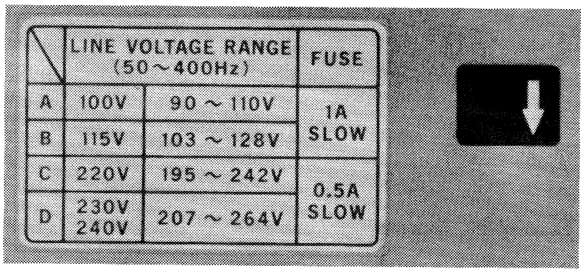
2-3 BASIC OPERATIONS FOR SIGNAL MEASURING

2-3-1 Line Voltage Selection



The voltage select plug on the rear panel can be pulled out and reinserted after removing the rear panel. The letters A, B, C, and D printed around the plug correspond to the letters A, B, C, and D printed on the LINE VOLTAGE RANGE plate on its left.

After checking which of the letters A, B, C, and D in the LINE VOLTAGE RANGE plate represents the primary line voltage to be applied to operate this device, reinsert the voltage select plug so that the arrow points the correct letter.

> CAUTION
>
> Be sure to unplug the power cord from the electrical outlet before reinserting the voltage select plug.

2-3-2 How to Apply Signals (INPUT, probe)

Apply signals to be measured to the INPUT connectors for channels 1, 2, and 3, using a probe.

The use of a probe reduces the adverse effect of external fields on the signals measured.

The SS-5706 is provided with a Model SS-0060 probe (1.5 m long), with attenuation ratios of 10 to 1 and 1 to 1 selectable with a switch, as an accessory.

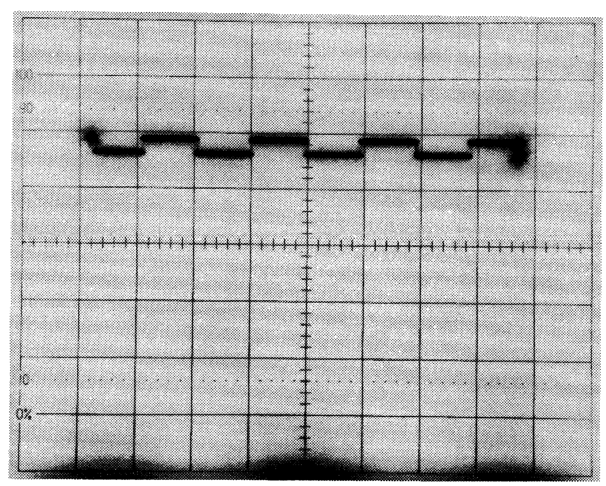
Input impedance is higher when the probe is used at the attenuation ratio of 10 to 1 than when it is used at the attenuation ratio of 1 to 1 or when the probe is not used so that the load effect on the signal source is reduced. Even if the signal source has a relatively high impedance, therefore, signals can be measured accurately.

If the probe is used at 10 to 1, however, the input signal is attenuated to one-tenth so that, in measuring the amplitude of the input signal, the values indicated by the channels 1 and 2 VOLTS/DIV switches, or the value indicated for channel 3 must be multiplied by ten.

If the probe is used at 1 to 1 in measuring high-frequency signals, a large load effect will be produced on them. That is, the use of the probe at the attenuation ratio of 1 to 1 is suitable for measuring low-frequency, low-level signals.

(For detailed information on the probe, refer to the instruction manual for the probe.)

Figure 2-3-2. Example of probe connection



2-3-3 Input Coupling Selection (AC-DC, GND)

There are many types of signals to be measured, including DC, AC, and AC superimposed on DC signals. To correct measure these signals, it is necessary to select the proper signal input coupling, using the AC-DC switch. This switch is used for selecting a type of signal input coupling for the vertical axis. When the switch is pressed to the AC position, the AC coupling in which the INPUT connectors are connected via a capacitor to the input of the vertical amplifier is selected. If the switch is released to the DC position, the DC coupling in which the INPUT connectors are directly connected to the vertical amplifier is selected. With switches S02 (CH1) and S05 (CH2) at GND, input signals are not connected to the vertical amplifier, but the input of the vertical amplifier is grounded.

AC Coupling

When the AC-DC switch is pressed to the AC position, only the AC signal component of superimposed on DC signal input is allowed to pass, while the DC signal component is blocked by the capacitor. Even if the deflection factor is raised, therefore, the AC signal waveform will not be moved out of the CRT screen by the DC (signal offset), but can be observed with its amplitude magnified on the screen. If a signal with a low repetition frequency is observed in the AC coupling mode, a sag occurs if the signal is a square wave, or the signal is shown attenuated in amplitude. This attenuation is about -3 dB per 4 Hz.

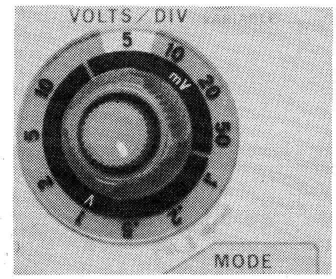
DC Coupling

When the AC-DC switch is released to the DC position, all the frequency components of the input signal are allowed to pass. Normally, this mode should be used except when blocking the DC components of the input.

Ground (GND)

When switch S02 or S05 is at GND, the input of the vertical amplifier is grounded so that a ground potential is displayed on the CRT screen. This potentially is normally used as the reference potential in measuring signals.

2-3-4 Deflection Factor Setting (VOLTS/DIV, VARIABLE)



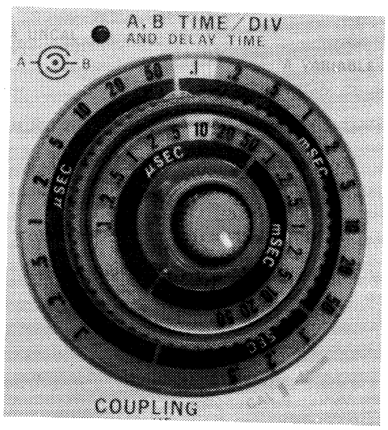
To display and measure a signal on the CRT screen, it is necessary to show it in an appropriate amplitude on the screen. Correct measurement cannot be expected if the amplitude on the CRT screen is too small or so large that it extends beyond the limits of the screen. Therefore, the deflection factor must be increased if the input signal has too small an amplitude, or decreased if it has too large an amplitude. The switches for channels 1 and 2 VOLTS/DIV, which have a fine control called VARIABLE are used for varying the deflection factor.

If the VARIABLE control is turned fully clockwise to the CAL position, the deflection factor is directly indicated by the VOLTS/DIV switches.

VOLTS/DIV indications represent voltages per division of the amplitude of a signal waveform displayed on the CRT screen. Turning VARIABLE counterclockwise decreases the deflection factor. When VARIABLE is fully turned counterclockwise, each position represents 1/2.5 (or less) of the value indicated.

The deflection factor for channel 3 is fixed at 0.1 V/division. No fine control is provided for channel 3.

2-3-5 Sweep Rate Setting (A.B TIME/DIV, VARIABLE)



Signals to be measured may include a low-frequency signal, high-frequency signal, and a pulse with a slow rise or quick rise. It is necessary to select a sweep rate suitable to the signal to be measured.

Lower the sweep rate when measuring, for example, a low-frequency signal, or a pulse with slow repetition, and raise the sweep rate when measuring, for example, a high-frequency signal, or a pulse with a quick rise.

