Model V-152F

OSCILLOSCOPE

OPERATION MANUAL

HITACHI

Hitachi Denshi, Ltd.

CONTENTS

Page

1. Introduction 1

1.1 Outline 1

1.2 Specifications 2

1.3 Composition 3

2. Operation 4

2.1 Description of Panel Functions 4

2.2 Precautions 10

2.3 Fundamental Operation Instructions 11

3. User Adjustments 17

4. Applications 18

4.1 Measurement of time difference 18

4.2 Measurements of rise (fall) time 19

4.3 Measurement of phase shift 20

(1) Phase shift between two signals

(2) Measurement by X-Y operation

4.4 Measurement of composite video signal 23

5. Schematic Diagrams 25

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. Introduction

1.1 Outline

MODEL V-152F is a dual trace oscilloscope with a bandwidth of DC-15MHz and sensitivity of 1mV/DIV (pull ×5 Gain). The time base provides a maximum sweep speed time of 0.2μS/DIV. When magnified by 10, the sweep speed is 100ns/DIV. High accelerated voltage CRT, with 8 × 10DIV effective display area and post acceleration, enables high speed pulses to be clearly displayed.

Engineered for service in the field of television, VTR, and computer, the V-152F is portable, easy and features convenient operation for use in education and industry.

o Wide bandwidth and high sensitivity

In addition to wide bandwidth, DC-15 MHz, (-3dB) this instrument provides high sensitivity of 5mV/DIV. A 15MHz frequency is obtained with improved triggered synchronization.

o Bright CRT

By using a New, high brightness CRT, a stable accelerated CRT high voltage, calibration voltage accuracy, and time base are obtained.

o TV Synchronization

A circuit for extracting the synchronizing signal is equipped to trigger easily with a composite video signal. TV vertical or horizontal sync signal is automatically selected by the time base switch.

o Two functions of Addition and Subtraction by two signals. Not only phase or level comparison but also addition and subtraction can be observed by two signals functions. This function enables a push pull signal to be displayed accurately.

o Improvement in portability and operation

Equipped with a convenient carrying handle and designed for light weight, this unit is excellent both in portability and operation with various functions installed on the front panel.

o X-Y functions

Set the switch to X-Y position and X-Y oscilloscope is displayed with CH-1 as X axis and CH-2 as Y axis.

1.2 Specifications

CRT Display	
Type	130BUB31
Acceleration Voltage	2kV
Effective display area	8 × 10 div (1 div=9.5mm)
Vertical amplifier	
(Identical for both 5mV/div - 5V/div channels)	
Sensitivity:	Calibrated in 10 steps (1-2-5 Sequence up to 25V/div with variable control) *1mV-1V/div (using ×5 GAIN)
Bandwidth	DC to 15MHz DC - 5MHz (using ×5 GAIN)
Rise time	24ns
Input impedance	1M Ω shunted by 30pF ±5pF (direct)
Input coupling	AC, GND, DC
Max. input voltage	600Vp-p, 300V(DC+AC peak)
Input connector	BNC
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
Time base	
Sweep speed	0.2μs - 0.2s/div 19 step, 1-2-5 sequence
Magnification	×10 (max. speed 100ns/div)
Dual trace display	
Mode	CH1, CH2 (X-Y), DUAL, ADD, DIFF
ADD	CH1 and CH2 are added
DIFF	CH1 and CH2 (inverted signal) are added
X-Y display	
(X=CH1 Y=CH2)	
Sensitivity	Y axis: 5mV/div-5V/div X axis: 5mV/div-5V/div
Bandwidth	X axis: DC 500 kHz
X-Y phase	Less than 3° at 10 kHz
Synchronization	
Trigger sensitivity	

Frequency	INT.trig	EXT.trig
20Hz - 2MHz	0.5 div	200 mV
2MHz - 15MHz	1.5 div	800 mV

Mode	Normal trigger and Automatic trigger
	Automatic (sweep free-run)
	Normal (sweep run when triggered)
	TV(+), TV(-)
	Extracts the synchronizing signal from composite video signal and provides stable trigger.
	Slope switch is selected according to polarity of video signals.
Source	Internal (CH1 or CH2), External or Line.
Calibration	
Waveform	Square wave 1kHz ±10% (typ)
Voltage	0.5 Vp-p ±3%
Power supply	AC 100/120/220/240V
Size and weight	190(H)×275(W)×400(D)mm approx. 8.5 kg [7.5(H)×10.8(W)×15.7(D) in 18.7 lbs]

