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DBT STAR COLLEGE SCHEME

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Department of Physics – Laboratory Manual

Name of the Instrument
Cathode Ray Oscilloscope

I .Brief Introduction

1. Summary

These Oscilloscope has been developed by our Company combined with the advanced technology both at home and abroad. The upgrade flake-sticking technique is adopted to it and code switch s used for scanning and decay. It' s comfortable in feel and reliable in touch. The max. sensitivity is 1mV/div, Some oscilloscopes switch by numeral displaying. The max. scanning speed is 0.1us/div. A part of oscilloscopes reach **0.2**us/div and can magnify 10 times to make the scanning speed reach 20ns/div(some oscilloscope reach 10ns/div).

2. Feature

2.1 The CRT made in China is adopted for the oscilloscope,But the CRT made in Holland can also be used according ti the demands from the customers.

2.2 Locking Function of Trigger Level.

When the trigger level is locked at a fixed value,even if the range and frequency of the input signal are changed , can still gain the stable wave shape without adjusting the trigger level again .

2.3 Alternating trigger function can , at the same time ,observe the two signal waves with different frequencies.

2.4 Synchronous function with television signals.

2.5 Output for External Frequency Signal:

The pulse signal on the back panel which is the same as the input signal frequency can directly drive the frequency meter.

2.6. Z.Axis Input

The function of adjusting intersification can add the designations of frequency and time to the oscilloscope. The positive signal trace is blanking and TTL matched.

2.7.X-Y Operation

When set the function X-Y positions , The instrument can make an X-Y oscilloscope . CH1 is horizontal axis and CH2 is vertical axis.

2.8 Built –in 6 digit frequency counter (only a part of oscilloscope has been function of frequency measuring)

2. Technical Index

Technical Data		20M/40M/60M
CRT	type	6"rectangle,internal graticule,0%,10%,90% and 100% marks
	Display area	8×10DIV (DIV=10mm)
	Accelerating voltage	2kV(20M) 12kV(40M/60M)
	Intensity and focusing	Continuously adjustable at front panel
	Trace rotation	Adjustable at the front panel
Vertical System	Sensitivity and accuracy	1mV/DIV ~ 5V/DIV ±5% 12 calibration steps in 1-2-5 sequence
	trimming ratio	≥2.5:1
	Width of band(-3dB)	DC(AC 10Hz) ~ 20MHz(20M)
		DC(AC 10Hz) ~ 40MHz(40M)
		DC(AC 10Hz) ~ 60MHz(60M)

Vertical System	Rise time	≤17.5ns(20M) ≤9.5ns(40M) ≤5.83ns(60M)
	Input impedance	1MΩ ±3%　25pF±5pF
	Input coupling	DC,GND,AC
	Max.input voltage	400V (DC+AC peak)
	Vertical mode	CH1,CH2,DUAL(CHOP,ALT),ADD,CH2 inverse
horizontal system	Sweep time	0.2μs～0.5s/DIV (20M)
		0.1μs～0.1s/DIV (40M/60M)
	Sweep accuracy	±5% ,±5% at ×10MAG(20ns～50ns/DIV uncalibrated)
	Trimming ratio	≥2.5:1
	Sweep magnificaton	×10MAG
	max sweep time	10ns/DIV(40M/60M)
Trigger system	Mode	SIGNAL,AUTO,NORM,TV-V,TH-H
	Source	ALT,CH1,CH2,EXT,LINE
	polarity	"+" or "-"
	Trigger sensitivity	10Hz～10MHz　10MHz～20MHz　20MHz～30MHz
		CH1,CH2　0.5DIV　1.5DIV　2DIV
		ALT　2DIV　3DIV　3DIV
		EXT　0.2DIV　0.8DIV　0.2DIV
		TV sync pulse ＞1 DIV or 1V (EXT)
	External trigger input	Input impedance:1MΩ±3%,25pF±5pF
		Max.input voltage :300V(DC+AC peak) at 1kHz
X-Y operation	Sensitivity &accuracy	5mV～20V/DIV ±5%　10 calibration steps in 1-2-5 sequence
	Width of band (-3dB)	DC（AC　10Hz）～500kHz
	Phase difference	≤3°or less from DC to 50kHz
Axis Z	Sensitivity	5Vp-p
	Polarity	Negative going input incress intensity
	input impendance	47kΩ
	Usable frequency range	DC～2MHz
	Max input voltage	30V(DC+AC peak) at 1kHz
Calibration		Voltage :2Vp p ±5% ,Square wave
power source		110～127VAC ±10% ,220～240VAC±10%,50Hz±2Hz/60Hz±2Hz
Dimensions		316mm×132mm×410mm(W×H×D)
Weight		7.8kg
other	Accessories	One operation maneal ,one fuse ,one power cable ,two probes

3. Matters needing paying attention to

3.1 Opening

The oscilloscope has been inspected and tested strictly before it is taken out of the factory. Please check whether it is damaged during delivery after receiving it. And please contact with the supplier or the consigner if there is any problem with the machine.

3.2 Voltage & Power Checking

Please check whether the voltage used can meet the voltage requirement before the machine is put to use.

Pay attention: The wrong voltage used would damage the oscilloscope.

!!! Warning: The ground protection terminal should be well connected to avoid the electric shock.

Please replace the specific fuse listed in the following table when it is burnt.

Power voltage	Range	Fuse
AC220V	198~242V	1A

!!! Warning: The power should be shut off while replacing fuses to protect human beings.

3.3 Environment

The environment temperature would be in the range of 0~40°C. Otherwise the circuits inside the machine would be damaged.

3.4 Installation & Operation

Please be sure that the holes for heat radiating on the oscilloscope would not be plugged. The auto-protection function would be weakened if the machine is not used under the specific condition.

3.5 Fluorescent Coating for CRT

Please don' t set the CRT brightness to be the brightest state or leave the dot to be in one position for a long time in order that the CRT fluorescent coating can be protected.

