Model V－203F

OSCILLOSCOPE

OPERATION MANUAL

HITACHI
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 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.

1. Features

Hitachi Model **V-203F** oscilloscope is a portable-type, advanced-class oscilloscope with a bandwidth of DC to 20MHz. Designed by putting special emphasis on operability and ruggedness, this oscilloscope has the following features:

(1) Wide bandwidth:
The instrument has a bandwidth of DC to 20MHz.

(2) High sensitivity:
Sensitivity is 1 mV/div.

(3) Large 5.5" screen:
Employment of a large square CRT makes waveforms easier to observe.

(4) Internal graticule:
Employment of internal graticule CRT permits waveforms observation to be made without parallax error.

(5) TV synchronization:
Employment of a new TV sync/separator circuit allows instrument to observe TV signals stably.

(6) **Single time base with delayed sweep:**
Enlarges any given portion of signal for easy observation.

2. Composition

Composition of Model **V-203F** oscilloscope is as follows.

(1) Model **V-203F** oscilloscope unit.....1
(2) **Probe** (AT-10 AF 1.5).....2
(3) Power supply cord.....1
(4) Operation Manual 1

3. Precautions

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

Installation site

* Avoide installing instrument in an extremely hot or cold place.
  - o 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.
  - o 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 of 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 instrusion 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 ventillation holes.
* Do not apply a heavy shock to the oscilloscope.
* Do not insert a wire, pin, etc. through the ventillation 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.

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.
  - o 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.
  - o 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 and then wipe thoroughly with a dry cloth.
  - o When dust has accumulated on the in side, remove it by using a dry brush, or by using the exhaust of a compressor or a vacuum cleaner.

NOTE: When opening the case, disconnect 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.

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.

o 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 finger prints on it.

Cautions to be observed before measurement

* 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

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 rear panel 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 belown 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 if the fuses are as follows.

	Shape (Diameter × length)mm	JIS type name
2A	6.35ϕ × 31.8	MF61NM250V 2A AC
1A	6.35ϕ × 31.8	MF61NM250V 1A AC

* Do not increase the brightness to 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 no apply an excessive voltage.
The input withstand voltage of each in put connector and probe input is as follows. Never apply a voltage higher than specified.

INPUT direct	500V pp or 300V (DC + AC peak at 1 kHz)
When probe is used	600V(DC + AC peak at 1 kHz)
EXT TRIG INPUT	300V(DC + AC peak)
EXT BLANKING	30V(DC + AC peak)

The highest sweep speed is 100 ns/DIV.

* Sweep time switch can be changed from 0.2 μs/DIV to 0.2s/DIV in accordance with your requirements, and by using ×10 MAG, the sweep time is magnified by 10 in each range.
Therefore, as permissive ranges of magnified sweep speed are 0.1 μs/DIV 0.2s/DIV, don't use MAG ×10 at 0.2 μs/DIV, 0.5 μs/DIV.

4. How to produce the bright line.

Unless handled erroneously , this instrument will never become faulty by ordinary operation.

Before turning ON the POWER switch, insure the power supply voltage is within the range of 108V ~ 132V for AC 120V set, 198V ~ 242V for AC 220V set, and 216V ~ 264V for AC 240V set. Refer to the indication on the rear panel of the instrument for other voltages.

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

POWER INTENSITY	OFF
FOCUS	Center
AC - GND - DC	GND
↕ POSITION	Center (the knob is in the depressed state.)
VOLTS/DIV	Arbitrary
TRIG MODE	AUTO
TRIG SOURCE	CH1
TIME/DIV	0.5 ms/DIV
LEVEL	Center
⇄ POSITION	Center (The knob is in the depressed state.)
MODE	CH1
DISPLAY	NORM

Set all the levers of the switches either to the left side or to the upper side.

After ending all the settings mentioned above, turn ON the POWER and, 15 seconds

later, rotate the INTENSITY knob clockwise. Then the sweep bright line will appear.

If observation is to be started immediately, set the FOCUS knob 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 Rotate in the direction of arrow. In this case the 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 Axis	CH1
MODE Switch of TRIG	AUTO
TRIG SOURCE	CH1

Under these settings almost all the repetitive signals of about 100 Hz or more applied to CH1 can be triggered and observed by adjusting TRIG LEVEL. Since the MODE of horizontal axis is at AUTO position, the bright line appears even when no signal is present or when AC-GND-DC 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 100 Hz or less.

TRIG MODE NORM

Triggering can be effected by operating LEVEL knob under this setting.

When using only CH2, use the instrument after making the following settings.

MODE Switch of
Vertical Axis CH2
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 DUAL.

When observing two waveforms of high repetition frequencies set the TIME/DIV switch to 0.2μs-0.5ms/DIV. TIME/DIV switch does automatic-change over to CHOP at 1ms-0.2s/DIV and to ALT at 0.2μs-0.5ms/DIV.

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

(3) When observing waveform with X-Y.

Set the MODE switch of vertical axis to CH2 (X-Y) and 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 × 10MAG) at depressed position, the AC-GND-DC of X-axis (CH1) to AC and DISPLAY switch to NORM.

5. Method for Connecting Signals

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

(1) When using a probe.

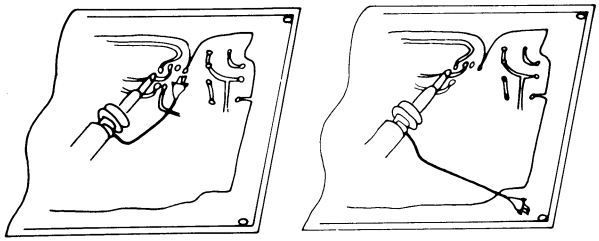
Use the attached probe, AT-10AF 1.5, when measuring a high frequency wave with high accuracy.

The input signal is attenuated by this probe to 1/10 and 1/1 before it is input to the oscilloscope the use of the probe is advantageous for low signals, and high signals.

<CAUTIONS>

- o Do not apply a signal which exceed 600 V (DC+AC peak at 1 kHz).
- o 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



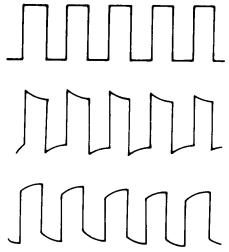
A good example A bad example

o Multiply the reading of VOLTS/DIV by 10. (at using ×10)

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

50mV/DIV × 10 = 500mV/DIV

o 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 0.5 V of 1 kHz calibration square wave voltage. The display should have flat tops. Any distortion in the presentation in caused by incorrect probe compensation. If overshoot or undershoot is present, turn the screwdriver adjustment in the probe for a flat-top presentation.



(a) Correct

(b) Overshoot

(c) Undershoot

(2) At time of direct connection

When connecting a signal directly to the oscilloscope not using the attached probe AT-10AF 1.5 (10:1), pay attention to the following points in order to minimize the measurement error.

o 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, 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 oscil-

loscope 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.

- o The following cautions must be observed when performing a wide hand 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.

- o 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.

- o 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.

- o When the length of the shield wire used or when the length of the non-terminated cable reaches 1/4 wave length or its multiples within the band of **V-203F** type (1/4 wave length is about 3 meter when using a coaxial cable at 20 MHz), oscillation may be caused near 5 mV/DIV range. This is caused by the reasonance 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 100 Ω to 1 kΩ resistor, or perform measurement at other VOLTS/DIV range.

(3) Caution for using the measured signal as an external trigger signal.

