss of RT901 when the control circuit starts to oscillate.

2.2.3 DEGAUSS CIRCUIT

- (1) This monitor is provided the auto and manual degauss function.
- (2) The auto-degauss circuit is operated as follows after started up the micro computer. The degauss signal from micro computer via 4 pin of connector J904, then it turns on Q951, and then RY901 operates degauss circuit during approx. 5 sec so that the degauss current could flow to the degauss coil via RP901.
- (3) The manual degauss circuit works during approx. 5 sec which is controlled by the degauss signal from micro computer (when pushing the degauss switch (SW110)).
- (4) A varistor RV901 works to keep approximately the same degauss current in both case of 220-240VAC and 100-120 VAC line input.

2.2.4 PRIMARY CIRCUIT

- (1) Main DC power supply of this monitor consists of RCC (Ringing Choke Converter).

When the power switch is turned on, triggering current is fed through R906, R907, R908 and R909 to flow the collector current of Q1 in IC901 which is a main-switching transistor. An error amp. IC956 detects an output voltage and makes a feed back to primary circuit via photo-coupler IC902.

- (2) When Q901 switch off, the energy which is stored in primary winding T901 transfers to secondary circuit. When all stored energy is discharged, the voltage of each coil is reversed and Q1 (main switch transistor in IC901) switches on. The base current of Q1 is supplied by the discharge of C916.
- (3) Photo-coupler IC902 controls the reversed charge current of C918 and changes the turn on thresh time by which on time of Q1 is controlled.
- (4) R915 is a resistor to detect over-current.

2.2.5 SECONDARY CIRCUIT

- (1) In this paragraph chopper circuit which is applied for auto-scanning circuit will be explained.
- (2) Chopper circuit mainly consists of L955, IC955 and Q952.

The output voltage +B is regulated by Q952 on PCB-MAIN in terms of PWM control to change the horizontal display size. The output from 12 pin of IC955 is pulse wave whose on-duty is followed by feed-back signal to pin 8 of IC955 from the emitter of Q520 in order to change +B.

The increase or decrease command of H-size coming from MPU goes to DAC on PCB-DEFL-SUB and then into pin 9 of IC955 as a H-size signal. A pin 9 of IC955 is connected to pin 8 of IC955 internally through PNP transistor like Fig. 1-1 so that a signal to pin 9 of IC955 could change feed-back signal from emitter of Q520 seemingly and change H-size finally.

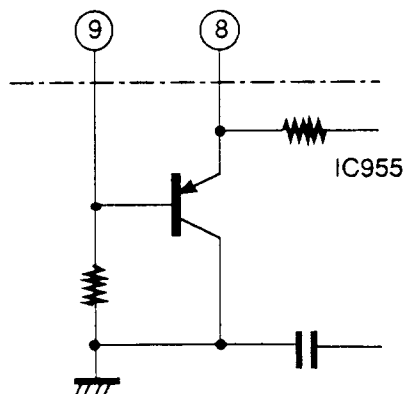


Fig. 1-1

2.3 CONTROL BLOCK

2.3.1 GENERAL

The CONTROL BLOCK is on PCB-CONTROL. Fig.2-1 shows the block diagram of PCB-CONTROL.

- (1) PCB-CONTROL has one CPU IC101, one non-volatile memory IC102, and other control ICs. The input signal for PCB control are fed from tact switches on PCB-CONTROL, horizontal and vertical sync signals, sync polarity detecting signals from PCB-SYNC-SUB. The FAN rotation detect signals are also provided to PCB-CONTROL.
- (2) Based on above signals, IC101 reads out data like as screen size, screen position etc., which are stored in IC102, and stores into RAM on IC101. IC101 provides the horizontal deflection control signals like as AFC constant and Cs changing which are stored in ROM on IC101. Each outputs of IC101 are as follows;

P00: For changing horizontal linearity control
P01,P02: For changing AFC time constant
P03~P06: For changing Cs compensate

- (3) The D/A conversion data is sent from P70, P71 PORT and P30~P33 PORT of IC101 to IC452 (DAC on PCB-DEFL-SUB), IC304 (DAC on PCB-SYNC-SUB), IC302 (DAC on PCB-SYNC-SUB). The clock(P32,P71), serial data output (P31, 70) and load (P33,P30) strobe pin make up the three-wire interfaces. The DC voltages from IC452, IC304, IC302 are used to control screen size, position, brightness, etc.
- (4) IC102 is EEPROM which are written control data like screen size, position, brightness, etc. IC103 is provided to reset at power on, program run away watching, and +5V power source voltage watching.
- (5) SW101~110 on PCB-CONTROL are corresponding to each buttons on front panel as follows.
- (6) IC107,108,109 on PCB-CONTROL are not used whose patterns are prepared just for future function.

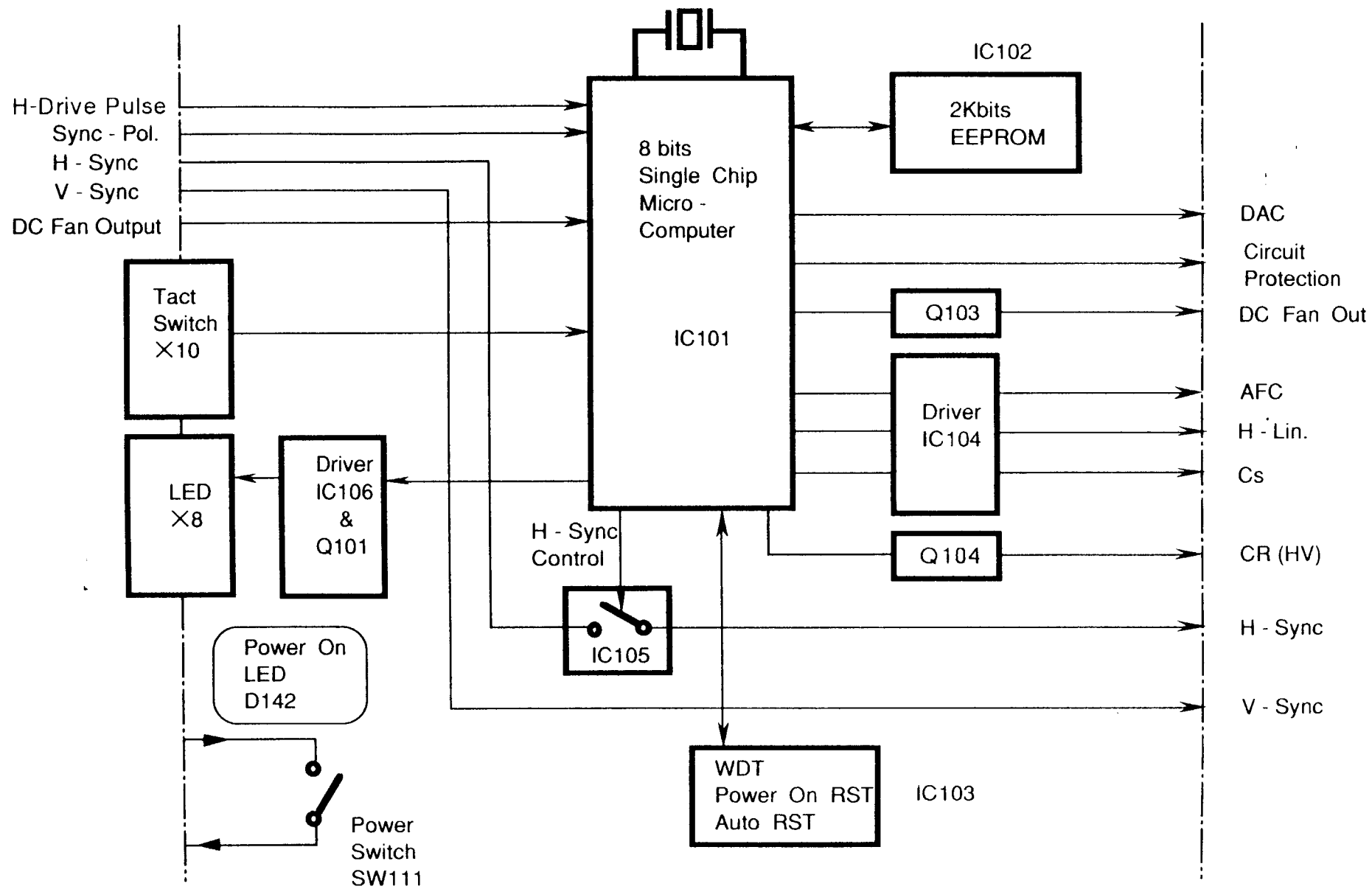
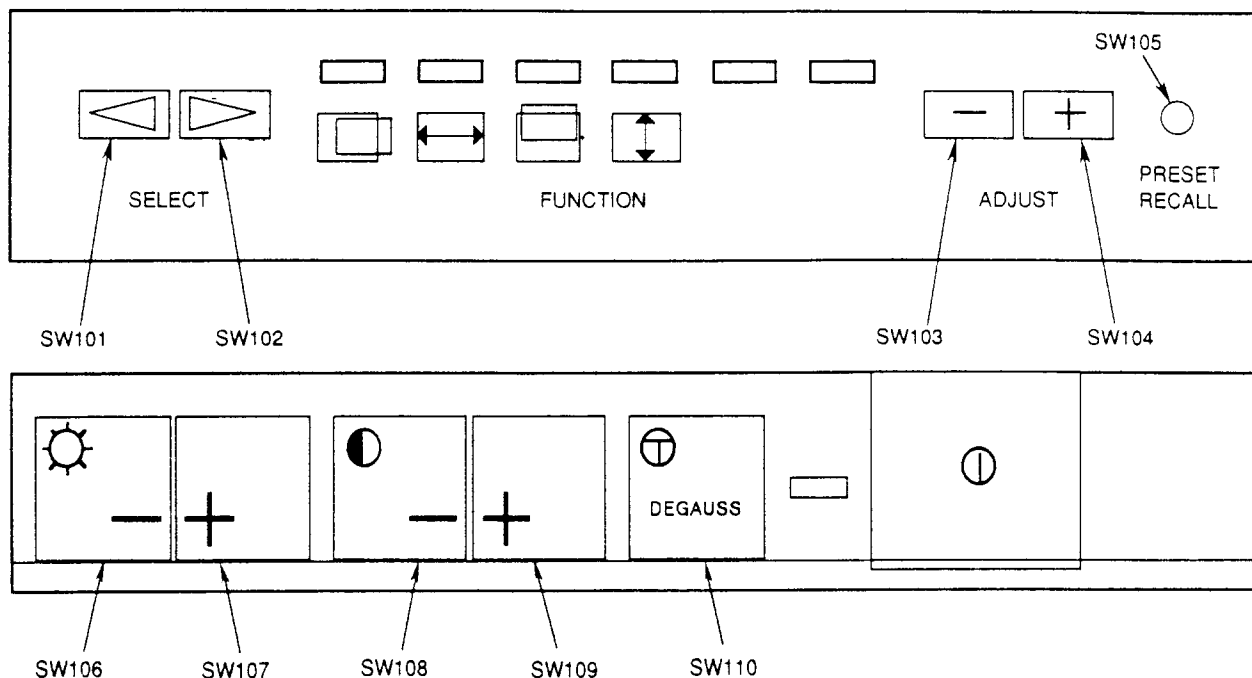


Fig. 2-1 Control Block



2.3.2 CONTROL FUNCTION

(1) Maximum timing number: 12 timings

(6 timings: for preset, 4 timings: for user, 2 timings: reserved)

There are 6 timings preset at factory which are shown in Fig. 2-2. And there are 4 additional timings available for user.

(2) To detect a timing, one of following conditions are necessary at least.

- ※ $|f_H' - f_H| > 3 \text{ KHz}$
(internal check uses 2 KHz in program)
- ※ $|f_V' - f_V| > 5 \text{ Hz}$
(internal check uses 4 Hz in program)
- ※ different polarity of H-SYNC
- ※ different polarity of V-SYNC

(3) In following cases, the output of H-SYNC signal in chassis are set off to protect deflection circuit.

- (a) Out of horizontal frequency range from $28.3\text{KHz} \pm 1 \text{ KHz} \sim 66 \text{ KHz} \pm 1\text{KHz}$ and / or out of vertical frequency range $45\text{Hz} \pm 2\text{Hz} \sim 135\text{Hz} \pm 2\text{Hz}$.
- (b) No H or V sync signal.
- (c) Unstable sync signal that Δf_v exceeds 4Hz and / or Δf_H exceeds 1.5KHz often.

(4) Each 12 timings has one common data for R, G, B- BIAS and GAIN, DBF-H, DBF-V, CONTRAST, BRIGHT.

(5) Select buttons function

- (a) Operation mode ----- shift to right / left
- (b) Service mode ----- change lit-on pattern followed by adjustment items of Fig. 2-3
- (c) Factory mode ----- ditto

(6) When +/- buttons of bright are pushed at the

same time, the brightness becomes a middle level of brightness set at factory.

(7) RECALL FUNCTION

When pushing the recall button on front panel in case of operate mode and service mode, the all factory adjustment items as shown in Fig. 2-3 that may have been overwritten by the user are restored.

(8) FAN WATCHING

When the revolutions per minute of FAN becomes less than 1006 rpm (normally 3300 rpm), the monitor stops to operate in order to protect the electrical components inside. So a pin 10 of J102 becomes high and enables Q953 to shunt. Then the current limiter of IC901 works.

2.3.3 Adjustment Mode

There are 3 adjustment modes in this monitor.

- (a) Operate mode
- (b) Service mode
- (c) Factory mode

(a) Operate mode

The operate mode is opened for the general end user operation and is available to adjust the raster size, position, brightness and contrast by the adjustment buttons on the front panel.

The adjusted picture conditions are automatically memorized into EEPROM (During pushing the adjust button, picture conditions change in terms that datas on CPU RAM and DAC output datas are changed. All-CPU RAM datas are written into EEPROM just after the adjust button is released.).

(b) Service mode

The service mode has additional following items from the operate mode.

- (1) R,G,B-GAIN
- (2) PCC-AMP,PHASE
- (3) KEY BALANCE
- (4) PIN BALANCE

The meanings of above (2), (3), (4) are as follows.

To enable Service mode, perform the following.

- 1) Power off the monitor.
- 2) Push and hold both the plus (+) and minus (-) adjustment buttons while switching the monitor power on.
After the power is on, release both buttons.
- 3) The adjustment function indicators blink for approximately 10 seconds.
During this time, push and release both the (+) and (-) buttons one more time. When the indicators stop blinking, they should indicate the V-SIZE function as shown in Fig.2-3.

NOTE:

If the adjustment function indicators do not blink, or if both adjustment buttons were not pushed while the indicators were blinking, or if some other button was pushed, or the indicators do not show the display service status, the service mode is not enabled. In this case, repeat steps 1) through 3).

- 4) Use the Adjustment Function Select Buttons to select the desired Adjustment Function Indicator Code as shown in Figure 2-3.
- 5) Use the Adjustment Control Buttons to perform the adjustments as required for optimum raster geometry or R, G, B-Gains.
- 6) All adjustments are automatically memorized.
To exit the service mode, turn off the monitor.

(c) Factory mode

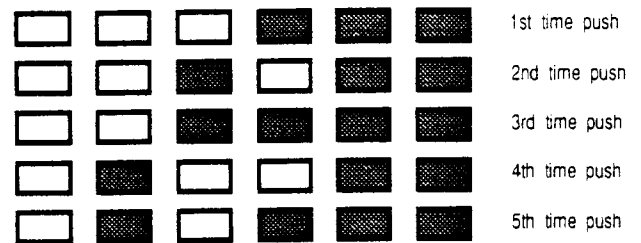
The factory mode has some additional items from service mode, which are different adjustment items by the way to enable factory mode.

To enable factory mode by front panel

- (c*-1) Power on while pushing and holding both + button of contrast and - button of brightness.
- (c*-2) Both contrast LED and bright LED blink for approximately 10 seconds.
- (c*-3) ITEM LED is lit on as follows.



- (c*-4) Push select button 5 times

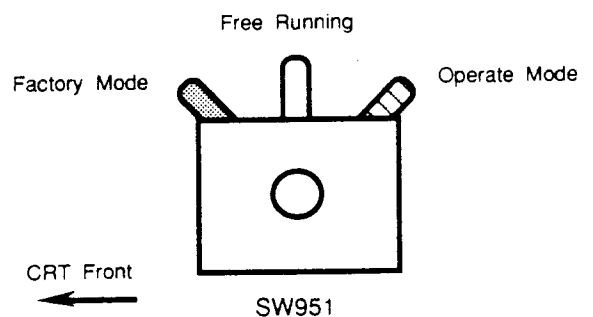


Indication of LED

- (c*-5) Push both + and - buttons of adjust at the same time.
- (c*-6) Use the Adjustment Control Buttons to perform the adjustments as required for.
- (c*-7) To release factory mode, turn off the monitor.