3.6 Max. Voltage on Input Terminal

The following table lists the maximum voltage on the input terminal and the probe. When the probe is set as 1:1, the maximum effective readout voltage is 160Vp-p(56Vrms at the sine wave). If the probe is set as 10:1, the maximum effective readout voltage is 400Vp-p(140Vrms at the sine wave).

Input Terminal	Max. Input Voltage
CH1, CH2	300Vp-p
Ext Trigger In	300Vp-p
Probe	600Vp-p
Z-Axis	30V Peak

!!!Warning: to avoid the damage to the instrument ,Please don' t be beyond the values. The frequency of max input voltage must be less than 1kHz.

If an AC voltage is added on a DC voltae , The max peak input voltage of CHI and CH2 mustn' t be over ±300V. So to an voltage whose average value is zero ,It' s peak value is 600Vpp.

Fig. 4-1B

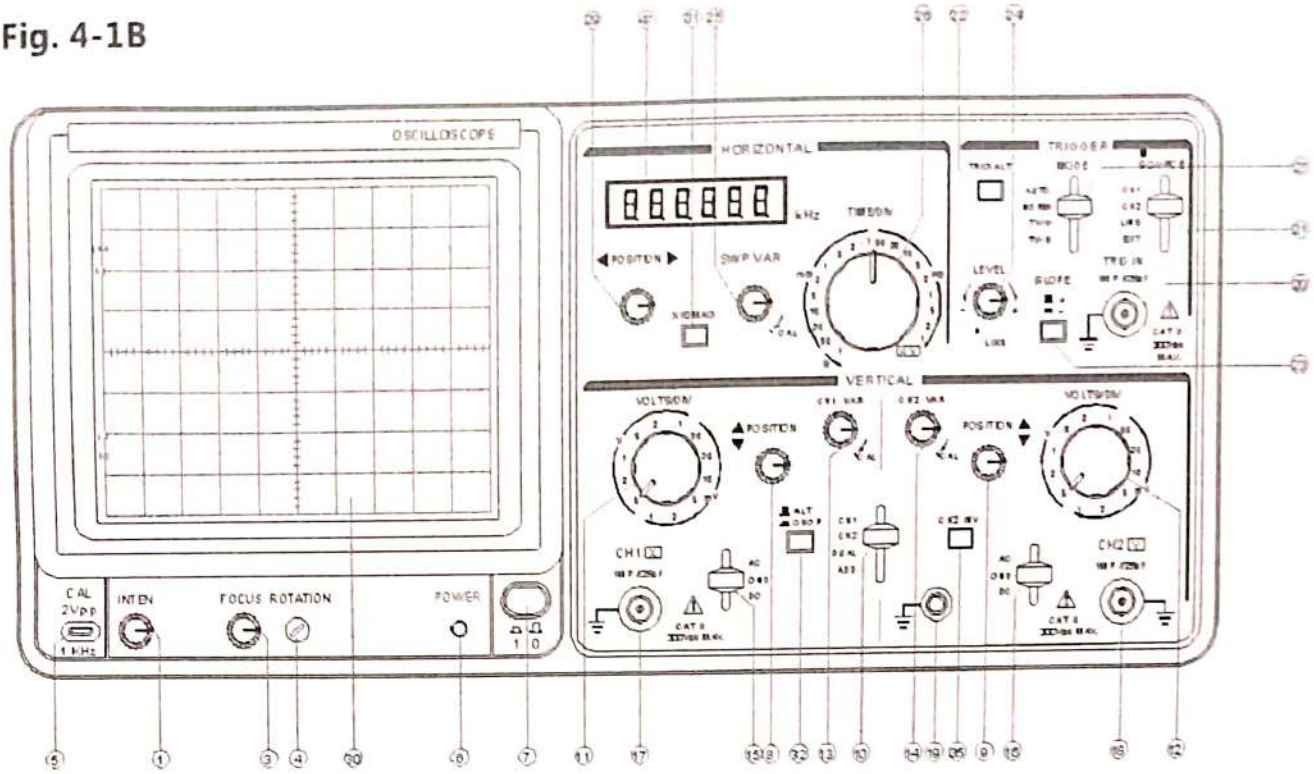
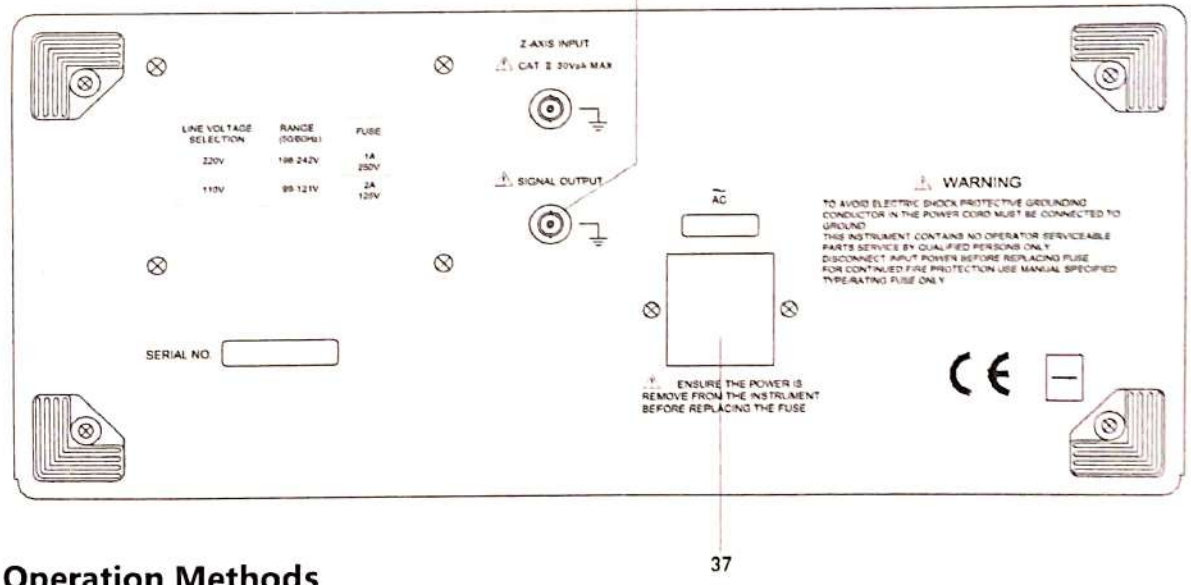


Fig. 4-2



4. Operation Methods

4.1 Description on Front Panel (Refer to Fig. 4-1A or Fig. 4-1B)

CRT:

7 —Power: Main power switch. The LED 6 would be lighted When it is on.