The switch for sweep rate selection in sweep A is A TIME/DIV, which has a fine control called A VARIABLE.

When the A VARIABLE control is fully turned clockwise to the CAL position, the A TIME/DIV switch directly indicates a sweep rate. Turning the A VARIABLE control counterclockwise lowers the sweep rate. When it is fully turned counterclockwise, each position represents 2.5 times or less of the value indicated.

The switch for sweep rate selection in sweep B is B TIME/DIV, which has no fine control.

2-3-6 Triggering

The operation for displaying a signal to be measured still on the CRT screen is called triggering. It is described in this section.

The following six steps of operation are necessary for triggering.

(1) Trigger mode selection
Select either the horizontal MODE AUTO or NORM.

(2) Trigger signal source selection
Select a trigger signal with SOURCE.

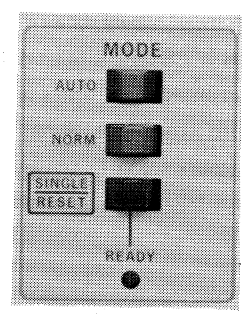
(3) Trigger coupling selection
Select a coupling mode with COUPLING.

(4) Slope selection
Push LEVEL for positive trigger slope or pull it for negative trigger slope.

(5) Trigger level selection
Select a suitable trigger level in the tirgger level range.

(6) Hold-off adjustment
This adjustment is made for stabilized triggering of the waveform of a complex pulse line.

(1) Trigger mode selection (MODE)



The SS-5706 has two trigger modes: AUTO and NORM, each of which can be selected with the horizontal MODE buttons.

AUTO: A desired trigger level can be set with the LEVEL control.
If the set trigger level is within the trigger level range (see (4) Slope Selection), the input signal is triggered.

If the set trigger level is outside the trigger level range, or if no trigger signal is available, a free running sweep takes place.
Therefore, a signal too small to provide sufficient amplitude can be easily checked, and the ground potential can be easily confirmed by grounding the input.

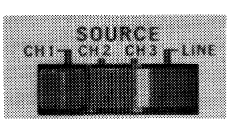
Input signals of 50 Hz or below will not be synchronized. In this case, use the NORM mode mentioned below.

NORM: If the set trigger level is within the trigger level range, the input signal is synchronized as in the AUTO mode, but if it is outside the trigger level range or if no trigger signal is available, there will be no sweep.

SINGLE: Only a single sweep takes place. When the SINGLE/RESET button is pressed once, the device stands by for the start of a sweep. If the same button is pressed again when the input signal is synchronized and when the A TRIG'D lamp is lighted, a single sweep takes place.

This mode is used when photographing waveforms on the CRT screen or observing attenuated waveforms.

(2) Trigger signal source selection (SOURCE)



Triggering requires applying an input signal, or a signal which has a specific time relationship (an integer or times an integer) with the input signal (called a trigger signal), to the trigger circuit to drive it to generate a trigger pulse and drive the sweep circuit with it.

The method of applying the input signal applied to INPUT to the trigger circuit via internal circuits (half way in the vertical deflection system) is called Internal Trigger.
Internal Trigger is selected when SOURCE is set to CH 1 or CH 2. In Internal Trigger, an input signal is internally connected to the trigger circuit when it is half way in the vertical deflection system. Thus, if it is directly applied to INPUT, though it may be a low-voltage input signal, it is amplified to an appropriate voltage level, and automatically routed to the trigger circuit. This means simple operation and no need for lowering the output impedance of the trigger signal source as in External Trigger. Internal Trigger is normally more convenient than External Trigger for these advantages. To select a trigger signal for Internal Trigger, set SOURCE to CH 1 so that the input signal that is applied to the INPUT connector for channel 1 is routed to the trigger circuit. If SOURCE is set to CH 2, the input signal that is applied to the INPUT connector for channel 2 is routed to the trigger circuit. In measuring two input signals of the same frequency, selection of the channel to which the input signal that has the higher voltage and less noise than the other is applied provides higher trigger stability.
In measuring two input signals having different frequencies as shown in Figure 2-3-6-(2), it is necessary to select the channel to which the input signal of the lower frequency is applied (provided that their relationship is that of times an integer). If the other channel is selected, the waveform of the input signal that has the lower frequency will not be triggered. In the case shown in Figure 2-3-6-(2), for example, a pulse must be used for triggering. If a sawtooth wave is used for this purpose, a pulse wave cannot be triggered. In measuring a phase difference, it is necessary to select the channel to which the signal that has the advanced phase is applied.

The method of applying an external input signal or a signal having a specific time relationship with the input signal to the trigger circuit is called External Trigger.

If SOURCE is set to CH 3 and if a signal that has a time relationship with the signal applied to the INPUT connector for channel 1 or 2 is applied to the INPUT connector for channel 3, the input signal applied to the INPUT connector for channel 1 or 2 can be triggered by the input signal to channel 3. Also, quantitative measurement is possible by displaying the input signal on the CRT screen. The advantages of Internal Trigger are directly the disadvantages of External Trigger, but External Trigger provides the following advantages that can hardly be disregarded.
First, External Trigger is unaffected by the vertical deflection system. In Internal Trigger, the voltage applied to the trigger circuit varies as VOLTS/DIV is turned. In the sweep mode NORM, however, LEVEL must be adjusted each time

VOLTS/DIV is turned depending on the input signal waveform. In External Trigger, however, accurate triggering is assured once satisfactory triggering is obtained no matter how the VOLTS/DIV switch is turned unless the external trigger signal waveform changes.

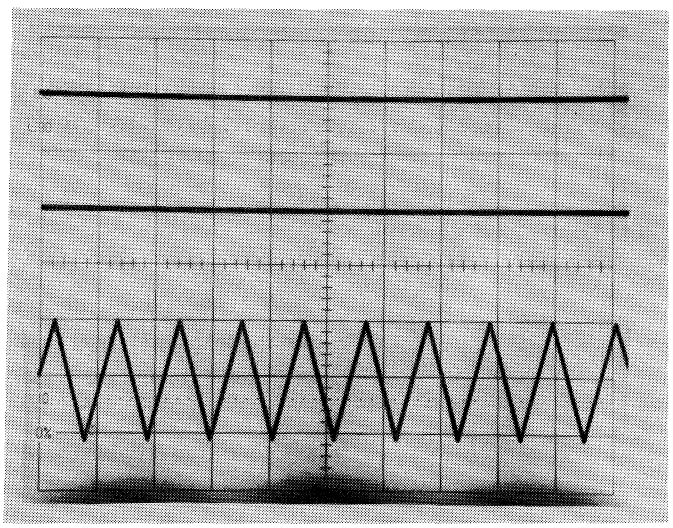
Second, if a sweep is desired a specific time before or after an input signal waveform appears, and if a signal is obtained at the point before or after that specific time, this signal may be applied to the INPUT connector for channel 3 for measuring the input signal waveform.

The method of applying a divided line voltage to the trigger circuit is called Line Trigger.

