1. FEATURES

The L-212,L-5040,L-5060,L-50100 is a portable-type, advanced-class oscilloscope with a bandwidth of DC to 20Mhz-100MHz designed with the emphasis on operability and portability and has a following features.

(1) Wide bandwidth:

The instrument has a bandwidth from DC to 20MHz-100MHz.

(2) High sensitivity:

Sensitivity is 1 mV/div

(3) Large 6// screen:

Employment of a large square CRT makes waveforms easier to observe.

(4) Internal graticule

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

(5) DCOFFSET: (L-5040, L-5060, L-50100 only)

Allows a proportionate observation of any part of an input waveform even when it is in a large amplitude.

(6) ALTMAG (L-5040, L-5060, L-50100 only)

Allows simultaneous observation of X1 and X10 sweeping waveforms.

(7) ALT TRIG

Even an observation of two waveforms of different frequncies, the waveform of the each cannel is stably triggered.

(8) TV synchronization:

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

(9) Auto focusing:

Focusing shift is automatically corrected.

2. ACCESSORIES

This instrument is shipped with the following standard accessories.

2 Probes

L-5040: AT-10AK 1.5

L-212: AT-10AR 1.5

1 AC power supply cord

1 Operation manual

In case of (EM) TYPE: Without Probes

3. PRECAUTIONS

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

Installation site

***** Avoid installing instrument in an extremely hot or cold place.

1. 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.
2. The operating maximum ambient temperature is +40℃.

***** Do not use instrument that has been left outdoors on a cold winter day.

The operating ambient temperature is 0℃ 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 intrusion of water may also cause troubles, do not place a water-filled container 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 vibration violently. Since the oscilloscope is a precision instrument, excessively strong vibration may cause damage.

***** do not place the instrument near a magnet or magnetic body. An oscilloscope is equipment using electron beam. Therefore, do not bring a magnet close to the instrument or do not use the instrument near equipment generating strong magnetic force.

Handling

***** Do not pit a heavy objects on the oscilloscope.

Do not block the ventilation holes.

***** Do not apply a heavy shock to the oscilloscope.

***** Do not insert a wire, pin, etc. through the ventilation hole.

Do not drag the set, leaving the probe attached to it.

Do not leave a hot soldering iron on the cabinet or the screen.

Do not try to turn the instrument upside down. Otherwise, knobs may be broken.

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

When operation is faulty

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

Care and repair

Removal of stain from the case.

When the outside of the case is stained, remove the stain by first wiping it lightly with a cloth moistened with neutral washing agent and then wipe the surface with a dry cloth.

Never use strongly volatile agent such as benzene and thinner.

1. When the panel surface is stained, remove the stain in similar way with a clean, soft cloth. When heavy stains are present, first remove the stains by wiping the surface lightly with a cloth moistened with diluted neutral washing agent or with alcohol and then wipe thoroughly with a dry cloth.
2. When dust has accumulated on the inside, remove it by using dry brush, or by using the exhaust of a compressor or a vacuum cleaner. By a SERVICE PERSONNEL.

NOTE: When opening the case, pull out the power supply plus beforehand without fail. When cleaning the inside, insure beforehand that no electricity remains in the condensers of the power supply circuit." **NOT FOR AN OPERATOR**"

Operation

Prior to shipment, the voltage selector is set property. When the oscilloscope is intended to be used on a different voltage, relocate the voltage selector in the procedures which follow.

1) Disconnect the power connector.
2) Insert a screwdriver into the right side or cap and remove the fuse holder cap.
3) Mount the fuse holder cap in to the fuse holder so that the marking of the correct voltage faces up.
4) Connect the power connector.

***** 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 not apply an excessive voltage.**

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

INPUT direct,	300V (DC+AC peak at 1 KHz)
When×10 probe is used	400V (DC+AC peak at 1 KHz)
When×1 probe is used	300V (DC+AC peak at 1 KHz)
EXT TRIG INPUT	300V (DC+AC peak)
EXT BLANKING	30V (DC+AC peak)

Calibration Interval

To maintain instrument accuracy, performs the calibration of the L-212, L-5040, L-5060, and L-50100 at least every 1000 hours of operation, or every month if used infrequently.

4. CONTROLS AND CONNECTORS

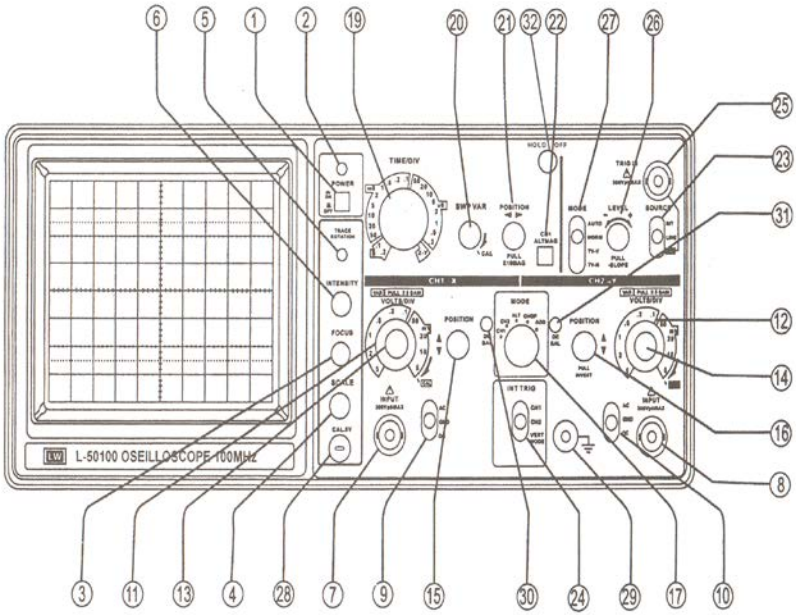


Fig.4-1L - 50100/5060 Front View

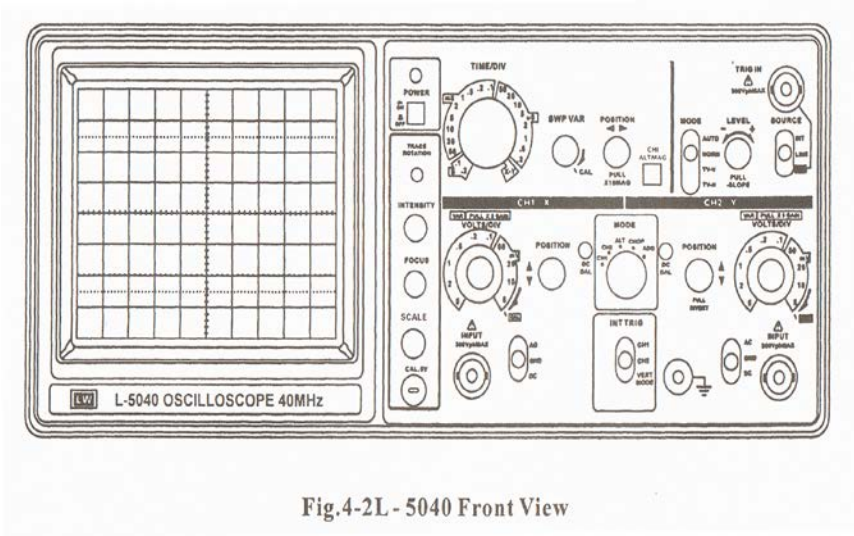


Fig.4-2L - 5040 Front View

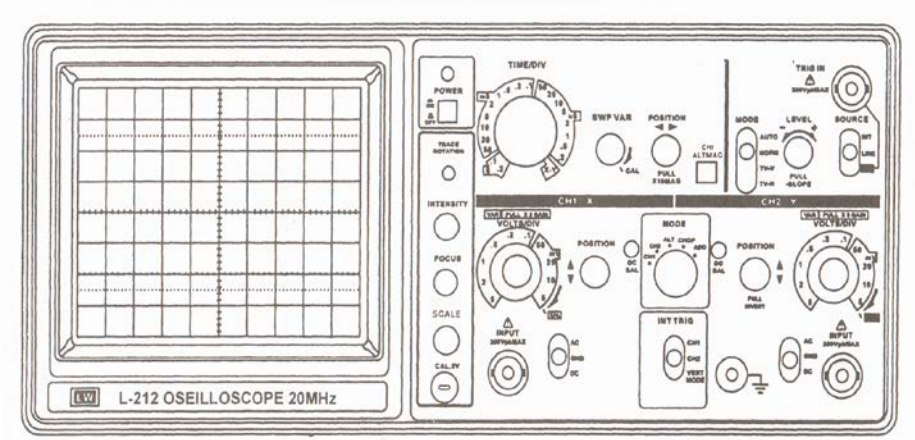


Fig.4-3L - 212 Front View

① **POWER switch**

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

② **POWRR lamp**

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

③ **FOCUS control**

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

④ **SCALE ILLUM control (L-5040,L-5060,-50100 only)**

Controls graticule illumination. Useful to illuminate the graticule when viewing in a dark area, photographing.