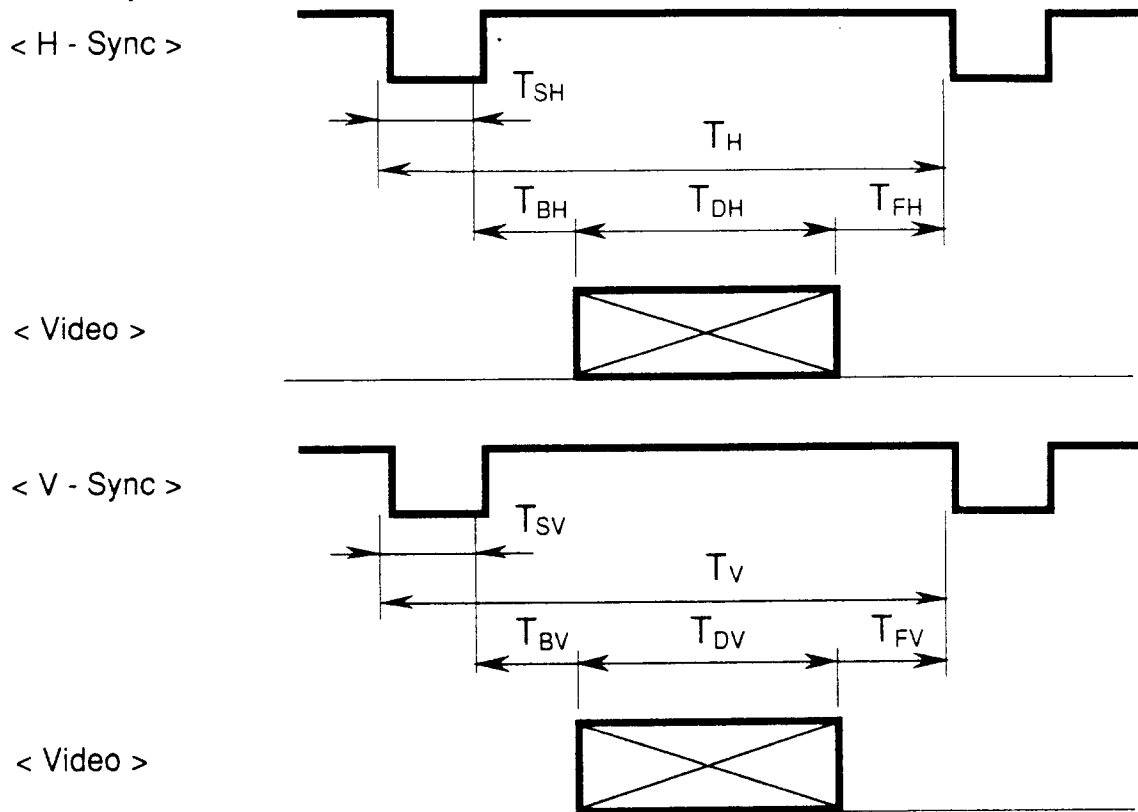
To enable factory mode by switch inside the cabinet.

- (c**-1) Power off.
- (c**-2) Power on after setting SW951 to the factory mode side as shown below.



Adjusted Items additional to items of service mode
the way of (c*) ----- R, G, B-BIAS by the way of (c*)
the way of (c**) ----- DBF-H, DBF-V, R, G, B-BIAS

Fig. 2-2 Preset Timing Datas at Factory



	IBM PS / 2			APPLE MAC II	$f_H = 48.36\text{KHz}$ $f_V = 60.00\text{Hz}$	$f_H = 56.48\text{KHz}$ $f_V = 70.07\text{Hz}$
	640×480	640×400	640×350			
T_H	31.778	←	←	28.570	20.676	17.710
T_{SH}	3.813	←	←	2.120	2.092	1.810
T_{FH}	0.636	←	←	2.120	0.360	0.330
T_{BH}	1.907	←	←	3.170	2.462	1.920
T_{DH}	25.422	←	←	21.160	15.754	13.650
T_V	16.683	14.268	←	15.000	16.667	14.272
T_{SV}	0.064	←	←	0.086	0.124	0.106
T_{FV}	0.318	←	1.176	0.084	0.063	0.094
T_{BV}	1.048	1.112	1.906	1.114	0.600	0.513
T_{DV}	15.253	12.711	11.122	13.714	15.880	13.599
H - Sync	—	—	+	Comp. Sync	—	—
V - Sync	—	+	—	Comp. Sync	—	—

Fig. 2-3 Indication Table for LED

Indication of LED	ITEM	Service Mode	Factory Mode(1)	Factory Mode(2)
	V-STAT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	H-STAT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	V-SIZE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	V-POSI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	H-SIZE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	H-Phase	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not Used	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	PCC-Amp	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	PCC-Phase	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Key Balance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Pin Balance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	G-Gain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	B-Gain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	R-Gain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	G-Bias		<input type="radio"/>	<input type="radio"/>
	B-Bias		<input type="radio"/>	<input type="radio"/>
	R-Bias		<input type="radio"/>	<input type="radio"/>
	DBF-V			<input type="radio"/>
	DBF-H			<input type="radio"/>

2.4 DEFLECTION BLOCK

Deflection block consists of horizontal, vertical, high voltage circuits, and horizontal and vertical deflections are fundamentally operated by changing DC control voltages.

2.4.1 HORIZONTAL DEFLECTION CIRCUIT

- (1) All DC control voltage are fed from PCB-DEFL-SUB.

Positive H-sync signal is fed from PCB-SYNC-SUB and DC voltage in accordance with that frequency is given in pin 5 of J5A5 on PCB-MAIN to oscillate horizontal frequency.

If H-oscillation frequency is high, relative DC voltage of 5 pin of J5A5 is higher, then the charge current to add to time constant circuit consisting of R504 and C506 increase to shorten charge time. So the oscillation frequency goes to higher. When no sync signal is connected, free running frequency is about 47KHz.

- (2) The output of 26 pin of IC501 on PCB-MAIN works as a drive voltage for H-deflection, and High Voltage circuits.

The principle of horizontal deflection is shown in Fig. 2-4. Q591 works as a horizontal output, and D508, D509 and D510 work as dumper diodes. Q511, Q512, Q513, Q514 and Q510 are switched on as follows in accordance with the horizontal frequency to compensate the horizontal linearity.

~33.5KHz	Q511~Q513 are on.
33.5~37.1KHz	Q512 and Q513 are on.
37.1~40.5KHz	Q512 and Q514 are on.
40.5~44.0KHz	Q513 and Q514 are on.
44.0~49.3KHz	Q513 is on.
54.5~61.5KHz	Q514 is on.
61.5KHz~	All is off.

- (3) In Fig.2-4, the horizontal output Tr Q591 is turned on by the drive pulse from IC501 via Q506 and Q508. During Q591 is turned on, the deflection current IDY increase from 0 to positive max Ip in accordance with the equation as follows.

$$I_p = (VDY \times T_{on}) / LDY.$$

*(LDY : parallel value of HOT and DY)

When the drive pulse goes to negative polarity, Q591 is turned off, and IDY begins to flow to charge C519 and C520 until Vcp reaches maximum value " $\pi / 2 \times (T_s / T_r) \times V_{cc}$ ".

- (4) The source voltage of Q501 is varied from approx. 60V to 140V to regulate the horizontal width regardless of horizontal frequency. This is performed to maintain the DC voltage of the cathode of D518 which is proportional to collector pulse voltage of Q591.

The DC voltage across C533 is fed to 8 pin of IC955. If DC voltage across C533 is higher, +B voltage of Drain of Q952 becomes lower in procedure stated in 2.2.5 (2).

- (5) Q502~Q505 consist of regulator to optimize the driving condition of H-deflection output Tr Q591. The output voltage of Q504 is controlled by 2 modes.

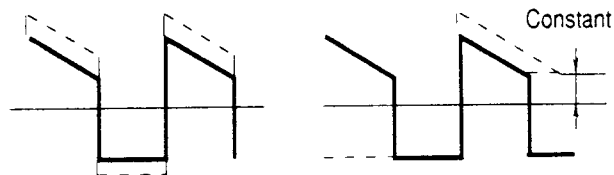
(5-1) If the H-WIDTH control voltage from 9 pin of J5A5 on PCB-MAIN decreases (Horizontal width increases), then output voltage of Q504 increases to supply enough driving power for Q591.

Refer to Fig. 2-5.

(5-2) On the other hand, when the 1 pin voltage of J5A4 on PCB-MAIN decreases according to the lower horizontal frequency, the base voltage of Q502 also decreases, so the output voltage of Q504 increases to optimize the base current of Q591. Refer to Fig. 2-7.

By the manner stated (5-1), (5-2), Q591 is driven enough, and power loss is minimized.

Base Current of Q591



Collector Current of Q591

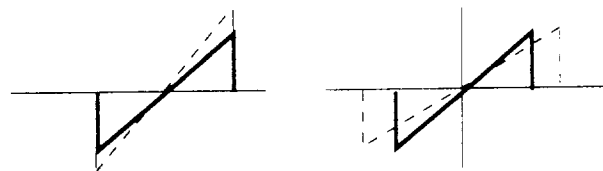
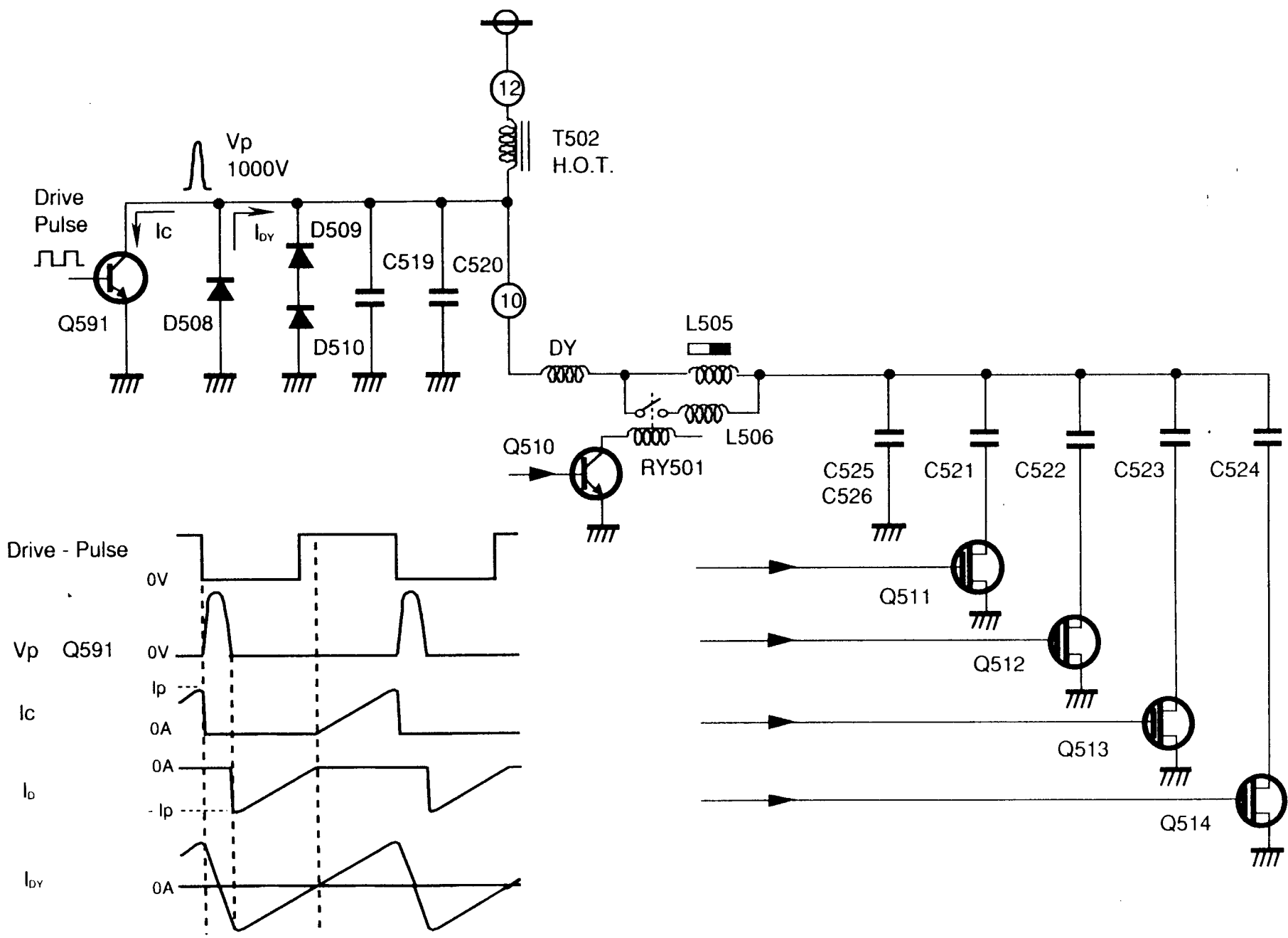


Fig. 2-5

Fig. 2-6

Fig. 2-4 Principle of Horizontal Deflection



- (6) The 6 and 7 pin of J502 on PCB-MAIN are control signals to change AFC components R506~R509. The combination of these are as follows.

~40.5KHz	C545/R508
40.5~49.3KHz	C549/R507
49.3~59.7KHz	C543/R506
59.7KHz~	C546/R509

- (7) In case of more than 44.0KHz, RY501 is on to add L506 in parallel with L505 to keep good H-linearity condition on the screen.

2.4.2 HIGH VOLTAGE CIRCUIT

(1) HIGH VOLT. SUPPLY & CONTROL CIRCUIT

The drive pulse, which is the same frequency as the horizontal deflection, is connected to the base of Q603 via the emitter follower Q601 and Q602. The flyback transformer steps up collector pulse generated by Q603 to the high voltage when Q603 turned off. The maximum V_{cp} of Q603, which depends on the horizontal frequency normally, is kept the same value independent on horizontal frequency by T601 (1/2) and D605 in spite of the fixed +B and resonance capacitor. During Q603 is on, C608 is changed to reversed +B voltage. Because the impedance between 10 and 9 pin of T601 (1/2) and between 6 and 8 pin of T601 (1/2) are the same. When Q603 turns off, the current through the coil between 6 and 8 pin of T601 (1/2) starts to charge into C608 oppositely until collector pulse of Q603 becomes 2 times as +B voltage and D605 goes to on. To get enough collector pulse for this operation, Q605 turns off at more than 38.8KHz of horizontal frequency to change capacity of resonance capacitor. The high voltage should be stabilized by T601 (2/2) which is controlled by Q607 (shunt regulator) and Q801. The proportional high voltage is fed to pin R of Q607. If the high voltage increases, the output voltage of pin K of Q607 decreases. The DC level of pulse made by a coil between pin 2 and pin 3 of T601 (1/2) decreases. It raises up the threshold level of gate voltage of Q801 relatively. It makes the high voltage decrease to the correct value. If the high voltage decreases, stabilized circuit works opposite direction of increase as above mentioned. The high voltage is set to 27.0KV by VR601 at factory.

(2) HIGH VOLTAGE SAFETY CIRCUIT

Safety circuits described below are equipped to prevent abnormal increase of the high voltage

that may cause a X-radiation of harmful level. No modification should be applied to the high voltage supply and safety circuits.

The safety circuit works as the over voltage protector for a high voltage. Excessive high voltage is detected by R610 which is fed to Hold-Down circuit. The voltage across the capacitor C612 which is proportional to the high voltage is fed to Hold-Down circuit through R611, VR602 and R612. When high voltage reaches 29.0KV, the voltage across D806 is over 6.0V and then IC801 goes to turn on, and Drain of Q611 is connected to the secondary ground via Q606. When this happens, horizontal oscillation signal can no longer drive Q601, Q602 and Q603, so high voltage goes down. Once Hold-Down circuit operates, hold-down status is held till power is off. Additionally, in case of T601 generates too high voltage across C803, D807 becomes on to enable high voltage protection circuit.

2.4.3 VERTICAL DEFLECTION CIRCUIT

The vertical deflection is performed by one IC and some attached components. The oscillating frequency is fixed by R406 and C406.

The vertical size is controlled by changing the output current from 9 pin of IC501. The vertical linearity is adjusted by changing charge current into C404 and C405. IC450 (analog switch) on the PCB-DEFL-SUB can achieve this.

2.4.4 SIDE DISTORTION CORRECTION

The deflection current is modulated to parabolic and sinuous waveform by Q501 and T502 on the PCB-MAIN to compensate the side pincushion distortion. The gate of Q501 is controlled by PWM method from a signal of 8 pin of J5A5 on the PCB-MAIN leading to 8 pin of J7A2 on the PCB-DEFL-SUB which is the pulse output from Q718 and Q719 on the PCB-DEFL-SUB. This pulse is generated as follows. The signals to correct the sea gull shape distortion coming from 9 pin of J7V1 (sine wave), to correct the Side-PCC distortion coming from 3 pin of IC708 (parabolic wave) and PCC-Phase distortion coming from 2 pin of IC708 (V-saw wave) are combined at 5 pin of IC707 and amplified.

This output signal is compared with H-saw signal at 5 pin and 6 pin of IC703 in order to generate pulse signals whose width is varied according to the distortion corrections. The H-saw signal is

made by charging current into C730 and synchronized by trigger from 7 pin of J7A2 to Q725. The voltage (p-p) of H-saw wave is kept approx. 6V by feed-back into 5 pin of IC704 via D721.

2.4.5 DYNAMIC BEAM FOCUS

In order to get best focus condition on the entire screen, the dynamic modulated focus voltage is supplied to FOCUS (D) connector in addition to static focus voltage. This modulated voltage is coming from 1 pin of J706 after amplification by Q731 and Q714. The modulated signal is combined with horizontal and vertical parabolic waves at R7J1 and R7J2. The source of these parabolic waves are outputs of 18 pin and 11 pin of IC705.

