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Service Training

NTDPJTV02

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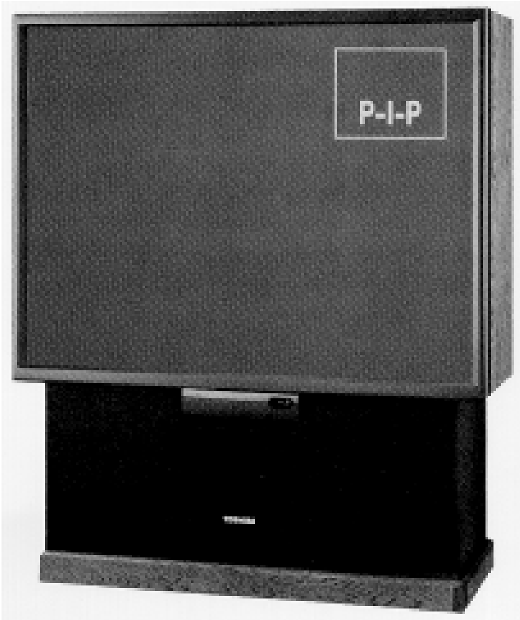

TOSHIBA AMERICA CONSUMER PRODUCTS, INC.

"In Touch with Tomorrow"

FOREWORD

The material presented in this manual is provided and intended only for the technical training of TACP employees and other authorized service personnel.

Although it uses the model TP48C90 as an example, the material in this manual may be typical of several different models of Projection Television receivers.

The specific circuit reference designations, pin numbers, etc., were taken from the TP48C90 Service Manual, file number 050-644. However, the diagrams included herein should not be used for actual servicing as some of them may have been simplified for training purposes.

Always obtain the proper service manual for the model number of the unit being serviced whenever performing any kind of service.

Because this manual is an update, it does not describe every part of any TV; its purpose is to acquaint authorized trainees with circuits that have been changed from or added to earlier model circuits presented in previous manuals.

This manual was prepared by

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SECTION 1
INTRODUCTION

1. MAJOR MODEL FEATURE

The major feature of the model TP48C50/51 and the TP-48C90 is based on the the N2DB chassis. This chassis introduces a new bus system, developed by the PHILIPS company, called the I^2C (or IIC) bus. IIC stands for Inter-Integrated Circuit control. This bus co-ordinates the transfer of data and control between ICs inside the TV. It is a bi-directional serial bus consisting of two lines, named SDA (Serial DATA), and SCL (Serial CLOCK). This bus control system is made possible through the use of digital-to-analog converters built into the ICs, allowing them to be addressed and controlled by strings of digital instructions.

2. MERITS OF THE BUS SYSTEM

2-1. Improved Serviceability

Most of the adjustments previously made by resetting variable resistors and/or capacitors can be made on the new chassis by operating the remote control and seeing the results on the TV screen. This allows these adjustments to be made without removing the back cover, thus improving servicing speed and efficiency.

2-2. Reduction of Parts Count

The use of digital-to-analog converters built into the ICs, allowing them to be controlled by software, has eliminated or reduced the requirement for many discrete parts such as potentiometers and trimmers, etc.

2-3. Quality Control

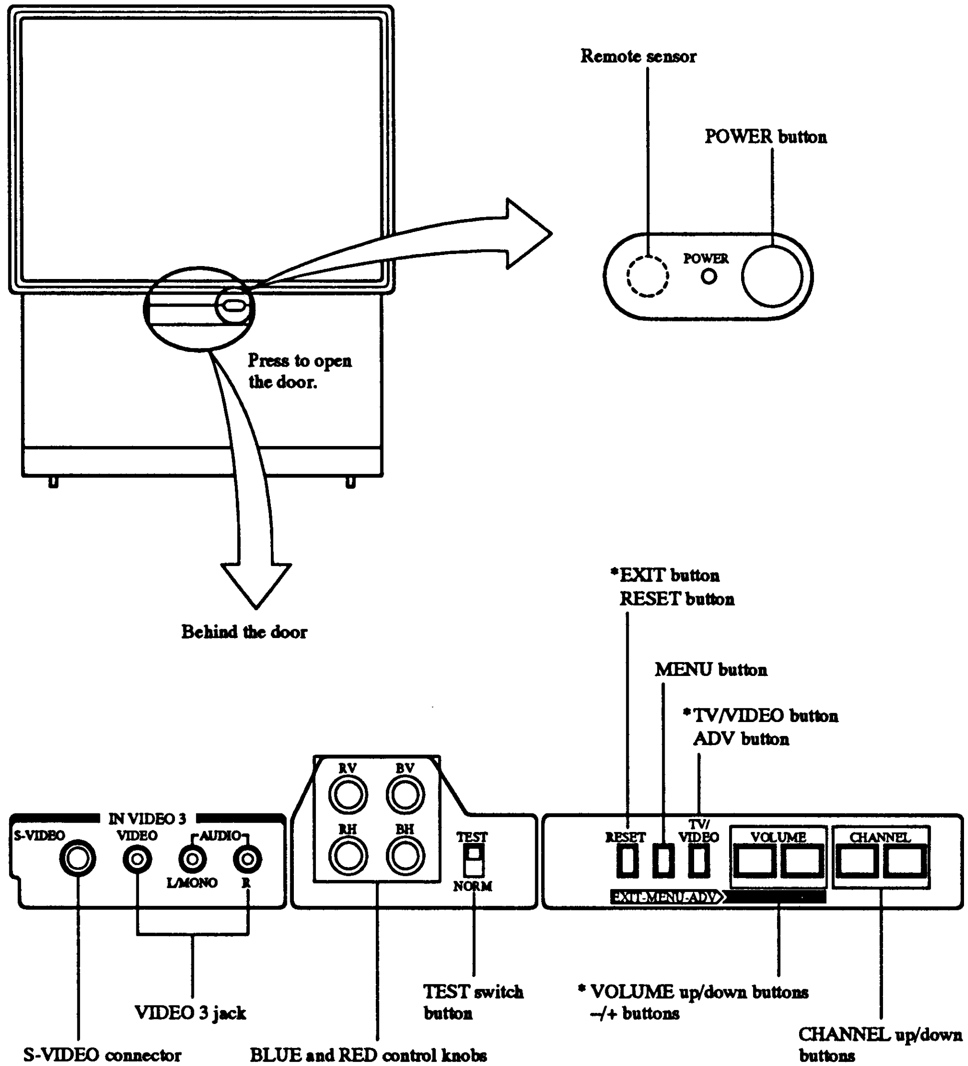
This central control of the adjustment data makes it easier to understand, analyze, and review the data, thus improving quality of the product.

3. SPECIFICATIONS

	Model Number	TP55C80 / TP55C81 / PJ55C80	TP48C90 / PJ48C90	TP48C70 / TP48C71	TP48C50 / TP48C51 / PJ48C50
GENERAL	Screen Size & CRT	55" Projection	48" Projection	48" Projection	48" Projection
	Channel Capacity	181CH	181CH	181CH	181CH
	MTS with dbx	•	•	•	•
	SAP	•	•	•	•
	Remote Controls	Preprogram Univ. & EZ	Preprogram Univ. &EZ	Preprogram Univ.	Preprogram Univ.
	Number of Keys	45 & 7	45 & 7	44	42
	Picture-In-Picture	2 Tuner	2 Tuner	2 Tuner	1 Tuner
	Projection Brightness	450 Ft L	600 Ft L	600 Ft L	600 Ft L
	Projection Viewing Angle	160°	160°	160°	160°
SOUND	Dolby Surround	•	•	—	—
	Digital Sound Processor (DSP)	(4CH)	(4CH)	•	—
	Front Surround Sound	—	—	—	•
	Sub Bass System (SBS)	•	•	•	—
	Bass/Treble Control	•	•	•	•
	Number of Speakers	2+2	2+2	2	2
	Rear Speaker	•	•	—	—
	Audio output	28W+20W	28W+20W	28W	28W
PICTURE	Comb Filter	Digital	Digital	Digital	CCD
	Dynamic Quadruple Focus	•	•	•	•
	Velocity Scan Modulation	•	•	•	•
	Black Level Expander	•	•	•	•
	Flesh Tone Control	•	•	•	•
	Dynamic Noise Reduction	•	•	•	•
	Picture Preference	•	•	•	•
	Horizontal Resolution	800 (S-IN)	800(S-IN)	800 (S-IN)	800
CONVENIENCE	Channel Return	•	•	•	•
	Parental Channel Lock	•	•	•	•
	Channel Caption	•	•	•	•
	3 Language Display	•	•	•	•
	Built-In Clock	•	•	•	•
	Closed Caption	•	•	•	•
TERMINALS	S-Video Input	1+1	1+1	1+1	1+1
	Audio/Video In/Out	2+1 In/1 Out	2+1 In/1 Out	2+1 In/1 Out	2+1 In/1 Out
	Front Terminal	•	•	•	•
	Variable Audio Output	•	•	•	•
	2RF Input	•	•	•	—
	External Speaker Terminal	•	•	•	•

4. FRONT AND REAR CONTROL VIEWS

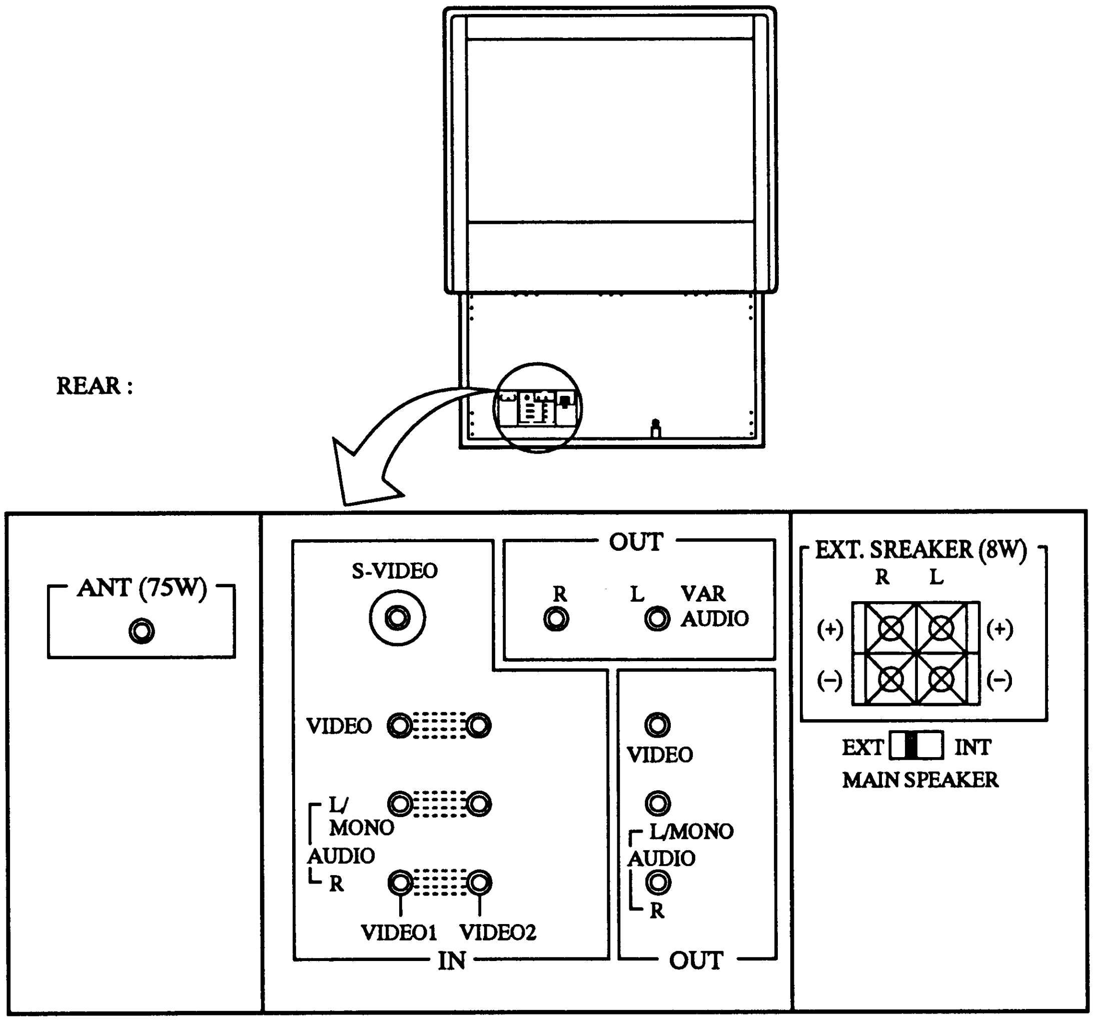
4-1. Front View



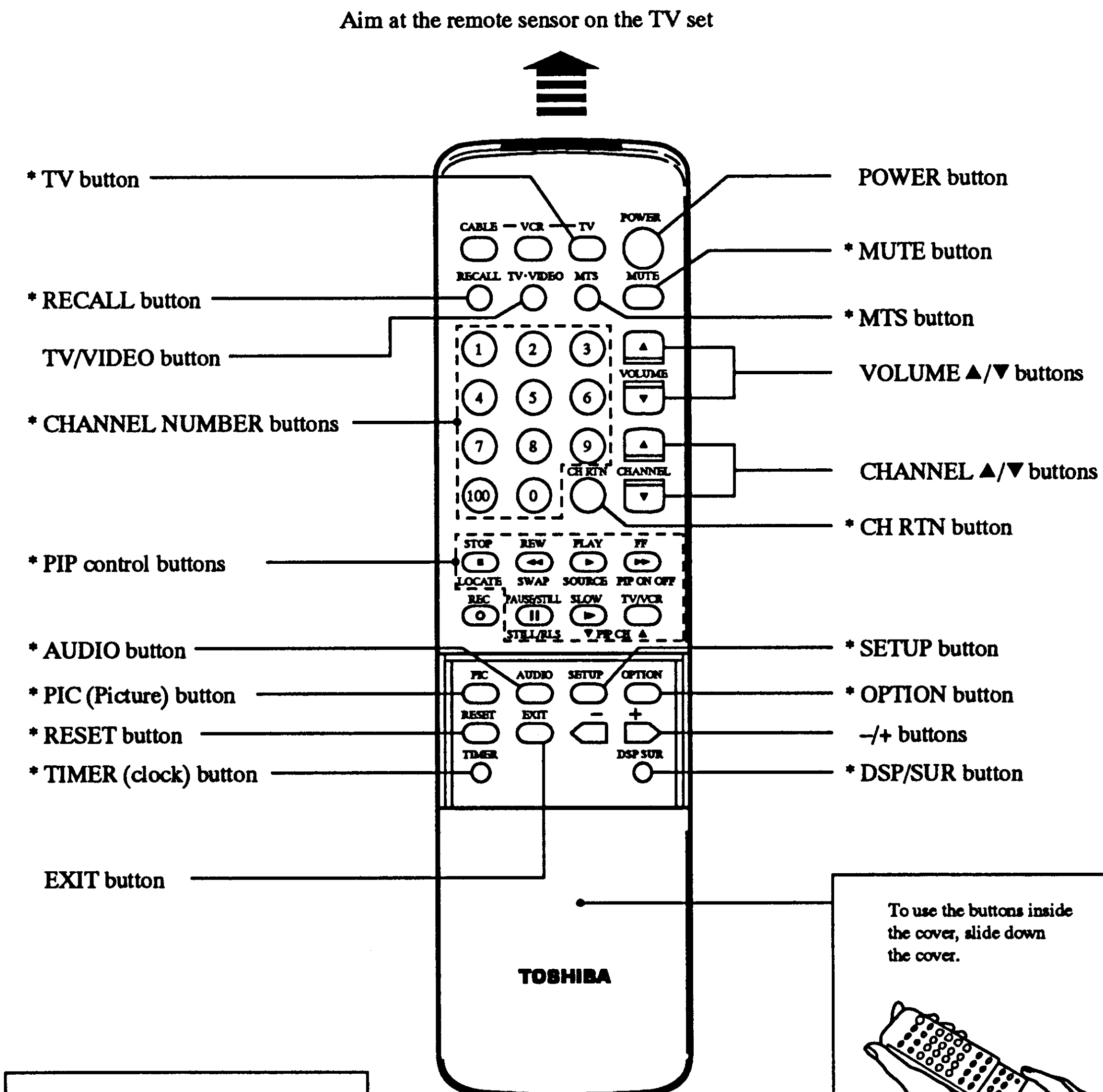
* These buttons have dual functions.

4-2. Rear View

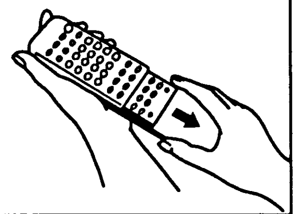
REAR :



4-3. Remote Transmitter



To use the buttons inside the cover, slide down the cover.



- These functions do not have duplicate locations on the TV set. They can be controlled only by the Remote Control.

5. CONSTRUCTION OF CHASSIS

① Power Unit

② Conver-out Unit

③ Def. H.V. Unit

④ Main Unit (Comb. A/V, C/C, PIP Unit)

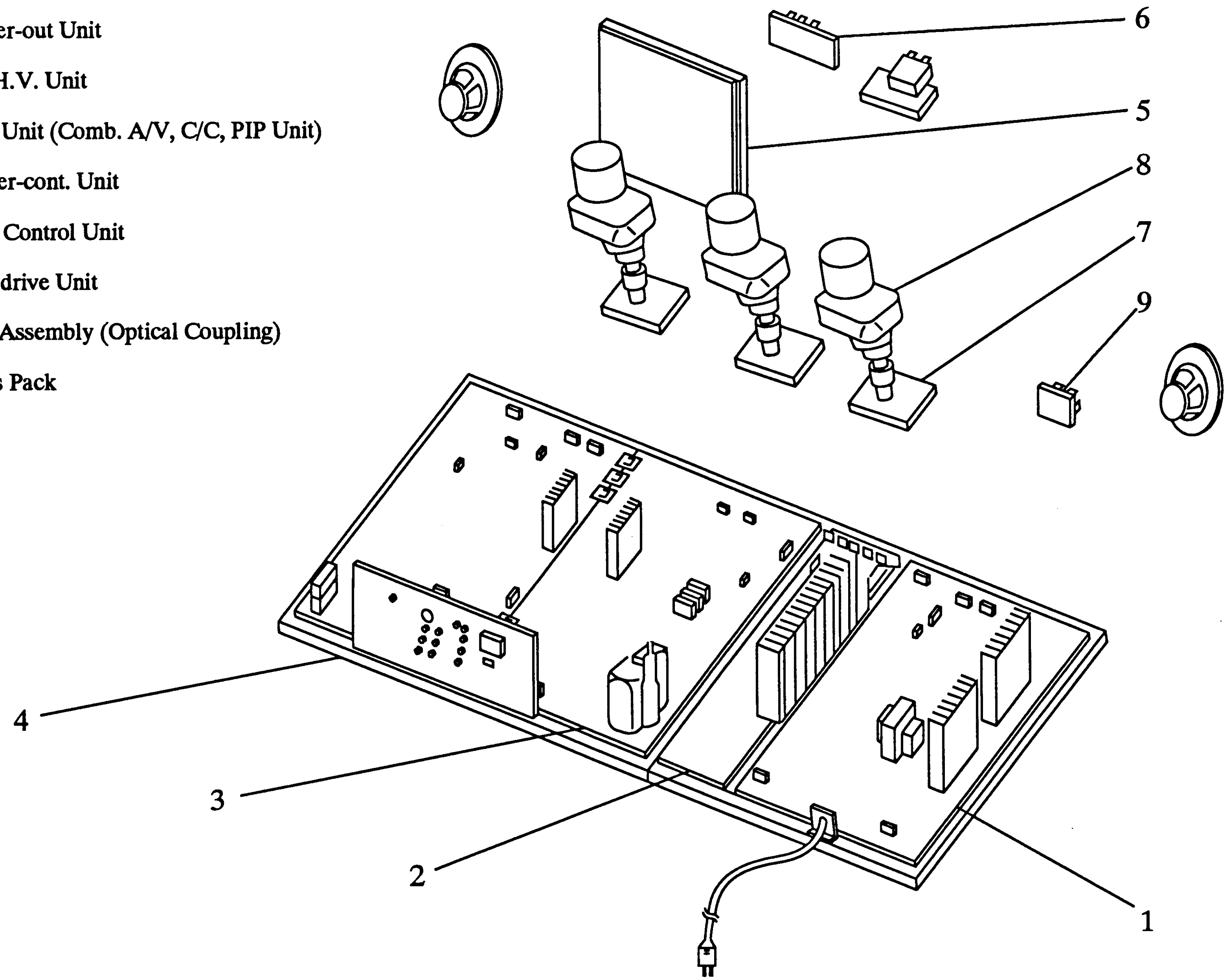
⑤ Conver-cont. Unit

⑥ Front Control Unit

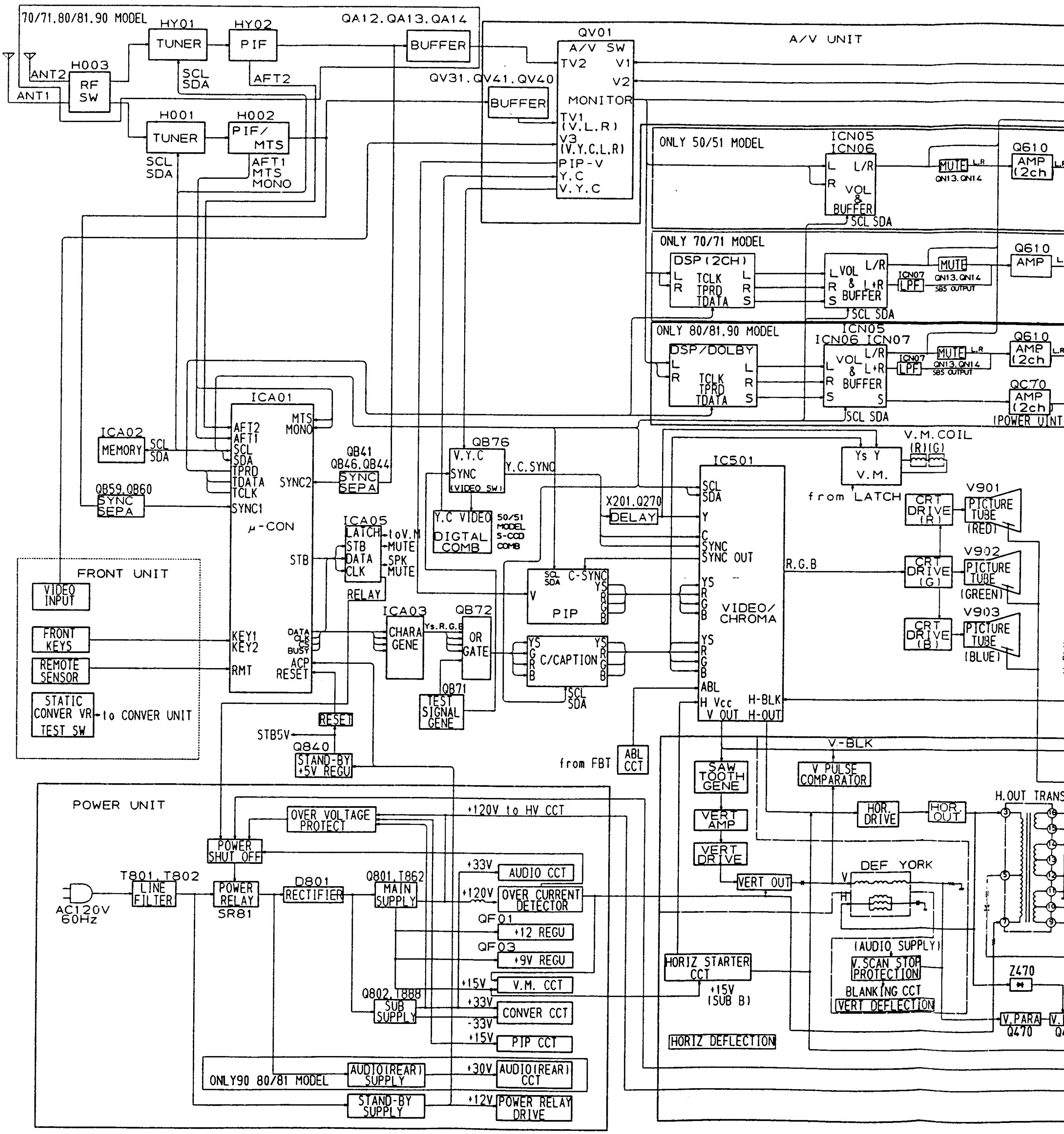
⑦ CRT-drive Unit

⑧ CRT Assembly (Optical Coupling)

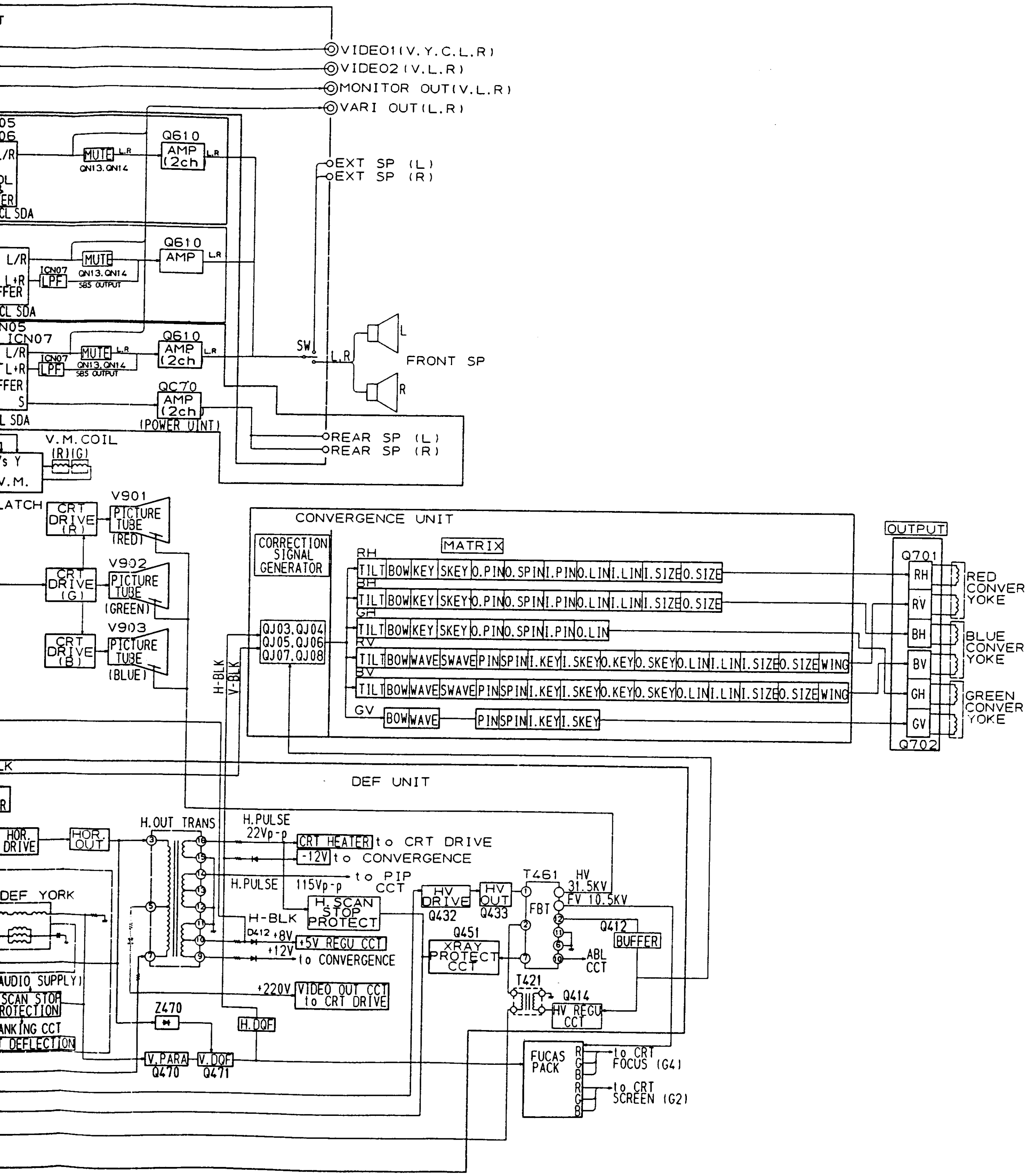
⑨ Focus Pack



6. BLOCK DIAGRA



OCK DIAGRAM


VIDEO1 (V.Y.C.L.R)
VIDEO2 (V.L.R)
MONITOR OUT (V.L.R)
VARI OUT (L.R)
Q610
AMP (2ch)
MUTE
QN13.QN14
EXT SP (L)
EXT SP (R)
AMP
ICN07
LPF
585 OUTPUT
ICN07
SW
L.R
L
FRONT SP
R
QC70
AMP (2ch)
(POWER UINT)
REAR SP (L)
REAR SP (R)
V.M.COIL
(R)(G)
V901
CRT DRIVE (R)
PICTURE TUBE
(RED)
V902
CRT DRIVE (G)
PICTURE TUBE
(GREEN)
V903
CRT DRIVE (B)
PICTURE TUBE
(BLUE)
H-BLK
V-BLK
CONVERGENCE UNIT
CORRECTION SIGNAL GENERATOR
MATRIX
QJ03.QJ04
QJ05.QJ06
QJ07.QJ08
RH
TILT BOW KEY SKEY O.PIN O.SPIN I.PIN O.LIN I.LIN I.SIZE O.SIZE
BH
TILT BOW KEY SKEY O.PIN O.SPIN I.PIN O.LIN I.LIN I.SIZE O.SIZE
GH
TILT BOW KEY SKEY O.PIN O.SPIN I.PIN O.LIN
RV
TILT BOW WAVE SWAVE PIN SPIN I.KEY I.SKEY O.KEY O.SKEY O.LIN I.LIN I.SIZE O.SIZE WING
BV
TILT BOW WAVE SWAVE PIN SPIN I.KEY I.SKEY O.KEY O.SKEY O.LIN I.LIN I.SIZE O.SIZE WING
GV
BOW WAVE
PIN SPIN I.KEY I.SKEY
OUTPUT
Q701
RH
RV
BH
BV
GH
GV
Q702
RED CONVER YOKE
BLUE CONVER YOKE
GREEN CONVER YOKE
DEF UNIT
H.OUT TRANS
H.PULSE 22Vp-p
CRT HEATER to CRT DRIVE
-12V to CONVERGENCE
H.PULSE 115Vp-p
to PIP CCT
HOR. DRIVE
HOR. OUT
DEF YORK
H-BLK
H.SCAN STOP PROTECT
D412 +8V
+5V REGU CCT
+12V to CONVERGENCE
+220V VIDEO OUT CCT to CRT DRIVE
AUDIO SUPPLY)
SCAN STOP ROTECTION
ANKING CCT
DEFLECTION
Z470
H.DOF
V.PARA Q470
V.DOF Q471
HV DRIVE Q432
HV OUT Q433
T461
HV 31.5KV
FV 10.5KV
FBT
Q451
XRAY PROTECT CCT
Q412
BUFFER
ABL CCT
T421
Q414
HV REGU CCT
FUCAS PACK
to CRT FOCUS (G4)
to CRT SCREEN (G2)

SECTION 2
DIGITAL COMB FILTER

1. OUTLINE

The purpose of the Digital Comb Filter is to separate the chrominance (C) from the luminance (Y). The Digital Comb Filter is only available in selected models, including: TP48C70/71, TP48C90, TP55C80/81, PJ48C90, and PJ55C80. Other projection TV models use the 2CCD Comb Filter as used in the direct view N2DB chassis. The Digital Comb Filter circuit is contained on a single shielded PC Board.

