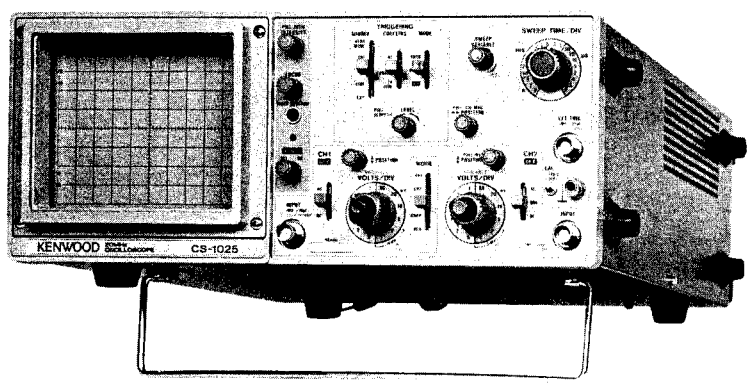
KENWOOD

DUAL TRACE OSCILLOSCOPE

CS-1025

SERVICE MANUAL

KENWOOD CORPORATION



CONTENTS

WARNING

1. The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.
2. High voltage up to 6000 volts dc is present when the oscilloscope is operating. Line voltage (100 to 240 VAC) is present on the power transformer, on-off switch, fuse holder, and line voltage selector 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.

SPECIFICATIONS

CRT : 150QTM31
Acceleration Voltage : 6 kV
Display Area : 8×10 div (1 div=10 mm)
Type : Rectangular, with internal graticule
VERTICAL AXIS : CH1 and CH2
Sensitivity : 1 mV/div to 5 V/div, ±3%
Attenuator : 12 steps, 1 mV/div to 5 V/div in 1-2-5 sequence.
Vernier control for fully adjustable sensitivity between steps.
Input Impedance : 1 MΩ ±2%, approx. 22pF
Frequency Response
5 mV/div to 5 V/div : DC; DC to 20 MHz, −3 dB
AC; 5 Hz to 20 MHz, −3 dB
1 mV/div, 2 mV/div : DC; DC to 10 MHz, −3 dB
AC; 5 Hz to 10 MHz, −3 dB
Rise Time : 17.5 nsec or less (20 MHz)
35 nsec or less (10 MHz)
Crosstalk : −40 dB minimum
Operating Modes : CH1; single trace
CH2; single trace
ALT; two waveforms alternating
CHOP; two waveforms chopped
ADD; CH1+CH2 added display
Chop Frequency : Approx. 250 kHz
Channel Polarity : Normal or inverted, Channel 2 only inverted
⚠ Maximum Input voltage : 500 Vp-p or 250 V (DC+AC peak)
HORIZONTAL AXIS : (input thru CH2, ×10 MAG not included)
Operating Mode : With TRIG MODE switch, X-Y operation is selectable.
CH1; Y axis
CH2; X axis
Sensitivity : Same as vertical axis (CH2)
Input Impedance : Same as vertical axis (CH2)
Frequency Response : DC; DC to 500 kHz, −3 dB
AC; 5 Hz to 500 kHz, −3 dB
X-Y Phase Difference : 3° or less at 50 kHz
⚠ Maximum Input Voltage : Same as vertical axis (CH2)
SWEEP
Type NORM : Triggering sweep
AUTO : Sweep free runs in absence of trigger
Sweep Time : 0.2 μs/div to 0.5 s/div ±3%, in 20 ranges, in 1-2-5 sequence.
Vernier control provides fully adjustable sweep time between steps.
Sweep Magnification : ×10 (ten times) ±5%
(0.2 μs/div range; ±8%)
Linearity : ±3% all ranges,
±5% on 0.2 μs/div range at ×10 magnification.
TRIGGERING
Internal Sync
V. MODE; Triggered by input signal selected by vertical MODE setting.
CH1; Triggered by CH1 signal
CH2; Triggered by CH2 signal
LINE; Triggered by line frequency
External Sync
EXT; Trigeered by signal applied to EXT TRIG INPUT jack
External sync Input Impedance : approx. 1 MΩ ±20%
approx. 30pF
Maximum External Trigger Voltage : 50 V (DC+AC peak)
Coupling : AC, TV FRAME, TV LINE
Tigger Sensitivity

	FREQ. RANGE	INT	EXT
AUTO	50 Hz – 20 MHz	1 div	0.1 Vp-p
NORM	10 Hz to 20 MHz	1 div	0.1 Vp-p
TV	FRAME, LINE	1 div	0.1 Vp-p

PROBE ADJ, VOLTAGE : 1 V ±3%, square wave, positive polarity, approx. 1 kHz
INTENSITY MODULATION
Sensitivity : TTL compatible
Positive voltage decreases brightness.
Negative voltage increases brightness.
Input Impedance : Approx. 10 kΩ
Usable Frequency Range : DC to 2 MHz
Maximum Input Voltage : 50 V (DC+AC peak)
VERTICAL AXIS SIGNAL OUTPUT: (CH1 SIGNAL OUTPUT)
Output Voltage : Approx. 50mV/div (50 Ω load)
Output Impedance : Approx. 50 Ω
Frequency Response : 100 Hz to 20 MHz, −3 dB
TRACE ROTATION : Electrical, adjustable from front panel

SPECIFICATIONS

POWER REQUIREMENT

Power Supply	: AC 100 V/120 V/220 V/240 V ±10%
Line Frequency	: 50/60 Hz
Power Consumption	: Approx. 35 W
DIMENSIONS (W×H×D×)	: 319 (341)×132 (145)×380 (442) ( ) dimensions include progrusion from basic outline dimensions
WEIGHT	: Approx. kg

ENVIRONMENT

Operating Temperature and Humidity for Guaranted Specifications	: 10°C to 35°C, 85% maximum RH
Full Operating Temperature and Humidity	: 0°C to 40°C, 85% maximum RH

ACCESSORIES SUPPLIED

Probe		: 2
Replacement Fuse:	0.5 A	: 2
	0.3 A	: 2
Instruction		: 1

■ Circuit and rating are subject to change without notice due to developments in technology.

STANDARD ACCESSORIES INCLUDED

Probe (PC-20) Y87-1840-00
- Attenuation 1/10, 1/1
- Input Impedance
  - 1/10 ..... 10 MΩ, 18pF or less
  - 1/1 ..... 1 MΩ, 100pF or less

Instruction Manual B50-7583-00

Replacement Fuse
- 0.5 A F05-5013-05
- 0.3 A F05-3011-05

OPTIONAL ACCESSORIES

Probe Pouch (MC-78) Y87-1600-00

SPECIFICATIONS

CRT 150FTM 31 SPECIFICATIONS (150GTM31A)

Screen and Shape

Dimensions;

Overall length;	330 mm max. (355mm max)
Face plate dimensions;	149.3±3 mm max. (149±3 mm)
Screen shape;	Rectangular flat face, internal graticule, non-metal back
Deflection and focusing system;	Electrostatic deflection, electrostatic focusing and post-deflection acceleration
Color;	Green
Persistence;	Medium short
Useful display area	Y axis.....80 mm X axis.....100 mm

Heating

Heater voltage	6.0 V
Heater current	75 mV

Weight 900 gr

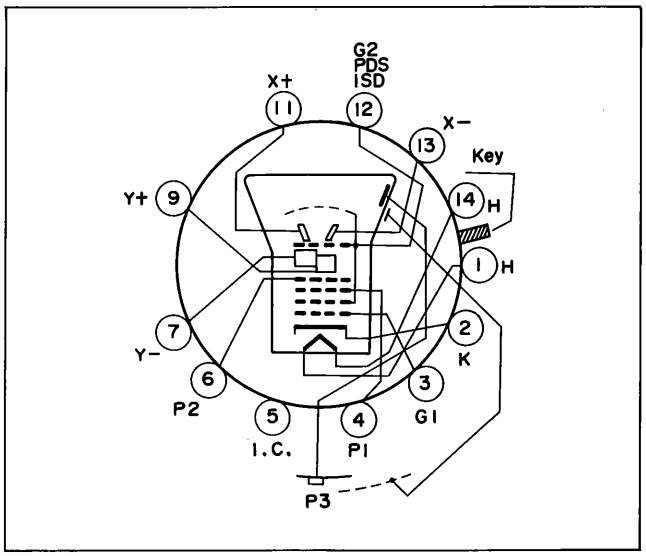


Fig. 3 150QTM31 Basing

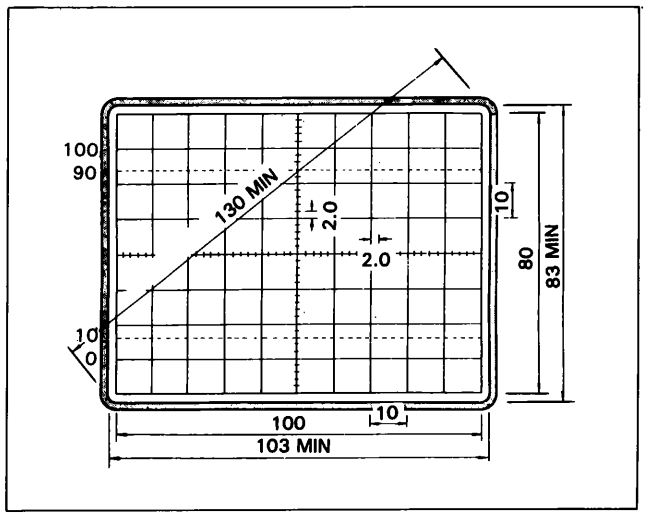
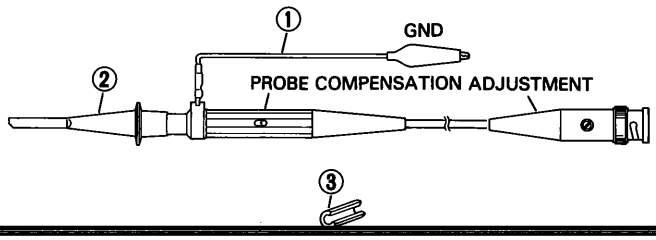


Fig. 1 150QTM31 Graticule

MODEL PC-30 (LOW CAPACITY PROBE)



ITEM	DESCRIPTION	PARTS NO.
①	Ground Wire Assembly	E30-1883-08
②	Retractable Hook Tip	E29-0540-08
③	Insulator Cap	B42-1950-08

PC-30 SPECIFICATIONS

	X10 position	X1 position
Attenuator	1/10 ±2% (at oscilloscope input impedance of 1 MΩ ±1%	—
Input impedance	10 MΩ ±1%	1 MΩ ±1%
Input capacity	22 pF ±10%	Less than 200 pF
[illegible]	50 MHz	6 MHz
Rise time	7 ns	58 ns
Oscilloscope input capacity	20 to 45 pF	
Max. input voltage	DC 600 V	

SAFETY

Before connecting the instrument to a power source, carefully read the following information, then verify that the proper power cord is used and the proper line fuse is installed for power source. The specified voltage is shown at the left side of the power cord on the rear panel. If the power cord is not applied for specified voltage, there is always a certain amount of danger from electric shock.

Line voltage

This instrument operates using ac-power input voltages that 100/120/220/240 V at frequencies from 50 Hz to 60 Hz.

Power cord

The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Do not attempt to defeat the ground wire connection or float the oscilloscope; to do so may pose a great safety hazard. The appropriate power cord is supplied by an option that is specified when the instrument is ordered.

The optional power cords are shown as follows in Fig. 4.

Line fuse

The fuse holder is located on the rear panel and contains the line fuse. Verify that the proper fuse is installed by replacing the line fuse.

Voltage conversion

This oscilloscope may be operated from either a 100 V to 240 V, 50/60 Hz power source. Use the following procedure to change from 100- to 240 volt operation or vice versa.

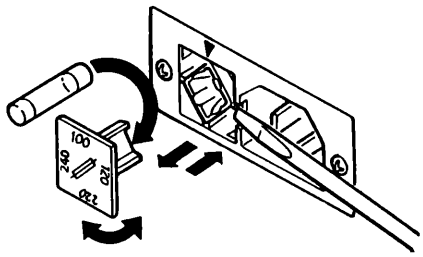
Replacing the fuse

In case the fuse has blown, locate the cause. If the fuse itself is the cause, replace it as follows:

1. Pull the plug of the power cord from the power outlet.
2. Remove the fuse holder in the rear panel using a standard screwdriver.
3. Take out the blown fuse, and in its place, insert a new fuse.
4. Set the label of your line voltage to the mark ▼, then plug the fuse holder containing the new fuse into the rear panel.

Changing the supply voltage

Remove the fuse holder in the rear panel using a standard screwdriver. Then set the label of your line voltage to the mark ▼ and plug the fuse holder back into place. When changing the supply setting from 100/200 V to 220/240 V, change the 0.5 A fuse for a 0.3 A one.



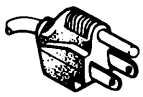
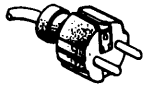
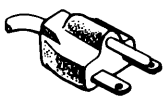
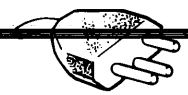
Plug configuration	Power cord and plug type	Factory installed instrument fuse	Line cord plug fuse	Parts No. for power cord and plate
	North American 120 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.5 A, 250 V Fast blow AGC/3AG	None	Cord:
	Universal Europe 220 volt/50 Hz Rated 16 amp	0.3 A, 250 V Fast blow 5 × 20 mm	None	Cord:
	U.K. 240 volt/50 Hz Rated 13 amp	0.3 A, 250 V Fast blow 5 × 20 mm	0.3 A Type C	—
	Australian 240 volt/50 Hz Rated 10 amp	0.3 A, 250 V Fast blow 5 × 20 mm	None	Cord:
	North American 240 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.3 A, 250 V Fast blow AGC/3AG	None	—
	Switzerland 240 volt/50 Hz Rated 10 amp	0.3 A, 250 V Fast blow AGC/3AG 5 × 20 mm	None	—

Fig. 3 Power Input Voltage Configuration

CIRCUIT DESCRIPTION

Vertical Attenuator Circuit (X73-1640-00)

The attenuators of CH1 and CH2 incorporate a unit encompassing the entire attenuator circuit.

The vertical signals input from the BNC connectors are switches by the AC-DC-GND switch, supplied through the 1/1, 1/10 or 100/1 attenuator, and input to the first-stage buffer amplifier.

The first-stage buffer amplifier consists of Q1 to Q6 and U1 (CH2: Q21 to Q26, U3). The signal which enters the buffer amp is separated into high-frequency and low-frequency components. The high-frequency component is impedance-converted by Q3 (Q23), and the low-frequency component by U1 (U3). The respective components are recombined at Q4 (Q24) and output from the emitter-follower of Q5 (Q25). Q4 (Q24) and Q6 (Q26) provided with the same forms as Q3 (Q23) and Q5 (Q25) in order to reduce the DC offset drift. The buffer amplifier is designed in consideration of the temperature drift by selecting a device with a small temperature drift as U1 (U3) and by applying negative feedback. The signal output from the buffer amplifier is once again input to the second-stage attenuator of the attenuator unit, where it is attenuated to 1/1, 1/2 or 1/5 and supplied to the vertical preamplifier. The second-stage attenuator consists of a low-impedance resistor network with good frequency characteristics, and is provided with a switch for boosting the preamplifier gain 5-fold when the deflection factor is 1 mV/div or 2 mV/div. Q1 (Q21) and Q2 (Q22) are provided for the input circuitry so that they can function equivalently as diodes in order to prevent devices when the input has a large amplitude.

VR1 (VR10) is used for adjusting the DC balance between attenuator steps and can be adjusted from outside the case. VR2 (VR11) is used for adjusting the gain of the low-frequency component.

Vertical Preamplifier Circuit (X73-1640-00)

The signal output from the attenuator circuit enters the second amplifier which consists of transistor array U2 (U4). This stage is a differential amplifier, which generates complementary signals, amplifies and supplies them to the third amplifier. When the deflection factor is 1 mV/div or 2 mV/div, the emitter resistance of U2 a, b (U4a, b) can be switched by the switch in the second-stage attenuator to boost the gain 5-fold. VR4 (VR13) is used for adjusting the DC offset at this time, and can be adjusted from the outside. TC1 (TC3), TC2 (TC4) and VR3 (VR12) form a circuit which adjusts the frequecncy characteristic, and VR26 (VR27) is used for adjusting the deflection factor to 1 mV/div or 2 mV/div.

Thermistor TH1 (TH2) is used to compensate for the gain drift due to temperature when the deflection factor is 1 mV/div or 2 mV/div.

The signal amplifier by the second amplifier is further amplified by the cascode amplifier of U2 c, d (U4 c, d), Q7 (Q28) and Q8 (Q29). This third amplifier has a large gain therefore uses the cascode-connected structure in order to suppress the influence from the transistor's feedback capacity.

With CH2, Q27 and Q30 from the CH2 INV Circuit. Q28 and Q29 can be switched to Q27 and Q30 by the switch provided with CH2 POSITION VR.

U2e (U4e) is the regulated power supply or the third amplifier provided for improving the CMRR of the differential amplifier.

Between the second and third amplifier, the vertical deflection factor variation circuit is formed using the VR on the attenuator unit. VR6 (VR15) is used for the balance adjustment in this operation, and can be adjusted from the outside.

VR25 (VR16) is used for the balance adjustment of the third amplifier. VR25 is the CH1 POSITION adjustment control and VR16 is the CH2 INV balance adjustment control.

The signal amplified by the third amplifier is sent to the fourth amplifier via the emitter-follower of Q9 (Q31) and Q10 (Q32). D3 (D12) and D4 (D13) are used for limiting the amplitude of the signal.

