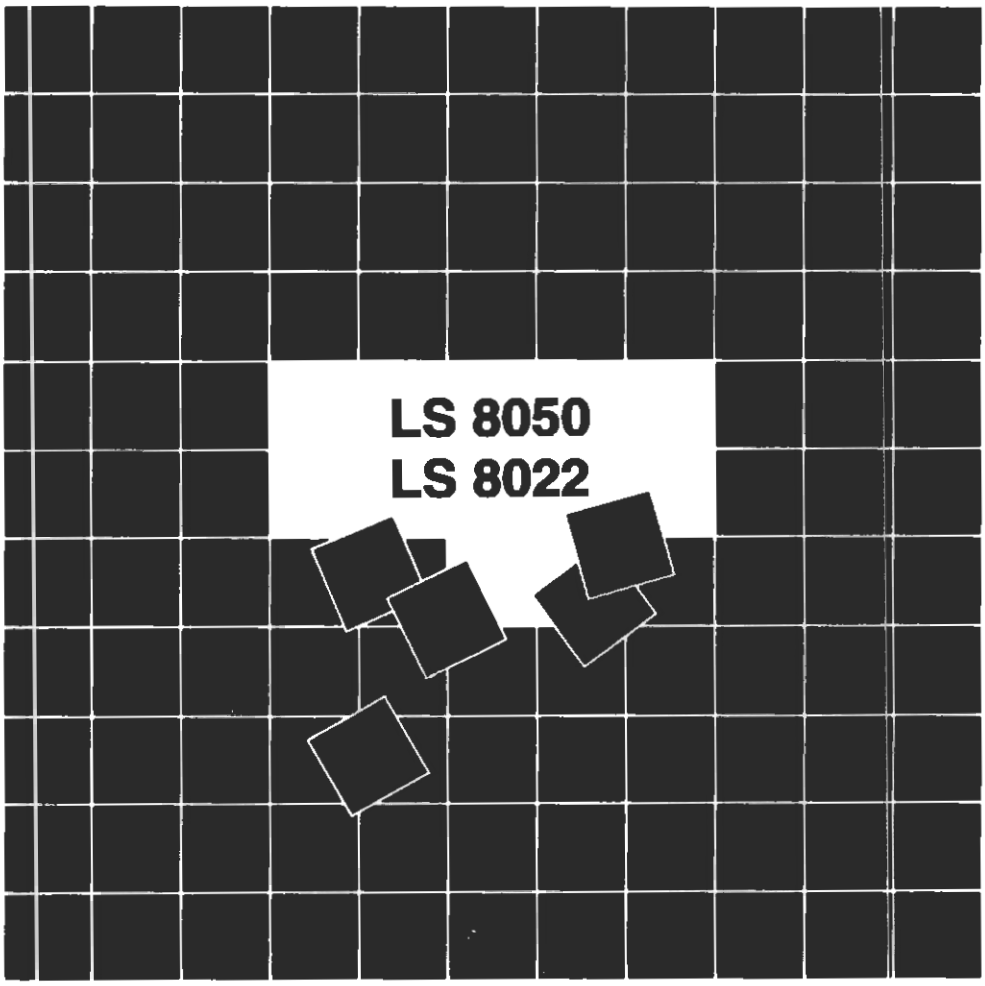
LEADER

50MHz オシロスコープ
20MHz オシロスコープ

取扱説明書

50MHz OSCILLOSCOPES
20MHz OSCILLOSCOPES

INSTRUCTION MANUAL



LEADER ELECTRONICS CORP.

FOR SAFETY'S SAKE

Thank you for purchasing our product.
Please observe the following safety precautions when operating this instrument.

⚠WARNING

- Do not remove any cases or covers.
  The high-voltage section inside this instrument can cause electrical shock.
- Do not operate this instrument and connected units in a volatile or flammable atmosphere.
  An explosive can result.
- Do not insert metal objects (e.g., wire, pin) into the vents.
  Otherwise, you may damage the instrument or suffer electrical shock.
- Connect this instrument to the rated power line voltage.
  Excessive voltage can cause fire.
- Do not touch the high-voltage section with hand directly when measuring it. You may suffer electrical shock.
- Do not connect this instrument to equipment whose chassis has electrical potential to ground (i.e., transformerless equipment).
  Otherwise, you may damage the instrument or suffer electrical shock.

⚠CAUTION

- Use only the fuse of correct type and rating for replacement.
  Before replacing the fuse, be sure to turn the power switch off and disconnect the power cord from the mains.

Cautions on operation appear in the instruction manual. Read the manual carefully to ensure correct operation.

Explanation of the Terms

⚠WARNING ..... The WARNING calls attention to abnormal conditions or dangerous practices that could result in personal injury or death.

⚠ CAUTION ..... The CAUTION calls attention to abnormal conditions or dangerous practices that could result in damage the instrument or other property.

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1. GENERAL

1.1 Description

The LS 8050 and LS 8022 oscilloscopes are dual-channel oscilloscopes with maximum sensitivity of 1 mV/div, and maximum sweep time of 10 nSec/div. Each of these oscilloscopes employs a 6-inch rectangular type cathode-ray tube with red internal graticule. LS 8050 has a sweep magnification feature with B sweep.
These oscilloscopes are sturdy, easy to operate and exhibits high operational reliability.

1.2 Features

(1) High intensity CRT with high acceleration voltage:
The CRT is a high beam transmission, high intensity type with a high acceleration voltage of 2 kV for models LS 8022 (and 12 kV for model LS 8050). It displays clear readable traces even at high sweep speeds.

(2) High stability with less drift:
The oscilloscope employs a temperature compensation circuit which is newly developed to reduce the drift of base lines and DC balance disturbance caused by temperature change.

(3) A trigger level lock function which makes the triggering adjustment unnecessary:
A new trigger level lock circuit is incorporated. This circuit eliminates the procedures of the troublesome triggering adjustment not only for displaying signals but also for that of video signals and large duty-cycle signals.

(4) TV sync triggering:
The oscilloscope has a sync separator circuit incorporated within the TIME/DIV switch for automatic triggering of TV-V and TV-H signals.

(5) Linear focus:
Once the beam focus is adjusted to the optimum position, it is automatically maintained regardless to the intensity change.

2. TECHNICAL SPECIFICATIONS

SPECIFICATIONS \ MODEL		20 MHz OSCILLOSCOPE	50 MHz OSCILLOSCOPE
		LS 8022	LS 8050
VERTICAL AXIS	Sensitivity	1 mV~5 V/div, 12 steps in 1-2-5 sequence	
	Sensitivity accuracy	5 mV~5 V/div: ≤3%, 1 mV~2 mV/div: ≤5% (10°C to 35°C (50°F to 95°F))	
	Vernier vertical sensitivity	To 1/2.5 or less of panel-incicated value.	
	Frequency bandwidth	5 mV~5 V/div: DC~20 MHz, 1 mV~2 mV/div: DC~10 MHz	5 mV~5 V/div: DC~50 MHz, 1 mV~2 mV/div: DC~15 MHz
		AC coupling: Low limit frequency 10 Hz (With reference to 100 kHz, 8 div. Frequency response with -3dB.)	
	Rise time	5 mV~5 V/div: ~17.5 ns, 1 mV~2 mV/div: ~35 ns	5 mV~5 V/div: ~7 ns, 1 mV~2 mV/div: ~23 ns
	Input impedence	1 MΩ ±2%//Approx. 27 pF	
	Vertical modes	CH1: CH1 single channel. CH2: CH2 single channel. DUAL: CHOP/ALT are auto-set by TIME/DIV switch. (CHOP:0.5 s~5 ms/div, ALT:2 ms~0.1 μs/div) When CHOP switch is pushed in, the two traces are displayed in the CHOP mode at all range ADD: CH1 + CH2 algebraic addition.	
	Chopping repetition frequency	Aoprox. 250 kHz	
	Input coupling	AC, DC, GND	
	Maximum input voltage	400 V (DC + AC peak), AC:frequency 1 kHz or lower.	
	CH1 signal output	Approx. 100 mV/div without termination, 50 mV/div with 50 Ω termination.	
	CH2 INV BAL.	Balanced point variation:≤1 div (Reference at center graticule.)	
TRIGGERING	Triggering source	CH1, CH2, LINE, EXT (CH1 and CH2 can be selected only when the vertical mode is DUAL or ADD. In ALT mode, if the TRIG. ALT switch is pushed in, it can be use for alternate triggering of two different source.	
	Coupling	AC, HF-REJ, TV, DC (TV-V/TV-H can be auto-set by TIME/DIV range. TV-V: 0.5 s-0.1 ms/div; TV-H: 50 μs-0.1 μs/div)	
	Polarity	+/-	

