MODEL V-509

OSCILLOSCOPE

OPERATION MANUAL

Hitachi Denshi, Ltd.

CONTENTS

NOTE

- This instrument should be adjusted at an ambient temperature of +20°C for best overall accuracy.
  Allow at least 15 minutes warmup before proceeding.
- Polyvinyl chloride (PVC) film is attached on the enclosure and the front panel of the oscilloscope to protect the metal surface. If the PVC film is damaged by scratches, remove it.
- 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 are 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.

1. FEATURES

The Hitachi V-509 is a handy-type, advanced-class oscilloscope with a bandwidth of DC to 50 MHz designed with the emphasis on operability and portability and has a following features.

(1) Wide bandwidth:

The instrument has a bandwidth from DC to 50 MHz.

(2) High sensitivity:

Sensitivity is 1 mV/div

(3) 3.5-inch screen:

Employment of an internal graticule CRT permits the waveform observation to be made without parallax error.

(4) 3-way operation:

The instrument is operated with AC-line, external DC and Battery Pack AD-509 (option).

(5) TV synchronization:

Employment of a new TV sync separator circuit allows the instrument to observe TV signals stably.

(6) Delayed sweep:

A portion of the signal can be magnified before observation.

(7) Auto focusing:

Focusing shift is automatically corrected.

2. ACCESSORIES

This instrument is shipped with the following standard accessories.

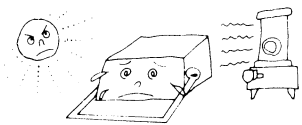
2 Probes (AT-10 AP1.5)
1 Fuse 1A for 100V set or 0.5A for 200V set
1 Fuse 5A for DC line
1 Front cover
1 AC power supply cord
1 DC power supply cord
1 Operation manual

3. PRECAUTIONS

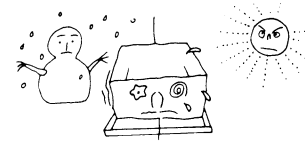
Precautions to be observed to lengthen the service life of this instrument.

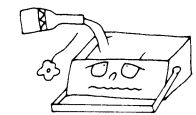
Installation site

* Avoid installing instrument in an extremely hot or cold place.
  - ○ Avoid placing this instrument in a place exposed to sunlight for a long period of time, in a closed car in midsummer, or near a room heating device such as a stove.
  - ○ The operating maximum ambient temperature is +50°C.
* Do not use instrument that has been left outdoors on a cold winter day.
  The operating ambient temperature is 0°C or more.

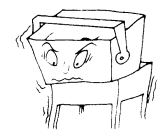


* Avoid moving the instrument rapidly from a hot place to a cold place on vice versa, or condensation may form on inside of the instrument.
* Keep the instrument away from damp air, water, and dust. Unexpected trouble may be caused when the instrument is placed in a damp or dusty place.
  The operating 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.





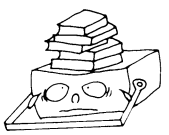
* Do not place the instrument in a place where vibration is strong. Avoid using the instrument at a place vibrating violently. Since the oscilloscope is a precision instrument, excessively strong vibrations may cause damage.
* Do not place the instrument near a magnet or magnetic body. An oscilloscope 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.

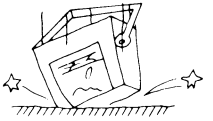


Handling

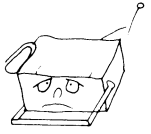
* Do not put a heavy objects on the oscilloscope.
* Do not block the ventilation holes.

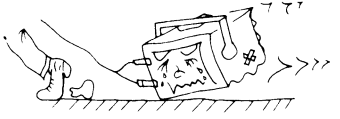
* Do not apply a heavy shock to the oscilloscope.



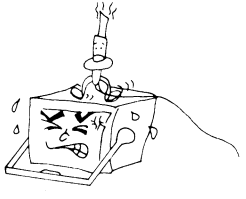


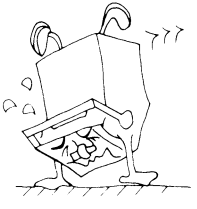
* Do not insert a wire, pin, etc. through the ventilation hole.
* Do not drag the set, leaving the probe attached to it.



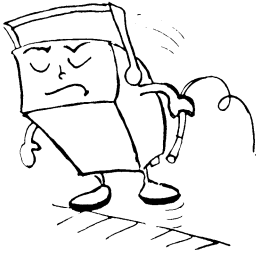


* Do not leave a hot soldering iron on the cabinet or the screen.
* Do not try to turn the instrument upside down. Otherwise, knobs may be broken.





* Do not use the instrument upright, leaving BNC cable connected to EXT BLANKING and CH1 OUTPUT terminal on the rear panel. Otherwise, the cable may be damaged.

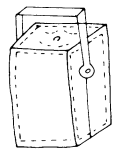


Handle

The handle of the V-509 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 deisred position. 15 positions are provided for convenient carrying or viewing.

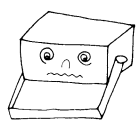
When not in use

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



When Operation is faulty

Recheck the operating procedure and if problem persists, contact a nearly service station or agent.



Care and repair

* Removal of stain from the case
  - When the outside of the case is stained, remove the 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 becames visible when the bezel is removed.

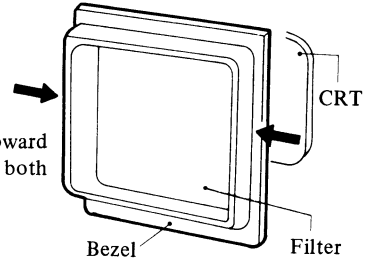
Remove the stains on CRT and filter by using a clean and soft cloth, paying attention not to impair them.

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 make observation hard. Pay attention not to leave finger prints on it.

To dismount it; pull it toward you by pressing it at the both ends.



Operation precautions

* Check the line voltage is in the range specified in the table below.

Rating	Allowable line voltage (50/60Hz)
AC100V	AC90V – 130V
AC200V	AC180V – 260V

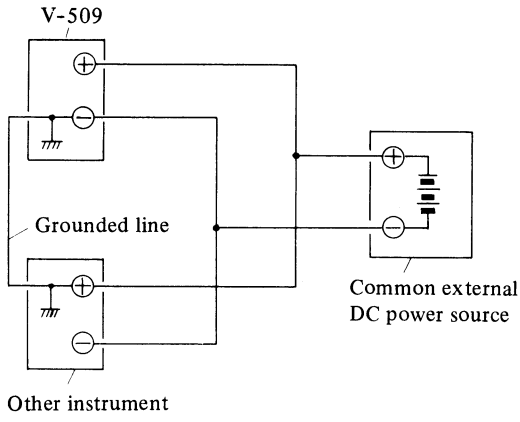
Usually the voltage selector switch on the rear of the V-509 has been set to 100V AC at the factory. When this is operated on 200AC voltage, set the selector switch to 200 V AC. (Rated voltages are marked above the power connector on the rear panel.)

* Use only specified fuses

In order to protect the circuit against over-current, a 0.5A (in primary side of power circuit) and 5A (in secondary side of power circuit) are used. When the fuses blow out, check thoroughly the cause, repair any faulty point present, and replace then with specified fuses. 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.

	Shape (Diameter x length) mm	JIS type name
5A	6.35ϕ x 31.8	MF61NM250V 5A AC
1A	6.35ϕ x 31.8	MF61NM250V 1A AC
0.5A	6.35ϕ x 31.8	MF61NM250V 0.5A AC

* -(negative) terminal of EXT DC IN is inside connected to case ground. Do not connect - (negative) terminal of the V-509 to the + (positive) grounded case of other instruments with common external DC power source to the V-509. If not, it is very dangerous because a large current flows through the grounded line.



< DANGEROUS CONNECT >

* Do not apply reverse polarities to EXT DC IN.
* Do not increase the brightness too much. Your eyes may be strained and the fluorescent surface of CRT may be burnt.
* Do not apply an excessive voltage.
  The maximum voltage of each input is as follows.

INPUT direct	250V (DC+ peak AC at 1 kHz)
When x10 Probe is used	250V (DC+peak AC at 1 kHz)
EXT TRIG INPUT	250V (DC+peak AC)
EXT BLANKING	50V (DC +peak AC)

4. CONTROLS AND CONNECTORS

(1) Power supply and CRT

Operating voltage and fuse

This model can be operated from either a 100 volts or a 200 volts nominal line voltage source. The line voltage select switch on the rear panel, turn the instrument from one operating range to the other. In addition, this switch changes the primary connections of the transformer to allow selection of one of two regulating ranges. Use the following procedure to convert this instrument between normal line voltage or regulating ranges.

a. Disconnect the instrument from the power source.
b. To convert from 100 volts nominal to 200 volts nominal line voltage or vice versa, remove the protector of the line voltage select switch.
   Change the line voltage select switch from 100 volts to 200 volts and remounting the protector.
c. Before apply the power to the instrument, check that the indicating tabs on the rear panel.

Selection of power supply mode

This oscilloscope can be operated on power supply –AC source, external DC source or optional battery pack AD-509.

Set the power source select and Power mode select

switches in accordance with the type of the power source referring to the table below.

Switches / Power supply mode	Power source select switch ⑥	Power mode Select switch ⑦
AC power supply	AC	DC OPE
External DC power supply*	DC	DC OPE
Optional battery pack (AD-509)	DC	DC OPE
When charging (AD-509)	DC	BATT CHARGE

* DC 11 to 14V is supplied via EXT DC INPUT connector.

< WARNING >

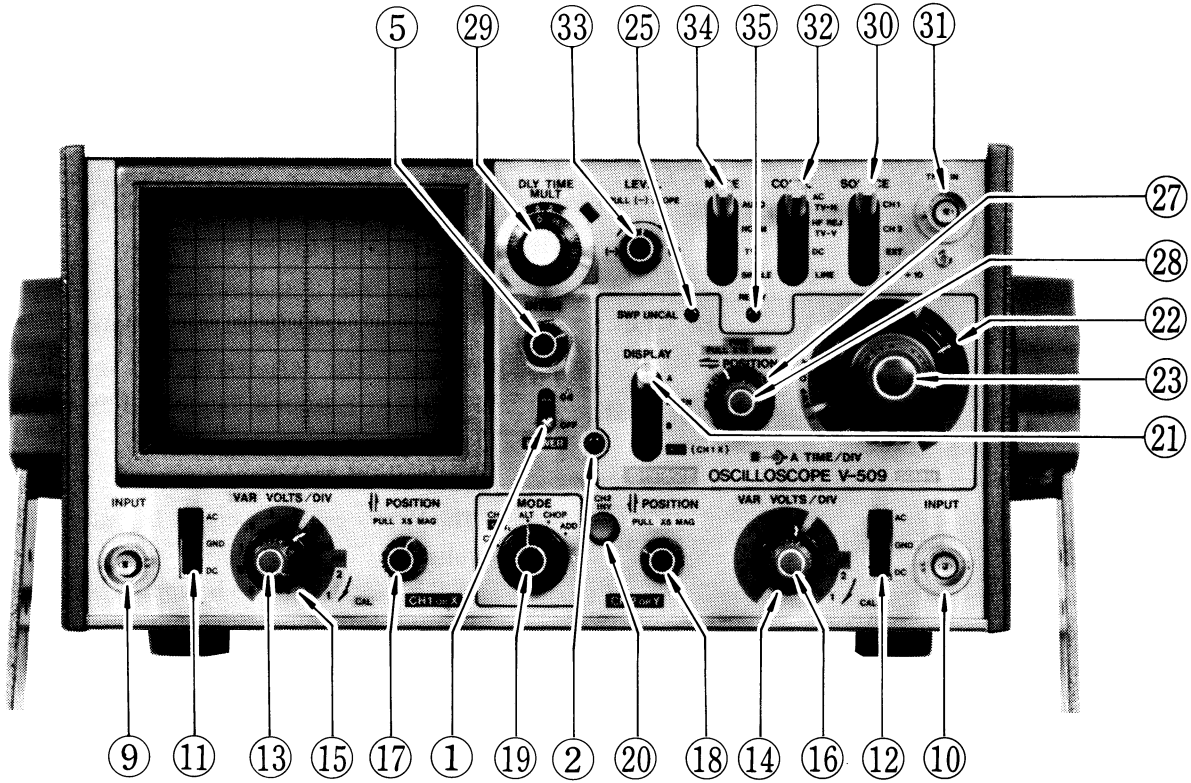
- ○ After completing the charge of AD-509, be sure to set power mode select switch to DC OPE.
- ○ When the output voltage of DC power supply becomes less than 11V, the power lamp is blinking. When the output voltage is less than approx. 10.5V, it stops the operation to prevent the battery overcharge.
- ○ When the instrument is operated by using the AD-509 (option), refer to chapter 8 Option.
- ○ When the AD-509 is not used it is possible that the CHARGE lamp is illuminated by setting the Charge mode.

