

OPERATOR'S MANUAL

READOUT OSCILLOSCOPE

OS-8020R



GoldStar Precision Co., Ltd.

WARRANTY

This Gold Star Precision Co, Ltd. product is warranted against defects in workman ship and materials. If any failure, resulting from a defect in either workman ship or material, shall occur under normal use within one year from the original date of purchase, such failure shall be corrected free of charge to the original purchaser by repair or, at Gold Star Precision's sole option, replacement of the defective part or parts. No charge shall be made for labor or services performed during said one year period providing the defective product is brought to our Authorized Service Station. Gold Star Precision Co, Ltd. will either repair or at its sole option, replace any part except for fuses, probes, lamps, batteries and other optional materials which are defective in either workmanship or material under normal and proper use.

This warranty does not cover equipment which has been tampered with in any way, or damage caused by accident, negligence, alteration, or misapplication. This product must be returned transportation prepaid, properly packed and insured. Gold Star Precision Co, Ltd. bears transportation cost of the repaired product to the purchaser. This warranty applies only to the original purchaser, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED. Gold Star Precision Co, Ltd. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

NOTE

- This instrument should be adjusted at ambient temperature of $+20^{\circ}\text{C}$ for best overall accuracy.
Allow at least 15 minutes warmup before proceeding.
- To clean the enclosure or the front panel, use neutral detergent. Refrain from using thinner, benzine, alcohol or other chemicals.
- For safety operation, the instrument chassis and cabinet be sure to connect the ground lead of the GND (ground) terminal to earth ground, if a two-wire AC power system is used. Failure to complete the ground system may allow the chassis and cabinet of this instrument to be elevated above ground potential and pose a shock hazard.

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1. FEATURES

This model is a compact type and advanced class on screen readout oscilloscope which covers a frequency bandwidth from DC to 20MHz.

- (1) Wide bandwidth :
The instrument has a bandwidth from DC to 20 MHz.
- (2) High sensitivity :
Sensitivity is 1 mV/div.
- (3) Large 6" screen :
Employment of a large square CRT makes waveforms easier to observe.
- (4) Internal graticule :
Employment of an internal graticule CRT permits waveforms observation to be made without parallax error.
- (5) Scale illumination :
Useful to illuminate the graticule when viewing in a dark area or photographing.
- (6) TV synchronization :
Employment of a new TV sync separator circuit allows the instrument to observe TV signals stably.
- (7) Auto focusing :
Focusing shift is automatically corrected.
- (8) Readout function :
Set values can be displayed on the CRT for photographing a waveform with the data.
- (9) Cursor measurement function
The voltage difference and the time difference are measured by the two electronic cursors and displayed on the CRT.
- (10) Automatic conversion of scale factor
The magnified sweep time and vertical deflection factor are automatically converted and displayed on the CRT.

2. ACCESSORIES

This instrument is shipped with the following standard accessories.

Fuse	:	1
AC power cord	:	1
Operator's manual	:	1

3. PRECAUTIONS

Precautions to be observed to lengthen the service life of this instrument.

Installation site

- * Avoid installing instrument in an extremely hot or cold place.
 - Avoid placing this instrument in a place exposed to sun-light for a long period of time, in a closed car in mid-summer, or near a room heating device such as a stove.
 - The operating maximum ambient temperature is +40°C.
- * Do not use instrument that has been left outdoors on a cold winter day.
The operating ambient temperature is 0°C or more.
- * Avoid moving the instrument rapidly from a hot place to a cold place or vice versa, or condensation may form on inside of the instrument.
- * Keep the instrument away from damp air, water, and dust.
Unexpected trouble may be caused when the instrument is placed in a damp or dusty place.
The operation ambient humidity is 35–85%.
Since an accidental intrusion of water may also cause troubles, do not place a water-filled containers such as a vase on the oscilloscope.

- * Do not place the instrument in a place where vibration is strong. Avoid using the instrument at a place vibrating violently. Since the oscilloscope is a precision instrument, excessively strong vibrations may cause damage.
- * Do not place the instrument near a magnet or magnetic body. An oscilloscope is an equipment using electron beam. Therefore, do not bring a magnet close to the instrument or do not use the instrument near an equipment generating strong magnetic force.

Handling

- * Do not put a heavy objects on the oscilloscope.
- * Do not block the ventilation holes.
- * Do not apply a heavy shock to the oscilloscope.
- * Do not insert a wire, pin, etc. through the ventilation hole.
- * Do not drag the set, leaving the probe attached to it.
- * Do not leave a hot soldering iron on the cabinet or the screen.
- * Do not try to turn the instrument upside down. Otherwise, knobs may be broken.
- * Do not use the instrument upright, leaving BNC cable connected to EXT BLANKING terminal on the rear panel. Otherwise, the cable may be damaged.

Handle

The handle, placed in the side cover, can be positioned for carrying or as a tilt-stand for the instrument. To position the handle, press in at both pivot points and turn the handle to the desired position. 13 positions are provided for convenient carrying or viewing.

When not in use

When not in use, put the dust-proof cover on the instrument and store it with care.

Power supply

Allow three seconds or more before turning on the power switch after it has been set to off. This is applicable to the case that the power cord is disconnected with the power switch set on. The built-in microprocessor may not normally operate if the rated voltage is not supplied. In this case, set the POWER switch to OFF, and then to ON to reset the microcomputer in the normal operation mode. If any problem persists, contact your local GOLD STAR PRECISION service station.

Care and repair

- * Removal of stain from the case.
 - When the outside of the case is stained, remove stain by first wiping it lightly with a cloth moistened with neutral washing agent and then wipe the surface with a dry cloth.
- * Never use strongly volatile agent such as benzine and thinner.
 - When the panel surface is stained, remove the stain in similar way with a clean, soft cloth. When heavy stains are present, first remove the stains by wiping the surface lightly with a cloth moistened with diluted neutral washing agent or with alcohol and then wipe thoroughly with a dry cloth.
 - When dust has accumulated on the inside, remove it by using dry brush, or by using the exhaust of a compressor or a vacuum cleaner.

NOTE : When opening the case, pull out the power supply plug beforehand without fail.

When cleaning the inside, insure beforehand that no electricity remains in the condensers of the power supply circuit.

* Cleaning of CRT

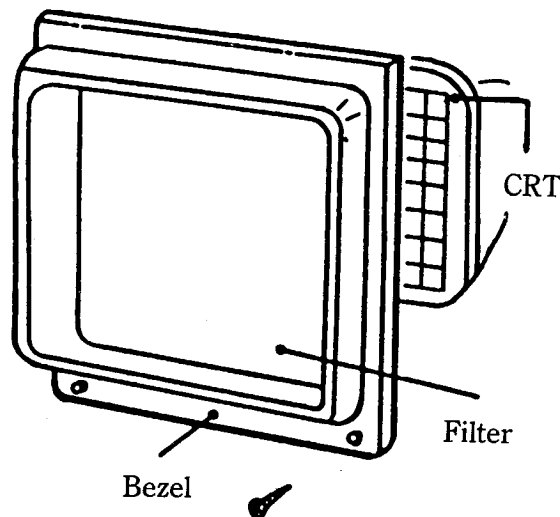
Dirty surface of CRT screen tends to cause measuring errors.

The screen surface becomes visible when the bezel is removed.

Remove the stains on CRT and filter by using a clean and soft cloth, paying attention not to impair them.

When the stain is extremely heavy, wash them with neutral washing agent and then leave them stand until the moisture is removed naturally.

- If the screen is installed while it is moistened, water rings may be formed and the waveform may be blurred to become hard to observe. Pay attention not to leave fingerprints on it.



Operation precautions

- * Check the line voltage.

The operating voltage range of this oscilloscope is as shown below. Check the line voltage without fail before turning on the power switch.

Rating	Line Voltage (50/60Hz)
AC100V	AC 90V – 110V
AC120V	AC108V – 132V
AC220V	AC198V – 242V
AC240V	AC216V – 264V

Nominal volts $\pm 5\%$ at 400Hz.

In the case of normal shipment, the voltage selector will be set convenient for user up. When it is intended to use the oscilloscope on voltages other rating, voltage selector can be turned. (Rated voltages are indicated on the rearpanel of the oscilloscope.)

- * Use only specified fuses.

In order to protect the circuit against overcurrent, a 2A (make use of AC100V or AC120V) or 1A (make use of AC220V or AC240V) is used on the primary side of the power supply. When this fuse is below out. check thoroughly the cause, repair any faulty point present, and then replace with a specified fuse. Do not try to use the fuse other than the specified ones. Otherwise, fault may be caused or danger may be invited.

(Particularly, do not use a fuse different from the specified one in current capacity and in length.) The standards of the fuses are as follows.

	Dimensions (Diameter \times length) mm	Type number
2A	5.2 \times 20	MF 51NM 125V 2A AC
1A	5.2 \times 20	MF 51NM 250V 1A AC

- * Do not increase the brightness too much.

Do not increase the brightness of the spot and trace too much. Your eyes may be strained and the fluorescent surface of CRT may be burnt.

- * Do not apply an excessive voltage.

The input withstand voltage of each input connector and probe input is as follows. Never apply a voltage higher than specified.

INPUT direct : 300V (DC + AC peak at 1 kHz)
 When $\times 10$ probe is used : 400V (DC + AC peak at 1 kHz)
 When $\times 1$ probe is used : 300V (DC + AC peak at 1 kHz)
 EXT TRIG INPUT : 300V (DC + AC peak)
 EXT BLANKING : 30V (DC + AC peak)

Calibration Interval

To maintain instrument accuracy, perform the calibration at least every 1000 hours of operation, or every six months if used infrequently.

- * Check the initial set values.

When the power is turned off, and then turned on, the initial set values are set as shown below.

Item	Initial setting
Cursor	REF(\times)
Cursor value	ΔV : 4div ΔT : 6div

4. SPECIFICATIONS

CRT

- Type

Large 6" screen with internal graticule.
Approximate 2KV acceleration potential.

- Phosphor

P31 standard

- Graticule

8 × 10 div (1div = 10mm)
Internal graticule

- Trace rotation : Provided
- Intensity control : Provided
- Focussing : Possible
- Scale illumination : Variable

VERTICAL DEFLECTION SYSTEM

- Frequency response & Rise time

DC to at least 20MHz and rise time 17.5ns or less. DC to at least 7 MHz and rise time 50ns or less at magnifier extends. The AC coupled lower - 3dB point is 10Hz or less.

- Deflection factor

5mV/div in 10 calibrated steps in a 1-2-5 sequence. Uncalibrated continuous control extends deflection factor to at least 12.5 Volts per division in the 5 Volts/div position. ×5 magnifier increases sensitivity of each deflection factor setting to 1mV/div.

- Accuracy

± 3%
Additional error for magnifier ± 2%.

- Display modes

CH1, CH2 (normal or invert), Alternate, Chopped (approximate 250KHz)

- Input impedance

Approximately $1\text{ M}\Omega$ in parallel with 25pF

- Maximum input voltage

300V (DC + peak AC) or 500 Vp-p AC at 1kHz or less

- Input coupling

AC, GND, DC

HORIZONTAL DEFLECTION SYSTEM

- Sweep rate

$0.2\mu\text{s/div}$ to 0.2s/div in 19 calibrated steps in a 1-2-5 sequence. Uncalibrated continuous control extends deflection factor to at least 0.5 seconds per division in the 0.2 sec/div position. $\times 10$ mag extends maximum sweep rate to 20 ns/div .

- Accuracy

$\pm 3\%$

Additional error for magnifier $\pm 2\%$

TRIGGERING SYSTEM

- Trigger modes

Automatic, Normal, TV (TV-H or TV-V)

- Trigger source

CH1, CH2, LINE, EXTERNAL

- Trigger coupling

AC, HF Rejection, LF Rejection, DC

- HOLD OFF

Variable

- Trigger slope

+, -

* NOTE : In TV trigger mode, the slope is inverted.

- Triggering sensitivity and frequency

	20Hz - 2MHz	2MHz - 20MHz
INT	0.5div	1.5div
EXT	200mV	800mV

- TV-V sensitivity

SYNC section less than 1 div or 1V

- External trigger input

Approximately 1 M Ω in parallel with 20pF

- Maximum input voltage

300V (DC + peak AC)

X-Y OPERATION (CH1 ; Horiz, CH2 ; Vert)

- Deflection factor

Same as vertical deflection

- X-bandwidth

DC to at least 500KHz

- Phase error

3 ° or less from DC to 50KHz

Z-AXIS INPUT (INTENSITY MODULATION)

DC-coupled, positive-going signal decreases intensity.

5Vp-p signal causes noticeable modulation at normal intensity : DC to 2MHz

Input impedance : 21 K Ω (typ.)

Maximum input voltage : 30V (DC + peak AC)

CALIBRATOR

An approximate 1KHz frequency 0.5V ($\pm 3\%$) squarewave.

SIGNAL OUTPUT

CH1 VERT Signal output

Output voltage is at least 20mV/div into a 50 ohm load.

Bandwidth is DC to at least 10MHz

READOUT FUNCTION

The readout function is not applicable to the ADD mode or X-Y mode, when MAG $\times 10$ Switch is pulled. And the function can be OFF.