⑤ **TRACE ROTATION control**

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

⑥ **INTEN sity control**

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

⑦ **CH1 INPUT connector**

BNC connector for vertical axis input.

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

⑧ **CH2 INPUT connector**

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

⑨ ⑩ Input coupling switches (AC-GND-DC)

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

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

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

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

12 VOLTS/DIV select switches

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

Multiply the3 reading by 10 when the 10:1 probe is used in combination with the instrument.

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

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

⑮ POSITION controls
PULLDCOFFSET (L-5040,L-5060,L-50100 only)

This knob used to adjusting the position of the vertical axis.

The image rises with the clockwise rotation of this knob and falls with the counterclockwise rotation.

When the knob is pulled up, the adjustment range of the trace position of the vertical axis can be magnified by the DC OFFSET function. Therefore, the peak value of an input waveform with large amplitude can be measured. (Keep pushed-in for the normal operation.)

⑯ POSITION control
PULL INVERT

The same as CH1, but when the knob is as PULL position (pulled up state), this is used to inverse the polarity of the input signal applied to CH2.

This control is conveniently used in the comparison of two waveforms having different polarity or in the observation of the waveform of the difference signal (CH1)-(CH2) between CH1 and CH2 using ADD

⑰ MODE select switch

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

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

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

ALT signals applied respectively to CH1 and CH2 appear on the screen alternatively at each sweep.

This setting is used the sweep time is short in-2-channel observation.

CHOP At this setting the input signals applied respecting to CH1 and CH2 are switched at about 250 KHz independent of the sweep and at the same time appear on the screen.

This setting is used when the sweep time is long in 2-channel observation.

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

⑱ DC BAL adjustment controls

There are used for the ATT balance adjustment.

See8. ADJUSTMENTS . . for the details.

(3) Controls of horizontal deflection system

⑲ TIME/DIV select switch

Sweep time ranges are 19 steps from 0.2 us/div to 0.2s/div.

X-Y This position is used when using the instrument as an X-Y oscilloscope.

In this position the X (horizontal) signal is connected to the input of CH1; The Y (vertical) signal is applied to the input of CH2 and has a deflection range from less than one millivolt to 5 volts/div at a reduced band-wide of 500 KHz.

⑳ SWP VARiable control

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

TIME/DIV of sweep can be varied continuously when shaft is out of CAL position. Then the control is rotated in the direction of arrow to the full, the CAL state is produced and the sweep time is calibrated to the value indicated by TIME/DIV. Counterclockwise rotation to the full delays the sweep by 2.5 times or more.

㉑ POSITION PULL × 10 MAG control

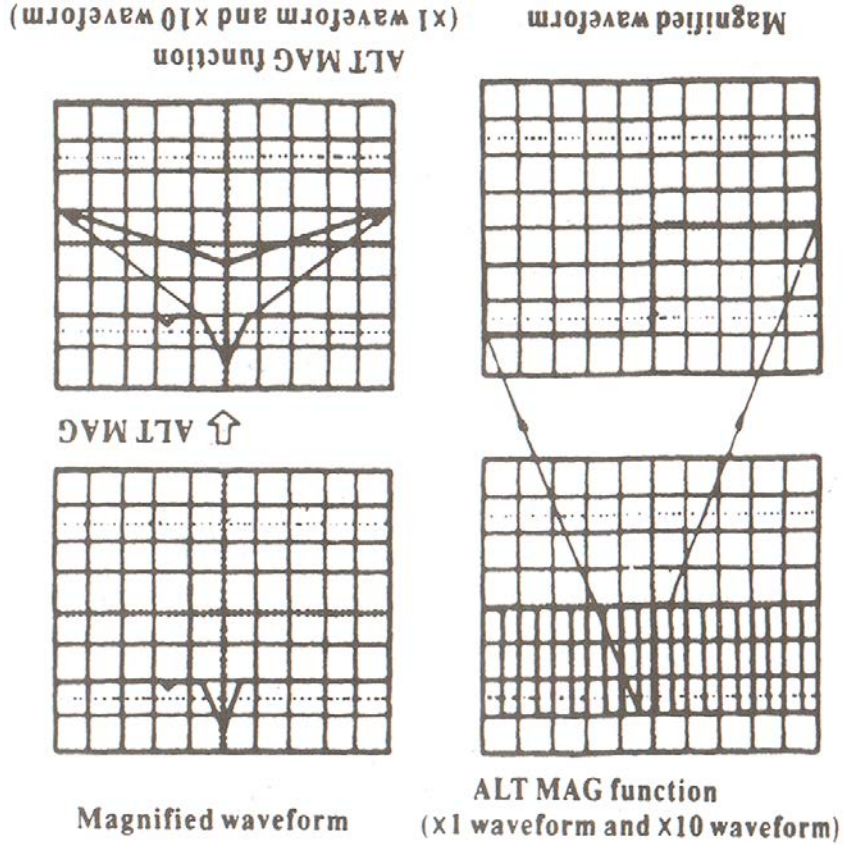
This knob is used to move the bright line in horizontal directions. It is indispensable in the measurement of the time of waveform.

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

Sweep is magnified 10 times by pulling out knob of POSITION. In this case the sweep times is 1/10 of the waveform indicated by TIME/DIV. Bring the position of the

Waveform desired to be magnified observed to the outer of the scale by operating

◀▶ POSITION of the horizontal axis. Next, switch ×10 MAG switch to PULL (pulled out state). Then the waveform placed at the center is magnified in right and left directions. The sweep time in this case is 10 times the sweep speed obtained by TIME/DIV, in other words, the reading is 1/10 of the sweep time



indicated.

㉒ CH1 ALT MAG (L-5040, L-5060, L-50100 only)

CH1 input signal is displayed alternately by each single sweep of ×1 (NORM) and × 10(MAG).

○ Set the wished portion of the waveform to the screen center for magnification.

○ The ×10 waveform, appears 3 divisions below the ×1 waveform.

(4) Synchronization system

㉓ SOUKCE select switch

This switch is used to select the triggering signal source sweep.

INT The input signal applied to CH1 or CH2 becomes the triggering signal.

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

EXT External triggering signal applied to TRIG INPUT becomes the triggering signal.

㉔ INT TRIG select switch

This switch is used to select the internal triggering signal source sweep.

CH1 The input signalk applied to CH1 becomes the triggering signal.

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

VERT MODE

For observing two waveforms, the sync signal changes alternately corresponding to the signals on CH1 and CH2 to trigger the signal.

㉕ TRIG INPUT connector

Input terminal for use for external triggering signal of sweep.

