SERVICE MANUAL

CS-1577A

DUAL TRACE OSCILLOSCOPE

FEATURE

The Model CS-1577A Dual-Trace Oscilloscope is an accurate, professional instrument with its primary applications in engineering design labs, factory test and analysis centers, and well-equipped service shops or field service facilities. Rectangular, domed CRT provides constant electron beam length. Internal 8 × 10 division graticule reduces parallax error. Mesh type acceleration provide fine trace for accurate measurements. 6 kV mesh-type acceleration and bright phosphors permit waveforms to be viewed at trace duty cycle of 0.1% or less.

DC to 35 MHz bandwidth and 10 nsec rise time assure distortion-free, high-resolution presentation at high frequencies. Smooth roll-off makes scope usable well above 35 MHz. Distortion-free display of signals up to 35 MHz on full area of the CRT screen.

SINGLE mode allow push button to enable a single sweep which will begin at the next sync trigger. ×5MAG of horizontal sweep allows close-up examination of any portion of the waveform. In addition, the ×5MAG provides maximum sweep speed of 20 nsec/div. CH2 input can be applied as horizontal deflection (X axis) while CH1 input provides vertical deflection (Y axis). A selectable sync pulses at sweep speeds of 0.1 ms/div and slower for viewing television frames and horizontal sync pulses at sweep times of 50 μs/div and faster for viewing television line. FIX mode automatically fixes sync level at center of sync signal, regardless of setting of LEVEL control.

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SPECIFICATIONS

Cathode Ray Tube

Type:
140CGB31 (rectangular CRT, internal graticule)
Acceleration voltage:
Approx. 6 kV
Scale:
8 div × 10 div (1 div = 9.5 mm)

Vertical Axis (CH1 and CH2)

Deflection factor:
2 mV/div-10 V/div ±3%, at 10-30°C,
±5%, at 0-40°C
Attenuator:
12 steps in 1-2-5 sequence, 2 mV/div-10 V/div, with variable control for fully adjustable sensitivity between steps.
Input impedance:
1 MΩ ± 2% shunted by 22 pF ± 3 pF
Frequency response:

DC	DC – 35 MHz (– 3 dB)
AC	5 Hz – 35 MHz (– 3 dB)

Rise Time:
10 nsec. or less
Over-shoot:
3% or less (100 kHz square wave)
Cross-talk:
Better than – 60 dB (alternate operation)
Better than – 40 dB (chop operation)
Operating modes:

CH1	CH1 only
CH2	CH2 only
DUAL	Dual trace
ADD	Single trace algebraic sum of CH1 and CH2 (single trace algebraic difference of CH1 and CH2 when CH2 signal is inverted)
X-Y	X axis; CH2 Y axis; CH1

Dual-trace Changeover:
ALT is effected when TRIG SOURCE is ALT or NORM-CHOP is NORM and SWEEP TIME/DIV is 0.5 ms/div-0.1 μs/div.
CHOP is effected (about 350 kHz switching) in other modes.
Invert polarity:
CH2 only
Signal delay time:
Approx. 10 nsec. (on CRT screen)
Maximum Undistorted Amplitude:
500 Vp-p or 250 V (DC + AC)

Horizontal Amplifier (CH2 input)

Operating modes:
X-Y changeover with vertical MODE switch
CH1: Y axis CH2: X axis
Deflection Factor:
Same as vertical (CH1)
Input impedance:
Same as vertical (CH1)
Frequency response:
DC: DC – 2 MHz (– 3 dB)
AC: 5 Hz – 2 MHz (– 3 dB)
X-Y phase difference:
Less than 3° at 100 kHz

Sweep Circuit

Sweep system:

SINGLE	Single sweep
NORM	Triggering sweep
AUTO	Triggering sweep and auto free-run sweep in absence of trigger signal.
FIX	The triggering level is automatically set to the center of the input signal level.

Sweep time:
0.1 μs/div-0.5s/div ± 3%, in 21 steps, in 1-2-5 sequence, Each overlapping range provides for fine adjustment.
Magnifier:
5 times ± 5%
Linearity:
Better than ± 3% (10% at × 5MAG)

Triggering

Source (Internal):
ALT
CH1 trigger in CH1 and ADD mode.
CH2 trigger in CH2 mode.
Alternate CH1 and CH2 trigger in DUAL mode.
CH1: CH1 trigger regardless of mode.
CH2: CH2 trigger regardless of mode.
Source (External):
EXT 1/10: 10: 1 attenuation
EXT 1: No attenuation
External triggering input voltage:
50 V (DC + AC peak)
Triggering system:
SINGLE, NORM, AUTO; Manual sync
FIX; Auto sync
Slope:
Positive or negative
Coupling:
AC, LF Rej, HF Rej, VIDEO, DC,
LINE, and FRAME are automatically switched by SWEEP TIME/DIV
LINE; VIDEO-Line; 0,1 μs/div-50 μs/div
FRAME; VIDEO-Frame; 0.1 ms/div-0.5s/div

SPECIFICATIONS

Sensitivity:

Triggering mode in SINGLE or NORM

Coupling	Bandwidth (Hz)	Minimum sync. voltage		
		INT (div)	EXT1/10 (Vp-p)	EXT1 (Vp-p)
AC	50~15M	0.5	3	0.3
	10~40M	0.8	3	0.3
VIDEO	VIDEO	1	5	0.5
DC	DC~15M	0.5	3	0.3
	DC~40M	0.8	3	0.3

HF REJ: Attenuate above 100 kHz

LF REJ: Attenuate below 10 kHz

TRIGGERING MODE	Bandwidth (Hz)	Minimum sync. voltage		
		INT (div)	EXT1/10 (Vp-p)	EXT1 (Vp-p)
AUTO	100~15M	0.5	3	0.3
	50~40M	0.8	3	0.3
FIX	100~15M	0.5	3	0.3
	50~40M	0.8	3	0.3

HOLDOFF

NORM-MAX (Continuously variable from zero more than ten times)

Calibrating voltage

0.1 Vp-p ±3%, positive polarity
Reference level 0 V (1 kHz ±3% square wave)

Intensity Modulation

Input voltage:
TTL level (more than 2.5 Vp-p)
Input impedance:
10 kΩ
Bandwidth:
DC-5 MHz
Maximum input voltage
50V (DC+AC peak)

Trace rotation

Trace angle is adjustable by panel surface adjuster.

Power Requirements

Power supply voltage:
AC 100/120/220/240V ±10%, 50/60 Hz
Power consumption
Approx. 45 W

Dimensions

Width 260 mm (277 mm)
Height 190 mm (204 mm)
Depth 375 mm (440 mm, max)
Figures in ( ) show maximum size.

Weight

9.1 kg

Accessories

Instruction manual 1
Replacement fuse
0.5 A 2
0.8 A 2
AC power cord 1
Probe (PC-22) 2
Attenuation: Combination 10:1 and direct
Input Impedance: 10 MΩ, 18 pF or less

SPECIFICATIONS

CRT 140CGB31 SPECIFICATION

Screen and Shape

Dimensions:

Overall length: 310 mm or less

Diagonal: Max 143.5 ± 1.5 mm

Screen shape:

Rectangular, flat face, internal graticule

Deflection and focusing system:

Electrostatic deflection

Electrostatic focusing

Post-deflection acceleration

Fluorescence:

Green

Persistence:

Medium short

Heating

Heater voltage:

6.3 V

Heater current:

0.24 A

Maximum Ratings

3rd plate voltagte (Eb_3):

Max 6500 V

2nd plate voltage (Eb_2):

Max 1800 V

2nd grid voltage (Ec_2):

Max 1700 V

1st grid voltage (Ec_1):

Max 200 V

Cathode to heater voltage (Ehk):

Max 125 V

Voltage between 2nd plate and any deflection plate:

Max 500 V

Display area:

95.0×76.0 mm²

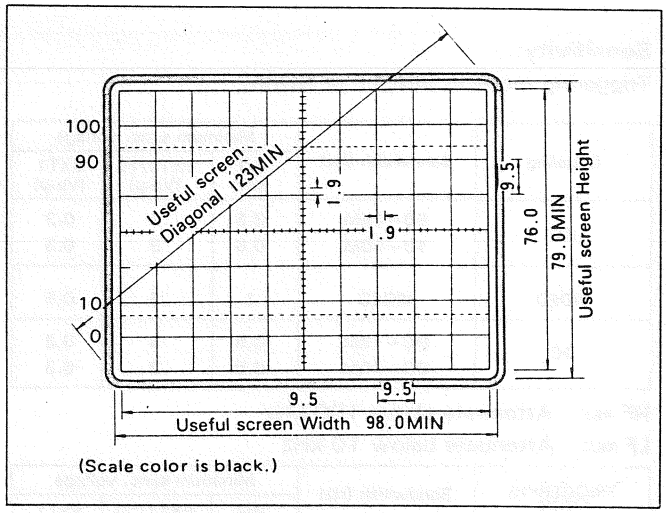


Fig. 1 140CGB31 Graticule

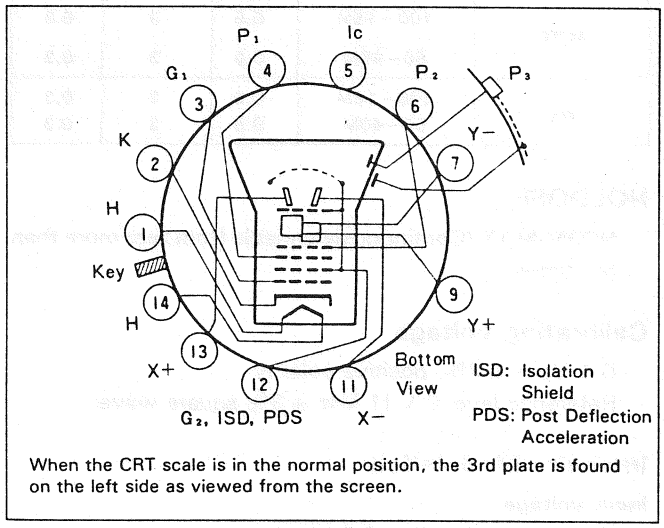


Fig. 2 140CGB31 Basing

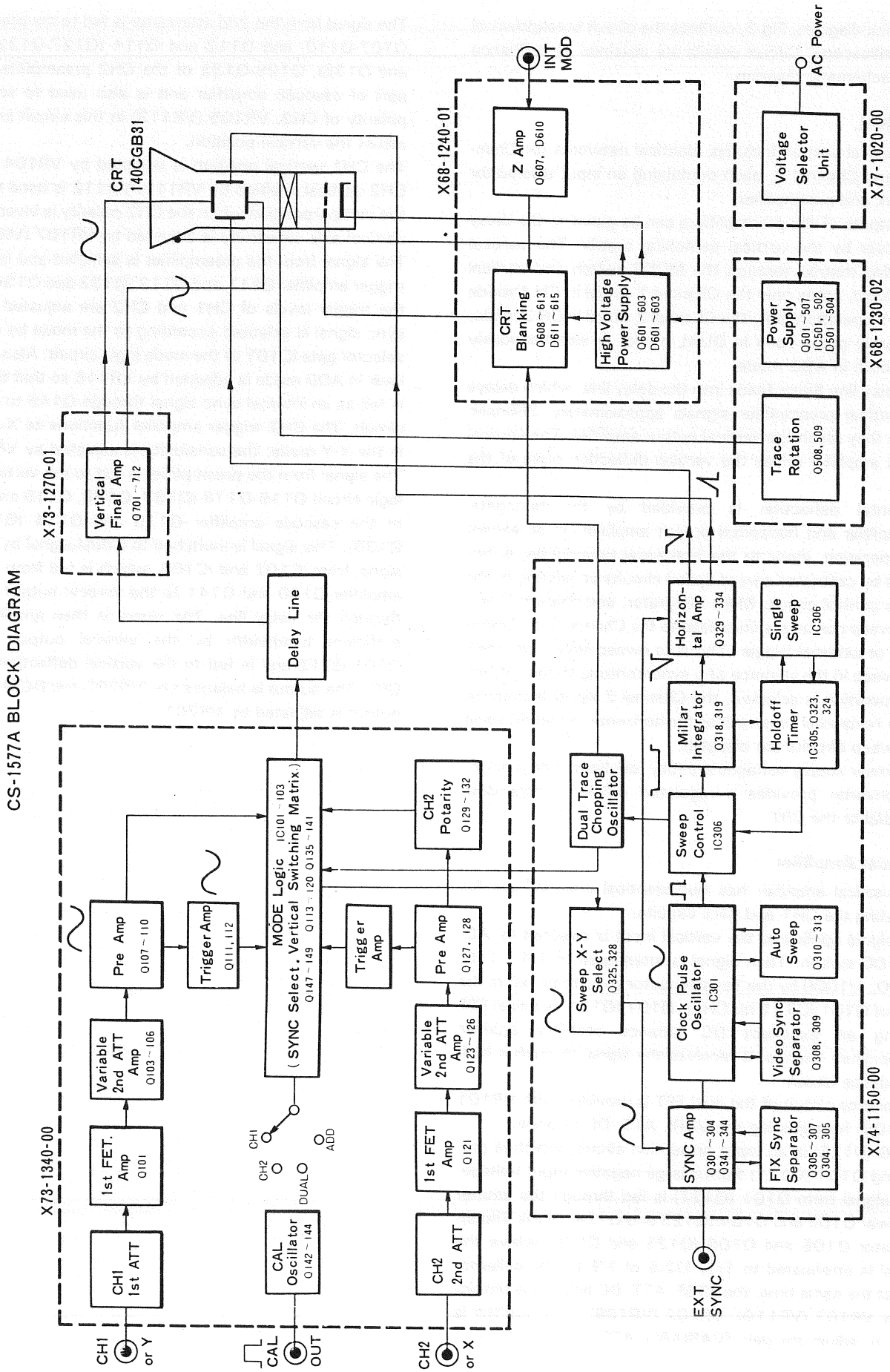


Fig. 3 Block Diagram

CIRCUIT DESCRIPTION

The block diagram, Fig 3, outlines the circuit breakdown of the oscilloscope. Circuit details are obtained by reference to the schematic diagram.

GENERAL

The vertical section includes identical networks for Channel 1 and Channel 2, each containing an input attenuator network and preamplifier.

The outputs of the preamplifiers can be gated to the delay line driver by the vertical switching matrix. The vertical switching matrix, through the MODE switch and vertical mode logic, gates only the Channel 1 singal in CH 1 mode and X-Y operation, only the Channel 2 singal in CH 2 mode, alternately gates each in DUAL mode, or simultaneously gates both in ADD mode.

The delay line driver feeds into the delay line, which delays the vertical preamplifier signals approximately 160nsec before they reach the vertical output amplifier. The vertical output amplifier drives the vertical deflection plate of the CRT.

Horizontal deflection is provided by the horizontal preamplifier and horizontal output amplifier. In all except X-Y operation, input to the horizontal preamplifier is furnished by calibrated sweep speed circuits consisting of the sweep control circuit. Miller integrator, and hold-off timer. The sweep can be synchronized to the Channel 1 or 2 input signal or external trigger. The auto sweep circuit can start the sweep in the absence of a synchronizing trigger. When X-Y operation is selected, the Channel 2 signal is coupled to the horizontal preamplifier for horizontal deflection and the sweep circuits are disabled.

The power supply voltages are fully regulated, and a dc-to-dc converter provides a regulated 4.5 kV accelarating potential to the CRT.

Vertical Amplifier

The vertical amplifier has two identical preamplifiers for operating the CH1 and CH2 circuits.

The signal applied to the vertical input is selected by AC-GND-DC switch. Then signal is attenuated to 1/1, 1/10, 1/100, 1/1000 by the 1st attenuator so as to be fed to the gate of Q101 (Q121 for CH2). Q101 (Q121) is a dual FET having an excellent DC balance stability against temperature change. It receives the signal through a high impedance circuit.

The source circuit of the dual FET is provided with VR101 (VR108) for adjusting the VARI. ATT. DC balance.

D126 (D125) is an input protection circuit, which is protecting Q101 (Q121) from a large negative input voltage.

The signal from Q101 (Q121) is fed through the emitter follower Q103 and Q104 (Q123 and Q124) to the 2nd attenuator Q105 and Q106 (Q125 and Q126) where the signal is attenuated to 1/1, 1/2.5 of 1/5 by the collector and at the same time, the STEP. ATT. DC balance is obtained by VR103 (VR110). VR102 (VR109) in the emitter is used to adjust the gain (VARIABLE ATT.).

The signal from the 2nd attenuator is fed to the preamplifier Q107-Q110, and Q113 and Q114 (Q127-Q132, Q135 and Q136). Q129-Q132 of the CH2 preamplifier from a part of cascode amplifier and is also used to select the polarity of CH2. VR105 (VR113) in this circuit is used to adjust the vertical position.

The CH1 vertical position is adjusted by VR104 and the CH2 vertical position by VR111. VR112 is used to adjust the vertical position when the CH2 polarity is inverted. The vertical axis sensitivity is adjusted by VR107 (VR115).

The signal from the preamplifier is sampled and fed to the trigger amplifier Q111 and Q112 (Q133 and Q134) where the trigger levels of CH1 and CH2 are adjusted and the sync signal is selected according to the mode by the sync selector gate IC101 of the mode logic circuit. Also DC sync level in ADD mode is adjusted by VR116 so that the signal is fed as an internal sync signal through Q148 to the sync circuit. The CH2 trigger amplifier functions as X-amplifier in the X-Y mode; the sensitivity is adjusted by VR114.

The signal from the preamplifier is fed to the vertical mode logic circuit Q115-Q118 (Q137, Q138, Q119 and Q120) of the cascode amplifier Q113 and Q114 (Q135 and Q136). This signal is switched to a dual-signal by the gate signal from IC102 and IC103, which is fed from the drive amplifier Q140 and Q141 to the vertical output amplifier through the delay line. The signal is then amplified to a sufficient bandwidth by the vertical output amplifier Q701-Q712 and is fed to the vertical deflection plate of CRT. The output is balanced by VR702 and DC level of the output is adjusted by VR701.

CIRCUIT DESCRIPTION

Sync and Sweep Circuits

The sync signal from the vertical amplifier is fed to the drive amplifier Q328 where the DC level is adjusted by VR308. Then, the signal is fed to FET Q302 through the sync source switch and the sync coupling circuit. The sync level is adjusted by VR301. The sync signal is fed from the emitter follower circuit Q303 and Q304 the limiter amplifier IC301.

The sync signal from the limiter amplifier is fed to IC302 where the polarity is inverted.

The signal is selected by IC303 whether or not it passes through the VIDEO sync separation circuit Q308 and Q309 and then it is fed as clock pulses to the sweep control gate IC306-b. The output of IC306-b is inverted by the clock pulse.

Q316 is turned OFF and the mirror integrator Q318 and Q319 is charged at the speed determined by the base CR. The sweep time can be varied by adjusting the VARIABLE VR303.

When the mirror integrator output is increased to the voltage set by the SWEEP LENGTH VR304 the output of the HOLDOFF circuit IC305 is inverted to stop the sweep. IC305-a,b holds this condition until the sweep control gate is set in the standby condition of the next clock pulse. The hold-off time is determined by the mirror integrator circuit Q323 and Q324 and can be varied by the HOLDOFF VR5.

Horizontal Amplifier Circuit

The output of the mirror integrator Q318 and Q319 is fed through VR305 (WIDTH) to VR4 (H. POSITION) and the emitter of Q325 and then to VR306 (H. POSITION) and the emitter of Q326. The collector of Q326 is connected to the collector of Q327. Q327 feeds the X-axis signal in X-Y mode. Both Q326 and Q327 are switched compremental-ly to feed saw-tooth wave (sweep) or X-axis signal (CH2 input in X-Y mode) to the horizontal output amplifier Q329-Q334 where the signal is sufficiently amplified and is fed to the horizontal deflection plate of CRT.

Trigger Mode Circuit

1. Single sweep circuit

Normally, IC306-a functions as R-S flip flop. Its output Qa is inverted and become "H" at the end of the hold off time. The sweep control gate IC306-b is set to the standby condition of trigger pulse. In the single sweep of trigger mode, IC306-a functions as J-K flip flop. It is not inverted until a clock pulse is inputted to RESET S4 even when the hold off time is completed, and IC306-b remain in the sweep stop mode. When a clock pulse is inputted by S4, IC306-a is inverted and IC306-b is set in the trigger pulse standby mode.

2. Auto (Auto free-run sweep) circuit

The auto circuit Q310 and Q311 detects the clock pulse of IC303-a,c. The clock pulse passes through Q312 and Q313 and a pulse for no-signal free-run sweep is fed to the sweep control gate IC306-b. The pulse is also fed from Q314 and Q315 to IC306-a to turn on the LED D2 of TRIG./DELAY.

3. FIX sync circuit

With the trigger mode set to FIX, the upper and lower peaks of the sync signal from Q303 and D302 are detected by D304 and D305. The signal passes through the emitter follower Q305 and Q306. The center voltage of the upper and lower peaks is then obtained, which is fed from the emitter follower Q307 to IC301. Therefore, the trigger level is always set in the center of the trigger signal amplitude.

CRT Circuit and Power Supply Circuit

The Qb output of the sweep control gate IC306-b drives the vertical switching signal generator IC304, IC305-c,d. The output is also fed through Q321 to the blanking circuit Q608-Q613 as an unblanking signal after the amplitude is DC controlled by Q322. The blanking signal amplified in this circuit is DC regenerated to a high voltage by Q605, and D606 and D607, which is fed to the grid of CRT.

The CRT requires acceleration voltages of -1.5 kV and $+4.5$ kV. The high voltages are generated by the DC-DC converter circuit Q604 and T601 and are regulated by the feedback type voltage regulator circuit Q601-Q603. The -1.5 kV is adjusted by VR601 and the $+4.5$ kV is obtained from the tripled voltage circuit. Other voltages are adjusted at the same time by VR501, thus providing highly stabilized operation against power voltage variation.

Calibrating Voltage

The output of the multivibrator Q143 and Q144 is controlled by D112 and Q142 to produce a calibrating voltage. The frequency (pulse width) is adjusted by VR118 and VR119, and the output level is adjusted by VR117.

MAINTENANCE

TRACE ROTATION ADJUSTMENT

Strong magnetic fields, present in many locations where an oscilloscope may be used, may cause the trace to be tilted. The degree of tilt may vary as the scope is moved from on location to another. The TRACE ROTATION control provides an electrically adjustable offset to compensate for trace tilt.

Perform the adjustment as follows.

1. Set oscilloscope controls to produce a horizontal trace with no input signal (triggering MODE switch in AUTO)
2. Use POSITION control as required to position the trace along a horizontal line of the graticule scale.
3. Adjust TRACE ROTATION so trace parallel with the reference line on the graticule scale.

AC VOLTAGE CONVERSION

When operating the unit on voltage other than 240 V, set AC voltage selector switch to 100 V, 120 V or 220 V according to your local AC current. The voltage selector switch is locate on the rear panel of the unit as indicated by the arrow mark. When operating on 100 V or 120 V, remove the 0.5A fuse and replace it with one rate at 0.8A.

REMOVING THE CASE

The case is removed in two sections. The top section can be lifted off after removing seven Phillips-head screws from the top and sides of the case. The bottom section can be lifted off after removing four Phillips-head screws from the bottom of the case.

WARNING

High voltage up to 5000 volts DC is present on the CRT and high voltage power supply when the oscilloscope is operating. Up to 130 volts DC is present on all circuit boards except the vertical amplifier board. Line voltage (120 or 240 VAC) is present on the power transformer, on-off switch, fuse holder, and line voltage selector assembly any time the oscilloscope is connected to an AC power source, even if turned off. Always observe caution when the housing is removed from the unit. Contacting exposed high voltage could result in fatal electric shock.

WARNING

High voltage is applied to the CRT. Make sure to turn the power switch OFF and further pull out the power plug from the AC outlet when replacing the CRT.
The CRT anode voltage will remain for a time after the power switch is turned off. If the anode cap is removed, never touch the metal part of the cap and short circuit it to the chassis. Further, short circuit the CRT anode to the chassis using wire because the anode may remain charged. Never pull out the power plug before turning the power switch OFF, or the cathode circuit is unable to discharge, which is dangerous.

PROBE COMPENSATION

Probe compensation adjustment matches the probe to the input of scope. For best result, compensation of both should be adjusted initially, then the same probe always used with CH1 and CH2 respectively. Probe compensation should be readjusted whenever a probe from a different oscilloscope is used, or CH1 and CH2 probes are interchanged.

1. Connect probes to both V. INPUT terminal.
   Connect ground clip of probes to oscilloscope ground terminal and touch tips of both probes to CAL 1 kHz ⎍ 0.1 $V_{p\text{-}p}$ terminal.
2. Select signal trace operation of CH1 and CH2 for steps 3 and 4.
3. Set oscilloscope control to display 3 or 4 cycles of CAL square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave, waveshape (minimum overshoot, rouding off and tilt).

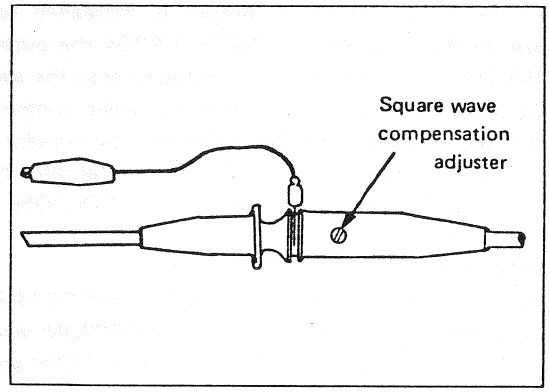


Fig. 4

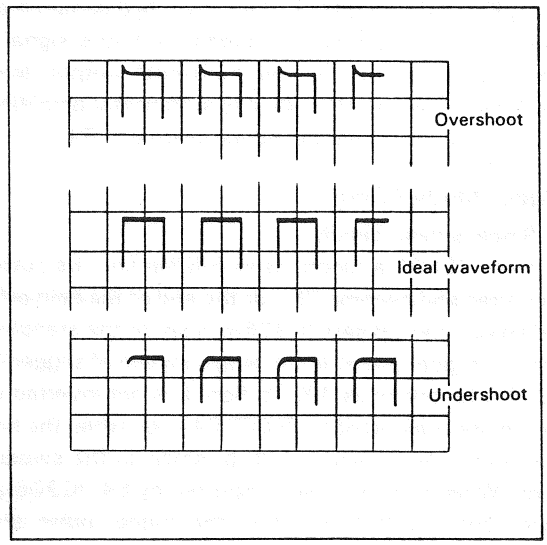


Fig. 5

ADJUSTMENT

Before making adjustment, perform the following notes.

