

# 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.	PC Board Plug No.	Pin	Color
CRT	B239	DY	1	Green
Yoke	D4137		2	Yellow
Yoke Setting	YP2A		4	Red
Comments	Focus Tap		6	Blue

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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## SAFETY CHECKS – FIRE AND SHOCK HAZARD

### Cold Leakage Checks for Receivers with Isolated Ground

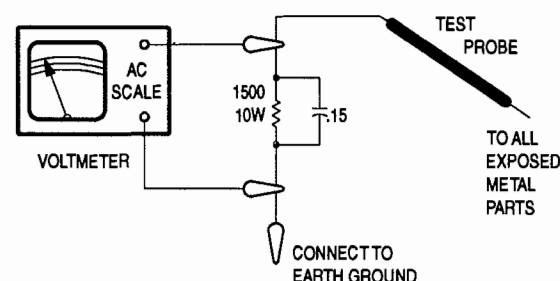
Unplug the AC cord, connect a jumper across the plug prongs, and turn the power switch on (if applicable). Use an ohmmeter to measure the resistance between the jumped AC plug and any exposed metal cabinet parts such as antenna screw heads, control shafts, or handle brackets. Exposed metal parts with 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.



# PHOTOFACT® Technical Service Data

SET 3399

MODEL CT-20S12S (CHASSIS AMEDP233)

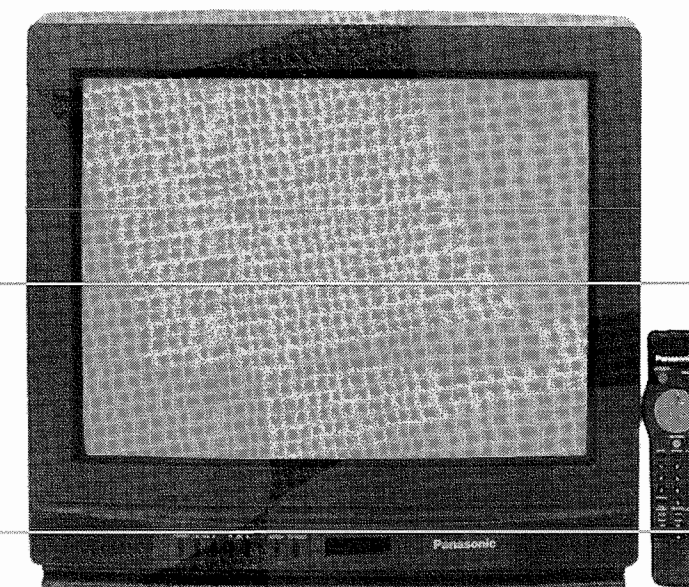
PANASONIC

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## PANASONIC

Model CT-20S12S (Chassis AMEDP233)



Complete coverage  
for servicing a television receiver...

- Schematics
- Parts list
- Component locations
- Troubleshooting guide

Coverage includes these additional models and chassis:

MODEL	CHASSIS
CT-20S11CS	ALEDP233
CT-20S11S	ALEDP233
CT-20S21S	APEDP233
CT-20XF21CS	APEDP233
CT-2040SS	ATEDP233
CT-2045SS	ASEDP233



**HOWARD W. SAMS & COMPANY**

NOVEMBER 1994 SET 3399



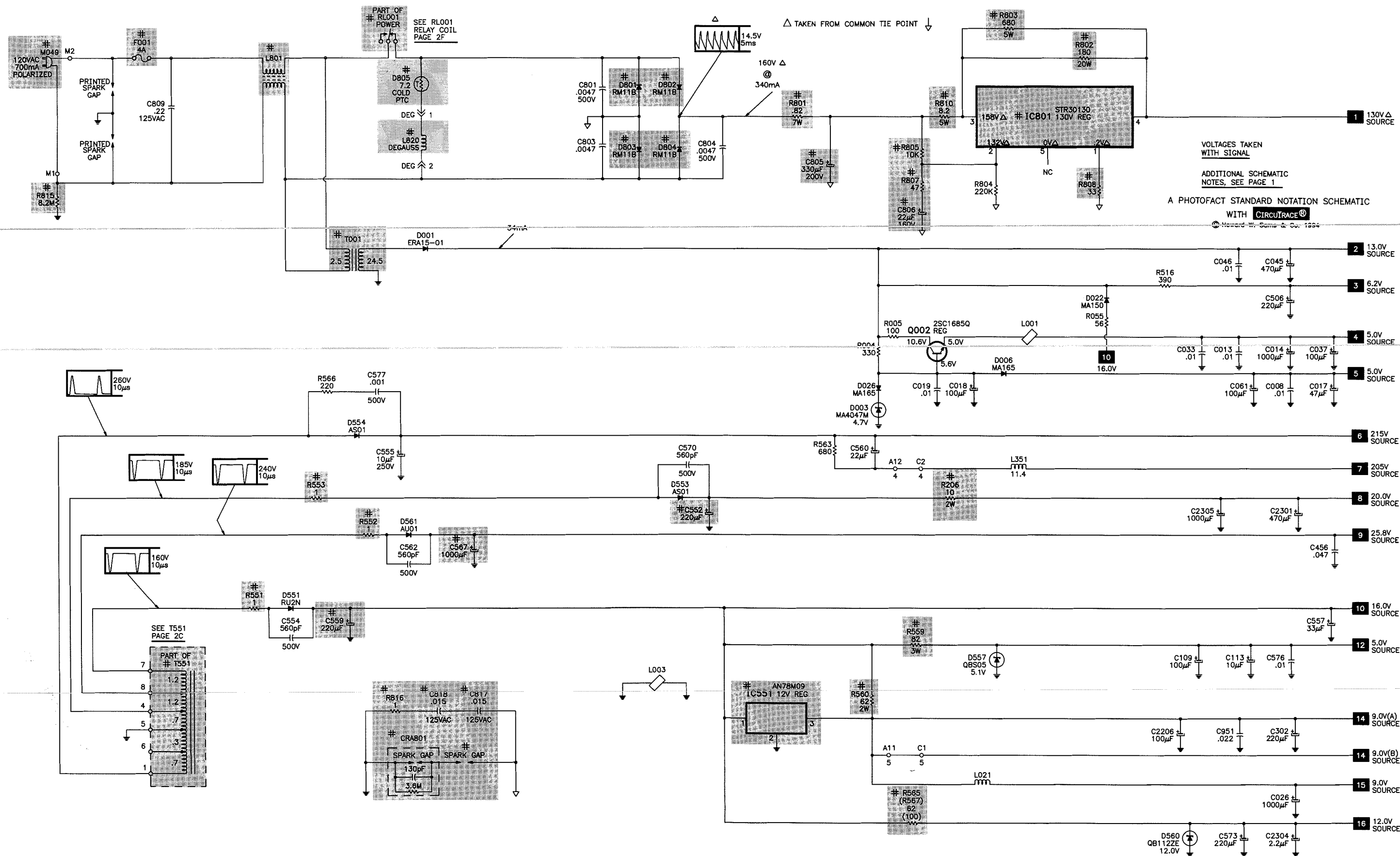
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For Supplier Address,  
See PHOTOFACT Annual Index

# POWER SUPPLY SCHEMATIC



PANASONIC

MODEL CT-20S12S (CHASSIS AMEDP23)

G

H

TROUBLESHOOTING

POWER SUPPLY

Check F001. If fuse is open, check T001, D801 thru D804, C801, C803, C804, C805, and C809. Apply 120VAC and check for 5.0V at the emitter of Q002. If 5.0V is missing, check D001, D022, Q002, D003, and T001. If 5.0V is present, turn receiver on and check for 160V\* at the cathode of D802. If 160V\* is missing, check D801 thru D804, and RL001. If 160V\* is present, check for 130V\* at pin 4 of IC801. If 130V\* is missing, check IC801. If 130V is present, refer to the "Horizontal" section of this Troubleshooting guide.

