USER MANUAL

Protek P-3502C

20 MHz Dual Trace Oscilloscope

20 MHz Dual Trace Oscilloscope

Protek

TABLE OF CONTENTS

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
9) Component Tester

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	×5 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) × 356(W) × 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.

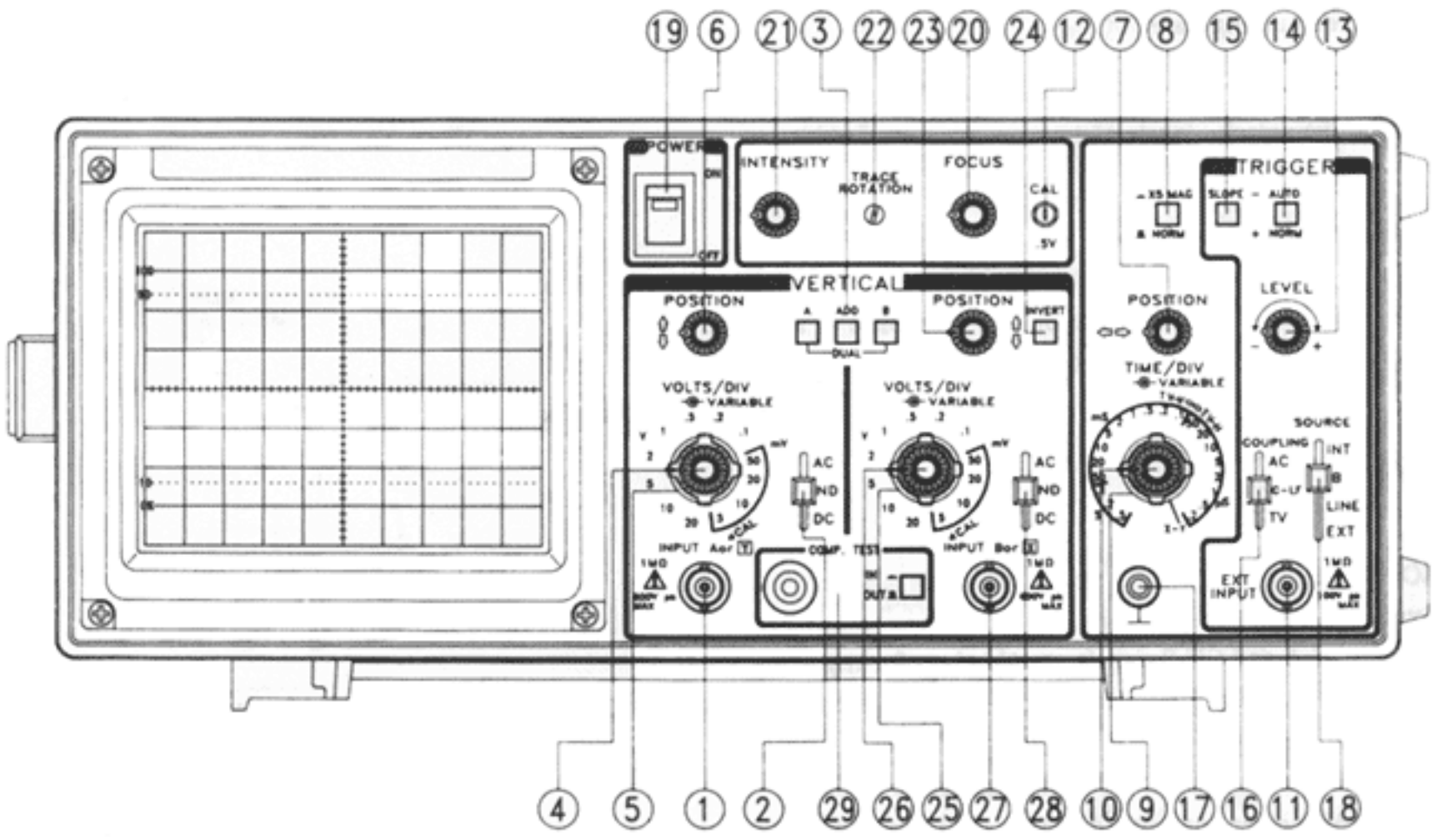
3-2 CONTROLS & INDICATIONS

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 20V/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 0.2μsec/DIV to 0.5sec/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.

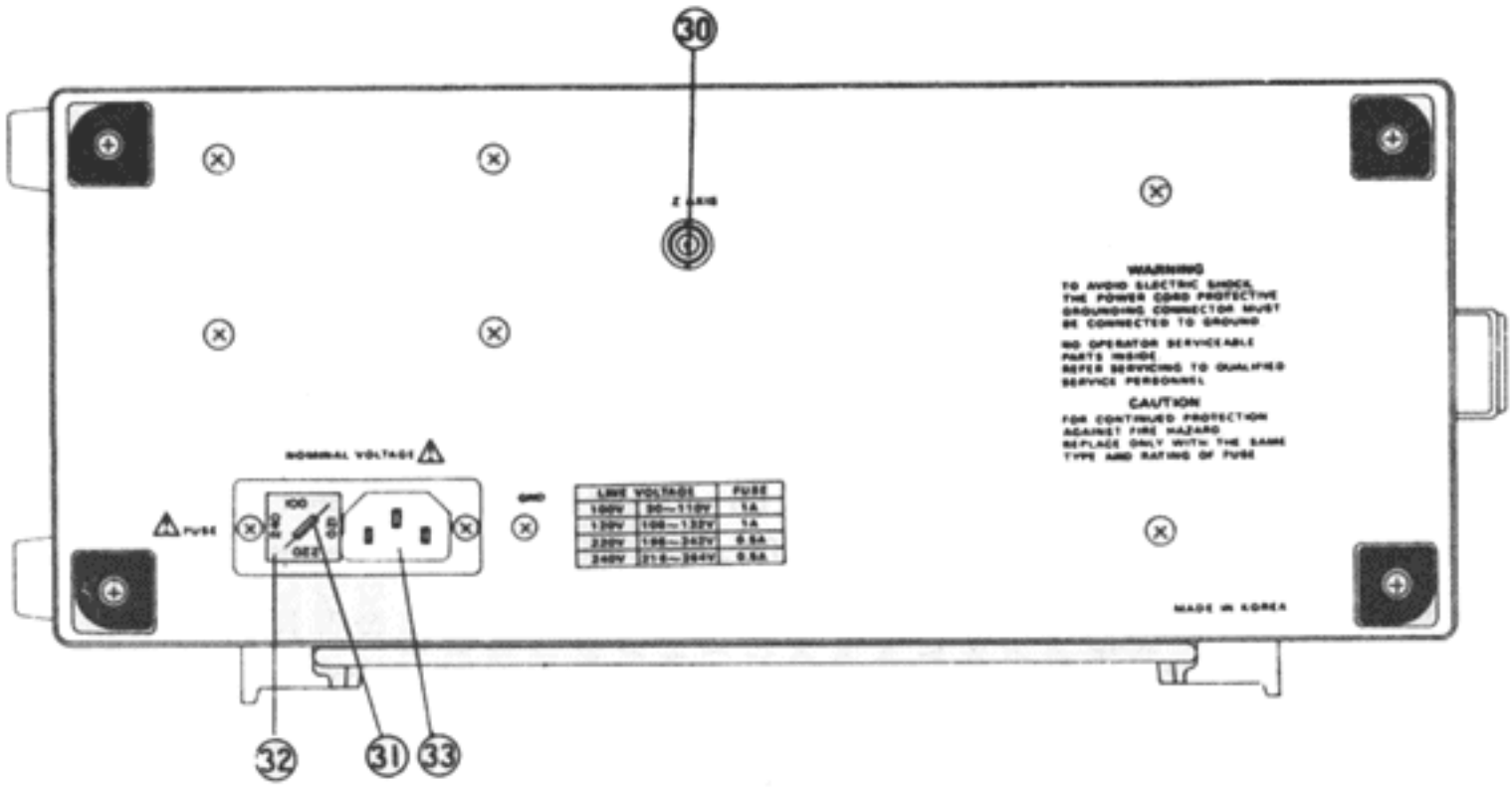
19. POWER SWITCH
    On or off.

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
    Wh n 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. COMP. TEST
    Switch to change from oscilloscope mode to component tester mode.
    For component testing set the SWEEP TIME/DIV ⑨ to the X-Y setting (fully clockwise) and both vertical coupling switches ② ㉘ to the GND position.



30. Z AXIS
    External Intensity Modulation Input.
31. FUSE HOLDER
    Proper ampere fuse must be in compartment
32. VOLTAGE SELECTOR
    Proper line voltage must be selected where this oscilloscope is used.
33. 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

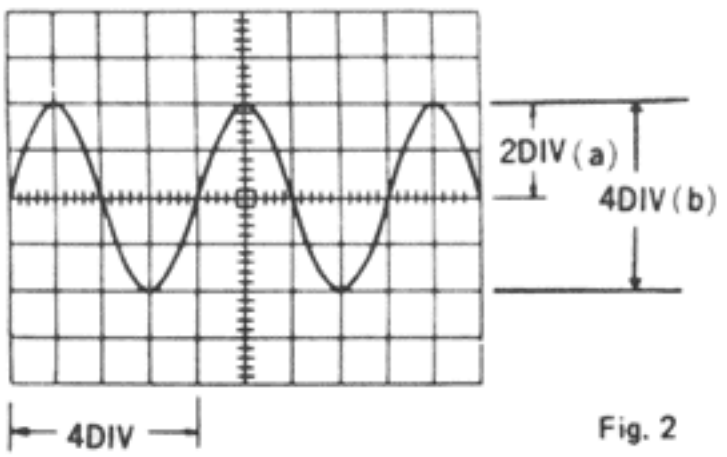


Fig. 2

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.

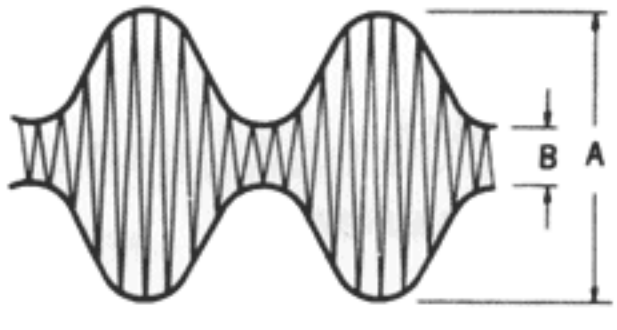
DC voltage = Shift (DIV) x VOLTS/DIV

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

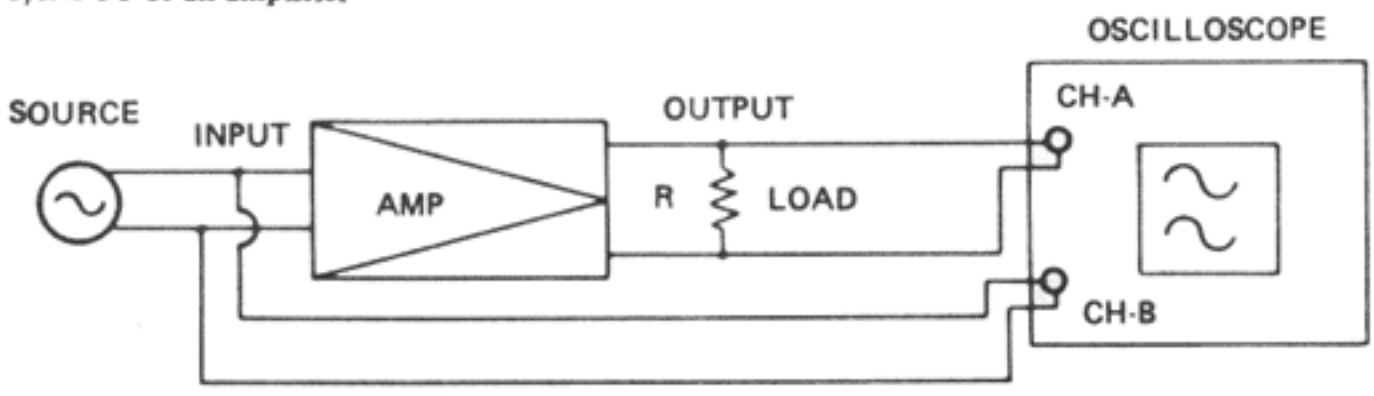


Fig. 4

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.

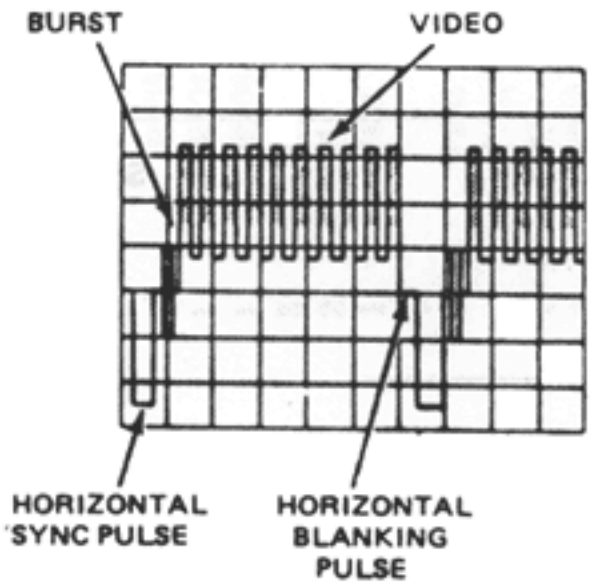


Fig. 5

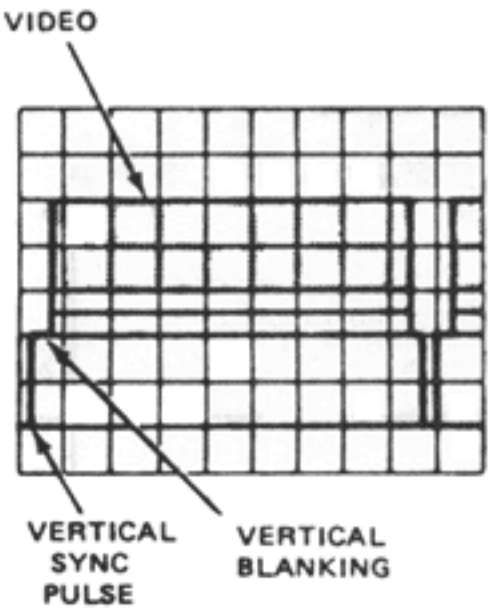


Fig. 6

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.