1 —Intensity: Adjust the intensity of the trace or the dot.

3 —Focus: Adjust the clearness of the trace or the dot.

4 —Trace Rotation: The half-fixed potentiometer is used to adjust the horizontal trade to be parallel with the scale.

30 – Color Filter: Make the display effect be more comfortable.

Vertical Axis:

17 —CH1 (X) Input: Channel 1 input terminal, which is used as X axis input in X-Y mode.

18 —CH2 (Y) Input: Channel 2 input terminal, which is used as Y axis input in X-Y

mode.
28 33 -- ×5 MAG for CH1 & CH2: Used to adjust the vertical sensitivity to be 1mV/DIV.
15 16 —AC-GND-DC: Select the input mode for the input signals of the vertical axis.
AC: AC coupling
GND: The input of the vertical magnifier is grounded and the input is cut off.
DC: DC coupling
11 12 —Vertical Attenuator: Adjust the vertical deflection sensitivity from 5mV to 20V/DIV in 12 steps.
13 14 – Vertical Variable: The variable ratio would be no less than 2.5:1. The sensitivity calibration would the label value in the calibrated position.
8 9 --▲▼Vertical Position: Adjust the vertical position of the trace on the screen.
10 —Vertical Mode: Select the operating modes for CH1 & CH2 magnifiers.
CH1 or CH2: Channel 1 or 2 displayed separately.
Dual: Two channels are displayed at the same time.
32 —Dual-trace Display:
ADD: Press to display the algebraic sum of the two channels CH1+CH2 in the dual-trace display mode. Press CH2 INV 35 , the display would be the algebraic difference CH1-CH2.
ALT: Press the display the traces alternatively of CH1 and CH2 in the dual-trace display mode (usually for the quick-speed sweep).
CHOP: Press to display the traces on CH1 & CH2 in Chop mode.
35—CH2 INV: The signal in CH2 would be inversed. Press the key to make the signals from CH2 and the inner trigger signals of CH2 be inversed at the same time.
40 41 Decay switch display
42 43 Decay switch polarity display

Trigger:

20—EXT trigger input: For the external trigger signals. The trigger source selector should be set to be EXT when it functions. (Only for specifically model)
21—Trigger Source Selection:
INT: Select the signals from CH1 or CH2 as the trigger source.
LINE: Select AC power as the trigger signal.
EXT: The external signals on 20 is selected as the trigger signal.
CH1: Select Channel 1 as the internal trigger signal source.
CH2: Select Channel 2 as the internal trigger signal source.
22—TRIG ALT: When vertical mode ia set at DUAL or ADD and 21 switch is elected at CH1 or CH2, At this time press 22 button can alternately elect CH1 or CH2 as internal trigger signal source.
23—Polarity: Select the polarity of the trigger signals. "+" means the rising-edge trigger and "-" means the trailing-edge trigger.
24—Trigger Level: Display a synchronized stable waveform and set the starting point for the waveform. Rotate clockwise to increase the level and rotate counterclockwise to decrease the level.
27—Trigger mode: Select the trigger mode.
AUTO (TV-H): The sweep mode is the AUTO mode when there is no trigger signal input.
Used to observe the TV-H signals. (It can only be synchronized when the synchronized signal is of negative pulse.)
NORM: The trace wouldn' t be displayed when there is no trigger signal.

TV-V: Used to observe the TV-V signals.
(It can only be synchronized when the synchronized signal is of negative pulse.)
24 LOCK: The trigger lock is locked in a fixed level. It is not necessary to adjust the level to get the synchronized signal when the sweep speed or the signal amplitude is changed.
48 At 27 switch on signal trigger at this rime press 49 button can single trigger and bright indication light.
49 At 27 switch on signal trigger at this rime press button can inside trigger wait for state..

Time base:

26—Horizontal Sweep Speed Switch: The sweep speed would be divided into 20 steps from 0.2us/DIV to 0.5s/DIV. (Only for specifically model)
25—Horizontal Variable: Adjust the horizontal sweep time to calibrate it to be the same shown by TIME/DIV on the panel. The TIME/DIV can be adjusted continuously and would be in calibrated position when it is rotated to the end clockwise. The whole time delay can be up to 2.5 times or more.
29-◄ ►Horizontal Position: Adjust the horizontal position of the traces on the screen.
31—×10 MAG:Sweep Mode: Press the button down,the sweep speed can be expanded for 10 times.
44 Sweep switch steps display.
45 Sweep Tiem indication LED.
46 X-Y mode indication LED

Others:

5 – CAL: Supply a square wave signal with the amplitude 2Vp-p and the frequency 1kHz to calibrate the compensate capacity of the 10:1 probe and detect the deflection factors of the horizontal and vertical systems of the oscilloscope.
19—GND: The ground terminal for the oscilloscope.
47—Frequency displaying : display the frequency of trigger singal in certical mode CH1 or CH2,adjusting trigger level for receive wave receate ,at this time can reading .(some oscilloscope in "AUTO" or "NORM" mode)

4.2 Introduction to back Panel (Refer to Fig. 4-2)

38—Singal output :External frequency –measuring output . Offers the signal whose frequency is the same as measured signall . Suitable for connecting the frequency meter externally. (option)
39—Z-Axis Input: Input terminal for external intensity modulation signal.(option)
37—AC:AC power source . The socket for AC power input . AC power line is connected at this place.