When using the measured signal connected to the INPUT and EXT TRIG connectors as an external trigger signal, use a divider so that the both connectors are not connected directly. Otherwise, the measuring waveform may be distorted or oscillated.

6. Measuring Procedure

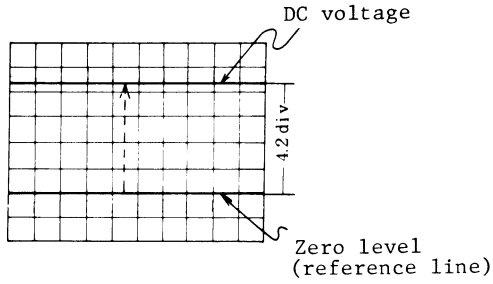
The first things to do are as follows.

- o Adjusts the brightness and FOCUS in condition for easy read out.
- o Display the waveform as large as possible to minimize the read error.
- o Check the capacity correction when using a probe. (Refer to Paragraph (1) "When using a probe" of Section 5. "Method for connecting signal" for the method for correcting capacity.)

(1) DC voltage measurement

Set AC-GND-DC switch to GND and decide the zero level properly.

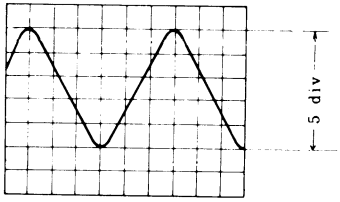
Set VOLTS/DIV appropriately and set AC-GND-DC to DC. Since the bright line shifts here by the amount of DC voltage, the DC voltage of the signal can be obtained by multiplying the shift width by the indicated value of VOLTS/DIV. When VOLTS/DIV is 50 mV/DIV, then 50 mV/DIV × 4.2 = 210mV (However, if the probe AT-10 AF 1.5(10:1) is in use, the true value of the signal becomes 10 times the value, it will be 50 mV/DIV × 4.2 × 10 = 2.1V.)



(2) AC voltage measurement

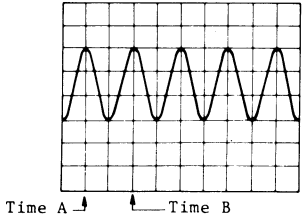
The same as paragraph 6 (1), "DC voltage measurement", but here those is no need of matching the zero level with the scale line. Move the zero level at will to a position easy to observe.

In the drawing as follows, VOLTS/DIV is 1V/DIV, 1V/DIV × 5 = 5 V_{p-p} [50 V_{p-p} at using the probe AT-10AF 1.5(10:1)]. When magnifying and observing a small-amplitude signal superinposing as increases, set AC-GND-DC switch to AC. The DC voltage is cut off and AC voltage can be observed by increasing sensitivity.



(3) Period measurement

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 2.0 DIV on the CRT.

When the sweep time is lms/DIV, the period is given by

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

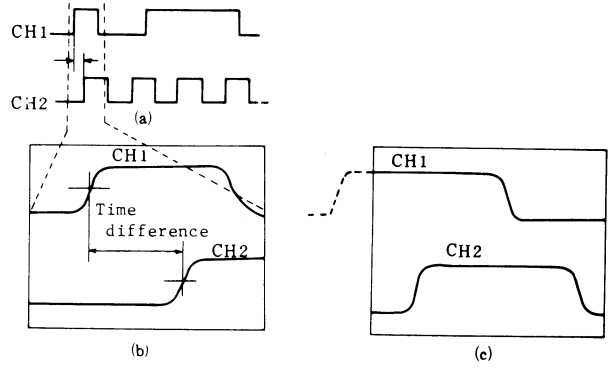
Accordingly, the frequency is

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

(However, when the knob MAG × 10 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 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.

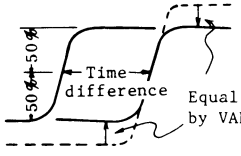


This means that CH1 is used as the triggering signal when investigating the length of time by which the signal of CH2 is delayed from the signal of CH1. CH2 is used in the reversed case. In other words, the signal leading in phase is selected as the triggering signal source.

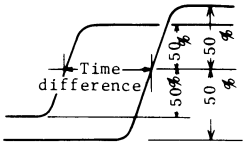
If this process is reversed, the portion to be measured may sometimes not appear on the screen. Thereafter, equlize the amplitudes of the two signals appearing on the screen or superimpose one another.

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

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



Equal amplitude measuring method



Superposition 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 above mentioned items but also to measurement error.

The following relationship exists between 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.

$$Trx^2 + Trs^2 = Tro^2$$

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

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

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.

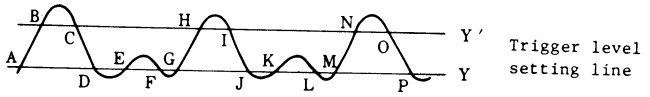
$$f_C \times t_r = 0.35$$

where, 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.

(6) Triggering of complexed waveform

In the case shown in the Fig. (a) below where two waveforms greatly different 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·····,



(a) Signal waveform

will appear alternately on the screen. They will be doubled as shown in Fig. (b), for which no triggering can be taken.

(b) When the trigger setting level is Y

(c) When the trigger setting level is Y'

Triggering of complexed waveform

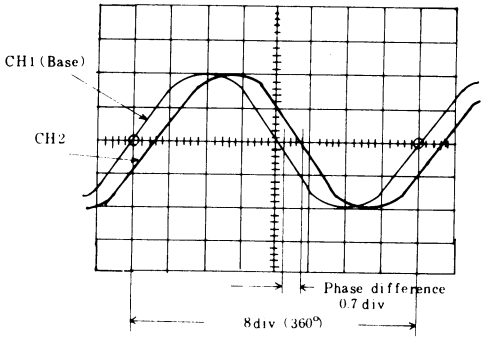
In such a case, rotate LEVEL clockwise until the trigger level comes to Y' line. Then the waveform on the screen becomes the one is shown in Fig. (c) above which start with B and advances to C, E, F,···· and which allows synchronization.

(7) Phase shift between two signals

To measure a phase shift between two signals of the same frequency, the dual trace display system can be utilized up to the upper limit frequency of the amplifier.

First, position both signals on the center line of the scale, e.g. just 4 div, as shown in the following figure by means of the VARIABLE and horizontal positioning knobs.

Next, set the distance where the center of the waveform of the base channel intersects with that of the scale to 8 div horizontally.



As shown in the above figure, set 1 cycle, 360° to 8 div. Then, $\frac{360°}{8\text{div}}$ = 45°/div.

Accordingly, the phase difference in the above example can be calculated as follows:

Horizontal distance on the screen: 0.7div
Phase difference=45°/DIV×0.7 div=31.5°

If the portion of the phase difference is much smaller, use the MAGNIFIER at the ×10 position in the above setting. At this time, 360° is displayed in 8 div ×10.

Then, $\frac{360°}{8\ \text{div}\times 10}$ = 4.5°/DIV (0.2 div=0.9°)

(8) Measurement by X-Y operation

The phase shift between two signals of the same frequency can also be measured using a Lissajou's figure by X-Y operation.

A sine wave input is applied to the audio circuit being tested. The same sine wave input is applied to the vertical input of the oscilloscope, and the output of the tested circuit is applied to the horizontal input of the oscilloscope. The amount of phase difference between the two signals can be calculated from the resulting wave form.