- Panel setting displays

Vertical axis (CH1, CH2) : V/DIV, UNCAL, MAG (Converted Value)

Horizontal axis : S/DIV, UNCAL, MAG (Converted value)

- Cursor readout function

Voltage difference ΔV : Δ to REF

Time difference ΔT : Δ to REF

Frequency difference $1/\Delta T$: $1/1\Delta$ to REF 1

NOTE : When the X-Y mode, ΔV is changed to ΔX
and ΔT to ΔY .

- Cursor measurement resolution : 1/25 DIV

- Effective cursor range from center graticule

Vertical : within ± 3 DIV

Horizontal : within ± 4 DIV

POWER SUPPLY

VOLTAGE(50/60Hz)	FUSE
100V(90 – 110V)	2A
120V(108 – 132V)	2A
220V(199 – 242V)	1A
240V(216 – 264V)	1A

Power supply frequency : 50, 60, 400Hz

Power consumption : Approx. 50W

ENVIRONMENT

Limit of operation temperature	:	0	to +40°C
Limit of operation humidity	:	35	to 85%
Rated range of use temperature	:	+10	to +35°C
Rated range of use humidity	:	45	to 85%
Storage and transport temperature	:	-20	to +70°C

DIMENSIONS AND WEIGHT

Approx. 290(W) × 145(H) × 375(D)mm
(11.6(W) × 5.8(H) × 15(D)inch)

Approx. 7.4Kg (16.2 lbs)

5. MAINTENANCE AND SIMPLE TROUBLE SHOOTINGS

(1) Maintenance

- Since semiconductors, precision components, etc. are employed in this oscilloscope, use at most care for operation and storage.
- Clean the screen with soft tissue periodically.

- Side panel can be removed with a screw driver.
- Store this oscilloscope in the ambient temperature from -10 to $+60^{\circ}\text{C}$.

(2) Simple trouble shooting

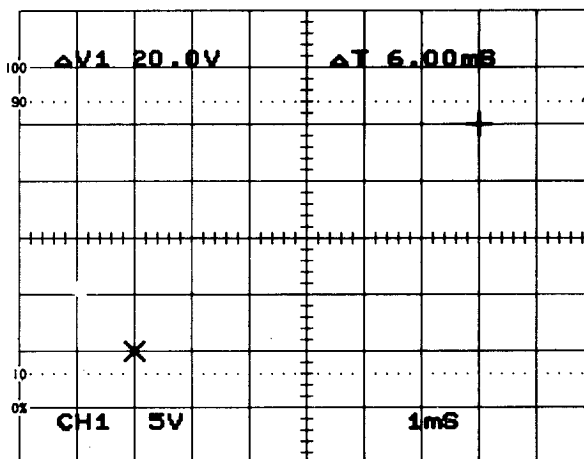
* NO operation or misoperation when power ON.

- 1) Check the power source voltage and power selection switch location.
- 2) Check the fuse which is located in the power selection switch.

* Readout characters displacement

- 1) Check and remove the magnetic source around the equipment.
- 2) If the symptom is severed, adjust the position as followings ;

- Power ON and warm up the equipment about 15 minutes at room temperature ($+25^{\circ}\text{C}$).
- Set all the panel switches as followings ;
 - V. MODE : CH1
 - CH1 V. POSITION : Center, pushed
 - CH1 V. VARIABLE : Clockwise max, pushed
 - CH1 VOLTS/DIV : 5 V
 - H. POSITION : Center, pushed
 - H. VARIABLE : Clockwise max, pushed
 - TIME/DIV : 1 mS
 - READOUT INTEN : Clockwise max
 - SWEEP INTEN : Center
- Warm up 15 minutes or longer at room temperature ($+25^{\circ}\text{C}$).
- To initialize the microporcessor turn off the power and then on again.
- Loosen the top cover screws, and open the top cover.
- Adjust the X-CENT, X-GAIN, Y-GAIN variable resistors, which is located on R/O CPU BOARD, as the following figure. And then, close the top cover and tighten the top cover screws.



6. CONTROLS AND CONNECTORS

(1) Power supply and CRT

Operating voltage fuse

This model can be operated from either a 100-volt, a 120-volt, a 220-volt or a 240-volt nominal line voltage source.

The Line Voltage Selector assembly on the rear panel converts the instrument from one operating range to the other. In addition, this assembly changes the primary connections of the power transformer to allow selection of one of four regulating ranges. The assembly also includes the line fuse. Use the following procedure to convert this instrument between nominal line voltage or regulating ranges.

1. Disconnect the instrument from the power source.
2. To convert from 100-volts nominal to 220-volts nominal line voltage or vice versa, pull out the voltage Selector switch turn it, and plug it back into the remaining holes. Change the line-cord power plug to match the power-source receptacle.
3. Before apply power to the instrument, check that the indication tabs on the rear panel.

① POWER switch

The POWER is set on at the pushed-in position, and set off at the released position.

② POWER lamp

This lamp goes on in red when the power supply is in ON state.

③ INTENsity control

This knob also works as the brightness adjust variable resistor. Brightness is increased by rotating INTENsity clockwise.

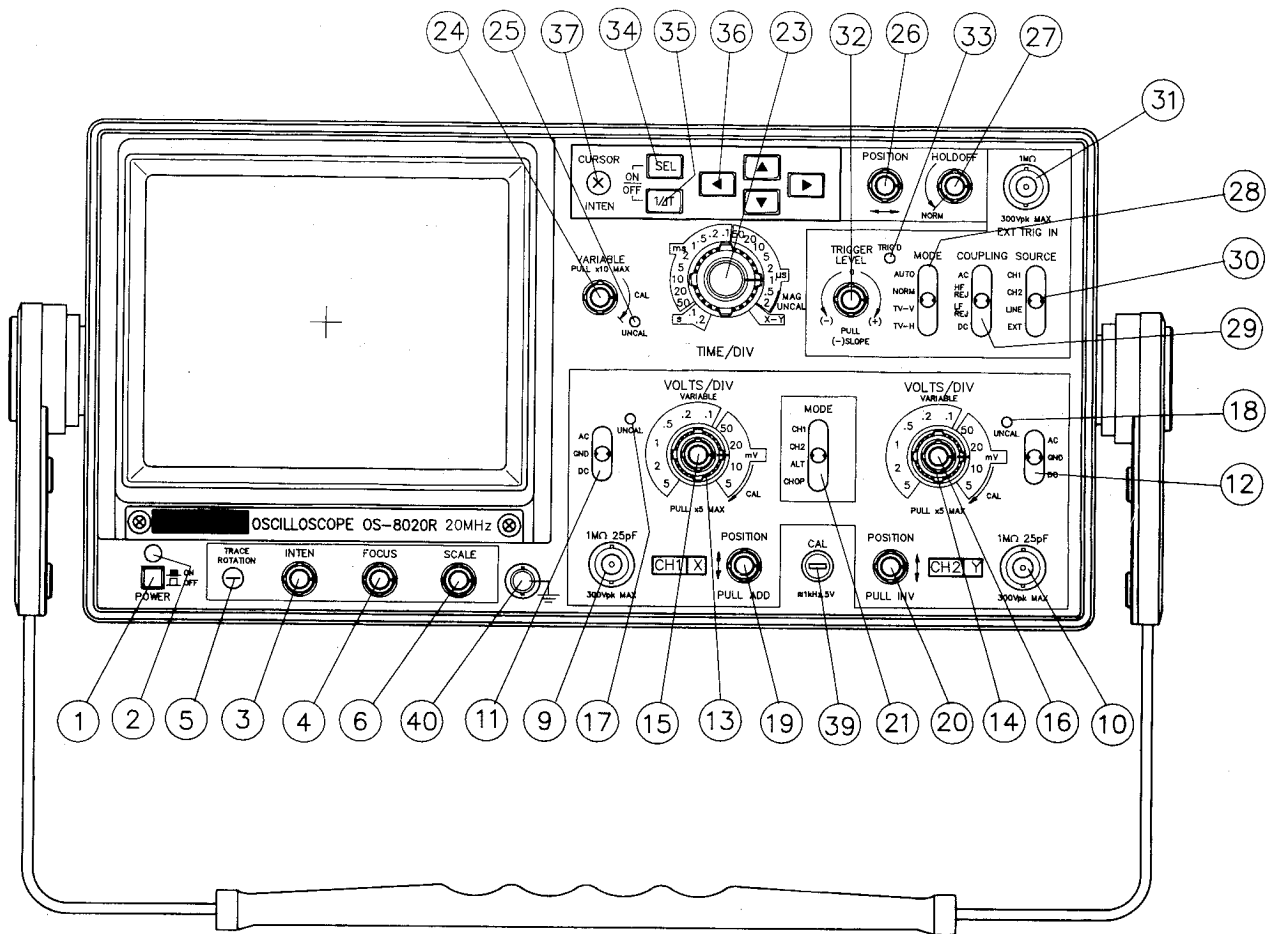


FIG. 6-1 OS-802OR FRONT VIEW

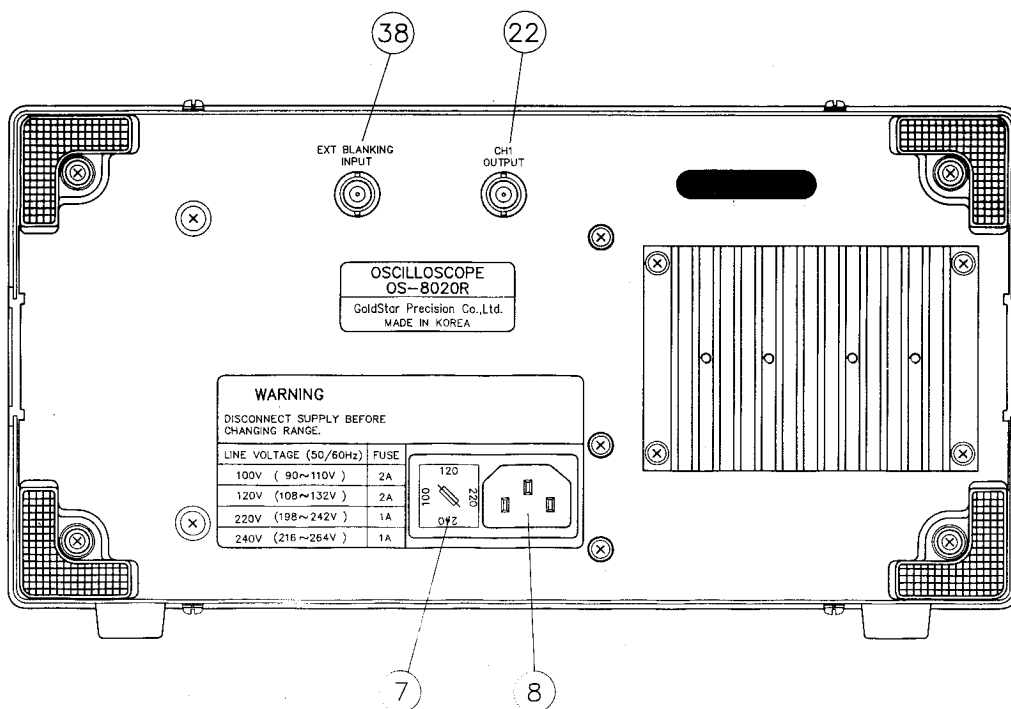


FIG. 6-2 OS-802OR REAR-VIEW

④ FOCUS control

After obtaining an appropriate brightness by operating INTENSity, adjust FOCUS until the bright line is clearest. Although the focus is also corrected automatically when INTEN is rotated, the focus is sometimes slightly shifted.

⑤ TRACE ROTATION control

Used to aline the trace of CRT with the horizontal graticule.

⑥ SCALE illumination control

Control graticule illumination, Useful to illuminate the graticule when viewing at a dark area or photographing.

⑦ Power source select switch

Used to select the power sources.

⑧ AC inlet

This is inlet for detachable AC power cord.

(2) Controls of vertical deflection system

⑨ CH1 INPUT connector

BNC connector for vertical axis input.

The signal input to this terminal becomes the X-axis[Y-axis] signal when the instrument is used as an X-Y oscilloscope.

⑩ CH2 INPUT connector

The same as CH1, but when the instrument is used as an X-Y oscilloscope, the signal input to this terminal becomes the Y-axis signal.

⑪ ⑫ Input coupling switches (AC-GND-DC)

The switches used to select the coupling system between the input signal and vertical axis amplifier.

AC : At this setting the signal is connected through a capacitor. The DC component of the input signal is cut off and only the AC component is displayed.

GND : At this setting the input to the vertical axis amplifier is grounded.

DC : At this setting the input signal is directly connected to the vertical axis amplifier and displayed unchanged, including the DC component.

⑬ ⑭ VOLTS/DIV select switches

A step attenuator which selects vertical deflection factor. Set it to an easily observable range corresponding to the amplitude of the input signal.

Multiply the reading by 10 when the 10 : 1 probe is used in combination with the instrument.

⑮ ⑯ VARIABLE PULL ×5 GAIN controls

Fine tuning device used to vary the vertical deflection sensitivity continuously. Attenuation of less than 1/ 2.5 is obtained when this device is rotated in the reverse direction of the arrow to the full.

This control is used when comparing waveforms or when measuring the rise time of a square wave in 2-channel observation. Normally this control is left rotated in the direction of the arrow to the full. When the knob is at PULL position (pulled up state) the gain of the vertical axis is magnified 5 times and the maximum sensitivity becomes 1mV/DIV.

