KENWOOD

OSCILLOSCOPE

CS-5200 SERIES

CS-5270 CS-5275
CS-5260 CS-5265
CS-5230 CS-5235

INSTRUCTION MANUAL

KENWOOD CORPORATION

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SAFETY

Symbol in This Manual

⚠ This symbolindicates where applicable cautionary or other imformation is to be found.

Power Source

This equipment operates from a power source that does not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This equipment is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the equipment input or output terminals.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use the Proper Fuse

To avoid fire hazard, use a fuse of the correct type.

Do not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere.

Do not Remove Cover or Panel

To avoid personal injury, do not remove the cover or panel. Refer servicing to qualified personnel.

Voltage Conversion

If the power source is not applied to your product, contact your dealer. To avoid electrical shock, do not perform the voltage conversion.

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1. GENERAL

Please note the following when using this manual.

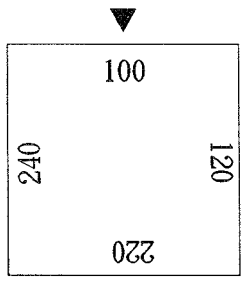
●This manual covers 6 oscilloscope models; CS-5270, CS-5260, CS-5230, CS-5275, CS-5265, and CS-5235. However, explanation about the panels, operating procedures and applications is made using the CS-5270. Although most of the contents is common to 6 models, please note that any portion which is not is expressed within brackets [ ].

●This manual uses, in some descriptions, the terms and abbreviations shown below:

Channel 1 or Y input	CH1 input
Channel 2 or X input	CH2 input
Vertical mode (VERT MODE)	V. mode
Vertical variable	V. variable
Channel 2 invert	Inv.
Vertical position	▲▼position
Alternate vertical axis switching mode	Alt. mode
Alternate main sweep and delayed sweep operation	Alt. sweep
Main sweep operation	A sweep
Delayed sweep operation	B sweep
Horizontal variable	H. variable
Horizontal position	◀▶position
Horizontal mode	H. mode
Triggering mode	T. mode
Triggering source vert. mode	Vert.

2. SAFETY AND EQUIPMENT PROTECTION PRECAUTIONS

1) Check your line voltage before use. The oscilloscope has a fuse holder and voltage selector on the left of the AC inlet on the rear panel. The voltage below the ▼ mark shows the line voltage setting of your oscilloscope. If your line voltage is different from the oscilloscope setting, there is a danger of malfunctioning. Do not connect to the supply until the voltage selector matches the supply voltage.



Set to 100 V.

2) The oscilloscope is equipped with internal components that are highly charged electrically. For your own protection, do not remove the casing for any reason.

3) Do not use the oscilloscope in the following locations.
- In direct sunlight
- In extremely hot and/or humid areas
- In areas affected by high levels of mechanical vibration
- Around areas with strong lines of magnetic forces or impulse voltage

4) Make sure that the voltage applied to each input terminal does not exceed the maximum specified.

⚠ CH1 and CH2 input terminals : 500 Vp-p or 250 V (DC+AC peak, 1kHz or less)
CH3 and Z AXIS input terminals: 100 Vp-p or 50 V (DC+AC peak, 1kHz or less)

Do not under any circumstances apply voltage to the output terminals from external power sources.

5) In order to prevent the CRT's fluorescent screen from scorching, do not adjust the brightness higher than necessary. Do not leave the spotting function on for long periods of time.

6) The instrument is equipped with auxiliary support. You can use it either horizontally or vertically. Do not place any object on the top of the instrument or position it in areas where the ventilation holes in the casing are blocked. Any blockage will cause the temperature of the internal components to increase, resulting in possible damage.

7) Connect a ground wire to the GND terminal for safety.

8) If the power is turned on and off repeatedly, the oscillscope may malfunction. Once the power is turned off, leave five seconds before turning the power on again.

9) The probes supplied with the oscilloscope are precision parts. Handle them with great care. [The probes supplied with the CS-5230, CS-5260, or CS-5270 have terminals for detecting readout signals. Do not use them with an oscilloscope with no probe detection function.]

3. FEATURES

High Sensitivity	: Sensitivity up to 1 mV/div.
Wide Bands	: The frequency range is DC to 20 MHz (−3 dB) at 1 mV and, 2 mV/div range and DC to 100 MHz [DC to 40 MHz for the CS-5230 or CS-5235, DC to 60 MHz for the CS-5260 or CS-5265] (−3 dB) for 5 mV/div.
HDTV	: A specially designed HDTV signal triggering circuit offers stable and adjustment-free synchronization with the FRAME and LINE signals from small to large amplitudes.
Ease of operation	: The oscilloscope does not use multi-function knobs. Thus, an inexperienced person may use it easily. Straightfoward switch layout on the panel eliminates errors even for complicated operations.
Three-channel vertical axis	: Trigger signals may be measured on CH3 without using the trigger view function.
Stepless sensitivity control	: The vertical axis sensitivity may be changed from 1 mV/div to 5 V/div continuously with a rotary switch.
High Speed Sweep	: High speed sweeping is possible at a time base of 5 ns/div (during ×10 MAG operation) [10 ns/div for the CS-5230 or CS-5235].
High Accuracy	: Accuracy is within 3% for both vertical axis sensitivity and sweep time.
Fixed Synchronization	: The fixed synchronization function eliminates troublesome synchronization.
One Touch X-Y	: Switching to X-Y operation is via a single switch.
Automatic Trigger Signal Selection	: Trigger signal can be selected automatically according to the VERT MODE control setting by switching the SOURCE control to VERT.
CH1 OUTPUT	: A channel 1 output terminal is added for CH1 input signal monitoring.
High Stability, High Reliability	: Hybrid integrated circuits are employed in all circuits, realizing high standards in stability and reliability.
Scale Illumination	: The scale illumination function makes it possible to take photographs of waveform data displayed on the CRT in a dark room.

Delay Time Position : A delay time position may be set quickly and accurately with coarse and fine controls.

[The following features apply to the CS-5230, CS-5260 and CS-5270.]

Readout : The vertical axis input sensitivity, sweep time and other scale factors are displayed in characters on the CRT.

Cursor Function : The voltage difference, current ratio, time difference, time ratio, frequency and phase difference may be measured with two cursors. They are displayed on the CRT for quick and accurate measurement.

4. SPECIFICATION

Items		CS-5230, 5235	CS-5260, 5265	CS-5270, 5275
CRT				
Type		150 mm rectangular tube with an integral graticule		
Acceleration voltage		Approx. 12 kV		
Effective area		8 × 10 divisions (1 division = 10 mm)		
VERTICAL AXIS (COMMON TO CHANNELS 1 AND 2)				
Sensitivity (+10 to +35℃)		1 mV, 2 mV/div : ±5%, 5 mV to 5 V/div: ±3%		
Attenuation		1-2-5 steps, 12 ranges, fine control between ranges		
Input impedance		1 MΩ ± 2%, approx. 25 pF		
Frequency response (-3 dB) (+10 to +35℃)	5mV to 5V/div	DC: DC to 40MHz AC: 5Hz to 40MHz	DC: DC to 60MHz AC: 5 Hz to 60MHz	DC: DC to 100MHz AC: 5Hz to 100MHz
	1mV to 2mV/div	DC: DC to 20MHz, AC: 5Hz to 20MHz		
Rise time (+10 to +35℃)	5mV to 5V/div	Approx. 8.8 ns	Approx. 5.8 ns	Approx. 3.5 ns
	1mV to 2mV/div	Approx. 17.5 ns		
Signal delay time		The leading edge may be checked using a square wave of the rise time less than that of this model.		
Crosstalk		-40 dB or less (at 1 kHz)		
⚠Maximum input voltage		500 Vp-p or 250 V (DC+AC peak, 1 kHz or less)		
VERTICAL AXIS (CH3)				
Sensitivity (+10 to +35℃)		0.1 V/div: ±3%		
Input impedance		1MΩ ± 2%, approx. 25 pF		
Frequency response (-3 dB) (+10 to +35℃)		DC to 40 MHz	DC to 60 MHz	DC to 100 MHz
Rise time (+10 to +35℃)		Approx. 8.8 ns	Approx. 5.8 ns	Approx. 3.5 ns
Signal delay time		The leading edge may be checked using a square wave of the rise time less than that of this model.		
⚠Maximum input voltage		100 Vp-p or 50 V (DC+AC peak, 1 kHz or less)		
Operation		Single trace: CH1, CH2, CH3 or ADD single trace operation Multi-trace : 2 to 4 traces of CH1, CH2, CH3 and ADD		
		ALT/CHOP: Display by selecting ALT and CHOP ADD : Composite waveform of CH1 and CH2 signals are displayed.		

