

SAFETY PRECAUTIONS

SERVICE WARNING

Only qualified service technicians who are familiar with safety checks and guidelines should perform service work. Before replacing parts, disconnect power source to protect electrostatically sensitive parts. Do not attempt to modify any circuit unless so recommended by the manufacturer. When servicing the receiver, use an isolation transformer between the line cord and power receptacle.

SERVICING THE HIGH VOLTAGE AND CRT

Use **EXTREME CAUTION** when servicing the high voltage circuits. To discharge static high voltage, connect a 10K ohms resistor in series with a test lead between the receiver and CRT anode lead. **DO NOT** lift the CRT by the neck. Always wear shatterproof goggles when handling the CRT to protect eyes in case of implosion.

X-RAY RADIATION AND HIGH VOLTAGE LIMITS

Be aware of the instructions and procedures covering X-ray radiation. In solid-state receivers and monitors, the CRT is the only potential source of X-rays. Keep an accurate high voltage meter available at all times. Check meter calibration periodically. Whenever servicing a receiver, check the high voltage at various brightness levels to be sure it is regulating properly. Keep high voltage at rated value, **NO HIGHER**. Excessive high voltage may cause X-ray radiation or failure of associated components. **DO NOT** depend on protection circuits to keep voltage at rated value. When troubleshooting a receiver with excessive high voltage, avoid close contact with the CRT. **DO NOT** operate the receiver longer than necessary. To locate the cause of excessive high voltage, use a variable AC transformer to regulate voltage. In present receivers, many electrical and mechanical components have safety related characteristics which are not detectable by visual inspection. Such components are identified by a # on both the schematic and the parts list. For **SAFETY**, use only equivalent replacement parts when replacing these components.

TEST JIG HOOKUP

| Function | Chek-A-Color Adapter No. |
|--------------|--------------------------|
| CRT | B239 |
| Yoke | D4157 |
| Yoke Setting | YP1A |
| Comments | Focus Tap |

The listing of any available replacement part herein in no case constitutes a recommendation, warranty, or guarantee by Howard W. Sams & Company as to the quality and suitability of such replacement part. The numbers of the listed parts have been compiled from information furnished to Howard W. Sams & Company by the manufacturers of the specific type of replacement part listed.

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2647 Waterfront Parkway East Drive, Suite 300
Indianapolis, IN 46214-2012

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SAFETY CHECKS -- FIRE AND SHOCK HAZARD

Cold Leakage Checks for Receivers with Isolated Ground

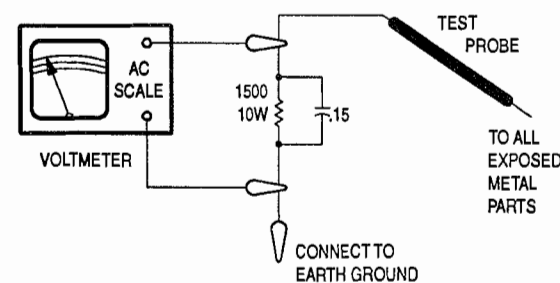
Unplug the AC cord, connect a jumper across the plug prongs, and turn the power switch on (if applicable). Use an ohmmeter to measure the resistance between the jumped AC plug and any exposed metal cabinet parts such as antenna screw heads, control shafts, or handle brackets. Exposed metal parts with a return path should measure between 1M ohms and 5.2M ohms. Parts without a return path must measure infinity.

Hot Leakage Current Check

Plug the AC cord directly into an AC outlet. **DO NOT** use an isolation transformer. Use a 1500 ohms, 10W resistor in parallel with a .15µF capacitor to connect between any exposed metal parts on the receiver and a good earth ground. (See figure below.) Use an AC voltmeter with at least 5000 ohms per volt sensitivity to measure the voltage across the resistor. Check all exposed metal parts and measure voltage at each point. Voltage measurements should not exceed .75VAC, 500µA. Any value exceeding this limit constitutes a potential shock hazard and must be corrected. If the AC plug is not polarized, reverse the AC plug and repeat exposed metal part voltage measurement at each point.

GENERAL GUIDELINES

Perform a final **SAFETY CHECK** before returning receiver to customer. Check repaired area for poorly soldered connections, and check entire circuit board for solder splashes. Check inner board wiring for pinched wires or wires contacting any high wattage resistors. Check that all control knobs, shields, covers, grounds, and mounting hardware have been replaced. Be sure to replace all insulators and restore proper lead dress.



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PHOTOFACT® Technical Service Data

SET 3430

MODELS CT-27SF31S, CT-27XF31CS (CHASSIS ALEDP238)

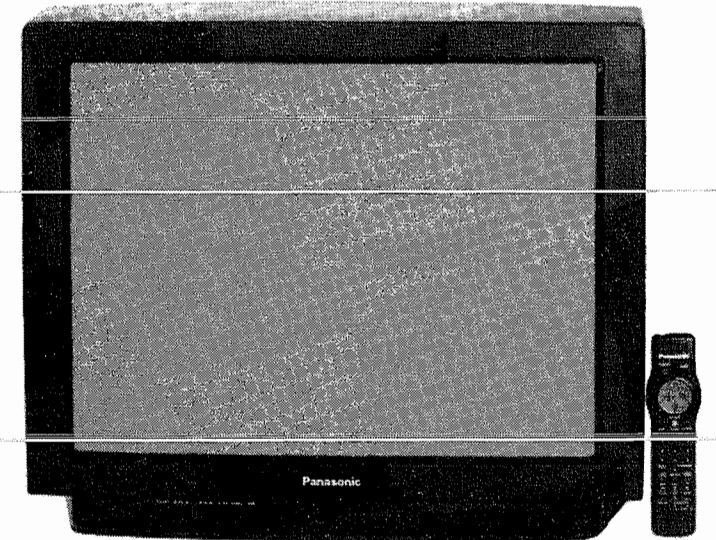
PANASONIC

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PANASONIC

Models CT-27SF31S, CT-27XF31CS (Chassis ALEDP238)



Model CT-27SF31S

Essential coverage
for servicing a television receiver...

- Schematics
- Component locations
- Parts list

Coverage includes these additional models and chassis:

| MODEL | CHASSIS |
|-----------------|----------|
| CT-31SF31S | ALEDP240 |
| CT-31XF31CS | ALEDP240 |
| CT-F33L6S/LS/VS | ALEDP240 |



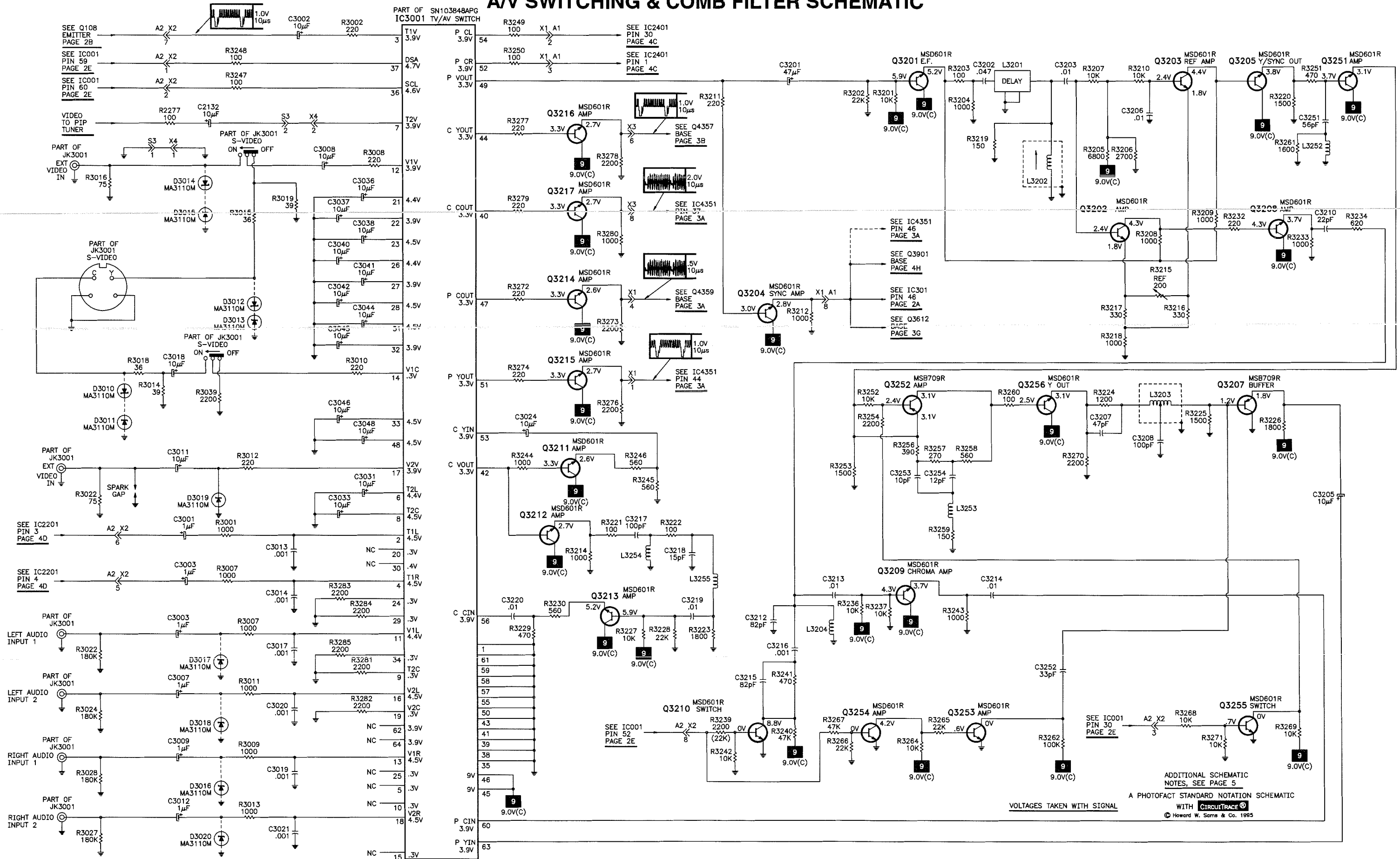
HOWARD W. SAMS & COMPANY

JANUARY 1995 SET 3430

For Supplier Address,
See PHOTOFACT Annual Index

3430

A/V SWITCHING & COMB FILTER SCHEMATIC



PANASONIC
MODEL S CT-27SE31S CT-27XE31CS (CHASSIS ALEDPE238)

MISCELLANEOUS ADJUSTMENTS continued

Filter

Select SAP mode on the receiver. On generator select SAP, 1kHz audio frequency, and L-R modulating signal. Connect oscilloscope to pin 36 of IC2201. Adjust R2221 for minimum.

Separation

On generator select pilot, 8kHz audio frequency, and left modulating signal. Connect an oscilloscope to pin 4 of IC2201. Adjust R2213 for minimum amplitude of waveform.

Input Level

On generator select pilot, 1kHz audio frequency, and L-R modulating signal. Connect oscilloscope to pin 39 IC2201, low side to ground. Adjust R2217 for 900mVp-p.

PINCUSHION ADJUSTMENTS

Tune in a crosshatch pattern. Enter serviceman mode and select pincushion adjustment. Adjust crosshatch pattern for uniform boxes with perpendicular and straight lines on all areas of screen.

Pincushion Adjustment Range and Default Level

| Adjustment | Range Level | Default Level | On Unit |
|----------------------------|-------------|---------------|---------|
| Vertical Size (D0) | 0-127 | 87 | 96 |
| Vertical Linearity (D1) | 0-63 | 34 | 43 |
| Vertical S Correction (D2) | 0-63 | 14 | 16 |
| Horizontal Size(D3) | 0-63 | 40 | 43 |
| Horizontal Center (D4) | 0-31 | 16 | 10 |
| E-W Parabola (D5) | 0-31 | 24 | 20 |
| Vertical Keystone (D6) | 0-31 | 34 | 38 |
| E-W Top Corner (D7) | 0-7 | 08 | 11 |
| E-W Bottom Corner (D8) | 0-7 | 08 | 08 |
| EHT Vertical Comp (D9) | 0-15 | 08 | 08 |
| EHT Horizontal Comp (DA) | 0-15 | 08 | 08 |
| Vertical Position (DB) | 0-63 | 32 | 12 |

FACTORY ADJUSTMENTS (S0 - S21)

Factory adjustments can be entered but no adjustments should be made by serviceman. This is for factory setup only. Note original value in case one of these adjustments are changed by mistake.

Factory Adjustments and Default Level Values

| Adjustment | Default Level | Adjustment | Default Level |
|------------|---------------|------------|---------------|
| S0 | 03 | S11 | 102 |
| S1 | 04 | S12 | 08 |
| S2 | 15 | S13 | 08 |
| S3 | 15 | S14 | 27 |
| S4 | 07 | S15 | 09 |
| S5 | 12 | S16 | 08 |
| S6 | 28 | S17 | 143 |
| S7 | 01 | S18 | 08 |
| S8 | 04 | S19 | 30 |
| S9 | 05 | S1A | 60 |
| SA | 36 | S1B | 240 |
| SB | 00 | S1C | 02 |
| SC | 36 | S1D | 04 |
| SD | 109 | S1E | 50 |
| SE | 00 | S1F | 55 |
| SF | 00 | S20 | 20 |
| S10 | 00 | S21 | 20 |

TUNER INFORMATION

MAIN TUNER VOLTAGE CHART

| Pin | VHF Low Band | VHF High Band | UHF Band |
|--------|--------------|---------------|----------|
| 30V | 4.2V | 9.2V | 8.1V |
| 5V | 5.0V | 5.0V | 5.0V |
| CLOCK | 2.2V | 2.2V | 2.2V |
| DATA | 2.2V | 2.2V | 2.2V |
| ENABLE | 0.1V | 0.1V | 0.1V |
| IF | 0V | 0V | 0V |
| BM | 9.0V | 9.0V | 9.0V |
| AGC | 5.4V | 5.3V | 4.4V |
| BT | 1.6V | 6.4V | 5.2V |

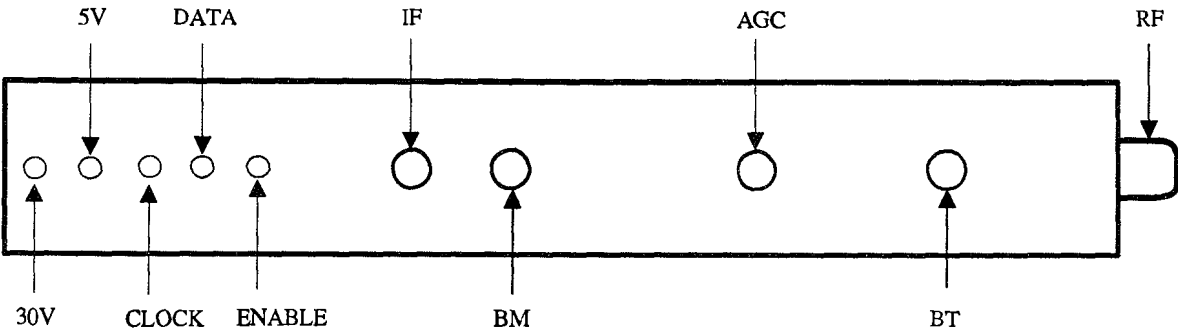
NOTE: VHF Low Band voltages taken on channel 2.
VHF High Band voltages taken on channel 7.
UHF Band voltages taken on channel 14.

PIP TUNER VOLTAGE CHART

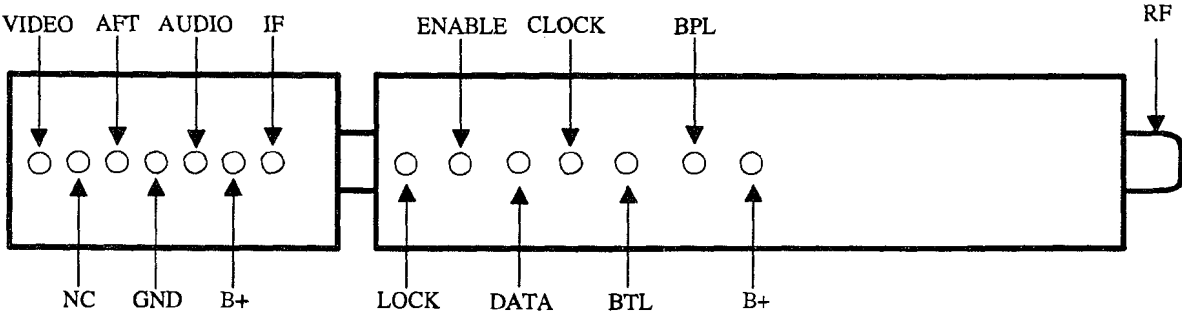
| Pin | VHF Low Band | VHF High Band | UHF Band |
|--------|--------------|---------------|----------|
| B+ | 8.7V | 8.7V | 8.7V |
| BPL | 5.0V | 5.0V | 5.0V |
| BTL | 31.0V | 31.0V | 31V.0 |
| CLOCK | 2.5V | 2.5V | 2.5V |
| DATA | 2.4V | 2.4V | 2.4V |
| ENABLE | 0V | 0V | 0V |
| LOCK | 0V | 0V | 0V |
| IF | 0V | 0V | 0V |
| B+ | 8.7V | 8.7V | 8.7V |
| AUDIO | 0V | 0V | 0V |
| GND | 0V | 0V | 0V |
| AFT | 2.6V | 2.6V | 2.7V |
| NC | 0V | 0V | 0V |
| VIDEO | 4.5V | 4.5V | 4.5V |

NOTE: Voltages taken with PIP window on, and displaying a color bar pattern.
VHF Low Band voltages taken on channel 2.
VHF High Band voltages taken on channel 7.
UHF Band voltages taken on channel 14.