\* Taken from common tie point.

HORIZONTAL

Determine if the receiver is in shutdown, refer to the "Horizontal Oscillator Disable" and "Power Supply Protection Circuit" sections of this Troubleshooting guide. If the receiver is not in shutdown, inject a horizontal signal at the base of Q551. If horizontal deflection is now present, check Q501, T501, T502, and pins 44 thru 50 of IC101. If horizontal deflection is still missing, check Q551 and T551. Check D554, D551, D553, and D561. The high voltage rectifier is part of T551 and if defective, it will affect the performance of the horizontal circuits. Horizontal linearity or width problems may be caused by C563, C564, and C569 being defective.

HORIZONTAL OSCILLATOR DISABLE

NOTE: Care should be taken in defeating the high voltage shutdown circuit, as this may cause excessive X-radiation and damage to the CRT, T551, and associated components. The high voltage is monitored by D531 rectifying pulses from T551. Should the high voltage increase, the rectified voltage at the cathode of D531 will also increase. This causes the horizontal oscillator frequency to increase which lowers the high voltage. To troubleshoot, remove D531. Use a variable AC power supply to supply 90VAC and turn on the receiver. Slowly increase AC voltage as required to isolate and repair the malfunction. Return D531 to the circuit.

Voltages Taken In Shutdown

IC101

Pin 49 3.9V

Pin 51 4.7V

HORIZONTAL OSCILLATOR DISABLE TEST

Connect the positive lead of a voltmeter to TPD1 and the negative lead to TPD2. Adjust brightness to zero and picture for .9V. Turn receiver off and connect a jumper between pins 3 and 4 of IC801. Set AC supply to 100VAC. Monitor the high voltage with a high voltage probe. Turn receiver on and slowly increase AC supply. Confirm the high voltage does not exceed 34.2KV when horizontal just begins to pull out of sync. If the high voltage should exceed 34.2KV or the receiver fails to lose horizontal sync, refer to the "Horizontal Oscillator Disable" section of this Troubleshooting guide.

VERTICAL

Inject a vertical signal at pin 2 of IC451. If vertical deflection is present, check pins 40, 43, and 52 of IC101. If vertical deflection is missing, check IC451. Vertical linearity or height problems may be caused by vertical feedback and bias circuits, check C451 thru C455 and C457 for defects.

RASTER

Check the CRT and CRT voltages. If red is missing, check Q351 and pin 9 of IC101. If green is missing, check Q352 and pin 10 of IC101. If blue is missing, check Q353 and pin 11 of IC101. If raster has

height or width problems, refer to the "Vertical", "Horizontal", or "Power Supply" sections of this Troubleshooting guide.

AUDIO

Select an active channel and check for an audio waveform at pin 23 of IC101. If the waveform is missing, check pins 21, 23, 25, and 29 of IC101. If waveform is present, select a station transmitting a signal in stereo and check for audio waveforms at pins 3 and 4 of IC2201. If waveforms are missing, check IC2201. If waveforms are present, check IC2301 and IC2302.

VIDEO/CHROMA

See "CRT Protection" section of this Troubleshooting guide. Inject a video signal at TP12 and check for video on the CRT. If video is present, refer to the "IF AGC" section of this Troubleshooting guide. If the video is missing on the CRT, check for a video waveform at pin 39 of IC101. If the waveform is missing, check Q306 and pins 27, 31, 33, and 38 of IC101. If present, check for the proper waveforms on pins 9, 10, and 11 of IC101. If waveforms are incorrect, check pins 1 thru 16, 39, and 42 of IC101. If waveforms are correct, refer to the "Raster" section of this Troubleshooting guide.

IF AGC

Inject a video IF signal at the IF input and check for video on the CRT. If video is present, check the tuner, tuner control, and tuner AFC circuits. If video is missing on the CRT, check for a video waveform at TP12. If video is present, refer to the "Video" section of this Troubleshooting guide. If video is missing at TP12, apply AGC bias to pin 24 of IC101. If video is now present at TP12, check pins 22, 24, 26, and 32 of IC101. If video is still missing at TP12, check pins 17 thru 20, 27, 31, and 34 thru 37 of IC101.

POWER SUPPLY PROTECTION CIRCUIT

WARNING: DO NOT press the action button on the receiver when the above symptom occurs because this will prevent over voltage protection and may cause severe damage to the entire receiver.

The 16.0V power supply voltage is monitored at pin 19 of IC001. Normal operating voltage at pin 19 is .6V to 3.1V. If a major power supply failure occurs the voltage at pin 19 will increase above 3.2V and cause pin 6 to go low, which triggers Q003, and de-energizes RL001 turning off the receiver. This condition will remain until AC power is momentarily disconnected. If receiver goes off again, after pressing the power button when power is reapplied, it indicates that there is a problem with the power supply.

CRT PROTECTION

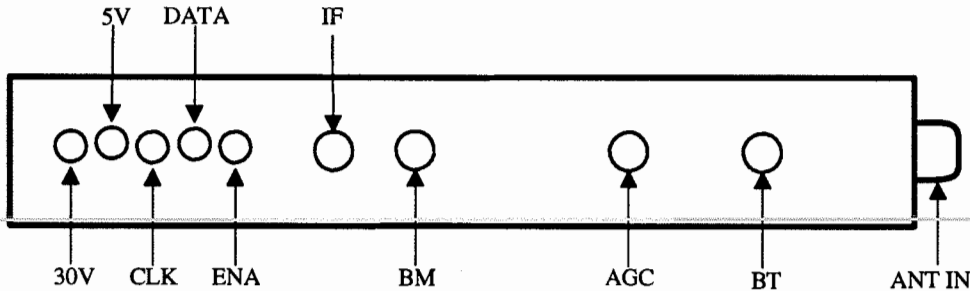
The CRT protection circuit is made up of Q451 and Q452. This circuit blanks out the CRT if vertical deflection failure occurs. It is important for the life of the CRT that this circuit be tested before returning the receiver to the customer. To test, short the base of Q452 to ground. The screen should go blank, if this circuit does not need repair.

