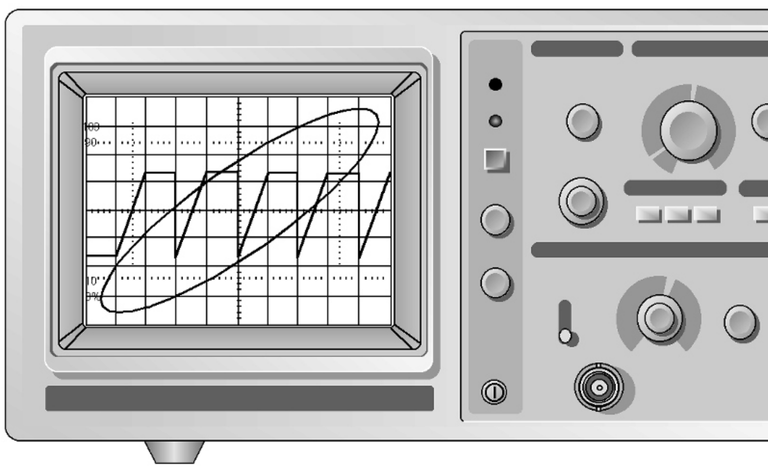
EZ

Oscilloscope

OS-5020G

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-5020G
Date:	Aug. 18 . 1995.

Conforms to the following product specifications :

Certified by TÜV Rheinland

Safety:	EN 61010-1 : 1993 (IEC 1010-1: 1990 + A1:1992,modified)
EMC :	EN 50081-1 : 1992 EN 50082-2 : 1992

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 precision and utmost reliability. For proper use of the product, please read this user manual carefully.

EZ Digital Co.,Ltd.

Note

1. To fully maintain the precision and reliability of the product use it within the range of standard setting (temperature 10℃～35℃, humidity 45%～85%).

2. After turning of power, please allow a pre-heating period of as long as some 15 minutes before use.

3. This equipment should be used with a triple line power cord 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

Warranty service covers a period of one year from the date of original purchase.

In case of technical failure occurred spontaneously within a year, repair service will be provided by our service center or sales outlet free of charge.

We charge customers for repairs after the one-year warranty period has been expired. Provided that against any failure resulted from the user's negligence, natural disaster or accident, we charge you for repairs regardless of the warranty period.

For more professional repair service, be sure to contact our service center or sales outlet.

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1. DESCRIPTIONS OF THE PRODUCT

1-1. INTRODUCTION

This product is the multi-purpose portable oscilloscope as shown on Fig.1-1 equipped with such device as waveform measuring instrument having wide band width of frequency ranging from DC to 20 MHz and function generator which generates triangle wave, sine wave, and square wave having functions of frequency range from 0.1 Hz to 1 MHz and DC offset plus separate TTL level pulse of the same frequency as the afore mentioned one.

1-2. SPECIFICATIONS

Classifications	Sepecifications
* CRT	
1) Configuration & Effective Surface	6-inch rectangular tube with internal graticule ; 8×10 division (1 div. = 1cm), marking for measureing rise and fall time. Central axis is graduated in 2mm subdivisions.
2) Accelerating Potential	Approx. × 1.9kVDC (Cathode basis)
3) Phosphor	P31 (Standard)
4) Focussing	Possible
5) Trace Rotation	Provided
6) Intensity Control	Provided
* Vertical Deflection	
1) Band-width(-3dB)	
DC coupled	DC to 20MHz normal (x1) DC to 7MHz magnified (x5)
AC coupled	10Hz to 20MHz normal (x1) 10Hz to 7MHz magnified (x5)
2) Modes	CH1, CH2, ADD, DUAL(CHOP : Time/div switch : 0.2s - 5ms, ALT :Time/div switch:2ms - 0.2us
3) Deflection Factor	5mV/div to 5V/div in 10 calibrated steps of a 1-2-5 sequence. Continuous reduction of over 2/5 is possible in each step. x5 MAG : 1mV/div to 1V/div in 10 calibrated steps is possible.
4) Accuracy	Normal : ±3% Magnified : ±5%
5) Input Impedance	Approx. 1M-ohm in parallel with 25pF
6) Maximum Input Voltage	Direct : 250V(DC+peak value AC) Probe : Refer to probe specification.
7) Input Coupling	DC - GND - AC
8) Rise Time	17.5ns or less(50ns or less:x5 MAG)

Classifications	Specifications
9) CH1 Output	Termination connectionin 20mV/div to 50 ohms : DC to 10 MHz(-3dB)
10) Polarity inversion	CH2 only
* Horizontal Deflection	
1) Display Modes	x1, x10, X-Y
2) Time base	0.2μs/div to 0.2s/div in 19 calibrated steps with 1-2-5 sequence. Uncalibrated continuous control of over 2.5 times is possible.
3) Hold-off Time	Variable with the Hold-off control
4) Sweep Magnification	10times (maximum sweep rate : 20ns/div) Note : 50ns/div, 20ns/div of A time bases are uncalibrated.
5) Accuracy	±3%, ±5% (0°C to 40°C), ±2% increase when magnified
* Trigger System	
1) Modes	AUTO, NORM, TV-V, TV-H
2) Source	CH1, CH2, LINE, EXT
3) Coupling	AC
4) Slope	+ or -
5) Sensitivity & Frequency Range AUTO, NORM	(see table below)
TV-V, TV-H	More than 1 div or 1.0 Vp-p
6) External trigger Input Impedance	Capacitive of some 25pF with approx. 1M-ohm in parallel
Max Input Voltage	250V (DC + Peak value AC)

	20Hz-2MHz	2MHz-20MHZ
INT	0.5 div	1.5 div
EXT	0.2 Vp-p	0.8 Vp-p

Classifications	Specifications
* 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(up to 50kHz in DC)
* Calibrator(Probe Adjustor)	Approx. 1kHz, 0.5V(±3%)square wave duty ratio : 50%
* Function Generator	
1) Output Frequency Range	0.1Hz to 1MHz (7 steps)
2) Output Waveform	Sine wave, square wave, triangle wave, TTL-level square wave,
3) Frequency Stability	±0.5%(Range:1, 10, 100, 1k, 10k, 100k)±1%(Range:1M) Pre-heating for over 15 minutes after power supply
4) Frequency Variable Range	10 : 1 or more
5) Output Impedance	50Ω±10%(TTL Output : FAN-OUT 20EA)
6) Output Voltage	Over maximum 14Vp-p(open circuit) continuous conversion, DC offset possible (over ±6V when opened, TTL-level possible (square wave) ; over 3Vp-p
7) Sinewave Distortion & Jitter	2% Max.(10Hz~100kHz), Less than 1/33
8) Square Wave Unsymmetry	±3% or less(in 1kHz maximum)
9) Square Wave Rise/Fall Time	50Ω output : 120ns or less(at maximum output level), TTL Output : 25ns or less

<table>
<tr><th>Classifications</th><th>Specifications</th></tr>
<tr><td>* AC Input Power
1) Voltage Range</td><td>
<table>
<tr><th rowspan="2">Voltage Range</th><th colspan="2">FUSE(250V)</th></tr>
<tr><th>UL198G</th><th>IEC127</th></tr>
<tr><td>100V(90 - 110V)/AC</td><td rowspan="2">2A</td><td rowspan="2">F2A</td></tr>
<tr><td>120V(108 - 132V)/AC</td></tr>
<tr><td>220V(198 - 242V)/AC</td><td rowspan="2">1A</td><td rowspan="2">F1A</td></tr>
<tr><td>230V(207 - 250V)/AC</td></tr>
</table>
</td></tr>
<tr><td>2) Frequency</td><td>50/60Hz</td></tr>
<tr><td>3) Power Consumption</td><td>Approx. 50W</td></tr>
<tr><td>* Weight & Dimension
1) Weight</td><td>7.4kg</td></tr>
<tr><td>2) Dimension</td><td>320mm(W)×140mm(H)×430mm(L)</td></tr>
<tr><td>* Environmental Charac.
1) Temperature range for rated operation</td><td>+10℃ to +35℃(+50°F to+95°F)</td></tr>
<tr><td>2) Max. ambient operating temperature</td><td>0℃ to + 40℃(+32°F to 104°F)</td></tr>
<tr><td>3) Max. storage temperature</td><td>-20℃ to + 70℃(-4°F to 158°F)</td></tr>
<tr><td>4) Humidity range for rated operation</td><td>45% to 85% RH</td></tr>
<tr><td>5) Max. ambient operating humidity</td><td>35% to 90% RH</td></tr>
<tr><td>* safety</td><td>EN61010-1 overvoltage CAT Ⅱ, degree of polution 2
Approval:TÜV</td></tr>
<tr><td>* EMC</td><td>Interference:EN50081-1
Susceptability:EN50082-1, IEC801-2, 3, 4</td></tr>
</table>

〈Caution〉Sources like small hand-held radio transceivers, fixed station radio and television transmitters, vehicle radio transmitters and cellular phones generate electromagnetic radiation that may induce voltages in the leads of a test probe in such cases the accuracy of the oscilloscope cannot be guaranteed due to physical reasons.
Conducted and radiated emission are only kept under the condition that 4 DIV scale is used.

1-3. POINTS TO BE CHECKED PRIOR TO USE

Comply with the following procedures for safety and to prevent damage to the product prior to operating this product.

1-3-1. Line Voltage Selection

This instrument must be operated with the correct Line Voltage Selector switch setting and the correct line fuse for the line voltage selected to prevent damage. The instrument operates from either a 90 to 132 volts or a 198 to 250 volt 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 Table 1-1. Slide the arrow mark to the desired position and plug it in.

3. Pull out the Line Fuse Holder containing the fuse for overload protection. Replace the fuse in the holder with the correct fuse from Table 1-1 and plug it in.