2.4.6 H & V STATIC CONVERGENCE

1pin (RCV) of J702 is the output voltage to change horizontal static convergence, which depends on the output from 18 pin of IC452 (DAC) operated by the front button. A pin (V-STATIC) of J701 is the output current to change the vertical static convergence, which depends on VR701 (V-STA-ADJ) adjusted at the factory and output from 17 pin of IC452.

2.5 VIDEO BLOCK

2.5.1 VIDEO AMPLIFIER

- (1) The circuits of video amplifier are in PCB-VIDEO.
- (2) There are three video amps for RGB inputs which have identical circuit configuration. For simplification, the green-channel amp. will be explained in this chapter.
- (3) This amplifier is composed of the pre-amplifier section and the main-amplifier section. The video signal (0.7Vp-p STD) is amplified to approx. 2 V p-p in the pre-amplifier section and is amplified again to approx. 35 Vp-p during the main-amplifier section.
- (4) The input signal is fed to 22 pin of IC201 via C2G0. The gain of IC201 is controlled by the DC voltage of 21 pin. The higher voltage of 4 pin makes the gain of IC201 larger. This IC also provides the function of the black level clamp. The clamp pulse which is added at the back-porch duration of video signal is fed to 15 pin. The voltage level of 14 pin is fixed, which is a control of brightness for RGB signal.
- (5) The output signal of IC201 is connected to the main-amplifier (IC203) via emitter follower Q2G0.

- (6) The main-amplifier (IC203) is composed of the amplifier and the push-pull emitter follower. The amplifier circuit composed of IC203 is the complimentary push-pull circuit which has an infinite open loop gain.

- (7) To display a pure white image on screen, both the DC level and the amplitude of video output signal should be adjusted as the 3 guns characteristics of CRT's are not identical. The DC level of cathod can be adjusted by the DAC of IC202, pin 11 (R-BIAS), pin 4 (G-BIAS) and pin 18 (B-BIAS).

2.5.2 SYNC SEPARATION CIRCUIT

- (1) This monitor can be synchronized under following conditions.
 - (a) Composite sync signal on green video
 - (b) Composite sync signal (negative going)
 - (c) Horizontal sync./ vertical sync signals (positive or negative going)
- (2) The sync separation circuit provides following functions.
 - (a) Separating the composite sync signal from the green video signal
 - (b) Amplifying the composite sync signal level to TTL level
 - (c) Separating the horizontal and vertical sync signal from the composite sync signal
- (3) This sync separation circuit is controlled by IC301 on PCB-SYNC-SUB. The horizontal sync signal is input to 6 pin of IC301. And the output of horizontal sync is fed from 14pin of IC301 to 6 pin of IC101 on PCB-CONTROL. Vertical sync signal is input to 8 pin of IC301. And the output of vertical sync is fed from 13 pin of IC301 to 17 pin of IC101 on PCB-CONTROL. Clamp pulse is fed from 17 pin of IC301 to 15 pin of IC201 on PCB-VIDEO. IC301 is located on PCB-SYNC-SUB.

2.5.3 ABL CIRCUIT

- (1) This circuit is for limiting the beam current of CRT, and is in PCB-SYNC-SUB.
- (2) The brightness of CRT is determined by the beam current. The beam current is detected by R810 (PCB-HV-SUB). When the beam current exceeds the limit value (approx. 600 μ A), the voltage across R334 causes Q301 turn on, the voltage of 16 pin of IC201 on PCB-VIDEO which controls the gain of pre-amplifier, goes down to lower level. It means that the circuit suppresses the output of pre-amplifiers for limiting the brightness of CRT.

- (3) When the voltage across R810 drops until Q301 turn on and Q302 is supplied its base current and then the collector voltage of Q302 decreases. As the result, the gain control voltage of pre-amplifiers are decreased.
- (4) A voltage across R812 is increased proportional to the beam current. If the beam current reaches $1000\ \mu\text{A}$, the voltage across R812 is over 2.4V and then the drain of Q611 is connected to the secondary ground via Q606. At this condition, horizontal oscillation signal can no longer drive Q601, Q602 and Q603, and high voltage goes down. Once HOLD-DOWN circuit operates, hold-down status is held till power is off.

2.5.4 PCB-CRT

- (1) The blanking circuit and the bright control circuit are in PCB-SYNC-SUB.
- (2) The blanking pulse generated in PCB-SYNC-SUB is fed to IC305 which amplifies the blanking pulse to approx. 24Vp-p negative going pulse. This pulse is connected to G1 of CRT via the coupling capacity C540 on PCB-MAIN. The blanking action is realized so that the voltage of G1 is kept in the negative potential during the blanking period (11 pin of IC305 is blanking output of Horizontal and Vertical).
- (3) The bright control is performed by adjusting the voltage of G1. VR503 (G1-ADJ) on PCB-MAIN can control G1 voltage as a brightness of back-raster and the DAC output (7 pin of IC304) as brightness level can also change voltage of 12 pin of IC305 which is brightness control.

3. ADJUSTMENT PROCEDURE

This display monitor can be memorized totally 10 different timings of screen images.

The first, internal adjustment mode which has no relation to timings of screen image should be explained.

*All adjustment LEDs in the front lid control blink at either maximum or minimum position.

*Contrast and brightness LEDs also blink at either maximum or minimum position.

3.1 PREPARATION

Set each VR to following position.

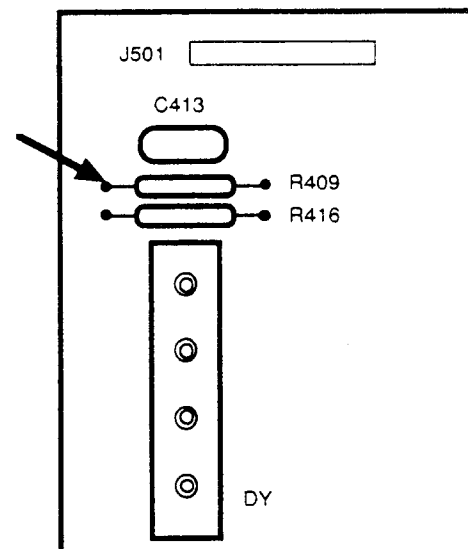
- (1) Center position
 - (a) PCB-MAIN:
 - VR502 (H-CENT), VR504 (H-WIDTH)

- (b) PCB-DEFL-SUB:
 - VR550 (FH-BIAS), VR551 (FH-GAIN), VR701 (V-STATIC)
- (c) VIDEO-UNIT: VR791 (H-STATIC)
- (d) PCB-SINE: VR7V1 (PCC-SINE)
- (2) Fully CCW position
 - (a) PCB-MAIN:
 - VR601 (HV-ADJ), VR602 (HV-PROT)
 - VR951 (+B ADJ), VR501 (H-DRIVE)
 - (b) FBT:
 - D-FOCUS, FOCUS, SCREEN
- (3) SW591: At the side of CRT neck
- (4) SW501: At the position of 2

3.2 PRE-ADJUSTMENT

3.2.1 VERTICAL FREE RUNNING

- (1) Connect a frequency counter to R409 on the PCB-MAIN as shown below.
- (2) After power on, turn the SCREEN VR to get a proper brightness.
- (3) Confirm that vertical free running frequency is $37\text{Hz} \pm 3\text{Hz}$.



3.2.2 HORIZONTAL FREE RUNNING

(only input sync signal)

- (1) Grasp a red lead wire from PCB-MAIN to horizontal deflection yoke by frequency counter probe.
- (2) Set SW951 on PCB-POWER-SUB to center position to get a free running condition.
- (3) After input of horizontal frequency 40KHz sync signal, adjust VR550 (FH-BIAS) to get $40\text{KHz} \pm 0.2\text{KHz}$ of free running frequency.
- (4) While input of 64KHz horizontal sync signal, adjust VR551 (FH-GAIN) to get $64\text{KHz} \pm 0.2\text{KHz}$ of free running frequency.

3.2.3 +B ADJUSTMENT

- (1) Connect a voltmeter to TP+B on PCB-MAIN.
- (2) Adjust VR951 on PCB-MAIN to get $168V \pm 0.3V$.

3.2.4 HIGH VOLTAGE ADJUSTMENT

Adjust high voltage to $27.0KV \pm 0.3KV$ by VR601 (HV-ADJ) on PCB-MAIN.

3.2.5 H-DRIVE ADJUSTMENT

- (1) Input MAC-II timing signal as shown in Fig.2-2.
- (2) Select the indication of H-SIZE pattern of LED by select button in the front panel.
- (3) Adjust the horizontal raster size to get a max. width by adjust button in the front panel.
- (4) Input 64KHz timing signal as shown in Fig.2-2.
- (5) Adjust the horizontal width to $300mm \pm 4mm$ by VR504 (H-SIZE) on the PCB-MAIN.
- (6) Connect a digital voltmeter to TP-H-DRIVE on the PCB-MAIN.
- (7) Adjust VR501 to get a minimum indication.

3.3 INTERNAL ADJUSTMENT

3.3.1 H-FREE RUNNING FREQUENCY ADJUST.

- (1) Grasp red lead wire from PCB-MAIN to horizontal deflection yoke by frequency counter probe.
- (2) Set SW951 on PCB-POWER-SUB at center position to have free running condition.
- (3) Input sync. signal whose frequency is 40 KHz, then adjust VR550 (fH bias) on PCB-DEFL-SUB to oscillate free-running frequency at $40 KHz \pm 0.2KHz$.
- (4) Input sync. signal whose frequency is 64 KHz, then adjust VR551 on PCB-DEFL-SUB to oscillate free-running frequency at $64KHz \pm 0.2KHz$.
- (5) Repeat (3) and (4).

3.3.2 +B ADJUSTMENT

- (1) Input only sync signal of horizontal frequency 31.5KHz.
- (2) Turn VR951 until TP+B reaches $168 \pm 0.3V$.

3.3.3 HIGH VOLTAGE ADJUSTMENT

- (1) Input only sync signal. (fH = 31.5KHz)
- (2) Connect HV meter between anode of CRT and chassis (ground).
- (3) Turn the screen potentiometer of FBT to fully CCW.
- (4) Turn the HV-ADJ (VR601) to CW until HV-meter indicates $30.0KV \pm 0.3 KV$.

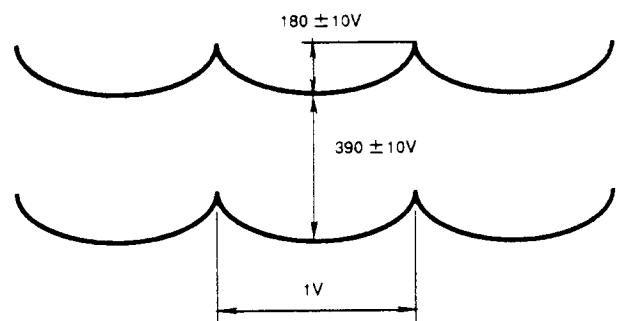
- (5) Turn the HV-LIMIT (VR602) until HV-LIMIT circuit works. (confirm 0(zero) V of high voltage.)
- (6) Turn off the power SW, and turn the HV-ADJ (VR601) to CCW.
- (7) Turn on the power SW, and turn HV-ADJ (VR601) slowly to CW to check HV-LIMITER works at $30.0KV \pm 0.3 KV$. Turn off power SW, and turn HV-ADJ (VR601) to CCW.
- (8) Fix VR602 with glue.
- (9) Turn on the power SW, and set HV-ADJ (VR601) to $27.0 KV \pm 0.2 KV$.
- (10) Check if HV-LIMITER does not work after SW off and on.
- (11) Fix VR601 with glue.

*CAUTION

HV-ADJ (VR601) and HV-LIMIT (VR602) are sealed and no field serviceable parts to avoid exposure of X-ray. Please contact to qualified personnel of MITSUBISHI, if need to re-adjust.

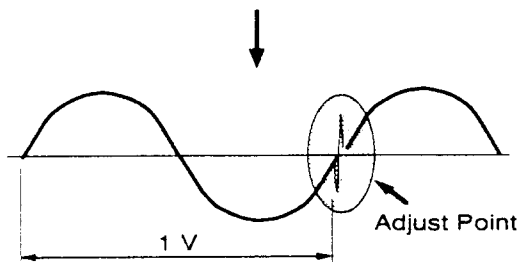
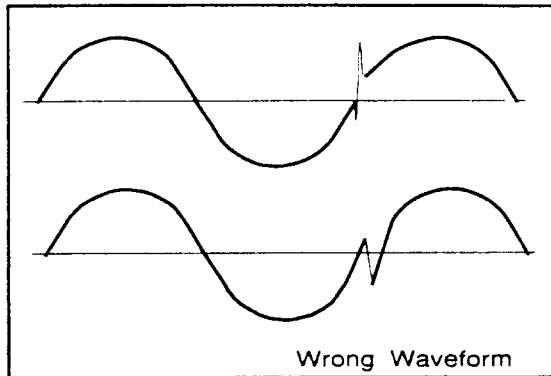
3.3.4 SUB-FOCUS ADJUSTMENT

- (1) Input sync signal of fH = 57KHz and fV = 70Hz.
- (2) Connect a probe of the oscilloscope to pin 1 of J706 on PCB-DEFL-SUB.
- (3) Select DBF-H pattern of LED on front panel.
- (4) Use adjust button on front panel to get $390V \pm 10V$ amplitude of horizontal parabolic wave.
- (5) Select DBF-V pattern of LED on front panel.
- (6) Use adjust button on front panel to get $180V \pm 10V$ amplitude of vertical parabolic wave.



3.3.5 PCC DISTORTION SINE WAVE ADJUST.

- (1) Input 56KHz timing signal as shown in Fig. 2-2.
- (2) Connect a probe of the oscilloscope to TP-SINE on the PCB-SINE.
- (3) Adjust VR7V1 on the PCB-SINE to have following waveform.



3.3.6 SWITCH SET

Set SW951 on the PCB-POWER-SUB to the factory mode position as stated in chapter 2.3.3.

3.3.7 SCREEN IMAGE ADJUSTMENT

All screen images should be adjusted with the 6 timing datas in Fig. 2-2 at factory mode.

3.3.8 HORIZONTAL RASTER POSITION

- (1) Turn VR503 (G1-ADJ) on PCB-MAIN until dim back-raster appears.
- (2) Set SW501 & VR502 to get raster position nearly at the center of CRT.

3.3.9 CRT CUT-OFF ADJUSTMENT (fH = 57KHz)

- (1) Input only sync signal (fH = 57KHz).
- (2) Set contrast to maximum position by contrast buttons on front panel.
- (3) Push + button of bright to get a max. brightness.
- (4) Set R, G, B-Bias to minimum position (- button of bright) after selecting R, G, B-Bias pattern by select button in the front panel.
- (5) Turn the SCREEN VR on FBT to get a dim raster.
- (6) Adjust 2 bias control except 1 bias control potentiometer which is the brightest at adjustment (5) item, to get a white raster.

- (7) Set the VR503 (G1-ADJ) to get a dim raster (about 0.4 nit).

3.3.10 BRIGHTNESS & WHITE BALANCE ADJUSTMENT (fH = 57KHz)

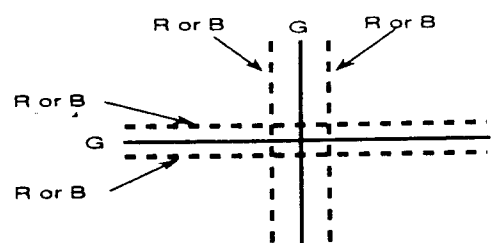
- (1) Set contrast control to maximum position by contrast button on the front panel (LED blinks).
- (2) Set brightness control to maximum position by brightness button on the front panel (LED blinks).
- (3) Input green video signal whose size is about 80x80 mm square at CRT center position.
- (4) Adjust G-Gain to 73 nits.
- (5) Input R, B video signal together with G, then adjust only R-gain, B-gain controls to get color coordination $X=0.283\pm0.02$, $Y=0.297\pm0.02$.
- (6) Make sure that brightness is more than 100 nits at the full white pattern.