Items		CS-5230, 5235	CS-5260, 5265	CS-5270, 5275
Chop frequency		Approx. 250 kHz (in multi-trace operation)		
Channel polarity		Normal or inverted, CH2 only inverted		
Horizontal axis (CH2, except for ×10 MAG operation)				
Sensitivity (+10 to +35℃)		Same as vertical axis (CH2)		
Input impedance		Same as vertical axis (CH2)		
Frequency response (-3 dB) (+10 to +35℃)		DC: DC to 1 MHz, AC: 5 Hz to 1 MHz		
X-Y phase difference		3° or less at 100 kHz		
Operation mode		X-Y mode is selected with H. MODE CH1: Y-axis, CH2: X-axis		
⚠Maximum input voltage		Same as vertical axis (CH2)		
SWEEP				
Sweep types		A : A sweep ALT : Alternate A sweep and B sweep B : B sweep X-Y : X-Y oscilloscope operation		
Sweep time (+10 to +35℃)	A sweep	0.5s to 0.1μs/div ±3% 1-2-5 steps, 21 ranges, fine adjustment between ranges	0.5s to 50ns/div ±3% 1-2-5 steps, 22 ranges, fine adjustment between ranges	
	B sweep	50ms to 0.1μs/div ±3% 1-2-5 steps, 18 ranges, fine adjustment betwen ranges	50ms to 50ns/div ±3% 1-2-5 steps, 19 ranges, fine adjustment betwen ranges	
Sweep magnified operation (+10 to +35℃)		×10 ± 5% (±8% for over 0.5 ns/div)		
Linearity (+10 to +35℃)		±3% (±5% in ×10 MAG operation)		
HOLDOFF		Continuously variable from A sweep NORM position		
Trace separation		B sweep is continuously variable by ±4 divisions or more with respect to A sweep.		
Delayed sweep operation		Continuous delay operation (AFTER DELAY) Synchronous delay operation (B TRG'D) : Synchronous with the trigger signal		
Delay time		Continuous control by 0.2 to 10 divisions for 0.5 div to maximum speed sweep		
Delay time error (+10 to +35℃)		[CS-5235, 5265, 5275]: ±(3% of set value+1% of full scale)+(0 to 300 ns) [CS-5235, 5265, 5275]: Reading on CRT ±4% (0 to 300 ns)		
Delay jitter		10000 : 1 of a value 10 times as high as A sweep setting		

Items	CS-5230, 5235	CS-5260, 5265	CS-5270, 5275
TRIGGERING			
Trigger modes	AUTO : Automatic free running with no signal NORM : Triggered sweep FIX : Sweep at triggering point set to center of signal amplitude SINGLE: Single sweep mode RESET : Restarting single sweep operation		
Trigger signal sources	VERT: Input signal selected for V. mode CH1 : Channel 1 input signal CH2 : Channel 2 input signal CH3 : Channel 3 input signal LINE: Commercial power line		
Trigger coupling (For trigger sensitivity, see the table below.)	AC : AC coupling from 10 Hz HFrej : Low-pass filter coupling up to 30 kHz DC : DC coupling TV FRAME: Composite video signal, vertical synchronization separation TV LINE : Composite video signal, horizontal synchronization separation		

Trigger sensitivity (+10 to +35℃)

MODE	COUPLING	Signal frequency			Sensitivity (Amplitude)	
		CS-5230, 5235	CS-5260, 5265	CS-5270, 5275	NORM	FIX *
NORM	AC	10Hz to 20MHz	10Hz to 40MHz	10Hz to 50MHz	1div	1.5div
		20M to 40MHz	40M to 60MHz	50M to 100MHz	1.5div	2div
	HFrej	10Hz to 30kHz	10Hz to 30kHz	10Hz to 30kHz	1div	1.5div
		over 30kHz	over 30kHz	over 30kHz	>min.	>min.
	DC	DC to 20MHz	DC to 40MHz	DC to 50MHz	1div	1.5div
		20M to 40MHz	40M to 60MHz	50M to 100MHz	1.5div	2div
	TV-F, -L	Composite video signal			1.5div	
	HDTV	HDTV video signal			1.5div	

AUTO : Same as above specifications for above 40Hz.

(The table shows the sensitivities in terms of the amplitude displayed on the CRT.)
(>min. for the HFrej sensitivity shows that the amplitude necessary for synchronization increases.)

FIX * : Same as above specifications for above 50Hz.

Items		CS-5230, 5235	CS-5260, 5265	CS-5270, 5275
CALIBRATION SIGNAL : POSITIVE SQUARE WAVE, 1 Vp-p ±3%, APPROX. 1 kHz				
INTENSITY MODULATION				
Input voltage		Darkens at TTL level (+5 V).		
Input impedance		Approx. 10 kΩ		
Frequency response (+10 to +35℃)		DC to 3.5 MHz	DC to 5 MHz	
⚠Maximum input voltage		100 Vp-p or 50V (DC+AC peak)		
CH1 OUTPUT SIGNAL (WITH 50 Ω LOAD)				
Output voltage		Approx. 50 mVp-p/div		
Output impedance		Approx. 50 Ω		
Frequency response (-3dB)	1, 2 mV	100 Hz to 20 MHz		
	5 mV to	100 Hz to 40 MHz	100 Hz to 60 MHz	100 Hz to 100 MHz
TRACE ROTATION : TRACE ANGLE IS ADJUSTABLE WITH A SEMI-FIXED CONTROL ON PANEL.				
POWER SUPPLY				
Voltage		100/120/220 VAC ± 10%, 207 to 250 V		
Frequency		50 Hz or 60 Hz		
Power consumption		Approx. 43 W, 39 W Approx. 52VA, 49VA	Approx. 48 W, 43 W Approx. 56VA, 51VA	Approx. 48 W, 43 W Approx. 56VA, 51VA
DIMENSIONS AND WEIGHT (VALUES ENCLOSED IN PARENTHESES INCLUDE PROJECTIONS.)				
Width		300 mm (300 mm)		
Height		150 mm (172 mm)		
Depth		400 mm (469 mm)		
Weight		Aprrox. 8.7 kg		
OPERATING TEMPERATURE AND HUMIDITY				
Operating temperature and humidity		0 to 40℃, 85% RH or less		
Storage temperature and humidity		−20 to 70℃, 85% RH or less		
ACCESSORIES				
Probe		PC-33: 10 MΩ ±1%, 22 pF±10%, 10:1 [CS-5230] PC-31: 10 MΩ ±1%, 12.5 pF±10%, 10:1 [CS-5260, CS-5270] PC-35: 10 MΩ ±1%, 19.5 pF±10%, 10:1 [CS-5235] PC-39: 10 MΩ ±1%, 12.5 pF±10%, 10:1 [CS-5265, CS-5275]		
		2 each		
Instruction manual		1 copy		
Adjusting screwdriver		1		
Power cord		1		
Replacemen fuse		2		

[The specifications shown below do not apply to the CS-5235, CS-5265 or CS-5275.]

Items	CS-5230, 5235	CS-5260, 5265	CS-5270, 5275
Replacement fuse	1 A×2 (for 100 V area) 630 mA×2 (for 200 V area)		
READOUT			
Set values	CH1 and CH2 scale factors (with probe detection), CH3 scale factor (0.1 V/div fixed, with no probe detection), V-UNCAL, ADD, INV, A/B sweep scale factors (MAG-converted), sweep - UNCAL, DELAY TIME, TRIG'D, X-Y		
Cursor modes (Between ΔREF and Δ cursors) In X-Y mode, only ΔV1 may be set.	ΔV1 :Displayed in voltage with conversion according to CH1 scale factor ΔV2 :Displayed in voltage with conversion according to CH2 scale factor ΔV3 :Displayed in voltage with conversion according to CH3 0.1 V/div ΔT :Displayed in time with conversion according to A sweep scale factor 1/ΔT:Displayed in frequency with conversion according to A sweep scale factor		
In V, H-VARI or UNCAL mode	RATIO:Voltage ratio and time ratio are displayed, with 5 divisions on the CRT as 100%. PHASE:Phase difference is displayed, with 5 divisions on the CRT as 360°.		
Cursor measurement	Resolution : 10 bits Measuring error: ±4% Measuring range: ±3.6 divisions or more vertically from CRT center. ±4.6 divisions or more horizontally from CRT center.		

■The specifications shown above are subject to change without notice.

5. PANEL EXPLANATION

5 – 1 Front Panel

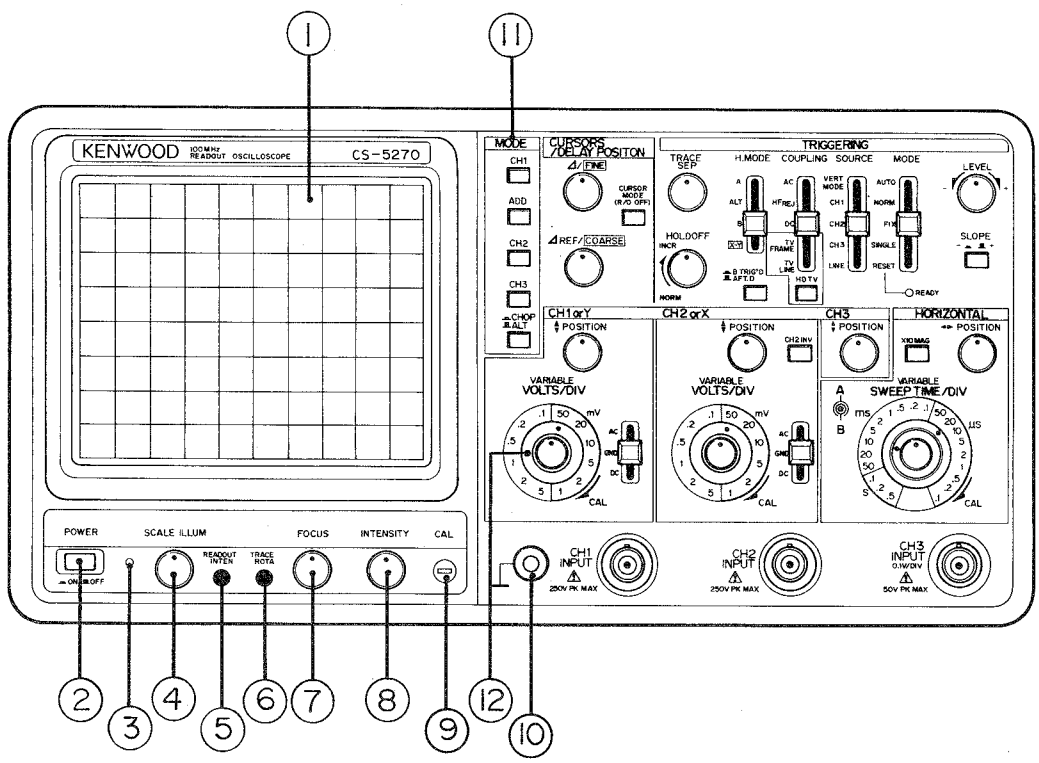


Figure 1 Front Panel (CS-5270)

① Cathode ray tube (CRT)

The effective display screen surface runs over an area of eight 10 mm divisions (80 mm) along the vertical axis and ten 10 mm divisions (100 mm) along the horizontal axis. With an integral graticule etched on the tube surface, the chance of measurement errors due to parallax occurring between the trace and the graticule is significantly reduced. There is also a % display on the left of the CRT for measuring the rise time.

