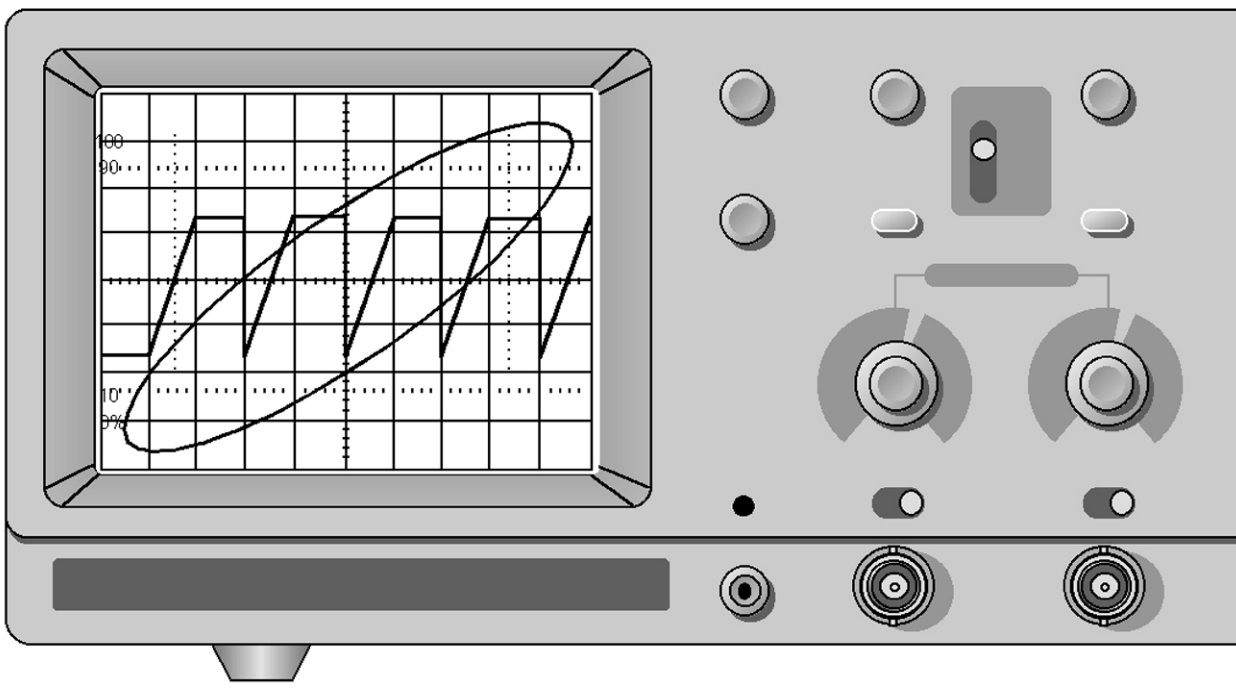
Oscilloscope

OS-5020/5020C

Analog Oscilloscope
Service Manual



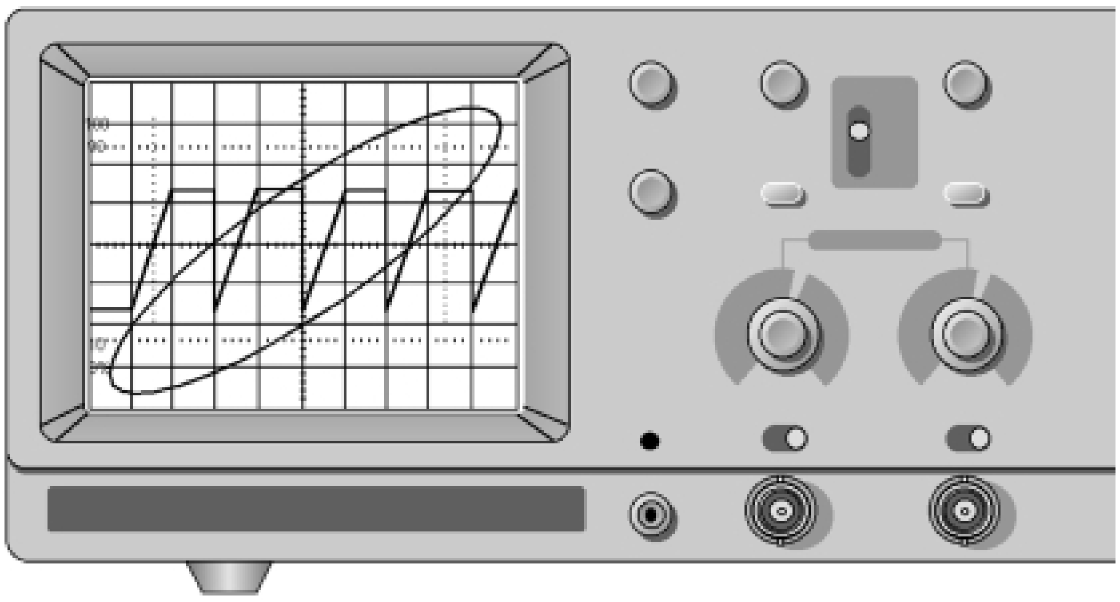
EZ Digital Co.,Ltd.

EZ

Oscilloscope

OS-5020/5020C

Analog Oscilloscope
Operation Manual



EZ Digital Co.,Ltd.

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	EZ Digital Co., Ltd.
Manufacturer's Address:	222-28, Nae-dong, Ojeong-gu Bucheon-si, Gyeonggi-do R.O.K, 421-160

Declares that the product:

Product Name:	OSCILLOSCOPE
Model Numbers:	OS-5020 OS-5020C
Date:	July. 10 . 1998.

Conforms to the following product specifications:

Safety:	EN 61010-1 : 1993 (IEC 1010-1 : 1990 + A1:1992, modified) Certified by TÜV Rheinland
EMC :	EN 61000-3-2 : 1995 EN 61000-3-3 : 1995 EN 55011 : 1991 Class A EN 50082-1 : 1997 (EN 61000-4-2 : 1995) (EN 61000-4-3 : 1995) (EN 61000-4-4 : 1995) (EN 61000-4-5 : 1995) (EN 61000-4-6 : 1996) (EN 61000-4-8 : 1993) (EN 61000-4-11 : 1994) (ENV50204 : 1995) Certified by KOREA TOKIN EMC

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Bucheon, Gyeonggi

Location

C. Y. Kim

Cheol Young Kim
Quality Assurance Manager

Safety Summary

Safety Precautions

Please take a moment to review these safety precautions.
They are provided for your protection and to prevent damage to the oscilloscope.
This safety information applies to all operator and service personnel.

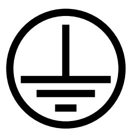
Caution and warning statements.

CAUTION : Is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.

WARNING : Calls attention to a potential danger that requires correct procedures or practices in order to prevent personal injury.

Symbols

Caution(refer to accompanying documents) and Warning



Protective ground(earth) symbol

Introduction

Thank you for purchasing a EZ product. Electronic measuring instruments produced by EZ Digital are high technology products made under strict quality control. We guarantee their exceptional and utmost reliability. For proper use of the product please read this manual carefully.

EZ Digital Co.,Ltd.

Instructions

1. To maintain the precision and reliability of the product use it in the standard conditions(temperature 10 ℃~ 35℃ and humidity 45%~85%)

2. After turning on power, please allow a 15minute preheating warmup period before using.

3. Triple-line power cord is to be used for this product. But when you are using doubleline power cord. Make sure for safety

4. For quality improvement the exterior design and specifications of the product can be changed without prior notice.

5. If you have further questions concerning use, please contact the EZ Digital service center or sales outlet.

Warranty

This instrument is warranted against defects in workmanship and materials. If any failure, resulting from a defect in either workmanship or material should occur under normal use within a year from the original date of purchase, such failure will be corrected free of charge to the purchaser by repair or replacement of the defective part or parts. When the failure is a result of user's neglect, natural disaster or accident, we charge for repairs regardless of the warranty period.

This warranty is subject to the following conditions and limitations.
The warranty is void and inapplicable if the defective product is not brought or sent prepaid to our authorized service center or sales outlet within a warranty period. Defective product is, on EZ Digital Co., Ltd. 's sole judgement, indemnified at a purchased price, replaced with new one or repaired without charge or with charge

In the event warranty service is needed, purchaser should get in touch with service center or sales outlet, or properly packed and return the product to the service center or sales outlet at his or her sole expense. A returned product must be accompanied by a written description of the defect. We returns the product to the purchaser at his own expense. In case that warranty does not cover the product on EZ Digital Co., Ltd. 's sole judgement, we repairs the product after obtaining prior permission from the purchaser who received pro forma statement about repairing charges. In such a case, EZ Digital Co., Ltd. bears the transporting expenses required to send back all the repaired products for the moment, and then repair and transporting expenses will be charged against the purchaser by the statement of accounts.

When the authorized sales agents sell our product, they must notify the purchaser of the warranty contents, but have not any rights to stretch the meaning of original warranty contents or offer additional warranty. EZ Digital Co., Ltd. does not provide any other promise or suggestive warranty and hold no liability for the damage caused by negligence, abnormal use or natural disaster. EZ Digital Co., Ltd. is not responsible for the damages though it is notified above dangers in advance as well.

For more special service or overall repairs and maintenance of old and decrepit products, be sure to contact our service center or sales outlet.

EZ Digital Co.,Ltd.

CONTENTS

1.PRODUCT DESCRIPTION

2. OPERATING INSTRUCTIONS

3. USER MAINTENANCE GUIDE

4. DIAGRAMS

1. PRODUCT DESCRIPTION

1-1. INTRODUCTION

The OS-5020SRS is an oscilloscope with a frequency bandwidth of DC to 20MHz that display 2 traces on 2 channels.

The OS-5020SRS provides a set of powerful features for a wide range of applications such as production, maintenance, service, research and Development.

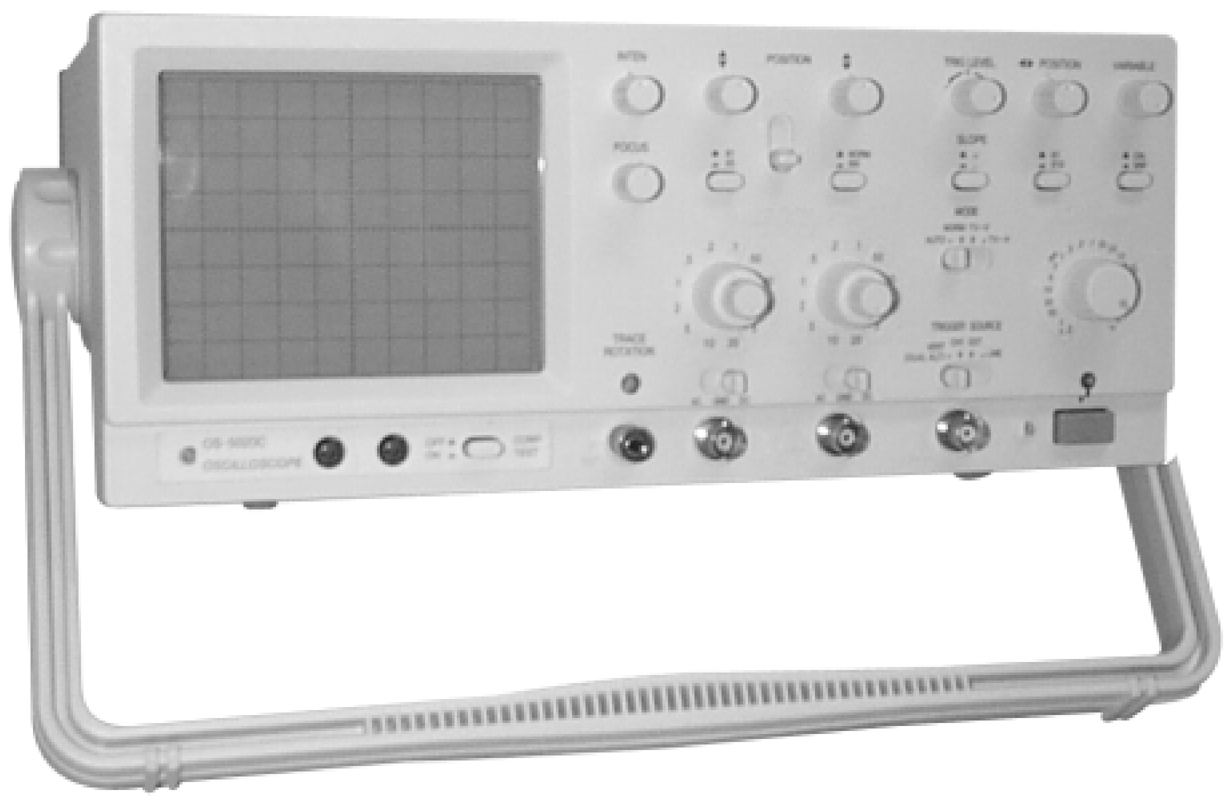
The features of the OS-5020SRS are as follows;

- The OS-5020SRS has ADD function for measuring the sum of two Signals.

- The OS-5020SRS has X-Y operation function, alternate trigger and independent TV synchronizing signal separate circuit so that television and other composite video signal waveforms can be observed.

- The OS-5020SRS is designed for compact size and portable function.

The OS-5020C is an oscilloscope that is added to component test function for measuring the good or fault of component in the OS-5020.



1-2. SPECIFICATIONS

PART	SPECIFICATION
* CRT	
1)Configuration and useful screen	6-inch rectangular screen with internal graticule: 8x10DIV (1DIV=1 cm) , marking for measurement of rise time. 2mm subdivisions along the central axis.
2)Accelerlating Potential	+1.9kV approx. (ref. cathode)
3)Phosphor	P31
4)Focusing	possible
5)Trace Rotation	provided
6)Intensity Control	provided
* Z-Axis input (Intensity Modulation)	
1)Input Signal	Positive going signal decreases intensity +5Vp-p or more signal cases noticeable modulation at normal intensity settings.
2)Band-width	DC-2MHz(-3dB)
3)Coupling	DC
4)Input impedance	20k -30kohms
5)Maximum input voltage	30V(DC+peak AC)
* Vertical Deflection	
1)Band-Width(-3dB) DC coupled	DC to 20MHz normal DC to 10MHz magnified (CH1 only)
AC coupled	10Hz to 20MHz normal 10Hz to 10MHz magnified (CH1 only)
2)Modes	CH1,CH2,ADD,DUAL(CHOP:Time/div switch 0.2s to 1ms ALT:Time/div switch 0.5ms to 0.2us)
3)Deflection factor	5mV/div to 20V/div in 12 calibrated steps of a 1:2:5 sequence. Continuously variable between steps at least 1:2.5 x5 MAG:1mV/div to 1V/div in 10 calibrated steps. (CH1 only)

PART	SPECIFICATION
4)Accuracy	normal; ±3% , magnified; ±5% (CH1 only)
5)Input impedance	approx. 1Mohm in parallel with 30pF
6)Maximum input voltage	Direct:400V(DC+peak AC) With probe:refer to probe specification
7)Input coupling	DC-GND-AC
8)Rise time	17.5ns or less (35ns or less: X5MAG)
9)CH1 out	25mV/div±20% into 50 ohms:20Hz to 10MHz(-3dB)
10)Polarity inversion	CH2 only
* Horizontal Deflection	
1)Display modes	Normal, X-Y, X10, VARIABLE
2)Time base	0.2us/div to 0.2s/div in 19 calibrated steps, 1-2-5 sequence. uncalibrated continuous control between steps at least 1:2.5
3)Sweep magnification	10 times (maximum sweep rate ; 20ns/div) Note:50ns/div,20ns/div of TIME BASE are ±10%.
4)Accuracy	±3%,±5%(0℃ to 40℃), additional error for magnifier ±2%
* Trigger System	
1)Modes	AUTO, NORM, TV-V, TV-H
2)Source	VERT(DUAL,ALT), CH1, EXT, LINE
3)Coupling	AC
4)Slope	+ or -
5)Sensitivity and Frequency AUTO, NORM	| | 20Hz-2MHz | 2MHz-20MHz | | INT(VERT) | 0.5div(2.0) | 1.5div(3.0) | | EXT | 0.2 Vp-p | 0.8 Vp-p |
TV-V, TV-H	at least 1 div or 1.0 Vp-p

PART	SPECIFICATION
6)External trigger Input impedance	approx. 1M-ohm
Max. Input voltage	400V(DC + peak AC)
* X-Y Operation 1)X-axis	(same as CH1 except for the following) Deflection factor : same as that of CH1 Accuracy : 5% Frequency response : dc to 500kHz(-3dB)
2)Y-axis	same as CH2
3)X-Y phase difference	3° or less(at DC to 50kHz)
* Component Test. (OS-5020C Only)	* One test lead is grounded (safety earth)
1)Test Voltage	approx. 4.5Vrms (open circuit)
2)Test Current	max. 6.6mArms(short circuit)
3)Test Frequency	approx. 60Hz
* Calibrator(probe adj.)	1kHz(±20%) frequency, 0.5V(±10%) square wave duty ratio:40- 60%
* Power Supply 1)Voltage range	see table below
2)Frequency	50/60Hz
3)Power consumption	approx. 45W
* Physical Charac. 1)Weight	7.8kg
2)Dimension	316mm(W) X 132mm(H) X 410mm (L)

voltage range	fuse(250V)	
	UL198G	IEC127
115(98-125V) / AC	1.25A	1.25A
230(198-250V)/AC	0.63A	0.63A

PART	SPECIFICATION
* Environmetal Charac-teristic	
1)Temperature range for rated operation	+10° C to +35° C (+50° F to +95° F)
2)Max. ambient operating temperature	0° C to +40° C (+32° F to +104° F)
3)Max Storage temperature	- 20° C to +70° C (4° F to +158° F)
4)Humidity range for rated operation	45% to 85% RH
5)Max. ambient operating humidity	35% to 85% RH
6)Safety	EN61010-1 overvoltage CAT 2, degree of pollution 2. Approval:TÜV/GS
7)EMC	Interference:EN500811 Susceptability:EN500821, IEC8012,3,4

<Caution>
Sources like small handheld ratio transceivers, fixed station radio & television transmitters, vehicle radio transmitter & cellular phones generate electromagnetic radiation that may induce voltages in the leads of a test probe in such cases the accuracy of the oscilloscope can not be guaranteed due to physical reasons. Using the 4DIV scale, the oscilloscope radiation can be exceeded the limit.

1-3. PRECAUTIONS

1-3-1. Line Voltage Selection

This instrument must be operated with the correct Line Voltage Selector Switch setting and the correct line fuse the line voltage selected to prevent damage. The instrument operates from either a 98 to 125 volts or a 198 to 250volt line voltage source. Before line voltage is applied to the instrument, make sure the Line Voltage Selector Switch is set correctly.

To change the line voltage selection:

1. Make sure the instrument is disconnected from the power source.

2. Pull out the Line Voltage Selector Switch on the rear panel. Select the arrow mark position of the switch from Table1-1. Slide the arrow mark to the desired position and plug it in the holder with the correct fuse from table 1-1.