2. SIGNAL FLOW

As shown in the Y/C Separation Signal Flow Block Diagram, Figure 2-1, the selected composite video signal is routed from the AV Board, through the Main Board, and into the Digital Comb Filter via terminal DG.

The Comb Filter also receives (terminal DF) the 3.58MHz sub-carrier (Fsc) signal and the 9Vdc supply (DE) as inputs. Ground is supplied by the shield and terminal DB. The composite video is processed in the Comb Filter to output the luminance (Y) signal via terminal DC and the chrominance (C) signal via terminal DD.

Processing takes place using three ICs, besides the discrete semiconductors and passive components. QZ03 is a PLL Oscillator IC that develops the 4fsc signal that is fed to QZ01. The fsc signal fed to Pin 1 comes from the VCD IC, Pin 40.

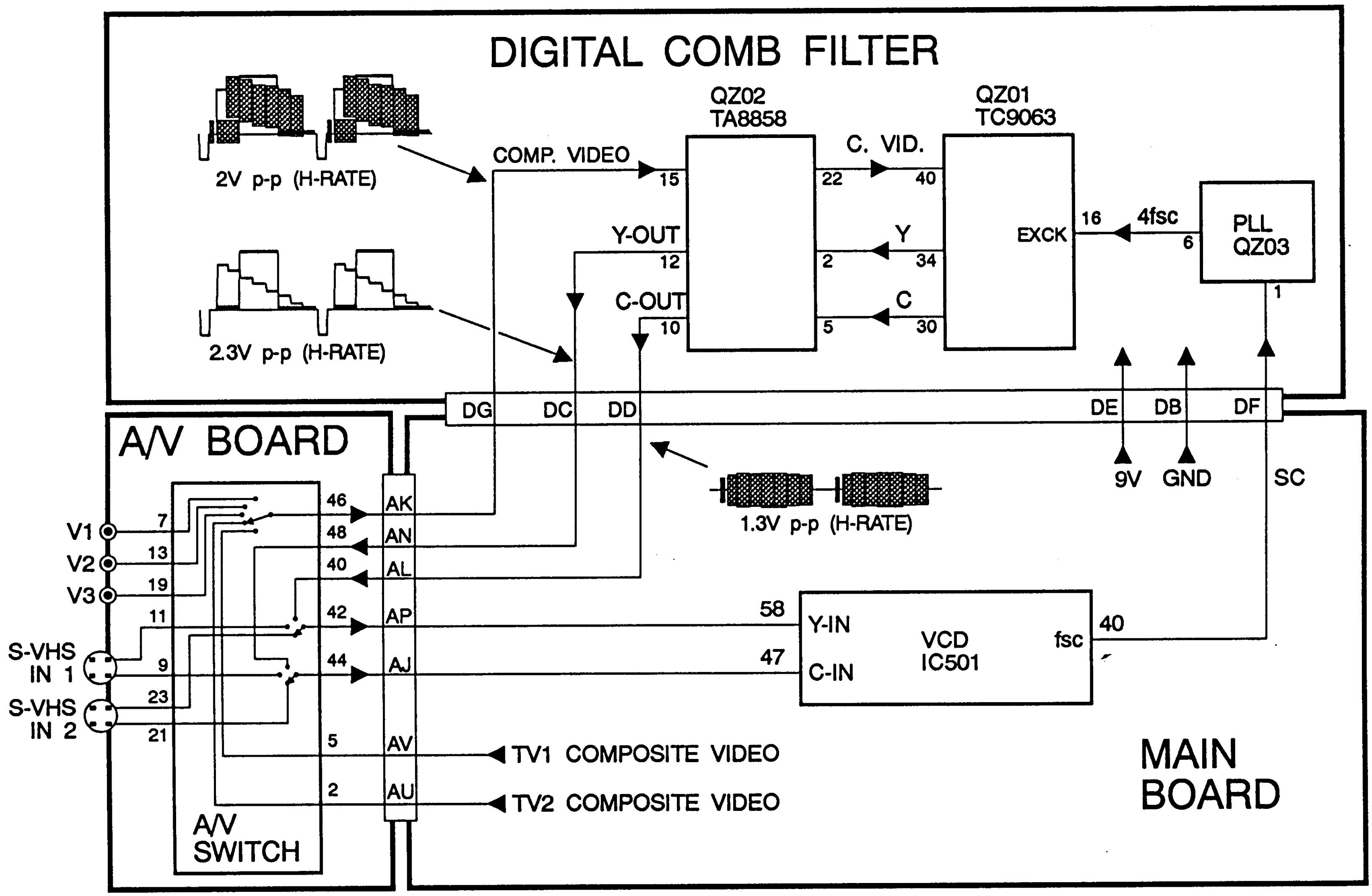


Fig. 2-1 Y/C Separation Signal Flow Block Diagram

3. DIGITAL COMB FILTER PROCESSING

As shown in Figure 2-2, the composite video signal of 2Vp-p is fed to Pin 15 of QZ02 (TA8858), is processed by the internal clamp, LPF, and amplifier, and is sent out of Pin 12 as the Composite Video (C. Vid.) output signal of 1.5V p-p. This signal is then processed by QZ01 (TC9063).

QZ01 contains internal ADCs, DACs, and Memory to digitally process (detecting, delaying, filtering, summing, and subtracting) the composite video signal to output the separated luminance (1Vp-p) at Pin 34 and the chrominance (0.28Vp-p) at Pin 30.

The chroma and luminance signals are each routed back through QZ02, via Pins 5 and 2 respectively, to output the 1.3Vp-p chroma at Pin 10 and the 2.3Vp-p luminance at Pin 12. The output of the Digital Comb Filter luminance is available at terminal DC and the chroma is available at terminal DD.

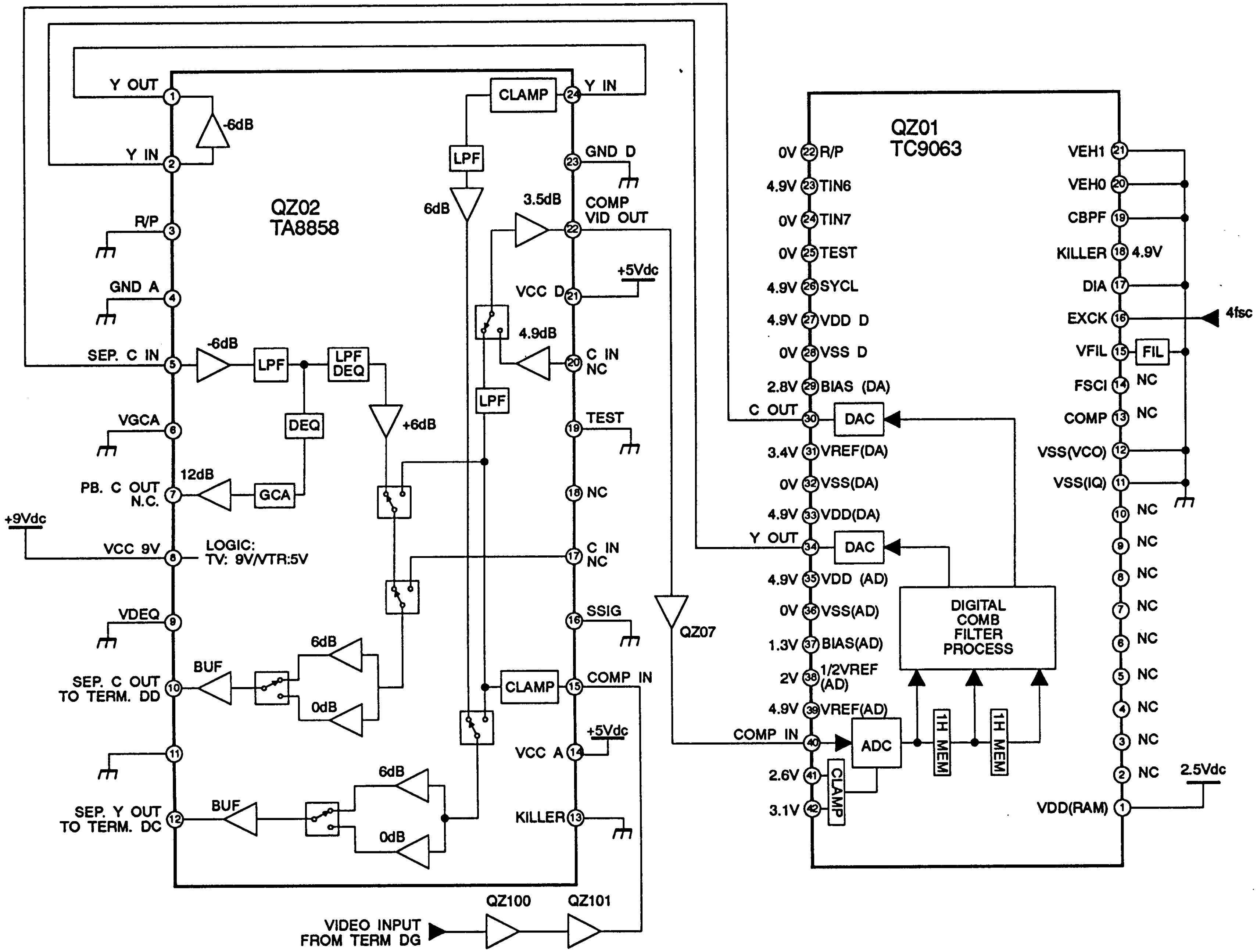


Fig. 2-2 Comb Filter Processing Circuit

SECTION 3
POWER SUPPLY CIRCUIT

1. LOWER VOLTAGE PROTECTION CIRCUIT

This circuit is provided to turn off the power when a short-circuit occurs across windings for low B +15V, or overload on the +15V, +12V, or +9V lines. Transistor Q809 is biased with a +33V-1 for CONV.OUT and turned on normally. Under this condition, the base voltage of Q809 is about 5.7V because of zener voltage of D813 + transistor V_{BE}.

The base of Q809 is connected to +12V through D818, R891, and to +9V through D819, R889. Normally, +12V and +9V are on and the cathode side voltages of D818 and D819 are high, so the base current does not flow.

On the other hand, if windings or a load is short-circuited, the voltage of +12V or +9V lowers and reaches 0V. The cathode voltage of D818 or D819 goes lower than the base voltage of Q809, causing current flow through D818 or D819, which lowers the base voltage of Q809.

With the base voltage lowered, Q809 turns off and the collector voltage of Q809 (charging voltage of C831) rises. When the collector voltage sufficiently rises up to a value which allows the zener diode D849 to turn on, SCR D862 turns on through D849, R892, D847, thus turning the relay off.

2. SUB (SWITCHING) SUPPLY

Circuit configuration and theory of operation of the sub-power supply is basically the same as those of the main power circuits.

The switching IC is also the same as that used in the main power supply.

The voltage outputs are: CONV.OUT +33V, AUDIO OUT +33V, CONV OUT –33V.

The +33V line uses one winding but the rectification and smoothing is carried out separately. A feedback is applied to CONV.OUT +33V line from the error amplifier circuit consisting of a transistor Q804, zener diode D815, etc.

An over voltage protection circuit is also provided in the CONV.OUT +33V line. The protection circuit works when the line voltage reaches about 40V and the zener diode D816 turns on.

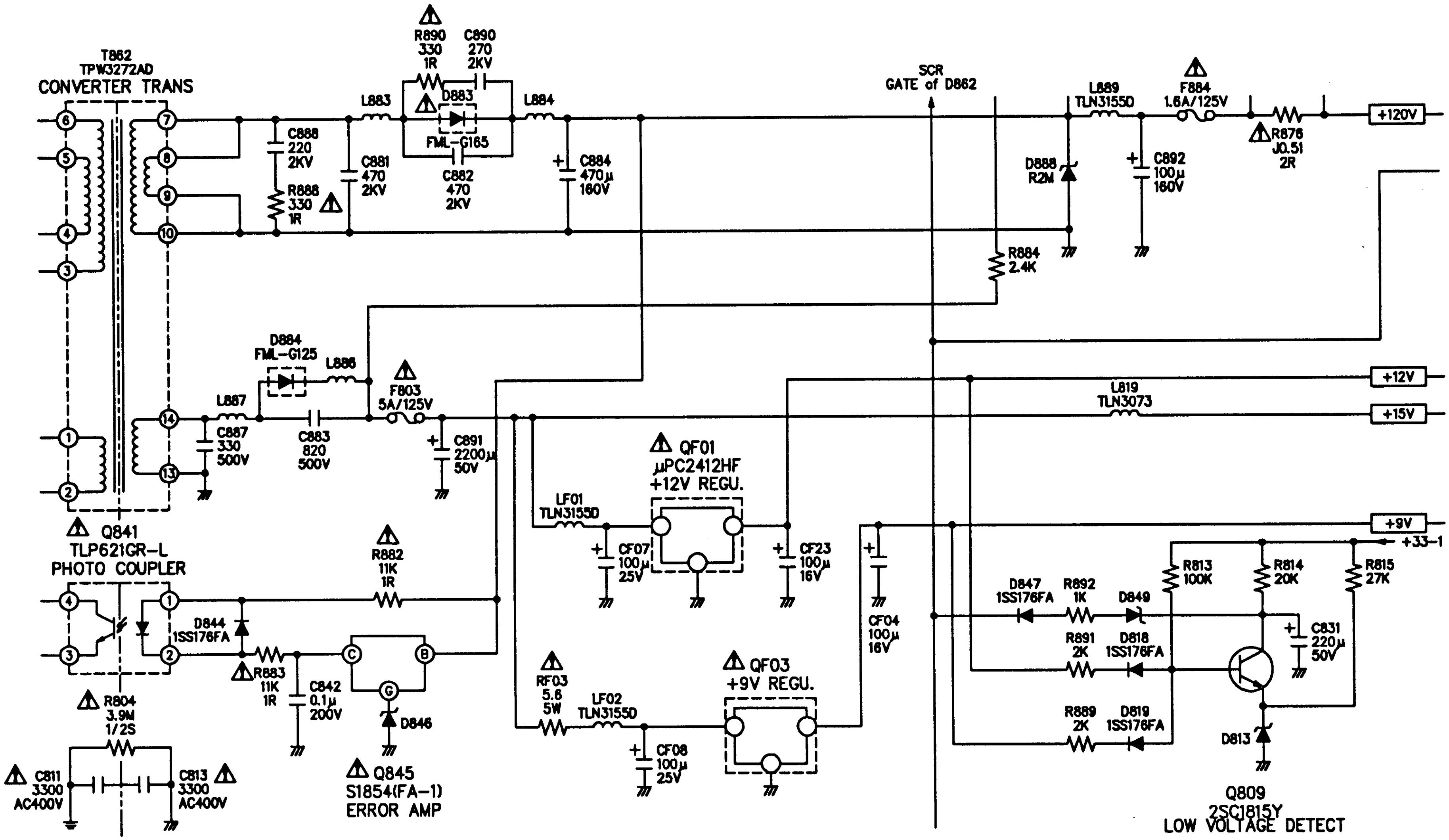
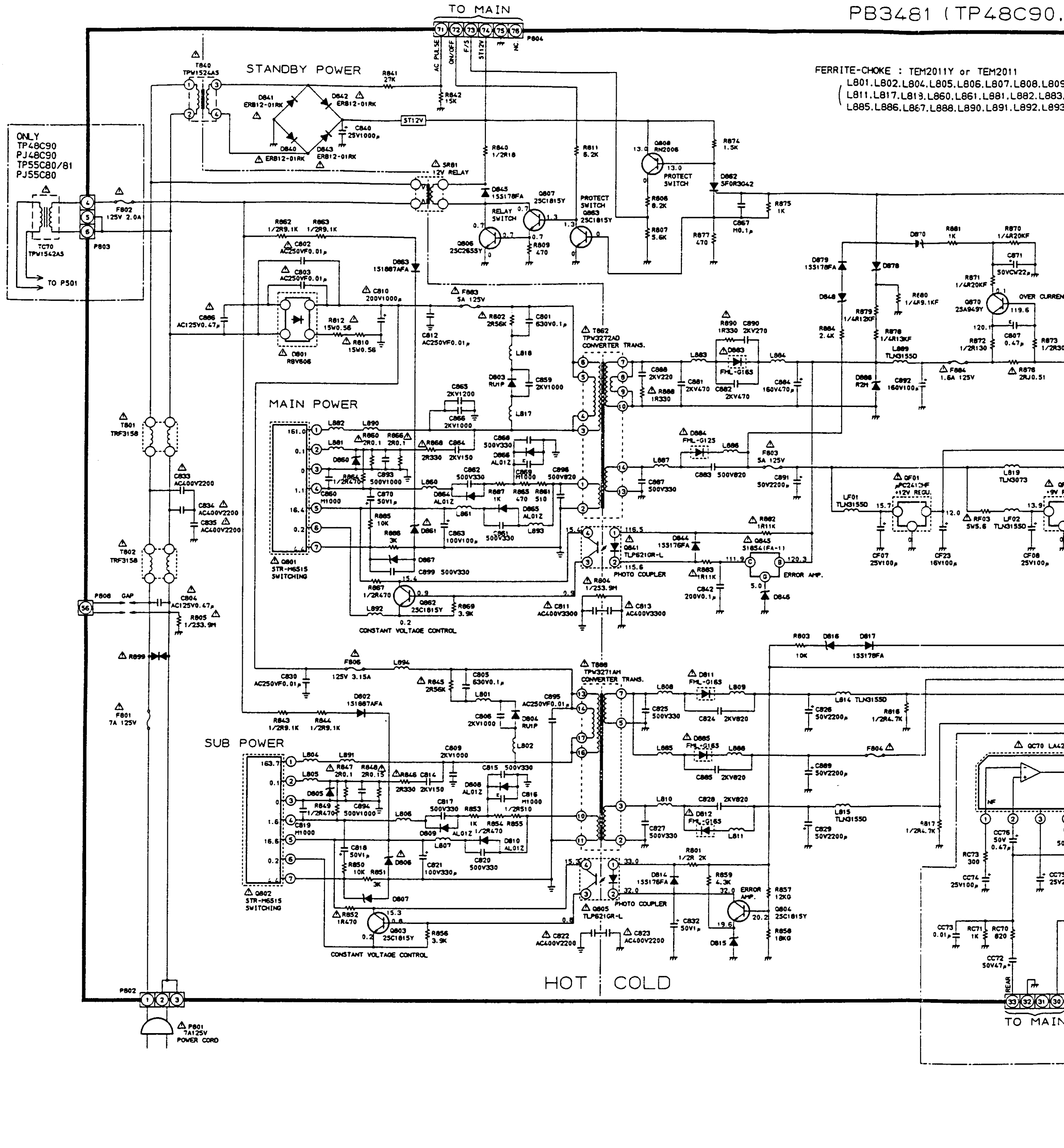


Fig. 3-1 Lower voltage protection circuit diagram

3. POWER SUPPLY CIRCU

POWER UNIT
PB3364 (TP48C50/
PB3481 (TP48C90.

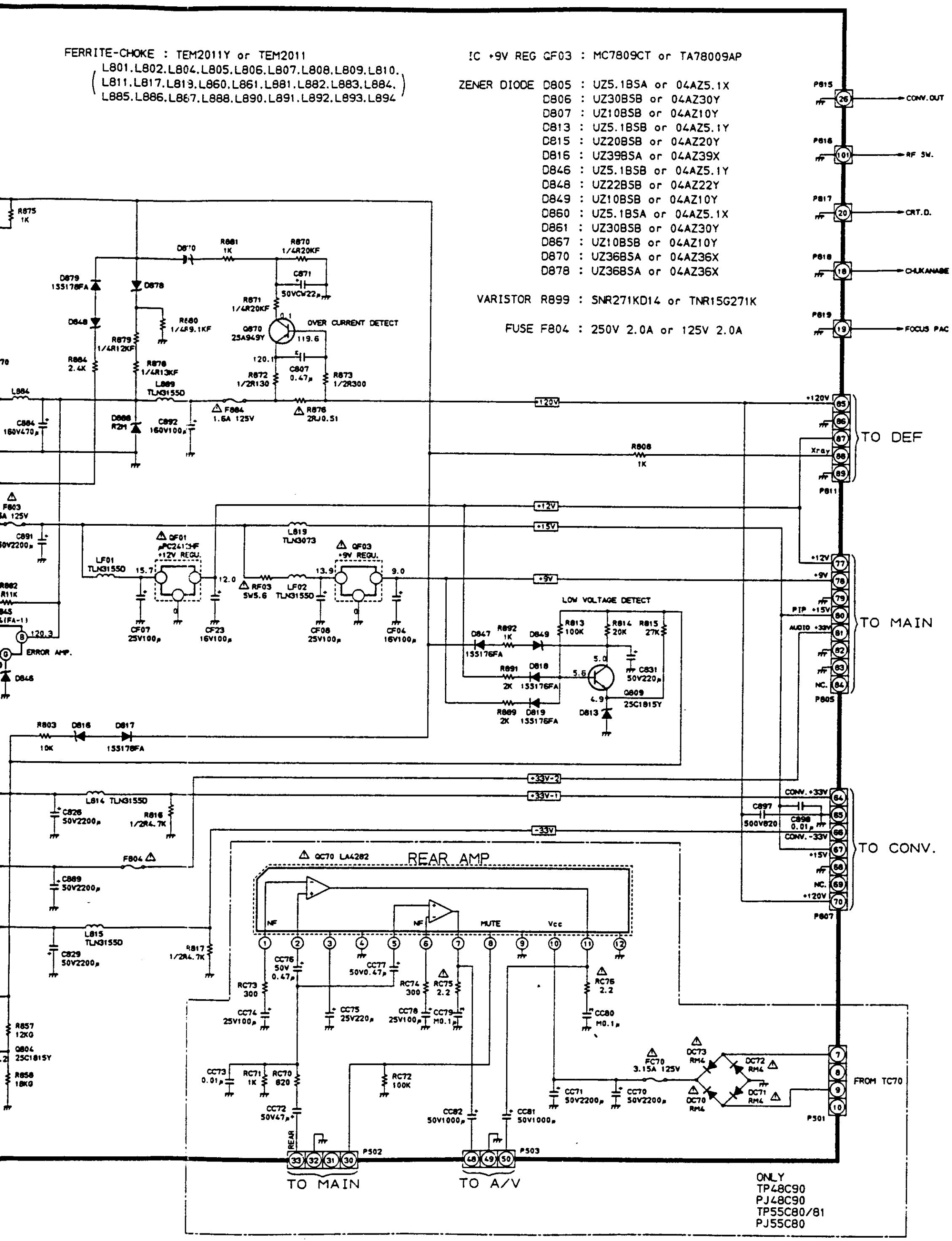


UPPLY CIRCUIT

POWER UNIT

PB3364 (TP48C50/51 . PJ48C50 . TP48C70/71)

PB3481 (TP48C90 . PJ48C90 . TP55C80/81 . PJ55C80)



SECTION 4
VERTICAL DEFLECTION CIRCUIT

1. OUTLINE

1-1. Comparison Between Model CX32C81

The vertical deflection circuit of the TP48C51 is basically the same as the N2DB chassis (CX32C81) except in following points.

(1) Three deflection yokes are provided because of three projection tubes.

(2) Protection circuit is provided to prevent fluorescent surfaces from burning when the deflection stops (horizontal one line).

(3) Vertical linearity can be adjusted.

(4) Vertical output circuit is of a discrete type.

The basic circuit consists of Q501 (TA8845AN), Q390 (TA75558S), and descrete transistors.

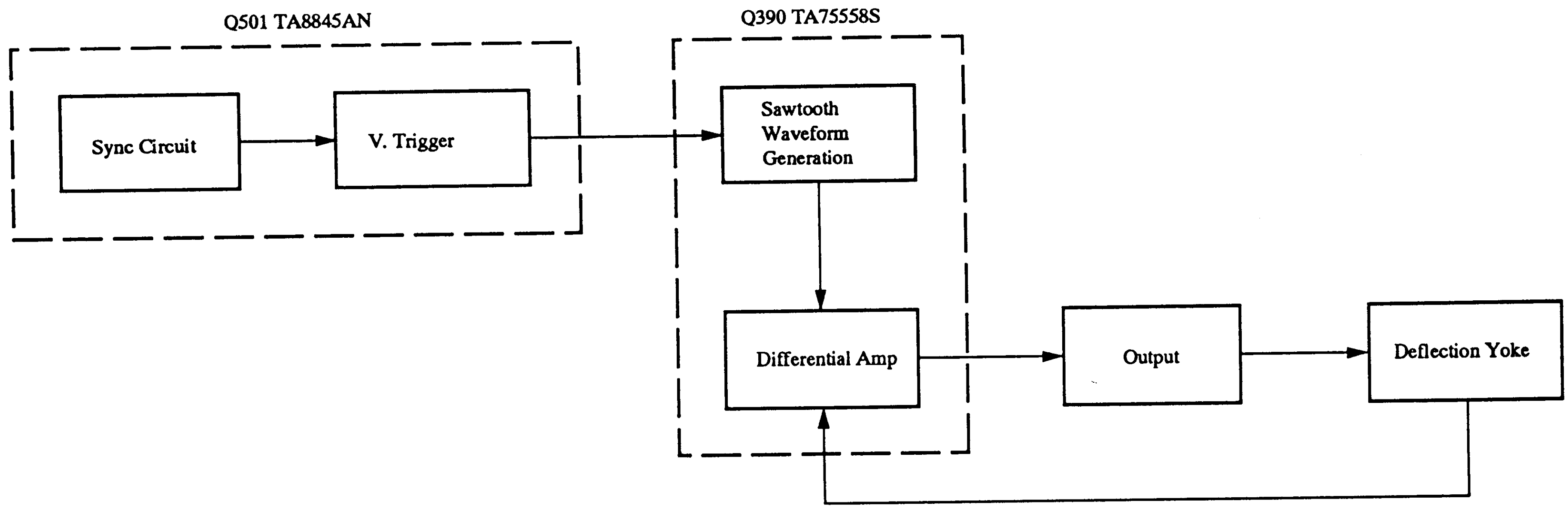


Fig. 4-1

1-2. Basic Theory of Operation

The Vertical deflection circuit works to supply a sawtooth wave current with good linearity to the Vertical deflection coil in synchronization with the V period.

As shown in Fig. 4-2, when a sync pulse enters, switch S turns on and C_1 is charged up to a reference voltage Vp. Next when the switch S turns off, the electrical charges in the capacitor charged up to the reference Vp is discharged at a constant current rate, and a reference sawtooth wave develops at point (a). This voltage is fed to the + side (non inverting input side) of the differential amplifier A. At the same time, the current flowing into the deflection yoke is converted into a voltage in passing through a feedback resistor R2 and the voltage is fed back to the– side (inverting input terminal) of amplifier A.

