

20 MHz DUAL TRACE OSCILLOSCOPE
MODEL 5502

OPERATORS
INSTRUCTION MANUAL



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TABLE OF CONTENTS

SECTION 1 GENERAL INFORMATION

1-1	FEATURES	Page 4
1-2	SAFETY CONSIDERATIONS	4
1-3	INSTALLATION	5
1-4	STORAGE AND SHIPMENT	7
1-5	SPECIFICATIONS	7

SECTION 2 CIRCUIT DESCRIPTION

2-1	OVERALL BLOCK DIAGRAM	9
2-2	VERTICAL DEFLECTION UNIT	10
2-2-1	Attenuator Circuit	10
2-2-2	Preamplifier Circuit	10
2-2-3	Trigger Amplifier Circuit	10
2-2-4	Vertical Switching Circuit	10
2-2-5	Vertical Output Amplifier Circuit	10
2-3	HORIZONTAL DEFLECTION UNIT	11
2-3-1	Trigger Generator Circuit	11
2-3-2	Sweep Generator Circuit	11
2-3-3	Horizontal Switching Circuit	11
2-3-4	Horizontal Output Amplifier Circuit	11
2-4	POWER SUPPLY UNIT	11

SECTION 3 OPERATION

3-1	INITIAL SETUP	12
3-1-1	Operators Check	12
3-1-2	Trace Rotation Adjustment	12
3-1-3	Probe Adjustment	12
3-2	CONTROLS, CONNECTORS AND INDICATORS	13
3-2-1	Front Panel	13
3-2-2	Rear Panel	15
3-3	TRIGGERING	15
3-4	X-Y OPERATION	16
3-5	CALIBRATED VOLTAGE MEASUREMENTS	16
3-6	DUAL TRACE WAVEFORM OBSERVATION	16
3-7	TV SIGNAL SYNCHRONIZATION	16
3-8	ADD & SUB MEASUREMENTS	16
3-9	APPLICATIONS	16
3-9-1	AC Voltage and Frequency Measurement	17
3-9-2	DC Voltage Measurement	17
3-9-3	AM Modulation Measurement	18
3-9-4	Dual-Trace Applications	18
3-9-5	Level Comparison	18
3-9-6	Repairing Stereo Systems	18
3-9-7	TV Servicing	18
3-9-8	Composite Video Analysis	18
3-9-9	Measurement of Frequency by X-Y	18
3-9-10	Phase Measurement	19
3-9-11	Photograph	19
3-9-12	Component Test	18

SECTION 4 ADJUSTMENT AND CALIBRATION

4-1	MAINTENANCE	20
4-2	TEST EQUIPMENTS REQUIRED	20
4-3	BASIC ADJUSTMENTS	20
4-3-1	Power Source	20
4-3-2	High Voltage Check	20
4-4	CRT ADJUSTMENTS	21
4-4-1	Intensity	21
4-4-2	Focus	21
4-4-3	Spot	21
4-5	VERTICAL ADJUSTMENTS	21
4-5-1	Step Balance Adjustment	21
4-5-2	Mag (X5) Balance Adjustment	21
4-5-3	Variable Balance Adjustment	22
4-5-4	Gain Adjustment	22
4-5-5	Mag (X5) Gain Adjustments	22
4-5-6	ADD Balance Adjustments	22
4-5-7	Band Balance Adjustments	22
4-5-8	1KHz Square Wave Adjustments	22
4-5-9	Input Capacity Adjustments	23
4-5-10	Trig DC Balance Adjustments	23
4-5-11	CH1 DC Balance Adjustment	23
4-5-12	X Gain Adjustment	23
4-6	HORIZONTAL TIME ADJUSTMENTS	24
4-6-1	X Cent Adjustment	24
4-6-2	Time 1mS/1 μ S Adjustment	24
4-6-3	Mag Cent Adjustment	24

SECTION 5 PARTS LIST

5-1	MECHANICAL PARTS	25
5-2	VERTICAL PCB ASS'Y	36
5-3	HORIZONTAL PCB ASS'Y	37
5-4	CAL & CONTROL PCB ASS'Y	38
5-5	MODE PCB ASS'Y	38
5-6	CRT PCB ASS'Y	38

SECTION 6 COMPONENTS LAY-OUT

SECTION 7 CIRCUIT DIAGRAM

SECTION 1. GENERAL INFORMATION

1-1. FEATURES

- 1) DUAL TRACE 20MHz OSCILLOSCOPE WITH HIGH BRIGHTNESS CRT
- 2) CHANNEL 1 SIGNAL OUTPUT for USE WITH A FREQUENCY COUNTER
- 3) COMPONENT TESTING SPECIAL CIRCUIT
- 4) CH2 POLARITY INVERSION SWITCH
- 5) VERTICAL DEFLECTION MAGNIFICATION, X5
- 6) SWITCHABLE CHOPPING FREQUENCY
- 7) SCALE ILLUMINATING SYSTEM
- 8) VARIABLE HOLD-OFF for OBSERVATION of WAVEFORMS with COMPLEX PERIODS
- 9) SINGLE SWEEP MODE for ONE TIME OR OTHER SUDDENLY OCCURRING EVENTS
- 10) SWEEP MAGNIFICATION, X10
- 11) SIGNAL DELAY LINE FOR ACCURATE VIEW of HIGH FREQUENCY PULSE LEADING EDGE
- 12) TRIGGER PRESET FUNCTION

1-2. SAFETY CONSIDERATIONS

This instrument and related documentation must be reviewed for familiarization with safety markings and instructions before operation. Before applying power, verify that the product is set to match the available line voltage and the correct fuse is installed.

The safety information in this part is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply and do not appear in this summary.

Power Source

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition. An uninterruptible safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cord, or supplied power cord set.

Use the Proper Fuse

To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your product.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

WARNING

The WARNING signal denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

1-3. INSTALLATION

OPERATING ENVIRONMENT

- TEMPERATURE. This instrument may be operated in temperatures from 0°C to 50°C.
- HUMIDITY. This instrument may be operated in environments with humidity up to 90% RH at 35°C. However, it should be protected from temperature extremes which cause condensation in the instrument.
- ALTITUDE. This instrument may be operated at altitudes up to 4,600 metres (15,000 feet).

POWER REQUIREMENTS

This instrument requires a power source of 100V/117V/220V/240V $\pm 5\%$, single phase, 50 to 60Hz

LINE VOLTAGE SELECTION

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINAL OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL BE INSERTED ONLY IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE GROUNDING CONDUCTOR.

CAUTION

This instrument may be damaged if operated with the LINE VOLTAGE SELECTOR switch set for the wrong applied ac input-source voltage or if the wrong line fuse is installed.

Before connecting the power cord to a power-input source, verify that the LINE VOLTAGE SELECTOR switch, located on the rear panel, is set for the correct nominal ac input-source voltage. To convert the instrument for operation from one line-voltage range to the other, move the LINE VOLTAGE SELECTOR switch to the correct nominal ac source-voltage setting. The detachable power cord may have to be changed to match the particular power-source output.

LINE FUSE

To verify that the instrument power-input fuse is of proper value for the nominal ac source voltage selected, perform the following procedure:

- Press in the fuse-holder cap and release it with a slight counterclockwise rotation
- Pull the cap (with the attached fuse inside) out of the fuse holder
- Verify proper fuse value
- Install the proper fuse and reinstate the fuse-holder cap.

NOTE The two types of fuses listed are not directly interchangeable; they require different types of fuse caps.

POWER CORD

This instrument has a detachable, three-wire power cord with a three-contact plug for connection to both the power source and protective ground. The power cord is secured to the rear panel by a cord-securing clamp. The protective-ground contact on the plug connects (through the power-cord protective grounding conductor) to the accessible metal parts of the instrument. For electrical-shock protection, insert this plug into a power-source outlet that has a properly grounded protective-ground contact.

INSTRUMENT COOLING

To prevent instrument damage from overheated components, adequate internal airflow must be maintained at all times. Before turning on the power, first verify that both the air-intake holes on the bottom of the cabinet and the fan-exhaust holes in the rear panel are free of any obstruction to airflow.

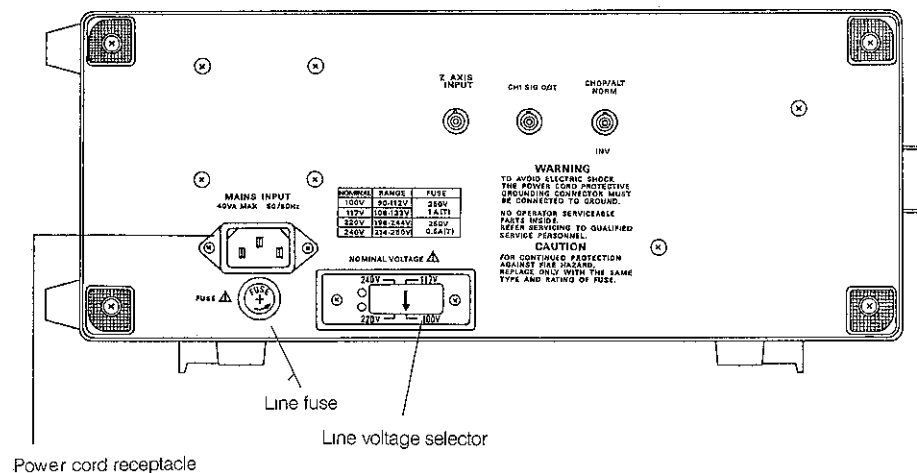


Fig. 1 LINE VOLTAGE SELECTOR

1-4. STORAGE AND SHIPMENT

ENVIRONMENT

The instrument may be stored or shipped in environments within the following limits:

TEMPERATURE	-40°C to +75°C
HUMIDITY	up to 90% RH at 60°C
ALTITUDE	7,620 metres (25,000 feet)

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

PACKAGING

ORIGINAL PACKAGING

Containers and materials identical to those used in factory packaging should be maintained. If the instrument is being returned for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number

OTHER PACKAGING

The following general instructions should be used for repacking with commercially available materials

- Wrap instrument in heavy paper or plastic.
- Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.
- Use a layer of shock-absorbing material 70 to 100mm (3-to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect control panel with cardboard.
- Seal shipping container securely.
- Mark shipping container FRAGILE to ensure careful handling
- In any correspondence, refer to instrument by model number and full serial number.

1-5. SPECIFICATIONS

1) VERTICAL DEFLECTION SYSTEM CHANNEL 1 AND CHANNEL 2

Sensitivity	5mV/DIV to 5V/DIV
Accuracy	1mV/DIV to 1V/DIV, X5 Mag ±3%
Attenuator	10 steps, 5mV/DIV to 5V/DIV in 1-2-5 sequence
Bandwidth	DC: DC to 20MHz, -3dB (X5 Mag: DC to 10MHz, -3dB) AC: 5Hz to 20MHz, -3dB (X5 Mag: 5Hz to 10MHz, -3dB) Less than 17.5 nS
Rise Time	Less than 17.5 nS
Maximum Input Voltage	400V (DC+AC peak)
Input Impedance	1M ohm ±2%, Apprx 25pF
Polarity Inversion	CH2 only
Chop Frequency	Approx 250KHz
Operating Mode	CH1, CH2, ADD, DUAL
Overshoot	Less than ± 6% (6mV/div to 0.5V/div, X1)

2) HORIZONTAL DEFLECTION SYSTEM

Operating Modes	XY operation CH1-X axis, CH2-Y axis
Input Impedance	1M ohm, 25pF
Bandwidth	DC: DC to 1MHz (-3dB) AC: 5Hz to 1MHz (-3dB)
XY Phase Shift	3° or less (at 50KHz)
Maximum Input Voltage	400V (DC+AC peak)

3) TIME BASE

Sweep Modes	AUTO, NORM, SINGLE
Sweep Time	0.2uS-0.5S/DIV ±3% in 1-2-5 steps (X1 only)
Magnified Sweep	10 times ±5%, Max. 20nS
Hold Off	Continuously adjustable

4) TRIGGERING

Trigger Source	CH1, CH2, LINE, EXT
Coupling	AC, HF REJ, TV, DC
Trigger Sensitivity	INT: DC~10MHz 1.0 div ~20MHz 2.0 div EXT: DC~10MHz 150mVp-p ~20MHz 300mVp-p
Trigger Level Preset	INT :50Hz~10MHz 1.5 div ~20MHz 3.0 div EXT:50Hz~10MHz 150mVp-p ~20MHz 300mVp-p

5) VERTICAL AMPLIFIER SIGNAL OUTPUT

Output Voltage	Approx, 50mV/DIV
Output Impedance	50 ohm
Bandwidth	50Hz-20MHz (-3dB)

6) INTENSITY MODULATION Z AXIS

Bandwidth	DC -1MHz
Maximum Input Voltage	50V (DC+AC peak), MAX AC 1KHz
Sensitivity	3Vp-p

7) PROBE CALIBRATOR OUTPUT VOLTAGE

Squarewave Approx 1KHz (± 20%), 1Vp-p (± 2%)

8) CRT DISPLAY

150mm rectangular, type with an illuminated, parallax-free, inner-face graticule
2KV accelerating potential
8x10 divisions (1 division=10mm)

9) POWER REQUIREMENTS

Voltage	AC 100V/117V/220V/240V ±10%, 50/60Hz
Power	40W

10) DIMENSIONS, NET WEIGHT

356x147x435mm, 8kg

11) ACCESSORIES

X1, Ref, X10 probe 2 pcs (optional), operational manual, power lead, fuse

SECTION 2. CIRCUIT DESCRIPTION

2-1. OVERALL BLOCK DIAGRAM

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 CH1, CH2 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-1, CH-2, ADD 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 controller, FET input Miller integrator, hold-off.