Table 1-1. Line Voltage Selection and Fuse Ratings

voltage range	Arrow Mark position	Fuse Rating (250V)	
		UL198G	IEC127
98 to 125 volts	115	F1.25A	F1.25A
198 to 250 volts	230	F0.63A	F0.63A

1-3-2. Installation and handling precautions

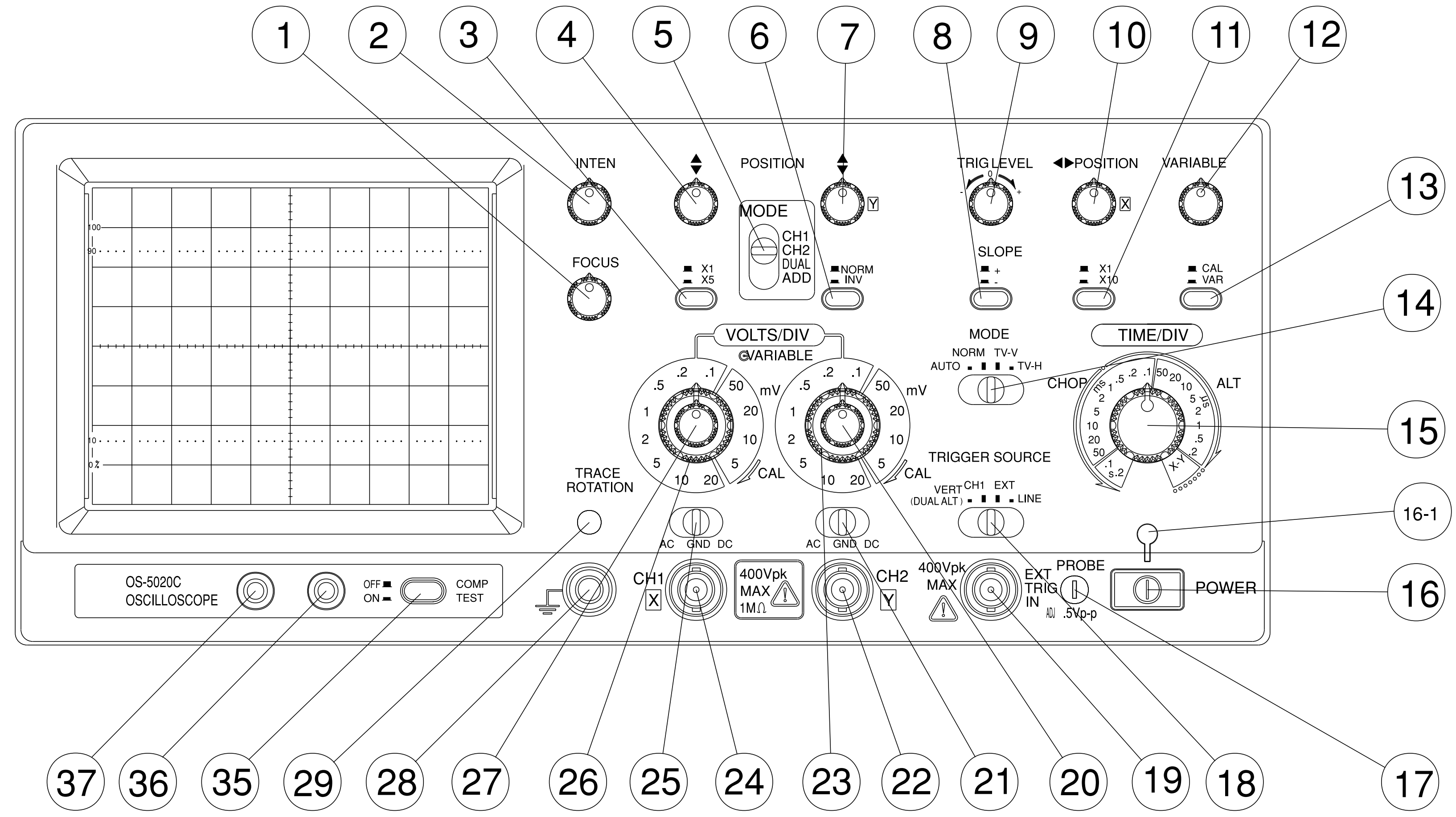
When placing the OS-5020SRS in service at your workplace, observe the following precautions for best instrument performance and longest servic life

1. Avoid placing this instrument in an extremely hot or cold place. Specifically, don't leave this instrument in a close car, exposed to sunlight in midsummer, or next to a space heater.
2. Do not use this instrument immediately after bringing it in from the cold. Allow time for it to warm to room temperature. Similarly don't move it from a warm place to a very cold place, as condensation might impair its operation.
3. Do not expose the instrument to wet or dusty environments.
4. Do not place liquid-filled containers (such as coffee cups) on top of this instrument. A Spill could seriously damage the instrument.
5. Do not use this instrument where it is subject to severe vibration, or strong blows.
6. Do not place heavy objects on the case, or otherwise block the ventilation holes.
7. Do not use this oscilloscope in strong magnetic fields, such as near motors.
8. Do not insert wires, tools, etc. through the ventilation holes.
9. Do not leave a hot soldering iron near the instrument.
10. Do not place this scope face down on the ground, or damage to the knobs may result.
11. Do not use this instrument upright while BNC cables are attached to the rear panel connectors. This will damage the cable.
12. Do not apply voltages in excess of the maximum ratings to the input connectors or probes.
13. This oscilloscope is to use UL listed double insulated probes only.

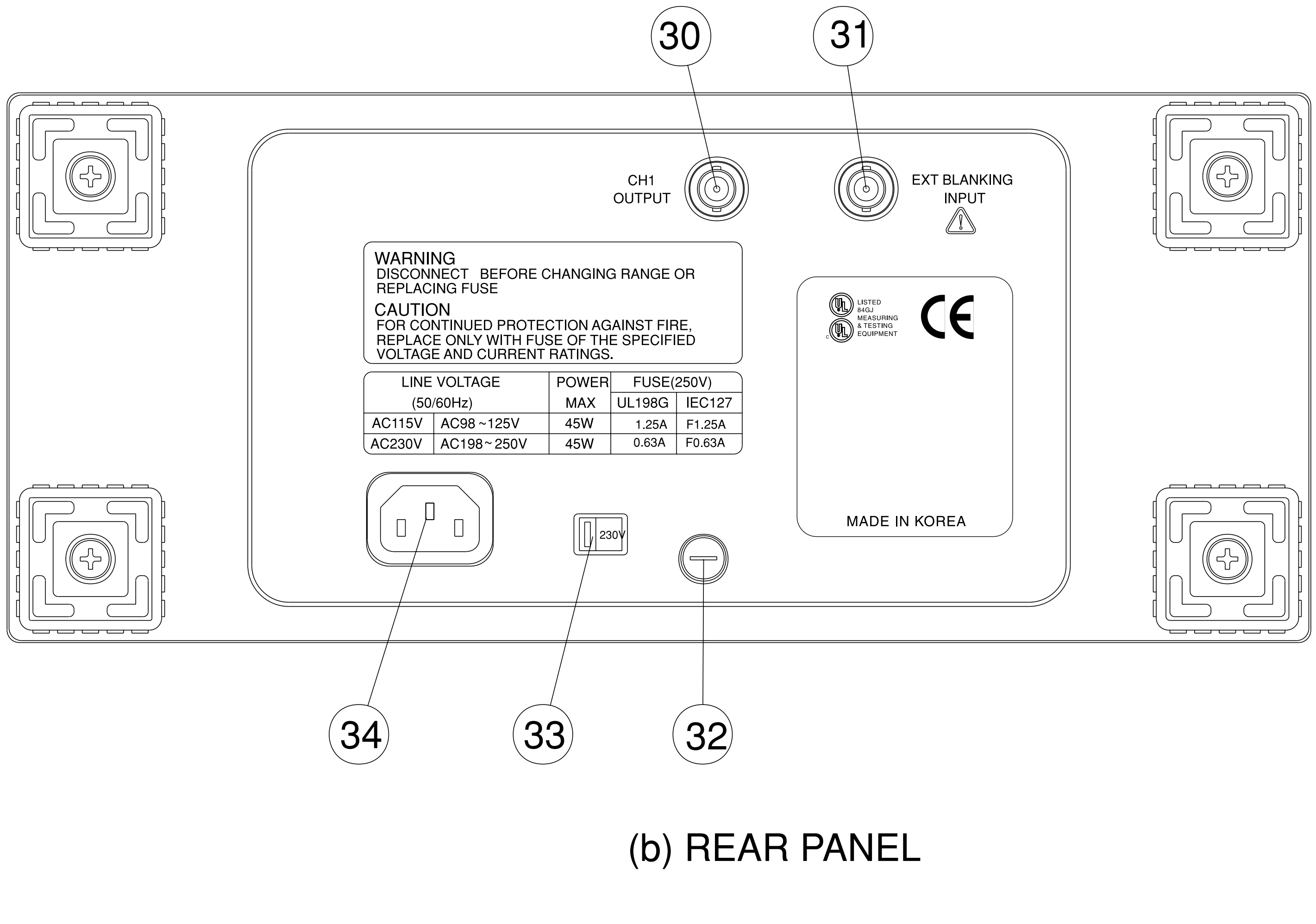
1-4. ACCESSORY

The following accessories are included in the packing of this product:

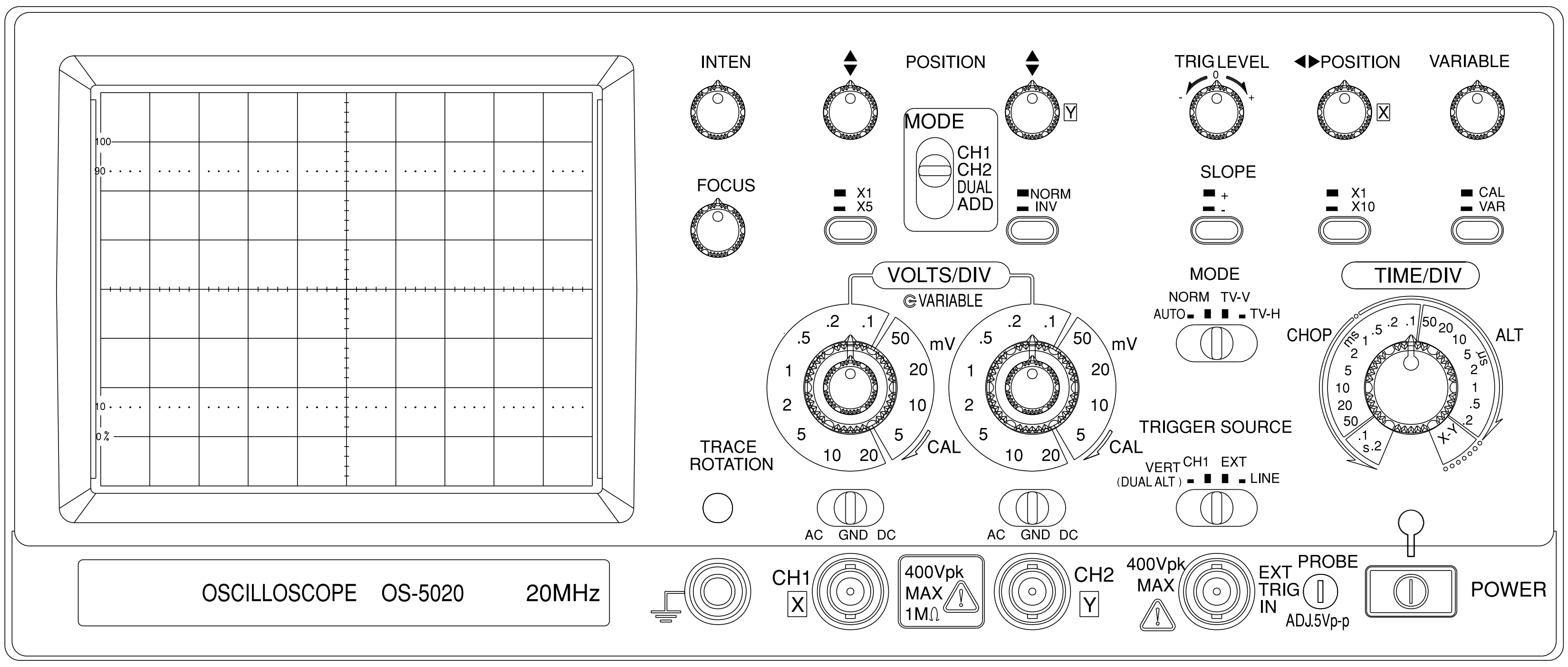
1. Operating Manual	:	1 copy
2. AC power cord	:	1 EA
3. Probe (option)	:	2 EA
4. Fuse	:	1 EA
5. DMM Probe(OS-5020C Only)	:	1 set



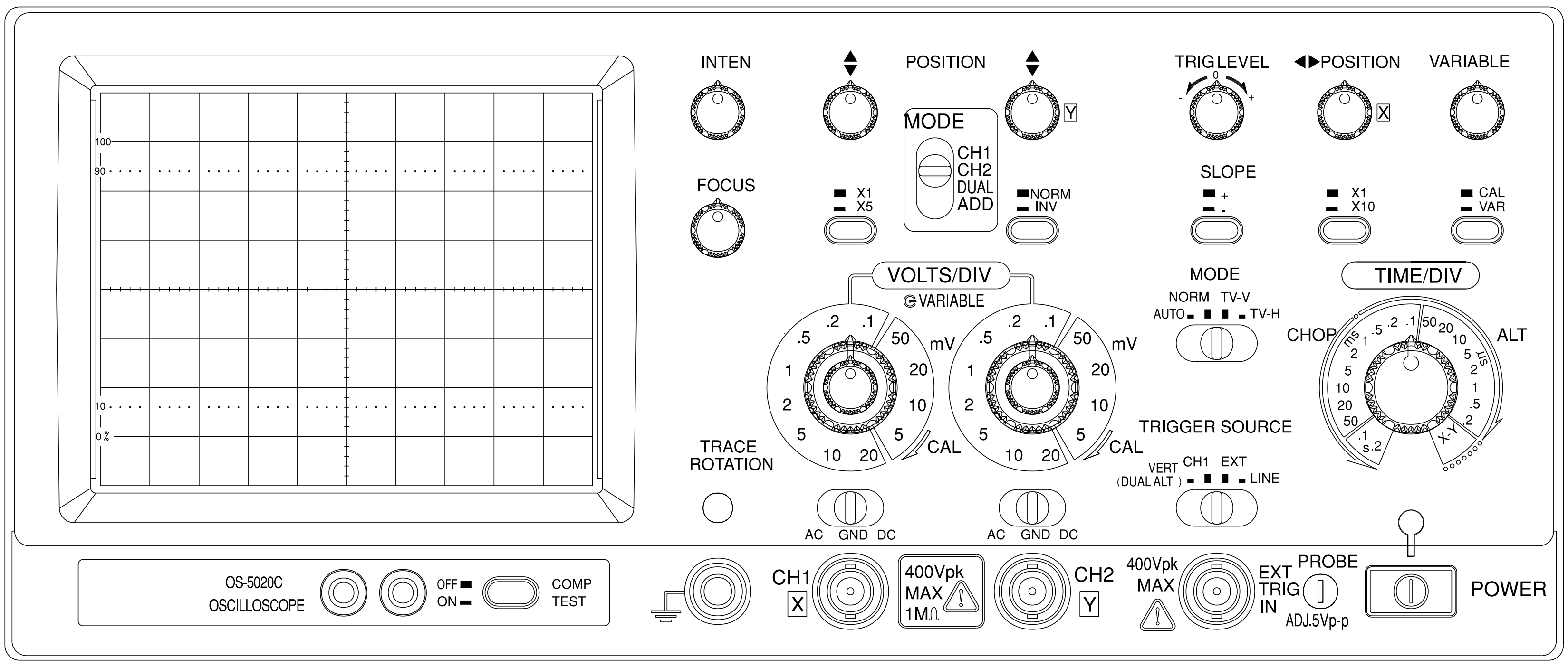
(a) FRONT PANEL



(b) REAR PANEL



(c) OS-5020



(d) OS-5020C

FIGURE 2-1. THE FRONT AND REAR PANEL OF OS-5020SRS

This section contains the information needed to operate the OS-5020SRS and utilize it in a variety of basic and advanced measurement procedures. Included are the identification and function of controls, connectors, and indicators, startup procedures, basic operation routines, and selected measurement procedures.

2-1. FUNCTION OF CONTROLS, CONNECTORS, AND INDCATORS

Before turning this instrument on, familiarize yourself with the controls, connectors, indicators, and other features described in this section. The following descriptions are keyed to the items called out in Figure 2-1.

2-1-1. Display and Power Blocks

Item	Function
(16) POWER switch	Push into turn instrument power on and off
(16-1) POWER lamp	Sights when power is on.
(2) INTEN control	Adjusts the brightness of the CRT display. Clockwise rotation increases brightness.
(1) FOCUS control	To obtain maximum trace sharpness.
(29) ROTATION control	Allows screwdriver adjustment of trace alignment with regard to the horizontal graticule lines of the CRT.
(33) Voltage Selector	Permits changing the operating voltage range.
(34) Power Connector	Permits removal or replacement of the AC power cord.

2-1-2. Vertical Amplifier Block

(24)CH1 or X IN connector	For applying an input signal to vertical amplifier CH1, or the X-axis(horizontal) amplifier during X-Y operation .
<CAUTION>	To avoid damage to the oscilloscope do not apply more than 400V (DC+Peak AC) between "CH1" terminal and ground.
(22)CH1 or Y IN connector	For applying an input signal to vertical amplifier CH2, or the Y-axis(Vertical) amplifier during X-Y operation.
<CAUTION>	To avoid damage to the oscilloscope do not apply more than 400V(DC+Peak AC) between "CH2" terminal and ground.
(25)CH1 AC/GND/DC switch	To select the method of coupling the input signal to the CH1 vertical amplifier. AC position inserts a capacitor between the input connector and amplifier to block any DC component in the input signal. GND position connects the amplifier to ground instead of the input connector, so a ground reference can be established. DC position connects the amplifier directly to its input connector, thus passing all signal components on to the amplifier.
(21)CH2 AC/GND/DC switch	To select the method of coupling the input signal to the CH2 vertical amplifier.
(26)CH1 VOLTS/DIV switch	To select the calibrated deflection factor of the input signal fed to CH1 vertical amplifier.
(23)CH2 VOLTS/DIV switch	To select the calibrated deflection factor of the input signal fed to CH2 vertical amplifier.
(27)(20)VARIABLE controls	Provide continuously variable adjustment of deflection factor between steps of the VOLTS/DIV switches. VOLTS/DIV calibrations are accurate only when the VARIABLE controls are click-stopped in their fully clockwise position.

(3)X5 MAG switch	The sensibility of vertical axis will become 5 times if the switch selected at X5 MAG. That's to say, the measuring voltage will be 1/5 of indicator value of VOLTS/DIV. (in this instance the maximum sensitivity will be 1mV/DIV.)
(4)CH1 POSITION control	For vertically positioning the CH1 trace on the CRT screen, clockwise rotation moves the trace upward, counterclockwise rotation moves the trace down.
(7)CH2 POSITION control	For vertically positioning the CH2 trace on the CRT screen, clockwise rotation moves the trace upward, counterclockwise rotation moves the trace downward.
(6)CH2 INV switch	Select switch at INV the signal added to CH2 will be turned over.
(5)V MODE switch	To select the verticalamplifier display mode. CH1 position displays only the CH1 input signal on the CRT screen. CH2 position displays only the CH2 input signal on the CRT screen. DUAL position displays the CH1 and CH2 input signal on the CRT screen simultaneously. If Trigger Source is selected CH1, CHOP mode : TIME/DIV 0.2s~1ms ALT mode : TIME/DIV 0.5ms~0.2us If Trigger Source is selected VERT, ALT mode : TIME/DIV 0.2s~0.2us ADD position displays the algebraic sum of CH1 and CH2 signal.
(30)CH1 OUTPUT connector	Connector provides amplified output of the CH1 signal suitable for driving a frequency counter or other instrument.

2-1-3. Sweep and Trigger Blocks

(15)TIME/DIV switch

To select either the calibrated sweep rate of the main timebase, the delay time range for delayed sweep operation or X-Y operation.

(12)VARIABLE control

Provides continuously variable adjustment of sweep rate between steps of the TIME/DIV switch. TIME/DIV calibrations are accurate only when the VARIABLE control is click-stopped fully clockwise.

(11)X10MAG switch

Placing the switch on X10MAG sweep time will be expanded to 10times and in this instance sweep time becomes 1/10 of TIME/DIV indicator value.

(10)Horizontal POSITION control

To adjust the horizontal position of the traces displayed on control the CRT. Clockwise rotation moves the traces to the right, counter-clockwise rotation moves the traces to the left.

(14)Trigger MODE switch

To select the sweep triggering mode.
AUTO position selects free-running sweep where a baseline is displayed in the absence of a signal.
This condition automatically reverts to triggered sweep when a trigger signal of 25Hz or higher is received and other trigger controls are properly set.
NORM position produces sweep only when a trigger signal is received and other controls are properly set. No trace is visible when the signal frequency is 25 Hz or lower.
TV-V position is used for observing a composite video signal at the frame rate.
TV-H position is used for observing a composite video signal at the scanning line rate.

(18)Trigger Source switch

To conveniently select the trigger source.

VERT: Signal which is put into CH1 or CH2 is source of operation.
In case of vertical mode switch is CH1 which automatically becomes registry source.
In case of vertical mode switch is CH2 which automatically becomes registry source.
When Vert Mode Switch is dual, the signals are displayed with ALT Mode in all TIME/DIV range.

CH1: When there is the signal in the CH1, you may select trigger source CH1.

LINE: Position selects a trigger derived from the AC poser line, This permits the scope to stabilize display line, related components of a signal even if they are very small compared to other components of the signal.

EXT: Position selects the signal applied to the EXT TRIG IN connector.