② POWER switch (▬ ON/ ▮ OFF)

A pushbutton type switch that turns the power source on and off.

Pressing the switch turns the power on. Pressing it again turns the power off.

③ Pilot lamp

Lights up when the power is turned on.

④ SCALE ILLUM control

Controls the illumination of the graticule on the CRT face.

⑤ R/O INTEN control [CS-5230, 5260, 5270]

Controls the brightness of readout values such as set values, measured values, etc. displayed on the CRT.

⑥ TRACE ROTA control

Controls the slope of the trace line. The slope of the line will change due to external influences such as the magnetic field of the earth. Use the screwdriver included with the accessories to adjust the trace line parallel with the horizontal axis graticule.

⑦ FOCUS control

Adjusts the focus to obtain the clearest display.

⑧ INTENSITY control

Adjusts the brightness of the trace line.

⑨ CAL terminal

A voltage terminal for calibration. Used for adjusting the probe. Outputs 1 Vp-p, positive polarity, approx. 1 kHz square waves.

⑩ GND terminal

Used to set up a common ground with other equipment.

⑪ V. MODE selector

Selects the vertical axis operation modes.

CH1 : CH1 input signal is displayed on the CRT.

ADD : Algebraic sum of CH1 and CH2 signals is displayed on the CRT. If CH2 is set to INV, difference between CH1 and CH2 signals is displayed.

CH2 : CH2 input signal is displayed on the CRT.

CH3 : CH3 input signal is displayed on the CRT.

ALT/CHOP: Selects the ALT and CHOP modes. In the ALT mode, input signals are displayed alternately every sweep in the multi-trace mode. In the CHOP mode, input signals are displayed alternately at a repetition rate of approx. 250 kHz (in dual-trace operation), regardless of sweep time.

REFERENCE

Alternate (ALT) and Chop (CHOP) Modes

When using these modes during multi-trace operation, the display is divided up according to time.

In the chop mode, each channel is subdivided according to time within each sweep. Normally, this kind of measurement is carried out with signals of either slower sweep rate from 1 ms/div or low repetition rates where flicker is quite noticeable.

In the alternate mode, each channel is displayed one after another. Therefore, each channel display appears much clearer. Normally, a faster sweep is employed.

⑫ VOLTS/DIV control

The vertical axis sensitivity is controlled with the CH1 vertical axis attenuator. The VOLTS/DIV control switches it in 1-2-5 steps. Calibrated vertical axis sensitivity is obtained by setting V. VARI to the CAL position.

In X-Y operation, the VOLTS/DIV control serves as a Y-axis attenuator.

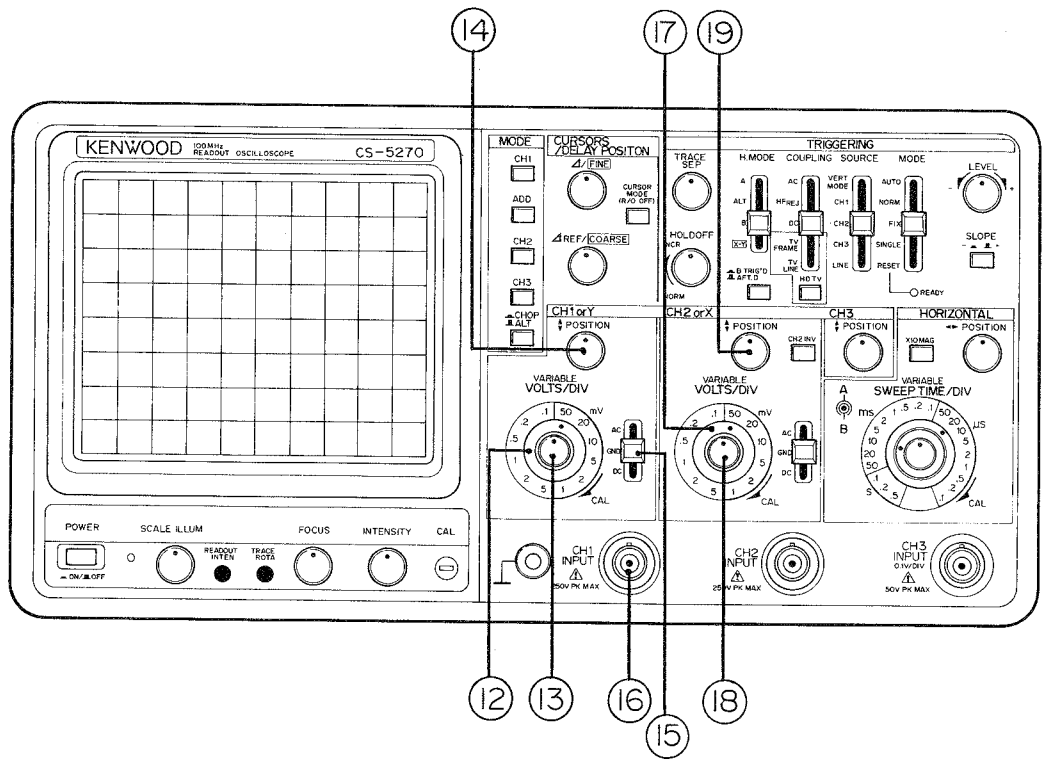


Figure 1-2

⑬ VARIABLE (V.VARI) control

Provides fine-control of the CH1 vertical axis sensitivity. Set with the VOLTS/DIV control. The attenuator is calibrated if it is fully turned clockwise to the CAL position.

In X-Y operation, the VARIABLE control serves as a Y-axis fine attenuator control.

⑭ ▲▼POSITION control

Adjusts the vertical position of CH1 waveform displayed on the CRT.

Serves as a Y-axis position control during X-Y operation.

⑮ AC-GND-DC switch

Selects the CH1 vertical axis input signal coupling mode.

AC : Input signals are AC coupled, and DC components are removed. Low frequency signal level falls by 3 dB or more below 5 Hz if the 1 : 1 probe or a coaxial cable is used. It falls below 0.5 Hz if a calibrated 10 : 1 probe is used.

GND : Input of the vertical amplifier is grounded, allowing the ground potential to be checked. The input resistance is 1 MΩ with respect to the ground. Input signals will not be grounded.

DC : Input signals are DC coupled, allowing signals containing DC components to be observed.

The switch serves as a Y-axis input selector during X-Y operation.

⑯ CH1 INPUT terminal

CH1 vertical axis input terminal.

Serves as a Y-axis input terminal during X-Y operation.

⑰ VOLTS/DIV control

CH2 vertical axis attenuator. Has the same function as the CH1 VOLTS/DIV control.

Serves as an X-axis attenuator during X-Y operation.

⑱ VARIABLE (V.VARI)

CH2 vertical axis attenuator for fine adjustment. Has the same function as the CH1 V. VARI control.

Serves as an X-axis fine adjustment attenuator during X-Y operation.

⑲ ▲▼ POSITION control

Adjusts the vertical position of CH2 waveform displayed on the CRT.

⑳ AC-GND-DC switch

Selects the CH2 vertical axis input signal coupling mode in the same way as the CH1 AC-GND-DC control.

Serves as an X-axis input selector during X-Y operation.

㉑ CH2 INPUT terminal

CH2 vertical axis input terminal.

Serves as an X-axis input terminal during X-Y operation.

㉒ CH2 INV switch

When the switch is pressed, the polarity of CH2 input signal is inverted.

㉓ ▲▼ POSITION control

Adjusts the vertical position of CH3 waveform displayed on the CRT.

㉔ CH3 INPUT terminal

CH3 vertical axis input terminal.

㉕ DELAY POSITION (COARSE), ΔREF CURSOR

Coarsely adjusts the delay time between A sweep and B sweep when H. MODE is set to ALT or B. (COARSE)

Adjusts the position of the ΔREF cursor. [The CS-5230, CS-5260 and CS-5270 have the cursor functions.]