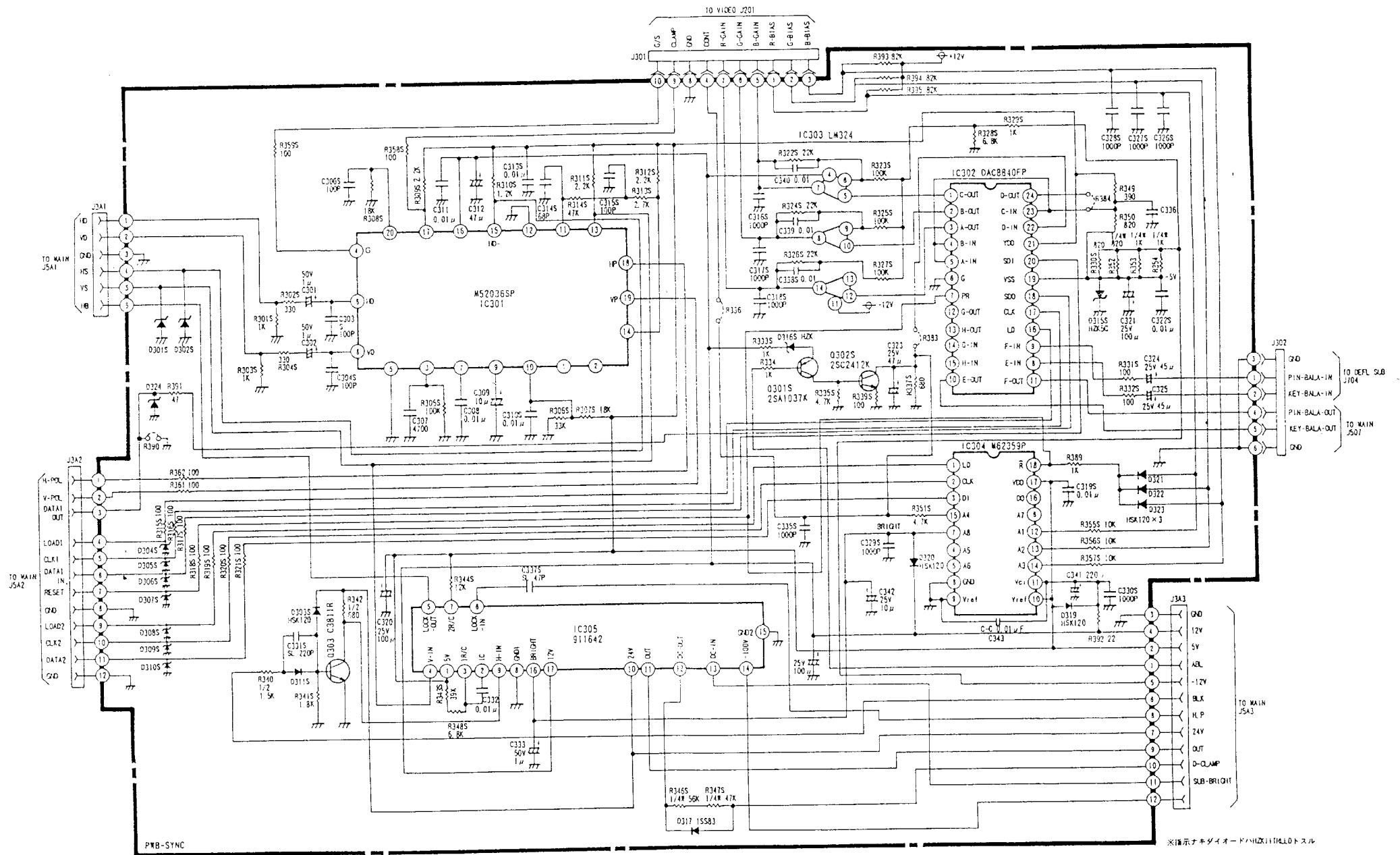
3.3.11 FOCUS ADJUSTMENT

- (1) Receive white ASII (H) characters pattern on the entire screen.
- (2) Adjust the FOCUS and DFOCUS VR on FBT to get best focus on the entire screen.
- (3) After adjustment, the marking paint should be used to mark the final condition.

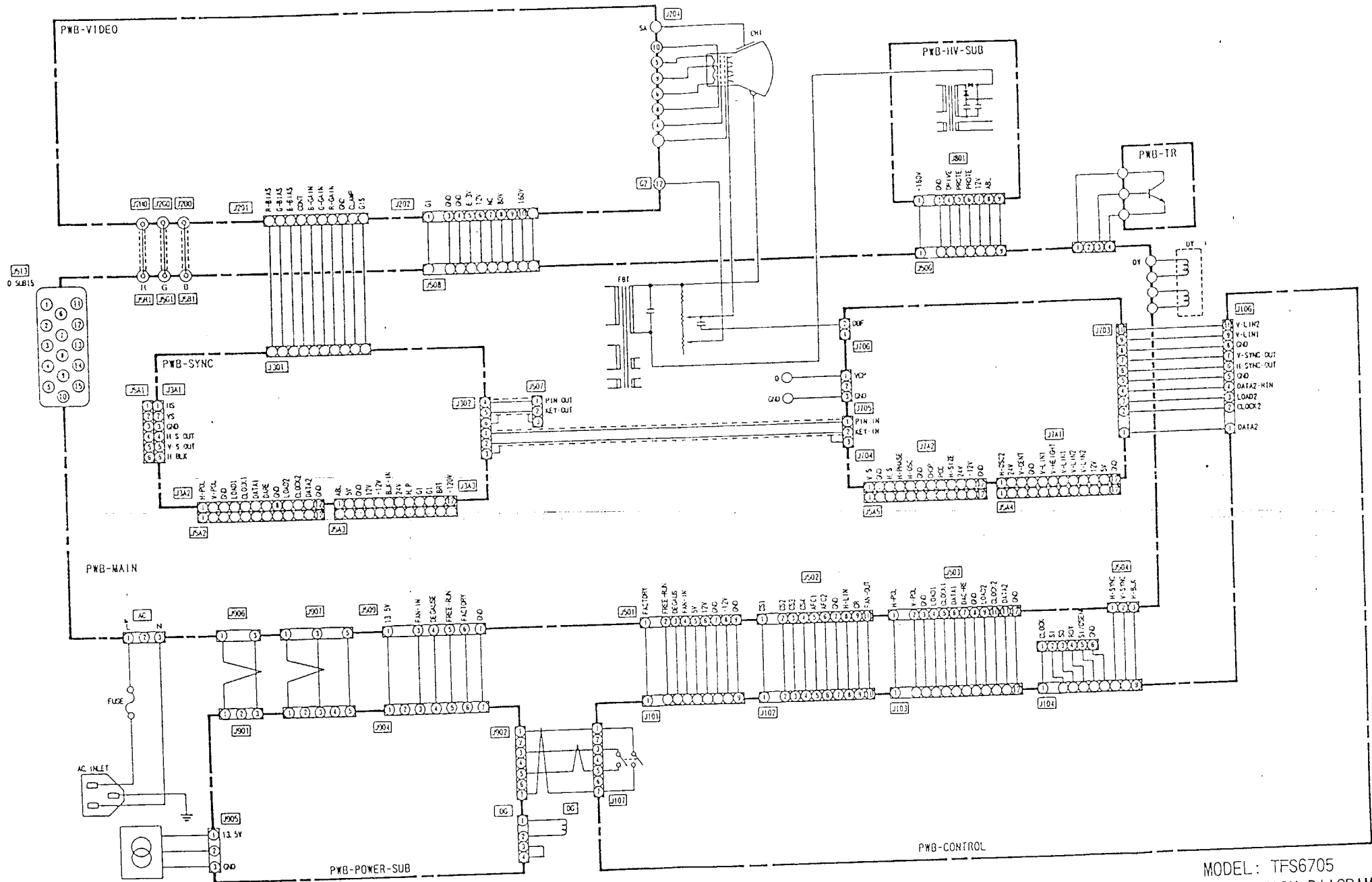
3.3.12 CONVERGENCE ADJUSTMENT

- (1) Receive a cross hatch test pattern.
- (2) Select the indication of V-STAT as shown Fig. 2-3 by select button in the front panel.
- (3) Push the both "+" and "-" buttons in the front panel at the same time to get center position of vertical convergence.
- (4) Adjust VR701 on the PCB-DEFL-SUB to make both horizontal red and blue lines the closest to horizontal green line on the center of screen.
- (5) Select the indication of H-STAT as shown Fig. 2-3 by select button in the front panel.
- (6) Push the both "+" and "-" buttons in the front panel at the same time to get center position of horizontal convergence.
- (7) Adjust RCVH-VR (H-STAT) on the radiator of VIDEO-UNIT to make both vertical red or blue lines the closest to vertical green line.





MODEL: TFS6705K
PCB-SYNC-SUB
SCHEMATIC DIAGRAM



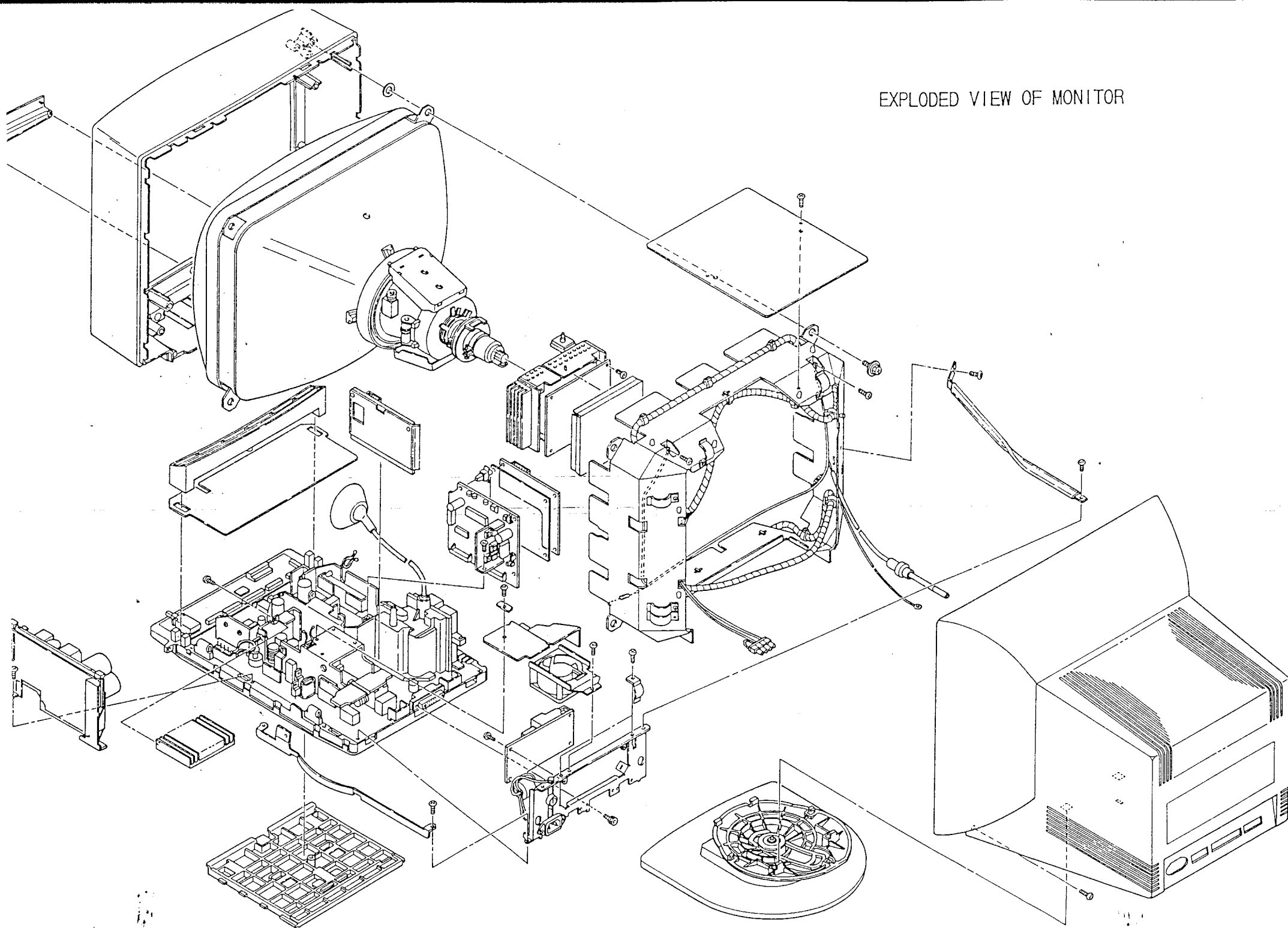
MODEL: TFS6705
CONNECTION-DIAGRAM

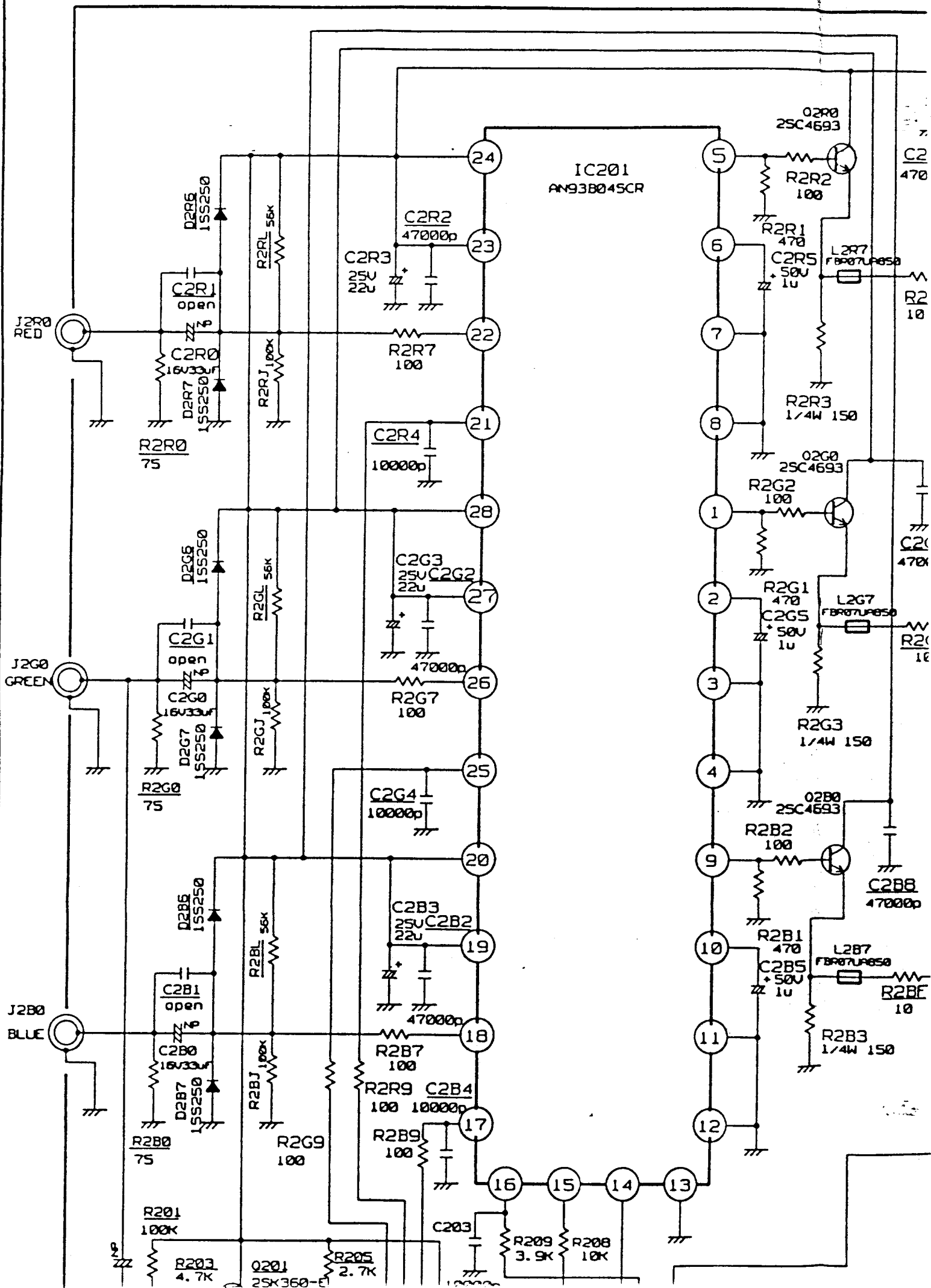


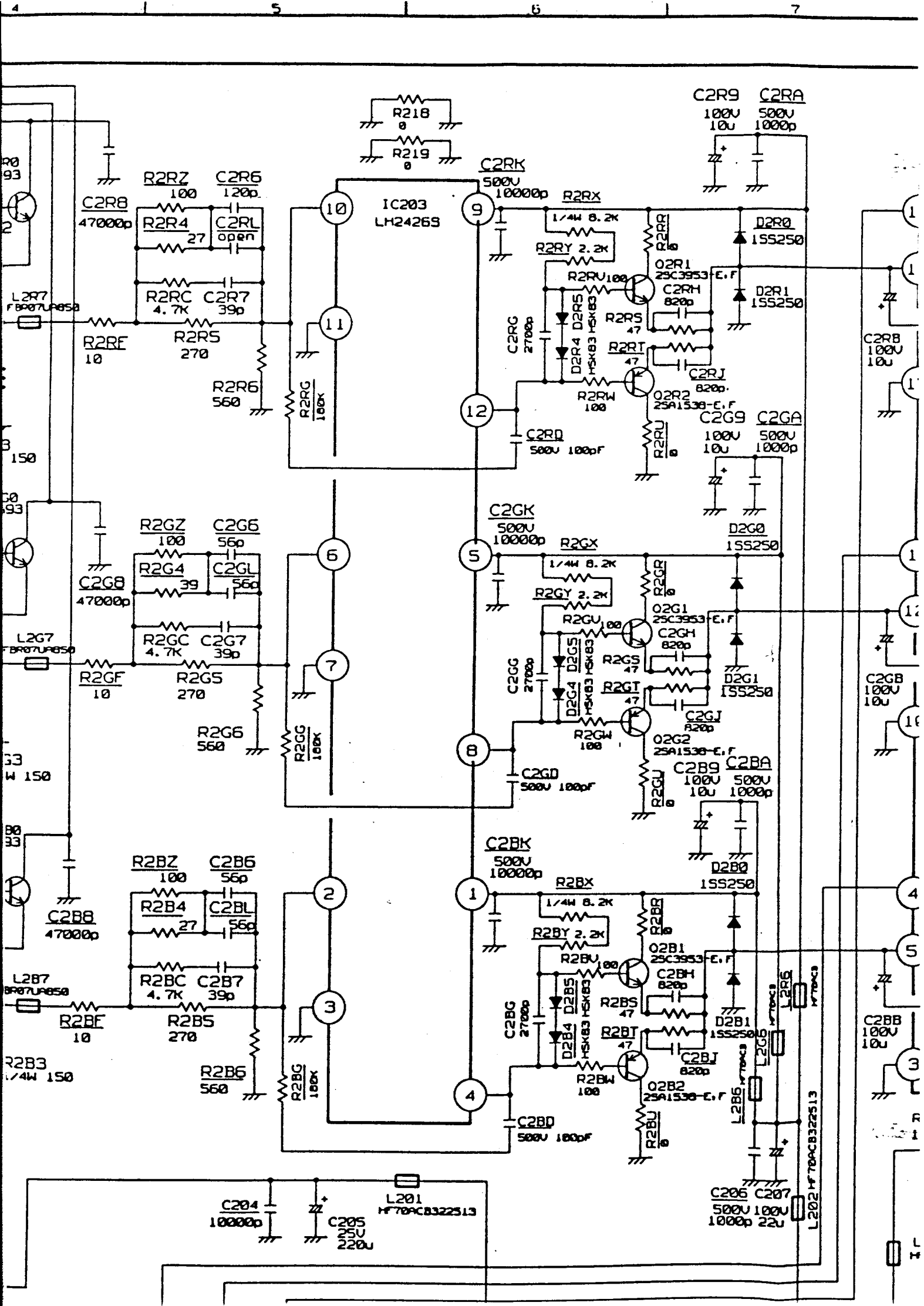
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1	0	1X, 1Y	70
0	1	2X, 2Y	90
1	1	3X, 3Y	120