The saw 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-1 input signal is led to the pick-off circuit, sweep X-Y selector, then horizontal final amplifier.

The 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 during 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.

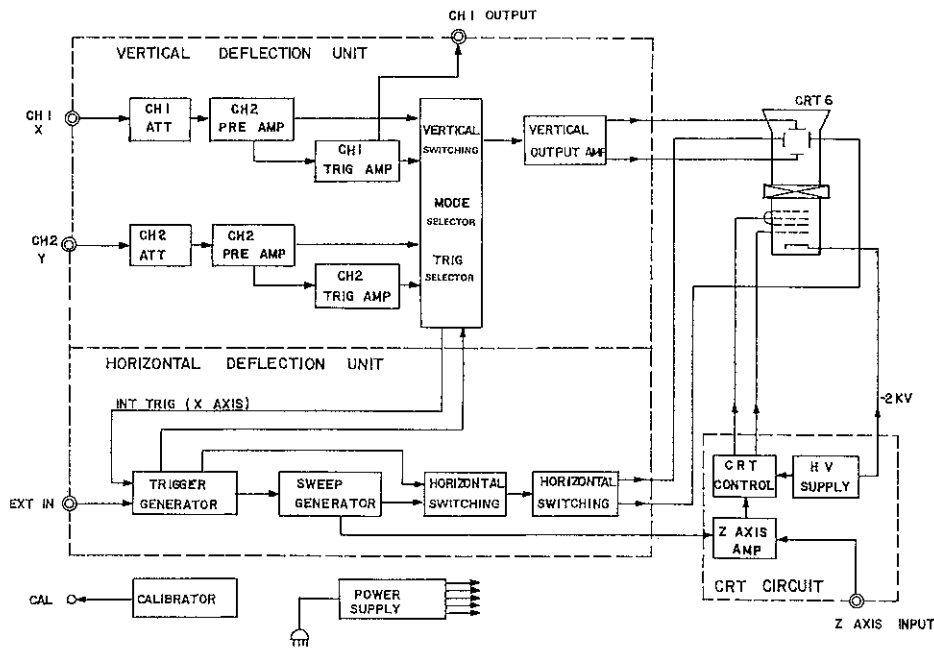


Fig. 2 OVERALL BLOCK DIAGRAM

2-2. VERTICAL DEFLECTION UNIT

Vertical deflection unit is composed of CH1 and CH2 attenuator, preamplifier, trigger amplifier, vertical switching and vertical output amplifier. Its block diagram is as follows.

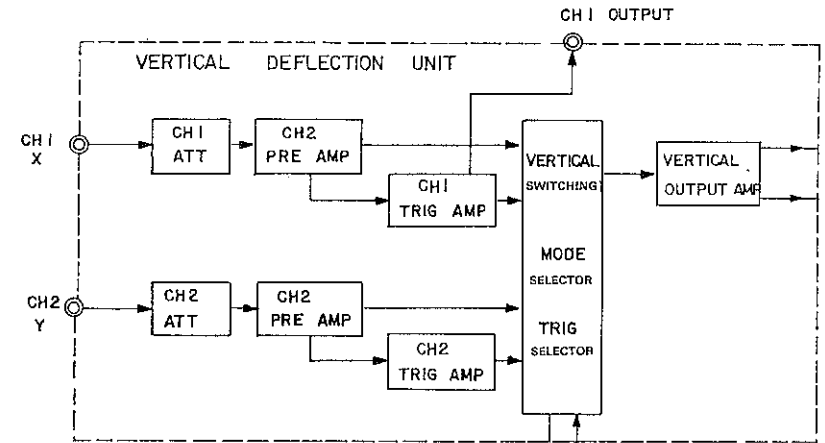


Fig. 3 VERTICAL DEFLECTION UNIT

2-2-1. ATTENUATOR CIRCUIT

CH1 and CH2 attenuators are identical in operation, with corresponding circuitry in each channel performing the same function. Input signals from BNC input terminals are attenuated through attenuator network circuit (for example).

The attenuator circuit has two sections, the first attenuates by ratios of 1:1, 10:1, 100:1 and the second by ratios of 2:1, 5:1, 10:1.

2-2-2. PREAMPLIFIER CIRCUIT

Preamplifier circuit converts the single-ended input signal from the attenuator to a differential output signal. It includes compensating circuits to get a good input signal waveform and to adjust square wave response.

2-2-3. TRIGGER AMPLIFIER CIRCUIT

Input signals amplified in preamplifier circuit are fed to the trigger amplifier circuit, as well as to the switching circuit. Trigger amplifier circuit amplifies the input signals fed from preamplifier and distributing to horizontal deflection unit and vertical switching circuit.

2-2-4. VERTICAL SWITCHING CIRCUIT

Vertical switching circuit is composed of diode-gate and mode control logic circuit to select CH-1, CH-2, DUAL and ADD. Mode control logic circuit is controlled by the output of diode-gate and conveying the selected signal to vertical output amplifier circuit.

2-2-5. VERTICAL OUTPUT AMPLIFIER CIRCUIT

The vertical signal through diode switching circuit passes the limiter circuit to obtain an adequate level, and then is fed to the output amplifier. The output obtained is sufficiently amplified by the amplifier with a constant current load. This amplifier is equipped with a booster for high frequency contents to obtain flat signal response. The signal is then fed to the vertical deflection plates of CRT.

2-3. HORIZONTAL DEFLECTION UNIT

Horizontal deflection unit is composed of trigger generator, sweep generator, horizontal switching and horizontal output amplifier. Its block diagram is as follows:

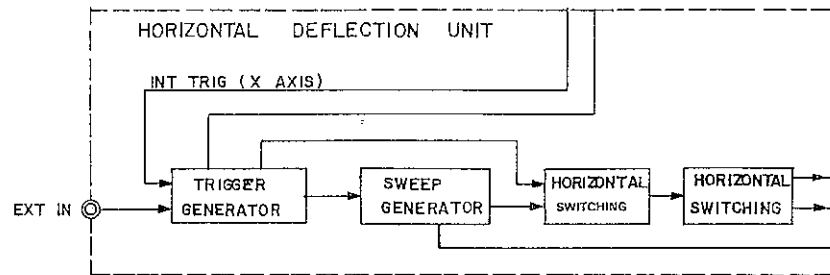


Fig. 4 HORIZONTAL DEFLECTION UNIT

2-3-1 TRIGGER GENERATOR CIRCUIT

Internal or external trigger signal is amplified and then activates the sweep generator circuit by clock pulse.

2-3-2. SWEEP GENERATOR CIRCUIT

The sweep generator circuit consists of sweep control circuit, MILLER integrator circuit, sweep length circuit and HOLD OFF circuit (see figure) and it is initiated by clock pulse.

2-3-3. HORIZONTAL SWITCHING CIRCUIT

Horizontal switching circuit is divided by trigger selector and time selection switch

Trigger selector switch selects the source and coupling according to characteristic of input signals from trigger generator

Time selection switch controls input signals from sweep generator and convey to horizontal output amplifier circuit

2-3-4. HORIZONTAL OUTPUT AMPLIFIER CIRCUIT

The horizontal output circuit amplifies signals from sweep generator circuit through differential amplifier circuit and conveys then to the CRT X-plate.

2-4. POWER SUPPLY UNIT

The power supply circuit is mainly designed using operational amplifiers and controlled by regulator circuits to supply stable power. High voltage for CRT is supplied by feed-back DC-AC converter generating the stable high voltage.

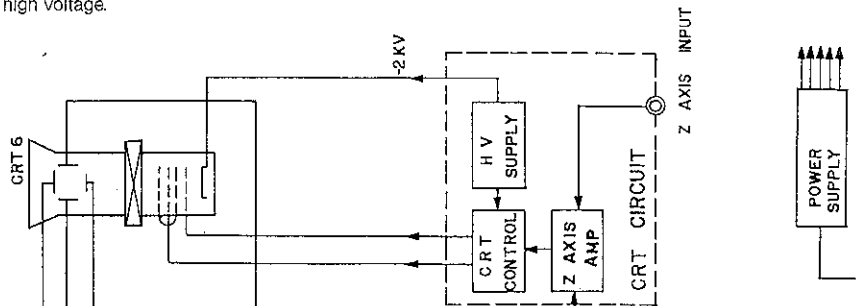


Fig. 5 POWER SUPPLY UNIT

-11-

SECTION 3. OPERATION

3-1. FIRST-TIME OPERATION

3-1-1. OPERATORS CHECK

- 1) Prior to any kind of operation of the instrument, proceed as follows to get familiarized with the instrument
 - a) Set the power switch ① to OFF
 - b) Turn all the three POSITION controls ⑦, ⑧, ⑨ to mid-position
 - c) Turn INTENSITY control ⑩ to mid-position ⑪ Turn TRIG LEVEL control ⑫ to FIX
 - e) Push SWEEP MODE switch ⑬ for AUTO
 - f) Check the AC line voltage ⑭
- 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 ① to ON. After approximately 10 seconds, trace lines appear on CRT creen. If no trace line 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 location required.

3-1-2 TRACE ROTATION ADJUSTMENT

- 1) Preset instrument controls and obtain a baseline trace as described in operators check
- 2) Use the channel 1 position control to move the base line trace to the center horizontal graticule line
- 3) If the trace is not parallel to the graticule line, use a small-bladed screwdriver to adjust the TRACE ROTATION control and align the trace with the graticule line

3-1-3. PROBE ADJUSTMENT

- 1) Misadjustment of probe compensation is one of the sources of measurement error The attenuator probes are equipped with compensation adjustment. To ensure optimum measurement accuracy, always check probe compensation before making measurements.
- 2) Preset instrument controls and obtain a base trace as described in operators check.
- 3) Connect a probe (10:1) to INPUT of CH1 and hook the tip of the probe to probe adjust 1V output Set AC-GND-DC switch to DC
- 4) Rotate CH1 Vertical attenuator VOLT/DIV switch to 0.2/DIV and turn the variable on the same axis clockwise to detent (CAL). Turn TRIG SOURCE to CH1. Then a square wave of 5 DIV is displayed on the screen.
- 5) If the square wave is distorted as Fig. 6, adjust the trimmer of the probe till it becomes a good square wave as Fig. 7

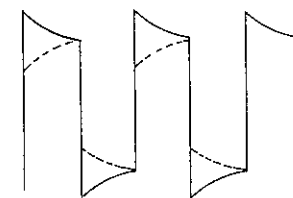


Fig. 6 DISTORED

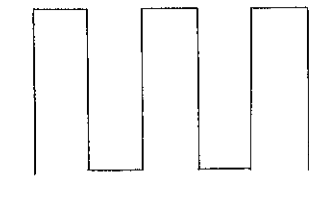


Fig. 7 GOOD

- 6) Remove the probe tip from probe adjust 1V output. Now the Oscilloscope is ready for use.

3-2. CONTROLS, CONNECTORS AND INDICATORS

3-2-1. FRONT PANEL

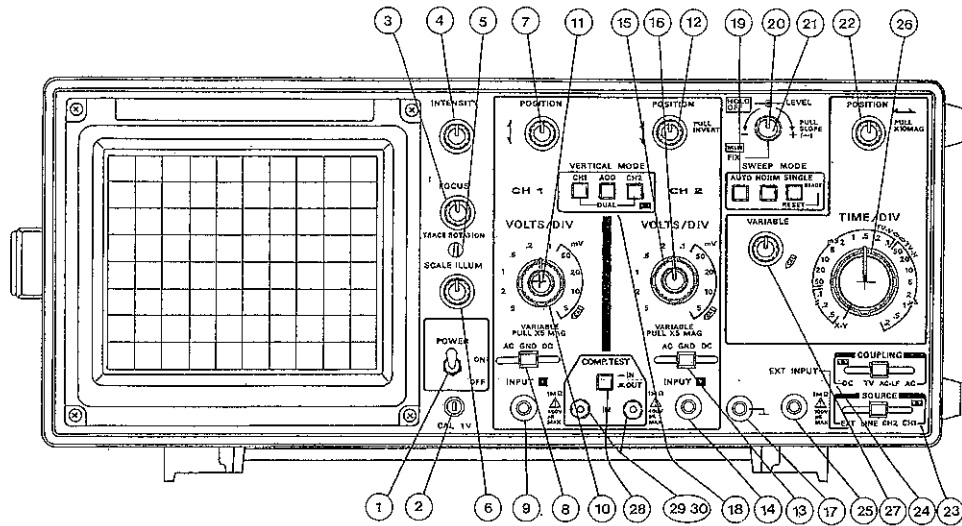
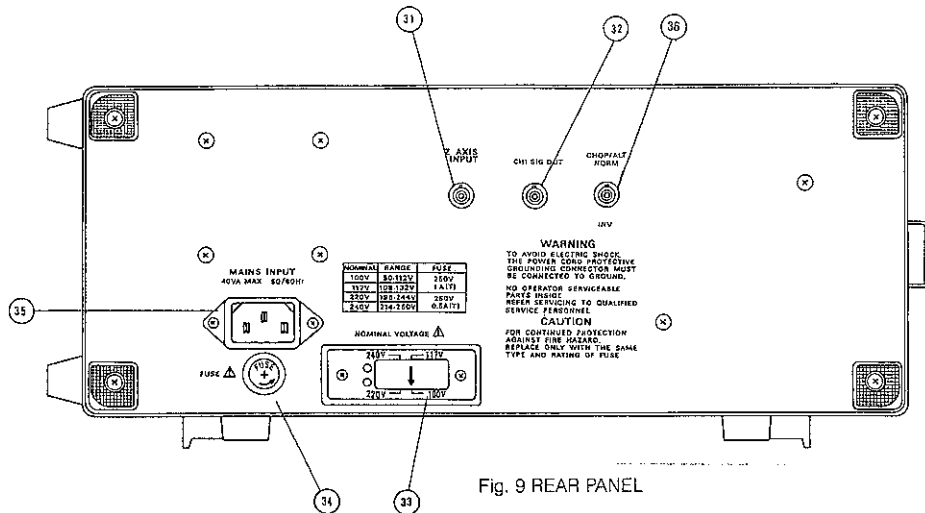