SPECIFICATIONS \ MODEL		20 MHz OSCILLOSCOPE LS 8022	50 MHz OSCILLOSCOPE LS 8050
TRIGGERING	Sensitivity	DC~5 MHz: 0.5 div (EXT: 0.1 V) 5~20 MHz: 1.5 div (EXT: 0.2 V)	DC~10 MHz: 0.5 div (EXT: 0.1 V) 10~50 MHz: 1.5 div (EXT: 0.2 V)
		TV (video signal): 2.0 div (EXT: 0.2 V) AC coupling: Attenuate signal components of lower than 10 Hz. HF-REJ: Attenuate signal components of higher than 50 kHz.	
	Triggering modes	AUTO: Sweeps run in the free mode when no triggering input signal is applied. (Applicable for repetitive signals of frequency 50 Hz or over.) NORM: When no triggering signal is applied, the trace is in the READY state and not displayed.	
		—	SINGLE: One-shot sweep with triggering signal. Can be reset to the READY state by means of the RESET switch. The READY lamp (LED) turns on when in the READY state or in the sweep operation.
	LEVEL LOCK and ALT triggering	Satisfies the value of the above trigger sensitivity plus 0.5 div (EXT: 0.05 V) for signal of duty cycle 20:80.	
		Repetition frequency: 50 Hz~20 MHz	Repetition frequency: 50 Hz~40 MHz
	EXT triggering signal input Input impedance Max. input voltage	EXT HOR input terminal is used in common. 1 MΩ ±2%//approx. 40 pF 100 V (DC + AC peak), AC: Frequency not higher than 1 kHz	
	B triggering signal.	—	The A triggering signal of main sweep is used as the B triggering signal.
HORIZONTAL AXIS	Horizontal axis display	A	A, A INT, B, B TRIG'D
	A sweep (main sweep) time	0.1 μSec~0.5 Sec/div, 21 steps in 1-2-5 sequence	
	Sweep time accuracy	±3%, (10°C to 35°C (50°F to 95°F))	
	Vernier sweep time control	≤1/2.5 of panel-indicated value	
	Hold off time	Continuous variable > = twice sweep length (time) at 0.1 μSec~1 mSec/div ranges.	
	B sweep delay system	—	Continuous delay and triggered delay
	B sweep (delay sweep) time	—	0.1 μSec~0.5 mSec/div 12 steps
	Sweep time accuracy	—	±3%, (10°C to 35°C (50°F to 95°F))
	Delay time	—	1 μSec~5 mSec
	Delay jitter	—	≤1/10000
	Sweep magnification	10 times (maximum sweep time 10 nSec/div)	
	x 10 MAG sweep time accuracy	0.1 μSec~50 mSec/div ±5%, 10 nSec~50 nSec/div ±8% (10°C to 35°C (50°F to 95°F))	

SPECIFICATIONS \ MODEL		20 MHz OSCILLOSCOPE	50 MHz OSCILLOSCOPE
		LS 8022	LS 8050
X-Y MODE	Sensitivity	Same as vertical axis. (X-axis: CH1 input signal; Y-axis: CH2 input signal)	
	Sensitivity accuracy	NORM: ±4%, x 10 MAG: ±6% (10°C to 35°C (50°F to 95°F))	
	Frequency bandwidth	DC~1 MHz (-3 dB)	DC~2 MHz (-3 dB)
	X-Y phase difference	≤3% at DC~50 kHz	≤3% at DC~100 kHz
EXT HOR MODE	Sensitivity	Approx. 0.1 V/div (Trace swept by an external horizontal signal applied to the EXT TRIG IN terminal. Vertical axis modes are CH1, CH2, DUAL and ADD modes in the CHOP mode.)	
	Frequency bandwidth	DC~1 MHz (-3 dB)	DC~2 MHz (-3 dB)
	Phase difference between vertical axis	≤3% at DC~50 kHz	≤3% at DC~100 kHz
Z AXIS	Sensitivity	3 V_{P-P} (Trace becomes brighter with negative input.)	
	Frequency bandwidth	DC~5 MHz	
	Input resistance	Approx. 5 kΩ	
	Maximum input voltage	50 V (DC + AC peak, AC frequency ≤1 kHz)	
CALIBRATION VOLTAGE	Waveform	Positive-going square wave	
	Frequency	1 kHz ±5%	
	Duty ratio	Within 48:52	
	Output voltage	2 V_{P-P} ±2%	
	Output impedance	Approx. 2 kΩ	
CRT	Type	6-inch rectangular type, internal graticule.	
	Phosphor	P 31	
	Acceleration voltage	Approx. 2 kV	Approx. 12 kV
	Effective screen size	8 x 10 div (1 div = 10 mm (0.39 in))	
	Graticule	Internal	Internal; continuous adjustable illumination
Operating Environment	Indoor use	Altitude up to 2000 m	
	Ambient temperature	To satisfy specifications: 5° to 35°C (41° to 95°F)	
	Maximum operating ranges	0° to 40°C (32° to 104°F)	
	Relative humidity	85% RH (max.) non condensing	
	Storage Temperature & Humidity	-10° to 70°C, 70% RH (maximum)	
	Installation Categorier	I	
	Pollution degree	2	
Mechanical Specifications	Dimensions (mm)	310 (W) x 150 (H) x 455 (D)	
	Weight	Approx. 8.2 kg (18 lbs)	
Line Power Requirements	Voltage	AC 100 V, 120 V, 220 V, 230 V ±10% selectable.max. 250 V	
	Frequency	50 Hz to 60 Hz	
	Power consumption	Approx 70 VA, 60 W (max.)	
Accessories	Power cord	1	
	Instruction manual	1	
	Probes	2	

3. PRECAUTIONS BEFORE OPERATING THE OSCILLOSCOPE

3.1 Unpacking the oscilloscope

The oscilloscope is shipped form the factory after being fully inspected and tested. Upon receiving of the instrument, immediately unpack and inspect it for any damages that might have been sustained during transportation. If any sign of damage is found, immediately notify the bearer and/or the dealer.

3.2 Checking the Line Voltage

These oscilloscopes will operate on any one of the line voltage shown in the table below, by inserting the line voltage selector plug in the corresponding position on the rear panel. Before connecting the power plug to an AC line outlet, make sure the voltage selector is set to the correct position corresponding to the line voltage. Note the oscilloscope may be damaged if it is connected to the wrong AC line voltage.

⚠ WARNING. To avoide electrical shock the power cord protective grounding conductor must be connected to ground.

When line voltages are changed, replace the required fuses shown below.

Rated Voltage	Operating Voltage Range (±10%)	Fuse Rating	Leader Part No.
100 V	90 to 110 V	0.63 A time lag	436 3555 005
120 V	108 to 132 V		
220 V	198 to 242 V	0.315 A time lag	436 3540 002
230 V	207 to 250 V		

⚠ WARNING. To avoide personal injury, disconnect the power cord before removing the fuse holder.