1. Preset the scope controls as follow unless otherwise specified.
2. All adjustment should follow the following order.

Name of knob	Position
SWEEP TIME/DIV	lms
SWEEP VARIABLE	CAL
H. POSITION VR	Mechanical center
PULL ×5 MAG	Push
INTENSITY	3 o'clock
TRIG. LEVEL	Mechanical center
TRIG. LEVEL AUTO	AUTO
NORM/CHOP	NORM
PULL SLOPE NEG	Push
HOLDOFF	NORM
FOCUS	Optimum position
TRIGGER COUPLING	AC
TRACE ROTATION	Optimum position
ASTIG	Optimum position
TRIGGER SOURCE	ALT
V. POSITION (both CH1 and CH2)	Mechanical center
AC-GND-DC (both CH1 and CH2)	AC
VOLTS/DIV (both CH1 and CH2)	2 mV
V. VARIABLE (both CH1 and CH2)	CAL
V. MODE	CH2

TEST EQUIPMENT REQUIRED

Test Equipment	Model	Minimum Specification
Digital Multi-Meter	Dr-706 (TRIO)	Impedance: More than 10 MΩ, Measuring range: 0.01 V to 199 V
Sine-Wave Generator	651B (YHP)	Frequency: 10 Hz to 10 MHz, constant voltage over tuning range
Sine-Wave Generator	SG-503 (Tektronix)	Frequency: 50 kHz to 100 MHz, Output impedance: 50 Ω, constant voltage over tuning range.
Square-Wave Generator	PG-506 (Tektronix)	Output signal: 1 kHz, Amplitude: 10 mVp-p to 10 Vp-p, Accuracy: within ±1%, Rise time: 35ns or less
Q Meter	4343B (YHP)	—
Color Pattern Generator	CG-911 (TRIO)	—
Oscilloscope	465 (Tektronix)	Sensitivity: more than 5 mV Frequency response: More than 100 MHz
Time-Marker Generator	TG-501 (Tektronix)	Time mark: 0.5 s to 0.1μs repeltive waveform
High-Voltage Probe	—	Input Impedance: 1000 MΩ
Termination	—	Impedance: 50 Ω Accuracy: within 3%
Termination	—	3 watts type impedance: 50Ω
Attenuator	—	−20dB attenuation (50Ω)

Power and CRT Circuit Adjustment

+130 V, +12 V, −12 V and +5 V adjustments and check

1. Connect a DC voltmeter to measure the voltages at pin 10 of P505 with respect to the chassis.
2. Adjust VR501 for 130 V ±1% reading on the voltmeter.
3. Next, measure the voltages should be +5 V, +12 V, and −12 V respectively ±5% at pin 8, 7 and 4..

−1.5 kV Adjustment

1. Connect a DC voltmeter to measure the voltage at pin 5 of P605 on the high voltage power supply unit with respect to the chassis.
2. Adjust VR601 for −1.5 kV reading on the voltmeter.

Caution:

Be sure to use the high-voltage probe.

CRT centering and vertical geometry adjustments

1. Short TP4 to TP5 on the vertical amplifier unit.
2. Adjust VR702 to center the trace vertically.
3. Connect a DC voltmeter (Input impedance 10 mΩ higher) to measure the voltage at P3 and P4 with respect to the chassis.
4. Adjust VR701 for 68 V ± 1 V reading on the voltmeter at the each point.
5. Adjust VR701 and VR702 alternately several times to find the optimum positions.

Note:

For easy adjustment, turn the FOCUS knob to make the trace thin. A low impedance DC voltmeter may cause the circuit to oscillate.

FOCUS and ASTIG Adjustments and TRACE ROTATION Adjustment

1. Set MODE switch to X-Y and both CH1 and CH2 AC-GND-DC switches to GND positions. This will produce a spot on the screen.
2. Adjust FOCUS and ASTIG on the front panel for the sharpest, roundest spot. Do not readjust the ASTIG control after this step.
3. Adjust the TRACE ROTATION control so that the trace is parallel with the reference line on the graticule scale if the trace tilts.

INTENSITY and Blanking Adjustments

1. Set TRIG MODE switch to X-Y to display a spot.
2. Adjust VR602 so that the trace disappears when INTENSITY control setting is reduced to the 10 o'clock position.
3. Set INTENSITY control to approximately 3 o'clock position for remaining adjustments.
4. Next, set SWEEP TIME/DIV control to 0.1 μs and TRIG MODE switch to AUTO to display a trace.

ADJUSTMENT

5. Apply 10 MHz sine wave signal to CH1 input to display 6 divisions vertical amplitude waveform on the screen.
6. Pull × 5 MAG knob to magnify a trace. Adjust TC601 so thickness at the start of the sweep equals to the thickness at the other points and no retrace is observed at the end of the sweep.

Caution:
After high voltage unit adjustment, be sure to install the bottom cover.

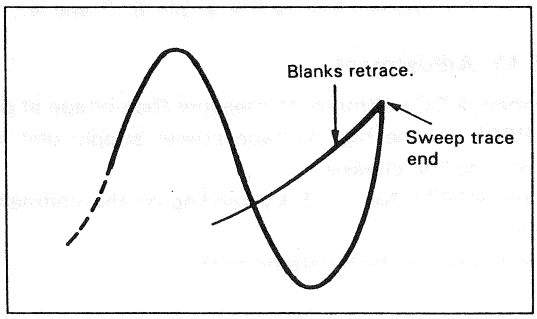


Fig. 6

Vertical Axis Circuit Adjustment

VARIABLE and STEP attenuator balance adjustments

1. Set scope control for a single horizontal trace on CH1 with CH1 AC-GND-DC switch set to GND and set SWEEP TIME/DIV control to 1 ms.
2. Rotate CH1 VARIABLE control from maximum clockwise to maximum counterclockwise, while observing the trace.
3. If the trace moves vertically, adjust VR101 (VARI.) for minimum or zero movement when performing step 2.
4. Rotate CH1 VOLTS/DIV control from maximum clockwise to maximum couterclockwise, while observing the trace.
5. If the trace moves vertically, adjust VR103 (STEP) for minimum or zero vertically movement when performing step 4.
6. Repeat the entire procedure for CH2, adjusting VR108 for variable balance and VR110 for step balance.
7. Repeat thru step 2 to step 6 so the trace does not sift if desire.

Position and CH2 INVERT Position Adjustments

1. Set CH1 AC-GND-DC switch to GND and MODE switch to DUAL.
2. Set CH1 and CH2 ▲▼ POSITION controls to these mechanical center.
3. Adjust VR104 and VR112 so the trace are overlapped in the center of the scale.
4. Next, adjust VR111 so the trace does not shift when the CH2 ▲▼ POSITION control is alternately pulled and pushed.

Vertical Gain Adjustment

1. Set both CH1 and CH2 AC-GND-DC switches to DC and SWEEP TIME/DIV control to 0.2 ms.
2. Set both CH1 and CH2 VOLTS/DIV controls to 5 mV (VARIABLE to CAL) and apply a 20 mVp-p, 1 kHz square wave signal to CH1 input.
3. Adjust VR107 for exactly 4 divisions vertical amplitude waveform.
4. Repeat the entire procedure for CH2, adjusting VR115 for vertical gain adjustment.
5. Next, apply 20 mVp-p, 1 kHz square wave to both CH1 and CH2 inputs and set MODE switch to ADD.
6. Apply 25 mV, 1 kHz square wave signal to both CH1 and CH2 inputs. Set MODE switch to ADD and pull the CH2 ▲▼ POSITION knob to INVERT position. Confirm that the amplitude observed on the screen is zero.

Vertical Gain Adjustment

1. Set MODE switch to CH1.
2. Connect CH1 input to CAL ⎍ 0.1 V terminal. (probe set for DIRECT measurement)
3. Set CH1 VARIABLE control to CAL and VOLTS/DIV control to 20 mV.
4. Adjust VR107 for exactly 5 divisions vertical amplitude of 1 kHz square wave signal display.
5. Repeat the entire procedure for CH2, adjusting VR115 for vertical gain adjustment.

100 kHz Square Wave Compensation

1. Rotate VOLTS/DIV control to 2 mV, MODE switch to CH2, SOURCE switch to CH2 and CH2 AC-GND-DC switch to AC.
2. Apply 100 kHz square wave signal through a 50 Ω terminator to CH2 input and adjust square wave generator for 6 divisions of 100 kHz signal on the screen.
3. Rotate SWEEP TIME/DIV control from 2 μs to 0.2 μs. Adjust TC704 (mid range) and VR703 (high range) for minimum overshoot (within 3%) and ringing (within 3%) at point ⓐ and ⓑ on waveform as shown in Fig.7.
4. Keeping the signal level constant, gradually decrease the input signal to 10 kHz. Amplitude should roll off gradually with no dip or peaks.

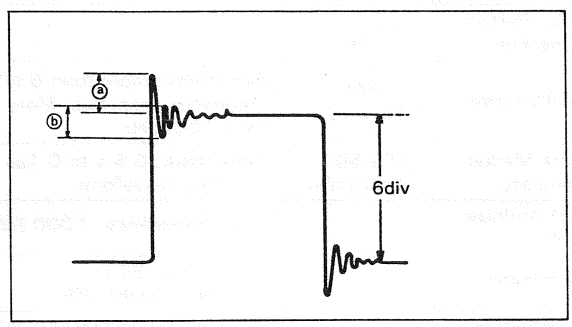


Fig. 7

ADJUSTMENT

1 kHz Square Wave Compensation

1. Set VOLTS/DIV control to 2 mV, MODE switch to CH1 and CH1 AC-GND-DC switch to DC.
2. Apply 1 kHz square wave signal to display 6 divisions vertical amplitude waveform on the screen.
3. Rotate VOLTS/DIV control to 20 mV (1/10), 0.2 V (1/100) and 2 V (1/1000) position.
4. Adjust TC104 (1/10), TC105 (1/100) and TC106 (1/1000) so the vertical amplitude is set to 6 divisions on the screen.
5. Repeat the entire procedure for CH2, adjusting TC110 (1/10), TC111 (1/100) and TC112 (1/1000).

Input Capacity Adjustment

1. Set CH1 VOLTS/DIV control to 2 mV and AC-GND-DC switch to DC.
2. Connect a "Q" meter to measure the input capacity at the CH1 input and make sure that the input capacity is 24 pF ±3 pF.
3. Rotate VOLTS/DIV control to 20 mV (1/10), 0.2 V (1/100) and 2 V (1/1000), adjusting TC101, TC102 and TC103 so the input capacity at each position is the same as that at the 2 mV (1/1) position.
4. Repeat the entire procedure for CH2, adjusting TC107, TC108 and TC109.

Frequency Response Adjustment

1. Set MODE switch to CH1 and CH1 AC-GND-DC switch to AC.
2. Set VOLTS/DIV control to 2 mV (VARIABLE to CAL) and apply 100 kHz square wave signal to CH1 input to display 6 divisions vertical amplitude waveform on the screen.
3. Adjust TC114 so the waveform quality is equal to 2 mV range when setting VOLTS/DIV control to 5 mV.
4. Next, rotate VOLTS/DIV control to 10 mV, adjusting TC113 for 10 mV range.
5. Repeat the entire procedure for CH2, adjusting TC 119 (5 mV range) and TC118 (10 mV range).

Frequency Response Check

1. Set MODE switch to CH2 and VOLTS/DIV control to 2 mV.
2. Apply 50 kHz sine wave signal to CH2 to display 6 divisions vertical amplitude waveform.
3. Keeping the signal level constant, gradually increase or decrease the frequency adjusting the frequency for 4.2 divisions amplitude. This range is −3 dB frequency response.
4 Check the frequency response of CH1 and CH2 at each attenuation range in the same way. If the frequency response is out of the standard, perform frequency response adjustment using 100 kHz square wave compensation again.

Triggering Amplitude Balance

1. Set SWEEP TIME/DIV control to 0.1 ms and TRIG SOURCE switch to CH2 and AC-GND-DC switch to GND.
2. Connect a DC voltmeter to measure the voltage at the TP2 and TP3 with respect to the chassis.
3. Adjust VR321 to obtain an equal voltage at the each point.

Triggering Level Adjustment

1. Rotate SWEEP TIME/DIV control to 0.1 ms and TRIG COUPLING switch to DC and MODE switch to DUAL.
2. Apply 1 kHz sine wave signal to both CH1 and CH2 inputs to display 6 divisions vertical amplitude waveform on the screen.
3. Adjust VR106 so the start points of waveforms are aligned on the screen.

DUAL-ADD and AC-DC Trig Level Adjustments

1. Set the control knob as follow.
   VOLTS/DIV; 0.1 V (both CH1 and CH2)
   AC-GND-DC; GND
   COUPLING; DC
   SWEEP TIME/DIV; 0.1 ms
2. With the traces of CH1 and CH2 overlapped, set MODE switch to ADD and DUAL alternately.
   Then, set it in such a position at which the traces do not shift on the Y axis. After setting, return MODE switch to DUAL
3. Next, set MODE switch to ADD and adjust VR308 to obtain 0 V at the test point (TP4). Then, set MODE switch to DUAL and adjust VR116 to obtain 0 V at the test point (TP4).
4. Recheck step 2 and step 3 for any interaction.

FIX Trig Level Adjustment

1. Set TRIG MODE switch to FIX and MODE to CH2 and the controls to display a optimum waveform on the screen.
2. Apply 1 kHz sine wave signal to CH2 input. Lower the SG output to locate a point at which the synchronization is disorder.
3. Adjust VR302 while further lowering the SG output to locate a point at which the signal is synchronized.
4. Recheck step 2 and step 3 for any interaction adjust VR302 to synchronize at minimum amplitude.
5. Check the triggering should be possible with any 50 Hz to 35 MHz signal.

Note:
Check the TRIG'D lamp for lighting before checking the synchronization sensitivity.

ADJUSTMENT

Horizontal Axis Circuit Adjustment

Sweep time and sweep length adjustments

1. Set MODE switch to CH1 and SWEEP TIME/DIV control to 1 ms.
2. Apply 1 ms marker signal to CH1 input.
3. Measuring the time period of the markers will assure calibration accuracy.
4 Adjust VR305 so that 11 visible markers occupy exactly 11 divisions of horizontal deflection as shown in Fig. 8.
5. Adjust VR304 for a total sweep length of 10 1/2 divisions.

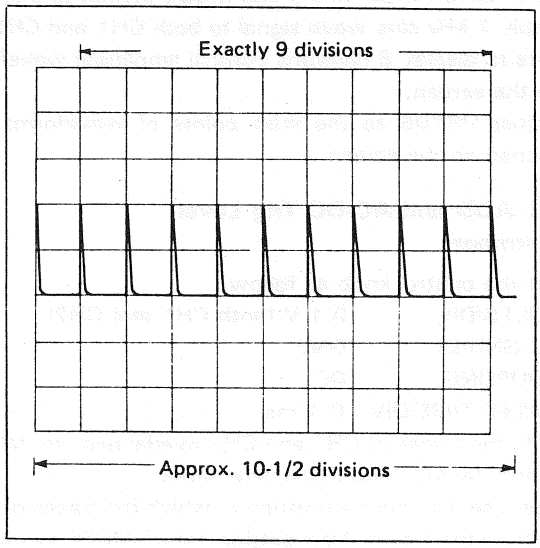


Fig. 8

Mag Centering and Mag Gain Adjustments

1. Set SWEEP TIME/DIV control to 1 ms and apply 1 ms marker signal to CH1 input to display 3 waves on the screen.
2. Pull ×5 MAG knob to magnify a trace and adjust VR310 so the center marker remains stationary whether the ×5 MAG knob is ON. Do not rotate the ◄► POSITION control.
3. Next, push ×5 MAG knob and adjust VR309 so that the 10 visible markers occupy exactly 10 divisions of horizontal deflection.
4. Recheck step 2. Repeat if required.

◄►H. POSITION Adjustment

1. Set ◄► POSITION control at its mechanical center.
2. Rotate SWEEP TIME/DIV control to 0.2 ms and apply 1 ms marker signal to CH1 input to display 3 waves on the screen.
3. Adjust VR306 so the center marker remains stationary.

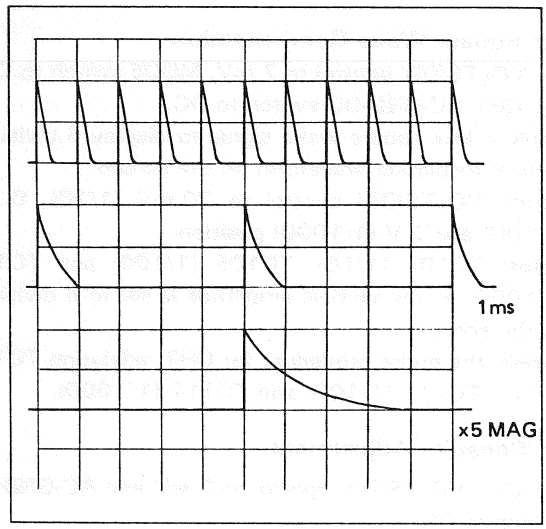


Fig. 9

20 μs 0.5 μs, 0.2 μs and 0.1 μs Ranges Adjustments

1. Rotate SWEEP TIME/DIV control to 20 μs, 0.5 μs, 0.2 μs and 0.1 μs gradually while appling the equal marker signal to CH1 input.
2. Adjust the following adjuster to duplicate the conditions shown in Fig. 8.

SWEEP TIME/DIV	Marker	Adj.
20 μs	20 μs	TC302
0.5 μs	0.5 μs	VR311
0.2 μs	0.2 μs	VR312
0.1 μs	0.1 μs	VR313

X Gain and Position Adjustments

1. Rotate VOLTS/DIV control to 5 mV and set CH2 AC-GND-DC switch to AC.
2. Set MODE switch to X-Y. Apply a calibrated 1 kHz 25 Vp-p sine or square wave signal to CH2 input.
3. Adjust VR114 for exactly 5 divisions horizontal deflection between the 2 spots on the screen.
4. Next, rotate both CH1 and CH2 VOLTS/DIV controls to 0.1 V and set both CH1 and CH2 AC-GND-DC switches to GND. Set SOURCE switch to CH1.
5. With ◄► POSITION control to its mechanical center and adjust VR306 to center the 2 traces vertically.
6. Next, set MODE switch to X-Y to display a spot on the screen.
7. Adjust VR307 to center the spot horizontally on the screen.

ADJUSTMENT

Calibration Voltage Adjustments

1. Connect CAL 1 kHz ⎍ 0.1 Vp-p signal to well-calibrated oscilloscope (VOLTS/DIV to 20 mV and SWEEP TIME/DIV to 0.1 ms) to display one cycle of square wave.
2. Adjust VR117 (CAL amplitude) for 5 divisions amplitude and VR118 and VR119 so the square wave is symmetrical; that is, so that positive and negative portions of the trace are equal in length.

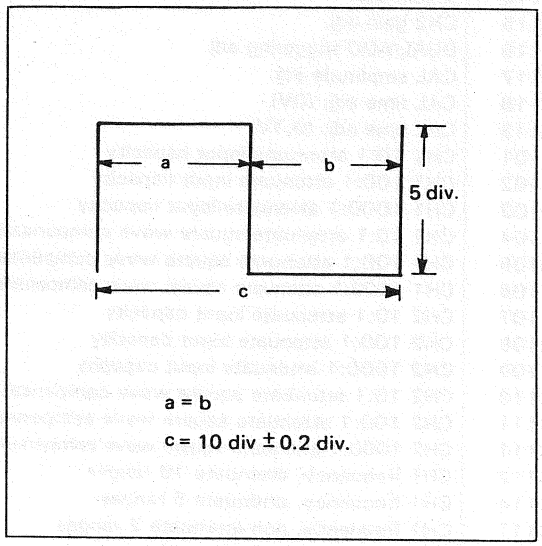


Fig. 10

PERFORMANCE TESTS

After calibration adjustments are completed, the following tests will check non-adjustable circuits to confirm that oscilloscope operation meets all specifications.
If unsatisfactory perfomance is indicated, service and repair is required.

Frequency Response Check

1. Switch setting
   CH1, CH2: AC-GND-DC; DC
   CH1, CH2: VOLTS/DIV; 2 mV
2. Apply 50 kHz sine wave signal to the CH2 input and adjust its level to display 6 divisions vertical amplitude waveform. Keeping the signal level, gradually vary the frequency to 35 MHz. The amplitude should be more than 4.25 divisions.
3. Again vary the frequency from 50 kHz to 35 MHz and check that the amplitude on the screen decreases smoothly and there is no peak or dip.
4. Perform the same checks for CH1. Perform the same checks for all ATT ranges.

Synchronization Check

1. Check that the TRIG'D lamp lights, then check synchronization circuit sensitivity according to the tables below.
   TRIG MODE in SINGLE or NORM

Coupling	Band width (Hz)	Minimum sync. voltage		
		INT (div)	EXT1/10 (Vp-p)	EXT1 (Vp-p)
AC	50~15M	0.5	3	0.3
	10~40M	0.8	3	0.3
VIDEO	VIDEO signal	1	5	0.5
DC	DC~15M	0.5	3	0.3
	DC~40M	0.8	3	0.3

HF REJ: Attenuate above 100 kHz
LF REJ: Attenuate below 10 kHz

TRIG, MODE (Sync method)	Band width (Hz)	Minimum sync. voltage		
		INT (div)	EXT1/10 (Vp-p)	EXT1 (Vp-p)
AUTO	100~15M	0.5	3	0.3
	50~40M	0.8	3	0.3
FIX	100~15M	0.5	3	0.3
	50~40M	0.8	3	0.3

Frequency Response Check

1. Switch setting
   V. MODE; X-Y
   CH1, AC-GND-DC; GND
   CH2, AC-GND-DC; DC
   CH2, VOLTS/DIV; 5 mV
2. Apply 1 kHz sine wave signal to the CH2 input and adjust its level to display 10 divisions vertical amplitude waveform. Keeping the signal level, gradually vary the frequency from DC to 2 MHz. The amplitude should be more than 7.1 divisions (−3 dB). Check that the variation of the amplitude is smooth.

Intensity Modulation Check

1. Switch setting
   VOLTS/DIV; 1 V
   SWEEP TIME/DIV; 5 μs
2. Apply 500 kHz sine wave signal to the CH1 input and adjust its level to display 5 divisions vertical amplitude waveform.
3. Then, apply 2.5 Vp-p, 5 MHz square wave signal to the Z input on the rear panel and check that parts of the waveform on the screen become brighter. In this case, the vertical input signal and the intensity modulation signal must be synchronized and the frequency of the latter must be an integral multiple of that of the former.

ADJUSTMENT

HOLD-OFF Operation Check

1. Switch setting
   V. MODE; CH1 or CH2
   SWEEP TIME/DIV; 0.1 μs
2. Apply the collector signal of Q319 in the horizontal unit to a precisely calibrated oscilloscope via a 1/10 probe. Set the sweep time of the oscilloscope to 2 μs/div and adjust its variable knob so that the HOLDOFF time displayed on the oscilloscope screen becomes 1 division. Then, rotate the HOLDOFF knob of the CS-1577A to full clockwise. The HOLDOFF time displayed on the oscilloscope screen should be more than 10 division.

X-Y Phase Check

1. Switch setting
   CH1, CH2: VOLTS/DIV; 2 mV
   V. MODE; X-Y
   CH1, CH2: AC-GND-DC; AC
2. Apply 100 kHz sine wave signal to both CH1 and CH2 input terminals simultaneously and adjust its level to display 8 divisions both vertical and horizontal amplitude Lissajous waveform. Then, check the phase difference as shown in Fig. 11. The phase difference must be 3° or less.

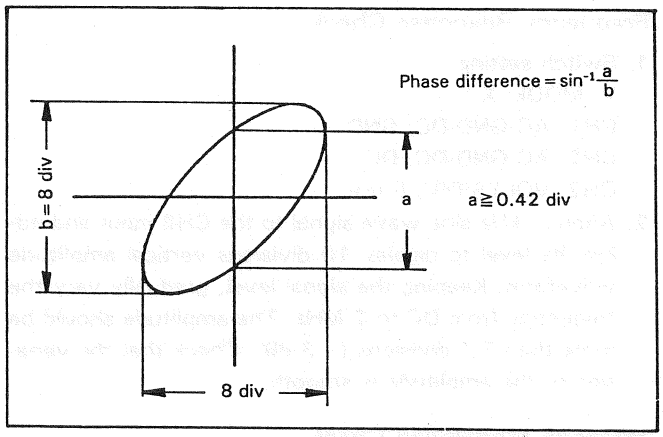


Fig. 11 Phase Difference Check

Function of Adjustments in Each Unit

Vertical amplifier unit (X73-1340-00)

VR101	CH1 VARI. ATT. BAL. adj.
VR103	CH1 STEP ATT. BAL adj.
VR104	CH1 ▲▼ position adj.
VR106	CH1-CH2 triggering adj.
VR107	CH1 gain adj.
VR108	CH2 VARI. ATT. BAL adj.
VR110	CH2 STEP ATT. BAL adj.
VR111	CH2 INV. position adj.
VR112	CH2 NORM. position adj.
VR114	X gain adj.
VR115	CH2 gain adj.
VR116	DUAL/ADD triggering adj.
VR117	CAL amplitude adj.
VR118	CAL time adj. (0V)
VR119	CAL time adj. (0.1V)
TC101	CH1 10:1 attenuate input capacity
TC102	CH1 100:1 attenuate input capacity
TC103	CH1 1000:1 attenuate input capacity
TC104	CH1 10:1 attenuate square wave compensation
TC105	CH1 100:1 attenuate square wave compensation
TC106	CH1 1000:1 attenuate square wave compensation
TC107	CH2 10:1 attenuate input capacity
TC108	CH2 100:1 attenuate input capacity
TC109	CH2 1000:1 attenuate input capacity
TC110	CH2 10:1 attenuate square wave compensation
TC111	CH2 100:1 attenuate square wave compensation
TC112	CH2 1000:1 attenuate square wave compensation
TC113	CH1 frequency, attenuate 10 ranges
TC114	CH1 frequency, attenuate 5 ranges
TC117	CH1 frequency, non-attenuate 2 ranges
TC118	CH2 frequency, attenuate 10 ranges
TC119	CH2 frequency, attenuate 5 ranges

Horizontal sweep amplifier (X74-1150-00)

VR302	FIX triggering level adj.
VR304	Sweep length adj.
VR305	Sweep width adj.
VR306	Horizontal position adj.
VR307	X position adj.
VR308	AC/DC triggering level adj.
VR309	MAG centering adj.
VR310	MAG gain adj.
VR311	0.5μs sweep time adj.
VR312	0.2μs sweep time adj.
VR313	0.1μs sweep time adj.
VR321	Trigger amplitude balance
TC302	1 ~ 50 μs sweep time adj.

