

# HITACHI

## SERVICE MANUAL

NTSC

NA6L CHASSIS

PA

No. 0093

20CX20B521

R/C:

HL00761



HITA-02934

**CAUTION:** Before servicing this chassis, it is important that the service technician read the "Safety Precaution" and "Product Safety Notices" in this service manual.

This television will display television  
Closed Captioning in accordance  
with paragraph 15.119 of the FCC rules.

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**SPECIFICATIONS AND PARTS ARE SUBJECT TO CHANGE FOR IMPROVEMENT**

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## SOLID STATE COLOR TELEVISION

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**MAY 1997**

**HHEA-MANUFACTURING DIVISION**

## SAFETY PRECAUTIONS

**NOTICE:** Comply with all cautions and safety-related notes located on or inside the cabinet and on the chassis or picture tube.

**WARNING:** Since the chassis of this receiver is connected to one side of the AC power supply during operation, whenever the receiver is plugged in, service should not be attempted by anyone unfamiliar with the precautions necessary when working on this type of receiver.

The following precautions should be observed:

1. Do not install, remove, or handle the picture tube in any manner unless shatterproof goggles are worn. People not so equipped should be kept away from the picture tube while handling.
2. When service is required, an isolation transformer should be inserted between power line and the receiver before any service is performed on a "HOT" chassis receiver.
3. When replacing a chassis in the receiver, all the protective devices must be put back in place, such as barriers, nonmetallic knobs, adjustment and compartment covers, isolation resistors, capacitors, etc.
4. When service is required, observe the original lead dress in the high voltage circuitry area.
5. Always use the manufacturer's replacement components. Critical components as indicated on the circuit diagram should not be replaced by another manufacturer's. Furthermore, where a short circuit has occurred, replace those components that indicate evidence of overheating.
6. Before returning a serviced receiver to the customer, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock, and be sure that no protective device built into the receiver by the manufacturer has become defective, or inadvertently defeated during servicing.

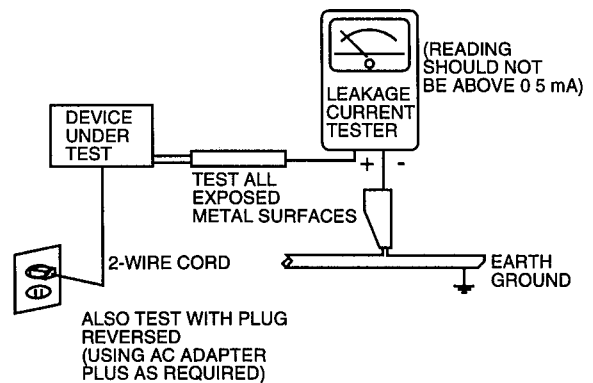
Therefore, the following checks should be performed for the continued protection of the customer and service technician.

### Leakage Current Cold Check

With the AC plug removed from the 120V AC 60Hz source, place a jumper across the two plug prongs. Turn the AC power switch ON using an insulation tester (DC500V), connect one lead to the jumpered AC plug and touch the other lead to each exposed metal part (antennas, screwheads, metal overlays, control shafts, etc.), particularly any exposed metal part having a return path to the chassis should have a minimum resistor reading of  $0.24M\Omega$  and a maximum resistor reading of  $12M\Omega$ . Any resistance value below or above this range indicates an abnormality which requires corrective action. An exposed metal part having a return path to the chassis will indicate an open circuit.

### Leakage Current Hot Check

Plug the AC line cord directly into a 120V AC 60Hz outlet (do not use an isolated transformer for this check). Turn the AC power ON. Using a Leakage Current Tester (Simpson's Model 229 or equivalent), measure for current from all exposed metal parts of the cabinet (antennas, screwheads, overlays, control shafts, etc.) particularly any exposed metal part having a return path to the chassis or to a known earth ground (water pipe, conduit, etc.). Any current measured must not exceed 0.5 milliamperes.



### AC LEAKAGE TEST

**ANY MEASUREMENTS NOT WITHIN THE LIMITS OUTLINED ABOVE ARE INDICATIVE OF A POTENTIAL SHOCK HAZARD AND MUST BE CORRECTED BEFORE RETURNING THE RECEIVER TO THE CUSTOMER.**

#### High Voltage

This receiver is provided with a hold down circuit for clearly indicating that voltage has increased in excess of a predetermined value. Comply with all notes described in this service manual regarding this hold down circuit when servicing, so that this hold down circuit is operated correctly.

#### Serviceman Warning

With minimum BRIGHTNESS, PICTURE, SHARPNESS, and COLOR, the operating high voltage in this receiver is lower than  $27.7kV \pm 1.25kV$ . In case any component having influence on the high voltage is replaced, confirm that high voltage with minimum BRIGHTNESS, PICTURE, SHARPNESS, and COLOR is lower than  $27.7kV \pm 1.25kV$ . To measure high voltage use a High Impedance High Voltage meter. Connect (-) to chassis earth and (+) to the CRT Anode button. (See the following connection diagram.)

**Note:** Turn power switch OFF without fail before the connection to the Anode button is made.

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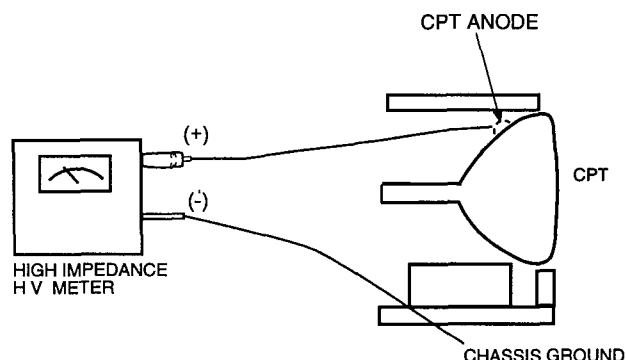
## PRODUCT SAFETY NOTICE

Many electrical and mechanical parts in HITACHI television receivers have special safety-related characteristics. These are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts which have these special safety characteristics are identified in this Service Manual.

Electrical components having such features are identified with an  $\Delta$  mark in the schematics and parts list in this Service Manual.

The use of a substitute replacement component which does not have the same safety characteristics as the HITACHI-recommended replacement component, shown in the parts list in this Service Manual, may create shock, fire, X-radiation, or other hazards.

Production safety is continuously under review and new instructions are issued from time to time. For the latest information, always consult the current HITACHI Service Manual. A subscription to, or additional copies of HITACHI Service Manuals may be obtained at a nominal charge from HITACHI Sales Corporation.



### X-Radiation

**TUBE:** The primary source of X-Radiation in this receiver is the picture tube. The tube utilized in this chassis is specially constructed to limit X-Radiation emissions. For continued X-Radiation protection, the replacement tube must be the same type as the original HITACHI-approved type.

When troubleshooting and making test measurements in a receiver with an excessive high voltage problem, avoid being unnecessarily close to the picture tube and the high voltage component.

Do not operate the chassis longer than is necessary to locate the cause of excessive voltage.

This Service Manual is intended for qualified service technicians; it is not meant for the casual do-it-yourselfer. Qualified technicians have the necessary test equipment and tools, and have been trained to properly and safely repair complex products such as those covered by this manual. Improperly performed repairs can adversely affect the safety and reliability of the product and may void warranty. Consumers should not risk trying to do the necessary repairs and should refer to a qualified service technician.

### WARNING

Lead in solder used in this product is listed by the California Health and Welfare agency as a known reproductive toxicant which may cause birth defects or other reproductive harm (California Health and Safety Code, Section 25249.5).

When servicing or handling circuit boards and other components which contain lead in solder, avoid unprotected skin contact with solder. Also, when soldering do not inhale any smoke or fumes produced.

### SAFETY NOTICE USE ISOLATION TRANSFORMER WHEN SERVICING

Components having special safety characteristics identified by  $\Delta$  on the parts list in this service manual and its supplements and bulletins. Before servicing this product, it is important that the service technician read and follow the "Safety Precautions" and the "Product Safety Notices" in this Service Manual.

For continued X-Radiation protection, replace picture tube with original type or HITACHI equivalent type.

### POWER SOURCE

This television receiver is designed to operate on 120 Volts/60Hz, AC house current. Insert the power cord into a 120 Volts/60Hz outlet.

NEVER CONNECT THE TV TO OTHER THAN THE SPECIFIED VOLTAGE OR TO DIRECT CURRENT.



# Service Notes

**IMPORTANT:** To protect against possible damage to the solid state devices due to arcing or static discharge, make certain that all ground wires and CRT DAG wire are securely connected.

**CAUTION:** The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing the Receiver to avoid damage to the test equipment or to the chassis. Connect the test equipment to the proper ground (  $\nabla$  ) or (  $\hbar$  ) when servicing, or incorrect voltages will be measured.

**WARNING:** This Receiver has been designed to meet or exceed applicable safety and X-ray radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X-ray radiation and shock and fire hazard, parts indicated with the symbol  $\triangle$  on the schematic must be replaced with identical parts. Order parts from the manufacturer's parts center using the part numbers shown in this service manual, or provide the chassis number and the part reference number.

For optimum performance and reliability, all other parts should be replaced with components of identical specifications.

## Horizontal Oscillator Disable Circuit

This chassis employs a special circuit to protect against excessive high voltage and beam current. If, for any reason, the high voltage and beam current exceed a predetermined level this protective circuit activates and detunes the horizontal oscillator that limits the high voltage.

The over-voltage protection circuit is not adjustable. However, if components indicated by the symbol  $\triangle$  on the schematic in either the horizontal sweep system or the over-voltage protection circuit itself are changed, the operation of the circuit should be checked using the following procedure.

Equipment needed to check the disable circuit:

1. Voltmeter (0 – 200V scale)
2. High Voltage Meter (0 – 40kV)
3. Variac or Isolation Transformer

### Procedure:

1. Tune in a station to verify that the horizontal is in sync.
2. Obtain a Monoscope pattern or a signal generator crosshatch pattern.
3. Connect the voltmeter (–) lead to TPD2 and the (+) lead to TPD1 (junction of D555 anode, R556 & R557). Set **Bright** level to (0) and **Picture** for a 1.8 volt reading on the voltmeter.
4. Turn the Receiver OFF. Connect a jumper across IC803 pin 3 and pin 4. Apply +9V DC to cathode of D001.
5. Reduce the AC supply voltage to approximately 45V. Connect the high voltage meter to the CRT anode (H.V. button). **NOTE:** Use the Dag Ground (C10 of the CRT Board) to connect the (–) lead of the meter.
6. Turn the Receiver ON. Slowly increase the AC supply voltage and verify that the high voltage does not exceed **35.5kV for a 20-inch Receiver**, when horizontal just begins to pull out of sync. If the high voltage is not within the specified limit, the cause must be determined and corrected before the Receiver is returned to the customer.

SPECIFICATIONS

OPERATION

SERVICE

CIRCUITS &  
BLOCK DIAGRAMS

PARTS LIST

## Receiver Feature Table

SPECIFICATIONS

FEATURE\MODEL	20CX20B501	20CX20B511	20CX20B521
Chassis	NA6L	NA6L	NA6L
# of channels / Phase	181 / PH22M	181 / PH22M	181 / PH22M
Menu language	ENG/SPAN/FR	ENG/SPAN/FR	ENG/SPAN/FR
Closed Caption	X	X	X
75 $\Omega$ Input	X	X	X
Remote Model #	HL00761	HL00761	HL00761
Picture tube	A51KQN011X	A51KQN011X	A51KQN011X
Black face regular tube	X	X	X
Notch filter	X	X	X
V/A norm switch (X=both)	V	V	V
MTS/SAP/DBX	X	X	X
Built-in audio power	1.5W X 2 (10%)	1.5W X 2 (10%)	1.5W X 2 (10%)
# of speakers	2	2	2
A/V In (rear/front)	1/0	1/0	1/0
Variable audio out	X	X	X
Dimensions mm (WxHxD) in	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0
Weight (kg/lb)	21 / 46.3	21 / 46.3	21 / 46.3
Power source (V / Hz)	120 / 60	120 / 60	120 / 60
Power consumption, Max (A)	1.4	1.4	1.4
Anode voltage	27.7kV $\pm$ 1.25kV	27.7kV $\pm$ 1.25kV	27.7kV $\pm$ 1.25kV
Video Input jack	1V <sub>p-p</sub> 75 $\Omega$ , phono jack	1V <sub>p-p</sub> 75 $\Omega$ , phono jack	1V <sub>p-p</sub> 75 $\Omega$ , phono jack
Audio Input jack	500mV RMS 47k $\Omega$	500mV RMS 47k $\Omega$	500mV RMS 47k $\Omega$
"A"-Board TNP2AH003	CL	CK	CM
"C"-Board TNP2AA005	AB	AB	AB

Table 1. Receiver Features

Specifications are subject to change without notice or obligation.  
Dimensions and weights are approximate.

## Location of Television Controls



Figure 2. Location of controls, Front panel

- ① **Power Button** – Press to turn ON or OFF.
- ② **Vol (Volume) Buttons** – Press to adjust Sound Level.
- ③ **Ch (Channel) Buttons** – Press to select programmed channels.
- ④ **Menu Button** – Press to display Main Menu and access On Screen features and Adjustment Menus.
- ⑤ **Input Button** – Press to select TV or Video Input.

# Button Location on Remote Control

OPERATION

## Power Button

Press to turn ON or OFF.

## Mute Button

Press to mute sound. A second press resumes sound. Press also to access and delete Closed Caption.

## Input Button

Press to select TV or Video Input.

## Menu Button

Press to display Main Menu and access or exit On Screen features and Adjustment Menus.

## Recall Button

Press to display Time, status of Sleep Timer, Channel, Video Mode, Channel I.D. and Audio Mode.

## Precoded VCR Buttons

These buttons transmit the chosen precoded VCR codes.

## Mode Buttons

These buttons allow the remote to control your TV, VCR, or Cable Box depending on which mode button is selected.

## Channel Buttons

Press to select channels.

## Keypad Buttons

Press desired channel number to randomly access any channel.

## Volume Buttons

Press to adjust TV sound level.

## LST-CH (Last Channel) Button

Press to switch to the previous channel.

## Sleep Button

Press to turn TV off in 30, 60, or 90 minutes.

## CURSOR Button

Press to adjust Audio menus, Video menus, and select operating features when menus are displayed.

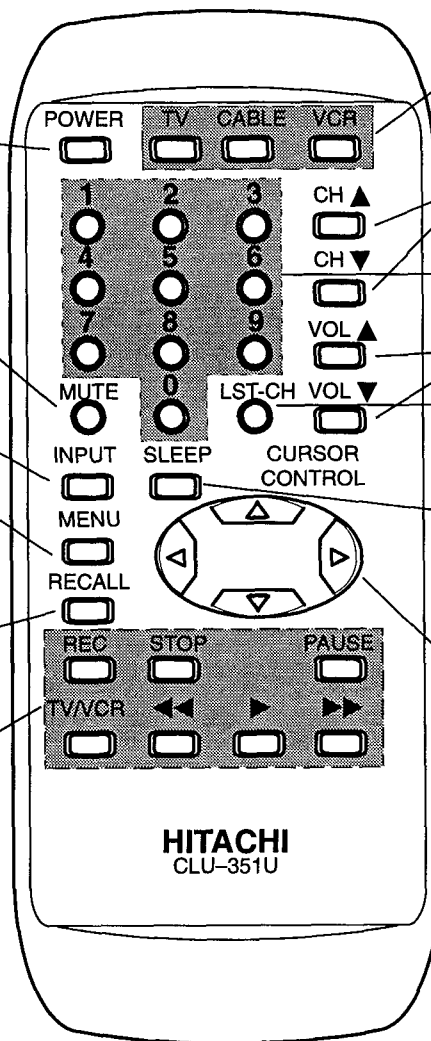


Figure 3. Location of controls, Remote control

# Using the Remote to Control VCR and Cable Box Functions

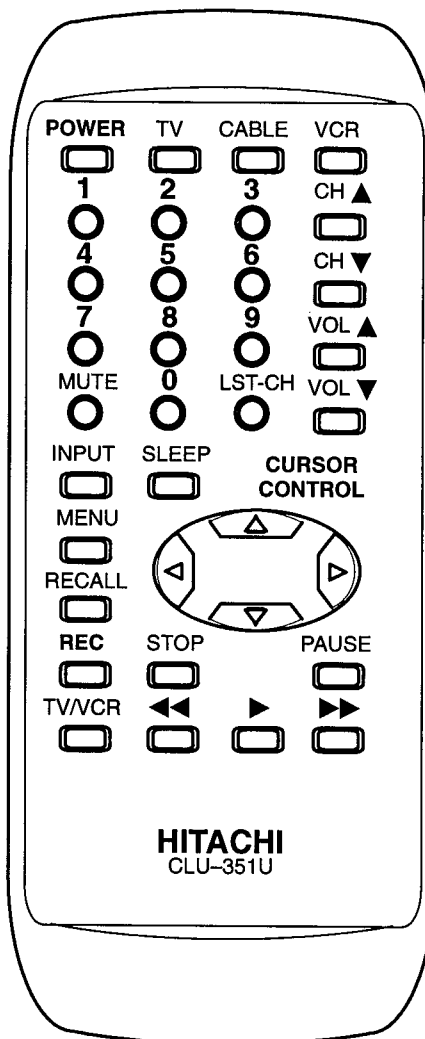
## Operating the Precoded Function for Your VCR

This remote is designed to operate different types of VCRs. You must first program the remote to match the remote system in your VCR. (Refer to the VCR Code Index section.)

1. Turn on your VCR.
2. Aim the remote control at the front of your VCR.
3. Press the VCR button to switch to the VCR precoded mode.
4. While holding down the VCR button, enter the 2-digit preset code that matches your VCR.\* The remote will turn on your VCR when the correct 2-digit preset code is entered. When this occurs, the remote control is programmed for your VCR. If the VCR does not turn off after 5 seconds, try a different 2-digit preset code.
5. The remote will now control your VCR.

### NOTES:

- If your VCR cannot be operated after performing the above procedures, this means that your VCR codes have not been precoded into the remote.
- In the unlikely event that your VCR cannot be operated after performing the above procedures, consult your VCR operating guide.
- The remote control will remember the codes you have programmed in until the batteries are removed from the remote control. After replacing the batteries repeat the entire programming procedure stated above.
- If your VCR does not have a power function, the remote will issue the CHANNEL UP function.



\* (Codes are listed on page 10.)

Figure 4. Remote Control

## Operating the Precoded function for Your Cable Box

1. Turn on your cable box.
2. Aim the remote control at the front of your cable box.
3. Press the cable box button to switch to the cable box precoded mode.
4. While holding down the CABLE button, enter the 2-digit preset code that matches your cable box.\* The remote will turn on your cable box when the correct 2-digit preset code is entered. When this occurs, the remote control is programmed for your cable box. If the Cable Box does not turn off after 5 seconds, try a different 2-digit preset code.
5. The remote will now control your Cable Box.

### NOTES:

- If your cable box cannot be operated after performing the above procedures, this means that your cable box codes have not been precoded into the remote.
- In the unlikely event that your cable box cannot be operated after performing the above procedures, consult your cable box operating guide.
- The remote control will remember the codes you have programmed in until the batteries are removed from the remote control. After replacing the batteries repeat the entire programming procedure stated above.
- If your cable box does not have a power function, the remote will issue the CHANNEL UP function.
- For some models, the remote control's channel ▲ and ▼ will control the cable box channel. The number buttons will control your television channel although you are in cable mode.

# VCR and Cable Box Codes Index

The Remote Control is capable of operating many brands of VCRs and Cable Boxes. You must first program the Remote Control to match the remote system in your VCR or Cable Box.

**NOTE:** The Remote Control memory is limited. Some models of VCRs or Cable Boxes may not operate. The Remote Control is not designed to control all features that are available in all models.


## Code Index For VCRs



VCR Brand	Code(s)
Emerson	00, 01, 10, 16, 23, 33 37, 40, 43
Funai	00
GE	09, 22
Hitachi	00, 14, 15
JVC	14, 26
Magnavox	09, 12, 28
Mitsubishi	16, 23, 26, 45
Panasonic	09, 35, 46
RCA	15, 22
Sony	06, 07, 08, 09
Toshiba	16, 17, 42
Zenith	07, 08, 12,

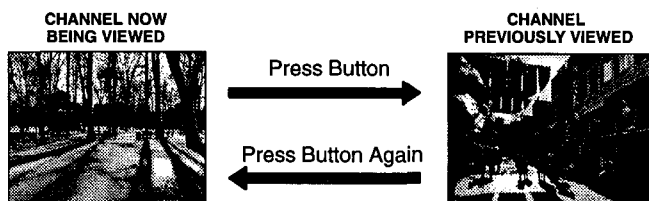
## Code Index For Cable Boxes

Cable Box Brand	Code(s)
G.I.	09
Jerrold	03, 09, 10, 12, 13, 51
Magnavox	40
Philips	40
Pioneer	39
Samsung	39
Scientific Atlantic	04, 06, 14, 52, 56
Zenith	00


# Special Functions

**LST-CH** — Pressing  will switch between the last two channels selected on the numeric keypad.

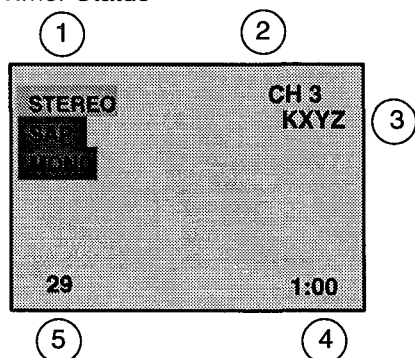
**NOTE:** When scanning channels with the CHANNEL  or  button, pressing the LST-CH button will switch between the last two channels scanned.



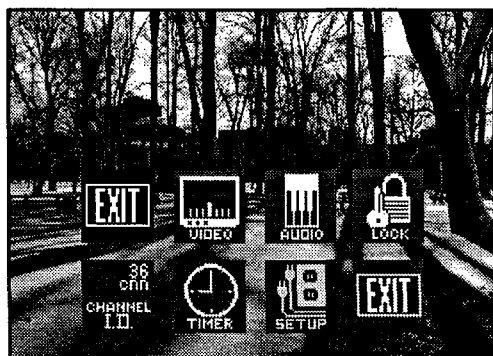
**RECALL**

**Recall** — Press  to review:

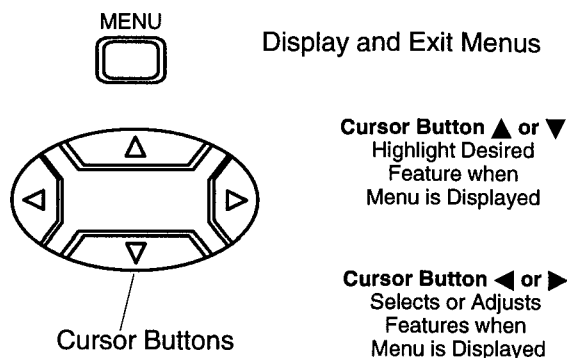
- ① Audio Mode Status
- ② CH Number or Video Input Selected
- ③ Channel I.D. (Station Identifier)
- ④ Clock Time
- ⑤ Sleep Timer Status










## Main Menu



**NOTE:** When Auto Power On feature is activated, Timer Icon changes to an Exit Icon.









Located On Remote Control






1. Press .
2. Press CURSOR  or  and  or  to select the desired icon.
3. Press  after selecting the desired icon to access sub menus.
4. Press  twice to exit sub menus.

## Menu Language Selection

The MENU LANGUAGE is factory set to ENGLISH. Follow the instructions to change the Menu Language to SPANISH, FRENCH, and back to ENGLISH.

1. Press .
2. Press CURSOR  or  and  or  to highlight the Set-Up Icon.
3. Press  to display the Set-Up Menu.

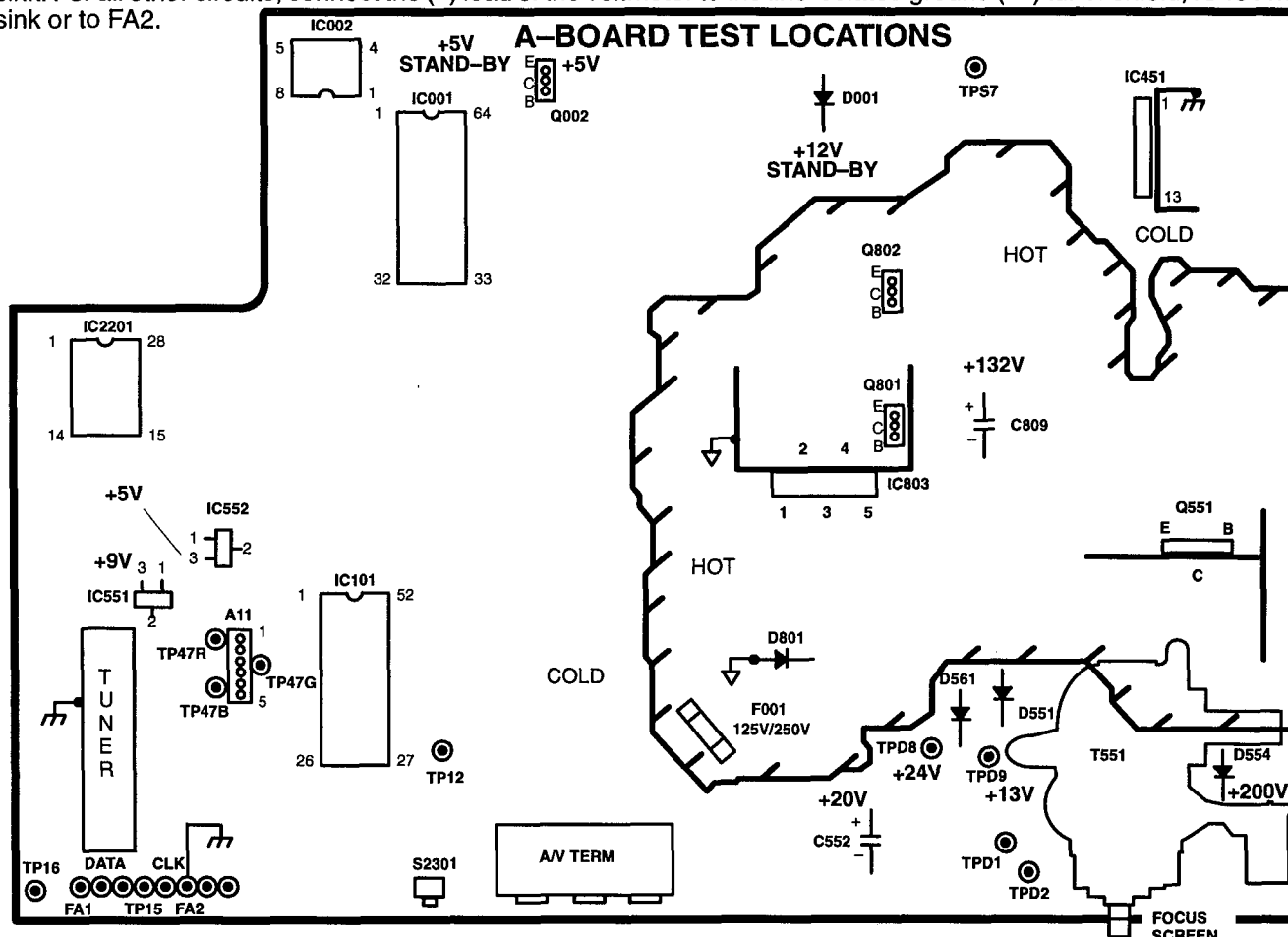


4. Press CURSOR  or  to highlight ENGLISH, ESPAÑOL, FRANÇAIS.
5. Press CURSOR  or  to select ENGLISH, ESPAÑOL, or FRANÇAIS.
6. Press  twice to exit menus.

# Chassis Service Adjustment Procedures

All service adjustments are factory preset and should not require adjustments unless controls and/or associated components are replaced.

**NOTE:** Connect the (-) lead of the voltmeter to the appropriate ground for the circuit being checked. When necessary to use a line operated ground, the ground indication ( $\nabla$ ) is marked. For this ground use anode of D801 or IC803 heat sink. For all other circuits, connect the (-) lead of the voltmeter to the line isolated ground ( $\overline{\text{H}}$ ) tuner shield, IC451 heat sink or to FA2.



MOMENTARILY CONNECT A JUMPER FOR ENTERING SERVICE MODE (FA1/TP8 to FA2/TP3)

## 132.0V B+ Voltage Confirmation

1. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu.
2. Connect a DVM between C809, + side and Hot ground ( $\nabla$ ).
3. Confirm that B+ voltage is 132.0V $\pm$ 2.5V. This voltage supplies B+ to the Horizontal Output & Flyback circuits.

## Source Voltage Chart

120V AC line input. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu. Use cold ground ( $\overline{\text{H}}$ ) for the (-) lead of the DVM.

IC551 pin 3	+9.0V $\pm$ 0.5V
Cathode of D551 (TPD9)	+13.0V $\pm$ 2V
C552 (+ side)	+20.0V $\pm$ 2V
Cathode of D561 (TPD8)	+24.0V $\pm$ 2V
Cathode of D554	+200V $\pm$ 15V

Adjust Picture menu for normalized video adjustments.

## B+ 5V Source Voltages

### Volatile 5V:

C572, + side = IC552 pin 3, Tuner BP, IC101 (B+ V<sub>cc</sub>).