External DC operation

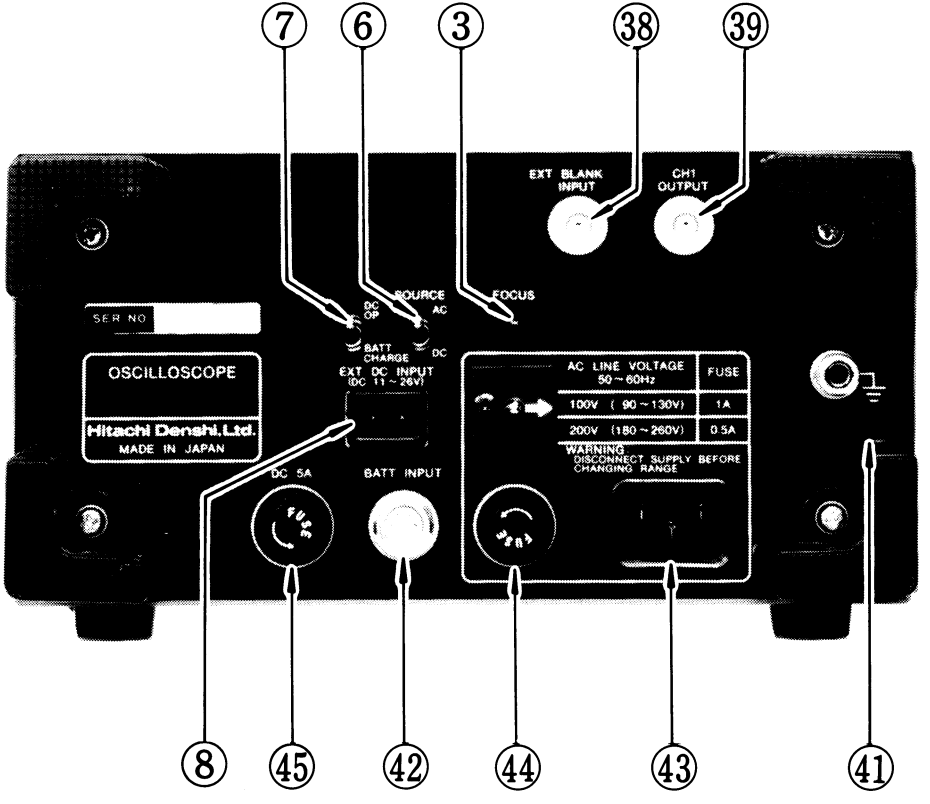
The V-509 can be operated by external DC source (11 to 14 volts)

In this case, DC source is supplied by the attached external DC source cable. Connect the white line of source cable to plus (+) side. Reversing polarity connection may cause blow of the fuse.

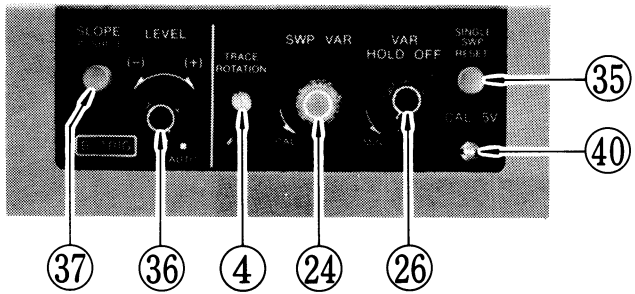
AD-509 (option) and external DC source are automatically switched by inserting the external DC source cable into EXT DC INPUT connector.


5
29
33
25
34
35
32
30
31
27
28
22
23
21
DLY TIME MULT
LEV
SWP UNCAL
DISPLAY
POSITION
A TIME/DIV
OSCILLOSCOPE V-509
INPUT
VAR VOLTS/DIV
POSITION
PULL X5 MAG
MODE
ALT CHOP ADD
CAL
9
11
13
15
17
1
19
2
20
18
14
16
12
10

Front View


7
6
3
38
39
EXT BLANK INPUT
CH1 OUTPUT
SOURCE
DC OP
AC
FOCUS
SER NO
BATT CHARGE
DC
EXT DC INPUT (DC 11 ~ 26V)
OSCILLOSCOPE
Hitachi Denshi,Ltd.
MADE IN JAPAN
AC LINE VOLTAGE 50 ~ 60Hz
FUSE
100V (90 ~ 130V)
1A
200V (180 ~ 260V)
0.5A
WARNING
DISCONNECT SUPPLY BEFORE CHANGING RANGE
DC 5A
BATT INPUT
FUSE
8
45
42
44
43
41

Rear View



Side View

① **POWER switch**

After checking the line voltage select switch, set POWER switch set to OFF and then connect the AC cord to AC wall socket.

② **POWER lamp**

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

③ **FOCUS control**

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

④ **TRACE ROTATION control**

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

⑤ **INTENsity control**

Adjust brightness of the CRT display. Brightness is increased by rotating INTENsity clockwise.

⑥ **Power source select switch**

Used to select the power sources.

AC Operated with the AC power source

DC Operated with the AD-509 (option) or external DC power source

⑦ **Power mode select switch**

Used to select the power mode.
See Selection of Power supply mode.

< CAUTION >

Do not set the Power mode select switch to the BATT CHARGE except charging batteries.

⑧ **EXT DC INPUT connector**

See External DC operation.

(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 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)

Used to select the coupling system between the input signal and vertical axis amplifier.

AC At this setting, the signal is connected through a condenser. 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 controls

Fine tuning device is 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.

⑰ ⑱ POSITION controls

Used to adjust the position of the vertical axis.
The image rises with the clockwise rotation of this knob and falls with the counterclockwise rotation. 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 1 mV/DIV.

⑲ MODE select switch

Used to select the operation mode of the vertical deflec-

tion 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 respectively to CH1 and CH2 are switched at about 250 kHz 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.

ADD The algebraic sum of the input signals applied respectively to CH1 and CH2 appears on the screen.

⑳ CH2 INV button

Used to inverse the polarity of the input signal applied to CH2. Inversion occurs in a state where the knob of the pushbutton is depressed (⎍) and restored to normal when the knob is in protruded state (⎍). This switch is conveniently used in the comparison of two waveforms having different polarity or in the observation of the waveform of the difference signal [CH1] - [CH2] between CH1 and CH2 using ADD.

(3) Controls of horizontal deflection system

㉑ DISPLAY select switch

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

A A sweep appears on the screen. This setting is used in normal case.

INTEN Although the sweep on the screen is A sweep it indicates B sweep (delay time sweep) by intensity modulation.

B The intensity modulated portion in INTEN mentioned above is magnified to occupy the full area of the screen. The sweep time at this time is B.

X-Y This position is used when using the instrument as an X-Y oscilloscope. X direction signal is input to CH1 and Y direction signal to CH2. The vertical deflection sensitivity at this time is read on CH2 VOLTS/DIV and horizontal axis sensitivity on CH1 VOLTS/DIV.

Vertical position is set by CH2 ↑↓ POSITION and horizontal position by ⇆ POSITION.

㉒ **A TIME/DIV select switch**

㉓ **B TIME/DIV select switch**

Those controls are used to set A and B sweep time. The outer knob is used for setting A sweep time and the inner knob for B sweep time. Those two knobs can be rotated independently to facilitate their use.
A sweep time ranges from 0.1 μs/DIV to 0.2s/DIV (20 steps) and B sweep time from 0.1μs/DIV to 2 ms/DIV (14 steps).

㉔ **SWP VARiable control**

This control works as CAL and the sweep time is calibrated to the value indicated by TIME/DIV. TIME/DIV of A sweep can be varied continuously when the 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.

㉕ **Sweep UNCAL lamp**

Light when SWP VAR is out of CAL detent position.

㉖ **VAL HOLD OFF control**

When triggering is hard to be effected caused by complexed signal, high-frequency signal, and irregular signal, rotate this knob slightly to obtain a stabilized triggering. In normal cases, leave this knob rotated counterclockwise to the full.

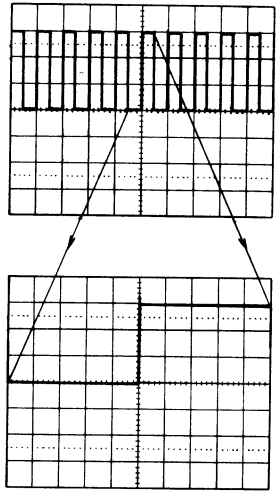
㉗ **FINE PULL x10 MAG ⇆ POSITION control**

Used to move the bright line in horizontal directions. It is indispensable to the measurement of the time of waveform.
Bright line is moved toward right when the knob is rotated clockwise and toward left with counterclockwise rotation. The outer shaft is for coarse adjustment and the inner shaft for fine adjustment.

㉘ **x10 MAG control**

A and B sweeps are magnified 10 times by pulling out FINE knob (inner shaft) of ⇆ POSITION. In this case the sweep time is 1/10 of the value indicated by TIME/DIV. Bring the portion of the waveform desired to be magnified for observation from the center of the scale by operating POSITION of the horizontal axis. Next switch x10 MAG switch to PULL (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 of the sweep speed obtained by

TIME/DIV, in other words, the reading is 1/10 of the sweep time indicated.



Magnified waveform

(29) DLY TIME MULT dial

This control is used to set the delay time of B sweep starting point with respect to A sweep starting point. When the above mentioned DISPLAY is set in INTEN or B.

(4) A synchronization system

(30) SOURCE select switch

Used to select the triggering signal source A sweep.

CH1 The input signal applied to CH1 becomes the triggering signal

CH2 The input signal applied to CH2 becomes the triggering signal.

EXT External triggering signal applied to TRIG INPUT becomes the triggering signal.
This setting is used when triggering with a special independency of the vertical axis signal.

EXT ÷ 10 Attenuates external TRIG INput signal by a factor of 10.

(31) TRIG INput connector

Input terminal used for external triggering signal of A sweep.

(32) 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 components of triggering

signal are cut off.

HF REJ Among the AC components of triggering signal, the high frequency components of about 60kHz or more are attenuated. A stabilized triggering unaffected by noises of about 60kHz or more can be obtained.

DC Accepts all trigger signals from DC to 50MHz.

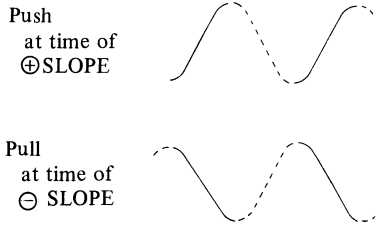
LINE This setting is used when observing a signal triggering with power supply line frequency.

(33) A TRIG LEVEL control

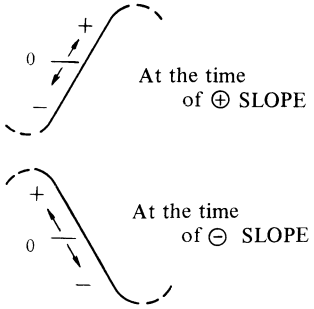
Used to decide at which portion of the waveform should the sweep be started by setting trigger level. This control is also enabled to switch SLOPE.

Depressed position (normal state) is for ⊕ SLOPE and PULL position (state in which the knob is protruding) is for ⊖ SLOPE.

Explanation of synchronization polarity SLOPE



Explanation of synchronization level LEVEL



(34) A TRIG MODE select switch

AUTO 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 (30 Hz 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.

SINGLE Conducts sweep for one time by trigger signal.

㉟ Single sweep RESET button, READY lamp

At time of SINGLE, the READY lamp goes on by depressing this switch.

READY lamp At time of SINGLE, this lamp is lit to show the instrument is ready for single sweep. The lamp goes out when the sweep is started.

(5) B synchronization system

㊱ B TRIG LEVEL control

AUTO B sweep is automatically started after elapsing the delay time determined by A sweep and DLY TIME POSITION.
Usually, the instrument is used at this setting.

B TRIG LEVEL control

This knob is used to determine the portion of the trigger signal of B sweep where the sweep is to be started. This knob has no relationship when B TRIG MODE is set at AUTO.

㊲ SLOPE button

Switching of slope is made simultaneously by this button. Depressed position is for ⊖ SLOPE and normal position for ⊕ SLOPE.

