INSTRUCTION MANUAL

Model: 3502

20MHz Dual Trace Oscilloscope

HUNG CHANG

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SECTION 1 INTRODUCTION

This model is a dual trace 20MHz oscilloscope using high brightness CRT.

The vertical amplifiers have high sensitivity of 5mV/DIV and the frequency characteristic response with the smooth rolloff exceeding 20MHz. The highest triggering sweep speed is 0.2 μsec/DIV.

FEATURES

1) Wide bandwidth & high sensitivity
2) Very low power consumption
3) High sensitivity X-Y mode
4) Z axis (intensity modulation)
5) TV VIDEO SYNC Filter
6) High frequency rejection filter in the trigger circuit
7) Front panel electrical trace rotator
8) Regulated power supply circuit for accuracy

SECTION 2 SPECIFICATIONS

VERTICAL DEFLECTION

Deflection Factor	5mV to 20V/DIV on 12 ranges in 1-2-5 step with fine control.
Bandwidth	DC: DC to 20MHz(-3dB)
	AC: 10Hz to 20MHz(-3dB)
Risetime	Less than 17.5nsec(Calculated from BW × Rise time = 0.35)
Overshoot	Less than 8%
Input Impedance	1MΩ shunted by 20pF±3pF(Max imput: 600Vp-p or 300V DC + AC peak)
Operating Modes	CH-A, CH-B, DUAL and ADD
Chop Frequency	200kHz approx.
Channel Separation	Better than 60dB at 1kHz
CH-B Polarity	CH-B can be inverted

TIME BASE

Type	Automatic and triggered. In automatic mode, sweep is obtained without input signal.
Sweep Time	0.2μsec to 0.5sec/DIV on 20 ranges in 1-2-5 step with fine control and X-Y
Magnifier	X5 at all ranges
Linearity	Less than 3%

TRIGGERING

Sensitivity	INT: 2 DIV or more
	EXT: 1 Vp-p or more
Source	INT, CH-B, LINE or EXT
Triggering Level	Positive and Negative, continuously variable level control Push for AUTO
Range	20Hz to 20MHz or more
Sync	AC, HF Rej, TV(each + or −)
	At TV Sync TV-H(Line) and TV-V(Frame) sync are switched automatically by SWEEP TIME/DIV switch.
	TV-V: 0.5sec/DIV to 0.1msec/DIV
	TV-H: 50μsec/DIV to 0.2μsec/DIV

HORIZONTAL DEFLECTION

Deflection Factor	5mV to 20V/DIV on 12 ranges in 1-2-5 step with fine control.
Frequency Response	DC to 1MHz(−3dB)
Input Inpedance	1MΩ shouted by 20pF ±3pF
Max Input Voltage	300V DC + AC peak or 600Vp-p
X-Y Operation	X-Y mode is selected by SWEEP TIME/DIV switch
	CH-A: Y axis
	CH-B: X axis
Intensity Modulation	Z Axis: TTL Level (3Vp-p ~ 50V) + bright, − dark.

OTHER SPECIFICATIONS

CRT HV	APPROX-2KV
Calibration Voltage	0.5Vp-p ±5%, 1kHz Square Wave
Power Requirement	AC: 100V/120V/220/V240V/, 50/60Hz, 19W
Weight	7kg approx.
Dimensions	147(H) X 356(W) X 435(D)mm

SECTION 3 OPERATION

3-1 INITIAL OPERATION

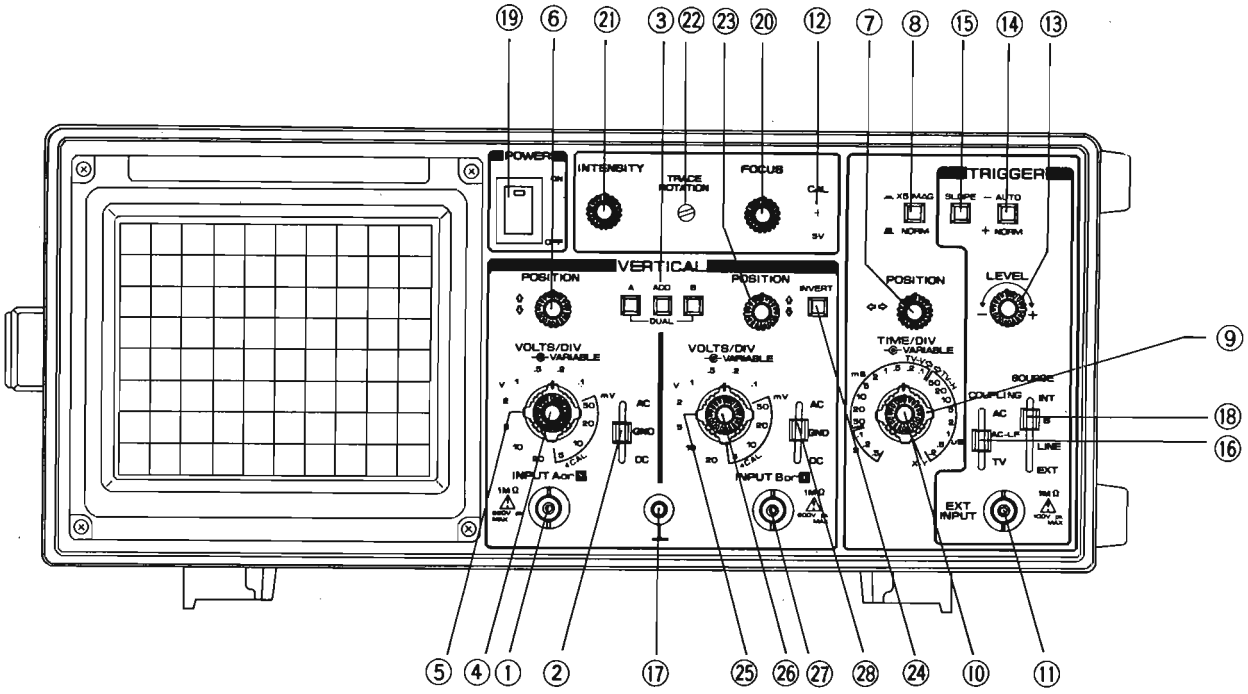
Inspect the carton for serious damage which might have caused failure of the instrument during transportation. If damage is noted, notify the agent you bought from before turning on.

INITIAL AC OPERATION

1. Prior to any kind of operation of the instrument, proceed as follows to get familiarized with the instrument.
   a) Set the POWER switch to OFF.
   b) Turn all the three POSITION controls to mid-position.
   c) Turn INTENSITY control to mid-position.
   d) PUSH TRIGGERING LEVEL control for AUTO.
   e) The rest of the controls remain at any position for normal operation.
   f) Check the line voltage.
2. Connect the AC line cable into the AC receptacle on the rear panel of the instrument, and plug into an AC power outlet.
3. Turn POWER to ON. After approximately 20 seconds, trace lines appear on CRT screen. If no trace lines appear, rotate INTENSITY clockwise till trace lines are easily observed.
4. Adjust FOCUS and INTENSITY controls for clear trace lines.
5. Readjust Vertical and Horizontal POSITION controls for locations required.
6. Connect a probe (10:1) to INPUT of CH-A and hook the tip of the probe to CAL 0.5Vp-p output.
7. Rotate CH-A Vertical attenuator VOLTS/DIV switch to 10mV/DIV and turn the VARIABLE on the same axis clockwise to detent. Turn TRIGGERING SOURCE to CH-A. Then a square-wave of 5 divisions is displayed on the screen.
8. If the square-wave is distorted, adjust the trimmer of the probe till it becomes a good square-wave.
9. Remove the probe tip from CAL 0.5Vp-p output. Now, the oscilloscope is ready for use.

3-2 CONTROLS & INDICATIONS

1. VERTICAL INPUT
   Vertical input terminal for CH-A.
2. AC-GND-DC
   Vertical input coupling for CH-A. In AC position, the DC component of input signal is blocked by a capacitor. In GND position, the input terminal opens and the input of the internal amplifier is grounded. In DC position, the input terminal is directly connected to the amplifier and all components of input signal are displayed.
3. MODE
   CH-A: Waveforms of CH-A are displayed.
   CH-B: Waveforms of CH-B are displayed.
   DUAL: In the range from 0.5 sec/DIV up to 1 msec/DIV, both channels are chopped at about 200 kHz.
   In the range from 0.5 msec/DIV up to 0.2 μsec/DIV, both channels are switched alternately.
   ADD: CH-A and CH-B signals are added. By Pushing (23) PUSH INVERT, SUB mode is obtained.
4. VOLTS/DIV VARIABLE for CH-A.



5. VOLTS/DIV
   Vertical attenuator for CH-A. The scale is graduated in voltage per "DIV" of CRT screen area.
   Calibrated voltage is indicated when the VARIABLE is turned fully clockwise.
   Selectable in 10 calibrated ranges from 5 mV/DIV to 20 V/DIV.
6. VERTICAL POSITION
   Vertical position adjuster for CH-A.
7. HORIZONTAL POSITION
   Horizontal position adjuster.
8. PUSH X5 MAG
   When pushed, SWEEP TIME is magnified by 5.

9. SWEEP TIME/DIV
   Horizontal sweep time selector. It selects sweep times of 0.2 μsec/DIV to 0.5 sec/DIV in 20 calibrated steps. X-Y operation is possible by turning the knob fully clockwise to CH-B.
   Change over between CHOP and ALTERNATE is also accomplished automatically by this selector in DUAL MODE

10. SWEEP TIME/DIV VARIABLE

11. EXT. TRIG
    Input for external triggering signal.

12. CAL
    Calibration voltage terminal. Calibration voltage is 0.5Vp-p of about 1 kHz square wave.

13. TRIGGERING LEVEL
    LEVEL control adjusts sync phase to determine the starting point of sweep on the slope of displayed waveform.

14. PUSH AUTO
    By Pushing LEVEL knob toward you, auto-sweep is effected; the sweep is set in free-running state even when no input signal is applied, with trace line displayed on CRT.
    With trigger signal, triggered-sweep is effected where sync level is adjustable. When sync level is deviated, the sweep is set in free-running state.

15. SLOPE + , –
    Sync slope polarity is selected.

16. COUPLING
    Sync mode selector switch.
    AC: For normal operation. In this mode sync signal is directly fed to the sync circuit.
    HF REJ: Low Pass Filter cuts off RF composite of the sync signal.
    TV: TV or Video composite signals are easily triggered.
    SWEEP TIME/DIV selects TV-V (50μsec~0.1 msec) or TV-H (50μsec~0.2μsec)

17. GND
    Ground terminal.

18. SOURCE
    Sync signal selector.
    INT: CH-A and CH-B signals are added on for triggering.
    CH-A: Sync signal for triggering comes only from CH-A. But, when in single sweep, the channel selected by MODE has priority.
    CH-B: Signal from CH-B. The rest is the same as CH-A.
    LINE: AC power line waveform is used as sync signal source.
    EXT: The signal hooked into EXT TRIG becomes the sync signal source.

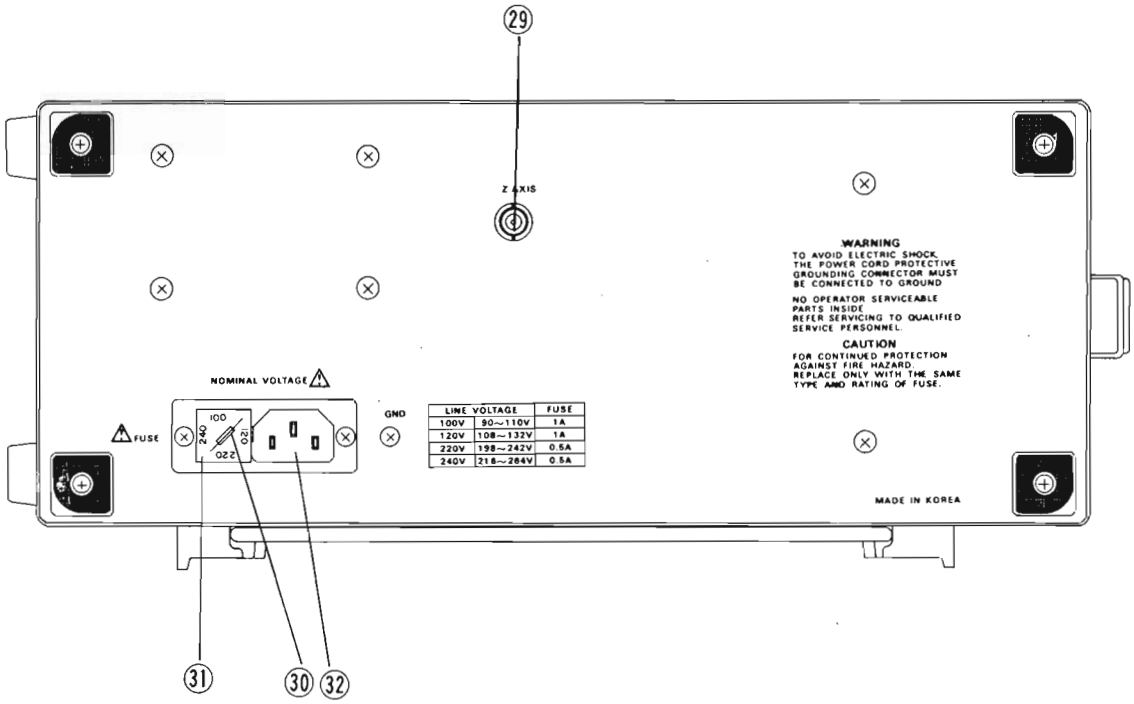
19. POWER SWITCH
    On or off.