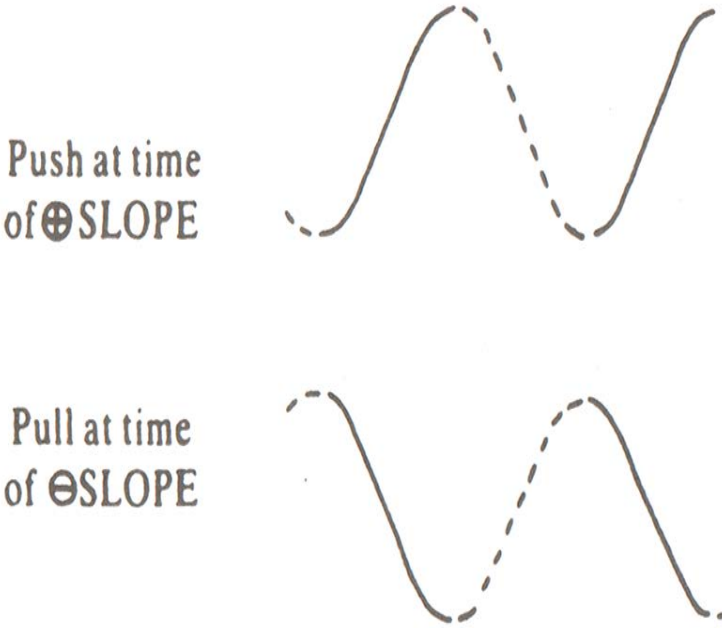
㉖ TRIG LEVEL control

This knob is used to decide at which portion of the waveform the sweep should be started by setting trigger level.

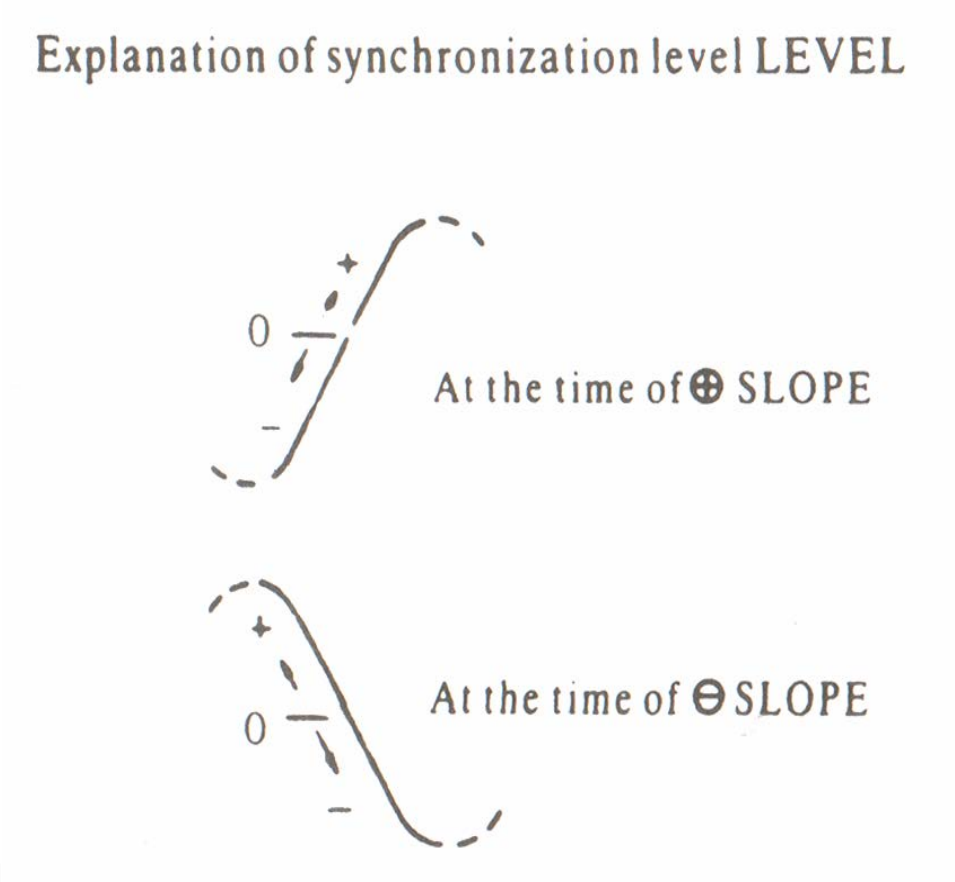
This knob is also enabled to switch SLOPE.

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

Explanation of synchronization polarity SLOVE



Explanation of synchronization



level

(27) **TRIG MODE select switch**

AUTO The instrument is brought into automatically triggering sweep in which sweep is always conducted.

In the presence of triggered signal, normal triggered sweep is obtained and the waveform stands still. In the case of no signal or out of triggering, sweep line will appear automatically.

This setting is convenient in usual cases.

NORM Triggered sweep is obtained and sweep is conducted only when triggering is effected. No sweep line will appear in the case of no signal or out of synchronization to a very low frequency signal (25Hz or Less).

TV (V) This setting is used when observing the entire vertical picture of television signal.

TV (H) This setting is used when observing the entire vertical picture of television signal.

(NOTE) Both TV V and TV H synchronize only when the synchronizing signal is negative.

(5) Miscellaneous

㉘ **CAL 0.56V tip**

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

㉙ GND terminal

Earth terminal of oscilloscope

5. HOW TO PRODUCE THE BRIGHT LINE

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

POWER	**OFF**
INTEN	**Counterclockwise to the full**
FOCUS	**Midrange**
AC-GND-DC	**GND**
▲▼**POSITION**	**Midrange (the knob is in the depressed)**
V. MODE	**CH1**
TRIG	**AUTO**
TRIG SOURCE	**INT**
INT TRIG	**CH1**
TIME/DIV	**0.5 ms/div**

◀▶ POSITION	**Midrange**

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

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

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

NOTE

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

VARIABLE	Rotate in the direction of arrow. In this case the VOLTS/DIV is calibrated to its indicating value.
SWP VAR	Leave the knob in depressed state. In this case the 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 slight by the effect of earth magnetism. In this case, bring the bright line until it lies on the horizontal scale line at the center of the screen by properly adjusting the semi-fixed variable resistor TRACE ROTATION on the front panel.

GENERAL MEASUREMENT

(1) In the case of observing a single waveform.

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

MODE switch of Vertical defection system CH1

MODE switch of TRIG AUTO

TRIG SOURCE INT

INT TRIG CH1

Under these setting almost all the repetitive signals of about 25Hz or more applied to CH1

can be synchronized 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 input coupling switch is at GND position. This means that the measurement of DC voltage can be measured. The following switching is needed when observing low frequency signals of about 25Hz or less.

MODE of TRIG NORM

Synchronization can be effected by operating LEVER knob under this setting.

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

MODE switch of Vertical Axis CH2

TRIG SOURCE INT

INT TRIG CH2

(2) When observing two waveforms

Observation of two waveforms can be made easily by setting the MODE switch of vertical axis to ALT or CHOP.

When observing two waveforms of high repetition frequencies set the MODE switch to ALT and, in the case of low frequencies, set it to CHOP.

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

6. METHOD FOR CONNECTING SIGNALS

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

(1) When using a probe

Use the attached probe when measuring a high frequency wave with high accuracy.

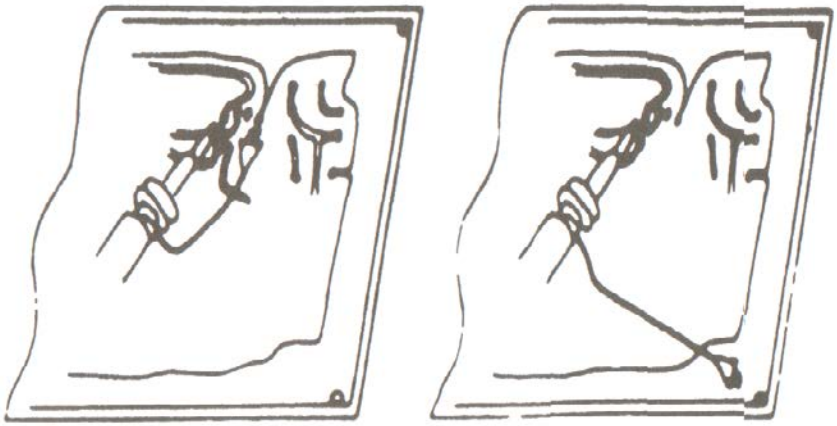
It should be noted, however, that since the input signal is attenuated by this probe to 1/10 before it is input to the oscilloscope the use of the probe is disadvantageous for low signals, and that at the same time the measuring range is extended by that amount for high signals.