### MPU 5V:

Emitter Q002 = IC001(V<sub>DD</sub>).

### Standby 5V:

IC001 (Key in 1), I<sup>2</sup>C EEPROM (IC002), TIMER LED, Remote Receiver.

### B+ 9V Source Voltage

IC551 pin 3 = IC101 (B+ V<sub>cc</sub>), Tuner (BM).

**B+ 12V (Stand-by) Note: +16V when power is on**  
Cathode D001 = RL801 (on-off relay), Q002 (+5V Reg).

## High Voltage Check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust Brightness and Picture using Picture Icon menu so video just disappears.
3. Confirm B+ 132V is within limit.
4. Using a high voltage meter confirm that the High Voltage is 27.7kV  $\pm$ 1.25kV.



## Disassembly for Service

### Back Cover

Remove all the screws marked with an arrow (➡) from the back of the Receiver.

**Note:** screw configuration and number of screws may vary depending on the model of the Receiver serviced; various models are covered in this Manual.

1. 2 screws at the top edge of the Receiver.
2. 1 screw by flyback assembly.
3. 1 screw by the A/V jacks.
4. 2 screws at the bottom edge of the Receiver.

### A-Board – Main Chassis

1. Press tab on left rail.
2. Slide the chassis completely out of the guide rails.  
**NOTE:** Some tie-wraps that secure the wire dressings may need to be unfastened for chassis removal.
3. Stand the Receiver on its edge. The underside of the board is completely accessible for component replacement.

### C-Board – CRT Output

Plugs into the socket on the CRT neck.

### Keyboard Push Button Assembly

Fastened to the inside of the cabinet front by 3 screws.

### Speakers

Secured to the cabinet by 2 screws each.

## Disassembly for CRT Replacement

1. Discharge the CRT as instructed in the **Safety Precautions**.
2. Disconnect the yoke plug, degaussing coil plug and the CRT 2nd anode button from the main board.
3. Remove the C-Board from the CRT base and unplug the black wire (CRT dag ground) C10-1 from the board.
4. Disconnect the A12 and SP plugs from the A-Board.
5. Slide the main chassis assembly completely out with the CRT Board attached.

### CRT Replacement

1. Perform **Disassembly for CRT Replacement** procedure.
2. Insure that the CRT H.V. anode button is discharged before handling the CRT. See the **Safety Precautions** on handling the picture tube.
3. Remove the components from the CRT neck and place the cabinet face down on a soft pad.
4. Note the original order of the CRT mounting hardware as they are removed from the CRT mounting brackets at each corner of the CRT.
5. Remove the CRT with the degaussing coil and the dag ground braid attached.
6. Note the original locations and mounting of the degaussing coil and the dag ground assembly to insure proper reinstallation on the replacement CRT.

#### To remove and re-mount the degaussing coil:

The degaussing coil is held in place by clampers fastened to the CRT corner ears.

These clampers must be installed onto the replacement CRT prior to mounting the degaussing coil.

#### To remove and re-mount the dag ground braid:

- Unhook the coil spring from the upper right CRT ear.
  - Release the braid loop from the upper left and the lower right CRT ear.
7. Mount the dag ground braid on the replacement CRT. Position the degaussing coil with new ties. Dress coil as was on the original CRT.
  8. Replace the components on the CRT neck and re-install into cabinet. Verify that all ground wires and circuit board plugs get connected.

# Purity and Convergence Procedure

Adjustment is necessary only if the CRT or the deflection yoke is replaced or if the setting was disturbed. The complete procedure consists of:

1. Initial static convergence.
2. Setting the purity.
3. Final static convergence.

## When the CRT or the Yoke is Replaced

Place the yoke on the CRT neck (do not tighten the clamp).

### For a 2-piece assembly (see Figure 5):

Position purity/convergence assembly as shown and tighten clamp snugly. Cut the hot-melt glue seal on assembly and place like tabs of purity device together at 12 o'clock to reduce its magnetic field effect. Manually degauss the CRT.

Turn the Receiver ON and slide the deflection yoke back and forth on the neck of the CRT. Stop at the position that produces a near white, uniform raster.

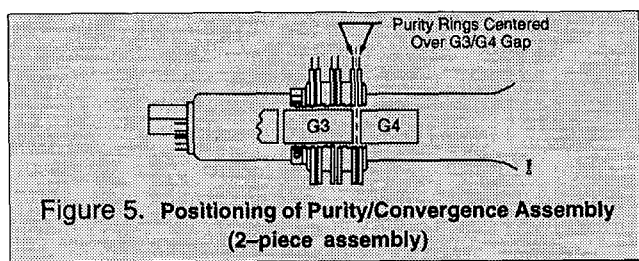


Figure 5. Positioning of Purity/Convergence Assembly (2-piece assembly)

### For a 1-piece assembly (see Figure 6):

Place like tabs of purity devices together at 12 O'Clock to reduce any magnetic field effect. Manually degauss the set.

Connect a Black/White pattern generator and tune the receiver to the signal. Slide the deflection yoke & purity ring assembly back and forth on the CRT neck. Stop at a position that produces a near white signal.

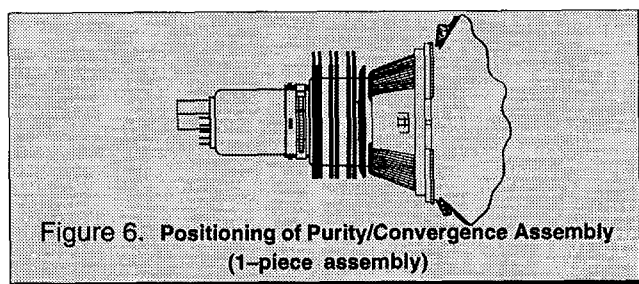


Figure 6. Positioning of Purity/Convergence Assembly (1-piece assembly)

## Initial Center Static Convergence

Connect a dot/crosshatch generator to the Receiver and tune in signal. Observe misconvergence at center of the screen only.

Adjust the 4 pole magnet (center rings); separate tabs and rotate to converge blue with red.

Adjust the 6 pole magnet (rear rings): separate tabs and rotate to converge blue and red (magenta) with green.

**Note:** Precise convergence at this point is not important.

## Purity Adjustment

When the Receiver is in the Serviceman Mode for making electronic adjustments, press the **Recall** button on the Remote Control to enter Purity Check. (See **Service Adjustments Electronic Controls**.)

Operate the Receiver for 60 minutes using the first Purity check field (white screen) to stabilize the CRT.

Fully degauss the Receiver by using an external degaussing coil.

Press the **Recall** button on the Remote Control again until the Purity Check (green screen) appears.

### For a 2-piece assembly (see Figure 5):

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.

Adjust the purity rings to set the vertical green raster precisely at the center of the screen (see Figure 7).

#### NOTES:

1. CRT warm up with white screen (three guns activated) is needed to stabilize the shadow mask expansion.
2. Initial center static convergence (roughly centers three gun beams) is required in order to perform purity adjustment.

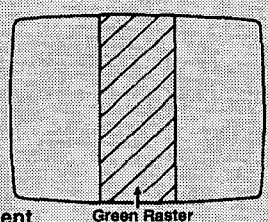


Figure 7. Green Raster Adjustment

Slowly move the deflection yoke forward until the best overall green screen is displayed.

### For a 1-piece assembly (see Figure 6):

Slowly move the deflection yoke and purity rings assembly toward the CRT board and adjust the purity magnet rings to set vertical green raster at center of screen (see Figure 7).

Gradually move the deflection yoke & purity rings forward and adjust for the best overall green screen.

### Continue from here for either assemblies:

Tighten the deflection yoke clamp screw.

Press the **Recall** button on the Remote Control again until the Purity Check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.

Press the **Recall** button on the Remote Control again until Purity check (white screen) appears. Observe the screen for uniform white. If purity has not been achieved, repeat the above procedure.

## Final Convergence Procedure (see Figure 8 through Figure 10):

**Note:** Vertical size and focus adjustments must be completed prior to performing the convergence adjustment. Connect a dot pattern generator to the Receiver. The **Brightness** level should not be higher than necessary to obtain a clear pattern.

Converge the red and blue dots at the center of the screen by rotating the 4 pole (R with B) Static Convergence Magnets.

Align the converged red/blue dots with the green dots at the center of the screen by rotating the 6 pole (R/B with G) Static Convergence Magnets. Melt wax with soldering iron to reseal the magnets.

Slightly tilt vertically and horizontally (do not rotate) the deflection yoke to obtain a good overall convergence.

If convergence is not reached at the edges, insert permalloy (see following section) from the DY corners to achieve proper convergence. Recheck for purity and readjust if necessary.

### Permalloy Convergence Corrector Strip (Part No. OFMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required.

First converge the set without the strip and observe the corners.

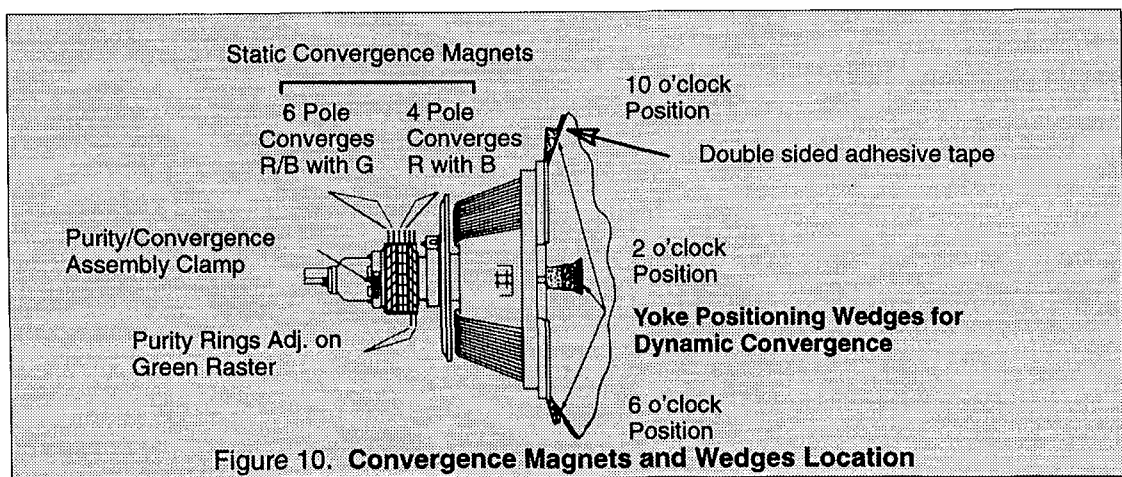
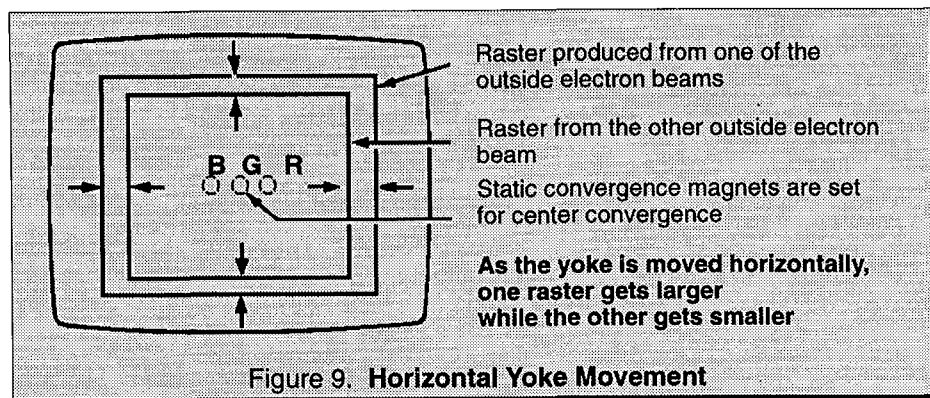
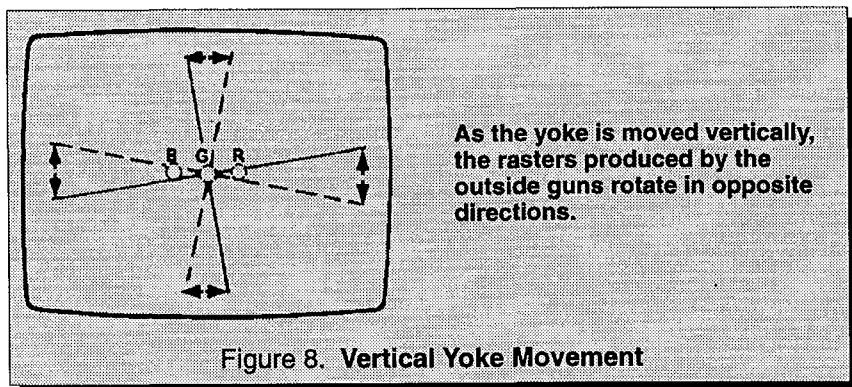
After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment.

Secure the deflection yoke by inserting two side wedges at 3 and 7 o'clock positions.

Apply adhesive between tab (thin portion) of wedge and CRT and place tape over the tab to secure to the CRT.

If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.



# Serviceman Mode (Electronic Controls)

This Receiver has electronic technology using the I<sup>2</sup>C Bus Concept. It performs as a control function and it replaces many mechanical controls. Instead of adjusting mechanical controls individually, many of the control functions are now performed by using the "On Screen Display Menu". (The **Serviceman Adjustment Mode**.)

**Note:** It is suggested that the technician reads all the way through and understand the following procedure for Entering/Exiting the **Serviceman Adjustment Mode**; then proceed with the instructions working with the Receiver. When becoming familiar with the procedure, the Flow Chart for Serviceman Mode may be used as a quick guide.

## Entering Serviceman Mode:

At times when minor adjustments need to be done to the electronic controls, the method of Entering the Serviceman Mode without removal of the cabinet back is as follows using the Remote Control:

1. Select SET-UP icon and select CABLE mode.
2. Select TIMER Icon and set SLEEP timer for 30.
3. Press ACTION button twice to exit Menus.

Tune to Channel 124.

Adjust VOLUME to Minimum (0).

On Receiver press the VOL ◀ button (decrease). Red "CHK" appears in upper corner.

## To toggle between Aging and Serviceman modes:

While the "CHK" is displayed on the left top corner of the CRT, pressing the **Action** and the **Volume Down** buttons on the Receiver simultaneously will toggle between the modes (red "CHK" for Serviceman; yellow "CHK" for Aging).

4. Press the **Power** button on the Remote Control to select one of five Serviceman Adjustment Modes.
  - 1) B = Serviceman VCJ SUB ADJUSTMENTS
  - 2) C = Serviceman VCJ CUT-OFF ADJUSTMENTS
  - 3) S = Serviceman OPTIONS (PIP and CLOCK) ADJUSTMENTS
  - 4) M = Serviceman MTS ADJUSTMENTS
  - 5) "CHK" = Normal operation of CHANNEL ▲▼ and VOLUME ◀▶

**Note:** Only the applicable settings for the Receiver serviced will be available (see a in Figure 11).

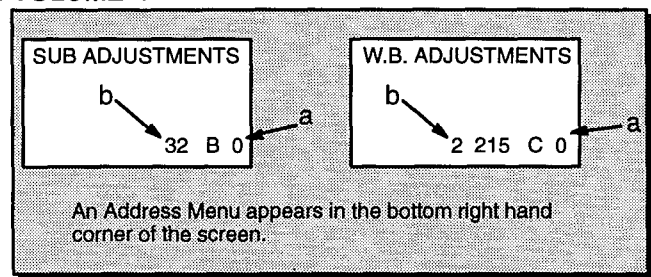


Figure 11. Serviceman Mode Menu Adjustments

## For DAC Adjustments:

1. Press **Channel Up/Down** on the Remote Control to select one of the 8 available Service Adjustments (a in Figure 11).

**Important Note:** Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.

2. Press **Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).

Sub Adjustment Mode			
B7	V-Size	0~63	20
B6	Audio Adjustment	0~31	16
B5	Video Adjustment	0~15	8
B4	Killer/ABL/Gamma	0~7	5
B3	Sub Contrast	0~63	34
B2	Sub Brightness	0~255	80
B1	Sub Tint	0~63	33
B0	Sub color	0~63	33
Mode	Adjustment	Range	Default

Figure 12. Sub Adjustment Mode

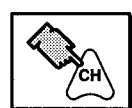
Press the **Power** button on the Remote Control to select the Serviceman White Balance Adjustment Mode.

### For VCJ Cut-Off Adjustments:

1. Press **Channel Up/Down** on the Remote Control to select one of the 12 available Service Adjustments (a in Figure 11).

**Important Note:** Write down the original value set (b in Figure 11) for each address adjustment before modifying anything. It is easy to erroneously adjust the wrong item.

2. Press **Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).



**\*\* Note:** Range is in steps:  
0 0 ~ 0 255  
1 0 ~ 1 255

Cut-Off Adjustment Mode			
Cb	Y Delay	0~2	2
Ca	Beam Limit	0~7	0
C9	Horizontal-Center	0~31	16
C8	YNR	0~7	0
C7	RF AGC	0~127	64
C6	AFT	**	0 120
C5	YNR Switch	0~1	0
C4	B Drive	0~127	64
C3	R Drive	0~127	64
C2	B Cut-Off	**	0 128
C1	G Cut-Off	0~255	64
C0	R Cut-Off	**	0 128
Mode	Adjustment	Range	Default

Figure 13. White Balance Adjustment Mode

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

### For Options (PIP and CLOCK) Adjustments:

#### IMPORTANT

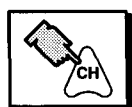
Only items "Sb" and "Sd" pertain to this manual. All other settings in this group will not affect the normal operation of the Television (please leave them in their default state).

1. Press **Channel Up/Down** on the Remote Control to select one of the 12 available Options Adjustments (a in Figure 11).

**Important Note:** Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.

2. Press **Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).

**\*\* Factory only**



Options Adjustment Mode			
Sd	Loudness Compensation	0~63	52
Sc	Pip Tint	0~63	50
Sb	Clock Adjustment	0~255	128
Sa	Freerun	**	**
S9	Right 1/16	0~255	118
S8	Left 1/16	0~255	9
S7	Down 1/16	0~255	163
S6	Up 1/16	0~255	27
S5	Right 1/9	0~255	103
S4	Left 1/9	0~255	9
S3	Down 1/9	0~255	146
S2	Up 1/9	0~255	26
S1	PIP Contrast	0~127	52
S0	PIP Color	0~63	80
Mode	Adjustment	Range	Default

Figure 14. Options Adjustment Mode

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

### For MTS Adjustments:

1. Press **Channel Up/Down** on the Remote Control to select one of the 5 available MTS Adjustments (a in Figure 11).  
  
***Important Note:** Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*
2. Press **Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).
3. Press the **POWER** button on the remote control to loop back to setting of the SUB ADJ Mode.

OR

Press **ACTION** and **POWER** buttons on the Receiver simultaneously for at least 2 seconds to return the Receiver to normal mode (exit Serviceman Mode).

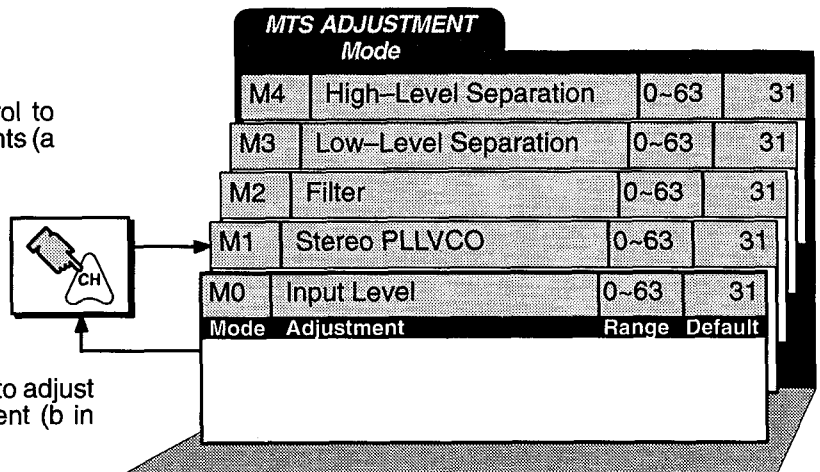


Figure 15. MTS Adjustment Mode

### To Check Purity:

Press the **Recall** button on the Remote Control when in Serviceman Modes (red "CHK" is displayed) to enter the Purity Field Check Mode.

***Note:** The Receiver must be in the Serviceman Mode to display color.*

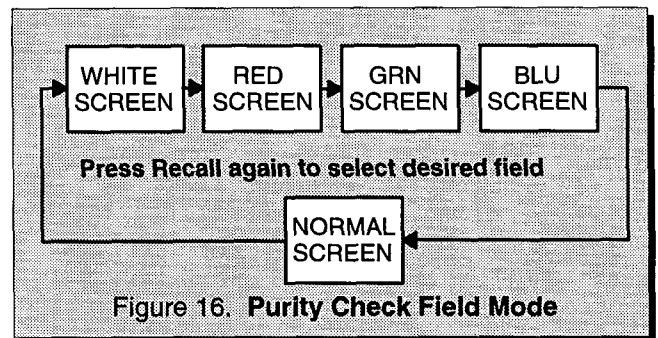


Figure 16. Purity Check Field Mode

### IMPORTANT NOTE:

**Always Exit the Serviceman Mode following Adjustments.**

### Exiting the Serviceman Mode:

Press the **Action** and the **Power** buttons on the Receiver simultaneously for at least 2 seconds.

***"The Receiver exits Serviceman Mode".***

The Receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound.

### Helpful Hints

#### Entering Serviceman Mode (Other Method – back open):

1. While the Receiver is ON and operating in Normal Mode, momentarily short test point FA1 to cold ground ( ) FA2 (A-Board: TP pin 8 to pin 3).  
***"The Receiver enters the Aging Mode".***  
Yellow letters "CHK" appear in the upper left corner of the CRT.  
(The Volume Up/Down will adjust rapidly.)
2. Simultaneously **press** the **Action** and the **Volume Up** buttons on the Receiver Control Panel.  
***"The Receiver enters the Serviceman's Mode".***  
The letters in "CHK" turn red.  
(The Volume Up/Down will adjust normally.)  
(All customer controls are set to a nominal level.)



## Notes

# Instructional Flow Chart for Serviceman Mode

**Caution: Always EXIT Serviceman Mode**

SERVICE

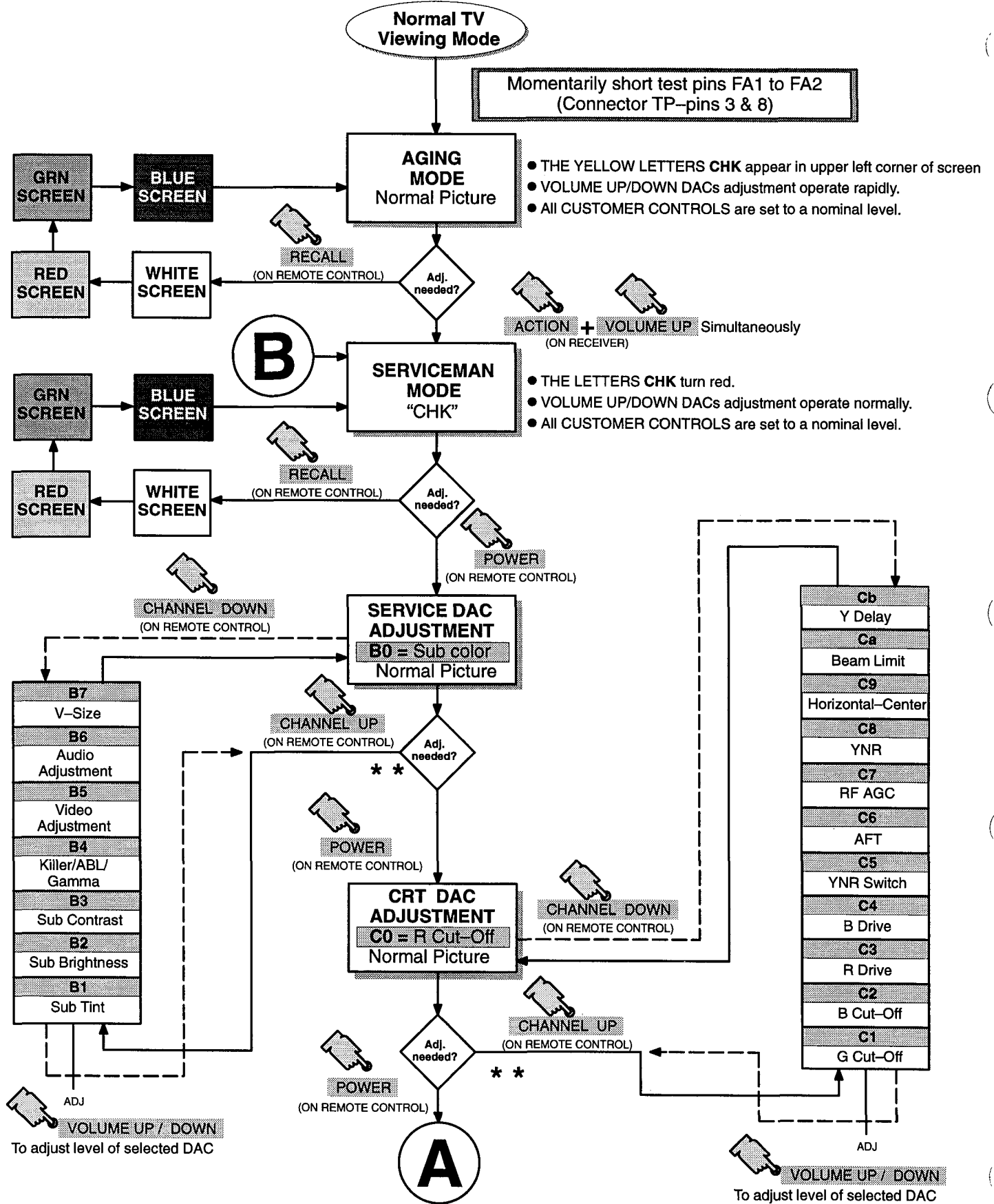


Figure 17. Flow Chart for Serviceman Mode



## Instructional Flow Chart for Serviceman Mode – Continued

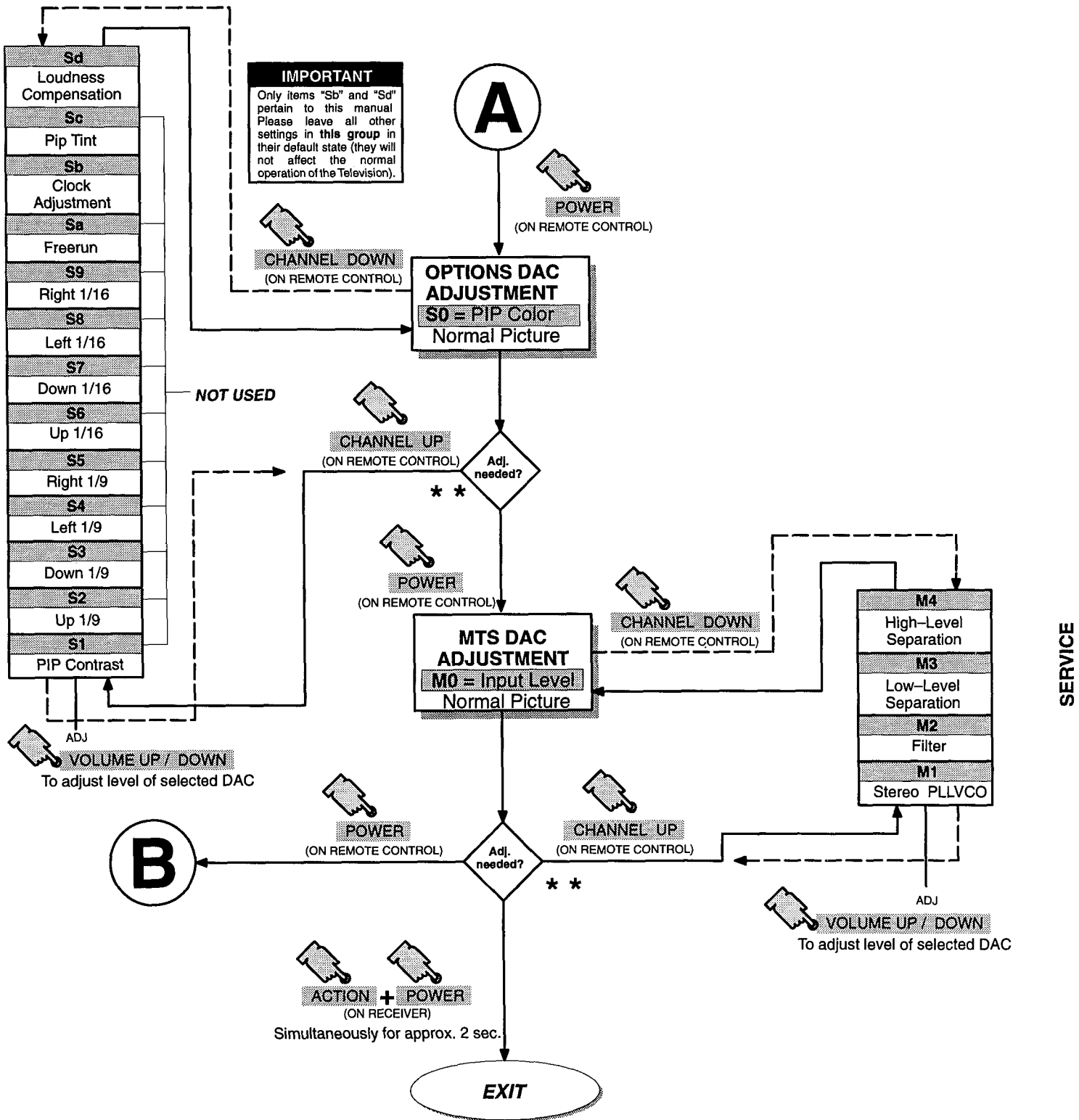


Figure 18. Flow Chart for Serviceman Mode (Continued)

**Note:** When *EXITING*, the Receiver shuts off; then turns on, TUNED TO CHANNEL 3 WITH A PRESET SOUND LEVEL.

Any Programmed Channels, Channels Caption data and some other user defined settings will be erased.