Table 1-1. Line Voltage Selection and Puse Ratings

Line Voltage	Arrow Mark Position	FUSE Ratings(250V)	
		UL198G	IEC127
90 to 110 volts	100V	2A	F2A
108 to 132 volts	120V		
198 to 242 volts	220V	1A	F1A
207 to 250 volts	230V		

1-3-2. Installation and handling precautions

When placing the OS-5020G in service at your workplace, observe the following precautions for best instrument performance and longest service 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. Don't 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.

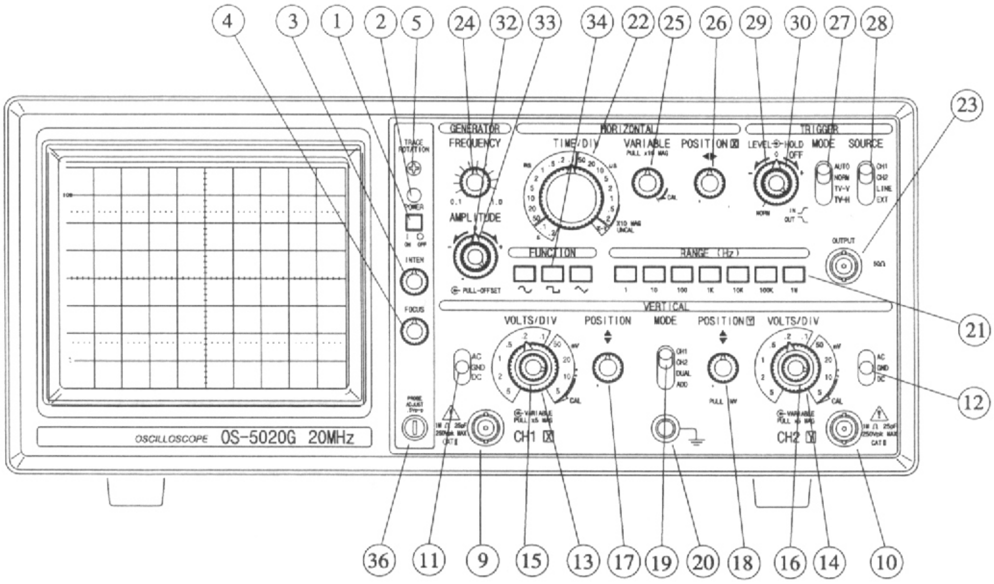
13. This oscilloscope is to use UL listed double insulated probes only.

1-4. ACCESSORIES

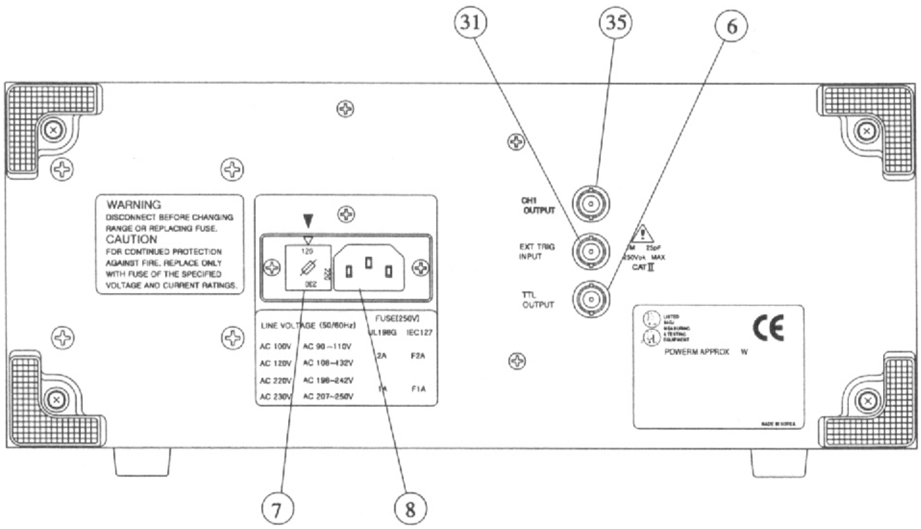
The below listed accessories are contained in the package of this instrument.

(1)Operation Manual	: 1 copy
(2)AC power Cord	: 1 EA
(3)Probe	: 2 EA
(4)Fuse	: 1 EA
(5)Cable (BNC to CLIP)	: 1 EA

2. OPERATING INSTRUCTIONS



(a) FRONT - PANEL ITEMS



(b) REAR - PANEL ITEMS

* OSCILLOSCOPE BLOCK

This section describes the measurement procedures and methods utilizing a variety of basic informations and functions needed for operating this instrument.

2-1. FUNCTION OF EACH BLOCK

The numbers shown in the following descriptions represent each terminal indicated on Figure 2-1.

2-1-1. Display and Power Blocks

Descriptions	Functions
(1) POWER Switch	: Push in to turn instrument power on and off.
(2) POWER Lamp	: Green lamp lights when power is on.
(3) INTENSITY	: Adjusts the brightness of the CRT. Clockwise rotation increases brightness.
(4) FOCUS	: Adjusts sweep lines for obtaining the highest definition.
(5) TRACE ROTATION	: Adjust it to align with horizontal lines of the CRT.
(6)CH1.OUTPUT Connector	: Provides amplified output of the channell signal suitable for driving a frequency counter or other instrument
(7) VOLTAGE Selector	: Selection is permissible to make the voltage suitable for operating power.
(8) POWER Connector	: Connection and removal of the AC power cord is easy when using.

2-1-2. Vertical Amplifier Block

(9) CH1, X IN Connector : Connects input signal to CH1 vertical amplifier or becomes a signal of X-axis during X-Y operation.

<CAUTION> To avoid damage to the oscilloscope, do not apply more than 250V(DC+Peak AC) between "CH1" terminal and ground.

(10) CH2, Y IN Connector : Connects input signal to CH2 vertical amplifier or becomes a signal of Y-axis during X-Y operation.

<CAUTION> To avoid damage to the oscilloscope, do not apply more than 250V(DC+Peak AC) between "CH2" terminal and ground.

(11), (12) AC,DC,GND : To be used when selecting the method of coupling input signal to vertical amplifier.

AC : Capacitor between input connector and vertical amplifier interrupts any DC component of the signal.

GND : Connects input connector of vertical amplifier to the ground, thus establishing GND as a reference point.

DC : With making direct connection between input connector and vertical amplifier, input signal is directly connected to vertical amplifier.

(13), (14) VOLTS/DIV : As being the attenuator by each step selecting vertical deflection sensitivity, measurement of waveform is practicable regardless of signal magnitude and those shall be used by having them placed at the appropriate position so as to make waveform measurement easy.

(15), (16) VARIABLE : As being the minute adjustor being used when having vertical deflection sensitivity continuously varied, if they are fully rotated counterclockwise the attenuation ratio becomes less than 1/2.5 of indicated value.
When you pull out the knob, vertical axis sensitivity becomes x5 times.
At this time, the maximum sensitivity becomes 1mV.

(17), (18) POSITION : Being used for moving vertical axis waveform. Clockwise roatation moves waveform up and counterclockwise rotation moves it down.

PULL CH2. INV (18) : When pulled out, the signal applied to CH2 appears inverted.

(19) V MODE Switch : Being used for selecting the display mode of vertical axis.

CH1 : Displays only the signal, input to CH1, on the CRT.

CH2 : Displays only the signal, input to CH2, on the CRT.

DUAL : Two signals that are input to CH1 and CH2 appear on the CRT simultaneously.

CHOP : TIME/DIV 0.2s~5ms
ALT : TIME/DIV 2ms~0.2μs

ADD : Displays the algebraic sum of CH1 and CH2 signals.

2-1-3. Sweep and Trigger Blocks

(22) TIME/DIV : Can select the calibrated time interval and X-Y operation.

(25) VARIABLE : Being used for having sweep time varied continuously from the calibrated position.

PULL x10MAG : When you pull the switch, sweep time magnifies by 10 times. At this time, sweep time becomes 1/10 of the indicated value of TIME/DIV.
When you make the part to be magnified align with the central scale of the vertical axis by adjusting the position of the horizontal axis and when you pull the x10 MAG switch, the waveform, the left and the right of which are magnified centering around the middle, appears. At this time, sweep time becomes 1/10 of the indicated value of TIME/DIV.

(26) Horizontal POSITION : Being used for adjusting horizontal position and being used independently of the time measurement of waveforms.
Clockwise rotation of the knob moves it to the right and counterclockwise rotation moves it to the left.

(27) TRIGGER MODE : Selects the sweep triggering mode.

AUTO : The sweep occurs automatically.
When there is a triggering signal, the sweep triggered normally is obtained and the waveform stops.
Where there is no signal and the trigger is not made, the sweep still occurs automatically. This position is convenient in general use.

NORM : Triggered sweep can be obtained, but when there is no triggering signal and triggering is not made, then the sweep does not occur, then the sweep does not occur. This mode is effective when the effective triggering is desired to be done in a low frequency (approx. 25Hz or less).

TV-V : Being used for measuring a composite video signal of a frame unit.

TV-H : This one is used for measuring a composite video signal of a scanning line unit.

(28) Trigger SOURCE : This can select the convenient portion of the trigger source.

CH1 : It can select the CH1 as the trigger source when there is a signal on CH1.

CH2 : This can select the CH2 as the trigger source when there is a signal on CH2.

LINE : This one is used for observing a signal which is triggered on the frequency of AC power. It can also stable observe components derived from the power in which a measuring signal is contained.

EXT : External signal becomes the source of triggering signals. And this one is used when making a triggering regardless of the size of signals of vertical axis.

(29) HOLD OFF : This one makes complex signal trigger for certain by changing the HOLD OFF time of the main sweep. It is also effective in triggering such complex signals as high frequency signal, irregular signal or digital signal, etc. by extending sweeping time.
Adjust it slowly for the stabilized triggering.It is normally used after having it fully rotated counterclockwise.

(30) TRIGGER LEVEL : This one selects a starting point of triggering signal. When the knob is rotated clockwise, the trigger point moves toward the +(positive) maximum value and when rotating it counterclockwise, it moves toward −(negative) maximum value.