4.3 Basic operation & Single-channel Operation

Check whether the voltage connected meets the requirements of the machine and set the following keys listed in the table below:

Function	No.	Setting
POWER	7	OFF
INTEN	1	MIDDLE
FOCUS	3	MIDDLE
VERT MODE	10	CH1
DUAL-TRACE DISPLAY	32	ALT
CH2 INV	35	Release
VERT POSITION	8,9	MIDDLE
VOLTS/DIV	11,12	50mV/DIV

VAR	13,14	CAL
AC-GND-DC	15,16	GND
TRIGGER SOURCE	21	INT
SLOPE	23	+
INT TRIGGIER SELECTOR	22	CH1
TRIGGER MODE	27	AUTO
TIME/DIV	26	0.5ms/DIV
SWP.VAR	25	CAL
HOR. POSITION	29	MIDDLE
SWEEP MODE	31	×1

After finishing the above setting, connect the power cable and:
(1) Turn on the power. The trace would appear on the screen about 20 seconds later. If the trace wouldn' t appear after 60 seconds, please check the setting of the switches and controlling knobs again.
(2) Adjust the knobs INTEN and FOCUS to get the clear and comfortable trace.
(3) Adjust CH1 position and the potentiometer for trace rotating to make the trace be parallel with the horizontal scale. (Use a screw to rotate the potentiometer ④).
(4) Use the probe 10:1 to input the calibrating signals into CH1 input.
(5) Set the key AC-GND-DC to be AC. A square wave shown as Fig. 4-3 would appear on the screen.
(6) Adjust the FOCUS to make the trace be clear.
(7) As for other kinds of waveforms, adjust the vertical attenuator, the sweep time switch, the vertical and horizontal position knob to the proper setting. The amplitude and the time can be read out easily.
The operation of CH2 is the same as that of CH1.

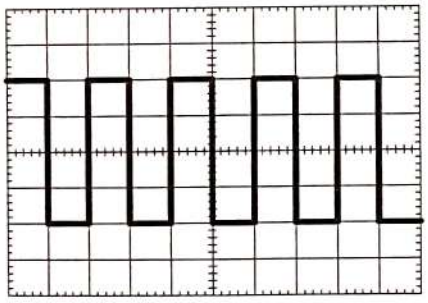


Fig. 4-3

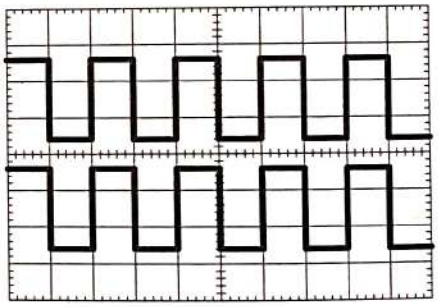


Fig. 4-4

4.4 Dual-channel Operation

Set the vertical mode to be DUAL mode and DUAL display mode is set to be ALT. the trace on CH2 would display on the screen. CH1 would display a square wave (from the calibrating signal) and CH2 would display a straight line (because no signals are input to the channel). Connect the calibrating signal to CH2 input and set AC-GND-DC to be AC mode. Adjust the vertical position ⑧ & ⑨ to get the waveforms shown as Fig. 4-4. The signals from CH1 & CH2 would be displayed alternatively on the screen, which can be used to observe the signals from two ways with short time sweeping. When the DUAL display is setting to be CHOP, the signals from CH1 & CH2 would be displayed on the screen separately with the speed of 250kHz, which can be used to observe the signals from two ways with long time sweeping. In two channels' operation, select the signals from CH1 or CH2 as the trigger signals by the trigger source selector in the mode of DUAL. If the signals from CH1 &* CH2 are synchronized, the two waveforms can be

displayed stably. Or one channel is for one stable wave. If the internal trigger source selector 22 is set as VERT, the two waves can be stably displayed.

4.5 Plus-minus Operation

Set DUAL trace display 32 to be ADD by setting Vertical mode 10 to be DUAL and the algebraic sum of CH1 & CH2 can be displayed. If CH2 INV is pressed, the algebraic difference would be displayed. And at this moment, the attenuators of the two channels should be set the same. The vertical position can be adjusted by the knob ▲▼Vertical Position. Set the knob to be in the middle since there is a linear change on the vertical magnifier.

4.6 Selection of Trigger Source

It is very important for you to select the effective trigger sources. You should be very familiar with the selection, the functions and the operation of the trigger source.

(1) Trigger mode selector:

AUTO (TV-H): The sweep generator would produce a sweep signal by free vibration. If there is a trigger signal, it would change to the trigger mode automatically. Set it to be AUTO when the first wave is observed. Set it to the proper position after a stable wave is observed. Reset the mode to be AUTO after Setting other knobs as specified. If DC signal or small signal is measured, AUTO mode must be used. Set the mode to be AUTO (TV-H) to observe TV-H signals. The sweep time should be set to be 10μs/DIV. Demonstrated that several line of waveforms, may use the vernier adjustment knob adjustment trace time to arrive need the number of lines. Sends in oscilloscope's synchronized signal to be the negative polarity. shown as Fig. 4-5 :

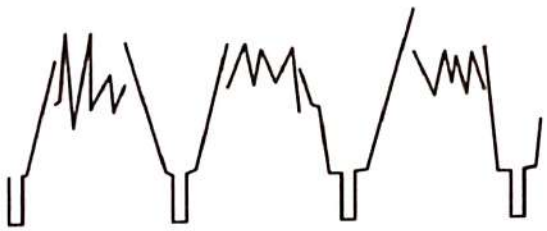


Fig. 4-5

NORM: There is no display on the screen when the sweep generator is in the statistic mode. Sweep for one time when the trigger signal passes through the gate level set by the trigger level switch, then the sweep generator returns back the statistic state. One trigger is for one sweep. When the dual-trace display is set to be ALT or CHOP, there is no display except there is sufficient trigger level from CH1 and CH2.

TV-V: Set the mode to be TV-V to observe TV-V signals. The sweep time should be set to be 2ms/DIV (one-frame signal) or 5ms/DIV(interlacing sweep signal of two frames) to synchronize TV signals.