NOTE: THIS CIRCUIT IS FOR EXPLANATION ONLY, NOT EXACT CIRCUIT

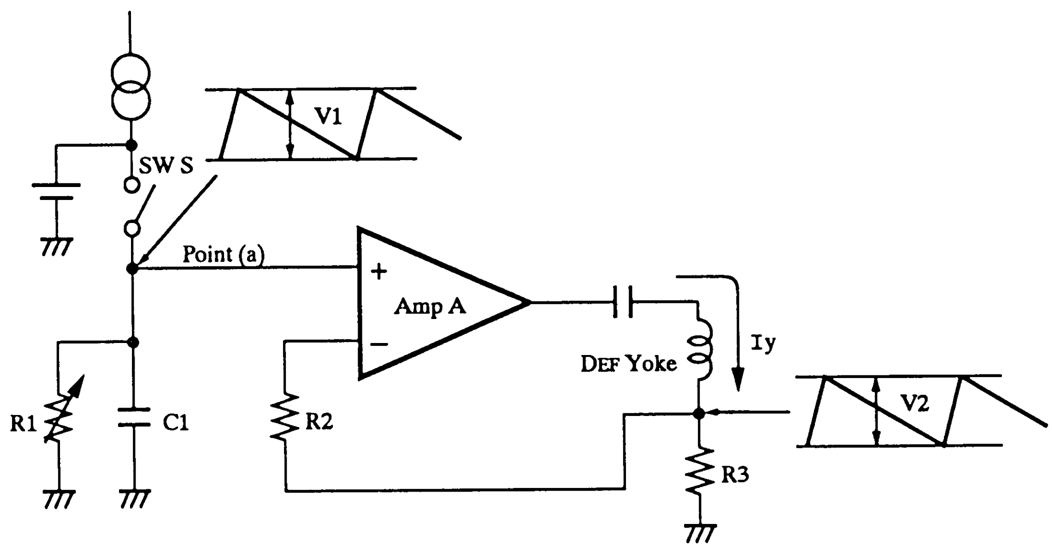


Fig. 4-2

2. V DEFLECTION CIRCUIT

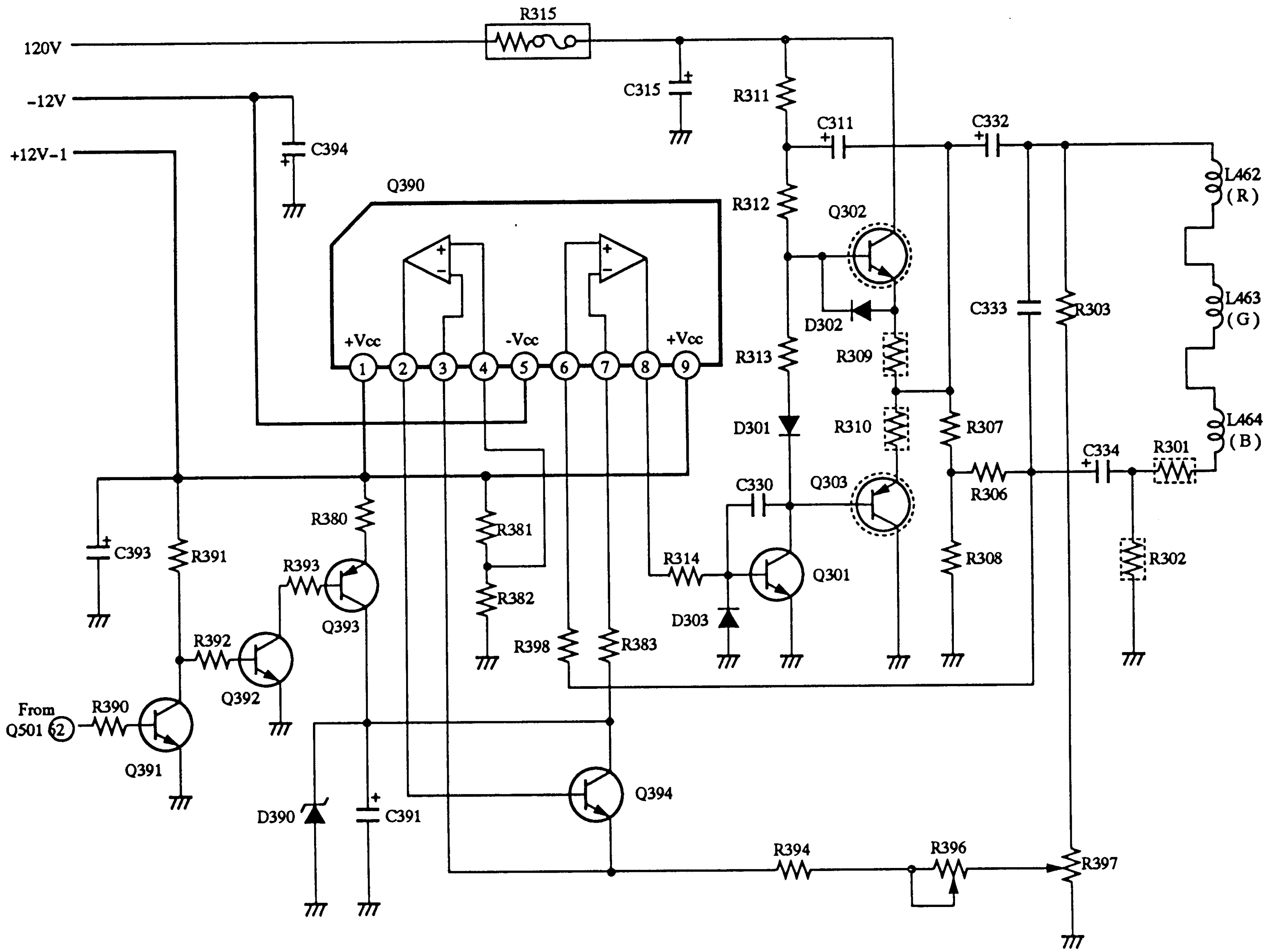


Fig. 4-3

2-1. Reference Saw-Tooth Waveform Voltage Generation Circuit

The sawtooth wave generation circuit has a configuration shown in Fig. 4-4.

During the V output pulse period, switch S_1 (Q393) turns on and the capacitor C391 is charged up to the reference voltage, and then when the S_1 opens at end of the V flyback period, the voltage stored in C391 is discharged as a constant current rate through Q394. As a result, the voltage across C391 proportionally drops with time, thus developing the reference sawtooth wave voltage.

The sawtooth wave voltage obtained in this way is compared and amplified in the op. (differential) amplifier Q390.

In practice, the V height adjustment VR is not grounded, but the sawtooth wave voltage obtained in the output circuit is applied for correction of the linearity. Adjustment of the linearity is carried out by adjusting the amount of correction.

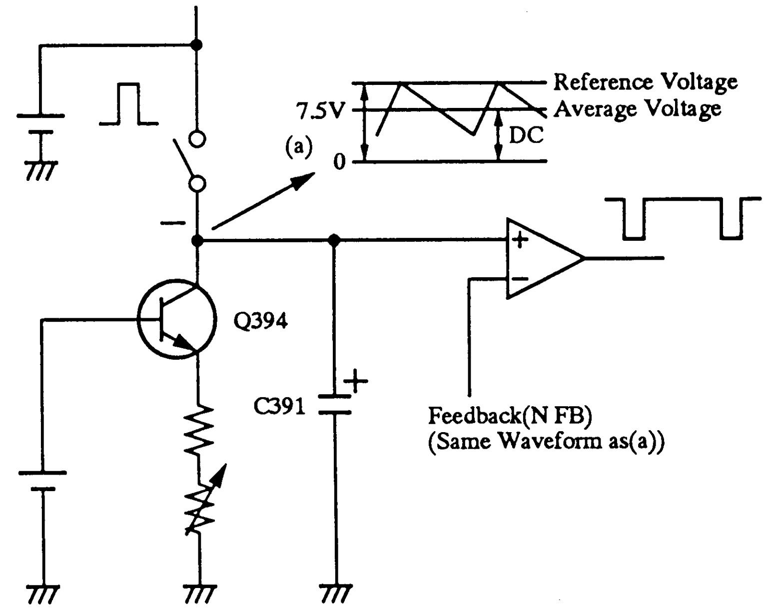


Fig. 4-4

2-2. V Output Circuit

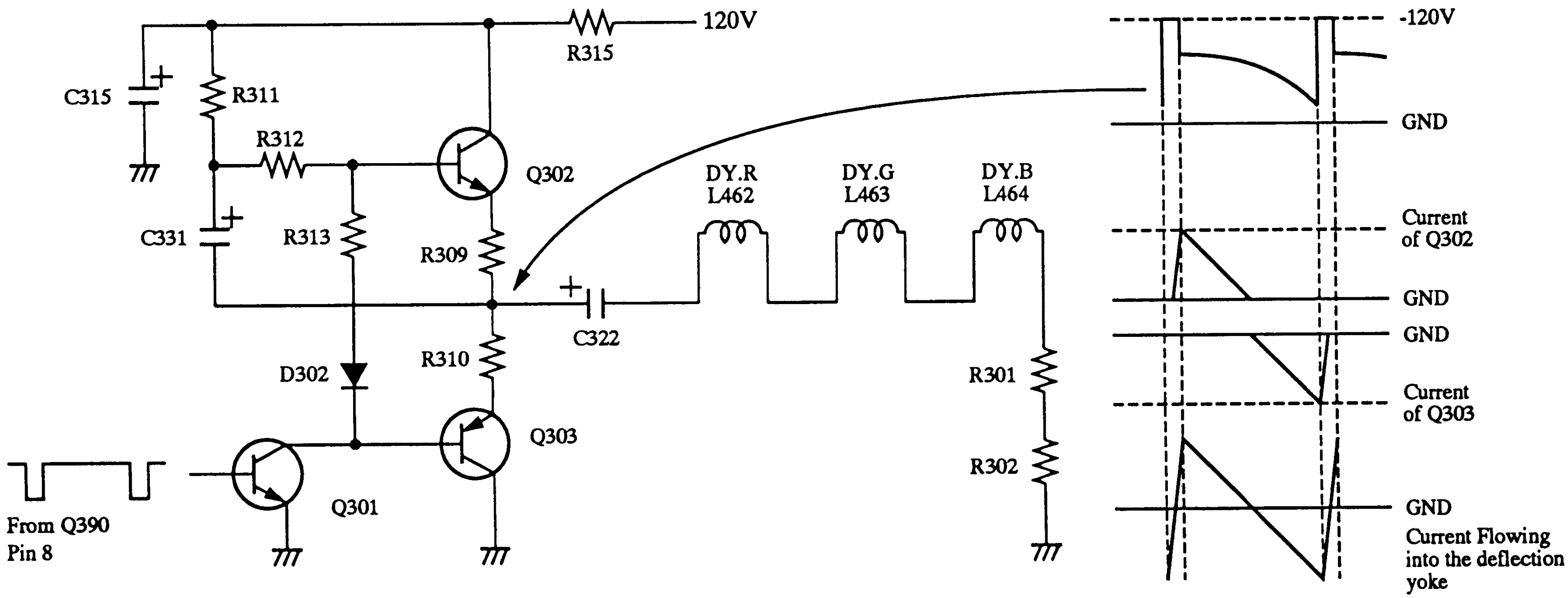


Fig. 4-5

The V output circuit supplies the sawtooth wave current to the V windings of the deflection yokes.

The V pulse from pin 8 of Q390 is amplified by Q301 drive transistor. The output stage, consisting of Q302 and Q303, amplifies the sawtooth wave current, which flows into the deflection yokes L462, L463 and L464.

Q302 performs amplification for a half of the scanning and supplies a positive current to the deflection yokes and Q303 performs amplification for the later half of the scanning and supplies a negative current to the deflection yokes. These operations are shown in Fig. 4-5.

2-3. Linearity Correction and Adjustment Circuit

(1) S character correction (expansion at upper and lower ends of the screen)

Since a sawtooth wave current flows into the output capacitor C332, a parabola voltage develops across the capacitor. This voltage is integrated with R307, R308, R306 and C334 to create a S character voltage. The S character voltage is fed back to the non inverting input to make the linearity correction.

(2) When obtaining the S character voltage just stated above, the integration circuit consisting of R307, R308, R306, and C334 also integrates the parabola voltage containing the sawtooth wave voltage across R302, and the resultant parabola voltage is also fed back. Under this condition the screen is compressed at the upper side and expanded at the lower side. To correct this, a sawtooth wave voltage component obtained across the deflection yoke is divided with R303 and R397 and fed back as an inverted input through R396 and R394. In other words, the sawtooth wave current component caused by the sawtooth wave voltage described here is also contained in the discharge current of C391 (refer to Fig. 4-4) used in the reference sawtooth wave voltage generation. The parabola component voltage is developed across C391 and this works to cancel the parabola component fed back to the non inverting input, thus correcting the linearity. R397 is a variable resistor and varies the amount of the sawtooth wave voltage component applied to the non inverting input terminal, thereby adjusting the linearity balance at upper and lower screen.

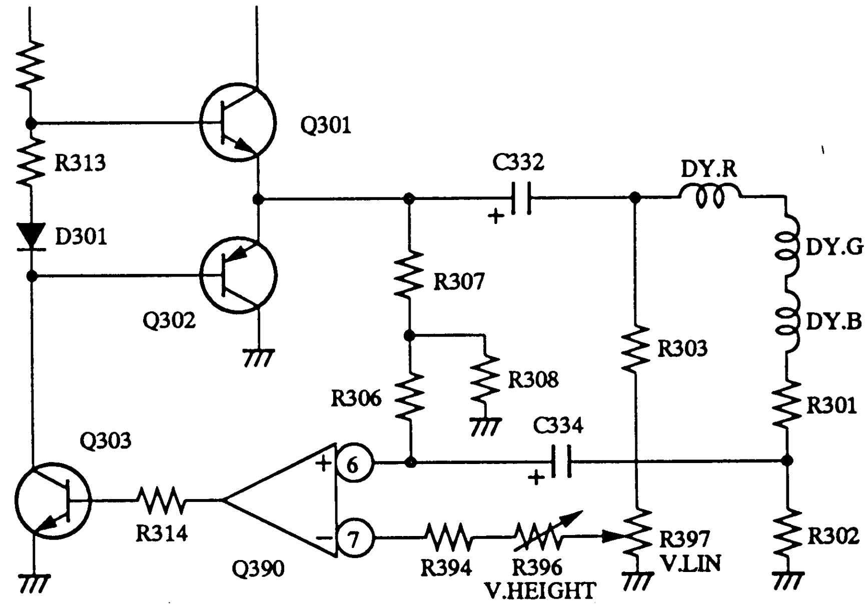


Fig. 4-6

3. PROTECTION CIRCUIT FOR V DEFLECTION STOP

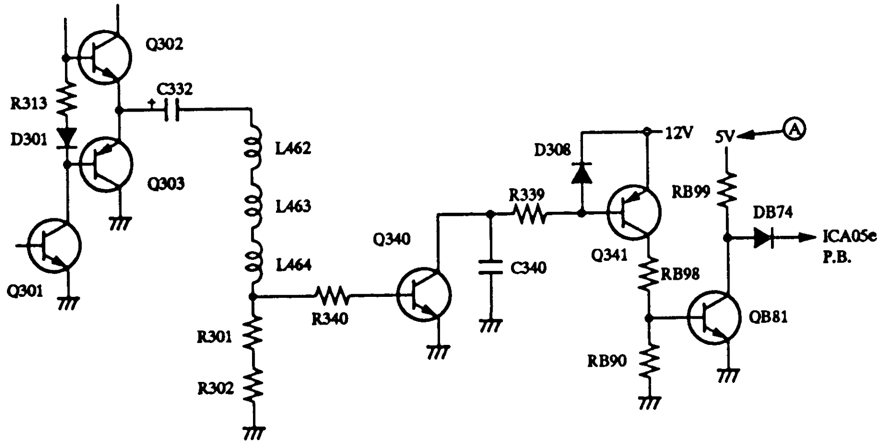


Fig. 4-7

When the deflection current is not supplied to the deflection coils, one horizontal line appears on the screen. If this condition is not continued for a long time, no trouble will occur in a conventional TV. But in the projection TV, all the electron beams are directly concentrated at the fluorescent screen because of no shadow mask, which can burn out the screen instantly.

To prevent this, the loss of the V deflection is detected when the horizontal one line occurs, and the video signals are blanked out so that the electron beams are not emitted.

When the V deflection circuit is operating normally, a sawtooth wave voltage is obtained across (R301 + R302), so Q340 repeats on-off operation in cycle of V sync. In this case, the collector voltage of Q340 is set to develop less than (12V – V_{BE} (Q341)) with R339 and C340 as shown in Fig. 4-8. Accordingly, Q341 and QB81 are continuously turned on. As a result, diode DB74 is turned off, giving no influence on the blanking operation.

When the V deflection stops, the voltage across R301 and R302 does not develop, so Q340 turns off, and both Q341 and QB81 are turned off. Then, the picture blanking terminal pin 13 of ICA05 is set to high through RB99 and DB74 connected to the 5V source, thus cutting off the projection tubes. In this case, the 5V marked Ⓐ is supplied from a separate power line not relating to the V deflection circuit so that the protection circuit will operate in any trouble mode.

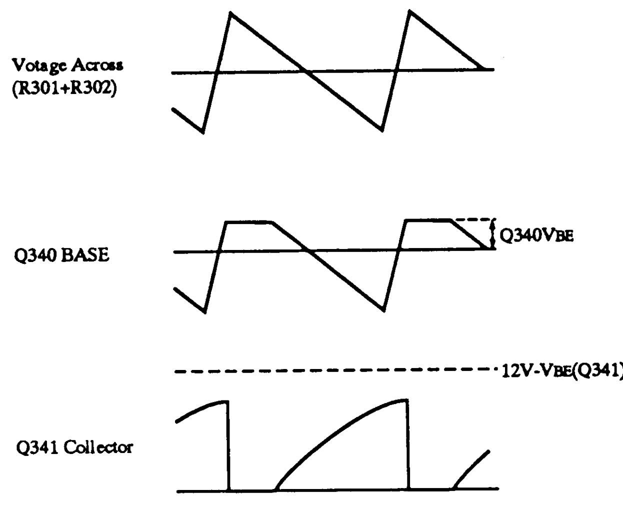


Fig. 4-8

SECTION 5
HORIZONTAL DEFLECTION CIRCUIT

1. OUTLINE

The horizontal (H) deflection circuit provides a sawtooth wave current of 15.734 kHz to the horizontal deflection coils to deflect electron beams from left to right horizontally on the screen.

Circuit configuration and ICs used for the synchronization and horizontal oscillator circuit are the same as those of N2DB (CX32C81).

Major differences from N2DB are as follows.

(1) Three deflection yokes are used as three projection tubes are used, and three yokes are connected in parallel and a same deflection current is supplied. (V deflection coils are connected in series).

(2) High voltage circuit and the Horiz. output circuit are separated. Accordingly, electrically speaking, the H output transformer is the same as a conventional FBT with a high voltage winding removed and the structure of the transformer is the same as that of a converter transformer used in the power circuit. That is, a pulse transformer is used.

(3) H amplitude adjustment coil is provided to adjust the Horiz. height. In N2DB a diode modulator system is employed to adjust left and right pin cushion distortion correction and Horiz. height. But in TP48C51, the left and right pin cushion distortion is corrected in the convergence circuit and the height adjustment is carried out with the height adjustment coil.

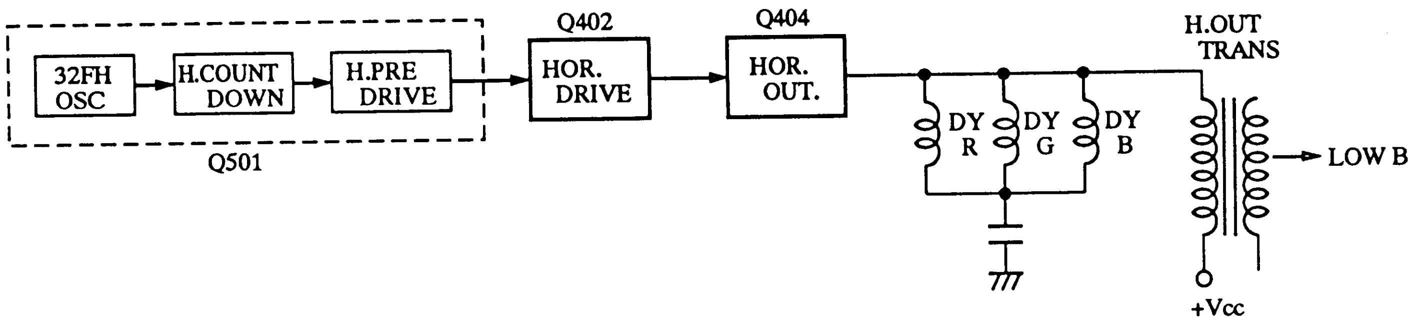


Fig. 5-1 Block diagram of Horizontal deflection circuit

2. THEORY OF OPERATION (N2DB)

2-1. Horizontal Start Circuit

The horizontal start circuit is provided to start the Horiz. output circuit by applying a bias voltage to pin 7 of Q501 (TA8845AN) (power supply for the horizontal system) at the power on.

When the power is on, first, the main power line 115V and +15V for Low + B rise at the same time. The 15V is applied to pin 7 of Q501 through R341 and drives the Horiz. oscillator circuit.

At the same time, a base current flows into the base of Q402 Horiz. drive transistor from pin 8 of Q501 and operates the Horiz. drive circuit which in turn drives the Horiz. output circuit.

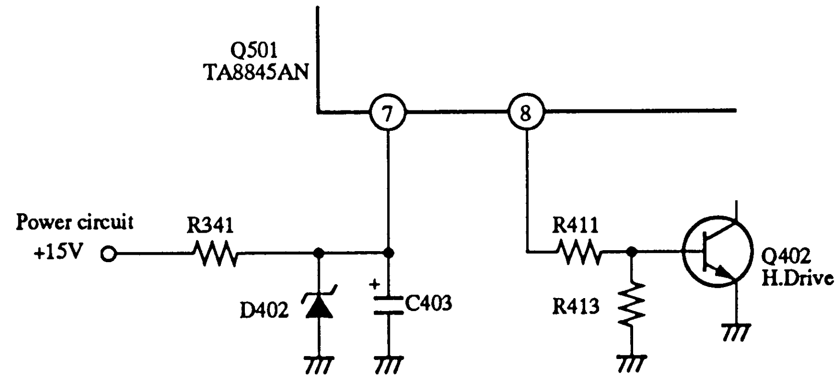


Fig. 5-2 Horizontal start circuit

2-2. Horizontal Drive Circuit

A collector current of the Horiz. output transistor is a heavy current, as much as several amperes, and such heavy current can not be driven directly by the output pulse of the Horiz. oscillator circuit. So, a drive circuit is provided between the oscillator circuit and the output circuit. The drive circuit amplifies the current to drive the output transistor.

The transistor Q_1 inside Q501 repeats on-off operation for the horizontal period and a rectangular pulse with the horizontal period is developed at pin 8 of Q501. When pin 7 (Hotiz. predrive) of Q501 output develops a forward bias (Q_1 is on), Q402 base is forward-biased through 15V → R341 → pin 7 of Q501 (H.Vcc) → pin 8 of Q501 (Horiz.out) → R411/R413 (resistor divider), and a Q402 collector current flows in passing through 120V → R416 and R417 → T401. As a result, an energy is stored in the primary winding of the drive transformer T401.

Under this condition, the Horiz. output transistor Q404 is turned off because its base-emitter is reverse-biased.

Next, when pin 8 is 0V (Q501 is off), the base-emitter of Q402 goes 0V and Q402 is turned off, and a high pulse voltage is developed at the collector of Q402 or the primary winding of T401 by the energy stored in the step just preceding.

The winding ratio between the primary winding and the secondary winding of the drive transformer is as large as 30 : 1, that is, as the winding number of the primary winding is large, the pulse voltage applied to the secondary winding or across the base-emitter of the output transistor is stepped down, but the transmitted energy is the same, so, a sufficient base current can flow into Q404 base.

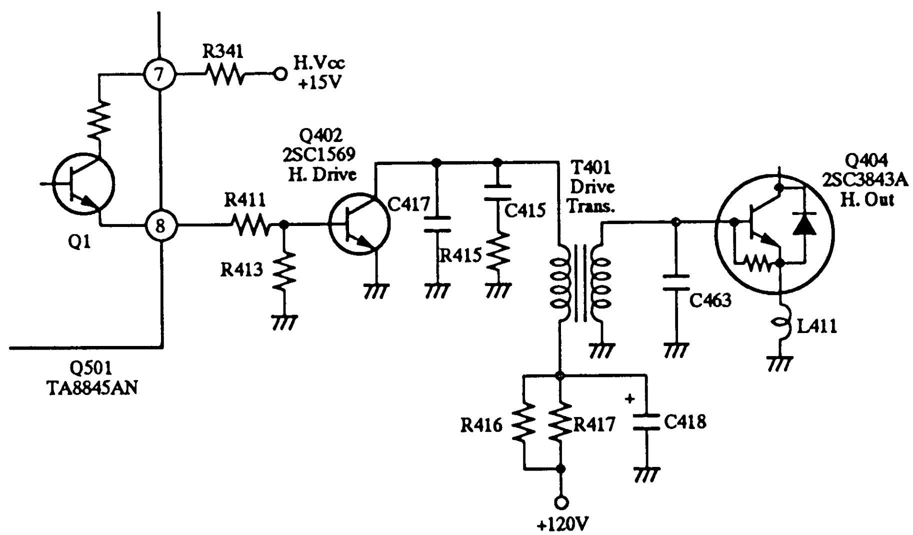


Fig. 5-3 Horizontal drive circuit

2-3. Horizontal Output Circuit

The Horiz. output circuit applies the sawtooth wave current of 15.734 kHz current to the H deflection coil by using a mutual switching effect of the H output transistor and a damper diode to deflect the electron beams in horizontal direction.

Low voltage DC supplies are derived from the Horizontal pulses induced in the primary and secondary windings of the FBT. A secondary winding (pins 15 & 16) supplies the heater (filament) voltage to the CRTs.

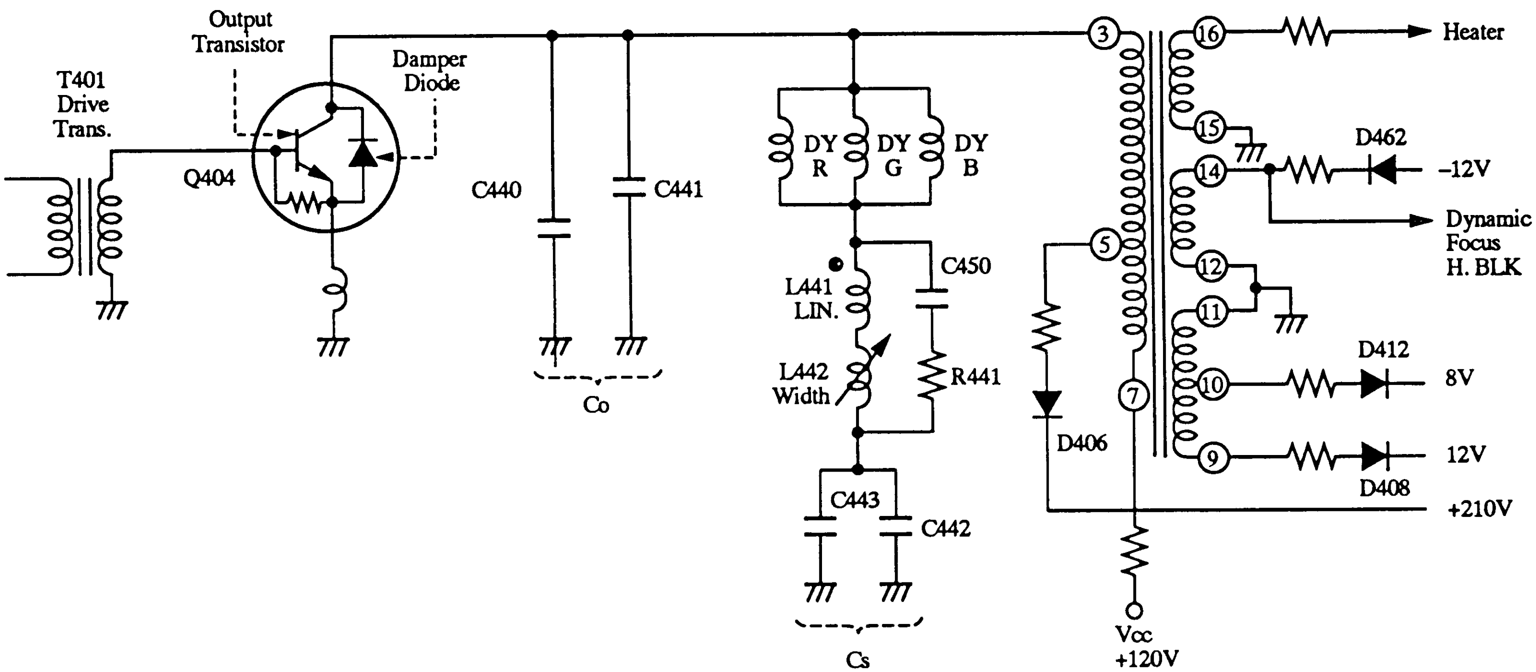
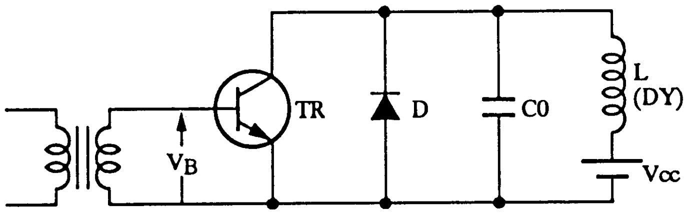


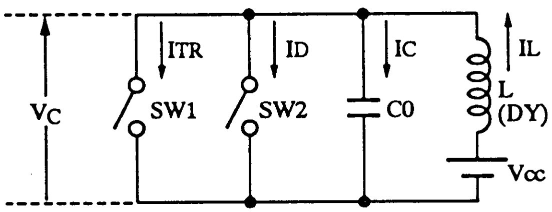
Fig. 5-4 Horizontal output circuit

2-3-1. Operation of Basic Circuit

Theory of the basic operation will be understood by referring to Fig. 5-5 (a) and (b). The Horiz. output circuit shown in Fig. 5-4 can be simplified as shown in Fig. 5-5 (a). Moreover, as the output transistor and the damper diode perform switching operations, they can be expressed as shown in Fig. 5-5 (b).



(a) Basic circuit



(b) Equivalent circuit

NOTE: These are basic circuits for explanation, not from the schematics.

Fig. 5-5

Fig. 5-6 shows basic operation waveforms.

(1) $t_1 \sim t_2$

The drive circuit applies a positive pulse to base of the output transistor, a forward base current is flowing, and the output transistor (SW1) is turned on to a sufficiently saturated level. As a result, the collector voltage lowers to nearly equal to the ground potential (0V) and the deflection current flowing into L increases proportionally from zero with time. The current reaches maximum at t_2, and a right half of picture is scanned up to this period.

(2) t_2

The base drive voltage rapidly changes to negative at t_2 and the base current becomes zero. The output transistor turns off, collector current reduces to zero, and the deflection current stops to increase.

(3) $t_2 \sim t_3$

The output transistor turns off at t_2, but the deflection current can not reduce to zero immediately because of inherent nature of the coil and continues to flow, gradually decreasing by charging the resonant capacitor C_0. On the other hand, the voltage at Co or the collector voltage slowly increases and reaches a maximum value at time t_3. At the same time, the deflection current goes to zero.

Under this condition, all the electro-magnetic energy stored in the deflection coil up to t_2 is converted into a static energy in the resonant capacitor.

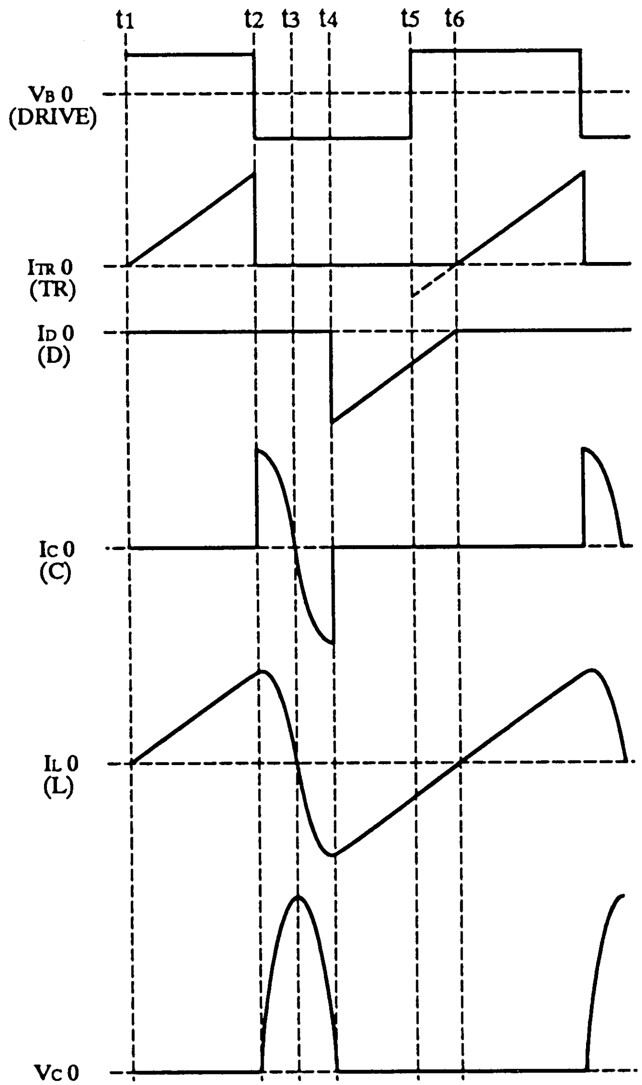


Fig. 5-6

(4) $t_3 \sim t_4$

Since the voltage charged in the resonant capacitor is discharged through the deflection coil, the deflection current increases in reverse direction and the capacitor voltage decreases slowly. This means the static energy in the resonant capacitor is converted into an electro-magnetic energy in the deflection coil.