The fourth amplifier is also a cascode amplifier, composed of Q11 (Q33), Q12 (Q34), Q16 (Q38) and Q17 (Q39). The vertical mode is switched at this stage by switching Q16 (Q38), Q17 (Q39), D5 (D14) and D6 (D15) using the vertical mode switching signal from the horizontal sweep unit. VR23 and VR24 are used to vary the differential amplifier current respectively as CH1 POSITION and CH2 POSITION.

Q13 and Q14 pick up signal from the fourth amplifier, and Q13 and Q46 send a current signal to the horizontal sweep unit for use as the CH1 trigger signal. Q14 picks up the CH1 OUT signal, which is supplied through the emitter-follower of Q18 and output from the push-pull single-ended amplifier of Q19 and Q20. Q15 is the regulated power supply for Q13 and Q14, and generates the operation current for the CH1 trigger current signal. D7 is used for the temperature compensation of the power supply.

VR7 is used to adjust the CH1 gain, and VR8 adjusts the gain of the CH1 trigger and CH1 OUT signals. VR9 is used to align the DC level of the CH1 trigger signal with that of the CH2 trigger signal.

Q35 and Q36 pick up the signal from CH2 of the fourth amplifier, Q35 and Q47 sends the power supply signal to the horizontal sweep unit for use as the CH2 trigger signal, and Q36 sends the same signal to the same unit for use as the X signal. Q37 is the regulated power supply for Q35 and Q36, and generates the operation current for the CH2 trigger and X current signals. D16 is used for the temperature compensation of the power supply.

VR17 is used to adjust the CH2 gain, and VR18 adjusts the

CIRCUIT DESCRIPTION

gain of the CH2 trigger and X signals. VR19 adjusts the DC level of the signal by adjusting the position of X.
TC7 is the trimmer which adjusts the CH2 frequency characteristic.
D20 is used for switching of the X-Y mode and sweep.

Vertical Output amplifier Circuit (X73-1640-00)

The signal switched by the fourth amplifier of the vertical preamplifier circuit is mixed at the collectors of Q16, Q17, Q38 and Q39, Sent through the emitter-follower of Q40 and Q41, and amplified by the output amplifier consisting of Q42. Q43, Q44 and Q45 to be used to drive the CRT's Y deflection plate.
The output amplifier is cascode-connected in order to suppress the influence from the transistor's feedback capacity and to offer high withstanding voltage and high fT. To maintain the amplifier's operating point at a constant level, non-adjusting circuit is achieved by the feedback using U5a and D17.
TH3 is used to compensate for the temperature drift of the gain of all stages of the vertical amplifier.
VR2 is used for adjusting the balance of +Y and −Y of the CRT. It adjusts so that the trace comes to the center position. VR21, VR22, TC5 and TC6 form a circuit which adjusts the frequency characteristic.

Vertical Mode Logic Circuit (X74-1430-00)

The vertical mode switching signal from the vertical amplifier unit and the signal from the sweep gate are input to the vertical mode logic circuit. The vertical mode switching signal controls the flip-flop consisting of D2, D3 and U2a and the chop signal generator consisting of U1c, U1d and D1, while the signal from the sweep gate controls the flip-flop via U1a and U1b. The flip-flop outputs the channel switching signal for the vertical axis, and sends it to the vertical amplifier unit via D6 and D8. Also in the X-Y mode, the flip-flop is controlled via D4, D5 and D7.

Trigger Signal Generator Circuit (X74-1430-00)

A total of four signals, i.e. the CH1 and CH2 trigger signals from the vertical amplifier unit, the signal from the external trigger amplifier and the line trigger signal, are switched by diodes D10 to D13 and trigger-source switch S1 a, b, c, and d. The selected signal is amplified by grounded-base amplifier Q4, supplied through the emitterfollower of Q5 and Q6, and amplified by the differential amplifier of Q7 and Q8. The amplified signal is sent to the coupling select switch after its polarity has been selected by the trigger slope switch.
On the other hand, in the TV trigger mode, the signal is extracted from the emitter of Q5, supplied through the coupling switch to Q11, where a signal with complementary polarity is generated. One of the two signals, which is selected by the trigger slope switch, is sent to the amplifier of Q12, Q13 and Q14, which amplifies only the TV signal trigger pulse. The amplified TV trigger pulse is then filtered to be separated into the vertical and horizontal trigger pulses, and they are both supplied to the coupling switch.

The coupling switch is supplied with the normal trigger signal vertical TV trigger signal and horizontal TV trigger signal. The signal selected is amplified by the final stage of trigger amplifier, Q9 and Q10, before being output.
The trigger signal from the trigger amplifier's final stage is shaped the schmitt trigger circuit Of U3c, its level and polarity are converted by Q15, and the signal obtained is output as the sweep gate clock signal.
The trigger signal, the waveform of which has been shaped, is also supplied to the differentiation circuit and input to the auto free-run circuit consisting of U3a, U3b, U3c and Q16. This circuit detects the presence or absence of the output from U3c, and controls the sweep gate so that free-run occurs when there is no signal in the AUTO mode.
The external trigger signal is input via the trigger amplifier consisting of Q37 and Q38. The impedance of the external input is converted by Q37 and amplified by Q38, so the trigger signal is output as a current signal.
The line trigger amplifier consists of Q24. It amplifies the line signal, which has been wave-shaped by the power supply high-voltage unit, and outputs it as a current signal.

Horizontal Sweep Circuit (X74-1430-00)

The output from sweep gate U2b is determined by the auto free-run circuit and schmitt trigger circuit. When Q23 is turned OFF via Q3 and Q22, the Miller integrator circuit starts charging at a speed determined by the CR timebase circuit. The sweep rate is variable using SWEEP VARIABLE VR1.
The sweep stopper circuit consisting of Q19 and Q20 detects the voltage output from the Miller integrator circuit, inverts the statuses at U4b, c and d, and controls the sweep gate via D24 and U4a so as to stop sweeping. At the same time, it also controls the holdoff circuit, turning Q21 OFF and charging the holdoff capacitor. The voltage output from it is detected and returned to U4c again. Its status is then inverted and used to control the sweep gate so as to start sweeping.
The sawtooth wave output from the Miller integrator circuit is sent to the horizontal output amplifier after its sweep rate has been adjusted by VR2. VR10 is used for adjusting the horizontal position of the trace.
VR3 and TC1 are used for adjusting the sweep time of the 10 μs/div and 10 μs/div ranges respectively.

Horizontal Amplifier Circuit (X74-1430-00)

The sawtooth wave signal is input to the emitter of Q25 as a current signal, and it is converted into a voltage. The horizontal position is obtained similarly by supplying DC

current to the emitter. The signal output from Q25 is sent via the emitter-follower of Q26, input to the differential amplifier of Q27 and Q28, and sent to the final stage via the emitter-follower consisting of Q30 and Q31. Q33 and Q35 are the constant-current loads for Q32 and Q34 respectively. After the negative feedback, the output with the better linearity is used to drive the CRT's C deflection plate at low impedance.

Q29 is the constant-current supply for biasing Q17 and Q28, and is temperature-compensated by D21. D28 and D29 are employed to present the delay in response due to the switching operation of Q32 and Q34.

TH2 is used for compensating the temperature drift of the horizontal amplifier gain, and TH1 is used for correcting the temparature drift of the gain in X10 MAG mode. X10 MAG refers to the magnification of gain by 10-fold, made possible by varying the gain resistance between the emitters of Q27 and Q28.

VR5 is used for adjusting the X10 MAG gain, and VR4 is for adjsuting the position center in X10 MAG mode.

Blanking Circuit (X74-1430-00)

Q, the output from sweep gate U2b, and the CHOP signal obtained by U1c and d are ANDed at U1a to obtain the blanking signal. After its amplitude is varied at Q17 and Q18 by the voltage from the INTENSITY VR, it is sent to the power-supply high-voltage unit.

X-Y Circuit (X74-1430-00)

To prevent sweeping in the X-Y mode, the sweep gate is controlled from the mode switch via D18. The CHOP signal oscillator is stopped via D4, the vertical mode logic is controlled by D5 and D7 so that CH1 is ON and CH2 is OFF, and the blanking signal is generated by D17. In addition, the sawtooth wave signal is switched to the X signal from the vertical amplifier unit, and the current signal is supplied to the horizontal amplifier circuit.

CRT G_2 Bias Circuit and ASTIG Circuit (X74-1430-00)

As the CRT's G_2 bias voltage has a large influence on its sensitivity and intensity, it is stabilized by Q36 and output at low impedance.

With the ASTIG circuit, +120 V is adjusted by a VR and connected directly to the CRT's second plate.

Blanking Amplifier Circuit and High Voltage Circuit (X68-1450-00)

The high-voltage used for driving the CRT is obtained using a DC-DC converter circuit.

By the oscillation with the non-regulated +10 V power supply, Q3 and T1, the secondary coil of T1 outputs the CRT heater power and the AC power supply for the CRT cathode and anode. The power for the cathode and anode are rectified by the rectifier block which is filled with epoxy resin.

The high-voltage cathode power supply is double-voltage rectified, high-voltage anode power supply is rectified to 6 times, and −1.5 kV and 4.5 kV high voltages are obtained respectively. For this purpose, the converter is designed to be a safe circuit without high-voltage leakage, having high efficiency and low current consumption.

The converter is also made highly stable thanks to the feedback applied using operational amplifier U4b.

For the blanking amplifier circuit, the blanking signal from the horizontal sweep unit is supplied to Q10 via the emitter-follower of Q13. Q9 is the constant-voltage load of Q10. It is subject to negative feedback so it amplifies and outputs the signal with low output impedance.

This blanking signal is DC-regerenated by the carrier signal from D14 to D17 and T1 to obtain a high voltage used for driving the CRT grid No. 1.

The focusing high voltage is obtained by dividing the cathode high voltage using a resistor with potentiometer, and applied to the first plate.

The external intensity modulation circuit is a simplified circuit, in which the input signal is supplied via a resistor to the base of Q13 of the blanking amplifier. The input voltage is +5 V, and the intensity decreases when the voltage increases positively.

VR2 is the intensity adjustment control.

Power Supply Circuit (X68-1450-00)

The constant-voltage regulated power supply circuit is designed to be highly stable by using operational amplifiers U1a, U1b, U2b, U3a and U3b as the error amplifiers of all of five lines. Q1 to Q7 are the control transistors. VR1 is used to adjust −10 V, which is the reference voltage of all error amplifiers.

Calibration Voltage Generator Circuit (X68-1450-00)

This is an oscillation circuit using operational amplifier U2a and outputs a highly stable signal. VR3 is used to adjust the amplitude of the calibration voltage output.

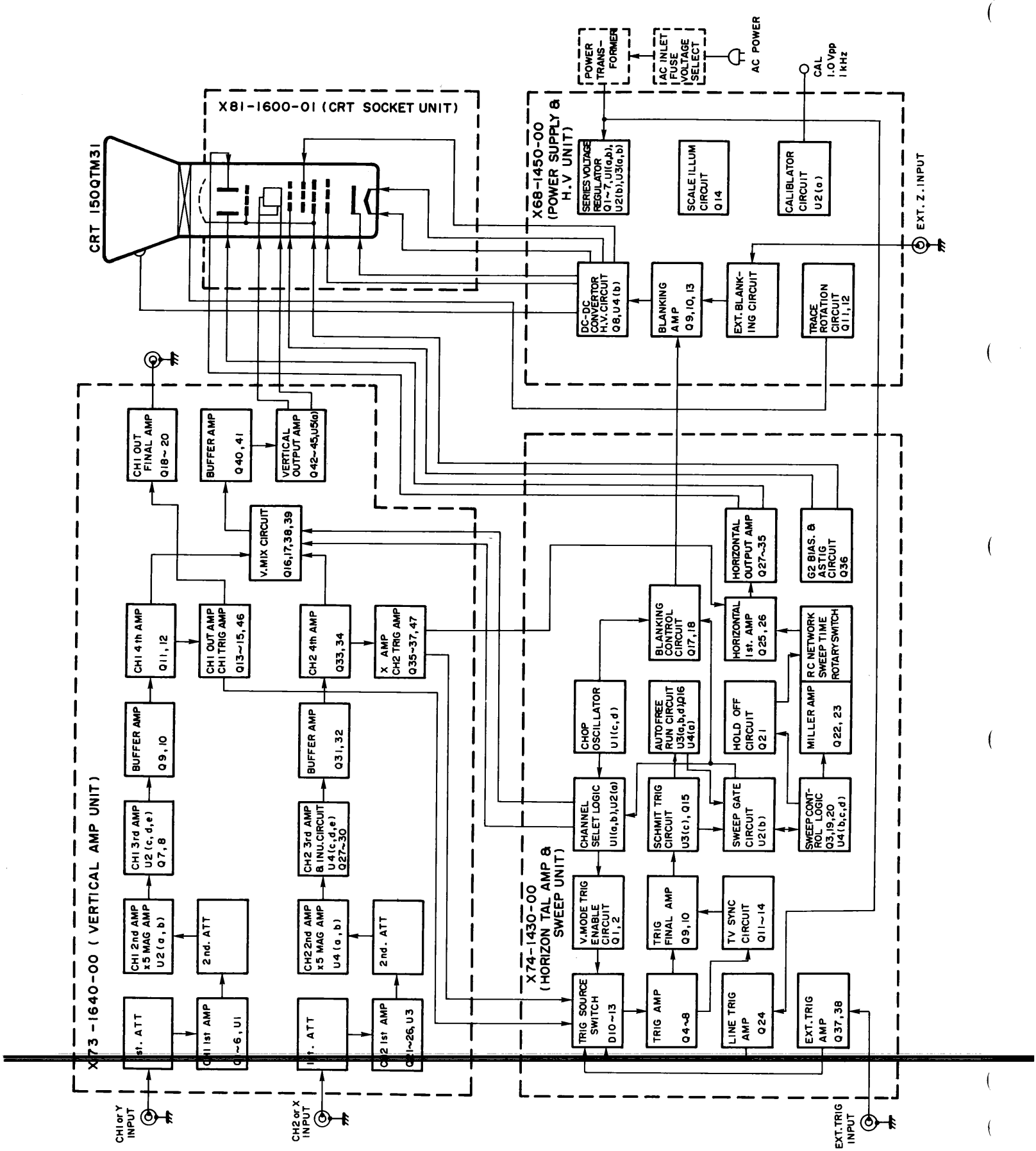
Trace Rotation Circuit (X68-1450-00)

Q11 and Q12 supply current to the rotator coil.

Scale Illumination Circuit (X68-1450-00)

The power is supplied via an independent line deriving from the ±10 V coil of the power transformer. The voltage is rectified by diode bridge D22 and supplied to the illumination lamp via a VR and control transistor Q14.

BLOCK DIAGRAM



ADJUSTMENT

To obtain the best performance, periodically calibrate the unit. Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated. When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.
The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer.
For optimum adjustment, turn the power on and warm up the this equipment sufficiently (more than 30 minutes) before starting.
Before calibrating the unit, check the power supply voltage.

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustment.

Test Equipment	Model	Minimum Specification
Digital Multi-Meter	DL-706 (KENWOOD)	Impedance: More than 10 MΩ, Measuring range: 0.01 V to 199 V
Sine-Wave Generator	651 B (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: 5 mVp-p to 5 Vp-p, Accuracy: within ±1%, Rise time: 35ns or less 1 MHz, Rise time: 1 ns or less
Q Meter	4343B (YHP)	—
Color Pattern Generator	CG-911A (KENWOOD)	—
Oscilloscope	CS-2110A (KENWOOD)	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 repetive waveform
High-Voltage Probe	—	Input Impedance: 1000 MΩ
Termination	—	Impedance: 50 Ω Accuracy: within 3%
Termination	—	3 watts type impedance: 50 Ω
Attenuator	—	−20 dB attenuation (50 Ω)

PREPARATION FOR ADJUSTMENT

Control Setting

The control setting listed below must be used for each adjustment procedure.
Exceptions to these settings will be noted as they occur.
After completing a adjustment, return the controls to the following settings.