Vertical final amplifier unit (X73-1270-01)

VR701	Vetical final amplitude
VR702	CRT centering adj.
VR703	High frequency overshoot adj.
TC702	High frequency overshoot adj.
TC703	High frequency overshoot adj.
TC704	Mid frequency overshoot adj.

ADJUSTMENT

Low voltage power supply unit (X68-1230-02)

VR501	+130V adj.

High voltage power supply unit (X68-1240-01)

VR601	−1.5kV adj.
VR602	Intensity adj.
TC601	Blanking adj.

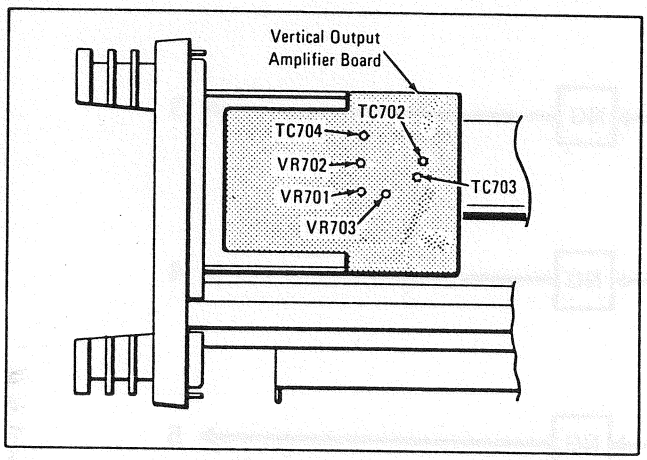


Fig. 12 Location of adjustments, left side of scope

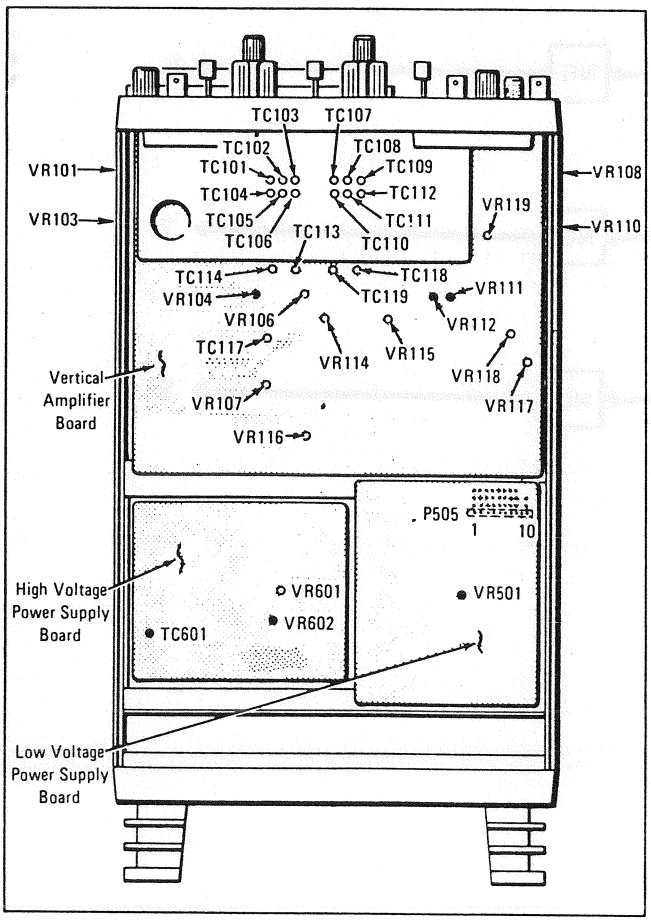


Fig. 13 Location of adjustments, bottom of scope

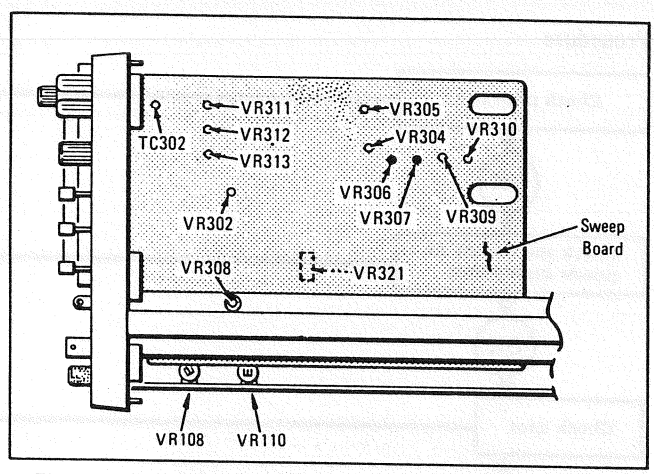
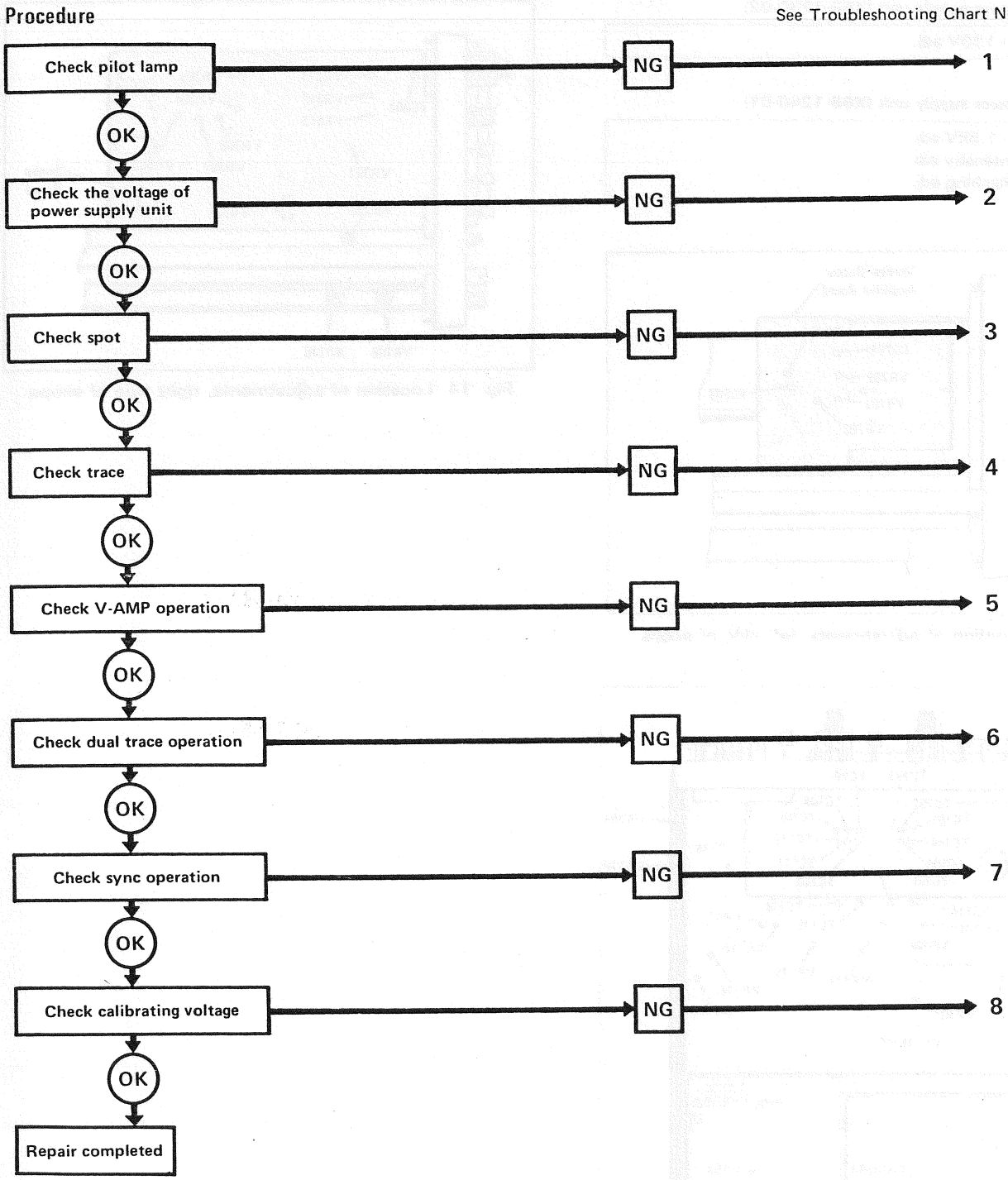


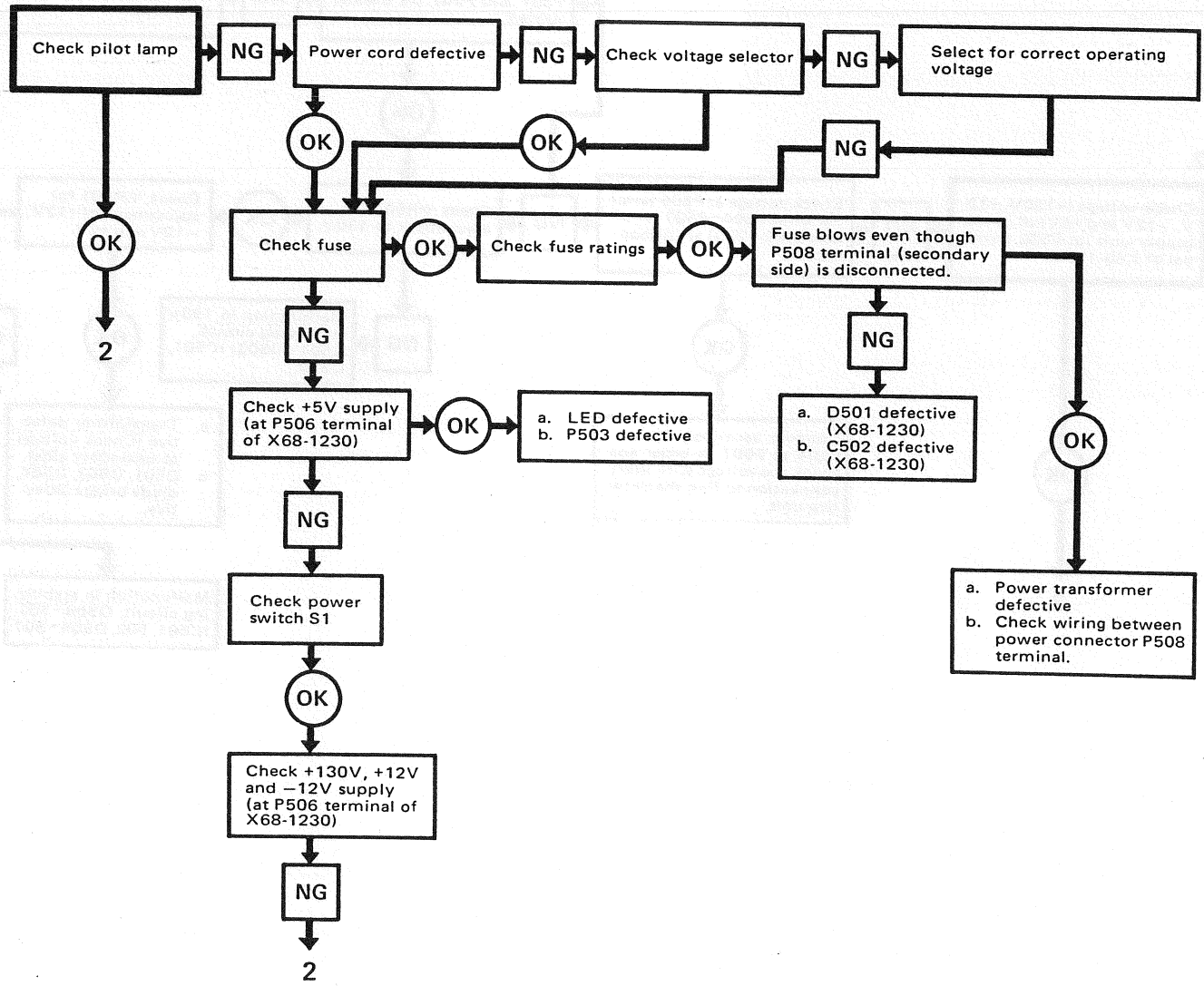
Fig. 14 Location of adjustments, right side of scope

TROUBLESHOOTING



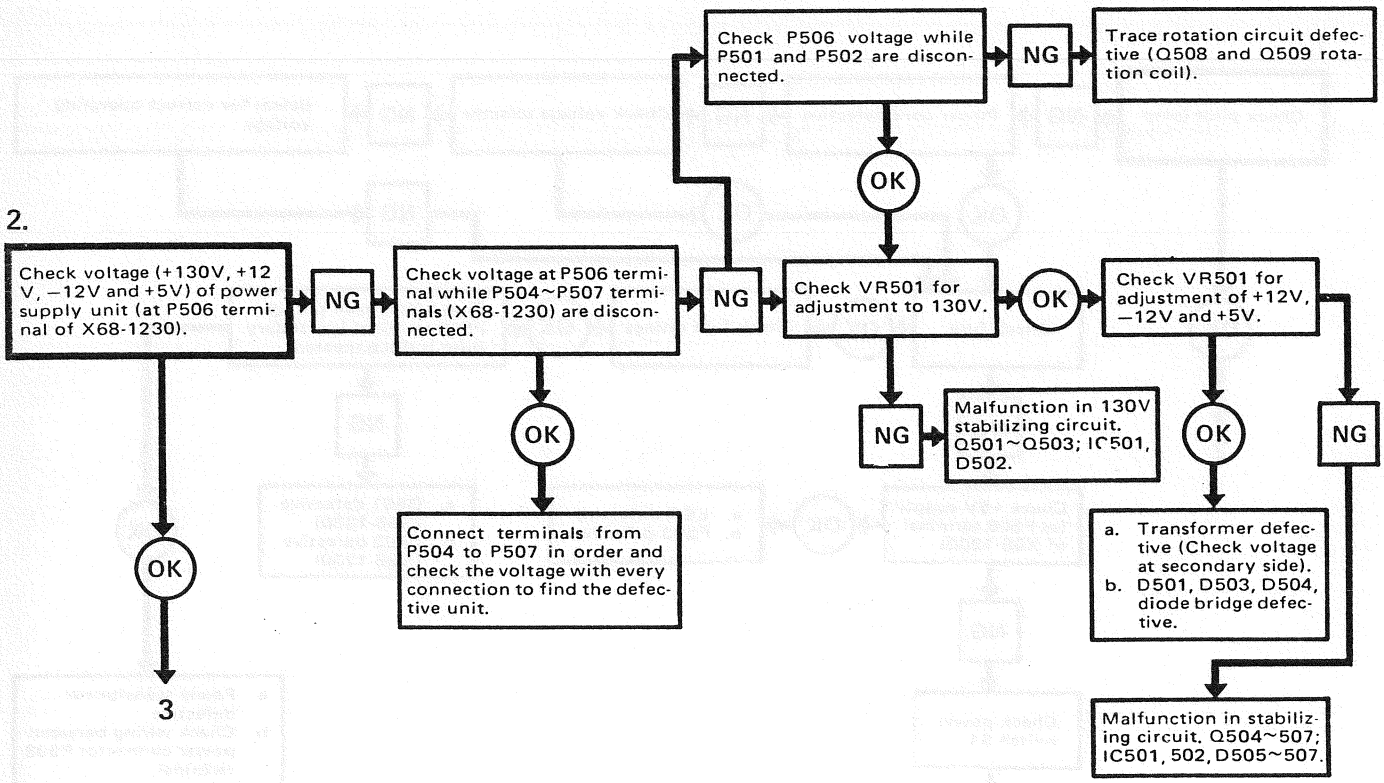
TROUBLESHOOTING

1.



TROUBLESHOOTING

2.



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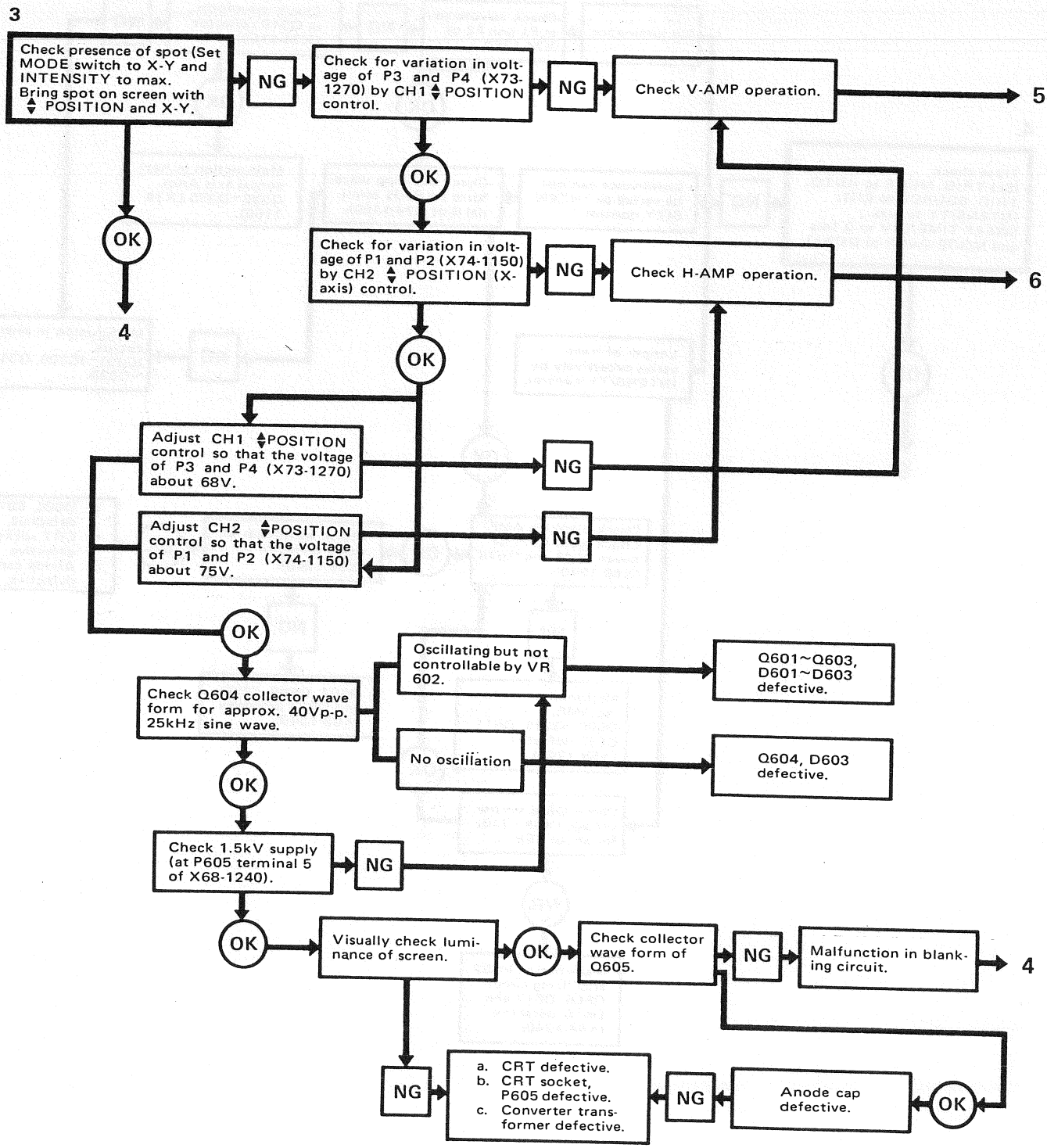
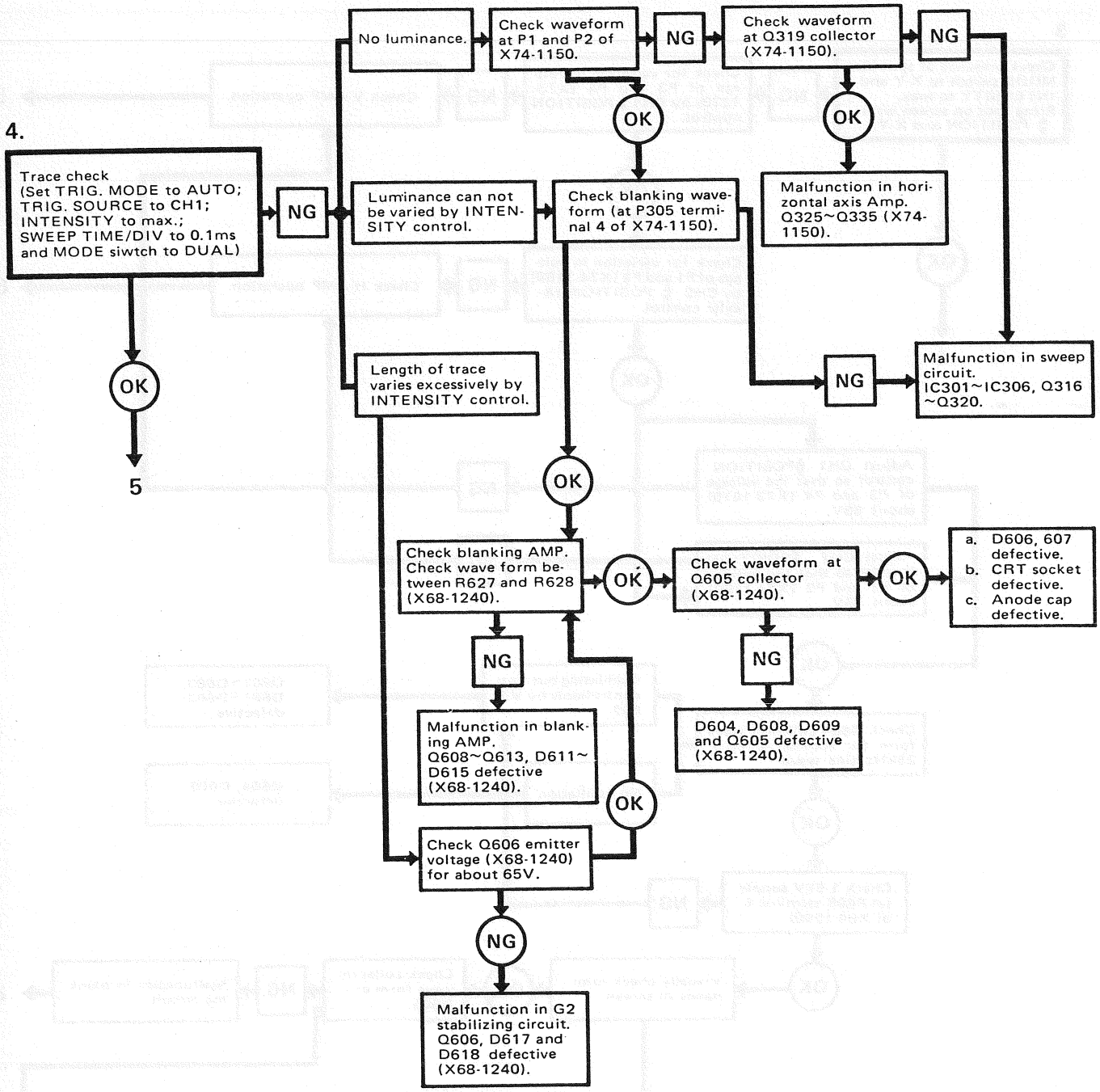
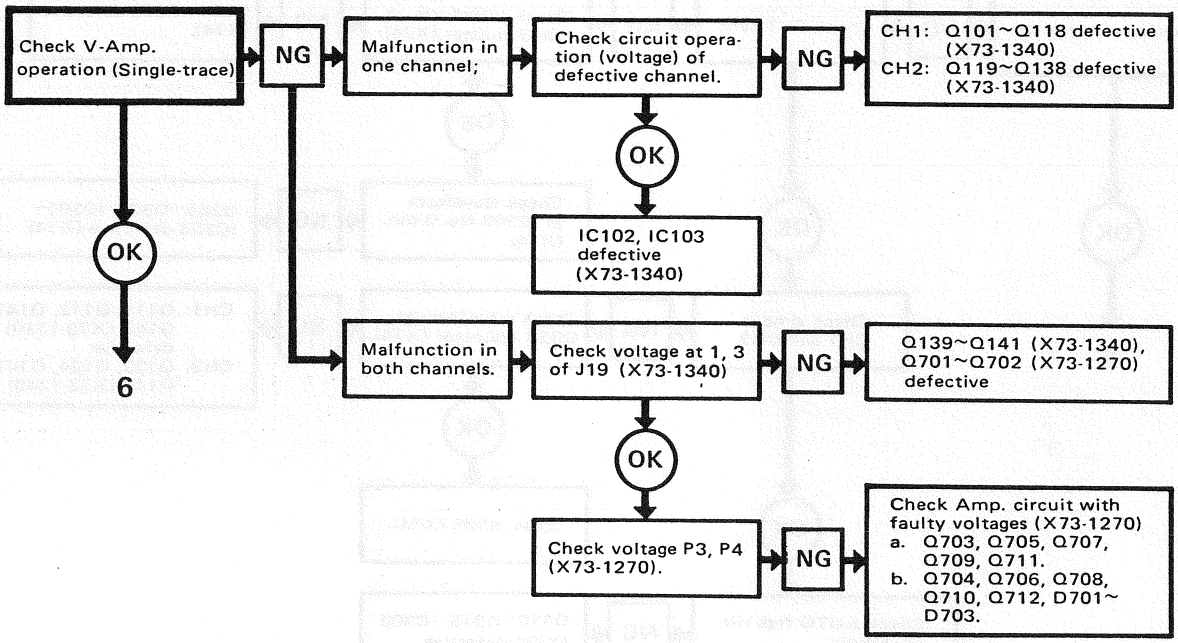


TROUBLESHOOTING



TROUBLESHOOTING

5.