(9)Trigger LEVEL control

To select the trigger signal amplitude at which triggering occurs. When rotated clockwise, the trigger point moves toward the positive peak of the trigger signal. When this control is rotated counterclockwise, the trigger point moves toward the negative peak of the trigger signal.

(8)Trigger Slope switch
(on LEVEL control)

To select the positive or negative slope of the trigger signal(on LEVEL control) for initiating sweep. pulled in, the switch selects the positive (+)slope, When pushed, this switch selects the negative (-)slope.

(19)EXT TRIG IN connector

For applying external trigger signal to the trigger circuits.

<CAUTION>

To avoid damage to the oscilloscope, do not apply more than 400V (DC+Peak AC) between "EXT Trig In" terminal and ground.

2-1-4. Miscellaneous Features

(31)EXT Blanking Input connector	For applying signal to intensity modulate the CRT, trace brightness is reduced with a positive signal, and increased with a negative signal.
(17)Probe Adjust	Provides a fast rise square wave of precise amplitude for probe adjustment and vertical amplifier calibration.
(28)Ground Connector	Provides an attachment point for a separate ground lead.

2-1-5. Component Test Block(Only OS-5020C)

(35)Component Test Switch	Push to test the component. Then the horizontal bar graph of 8div is displayed on the screen.
(36)Component Test Input (Red)	Be used for connecting component to component test circuit with DMM probe(Red).
(37)Component Test GND (Black)	Be used for grounding component to component test circuit with DMM probe(Black).

2-2. BASIC OPERATING PROCEDURES

The following paragraphs in this section describe how to operate the OS-5020SRS,beginning with the most elementary operating modes, and progressing to the less frequently used/or complex modes.

2-2-1. Preliminary Control Settings and Adjustments

Before placing the instrument in use, set up and check the instrument as follows:

1. Set the following controls as indicated.

POWER switch(16)	OFF(released)
INTEN control(2)	Mid rotation
FOCUS control(1)	Mid rotation
AC/GND/DC switch(25)(21)	DC
VOLTS/DIV switch(26)(23)	10mV
X5 MAG switch(3)	X1
Vertical POSITION controls(4)(7)	Mid rotation
INV switch(6)	Norm
VARIABLE controls(27)(20)	Fully CCW
V MODE switch(5)	CH1
TIME/DIV switch(15)	1ms
VARIABLE control(13)	CAL
Horizontal POSITION control(10)	Mid rotation
X10 MAG switch(11)	X1
Trigger MODE switch(14)	AUTO
Trigger SOURCE switch(18)	VERT
Trigger LEVEL control(9)	Mid rotation
SLOPE switch(8)	Button out

2. Connect the AC power Cord to the Power Connector (34), then plug the cord into a convenient AC outlet.

3. Press the POWER switch(16).
The POWER lamp(16-1) should light immediately.
About 30 seconds later, rotate the INTEN control colckwise until the trace appears on the CRT screen. Adjust brightness to your liking.

<CAUTION>
A burn-resistant material is used in the CRT. However if the CRT is left with an extremely bright dot or trace for a very long time, the screen may be damaged. Therefore, if a measurement requires high brightness, be certain to turn down the INTEN control immediately afterward. Also, get in the habit of turning the brightness way down if the scope is left unattended for any period of time.

4. Turn the FOCUS control(1) for a sharp trace.

5. Turn the CH1 Vertical POSITION control(4) to move the CH1 trace to the enter horizontal graticule line.

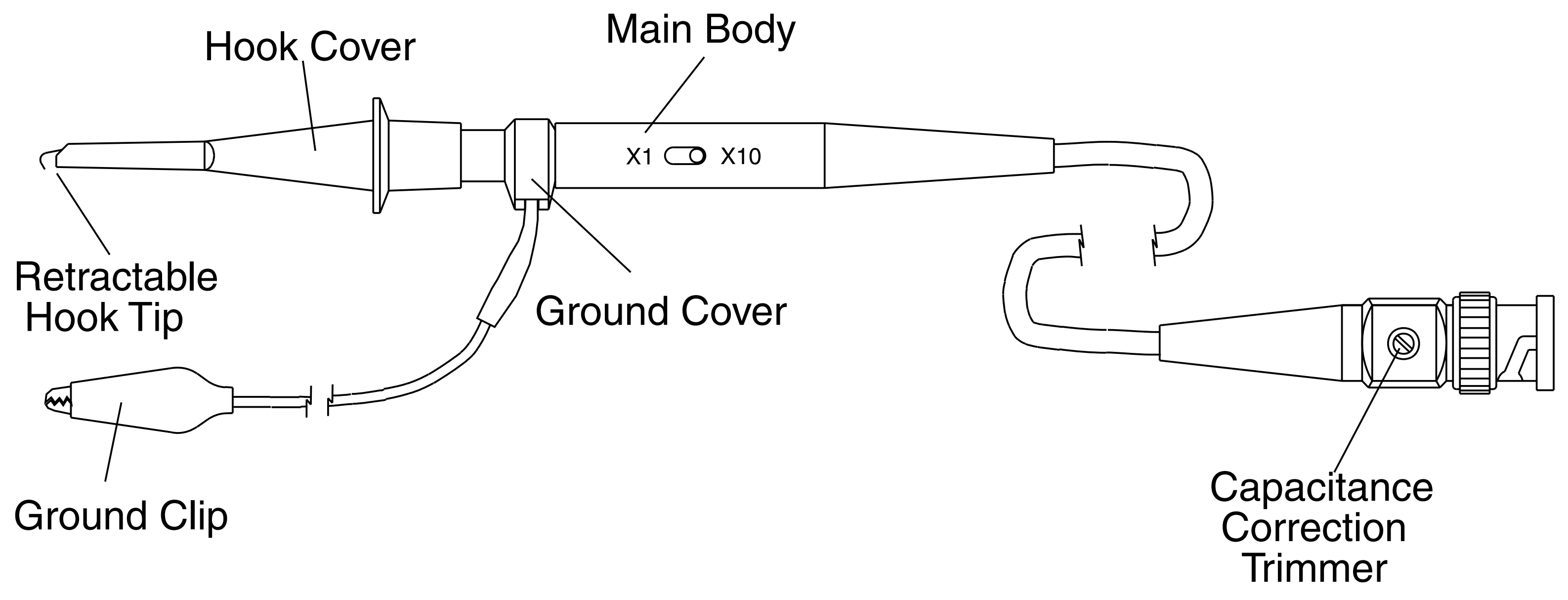
6. See if the trace is precisely parallel with the graticule line. If it is not, adjust the Rotation control (29) with a small screwdriver.

7. Turn the Horizontal POSITION control(10) to align the left edge of the trace with the left most graticule line.

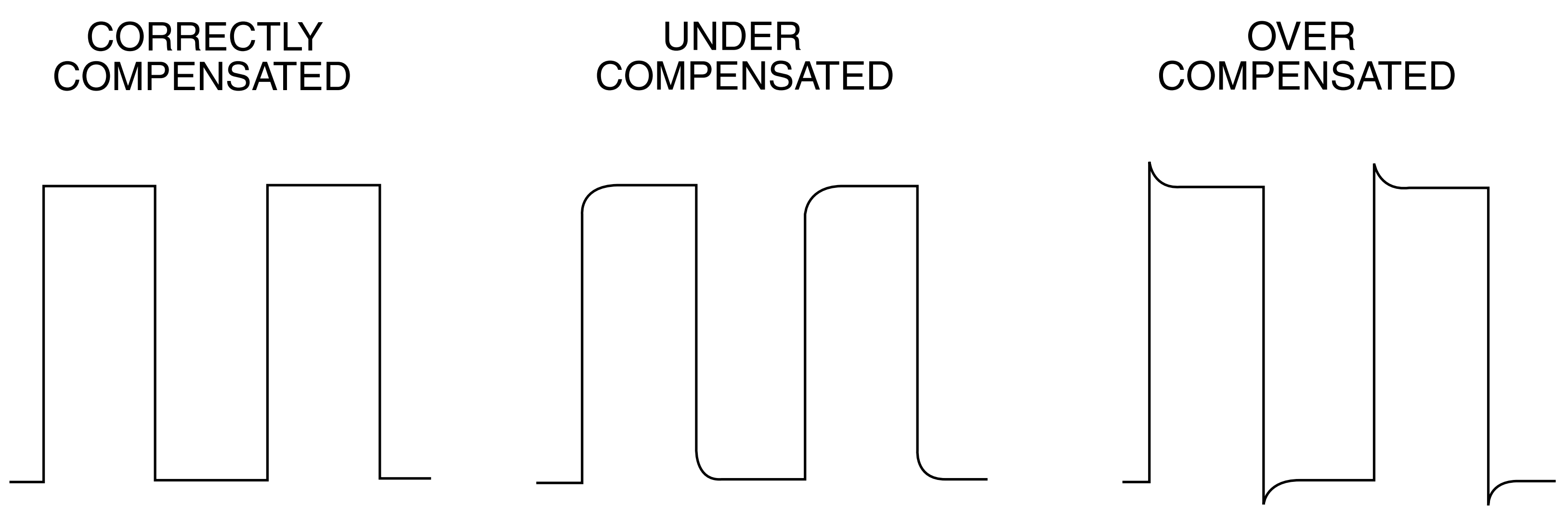
8. Set one of the supplied probes for X10 attenuation. Then, connect its BNC end to the CH1 or X IN connector(24) and its tip to the PROBE ADJUST connector(17). A square wave display, two and a half divisions in amplitude, should appear on the CRT screen.

9. If the tops and bottoms of the displayed square waves are tilted or peaked,the probes must be compensated(matched to the scope input capacitance). Adjust the capacitance correction trimmer of the probe with a small screwdriver, See Figure 2-2 (b).

10. Set the V MODE switch(5) to CH2, and perform Steps 8 and 9 with the other probe on CH2.



(a) PROBE



(b) PROBE COMPENSATION BY CORRECTION SQUARE-WAVE

FIGURE 2-2. PROBE COMPENSATION

2-2-2. Signal Connections

There are methods of connecting an oscilloscope to the signal you wish to observe. They are a simple wire lead, coaxial cable, and scope probes.
A simple lead wire may be sufficient when the signal level is high and the source impedance low(such as TTL circuitry), but is not often used,
Unshielded wire picks up hum and noise : this distorts the observed signal when the signal level is low. Also, there is the problem of making secure mechanical connection to the input connectors. A binding post-to BNC adapter is advisable in this case.
Coaxial cable is the most popular method of connecting an oscilloscope to signal sources and equipment having output connectors. The outer conductor of the cable shields the central signal conductor from hum and noise pickup. These cables are usually fitted with BNC connectors of each end, and specialized cable and adaptors are readily available for matching with other kinds of connectors.
Scope probes are the most popular method of connecting the oscilloscope to circuitry. These probes are available with X1 attenuation(direct connection) and X10 attenuation. The X10 attenuator probes increase the effective input impedance of the probe/scope combination to 10 megohms shunted by a few picofarads, the reduction in input capacitance is the most important reason for using attenuator probes at high frequencies, where capacitance is the major factor in loading down a circuit and distorting the signal. When X10 attenuator probes are used, the scale factor(VOLTS/DIV switch setting) must be multiplied by ten.
Despite their high input impedance, scope probes do not pick up appreciable hum or noise. As was the case with coaxial cable, the outer conductor of the probe cable shields the central signal conductor. Scope probes are also quite convenient from a mechanical standpoint.
To determine if a direct connection with shielded cable is permissible, you must know the source impedance of the circuit you are connecting to, the higher frequencies involved, and the capacitance of the cable. If any of these factors are unknown, use a X10 low capacitance probe.

An alternative connection method at high frequencies is terminated coaxial cable, a feed-thru terminator having impedance equal to that of the signal source impedance is terminated coaxial cable. A feed-thru terminator having an impedance equal to that of the signal source impedance is connected to the oscilloscope input connector. A coaxial cable of matching impedance connects the signal source to the terminator. This technique allows using cables of nearly and practical length without signal loss.

If a low resistance ground connection between oscilloscope and circuit is not established, enormous amounts of hum will appear in the displayed signal. Generally, the outer conductor of shielded cable provides the ground connection. If you are using plain lead wire, be certain to first connect a ground wire between the OS-5020SRS Ground connector(28) and the chassis or ground bus of the circuit under observation.

<WARNING>

The OS-5020SRS has an earth-grounded chassis (via the 3-prong power cord). Be certain the device to which you connect the scopes transformer operated. Do NOT connect this oscilloscope or any other test equipment to "AC/DC", "hot chassis", or "transformerless" devices.

Similarly, do NOT connect this scope directly to the AC power line or any circuitry connected directly to the power line.

Damage to the instrument and severe injurt to the operator may result form failure to heed this warning.

2-2-3. Single-trace Operation

Single-trace operation with single time base and internal triggering is the most elementary operating mode of the OS-5020SRS. Use this mode when you wish to observe only a single signal, and not be disturbed by other traces on the CRT. Since this is fundamentally a two channel instrument, you havea choice from your single channel. Channel has an output terminal:use channel if you also want to measure frequency with a counter While observing the waveform. Channel 2 has a polarity in verting switch, While this adds flexibility, it is not too useful in ordinary single-trace operation.

The OS-5020SRS is set up for single-trace operation as follows:

1. Set the following controls as indicated below. Note that the trigger source selected(CH1 or CH2 SOURCE)must match the single channel selected. (CH1 or CH2 V-MODE)

POWER switch(16)	ON(pushed in)
AC/GND/DC switches(25)(21)	AC
Vertical POSITION controls(4)(7)	Mid rotation
VARIABLE controls(27)(20)	Fully CW
V MODE switch(5)	CH1(CH2)
VARIABLE control(13)	CAL
Trigger MODE switch(14)	AUTO
Trigger SOURCE switch(18)	VERT
Trigger LEVEL control(9)	Mid rotation

2. Use the corresponding Vertical POSITION control (4) or (7) to set the trace near mid screen,

3. Connect the signal to be observed to the corresponding IN connector (24) or (22),and adjust the corresponding VOLTS/DIV switch (26) or (23) so the displayed signal is totally on screen.

<CAUTION>
Do not apply a signal greater than 400V(DC+peak AC).

4. Set the TIME/DIV switch(15) so the desired number of signal cycles are displayed. For some measurements just 2 of 3 cycles are best : for other measurements 50-100 cycles appearing like a solid band works best. Adjust the Trigger LEVEL control(9) if necessary for a stable display.

5. To set X5MAG switch at X5 in case motif is not made or difficult to measure as the signal to be measured is too small despite VOLT/DIV switch was placed at 5mV. In this instance if VOLT/DIV switch is 5mV, become to 1mV/DIV and frequency oscillation reduces to 10MHz and noise will be increased by the revolution.

6. To set X10MAG switch at X10MAG(11) when too many cycles appear on even the TIME/DIV switch was put on 0.2us position as the signal try to be measured is a high frequency. Then, it will be 20ns/DIV because of sweep speed increases by 10 times and in case of 0.5us it will be 50ns/DIV.

7. If the signal you wish to observe is either DC or low enough in frequency, the AC coupling will attenuate or distort the signal. So, flip the AC/GND/DC switch(25)or(21)toDC.

< CAUTION >
If the observed waveform is low level AC, make sure it is not riding on a high amplitude DC voltage.

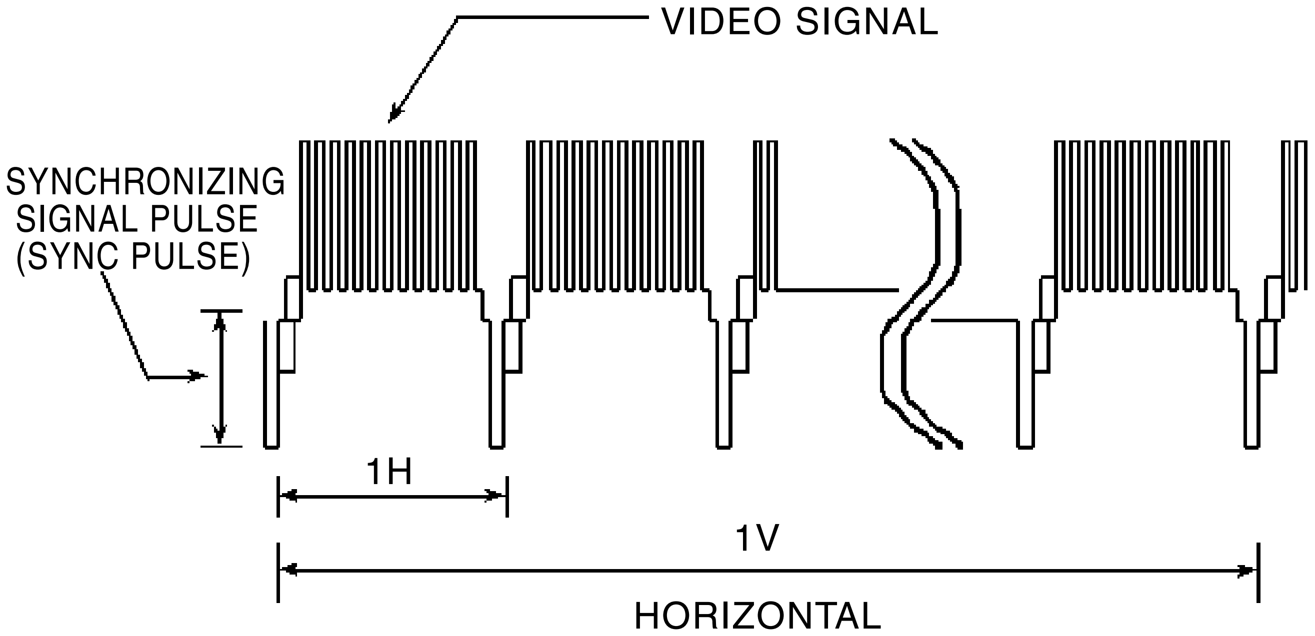
You will also have to reset the Trigger MODE switch (14) to NORM if the signal frequency is below 25Hz, and possibly readjust the Trigger LEVEL control(9).