1.3 Composition

(1) V-152F oscilloscope 1

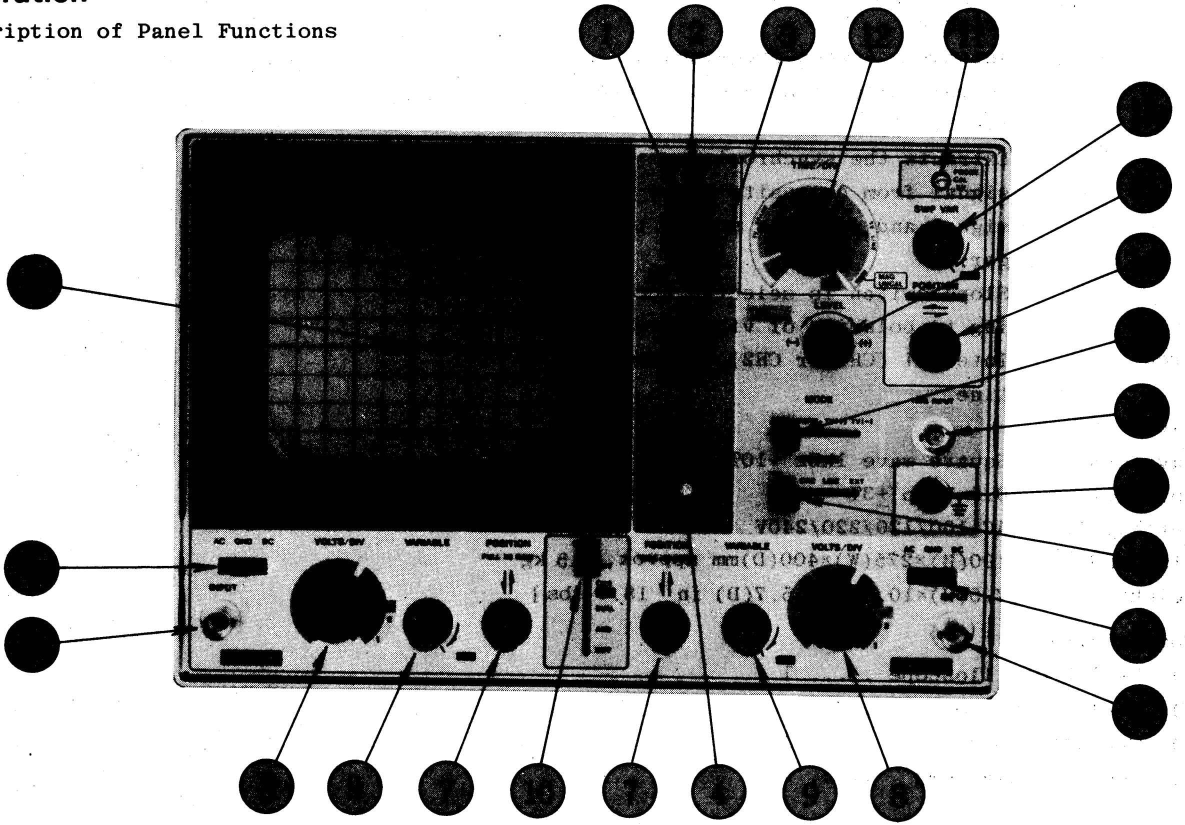
(2) AT-10AB1.5 probe 2

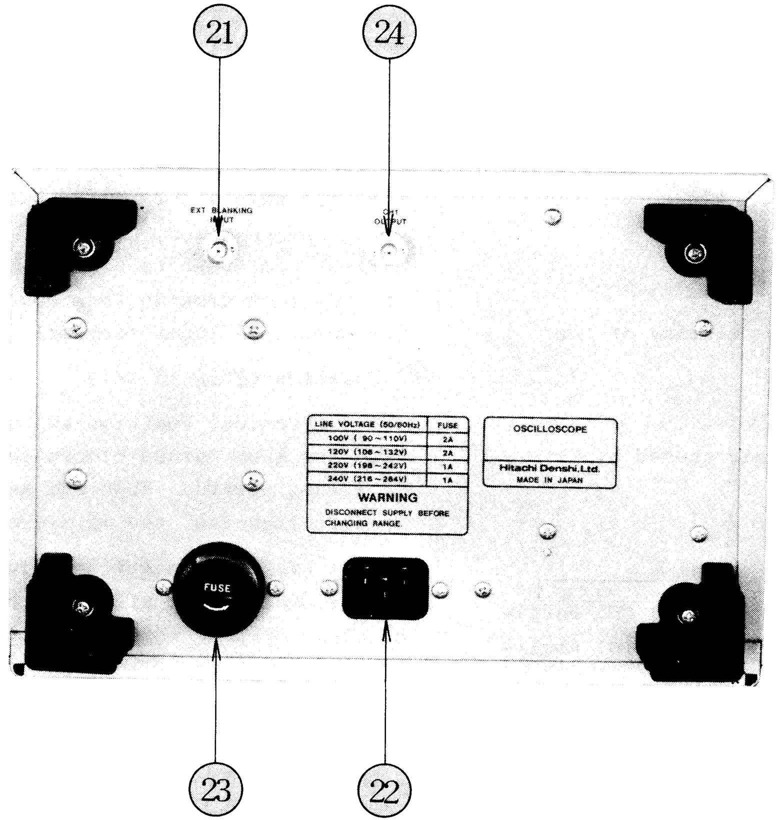
(3) Operation manual 1

(4) Power Supply Cord 1

2. Operation

2.1 Description of Panel Functions




21
24
23
22
EXT BLANKING INPUT
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.
OSCILLOSCOPE
Hitachi Denshi, Ltd.
MADE IN JAPAN
FUSE

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

Adjusts focus grid voltage for clarity of the display.

4. TRACE ROTATION

Corrects slight tilting of trace caused by external magnetic fields.

5. INPUT

CH1 or X IN
This is an input plug for use with the CH1 vertical amplifier and X-axis (horizontal axis) amplifier during X-Y operation.
CH2 or Y IN
This is an input plug for use with the CH2 vertical amplifier and Y-axis (vertical axis) amplifier during X-Y operation.
Do not exceed the maximum permissible input voltage, 600Vp-p or 300V (DC + AC peak)

6. AC-GND-DC

(Alternating Current-Ground Switch-Direct Current) Switches the coupling of the signal fed to the vertical axis input (5) . 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 (5) .

7. Position (PULL ×5 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.

8. VOLTS/DIV

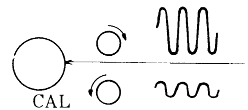
(CH1 or [X] sensitivity switch)
This is a knob for switching the sensitivity of

the input signal fed to CH 1 (5) . Switching action is accomplished in (10) 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 (5) . Switching action is accomplished in 10 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 (9) to CAL by turning fully clockwise (Click stop). If the signal is applied to the input terminal (5) by the use of a 1/10 low capacitance probe, the values are ten times the indicated voltage.

(9) 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.