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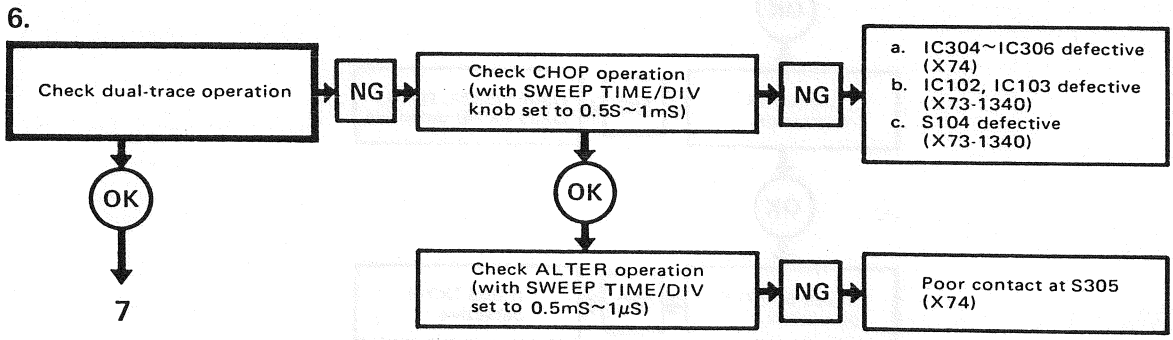
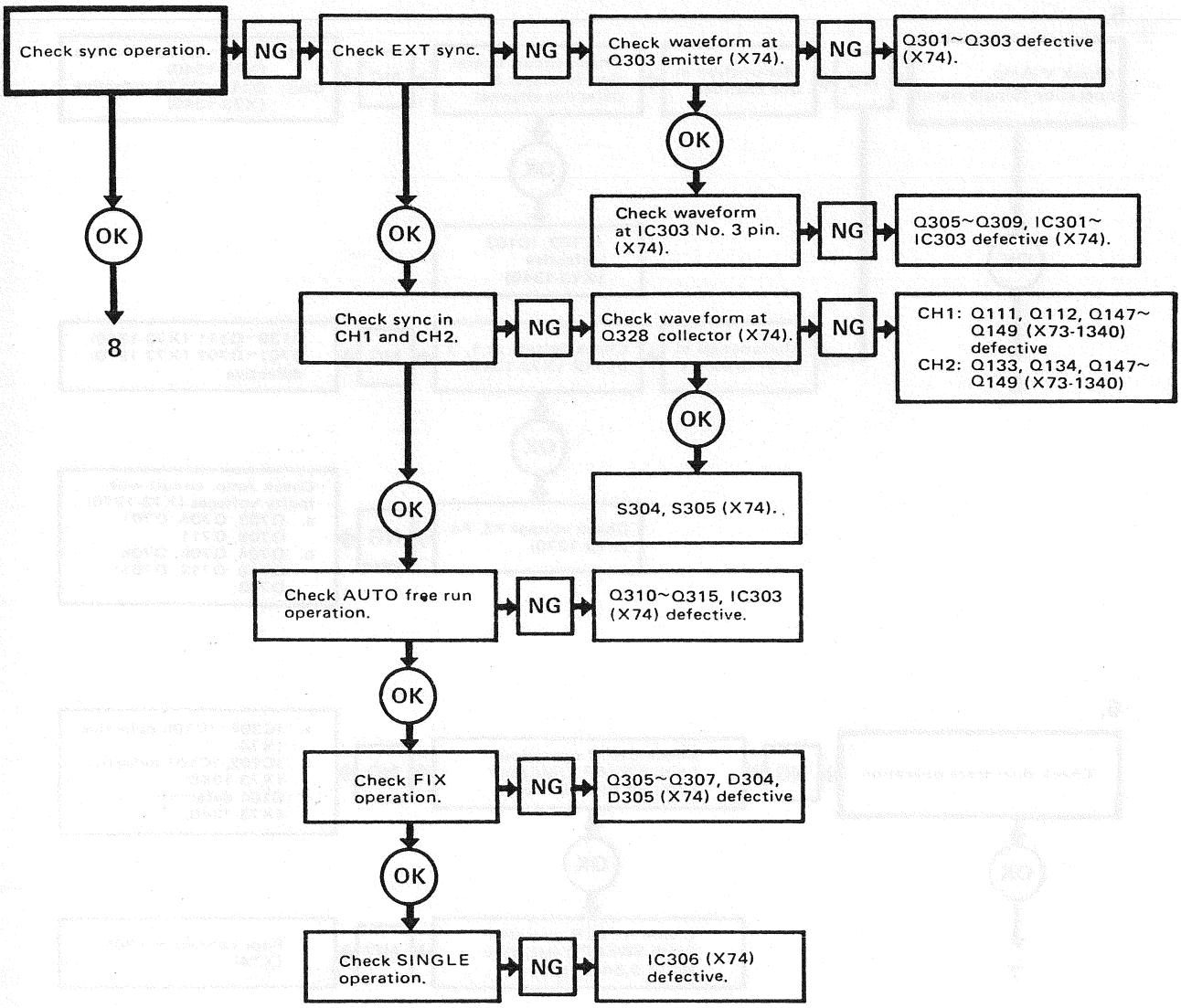


TROUBLESHOOTING

7.



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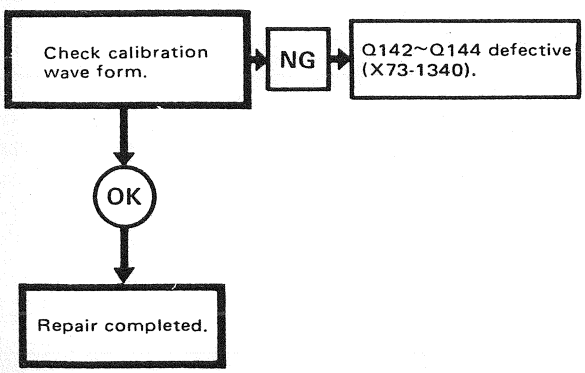
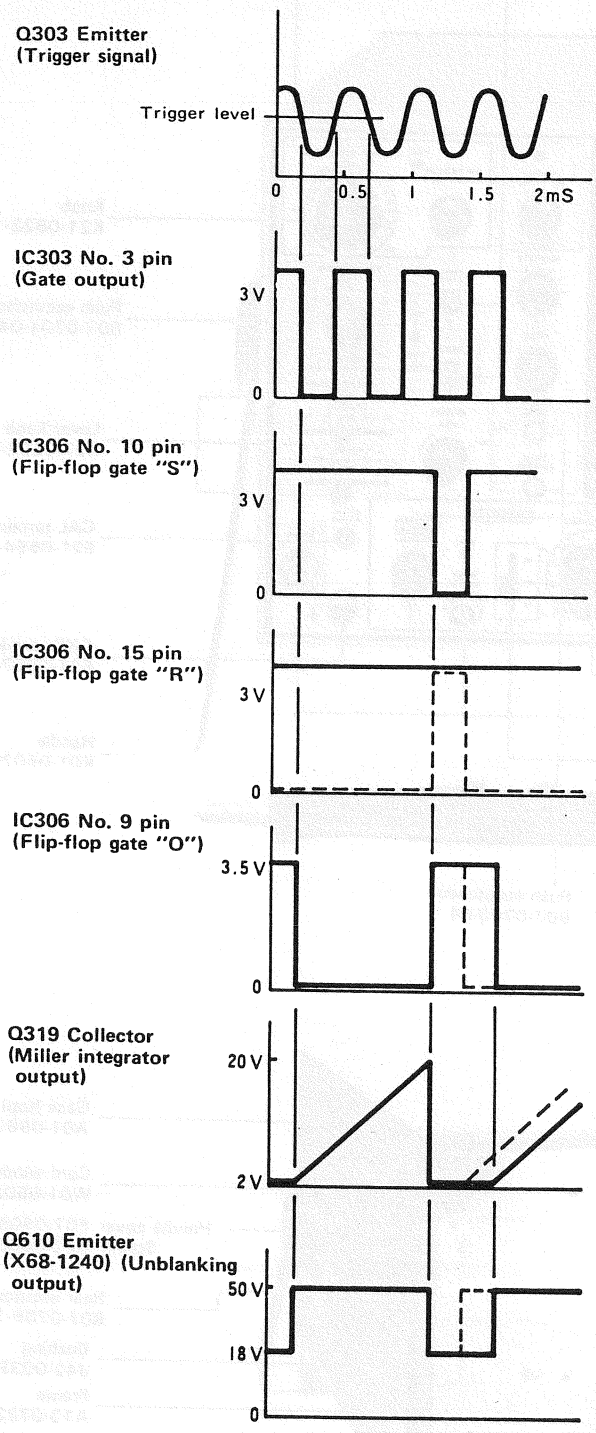


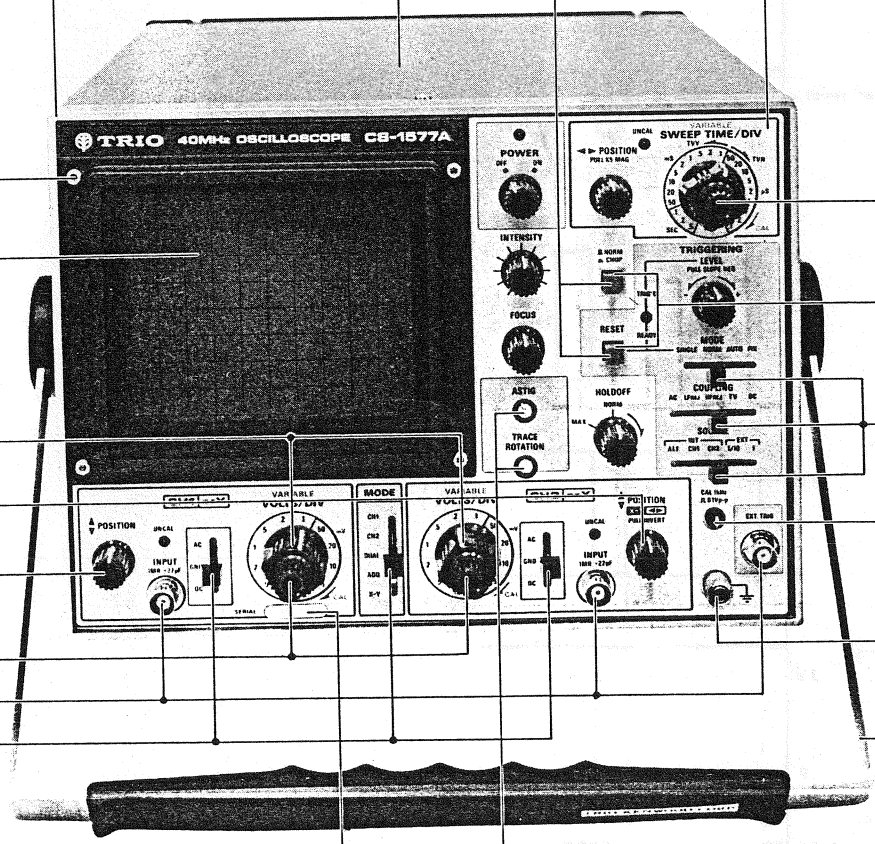
Fig. 15 SWEEP Circuit Waveform (X74-1150-00) (Input Signal 2kHz Sine Wave, SWEEP TIME 0.1mS/div)



(Dashed lines indicate free running sweep)

EXTERNAL VIEW

FRONT PANEL



Die-casting panel
A20-2732-22

Case (top)
A01-0867-13

Push knob
K27-0503-04

Decorative panel
A21-0875-02

Hex socket head screw
N08-0606-05

Bezel ass'y
J10-0077-13
Filter
B19-0708-04

Knob
K21-0819-03

Knob
K21-0820-04

Knob
K21-0821-14

BNC jack
E04-0251-05

Lever knob
K27-0501-04

Knob
K21-0822-14

Push escutcheon
B07-0704-04

Lever knob
K27-0502-04

CAL terminal
E21-0554-04

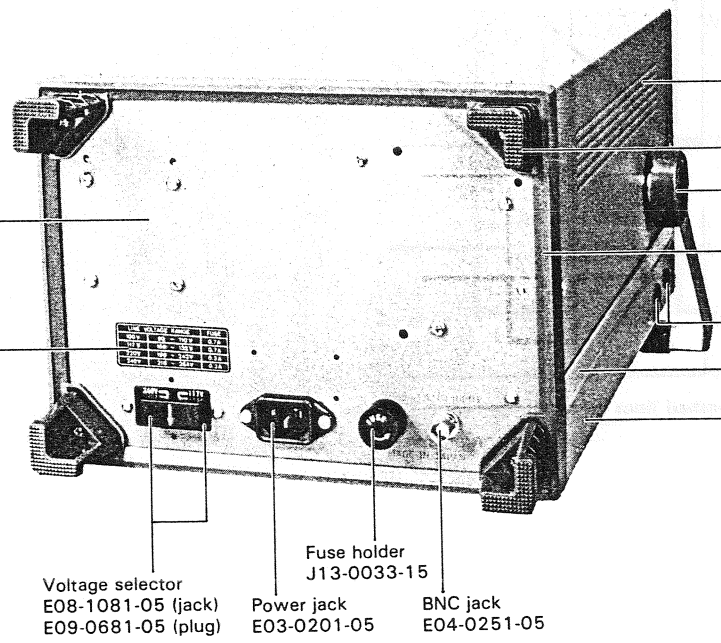
GND terminal
E21-0657-04

Handle
K01-0507-05

Name plate (serial no.)
B40-0765-14

Push escutcheon
B07-0703-04

REAR PANEL



Case (top)
A01-0867-13

Cord winder
W01-0503-04

Handle cover F07-0908-14
Spring G02-0603-14

Rear escutcheon
B07-0705-12

Bushing
J42-0038-04

Frame
A13-0722-13

Case (bottom)
A01-0830-13

Rear panel
A23-1621-22

Voltage indicating plate
B41-0719-04

Voltage selector
E08-1081-05 (jack)
E09-0681-05 (plug)

Power jack
E03-0201-05

Fuse holder
J13-0033-15

BNC jack
E04-0251-05

PARTS LIST

TOTAL

Ref. No.	Parts No.	Description
	A01-0867-13	Case (Top)
	A01-0830-13	Case (Bottom)
	A10-1425-02	Chassis
	A13-0722-13	Frame × 2
	A20-2732-22	Die-casting panel
	A21-0875-02	Decorative panel
	A23-1621-22	Rear panel
	B07-0703-04	Push escutcheon × 2 (round type)
	B07-0704-04	Push escutcheon × 2 (rectangular type)
	B07-0705-12	Rear escutcheon
	B19-0708-04	Filter
	B30-0923-05	Lamp ass'y
	B30-0903-15	LED
	B30-0910-25	Lamp mounting (TRIG'D)
	B40-0765-14	Name plate (serial no.)
	B41-0719-04	Voltage indicating plate
	B50-2916-00	Instruction manual (M)
	E01-1403-05	CRT socket
	E03-0201-05	Power jack
	E04-0251-05	BNC jack × 2
	E08-1081-05	Voltage selector jack
	E09-0681-05	Voltage selector plug
	E21-0654-04	CAL terminal
	E21-0657-04	GND terminal
	E23-0015-04	Grounding plate × 2
	E23-0513-05	Earth lug × 2
	E29-0504-05	Teflon terminal × 4
	E30-0554-15	Lead wire with connector
	E30-1818-05	JIS cord
J21	E31-0656-05	Lead wire with connector (for VOLT selector-power jack)
J15	E31-0564-05	Lead wire with connector (for power jack earth)
J10	E31-0526-05	Lead wire with connector (for CAL out)
J3	E31-0579-05	Lead wire with connector (for FOCUS ASTIG)
J12	E31-0580-05	Lead wire with connector (for H. POS)
J11	E31-0581-05	Lead wire with connector (for EXT TRIG)
J6	E31-0582-05	Lead wire with connector (for blanking)
—	E31-0532-05	Lead wire with connector (for power jack)
J22	E31-0657-15	Lead wire with connector (for H. amp—power)
J20	E31-0654-15	Lead wire with connector (for V. final amp—low volt)
J5	E31-0584-15	Lead wire with connector (for Z input)
J9	E31-0587-15	Lead wire with connector (for X5. H. POS)
J2	E31-0588-15	Lead wire with connector (for hi. volt—low volt)
J7	E31-0592-05	Lead wire with connector (for rotation VR)
J18	E31-0593-05	Lead wire with connector (for delay line)
J19	E31-0653-05	Lead wire with connector (for pre amp—delay line)
J17	E31-0533-05	Lead wire with connector (for CRT shield)
—	E31-0713-15	Lead wire with connector (for L39-0509-15)
J4	E31-0726-05)	Lead wire with connector (for CRT socket)
J13	E31-0727-15	Lead wire with connector (for H. out)
J14	E31-0728-05	Lead wire with connector (for V. out)
	F05-8015-05	Fuse 0.8A
	F05-5013-05	Fuse 0.5A
	F07-0908-14	Handle cover × 2
	F10-1525-24	Bezel shield
	F10-1528-13	Shield plate
	F10-1529-24	Shield plate
	F11-0942-03	CRT shield
	F11-0932-03	Shield case
	F15-0710-14	Felt
	F15-0713-14	Felt
	F19-0125-14	Scotical sheet
	G02-0603-14	Spring (Handle) × 2
	G13-0705-04	CRT mounting rubber × 2
	H01-2910-14	Packing case
	H10-2807-02	Pad (foamed styrene)
	H12-0522-04	Pad (carton)
	H20-1701-24	Protective cover
	H25-0029-04	Polyethylene bag
	J02-0089-05	Rubber leg × 4
	J10-0077-13	Bezel ass'y
	J10-0072-02	Bezel
	J13-0033-15	Fuse holder
	J19-1622-05	Cord keeper
	J19-1618-04	CRT band
	J19-1619-04	CRT band
	J21-2867-04	Bracket (for VR)
	J21-2868-04	Bracket (for SW)
	J21-2871-04	Bracket (for delay line)
	J21-2875-15	Bracket (for handle)
	J21-2876-05	Bracket (for handle)
	J21-2899-13	Bracket (for CRT)
	J42-0038-04	Bushing × 4
	J42-0510-04	Bushing
	J61-0049-05	Cable band × 8
	K01-0507-05	Handle
	K21-0819-03	Knob ϕ23 × 3
	K21-0820-04	Knob ϕ15 × 8
	K21-0821-14	Knob ϕ13 × 2 (red)
	K21-0822-14	Knob ϕ13 (red)
	K27-0501-04	Lever knob × 3 (black)
	K27-0502-04	Lever knob × 3 (gray)
	K27-0503-04	Push knob × 3 (blue)
		CRT 140CGB31
	L01-9146-05	Power transformer
	L39-0509-05	Rotator coil
	L76-0104-05	Delay line
	L40-3991-41	Ferri-inductor 1μH
	RD14BB2E151J	Carbon resistor 150Ω ±5% 1/4W
VR1	R03-1502-05	Variable resistor (S1) 1kΩC
VR2	R01-1011-05	Variable resistor (INTEN) 1kΩB
VR3	R01-3027-05	Variable resistor (ROTATION) 10kΩB
VR4	R01-0508-05	Variable resistor (H. POS) 500ΩB
VR5	R01-3503-05	Variable resistor (HOLDOFF) 10kΩB
VR6	R05-8001-05	Variable resistor (FOCUS) 3MΩB
VR7	R01-6011-05	Variable resistor (ASTIG) 250kΩB
C1	CK45D1H103M	Ceramic capacitor 0.01μF ±20%
S1	S59-2502-05	Power switch
S2	S42-2505-05	Push switch

PARTS LIST

Ref. No.	Parts No.	Description
	N08-0606-05	Hex socket head screw × 4
	W01-0503-04	Cord winder × 4
	X68-1230-02	Low voltage power supply unit
	X68-1240-01	High voltage power supply unit
	X73-1340-00	Vertical amplifier unit
	X73-1270-01	Vertical final amplifier unit
	X74-1150-00	Horizontal sweep amplifier unit
	X77-1020-00	Voltage selector unit

LOW VOLTAGE POWER SUPPLY UNIT (X68-1230-02)

Ref. No.	Parts No.	Description			
		RESISTOR			
R501	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R502	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R503	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R504	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R505	RD14BY2H100J	Carbon	10Ω	±5%	1/2W
R506	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R507	RD14BB2E124J	Carbon	120kΩ	±5%	1/4W
R508	RN14BK2E1303F	Metal film	130kΩ	±1%	1/4W
R509	RN14BK2E1202F	Metal film	12kΩ	±1%	1/4W
R510	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R511	RN14BK2E5101F	Metal film	5.1kΩ	±1%	1/4W
R512	RN14BK2E1202F	Metal film	12kΩ	±1%	1/4W
R513	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R514	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R515	RN14BK2E1102F	Metal film	11kΩ	±1%	1/4W
R516	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R517,518	RN14BK2E1202F	Metal film	12kΩ	±1%	1/4W
R519	RD14BB2E182J	Carbon	1.8kΩ	±5%	1/4W
VR501	R12-1033-05	Semi-fixed resistor	2.2kΩ		
		CAPACITOR			
C501	CE04W2E221	Electrolytic	220μF	250WV	
C502	CE04W2E4R7	Electrolytic	4.7μF	250WV	
C503	CE04W2C100	Electrolytic	10μF	160WV	
C504	CE04W1C472	Electrolytic	4700μF	16WV	
C505	CE04W1A331	Electrolytic	330μF	10WV	
C506	CE04W1E222	Electrolytic	2200μF	25WV	
C507	CE04W1E100	Electrolytic	10μF	25WV	
C508	CE04W1C221	Electrolytic	220μF	16WV	
C509	CE04W1E222	Electrolytic	2200μF	25WV	
C510	CE04W1C221	Electrolytic	220μF	16WV	
☆C511	C90-0298-05	Semiconductor ceramic	0.1μF	+80% −20%	
		SEMICONDUCTOR			
Q501,502		Transistor	2SC1505		
Q503		Transistor	2SC945(P)		
Q504		Transistor	2SA913		
Q506		Transistor	2SC1913(Q,R)		
Q507		Transistor	2SA913		
Q508		Transistor	2SA684 or 2SA773		
Q509		Transistor	2SC1384 or 2SC1475		
IC501,502		IC	NJM4558D		
D501		Bridge rectifier	SIQB60		
D502		Diode	1S1555		
D503,504		Bridge rectifier	S2VB40		
D505		Diode	1S1555		
D506		Zener diode	WZ-120		
D507~509		Diode	1S1555		
		MISCELLANEOUS			
P501	E40-0267-05	Connector 2P			
P502	E40-0367-05	Connector 3P			
P503	E40-0967-05	Connector 9P			
P504	E40-0867-05	Connector 8P			
P505	E40-1067-05	Connector 10P			
P506,507	E40-0964-05	Connector 9P			
P508	E40-0803-05	Connector 8P			
	E23-0047-04	Terminal			
	F01-0816-14	Heat sink			
	F01-0820-14	Heat sink			
	J25-2848-13	Printed circuit board			
	R92-0150-05	Jumper wire (resistor type) × 13			

HIGH VOLTAGE POWER SUPPLY UNIT (X68-1240-01)

Ref. No.	Parts No.	Description			
		RESISTOR			
R601	RN14BK2E1003F	Metal film	100kΩ	±1%	1/4W
R602,603	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R604	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R605	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R606	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R607	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R608	RD14BB2E183J	Carbon	18kΩ	±5%	1/4W
R609	R92-0756-05	Metal glaze film	47MΩ		1/2W
R610	R92-0761-05	Metal glaze film	2.7MΩ		1/2W
R611	R92-0707-05	Metal glaze film	8.2MΩ		1W
R612	RD14BB2E184J	Carbon	180kΩ	±5%	1/4W
R613	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R614	RD14BB2E333J	Carbon	33kΩ	±5%	1/4W
R615,616	RD14CB2E563J	Carbon	56kΩ	±5%	1/4W
R617	RD14BB2E563J	Carbon	56KΩ	±5%	1/4W
R618	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R619	RD14BB2E272J	Carbon	2.7kΩ	±5%	1/4W
R620	RD14CB2E123J	Carbon	12kΩ	±5%	1/4W
R621	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R622	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R623	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R624	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R625	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R626	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R627	RD14CB2E470J	Carbon	47Ω	±5%	1/4W
R628	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R629	RS14GB3D223J	Metal film	22kΩ	±5%	2W
R630	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R631	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R632	RD14CB2E331J	Carbon	330Ω	±5%	1/4W
R633	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R634	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
VR601	R12-3502-05	Semi-fixed resistor	33kΩB		
VR602	R12-4502-05	Semi-fixed resistor	68kΩB		
		CAPACITOR			
C601	C91-0033-05	Metalized polyester film	1μF	100WV	
C602	CQ93M1H103K	Mylar	0.01μF	±10%	
C603,604	CE04W1H471	Electrolytic	470μF	50WV	
C605,606	C91-0526-05	Metalized polypropylen film	0.01μF	1.2kWV	
C607,608	CK45E3D103P	Ceramic	0.01μF	+100%, −0%	
C609	CK45E3D102P	Ceramic	1000pF	+100%, −0%	
C610	CE04W2E010	Electrolytic	1μF	250WV	
C612	CC45CH2H010C	Ceramic	1pF	±0.25pF	
C613	CC45SL2H101J	Ceramic	100pF	±0.25pF	
C614	CK45D1H103M	Ceramic	0.01μF	±0.25pF	
C615	CE04W1A221	Electrolytic	220μF	10WV	
C616	CK45D1H103M	Ceramic	0.01μF	±20%	
C617~619	CK45D2H103M	Ceramic	0.01μF	±20%	
C620	CE04W2C100	Electrolytic	10μF	160WV	