< CAUTIONS>

○ Do not apply a signal which exceed 400V (DC+ peak AC at 1KHz)

○ Bring the grounding point of the earth lead wire of the probe close to the point to be measured when measuring a rapid rising signal or a high frequency signak. Long earth lead wire may cause waveform distorions such as ringing and overshoot.

Connection of earth lead wire



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

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

○ Multiply the reading of VOLTS/DIV by 10.

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

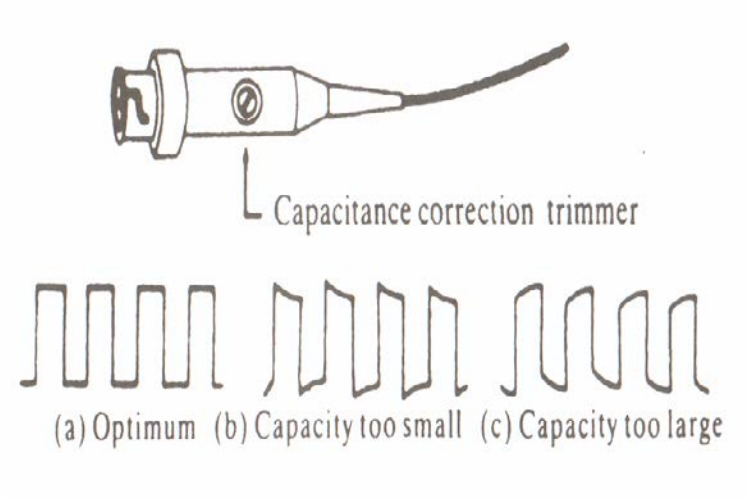
500mV/div×10=500mV/div

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

Connect the tip of the probe to the output terminal CAL 0.5V of 1 KHz calibration square wave voltage.

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

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



(2) At time of direct connection

When connecting a signal directly to the oscilloscope not using the attached probe (10.1), pay attention to the following points in order to minimize the measurement error.

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

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

This measurement error can not be ignored even in low frequency region.

In general, it is safe to avoid measuring with non-shielded connecting wire. When using a shielding wire connect one end of the shied to the earth terminal of the oscilloscope and the other end to grounding of the circuit to be measured. It is desirable to use a coaxial cable with BNC type connector.

The following cautions must be observed when performing a wide band measurement. It is necessary to terminate with the characteristic impedance of the cable when measuring a rapid rising waveform or a high frequency wave.

Especially when using a long cable, the absence of a terminating resistor will necessarily lead to a measurement error derived from ringing phenomenon. Some measuring circuits require a terminating resistor equal to the characteristic impedance of the cable also on the measurement terminal side.

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

○In order to perform measurement with the measuring circuit put in proper operating state it is sometimes necessary to terminate the cable with an impedance which corresponds to the circuit to be measured.

○ The stray capacity of the shield wire must be taken into account when performing measurement with a long shield wire. Since the shield wire normally in use has a capacity of about 100pF/per meter, its effect on the circuit to be measured can not be ignored. Use a probe to minimize the effection the circuit.

When the length of the shield wire used or when the length of the non-terminated cable reaches1/4 wave length or its multiples within the band of V-522[V-525] type (1/4 wavelength is about 1.2 meter [about 3 meter])when using a coaxial cable at 50MHz [20MHz], oscillation may be caused near 5mV/DIV range.

This is caused by the resonance between the externally connected high-Q inductance and the input capacity and can be avoided by reducing the Q.

Connect the cable or shield wire to the input connector by ways of a serially connected 100Ω to 1KΩ resistor, or perform measurement at/ other VOLTS/DIV rang.

(3) When observing waveform with X-Y

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

Each input is applied to the instrument as follows.

X-axis signal (horizontal axis signal) CH1 INPUT

Y-axis signal (vertical axis signal) CH2 INPUT

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

7. MEASURING PROCEDURE

The first things to do are as follows.

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

○ Display the waveform as large as possible to minimize the read error.

○ check the capacity correction when using a probe.

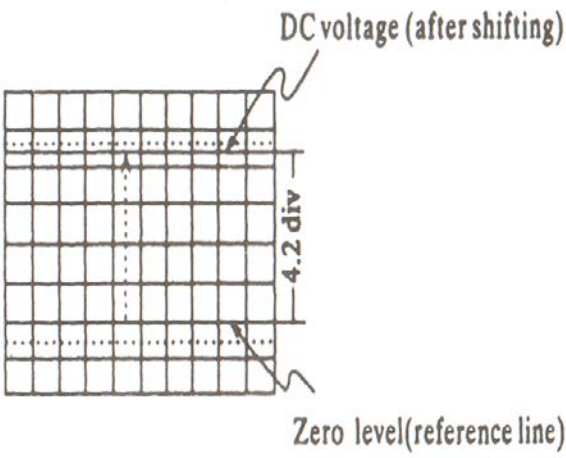
(Refer to paragraph (1)”when using a probe” of Section 6.” Method for connecting signals” for the method for correcting capacity.)

(1) DC voltage measurement

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

Set VOLTS/DIV appropriately and set AC-GVD-DC to DC. Since the bright line shifts

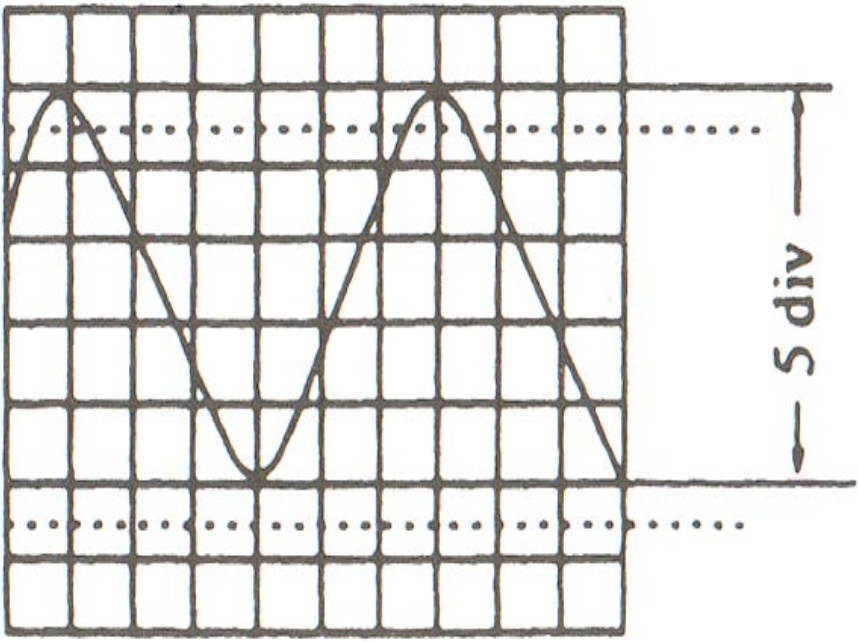
here by the amount of DC voltage, the DC voltage of the signal can be obtained by multiplying the shift width bu the indicated value of VOLTS/DIV. When VOLTS/DIV is 50 mV/DIV, then 50mV/div×4.2×10=2.1V.)