MAIN TUNER TERMINAL GUIDE

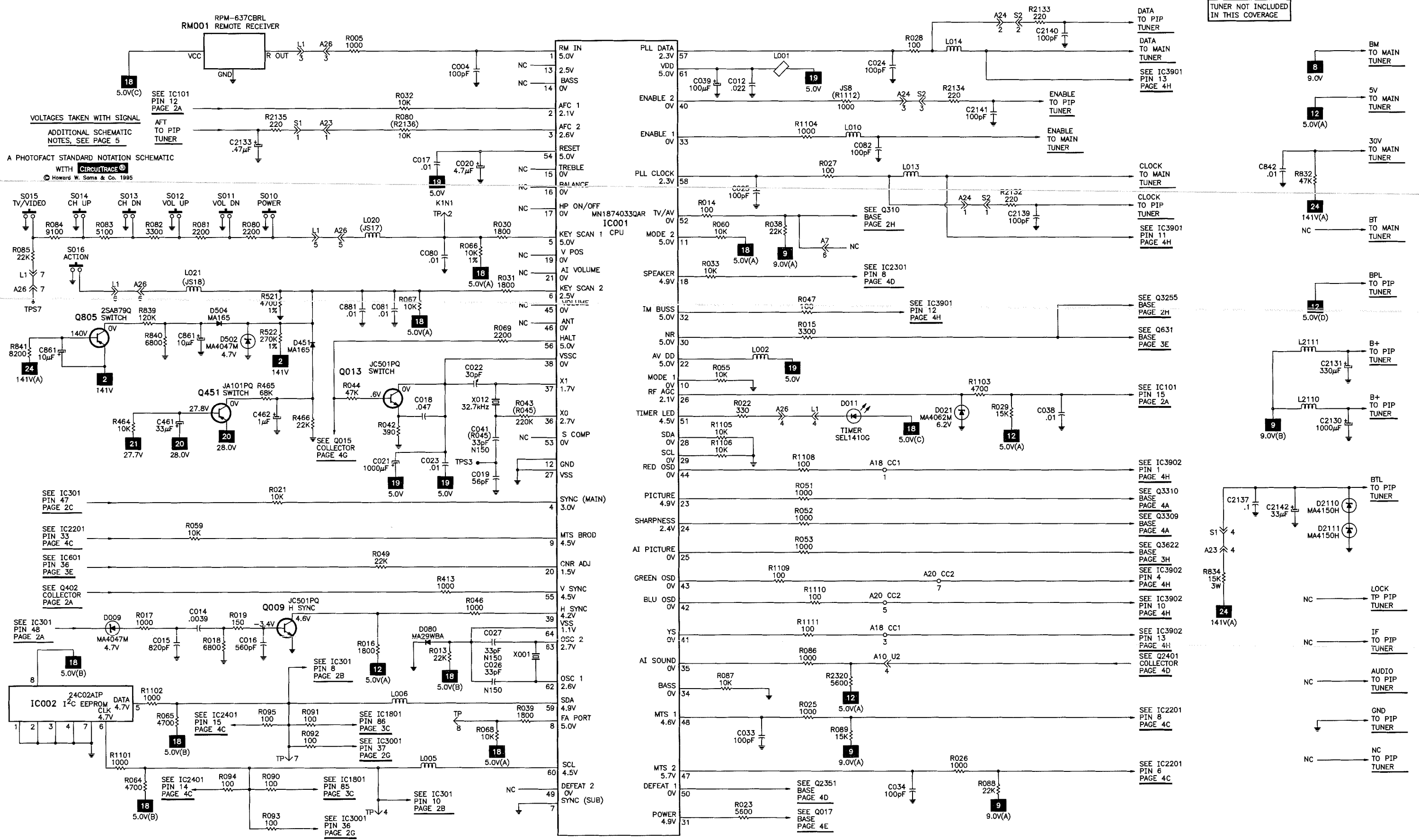


PIP TUNER TERMINAL GUIDE



PANASONIC MODELS CT-27SF31S, CT-27XF31CS (CHASSIS ALEDP28)

SYSTEM CONTROL SCHEMATIC



SERVICE INFORMATION

HORIZONTAL HOLD DOWN CIRCUIT

This circuit protects against excessive high voltage, and CRT beam current. If the high voltage or beam current increase above the designed level, the horizontal hold down circuit will cause the horizontal oscillator frequency to increase lowering the high voltage and in extreme cases blank the CRT.

Voltage from pin 5 of T551 is rectified by D531 and approximately 2.4V is applied to pin 4 of IC301. The hold down circuit inside IC301 is an NPN differential amp circuit. Pin 4 of IC301 is connected to one base, while pin 5 of IC301 is connected to the other base. The voltage at pin 4 of IC301 is monitored and compared to the voltage at pin 5 of IC301 which is fixed at approximately 6.0V by zener diode D532. If the voltage at pin 4 of IC301 exceeds half the value of the voltage at pin 5 of IC301 the horizontal hold down circuit is activated. When the voltage at pin 4 of IC301 is excessively high, there is another internal differential amp circuit which changes state to blank the CRT. If the beam current increases, the ABL voltage becomes more negative which lowers the voltage at pin 5 of IC301 and causes the horizontal hold down circuit to activate with a lower voltage at pin 4 of IC301.

The B+ circuit and horizontal hold down circuit are not adjustable. If safety components are replaced, the horizontal hold down circuit must be checked to insure that high voltage, and CRT beam current do not exceed safe operation limits. The voltage at pin 4 of IC301 should read around 2.4V, if not check D531, R531, C531, R532, R533, and IC301. The voltage at pin 5 of IC301 should read about 6.0V, if not check D532, R536, C506, R534, R535, and IC301.

POWER SUPPLY SHUTDOWN

WARNING: If the power button is pressed and the set comes on, then goes off after a few seconds, a problem in one of the over current monitor circuits is indicated. DO NOT press the action button, because this will defeat the power supply shutdown circuit.

Pin 6 of IC001 is a dual function port. When the voltage is 3.2V or higher at pin 6, the overvoltage protect function is activated. The action button function is activated when the voltage at pin 6 of IC001 is .588V or less. When pin 6 of IC001 goes higher than 3.2V, pin 31 of IC001 will be forced to go low, which will cause Q017 to turn off, which will cause RL001 to open, and shut off the set. This condition will remain until the AC power is disconnected.

The horizontal current is monitored by Q805. If for any reason there is a short in the horizontal circuit, Q805 will conduct, and thru D504, the voltage at pin 6 of IC001 will rise to the point of shutdown.

The vertical and pincushion current is monitored by Q451. If for any reason there is a short in the vertical or pincushion circuits, Q451 will conduct, and thru D451, the voltage at pin 6 of IC001 will rise to the point of shutdown.

PIP HOLD DOWN

Voltage from pin 5 of T551 is rectified by D531. If the high voltage increases the voltage at the emitter of Q502 will also increase. If the high voltage increases above the designed level, the voltage at the emitter of Q502 will increase to the point that D534 and D533 conduct and turn on Q503. When Q503 turns on, the vertical pulse to the PIP circuit is grounded and the PIP window blanks.

The PIP hold down circuit is not adjustable. If safety components are replaced, perform the horizontal oscillator disable test to insure that the high voltage, and CRT beam current do not exceed safe operation limits. If the PIP window does not blank, check R537, Q502, D534, D533, R540, Q503, R531, D531, R532, and R533.

HORIZONTAL OSCILLATOR DISABLE TEST

Disconnect the positive lead of D813 on the power board. Connect a variable 0 - 22V, 1 Amp DC power supply, thru a blocking diode, to TPP4. Monitor the high voltage with a high voltage probe. Apply 120VAC and turn on receiver. Turn PIP on and autocolour off. Set color to minimum. Adjust picture and bright for a just visible picture. Slowly increase DC power supply. Confirm the high voltage does not exceed 37kV (27") or 39.5kV (31") when horizontal just begins to pull out of sync. Also confirm that the PIP window blanks before horizontal pulls out of sync. Slowly reduce DC power supply to 0V, turn off receiver, disconnect DC power supply, and resolder D813. If the high voltage should exceed 37kV (27") or 39.5kV (31"), the receiver fails to lose horizontal sync, or the PIP window fails to blank, the cause must be determined and repaired.

TEST EQUIPMENT

Test equipment listed by participating manufacturer illustrates typical or equivalent equipment used by Sams engineers to obtain measurements. This equipment is compatible with most types used by field service technicians.

| Equipment | Sencore No. |
|-------------------------|--------------|
| Oscilloscope | SC3100 |
| Generators | |
| RGB | CM2000 |
| Multiburst Signal | VG91 |
| Color Bar | VG91 |
| TV Stereo | VG91 |
| Digital VOM | SC3100 |
| Frequency Meter | SC3100 |
| Hi-Voltage Probe | HP200 |
| Accessory Probes | TP212 |
| Isolation Transformer | PR57 |
| Capacitance Analyzer | LC101, LC102 |
| CRT Analyzer | CR70 |
| AC Leakage Tester | PR57 |
| Inductance Analyzer | LC101, LC102 |
| Flyback Yoke Tester | TVA92 |
| TV Stereo Power Monitor | SR68, PA81 |
| Field Strength Meter | SL750 |
| Transistor Tester | TF46 |
| Video Analyzer | VG91, TVA92 |

NEW CIRCUITS

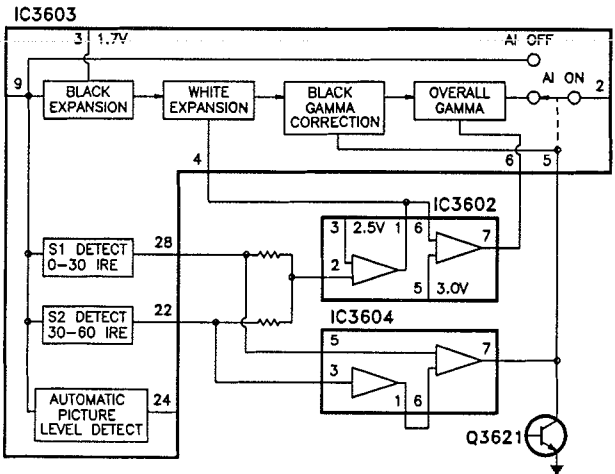
INTER-INTEGRATED (I²C) CIRCUIT BUS LINE SYSTEM

This receiver uses a bus line concept for data transfer. The SDA (Serial Data) line and the SCL (Serial Clock) line carry information between IC001 and IC002 and IC001 and IC301. IC001 initiates serial data transfer (SDA) and generates the serial clock signal (SCL). Most of the mechanical adjustments have been replaced with this system thru an electronic onscreen serviceman mode procedure.

AI PICTURE

The AI picture circuit is located on the F board. The Y signal from pin 3 of connector F4 enters IC3603 on pin 9. The AI picture function is turned off and on by a signal from pin 25 of IC001 to Q3621. When Q3621 conducts, the voltage at pin 5 of IC3603 goes low, which sets the internal switch inside IC3603 to the off position. If the AI picture function is turned off, the Y signal is output at pin 2 of IC3603 without passing through any correction circuits. If the AI picture function is turned on the Y signal passes thru 4 correction circuits before being output at pin 2 of IC3603. The Y signal IRE levels of 0 - 30 and 30 - 60 are detected by S1 and S2 detect circuits inside IC3603 and sent to IC3602 and IC3604. IC3602 and IC3604 analyze the IRE information and artificially correct changes in contrast. The black expansion circuit control voltage, at pin 3 of IC3603, is fixed at 1.7V. The white expansion circuit control voltage, at pin 4 of IC3603, is a black/white ratio obtain by taking the combined output of the S1 and S2 detect circuits, pins 28 and 29 of IC3603, and applying it to pin 2 of IC3602. IC3602 compares this voltage with the 2.5V reference voltage, at pin 3 of IC3602, and outputs the derived voltage to pin 4 of IC3603. The black gamma correction circuit control voltage, at pin 5 of IC3603, is supplied by pin 7 of IC3604. IC3604 derives this voltage from the combined output of the S1 and S2 detect circuits, pins 28 and 29 of IC3603. The overall gamma correction circuit control voltage, at pin 6 of IC3603, is supplied by pin 7 of IC3602. IC3602 derives this voltage by comparing the white expansion circuit control voltage and the 3.0V reference voltage, at pin 5 of IC3602. The automatic picture level detect circuit, pin 24 of IC3603, outputs a color saturation control voltage to pin 41 of IC301.

AI Picture Circuit



CHROMA CONTROL UNIT (CCU)

IC601 performs flesh tone correction, chroma noise reduction, chroma resolution improvement, and color limiter. The flesh tone correction is accomplished with "fuzzy logic" circuitry that recovers flesh tones from a tint shifted tone without affecting the red and green colors in the other areas in the picture. The color noise reduction circuit reduces color smearing by using line recursive filters to reduce color sagging. The chroma resolution improvement circuit eliminates blurring by adding the secondary differential components of the video signal to areas of high saturation. The color limiter circuit eliminates red and blue saturation by detecting the maximum level of the chroma signal and controlling the chroma saturation level.

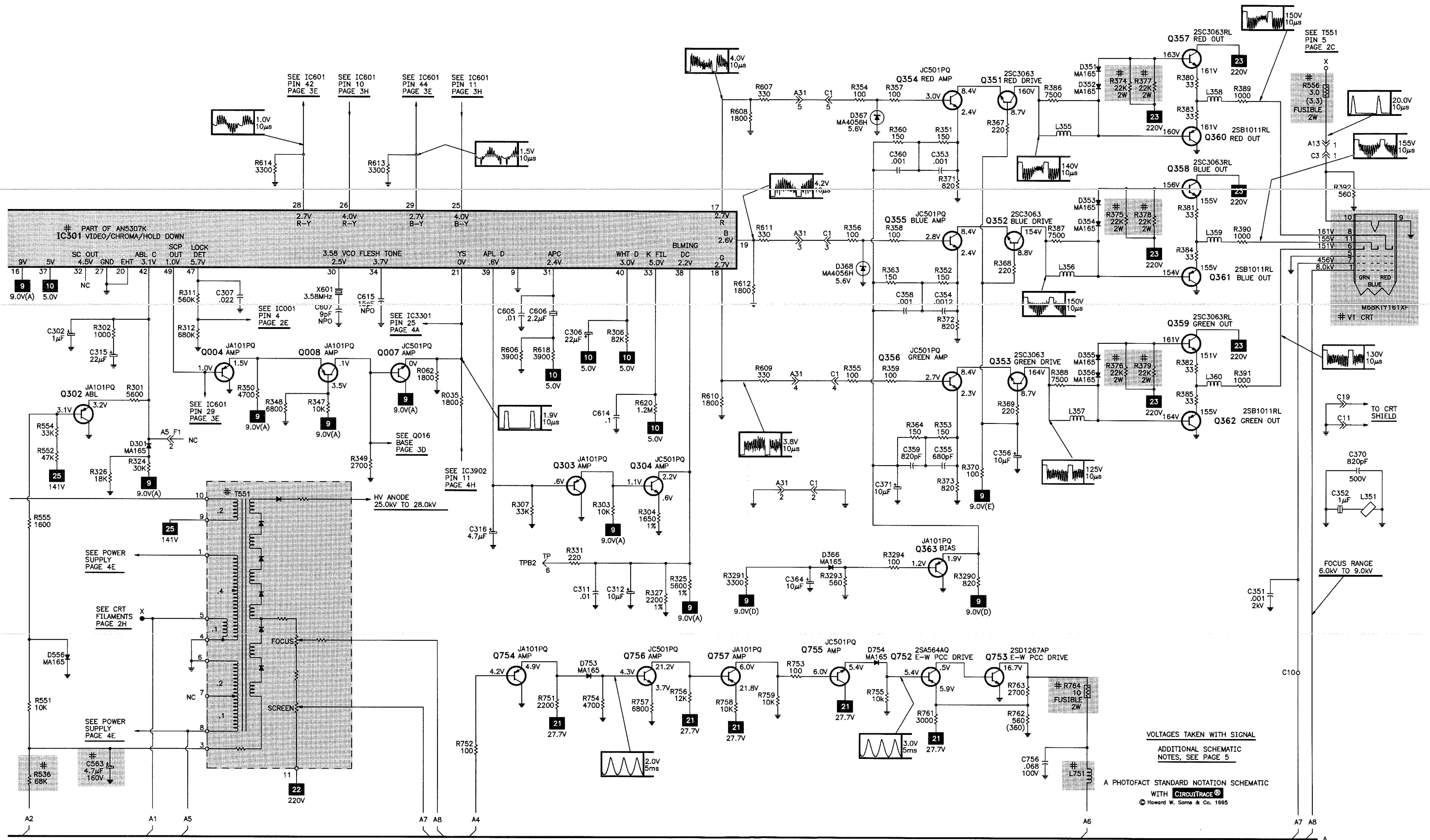
SOUND AI

The sound AI circuit is located on the U board. IC2401 has surround sound processor, graphic equalizer, volume, treble, bass, and balance circuits. IC2402 has automatic tone and volume control circuits. An algorithm is used to automatically adjust tone and volume level. The audio is sampled 256 times per second. If two consecutive samples are determined to be above or below the threshold an internal graphic equalizer will change the level by 2 DB per second until sample is within limits. An automatic gain circuit monitors the volume level for abrupt changes in volume levels and changes volume level to predetermined maximum level if required.