TRIGGER SLOPE : Being used for selecting trigger slope of the initial sweep. When the switch is depressed, this switch selects positive(+) slope and when pulled, the switch indicates negative (−) slope.

(31) EXT TRIG IN : Being used for connecting external trigger signals to trigger circuits.

〈CAUTION〉 To avoid damage to the oscilloscope, do not apply more than 250V(DC+Peak AC) between "EXT Trig In" terminal and ground.

2-1-4. Function Generator Block

(35) TTL-OUTPUT : This one is a terminal which generates TTL-level square wave signal having the frequency established by both the frequency range selecting switch and the frequency dial.

(21) Frequency Range Selecting Terminal : If you select one out of seven (7) ranges, the desired frequency range can be selected.

Frequency Ranges	Desired Output Waveform
1	0.1Hz ~ 1Hz
10	1Hz ~ 10Hz
100	10Hz ~ 100Hz
1k	100Hz ~ 1kHz
10k	1kHz ~ 10kHz
100k	10kHz ~ 100kHz
1M	100kHz ~ 1MH

(23) OUTPUT : This is the output connector of the waveform selected as the waveform selecting terminal.

(24) Frequency Dial : When the dial is adjusted, the output frequency is determined within the range in which frequency is decided.

(32) DC OFFSET Control Terminal : When the terminal is pulled, DC voltage is authorized for the signal. Clockwise rotation makes positive(+) voltage added and counterclockwise rotation makes negative(−) voltage added.

(33) AMPLITUDE : This is the control terminal that varies amplitude of the output signal by adjusting terminal. The more you have it rotated clockwise, the greater the amplitude becomes.

(34) Waveform Selection Terminal : When any one out of sine wave, triangle wave, square wave, and selecting terminal is depressed, the desired waveform can be obtained.

2-1-5. Miscellaneous Features

(36) PROBE ADJUST : This outputs square wave(0.5V 1kHz) for probe compensation.

(20) GROUND Connector : Grounding connection terminal.

2-2. BASIC MEASUREMENTS

2-2-1. Connection of Measuring Signals

There are three different methods for observing signals by means of the oscilloscope as follows :

1. Method using lead wire
2. Method using coaxial cable
3 Method using probe for oscilloscope

1. Method using lead wire

This method is the simple one but it can only be used in the event that the signal level you intend to measure is either a high level signal or a low impedance circuit (such as TTL circuits). At this time, ground wires shall be connected between the grounding terminal of oscilloscope and the grounding surface of objects to be measured.
However, in case that the wire picks up hum and noise because the wire is not shielded, the measurement may often be difficult when measuring low level signals. As it is hard to have the wire connected to the connector of oscilloscope, using a binding adapter for BNC is desirable.

2. Method using coaxial cable

This method is the most prevailing one which is widely used when an output connector is attached to the measuring object. As the shield coating of coaxial cable prevents hum and noise from without, accurate measurement can be performed.
Since the coaxial cable are usually fitted with BNC connectors on each end and there are many varieties of types by their purposes, it just would be advisable to use a suitable one as needed. When measuring high frequency signals, a terminator having an impedance of the same value as the impedance of measureing signal sources shall be used, and the coaxial cables should also be mated with the terminator in terms of impedance. Even when using a long cable, should you use the subject method, an accurate measurement could be performed without being affected by measurement signals.

3. Method using probe for oscilloscope

Using a probe is most preferable to any other alternatives when performing the measurement onto circuits. The probes are available with 1X (direct connection) position and 10 × (attenuation) position. As the input signal attenuates by 1/10 with the input impedance of oscilloscope probeincreased at 10 × position, measurement unit (VOLT/DIV) must be multiplied by ten (10). (e.g. it becomes 50mV × 10 = 0.5V in 50mV/DIV). As the probe of oscilloscope also uses shielded wires, it can prevent hum and noise. When you intend to perform the measurement by using the coaxial cable, you should exactly know the source impedance, the highest frequency involved, and the capacitance of the cable, etc.
If any of these factors are unknown, use a 10 × probe.

2-2-2. Adjustment During Initial Operation

Comply with the following procedure before conducting the measurement :

1. Adjusting knob is as follows :

POWER SWITCH	(1)	: OFF (released)
INTEN Control	(3)	: Fully counterclockwise
FOCUS Control	(4)	: Mid
AC-GND-DC SWITCH	(11,12)	: AC
VOLT/DIV SWITCH	(13, 14)	: 20mV
VERTICAL POSITION Control	(17, 18)	: In the middle and pushed in
VARIABLE Control	(15, 16)	: Fully clockwise and pushed in
V. MODE SWITH	(19)	: CH1
TIME/DIV	(22)	: 0.5ms
TIME VARIABLE	(25)	: Fully clockwise and pushed in
HORIZONTAL POSITION	(26)	: Mid
TRIGGER MODE	(27)	: AUTO
TRIGGER SOURCE	(28)	: CH1
TRIGGER LEVEL	(30)	: Mid
HOLD OFF	(29)	: NORM (max. CCW)
FUNCTION	(34)	: SINE
RANGE	(21)	: 1
FREQUENCY	(24)	: 1.0
DC OFFSET	(32)	: Pushed in
AMPLITUDE	(33)	: Fully CCW

2. Connect the power cord to the power connector (8).

3. Press in the POWER switch (1), then the POWER lamp (2) should light immediately. About 30 seconds later, rotate the INTEN (3) control clockwise until the trace appears. And then, adjust brightness so as to make it suitable for observing.

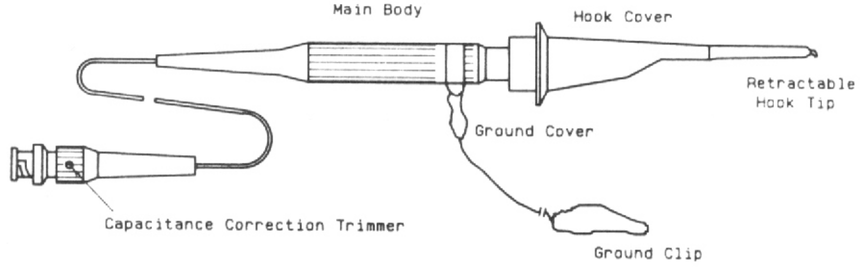
4. Adjust the FOCUS control (4) to make it produce the finest and distinctest definition.

5. Make sure that the traces align with horizontal graticule lines by turning the CH1 vertical POSITION control (17). Where the traces do not align with horizontal graticule lines, then make them align with each other by adjusting the TRACE ROTATION (5).

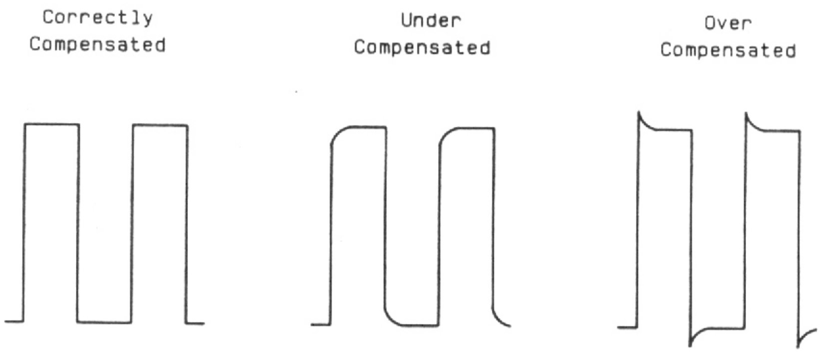
6. Turn the HORIZONTAL POSITION control (26) to make it align with the left-most graticule line.

7. Connect the PROBE to the CH1, X IN connector (9) and its tip to the PROBE ADJUST terminal (36). At this time, place the PROBE attenuation ratio on the 10X position and VOLTS/DIV switch (13) on the 10mV, respectively.

8. If the tops and a certain portion of the square waves are tilted or pointed, adjust the control terminal of the PROBE by means of a small screwdriver as shown on Figure 2-2 (b).



(a) PROBE



(b) PROBE Compensation by Correction SQUARE WAVE

Fig. 2-2. PROBE COMPENSATION

2-2-3. Single-trace Measurement

Single-trace measurement is the most elementary function of this measuring instrument.

Use this mode when·you wish to measure one single signal. Since this instrument comprises two channels, just choose one of CH1 and CH2. CH1 has an OUTPUT terminal (35), and it is desirable for you to use it when you intend to measure the frequency by means of a frequency counter.

CH2, as the INVERT switch (18), is practicable to have the polarity of wafeform inverted.

1. Set the switches as indicated below when you use the CH1. The words in the bracket represent the setting when using CH2.

POWER switch (1)	: ON
AC/GND/DC switches (11) (12)	: AC
Vertical POSITION (17) (18)	: Mid rotation and pushed in
VARIABLE (15) (16)	: Fully CW and pushed in
V. MODE switch (19)	: CH1 [CH2]
TIME VARIABLE (25)	: Fully CW and pushed
TRIGGER MODE (27)	: AUTO
TRIG SOURCE (28)	: CH1 [CH2]
TRIG LEVEL (30)	: Mid rotation
HOLD OFF (29)	: NORM (positioning it at the end of CCW)

2. Position the trace on the center of CRT by adjusting the Vertical POSITION control.

3. Connect the signal by means of the IN connector (9) (10) and turn the VOLT/DIV (13), (14) so as to make the signal fully appear on the CRT.

   CAUTION : Do not apply a signal greater than 250V (DC + peak AC).

4. Turn the TIME/DIV switch (22) so as to make the signal become the desired cycle. For the general measurement displaying of 2 or 3 cycles is suitable but when measuring the closed up waveforms, displaying of 50-100 cycles is proper. And adjust the TRIGGER LEVEL control (30) with having it rotated to make a stable waveform appear.