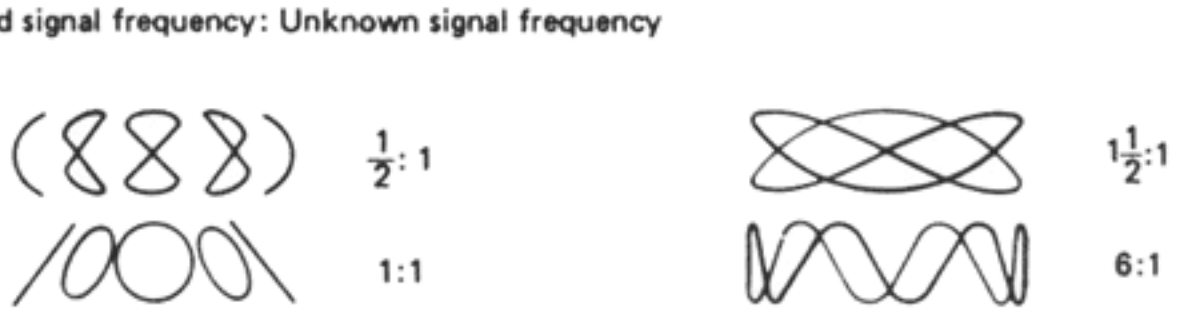
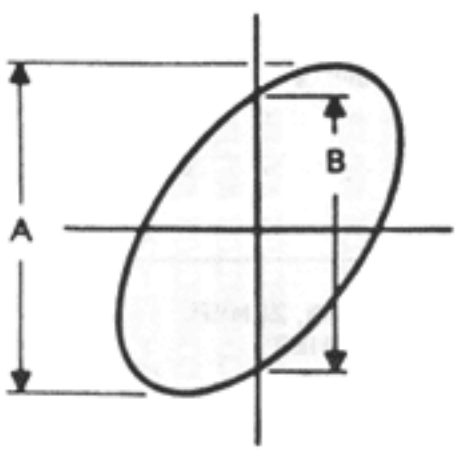


Fig. 7

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.

3-9-(12) COMPONENT TEST

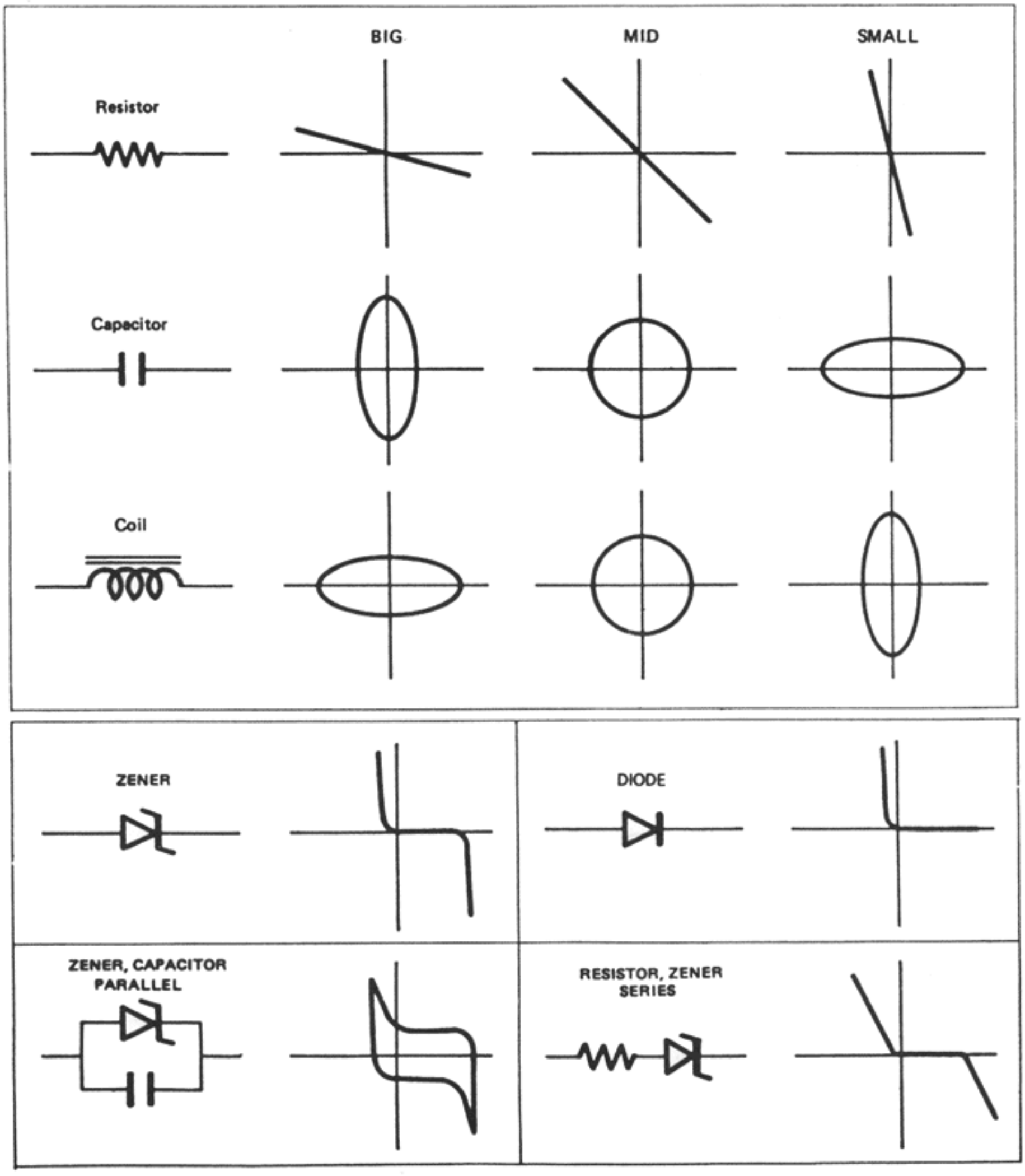
Turn SWEEP TIME/DIV switch to the X-Y mode (fully clockwise) and set both vertical coupling switches ② ㉘ to the GND position as well as setting the both VOLTS/DIV knob CH-1 to 2V/DIV, CH-2 to 5V/DIV, then push the COMP. TEST SW.

Components may be directly hooked to the COMP.TEST IN terminals or through lead wires.

Fig. 9 shows some reference displays.

Note: While in COMPONENT TEST operation, AC 9 VRMS is at the terminal for no load and about 2 mA will flow when they are shorted.

Fig. 9



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.

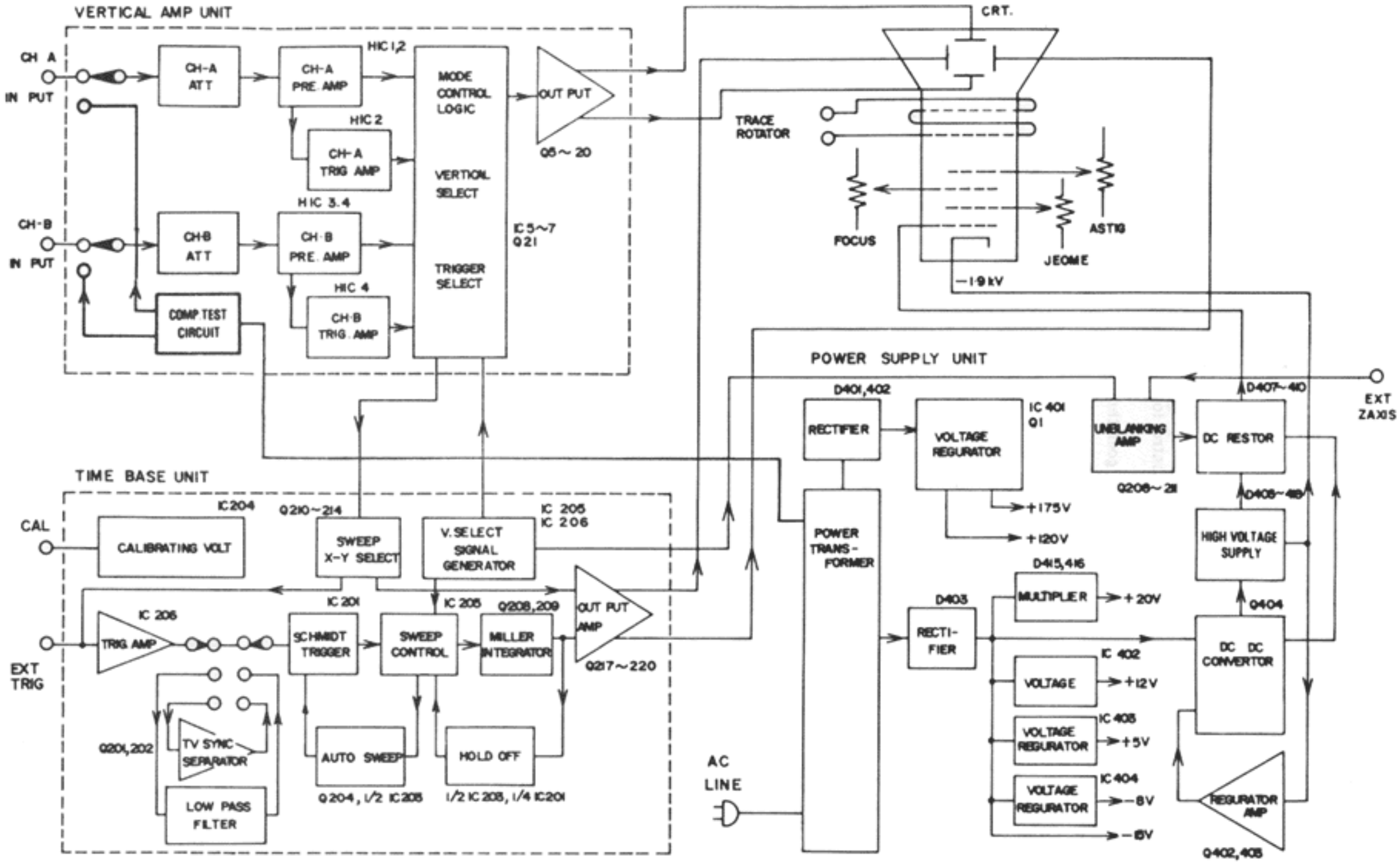

VERTICAL AMP UNIT
CH A
IN PUT
CH-A ATT
CH-A PRE. AMP
HIC 1,2
HIC 2
CH-A TRIG AMP
MODE CONTROL LOGIC
VERTICAL SELECT
TRIGGER SELECT
OUT PUT
Q5~20
IC 5~7 Q21
CH-B
IN PUT
CH-B ATT
CH-B PRE. AMP
HIC 3.4
HIC 4
CH-B TRIG. AMP
COMP TEST CIRCUIT
CRT.
TRACE ROTATOR
FOCUS
JEOME
ASTIG
-1.9kV
POWER SUPPLY UNIT
D401,402
RECTIFIER
VOLTAGE REGURATOR
IC 401 Q1
+175V
+120V
UNBLANKING AMP
Q206~211
DC RESTOR
D407~410
EXT Z AXIS
D408~412
HIGH VOLTAGE SUPPLY
Q404
D415,416
MULTIPLIER
+20V
D403
RECTI-FIER
IC 402
VOLTAGE
+12V
VOLTAGE REGURATOR
IC 403
+5V
VOLTAGE REGURATOR
IC 404
-8V
-15V
DC DC CONVERTOR
REGURATOR AMP
Q402,403
POWER TRANS-FORMER
AC LINE
TIME BASE UNIT
IC 204
Q210~214
IC 205 IC 206
CAL
CALIBRATING VOLT
SWEEP X-Y SELECT
V. SELECT SIGNAL GENERATOR
IC 201
IC 205
Q208,209
IC 206
TRIG AMP
SCHMIDT TRIGGER
SWEEP CONTROL
MILLER INTEGRATOR
OUT PUT AMP
Q217~220
EXT TRIG
Q201,202
TV SYNC SEPARATOR
LOW PASS FILTER
AUTO SWEEP
HOLD OFF
Q204, 1/2 IC205
1/2 IC205, 1/4 IC201

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.

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.

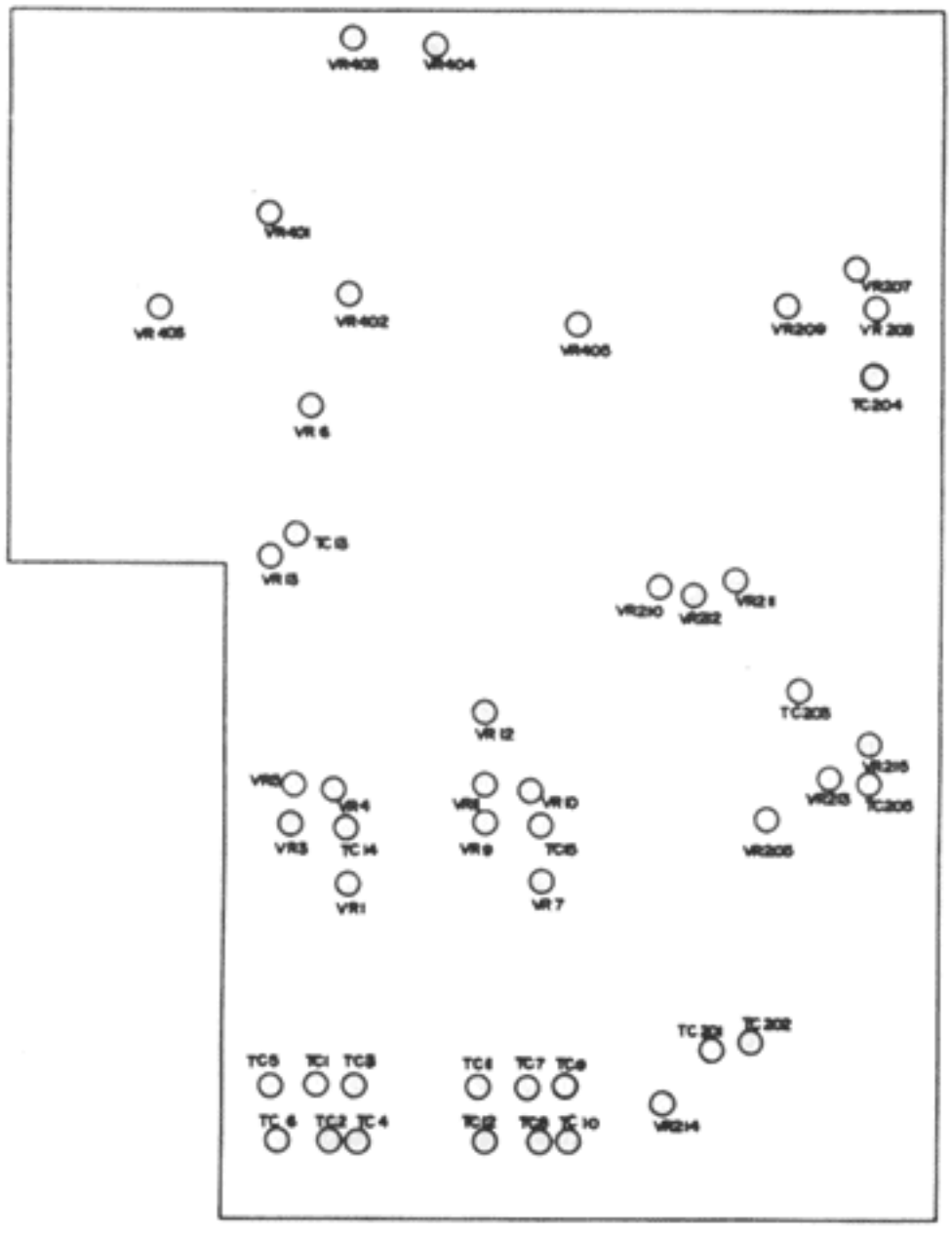


Fig. 10
ADJUSTMENT POINT

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.