1. Using an audio signal generator with a pure sinusoidal signal, apply a sine wave test signal at the desired test frequency to the audio network being tested.
2. Set the signal generator output for the normal operating level of the circuit being tested. If desired, the circuit's output may be observed on the oscilloscope. If the test circuit is over-driven, the sine wave display on the oscilloscope is clipped and the signal level must be reduced.
3. Connect the Channel 2 probe to the output of the test circuit.
4. Set the sweep TIME/DIV to X-Y position.
5. Connect the Channel 1 INPUT probe to the input of the test circuit. (The input and output test connections to the vertical and horizontal oscilloscope inputs may be reversed.)
6. Adjust the Channel 1 and 2 gain controls for a suitable viewing size.
7. Some typical results are shown in Fig.(b). If the two signals are in phase, the oscilloscope trace is a straight diagonal line. If the vertical and horizontal gains are properly adjusted, this line is at a 45° angle.

A 90° phase shift produces a circular oscilloscope pattern.

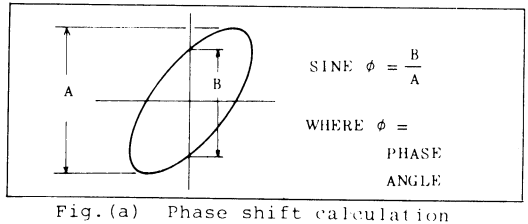


Fig.(a) Phase shift calculation

Phase shift of less (or more) than 90° produces an elliptical oscilloscope pattern. The amount of phase shift can be calculated from the oscilloscope trace as shown in Fig.(a).

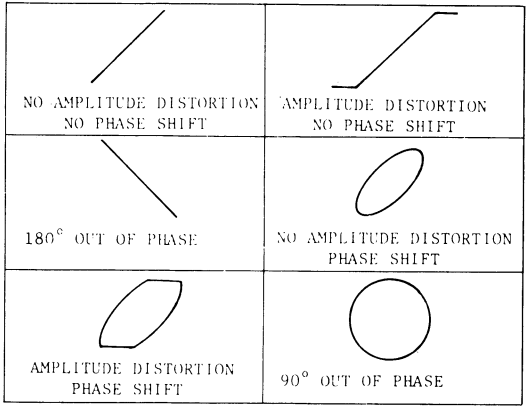
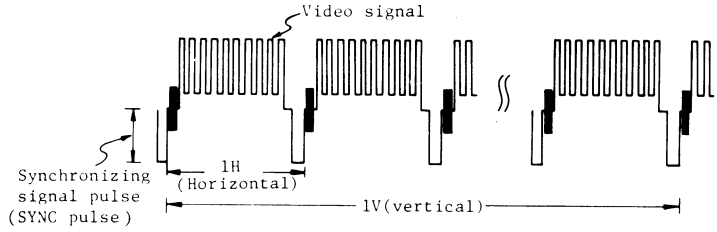


Fig.(b) Typical phase measurement oscilloscope displays.

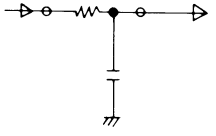
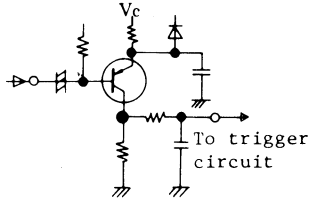
(9) How to use TV exclusive synchronization

① On the image waveform of TV



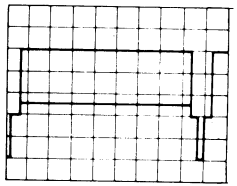
In the work concerned with TV, complexed signals containing video signal, blanking pedestal signal, and synchronizing signal are often measured. However, since the waveform is complexed, a special circuit is needed to effect a stable triggering with vertical waveform.

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
Circuit	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.	Stable synchronization is obtained since SYNC pulse is picked up, amplified, and then integrated to remove high frequency components

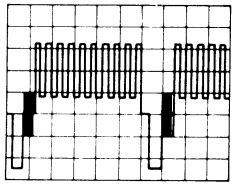
③ Operation

To observe vertical signal



TV FRAME
H MODE: TV(-)
TIME: 0.1ms/div-0.2s/div

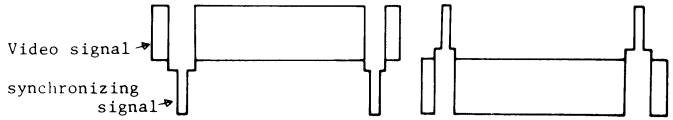
To observe horizontal signal



TV LINE
H MODE: TV(-)
TIME: 50μs/div-0.2μs/div

The selector of TV FRAME, TV LINE is located in DELAY VAR's knob.

When the sync and blanking pulses of the displayed video signals are negative, set the MODE switch to TV(-).



Example of (-) synchroniging signal

Example of (+) synchronizing signal

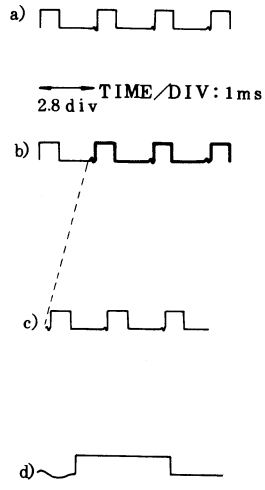
If the sync and blanking pulses are positive, set the switch to TV(+).

Note: Using the MODE switch with TV(-), don't set the slope switch to (-) slope.

(10) Operation procedure of single time base with delayed sweep.

This instrument has a convenient function that enlarges any given portion of signal for easy observation.

1) Read necessary portion of signal from the stably triggered display using the normal mode <Figure a) shows 2.8ms (TIME/DIV:1ms × 2.8 div).>
2) Set the delayed time by DELAY TIME (29) In this case set DELAY TIME to the range of 10-1 ms, and DISPLAY to the INTEN mode.
3) The display after the delay period will be intensified. Set the starting point of display to the required delay by DELAY VAR (30) which offers coarse and fine functions.
< Figure b) >
4) Set the DISPLAY switch to DELAY position and expanded the display using TIME/DIV.
< Figures c) & d) >



Note)

- o When the display switch is set to INTEN, the intensified display is out of focus.
- o If the TIME/div is set to faster sweep, the brightness of the display becomes weak.

7. Panel Descriptions

(1) Power Supply and CRT

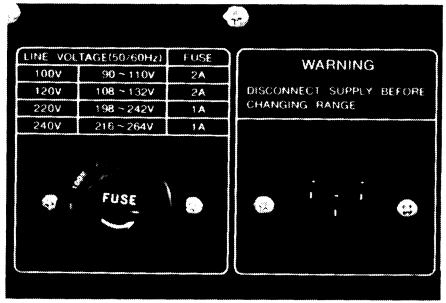
㉔ Operating voltage and ㉕ fuse

This model can be operated from either a 100 volt, a 120-volt, a 220-volt or a 240-volt nominal line voltage source. ㉖ 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 voltages or regulatting 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 indicating tabs on the rear panel.



① **POWER INTENSITY**

Turns the power on or off and adjusts trace brightness on the screen. Clockwise adjustment increases brightness

② Pilot lamp

Lights when the power is on.

③ **FOCUS**

Provides adjustment for optimum display definition.

④ **TRACE ROTATION**

Corrects slight tilting of trace caused by external magnetic fields.

⑤ **SCALE ILLUM**

Controls graticule illumination.

(2) Vertical deflection

⑥ **CH1 OR X INPUT**

This is an input plug for use with the CH1 vertical amplifier and X-axis (horizontal axis) amplifier during X-Y operation.