3.3 Environment

The normal ambient temperature range of this instrument is 0° to 40°C (32° to 104°F). Operation of the instrument above this temperature range may cause damage to the circuits. Do not use the instrument in a place where strong magnetic or electric field exists. Such fields may disturb the measurement.

3.4 CRT Intensity

To prevent permanent damage to the CRT phosphor, do not make the CRT trace excessively bright or leave the spot stationary for an unreasonably long time.

3.5 Withstanding Voltages of Input Terminals

The withstanding voltages of the instrument input terminals and probe Input terminals are as shown in the following table. Do not apply voltages higher than these limits.

Input terminal	Maximum input voltage
CH1, CH2, inputs	400 V (DC + AC peak)
EXT TRIG input	100 V (DC + AC peak)
Probe inputs	600 V (DC + AC peak)
Z AXIS input	50 V (DC + AC peak)

⚠ CAUTION. To avoide instrument damage, donot exceed maximum input voltages. Maximum input voltages must have frequencies less than 1 kHz.

4. OPERATION METHOD

4.1 Introduction of Front Panel

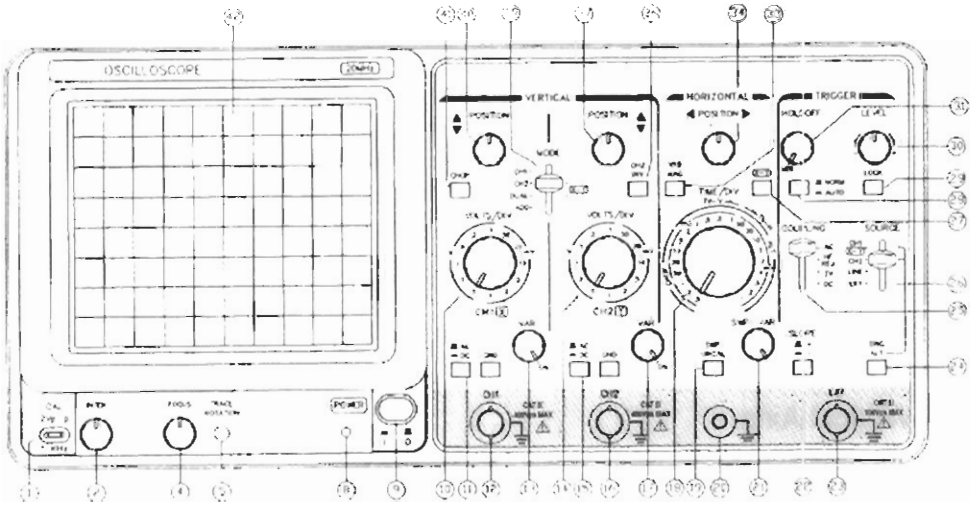
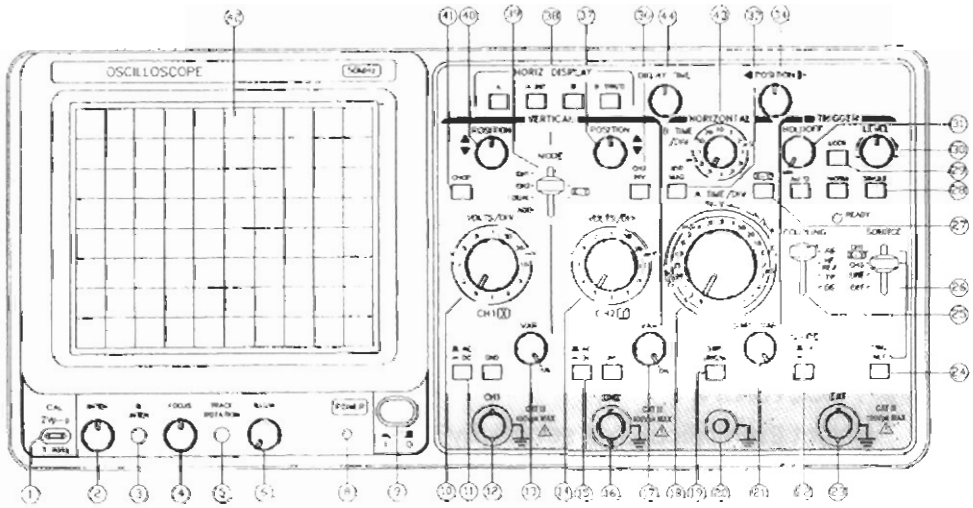


Figure 4-1 (a) Model LS 8022



Fugure 4-1 (b) Model LS 8050

CRT Circuits:

(1) POWER
Main power switch of the instrument. When this switch is turned on, the LED (8) is also turned on.

(2) INTEN
Controls the brightness of the spot or trace.

(3) B INTEN (LS 8050 only)
Semi-fixed potentiometer for adjusting trace intensity when in B sweep mode.

㊹ FOCUS

For focusing the trace to the sharpest image.

㊸ ILLUM (LS 8050 only)

Graticule illumination adjustment.

㊺ TRACE ROTATION

Semi-fixed potentiometer for aligning the horizontal trace in parallel with graticule lines.

㊷ FILTER

Filter for ease of waveform viewing.

Vertical Axis:

⑫ CH1 (X) input

Vertical input terminal of CH1. When in X-Y operation, X-axis input terminal.

⑮ CH2 (Y) input

Vertical input terminal of CH2. When in X-Y operation, Y-axis input terminal.

⑪⑮ AC-DC-GND

Switch for selecting connection mode between input signal and vertical amplifier.

AC: AC coupling

DC: DC coupling

GND: Vertical amplifier input is grounded and input terminals are disconnected.

⑩⑭ VOLTS/DIV

Select the vertical axis sensitivity, from 1 mV/div to 5 V/div in 12 ranges.

⑬⑰ VARIABLE

Fine adjustment of sensitivity, with a factor of≥1/2.5 of the indicated value. When in the CAL position, sensitivity is calibrated to indicated value.

㊹㊲ POSITION

Vertical positioning control of trace or spot.

㊴ VERT MODE

Select operation modes of CH1 and CH2 amplifiers.

CH1: The oscilloscope operates as a single-channel instrument with CH1 alone.

CH2: The oscilloscope operates as a single-channel instruments with CH2 alone.

DUAL: The oscilloscope operates as a dual-channel instrument both CH1 and CH2. CHOP/ALT are automatic changed by TIME/DIV switch ⑱. When CHOP ㊶ button is pushed in, the two traces are displayed in the CHOP mode at all ranges.

ADD: The oscilloscope displays the algebraic sum (CH1 + CH2) or difference (CH1 - CH2) of the two signals.
The pushed in state of CH2 INV 36 button is for the difference (CH1 - CH2).

Triggering:

23 EXT TRIG (EXT HOR) input terminal
Input terminal is used in common for external triggering signal and external horizontal signal. To use this terminal, set SOURCE switch 26 to the EXT position.

26 SOURCE
Select the internal triggering source signal. And the EXT HOR input signal.

CH1 (X-Y): When the VERT MODE switch 39 is set in the DUAL or ADD state, select CH1 for the internal triggering source signal. When in the X-Y mode, select CH1 for the X-axis signal.

CH2: When the VERT MODE switch 39 is set in the DUAL or ADD state, select CH2 for the internal triggering source signal.

TRIG. ALT 24: When the VERT MODE switch 39 is set in the DUAL or ADD state, and the SOURCE switch 26 is selected at CH1 or CH2, with the engagement of the TRIG. ALT switch 24, it will alternately select CH1 & CH2 for the internal triggering source signal.

LINE: To select the AC power line frequency signal as the triggering signal.

EXT: The external signal applied through EXT TRIG (EXT HOR) input terminal 23 is used for the external triggering source signal. When in the X-Y, EXT HOR mode, the X-axis operates with the external sweep signal.

25 COUPLING
Select COUPLING mode 25 between triggering source signal and trigger circuit: select connection of TV sync trigger circuit.

AC: AC coupling

DC: DC coupling

HF REJ: Removes signal components aboves 50 kHz (-3 dB).