5. If the signal to be measured does not trigger or the measurement is difficult because of its weakness though the VOLT/DIV switch is positioned on 5mV,

pull the VARIABLE (PULL × 5 MAG) (15) (16), At this time, where the VOLT/DIV switch is set to 5mV, it becomes 1mV/DIV and the frequency wide band width decreases to 7 MHz. However, the noise increases on the trace.

6. If the signal you wish to observe is a high frequency, thus resulting in too many cycles though the TIME/DIV switch is set to the position of 0.2μs pull the TIME VARIABLE terminal (PULL × 10MAG)(25). Then the sweep speed increases by ten(10) times so that 0.2μs becomes 20ns/DIV and 0.5μs becomes 50ns/DIV.
   0.2 and 0.5μs MAG are the uncalibrated terminal and 1μs or less is the calibrated terminal.(When magnified by × 10 in 1μs/DIV, the value is ±10% and when magnified by ±10% in less than 1μs, the value is ±5%)

7. Where measuring DC or very low frequency, the AC coupling results in the attenuation of signal or waveform so that use the instrument after having the AC/GND/DC switch (11), (12) positioned to DC.

   CAUTION : Where the waveform of very low AC level is loaded on the high DC voltage, it may not appear on DC position.

   The NORM of TRIGGER MODE switch (27) is the position to be reswept. When observing signal frequency below 25Hz, you can also perform the measurement by adjusting the TRIGGER LEVEL (30).

2-2-4. Dual-trace Measurement

Dual-trace measurement is the major function of this instrument, OS-9020G. The measuring procedure is same as that of 2-2-3 Single-trace Measurement above with the exception of the following :

1. Set the V MODE switch (19) to either ALT or CHOP.
   Use ALT for relatively high-frequency signals (TIME/DIV switch : 0.2ms or faster), and use CHOP for relatively low-frequency signals (TIME/DIV switch : 0.5ms or slower).

2. If the two channels are of the same frequency, you can exactly initiate the triggering with TRIGGER SOURCE switch (28).

2-2-5. Trigger Selection

Triggering is the most complex operation to perform for the oscilloscope because this instrument has many requirements that have to be incidentally applied, and it requires an exact synchronism as well.

(1) Trigger Mode Selection

Auto Trigger Mode :

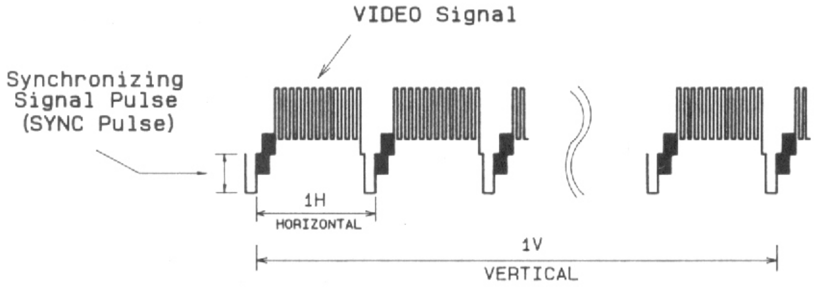
Since the synchronized sweep always appears, even though there exists no signal nor has the rigger adjusting been done improperly granting that there exists a signal, you have nothing to worry about that errors can possibly arise from the NORM.
However, where the signal frequency is less than 25Hz, the AUTO cannot be used. At this time, the measurement has to be done at the NORM position.

NORM Trigger Mode :

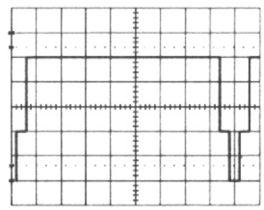
CRT beam appears only when the signal is synchronized. This Trigger MODE does not cause the trace to appear in case that there is no signal, that the synchronism adjusting has been done improperly and that the Vertical POSITION has been incorrectly adjusted or that the VOLT/DIV switch has been improperly positioned.

TV-V, TV-H Trigger Mode :

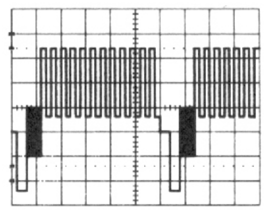
The cleanly synchronized waveform can be observed with separting the waveform such as a composite video signal (Figure 2-3a) into the horizontal and vertical components by adding a TV sync separation circuit. For the synchronism of vertical components of the TV signal (Figure 2-3b), set the Trigger MODE switch to TV-V. For the synchronism of horizontal components of the TV signal (Figure 2-3c), set the Trigger MODE switch to TV-H. When the TRIGGER has been separated (Figure 2-3d), the TV sync polarity should be negative(−).



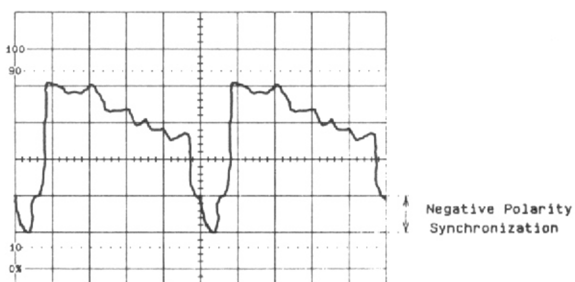
(a) Composite Video Signal



(b) TV-V Coupling



(c) TV-H Coupling



(d) SYNC Polarity

Fig. 2-3. TV SYNC SIGNAL SEPARATION

(2) Trigger Point Selection

The SLOPE switch (30) determines whether the sweep shall start from the rise-starting point or from the fall-starting point. (See Figure 2-4).
Depressed switch represents the rise-starting point and released switch indicates the fallstarting point.

(3) Trigger Level Selection

This position represents the starting point of the signal which is input with either CH1 or CH2.
The signal starting point varies as shown on Figure 2-5 by turning the TRIGGER LEVEL control (30) to the left and right.

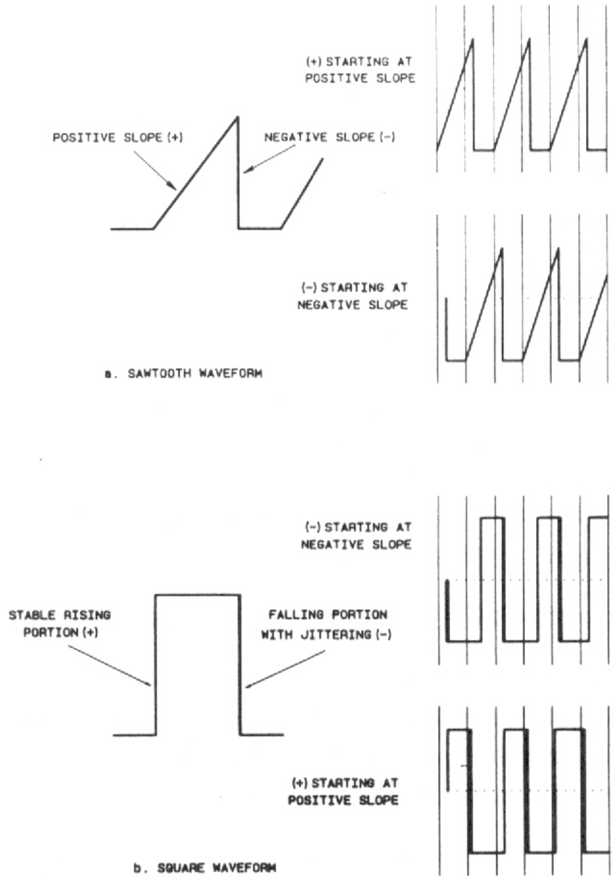


Fig. 2-4. TRIGGER POINT SELECTION

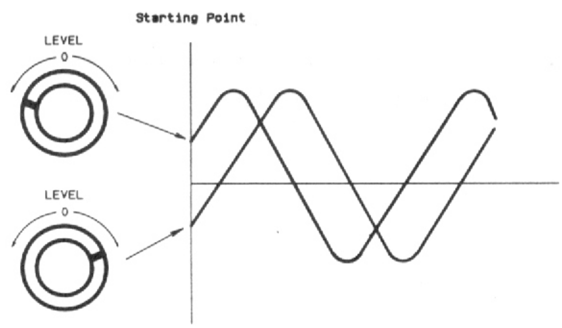


Fig. 2-5. TRIGGER LEVEL SELECTION

2-2-6. Addition and Difference Measurements

The measurement of the addition and difference is a function representing one waveform by adding two signals. The operation of the addition (ADD) represents the algebraic sum of the CH1 and CH2 signals, and the operation of the difference represents the algebraic difference of the CH1 and CH2 signals.

Measuring procedure of ADD of this instrument, OS-5020G is as follows :

1. Set up per paragraph 2-2-4 Dual-trace Measurement.
2. Set both VOLTS/DIV switches (13) and (14) to the same position and turn the VARIABLE controls (15) and (16) fully clockwise until being click-stopped. Where the amplitude difference of the two signals is considerably large, reduce both VOLTS/DIV switches simultaneously as much as to make the amplitude of the larger signal be within the screen display.
3. Select the TRIGGER switch having the biggest signal.
4. Set the V. MODE switch (19) to ADD position.
   Then, the algebraic sum of the CH1 and CH2 signals appears as a signal waveform. At this time, since the position change of Vertical POSITION controls (17) and (18) varies the measurement values, operation shall be prohibited.

   NOTE : If the two input signals are the same phase, the two signals appear as the algebraic sum of the individual traces (e.g. 4.2 DIV × 1.2 DIV = 5.4 DIV).
   Where the two input signals are 180° counter-phase, the two signals appear as the difference (e.g. 4.2 DIV − 1.2 DIV = 3.0 DIV).
5. If the p-p amplitude of the resultant trace is avery small signal, perform the measurement after having a large marking made on the screen display with adjusting both VOLTS/DIV switches.