⑦ **CH2 OR Y INPUT**

This is an input plug for use with the CH2 vertical amplifier and Y-axis (vertical axis) amplifier during X-Y operation.

⑧ **AC—GND—DC**

(Alternating Current-Ground Switch-Direct Current)

Switches the coupling of the signal fed to the vertical axis input. DC coupling is obtained on the DC position, On AC position, the direct current component is blocked by a capacitor. The GND position grounds the input of the amplifiers and opens the input terminal

⑨ **VOLTS/DIV**

(CH1 or X sensitivity switch)

This is a knob for switching the sensitivity of the input signal fed to CH1. Switching action is accomplished in ten steps from 5mV/DIV to 5V/DIV. On X-Y operation, the knob functions to change the sensitivity of the X-axis.

VOLTS/DIV (CH2 or Y sensitivity switch)

This is a knob for switching the sensitivity of the input signal fed to CH2. Switching action is accomplished in ten steps from 5mV/DIV to 5V/DIV. On X-Y operation, the knob functions to change the sensitivity of the Y-axis. To measure by the use of the indicated voltage sensitivity, be sure to set each of the VARIABLE to CAL position by turning fully clockwise. If the signal is applied to the input terminal by the use of a 1/10 low capacitance probe, the values are ten times the indicated voltage.

⑩ **VARIABLE**

This is a vertical axis sensitivity fine adjustment which is capable of attenuating to less than 1/2.5 by indication of each range of VOLTS/DIV.

To measure a voltage by the use of voltage sensitivity indicated by VOLTS/DIV, turn the VARIABLE clockwise fully to CAL.

⑪ **POSITION, PULL X5 GAIN**

CH1 ↓↑ (Vertical position adjustment)

With the knob turned clockwise, the waveforms of CH-1 move upward. When the knob

is turned counterclockwise, the waveforms move downward.

CH2 ↓↑ (Vertical position adjustment)

Clockwise rotation will move pattern up, and counterclockwise rotation will move pattern down.

When the knob is pulled, the vertical axis sensitivity at each range of VOLTS/DIV is increased by 5 times.

⑫ **MODE**

- o CH1
  only the input signal applied to CH 1 is displayed.
- o CH2, [X-Y]
  only the input signal applied to CH 2 is displayed.
- o DUAL

  Dual trace display can be obtained by CHOP or ALT

  ⑬ TIME/DIV switch does automatic-change over to CHOP at 1ms/DIV-0.2s/DIV, and to ALT at 0.2μs -0.5ms/DIV.
- o ADD (Addition)
  The input signals of CH 1 and CH 2 are algebraically added and displayed.
- o DIFF
  The input signals of CH 1 and inverted signals of CH 2 are algebraically added and displayed.

(3) Horizontal deflection

⑬ **TIME/DIV** (Sweep speed selection)

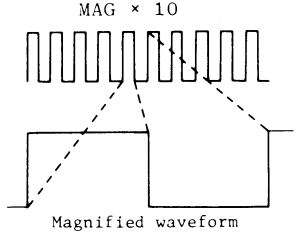
This is sweeptime change switch. A 19-position switch from 0.2 μs/DIV to 0.2s/DIV selects 19 fixed sweep speeds. When making a measurement at a given TIME/DIV setting, adjust variable knob ⑭ fully clockwise to CAL. When the switch is set to (X-Y) position, and ⑫ MODE set to CH2 [X-Y], X-Y oscilloscope works with CH 1 as X axis and CH 2 as Y axis.

⑭ **SWP VAR** (Time adjustment of Sweep Time)

This is fine adjustment covering time not covered by Time change-steps. When measuring with an indication of TIME/DIV, turn VARIABLE fully clockwise to CAL.

⑮ **POSITION, PULL X10 MAG**

The knob is used to position the trace in the horizontal direction. When the knob is pulled out, the sweep is magnified by a factor of 10.



Magnified waveform

(4) Triggering

⑯ **SOURCE**

- o CH1, CH2 — Used when triggering is made by observing signal for CH1 or CH2.
- o LINE — Used when observing a signal triggered with the frequency of AC power source.
- o EXT — Used when triggering is made by a signal applied to EXT input connector ⑰, independently from observation signal.

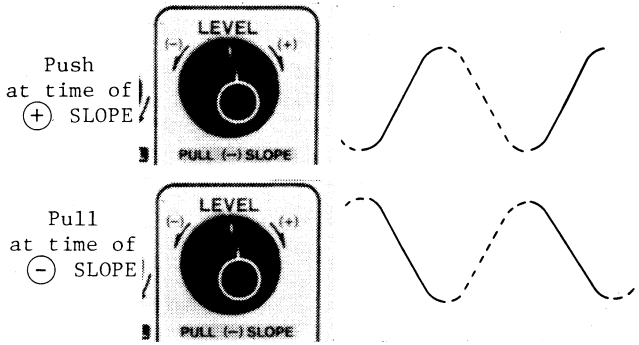
⑰ **TRIG INPUT**

This is an input BNC connector for external trigger signal.

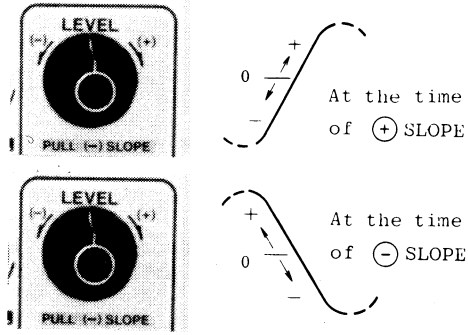
⑱ **LEVEL, PULL (—) SLOPE**

This knob is used to decide at 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 ⊕ SLOPE and and PULL position (state in which the knob is protruding) is for ⊖ SLOPE.

*Explanation of synchronization polarity SLOPE.



*Explanation of synchronization level.



⑲ **MODE**

o AUTO When there is no signal or a signal stepping out of synchronization, the sweep line will appear automatically.

o NORM This mode provides synchronizing sweep only when synchronization is required. If there is no signal or a signal stepping out of synchronization, the sweep line will not appear. This mode is employed for synchronizing a low frequency signal of more than 20Hz.

o TV(+), TV(-)

Video signals synchronized with horizontal sync pulse and vertical sync pulse is observed. Composite video signals can be observed at various stages of the TV receiver to determine whether circuits are performing normally.

㉘ DISPLAY

This switch is used to select the operation mode of the single time base with delayed sweep.

o NORM

Main sweep appears on the screen. This is used in normal operation.

o INTEN

Although the sweep on the screen is main sweep it indicates the single time base with delayed sweep by intensity modulation.

o DELAY

The intensity modurated portion is magnified.

㉙ DELAY TIME

This control is used to set the starting point of the single time base with delayed sweep. Five ranges (1μs-10μs, 10μs-100μs, 100μs-1ms, 1ms-10ms, 10ms-100ms) of delayed time can be set continuously with DELAY VAR.

㉚ DELAY VAR, TV FRAME/TV LINE

This control has two functions. One is delayed time control combined with DELAY TIME, (coarse and fine adjustments are provided). The other is selector, the inner shaft, for video synchronized signal as TV FRAME and TV LINE.

(5) Others

⑳ **PROBE CAL .5V**

Signal output terminal for amplitude and probe calibration. The frequency is approx. 1KHz.

㉑ **GND** This is the ground terminal of oscilloscope.

㉒ Handle

The handle of the V-202 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. Thirteen positions are provided for convenient carrying or viewing.