PARTS LIST

Ref. No.	Parts No.	Description
C621	CK45D2H103M	Ceramic 0.01μF ±20%
C622	CC45CH2H100D	Ceramic 10pF ±0.5pF
TC601	C05-0405-05	Ceramic trimmer 20pF
	SEMICONDUCTOR	
Q601,602		Transistor 2SC945 (P)
Q603		Transistor 2SA733 (Q)
Q604		Transistor 2SD401A (K)
Q605		Transistor 2SC983 (Y)
Q606		Transistor 2SC1505
Q607		Transistor 2SC1047 (C)
Q608		Transistor 2SC1973
Q609		Transistor 2SC1953 (R)
Q610		Transistor 2SA914 (R)
Q611		Transistor 2SC1953 (R)
Q612		Transistor 2SA914 (R)
Q613		Transistor 2SC1973
D601~604		Diode 1S1555
D605		Diode Y16JA
D606,607		Diode W06C
D608,609		Diode 1SS83
D610		Diode 1S1555
D611,612		Diode 1S1587
D613,614		Diode 1S1555
D615		Zener diode WZ-061
D616	W02-0403-05	High voltage rectifier MSL-2535A
D617,618		Diode W06C
	MISCELLANEOUS	
P601,602	E40-0269-05	Connector 2P
P603	E40-1069-05	Connector 10P
P604,605	E40-1269-05	Connector 12P
	F01-0813-05	Heat sink
	F01-0820-04	Heat sink × 2
	J25-2849-13	Printed circuit board
L601	L40-1025-03	Ferri-inductor 1mH
T601	L19-0405-05	Converter transformer
NL601,602		Neon lamp NE-2
	R92-0150-05	Jumper wire (resistor type) × 12

VERTICAL AMPLIFIER UNIT (X73-1340-00)

Ref. No.	Parts No.	Description
	RESISTOR	
R101	RD14BB2E470J	Carbon (with S101) 47Ω ±5% 1/4W
R102	RC05GF2H105J	Solid (with S101) 1MΩ ±5% 1/2W
☆R105	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R106,107	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R108~110	RD14CB2E220J	Carbon 22Ω ±5% 1/4W
R111	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R112,113	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R114	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R116	RN14BK2E1800F	Metal film 180Ω ±1% 1/4W
R117	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R119,120	RN14BK2E3901F	Metal film 3.9kΩ ±1% 1/4W
R121,122	RD14CB2E220J	Carbon 22Ω ±5% 1/4W
R123	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R124,125	RN14BK2E1501F	Metal film 1.5kΩ ±1% 1/4W
R126	RN14BK2E4700F	Metal film 470Ω ±1% 1/4W
R128	RN14BK2E2700F	Metal film 270Ω ±1% 1/4W
R129	RN14BK2E1000F	Metal film 100Ω ±1% 1/4W
R130	RD14BB2E1R2J	Carbon 1.2Ω ±5% 1/4W
R131	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R132	RD14BB2E121J	Carbon 120Ω ±5% 1/4W
R133	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R134	RN14BK2E1300F	Metal film 130Ω ±1% 1/4W
R135	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R136,137	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R138,139	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R140	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R141	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R142,143	RN14BK2E4300F	Metal film 430Ω ±1% 1/4W
R144	RD14BB2E821J	Carbon 820Ω ±5% 1/4W
R146,147	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R148,149	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R150	RN14BK2E1800F	Metal film 180Ω ±1% 1/4W
R151,152	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R155	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R156	RN14BK2E2201F	Metal film 2.2kΩ ±1% 1/4W
R157	RN14BK2E3300F	Metal film 330Ω ±1% 1/4W
R158	RN14BK2E2201F	Metal film 2.2kΩ ±1% 1/4W
R160	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R161,162	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R163	RN14BK2E4301F	Metal film 4.3kΩ ±1% 1/4W
R164	RN14BK2E9100F	Metal film 910Ω ±1% 1/4W
R165,166	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R167	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R168	RN14BK2E6200F	Metal film 620Ω ±1% 1/4W
R169,170	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R171	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R172,173	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R174	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R175	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R176	RD14BB2E393J	Carbon 39kΩ ±5% 1/4W
R177,178	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R179,180	RN14BK2E2700F	Metal film 270Ω ±1% 1/4W
R181	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R182,183	RN14BK2E91R0F	Metal film 91Ω ±1% 1/4W
R184	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R185~189	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R190	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R191,192	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R193	RD14BB2E561J	Carbon 560Ω ±5% 1/4W
R194	RD14BB2E182J	Carbon 1.8kΩ ±5% 1/4W
R195	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R196	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R197	RN14BK2E6200F	Metal film 620Ω ±1% 1/4W
R198,199	RD14BB2E221J	Carbon 220Ω ±5% 1/4W
R201	RD14BB2E470J	Carbon (with S102) 47Ω ±5% 1/4W
R202	RC05GF2H105J	Solid (with S102) 1MΩ ±5% 1/2W
☆R205	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R206,207	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R208~210	RD14CB2E220J	Carbon 22Ω ±5% 1/4W
R211	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R212,213	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R214	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R216	RN14BK2E1800F	Metal film 180Ω ±1% 1/4W
R217	RD14BB2E181J	Carbon 180Ω ±5% 1/4W
R219,220	RN14BK2E3901F	Metal film 3.9kΩ ±1% 1/4W
R221,222	RD14CB2E220J	Carbon 22Ω ±5% 1/4W
R223	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R224,225	RN14BK2E1501F	Metal film 1.5kΩ ±1% 1/4W
R226	RN14BK2E4700F	Metal film 470Ω ±1% 1/4W
R228	RN14BK2E2700F	Metal film 270Ω ±1% 1/4W
R229	RN14BK2E1000F	Metal film 100Ω ±1% 1/4W
R230	RD14BB2E1R2J	Carbon 1.2Ω ±5% 1/4W
R231	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R232	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R233	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R234	RN14BK2E1300F	Metal film 130Ω ±1% 1/4W
R235,236	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R237~240	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R241	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R242	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W

PARTS LIST

Ref. No.	Parts No.	Description
R243	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R244,245	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R246,247	RN14BK2E4300F	Metal film 430Ω ±1% 1/4W
R248	RD14BB2E821J	Carbon 820Ω ±5% 1/4W
R249,250	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R251,252	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R253	RN14BK2E1800F	Metal film 180Ω ±1% 1/4W
R254,255	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R258	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R259,260	RN14BK2E2201F	Metal film 2.2kΩ ±1% 1/4W
R261	RN14BK2E2200F	Metal film 220Ω ±1% 1/4W
R263	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R264,265	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R266	RN14BK2E4301F	Metal film 4.3kΩ ±1% 1/4W
R267	RN14BK2E9100F	Metal film 910Ω ±1% 1/4W
R268,269	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R270	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R271	RN14BK2E6200F	Metal film 620Ω ±1% 1/4W
R272	RN14BK2E4701F	Metal film 4.7kΩ ±1% 1/4W
R273	RN14BK2E1000F	Metal film 100Ω ±1% 1/4W
R274	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R275	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R276,277	RD14BB2E563J	Carbon 56kΩ ±5% 1/4W
R278	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R280	RN14BK2E3901F	Metal film 3.9kΩ ±1% 1/4W
R281	RN14BK2E75R0F	Metal film 75Ω ±1% 1/4W
R282	RN14BK2E1101F	Metal film 1.1kΩ ±1% 1/4W
R283,284	RD14BB2E4R7J	Carbon 4.7Ω ±5% 1/4W
R287	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R288	RD14CB2E821J	Carbon 820Ω ±5% 1/4W
R289~292	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R293	RD14BB2E331J	Carbon 330Ω ±5% 1/4W
R294	RD14BB2E121J	Carbon 120Ω ±5% 1/4W
☆R295,296	RD14BB2E561J	Carbon 560Ω ±5% 1/4W
R298,299	RD14BB2E270J	Carbon 27Ω ±5% 1/4W
R301,302	RN14BK2E2000F	Metal film 200Ω ±1% 1/4W
R303	RD14CB2E3R3J	Carbon 3.3Ω ±5% 1/4W
R304,305	RN14BK2E2000F	Metal film 200Ω ±1% 1/4W
R306	RD14CB2E3R3J	Carbon 3.3Ω ±5% 1/4W
R307	RD14BB2E561J	Carbon 560Ω ±5% 1/4W
R308	RN14BK2E2400F	Metal film 240Ω ±1% 1/4W
R309	RD14BB2E431J	Metal film 430Ω ±5% 1/4W
☆R312	RD14BB2E751J	Carbon 750Ω ±5% 1/4W
☆R313	RD14BB2E562J	Carbon 5.6kΩ ±5% 1/4W
☆R314	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
VR101	R12-0517-05	Semi-fixed resistor 220ΩB
VR103	R12-0515-05	Semi-fixed resistor 100ΩB
VR104	R12-0502-05	Semi-fixed resistor 100ΩB
VR105	R01-1013-25	Semi-fixed resistor 1kΩB
VR106	R12-0058-05	Semi-fixed resistor 490ΩB
VR107	R12-0511-05	Semi-fixed resistor 220ΩB
VR108	R12-0517-05	Semi-fixed resistor 470ΩB
VR110	R12-0515-05	Semi-fixed resistor 100ΩB
VR111,112	R12-0502-05	Semi-fixed resistor 100ΩB
VR113	R01-1502-05	Semi-fixed resistor 1kΩB
VR114	R12-0503-05	Semi-fixed resistor 150ΩB
VR115,116	R12-0511-05	Semi-fixed resistor 220ΩB
VR117	R12-1501-05	Semi-fixed resistor 1.5kΩB
VR118,119	R12-5025-05	Semi-fixed resistor 100kΩB
CAPACITOR		
C101	C91-0501-05	Mylar (with S101) 0.047μF ±10%
C103	CE04W1A470	Electrolytic 47μF 10WV
C104	CK45D1H103M	Ceramic 0.01μF ±20%
C106	CC45CH1H180J	Ceramic 18pF ±5%
C107,108	CC45CH1H120J	Ceramic 12pF ±5%
C109	CK45D1H103M	Ceramic 0.01μF ±20%
C111	CC45CH1H470J	Ceramic 47pF ±5%
C112	CH45D1H103M	Ceramic 0.01μF ±20%
C113,114	CE04W1C470	Electrolytic 47μF 16WV
C115~117	CK45D1H103M	Ceramic 0.01μF ±20%

Ref. No.	Parts No.	Description
C118	CE04W1C470	Electrolytic (with S102) 47μF 16WV
C119	C91-0501-05	Mylar (with S102) 0.047μF±10%
C121	CE04W1C470	Electrolytic 47μF 16WV
C122	CK45D1H103M	Ceramic 0.01μF ±20%
C124	CC45CH1H150J	Ceramic 15pF ±5%
C125,126	CC45CH1H120J	Ceramic 12pF ±5%
C127,128	CH45D1H103M	Ceramic 0.01μF ±20%
C130	CC45CH1H470J	Ceramic 47pF ±5%
C131	CK45D1H103M	Ceramic 0.01μF ±20%
C132,133	CQ93M1H682J	Mylar 6800pF ±5%
C134	CE04W1C470	Electrolytic 47μF 16WV
C135,136	CK45D1H103M	Ceramic 0.01μF ±20%
C137	CC45CH1H120J	Ceramic 12pF ±[B] %
C138	CC45CH1H150J	Ceramic 15pF ±5%
C141,142	CC45CH1H120J	Ceramic 12pF ±5%
C143	CE04W1C470	Electrolytic 47μF 16WV
C144	CK45D1H103M	Ceramic 0.01μF ±20%
C146	CK45D1H103M	Ceramic 0.01μF ±20%
C147~149	CE04W1C470	Electrolytic 47μF 16WV
C150	CC45CH1H030C	Ceramic 3pF ±5%
C152	CC45CH1H050C	Ceramic 5pF ±0.25pF
C154	CE04W1A221M	Electrolytic 220μF 10WV
C156	C90-0298-05	Semi-conductor ceramic 0.1μF +80%,−20%
C157	CC45CH1H680J	Ceramic 68pF ±5%
C159	CK45D1H103M	Ceramic (with VR102) 0.01μF ±20%
C160	CK45D1H103M	Ceramic (with VR109) 0.01μF ±20%
C163,164	CK45D1H103M	Ceramic 0.01μF ±20%
C167	CK45D1H103M	Ceramic 0.01μF ±20%
C169,170	CC45SL1H181J	Ceramic 180pF ±5%
C171	CC45CH1H100D	Ceramic 10pF ±0.5pF
☆C172	CC45CH1H100D	Ceramic 10pF ±0.5pF
☆C173	CC45CH1H020C	Ceramic 2pF ±0.25pF
☆C174,175	CC45CH1H050C	Ceramic 5pF ±0.25pF
☆C176,177	CC45CH1H330J	Ceramic 33pF ±5%
TC113,114	C05-0405-05	Ceramic trimmer 20pF
TC117	C05-0404-05	Ceramic trimmer 10pF
TC118,119	C05-0405-05	Ceramic trimmer 20pF
SEMICONDUCTOR		
Q101		FET 2SK228T-1-2 or 1-3
Q103,104		Transistor 2SC1047 (C)
Q105,106		Transistor 2SA838 (C)
Q107~120		Transistor 2SC1047 (C)
Q121		FET 2SK228T-1-2 or 1-3
Q123,124		Transistor 2SC1047 (C)
Q125,126		Transistor 2SA838 (C)
Q127~138		Transistor 2SC1047 (C)
Q139		Transistor 2SA733 (Q)
Q140,141		Transistor 2SC1047 (C)
Q142~144		Transistor 2SA733 (Q)
Q145		Transistor 2SA755
Q146		Transistor 2SA733 (Q)
Q147		Transistor 2SC1047 (C)
Q148,149		Transistor 2SA838 (C)
D101		Zener diode YZ-030
D102		Diode 1S1555
D105		Zener diode YZ-030
D106		Diode 1S1555
D109~111		Diode 1S1555
D112		Diode 1N60
D113~124		Diode 1S1555
D125,126		Diode 1S1544A
IC101		IC SN74S00N
IC102		IC SN74S02N
IC103		IC SN74S112N
MISCELLANEOUS		
—	A22-0810-13	Sub panel

PARTS LIST

Ref. No.	Parts No.	Description
–	B30-0913-05	LED with lead × 2
–	E04-0251-05	BNC jack × 2
–	E23-0047-04	Terminal
–	E23-0502-14	Grounding plate × 2
–	E23-0513-05	Earth lug × 2
–	E31-0630-05	Lead wire with connector
–	E29-0503-05	Termianl × 2 (Teflon)
–	E29-0504-05	Terminal × 2 (Teflon)
–	E29-0513-05	Terminal × 2 (Teflon)
P101	E40-0367-05	Pin connector 3P
P102	E40-1067-05	Pin connector 10P
–	F10-1534-04	Shield plate
–	F10-1934-14	Shield case
–	F11-0935-14	Shield case × 2
L101 ~ 103	L40-4701-03	Ferri-inductor 47μH
ATT101,102	R29-0501-15	ATT Rotary
–	R92-0150-05	Jumper wire (resistor type) × 80
S101,102	S33-1501-05	Lever switch
S104	S32-4008-05	Lever switch
TH101,102		Thermistor SDT-1000
–	J25-2846-22	Printed circuit board

VERTICAL FINAL AMPLIFIER UNIT (X73-1270-01)

Ref. No.	Parts No.	Description			
RESISTOR					
R701	RN14BK2E1800F	Metal film	180Ω	±1%	1/4W
R702,703	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R704,705	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R706	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R708	RD14BB2E511J	Carbon	510Ω	±5%	1/4W
R709,710	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R711,712	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R713,714	RD14BB2E821J	Carbon	820Ω	±5%	1/4W
R715	RD14BB2E470J	Carbon	120Ω	±5%	1/4W
R716	RD14BB2E912J	Carbon	9.1kΩ	±5%	1/4W
R717,718	RD14BB2E182J	Carbon	1.8kΩ	±5%	1/4W
R719	RD14BB2E222J	Caborn	2.2kΩ	±5%	1/4W
R720,721	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R724,725	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R726,727	RD14BB2E473J	Carbon	47kΩ	±5%	1/4W
R728,729	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R730	RS14AB3D223J	Metal film	22kΩ	±5%	2W
R731,732	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R733,734	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R735	RD14BB2E331J	Carbon	330Ω	±5%	1/4W
R736,737	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R738	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R739	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
VR701	R12-5002-05	Semi-fixed resistor 100kΩB			
VR702	R12-1028-05	Semi-fixed resistor 4.7kΩB			
VR703	R12-0058-05	Semi-fixed resistor 470ΩB			
CAPACITOR					
C703,704	CK45D1H103M	Ceramic	0.01μF	±20%	
C705	CC45CH1H100D	Ceramic	10pF	±0.5pF	
C706	CC45CH1H200J	Ceramic	20pF	±5%	
C707 ~ 710	CC45C2H010C	Ceramic	1pF	±0.25pF	
C711,712	CK45D2H102M	Ceramic	1000pF	±20%	
C713,714	CK45D1H103M	Ceramic	0.01μF	±20%	
C715,717	CK45D2H103M	Ceramic	0.01μF	±20%	
C718	CE04W2C100	Electrolytic	10μF	160WV	
C719	CC45CH1H220J	Ceramic	22pF	±5%	

Ref. No.	Parts No.	Description			
C723,724	CK45D1H103M	Ceramic	0.01μF	±20%	
C726	CC45CH1H050C	Ceramic	5pF	±0.25pF	
TC702 ~ 704	C05-0405-05	Ceramic trimmer	20pF		
SEMICONDUCTOR					
Q701 ~ 704		Transistor	2SC1047 (C)		
Q705,706		Transistor	2SC2407		
Q707,708		Transistor	2SC805A-2 (2)		
Q709,710		Transistor	2SA923-2 (2)		
Q711,712		Transistor	2SC1973 (TRIO)		
D701,702		Diode	1S1555		
D703		Zener diode	WZ-061		
MISCELLANEOUS					
–	E23-0046-04	Terminal × 2			
P701	E40-0367-05	Connector 3P			
P702	E40-1067-05	Connector 10P			
–	F01-0819-24	Heat sink × 2			
–	J19-1621-04	Supporter			
–	J21-2870-04	P.C. board mounting hardware × 2			
–	J25-2855-14	Printed circuit board			
–	J29-2870-04	Bracket (for p.c. board)			
–	J30-0605-05	Spacer (for diode)			
–	R92-0150-05	Jumper wire (resistor type) × 6			

HORIZONTAL SWEEP AMP. UNIT (X74-1150-00)

Ref. No.	Parts No.	Description			
RESISTOR					
R301	RD14CB2E183J	Carbon	18kΩ	±5%	1/4W
R302	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R303	RN14BK2H1004F	Metal film	1MΩ	±1%	1/2W
R304	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R305	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R306	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R307	RD14BB2E562J	Carbon	5.6kΩ	±5%	1/4W
R308	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R309	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R310	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R311	RD14CB2E474J	Carbon	470kΩ	±5%	1/4W
R312	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R313	RD14CB2E472J	Carbon	4.7kΩ	±5%	1/4W
R314	RN14BK2H9003F	Metal film	900kΩ	±1%	1/2W
R315	RN14BK2E1113F	Metal film	111kΩ	±1%	1/4W
R317,318	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R319	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R321	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R322	RD14BB2E562J	Carbon	5.6kΩ	±5%	1/4W
R323	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R324	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R325	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R326	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R327	RD14BB2E333J	Carbon	33kΩ	±5%	1/4W
R328	RD14CB2E103J	Carbon	10kΩ	±5%	1/4W
R329	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R330	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R331	RD14BB2E333J	Carbon	33kΩ	±5%	1/4W
R332	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R333	RD14BB2E151J	Carbon	150Ω	±5%	1/4W
R334	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R335	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R336	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R337	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R338 ~ 340	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R341	RD14BB2E471J	Carbon	470Ω	±5%	1/4W

PARTS LIST

Ref. No.	Parts No.	Description			
R342	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R343	RD14CB2E393J	Carbon	39kΩ	±5%	1/4W
R344	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R345	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R346	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R347	RD14BB2E562J	Carbon	5.6kΩ	±5%	1/4W
R348,349	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R350,351	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R352	RD14BB2E471J	Carbon	470Ω	±5%	1/4W
R353	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R354	RD14CB2E181J	Carbon	180Ω	±5%	1/4W
R355	RD14CB2E102J	Carbon	1kΩ	±5%	1/4W
R356	RD14CB2E333J	Carbon	33kΩ	±5%	1/4W
R357	RS14GB3D153J	Metal film	15kΩ	±5%	2W
R358	RD14BB2E104J	Carbon	100kΩ	±5%	1/4W
R359~361	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R362	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R363	RD14BB2E272J	Carbon	2.7kΩ	±5%	1/4W
R364	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R365	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R366	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R367	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R368	RD14BB2E2R2J	Carbon	2.2Ω	±5%	1/4W
R369	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R370	RD14BB2E152J	Carbon	1.5kΩ	±5%	1/4W
R371	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R372	R92-0709-05	Carbon	3MΩ		1/2W
R373	RN14BK2H1004F	Metal film	1MΩ	±1%	1/2W
R374	RN14BK2H5003F	Metal film	500kΩ	±1%	1/2W
R375	RN14BK2E3003F	Metal film	300kΩ	±1%	1/4W
R376,377	RN14BK2E1003F	Metal film	100kΩ	±1%	1/4W
R378	RN14BK2E4702F	Metal film	47kΩ	±1%	1/4W
R379	RN14BK2E1802F	Metal film	18kΩ	±1%	1/4W
R380	RN14BK2E9101F	Metal film	9.1kΩ	±1%	1/4W
R381	RD14BB2E222J	Carbon	2.2kΩ	±5%	1/4W
R382	RD14BB2E123J	Carbon	12kΩ	±5%	1/4W
R383	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
R384	RN14BK2E3301F	Metal film	3.3kΩ	±1%	1/4W
R385	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R386	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R387	RD14BB2E223J	Carbon	22kΩ	±5%	1/4W
R388	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R389	RN14BK2E2401F	Metal film	2.4kΩ	±1%	1/4W
R390	RD14CB2E332J	Carbon	3.3kΩ	±5%	1/4W
R391	RD14BB2E821J	Carbon	820Ω	±5%	1/4W
R392	RD14BB2E182J	Carbon	1.8kΩ	±5%	1/4W
R393	RD14BB2E822J	Carbon	8.2kΩ	±5%	1/4W
R394,395	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R396	RD14BB2E392J	Carbon	3.9kΩ	±5%	1/4W
R397	RD14BB2E302J	Carbon	3kΩ	±5%	1/4W
R398	RD14BB2E392J	Carbon	3.9kΩ	±5%	1/4W
R399	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R400	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R401	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R402	RD14BB2E332J	Carbon	3.3kΩ	±5%	1/4W
R403	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R404	RN14BK2E1301F	Metal film	1.3kΩ	±1%	1/4W
R405,406	RD14BB2E392J	Carbon	3.9kΩ	±5%	1/4W
R407	RN14BK2E1301F	Metal film	1.3kΩ	±1%	1/4W
R408	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R409,410	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R411	RN14BK2E3000F	Metal film	300Ω	±1%	1/4W
R412	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R413,414	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R415,416	RS14GB3F472J	Metal film	4.7kΩ	±5%	3W
R417	RD14BB2E472J	Carbon	4.7kΩ	±5%	1/4W
R418	RD14BB2E220J	Carbon	22Ω	±5%	1/4W
R419	RD14BB2E153J	Carbon	15kΩ	±5%	1/4W
R420	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R421	RD14BB2E102J	Carbon	1kΩ	±5%	1/4W
R422	RD14BB2E474J	Carbon	470kΩ	±5%	1/4W
R423	RD14BB2E561J	Carbon	560Ω	±5%	1/4W
R424	RD14BB2E470J	Carbon	47Ω	±5%	1/4W
R425	RD14BB2E272J	Carbon	2.7kΩ	±5%	1/4W
R431	RD14CB2E102J	Carbon	1kΩ	±5%	1/4W
R432	RD14CB2E332J	Carbon	3.3kΩ	±5%	1/4W
R434	RD14CB2E911J	Carbon	910Ω	±5%	1/4W
R435	RD14CB2E472J	Carbon	4.7kΩ	±5%	1/4W
R436	RD14CB2E682J	Carbon	6.8kΩ	±5%	1/4W
R437	RD14CB2E472J	Carbon	4.7kΩ	±5%	1/4W
R438	RD14CB2E202J	Carbon	2kΩ	±5%	1/4W
R439	RD14CB2E472J	Carbon	4.7kΩ	±5%	1/4W
R440	RD14CB2E682J	Carbon	6.8kΩ	±5%	1/4W
R441	RD14CB2E332J	Carbon	3.3kΩ	±5%	1/4W
R442	RD14BB2E682J	Carbon	6.8kΩ	±5%	1/4W
R443,444	RD14BB2E330J	Carbon	33Ω	±5%	1/4W
R445	RD14BB2E221J	Carbon	220Ω	±5%	1/4W
R446	RD14BB2E101J	Carbon	100Ω	±5%	1/4W
R447	RD14CB2E470J	Carbon	47Ω	±5%	1/4W
VR301	R01-3502-05	Semi-fixed resistor (S302)	10kΩB		
VR302	R12-8501-05	Semi-fixed resistor	2.2kΩB		
VR303	R01-2507-05	Semi-fixed resistor (S301)	5kΩB		
VR304	R12-1033-05	Semi-fixed resistor	2.2kΩB		
VR305	R12-1028-05	Semi-fixed resistor	4.7kΩB		
VR306~308	R12-3040-05	Semi-fixed resistor	22kΩB		
VR309	R12-0513-05	Semi-fixed resistor	680ΩB		
VR310	R12-0502-05	Semi-fixed resistor	100ΩB		
VR311	R12-3040-05	Semi-fixed resistor	22kΩB		
VR312	R12-3041-05	Semi-fixed resistor	10kΩB		
VR313	R12-1028-05	Semi-fixed resistor	4.7kΩB		
VR321	R12-0516-05	Semi-fixed resistor	150ΩB		