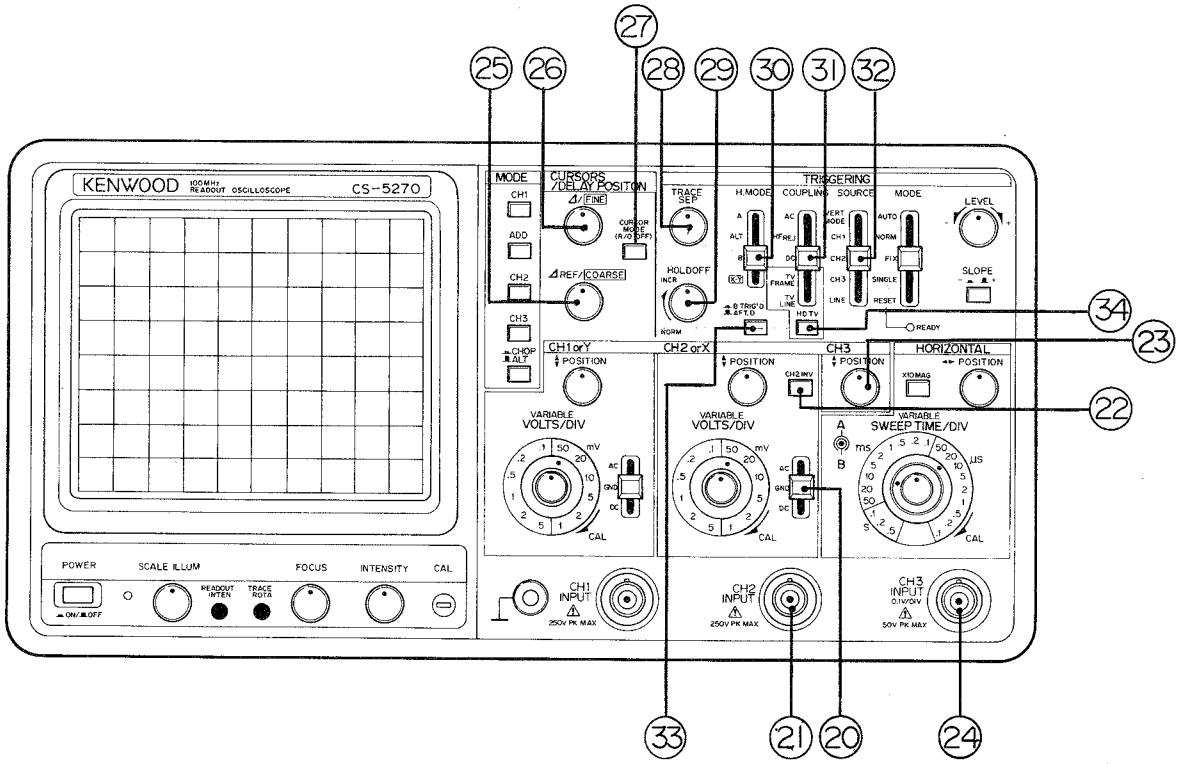


Figure 1-3 Front Panel (CS-5270)

㉖ DELAY POSITION (FINE), Δ CURSOR

Fine-adjustment the delay time.

Adjusts the position of the Δ cursor. [The CS-5230, CS-5260 and CS-5270 have the cursor function.]

㉗ CURSOR MODE (R/O OFF) [CS-5230, CS-5260 & CS-5270]

Selects the cursor display mode and turns the readout display on and off. Every time the switch is pressed, the cursor display mode changes in the order of Off, V cursor, H cursor, and Off. When the switch is pressed for a second or more during readout display, readout display including scale factor display is turned off. To turn the readout display function on, press the switch again.

㉘ TRACE SEP control

Adjusts the vertical position of A sweep with respect to A sweep when the H. MODE is set to ALT and A sweep and B sweep are displayed alternately.

㉙ HOLD OFF control

Adjusts the time between the end point of an A sweep and the start point of another A sweep. Use this control to adjust the hold off time and adjust the trigger level if triggering is required for complex signals. Turning the control fully counterclockwise to the NORM position minimizes the hold off time.

㉚ H. MODE switch

Selects the horizontal axis display mode as shown below:

A : Runs in the A sweep mode.

ALT : Displays A sweep and B sweep alternately.

B : Runs in the B sweep mode.

X-Y : Serves as an X-Y oscilloscope with channel 1 as the Y-axis and channel 2 as the X-axis, regardless of the V. MODE setting.

㉛ COUPLING switch

Selects the trigger signal coupling.

AC : AC coupled trigger signal without DC components is input to the trigger circuit. The AC position is used for normal waveform observation.

HFrej : Trigger signal is passed though a low-pass filter and input to the trigger circuit. The cut-off frequency of the low-pass filter is approx. 30 kHz.

DC : DC coupled trigger signal is input to the trigger curcuit.

TV FRAME: Vertical synchronization pulses are extracted from the composite video signals and input to the trigger circuit.

TV LINE : Horizontal synchronizing trigger circuit extracted from the composite video

㉜ SOURCE switch

Selects the trigger signal source.

VERT: Trigger signal source is selected with V. MODE.

If the single trace (CH1, CH2, CH3 or ADD) is selected with V. MODE, the selected input signal is the trigger signal source. If the ALT mode is selected for 2-trace, 3-trace or 4-trace operation, each input signal is the trigger signal source in each sweep operation.

NOTE

If the chop mode is selected, display is changed according to the chop switching signal, which is not synchronous with the input signal. Thus, the input signal cannot be used as the trigger signal source. The trigger signal source is fixed to channel 1 if the chop mode is selected in Vert. operation.

CH1 : Channel 1 input signal is the trigger signal source.

CH2 : Channel 2 input signal is the trigger signal source.

CH3 : Channel 3 input signal is the trigger signal source.

LINE: Waveform of the line voltage is the trigger signal source.

㉝ AFTER D/B TRIG'D switch

Selects the continuous delay or synchronous delay.

In the continuous delay mode, B sweep begins as soon as the delay time set with the DELAY POSITION control has passed after the A sweep started.

In the synchronous delay mode, B sweep begins at the first trigger point after the delay time set with the DELAY POSITION control has passed after the A sweep started.

㉞ HDTV switch

If TV FRAME coupling or TV LINE coupling is selected with the HDTV switch selected (ON), operation is synchronized with the HDTV composite video signal.

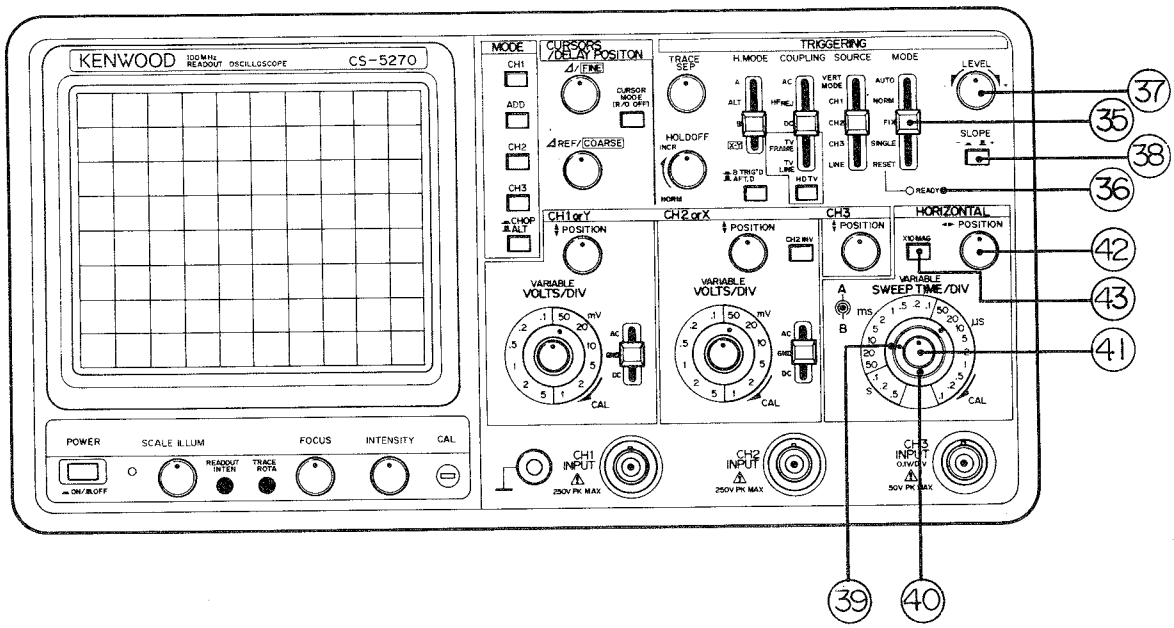


Figure 1-4

㉟ T. MODE switch

Selects the triggering mode.

AUTO : Sweep operation is executed according to the trigger signal. Operation runs free and the trace line appears if there is no trigger signal.

NORM : Sweep operation is executed according to the trigger signal. Different from AUTO, the trace line does not appear if there is no trigger signal.

FIX : Sweep operation is executed according to the center of the amplitude of a signal selected with the SOURCE switch, which is used as the trigger point. In this mode, the trigger level need not be adjusted.

SINGLE : Selects single sweep mode.

RESET : Sets the oscilloscope for triggering in the single sweep mode.

㊱ READY indicator

Shows that the oscilloscope is ready for triggering in the single sweep mode. It lights by resetting T. MODE and extinguishes when sweep is completed.

㊲ LEVEL control

Controls the trigger level. Specify at which point of the trigger signal slope to trigger and to start sweep.

㊳ SLOPE +/-

Selects the polarity of the slope of the trigger signal. With the button not pressed (+), triggering is executed at the leading edge of the input trigger signal. With the button pressed (-), triggering is executed at the trailing edge of the input trigger signal.

㊴ A SWEEP TIME/DIV switch

Switches 22 ranges of A sweep time in 1-2-5 steps between 0.5 second/div and 50 ns/div. Turning the H. VARI fully clockwise to the CAL position, the value is calibrated.
[21 ranges between 0.5 second/div and 0.1 μs/div for the CS-5230 and CS-5235.]