There is one more method measuring the algebraic sum of the two signals of this instrument.
That is the method performing the measurement at the same time pulling the CH2 Vertical POSITION control (18) on which "PULL CH2INV" is marked.
When the CH2 Vertical POSITION control is pulled and the input signal is the same phase, the waveform of ADD will be the difference of amplitude (e.g. 4.2 DIV − 1.2 DIV = 3.0 DIV).
If the input signals have 180° of phase difference, the two signals will be the arithmetic sum of the amplitude (e.g. 4.2 DIV + 1.2 DIV = 5.4 DIV).

2-2-7. X-Y Operation (Measurement)

The internal time bases are not used in X-Y operation and the deflections of both the vertical and horizontal directions are all operated via external signals.
Trigger switches and their associated controls and connectors are inoperative in the X-Y mode.

Proceed with the X-Y operation as follows :

1. Turn the TIME/DIV switch (22) fully clockwise to its X-Y position.

   CAUTION : When appearing as the spot without being swept, the spot would damage the CRT phosphor. As such, reduce the trace intensity to prevent it from becoming too bright.

2. If you apply the vertical signal to the CH2, Y IN connector (10) and the horizontal signal to the CH1, X IN connector (9), the trace appears.
   Then, adjust the trace to the proper brightness.

3. Adjust the trace height with the CH2 VOLTS/DIV switch (14) and the trace width with the CH1 VOLTS/DIV switch (13). Adjust the PULL X5 MAG switches (15) (16) and the VARIABLE as needed.
   The TIME VARIABLE control (25) is measured when it remains pushed in.

4. If you wish to move the waveform vertically (Y axis), adjust the CH2 Vertical POSITION control (18) and adjust the Horizontal POSITION control (26) when you intend to move the waveform horizontally (Xaxis).
(The CH1 Vertical POSITION control (17) does not operate in the X-Y mode).

5. The phase of the vertical (Y axis) signal can be inverted 180° by pulling the CH2 Vertical POSITION knob (18).

2-3. MEASUREMENT APPLICATIONS

This section contains the measurement procedures applying basic functions of this instrument, OS-5020G.
Though only some of them are introduced, we assure you that a variety of specific measurements can also be performed based on the said functions.
As the measurement applications set out herein are the important and essential particulars, it is desirable for you to make yourself familiar with those basic operating procedures while you use the oscilloscope.

2-3-1. Amplitude Measurement

The latest synchronous sweep oscilloscope has two major functions.
The first of these is to measure the amplitude.
It is practicable to perform all the measurements with the oscilloscope ranging from the simple waveforms to the complex ones.
The oscilloscope in general has two different voltage measurements, namely peak-to-peak (p-p) measurement and instantaneous peak-to-peak (p-p) measurement.
Instantaneous voltage measurement is to measure the voltage of each point on the waveform from a ground reference.
In order for you to perform the aforementioned measurements exactly, make sure that the VARIABLE controls are fully turned clockwise.

(1) Peak-to-Peak (p-p) Voltage Measurement

1. Set up the vertical mode switches of the oscilloscope in the same manner as that set out in 2-2. BASIC MEASUREMENTS.

2. Adjust the TIME/DIV switch (22) in such a manner as to form a waveform of as many as two or three cycles and the VOLTS/DIV switch shall be so adjusted as to make the waveform be on the CRT screen display.

3. Adjust the Vertical POSITION controls (17) and (18) properly and make the end of the waveform align with the horizontal graticule line of the CRT screen display. (See Figure 2-6).

4. Adjust the Horizontal POSITION control (26) and make the end of the waveform be on the central vertical line of the CRT screen display.
(This line is graduated in 0.2 scale divisions).

5. Count the number of divisions on both the top and bottom of the waveform and multiply the resultant number by the value of the VOLTS/DIV switch, thus resulting in the peak-to-peak voltage.
For example, if the value of the VOLTS/DIV switch was set to 2V when the waveform same as that shown in Figure 2-6 had been measured, it would in fact be 8.0 Vp-p.
(4.0div × 2.0V = 8.0V)

6. If the indication of the vertical magnification is X5, divide the measured value by 5.
However, if the probe is 10:1, multiply the voltage by 10.

7. When measuring a sine wave below 100Hz or a square wave below
set the AC/GND/DC switches to DC.

CAUTION : Where the waveform is loaded with the high potential DC voltage, the above measurement is difficult.
At this time, perform the measurement with setting the AC/GND/DC switches to DC.
(When the measurement of AC component is needed).

(2) Instantaneous Voltage Measurement

1. Set up the vertical mode switch of the oscilloscope in the same manner as that set out in 2-2.
BASIC MEASUREMENTS above.

2. Adjust the TIME/DIV switch (22) so as to become a complete waveform and set the VOLTS/DIV switch to produce 4 to 6 divisions (See Figure 2-8).

3. Set the AC/GND/DC switch (11) or (12) to GND.

4. Turn the Vertical POSITION control (17) or (18) and make it align with either the lowest central horizontal graticule line (in case of positive (+) signal) or the uppermost one (when the signal is negative(−)).

   NOTE : The vertical POSITION controls must not be touched until the measurement is completed.

5. Set the AC/GND/DC switch to DC.
   If the signal is positive (+), the waveform appears above the ground reference line and where the signal is negative (−), the waveform appears below the ground reference line.

   CAUTION : Where the DC voltage is relatively greatly loaded compared with the waveform, then measure the AC portion separately from others with setting the AC/GND/DC switch to AC.

6. Make the point you wish to measure align with the central vertical graticule line on the CRT screen display by moving the Horizontal POSITION control (26).
   Since the central vertical graticule is graduated in scales at every 0.2 division, the measurement is easy to perform.
   In the example cited for Figure 2-7, if the VOLTS/DIV switch is positioned at 0.5V, the value becomes 2.5V (5.0 div × 0.5V = 2.5V).

7. If the X5 magnified movement is performed, divide the value measured in paragraph 6 above by 5 and where the X10 PROBE is used, multiply the resultant value by 10.

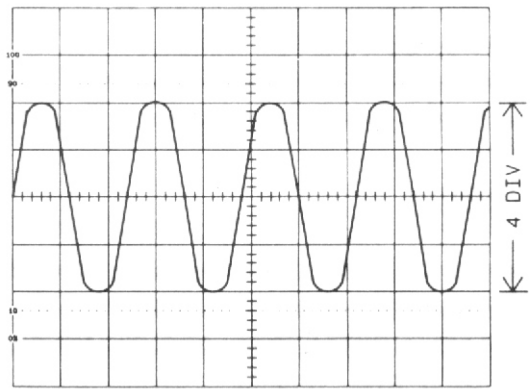


Fig. 2-6. PEAK-TO-PEAK VOLTAGE MEASUREMENT

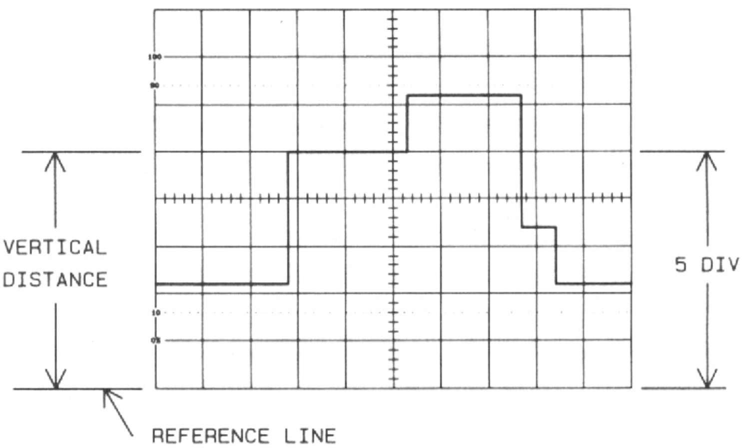


Fig. 2-7. INSTANTANEOUS VOLTAGE MEASUREMENTS

2-3-2. Time Interval Measurements

The second most important measurement of the synchronous-sweep oscilloscope is the very measurement of time interval.
Since the divisions uniformly marked on the CRT screen are all calibrated to the time bases, the time interval measurement is practicable.

(1) Basic Technique

The basic technique for measuring time interval is described in this section. In addition, characteristics measurement and variation technique using this technique will be helpful, if you apply the following procedures :

1. Set up switches in the same manner as that described in 2-2-3. Single-trace Measurement above.

2. Set the TIME/DIV switch (22) in such a manner as to make the waveform appear on CRT screen display as large as possible.
   Turn the TIME VARIABLE control (25) fully clockwise until being click-stopped.
   Unless otherwise you so do, the measured value will be inaccurate, thus requiring you to exercise due care.

3. Adjust the Vertical POSITION controls (17) and (18) and make the waveform you wish to measure align with the central horizontal graticule line.

4. Turn the Horizontal Position control (26) and make the left side of the waveform correspond to the vertical gracitule line.

5. Count the number of graticule divisions up to the point you intend to measure. Horizontal central graticule line is graduated in divisions ranging to 0.2 division.

6. If you multiply the value measured in Item 5 above by the value set by the TIME/DIV switch, the time you wish to measure will be obtained.

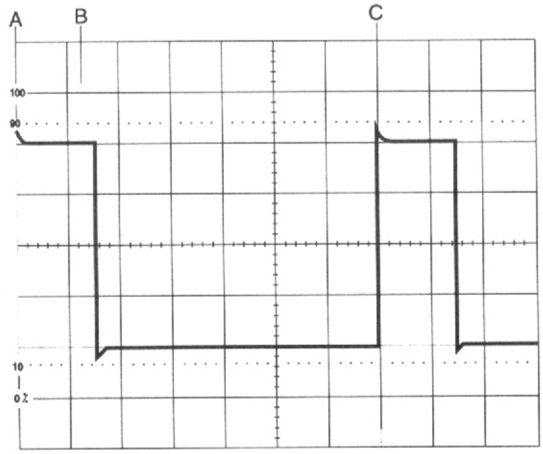
If the TIME/VARIABLE knob (25) is pulled (X10 magnified mode), divide the measured value by 10.