⑰ ⑱ UNCAL lamp(red LED)

These lamps go on in red when the variable switches are unlocked.

⑲ POSITION controls
PULL ADD

This knob is used to adjust the position of the vertical axis.

The display rises with a clockwise rotation of this knob and falls with a counterclockwise rotation.

When the knob is at PULL position(pulled up state), displays the algebraic sum of the channel 1 and channel 2 input signals.

If the channel 2 display is inverted, CH1 minus CH2 display results.

⑳ POSITION controls
PULL INVERT

The same as CH1, but when the knob is at PULL position (pulled up state), the polarity of the input signal applied to CH2 will be inverted.

This control is conveniently used in the comparison of two waveforms having different polarity or in the observation of the waveform of the difference between signals of CH1 and CH2 using ADD facility.

㉑ MODE select switch

This switch is used to select the operation mode of the vertical deflection system.

CH1 : Only the signal that has been applied to CH1 appears on the screen.

CH2 : Only the signal that has been applied to CH2 appears on the screen.

ALT : Signals applied respectively to CH1 and CH2 appear on the screen alternatively at each sweep. This setting is used when the sweep time is short in 2-channel observation.

CHOP : At this setting the input signals applied to CH1 and CH2 are switched at about 250kHz independent of the sweep and at the same time appear on the screen. This setting is used when the sweep time is long in 2-channel observation.

②② CH1 OUTPUT connector

Output connector providing a sample of the signal applied to the CH1 connector.

(3) Controls of Horizontal deflection system

②③ TIME/DIV select switch

Sweep time ranges are available in 19 steps from $0.2 \mu\text{s}/\text{div}$ to $0.2\text{s}/\text{div}$.
X-Y : This position is used when using the instrument as an X-Y oscilloscope. In this position the X (horizontal) signal is connected to the input of CH1 ; the Y (vertical) signal is applied to the input of CH2 and has a deflection range from less than one millivolt to 5 volts/div at a reduced bandwidth of 500kHz.

②④ SWEEP VARIABLE controls
PULL \times 10 MAG

This control works as CAL and the sweep time is calibrated to the value indicated by TIME/DIV.

TIME/DIV of sweep can be varied continuously when shaft is out of CAL position.

Then the control is rotated in the direction of arrow to the full, the CAL state is produced and the sweep time is calibrated to the value indicated by TIME/DIV.

Counterclockwise rotation to the full delays the sweep by 2.5 times or more. Sweep is magnified 10 times by pulling out knob of VARIABLE. In this case, the sweep time is 1/10 of the value indicated by TIME/DIV. Bring the position of the waveform desired to be magnified observed to the center of the scale by operating \rightarrow POSITION of the horizontal axis. Next, PULL \times 10 MAG switch is pulled out state. Then the waveform placed at the center is magnified in right and left directions.

The sweep time in this case is 10 times the sweep speed obtained by TIME/DIV, in other words, the reading is 1/10 of the sweep time indicated.

②⑤ UNCAL lamp (red LED)

This lamp goes on in red when the variable switch is unlocked.

②⑥ POSITION control

This knob is used to move the display in horizontal directions. It is indispensable in the measurement of the time of waveform.

Display is moved toward right when the knob is rotated clockwise and toward left with counterclockwise rotation.

②⑦ HOLD OFF control

Increases the time between sweeps and aids triggering on complex displays such as high frequency signal, irregular signal and digital words.

Rotate the HOLD OFF slightly to obtain a stabilized triggering.

Normally, leave this knob rotated to NORM position.

(4) Synchronization system

⑳ Trigger MODE select switch

- AUTO : The instrument is brought into automatically triggering sweep in which sweep is always conducted.
In the presence of triggered signal, normal triggered sweep is obtained and the waveform stands still. In the case of no signal or out of triggering, sweep line will appear automatically. This setting is convenient in usual cases.
- NORM : Triggered sweep is obtained and sweep is conducted only when triggering is effected. No sweep line will appear in the case of no signal or out of synchronization. Use this mode when effecting synchronization to a very low frequency signal (25Hz or less).
- TV(V) : This setting is used when observing the entire vertical picture of television signal.
- TV(H) : This setting is used when observing the entire horizontal picture of television signal.
- (NOTE) : Both TV-V and TV-H synchronize only when the synchronizing signal is negative.

㉑ COUPLING Select switch

- This switch is used to select the coupling mode of a sweep triggering signal.
- AC : At this setting both the DC component and the very low frequency of triggerings, signal are cut off.
- HF REJ : Among the AC components of triggering signal, the high frequency components of about 15 kHz or more are attenuated. A stabilized triggering unaffected by noises of about 15 kHz or more can be obtained.
- LF REJ : Among the AC components of the triggering signal the low frequency components of less than about 15 kHz are attenuated. A stabilized triggering free from noises of less than about 15 kHz can be obtained.
- DC : Triggering signal is amplified unchanged. This setting is used when triggering with a very low frequency signal or when effecting DC like triggering.

㉒ SOURCE select switch

- This switch is used to select the triggering signal source.
- CH1 : The input signal applied to CH1 becomes the triggering signal.
- CH2 : The input signal applied to CH2 becomes the triggering signal.
- LINE : This setting is used when observing a signal with power supply line frequency.
- EXT : External triggering signal applied to TRIG IN-put becomes the triggering signal.

This setting is used when triggering with a special independency of the vertical axis signal.

① External TRIG IN connector

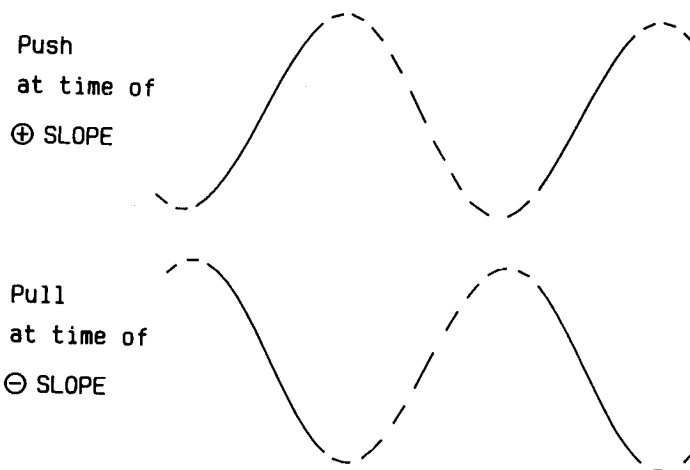
Input terminal for use for external triggering signal.

② TRIGGER LEVEL control
PULL(−)SLOPE

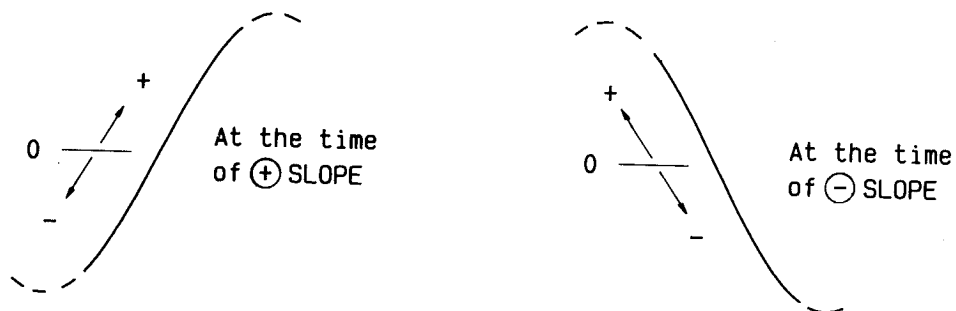
This knob is used to decide that which portion of the waveform should the sweep be started by setting trigger level. This knob is also enabled to switch SLOPE.

Depressed position (normal state) is for \oplus SLOPE and PULL position (state in which the knob is protruding) is for \ominus SLOPE.

Explanation of trigger polarity SLOPE



Explanation of trigger LEVEL



③ TRIG'D lamp (Green LED)

The lamp is lit up during input signal is triggered.

(5) Readout function switches

③④ Cursor SELECT switch

This switch has the function of changing the cursor selection mode, such as reference cursor (X), Delta cursor (+) and tracking cursor (X, +) The selected cursor is displayed brighter than the other.

③⑤ 1/ Δ T switch

This switch changes the measurement mode such as Δ T or 1/ Δ T.

③④ ③⑤ Readout ON/OFF switch

Readout OFF function can be achieved by pushing these two switches simultaneously. And by pushing one of the switches, readout function is restored.

③⑥ Cursor movement switches

By pushing these switches, the selected cursor can be moved to any position.

③⑦ Cursor INTENSity control

This is used to adjust the intensity of characters and cursors.

(6) Miscellanea

③⑧ EXT BLANKING INPUT connector

Input terminal for brightness modulation. It is of the DC coupling. The brightness is reduced with a positive signal and increases with a negative signal.

③⑨ CAL 0.5V tip

Output terminal of calibration square wave of about 1 kHz and 0.5V. It has a tip terminal. It is used to calibrate the probe combination.

④⑩ Grounding terminal

Earth terminal of the oscilloscope.

7. HOW TO OBTAIN THE DISPLAYS

Before turning ON the POWER switch, insure the power supply voltage is within the range of 108-132V for AC 120V set, 198-242V for AC 220V set, and 216-264V for AC 240V set.

Insert the plug of the power cord on the rear panel into an wall outlet and set the controls as follows.

POWER ①	OFF
INTENsity ③	Counterclockwise to the full
FOCUS ④	Mid-range
AC-GND-DC ⑪	GND
↕ POSITION → ⑱	Mid-range (The knob is in the depressed)
PULL ADD ↗	
MODE ⑳	CH1
Trigger MODE ㉓	AUTO
Trigger SOURCE ㉔	CH1
Trigger COUPLING ㉕	AC
TIME/DIV ㉖	0.5ms/div
↕ POSITION ㉗	Mid-range

After completion of the above settings, set the POWER switch to ON, Fifteen seconds later, rotate the INTEN control clockwise, and a trace and characters are displayed. (If the characters are not displayed, set the POWER switch to OFF, and then to ON again.)

To observe a waveform, rotate the FOCUS control so that the trace is sharpest.

If the oscilloscope is not used for a long time with the power on, rotate the INTEN control counterclockwise so that the intensity is lowest. Align the trace with the horizontal graticule line at the center of the screen by the CH1 POSITION control. At this time, the trace may be slightly oblique to the graticule line to earth magnetism. In this case, adjust the semi-fixed variable resistor TRACE ROTATION on the front panel to properly align the trace with the graticule line.

NOTE

For usual observation, leave the following non-calibrating function section set to 'CAL' position.

VARIABLE	Rotate in the direction of arrow. In this case, the VOLTS/DIV is calibrated to its indicating value.
SWP VAR	Leave the knob in depressed state. In this case, the TIME/DIV is calibrated to its indicating value.

GENERAL MEASUREMENT

(1) In the case of observing a single waveform

Use CH1 or CH2 when not observing the phase difference between two waveforms or when engaging in a operation other than X-Y operation. Make the following settings when using CH1.

MODE select switch ②① : CH1
Trigger MODE switch ②⑧ : AUTO
Trigger SOURCE ③⑩ : CH1
Trigger COUPLING ②⑨ : AC

Under these setting almost all the repetitive signals of about 25Hz or more applied to CH1 can be synchronized and observed by adjusting trigger LEVEL. Since the MODE of horizontal axis is at AUTO position, the base line appears even when no signal is present or when input coupling switch is at GND position. This means that the DC voltage can be measured. The following switching is needed when observing low frequency signals of about 25Hz or less.

Trigger MODE ②⑧ : NORM

Synchronization can be effected by operating LEVER knob under this setting. When using only CH2, use the instrument after making the following settings.

MODE select switch ②① : CH2
Trigger SOURCE ③⑩ : CH2
Trigger COUPLING ②⑨ : AC

(2) When observing two waveforms

Observation of two waveforms can be made easily by setting the MODE switch of vertical axis to ALT or CHOP. When observing two waveforms of high repetition frequencies set the MODE switch to ALT and, in the case of low frequencies, set it to CHOP.

When measuring the phase difference, measure after effecting synchronization with leading phase signal.

8. METHOD FOR CONNECTING SIGNALS

The first step of measurement is introducing the signal desired to measure to the oscilloscope properly.

Do it with utmost care.

(1) When using a probe :

Use the attached probe when measuring a high frequency wave with high accuracy. It should be noted, however, that since the input signal is attenuated by this probe to 1/10 before it is input to the oscilloscope the use of the probe is disadvantageous for low level signals, and that at the same time the measuring range is extended by that amount for high level signals.

<CAUTIONS>

- Do not apply a signal which exceed 400V(DC + peak AC at 1kHz).
- Bring the grounding point of the earth lead wire of the probe close to the point to be measured when measuring a rapid rising signal or a high frequency signal. Long earth lead wire may cause waveform distortion such as ringing and overshoot.
- Multiply the reading of VOLTS/DIV by 10.
For example, if the VOLTS/DIV is 50mV/DIV, then read the waveform as

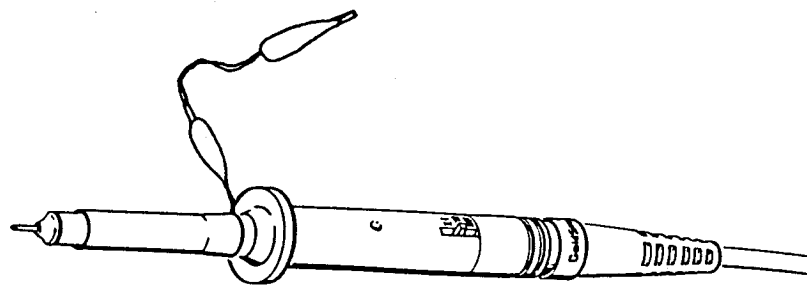
$$50\text{mV/div} \times 10 = 500\text{mV/div}$$

- To avoid measurement error, put the probe in the following correction state and check it before measurement without fail.