20. FOCUS
    Focus control to obtain optimum waveform display.

21. INTENSITY
    Adjust the brightness of waveform for easy viewing.

22. TRACE ROTATOR
    The earth magnetics effect the trace line. Rotate this with a screw driver for proper trace line.

23. CH-B POSITION
    CH-B vertical position control.
24. PUSH INVERT
    When pushed, the CH-B vertical polarity is inverted. This facilitates SUB MODE measurement at ADD MODE.
25. VOLTS/DIV
    Vertical attenuator for CH-B.
26. VARIABLE
27. VERTICAL INPUT
    Vertical input for CH-B.
28. AC-GND-DC
    For CH-B, same as (2).



29. Z AXIS
    External Intensity Modulation Input.
30. FUSE HOLDER
    Proper ampere fuse must be in compartment
31. VOLTAGE SELECTOR
    Proper line voltage must be selected where this oscilloscope is used.
32. RECEPTACLE for AC line cable.

3-3 TRIGGERING

Generally, triggered oscilloscopes have the following circuits to display stable waveform on the screen.
Vertical input signal or integral number related signal is used for a sync pulse signal, which is used as a triggering signal. This signal stabilizes the waveform display. However, this triggering must be exactly synchronized to the vertical input signal. And all the knobs should be correctly used.
This model has 4 knobs to control triggering. They are LEVEL, SLOPE, SYNC and SOURCE.

(SOURCES)

When the vertical input signal is supplied to the internal SYNC circuit, it is called INTERNAL TRIGGER.

When the same signal or integral number related signal is applied into the SYNC circuit through EXT TRIG input, it is refered as EXTERNAL TRIGGER. In this model INT, CH-A and CH-B of SOURCE switch are internal triggers.

The internal trigger signal is amplified in the vertical amplifier and triggering becomes easy.

LINE: The AC power line waveform is supplied to the SYNC circuit as a triggering source.

EXT: When SOURCE is turned to EXT, it becomes external trigger which has namely 3 benefits.

1. Triggering signal receives no effects from the vertical circuits.
   EX. Triggering level need be readjusted when VOLTS/DIV knobs are turned because the sync source voltage changes. In such case, unless the external trig input voltage is changed, triggering is very stable and free from vertical controls.
2. Input signal can be easily delayed by the use of the delaying function of a pulse generator.
3. Composite signal or modulated signal can be easily triggered by the signal which composes the composite signal.

(SYNC)

This switch has a selection of the sync circuit coupling. At AC position it becomes AC coupling and DC composite is isolated for stabilized synchronization. HF REJ has a low pass filter to eliminate RF noise interference to synchronization. At TV position either vertical or horizontal sync signal isolation circuit works to ensure the TV signal triggering.

Selection of TV-V or TV-H is done by SWEEP TIME/DIV switch.

(SLOPE)

SLOPE switch +, −selects the triggering source signal slope of positive or negative.

At TV sync, triggering point is set to sync pulse rising time or falling time.

(LEVEL)

When this knob is pushed it becomes AUTO for free running without the input signal for 0 level reference. When a signal is applied to the input, turn this knob for stable triggering.

3-4 X-Y OPERATION

For some special cases, this instrument is specially designed for easy X-Y application. Simply turn SWEEP TIME/DIV switch to CH-B. Then all CH-B functions work as horizontal amplifier, whereas CH-A remains as vertical amplifier.

3-5 CALIBRATED VOLTAGE MEASUREMENTS

Peak voltages, peak-to-peak voltages, DC voltages and voltages of a specific portion of a complex waveform can be measured using this instrument as a voltmeter. Voltages can be measured whenever waveforms are observed using either CH-A or CH-B inputs. Proceed as follows:

1. Set VARIABLE control fully clockwise to CAL position, then set VOLTS/DIV control to display the waveform in proper size to be observed. Vertical POSITION controls may be turned to obtain division reference.
2. For DC or complex signals, set the input switch to GND, and adjust the vertical POSITION control to a convenient reference level. Set the switch to DC and observe the amount of deflection. A positive voltage will deflect trace upwards: a negative voltage will deflect the trace downward. To calculate the voltage reading, multiply the vertical deflection (by division) by the setting of the VOLTS/DIV switch.

NOTE WHEN A PROBE (10:1) IS USED, THE WAVEFORM DISPLAY IS ONLY 1/10 OF THE ACTUAL VOLTAGE MEASURED.

3-6 DUAL TRACE WAVEFORM OBSERVATION

MODE switch to be turned to DUAL. Other procedures are in the same manner as mentioned above.

3-7 TV SIGNAL SYNCHRONIZATION

Set TRIGGERING SYNC to TV (+ or −), then specially designed circuitry provides easy triggering for complexed TV frame and line signal. TV frame and line waveform are easily obtained by simply tuning SWEEP TIME/DIV control.

3-8 ADD & SUB MEASUREMENTS

Simply turn MODE switch to ADD, added waveform of CH-A and CH-B is displayed.
With this MODE at ADD position, subtracted waveform is obtained by pulling INVERT knob which inverts the polarity of CH-B.

3-9 APPLICATIONS

This is a dual trace oscilloscope which has full capability of single trace mode. Thanks to the dual-trace functions, various effective measurements are feasible.

[SINGLE-TRACE APPLICATIONS]
Either Channel A or Channel B can be used for single-trace operation. Channel A is referred to hereunder for simplicity.

Set controls:

AC-GND-DC	AC
MODE	CH-A
SYNC	NORM +
SOURCE	INT
PROBE	to CH-A INPUT Jack

Connect the tip of the probe to the point in the circuit where the wave form is to be measured, and its ground clip to the chassis or the ground part.

CAUTION ! ! ! THE PEAK-TO-PEAK VOLTAGE AT THE POINT OF MEASUREMENT SHOULD NOT EXCEED 600 VOLTS.

3-9-(1) AC VOLTAGE AND FREQUENCY MEASUREMENT

When measuring voltage and frequency, set VOLTS/DIV VARIABLEs ④, ㉕ and SWEEP TIME/DIV VARIABLE ⑨ at their calibrated detent points (clockwise).

(EX) The signal displayed on the CRT is

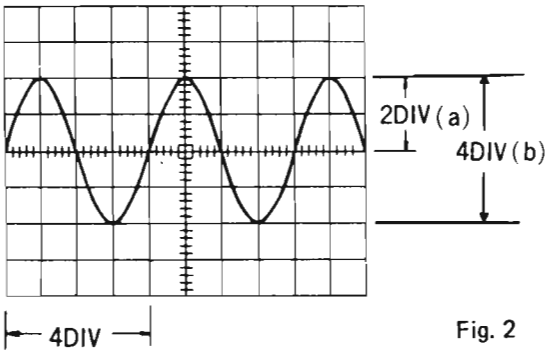


Fig. 2

VOLT/DIV . . . . . at 2V
SWEEP TIME/DIV . . . . . at 5 msec.

(a) Peak voltage . . . . 2V/DIV x 2DIV=4 volts
(b) p-p voltage . . . . 2V/DIV x 4DIV=8 volts
(c) Effective voltage . . . Peak voltage $\div\sqrt{2}$=2V x 2DIV x $\frac{1}{\sqrt{2}}$
=2.828 volts
(d) Frequency (Hz) . . . . . 1/Time (second)

** Time=Number of DIVs for 1 cycle x
value of SWEEP TIME/DIV

Therefore, the Fig 2 waveform is:

$$\text{Frequency} = \frac{1}{5\,\text{m sec} \times 4\,(\text{DIV})} = \frac{1}{20\,\text{m sec}}$$

=50Hz

NOTE ! ! ! The input of this oscilloscope is 1MΩ shunted by 20pF capacitance. When the probe is used in 10:1 attenuation, the impedance becomes 10MΩ shunted by 15pF. Then the voltage reading must be multiplied by 10.

3-9-(2) DC VOLTAGE MEASUREMENT

AC-GND-DC being at AC position, only AC was displayed on the CRT screen. For DC Measurement, set the switch to GND and push the TRIGGERING LEVEL knob ⑬ for a trace line, which must be positioned at a certain place as 0 volt reference.

After that, turn the switch to DC. Then the trace line shifts up or down. The value of movement is the DC voltage.

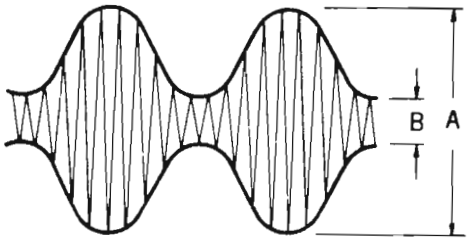
DC voltage = Shift (DIV) x VOLTS/DIV

When the trace line shifts up-ward, the polarity is (+), and down-ward is (−).

3-9-(3) AM MODULATION MEASUREMENT

There are various ways of measurements, but herein this manual the envelope method is introduced. This method is applicable when the carrier frequency is within the frequency bandwidth of the oscilloscope. See Fig. 3.

Fig. 3



$$\text{Mod. (\%)} = \frac{A - B}{A + B} \times 100$$

3-9-(4) DUAL-TRACE APPLICATIONS

MODE switch being turned to DUAL. both Channel A and Channel B works simultaneously.

Then, comparison of two relative signals are easily done such as level, waveforms, phase, etc.

3-9-(5) LEVEL COMPARISON

(EX) OUTPUT/INPUT of an amplifier

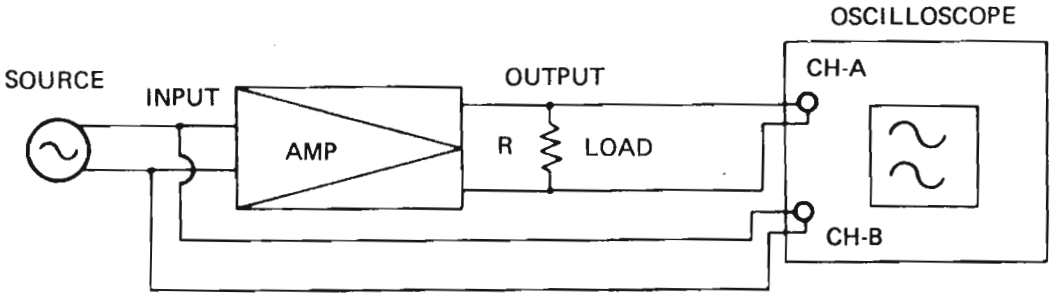


Fig. 4

With the connections of the Fig. 4 set the displays of CH-A and CH-B the same (POSITION controls be adjusted to place CH-B waveform onto CH-A). Then the difference between displays of CH-A VOLTS/DIV and CH-B's is the gain of the amplifier. If the two signals do not match each other even when variable controls are adjusted, the difference is the distortion caused in the amplifier. Then, simply turn the MODE switch to ADD and push INVERT knob for invert (SUB MODE), for viewing only distortion. When there is no distortion originated in the amplifier, a straight trace line is displayed in SUB MODE.

3-9-(6) REPAIRING STEREO SYSTEMS

Every stereo equipment has two symmetrical amplifier circuits.

So, simultaneous comparison of the same stages makes it so easy to locate defective point.

3-9-(7) TV SERVICING

Triggered oscilloscope is indispensable. This model has the very convenient TV SYNC circuits of TV-V (Frame) and TV-TV-H (line) for accurate synchronization to view VIDEO SIGNAL, BLANKING PEDESTALS, VITS and Vertical/Horizontal SYNC PULSES.

3-9-(8) COMPOSITE VIDEO ANALYSIS

The most important waveform in TV servicing is the composite signal consisting of the video signal, the blanking pedestals, and sync pulses. Fig. 5 and Fig. 6 show composite signals synchronized with horizontal sync pulses and vertical blanking pulses.

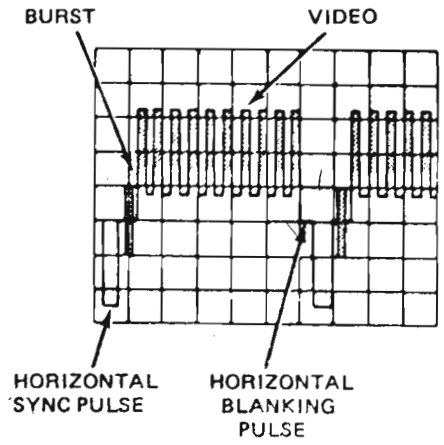


Fig. 5

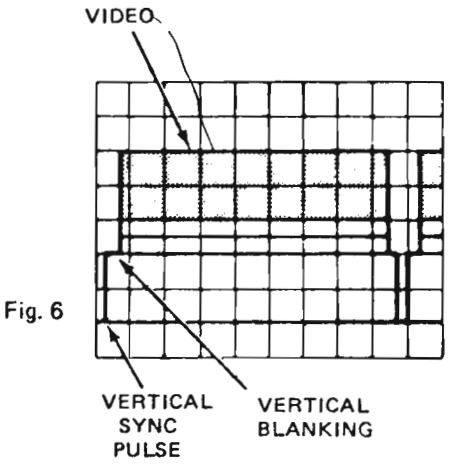


Fig. 6

3-9-(9) MEASUREMENT OF FREQUENCY BY X-Y

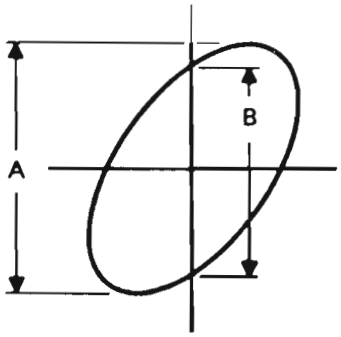
Simply turn SWEEP/DIV switch to CH-B for X-Y operation. Then CH-A becomes Y axis and CH-B X axis. Connect a standard frequency signal to CH-B and unknown signal to CH-A. Lissajous figure is displayed on the screen as shown in Fig. 7.