(5) t_4

When discharging of the resonant capacitor completes and the collector voltage goes zero, the deflection current reaches the maximum in reverse direction. t_2-t_4 is the horizontal flyback period and electron beams are returned from right end to left end on the screen by the deflection current for this period. The operation in this period is carried out by a resonant phenomenon with L and Co, and the operation period is equivalent to the half period. The flyback period is determined by values of L and Co.

(6) $t_4 \sim t_6$

The resonant phenomenon caused for $t_2 \sim t_4$ is going to continue after t4. That is, the resonant capacitor is charged to a negative voltage and this provides a forward bias for the damper diode (SW2) automatically, thus the damper diode is turned on after t_4.

As a result, the deflection current proportionally decreases with time by charging the power (Vcc) through the damper diode and goes zero at time t_6. A left half of the screen is deflected for this period.

As can be seen from the above description, the left half operation of the horizontal deflection is carried out with the current flowing through the damper diode and the right half with the horizontal transistor, and the deflection operation for the flyback period is carried out by the resonant current with both the damper diode and the output transistor deactivated.

Moreover, theoretically speaking, an energy is supplied from the power V_{CC} for the on-period of the Horiz. output transistor, but the energy is returned to the power source for the on- period of the damper. Both of these are theoretically the same, as a result, the power consumption in the Horiz. output circuit is zero. (In practice, the power consumption does not become zero because of a switching loss and losses caused by resistive components in the circuit.)

2-3-2. Horizontal amplitude adjustment

The Horiz. amplitude can be varied by varying the current of the sawtooth wave flowing into the Horiz. deflection coil. In practice, this is carried out by varying inductance of the amplitude adjustment coil L442 connected in series with the Horiz. deflection coil. The inductance is varied by adjusting the screw core (changing relative position of the coil and the core) with an alignment screw driver.

2-3-3. Horizontal linearity correction

(1) S character correction (S character capacitor)

With the deflection angle of the projection tube increased, pictures at left and right on the screen will be expanded if a good linearity sawtooth wave current is applied to the deflection coil. This is caused because the distance between the center of the deflection magnetic field (a point where the electron beams are deflected by the deflection yoke) and the fluorescent screen is different at the screen center and the screen peripheral. That is, the distance increases at the peripheral area, so the picture becomes large if a good linearity deflection current is applied.

To correct this expansion at screen peripheral, the expansion of the deflection current corresponding to the peripheral must be suppressed. This is realized by superimposing a current of S character waveform on the basic sawtooth wave current. In practice, the S character capacitors (C442, C443) are connected in series with the deflection coil as shown in Fig. 5-4.

The S character capacitors work to stop DC as well as to work as an equivalent power supply for the Horiz. output circuit. The basic waveform of the deflection current is a sawtooth wave and the current flows into the coil as well as into the S character capacitors. A voltage caused by integrating the flowing current is developed across the capacitors. That is, a voltage showing a parabola is developed across the S character capacitors.

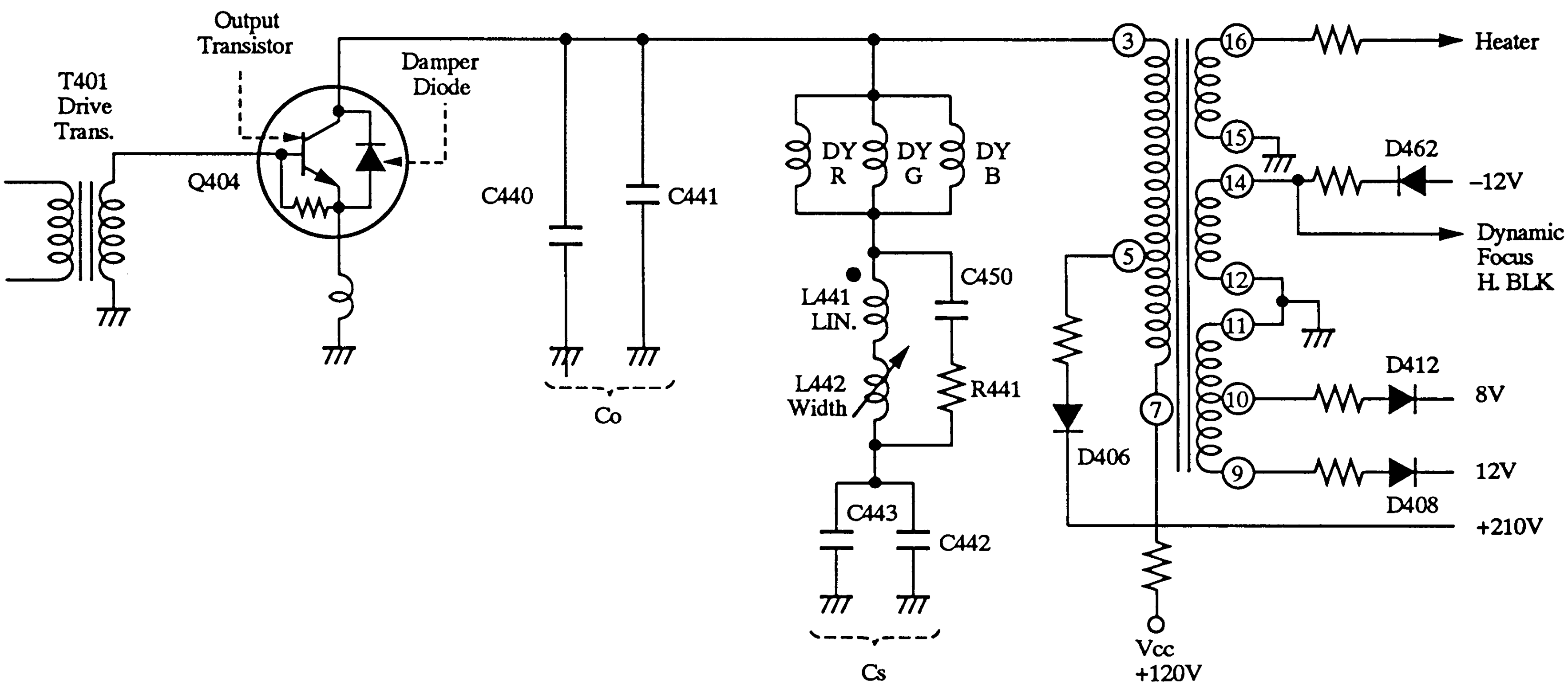


Fig. 5-4 Horizontal Output Circuit

The parabola voltage component also becomes a part of the power supply voltage of Vcc for the Horiz. output circuit. As a result, a current with a cubic function waveform or the S character waveform developed by integrating parabola wave of the quadratic function flows into the deflection coil.

The amount of S character correction can be adjusted by varying the level of the parabola voltage or the capacitance of the S character capacitor to provide a horizontally linear scan.

(2) Left and right asymmetry correction (LIN coil)

It is said under item 2-3-1 that "The deflection current changes proportionally with time." However, in practice, the current does not change proportionally and causes a distortion because of influence of the resistive component of the deflection coil, collector current vs. saturation voltage characteristics of the collector-emitter, VF of the damper diode, etc. This distortion of the current waveform is of a type which lowers current increasing rate with time. So, the picture expands at left screen and shortens at the right.

To correct this, a linearity coil (LIN coil) which increases the inductance for a negative polarity deflection current (flowing through the damper diode) and decreases the inductance for a positive deflection current (flowing through the output transistor) is connected in series with the deflection coil.

The LIN coil is made by winding a coil on a ferrite core under a near saturating condition with a magnetic bias applied by a permanent magnet, and if direction of the magnetic flux induced by the current flowing into the coil is in the same direction as that of the permanent magnet, the core enters a saturating condition and the inductance decreases.

On the other hand, if the direction of the flux induced by the current is opposite that of the permanent magnet, magnetic permeability increases and the inductance increases. The actual characteristics of the coil depend on size of the core, flux density of the magnet and turn number of the coil, and has been designed to give the best screen linearity.

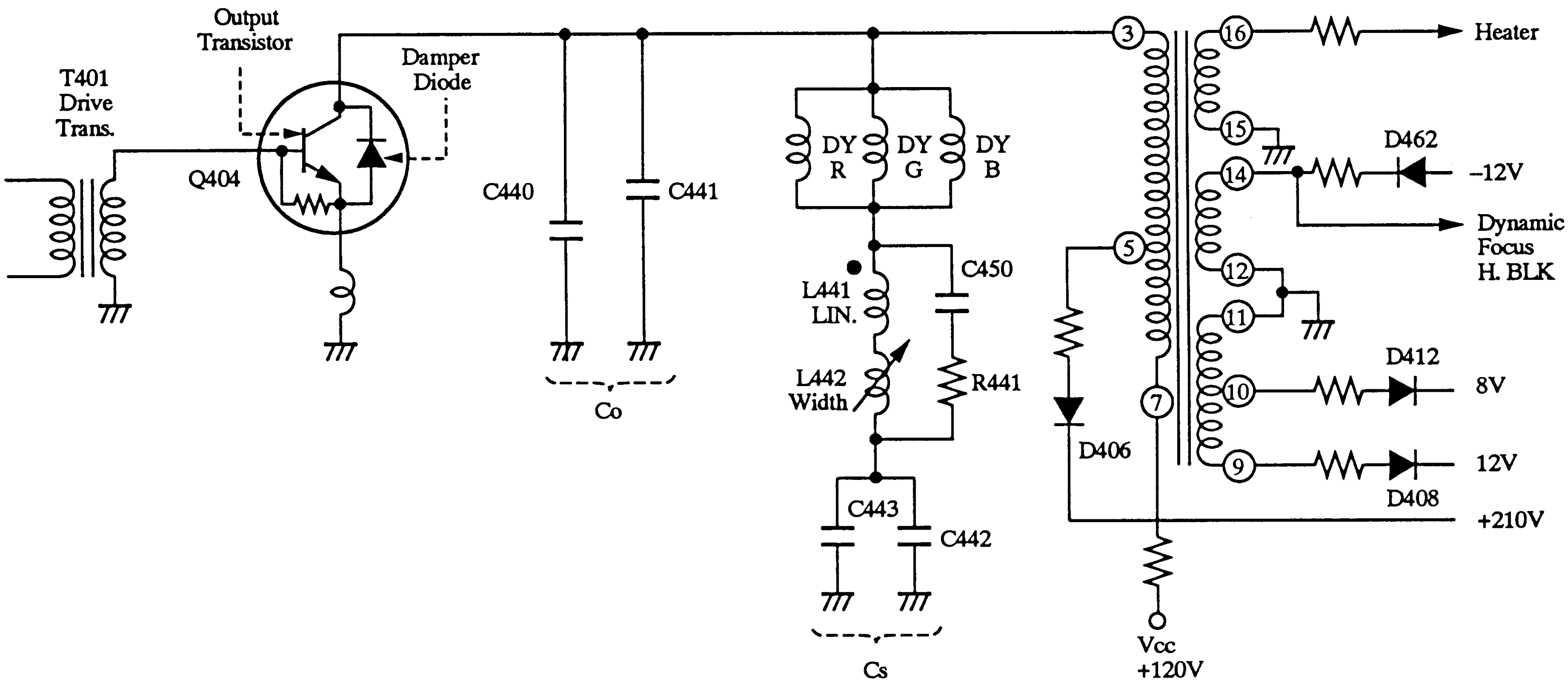


Fig. 5-4 Horizontal Output Circuit

2-3-4. Power Supply Circuit for The Horizontal Output Circuit

A choke coil is required to supply the power voltage to the Horiz. output circuit. Generally speaking, the choke coil employs a transformer type with a secondary coil wound on the choke coil, and such transformer is called a FBT and is used to develop a high voltage and lower voltage supplies by rectifying the pulse voltage induced in the secondary coil. However, in TP48C51, the high voltage is made by a separate circuit, so the choke coil is used to develop only the lower voltage supplies.

The Horiz. transformer T462 is made by winding a primary coil and secondary coil on an EE type core and has the same structure as that of the converter transformer used in the power supply circuit. But it is called a pulse transformer to discriminate it from the FBT.

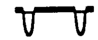
(1) Video output power supply

A positive flyback pulse voltage () obtained at pin 5 of the center tap of primary winding of T462 is rectified and filtered with D406 and C447, and added to +115V main power supply voltage, thereby developing +210V power voltage and supplying it to the video output circuit on the CRT drive P.C. board.

(2) Projection tube heater power supply

A pulse voltage obtained at pin 16 of secondary coil of T462 is directly, without rectifying, supplied to the heater of the projection tubes. In this case, the value of R469 is adjusted to provide the heater voltage of 6.3 Vrms.

(3) +12V winding

The negative polarity flyback pulse for scanning period () obtained at pin 9 of T462 is rectified and filtered with D408 and C449 to develop +12V power supply. The +12V supply is fed to the convergence circuit.

(4) +8V winding

The negative polarity flyback pulse for scanning period () obtained at pin 10 of T462 is rectified and filtered with D412 and C445 to develop +8V power supply.

The +8V power supply is fed to Q183 regulator circuit and becomes +5V regulated power supply. The +5V is supplied to the signal circuits on the main P.C. board.

(5) –12V power supply

The positive polarity pulse for scanning period () obtained at pin 14 of secondary winding of T462 is rectified and filtered with D462 and C466 to develop –12V power supply. This voltage is supplied to the convergence circuit. The positive polarity pulse obtained at pin 9 of secondary winding of T462 is supplied to the H blanking circuit and Horiz. dynamic focus circuit.

NOTES:

2-4. Protection Circuit for Horizontal Output Circuit

If the Horiz. output circuit stops, following occurs:

(1) The Horiz. deflection current stops to flow.

(2) Each voltage supplied from the pulse transformer T462 also stops.

If only the item (1) occurs, a "vertical one line" occurs. But if each voltage stops in (2), –12V for the op. amplifier Q390 in the Vertical deflection circuit also stops and the vertical deflection is not conducted. As a result, electron beams concentrate as a spot on the screen and light up.

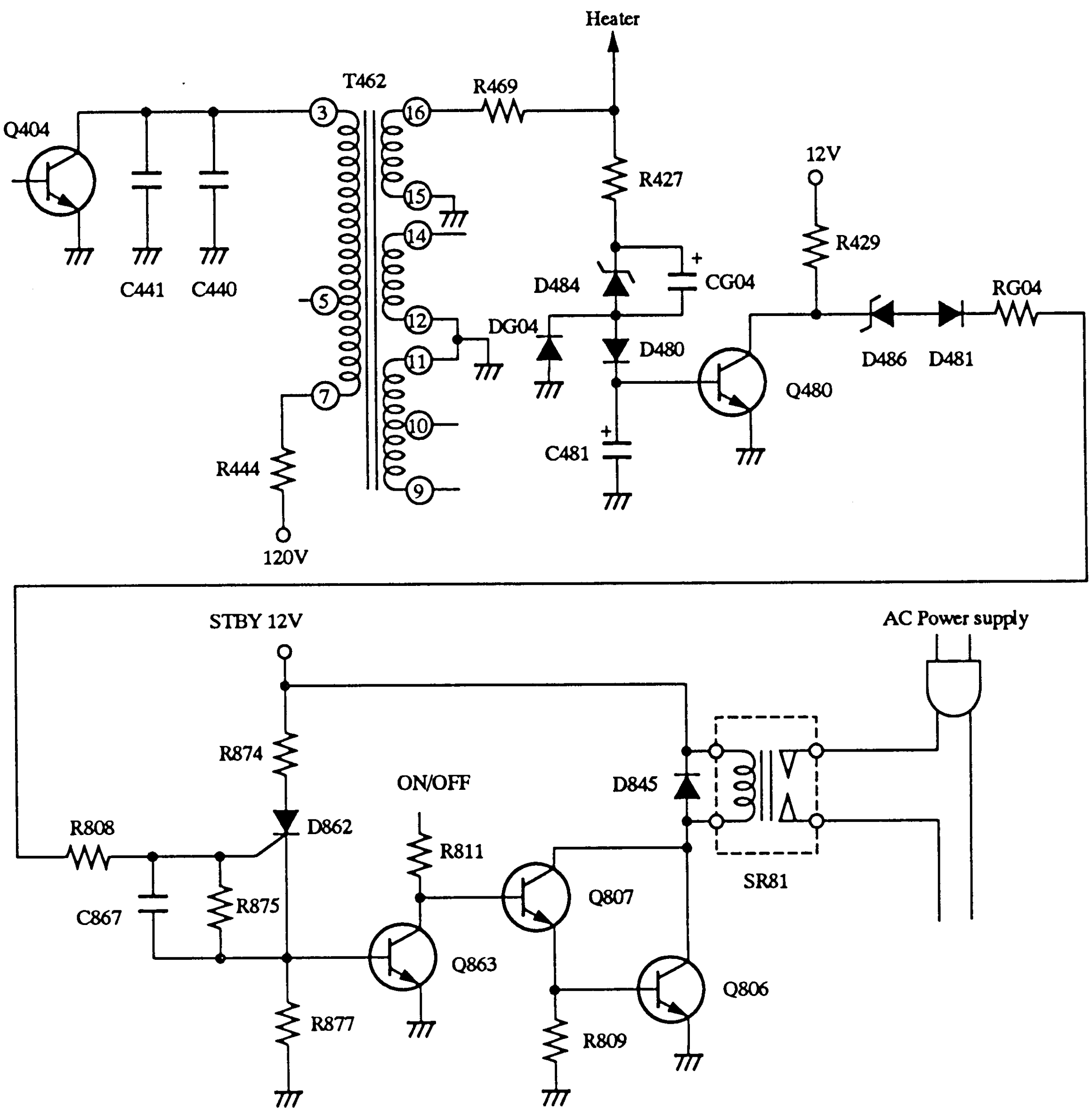
As previously described under the Vertical deflection circuit, if the beams concentrate at the fluorescent screen of the projection tube on a projection TV, the phosphor screen is burned.

To prevent this, the voltage at pin 16 of T462 pulse transformer is detected when the Horiz. output circuit stops, and the main power supply of the TV set is turned off.

This operation is described in more details by referring to Fig. 5-7.

Pin 16 of T462 develops a pulse of about 25 Vp-p in Horiz. sync when the Horiz. output circuit is working normally. The pulse is applied to the base of Q480 through R427, D484//CG04, D480, and Q480 is turned on. With Q480 turned on, Q480 collector is low. As a result, a thyristor D862 in the power supply circuit is not turned on, so, the relay SR81 is kept closed and the set works normally.

On the other hand when the Horiz. output circuit stops, the voltage at pin 16 of T462 disappears, Q480 turns off and collector of Q480 goes high. Since the collector voltage is applied to the gate of D862 thyristor in passing through D486, D481, RG04, so, D862 turns on, Q863 on → Q807, Q806 off, thus a current does not flow into the coil of relay SR81. That is the relay is opened and the main power supply of the set is turned off, thus protecting the projection tubes.



Heater
T462
R469
Q404
R427
12V
R429
C441
C440
D484
CG04
RG04
DG04
D480
D486
D481
Q480
C481
R444
120V
STBY 12V
AC Power supply
R874
ON/OFF
D845
R808
D862
R811
Q807
SR81
C867
R875
Q863
Q806
R877
R809

Fig. 5-7

SECTION 6
HIGH VOLTAGE CIRCUIT

1. OUTLINE

The high voltage circuit provides a high voltage of 31.5 kV to the anode of each projection tube. The major differences from the Direct View N2DB chjassis is that the high voltage circuit is separated from the H output circuit and employs a high voltage stabilization regulation circuit.

The high voltage circuit consists of a high voltage generation circuit, high voltage regulation circuit, and a X ray protection circuit. The high voltage circuit accepts the H OSC output pulse as its input and operates with +120V main power supply and +12V power supply.

2. HIGH VOLTAGE GENERATION CIRCUIT

An H oscillation pulse is applied to base of Q420 from pin 8 of Q501 (TA8845AN) and Q420 performs a switching operation in H sync period. (Q501 is located on the main P.C. board.)

Q431 base is connected to Q420 collector and Q431 also performs the switching operation in H sync period.

The switching circuit consisting of Q432 and T420 is a high voltage drive circuit and its operation is exactly the same as that of the H drive circuit. In other words, the switching circuit, consisting of Q420 and Q431, works as a simple buffer connected between the H oscillation circuit and the high voltage drive circuit. The buffer circuit isolates the horizontal deflection circuit from the high voltage circuit to prevent screen bending and jitter due to interference from the high voltage load, which varies according to the picture content.

Q433 is a high voltage output transistor and C431, C432, and C433 are resonant capacitors. This circuit is the same as that of the H output circuit, except, without the deflection coil, and the pulse transformer is replaced with the FBT. So, the operation theory is also exactly the same .

However, the purpose of the H output circuit, is to provide the sawtooth wave current into the deflection coil. In the high voltage generation circuit, the purpose is to obtain a pulse voltage, which is equivalent to the flyback pulse in the H output circuit developed by the resonance of the resonant capacitors and the inductance of FBT primary coil.

The pulse voltage of about 1000 Vp-p obtained at the primary side of the FBT is stepped up, rectified, filtered, and output as the high voltage of 31.5 kV. The voltage is applied to the anodes of the three projection tubes. The filtering capacitor inside the FBT works to reduce high voltage ripples due to dynamic variation of the load current. Moreover, a resistor divider is also incorporated to detect the high voltage. The detected voltage (NFB) from pin 12 of the FBT is fed back to the high voltage stabilization circuit.

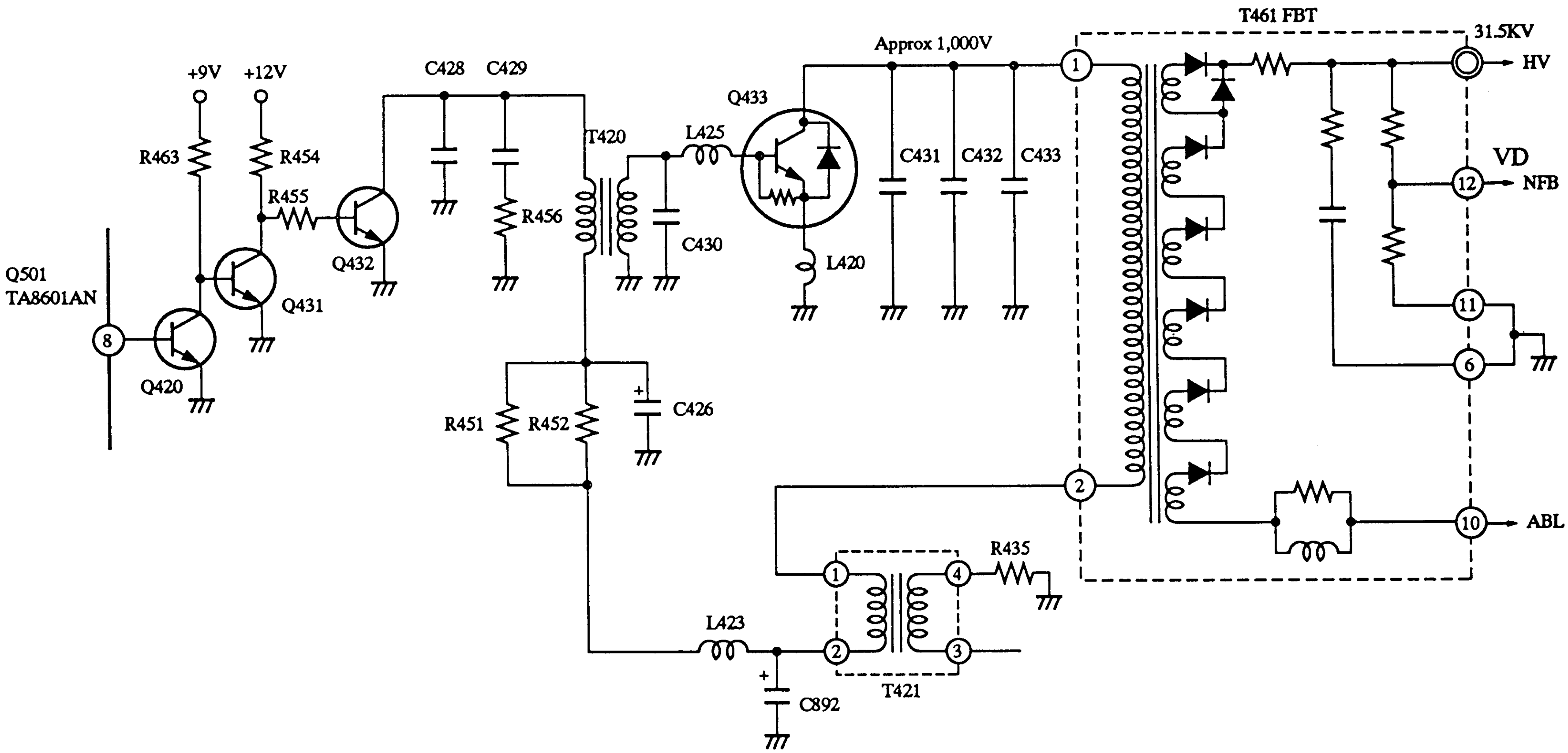


Fig. 6-1 High voltage generation circuit

3. HIGH VOLTAGE STABILIZATION CIRCUIT

The TP48C51 employs the high voltage stabilization circuit to prevent high voltage variations due to change of high voltage current and to stabilize the screen amplitude (raster size). This allows setting of the high voltage to a value near the maximum rating voltage of the projection tube. As a result the screen brightness can be increased. Moreover, it makes the raster size small. That is, it allows reproduction of more picture information.

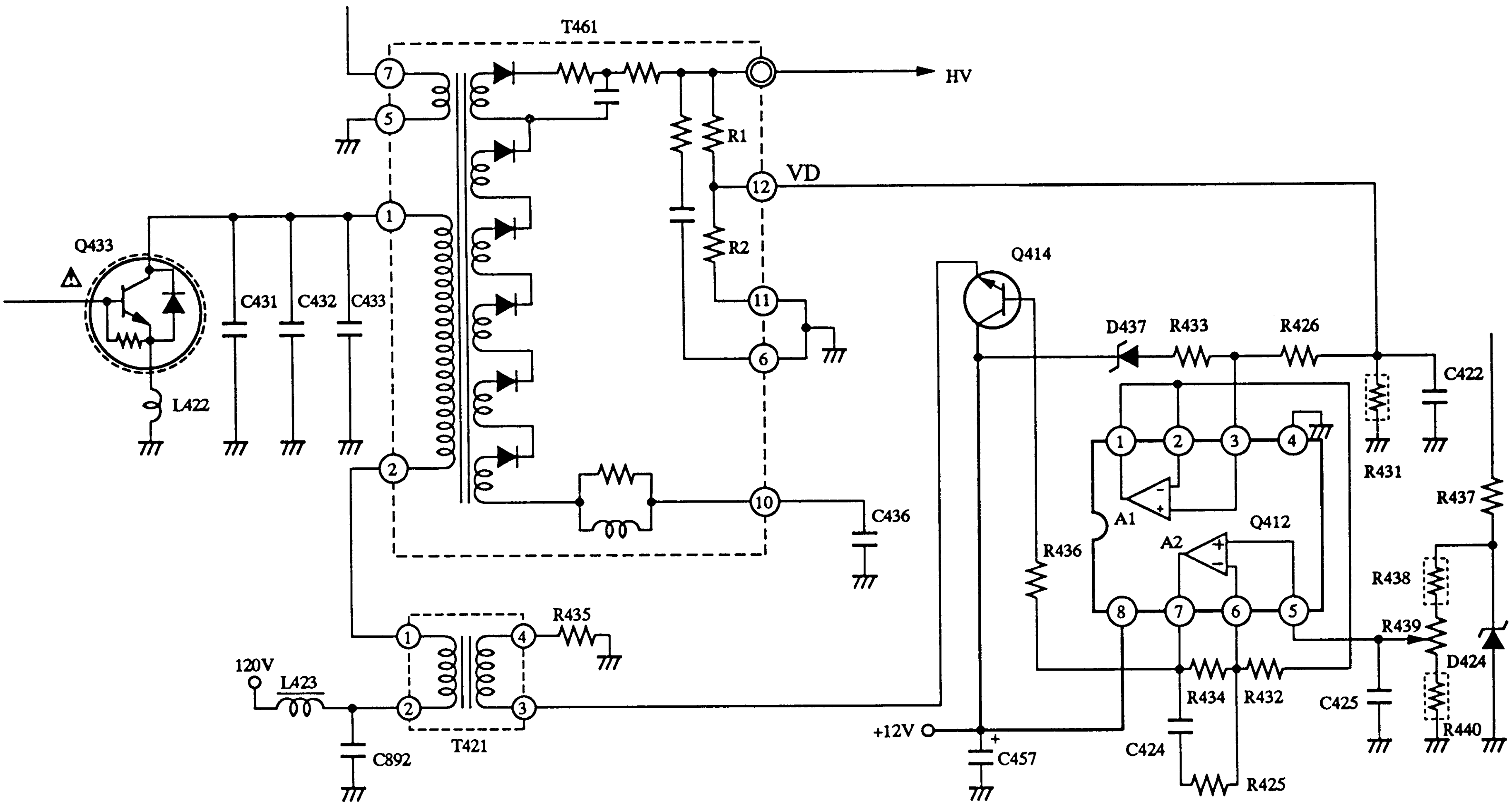


Fig. 6-2 High voltage stabilization circuit

3-1. Circuit Operation

The high voltage is obtained by stepping up (n times) the collector pulse (Vcp) generated at the primary side of the flyback transformer and rectifying it. The high voltage E_H will be given by following relation.

$$E_H \propto Vcp$$

That is, the high voltage (E_H) can be stabilized by controlling the Vcp.