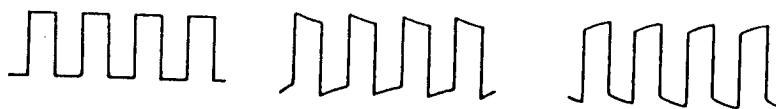
Connect the tip of the probe to the CAL 0.5V tip of 1kHz calibration square wave.

When this correction capacity value is at optimum the waveform takes the shape as shown in Fig. (a).

If the waveform is as shown in Fig. (b) or Fig. (c), rotate the trimmer on the matching box of the probe by using a screwdriver until the optimum state is obtained.



Capacitance correction trimmer



(a) correct

(b) over-shoot

(c) under-shoot

(2) At the time of direct connection

When connecting a signal directly to the oscilloscope not using the attached probe, pay attention to the following points in order to minimize the measurement error.

- When performing observation using a bare lead wire, no trouble occurs of the circuit to be measured is of low impedance and high level.

However, note that, in most cases, measurement error may be caused by static, stray coupling with other circuit and power line.

This measurement error cannot be ignored even in low frequency region.

In general, it is safe to avoid measuring with nonshielded connecting wire,

When using a shielding wire, connect one end of the shield to the earth terminal of the oscilloscope and the other end to the grounding of the circuit to be measured. It is desirable to use a coaxial cable with BNC type connector.

- The following cautions must be observed when performing a wide band measurement.

It is necessary to terminate with the characteristic impedance of the cable when measuring a rapid rising waveform or a high frequency wave.

Especially when using a long cable, the absence of a terminating resistor will necessarily lead to a measurement error derived from ringing phenomenon.

Some measuring circuits require a terminating resistor equal to the characteristic impedance of the cable also on the measurement terminal side.

BNC type terminating resistor (50Ω) is conveniently used for this purpose.

- In order to perform measurement with the measuring circuit put in proper operating state it is sometimes necessary to terminate the cable with an impeda-

nce which corresponds to the circuit to be measured.

- The stray capacity of the shielded wire must be taken into account when performing measurement with a long shielded wire. Since the shielded wire normally in use has a capacitance of about 100pF per meter, effect on the circuit to be measured cannot be ignored. Use a probe to minimize the effect on the circuit
- When the length of the shielded wire used or when the length of the non-terminated cable reaches 1/4 wave length or its multiples within the band of oscilloscope (1/4 wave length is about 3 meter when using a coaxial cable at 20 MHz), oscillation may be caused at 5mV/DIV or near range. This is caused by the resonance between the externally connected high-Q inductance and the input capacity and can be avoided by reducing the Q. Connect the cable or shielded wire to the input connector by way of a serially connected 100Ω to 1KΩ resistor, or perform measurement at other VOLTS/DIV range.

(3) When observing waveform with X-Y

Set the TIME/DIV switch to X-Y. Then the instrument works as an X-Y oscilloscope.

Each input is applied to the instrument as follows.

X-axis signal(horizontal axis signal)

CH1 INPUT

Y-axis signal(vertical axis signal)

CH2 INPUT

In this case, leave the horizontal axis magnification switch (PULL-MAG ×10 knob) at depressed position.

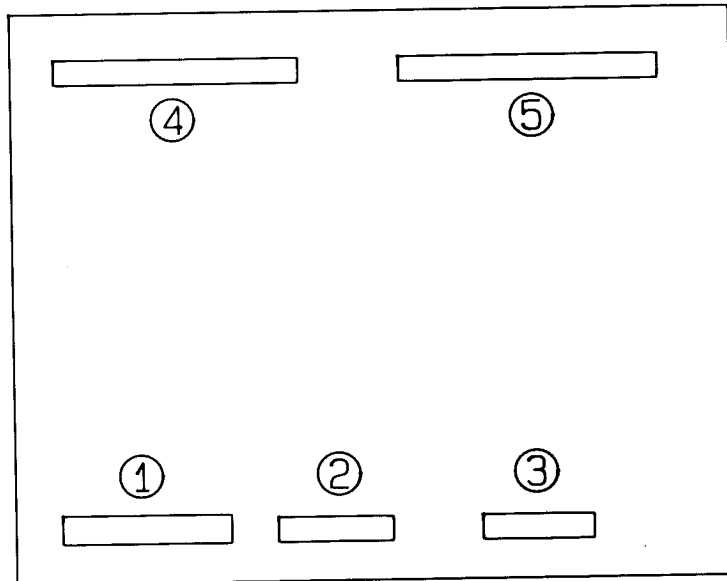
9. MEASURING INSTRUCTIONS

The first things to do are as follows.

- Bring the brightness and FOCUS at optimum positions for easy read out.
- Display the waveform as large as possible to minimize the read error.
- Check the capacity correction when using a probe. (Refer to paragraph (1) 'When using a probe' of Section 8 'Method for connecting signals' for the method for correcting capacity.)

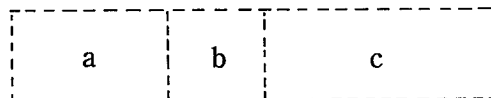
(1) Set value display

The following set values are displayed when the vertical mode is not ADDED, and the readout function is ON.



① CH1 or CH2 displays

Set values of CH1 VOLTS/DIV are displayed when the vertical mode is CH1, ALT or CHOP. And the values are altered to CH2 VOLTS/DIV when the vertical mode is CH2.



- a. The vertical mode is displayed when the mode is CH1 or CH2. When the vertical mode is ALT or CHOP and b and c information of CH1 are displayed from here.

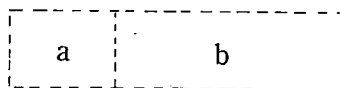
CH1 : CH1
 CH2 : CH2

- b. $\times 5$ GAIN : MG
- V/DIV UNCAL : >
- Normal state : Blank
- Note : MG is displayed prior to >.

- c. V/DIV : 1mV to 5V

② CH2 display

The values of CH2 VOLTS/DIV are displayed when vertical mode is ALT or CHOP. This part is not displayed when the vertical mode is CH1 and CH2.

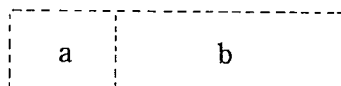


- a. $\times 5$ GAIN : MG
- V/DIV UNCAL : >
- Normal state : Blank

- b. V/DIV : 1mV to 5V

③ TIME display

The sweep time is displayed, or 'X-Y' is displayed when the TIME/DIV select switch is set to the position of X-Y.



- a. $\times 10$ GAIN : MG
- TIME/DIV UNCAL : >
- Normal state : Blank
- or X-Y mode : Blank

- b. TIME/DIV : 20nS to 0.2S
- X-Y mode : X-Y

④ Δ V cursor measurement value display



- a. CH1, ALT, CHOP : Δ V1
- CH2 : Δ V2
- X-Y : Δ X

b. Measurement signed value display

- Δ V1, Δ V2 : 0.00mV to 38.0V
- Δ X : 0.00mV to 48.0V

Note : When the REF (\times) cursor is above the Δ (+) cursor on the screen, the polarity display is (-), otherwise the polarity (+) is not displayed.

When the VOLTS/DIV variable is set to the uncalibrated position 'UNCAL' is displayed.

⑤ ΔT cursor measurement value display



a. ΔT : ΔT
 $1/\Delta T$: $1/\Delta T$
 X-Y : ΔY

b. Measurement signed value display
 ΔT : 0.0nS to 1.920S
 $1/\Delta T$: 0.521Hz to 40MHz
 X-Y : 0.00mV to 38.0V

Note : When the REF (\times) cursor is on the right of the Δ (+) cursor on the screen, the polarity display is (-) otherwise the polarity (+) is not displayed.

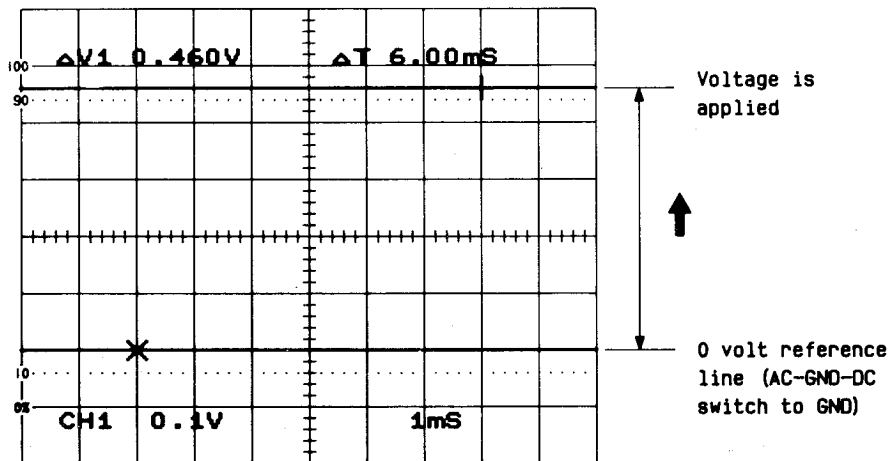
When $1/\Delta T$ mode, the polarity is not displayed always. If the difference is zero, '---' meaning 'Undefined frequency', is displayed, and when the frequency is higher than 40MHz, '>40MHz' is displayed.

When the SWP VAR control (or VOLTS/DIV select switch when X-Y mode) is set to the uncalibrated position 'UNCAL' is displayed.

(2) DC voltage measurement

Set input coupling to GND and decide the zero level properly.

Set VOLTS/DIV appropriately and set AC-GND-DC to DC. Since the base line shifts here by the amount of DC voltage, the DC voltage of the signal can be obtained by multiplying the shift width by the indicated value of VOLTS/DIV. When VOLTS/DIV is 0.1 V/DIV, then $0.1 \text{ V/div} \times 4.6 = 0.46 \text{ V}$ (However, if the probe 10 : 1 is in use, the true value of the signal becomes 10 times the value, or $0.1\text{V/div} \times 4.6 \times 10 = 4.6\text{V}$)

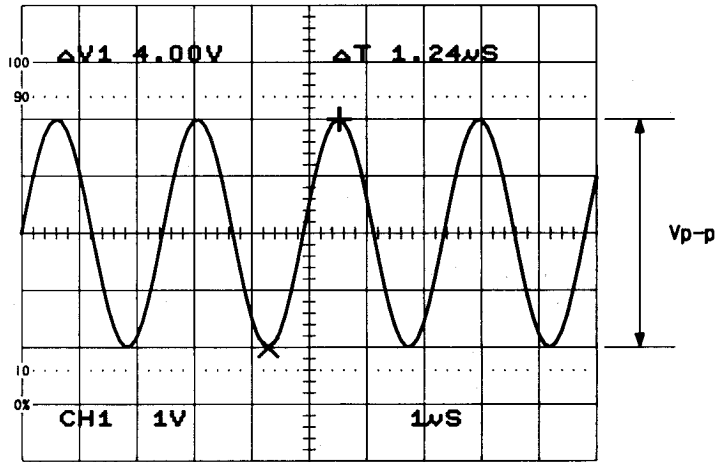


DC voltage measurement

(3) AC voltage measurement

The same as paragraph (1), "DC voltage measurement", but here there is no need of matching the zero level with the scale line. Move the zero level at will to a position easy to observe.

In the drawing as follows, VOLTS/DIV is 1V/DIV, $1\text{V/DIV} \times 4 = 4\text{V}_{\text{p-p}}$ (40 V_{p-p} at time using the probe 10 : 1). When magnifying and observing a small amplitude signal, superimposing on a high DC voltage, set input coupling to AC. The DC voltage is cut off and AC voltage can be observed by increasing sensitivity.



AC voltage measurement

(4) Measurement of frequency and period

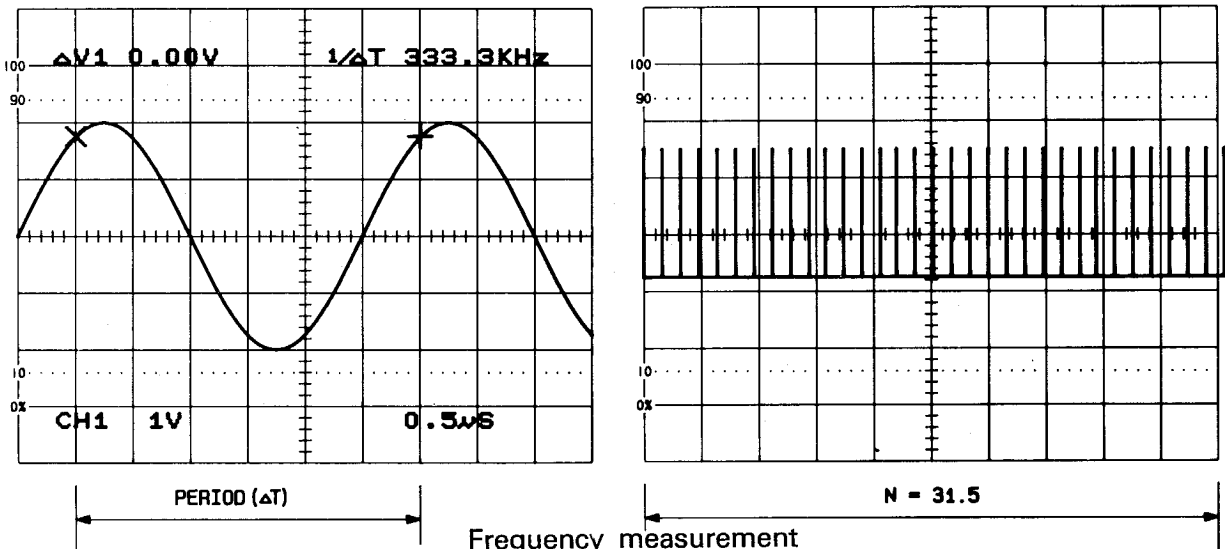
This will be explained taking the drawing at follows as an example.