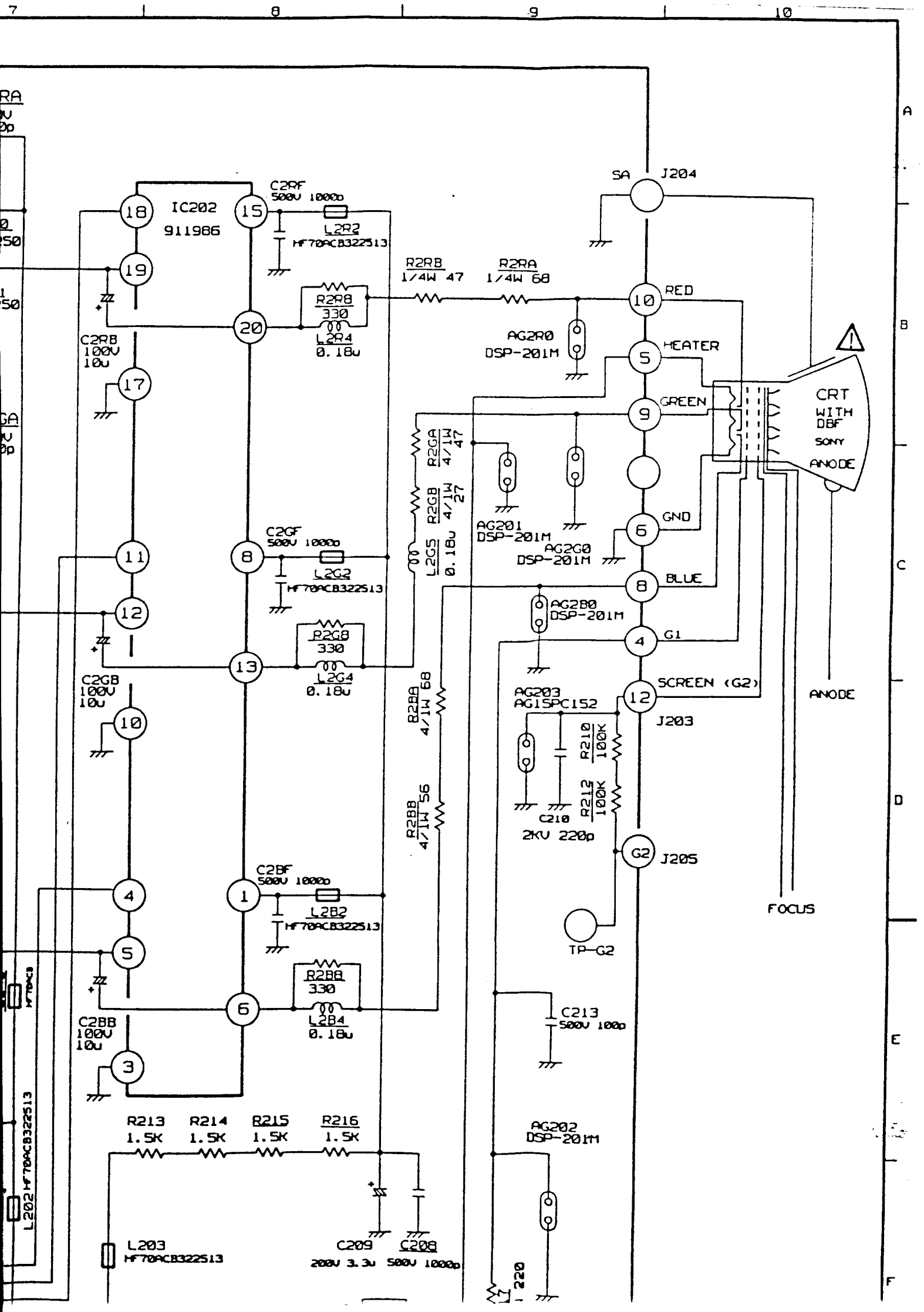
SCHEMATIC-DIAGRM

EXPLODED VIEW OF MONITOR




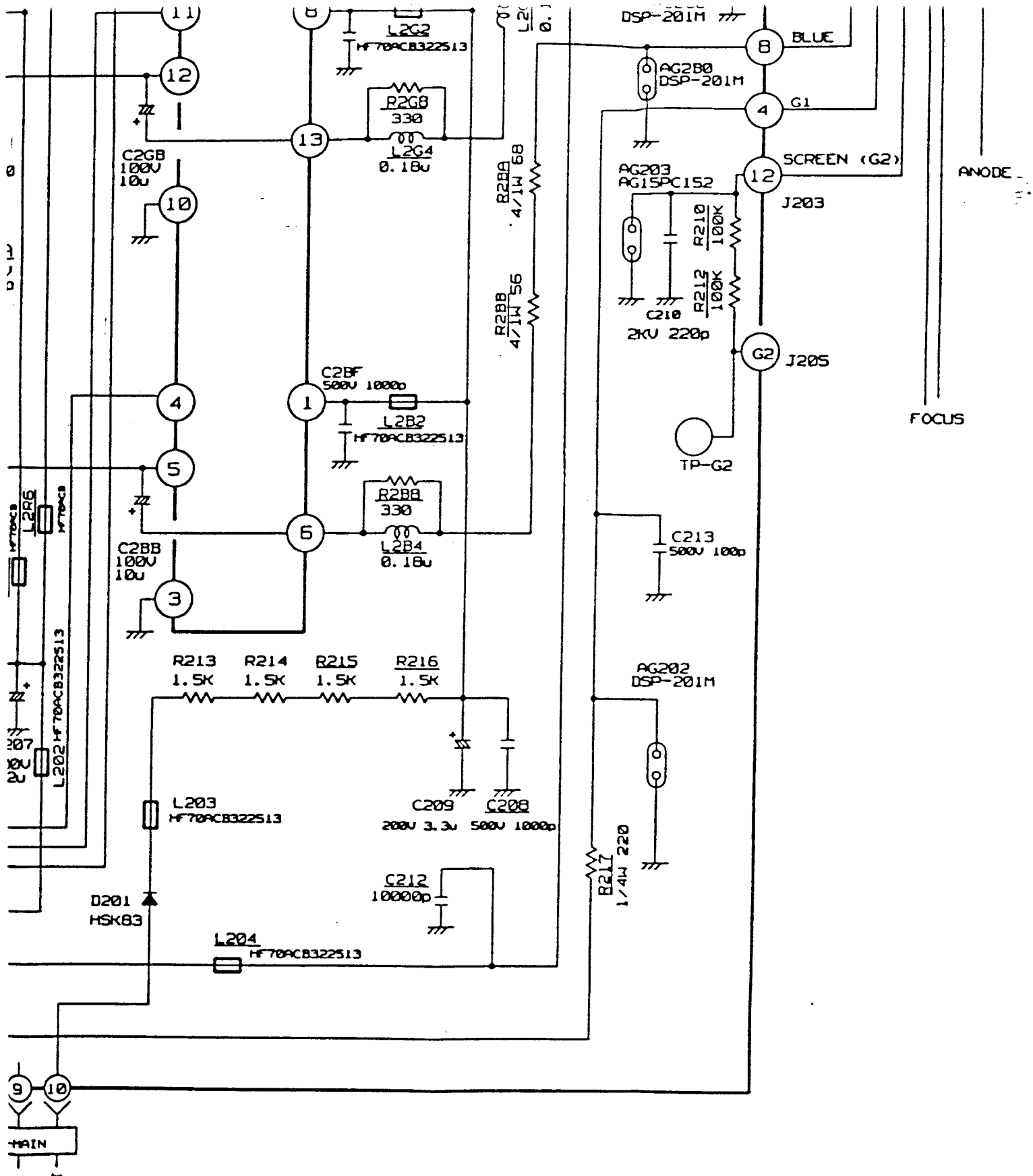









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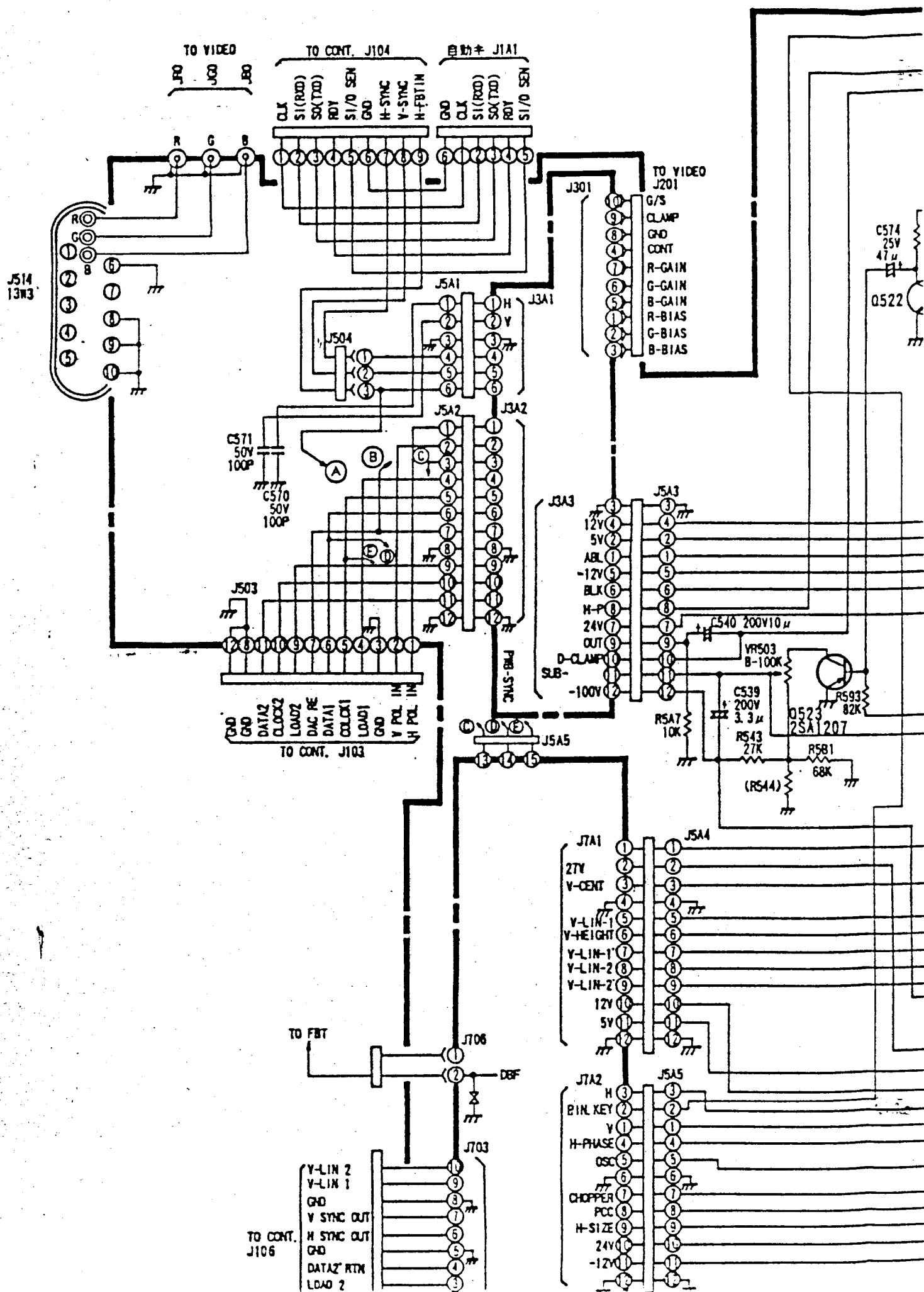
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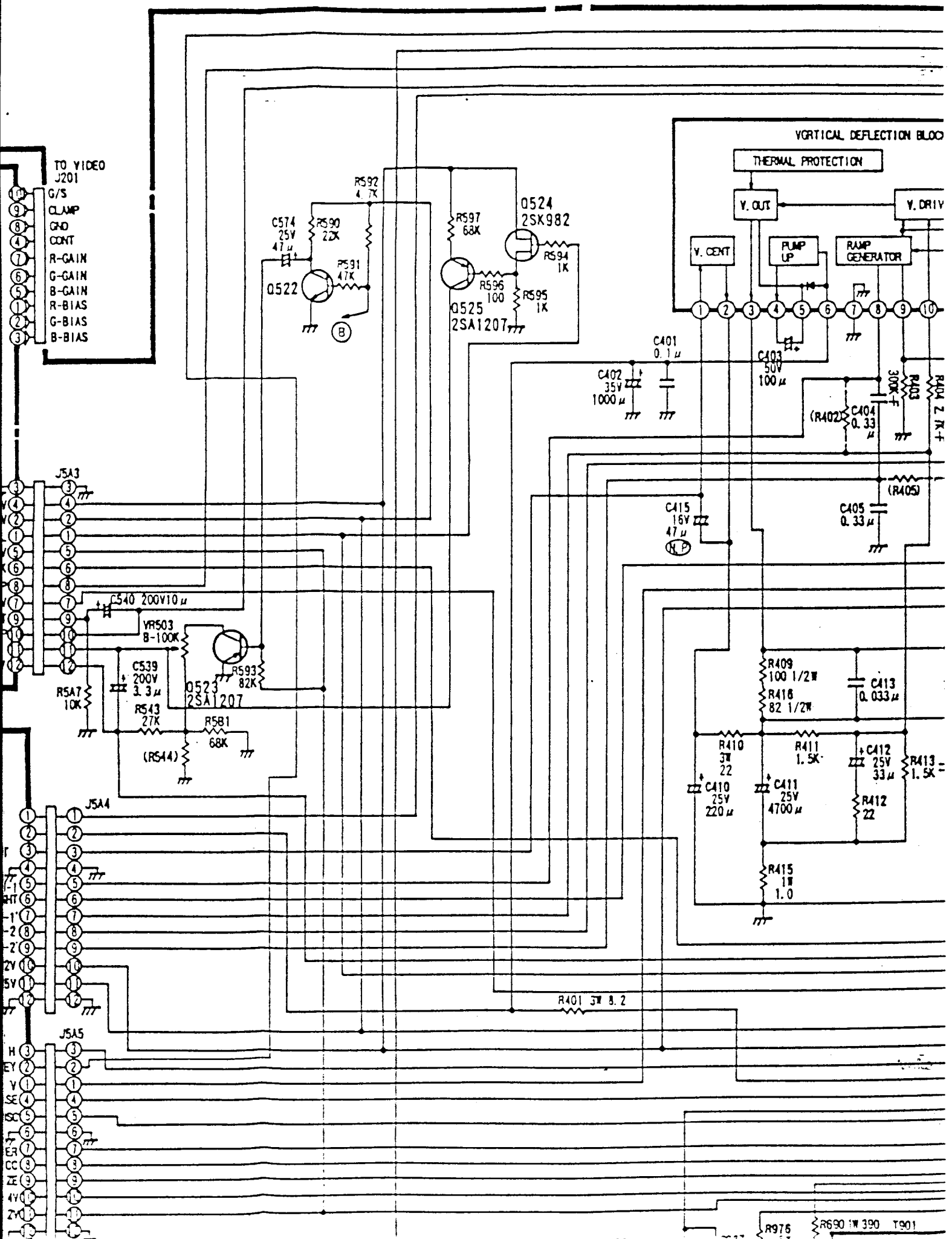