(6) Miscellaneous

㊳ EXT BLANK 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 CH1 OUTPUT connection

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

㊵ CAL 0.5V tip

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

㊶ GND terminal

Earth terminal of the oscilloscope.

5. HOW TO PRODUCE THE BRIGHT LINE

Before turning ON the POWER switch, insure the power supply voltage is within the range of 90–130V for AC 100V set, 180–260V for AC 200V set.

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

POWER	OFF
INTEN	Counterclockwise to the full
FOCUS	Midrange
AC-GND-DC	GND
↕ POSITION	Midrange (the knob is left depressed)
V. MODE	CH1
A TRIG	AUTO
A TRIG COUPLING	AC
A TRIG SOURCE	CH1
A TIME/DIV	0.5 ms/div
B TIME/DIV	Arbitrary
DISPLAY	A
VAR HOLD OFF	Counterclockwise to the full
⇆ POSITION	Midrange

Set all the levers of the switches to the upper side.

After ending all the setting mentioned above, turn ON the POWER and, 15 second later, rotate the INTEN knob clockwise. Then the sweep bright line will appear. If the observation is to be started immediately, set the FOCUS control at a point where the bright line is sharpest.

If the instrument is not used with the power supply turned on rotate the INTENsity counterclockwise to reduce the brightness and also blur the FOCUS.

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 A TIME/DIV is calibrated to its indicating value.

Align the bright line with the horizontal scale line at the center of the screen by operating CH1 POSITION. In some cases, the bright line may be oblique to the scale slightly by the effect of earth magnetism. In this case, bring the bright line until it lies on the horizontal scale line at the center of the screen by properly adjusting the semi-fixed variable resistor TRACE ROTATION on the front panel.

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 Switch of Vertical defection system	CH1
MODE Switch of A TRIG	AUTO
A TRIG SOURCE	CH1

Under these settings almost all the repetitive signals of about 30 Hz or more applied to CH1 can be synchronized and observed by adjusting A TRIG LEVEL. Since the MODE of horizontal axis is at AUTO position, the bright line appears even when no signal is present or when input coupling switch is at GND position. This means that the measurement of DC voltage can be measured. The following switching is needed when observing low frequency signals of about 30 Hz or less.

MODE of A TRIG	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 Switch of Vertical Axis	CH2
A TRIG SOURCE	CH2

(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.

Measurement of the phase difference is reformed after effecting synchronization with leading phase signal.

(3) When observing waveform with X-Y

Set the MODE switch of vertical deflection system to CH2 (X-Y) and DISPLAY switch to X-Y. Then the instrument works as 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 x10 inner shaft knob) at depressed position.

6. METHOD FOR CONNECTING SIGNALS

The first step of measurement is to introduce the signal desired to measure to the oscilloscope properly. Do it with utmost care.

(1) When using a probe

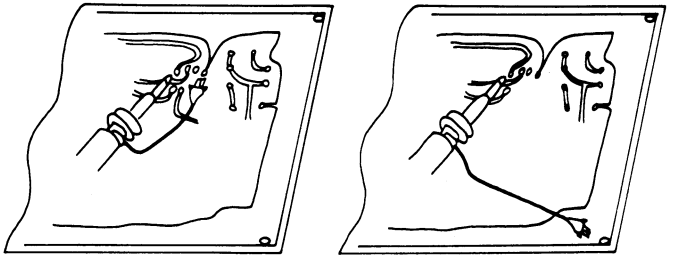
Use the attached probe, **AT-10AP1.5** , when measuring a high frequency wave with high accuracy.

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 signals, and that at the same time, the measuring range is extended by that amount for high signals.

< CAUTIONS>

- ○ Do not apply a signal which exceeds 250V (DC + peak AC at 1 kHz).
- ○ 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 distortions such as ringing and overshoot.

Connection of earth lead wire



(a) A good example (b) A bad example

For better measurement it is required to use an earth attachment available at option.

- ○ Multiply the reading of VOLTS/DIV by 10.

  For example, if the VOLTS/DIV is 50mV/DIV, then read the waveform as

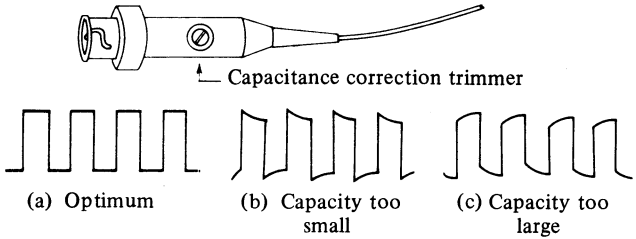
  50mV/DIV x 10 = 500mV/DIV

- ○ 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 output terminal CAL 0.5V of 1kHz calibration square wave voltage.

  When this correction capacity value is at optimum the waveform takes the shape as shown in Fig. (a) as follows. If the waveform is as shown in Fig. (b) or Fig. (c), rotate the semifixed adjusting screw on the matching

box of the probe by using a screwdriver until the optimum state is obtained.



(2) At time of direct connection

When connecting a signal directly to the oscilloscope not using the attached probe **AT-10AP1.5** (10:1), pay attention to the following points in order to minimize the measurement error.

- When performing observation using a bare lead wire, no trouble occurs on the circuit to be measured at 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 non-shielded 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 deirable 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 (50 Ω) 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 impedance which corresponds to the circuit to be measured.
- The stray capacity of the shield wire must be taken into account when performing measurement with a long shield wire. Since the shield wire normally in use has a capacity of about 100 pF per meter, its effect on the circuit to be measured cannot be ignored. Use a probe to minimize the effection the circuit.

○ When the length of the shield wire is used or when the length of the non-terminated cable reaches 1/4 wave length or its multiples within the band of V-509 type (1/4 wave length is about 1 meter when using a coaxial cable at 50 MHz), oscillation may be caused near 5 mV/DIV 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 shield wire to the input connector by way of a serially connected 100Ω to 1 kΩ resistor, or perform measurement at other VOLT/DIV range.

7. MEASURING PROCEDURE

The first things to do are as follows.

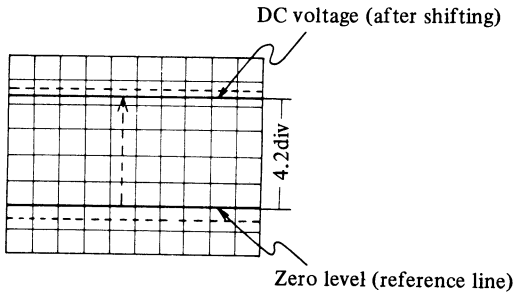
○ Bring the brightness and FOCUS at optimum positions for easy read out.

○ 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 6. "Method for connecting signals" for correcting capacity.)

(1) DC voltage measurement

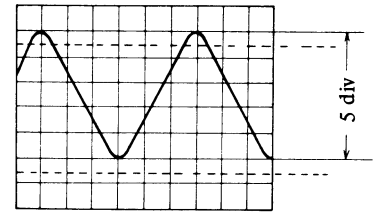
Set input coupling to GND and decide the zero level properly.
Set VOLTS/DIV appropriately and set AC-GND-DC to DC. Since the bright line shifts here by the amount of DC voltage, the DC voltage of the signal can be obtained by multiplying the shift width by the indicated value of VOLTS/DIV. When VOLTS/DIV is 50 mV/DIV, then 50 mV/DIV x 4.2 = 210mV (However, if the probe AT-10AP1.5 (10:1) is in use, the true value of the signal becomes 10 times of the value, or 50 mV/DIV x 4.2 x 10 = 2.1V.)



(2) AC voltage measurement

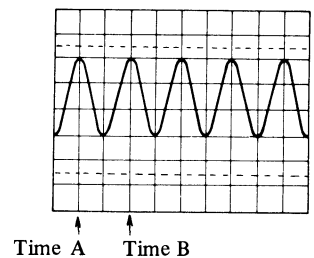
The same as paragraph 7(1), "DC voltage measurement," but here there is no need to align the zero level with the scale line. Set the zero level to the position that can be easily observed.

In the drawing as follows, VOLTS/DIV is 1V/DIV, 1V/DIV x 5 = 5 Vp-p (50 Vp-p at time using the probe AT-10 AP 1.5 (10:1). When magnifying and observing a small-amplitude signal, superimposing on a high DC voltage, set the input coupling to AC. The DC voltage is cut off and AC voltage can be observed by increasing sensitivity.



(3) Measurement of frequency and period

This will be explained with the following figure.



One period covers the time A and time B, which are separated from each other by 2.0 DIV on the screen.

When the sweep time is 1ms/DIV, the period is given by

$$1 \text{ ms/DIV} \times 2.0 = 2.0 \text{ ms}$$
$$= 2.0 \times 10^{-3} \text{ sec}$$

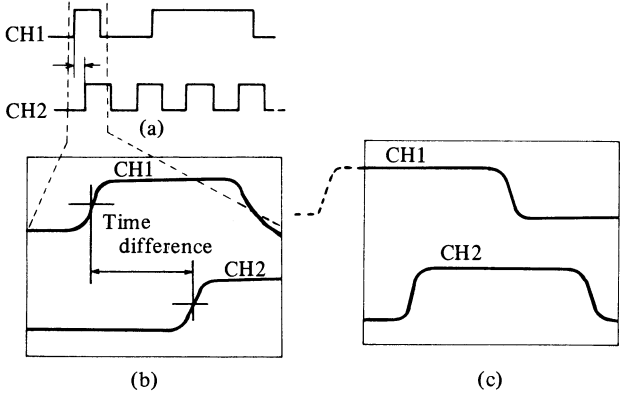
Accordingly, the frequency is

$$1/(2.0 \times 10^{-3}) = 500 \text{ Hz}$$

(However, when the knob MAG x10 is at pulled out position, TIME/DIV must be converted to 1/10 since the sweep is magnified.)

(4) Measurement of time difference

Triggering signal source "SOURCE" is selected as an offering reference signal when measuring the time difference between two signals. Assume that pulse trains as shown in (a). Then (b) shows the case when CH1 is taken as the triggering signal source and (c) the case where CH2 is taken.

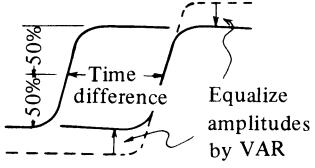


This means that CH1 is used as the triggering signal when investigating the length of time by which the signal of CH2 is delayed from the signal of CH1. CH2 is used in the reversed case. In other words, the signal leading in phase is selected as the triggering signal source.

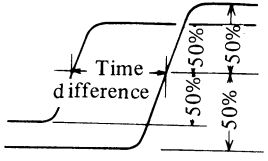
If this process is reversed, the portion to be measured may sometimes not appear on the screen. Thereafter, equalize the amplitudes of the two signals appearing on the screen or superimpose one on another.

Read the time difference between 50% amplitude points of the two signals.

Sometimes the superimposing method is more convenient from the point of view of procedure.



(a) Equal amplitude measuring method



(b) Suerposition measuring method

<CAUTIONS>

Since the pulsed wave contains many high-frequency wave components (higher harmonics) depending on its width or period, pay the same attention as given to high frequency signals when handling it. Accordingly, use a probe or coaxial cable and shorten the earth lead wire as much as possible.

(5) Measurement of rise (fall) time

To measure the rise time pay attention not only to the abovementioned items but also to measurement error.
The following equation is provided for the relation among the rise time Trx of the waveform to be measured, the rise time Trs of oscilloscope, and the rise time Tro displayed on the screen.

$$Tro = \sqrt{Trx^2 + Trs^2}$$

When the rise time of the pulse going to be measured is sufficiently longer than the rise time of the oscilloscope (7ns 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

$$Trx = \sqrt{Tro^2 - Trs^2}$$

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, fc : Frequency band (Hz)
tr : Rise time (s)

The rise time and fall time are determined by the time elapsed between the 10% to 90% values of pulse width.

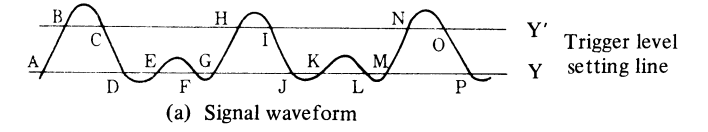
(6) Measurement of single-shot signal

Single sweep is conveniently used in the measurement and photography of single-shot signal, waveform of remarkably non-uniform repetition (such as impulse waves, sound waves, switch noise waves).
First set A TRIG MODE on the front panel to NORM and the effect synchronization by using a signal or repetitive waveform of about the same level and by rotating LEVEL.
Next, set A TRIG MODE to SINGLE and depress RESET button to insure that sweep is made one and only one time.
Then remove the vertical axis input signal (by, for example, setting input coupling switch to GND), depress SINGLE SWP RESET and insure that READY lamp goes on.