TUNER INFORMATION

TUNER VOLTAGE CHART

Pin	VHF Low Band	VHF High Band	UHF Band	Pin	VHF Low Band	VHF High Band	UHF Band
BT	2.0V	4.4V	5.6V	5V	5.0V	5.0V	5.0V
AGC	5.1V	5.2V	4.7V	30V	5.1V	7.4V	8.6V
BM	9.0V	9.0V	9.0V	NOTE: VHF Low Band voltages taken on channel 2. VHF High Band voltages taken on channel 7. UHF Band voltages taken on channel 14.			
ENA	.1V	.1V	.1V				
DATA	4.8V	4.8V	4.7V				
CLK	4.5V	4.5V	4.8V				

TUNER TERMINAL GUIDE

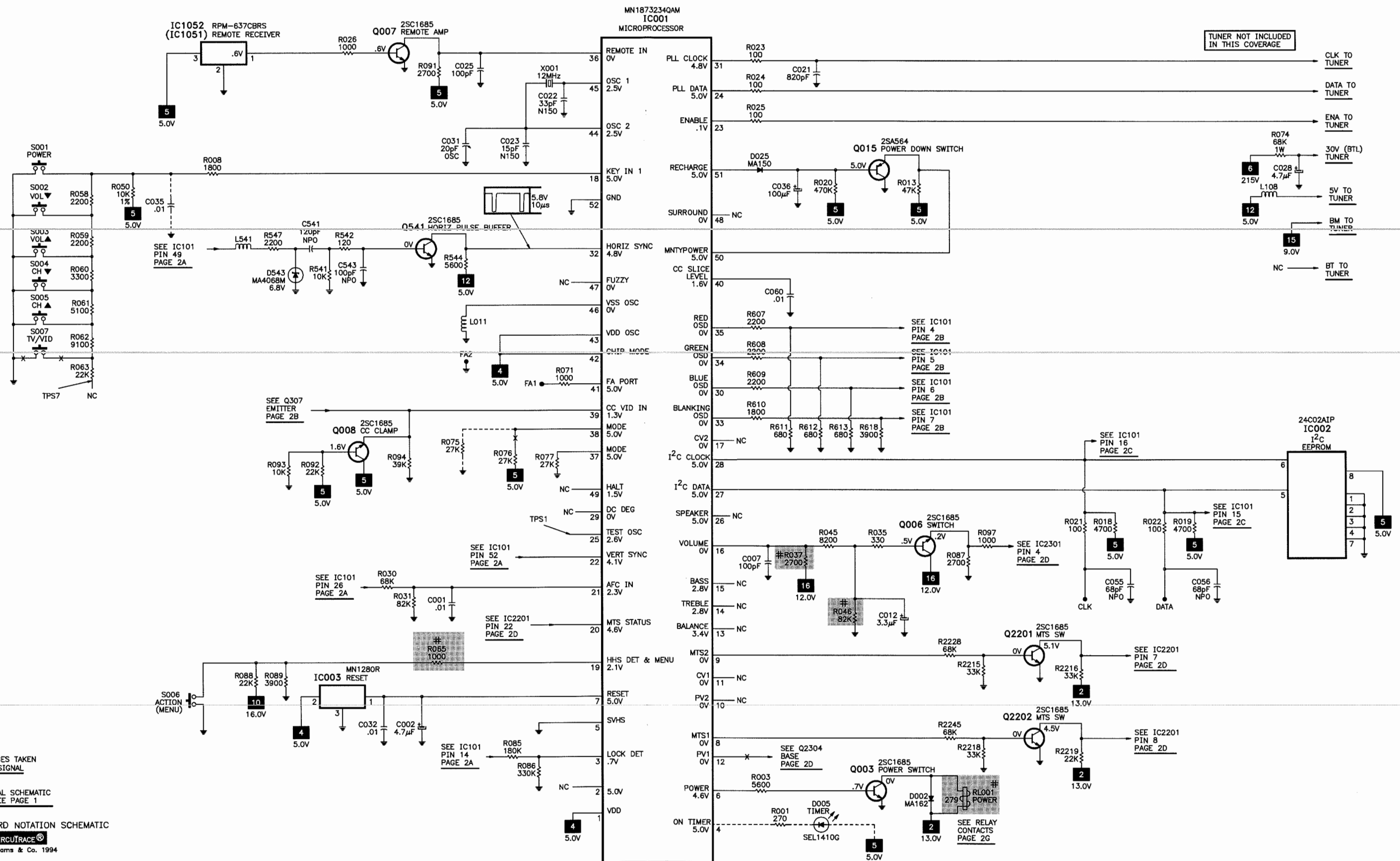


SCHEMATIC NOTES

- # 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.

## SYSTEM CONTROL SCHEMATIC



VOLTAGES TAKEN WITH SIGNAL

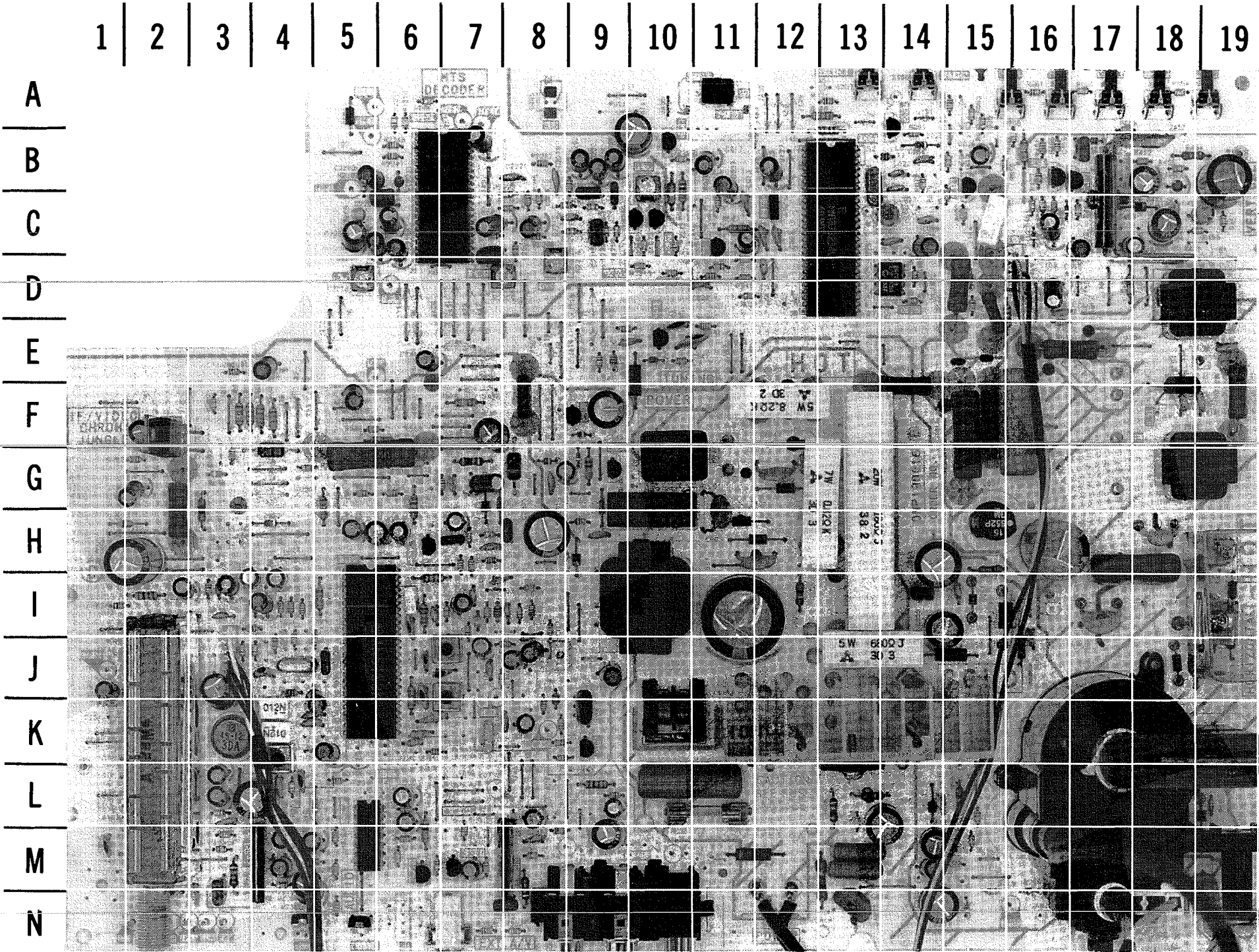
ADDITIONAL SCHEMATIC  
NOTES, SEE PAGE 1