NAME OF KNOBS	POSITION
INTENSITY	3 o'clock
FOCUS	Optimum position
CH1, CH2 POSITION	Mechanical center
◄► H. POSITION/PULL ×10MAG	Mechanical center, push
VARIABLE (SWEEP TIME/DIV, VOLTS/DIV)	CAL
AC-GND-DC (CH1 and CH2)	DC (GND at no signal)
MODE	CH1
CH2 POLARITY	NORM
COUPLING	AC
SOURCE	V.MODE
TRIG. LEVEL	Mechanical center, push
TRIG. MODE	AUTO
VOLTS/DIV	10 mV/DIV
SWEEP TIME/DIV	0.2 ms/DIV

ADJUSTMENT

Item	Control setting	Test equ.	Adjustment control	P.C.B	Procedure
POWER SUPPLY SECTION ADJ.					
−10 V ADJ.		DL 706	VR1	X68	The voltage of the terminal (×74 P15 pin 3) should be −10 V±0.1 V.
ASTIG, FOCUS	TRIG MODE; X-Y	—	ASTIG, FOCUS		For the shapest and roundest spot.
INTENSITY	AC-GND-DC; GND TRIG MODE; X-Y	—	VR2	X68	Spot disappears in 9 to 10 o'clock position.
TRACE ROTATION	AC-GND-DC; GND	—	TRACE ROTATION VR		Trace is in parallel with horizontal graduation.
CAL. ADJ.		CS 2110	VR3	X68	Input the Calibration voltage into CS-2110, the amplitude should be 1 Vp-p±2.5%.
VERTICAL AMPLIFIER SECTION ADJ. (1)					
CRT CENTER		—	VR20	X73	Short the short terminal (TP1). Trace should be in the CRT center.
CH1 ATT STEP BAL.	VOLTS/DIV; 10 mV AC-GND-DC; GND	—	VR1	X73	Trace does not move vertically when rotating CH1 variable control.
	VOLTS/DIV; 1 mV AC-GND-DC; GND	—	VR4		
CH1 DC BAL	VOLTS/DIV; 1 mV AC-GND-DC; GND	—	VR6	X73	Trace does not move vertically when rotating CH1 variable control.
CH2 ATT STEP BAL.	VOLTS/DIV; 10 mV AC-GND-DC; GND	—	VR10	X73	Trace does not move vertically when rotating CH2 variable control.
	VOLTS/DIV; 1 mV AC-GND-DC; GND	—	VR13		
CH2 DC BAL	VOLTS/DIV; 1 mV AC-GND-DC; GND	—	VR15	X73	Trace does not move vertically when rotating CH2 variable control.
CH2 INVERT	MODE; CH2 VOLTS/DIV; 1 mV AC-GND-DC; GND	—	VR16	X73	Trace should be overlapped in the center of the graduation.
CH1 POSITION	MODE; CH1 AC-GND-DC; GND	—	VR25	X73	Set the CH1 position control to its mechanical center. Trace should be in the CRT center.
CH1 100 Hz SQUARE WAVE COMP.	MODE; CH1 VOLTS/DIV; 10 mV	PG 506	VR2	X73	Apply a 100 Hz square wave signal to display a waveform of 6 division vertical amplitude. Adjust for the best flat-top waveform.
CH2 100 Hz SQUARE WAVE COMP.	MODE; CH2 VOLTS/DIV; 10 mV	PG 506	VR11	X73	Same as CH1.
CH1 GAIN	MODE; CH1 VOLTS/DIV; 5 mV	PG 506	VR7	X73	When applying a 1 kHz, 20 mVp-p square wave signal, vertical amplitude should be 4 div.
	MODE; CH1 VOLTS/DIV; 1 mV	PG 506	VR26	X73	When applying a 1 kHz, 5 mVp-p square wave signal, vertical amplitude should be 5 div.

ADJUSTMENT

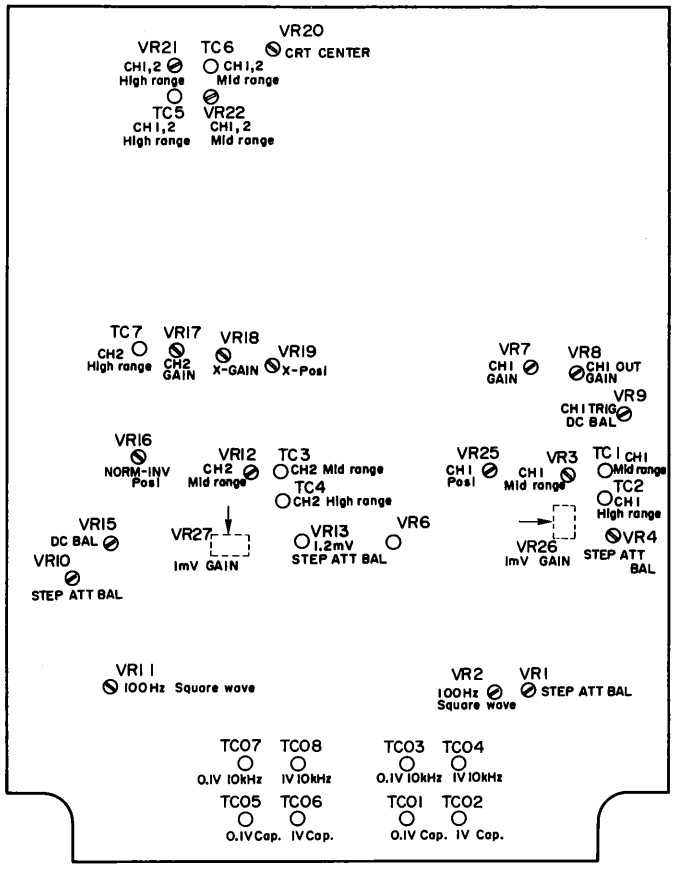
Item	Control setting	Test equ.	Adjustment control	P.C.B	Procedure
CH2 GAIN	MODE; CH2 VOLTS/DIV; 5 mV	PG 506	VR17	X73	When applying a 1 kHz, 20 mVp-p square wave signal, vertical amplitude should be 4 div.
	MODE; CH2 VOLTS/DIV; 1 mV	PG 506	VR27	X73	When applying a 1 kHz. 5 mVp-p square wave signal, vertical amplitude should be 5 div.
CH1 OUTPUT	MODE; CH1	SG 503 CS 2110	VR8	X73	Connect the CH1 OUTPUT connector to channel 1 of test oscilloscope through a 50 ohm BNC cable. Set test oscilloscope; CH1 VOLTS/DIV for 50 mV position. Applying a 50 kHz sine wave for 6 div on the CRT screen, display a 5 divisions vertical amplitude on the test oscilloscope.
X GAIN	TRIG MODE; X-Y VOLTS/DIV; 10 mV (CH2)	PG 506	VR18	X73	When applying a 1 kHz, 50 mVp-p square wave signal, horizontal amplitude should be 5 div.
HORIZONTAL AMPLIFIER AND SWEEP SECTION ADJ.					
1 ms SWEEP TIME	SWEEP TIME/DIV; 1 ms	TG 501	VR2	X74	Pulse should be on each division on the graduation line.
10 ms SWEEP TIME	SWEEP TIME/DIV; 10 ms	TG 501	VR3	X74	11th pulse should correspond to the right end of the graduation line.
10 μs SWEEP TIME	SWEEP TIME/DIV; 10 μs	TG 501	TC1	X74	11th pulse should correspond to the right end of the graduation line.
H. POSITION	TRIG MODE; AUTO SWEEP TIME/DIV; 1 ms	—	VR10	X74	Set H. POSITION control to its mechanical center. The left end of trace should correspond to the left end of the graduation line.
MAG GAIN	SWEEP TIME/DIV; 1 ms PULL×10MAG; PULL	TG 501	VR5	X74	Interval of pulses should be 10 div when applying a 1 ms time marker signal.
MAG CENTER	SWEEP TIME/DIV; 1 ms PULL×10 MAG; PUSH	TG 501	VR4	X74	The center of pulse should be center of the graduation scale when applying a 5 ms time marker signal. H. POSITION...mechanical center.
X POSITION	TRIG MODE; AUTO⇒X-Y AC-GND-DC; GND	—	VR19	X73	Adjust the left end of trace for the left end of the graduation line. When switching the TRIG MODE switch to X-Y position, spot should be the center of the screen.
VERT MODE TRIG OFFSET	TRIG SOURCE; VERT MODE MODE; ALT	SG 503	VR9	X73	When applying a 50 kHz, 8 div sine wave signal. CH1 trace should correspond to CH2 trace.

ADJUSTMENT

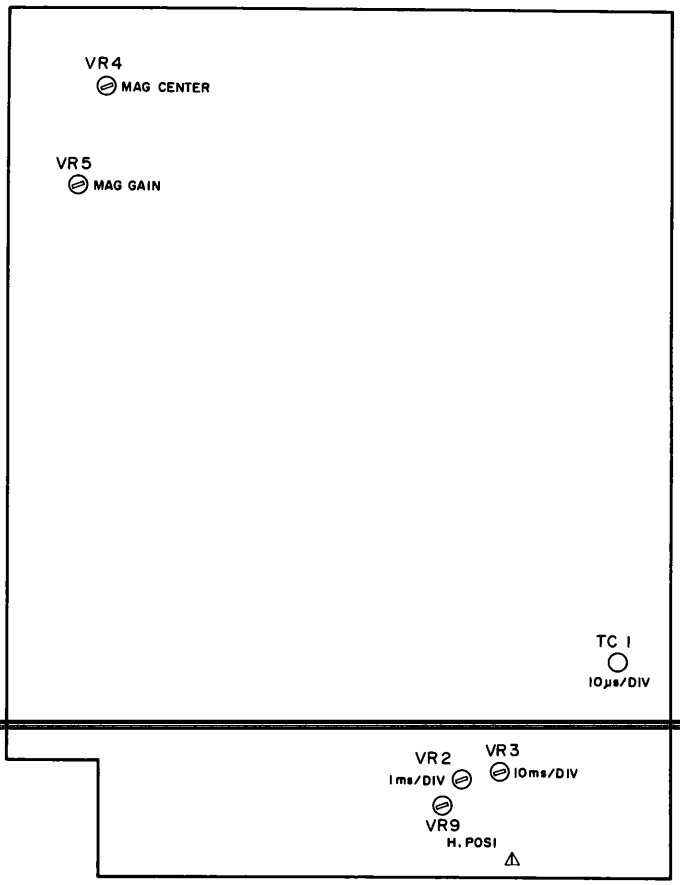
Item	Control setting	Test equ.	Adjustment control	P.C.B	Procedure
VERTICAL AMPLIFIER SECTION ADJ. (2)					
CH1 WAVE SHAPE		PG 506	TC03 TC04	X73	Same as 10 mV range, a best flat top waveform should be obtained. TC03...0.1 V TC04...1 V
CH2 WAVE SHAPE		PG 506	TC07 TC08	X73	Same as 10 mV range, a best flat top waveform should be obtained. TC07...0.1 V TC08...1 V
CH1 INPUT CAPACITY		4343B	TC01 TC02	X73	Same as 10 mV range. Input capacity should be 22 pF±3 pF. TC01...0.1 V TC02...1 V
CH2 INPUT CAPACITY		4343B	TC05 TC06	X73	Same as 10 mV range. Input capacity should be 22 pF±3 pF. TC05...0.1 V TC06...1 V
CH1 OVERSHOOT	SWEEP TIME/DIV; 0.2 μs VOLTS/DIV; 10 mV	PG 506	TC6, VR22, TC1, VR3 TC5, VR21, TC2	X73	When applying a 1 MHz, square wave signal, vertical amplitude should be 6 div. Set TC2 at mechanical center, for the sharpest waveform. TC6, VR22, TC1, VR3...mid range flat top waveform TC5, VR21...high range flat top waveform Set VOLTS/DIV to 10 mV for 6 div±3% vertical amplitude waveform. Overshoot should be ±3%.
CH2 OVERSHOOT	SWEEP TIME/DIV; 0.2 μs VOLTS/DIV; 10 mV	PG 506	TC3, VR12 TC4, TC7	X73	When applying a 1 MHz square wave signal for 6 div vertical amplitude. TC3, VR12...mid range flat top waveform TC4...high range flat top waveform TC7...peak top waveform. Overshoot should be ±3%.

ADJUSTMENT

VERTICAL AMP UNIT (X73-1640-00)

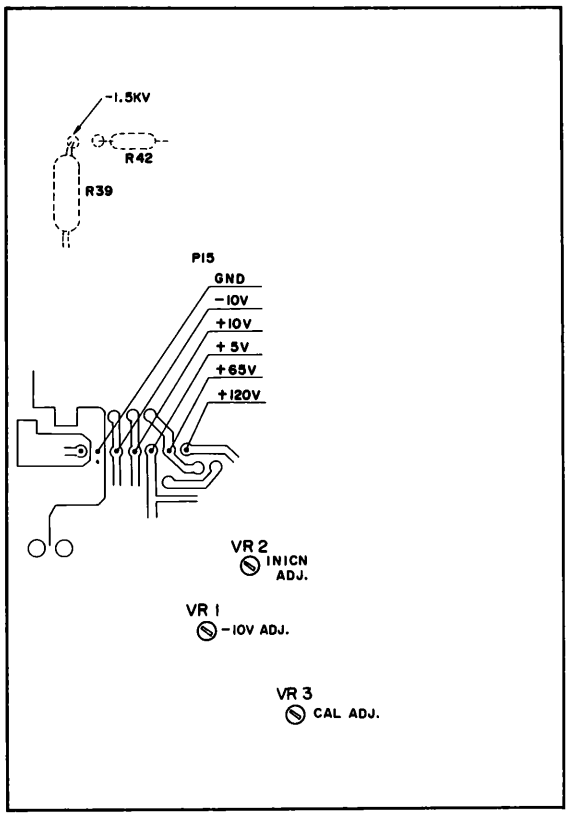


HORIZONTAL AMP & SWEEP UNIT (X74-1430-00)



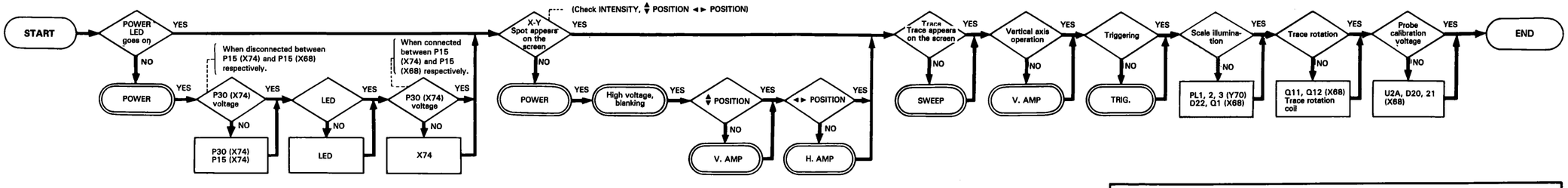
ADJUSTMENT

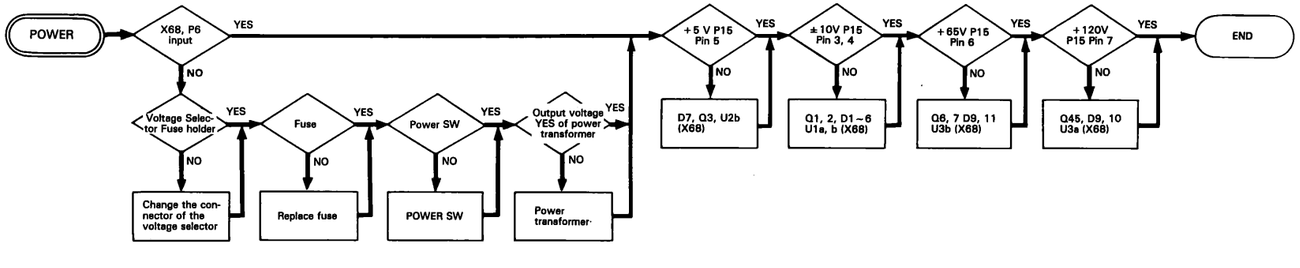
POWER SUPPLY & H.V UNIT (X68-1450-00)

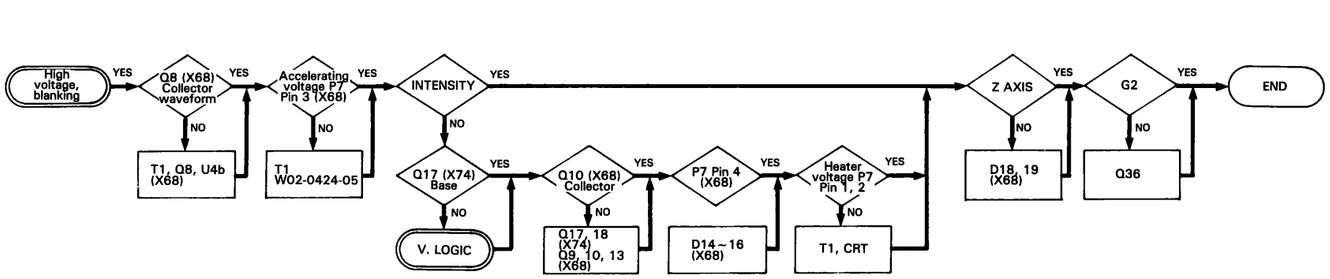


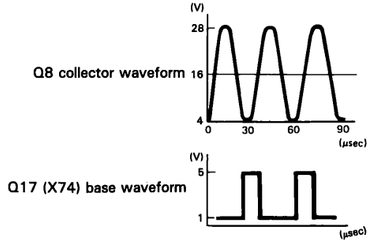
Heat sink

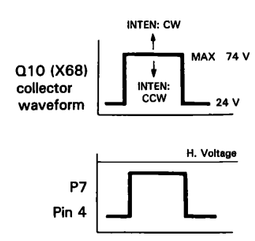
TROUBLESHOOTING

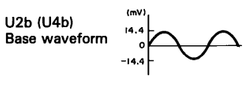


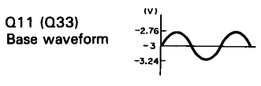


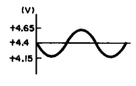


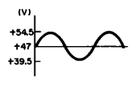


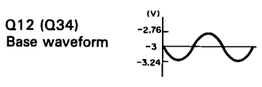


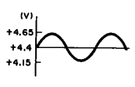


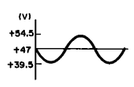












Note:

Index:

Y70 ..... Main chassis
X73 ..... X73-1640
X74 ..... X74-1430
X68 ..... X68-1450

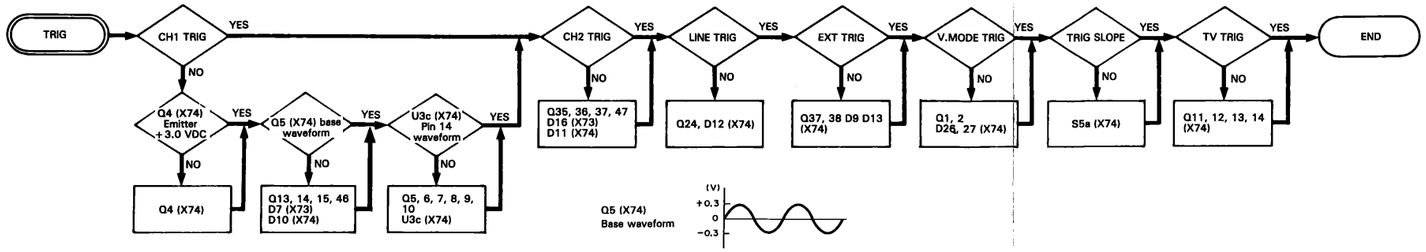
Check and judgement

Malfunction

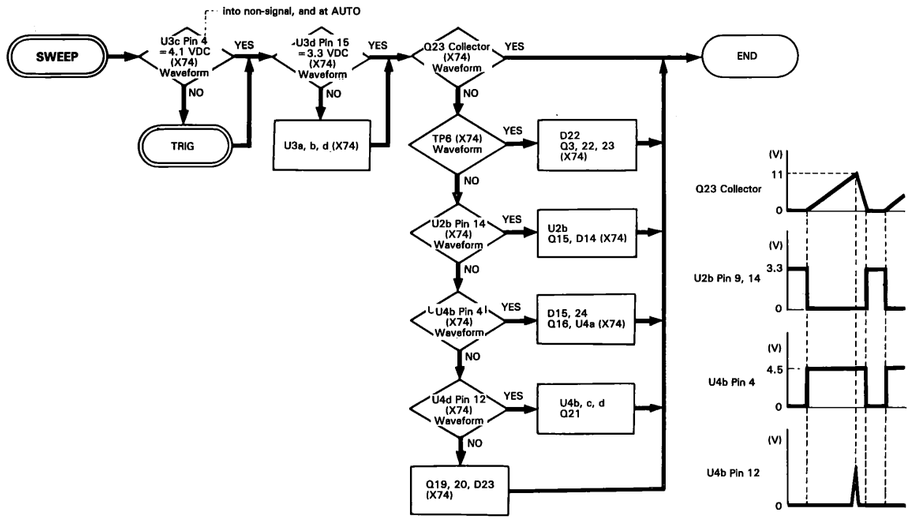
Item

Condition:
Apply a sine wave signal to X input for 6 div vertical amplitude.
[ ]: CH2

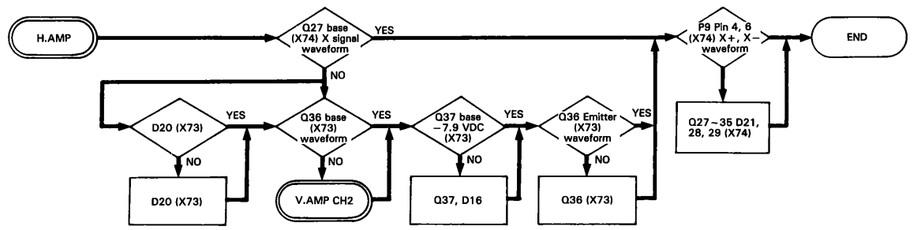
TROUBLESHOOTING

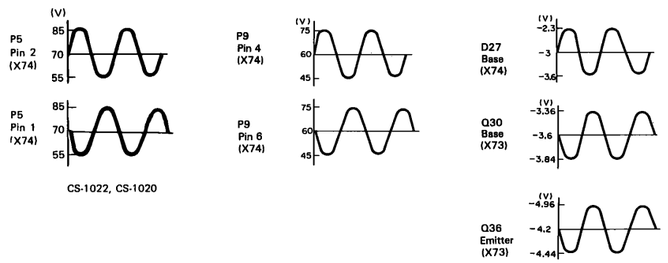


Waveform which synchronized at the center of the signal when applied a sine wave signal for 6 div.

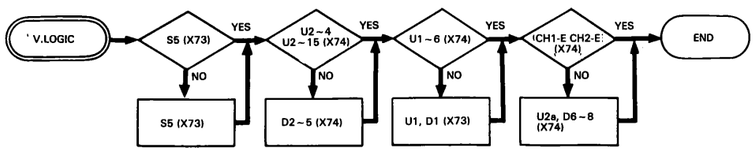


Waveform at auto free-run.





CS-1022, CS-1020



Note: Check the signal refer to table right.

	P14 (X74) ④ CH1	③ CH2	② ADD	① ALT CHOP	P14 (X74) Pin 4	Pin 15	U1 Pin 8	U1 Pin 6	P14 (X74) ⑥ CH1-E	⑤ CH2-E
CH1	L	H	H	L	L	H	H		H	L
CH2	H	L	H	L	H	L	H		L	H
ALT	H	H	H	L	H	H	H		CH1 SEEP	CH2 SWEEP
CHOP	H	H	H	H	H	H				
ADD	L	L	L	L	L	L	H		H	H
X-Y	L	—	—	L	L	—	H	—	H	L

SWEEP

Condition
Apply a sine wave signal to X input for 6 div vertical amplifude.

PARTS LIST

CS-1025 MAIN UNIT

Y-70-1540-61

REF.NO	PARTS NO	NAME & DESCRIPTION
1	A01-1153-02	CASE
2	A01-1154-12	CASE
3	A13-0901-22	FRAME
4	A13-0903-12	FRAME
5	A13-0906-12	FRAME
6	A13-0910-12	FRAME
7	A20-2795-21	PANEL
8	A21-1082-13	DECORATIVE PANEL
9	A22-0851-32	SUB PANEL
10	A23-1665-12	REAR PANEL
—	B07-0703-04	ESCUTCHEON
11	B07-0714-03	ESCUTCHEON
12	B19-0726-04	FILTER
13	B30-0951-25	SCALE ILLUM LAMP ASS'Y
—	B40-2765-04	NAME PLATE (SERIAL NO)
14	B40-2859-03	NAME PLATE
15	B41-0710-04	CAUTION LABEL (HIGH VOLTAGE)
16	B41-0783-23	CAUTION LABEL
—	B50-7583-30	INSTRUCTION MANUAL
17	D19-0908-03	EXTEN SION SHAFT
18	E04-0257-05	BNC RECEPTACLE
19	E18-0365-05	INLET SOCKET
20	E21-0660-04	TERMINAL(CAL)
21	E21-0667-05	TERMINAL
22	E23-0018-04	EARTH LUG
23	E23-0042-04	ERATH LUG
24	E23-0513-05	EARTH LUG
25	E23-0552-04	G. TERMINAL
26	E23-0561-14	G. TERMINAL
—	E30-1819-05	CEE CORD
—	E31-0564-05	LEAD WIRE WITH CONNECTOR
—	E31-0717-05	LEAD WIRE WITH CONNECTOR
—	E31-2633-05	LEAD WIRE WITH CONNECTOR
—	E31-2634-05	LEAD WIRE WITH CONNECTOR
—	E31-2636-05	LEAD WIRE WITH CONNECTOR
—	E31-2638-05	LEAD WIRE WITH CONNECTOR
—	E31-2639-05	LEAD WIRE WITH CONNECTOR
—	E31-2640-05	LEAD WIRE WITH CONNECTOR
—	E31-2641-05	LEAD WIRE WITH CONNECTOR
—	E31-2643-05	LEAD WIRE WITH CONNECTOR
—	E31-2644-05	LEAD WIRE WITH CONNECTOR
—	E31-2645-05	LEAD WIRE WITH CONNECTOR
—	E31-2646-05	LEAD WIRE WITH CONNECTOR
—	E33-4092-00	WIRE ASSY
—	F05-3011-05	FUSE 0.3A
—	F05-5013-05	FUSE 0.5A
27	F10-1587-23	SHIELD PLATE
28	F10-1593-14	SHIELD PLATE
29	F11-0996-04	SHIELD CASE
—	F15-0740-04	BLIND PLATE
—	F20-0658-04	INSULATOR
30	G01-0909-04	COIL SPRING
—	G16-0609-04	RUBBER SHEET
31	G16-0611-04	REFLECTOR SHEET (L)
32	G16-0612-04	REFLECTOR SHEET (R)
100	G16-0614-04	REFLECTOR SHEET
—	H01-5793-14	CARTON BOX
—	H10-2828-12	FOAMED STYRENE PAD
—	H10-2829-12	FOAMED STYRENE PAD
—	H20-1719-04	VINYL COVER
—	H25-0016-00	BAG
—	H25-0029-04	POLYETHYLENE BAG (FUSE)
33	J02-0089-05	RUBBER LEG
34	J02-0512-05	LEG
35	J02-0515-04	LEG
36	J10-0409-02	BEZEL
—	J19-1620-05	CORD CLAMP
—	J19-1622-05	CORD CLAMP
37	J19-1635-04	HOLDER FOR LED
38	J19-1645-24	BRACKET
39	J19-1646-04	BRACKET
40	J21-2573-04	HOLDER FOR LEG
41	J21-4562-03	BRACKET FOR CRT
42	J31-0608-05	COLLAR
—	J42-0017-05	BUSHING
43	J42-0528-05	BUSHING
44	J59-0403-05	NYLON RIVET
—	J61-0408-05	WIRE WRAPPING BAND
—	J61-0522-05	WIRE WRAPPING BAND
45	K01-0518-05	HANDLE
46	K21-0860-13	KNOB
47	K21-0886-03	KNOB
48	K21-0888-04	KNOB
49	K23-0803-13	KNOB
50	K27-0530-14	KNOB
51	L01-9536-05	POWER TRANSFORMER
52	L39-0524-05	COIL
53	N08-0611-04	DRESSED SCREW
54	N09-0623-04	SCREW
55	N09-0726-05	SCREW
56	N09-0731-05	SCREW
57	N09-0739-05	SCREW
58	N10-2030-46	NUT, HEX
59	N14-0602-04	NUT
60	N14-0624-04	NUT
61	N14-0625-04	NUT
62	N15-1030-41	WASHER, FLAT FOR M3
63	N17-1030-41	LOCK WASHER
64	N19-0725-04	WASHER
—	N30-3004-41	SCREW, PAN HD M 3X4
65	N30-3035-46	SCREW, PAN HD M 3X35
66	N32-3006-41	SCREW, FLAT HD M 3X6
67	N34-3012-41	SCREW, TRUSS M 3X12
68	N88-3008-41	SCREW, FLAT HD TAP TITE
69	N89-3008-41	SCREW, BINDING TAP TITE
70	N89-3016-46	SCREW, BINDING TAP TITE
71	R03-1509-05	V.R. 10K B
72	R05-3505-05	V.R. 20K B
73	R05-8001-05	V.R. 3M B
74	W01-0503-04	CORD WRAP
75	X68-1450-00	POWER SUPPLY UNIT
76	X73-1640-00	AMPLIFIER UNIT
77	X74-1430-00	HORIZONTAL SWEEP UNIT
78	X81-1600-01	CRT SOCKET UNIT
—	Y87-2260-00	PROBE PC-30
79	150QTM31	CRT
—	212-3017-05	TUBE (PLASTIC)
80D001	AR4133S	LED (RED)
—R001	RD14BB2E220J	RES. CARBON 22 5% 1/4W
—R002	RD14BB2E220J	RES. CARBON 22 5% 1/4W

POWER SUPPLY & H.V UNIT

X68-1450-00

REF.NO	PARTS NO	NAME & DESCRIPTION			
	E31-2170-05	JUMPING WIRE			
	F01-0813-05	HEAT SINK			
	F01-0855-03	HEAT SINK			
	F15-0727-04	HOLDER (NEON TUBE)			
	F20-0516-05	INSULATOR			
	J25-5107-13	PCB (UNMOUNTED)			
	J32-0848-04	BOSS			
	L19-0419-05	CONVERTOR TRANSFORMER			
	N09-0623-04	SCREW			
	N09-0731-05	SCREW			
	N14-0626-04	NUT			
	N19-0191-05	WASHER NONMETAL			
	W02-0424-05	HIGH VOLTAGE POWER BLOCK			
C001	CE04W1E222M	CAP. ELECTRO	2200	20%	25V
C002	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C003	CE04BW1H010M	CAP. ELECTRO	1	20%	50V
C004	CE04W1C101M	CAP. ELECTRO	100	20%	16V
C005	CE04W1E222M	CAP. ELECTRO	2200	20%	25V
C006	CE04W1C101M	CAP. ELECTRO	100	20%	16V
C007	CE04W1C102M	CAP. ELECTRO	1000	20%	16V
C008	C91-0572-05	CAP. CERAMIC	0.1		12V
C009	CE04W1A471M	CAP. ELECTRO	470	20%	10V
C010	CE04W2E470	CAP. ELECTRO	47		250V
C011	CK45B2H102K	CAP. CERAMIC	1000P	10%	500V
C012	CC45SL1H391J	CAP. CERAMIC	390P	5%	50V
C013	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C014	CE04W2C100	CAP. ELECTRO	10		160V
C015	CE04W2A221M	CAP. ELECTRO	220	20%	100V
C016	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C017	CK45B2H102K	CAP. CERAMIC	1000P	10%	500V
C018	CC45SL1H391J	CAP. CERAMIC	390P	5%	50V
C019	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C020	CE04W2A100M	CAP. ELECTRO	10	20%	100V
C021	CE04W1E331M	CAP. ELECTRO	330	20%	25V
C022	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C023	CQ92FM1H223K	CAP. MYLAR	0.022	10%	50V
C024	CK45B2H102K	CAP. CERAMIC	1000P	10%	500V
C025	CK45E3D102P	CAP. CERAMIC	1000P		2KV

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
C026	CQ92FM1H153K	CAP. MYLAR	0.015	10%	50V
C027	C91-0571-05	CAP. CERAMIC	0.01		2KV
C028	CQ92FM1H154K	CAP. MYLAR	0.15	10%	50V
C029	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C030	C91-0571-05	CAP. CERAMIC	0.01		2KV
C031	C91-0571-05	CAP. CERAMIC	0.01		2KV
C032	C91-0571-05	CAP. CERAMIC	0.01		2KV
C033	C91-0571-05	CAP. CERAMIC	0.01		2KV
C034	CE04W2C2R2	CAP. ELECTRO	2.2		160V
C035	CE04W2C100	CAP. ELECTRO	10		160V
C036	C91-0572-05	CAP. CERAMIC	0.1		12V
C037	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C038	CC45CH1H180J	CAP. CERAMIC	18P	5%	50V
C039	CC45CH2H010C	CAP. CERAMIC	1P	0.25P	500V
C040	CC45CH1H270J	CAP. CERAMIC	27P	5%	50V
C041	CE04BW1H010M	CAP. ELECTRO	1	20%	50V
C042	NO USE				
C043	CQ92FM1H103J	CAP. MYLAR	0.01	5%	50V
C044	CC45SL1H471J	CAP. CERAMIC	470P	5%	50V
C045	CC45SL1H471J	CAP. CERAMIC	470P	5%	50V
C046	NO USE				
C047	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C048	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
C049	CC45CH1H120J	CAP. CERAMIC	12P	5%	50V
D001	S2VB40F	DIODE, BRIDGE			
D002	MTZ10JC	DIODE, ZENER	10V		
D003	MTZ10JC	DIODE, ZENER	10V		
D004	MTZ5.1JB	DIODE, ZENER	5V		
D005	MTZ3.3JA	DIODE, ZENER	3.2V		
D006	1SS132	DIODE			
D007	S1VB20	DIODE			
D008	1SS132	DIODE			
D009	S1VB60	DIODE			
D010	1SS132	DIODE			
D011	1SS132	DIODE			
D012	1SS132	DIODE			
D013	1SS132	DIODE			
D014	1SR35-200	DIODE			
D015	1SR35-200	DIODE			
D016	1SS83	DIODE			
D017	1SS83	DIODE			
D018	1SS132	DIODE			
D019	1SS132	DIODE			
D020	1SS132	DIODE			
D021	1SS132	DIODE			
D022	S1VB20	DIODE			
F001	F06-8011-05	FUSE	0.8A		
L001	L40-1011-13	FERRI INDUCTOR	100UH		
L002	L40-1011-13	FERRI INDUCTOR	100UH		
L003	L40-1021-03	FERRI INDUCTOR	1MH		
NL001	NE-2B	NEON LAMP			
NL002	NE-2B	NEON LAMP			
P006	E40-7016-05	PIN CONNECTOR	8 P		
P007	E40-0535-05	PIN CONNECTOR	5 P		
P008	E40-0335-05	PIN CONNECTOR	3 P		
P015	E40-0773-05	PIN CONNECTOR	7 P		
P016	E40-0273-05	PIN CONNECTOR	2 P		
P019	E40-0273-05	PIN CONNECTOR	2 P		
P020	E40-0273-05	PIN CONNECTOR	2 P		
P021	E40-0273-05	PIN CONNECTOR	2 P		
P022	E40-0373-05	PIN CONNECTOR	3 P		
P023	E40-0473-05	PIN CONNECTOR	4 P		
P031	E40-0273-05	PIN CONNECTOR	2 P		
P032	E40-0373-05	PIN CONNECTOR	3 P		
Q001	2SB950(P,Q)	TR. SI, PNP			
Q002	2SD1276(P,Q)	TR. SI, NPN			
Q003	2SB950(P,Q)	TR. SI, PNP			
Q004	2SA1306B(O,Y)	TR. SI, PNP			
Q005	2SC2271(R)	TR. SI, NPN			
Q006	2SB940(P)	TR. SI, PNP			
Q007	2SC2909(S,T)	TR. SI, NPN			
Q008	2SD613(E)	TR. SI, NPN			
Q009	2SA1208(S,T)	TR. SI, PNP			
Q010	2SC2910(S,T)	TR. SI, NPN			
Q011	2SC1384(R,S)	TR. SI, NPN			
Q012	2SA684(R,S)	TR. SI, PNP			
Q013	2SA1175(F)	TR. SI, PNP			
Q014	2SD1276(P,Q)	TR. SI, NPN			
R001	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R002	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R003	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R004	RN14BK2C2002F	RES. METAL FILM	20K	1%	1/6W
R005	RN14BK2C2002F	RES. METAL FILM	20K	1%	1/6W
R006	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R007	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R008	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R009	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R010	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R011	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R012	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R013	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R014	RN14BK2C1002F	RES. METAL FILM	10K	1%	1/6W
R015	RN14BK2C2002F	RES. METAL FILM	20K	1%	1/6W
R016	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R017	RD14CB2E225J	RES. CARBON	2.2M	5%	1/4W
R018	RD14BB2C333J	RES. CARBON	33K	5%	1/6W
R019	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R020	RN14BK2C2403F	RES. METAL FILM	240K	1%	1/6W
R021	RN14BK2C2002F	RES. METAL FILM	20K	1%	1/6W
R022	RD14BB2C183J	RES. CARBON	18K	5%	1/6W
R023	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R024	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R025	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R026	RN14BK2C1303F	RES. METAL FILM	130K	1%	1/6W
R027	RN14BK2C2002F	RES. METAL FILM	20K	1%	1/6W
R028	RD14BB2C183J	RES. CARBON	18K	5%	1/6W
R029	RD14BB2C154J	RES. CARBON	150K	5%	1/6W
R030	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R031	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R032	RD14BB2C470J	RES. CARBON	47	5%	1/6W
R033	RD14BB2E334J	RES. CARBON	330K	5%	1/4W
R034	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R035	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R036	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R037	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R038	RN14BK2C2203F	RES. METAL FILM	220K	1%	1/6W
R039	R92-1033-05	RES. METAL FILM	33M	5%	1/4W
R040	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R041	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R042	R92-1034-05	RES. METAL FILM	47M	5%	1/2W
R043	R92-1050-05	RES. METAL FILM	5.1M	5%	1/2W
R044	R92-0800-05	RES. METAL FILM	10M	5%	1W
R045	RD14BB2C393J	RES. CARBON	39K	5%	1/6W
R046	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R047	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R048	RD14BB2C124J	RES. CARBON	120K	5%	1/6W
R049	RN14BK2C8202F	RES. METAL FILM	82K	1%	1/6W
R050	RN14BK2C3301F	RES. METAL FILM	3.3K	1%	1/6W
R051	RN14BK2C6201F	RES. METAL FILM	6.2K	1%	1/6W
R052	RD14BB2C203J	RES. CARBON	20K	5%	1/6W
R053	RD14BB2C203J	RES. CARBON	20K	5%	1/6W
R054	RN14BK2C9102F	RES. METAL FILM	91K	1%	1/6W
R055	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R056	RN14BK2C4302F	RES. METAL FILM	43K	1%	1/6W
R057	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R058	RN14BK2C2401F	RES. METAL FILM	2.4K	1%	1/6W
R059	RN14BK2C2400F	RES. METAL FILM	240	1%	1/6W
R060	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R061	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R062	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R063	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R064	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R065	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R066	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R067	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R068	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R069	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R070	NO USE				
R071	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R072	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
U001	NJM4558D	IC, OP AMP			
U002	NJM4558D	IC, OP AMP			
U003	NJM4558D	IC, OP AMP			
U004	NJM4558D	IC, OP AMP			
VR001	R12-1528-05	RES. SEMI FIXED	1K B		
VR002	R12-5524-05	RES. SEMI FIXED	100K B		
VR003	R12-0561-05	RES. SEMI FIXED	100 B		