TV: The trigger circuit is connected to the TV sync separator circuit and the triggered sweeps synchronize with TV-V or TV-H signal at a rate selected by the TIME/DIV switch 18

TV-V: 0.5 Sec/div-0.1 mSec/div

TV-H: 50 u Sec/div-0.1 u Sec/div

㉒ SLOPE

Select the triggering slope.

"+": Triggering occurs when the triggering signal crosses the triggering level in positive-going direction.

"-": Triggering occurs when the triggering signal crosses the triggering level in negative-going direction.

㉚ LEVEL

To display a synchronized stationary waveform and set a start point for the waveform.

Toward "+": The triggering level moves upward on the display waveform.

Toward "-": The triggering level moves downward on the disp ay waveform.

LOCK ㉙: Triggering level is automatically maintained at optimum value irrespective of the signal amplitude (from very small to large amplitudes), requiring no manual adjustment of triggering level.

㉛ HOLDOFF

Used when the signal waveform is complex and stable triggering cannot be attained with the LEVEL knob alone.

Time Base

⑱ (A) TIME/DIV

Select the sweep time of the A sweep. (LS 8050, B TIME/DIV < A TIME/DIV)

㊸ B TIME/DIV (LS 8050 only)

Select the sweep time of delayed sweep (B sweep).

㉑ SWP. VAR

Vernier control of sweep time. When SWP. UNCAL ⑲ button is pushed in, the sweep time can be made slower by a factor ≥2.5 of the indicated value. The indicated values are calibrated when this button is not pushed in.

㉞ POSITION

Horizontal positioning control of the trace or spot.

㉝ x 10 MAG

When the button is pushed in, a magnification of 10 occurs.

㊹ DELAY TIME POSITION (LS 8050 only)

Vernier control of the delay time selected by the A TIME/DIV ⑱ and B TIME/DIV ㊸ switch to finely select the portion of the A sweep waveform to be magnified.

㉘ TRIGGER MODE

Select the desired trigger mode.

AUTO: When no triggering signal is applied or when triggering signal frequency is less than 50 Hz, sweep runs in the free run mode.

NORM: When no triggering signal is applied, sweep is in a ready state and the trace is blanked out. Used primarily for observation of signal ≤50 Hz.

SINGLE: Use for single sweep. (LS 8050 only)

Push to RESET: Operation (one-short triggering operation), and in common as the reset switch. When these three buttons are disengaged, the circuit is in the single trigger mode. The circuits is reset as this button is pressed. When the circuit is reset, the READY lamp turns on. The lamp goes out when the single sweep operation is over.

㉙ HORIZ. DISPLAY MODE

Select A and B sweep modes as follows:

A: Main sweep (A sweep) mode for general waveform observation.

A INT: This sweep mode is used when selecting the section to be magnified of A sweep, in preparation for delayed sweep. The B sweep section (delayed sweep) corresponding to the A sweep is displayed with a high intensity beam.

B: Display the delayed sweep (B sweep) alone.

B TRIG'D: Select between continuous delay and triggered delay.

Disengaged: For continuous delay. The B sweep starts immediately after the sweep delay time set by A TIME/DIV AND B TIME/DIV switch and DELAY. TIME POSITION knob has elapsed.

Engaged: For triggered delay. The B sweep starts when the triggering pulse is applied after the sweep delay time set by A TIME/DIV and B TIME/DIV switch and DELAY TIME POSITION knob has elapsed.
(The triggering signal is used in common for both A sweep and B sweep).

㉗ X-Y

Press the X-Y button to enable X-Y operation.

Others

① CAL (V_{P-P})

This terminal delivers the calibration voltage of 2 V_{P-P}, 1 kHz, positive square wave. The output resistance is 2 kΩ see technical specification for tolerance.

⑳ GND

Ground terminal of oscilloscope mainframe.

4.2 Introduction of Rear Panel

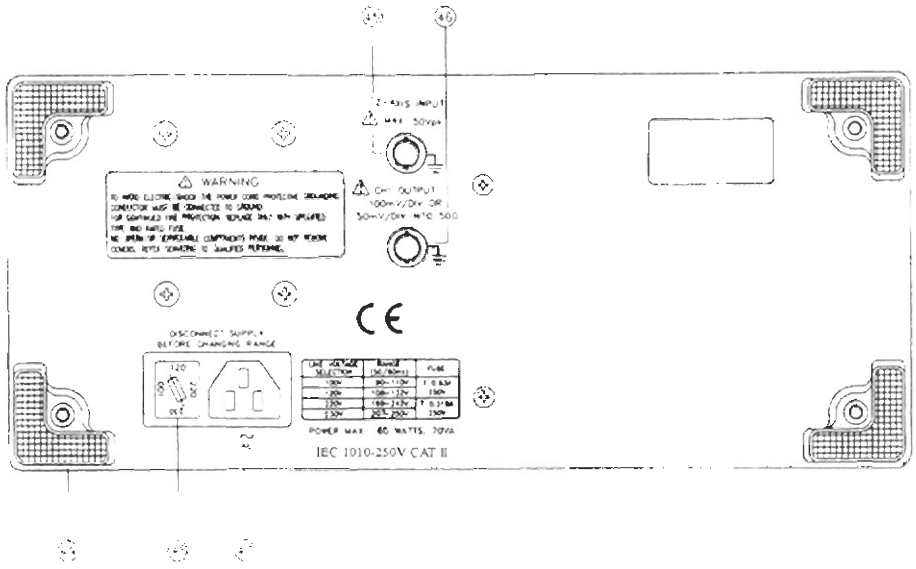


Figure 4-2

(5) Z AXIS INPUT

Input terminal for external intensity modulation signal.

(6) CH1 SIGNAL OUTPUT

Delivers the CH1 signal with a voltage of approximately 100 mV per 1 DIV of graticule. When terminated with 50 Ω, the signal is attenuated to about one half. Suitable for frequency counting, etc.

AC POWER Input Circuit

(7) AC Power input connector

AC Power input socket. Connect the AC power cord (supplied) to this connector.

(8) FUSE & line voltage selector

Fuse rating is shown in Page 3-1. Line voltage selector: to select power sources.

(9) Studs

Studs for laying the oscilloscope on its back to operate it in the upward posture. Also used to take up the power cord.

4.3 Basic Operation

Before connecting the power cord to an AC line outlet, make sure that the AC line voltage input switch on the rear panel of the instrument is correctly set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown below:

Item	No	Setting
POWER	9	Disengage position (OFF)
INTEN	2	Clockwise
		(3-o'clock position)
FOCUS	4	Mid-position
ILLUM	6	Full anti-clockwise Position
		(LS 8050 only)
VERT MODE	39	CH1
CHOP	41	Released
CH2 INV	36	Released
POSITION	40 37	Mid-position
VOLTS/DIV	10 14	0.5 V/DIV
VARIABLE	13 17	CAL (clockwise position)
AC-DC-GND	11 15	GND
SOURCE	26	Set to CH1
COUPLING	25	AC

Item	No	Setting
SLOPE	22	+
TRIG ALT	24	Released
LEVEL LOCK	29	Pushed in
HOLDOFF	31	MIN (anti-clockwise)
TRIGGER MODE	28	AUTO
HORIZ DISPLAY MODE	38	A (LS 8050 only)
TIME/DIV	18	0.5 mSec/DIV
SWP. UNCAL	19	Released
POSITION	34	Mid-position
x 10 MAG	33	Released
X-Y	27	Released

After setting the switches and controls as mentioned, connect the power cord to the AC line outlet, and then, continue as follows:

(1) Engage the POWER switch and make sure that the power LED is turned on. In about 20 seconds, a trace will appear on the CRT screen. If no trace appears in about 60 seconds, counter check the switch and control setting.

(2) Adjust the trace to an appropriate brightness and image with the INTEN control and FOCUS control respectively.