Standard signal frequency: Unknown signal frequency

Fig. 7

3-9-(10) PHASE MEASUREMENT

In X-Y function, apply two signals to each CH-A and CH-B. Calculate according to the formula.



SINE $\phi = \frac{B}{A}$

ϕ=PHASE ANGLE

Fig. 8

3-9-(11) PHOTOGRAPH

CRT CAMERA (using Polaroid film) exact hood size camera for this oscilloscope is available.

SECTION 4 CIRCUIT DESCRIPTION

4-1 OUTLINES OF CIRCUIT

Block diagram of this model is as Fig. 9.

This oscilloscope is equipped with 2 identical input attenuators and preamplifiers. The input signal is attenuated to the required level, amplified to the preamplifier, and led to the trigger pick off circuit, then to the switching circuit.

At the trigger pick off circuit, a part of the signal is picked up and fed to the trigger select logic for either CH-B, INT (CH-A + CH-B) and led to the trigger amplifier of the TIME BASE Block.

The switching circuit consists of diode-gate and mode control logic to select CH-A, CH-B and DUAL.

After the switching circuit the signal is amplified, and goes through a cascade type final stage amplifier for CRT vertical deflector.

The trigger signal or an external trigger signal is amplified and reformed as a clock pulse to drive the following saw tooth generator circuit, which consists of JKRS flip-flops and sweep controler, FET input Miller integrator, hold-off.

The tooth wave generated by the clock pulse, is led to a differential amplifier which, is equipped with a stabilized current supply, then fed to CRT horizontal deflector.
For X-Y operation, CH-B input signal is led to the pick-off circuit, sweep X-Y selector, then horizontal final amplifier.

Q signal in the sweep control flip-flop and NAND of chopper rising edges are used for unblanking and chop-blanking. It is led to a cascade amplifier with a constant current load, a DC producing circuit and then added on to a high voltage, and then fed between the control grid and cathode of the CRT. The CRT is cut off during trace fly-back, and while waiting for trigger and chop change over time.

The power supplies are all regulated.

A feed back type DC-DC converter is used for generating the stabilized high voltage to CRT.

4-2 VERTICAL AMPLIFIER CIRCUIT

The vertical input signal fed from the BNC input terminal is controlled by the AC-GND-DC switch and applied to the lst attenuator, where 1/10 step (20dB) attenuation takes place. The out of input protection circuit Q1 (Q3) is fed to the DUAL FET through high input impedance. DUAL FET is well DC balanced against temperature variation.
After being DC balanced, through VR1, 3, 4 (VR7, 9, 10), the output signal is fed to the diode switching circuit composed of D2-5, 16-19.

The mode logic circuit which is controlled by the MODE switch, makes the selection of dual-trace, single-trace, CHOP and ALT possible. Dual-trace operation is obtained by the trigger select logic circuit driven by TRIG SOURCE switch, while the vertical MODE switch works prior to TRIG SOURCE switch and selects a proper trigger signal for single-trace operation.

In single trace operation triggering is automatically logic controlled according to the vertical MODE switch prior to Trigger SOURCE Selector.

In X-Y operation, controlled by the SWEEP TIME/DIV control, CH-B signal is supplied to the trigger amplifier and fed to the horizontal amplifier as the X signal.

The vertical signal through diode switching circuit passes the limiter circuit of Q 5, 6 and D6-9 to obtain the adequate level, and then is fed to the output amplifier composed of Q11-20, The output obtained is sufficiently amplified by the feedback-type amplifier with the constant current circuit (Q15, 16, 19, 20). This amplifier is equipped with the booster (Q17, 18) for high frequency contents to obtain flat response signals. The signal is then fed to the vertical deflection plates of CRT.

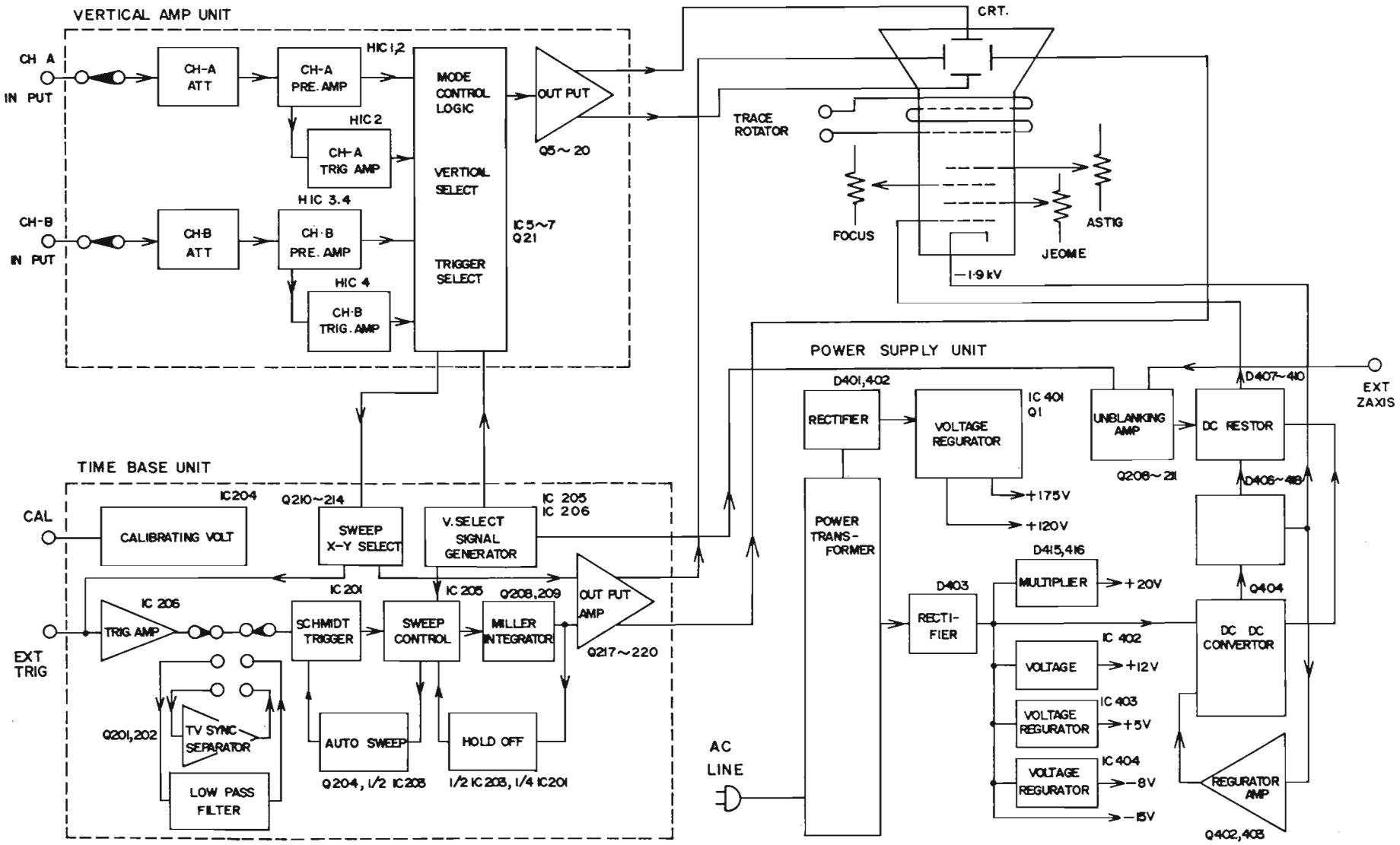

VERTICAL AMP UNIT
CH A
IN PUT
CH-A ATT
CH-A PRE. AMP
HIC 1,2
CH-A TRIG AMP
HIC 2
MODE CONTROL LOGIC
VERTICAL SELECT
TRIGGER SELECT
IC 5~7 Q21
OUT PUT
Q5~20
CH-B
IN PUT
CH-B ATT
CH-B PRE. AMP
HIC 3.4
CH-B TRIG. AMP
HIC 4
CRT.
TRACE ROTATOR
FOCUS
ASTIG
JEOME
-1.9 kV
POWER SUPPLY UNIT
D401,402
RECTIFIER
VOLTAGE REGURATOR
IC 401 Q1
+175V
+120V
UNBLANKING AMP
Q208~211
DC RESTOR
D407~410
EXT ZAXIS
D405~418
TIME BASE UNIT
CAL
IC204
CALIBRATING VOLT
Q210~214
SWEEP X-Y SELECT
V.SELECT SIGNAL GENERATOR
IC 205 IC 206
IC 206
TRIG. AMP
EXT TRIG
IC 201
SCHMIDT TRIGGER
IC 205
SWEEP CONTROL
Q208,209
MILLER INTEGRATOR
OUT PUT AMP
Q217~220
Q201,202
TV SYNC SEPARATOR
LOW PASS FILTER
AUTO SWEEP
Q204, 1/2 IC205
HOLD OFF
1/2 IC 203, 1/4 IC201
AC LINE
POWER TRANS-FORMER
D403
RECTI-FIER
D415,416
MULTIPLIER
+20V
Q404
IC 402
VOLTAGE
+12V
IC 403
VOLTAGE REGURATOR
+5V
IC 404
VOLTAGE REGURATOR
-8V
-15V
DC DC CONVERTOR
REGURATOR AMP
Q402,403

Fig. 9

4-3 HORIZONTAL/TIME BASE CIRCUIT

Time Base circuit consists of trigger section, the saw-tooth section and amplifier section. The output from trigger select circuit is led to sweep X-Y select circuit (Q210～214). This select circuit works as the internal trigger amplifier and the saw tooth wave amplifier in normal operation, and as the amplifier for CH-B signal in X-Y operation. The internal trigger signal is being amplified by IC206 and then fed to schmidt circuit (1/2 IC1). The external trigger signal is directly fed to IC206. With TRIG SOURCE switch set to HF REJ, noises and high frequency components in the trigger source are eliminated. With TRIG SOURCE switch set to TV, IC output is connected to TV sync separator (Q201, 202) to obtain horizontal sync signal (TVH) or vertical sync signal (TVV) and to supply it to schmidt circuit. Changeover between TVH and TVV is automatically accomplished by the SWEEP TIME/DIV switch. The signal in the schmidt trigger circuit is shaped into square waves and becomes clock pulses for sweep control gate (IC 205). The clock pulse is also supplied to auto sweep (Q204, 1/2 IC203). With no trigger input, the output of the auto sweep circuit becomes low level, and therefore sweep control gate starts automatic sweeping. With triggering input, or supply of clock pulse, the output of auto sweep circuit becomes high level and the gate F.F. is inverted by the clock pulses and the Miller integrator becomes charged. Also, the output of auto-circuit actuates Q223 ON/OFF. When the gate F.F. is inverted, and sets Q207 to OFF, the Miller integrator determines the sweep time by the C/R time constant selected by the SWEEP TIME/DIV switch to obtain saw-tooth waves of excellent linearity. When the output from the Miller integrator fully rises, the Hold-off F.F. is inverted and the sweep stops for the time detemined by the Hold-off time constant. When the Hold-off time passes, the next clock pulse is set in standby mode and thereby the sweep returns to the original status.

The output of this Miller integrator passes through sweep X-Y select circuit and is fed to the horizontal amplifier (Q217 ～220). In this amplifier, by use MAG X5 switch, sweep time is expanded by factor of 5. With SWEEP TIME/DIV switch set to X-Y position, sweep X-Y select circuit is switched to separate the Miller integrator from the horizontal amplifier and then the vertical CH-B input is applied as horizontal input amplifier. In CHOP operation, blanking effects are given with the use of the horizontal Q output and CHOP signal generator. In ALT operation, the effects are given by Q output.

The output from multivibrator of IC204 is shaped to obtain the calibrating voltage output. The variable resistor of VR203 is used to adjust the output level of 0.5p-p.

SECTION 5 MAINTENANCE & ADJUSTMENTS

5-1 GENERAL

This section contains information for preventive maintenance, adjustment and calibration.

5-1-(1) PREVENTIVE MAINTENANCE

Preventive maintenance consists of periodic cleaning, and recalibration of the oscilloscope. It should be performed on a regular bases to keep the instrument in its best operational and appearance condition.

5-1-(2) CLEANING

Accumulation of dirt, dust and grime should be removed whenever they become noticeable. The frequency of cleaning is largely dependent upon the environment in which the instrument is used. Dirt on the outside covers may by removed with a soft cloth moistened with a diluted household cleaning solution.

5-1-(3) RECALIBRATION

Recalibration of the instrument at regular intervals will assure that measurements within the accuracy specification. It is recommended that the instrument be recalibrated after 1000 hours of operation, or twice a year. The calibration procedures are provided in the latter part of this section of the manual.

5-2 ADJUSTMENT AND CALIBRATION

Most of the problems resulting in a malfunction will be a defective component or a mechanical defect. Verify that the problem is not due to an incorrect switch position. The CRT display can be a valuable aid in pinpointing the area of many problems. The defect of any of the amplifiers, triggering circuit will be noticeable on the CRT.