One period covers the time A and time B, which are separated from each other by 6.0 div on the screen.

When the sweep time is 0.5 /DIV, the period is given by $0.5 \mu\text{S} / \text{div} \times 6.0 = 3.0 \mu\text{S} = 3.0 \times 10^{-6} \text{ S}$

Accordingly, the frequency is $1 / (3.0 \times 10^{-6}) = 333.3 \text{ KHz}$

(However, when the knob MAG $\times 10$ is at pulled out position, TIME/DIV must be converted to 1/10 since the sweep is magnified).



(5) Measurement of rise(fall)time

To measure the rise time pay attention not only to the above-mentioned items but also to measurement error. The following relationship exists between the rise time T_{rx} of the waveform to be measured, the rise time T_{rs} oscilloscope, and the rise time T_{ro} displayed on the screen.

$$T_{ro} = \sqrt{T_{rx}^2 + T_{rs}^2}$$

When the rise time of the pulse going to be measured is sufficiently longer than the rise time of the oscilloscope(17.5ns in our case), the effect of the rise time of the oscilloscope on the measurement can be neglected. However, if both are close to each other, measurement error may be caused.

The true rise time is given by

$$T_{rx} = \sqrt{T_{ro}^2 - T_{rs}^2}$$

Moreover, in general, in a circuit free from waveform distortion such as overshoot and sag, the following relationship is established between frequency band and rise time.

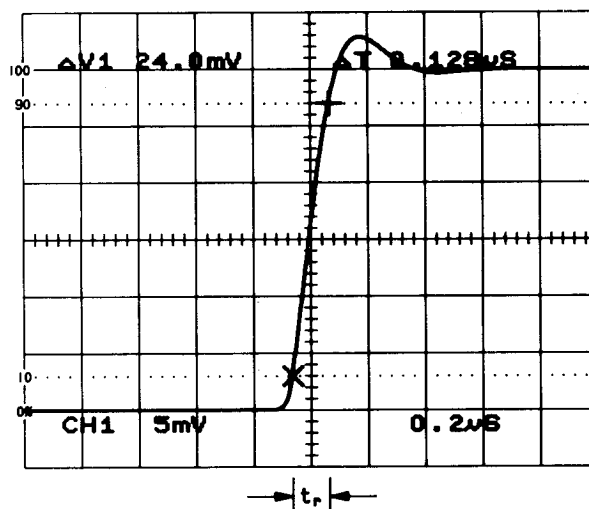
$$f_c \times t_r = 0.35$$

Where,

f_c : Frequency band(Hz)

t_r : Rise time (s)

The rise time and fall time are determined by the time elapsed between the 10% to 90% values of pulse width. This oscilloscope is provided with graduations for 0%, 10%, 90%, and 100% on the screen, which facilitate measurement.



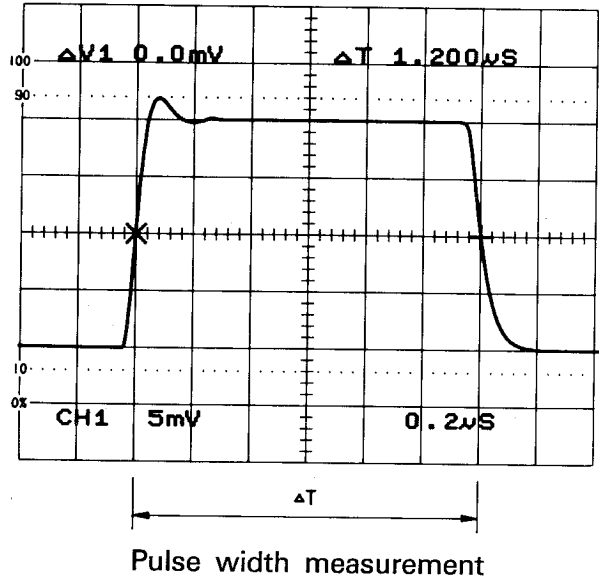
Rise(fall) time measurement

(6) Pulsewidth Measurement

The basic pulse width measurement procedure is as follows ; Display the pulse waveform vertically so that the distance between the top part of the pulse waveform and the horizontal center line of the graticule may be equal to the distance between the bottom part of the pulse and the horizontal center line as below.

Set the TIME/DIV switch in order to make the easy observation of the signal. Read the distance between centers of rising and falling edges, i. e., the distance

between two points at which pulse edges cross the horizontal center line of the graticule.



(7) Phase measurement

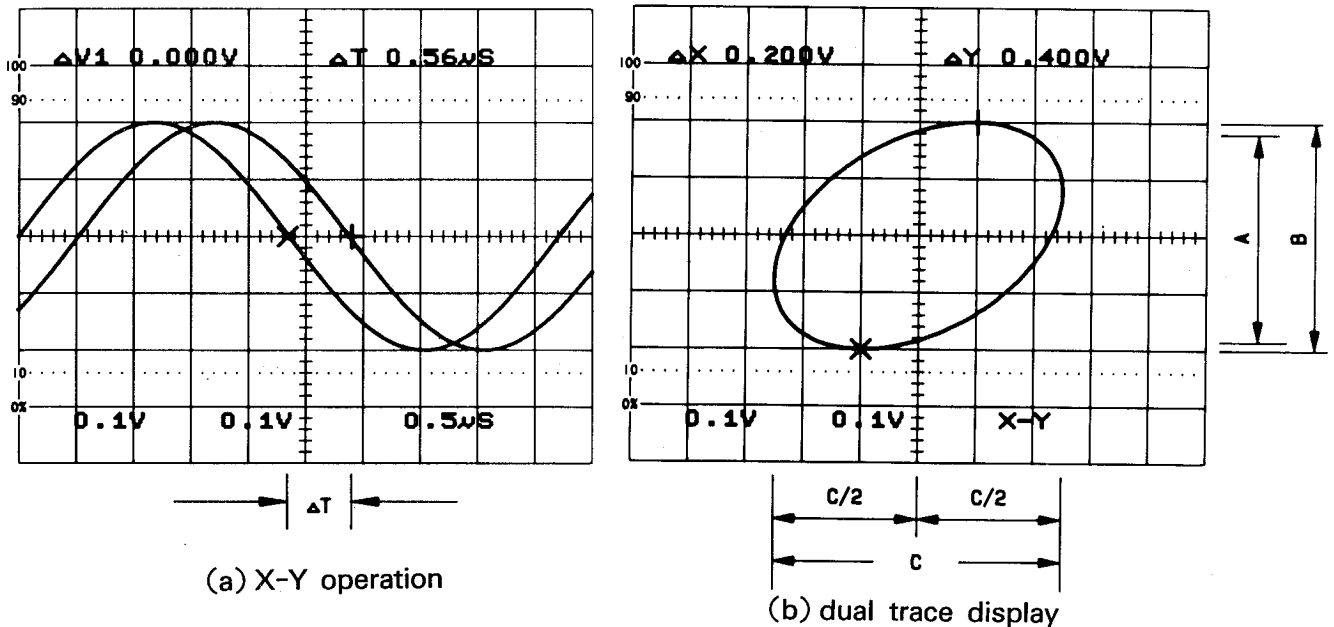
The measurement of phase difference between two signals, there are the following two methods ;

The first one is the Lissajous's pattern method by using the instrument as an X-Y scope.

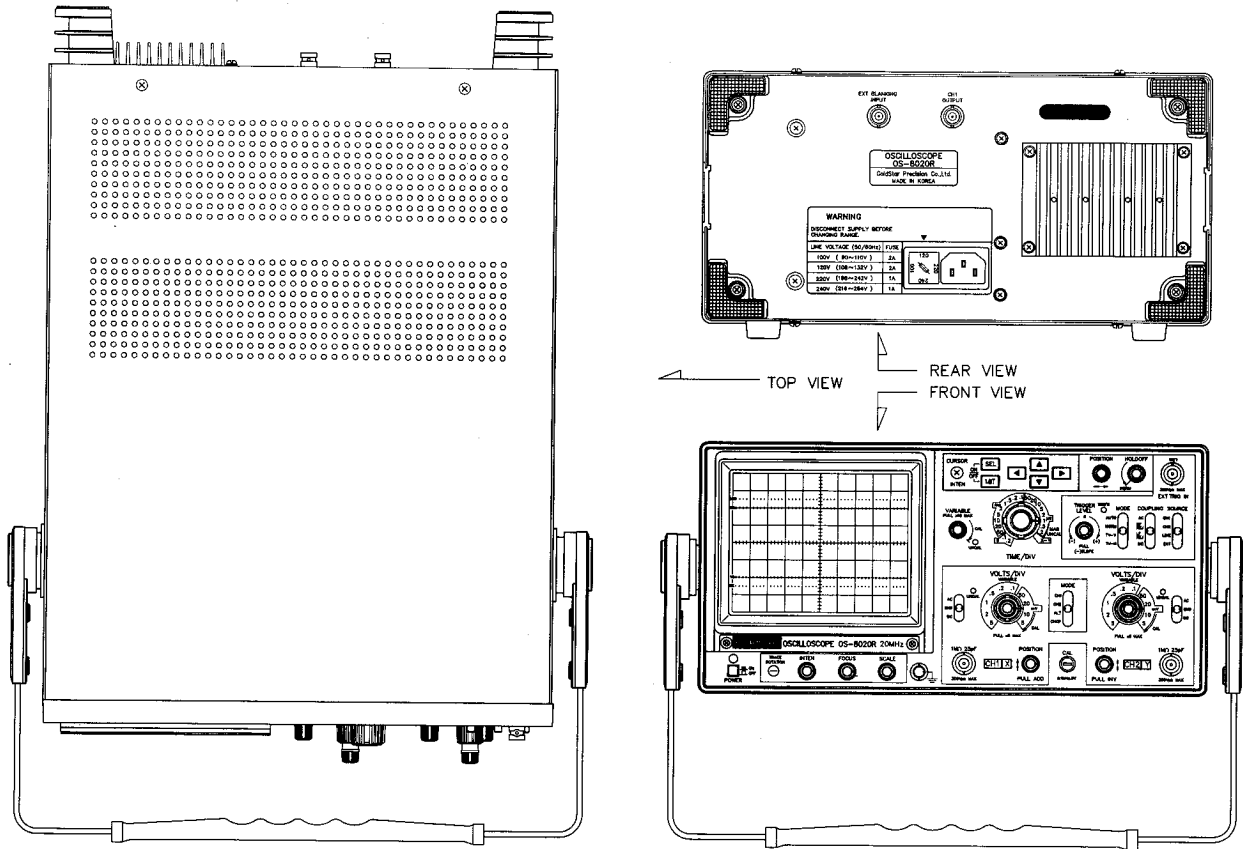
The phase difference of signals can be calculated from the amplitude A and B of the pattern shown in Fig(a) and by equation as follow.

$$\text{phase difference(deg)} = \text{Sine}^{-1} \frac{A}{B}$$

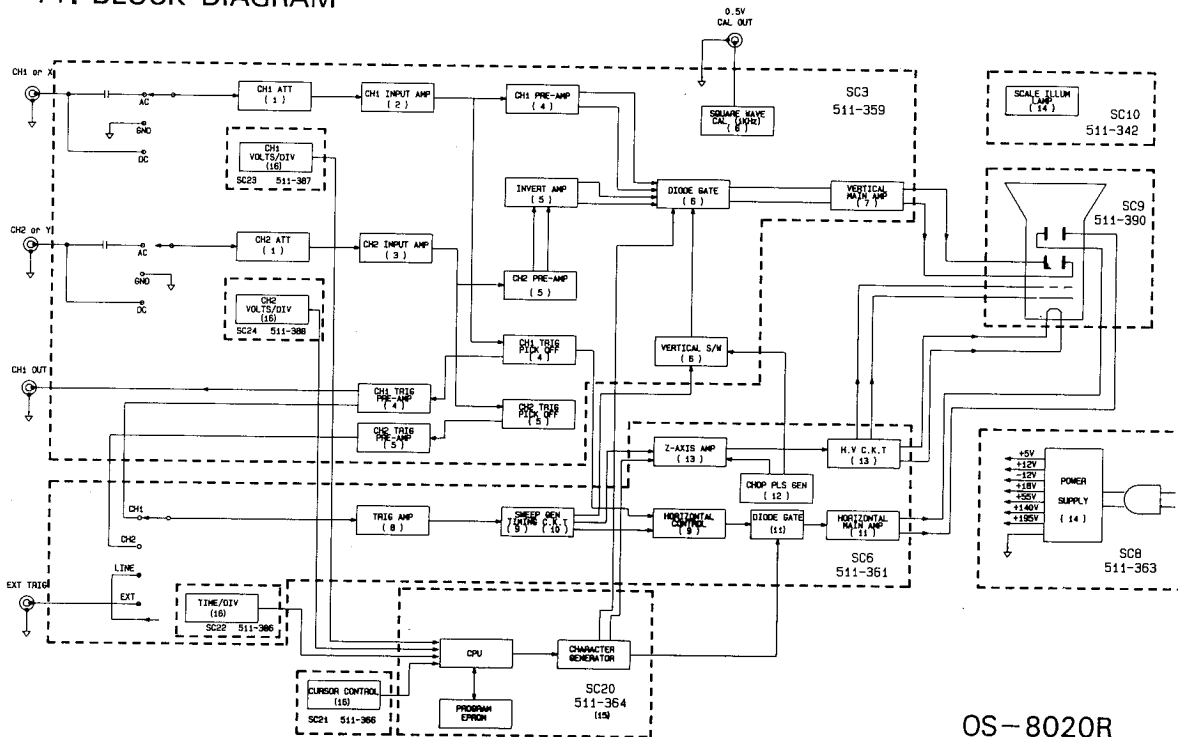
The second method is an application of dual-trace function Fig(b) shows an example of dualtrace display of leading and lagging sine wave signals having the same frequency.