In order to get a stable wave, one signal related to the display signal in time should supplied to the trigger circuit. The trigger source selector is used to select the trigger signals.

CH1: Internal trigger mode in most cases.

CH2: The signals to the vertical input would be divided and one part would be sent to the trigger circuit before it is preset. A stable wave would be displayed on the screen since the trigger signal is the signal needing measurement.

In DUAL mode, the trigger signals are selected by the trigger source selector.

LINE: Use the frequency of the AC power from the electrical net as the trigger signal. It is very effective to measure the signal relative with the power frequency, such as: AC noise of the sound system, SCR circuits and etc.
EXT: Use the external signals to generate the sweep trigger circuit. The signal should have some relation with the measured signal in time. The wave would be triggered and displayed by the external signals.
(3) Trigger Level and Slope switch
The trigger signal would pass through a gate level when it comes into being. Adjust the trigger level knob to change the level. The level would increase in + direction and decrease in – direction. And it would be the average value when it is in the middle.
The trigger level can be used to set the starting point of the wave. For the sine wave, the starting phase can be changed. Please note that if the trigger level is adjusted to be over negative or positive, there would be no sweep signals since the trigger level is excess the amplitude of the synchronized signals.
Set the slope to be + to get the rising-edge trigger. Set the slope to be – to get the trailing-edge trigger (shown as Fig. 4-6).
Trigger Level Lock:
When the trigger mode 27 is set to be LOCK, the trigger level is locked to be a fixed value. It is not necessary to adjust the trigger level to get a stable wave even if the amplitude and the frequency of the signal are changed at this moment.

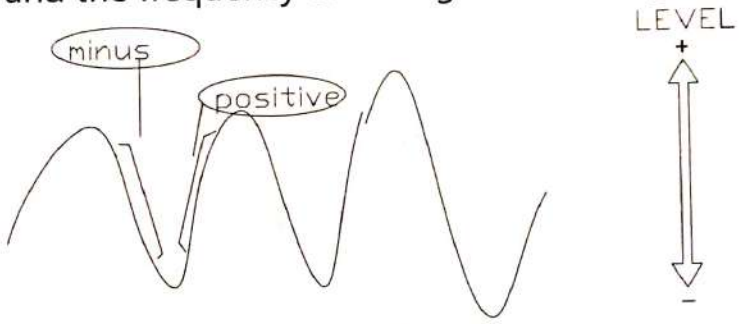


Fig. 4-6

The function is effective when the amplitude of the input signal or the external trigger signal is in the following range:
50Hz~5MHz≥1DIV(EXT:0.5V)
5MHz~20MHz≥2DIV(EXT:1V)
(4) VERT switch
When the vertical mode is set to be DUAL ALT display, the switch is used for alternative trigger and display. One alternative trigger signal is for one sweep cycle in ALT mode, which is helpful to test the amplitude and period of the wave, also two unrelatable signals in frequency can be observed. But it is unnecessary to measure the phase and time. One synchronized signal should be used for trigger for two channels.

4.7 Sweep-speed controlling

Adjust the sweep speed knob to select the number of the waves you want to observe. If there are too many waves on the screen, you can set the sweep speed much faster. And if there is only one wave on the screen, you can set the sweep speed much slower. If the speed is too fast, you can only observe one part of the cycle signal. If the measured signal is of square wave, the displayed on the screen would be only a straight line.

4.8 Sweep Magnification

Very fast sweep speed is needed to observe one part of a wave. If the part is far

from the starting point, it may be out of the screen. In such case, the sweep magnification switch is useful. Press the switch, the range displayed is 10 times of the original. The speed would be 1/10 of the original. For example: 1us/DIV to 0.1us/DIV.

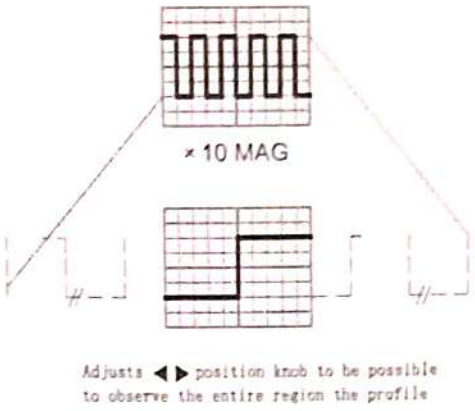


Fig.4-7

4.9 X-Y Operation

Set the sweep mode switch to be X-Y.
X-axis: CH1 input
Y-axis: CH2 input
Note: Please pay attention to the difference of the frequency and phase between X-axis and Y-axis when the HF signal is in X-Y mode.
The oscilloscope can do so many testing in X-Y mode compared with that it works in normal mode. CRT can display an electrical picture or two transient levels which would be the direct comparison of the two levels, just like the video color-bar picture shown by the vector oscilloscope. If such kind of dynamic factors are switched into the voltage signals, their pictures can be easily displayed in X-Y mode, for example: the amplitude and the frequency, which Y-axis corresponds to the signal amplitude and X-axis corresponds to the signal frequency (Shown as Fig. 4-8).
In some cases, Lissajous figures can be observed in X-Y mode. Input the sine wave signals from X-Y input, the Lissajous figures would be displayed on the screen. The relations of the frequency and the phase between the two signals can be calculated accordingly (shown as Fig. 4-9).

4.10 Probe Calibration

The oscilloscope probe can be used for a very wide frequency range mentioned above, but the phase should be compensated. The distorted wave would lead to the error measurement. So, the probe should be calibrated before measurement(the method is referred to Paragraph 1.2 of Chapter 5) .