### A PHOTOFAC T STANDARD NOTATION SCHEMATIC

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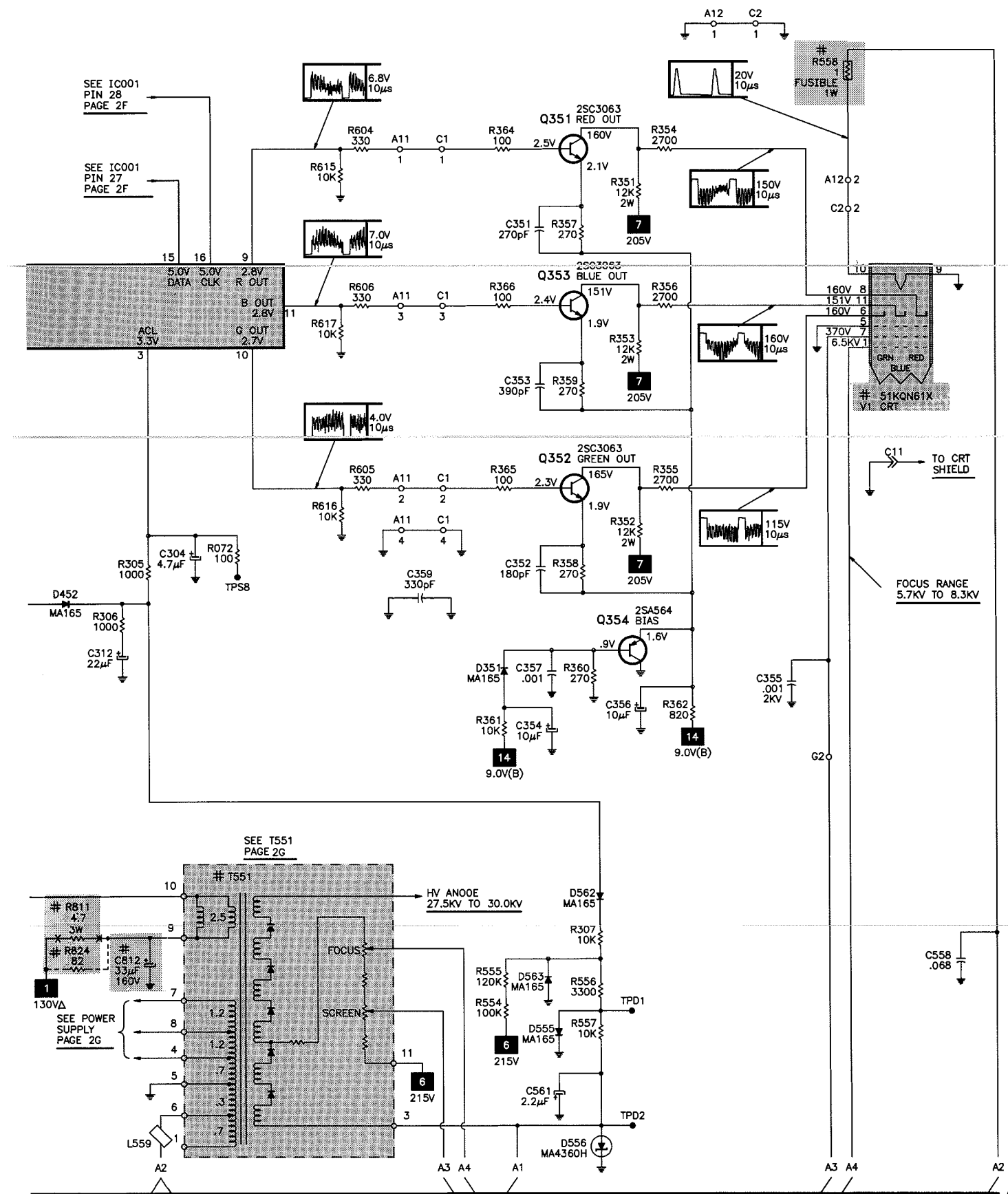
A BOARD