㉓ **EXT. BLANKING**

This is a terminal for applying a blanking signal from an external source.

The trace displayed on the screen may be intensity - modulated where pulse signal or time-scale marks are required. 5V AC signal applied at the connector on the rear of the oscilloscope will provide alternate brightness and blanking of the trace. Positive voltage input decreases brightness.

㉗ CH1 Output

Output connector providing a sample of the signal applied to the CH1 input connector. This connector is used for driving a frequency counter or other instrument.

8. Standards and Specifications

o Vertical deflection

Input sensitivity	×1 5mV/div to 5V/div (1,2,5-step 10 stages) ×5 1mV/div to 1V/div (1,2,5-step 10 stages)
Sensitivity accuracy rate	×1 + 3% ×5 ± 5% Attenuates continuously to 2.5 times or more of the indicated value in each range
Frequency bandwidth (8 div Reference)	×1 DC to 20MHz $\left(^{+1}_{-3}\ \text{dB}\right)$ AC 20Hz to 20MHz $\left(^{+1}_{-3}\text{dB}\right)$ ×5 DC to 7MHz $\left(^{+1}_{-3}\ \text{dB}\right)$ AC 20Hz to 7MHz $\left(^{+1}_{-3}\ \text{dB}\right)$
Rise time	×1 Approximately less than 17.5ns ×5 Approximately less than 50ns
Over shoot	×1 + 3% (at 100 kHz) ×5 ± 5% (at 100 kHz)
Input impedance	Direct 1MΩ, approximately 30pF
Maximum Input voltage	Direct 500V_{p-p} or 300V (DC + AC peak at 1 kHz) When using probe 600V(DC+AC peak at 1kHz)
Input coupling	AC-GND-DC
Magnifying function	×5 is possible
Operation mode	CH1, CH2, DUAL, ADD, DIFF
Dynamic range	more than 8 div.

CH1 Output

Output voltage*	20mV/div Min.
Bandwidth*	50Hz-5MHz (-3dB)(at ×1 GAIN)
Output Noise*	10mVp-p Max.

* Measured by 1m 50-ohm BNC Cable with 50-ohm terminator.

Output impedance	Approx. 50Ω
Output coupling	AC

o Horizontal deflection

Sweep mode	AUTO, NORM, TV(+), TV(-)
Sweep time	0.2μ s/div - 0.2s/div(1-, 2-, 5-step 19 stages)
Maximum sweep time	100ns (at MAG ×10)
Sweep variable	2.5 times or more
Sweep time accuracy	± 3% (at ×1) ± 5% (at ×10 MAG)

Sweep magnification: ×10

Time linearity: ±3% (at ×1)
±5% (at ×10MAG)

Position adjustment: Possible

Single time base with delayed sweep

Delay time: 1μs-100ms, 5 ranges
Fine/coarse adjustment between ranges.

Jitter: 5,000:1

o Triggering

Coupling: AC

Triggering polarity: +, -

Triggering sensitivity and frequency

Frequency	Internal	External
20Hz - 2MHz	0.5 div	200 mV
2MHz - 20MHz	1.5 div	800 mV

TV-V sensitivity: SYNC section more than 1 div or 1 V

External trigger input impedance: approx. 1MΩ, approx.30pF

Maximum input voltage: Direct 300V(DC+AC peak at 1kHz)

At using ×10 probe 600V (DC+AC peak at 1kHz)

o Z-AXIS brightness modulation

Voltage: Brightness is reduced with a positive signal of +5V or more

Frequency bandwidth: DC to 2 MHz

Input impedance: Approximately 47 kΩ

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

o X-Y operation

X input: CH1

Y input: CH2

Sensitivity: Same as vertical axis

X frequency bandwidth: DC to 500 kHz (-3dB)

Phase shift: Within 3° (DC to 50kHz)

o Calibrator

Waveform: 1kHz square wave, within ±10% (Typical)

Voltage: 0.5V ± 3%

o CRT

CRT: 140 DFB 31 (5.5, square with internal graph)

Acceleration voltage: Approximately 5.2 kV

Screen area 8 div ×10 div, 1 div=9.4mm

Trace rotation Present

Scale illumination Variable edge lighting

o Power supply

VOLTAGE	FUSE
100 V (90 ~ 110 V)	2A
120 V (108 ~ 132 V)	2A
220 V (198 ~ 242 V)	1A
240 V (216 ~ 264 V)	1A

Power supply frequency 50, 60Hz

Power consumption Approximately 45W

o Environment

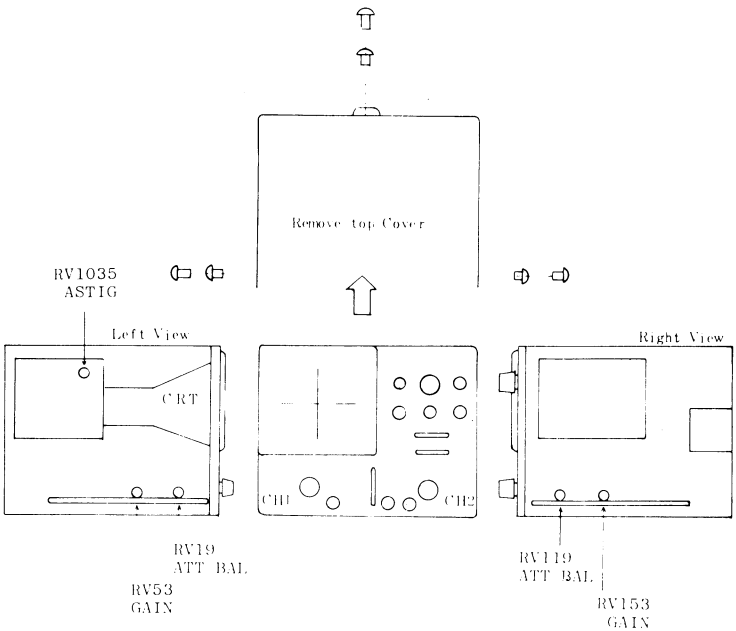
Rated range of use: +10 to +35°C
Limit of operation: 0 to +40°C
Storage and transport: -20 to +70°C
Operating ambient humidity: 35 to 85%

o Construction

Dimensions Approximately 275(W) ×190(H) × 400(D)(mm) (Dimensions of cabinet)

Weight Approximately 8.5Kg

9. User Adjustments



The following adjustments should be made by means of a screw driver.

(1) TRACE ROTATION

Adjust the TRACE ROTATION on the front panel when slight tilting of the trace is caused by the effect of external magnetic fields.

Make certain that tilting of the traces is not caused by the effect of unusually strong external magnetic fields due to the position of the oscilloscope.

(2) ASTIG ADJUSTMENT

Set the knob TIME/DIV switch to [X-Y], and MODE switch to CH2 [X-Y] observing the spot on the center of the screen.

RV1035 astigmatism adjustment provides optimum spot POWER/INTENSITY roundness when used in conjunction with FOCUS and POWER/INTENSITY control.

Little readjustment of this control is required after initial adjustment.

(3) Adjust VOLTS/DIV Balance (STEP ATT BAL)

a. Position the trace to the center horizontal line with the vertical POSITION control.
b. Check-Change the VOLTS/DIV switch from 5mV to 10mV. Trace should not move more than 0.1 division.
c. Adjust RV19(CH1), or RV119(CH2), for minimum trace shift when rotation the VOLTS/DIV switch from 5m volt to 10m volt. If necessary, rotate the vertical position control to keep the trace in the center of the screen.