### \* \* Important Note

**Before making any DAC adjustments note the existing values!**

# Service Adjustments (Electronic Controls)

## Video Adjustment Level

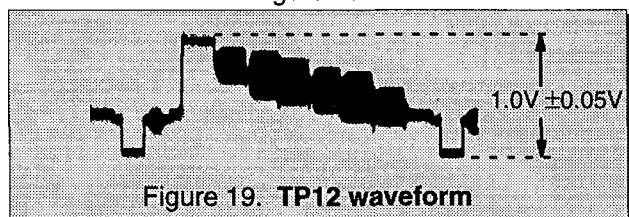
### Serviceman DAC Adjustment (B5)

#### Preparation:

1. Obtain an NTSC color bar pattern with 100 IRE white and 87.5% modulation.
2. Connect the oscilloscope to TP12. Use cold ground for scope connection. Set the scope at Horizontal Sweep rate (20 $\mu$ s) time base.

#### Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Video Adjustment Level (B5) and adjust for 1.0V  $\pm$ 0.05V from sync tip to white level. See Figure 19.



2. Set the DAC Sub-Contrast Adjustment (B3).

### Sub-Contrast

#### Serviceman DAC Adjustment (B3)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuits, the CRT Board, or when the CRT is replaced.

#### Preparation:

1. Apply a color bar signal pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

**NOTE:** The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to the pattern used if another signal is used.

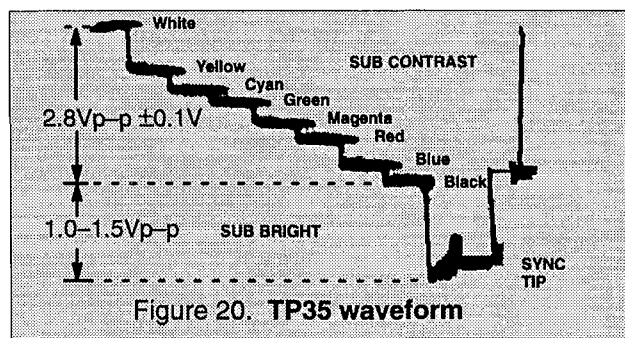
2. Preset the following controls:

- Brightness ..... Center
- Color ..... Min
- Picture ..... Max.
- Sharpness ..... Center

3. Connect the oscilloscope to the CRT-Board connector C1-2. Set the scope time base to 20 $\mu$ s (horizontal).
4. Connect a jumper from TPD2 to ground (rh).
5. Connect a jumper from IC101 pin 28 to ground (rh).

#### Procedure:

1. In the Serviceman Mode for electronic adjustments, select DAC Sub-Brightness Adjustment (B2) and adjust for 1.0–1.5Vp-p between blanking and 7.5 IRE level so that the black level cannot be compressed. (see video waveforms detail, Figure 20).
2. In the Serviceman Mode for electronic adjustments, select DAC Sub-Contrast Adjustment (B3) and adjust for 2.8Vp-p  $\pm$ 0.1V from white level to black level on video waveform (see video waveforms detail, Figure 20).



3. Remove the jumpers (Preparation steps 4 and 5).

## Tint/Color Adjustment

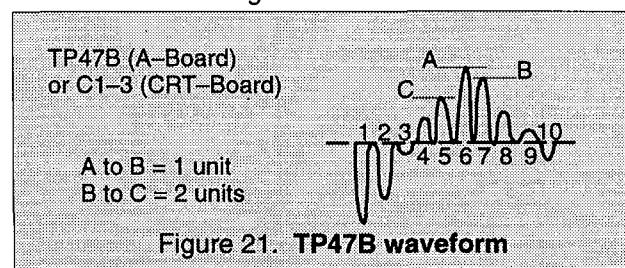
### Serviceman DAC Adjustment (B1) (B0)

#### Preparation:

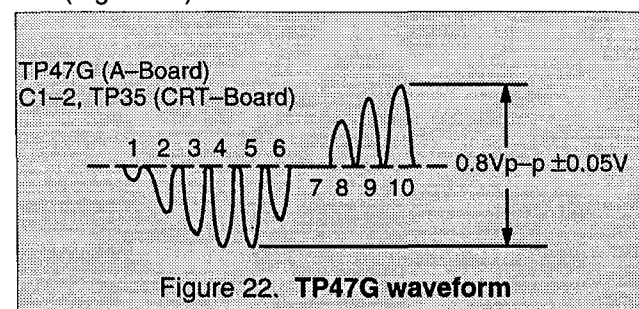
1. Apply a rainbow color bar signal.
2. Preset the following controls:
  - Brightness ..... Min.
  - Color ..... Center
  - Picture ..... Max.
  - Sharpness ..... Min
  - Tint ..... Center
3. Connect the oscilloscope to TP47B (A-Board) or to connector C1 pin 3.
4. Connect a jumper from TPD2 to GND (rh).
5. Connect a jumper from IC101 pin 28 to ground (rh).

#### Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Sub-Tint Adjustment (B1). Adjust until the waveform measured is as the one shown in Figure 21.



2. Connect the oscilloscope to TP47G (A-Board) or to connector C1 pin 2 (CRT-Board).
3. Select DAC Sub-Color Adjustment (B0) and adjust for peak to peak amplitude to be 0.8V p-p  $\pm$ 0.05V (Figure 22).



4. Remove the jumpers (Preparation steps 4 and 5).

# Service Adjustments (Electronic Controls,cont.)

## Color Temperature Adjustment (B/W Tracking)

### Serviceman DAC Adjust. (C0) (C1) (C2) (C3) (C4)

#### Minor Touch-Up Method

OBSERVE low and high brightness areas of a B/W picture for proper tracking. Adjust only as required for "good grey scale and warm highlights".

1. LOW LIGHT areas – In Serviceman Mode for making electronic adjustments, select Cutoff (C0) RED, (C1) GRN, (C2) BLU and adjust the picture for grey.
2. HIGH LIGHT areas – In Serviceman Mode for making electronic adjustments, select Drive (C3) RED, (C4) BLU and adjust the picture for warm whites.

## Complete Adjustment

### Preparation:

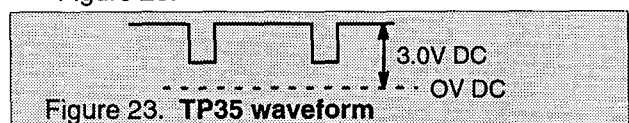
1. Turn the Receiver "ON" and allow 10 minutes warm up at high brightness.
2. Apply a color bar signal with color "OFF".
3. Turn the SCREEN control (part of FBT T551) fully counterclockwise.

### Procedure:

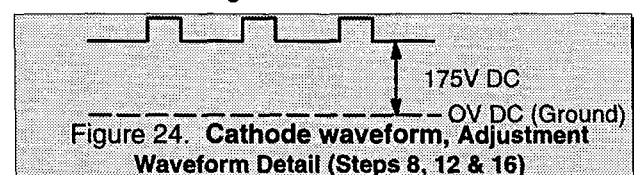
Preset the following Serviceman DAC's for the best results.

- C0 ..... 0 128
- C1 ..... 64
- C2 ..... 0 128
- C3 ..... 64
- C4 ..... 64

1. Connect the oscilloscope to C1-2 (CRT-Board).
2. In Serviceman Mode for making electronic adjustment, select the Sub-Bright DAC (B2).
3. Press the R-Tune key on the remote.
4. Observe the oscilloscope waveform at Horizontal rate and adjust the Serviceman Mode Sub-Bright DAC (B2) level until a scanning period of 3.0V above DC ground is measured, as indicated in Figure 23.



5. Connect the scope to GRN Cathode (KG) on the CRT-Board.
6. In the Serviceman Mode for making electronic adjustments, select the GREEN CUTOFF DAC (C1).
7. Press the R-Tune key on the remote.
8. View scope trace at Horizontal rate and adjust the Serviceman Mode DAC (C1) level until a scanning period of 175V above DC ground is measured, as indicated in Figure 24.



9. Connect the scope to the RED Cathode (KR).
10. In Serviceman Mode for making electronic adjustments, select the RED CUTOFF DAC (C0).
11. Press the R-Tune key on the remote.
12. View the scope trace and adjust the Serviceman Mode DAC (C0) for the scanning period to be 175V above DC ground. (See Figure 24)
13. Connect the scope to the BLU Cathode (KB).
14. In Serviceman Mode for making electronic adjustments, select the BLU CUTOFF (C2).
15. Press the R-Tune key on the remote.
16. View the scope trace and adjust the Serviceman Mode DAC (C2) for the scanning period to be 175V above DC ground. (See Figure 24)
17. Turn the Screen Control (part of FBT) slowly clockwise until a color horizontal line appears.
18. With the other two colors Serviceman Mode DAC CUTOFF adjustments (C0) RED, (C1) GRN, (C2) BLU; increase the colors to create a white horizontal line.
19. Confirm that a good gray scale is established by viewing B/W color bar pattern.
20. In the Serviceman Mode for making electronic adjustments select the DAC DRIVE adjustments (C3) RED, (C4) BLU and adjust for warm white in a white color bar pattern.
25. EXIT the Serviceman Mode.
26. Adjust the Picture Menu Video Adjustments **Bright** and **Picture** from low scale to high scale and check Black and White tracking.
27. If correction is needed: Re-Enter the Serviceman Mode and perform the **Minor Touch - Up Method**.
28. Perform **Sub-Brightness** Adjustment procedure.

## Sub-Brightness

### Serviceman DAC Adjustment (B2)

Adjustment of this control is important for setting proper operation of customer brightness and picture controls. This adjustment must be made after Sub-Contrast or Color Temperature adjustments are made. **Do not adjust SCREEN** after the Sub-Brightness is set.

### Preparation:

1. Apply a color bar signal with 100 IRE white and 7.5 IRE black. (Switch Color to "OFF" on the signal generator.) Operate the Receiver for a minimum of 10 minutes prior to performing this adjustment.
2. Preset the following controls:
  - Color ..... Center
  - Picture ..... Max.
  - Tint ..... Center

### Procedure:

In the Serviceman Mode for making electronic adjustments, select the DAC adjustment (B2) and adjust until the black bar starts to look grey. Then decrease the level to the point where grey turns to black.

## Service Adjustments (Electronic Controls,cont.)

### Horizontal Centering

#### Serviceman DAC Adjustment (C9)

##### Preparation:

Connect a crosshatch generator.

##### Procedure:

1. In the Serviceman Mode for making electronic adjustments. Select the Horizontal Centering Adjustment DAC (C9) and adjust until the center of the crosshatch pattern is centered on CRT.
2. EXIT the Serviceman Adjustment Mode.

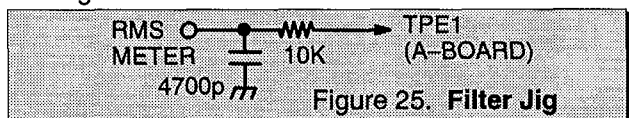
### Audio Adjustment

#### Serviceman DAC Adjustment (B6)

This adjustment is factory set and needs to be performed only when IC002 or IC101 is replaced.

##### Preparation:

1. Apply the following signal at the antenna (70dB  $\pm$ 5dB, 75 $\Omega$  open P/S 10dB): audio signal set to monaural, 300Hz. 100% modulation; video input of 100 IRE flat field, 30% modulation.
2. Connect the RMS Meter with filter jig as shown in Figure 25.



##### Procedure:

1. In the Serviceman Mode for making electronic adjustments, select the Audio Adjustment DAC (B6) and adjust until the RMS meter reading are: 150mV RMS  $\pm$ 7.5mV RMS
2. EXIT the Serviceman Adjustment Mode.

### Clock Adjustment (Sb)

##### Preparation:

Connect the frequency counter from TPS1 (IC001 Pin 13) to cold ground (  $\text{---}$  ).

**NOTE:** Frequency Counter probe capacitance should be 8pF or less.

##### Procedure:

1. Turn the Receiver "OFF" with the AC power applied.
2. Measure TPS1 (IC001 pin 13) for the frequency of the waveform and record the reading.

**Note:** Pin 13 measurement must have at least four digits of resolution following the decimal point Example: 000.0000

3. Turn the Receiver "ON".
4. Place the Receiver into Serviceman Mode for making electronic adjustment, select the Clock Adjustment DAC (Sb).
5. Calculate and set Sb based on the following formula:

$$Sb = 128 + 0.901 \times 10^6 \times \frac{\{244.1406 - \text{pin 13 [Hz]}\}}{244.1406}$$

**NOTE:** Pin 13 measurement will not change regardless of the value stored in Sb.

### Vertical Size (B7)

1. Adjust the VERTICAL SIZE DAC control, B7, until the top and the bottom edges of the raster are visible.
2. Adjust the VERTICAL SIZE control B7, until the top and the bottom of the raster touch the bezel edge. Then advance SIZE control to obtain an approximately 10% overscan. Linearity adjustment is done automatically when the size is being adjusted. (Best results can be obtained with a round test pattern.)

## Service Adjustments (Mechanical Controls)

### VCO Field Alignment L105

1. Connect a balance antenna and select a midband channel (Ch 10, 11 or 12)
2. Attenuate the signal strength for a weak noisy video.
3. While observing the picture tube, adjust L105 until best picture appears.
4. Change channels and observe that they are tuning properly.
5. If the channel monitored is not clear, repeat steps 1, 3 and 4 while applying a stronger signal.

### Focus (Part of T551)

##### Preparation:

Connect a Signal generator and select a dot pattern.

##### Procedure:

Adjust the FOCUS control to obtain the sharpest and clearest dot pattern.

- a. adjust for best center.
- b. adjust for best area between the center and top right corner.

# Notes

# Audio Signal Path Block Diagram

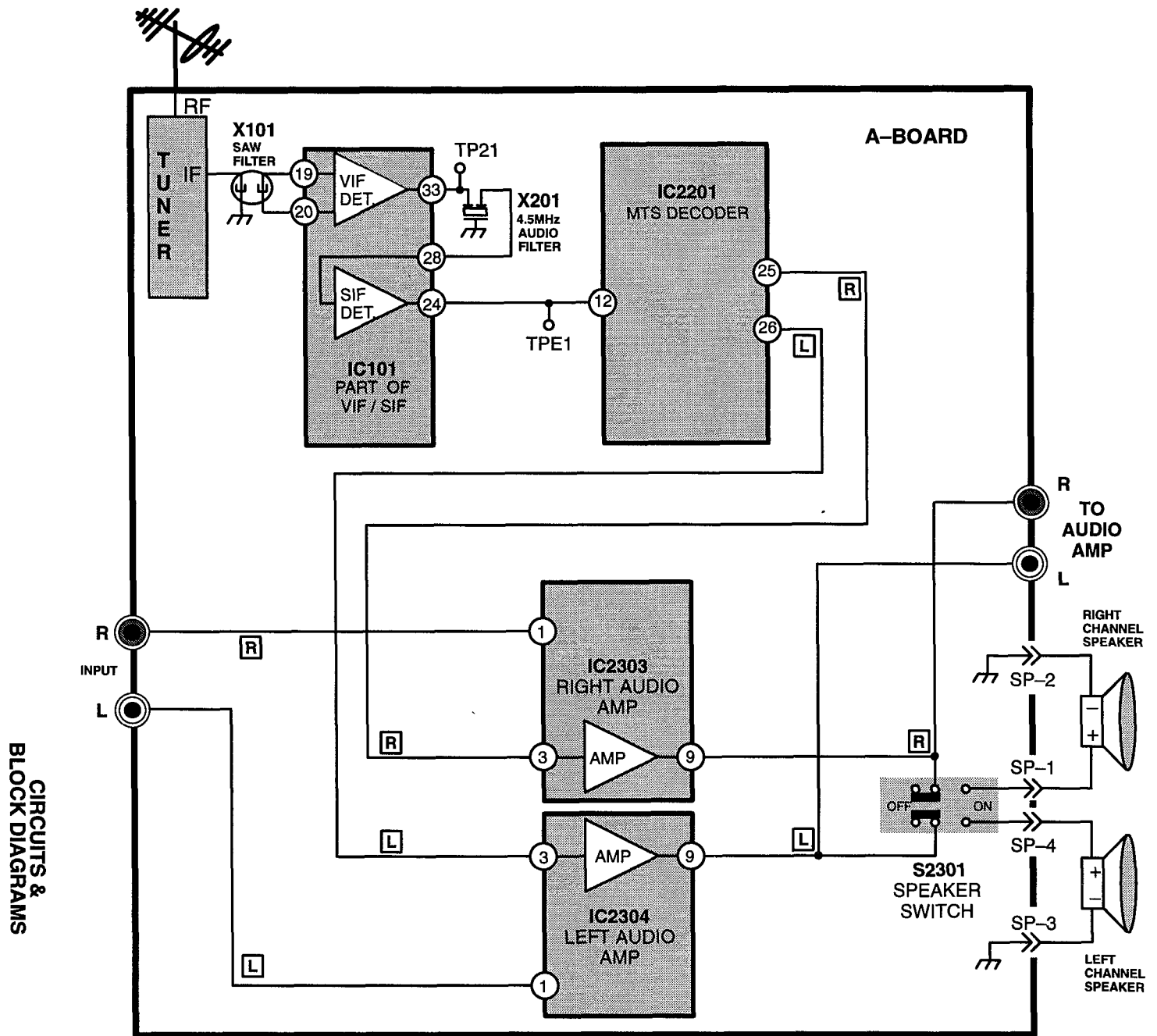


Figure 26. Audio Signal Path Block Diagram

## Video-Chroma Signal Path Block Diagram

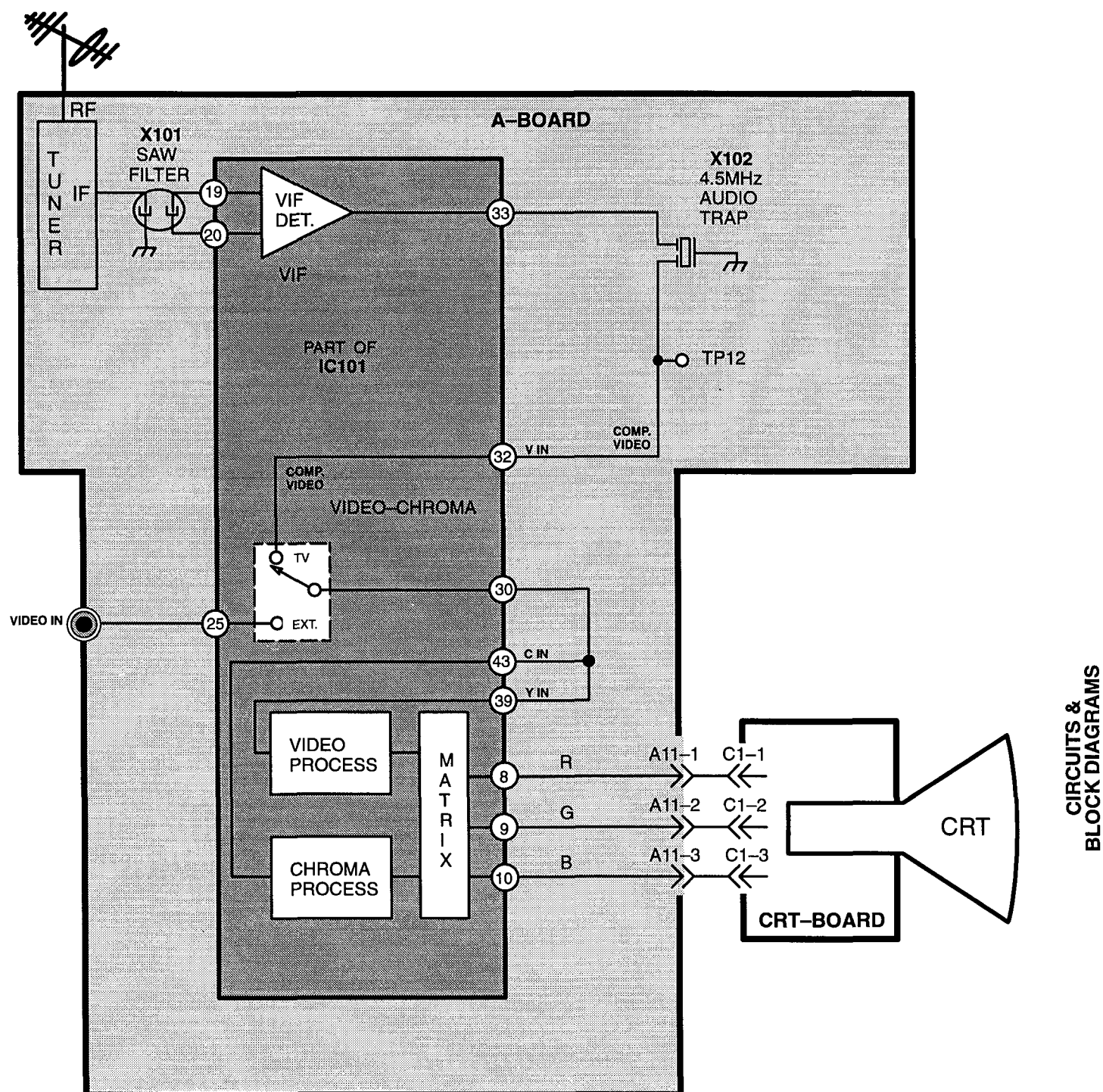
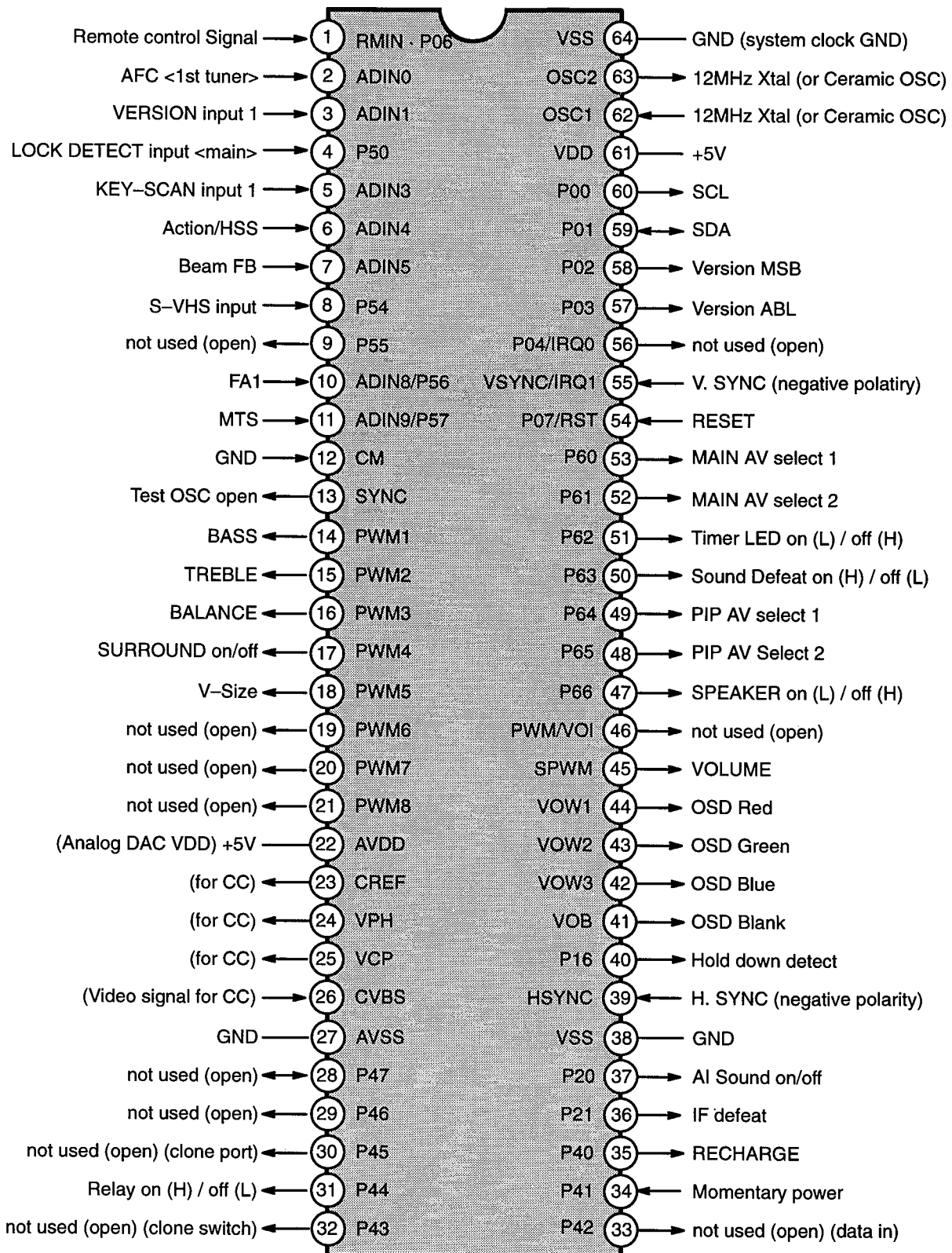