10. EXTERNAL VIEW

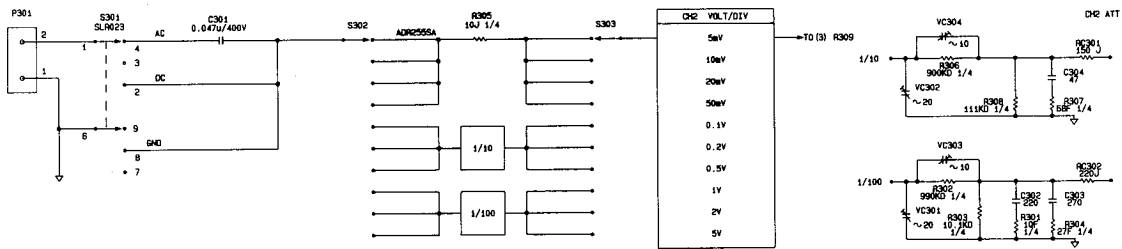
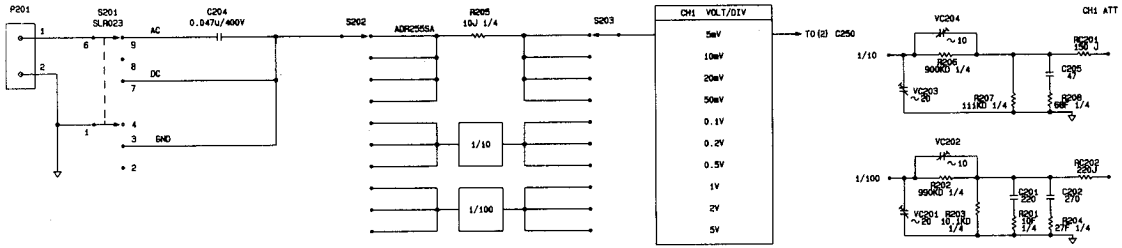


11. BLOCK DIAGRAM

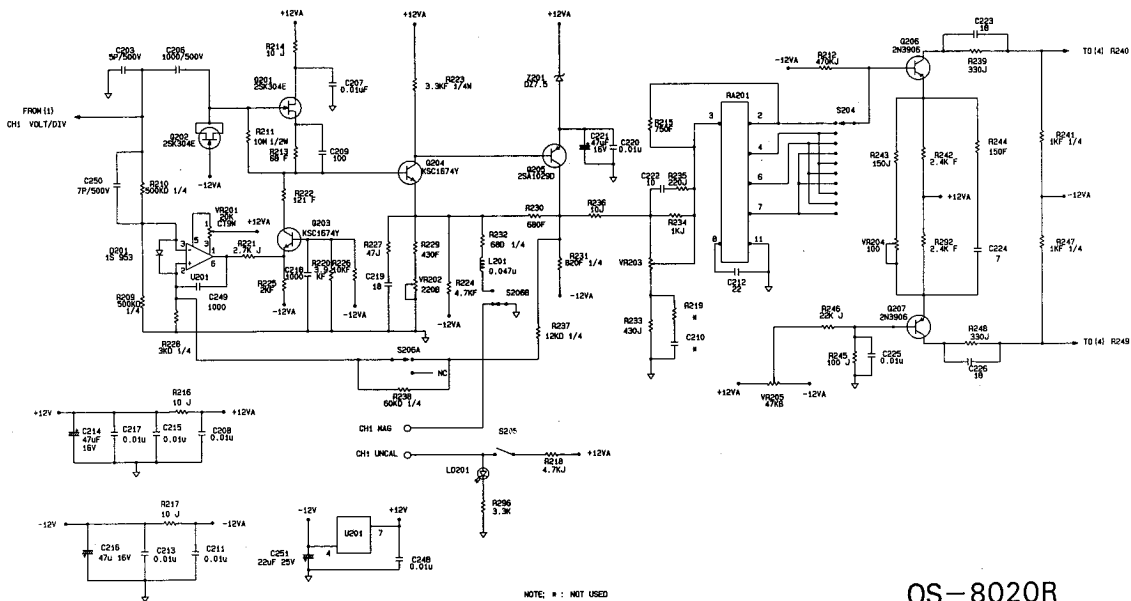


OS-802R
BLOCK DIAGRAM

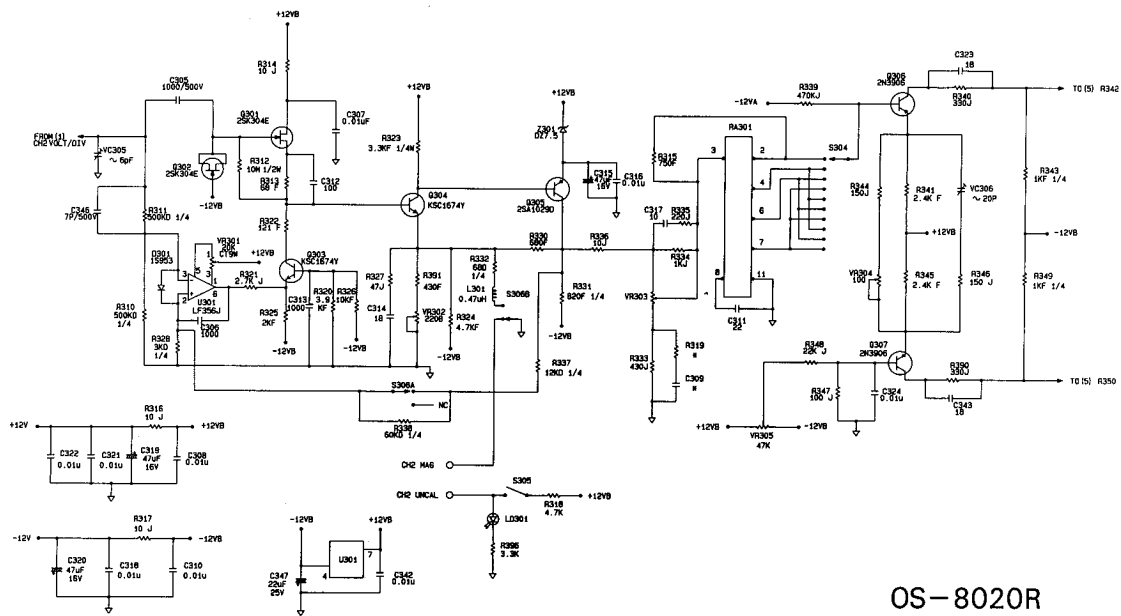
12. SCHEMATIC DIAGRAMS



OS-8020R
ATTENUATOR (1)

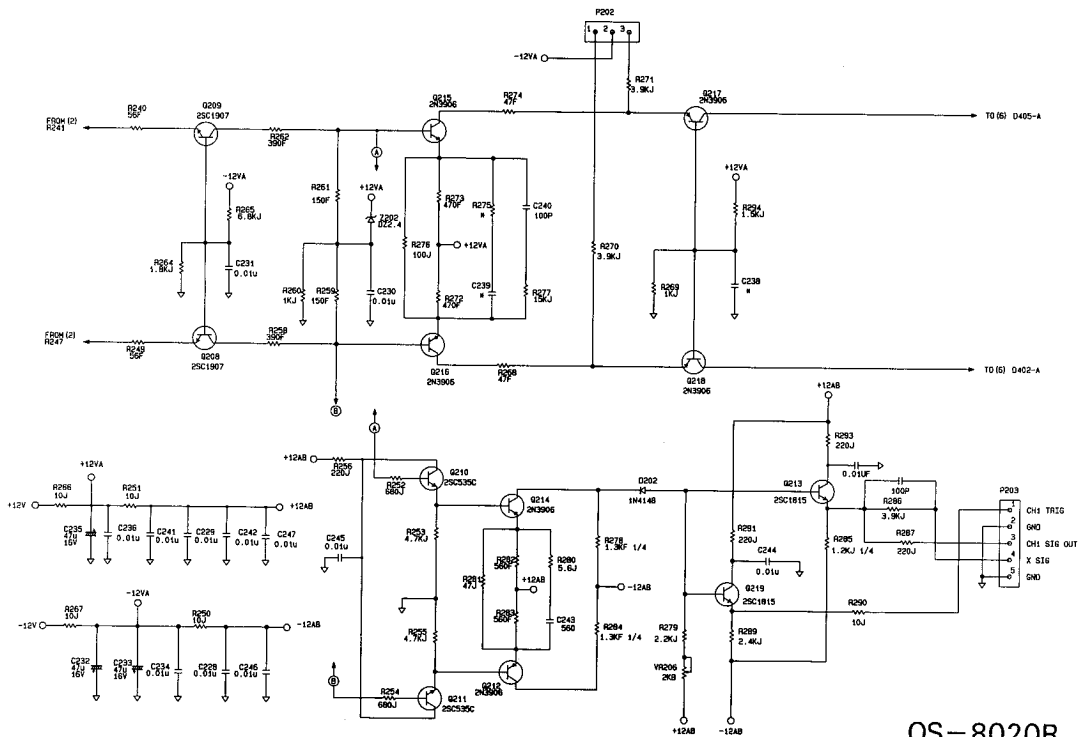


OS-8020R
CH1 INPUT AMP (2)



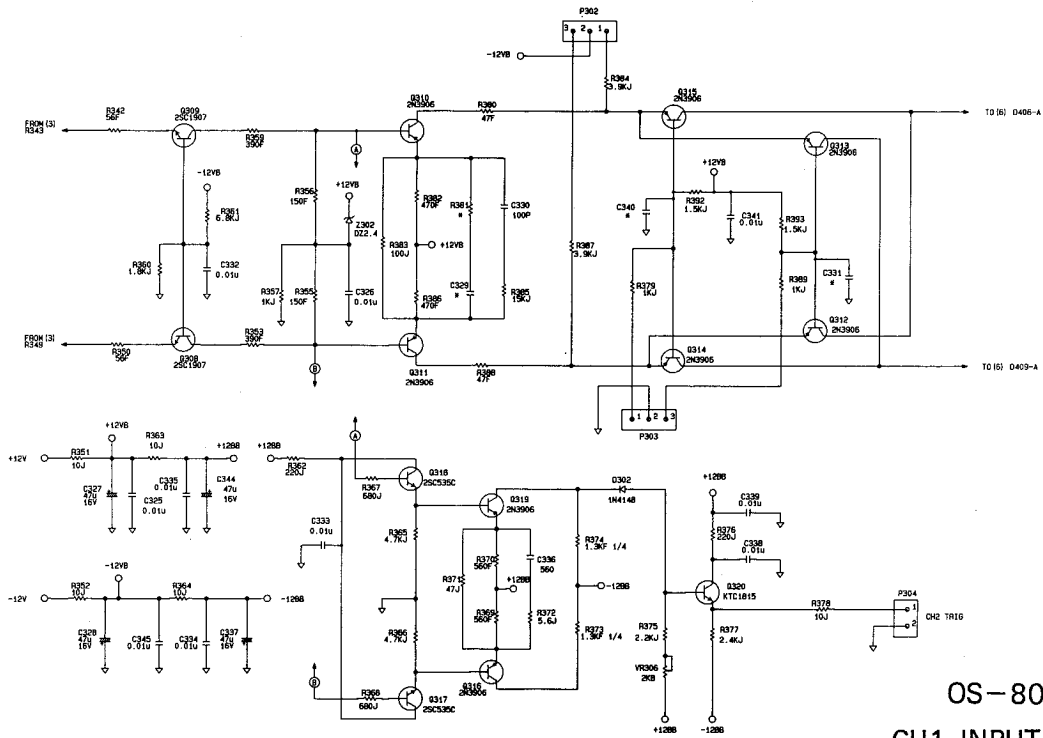
OS-8020R
CH2 INPUT AMP (3)