SECTION 6

I. PARTS LIST

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-A10-002	CRT ASS'Y	3502 (HC)		1	
2-T21-063	ROTATION COIL	3502	EA	1	
2-C09-017	CRT	150 BTB 31 (20MHz)	EA	1	
2-T22-002	CRT SHEET	0.4*170*190 (URETHANE SPONGE)	EA	1	
2-T04-017	CRT SHIELD	PI42.0*140 (PERMALLOY T0.2 PB)	EA	1	
2-T02-029	CABLE TIE	300MM (TY-30)	EA	1	
2-A10-532	CRT SOCKET PCB ASS'Y	3502 (HC)		1	
2-C32-011	INDUCTOR	2.2UH K (SPO203-2R2K)	EA	2	
2-C43-003	CRT PCB	OS620(FR1)	EA	1	
2-C10-033	CARBON FILM RESISTOR	330 OHM 1/4W J	EA	2	
2-C42-011	CRT SOCKET	1339-01 (215-1002-05)	EA	1	
2-C26-040	CONNECTOR LEAD WIRE	350201	EA	1	
2-C26-041	CONNECTOR LEAD WIRE	350202	EA	1	
2-C26-048	CONNECTOR LEAD WIRE	350209	EA	1	
2-A10-812	MAIN PCB ASS'Y	3502C (HC)	KIT	1	
2-C33-269	CERAMIC CAPACITOR	0.01UF 50V Z	PCS	12	C204 C218 C235 C26 C27 C32 C416 C513 C514 C515 C516 C60
2-C28-050	CERAMIC CAPACITOR	10000PF 2KV E	EA	7	C418 C419 C420 C421 C423 C425 C438
2-C28-043	CERAMIC CAPACITOR	1000PF 500V K	EA	5	C432 C434 C450 C451 C511
2-C28-256	CERAMIC CAPACITOR	100PF 50V J	PCS	1	C506
2-C28-257	CERAMIC CAPACITOR	10PF 50V D	PCS	2	C211 C504
2-C28-258	CERAMIC CAPACITOR	12PF 50V J	PCS	2	C21 C244
2-C28-259	CERAMIC CAPACITOR	150PF 50V J	PCS	1	C228
2-C28-260	CERAMIC CAPACITOR	15PF 50V J	PCS	1	C222
2-C28-039	CERAMIC CAPACITOR	1PF 500V C	EA	2	C23 C28
2-C28-261	CERAMIC CAPACITOR	20PF 50V J	PCS	1	C35
2-C28-262	CERAMIC CAPACITOR	220PF 50V J	PCS	5	C2 C210 C226 C237 C40
2-C33-242	CERAMIC CAPACITOR	22PF 50V J	PCS	5	C13 C19 C47 C52 C9
2-C28-040	CERAMIC CAPACITOR	2PF 500V C	EA	2	C3 C41
2-C28-263	CERAMIC CAPACITOR	2PF 50V C	PCS	1	C299
2-C33-270	CERAMIC CAPACITOR	33PF 50V J	PCS	5	C1 C221 C39 C69 C70

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C28-264	CERAMIC CAPACITOR	39PF 50V J	PCS	2	C65 C67
2-C28-265	CERAMIC CAPACITOR	3PF 50V C	PCS	3	C46 C505 C8
2-C28-266	CERAMIC CAPACITOR	47PF 50V J	PCS	3	C217 C227 C238
2-C28-267	CERAMIC CAPACITOR	560PF 50V J	PCS	3	C224 C225 C242
2-C28-041	CERAMIC CAPACITOR	5PF 500V C	EA	1	C203
2-C28-268	CERAMIC CAPACITOR	5PF 50V C	PCS	4	C507 C512 C56 C68
2-C28-269	CERAMIC CAPACITOR	68PF 50V J	PCS	2	C29 C36
2-C33-017	ELECTROLYTIC CAPACIOR	100UF 160V M	EA	2	C401 C404
2-C33-017	ELECTROLYTIC CAPACITOR	10UF 250V M	EA	1	C405
2-C33-017	ELECTROLYTIC CAPACITOR	1UF 250V M	EA	1	C425
2-C33-017	ELECTROLYTIC CAPACITOR	1UF 50V M	EA	17	C15 C16 C17 C20 C207 C212 C214 C229 C234 C25 C225 C406 C409 C413 C417 C441 C73
2-C33-035	ELECTROLYTIC CAPACITOR	2200UF 25V M	EA	3	C407 C410 C442
2-C33-030	ELECTROLYTIC CAPACITOR	220UF 16V M	EA	2	C248 C250
2-C33-033	ELECTROLYTIC CAPACITOR	220UF 50V M	EA	1	C437
2-C33-026	ELECTROLYTIC CAPACITOR	22UF 16V M	EA	5	C10 C12 C247
2-C33-042	ELECTROLYTIC CAPACITOR	330UF 10V M	EA	3	C251 C252 C253
2-C33-043	ELECTROLYTIC CAPACITOR	330UF 25V M	EA	1	C436
2-C33-041	ELECTROLYTIC CAPACITOR	33UF 250V M	EA	1	C403
2-C33-047	ELECTROLYTIC CAPACITOR	4.7UF 250V M	EA	1	C241
2-C33-122	ELECTROLYTIC CAPACITOR	4.7UF 50V M	EA	6	C18 C22 C45 C49 C59 C7
2-C33-122	ELECTROLYTIC CAPACITOR	470UF 25V M	EA	1	C408
2-C33-122	ELECTROLYTIC CAPACITOR	47UF 10V M	EA	1	C208
2-C31-017	METALIZED FILM CAPACITOR	0.01UF 630V K	EA	2	C43 C5
2-C31-017	METALIZED FILM CAPACITOR	0.022UF 630V K	EA	2	C71 C72
2-C30-040	POLYESTEL FILM CAPACITOR	1000PF 100V K	EA	1	C236
2-C30-004	POLYESTEL FILM CAPACITOR	0.1PF 100V K	EA	2	C206 C431
2-C30-059	POLYESTER FILM CAPACITOR	0.0047UF 100V K	EA	2	C220 C439
2-C30-007	POLYESTER FILM CAPACITOR	220PF 50V K	EA	2	C209 C443
2-C30-046	POLYPROPYLEN FILM CAPACITOR	0.022UF 100V K	EA	1	C246
2-C30-058	POLYPROPYLEN FILM CAPACITOR	0.047UF 100V K	EA	1	C414

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C33-103	POLYPROPYLEN FILM CAPACITOR	0.47UF 200V F	EA	1	C219
2-C31-057	POLYPROPYLEN FILM CAPACITOR	1500PF 100V G	EA	2	C4 C42
2-C28-136	SEMI CONDUCTOR CERAMIC CAPACITOR	0.01UF 25V M	EA	8	C240 C31 C33 C34 C422 C427 C429 C58
2-C28-091	SEMI CONDUCTOR CERAMIC CAPACITOR	0.1UF 25V M	PCS	21	C205 C213 C215 C223 C230 C231 C233 C24 C245 C246 C428 C435 C44 C501 C502 C503 C508 C6 C62 C74 C75
2-C34-129	TRIMMER CAPACITOR	10PF (CV05B1003)	PCS	12	TC10 TC12 TC13 TC2 TC201 TC202 TC203 TC204 TC205 TC4 TC6 TC8
2-C31-037	TRIMMER CAPACITOR	30PF (CV05E3003)	PCS	2	TC14 TC15
2-C34-068	TRIMMER CAPACITOR	5PF (CV05A0503)	PCS	6	TC1 TC11 TC3 TC5 TC7 TC9
2-C02-124	DIODE	1K 60	EA	1	D204
2-C03-025	DIODE	1S 1587	EA	3	D205 D210 D217
2-C03-126	DIODE	1S 1588	EA	33	D1 D11 D15 D16 D17 D18 D19 D2 D20 D203 D206 D207 D208 D208 D21 D213 D214 D215 D216 D218 D220 S221 D23 D3 D4 D404 D412 D413 D5 D6 D7 D8 D9
2-C03-007	DIODE	1SS 83	EA	4	D4-7 D408 D409 D410
2-C03-012	DIODE	2W02	EA	3	D401 D402 D403
2-C03-022	DIODE	HZ 4B3	EA	1	D414
2-C03-023	DIODE	HZ 5C2	EA	5	D10 D14 D211 D212 D411
2-C03-009	DIODE	HZ 6C2	EA	1	D417
2-C46-033	DIODE	VO 6C	EA	2	D415 D416
2-C03-297	DIODE	Y-10GA	EA	2	D406 D418
2-C03-149	FET	2SK 105-H	EA	4	Q2 Q4
2-C03-041	FET	2SK 30A-O	EA	3	Q1 Q208 Q3
2-C42-974	FUSE	0.5A 250V (50*20)	EA	1	

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C39-215	FUSE HOLDER	SN-5053	EA	2	
2-C05-047	IC	AX1015 (DO272)	EA	4	IC1 IC2 IC3 IC4
2-C05-001	IC	MC 14001 BCP	EA	1	IC5
2-C05-005	IC	MC 14572 UBCP	EA	2	IC203 IC204
2-C05-021	IC	MC 7812 CT	EA	1	IC402
2-C05-007	IC	SN 7400 N	EA	1	IC202
2-C21-134	IC	SN 74LS00 N	EA	1	IC7
2-C05-019	IC	SN 74LS03 N	EA	1	IC203
2-C05-010	IC	SN 74LS76 N	EA	1	IC205
2-C05-030	IC	TC 4011 BP	EA	1	IC6
2-C05-017	IC	UA 1733 CN	EA	1	IC206
2-C05-014	IC	UA 741 TC	EA	1	IC401
2-C05-020	IC	UA 7805 UC	EA	1	IC403
2-C05-013	IC	UA 78L15 AWC	EA	1	IC405
2-C05-012	IC	UA 7908UC	EA	1	IC404
2-C32-004	INDUCTOR	1UH	EA	1	L201
2-C32-011	INDUCTOR	2.2UH K	EA	1	L202
2-C32-013	INDUCTOR	4.7UH K	EA	1	L402
2-C32-015	INDUCTOR	470UH K	EA	3	L1 L4 L7
2-C32-014	INDUCTOR	47UH K	EA	4	L2 L203 L3 L8
2-C32-019	INDUCTOR	820UH K	EA	2	L204 L205
2-C42-016	NEON LAMP	NE-38B BH	EA	3	N2 N3 N4
2-C43-307	MIAN PCB	01-061-05	EA	1	
2-C11-004	CARBON FILM RESISTOR	1.5K OHM 1/4W J	EA	3	R258 R261 R445
2-C11-005	CARBON FILM RESISTOR	1.8K OHM 1/4W J	EA	2	R265 R273
2-C11-063	CARBON FILM RESISTOR	1.8K OHM 1/4W J	EA	1	R443
2-C10-008	CARBON FILM RESISTOR	10 OHM 1/4W J	EA	4	R128 R172 R25 R309
2-C10-022	CARBON FILM RESISTOR	100 OHM 1/4W J	EA	15	R103 R153 R208 R217 R223 R241 R259 R260 R274 R296 R297 R427 R436 R46 R95
2-C11-044	CARBON FILM RESISTOR	100K OHM 1/4W J	EA	13	R113 R205 R216 R222 R231 R243 R250 R257 R298 R306 R403 R426 R9