(1) The FBT has high voltage divider resistors R_1 and R_2, to output a high voltage detection voltage (VD) across the external resistor of R431. The VD enters pin 3 of Q412 amplifier control IC which contains two op amps. The pin 3 is a non inverting input terminal of the first stage op amp A_1.

(2) Pin 2 and pin 1 of A_1 are short-circuited and A_1 operates as a buffer amplifier (linear gain amplifier). That is, the detection voltage VD directly appears at the output terminal pin 1 and enters pin 6 of the next op amp A_2.

(3) The high voltage detection voltage is compared to a reference voltage obtained by dividing the zener voltage developed by D424 with R438, R439 and R440 applied to pin 5 of A_2. The error is amplified and developed at pin 7 of A_2.

(4) The output voltage of A_2 is fed to the base of Q414, which controls the collector current of Q414. With the collector current of Q414 varied, a current flowing through a secondary winding (pins 3&4) of T421 (saturable reactance transformer) varies which changes the inductance value of the primary winding (pins 1&2) of T421. In practice, when the secondary current increases, the value of L in the primary winding decreases.

(5) When L of the primary winding of T421 connected in series with Lp of the FBT changes, the voltage across Lp of the FBT also changes. In turn, Vcp changes, to control the high voltage.

(6) For example, actual operations are carried out as follows .

- When the high voltage current I_H increases and the high voltage E_H is going to decrease, due to the increased load:

  1) High voltage E_H decreases
  2) High voltage detection voltage V_D decreases
  3) A_1 output voltage at pin 1 decreases
  4) Voltage at pin 6 of A_2 decreases
  5) A_2 output voltage at pin 7 increases
  6) Base current of Q414 increases
  7) Collector current of Q414 increases
  8) Secondary current of T421 increases
  9) Primary reactance of T421 decreases
  10) Voltage across Lp of FBT increases
  11) Vcp increases
  12) High voltage E_H increases (stabilizes)

- When the high voltage current I_H decreases and the high voltage E_H is going to increase, the variations for all the operations occur in oposite direction.

In this way, with the correction loops shown above, the high voltage is stabilized if the high voltage current I_H varies.

R439 is a high voltage adjustment control to adjust the high voltage to 31.5 kV.

D437 is a zener diode to control the lower limit of the high voltage detection voltage and prevents a latch up for the op amps due to high voltage spark, etc.

4. X RAY PROTECTION CIRCUIT

Generally speaking, when high speed electrons collide with an object, a X-ray is emitted, if the high voltage to the projection tubesincreases excessively due to failure of the high voltage circuit or abnormal operation, the emission of X-rays increase. To prevent this, a X-ray protection circuit is provided with TP48C51.

In the TP48C51, a variation of the high voltage is detected with a pulse voltage Vx stepped down with a winding ratio of Nx/Np, here Np is a primary winding of the FBT. The Vx is rectified with D471 and C451, and the Vx of about 21V is obtained. If the high voltage increases excessively due to some reasons, the Vcp increases, Vx increases, and Va increases. With the Va increased, a voltage divided by R487, R488. and R461 increases which increases the emitter voltage of Q451 . Since, the base voltage of Q451 is fixed at a zener voltage of 6.2V, Q451 turns on when the emitter voltage of Q451 becomes 6.2V + V_{BE}. Then, Q452 turns on.

With Q452 turned on, the thyristor D862 fires due to the current through D473, R495, and R808. Then Q863 turns on, and Q807and Q806 turn off. The power relay SR8 1opens and the main power supply of the set is turned off.

The operation voltage of the X ray protection circuit is set to a higher value so that the protection circuit does not operate under the normal operation.

When repairs to the unit are completed, check the operation of the X-ray protection circuit by short-circuiting the test points R and X . When the R and X test points are short-circuited, R487 and R486 are connected in parallel. This rises Q451 emitter voltage and makes Q451 turn on, to initiate X-ray protection shut down.

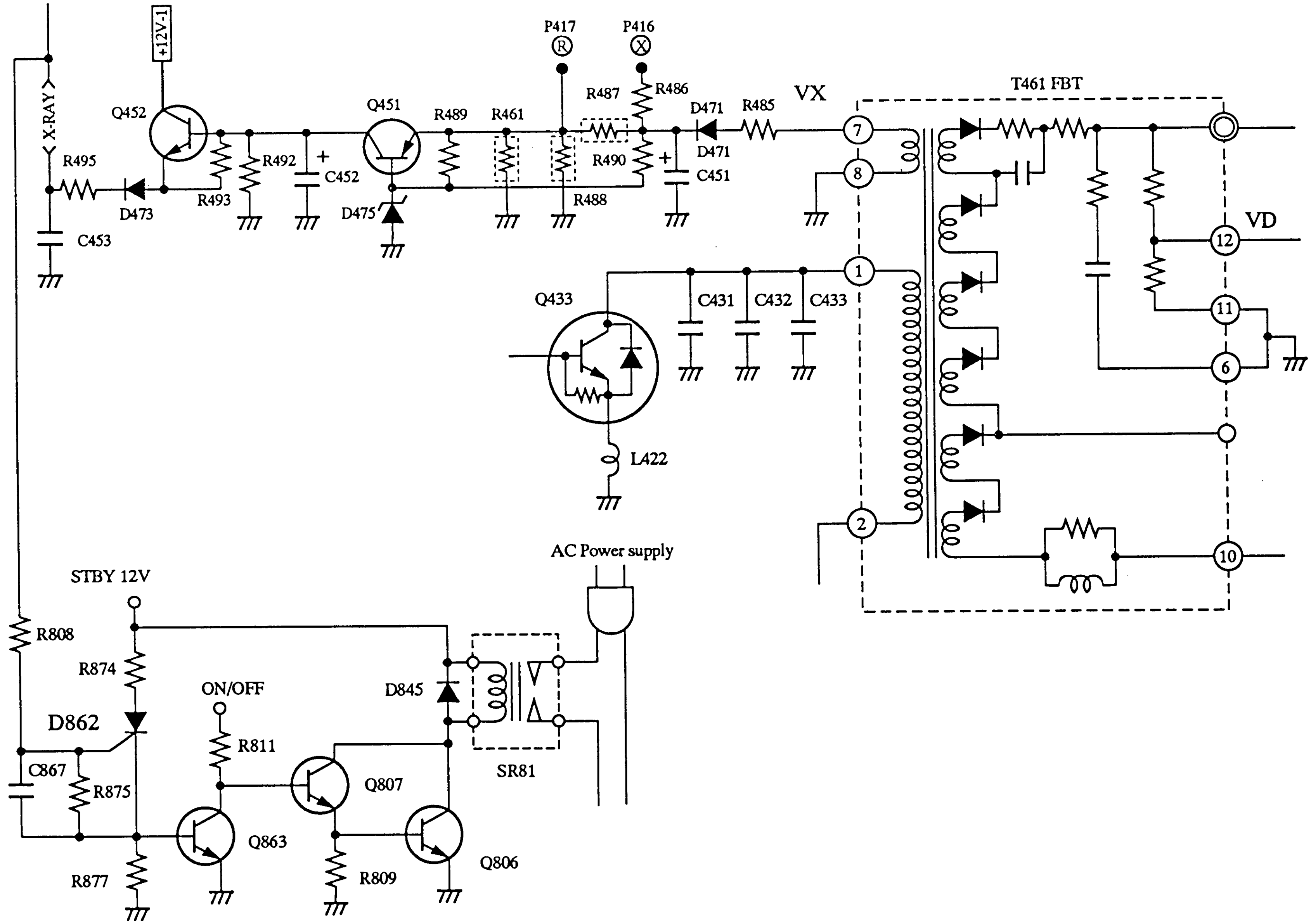


Fig. 6-3 XRAY Protection Circuit

SECTION 7
DYNAMIC FOCUS CIRCUIT

1. OUTLINE

In TP48C51, a static focus system is employed in the projection tube. Degradation of the focus quality at peripheral screen is improved by applying focus correction voltages (parabola voltages in H/V periods). The dynamic focus circuit creates this focus correction voltage and consists of an H and a V dynamic focus circuit.

To obtain a flat focus at the center and peripheral of the screen, the focus correction is carried out by applying the H sync parabola correction voltage (efH = 700 Vp-p) and the V sync parabola correction voltage (efv = 300 Vp-p) to the focus electrode in addition to the focus DC voltage of Ef (= EH x 0.27 ~ 0.29).

2. H DYNAMIC FOCUS CIRCUIT

2-1. Theory of Operation

Fig. 7-1 shows a block diagram of the circuit which develops an H parabola correction voltage.

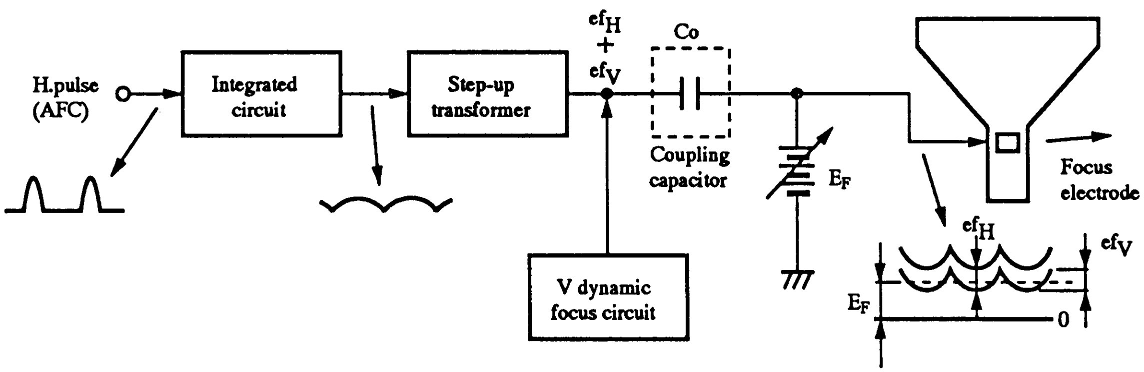


Fig. 7-1 Block diagram of H dynamic focus circuit

2-2. Circuit Operation

The H pulse developed at pin 14 of the pulse transformer T462 enters the integration circuit consisting of L470 and C_1. The C_1 does not exist in the actual circuit as shown in a dotted line. The C_1 is an equivalent capacitance of the stray capacitance of Cs in secondary side of the step-up transformer T470 converted into the primary side, and can be expressed as:

$$C_1 = n^2 C_s$$

The H pulse is integrated with L470 and C_1, and a sawtooth wave current of I_{C1} flows into C_1.

Accordingly, an integrated parabola voltage V_1 is developed across C_1 and this is used as the input voltage (primary side voltage) for the step-up transformer. A parabola voltage V_2 stepped-up and inverted is obtained at secondary side (F P terminals) of T470. This parabola voltage is mixed with the V parabola voltage described under the V dynamic focus circuit, and the mixed voltage is superimposed with the focus DC voltage (about 9 kV) through a coupling capacitor , and supplied to the focus electrodes of each projection tube.

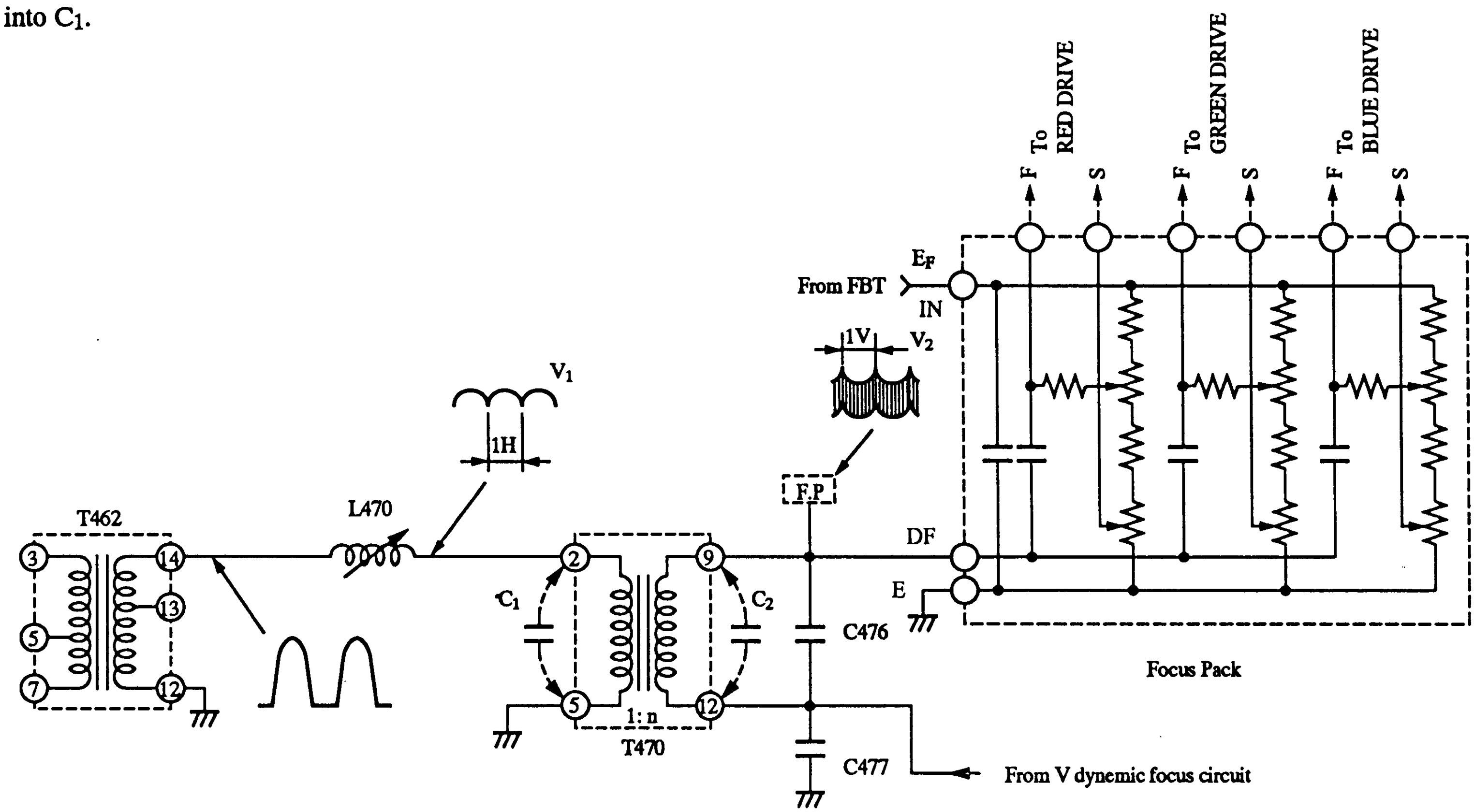


Fig. 7-2

3. V DYNAMIC FOCUS CIRCUIT

3-1. Theory of Operation

Fig. 7-3 shows the circuit which develops the V parabola correction voltage.

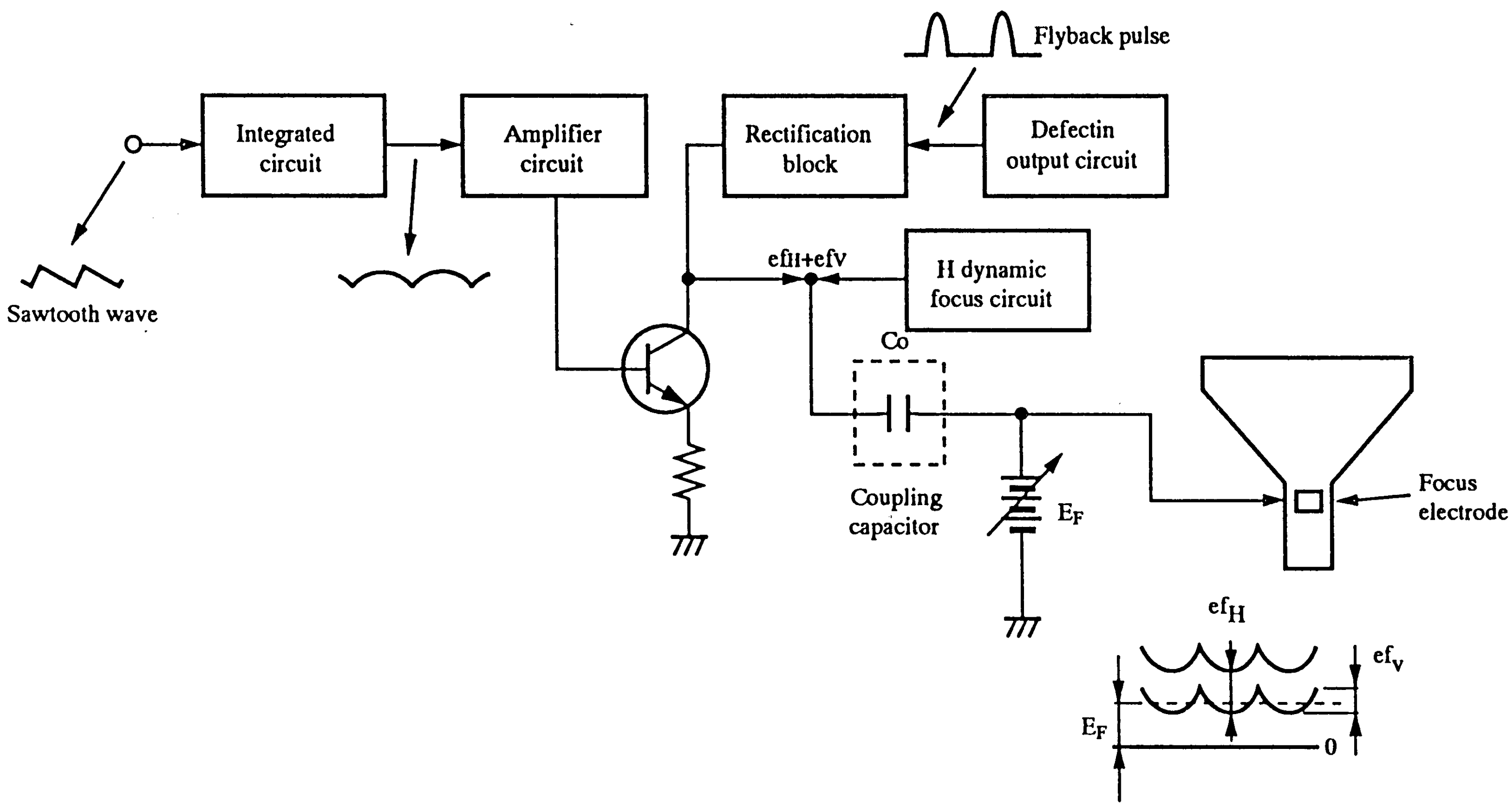


Fig. 7-3 Block diagram of V dynamic focus circuit

3-2. Circuit Operation

A sawtooth wave voltage developed across (R301+R302) in the V output circuit is AC coupled to the integrator circuit to develop the parabola waveform by a mirror integrator in the first stage. The parabola is amplified with a specified gain level set by R471/R470. The amplified parabola wave is further amplified by the next stage op amp. (A2) The op amp works as an inverting amplifier and the gain is determined by (R478/R475)/R477. The parabola voltage amplified in this way enters the base of Q471, and is amplified and inverted to develop the V focus parabola voltage (300 Vp-p, DC component 60V). At the collector of Q471 this voltage is added with the H focus parabola voltage in passing through R483, resulting in a mixed parabola voltage consisting of a H component of 700 Vp-p and a V component of 300 Vp-p. The obtained mixed output is fed to the focus electrodes of R, G, B projection tubes through the coupling capacitor for each tube. (3 coupling capacitors internal to the Focus/G2 Block)

The parabola level of the V focus parabola output voltage is adjusted by varying R475 and the DC voltage level by varying R482.

The Vcc for Q471 is obtained by rectifying collector pulse of the deflection output circuit with the rectification circuit Z470. The rectification circuit Z470 is assembled as a separate block for safety because of its high rectified output voltage of about 1000V.

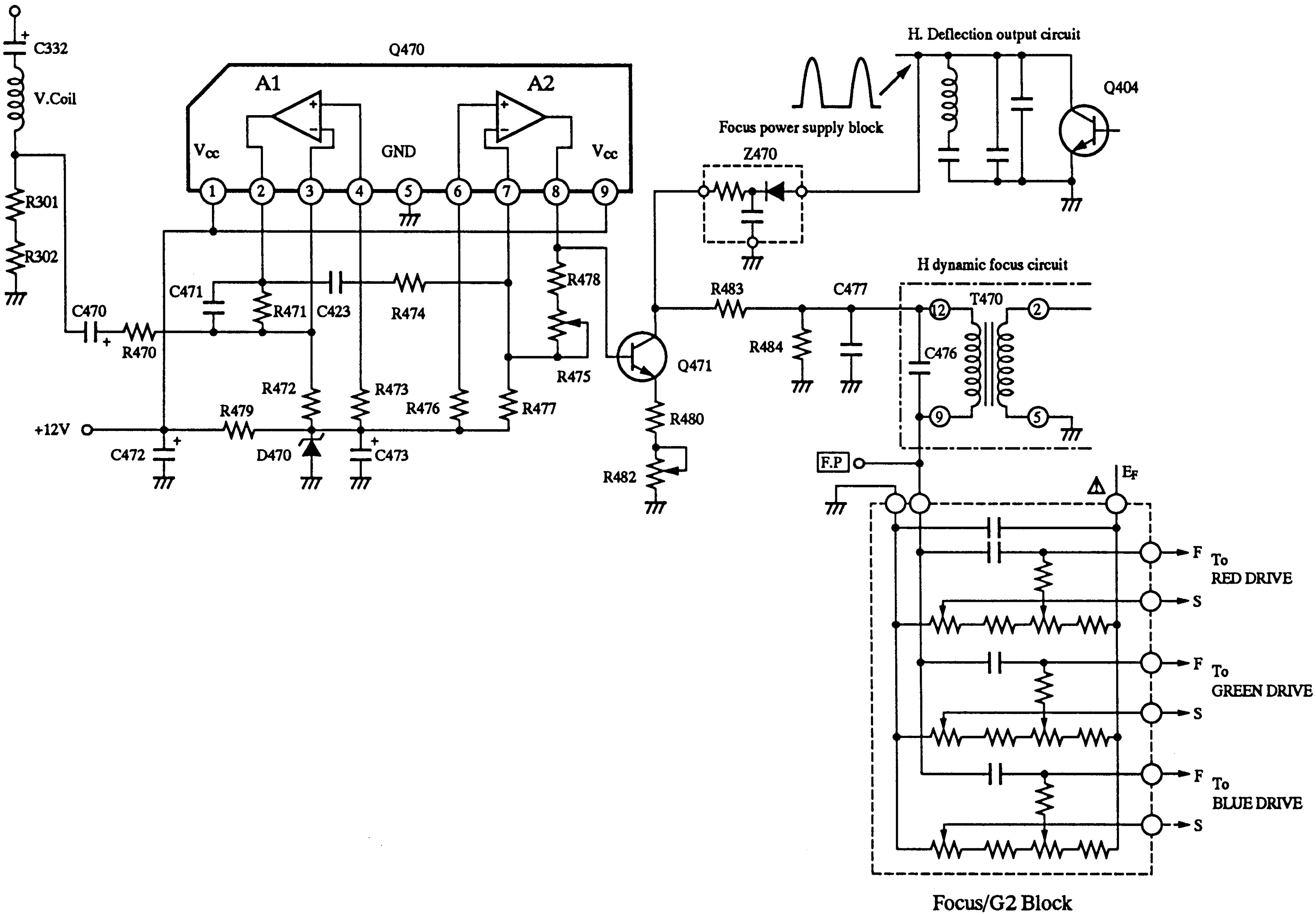


Fig. 7-4 V output circuit

SECTION 8
OPTICAL SYSTEM

1. NECK COMPONENTS

1-1. Outline of Components Around Neck of The Projection Tube

Fig. 8-1 shows names and mounting locations of neck components around the projection tube.

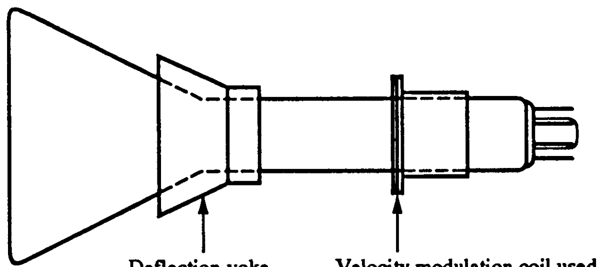


Fig. 8-1

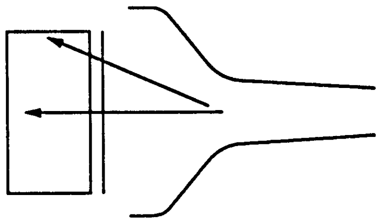
1-2. Theory of Operation

The neck components, are: (1) the deflection yoke (consisting of main yoke, sub-yoke, and centering magnet), and (2) the velocity modulation coil . The main yoke of the deflection yoke consists of an horizontal and a vertical deflection coil, which deflects electron beams horizontally and vertically. The sub-yoke is called a convergence yoke and also consists of horizontal and vertical windings. The sub-yoke performs distortion correction and color registration according to correction currents supplied from the convergence output circuit. A centering magnet, consisting of two 2-pole magnets, is provided at the end of the deflection yoke to adjust the raster position.

1-3. Projection Tube Comparison

TP4688J, TP4880A

- Fluorescent screen: flat



Electrons around peripheral of CRT screen come into collision with the A/B lenses and are not used, thus lowering contrast, brightness, and efficiency.

TP48C50/51

⇒ • Fluorescent screen: inverted R 350mm

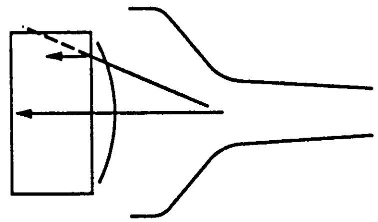
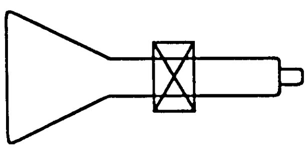


Fig. 8-2

Light beams around peripheral of the CRT screen are collected around the center, increasing the light output.

- Electromagnetic Focus

Electromagnetic focusing with magnets mounted around the CRT neck



Since the deflection is carried out by using magnetic field applied from outside of the neck, high deflection power is obtained and focusing quality is high. Moreover, since the coils are mounted outside the neck, the deflection elements in the neck mininizes distortion, thus the best beam pattern is obtained.

⇒ • Electrostatic Focus

High unipotential focus

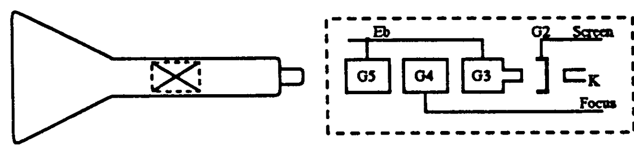


Fig. 8-3

The best beam pattern is obtained at the screen center and peripheral by applying parabolic voltages for H and V periods to the focus terminals. This also assures a flat focusing characteristic on the entire screen.

To obtain sharper pictures, a velocity modulation circuit is provided .

1-4. Replacement of CRT (Taking Care On Combinations of CRT and R469)

When shipped at the factory, there are two types of CRT combinations. First combination: each CRT using 180DUB22 (R, G, B); and second combination: each CRT using 180CSB22 (R, G, B) K. However, only 180DUB22 (R, G, B) is supplied as the service part. So, four kinds of combinations occur when replacing the CRTs. Since the heater resistor R469 is different for each combination when replacing a CRT, select the correct resistor (R469) in the service kit according to the table shown below.

NOTE: There is no need to replace R469 if the original tubes are all type number 180DUB22(R,G,B)

Table 8-1

180DUB22 (R, G, B)	180CSB22 (R, G, B)K	R469
0	3	2.4Ω
1	2	2.0Ω
2	1	2.0Ω
3	0	1.8Ω

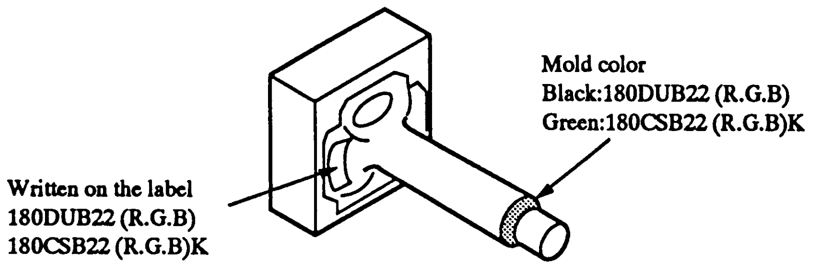


Fig. 8-4

1-5. Construction

a. Kit Serv. 180DUB22 (R) 48 SN23305447 (48" only)

Type	SN	Spec. No.	pcs.
Coupling 48R	23791382		1
Instruction	23561976	E9093Y001	1
Fuse Res 1.8Ω	24000945	E2080R0051	1
Fuse Res 2.0Ω	24000940	E2080R0051	1
Polyethylene Bag			1 (Packing use)

b. Kit Serv. 180DUB22 (G) SN23305448 (48"/55" common use)

Type	SN	Spec. No.	pcs.
Coupling 48G	23791383		1
Instruction	23561976	E9093Y001	1
Fuse Res 1.8Ω	24000945	E2080R0051	1
Fuse Res 2.0Ω	24000940	E2080R0051	1
Polyethylene Bag			1 (Packing use)

c. Kit Serv. 180DUB22 (B) SN23305455 (48"/55" common use)

Type	SN	Spec. No.	pcs.
Coupling 48B	23791384		1
Instruction	23561976	E9093Y001	1
Fuse Res 1.8Ω	24000945	E2080R0051	1
Fuse Res 2.0Ω	24000940	E2080R0051	1
Polyethylene Bag			1 (Packing use)

d. Kit Serv. 180DUB22 (R) 55 SN23305493 (55" only)

Type	SN	Spec. No.	pcs.
Coupling 55R	23791780		1
Instruction	23561976	E9093Y001	1
Fuse Res 1.8Ω	24000945	E2080R0051	1
Fuse Res 2.0Ω	24000940	E2080R0051	1
Polyethylene Bag			1 (Packing use)

2. FUNCTION OF KEY COMPONENTS

2-1. Outline

The optical system of the TP48C50/51 consists of a screen, mirrors and lenses.