㊵ B SWEEP TIME/DIV switch

Switches 19 ranges of B sweep time in 1-2-5 steps between 50 ms/div and 50 ns/div.
[18 ranges between 50 ms/div and 0.1 μs/div for the CS-5230 and CS-5235.]
For practicality, we recommend use of a higher-speed range than the A sweep set range.

㊶ VARIABLE control (H. VARI)

Fine-controls the A sweep time continuously in the range selected with the A-SWEEP TIME/DIV switch. Turning the control fully clockwise to the CAL position, the A sweep time is calibrated.

㊷ ◀▶ POSITION control

Adjusts the horizontal position of the waveform displayed on the CRT.
Serves as an X-axis position control during X-Y operation.

㊸ ×10 MAG switch

Press this switch to magnify the display 10× in the center of the CRT.

NOTE

Do not use ×10 MAG in X-Y operation. Otherwise, the waveform can become noisy.

5 — 2 Rear Panel

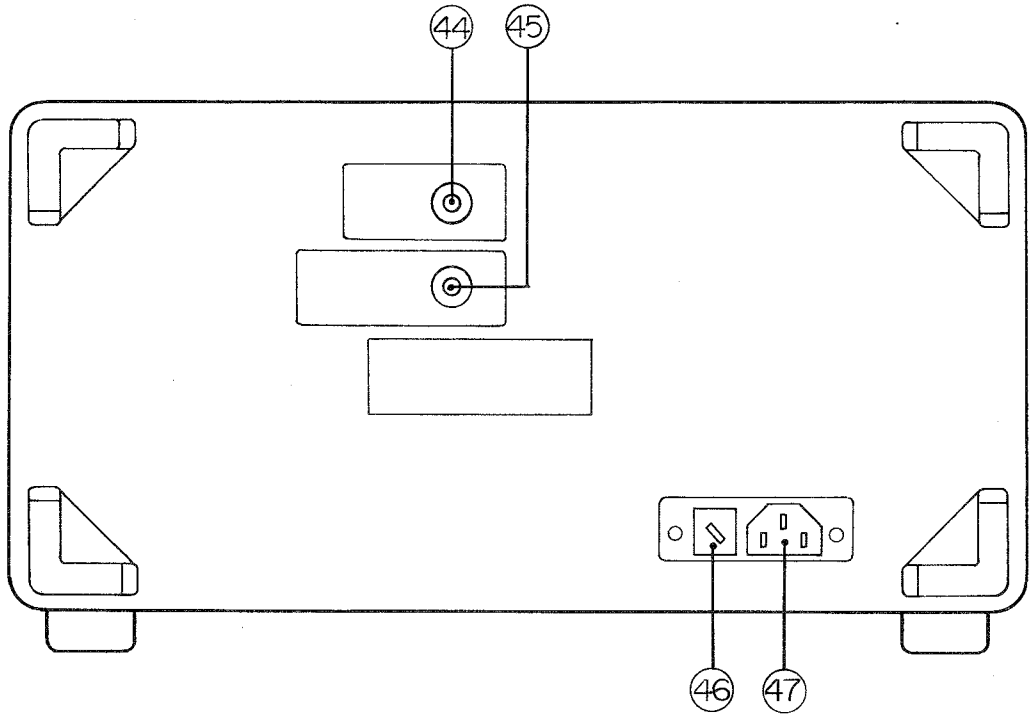


Figure 2 Rear Panel

㊹ CH1 OUTPUT terminal

Outputs AC couple CH1 vertical signal.

Used for connecting a counter when measuring frequencies.

NOTE

- When using a counter to measure frequencies, there is the possibility that accurate measurements are not displayed due to noise interference. In such a case, adjust the amplitude properly with CH1 VOLTS/DIV or V. VARI.
- Cascade connection between CH1, CH1 OUTPUT, and CH2 is not possible.

㊺ Z. AXIS INPUT terminal

Input jack for external intensity modulation signals. Intensity modulation is performed at TTL level. (Positive voltage reduces the intensity.)

NOTE

If a voltage over 5 V (TTL level) is input, the READ OUT display may be disturbed according to frequencies. In such a case, lower the input to Z. AXIS down to the TTL level or so.

㊻ Fuse holder, line voltage selector

Use a 1 A fuse in 100/120 V areas. Use a 630 mA fuse in 220/230/240 V areas. Changing the voltage rating should be done strictly according to the directions in section 9. FUSE REPLACEMENT, LINE VOLTAGE SELECTION only after disconnecting the power cord from the power source inlet.

㊼ Power cord receptacle

A commercialy-used power source input connector.

5 — 3 Bottom Plate

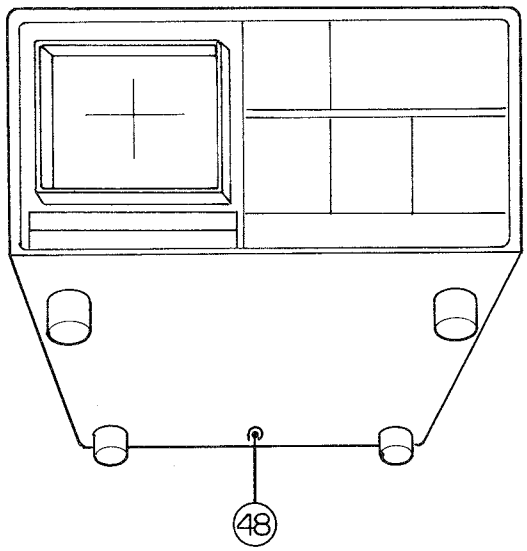


Figure 3 Bottom Plate

㊽ ASTIG control

Controls the trace or spot astigmatism. Astigmatism has been adjusted before shipment. If necessary, adjust the waveform to the optimum condition with the ASTIG and FOCUS controls.

NOTE

Do not use a metallic device for astigmatism adjustment to avoid accidents.
Use the insulated screwdriver included in the accessories.

5 — 4 Readout Display [CS-5230, 5260, 5270]

1) Display positions

Figure 4 below shows the display positions of the scale factors and the values measured with the cursor.

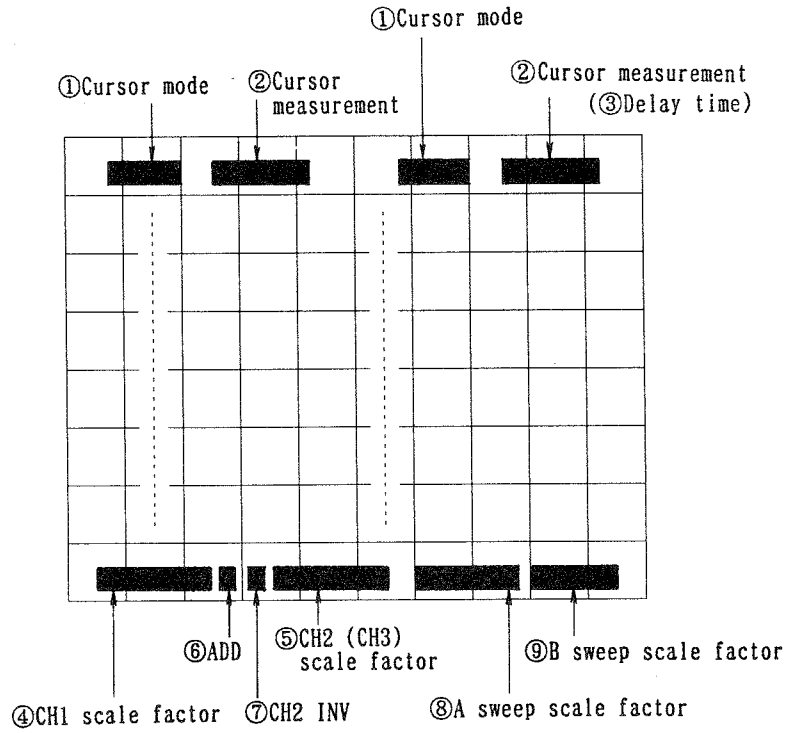


Figure 4 Readout Display

2) Display

① Cursor mode

The folllowing cursors are displayed according to the setting of the controls.

ΔV1, ΔV2, ΔV3, ΔT, 1/ΔT, RATIO, PHASE

② Cursor measurement

A value measured with two cursors is displayed.

NOTE

If two cursors are too near beyond the measuring limits in the 1/ΔT mode, "?" is displayed following "1/ΔT", indicating that the measured value has an error out of standard.

③ Delay time

If the H. MODE is set to ALT or B, "DELAY" is displayed at the cursor mode position and the delay time is displayed at the cursor measurement position. If TRIG'D is selected or the cursor measurement is located within 0.2 division from the left side of the CRT, DELAY is followed by "?", indicating that the measured value has an error.

Voltage or time cannot be measured with the cursors during delay time display.

④ CH1 scale factor

The sensitivity per 1 division of the CH1 vertical axis is displayed when CH1 is selected with V. MODE. If UNCAL is selected, "CH1" is followed by ">".

⑤ CH2 scale factor (CH3 scale factor)

Displayed in the same condition as CH1 above.

NOTE

The CH3 scale factor is displayed when only CH3 is selected with V. MODE. The sensitivity is fixed to 0.1 V/div.

⑥ ADD

If ADD is selected with V. MODE, "+" is displayed.

⑦ CH2 INVERT

"↓" is displayed if INV is turned on.

⑧ A sweep scale factor

The time per (1) division is displayed when A, ALT or B is selected with H. MODE. If UNCAL is selected, "A" is followed by ">". If×10 MAG is turned on, time is also converted (i.e., divided by 10).

If X-Y is selected with H. MODE, "X-Y" is displayed in the A and B scale factor positions.