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C11-023	CARBON FILM RESISTOR	10K OHM 1/4W J	EA	11	R176 R218 R221 R233 R235 R252 R254 R262 R283 R414 R702
2-C11-045	CARBON FILM RESISTOR	110K OHM 1/4W J	EA	1	R411
2-C10-025	CARBON FILM RESISTOR	120 OHM 1/4W J	EA	1	R154
2-C11-047	CARBON FILM RESISTOR	120K OHM 1/4W J	EA	1	R433
2-C11-025	CARBON FILM RESISTOR	12K OHM 1/4W J	EA	1	R228
2-C10-011	CARBON FILM RESISTOR	15 OHM 1/4W J	EA	4	R130 R27
2-C18-044	CARBON FILM RESISTOR	15K OHM 1/4W J	EA	2	R266 R435
2-C10-027	CARBON FILM RESISTOR	180 OHM 1/4W J	EA	2	R431 R51
2-C11-027	CARBON FILM RESISTOR	18K OHM 1/4W J	EA	1	R270
2-C11-001	CARBON FILM RESISTOR	1K OHM 1/4W J	EA	17	R185 R187 R229 R280 R305 R307 R308 R314 R315 R404 R413 R432 R440 R62 R87 R89 R91
2-C11-007	CARBON FILM RESISTOR	2.2K OHM 1/4W J	EA	6	R211 R236 R278 R300 R67 R69
2-C11-064	CARBON FILM RESISTOR	2.2K OHM 1/4W J	EA	1	R301
2-C10-013	CARBON FILM RESISTOR	22 OHM 1/4W J	EA	30	R1 R101 R105 R178 R179 R284 R285 R290 R291 R293 R293 R299 R312 R313 R429 R430 R434 R65 R70 R74 R75 R76 R77 R79 R81 R83 R84 R86 R92 R98
2-C18-018	CARBON FILM RESISTOR	220 OHM 1/4W J	EA	1	R104
2-C11-052	CARBON FILM RESISTOR	220K OHM 1/4W J	EA	3	R201 R251 R428
2-C11-029	CARBON FILM RESISTOR	22K OHM 1/4W J	EA	4	R206 R210 R249 R267
2-C18-020	CARBON FILM RESISTOR	270 OHM 1/4W J	EA	3	R132 R28 R61
2-C11-030	CARBON FILM RESISTOR	27K OHM 1/4W J	EA	2	R271 R272
2-C11-011	CARBON FILM RESISTOR	3.3K OHM 1/4W J	EA	5	R184 R186 R207 R237 R316
2-C11-012	CARBON FILM RESISTOR	3.9K OHM 1/4W J	EA	4	R264 R318 R319 R437
2-C10-015	CARBON FILM RESISTOR	33 OHM 1/4W J	EA	1	R442
2-C11-032	CARBON FILM RESISTOR	33K OHM 1/4W J	EA	3	R164 R219 R438
2-C10-034	CARBON FILM RESISTOR	390 OHM 1/4W J	EA	1	R417

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C18-003	CARBON FILM RESISTOR	4.7 OHM 1/4W J	EA	2	R402 R408
2-C18-039	CARBON FILM RESISTOR	4.7K OHM 1/4W J	EA	12	R100 R224 R226 R234 R255 R263 R269 R275 R281 R282 R701 R99
2-C18-007	CARBON FILM RESISTOR	47 OHM 1/4W J	EA	19	R10 R11 R114 R115 R134 R213 R214 R215 R30 R310 R311 R320 R55 R56 R58 R59 R68 R88 R90
2-C18-024	CARBON FILM RESISTOR	470 OHM 1/4W J	EA	5	R225 R256 R286 R287 R288
2-C11-054	CARBON FILM RESISTOR	470K OHM 1/4W J	EA	4	R407 R421 R72 R73
2-C11-036	CARBON FILM RESISTOR	47K OHM 1/4W J	EA	8	R163 R166 R220 R253 R325 R415 R416 R439
2-C11-016	CARBON FILM RESISTOR	5.6K OHM 1/4W J	EA	1	R240
2-C10-037	CARBON FILM RESISTOR	560 OHM 1/4W J	EA	1	R212
2-C11-039	CARBON FILM RESISTOR	56K OHM 1/4W J	EA	2	R227 R412
2-C18-041	CARBON FILM RESISTOR	6.8K OHM 1/4W J	EA	6	R116 R117 R12 R13 R238 R304
2-C10-038	CARBON FILM RESISTOR	680 OHM 1/4W J	EA	2	R102 R97
2-C18-049	CARBON FILM RESISTOR	68K OHM 1/4W J	EA	3	R209 R303 R425
2-C15-018	CARBON FILM RESISTOR	750 OHM 1/4W J	EA	1	R317
2-C11-042	CARBON FILM RESISTOR	75K OHM 1/4W J	EA	1	R302
2-C11-021	CARBON FILM RESISTOR	8.2K OHM 1/4W J	EA	2	R268 R277
2-C18-029	CARBON FILM RESISTOR	820 OHM 1/4W J	EA	1	R276
2-C11-043	CARBON FILM RESISTOR	82K OHM 1/4W J	EA	3	R161 R162 R165
2-C10-001	JUMP RESISTOR	0 OHM 1/4W TYPE	EA	5	
2-C13-006	METAL FILM RESISTOR	1.5K OHM 1/4W F	EA	2	R136 R52
2-C17-016	METAL FILM RESISTOR	10.1K OHM 1/4W D	EA	2	R109 R5
2-C17-019	METAL FILM RESISTOR	100K OHM 1/4W D	EA	3	R239 R242 R244
2-C13-056	METAL FILM RESISTOR	100K OHM 1/4W F	EA	4	R560 R562 R78 R82
2-C18-094	METAL FILM RESISTOR	10K OHM 1/4W F	EA	2	R555 R558
2-C17-020	METAL FILM RESISTOR	111K OHM 1/4W D	EA	2	R107 R3
2-C14-004	METAL FILM RESISTOR	120K OHM 1/4W F	EA	1	R405
2-C17-009	METAL FILM RESISTOR	1K OHM 1/4W D	EA	7	R111 R127 R23 R552 R57 R60 R7

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C17-027	METAL FILM RESISTOR	1K OHM 1/4W D	EA	3	R112 R247 R8
2-C13-012	METAL FILM RESISTOR	2.2K OHM 1/4W F	EA	2	R85 R93
2-C14-007	METAL FILM RESISTOR	200K OHM 1/4W F	EA	1	R561
2-C17-005	METAL FILM RESISTOR	220 OHM 1/4W D	EA	2	R131 R26
2-C14-029	METAL FILM RESISTOR	220K OHM 1/4W F	EA	1	R559
2-C19-086	METAL FILM RESISTOR	3.3K OHM 1/4W F	EA	1	R63
2-C13-020	METAL FILM RESISTOR	3.9K OHM 1/4W F	EA	1	R406
2-C17-022	METAL FILM RESISTOR	300K OHM 1/4W D	EA	1	R245
2-C19-068	METAL FILM RESISTOR	330 OHM 1/4W F	EA	2	R138 R35
2-C13-047	METAL FILM RESISTOR	39K OHM 1/4W F	EA	1	R80
2-C17-029	METAL FILM RESISTOR	3M OHM 1/4W D	EA	1	R248
2-C13-022	METAL FILM RESISTOR	4.7K OHM 1/4W F	EA	3	R64 R66 R71
2-C18-071	METAL FILM RESISTOR	470 OHM 1/4W F	EA	1	R554
2-T45-011	METAL FILM RESISTOR	470K OHM 1/4W F	EA	1	R557
2-C17-023	METAL FILM RESISTOR	500K OHM 1/4W D	EA	1	R246
2-C17-008	METAL FILM RESISTOR	820 OHM 1/4W D	EA	2	R129 R24
2-C17-024	METAL FILM RESISTOR	900K OHM 1/4W D	EA	2	R106 R2
2-C17-025	METAL FILM RESISTOR	990K OHM 1/4W D	EA	2	R108 R4
2-C17-026	METAL FILM RESISTOR	999KM OHM 1/4W D	EA	2	R110 R6
2-C16-088	METAL GRAZE RESISTOR	10M OHM 1/4W J	EA	1	R410
2-C16-025	METAL OXIDE RESISTOR	10 OHM 1W G	EA	1	R409
2-C16-043	METAL OXIDE RESISTOR	2.7K OHM 2W G	EA	1	R553
2-C16-036	METAL OXIDE RESISTOR	27 OHM 1W G	EA	1	R441
2-C12-137	METAL OXIDE RESISTOR	6.8K OHM 3W J	PCS	2	R294 R295
2-C16-034	METAL OXIDE RESISTOR	82 OHM 1W G	EA	1	R401
2-C03-060	NETWORK RESISTOR	10K OHM J	EA	1	RA1
2-C20-068	SOLID RESISTOR	100K OHM 1/4W J	EA	1	R424
2-C20-067	SOLID RESISTOR	1M OHM 1/4W J	EA	1	R418
2-C20-069	SOLID RESISTOR	22M OHM 1/4W J	EA	2	R422 R423
2-C20-064	SOLID RESISTOR	4.7 OHM 1/4W J	EA	1	R419
2-C20-070	SOLID RESISTOR	47K OHM 1/4W J	EA	1	R420
2-C36-011	LEVEL SWITCH	SLLR 52157A	EA	3	
2-C36-012	LEVEL SWITCH	SLLR 52169A	EA	1	

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C36-082	TIME ROTARY SWITCH	3502 (BTR 3022)	EA	1	
2-C36-083	VERTICAL ROTARY SWITCH	BTR 3021	EA	2	
2-C30-027	THERMISTOR	10K OHM SDT-1000	EA	1	TH1
2-C06-033	TR	2SA 1360-Y	EA	2	Q15 Q16
2-C06-038	TR	2SA 781-K	EA	2	Q17 Q18
2-C06-024	TR	2SA 836-D	EA	14	Q10 Q204 Q207 Q210 Q211 Q212 Q213 Q214 Q222 Q403 Q406 Q411 Q8 Q9
2-C06-014	TR	2SB 861-C	EA	1	Q401
2-C06-001	TR	2SC 2632	EA	3	Q408 Q409 Q412
2-C06-035	TR	2SC 3423-Y	EA	2	Q13 Q14
2-C06-024	TR	2SC 458-D	EA	23	Q11 Q12 Q19 Q20 Q201 Q202 Q203 Q206 Q209 Q21 Q215 Q216 Q217 Q218 Q221 Q223 Q224 Q225 Q226 Q402 Q405 Q410 Q7
2-C06-006	TR	2SC 535-B	EA	2	Q5 Q6
2-C06-009	TR	2SD 401-K	EA	1	Q404
2-C06-018	TR	2SD 668A-C	EA	2	Q219 Q220
2-C38-105	CONVERTER TRANSFORMER	CT-3502C	EA	1	
2-C29-026	SEMI FIXED RESISTOR	100K OHM B (RH 1051C15J48A)	EA	1	VR405
2-C29-019	SEMI FIXED RESISTOR	1K OHM B (RH 1051C13J4QA)	PCS	2	VR1 VR7
2-C29-029	SEMI FIXED RESISTOR	1M OHM B (RH 1051C16J27A)	EA	1	VR403
2-C29-020	SEMI FIXED RESISTOR	2.2K OHM B (RH 1051CJ3J3WA)	EA	1	VR406
2-C29-024	SEMI FIXED RESISTOR	47K OHM B (RH 1051CS4J4DA)	EA	1	VR401
2-C29-036	SEMI FIXED RESISTOR	V6EK PV(1S) 100 OHM B	EA	5	VR11 VR211 VR3 VR5 VR9
2-C29-044	SEMI FIXED RESISTOR	V6EK PV(1S) 100K OHM B	EA	2	VR213 VR214
2-C29-041	SEMI FIXED RESISTOR	V6EK PV(1S) 10K OHM B	EA	1	VR402
2-C29-039	SEMI FIXED RESISTOR	V6EK PV(1S) 1K OHM B	EA	3	VR12 VR13 VR210
2-C29-042	SEMI FIXED RESISTOR	V6EK PV(1S) 22K OHM B	EA	1	VR209
2-C29-032	SEMI FIXED RESISTOR	V6EK PV(1S) 2K OHM B	EA	2	VR10 VR4
2-C29-040	SEMI FIXED RESISTOR	V6EK PV(1S) 4.7K OHM B	EA	1	VR215
2-C29-038	SEMI FIXED RESISTOR	V6EK PV(1S) 470 OHM B	EA	1	VR212
2-C29-045	SEMI FIXED RESISTOR	V6EK PV(1S) 470K OHM B	EA	1	VR6

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C29-043	SEMI FIXED RESISTOR	V6EK PV(1S) 47K OHM B	EA	3	VR205 VR207 VR208
2-C29-035	SEMI FIXED RESISTOR	VM 6CK PV (1S) 1M OHM	EA	1	VR404
2-C35-044	VARIABLE RESISTOR	10K OHM (V16L4 7*5 PH2A N10S-15A)3TS	EA	1	VR206
2-C35-043	VARIABLE RESISTOR	5K OHM (V16L4 7*5 PH2A N10S-15A)3TS	EA	2	VR2 VR8
2-C21-069	2-C21-258	LW 0640-10A	EA	2	P1 P202
2-C21-013	CONNECTOR WAFER	FEP 1143-7A	EA	1	P401
2-C21-001	CONNECTOR WAFER	LW 0640-2A	EA	1	
2-C21-002	CONNECTOR WAFER	LW 0640-3A	EA	7	P203 P3 P404 P405 P406 P701 P702
2-C21-004	CONNECTOR WAFER	LW 0640-5A	EA	1	P2
2-C21-006	CONNECTOR WAFER	LW 0640-8A	EA	2	P201 P402
2-C21-007	CONNECTOR WAFER	LW 0640-9A	EA	1	P403
2-C21-039	CONNECTOR WAFER	TEWP 0640-02A (5MM)	EA	1	
2-C26-069	CONNECTOR LEAD WIRE	350230	PCS	1	
2-C22-040	CONNECTOR LEAD WIRE	55059	EA	2	JP45 JP47
2-C26-057	JUMP GROUND WIRE	350218	EA	3	
2-C26-058	JUMP GROUND WIRE	350219	EA	3	
2-C26-059	JUMP GROUND WIRE	350220	PCS	4	JP41 JP43 JP49
2-C26-062	JUMP GROUND WIRE	350223	EA	1	
2-C11-074	JUPM WIRE	10MM	EA	309	
2-C26-060	JUPM WIRE	350221	EA	1	JP3
2-C26-061	JUPM WIRE	350222	EA	1	JP9
2-C26-063	JUPM WIRE	350224	EA	1	JP17
2-C11-072	JUPM WIRE	JW-62	EA	11	
2-C26-051	SHIELD WIRE	350212	EA	1	JP15
2-C26-052	SHIELD WIRE	350213	PCS	2	JP7
2-C26-053	SHIELD WIRE	350214	PCS	3	JP1 JP21
2-C26-054	SHIELD WIRE	350215	EA	1	JP23
2-C26-055	SHIELD WIRE	350216	EA	1	JP5
2-C26-056	SHIELD WIRE	350217	EA	1	JP13
2-C26-086	SHIELD WIRE	350223	EA	1	JP25
2-C42-021	INSULATION BUSHING	B24	EA	3	
2-T22-060	SHIELD CASE(1)	3502 (HC) (SPC T0.1 ZNW/PL C310223)	EA	1	
2-C37-136	HEAT SINK(2)	5510 (HC) (C2600P-1/2H T0.5 C310149)	EA	1	