CAPACITOR

C301	CQ93M1H103K	Mylar	0.01μF	±10%
C302,303	C91-0531-05	Dipped mica	100pF	±5%
C304	CQ93M1H103K	Mylar	0.01μF	±10%
C307	CC45CH1H020C	Ceramic	2pF	±0.25pF
C308	CE04BW1H010M	Electrolytic	1μF	50WV
C309,310	CK45D1H103M	Ceramic	0.01μF	±20%
C311,312	CE04BW1H010M	Electrolytic	1μF	50WV (Non-poler)
C314	CC45CH1H330J	Ceramic	33pF	±5%
C315	CQ93M1H103K	Mylar	0.01μF	±10%
C316	CC45CH1H020C	Ceramic	2pF	±0.25pF
C317	CE04BW1H010M	Electrolytic	1μF	50WV (Non-poler)
C318,319	CK45D1H103M	Ceramic	0.01μF	±20%
C320	CE04BW1H010M	Electrolytic	1μF	50WV (Non-poler)
C321	CE04W1H3R3	Electrolytic	3.3μF	50WV
C322	CM93BD2A470J	Mica	47pF	±5%
C323	CQ93M1H332J	Mylar	3300pF	±5%
C324	CM93BD2A221J	Mica	220pF	±5%
C325	CE04W1C101Q	Electrolytic	100μF	16WV
C326	CC45SL1H470J	Ceramic	47pF	±5%
C328	C91-0517-05	Polypropylen	0.47μF	±1%
C329	C91-0516-05	Polypropylen	4700pF	±1%
C330	CM93BD2A330J	Mica	33pF	±5%
C331	CQ93M1H474J	Mylar	0.47μF	±5%
C332	CQ93M1H472J	Mylar	4700μF	±5%
C333	CK45D1H331M	Ceramic	330pF	±20%
C334	CC45CH1H680J	Ceramic	68pF	±5%
C335	CC45CH1H050C	Ceramic	5pF	±0.25pF
C336	CM93BD2A390J	Mica	39pF	±5%
C337	CC45CH1H470J	Ceramic	47pF	±5%
C338	CE041WC101Q	Electrolytic	100μF	16WV
C339	CK45D1H471M	Ceramic	470pF	±20%
C340	CK45D1H103M	Ceramic	0.01μF	±20%
C341,342	CE04W1A221	Electrolytic	220μF	10WV
C343,344	CK45D1H103M	Ceramic	0.01μF	±20%
C345,346	CE04W1C101Q	Electrolytic	100μF	16WV
C347	CE04W2C100	Electrolytic	10μF	160WV
C348	CC45SL1H221J	Ceramic	220pF	±5%
C349	CK45D1H103M	Ceramic	0.01μF	±20%
C351~352	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%,−20%
C354	C90-0298-05	Semi-conductor ceramic	0.1μF	+80%,−20%

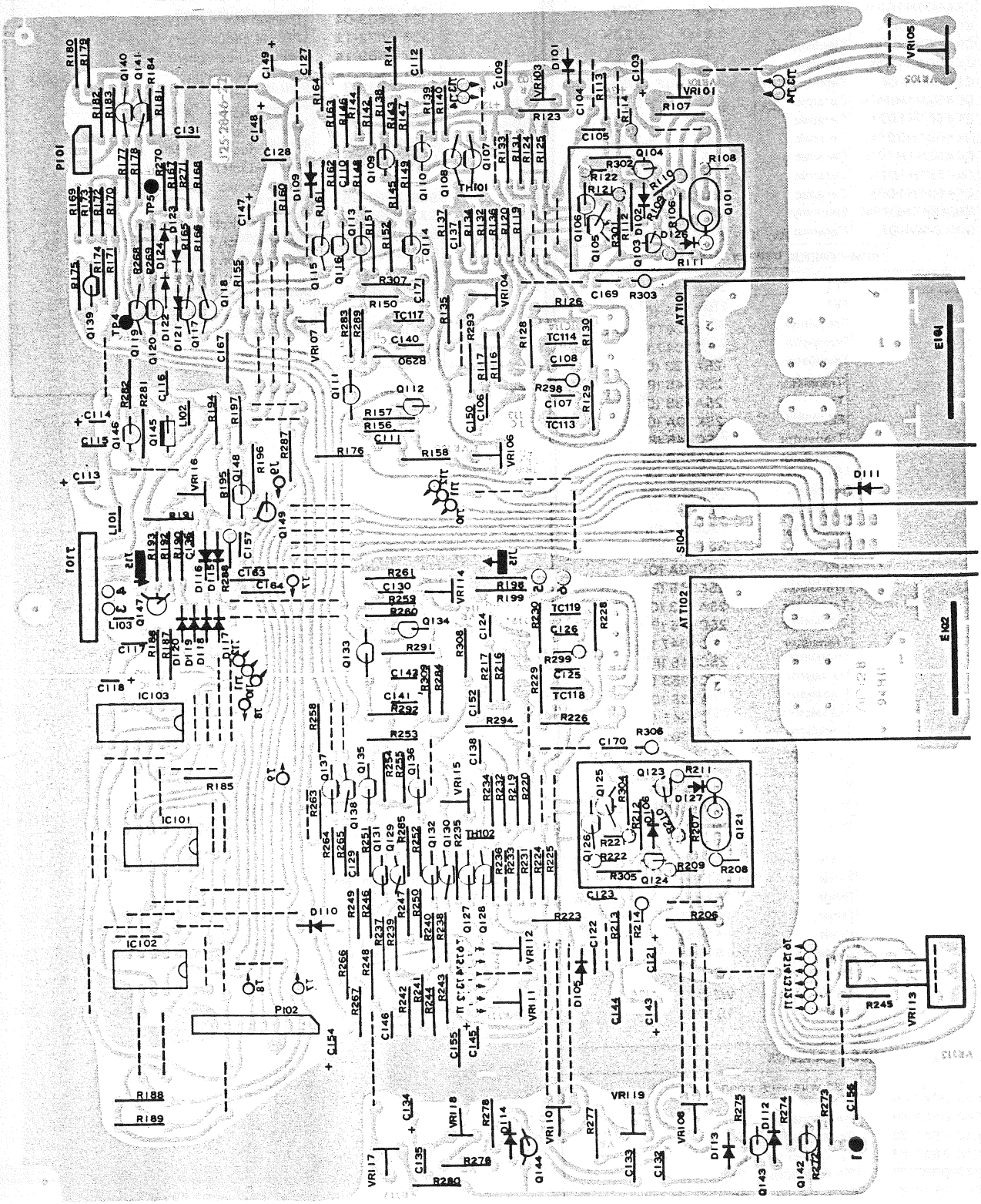
PARTS LIST

Ref. No.	Parts No.	Description
C355,356	CE04W1A470	Electrolytic 47μF 10WV
C357,358	CK45D1H103M	Ceramic 0.01μF ±20%
C359	CE04W1A470	Electrolytic 47μF 10WV
C361	CE04W1A470	Electrolytic 47μF 10WV
C363	CK45D1H103M	Ceramic 0.01μF ±20%
C365	C90-0298-05	Semi-conductor ceramic 0.1μF +80% −20%
C367	CC45CH1H050C	Ceramic 5pF ±0.25pF
☆C368	CK45B1H102K	Ceramic 1000pF ±10%
C371	CK45D1H331M	Ceramic 330pF ±20%
C372	CC45CH1H100D	Ceramic 10pF ±0.5pF
C373	CK45B1H102K	Ceramic 1000pF ±10%
C374~379	CK45D1H103M	Ceramic 0.01μF ±20%
C380	CE04BW1H010M	Electrolytic 1μF 50WV (Non-poler)
TC302	C05-0404-05	Ceramic trimmer 10pF
SEMICONDUCTOR		
Q301		FET 2SK30A (O)
Q302		FET 2SK228T1-2 or 3
Q303,304		Transistor 2SC1047 (C)
Q305		Transistor 2SA733 (Q)
Q306		Transistor 2SC945 (P)
Q307		Transistor 2SA733 (Q)
Q308		FET 2SK30A (GR)
Q309~315		Transistor 2SC945 (P)
Q316		Transistor 2SA838 (C)
Q317		Transistor 2SC945 (P)
Q318		FET 2SK30A (O)
Q319,320		Transistor 2SC945 (P)
Q321		Transistor 2SC1047 (C)
Q322		Transistor 2SC945 (P)
Q323		FET 2SK30A (O)
Q324		Transistor 2SC945 (P)
Q325		Transistor 2SA733 (Q)
Q326,327		Transistor 2SC945 (P)
Q328		Transistor 2SC1047 (C)
Q329~332		Transistor 2SC945 (P)
Q333,334		Transistor 2SC1953 (R)
Q335		Transistor 2SA733 (Q)
Q341		Transistor 2SC1047 (C)
Q342		Transistor 2SA838 (C)
Q343,344		Transistor 2SC1047 (C)
IC301		IC NE529N
IC302~304		IC SN74S00N
IC305		IC SN74S02N
IC306		IC SN74S112N
D301~313		Diode 1S1555
D317		Diode 1S1555
D318		Diode 1S1587
D319~322		Diode 1S1555
D323,324		Diode 1S1587
D325~330		Diode 1S1555
D331		Zener diode WZ-071
D341~343		Diode 1S1555
MISCELLANEOUS		
J308	E31-0628-05	Lead wire with connector
P301,302	E23-0047-04	Terminal
P303	E40-0367-05	Pin connector 3P
P304,305	E40-0567-05	Pin connector 5P
P306	E40-0667-05	Pin connector 6P
P307	E40-0367-05	Pin connector 3P
P308	E40-0964-05	Pin connector 9P
—	E04-0251-05	BNC jack
—	E15-0501-05	Socket (for LED)
—	F01-0231-14	Heat sink

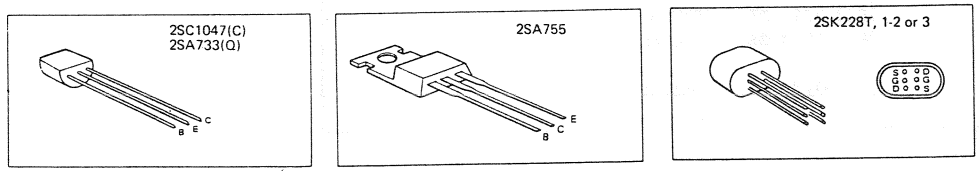
Ref. No.	Parts No.	Description
—	J21-2869-04	Bracket (for p.c. board)
—	J25-2872-13	Printed circuit board
—	J25-2859-14	Printed circuit board
—	J61-0501-15	Supporter (for p.c. board)
L301	L40-4701-03	Ferri-inductor 47μH
L302	L40-3311-03	Ferri-inductor 330μH
L303,304	L40-1511-03	Ferri-inductor 150μH
L305,306	L40-4711-03	Ferri-inductor 470μH
L308	L40-4711-03	Ferri-inductor 470μH
S301	S29-3501-05	Rotary switch
S303	S37-2005-05	Lever switch (MODE)
S304	S32-4008-05	Lever switch (COUPLING)
S305	S33-2501-05	Lever switch (SOURCE)
—	R92-0150-05	Jumper wire (resistor type)
—	A22-0815-03	Sub panel

P.C. BOARD

X73-1340-00

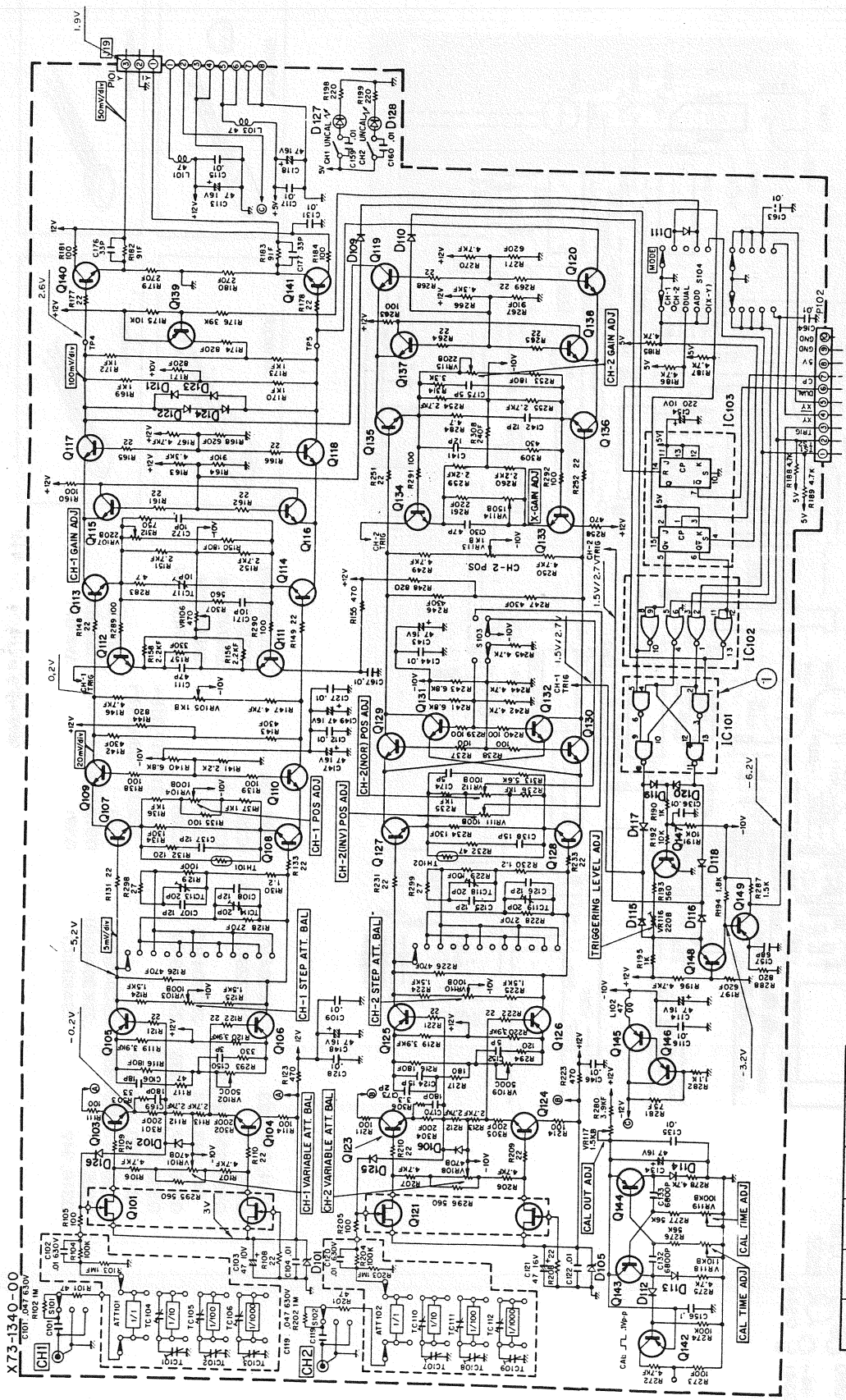


Q101, 121 :2SK228T, 1-2 or 3
Q103, 104, 107~120, 123, 124, 127~138, 140, 141, 147 :2SC1047(C)
Q105, 106, 125, 126, 148, 149 :2SA838(C)
Q139, 142~144, 146 :2SA733(Q)
Q145 :2SA755
IC101 :SN74S00N
IC102 :SN74S02N
IC103 :SN74S112N
TH101, 102 :SDT-1000
D101, 105 :YZ-030
D127, 128 :AR4133S
D102, 106, 109~111, 113~124 :1S1555
D112 :1N60
D103, 104, 107, 108 :1S1587



CIRCUIT DIAGRAM

X73-1340-00

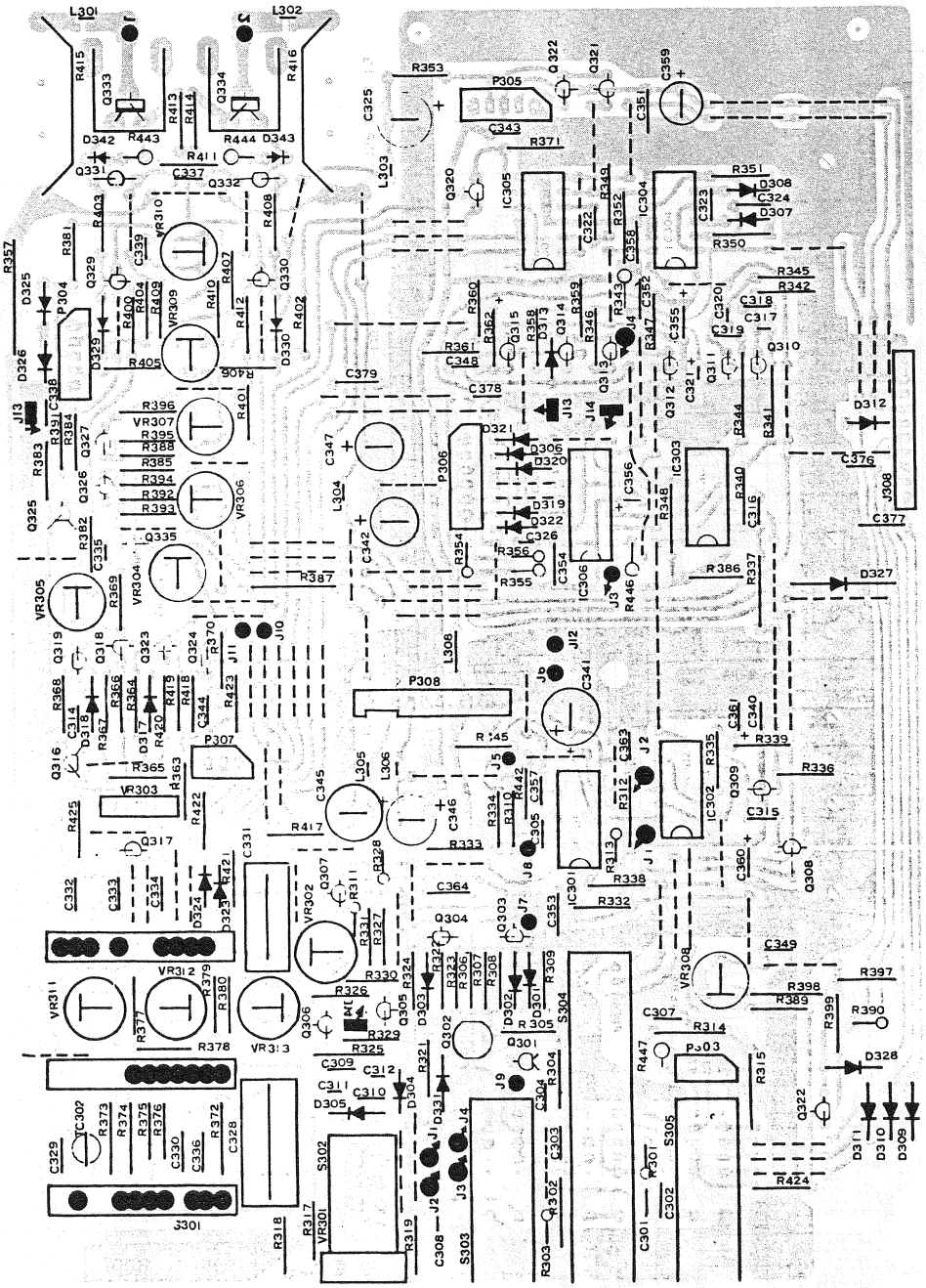


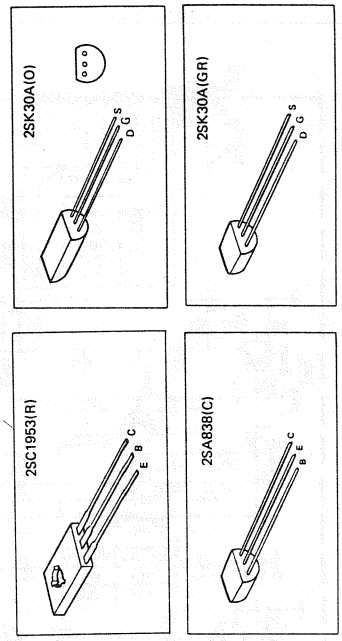
MODE SWITCH	IC101 PIN NO.8	IC101 PIN NO.11
CH1	0	1
CH2	1	0
DUAL	TRIG MODE	TRIG MODE
ADD	0	0
X-Y	1	0

(TRIG MODE in ALT)
0 = TTL Low level
1 = TTL High level

P.C. BOARD

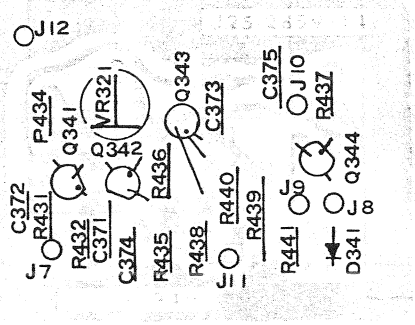
X74-1150-00





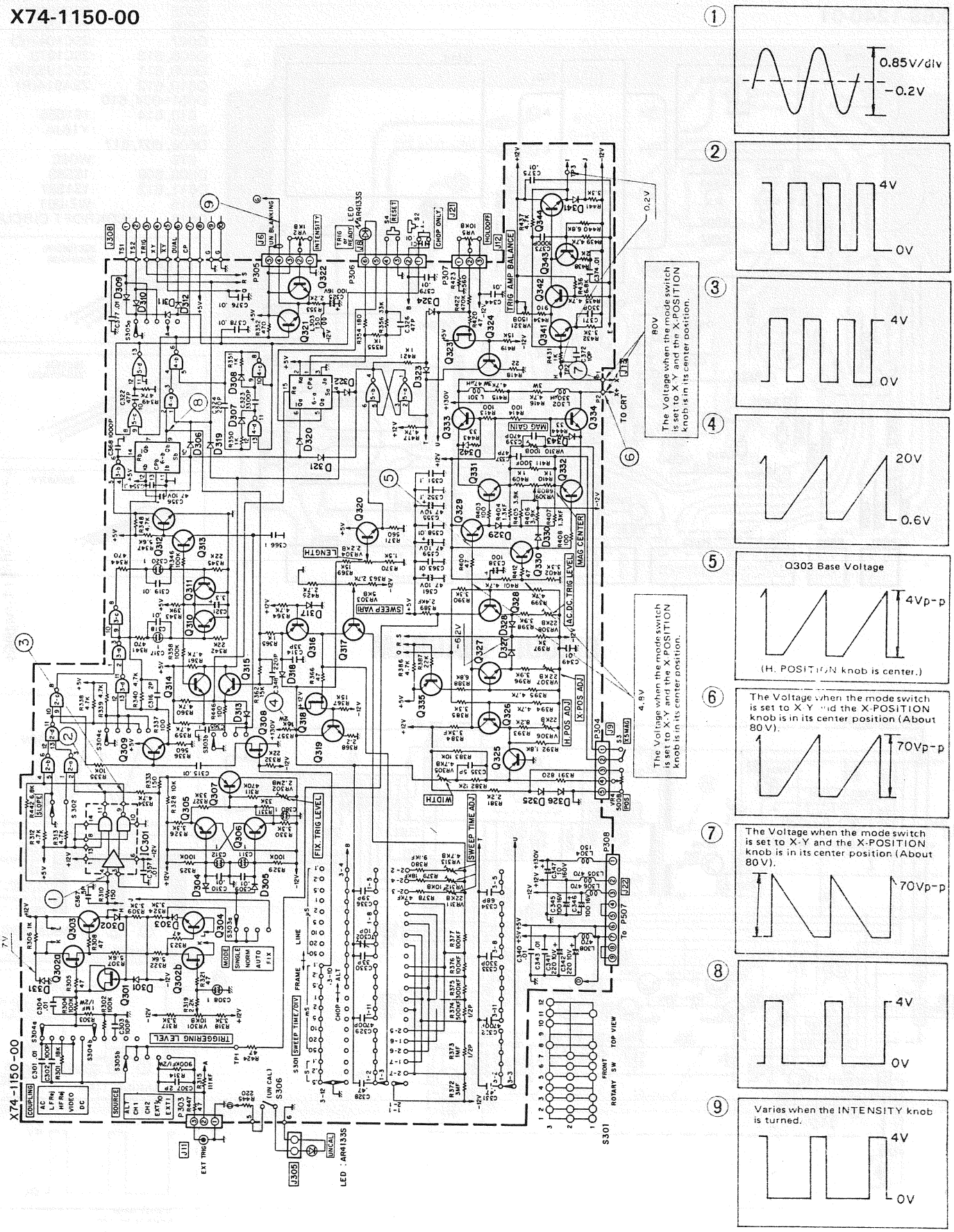
Q301, 318, 323	:2SK30A(O)	Q333, 334	:2SC1953(R)
Q302	:2SK228T, 1-2 or 3	IC301	:NE529N
Q303, 304, 321, 328, 341, 343, 344	:2SC1047(C)	IC302~304	:SN74S00N
Q305, 307, 325, 335	:2SA733(Q)	IC305	:SN74S02N
Q306, 309~315, 317, 319, 320, 322, 324, 326, 327, 329~332	:2SC945(P)	IC306	:SN74S112N
Q308	:2SK30A(GR)	D301~313,317,319~322,325~330,341~343	:1S1555
Q316, 342	:2SA838(C)	D318,323,324	:1S1587
		D331	:WZ-071