(2) AC voltage measurement

The same as paragraph 7(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 is follows, VOLTS/DIV is 1V/DIV, 1V/div×5=5V_{p-p} (50V_{p-p} at time using the probe (10:1). When magnifying and observing a small-amplitude signal, superimposing on a high DC voltage, set input coupling of AC. The DC voltage is cut off and AC voltage can be observed by increasing sensitivity.



(3) Measurement of frequency and period

This will be explained 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 screen.

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

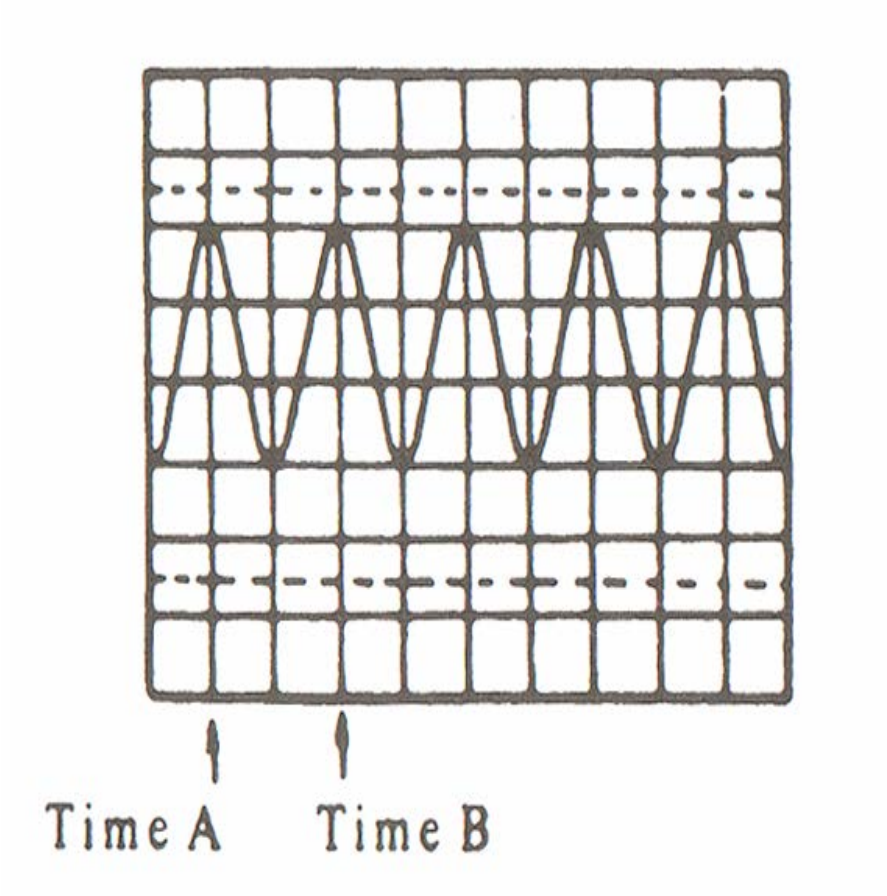
$1\text{ms/div} \times 2.0 = 2.0\text{ms}$

$= 2.0 \times 10^{-3}\text{s}$

Accordingly, the frequency is

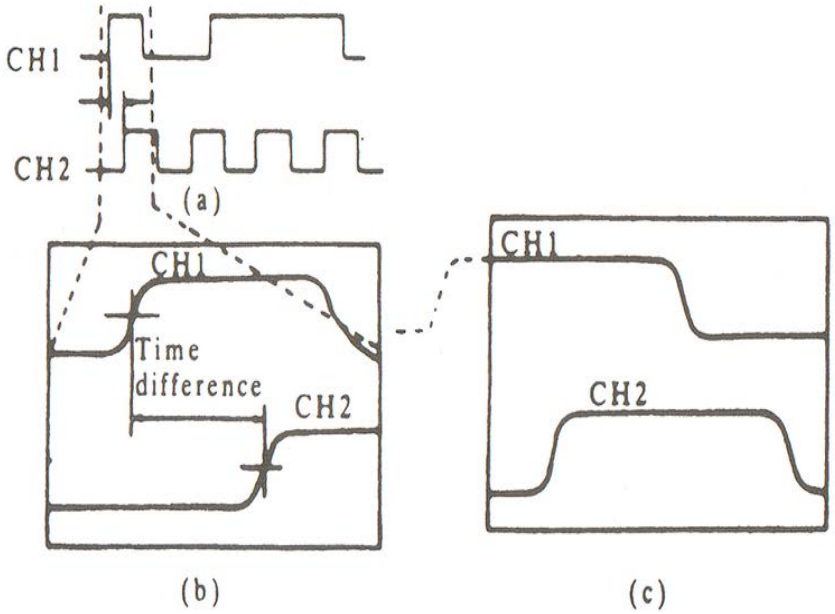
$1/(2.0 \times 10^{-3}\text{s}) = 500\text{Hz}$

(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

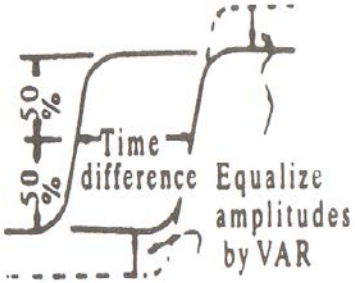
Triggering signal source" SOURCE" is selected as offering reference signal when measuring the time difference between two signals. Assume that pulse trains as shown in (a). Then (b) shows the case when CH1 is taken as the triggering signal source and (c) the case where CH2 is taken.



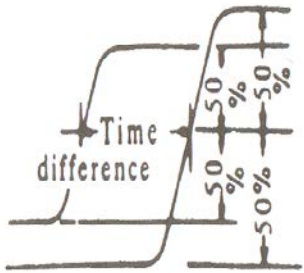
This means that CH1 is used as the triggering signal when investigating the length of time by which the signal of CH2 is delayed from the signal of CH1. CH2 is used in the reversed case. In other words, the signal leading in phase is selected as the triggering signal source.

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



(a)Equal amplitude measuring method



(b)Superposition measuring method

<CAUTIONS>

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

(5) Measurement of rise (fall) time

To measure the rise time pay attention not only to the abovementioned items but also to measurement error.

The following 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.

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

When the rise time of the pulse going to be measured is sufficiently, longer than the rise time of the oscilloscope (7ns in our case), the effect of the rise time of the oscilloscope on the measurement can be neglected. However, if both are close to each other, measurement error may be caused.

The true rise time is given by

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

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

$f_c \times tr = 0.35$

Where, f_c: Frequncy band (Hz)

tr : Rise time (s)

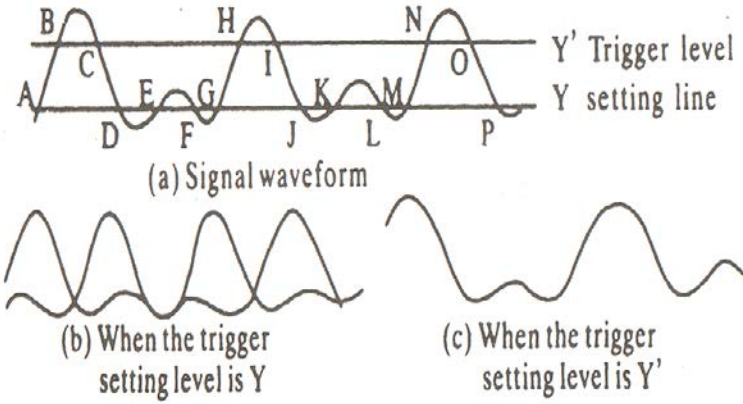
The rise time and fall time are determined by the time elapsed between the 10% to 90% values of pulse width.

This oscilloscope is provided with graduations for 0%, 10%, 90%, and 100% on the screen, which facilitate measurement.

(6) Synchronization 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 advaneing to B,C,D,E,F,G,H,I…, will appear alternately, on the screen. They will be doubled as shown in Fig.(b), for which no synchronization can be taken.