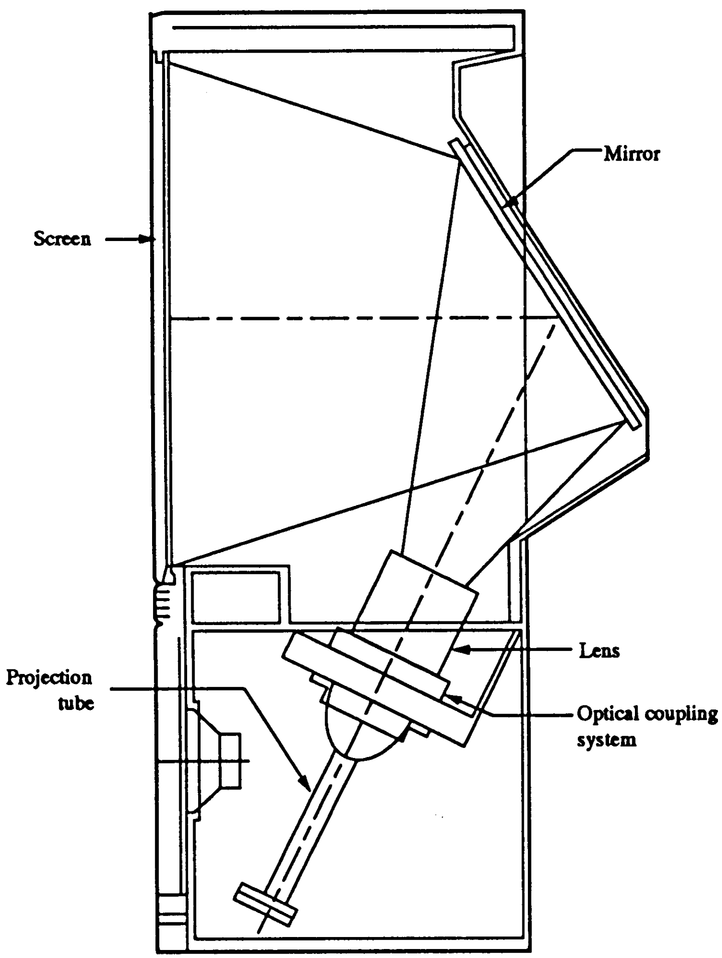


Fig. 8-5

2-2. Theoretical Operation

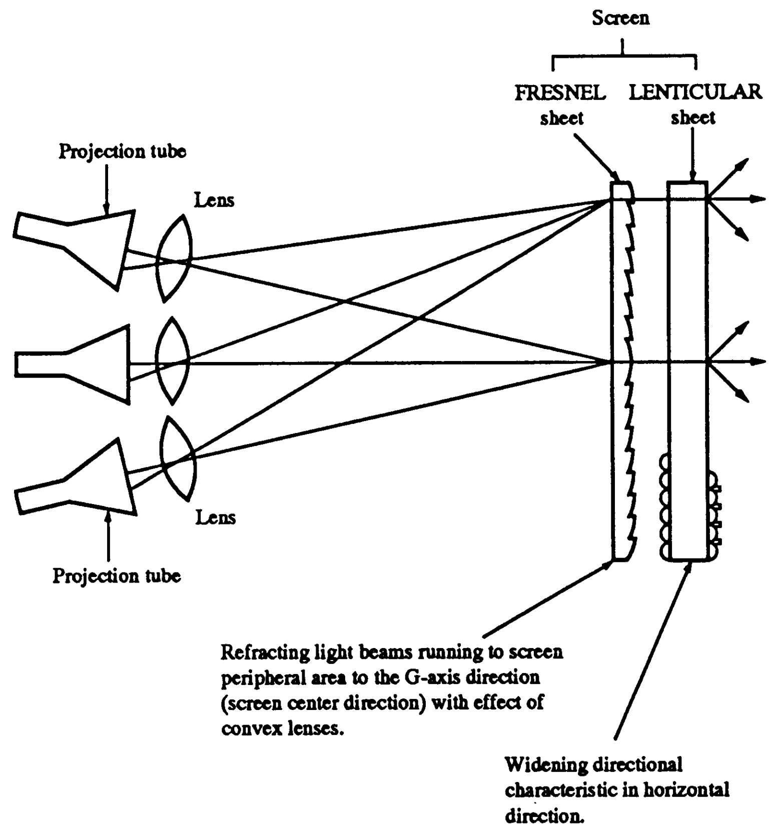


Fig. 8-6

2-3. Screen

2-3-1. Effect of Fresnel Sheet

Shape of the lens has been changed to reduce focal length in comparison to TP4880A. (This allows reduction on size of product.)

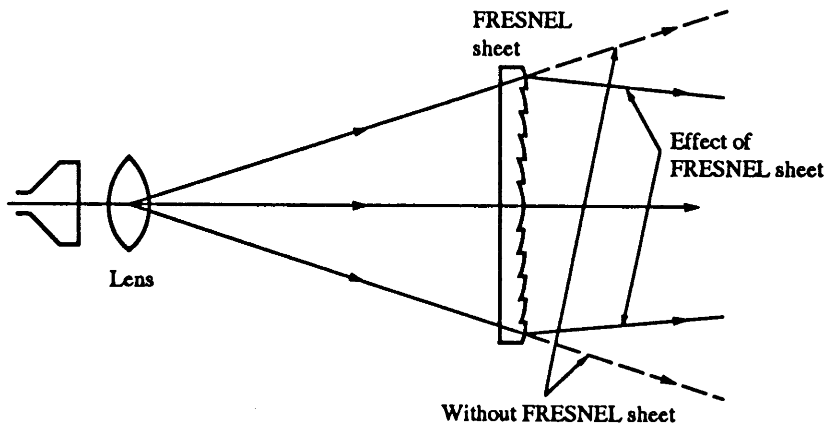


Fig. 8-7

2-3-2. Appearance of LENTICULAR Sheet

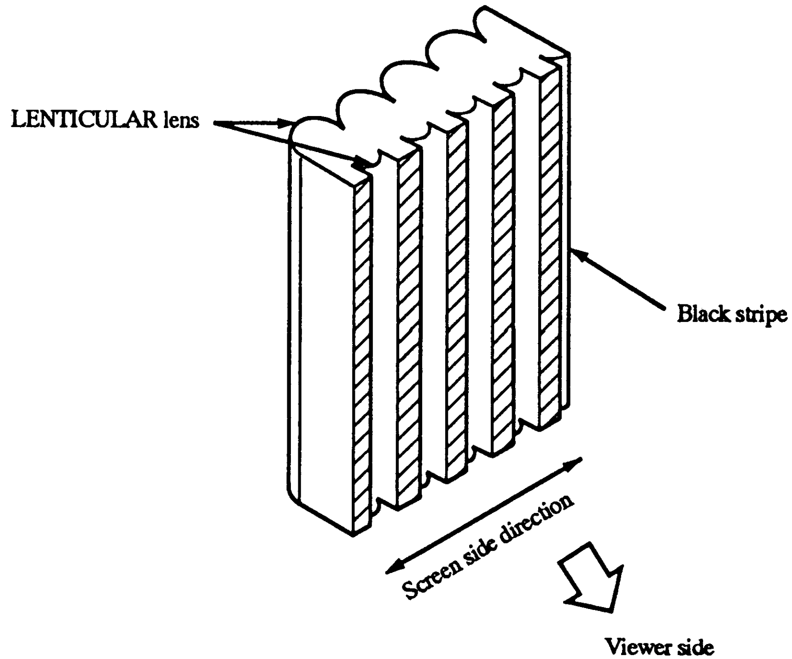


Fig. 8-8

LENTICULAR sheet

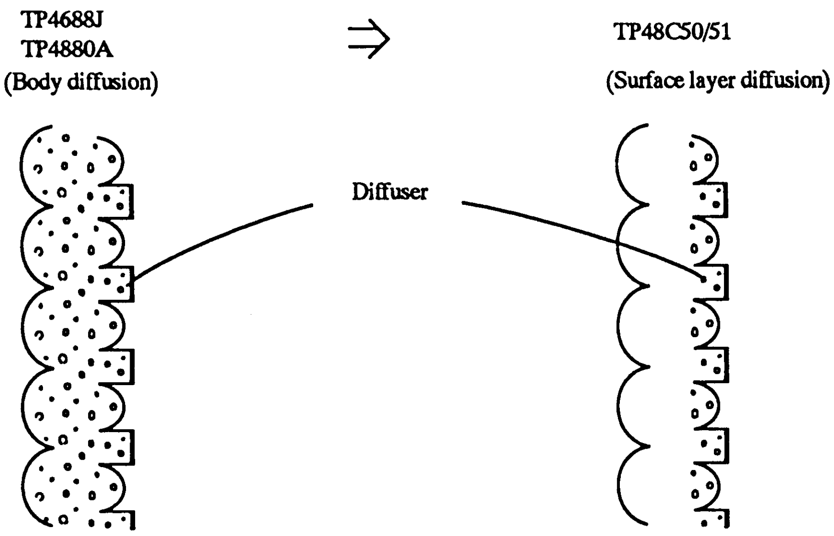
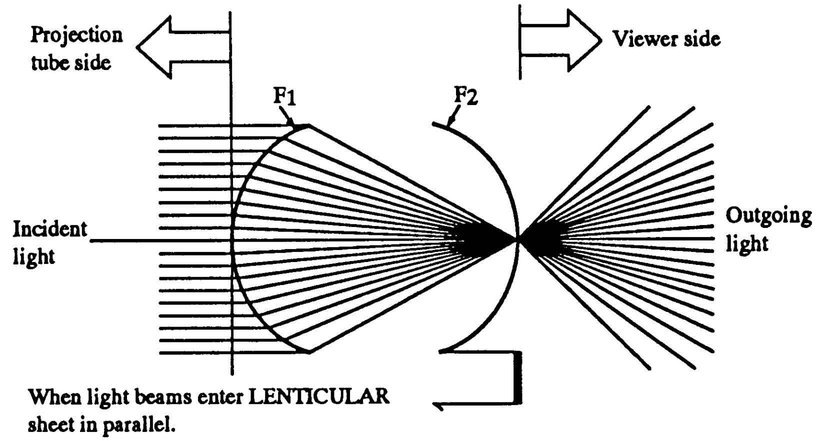


Fig. 8-9

Light beams will be effectively used by collecting the diffuser at surface of the layer, thus increasing the brightness by about 10%.

2-3-3. Effect of LENTICULAR Sheet

If the light enters diagonally, the light is diffused in the same way as in parallel light incidence when viewed in front of the TV.



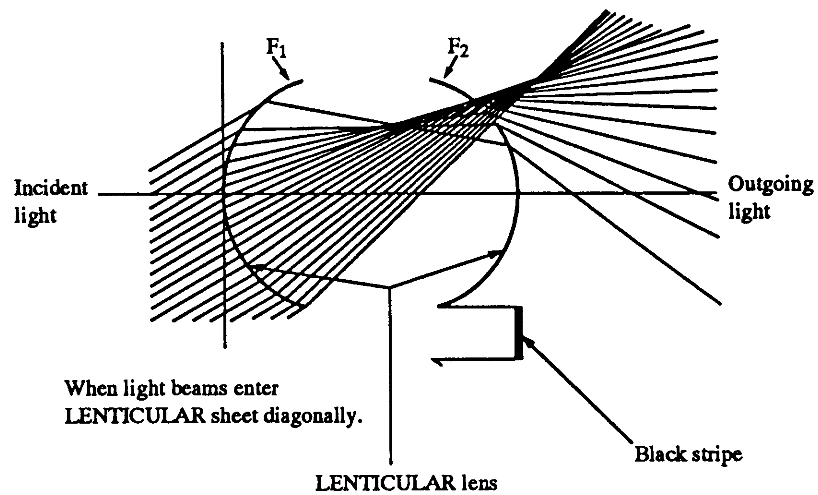


Fig. 8-10

2-4. Optical Coupling Effect

An object (liquid) with near refraction index of glass is filled between the projection tube and lens to suppress (1) total reflection from the tube, thereby improving the contrast; (2) interfacial reflection to reduce loss of light. Moreover, with the cooling effect of the liquid, power of the projection tube will be increased.

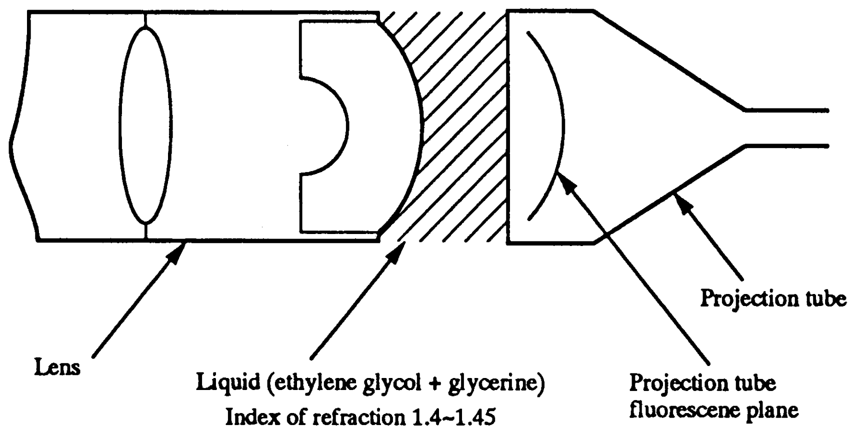


Fig. 8-11

2-4-1. If the Optical Coupling is Not Used:

(1) Light beams ①,② emitted from the fluorescent surface A advance up to the lens, but light beam ③ returns to the fluorescent surface due to the total reflection.

(2) This lowers the contrast at the fluorescent surface.

With assumption reflection index of air is 1.0 and that of glass 1.5, the angle which causes the total reflection is 41.8°.

That is, the light beams with angle of θ higher than 41.8° can not go out of the projection tube. The light beams returned to the fluorescent surface reaches 56% of the total beams coming out from A.

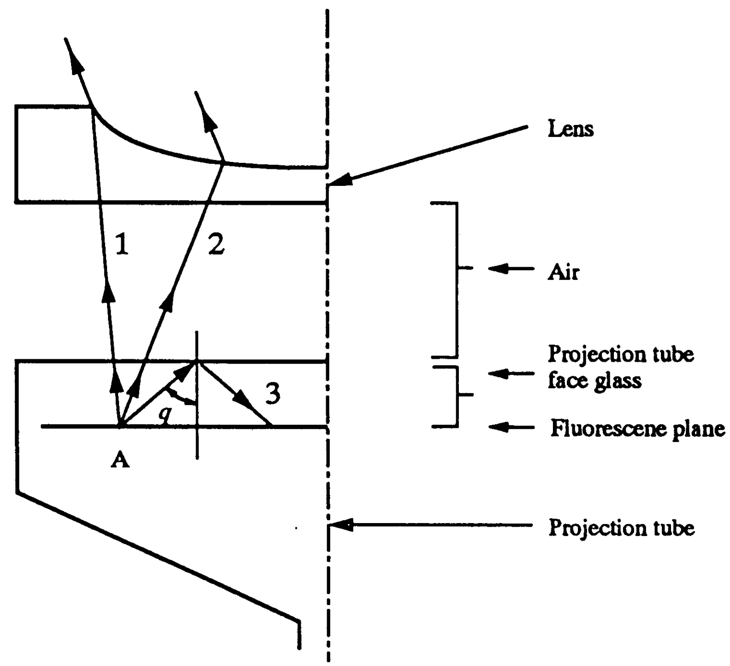
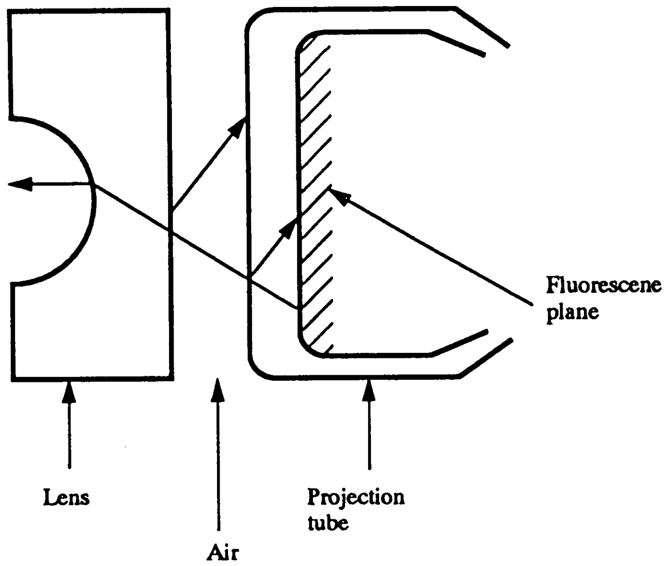
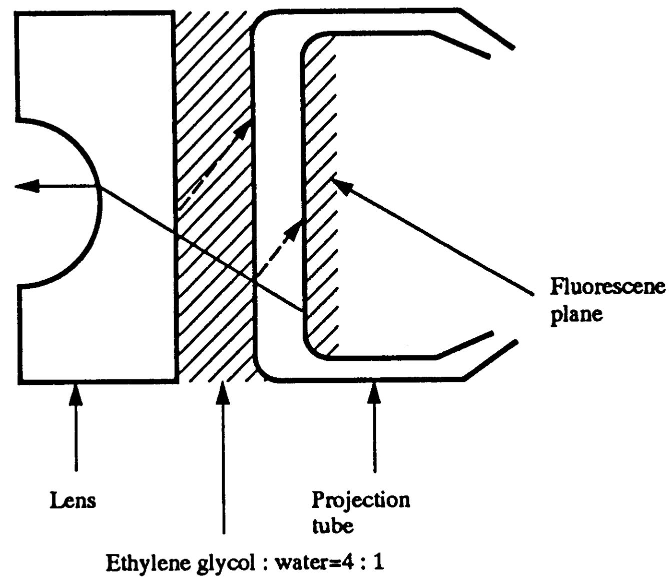


Fig. 8-12

2-4-2. Effect of Optical Coupling

Air coupling system (conventional system)	Optical coupling
	
Light reflection loss of higher than 4% occurs at each boundary surface of the face glass of the projection tube, air, and lens.	Since the index of refraction of the ethylene glycol liquid is near that of the glass, the reflection loss at the boundary surfaces will be suppressed to lower than 0.1%.
Index of refraction Glass: 1.5 Air: 1.0 $Reflection\ (loss) = \left(\frac{1.5-1}{1.5+1}\right)^2 \times 100\% = 4\%$	Index of refraction Glass: 1.5 Ethylene glycol: 1.4 $Reflection\ (loss) = \left(\frac{1.5-1.4}{1.5+1.4}\right)^2 \times 100\% = 0.1\%$

2-5. Lens

The lens system consists of a main lens (3 elements), C lens, and the face plate of inverted r CRT (used as a lens), which results in a short focus optical lens system with fewer lens elements

With the short focus optical system, the depth of the unit is reduced by about 30%, thus making the unit slim and compact.

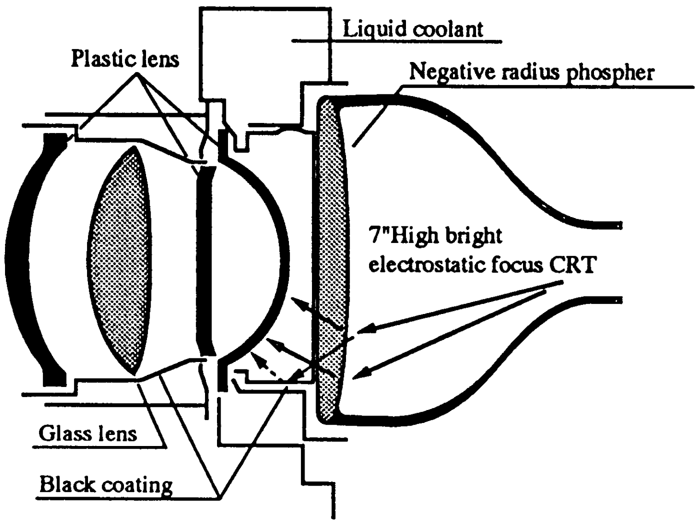
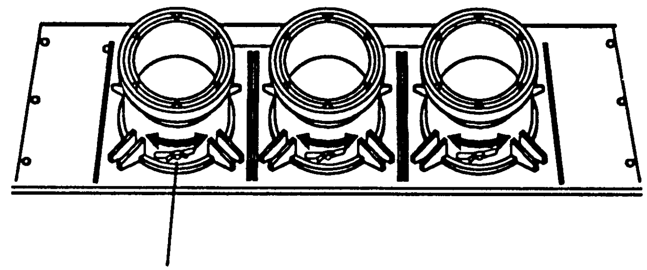


Fig. 8-13

2-5-1. Focus Adjustment

Note: When making adjustments on the neck components, always use dedicated drivers (stainless) made of non magnetic material.

Optical focus should be made according to the procedures shown below. After completion of the electrical and optical focus adjustments, convergence adjustment should be made.



NOTE: Lens can be turned 180°to make access to screws better.

Fig. 8-14 Lens focus adjustment

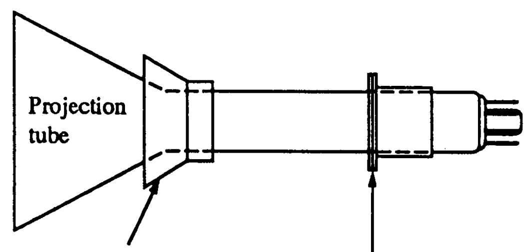


Fig. 8-15 Mounting position of deflection yoke and V.M. coil

2-6. Focus Adjustment

(1) Place the test switch (customer convergence) in the test position to display a cross hatch pattern.

(2) For easy adjustment, project one color to be adjusted at a time on the screen. (Other colors can be interrupted by putting caps on the lens.)

(3) Turn the electrical focus control for the color to be adjusted clockwise or counterclockwise so that the focus at center of the cross hatch shows the best focus.

(4) Loosen screws securing the lens and move the lens toward left or right until the best focus is obtained at center of the cross hatch pattern.

(5) Repeat steps 3 and 4 to obtain the best focus. Finally, secure the screws.

(6) Perform the convergence adjustment according to the convergence adjustment method.

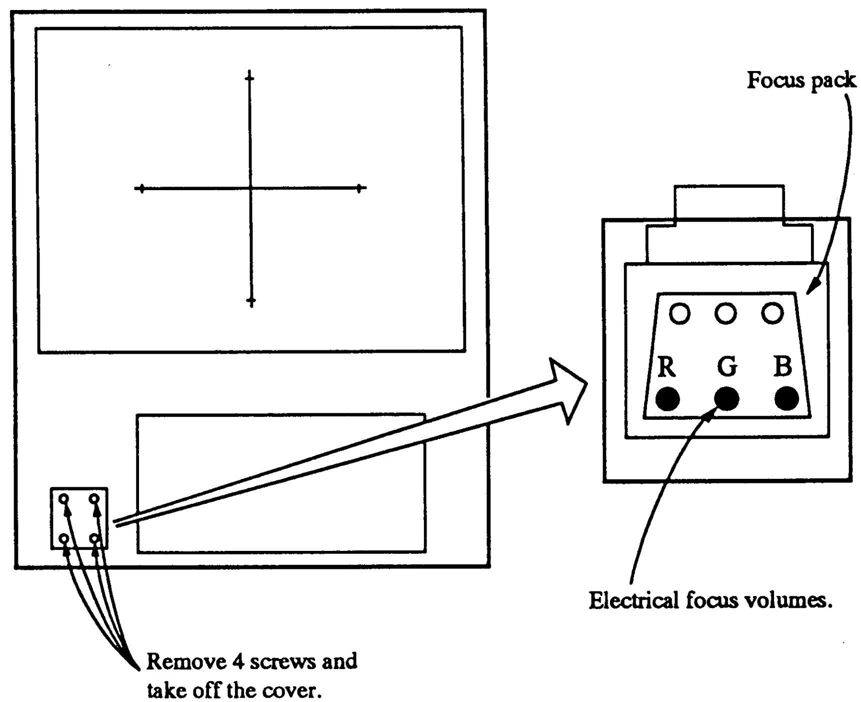


Fig. 8-16

SECTION 9
CONVERGENCE CIRCUIT

1. BASIC OPERATION

A projection TV requires the convergence circuit to provide correction waveforms to converge the video from the three tubes and to correct geometric distortion. As shown in Figure 9-1, the convergence circuit for this chassis is located on two circuit boards, the Convergence Control PCB (PB3366-1) and the Convergence Output PCB (PB3366-2). The Convergence Control PCB contains the Waveform Generation Circuit, the Matrix Circuit (which includes the controls), and the Summing Amplifier

The Convergence Output PCB contains the Convergence Drive Amplifiers, which drive the convergence yokes (Vertical and Horizontal) for each CRT. In addition, the Convergence Output PCB contains the SVM (Scan Velocity Modulation) circuit.

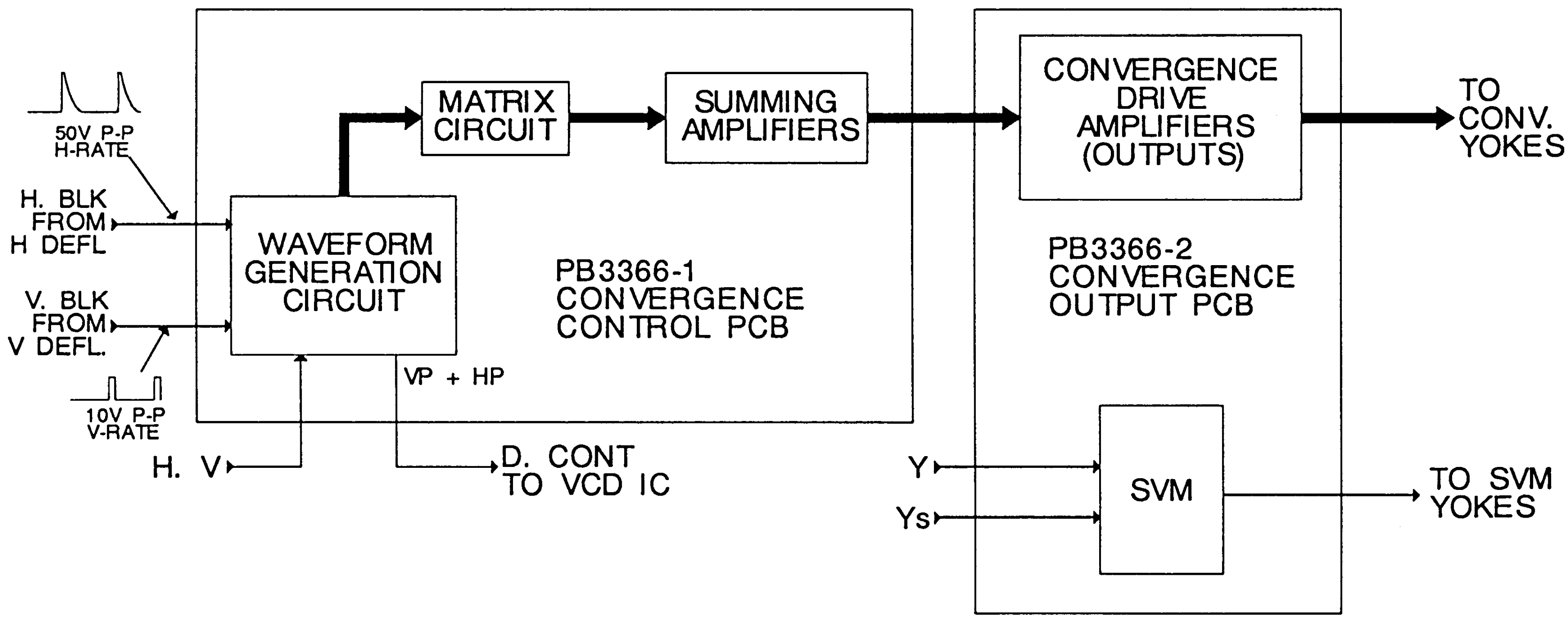


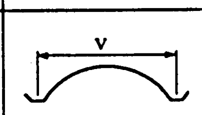
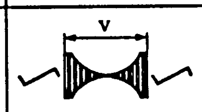
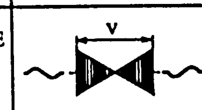
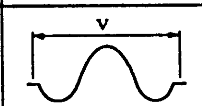
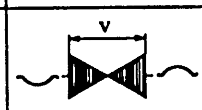
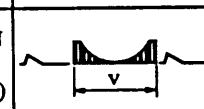
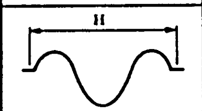
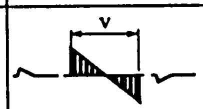
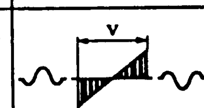
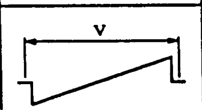
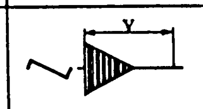
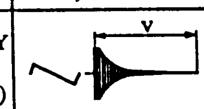
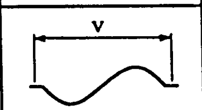
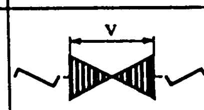
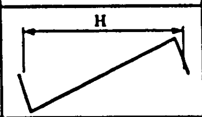
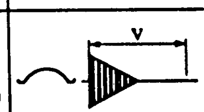
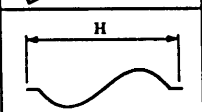
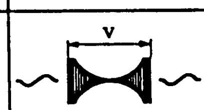
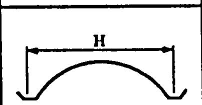
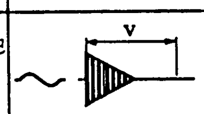
Fig. 9-1 Convergence Block Diagram

2. CONVERGENCE WAVEFORM GENERATION

The correction waveforms are derived from the H.BLK (Horizontal Blanking pulse from the H Deflection circuit) and V.BLK (Vertical Blanking pulse from the Vertical Deflection Circuit) pulses.

Each pulse is used to develop the fundamental waveforms, including theVertical Sawtooth (VS), the Horizontal Sawtooth (HS), the Vertical Parabola (VP), and the Horizontal Parabola (HP) waveforms. All the other waveforms are derived from these four fundamental waveforms as illustrated by Table 9-1.