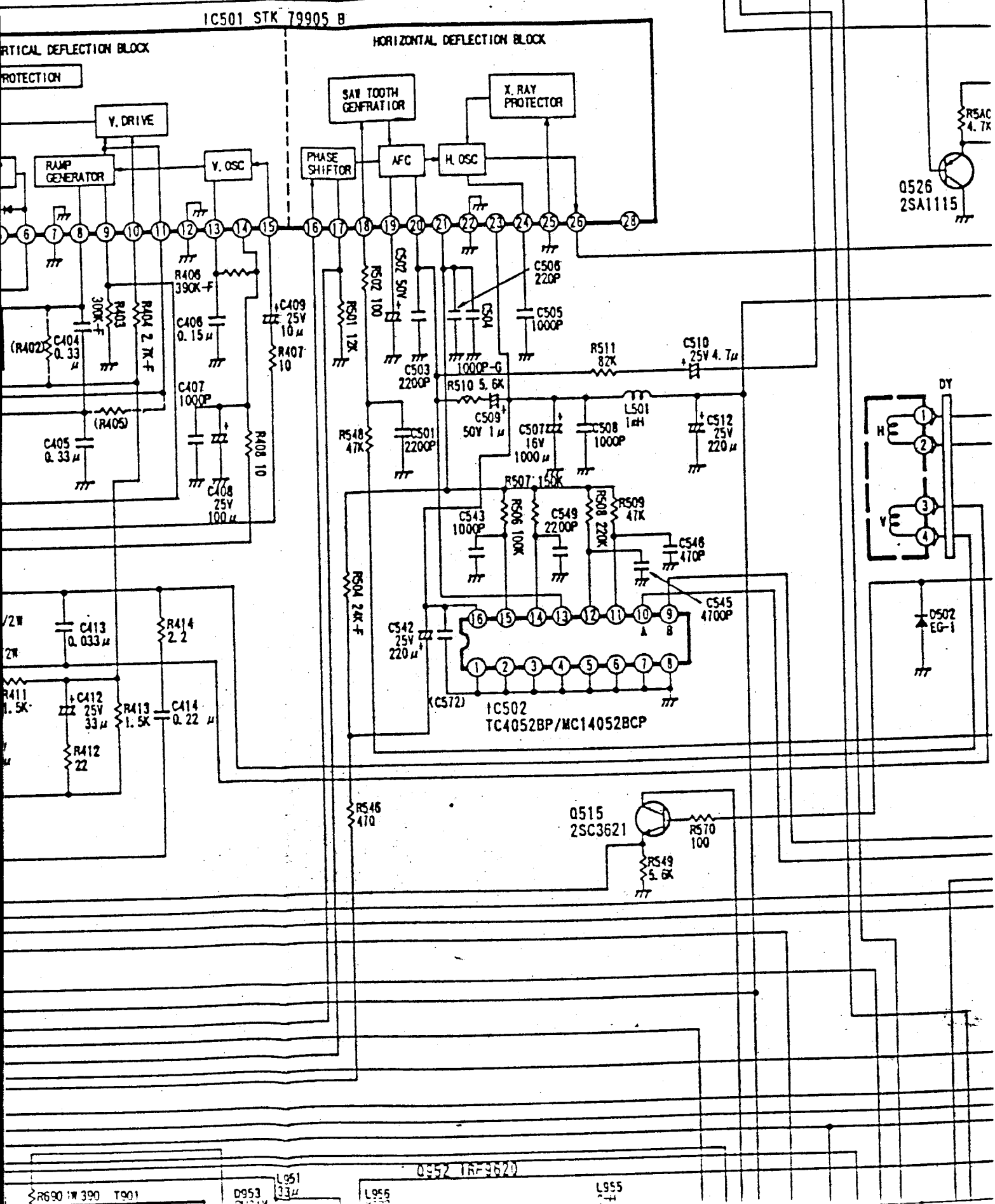

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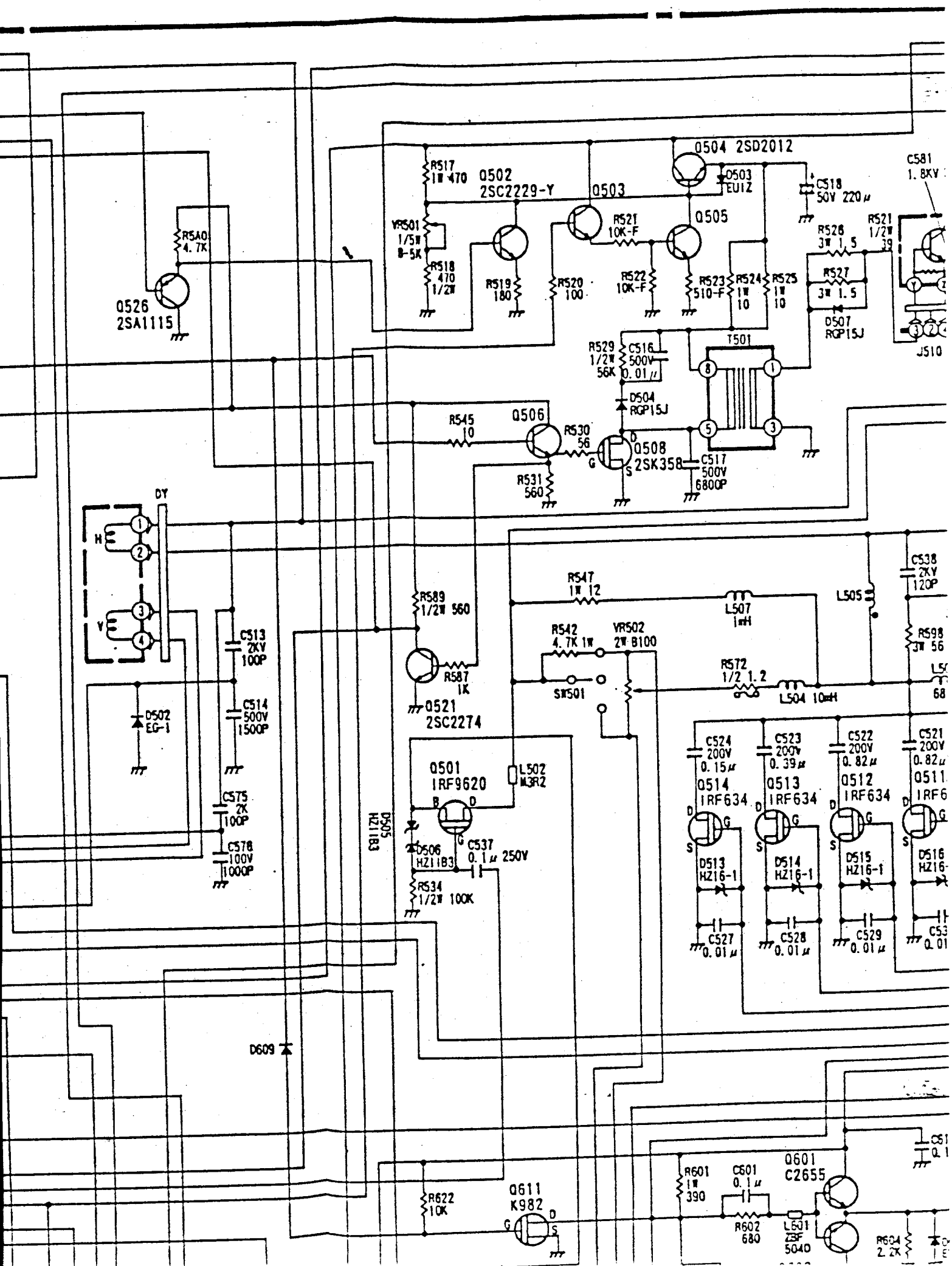
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SCHEMATIC DIAGRAM			
PCB-VIDEO			

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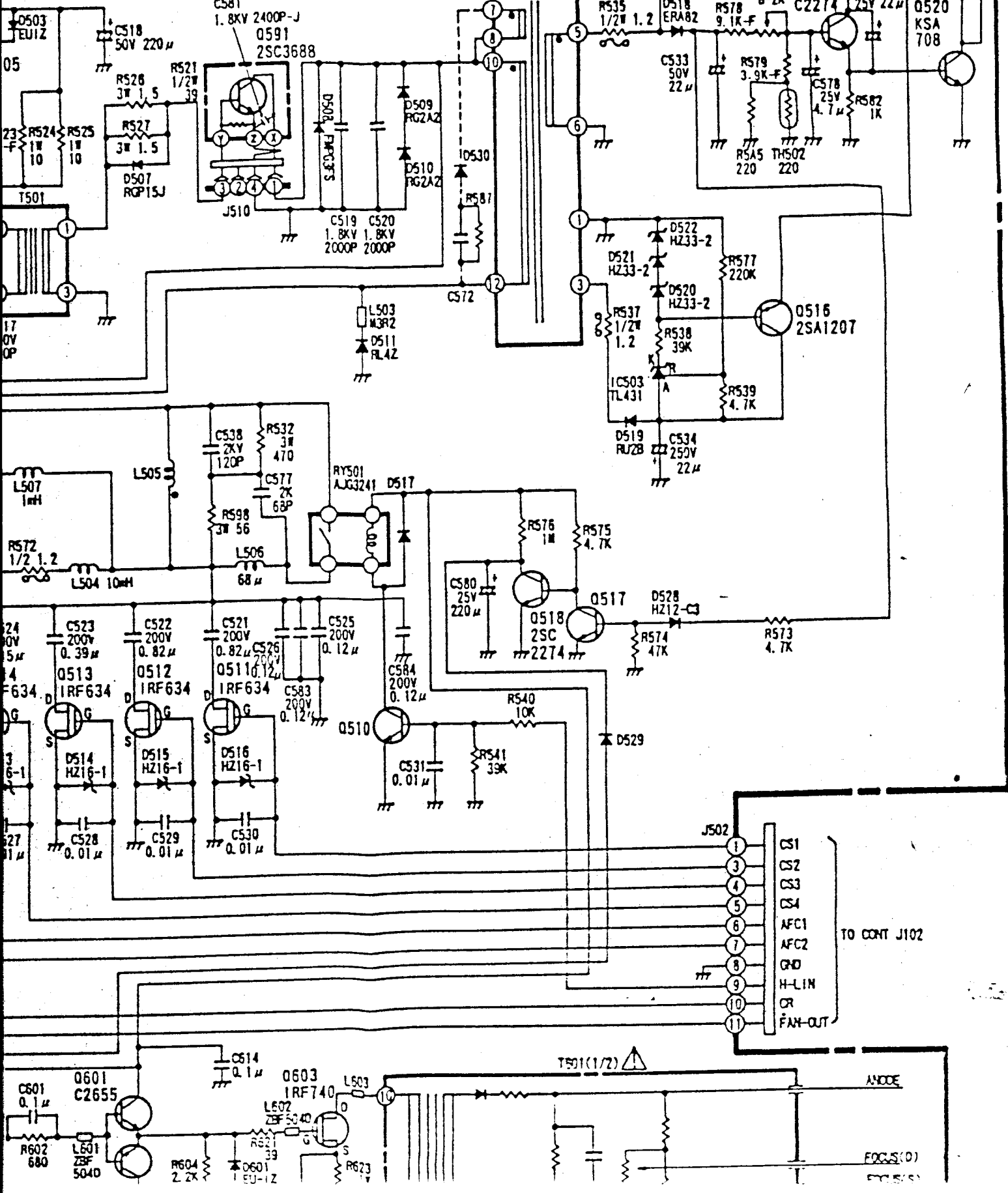


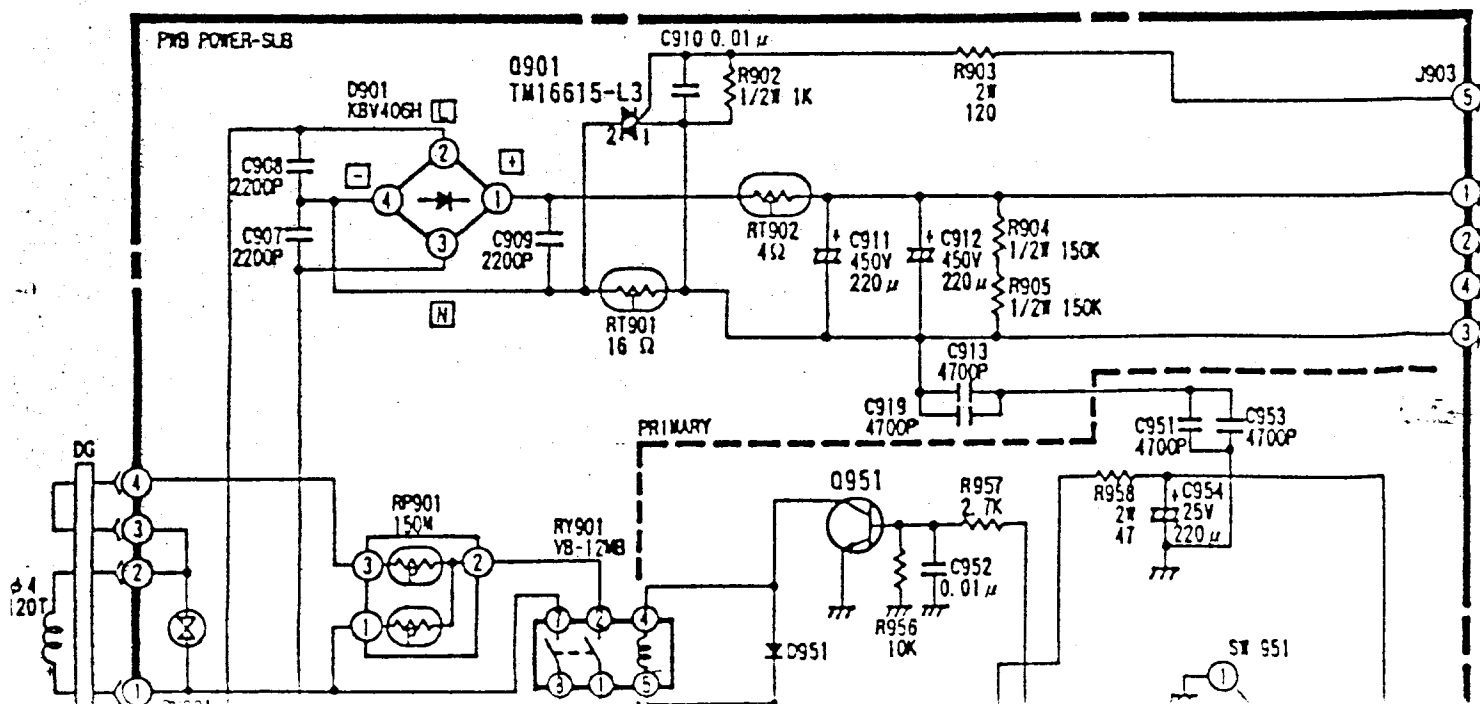
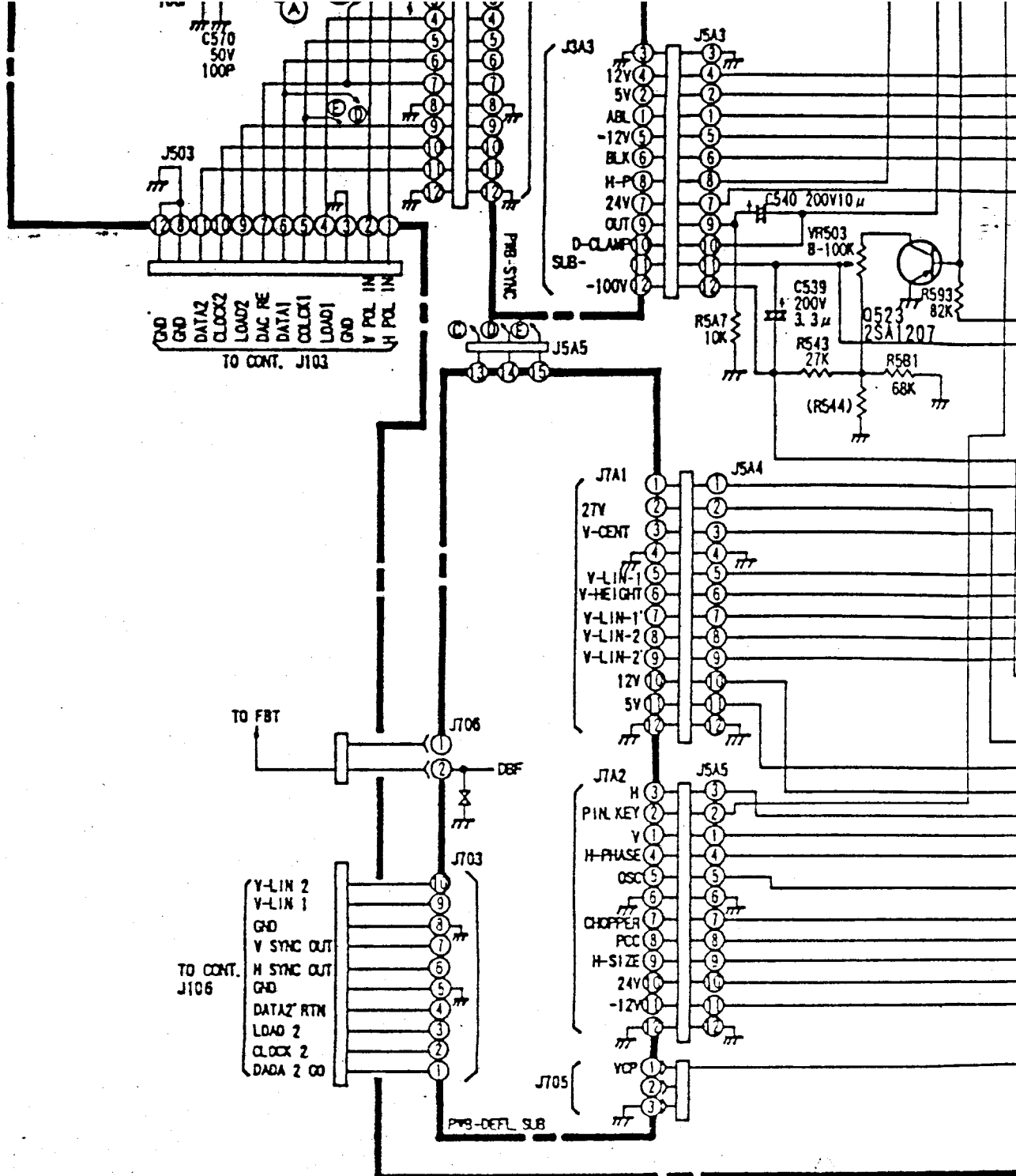