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 brand and advances to C,E,F,…and which allows synchronization.



Synchronization of complexed waveform

(7) Synchronization of observing two waveforms

① When two signals of CH1 and CH2 have same frequencies or the frequencies of an integral number or the frequencies in a relation of a specific time difference, the INT TRIG switch selects either CH1 or CH2 as a reference signal. CH1 position selects CH1 signal as a reference, and CH2 position selects CH2 signal.

② For an observation of signals of different frequencies, set the INT TRIG switch to the VERT MODE. The sync signal switched at each alternation of channels, and the waveform of the each channel is stably triggered.

SELECTION OF A TRIGGER SOURCE ON THE VERT MODE

A. Trigger signal is obtained in the following steps.

1) Set the source switch (31) to INT.

2) Set the INT TRIG switch (32) to VERT MODE.

3) Select the MODE switch (21)

Table 1.

Relation of trigger signal sources and switched.

SOURCE		INT			LINE	EXT
INT TRIG		CH1	CH2	VERT MODE		
V MODE	CH1	CH1	CH2	CH1	Line	External
	CH2	CH1	CH2	CH2		
	ALT	CH1	CH2	CH1CH2(ALT)		
	CHOP	CH1	CH2	ADD		
	ADD	CH1	CH2	ADD		

When the SOURCE switch to INT, INT TRG switch to VERT MODE, and MODE switch to

ALT, the input signals applied to CH1 and CH2 become trigger source alternatively at each sweep. Consequently, even for an observation of two waveforms of different frequencies, the waveform of the each channel is stably triggered.

In this case, the signal should be applied to both CH1 and CH2, and the two signals have the same level portion in excess of the rated amplitude each other. There should be a common portion of levels available that is above the rated amplitude of CH1and CH2.

When a sine wave is applied to CH1 and a square wave is applied to CH2, “A” is in Fig.1 are the levels possible for synchronization.

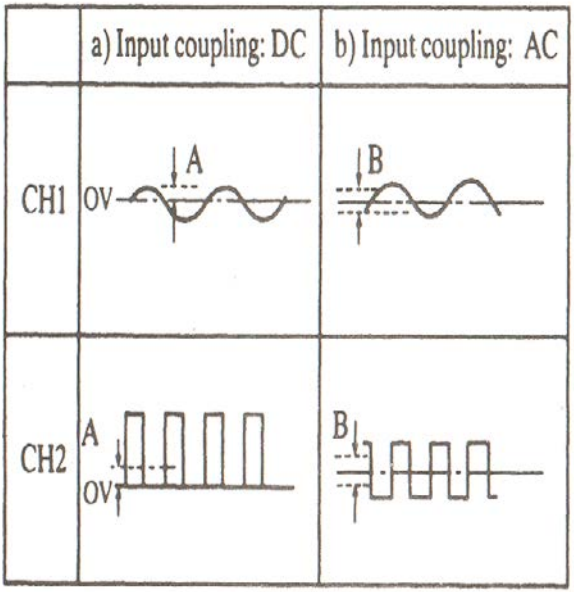


Fig. 1

In order to expand the synchronization range, AC coupling is applied to the CH2 side.

When either the CH1 or CH2 input signal is smaller as shown in Fig.2, adjust the VOLTS/DIV switches ⑬ and ⑭ to obtain sufficient amplitudes.

The VERT MODE triggering requires 1.5 div more than the amplitude required for an observation of CH1 or CH2.

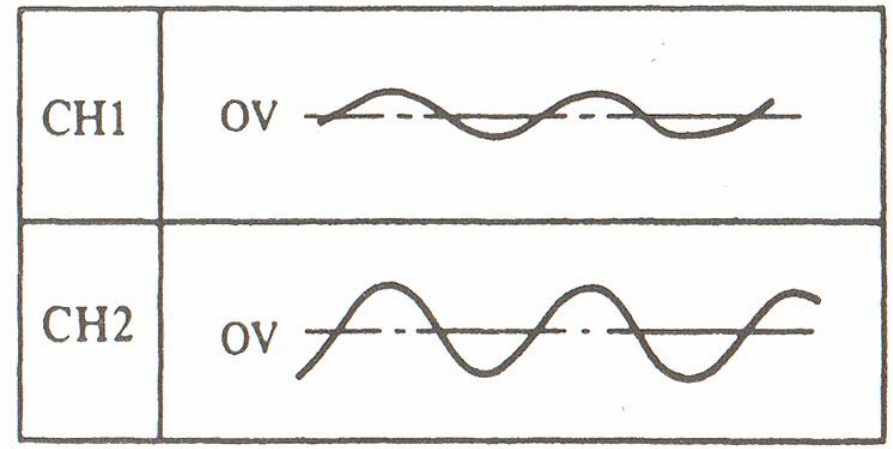


Fig. 2

The VERT MODE triggering is not possible when the signal is applied to only one channel as illustrated on Fig.3.

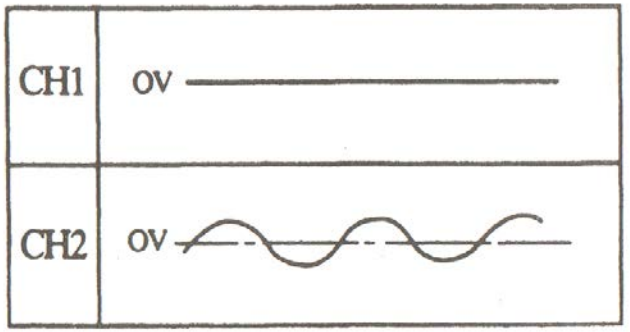


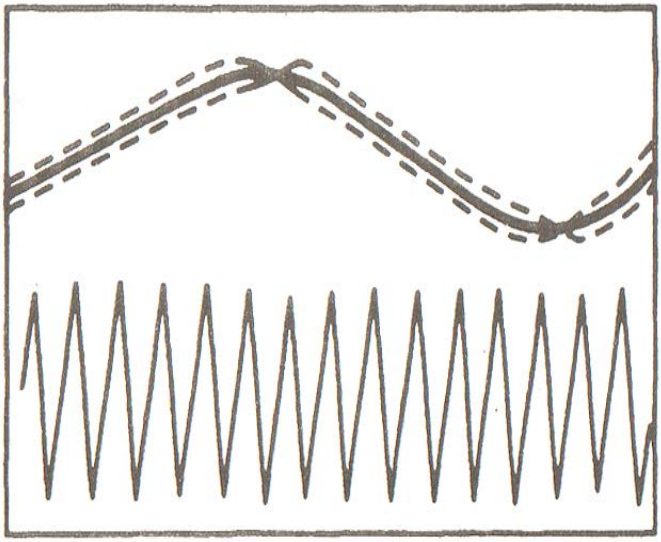
Fig.3

Caution: Do not use the INT TRIG to the VERT MODE when

VAR
PULL × 5 GAIN ⑮ and /or ⑯ are in the pulled out position (×5 GAIN mode).

ALTERNATE TRIGGER

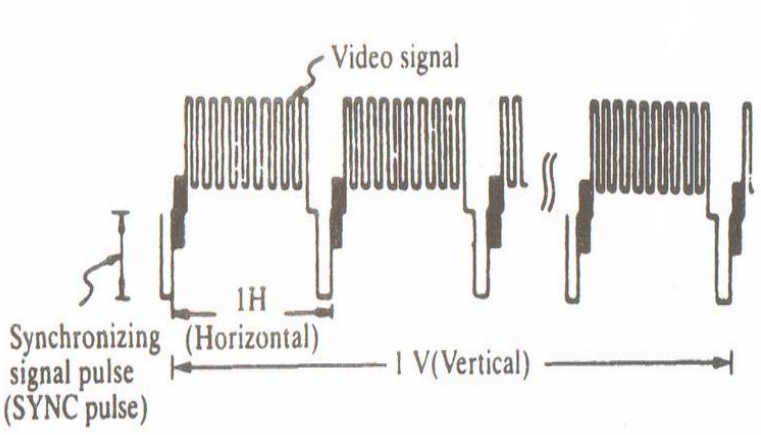
Jittering wave as shown below may appear on the screen when a gently-sloping signal is displayed by approximately 10 cycles or less. With the VER MODE for the INT TRIG switch and the ALT position for the MODE select switch. For detailed and clear observation of each signal, set the MODE select switch to the CH1 or CH2.