VARIABLE KNOB



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

(10) MODE

o CH1
Only the input signal applied to CH1 is displayed.

o CH2
Only the input signal applied to CH2 is displayed.

o DUAL
Dual trace display can be obtained by CHOP or ALT Time Switch (12) does automatic-changeover to CHOP at 1mS/DIV-0.2s/DIV, and to ALT at 0.2μS - 0.5mS/DIV. Time Switch (12) does automatic-changeover to CHOP at 1mS/DIV - 0.2S/DIV, and to ALT at 0.2μS - 0.5mS/DIV.

o ADD (Addition)

The input signals of CH1 and CH2 are algebraically added and displayed.

o DIFF

The input signals of CH1 and inverted signals of CH2 are algebraically added and displayed.

⑪ CAL .5V (Calibration wave)

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

0.5Vp-p

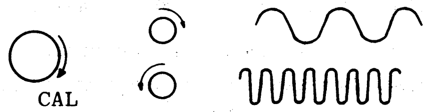
⑫ TIME/DIV (Sweep Speed selection)

This is sweeptime change switch. A 19-position switch from 0.2μS/DIV to 0.2S/DIV selects 19 fixed sweep speeds. When making a measurement at a given TIME/DIV setting, adjust variable knob ⑬ fully clockwise to CAL. When the switch is set to (X-Y) position, X-Y oscilloscope works with CH1 as X axis and CH2 as Y axis.

⑬ 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 (Click stop).

SWP VAR



⑭ POSITION (PULL ×10 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.

⑮ LEVEL (Slope)

The control knob is used to adjust the triggering level of the sweep.

In operation, the knob is generally at the AUTO setting. When triggered sweep is desired against the positive slope of waveforms displayed on the screen, set this switch to (+) position, and against negative slope, set it to (-) position.

⑯ 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.

⑰ SOURCE

CH1,CH2: Used when synchronization is made by observing signal for CH1 or CH2.

LINE : Used when observing a signal synchronized with the frequency of AC power source.

EXT : Used when synchronization is made by a signal applied to EXT input connector ⑱ , independently from observation signal.

⑱ TRIG INPUT : This is an input BNC connector for external sync signal.

⑲ GND : This is the ground terminal of oscilloscope.

⑳ Graticule

The size of graticule is 8 by 10 div (1 div= 9.5mm). A subscale at intervals of 1/5 div is imprinted on the X and Y axis of the graticule to facilitate of making measurement. Vertical Voltage sensitivity (Volt/DIV) and Sweep time (Time/DIV) is calibrated and can be read with reference to the sub-scales.

㉑ 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.

㉒ Power Supply Cord Connecting Terminal

(23) FUSE

The fuse is released when the cap is rotated counterclockwise.

FUSE: 1A 6.35ϕ ×31.8 (mm)

Caution - Replace only with same type and rating fuse.

(24) 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.

2.2 Precautions

(1) Power Source Voltage

Apply a power source voltage that is within ±10% of the rated values as given in the table below. Operation with a voltage less than 10% of the rated value may result in improper performance and a voltage more than 10% of rated value may damage power supply circuitry.

Rated Voltage Values	Applicable Voltage Ranges	Fuse
AC 100V AC 120V	90 - 110V 108 - 132V	2A Fast Blow
AC 220V AC 240V	198 - 242V 216 - 264V	1A Fast Blow

(2) Signal Input

Vertical input terminal	MAX 600V (ACp-p), 300V(DC+ AC peak)
External synchronizing signal	MAX 300V (DC + AC peak)
EXT BLANKING	30V (DC + AC peak)

(3) Horizontal Trace Tilt

Horizontal Trace, in some case, tilts due to the earth's magnetism.

(4) Operation in a Powerful Magnetic Field

Operation in a powerful magnetic field will cause distortion of waveforms or make traces tilt excessively. Special care should be exercised when operating the instrument close to machinery or equipment using a large transformer.

(5) FUSE

Note the type and rating of the fuse used.

(6) Operation in a Hot and Humid Place

This instrument is designed to operate in a temperature range of 0°C to +40°C and humidity range of 40 to 90%. Operation in a severe environment may shorten the life of the instrument.

(7) Intensity

A burn-resisting fluorescent material is used in the cathode ray tube. If the cathode ray tube is left with a bright dot or bright line, or with unnecessarily raised intensity, its fluorescent screen may be damaged. When observing waveforms the intensity should be maintained at the minimum necessary level. If the instrument is left on for extended periods, lower the intensity and obscure the focus.

(8) EXT. BLANKING

When a cable is connected to the EXT BLANKING connector don't place the oscilloscope in an upright position damage to the cable.

(9) The highest sweep speed is 100 ns/DIV.

Sweep time switch can be changed from 0.2μS/DIV to 0.2S/DIV in accordance with your requirements, and by using the knob (14) , the sweep time is magnified by 10 in each range.

Therefore, as permissive ranges of magnified sweep speed are 0.1μS/DIV 0.2S/DIV, don't use MAG ×10 at 0.2μS/DIV, 0.5 S/DIV.

(10) Caution for using the measured signal as an external sync signal.

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

2.3 Fundamental Operation Instructions

The fundamental operation for observing waveforms with the Oscilloscope V-152F are described below.

(1) Preparation

Before using the V-152F set the controls are switches as follows.

In addition, use these setting with checking proper operation of the instrument.

1. FOCUS (3)	Midposition
2. AC GND DC (6)	DC
3. Position (7)	Midposition
4. VOLTS/DIV. (8)	10 mV
5. VARIABLE (9)	Turn fully clockwise to CAL
6. MODE (10)	CH1
7. TIME/DIV. (12)	0.5mS/DIV
8. SWP VARIABLE (13)	Turn fully clockwise to CAL
9. Position (14) (PULL MAG. ×10)	Midposition (PUSH IN ×1)

10. LEVEL (15) Midposition
PULL (-) SLOPE Push-in (+) SLOPE
11. MODE (16) AUTO
12. SOURCE (17) CH1

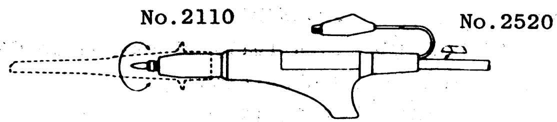
After all settings are made, set the POWER/INTENSITY switch (1) at ON, and adjust the knob at midposition. After about 10 seconds, a bright line will appear on the screen. Adjust the FOCUS (3) controls for a clear display of the traces.