2-2-4. Dual trace Operation

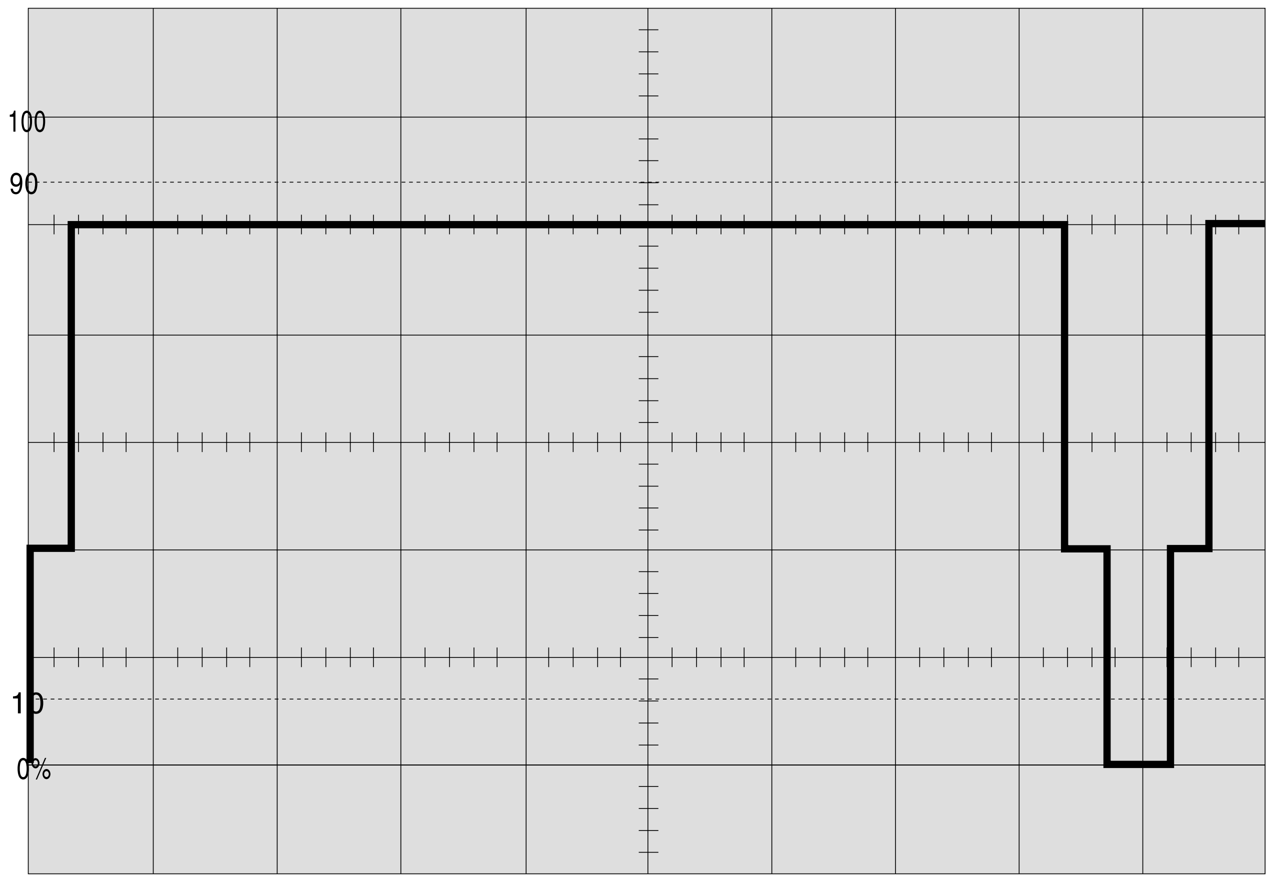
Dual trace operation is the major operating mode of the OS-5020SRS. The setup for dual trace operation is identical to that of 2-3-2 single trace operation with the following exceptions:

1. Set the V MODE switch(5) to either DUAL. Select ALT for relatively high frequency signals(TIME/DIV sw itch set to 0.5ms or faster). Select CHOP for relatively low frequency signals(TIME/DIV switch set to 1ms or slower)

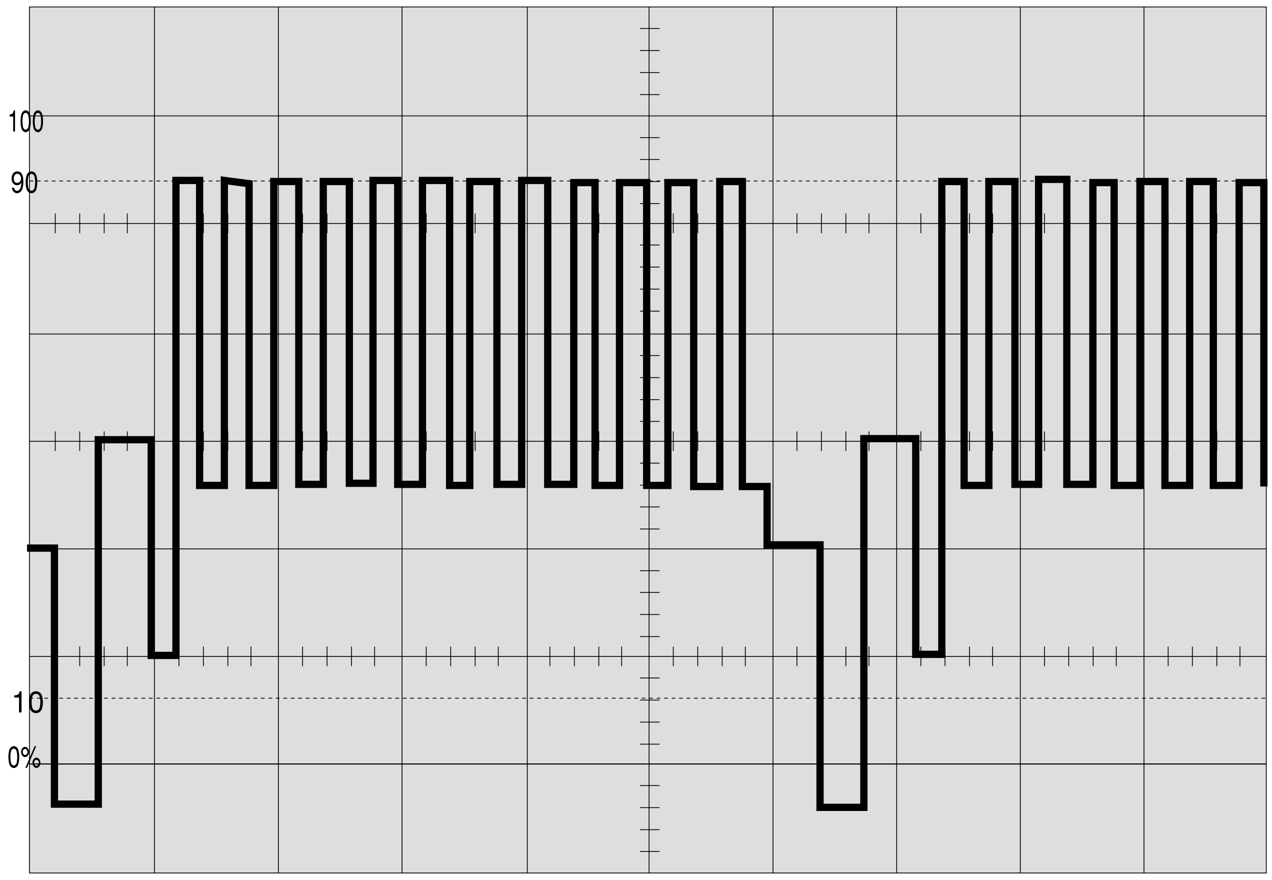
2. If both channels are displayed in signals of the same frequency, set the Trigger SOURCE switch(18) to the channel having the steepest-slope waveform. If the signals are dfifferent but harmonically related, trigger from the channel carrying the lowest frequency. Also, remember that if you disconnect the channel serving as the trigger source, the entire display will free run.



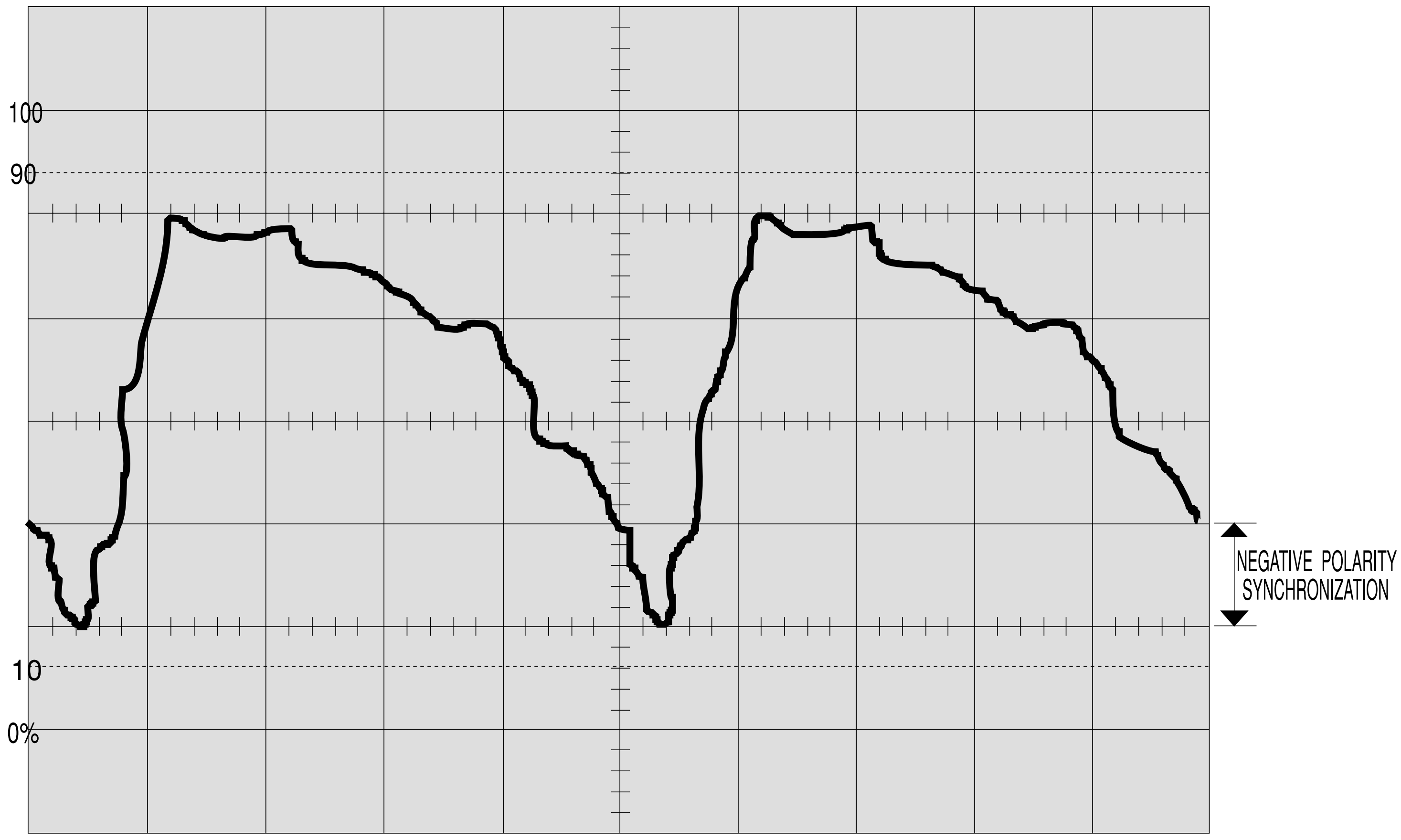
(a) COMPOSITE VIDEO SIGNAL



(b) TV-V COUPLING



(c) TV-H COUPLING



(d) SYNC POLARITY

FIGURE 2-3. TRIGGER OPTIONS

2-2-5. Trigger options

Triggering is often the most difficult operation to perform an oscilloscope because of many options available and the exact requirements of certain signals.

Trigger Mode Selection : When the NORM trigger mode is selected, the CRT beam is not swept horizontally across the face of the CRT until a sample of the signal being observed, or another signal harmonically related to it, triggers the timebase. However, this trigger mode is inconvenient because no baseline appears on the CRT screen in the absence of a signal, or if the trigger controls are improperly set. The AUTO trigger mode solves this problem by causing the timebase to automatically free run when not triggered. This yields a single horizontal line with no signal, and a vertically deflected but non-synchronized display when vertical signal is present but the trigger controls are improperly set. This immediately indicates what's wrong. The only hitch with AUTO operation is that signals below 25Hz cannot, and complex signals of any frequency may not, reliably trigger the timebase. Therefore, the usual practice is to leave the Trigger MODE SWITCH(14) set to AUTO, but reset it to NORM if any signal(particularly one below 25Hz) fails to produce a stable display.

The TV-V and TV-H positions of the Trigger MODE switch insert a TV sync-separator into the trigger chain, so a clean trigger signal at either the vertical or horizontal repetition rates can be removed from a composite video signal(Figure 2-3a). To trigger the scope at the vertical rate(Figure 2-3b), set the Trigger MODE switch to TV-V. To trigger the scope at the horizontal(line)rate(Figure 2-3c) set the Trigger MODE switch to TV-H. For best results,the TV sync polarity should be negative(Figure 2-3d) when the sync separator is used.

Trigger Point Selection: The SLOPE switch determines whether the sweep will be on a positive-going or negative-going transition of the trigger signal. (See Figure 2-4).Always select the steepest and most stable slope or edge. For example, small changes in the amplitude of the sawtooth shown in Figure 2-4a will cause jittering if the timebase is triggered on the positive(ramp)solpe,but have no effect if triggering occurs on the negative slope(a fast-fall edge).
In the example shown in Figure 2-4b, both leading and trailing edges are very steep trace to jitter, making observation difficult. Triggering from the stable leading edge(+slope) yields a trace that has only the trailing edge jitter of the original signal. If you are ever in doubt, or have an unsatisfactory display, try both slopes to fine the best way.
Trigger LEVEL control : The LEVEL control determines the point on the selected slope at which the main(A) timebase will be triggered. The effect of the LEVEL control on the displayed trace is shown in Figure 2-5. The -, 0, and + panel markings for this control refer to the waveform's zero crossing and points more positive(+) and more negative(-)than this. If the trigger slope is very steep, as with square waves or digital pulses, there will be no apparent change in the displayed trace until the LEVEL control is rotated past the most positive or most negative point, where upon the display will free run(AUTO sweep mode) or disappear completely(NORM sweep mode). Try to trigger at the mid point of slow rise waveforms(such as sine and triangular waveforms),since these are usually the cleanest spots on such waveforms.

2-2-6. Measurement of different frequency

1. In case of two input signals of CH1 & CH2 is the same frequency with a certain times or one signal has a certain time difference, to select INT Trigger switch(18) in option to CH1 or CH2.
   The signal is triggered based CH1 for CH1 and CH2 for CH2 signal respectively.

2. But if you try to trigger two signals which have different frequency to set INT trigger switch to VERT. In this instance, two waveforms trigger stabilized as the motif signal input to each signal source in shift.

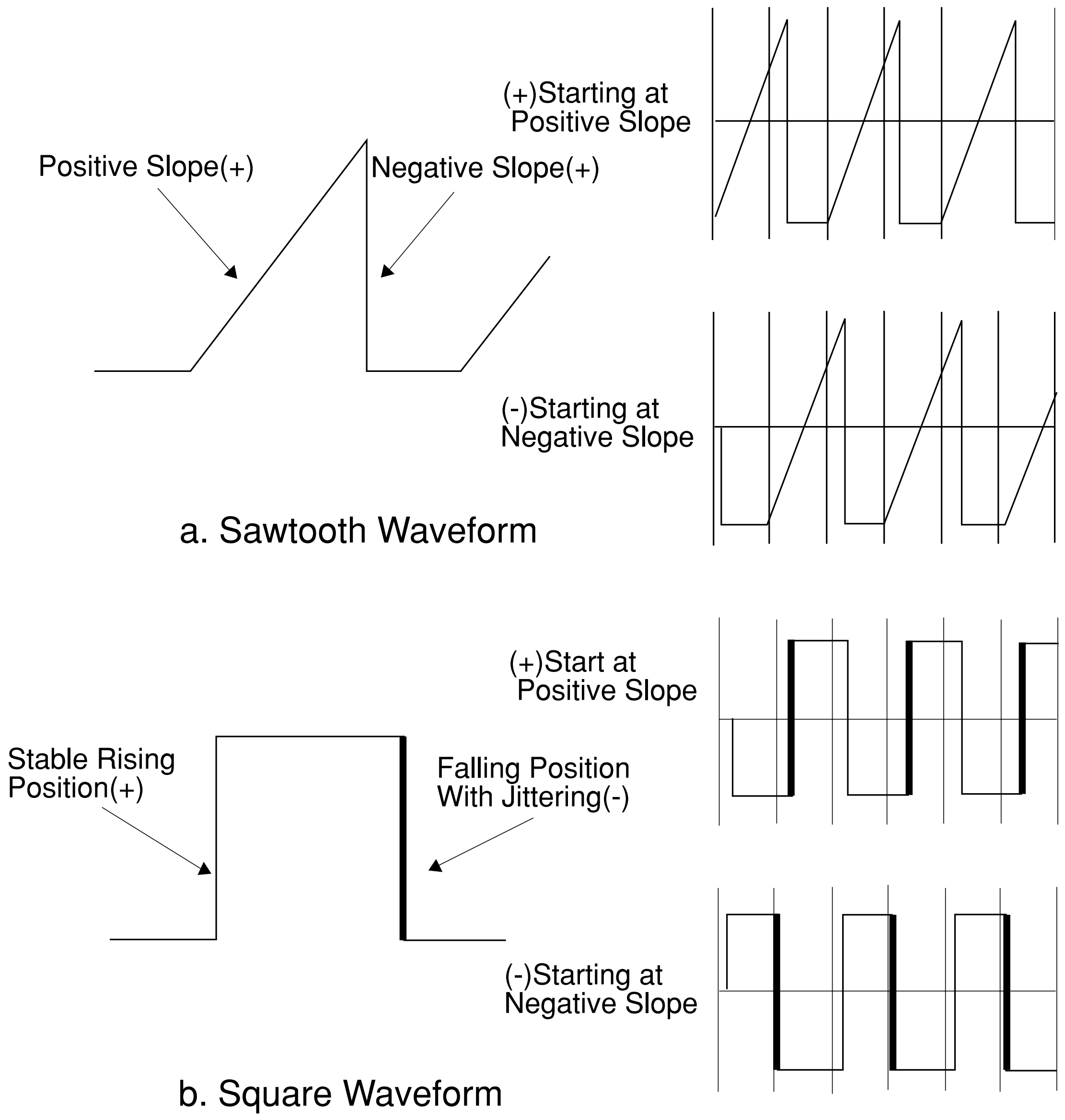


FIGURE 2-4. TRIGGER SLOPE SELECTION

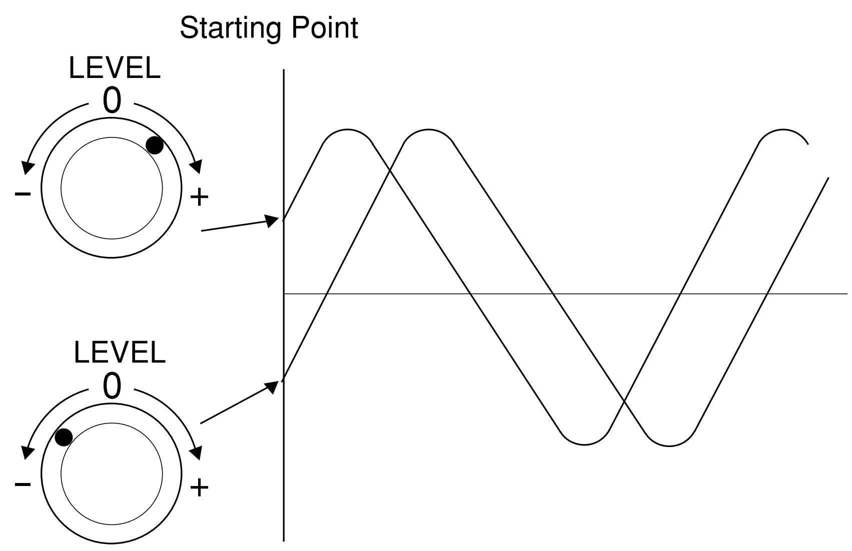


FIGURE 2-5. TRIGGER LEVEL CONTROL

2-2-7. Additive and Differential Operation

Additive and differential operation are called into two channel operation where two signals are combined to display one trace. In additive operation, the resultant trace represents the algebraic sum of the CH1 and CH2 signals. In differential operation, the resultant trace represents algebraic difference between to CH1 and CH2 signals.

To set up OS-5020 for additive operation, proceed as follows:

1. Set up for dual-trace operation per paragraph 2-3-4 dual-trace Operation.

2. Make sure both VOLTS/DIV switchs(26) and (23) are set to the same position and the VARIABLE controls(27)and(20)are click-stopped fully clockwise.
   It the signal levels are very different, set both VOLTS/DIV switches to the position producing a large on-screen display of the highest-amplitude signal.

3. Trigger from the channel having the biggest signal.

4. Set the V MODE switch to ADD position. Then, the single trace resulting is the algebraic sum of the CH1 and CH2 signals. Either of both of the vertical position controls(4) and (7) can be used to shift the resultant trace.

> < NOTE >
> If the input signals are in-phase, the amplitude of the resultant trace will be the arithmetic sum of the individual traces(eg., 4.2DIV+1.2DIV = 5.4DIV)If the input signals are 180° out-of-phase, the amplitude will be the difference(eg., 4.2DIV-1.2DIV = 3.0DIV)

5. If the pp amplitude of the resultant trace is very small, turn both VOLTS/DIV switch to increase the height. Make sure both are set to the same position.

   There is another method to measure the sum of two signs to this product. It is the method to select INV switch to INV concurrently. When input signal is on the equal phase by selection of INV switch, the waveform of ADD will be difference in amplitude of the two signals. (EX:4.2DIV-1.2DIV=3.0DIV)
   When input signal has phase difference of 180° , two signals become sum of amplitude.

2-2-8. X-Y Operation

The internal timebase of the OS-5020SRS are not utilized in X-Y operation: deflection in both the vertical and horizontal directions is via external signals. Vertical CH1 serves as the X-axis(horizontal)signal processor, so horizontal and vertical axis have identical control facilities.

All of the V MODE, and trigger switches, as well as their associated controls and connectors, are inoperative in the X-Y mode.

To set up the OS-5020 for X-Y operation, proceed as follows:

1. Turn the TIME/DIV switch(15) fully clockwise to its X-Y positions.

> < CAUTION >
> Reduce the trace intensity lest the undelected spot damage the CRT phosphor.

2. Apply the vertical signal to the CH2 or Y IN connector(22),and the horizontal signal to the CH1 or X IN connector(24). Once the trace is deflected, restore normal brightness.