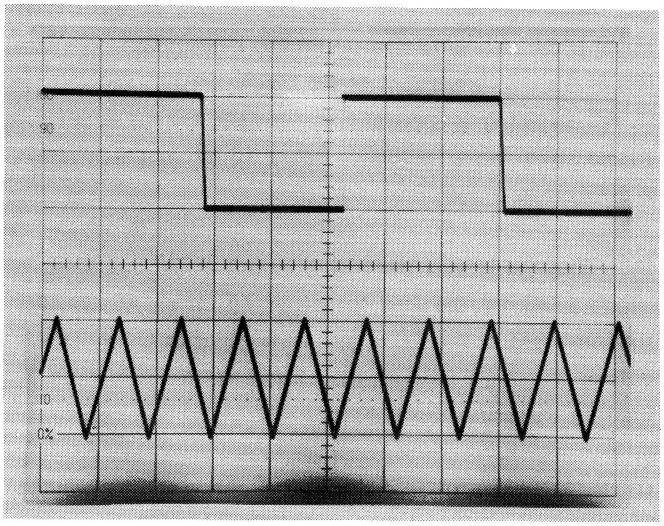
Line Trigger is selected when SOURCE is set to the LINE position.

Line Trigger assures stable trigger in measuring line frequencies or line frequency harmonics regardless of the vertical deflection system because the line voltage is divided for use as a trigger signal.

Figure 2-3-6-(2). Triggering signals of different frequencies

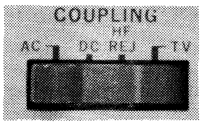


(a) Trigger by sawtooth wave



(b) Trigger by pulse

(3) Trigger coupling selection



Use COUPLING to select a trigger signal input circuit coupling mode.

The purpose of it is to stably triggering an AC signal, DC signal, or a signal superimposed on harmonic noise and display its waveform on the CRT screen.

AC: This mode puts the trigger circuit in AC coupling, in which only the AC component of the trigger signal is used for triggering. Because the DC component of the trigger signal is cut off, synchronization can be established regardless of the DC component of the trigger signal.

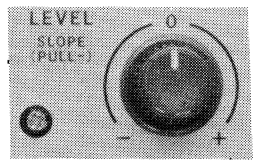
AC coupling is generally convenient except when the trigger signal has a frequency below 10 Hz, in which case it is difficult to trigger.

DC: This mode puts the trigger circuit in DC coupling, in which a DC may be used for triggering. If an AC signal is superimposed or the DC trigger signal, or if its DC voltage is outside the range set with the LEVEL control, it cannot be used for triggering.

HF REJ: In this mode, the trigger circuit is coupled via the lowpass filter. A high-frequency trigger signal (about 10 kHz or over) or a trigger signal mixed with high frequency noise is attenuated by the filter which passes only the low-frequency component of the trigger signal.

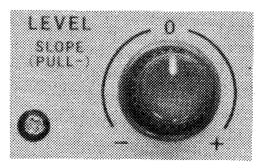
TV: This mode couples the trigger circuit for stabilized synchronization of television signals. (For measuring television signals, refer to 2-4-6 Operation for TV signal measuring.

(4) SLOPE selection (SLOPE)



Select either positive slope or negative slope for the trigger signal to be used for triggering. Push LEVEL in for selecting positive slope, or pull it for selecting negative slope.

(5) Trigger level selection (LEVEL)



Trigger level must be set within the specified trigger level range (refer to Figure 2-3-6-(5)) for proper triggering. Proper trigger condition is indicated by the lighting of the A TRIG'D lamp.