Figure 27. Video-Chroma Signal Path Block Diagram



# IC001 MPU IN/OUT Pins and Functions

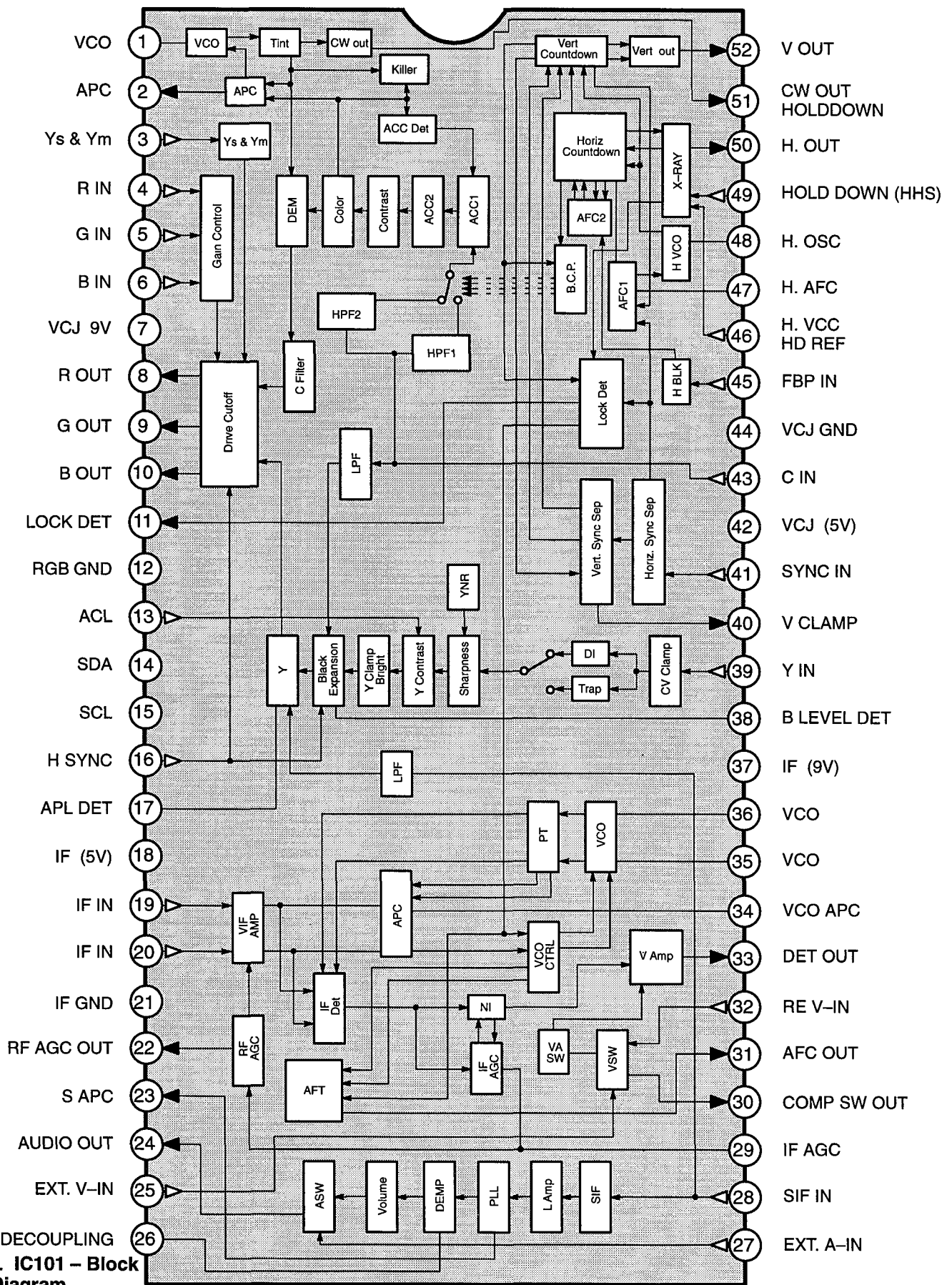
## MN1873265T7P





# IC101 Block Diagram

INPUT PINS = ◁ ▷ OUTPUT PINS = ◀ ▶



CIRCUITS & BLOCK DIAGRAMS

Figure 28. IC101 – Block Diagram

# REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

**Important Safety Notice:** Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
CRA801 CRA802	EXNG471P365	<b>CAPRISTORS</b>	C353	TACCW471T50V	CAP,C 470PF/50V
		<b>RES-CAP 470PF/3.6 MEG</b>	C354	ECKD3D102KB	CAP,C .001UF-K-2KV
		<b>RES-CAP 470PF/3.6 MEG</b>	C357	ECEA1HN010U	CAP,E 1UF/50V
		<b>CAPACITORS</b>	C401	ECQB1H153KF	CAP,P .015UF-K-50V
C001	ECA1AM101	CAP,E 100UF/10V	C402	ECUX1H471K BX	CAP,C 470PF-K-50V
C003	ECA1HM4R7	CAP,E 4.7UF/50V	C403	ECA1HM2R2	CAP,E 2.2UF/50V
C004	ECUX1H330JCX	CAP,C 33PF-J-50V	C451	ECA1AM470	CAP,E 47UF/10V
C005	ECUX1H330JCX	CAP,C 33PF-J-50V	C452	ECSF1EE105	CAP,T 1.0UF/25V
C008	TCUX1H103ZFN	CAP,C .01UF-Z-50V	C453	ECEA1HFS2R2	CAP,E 2.2UF/50V
C010	TCUX1H103ZFN	CAP,C .01UF-Z-50V	C454	ECA1EM102	CAP,E 1000UF/25V
C011	ECA1CM221	CAP,E 220UF/16V	C455	ECEA1EGE101	CAP,E 100UF/25V
C013	ECA0JM101	CAP,E 100UF/6.3V	C456	ECQB1H103JF	CAP,P .01UF-J-50V
C016	ECUX1H101JCX	CAP,C 100PF-J-50V	C459	ECA1VM471	CAP,E 470UF/35V
C017	ECUX1H220JCX	CAP,C 22PF-J-50V	C462	ECA1EM100	CAP,E 10UF/25V
C018	ECUX1H220JCX	CAP,C 22PF-J-50V	C502	ECQB1H223JF	CAP,P .022UF-J-50V
C019	ECA0JM101	CAP,E 100UF/6.3V	C503	ECA1HM2R2	CAP,E 2.2UF/50V
C020	ECA0JM101	CAP,E 100UF/6.3V	C504	ECUX1H101JCX	CAP,C 100PF-J-50V
C022	ECA1CM471	CAP,E 470UF/16V	C505	ECUX1H221JUX	CAP,C 220PF-J-50V
C024	ECA1EM4R7	CAP,E 4.7UF/25V	C506	ECA1CM221	CAP,E 220UF/16V
C025	ECUX1H101JCX	CAP,C 100PF-J-50V	C507	ECUX1H221JCX	CAP,C 220PF-J-50V
C026	ECA1HM010	CAP,E 1.0UF/50V	C508	ECUX1H121JCX	CAP,C 120PF-J-50V
C031	ECUX1H821K BX	CAP,C 820PF-K-50V	C510	ECCD2H100D	CAP,C 10PF-D-500V
C032	ECA1AM470	CAP,E 47UF/10V	C511	ECKD2H821KB	CAP,C 820PF-K-500V
C033	ECUX1H101JCX	CAP,C 100PF-J-50V	C512	ECKD2H101KB	CAP,C 100PF-K-500V
C036	ECUX1H220JCX	CAP,C 22PF-J-50V	<b>C531</b>	<b>ECA1EM220</b>	<b>CAP,E 22UF/25V</b>
C037	ECUX1H220JCX	CAP,C 22PF-J-50V	C532	ECA1AM102	CAP,E 1000UF/10V
C038	ECUX1H220JCX	CAP,C 22PF-J-50V	C534	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C101	ECUX1H223ZFX	CAP,C .022UF-Z-50V	<b>C551</b>	<b>ECA1VM331</b>	<b>CAP,E 330UF/35V</b>
C102	ECA1EM100	CAP,E 10UF/25V	<b>C552</b>	<b>ECA1EM471</b>	<b>CAP,E 470UF/25V</b>
C103	ECUX1H300JCX	CAP,C 30PF-J-50V	C553	ECKD2H561KB	CAP,C 560PF-K-500V
C105	ECUX1H221JCX	CAP,C 220PF-J-50V	C554	ECKD2H561KB	CAP,C 560PF-K-500V
C106	ECA1HMR47	CAP,E .47UF/50V	<b>C555</b>	<b>ECEA2EU220</b>	<b>CAP,E 22UF/250V</b>
C107	ECUX1H560JCX	CAP,C 56PF-J-50V	<b>C556</b>	<b>ECA1CM471</b>	<b>CAP,E 470UF/16V</b>
C108	ECA1HMR22	CAP,E .22UF/50V	C557	ECKD2H222KB	CAP,C .0022UF-K-500V
C109	ECEA1HN4R7U	CAP,E 4.7UF/50V	C559	ECA1HM220	CAP,E 22UF/50V
C110	TCUX1H103ZFN	CAP,C .01UF-Z-50V	<b>C560</b>	<b>ECEA1HN2R2U</b>	<b>CAP,E 2.2UF/50V</b>
C111	ECA1EM100	CAP,E 10UF/25V	C561	ECKD2H561KB	CAP,C 560PF-K-500V
C113	ECA1EM100	CAP,E 10UF/25V	<b>C564</b>	<b>ECWH12H822JS</b>	<b>CAP,P .0082UF-J-1.2KV</b>
C117	ERJ6GEYJ333	RES,M 33K-J-1/10	<b>C565</b>	<b>ECKD3D102JB</b>	<b>CAP,C .001UF-J-2KV</b>
C151	ECA1HMR22	CAP,E .22UF/50V	<b>C566</b>	<b>ECKD3D181JB</b>	<b>CAP,C 180PF-J-2KV</b>
C201	TCUX1H103ZFN	CAP,C .01UF-Z-50V	<b>C569</b>	<b>ECWF2394JBB</b>	<b>CAP,P .39UF-J-200V</b>
C202	ECUX1H101JCX	CAP,C 100PF-J-50V	C571	ECA1EM220	CAP,E 22UF/25V
C203	ECA1EM4R7	CAP,E 4.7UF/25V	C572	ECA1EM100	CAP,E 10UF/25V
C301	ECUX1H390JCX	CAP,C 39PF-J-50V	C573	ECA1CM101	CAP,E 100UF/16V
C302	ECEA1HN010U	CAP,E 1UF/50V	C601	ECUX1H181JCX	CAP,C 180PF-J-50V
C304	ECEA1HNR47U	CAP,E .47UF-50V	C602	ECUX1H680JCX	CAP,C 68PF-J-50V
C305	ECA1EM4R7	CAP,E 4.7UF/25V	C604	ECUX1H150JUX	CAP,C 15PF-J-50V
C306	ECA1CM221	CAP,E 220UF/16V	C605	ECUX1H332K BX	CAP,C .0033UF-K-50V
C308	ECQB1H823KF	CAP,P .082UF-K-50V	C606	ECA1HM010	CAP,E 1.0UF/50V
C309	ECA1AM101	CAP,E 100UF/10V	<b>C801</b>	<b>ECKD2H472PU</b>	<b>CAP,C .0047UF-P-500V</b>
C310	ECA1EM4R7	CAP,E 4.7UF/25V	<b>C802</b>	<b>ECKD2H472PU</b>	<b>CAP,C .0047UF-P-500V</b>
C311	ECA1EM4R7	CAP,E 4.7UF/25V	<b>C805</b>	<b>EC0S2DG151DG</b>	<b>CAP,E 151UF/200V</b>
C312	ECA1EM220	CAP,E 22UF/25V			
C314	ECUX1H104ZFX	CAP,C .1UF-Z-50V			
C351	TACCW391T50V	CAP,C 390PF/50V			
C352	TACCW391T50V	CAP,C 390PF/50V			
			C805	EC0S2EG151B4	CAP,E 150UF-250V

20CX20B501 20CX20B511

20CX20B521

PARTS LIST

# REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

**Important Safety Notice:** Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
C806	EC0S2DG151DG	CAP,E 151UF/200V 20CX20B501 20CX20B511	C2354	ECQB1H104JF	CAP,P .1UF-J-50V
C806	EC0S2EG151B4	CAP,E 150UF-250V 20CX20B521	C2356	ECA1CM221	CAP,E 220UF/16V
C807	ECA1HM3R3	CAP,E 3.3UF/50V	C2357	ECEA1HN010U	CAP,E 1UF/50V
C808	ECA1CM101	CAP,E 100UF/16V	C2358	ECUX1H332KBX	CAP,C .0033UF-K-50V
C809	EC0S2DG151DG	CAP,E 151UF/200V	C3001	ECA1HM010	CAP,E 1.0UF/50V
C810	ECQU2A153MN	CAP,P .015UF-M-250VAC 20CX20B501 20CX20B511	C3002	ECA1HM010	CAP,E 1.0UF/50V
C810	ECQU2A682MN	CAP,P 6800UF-M-250VAC 20CX20B521	C3003	ECA1HM010	CAP,E 1.0UF/50V
C811	ECQU2A153MN	CAP,P .015UF-M-250VAC 20CX20B501 20CX20B511	C3005	ECUX1H272KBX	CAP,C .0027UF-K-50V
C811	ECQU2A682MN	CAP,P 6800UF-M-250VAC 20CX20B521	C3006	ECUX1H272KBX	CAP,C .0027UF-K-50V
C812	ECQU2A224MV	CAP,P .22F-M-250V	<b>DIODES</b>		
C814	ECQB1H333JF	CAP,P .033UF-J-50V	D001	ERA15-01	DIODE
C815	ECEA1HGE470	CAP,E 47UF/50V	D002	MA165	DIODE
C818	ECKD3A821KB	CAP,C 820PF-K-1KVDC	D003	MA4047M	DIODE, ZENER
C820	ECEA1JGE100	CAP,E 10UF/63V	D006	MA4330H	DIODE
C823	ECEA160V33Z	CAP,E 33UF/160V	D008	MA165	DIODE
C824	ECKD3A331KB	CAP,C 330PF-K-1KVDC	D009	MA165	DIODE
C825	ECKD3A471KB	CAP,C 470PF-K-1KV	D011	MA165	DIODE
C2201	AP335K016CAE	CAP,T 3.3UF/16V	D016	MA165	DIODE
C2202	ECA1EM4R7	CAP,E 4.7UF/25V	D017	MA165	DIODE
C2203	ECA1HM010	CAP,E 1.0UF/50V	D451	ERA15-01	DIODE
C2204	ECA1EM4R7	CAP,E 4.7UF/25V	D452	MA4047M	DIODE, ZENER
C2205	ECA1EM4R7	CAP,E 4.7UF/25V	D501	MA4082L	DIODE
C2206	ECA1EM4R7	CAP,E 4.7UF/25V	D531	AS01	DIODE
C2207	ECA1EM4R7	CAP,E 4.7UF/25V	D532	MA4062L	DIODE
C2208	ECA1EM4R7	CAP,E 4.7UF/25V	D551	TVSRU2N	DIODE
C2209	ECA1AM101	CAP,E 100UF/10V	D553	BYD33G-143	DIODE
C2210	ECA1HMR33	CAP,E .33UF/50V	D554	BYD33G-143	DIODE
C2211	ECEA1HUR68	CAP,E .68UF/50V	D555	MA165	DIODE
C2212	ECA1HM2R2	CAP,E 2.2UF/50V	D556	MA4360H	DIODE, ZENER
C2213	ECA1EM100	CAP,E 10UF/25V	D560	MA165	DIODE
C2214	ECQB1H104JF	CAP,P .1UF-J-50V	D561	BYD33G-143	DIODE
C2215	ECQB1H223JF	CAP,P .022UF-J-50V	D801	EM02BM	DIODE
C2216	ECUX1H332KBX	CAP,C .0033UF-K-50V	D802	EM02BM	DIODE
C2217	ECEA1HN010U	CAP,E 1UF/50V	D806	MA4047H	DIODE
C2218	ECEA1HN010U	CAP,E 1UF/50V	D807	MA165	DIODE
C2219	AP106K016CAE	CAP,T 10UF/16V	D810	TAP104XM05	PTC
C2220	ECEA1CN100U	CAP,E 10UF-16V	D820	EU02V1	DIODE
C2221	TCUX1H103KBN	CAP,C .01UF-K-50V	D821	EU02V1	DIODE
C2222	ECUX1H472KBX	CAP,C .0047UF-K-50V	D822	EU02V1	DIODE
C2302	ECEA1HGE3R3	CAP,E 3.3UF/50V	D823	RL30A	DIODE
C2303	ECEA1EGE100	CAP,E 10UF/25V	D824	EU02V1	DIODE
C2304	ECQB1H104JF	CAP,P .1UF-J-50V	D825	TVSSR2KL	DIODE, PROTECTION
C2306	ECA1CM221	CAP,E 220UF/16V	D826	EU02V1	DIODE
C2307	ECEA1HN010U	CAP,E 1UF/50V	D829	MA165	DIODE
C2309	ECEA1HGE010	CAP,E 1UF/50V	D2301	MA165	DIODE
C2310	ECUX1H332KBX	CAP,C .0033UF-K-50V	D2302	MA165	DIODE
C2311	ECA1HM3R3	CAP,E 3.3UF/50V	D2312	MA4068M	DIODE, ZENER
C2351	ECA1EM102	CAP,E 1000UF/25V	D3001	MA165	DIODE
C2352	ECEA1HGE3R3	CAP,E 3.3UF/50V	D3002	MA4110M	DIODE, ZENER
C2353	ECEA1EGE100	CAP,E 10UF/25V	D3004	MA4110M	DIODE, ZENER
			D3005	MA4110M	DIODE, ZENER
			D3006	MA4110M	DIODE, ZENER
			D3007	MA4110M	DIODE, ZENER
			D3008	MA4110M	DIODE, ZENER
			D3009	MA4110M	DIODE, ZENER
			D3010	MA4110M	DIODE, ZENER

# REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

**Important Safety Notice:** Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
D3011	MA4110M	DIODE, ZENER	Q452	MSD601-RT1	TRANSISTOR
		<b>FUSES</b>	Q501	2SC1573AH	TRANSISTOR
F801	XBA2C63TR0	FUSE, 250V-6.3A <i>20CX20B521</i>	Q551	BU2506DF	TRANSISTOR
F801	OBA1C63NU100	FUSE (6.3A-125V) <i>20CX20B501 20CX20B511</i>	Q801	2SC1685RS	TRANSISTOR
		<b>INTEGRATED CIRCUITS</b>	Q802	2SC1685RS	TRANSISTOR
IC001	MN1873265T7P	INT CKT	Q804	2SA1767Q	TRANSISTOR
IC002	24LC02BIP	INT CKT	Q2309	MSB709-RT1	TRANSISTOR
IC003	PIC-12042SRB	RECEIVER, REMOTE CONTROL	Q3001	MSD601-RT1	TRANSISTOR
IC101	AN5165K	INT CKT			<b>RELAYS</b>
IC451	LA7837-TV	INT CKT	RL801	TSEH8007	RELAY
IC551	AN78M09	PLUS 9V AVR			<b>RESISTORS</b>
IC552	AN78M05	PLUS 5V AVR	C117	ERJ6GEYJ333	RES,M 33K-J-1/10
IC801	0N3131R	INT CKT	R002	ERJ6GEYJ182	RES,M 1.8K-J-1/10
IC803	STR58041A	INT CKT	R003	ERJ6GEYJ562	RES,M 5.6K-J-1/10
IC2201	AN5819K	INT CKT	R004	ERDS1TJ181	RES,C 180-J-1/2
IC2303	LA4285	INT CKT	R005	ERDS2TJ101	RES,C 100-J-1/4
IC2304	LA4285	INT CKT	R006	ERJ6GEYJ391	RES,M 390-J-1/10
		<b>COILS</b>	R007	ERJ6GEYJ561	RES,M 560-J-1/10
DEG	OLK19042A	COIL, DEGAUSSING 20"	R008	ERJ6GEYJ562	RES,M 5.6K-J-1/10
DY	OLY15312F1	YOKE, DEFLECTION	R010	ERJ6GEYJ154	RES,M 150K-J-1/10
L001	TSKA074	FERRITE BEAD	R011	ERJ6GEYJ684	RES,M 680K-J-1/10
L002	TLTACT390K	COIL, PEAKING 39UH	R012	ERJ6GEYJ473	RES,M 47K-J-1/10
L003	TLUABTA2R2K	COIL, PEAKING 2.2UH	R016	ERJ6GEYJ472	RES,M 4.7K-J-1/10
L004	TLUABTA2R2K	COIL, PEAKING 2.2UH	R017	ERJ6GEYJ472	RES,M 4.7K-J-1/10
L006	TSKA072	FERRITE BEAD	R020	ERJ6GEYJ474	RES,M 470K-J-1/10
L008	TLUABTA470K	COIL, PEAKING 47UH	R021	ERJ6GEYJ101	RES,M 100-J-1/10
L009	TSKA074	FERRITE BEAD	R022	ERJ6GEYJ101	RES,M 100-J-1/10
L103	TLUABTA150K	COIL, PEAKING 15UH	R023	ERJ6GEYJ102	RES,M 1K-J-1/10
L104	TLUABTA1R0K	COIL, PEAKING 1.0UH	R025	ERJ6GEYJ103	RES,M 10K-J-1/10
L105	EIV7EN053B	COIL, VCO	R027	ERJ6GEYJ103	RES,M 10K-J-1/10
L106	TLTACT180J	COIL, PEAKING 18UH	R028	ERJ6GEYJ103	RES,M 10K-J-1/10
L551	TLH15652P	COIL, LINEARITY	R030	ERJ6GEYJ102	RES,M 1K-J-1/10
L602	TLTACT120J	COIL, PEAKING 12UH	R032	ER0S2CKF1002	RES,M 10K-F-1/4
L801	ELF15N013A	LINE FILTER <i>20CX20B511 20CX20B521</i>	R033	ERJ6GEYJ222	RES,M 2.2K-J-1/10
L801	ELF20N020A	COIL, 2UH <i>20CX20B501</i>	R034	ERJ6GEYJ222	RES,M 2.2K-J-1/10
L802	ELEIE680KA	COIL, PEAKING 68UH	R035	ERJ6GEYJ332	RES,M 3.3K-J-1/10
L804	TSKA076	FERRITE BEAD	R036	ERJ6GEYJ562	RES,M 5.6K-J-1/10
L2201	ELESN102JA	COIL, PEAKING 1000UH	R037	ERJ6GEYJ103	RES,M 10K-J-1/10
L2202	ELESN471JA	COIL, PEAKING 470UH	R038	ERJ6GEYJ223	RES,M 22K-J-1/10
L2301	TSKA064	FERRITE BEAD	R039	ERDS2TJ102	RES,C 1K-J-1/4
		<b>TRANSISTORS</b>	R046	ERDS2TJ223	RES,C 22K-J-1/4
Q001	MSD601-RT1	TRANSISTOR	R047	ERJ6GEYJ562	RES,M 5.6K-J-1/10
Q002	JC501PQ	TRANSISTOR	R048	ERJ6GEYJ221	RES,M 220-J-1/10
Q003	MSB709-RT1	TRANSISTOR	R049	ERJ6GEYJ221	RES,M 220-J-1/10
Q004	MSB709-RT1	TRANSISTOR	R053	ERJ6GEYJ103	RES,M 10K-J-1/10
Q005	MSD601-RT1	TRANSISTOR	R055	ERJ6GEYJ103	RES,M 10K-J-1/10
Q302	MSD601-RT1	TRANSISTOR	R060	ERJ6GEYJ102	RES,M 1K-J-1/10
Q304	MSD601-RT1	TRANSISTOR	R065	ERJ6GEYJ222	RES,M 2.2K-J-1/10
Q351	2SC3063	TRANSISTOR	R066	ERJ6GEYJ222	RES,M 2.2K-J-1/10
Q352	2SC3063	TRANSISTOR	R067	ERJ6GEYJ222	RES,M 2.2K-J-1/10
Q353	2SC3063	TRANSISTOR	R068	ERJ6GEYJ222	RES,M 2.2K-J-1/10
Q451	MSD601-RT1	TRANSISTOR	R070	ERJ6GEYJ101	RES,M 100-J-1/10
			R101	ERJ6GEYJ750	RES,M 75-J-1/10
			R102	ERJ6GEYJ683	RES,M 68K-J-1/10
			R103	ERJ6GEYJ183	RES,M 18K-J-1/10
			R104	ERJ6GEYJ681	RES,M 680-J-1/10

# REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

**Important Safety Notice:** Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
R105	ERJ6GEYJ681	RES,M 680-J-1/10	R502	ERDS2TJ562	RES,C 5.6K-J-1/4
R106	ERJ6GEYJ122	RES,M 1.2K-J-1/10	R503	ERJ6GEYJ822	RES,M 8.2K-J-1/10
R107	ERJ6GEYJ222	RES,M 2.2K-J-1/10	R504	ERJ6GEYJ821	RES,M 820-J-1/10
R108	ERJ6GEYJ471	RES,M 470-J-1/10	R505	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R152	ERDS2TJ183	RES,C 18K-J-1/4	R506	ERJ6GEYJ182	RES,M 1.8K-J-1/10
R153	ERJ6GEYJ223	RES,M 22K-J-1/10	R507	ERJ6GEYJ392	RES,M 3.9K-J-1/10
R154	ERJ6GEYJ393	RES,M 39K-J-1/10	R508	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R201	ERJ6GEYJ471	RES,M 470-J-1/10	R509	ERDS2TJ331	RES,C 330-J-1/4
R202	ERJ6GEYJ682	RES,M 6.8K-J-1/10	<b>R510</b>	<b>ERG3FJ182H</b>	<b>RES,M 1.8K-J-3W</b>
R203	ERJ6GEYJ562	RES,M 5.6K-J-1/10	R512	ERG2FJ562H	RES,M 5.6K-J-2W
R303	ERJ6GEYJ682	RES,M 6.8K-J-1/10	<b>R531</b>	<b>ERD25FJ470</b>	<b>RES,C 47-J-1/4</b>
R304	ERJ6GEYJ332	RES,M 3.3K-J-1/10	<b>R532</b>	<b>ERJ6ENF4422</b>	<b>RES,M 44.2K-F-1/10</b>
R305	ERDS2CKF3001	RES,M 3K-F-1/4	<b>R533</b>	<b>ERJ6ENF1502</b>	<b>RES,M 15K-F-1/10W</b>
R306	ERJ6ENF1651	RES,M 1.65K-F-1/10	R536	ERJ6GEYJ223	RES,M 22K-J-1/10
R307	ERJ6GEYJ564	RES,M 560K-J-1/10	R537	ERJ6GEYJ473	RES,M 47K-J-1/10
R308	ERJ6GEYJ102	RES,M 1K-J-1/10	<b>R551</b>	<b>ERDS1FJ1R0</b>	<b>RES,C 1.0-J-1/2</b>
R309	ERJ6GEYJ333	RES,M 33K-J-1/10	<b>R552</b>	<b>ERDS1FJ1R0</b>	<b>RES,C 1.0-J-1/2</b>
R310	ERJ6GEYJ223	RES,M 22K-J-1/10	<b>R553</b>	<b>ERDS1FJ1R0</b>	<b>RES,C 1.0-J-1/2</b>
R311	ERJ6GEYJ185	RES,M 1.8MEG-J-1/10W	R554	ERG2FJ390H	RES,M 39-J-2W
R317	ERJ6GEYJ684	RES,M 680K-J-1/10	R555	ERDS1FJ101	RES,C 100-J-1/2
R319	ERJ6GEYJ122	RES,M 1.2K-J-1/10	R556	ERDS2TJ332	RES,C 3.3K-J-1/4
R320	ERJ6GEYJ102	RES,M 1K-J-1/10	R557	ERDS2TJ103	RES,C 10K-J-1/4
R351	ERG2FJ123H	RES,M 12K-J-2W	<b>R558</b>	<b>ERQ2CJP1R3</b>	<b>RES,F 1.3-J-2W</b>
R352	ERG2FJ123H	RES,M 12K-J-2W	R559	ERG2FJ683H	RES,M 12K-J-2W
R353	ERG2FJ123H	RES,M 12K-J-2W	R560	ERDS1FJ182	RES,C 1.8K-J-1/2
R354	ERDS1TJ272	RES,C 2.7K-J-1/2	R563	ERDS2TJ124	RES,C 120K-J-1/4
R355	ERDS1TJ272	RES,C 2.7K-J-1/2	R564	ERDS2TJ104	RES,C 100K-J-1/4
R356	ERDS1TJ272	RES,C 2.7K-J-1/2	R565	ERDS2TJ103	RES,C 10K-J-1/4
R357	ERDS2TJ301	RES,C 300-J-1/4	R567	ERG2FJ122H	RES,M 12K-J-2W
R358	ERDS2TJ301	RES,C 300-J-1/4	R602	ERJ6GEYJ331	RES,M 330-J-1/10
R359	ERDS2TJ301	RES,C 300-J-1/4	R603	ERJ6GEYJ331	RES,M 330-J-1/10
R360	ERDS2TJ102	RES,C 1K-J-1/4	R604	ERJ6GEYJ331	RES,M 330-J-1/10
R361	ERDS2TJ102	RES,C 1K-J-1/4	R614	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R362	ERDS2TJ102	RES,C 1K-J-1/4	<b>R801</b>	<b>ERF7ZK1R5</b>	<b>RES,W 1.5-K-7W</b>
R363	ERDS2TJ101	RES,C 100-J-1/4	R805	ERDS2TJ274	RES,C 270K-J-1/4
R364	ERDS2TJ101	RES,C 100-J-1/4	R806	ERDS2TJ274	RES,C 270K-J-1/4
R365	ERDS2TJ101	RES,C 100-J-1/4	R808	ERDS1FJ1R5	RES,C 1.5-J-1/2
R401	ERJ6GEYJ102	RES,M 1K-J-1/10	R809	ERDS1FJ1R5	RES,C 1.5-J-1/2
R451	ERDS1FJ1R2	RES,C 1.2-J-1/2	R810	ERDS1FJ272	RES,C 2.7K-J-1/2
R454	ERJ6GEYJ473	RES,M 47K-J-1/10	R812	ERDS1TJ183	RES,C 18K-J-1/2
R455	ERJ6GEYJ153	RES,M 15K-J-1/10	R813	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R456	ERJ6GEYJ562	RES,M 5.6K-J-1/10	<b>R815</b>	<b>ERC12ZGM825</b>	<b>RES,S 8.2MEG-M-1/2</b>
R457	ERJ6GEYJ911	RES,M 910-J-1/10	<b>R817</b>	<b>ERX3FJ4R7</b>	<b>RES,M 4.7-J-3W</b>
R458	ERJ6GEYJ273	RES,M 27K-J-1/10	R820	ERJ6GEYJ153	RES,M 15K-J-1/10
R459	ERJ6GEYJ683	RES,M 68K-J-1/10	R821	ERJ6GEYJ392	RES,M 3.9K-J-1/10
R460	ERDS2TJ102	RES,C 1K-J-1/4	R822	ERD50FJ474	RES,C 470K-J-1/2W
R462	ERJ6GEYJ473	RES,M 47K-J-1/10	R823	ERDS2TJ222	RES,C 2.2K-J-1/4
R463	ERJ6GEYJ473	RES,M 47K-J-1/10	R824	ERG3FJ680H	RES,M 68-J-3W
R465	ERJ6GEYJ103	RES,M 10K-J-1/10	R825	ERDS2TJ102	RES,C 1K-J-1/4
R466	ERJ6GEYJ103	RES,M 10K-J-1/10	R826	ERF2AKR33	RES,W .33-K-2W
R467	ERJ6GEYJ104	RES,M 100K-J-1/10	R827	ERDS1FJ561	RES,C 560-J-1/2
R468	ERJ6GEYJ101	RES,M 100-J-1/10	R828	ERG3FJ470H	RES,M 47-J-3W
R469	ERJ6GEYJ220	RES,M 22-J-1/10	R829	ERQ14AJ270	RES,F 27-J-1/4
R470	ERDS2TJ152	RES,C 1.5K-J-1/4	R2201	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R471	ERJ6GEYJ223	RES,M 22K-J-1/10	R2202	ERJ6GEYJ153	RES,M 15K-J-1/10
R501	ERJ6GEYJ102	RES,M 1K-J-1/10	R2203	ERJ6GEYJ104	RES,M 100K-J-1/10

# REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

**Important Safety Notice:** Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
R2204	ERJ6GEYJ473	RES,M 47K-J-1/10			<b>TRANSFORMERS</b>
R2205	ERJ6GEYJ154	RES,M 150K-J-1/10	T001	TLP16297	TRANSFORMER, POWER SUPPLY
R2206	ERJ6GEYJ102	RES,M 1K-J-1/10	T501	ETH19Y70AYM	TRANSFORMER, HORIZONTAL DRIVER
R2207	ERJ6GEYJ102	RES,M 1K-J-1/10			
R2208	ERJ6ENF9102	RES,M 91K-F-1/10	T502	ETE19Z30AY	TRANSFORMER, HORIZONTAL COUPLING
R2212	ERJ6GEYJ682	RES,M 6.8K-J-1/10			
R2301	ERQ2CJP120	RES,F 12-J-2W	T551	KFT3AB054F	TRANSFORMER, FLYBACK
R2303	ERD25FJ1R0	RES,C 1.0-J-1/4	T801	ETS25AD129NC	TRANSFORMER
R2306	ERJ6GEYJ682	RES,M 6.8K-J-1/10			<b>CRYSTALS/FILTERS</b>
R2310	ERDS2TJ221	RES,C 220-J-1/4	X001	TSS2080MX	CRYSTAL, 12 MHZ CLOCK
R2311	ERJ6GEYJ103	RES,M 10K-J-1/10	X101	M1969M	SAW FILTER
R2312	ERJ6GEYJ682	RES,M 6.8K-J-1/10	X102	EFCWS4504AB	FILTER 4.5MHZ
R2313	ERJ6GEYJ683	RES,M 68K-J-1/10	X201	EFCS4R5MS5W	FILTER 4.5MHZ BANDPASS
R2314	ERJ6GEYJ104	RES,M 100K-J-1/10	X501	TAFC5B503F38	CRYSTAL, CLOCK
R2317	ERJ6GEYJ561	RES,M 560-J-1/10	X601	TSS2AA001	CRYSTAL, 3.58MHZ
R2318	ERJ6GEYJ103	RES,M 10K-J-1/10			<b>OTHERS</b>
R2319	ERDS2TJ392	RES,C 3.9K-J-1/4	M001	A51KQN011X	CRT 20"
R2321	ERDS2TJ101	RES,C 100-J-1/4	M002	EASG9D550B2	SPEAKER
R2322	ERJ6GEYJ472	RES,M 4.7K-J-1/10	TNR001	ENV56D18G3	TUNER
R2353	ERD25FJ1R0	RES,C 1.0-J-1/4	M003	HL00761	TRANSMITTER, REMOTE CONTROL
R2356	ERJ6GEYJ682	RES,M 6.8K-J-1/10	M004	TBX1886601	PUSHBUTTON, SPEAKER
R2357	ERJ6GEYJ103	RES,M 10K-J-1/10	M005	TBX2A50211G	ASSY. 7 PUSHBUTTON
R2358	ERJ6GEYJ122	RES,M 1.2K-J-1/10	JK351	TJSC00300	CRT SOCKET
R2359	ERJ6GEYJ103	RES,M 10K-J-1/10	M006	TMM2A30702	WEDGE, YOKE
R2360	ERJ6GEYJ122	RES,M 1.2K-J-1/10	M007	TPC2AA03901	PKG., RSC
R2361	ERJ6GEYJ681	RES,M 680-J-1/10	M008	TPD2A30261-1	PKG., TOP PAD
R2362	ERJ6GEYJ681	RES,M 680-J-1/10	M009	TPD2A30262	PKG., BOTTOM PAD
R3001	ERJ6GEYJ473	RES,M 47K-J-1/10	M010	TQB2AA0180	MANUAL, OWNERS
R3002	ERJ6GEYJ104	RES,M 100K-J-1/10			20CX20B511
R3005	ERDS2TJ750	RES,C 75-J-1/4	M011	TQB2AA0181	MANUAL, OWNERS (BI-LING)
R3006	ERDS2TJ390	RES,C 39-J-1/4			20CX20B501
R3009	ERDS2TJ682	RES,C 6.8K-J-1/4	M012	TQB2AA0182	MANUAL, OWNERS (SPANISH)
R3010	ERJ6GEYJ334	RES,M 330K-J-1/10			20CX20B521
R3011	ERDS2TJ682	RES,C 6.8K-J-1/4	M013	TSX2AA0011	LINE CORD
R3012	ERDS2TJ334	RES,C 330K-J-1/4	M014	TXFKU2497SER	ASSY. CABINET BACK 20"
R3013	ERDS2TJ682	RES,C 6.8K-J-1/4			20CX20B501
R3014	ERDS2TJ682	RES,C 6.8K-J-1/4	M015	TXFKU2597SER	ASSY. CABINET BACK 20"
		<b>SWITCHES</b>			20CX20B511
S001	EVQQBH12T	SWITCH, PUSH	M016	TXFKU2697SER	ASSY. CABINET BACK 20"
S002	EVQQBH12T	SWITCH, PUSH			20CX20B521
S003	EVQQBH12T	SWITCH, PUSH	M017	TXFKY2797SER	ASSY. CABINET FRONT 20"
S004	EVQQBH12T	SWITCH, PUSH			20CX20B501 20CX20B511
S005	EVQQBH12T	SWITCH, PUSH	M018	TXFKY2897SER	ASSY. CABINET FRONT 20"
S006	EVQQBH12T	SWITCH, PUSH			20CX20B521
S007	EVQQBH12T	SWITCH, PUSH	M019	TXF3A011DB2	ASSY. DAG GROUND
S2301	ESB621283	SWITCH, CATV	M020	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
			JK3001	TJB2A9063B	ASSY. JACK 1AV

**DESCRIPTION OF ABBREVIATIONS  
GUIDE**

RESISTOR			
TYPE		TOLERANCE	
C	Carbon	F	+/- 1%
F	Fuse	J	+/- 5%
M	Metal Oxide	K	+/- 10%
S	Solid	M	+/- 20%
W	Wire Wound	G	+/- 2%

RES, C 270-J-1/4

CAPACITOR			
TYPE		TOLERANCE	
C	Ceramic	C	+/- 0.25pF
E	Electrolytic	D	+/- 0.5pF
P	Polyester	F	+/- 1pF
S	Styrol	J	+/- 5%
T	Tantalum	K	+/- 10%
		L	+/- 15%
		M	+/- 20%
		P	+100% -0%
		Z	+80% -20%

CAP, P .068UF-K-50V

# SERVICEMAN MODE (ELECTRONIC CONTROL) SERVICE ADJUSTMENT VALUES

Model \_\_\_\_\_ Ser # \_\_\_\_\_ Date \_\_\_\_\_

**Note: Record the original settings PRIOR to modifying the registers.**

Mode	Service Adjustment	Adjustment Range	Def. Val.	Original Value	New Value
<b>Sub Adjustments</b>					
B0	Sub Color	0 ~ 63	33		
B1	Sub Tint	0 ~ 63	33		
B2	Sub Brightness	0 ~ 255	80		
B3	Sub Contrast	0 ~ 63	34		
B4	Killer/ABL/Gamma	0 ~ 7	5		
B5	Video Adjustment	0 ~ 15	8		
B6	Audio Adjustment	0 ~ 31	16		
B7	V-Size	0 ~ 63	20		
<b>White Balance Adjustments</b>					
C0	RED Cutoff	*	0 128		
C1	GRN Cutoff	0 ~ 255	64		
C2	BLU Cutoff	*	0 128		
C3	R Drive	0 ~ 127	64		
C4	Blue Drive	0 ~ 127	64		
C5	YNR Switch	0 ~ 1	0		
C6	AFT	*	0 120		
C7	RF AGC	0 ~ 127	64		
C8	YNR	0 ~ 7	0		
C9	Horizontal-Center	0 ~ 31	16		
Ca	Beam Limit	0 ~ 7	0		
Cb	Y Delay	0 ~ 2	2		

Mode	Service Adjustment	Adjustment Range	Def. Val.	Original Value	New Value
<b>Options Adjustments</b>					
S0	PIP Color	0 ~ 63	25	N/A	N/A
S1	PIP Contrast	0 ~ 127	52	N/A	N/A
S2	Up 1/9	0 ~ 255	26	N/A	N/A
S3	Down 1/9	0 ~ 255	146	N/A	N/A
S4	Left 1/9	0 ~ 255	9	N/A	N/A
S5	Right 1/9	0 ~ 255	103	N/A	N/A
S6	Up 1/16	0 ~ 255	27	N/A	N/A
S7	Down 1/16	0 ~ 255	163	N/A	N/A
S8	Left 1/16	0 ~ 255	9	N/A	N/A
S9	Right 1/16	0 ~ 255	118	N/A	N/A
Sa	Freerun	**	**	N/A	N/A
Sb	Clock Adjustment	0 ~ 255	128		
Sc	Pip Tint	0 ~ 63	50	N/A	N/A
Sd	Loudness Compensation	0 ~ 63	52		
<b>MTS Adjustments</b>					
M0	Input Level	0 ~ 63	31		
M1	Stereo PLLVCO	0 ~ 63	31		
M2	Filter	0 ~ 63	31		
M3	Low-level Separation	0 ~ 63	31		
M4	High-level Separation	0 ~ 63	31		

\*\* Factory Only.

\* Adjustment indicated in steps:

0 0 ~ 0 255

1 0 ~ 1 255



**Sheet 1 of 2**  
**Side B**

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# HITACHI

## SERVICE MANUAL

**PA****No. 0094**

### NA6L Chassis

## TECHNICAL INFORMATION

MODELS	NA6L	20CX20B501 20CX20B511 20CX20B521	 HITA-02935
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This NA6L chassis edition shows "Description of Circuit" and "ICs and Functions". When servicing each model listed above, it is highly recommended to use not only this edition but also each model's service manual.

**CAUTION:** Before servicing this chassis, it is important that the service technician read the "Safety Precaution" and "Product Safety Notices" in the service manual.

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**SPECIFICATIONS AND PARTS ARE SUBJECT TO CHANGE FOR IMPROVEMENT**

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## SOLID STATE COLOR TELEVISION

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**MAY 1997**

**HHEA-MANUFACTURING DIVISION**

The purpose of this Technical guide is to present an overall view of the circuits used in the NA6 Chassis. The Guide can assist the service technician in troubleshooting a receiver. By using general block diagrams, the technician can obtain an overall view of the entire system.

The Block Diagrams include a general description of each circuit. The purpose of these descriptions is to help the technician understand how a particular circuit operates.

By using block diagrams and circuit descriptions, the Technical Guide helps the technician to develop a knowledge of the NA6 Chassis.

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# BLOCK DIAGRAMS

COLOR TELEVISION SYSTEM

## NA6D/L CHASSIS

# SYNC SIGNAL PATH BLOCK DIAGRAM

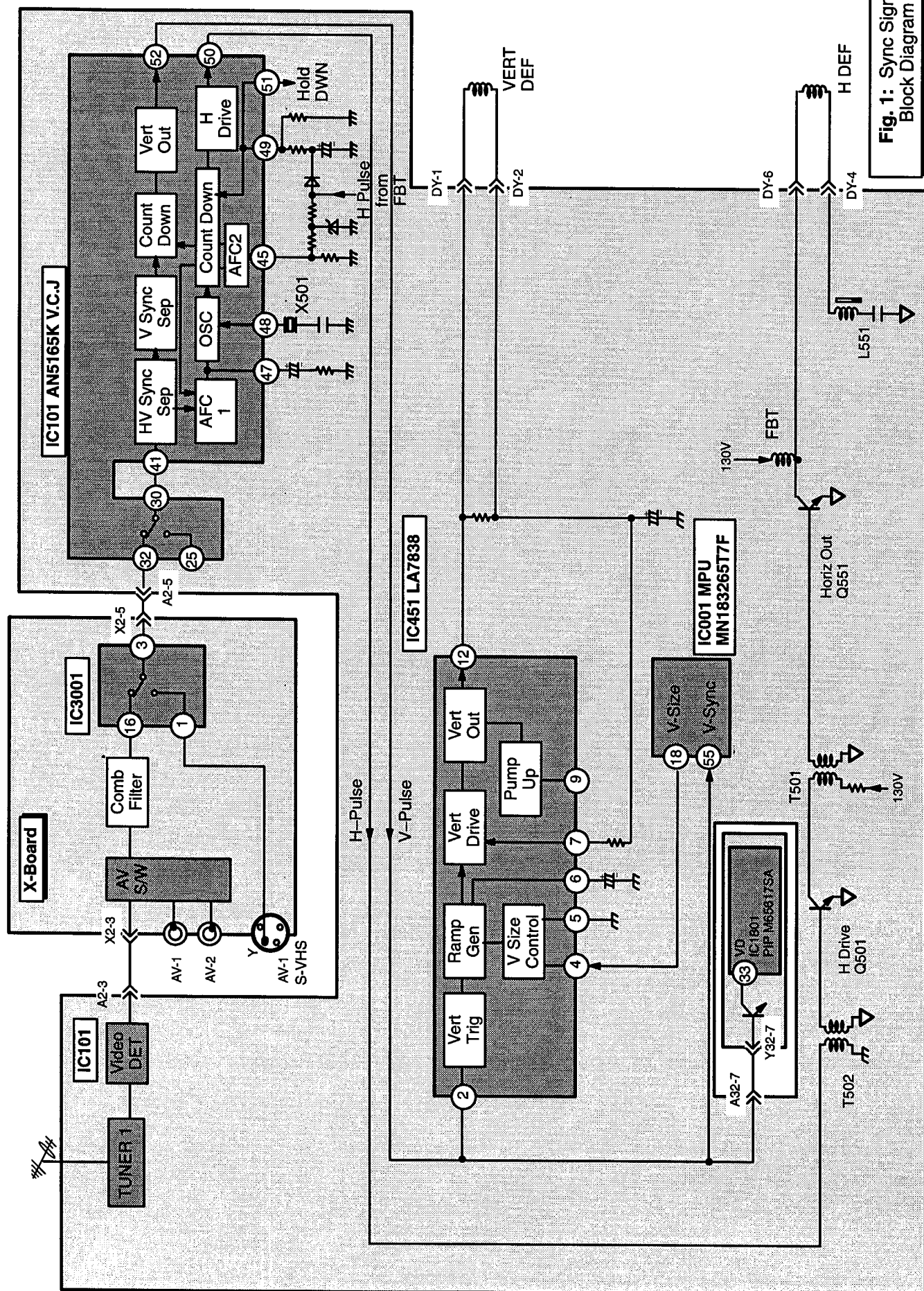


Fig. 1: Sync Signal Block Diagram



# VIDEO-CHROMA SIGNAL PATH BLOCK DIAGRAM NA6L CHASSIS (ONE VIDEO INPUT MODEL)

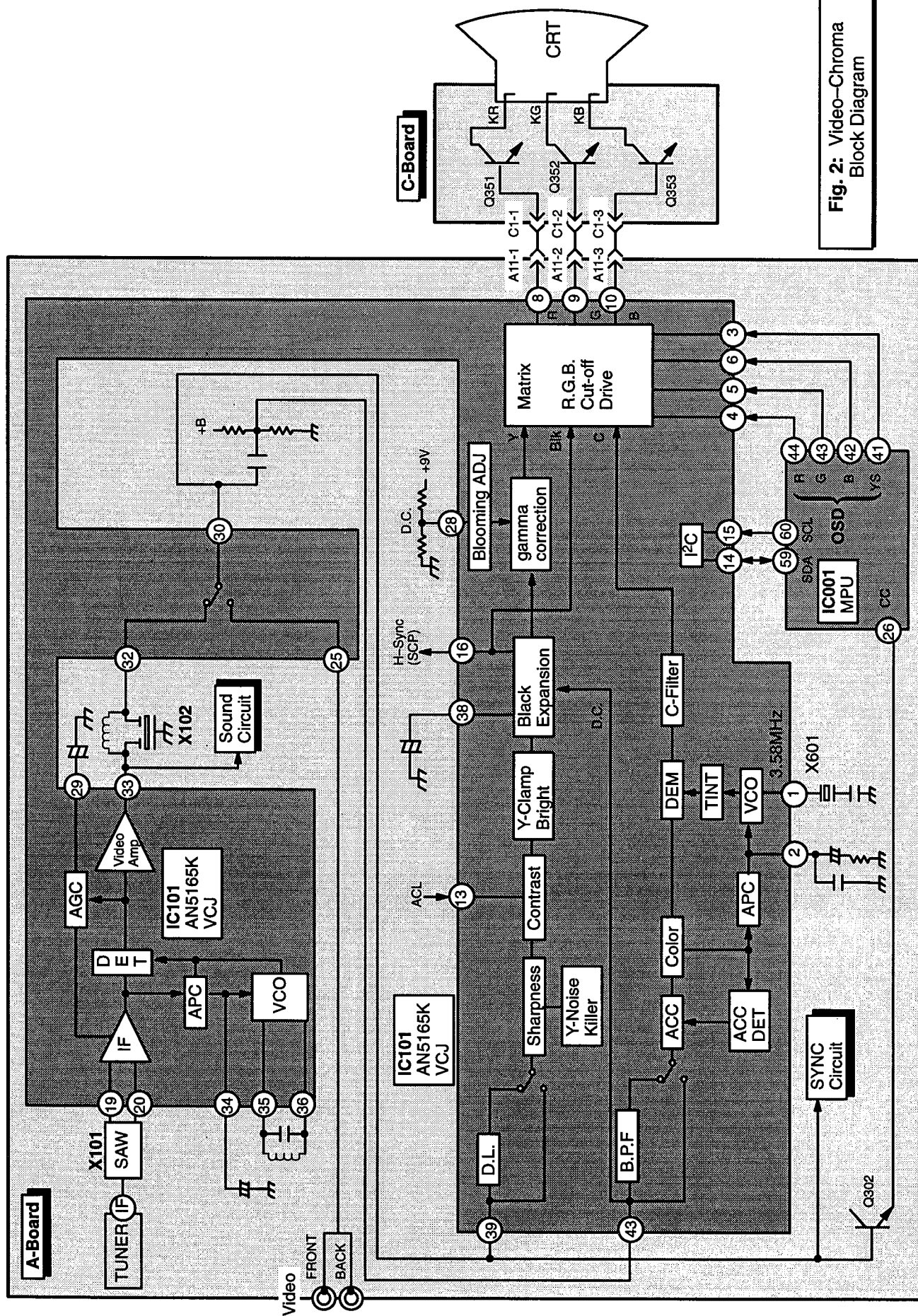
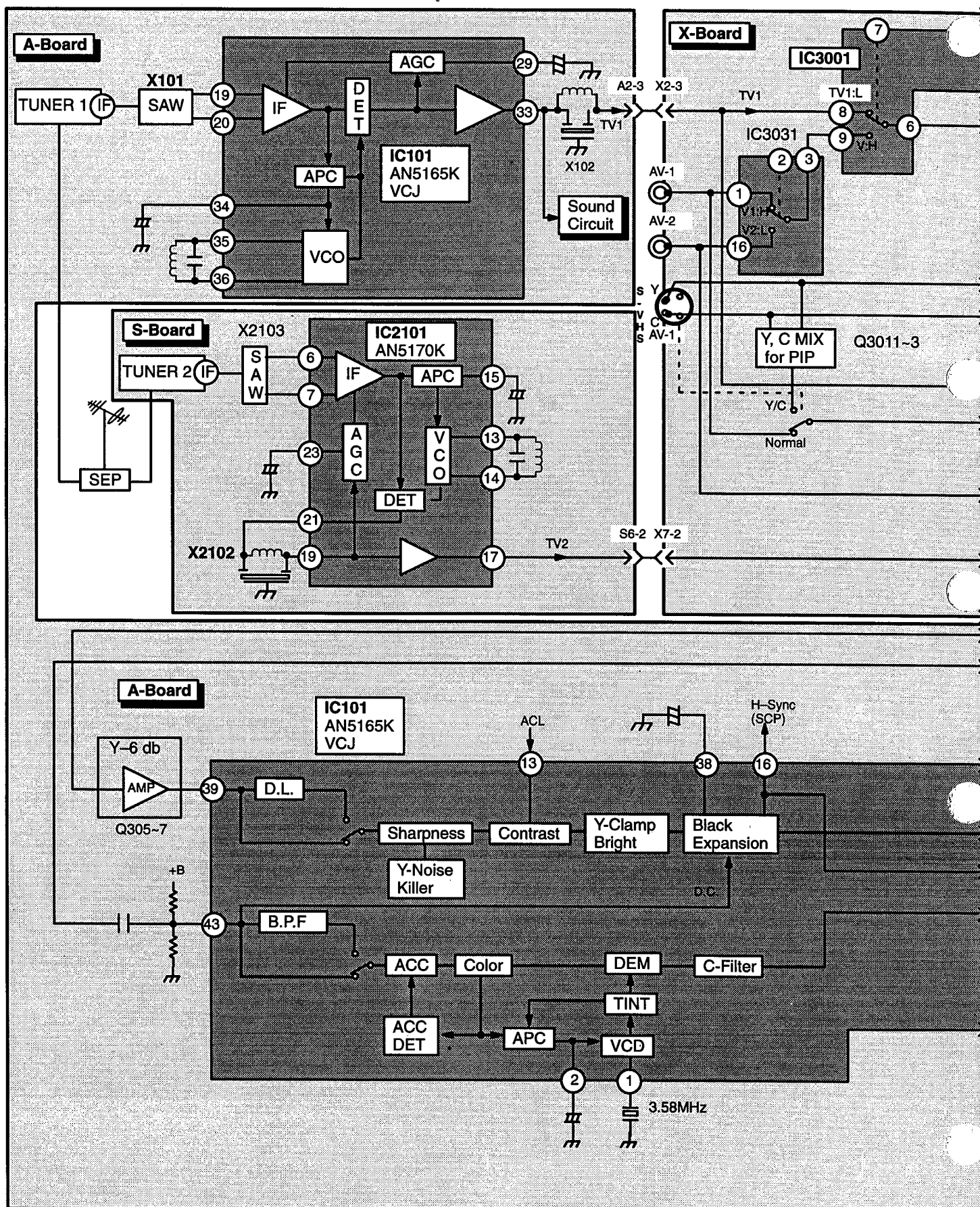
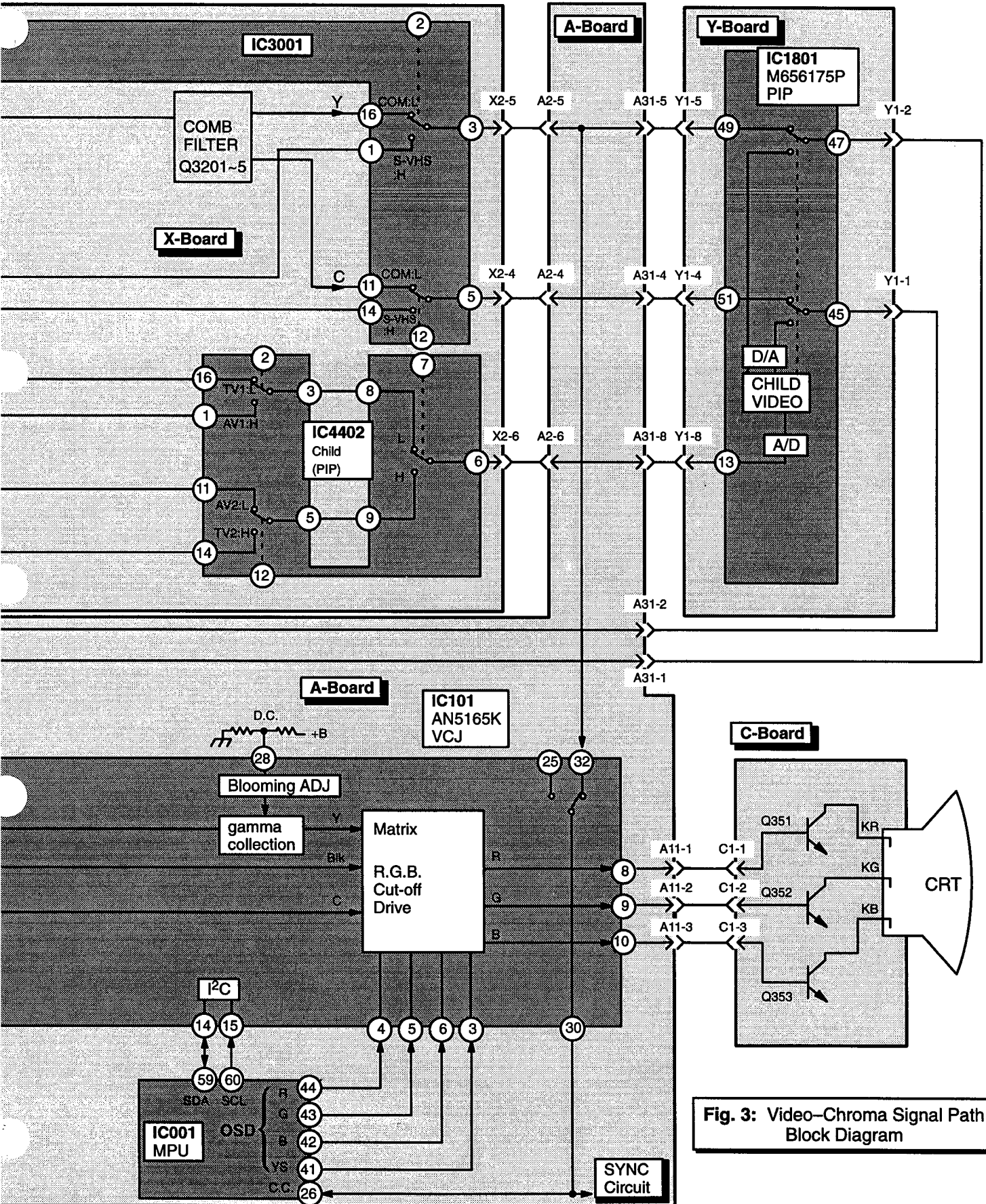


Fig. 2: Video-Chroma  
Block Diagram

# VIDEO-CHROMA SIGNAL PATH BLOCK DIAGRAM NA6D CHASSIS (TWO TUNER PIP MODEL)







**Fig. 3: Video-Chroma Signal Path Block Diagram**

# SOUND SIGNAL PATH BLOCK DIAGRAM

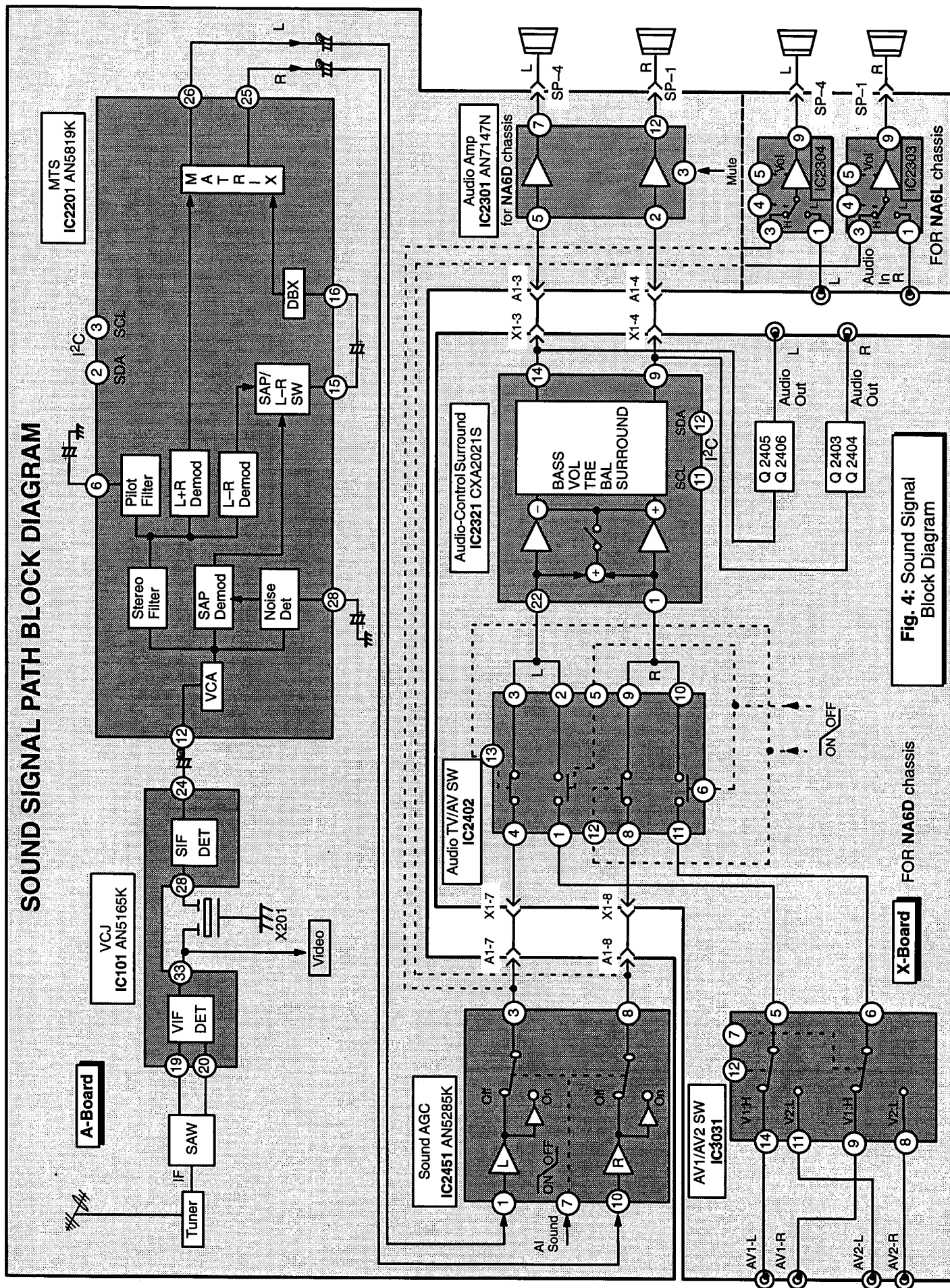
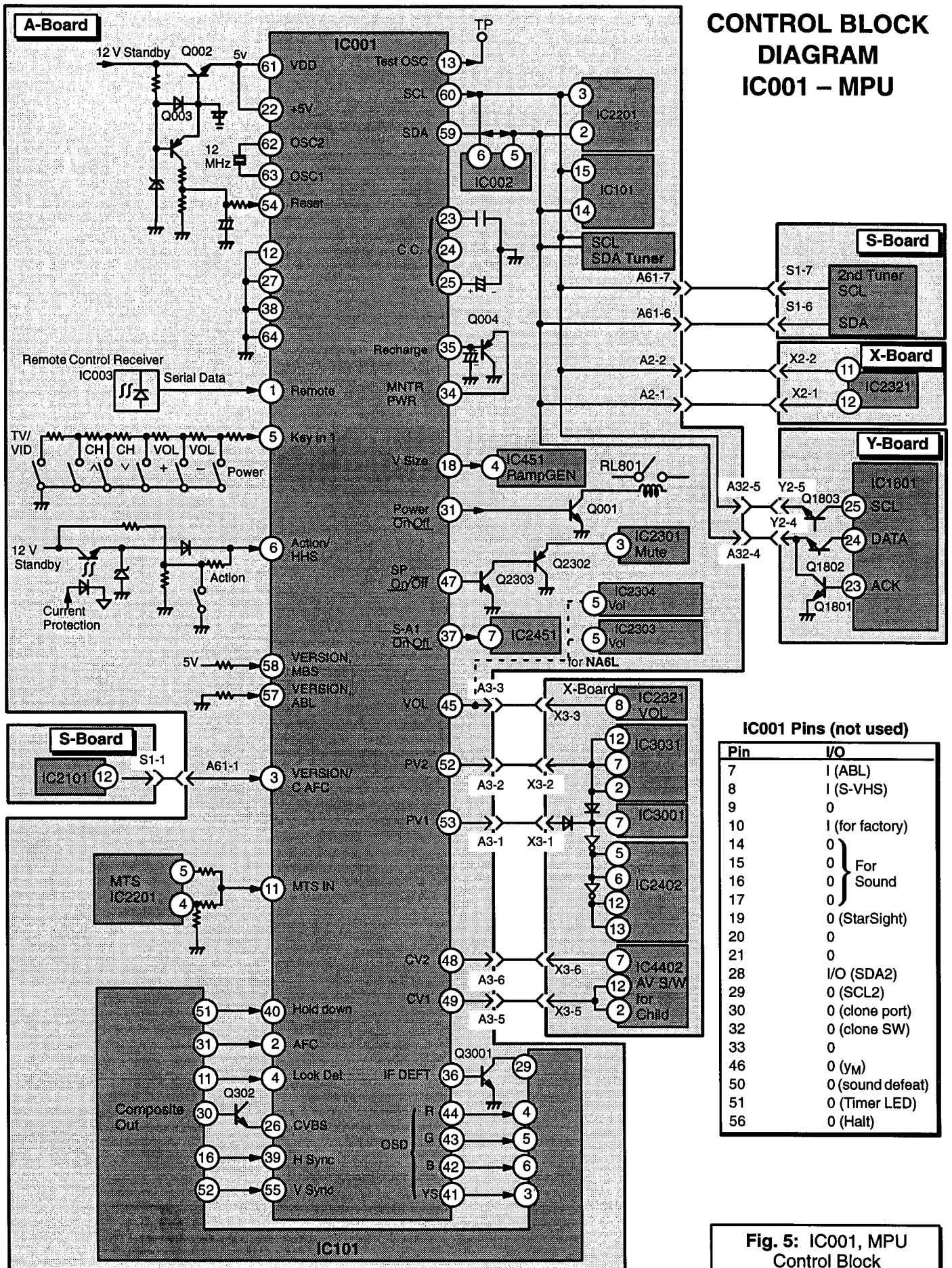