(2) Period, Pulse Width, and Duty Cycle Measurement

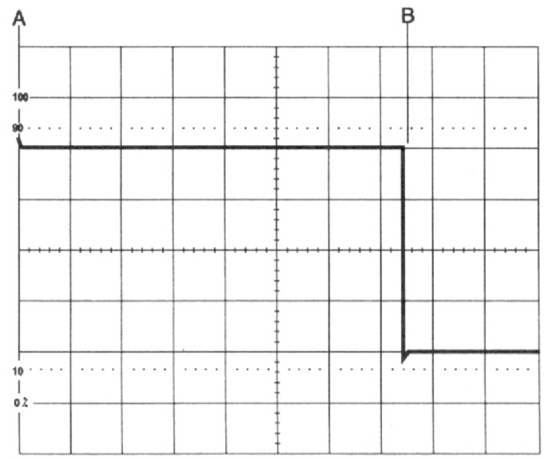
If you make good use of the measurement based on the basic technique, you can also measure the period of pulse, pulse width, and duty cycle, etc.
When a complete period of pulse of the signal appears on the CRT screen display, the period of pulse of that time can be measured.
For example, say the TIME/DIV switch were set to 10mS, the measured value of one cycle between A and C in Figure 2-8a would be a waveform having a period of cycle of 10ms × 7 = 70ms
The pulse width represents the time between A and B.
In Figure 2-8a, it is 1.5 division so that it becomes 1.5DIV × 10ms = 15ms.
However, in this example, as an 1.5 division is a rather short distance, should you set the TIME/DIV switch to 2ms, it would be seen magnified as shown on Figure 2-8b.
Then, though the pulse is short, the measurement accuracy becomes increasingly better. Where it is still displayed small even with adjusting the TIME/DIV switch, it is advisable to perform the measurement under X10 magnified condition by pulling the TIME VARIABLE knob (25).
When pulse width and period are known, duty cycle can be calculated.
Duty cycle is the percentage against ON-time of the pulse period (total of ON-and OFF-time).
In Figure 2-8, the duty cycle is as follows :

$$\text{Duty cycle}(\%) = \frac{\text{Pulse width}}{\text{Period}} \times 100 = \frac{A \rightarrow B}{A \rightarrow C} \times 100$$

$$\text{(e.g) Duty cycle}(\%) = \frac{15\text{ms}}{70\text{ms}} \times 100 = 21.4\%$$



(a) 10mS DIVISION



(b) 2mS DIVISION

Fig. 2-8. TIME INTERVAL MEASUREMENT

2-3-3. Frequency Measurement

When an accurate measurement is needed, a frequency counter shall be used. If you have the frequency counter connected to the CH1 OUTPUT connector (35) on the rear panel of the oscilloscope, you will enjoy the convenience and advantage to perform both the waveform observing and frequency measurement simultaneously. However, when a frequency counter is not available, the oscilloscope can directly measure the modulated waveform that can hardly be measured by means of a frequency counter, or the waveform bearing a lot of noise. Frequency is interrelated to the period. First of all, in brief, you can simply obtain the frequency by calculating with 1/t assuming that you have already known the period "t" appearing in section 2-3-2 Time Interval Measurement. With applying the formula of 1/t, when period is depicted in seconds, the frequency is Hertz(Hz) ; period in milliseconds (μs) yields frequency in kilohertz (kHz) ; period in microseconds (ms) yields frequency in megahertz(MHz).

The accuracy of frequency is determined by an accurate calibration of the timebase and careful measurement of the period.

2-3-4. Phase Difference Measurements

Phase difference of phase angle between signals can be measured using the dual-trace method of phase measurement or Lissajous diagrammatic method of phase measurement in the X-Y mode of the oscilloscope.

(1) Dual-trace Method

This method works with any type of waveform. Even if the waveforms are different from each other or the phase difference is great, the measurement up to 20MHz is practicable.

Measurement shall comply with the following :

1. Set the switches as described in 2-2-4 Dual-trace Measurement. Connect one signal to the CH1 IN connector (9) and another one to the CH2 IN connector (10).

   NOTE : Where the frequency is becoming higher, use the same probe or the cable having an equal delay time so that an observational error can be reduced.

2. Position the Trigger SOURCE switch (28) toward the stable waveform. At this time, move another waveform upward or downward by adjusting the Vertical POSITION control so as to make the said waveform invisible.

3. Move the waveform to the center adjusting the Vertical POSITION control, and adjust the VOLTS/DIV switch and VARIABLE control exactly so as to make the waveform occupy 6 divisions.

4. Adjust the Trigger LEVEL control (30) and ensure that the beginning point of the waveform corresponds exactly to the starting point of the horizontal graticule line (See Figure 2-9).

5. Adjust the TIME/DIV switch (22), TIME VARIABLE control (25), and the Horizontal POSITION control (26) properly so as to make one cycle of the waveform become 7.2 divisions. When this is done, each major horizontal division represents 50° and each subdivision represents 10°.

6. Perform the same procedure as that described in Item 3 above so as to have another waveform already moved to be invisible also displayed on center of the horizontal graticule line.

7. The horizontal distance between the beginning points on the horizontal axis of two waveforms is the phase difference. For example, the phase difference shown in Figure 2-9 is 5.2 divisions, hence 60°.

8. If the phase difference is less than 50°, the measurement can be performed closely using X10 magnification mode. In this case, note that one major division represents 5°.

(2) Lissajous Pattern Method

This method can only be used where the waveform is sine wave. Measurements can possibly be performed at frequencies even 500kHz depending on wide band width of the amplifier. However, in order for you to maintain the maximum accuracy provided in features, it is desirable to conduct the measurement at the phase difference less than 50KHz.

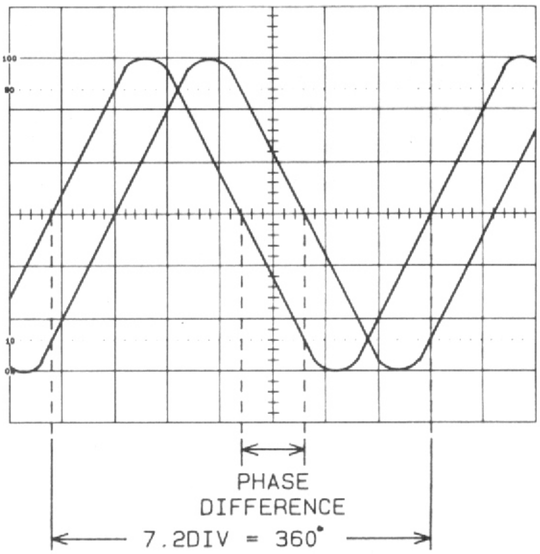


Fig. 2-9. DUAL-TRACE METHOD OF PHASE MEASUREMENT

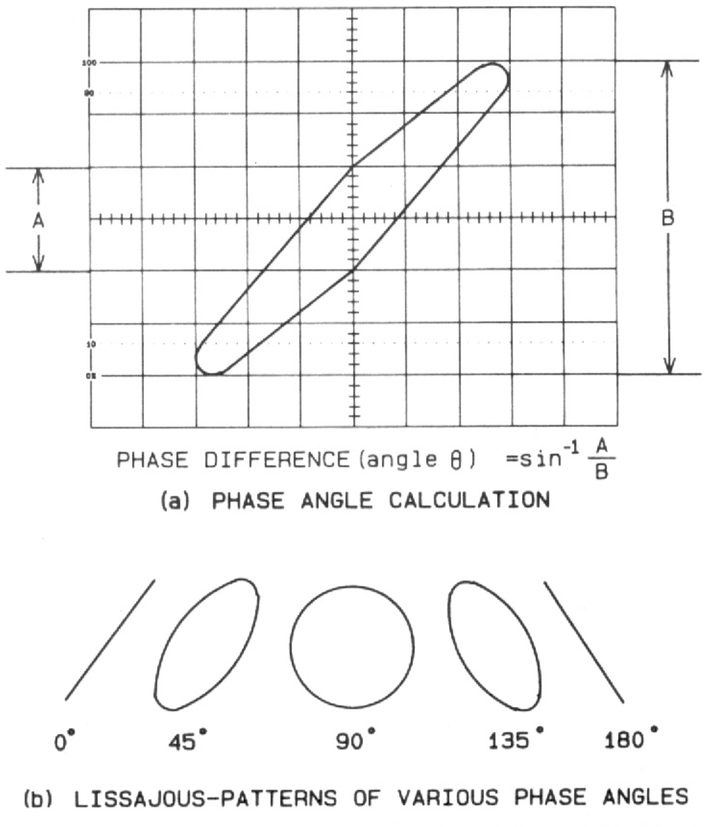


Fig. 2-10. LISSAJOUS METHOD OF PHASE MEASUREMENT

Phase difference measurement shall comply with the following procedure :

1. Rotate the TIME/DIV switch fully clockwise and set it to the X-Y position.
   CAUTION : At this time, the trace on the CRT screen is so bright that it could often damage the CRT phosphor so that reduce the trace intensity properly.

2. Make sure that CH2 POSITION (18) and PULL X5 MAG knob (16) are pushed in.

3. Connect one signal to the CH1, X IN connector (9), and another signal to the CH2, Y IN connector (10).

4. Center the waveform by adjusting the CH2 Vertical POSITION control (18), and adjust the CH2 VOLTS/DIV switch (14) and VARIABLE control (16) together so as to make the waveform become 6 divisions (the waveform exists on the 100% and 0% graticule line).

5. Adjust the CH1 VOLTS/DIV switch (13) and VARIABLE to make the waveform become 6 divisions as done in Item 4 above.

6. Precisely center the waveform to have it exactly positioned right on the horizontal center adjusting the Horizontal POSITION control (26).

7. Count the number of divisions indicated by the waveform along the central vertical graticule line. You may count moving the waveform by means of the CH2 position control for close measurement.