Figure 2-3-7-(3). Trigger signal input circuit SOURCE and COUPLING

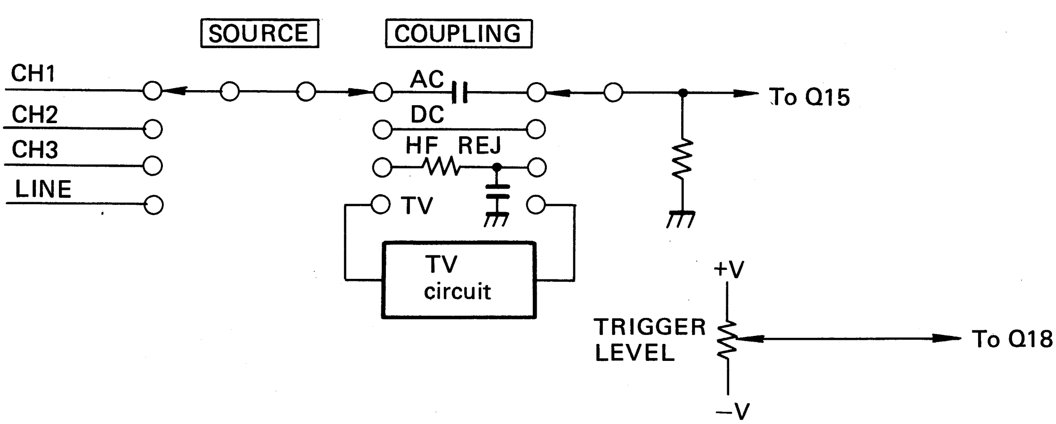


Figure 2-3-7-(4). Trigger signal slope

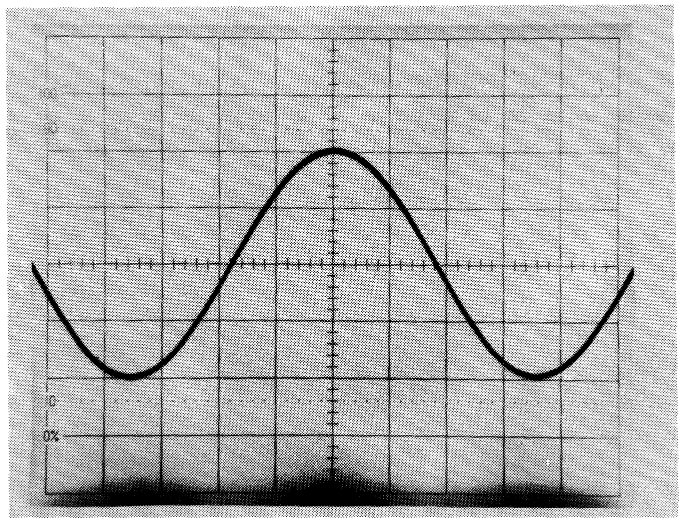


Figure 2-3-7-(5). Trigger level

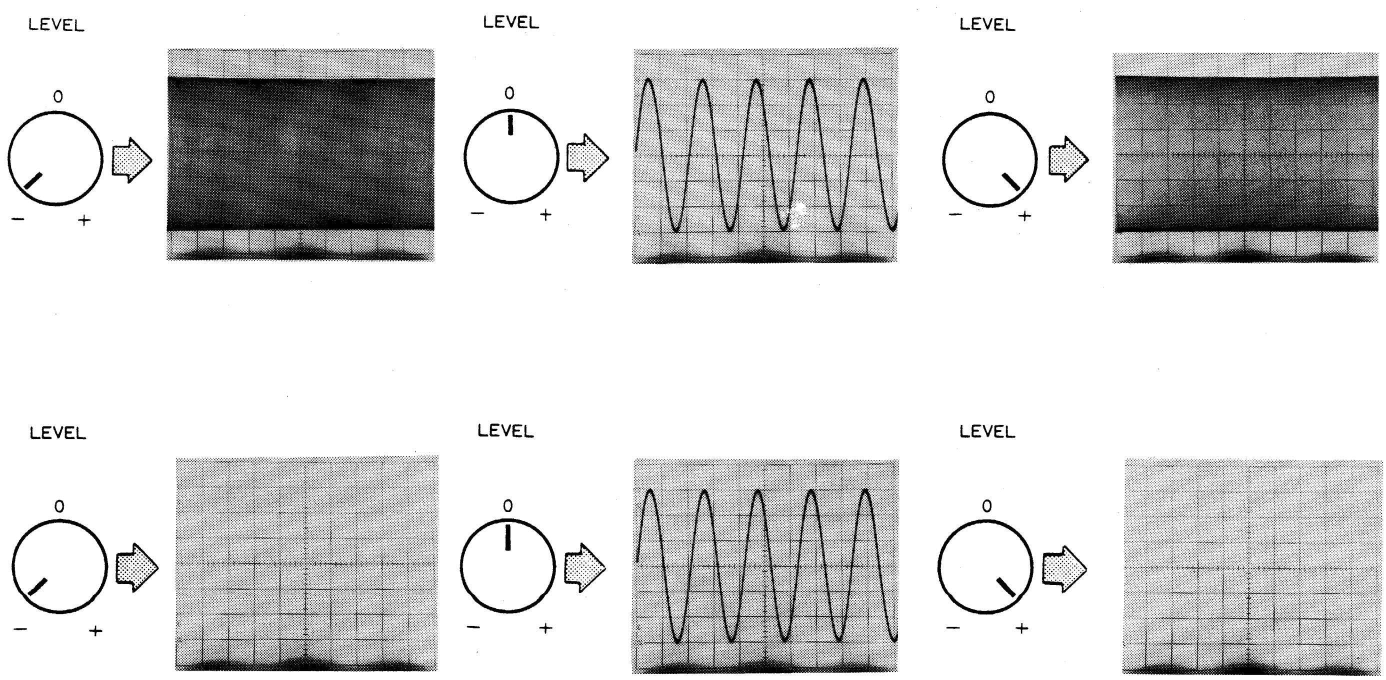
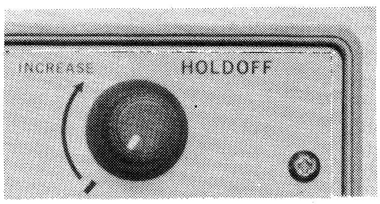


Figure 2-3-6 shows trigger levels set when the positive and negative trigger slopes are selected by use of the **LEVEL** control.

The four waveforms on the CRT screen start sweeping at the trigger level position selected with the LEVEL control.

(6) HOLD OFF



In observing the waveform of a complex line of pulses, the waveform may appear doubled despite synchronization depending on sweep rate setting.

In such a case, fully turn the HOLD OFF control from the counterclockwise extremity in the direction of INCREASE to adjust the sweep cycle so that the sweep always starts on the basic cycle of the signal. The waveform then appears in a way easy to observe.

Figure 2-3-7-(6). Example of measuring complex pulse train

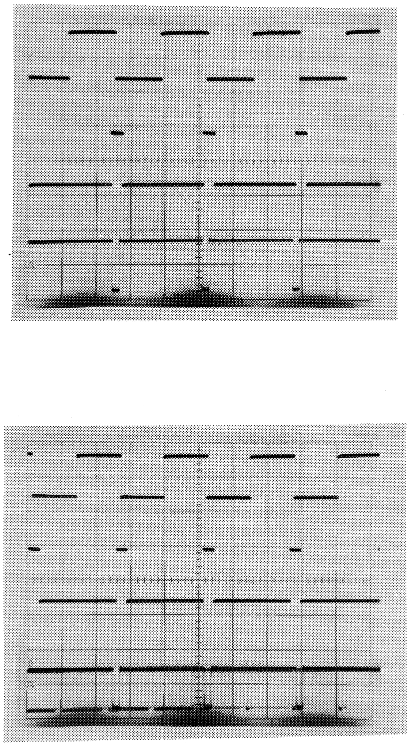
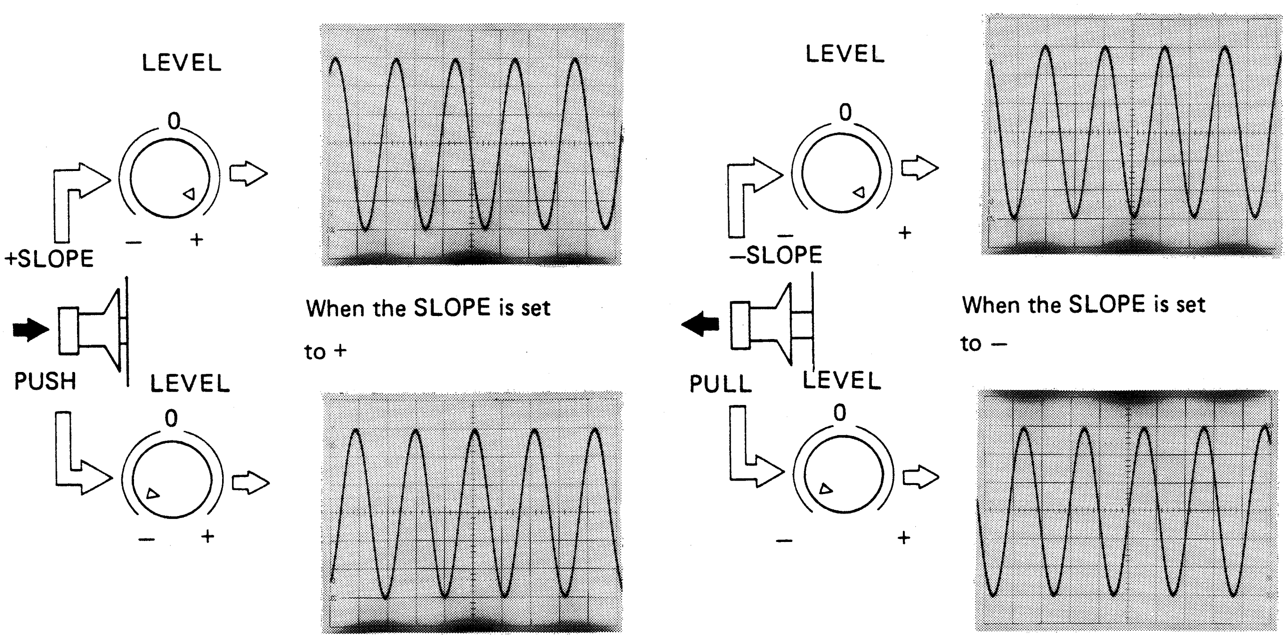
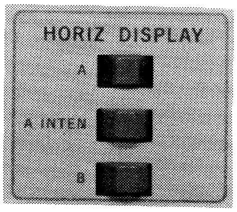


Figure 2-3-7. Trigger level and slope



2-3-7 Horizontal Axis Operation Selection



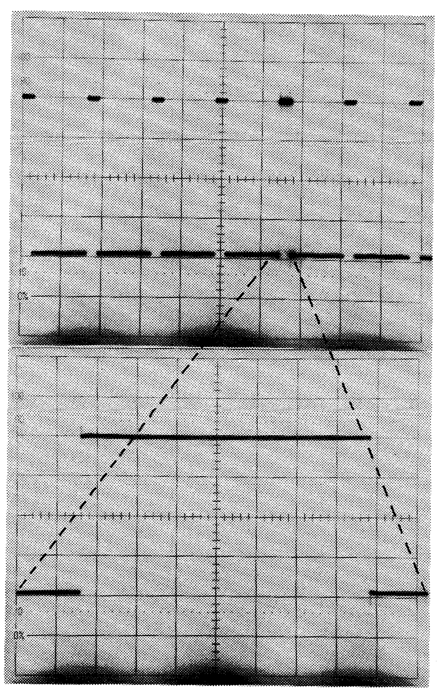
Select a horizontal axis sweep mode.