3. Adjust the trace height with the CH2 VOLTS/DIV switch(23) and the trace width with the CH1 VOLTS/DIV SWITCH(13). The X5 MAG switch(3) on the VARIABLE controls can be used for greater necessary, so leave the VARIABLE control(27) knob set CAL.

4. Adjust the trace position vertically(Y-axis) with the CH2 Vertical POSITION control(7). Adjust the trace position horizontally(X-axis) with the Horizontal POSITION control(10); the CH1 Vertical POSITION control has no effect during X-Y operation.

5. Vertical(Y-axis) signal may change the phase by 180°, setting CH2 INV switch.

2-2-9. Component Test Operation(Only OS-5020C)

The component test board delivers a sine voltage(60Hz) which is applied across the component under test. The sine voltage across the test object is used for the horizontal deflection(V) and voltage-drop(current through the test object) is used for vertical deflection(I) of the oscilloscope.

By this V-I characteristic curve, the good or fault of component is measured.

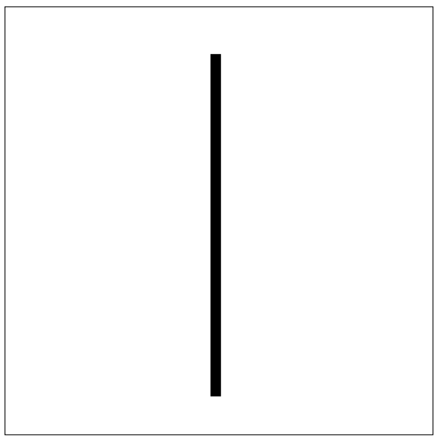
To set up the OS-5020C for component test operation, proceed as follows:

1. Push the component test switch.
   Then the horizontal bar graph of 8div is displayed on the screen.
   The position of graph is controlled with CH2 V-POSITION(7) and H-POSITION(10).

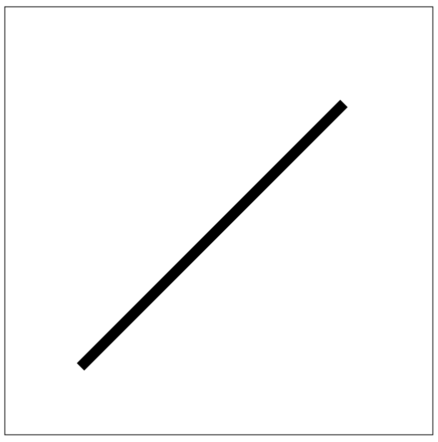
2. Connect the component test input (36) and GND(37) to both terminals of component with DMM probe. Then V-I characteristic curve is displayed on the screen. (See figure 2-6)

< CAUTION >

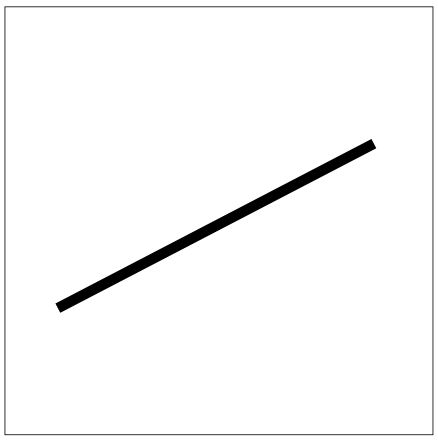
Using the component test function, don't apply the signal to CH1 and CH2 input because the oscilloscope doesn't operate in the component test mode.
Don't push X10 switch because the bar will be fatted.
Don't test the live circuit(operating the power signal) component.



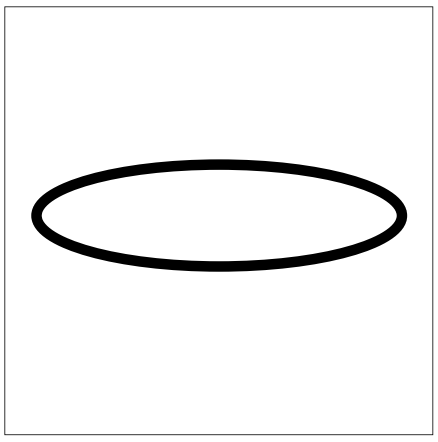
a. Short Circuit



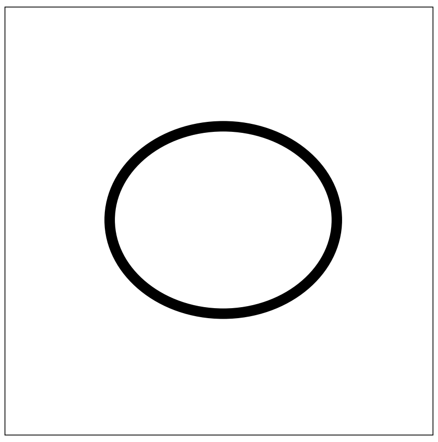
b. Resistor 600Ω



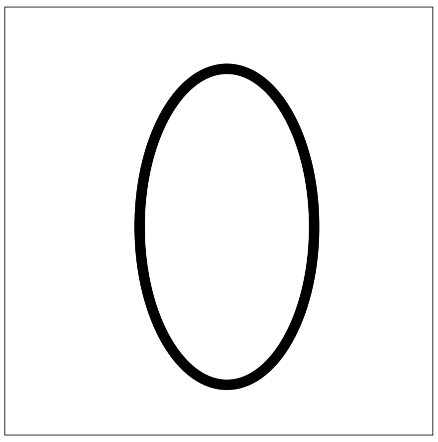
c. Resistor 1.3kΩ



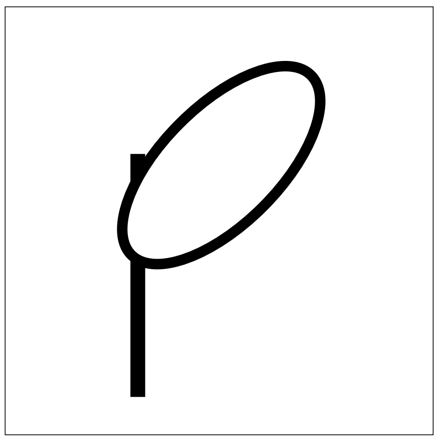
d. Al. Capacitor 1μF



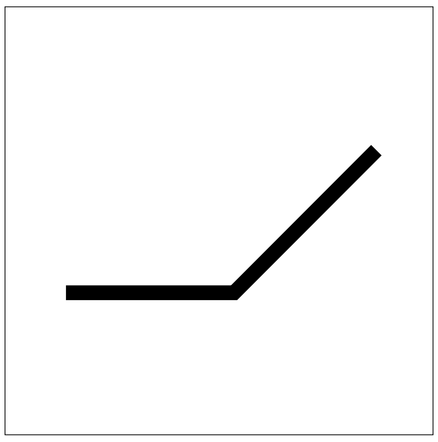
e. Al. Capacitor 4.7μF



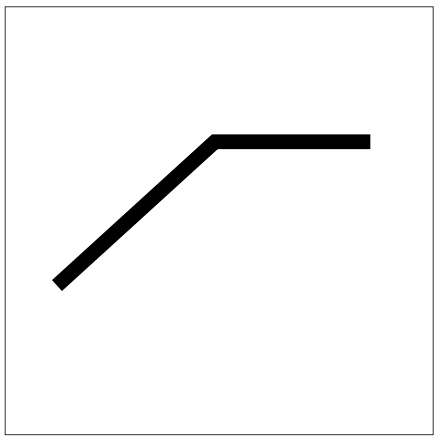
f. Al. Capacitor 100μF



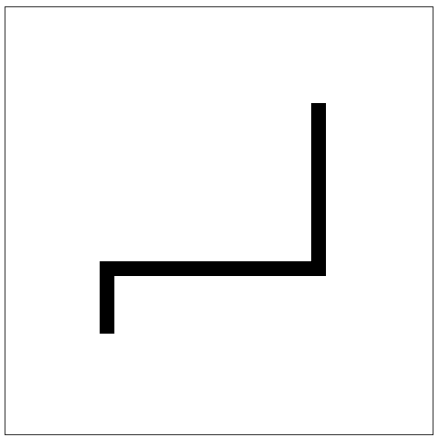
g. Zener+Capacitor 1μF



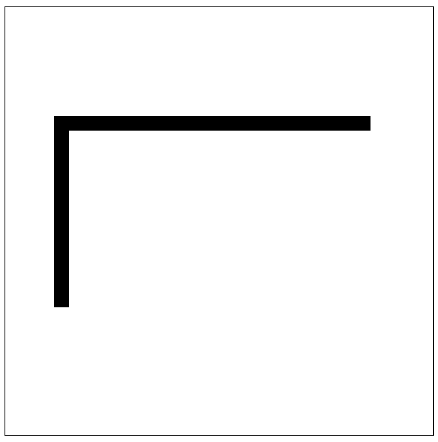
h. Resistor+Zener(Forward) diode



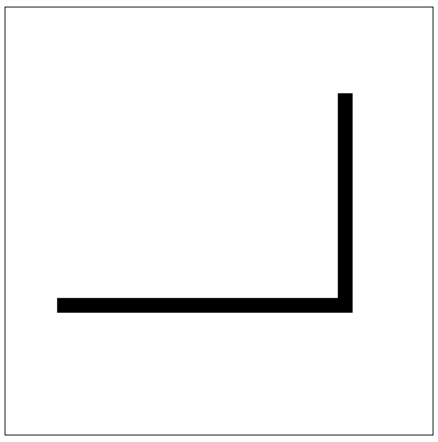
i. Resistor+Zener(Reverse)



j. Zener Diode below 7V



k. Zener Diode beyond 7V



l. Silicon Diode

FIGURE 2-6. THE V-I CHARACTERISTIC CURVE OF COMPONENTS

2-3. MEASUREMENT APPLICATIONS

This section contains instructions for using your OS-5020SRS for specific measurement procedures. However, this is only a small sampling of the many applications possible for this oscilloscope. These particular applications were selected to demonstrate certain control and features not fully coerced in BASIC OPERATING PROCEDURES, to clarify certain operations by example, or for their importance and universality.

2-3-1. Amplitude Measurements

The mode triggered sweep oscilloscope has two major measurement functions. The first of these is amplitude. The oscilloscope has an advantage over most other forms of amplitude measurement in which complex as well as simply waveforms can be totally characterized(i.e.,complete voltage information is available).
Oscilloscope voltage measurement generally fall into one of two types : peak to peak or instantaneous peak to peak(p-p) measurement simply notes the total amplitude between extremes without regard to polarity reference. Instantaneous voltage measurement indicates the exact voltage from each every point on the waveform to a ground reference.
When making either type of measurement, make sure that the VARIABLE controls are click-stopped fully clockwise.

Peak-to-peak Voltages. To measure peak-to-peak voltage, proceed as follows.

1. Set up the scope for the vertical mode designed per the instructions in 2-2 BASIC OPERATING PROCEDURES.

2. Adjust the TIME/DIV switch (15) for two or three cycles of waveform,and set the VOLTS/DIV switch for the largest-possible on-screen display.

3. Use the appropriate Vertical POSITION control(4) or (7) to position the negative signal peaks on the nearest horizontal graticule line below the signal peaks, per Figure 2-7.

4. Use the Horizontal POSITION control(10) to position one of the positive peaks on the central vertical graticule line. This line has additional calibration marks equal to 0.2 major division each.

5. Count the number of division from the graticule line touching the negative signal peaks to the intersection of the positive signal peak with the central vertical graticule line. Multiply this number by the VOLTS/DIV switch setting to get the peak-to-peak voltage of the waveform. For example, if the VOLTS/DIV switch was set to 2V, the waveform shown in Figure 2-7 would be 8.0V p-p(4.0DIV X 2V)

6. If X5 vertical magnification is used, divide the Step 5 voltage by 5 to get the correct peak- to- peak voltage. However if x10 attenator probes are used, multiply the voltage by 10 to get the correct peak to peak voltage.

7. If measuring a sine wave below 100Hz, or a rectangular wave below 1000Hz, flip the AC/GND/DC switch to DC.

< CAUTION >

Make sure the waveform is not riding on a higher amplitude DC voltage.

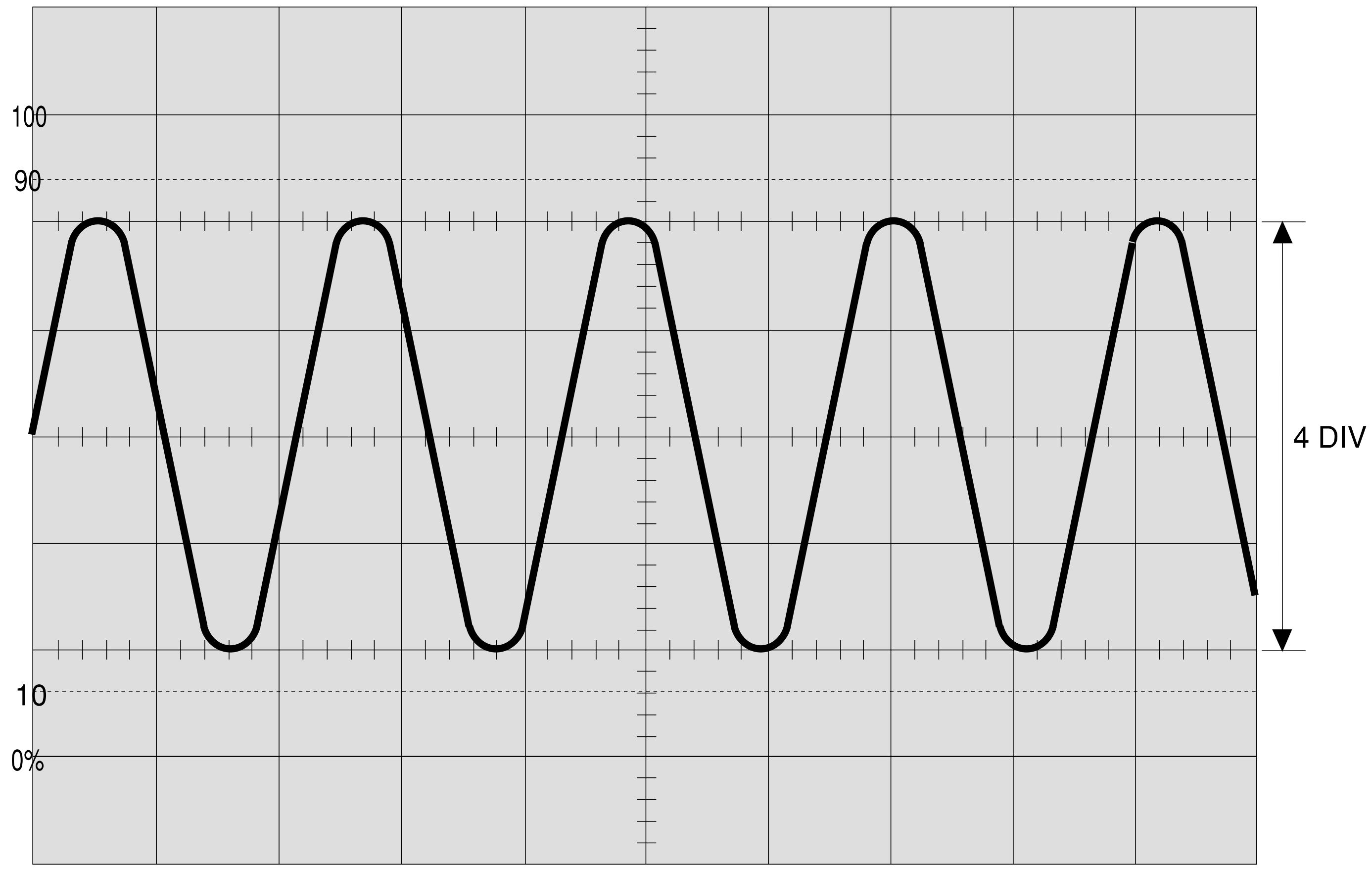


FIGURE 2-7. PEAK-TO-PEAK VOLTAGE MEASUREMENT

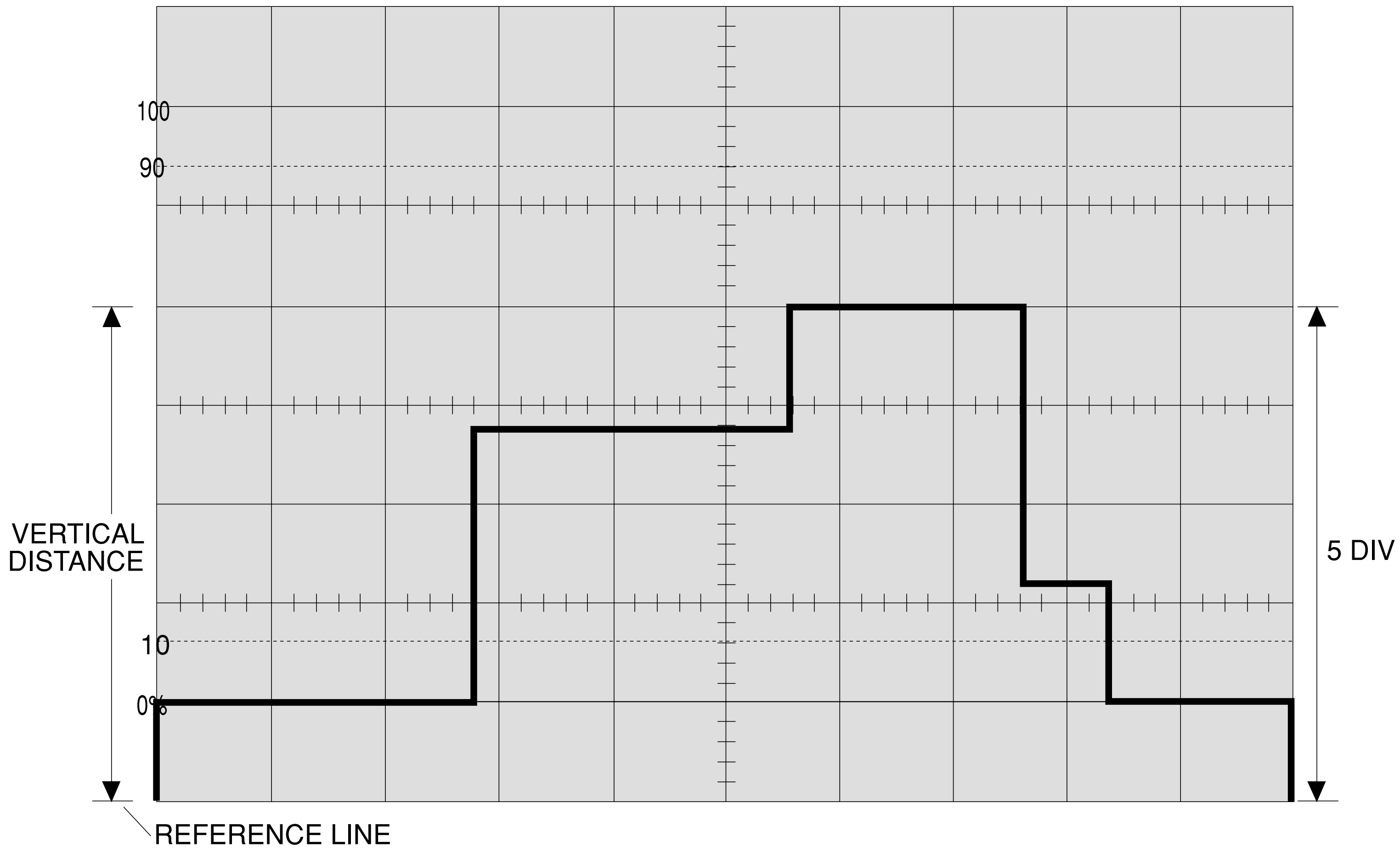


FIGURE 2-8. INSTANTANEOUS VOLTAGE MEASUREMENT

Instantaneous Voltages. To measure instantaneous voltage, proceed as follows.

1. Set up the scope for the vertical mode designed per the instructions in 2-2 BASIC OPERATING PROCEDURES.

2. Adjust the TIME/DIV switch (15) for one complete cycle of waveform, and set the VOLTS/DIV switch for the trace amplitude of 4 to 6 division. (see Figure 2-8)

3. Flip the AC/GND/DC switch (25) or (21) to GND.

4. Use the appropriate Vertical POSITION control(4) or (7)to set the baseline on the central horizontal graticule line. However, if you know the signal voltage is wholly positive, use the bottommost graticule line, If you know the signal voltage is wholly negative, use the uppermost graticule line.

5. Flip the AC/GND/DC switch to DC. The polarity of all points above the ground reference line is positive : all points below the ground reference line are negative.