Created with pride by the employees of Howard W. Sams & Company.

J. Barker, B. Bryant,
B. Buchanan, T. Clensy,
D. Cobb, G. Farrell, B. Fink,
M. Herkless, J. Kocha,
J. Limp, F. Malek, B. Medaris,
R. Raus, B. Skinner, J. Young



MISCELLANEOUS ADJUSTMENTS

REMOTE OPERATION

Picture Adjustments

- 1. Press the action button to display the main menu.
- 2. Press the channel down button to select the picture icon.
- 3. Press the action button to display the picture adjustment menu.
- 4. Press the channel up or down button to select the desired picture adjustment.
- 5. Press the volume left or right button to adjust selection.
- 6. Press the action button twice to exit picture adjustment.

Normalize Settings

- 1. Press action button to display main menu.
- 2. Press channel down button to select audio or picture icon.
- 3. Press action button to display adjustment menu.
- 4. Press channel up or down button to select norm.
- 5. Press volume left or right button to reset adjustment settings to factory preset levels.
- 6. Press action button twice to exit.

NOTE: This receiver employs digital customer controls. All adjustments are at normalized position unless otherwise indicated.

HIGH VOLTAGE CHECK

Tune in a picture. Set picture, sharpness, color, and brightness to minimum. Connect a high voltage probe to CRT anode. High voltage should read 29.5kV ±1.25kV (27") or 31kV +2kV/-500V (31").

VIDEO LEVEL

NOTE: Do not adjust unless R115 has been replaced or misadjusted. Tune in a color bar pattern. Connect oscilloscope to pin 6 of connector A21. Adjust R115 for 1V ± .1Vp-p.

PINCUSHION

Tune in a crosshatch pattern. Normalize picture settings. Set R786 to center position. Adjust L770 and R786 for square perpendicular boxes. Perform or check pincushion adjustments in serviceman mode (D0-DA).

COMB FILTER

Tune in an NTSC color bar pattern. Normalize picture settings. Set sharpness to maximum and color to minimum. Connect an oscilloscope to pin 1 of connector X1. Set R3215 fully clockwise. Adjust L3202 for minimum burst amplitude. Adjust R3215 for minimum burst amplitude. Alternately adjust L3202 and R3215 until burst amplitude cannot be reduced any further.

MPU REFERENCE OSCILLATOR

Connect a frequency counter to TPS3. Turn receiver off with AC power applied. Adjust C022 for 32,768.0Hz ±.1Hz.

PURITY

Operate the set for 60 minutes with the brightness control at maximum to allow CRT temperature to stabilize. Use a degaussing coil to demagnetize the CRT. Press recall button on remote to enter

purity check mode.

NOTE: Receiver must be in serviceman mode for purity colors to display on screen. Press recall button to display desired colors. Loosen the deflection yoke and move it back as far as possible. Loosen locking ring and move the purity tabs to center the vertical green band. Slowly slide the deflection yoke forward until a uniform screen of desired color is obtained.

CONVERGENCE

Connect a signal generator to antenna terminals and tune in a dot pattern. Adjust 4-pole magnets to coverage the red and blue dots at the center of the screen. Adjust 6-pole magnets to converge the red/blue dots over the green dots at the center of the screen. Tune in a crosshatch pattern. Remove rubber wedges between the deflection yoke L555 and the CRT. Tilt deflection yoke up or down to converge the vertical lines at the top and bottom of the screen and the horizontal lines at the left and right sides of the screen. Tilt the deflection yoke left or right to converge the horizontal lines at the top and bottom of the screen and the vertical lines at the left and right sides of the screen. Repeat convergence procedure if necessary to obtain the best overall convergence. Replace rubber wedges. To obtain the best corner convergence it may be necessary to order the permalloy convergence corrector strip (part no. 0FMK014ZZ). Place strip between CRT and yoke in area needing correction. Move and or rotate the magnetic strip until the best correction is obtained. Use tape in addition to the adhesive strip to secure it to the CRT.

ENTERING SERVICEMAN MODE

Turn on receiver and momentarily connect pins 8 and 3 of connector TP. The letters "CHK" will appear in yellow on the upper right of the screen, volume up/down will adjust rapidly. Press the action button and volume up button on receiver control panel simultaneously. The receiver will enter the serviceman mode, the letters "CHK" will turn red, the volume up/down buttons will adjust normally and all customer controls are set to normal.

NOTE: For quick entry into serviceman mode perform the following:

- 1. Select setup icon from main menu and select cable mode.
- 2. Select time icon and set sleep for 30 min.
- 3. Press action key twice and tune in channel 124 with volume at minimum.
- 4. Press volume down button on receiver, set should be in serviceman mode.

SERVICEMAN MODES

Press power button on remote to select one of five service modes.

- B= Serviceman Sub Adjustments
- C= Serviceman CRT Adjustments
- D= Serviceman Pincushion Adjustments
- S= Factory Adjustments only
- Normal = Normal operation of channel and volume buttons

EXIT SERVICEMAN MODE

Press action and power buttons simultaneously on receiver control panel for approximately 2 seconds to exit serviceman mode. The receiver will shutoff then come back on with audio on channel 3. NOTE: Always exit serviceman mode after making adjustments.

SUB ADJUSTMENTS

NOTE: Write down original values in detail before making any adjustments in case a misadjustment occurs. Press channel up/down buttons on remote to select adjustment.

Press volume up/down buttons on remote to adjust level of adjustment.

Sub Adjustment Range and Default Level Values

| Adjustment | Range Level | Default Level | On Unit Level |
|---------------------|-------------|---------------|---------------|
| Sub Color (B0) | 0-63 | 32 | 22 |
| Sub Tint (B1) | 0-63 | 32 | 38 |
| Sub Brightness (B2) | 0-127 | 96 | 87 |
| Sub Contrast (B3) | 0-63 | 32 | 24 |
| RF AGC (B4) | 0-127 | 64 | 97 |

Sub Color (B0)

Tune in an active station. Enter serviceman mode and select sub color (B0). Adjust for proper color in picture.

Sub Tint (B1)

Tune in an active station. Enter serviceman mode and select sub tint (B1). Adjust for proper flesh tones.

Sub Brightness (B2)

This adjustment must be made after sub contrast or color temperature adjustments are made. DO NOT adjust screen after sub brightness is set. Connect a color bar signal with pure white and pure black to the antenna input. Switch color off. Enter serviceman mode and select sub brightness (B2). Adjust until the black bars start to turn gray, then decrease adjustment until bars turn black.

Sub Contrast (B3)

NOTE: This adjustment is factory set, DO NOT adjust unless CRT or CRT board is replaced. Connect a bar sweep signal to the antenna input. Connect oscilloscope to pin 4 of connector C1 on CRT board. Enter serviceman mode and select sub contrast (B3). Adjust for 3.0Vp-p ±.1Vp-p from white to black level. Do not include sync tip in measurement.

RF AGC (B4)

Tune in a picture. Enter serviceman mode and select RF AGC (B4). Decrease B4 until snow appears in picture, then back until snow disappears.

CRT ADJUSTMENTS

Follow same procedure used for Sub Adjustments.

CRT Adjustment Range and Default Level Values

| Adjustment | Range Level | Default Level | On Unit Level |
|-------------------|-------------|---------------|---------------|
| Red Cutoff (C0) | 3 X 0-256 | 2 020 | 2 130 |
| Green Cutoff (C1) | 0-256 | 128 | 176 |
| Blue Cutoff (C2) | 3 X 0-256 | 2 020 | 2 148 |
| Brightness(C3) | 0-63 | - | 63 |
| Sub Bright (C4) | 0-127 | - | 87 |
| Red Drive (C5) | 0-256 | 128 | 92 |
| Blue Drive (C6) | 0-256 | 128 | 95 |
| (C7) | 0-63 | - | 12 |
| (C8) | 0-63 | - | 12 |
| (C9) | 0-63 | - | 20 |
| (CA) | 0-63 | - | 12 |

Purity Check

Press recall button on remote to enter purity check mode.

NOTE: Receiver must be in serviceman mode for purity colors to display on screen. Press recall button to display desired colors.

Color Temperature (C0 thru C6)

NOTE: Observe low and high brightness areas of a B/W picture for proper tracking. Enter DAC mode and select CRT adjustments. Set the red cutoff (C0), green cutoff (C1), and blue cutoff (C2) for a gray picture. Set the red drive (C5) and blue drive (C6) for correct white areas. NOTE: PIP adjustments are factory set. Adjustment is not recommended unless replacement or repair of the Y-board has been performed. Unless otherwise stated all adjustments were performed with the large PIP window activated and displaying a colorbar pattern.

STEREO ADJUSTMENTS

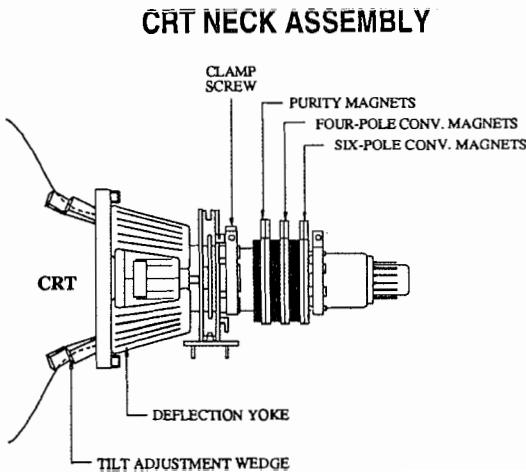
All adjustments were made using a MTS TV / stereo generator connected to the antenna terminals, with the customer controls set to normal listening levels. Select stereo mode.

WB Level

On generator select pilot, 1kHz audio frequency, and L+R modulating signal. Connect a digital voltmeter to pin 20 of IC2201. Set R2209 fully counterclockwise. Turn back slowly until voltage stops dropping, approximately 7.6V.

VCO

Tune in a stereo signal. Set R2220 fully clockwise. Adjust R2220 slowly counterclockwise until stereo icon turns red on screen.



SEE IC001 PIN 2 PAGE 2E

TUNERS NOT INCLUDED IN THIS COVERAGE

IF TO MAIN TUNER

AGC TO MAIN TUNER

SEE Q3204 EMITTER PAGE 2H

VOLTAGES TAKEN WITH SIGNAL

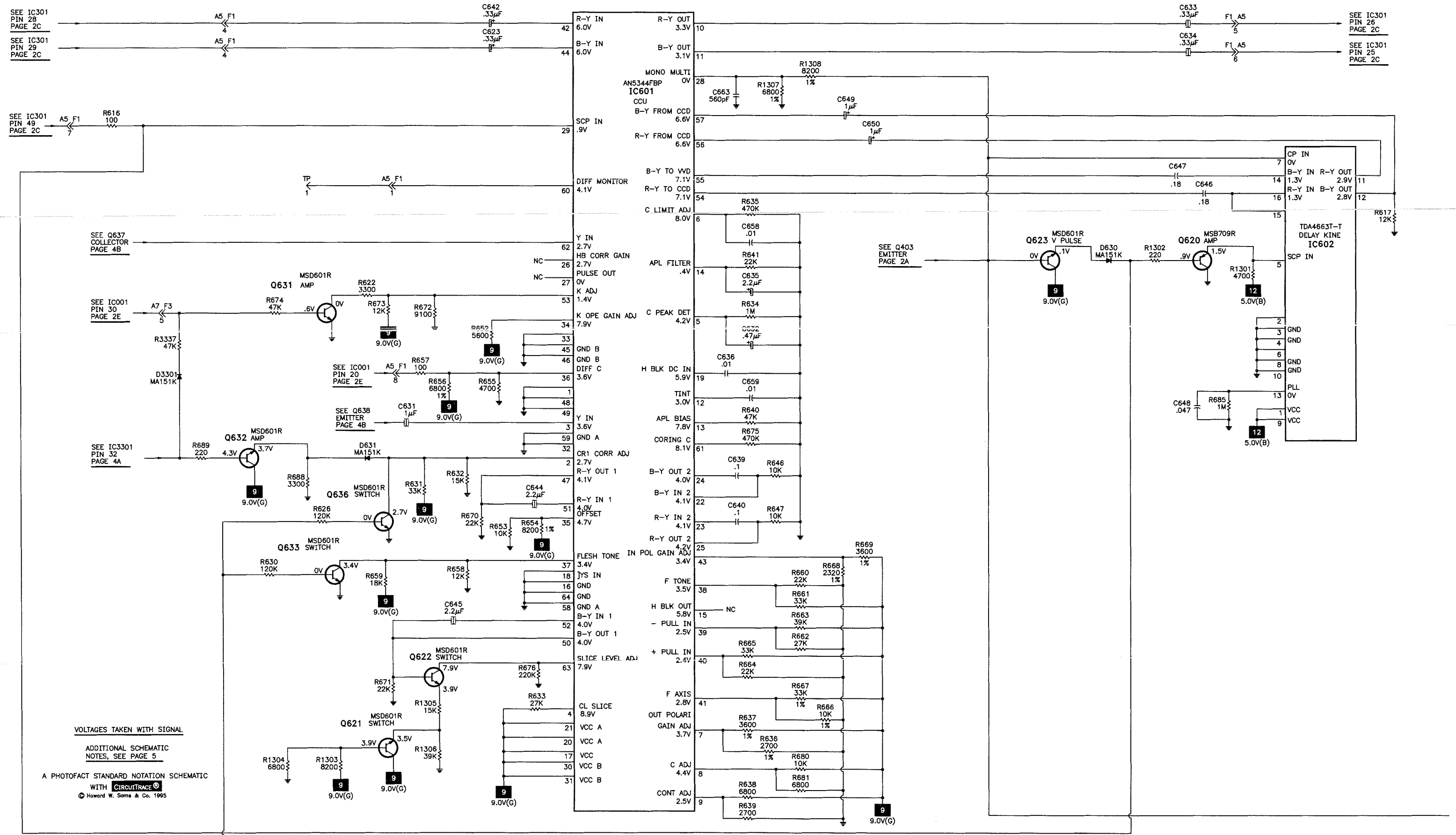
ADDITIONAL SCHEMATIC NOTES, SEE PAGE 5

A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITTRACE®

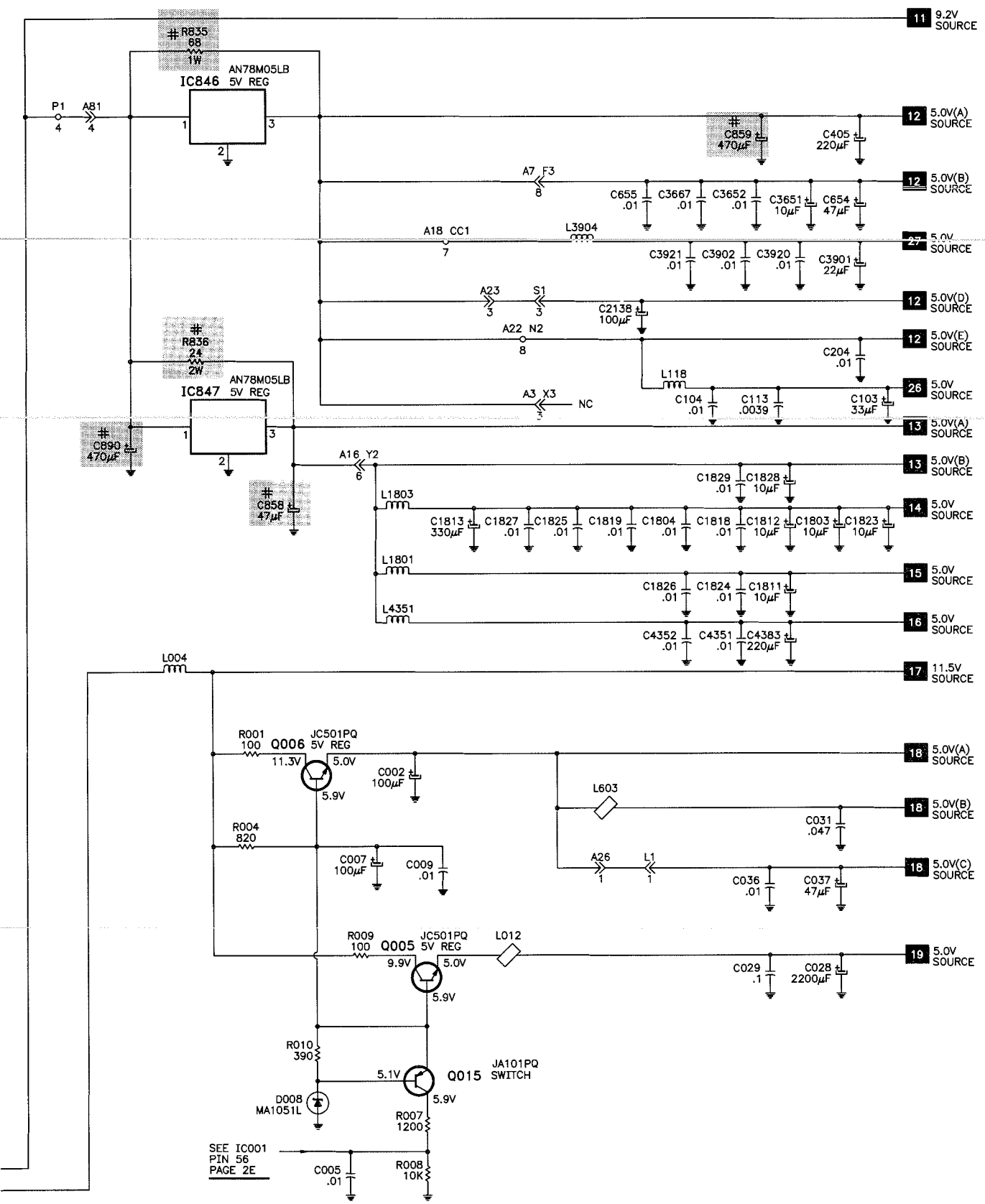
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CHROMA CONTROL SCHEMATIC