A: The A-sweep circuit is used for sweep. A sweep rate can be selected with the A TIME/DIV and VARIABLE.

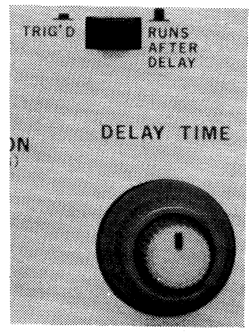
A INTEN: The B-sweep is intensity-modulated and displayed on the A-sweep to check the start position of the B-sweep (delay sweep) and sweep length. A sweep rate can be selected with the A TIME/DIV and B-sweep width (sweep rate) with the B TIME/DIV.

B: The B-sweep circuit is used for sweep. The intensity modulated part (B-sweep rate) in the INTEN sweep mode is displayed fully magnified on the CRT screen. The B TIME/DIV is used for sweep rate selection.

Figure 2-3-9. Example of delay sweep display



2-3-8 TRIG'D, RUNS AFTER DELAY, and DELAY TIME



The delay sweep function is used to display magnified a part of the signal to be measured a specific time after the sweep start point.

The A TIME/DIV and DELAY TIME are used for delay time setting, and the A.B TIME/DIV for magnification selection.

If an A-sweep of 1 ms/division, for example, is selected in Figure 2-3-8, a delayed sweep starts 6.3 divisions after the start point of the A-sweep. Thus, 1 ms/division x 6.3 divisions = 6.3 ms.

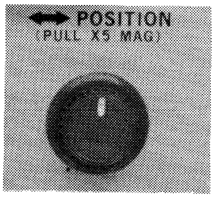
If a B-sweep of 50 μs/division is selected, the magnification ratio will be $\frac{1\text{ ms/division}}{50\ \mu\text{s/division}}$, that is, 1 to 20.

Two delay sweep modes, i.e., Trigger Delay and Runs After Delay, are available, and can be selected with the button TRIG'D (▃) – RUNS AFTER DELAY (▙).

TRIG'D: B-sweep is triggered by the first trigger pulse coming after the delay time selected with the A TIME/DIV and DELAY TIME.
This mode is used if delay jitters appear in the waveform on the CRT screen in the RUNS AFTER DELAY mode which is described below.
If a regularly repeating sine wave or square wave is input, the waveform may appear still even through the DELAY TIME is turned, but delay time changes.

RUNS AFTER DELAY: Delay time can be selected as desired. This mode offers the advantage that a B-sweep can be started at any point of an A-sweep. If the magnification ratio is increased so much, however, delay jitters appear on the CRT screen.

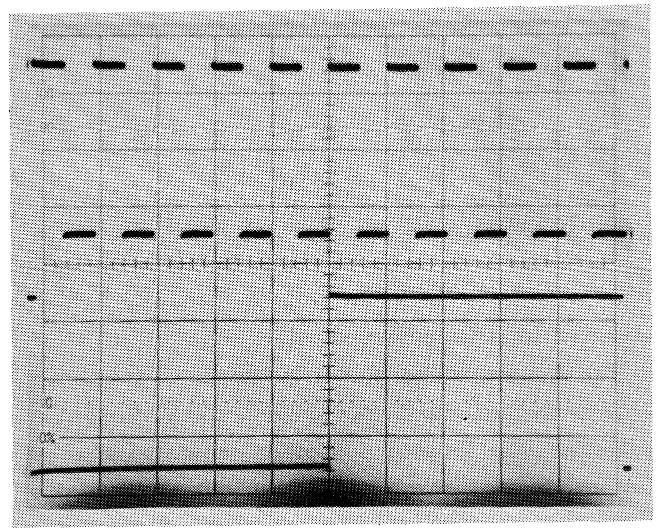
2-3-9 ↔ POSITION (PULL x5 MAG)



Waveforms shown on the CRT screen can be horizontally magnified ten times.

Waveforms are horizontally magnified from the center of the graticule on the CRT screen so, first adjust the waveform to the center of the graticule with the ↔ POSITION and next pull ↔ POSITION.

Figure 2-3-9. Example of waveform display by FINE —— (PULL x 10 MAG)



2-4 APPLIED OPERATIONS FOR SIGNAL OBSERVATION

The oscilloscope has various convenient functions for observing signals. After mastering the basic operations, applied operations using these functions for observing signals can be performed as follows:

2-4-1 Operation for Dual Trace Observation

There are two modes of operation, ALT (alternate sweep) and CHOP (chopped sweep), for dual trace observation.

Dual traces of high- to low-frequency signals can be observed by using these ALT and CHOP modes.

In observing dual traces, first press the vertical axis MODE button DUAL, and select ALT or CHOP with the CHOP (▬) – ALT (▮) switch.

Dual trace observation in the ALT mode

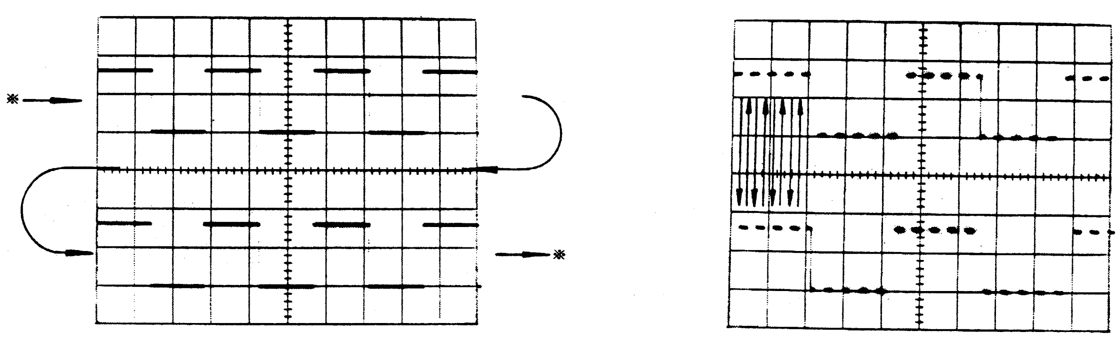
This mode is suitable for observing two signals of high frequency. In the ALT mode, channels 1 and 2 are alternated in sweep so that dual traces can be observed by applying two signals to be observed to the INPUT connectors for channels 1 and 2.

Alternate sweeps are possible in the full range of TIME/DIV, but lowering the sweep rate causes a flickering, which makes dual trace observation difficult. In observing signals that have a low repetition frequency, use the CHOP mode described below.

Dual trace observation in the CHOP mode

The CHOP mode is suitable for dual trace observation of low-frequency signals. In this mode, channels 1 and 2 are switched from one to the other at about 130 kHz so that, unlike in the ALT mode, it is difficult to observe high-frequency signals because their traces appear like dotted lines.