< CAUTION >

Make certain the waveform is not riding on a high amplitude DC voltage before flipping the AC/GND/DC switch.

6. Use the Horizontal POSITION control(10)to position any point of interest on the central vertical graticule line. This line has additional calibration marks equal to 0.2 major division each. The voltage which is relative to ground at any point selected is equal to the number of divisions from that point to the ground reference line multiplied by the VOLTS/DIV setting. In the example used for Figure 2-8, the voltage for a 0.5V/DIV scale is 2.5V(5.0DIV, 5V).

7. If X5 vertical magnification is used, divide the Step 6 voltage by 5. However, if X10 attenuator probes are used. multiply the voltage by 10.

2-3-2. Time Interval Measurements

The second major measurement function of the triggered sweep oscilloscope is the measurement of time interval. This is possible because the calibrated time base results in each division of the CRT screen representing a known time interval.

Basic Technique: The basic technique for measuring time interval is described in the following steps. This same technique applies to the specific procedures and variations as follows.

1. Set up scope as described in 2-3-2 Single-trace Operation.

2. To set up TIME/DIV(15) larger as much as possible so that it may appear on the screen. Place VAR switch(13) at CAL. Please be careful as the measured value may be incorrect if you do not follow this instruction.

3. Use the Vertical POSITION control(4) or (7) to position the trace so the central horizontal graticule line passes through the points on the waveform between which you want to make the measurement.

4. Use the Horizontal POSITION control(10) to set the left-most measurement point on a nearly vertical gratitude line.

5. Count the number of horizontal gratitude divisions between the Step4 gratitude line and the second measurement point. Measure to tenth of a major division. Note that each minor division on the central horizontal gratitude line is 0.2 major division.

6. To determine the time interval between the two measurement points, multiply the number of horizontal divisions counted is Step 5 by the setting of the TIME/DIV switch. If the X10 MAG(11) is X10(X10 magnification), be certain to divide the TIME/DIV switch setting x10.

Period, pulse width, and duty cycle: The Basic technique described in the preceeding paragraph can be used to determine pulse parameters such as period, pulse width, duty cycle, etc. The period of a pulse or any other waveform is the time it takes for one full cycle of the signal. In Figure 2-9a, the distance between points(A) and (C) represent one cycle : the time interval of this distance is the period. The time scale for the CRT display of Figure 2-9a is 10ms/DIV, so the period is 70 milliseconds in this example.
Pulse width is the distance between points(A) and(B). In our example it is conveniently 1.5 divisions, so the pulse width is 15 milliseconds. However, 1.5 divisions is a rather small distance for accurate measurements, so it is advisable to use a faster sweep speed for this particular measurement. Increasing the sweep speed to 2ms/DIV as if Figure 2-9b gives a large display, allowing more accurate measurement.
If it is seen small with the Time/Div switch you may measure X10 is expanded condition by putting X10MAG switch to X10MAG. The duty cycle may be calculated by knowing pulse breadth and cycle.
The distance between points(B) and (C) is then called off time. This can be measured in the same manner as pulse width.
When pulse width and period are known, duty cycle can be calculated. Duty cycle is the percentage of the period (or total on and off times) represented by the pulse width(on time).

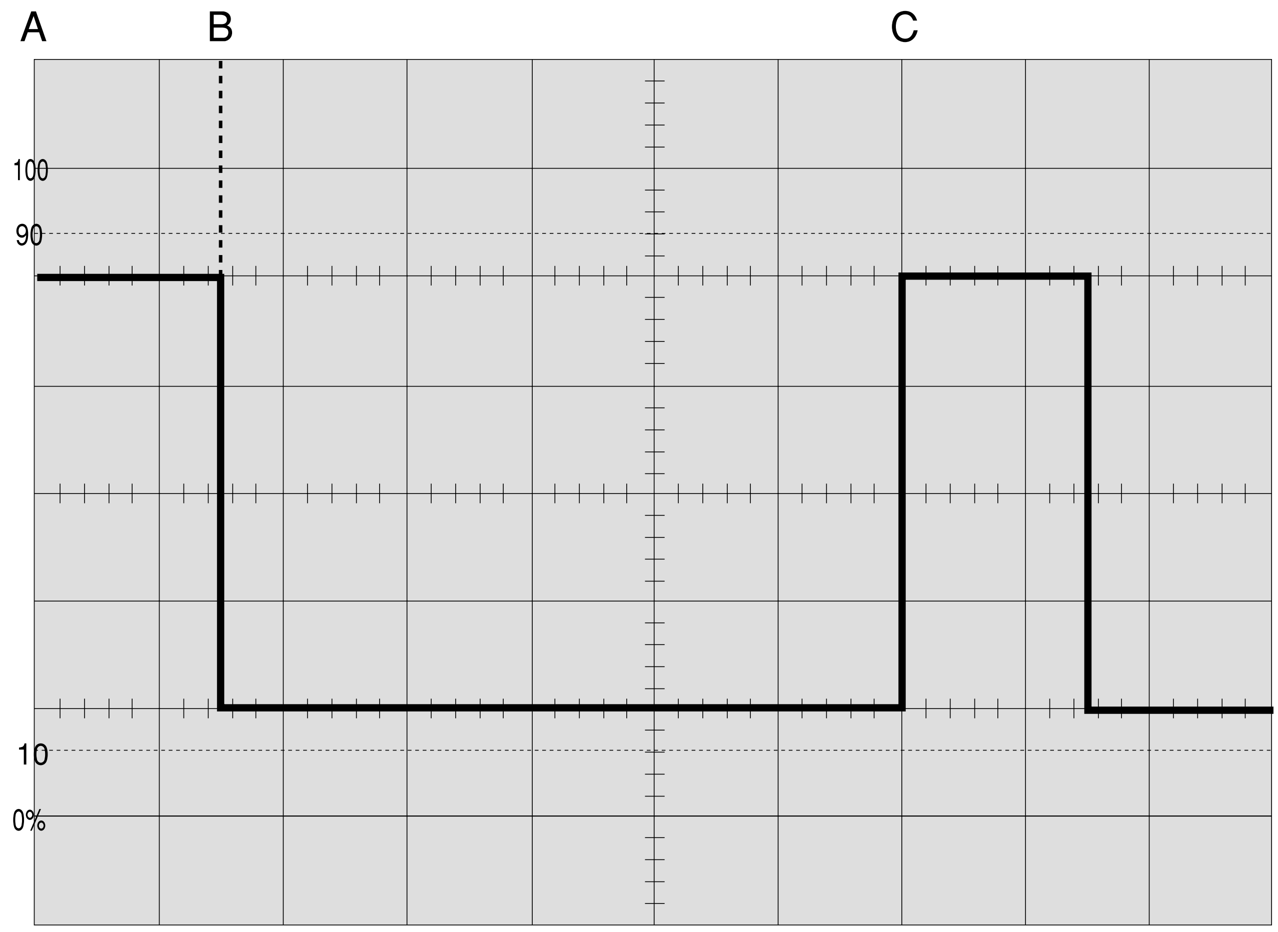
$$\text{Duty Cycle(\%)} = \frac{\text{Pw(100)}}{\text{Period}} = \frac{\text{A->B(100)}}{\text{A->C}}$$

$$\text{Duty Cycle of example} = \frac{\text{15ms X 100}}{\text{70ms}} = 21.4\%$$

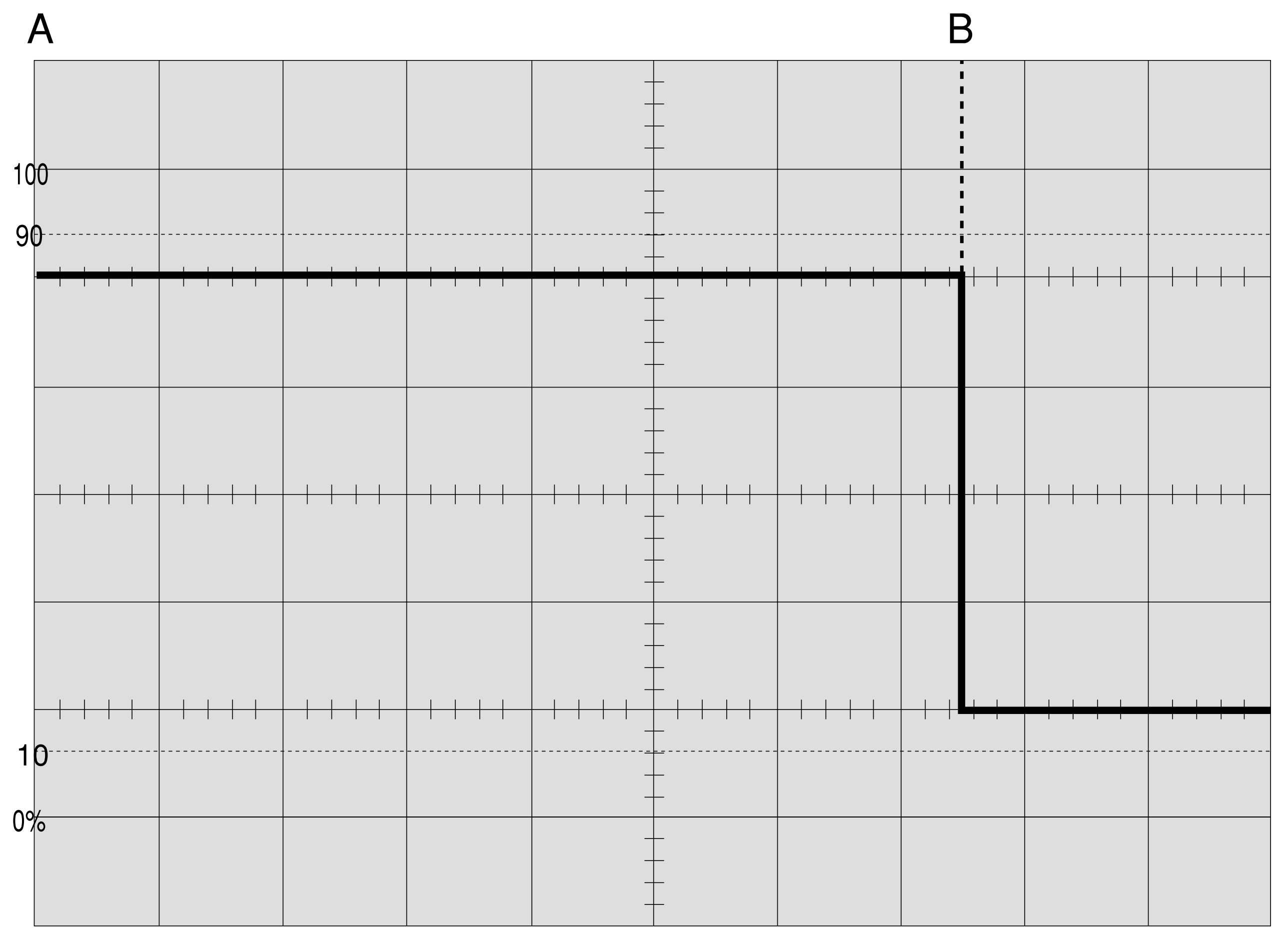
2-3-3. Frequency Measurement

When a precise determination of frequency is needs, a frequency counter is obviously the first choice. A counter can be connected to the CH1 OUTPUT connector(30) for convenience when both scope and counter are used. However, and oscilloscope alone can be used to measure frequency when a counter is not available, or modulation and/or noise makes a counter unusable.

Frequency is the reciprocal of period. Period in seconds(s) yields frequency in Hertz(Hz): period in millisecond(ms) yields frequency in kilohertz(kHz): period in microseconds(us) yields frequency in megahertz(MHz). The accuracy of this technique is limited by the timebase calibration accuracy(see Table of Specifications.)



(a) 10ms DIVISION



(b) 2ms DIVISION

FIGURE 2-9. TIME INTERVAL MEASUREMENT

2-3-4. Phase Difference Measurements

Phase difference or phase angle between two signals can be measured using the dual-trace feature of the oscilloscope, or by operating the oscilloscope in theX-Y mode.

Dual-trace Method. This method works with any type of waveform, In fact, it will often work even if different waveforms are being compared. This method is effective in measuring large or small differences in phase, at any frequency up to 20MHz.

To measure phase difference by the dual-trace method, proceed as follows :

1. Set up the scope as described in 2-3-3 dual-trace operation, connecting One signal to the CH1 IN connector(24) and the other to the CH2 IN connector(22).

> < NOTE >
> At high frequencies use identical and correctly compensated probes, or equal lengths of the same type of coaxial cable to ensure equal delay times.

2. Position the Trigger Source switch(18) to the channel with the cleanest and most stable trace. Temporarily move the other channel's trace off the screen by means of it Vertical POSITION control.

3. Center the stable(trigger source)trace with its Vertical Position control, and adjust its amplitude to exactly 6 vertical divisions by means of its VOLTS/DIV switch and Variable control.

4. Use the Trigger LEVEL control(9) to ensure that the trace crosses the central horizontal graticule line at or near the beginning of the sweep. See Figure 2-11.

5. Use the TIME/DIV switch(15), variable control(12), and the Horizontal Position control(10) to display one cycle of trace over 7.2 divisions. When this is done, each major horizontal division represents 50, and each minor division represents 10°

6. Move the off screen trace back on the CRT with its Vertical POSITION control, precisely centering it vertically. Use the associated VOLTS/DIV switch and variable control to adjust its amplitude to exactly 6 vertical divisions.

7. The horizontal distance between corresponding points on the waveform is the phase difference. For example, in the Figure 2-11 illustration the phase difference is 6 minor divisions, or 60°

8. If the phase difference is less than 50° (one major division), set the X10MAG switch is X10, and use the Horizontal POSITION control(if needed) to position the measurement area back on screen. With X10 magnification, each major division is 5° and each minor division is 1°

Lissajous Pattern Method. This method is used primarily with sine waves. Measurements are possible at frequencies up to 500 KHz, the bandwidth of the horizontal amplifier. However, for maximum accuracy, measurements of small phase differences should be limited below 50kHz.

To measure phase difference by the Lissajous pattern method, proceed as follows:

1. Rotate the TIME/DIV switch fully clockwise to its X-Y position.

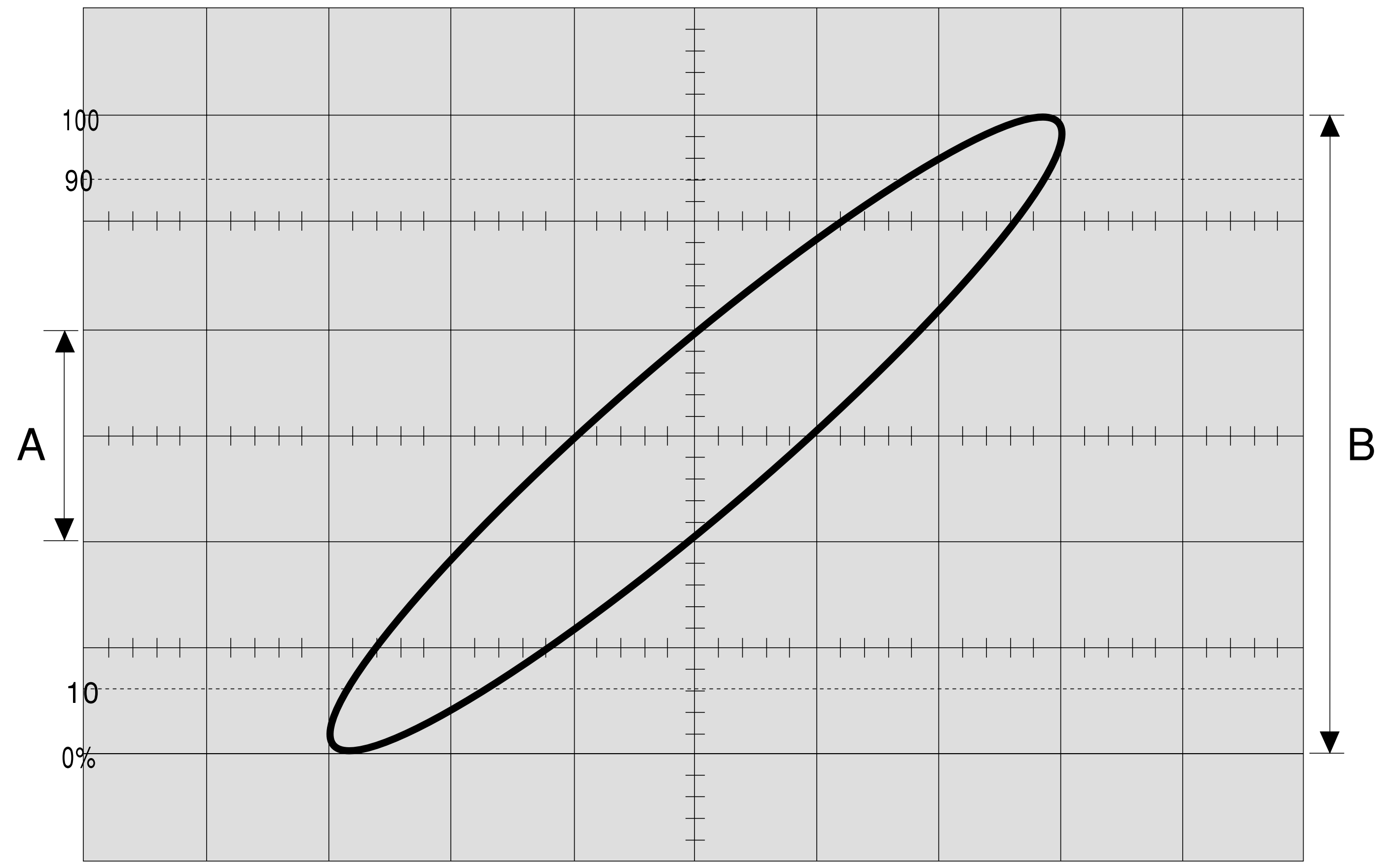
< CAUTION >
Reduce the trace intensity lest the undeflected spot damage the CRT phosphor.

2. To measure by setting INV to NORM and X5MAG to X1.

3. Connect one signal to the CH1 or X IN connector(24), and other sight to the CH2 or Y IN connector(22).

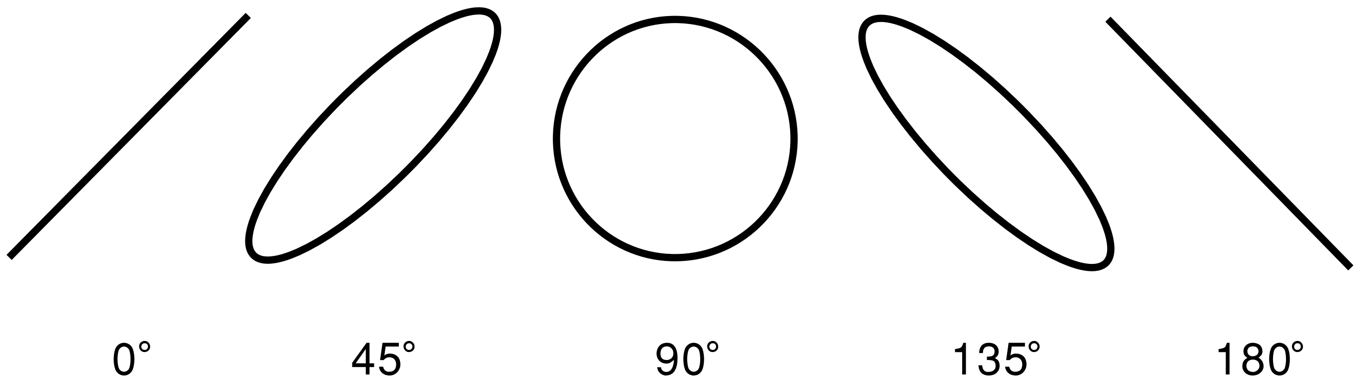
4. Center the trace vertically with the CH2 Vertical POSITION control(18) and adjust the CH2 VOTS/DIV switch(23) and VARIABLE control(20) for a trace height of exactly 6 divisions(the 100% and 0% graticule linestangent to the trace.)