Test Instruments Required

Instrument	Brief Specification
1. Digital Voltmeter	Range : 0 to 1000V DC Accuracy : Within 0.5%
2. 10 : 1 High Voltage Divider	± 2%
3. Square wave generator	1KHz ~ 1MHz, Resetime < 5nS
4. Oscillator	1KHz ~ over 20MHz
5. Time Mark Generator	Pulse ranges from 0.1μs to 0.5mS ± 1%
6. Cable	Male BNC to male BNC, 50Ω

5-2-1 PRELIMINARY PROCEDURE

1. check that the 100V/117V/220V/240V/ and Voltage selector is properly set.
2. turn the instrument on and allow at least 20 minutes warm-up before starting the adjustment procedure. For the best overall accuracy, make adjustments in ambient temperature of +20°C to +30°C.

5-2-2 POWER SUPPLY UNIT ADJUSTMENTS

Some problems may result severe loading on the power supplies. The power supply unit for the this model comprises a DC to DC converter. The normal operating frequency of the converter is approximately 40KHz. Modifying pulse width with the change of loads, this converter assures the constant voltage supply. When the secondary voltage of the converter is incorrect, remove the P4 and P7 connectors of the Power Supply unit for checking.

1. Voltage Adjustments
   a) Connect Digital Voltmeter common (or -) lead to the 5th ground.
   b) Connect Digital Voltmeter V. Ω (or +) lead to the 1st Pin +of D401.
   c) Adjust VR406 until + 200V supply gives reading of + 200V ±0.5V.

d) Transfer Digital Voltmeter V. Ω (or +) lead to the 2nd pin on connector P403.
e) Adjust VR401 for Digital Voltmeter reading of -1.9 KV ±5V.
f) Disconnect Digital Voltmeter.

2. Adjustments of intensity limit, Astingmatism, Trace Alignments.
a) Set Time/Div. switch to CH B position.
b) Center beam using Position (↕).
c) Rotate Intensity to 10 o'clock position.
d) Adjust VR405 (intensity limit adjustment) so beam is just extinguished.
e) Adjust INTENSITY to obtain normal spot brightness and FOCUS to center position.
f) Adjust Astingmatism adjustment, VR403 and jeome adjustment, VR404 to get a sharp, round dot.
g) Set TIME/DIV. switch to 0.5μs position.
h) When fly-back line appears on the CRT with trace line, adjust VR402 until the fly-back line is minimized.
i) Repeat step a to f
j) Adjust trace rotator so that trace is parallel with horizontal graticule lines. Local magnetic field affects this setting.

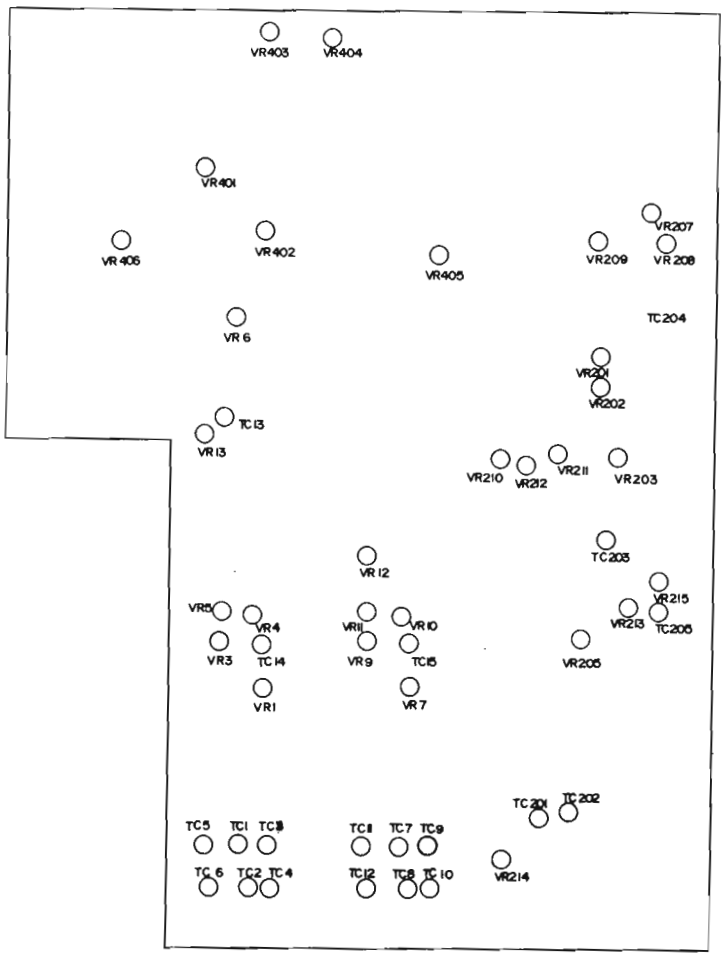


Fig. 10
ADJUSTMENT POINT

5.2.3 VERTICAL AMPLIFIER UNIT ADJUSTMENTS

1. Adjustments of preamplifier

a) Preliminary control setting : preset front panel controls as follows:

Intensity	Midrange
Focus	Midrange
Vertical Mode	CH A
Volts/Div. (both)	10mV
AC-GND-DC (both)	GND
Variable	Detent
Time/Div.	0.5mS
Source	INT
SYNC	NORM +
Level	Midrange and pull auto
Position (All)	Midrange

b) Short TP terminal of V-PCB.
c) Adjust VR6 so that sweep lines could be at the center of CRT.
d) Open TP terminal
e) Use CH A Position (↕) control to set trace on center horizontal graticule line.
f) Adjust VR1 (VR7 for CH B) for no trace shift while switching CH A Volts/Div control between 2mV and 10mV.
g) Adjust VR3 (VR9 for CH B) until no trace shift occurs when CH A Variable move between minimum and maximum.
h) Rotate CH A Position (↕) to 12 o'clock position and adjust VR4 (VR10 for CH B) so that sweep lines could be at the center of CRT.
i) Repeat steps e through h for CH B.

2. Adjustments of attenuator

a) Set CH A Volts/Div switch to 0.1V setting and Time/Div switch to 20μs setting.
b) Set vertical Mode switch to CH A
c) Connect square-wave generator (600Ω output) to CH A input connector.
d) Set square-wave generator control for 1 KHz output with sufficient amplitude to produce 6 divisions of vertical deflection.
e) Adjust TC1 (TC7 for CH B) compensation adjustments to achieve squarest corners on the displayed waveform.
f) Set square wave generator for 1KHz signal 6 divisions of vertical deflection.
g) Adjust input capacitor adjustment TC2 (TC8 for CH B) for best possible waveform.
h) Set Volts/Div switch to 1V settings. Adjust square wave generator output for 1 KHz and 6 divisions of vertical deflection.
i) Adjust TC3 (TC9 for CH B) compensation adjustment to achieve squarest corners on displayed waveform.
j) Set square wave generator controls for 1KHz output with sufficient amplitude to produce 6 divisions of vertical deflection.
k) Adjust input capacitors TC4 (TC10 for CH B) for best possible wave form.
l) Set Volts/Div switch to 10V settings. Adjust square wave generator output for 1 KHz and 6 divisions of vertical displays.
m) Adjust TC5 (TC11 for CH B) compensation adjustment to achieve squarest corners on displayed waveform.
n) Set square wave generator control for 1KHz output with sufficient amplitude to produce 6 division of vertical deflection.
o) Adjust input capacitors TC6 (TC12 for CH B) for best possible waveform.
p) Repeat steps a through O for CH B.
q) Setting

Volts/Div (both)	0.1V
CH A AC-GND-DC	DC
CH B AC-GND-DC	GND
Vertical Mode	CH A
Time/Div	1μS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

r) Adjust square wave generator output for 100KHz and 6 division of vertical display.

s) Adjust TC13 until squarest waveform.

t) Adjust TC14 (CH-A) and TC15 (CH-B) until squarest waveform for over shoot and under shoot.

u) Adjust VR13 until no waveform distortion occurs when position (↕) control between up and down.

3. Adjustment of Vertical gain

a) Setting

Volts/Div (both)	2mV
Vertical Mode	CH A
AC-GND-DC (both)	DC
Time/Div	0.5mS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

b) Connect Oscillator to CH A input connector.

c) Set Oscillator for 1KHz at exactly 10mV p-p Amplitude.

d) Adjust vertical gain adjustment VR5 (VR11 for CH B) for exactly 5 divisions of vertical deflection. This ensures 3% accuracy in the vertical amplifier.

e) Set vertical Mode to CH B.

f) Repeat steps b) through d) for CH B.

g) Set Time/Div. switch to CH B position and CH B Volts/Div switch to 20mV setting. Center beam using position (↕) controls.

h) Connect Oscillator to CH B input connector and Set Oscillator for 1KHz at exactly 10mV P-P amplitude.

i) Adjust VR 12 for exactly 5 divisions of horizontal deflection.

j) Disconnect Oscillator.

5-2-4 Horizontal/Time Base Unit Adjustments.

1. Adjustment of Sweep Time/Div.
   a) setting.

Volts/Div (both)	0.1mV
Vertical Mode	CH A
Time/Div	0.1mS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

   b) Connect Time marker generator to CH A input connector and set generator for 0.1mS marker interval.
   c) Adjust VR208 so that lie on vertical graticule lines.
   d) Set generator for 1 μS marker interval and Time/Div switch to 0.5 μS setting.
   e) Adjust TC202 so that time marker again co-incide with vertical line of graticule.
   f) Set generator for a 0.5 μS marker interval and Time/Div switch to 0.5 μS settings.
   g) Adjust TC201 so that markers lie on Vertical graticule and adjust VR214 for realignment of the range of 0.2 μS /Div.
   h) Set Time/Div switch to 0.1mS setting and set generator for a 0.1mS marker interval.
   i) Set 5 × MAG switch to push.
   j) Adjust VR212 for exactly 5 divisions fo horizontal deflection and then push MAG switch.
   k) Adjust VR7 to obtain the same center position when the display is magnified.
   l) Adjust of sweep linearity : Adjust VR210 so that sine wave could not be concentrated at one side under time 0.1mS/Div.
   m) Adjustment of triggering : Adjust VR205 so that both(Sync+or−)start at the same point.
2. ADJUSTMENT OF X-AXIS(CH-B)POSITION·····With SWEEP TIME/DIV. control set at CH-B, check if shift range is balanced when X-axis POSITION (CH-B VERTICAL POSITION) is turned. If there is unbalance, Adjust VR209 and then Adjust VR211 to be at the center of X-axis.
3. ADJUSTMENT OF TRACE LINE LENGTH·····Adjust VR213 to obtain the length of 11DIV on CRT screen.
4. ADJUST VR201 VR202 AND VR203 for CALIBRATION··To be 0.5V P-P when 1 : 1 probe is connected to the terminal of front panel calibration under VOLT/DIV 0.1V and TIME/DIV 0.1ms
5. ADJUST TC205 FOR 0.5 sec LENGTH·····The length of trace line could be reached on the CRT surface when you input 0.5μS pulse under TIME/DIV 0.5μS range.
6. ADJUST TC204 FOR 0.5 sec/DIV MAG LINEARITY·····Same as 3 adjustment after you draw PULL 5 × MAG SWITCH
7. Adjust VR215 for jittering.
8. Adjust TC203 for unblanking start position.

6-1 PCB ASS'Y PART

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-C43-101		PCB	01-061-03	EA	1
2-C36-026	VERTICAL	ROTARY SWITCH	SNO-3224	EA	2
2-C36-028	TIME		SNO-3226	EA	1
2-C36-011	AC-GND-DC,COUPLING	LEVER SWITCH	SLR 523	EA	3
2-C36-012	SOURCE SW		SLR 524	EA	1
2-C36-069		PUSH SWITCH	PS-135 M2-A22S	EA	7
2-C35-037	VR2,8	VARIABLE RESISTOR	V16L4 (7×5) (PH2A) NIOS-15A 5KΩ(3TC)	EA	2
2-C35-038	VR206	VARIABLE RESISTOR	V16L4 (7×5) (PH2A) NIOS-15A 10KΩ(3TC)	EA	1
2-C35-039	FOCUS VOLUME	VARIABLE RESISTOR	VO161 PV-25KS-B2M	EA	1
2-C35-034	INTEN VOLUME	VARIABLE RESISTOR	VO12LPV-30KS(BC)-B50K	EA	1
2-C35-035	CH1,2 POSITION VOL	VARIABLE RESISTOR	VO12LPV-30KS(BC)-B1K	EA	2
2-C35-036	TIME POSITION VOL	VARIABLE RESISTOR	VO12LPV-30KS(BC)-20K	EA	1
2-C35-036	TRIGGER LEVEL VOL	VARIABLE RESISTOR	VO12LPV-30KS(BC)-20K	EA	1
2-C35-047	TRACE ROTATE	VARIABLE RESISTOR	TM 10K(PV)8US-B50K	EA	1
2-C38-035		CONVERTER TRANS	040-1008-05	EA	1
2-T01-025		CAL TERMINAL	ABS WITH BSP t 0.5 Ni/pl	EA	1
2-C37-002		Heat Sink (A)	Al 2. 0t 302-M40025	EA	6
		Heat Sink (2)	C2600P-1/2H t0.5 C310149-1	EA	1
2-T22-056		SHIELD PLATE (1)	C2600P-1/2H t0.5 C310225	EA	1
2-T22-057		SHIELD PLATE (2)	C2600P-1/2H t0.5 C310226	EA	1
2-T22-058		SHIELD PLATE (3)	C2600P-1/2H t0.5 C310227	EA	1
2-T22-060		SHIELD CASE (1)	SPC t1.0 (Zn/pl) C310223	EA	1
2-T22-061		SHIELD CASE (2)	SPC t1.0 (Zn/pl) C310224	EA	1
2-C42-136		Silicone RUBBER(1)	ARH230(13×18)	EA	3
2-C42-017		FUSE CLIP	SN-5053	EA	2
2-C42-012		INSULATION BUSHING	B24	EA	1
2-T22-011		BIND SCREW	M3×6(Ni/pl)	EA	15
2-T10-016		BIND SCREW	M3×10 (Ni/pl)	EA	2
2-T11-026		NUT	M3 (Ni/pl)	EA	2
2-T10-017		BIND SCREW	M3×12 (Ni/pl)	EA	2
2-T11-017		TOOTHED LOCK WASHER	3Pi OUTSIDE (Ni/pl)	EA	4
	JP15-JP16	PCB JUMP SHIELD WIRE	350212	EA	1
	JP7-JP8 JP19-JP20	PCB JUMP SHIELD WIRE	350213	EA	2
	JP1-JP2 JP11-JP12 JP21-JP22	PCB JUMP SHIELD WIRE	350214	EA	3
	JP23-JP24	PCB JUMP SHIELD WIRE	350215	EA	1
	JP5-JP6	PCB JUMP SHIELD WIRE	350216	EA	1
	JP13-JP14	PCB JUMP SHIELD WIRE	350217	EA	1
		JUMP GND WIRE	350218	EA	2
		JUMP GND WIRE	350219	EA	2
		JUMP GND WIRE	350220	EA	2
	JP3-JP4	PCB JUMP WIRE	350221	EA	2
	JP9-JP10	PCB JUMP WIRE	350222	EA	1
		JUMP GND WIRE	350223	EA	1
	JP25-JP26	PCB JUMP WIRE	350224	EA	1
2-C05-019	IC7	I. C	74LS03	EA	1