13. Connect the attached probe to INPUT (5) and CAL (11) terminals. For use of the probe, refer to Section; "How to Use a Low-capacity/Direct Probe."

(2) Check of Gain by Calibrated Waves

After all settings are made as shown 2.3 (1), ascertain that a square wave with an amplitude of 5 DIV. is displayed on the screen. This indicates that the instrument is operating properly.

(3) How to use a low-capacitance/direct probe



ITEM	SPECIFICATIONS	ACCESSORIES
Bandwidth	DC ~ 30MHz (±1dB) DC ~ 40MHz (±3dB)	Pincher tip No.2110 Cable marker No.2520
Input R	=10MΩ	
Input C	=22pF (at oscilloscope input 25pF)	
ATT Ratio	1/10	
MAX Input voltage	600V (DC+AC Peak)	

The knob and hook cover may be turned in any direction, but care must be used not to disconnect the ground over that holds the hook cover in place by an internal spring, which could loosen or break.

(4) Measurement

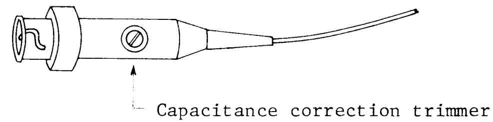
The probe exhibits high resistance and capacitance at × 10, however, the input voltage is attenuated to 1/10. This must be accounted for in voltage measurements.

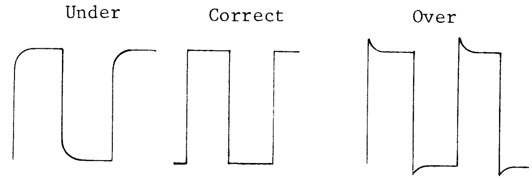
Measured voltage = Sensitivity of oscilloscope V/DIV. X screen amplitude div × 10 (× 10), it is necessary to correct the pulse characteristic by adjusting the capacitor in the probe for flat top of the square wave calibration voltage.

(5) Adjustment of Probe

When observing the signal waveforms of high impedance circuits, the operation of the signal source and waveforms on the screen may change due to the input impedance of the oscilloscope, parallel capacitance of a coupling line, induction noise, and other effects leading to measurement error. The use of a low-capacitance probe avoids these effects. A low-capacitance probe of 10:1 attenuation such as the AT-10AB should be used for high impedance circuitry measurements. Its input impedance is 10MΩ at 22pF.

When adjusting the probe observing CAL (11) adjust the capacitance correction trimmer in the probe using a small screw driver, to provide proper square wave compensation.





(6) Dual Trace Measurement

Two vertical axis input circuits are provided in this instrument. The waveforms of the two input signals are alternately shown on the screen by means of an electronic switch. However, since there is only one horizontal sweep circuit, it is not possible to have two synchronized or locked in waveforms of two unrelated, independent input signals simultaneously on the screen. Two different methods are available for alternately switching of two signals making use of the electronic switch.

ALT, and CHOP are selected automatically by TIME/ DIV switch.
Time Switch of (12) does automatic-changeover to CHOP at 1mS/DIV~0.2S/DIV. and to ALT at 0.2μS/ DIV ~ 0.5mS/DIV.

(7) Precautions on Direct Connection and Using Probe

Two different methods are available for applying signals. One is to connect a lead wire to the input terminal of the oscilloscope directly, and another is to use a probe.
When viewing a small signal in a circuit having high signal source impedance, error may occur in measurement due to the effect of parallel capacitance or induced noise in the input cable. The following precautions should be observed to avoid false readings. Generally, with the exception of a low-impedance circuit, the use of a lead wire should be avoided. If a lead wire other then the probe or shielded wire is used, make the lead as short as possible. When using a shielded wire in circuit having high impedance, attention should be paid to the loading effects of the sum of the input capacitance of the oscilloscope and the distributed capacitance of the probe or shielded wire on the signal source. The input terminal of the oscilloscope has a capacitance of about 30pF in parallel with 1MΩ. If the effect of this parallel capacitance on the high impedance signal source cannot be ignored, the use of the low capacitance ×10 probe is recommended.

(8) Low-capacitance probe

To avoid the ill effects by direct connection, use a low-capacitance probe (×10) whenever possible. When this probe is used, input impedance is 10MΩ, 22pF, making it possible to reduce the loading effects upon the signal source to a great extent. However, when the probe is used at ×10, the input signal is attenuated to 1/10. This must be taken into account in all measurements.

(9) Ground Connection

When using a probe, connect to a ground point close to the signal source and use the probe ground wire.

Triggering on waveforms

The most important factor in operating is to lock and display waveforms properly before measuring them with the oscilloscope.

(10) How to provide synchronization

o Select the position of the SOURCE switch (17), according to the connector where sync signal is supplied, also select the position of the MODE selector.

Select the sweep mode by the MODE selector (16) . When no input signal is applied or the trigger level is not correct, set the selector to NORM to remove waveforms on the screen.

The triggered sweep circuit of this instrument stops functioning if a trigger pulse is not produced as a sweep starting pulse. It is therefore necessary to select this sweep according to purpose desired. Generally, for waveforms which have a frequency of 20Hz or more and are not complex, use AUTO triggering. At AUTO triggering, the sweep circuit is automatically placed in the free-run state when the aforementioned trigger pulse is not produced and a horizontal trace is displayed irrespective of sweep time set by the knob (12) .

Next, set the synchronizing polarity to either PUSH (+) or PULL (-) by the level knob and provide synchronization by turning the knob to stabilize the waveform.

* Explanation of synchronizing polarity level.

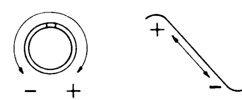
PUSH (+) SLOPE

The polarities synchronize with each other in the solid line parts.