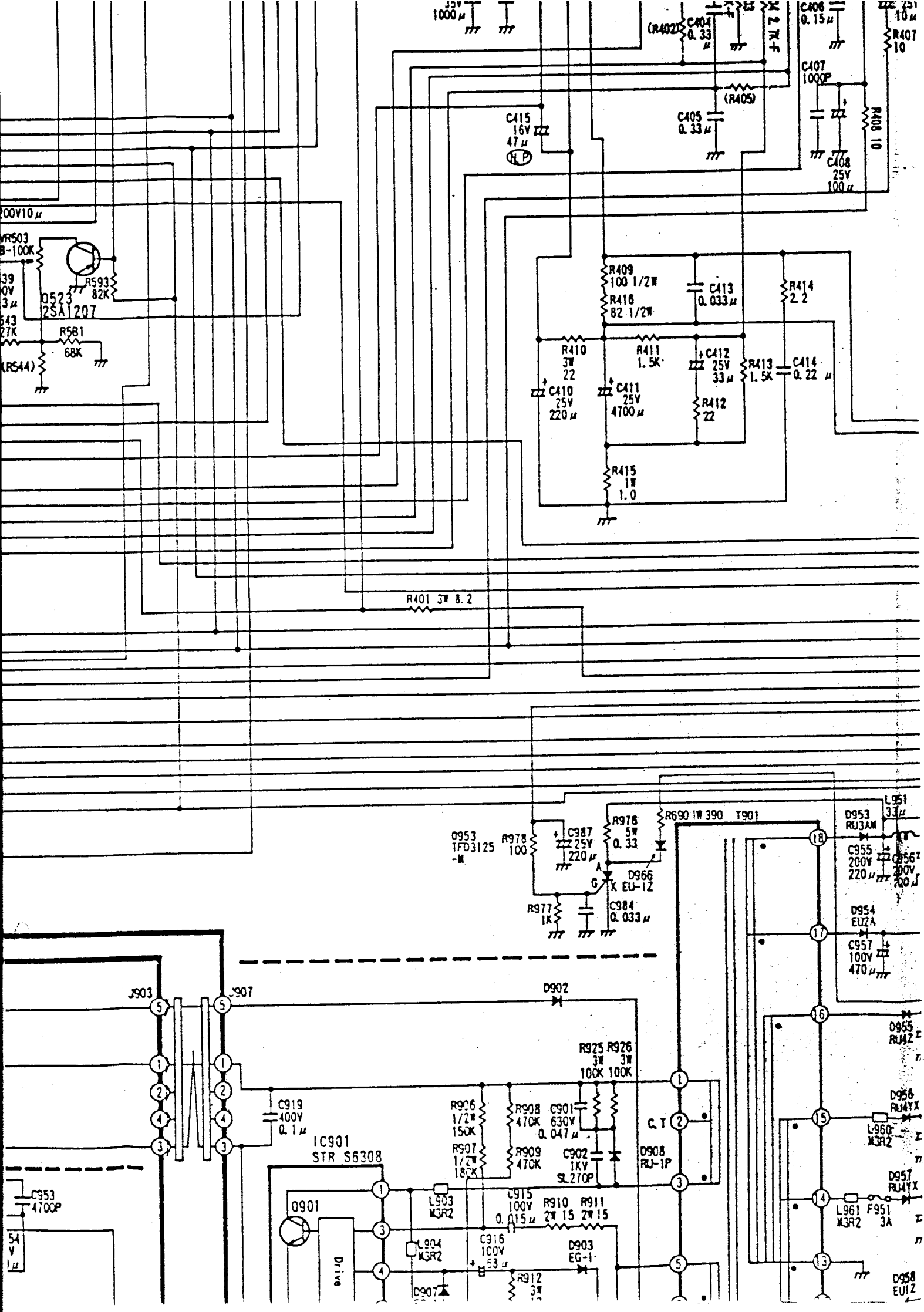


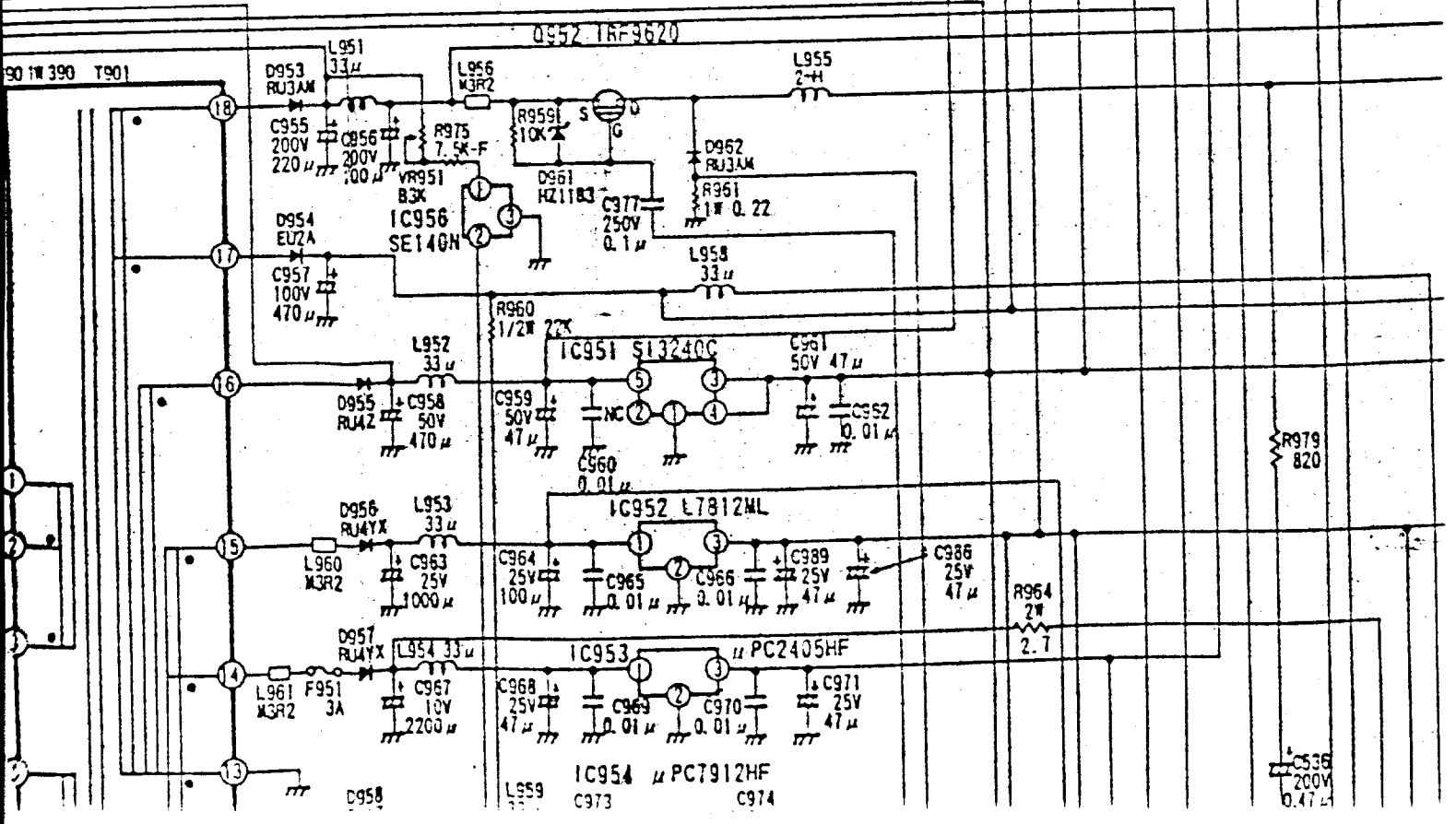
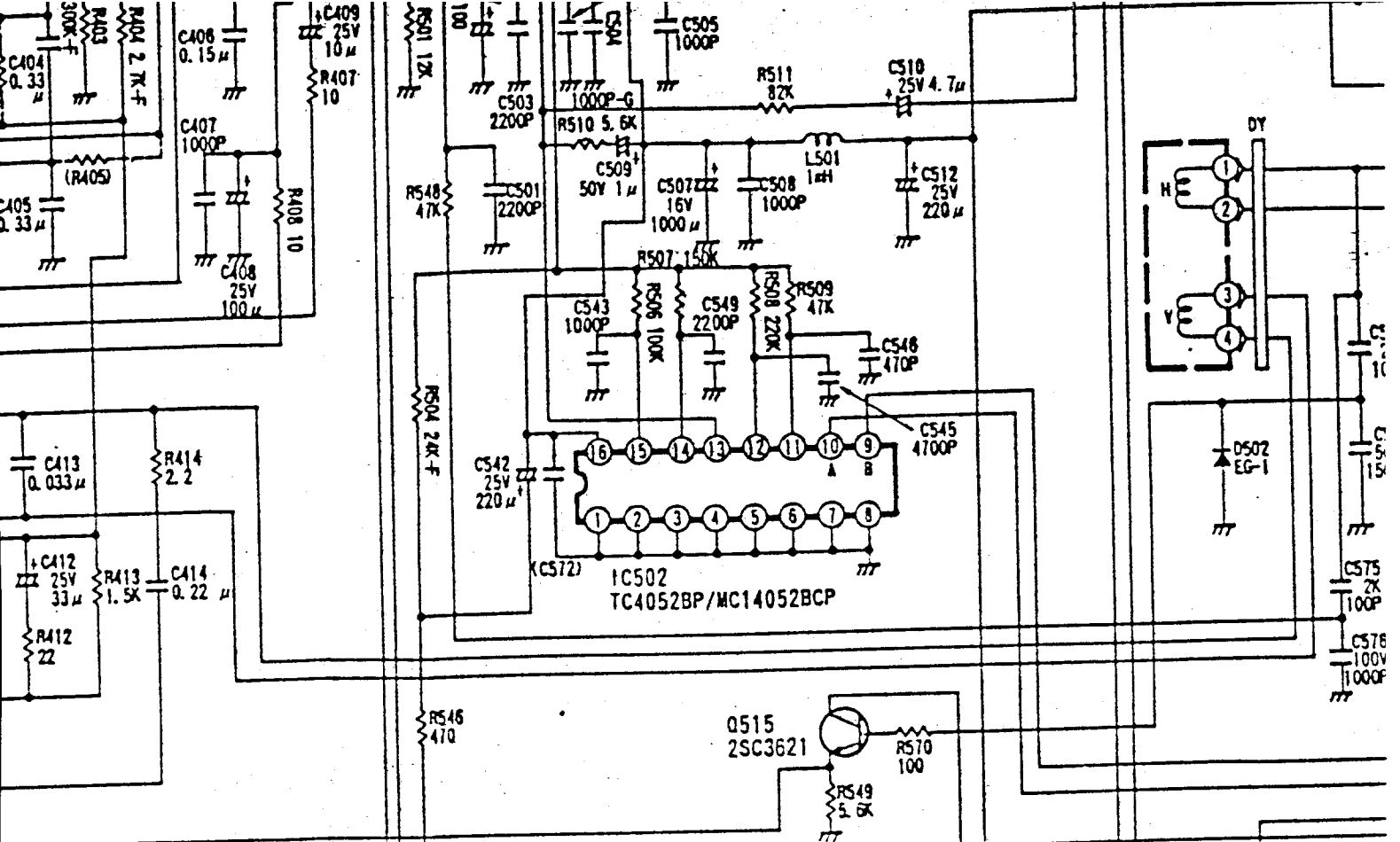


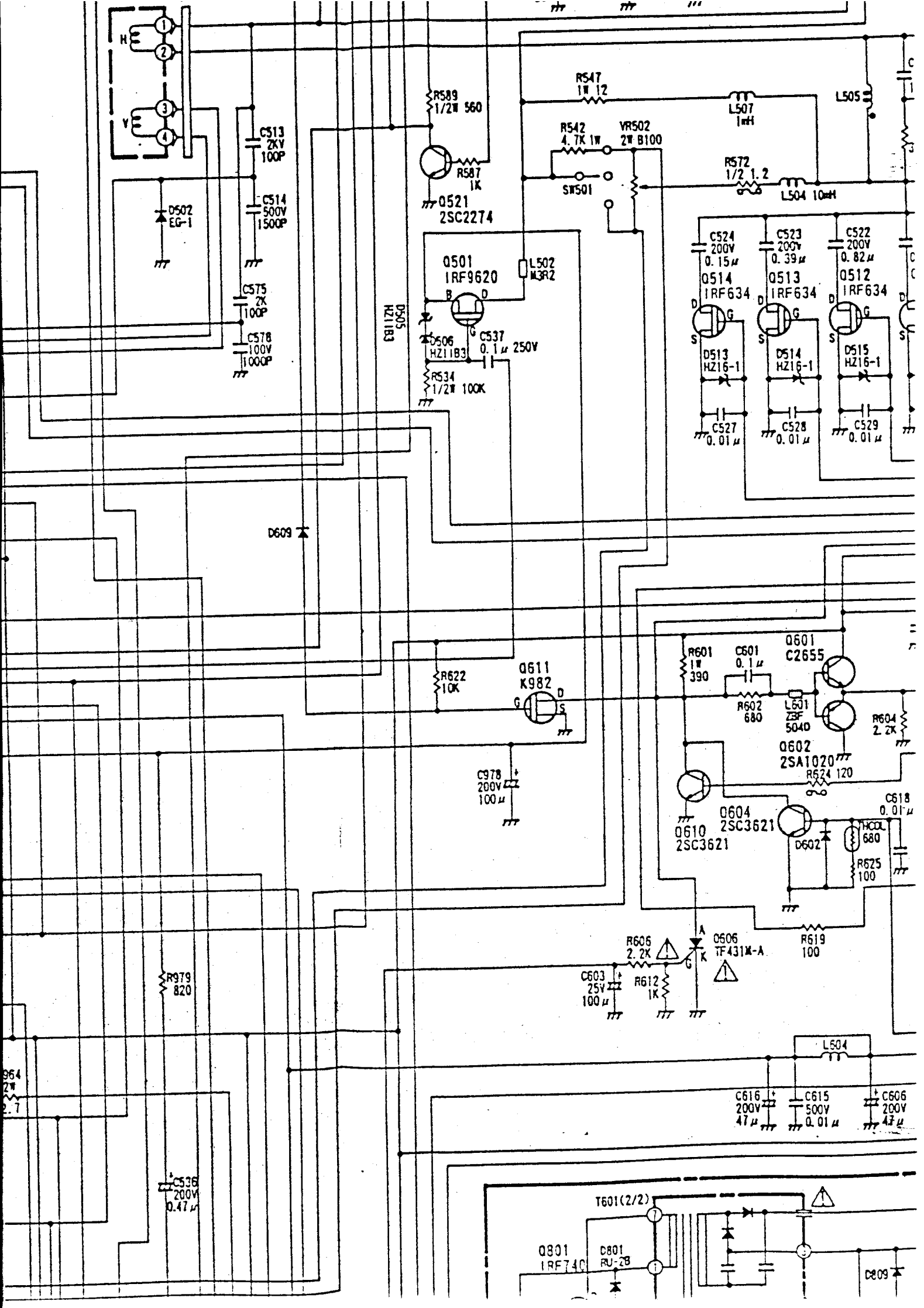
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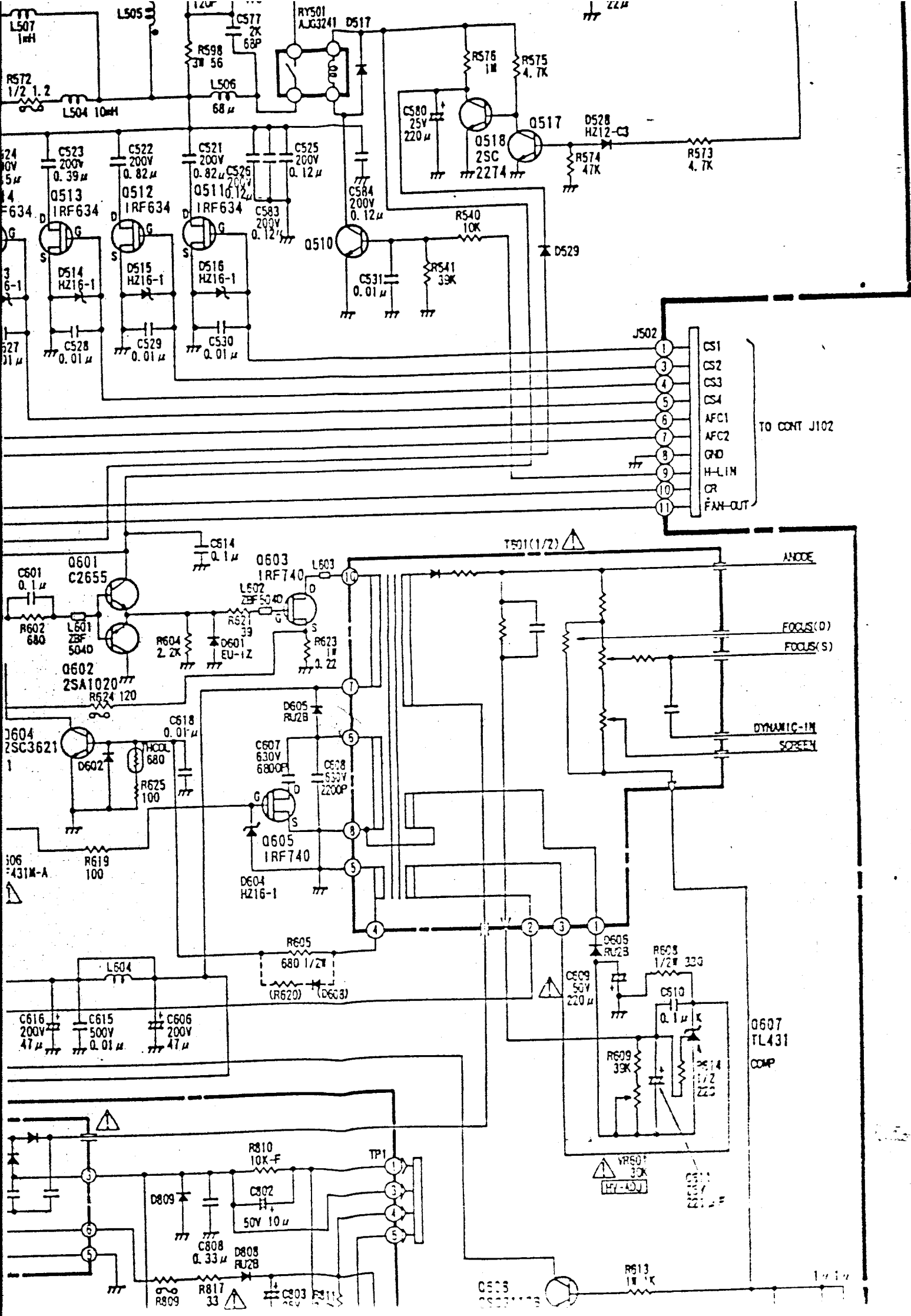