Apply the input signal. Sweep is made for one time and Ready lamp goes out. Since sweep is also made at no signal time depending on the level, do not rotate LEVEL once SINGLE SWP RESET is completed.

(7) Synchronization of complexed waveform

In the case shown in the Fig. (a) below where two waveforms have difference in amplitude alternate, the waveform is doubled if the trigger level is not set properly. In the case where the trigger level is selected as Y line two waveforms, one starting with A and advancing to B, C, D, E, F, . . . and the other starting with E and advancing to F, G, H, I . . . , will appear alternately on the screen. They will be doubled as shown in Fig. (b), for which no synchronization can be taken.



(a) Signal waveform

(b) When the trigger setting level is Y

(c) When the trigger setting level is Y'

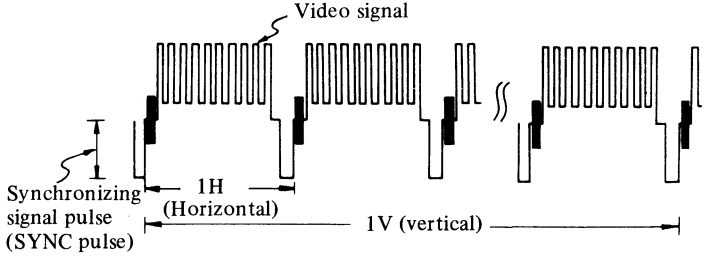
Synchronization of complexed waveform

In such a case, rotate LEVEL clockwise until the trigger level comes to Y' line. Then the waveform on the screen becomes the one is shown in Fig. (c) above which starts with B and advances to C, E, F, . . . and which allows synchronization.

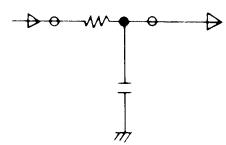
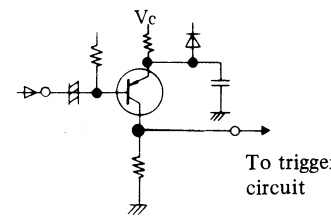
(8) How to use TV exclusive synchronization

① On the image waveform of TV

In the work concerned with TV, complexed signals containing video signal, blanking pedestal signal, and synchronizing signal are often measured. However, since the waveform is complexed, a special circuit is needed to effect a stable syncrhonization with vertical waveform.

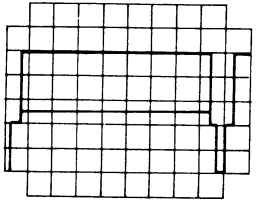


② Difference in the circuits

	Exclusive circuit for conventional oscillograph		Exclusive circuit for this instrument (Principle drawing)
	General circuit	**Simple synchronizing circuit**	**TV exclusive synchronizing separator circuit**
Circuits	Video signal To trigger circuit 	To trigger circuit 	
	Hard to synchronize, because video signal is applied directly as trigger signal.	Synchronization is more easily effected than in the circuit shown at left, because the signal is integrated to remove high frequency components.	After picking up the SYNC pulse, the vertical synchronization is separated. Then, the stable synchronization is obtained

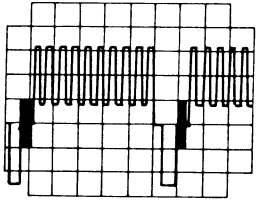
③ Operation

To observe frame signal



A TRIG MODE: TV
COUPL : TV-V

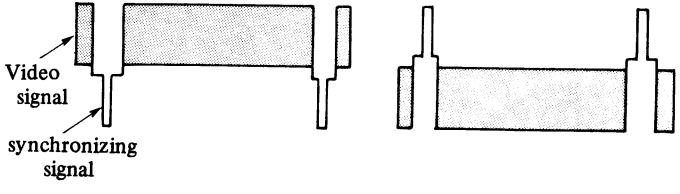
To observe scanning signal



A TRIG MODE: TV
COUPL: TV-H

(NOTE) This oscilloscope synchronizes with only (-) synchronizing signal.

(REFERENCE)



(a) Example of (-) synchronizing signal

(b) Example of (+) synchronizing signal

(9) Operating procedure of delayed sweep

(Used to magnify and observe any portion of a complexed waveform in horizontal direction.)

There are two kinds of time delay sweep; one is AUTO time delay sweep (continuous time delay sweep) and the other TRIG time delay sweep (triggering time delay sweep). These are selected by MODE switch of B TRIG.

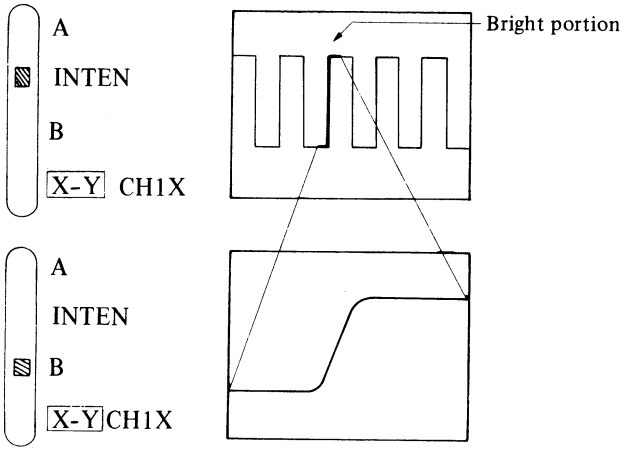
TRIG time delay sweep is further classified into two, the INT (internal triggering time delay sweep) and EXT (external triggering time delay sweep) . Usually, the instrument is used in AUTO mode. Although the AUTO time delay sweep is easy to operate the maximum magnification factor is limited the other hand, since no jitter is generated in TRIG time delay sweep, this sweep has the feature of being enabled to increase the magnification factor. However, the magnification factor is limited by the brightness of CRT (to a few hundred times).

① At time of AUTO (continuous time delay sweep)

Effect triggering by A sweep and set the knobs as follows.

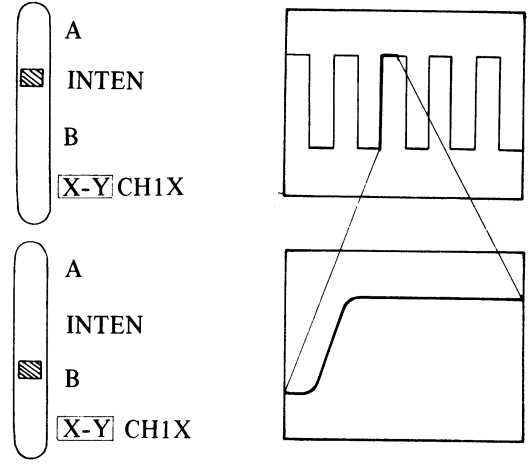
B TRIG MODE	AUTO
DISPLAY	INTEN
A TIME/DIV	Choose A TIME/DIV properly
B TIME/DIV	Set B TIME/DIV at a more rapid sweep time than the one set by A TIME/DIV

Then the high brightness portion of A sweep will appear without fail (if not, adjust INTEN).
Rotate DLY TIME MULT dial. The high brightness portion will move continuously. Bring this high brightness portion to the position desired to be magnified, switch DISPLAY to B. Then the high brightness portion is magnified to occupy the full area of the screen. The sweep time is the indicated value of B TIME/DIV.



② At time of TRIG (TRIGGERING time delay sweep) Effect TRIGGERING with A sweep and set the knobs as follows.

B TRIG MODE	TRIG (INT or EXT)
DISPLAY	INTEN
A TIME/DIV	Chose A TIME/DIV properly
B TIME/DIV	Set B TIME/DIV at a more rapid sweep time than the one set by A TIME/DIV
SLOPE	Set SLOPE either to + or to −.



The case in which SLOPE is + is shown

Thereafter, rotate LEVEL. The high brightness portion of A sweep will appear without fail. (This state is called the B-TRIGGERED state.)

Rotate DLY TIME MULT dial. The high brightness portion will move continuously. Further rotation will bring this portion to the next "peak."
Therefore, bring this high bright portion to a position desired to be magnified and then set DISPLAY at B.
The high brightness portion is magnified to occupy the full area of the screen. The sweep time for this case is the value indicated by B TIME/DIV.
The gen-locking is fixed at AC.

③ Magnification of TV signal

Model V-509 has the following methods to select and display the magnified image of any line of TV signal.

Control	Setting
A TIME/DIV	5 ms/div (2 ms/div)
A TRIG INPUT	Not needed
A TRIG SOURCE	CH1, CH2 or EXT
A TRIG MODE	TV
COUPLE	TV-V
VAR HOLD OFF	Adjust until the doubled image of fields 1 and 2 disappear.
A TRIG LEVEL (SLOPE)	No operation is needed.
B TIME/DIV	10 μs/div
B TRIG MODE	AUTO or NORM
B TRIG LEVEL (SLOPE)	No operation needed
DISPLAY	After setting with INTEN the position to be magnified, set DISPLAY to B.
DLY TIME MULT	Set the desired mangification position.

8. OPTION

Battery pack AD-509

Operation

1) Connect the cable from the AD-509 to the BATT INPUT connector ㊷ in the V-509 oscilloscope.
2) Set the Power source select switch ⑥ to DC and the Power mode select switch ⑦ to DC OPE.
3) Turn on the POWER switch ① . Then the V-509 starts to operate on the power from the AD-509.
   The continuous operation time is one hour and half. If the battery is operated in excess of this period, the terminal voltage will decrease sharply and the battery will be in the over-discharged condition.
   In this model, an alarm circuit will be activated before the over-discharging and the POWER lamp ② starts to flash. In this case, charge the battery immediately.

Note: When the alarm circuit is energized and the voltage is lowered down to 10.5V, the power of the V-509 is off automatically to prevent the over-discharge of the AD-509.
The selection of the AD-509 and an external DC source is made by the EXT DC INPUT connector ⑧.

Charging of battery

1) Connect the AC cord to an AC outlet and set the Power source select switch ⑥ to DC and the Power mode select switch ⑦ BATT CHARGE.
2) Turn on the power switch ① and the charging will start. In this case the POWER lamp is not illuminated.
3) The CHARGE lamp is being illuminated during the charge. It will take about 15 hours until the battery is charged completely. When the charging is completed, the CHARGE lamp becomes dark.
4) When the V-509 is operated on AC source while it is connected with the AD-509 , the AD-509 is in the trickle charge mode.

Operating considerations

- **Do not short the both polarities.**
- **Do not throw the battery pack into fire.**

a) Charge the battery in the ambient temperature from 10 to 35°C.
   Do not charge the battery for three days or 48 hours in succession. This will shorten the life of the battery.

b) Store the battery pack in a cool and dark place and in the ambient temperature from -15 to 35°C.

When a battery stored for an extended period is used, charge it for 15 hours.

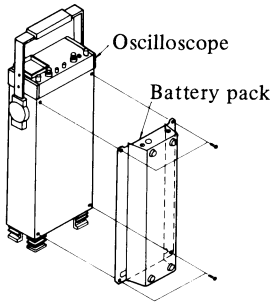
c) The life of the battery pack is subject to the ambient temperature, load condition and continuous operation.
Usually, the number of the charge and discharge is over 300.

If a charge and discharge is made once a day, the life will be more than one year. If the life is over, the battery can not operate normally if the normal charge has been made. In this case, replace the battery.

d) Charge the spare battery once a month to prevent a self-discharge of the battery.

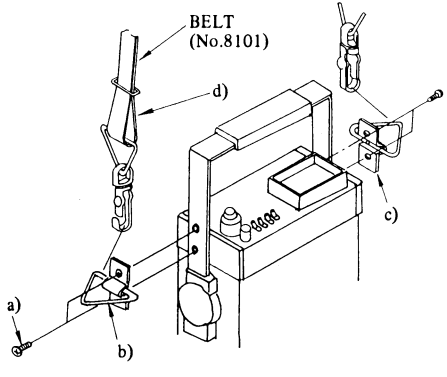
Replacement procedure

1) Disconnect the power cord.
2) a) Remove the screws and the plate of AD-509.
   b) Disconnect the connectors between the battery pack and the AD-509 unit and take out the battery pack.
   c) Install the new battery pack to the compartment. Then connect the battery pack connector to the connector of AD-509 unit.
   d) Mount the plate with screws.