(4) Vertical GAIN Adjustment

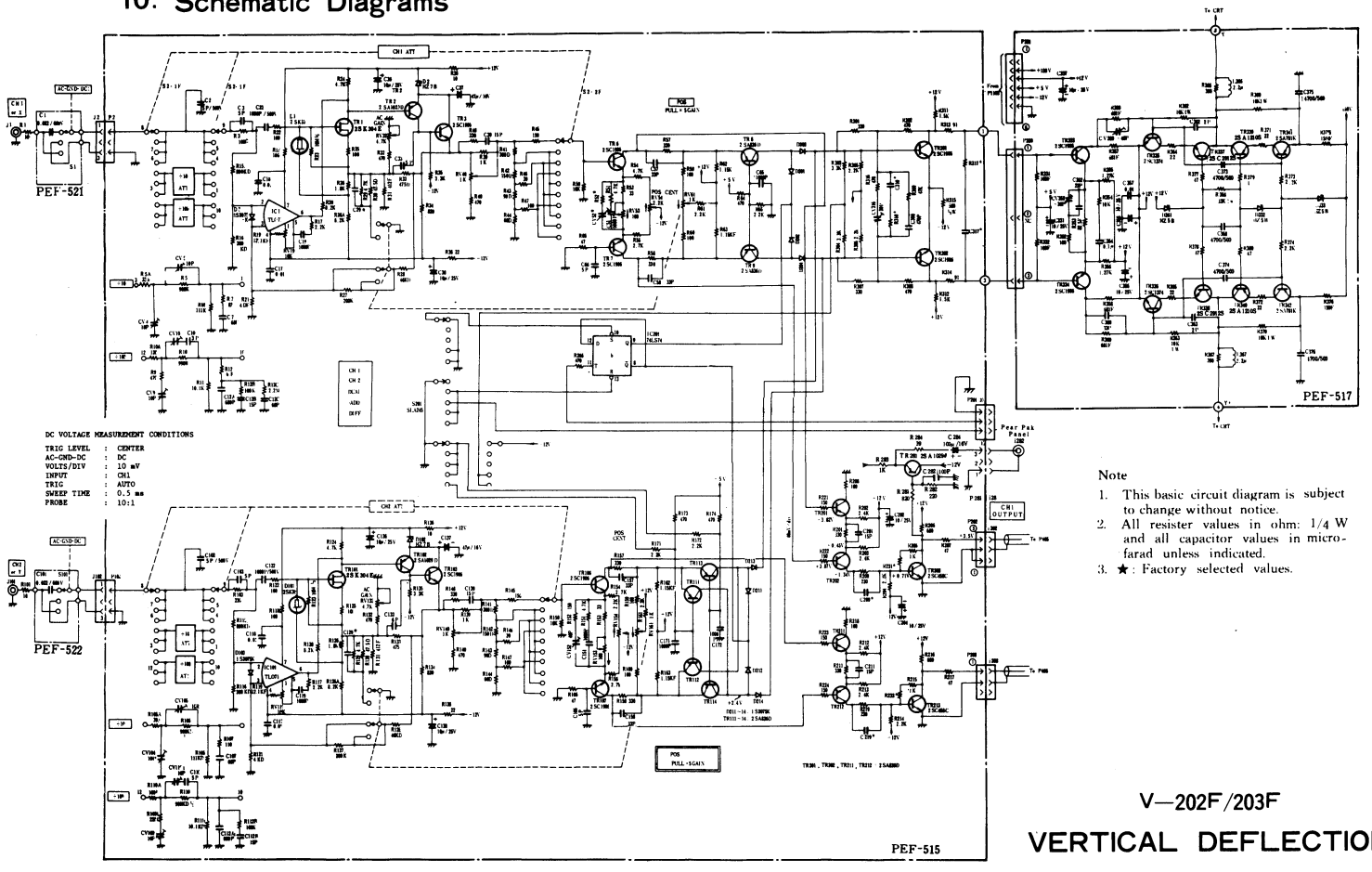
a. Set the VOLTS/DIV for 10mV/DIV.

Connect the CAL .5 V output to the CH1 or CH2 connector with probe.

b. Check-CRT display for five divisions of deflection.

c. Adjust the GAIN controls, RV53 (CH1) or RV153 (CH2), for exactly five divisions of deflection.

10. Schematic Diagrams



Note

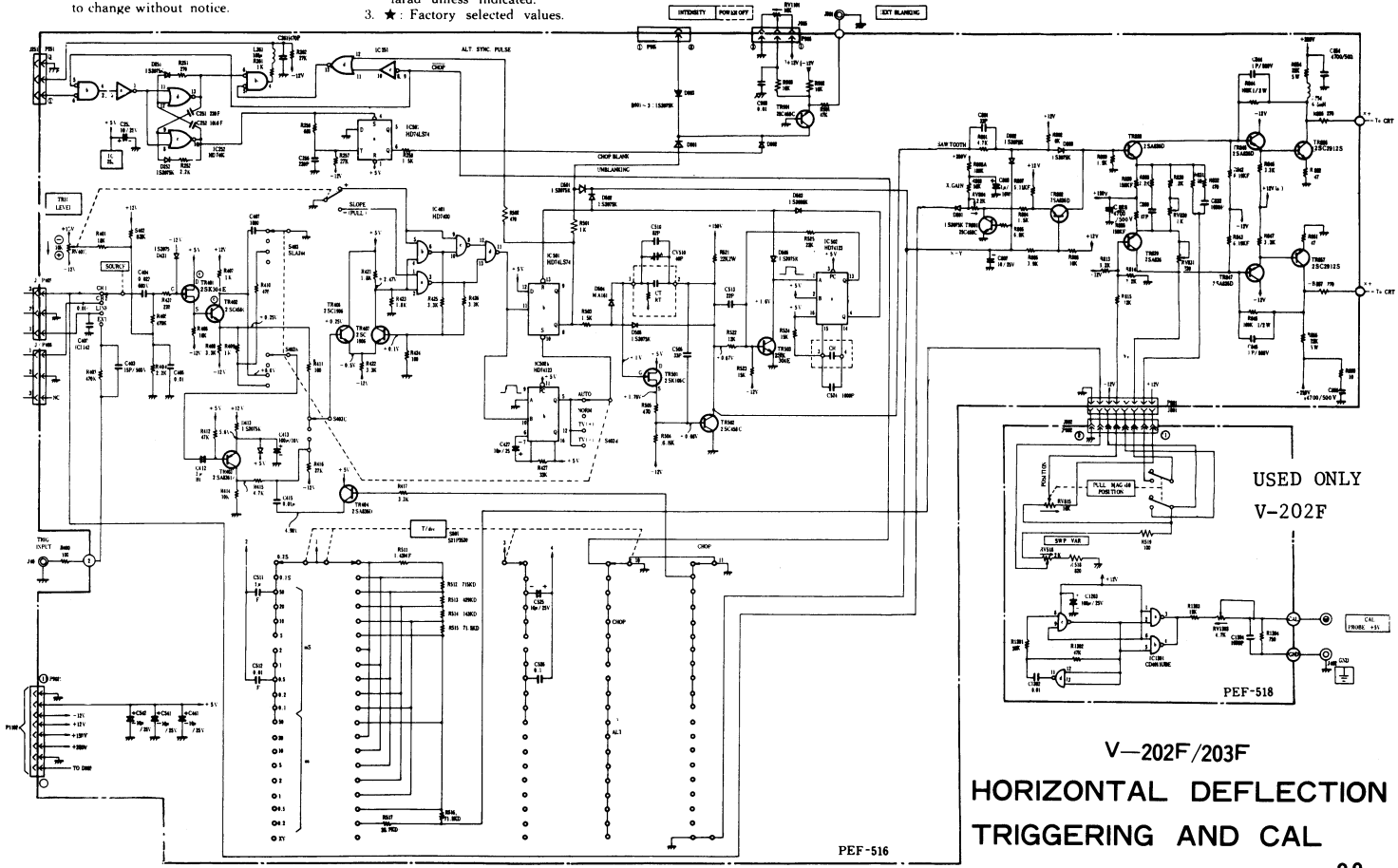
1. This basic circuit diagram is subject to change without notice.
2. All resister values in ohm: 1/4 W and all capacitor values in micro-farad unless indicated.
3. ★: Factory selected values.