8. The phase difference of the two signals (angle θ) is equal to the arc sine of $A \div B$ (the number divided by 6 in Item 7 above). For example, when the waveform is same as that described in Figure 2-10a, if you perform the calculation according to Item 7 above, the resultant is the arc sine value of $2 \div 6 = 0.3334$

which is converted into 19.5° in terms of the angle.

Phase difference (angle θ) = $\mathrm{Sin}^{-1}\frac{A}{B}$

9. The simple method can directly be applied to angles less than 90°. As for angles greater than 90°, add 90° thereto. So that you are required to determine its value with referring to various phase angle indicated in Figure 2-10b.

NOTE : The conversion of sine angle can be obtained in accordance with trigonometric function table and trigonometric function expression.

2-3-5. Risetime Measurement

Rise time is the time required 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 the 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 you wist to measure 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 sure that the TIME VARIABLE control (25) is rotated fully clockwise and pushed in.

3. Center the pulse vertically by adjusting the CH1 Vertical POSITION (17).

4. Adjust the CH1 VOLTS/DIV switch (13) so as to make top of the pulse be closest to the 100% graticule line, and the bottom of the pulse be closest to the

0% line. Where the correspondence is not made, then rotate the VARIABLE control (15) slightly counterclockwise with making graticule lines of both sides deviate a little to make the both pulse peaks rest exactly on the 100% and 0% graticule lines, respectively. (See Figure 2-11).

5. Adjust the Horizontal POSITION control (26) and make the rising edge rest on the central vertical graticule line (crosses at the 10% point).

6. If the risetime is slow compared to the period, no further magnification is necessary. If, however, the risetime is as short as to correspond almost to the vertical graticule line, make an adjustment as described in Item 5 above by pulling the TIME VARIABLE/PULL X10 MAG control (25). (See Figure 2-11b).

7. Count the number of horizontal divisons between the 10% point (central vertical graticule line) and the 90% point.

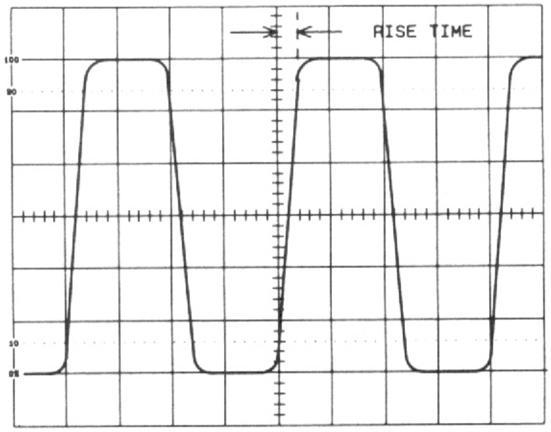
8. Multiply the number of divisions counted in Item 7 above by the numerical value of the TIME/DIV switch, then you will obtain the measured risetime.
Where the mode is X10 magnification, divide the value of the TIME/DIV setting by 10. For example, if the TIME/DIV switch was set to 1 μs, and the measurement was conducted as shown in Figure 2-11a, the risetime would be 360ns.(1000ns ÷ 10 = 100ns, 100ns × 3.6DIV = 360ns ; because the mode is X10

9. When measuring falltime, simply make the 10% point in fall time align with the central vertical graticule line, and perform the measurement conforming to the procedure set out in Items 7 and 8 above.

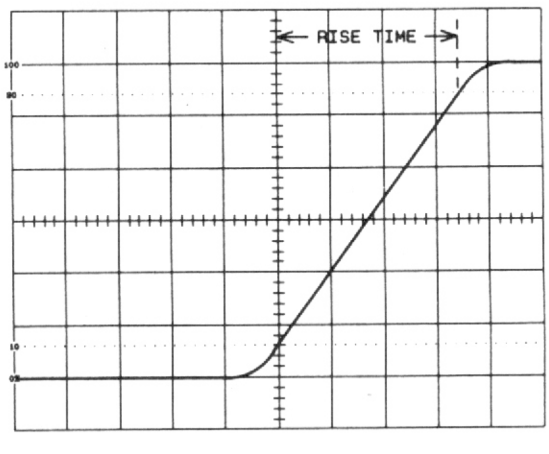
10. When measuring the rise and fall time, note that 17.5ns-Rise time (t_r)=0.35/f_{-3dB} which is transition time is contained in the OS-5020G oneself. Therefore the real transition time (t_c)is composed of measure transistion time (t_m) and t_r.
The above all is explained with the following formula:

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

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



a. BASIC DISPLAY SETUP



b. WITH HORIZONTAL MAGNIFICATION

Fig. 2-11. RISETIME MEASUREMENT

* FUNCTION GENERATOR BLOCK

2-4. OPERATION INSTRUCTIONS

2-4-1. Output Frequency Adjustment & Waveform Selection

1. Select the desired waveform and frequency by select ing the FUNCTION switch (34) and RANGE switch (21), and by adjusting the FREQUENCY control (24). At this time (TTL, 50 ohm), the output frequency also is always same as the selected frequency, and the frequency range that can be varied with FREQUENCY control (24) is 0.1 to 1 of the frequency value of selected RANGE. At this point in time, as the frequency of graticule lines has the error of as much as approx. ±20%, use the external FREQUENCY COUNTER or the oscilloscope installed inside this equipment.

2. Select the desired output waveform with the FUNCTION switch (34). The phase of each output waveform is as shown in Figure 2-12.

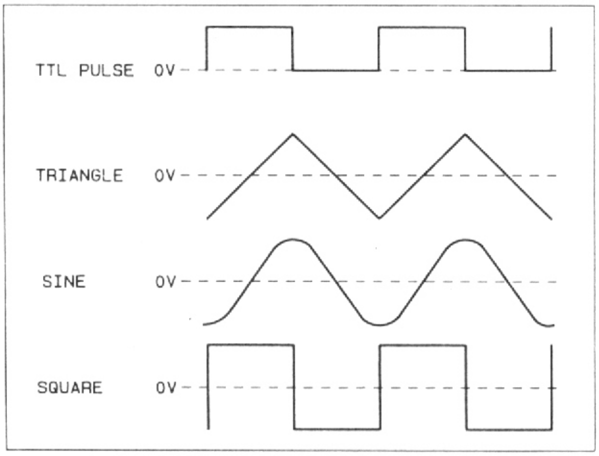


Fig. 2-12. PHASE OF OUTPUT WAVEFORM

3. Adjust the amplitude of output signals to the desired size with the AMPLITUDE control (33). At this time, the AMPLITUDE control does not affect the TTL OUTPUT.

4. Admix the DC components of desired sizes to the output signals by adjusting the DC OFFSET control (32). Admixed DC components do not affect both the

AMPLITUDE control (33) and the TTL output, and the variable ranges of DC components are as follows :

Output Condition	Open Output (Open Circuit)	50 Ohm Output (50 Ohm Loaded)
Variable Range	±6V	±3V

* The maximum voltage of output signal of this instrument is±6V (when output is open). When there is a load of 50 ohm for 50 ohm output, the output signal is below ±3V.
Therefore, if the output signal containing DC OFFSET components (VAC + DC OFFSET) deviates from the aforementioned limit, crimping phenomena occur as shown in Figure 2-13.

Fig. 2-13. Crimping Phenomena

2-4-2. DC Output

This instrument can be used with the power of 2-polarity, the internal impedance of which is 50 ohm, and operation procedures are as follows :

1. Depress the FUNCTION switch (34) slightly and make all of 3 switches be OFF. At this time, only the DC signal appears on the output.

2. Adjust the output between +6V and −6V (when output is open) using the DC OFFSET control (32).

2-4-3. TTL Output

TTL OUTPUT (35) is the square wave having a fast risetime so that the cable termination must be done by all means to reduce the ringing phenomena resulting from the fast varying time. And the potential is always higher than GND.
In addition, the TTL output can be used as an external synchronous signal for the oscilloscope when using other outputs, and it can also be used as a variable frequency signal apparatus when conducting a logical-circuit test.

Operation Sequence

1) Select the desired frequency.
2) Connect the cable to the TTL OUTPUT terminal (35).
3) Neither the AMPLITUDE control (33) nor the DC OFFSET control (32) affects the TTL output.

3. USER MAINTENANCE GUIDE

In order for you to use better this instrument, OS-5020G, please refer to the following. And if any failure occurs during your use, please contact the EZ Digital service center for professional repair service.

3-1. CLEANING

Where the outside of the case is stained, remove the stain by wiping it lightly with cloth moistened with neutral detergent, and then wipe the cleaned surface again with a dry cloth. In case where the surface got rusty, wipe the surface with cloth saturated with alcohol. Do not use strong volatile solvents such as benzine or thinner.

When you clean the surface of the CRT, wipe the surfaces of the filter and the CRT carefully with soft cloth moistened with mild detergent after having the front case and the filter disassembled first (see Figure 3-1). Under no circumstances shall the abrasive or strong solvents be used. And then, reassemble the filter and front case after having them thoroughly dried so as to prevent dew from being formed on their surfaces. Take care not to leave any hand mark or the like on the surface of the CRT or filter.

3-2. CALIBRATION

To maintain the accuracy of the measurement, calibration of OS-5020G should be performed at least every 1000 service hours when the instrument is used continuously, and every 6 months when used intermittently. In so far as the calibration of this instrument is concerned, please contact the EZ Digital calibration and inspection agency authorized by the government.

3-3. FUSE REPLACEMENT

Fuse of the input power is contained in the INPUT voltage selection switch (7) on the rear panel. When replacing the fuse due to the failure, comply with the following procedure :

1. Remove the power cord from the POWER connector (8).

   CAUTION : Exercise exceptional care because personnel injury, a loss of lives or mechanical failure may occur unless the power cord is removed when replacing the fuse.