Fig. 4: Sound Signal Block Diagram





**Fig. 5: IC001, MPU**  
**Control Block**

## IC001 MPU IN/OUT PINS AND FUNCTIONS

Pin No.	In/Out	Name	Function
1	I	REMOTE	Remote control signal from the Infrared receivers input (48 bit Serial Data)
2	I	AFC	AFC voltage input form 1st. tuner (0~5.0V)
3	I	VERSION / C AFC	AFC voltage input form 2nd tuner (0~5.0V) or Version of model input 1
4	I	LOCK DET	H-Detect input H: If TV station horizontal sync and FBT horizontal pulse in sync
5	I	KEY IN 1	KEY-SCAN input 1 (0~0.5V:Power, 0.7~1.1V:Vol- , 1.4~1.7V:Vol+ , 2.0~2.4V:CH DW, 2.6~3.0V:CH UP, 3.3~3.6V:TV/AV)
6	I	ACTION / HHS	Action KEY & Current-Protection input (0~0.5V:Action, 3.9~5V:C-Protection, turn off the relay)
7	I	BEAM FB (NOT USED)	Beam FB (NOT USED)
8	I	S-VHS (NOT USED)	S-VHS input (NOT USED Composite:L, S-VHS:H)
9	O	SUB POWER (NOT USED)	(NOT USED)
10	I	FA1	Factory use
11	I	MTS IN	MTS receiving status input for OSD (0~0.6V:Stereo+SAP, 0.9~1.9V:Stereo, 2.2~3.8V:SAP, 4.0~5.0V:Mono)
12	-	MODE	GND
13	O	TEST OSC	TEST OSC Output
14	O	BASS	Sound control for Bass (NOT USED)
15	O	TREBLE	Sound control for Treble (NOT USED)
16	O	BALANCE	Sound control for Balance (NOT USED)
17	O	SRND ON / OFF	Surround effect ON/OFF (NOT USED)
18	O	V-SIZE	Vertical size control
19	O	S.S. RST	(NOT USED)
20	O		(NOT USED)
21	O		(NOT USED)
22	-	AVDD 5V INPUT	5V input
23	O	C REF	Color REF. for Closed Caption
24	O	VPH	VPH for Closed Caption
25	O	VCP	VCP for Closed Caption
26	I	CVBS	Composite signal input for Closed Caption
27	-	CC GND	CC GND
28	I/O	SDA2	2nd Serial DATA in-out (I <sup>2</sup> C-Bus) (NOT USED)
29	O	SCL2	2nd Serial CLOCK out (I <sup>2</sup> C-Bus) (NOT USED)
30	O	CLONE PORT	(NOT USED)
31	O	POWER	Power Relay control output (ON:H, OFF:L)
32	O	CLONE SW	(NOT USED)
33	O	DATA IN	(NOT USED)
34	I	MNTR PWR	Momentary power down detect (Reset:L, Normal:H)
35	O	RECHARGE	Always High
36	O	IF DEFT	IF defeat output to make maximum gain for the IF AGC (Defeat:H, Normal:L)
37	O	S-AI ON/OFF	AI Sound On/Off control output (On:H, Off:L)
38	-	GND	GND
39	I	H SYNC	Horizontal sync signal input for OSD
40	I	HOLD DOWN	Hold down detect input to turn off the relay (Detects less than 1.2V)
41	O	YS	Background OSD output (to select the OSD R,G,B and Picture)
42	O	OSD B	OSD output for Blue
43	O	OSD G	OSD output for Green
44	O	OSD R	OSD output for Red
45	O	VOL	Volume control output
46	O	YM	PWM/VOL (NOT USED)
47	O	SP ON/OFF	Speaker Switch output (On:L, Off:H)
48	O	CV2	Child Picture selection output 2 (TV1 & AV1:L, AV2 & TV2:H)
49	O	CV1	Child Picture selection output 1 (TV1 & AV2:L, AV1 & TV2:H)
50	O	S DEFT	Sound defeat On:H, Off:L (NOT USED)
51	O	MATE CLK	Timer LED On:L, Off:H (NOT USED)
52	O	PV2	Parent Picture selection output 2 (TV1 & AV1:L, AV2 & AV1:H)
53	O	TV/V PV1	Parent Picture selection output 1 (TV1 & AV2:L, AV1:H)
54	I	RESET	Reset voltage input (more than 4.3v will operate MPU)
55	I	V SYNC	Vertical sync signal input for OSD
56	O	HALT	(NOT USED)
57	I	VERSION ABL	Version of model input or ABL input
58	I	VERSION MSB	Version of model input or MSB input
59	I/O	SDA	Serial DATA in-out (I <sup>2</sup> C-Bus)
60	O	SCL	Serial CLOCK out (I <sup>2</sup> C-Bus)
61	-	VDD 5V	5V input
62	I	OSC2	12MHz OSC input
63	O	OSC1	12MHz OSC output
64	-	GND	GND

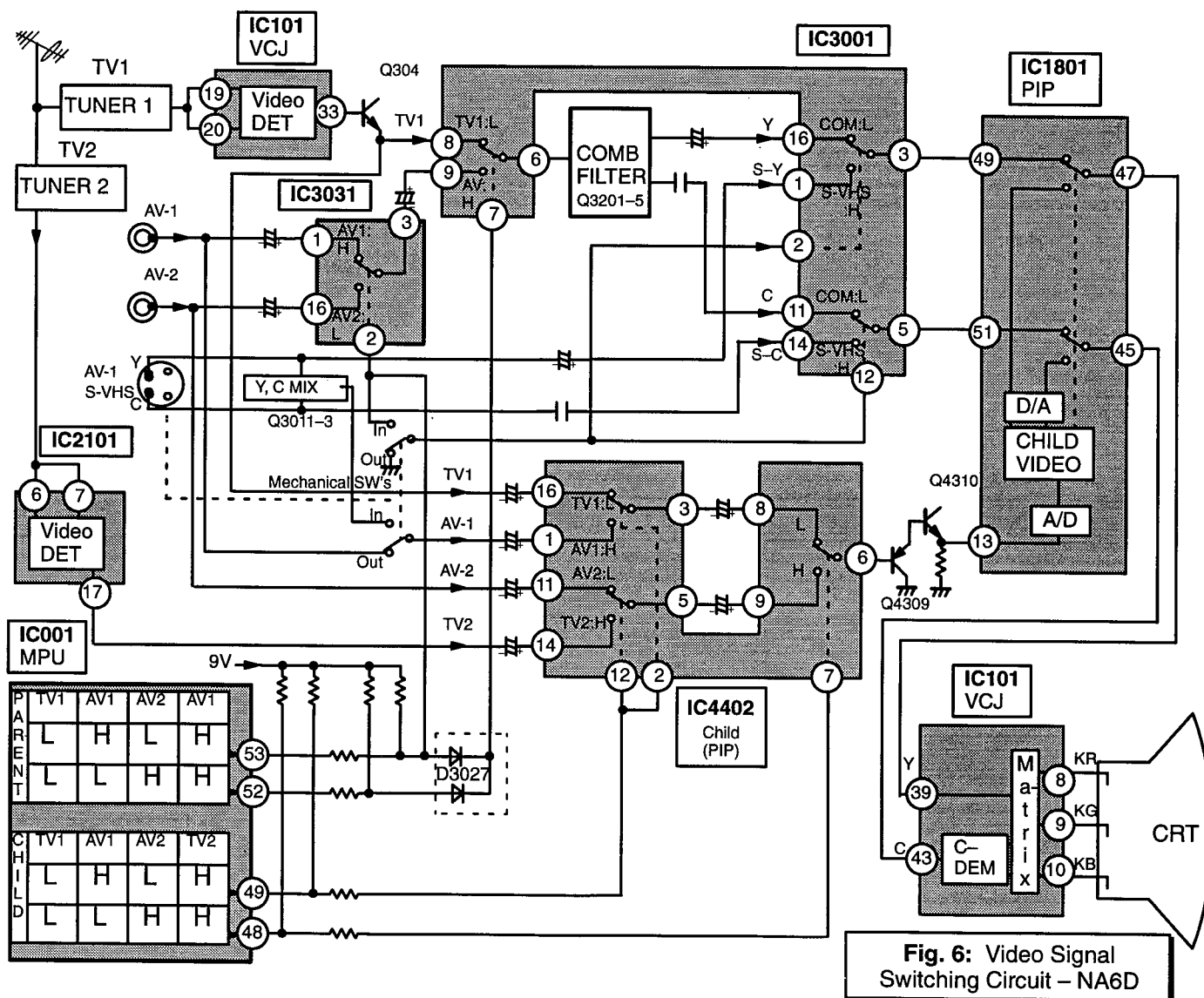
# **SIGNAL SWITCHING**

**COLOR TELEVISION SYSTEM**

**NA6D/L CHASSIS**

## VIDEO SIGNAL SWITCHING CIRCUIT

### NA6D Chassis (Two Tuner PIP Model)

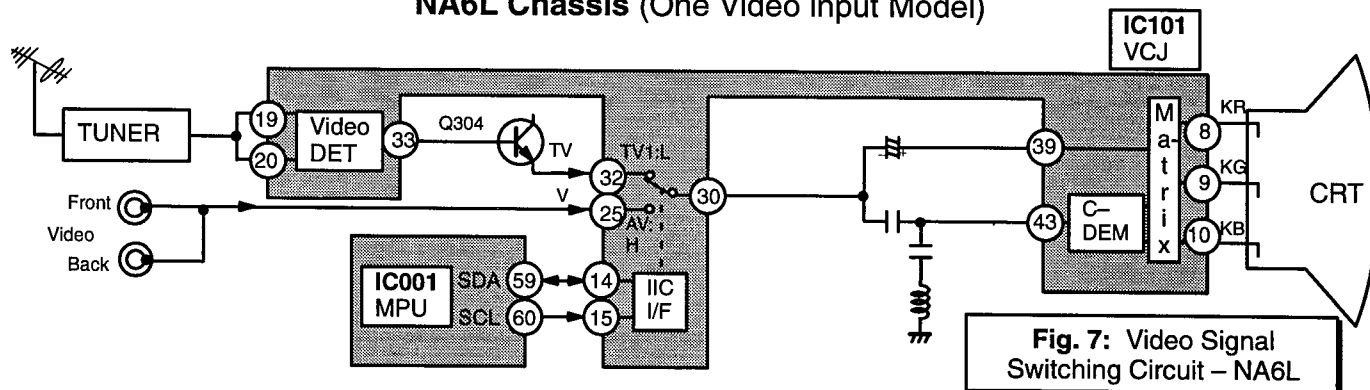


**Fig. 6: Video Signal Switching Circuit – NA6D**

All video switching is controlled by the output voltages of pins 53, 52, 49, and 48 of the MPU (IC001). The

control matrix for the output signals is shown in the figure above.

### NA6L Chassis (One Video input Model)

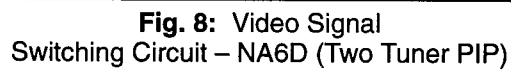


**Fig. 7: Video Signal Switching Circuit – NA6L**

On single tuner models, video switching is controlled by the MPU through the I<sup>2</sup>C Bus. The VCJ receives the commands and switches between the signals at pins 32

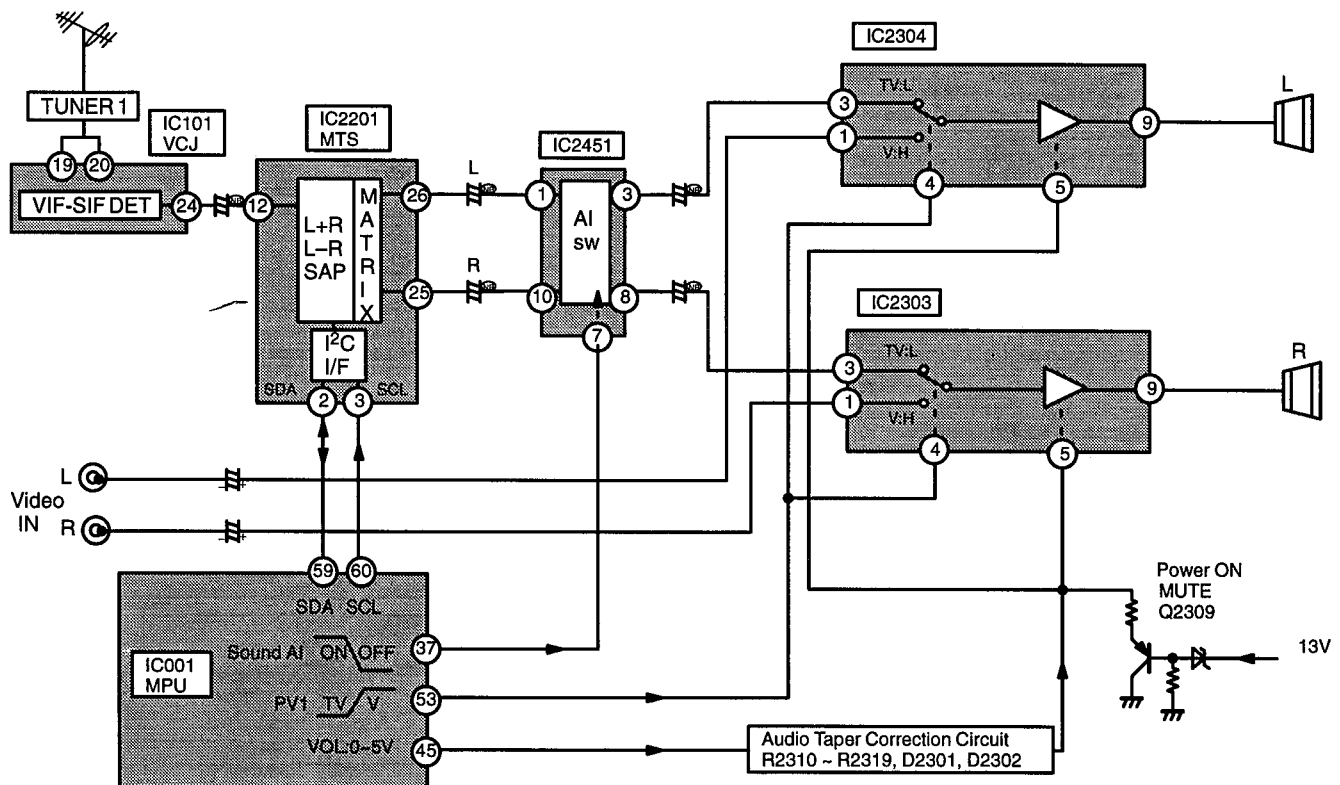
(TV) and 25 (Video). The output of the switch goes to pin 30 of the MPU.

## NA6D Chassis (Two Tuner PIP Model)



AI sound and mute functions are turned On/Off through Pins 37 (AI sound) and 47 (Mute) of the MPU.

## NA6L Chassis (One Video input Model)



**Fig. 9: Video Signal Switching Circuit – NA6L (One Video input)**

The sound switching between TV and Video input signal is selected by the switches in IC2304 and IC2303. Pin 53 of the MPU IC001 supplies the switching voltage. The Multiple Television (MTS) Sound system is controlled by IC001 via the I<sup>2</sup>C bus.

AI sound is turned on/off through pin 37 of the MPU. Volume is controlled by pin 45 of the MPU after it has passed through the audio taper circuit. When the TV is first turned on, Q2309 mutes the audio until +13 volts is present.



# AUDIO

COLOR TELEVISION SYSTEM

**NA6D/L CHASSIS**

## SOUND AGC

The sound AGC circuit detects changes in volume level. It controls the sound by lowering the high levels to a pre-determined maximum level, and increases the low levels. It is primarily used to lower sudden changes in volume due to commercials. Additional benefit is the equalization of the sound level among TV channels and various sound sources attached to the TV via the A/V jacks.

The sound level is monitored by level sensor 2, IC2451 (AN5285K). The output from level sensor 2 is fed to a control circuit that provides a gain factor for the VCA amplifiers. At a level, predetermined by the components connected to pins 2 and 9, the switch toggles the contacts, lowering the gain applied to the output terminals.

Pin 7 controls the AGC ON/OFF. AGC is off when pin 7 is greater than 1.2V.

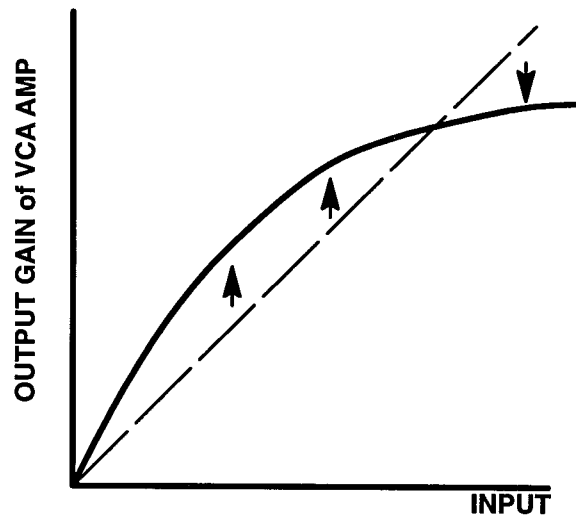


Fig. 10: AGC Effect on Sound

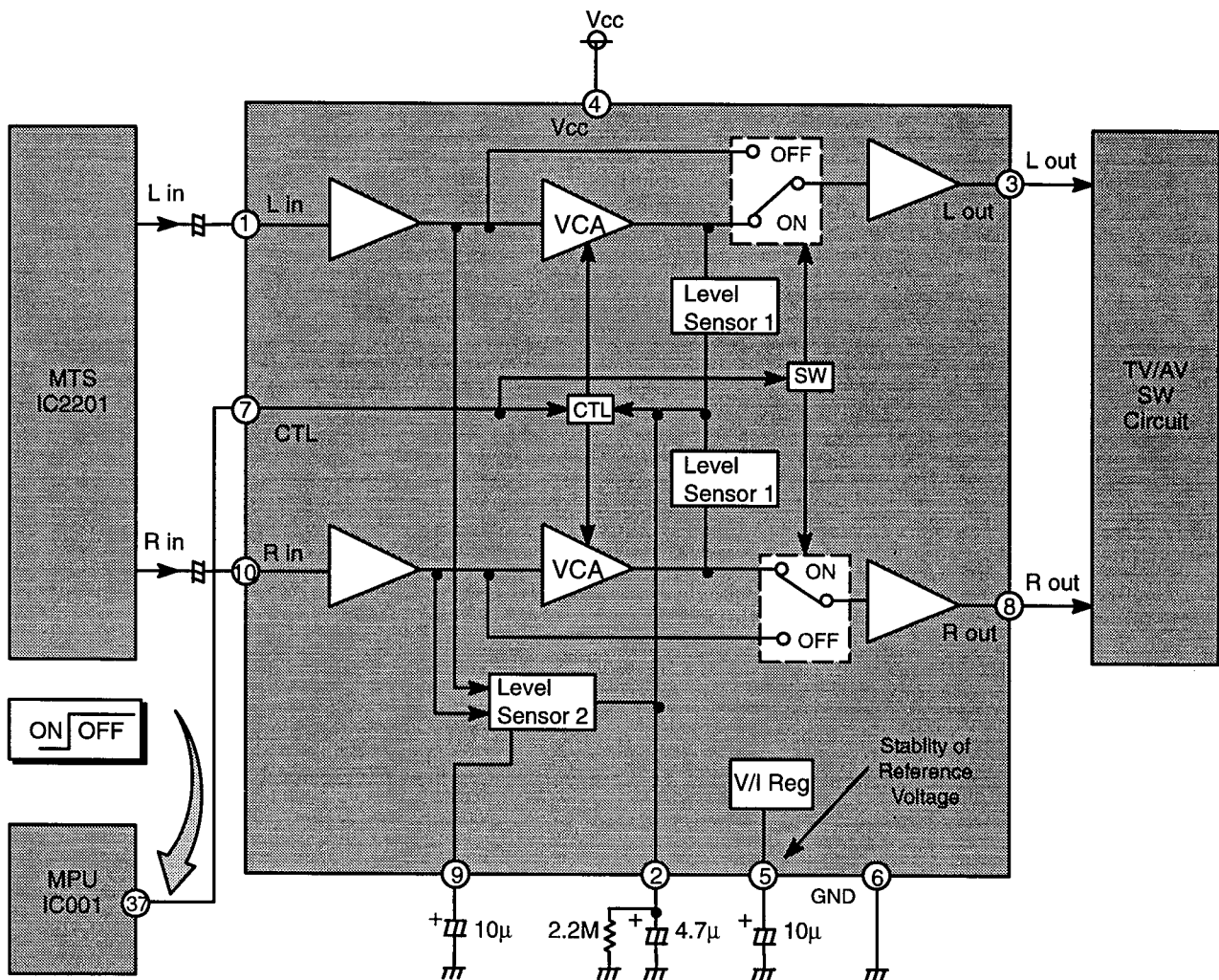


Fig. 11: Sound AGC, IC2451 Block Diagram

# MULTIPLEX TELEVISION SOUND (MTS) CIRCUIT

## IC2201, AN5819K

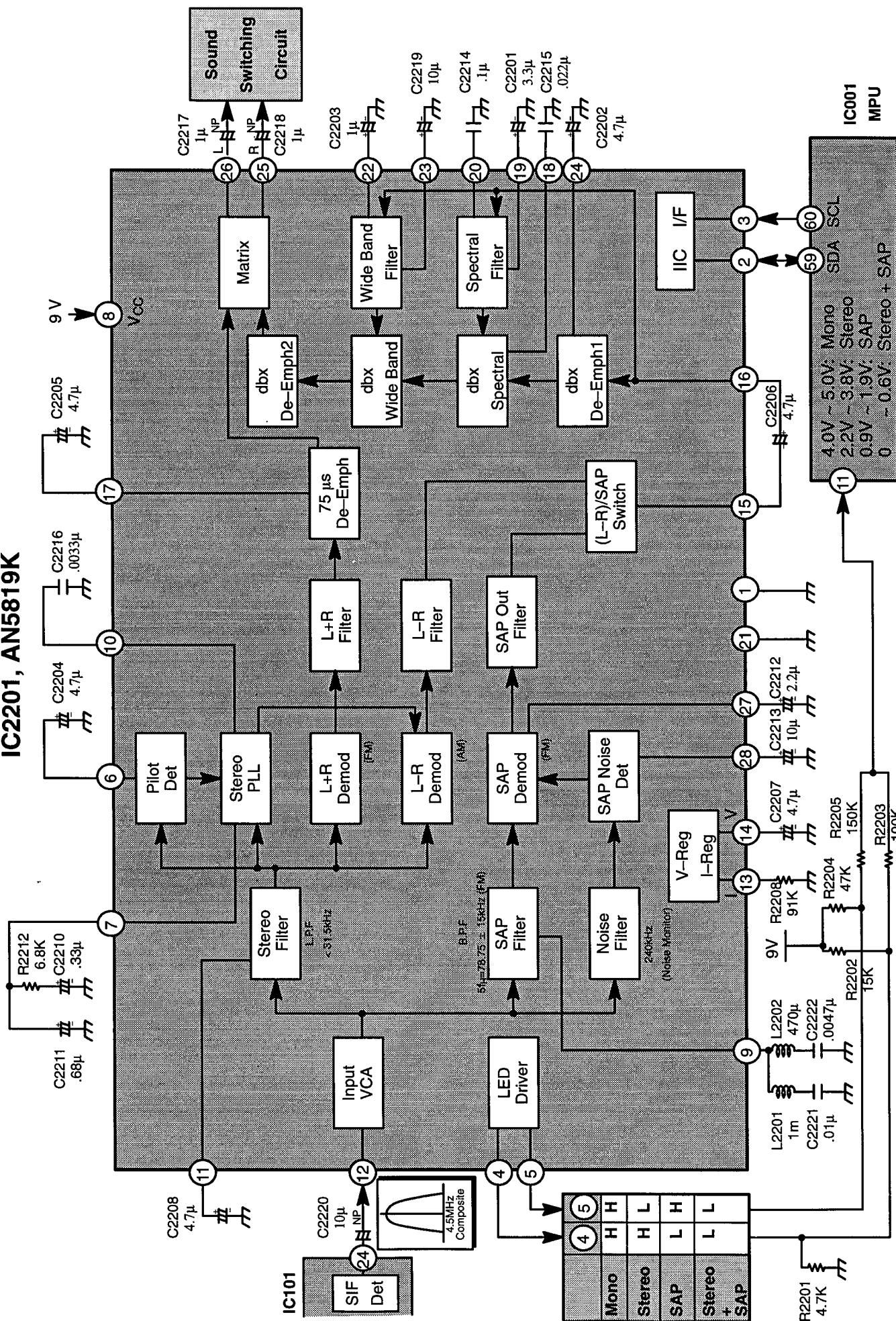


Fig. 12: Multiplex Television Sound (MTS) Block Diagram

## SOUND DETECTION AND SEPARATION – OPERATION

The audio signal from IC101 pin 24 (SIF detector) is applied to pin 12 of IC2201 (MTS).

The signal is processed via a stereo filter which is a low pass filter (L.P.F.), for signals below 31.5kHz. Signal from the L.P.F. contains the L+R signal (mono) and may also contain the L-R (for stereo broadcasting) signal and a Stereo Pilot signal (indicating stereo broadcast). The signal is applied to four circuits:

- Pilot detector
- Stereo PLL
- L + R (mono) demodulator (FM)
- L – R demodulator (AM)

### Mono or L + R Signal

① The mono (L+R) signal is FM demodulated and passed through to the L+R filter. The high frequency components of the signal are de-emphasized and then sent to the matrix circuit for left and right channel simulation.