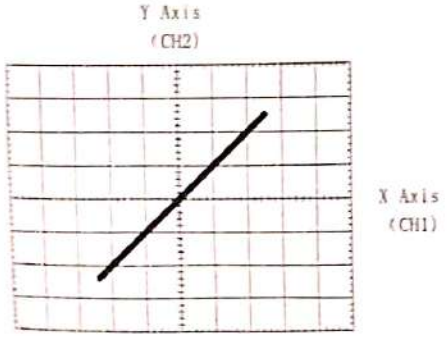


Fig.4-8

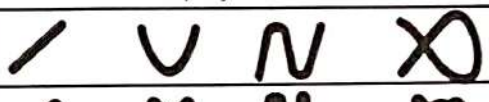
Phase Difference	Display Wave			
0°				
45°				
90°				
f(y):f(x)	1:1	2:1	3:1	3:2

Fig.4-9

5. Measurement

5.1 Checking & Adjusting before measuring

The following items should be rechecked to keep the correct measurement and high accuracy before measurement.

5.1.1 Trace Rotation

The horizontal trace displayed on the screen would be parallel with the horizontal scale in normal cases. But there would be a slight incline on the horizontal trace because of the earth magnetic field or some other factors. So, you should check and examine the machine as following before using:

(1) Preset the knobs on the panel to get a horizontal sweep line.

(2) Adjust the vertical position to keep the sweep baseline on the horizontal scale on the vertical center.

(3) Check whether the sweep baseline is parallel with the horizontal scale. If not, adjust the "Rotation" potentiometer on the front panel with a screw.

5.1.2 Probe Compensation

The probe compensation is used to compensate the error resulted from the feature difference input from the oscilloscope. The detailed procedures are listed as following:

(1) Set the knobs on the panel (shown as Table 3) to get a sweep baseline.

(2) Set V/DIV to be 50ms/DIV.

(3) Connect 10:1 probe to CH1 and connect to the calibrating signal 5.

(4) Operate the controlling knobs mentioned as Chapter 4 to get a wave like Fig. 5-1.

(5) Observe whether the compensation is proper. If not, adjust the probe compensation component shown as Fig. 5-2.

(6) Set the vertical mode to CH2, and connect 10:1 probe to CH2. Check and adjust CH2 probe according to the step 2 to 5.

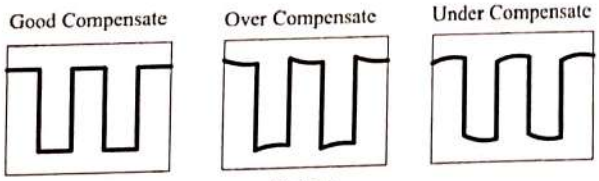


Fig.5-1

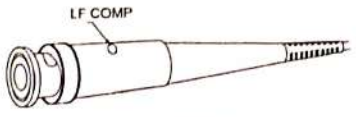


Fig.5-2

5.2 Amplitude Measuring

5.2.1 Vp-p Measurement

Please measure the Vp-p value of the measured signal according to the following steps:

(1) Input the signal to CH1 or CH2 and set the selected channel to VERT.

(2) Set the voltage attenuator and observe the waveform. Keep the displayed waveform to be about 5 DIV. Check the variable and rotate to CAL clockwise.

(3) Adjust the level to keep the waveform stable (not necessary if the level is locked)

(4) Adjust the sweep speed to keep at least one wave cycle to be displayed on the screen.

(5) Adjust the vertical position to keep the wave bottom to be on a certain horizontal coordinate on the screen (shown as Point A in Fig. 5-3)

(6) Adjust the horizontal position to keep the wave top to be on a certain horizontal coordinate in the center of the screen (shown as Point B in Fig. 5-3)

(7) Read out the division numbers between Point A & B in vertical direction.

(8) Work out the Vp-p of the measured signal using the following formula:

Vp-p=DIV (vertical direction)×Vertical Deflection Factor
For example: in Fig. 5-3, the vertical division number between Point A & B is 4.2 DIV, the vertical deflection factor of 10:1 probe is 2V/DIV, so, Vp-p=2×4.2=8.4V

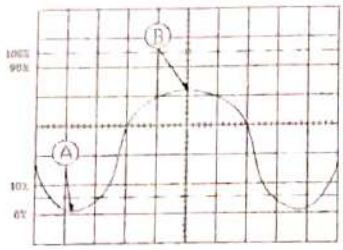


Fig. 5-3

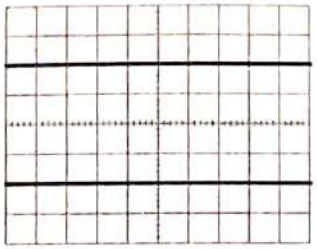


Fig. 5-4

5.2.2 DC Voltage Measurement
Measure DC Voltage following the steps below:
(1) Set the knobs on the panel to get a sweep baseline.
(2) Set the coupling mode of the selected channel to be GND.
(3) Adjust the vertical position to keep the sweep baseline to be on a certain horizontal coordinate (shown as Fig. 5-4 Before Measurement) and define the point as the voltage zero value.
(4) Feed in the measured voltage to the plug of the selected channel.
(5) Set the input coupling to be DC. Adjust the voltage attenuator to keep the sweep baseline to be on a proper position on the screen. Rotate the variable clockwise to the calibrated position first.
(6) Read out the deflected division number in vertical direction, shown in Fig. 5-4, after measurement.
(7) Work out DC voltage using the following formula:
V=DIV (vertical direction)×Vertical Deflection Factor×Deflection Direction(+/-)
For example, in Fig. 5-4, the sweep baseline is 4 divisions above the original baseline, the vertical deflection factor is 2V/DIV, so: V=2×4×(+)=+8V
5.2.3 Amplitude Comparison
Use the following steps to measure the amplitude differences between two signals:
(1) Feed in the reference signals into CH1 or CH2. Set the selected channel to VERT.
(2) Adjust the voltage attenuator and the variable to make the displayed amplitude be 5 divisions vertically, from 0% to 100% in scale.
(3) Keep the original setting of the voltage attenuator and the variable and switch the probe from the reference signal to the compared signals. Adjust the vertical position to make the wave bottom directly to the 0% scale on the screen.
(4) Adjust the horizontal position to keep the wave top on the vertical scale in the center of the screen.
(5) Read out the percentage (1 division equals to 4%) from the vertical coordinate in the center of the screen according to the 0% & 100% percentage standard on the left screen.
For example: In Fig. 5-5, the dashed line indicates the reference signal and the

real line indicates the compared signals. The vertical amplitude is 2DIV, so the amplitude would be 40% of the reference signal.