Table 9-1

No	Name	Wave form	Raster correction	No	Name	Wave form	Raster correction	No	Name	Wave form	Raster correction
1	H-BOW V-O.LIN (VP)		H-bow distortion V-outside linear distortion	9	H-O.PIN V-O.KEY (VPHS)		H-outside pin-cushion distortion V-outside pedestal distortion	17	V-WAVE (VSH3)		V S charactor distortion
2	V-LLIN (V4)		V-inside linear distortion	10	V-PIN (VSHP)		V-outside pin-cushion distortion	18	H-O.SPIN (1/2VPHS)		H-outside upper side pin-cushion distortion
3	H-LLIN (H4)		H-inside linear distortion	11	H-SKEY (VS1/2HS)		H-left side pedestal distortion	19	V-WING (VSH4)		V-seagull distortion
4	H-TILT V-O.SIZE (VS)		H-tilt distortion V-outside amplitude distortion	12	V-I.SKEY (1/2VSHS)		V-inside upperside pedestal distortion	20	V-O.SKEY (1/2VPHS)		V-outside upper side pedestal distortion
5	V-I.SIZE (V3)		V-inside amplitude distortion	13	H-KEY V-I.KEY (VSHS)		H-pedestal distortion V-inside pedestal distortion				
6	H-O.SIZE V-TILT (HS)		H-outside amplitude distortion V-tilt distortion	14	V-SPIN (1/2VSHP)		V-upper side pin-cushion distortion				
7	H-I.SIZE (H3)		H-inside amplitude distortion	15	H-I.PIN (VPH3)		H-inside pin-cushion distortion				
8	H-O.LIN V-BOW (HP)		H-outside linear distortion	16	V-SWAVE (1/2VSH3)		V-upper side S character distortion				

Description of words in ( )

- V: V period correction wave
- H: H period correction wave
- 1/2: 1/2 correction wave
- S: Primary wave (saw tooth)
- P: Secondary wave (parabola)
- 3: 3rd wave (S charactor)
- 4: 4th wave (Seagull)

The vertical and horizontal sawtooth waveforms are derived in the following manner (see Figure 9-2):

a. The 10V P-P V. BLK is voltage sliced by a voltage slicer circuit to develop the 6V P-P vertical pulse (QJ08, Pin 4). The 50V P-P H. BLK is similarly sliced to 6V P-P (QJ08, Pin 12).

b. The vertical signal is applied to Pin 4 of the MMV (QJ08; Monostable Multivibrator) to output 5V P-P at Pin 6 (PJ11 test point); the horizontal signal is applied to Pin 12 to develop 5V P-P at Pin 10.

c. The vertical pulse is then applied to Pin 2 of QJ03, which is integrated internally to output the vertical sawtooth (VS) waveform at Pin 3. The constant current value for vertical sawtooth generation is set by RJ15. CJ20 is the vertical pulse integration capacitor. The horizontal sawtooth, which is available at Pin 34, is derived from the H pulse applied to Pin 1. For the horizontal sawtooth generation, the constant current resistor is RJ17 and the integration capacitor is CJ19.

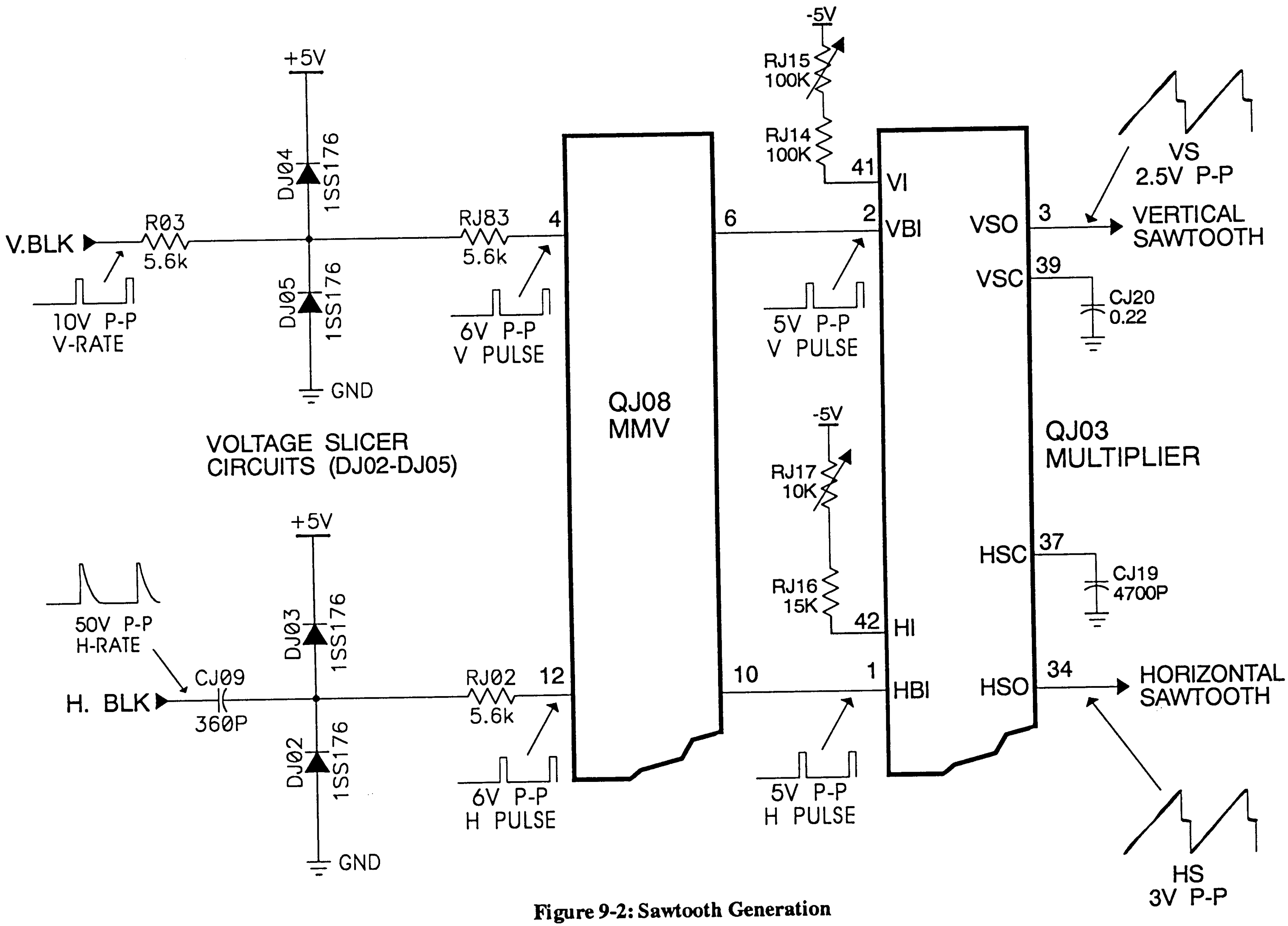


Figure 9-2: Sawtooth Generation

As illustrated in Figure 9-3, multiplier integrated circuits, QJ03 and QJ04, are used to develop the correction waveforms that are derived from the four fundamental waveforms.

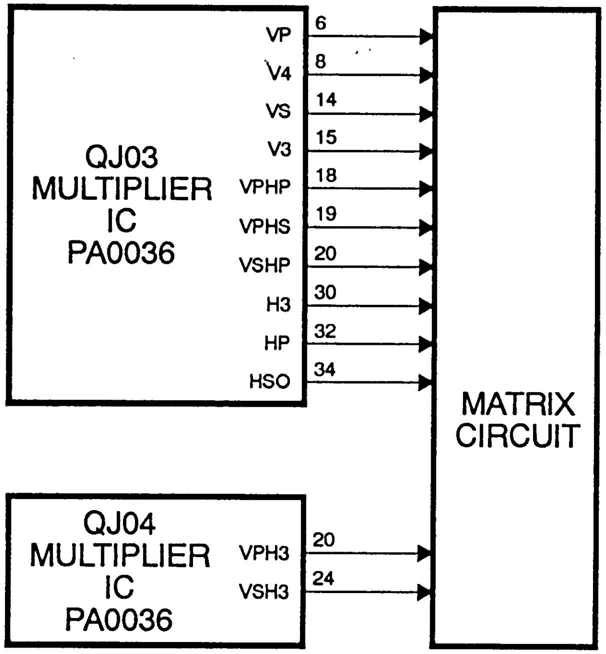


Figure 9-3: Waveform Generation

3. HIGH VOLTAGE RASTER DISTORTION CONTROL CIRCUIT

The circuit shown in Figure 9-4 is incorporated into the convergence circuit to prevent raster distortion during PIP insertion. A ripple detection signal is extracted from the HV Detection Circuit (Q412), and is filtered by the DC cut/Bias Filter circuit. This signal is proportional to the raster distortion during the vertical period. The signal is multiplied with the Horizontal Sawtooth (HS), and the result is applied to each of horizontal convergence summing amplifiers (Synthetic amp).

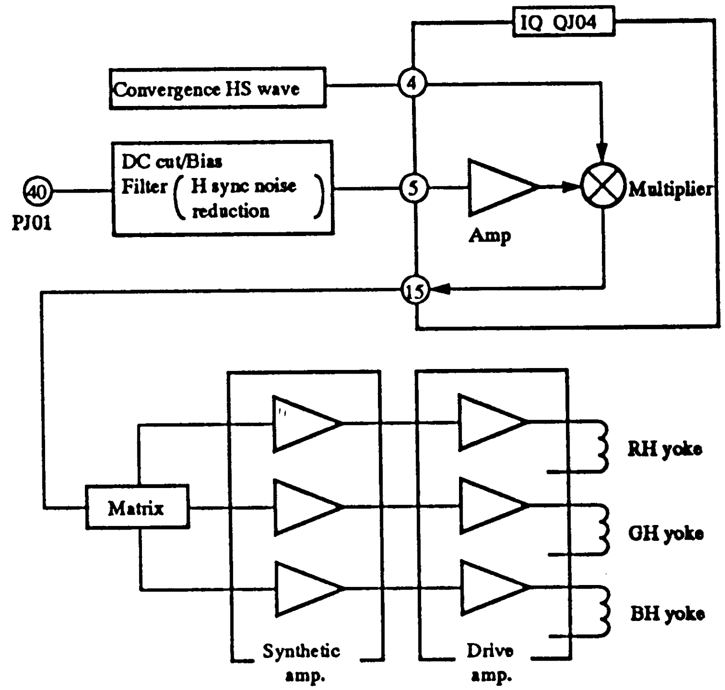


Figure 9-4: HV Raster Distortion Control Circuit

4. DYNAMIC CONTRAST CIRCUIT

A Dynamic Contrast circuit is included to improve contrast in the center of the screen. The Horizontal Parabola (HP) and Vertical Parabola (VP) waveforms from the convergence circuit are added via the capacitors and resistors as shown in Figure 9-5. This signal is applied to the VCD IC, Pin 52.

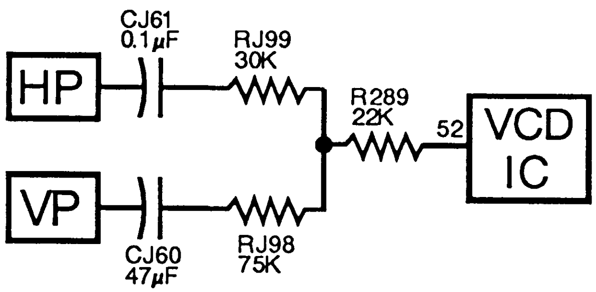


Figure 9-5: Dynamic Contrast Circuit

5. SUMMING CIRCUIT

As illustrated in Figure 9-6, the summing circuit consists of summing amplifiers to add all the correction waveforms (inverted and non-inverted) that come from the variable resistors (A) in the matrix circuit (there are actually six summing circuits in the projection TV convergence circuit). The variable resistors (controls) in the matrix are used to correct geometric distortions and to converge the red, green, and blue rasters. Each waveform is applied to the taper of at least two controls. The correction waveform currents from the bottom side of each control are summed and applied to an inverter (C). The signals from the other side of each control and the inverted sum from point D are applied to the inverting input of the other summing amplifier (B), resulting in the convergence correction current at point E. This signal is amplified by the drive amplifier to drive the convergence yokes.

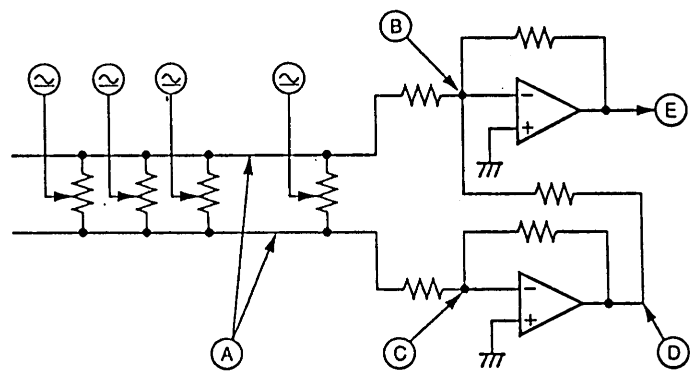
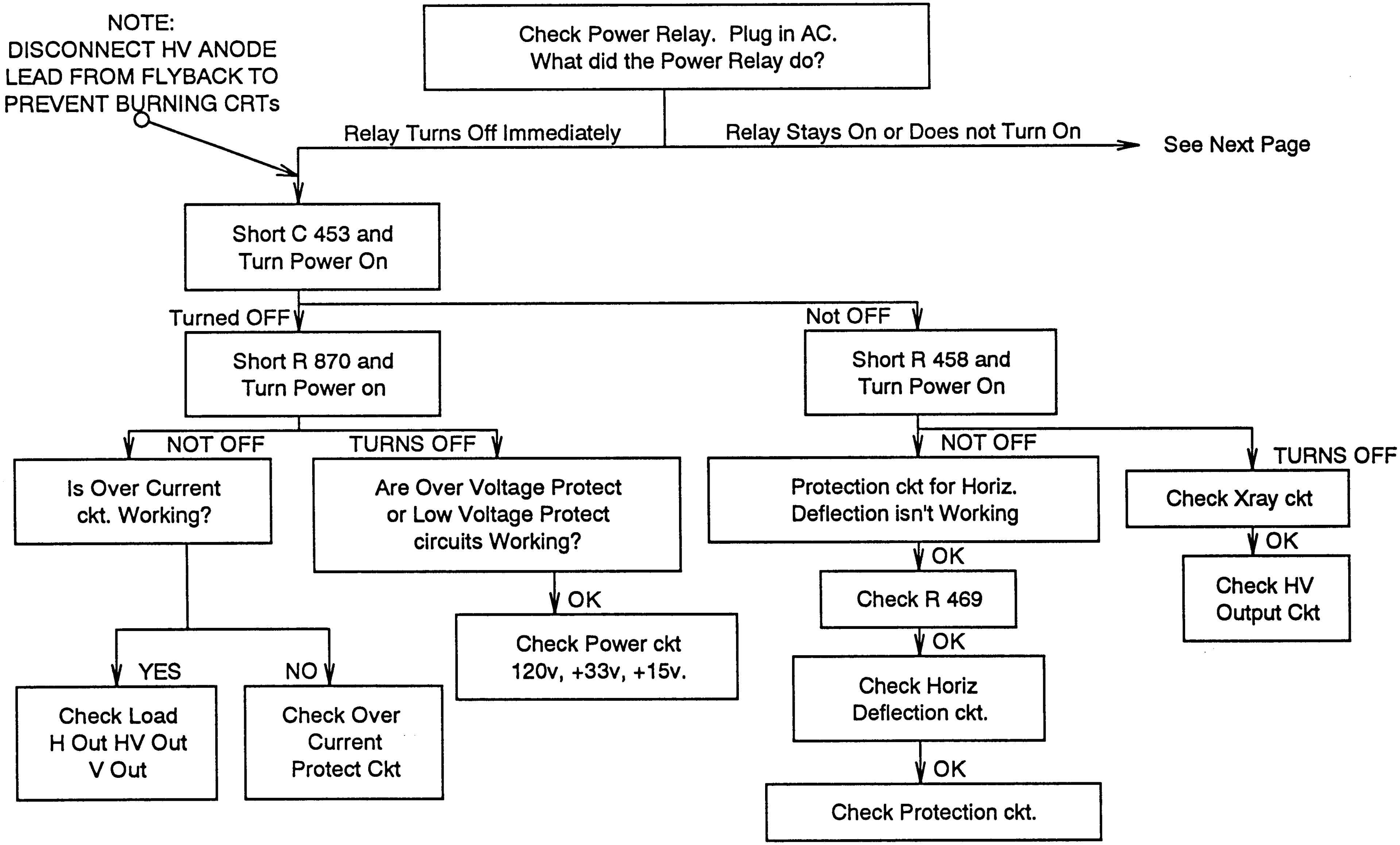


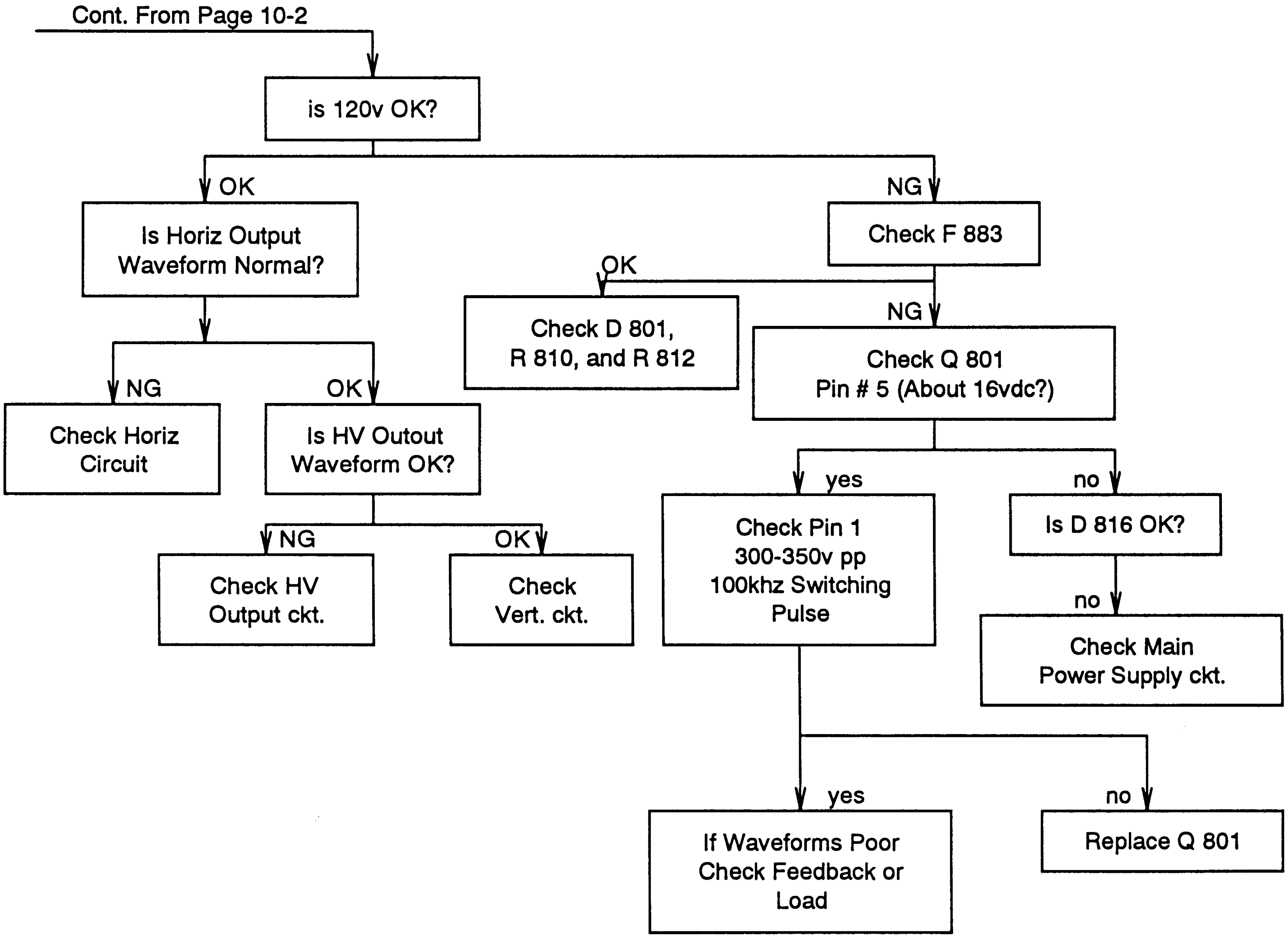
Figure 9-6: Summing Circuit

SECTION 10
TROUBLESHOOTING FLOW CHARTS

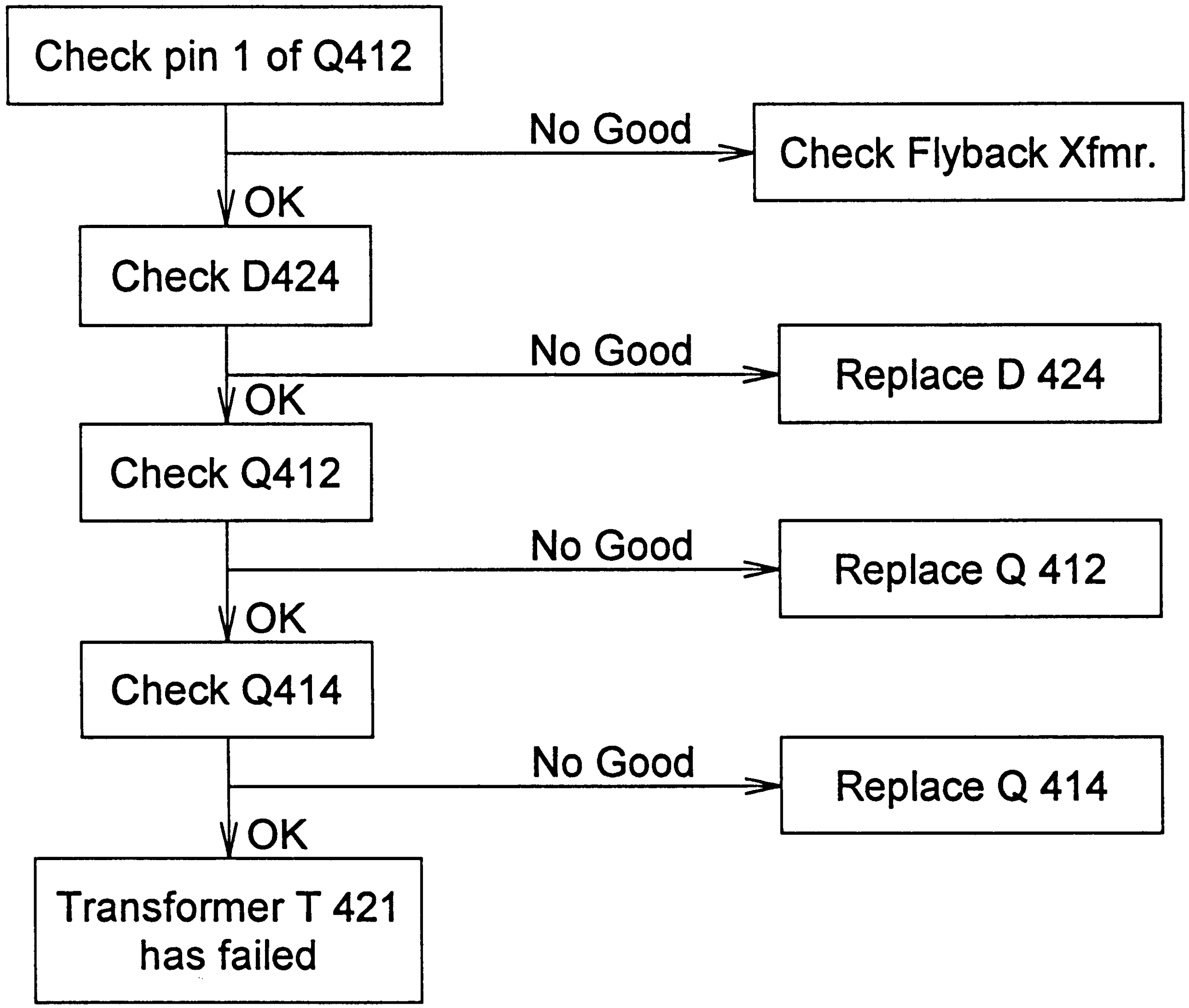
NO RASTER NO SOUND



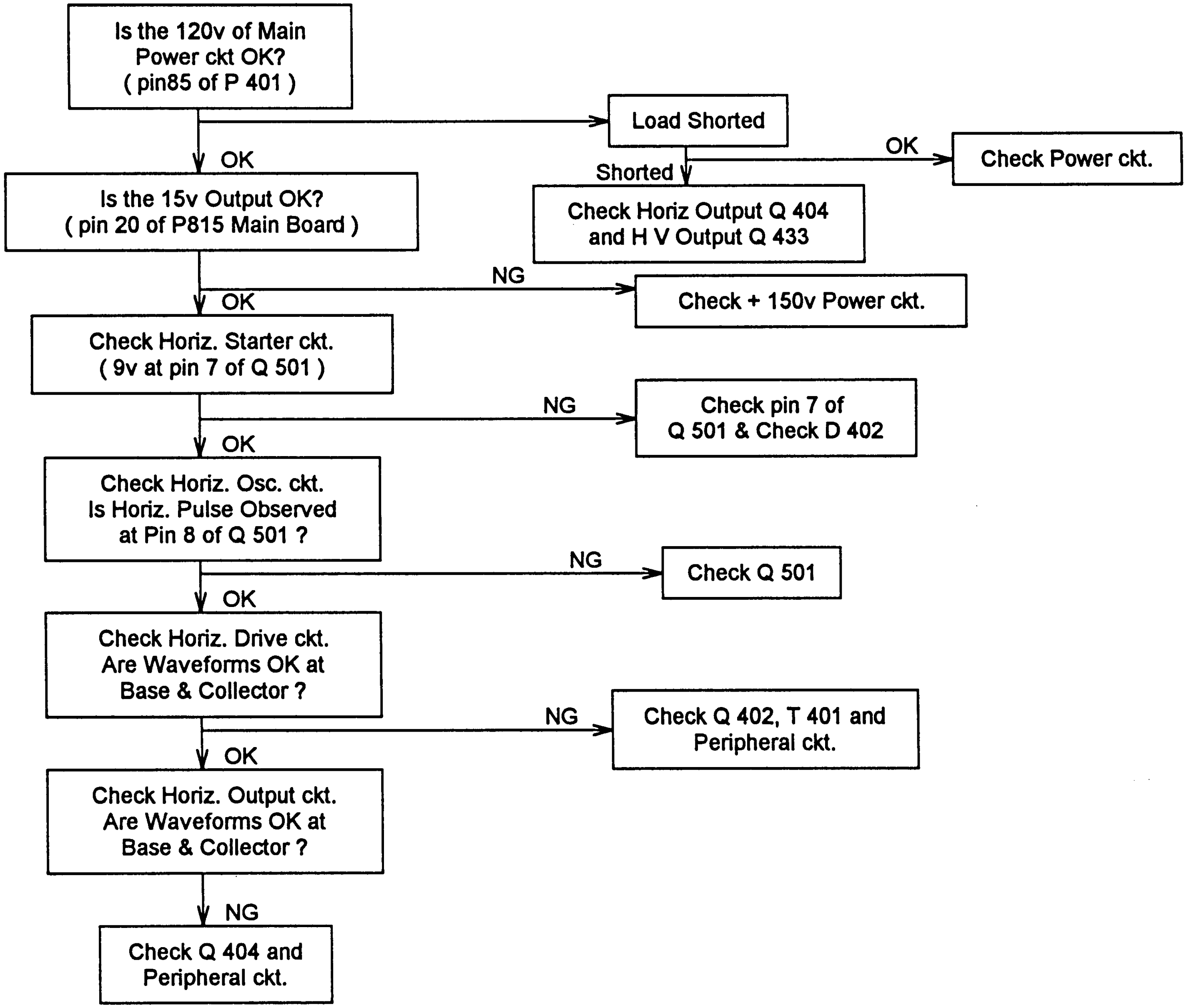
NO RASTER NO SOUND CONT.