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C37-002	HEAT SINK(A)	OS620 (AL T2.0 302-M40025)	EA	4	
2-C21-168	HOUSING	5051-03A	PCS	2	Q219 Q220
2-T11-026	HEXAGON NUT	M3 NI/PL	EA	4	
2-C42-136	SILCON RUBBER(1)	ARH 230 (T0.3*13*18)	EA	11	
2-T10-017	MACHINE SCREW	BH(+) M3.0*12.0 NI/PL	EA	2	
2-T48-016	MACHINE SCREW	BH(+) M3.0*6.0 NI/PL	EA	6	
2-T10-015	MACHINE SCREW	BH(+) M3.0*8.0 NI/PL	EA	4	
2-T22-056	SHIELD PLATE(1)	3502 (HC) (C2600P-1/2H T0.5 C310225)	EA	1	
2-T22-057	SHIELD PLATE(2)	3502 (HC) (C2600P-1/2H T0.5 C310226)	EA	1	
2-T11-017	TOOHED LOCK WASHER	3PI NI/PL (OUT SIDE)	EA	3	
2-A10-149	MODE PCB ASS'Y	3502 (HC)		1	
2-C39-213	PUSH SWITCH	PS-135 (M2-A22S)	EA	7	
2-C35-045	SEMI FIXED RESISTOR	TM10K(PV)8US-B50K	EA	1	TRACE
2-C35-035	VARIABLE RESISTOR	V012L-PV30KS-B1K	EA	2	CH1PO CH2PO
2-C35-036	VARIABLE RESISTOR	V012L-PV30KS-B20K	EA	2	TIMPO TRIGG
2-C35-034	VARIABLE RESISTOR	V012L-PV30KS-B50K	EA	1	INTEN
2-C35-039	VARIABLE RESISTOR	V0161-PV30KS-B2M	EA	1	FOCUS
2-C26-043	CONNECTOR LEAD WIRE	350204 (350MM)	EA	1	P404
2-C26-045	CONNECTOR LEAD WIRE	350206	EA	1	P2
2-C26-046	CONNECTOR LEAD WIRE	350207	EA	1	P201
2-C26-047	CONNECTOR LEAD WIRE	350208	EA	1	P402
2-C26-049	CONNECTOR LEAD WIRE	350210	EA	1	P1
2-C26-050	CONNECTOR LEAD WIRE	350211	EA	1	P202
2-C11-074	JUPM WIRE	10MM	EA	6	
2-T01-025	CAL TERMINAL	HC5502(ABS WITH BSP T0.5 NI/PL)	EA	1	
2-A10-813	COMP SWITCH ASS'Y	3502C (HC)	KIT	1	
2-C32-004	INDUCTOR	1UH (SP0305-1R0K-2)	EA	1	
2-C36-006	PUSH BUTTON SWITCH	SPUF 12755A	EA	1	
2-C37-142	EMPIRE TUBE	60MM	EA	4	
2-C21-453	JUMP WIRE	70MM	EA	4	
2-C25-157	LEAD WIRE	55056 (70MM BLOCK)	EA	2	
2-C22-157	SHIELD WIRE	3502C-100 (430MM)	EA	1	
2-T11-025	HEXAGON NUT	M2.6*0.45 NI/PL	EA	2	
2-T10-039	MACHINE SCREW	FH(+) M2.6*6.0 ZN/PL	EA	2	

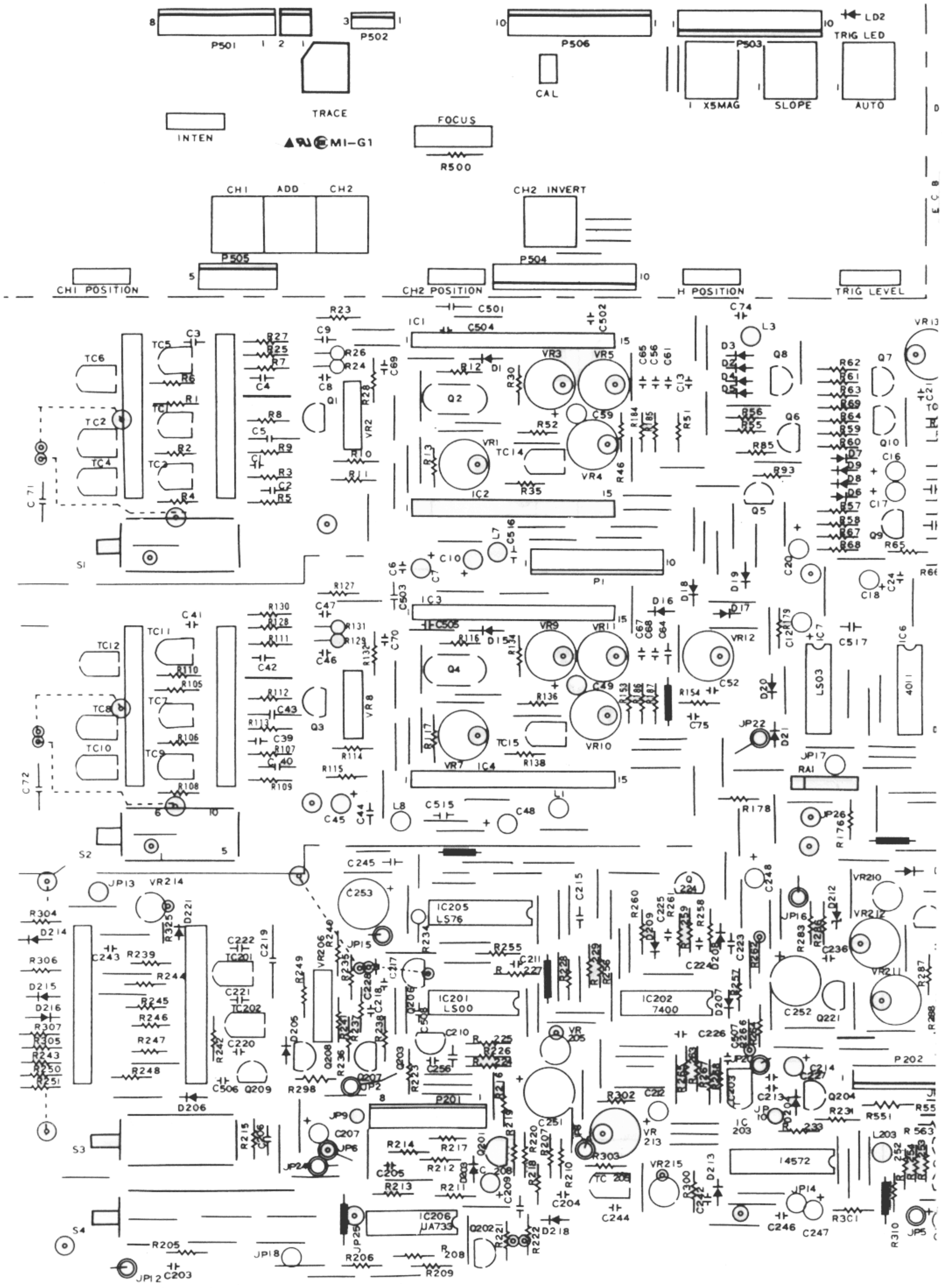
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-C37-021	SHIELD PLATE	C2600P-1/2 T0.3, C310040-1	EA	1	
2-B10-085	CASE ASS'Y	3502 (HC)		1	
2-T22-139	BOTTOM CASE	5502 (FANALL)	EA	1	
2-T22-034	TOP CASE	(5502 F.L)L-SHEET T1.0 SB-038L DARK GREY	EA	1	
2-T01-006	MOULD LEG	OS620(ACETAL BLOCK)	EA	2	
2-C42-128	PLASTIC FOOT	TM-127	EA	2	
2-T02-002	RUBBER FOOT	HC5502(RUBBER BLOCK)	EA	4	
2-T01-022	HANDLE	OS620 (PVC WHITH SPS T0.5)	EA	1	
2-T01-023	HANDLE METAL	620 (HC) (SPC NI/PL C310088)	EA	2	
2-T11-027	HEXAGON NUT	M4 NI/PL	EA	2	
2-T10-021	MACHINE SCREW	BH(+) M4.0*10.0 NI/PL	EA	2	
2-T10-005	MACHINE SCREW	OH(+) M4.0*12.0 NI/PL	EA	2	
2-T58-042	WASHER WITH MACHINE SCREW	PH(+) M0.3*10.0 NI/PL	EA	4	
2-T01-018	STAND	620 (HC) (SBPR PI2.0 CR/PL C310098)	EA	1	
2-B10-27	FRONT PANEL ASS'Y	3502C (HC)	KIT	1	
2-T01-001	BNC CONNECTOR	UG-625/U	EA	3	
2-C10-013	CARBON FILM RESISTOR	22 OHM 1/4W J	EA	2	
2-C39-214	POWER SWITCH	DS 850 LED(G)	EA	1	
2-C26-064	LEAD WIRE	350225	EA	4	
2-C26-065	LEAD WIRE	350226	EA	1	
2-T21-090	COMP S/W BAR	3502C (ACETAL PI6*20 C310321)	EA	2	
2-T22-019	CRT CUSHION(4)	2.0*91*5.5(URETHANE SPONGE,BLOCK)	EA	2	
2-T22-021	CRT CUSHION(5)	2.0*112*5.5(URETHANE SPONGE,BLOCK)	EA	2	
2-T22-020	CRT CUSHION(6)	2.0*35*50(URETHANE SPONGE,BLOCK)	EA	4	
2-T21-058	FRONT FRAME	3502(HANNAM ABS750+GRASS 10% BLOCK)	EA	1	
2-T11-029	HEXAGON NUT	M6 NI/PL	EA	1	
2-T58-065	NUT	HZ-04-R146	EA	1	
2-T22-048	FRONT PANEL	3502 (SPC T1.2 ZN/PL)	EA	1	
2-T22-324	TOP PLATE	3502C (HC: 3502C, OST3502C-001)	EA	1	
2-T22-322	COMP S/W POLE	3502C (C3650B 5.0*26.0 C310320)	EA	2	
2-T22-063	PCB POLE	3502 (HC) (C3650B 5.0*14.0 C310228)	EA	4	
2-T48-091	MACHINE SCREW	BH(+) M2.6*6.0 NI/PL	EA	6	
2-T48-092	MACHINE SCREW	BH(+) M3.0*10.0 BLACK	EA	4	
2-T53-105	MACHINE SCREW	FH(+) M2.6*6.0 NI/PL	EA	6	

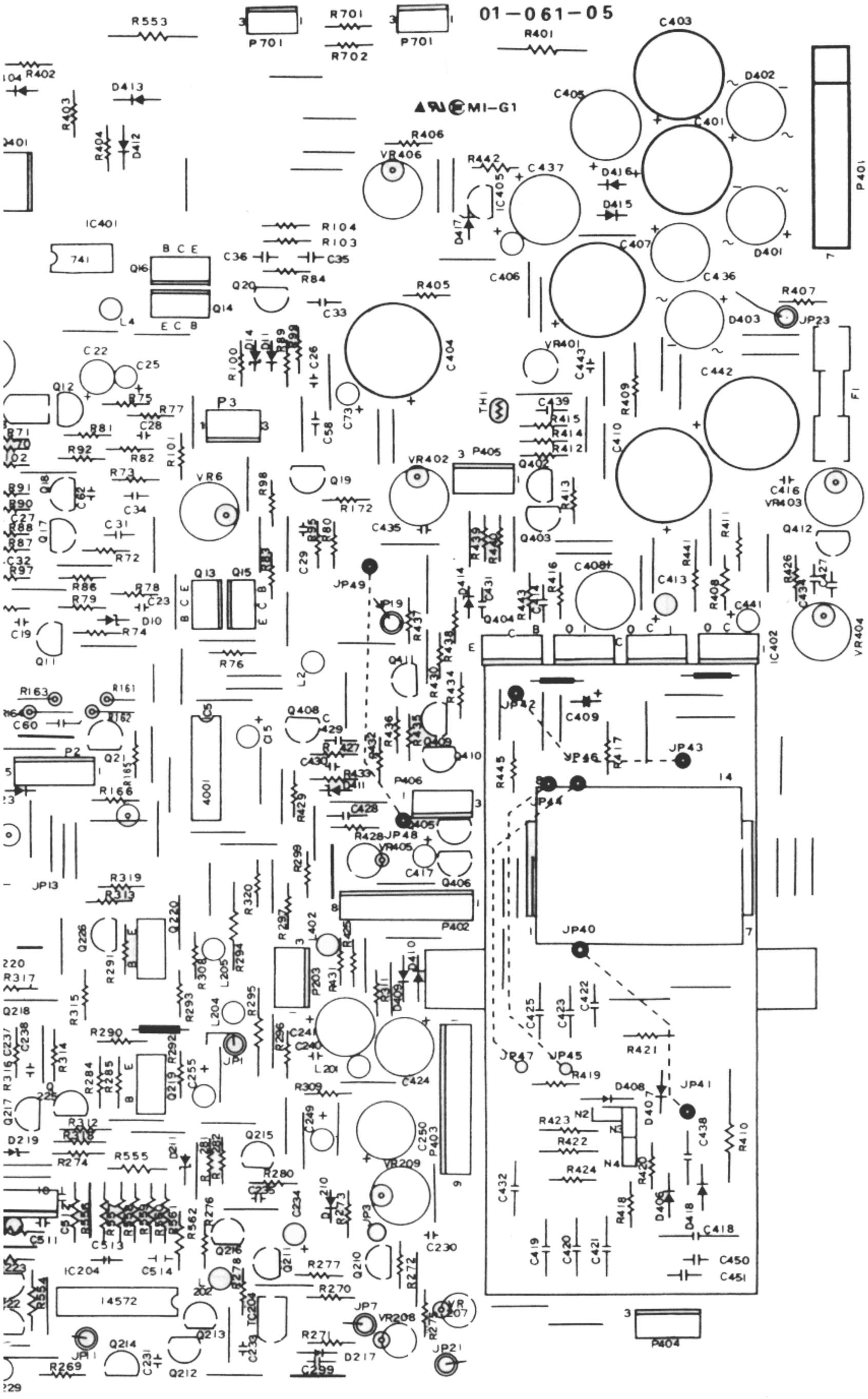
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-T48-093	MACHINE SCREW	OH(+) M3.0*6.0 BLACK	EA	4	
2-T01-021	GROUND TERMINAL	5500 (BSBM NI/PL C310303)	EA	1	
2-T20-290	INPUT TERMINAL	HZ-04-M147 (DARK GRAY)	EA	1	
2-T42-090	LUG TERMINAL	6PI SN/PL	EA	1	
2-T11-018	TOOTHED LOCK WASHER	6PI ZN/PL (INSIDE)	EA	1	
2-B10-218	PEAR PANEL ASS'Y	3502C (HC)	KIT	1	
2-C28-106	CERAMIC CAPACITOR	1000PF 400V K	EA	2	
2-T01-020	BNC CONNECTOR	UG-625/U	EA	1	
2-C42-020	FUSE	0.5A 250V M TYPE UL APPROVED	EA	1	
2-C40-058	AC INLET	BACI-01	EA	1	
2-C38-104	POWER TRANSFORMER	PT-3502C	EA	1	
2-T58-009	HEAT SINK TUBE	4.5PI 20MM	EA	6	
2-C26-044	CONNECTOR LEAD WIRE	350205	EA	1	
2-T26-070	CONNECTOR LEAD WIRE	50832	EA	4	
2-C26-067	LEAD WIRE	350228	EA	1	
2-C21-271	LEAD WIRE	80MM BLACK (AWG22 UL1015 STR-5MM*2)	EA	1	
2-T11-026	HEXAGON NUT	M3 NI/PL	EA	2	
2-T11-027	HEXAGON NUT	M4 NI/PL	EA	4	
2-T22-052	REAR PANEL	3502(HC)	EA	1	
2-T01-005	POWER CORD REST	OS620 ACETAL BLOCK (C810040-1A)	EA	4	
2-T10-017	MACHINE SCREW	BH(+) M3.0*12.0 NI/PL	EA	1	
2-T10-021	MACHINE SCREW	BH(+) M4.0*12.0 NI/PL	EA	4	
2-T53-106	MACHINE SCREW	FH(+) M3.0*8.0 NI/PL	EA	2	
2-T10-121	MACHINE SCREW	PH(+) M3.0*20.0 NI/PL	EA	4	
2-T11-007	PLAIN WASHER	4PI NI/PL	EA	4	
2-T11-009	SPRING WASHER	3PI NI/PL	EA	1	
2-T11-010	SPRING WASHER	4PI NI/PL	EA	8	
2-T11-017	TOOTHED LOCK WASHER	3PI NI/PL (OUT SIDE)	EA	2	
2-Z10-036	LINE ASS'Y	3502 (HC)	KIT	1	
2-C26-078	GROUND WIRE	350231	EA	3	
2-T21-050	CRT BEZEL	PM3208(NYLAN 6 BLACK)	EA	1	
2-T60-096	MAIN PCB BRACKET	3502 (HC) (SECC T1.5 C310235)	EA	1	
2-T22-061	SHIELD CASE(2)	3502 (HC) (SPC T1.0 ZNW/PL C310224)	EA	1	
2-T22-006	RUBBER CUSHION(2)	3T*65*20(RUBBER,BLACK)	EA	2	

CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-T22-016	FILTER	5502(HC) (ACRYL T1.5 SKY BLUE)	EA	1	
2-T22-053	FRAME (2)	3502 (HC) (SPC T1.2 ZN/PL C310219)	EA	1	
2-T22-054	FRAME (3)	3502 (HC) (SPC T1.2 ZN/PL C310220)	EA	1	
2-T22-055	FRAME (4)	3502 (HC) (SPC T1.2 ZN/PL C310221)	EA	1	
2-T21-029	FRAME(1)	HC5502(SPC T1.2 ZN/PL)	EA	2	
2-T21-025	CRT HOLDER(1)	HC5502(SPG T1.6)	EA	1	
2-T21-026	CRT HOLDER(2)	HC5502(SPG T1.6)	EA	1	
2-T21-140	KNOB(15)	3502 (HC) (ABS DARK GRAY C310082)	EA	7	
2-T21-064	KNOB(7)	3502 (HC) (ABS DARK GRAY)	EA	4	
2-T21-075	KNOB(8)	5502(PROTEK) (HANNAM ABS 750,DARK GREY)	EA	1	
2-T01-029	SELECTOR KNOB(S)	3502 (HC) (ABS DARK GRAY)	EA	3	
2-T01-027	VOLUME KNOB(L)	3502(HANNAM ABS750.GRAY)	EA	6	
2-T01-028	VOLUME KNOB(S)	3502(HANNAM ABS750.GRAY)	EA	3	
2-T22-040	CRT GROUND PANEL	5504(PH) (BSP T3.0)	EA	1	
2-T07-023	BLIND RIVET	3.2 (PI)	EA	1	
2-T25-044	SNAP RIVET	DASR 5070	EA	2	
2-T48-027	MACHINE SCREW	BH(+) M3.0*20.0 NI/PL	EA	2	
2-T48-016	MACHINE SCREW	FH(+) M3.0*6.0 NI/PL	EA	10	
2-T10-021	MACHINE SCREW	PH(+) M4.0*10.0 NI/PL	EA	2	
2-T25-038	SET SCREW	3*3(BLACK)	EA	6	
2-T25-039	SET SCREW	3*4(BLACK)	EA	9	
2-T10-031	TAPPING SCREW	BH(+) PI 3.0*6.0 ZN/PL,2PART H.T	EA	7	
2-T10-049	TAPPING SCREW	FH(+) PI 3.0*8.0 ZN/PL,2PART H.T	EA	7	
2-T54-191	WASHER WITH MACHINE	PH(+) M3.0*6.0 BLACK	EA	12	
2-T23-164	INSULATION SHEET	3502 (HC) (PE T0.3 C310261)	EA	1	
2-T23-282	INSULATION SHEET(C)	3502C (PE T0.3 C310322)	EA	1	
2-T22-058	SHIELD PLATE(3)	3502 (HC) (C2600P-1/2H T0.5 C310227)	EA	1	
2-T07-228	CONTACT SPRING	3502 (C5210S T0.5 C310299)	EA	1	
2-T02-031	CABLE TIE	100MM (SMALL AN-1)	EA	7	
2-T11-009	SPRING WASHER	3PI NI/PL	EA	3	
2-T11-017	TOOTHED LOCK WASHER	3PI NI/PL (OUT SIDE)	EA	11	
2-Z50-181	PACKING ASS'Y	3502C (HC)	KIT	1	
2-T05-073	TEST PROBE	OP-20	EA	2	
2-T22-323	NAME PROBE	3502C (HC: 3502C, OSN3502C-001)	EA	1	

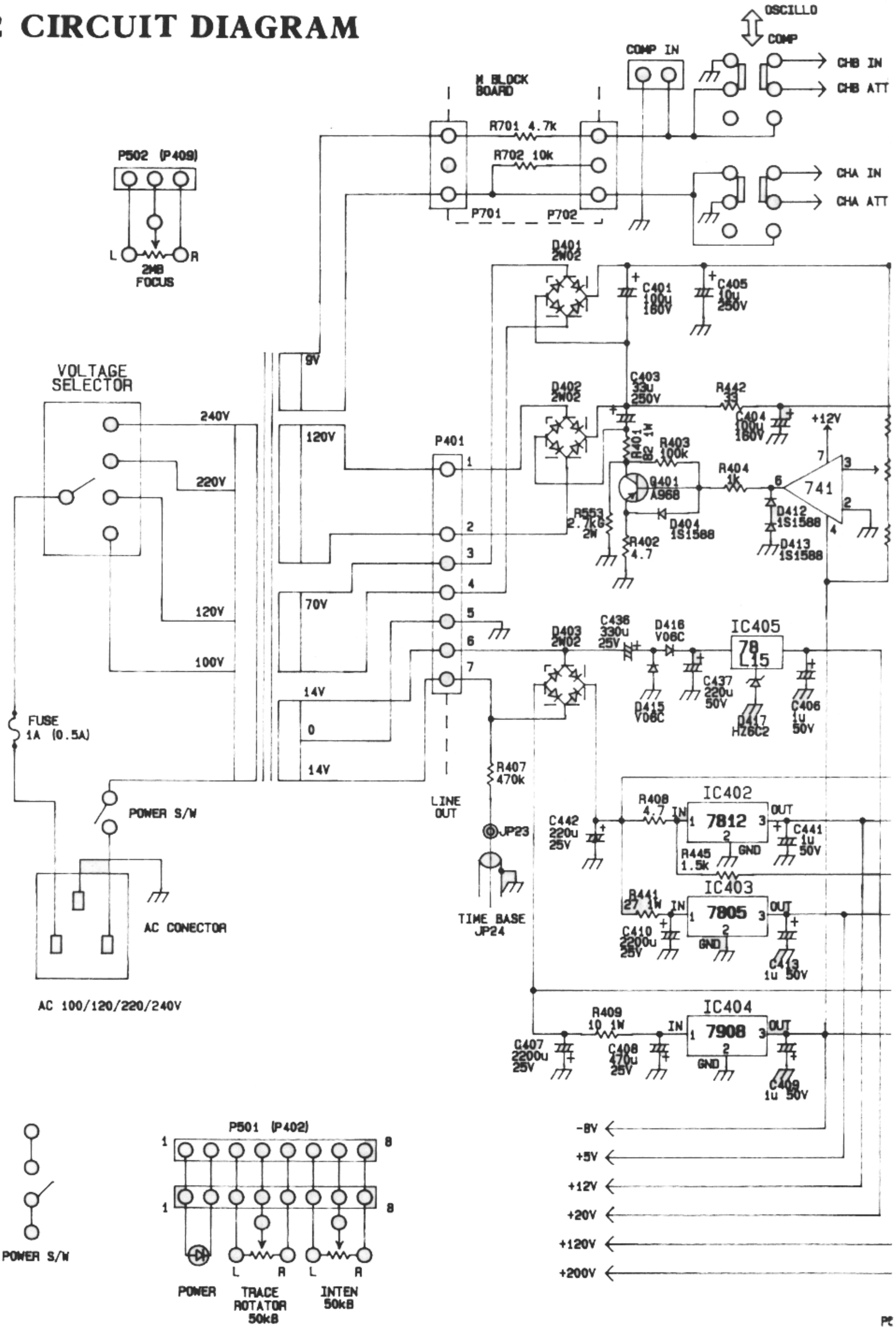
CODE-NO	PARTS NAME	SPEC (DESCRIPTION)	UNIT	Q'TY	REF-NO
2-T14-084	INNER BOX	DW-1 530*408*212 (5502,04)	EA	1	
2-T14-055	OUT BOX	DW-1 546*423*233 (5502,04)	EA	1	
2-T14-053	SNOW BOX	5502,04 (FRONT&REAR)	EA	1	
2-T25-163	BOX HOLDER	DASH-100	EA	2	
2-T25-179	MANUAL	3502C (HC) (ENGLISH)	EA	1	
2-T14-015	POLY BAG	0.1*13*35	EA	1	
2-T14-008	POLY BAG	14*22	EA	1	
2-T14-010	POLY BAG	48*32*47	EA	1	
2-T14-014	POLY BAG	5.5*8 (ZIPPER)	EA	1	
2-T52-003	SILICA GEL	5/G	EA	4	