Fig. 8 FRONT PANEL

- ① POWER Switch — Turns instrument power on and off
- ② PROBE ADJUST 1Vp-p — Used for adjusting input capacitance of probe
- ③ FOCUS Control — Adjusts waveform display for optimum definition
- ④ INTENSITY Control — Adjusts brightness of the CRT trace line and point display
- ⑤ TRACE ROTATION Control — Operator-adjusted screwdriver control used to align the crt trace with the horizontal graticule lines. Once adjusted, it does not require readjustment during normal operation of the instrument unless it is moved to another location.
- ⑥ SCALE ILLUM Control — Adjusts the light level of the graticule illumination.
- ⑦ POSITION Control — Set vertical position of the channel 1 signal display
- ⑧ AC-GND-DC Input Coupling Switches—Select the method of coupling input signals to the channel 1 Vertical attenuator
AC: Input signal is capacitively coupled to the vertical attenuator and the DC component of the input signal is blocked
GND: The input of the vertical amplifier is grounded to provide a zero (ground) reference voltage display
DC: All frequency components of the input signal are coupled to the vertical attenuator
- ⑨ CH1 INPUT & X Connector — Provide for application of external signals to the inputs of channel 1 vertical attenuator, X-Y operation: Input terminal for X-axis.
- ⑩ VOLTS/DIV Switch — Select vertical deflection factor settings in a 1-2-5 sequence with 10 positions for channel 1. The VAR control must be in the detent (fully clockwise) position to obtain a calibrated deflection factor
- ⑪ VARIABLE, PULL X5 MAG — Provide continuously variable, uncalibrated deflection factors for Channel 1 between the calibrated settings of the VOLT/DIV switches and with pull-out position, the gain is magnified 5 times
- ⑫ POSITION PULL INVERT — Pulling out channel 2 position control switch, the polarity of channel 2 input signal is reversed such that positive input voltages cause downward deflection of trace.

- ⑬ AC-GND-DC Input Coupling Switches — Same function as No. 8 for channel 2
- ⑭ CH2 INPUT & Y Connector — Same function as No. ⑨ for channel 2 X-Y operation: Input terminal for Y-axis CH2.
- ⑮ VOLTS/DIV Switch — Same function as No. ⑩ for Channel 2
- ⑯ VARIABLE, PULL X5 MAG — Same function as No. ⑪ for Channel 2
- ⑰ $\frac{1}{2}$ Ground Jack — Provides an auxiliary signal ground when interconnecting equipment under test and the Oscilloscope
- ⑱ VERTICAL MODE Switches — Select the indicated channel(s) for display. Any combination of the possible signal selections can be displayed by pressing in the appropriate push buttons
CH1 : Channel 1 input signal only when pushed in
CH2 : Channel 2 input signal only when pushed in
ADD : The algebraic sum of channel 1 and channel 2 is displayed when pushed in. When both ADD pushed in and INVERT knob pulled out, the waveform displayed is the difference between CH1 and CH2
DUAL : Each input signal of channel 1 and channel 2 can be displayed when both pushed in. Both channels are chopped at about 250KHz from 0.5S/DIV to 1mS/DIV and both channels are switched alternately from 0.5mS/DIV to 0.2uS/DIV
- ⑲ SWEEP MODE Switch — Select the trigger mode.
AUTO : Sweep free runs in the absence of a triggering signal. The triggering level changes only when the LEVEL control is adjusted to a new position
NORM : Sweep is triggered and runs when a triggering signal compatible with the LEVEL setting is applied.
SINGLE : Push to reset. The sweep runs one or more times to produce a single sweep of each of the traces defined by the controls. Each sweep requires a distinct triggering event. The READY indicator remains illuminated until the final trace in the sequence is completed
- ⑳ HOLD OFF Control — Varies the amount of holdoff time between the end of the sweep and the time a trigger can initiate the next sweep. Set this control fully counter clockwise for normal operation to give brightest display.
- ㉑ TRIG LEVEL Control — Sets the amplitude point on the triggering signal at which the sweep triggering occurs. This control produces fine resolution for a portion of its range.
- ㉒ Position, pull X10 MAG — Sets the horizontal position of the sweep displays on the CRT
X10 MAG switch when pull out, horizontally magnifies the length of the sweep display by a factor of 10.
- ㉓ SOURCE Switch — Selects the trigger signal source for the sweep CH1, CH2: A triggering signal is obtained from the corresponding vertical channel
LINE : A triggering signal is obtained from a sample of the AC power-source waveform. This trigger source is useful when vertical input signals are time related to the frequency of the AC power-source voltage
EXT : A trigger signal is obtained from an external waveform.
- ㉔ COUPLING Switch — Selects the method of coupling the triggering signal to the trigger generator circuit
DC : All frequency components of the signal are coupled to the trigger generator circuitry. This coupling method is useful for triggering on most signals
AC : Signals are capacitively coupled. Frequency components below 10 Hz are attenuated, and the DC component of the input signal is blocked. This coupling method is useful for signals that are super imposed on slowly changing DC voltage
HF REJ : Attenuates high-frequency triggering signal components above 50 KHz. This coupling method is useful for eliminating radio frequency interference and high frequency noise components from the signal applied to the trigger generator circuitry
TV : TV or Video composite signals are coupled to trigger generator circuitry
SEC/DIV switch selects TVV (Frame) and TV-H (Line) for accurate synchronization. The most important waveform in TV servicing is the composite signal consisting of the video signal, the blanking pedestals and sync pulses
- ㉕ EXT INPUT: External trigger signal input connector
- ㉖ SEC/DIV Control — Selects 20 calibrated sweep speeds from 0.2uS to 0.5S per division in a 1-2-5 sequence. Extreme counterclockwise switch rotation selects XY display mode. In XY, the signal applied to the CH1 or X input connector drives the horizontal deflection system.
- ㉗ VARIABLE Control — Continuously varies the sweep speed between settings of the SEC/DIV switch. Fully counterclockwise rotation extends the sweep speed of the slowest SEC/DIV switch setting (0.5S per division) to 1.25S per division and fully clockwise rotation produces the sweep speed indicated by the position of the SEC/DIV switches
- ㉘ COMP TEST S.W
- ㉙ ㉚ COMP TEST IN

3-2-1. REAR PANEL



- 31 Z AXIS INPUT Connector — provides an input connection point to apply external Z-axis modulation signals to the Z-Axis Amplifier. Either the sweep or XY display may be intensity modulated.
- 32 CH1 SIG OUT Connector — Provides an output signal that is a normalized representation of the channel 1 input signal
- 33 VOLTAGE SELECTOR Switch — Selects the nominal instrument operating voltage range.
- 34 FUSE HOLDER — Contains the AC power-source fuse
- 35 RECEPTACLE — Detachable power cord receptacle provides the connection point for the AC power source to the instrument
- 36 CHOP/ALT — CHOP/ALT function is operated by TIME/DIV switch in the NORM position, and always being operated as ALT state in no-relation with TIME/DIV switch in the INV position.

3-3. TRIGGERING

This model has 4 knobs to control triggering. They are LEVEL, SLOPE, COUPLING 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 referred to as EXTERNAL TRIGGER. In this model INT, CH-1 and CH-2 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
Triggering level need not be readjusted when VOLTS/DIV knobs are turned because the 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

COUPLING

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 TV signal triggering. Selection of TV-V or TV-H is done by SEC/DIV switch

SLOPE

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

When using TV mode, triggering point is set to sync pulse rising time or falling time

LEVEL

Sets the amplitude point on the triggering waveform at which the time base is triggered.

3-4. X-Y OPERATION

This instrument is specially designed for easy X-Y application. Simply turn SEC/DIV switch to X-Y and use CH1 input for X-signals and CH2 for Y-signals.

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-1 or CH-2 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 AC-GND-DC to GND, and adjust the vertical POSITION control to a convenient reference level. Set AC-GND-DC 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 COUPLING to TV, then specially designed circuitry provides easy triggering for complexed TV frame and line signal. TV frame and line waveform are easily obtained by simply turning SEC/DIV control.

3.8 ADD & SUBTRACT MEASUREMENTS

Simply turn vertical MODE switch to ADD, added waveform of CH-1 and CH-2 is displayed. With this MODE at ADD position, subtracted waveform is obtained by pulling INVERT knob which inverts the polarity of CH-2.

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 1 or Channel 2 can be used for single-trace operation. Channel 1 is referred to hereunder for simplicity.

Set controls
 AC-GND-DC AC
 VERTICAL MODE CH1
 COUPLING AC
 SOURCE CH1
 PROBE to CH-1 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 400 VOLTS.

3-9-1. AC VOLTAGE AND FREQUENCY MEASUREMENT

When measuring voltage and frequency, set VOLTS/DIV VARIABLES (4), (25) and SEC/DIV VARIABLE (3) at their calibrated detent points (clockwise).

(EX) The signal displayed on the CRT is

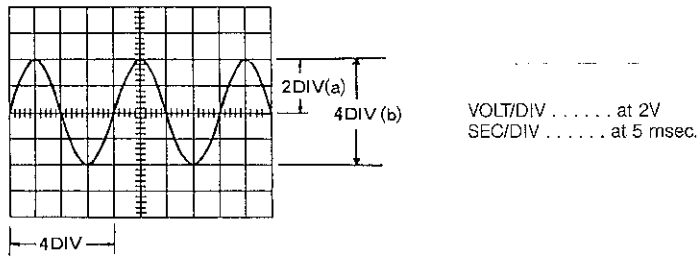


Fig. 2

- (a) Peak voltage $2V/DIV \times 2DIV = 4$ volts
 - (b) p-p voltage $2V/DIV \times 4DIV = 8$ volts
 - (c) Effective voltage (rms) $(\text{Peak voltage} \times 1/\sqrt{2}) = 2V \times 2DIV / \sqrt{2} = 2.828$ volts
 - (d) Frequency (Hz) $1/\text{Time (second)}$
- ** Time = Number of DIVs for 1 cycle \times value of SEC/DIV

Therefore, the Fig. 10 waveform is:
 Frequency = $1/\text{time}$

$$\text{Frequency} = \frac{1}{5m \text{ SEC} \times 4 (DIV) \times 20m \text{ SEC}} = 50\text{Hz}$$

NOTE!!!

The input of this oscilloscope is $1M\Omega$ shunted by $20pF$ capacitance. When the probe is used in 10:1 attenuation, the impedance becomes $10M\Omega$ shunted by $10pF$. Then the voltage reading must be multiplied by 10.

3-9-2. DC VOLTAGE MEASUREMENT

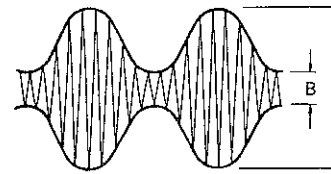
AC-GND-DC being at AC position, only AC or AC component was displayed on the CRT screen. For DC measurement, set the switch to GND and pull the LEVEL knob for a trace line, which must be positioned at a certain place as 0 volt reference.

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) \times VOLTS/DIV
 When the trace line shifts upward, the polarity is (+), and down-ward is (-).