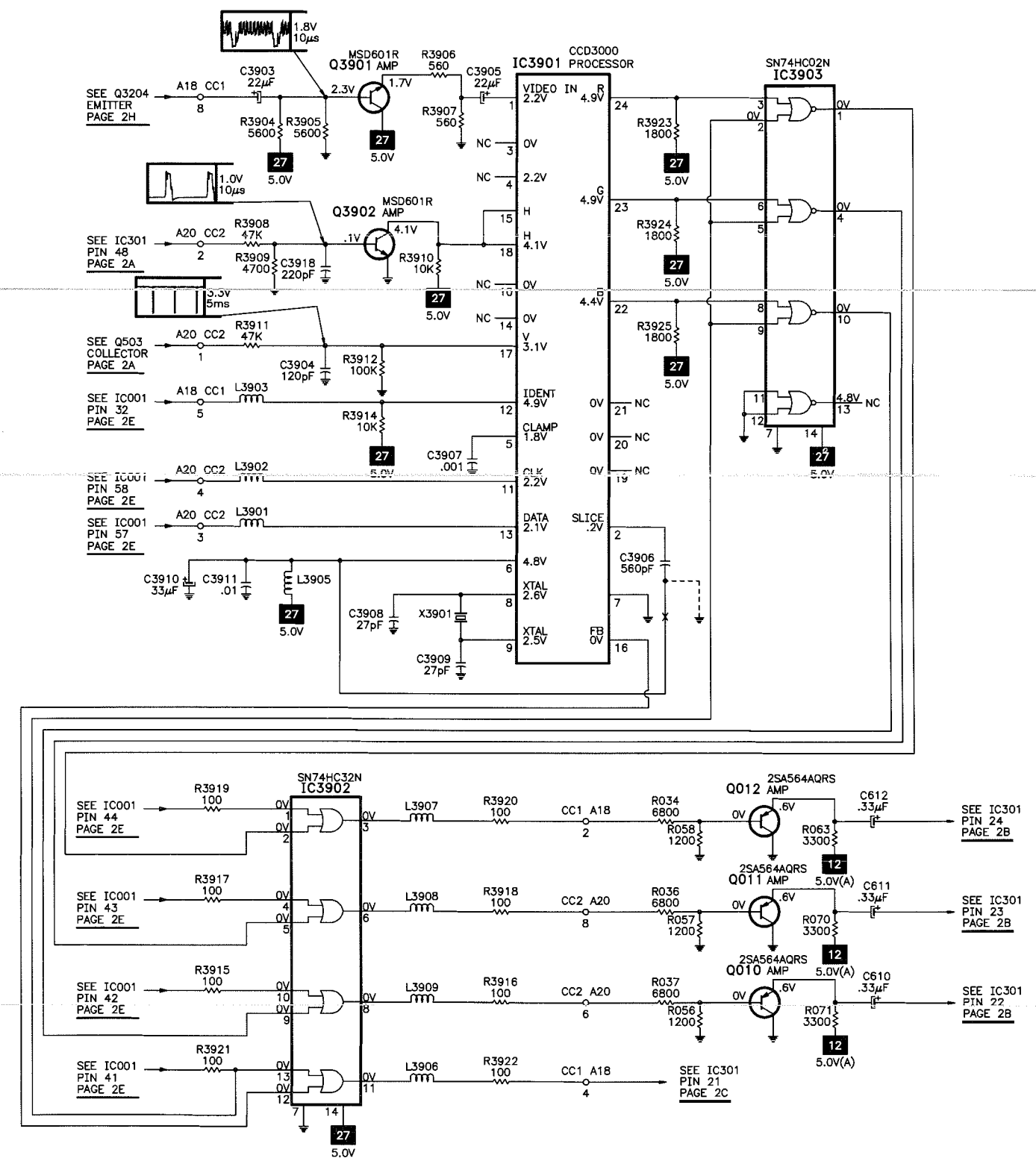


POWER SUPPLY SCHEMATIC continued



G

CLOSED CAPTION SCHEMATIC



VOLTAGES TAKEN WITH CLOSED CAPTION ON

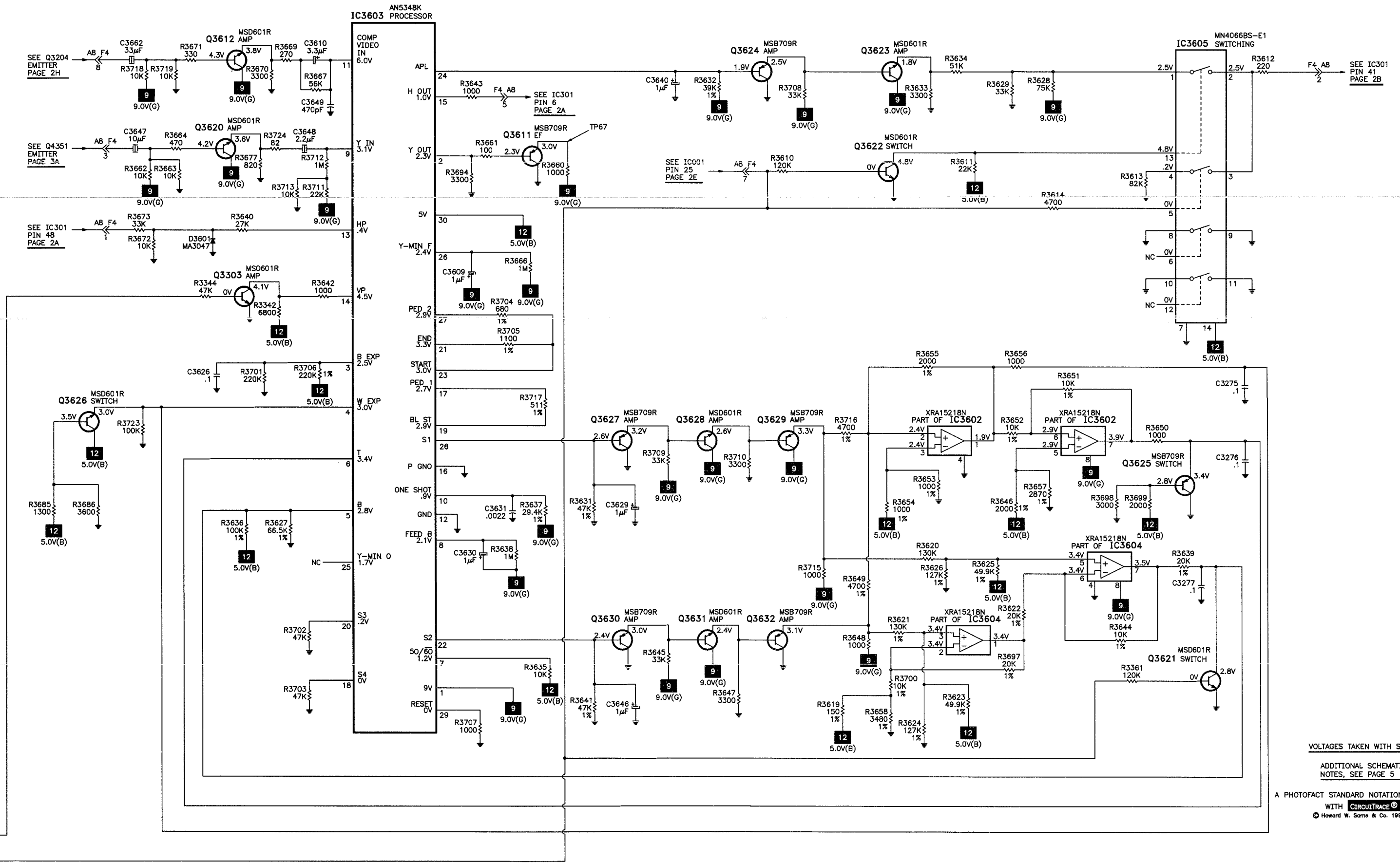
VOLTAGES TAKEN WITH SIGNAL

ADDITIONAL SCHEMATIC NOTES, SEE PAGE 5

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H

AI PICTURE SCHEMATIC



PANASONIC
MODELS CT-27SF31S, CT-27XF31CS (CHASSIS AL2DP238)