⑨ B sweep scale factor

The time per (1) division is displayed when ALT or B is selected with H. MODE. If ×10 MAG is turned on, time is also converted (i.e., divided by 10).

6. CHECKING AND ADJUSTMENT PRIOR TO MEASUREMENT

In order to operate the oscilloscope at its optimum performance level, carry out the following checks and adjustments before making any measurements. The instructions which follow concerning basic operation techniques and applications assume that the checks and adjustments described here have been completed.

1) Adjust the control panel to the following settings.

CH1 (or Y) and CH2 (or X)

V.MODE	CH1
▲▼POSITION	Center
V.VARI	CAL
VOLTS/DIV	5 V/DIV
AC-GND-DC	GND
CH2 INVERT	Off

HORIZONTAL

◀▶POSITION	Center
H.VARI	CAL
A SWEEP TIME/DIV	2 ms/DIV
×10 MAG	Off

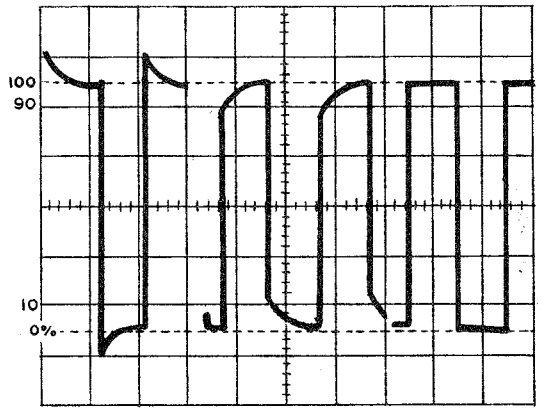
TRIGGERING

H.MODE	A
T.MODE	AUTO
COUPLING	AC
SOURCE	VERT
SLOPE	+
TRIGGER LEVEL	Center

After checking the power source and voltage selection, press the POWER switch. The pilot lamp lights up, and a trace line appears in 10 to 15 seconds. Check to see that rotating the INTENSITY control clockwise increases the brightness, and rotating it counterclockwise decreases the brightness. Then, rotate the INTENSITY control fully counterclockwise and extinguish the trace line to begin preheating. For the most accurate measurement results, it is necessary to warm-up the oscilloscope for about 30 minutes. However, if you intend only to display waveforms, warm-up is not necessary.

2) After warm-up adjust the INTENSITY control so that the trace line is easy to see, and adjust the FOCUS control to obtain the clearest display image. Then, use the TRACE ROTA control to bring the trace line parallel with the horizontal graduation line.

3) Plug the probe into the INPUT terminal of each channel. Set the AC-GND-DC control to DC. Attach the CH1 probe to the CAL terminal. Set the VOLTS/DIV control to 20 mV/div. [For the CS-5230, CS-5260 or CS-5270, set the VOLTS/DIV control to 0.2 V/div.] Adjust the CH1 ▲▼ POSITION control so that the whole waveform can be seen. With the waveform in this position, carry out probe compensation adjustment according to Figure 5 and the probe instruction manual.



① Left waveform : Excessive compensation
② Middle waveform: Insufficient compensation
③ Right waveform : Correct compensation

Adjust the probe trimmer so that a correctly compensated waveform is displayed.

Figure 5 Probe Compensation

4) Set the VERT MODE control to CH2 and carry out compensation adjustment of the CH2 probe. After compensating both channel probes, use the CH1 probe exclusively in channel 1 and the CH2 probe exclusively in channel 2. This is necessary because there is a slight capacitance variation between the two channels, and confusing the probes will cause changes in compensation adjustments.

5) Return the VERT MODE control to CH1, each channel's AC-GND-DC control to the GND setting, each channel's VOLTS/DIV control to 5 V/div, and the ▲▼ POSITION and ◀▶ POSITION controls to the center.

This is what we refer to as the "initial setting" condition.

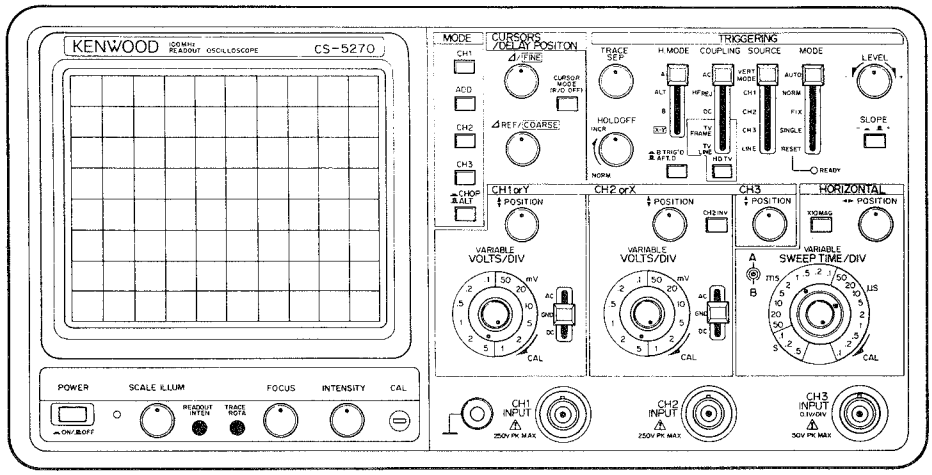


Figure 6 Initial Setting (CS-5270)

7. OPERATING PROCEDURES

7 − 1 Single Trace Operation

1) Alternating current display

With the oscilloscope in the initial setting condition (refer to 6. CHECKING AND ADJUSTMENT PRIOR TO MEASUREMENT), the signal applied to the CH1 INPUT terminal is displayed on the CRT. Adjust the signal amplitude to an easy-to-measure size by changing the VOLTS/DIV control. Use the V.VARI control to change the amplitude continuously. However, if this is not necessary, leave the setting at CAl.

Then, move the waveform to an easy-to-observe position with the SWEEP TIME/DIV control. The H.VARI control should be set to CAL if possible.

2) Trigger

Trigger operation is required if the displayed waveform wavers or is unstable.

• Trigger level

Turn the TRIGGER LEVEL control clockwise or counterclockwise to lock the waveform. Some signals are easier to see by changing the slope. This operation with the TRIGGER LEVEL and SLOPE controls is called trigger point setting. The oscilloscope starts the sweep at a set trigger point.

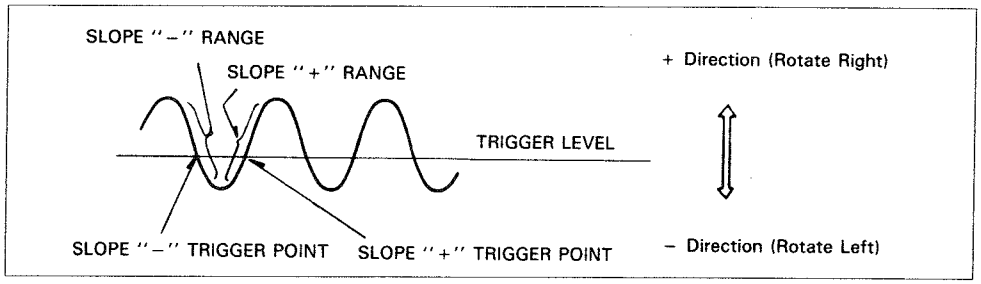


Figure 7 Relationship between Trigger Level and Slope

• Trigger coupling

Select an intended trigger coupling.

AC : AC coupled trigger signal without DC components is input to the trigger circuit. The AC position is used for normal waveform observation higher than 10 Hz.

HFrej : Trigger signal passed though a low-pass filter is input to the trigger circuit. The cut-off frequency of the low-pass filter is approx. 30 kHz. This position is used for signals with high-frequency noise.

DC : DC coupled trigger signal is input to the trigger circuit. This position is used for low-frequency signals below 10 Hz.

TV FRAME: Vertical synchronization pulses are extracted from the composite video signals and input to the trigger circuit.

TV LINE : Horizontal synchronization pulses are extracted from the composite video signals and input to the trigger circuit.

• Trigger mode

Select an intended trigger mode.

AUTO : Operation runs free and the trace line appears even if there is no trigger signal. Use NORM to observe low-frequency waveform below 40 Hz.

NORM : Sweep operation is executed according to the trigger signal. Sweep operation is not executed if there is no trigger signal.

FIX : Sweep operation is executed according to the center of the amplitude of the trigger signal as the trigger point. In this mode, the trigger level need not be adjusted.

SINGLE: Selects the single sweep mode. (See 7-6)

RESET : Sets the oscilloscope for triggering in the single sweep mode. (See 7-6.)

3) Composite video signal display

When inputting composite video signals, set the COUPLING control to either TV FRAME or TV LINE. Also switch the SLOPE control in accordance with the signal polarity.

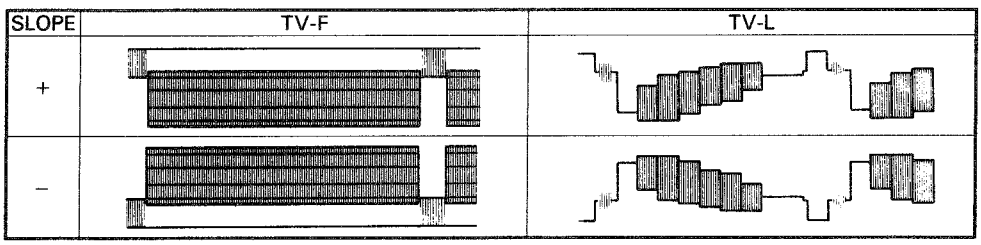


Figure 8 Relationship between COUPLING and SLOPE

7 — 2 Multi-Trace Operation

1) Switching vertical operation modes

When two or more switches other than the ALT/CHOP are activated with the V. MODE, the CRT screen displays the signals applied to the INPUT terminals of the activated channels. Changing the sweep time and setting the trigger point may be completed in the same way as CH1 single trace operation. When the V. MODE control is set to ALT, signals of the selected channels are displayed one after another for each sweep. When it is set to CHOP, the signals are sub-divided according to time and displayed on the CRT. When the V. MODE control is set to ADD, the signals (CH1 and CH2) are displayed in the same manner as in a single channel operation. If the INV control is selected in the ADD mode, the differential (CH1 -CH2) is displayed. In order to measure displayed waveforms in the ADD mode, it is necessary that the VOLTS/DIV control settings be the same for both channels.