3-9-3. AM MODULATION MEASUREMENT

There are various ways of measuring A.M. depth, here we suggest the envelope method. This method is applicable when the carrier frequency is within the frequency bandwidth of the oscilloscope. See Fig. 11



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

Fig. 11

3-9-4. DUAL-TRACE APPLICATIONS

Pressing MODE switches to DUAL, both Channel 1 and Channel 2 work simultaneously. Then, comparison of two relative signals is easily done such as level, waveforms, phase, etc

3-9-5. LEVEL COMPARISON

OUTPUT/INPUT of an amplifier

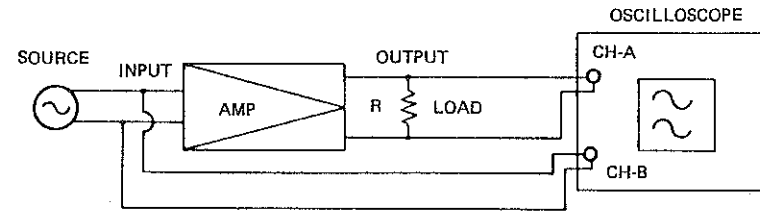


Fig. 12

With the connections shown in Fig. 12 set the displays of CH-1 and CH-2 the same (POSITION controls adjusted to place CH-2 waveform onto CH-1). Then the difference between displays of CH-1 VOLTS/DIV and CH-2'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 pull the CH-2 position 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

A triggered oscilloscope is indispensable. This model has the very convenient TV SYNC circuits of TV-V (Frame) and 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. 13 and Fig. 14 show composite signals synchronized with horizontal sync pulses and vertical blanking pulses

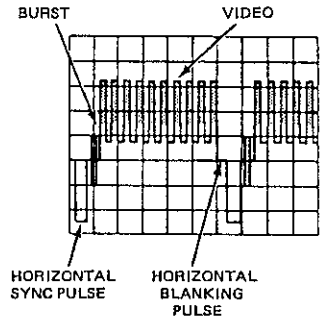


Fig. 13

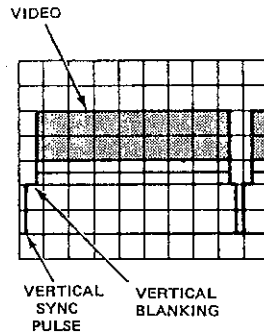


Fig. 14

3-9-9. MEASUREMENT OF FREQUENCY BY X-Y

Simply turn SEC/DIV switch for XY operation. Then CH-1 becomes X axis and CH-2 Y axis. Connect a standard frequency signal to CH-2 and unknown signal to CH-1. Lissajous figure is displayed on the screen as shown in Fig. 15

Standard signal frequency: Unknown signal frequency

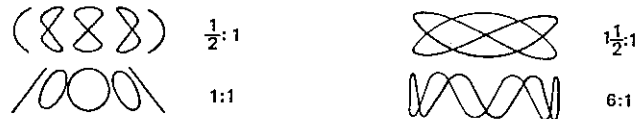
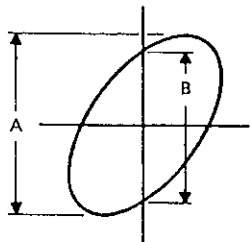


Fig. 15

3-9-10. PHASE MEASUREMENT

In XY function, apply two signals to each CH-1 and CH-2. Calculate according to the formula



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

$\phi = \text{PHASE ANGLE}$

Fig. 16

3-9-11. COMPONENT TEST

Turn SWEEP/DIV for XY mode and set both AC-GND-DC switches 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. 17 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.

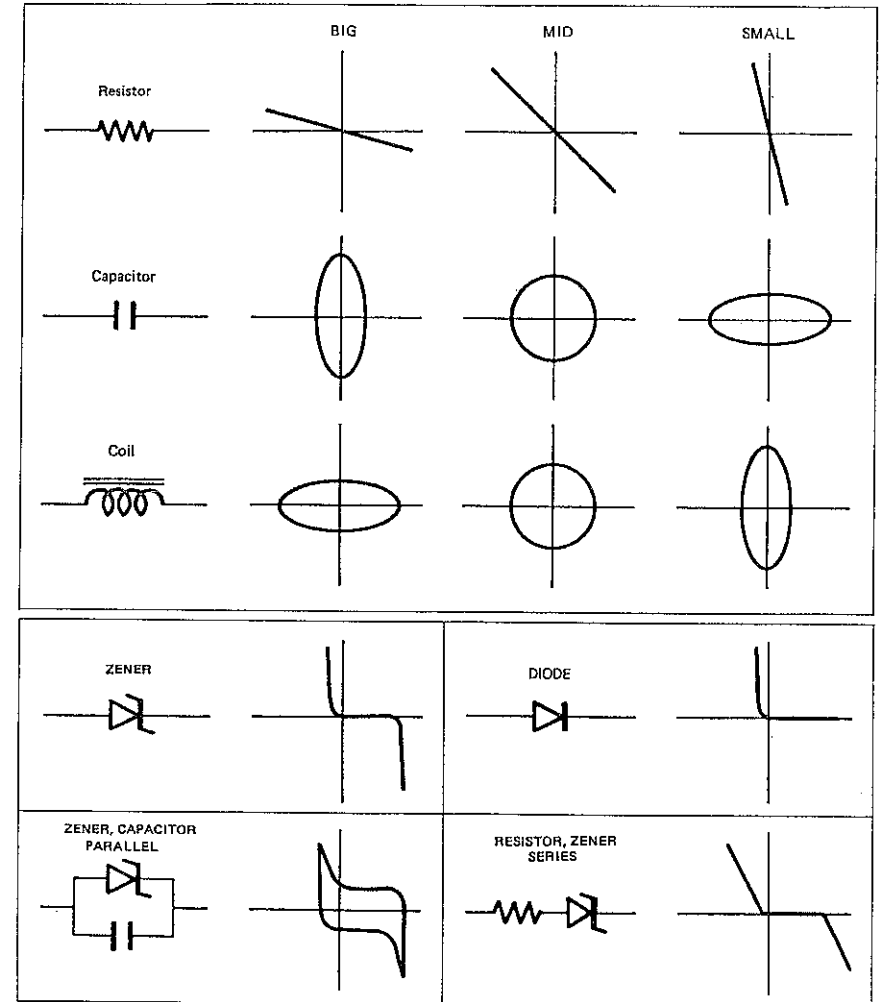


Fig. 17

SECTION 4 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.

4-1. MAINTENANCE

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.

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 be removed with a soft cloth moistened with a diluted household cleaning solution.

RECALIBRATION

Recalibration of the instrument at regular intervals will assure that measurements are 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.

4-2. TEST EQUIPMENTS REQUIRED

- 1) Calibration Generator 0.2mV — 100V
- 2) Sine Wave Generator 25KHz — 100MHz
- 3) Time Mark Generator 5S — 5 μ S
- 4) Square Wave Generator 10Hz — 1MHz
- 5) Audio Oscillator 20Hz — 2MHz
- 6) Digital Multimeter DC 1000V
- 7) High Voltage Probe (High Impedance Probe) 10:1
- 8) Oscilloscope Probes
- 9) Oscilloscope (over 20MHz)

4-3. BASIC ADJUSTMENTS

4-3-1. POWER SOURCE

- 1) Adjust semi-fixed resistor (VR1006) to read +12.00V (± 0.12 V) between the ground and Pin No. 2 of Connector P1005 in Vertical PCB (5504-01) assembly.
- 2) Verify if the voltage of each pin is as follows
 - P1005 Pin No. 3: -12V (-11.88V to -12.12V)
 - P1005 Pin No. 4: +5V (+5.00V to +5.15V)
 - P1005 Pin No. 6: +160V (+152V to +168V)

4-3-2. HIGH VOLTAGE CHECK

Verify that the voltage is within tolerance (-1950V to -2050V) between the ground and pin No. 3 of connector P2005 in Horizontal PCB (5504-02) assembly.

CAUTION

Make sure to use High Impedance Probe when measuring high voltage and be careful extremely to pin-point the measured parts.

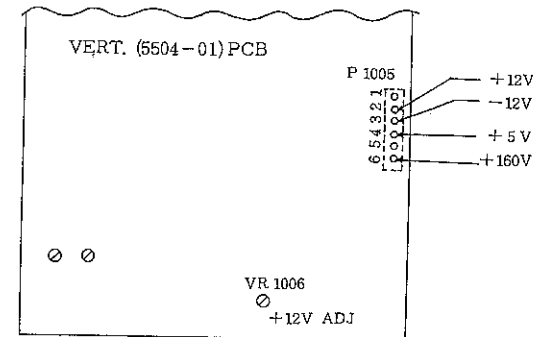


Fig. 18

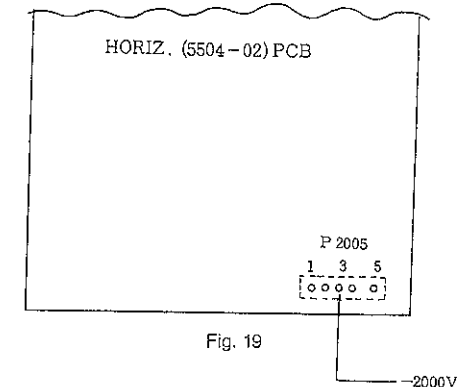


Fig. 19

4-4. CRT ADJUSTMENTS

4-4-1. Intensity

Put the INTENSITY control knob at the position of 10 O'clock and adjust semi-fixed resistor (VR3002, INTEN) in Horizontal PCB (5504-02) assembly until the trace line fades away.

4-4-2. Focus

Put the FOCUS control knob at center position and the SEC/DIV control knob at the X-Y position and then adjust semi-fixed resistor (VR2011, FOCUS) to get the optimum brightness of the spot.

4-4-3. Spot

After the above two steps, adjust semi-fixed resistor (VR2018, ASTIG) to make the spot a small circle.

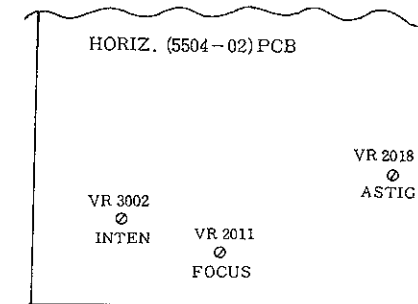


Fig. 20

4-5. VERTICAL ADJUSTMENTS

4-5-1. STEP BALANCE ADJUSTMENT

Adjust semi-fixed resistor (VR15, CH1) and (VR115, CH2) in Vertical PCB assembly to get a fixed line, without moving up and down when switching VOLTS/DIV knob over each range.

4-5-2. MAG (X5) BALANCE ADJUSTMENT

Adjust VR32 (CH1), VR132 (CH2) with the variable knob pull-out, X5 MAG position, until the trace line is without vertical movement.

4-6. HORIZONTAL TIME ADJUSTMENTS

4-6-1. X CENTER ADJUSTMENT

SEC/DIV: XY
Horizontal Position: Center
AC-GND-DC: DC (CH1), GND (CH2)
Vertical Mode: CH2

Adjust semi-fixed resistor VR413 (X-CENT) until the spot can be positioned at the center of X-axis.

4-6-2. TIME 1mS/1 μ S ADJUSTMENT

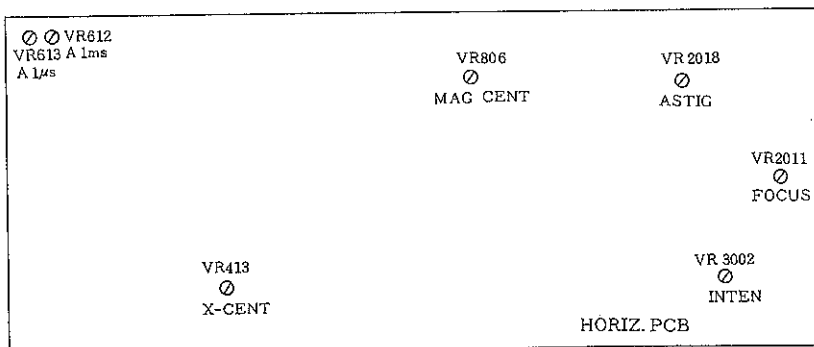
Time Marker: 1mS --- 1 μ S
Vertical Mode: CH1
SEC/DIV: 1mS

Input Marker signal 1mS (pulse train) into CH1 and adjust semi-fixed resistor VR612 (A 1mS) until the signal can be on the graticule line.
Input Marker Signal into CH1 and switch SEC/DIV to 1 μ S/DIV and adjust semi-fixed resistor VR613 (A 1 μ S) until the signal can be on the graticule line.

4-6-3. X 10 MAG CENTER ADJUSTMENT

Vertical Mode: CH1
SEC/DIV: 1mS

Input 1mS Marker signal to CH1 and pull the horizontal position knob (PULL X10 MAG) and adjust UR806 (MAG CENT) until the balance can be maintained at the center of X axis.