VOLTAGES TAKEN WITH SIGNAL

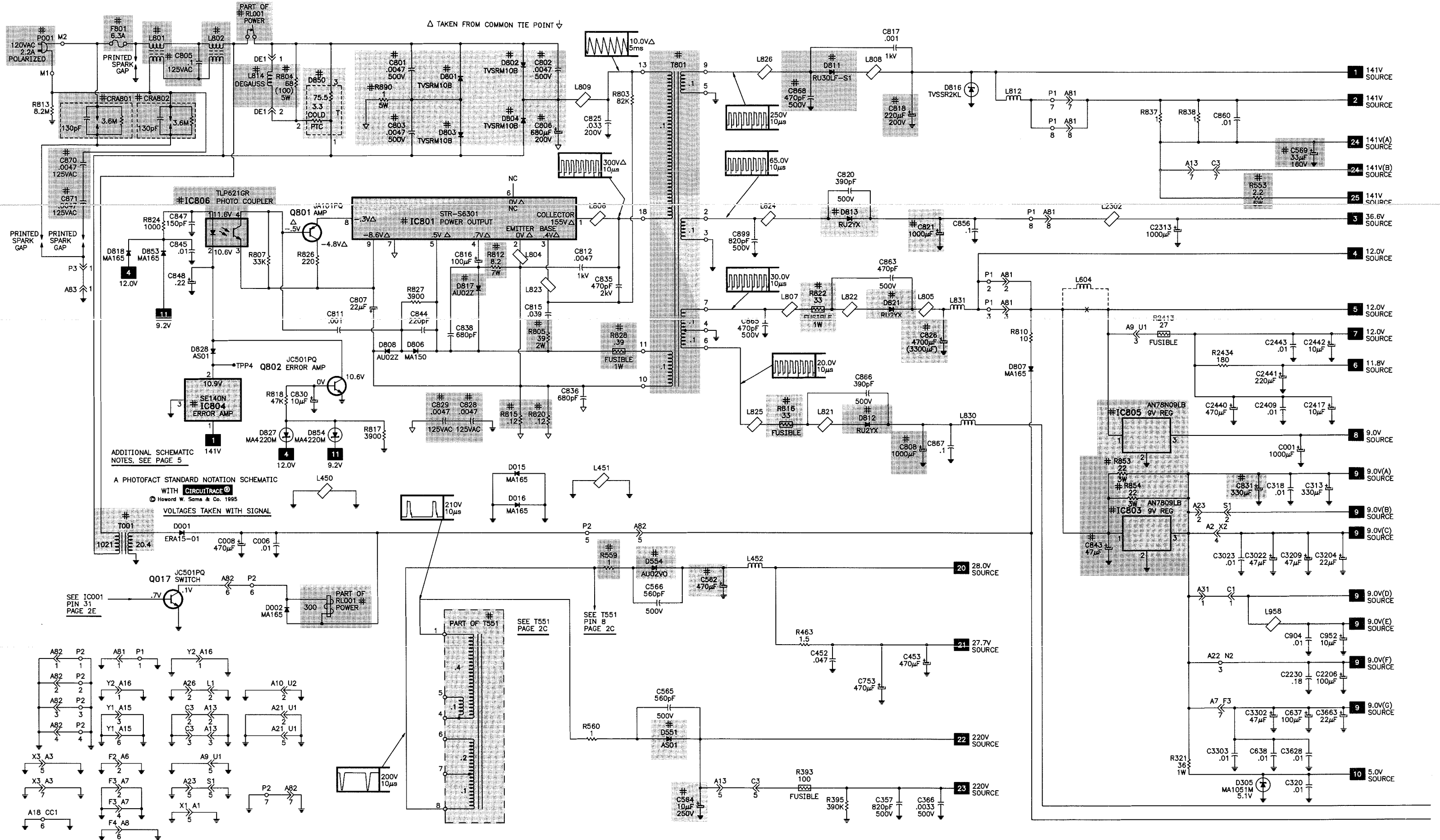
ADDITIONAL SCHEMATIC
NOTES, SEE PAGE 5

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G

H

POWER SUPPLY SCHEMATIC



SEE Q3215
EMITTER
PAGE 2G

SEE Q3214
EMITTER
PAGE 2G

SEE Q3217
EMITTER
PAGE 2G

SEE Q3204
EMITTER
PAGE 2H

SEE Q3216
EMITTER
PAGE 2G

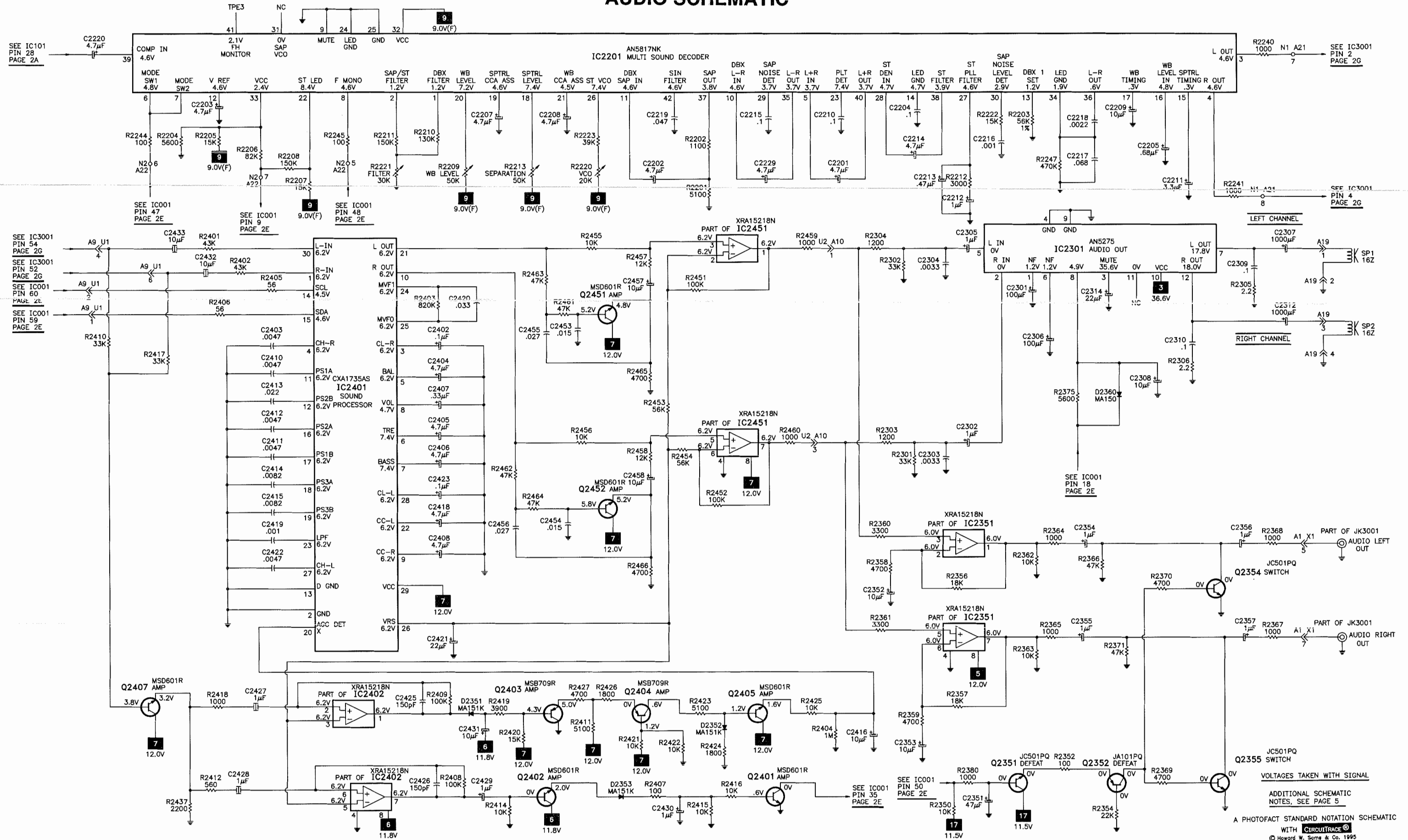
VOLTAGES TAKEN WITH SIGNAL

ADDITIONAL SCHEMATIC
NOTES, SEE PAGE 5

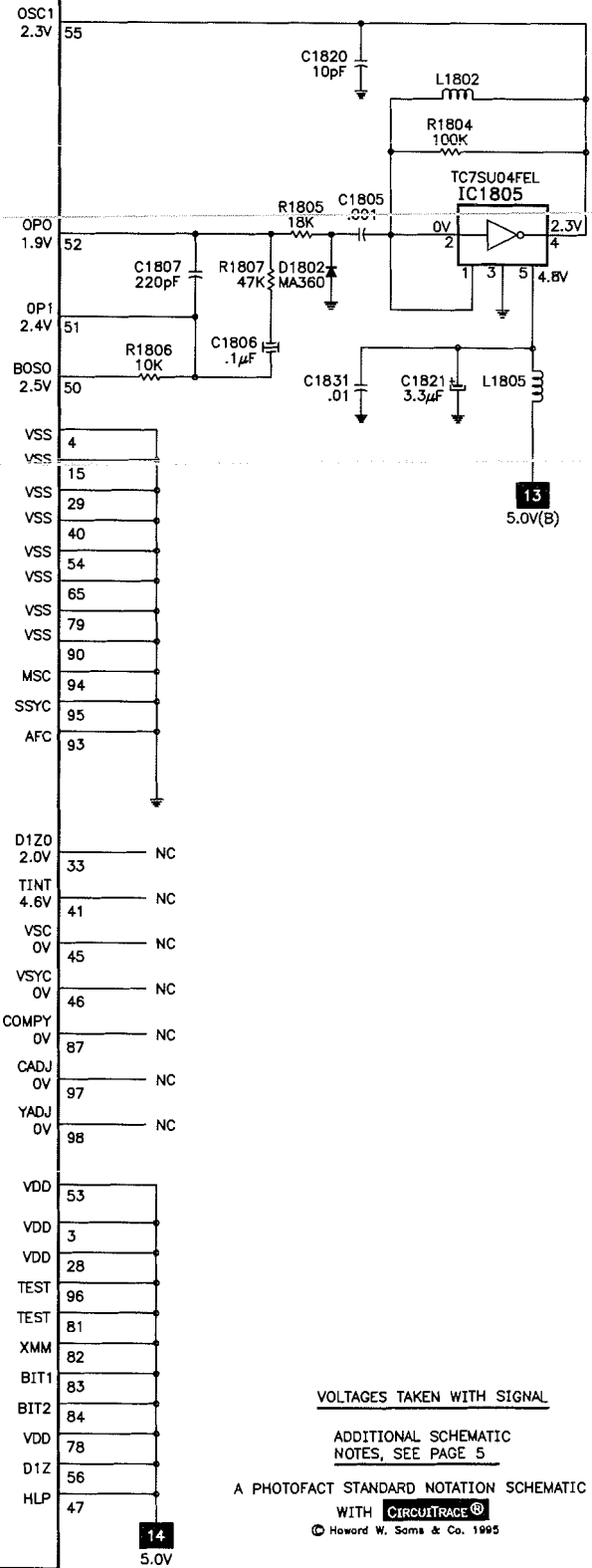
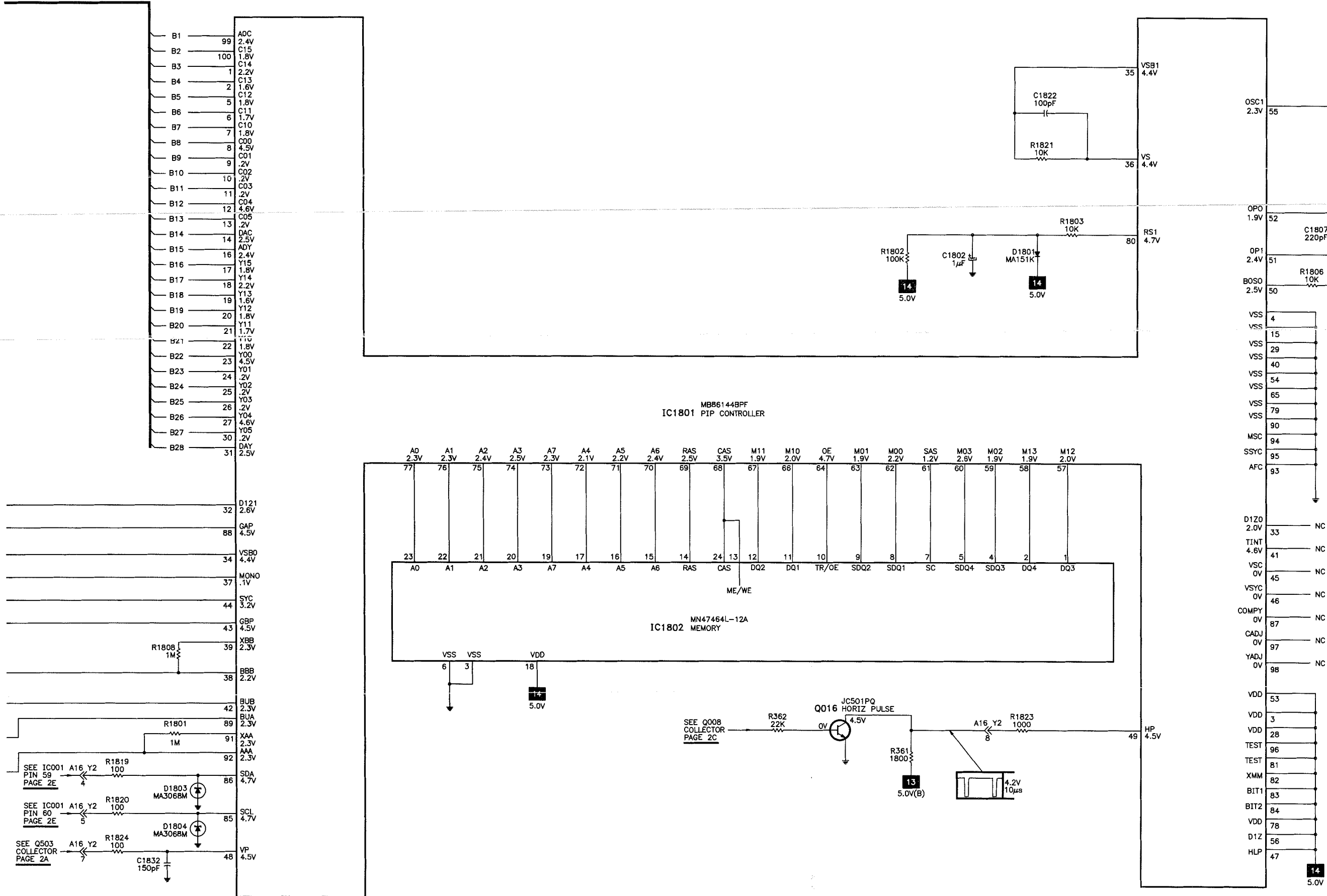
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AUDIO SCHEMATIC



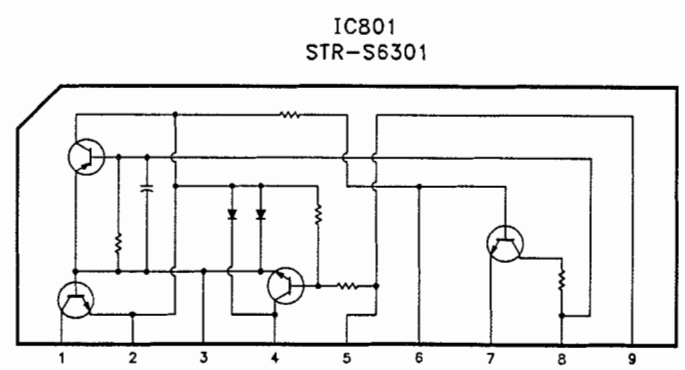
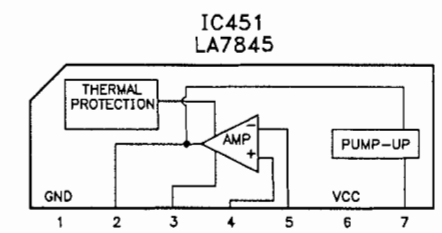
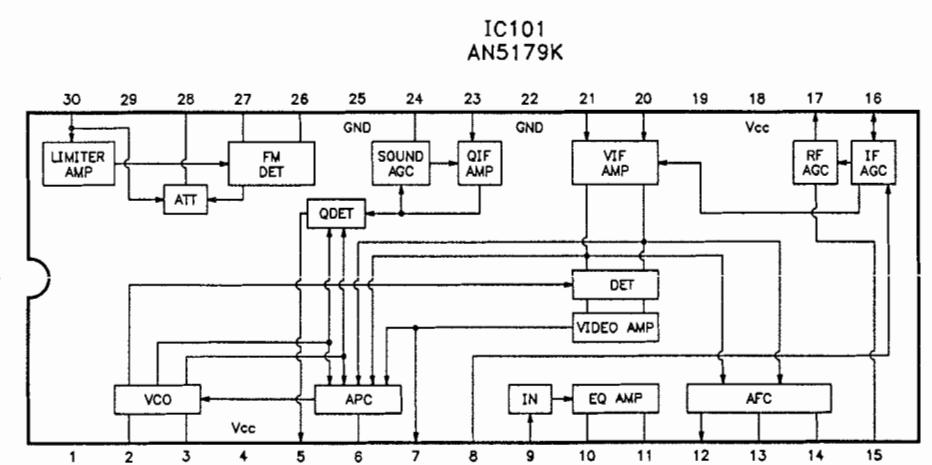
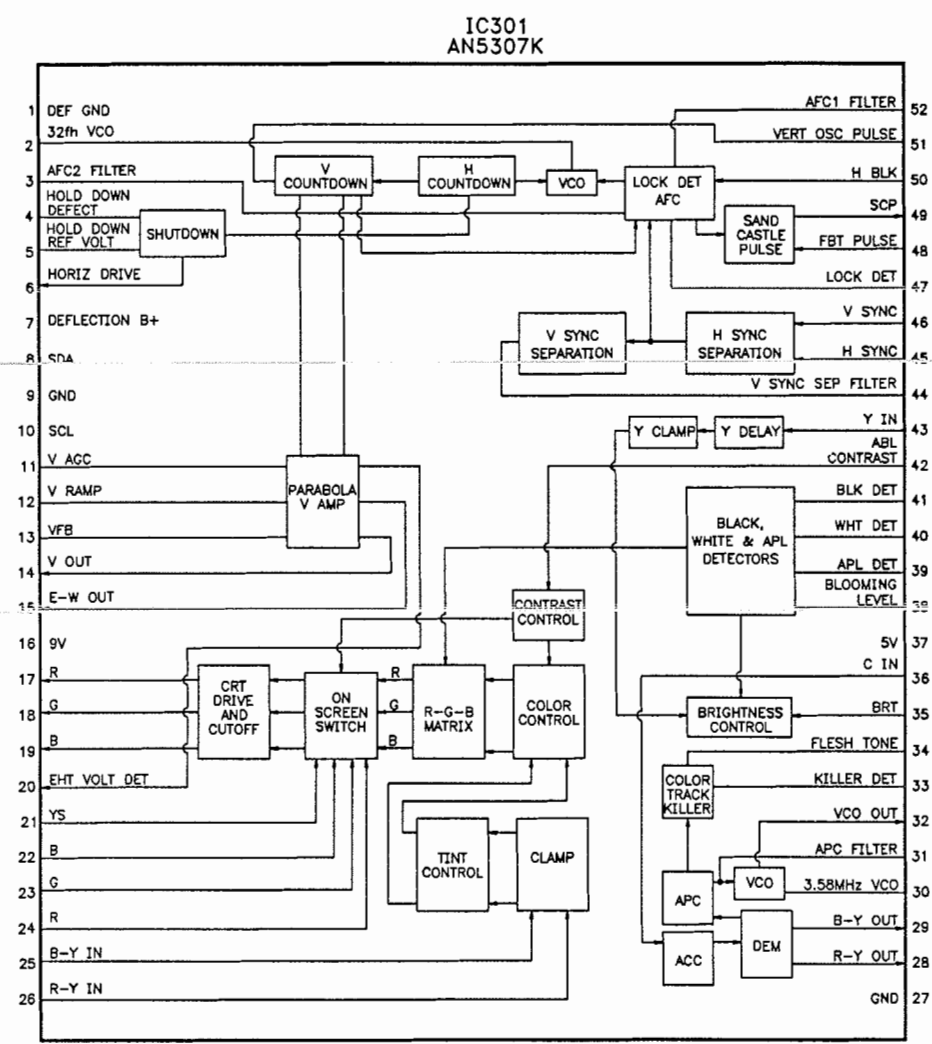
PIP SCHEMATIC continued



VOLTAGES TAKEN WITH SIGNAL
ADDITIONAL SCHEMATIC
NOTES, SEE PAGE 5
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IC FUNCTIONS



SCHEMATIC NOTES

- # For SAFETY use only equivalent replacement part, see parts list.
- ✕ Circuitry not used in some versions.
- Circuitry used in some versions.
- ⏏ Ground
- ⏏ Chassis ground
- ▽ Common tie point
- △ Taken from common tie point
- 3 Schematic CIRCUITRACE®: Voltage source tie point.
- A Cabling: Heavy lines reduce use of multiple lines.

Waveforms and voltages are taken from ground, unless noted otherwise.
Waveforms taken with triggered scope and colorbar signal. Waveform voltage is peak to peak. Timebase is per division. Waveforms shown at 10 divisions.
Supply voltages maintained as seen at input.
Voltages measured with digital meter and a 1000µV RF signal, with colorbar pattern, applied to antenna terminal. Controls adjusted for normal operation.
Capacitors are 50 volts or less, 5% or greater unless noted. Electrolytic capacitors are 50 volts or less, 20% or greater unless noted.
Resistors are 1/2W or less, 5% or greater unless noted. Value in () used in some versions.
Measurements with switching as shown, unless noted. Rated voltage shown on zener diodes.