NOTE: # : NOT USED



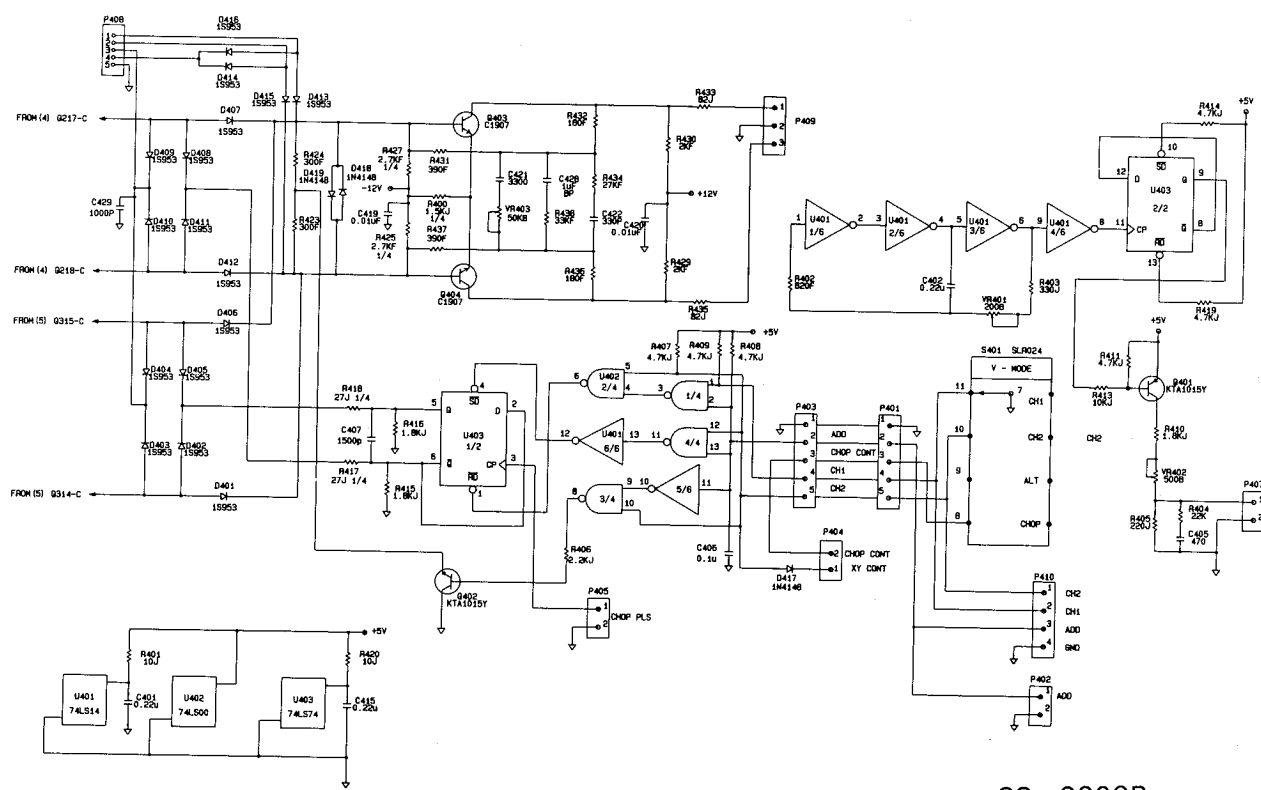
OS-8020R
CH1 INPUT AMP &
TRIG PICK OFF (4)

NOTE: # : NOT USED

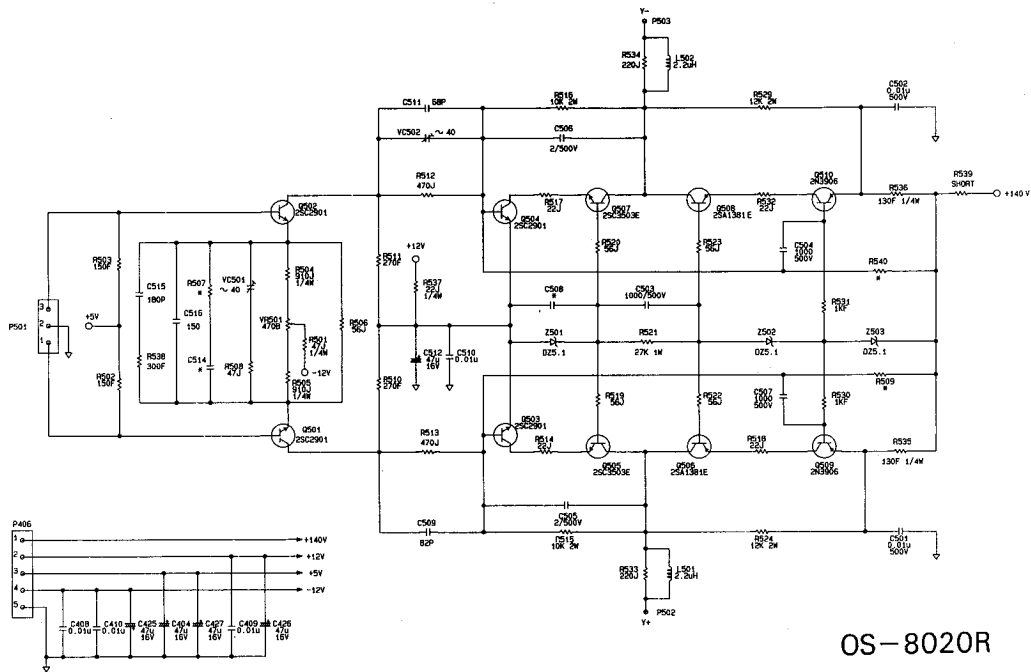


NOTE: * : NOT USED

OS-8020R
CH1 INPUT AMP &
TRIG PICK OFF (5)

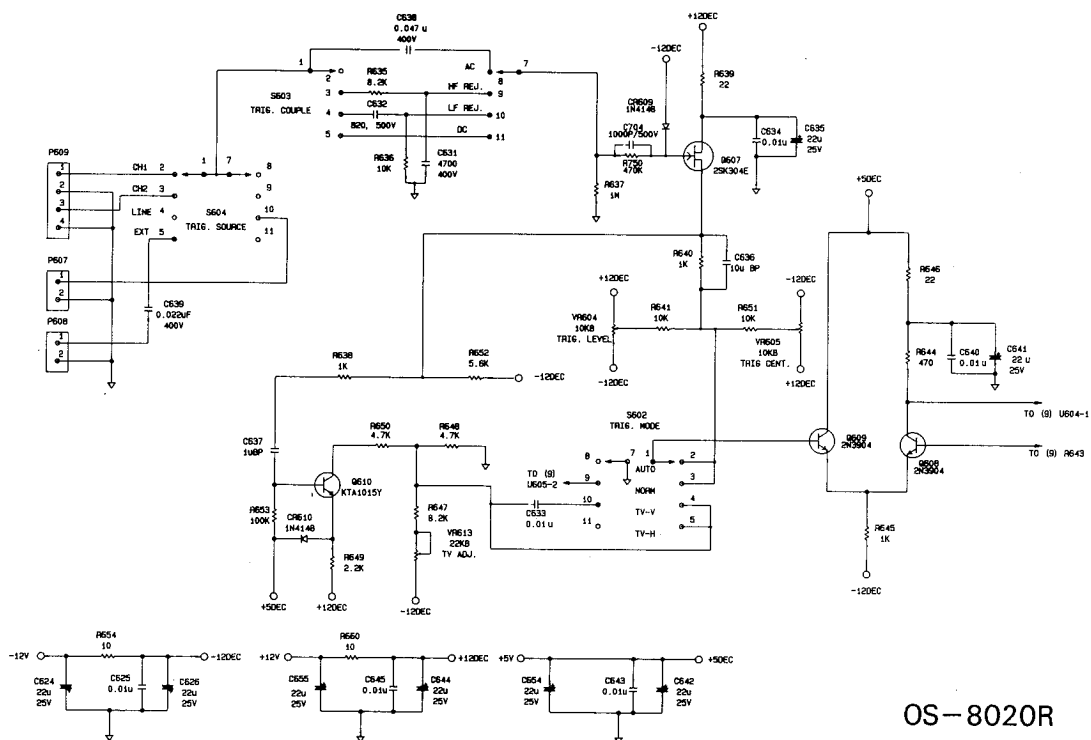


OS-8020R
VERTICAL CONTROL (6)

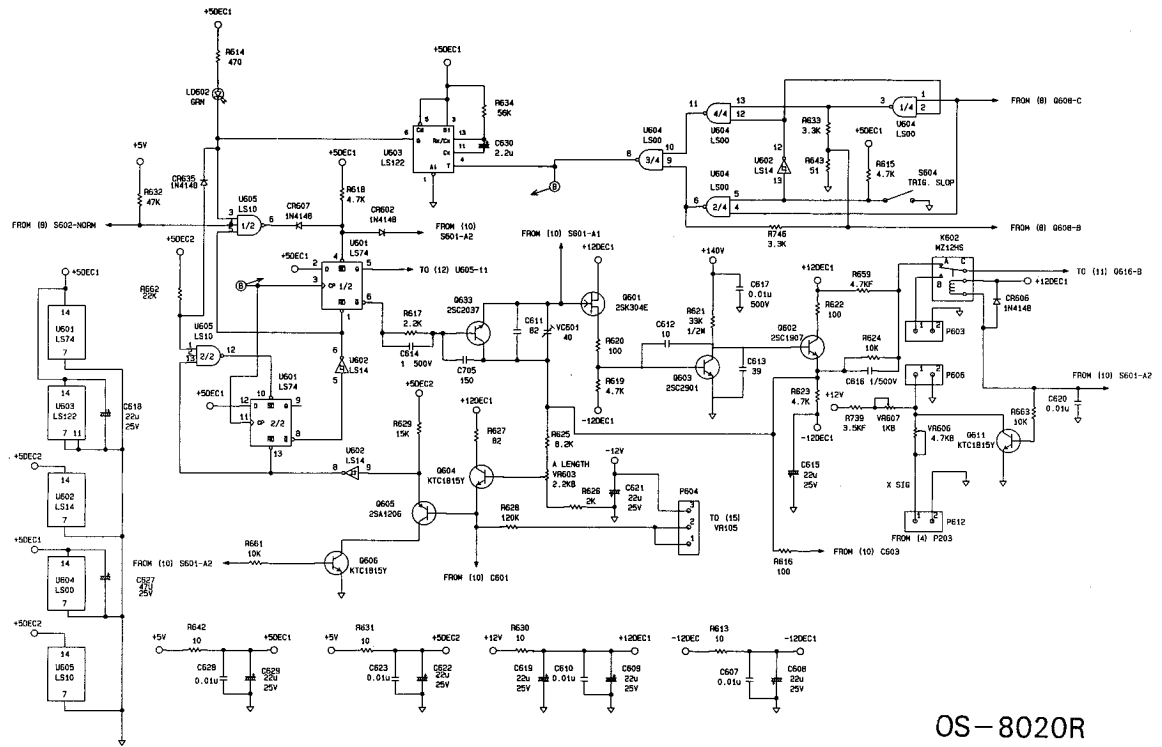


NOTE: * : NOT USED

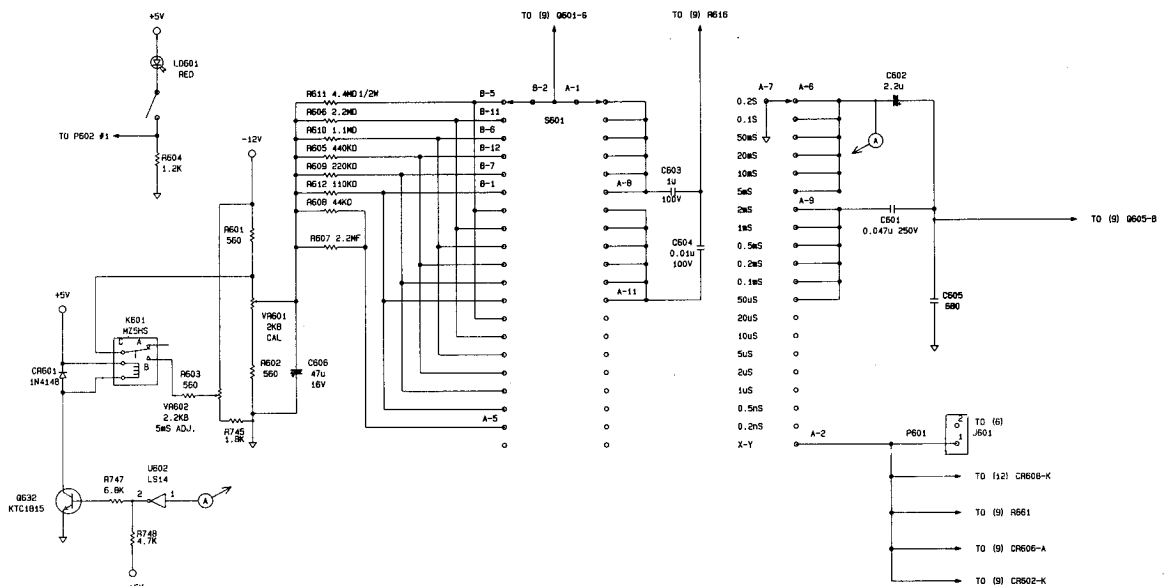
OS-802OR
VERTICAL MAINAMP (7)