PARTS LIST

VERTICAL AMP UNIT

X73-1640-00

REF.NO	PARTS NO	NAME & DESCRIPTION			
	E31-2170-05	JUMPING WIRE			
	E33-4113-00	WIRE ASSY			
	F01-0857-05	HEAT SINK			
	F10-1588-04	SHIELD PLATE			
	F10-1589-04	SHIELD PLATE			
	F10-1590-14	SHIELD PLATE			
	J25-5106-22	PCB (UNMOUNTED)			
	N30-3006-46	SCREW, PAN HD	M 3X6		
	R92-1061-05	JUMPING RES.	ZERO OHM		
	212-1018-05	TUBE (PLASTIC)			
C001	C91-0501-05	CAP. METAL FILM	0.047	10%	630V
C002	CC45FCH1H330J	CAP. CERAMIC	33P	5%	50V
C003	C91-0502-05	CAP. METAL FILM	0.01	20%	630V
C004	CC45CH1H221J	CAP. CERAMIC	220P	5%	50V
C005	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C006	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C007	CC45FCH1H080D	CAP. CERAMIC	8P	0.5P	50V
C008	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C009	CE04W1C100M	CAP. ELECTRO	10	20%	16V
C010	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C011	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C012	CC45FCH1H150J	CAP. CERAMIC	15P	5%	50V
C013	CC45CH1H221J	CAP. CERAMIC	220P	5%	50V
C014	CC45FCH1H180J	CAP. CERAMIC	18P	5%	50V
C015	NO USE				
C016	CC45FCH1H220J	CAP. CERAMIC	22P	5%	50V
C017	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C018	CC45FCH1H010C	CAP. CERAMIC	1P	0.25P	50V
C019	CC45FCH1H030C	CAP. CERAMIC	3P	0.25P	50V
C020	CC45FCH1H150J	CAP. CERAMIC	15P	5%	50V
C021	CC45FCH1H270J	CAP. CERAMIC	27P	5%	50V
C022	CC45FCH1H080D	CAP. CERAMIC	8P	0.5P	50V
C023	CE04BW1E220M	CAP. ELECTRO	22	20%	25V
C024	C91-0501-05	CAP. METAL FILM	0.047	10%	630V
C025	CC45FCH1H330J	CAP. CERAMIC	33P	5%	50V
C026	C91-0502-05	CAP. METAL FILM	0.01	20%	630V
C027	CQ92FM1H103K	CAP. MYLAR	0.01	10%	50V
C028	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C029	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C030	CC45FCH1H080D	CAP. CERAMIC	8P	0.5P	50V
C031	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C032	CE04W1C100M	CAP. ELECTRO	10	20%	16V
C033	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C034	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C035	CC45FCH1H150J	CAP. CERAMIC	15P	5%	50V
C036	CC45FCH1H221J	CAP. CERAMIC	220P	5%	50V
C037	CC45FCH1H180J	CAP. CERAMIC	18P	5%	50V
C038	NO USE				
C039	CC45FCH1H220J	CAP. CERAMIC	22P	5%	50V
C040	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C041	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C042	CE04W1A331M	CAP. ELECTRO	330	20%	10V
C043	CC45FCH1H150J	CAP. CERAMIC	15P	5%	50V
C044	CC45FCH1H070D	CAP. CERAMIC	7P	0.5P	50V
C045	CE04W1A331M	CAP. ELECTRO	330	20%	10V
C046	CC45SL1H471J	CAP. CERAMIC	470P	5%	50V
C047	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C048	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C049	CC45FCH1H050C	CAP. CERAMIC	5P	0.25P	50V
C050	CC45CH1H221J	CAP. CERAMIC	220P	5%	50V
C051	CC45FCH1H100D	CAP. CERAMIC	10P	0.5P	50V
C052	NO USE				
C053	CE04W1C101M	CAP. ELECTRO	100	20%	16V
C054	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C055	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C056	CE04W1C101M	CAP. ELECTRO	100	20%	16V
C057	CE04W1C470M	CAP. ELECTRO	47	20%	16V
C058	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C059	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C060	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C061	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C062	CE04W1C471M	CAP. ELECTRO	470	20%	16V
C063	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C064	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C065	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C066	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C067	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C068	CE04W1C471M	CAP. ELECTRO	470	20%	16V
C069	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C070	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C071	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C072	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C073	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C074	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C075	CE04W2A220M	CAP. ELECTRO	22	20%	100V
C076	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C077	NO USE				
C078	C91-0572-05	CAP. CERAMIC	0.1		12V
C079	C91-0572-05	CAP. CERAMIC	0.1		12V
C080	CC45FCH1H200J	CAP. CERAMIC	20P	5%	50V
C081	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C082	CC45FCH1H180J	CAP. CERAMIC	18P	5%	50V
C083	CC45FCH1H010C	CAP. CERAMIC	1P	0.25P	50V
C084	CC45CH1H181J	CAP. CERAMIC	180P	5%	50V
C085	CC45CH1H470J	CAP. CERAMIC	47P	5%	50V
C086	CE04DW0J153M	CAP. ELECTRO	5000	20%	6.3V
C087	CE04DW0J153M	CAP. ELECTRO	5000	20%	6.3V
C088	CC45FCH1H101J	CAP. CERAMIC	100P	5%	50V
C089	CC45FCH1H101J	CAP. CERAMIC	100P	5%	50V
C090	CC45FCH1H221J	CAP. CERAMIC	220P	5%	50V
C091	CC45FCH1H200J	CAP. CERAMIC	20P	5%	50V
C092	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C093	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C094	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C095	C91-0769-05	CAP. CERAMIC	0.01	20%	16V
C096	CE04W1C330M	CAP. ELECTRO	33	20%	16V
C097	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C098	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C099	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C100	CC45FCH1H120J	CAP. CERAMIC	12P	5%	50V
D001	1SS132	DIODE			
D002	MTZ5.1JB	DIODE, ZENER	5V		
D003	1SS132	DIODE			
D004	1SS132	DIODE			
D005	1SS132	DIODE			
D006	1SS132	DIODE			
D007	1SS132	DIODE			
D008	1SS132	DIODE			
D009	1SS132	DIODE			
D010	1SS132	DIODE			
D011	MTZ5.1JB	DIODE, ZENER	5V		
D012	1SS132	DIODE			
D013	1SS132	DIODE			
D014	1SS132	DIODE			
D015	1SS132	DIODE			
D016	1SS132	DIODE			
D017	MTZ10JC	DIODE, ZENER	10V		
D018	MTZ5.1JB	DIODE, ZENER	5V		
D019	MTZ5.1JB	DIODE, ZENER	5V		
D020	1SS132	DIODE			
J014	E31-2648-05	LEAD WIRE WITH CONNECTOR			
J026	E31-2652-05	LEAD WIRE WITH CONNECTOR			
J027	E31-2651-05	LEAD WIRE WITH CONNECTOR			
J070	E31-2702-05	LEAD WIRE WITH CONNECTOR			
J080	E31-2702-05	LEAD WIRE WITH CONNECTOR			
J090	E31-2703-05	LEAD WIRE WITH CONNECTOR			
J099	E31-2703-05	LEAD WIRE WITH CONNECTOR			
P017	E40-0473-05	PIN CONNECTOR	4 P		
P018	E40-0273-05	PIN CONNECTOR	2 P		
P023	E40-0473-05	PIN CONNECTOR	4 P		
P024	E23-0503-05	TERMINAL			
P025	E23-0503-05	TERMINAL			
P026	E40-0673-05	PIN CONNECTOR	6 P		
P027	E40-0373-05	PIN CONNECTOR	3 P		
P028	NO USE				
P029	E40-0273-05	PIN CONNECTOR	2 P		
Q001	2SK184(Y)	FET, N-CHANNEL			
Q002	2SA1005(K)	TR. SI, PNP			
Q003	2SK304(E)	FET, N-CHANNEL			
Q004	2SK304(E)	FET, N-CHANNEL			
Q005	2SA1005(K)	TR. SI, PNP			
Q006	2SA1005(K)	TR. SI, PNP			
Q007	2SA1005(K)	TR. SI, PNP			
Q008	2SA1005(K)	TR. SI, PNP			
Q009	2SC2785(F)	TR. SI, NPN			
Q010	2SC2785(F)	TR. SI, NPN			

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION
Q011	2SC3315(C,D)	TR. SI, NPN
Q012	2SC3315(C,D)	TR. SI, NPN
Q013	2SC2785(F)	TR. SI, NPN
Q014	2SC2785(F)	TR. SI, NPN
Q015	2SC2785(F)	TR. SI, NPN
Q016	2SC2786(K)	TR. SI, NPN
Q017	2SC2786(K)	TR. SI, NPN
Q018	2SC2785(F)	TR. SI, NPN
Q019	2SC2785(F)	TR. SI, NPN
Q020	2SA1175(F)	TR. SI, PNP
Q021	2SK184(Y)	FET, N-CHANNEL
Q022	2SA1005(K)	TR. SI, PNP
Q023	2SK304(E)	FET, N-CHANNEL
Q024	2SK304(E)	FET, N-CHANNEL
Q025	2SA1005(K)	TR. SI, PNP
Q026	2SA1005(K)	TR. SI, PNP
Q027	2SA1005(K)	TR. SI, PNP
Q028	2SA1005(K)	TR. SI, PNP
Q029	2SA1005(K)	TR. SI, PNP
Q030	2SA1005(K)	TR. SI, PNP
Q031	2SC2785(F)	TR. SI, NPN
Q032	2SC2785(F)	TR. SI, NPN
Q033	2SC3315(C,D)	TR. SI, NPN
Q034	2SC3315(C,D)	TR. SI, NPN
Q035	2SC2785(F)	TR. SI, NPN
Q036	2SC2785(F)	TR. SI, NPN
Q037	2SC2785(F)	TR. SI, NPN
Q038	2SC2786(K)	TR. SI, NPN
Q039	2SC2786(K)	TR. SI, NPN
Q040	2SC2785(F)	TR. SI, NPN
Q041	2SC2785(F)	TR. SI, NPN
Q042	2SC3779(D)	TR. SI, NPN
Q043	2SC3779(D)	TR. SI, NPN
Q044	2SC2911(R,S)	TR. SI, NPN
Q045	2SC2911(R,S)	TR. SI, NPN
Q046	2SC2785(F)	TR. SI, NPN
Q047	2SC2785(F)	TR. SI, NPN

REF.NO	PARTS NO	NAME & DESCRIPTION			
R001	RD14BB2E105J	RES. CARBON	1M	5%	1/4W
R002	RD14BB2C330J	RES. CARBON	33	5%	1/6W
R003	RN14BK2E5003F	RES. METAL FILM	500K	1%	1/4W
R004	RN14BK2E5003F	RES. METAL FILM	500K	1%	1/4W
R005	RD14BB2E684J	RES. CARBON	680K	5%	1/4W
R006	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R007	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R008	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R009	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R010	RD14BB2C242J	RES. CARBON	2.4K	5%	1/6W
R011	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R012	RD14BB2E511J	RES. CARBON	510	5%	1/4W
R013	RD14BB2C684J	RES. CARBON	680K	5%	1/6W
R014	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R015	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R016	RN14BK2C1601F	RES. METAL FILM	1.6K	1%	1/6W
R017	RN14BK2C1301F	RES. METAL FILM	1.3K	1%	1/6W
R018	RD14BB2C911J	RES. CARBON	910	5%	1/6W
R019	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R020	RN14BK2C82R0F	RES. METAL FILM	82.0	1%	1/6W
R021	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R022	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R023	RD14BB2C562J	RES. CARBON	5.6K	5%	1/6W
R024	RN14BK2C2700F	RES. METAL FILM	270	1%	1/6W
R025	RD14BB2C430J	RES. CARBON	43	5%	1/6W
R026	RD14BB2C560J	RES. CARBON	56	5%	1/6W
R027	RD14BB2C683J	RES. CARBON	68K	5%	1/6W
R028	RD14BB2C301J	RES. CARBON	300	5%	1/6W
R029	RN14BK2E1501F	RES. METAL FILM	1.5K	1%	1/4W
R030	RN14BK2E1501F	RES. METAL FILM	1.5K	1%	1/4W
R031	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R032	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R033	RD14BB2C301J	RES. CARBON	300	5%	1/6W
R034	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R035	RD14BB2E681J	RES. CARBON	680	5%	1/4W
R036	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R037	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R038	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R039	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R040	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R041	RD14BB2C223J	RES. CARBON	22K	5%	1/6W
R042	RD14BB2C163J	RES. CARBON	16K	5%	1/6W
R043	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R044	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R045	RD14BB2C243J	RES. CARBON	24K	5%	1/6W
R046	RN14BK2C2401F	RES. METAL FILM	2.4K	1%	1/6W
R047	RN14BK2C2401F	RES. METAL FILM	2.4K	1%	1/6W