2-C05-053	IC5	I. C	TC4001	EA	1
2-C05-030	IC6	I. C	TC4011	EA	1
2-C05-022	IC201	I. C	SN74LS00	EA	1
2-C05-010	IC205	I. C	SN74LS76	EA	1
2-C05-007	IC202	I. C	SN7400	EA	1
2-C05-017	IC206	I. C	μ A 733DC	EA	1
2-C05-014	IC401	I. C	μ A 741TC	EA	1
2-C05-020	IC403	I. C	μ A 7805	EA	1
2-C05-021	IC402	I. C	μ A 7812	EA	1
2-C05-012	IC404	I. C	μ A 7908	EA	1
2-C05-013	IC405	I. C	μ A 78L15	EA	1
2-C05-005	IC203,204	I. C	MC 14572 B	EA	2
2-C05-047	IC1,2,3,4	HYBRID IC	AX-1015	EA	4
2-C05-041	Q1,3,208	FET	2SK 30A	EA	3
2-C05-040	Q2,4	FET	2SK 228T	EA	2
2-C05-038	Q17,18	T.R	2SA 781	EA	2
2-C05-026	Q8,9,10,204 207,210,211,212,213 214,222,403,406,411	T.R	2SA 836	EA	14
2-C06-033	Q15,16	T.R	2SA 1360	EA	2
2-C06-014	Q401	T.R	2SB 861	EA	1
2-C06-024	Q7,21,201,202,203 206,209,215,Q11,12,19,20 217,218,221,223,224,225 226,402,405,410	T.R	2SC 458	EA	23
2-C06-006	Q5,6	T.R	2SC 535	EA	2
2-C06-001	Q408,409,412	T.R	2SC 2632	EA	3
2-C06-035	Q13,14,219,220	T.R	2SC 3423	EA	4
2-C06-018	Q219,220	T.R	2SD 668A	EA	2
2-C06-009	Q404	T.R	2SD 401 (K)	EA	1
2-C03-018	D204	DIODE	IN60	EA	1
2-C03-007	D401,402,403	DIODE	2W02	EA	2
2-C03-024	D406,418	DIODE	Y16GA	EA	2
2-C03-033	D415,416	DIODE	VO6C	EA	2
2-C03-012	D407,408,409,410	DIODE	1SS83	EA	4
2-C03-025	D205,210,217	DIODE	1S1587	EA	3
2-C03-026	D1～9,11,15～21,23 D218,220,221 D201～203,206～209 213～216,404,412,413	DIODE	1S1588	EA	35
2-C03-022	D414	DIODE	HZ 4B3	EA	1
2-C03-023	D10,14,211,212,411	DIODE	HZ 5C2	EA	5
2-C03-009	D417	DIODE	HZ 6C2	EA	1
2-C03-030	D219	DIODE	HZ 12C2	EA	1
2-C29-036	VR3,5,9,11,211	SEMI FIXED RESISTOR	V6EK-PV(1S) B 100 (100Ω B)	EA	5
2-C29-038	VR212	SEMI FIXED RESISTOR	V6EK-PV(1S) B 470 (470Ω B)	EA	1
2-C29-039	VR1,7,13,210	SEMI FIXED RESISTOR	V6EK-PV(1S) B 1K (1KΩ B)	EA	5
2-C29-032	VR406,4,10	SEMI FIXED RESISTOR	V6EK-PV(1S) B 2K (2KΩ B)	EA	3
2-C29-040	VR203,215	SEMI FIXED RESISTOR	V6EK-PV(1S) B 4.7k (4.7kΩ B)	EA	2
2-C29-041	VR402	SEMI FIXED RESISTOR	V6EK-PV(1S) B 10K (10KΩ B)	EA	1
2-C29-042	VR209	SEMI FIXED RESISTOR	V6EK-PV(1S) B 22K (22KΩ B)	EA	1
2-C29-043	VR205,207,208	SEMI FIXED RESISTOR	V6EK-PV(1S) B 47K (47KΩ B)	EA	3
2-C29-033	VR201,202,401	SEMI FIXED RESISTOR	V6EK-PV(1S) B 50K (50KΩ B)	EA	3

2-C29-044	VR213,214	SEMI FIXED RESISTOR	V6EK-PV(1S) B 100K (100KΩB)	EA	2
2-C29-045	VR6	SEMI FIXED RESISTOR	V6EK-PV(1S) B 470K (470KΩB)	EA	1
2-C29-035	VR403,404	SEMI FIXED RESISTOR	VM6CK-PV(1S) 1MΩ	EA	2
	VR405	SEMI FIXED RESISTOR	VM 6CK-PV(1S) 220KΩ	EA	1
2-C31-020	TC1,3,5,7,9,11	TRIMMER	ECV- 1ZW 06×64 6PF	EA	6
2-C31-021	TC2,4,6,8,10,12 13,201～205	TRIMMER	ECV-1ZW 10×64 10PF	EA	12
	TC14,15	TRIMMER	ECV-1ZW 30×64 30PF	EA	2
2-C42-016	N1～4	NEON LAMP	NE 38B	EA	4
2-C30-027	TH1	THERMISTER	SDT 1000 10K	EA	1
2-C16-053	R410	METAL GLAZE RESISTOR	RKIP 10MΩJ	EA	1
2-C13-023	R26,131	METAL FILM RESISTOR	RN14BK2E 1/4W 220ΩF	EA	2
2-C12-029	R35,138	METAL FILM RESISTOR	RN14BK2E 1/4W 330ΩF	EA	2
2-C12-046	R24,129	METAL FILM RESISTOR	RN14B2E 1/4W 820ΩF	EA	2
2-C13-001	R7,23,57,60 111,127	METAL FILM RESISTOR	RN14BK2E 1/4W 1KΩF	EA	6
2-C13-006	R52,136	METAL FILM RESISTOR	RN14B2E 1/4W 1.5KΩF	EA	2
2-C13-014	R85,93	METAL FILM RESISTOR	RN14B2E 1/4W 2.7KΩF	EA	1
2-C13-018	R63	METAL FILM RESISTOR	RN14BK2E 1/4W 3.3KΩF	EA	1
2-C13-020	R406	METAL FILM RESISTOR	RN14BK2E 1/4W 3.9KΩF	EA	1
2-C13-022	R64,66,71	METAL FILM RESISTOR	RN14BK2E 1/4W 4.7KΩF	EA	3
2-C13-033	R5,109	METAL FILM RESISTOR	RN14BK2E 1/4W 10.1KΩF	EA	2
2-C13-057	R80	METAL FILM RESISTOR	RN14BK2E 1/4W 43KΩF	EA	1
2-C13-056	R78,82,239,242,244	METAL FILM RESISTOR	RN14BK2E 1/4W 100KΩF	EA	5
2-C14-003	R3,107	METAL FILM RESISTOR	RN14BK2E 1/4W 111KΩF	EA	2
2-C14-004	R405	METAL FILM RESISTOR	RN14BK2E 1/4W 120KΩF	EA	1
2-C14-009	R245	METAL FILM RESISTOR	RN14BK2E 1/4W 300KΩF	EA	1
2-C14-016	R2,106	METAL FILM RESISTOR	RN14BK2E 1/4W 900KΩF	EA	2
2-C14-017	R4,108	METAL FILM RESISTOR	RN14BK2E 1/4W 990KΩF	EA	2
2-C14-018	R6,110	METAL FILM RESISTOR	RN14BK2E 1/4W 999KΩF	EA	2
2-C14-019	R112,247,8	METAL FILM RESISTOR	RN14BK2E 1/4W 1MΩF	EA	3
2-C14-012	R246	METAL FILM RESISTOR	RN14BK2E 1/4W 500KΩF	EA	1
2-C14-022	R248	METAL FILM RESISTOR	RN14BK2E 1/4W 3MΩF	EA	1
	R500	METAL FILM RESISTOR	RN14BK 1/2W 2.2MF	EA	1
2-C16-025	R409	METAL OXID RESISTOR	RS14AB 3A1W 10ΩJ	EA	1
2-C16-036	R441	METAL OXID RESISTOR	RS14AB 1W 27ΩJ	EA	1
2-C16-044	R294,295	METAL OXID RESISTOR	RS14AB 3F 3W 6.8KΩG	EA	2
2-C20-173	R419	SOLID RESISTOR	RC05GF2E 1/4W 4.7Ω	EA	1
2-C20-070	R420	SOLID RESISTOR	RC05GF2E 1/4W 47KΩ	EA	1
2-C20-068	R424	SOLID RESISTOR	RC05GF2E 1/4W 100KΩ	EA	1
2-C20-174	R422,423	SOLID RESISTOR	RC05GF2E 1/4W 22MΩ	EA	2
	R418	SOLID RESISTOR	RC05GF 2E 1/4W 1.8Ω	EA	1
2-C10-008	R25,128,172,309	CARBON FILM RESISTOR	RD14BY2E 1/4W 10ΩJ	EA	4
2-C10-011	R27,130	CARBON FILM RESISTOR	RD14BY2E 1/4W 15ΩJ	EA	2
2-C10-013	R1,65,70,74～77 79,81,83,84,86,92 98,101,105,178,179 284,285,290～293,299 312,313,429,430,434	CARBON FILM RESISTOR	RD14BY2E 1/4W 22ΩJ	EA	30
2-C10-015	R442	CARBON FILM RESISTOR	RD14BY2E 1/4W 33ΩJ	EA	1
2-C10-017	R10,11,30,55,56,58 59,68,88,90,114,115 134,215,310,311,320,213,214	CARBON FILM RESISTOR	RD14BY2E 1/4W 47ΩJ	EA	19