Figure 2-4-1. Displayed waveforms in ALT and CHOP modes



2-4-2 Operation for Observing the Sum or Difference of Two Signals

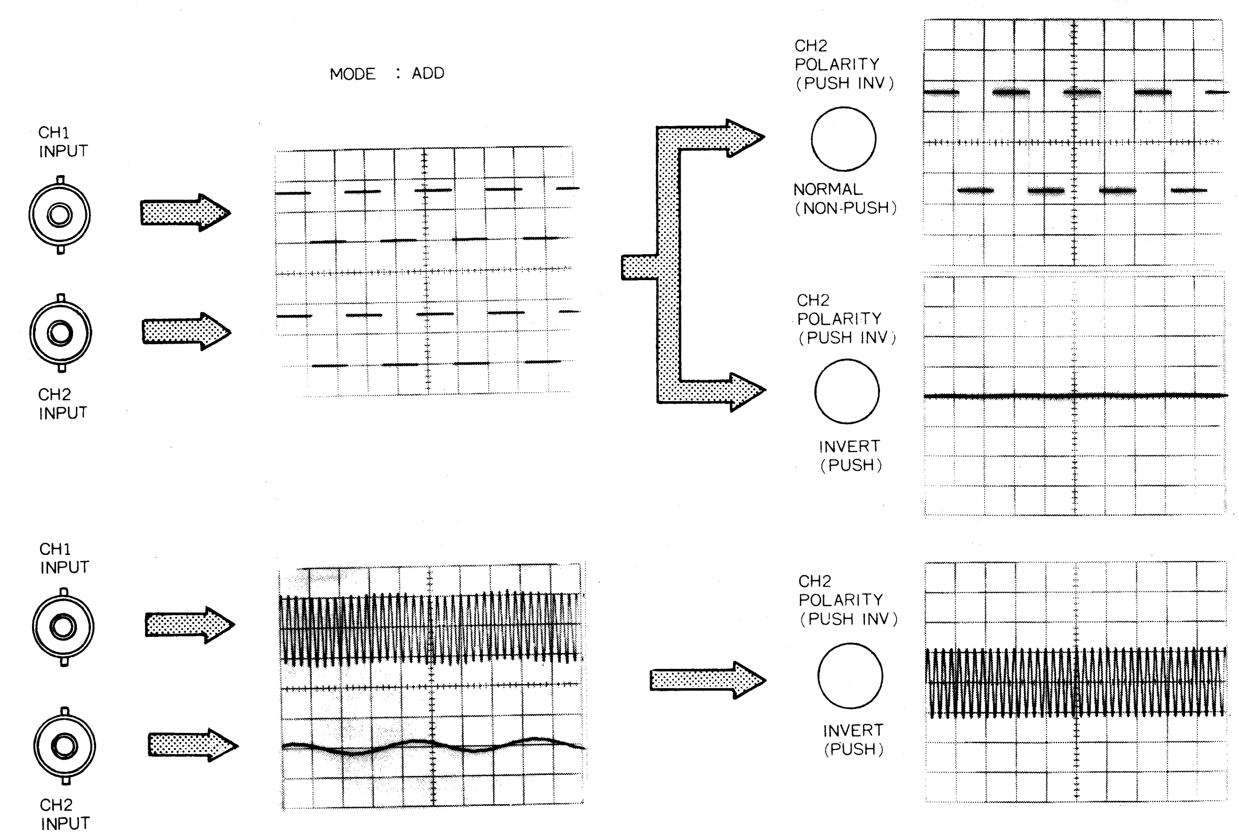
Observation in the ADD mode

The ADD mode is selected when both vertical MODE switches CH 1 and CH 2 are simultaneously pressed. When signals are applied to the INPUT connectors for channels 1 and 2 in this mode, the sum of the two signals (on channels 1 and 2) can be observed. When the CH 2 POSITION switch is pulled to the INV position, the difference between the two signals (channel 1 minus channel 2) can be observed.

In using the ADD mode, the deflection factors for the individual channels must be adjusted to suit the purpose.

The ↕ POSITION controls for both channels may be used for adjusting trace positions in the ADD mode. These switches, however, should be kept nearly at the center position for correct measurement.

Figure 2-4-2. ADD operation



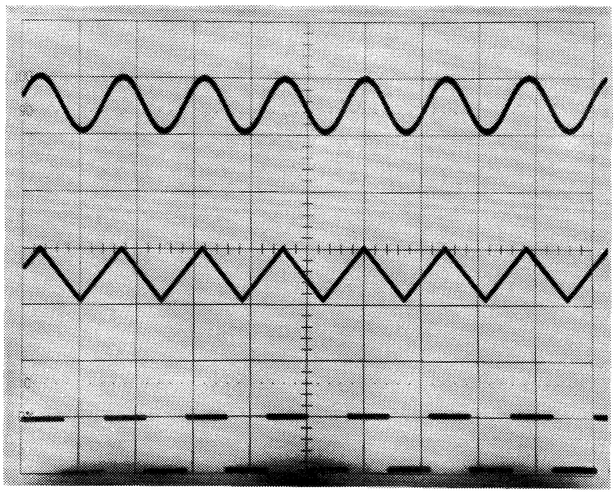
2-4-3 Operation for Triple Trace Observation

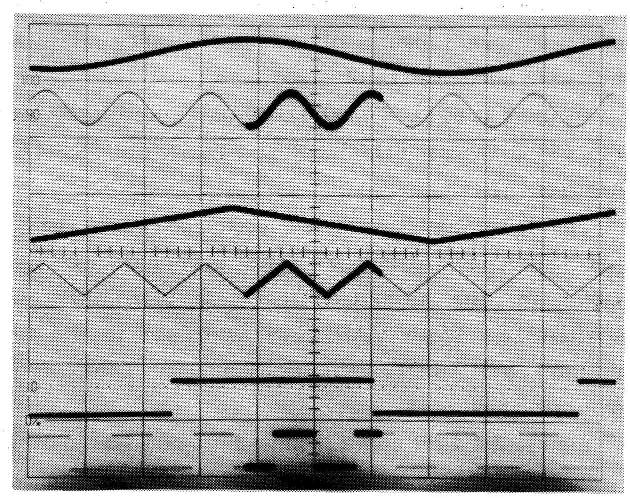
The SS-5705 can display not only two waveforms but three simultaneously on the CRT screen for observation.

When the DUAL and X-Y switches of vertical MODE are pressed, three signals applied to the INPUT connectors for channels 1, 2, and 3 can be simultaneously observed.

When the vertical mode CHOP is selected, triple waveforms are displayed chopped. If the ALT mode is selected, they are displayed alternately. Select the CHOP mode for observing signals that repeat slowly, or the ALT mode for observing signals that repeat fast.

Figure 2-4-3. Triple trace display





2-4-4 Operation as X-Y Scope

The SS-5706 operates as an X-Y scope if the vertical MODE X-Y is selected.

When signals are applied to the INPUT connectors for channels 1 and 2, the signal on channel 1 drives the horizontal axis (X) and the signal on channel 2 drives the vertical axis (Y) to display a Lissajou's figure.

By operating the SS-5706 as an X-Y scope, phase differences, Lissajou's figures of various frequency ratios, and hysteresis curves can be observed.

In using it as an X-Y scope, move the waveforms using the CH 2 vertical POSITION and horizontal POSITION controls.