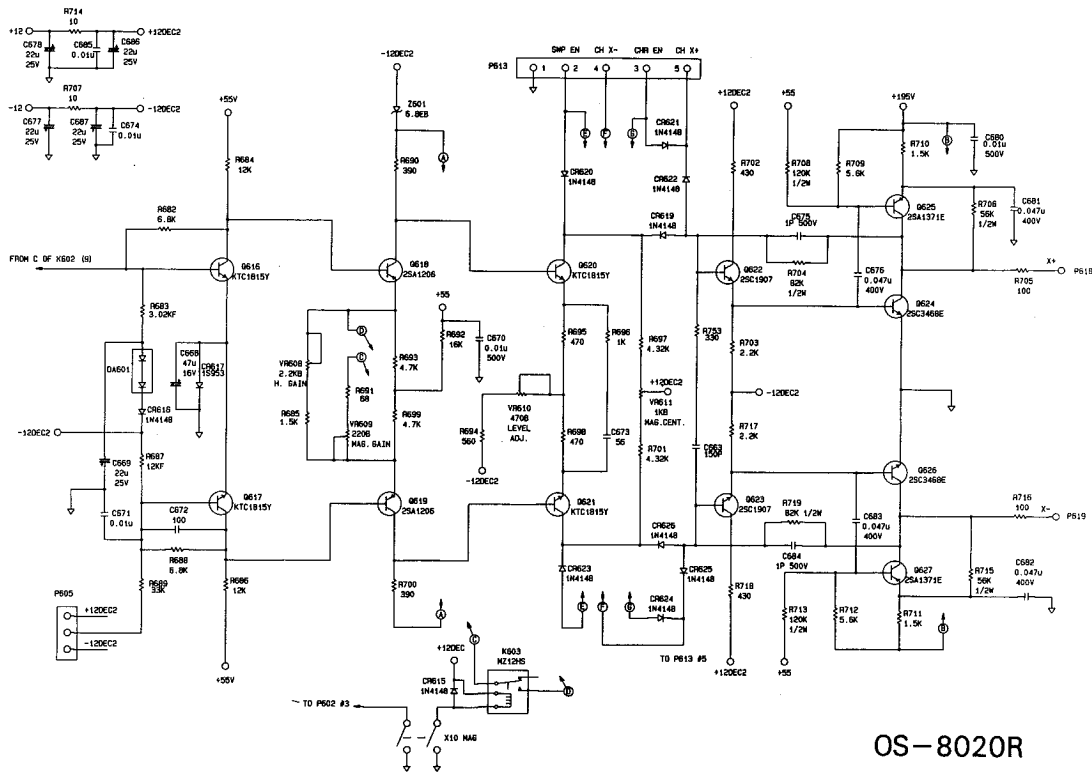
OS-802OR
TRIG. AMP. (8)



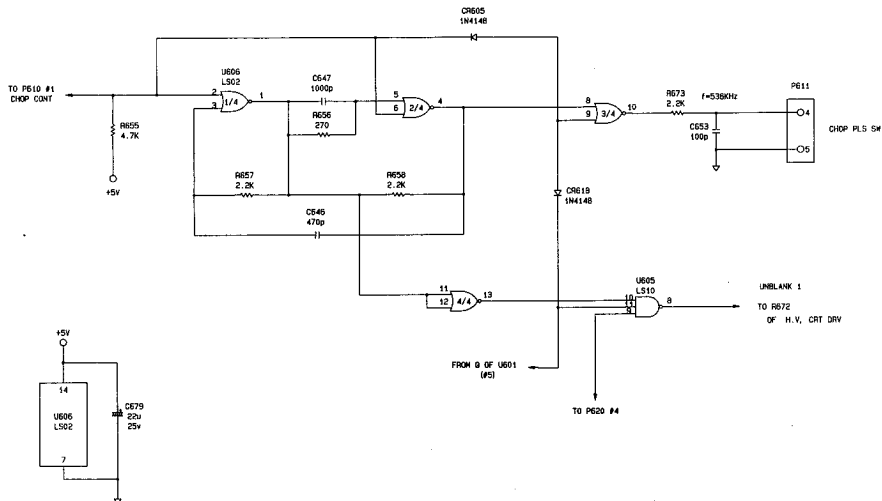
OS-8020R
SWEEP GEN. (9)



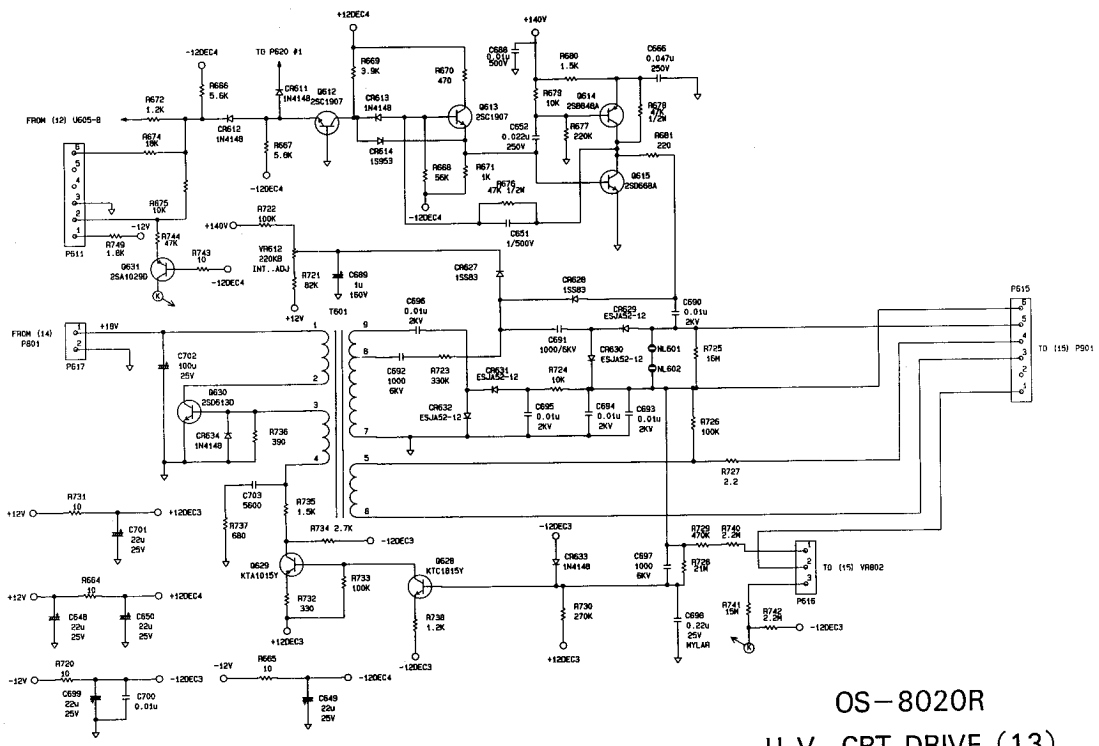
OS-8020R
TIMING C.K.T. (10)



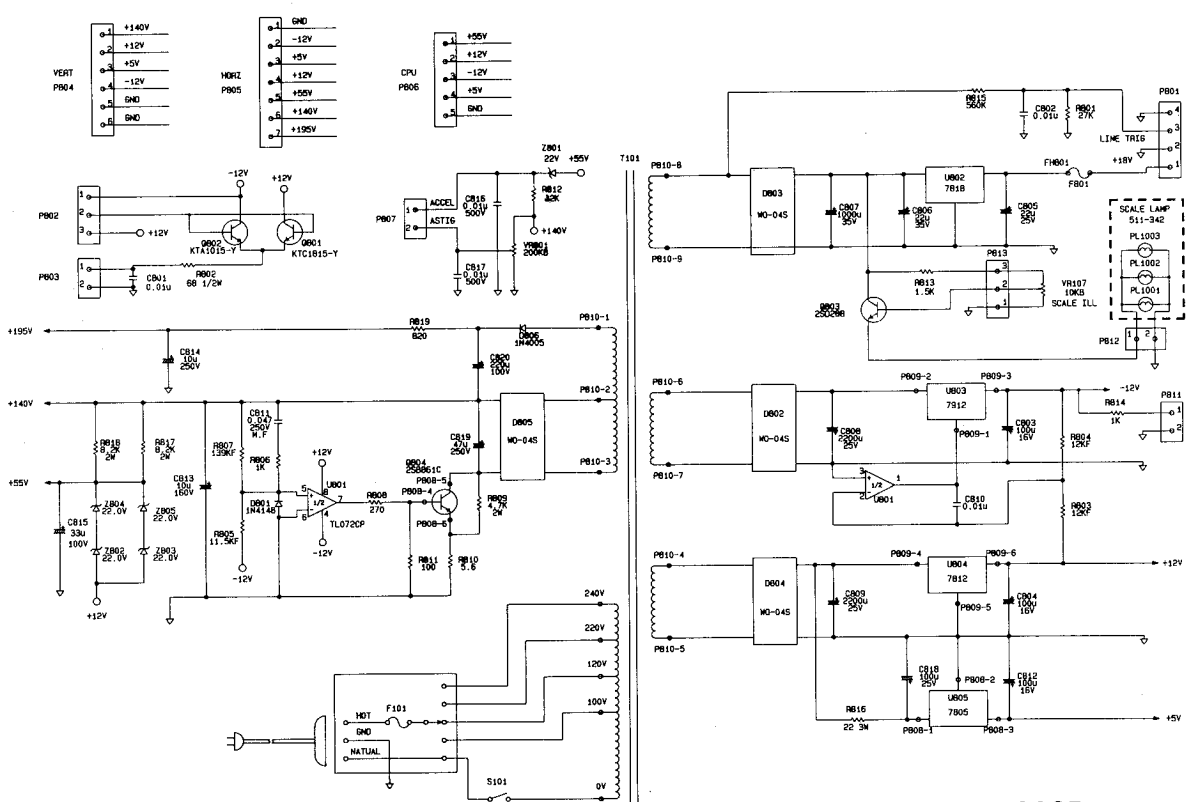
OS-8020R
HORIZONTAL MAIN AMP
(11)



OS-8020R
CHOP PULSE
GENERATOR (12)

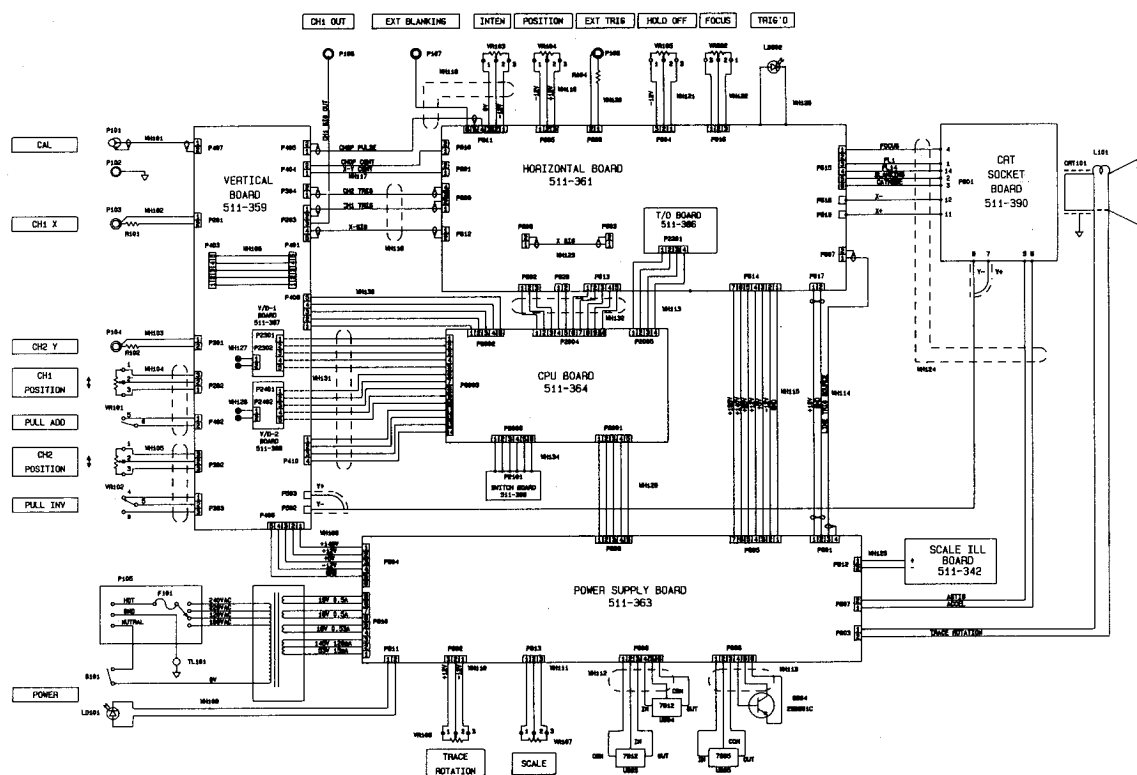


OS-8020R
H.V. CRT DRIVE (13)



OS-8020R
POWER SUPPLY (14)

13. WIRING DIAGRAM



OS-8020R
WIRING DIAGRAM (17)



GoldStar Precision Co., Ltd.

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Tel: 783-9511-20 Tlx: GSRADAR K22838 Fax: (02) 784-1646
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