2-C10-021	R46,153	CARBON FILM RESISTOR	RD14BY2E 1/4W 82ΩJ	EA	2
2-C10-022	R95,103,208,217,223 241,259,260,274,296 297,427,436	CARBON FILM RESISTOR	RD14BY2E 1/4W 100ΩJ	EA	13
2-C10-025	R154	CARBON FILM RESISTOR	RD14BY2E 1/4W 120ΩJ	EA	1
2-C10-027	R51,431	CARBON FILM RESISTOR	RD14BY2E 1/4W 180ΩJ	EA	2
2-C10-029	R104	CARBON FILM RESISTOR	RD14BY2E 1/4W 220ΩJ	EA	1
2-C10-031	R28,61,132	CARBON FILM RESISTOR	RD14BY2E 1/4W 270ΩJ	EA	3
2-C10-034	R417	CARBON FILM RESISTOR	RD14BY2E 1/4W 390ΩJ	EA	1
2-C10-035	R256,286,287,288	CARBON FILM RESISTOR	RD14BY2E 1/4W 470ΩJ	EA	4
2-C10-037	R212	CARBON FILM RESISTOR	RD14BY2E 1/4W 560ΩJ	EA	1
2-C10-038	R97,102	CARBON FILM RESISTOR	RD14BY2E 1/4W 680ΩJ	EA	2
2-C11-001	R276	CARBON FILM RESISTOR	RD14BY2E 1/4W 820ΩJ	EA	1
	R62,87,91,204 229,185,187,305,307 308,314,315,89,404 413,432,440,280		RD14BY2E 1/4W 1KΩJ	EA	18
2-C11-004	R258,261,445	CARBON FILM RESISTOR	RD14BY2E 1/4W 1.5KΩJ	EA	3
2-C11-005	R265,273	CARBON FILM RESISTOR	RD14BY2E 1/4W 1.8KΩJ	EA	2
2-C11-007	R67,69,211,236,278,300,224	CARBON FILM RESISTOR	RD14BY2E 1/4W 2.2KΩJ	EA	7
2-C11-011	R207,237,184,186,316	CARBON FILM RESISTOR	RD14BY2E 1/4W 3.3KΩJ	EA	5
2-C11-012	R264,318,319,437	CARBON FILM RESISTOR	RD14BY2E 1/4W 3.9KΩJ	EA	4
2-C11-014	R99,100,226 234,255,263,275,281,282 269		RD14BY2E 1/4W 4.7KΩJ	EA	10
2-C11-016	R240	CARBON FILM RESISTOR	RD14BY2E 1/4W 5.6KΩJ	EA	1
2-C11-019	R12,13,203,116,238,304,117	CARBON FILM RESISTOR	RD14BY2E 1/4W 6.8KΩJ	EA	7
2-C11-021	R268,277	CARBON FILM RESISTOR	RD14BY2E 1/4W 8.2KΩJ	EA	2
2-C11-023	R218,221,233,235,254 252,262,176,414,283	CARBON FILM RESISTOR	RD14BY2E 1/4W 10KΩJ	EA	10
2-C11-025	R228 262,176,411	CARBON FILM RESISTOR	RD14BY2E 1/4W 12KΩJ	EA	1
	R228		RD14BY2E 1/4W 12KΩJ	EA	1
2-C11-026	R266,435	CARBON FILM RESISTOR	RD14BY2E 1/4W 15KΩJ	EA	2
2-C11-027	R270	CARBON FILM RESISTOR	RD14BY2E 1/4W 18KΩJ	EA	1
2-C11-029	R206,210,249,267	CARBON FILM RESISTOR	RD14BY2E 1/4W 22KΩJ	EA	4
2-C11-030	R271,272	CARBON FILM RESISTOR	RD14BY2E 1/4W 27KΩJ	EA	2
2-C11-032	R202,219,164,438	CARBON FILM RESISTOR	RD14BY2E 1/4W 33KΩJ	EA	4
2-C11-036	R220,253,163,166,325 415,416,439	CARBON FILM RESISTOR	RD14BY2E 1/4W 47KΩJ	EA	8
2-C11-039	R227,412	CARBON FILM RESISTOR	RD14BY2E 1/4W 56KΩJ	EA	2
2-C11-041	R209,303	CARBON FILM RESISTOR	RD14BY2E 1/4W 68KΩJ	EA	2
2-C11-042	R302	CARBON FILM RESISTOR	RD14BY2E 1/4W 75KΩJ	EA	1
2-C11-043	R161,165	CARBON FILM RESISTOR	RD14BY2E 1/4W 82KΩJ	EA	2
2-C11-044	R9,205,113,216,222 231,243,250,257,162 306,403,426,298	CARBON FILM RESISTOR	RD14BY2E 1/4W 100KΩJ	EA	14
2-C11-047	R411,425	CARBON FILM RESISTOR	RD14BY2E 1/4W 120KΩJ	EA	2
2-C11-052	R201,251,428	CARBON FILM RESISTOR	RD14BY2E 1/4W 220KΩJ	EA	3
2-C11-054	R72,73,407,421	CARBON FILM RESISTOR	RD14BY2E 1/4W 470KΩJ	EA	4
2-C11-063	R443	CARBON FILM RESISTOR	RD14BY2E 1/4W 1.8MΩJ	EA	1
2-C11-064	R301	CARBON FILM RESISTOR	RD14BY2E 1/4W 2.2MΩJ	EA	1
2-C10-006	R401,402,408	CARBON FILM RESISTOR	RD14BY2E 1/4W 4.7ΩJ	EA	3
2-C15-018	R317	CARBON FILM RESISTOR	RD14BY2H 1/2W 750ΩJ	EA	1

2-C10-001		0 OHM RESISTOR	RD14BY2E 0 OHM	EA	377
2-C33-048	C208	ELECTROLYTIC CARACITOR	CE04WIA 47 μ/10V	EA	1
2-C33-042	C251,252,253		CE04WIA 330 μ/10V	EA	3
2-C33-026	C10,12,48,247,249		CE04WIC 22 μ/16V	EA	5
2-C33-030	C248,250		CE04WIC 220 μ/16V	EA	2
2-C33-043	C436		CE04WIE 330 μ/25V	EA	1
2-C33-056	C408		CE04WIE 470 μ/25V	EA	1
2-C33-035	C407,410,442		CE04WIE 2200 μ/25V	EA	3
2-C33-002	C15~17,20,25,73,207 212,214,229,234,255 406,409,413,417,441		CE04WIH 1 μ/50V	EA	17
2-C33-046	C7,18,22,45,49,59		CE04WIH 4.7 μ/50V	EA	6
2-C33-033	C437		CE04WIH 220 μ/50V	EA	1
2-C33-017	C401,404		CE04W2C 100 μ/160V	EA	2
2-C33-005	C424		CE04W2E 1 μ/250V	EA	1
2-C33-047	C241		CE04W2E 4.7 μ/250V	EA	1
2-C33-010	C405	ELECTROLYTIC CARACITOR	CE04W2E 10 μ/250V	EA	1
2-C33-041	C403		CE04W2E 33 μ/250V	EA	1
2-C28-073	C6,24,44,62,74,75 205,213,215,223,231,233 245,256,428,230,501,502,503	CERAMIC CAPACITOR	DD600BC 104Z 12V	EA	19
2-C30-001	C236	MYLAR CAPACITOR	CQ92MIH 102K 50V	EA	1
2-C30-007	C209,443	MYLAR CAPACITOR	CQ92MIH 222K 50V	EA	2
2-C30-007	C202,439	MYLAR CAPACITOR	CQ92MIH 472K 50V	EA	2
2-C30-008	C246	MYLAR CAPACITOR	CQ92MIH 223K 50V	EA	1
2-C30-010	C414	MYLAR CAPACITOR	CQ92MIH 473K 50V	EA	1
2-C30-004	C206,431	MYLAR CAPACITOR	CQ92MIH 104K 50V	EA	2
	C8,46,505	CERAMIC CAPACITOR	CC45CH1H 3ROD 3P/50V	EA	3
2-C28-005	C21,507	CERAMIC CAPACITOR	CC45CH1H 5ROD 5P/50V	EA	2
2-C28-008	C211,64,504	CERAMIC CAPACITOR	CC45CH1H 100J 10P/50V	EA	3
2-C28-009	C244	CERAMIC CAPACITOR	CC45CH1H 120J 12P/50V	EA	1
2-C28-010	C22	CERAMIC CAPACITOR	CC45CH1H 150J 15P/50V	EA	1
2-C28-011	C56,68	CERAMIC CAPACITOR	CC45CH1H 180J 18P/50V	EA	2
2-C28-012	C35	CERAMIC CAPACITOR	CC45CH1H 200J 20P/50V	EA	1
2-C28-013	C9,13,19,47,52	CERAMIC CAPACITOR	CC45CH1H 220J 22P/50V	EA	5
2-C28-017	C69,70,221	CERAMIC CAPACITOR	CC45CH1H 330J 33P/50V	EA	3
2-C28-019	C201,217,227,238	CERAMIC CAPACITOR	CC45CH1H 470J 47P/50V	EA	4
2-C28-031	C210,226,237	CERAMIC CAPACITOR	CC45CH1H 221J 220P/50V	EA	3
2-C28-023	C506	CERAMIC CAPACITOR	CC45CH1H 101J 100P/50V	EA	1
2-C28-039	C23,28	CERAMIC CAPACITOR	CC45CH2H 1P/500V	EA	2
2-C28-040	C3,41	CERAMIC CAPACITOR	CC45CH2H 2P/500V	EA	2
2-C28-041	C203	CERAMIC CAPACITOR	CC45CH2H 5P/500V	EA	1
2-C28-032	C228	CERAMIC CAPACITOR	CK45E1H 2200P/50V	EA	1
2-C28-025	C26,27,32,60,204 218,235,416	CERAMIC CAPACITOR	CK45E1H 103P/50V	EA	8
2-C28-037	C224,225,242	CERAMIC CAPACITOR	CK45E1H 560P/50V	EA	3
	C29,36	CERAMIC CAPACITOR	CC45CH1H 680J 68P/50V	EA	2
	C65,67	CERAMIC CAPACITOR	CC45CH1H 390J 39P/50V	EA	2
2-C28-044	C31,33,34,58,240 422,427,429	CERAMIC CAPACITOR	CK45E2H 103P/500V	EA	8
2-C28-043	C432,434,450,451	CERAMIC CAPACITOR	CK45E2H 102P/500V	EA	4
2-C28-093	C435	CERAMIC CAPACITOR	CK45E2H 104P/500V	EA	1
2-C28-050	C418,419,420,421,423 425,438	CERAMIC CAPACITOR	CK45E3D 103P/2KV	EA	7

2-C31-018	C71,72	METAL FILM CAPACITOR	630V 0.022 μF (MF-1)	EA	2
2-C31-017	C5,43	METAL FILM CAPACITOR	600WV 0.01 μF	EA	2
2-C31-011	C219	METAL FILM CAPACITOR	200WV 0.47 μF	EA	1
2-C31-010	C220	METAL FILM CAPACITOR	200WV 0.0047 μF	EA	1
2-C30-015	C1,39	MICA CAPACITOR	CM93D1H 33PJ	EA	2
2-C30-014	C2,40	MICA CAPACITOR	CM93D1H 220PJ	EA	2
2-C30-013	C4,42	MICA CAPACITOR	CM93D1H 1500PJ	EA	2
2-C32-006	L201	INDUCTOR	EL0810SK1-102K 1mH	EA	1
2-C32-011	L202	INDUCTOR	EL0606SK1-2R2K 2.2μH	EA	1
2-C32-013	L402		EL0606SK1-4R7K 4.7 μH	EA	1
2-C32-014	L2,3,203,8		EL0606SK1-470K 47 μH	EA	4
2-C32-015	L1,4,7		EL0606SK1-471K 470 μH	EA	3
2-C32-019	L204,205		EL0606SK1-82K 820 μH	EA	2
2-C03-060	RA1	R NETWORK RESISTOR	10K×4 (5PIN)	EA	1
2-C21-002	P3,404~406	WAFER	5045-03A	EA	5
2-C21-004	P2		5045-05A	EA	1
2-C21-006	P201,402		5045-08A	EA	2
2-C21-007	P403		5045-09A	EA	1
2-C21-069	P1,202		5045-10A	EA	2
	P401		FWP1145-07A	EA	1

6-2 MECHANICAL PARTS Front Panel ASS'Y

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-T22-048		Front Panel	SPC t1,2 Zn/pl	EA	1
2-T22-049		Top Plate	P.C t0.3 Silk Screen	EA	1
2-T21-050		CRT Bezel	Nylon 6+ABS (Black Color)	EA	1
2-T22-016		Filter	Acryl t1.5 (Sky Blue)	EA	1
2-T22-050		Name plate	P.C t0.3 Silk Screen	EA	1
		Front Frame	ABS+Glass 20% (Black Color)	EA	1
		V/R knob (L)	ABS (Grey Color)	EA	6
		V/R Knob (S)	ABS (Grey Color)	EA	3
		S/R Knob (S)	ASB (Dark Grey Color)	EA	3
		Knob (7)	ABS (Dark Grey Color)	EA	4
2-T22-051		Knob (15)	ABS (Dark Grey Color)	EA	7
2-T22-063		PCB Pole	BSBM (5×14)	EA	5
2-T22-019		Cushion (4)	Spongy(t2×91×5.5)	EA	2
2-T22-021		Cushion (5)	Spongy(t2×112×5.5)	EA	2
2-T22-020		Cushion (6)	Spongy(t2×35×50)	EA	4
2-T01-001		BNC Connector	UG-625/μ	EA	3
2-T01-021		GND Teminal	BsBM(Ni/pl)	EA	1
		LUG TERMINAL	6pi (Sn/pl)	EA	1
2-T10-006		Bind screw	M2.6×6 (Ni/pl)	EA	5
		Bind Screw	M3×10 (Black)	EA	4
		Oval Screw	M3× 6 (Black)	EA	4
2-T10-040		Flat Screw	M2.6×6 (Ni/pl)	EA	5
2-T10-049		Flat Tapping Screw	Pi3×8 (Zn/pl)	EA	7
2-T25-038		Set Screw	M3×3 (Black)	EA	6
2-T25-039		Set Screw	M3×4 (Black)	EA	9
2-T11-018		Toothed Lock washer	Pi6 (Zn/pl) inside	EA	1
2-T11-029		Nut	M6 (Ni/pl)	EA	1
		Power Switch	DS-850-LED (G)	EA	1

Rear Panel ASS'Y

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-T22-052		Rear Panel	Laminated sheet t1.0 (SB-038L Dark Grey)	EA	1
		Power Cord Rest	ACETAL (Black Color)	EA	4
2-T01-001		BNC Connector	UG-625/μ	EA	1
		Flat Screw	M3×8 (Ni/pl)	EA	2
2-T10-021		Bind Screw	M4×10 (Ni/pl)	EA	6
2-T10-026		Pan Screw	M4×20 (Zn/pl)	EA	4
2-T10-031		Bind Tapping Screw	Pi3×6 (Zn/pl) 2 Sorts	EA	7
2-T11-010		Spring washer	Pi4 (Ni/pl)	EA	8
2-T11-007		Plain washer	Pi4 (Ni/pl)	EA	4
2-T11-027		Nut	M4 (Ni/pl)	EA	4
		AC INLET	Belton	EA	1
2-C38-027		Power Transformer	PT-3502	EA	1
		Ceramic capacitor	DE 110 102Z 400V	EA	2
		Fuse	250V 0.5A Pi5.2×30	EA	1
2-C36-044	P405-ZAXIS	Connect Lead Wire	350205	EA	1
		GND Wire	350232	EA	1
2-T10-017		Bind Screw	M3×12 (Ni/pl)	EA	1
2-T11-009		Spring Washer	Pi3 (Ni/pl)	EA	1
2-T11-017		Toothed Lock Washer	Pi3. (Ni/pl) Outside	EA	2
2-T11-026		Nut	M3 (Ni/pl)	EA	2
		HEAT Shink TUBE	20mm Clear 4.50	EA	6