V—202F/203F

VERTICAL DEFLECTION

Note

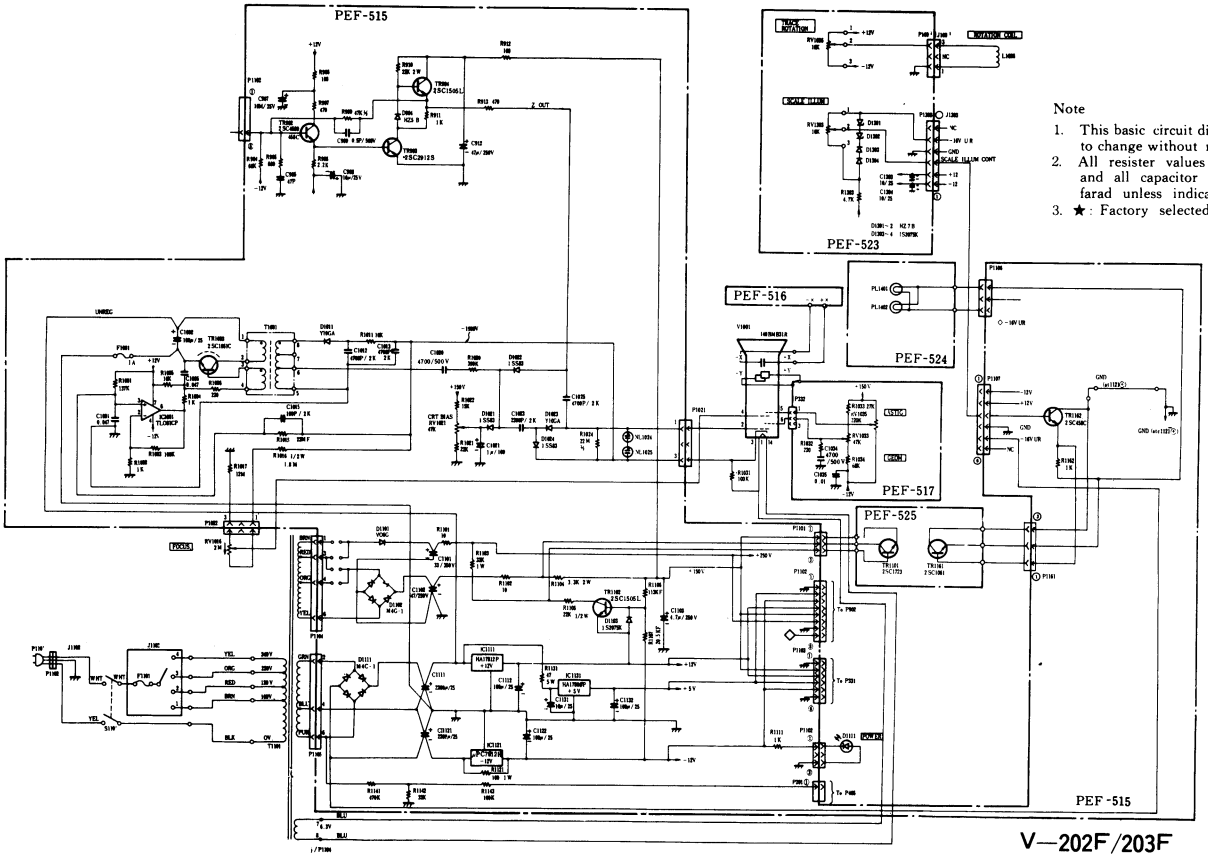
1. This basic circuit diagram is subject to change without notice.
2. All resister values in ohm: 1/4 W and all capacitor values in micro-farad unless indicated.
3. ★: Factory selected values.