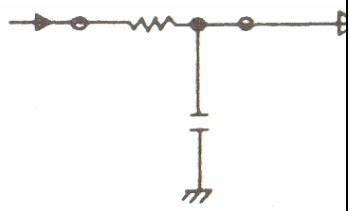
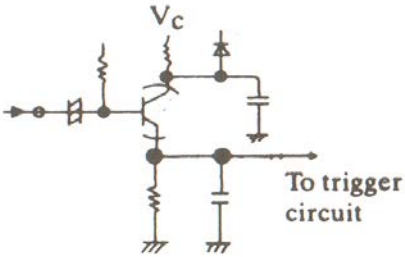
(8) How to use TV exclusive synchronization

① On the image waveform of TV

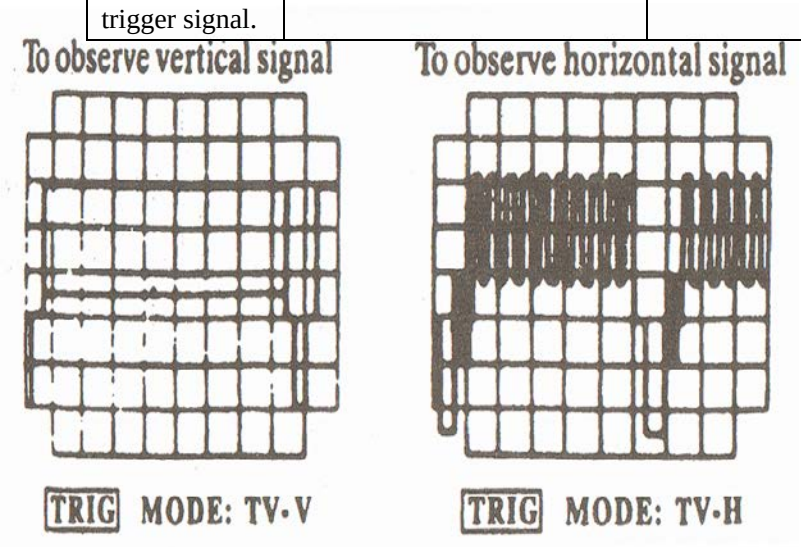
In the work concerned with TV, complexed signals containing video signal, blanking pedestal signal, and synchronizing signal are often measured. However, since the waveform is complexed, a special circuit is needed to effect a stable synchronization with vertical waveform.



② **Difference in the circuits**

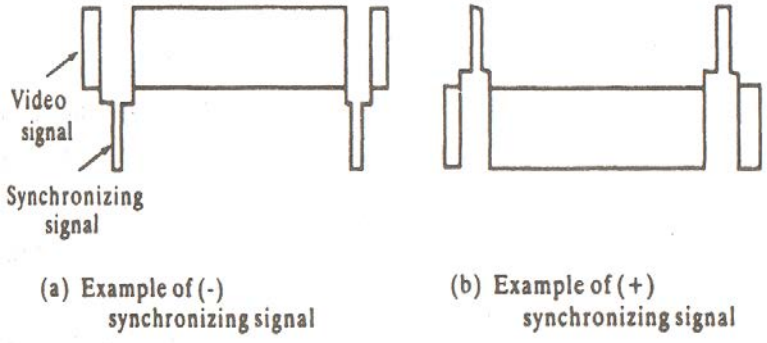
Exclusive circuit for conventional oscillograph		Exclusive circuit for this instrument (Principe drawing)
General circuit	Simple synchronizing circuit	TV exclusive synchronizing separator circuit
Video signal To trigger circuit 	To trigger circuit 	
Hard to synchronize, because video	Synchronization is more easily affected than in the circuit shown at left, because	Stable synchronization is obtained since SYNC pulse is pich\ked up. Amplified, and then integrated to

③ Operation	signal is applied directly as trigger signal.	the signal is integrated to remove high frequency components.	remove high frequency components.



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

(REFERENCE)



(9)DC OFFSET (L-5040, L-5060, L-50100 only)

The oscilloscope provides the DC offset voltage display or ± 1 to ± 100V according to the range.

An output terminal for voltage reading. (Except: × 5 GAIN, out of CAL)

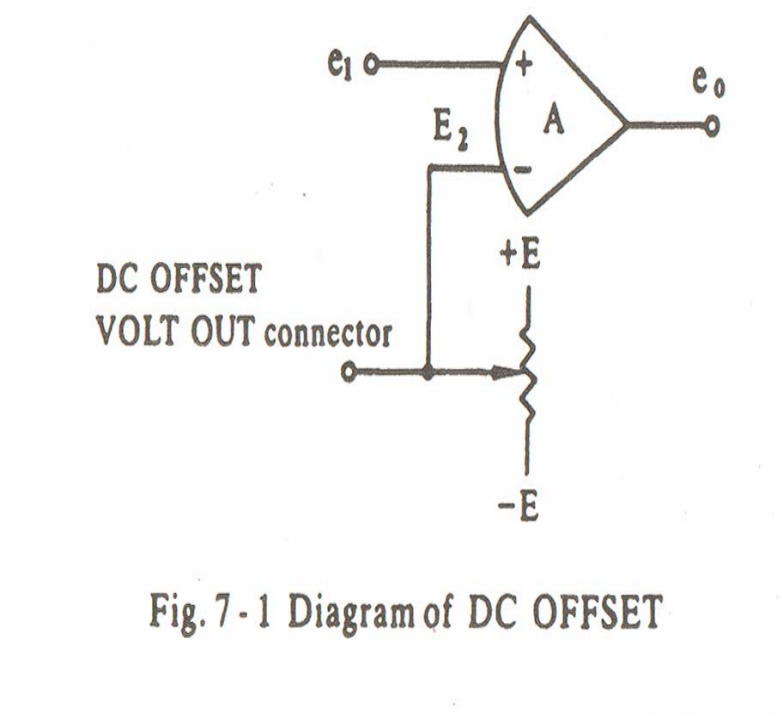


Fig. 7 - 1 Diagram of DC OFFSET

See Fig.7-1 for the function of the DC OFFSET.

There is following relation among the differential amplifier output voltage e_o, the input voltage e_i and E_2.

$$e_o = A(e_i - E_2)$$

$$e_i = E_{DC} + e_{AC}$$

(Where E_{DC} is a DC input and e_{AC} is an AC input)

Set the controls so that $E_2 = E_{DC}$ is attained. Then $e_o = A \times e_{AC}$ is obtained.

The DC component can be removed for an observation.

OFFSET voltage ranges

VOLES/DIV	DC OFFSET voltage
5mV/div- 50mV/div	More then ± 1V (× 1)
0.1V/div-0.5V/div	More then ± 1V (× 10)
1V/div-5/div	More than ± 100V (× 100)

When measured with a DMM connection, multiply the DMM reading by the multiplier

written above in indentation ( ).

Read next paragraph for the detailed explanation of measurement with a DMM connection.

(10)Measurement by the DC OFFSET function (KTL-2050 only)

In order to readout the voltage level digitally, connect a DMM (digital multimeter) to the DC OFFSET output terminal and setthe oscilloscope to the DC OFFSET mode.

See Fig.7-2.