PARTS LIST continued

| MISCELLANEOUS | | | |
|---|-----------------|---------------|---------------------------|
| Item No. | Description | Mfr. Part No. | Notes |
| # CRA801, 02 | Capristor | EXNG131P365 | 130pF/3.6M |
| # F801 | Fuse | 0BA1C63NU100 | 6.3Amp, 125V, Slow Blow |
| # F801 (1) | Fuse | XBA1C63NU100 | 6.3Amp, 125V, Slow Blow |
| # JK351 | Socket | TJS1A5210 | CRT |
| JK3001 | Jack | TJB2A9051 | Assembly |
| L3201 | Delay Line | EFDEN645B35B | - |
| L3202 | Delay Line | EIK1EG024B | - |
| L3203 | Delay Line | EIK1EG025Q | - |
| L3302 | Delay Line | EIK1EG020Q | - |
| # F001 | Line Cord | TSX3134X | AC, Polarized |
| # RL001 | Relay | TSE1864 | Power |
| RM001 | Receiver | RPM-637CBRL | Remote |
| S010 | Switch | EVQQVC13T | Power |
| S011 | Switch | EVQQVC13T | Volume Down |
| S012 | Switch | EVQQVC13T | Volume Up |
| S013 | Switch | EVQQVC13T | Channel Down |
| S014 | Switch | EVQQVC13T | Channel Up |
| S015 | Switch | EVQQVC13T | TV/Video |
| S016 | Switch | EVQQVC13T | Action |
| SP1, SP2 | Speaker | EAS12D128W2 | 3" X 5", 16 Ohms, 2W |
| # TNR001 (2) | Main Tuner | ENV568L4G3 | UHF/VHF |
| # TNR002 (2) | PIP Tuner | ENG26201G | UHF/VHF |
| # V1 | CRT | M68KTY161XF | - |
| # V1 (1) | CRT | M78KTY161X | - |
| X001 | Crystal | TAF10020 | - |
| X012 | Crystal | TSS1013-D | 32.7kHz |
| X101 | Filter | EFCH45MSP6N | SAW |
| X102 | Trap | EFCS4R5MW3BA | 4.5MHz |
| X201 | Filter | EFCS4R5MS4W | 4.5MHz |
| X501 | Crystal | TAFCSB503F38 | 503kHz |
| X601 | Crystal | TSS816MX | 3.58MHz |
| X3901 | Crystal | CSA120MT | - |
| X4351 | Crystal | TSS2163-M | - |
| X4352 | Crystal | TSS2163-M | - |
| | Magnet | 0FMK014ZZ | Correction Strip |
| | PC Board (2) | TNP190220 | A |
| | PC Board (1)(2) | TNP190220AZ | A |
| | PC Board (2) | TNP111545 | C |
| | PC Board (2) | TNP110771 | CC |
| | PC Board (2) | TNP111548 | F |
| | PC Board (2) | TNP111504 | L |
| | PC Board (2) | TNP111501 | N |
| | PC Board (2) | TNP111505 | P |
| | PC Board (2) | TNP111546 | U |
| | PC Board (2) | TNP111554 | S |
| | PC Board (2) | TNP111542 | X |
| | PC Board (1)(2) | TNP111542AZ | X |
| | PC Board (2) | TNP111541AZ | Y |
| | Transmitter | EUR501230 | Remote |
| | VM Coil | ETC-35C6NA | - |
| | VM Coil (1) | ETC-39C6NA | - |
| | Wedges | TMM2A30202 | Yoke Positioning (3 Used) |
| # For SAFETY use only equivalent replacement part. | | | |
| (1) Used in models CT-31SF31S, CT-31XF31CS, CT-F33L6S, CT-F33L6LS, and CT-F33L6VS. | | | |
| (2) Contact PTS Electronics Corporation for replacement; order by manufacturer's part number. | | | |

| CABINET PARTS | |
|------------------------------------|---------------|
| Item | Mfr. Part No. |
| Model CT-27SF31S | |
| Cabinet Back Assembly | TXFKU3193SER |
| Cabinet Front Assembly | TXFKY0894SER |
| Pushbutton Assembly | TBX2A50191G |
| Model CT-27XF31CS | |
| Cabinet Back Assembly | TXFKU3093SER |
| Cabinet Front Assembly | TXFKY1794SER |
| Pushbutton Assembly | TBX2A50191G |
| Models CT-31SF31S, CT-F33L6S/LS/VS | |
| Cabinet Back Assembly | TXFKU0694SER |
| Cabinet Front Assembly | TXFKY2093SER |
| Pushbutton Assembly | TBX2A50191G |
| Model CT-31XF31CS | |
| Cabinet Back Assembly | TXFKU0594SER |
| Cabinet Front Assembly | TKY2A3052 |
| Pushbutton Assembly | TBX2A50191G |
| Remote Transmitter | |
| Battery Cover | UR50EC1098 |

PARTS LIST

Important Parts Information

- The parts listed here are those not usually available from a well-stocked supply cabinet or bin.
- Where items may be replaced with equivalent parts, several alternates are shown from participating vendors.
- On the parts lists, safety items are marked with a # to remind you that only exact replacements are recommended for these items.

- When ordering parts, state the model number, part number, and description.

Obtaining Parts

Many of these parts are available from your local Sams authorized distributor or the manufacturer of the equipment. Call Sams for the name of your nearest distributor:

800-428-7267

Or consult the Sams *Annual Index* for the address of the original equipment manufacturer.

Participating Vendors

Information on test equipment and replacement parts is listed in these pages for the following participating vendors. Consult the Sams *Annual Index* for their current address.

- Custom Components Corporation (Chek-A-Color)
- NTE Electronics, Inc. (NTE)
- Philips ECG Company (ECG)
- PTS Electronics Corporation (PTS)
- Sencore, Inc.
- Thomson Consumer Electronics, Inc. (SK, TCE)

SEMICONDUCTORS

(Select the replacement that gives the best results.)

| Item No. | Type No. | Mfr. Part No. | NTE Part No. | ECG Part No. | TCE Part No. |
|-------------|------------|---------------|--------------|--------------|--------------|
| D001 | ERA15-01 | - | NTE552 | ECG552 | SK9000 |
| D002 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D008 | MA1051L | - | NTE5010A | ECG5010A | SK5A1 |
| D009 | MA4047M | - | NTE5009A | ECG5009A | SK4A7 |
| D011 | SEL1410G | - | - | - | - |
| D015, 16 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D021 | MA4062M | - | NTE5013A | ECG5013A | SK6A2 |
| D080 | MA29WBA | - | - | - | - |
| D301 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D305 | MA1051M | - | NTE5010T1 | ECG5010T1 | SK2267 |
| D351 Thru | | | | | |
| D356 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D366 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D367, 68 | MA4056H | - | NTE5011A | ECG5011A | SK5A6 |
| D451 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D455 | TVSEM1Z | - | NTE552 | ECG552 | SK9000 |
| D501 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D502 | MA4047M | - | NTE5009A | ECG5009A | SK4A7 |
| D504 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D530 | MA4039H | - | - | - | - |
| # D531 | AS01 | - | NTE552 | ECG552 | SK9000 |
| | ERA2204 | - | NTE116 | ECG116 | SK3312 |
| # D532 | QA206M | TVSQA206M | NTE5012A | ECG5012A | SK6A0 |
| # D533 | MA29QA | - | - | - | - |
| # D534 | MA4220H | - | NTE5030A | ECG5030A | SK22A |
| # D551 | AS01 | - | NTE552 | ECG552 | SK9000 |
| | AU01Z | - | NTE552 | ECG552 | SK9000 |
| | ERA2204 | - | NTE552 | ECG552 | SK9000 |
| # D552 | ERD07-15 | - | NTE551 | ECG551 | SK3125A |
| # D553 | TVSRU3N | - | NTE580 | ECG580 | SK5036 |
| # D554 | AU02 | - | NTE552 | ECG552 | SK9000 |
| | AU02V0 | - | NTE552 | ECG552 | SK9000 |
| | ERA18-04V3 | - | NTE552 | ECG552 | SK9000 |
| D555 | MA171 | - | NTE519 | ECG519 | SK3100 |
| D556 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D630, 31 | MA151K | - | NTE593 | ECG593 | SK9942 |
| D753, 54 | MA165 | - | NTE519 | ECG519 | SK3100 |
| # D801 Thru | | | | | |
| # D804 | TVSRM10B | - | - | - | - |
| | TVSRM10BV | - | - | - | - |
| D806 | MA150 | - | NTE177 | ECG177 | SK9091 |
| D807 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D808 | AU02Z | - | NTE552 | ECG552 | SK9000 |
| # D811 | RU30LF-S1 | - | - | - | - |
| # D812, 13 | RU2YX | - | NTE588 | ECG588 | SK9938 |
| D816 | TVSSR2KL | - | - | - | - |
| # D817 | AU02Z | - | NTE552 | ECG552 | SK9000 |
| | AU02ZV0 | - | NTE552 | ECG552 | SK9000 |
| D818 | MA165 | - | NTE519 | ECG519 | SK3100 |
| # D821 | RU2YX | - | NTE588 | ECG588 | SK9938 |
| D827 | MA4220M | - | - | - | - |
| D828 | AS01V0 | - | NTE552 | ECG552 | SK9000 |
| | AS01 | - | NTE552 | ECG552 | SK9000 |
| D853 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D854 | MA4220M | - | - | - | - |
| D955 | MA29WBA | - | - | - | - |
| D957 | MA165 | - | NTE519 | ECG519 | SK3100 |
| D1801 | MA151K | - | NTE593 | ECG593 | SK9942 |
| D1802 | MA360 | - | - | - | - |
| D1803, 04 | MA3068M | - | - | - | - |
| D2110, 11 | MA4150H | - | - | - | - |

For SAFETY use only equivalent replacement part.

SEMICONDUCTORS continued

(Select the replacement that gives the best results.)

| Item No. | Type No. | Mfr. Part No. | NTE Part No. | ECG Part No. | TCE Part No. |
|---------------|--------------|---------------|--------------|--------------|--------------|
| D2351, 52, 53 | MA151K | - | NTE593 | ECG593 | SK9942 |
| D2360 | MA150 | - | NTE177 | ECG177 | SK9091 |
| D3010 Thru | | | | | |
| D3020 | MA3110M | - | - | - | - |
| D3301, 04 | MA151K | - | NTE593 | ECG593 | SK9942 |
| D3601 | MA3047 | - | - | - | - |
| IC001 | MN1874033QAR | - | - | - | - |
| IC002 | 24C02AIP | - | - | - | - |
| IC101 | AN5179K | - | - | - | - |
| # IC301 | AN5307K | - | - | - | - |
| IC451 | LA7845 | - | - | - | - |
| IC601 | AN5344FBP | - | - | - | - |
| IC602 | TDA4663T-T | - | - | - | - |
| # IC801 | STR-S6301 | - | NTE7073 | ECG7073 | - |
| # IC803 | AN7809LB | - | NTE1910 | ECG1910 | - |
| | AN7809 | - | NTE1910 | ECG1910 | - |
| # IC804 | SE140N | - | - | - | - |
| # IC805 | AN78N09 | - | - | - | - |
| | AN78N09LB | - | - | - | - |
| # IC806 | TLP621GR | - | NTE3098 | ECG3098 | SK10178 |
| IC846, 47 | AN78M05LB | - | NTE960 | ECG960 | SK3591 |
| IC1801 | MB86144BPF | - | - | - | - |
| IC1802 | MN47464L-12A | - | - | - | - |
| IC1803 | MB40166PF-EF | - | - | - | - |
| IC1804 | MB40176PF-EF | - | - | - | - |
| IC1805 | TC7SU04FEL | - | - | - | - |
| IC2201 | AN5817NK | - | - | - | - |
| IC2301 | AN5275 | - | - | - | - |
| IC2351 | XRA15218N | - | - | - | - |
| | TVSM5218N | - | - | - | - |
| | BA15218N | - | - | - | - |
| IC2401 | CXA1735AS | - | - | - | - |
| IC2402, 51 | XRA15218N | - | - | - | - |
| | TVSM5218N | - | - | - | - |
| | BA15218N | - | - | - | - |
| IC3001 | SN103848APG | - | - | - | - |
| | SN103848PG | - | - | - | - |
| IC3301 | AN5342FBP | - | - | - | - |
| IC3602 | XRA15218N | - | - | - | - |
| | TVSM5218N | - | - | - | - |
| | BA15218N | - | - | - | - |
| IC3603 | AN5348K | - | - | - | - |
| IC3604 | XRA15218N | - | - | - | - |
| | TVSM5218N | - | - | - | - |
| | BA15218N | - | - | - | - |
| IC3605 | MN4066BS-E1 | - | - | - | - |
| | MN4066BS | - | - | - | - |
| IC3901 | CCD3000 | - | - | - | - |
| IC3902 | SN74HC32N | - | NTE74HC32 | ECG74HC32 | - |
| IC3903 | SN74HC02N | - | NTE74HC02 | ECG74HC02 | SK7C02 |
| IC4351 | MB3512PFQ | - | - | - | - |
| Q004 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q005 Thru | | | | | |
| Q007 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q008 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q009 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |

For SAFETY use only equivalent replacement part.

PARTS LIST continued

CAPACITORS & ELECTROLYTICS

| Item No. | Rating | Mfr. Part No. |
|--------------|----------------------|---------------|
| C022 | 30pF Trimmer | ECRHA030E81 |
| C026, 27, 41 | 33pF 5% 50V N150 | ECCF1H330JP |
| C301 | 33μF 16V NP | ECEA1CN330S |
| C351 | .001 10% 2kV | ECKD3D102KB |
| C352 | 1μF 50V NP | ECEA1HN010S |
| C402 | 1μF 25V Tantalum | ECSF1EE105 |
| C403 | .33μF 35V Tantalum | ECSF1VE334 |
| C504 | 220pF 5% 50V N750 | ECCF1H221JU |
| # C531 | 33μF 50V | ECEA1HU330 |
| # C551 | .01 5% 1.2kV | ECWH12H103JS |
| # C552 | .033 5% 400V | ECQM4333JZ |
| # C554 | 820pF 5% 2kV | ECKD3D821JB |
| # C554 (1) | .0015 5% 2kV | ECKD3D152JB |
| # C555 | .0047 5% 1.2kV | ECWH12H472JS |
| # C556 | 560pF 5% 2kV | ECKD3D561JB |
| # C556 (1) | 680pF 5% 2kV | ECKD3D681JB |
| # C557 | 470pF 5% 2kV | ECKD3D471JB |
| # C558 | 820pF 5% 2kV | ECKD3D821JB |
| # C559 | .43 5% 200V | ECQF2H434JS |
| # C559 (1) | .5 5% 200V | ECQF2H504JS |
| # C560 | .033 5% 100V | ECQM1333JZ |
| # C562 | 470μF 35V | ECEA1VU471 |
| # C563 | 4.7μF 160V | ECEA2CU4R7 |
| # C564 | 10μF 250V | ECEA2EGE100 |
| # C567 | 470pF 5% 2kV | ECKD3D471JB |
| # C569 | 33μF 160V | ECEA160V33Z |
| C606 | 2.2μF 50V NP | ECEA1HN2R2S |
| C607 | 9pF ±.5pF 50V NPO | ECCH1H090DC |
| C615 | 15pF 5% 50V NPO | ECCF1H150JC |
| C631 | 1μF 50V NP | ECEA1HKN010 |
| C633, 34 | .33μF 50V NP | ECEA1HKNR33 |
| C644, 45 | 2.2μF 35V NP | ECEA1VKN2R2 |
| # C801 Thru | | |
| # C803 | .0047 +100% -0% 500V | ECKD2H472PU |
| # C805 | .1 10% 125VAC | ECQU1A104KH |
| # C806 | 680μF 200V | EC0S2DA681C4 |
| # C808 | 1000μF 16V | ECEA1CU102 |
| C812 | .0047 10% 1kV | ECKD3A472KB |
| C817 | .001 10% 1kV | ECKD3A102KB |
| # C818 | 220μF 200V | ECES2DU221E4 |
| # C821 | 1000μF 50V | ECEA1HU102 |
| # C826 | 4700μF 16V | ECEA1CU472 |
| # C826 (1) | 3300μF 16V | ECEA1CU332 |
| # C828, 29 | .0047 20% 125VAC | ECKCNS472ME |
| # C831 | 330μF 16V | ECEA1CFS331 |
| C835 | 470pF 10% 2kV | ECKD3D471KB |
| # C843, 58 | 47μF 25V | ECEA1EFS470 |
| # C859 | 470μF 16V | ECEA1CFS471 |
| # C868 | 470pF 10% 500V | ECKD2H471KB |
| # C870, 71 | .0047 20% 125VAC | ECKCNS472ME |
| # C890 | 470μF 16V | ECEA1CFS471 |
| # C958 | 10μF 160V | ECEA2CU100 |
| C1806 | .1μF 50V NP | ECEA1HKN0R1 |
| C2209 | 10μF 16V Tantalum | AP106K016CAE |
| C2211 | 3.3μF 16V Tantalum | ECSF16E3R3 |
| C2427, 28 | 1μF 50V NP | ECEA1HKN010 |
| C2432, 33 | 10μF 16V NP | ECEA1CKN100 |
| C3647 | 10μF 16V NP | ECEA1CKN100 |
| C3648 | 2.2μF 50V NP | ECEA1HKN2R2 |
| C3662 | 33μF 16V NP | ECEA1CNK330 |
| C4380 | .47μF 50V NP | ECEA1HKNR47 |

For SAFETY use only equivalent replacement part.
(1) Used in models CT-31SF31S, CT-31XF31CS, CT-F33L6S,
CT-F33L6LS, and CT-F33L6VS.