PULL (-) SLOPE

* Explanation of the synchronizing level.

When the slope is positive (+)



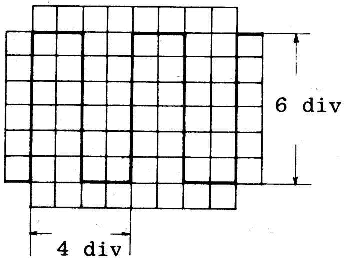
When the slope is negative (-)

(11) How to observe waveforms

If (8) VOLTS/DIV is set to 0.5V, then the amplitude is $0.5 \times 6 = 3.0V$

If (12) TIME/DIV is set to 0.5ms, then the period is $0.5 \times 4 = 2mS = 0.002S$

So the frequency is
1/0.002 = 500Hz



Example of measurement of voltage, period and frequency

Caution:

Keep the VARIABLE knob (9) at the CAL position and the SWP VAL knob (13) at the CAL position.

At the CAL position the waveform is calibrated by the specified value of each range.

(12) Magnification of part of waveform

Turn the Position (PULL ×10 MAG) knob (14) to locate the 1 division of trace to the horizontal graticule center and pull the knob. That part will be magnified to cover the full length of the graticule.

Any 1 division of the sweep can be displayed as a 10 division trace by use of the knob of (14).

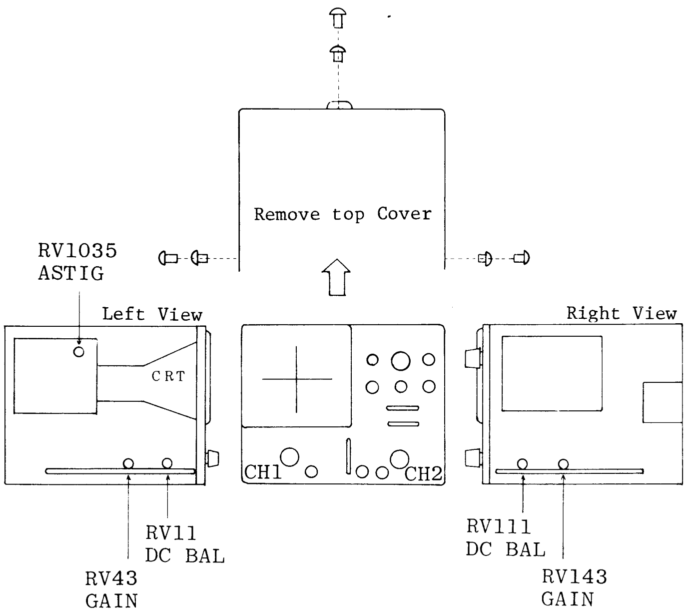
(13) Operation of X-Y

Set the knobs as follows:

(12) TIME/DIV	:	set to X-Y
CH1 INPUT	:	feed X-axis signal (horizontal-axis signal) as input.
CH2 INPUT	:	feed Y-axis signal (vertical-axis signal) as input.

By this setting the X-axis sensitivity operates by means of CH1 VOLTS/DIV and the Y-axis sensitivity by means of CH2 VOLTS/DIV as an X-Y oscilloscope providing a maximum sensitivity of 1mV/DIV. However, the position in the Y direction (vertical direction) operates by means of CH2 ↓↑POSITION and the position in the X direction (horizontal direction) operates by means of ⇄POSITION.

3. User Adjustments



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

(1) TRACE ROTATION (Trace slope)

Adjust the TRACE ROTATION (4) 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 (12) to X-Y, and MODE (10) 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 (3) and POWER/INTENSITY (1) 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 V/DIV switch from 5mV to

10mV. Trace should not move more than 0.1 division.

c. Adjust RV11(DH1), or RV111(CH2), for minimum trace shift when rotation the V/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

Set the knob (8) for 10mV/DIV.
Connect the CAL output (11) to the CH1 or CH2 connector with probe.

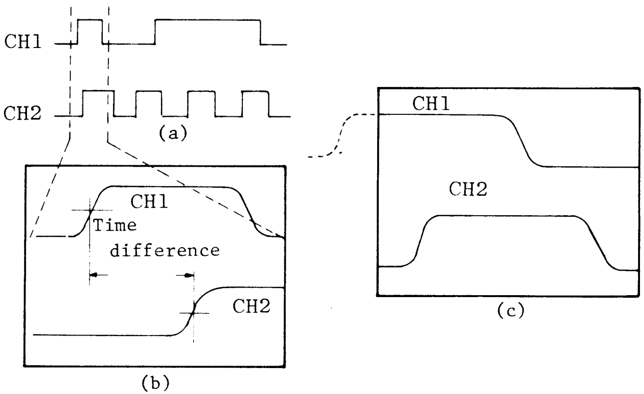
Check - CRT display for five divisions of deflection. Adjust the GAIN controls, RV43 (CH1) or RV143 (CH2), for exactly five divisions of deflection.

4. Applications

The most useful feature of a dual-trace oscilloscope is it's capability for viewing simultaneously two waveforms that are frequency or phase related, or that have a common synchronizing voltage, such as in digital circuitry. Simultaneous viewing of "cause and effect" waveforms is an invaluable aid to the circuit designer or the repairman. Several possible applications of the dual trace oscilloscope will be reviewed in detail to familiarize the user further with the basic operation of this oscilloscope.

4.1 Measurement of time difference

When measuring the time difference between two signals, the triggering signal (17) CH1 is selected as the reference for comparison between them. For a pulse train as shown in the adjacent diagram (a), CH1 is taken as the synchronizing signal source as shown in the diagram (b), while CH2 is used as the synchronizing signal source as shown in diagram (c).