USED ONLY
V-202F

V—202F/203F

HORIZONTAL DEFLECTION TRIGGERING AND CAL

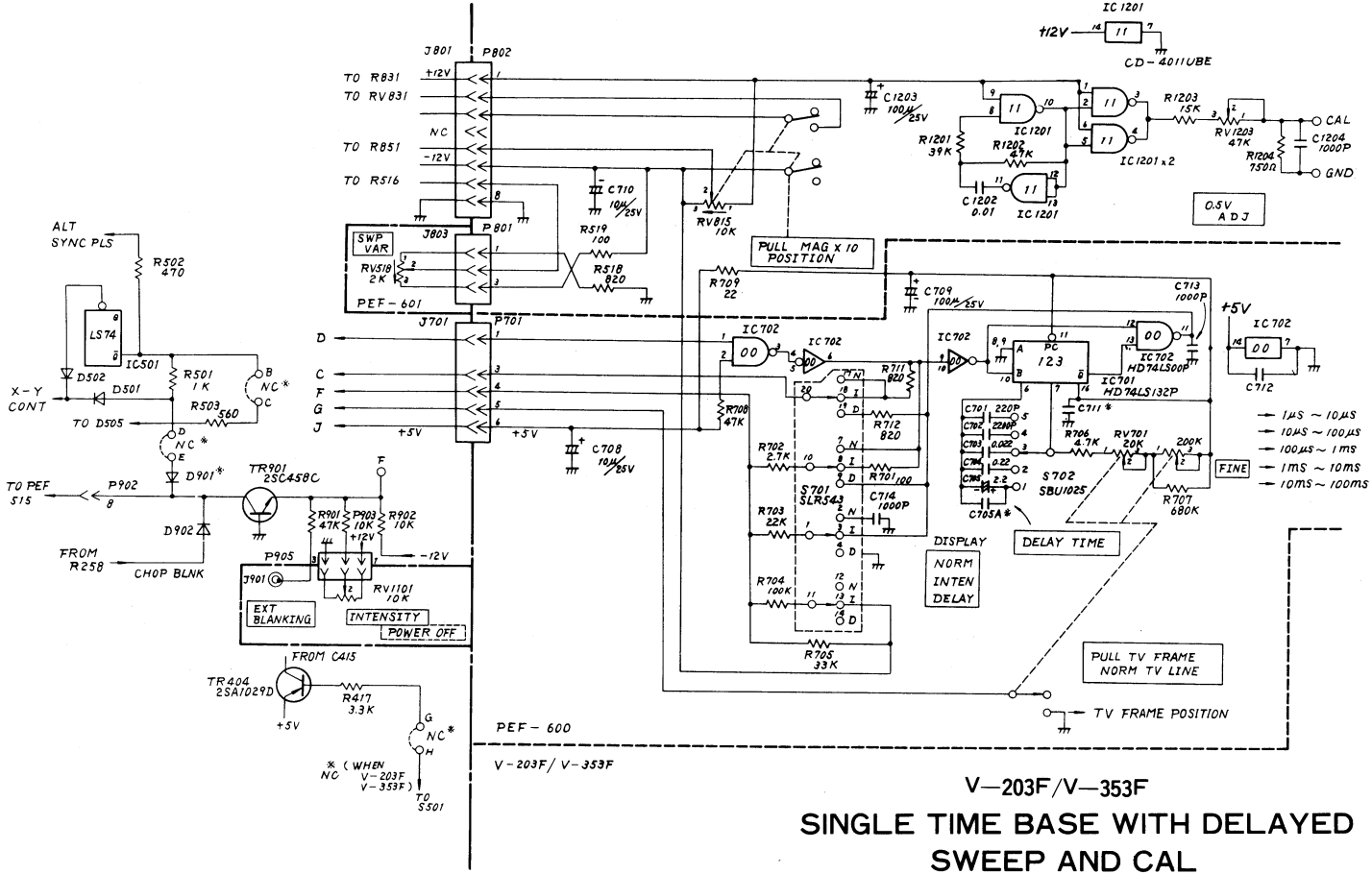


Note

1. This basic circuit diagram is subject to change without notice.
2. All resister values in ohm: 1/4 W and all capacitor values in microfarad unless indicated.
3. ★: Factory selected values.

V—202F/203F

POWER SUPPLY HIGH VOLTAGE AND C.R.T CONTROLES

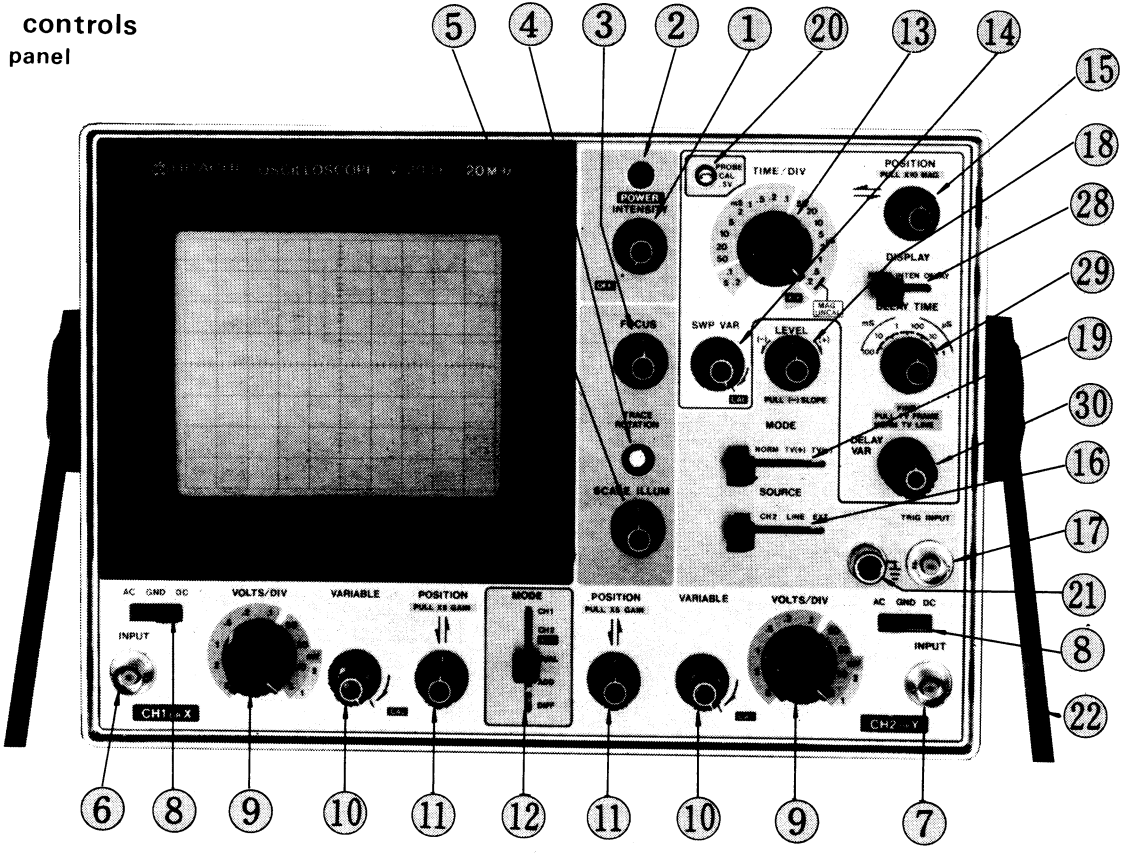


V—203F/V—353F

SINGLE TIME BASE WITH DELAYED SWEEP AND CAL

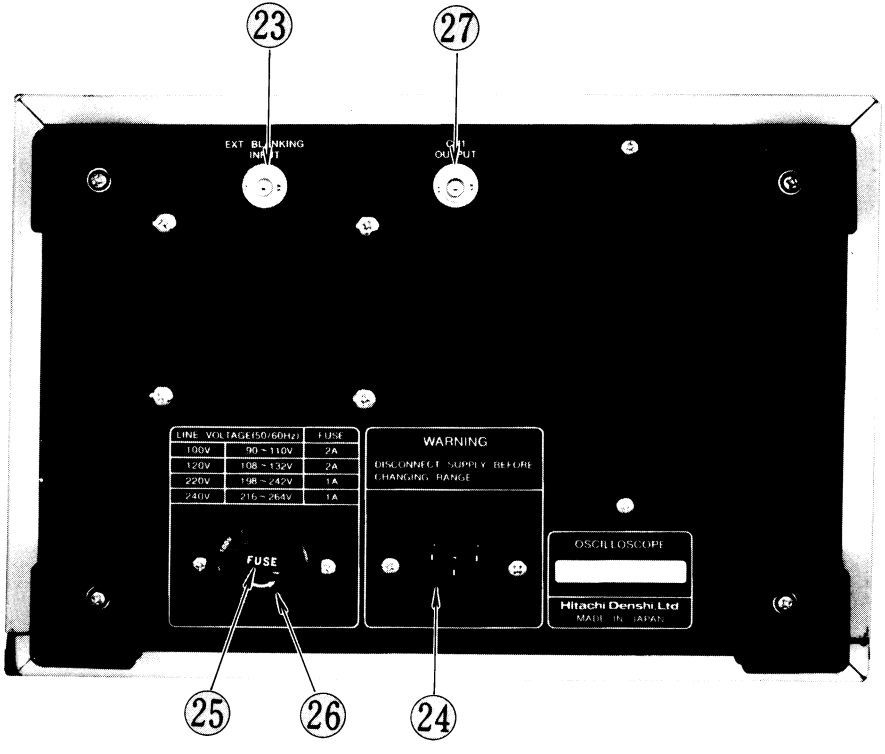
11. Panel controls

(1) Front panel



The number on the front and rear panel means the number in the description of this manual.

(2) Rear panel


23
27
EXT BLANKING INPUT
GATE OUTPUT
LINE VOLTAGE(50/60Hz)
FUSE
100V
90 ~ 110V
2A
120V
108 ~ 132V
2A
220V
198 ~ 242V
1A
240V
216 ~ 264V
1A
WARNING
DISCONNECT SUPPLY BEFORE CHANGING RANGE
FUSE
OSCILLOSCOPE
Hitachi Denshi,Ltd
MADE IN JAPAN
25
26
24