Measuring DC component

Align level ⓑ with the center graticule and read the DMM digital value.（+2V should be displayed.）

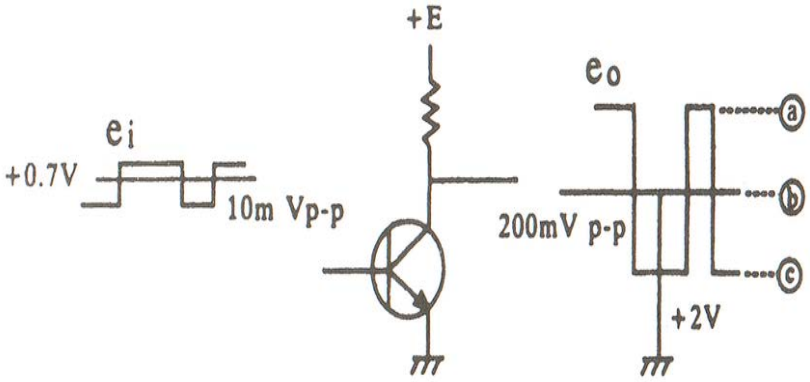


Fig. 7-2 Transistor amplifier

1) Measuring AC component

When the above is performed with an input sensitivity of 50mV, then div of amplitude must be present on the oscilloscope screen.

The AC component is observable on the oscilloscope screen where as the DC component is measurable on a DMM, and there is no need for any complicated switching as such needed for conventional oscilloscopes.

More over, the DC OFFSET function provides readings of peak to peak value (p-p) of e_o on a DMM.

Align level ⓐ with the center graticule line on the screen, read the DMM value and

name it V (a). Then align level  with the graticule line and readout V(c). The p-p the difference between V(a) and V(c), and the value can be read digitally on the DMM.

As explained above, the DC OFFSET function with DC OFFSET output terminal offers an improved operational convenience and a highly accurate measurement in detailed waveform portions.

8. ADJUSTMENTS

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

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

② Turn the VOLTS/DIV switch to 5mV-10mV and adjust so that the bright line does not move. (DC BAL ㉚ ㉛).

9. MAINTENANCE

1) Since semiconductors, precision components, etc. are employed in this oscilloscope, use at most cares for operation and storage.

2) Clean the scale with soft tissue periodically.

3) Side panel can be removed with screws.

4) Store this oscilloscope in the ambient temperature from -10 to + 60℃.

10. SPECIFICATIONS

CRT

Type

Large 6″ screen with internal graticule.

Approximate 12kV [2 kV] acceleration potential.

Phosphor

P31 standard

Graticule

8 ×10 div(div=10mm)

Internal graticule

Focusing

Possible (with automatic focus correction circuit)

Trace rotation Present

Brightness adjustment Possible

Scale illumination Variable (L-5040, L-5060, L-50100 only)

Z-AXIS INPUT (INTENSITY MODULTION)

DC-coupled, positive-going signal decreases intensity: 5Vp-p signal cause noticeable modulation at normal intensity: DC to 2MHz

Input impedance 33kohm (typ.)[47k ohms(typ.)]

Maximum input voltage 30V (DC + peak AC)

VERTICAL DEFLECTION SYSTEM (2 identical channels)

Bandwidth and rise time

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

Deflection factor

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

Accuracy

±3%

Additional error for magnifier ±2%

Display modes

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

Input impedance

Approximately 1 MΩ in parallel with 25pF

Maximum input voltage

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

Input coupling

AC, GND, DC

DC OFFSET possible (L-5040, L-5060, L-50100 only)

DC OFFSET VOLT OUT Present (L-5040, L-5060, L-50100 Only)

HORIZONTAL DEELECTION SYSTEM

Time base

0.2us/div to 0.2s/div in 19 calibrated steps in a 1-2-5 sequence. Uncalibrated continuous control extends deflection factor to at least 0.5 seconds per division in the 0.2 sec/div position. ×10mag extends maximum sweep rate to 20 ns/div [100ns/div].

Accuracy

±3%

Additional error for magnifier ±2%

TRIGGERING SYSTEM

Trigger modes

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

Trigger source

Internal (CH1, CH2 V-MODE), Line, External

Trigger slope

+,-

TV sync polarity

TV (-)

Triggering sensitivity and frequency

	Internal (V-MODE)	External
20Hz-5MHz [20Hz-2MHz]	0.5div (2.0 div)	200mV
5MHz-40MHz [2MHz-20MHz]	1.5 div (3.0 div)	800mV
40MHz-50MHz	2.0 div (3.5 div)	1V

TV-V sensitivity: SYNC section less 1 div or 1V

AUTO low band: Approximately 25Hz

Trigger coupling

AC: 20Hz to full brand width

External trigger input impedance

Approximately 1 MΩ in parallel with 30 pF

Maximum input voltage

300V (DC+AC peak)

ALT MAG Present (CP-2050)

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

Deflection factor

Same as vertical deflection

X-bandwidth

DC to at least 500 KHz

Phase error

3℃ or less from DC to 50 kHz

CALIBRATOR

An approximate 1 kHz frequency 0.5V (±3%) square wave.

SIGNAL OUTPUT

CH1 VERT SIGNAL OUTPUT

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

Bandwidth is 50 Hz to at least 5 MHz/

POWER SUPPLY

	FUSE	
VOLTAGE (50Hz)	L-212	L-5040, L-5060, L-50100
220V (198-242V)	0.5A	1A

Power supply frequency: 50 Hz

Power consumption: Approx. 35W [30W]

Max. 40 W at 120V 60Hz

ENVIRONMENT

Limit of operation temperature 0-40℃

Limit of operation humidity 35-85%

Rated range of use temperature 10-35℃

Rated range of use humidity 45-85%

Storage and transport temperature -20-70℃

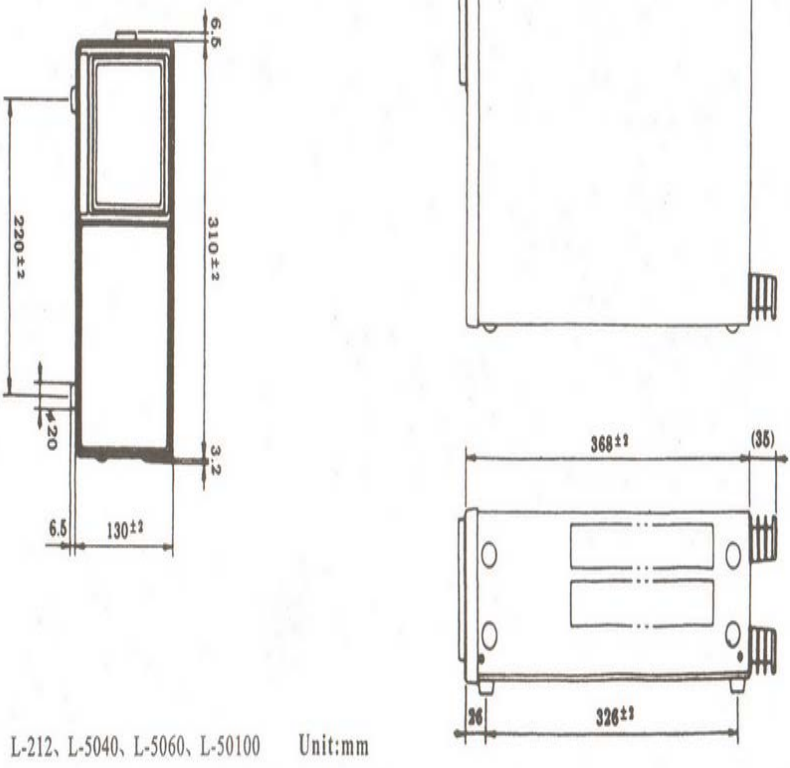
DIMEMSIONS AND WEIGHT

Approx. 310 (W) × 130 (H) × 370(D) mm

(12.4(W) ×5.2(H) ×14.8(D) inch

APPROX>6.5Kg (14.6 1bs) [6Kg(13.5 1bs)

11. EXTERNAL VIEW



L-212、L-5040、L-5060、L-50100 Unit:mm