A BOARD, GRIDTRACE LOCATION GUIDE													
A11	J-3	C502	H-7	C2306	M-4	L107	K-4	R097	E-3	R554	L-15	R2306	M-3
A12	D-16	C503	H-7	C2307	N-3	L108	J-4	R102	L-2	R555	M-15	R2308	M-8
C001	D-11	C504	H-7	C2308	L-3	L201	K-4	R103	K-2	R556	M-15	R2309	L-8
C002	B-12	C505	H-8	C2309	M-4	L541	E-9	R104	J-7	R557	N-15	R2310	M-8
C007	D-12	C506	H-5	C2311	L-8	L551	H-15	R105	L-5	R558	C-15	R2311	M-8
C008	C-14	C507	I-6	C2312	M-8	L552	J-18	R106	N-4	R559	G-5	R2312	M-7
C012	C-11	C508	J-5	C2313	N-8	L553	J-19	R107	M-2	R560	H-2	R2318	N-5
C013	C-11	C509	I-6	C2314	M-9	L558	I-19	R111	K-8	R562	F-15	R2319	M-4
C014	A-10	C510	F-18	C2315	J-9	L559	J-15	R112	K-8	R563	D-16	R2320	N-7
C017	B-11	C511	E-19	C2316	E-6	L601	I-7	R152	G-2	R565	F-8	R2321	N-8
C018	G-8	C515	F-19	C2318	M-4	L801	K-10	R201	K-8	R566	L-19	R2322	M-4
C019	G-8	C531	G-7	C2319	L-6	LC301	J-8	R202	G-5	R601	I-7	R2323	M-4
C021	I-3	C532	H-6	C2323	M-7	Q002	F-9	R203	L-4	R602	I-6	R2324	M-6
C022	B-14	C541	E-10	C3104	L-9	Q003	G-9	R204	G-4	R604	I-4	R2325	M-6
C023	B-14	C543	E-10	CRA801	N-13	Q006	C-11	R206	D-15	R605	J-4	R2334	M-6
C025	C-14	C552	M-14	D001	H-9	Q007	A-14	R304	I-3	R606	J-3	R2335	M-5
C026	H-1	C554	J-16	D002	G-9	Q008	B-10	R305	I-3	R607	F-4	R2338	L-6
C028	G-2	C555	N-14	D003	G-8	Q015	B-15	R306	I-3	R608	F-4	R2339	M-6
C031	C-14	C557	F-2	D006	F-9	Q306	K-9	R307	D-15	R609	F-4	R2343	M-7
C032	C-12	C558	I-14	D022	H-4	Q307	H-6	R317	I-8	R610	G-3	R3101	L-9
C033	C-13	C559	I-14	D025	B-14	Q451	B-16	R318	J-8	R611	I-4	R3120	L-9
C036	B-15	C560	D-16	D026	G-9	Q452	B-17	R324	K-6	R612	I-4	RL001	G-10
C037	B-11	C561	M-14	D451	C-18	Q501	E-18	R326	K-8	R613	I-4	S001	A-19
C045	F-9	C562	I-15	D452	C-16	Q541	E-10	R327	I-8	R614	I-5	S002	A-18
C046	H-9	C563	H-18	D453	C-16	Q551	I-19	R328	G-6	R615	I-5	S003	A-17
C055	N-2	C564	I-17	D455	B-17	Q2201	C-10	R339	J-6	R616	J-4	S004	A-16
C056	M-1	C566	H-18	D501	G-7	Q2202	C-10	R401	I-7	R617	J-4	S005	A-16
C060	B-14	C567	H-14	D531	G-7	Q2304	M-7	R402	I-8	R618	G-3	S006	A-14
C061	C-14	C569	F-16	D532	F-5	Q2305	M-6	R404	I-7	R619	I-8	S007	A-13
C101	K-4	C570	L-14	D543	E-10	R003	C-11	R451	B-16	R801	G-13	S2301	N-7
C102	L-3	C573	F-7	D551	I-16	R004	G-9	R452	B-18	R802	H-13	SP	N-6
C103	K-4	C576	E-10	D553	L-14	R005	H-9	R453	N-5	R803	J-13	T001	I-10
C104	K-5	C577	M-19	D554	L-19	R008	A-13	R454	B-18	R804	L-13	T501	G-19
C105	J-6	C601	I-8	D555	N-15	R013	B-15	R455	B-18	R805	I-12	T502	D-19
C106	J-7	C602	J-4	D556	N-16	R018	D-14	R456	C-18	R807	L-13	T551	K-17
C107	J-8	C607	I-8	D557	G-4	R019	D-14	R457	C-19	R808	L-13	TP12	K-8
C108	K-8	C801	H-11	D560	G-8	R020	C-15	R458	C-19	R810	F-12	TP15	N-3
C109	H-5	C803	H-12	D561	I-15	R021	I-1	R459	E-16	R811	F-15	TP21	A-6
C110	N-3	C804	G-12	D562	D-15	R022	J-1	R462	D-17	R815	M-11	TPD1	N-15
C113	K-5	C805	I-11	D563	M-15	R023	J-2	R463	C-17	R816	M-13	TPD2	N-15
C123	J-7	C806	K-14	D801	H-11	R024	J-2	R464	C-16	R2201	B-9	TPS1	D-12
C151	J-1	C809	L-10	D802	G-12	R025	J-2	R466	B-16	R2202	B-8	X001	B-13
C152	J-6	C812	H-16	D803	H-12	R026	A-13	R467	E-9	R2203	B-5	X101	K-3
C153	K-8	C817	M-13	D804	F-12	R030	F-3	R470	C-16	R2204	C-9	X102	K-9
C201	L-4	C818	M-13	D805	G-10	R031	D-11	R471	C-16	R2205	C-8	X201	K-7
C202	L-4	C951	K-6	D2321	L-5	R035	D-11	R472	B-16	R2206	C-8	X501	I-6
C203	K-6	C2201	B-9	DEG	G-11	R037	D-11	R501	G-7	R2207	D-8	X601	J-4
C207	F-5	C2202	B-9	DY	E-17	R045	D-11	R502	H-7	R2208	D-8		
C301	J-8	C2203	B-5	F001	L-11	R046	D-10	R503	H-7	R2209	D-8		
C302	J-3	C2204	C-6	FA1	N-2	R050	B-16	R504	I-6	R2210	A-6		
C303	I-4	C2205	C-6	FA2	N-3	R055	G-3	R505	I-7	R2211	A-6		
C304	I-3	C2206	C-5	IC001	B-12	R058	A-18	R506	H-7	R2212	C-8		
C305	I-3	C2207	C-6	IC002	D-14	R059	A-17	R507	H-7	R2213	D-5		
C306	I-4	C2208	C-6	IC003	C-12	R060	A-17	R508	H-7	R2215	D-10		
C309	E-4	C2209	C-5	IC101	I-5	R061	A-16	R509	F-19	R2216	C-9		
C312	I-2	C2210	C-7	IC451	B-17	R062	A-15	R510	E-16	R2218	C-10		
C313	I-7	C2211	B-6	IC551	F-2	R063	A-15	R511	E-14	R2219	C-9		
C316	K-6	C2212	C-8	IC801	L-13	R065	A-15	R516	G-5	R2220	D-8		
C401	J-7	C2213	C-7	IC1052	A-11	R071	A-13	R517	F-6	R2221	B-10		
C402	I-7	C2214	B-7	IC2201	B-6	R072	I-2	R531	G-7	R2222	C-8		
C403	I-7	C2215	C-9	IC2301	M-4	R074	D-15	R532	G-6	R2223	C-7		
C451	B-18	C2216	C-9	IC2302	M-8	R076	B-15	R533	F-5	R2226	C-9		
C452	B-18	C2217	B-9	IC2303	L-5	R077	B-14	R534	F-7	R2228	D-10		
C453	C-19	C2218	B-8	JK3001	N-9	R085	F-3	R538	G-6	R2237	C-9		
C454	B-19	C2219	B-9	L001	A-5	R086	A-6	R539	G-6	R2245	C-10		
C455	C-18	C2220	B-9	L003	E-10	R087	C-11	R541	E-11	R2247	B-6		
C456	B-17	C2221	B-8	L011	B-14	R088	B-16	R542	E-11	R2248	B-6		
C457	C-18	C2301	L-3	L021	H-2	R089	B-16	R544	E-10	R2301	M-5		
C458	C-16	C2302	L-3	L101	K-8	R091	B-14	R547	E-10	R2302	M-4		
C461	C-17	C2303	M-4	L103	J-7	R092	B-10	R551	J-16	R2303	L-3		
C465	D-16	C2304	L-6	L105	J-7	R093	B-10	R552	H-15	R2304	M-3		
C501	G-7	C2305	H-8	L106	K-4	R094	B-10	R553	L-15	R2305	M-3		

# C TELEVISION SCHEMATIC continued

# D AUDIO SCHEMATIC



## 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 up or down button to adjust selection.
6. Press the action button twice to exit picture adjustment.

#### Normalize Settings

1. Press the action button to display the main menu.
2. Press the channel down button to select the picture adjustment.
3. Press the volume up or down button to reset picture adjustments to factory preset levels.

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

#### B+ CHECK

Connect a digital DC voltmeter to pin 4 of IC801 and the common tie point. Set brightness and picture to minimum. With AC line voltage set to 120VAC, B+ should read 130V ±1.0V.

#### HIGH VOLTAGE CHECK

Tune in a picture. Set brightness and picture for a black raster. Connect a high voltage probe to CRT anode. High voltage must read 27.5KV to 30KV.

#### RF AGC DELAY

Tune in a picture. Adjust R106 counterclockwise until snow appears in picture, then clockwise to a point just past where snow disappears.