5. Adjust the CH1 VOLTS/DIV switch(26) for the largest possible on screen display.



PHASE DIFFERENCE(ANGLE θ) = $\sin^{-1}$ A/B

(a) PHASE ANGLE CALCULATION



(b) LISSAJOUS PATTERNS OF VARIOUS PHASE ANGLES

FIGURE 2-10. LISSAJOUS METHOD OF PHASE MEASUREMENT

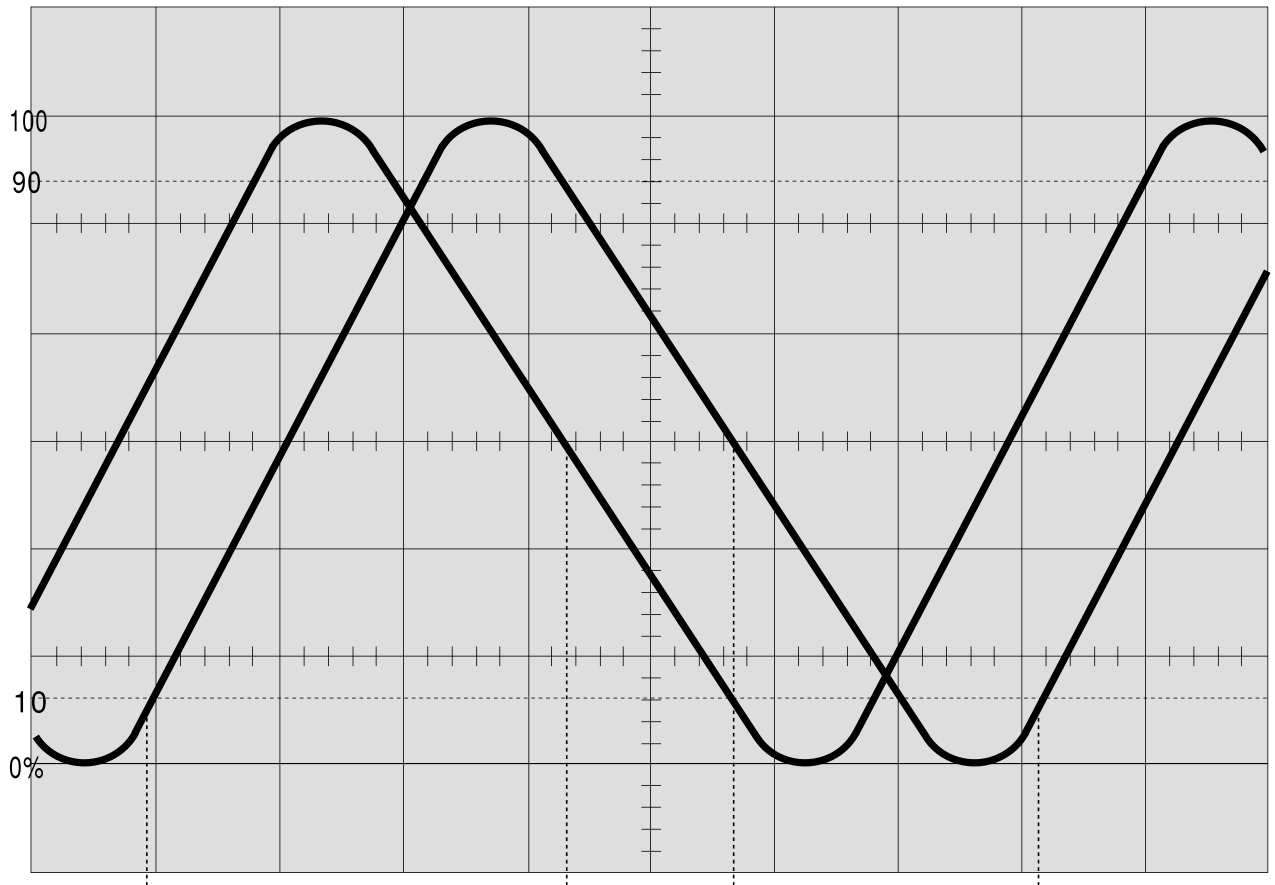


FIGURE 2-11. DUAL-TRACE METHOD OF PHASE MEASUREMENT

6. Precisely center the trace horizontally with the Horizontal POSITION control(10).

7. Count the number of divisions subtended by the trace along the central vertical graticule line(dimension B). You can now shift the trace vertically with CH2 POSITION control to a major division line for easier counting.

8. The phase difference(angle θ) between the two signals is equal to the are sine of dimension A ÷ B(the Step 7 number divided by 6). For example, the Step 7 value of the Figure 2-10a pattern is 2.0 Dividing this by 6 yields 0.3334, whose arcsine is 19.5°

9. The simple formula in Figure 2-10a works for angles less than 90°, For angles over 90° (leftware tilt), and 90° to the angle found in Step 7. Figure 2-10b shows the lissajous patterns of various phase angles: use this as guide in determining whether or not to add the additional 90°

<NOTE>
The sine-to-angle conversion can be accomplished by using trig tables or a trig calculator

2-3-5. Risetime Measurement

Risetime is the time for the leading edge of a pulse to rise from 10% to 90% of the total pulse amplitude.
Falltime is the time required for the trailing edge of a pulse to drop from 90% of total pulse amplitude to 10% Risetime and falltime, which may be collectively called transition time, are measured in essentially the same manner,

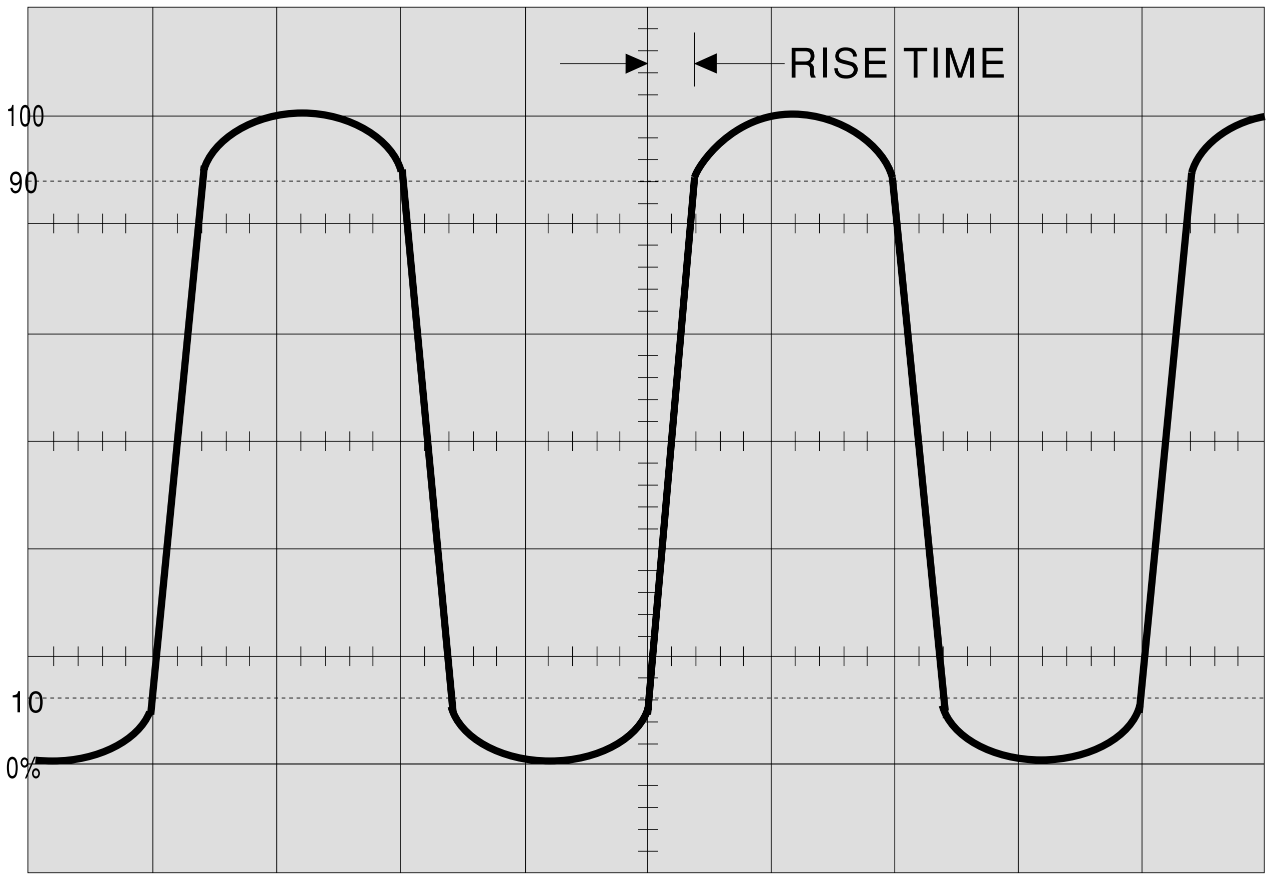
To measure rise and fall time, proceed as follows :

1. Connect the pulse to be measured to the CH1 IN connector(9),and set the AC/GND/DC switch (11) to AC
2. Adjust the TIME/DIV switch(22) to display about 2 cycles of the pulse. Make certain the VAR switch (23) is rotated fully clockwise.
3. Center the pulse vertically with the channel 1 Vertical Position control(17).
4. Adjust the channel 1 VOLTS/DIV switch(13) to make the positive pulse peak exceed the 100% graticule line, and the negative pulse peak exceed the 0% line, then rotate the VARIABLE control(15) counterclockwise until the positive and negative pulse peeks rest exactly on the 100% and 0% graticule lines(See Figure 2-12).
5. Use the Horizontal POSITION control(26) to shift the trace so the leading edge passes through the intersection of the 10% and central vertical graticule lines.
6. If the risetime is slow compared to the period, no further control manipulations are necessary. If the risetime is fast(leading edge almost vertical), To Set X10 MAG the to X10 MAG position and reposition the trace as in Step 5. (See Figure 2-12b.)
7. Count the number of horizontal divisions between the central vertical line (10% point) and the intersection of the trace with the 90% line.
8. Multiply the number of divisions counted in Step 7 by the setting of the TIME/DIV switch to find the measured risetime. If X10 magnification was used, divide the TIME/DIV setting by 10. For example, if the timebase setting in Figure 2-12 was 1s/div (1000ns), the risetime would be 360 nanoseconds (1000nsθ 10=100ns, 100nsx3.6div=360ns)
9. To Measure falltime, simply shift the trace horizontally until a trailing edge passes through the 10% and center vertical gratitude lines, and repeat steps 7 and 8.
10. When measuring the rise and fall time, note that 17.5nsRise time(t_r)=0.35/f $_{-3dB}$ which is transition time is contained in the OS-5020SRS oneself. Therefore the real transition time(t_c) is composed of measure transition time(t_m) and t_r.

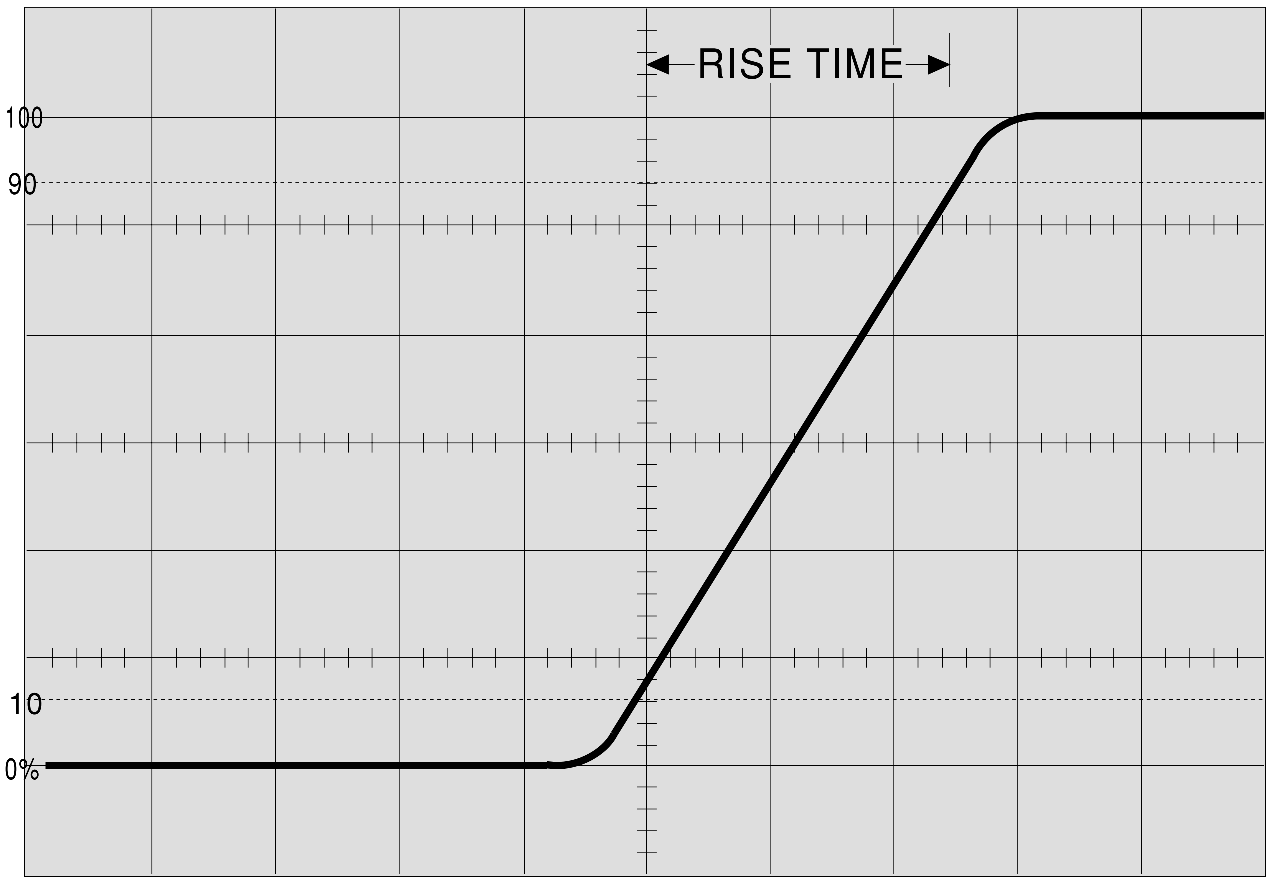
The above all is explained with the following formula:

$$t_c = \sqrt{t_m^2 - t_r^2}$$

t_c = Real transition time
t_m = Measured transition time
t_r = Rise time of oscilloscope



a. BASIC DISPLAY SETUP



b. WITH HORIZONTAL MAGNIFICATION

FIGURE 2-12. RISE TIME MEASUREMENT

3. USER MAINTENANCE ROUTINES

Maintenance routines performable by the OS-5020SRS operator are listed in this section.
More advanced routines(i,e., procedures involving repairs or adjustments within the instrument) should be referred to EZ service personnel.

3-1. CLEANING

If the outside of the case becomes dirty or stained, carefully wipe the soiled surface with a rag moistened with detergent, than wipe the cleaned surface with a dry cloth. In case of severe stain, try a rag moistened with alcohol.
Do not use powerful hydrocarbons such as benzene or paint thinner.
Dust and/or smudges can be removed from the CRT screen, First remove the front case and filter(see Figure 3-1). Clean the filter(and the CRT face, if necessary) by wiping carefully with a soft cloth or commercial wiping tissue moistened with a mild cleaning agent. Take care not to scratch them.
Do not use abrasive cleanser or strong solvents.
Let the cleaned parts air dry thoroughly and blur the waveforms.
Be particularly careful not to get fingerprints on the filter of CRT face.

3-2. CALIBRATION INTERVAL

To maintain the accuracy specifications of the OS-5020SRS, calibration checks and procedures should be performed after every 1000hours of service.
However,if the instrument is used infrequently, the calibration checks should be performed every six months.

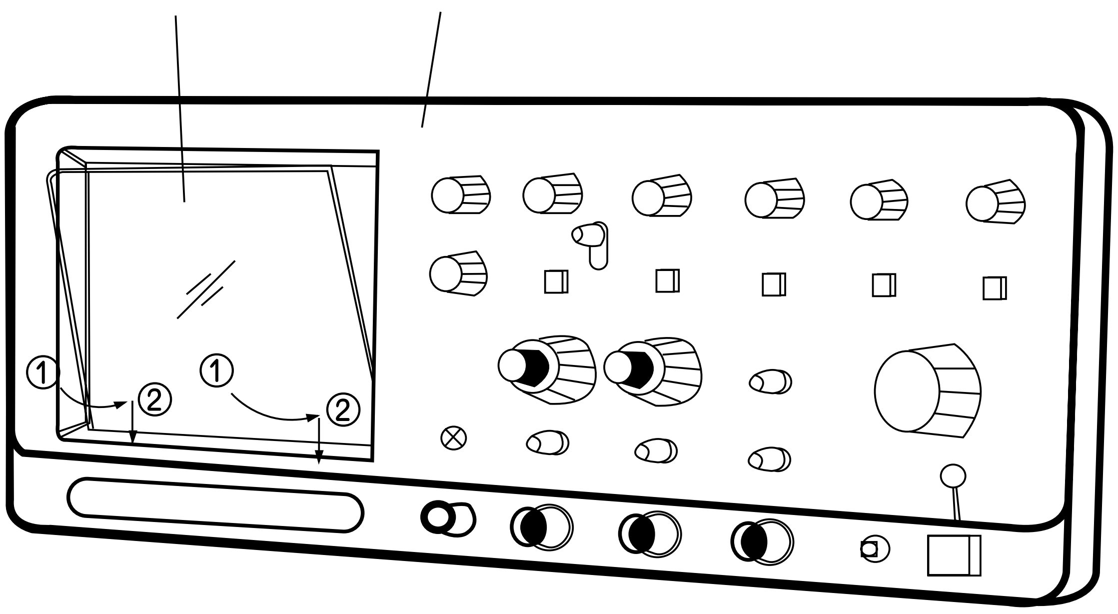
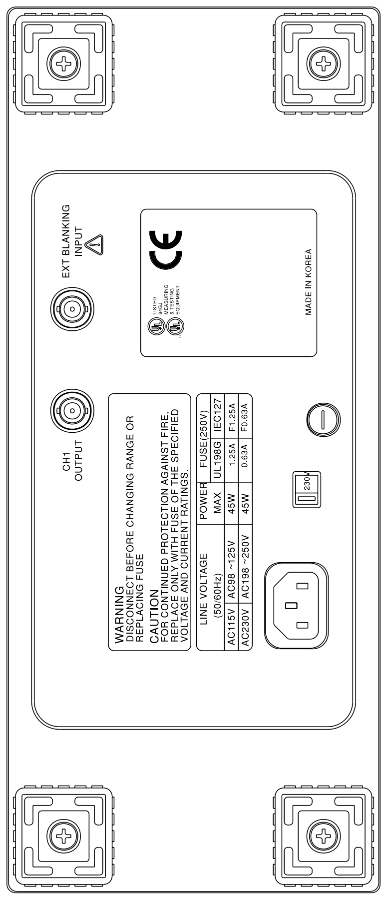