(3) Align the trace with the horizontal center line of the graticule by adjusting the CH1 POSITION control and TRACE ROTATION control (adjustable by screwdriver).

(4) Connect the probe to the CH1 INPUT terminal and apply the 2 V_{P-P} CALIBRATOR signal to the probe tip.

(5) Set the AC-DC-GND switch to the AC state. A waveform as shown in the figure 4-3 will be displayed on the CRT screen

(6) Adjust the FOCUS control so that the trace image appears sharply.

(7) For signal viewing, set the VOLTS/DIV switch and TIME/DIV switch in appropriate positions so that signal waveform is displayed clearly.

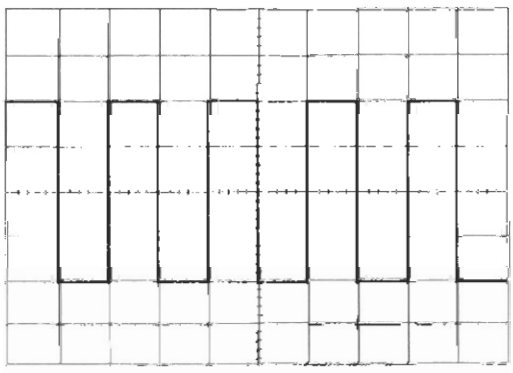


Figure 4-3

(8) Adjust the △▽ POSITION and <> POSITION controls in appropriate positions so that the displayed waveform is aligned with the graticule and voltage (V_{P-P}) and period (T) can be read conveniently. The above are the basic operating procedures of the oscilloscope. The above procedures are for single-channel operation with CH1. Single-channel operation with CH2 can also be achieved in a similar manner. Further operation methods are explained in the subsequent paragraph.

5.4 Dual-channel Operation

Change the VERT MODE switch to the DUAL states so that trace (CH2) is alsodisplayed (The explanation in the proceeding section is of CH1). At this state of procedure, the CH1 trace is the square wave of the calibrator signal and the CH2 trace is a straight line since no signal is applied to this channel yet.

Now, apply the calibrator signal to the vertical input terminal of CH2 with the probe as is the case for CH1. Set the AC-DC-GND switch to the AC state. Adjust vertical POSITION knobs 40 and 37 so that both channel signals are displayed as shown in Figure 4-4.

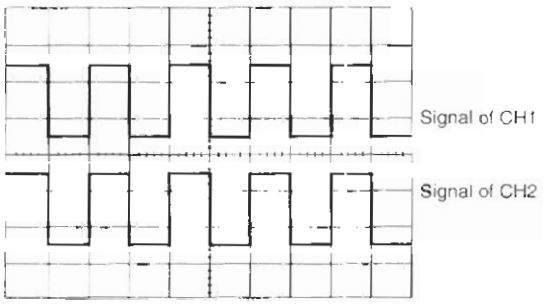


Figure 4-4

When in the dual channel operation (DUAL or ADD mode), the CH1 or CH2 signal must be selected for the triggering source signal by means of tha SOURCE switch. If both CH1 and CH2 signals are in a synchronized relationship, both waveforms can be displayed stationary; if not, only the signal selected by the SOURCE switch can be displayed stationary. If the TRIG. ALT push switch is engaged, both waveforms can be displayed stationary (Do not use "CHOP" and "ALT" triggering source switch at the same time).

Selection between CHOP mode and ALT mode is automatically made by the TIME/DIV switch shown in Figure 4-5. The 5 mSec/DIV and lower ranges are used in the CHOP mode and the 2 mSec/DIV and higher ranges are used in the ALT mode.

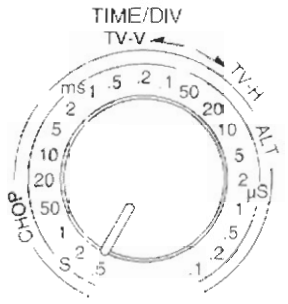


Figure 4-5

When the CHOP push switch is engaged, the two traces are displayed in the CHOP operation at all ranges. The CHOP operation has better priority compare to the ALT operation.

4.5 ADD Operation

An algebraic sum of the CH1 and CH2 signals can be displayed on the screen by setting the VERT MODE switch to the ADD state. The displayed signal is the difference between CH1 and CH2 signals if the CH2 INV push switch is engaged.

For accurate addition or subtraction, it is a prerequisite that the sensitivities of the two channels are adjusted accurately at the same value by means of the VARIABLE knobs. Vertical positioning can be made with the △▽ POSITION knob of either channel. In view of the linearity of the vertical amplifiers, it is most advantage to set both knobs in their mid-positions.

4.6 X-Y Operation and EXT Operation

When the TIME/DIV switch is set in the X-Y/EXT HOR state, the internal sweep circuit is disconnected and the trace in the horizontal direction is driven by the signal selected by the SOURCE switch. When the SOURCE switch is set to the CH1 X-Y position, the oscilloscope operates as an X-Y scope with the CH1 signal for the X-axis; when it is set to the EXT position, the oscilloscope operates in the EXT HOR (external sweep) mode.

X-Y Operation

The X-Y operation is with CH1 as X-axis and CH2 as Y-axis. The bandwidth of the X-axis becomes DC to 1 MHz (-3 dB) (or DC to 2 MHz for LS 8050) and the horizontal POSITION control is directly used as the X-axis POSITION control. For the Y-axis, the CH2 (X-Y) should be selected by the VERT MODE switch.

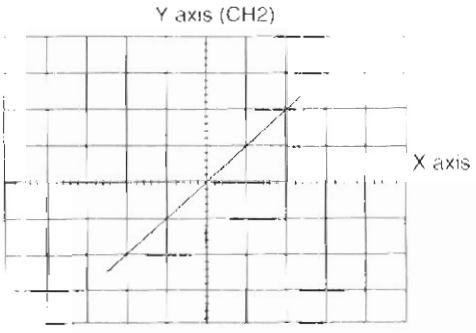


Figure 4-6

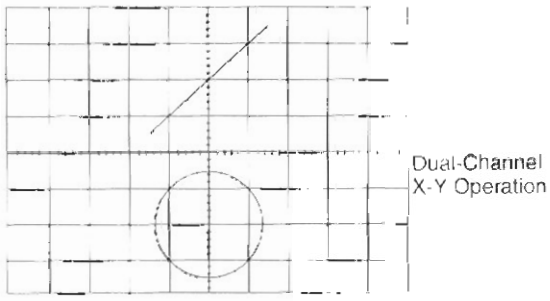


Figure 4-7

Note: When high frequency signals are displayed in the X-Y operation, pay attention to the frequency bandwidths and phase difference between X and Y-axis.

EXT HOR (external sweep) Operation

The external signal applied through the EXT HOR terminal (23) drives the X-axis. The Y-axis is with any channels as selected by the VERT MODE switch. When the DUAL mode is selected by the switch, both CH1 and CH2 signals are displayed in the CHOP mode.

4.7 Triggering

Proper triggering is essential for efficient operation of an oscilloscope. The user must be thoroughly familiar with the triggering functions and procedures

(1) Functions of SOURCE switch:

The displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit to display a stationary signal on the CRT screen. The SOURCE switch is used for selecting such a triggering source.

CH1: The internal trigger method which is used most commonly.

CH2: The signal applied to the vertical input terminal is branched off from the preamplifier and is fed to the trigger circuit through the VERT MODE switch. Since the triggering signal is the measured signal itself, a stable waveform can be readily displayed on the CRT screen. When in the DUAL or ADD operation, the signal selected by the SOURCE switch is used as the triggering source signal.

LINE: The AC power line frequency signal is used as the triggering signal. This method is effective when the measured signal has a relationship with the AC line frequency, especially for measurements of low level AC noise of audio equipment, thyristor circuits, etc.

EXT: The sweep is triggered with an external signal applied to the external trigger input terminal. An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal is not used as the triggering signal, the waveforms can be displayed more independent than the measured signal.