#### MPU REFERENCE OSCILLATOR

Tune in channel 13. Connect a frequency counter to TPS1. Adjust C031 for 12MHz ±72Hz.

#### PURITY CHECK

Press recall button on remote transmitter 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 color.

#### PURITY

Enter serviceman mode. Press recall button on remote transmitter to enter purity check mode. Press recall button again to display a green raster. Loosen 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 green screen is obtained.

#### CONVERGENCE

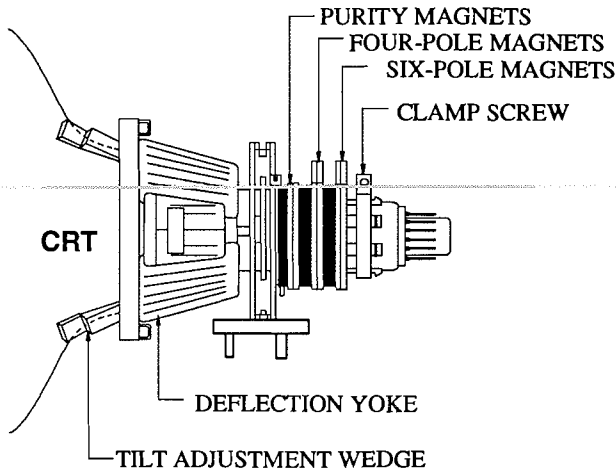
Connect a signal generator to antenna terminals and tune in a dot pattern. Adjust 4-pole magnets to converge the red and blue dots at the center of the screen. Adjust 6-pole magnets to converge the red/blue dots over the green dots at the center of the screen.

NOTE: Spread the two tabs of each set of magnets equally and opposite to converge vertically, and rotate both tabs in the same

direction to converge horizontally. The four and six pole magnets interact, repeat adjustment until center convergence is correct.

Tune in a crosshatch pattern. Remove rubber wedges between the deflection yoke and 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. If the yoke or CRT is replaced, a convergence corrector strip (Part No. 0FMK014ZZ) may be required to match the yoke and CRT for optimum convergence. Position the strip between the CRT and yoke for best convergence at corners of screen and secure with tape.

#### CRT NECK ASSEMBLY



#### 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

On generator select pilot, 1kHz audio frequency, and L-R modulating signal. Set R2220 fully clockwise. Connect digital voltmeter to pin 23 of IC2201. Adjust R2220 slowly counterclockwise until voltage goes from a high to a low.

#### Filter

Select SAP mode on the receiver. On generator select SAP, 1kHz audio frequency and L-R modulating signal. Connect a digital voltmeter to TP21. Adjust R2221 for 175mV.

#### 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.

### ENTERING SERVICEMAN MODE

Turn on receiver and momentarily connect test point FA1 to FA2. The receiver will enter aging mode, volume up and down buttons will adjust rapidly. Press the action button and volume up buttons on receiver control panel simultaneously. The receiver will enter the serviceman mode, the volume up and down buttons will adjust normally and all customer controls are set to normal. Press power button on remote to select one of three service modes.

B= DAC Adjustments

C= CRT Adjustments

Normal = Normal operation of channel and volume buttons

### EXIT SERVICEMAN MODE

NOTE: Always exit serviceman mode when finished making adjustments.

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

### DAC ADJUSTMENTS

NOTE: Write down original values in detail before making any adjustments in case a misadjustment occurs.

Press channel up or down buttons on remote to select any of 6 service adjustment addresses. Press volume up or down buttons on remote to change level of adjustment.

#### DAC Adjustment Range and Default Levels

Adjustment	Range	Default Level
Sub Bright (B0)	0-127	67
Sub Color (B1)	0-63	33
Sub Tint (B2)	0-63	33
Sub Picture (B3)	0-63	35
Video Det Level (B4)	0-15	8
Sound Out (B5)	0-15	8

#### Sub Brightness (B0)

This adjustment must be made after sub picture and 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. Set color to minimum. Enter serviceman mode and select DAC adjustment. Select sub brightness (B0). Adjust until the black bars start to turn gray, then decrease adjustment until bars turn black.

#### Sub Color (B1)

Tune in a color bar signal. Connect oscilloscope to pin 1 of connector C1 on the CRT board. Connect a 1000 ohms resistor from TPD1 to pin 3 of IC551. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub color (B1). Adjust waveform for 6.0Vp-p ±.05Vp-p. Remove jumpers.

#### Sub Tint (B2)

Tune in a color bar signal. Connect oscilloscope to pin 1of connector C1 on the CRT board. Connect a 1000 ohms resistor from TPD1 to pin 3 of IC551. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub tint (B2). Adjust waveform so the 1st and 4th peaks are of equal amplitude. Remove jumpers.

#### Sub Picture (B3)

NOTE: This adjustment is factory set, DO NOT adjust unless CRT or CRT board is replaced.

Connect a color bar signal to the antenna input. Connect oscilloscope to pin 2 of connector C1 on CRT board. Connect a 1000 ohm resistor from TPD1 to pin 3 of IC551. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub picture (B3). Adjust for 3.0Vp-p ± .1Vp-p from white to black level. Do not include sync tip in measurement. Remove jumpers.

#### Video Detector Level (B4)

Connect a color bar signal to the antenna input. Connect oscilloscope to TP12. Enter serviceman mode and select DAC adjustment. Select video detector level (B4). Adjust for 1.0Vp-p ± .2Vp-p

#### Sound Out (B5)

This adjustment is factory set, do not adjust unless IC002 or IC101 has been replaced. Connect a generator with a 1kHz mono audio tone to the antenna terminal. Connect an oscilloscope to junction of R202 and R204. Enter serviceman mode and select DAC adjustment. Select sound out (B5). Adjust for 720mV ±20mV.

### CRT ADJUSTMENTS

Follow same procedure used for DAC adjustments.

#### CRT Adjustment Range and Default Levels

Adjustment	Range	Default Level
Horiz Centering (C0)	0-15	8
Red Cutoff (C1)	*0-511	128
Green Cutoff (C2)	*0-511	128
Blue Cutoff (C3)	*0-511	128
Red Drive (C4)	0-255	128
Blue Drive (C5)	0-255	128
* Range indicated in 2 steps (0-255) -> (H0 - H255).		

#### Horizontal Centering (C0)

Tune in a crosshatch pattern. Enter serviceman mode and select CRT adjustments. Select CRT horizontal centering (C0) adjustment and adjust crosshatch pattern for correct horizontal centering.

#### Color Temperature (C1 thru C5)

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 (C1), green cutoff (C2), and blue cutoff (C3) for a gray picture. Set the red drive (C4) and blue drive (C5) for correct white areas.