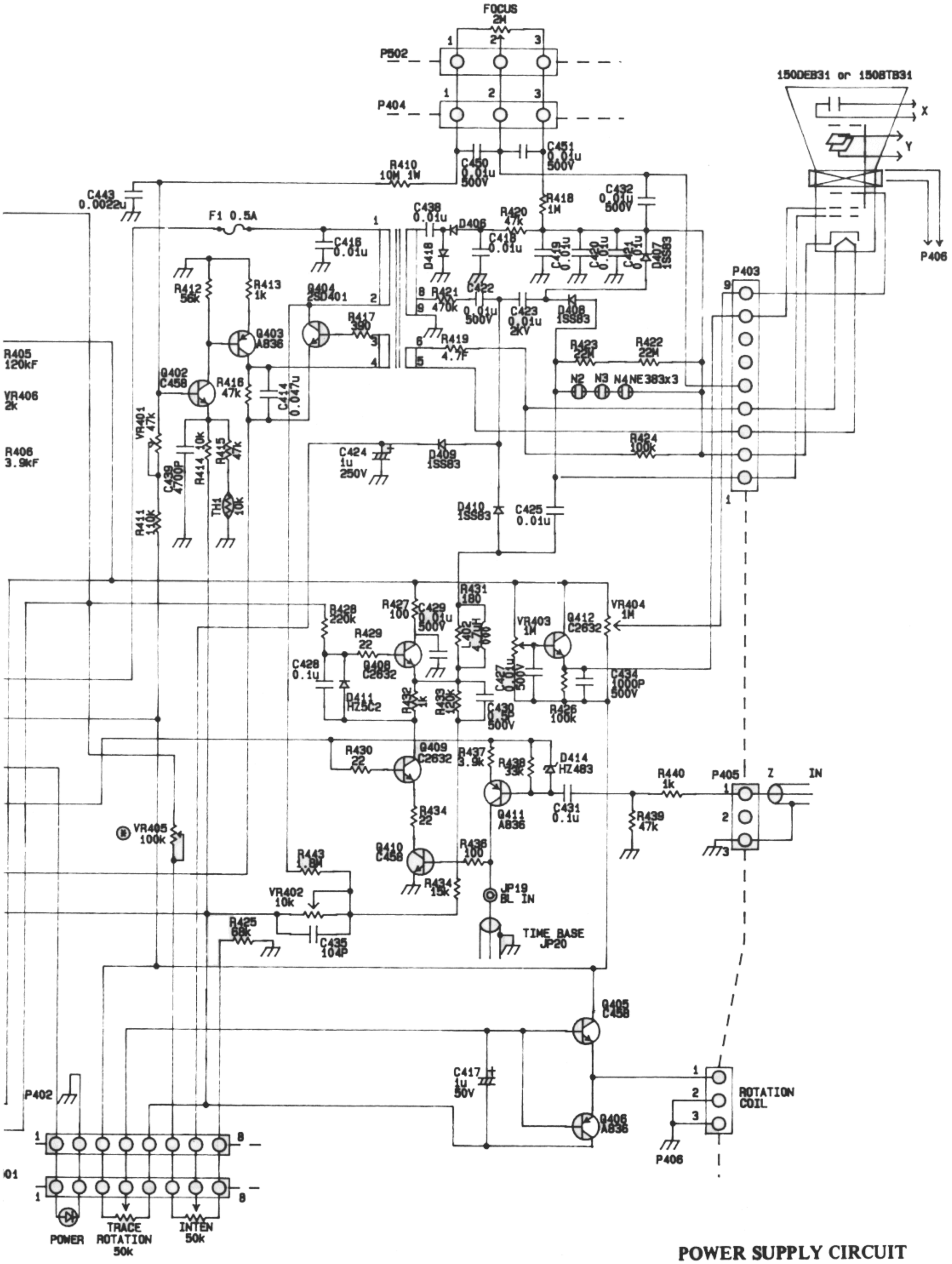
7-1 PCB LAYOUT



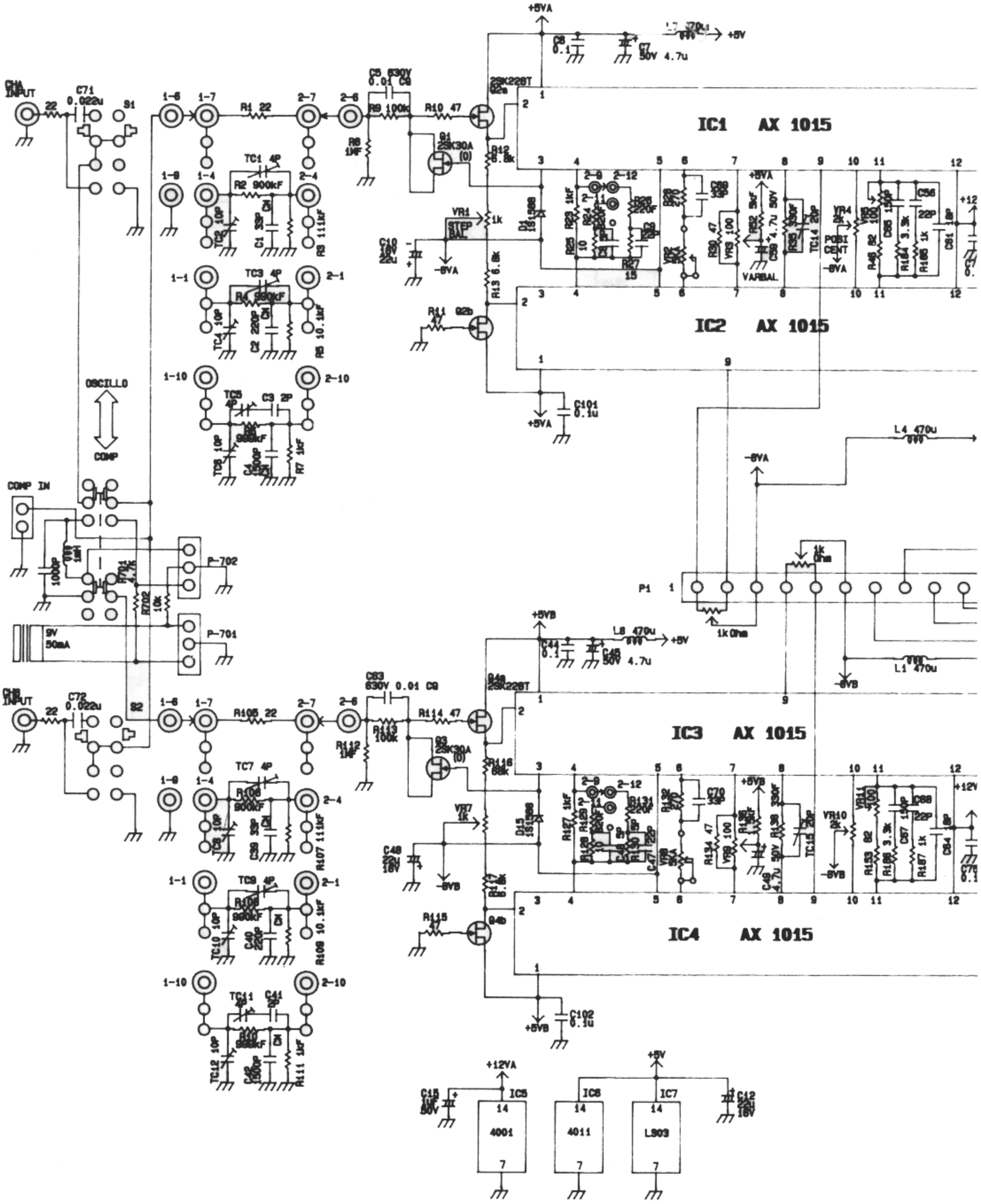

01-061-05
MI-G1
R553
P701
R701
R702
P701
R401
C403
D402
C405
C401
P401
R402
D413
R403
R404
D412
R406
VR406
R442
C437
IC405
D416
D415
D417
D401
IC401
741
R104
R103
C36
C35
R84
B C E
Q16
Q20
Q14
E C B
L4
C33
R405
C404
C406
C407
C436
R407
D403
JP23
VR401
C443
C442
C22
C25
Q12
R75
R77
C28
P3
R100
C26
C58
C73
THI
C439
R415
R414
R412
R409
C410
F1
R71
R70
Q02
R92
R82
R81
R101
VR6
R98
Q19
R172
VR402
P405
Q402
R413
C435
C416
VR403
Q412
R73
C34
C31
R72
R91
R90
C27
R88
R87
C32
R97
Q17
Q18
C62
R95
R80
C29
R439
R440
Q403
R411
R441
R426
C427
C431
R86
R78
C23
R79
D10
C19
Q11
R74
R76
Q13
Q15
B C E
E C B
JP49
Q404
R414
R443
C411
R416
C408
C413
R408
C441
IC402
VR404
R163
R161
R162
C60
P2
Q21
R165
R166
4001
C5
Q5
Q408
C429
C430
R427
R432
R436
R435
Q409
C410
R433
R429
C428
P406
P405
JP48
VR405
C417
Q406
P402
R299
R319
R313
JP13
R320
R297
L402
R425
D410
Q220
Q226
R291
R308
L205
R294
R293
L204
R295
P203
R431
R311
D409
R317
R315
R290
R292
R284
R285
Q219
C255
L201
C424
R309
C249
C250
P403
C409
JP42
JP46
JP43
R417
R445
14
JP44
JP40
7
R421
JP47
JP45
R419
D408
JP41
D407
R423
N2
N3
R422
N4
R424
R420
C438
R410
C432
R418
D406
D418
C418
C419
C420
C421
C450
C451
Q218
R316
C237
C238
R314
Q217
D219
R274
R555
D211
R280
C234
D210
R273
JP3
VR209
C230
C511
C513
C514
IC204
R562
R276
Q216
Q211
R277
Q210
R272
R270
JP7
VR208
VR207
14572
Q214
Q213
Q212
R269
C231
D217
JP21
P404
9
3