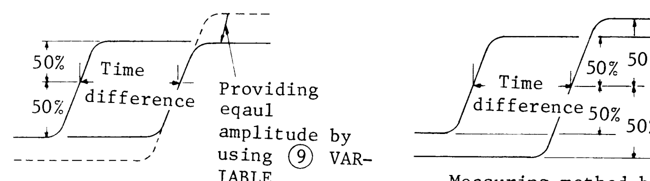
Accordingly, when investigating how much the signal CH2 lags behind the signal CH1, the latter is taken as the synchronizing signal source; in a reverse case the former is used as the synchronizing signal source.
A signal with a phase lead is chosen as the synchronizing signal source. If this is reversed, the part, whose observation is required, may sometimes fail to appear on the screen surface. Then, for two signals that appear on the screen surface, make their amplitudes equal to each other or superimpose them one upon the other.
The time difference between them is measured by the time interval between the 50% points of their amplitudes. The measuring method by superimposition is more convenient than that by the equal amplitude.

CAUTION:

Since a pulse wave contains a number of harmonic components (harmonic waves) depending on its width or period, it is necessary to treat it with the same care as of for high-frequency signals. Therefore, use either a probe or a coaxial cable and make its ground lead wire as short as possible.

4.2 Measurement of rise (fall) time

The measurement of the rist time of a pulse requires not only the attention described above but also attention to measuring errors.



Measuring method by equal amplitude

Measuring method by super position

The relationship between the rise time of a measured pulse. Trx and the rise time of an oscilloscope Tro and the rise time shown on the screen surface Trs is as follows:

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

If the rise time of the measured pulse is sufficiently larger than that of the oscilloscope (12nS for this oscilloscope), the error caused by the latter on measurement may by ignored, but if the latter approximates the former to a marked degree, a measuring error is produced.
A true rise time is obtained by:

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

Generally speaking, for circuit which produces no waveform distortions, such as tilt, overshooting etc, the relationship between the frequency band and the rise time can be expressed by:

$$fc \times tr \fallingdotseq 350$$

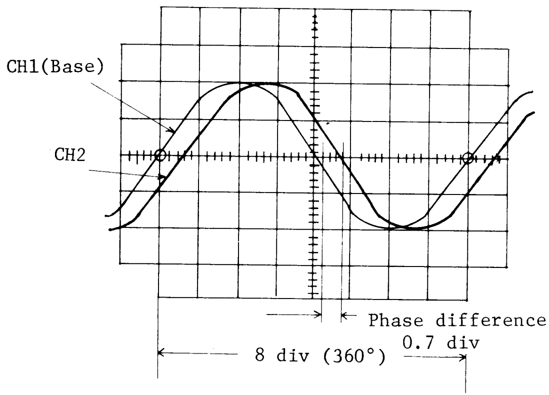
where fc = frequency band (MHz) and tr = rise time (ns).

4.3 Measurement of phase shift

Measurement of a phase shift can be made by several methods using an oscilloscope.
Typical applications are in circuits designed to produce a specific phase shift, and measurement of phase shift distortions in audio amplifiers and networks.
In all amplifiers, a phase shift is always associated with a change in amplitude response.
For example, at the -3dB response paints, a phase shift of 45° occurs.

(1) 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, $\frac{360°}{8div} = 45°/div$.

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

Horizontal distance on the screen: 0.7 div

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

(2) 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 waveform.

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 oscil-

loscope 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.

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).

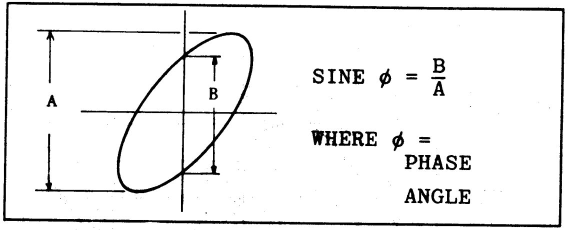


Fig.(a) Phase shift calculation

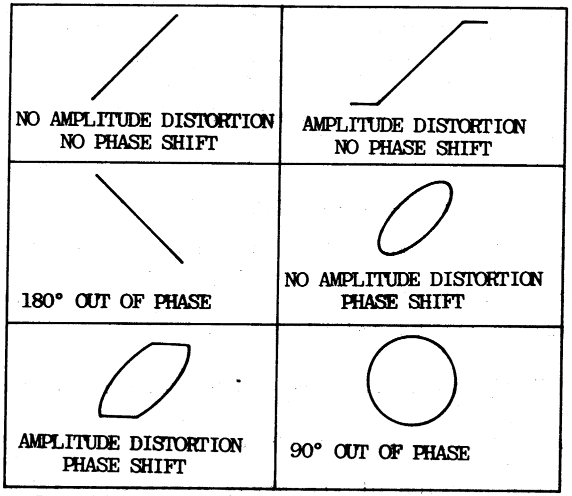
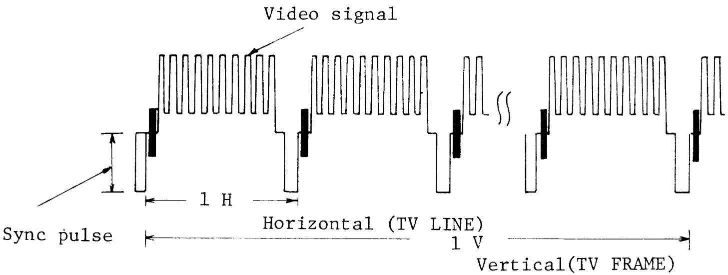
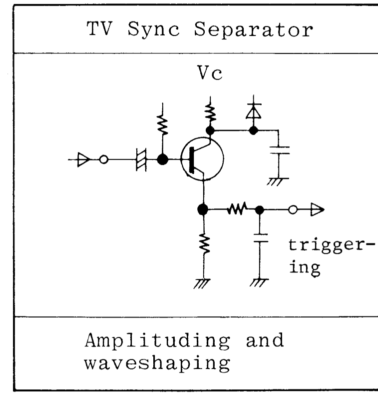


Fig.(b) Typical phase measurement oscilloscope displays.