The deflection factor for the X axis can be adjusted with CH 1 VOLTS/DIV and VARIABLE, and the deflection factor for the Y axis with CH 2 VOLTS/DIV and VARIABLE. When VARIABLE is turned to the CAL position, VOLTS/DIV indications directly represents the deflection factors selected.

Figures 2-4-4-(1) and -(2) show Lissajou's figures of sine waves of different frequencies. As shown, various figures are described depending on the phase difference and frequency ratio. All of them are to be observed still.

Figure 2-4-4-(3) shows examples of Lissajou's figures of different waveforms.

Figure 2-4-4-(1). Lissajou's figures of sine waves

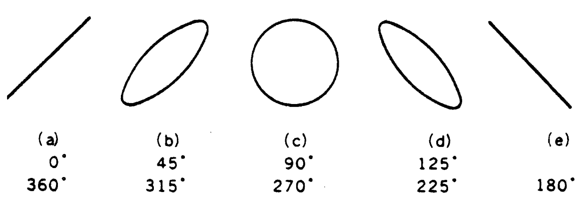


Figure 2-4-4-(2). Lissajou's figures of various frequency ratios

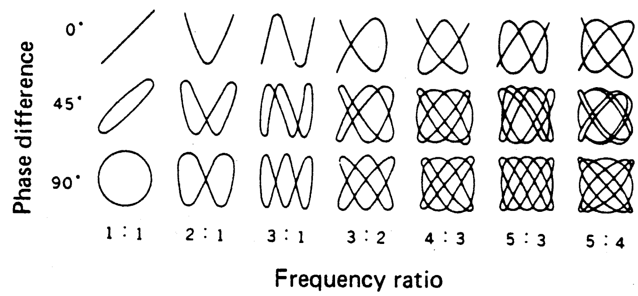
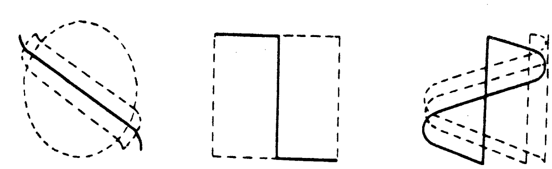


Figure 2-4-4-(3). Lissajou's figures of different waveforms (Frequency ratio: 1 to 1)



(a) Sine wave and triangle wave (b) Sine wave and square wave (c) Sine wave and sawtooth wave

2-4-5 Operation for Single Sweep Observation

Discharge waveforms and other high-speed transient phenomena, such as of relay chattering, are displayed in multiple overlapped waveforms in the normal high-speed repeating sweep mode. If the sweep rate is lowered to display an entire waveform, transient phenomena cannot be observed in detail. If the single sweep function is used, however, transient phenomena can be observed fully magnified in the horizontal axis direction, or recorded by photographing them. (See Figure 2-4-5.)

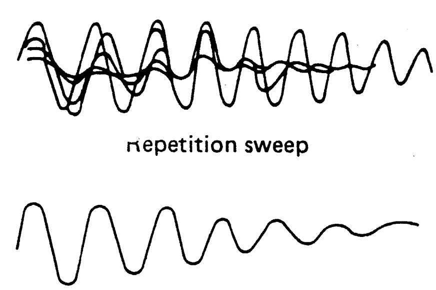
The basic single sweep operation procedure using a calibrated voltage as an input signal is described below.

1. Select the HORIZ DISPLAY mode A and horizontal MODE NORM.
2. Apply a calibrated voltage of 0.3 V to INPUT, using the supplied probe. Set VOLTS/DIV to 5 mV, and confirm proper triggering.
3. Select the horizontal MODE SINGLE, and press SINGLE/RESET so that a single sweep occurs.
4. Disconnect the input signal, and press SINGLE/RESET. Check the lower READY lamp that it lights.

If the READY lamp lights, the device is in a standby state for sweep. It performs a single sweep upon receiving a trigger signal. (The device may not be in a standby state at a point near the center of LEVEL. In that case, slightly turn LEVEL clockwise or counterclockwise.) When a signal is input to the device in this state, a single sweep takes place to properly display a waveform.

This single sweep operation is also possible in the A INTEN sweep and B (DLY'D) sweep modes. It is also possible in the external trigger mode if an external trigger signal is used in the same way as an input signal in the internal trigger mode. A simultaneous single sweep of two waveforms can be made only in the CHOP mode, not in the ALT mode.

Figure 2-4-5. Example of repetition sweep and single sweep waveforms



2-4-6 Operation for Television Signal Observation

The SS-5706 has a television trigger signal separation circuit which allows observation of waveforms of composite television signals. The operation procedure is as follows:

Observation by V trigger signal

1. Set the switches as follows:

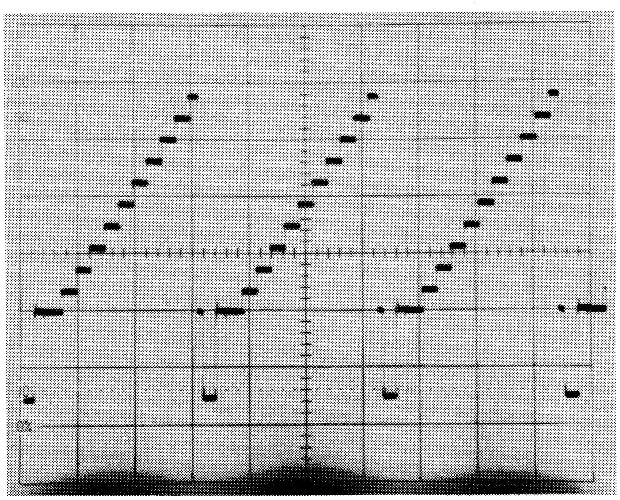
A TIME/DIV:	2 mSEC
HORIZ DISPLAY:	A
Vertical MODE:	CH 1 or CH2 (whichever a signal is applied to)
COUPLING:	TV
SOURCE: (Internal Trigger)	CH 1 or CH 2 (whichever a signal is applied to)
(External Trigger)	CH 3. Apply a signal to the INPUT connector for this channel.

2. Apply a composite television signal to channel 1/2 or channel 3.
3. Set VOLTS/DIV so that the trigger signal appears one division amplitude or more on the CRT screen.
4. Select the horizontal MODE of AUTO or NORM.
5. Turn SLOPE to the + position if the trigger signal is positive, or to the – position if it is negative.

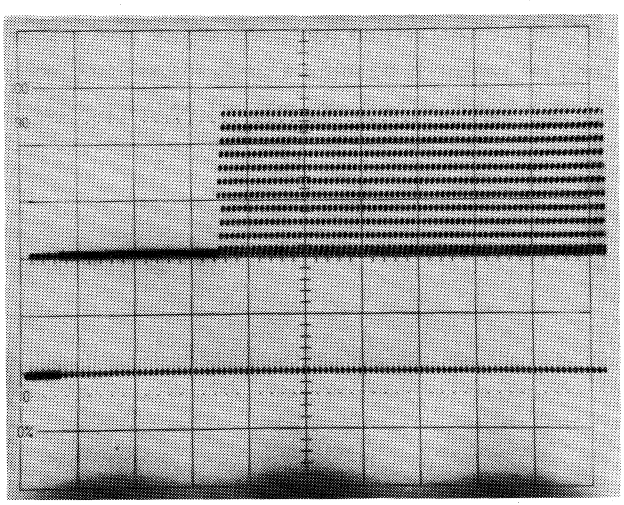
Observation by H trigger signal

1. In continuation of the above operations, select the HORIZ DISPLAY mode of A INTEN.
2. Set B TIME/DIV to 10 μSEC.
3. Set DELAY TIME to a point where the H trigger signal can be observed.
4. Select the HORIZ DISPLAY mode of B (DLY'D), and the desired magnification ratio with a TIME/DIV.
5. Press the TRIG'D – RUNS AFTER DELAY switch to the TRG'D position for stabilized triggering.