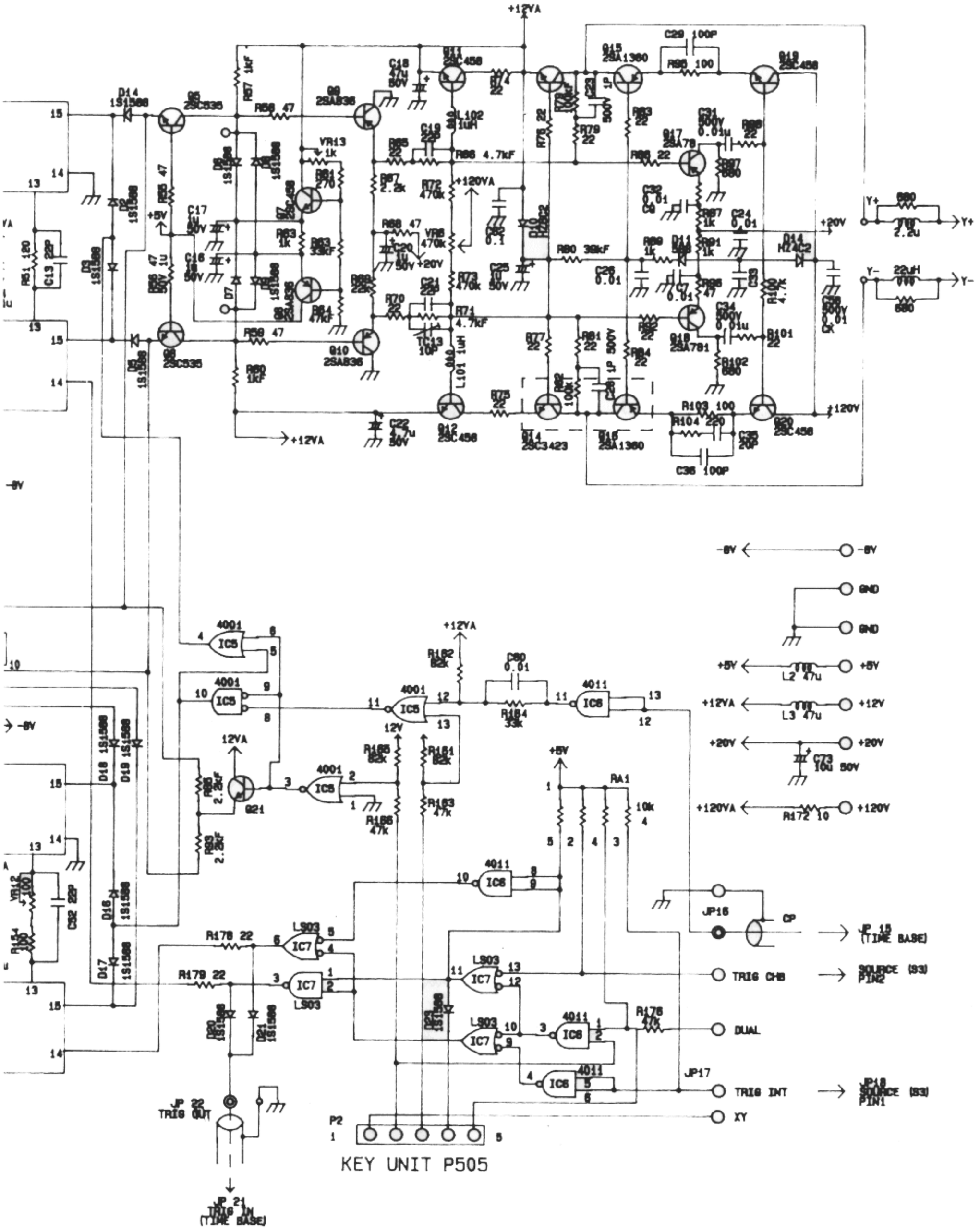
7-2 CIRCUIT DIAGRAM



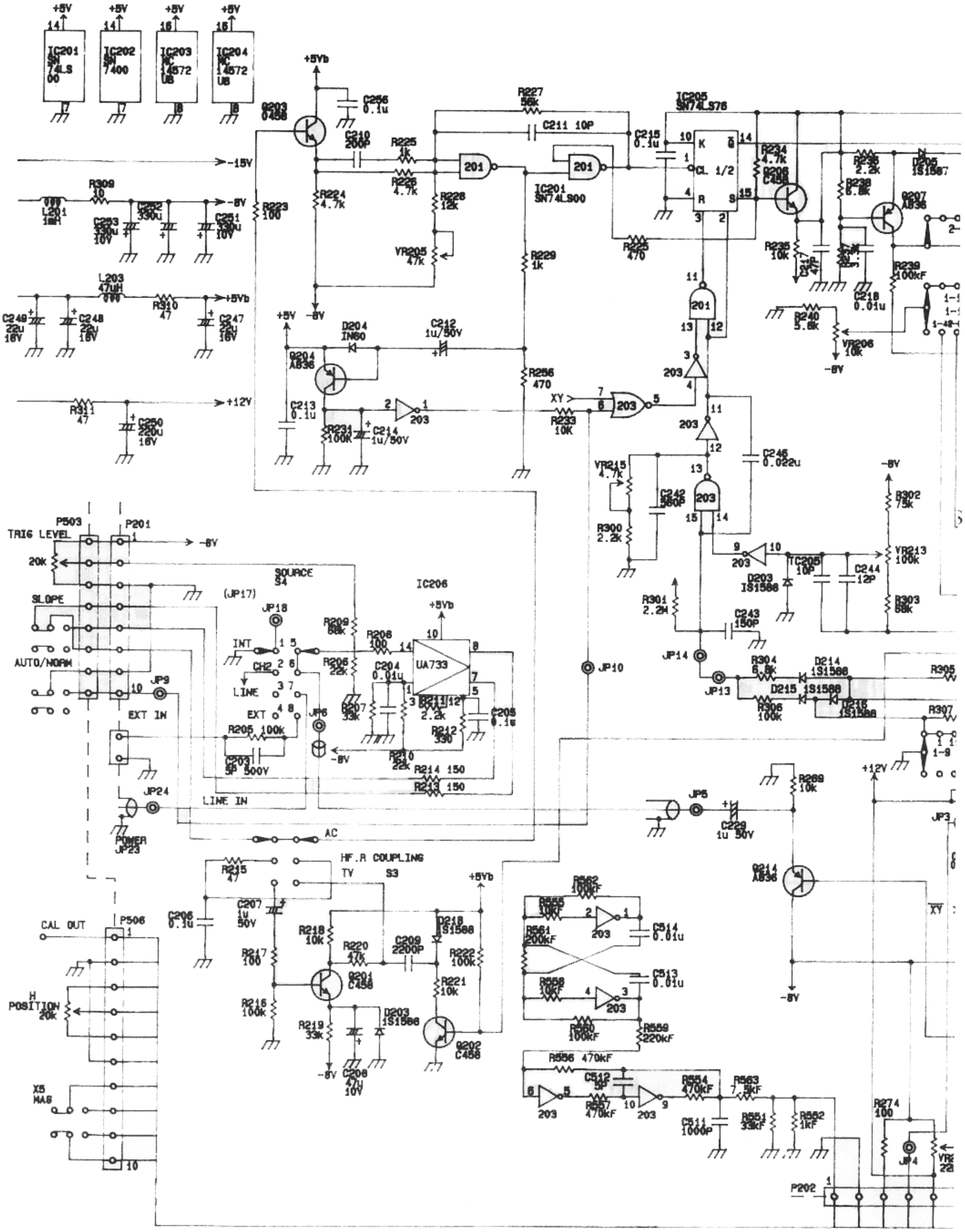


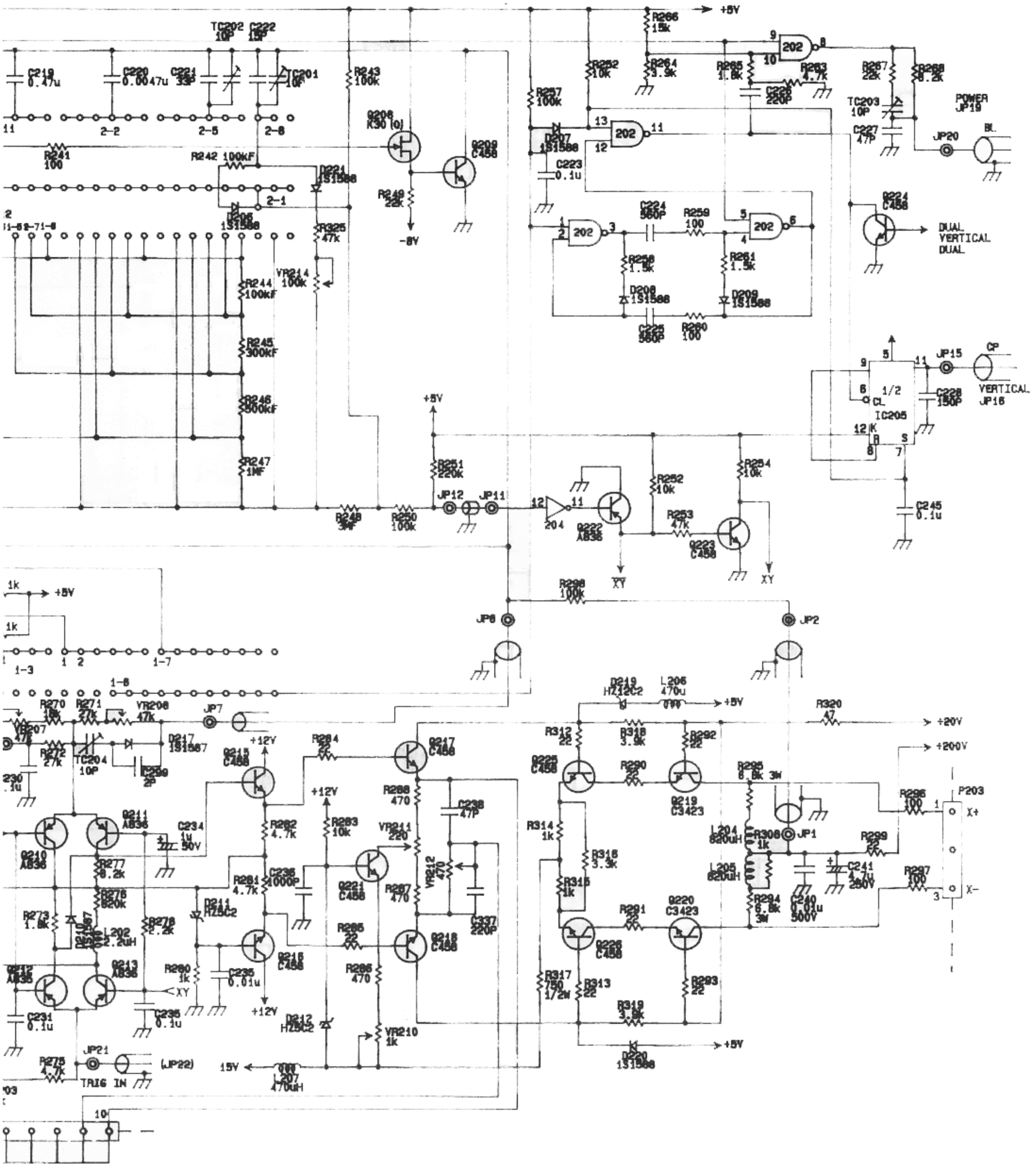
POWER SUPPLY CIRCUIT


IC1 AX 1015
IC2 AX 1015
IC3 AX 1015
IC4 AX 1015
OSCILLO
COMP
COMP IN
9V 50mA
P-702
P-701
P1
+5VA
+5VB
-8VA
-8VB
+5V
+12V
+12VA
4001
4011
LS03
VARBAL
1k Ohm

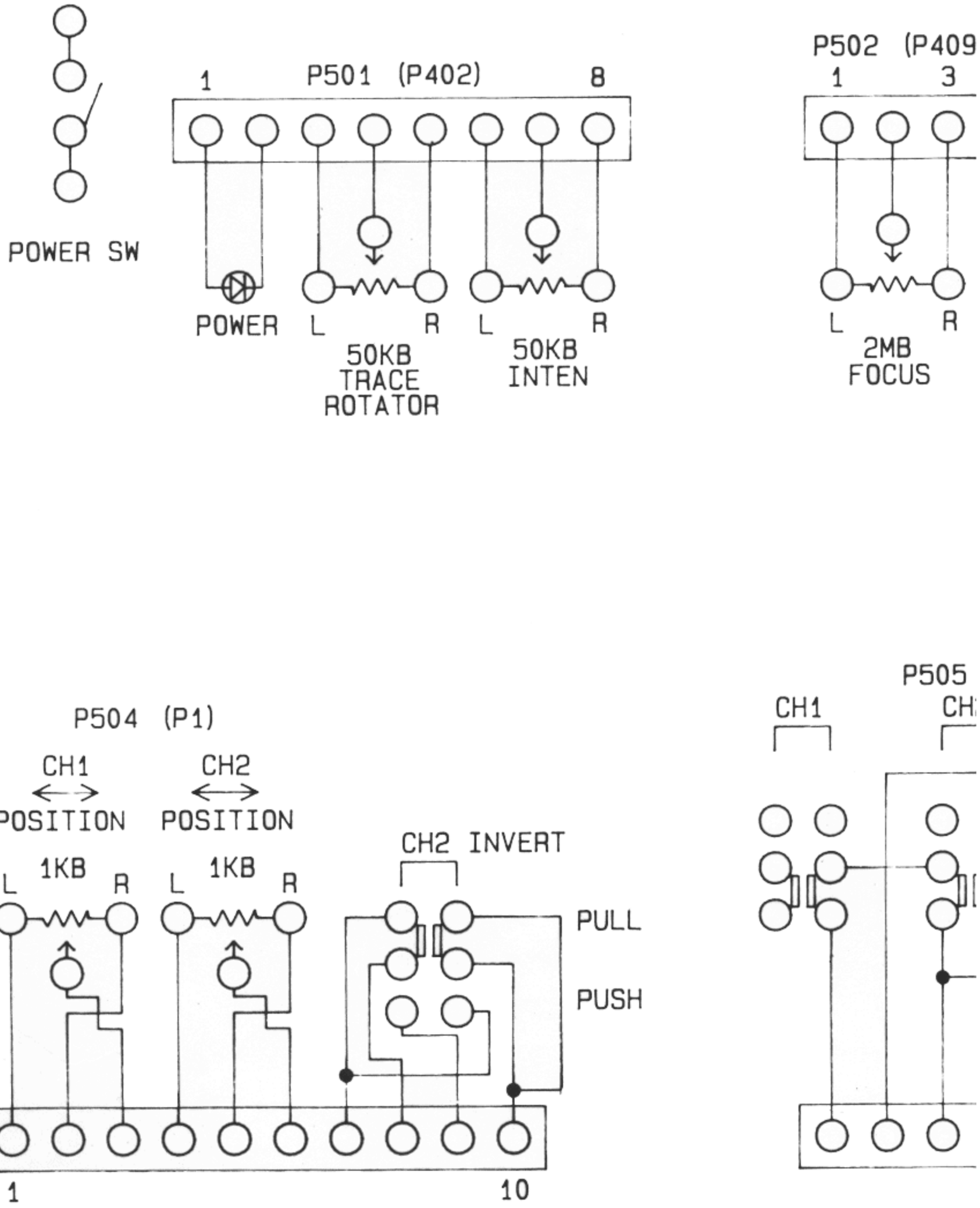


VERTICAL AMP CIRCUIT


IC201 SN 74LS 00
IC202 SN 7400
IC203 MC 14572 UB
IC204 MC 14572 UB
+5V
+5Vb
-15V
-8V
+12V
Q203 C458
C256 0.1u
C210 200P
R225 1k
R226 4.7k
R224 4.7k
R223 100
R227 56k
C211 10P
R228 12k
VR205 47k
R229 1k
IC201 SN74LS00
IC205 SN74LS76
C215 0.1u
R234 4.7k
R235 10k
R236 2.2k
R238 6.8k
Q207 A836
D205 1S1588
C217 47P
C218 0.01u
R239 100kF
R240 5.6k
VR206 10k
R225 470
L201 1mH
R309 10
C252 330u
C253 330u 10V
C251 330u 10V
L203 47uH
R310 47
C249 22u 16V
C248 22u 16V
C247 22u 16V
R311 47
C250 220u 16V
D204 IN60
C212 1u/50V
Q204 A836
C213 0.1u
R231 100K
C214 1u/50V
R256 470
XY
R233 10K
C245 0.022u
VR215 4.7k
R300 2.2k
C242 560P
R302 75k
VR213 100k
R303 68k
TC205 10P
C244 12P
D203 1S1588
R301 2.2M
C243 150P
JP14
JP13
JP10
R304 6.8k
D214 1S1588
D215 1S1588
D216 1S1588
R306 100k
R305
R307
1-9
R269 10k
JP5
C229 1u 50V
Q214 A836
JP3
P503
P201
TRIG LEVEL
20k
SLOPE
AUTO/NORM
JP9
EXT IN
JP24
LINE IN
POWER JP23
SOURCE S4
(JP17)
JP18
INT
CH2
LINE
EXT
JP6
R205 100k
C203 5P 500V
IC206
UA733
R209 68k
R206 100
R208 22k
C204 0.01u
R207 33k
R211 2.2k
R212 330
C205 0.1u
R210 22k
R214 150
R213 150
AC
HF.R COUPLING
TV S3
R215 47
C207 1u 50V
C206 0.1u
R218 10k
R220 47k
C209 2200P
R222 100k
R217 100
R216 100k
R201 C458
R219 33k
D218 1S1588
R221 10k
D203 1S1588
Q202 C458
C208 47U 10V
CAL OUT
P506
H POSITION 20k
X5 MAG
10
R562 100kF
R555 10kF
R561 200kF
R558 10kF
R560 100kF
R559 220kF
C514 0.01u
C513 0.01u
R556 470kF
C512 5P
R554 470kF
R563 7.5kF
R557 470kF
C511 1000P
R551 33kF
R552 1kF
R274 100
JP4
P202
203



HORIZONTAL CIRCUIT


POWER SW
1
P501 (P402)
8
POWER
L
R
L
R
50KB
TRACE
50KB
INTEN
P502 (P409
1
3
L
R
2MB
FOCUS
ROTATOR
P504 (P1)
CH1
POSITION
CH2
POSITION
1KB
L
R
1KB
L
R
CH2 INVERT
PULL
PUSH
1
10
P505
CH1
CH

(P409)

3

)

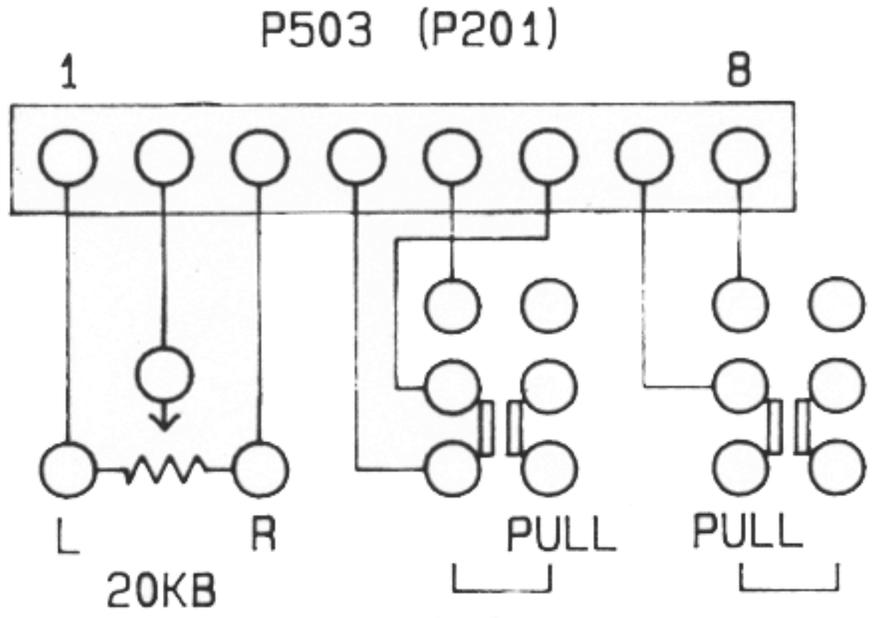
)

R

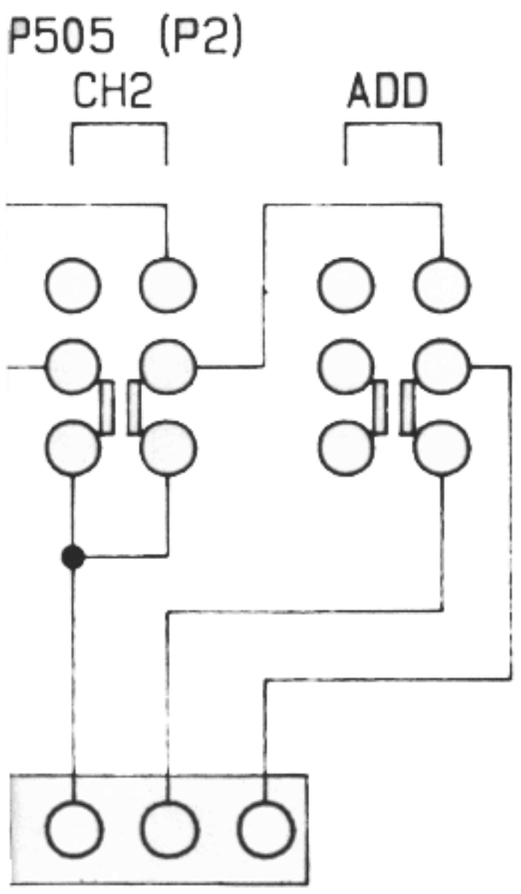
3

US

P503 (P201)



P505 (P2)



P506 (P202)