PARTS LIST

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	MA162	-	NTE519	ECG519	SK3100
D003	MA4047M	-	NTE5009A	ECG5009A	SK4A7
D005 (1)	SEL1410G	-	-	-	-
D006	MA165	-	NTE519	ECG519	SK3100
D022, 25	MA150	-	NTE177	ECG177	SK9091
D026	MA165	-	NTE519	ECG519	SK3100
D351	MA165	-	NTE519	ECG519	SK3100
D451	ERA15-01V3	-	NTE552	ECG552	SK9000
D452, 53	MA165	-	NTE519	ECG519	SK3100
D455	MA4120M	-	NTE5021T1	ECG5021T1	SK9971
D501	QA208C	TVSQA208C	NTE5016A	ECG5016A	SK8A2
# D531	AS01VO	-	-	-	-
# D532	QA206M	TVSQA206M	NTE5012A	ECG5012A	SK6A0
D543	MA4068M	-	NTE5014A	ECG5014A	SK6A8
D551	RU2N	-	NTE552	ECG552	SK9000
D553, 54	AS01	-	NTE552	ECG552	SK9000
D555	MA165	-	NTE519	ECG519	SK3100
D556	MA4360H	-	-	-	-
D557	QB105	TVSQB105N	-	-	-
D560	QB112ZE	TVSQB112ZE	-	-	-
D561	AU01	-	NTE552	ECG552	SK9000
	AS01	-	NTE552	ECG552	SK9000
	ERA2204	-	NTE552	ECG552	SK9000
D562, 63	MA165	-	NTE519	ECG519	SK3100
# D801 Thru					
# D804	RM11B	-	NTE125	ECG125	SK3081
	EM02BM	-	NTE125	ECG125	SK3081
D2321 (2)	MA150	-	NTE177	ECG177	SK9091
IC001	MN1873234QAM	-	-	-	-
	MN1873234QAS	-	-	-	-
IC002	24C02AIP	-	-	-	-
IC003	MN1280R	-	NTE15044	-	SK9854
# IC101	AN5163K	-	-	-	-
IC451	LA7835	LA7835-TV	NTE1855	ECG1855	SK10085
# IC551	AN78M09	-	NTE1902	ECG1902	SK3962
# IC801	STR30130	TVSSTR30130	NTE1777	ECG1777	SK9870
IC2201	AN5817K	-	-	-	-
IC2301, 02	AN5265	-	NTE1789	ECG1789	SK9876
IC2303 (2)	MN64066BP	-	-	-	-
Q002, 03	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
Q006 Thru					
Q008	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
Q015	2SA564AQRS	-	NTE290A	ECG290A	SK3932
	JA101PQ	-	NTE290A	ECG290A	SK3932
# For SAFETY use only equivalent replacement part.					
(1) Used in models CT-20S21S and CT-20XF21CS only.					
(2) Not used in model CT-2045SS.					

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.
Q306, 07	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
Q351 Thru					
Q353	2SC3063RL	-	NTE157	ECG157	SK3747
Q354	2SA564AQRS	-	NTE290A	ECG290A	SK3932
	JA101PQ	-	NTE290A	ECG290A	SK3932
Q451, 52	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
Q501	2SC1573AH	-	NTE399	ECG399	SK9352
Q541	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
# Q551	BU2506DFLB	-	-	-	-
Q2201, 02	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
Q2304, 05 (3)	2SC1685QRS	-	NTE85	ECG85	SK9229
	JC501PQ	-	NTE85	ECG85	SK3124A
# For SAFETY use only equivalent replacement part.					
(3) Used in models CT-20S11CS and CT-20S11S.					

### 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)

EL CT-20S12S (CHASSIS AMEDP233)

MISCELLANEOUS			
Item No.	Description	Mfr. Part No.	Notes
# CRA801	Capristor	EXNG131P365	130pF, 3.6M
# F001	Fuse	0BA1C40NU100	4Amp, 125V/250V, Slow Blow
IC1501 (5)	Receiver	ONQ1407	Remote
IC1502	Receiver	RPM-637CBRS	Remote
IC1502 (4)	Receiver	ONQ1409	Remote
# JK351	Socket	TJS1A5050	CRT
JK3001 (3)	Jack	TJB2A9063	Assembly
# M049	Line Cord	TSX5140X	AC, Polarized
# M049 (2)	Line Cord	TSX3134X	AC, Polarized
# RL001	Relay	TSE1864	Power
S001	Switch	EVQQBH12T	Power
S002	Switch	EVQQBH12T	Volume Down
S003	Switch	EVQQBH12T	Volume Up
S004	Switch	EVQQBH12T	Channel Down
S005	Switch	EVQQBH12T	Channel Up
S006	Switch	EVQQBH12T	Action (Menu)
S007 (3)	Switch	EVQQBH12T	TV/Video
S2301 (3)	Switch	ESB621283	Speaker
SP1, SP2	Speaker	EASG9D523A2	2" X 3.5", 16 Ohms
SP1, SP2 (4)	Speaker	EAS9D530KAG	2" X 3.75", 16 Ohms
SP1, SP2 (5)	Speaker	EASG12D533B2	3" X 5", 16 Ohms
# V1	CRT	A51KQN61X	51KQN61X
# V1 (4)	CRT	A51KQN90X	-
X001	Crystal	TSS2080MX	12MHz
X101	Filter	EFCH45MVK12N	SAW
X102	Filter	EFCS4R5MW3BA	4.5MHz
X201	Filter	EFCS4R5MS4W	4.5MHz
X501	Crystal	EF0A503KS41	503kHz
X601	Crystal	TS816M32	3.58MHz
	Corrector Strip	0FMK014ZZ	Convergence
	PC Board (7)	ONP15007	C
	PC Board (7)(6)	ONP15007ZA	C
	PC Board (7)(1)	ONP19001ZA	A
	PC Board (7)(8)	ONP19001JA	A
	PC Board (7)(9)	ONP19001LA	A
	PC Board (7)(5)	ONP19001GA	A
	Transmitter	EUR501200	Remote
	Transmitter	EUR501050A	Remote
#	Tuner (7)	ENV568M4G3	UHF/VHF
	Tuner (7)(5)	ENV568L2G3	UHF/VHF
	Wedges	TMM2A30202	Yoke Positioning (3 Used)
# For SAFETY use only equivalent replacement part.			
(1) Used in models CT-20S11CS, CT-20S11S, and CT-20S12S.			
(2) Used in models CT-20S21S, CT-20XF21CS, CT-2040SS, and CT-2045SS.			
(3) Not used in model CT-2045SS.			
(4) Used in models CT-2040SS and CT-2045SS.			
(5) Used in models CT-20S21S and CT-20XF21CS.			
(6) Used in models CT-20S12S, CT-20S21S, and CT-20XF21CS.			
(7) Contact PTS Electronics Corporation for replacement; order by manufacturer's part number.			
(8) Used in model CT-2040SS.			
(9) Used in model CT-2045SS.			