COILS & TRANSFORMERS

| Item No. | Function/Rating | Mfr. Part No. |
|--------------|---------------------------------------|---------------|
| L001 | Ferrite Bead | EXCELSA35 |
| L002, 04 | 5.6μH | ELESN5R6KA |
| L005, 06 | 10μH | ELESN100KA |
| L010 | 10μH | TLUABTA100K |
| L012 | Ferrite Bead | EXCELSA35 |
| L013, 14 | 22μH | TLUABTA220K |
| L020, 21 | 10μH | TLUABTA100K |
| L103 | 15μH | ELESN150KA |
| L105 | VCO | EIV7EN068B |
| L108 | 33μH | ELESN330JA |
| L118 | 1μH | ELESN1R0KA |
| L135 | 56μH | ELESN560JA |
| L152 | AFT | EIV7EN041B |
| L201 | Quadrature | EIS7ES004B |
| L202 | 1.2μH | TLQ012K205C |
| L351 | Ferrite Bead | EXCELSA35 |
| L355, 56 | 39μH | ELESN390KA |
| L357, 58 | 27μH | ELESN270KA |
| L359 | 18μH | ELESN180KA |
| L360 | 10μH | ELESN100KA |
| L450, 51 | Ferrite Bead | EXCELSA35 |
| L452 | Power | ELC08D067 |
| # L551 | Horizontal Linearity | TLH6618P |
| # L551 (1) | Horizontal Linearity | TLH6663P |
| L553 | Ferrite Bead | EXCELSA24 |
| L554 | Ferrite Bead | EXCELSA35 |
| # L555 | Yoke 110° Horiz 1.15mH Vert 22.9mH | OLY15901F |
| # L555 (1) | Yoke | TLY15496F |
| # L556 | Ferrite Bead | EXCELSA35 |
| L603 | Ferrite Bead | EXCELSA39 |
| L606 | 120μH | ELESN121KA |
| # L751 | Phasing | TLH15733M |
| L770 | Pincushion | ELH11Y751 |
| # L801, 02 | Line Filter | ELF18D656Y |
| L804 Thru | | |
| L808 | Ferrite Bead | EXCELSA35 |
| L809 | Ferrite Bead | EXCELSA39 |
| L812 | Line Filter | ELC10B011 |
| # L814 | Degaussing | OLK19041A |
| # L814 (1) | Degaussing | OLK19036-1A |
| L821 Thru | | |
| L826 | Ferrite Bead | EXCELSA35 |
| L830, 31 | 33μH | ELEIE330KA |
| L953, 54, 58 | Ferrite Bead | EXCELSA35 |
| L1801 | 47μH | ELESN470KA |
| L1802 | 10μH | ELESN100KA |
| L1803 | 47μH | ELESN470KA |
| L1805 | 100μH | ELESN101KA |

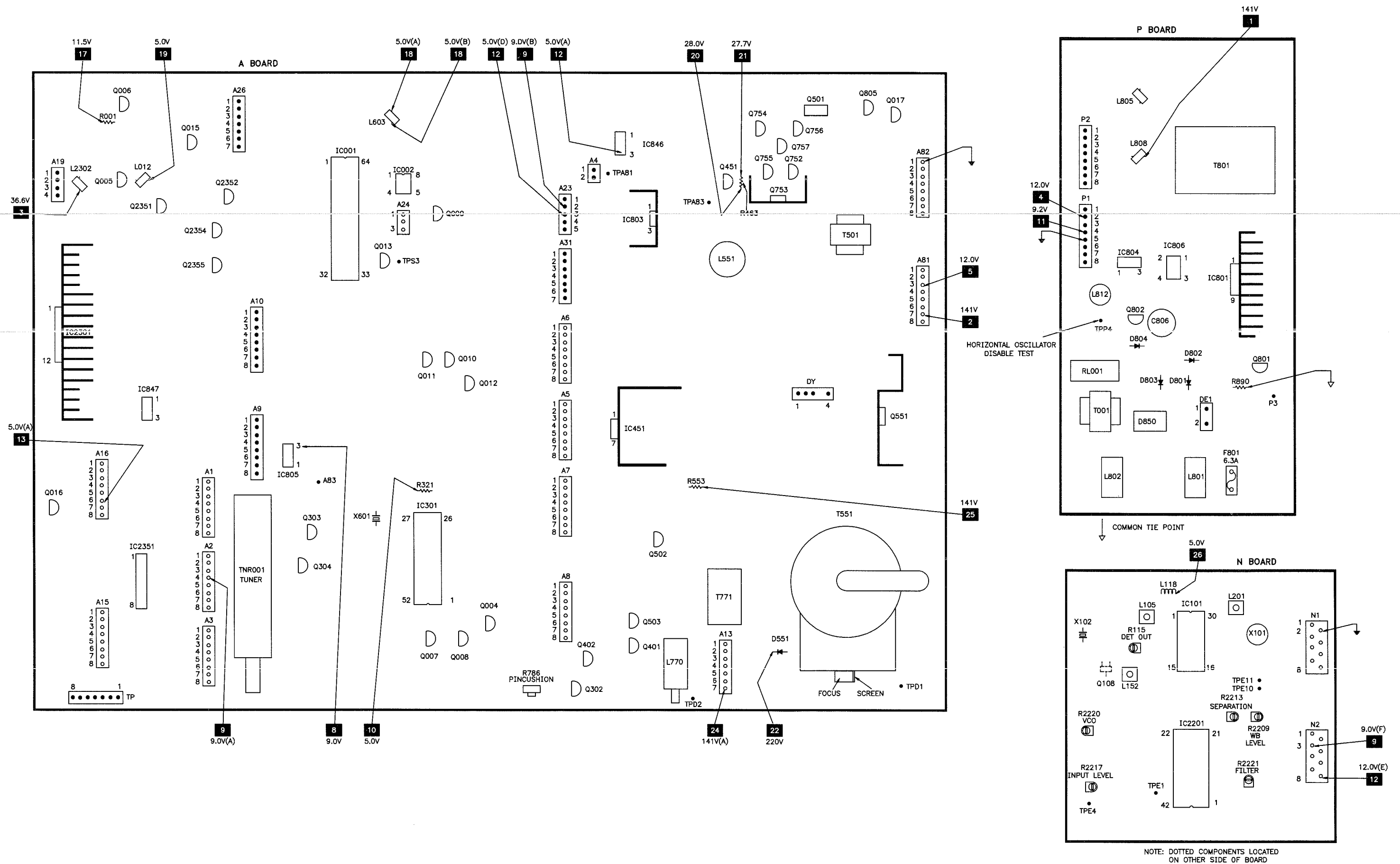
For SAFETY use only equivalent replacement part.
(1) Used in models CT-31SF31S, CT-31XF31CS, CT-F33L6S,
CT-F33L6LS, and CT-F33L6VS.

COILS & TRANSFORMERS continued

| Item No. | Function/Rating | Mfr. Part No. |
|---------------|-------------------|---------------|
| L2110, 11 | 12μH | ELESN120KA |
| L2302 | Ferrite Bead | EXCELSA35 |
| L3204 | 12μH | ELESN120KA |
| L3252 | 39μH | ELESN390JA |
| L3253 | 82μH | ELESN820JA |
| L3254 | 15μH | ELESN150KA |
| L3255 | 22μH | ELESN220KA |
| L3301 | 27μH | ELESN270KA |
| L3303 | 82μH | ELESN820KA |
| L3304 | 10μH | ELESN100KA |
| L3305 | 82μH | ELESN820KA |
| L3901 Thru | | |
| L3909 | 5.6μH | ELEPH5R6KA |
| L4351 | 10μH | ELESN100KA |
| L4352 | 68μH | ELESN680KA |
| L4353 Thru | | |
| L4356 | 33μH | ELESN330KA |
| LC4351, 52 | Filter | ELKTH101GA |
| # T001 | Power | TLP16297 |
| # T501 | Horizontal Drive | ETH19Y70AYM |
| # T551 (2) | Horizontal Output | OLF04507F1 |
| # T551 (1)(2) | Horizontal Output | TLF14459F |
| T771 | PCC | ETR26L32A |
| # T801 | Power | ETS42AF125AC |

For SAFETY use only equivalent replacement part.
(1) Used in models CT-31SF31S, CT-31XF31CS, CT-F33L6S,
CT-F33L6LS, and CT-F33L6VS.
(2) Focus and screen controls are part of T551.

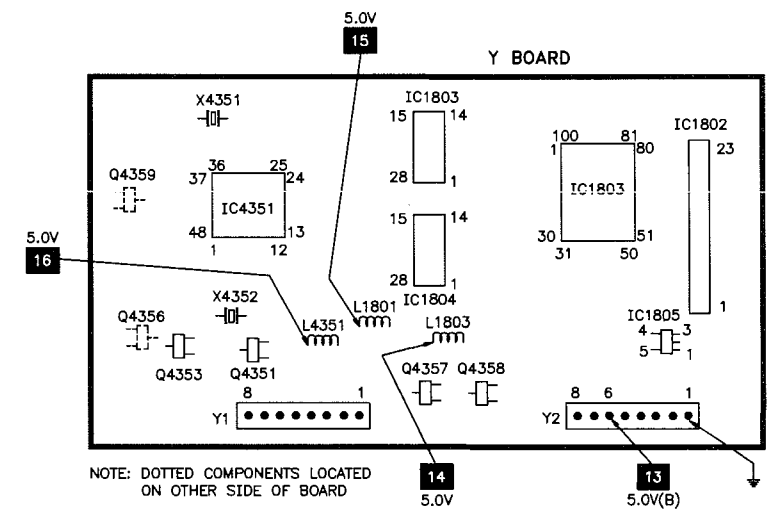
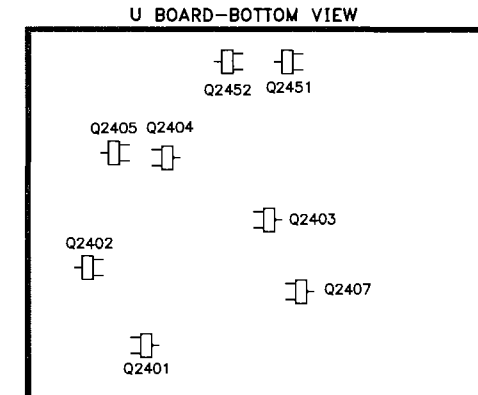
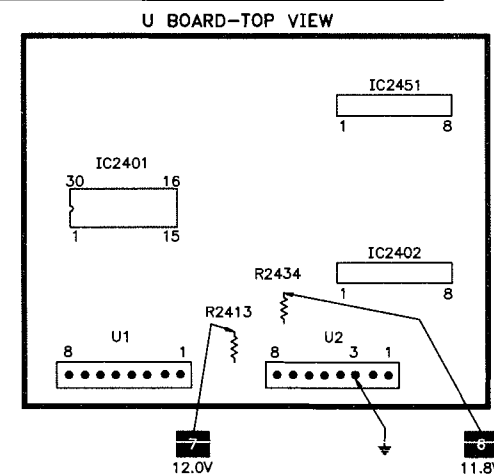
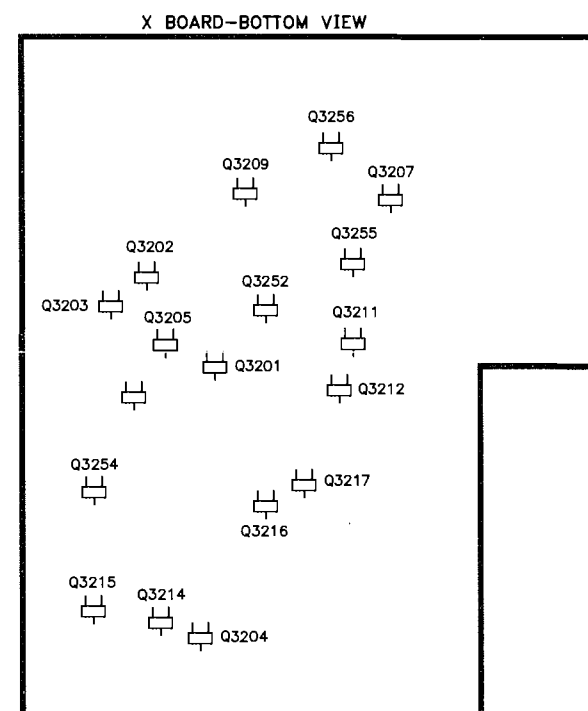
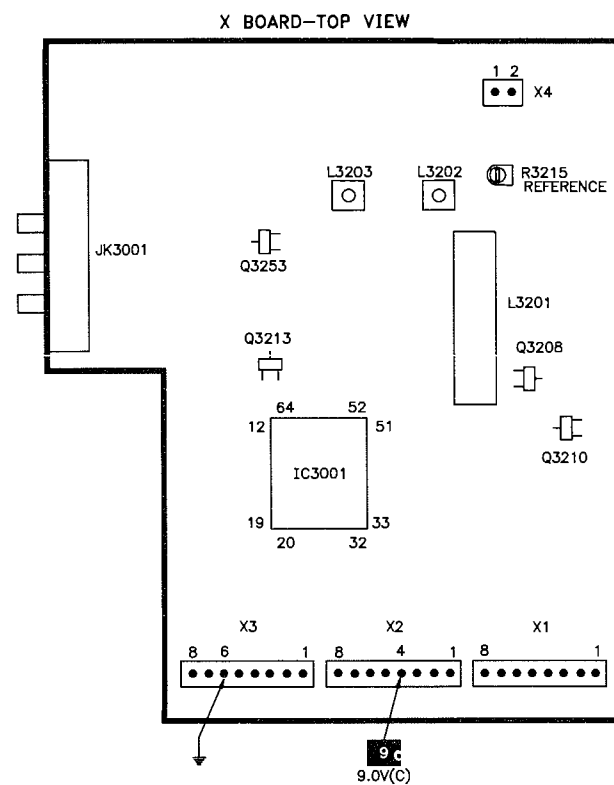
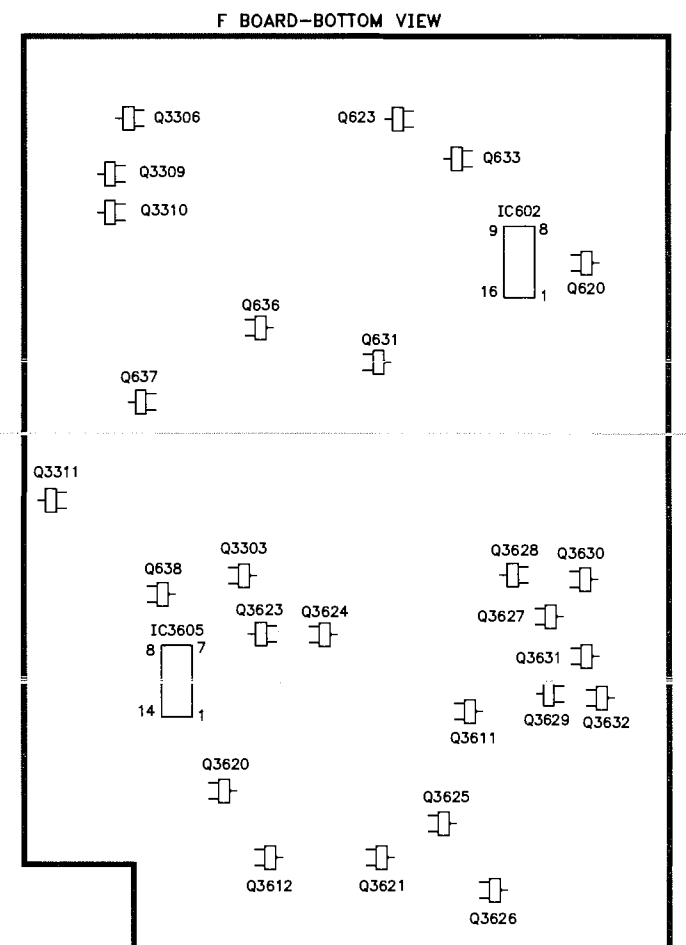
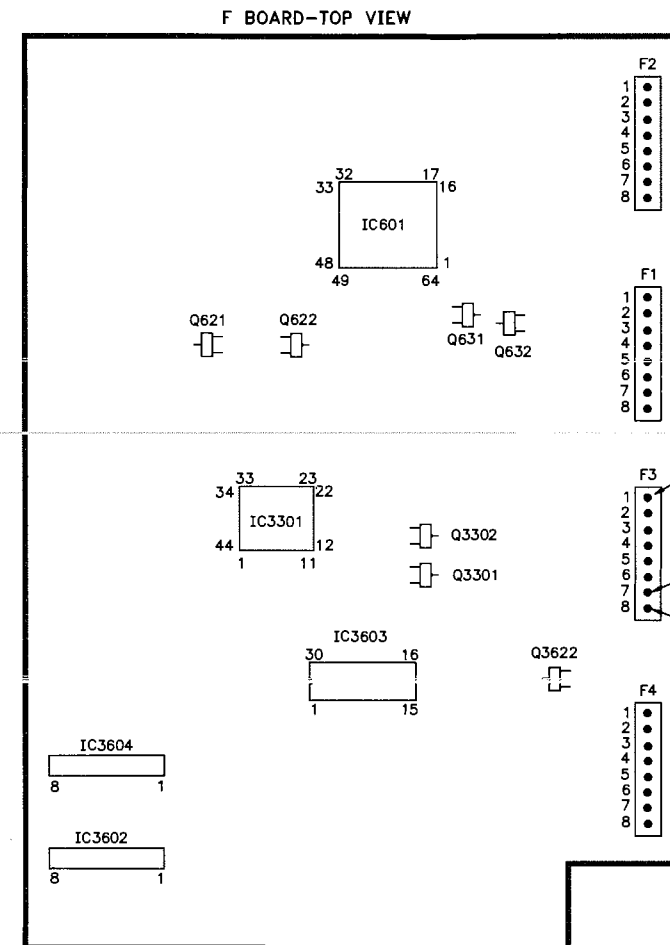
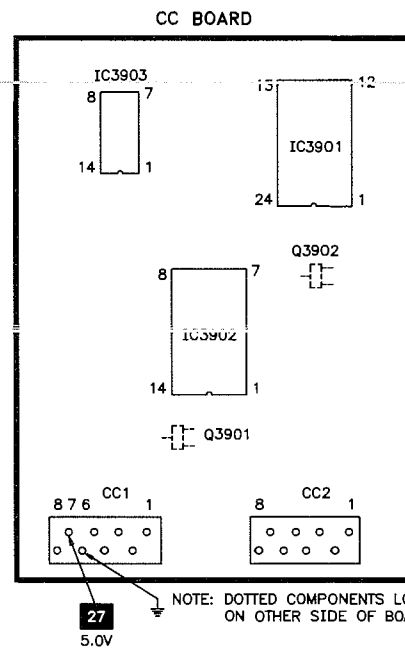
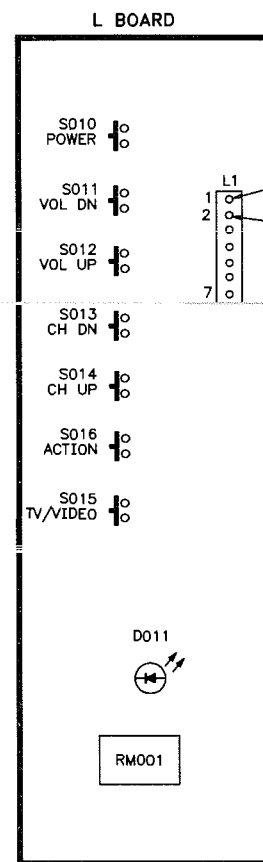
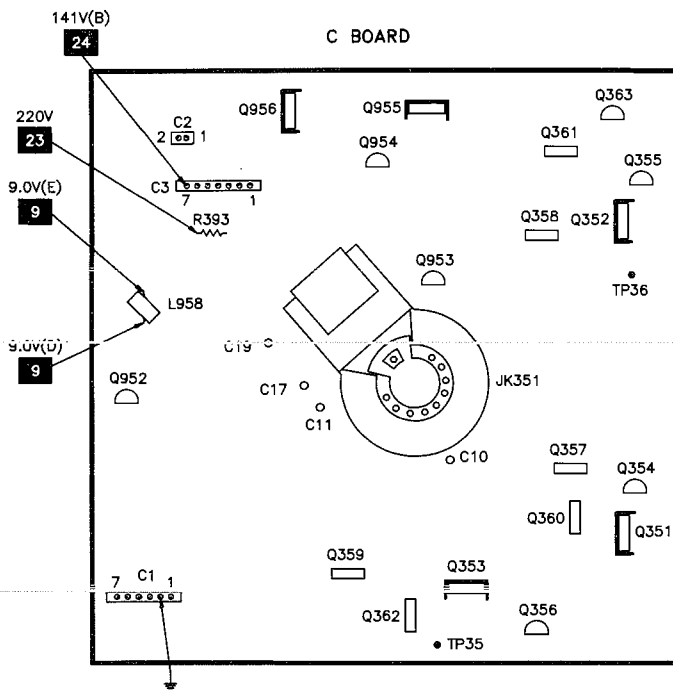
PLACEMENT CHART