The above triggering source signal selection functions are shown collectively in the following table.

VERT. MODE / SOURCE	CH1	CH2	DUAL	ADD
CH1	Triggered by CH1 signal			
CH2	Triggered by CH2 signal			
ALT	Alternately triggered by CH1 & CH2			
LINE	Trigged by LINE signal			
EXT	Trigged by EXT TRIG input signal			

(2) Functions of COUPLING switch:

The switch is used for selecting the coupling of the triggering signal to the trigger circuit in accordance with he characteristics of the measured signal

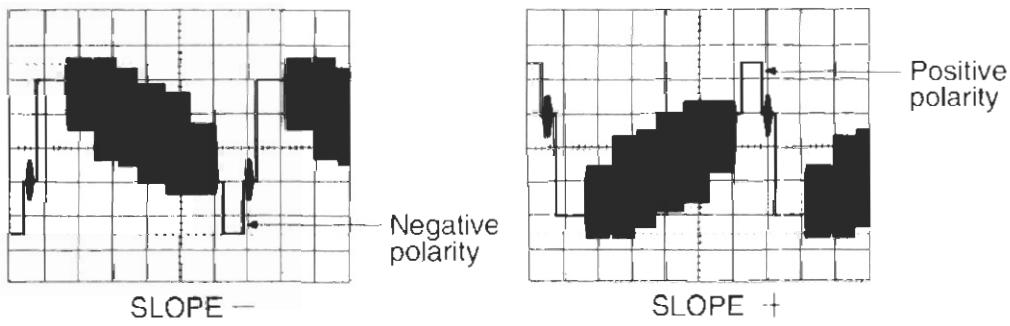
AC: his coupling is for AC triggering which is used most commonly. As the triggering signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is 10 Hz (-3 dB).
When the ALT trigger mode is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

HF REJ: The triggering signal is fed to the trigger circuit through an AC coupling circuit and a low pass filter (approximately 50 kHz, -3 dB). The higher components of the trigger signal are rejected and only the lower components are applied to the trigger circuit.

TV: This coupling is for TV triggering, for observation of TV video signals. The triggering signal is AC-coupled and fed through the triggering circuit (level circuit) the TV sync separator circuit. The separator circuit picks off the sync signal, which is used to trigger the sweep. Thus, the video signal can be displayed stably. Being linked to the TIME/DIV switch, the sweep speed is switched for TV-V and TV-H as follows:

TV-V: 0.5 Sec-0.1 mSec
TV-H: 50 μSec-0.1 μSec

The SLOPE switch should be set to conform to the video signal as shown in Figure 4-8.



Selection of Video Signal Trigger Pulse and Slope

Figure 4-8

DC: The triggering signal is DC-coupled to the trigger circuit. This mode is used when triggering is desired with the DC component of the triggering signal or when a signal with very low frequency or a signal with large duty cycle ratio isneeded to be displayed.

(3) Function of SLOPE switch:

This switch selects the slope (polarity) of the triggering signal as shownin Figure 4-9.

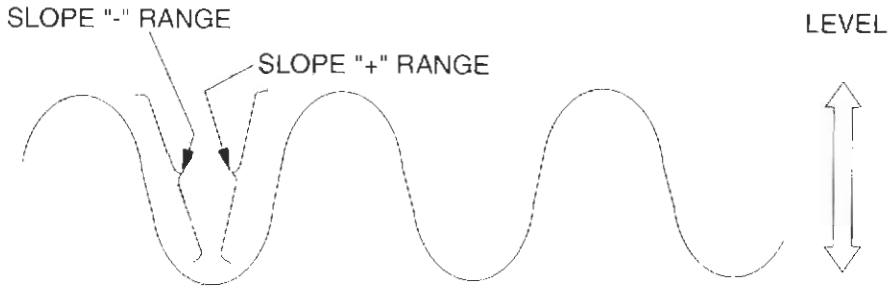


Figure 4-9

"+": When set in the "+" state, triggering occurs as the triggering signal crosses the triggering level in the positive-going direction.

"-": When set in the "-" state, triggering occurs as the triggering signal crosses the triggering level in the negative-going direction.

(4) Fucntion of Level (LOCK) control:

The function of this control is to adjust the triggering level and displays stationarymage. At the instant, the triggering signal has crossed the triggering level set by the control, the sweep is triggered and a waveform is displayed on the screen.

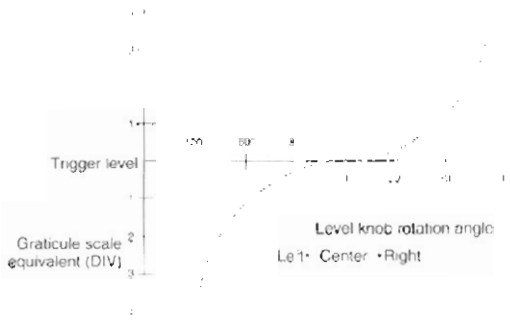


Figure 4-10

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise, and it changes in the negative direction (downward) as the knob is turned counter clockwise. The characteristic changes are as shown in Figure 4-10.

LEVEL LOCK:

When LEVEL LOCK push switch is engaged, the triggering level is automatically maintained within the amplitude of the triggering signal, and stable triggering is made without requiring level adjustment (although jitter may not be suppressed when in the ALT mode).

This automatic level lock unction is effective when the signal amplitude on the screen or the input voltage of the external triggering signal is within the following range:

LS 8022	50 Hz-5 MHz:	1.0 DIV (0.15 V) or less
	10 Hz-20 MHz:	2.0 DIV (0.25 V) or less
LS 8050	50 Hz-10 MHz:	1.0 DIV (0.15 V) or less
	10 Hz-40 MHz:	2.0 DIV (0.25 V) or less

(5) Functions of HOLD OFF control:

When the measured signal is a complex waveform with two or more repetition frequencies (periods), triggering with the above mentioned LEVEL control alone may not be sufficient to attain a stable waveform display. In such a case, the sweep can be stable synchronized to the measured signal waveform by adjusting the HOLD OFF time (sweep pause time) of the sweep waveform. The control covers at least one full sweep time for sweeps faster than 0.2 Sec/DIV.

Figure 4-11 (a) shows several different waveforms which overlapped on the screen, making the signal observation unsuccessful when the off. HOLD OFF knob is in the MIN state.

Figure 4-11 (b) shows the undesirable portion of the signal is held off. The same waveforms are displayed on the screen without overlapping.