2. Remove the voltage selection switch (7).

3. Replace the blown fuse.

CAUTION : Make it a rule to use the rated fuse. Fuse standards for this instrument are as follows :

Service Voltage	Fuse Rating	Size (Dia. xL.) mm	Designation
110, 120V	2A 250V	5.2φx20	MF51NM125V2AAC
220, 230V	1A 250V	5.2φx20	MF51NM250V1AAC

4. Carefully insert the voltage selection switch (7) in the correct direction of input voltage corresponding to the indication.

5. Plug in the power cord and turn on the POWER switch. If the fuse blows again, please contact the EZ Digital service center.

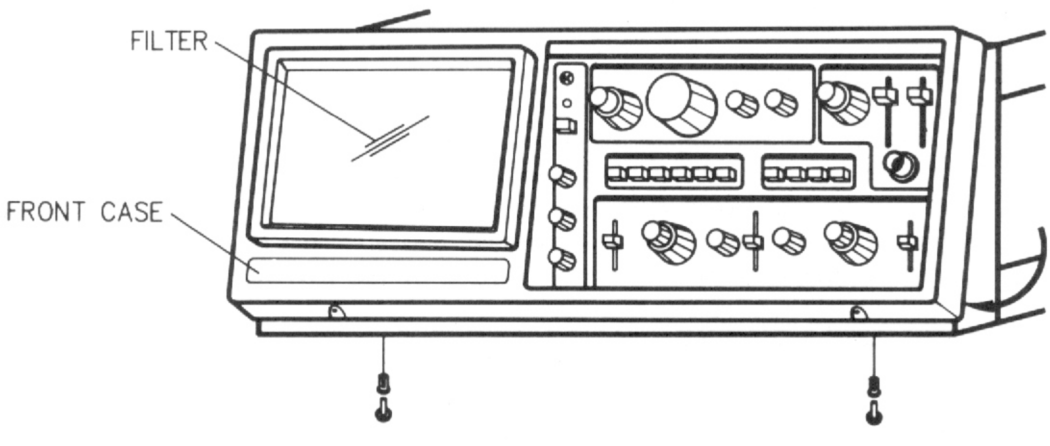
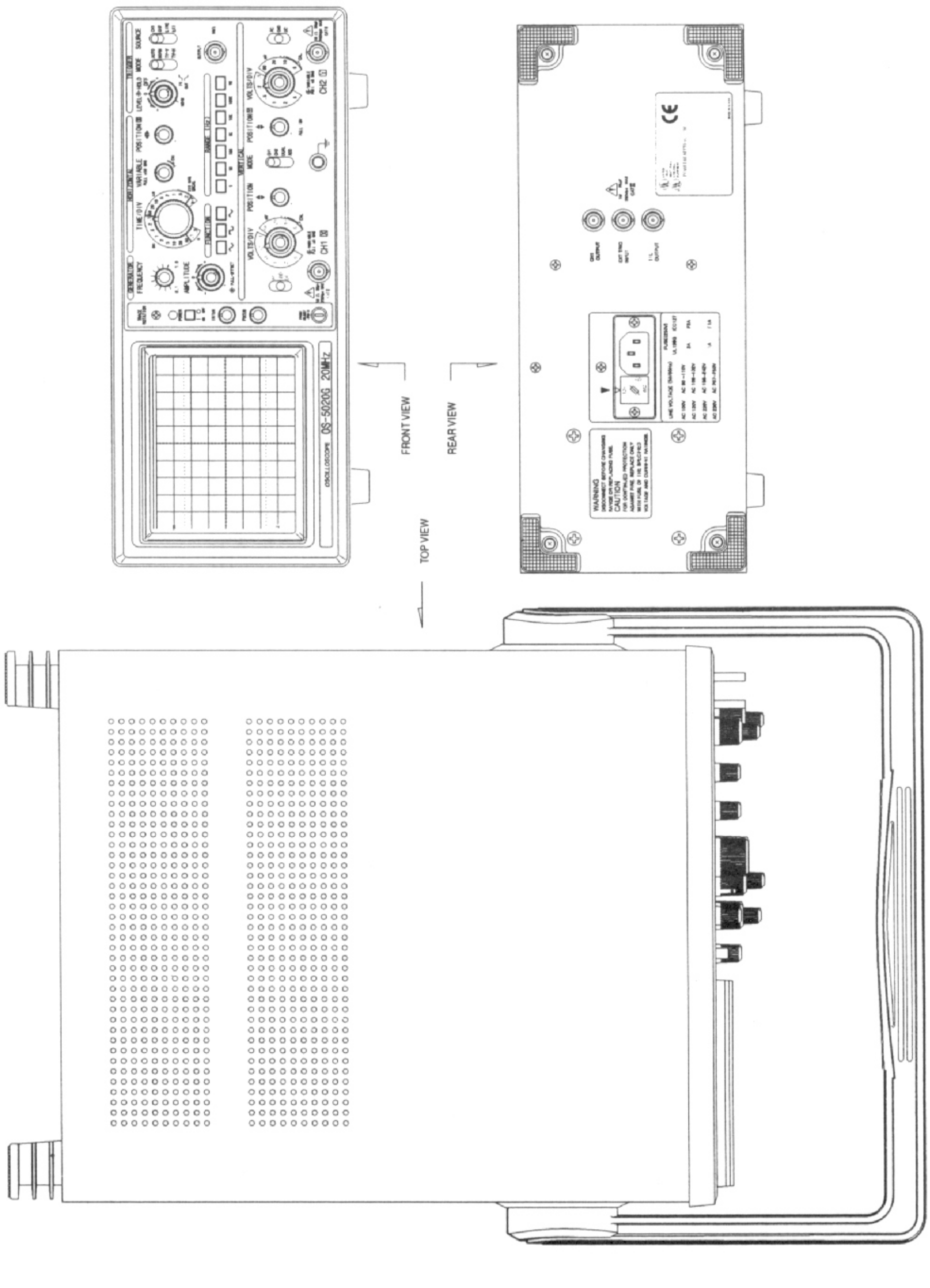


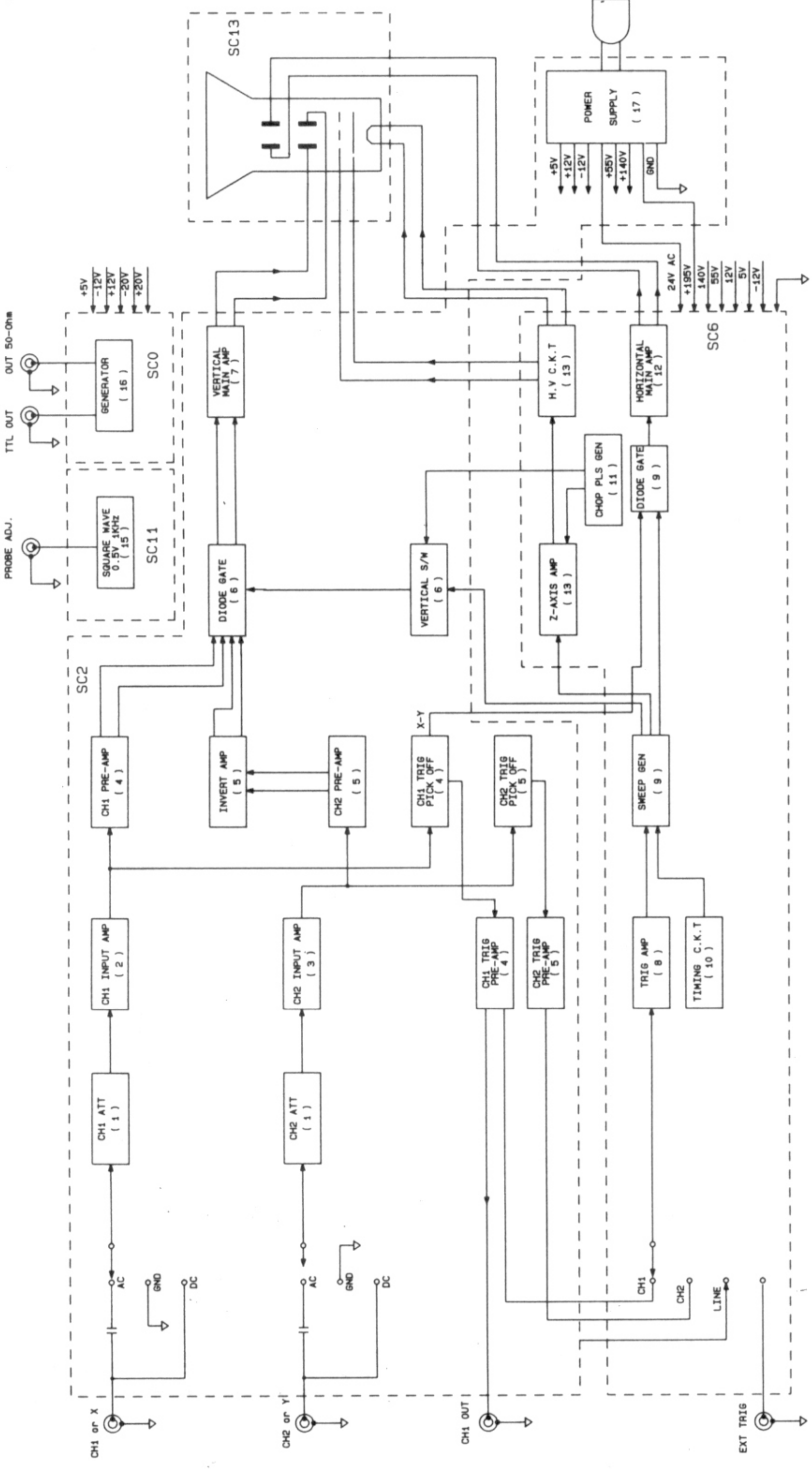
Fig. 3-1. FILTER DISASSEMBLYING

4. OS-5020G DIAGRAMS

4-1 EXTERNAL VIEWS



4-2 BLOCK DIAGRAM



EZ Digital Co.,Ltd.

The specifications are subjected to change without notice.