2) Switching trigger sources

Select a trigger signal channel with the SOURCE switch. If VERT is selected with the SOURCE switch and the ALT/CHOP switch is set to ALT, the signal of each channel is used as the trigger signal source in each sweep. If the ALT/CHOP switch is set to CHOP, only CH1 input signal is used as the trigger signal source.

NOTE

If the SOURCE switch is set to VERT, input signals to all channels. Sweep may be unstable if a channel carries no signal or a signal of an amplitude below the trigger sensitivity of the oscilloscope.

If the trigger coupling is used to set TV FRAME or TV LINE, triggering with plural channels is disabled. Set SOURCE to an intended triggering channel, instead of VERT.

3) Line trigger

If the signal of the displayed channel is synchronous with the line frequency, the trigger point becomes stable by setting the SOURCE switch to LINE.

7 — 3 Sweep Magnified Operation

When magnifying a portion of the displayed waveform in terms of time, increasing the sweep speed may cause the waveform portion to be measured to disappear from the screen. Use the ◀▶ POSITION control to move the waveform portion to be magnified to the middle of the CRT screen. Then, press the ×10 MAG switch to magnify the waveform 10 times in the horizontal direction.

7 — 4 Delayed Sweep Operation

Delayed sweep (B sweep) is another way to observe a waveform portion by magnifying it in terms of time. It allows the magnification to be set freely and the magnified and non-magnified portions to be displayed alternately by using the ALT sweep function.

1) Set the H. MODE control to A. Adjust the controls so that the portion of the input waveform to be observed is displayed on the CRT.

2) Set the AFTER D/B TRIG'D control to AFTER. D. Set the H. MODE control to ALT. The waveform portion to be magnified is intensity-modulated and displayed bright. In Figure 9, the upper trace line shows the non-magnified waveform, and the lower trace line shows the magnified waveform.

3) Properly adjust the time of displaying the magnified portion with the B SWEEP TIME/DIV, the time position of the magnified portion with the DELAY POSITION COARSE and FINE controls, and the relationship between A sweep and B sweep vertical positions with the TRACE SEP.

4) Set the H. MODE control to B. Only the magnified portion is displayed on the CRT.

NOTE

If the magnification of A sweep and B sweep exceeds several hundred times with AFTER D setting, delay jitter can appear. For jitter-free observation, set the control to B TRIG'D. The trigger signal selected with the SOURCE switch is the trigger signal for B sweep. B sweep start point is set with the DELAY POSITON and TRIGGER LEVEL. Thus, the delay time is for reference only.

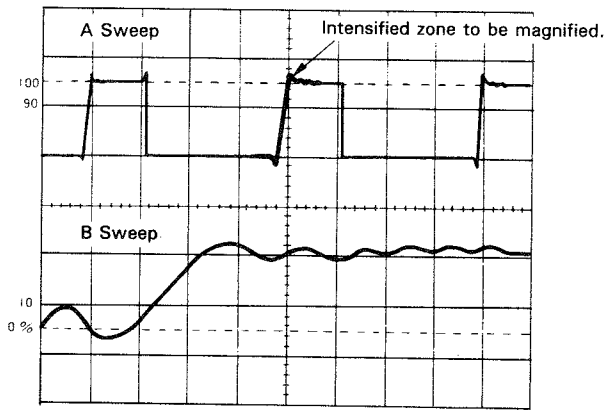


Figure 9 ALT Sweep Operation

7 — 5 X-Y Operation

The oscilloscope not only has all the functions of a conventional oscilloscope but may also be operated as an X-Y oscilloscope. In X-Y operation, signals applied to the CH1 INPUT terminal are deflected on the Y-axis (vertical axis), signals applied to the CH2 INPUT terminals are deflected on the X-axis (horizontal axis), and a Lissajous pattern is displayed. A Lissajous pattern makes it possible to measure phase differences between two signals and their relative frequency proportion.

NOTE

Waveforms may be noisy by pressing the ×10 MAG switch. Do not use the ×10 MAG switch for X-Y oepration.

7 — 6 Single Sweep Operation

Single sweep operation is used to observe a single event or occurence.
If the trigger point of a signal to be observed is unknown, set the trigger point using the signal or a signal approximate to it.

1) Set the T. MODE switch to AUTO or NORM. Adjust the trigger point with the TRIGGER LEVEL control. If the COUPLING switch is set to DC, the trigger point may be adjusted accurately for a signal which changes slowly.

2) Set the T. MODE switch to RESET, and check the READY LED is lit.

3) Observe the signal. When sweep is executed once, the READY LED goes out. If observation is continued, repeat step 2).

NOTE

- A sweep and B sweep are alternated in the single sweep mode with the H. MODE switch set to ALT.
- In single sweep operation in the multi-trace ALT mode, selected signal change in each sweep cannot be observed simultaneously. Select chop mode to observe them simultaneously.

7 – 7 Readout Operation [CS-5230, 5260, 5270]

1) Set value (scale factor) display

The oscilloscope displays the scale factors when the power is turned on. Adjust the brightness with the R/O INTEN control as necessary. To turn off the readout display, press the CURSOR MODE switch for approximately two seconds. To turn it on again, press the switch again.

NOTE

- The oscilloscope displays readout data in terms of waveforms and time sharing. Waveforms may occasionally look like intensity-modulated waveforms, depending on combinations of waveform types and sweep times. If the display is not suitable for observation or measurement, turn the readout display off by the above procedure.
- When a signal out of the effective area is displayed, the readout display may waver or be thick. We recommend that waveforms be displayed in the effective area.

2) Cursor measurement

During readout display, every press of the CURSOR MODE switch changes the cursor mode in the order of Off, ΔV, ΔT, 1/ΔT, and Off. Data is displayed on the upper part of the CRT.

ΔV (Voltage measurement mode)

Two horizontal cursors are displayed. Distance between these cursors is converted into the vertical axis sensitivity (VOLTS/DIV), and the voltage is displayed. If a probe is attached, its attenuation ratio is converted and displayed. CH1 and CH2 data are displayed simultaneously if selected with V. MODE. If V. VARI is set to UNCAL, voltage ratio (RATIO) is displayed, using 5 divisions on the CRT as 100%.

ΔT. 1/ΔT (Time and frequency measurement mode)

Two vertical cursors are displayed. The distance between these cursors is converted into sweep time, and time and freqency, the reciprocal of the time, is displayed simultaneously. If H. VARI is set to UNCAL, ΔT data is voltage ratio, using 5 divisions on the CRT as 100%, and 1/ΔT data is phase difference, using 5 divisions as 360° .

8. APPLICATIONS

Since both the vertical and horizontal axes of the oscilloscope have been calibrated, the oscilloscope is capable of not only displaying waveforms but also measuring voltage or time quantitatively. For these measurements, be sure to rotate the V. VARI and H. VARI controls fully clockwise to the CAL position (until a click sound is heard). We recommend that the probe (included in the accessories) be used to minimize interference to the signals you want to measure.

8 – 1 Measuring Voltage Between Two Points on a Waveform

Use the following procedures for measuring voltage between two points, peak to peak voltage, etc.

1) Apply a signal to the INPUT terminal, and adjust the VOLTS/DIV and SWEEP TIME/DIV controls. Reset the trigger point if necessary.
   Set the AC-GND-DC control to AC.

2) Use the ▲▼ POSITION control so that one of the points to be measured falls on one of the horizontal graduation lines, while the other point can still be observed on the CRT screen.

3) Use the ◀▶ POSITION control so that the point to be measured falls on the vertical scale at the center of the CRT.

4) Measure the vertical distance between the two points. Multiply that value by the VOLTS/DIV setting.
   When the 10:1 probe is used, also multiply the value by the attenuation rate of the probe.

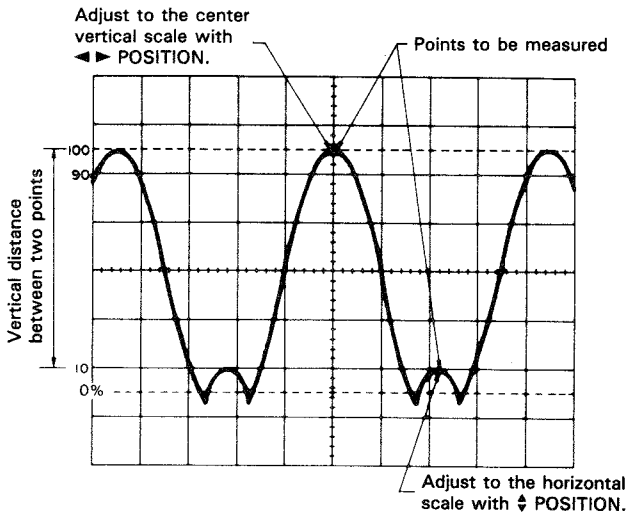


Figure 10-1 Measuring Voltage between Two Points

Example : In Figure 10, the vertical distance between the two points is 4.4 div. The voltage is found as shown below, provided the VOLTS/DIV control is set to 0.2 V/div and the 10:1 probe is used:

Voltage between 2 points = 4.4 (div)×0.2 (V/div)×10 = 8.8 V

• Cursor measurement [CS-5230, 5260, 5270]

(1) Move the waveform to be measured to an easy-to-see position.