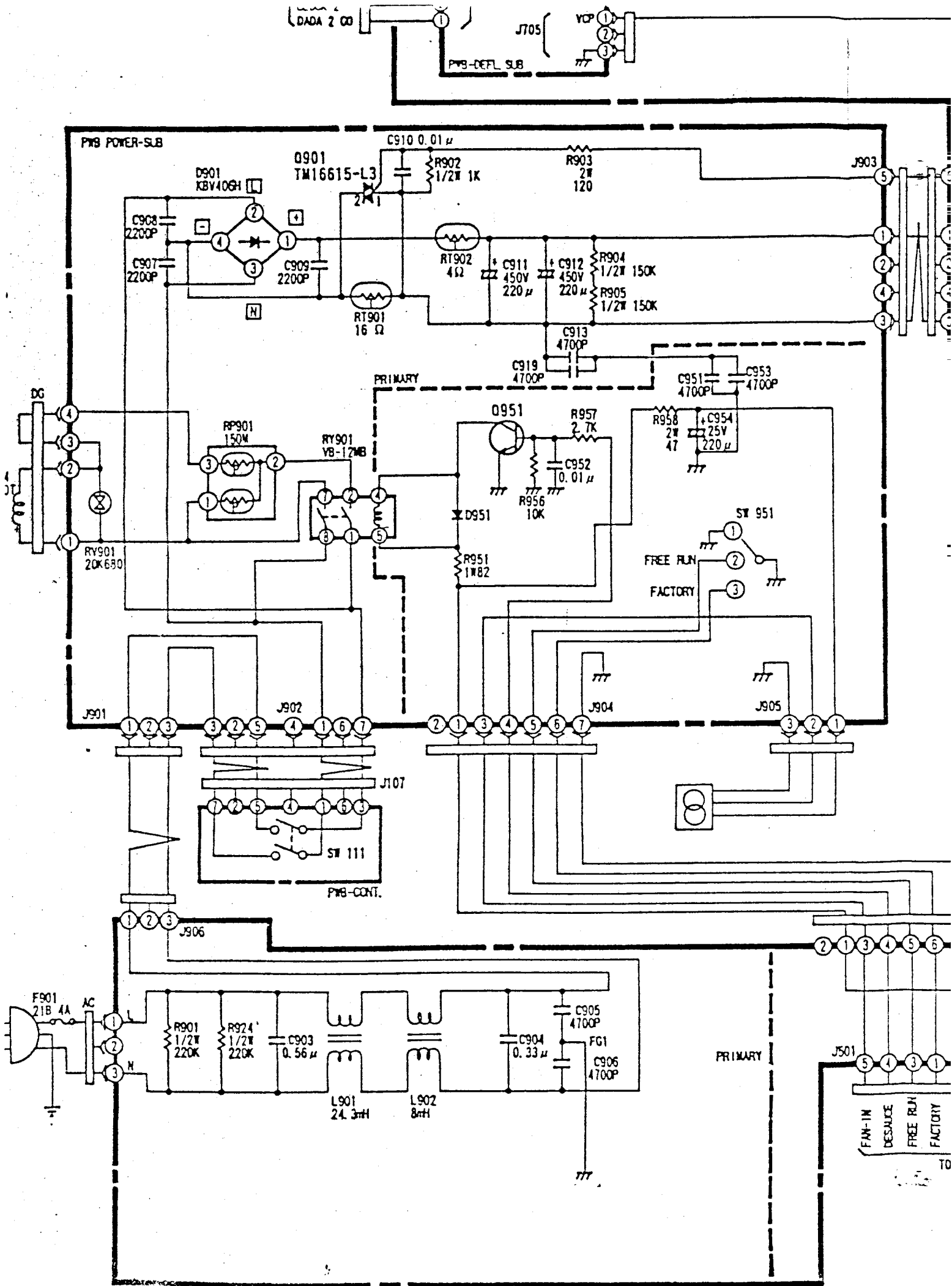


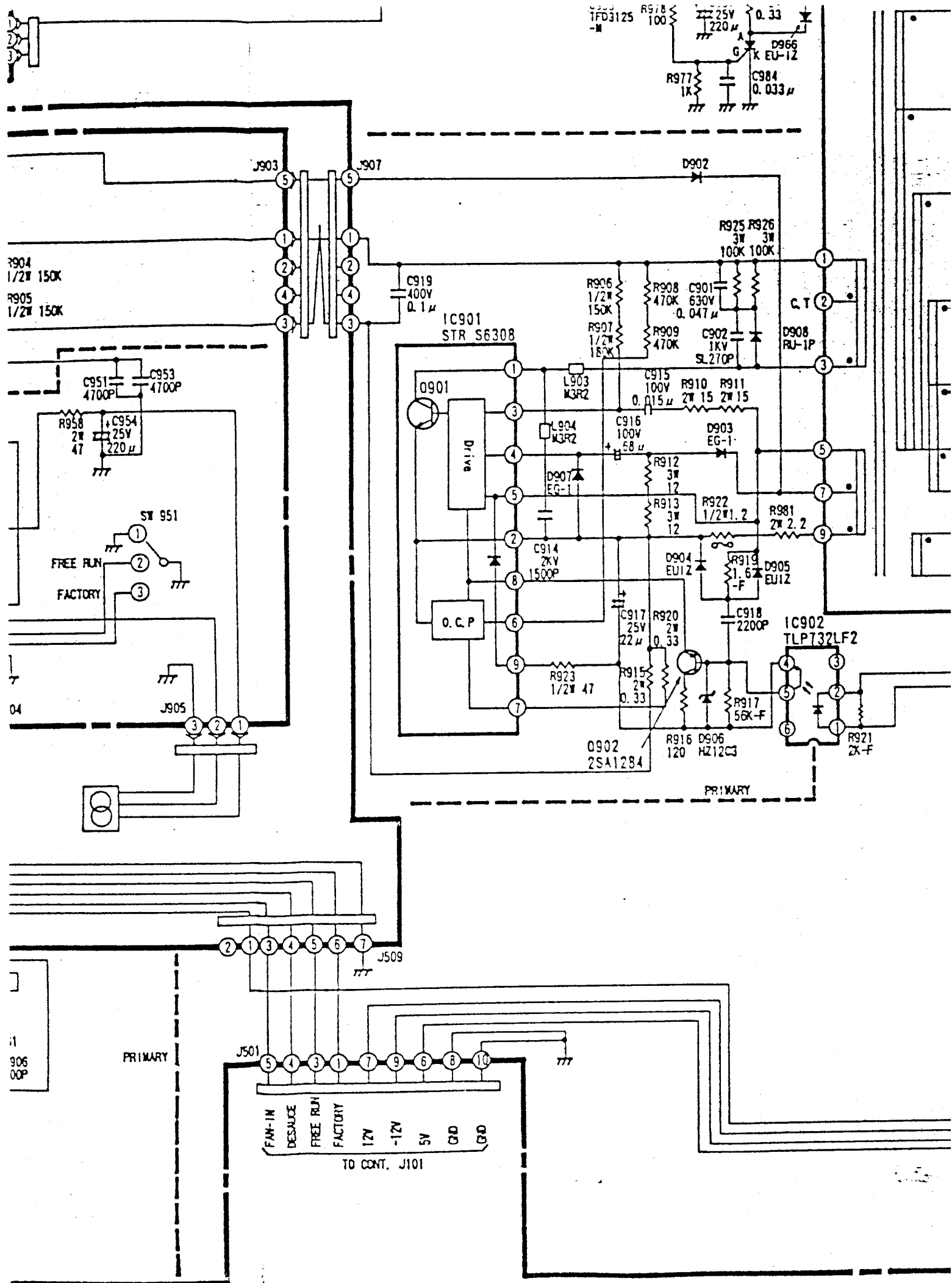


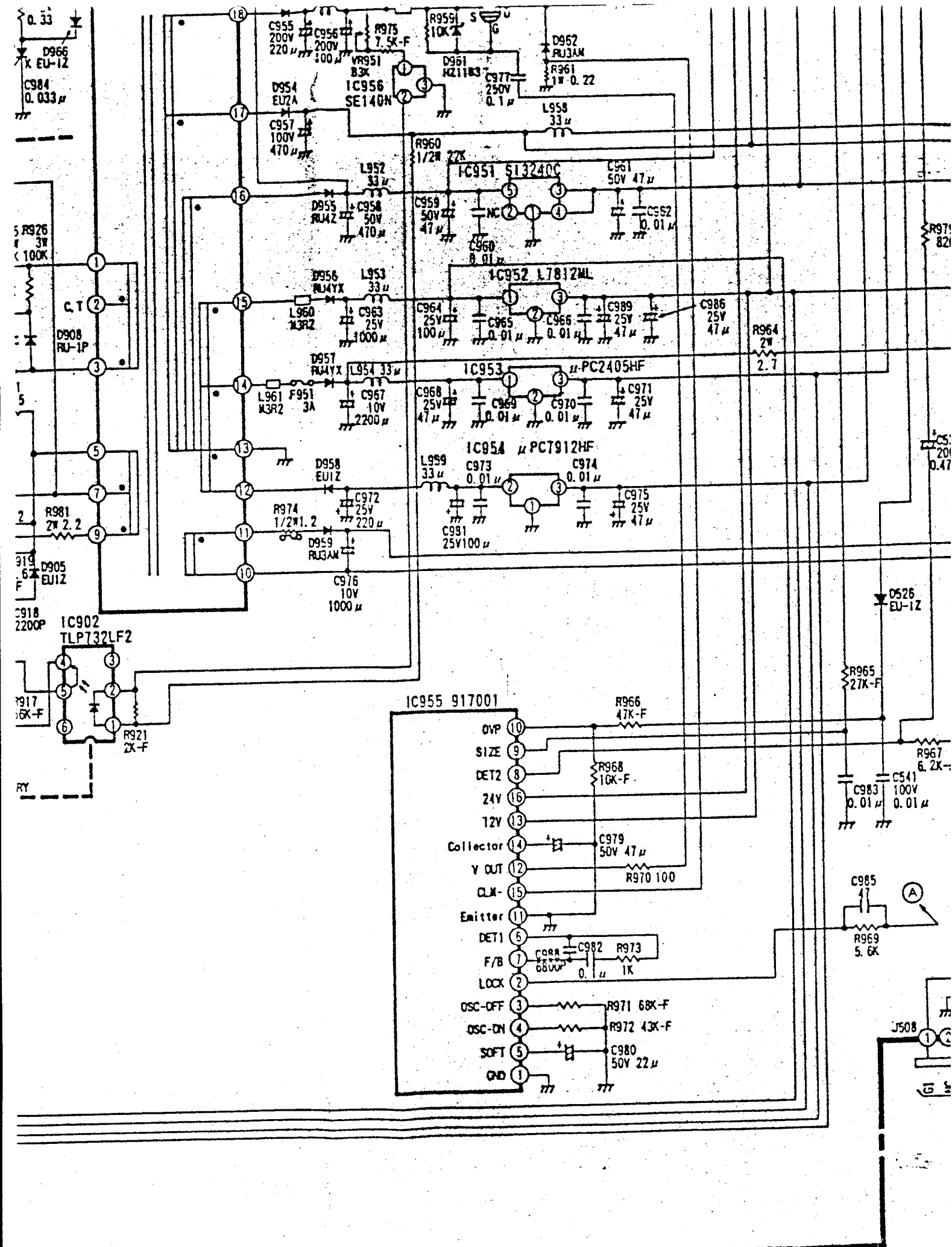


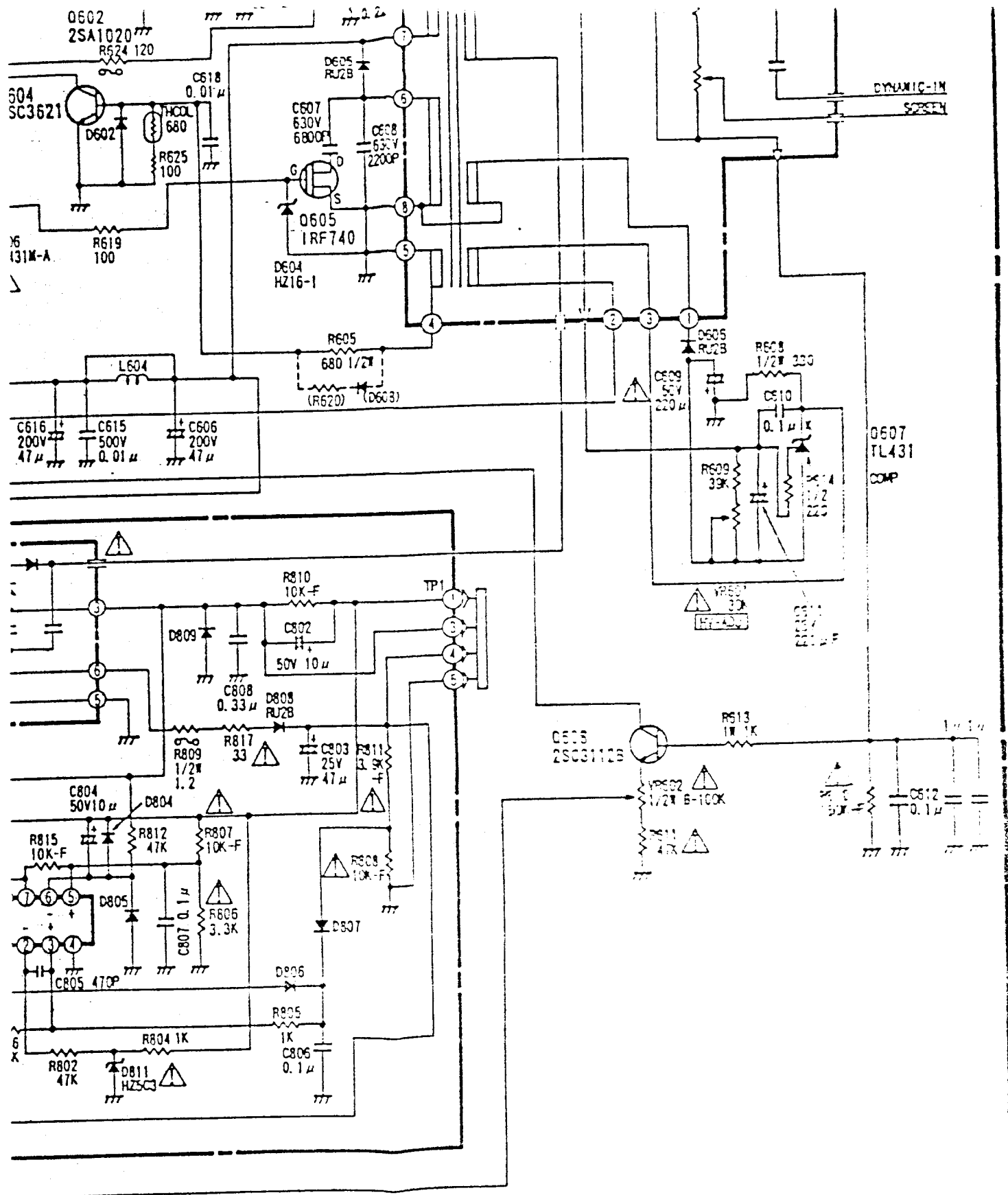












MODEL: TFS6705K
PCB - MAIN
SCHEMATIC DIAGRAM

ON GND

Parts No.

MODEL

R193

R194

R198

R199

R1A3

R1A4

FS6605K

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TF56705K

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○ ⇒ Mounted

✕ ⇒ Not Mounted