FIGURE 3-1. FRONT CASE AND FILTER

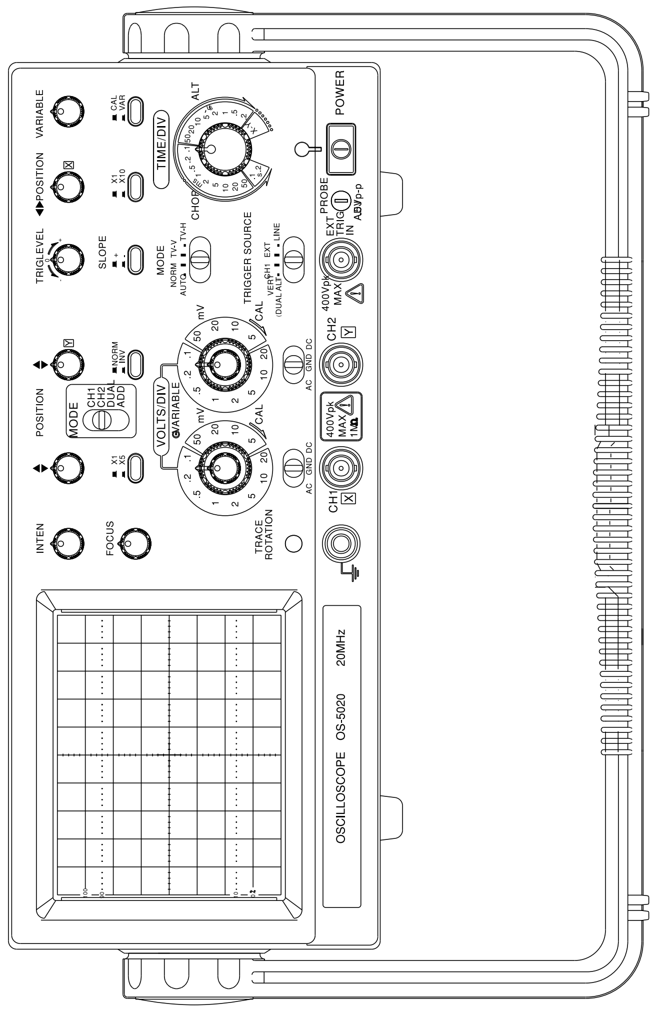
4. DIAGRAM

4-1. EXTERNAL VIEWS

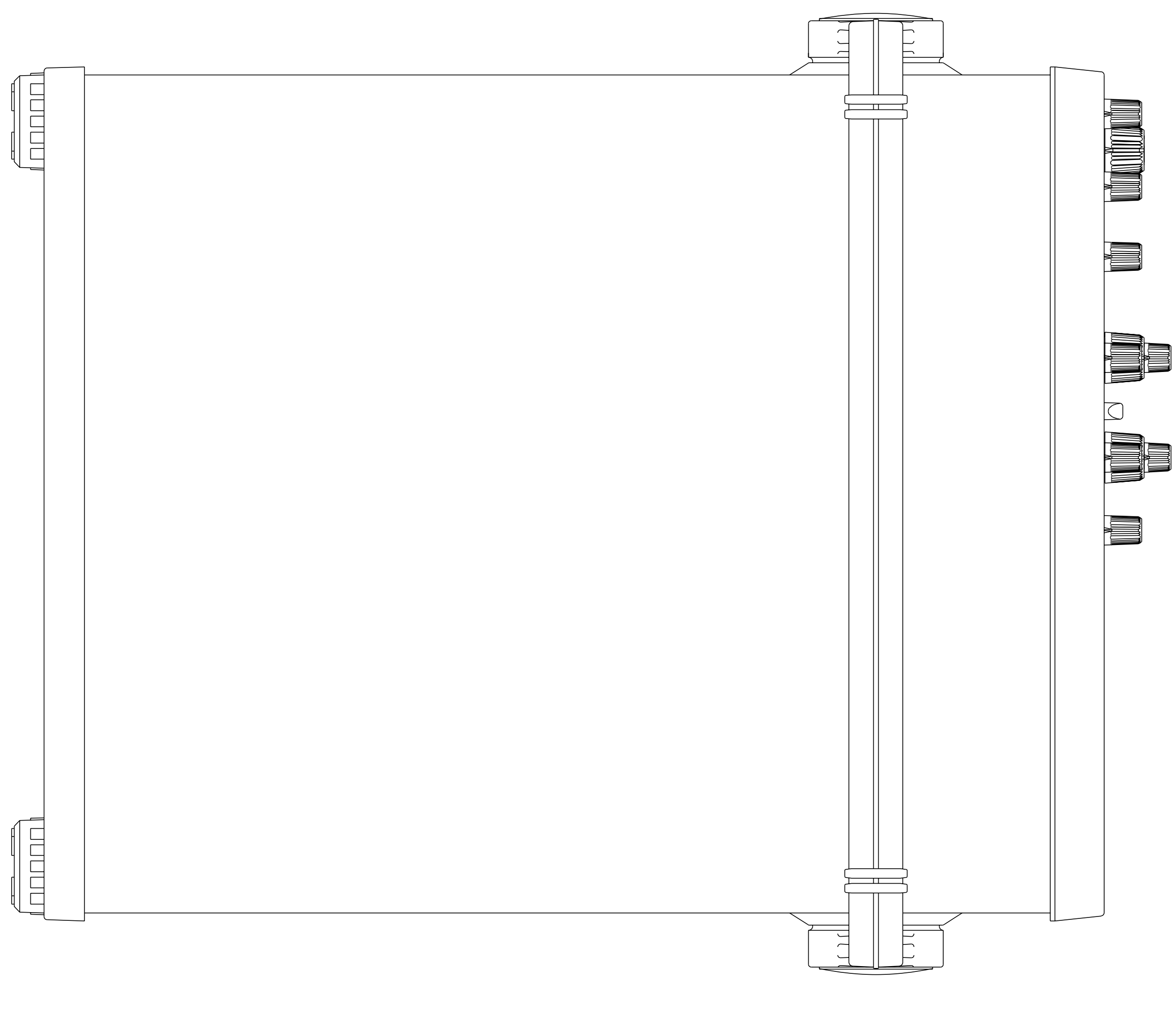
- OS-5020



REAR VIEW

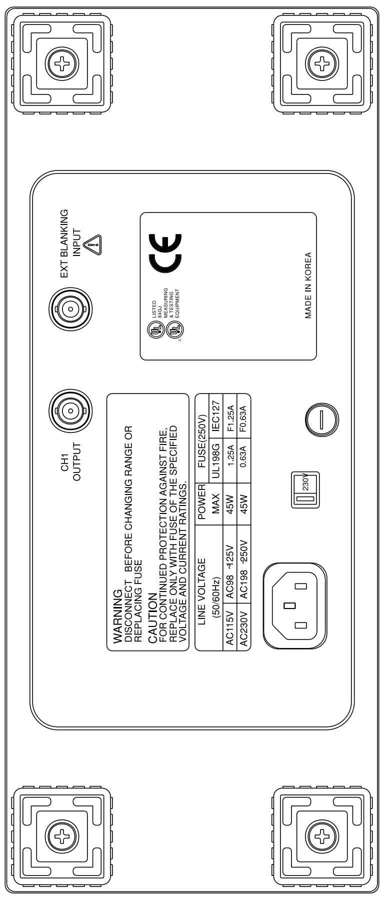


FRONT VIEW

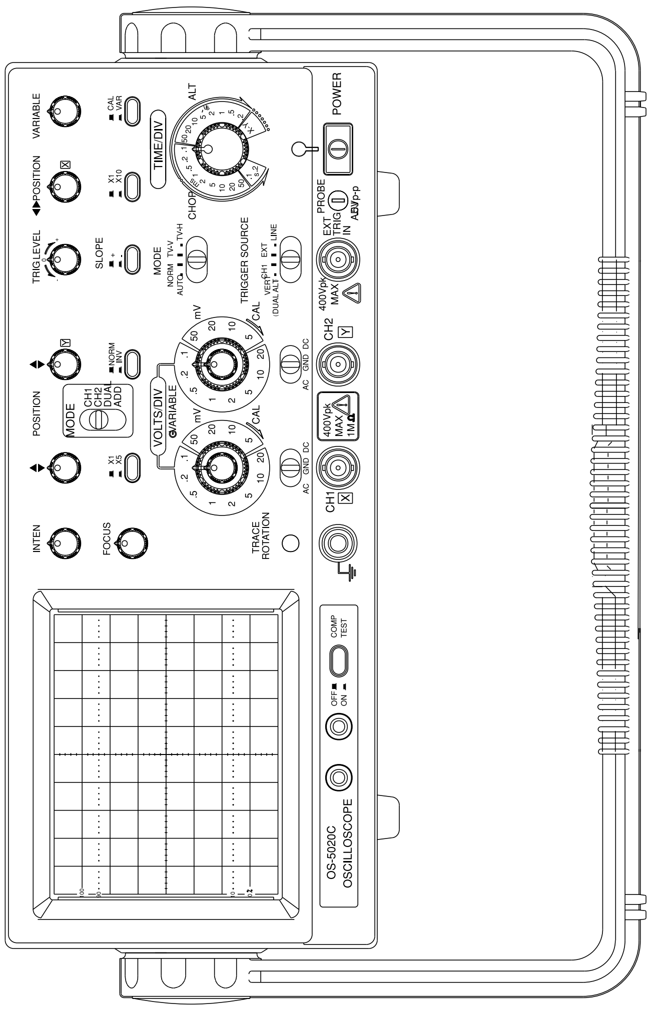


TOP VIEW

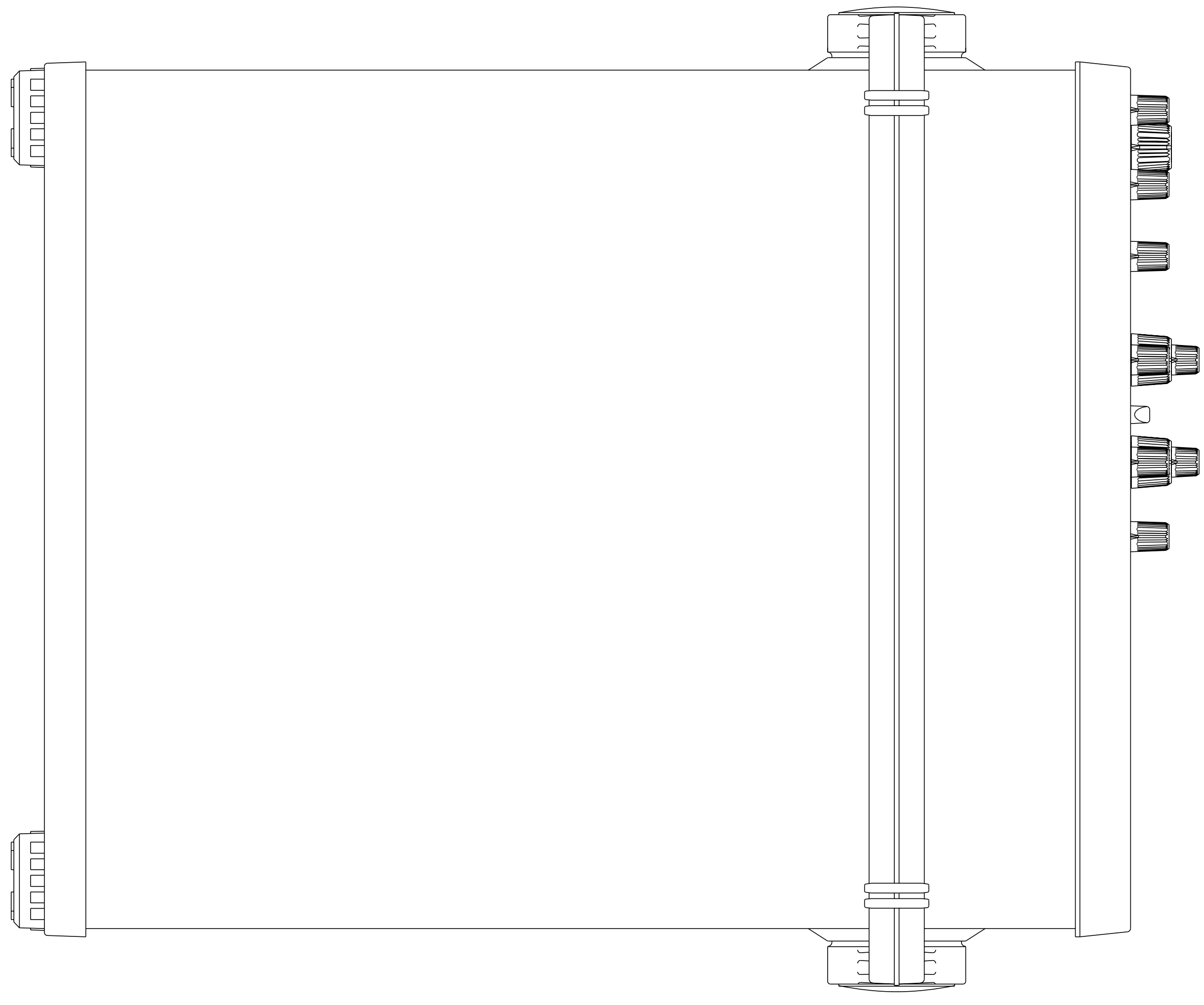
- OS-5020C



REAR VIEW



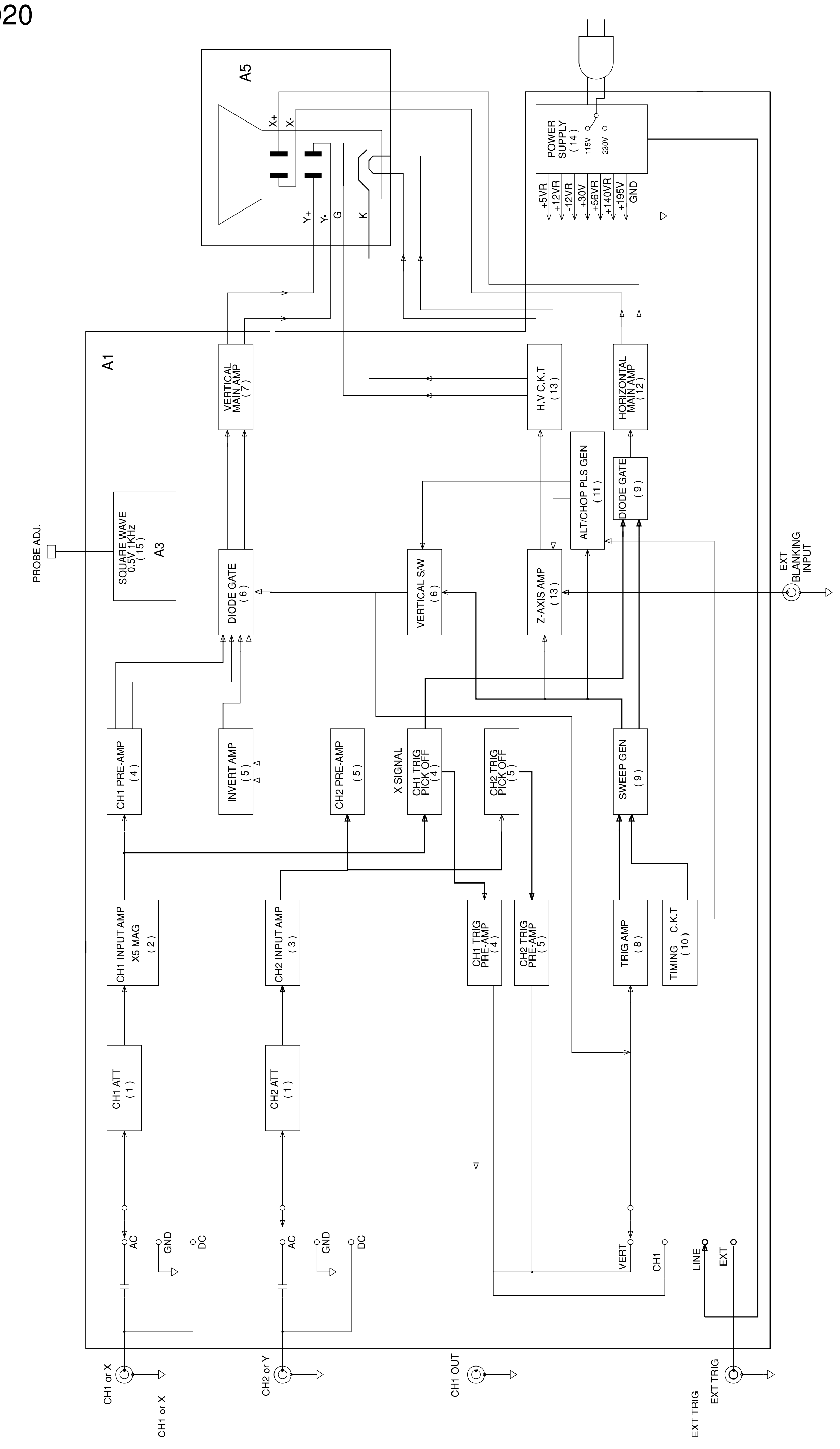
FRONT VIEW



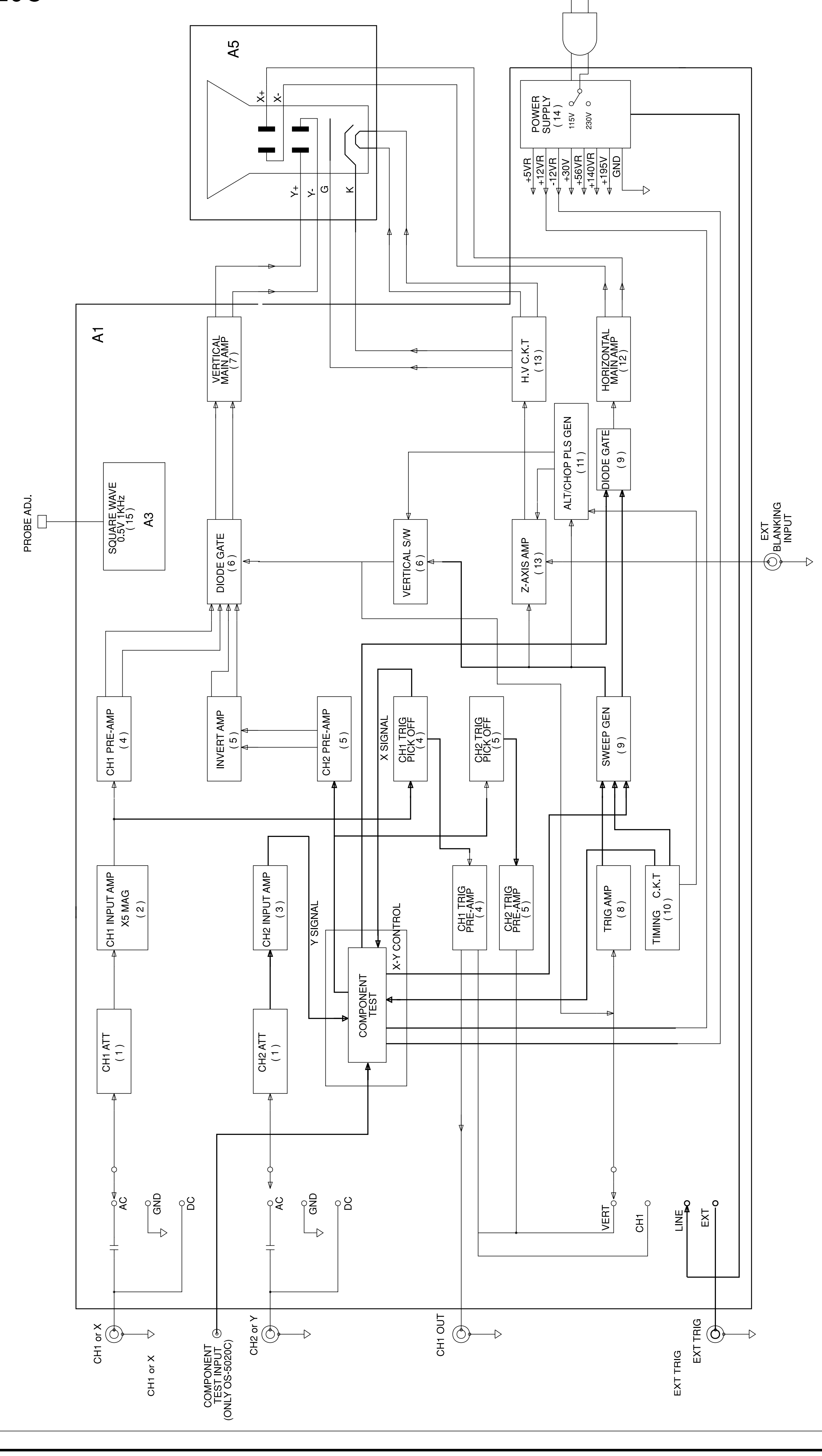
TOP VIEW

4-2. BLOCK DIAGRAM

- OS-5020



- OS-5020C



A5
X+
X-
Y+
Y-
G
K
POWER SUPPLY (14)
115V
230V
+5VR
+12VR
-12VR
+30V
+56VR
+140VR
+195V
GND
A1
VERTICAL MAIN AMP (7)
H.V C.K.T (13)
HORIZONTAL MAIN AMP (12)
ALT/CHOP PLS GEN (11)
DIODE GATE (9)
PROBE ADJ.
SQUARE WAVE 0.5V 1KHz (15)
A3
DIODE GATE (6)
VERTICAL S/W (6)
Z-AXIS AMP (13)
EXT BLANKING INPUT
CH1 PRE-AMP (4)
INVERT AMP (5)
CH2 PRE-AMP (5)
X SIGNAL
CH1 TRIG PICK OFF (4)
CH2 TRIG PICK OFF (5)
SWEEP GEN (9)
CH1 INPUT AMP X5 MAG (2)
CH2 INPUT AMP (3)
Y SIGNAL
X-Y CONTROL
CH1 TRIG PRE-AMP (4)
CH2 TRIG PRE-AMP (5)
TRIG AMP (8)
TIMING C.K.T (10)
COMPONENT TEST
CH1 ATT (1)
CH2 ATT (1)
AC
GND
DC
VERT
CH1
LINE
EXT
CH1 or X
COMPONENT TEST INPUT (ONLY OS-5020C)
CH2 or Y
CH1 OUT
EXT TRIG

EZ Digital Co.,Ltd.

The specifications are subjected to change without notice.