REF.NO	PARTS NO	NAME & DESCRIPTION			
R048	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R049	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R050	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R051	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R052	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R053	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R054	RN14BK2C5600F	RES. METAL FILM	560	1%	1/6W
R055	RN14BK2C5600F	RES. METAL FILM	560	1%	1/6W
R056	RD14BB2C124J	RES. CARBON	120K	5%	1/6W
R057	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R058	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R059	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R060	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R061	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R062	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R063	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R064	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R065	RD14BB2C751J	RES. CARBON	750	5%	1/6W
R066	RD14BB2C132J	RES. CARBON	1.3K	5%	1/6W
R067	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R068	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R069	RD14BB2E102J	RES. CARBON	1K	5%	1/4W
R070	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R071	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R072	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R073	RD14BB2E243J	RES. CARBON	24K	5%	1/4W
R074	RD14BB2E392J	RES. CARBON	3.9K	5%	1/4W
R075	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R076	RD14BB2E472J	RES. CARBON	4.7K	5%	1/4W
R077	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R078	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R079	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R080	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R081	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R082	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R083	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R084	RD14BB2C390J	RES. CARBON	39	5%	1/6W
R085	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R086	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R087	RD14BB2E105J	RES. CARBON	1M	5%	1/4W
R088	RD14BB2C330J	RES. CARBON	33	5%	1/6W
R089	RN14BK2E5003F	RES. METAL FILM	500K	1%	1/4W
R090	RN14BK2E5003F	RES. METAL FILM	500K	1%	1/4W
R091	RD14BB2E684J	RES. CARBON	680K	5%	1/4W
R092	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R093	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R094	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R095	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R096	RD14BB2C242J	RES. CARBON	2.4K	5%	1/6W
R097	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R098	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R099	RD14BB2C684J	RES. CARBON	680K	5%	1/6W
R100	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R101	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R102	RN14BK2C1601F	RES. METAL FILM	1.6K	1%	1/6W
R103	RN14BK2C1301F	RES. METAL FILM	1.3K	1%	1/6W
R104	RD14BB2C911J	RES. CARBON	910	5%	1/6W
R105	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R106	RN14BK2C82R0F	RES. METAL FILM	82.0	1%	1/6W
R107	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R108	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R109	RD14BB2C562J	RES. CARBON	5.6K	5%	1/6W
R110	RN14BK2C2700F	RES. METAL FILM	270	1%	1/6W
R111	RD14BB2C430J	RES. CARBON	43	5%	1/6W
R112	RD14BB2C560J	RES. CARBON	56	5%	1/6W
R113	RD14BB2C683J	RES. CARBON	68K	5%	1/6W
R114	RD14BB2C301J	RES. CARBON	300	5%	1/6W
R115	RN14BK2E1501F	RES. METAL FILM	1.5K	1%	1/4W
R116	RN14BK2E1501F	RES. METAL FILM	1.5K	1%	1/4W
R117	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R118	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R119	NO USE				
R120	RD14BB2C301J	RES. CARBON	300	5%	1/6W
R121	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R122	RD14BB2E681J	RES. CARBON	680	5%	1/4W
R123	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R124	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R125	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R126	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R127	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R128	RD14BB2C223J	RES. CARBON	22K	5%	1/6W
R129	RD14BB2C393J	RES. CARBON	39K	5%	1/6W
R130	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R131	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R132	RD14BB2C101J	RES. CARBON	100	5%	1/6W

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
R133	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R134	RD14BB2C223J	RES. CARBON	22K	5%	1/6W
R135	RD14BB2C393J	RES. CARBON	39K	5%	1/6W
R136	RD14BB2C181J	RES. CARBON	180	5%	1/6W
R137	RN14BK2C2401F	RES. METAL FILM	2.4K	1%	1/6W
R138	RN14BK2C2401F	RES. METAL FILM	2.4K	1%	1/6W
R139	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R140	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R141	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R142	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R143	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R144	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R145	RN14BK2C5600F	RES. METAL FILM	560	1%	1/6W
R146	RN14BK2C5600F	RES. METAL FILM	560	1%	1/6W
R147	RD14BB2C124J	RES. CARBON	120K	5%	1/6W
R148	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R149	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R150	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R151	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R152	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R153	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R154	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R155	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R156	RD14BB2C751J	RES. CARBON	750	5%	1/6W
R157	RD14BB2C132J	RES. CARBON	1.3K	5%	1/6W
R158	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R159	RD14BB2E273J	RES. CARBON	27K	5%	1/4W
R160	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R161	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R162	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R163	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R164	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R165	RD14BB2C243J	RES. CARBON	24K	5%	1/6W
R166	RD14BB2C392J	RES. CARBON	3.9K	5%	1/6W
R167	RD14BB2E100J	RES. CARBON	10	5%	1/4W
R168	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R169	RD14BB2C822J	RES. CARBON	8.2K	5%	1/6W
R170	RD14BB2C822J	RES. CARBON	8.2K	5%	1/6W
R171	RN14BK2E1001F	RES. METAL FILM	1K	1%	1/4W
R172	RN14BK2E1001F	RES. METAL FILM	1K	1%	1/4W
R173	RN14BK2E3300F	RES. METAL FILM	330	1%	1/4W
R174	RN14BK2E3300F	RES. METAL FILM	330	1%	1/4W
R175	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R176	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R177	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R178	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R179	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R180	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R181	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R182	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R183	RD14BB2C822J	RES. CARBON	8.2K	5%	1/6W
R184	RN14BK2C68R0F	RES. METAL FILM	68.0	1%	1/6W
R185	RD14BB2C241J	RES. CARBON	240	5%	1/6W
R186	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R187	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R188	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R189	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R190	RD14BB2C752J	RES. CARBON	7.5K	5%	1/6W
R191	RN14BK2E1003F	RES. METAL FILM	100K	1%	1/4W
R192	RN14BK2E1003F	RES. METAL FILM	100K	1%	1/4W
R193	RS14AB3H751J	RES. METAL FILM	750	5%	5W
R194	RS14AB3H751J	RES. METAL FILM	750	5%	5W
R195	RN14BK2C1102F	RES. METAL FILM	11K	1%	1/6W
R196	RD14BB2C334J	RES. CARBON	330K	5%	1/6W
R197	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R198	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R199	RD14BB2C241J	RES. CARBON	240	5%	1/6W
R200	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R201	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R202	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R203	RD14BB2C621J	RES. CARBON	620	5%	1/6W
R204	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R205	RD14BB2C133J	RES. CARBON	13K	5%	1/6W
R206	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R207	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R208	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R209	RD14BB2C510J	RES. CARBON	51	5%	1/6W
R210	RD14BB2C510J	RES. CARBON	51	5%	1/6W
R211	RN14BK2C1000F	RES. METAL FILM	100	1%	1/6W
R212	RN14BK2C1000F	RES. METAL FILM	100	1%	1/6W
S001	S32-4007-05	LEVER SWITCH			
S002	S02-4505-05	ROTARY SWITCH			
S003	S32-4007-05	LEVER SWITCH			
S004	S02-4505-05	ROTARY SWITCH			
S005	S33-2501-05	LEVER SWITCH			
S006	R01-1513-05	V.R.	2K B		
TC001	C05-0444-05	CAP. TRIMMER	10P		
TC002	C05-0445-05	CAP. TRIMMER	20P		
TC003	C05-0444-05	CAP. TRIMMER	10P		
TC004	C05-0445-05	CAP. TRIMMER	20P		
TC005	C05-0446-05	CAP. TRIMMER	30P		
TC006	C05-0446-05	CAP. TRIMMER	30P		
TC007	C05-0447-05	CAP. TRIMMER	50P		
TH001	SDT-20	THERMISTOR			
TH002	SDT-20	THERMISTOR			
TH003	SDT-20	THERMISTOR			
TP001	E40-0211-05	PIN CONNECTOR	2 P		
U001	LF411CN	IC, DUAL JFET INPUT OP-AMP			
U002	CA3083	IC, NPN TRANSISTOR ARRAY			
U003	LF411CN	IC, DUAL JFET INPUT OP-AMP			
U004	CA3083	IC, NPN TRANSISTOR ARRAY			
U005	NJM4558D	IC, OP AMP			
VR001	R12-4510-05	RES. SEMI FIXED	50K B		
VR002	R12-0563-05	RES. SEMI FIXED	500 B		
VR003	R12-2517-05	RES. SEMI FIXED	5K B		
VR004	R12-4510-05	RES. SEMI FIXED	50K B		
VR005	S02-4505-05	ROTARY SWITCH			
VR006	R12-0561-05	RES. SEMI FIXED	100 B		
VR007	R12-0563-05	RES. SEMI FIXED	500 B		
VR008	R12-4510-05	RES. SEMI FIXED	50K B		
VR009	R12-1528-05	RES. SEMI FIXED	1K B		
VR010	R12-4510-05	RES. SEMI FIXED	50K B		
VR011	R12-0563-05	RES. SEMI FIXED	500 B		
VR012	R12-2517-05	RES. SEMI FIXED	5K B		
VR013	R12-4510-05	RES. SEMI FIXED	50K B		
VR014	S02-4505-05	ROTARY SWITCH			
VR015	R12-0561-05	RES. SEMI FIXED	100 B		
VR016	R12-0561-05	RES. SEMI FIXED	100 B		
VR017	R12-0563-05	RES. SEMI FIXED	500 B		
VR018	R12-4510-05	RES. SEMI FIXED	50K B		
VR019	R12-1528-05	RES. SEMI FIXED	1K B		
VR020	R12-0561-05	RES. SEMI FIXED	100 B		
VR021	R12-0562-05	RES. SEMI FIXED	200 B		
VR022	R12-2517-05	RES. SEMI FIXED	5K B		
VR023	R06-1503-05	V.R.	2K B X2		
VR024	R01-1513-05	V.R.	2K B		
VR025	R12-0561-05	RES. SEMI FIXED	100 B		
VR026	R12-0561-05	RES. SEMI FIXED	100 B		
VR027	R12-0561-05	RES. SEMI FIXED	100 B		

HORIZONTAL AMP & SWEEP UNIT

X74-1430-00

	E31-2170-05	JUMPING WIRE			
	E33-4111-00	WIRE ASSY			
	J25-5108-22	PCB (UNMOUNTED)			
	J61-0511-05	SADDLE FOR WIRE			
C001	CK45B1H102K	CAP. CERAMIC	1000P	10%	50V
C002	CC45CH1H221J	CAP. CERAMIC	220P	5%	50V
C003	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C004	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C005	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C006	C91-0572-05	CAP. CERAMIC	0.1		12V
C007	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C008	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C009	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C010	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C011	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C012	CE04W1H100M	CAP. ELECTRO	10	20%	50V
C013	C91-0572-05	CAP. CERAMIC	0.1		12V
C014	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C015	CK45B1H472K	CAP. CERAMIC	4700P	10%	50V
C016	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C017	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C018	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C019	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C020	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C021	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
C022	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C023	CE04BW1H010M	CAP. ELECTRO	1	20%	50V
C024	CE04FW1A101M	CAP. ELECTRO	100	20%	10V
C025	CK45F1H103Z	CAP. CERAMIC	0.01		50V

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
C026	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C027	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C028	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C029	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C032	CC45CH1H030C	CAP. CERAMIC	3P	0.25P	50V
C033	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C034	CC45CH1H150J	CAP. CERAMIC	15P	5%	50V
C035	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C036	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
C037	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C038	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C039	C91-0574-05	CAP. MYLAR	1	5%	100V
C040	C91-0573-05	CAP. MYLAR	0.01	1%	100V
C041	CQ92FM1H102K	CAP. MYLAR	1000P	10%	50V
C042	CM93BD2A900J	CAP. MICA	90P	5%	100V
C043	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C044	CE04FW1E470M	CAP. ELECTRO	47	20%	25V
C045	CE04W1H010M	CAP. ELECTRO	1	20%	50V
C046	CQ92FM1H223K	CAP. MYLAR	0.022	10%	50V
C047	CE04BW1H010M	CAP. ELECTRO	1	20%	50V
C051	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C052	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C053	CC45SL1H331J	CAP. CERAMIC	330P	5%	50V
C054	C91-0572-05	CAP. CERAMIC	0.1		12V
C055	NO USE				
C056	CQ92FM1H154K	CAP. MYLAR	0.15	10%	50V
C057	NO USE				
C058	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C059	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C060	NO USE				
C061	C91-0572-05	CAP. CERAMIC	0.1		12V
C062	C91-0572-05	CAP. CERAMIC	0.1		12V
C063	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C064	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C065	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C066	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C067	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C068	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C069	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C070	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C071	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C072	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C073	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C074	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C075	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C076	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C077	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C078	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C079	CE04FW1C470M	CAP. ELECTRO	47	20%	16V
C080	CE04W1A221M	CAP. ELECTRO	220	20%	10V
C081	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C082	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C083	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C084	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C085	CE04FW1A101M	CAP. ELECTRO	100	20%	10V
C086	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C087	CE04W2A220M	CAP. ELECTRO	22	20%	100V
C088	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C089	CE04W2C3R3	CAP. ELECTRO	3.3		160V
C090	CK45B2H472K	CAP. CERAMIC	4700P	10%	500V
C091	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C092	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C093	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C094	CQ92FM1H104K	CAP. MYLAR	0.1	10%	50V
C095	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C096	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C097	CC45CH1H330J	CAP. CERAMIC	33P	5%	50V
C098	CQ92FM1H473K	CAP. MYLAR	0.047	10%	50V
C099	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C100	CQ92FM1H103K	CAP. MYLAR	0.01	10%	50V
C101	CC45CH1H070D	CAP. CERAMIC	7P	0.5P	50V
C102	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
C103	CC45CH1H121J	CAP. CERAMIC	120P	5%	50V
C104	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
D001	1SS132	DIODE			
D002	1SS132	DIODE			
D003	1SS132	DIODE			
D004	1SS132	DIODE			
D005	1SS132	DIODE			
D006	1SS132	DIODE			
D007	1SS132	DIODE			
D008	1SS132	DIODE			

REF.NO	PARTS NO	NAME & DESCRIPTION	
D009	1SS135	DIODE	
D010	1SS132	DIODE	
D011	1SS132	DIODE	
D012	1SS132	DIODE	
D013	1SS132	DIODE	
D014	1SS132	DIODE	
D015	1SS132	DIODE	
D016	1SS132	DIODE	
D017	1SS132	DIODE	
D018	1SS132	DIODE	
D019	1SS132	DIODE	
D020	1SS132	DIODE	
D021	1SS132	DIODE	
D022	1SS132	DIODE	
D023	1SS132	DIODE	
D024	1SS132	DIODE	
D025	1SS132	DIODE	
D026	1SS132	DIODE	
D027	1SS132	DIODE	
D028	1SS83	DIODE	
D029	1SS83	DIODE	
D030	1SS132	DIODE	
D031	MTZ3.0JB	DIODE, ZENER	3.0V
D032	1SS132	DIODE	
D033	MTZ3.0JB	DIODE, ZENER	3.0V
J010	E31-2656-05	LEAD WIRE WITH CONNECTOR	
J011	E31-2657-05	LEAD WIRE WITH CONNECTOR	
J012	E31-2655-05	LEAD WIRE WITH CONNECTOR	
J013	E31-2654-05	LEAD WIRE WITH CONNECTOR	
J017	E31-2647-05	LEAD WIRE WITH CONNECTOR	
J018	E31-2642-05	LEAD WIRE WITH CONNECTOR	
J060	E31-2653-05	LEAD WIRE WITH CONNECTOR	
L002	L40-1011-03	FERRI INDUCTOR	100UH
L003	L40-1001-03	FERRI INDUCTOR	10UH
L004	L40-1001-03	FERRI INDUCTOR	10UH
L005	L40-1011-03	FERRI INDUCTOR	100UH
L006	L40-1011-03	FERRI INDUCTOR	100UH
L007	NO USE		
L008	L40-1001-03	FERRI INDUCTOR	10UH
L009	NO USE		
L010	L40-1011-13	FERRI INDUCTOR	100UH
P009	E40-0674-05	PIN CONNECTOR	6 P
P010	E40-0673-05	PIN CONNECTOR	6 P
P011	E40-0573-05	PIN CONNECTOR	5 P
P012	E40-0673-05	PIN CONNECTOR	6 P
P013	E40-0373-05	PIN CONNECTOR	3 P
P014	E40-0673-05	PIN CONNECTOR	6 P
P015	E40-0773-05	PIN CONNECTOR	7 P
P016	E40-0273-05	PIN CONNECTOR	2 P
P028	E40-0273-05	PIN CONNECTOR	2 P
P029	NO USE		
P030	E40-0273-05	PIN CONNECTOR	2 P
Q001	2SA1323(B,C)	TR. SI, PNP	
Q002	2SA1323(B,C)	TR. SI, PNP	
Q003	2SC2786(K)	TR. SI, NPN	
Q004	2SA1005(K)	TR. SI, PNP	
Q005	2SC2785(F)	TR. SI, NPN	
Q006	2SC2785(F)	TR. SI, NPN	
Q007	2SC2786(K)	TR. SI, NPN	
Q008	2SC2786(K)	TR. SI, NPN	
Q009	2SA1005(K)	TR. SI, PNP	
Q010	2SA1005(K)	TR. SI, PNP	
Q011	2SC2785(F)	TR. SI, NPN	
Q012	2SC2785(F)	TR. SI, NPN	
Q013	2SA1175(F)	TR. SI, PNP	
Q014	2SA1175(F)	TR. SI, PNP	
Q015	2SA1175(F)	TR. SI, PNP	
Q016	2SA1175(F)	TR. SI, PNP	
Q017	2SC2786(K)	TR. SI, NPN	
Q018	2SC2785(F)	TR. SI, NPN	
Q019	2SC2785(F)	TR. SI, NPN	
Q020	2SC2785(F)	TR. SI, NPN	
Q021	2SC2785(F)	TR. SI, NPN	
Q022	2SK117(Y)	FET. P-CHANNEL	
Q023	2SC2785(F)	TR. SI, NPN	
Q024	2SC2785(F)	TR. SI, NPN	
Q025	2SA1175(F)	TR. SI, PNP	
Q026	2SA1175(F)	TR. SI, PNP	