HV REGULATION CIRCUIT CHECK

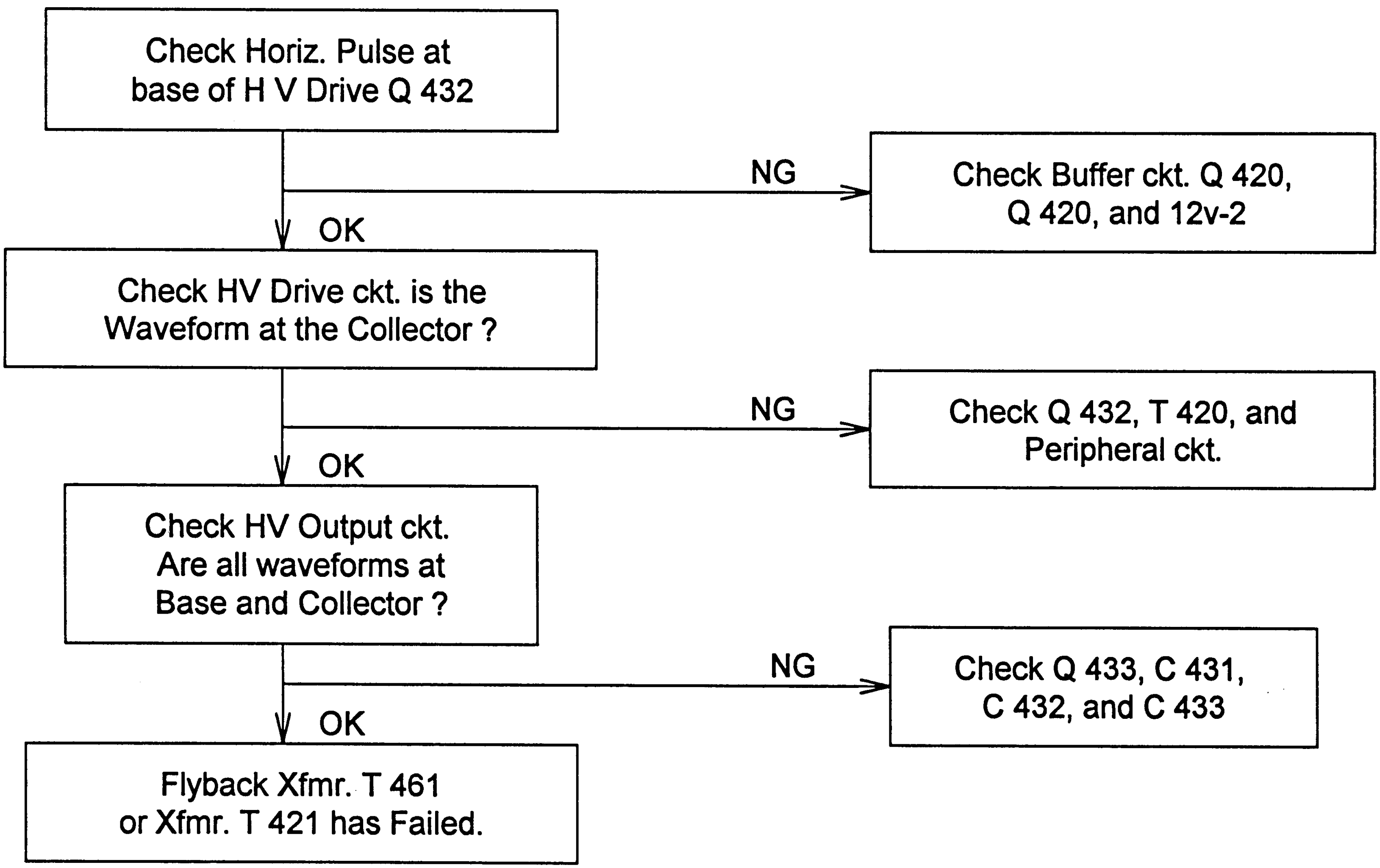


HORIZ. CIRCUIT CHECK

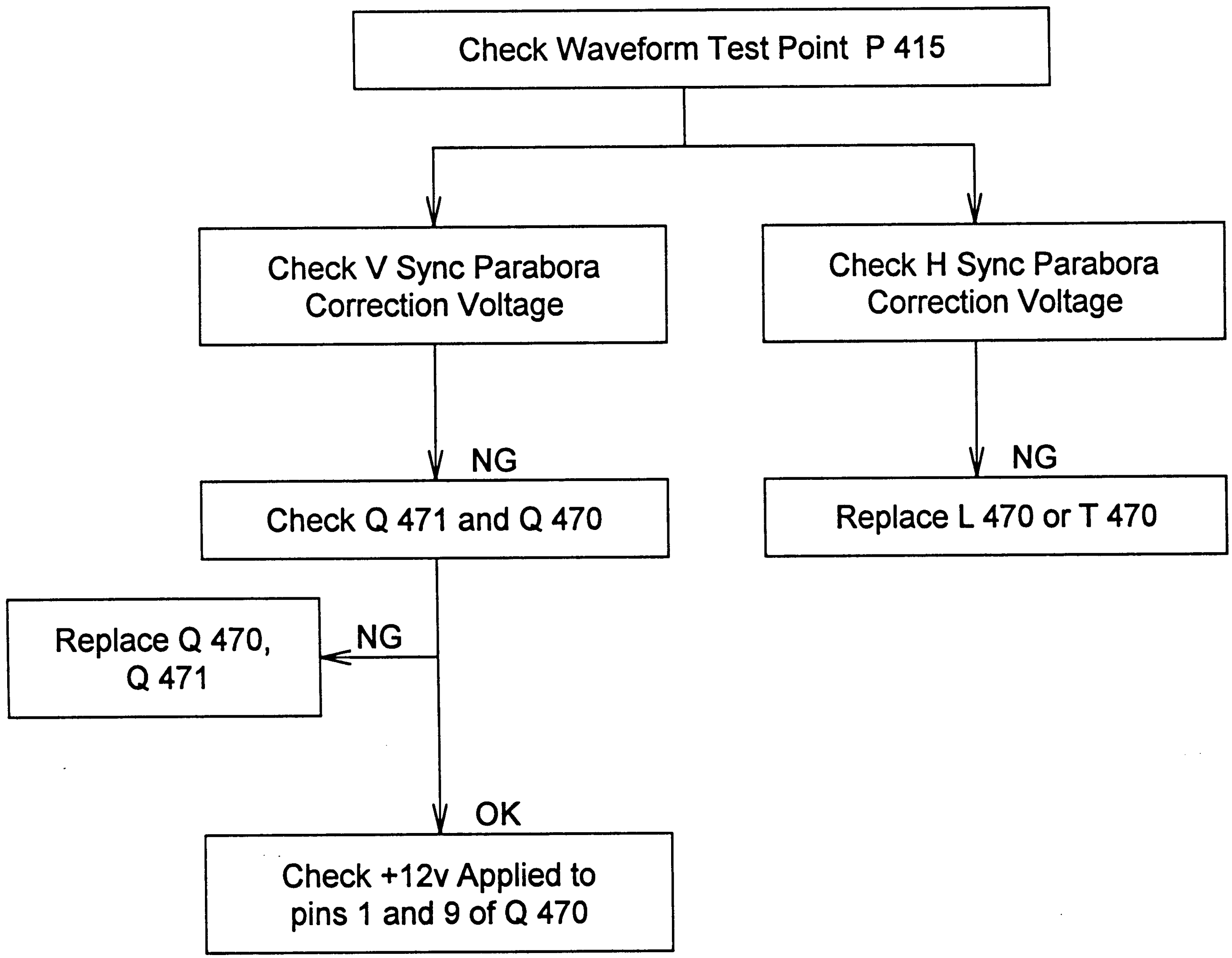


HV GENERATION CIRCUIT CHECK

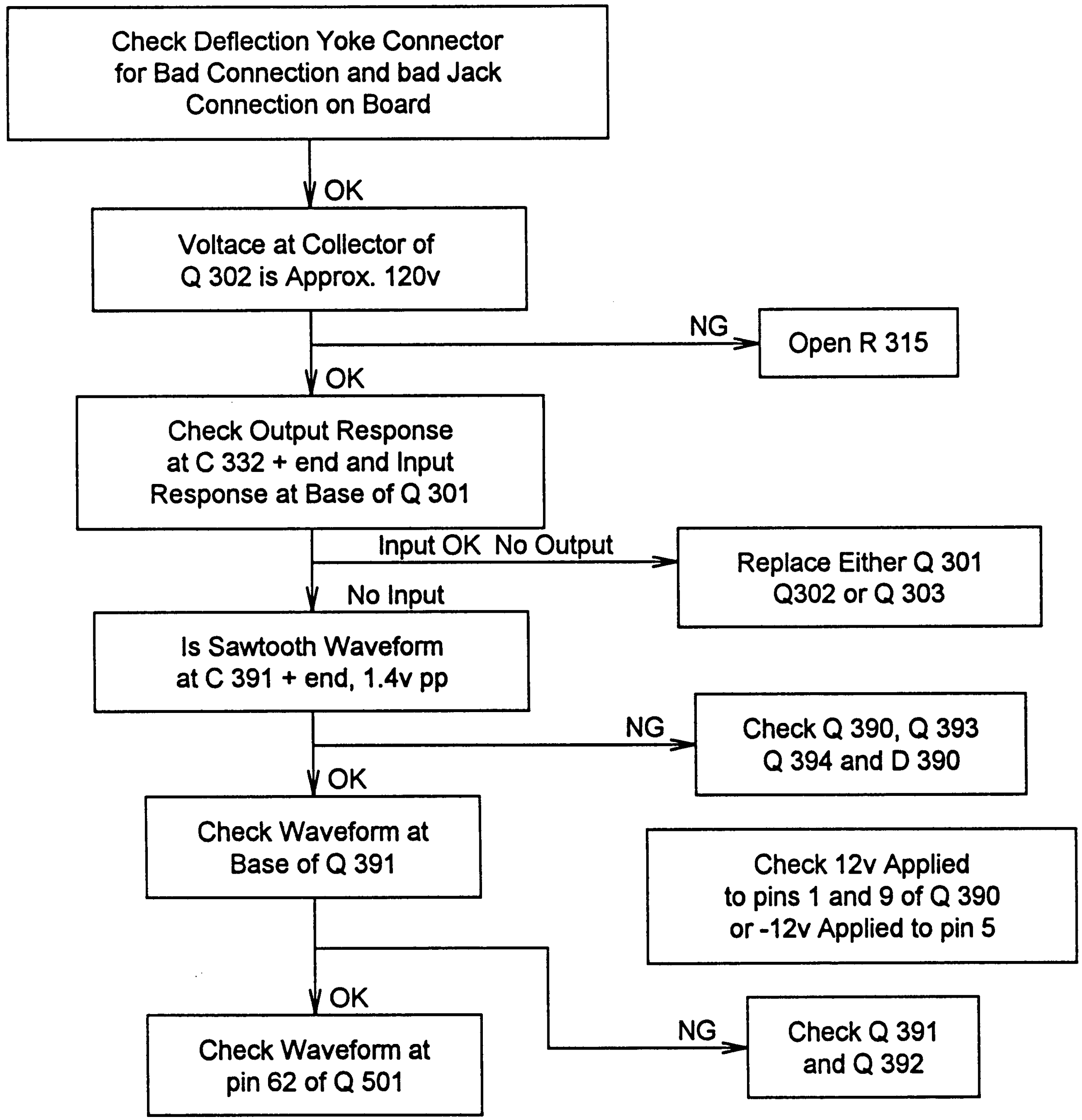
NOTE: First Perform the Horiz. ckt. Check, Then Proceed with the Items Below



DYNAMIC FOCUS CIRCUIT CHECK



VERTICAL DEFLECTION CIRCUIT CHECK



SECTION 11
TROUBLESHOOTING LAB

Lab 1 - Disassembly and Service Position

A. Rear Access

1. Remove the back cover fig. 11-1A.

2. Identify the following boards. Place a check mark by each as identified.

   a. _____ Deflection/HV Board (PB3361)

   b. _____ Convergence Power Output Board (PB3366-2)

   c. _____ Power Board (PB3364)

   d. _____ Main Board (PB3707)

   e. _____ DSP Board (PB3708)

   f. _____ Closed Caption Board (PB3375)

   g. _____ PIP Board (PB3377)

   h. _____ Digital Comb Filter Board (PB3376)

   i. _____ A/V Board (PB3368-4)

3. Place the main and power chassis in the service position as shown in Figure 11-1B.

   a. Remove the chassis screws.

   b. Remove wire harnesses from the wire harness retainers.

   c. Pull both chassis together and stand them up by inserting the front edges (ridges) into the slit in the bottom of the cabinet as shown in the illustration. Make certain that the chassis are secure. This position allows access to the bottom of the circuit boards.

4. Place both chassis into their original positions and route the cables into their retainers.

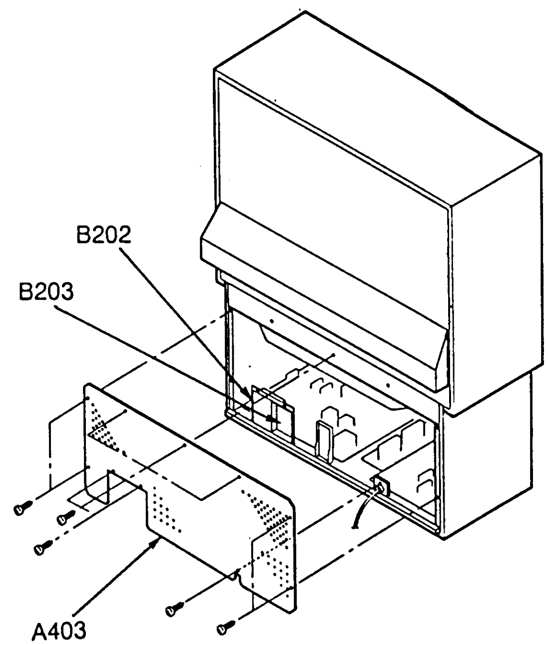


Fig. 11-1A

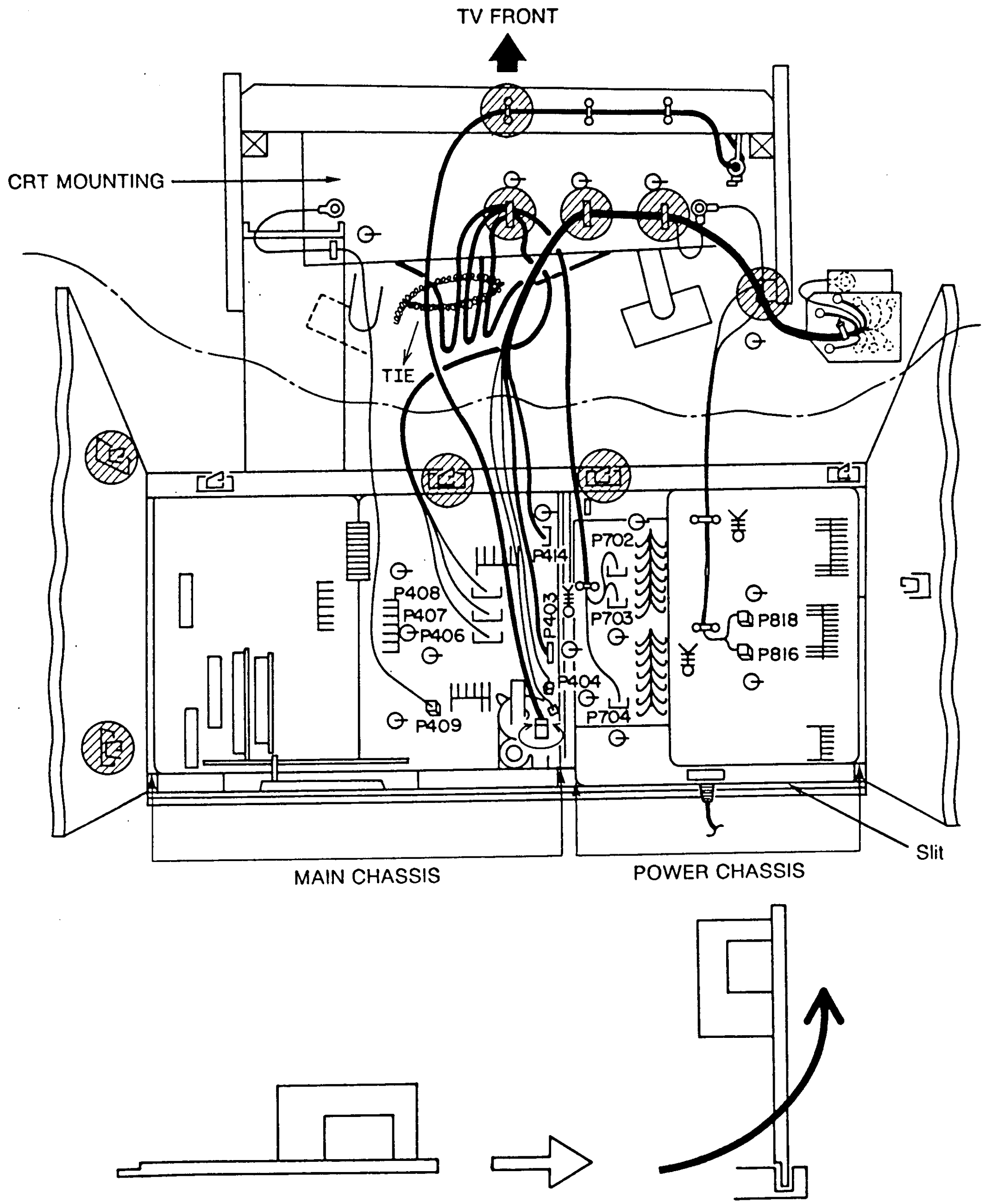

TV FRONT
CRT MOUNTING
TIE
P702
P414
P408
P407
P406
P403
P703
P818
P816
P404
P704
P409
MAIN CHASSIS
POWER CHASSIS
Slit

Fig. 11-1B

B. Front Access (refer to Figure 11-2)

1. Remove the speaker grill (step 1).

2. Remove the Convergence Shield (step 1).

3. Remove the front mask and screen lens assembly (step 2).

   a. Remove 4 screws at the bottom of the screen frame.

   b. Remove front screen by lifting the screen up slightly and then out.

4. Place the Convergence Control Board in the Service Position (step 3).

5. Remove the X-Ray Shield (step 4).

6. Identify the following components. Place a check mark by each as identified.

   a. _____ Convergence Control Board (PB3366-1)

   b. _____ Front Control Board (PB3470-1)

   c. _____ Front Input Board (PB3470-2)

   d. _____ CRT Drive Boards

   e. _____ Deflection Yokes

   f. _____ Focus Block

   g. _____ VM Coils

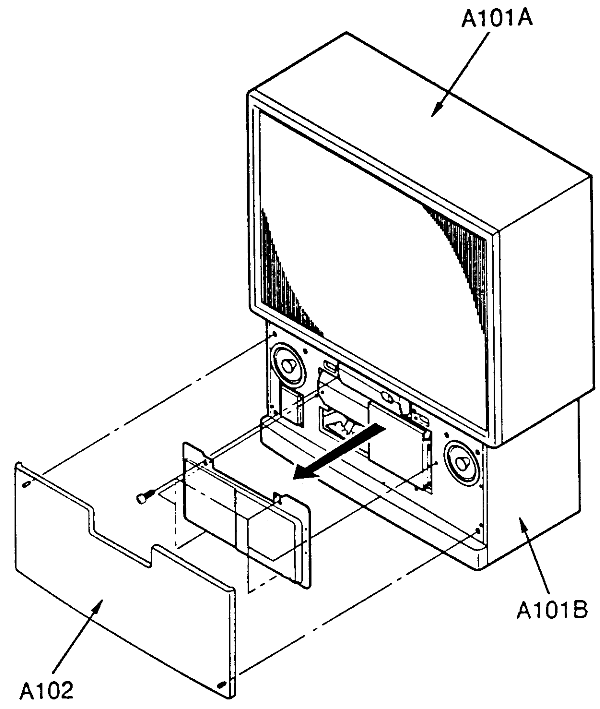


Fig. 11-2 Step 1

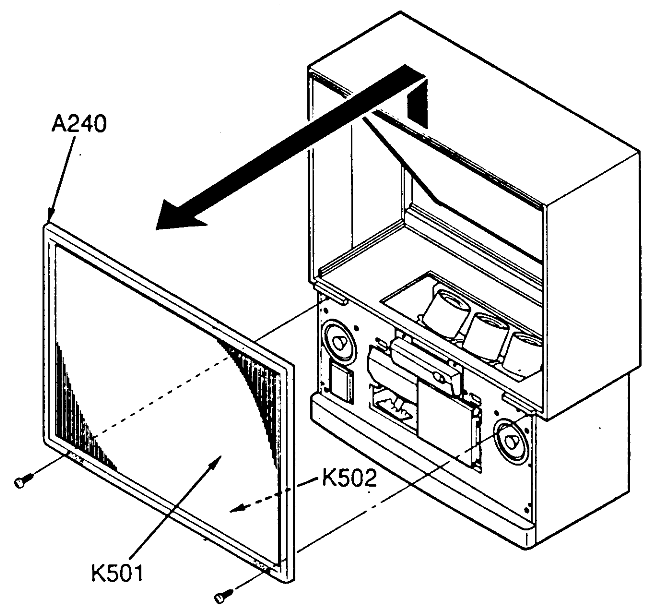


Fig. 11-2 Step 2

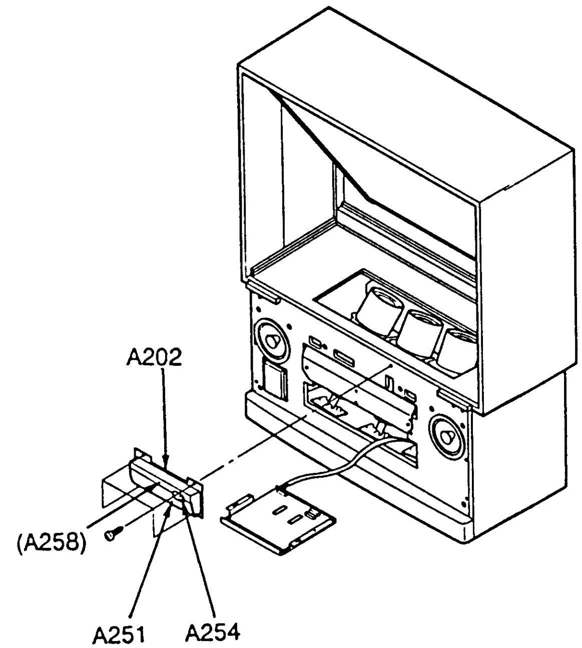


Fig. 11-2 Step 3

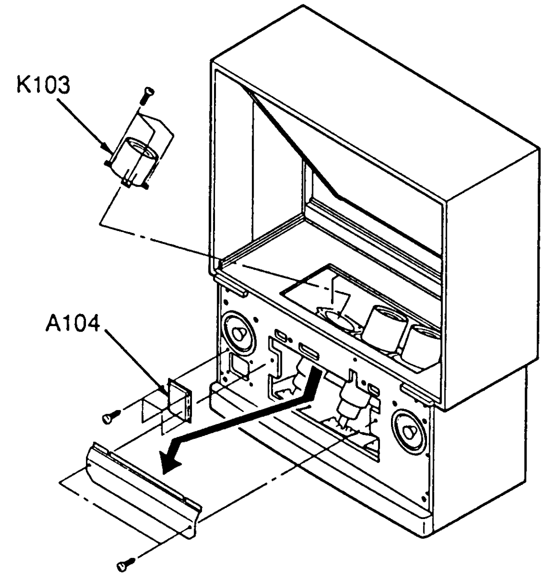


Fig. 11-2 Step 4

C. Light Box Disassembly (see Figure 11-3)

1. Remove 8 screws from bottom of the light box.

2. Remove light box.

3. Reassemble the light box and front screen.

NOTES:

3 Remove the Upper Cabient (8 screws).

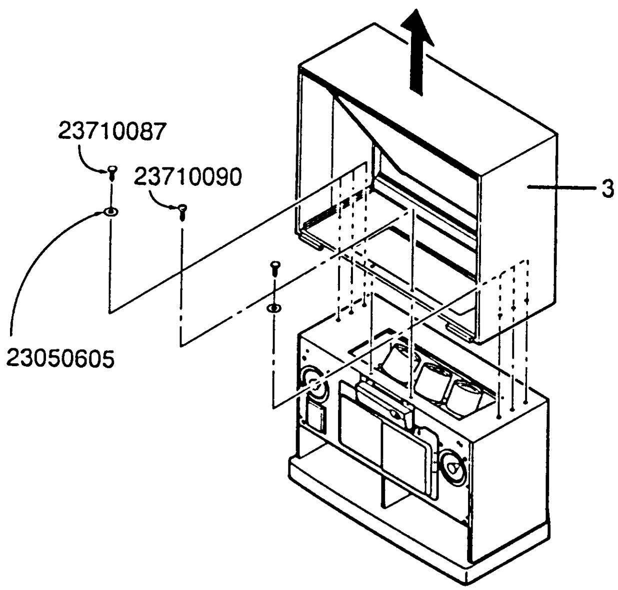


Fig. 11-3

Lab 2 - Set-up and Convergence

Note: Refer to Service Data 050-638 for the complete adjustment procedures.

A. Preliminary adjustments. These adjustments are normally made after a picture tube replacement, before preceding with the convergence.

1. Center all the convergence controls.

2. Focus (see Service Data 050-638, Page 18).

a. Disconnect PJ05.

b. Select the TEST position on the TEST/NORM Switch.

c. Green focus adjustments:

(1) Cover the blue and red lenses.

(2) Adjust the green optical focus for best focus.

(3) Adjust the green electrical focus for best focus.

d. Blue focus adjustments:

(1) Remove the cover from the blue lens and cover the green and red lenses.

(2) Adjust the blue optical focus for best focus.

(3) Adjust the blue electrical focus for best focus.

e. Red focus adjustments:

(1) Remove the cover from the red lens and cover the blue and green lenses.

(2) Adjust the red optical focus for best focus.

(3) Adjust the red electrical focus for best focus.

f. Remove all lens covers.

3. Tilt adjustment

a. Set the TEST/NORM Switch to the Test position.

b. Loosen the yoke clamp screw on the green yoke and rotate the yoke to correct tilt of green horizontal center line. Then retighten (DO NOT OVER-TIGHTEN) the yoke clamp.

c. Follow the tilt adjustment procedure for red and blue.

d. Reconnect PJ05.

4. Centering (refer to Figure 11-4).

Note: the customer convergence controls (RV, BV, RH, and BH) located on the front control board must be centered prior to performing the centering adjustments.

a. Set the TEST/NORM Switch to the Test position.

b. Adjust the green centering magnet to center the green cross-hairs.

c. Set the TEST/NORM Switch to the Norm position.

d. Switch SJ01 to the on position to display a crosshatch pattern.

e. Switch SJ02 to the G-ADJ position.

f. Referring to Figure 11-4, adjust the following to achieve a linear green raster:

(1) Vertical Linearity (V LIN), R397

(2) Vertical Height (V HEIGHT), R396

(3) Horizontal Width (H WIDTH), L442

(4) Green Horizontal Outside Linearity (GH-O LIN), RK82.

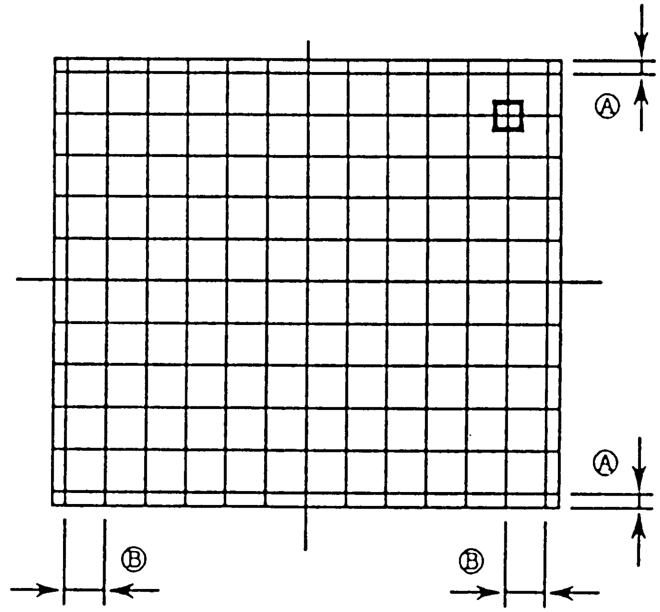
g. Switch SJ01 Off.

h. Switch the TEST/NORM Switch to the Test position.

i. Adjust the blue centering rings to center the blue cross-hairs (converge to green).

j. Adjust the red centering rings to center the red cross-hairs (converge to green).

k. Switch the TEST/NORM Switch the Normal position.



< reference data >

Ⓐ: 48" ...... 35 mm
55" ...... 40 mm

Ⓑ: 48" ...... 43 mm
55" ...... 49 mm

Fig. 11-4

B. Convergence

1. Perform the green convergence adjustments (see page 19 of Service Data 050-638).

Note: Although this procedure is referred to as the green convergence adjustments, the green is normally adjusted to correct the screen linearity and geometry. The blue and red are then converged to the green.

a. Press SJ01 On to display the Crosshatch pattern.

b. Switch SJ02 to the G-ADJ position.

c. Adjust the Green Horizontal Adjustments in the following order:

(1) TILT, RK03

(2) BOW, RK06

(3) KEY, RK09

(4) SKEY, RK24

(5) O. PIN, RK14

(6) O. SPIN, RK17

(7) I. Pin, RK27

d. Adjust the Green Vertical Adjustments in the following order:

(1) BOW, RK41

(2) WAVE, RK86

(3) PIN, RK49

(4) SPIN, RK81

(5) I. KEY, RK44

(6) I. SKEY, RK80

e. Repeat the above if necessary.

3. Perform the blue convergence adjustments.

a. Switch SJ02 to the B-ADJ position.

b. Adjust the Blue Horizontal Convergence in the following order:

(1) TILT, RK02

(2) BOW, RK05

(3) KEY, RK08

(4) SKEY, RK11

(5) O. PIN, RK13

(6) O. SPIN, RK16

(7) I. PIN, RK26

(8) O. LIN, RK18

(9) I. LIN, RK35

(10) I. SIZE, RK23

(11) O. SIZE, RK21

c. Adjust the Blue Vertical Convergence in the following order:

(1) TILT, RK38

(2) BOW, RK40

(3) WAVE, RK76

(4) SWAVE, RK46

(5) PIN, RK48

(6) SPIN, RK51

(7) I. KEY, RK43

(8) I. SKEY, RK79

(9) O. KEY, RK61

(10) O. SKEY, RK56

(11) O. LIN, RK56

(12) I. LIN, RK64

(13) I. SIZE, RK59

(14) O. SIZE, RK84

(15) WING, RK73

d. repeat the above if necessary.

4. Perform the red convergence adjustments.

a. Switch SJ02 to the R-ADJ position.

b. Adjust the Red Horizontal Convergence in the following order:

(1) TILT, RK01

(2) BOW, RK04

(3) KEY, RK07

(4) SKEY, RK10

(5) O. PIN, RK12

(6) O. SPIN, RK15

(7) I. PIN, RK25

(8) O. LIN, RK19

(9) I. LIN, RK34

(10) I. SIZE, RK22

(11) O. SIZE, RK20

c. Adjust the Red Vertical Convergence in the following order:

(1) TILT, RK37

(2) BOW, RK39

(3) WAVE, RK75

(4) SWAVE, RK45

(5) PIN, RK47

(6) SPIN, RK50

(7) I. KEY, RK42

(8) I. SKEY, RK78

(9) O. KEY, RK60

(10) O. SKEY, RK55

(11) O. LIN, RK52

(12) I. LIN, RK63

(13) I. SIZE, RK58

(14) O. SIZE, RK83

(15) WING, RK72

d. repeat the above if necessary.

e. Switch SJ01 Off.

C. Gray Scale Adjustment

1. Press the RESET Key (TV or remote control).

2. Select Video 3 input (no signal).

3. Enter the Service Mode (see Service Data 050-638, Page 11).

4. Go to address 109 (Hex), using the menu and volume up/down keys, and adjust its value 40 (Hex) with the +/- keys.

5. Go to address 10B (Hex), and adjust its value to 40 (Hex).

6. Exit the Service Mode (press Exit on the Remote Control).

7. Remove the Projection Screen.

8. Looking into the CRTs, adjust the screen controls until the raster of each just becomes visible.

9. Reinstall the projection screen.

10. Tune to an active channel.

11. Adjust the color to minimum.

11. Enter the Service Mode.

12. Adjust the data of address 109 and address 10B for gray in the low lit areas.

13. Adjust the R-Drive and B-Drive controls on the CRT boards for white balance in the high lit areas.

14. Check the overall white balance and readjust if needed.

15. Exit the Service Mode.

D. After completing the convergence and gray scale adjustments, reassemble the set.

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