4.4 Measurement of composite video signal

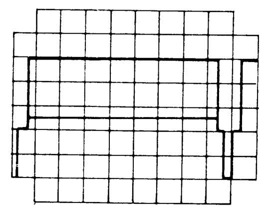
1. Video Signal





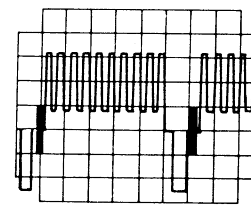
An internal TV Sync Separator circuit permits stable line or field-rate triggering from displayed composite video waveforms.

Observing the vertical signal



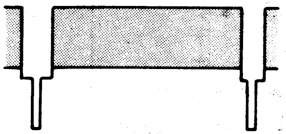
TIME/DIV renge: FRAME
(0.1mS/DIV ~ 0.2S/DIV)

Observing the Horizontal signal



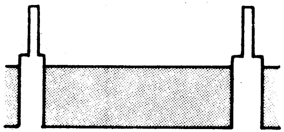
TIME/DIV renge: LINE
(50μS/DIV ~ 0.2μS/DIV)

TV(-) : generally



TV Sync (-)

TV (+)



TV Sync (+)

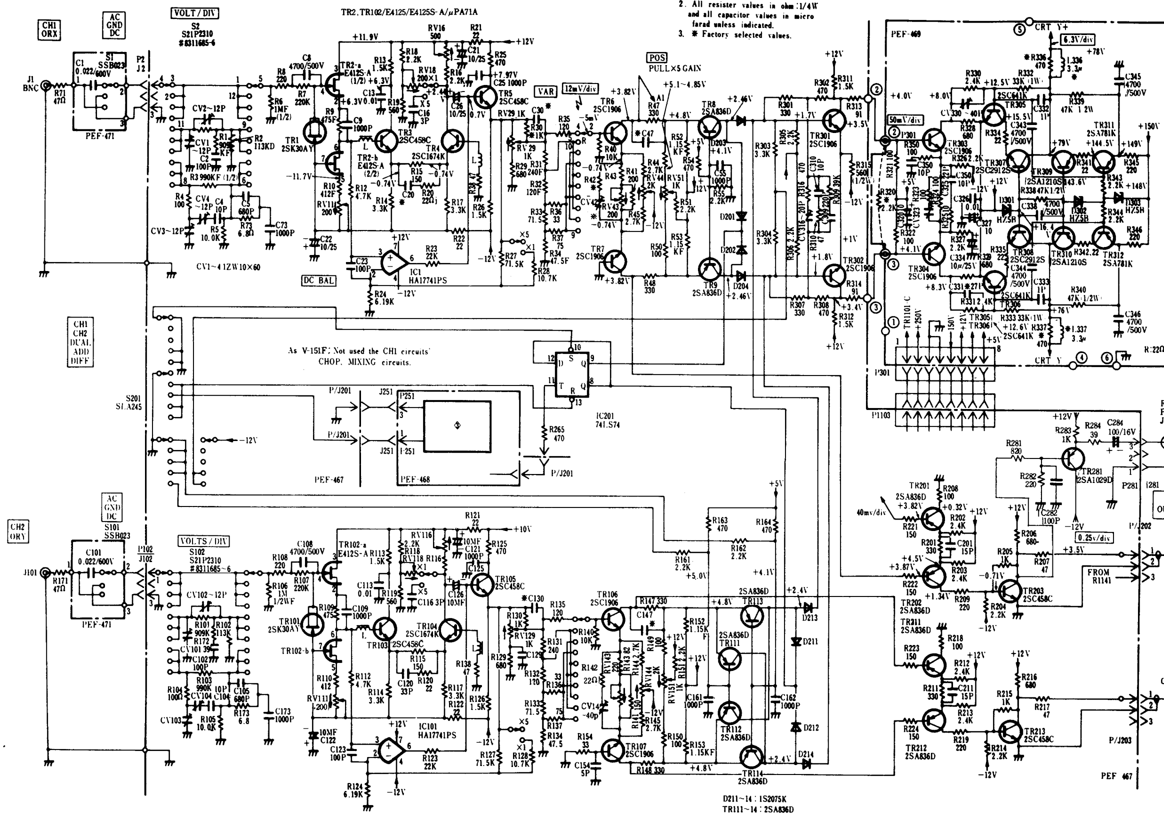
When the sync and blanking pulses of the displayed video signals are negative, set the MODE switch (16) to TV(-).

If the sync and blanking pulses are positive, set the switch (16) to TV (+).