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
Q027	2SC2785(F)	TR. SI, NPN			
Q028	2SC2785(F)	TR. SI, NPN			
Q029	2SC2785(F)	TR. SI, NPN			
Q030	2SC2785(F)	TR. SI, NPN			
Q031	2SC2785(F)	TR. SI, NPN			
Q032	2SC2910(S,T)	TR. SI, NPN			
Q033	2SA1208(S,T)	TR. SI, PNP			
Q034	2SC2910(S,T)	TR. SI, NPN			
Q035	2SA1208(S,T)	TR. SI, PNP			
Q036	2SC2909(S,T)	TR. SI, NPN			
Q037	2SK117(Y)	FET, P-CHANNEL			
Q038	2SC2785(F)	TR. SI, NPN			
R001	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R002	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R003	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R004	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R005	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R006	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R007	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R008	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R009	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R010	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R011	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R012	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R013	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R014	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R015	RN14BK2C1302F	RES. METAL FILM	13K	1%	1/6W
R016	RN14BK2C3901F	RES. METAL FILM	3.9K	1%	1/6W
R017	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R018	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R021	RD14BB2C163J	RES. CARBON	16K	5%	1/6W
R022	RD14BB2C153J	RES. CARBON	15K	5%	1/6W
R023	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R024	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R025	RN14BK2C3301F	RES. METAL FILM	3.3K	1%	1/6W
R026	RN14BK2C3301F	RES. METAL FILM	3.3K	1%	1/6W
R027	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R028	RD14BB2C153J	RES. CARBON	15K	5%	1/6W
R029	RN14BK2C1800F	RES. METAL FILM	180	1%	1/6W
R030	RN14BK2C1800F	RES. METAL FILM	180	1%	1/6W
R031	RD14BB2C202J	RES. CARBON	2K	5%	1/6W
R032	RD14BB2C202J	RES. CARBON	2K	5%	1/6W
R033	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R034	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R035	RD14BB2C562J	RES. CARBON	5.6K	5%	1/6W
R036	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R037	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R038	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R039	RD14BB2C432J	RES. CARBON	4.3K	5%	1/6W
R040	RD14BB2C224J	RES. CARBON	220K	5%	1/6W
R041	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R042	RD14BB2C622J	RES. CARBON	6.2K	5%	1/6W
R043	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R044	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R045	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R046	RD14BB2C470J	RES. CARBON	47	5%	1/6W
R047	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R048	RN14BK2C2400F	RES. METAL FILM	240	1%	1/6W
R049	RN14BK2C2400F	RES. METAL FILM	240	1%	1/6W
R050	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R051	RN14BK2C2701F	RES. METAL FILM	2.7K	1%	1/6W
R052	RD14BB2C202J	RES. CARBON	2K	5%	1/6W
R053	RD14BB2C562J	RES. CARBON	5.6K	5%	1/6W
R054	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R055	RD14BB2C561J	RES. CARBON	560	5%	1/6W
R056	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R057	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R058	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R059	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R060	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R061	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R062	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R063	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R064	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R065	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R066	RD14BB2C103J	RES. CARBON	1K	5%	1/6W
R067	RD14BB2C271J	RES. CARBON	270	5%	1/6W
R068	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R069	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R070	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R071	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R072	RD14BB2C821J	RES. CARBON	820	5%	1/6W
R073	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R074	RD14BB2C752J	RES. CARBON	7.5K	5%	1/6W
R075	NO USE				
R076	RD14BB2C223J	RES. CARBON	22K	5%	1/6W
R077	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R078	RS14GB3A682J	RES. METAL FILM	6.8K	5%	1W
R079	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R080	RN14BK2C3002F	RES. METAL FILM	30K	1%	1/6W
R081	RN14BK2C3901F	RES. METAL FILM	3.9K	1%	1/6W
R082	RN14BK2C3002F	RES. METAL FILM	30K	1%	1/6W
R083	RD14BB2C182J	RES. CARBON	1.8K	5%	1/6W
R084	RD14BB2C302J	RES. CARBON	3K	5%	1/6W
R085	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R086	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R087	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R088	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R089	RN14BK2H3004F	RES. METAL FILM	3M	1%	1/2W
R090	RN14BK2E1004F	RES. METAL FILM	1M	1%	1/4W
R091	RN14BK2E5003F	RES. METAL FILM	500K	1%	1/4W
R092	RN14BK2E3003F	RES. METAL FILM	300K	1%	1/4W
R093	RN14BK2E1003F	RES. METAL FILM	100K	1%	1/4W
R094	RN14BK2E5002F	RES. METAL FILM	50K	1%	1/4W
R095	RN14BK2E3002F	RES. METAL FILM	30K	1%	1/4W
R096	RN14BK2E2002F	RES. METAL FILM	20K	1%	1/4W
R097	RD14BB2C821J	RES. CARBON	820	5%	1/6W
R098	RD14BB2C183J	RES. CARBON	18K	5%	1/6W
R099	RD14BB2C303J	RES. CARBON	30K	5%	1/6W
R100	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R101	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R102	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R103	RD14BB2C621J	RES. CARBON	620	5%	1/6W
R104	RD14BB2C391J	RES. CARBON	390	5%	1/6W
R105	RD14BB2C432J	RES. CARBON	4.3K	5%	1/6W
R106	RD14BB2C303J	RES. CARBON	30K	5%	1/6W
R107	RD14BB2C622J	RES. CARBON	6.2K	5%	1/6W
R108	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R109	RN14BK2C1501F	RES. METAL FILM	1.5K	1%	1/6W
R110	RN14BK2C1501F	RES. METAL FILM	1.5K	1%	1/6W
R111	RN14BK2C2000F	RES. METAL FILM	200	1%	1/6W
R112	RN14BK2C3301F	RES. METAL FILM	3.3K	1%	1/6W
R113	RN14BK2C1801F	RES. METAL FILM	1.8K	1%	1/6W
R114	RN14BK2C6802F	RES. METAL FILM	68K	1%	1/6W
R115	RN14BK2C8201F	RES. METAL FILM	8.2K	1%	1/6W
R116	RN14BK2C5100F	RES. METAL FILM	510	1%	1/6W
R117	NO USE				
R118	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R119	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R120	RD14BB2E683J	RES. CARBON	68K	5%	1/4W
R121	RD14BB2E683J	RES. CARBON	68K	5%	1/4W
R122	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R123	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R124	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R125	RD14BB2C332J	RES. CARBON	3.3K	5%	1/6W
R126	RD14BB2C124J	RES. CARBON	120K	5%	1/6W
R127	RD14BB2C124J	RES. CARBON	120K	5%	1/6W
R128	RD14BB2C823J	RES. CARBON	82K	5%	1/6W
R129	RD14BB2C563J	RES. CARBON	56K	5%	1/6W
R130	RD14BB2C473J	RES. CARBON	47K	5%	1/6W
R131	RD14BB2C204J	RES. CARBON	200K	5%	1/6W
R132	RD14BB2C303J	RES. CARBON	30K	5%	1/6W
R133	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R134	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R135	RD14BB2C132J	RES. CARBON	1.3K	5%	1/6W
R136	RD14BB2C302J	RES. CARBON	3K	5%	1/6W
R137	RD14BB2C133J	RES. CARBON	13K	5%	1/6W
R138	RD14BB2C622J	RES. CARBON	6.2K	5%	1/6W
R139	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R140	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R141	RD14BB2E103J	RES. CARBON	10K	5%	1/4W
R142	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R143	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R144	RD14BB2E472J	RES. CARBON	4.7K	5%	1/4W
R145	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R146	RD14BB2C113J	RES. CARBON	11K	5%	1/6W
R147	RD14BB2E332J	RES. CARBON	3.3K	5%	1/4W
R148	RD14BB2C100J	RES. CARBON	10	5%	1/6W
R149	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R150	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R151	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R152	RD14BB2C913J	RES. CARBON	91K	5%	1/6W
R153	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R154	RD14BB2C153J	RES. CARBON	15K	5%	1/6W
R155	RD14BB2C101J	RES. CARBON	100	5%	1/6W
S001	S32-4008-05	LEVER SWITCH			
S002	S32-2012-05	LEVER SWITCH			

PARTS LIST

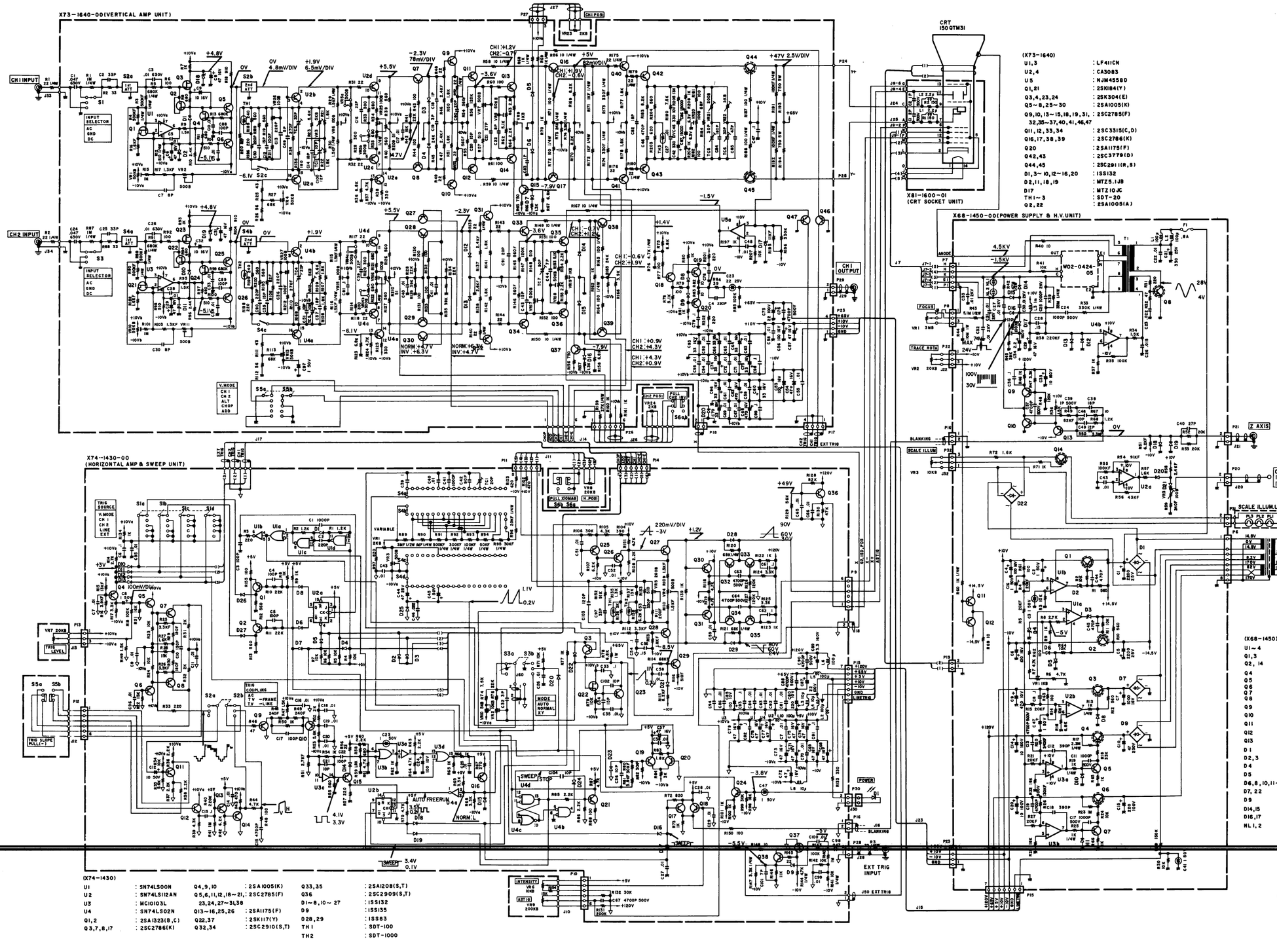
REF.NO	PARTS NO	NAME & DESCRIPTION
S003	S32-2012-05	LEVER SWITCH
S004	S02-2510-05	ROTARY SWITCH
S005	R01-3514-05	V.R. 20K B
S006	R01-3514-05	V.R. 20K B
TC001	C05-0445-05	CAP. TRIMMER 20P
TH001	SDT-100	THERMISTOR
TH002	SDT-1000	THERMISTOR
U001	SN74LS00N	IC, QUAD 2-INPUT NAND GATE
U002	SN74LS112AN	IC, DUAL JK-FF
U003	MC10103L	IC, QUAD 2-INPUT OR GATE
U004	SN74LS02N	IC, QUAD 2-INPUT NOR GATE
VR001	R06-1504-05	V.R. 2K B X2
VR002	R12-3536-05	RES. SEMI FIXED 10K B
VR003	R12-0563-05	RES. SEMI FIXED 500 B
VR004	R12-0563-05	RES. SEMI FIXED 500 B
VR005	R12-0562-05	RES. SEMI FIXED 200 B
VR006	R29-9501-05	V.R. 10K B 200K B
VR007	R01-3514-05	V.R. 20K B
VR008	R01-3514-05	V.R. 20K B
VR009	R29-9501-05	V.R. 10K B 200K B
VR010	R12-2517-05	RES. SEMI FIXED 5K B

CRT SOCKE UNIT

X81-1600-01

REF.NO	PARTS NO	NAME & DESCRIPTION
	E01-0103-05	CRT SOCKET
	J25-5102-14	PCB (UNMOUNTED)
C001	CC45CH1H020C	CAP. CERAMIC 2P 0.25P 50V
C002	CC45CH1H010C	CAP. CERAMIC 1P 0.25P 50V
J007	E31-2658-05	LEAD WIRE WITH CONNECTOR
J008	NO USE	
J009	E31-2661-05	LEAD WIRE WITH CONNECTOR
J024	E31-2660-05	LEAD WIRE WITH CONNECTOR
J025	E31-2659-05	LEAD WIRE WITH CONNECTOR
L001	L40-2292-13	FIXED INDUCTOR 2.2UH
L002	L40-2292-13	FIXED INDUCTOR 2.2UH
R001	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R002	RD14BB2C151J	RES. CARBON 150 5% 1/6W

SCHEMATIC DIAGROM



(X73-1640)

U1,3	: LF411CN
U2,4	: CA3083
U5	: NJM4558D
Q1,21	: 2SK184(Y)
Q3,4,23,24	: 2SK304(E)
Q5~8,25~30	: 2SA1005(K)
Q9,10,13~15,18,19,31, 32,35~37,40,41,46,47	: 2SC2785(F)
Q11,12,33,34	: 2SC3315(C,D)
Q16,17,38,39	: 2SC2786(K)
Q20	: 2SA1175(F)
Q42,43	: 2SC3779(D)
Q44,45	: 2SC2911(R,S)
D1,3~10,12~16,20	: 1SS132
D2,11,18,19	: MTZ5.1JB
D17	: MTZ10JC
TH1~3	: SDT-20
Q2,22	: 2SA1005(A)

(X68-1450)

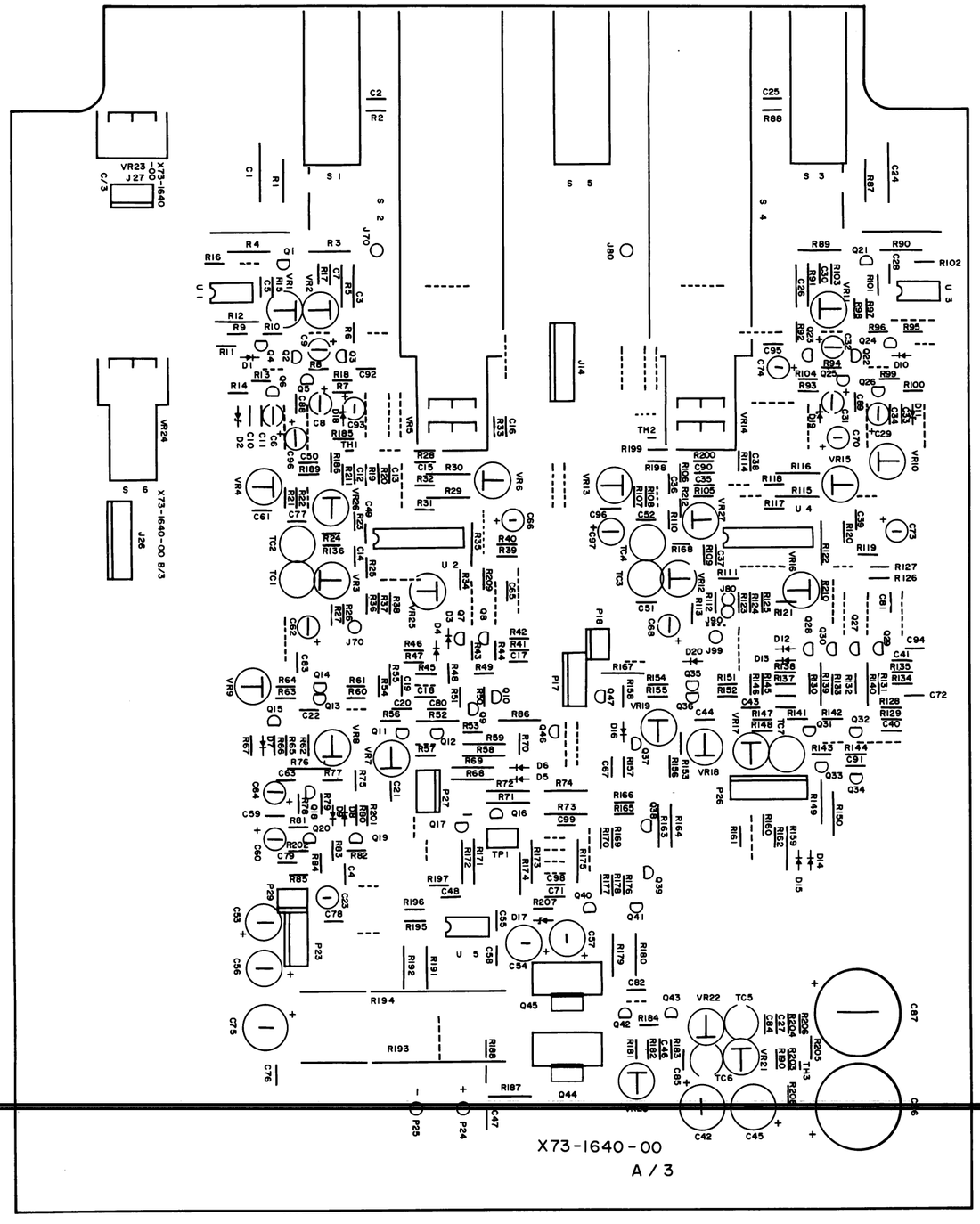
U1~4	: NJM4558D
Q1,3	: 2SB950(P,Q)
Q2,14	: 2SD1276(P,Q)
Q4	: 2SA1306B(O,Y)
Q5	: 2SC5271(E)
Q6	: 2SB940(P,Q)
Q7	: 2SC2909(S,T)
Q8	: 2SD613(E)
Q9	: 2SA1208(S,T)
Q10	: 2SC2910(S,T)
Q11	: 2SC1384(S,R)
Q12	: 2SA684(S,R)
Q13	: 2SA1175(F)
D1	: S2VB40F
D2,3	: MTZ10JC
D4	: MTZ5.1JB
D5	: MTZ3.3JA
D6,8,10,11~13,18~21	: 1SS132
D7,22	: S1VB20
D9	: S1VB60
D14,15	: 1SR35-200
D16,17	: 1SS83
NL1,2	: NE-28