Figure 2-4-6. Television signal observation



(1) Example of observation of V trigger signal and video signal



(2) Example of observation of H trigger signal and video signal

2-4-7 Operation for Waveform Magnification

Part of the waveform displayed on the CRT screen can be magnified timewise (in the horizontal axis direction) for detailed observation in the following three ways.

- o Raising the sweep rate.
- o Magnifying by use of the function.
- o Magnifying by use of the delayed sweep function.

Each of these is described in detail below.

Raising the sweep rate

Select a high sweep rate for magnified observation of the tip of the waveform. Remember, however, that a high sweep rate moves the center and end of the waveform out of the CRT screen so they cannot be observed. In such a case, use the MAG function described below.

Waveform magnification by the MAG function

The MAG function is mainly used for magnifying the center or end part of the waveform displayed on the CRT screen.

As described in 2-3-9, move the desired part of the waveform to be magnified to the center of the screen with ↔ POSITION, and pull ↔ POSITION (PULL x5 MAG) so that the desired part of the waveform is magnified five times from the center of the CRT screen to the right and left. The trace length at this time is about ten divisions on the CRT screen, but is actually about 50 divisions. The trace can be observed full length by use of ↔ POSITION.

This method is simple, but the magnification ratio is limited to 1 to 5. The sweep rate for a magnified waveform is the value indicated by TIME/DIV multiplied by 1/5. The maximum sweep rate for magnified observation is 0.1 μs/division x 1/5 = 20 ns/division, as compared with the maximum sweep rate for non-magnified observation which is 0.1 μs/division.

Waveform magnification by the delayed sweep function

The above magnification method has the advantages of simple operation and raising the sweep rate by five times the value indicated by TIME/DIV, but the magnification ratio is limited to 1 to 5.

The delayed sweep function permits magnification of any part of the waveform displayed on the CRT screen by a value dependent on the A-sweep to B-sweep ratio:

$$\frac{\text{A TIME/DIV (SEC/div)}}{\text{B TIME/DIV (SEC/div).}}$$

This magnification method, however, is subject to limitation depending on the input signal frequency. In other words, if an input signal has a high frequency and if A TIME/DIV is at the highest rate position before magnifying the waveform, it cannot be magnified any more. Therefore, the delayed sweep magnification method is suitable to magnifying input signals of relatively low frequency for observing any desired parts of them.

This method comes in two types: RUNS AFTER DELAY and TRIG'D. (For detailed information, see 2-3-8.)

Figure 2-4-8-(1). Examples of A INTEN sweep and B sweep by TRACE SEPARATION

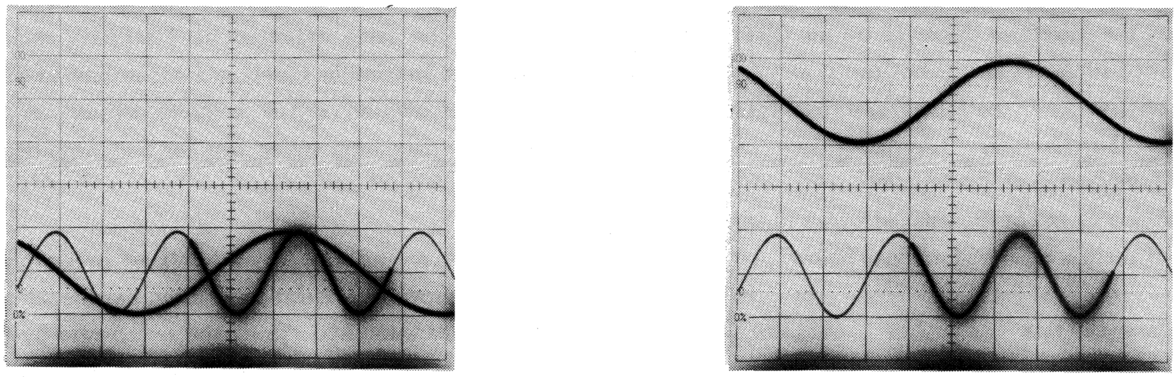
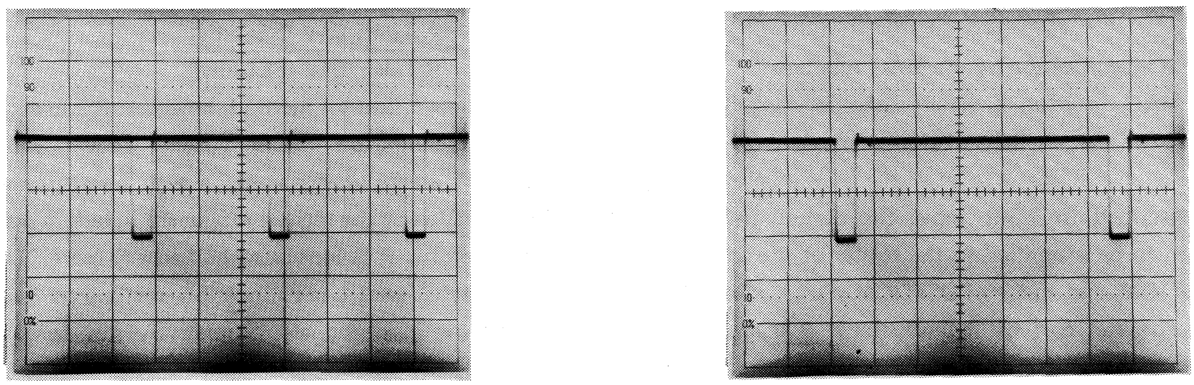


Figure 2-4-8-(2). Examples of the same waveformed displayed in RUNS AFTER DELAY and TRIG'D modes



Example of display in RUNS AFTER DELAY mode

Example of display in TRIG'D mode

2-4-9 External Intensity Modulation

In addition to the vertical (Y) axis and horizontal (X) aixs, the Z axis is used for displaying signals to be measured. The SS-5705 is so designed that the intensity of the waveform displayed on the CRT screen can be changed by applying an input signal from Z AXIS INPUT on the rear panel to the CRT circuit. Intensity modulation of an intermediate level can be obtained by applying a signal not high enough to completely erase the displayed waveform.

A negative signal increases the intensity, and a positive signal decreases it. An input voltage of 3 Vp-p produces a signal amplitude at which intensity modulation can be observed, provided that the intensity setting is correct. The effect input frequency range is from DC to 3 MHz, and the maximum input voltage is 50 V (DC + peak AC).

A time reference for displayed waveforms can be obtained by applying a time marker to Z AXIS INPUT. The time relationships of displayed waveforms observed at a non-calibrated sweep rate can be measured using this time marker.

Figure 2-4-9. Example of intensity modulation display