X74-1150-00



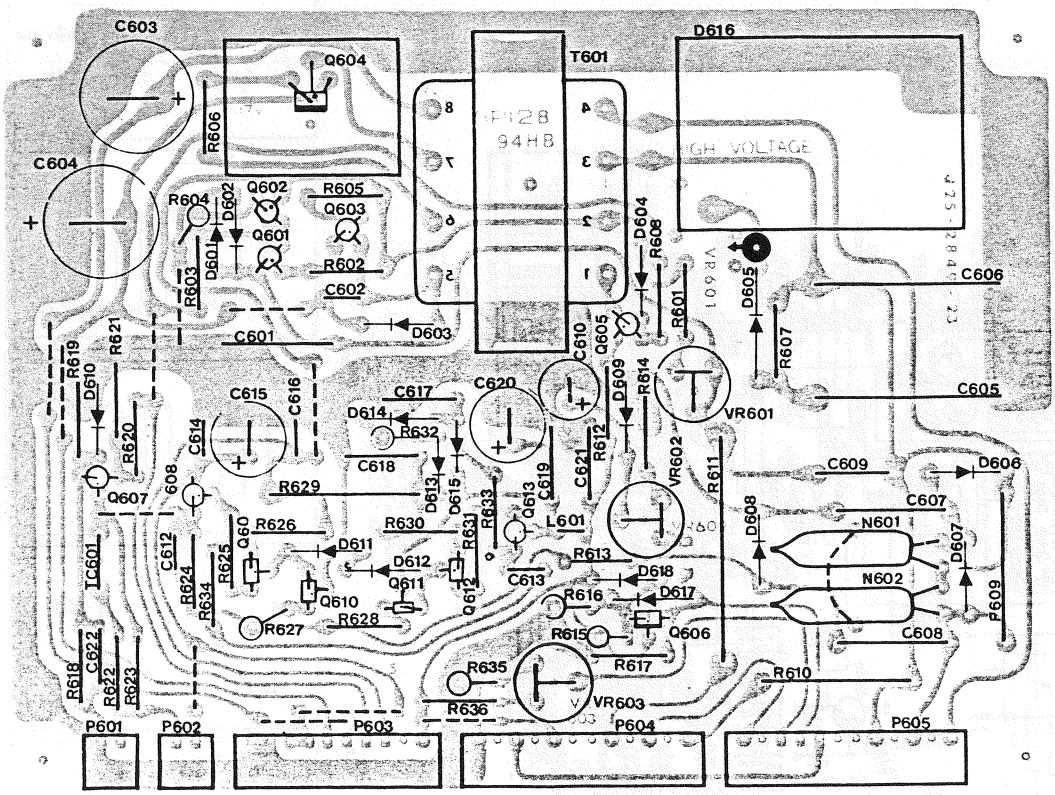
CIRCUIT DIAGRAM

X74-1150-00

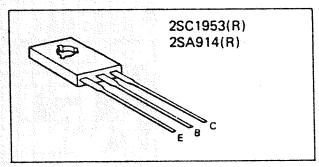


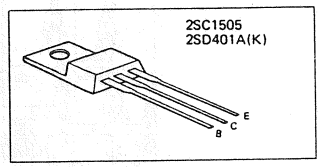
P.C. BOARD

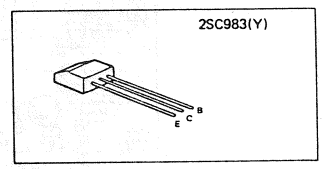
X68-1240-01



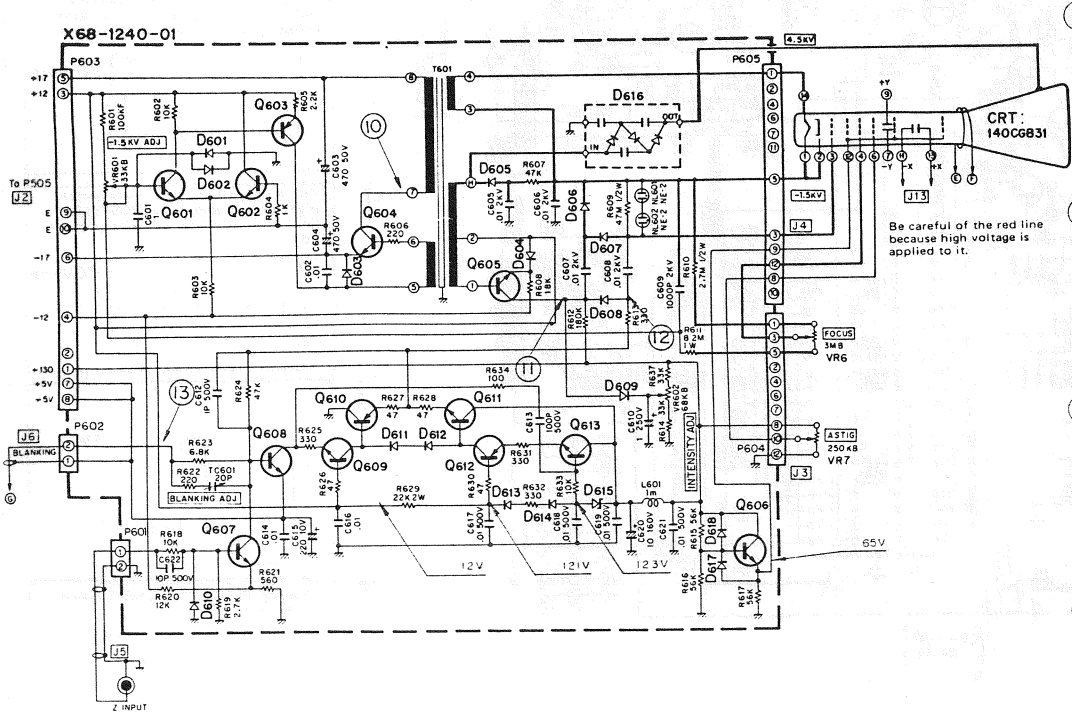
Q601, 602	:2SC945(P)
Q603	:2SA733(Q)
Q604	:2SD401A(K)
Q605	:2SC983(Y)
Q606	:2SC1505
Q607	:2SC1047(C)
Q608, 613	:2SC1973
Q609, 611	:2SC1953(R)
Q610, 612	:2SA914(R)
D601~604, 610 613, 614	:1S1555
D605	:Y16JA
D606, 607, 617 618	:W06C
D608, 609	:1SS83
D611, 612	:1S1587
D615	:WZ-061
D616	:COKROFT CIRCUIT

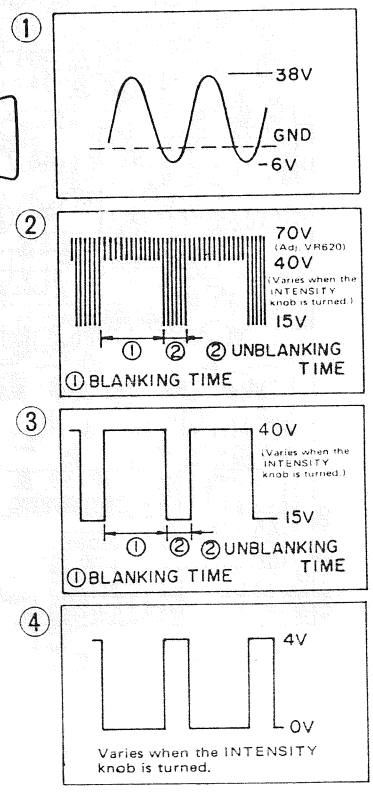






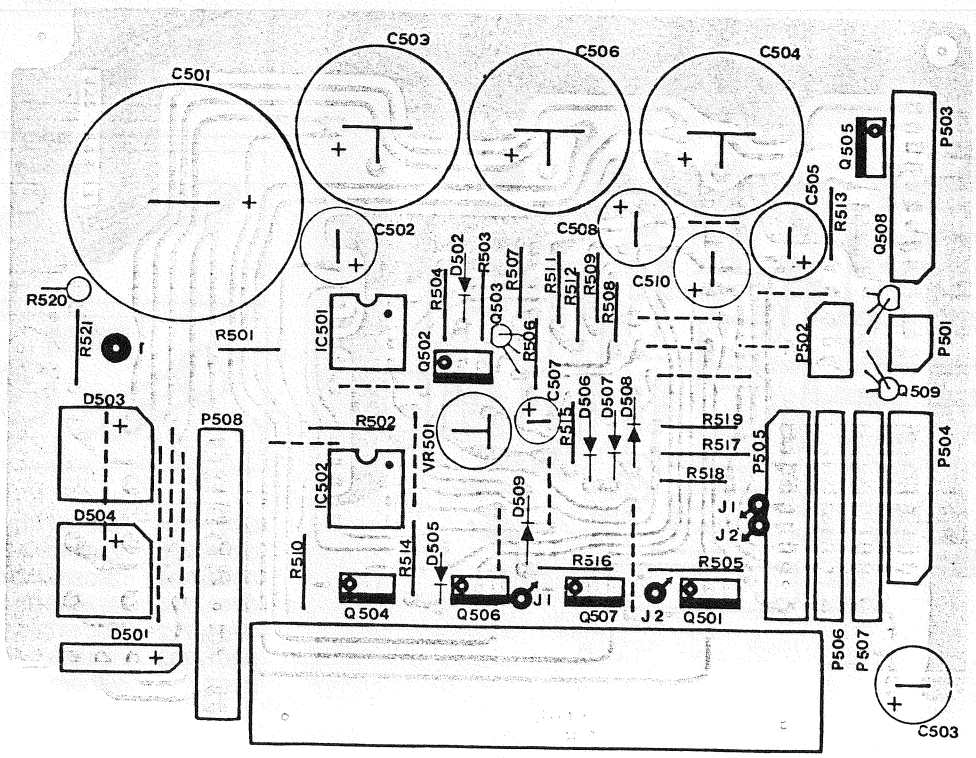
CIRCUIT DIAGRAM

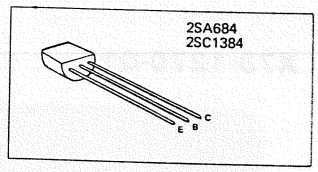


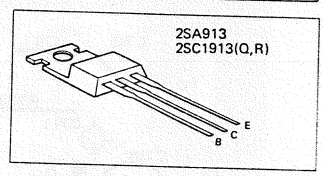


P.C. BOARD / CIRCUIT DIAGRAM

X68-1230-02

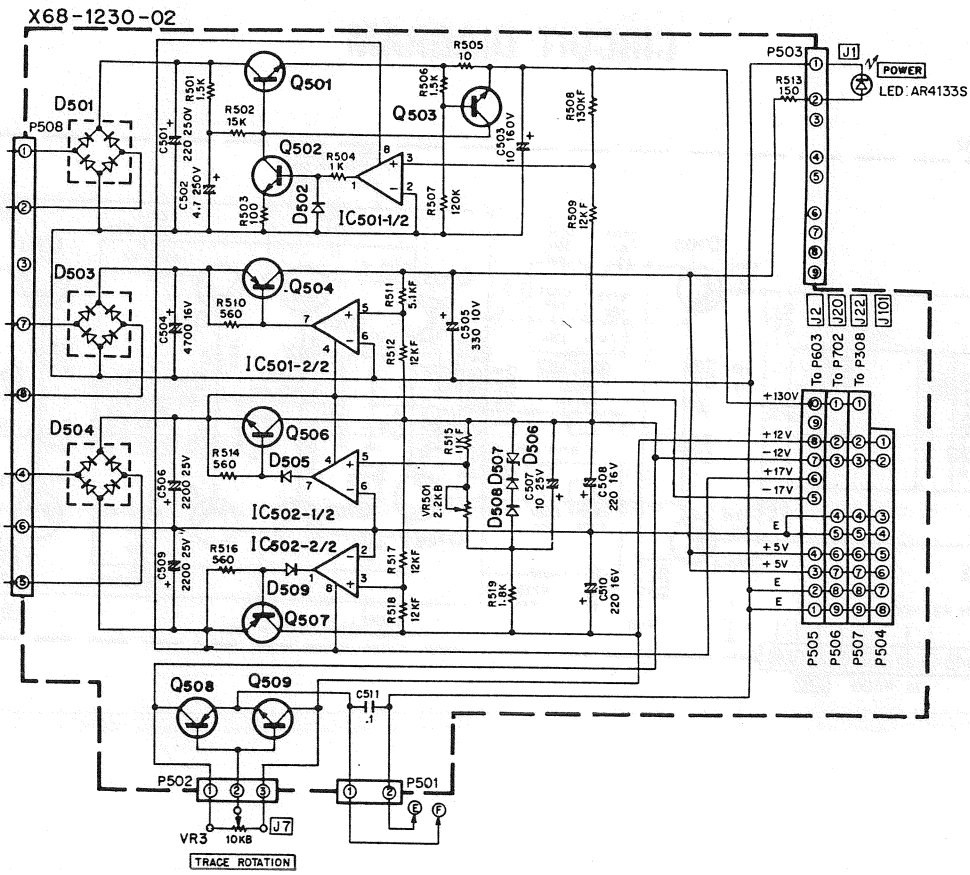






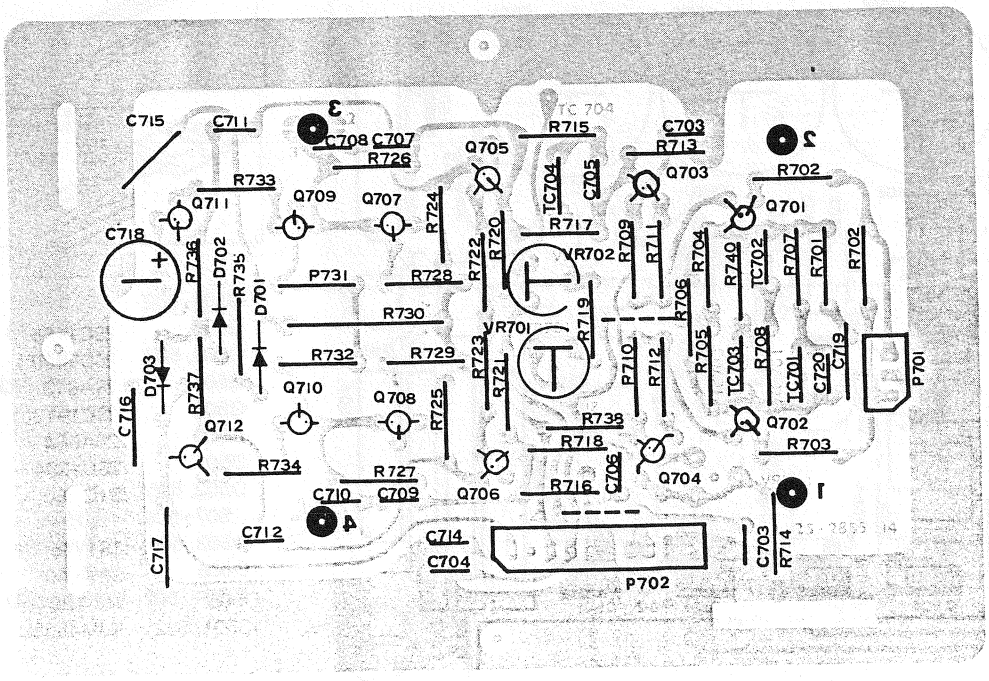
Q501, 502	:2SC1505
Q503	:2SC945(P)
Q504, 507	:2SA913
Q506	:2SC1913(Q,R)
Q508	:2SA684
Q509	:2SC1384
D501	:S1QB60
D502, 505 507~509	:1S1555
D503, 504	:S2VB40
D506	:WZ-120
IC501, 502	:NJM4558D

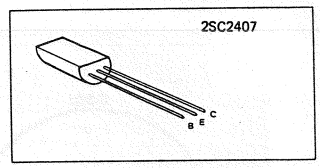
CIRCUIT DIAGRAM

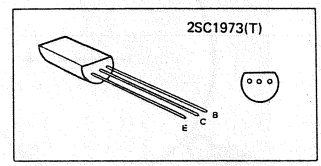


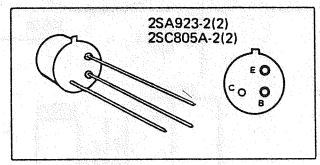
P.C. BOARD

X73-1270-01



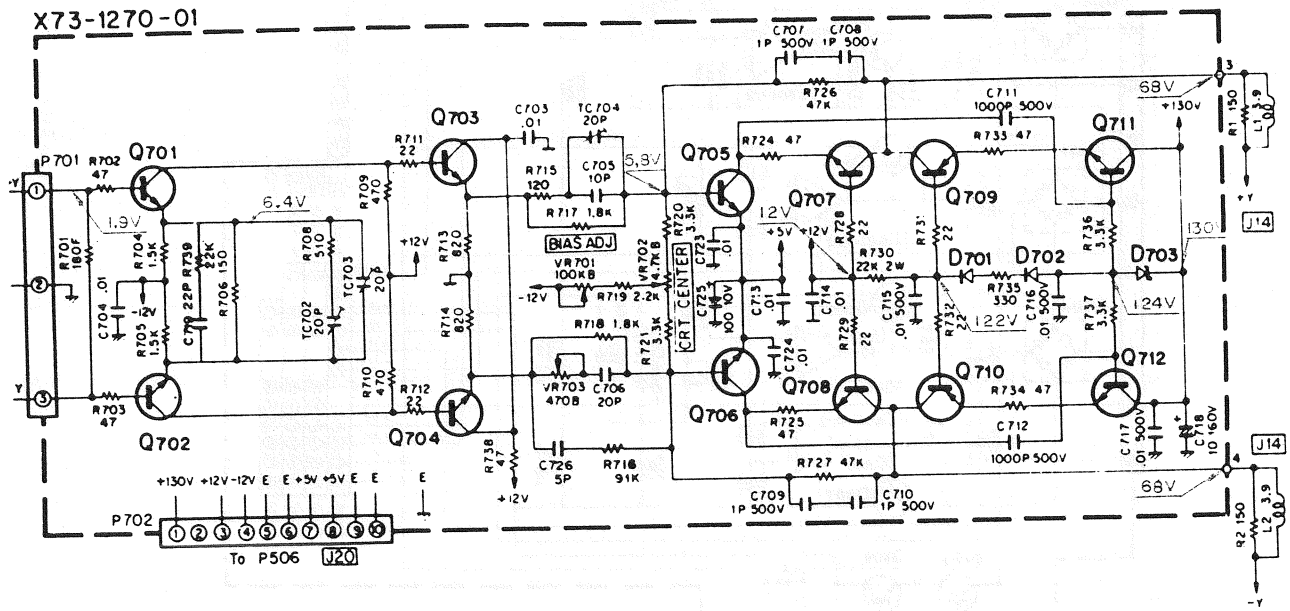






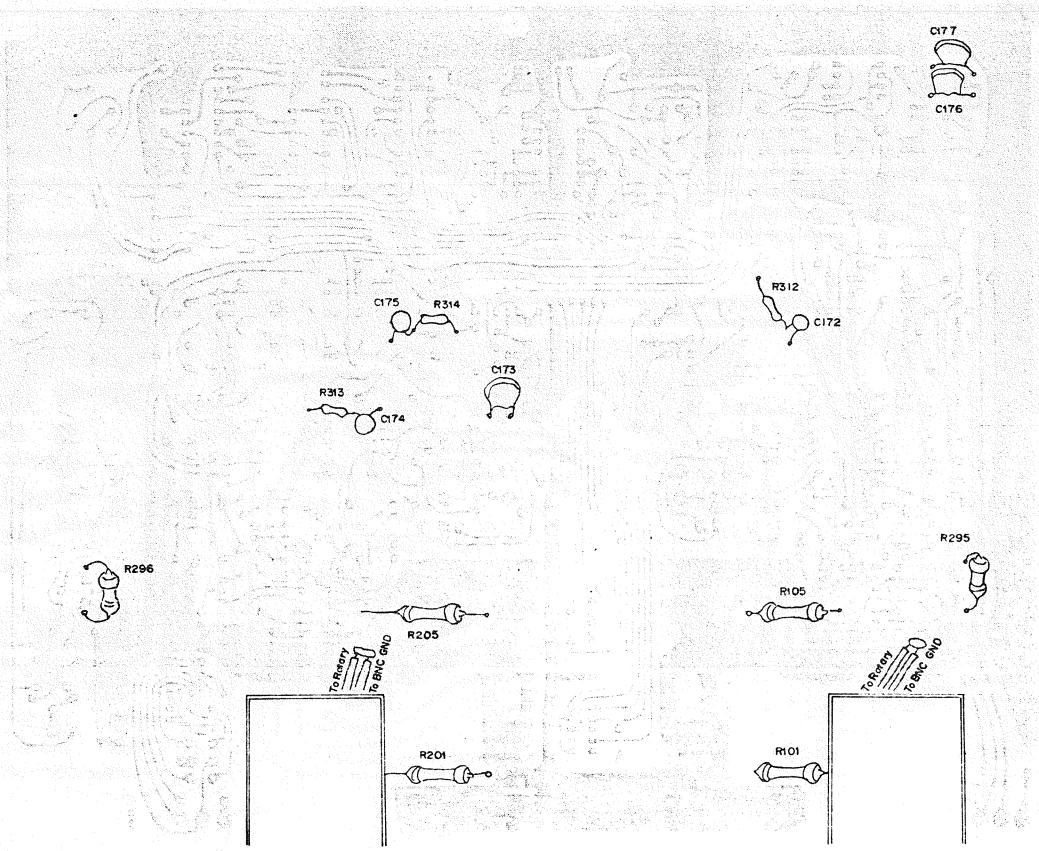
Q701~704	:2SC1047(C)
Q705, 706	:2SC2407
Q707, 708	:2SC805A-2(2)
Q709, 710	:2SA923-2(2)
Q711, 712	:2SC1973(T)
D701, 702	:1S1555
D703	:WZ-061

CIRCUIT DIAGRAM

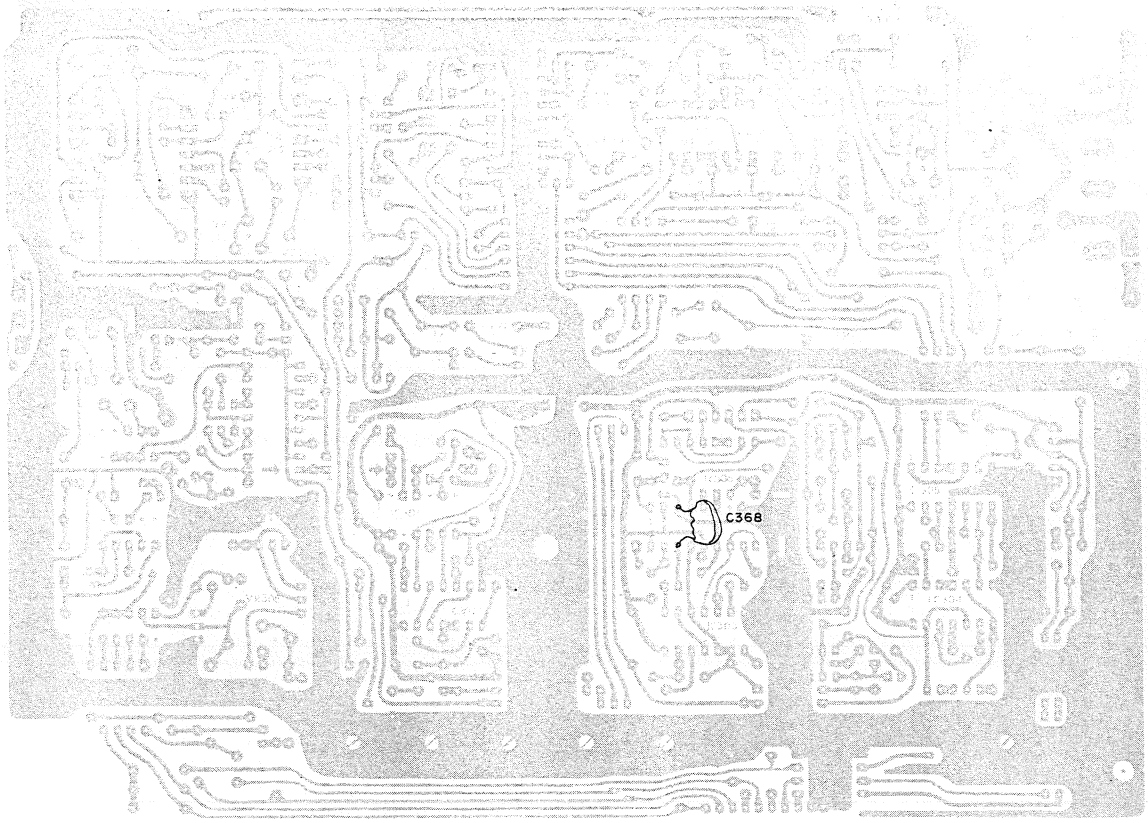


P.C. BOARD (on under side of p.c. board)

X73-1340-00

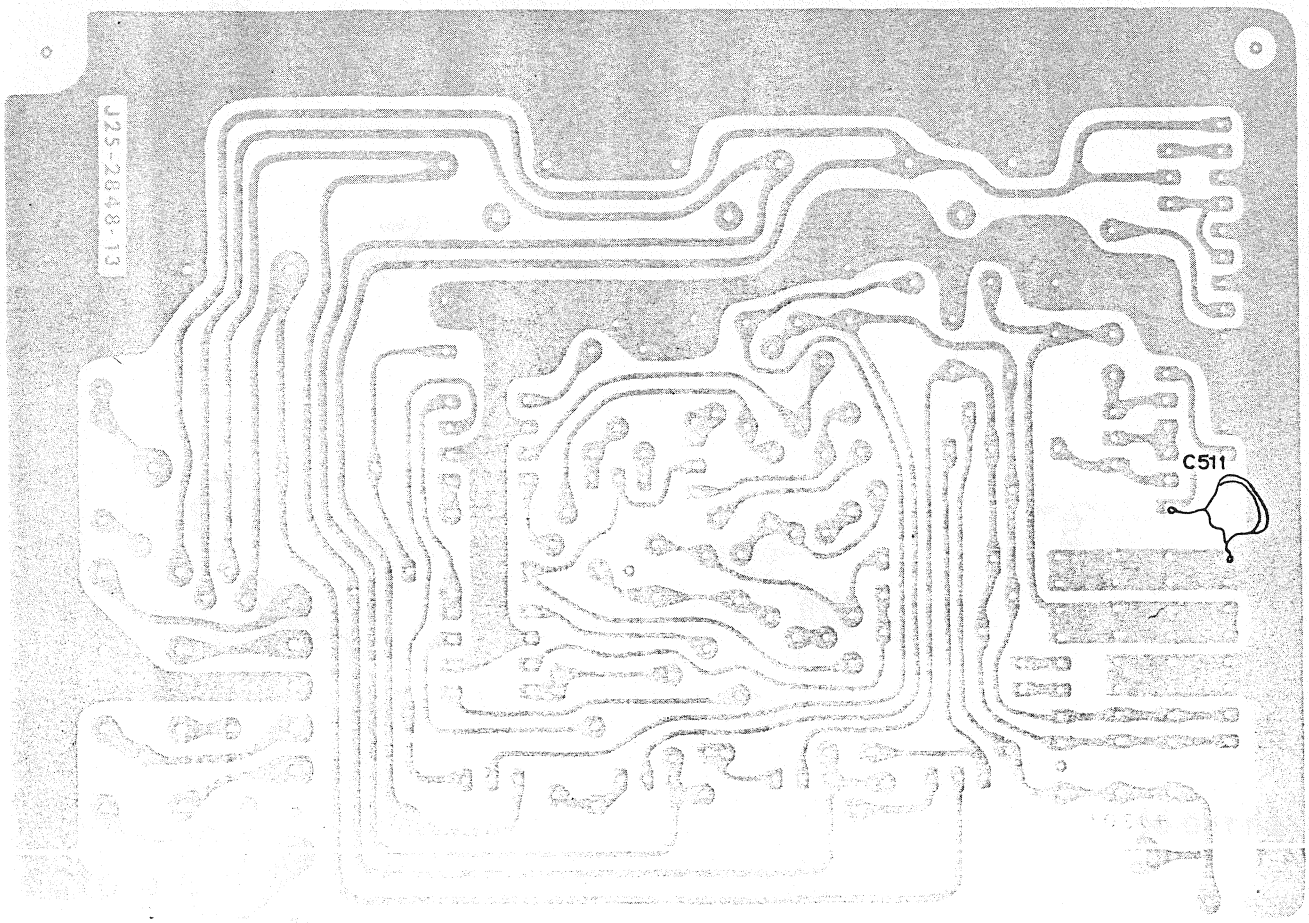


X74-1150-00



P.C. BOARD (on under side of p.c. board)

X68-1230-02



PARTS DESCRIPTION

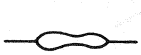
Note
Only special type of resistors (example: cement, metal film, etc.) and capacitors (example: electrolytic, tantalum, mylar, temp. coeff. capacitors) are detailed in the PARTS LIST. For the value of all common type components, refer to the schematic diagram of the P.C. board illustration.
Resistors not otherwise detailed are carbon type (1/4W or 1/8W).
Order carbon resistors and capacitors according to the following example:

A carbon resistor's part number is RD14BY 2E222J.