SECTION 5. PARTS LIST

5-1. MECHANICAL PARTS

MAT'L CODE	DESCRIPTION	SPECIFICATION	UNIT	Q'TY	REMARKS
K55020101	FRONT PANEL SET		ST	1	
645000101	FRONT PANEL	C310020-1, C310038-1A, C310021-1	EA	1	
640400101	TOP PLATE	C810021-1A	EA	1	
070100601	FRONT FRAME	C310015-1A	EA	1	
420800101	BEZEL	C810011-1B	EA	1	
640200101	NAME PLATE	C810016-1	EA	1	
820100101	C.R.T. FILTER	C810041-1	EA	1	
400100101	TOGGLE SWITCH	MS-165	EA	1	
860100101	CAL TERMINAL	PART NO. 200-1000-03, DRW NO. A3043	EA	1	
090200101	BNC RECEPTACLE	UG-625	EA	3	
860200101	GROUND TERMINAL	PART NO. 200-1001-05, DRW NO. CQ0204-02	EA	1	
860300101	MOULD TERMINAL	PART NO. 200-1002-05	EA	2	
400200101	SLIDE SWITCH	SSB-423	EA	2	
070200101	SWITCH BRACKET	C310034-1	EA	1	
400300101	PUSH SWITCH	1 KEY	EA	1	
420700201	PUSH SWITCH SPACER	C310039-1	EA	2	
150300101	SHIELD COVER	C310040-1	EA	1	
63L5H102K	INDUCTOR	FL5H 102K	EA	1	
23060223K	METAL FILM CAPACITOR	CF921L2J 223KX	EA	2	
30SB0470J	CARBON FILM RESISTOR	RD 25ST 47 ohm J	EA	2	
420700310	LEVER SWITCH SPACER	C310022-1	EA	1	
070200201	SCALE ILLUM BRACKET	C310023-1A	EA	1	
34310103B	POTENTIOMETER	10KB 15S, C610017-1	EA	1	CH1 POS1
3430M103B	POTENTIOMETER	10KB MAG, C610008-1	EA	1	CH 2 POS1
3430S104B	POTENTIOMETER	100KB/10KB/S.W., C610019-1	EA	1	LEVEL/HOLD OFF
3431S103B	POTENTIOMETER	10KB 15S/S.W., C610009-1	EA	1	TIME VARI
3431M103B	POTENTIOMETER	10KB 15S/MAG, C610008-1	EA	1	H --- POS1
750100101	RUBBER CUSHION (1)	C310028-1	EA	4	
750100301	RUBBER CUSHION	C310078-1	EA	4	
30SB08225	CARBON FILM RESISTOR	RD 25ST 8.2K ohm J	EA	1	R441 LEVEL/HOLD (OFF V.R)
30SB0560J	CARBON FILM RESISTOR	RD 25ST 56 ohm J	EA	1	EXT INPUT
650300201	SCALE LAMP	T-1 3/4 2182-AS25	EA	2	LAMP PCB
84SCML201	LAMP P.C.B.	5504-07-00	EA	1	
K55020201	REAR PANEL SET		ST	1	
645100101	REAR PANEL	C310009-1B	EA	1	
420600101	CORD REST	C810040-1A	EA	4	
650100101	FUSE	1A 250V	EA	1	
670100101	FUSE HOLDER	FH-003	EA	1	
090400101	AC INLET	NC-174C	EA	1	
090200101	BNC RECEPTACLE	UC-625	EA	2	
090500101	VOLTAGE SELECTOR	PC-235 (F)/SC-335	ST	1	
260100101	POWER TRANS	PT5500BK	EA	1	
21A091025	CERAMIC CAPACITOR	DE0707E 102ZAC 250V	EA	2	
150300201	SELECTOR COVER	C810039-1	EA	1	
070300701	SELECTOR COVER POLE	C310074-1	EA	1	
22UIN223K	MYLAR CAPACITOR	501N5002, 223K 50V	EA	1	
400100201	TOGGLE SWITCH	M0-500K	EA	1	

K55020301	UPPER & LOWER CASE		ST	1
150200101	UPPER CASE	C310032-1	EA	1
550100101	HANDLE ASS'Y	400-1002-05	EA	1
070300101	RUBBER LEG	405-1002-05	EA	4
070300201	STAND	405-1005-03	EA	1
150200201	LOWER CASE	C310033-1A	EA	1
070300301	MOULD LEG	C810042-1A	EA	2
070300401	PLASTIC LEG	TM-127 NO. 2	EA	2
K55020401	C.R.T. ASS'Y		ST	1
650400101	C.R.T.	150DEB31	EA	1
260300101	ROTATION COIL	050-1003-05	EA	1
140100201	C.R.T. SHIELD	C31006-1A	EA	1
420400201	TIE BAND	TY 26M	EA	1
070300501	C.R.T. HOLDER	C310016-1B	EA	1
070300601	C.R.T. HOLDER	C310017-1B	EA	1
750100201	RUBBER CUSHION (2)	C310029-1	EA	2
070100701	C.R.T. FRAME	C310075-1	EA	1
K55020501	KNOB SET		ST	1
021000001	KNOB (1)	C810001-1	EA	7 V.R
021000002	KNOB (2)	C810002-1A	EA	1 HOLD OFF
021000003	KNOB (3)	C810003-1A	EA	1 LEVEL
021000004	KNOB (4)	C810004-1A	EA	2 ATT
021000005	KNOB (5)	C810005-1A	EA	2 V-VARIABLE
021000006	KNOB (6)	C810006-1A	EA	1 TIME
021000007	KNOB (7)	C810007-1	EA	4 LEVER SW
021000008	KNOB (8)	C810008-1	EA	7 PUSH SW
420400101	TIE BAND	TA 1	EA	20
420700101	LOCKING SPACER	KGLS-14S	EA	8
640300101	C.R.T. GROUND	C310031-1	EA	1
810200101	POWER CORD	M117	EA	1 OPTION
810200201	POWER CORD	W220	EA	1 OPTION
810200301	POWER CORD	A240	EA	1 OPTION
810400101	TEST PROBE	SP-100, X-7034	EA	2
070100101	FRAME (1)	C310010-1A	EA	2
070100201	FRAME (2)	C310011-1A	EA	1
070100301	FRAME (3)	C310012-1A	EA	1
070100401	FRAME (4)	C310013-1A	EA	1
070100501	FRAME (5)	C310014-1A	EA	1
640100201	SHIELD PLATE (2)	C310041-1	EA	1

5-2. VERTICAL PCB ASS'Y

REF NO.	PARTS NO.	DESCRIPTION	
IC2, 102	84SCMV201	VERTICAL P.C.B.	5504-01-00
IC1, 101	510603086	I.C.	CA 3086
IC201	510613741	I.C.	LF 13741N
IC202	5101LS000	I.C.	SN 74LS00N
IC1001, 1002	5101LS074	I.C.	SN 74LS74N
IC1001, 1002	510204558	I.C.	UPC 4558C
Q201, 202	481000711	TRANSISTOR	2SA 711
Q7-10, 107-112	48100838B	TRANSISTOR	2SA 838-B
Q3, 103, 203, 204	48100844D	TRANSISTOR	2SA 844-D
Q5, 6, 105, 106	48101005L	TRANSISTOR	2SA 1005-L
Q303, 304	48101206L	TRANSISTOR	2SA 1206-L
Q309, 310	48100648A	TRANSISTOR	2SB 648A
Q1001	481000834Y	TRANSISTOR	2SB 834-Y
Q1003	48100861C	TRANSISTOR	2SB 861-C
Q2, 4, 102, 104	482009450	TRANSISTOR	2SC 945-Q
D1, 101, Q11, 301, 302, 305, 306	482001907	TRANSISTOR	2SC 1907
Q311, 312	482002570	TRANSISTOR	2SC 2570
Q307, 308	48200668A	TRANSISTOR	2SD 668A
Q1002, 1004	482008806	TRANSISTOR	2SD 880-Y
Q1, 101	4830107P3	F.E.T	2SK-107-3
R20, 72, 120	36100251K	THERMISTOR	251-2 ± 10% (250)
D60-3, 75-7, 160-3, 201-9, 215, 320-3, 1004, 1019	4911S1588	DIODE	1S1588
D1001, 1002	4911G4B42	DIODE	1G4B-42
D1005	491R506EL	DIODE	RD 5, 6EL
D1003, 1011	491RD13EL	DIODE	RD 13EL
D59, 159	4910HZ3C2	DIODE	HZ3C-2
D308, 309	4910HZ2B3	DIODE	HZ2B-3
R94, 194	31SBK250F	METAL FILM RESISTOR	RSN 1/4K 25 F
R97, 197	31SBK400F	METAL FILM RESISTOR	RSN 1/4K 40 F
R37, 38, 137, 138	31SBK560F	METAL FILM RESISTOR	RSN 1/4K 56F
R95, 195	31SBK600F	METAL FILM RESISTOR	RSN 1/4K 60 F
R96, 196	31SBK640F	METAL FILM RESISTOR	RSN 1/4K 64 F
R301, 302	31SBK910F	METAL FILM RESISTOR	RSN 1/4K 91 F
R91, 93, 191, 193	31SBK101F	METAL FILM RESISTOR	RSN 1/4K 100 F
R92, 192	31SBK201F	METAL FILM RESISTOR	RSN 1/4 200 F
R33, 34, 133-34, 201-02, 303-04	31SBK471F	METAL FILM RESISTOR	RSN 1/4K 470 F
R42, 43, 142, 143	31SBK681F	METAL FILM RESISTOR	RSN 1/4K 680 F
R73, 74, 172, 173	31SBK102F	METAL FILM RESISTOR	RSN 1/4K 1K F
R1022	31SBK392F	METAL FILM RESISTOR	RSN 1/4K 3.9K F
R1019, 1023	31SBK912F	METAL FILM RESISTOR	RSN 1/4K 9.1K F
R9, 109	31SBK1012	METAL FILM RESISTOR	RSN 1/4K 10.1K F
R1005, 1008	31SBK123F	METAL FILM RESISTOR	RSN 1/4K 12K F
R6, 106	31SBK1113	METAL FILM RESISTOR	RSN 1/4K 111K F
R1020	31SBK124F	METAL FILM RESISTOR	RSN 1/4K 120K F
R5, 105	31SAE904F	METAL FILM RESISTOR	RK 14B2H 900K F (1/2)
R8, 108	31SAE994F	METAL FILM RESISTOR	RK 14B2H 990K F
R4, 104	31SAE105F	METAL FILM RESISTOR	RK 14B2H 1M F
R1001	3211E010J	METAL OXID RESISTOR	RS 1B 1 J
R1003, 1009, 1026	3211E101J	METAL OXID RESISTOR	RS 1B 100 J
R1014	3212E122J	METAL OXID RESISTOR	RS 2B 1.2K J
R315, 316	3211E333J	METAL OXID RESISTOR	RS 1B 33K J
R30, 130, 317-18, 328-29, 326-27	30SBO4R7J	CARBON FILM RESISTOR	RD 25ST 4.7 J (1/4)
R10, 23-4, 80, 100, 123-4, 251-4, 319, 330, 351-3, 1015	30SBO100J	CARBON FILM RESISTOR	RD 25ST 10 J
R11, 111	30SBO150J	CARBON FILM RESISTOR	RD 25ST 15 J
R44, 45, 58, 71, 144-45, 161, 310, 311	30SBO220J	CARBON FILM RESISTOR	RD 25ST 22J