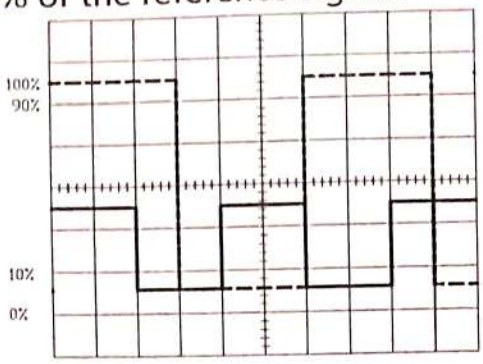


Fig.5-5

5.2.4 Algebra superposition

Use the following steps to measure the algebra sum or difference of two signals:

(1) Set the vertical mode to be DUAL and select ALT or CHOP if necessary.

(2) Feed in the two signals into CH1 & CH2.

(3) Adjust the voltage attenuator to make the displayed amplitudes of the two signals be moderate and VOLS/DIV be the same. Adjust the vertical position to make the waves of the two signals be in the center of the screen.

(4) Set DUAL to be ADD to get the algebra sum displayed. If you want to observe the algebra difference, please press in the knob CH2 INV. Fig. 5-6 shows the algebra sum and difference of two signals.

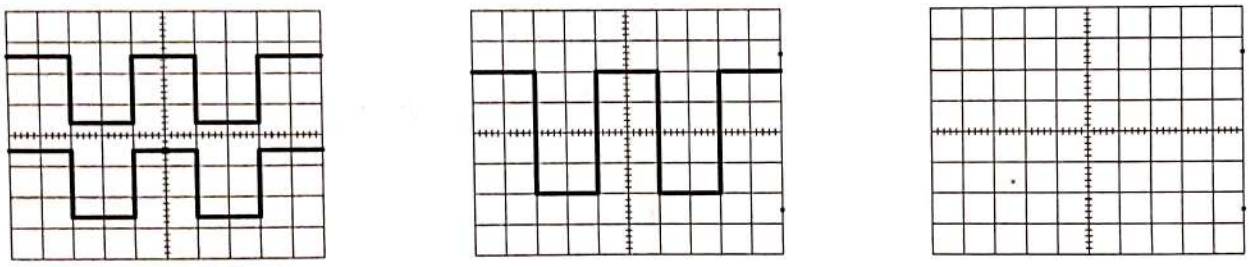


Fig.5-6

5.3 Time Measuring

5.3.1 Measurement of Time Intervals

The time intervals can be measured as following steps:

(1) Feed in the signal to CH1 or CH2 and set the selected channel to be VERT.

(2) Adjust the level to keep the wave to be displayed stably (It is unnecessary to adjust the level if it is locked).

(3) Rotate the variable clockwise to the calibrated position. Adjust the sweep speed switch to display one to two signal cycles on the screen.

(4) Adjust the vertical and horizontal positions to make the two points on the wave measured be on the horizontal scale in the center of the screen.

(5) Measure the horizontal scale between the two points and work out the time interval using the following formula:

Time interval (T)=[Horizontal distance between two points (DIV)×Sweep time factor (Time/DIV)]/Horizontal Magnification Rate

For example: In Fig. 5-7, the horizontal distance between A and B is 8DIV, the sweep time factor is 2us/DIV, the horizontal magnification rate is ×1, so: Time Interval = (2us/DIV×8DIV)/1=16us.

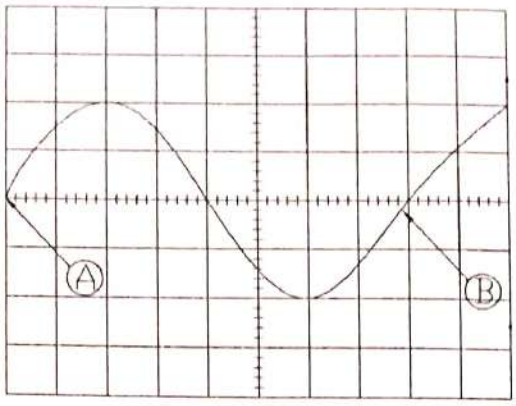


Fig.5-7

5.3.2 Measurement of Cycle and Frequency

In Fig. 5-7, the measured time interval is the cycle of the signal T, the frequency would be 1/T. For example: T=16us,then the frequency would be : f=1/T-1/16× 10^{-6}=62.5kHz

5.3.3 Measurement of Rising Time and Trailing Time

The measuring method of the rising time and trailing time is just the same as that of the time interval, only except the measurement is done to one part of the signal amplitude: from 10% to 90%. The steps are listed as following:

(1) Set the vertical mode to be CH1 or CH2. Feed in the signals to the selected channel.

(2) Adjust the voltage attenuator and the variable to keep the signal vertical amplitude to be displayed for 5 divisions.

(3) Adjust the vertical position to make the top and the bottom of the signal be located on the scale of 0% and 100% separately.

(4) Adjust the sweep speed switch to make the rising edge or the trailing edge be displayed on the screen.

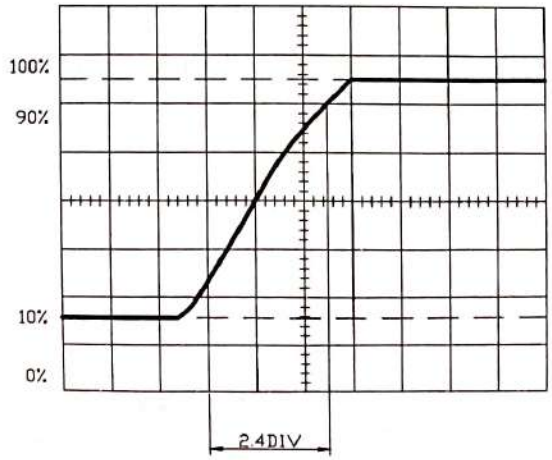
(5) Adjust the horizontal position to make the 10% of the rising edge be located on a certain vertical scale.