PARTS LIST continued

| CONTROLS & RESISTORS | | | |
|--|------------------------|---------------|--------------|
| Item No. | Function/Rating | Mfr. Part No. | NTE Part No. |
| # D850 | 75.5/3.3 Cold PTC | TRPW5B0M030D | - |
| R066 | 10K 1% 1/4W | ER0S2CKF1002 | - |
| R115 | 1000 Detector Out | EVND4AA00B13 | - |
| R304 | 1650 1% 1/4W | ER0S2CKF1651 | - |
| R325 | 5600 1% 1/4W | ER0S2CKF5601 | - |
| R327 | 2200 1% 1/4W | ER0S2CKF2201 | - |
| # R374 Thru | | | |
| # R379 | 22K 5% 2W | ERG2SJS223 | 2W322 |
| R393 | 100 5% 1/2W Fusible | ERQ12AJ101 | - |
| # R456 | 330 5% 1W | ERG1ANJ331 | 1W133 |
| R468 | 4700 5% 1/4W | - | QW247 |
| | 4700 1% 1/4W | ER025CKF4701 | - |
| R469 | 1500 5% 1/4W | - | QW215 |
| | 1470 1% 1/4W | ER0S2CKF1471 | - |
| # R515, 16 | 2700 5% 3W | ERG3SJS272 | 3W227 |
| | 2000 5% 3W (1) | ERG3SJS202 | 3W220 |
| # R517 | 4700 5% 2W | ERG2ANJ472 | 2W247 |
| | 3900 5% 2W (1) | ERG2ANJ392 | 2W239 |
| R521 | 4700 1% 1/4W | ER0S2CKF4701 | - |
| R522 | 270K 1% 1/4W | ER0S2CKF2703 | - |
| # R531 | 47 5% 1/4W | ERD25FJ470 | QW047 |
| # R532 | 24.3K 1% 1/4W | ER0S2CKF2432 | - |
| # R533 | 2740 1% 1/4W | ER0S2CKF2741 | - |
| # R534 | 680 5% 1/4W | ERDS2TJ681 | QW168 |
| # R535 | 820 5% 1/4W | ERDS2TJ821 | QW182 |
| # R536 | 68K 5% 1/2W | ERDS1TJ683 | HW368 |
| # R537, 40 | 10K 5% 1/4W | ERDS2TJ103 | QW310 |
| # R553 | 2.2 10% 5W Wirewound | ERF5ZK2R2 | 5W2D2 |
| # R556 | 3.0 5% 2W Fusible | ERQ2CJ3R0 | F2W3D0 |
| # R556 (1) | 3.3 5% 2W Fusible | ERQ2CJ3R3 | F2W3D3 |
| # R558 | 1000 5% 1W Fusible | ERQ1CJP102 | F1W210 |
| # R559 | 1 5% 1/4W | ERD25FJ1R0 | QW1D0 |
| R636 | 2700 1% 1/10W SMT | ERJ6ENF2701 | - |
| R637 | 3600 1% 1/10W SMT | ERJ6ENF3601 | - |
| R654 | 8200 1% 1/10W SMT | ERJ6ENF8201 | - |
| R656 | 6800 1% 1/10W SMT | ERJ6ENF6801 | - |
| R666 | 10K 1% 1/10W SMT | ERJ6ENF1002 | - |
| R667 | 33K 1% 1/10W SMT | ERJ6ENF3302 | - |
| R668 | 2320 1% 1/10W SMT | ERJ6ENF2321 | - |
| R669 | 3600 1% 1/10W SMT | ERJ6ENF3601 | - |
| # R764 | 10 5% 2W Fusible | ERQ2CJP100 | F2W010 |
| R786 | 1000 Pincushion | EVN64UA00B13 | - |
| # R795 | 3300 5% 1W | ERG1ANJ332 | 1W233 |
| # R804 (1) | 100 5% 5W | ERG5SJ101 | 5W110 |
| # R804 | 68 5% 5W | ERG5SJ680 | - |
| # R805 | 39 5% 2W | ERG2ANJ390 | 2W039 |
| # R812 | 8.2 10% 7W Wirewound | ERF7ZK8R2 | - |
| # R815 | .12 10% 1/2W Wirewound | ERW12VKR12 | - |
| # R816 | .33 10% 1/2W Fusible | ERQ12HKR33 | - |
| # R820 | .12 10% 1/2W Wirewound | ERW12VKR12 | - |
| # R822 | .33 10% 1W Fusible | ERQ1CKPR33 | - |
| # R828 | .39 10% 1W Fusible | ERQ1CKPR39 | - |
| # R835 | 68 5% 1W | ERG1ANJ680 | 1W068 |
| # R836 | 24 5% 2W | ERG2ANJ240 | 2W024 |
| # R853, 54 | 22 5% 3W | ERG3SJ220 | 3W022 |
| # R890 | 1 10% 5W Wirewound | ERF5ZK1R0 | 5W1D0 |
| R960 | 10 5% 1/4W Fusible | ERQ14AJ100 | - |
| # R961 | 330 5% 1W Fusible | ERQ1CJP331 | F1W133 |
| R1307 | 6800 1% 1/10W SMT | ERJ6ENF6801 | - |
| # For SAFETY use only equivalent replacement part. | | | |
| (1) Used in models CT-31SF31S, CT-31XF31CS, CT-F33L6S, CT-F33L6LS, and CT-F33L6VS. | | | |

| CONTROLS & RESISTORS continued | | | |
|--------------------------------|--------------------|---------------|--------------|
| Item No. | Function/Rating | Mfr. Part No. | NTE Part No. |
| R1308 | 8200 1% 1/10W SMT | ERJ6ENF8201 | - |
| R2203 | 56K 1% 1/10W SMT | ERJ6ENF5602 | - |
| R2209 | 50K WB Level | EVND4AA00B54 | - |
| R2213 | 50K Separation | EVND4AA00B54 | - |
| R2217 | 10K Input Level | EVND4AA00B14 | - |
| R2220 | 20K VCO | EVND4AA00B24 | - |
| R2221 | 30K Filter | EVND4AA00B34 | - |
| R2413 | 27 5% 1/4W Fusible | ERQ14AJ270 | - |
| R3215 | 200 Reference | EVND4AA00B22 | - |
| R3302 | 3240 1% 1/10W SMT | ERJ6ENF3241 | - |
| R3303 | 47K 1% 1/10W SMT | ERJ6ENF4702 | - |
| R3304 | 4020 1% 1/10W SMT | ERJ6ENF4021 | - |
| R3328 | 5230 1% 1/10W SMT | ERJ6ENF5231 | - |
| R3329 | 2870 1% 1/10W SMT | ERJ6ENF2871 | - |
| R3619 | 150 1% 1/10W SMT | ERJ6ENF1500 | - |
| R3620, 21 | 130K 1% 1/10W SMT | ERJ6ENF1303 | - |
| R3622 | 20K 1% 1/10W SMT | ERJ6ENF2002 | - |
| R3623 | 49.9K 1% 1/10W SMT | ERJ6ENF4992 | - |
| R3624 | 127K 1% 1/10W SMT | ERJ6ENF1273 | - |
| R3625 | 49.9K 1% 1/10W SMT | ERJ6ENF4992 | - |
| R3626 | 127K 1% 1/10W SMT | ERJ6ENF1273 | - |
| R3627 | 66.5K 1% 1/10W SMT | ERJ6ENF6652 | - |
| R3631 | 47K 1% 1/10W SMT | ERJ6ENF4702 | - |
| R3632 | 39K 1% 1/10W SMT | ERJ6ENF3902 | - |
| R3636 | 100K 1% 1/10W SMT | ERJ6ENF1003 | - |
| R3637 | 29.4K 1% 1/10W SMT | ERJ6ENF2942 | - |
| R3639 | 20K 1% 1/10W SMT | ERJ6ENF2002 | - |
| R3641 | 47K 1% 1/10W SMT | ERJ6ENF4702 | - |
| R3644 | 10K 1% 1/10W SMT | ERJ6ENF1002 | - |
| R3646 | 2000 1% 1/10W SMT | ERJ6ENF2001 | - |
| R3649 | 4700 1% 1/10W SMT | ERJ6ENF4701 | - |
| R3651, 52 | 10K 1% 1/10W SMT | ERJ6ENF1002 | - |
| R3653, 54 | 1000 1% 1/10W SMT | ERJ6ENF1001 | - |
| R3655 | 2000 1% 1/10W SMT | ERJ6ENF2001 | - |
| R3657 | 2870 1% 1/10W SMT | ERJ6ENF2871 | - |
| R3658 | 3480 1% 1/10W SMT | ERJ6ENF3480 | - |
| R3697 | 20K 1% 1/10W SMT | ERJ6ENF2002 | - |
| R3700 | 10K 1% 1/10W SMT | ERJ6ENF1002 | - |
| R3704 | 680 1% 1/10W SMT | ERJ6ENF6800 | - |
| R3705 | 1100 1% 1/10W SMT | ERJ6ENF1101 | - |
| R3706 | 220K 1% 1/10W SMT | ERJ6ENF2203 | - |
| R3716 | 4700 1% 1/10W SMT | ERJ6ENF4701 | - |
| R3717 | 511 1% 1/10W SMT | ERJ6ENF5110 | - |



PARTS LIST continued

| SEMICONDUCTORS continued | | | | | |
|---|--------------|---------------|--------------|--------------|--------------|
| (Select the replacement that gives the best results.) | | | | | |
| Item No. | Type No. | Mfr. Part No. | NTE Part No. | ECG Part No. | TCE Part No. |
| Q010, 11, 12 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q013 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q015 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q016, 17 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q108 | MSB709R | - | - | - | - |
| Q302, 03 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q304 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q351 Thru | | | | | |
| Q353 | 2SC3063RL | - | NTE157 | ECG157 | SK3747 |
| Q354 Thru | | | | | |
| Q356 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q357 | 2SC3063RL | - | NTE157 | ECG157 | SK3747 |
| Q358 | 2SC3063RL | - | NTE157 | ECG157 | SK3747 |
| Q359 | 2SC3063RL | - | NTE157 | ECG157 | SK3747 |
| Q360 | 2SB1011RL | - | - | - | - |
| Q361 | 2SB1011RL | - | - | - | - |
| Q362 | 2SB1011RL | - | - | - | - |
| Q363 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SB642QRS | - | NTE19 | ECG19 | SK3912 |
| Q401 Thru | | | | | |
| Q403 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q451 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q501 | 2SC4212HLB | - | - | - | - |
| # Q502, 03 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| # Q551 | 2SD1556LBMA | - | NTE2331 | ECG2331 | SK10088 |
| Q620 | MSB709R | - | - | - | - |
| Q621 | MSD601R | - | - | - | - |
| Q622 | MSD601R | - | - | - | - |
| Q623 | MSD601R | - | - | - | - |
| Q631 | MSD601R | - | - | - | - |
| Q632 | MSD601R | - | - | - | - |
| Q633 | MSD601R | - | - | - | - |
| Q636 | MSD601R | - | - | - | - |
| Q637 | MSD601R | - | - | - | - |
| Q638 | MSB709R | - | - | - | - |
| Q752 | 2SA564AQR | - | NTE290A | ECG290A | SK3932 |
| Q753 | 2SD1267ALBPQ | - | - | - | - |
| Q754 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q755, 56 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q757 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q801 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q802 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q805 | 2SA879Q | - | NTE288* | ECG288* | SK3434* |
| Q952, 53 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |

For SAFETY use only equivalent replacement part.
* Lead configuration may vary from original.

| SEMICONDUCTORS continued | | | | | |
|---|------------|---------------|--------------|--------------|--------------|
| (Select the replacement that gives the best results.) | | | | | |
| Item No. | Type No. | Mfr. Part No. | NTE Part No. | ECG Part No. | TCE Part No. |
| Q954 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q955 | 2SB940P | - | NTE398 | ECG398 | SK9363 |
| Q956 | 2SD1264P | - | NTE375 | ECG375 | SK9118 |
| Q2351 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q2352 | JA101PQ | - | NTE290A | ECG290A | SK3932 |
| | 2SA564AQRS | - | NTE290A | ECG290A | SK3932 |
| Q2354, 55 | JC501PQ | - | NTE85 | ECG85 | SK3124A |
| | 2SC1685QRS | - | NTE85 | ECG85 | SK9229 |
| Q2401, 02 | MSD601R | - | - | - | - |
| Q2403, 04 | MSB709R | - | - | - | - |
| Q2405, 07 | MSD601R | - | - | - | - |
| Q2451, 52 | MSD601R | - | - | - | - |
| Q3201 Thru | | | | | |
| Q3205 | MSD601R | - | - | - | - |
| Q3207 | MSB709R | - | - | - | - |
| Q3208 Thru | | | | | |
| Q3217 | MSD601R | - | - | - | - |
| Q3251 Thru | | | | | |
| Q3256 | MSD601R | - | - | - | - |
| Q3301 Thru | | | | | |
| Q3303 | MSD601R | - | - | - | - |
| Q3306 | MSD601R | - | - | - | - |
| Q3309 Thru | | | | | |
| Q3611 | MSB709R | - | - | - | - |
| Q3612 | MSD601R | - | - | - | - |
| Q3620 Thru | | | | | |
| Q3623 | MSD601R | - | - | - | - |
| Q3624, 25 | MSB709R | - | - | - | - |
| Q3626 | MSD601R | - | - | - | - |
| Q3627 | MSB709R | - | - | - | - |
| Q3628 | MSD601R | - | - | - | - |
| Q3629, 30 | MSB709R | - | - | - | - |
| Q3631 | MSD601R | - | - | - | - |
| Q3632 | MSB709R | - | - | - | - |
| Q3901, 02 | MSD601R | - | - | - | - |
| Q4351, 52 | MSB709R | - | - | - | - |
| Q4353, 56 | MSD601R | - | - | - | - |
| Q4357, 58 | MSB709R | - | - | - | - |
| Q4359 | MSD601RT1 | - | - | - | - |