R39, 40, 139, 140	30SBO270J	CARBON FILM RESISTOR	RD 25ST 27 J					
R3, 103	30SBO330J	CARBON FILM RESISTOR	RD 25ST 33 J					
R56, 57, 79, 156, 157	30SBO470J	CARBON FILM RESISTOR	RD 25ST 47 J					
R171, 205, 206, 331	30SBO820J	CARBON FILM RESISTOR	RD 25ST 82 J					
R14, 31, 48, 114, 131, 148, 53, 153, 1002, 1011, 1016	30SBO101J	CARBON FILM RESISTOR	RD 25ST 100 J					
R25, 26, 125, 126	30SBO121J	CARBON FILM RESISTOR	RS 25ST 120 J					
R46, 146, 47, 147, 1021	30SBO151J	CARBON FILM RESISTOR	RS 25ST 150 J					
R51, 52, 151, 152	30SBO181J	CARBON FILM RESISTOR	RS 25ST 180 J					
R75, 159, 163, 164, 174, 175, 312, 313, 1017	30SBO221J	CARBON FILM RESISTOR	RS 25ST 220J					
R36, 136, 211	30SBO271J	CARBON FILM RESISTOR	RS 25ST 270 J					
R21, 121	30SBO391J	CARBON FILM RESISTOR	RD 25ST 390 J					
R212, 308, 309	30SBO471J	CARBON FILM RESISTOR	RD 25ST 470 J					
R1018	30SBO451J	CARBON FILM RESISTOR	RD 25ST 560 J					
R16, 118, 29, 129, 305, 306	30SBO681J	CARBON FILM RESISTOR	RD 25ST 680 J					
R203, 204, 207	30SBO821J	CARBON FILM RESISTOR	RD 25ST 820 J					
R13, 15, 77, 113, 115, 209-10, 215, 217-8, 307, 324-5	30SBO102J	CARBON FILM RESISTOR	RD 25ST 1K J					
R22, 49, 50, 122, 149, 150, 158	30SBO122J	CARBON FILM RESISTOR	RD 25ST 1.2K J					
R78, 341	30SBO152J	CARBON FILM RESISTOR	RD 25ST 1.5K J					
R162	30SBO222J	CARBON FILM RESISTOR	RD 25ST 2.2K J					
R322, 323	30SBO332J	CARBON FILM RESISTOR	RD 25ST 3.3K J					
R17, 76, 117	30SBO392J	CARBON FILM RESISTOR	RD 25ST 3.9K J					
R54, 55, 154, 155	30SBO472J	CARBON FILM RESISTOR	RD 25ST 4.7K J					
R19, 27, 28, 59, 119, 127, 28, 216 1004, 1006-07	30SBO562J	CARBON FILM RESISTOR	RD 25ST 5.6K J					
R160	30SBO682J	CARBON FILM RESISTOR	RD 25ST 6.8K J					
R18, 118	30SBO822J	CARBON FILM RESISTOR	RD 25ST 8.2K J					
4208, 213, 214	30SBO103J	CARBON FILM RESISTOR	RD 25ST 10K J					
R314	30SBO123J	CARBON FILM RESISTOR	RD 25ST 12K J					
R32, 132, 41, 141	30SBO473J	CARBON FILM RESISTOR	RD 25ST 47K J					
R1024, 1025	30SBO225J	CARBON FILM RESISTOR	RD 25ST 2.2M J					
R1010	30SAO225J	CARBON FILM RESISTOR	RD 50ST 2.2 J (1/2)					
R320, 321	30SAO473J	CARBON FILM RESISTOR	RD 50ST 47K J					
R12, 112	30SAO474J	CARBON FILM RESISTOR	RD 50ST 470K J					
RN201	51074103J	NETWORK RESISTOR	RK L4-103 J					
C33, 34, 133, 134	211CH0500D	CERAMIC CAPACITOR	DD104CH 050D 50 (5 pf 50 V)					
C15, 115	211CH100D	CERAMIC CAPACITOR	DD104CH 100D 50 (10 pf 50 V)					
C20, 120, 308, 309	211CH150K	CERAMIC CAPACITOR	DD104CH 150K 50 (15 pf 50 V)					
C7, 107	212CH330K	CERAMIC CAPACITOR	DD105CH 330K 50 (33 pf 50 V)					
C37, 38, 137, 138	215CH820K	CERAMIC CAPACITOR	DD107CH 820K 50					
C31, 131	215CH101K	CERAMIC CAPACITOR	DD107CH 101K 50					
C7, 147	217CH151K	CERAMIC CAPACITOR	DD109CH 151K 50					
C30, 39, 139	219CH221K	CERAMIC CAPACITOR	DD111CH 221K 50					
C10, 110, 11, 111	210CH271K	CERAMIC CAPACITOR	DD112CH 271K 50					
C130	210SH331K	CERAMIC CAPACITOR	DD112SH 331K 50					
C14, 18, 114, 118, 210	2110B102K	CERAMIC CAPACITOR	DD104B 102K 50					
C215	2130B152K	CERAMIC CAPACITOR	DD105B 152K 50					
C17, 24, 51-2, 75, 117, 124, 151-2, 161, 163, 175, 217, 254	2140FL03Z	CERAMIC CAPACITOR	DD106F 103Z 50					
C71, 171	214CH470K	CERAMIC CAPACITOR	DD106CH 470K 50					
C312	211CH070D	CERAMIC CAPACITOR	DD104CH 070D 50					
C317, 318	23060223K	METAL FILM CAPACITOR	CF921L2J 223K (223/630V)					
C320, 321	23040473K	METAL FILM CAPACITOR	CF92112E 473K (473/250V)					
C310, 311	2302E103K	METAL FILM CAPACITOR	ECQ-E 1103KN (JNB)					
C319	2312B473K	POLYETHYLENE CAPACITOR	CQ92M2A 473KB (473/100V)					
				C1024, 1025	2312B223K	POLYETHYLENE CAPACITOR	CQ92M2A 223KB (223/100V)	
				C12, 112	232M4222K	POLYPROPYLENE CAPACITOR	ECQ-M4222KZ (222/400V)	
				C315, 316	233CGMCK47K	CEMICON CAPACITOR	CGM-C 0.47 PM (0.47 pf)	
				C1002	251E0470M	ELECTROLYTIC CAPACITOR	RE-25V 470M (47 uf 25V)	
				C251, 252	251E0101M	ELECTROLYTIC CAPACITOR	RE-25V 101M (100 uf 25 V)	
				C1001, 1010	251V0102M	ELECTROLYTIC CAPACITOR	RE-35V 102M (1000 uf 35 V)	
				C23, 123, 80, 129, 351, 352	251H0100M	ELECTROLYTIC CAPACITOR	RE-50V 100M (10 uf 50 V)	
				C330, 1010	251D0010M	ELECTROLYTIC CAPACITOR	RH-160V 010M (1 uf 160 V)	
				C1012	251F0470M	ELECTROLYTIC CAPACITOR	RH-200V 470M (47 uf 200 V)	
				C1013	251G02R2M	ELECTROLYTIC CAPACITOR	RH-250V 2R2M (2.2 uf 250 V)	
				C253	251H0010M	ELECTROLYTIC CAPACITOR	RH-50V 010M (1 uf 50 V)	
				VC5, 8, 105, 108	201Z06P65	TRIMMER	RCV-1ZW 06x65 (6 pf)	
				VC4, 7, 104, 107	201Z10P65	TRIMMER	RCV-1ZW 10x65 (10 pf)	
				VC25, 125, 312	201Z30P65	TRIMMER	RCV-1ZW 30x65 (30 pf)	
				VC47, 147	201Z50P65	TRIMMER	RCV-1ZW 50x65 (50 pf)	
				VR30, 130, 71	34100101B	SEMI-FIXED RESISTOR	TM64K-3-PV2-100B (100 ohm)	
				VR25, 47, 48, 125, 147, 148, 163	34100501B	SEMI-FIXED RESISTOR	TM64K-3-PV2-500B (500 ohm)	
				VR53, 73, 153, 173, 1006	34100102B	SEMI-FIXED RESISTOR	TM64K-3-PV2-1K B (1K ohm)	
				VR76, 313	34100202B	SEMI-FIXED RESISTOR	TM64K-3-PV2-2K B (2K ohm)	
				VR15, 32, 41, 115, 132, 141	34100203B	SEMI-FIXED RESISTOR	TM64K-3-PV2-20K B (20K ohm)	
				P2, 101, 1003	090300102	CONNECTOR	5045-02A (2P)	
				P1, 201, 301	090300203	CONNECTOR	5045-03A (3P)	
				P203	090300304	CONNECTOR	5045-04A (4P)	
				P101, 1004	090300405	CONNECTOR	5045-05A (5P)	
				P202, 1005	090300506	CONNECTOR	5045-06A (6P)	
				P1002	090300608	CONNECTOR	5045-08A (8P)	
				P1001	090300202	CONNECTOR	5045-5A (5P)	
				P302, 303	860400101	TERMINAL	1712551-1 (1Pin)	
				S2, 102	400500201	ROTARY-SWITCH	C610001-1/C61000 2-1	
				RV39, 139	34220102B	VARIABLE RESISTOR	10SA-1KB (C610020-1)	
				H/S 1	640500201	HEAT SINK (1)	C310024-1A (11.0)	
				H/S 2, 3	640100301	HEAT SINK (2)	C310025-1A (10.5)	
				S/P 1, 2, 3	640100301	SHIELD PLATE	C310026-1	
				C331	21CBC104Z	CERAMIC CAPACITOR	DD312BC 104Z 25	
					84SCMH201	HORIZONTAL P.C.B.	5504-02-00	

5-3. HORIZONTAL PCB ASS'Y

REF NO.	PARTS NO.	DESCRIPTION			
IC 2001	510613741	I.C.	LF 13741N	R412	30SBO330J CARBON FILM RESISTOR RD 25ST 33 J
IC 401	5101LS000	I.C.	SN 74LS00N	R401, 405, 603, 827, 828	30SBO470J CARBON FILM RESISTOR RD 25ST 47 J
IC 601	5101LS112	I.C.	SN 74LS112N	R414	30SBO680J CARBON FILM RESISTOR RD 25ST 68 J
IC 602	510204053	I.C.	TL 4053BP	R435, 436, 622, 3012, 3013, 3015, 3038	30SBO101J CARBON FILM RESISTOR RD 25ST 100 J
IC 603	510600081	I.C.	TL 081CP	R3002	30SBO121J CARBON FILM RESISTOR RD 25ST 120 J
Q401, 402, 411, 808	48100838B	TRANSISTOR	2SA 838B	R608, 3003	30SBO221J CARBON FILM RESISTOR RD 25ST 220 J
Q406-409, 602-605, 608, 610, 612, 3008	48100844D	TRANSISTOR	2SA 844D	R434	30SBO271J CARBON FILM RESISTOR RD 25ST 270 J
Q402, 803, 804	48101015Y	TRANSISTOR	2SA 1015-Y	R423, 601, 825, 826, 7004	30SBO331J CARBON FILM RESISTOR RD 25ST 330 J
Q811, 812	48100648Q	TRANSISTOR	2SB 648-A	R433	30SBO391J CARBON FILM RESISTOR RD 25ST 390 J
Q609, 613, 616, 617, 801, 802	48200945Q	TRANSISTOR	2SC 945-Q	R2009	30SBO471J CARBON FILM RESISTOR RD 25ST 470 J
Q611, 706	48201843E	TRANSISTOR	2SC 1843-E	R809	30SBO511J CARBON FILM RESISTOR RD 25ST 510 J
Q404, 405, 413, 601, 615, 805, 806, 807, 3001, 3002	482001907	TRANSISTOR	2SC 1907	R421, 422, 637	30SBO561J CARBON FILM RESISTOR RD 25ST 560 J
Q809, 810	4820668AC	TRANSISTOR	2SD 668A-C	R417, 418, 419, 420, 3008, 3009	30SBO681J CARBON FILM RESISTOR RD 25ST 680 J
Q2001	48200880Y	TRANSISTOR	2SD 880-Y	R626, 813, 814	30SBO821J CARBON FILM RESISTOR RD 25ST 820 J
Q3003, 3004, 3005, 3006	48202371L	TRANSISTOR	2SC 2371-L	R431, 438, 604, 620, 635, 638, 2006, 2014	30SBO102J CARBON FILM RESISTOR RD 25ST 10K J
Q403	4830107P3	F.E.T	2SK-107-3	R403, 605	30SBO122J CARBON FILM RESISTOR RD 25ST 1.2K J
Q410, 606, 607, 3007	4831170BL	F.E.T	2SK-117-BL	R413, 823, 824	30SBO152J CARBON FILM RESISTOR RD 25ST 1.5K J
D406-7, 602, 611, 618-9, 627-35, 820-1, 2001, 436	4911S1588	DIODE	1S1588	R639, 3029	30SBO182J CARBON FILM RESISTOR RD 25ST 1.8K J
D822, 3013, 3015, 3021, 3022	49101SS83	DIODE	1SS83	R404, 407, 428, 437, 627, 819, 820, 3028	30SBO222J CARBON FILM RESISTOR RD 25ST 2.2K J
D433, 601, 819	49101SS83	DIODE	1SS86	R406, 623, 624, 804, 805, 2007, 3014, 3027	30SBO332J CARBON FILM RESISTOR RD 25ST 3.3K J
D2010, 2011	4910Y16GA	DIODE	Y-16GA	R415, 416, 607	30SBO392J CARBON FILM RESISTOR RD 25ST 3.9K J
D617, 2006	491R5P6EL	DIODE	RD 5, 6EL	R614, 2002, 3005	30SBO472J CARBON FILM RESISTOR RD 25ST 4.7K J
D3018, 3019, 3024	4910BAV21	DIODE	BAV21	R630, 801, 802, 3001	30SBO562J CARBON FILM RESISTOR RD 25ST 5.6K J
D3025	491ERB26P2C	DIODE	ERB26-20	R808	30SBO682J CARBON FILM RESISTOR RD 25ST 6.8K J
D603	4910HZ3C2	DIODE	HZ3C02	R722	30SBO752J CARBON FILM RESISTOR RD 25ST 7.5K J
D3008, 3009	4910HZ2B3	DIODE	HZ2B-3	R408, 411, 426, 432, 610, 612, 617, 628, 633-4, 815, 2013, 3016	30SBO103J CARBON FILM RESISTOR RD 25ST 10K J
R806	31SBK560F	METAL FILM RESISTOR	BSN 1/4K 56 F	R606	30SBO183J CARBON FILM RESISTOR RD 25ST 18K J
R618	31SBK471F	METAL FILM RESISTOR	RSN 1/4K 470 F	R427, 807	30SBO223J CARBON FILM RESISTOR RD 25ST 22K J
R402, 803, 810, 811	31SBK102F	METAL FILM RESISTOR	RSN 1/4K 1K F	R613	30SBO333J CARBON FILM RESISTOR RD 25ST 33K J
R616	31SBK162F	METAL FILM RESISTOR	RSN 1/4K 1.6K F	R409, 629, 638, R439	30SBO473J CARBON FILM RESISTOR RD 25ST 47K J
R691	31SBK202F	METAL FILM RESISTOR	RSN 1/4K 2.0K F	R625	30SBO563J CARBON FILM RESISTOR RD 25ST 56K J
R615	31SBK222F	METAL FILM RESISTOR	RSN 1/4K 2.2K F	R3020	30SBO823J CARBON FILM RESISTOR RD 25ST 82K J
R619	31SBK392F	METAL FILM RESISTOR	RSN 1/4K 3.9K F	R424, 425, 611, 816, 821, 822, 3019, 2016	30SBO104J CARBON FILM RESISTOR RD 25ST 100K J
R690	31SBK502F	METAL FILM RESISTOR	RSN 1/4K 5.0K F	R2017	30SBO154J CARBON FILM RESISTOR RD 25ST 150K J
R2004	31SBK822F	METAL FILM RESISTOR	RSN 1/4K 8.2K F	R429, 430, 609, 621, 3026	30SBO474J CARBON FILM RESISTOR RD 25ST 470K J
R689, 812	31SBK109F	METAL FILM RESISTOR	RSN 1/4K 10K F	R2010	30SAO223J CARBON FILM RESISTOR RD 50ST 22K J
R2003	31SBK123F	METAL FILM RESISTOR	RSN 1/4K 12K F	R3006, 3007, 3010, 3011	30SAO473J CARBON FILM RESISTOR RD 50ST 47K J
R688	31SBK223F	METAL FILM RESISTOR	RSN 1/4K 20K F	R3017, 3018	30SAO155J CARBON FILM RESISTOR RD 50ST 1.5M J
R631	31SBK229F	METAL FILM RESISTOR	RSN 1/4K 22K F	R3023	30SAO225J CARBON FILM RESISTOR RD 50ST 2.2M J
R632	31SBK333F	METAL FILM RESISTOR	RSN 1/4K 33K F	R3021, 3022, 3024, 3025	30SAO106J CARBON FILM RESISTOR RD 50ST 10M J
R687	31SBK503F	METAL FILM RESISTOR	RSN 1/4K 50K F	R3030	30SBO153J CARBON FILM RESISTOR RD 25ST 15K J
R2001	31SBK683F	METAL FILM RESISTOR	RSN 1/4K 68K F	L2008	637R5102K INDUCTOR LF-7.5 100 uh
R686, 817, 818	31SBK104F	METAL FILM RESISTOR	RSN 1/4K 100K F	C433	211CJ030C CERAMIC CAPACITOR DD104CJ 030C 50 (3 pf 50 V)
R685	31SBK204F	METAL FILM RESISTOR	RSN 1/4K 200K F	C615	211CH150K CERAMIC CAPACITOR DD104CH 150K 50 (15 pf 50 V)
R684	31SBK504F	METAL FILM RESISTOR	RSN 1/4K 500K F	C411, 601, 631	214CH470K CERAMIC CAPACITOR DD106CH 470K 50 (47 pf 50 V)
R682, 683	31SAE105F	METAL FILM RESISTOR	RSN 1/4K 1M F	C608	215CH101K CERAMIC CAPACITOR DD107CH 101K 50 (100 pf 50 V)
R410	31SAE105F	METAL FILM RESISTOR	RK 14B 2H 1M F (1/2W)	C408, 3003	210CH151K CERAMIC CAPACITOR DD109CH 151K 50 (150 pf 50 V)
R2011	31SAE225F	METAL FILM RESISTOR	RK 14B 2H 2.2M F (1/2W)	C635	2110B102K CERAMIC CAPACITOR DD104B 102K 50 (1000 pf 50 V)
R681	31SAE505F	METAL FILM RESISTOR	RK 14B 2E 5M F	C406, 614, 3008, 3009, 3028	2140F103Z CERAMIC CAPACITOR DD106F 103Z 50 (10000 pf 50 V)
R2008	3211E010J	METAL OXID RESISTOR	RS 1B 1J (1 Ohm)	C821, 822, 824, 825, 826, 2026, 3010, 3016	21B12103P CERAMIC CAPACITOR DD14E 103P500V (10000 pf 500 V)
R2012	33S1B106F	METAL GLAZE RESISTOR	.GS 1B 10M F (1W)		
NE3001, 3002	650300101	NEON LAMP	NE-2		
R451, 651	30SBO100J	CARBON FILM RESISTOR	RD 25ST 10 J		
R602	30SBO220J	CARBON FILM RESISTOR	RD 25ST 22 J		