Frame ASS'Y

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-T21-029		Frame (1)	SPC t1.2 (Zn/pl)	EA	2
2-T22-053		Frame (2)	SPC t1.2 (Zn/pl)	EA	1
2-T22-054		Frme (3)	SPC t1.2 (Zn/pl)	EA	1
2-T22-055		Frame (4)	SPC t1,2 (Zn/pl)	EA	1
2-T02-031		Cable Tie	(small) AN-1 (100mm)	EA	7
2-T10-015		Bind Screw	M3×8 (Ni/pl)	EA	2
2-T11-017		Toothed Lock Washer	Pi3 (Ni/pl) outside	EA	2
2-T11-009		Spring Washer	Pi3 (Ni/pl)	EA	2

CRT ASS'Y

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-T04-022		CRT Shield	Pi3 × 165 (PERMALLOY t0.2 PB)	EA	1
2-T21-027		CRT Holder (3)	SPG t1.6	EA	1
2-T21-028		CRT Holder (4)	SPG t1.6	EA	1
2-T22-007		RUBBER Cushion (3)	Rubber t3×20×80	EA	2
2-T22-040		CRT Ground Plate	BSP t0.3	EA	1
2-T02-030		Cable Tie	TY-26M (260mm)	EA	1
2-T10-020		Bind Screw	M3×20 (Ni/pl)	EA	2
2-C09-005		CRT	150 DTB31	EA	1
		Rotation Coil	RC3502	EA	1
		CRT PCB		EA	1
		CRT SOCKET	1339-01	EA	1
2-T22-002		CRT SHEET	0.4×170×190 (Urethane spongy)	EA	1

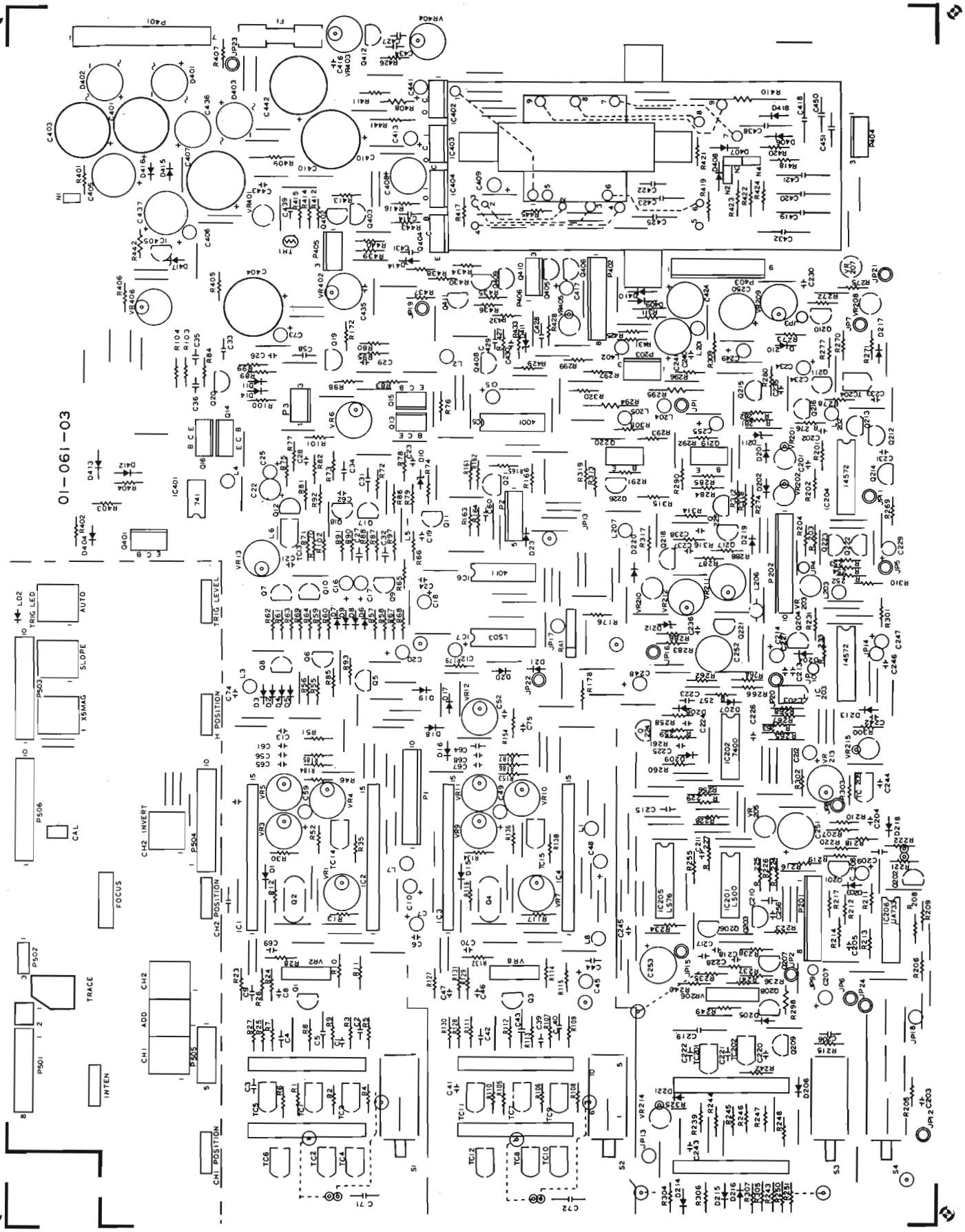
Case ASS'Y

CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
		Top Case	Laminataed sheet t1,0 (SB-038L Dark Grey)	EA	1
		Bottom Case	Laminataed sheet t1,0 (SB-038L Dark Grey)	EA	1
2-T01-022		Handle	PVC With sps t0.5	EA	1
2-T01-023		Handle Metal	SPC (Ni/pl)	EA	2
2-T01-006		Mould Leg	ACETAL BLACK	EA	2
2-T01-018		Stand	SBPR Pi5,0 (Cr/pl)	EA	1
2-T02-002		Rubber Foot	Rubber (Black)	EA	4
2-T27-027		Plastic Foot	TM-127 No.2	EA	2
2-T10-021		Bind Screw	M4×10 (Ni/pl)	EA	2
2-T11-005		Oval Screw	M4×12 (Ni/pl)	EA	2
		Screw With Washer	M3×6 (Black)	EA	12
		Screw With Washer	M3×10 (Ni/pl)	EA	4
2-T11-027		Nut	M4 (Ni/pl)	EA	2

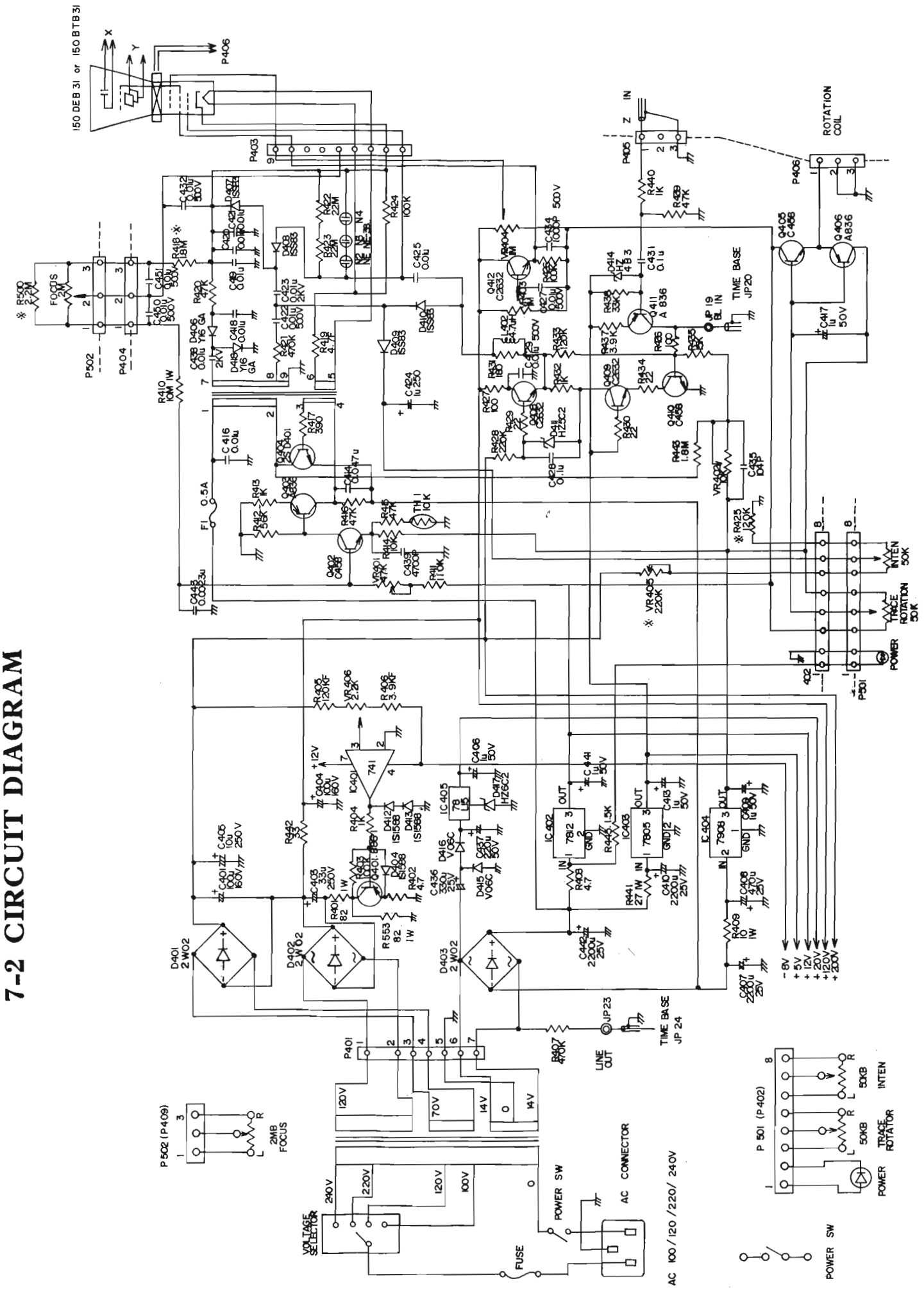
PACKING ASS'Y

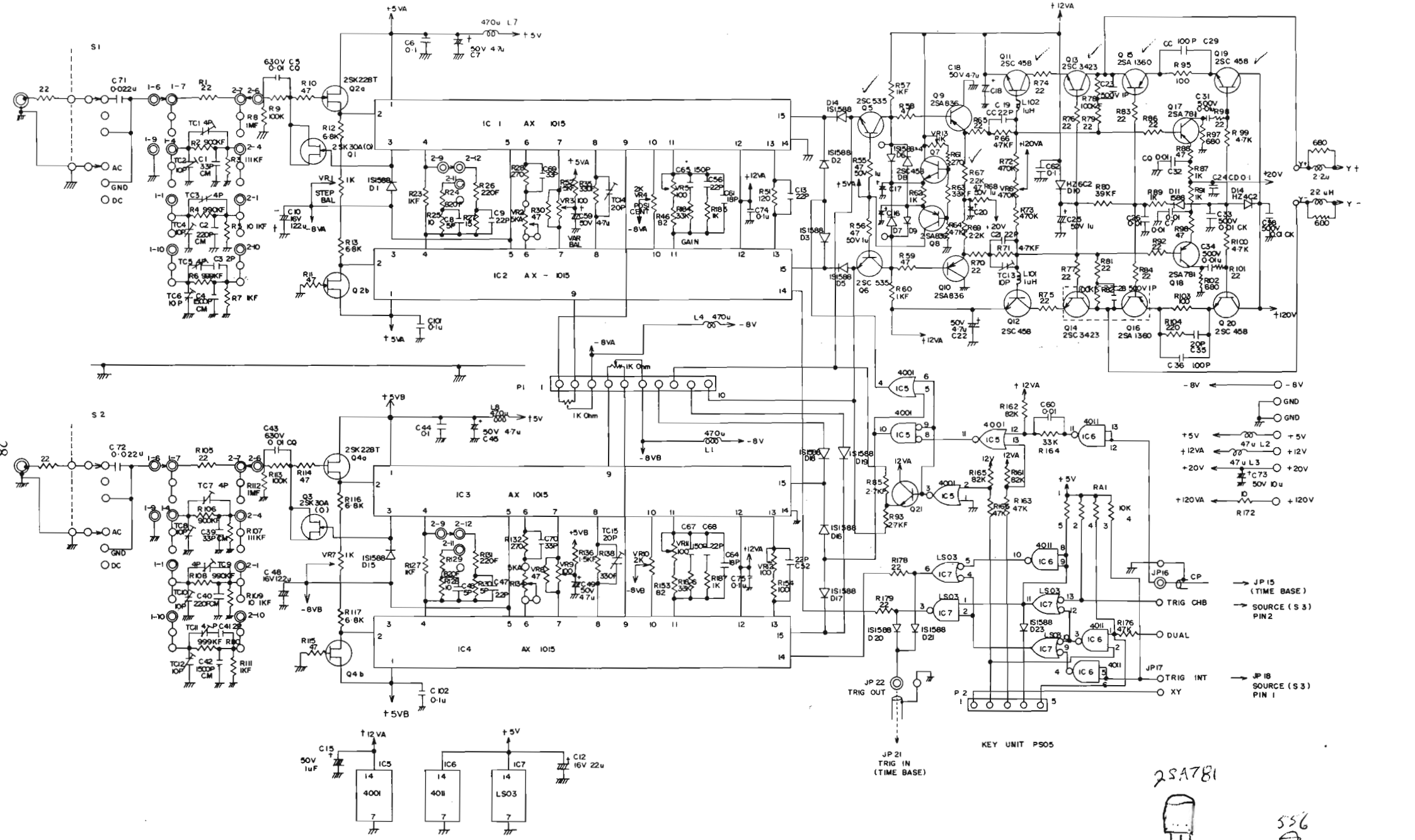
CODE NO	REF-NO	DESCRIPTION	SPECIFICATION	UNIT	Q'TY
2-T14-053		Snow Box	Styroform (Front and Rear)	Set	1
2-T14-054		Inner Box	DW-2 Sorts (530×408×312)	EA	1
2-T14-055		Out Box	DW-3 Sorts (546×423×233)	EA	1
		Instruction Manual	3502	EA	1
2-T52-003		Silica-Gel	5g	EA	4
2-T14-010		Poly Bag	48×32×47	EA	1
2-T14-008		Poly Bag	0.1×13×35	EA	1
2-T14-013		Poly Bag	5.5×8 (Zipper)	EA	1
2-T27-003		AC power cord	W-220 (P13L30) Option	EA	1
2-T27-004		AC power cord	M-117V (U L) Option	EA	1
2-T27-007		AC power cord	A240 (PVC 7.5A 250V) Option	EA	1
2-T27-008		Fuse	250V 0.5A (5.2Pi×30)	EA	2
		Test Probe	OP-20	EA	1