② When the 15.75 kHz stereo pilot signal is detected at pin 6, the stereo PLL circuit switches on the L – R demodulator. The amplitude modulated L – R signal is then demodulated.

③ The SAP filter is a Band Pass filter (B.P.F.) with 50 kHz and 108 kHz traps. The signal at pin 9 is passed to the SAP demodulator. The SAP signal is a FM modulated +/- 15 kHz signal at 78.75 kHz (5Fh) in the secondary channel.

### L – R Signal

① When the stereo pilot signal is detected at 15.75kHz (at pin 6, indicating stereo broadcast), the amplitude modulated stereo PLL switches the L-R demodulator which then demodulates the AM signal.

② The high frequency noise of the L-R signal is removed by the L-R filter.

③ The signal is passed through the L-R/SAP switch which is controlled by the I<sup>2</sup>C bus according to the selection entered by the user, and the signal outputs the IC via pin 15.

④ The signal from pin 15 is passed through a capacitor and is re-inserted into the IC through pin 16, and applied to a dbx circuit.

### SAP (Second Audio Program) mode

① The input signal applied at pin 12 is fed through a SAP filter and a noise filter. The noise filter

removes signals around 240kHz. The signal is passed through a SAP noise detector and into the SAP (FM) demodulator to mute the SAP demodulator.

② The SAP signal is passed through the L-R/SAP switch and the signal outputs the IC via pin 15.

### dbx Effect

① The dbx effect in the SAP or L-R signal that was added for transmission is removed.

② The audio signal that is applied at pin 16 is sent through a spectral filter that detects high audio levels and reduces the gain.

③ The audio signal is also sent through a wide band filter which detects low levels and also reduces the gain.

④ The signal continues to a matrix circuit.

**Note:** Pin 13 is timing current setting of the dbx rms value detection, which is set at approximately 1.3V

Pin 14 is the reference power supply stabilization voltage, which is set at approximately 4.5V.

### Matrix Circuit

The matrix circuit switches the output audio signal according to the selection received from the microprocessor IC001 (MPU) through the I<sup>2</sup>C bus, at pin 2 (SDA) and pin 3 (SCL), and output the signals through pins 25 (R) and 26 (L) to the sound switching circuit.

Selection	Matrix Effect
Mono	Select L+R or mono to output to pins 25 & 26
Stereo	$\frac{(L+R)+(L-R)}{2}$ to pin 26 $\frac{(L+R)-(L-R)}{2}$ to pin 25
SAP	Select SAP to output to pins 25 & 26

### On Screen Display (OSC) indication

Pins 4 and 5 are the OSD control output. that is fed to the MPU (IC001) to indicate which type of . sound system is used (mono, stereo or SAP). The signals from pins 4 and 5 are fed through a circuit of resistors that vary the voltage applied to the MPU pin 11. See the associated table and voltage levels indicated on the accompanying Block Diagram.

## AUDIO MULTIPLEX SYSTEM

### Abstract

In audio multiplex broadcasting, a separate sound signal, unrelated to the broadcast contents, is sent in addition to the monaural sound. This is done in order to accomplish transmission of stereo signals and is achieved via frequency multiplex technology. In today's broadcast, the traditional  $L + R$  signal is sent and the  $L - R$ . The signals are monitored, cleaned, decompressed and finally separated in the matrix circuit to the  $L$  and  $R$  components.

$$\begin{aligned} \text{Matrix: } (L+R) + (L-R) &= 2L \\ (L+R) - (L-R) &= 2R \end{aligned}$$

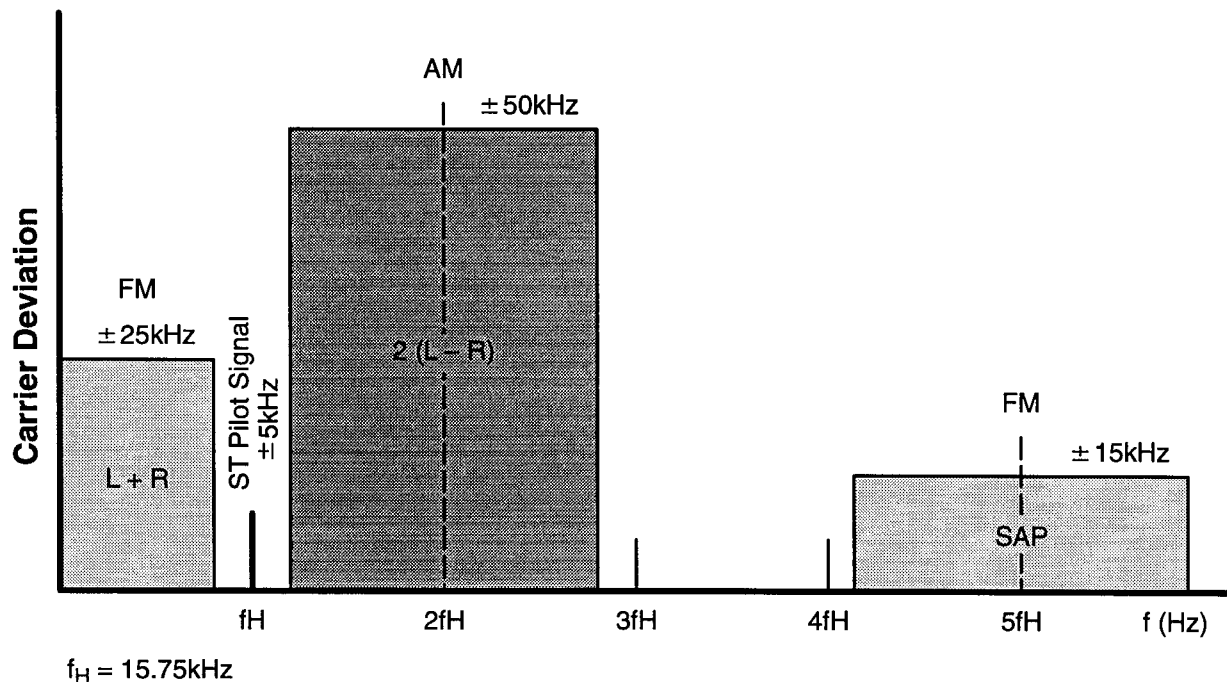
### The North American System

The North American Television sound system is composed of three types of modulation: FM, FM Multiplex (stereo and SAP) and AM.

**Monaural Broadcasting:** Monaural sound ( $L + R$ ) is sent as  $\pm 25\text{kHz}$  FM signal in the 4.5 MHz audio carrier wave.

**Multiplex Broadcasting:** The  $L$  (left) and  $R$  (right) signals are sent in two different "packets" in addition to other required signals. The multiplex signal has four components:

- ①  $L + R$  – identical to the monaural signal.
- ②  $L - R$  – amplitude modulated with a center frequency of 35.1 kHz (twice the horizontal frequency of 15.75 kHz.)
- ③ Secondary Audio Programming (SAP) – FM modulated ( $\pm 15\text{kHz}$ ) with a center frequency of 78.75 kHz ( $5f_H$ ).
- ④ Stereo pilot – FM signal at 15.75 kHz ( $\pm 5\text{kHz}$ ).



**Fig. 13: North American System (FM-AM-FM Multiplex)**

## NOTES

# VIDEO

COLOR TELEVISION SYSTEM

**NA6D/L CHASSIS**



# PIP CIRCUIT – IC1801, M65617SP

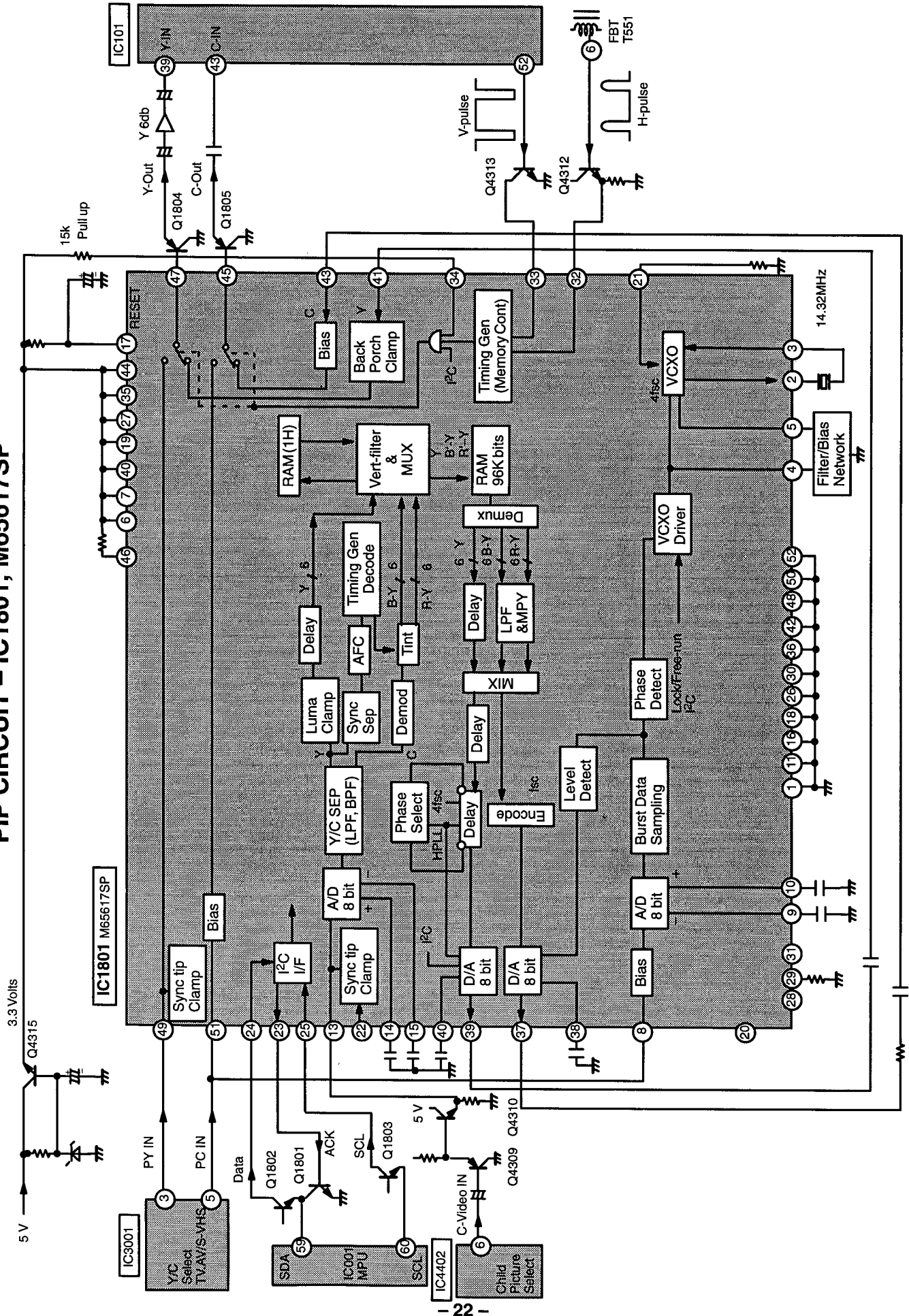


Fig. 14: PIP Circuit Block Diagram



## PIP CIRCUIT OPERATION

1. Picture-in-picture allows the viewer to view two programs simultaneously. There are two tuners (parent and child), plus video 1 and video 2. The heart of the PIP is IC 1801 (M65617SP) located on the Y board.
2. In non-PIP mode, the parent PY signal enters IC1801 at Pin 49 and the parent chroma PC signal at Pin 51. Both of these signals pass through an internal switch located within IC1801, and exit at Pin 47 (Y signal) and Pin 45 (chroma) of IC1801.
3. In PIP mode, the horizontal and vertical sync signals of the parent picture are used to determine the location of the PIP. The composite video from the child picture select IC enters IC1801 at Pin 13 via Q4309 and Q4310. This signal is then converted to digital data by an 8-bit analog to digital converter.
4. The digital signal is separated into Y and C data. The chroma data is demodulated and is fed along with the Y data, to the vertical filter and mux. The child or picture data is stored in RAM.
5. The heart of PIP is VCXO and the crystal on Pin 2. The digital data is sampled at 4fsc(14.31818MHz) time and is fed to two counters. One counter keeps track of horizontal lines. This determines the vertical position of PIP. The other counter counts the clock signal along the horizontal axis. This determines the horizontal position of the PIP. This information is stored in memory. When the scanning of the parent picture reaches the insert position, the video path is switched to the video memory. The image for the PIP is created from memory through the D/A converter.
6. The Y signal of child picture is the output from Pin 39. The C signal of child picture is the output from Pin 37.
7. These signals enter Pin 41 and Pin 43. Both of these signals pass through an internal switch.
8. The internal switch is controlled via the internal And gate. Input Pin 34 (And) is held high by the 15k pull up resistor. The positive edge of the horizontal sync pulse is "synched" to the timing generator and the output becomes the second high to the And gate. The third input line to the And gate is high or low based on the data from I<sup>2</sup>C bus.
9. The PIP signal from Pin 47 and Pin 45 to pass IC101.

# VIDEO/CHROMA CIRCUIT

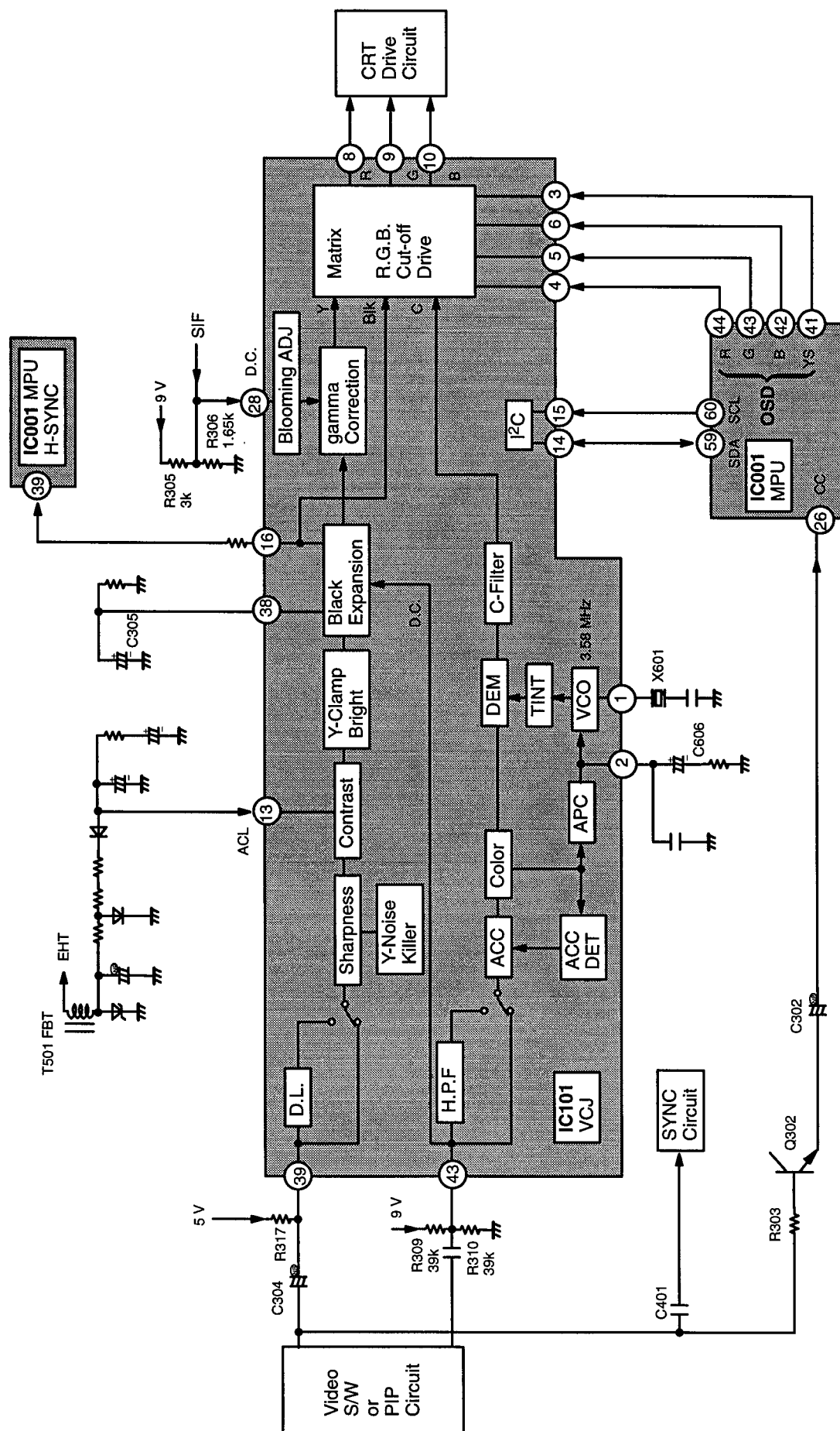
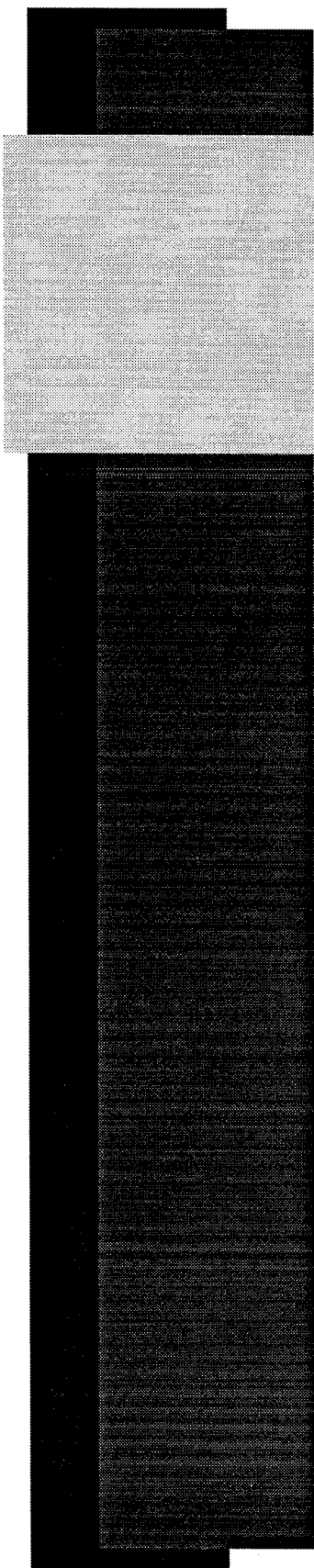


Fig. 15: Video/Chroma IC Block Diagram

## VIDEO/CHROMA OPERATION

1. The signal output of the surface acoustic wave (saw) filter enters IC101 (AN5165K) at pins 19 and 20. This signal has four components;
  - 1) luminance (Y-signal),
  - 2) color difference (C signal)
  - 3) Horizontal and vertical sync
  - 4) sound.The sound is picked off at Pin 33, sound detect out. The remaining 3 signals pass through sound trap X102 to Pin 32 of IC101. (REF. Page 3)
2. An internal video switch selects TV from Pin 32 or external video from pin 25, then returns the signal to Pin 30, video out of IC101. (REF. Page 3)
3. The composite video signal is split, the C-signal goes through an external high pass filter then to Pin 43 of IC101. The Y signal goes to Pin 39 of IC101. On pin 43 is a +DC reference voltage produce by R309 and R310 that is used in the control of the black expansion section of IC101.
4. The internal switch selects either video from Pin 39 via a delay line or a straight through option. The position of this switch is determined by what version is selected in the MPU. The delay line is selected when there is no external comb filter. The delay line is used to compensate for the propagation differences between the Y circuit and color circuit.
5. The output Y signal of the internal switch goes through sharpness, contrast, black expansion, and then to the matrix where the R-Y and B-Y are matrixed with the Y signal.
6. Pin 13 of IC101 is the ACL (Auto Contrast Limit) terminal to control contrast by detecting the electron beam in CRT.  
If there is too much beam, the voltage will decrease to reduce the contrast.
7. Pin 38 is the Black level detect filter. It expands the black level when picture is dark scene. If the voltage is reduced, the filter will not detect.
8. Pin 28 of IC101 has two signals, sound IF and a fixed reference DC voltage that is used for blooming adjustment. Resistors R306 and R305 are the voltage divider for +9 volts.
9. At Pin 43 of IC101, the color signal passes through a 3.58 MHz high pass filter. The internal switch selects either the high pass filter or bypass, depending on what version is selected by the MPU. The output of the switch goes to the ACC (Amplitude Carrier Chrominance) circuit. The ACC circuit compensates for the different color levels from different television stations.
10. In the APC (Automatic Phase Control) circuit, the phase difference between the reference burst signal and voltage controlled oscillator is detected as a DC voltage. The 3.58 MHz frequency of the VCO is controlled by this DC voltage. The R/C network on Pin 2 develops a reference voltage that is used by the VCO and APC.
11. At the Matrix circuit, the R.G.B. output signals are adjusted for Cut-off of low light level and Drive of high light level by the MPU via I<sup>2</sup>C.
12. Also, there are R.G.B. input terminals for on-screen display which are switched by YS pulse to add on R.G.B. signal of video.
13. The primary color of R.G.B. signals are fed to the CRT Drive circuit.

## NOTES



# SYNC

COLOR TELEVISION SYSTEM

## NA6D/L CHASSIS



The vertical pulse generating circuit not only counts down and creates pulses from the horizontal oscillating circuit, it also compares the pulses generated with the vertical synchronous signal, and can respond to non-standard signals (such as from VTR's or games)

enabling the circuit to slowly follow deviations (i.e., modify the count no.).

The vertical pulses created are amplified in the pulse amplifier circuit, with an approximate 3.5 Vp-p pulse output from pin no. 52.

### AFC2 Circuit

Compares the output of the count down circuit with the horizontal pulse from the fly back transformer. By

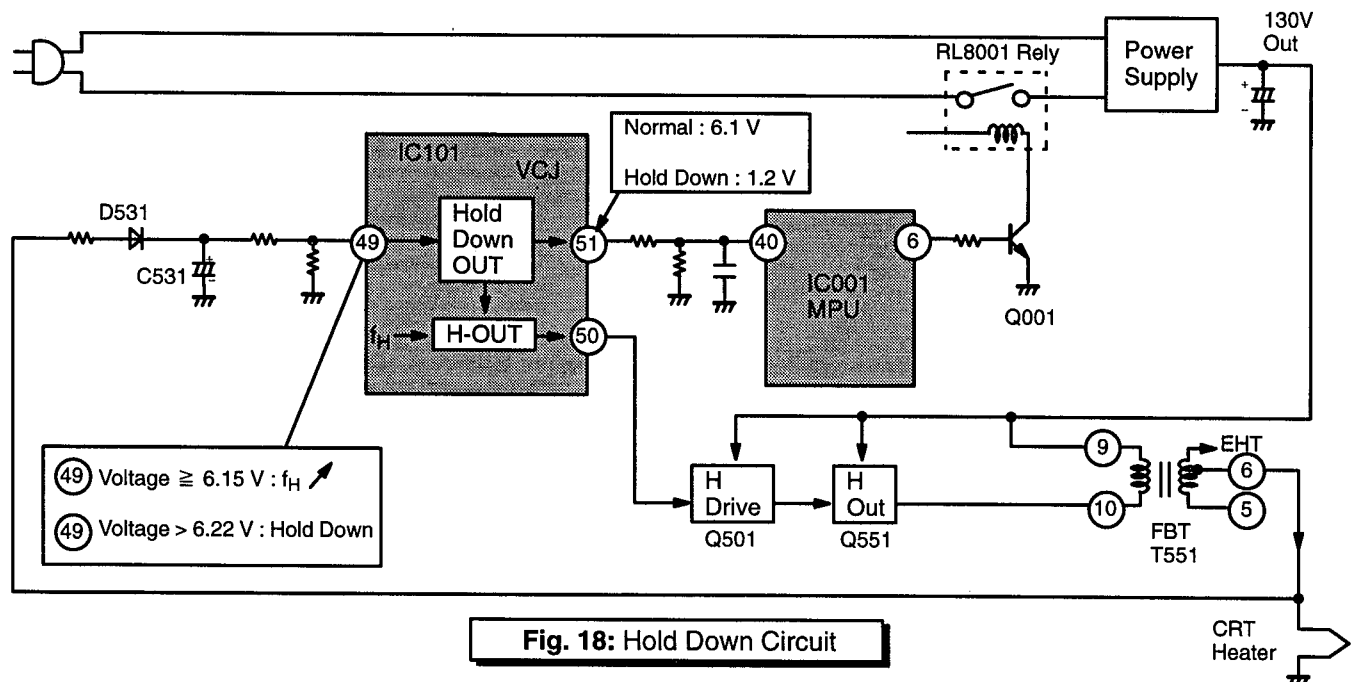
comparing the two signals, the AFC-2 is able to control the rate of the count down.

### Lock Detection Circuit

The horizontal pulse from the FBT is locked to the horizontal sync pulse from the T.V. station. If the pulses are synched, the voltage at Pin 11 is 4.5 volts, if not

synched, 0.1 volt. The voltage is supplied to Pin 4 of IC001 MPU for the Auto Programming function.

### Hold Down Circuit

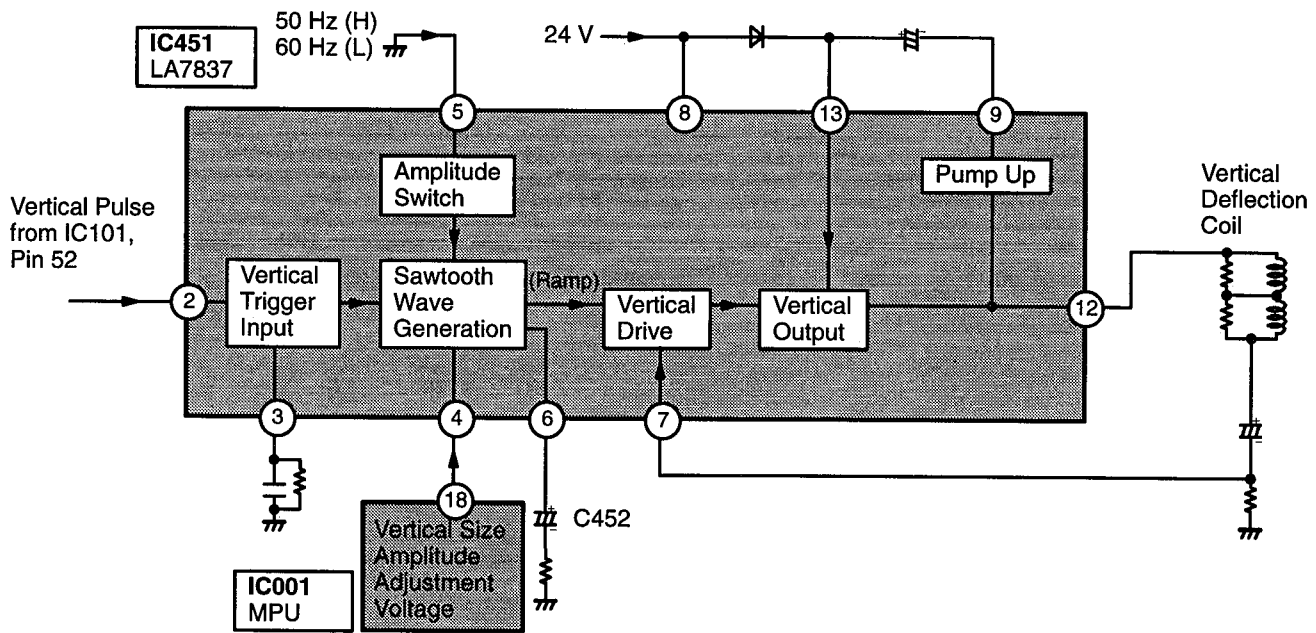


**Fig. 18: Hold Down Circuit**

1. The horizontal hold down circuit is to limit Extra High Tension Voltage.
2. The voltage from Pin 6 of the FBT is converted to DC by diode D531 and capacitor C531. Under normal operation IC101 Pin 49 is less than 6.15 volts and output Pin 51 is 6.1 volts.
3. If the output of the secondary of the FBT increases, the voltage at Pin 49 of IC101 also increases. This will cause the horizontal frequency of Pin 50 to increase. This increased frequency will reduce the induced voltage in the primary of the FBT.
4. If the voltage on Pin 49 is more than 6.22 volts, Pin 51 of IC101 will change from a nominal 6.1 volts to a hold down of 1.2 volts.
5. This 1.2 volts connects to pin 40 of IC001 via a R/C network. Pin 6 of IC001 will go low which turns off Q001. With Q001 OFF, the power relay opens and the receiver shuts down.