Shoulder belt

1) Check the following parts packed along with the shoulder belt (No. 8101) in the polybag.
   a) Binding screw M3 x 6
   (Code XCA6306) ..... Four pieces



b) Triangle clasp
(D#x8301104) ..... Two pieces
c) Clasp (D#x8301102) Two pieces
d) Belg (D#x876416) ..... One piece

2) Mounting

To carry the model V-509 oscilloscope with the shoulder belt hanged up, excute the hooking of the shoulder belt (No. 8101) as follows.

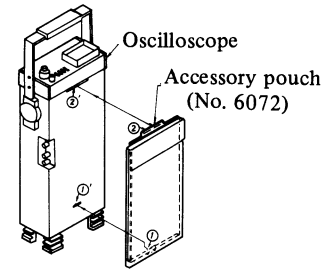
a) Mount the triangle band clasps on the positions shown in the figure, using the screws a).
Make sure the screws are tightened up.

b) Then, hang the clasp mounted across the shoulder belt (No. 81010) into the triangle clasps mounted as 1).

Accessory pouch

Mount the accessory pouch to the model V-509 oscilloscope.

1) Insert the edge ① of the accessory pouch into the body ①'.
2) Bend the accessory pouch and insert the section ② into ②'.

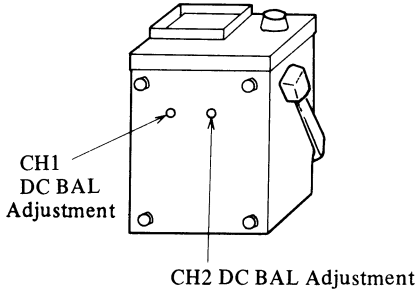


9. ADJUSTMENTS

The ATT balance of the vertical axis can be made easily.

① Set the input coupling switches of CH1 and CH2 to GND and set the TRIG MODE to AUTO. Then position the bright line to the center.

② Turn the VOLTS/DIV switch to 5mV–10mV and adjust so that the bright line does not move.



10. MAINTENANCE

1) Since semiconductors, precision components, etc. are employed in this oscilloscope, use atmost care for operation and storage.
2) Clean the scale with soft tissue periodically.
3) Store this oscilloscope in the ambient temperature from -15 to 60°C. (except for the battery pack AD-509)

11. SPECIFICATIONS

CRT

Type

Hitachi 95LB31 rectangular mesh type tube with 12kV acceleration potential and metal backed phosphor

Phosphor

P31 standard

Graticule

8 x 10 div (div = 6.35 mm)
Internal graticule

Focussing

Possible (with automatic focus correction circuit)

Trace rotation Present

Brightness adjustment Possible

Z-AXIS INPUT (INTENSITY MODULATION)

DC-coupled, positive-going signal decreases intensity: 5Vp-p signal causes noticeable modulation at normal intensity: DC to 1 MHz.

Input impedance Approximately 20 k ohm

Maximum input voltage 50V (DC + peak AC)

Coupling DC

VERTICAL DEFLECTION SYSTEM (2 identical channels)

Bandwidth and rise time

DC to at least 50 MHz and rise time 7 ns or less. DC to at least 10 MHz and rise time 35ns or less at magnifier extends. The AC coupled lower -3dB point is 10Hz or less.

Deflection factor

5mV/div to 5V/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. x5 MAG increases sensitivity of each deflection factor setting to 1mV/div.

Accuracy

±3% (+10 to +35°C)

Additional error for magnifier ±2%

Display modes

CH1, CH2 (normal or invert), Alternate, Chopped (250 kHz rate), Added

Input impedance

1MΩ ±1.5% in parallel with 30±3pF

Maximum input voltage

250V (DC + peak AC) or 500Vp-p AC at 1kHz or less

Input coupling

AC, GND, DC

Delay line

Permits viewing leading edge of display waveform

HORIZONTAL DEFLECTION SYSTEM

Time base A

0.1μs/div to 0.2s/div in 20 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. x10 MAG extends maximum sweep rate to 10ns/div.

Time base B

0.1μs/div to 2ms/div in 14 calibrated steps in a 1–2–5 sequence. x10 mag extends maximum sweep rate to 2ns/div.

Accuracy

±3% (+10°C to +35°C)
Additional error for magnifier ±2%

Horizontal display modes

A only, A intensified, B delayed, X-Y operation

Delayed sweep position adjustment 1 div or less–10 div or more

Delay sweep variable Present

Delay time jitter Better than 1:20,000

A AND B TRIGGERING SYSTEM

A trigger modes

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

A trigger hold-off

Adjustable control permits a stable presentation of repetitive complex waveform.

A Trigger source

Internal (Ch1, Ch2), Line, External, External ÷10

A trigger slope

+, -

TV sync polarity

TV (-)

Triggering level variable range

For both A and B. Internal; ±4 div or more
External; approximately ±1V
External ÷10; approximately ±10V

Triggering sensitivity and frequency

For both A and B. However, ( ) is only for B

Frequency	Internal	External	External ÷10
DC (30Hz)–10MHz	0.5 div	150 mV	1.5 V
10MHz–50MHz	1.5 div	500 mV	5 V

TV-V sensitivity: SYNC section less than 0.7 div or 200mV

AUTO low band : Approximately 30Hz (when time Base A is 0.1μs/div to 2ms/div)

A trigger coupling

AC : 30Hz to full bandwidth
HF REJ: attenuates signals below approximate 60 kHz
DC : DC to full bandwidth

A external trigger input impedance

1 MΩ ±20% in parallel with 30 ±6pF (however, setting HF REJ and LF REJ are not included.)

Maximum input voltage

250V (DC + AC peak)

B trigger modes

Automatic, Normal

B trigger slope

+ , –

Trigger coupling

AC only; 30Hz to full bandwidth

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

Deflection factor

Same as vertical deflection

Accuracy

Y: ±3% (+10 to +35°C)
X: ±5% (+10 to +35°C)
Additional error for magnifier ±2%

X-bandwidth

DC to at least 500kHz -3dB

Phase error

3° or less from DC to 100kHz

CALIBRATOR

An approximate 1kHz frequency 0.5V (±1%) square wave

SIGNAL OUTPUTS

CH1 VERT SIGNAL OUTPUT

Output voltage is at least 25mV/div into a 50 ohm load. Bandwidth is DC to at least 10 MHz.

POWER SUPPLY

VOLTAGE (50/60Hz)	FUSE
100V (90–130V)	1A
200V (180–260V)	0.5A

Power supply frequency:	50, 60, 400Hz
Power consumption:	Approx. 25W
EXT DC power supply	DC11–14V approx. 1.5A

ENVIRONMENT

Limit of operation temperature	0–+50°C
Limit of operation humidity	35–85%
Rated range of use temperature	+10–+35°C
Rated range of use humidity	45–85%
Strorage and transport temperature	-20–+70°C

DIMENSIONS AND WEIGHT

Approx. 215(W) x 110(H) x 330(D) mm
(8.6(W) x 4.4(H) x 6.4(D) inch)

Approx. 5 kg (11 lbs)

Option

Battery pack AD-509

Accessory pouch

Hood

Shoulder belt

AD-509 type Battery Pack

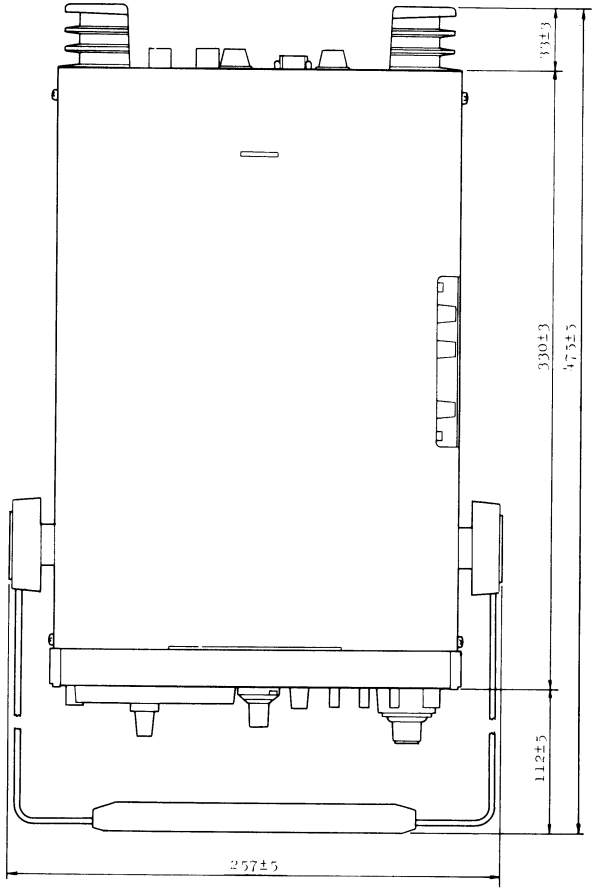
Batteries	10 rechargeable A nickel-cadmium cells
Nominal capacity	3500 mAh
Nominal voltage	12V

Battery execessive discharge protection

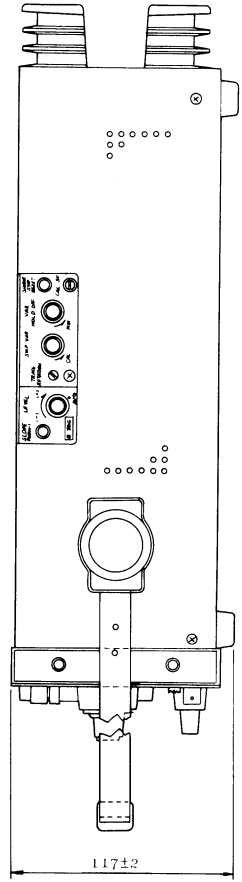
Instrument operation automatically interruped when battery charge drops to approximately 10.5V.