C607	2302K102J	METAL FILM CAPACITOR	ECQ-K-1102JN (102J100V)
C429, 2002	2411V105M	TANTAL CAPACITOR	SC-1V105M (1 uf 35 V)
C424, 425, 602, 628, 611	251E0470M	ELECTROLYTIC CAPACITOR	RE-25V 470M (47 uf 25 V)
C417, 426-7, 441, 451, 603, 617, 651, 810, 2023-5, 3005, 3011	251H0100M	ELECTROLYTIC CAPACITOR	RE-50V 100M (10 uf 50 V)
C2008	251H0220M	ELECTROLYTIC CAPACITOR	RE-50V 220M (22 uf 50 V)
C815	251E0220M	ELECTROLYTIC CAPACITOR	RE-25V 101M (100 uf 25 V)
C851	251E0221M	ELECTROLYTIC CAPACITOR	RE-25V 221M (220 uf 25 V)
VR413, 806	34100502B	SEMI-FIXED RESISTOR	TM64K-3-PV2-5K B (5K ohm)
VR612	34100103B	SEMI-FIXED RESISTOR	TM64K-3-PV2-10K B (10K)
VR3002	34100203B	SEMI-FIXED RESISTOR	TM64K-3-PV2-20K B
VR2018	34100104B	SEMI-FIXED RESISTOR	TM64K-3-PV2-100K B
VR613	34100504B	SEMI-FIXED RESISTOR	TM64K-3-PV2-500K B
VR2011	34100205B	SEMI-FIXED RESISTOR	EVM-HIG 205 (2M ohm)
P401, 404, 602, 2001, 2006, 3001	090300102	CONNECTOR	5045-02A (2P)
P603, 801, 802	090300203	CONNECTOR	5045-03A (3P)
P402	090300304	CONNECTOR	5045-04A (4P)
P403, 601, 2002	090300405	CONNECTOR	5045-05A (5P)
P406, 2003	090300506	CONNECTOR	5045-06A (6P)
P2004	090300602	CONNECTOR	5288-2A (2P)
P2005	090300705	CONNECTOR	5288-5A (5P)
Q2001	640500101	HEAT SINK	OSH-2425-SP
S401, 402	400400101	LEVER SWITCH	SLR524, C600003-1
S602	400500101	ROTARY SWITCH	000-117 5A, C610003-1/C610004-1
CT5500	260400101	CONVERTER TRANS	CT5500, C610025-1
P405, 803, 804	860400101	TERMINAL	1712551-1 (1 Pin)
CT5500	150200301	H VOLT CASE	C310027-1
	540100101	LABEL	DANGER HIGH VOLTAGE
	140100101	INSULATED SHEET	C810026-1B
	480200101	SNAP RIVET	DASR 5070
D2008-9, 3010, 3026-27, 3029	4911S1588	DIODE	1S1588
	84SCMC201	CAL & CONTROL PCB	5504-03-00
C2015	21A092202	CERAMIC CAPACITOR	DE070SL 220K 2K (22 pf 2K V)
C3014, 3015, 3017, C3018, 3022, 3023	21A291025	CERAMIC CAPACITOR	DE1110E 102Z 6K (10000 pf 6K V)
C2010, 2011, 2012, 2014	21A264723	CERAMIC CAPACITOR	DE1610E 472Z 3K (4700 pf 3K V)
C414	218CH181K	CERAMIC CAPACITOR	DD110CH 181K 50 (180 pf 50 V)
C2004	2130B152K	CERAMIC CAPACITOR	DD105B 152K 50 (1500 pf 50 V)
C3004	215CH820K	CERAMIC CAPACITOR	DD107CH 820K 50 (82 pf 50 V)
C630	22U1N102K	MYLAR CAPACITOR	501N5002 102K 50 V
C629	22U1N103K	MYLAR CAPACITOR	501N5002 103K 50 V
C2022	22U1N223K	MYLAR CAPACITOR	501N5002 223K 50 V
C437	22U2N103K	MYLAR CAPACITOR	501N1003 103K 100 V
C409	22U2N223K	MYLAR CAPACITOR	501N1003 223K 100 V
C2006	22U2N104K	MYLAR CAPACITOR	501N1003 104K 100 V
C608	2302K105J	METAL FILM CAPACITOR	ECQ-K-1105JG (105J100V)

5-4. CAL & CONTROL PCB ASS'Y

REF NO.	PARTS NO.	DESCRIPTION	
IC4001	510204011	I.C.	TC 4011BP
Q3010, 3011	48201846R	TRANSISTOR	2SC 1846-R
D3035, 3036, 3037	491HZ36L2	DIODE	HZ 36L-2
LD3035	492SLR34M	L.E.D	SLR-34MG (GREEN)
R4011	31SBK102F	METAL FILM RESISTOR	RNS 1/4K 1K F
R4010	31SBK103F	METAL FILM RESISTOR	RNS 1/4K 10K F
R4051	30SBO100J	CARBON FILM RESISTOR	RD 25ST 10 J
R3034	30SBO101J	CARBON FILM RESISTOR	RD 25ST 100 J
R3033, 3035	30SBO681J	CARBON FILM RESISTOR	RD 25ST 680 J
R4009	30SBO471J	CARBON FILM RESISTOR	RD 25ST 470 J
R4001, 4002	30SBO103J	CARBON FILM RESISTOR	RD 25ST 10K J
R4012	30SBO433J	CARBON FILM RESISTOR	RD 25ST 43K J
R4003, 4004, 4005	30SBO104J	CARBON FILM RESISTOR	RD 25ST 100K J
R4006	30SBO224J	CARBON FILM RESISTOR	RD 25ST 220K J
R4007, 4008	30SBO474J	CARBON FILM RESISTOR	RD 25ST 470K J
C4007	214CH050D	CERAMIC CAPACITOR	DD104CH 050D50 (5 pf 50 V)
C4009	2140B102K	CERAMIC CAPACITOR	DD104B 102K 50 (1000 pf 50 V)
C4001, 4002	22U1N103J	MYLAR CAPACITOR	501N5002 103 J 50 V
C4051	251FO470M	ELECTRALYTIC CAPACITOR	RE-25V 470M (47 uf 25 V)
P3001, 4001	090300102	CONNECTOR	5045-02A (2P)
P3002	090300304	CONNECTOR	5045-04A (4P)
P1002	090300808	CONNECTOR	5045-08A (8P)
VR3033, 3037	34300103B	POTENTIO METER	C610010-1-1 (10KB)
VR3036	34300202B	POTENTIO METER	C610011-1-1 (2KB)
VR3035	34300204B	POTENTIO METER	C610010-2 1 (200KB)
	84SCMM201	MODE PCB	5504-04-00

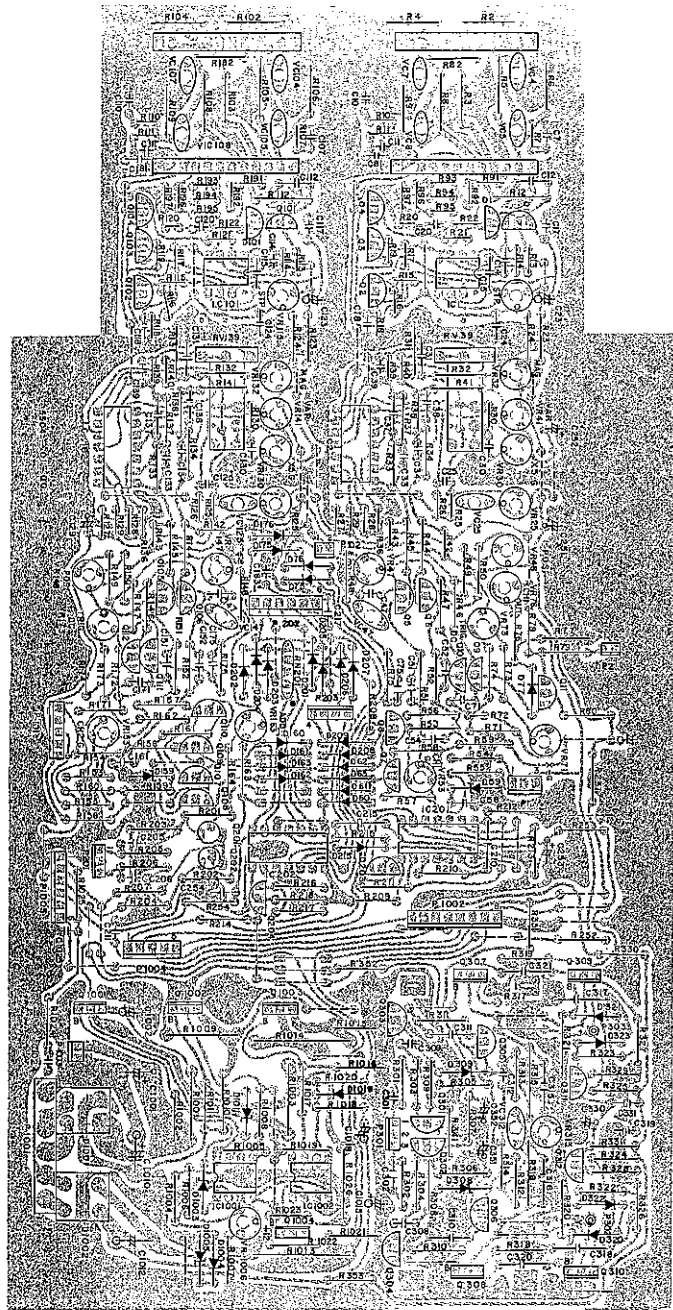
5-5. MODE PCB ASS'Y

REF NO.	PARTS NO.	DESCRIPTION	
D640	491S1588	DIODE	1S1588
LD640	492SLR34D	L.E.D	SLR-34DU
R640	30SBO103J	CARBON FILM RESISTOR	RD 25ST 10K J
C641	21CBC104Z	CERAMIC CAPACITOR	DD312BC 104Z 50
C640	2110B102K	CERAMIC CAPACITOR	DD104B 102K 50
S201	400300201	PUSH SWITCH	SUF 30 (C610015-1)
S601	400300301	PUSH SWITCH	SUF 30 (C610016-1)
P601	090300405	CONNECTOR	5045-05A (5P)
P202	090300506	CONNECTOR	5045-06A (6P)
	84SCMR201	C.R.T PCB	5504-05-00