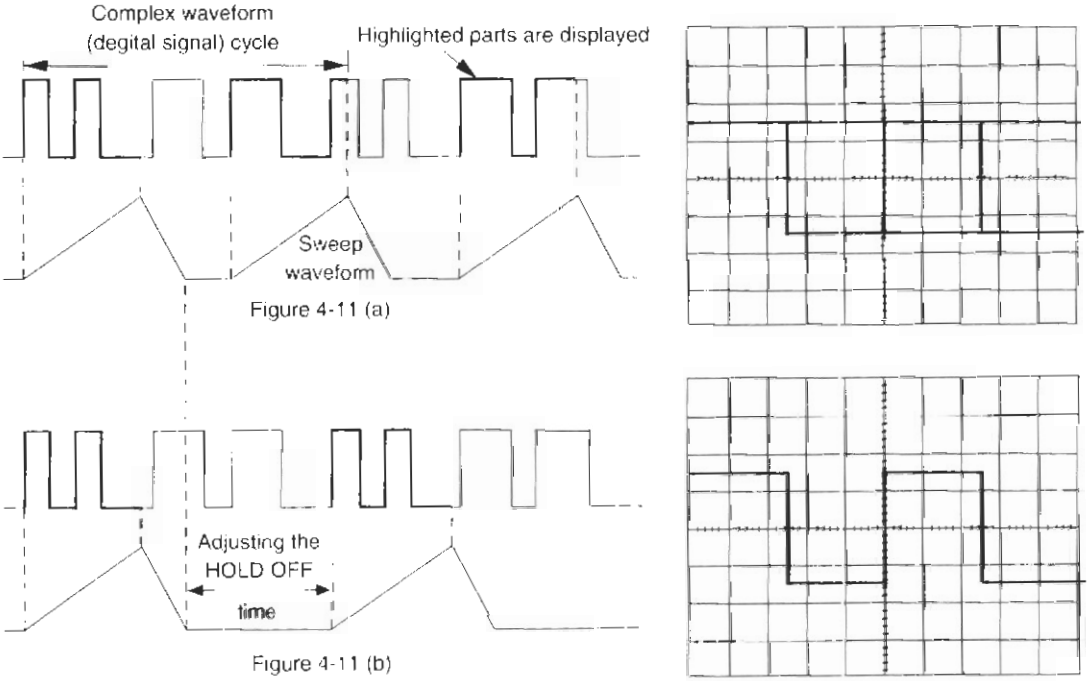


Figure 4-11

4.8 Single-sweep Operation

Non-repetitive signals and one-shot transient signals can hardly be observed on the screen with the regular repetitive sweep operation. Such signals can be measured by displaying them in the single-sweep mode on the screen and photographing them.

Measurement of non-repetitive signal:

(1) Set the TRIGGER MODE to the NORM state.

(2) Apply the measured signal to the vertical input terminal and adjust the triggering level.

(3) Set the TRIGGER MODE to the SINGLE state (the three push-button switches are pushed out).

(4) Press the SINGLE button. The sweep will run only for one cycle and the measured signal will be displayed only once on the screen.

Measurement of single-shot signal: (LS 8050 only)

(1) Set the TRIGGER MODE to the NORM state.

(2) Apply the calibrator output signal to the vertical input terminal, and adjust the triggering level at a value corresponding to the predicted amplitude of the measured signal.

(3) Set the TRIGGER MODE to the SINGLE state. Apply the measured signal instead of the calibrator signal to the vertical input.

(4) Depress the SINGLE button. The sweep circuit is now in the ready state and the READY indicator lamp will be turned on. However, this cannot be done when the dual-channel ALT mode is in operation. For the dual-channel one-sweep operation, use the CHOP mode instead.

(5) As the one-shot signal occurs in the input circuit, the sweep runs only for one cycle and the one-shot signal is displayed on the CRT screen. However, this cannot be done when the dual-channel ALT mode is in operation. For the dual-channel one-sweep operation, use the CHOP mode instead.

4.9 Sweep Magnification

When a certain part of the displayed waveform is needed to be expanded timewise, a faster sweep speed may be used. However, if the required portion is apart from the starting point of the sweep, the required portion may run off the CRT screen. In such a case, push in the x 10 MAG button center of expansion.

When this has been done, the displayed waveform will be expanded 10 times to the right and left with the center of screen as the center of expansion.

The sweep time during the magnification operation is as follows:

(Value indicated by TIME/DIV switch) x 1/10

Thus, the unmagnified maximum sweep speed (0.1 uSec/DIV) can be increased with the magnification as follows:

0.1 uSec/DIV x 1/10 = 10 nSec/DIV

When the sweep is magnified and the sweep speed is above 0.1 uSec/DIV, the trace may become darker. In such a case, the displayed waveform should be expanded in the B sweep mode as explained in the subsequent paragraphs.

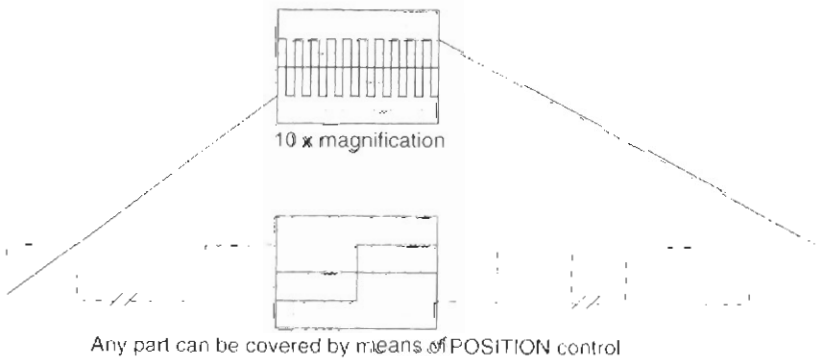


Figure 4-12

4.10 Waveform Magnification with Delayed Sweep (LS 8050 only)

With sweep magnification of the preceding paragraph, although the magnification method is simple, the magnification ratio is limited to 10. With the delayed sweep method of this paragraph, the sweep can be expanded for a wider range from several times to several thousand tumes accoding to the ratio between A sweep time and B sweep time.
As the measured signal frequency increases, the A sweep range for the non-expanded signal becomes higher whereas the available expans on ratio becomes smaller. Furthermore, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with these situations, a continuous variable delay circuit and a triggering delay circuit are incorporated into the oscilloscope.

(1) Continuous variable delay

Set the HORIZ. DISPLAY MODE switch to A and display the signal waveform with the A sweep in the regular operation mode. Next, set the B TIME/DIV switch to a position several steps faster than that of the A TIME/DIV switch. After ensuring the B TRIG'D button of the HORIZ. DISPLAY MODE switch is disengaged, engage the HORIZ. DISPLAY MODE switch to the A INTEN position. A porition of the displayed waveform will be accentuated as shown in Figure 4-14, indicating the state ready for delayed sweep. The portion of the accentuated brightness indicates the section corresponding to the B sweep time (DELAYED SWEEP). This portion is expanded on the B sweep.
The period from the start of the A sweep to that of the B sweep (the period to the start of trade accentuation) is called "SWEEP DELAY TIME". This period is a continuous variably by means of the DELAY TIME POSITION knob. Next, change the HORIZ. DISPLAY MODE switch to the B position. The B sweep time will be expanded for the full span of the CRT screen as shown in Figure 4-15. The B sweep time is set by the B TIME/DIV switch, the magnification ratio becomes:

$$\text{Magnification} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

(2) Triggering delay:

When the display waveform is magnified by 100 or higher in the above-mentioned continuous delay method, delay jitter is produced. To suppress the jitter, the triggering delay method may be used. With the triggering delay, delay jitter is reduced by triggering the B sweep again, after a sweep delay time as effected by the continuous delay method has elapsed.

For this operation, the A trigger circuit continues to operate even after the B TRIG'D button is engaged and the B sweep is triggered by the triggering pulse. Therefore, even when the delay time is continuously varied by turning the TIME DELAY POSITION knob, the starting point of the sweep moves discretely, not continuously. In the A INTEN mode, this operation is characterized by the discrete shifts of the brightness-accentuated section of sweep across the CRT screen; While in the B mode this section remains stationary.