(X74-1430)

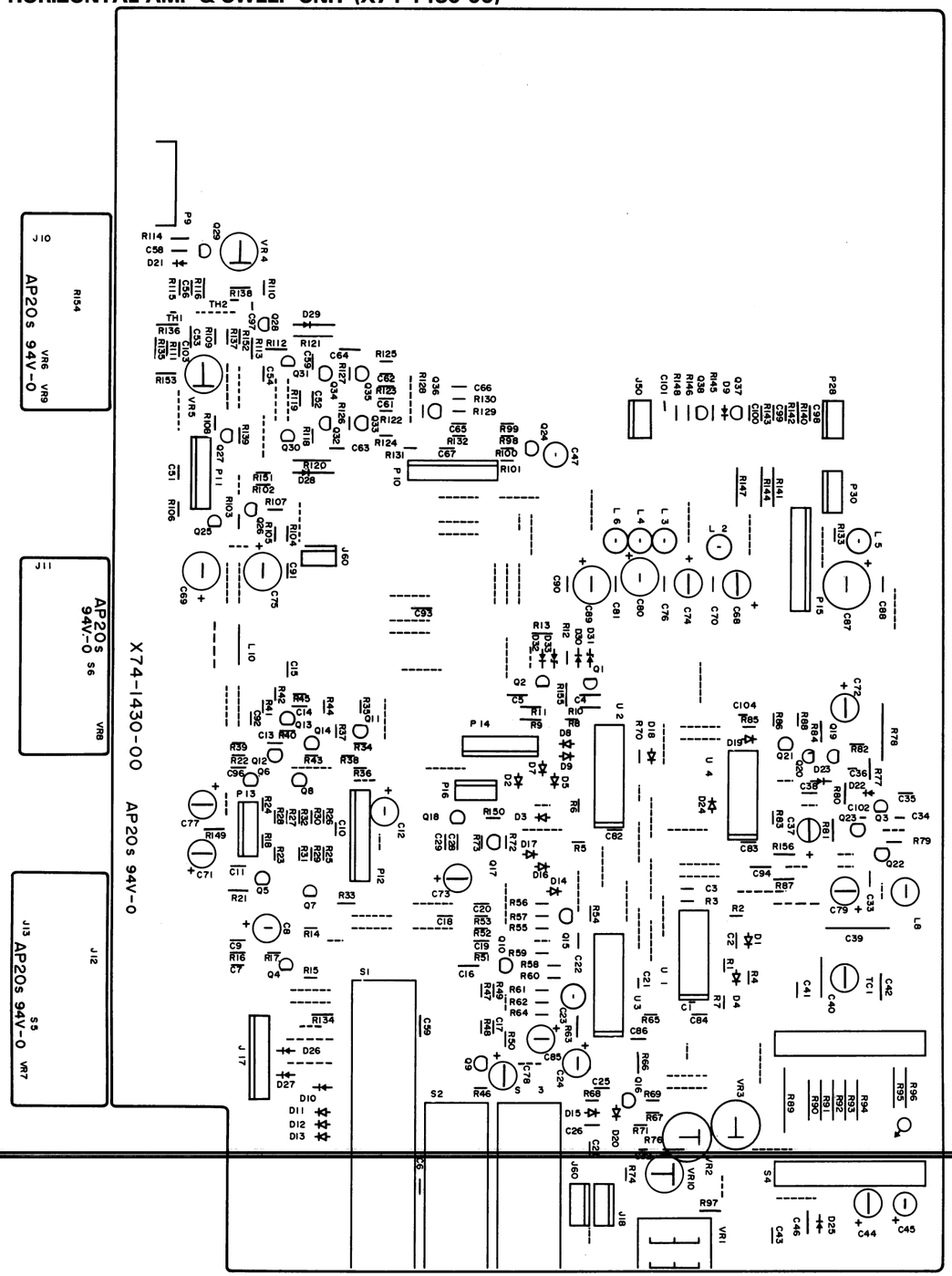
U1	: SN74LS00N	Q4,9,10	: 2SA1005(K)	Q33,35	: 2SA1208(S,T)
U2	: SN74LS112AN	Q5,6,11,12,18~21, 23,24,27~31,38	: 2SC2785(F)	Q36	: 2SC2909(S,T)
U3	: MC10103L	Q13~16,25,26	: 2SA1175(F)	D1~8,10~27	: 1SS132
U4	: SN74LS02N	Q22,37	: 2SK117(Y)	D9	: 1SS155
Q1,2	: 2SA1323(B,C)	Q32,34	: 2SC2910(S,T)	D28,29	: 1SS83
Q3,7,8,17	: 2SC2786(K)			TH1	: SDT-100
				TH2	: SDT-1000

P.C. BOARD

VERTICAL AMP UNIT (X73-1640-00)

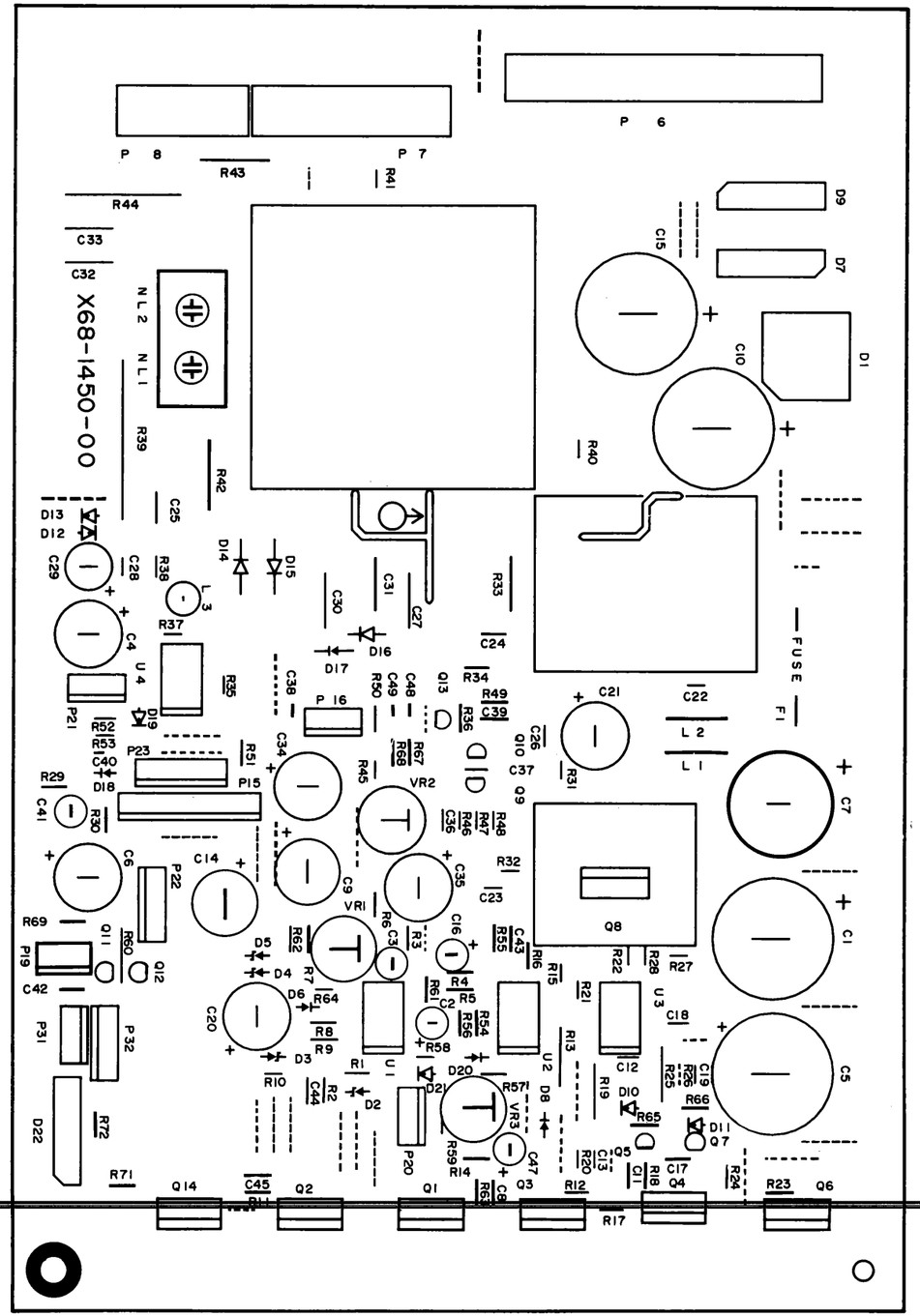


HORIZONTAL AMP & SWEEP UNIT (X74-1430-00)



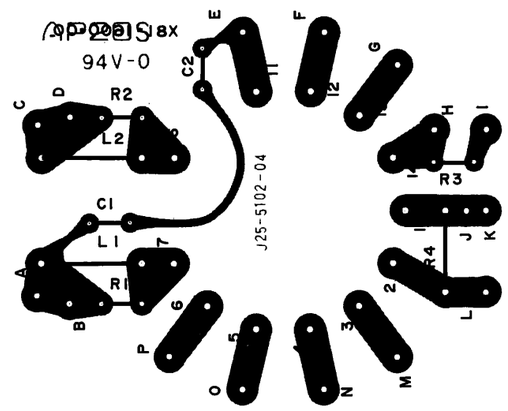
P.C. BOARD

POWER SUPPLY & H.V UNIT (X68-1450-00)

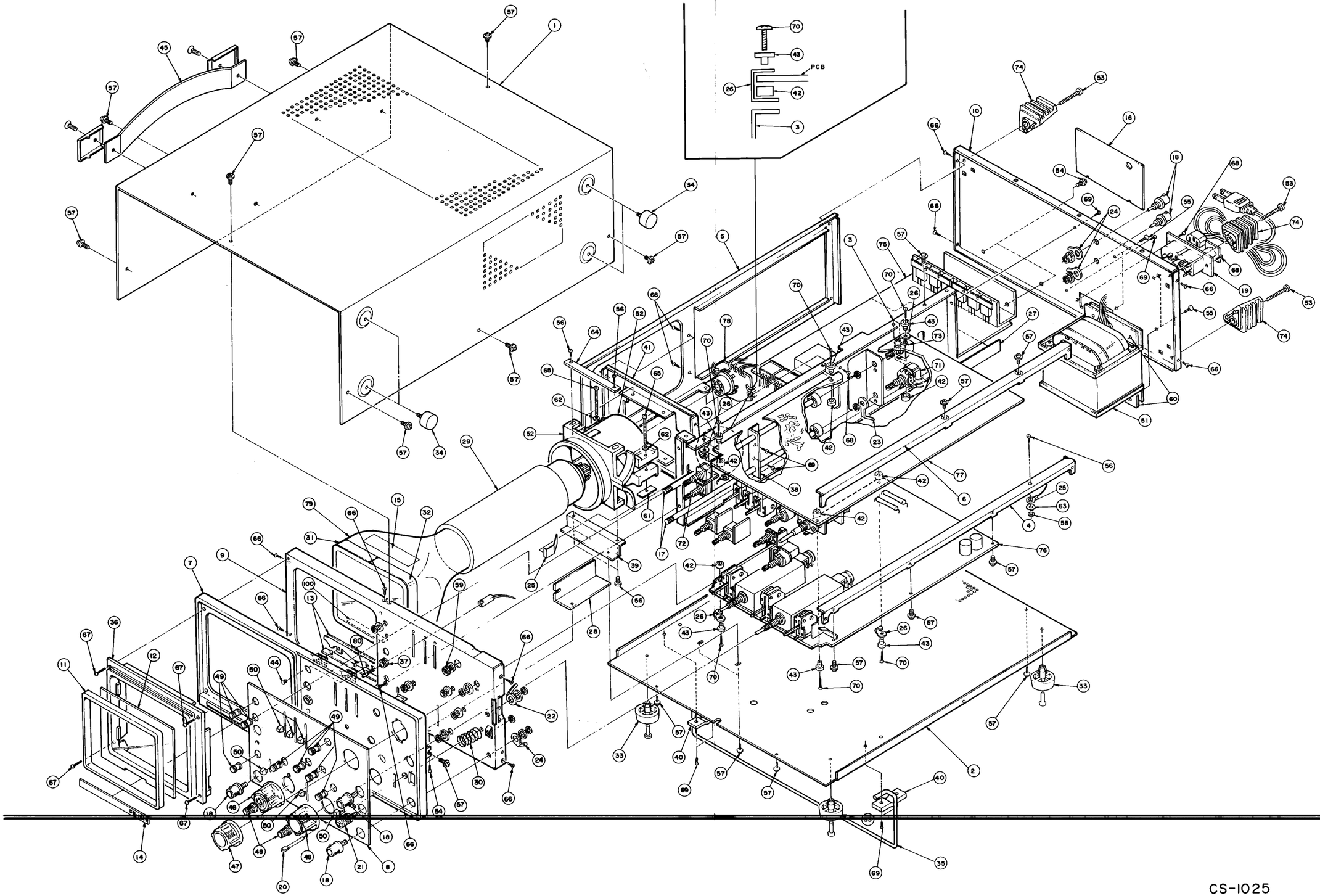


CRT SOCKET UNIT (X81-1600-01)

Foil side view

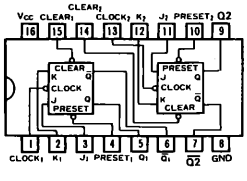


DISASSEMBLY



CS-1025

SEMICONDUCTORS



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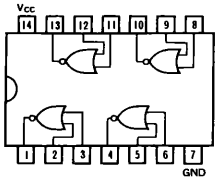
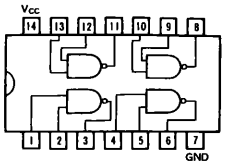


LS74LS02N



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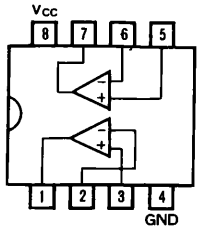

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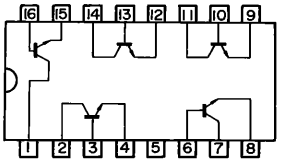
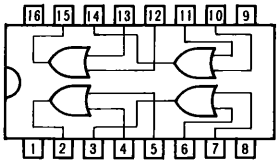
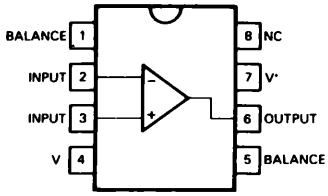


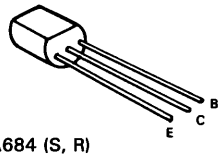
CA3083
Top View



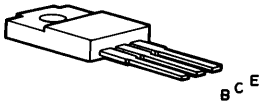
MC10103L



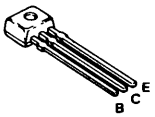
LF411CN



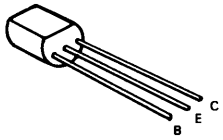
2SA684 (S, R)
2SA1208 (S, R)
2SA1005 (K)
2SC2909 (S,T)
2SC2910 (S,T)
2SC1384 (S,R)
2SC2271 (E)



2SB940 (P,Q)
2SD613 (E)
2SA1306B (O)
2SD1264 (P,Q)



2SA1175 (F)
2SC2785 (F)
2SC2786 (K)
2SC3315 (C, D)
2SA1323 (B, C)



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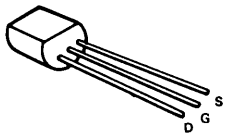

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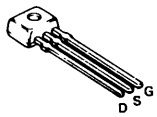

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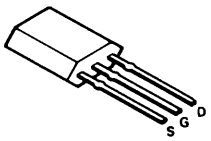
2SK184 (Y)



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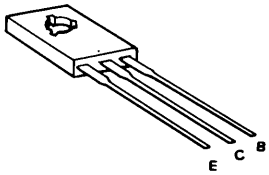

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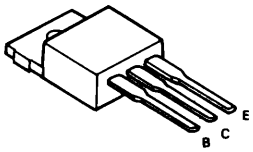

2SA1009 (L, K)
2SD613E

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