7-1 PCB LAYOUT

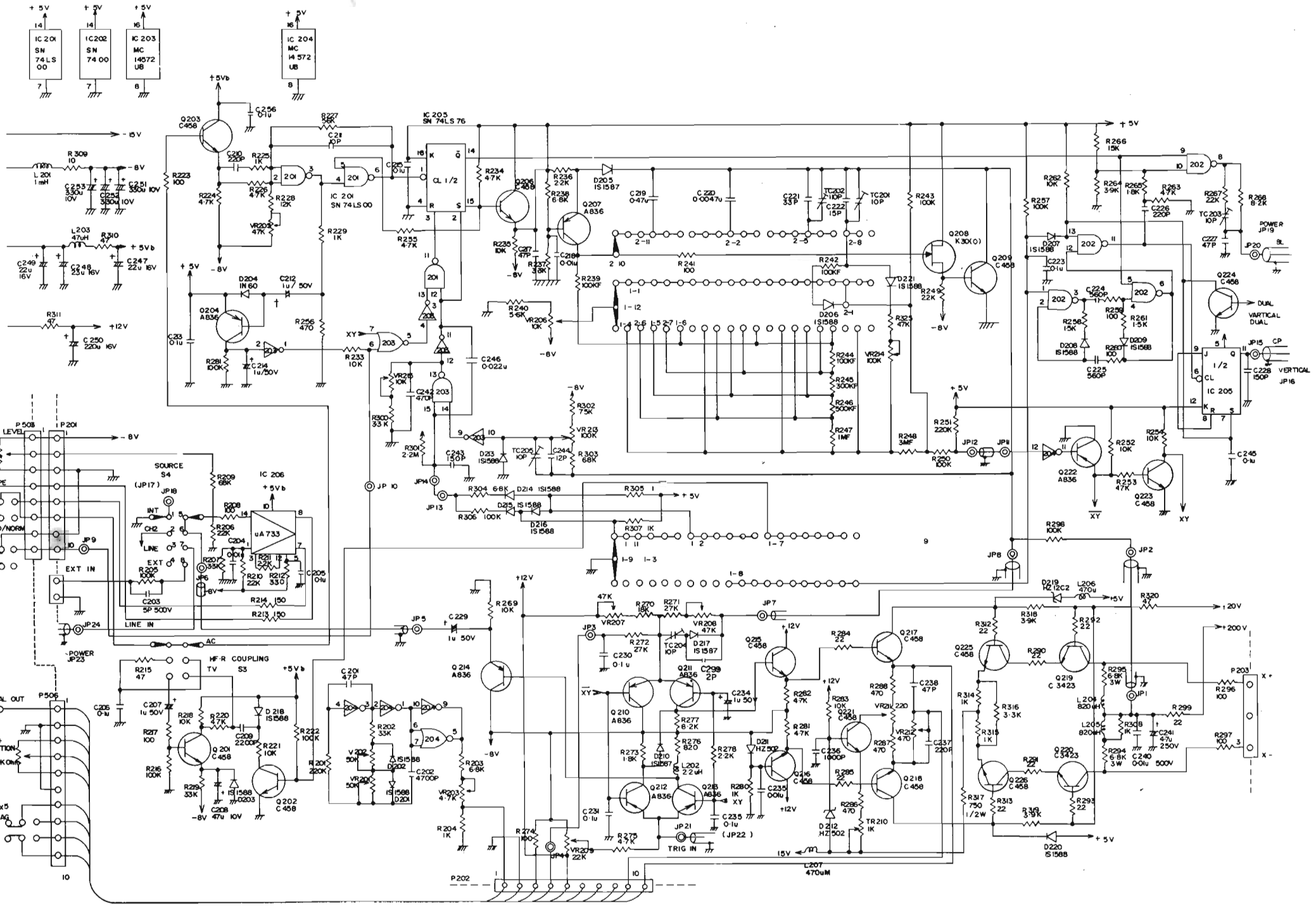


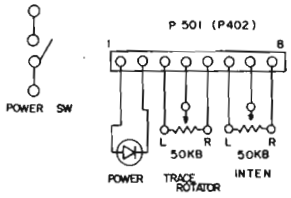
7-2 CIRCUIT DIAGRAM

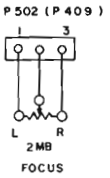


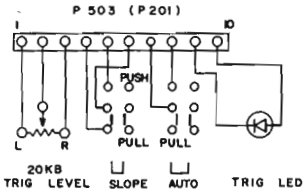


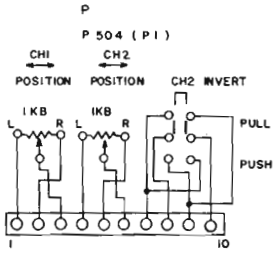
MODEL 3502 VERTICAL AMP

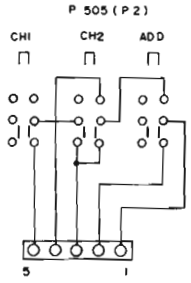

IC 201 SN 74LS 00
IC 202 SN 74 00
IC 203 MC 14572 UB
IC 204 MC 14 572 UB
IC 205 SN 74LS 76
IC 206 uA 733
IC 201 SN 74LS 00
+5V
-8V
+12V
-15V
+5Vb
TRIG LEVEL
SLOPE
AUTO/NORM
EXT IN
LINE IN
SOURCE S4
(JP17)
INT
LINE
EXT
CH2
AC
POWER JP23
HF-R COUPLING
TV S3
CAL OUT
H-POSITION
x5 MAG
TRIG IN
DUAL VARTICAL DUAL
VERTICAL JP16
POWER JP19
P508
P201
P506
P202
P203
JP1
JP2
JP3
JP4
JP5
JP6
JP7
JP8
JP9
JP10
JP11
JP12
JP13
JP14
JP15
JP18
JP20
JP21
JP24
Q201 C458
Q202 C458
Q203 C458
Q204 A836
Q205 C458
Q206 C458
Q207 A836
Q208 K30(0)
Q209 C458
Q210 A836
Q211 A836
Q212 A836
Q213 A836
Q214 A836
Q215 C458
Q216 C458
Q217 C458
Q218 C458
Q220 C3423
Q221 C458
Q222 A836
Q223 C458
Q224 C456
Q225 C458
Q226 C458
Q219 C 3423
TRIG IN
(JP22)
L 201 1mH
L203 47uH
L204 820uH
L205 820uH
L206 470u
L207 470uH
L202 2.2uH
D201 HZ502
D202 IS1588
D203 IS1588
D204 IN60
D205 IS1587
D206 IS1588
D207 IS1588
D208 IS1588
D209 IS1588
D210 IS1587
D211 HZ502
D212 HZ502
D213 IS1588
D214 IS1588
D215 IS1588
D216 IS1588
D217 IS1587
D218 IS1588
D219 HZ12C2
D220 IS1588
D221 IS1588
C201 47P
C202 4700P
C203 5P 500V
C204 0-01u
C205 0-1u
C206 0-1u
C207 1u 50V
C208 47u 10V
C209 2200P
C210 220P
C211 10P
C212 1u / 50V
C213 0-1u
C214 1u/50V
C215 0-1u
C216 0-01u
C217 47P
C218 0-01u
C219 0-47u
C220 0-0047u
C221 33P
C222 15P
C223 0-1u
C224 560P
C225 560P
C226 220P
C227 47P
C228 150P
C229 1u 50V
C230 0-1u
C231 0-1u
C233 0-1u
C234 1u 50V
C235 0-1u (JP22)
C236 1000P
C237 220P
C238 47P
C239 2P
C240 0-01u 500V
C241 47u 250V
C242 470P
C243 150P
C244 12P
C245 0-1u
C246 0-022u
C247 22u 16V
C248 22u 16V
C249 22u 16V
C250 220u 16V
C251 330u 10V
C252 330u 10V
C253 330u 10V
C254 0-1u
R201 220K
R202 33K
R203 6-8K
R204 1K
R205 100K
R206 22K
R207 33K
R208 100
R209 68K
R210 22K
R211 22K
R212 330
R213 150
R214 150
R215 47
R216 100K
R217 100
R218 10K
R219 33K
R220 47K
R221 10K
R222 100K
R223 100
R224 4-7K
R225 1K
R226 4-7K
R227 56K
R228 12K
R229 1K
R230 4-7K
R231 3-9K
R232 6-8K
R233 10K
R234 4-7K
R235 10K
R236 2-2K
R237 3-9K
R238 6-8K
R239 100KF
R240 5-6K
R241 100
R242 100KF
R243 100K
R244 100KF
R245 300KF
R246 500KF
R247 1MF
R248 3MF
R249 100K
R250 100K
R251 220K
R252 10K
R253 47K
R254 10K
R255 100
R256 470
R257 100K
R258 15K
R259 100
R260 100
R261 1-5K
R262 10K
R263 4-7K
R264 3-9K
R265 1-8K
R266 15K
R267 22K
R268 8-2K
R269 10K
R270 18K
R271 27K
R272 27K
R273 1-8K
R274 100
R275 4-7K
R276 820
R277 6-2K
R278 2-2K
R279 IK XY
R280 IK XY
R281 4-7K
R282 47K
R283 10K
R284 22
R285 22
R286 470
R287 470
R288 470
R289 470
R290 22
R291 22
R292 22
R293 22
R294 6-8K 3W
R295 6-8K 3W
R296 100
R297 100
R298 100K
R299 22
R300 33K
R301 2-2M
R302 75K
R303 68K
R304 6-8K
R305 1
R306 100K
R307 1K
R308 1K
R309 10
R310 47
R311 47
R312 22
R313 22
R314 1K
R315 1K
R316 3-3K
R317 750 1/2W
R318 3-9K
R319 3-9K
R320 47
VR201 47K
VR202 50K
VR203 4-7K
VR204 22K
VR205 10K
VR206 10K
VR207 47K
VR208 47K
VR209 10K
VR210 10K
VR211 220
VR212 470
VR213 100K
VR214 100K
TR210 1K
TC201 10P
TC202 10P
TC203 10P
TC204 10P
TC205 10P
uA 733
SN 74LS 76
SN 74LS 00
SN 74 00
MC 14572 UB
MC 14 572 UB
MODEL 3502 TIME BASE

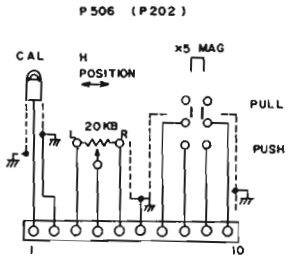

POWER SW
P 501 (P402)
1
8
L
R
50KB
50KB
POWER
TRACE ROTATOR
INTEN


P 502 (P 409)
1
3
L
R
2MB
FOCUS


P 503 (P 201)
1
10
PUSH
L
R
PULL
PULL
20KB
TRIG LEVEL
SLOPE
AUTO
TRIG LED


P
P 504 (P1)
CH1
POSITION
CH2
POSITION
CH2 INVERT
1KB
1KB
L
R
L
R
PULL
PUSH
1
10


P 505 (P 2)
CH1
CH2
ADD
5
1


P 506 (P202)
CAL
H
POSITION
x5 MAG
20KB
R
PULL
PUSH
1
10

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