CABINET PARTS	
Item	Mfr. Part No.
MODEL CT-20S11CS	
Cabinet Back Assembly	TXFKU2293SER
Cabinet Front Assembly	TXFKY1293SER
Pushbutton Assembly	TBX2A50181G
MODEL CT-20S11S	
Cabinet Back	TKU2A22207M
Cabinet Front Assembly	TXFKY1393SER
Pushbutton Assembly	TBX2A50181G
MODEL CT-20S12S	
Cabinet Back	TKU2A22207M
Cabinet Front Assembly	TXFKY1393SER
MODEL CT-20S21S	
Cabinet Back Assembly	TXFKU3293SER
Pushbutton Assembly	TBX2A50151
MODEL CT-20XF21CS	
Cabinet Back Assembly	TXFKU3393SER
Pushbutton Assembly	TBX2A50151
MODEL CT-2040SS	
Cabinet Back Assembly	TXFKU3593SER
Cabinet Front Assembly	TXFKY2893SER
Pushbutton Assembly	TBX2A52003G
MODEL CT-2045SS	
Cabinet Back Assembly	TXFKU3693SER
Cabinet Front Assembly	TXFKY2993SER
Pushbutton Assembly	TXFBX0593SER

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

PANASONIC

MODEL CT-20S12S (CHASSIS AMEDP233)



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M. Herkless, J. Kocha,  
J. Limp, F. Malek, B. Medaris,  
R. Raus, B. Skinner, J. Young



PARTS LIST continued

CONTROLS & RESISTORS			
Item No.	Function/Rating	Mfr. Part No.	NTE Part No.
# D805	7.2 Cold PTC	TRPW5B0M050D	-
# R037	2700 5% 1/4W	ERDS2TJ272	QW227
# R046	82K 5% 1/4W	ERDS2TJ823	QW382
R050	10K 1% 1/4W	ER0S2CKF1002	-
# R065	1000 5% 1/4W	ERDS2TJ102	QW210
R106	10K RF AGC	EVND1AA00B14	-
# R206	10 5% 2W	ERG2ANJ100	2W010
R453	30K Vertical Size	EVND1AA00B34	-
# R510	910 5% 2W	ERG2ANJ911	2W191
# R511	910 5% 2W	ERG2ANJ911	2W191
# R531	47 5% 1/4W	ERD25FJ470	QW047
# R532	43.2K 1% 1/4W	ER0S2CKF4322	-
# R533	7150 1% 1/4W	ER0S2CKF7151	-
# R534	680K 5% 1/4W	ERD25TJ684	QW468
# R539	680 5% 1/4W	ERDS2TJ681	QW168
# R551	1 5% 1/2W	ERDS1FJ1R0	HW1D0
# R552	1 5% 1/2W	ERDS1FJ1R0	HW1D0
# R553	1 5% 1/2W	ERDS1FJ1R0	HW1D0
# R558	1 5% 1W Fusible	ERQ1CJP1R0	F1W1D0
# R559	82 5% 3W	ERG3ANJ820	3W082
# R560	62 5% 2W	ERG2ANJ620	2W062
# R565 (R567)	62 5% 1W	ERG1ANJ620	1W062
	100 5% 1W	-	1W110
# R801	.82 10% 7W Wirewound	ERF7ZKR82	-
# R802	180 5% 20W Wirewound	ERF20ZJ181	-
# R803	680 5% 5W Wirewound	ERF5ZJ681	5W168
# R805	10K 5% 1/2W	ERDS1FJ103	HW310
# R807	47 5% 1/4W	ERD25FJ470	QW047
# R808	33 5% 1/4W	ERD25FJ330	QW033
# R810	8.2 10% 5W Wirewound	ERF5ZK8R2	5W8D2
# R811	4.7 5% 3W	ERX3ANJP4R7	3W4D7
# R815	8.2M 20% 1/2W	ERC12ZGM825	HW582
# R816	1 10% 1/2W	ERW12PK1R0	HW1D0
# R824 (1)	82 5% 1/4W	ERD25TJ820	QW082
R2203	56K 1% 1/4W	ER0S2CKFS602	-
R2209	50K Low Separation	EVND4AA00B54	-
R2213	50K High Separation	EVND4AA00B54	-
R2220	30K VCO	EVND4AA00B34	-
R2221	30K Filter	EVND4AA00B34	-
# For SAFETY use only equivalent replacement part. (1) Used in models CT-20S21S and CT-20XF21CS.			

COILS & TRANSFORMERS		
Item No.	Function/Rating	Mfr. Part No.
L001	Ferrite Bead	EXCELSA24
L003	Ferrite Bead	EXCELSA39
L011	1μH	TLUABTA1R0K
L021	39μH	TLUABTA390K
L101	15μH	TLUABTA150K
L103	AFT	EIV7EN041B
L105	VCO	EIV7EN053B
L106	1.2μH	TLQ012K205C
L107	1.2μH	TLQ012K205C
L108	1μH	TLUABTA1R0K
L201	Quadrature	EIS7ES004B
L351	150μH	TLUABTA151K
L541	150μH	TLUABTA151K
# L551	Horizontal Linearity	TLH15652P
L552	Ferrite Bead	EXCELSA35
L553	Ferrite Bead	EXCELSA35
L558	Ferrite Bead	EXCELSA35
L559	Ferrite Bead	EXCELSA39
# L570	Yoke 90° Horiz 2.45 mH Vertical 19.3 mH	OLY15307F
L601	10μH	TLUABTA100K
# L801	Line Filter Choke	TLP15578J
# L820	Degaussing	OLK19042M
# L820 (1)	Degaussing	OLK19039A
LC301	Trap, 3.58MHz	ELB5A082
# T001	Power	TLP16297
# T501	Horizontal Driver	ETH19Y70AYM
# T502	Horizontal Coupling	ETE19Z30AY
# T551 (2)	Horizontal Output	TLF15615F
# For SAFETY use only equivalent replacement part. (1) Used in model CT-20S11CS. (2) Focus and screen controls are part of T551.		

CAPACITORS & ELECTROLYTICS		
Item No.	Rating	Mfr. Part No.
C022	33pF 5% 50V N150	ECCF1H330JP
C023	15pF 5% 50V N150	ECCF1H150JP
C031	20pF Trimmer	ECRHA020D41
C105	27pF 5% 50V NPO	ECCF1H270JC
C108	10μF 16V NP	ECEA1CN100S
C123	1pF ±.25pF 50V NPO	ECCF1H010CC
C152	82pF 5% 50V NPO	ECCF1H820JC
C201	68pF 5% 50V NPO	ECCF1H680JC
C207	10μF 16V NP	ECEA1CN100S
C309	1μF 50V NP	ECEA1HN010S
C355	.001 10% 2KV	ECKD3D102KB
C403	1μF 50V NP	ECEA1HN010S
# C451	220μF 16V	ECEA1CGE221
C509	220pF 5% 50V N750	ECCF1H221JU
C541	120pF 5% 50V NPO	ECCF1H121JC
C543	100pF 5% 50V NPO	ECCF1H101JC
# C552	220μF 25V	ECEA1EU221
# C559	220μF 25V	ECEA1EFS221
# C563	.0082 5% 1.2KV	ECWH12H822JS
# C564	680pF 5% 2KV	ECKD3D681JB
# C566	180pF 5% 2KV	ECKD3D181JB
# C567	1000μF 35V	ECEA1VGE102
# C569	.39 5% 200V	ECQF2H394JS
C602	15pF 5% 50V N750	ECCF1H150JU
# C805	330μF 200V	EC0S2DG331G4
# C806	22μF 160V	ECEA2CU220
C809	.22 10% 125VAC	ECQU1A224KH
# C812	33μF 160V	ECEA160V33Z
# C817	.015 10% 125VAC	ECQU1A153KH
# C818	.015 10% 125VAC	ECQU1A153KH
C2209	10μF 16V Tantalum	AP106K016CAE
C2211	3.3μF 16V Tantalum	ECSF16E3R3
C2221	68pF 5% N150	-
C2221	180pF 10% 50V	ECKF1H181KB
C2221 (1)	56pF 5% 50V	ECCF1H560K
# For SAFETY use only equivalent replacement part. (1) Used in models CT-20S21S and CT-20XF21CS.		