Charge current	Approx. 350 mA
Charge time	13–16 hours for full charge

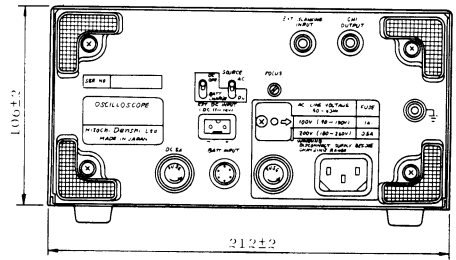
12. EXTERNAL VIEW



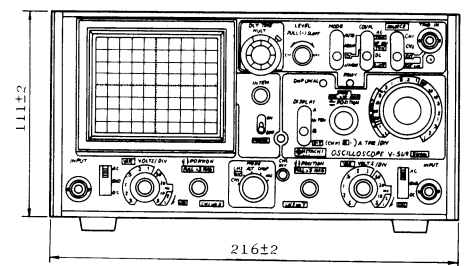
TOP view



SIDE view



REAR view

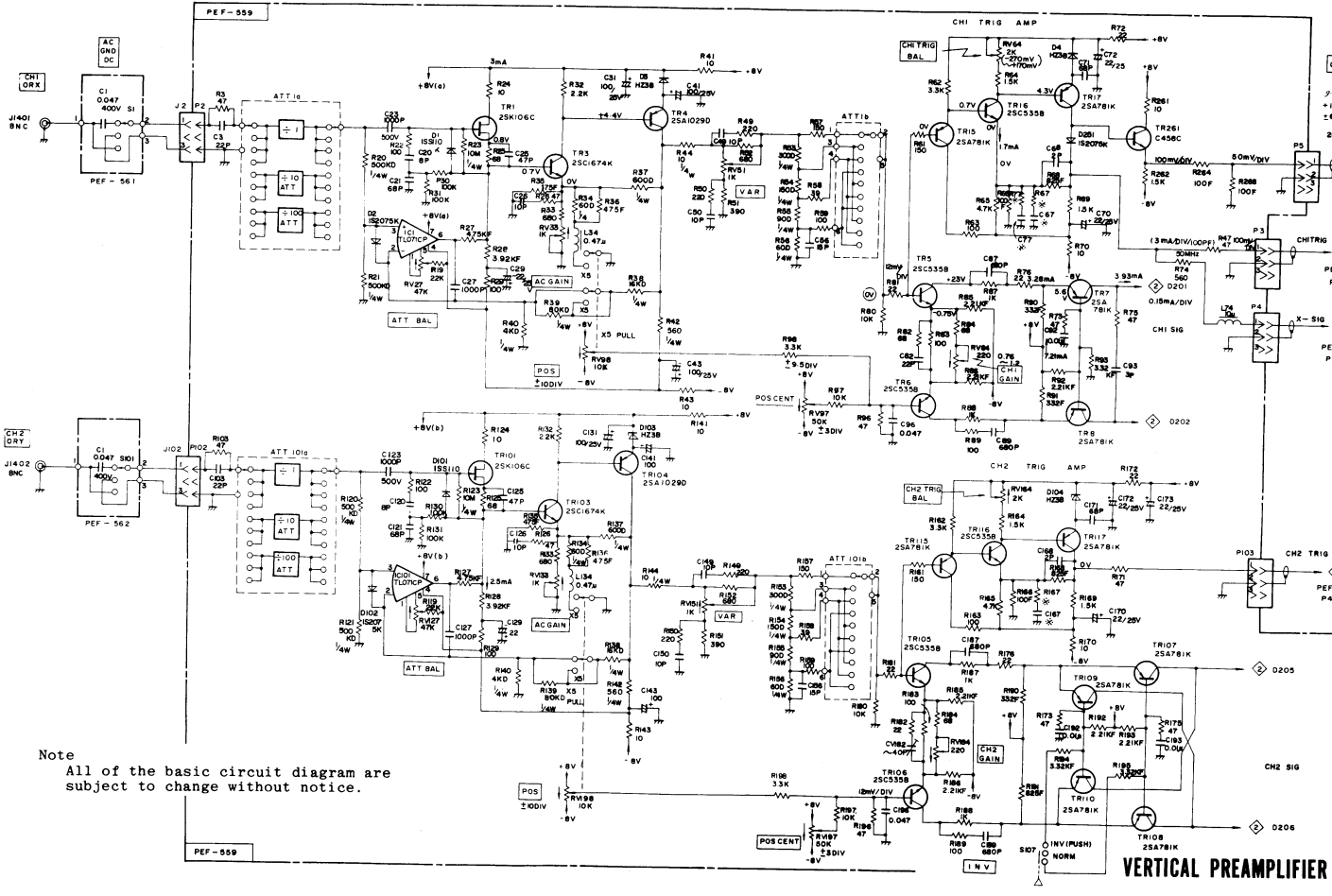


FRONT view

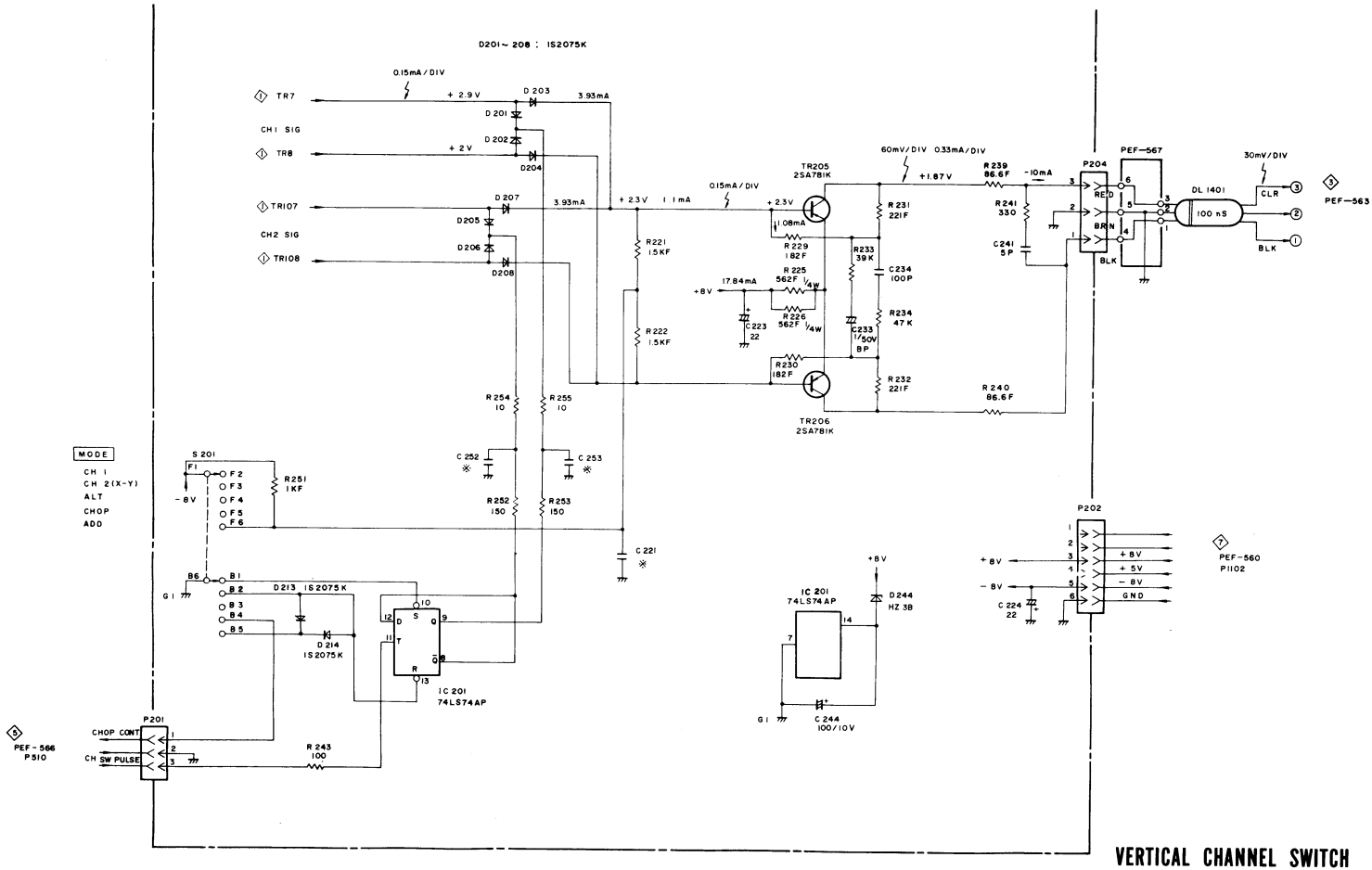
Unit: mm

MODEL V-509

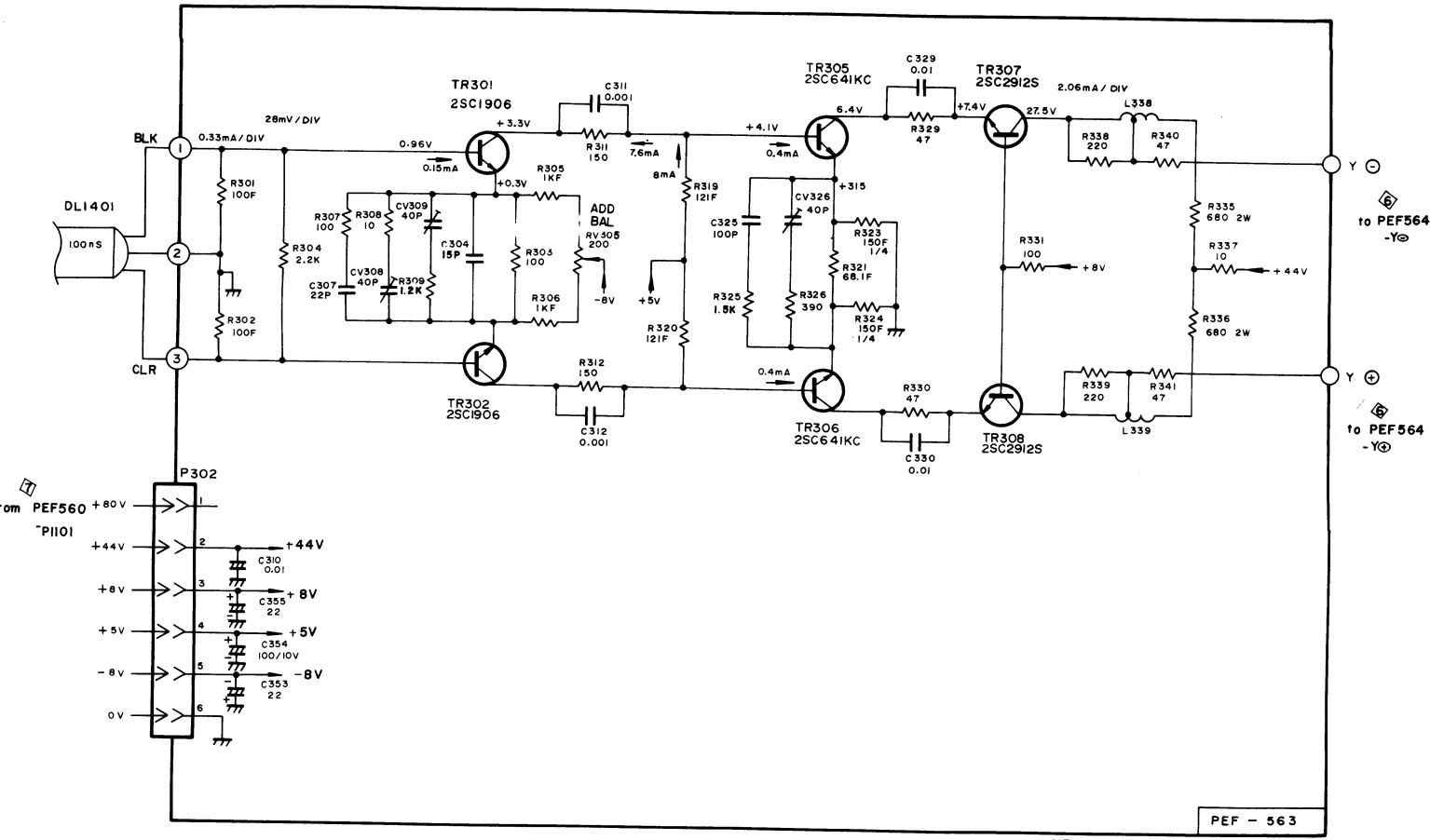
13. SCHEMATIC DIAGRAMS



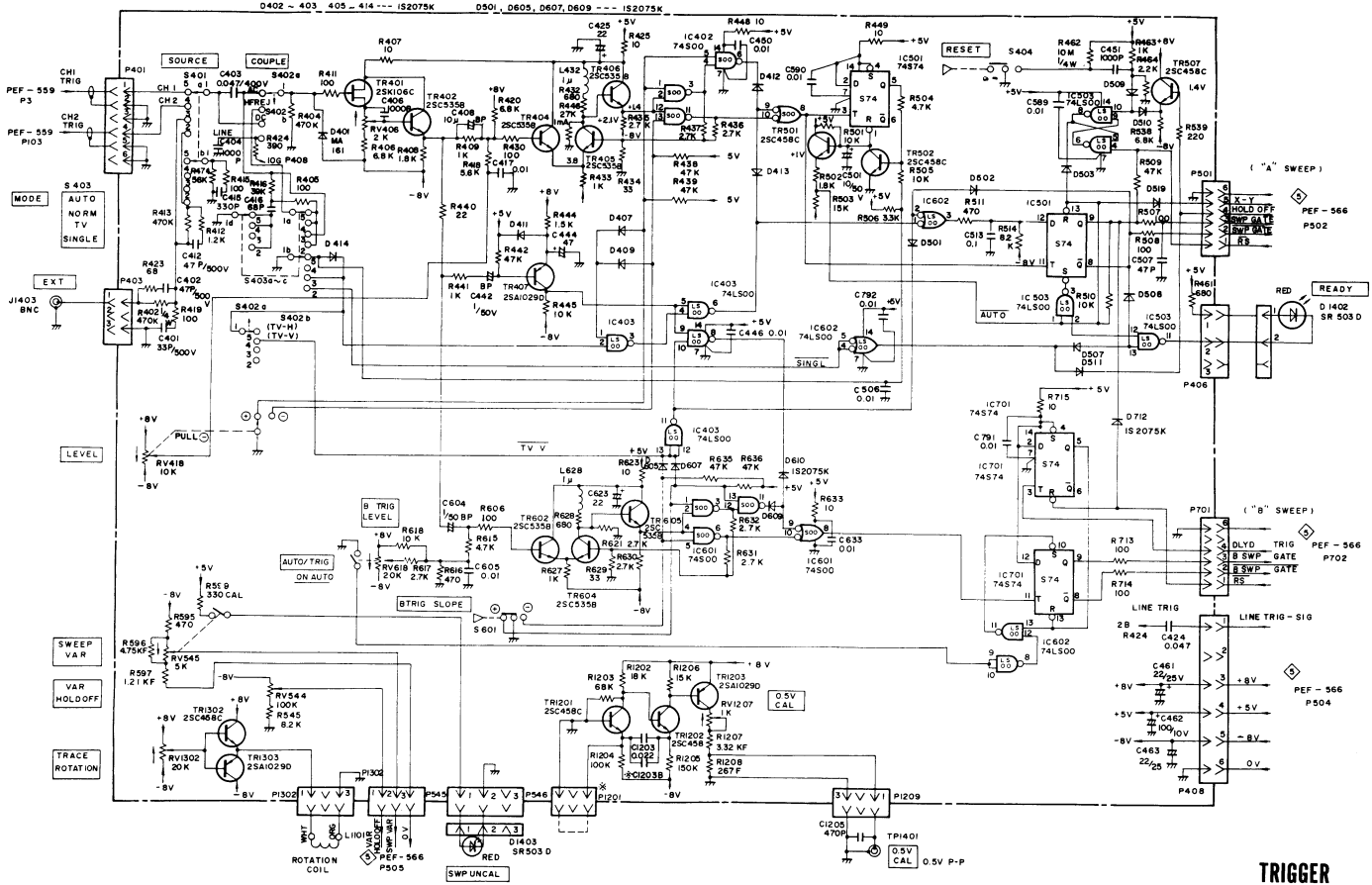
Note
All of the basic circuit diagram are subject to change without notice.