## DEFLECTION CIRCUIT

### Vertical Output Circuit



**Fig. 19: IC451 – Vertical Deflection Circuit Block Diagram**

### Sawtooth Wave Generating Circuit

The vertical sync pulse at Pin 2 creates a timing sawtooth wave in C452. This determines the amplitude of the voltage at Pin 4 which is controlled by Pin 18 of IC001. This adjustment is available in service mode. The voltage at

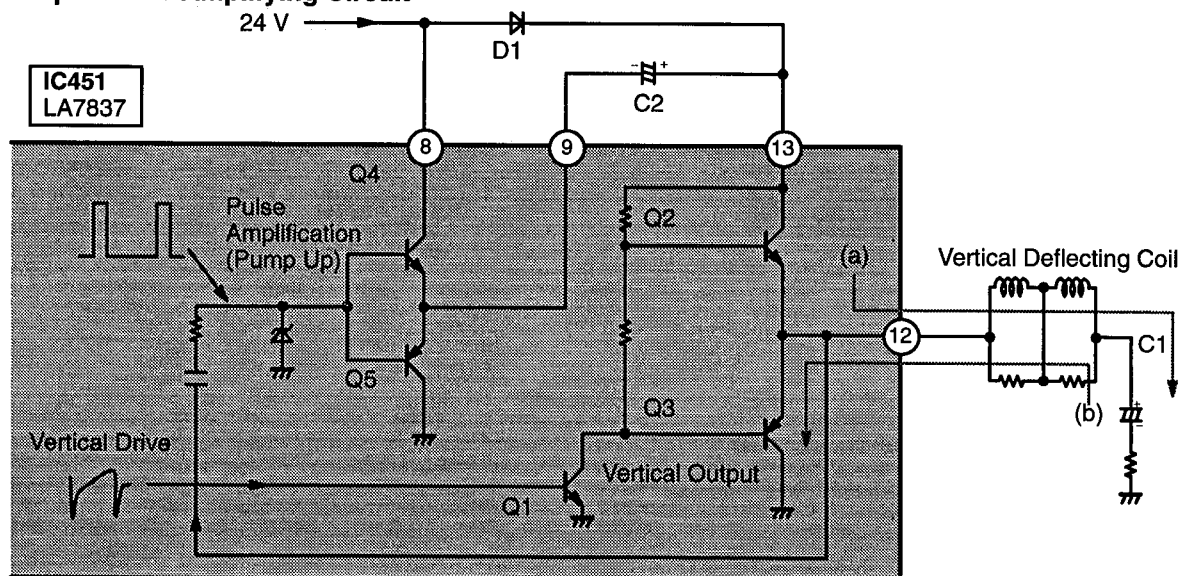
Pin 4 sets the 50-60 Hz amplitude for the voltage at Pin 5. The vertical drive corrects the rectilinear straightness, the vertical amplitude and pulse amplitude in the same IC.

### Drive Circuit

1. The sawtooth wave is sent to the vertical drive circuit. The sawtooth wave current in the vertical deflection coil is fed back to Pin 7 to improve the vertical straightness of the signal.

2. The vertical drive section of IC451 amplifies the sawtooth wave to correct for straightness of the sawtooth wave so that the vertical output circuit will operate. The corrected sawtooth wave is sent to the vertical output circuit.

### Vertical Output Pulse Amplifying Circuit



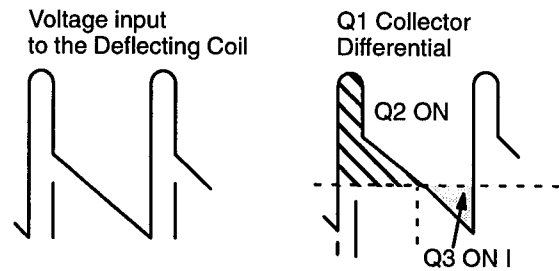
**Fig. 20: IC451 – Vertical Output Amplifying Circuit**



### Vertical Output Circuit Operation

1. The sawtooth wave voltage from the vertical drive circuit is inverted in Q1, and then input to Q2 and Q3.
2. The Q2 and Q3 threshold voltage is set to the center of the sawtooth wave, and the first half of the sawtooth wave turns on the Q2, resulting in the charging current (a) being sent to the C1.
3. The second half of the sawtooth wave turns on the Q3, resulting in the discharge current (b) being output from the C1.
4. Because of this, a sawtooth wave current is sent to the deflection coil. However, in order to reverse the current within the vertical flyback period, the pulse from the pulse amplifier circuit is added to the collector

of Q2, resulting in a large voltage input to the deflection coil during the instant after the Q2 has turned on.

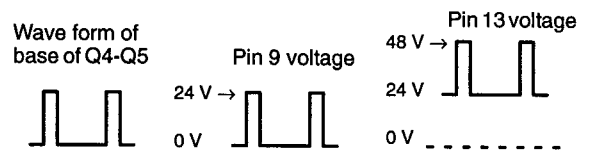


**Fig. 21: IC451 Pin 12 Voltage**

### Pulse Amplifier Circuit (Pump Up) Operation

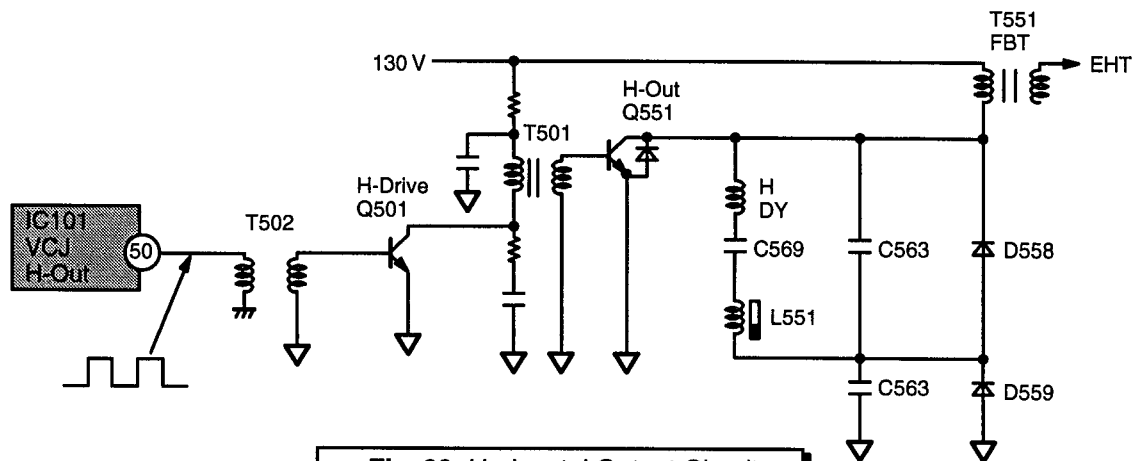
1. During the time the currents (a) and (b) are sent (vertical scanning period), Q4 is off since no voltage is input to base of Q4. A negative pulse from the vertical deflection coil is fed back to the base of Q5. Q5 then turns on, sending 24 V through D1, inputting a 24 V charge to C2.
2. The pulse differentiated by the differentiating circuit during the flyback period is added to the base of Q4 and Q5, turning Q4 On, and Q5 Off. The 24 V voltage is then input to the C2 minus pin through Q4, and added to the 24 V C2 charge thereby, resulting in a 48 V pulse at Pin 13.

3. As expressed above, during the flyback period, a 48 V pulse is input to the deflection coil, raising the electron beam in one instant.



**Fig. 22: Pump Up Wave**

### Horizontal Output Circuit



**Fig. 23: Horizontal Output Circuit**

The square wave of a horizontal signal is applied to T502 which is an Isolation transformer between hot and cold circuits.

The horizontal pulse is induced into the secondary of T502, turning on Q501. The 130 V now flows through

the primary of T501 and horizontal drive transistor Q501. A horizontal pulse is induced into the secondary of T501. This pulse drives the horizontal output transistor Q551 to make the sawtooth wave current in H-DY (horizontal deflection coil) and EHT (Extra High Tension voltage).

## NOTES

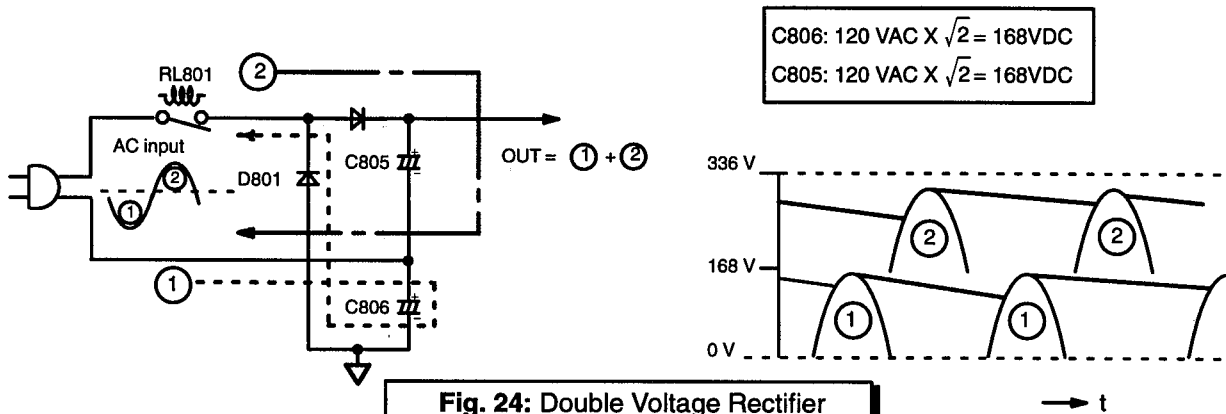
# **POWER SUPPLY**

**COLOR TELEVISION SYSTEM**

## **NA6D/L CHASSIS**

## POWER CIRCUIT

### Double Voltage Rectifier Circuit

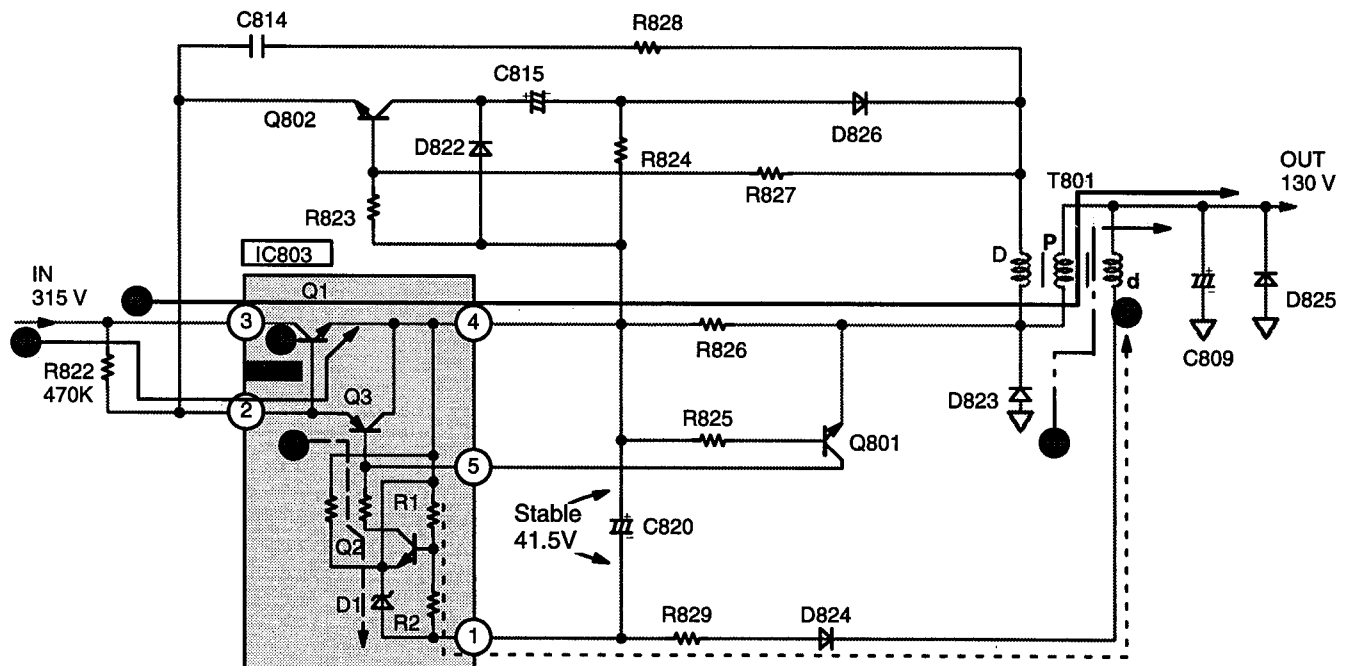


The negative half of AC input charges C806 in direction ① and positive half charges C805 in the direction ② thus a

voltage doubler rectifier is formed. The output voltage is  $① + ② \approx 336 \text{ V}$  theoretically.

### Power Supply Circuit

#### Chopper Power Supply



1. The starting voltage (315V) from the voltage doubler rectifier is applied to Pin 3 of IC 803 (collector of Q1) and the base of Q1, through resistor R822.
2. Q1 turns on and collector current starts to flow through the P winding of T801.
3. At the same time P winding applies the power to the load and stores the energy. This voltage is induced

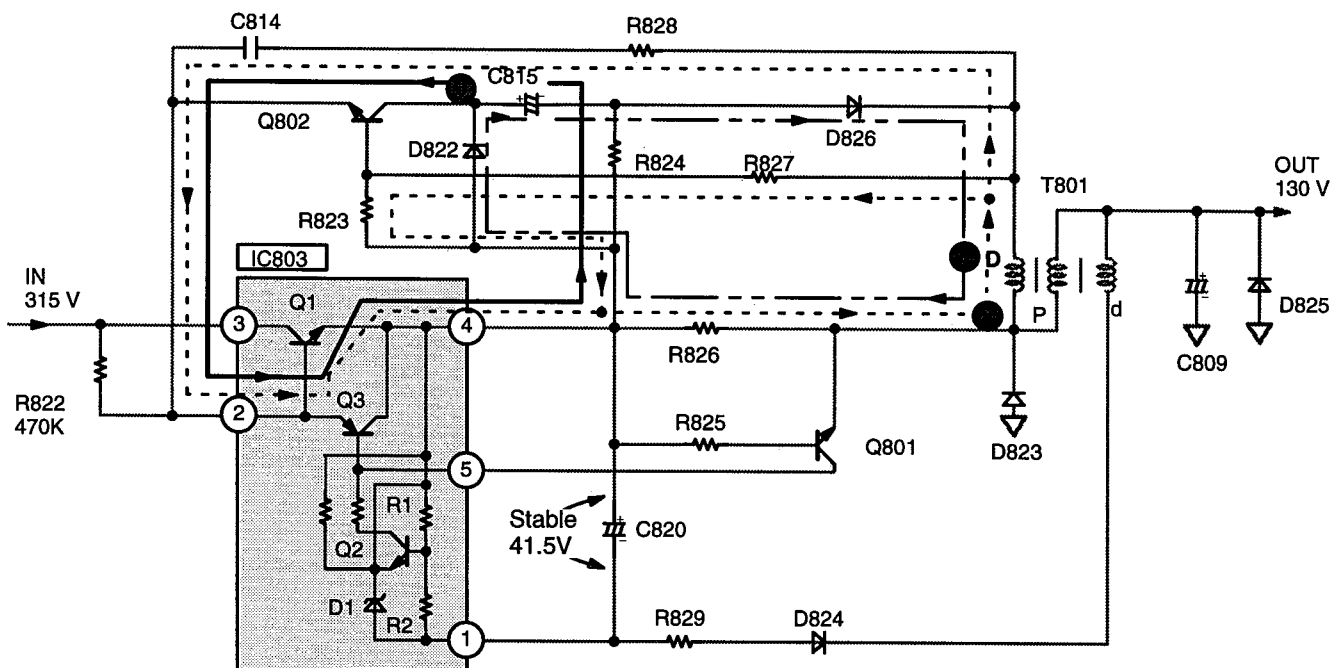
into windings D & d of T801. Both D & d windings are wound opposite in polarity to the P winding.

4. Current induced by the voltage in the d winding of T801 flows through diode 824, R829 and R2 causing the base voltage of Q2 to rise.
5. When the base voltage of Q2 is higher than the voltage of D1, Q2 turns on, reducing the voltage at the base of Q3. This will lower the voltage at the base of Q1, turning off Q1.

Q2b and Q2e	Q2	Q3b	Q1b	Q1	Q1c
Q2b > Q2e	ON	↘	↘	OFF	constant
Q2b < Q2e	OFF	↗	↗	ON	

6. When Q1 turns off, the energy stored in the p winding discharges into the load through C809 and fly wheel diode D823. At this time, the negative voltage is induced into the D winding which reverse bias the emitter of Q1, keeping it turned off. Once the energy stored in the D winding is discharged, Q1 is turned on again by R822.

### Constant Current Drive



**Fig. 26: Constant Current Drive Circuit**

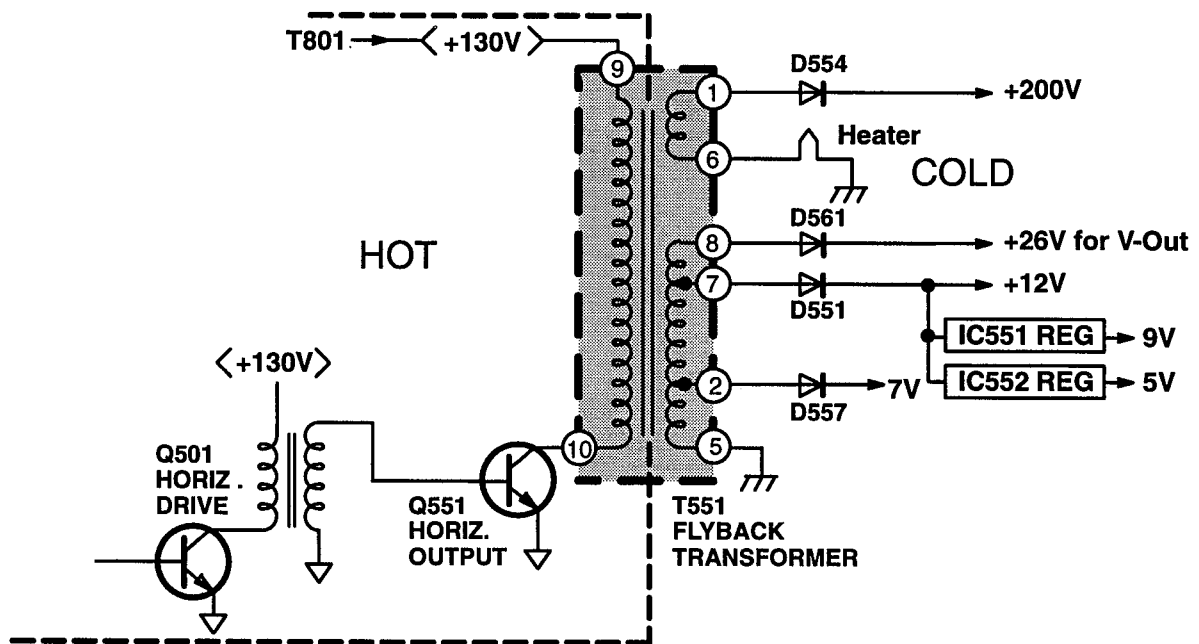
1. When Q1 turns off, the current flows through the D winding, R826, D822 to charge C815. D826 then conducts to the D winding forming a complete current loop.
2. When the starting voltage turns on Q1, the current loop in the D winding now flows through R828, C814, the base emitter junction of Q1 and back to the D winding. At the same time, the voltage from voltage divider R827 and R823 turns on Q802.
3. The drive current of Q1 flows through the loop of C815, Q802, base emitter junction of Q1, R824 and back to C815.
4. The value of R824 decides the constant current of the circuit since the charge on C815 comes from the D winding.

### B+ Source Voltages Supply Circuit

The NA6L chassis B+ source voltages are derived from secondary windings on the Flyback Transformer (T551).

B+ for the Horizontal Drive, Horizontal Output (Q501/Q551) and Flyback Transformer (T551) is supplied by T801 switching transformer 130 volt output. Since the secondary B+ voltages are dependant on scan waveform or flyback pulse amplitude, these voltages are also regulated for AC line and/or load variations.

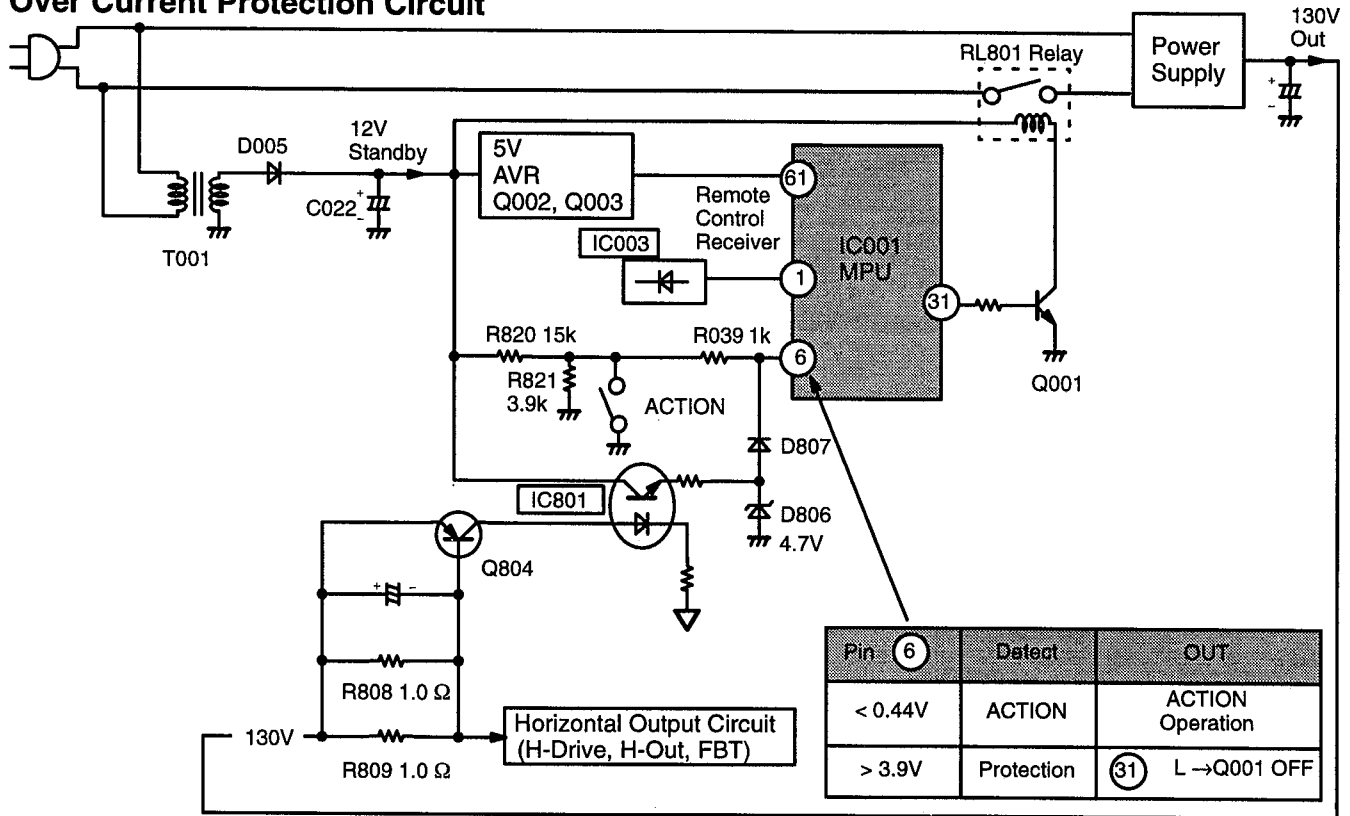
The +26 volt, +12 volt and +7 volt supplies are derived by diode rectification of the scan waveform and are relatively high current supplies. The 12 volt B+ source is also coupled to a 5 volt and 9 volt regulator. IC552 supplies +5 volt B+ to the Audio circuit while IC551 supplies +9V B+ to most of the Main Board circuitry. The +200 volt for CRT is developed from diode rectification of the flyback pulse.



**Fig. 27: B+ Source Voltages Supply**

# PROTECTION CIRCUIT

## Over Current Protection Circuit



**Fig. 28: Over Current Protection Circuit**

### Normal Operation

1. AC is induced into the primary of T001. The secondary voltage is stepped down to a lower voltage, then converted to 12 V DC by D005 and capacity C022.
2. The 12 V goes to 5 V regulator Q002 and Q003. The 5 volt output of Q002 goes to Pin 61 of MPU IC001. This 5 volts starts the initial operation of MPU IC001.

### Dual Function for Pin 6

Pin 6 of MPU IC001 is a dual function Pin.

This action button function is activated when Pin 6 voltage is 0.44 V or less. An over current protect function is activated when Pin 6 voltage is 3.9 V or higher.

### Over Current Protection Operation

1. If the horizontal output draws excess current, the voltage drop across resistors R808 and R809 will increase. This will turn on Q804 which turns on opto-isolator IC801.
2. The emitter output voltage of IC801 causes the voltage at Pin 6 to be more than 3.9 volts. The internal circuit of MPU IC001 causes Pin 31 to go low which turns off Q001. Relay RL801 then opens, shutting off the Receiver.
3. The Receiver will remain off until AC power is momentarily disconnected.

3. If the remote control receiver sends a power-on signal to Pin 1 of the MPU, the output Pin 31 turns on high voltage transistor Q001, which then pulls in relay RL801. 130 Volts DC from the power supply flows through the relay contacts to operate the horizontal output circuit.

With the Receiver on, +12 V is divided by R820 and R821. As long as the voltage at IC001 Pin 6 is 0.8 V ~ 3.6 V (depending on power supply operation) the Receiver operates normally.

4. If pressing the power button on after AC is reapplied, the Receiver comes on but then goes off after a few seconds, there is a problem in the horizontal output circuit or the power supply circuit.

**WARNING:** Because Pin 6 is a dual function Pin, do not press the "ACTION" button on the Receiver. Pressing the button when the above symptom appears will inhibit the Over Current Protection. If the Receiver is powered on again, severe damage may happen to the entire chassis.



Over Current Limiter

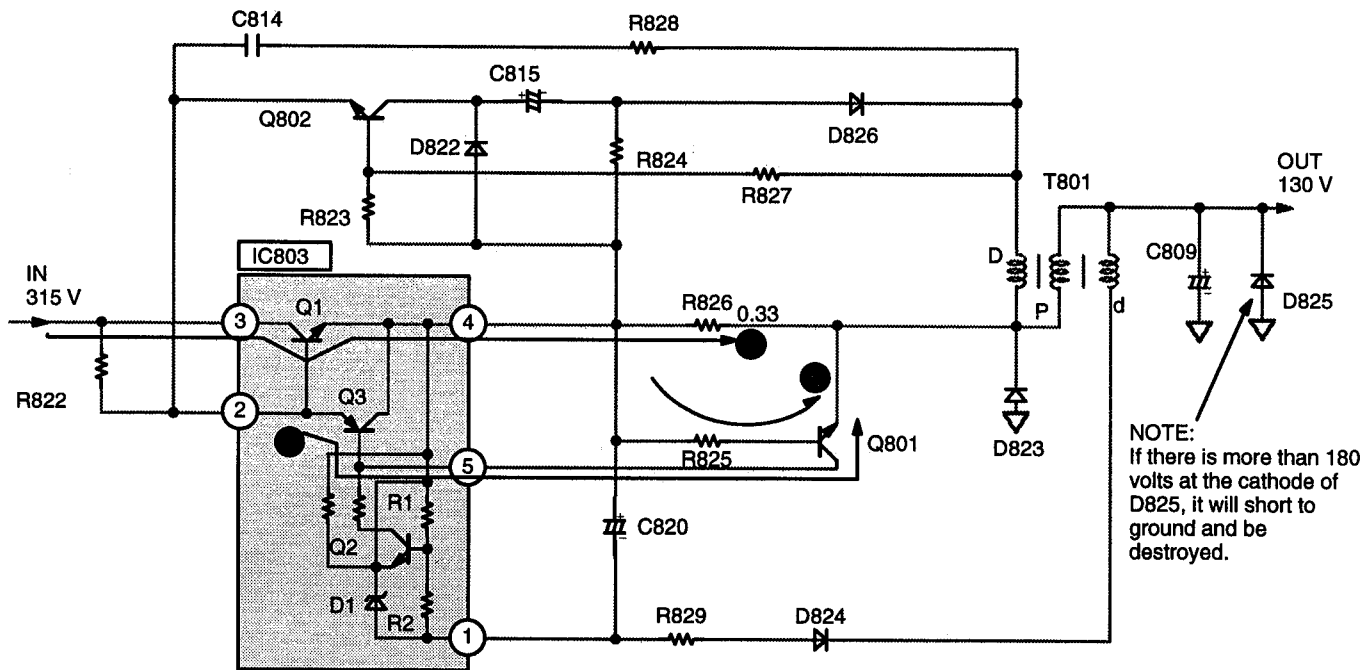


Fig. 29: Over Current Limiter Circuit

- 1. R826 detects the collector current of Q1.
- 2. If the voltage drop across R826 is almost equal to the turn on voltage of Q801, Q801 turns ON.
- 3. The voltage at pin 5 goes low turning on Q3 which reduces the voltage between base and collector of Q1 to turn OFF the current Ic.

Ic	R826 Voltage	Q801	Ic
Abnormal current	↗	OFF	Stop

Over Voltage Circuit

- D825 is avalanche diode, avalanche voltage is 180 V ~ 240 V. If output voltage rises more than avalanche voltage, the D825 will short to ground and be destroyed.

**Warning:** If IC803 is changed to correct a power supply failure, also check or change R829, D823, D824, and D825 before reapplying power to the chassis. During a major failure, these components can fail, causing the IC to appear to operate normally, but it may run very hot, quickly leading to another IC failure. D825 is the over voltage protection diode (avalanche) for the 130 V line. D825 conducts when the output of the horizontal oscillator is zero. If D825 has failed, check the output of Q551 (H. out).

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