(6) Measure the horizontal distance between two points from 10% to 90%. If the rising or trailing edge is too fast, the horizontal magnification ×10 can be used to magnify the wave to be 10 times in horizontal direction.

(7) Use the following formula to work out the rising or trailing time of the wave:

Rising (trailing) time=[Horizontal distance (DIV)×Sweep Time Factor (Time/Div)]/ Horizontal Magnification Rate

For example: In Fig. 5-8, the distance from 10% to 90% of the rising edge of the wave is 2.4 divisions, the sweep time factor is 1us/DIV, the horizontal magnification rate is ×10, use the formula to work out the rising time as following:



Rising

Fig.5-8

time=(1us/DIV×2.4DIV)/10=0.24us

5.3.4 Measurement of Time Difference

Use the following steps to measure the time difference of two relative signals:

(1) Feed the reference signal and the compared signal into CH1 and CH2 separately.

(2) Set the vertical mode to be ALT or CHOP according to the frequency.

(3) Set the trigger source to be the reference signal channel.

(4) Adjust the voltage attenuator and the variable to display the proper amplitude.

(5) Adjust the level to get stable wave displayed.

(6) Adjust TIME/DIV to make sure that there is a horizontal distance between two measuring points of the waves, which is convenient for observation.

(7) Adjust the vertical position to make the measuring points be located on the horizontal scale in the center of the screen.

Time difference=[Horizontal Distance(DIV) × Sweep Time Factor (Time/DIV)]/ Horizontal Magnification Rate

For example: In Fig. 5-9, the sweep time factor is 10us/DIV, the horizontal magnification rate is 1, the horizontal distance between two points is 1 division, so: Time Difference=(10us/DIV×1DIV)/1=10us.

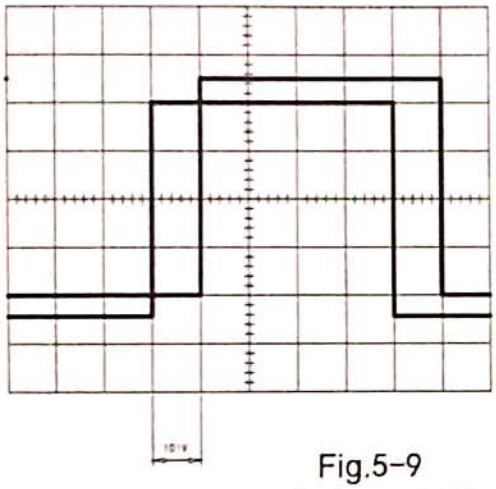


Fig.5-9

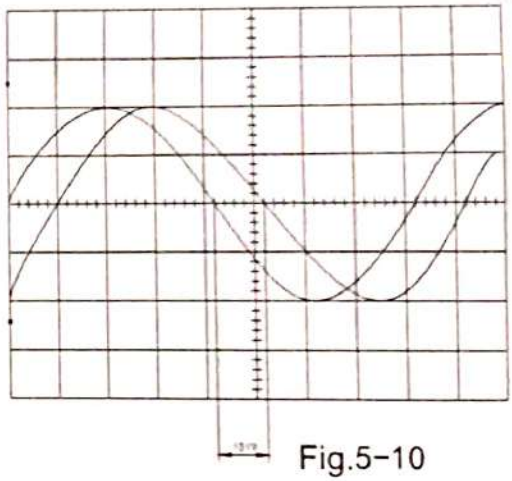


Fig.5-10

5.3.5 Measurement of Phase Difference

You can refer the measurement of time difference for the measurement of phase difference using the following steps:

(1) Set the controlling knobs as step 1 to 4 mentioned above.

(2) Adjust the voltage attenuator and the variable to make the displayed amplitude the same.

(3) Adjust the sweep time switch and the variable to make one cycle of the wave be displayed in 9 divisions. Then one division in the horizontal scale would represent 40 degree (360°÷9).

(4) Measure the relative horizontal distance between two waves.

(5) Work out the phase difference between two signals using the following formula: Phase Difference=Horizontal Distance (DIV)×40°/DIV

For example: In Fig. 5-10, the relative horizontal distance between two waves is 1 division, then Phase Difference=40°/DIV×1DIV=40°.

5.4 TV-V Signal Measuring

The TV-V signals can be displayed on the screen using the oscilloscope. The detailed steps are listed as following:

(1) Set the vertical mode to be CH1 or CH2. Feed the TV-V signals into the

selected channel.
(2) Set the trigger mode to be TV-V and set the sweep speed switch to be 2ms/DIV.
(3) Observe whether there is a negative synchronized signal is displayed on the screen. If not, please switch CH1 to CH2 and press CH2 INT in to inverse the positive synchronized TV signal into the negative synchronized TV signal.
(4) Adjust the voltage attenuator and the variable to display proper amplitude.
(5) Horizontal magnification ×10 can be used if necessary.

6. Maintenance

!!! Warning: Only qualified professional can do the maintenance.

6.1 Replacement for Fuse

The power indicator would be off and the oscilloscope wouldn' t function if the fuse is broken. Usually the fuse would not be open-circuited except there is anything wrong with the circuit. Please check the circuit which would lead to the broken fuse. Replace the broken fuse with the specific one.

! ! ! Warning: To avoid fire disaster ,use the fuse fit for 250V and corresponding current.Should cut off the power before replacing fuse.

2 Cleaning

Please use soft cloth with neutral detergent and water to clean the oscilloscope.
Don' t spray the detergent directly to the surface of the machine so that the water can be prevented entering inside the machine.
Don' t use the detergent which contents chemical matters like gasoline, benzene, toluene(-uol), xylene, acetone and etc.
Don' t use the abrasive agent and the like to clean the machine.

3 Standard Arrangement

1. Operation manual 1 copy
2. Power cable 1 pc
3. Probe 2 pcs