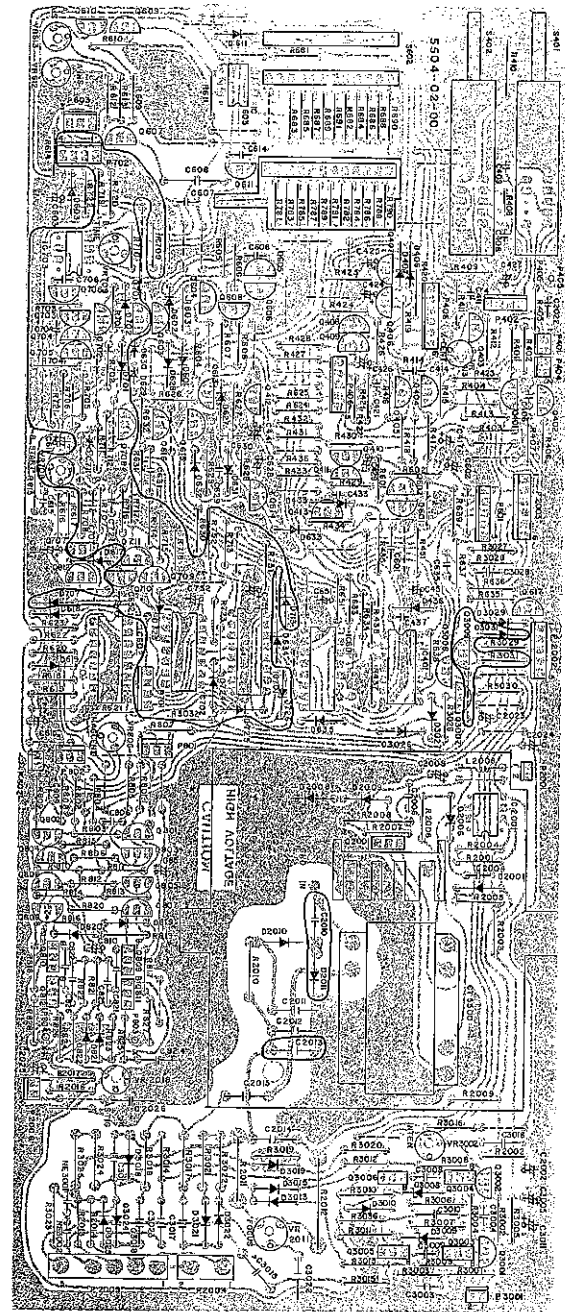
5-6. CRT PCB ASS'Y

REF NO.	PARTS NO.	DESCRIPTION	
R332, 333	30SBO561J	CARBON FILM RESISTOR	RD 25ST 560 J
L332, 333	637R72R2K	INDUCTOR	LF-7.5-2.2 uH
	090100101	C.R.T SOCKET	1339-1

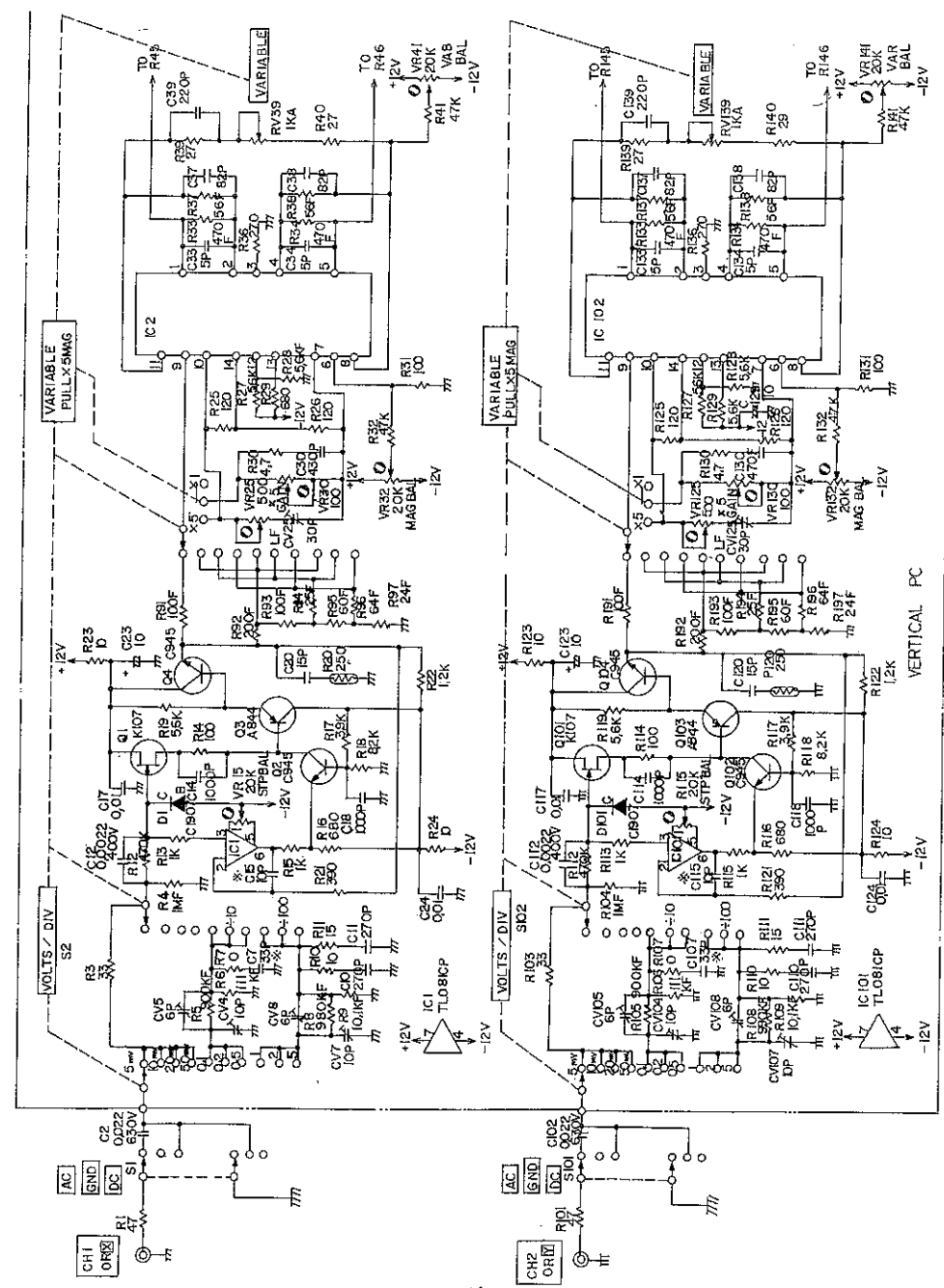
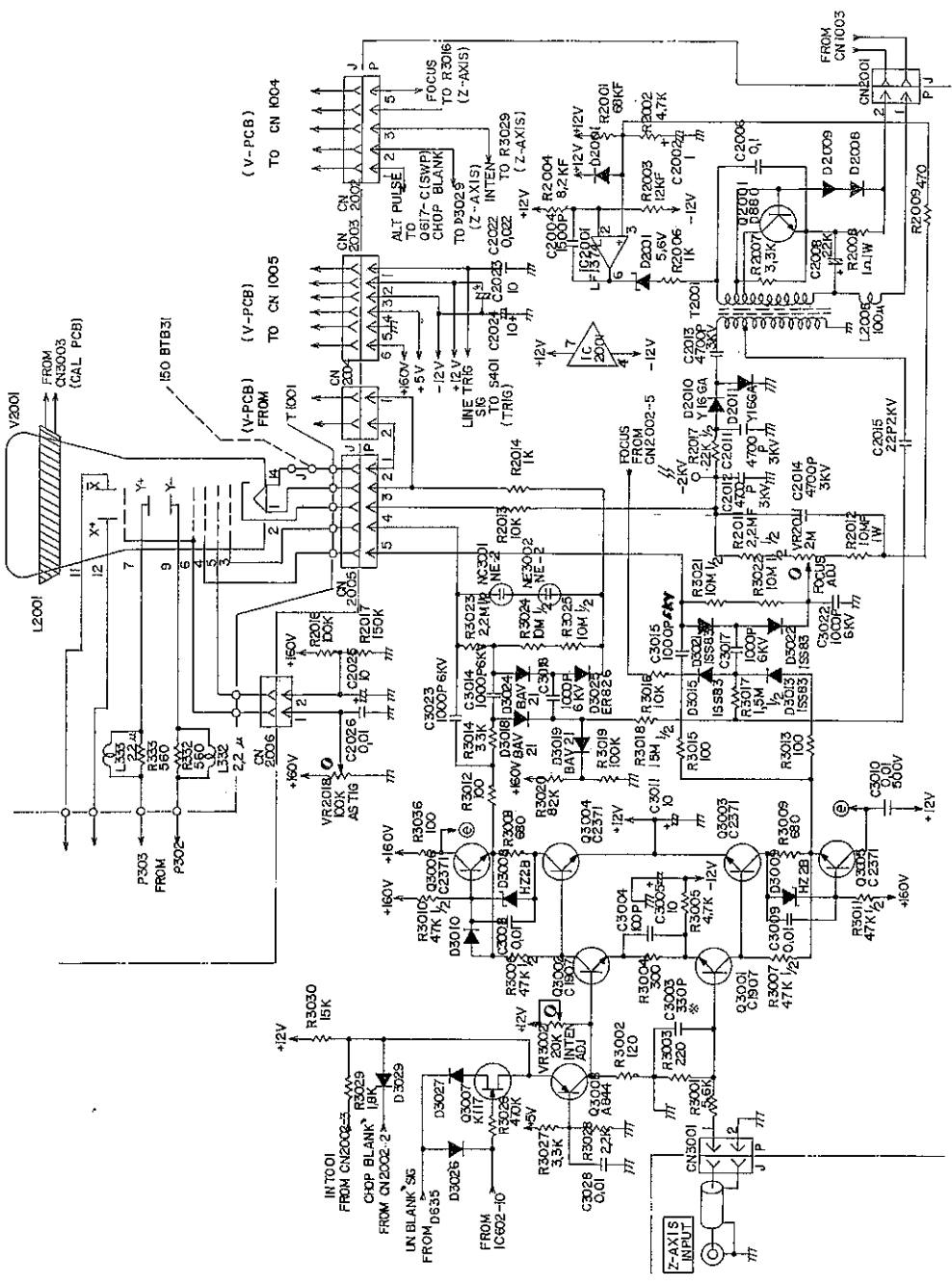
SECTION 6. COMPONENTS LAY-OUT

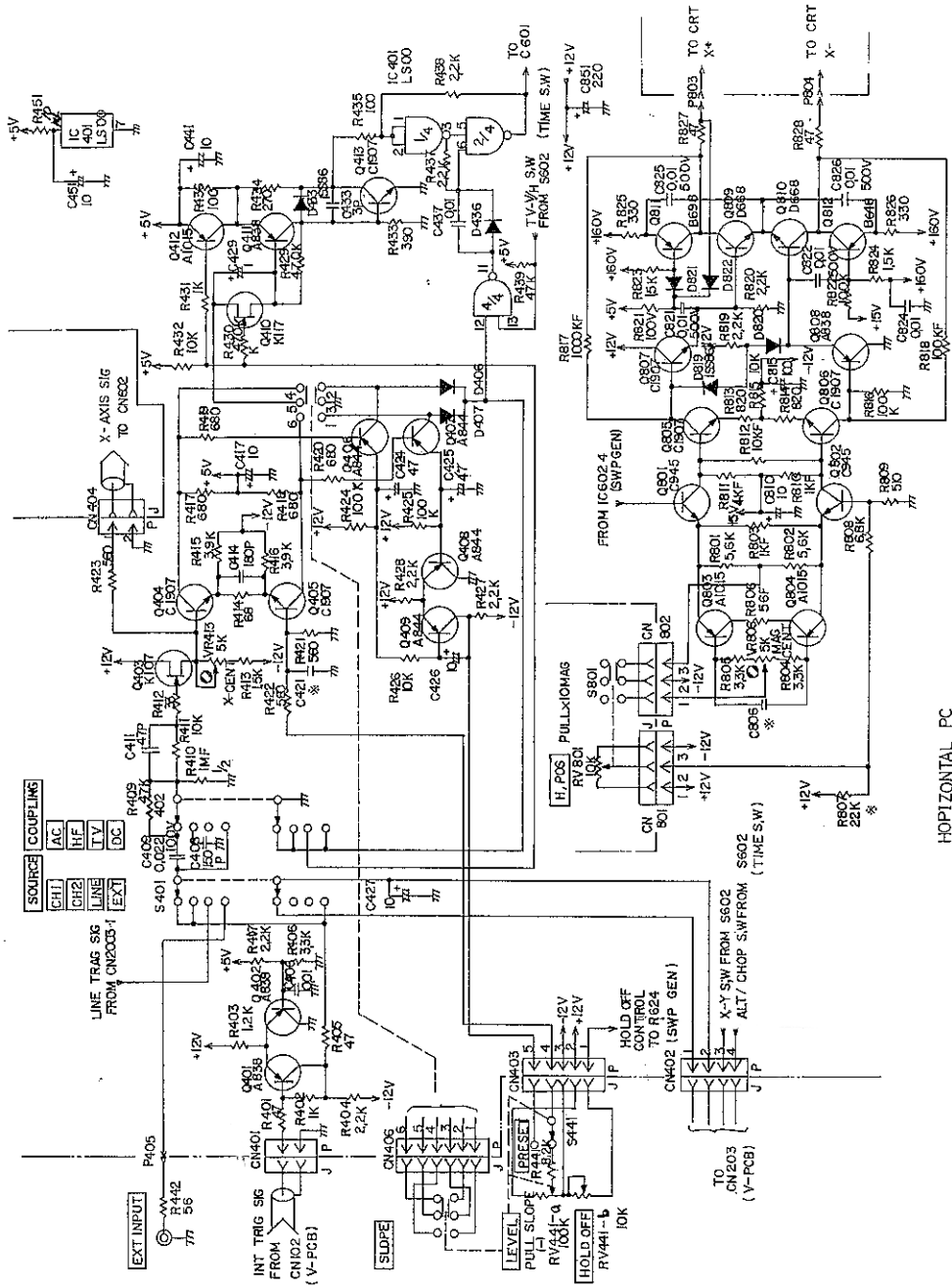


VERTICAL PCB UNIT



TIME HORIZONTAL PCB UNIT





HORIZONTAL PC

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