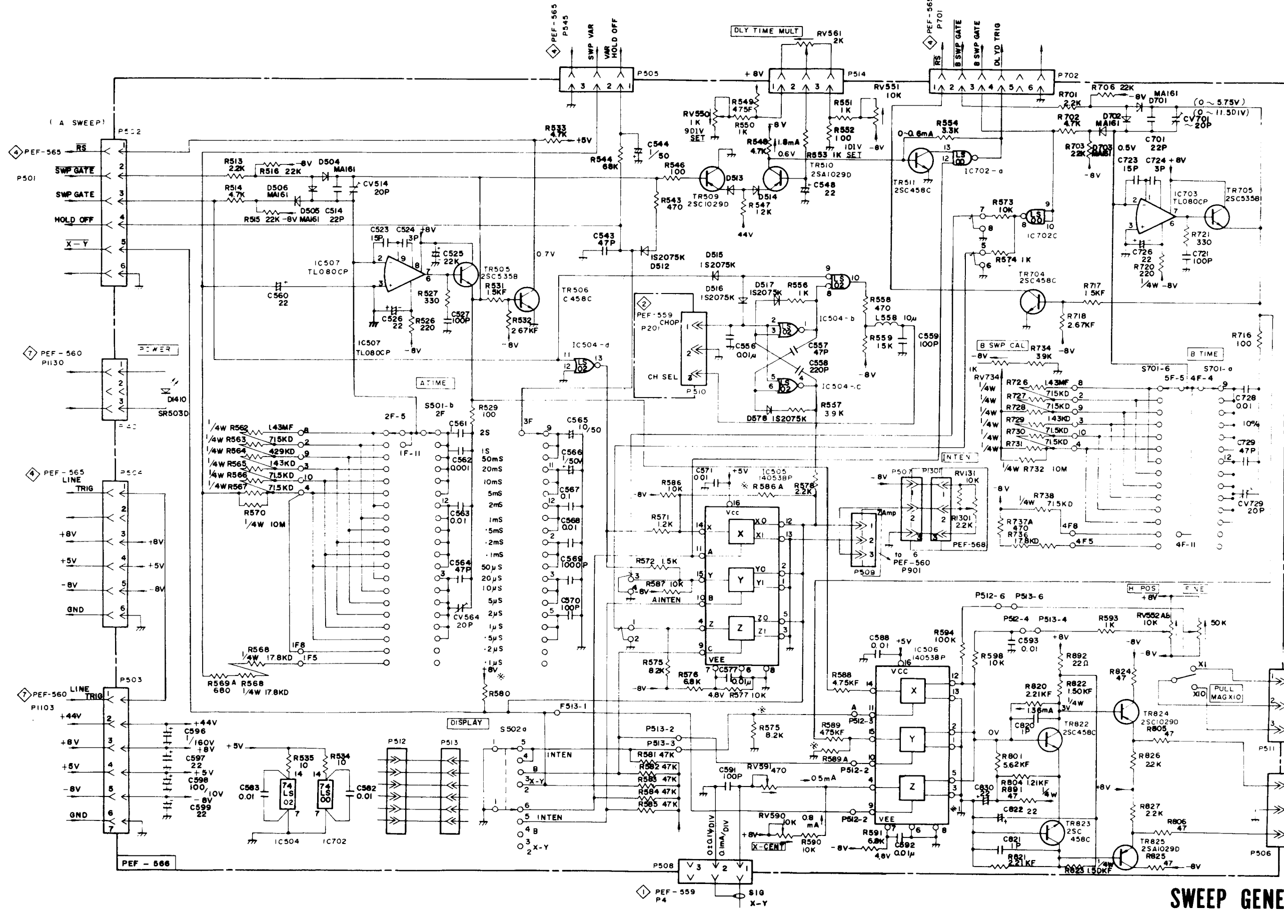


VERTICAL CHANNEL SWITCH

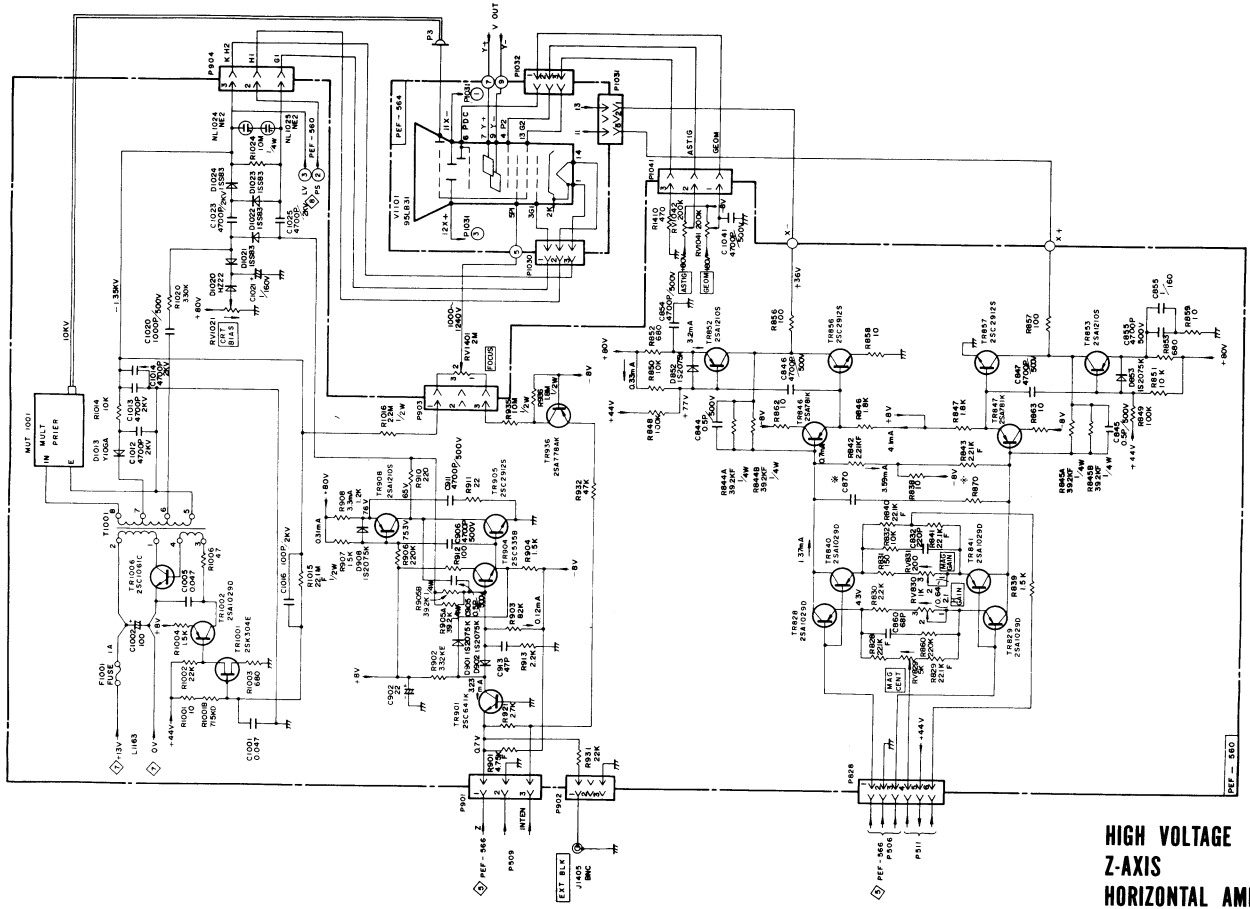


VERTICAL OUTPUT AMPLIFIER

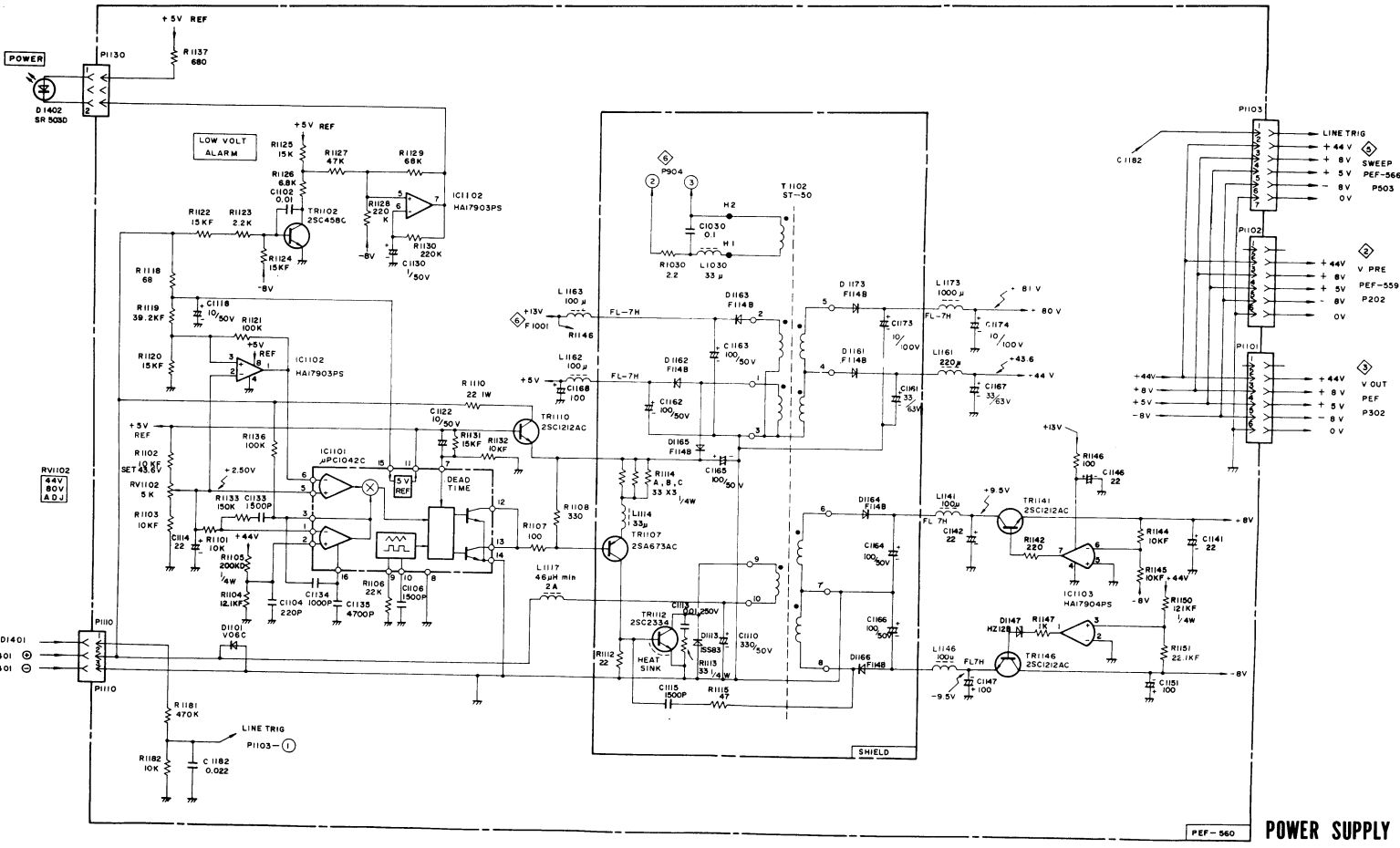

D402 ~ 403 405 ~ 414 --- IS2075K
D501 , D605, D607, D609 --- IS2075K
SOURCE
COUPLE
CH1 TRIG
CH2 TRIG
PEF - 559 P3
PEF - 559 P103
MODE
AUTO
NORM
TV
SINGLE
EXT
J1403 BNC
LEVEL
PULL
TV V
TRIG LEVEL
AUTO/TRIG
ON AUTO
BTRIG SLOPE
SWEEP VAR
VAR HOLDOFF
TRACE ROTATION
ROTATION COIL
SWP UNCAL
RESET
RED
READY
D 1402 SR 503 D
AUTO
SINGL
("A" SWEEP)
X-Y
HOLD OFF
SWP GATE
SWP GATE
RS
PEF - 566 P502
("B" SWEEP)
DLYD TRIG
B SWP GATE
B SWP GATE
RS
PEF - 566 P702
LINE TRIG
LINE TRIG - SIG
+8V
+5V
-8V
0V
PEF - 566 P504
P408
0.5V CAL
0.5V P-P
TRIGGER