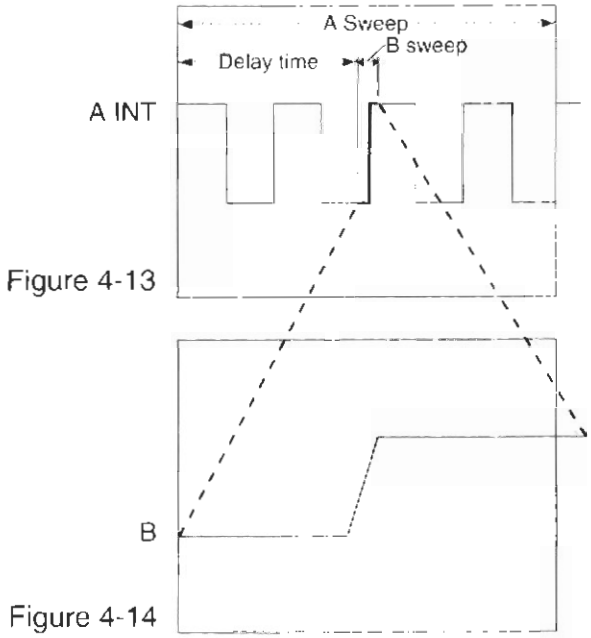


Figure 4-13

Figure 4-14

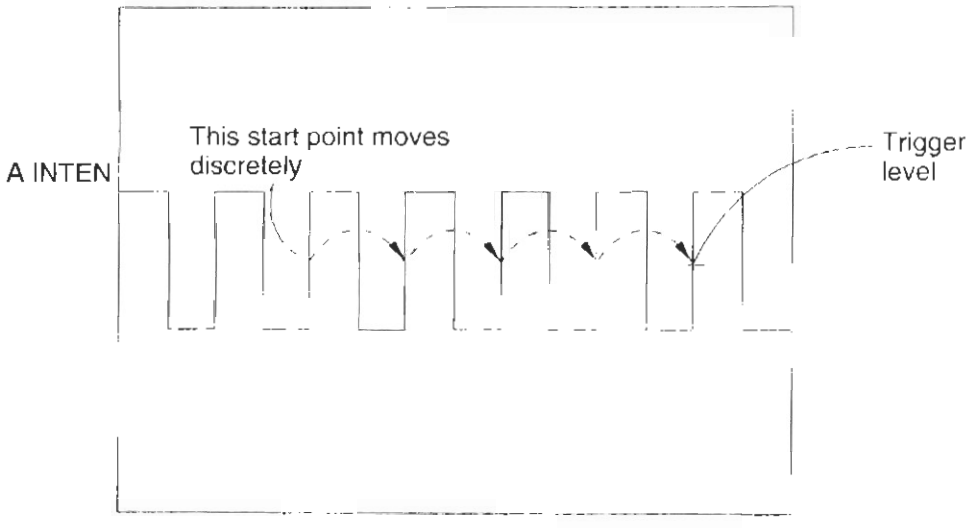


Figure 4-15

4.11 Calibration of Probe

As explained previously, the probe makes up a wide range attenuator. Unless phase compensation is properly done, the displayed waveform is destorted causing measurement errors. Therefore, the probe must be properly compensated before use.

Connect the probe BNC to the INPUT terminal of CH1 or CH2 and set VOLTS/DIV switch at 50 mV. Connect the probe tip to the calibration voltage output terminal and adjust the compensation trimmer on probe for optimum square wave (minimum overshoot, rounding off and tilt). Refer to 4-16 & 4-17:

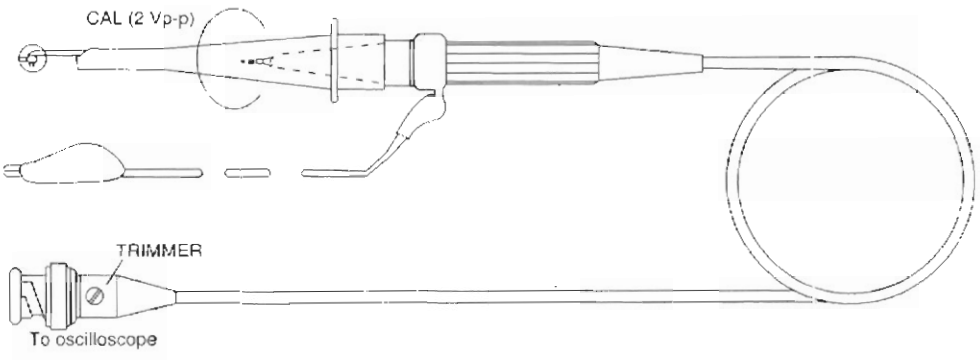


Figure 4-16

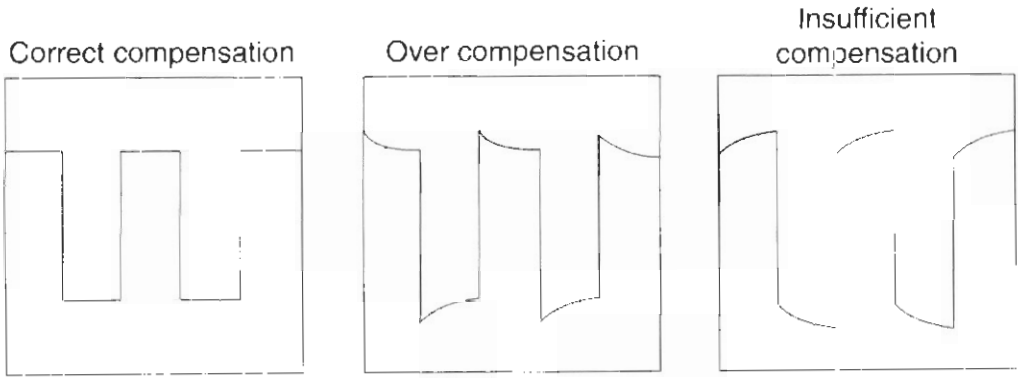


Figure 4-17

5. MAINTENANCE

WARNING

The following instructions are for use by qualified personnel only. To avoid electrical shock. Do not perform any servicing other than in the operating instructions unless you requalified to do so.

5.1 Fuse Replacement

If the fuse blows, the power lamp indicatiors will not light and the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse. The replace only with a fuse of the correct rating and type see page)
The fuse is located on the rear panel (see fig. 4-2)

⚠ WARNING. For continued fire protection. Replace fuse only with 250 V fuse of the specified type and rating, and disconnect power cord replacing fuse.

5.2 Line Voltage Conversion

The primary winding of the power transformer is tapped to permit operation from 100, 120, 220, or 230 VAC 50/60 Hz line voltage. Conversion from one line voltage to another is dine by change AC selects switch as shown in Fig. 4-2
The pear panel indentifies the line voltage to which the unit was factory setted. To convert to a different line voltage. Perform the following procedure:

(1) Make sure the power cord is unplugged.
(2) Change the AC selects switch to the desired line voltage position.
(3) A change in line voltage may also require a corresponding change of fuse value. Install the correct fuse value as listed on rear panel.

5.3 Cleaning

To clean the oscilloscope, use a soft cloth dampened in a solution of mild detergent and water. Do not apray cleaner directly onto the oscilloscope because it may leak into the cabinet and cause damage.
Do not use chemicals containing benzine, benzene, toluene, xylene, acetone, or similar solvents.
Do not use abrasive cleaners on any portion of the oscilloscope.

リーダー電子株式会社

本社・国内営業部	〒223-8505	横浜市港北区綱島東2丁目6番33号	(045)541—2122 (代表)
関西営業所	〒550-0014	大阪市西区北堀江2丁目7番9号	(06) 541—2121 (代表)
東北営業所	〒984-0816	仙台市若林区河原町1丁目7番14号	(022)224—2345 (代表)
北関東営業所	〒323-0822	栃木県小山市駅南町4丁目31番12号	(0285)27—5331 (代表)
関越営業所	〒360-0004	熊谷市上川上515—1番地	(0485)27—3900 (代表)
甲信営業所	〒390-0863	松本市白板2丁目3番28号	(0263)33—7171 (代表)
中部営業所	〒465-0035	名古屋市名東区豊が丘702番地	(052)778—2601 (代表)
北陸営業所	〒920-1135	金沢市北袋町ト41—1番地	(0762)35—1288 (代表)
九州営業所	〒815-0032	福岡市南区塩原3丁目10番26号	(092)552—7117 (代表)

LEADER ELECTRONICS CORP.

2-6-33 Tsunashima-Higashi, Kohoku-ku, Yokohama 223-8505 Japan
PHONE: 81-45-541-2123 FAX: 81-45-541-2823

Leader Instruments Corporation
6484 Commerce Drive, Cypress, California 90630 Tel: (714) 527-9300 Fax: (714) 527-7490
Regional Offices: Atlanta, Boston, Chicago, Cleveland, Dallas, Los Angeles, New York

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