A ceramic capacitor's number is CK45F1H103Z, CC45TH1H220J.

RESISTOR

1. Type of the carbon resistor



RD14BY
RD14BB (small size)

RD14CY
RD14CB (small size)

2. Wattage

1W → 3A 3W → 3F 5W → 3H
2W → 3D 4W → 3G

3' = CC45 ○ ○ ...

Ceramic capacitor (type I) temperature coeff. capacitor 1' 3'.

1st word (Color)	C (Black)	L (Red)	P (Orange)	R (Yellow)	S (Green)	T (Blue)	U (Violet)
ppm/°C	0	−80	−150	−220	−330	−470	−750

3 = CK45 ○

Ceramic capacitor (type II) 3

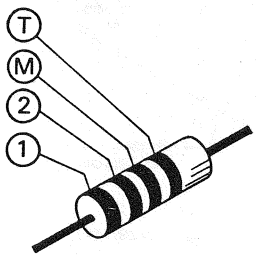
Cord	B	D	E	F
Operating temperature °C	−30 +85	−30 +85	−30 +85	−10 +70

6 = Tolerance

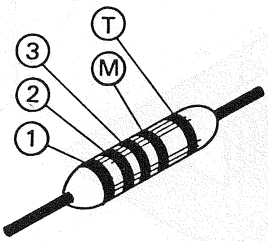
Cord	C	D	G	J	K	M	X	Z	P	No cord
(%)	±0.25	±0.5	±2	±5	±10	±20	+40 −20	+80 −20	+100 −0	More than 10 μF −10 ~ +50 Less than 4.7 μF −10 ~ +75

Less than 10 pF

Cord	B	C	D	F	G
(pF)	±0.1	±0.25	±0.5	±1	±2



COMPOSITION RESISTORS



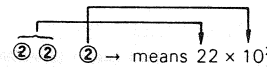
METAL-FILM RESISTORS

①②and③- 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.

Ⓜ - MULTIPLIER Ⓣ - TOLERANCE;

Ⓣⓒ - TEMPERATURE COEFFICIENT.

3. Resistance value



Example: 221 → 220Ω 223 → 22 kΩ 225 → 2.2 MΩ
222 → 2.2 kΩ 224 → 220 kΩ

4. Tolerance

J = ±5% (Gold) K = ±10% (Silver)

CAPACITORS

Type I

CC	45	TH	1H	220	J
1'	2	3'	4	5	6

1 = Type ..... ceramic, electrolytic, etc.
2 = Shape ..... round, square, etc.
3 = Temp range
3' = Temp coefficient

Type II

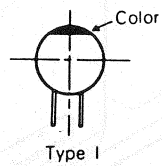
CK	45	F	1H	103	Z
1	2	3	4	5	6

4 = Voltage rating
5 = Value
6 = Tolerance

Ex CC45TH = −470 ±60 ppm/° C

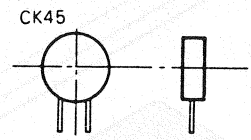
2nd Word	G	H	J	K	L
ppm/°C	±30	±60	±120	±250	±500

CC45



Type I

CK45



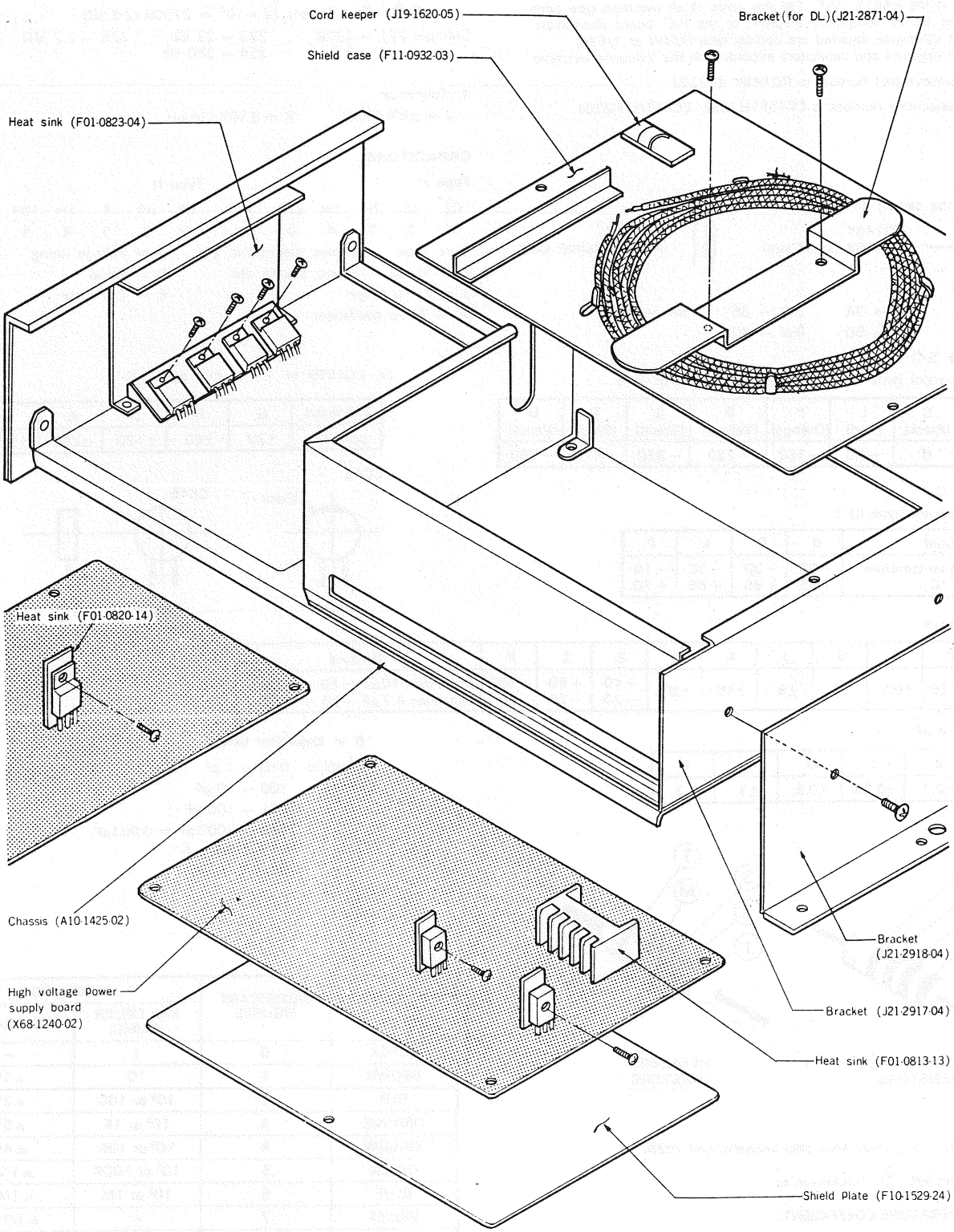
Type II

5 = Capacitor value

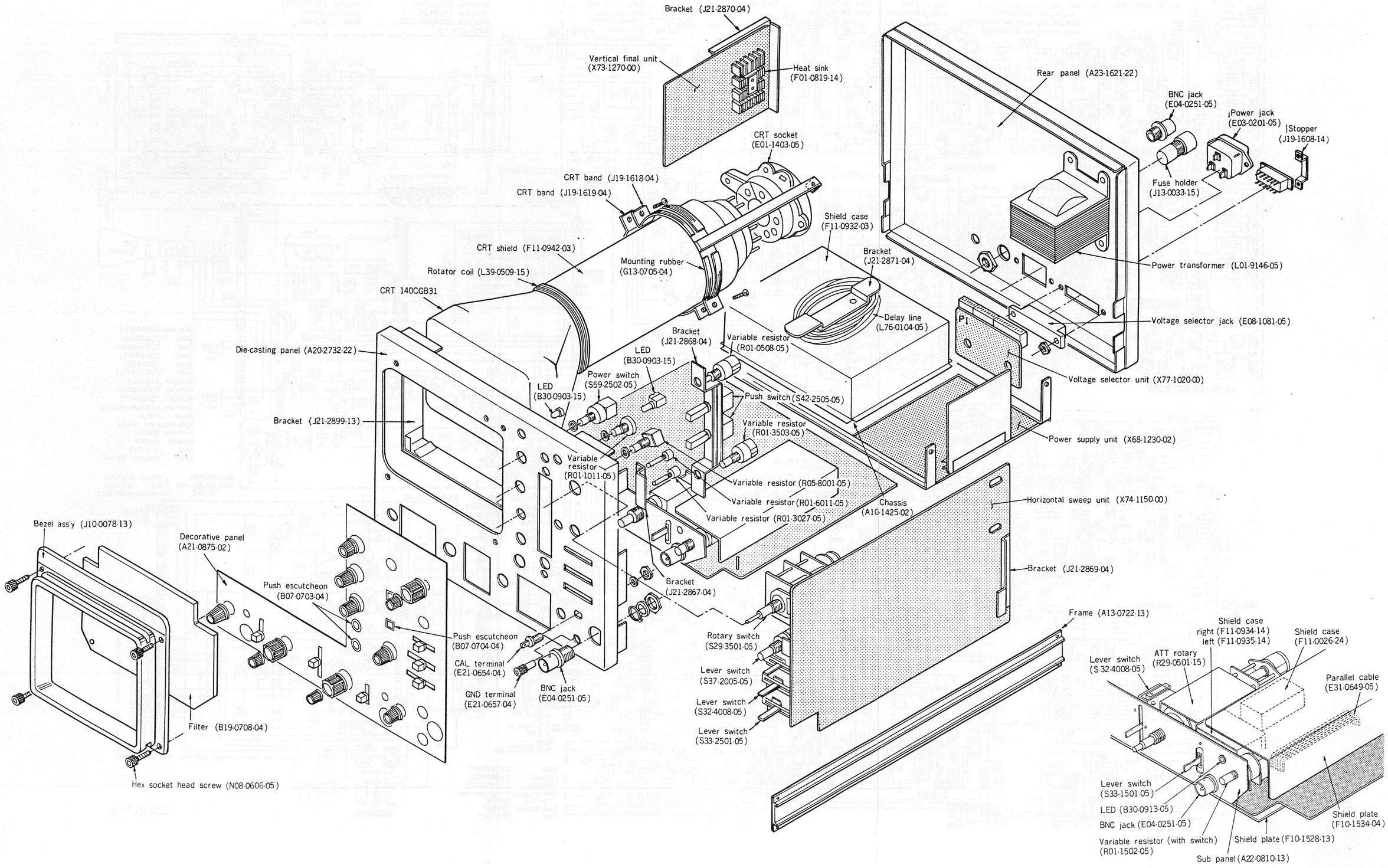
Example: 010 → 1 pF
100 → 10 pF
101 → 100 pF
102 → 1000 pF = 0.001μF
103 → 0.01 μF

COLOR	SIGNIFICANT FIGURES	RESISTORS	
		MULTIPLIER (OHMS)	TOLERANCE
BLACK	0	1	–
BROWN	1	10	±1%
RED	2	10^2 or 100	±2%
ORANGE	3	10^3 or 1K	±3%
YELLOW	4	10^4 or 10K	±4%
GREEN	5	10^5 or 100K	±1/2%
BLUE	6	10^6 or 1M	±1/4%
VIOLET	7	–	±1/10%
GRAY	8	–	–
WHITE	9	–	–
GOLD	–	10^{-1} or 0.1	±5%
SILVER	–	10^{-2} or 0.01	±10%
NONE	–	–	±20%

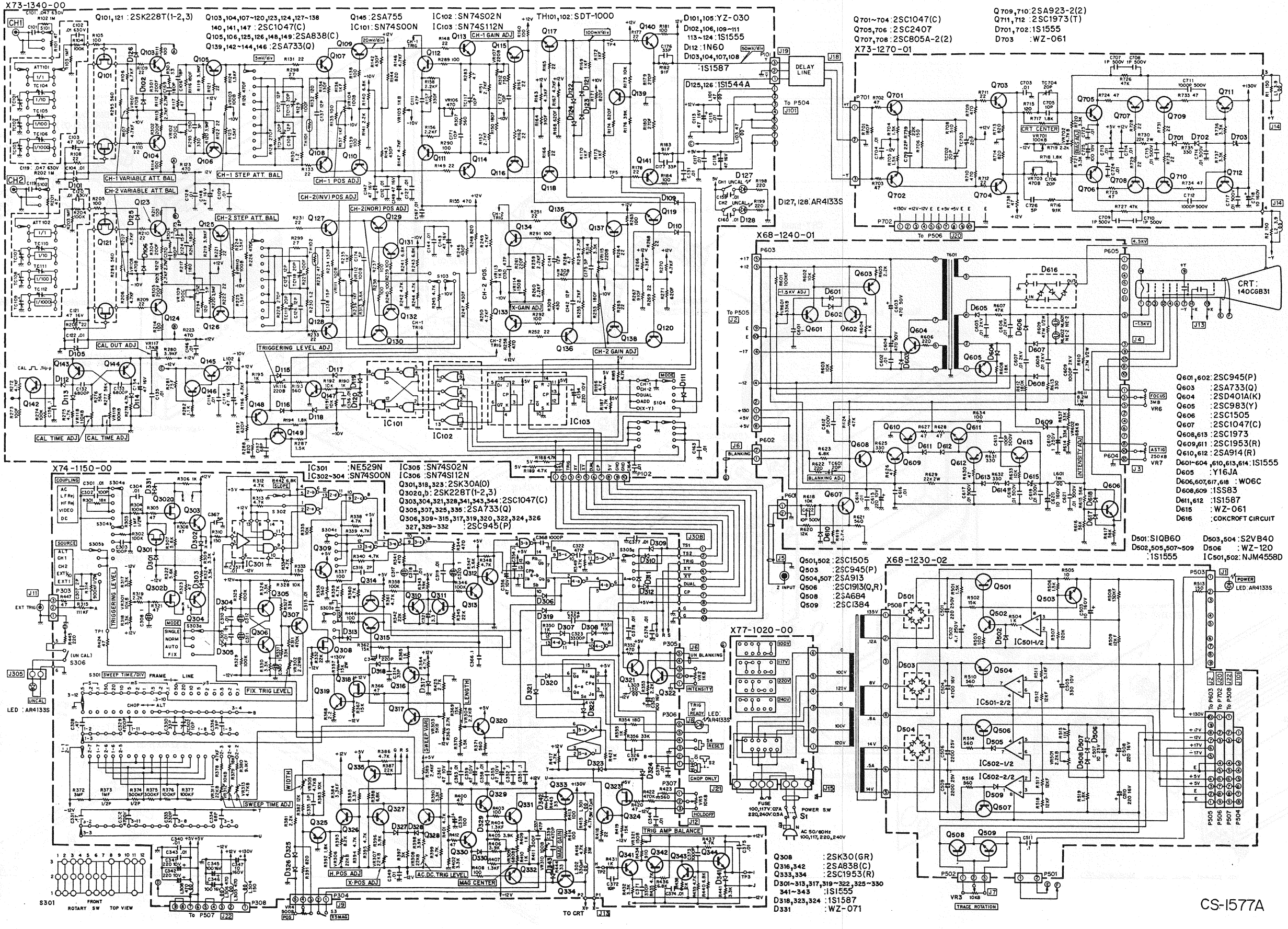
DISASSEMBLY

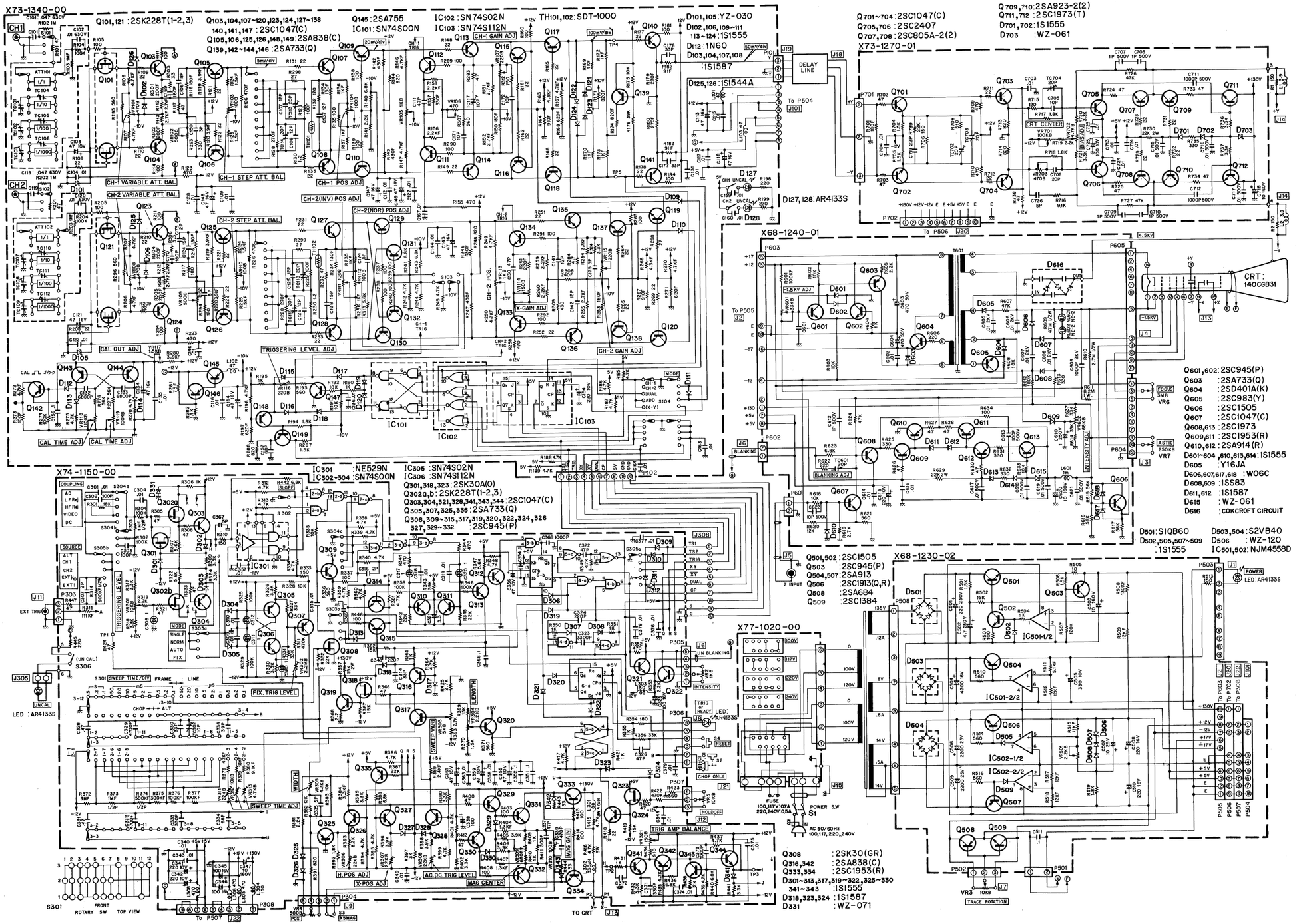


DISASSEMBLY



CIRCUIT SCHEMATIC DIAGRAM




X73-1340-00
Q101,121 :2SK228T(1-2,3)
Q103,104,107~120,123,124,127~138
140,141,147 :2SC1047(C)
Q105,106,125,126,148,149:2SA838(C)
Q139,142~144,146 :2SA733(Q)
Q145 :2SA755
IC101 :SN74S00N
IC102 :SN74S02N
IC103 :SN74S112N
TH101,102:SDT-1000
D101,105:YZ-030
D102,106,109~111
113~124:1S1555
D112 :1N60
D103,104,107,108
:1S1587
D125,126:1S1544A
D127,128:AR4133S
CH1
CH2
CH-1 VARIABLE ATT. BAL
CH-2 VARIABLE ATT. BAL
CH-1 STEP ATT. BAL
CH-2 STEP ATT. BAL
CH-1 POS ADJ
CH-2(INV) POS ADJ
CH-2(NOR) POS ADJ
CH-1 GAIN ADJ
CH-2 GAIN ADJ
CH-2 POS.
X-GAIN ADJ
CAL OUT ADJ
TRIGGERING LEVEL ADJ
CAL TIME ADJ
CAL TIME ADJ
DELAY LINE
To P504
To P505
To P506
X74-1150-00
IC301 :NE529N
IC302~304 :SN74S00N
IC305 :SN74S02N
IC306 :SN74S112N
Q301,318,323 :2SK30A(O)
Q302a,b :2SK228T(1-2,3)
Q303,304,321,328,341,343,344 :2SC1047(C)
Q305,307,325,335 :2SA733(Q)
Q306,309~315,317,319,320,322,324,326
327,329~332 :2SC945(P)
COUPLING
AC
LF Rej
HF Rej
VIDEO
DC
SOURCE
ALT
CH1
CH2
EXT
EXT TRIG
TRIGGERING LEVEL
MODE
SINGLE
NORM
AUTO
FIX
SWEEP TIME/DIV
FRAME
LINE
FIX. TRIG LEVEL
SWEEP TIME ADJ
WIDTH
H.POS ADJ
X-POS ADJ
AC.DC.TRIG LEVEL
MAG CENTER
TRIG AMP BALANCE
CHOP ONLY
HOLDOFF
RESET
INTENSITY
TRIG OR READY LED: AR4133S
UNCAL LED :AR4133S
S301 ROTARY SW TOP VIEW
FRONT
TO CRT
To P507
To P508
X68-1240-01
Q601,602:2SC945(P)
Q603 :2SA733(Q)
Q604 :2SD401A(K)
Q605 :2SC983(Y)
Q606 :2SC1505
Q607 :2SC1047(C)
Q608,613 :2SC1973
Q609,611 :2SC1953(R)
Q610,612 :2SA914(R)
D601~604,610,613,614:1S1555
D605 :Y16JA
D606,607,617,618 :WO6C
D608,609 :1SS83
D611,612 :1S1587
D615 :WZ-061
D616 :COKCROFT CIRCUIT
CRT : 14QGB31
-1.5KV ADJ
FOCUS
ASTIG
INTENSITY ADJ
TRACE ROTATION
Q701~704:2SC1047(C)
Q705,706 :2SC2407
Q707,708:2SC805A-2(2)
Q709,710:2SA923-2(2)
Q711,712 :2SC1973(T)
D701,702:1S1555
D703 :WZ-061
X73-1270-01
CRT CENTER
X77-1020-00
FUSE
100,117V:.07A
220,240V:.05A
POWER SW
S1
AC 50/60Hz
100,117,220,240V
Q308 :2SK30(GR)
Q316,342 :2SA838(C)
Q333,334 :2SC1953(R)
D301~313,317,319~322,325~330
341~343 :1S1555
D318,323,324 :1S1587
D331 :WZ-071
X68-1230-02
D501:S1QB60 D503,504 :S2VB40
D502,505,507~509 D506 :WZ-120
:1S1555 IC501,502: NJM4558D
Q501,502 :2SC1505
Q503 :2SC945(P)
Q504,507:2SA913
Q506 :2SC1913(Q,R)
Q508 :2SA684
Q509 :2SC1384
POWER
LED :AR4133S
Z INPUT

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