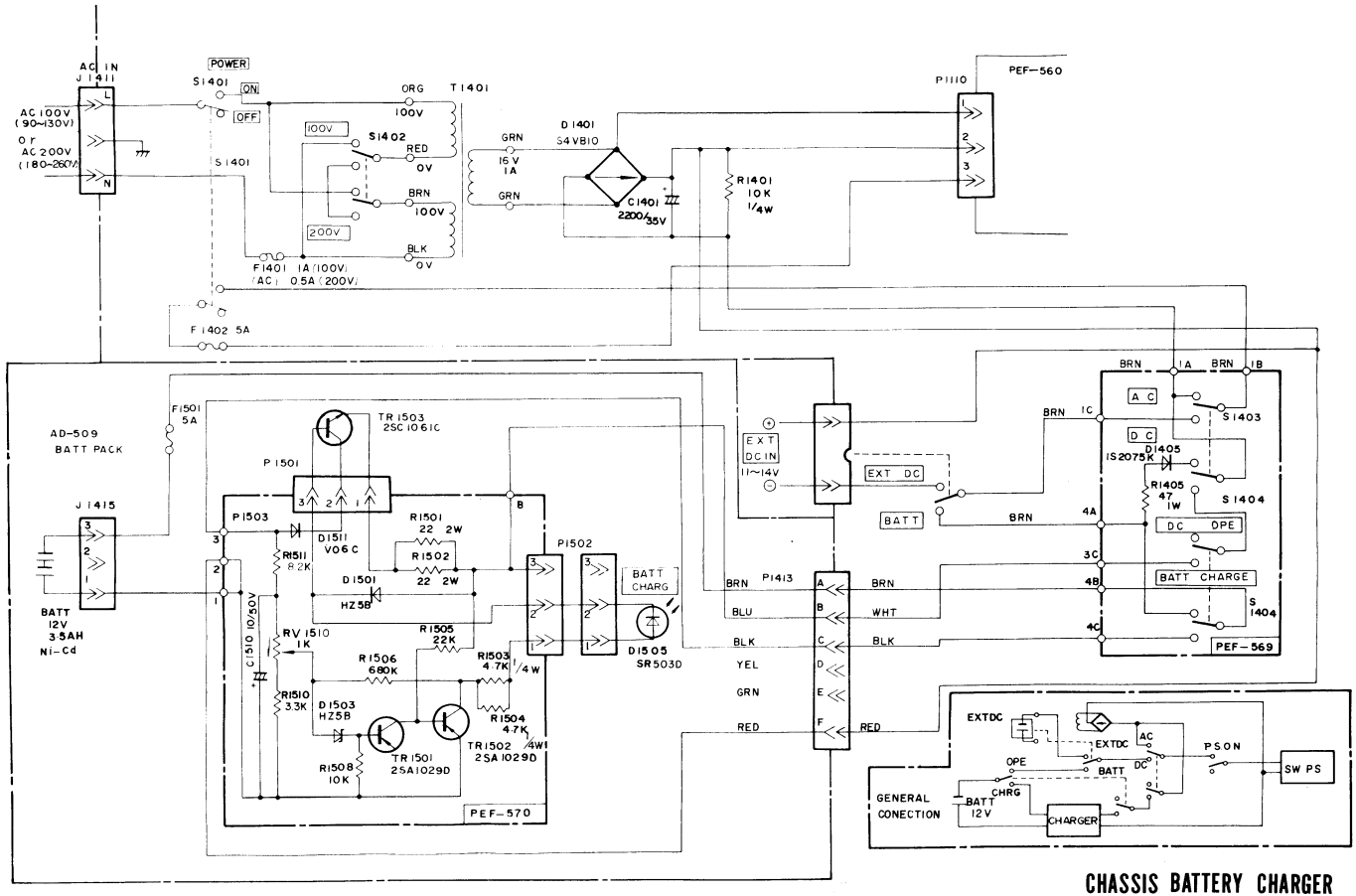


SWEEP GENERATOR

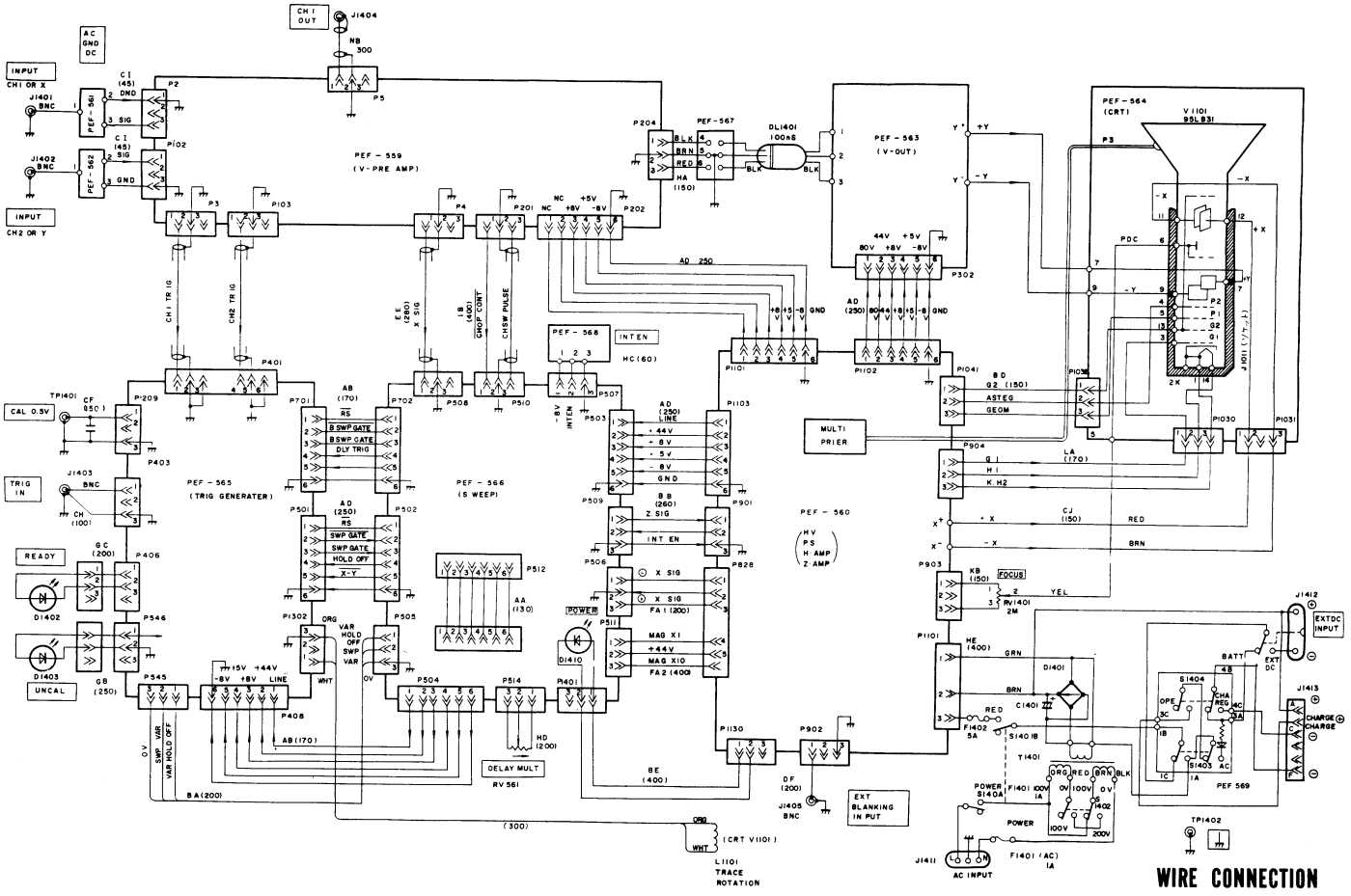


HIGH VOLTAGE
Z-AXIS
HORIZONTAL AMPLIFIER


POWER
P1130
D1402 SR 5030
+5V REF
R1137 680
LOW VOLT ALARM
R1125 15K
R1127 47K
R1129 68K
R1126 6.8K
C1102 0.01
TR1102 2SC458C
IC1102 HA17903PS
R1128 220 K
R1130 220K
C1130 1/50V
-8V
R1122 15KF
R1123 2.2K
R1124 15KF
R1118 68
R1119 39.2KF
C1118 10/50V
R1121 100K
R1120 15KF
RV1102 44V 80V ADJ
R1102 10 KF SET 43.6V
RV1102 5K
R1103 10KF
R1136 100K
+2.50V
IC1101 μPC1042C
5 V REF
DEAD TIME
R1133 150K
C1133 1500P
C1114 22
R1101 10K
+44V
R1105 200KΩ 1/4W
R1104 12.1KF
C1104 220P
C1134 1000P
C1135 4700P
R1106 22K
C1106 1500P
D1101 V06C
P1110
D1401
R1181 470K
LINE TRIG
P1103-(1)
R1182 10K
C1182 0.022
R1110 22 1W
C1122 10/50V
R1131 15KF
R1132 10KF
TR1110 2SC1212AC
R1108 330
R1107 100
L1117 46μH min 2A
L1163 100 μ
+13V
F1001
FL-7H
R1146
L1162 100 μ
C1168 100
+5V
P904
T1102 ST-50
H2
H1
C1030 0.1
R1030 2.2
L1030 33 μ
D1163 FI14B
D1162 FI14B
C1163 100/50V
C1162 100/50V
D1165 FI14B
C1165 100/50V
R1114 A,B,C 33 X3 1/4W
L1114 33μ
TR1107 2SA673AC
C1113 001/250V
TR1112 2SC2334
D1113 SS83
C1110 330/50V
R1113 33 1/4W
HEAT SINK
R1112 22
C1115 1500P
R1115 47
D1173 FI14B
C1173 10/100V
L1173 1000 μ
+81 V
+80 V
C1174 10/100V
D1161 FI14B
L1161 220μ
+43.6
+44 V
C1167 33/63V
C1161 33/63V
SHIELD
+13V
R1146
C1146 22
L1141 100μ
+9.5V
TR1141 2SC1212AC
C1142 22
R1142 220
C1164 100/50V
D1164 FI14B
R1144 10KF
C1141 22
R1145 10KF+44V
IC1103 HA17904PS
-8V
R1150 121KF 1/4W
D1147 HZ12B
R1147 1K
R1151 22.1KF
C1151 100
L1146 100μ
FL7H
TR1146 2SC1212AC
C1147 100
-9.5V
D1166 FI14B
C1166 100/50V
P1103
C1182
LINE TRIG
+44 V
+8 V
+5 V
-8 V
0 V
SWEEP PEF-566 P503
P1102
V PRE PEF-559 P202
P1101
V OUT PEF P302
PEF-560



CHASSIS BATTERY CHARGER


WIRE CONNECTION
PEF - 559 (V-PRE AMP)
PEF - 563 (V-OUT)
PEF - 564 (CRT)
PEF - 565 (TRIG GENERATER)
PEF - 566 (S WEEP)
PEF - 567
PEF - 568
PEF - 560 (HV PS H AMP Z AMP)
PEF 569
INPUT CH1 OR X
INPUT CH2 OR Y
TRIG IN
CAL 0.5V
READY
UNCAL
MULTI PRIER
EXT BLANKING IN PUT
EXT DC INPUT
CHARGE
AC INPUT
DELAY MULT RV 561
TRACE ROTATION
INTEN
FOCUS
POWER