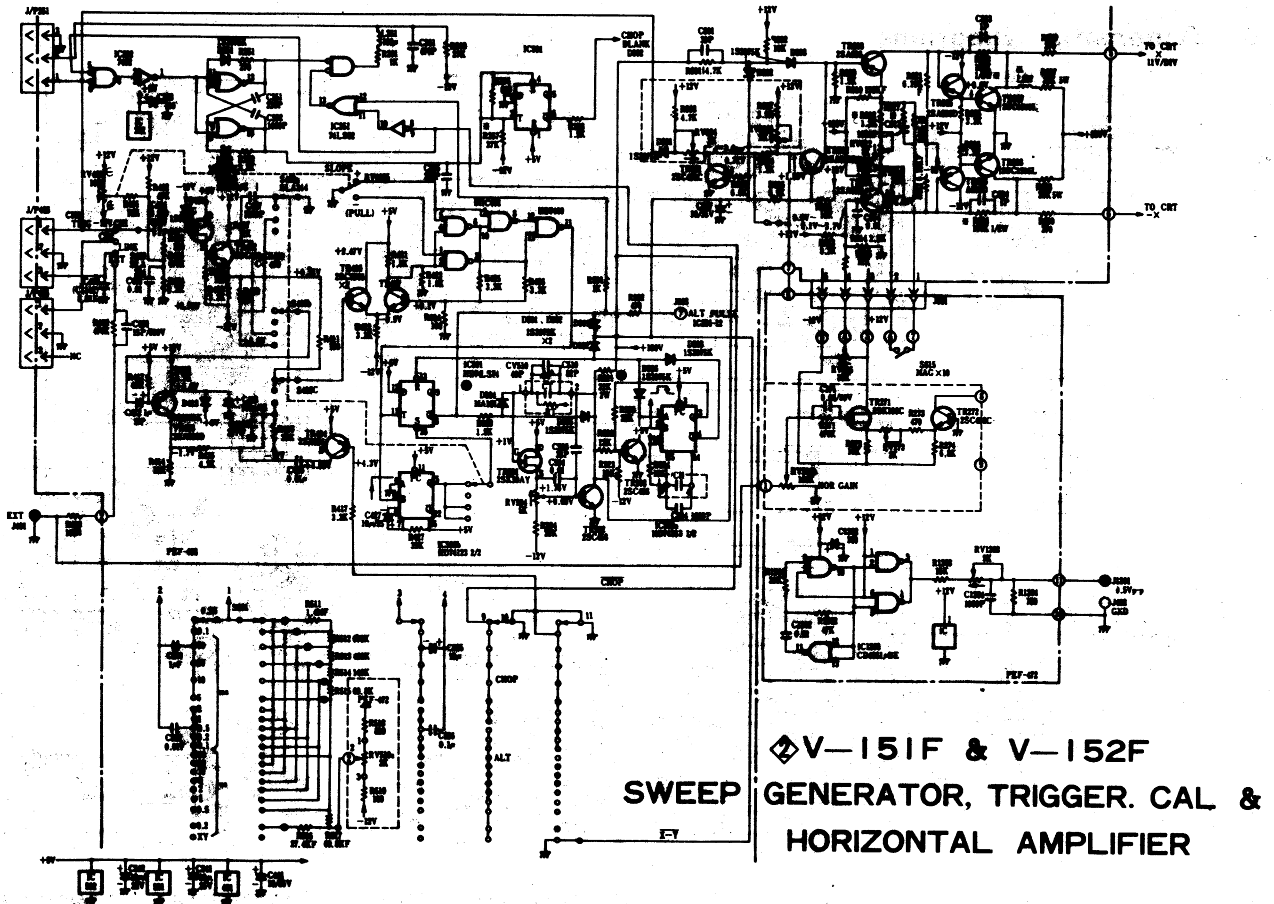
Note: Using the MODE switch (16) with RV(-), don't set the slope switch (15) to (-) slope.

5. Schematic Diagrams

Note
1. All of the basic circuit diagram are subjects to change without notice.
2. All resister values in ohm :1/4W and all capacitor values in micro farad unless indicated.
3. ✻ Factory selected values.

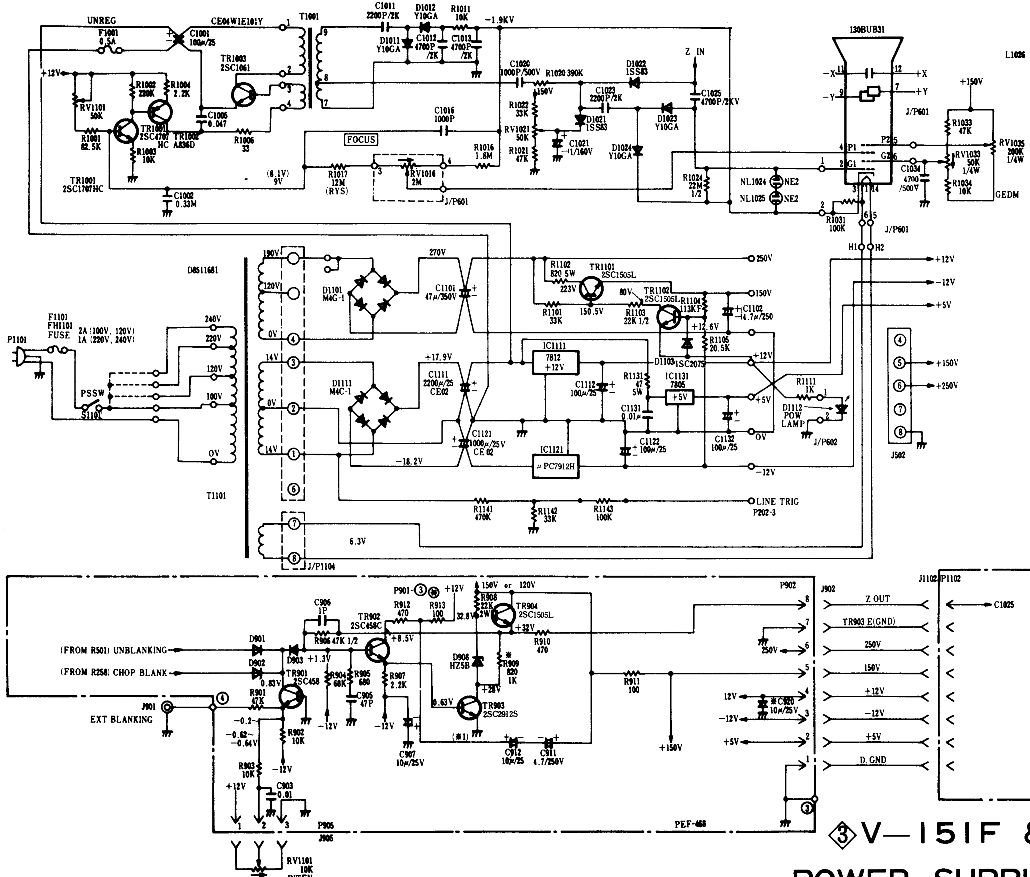


①V—151F & V—152F VERTICAL SYSTEM



②V—151F & V—152F

SWEEP GENERATOR, TRIGGER. CAL & HORIZONTAL AMPLIFIER



③V—151F & V—152F

POWER SUPPLY & Z-AXIS