(2) Press the CURSOR MODE switch to select the voltage measurement mode. Bring the ΔREF and Δ cursors in contact with the points to be measured. Read the measurement.

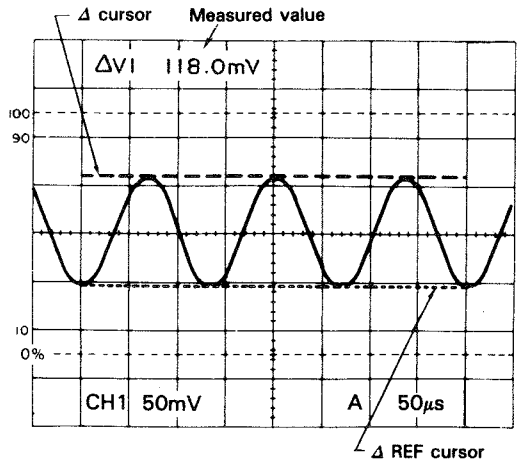


Figure 10-2 Measuring Voltage between Two Points (Cursor measurement)

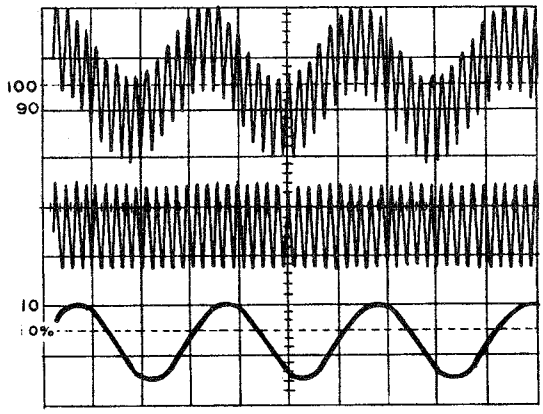
8 — 2 Elimination of undesired signal components

By using the V. MODE control's ADD setting, undesired signal components can be eliminated, allowing only desired signal components to be displayed.

1) Apply signals including undesired components to the CH1 INPUT terminal.
   Now apply the components you want to eliminate to the CH2 INPUT terminal.

2) Set the V. MODE switch to ALT or CHOP. Set the SOURCE control to CH2. Set the trigger point to the CH2 signal, and make sure that CH2 contains the undesired components of CH1.

3) Press the INV switch, and make sure that the CH2 signal represents the undesired components in the reverse polarity.
   When the V. MODE switch is set to ADD in these conditions, only the desired signal components are displayed on the CRT.



←CH : Signal with undesired components

←ADD : Signal without undesired component

←CH2 : Undesired component

Figure 11 Common Mode Rejection

4) Elimination capabilities vary with the size of the undesired component. In order to attain the best results, display the CH2 signal with slightly higher VOLTS/DIV setting. After pressing the INV switch and activating the ADD function, adjust the CH2 V. VARI control to get a good waveform.

8 — 3 Measuring Direct Current (DC) Voltage

The oscilloscope's vertical amplification is proven by a direct current amplifier circuit characterized by excellent stability. By switching the AC-GND-DC control to the DC setting, direct current voltage may be measured.

1) Apply the signal to the INPUT terminal. Use the VOLTS/DIV and SWEEP TIME/DIV controls to display the waveform at an easy-to-see size. Adjust the TRIGGER LEVEL control as necessary.

2) Set the T. MODE control to AUTO. Set the AC-GND-DC control to GND. The trace line is displayed on the CRT. This trace line represents the ground potential. Use the ▲▼POSITION control to bring the trace line in contact with one of the horizontal graduation lines. It is normally lined up on the 0% graduation line if the signal is positive. Or, it is lined up on the 100% line if the signal is negative. Once lined up, the trace position becomes the reference potential, so do not touch the ▲▼POSITION control during measurement processes.

3) Set the AC-GND-DC control to DC. The signal is displayed on the CRT with the direct current components intact.
If either the VOLTS/DIV or reference potential setting is inappropriate, the waveform may disappear from the display screen. Make sure the settings are correct.

4) Measure the potential in the equivalent procedure to measuring the voltage between two points. The potential sign is plus if above the reference or minus if below the reference.

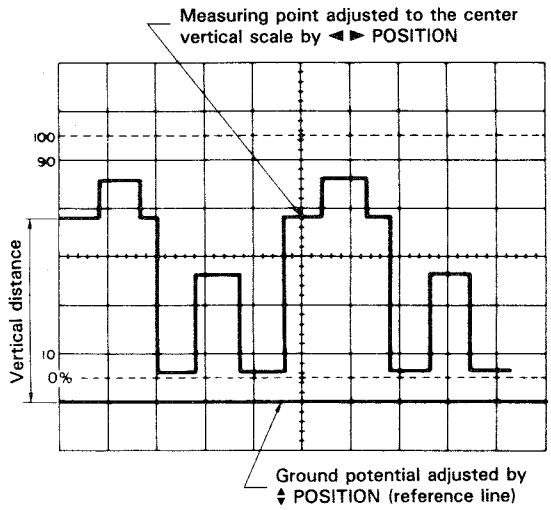


Figure 12-1 DC Voltage Measurement

5) If there is only one signal to be measured, apply it to CH1, and use the CH2 ▲▼ POSITION control so that CH2 displays the ground potential. If the V. MODE control is set to ALT or CHOP, you will be certain of the ground potential throughout the procedure. However, make certain that the ground potentials of both channels are always the same.

• Cursor measurement [CS-5230, 5260, 5270]

(1) Carry out steps 1 and 2 for measuring with the scale on the CRT.

(2) Press the CURSOR MODE switch to select the voltage measurement mode. Align the ΔREF cursor to the ground potential.

(3) Set the AC-GND-DC control to DC. Adjust the Δ cursor to the point to be measured. Read the measurement.

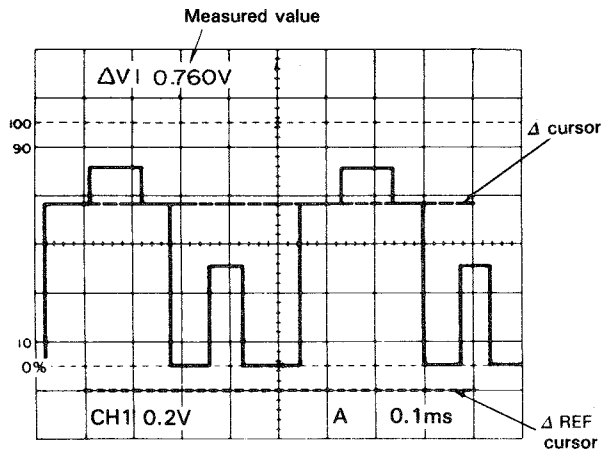


Figure 12-2 DC Voltage Measurement (Cursor measurement)

8 — 4 Measuring Voltage Ratio with Cursors [CS-5230, 5260, 5270]

Overshoot of a square wave, etc. may easily be measured with the cursors.

1) Apply the signal to the INPUT terminal. Use the VOLTS/DIV and SWEEP TIME/DIV controls to display the waveform at an easy-to-see position.

2) Adjust the amplitude to 5 divisions with the V. VARI control.

3) Press the CURSOR MODE switch to select the voltage measurement mode. Align the ΔREF cursor to the top of the square wave and the Δ cursor to the peak of the overshoot.

4) When the V. VARI control is set to UNCAL, ratio measurement is selected and accordingly the displayed data represents the percentage of the overshoot.

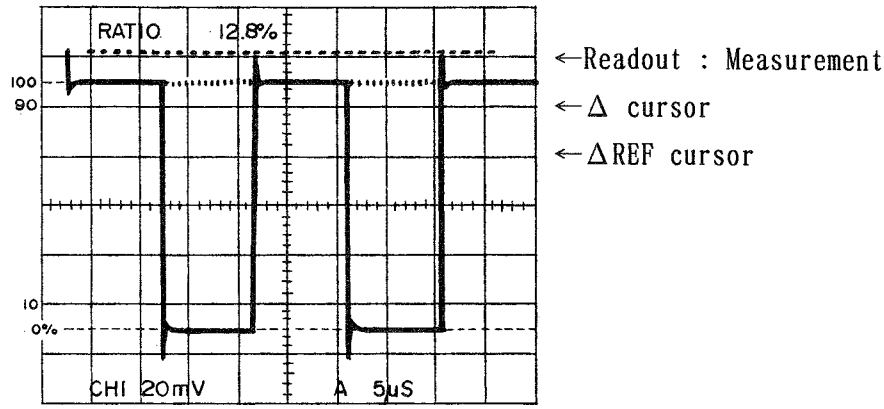


Figure 13 Measuring Voltage Ratio with Cursors

8 — 5 Measuring Signals with Low Frequency Components

When the oscilloscope's AC-GND-DC control is set to AC, there is a chance that errors may occur in the voltage measurement. This inaccuracy is caused by low range cut-off frequencies. At AC, the most accurate frequency measurements are realized above the 20 to 30 Hz range. Therefore, when measuring frequencies below this range, switch the AC-GND-DC control to the DC setting. If you are using the probe supplied with the oscilloscope, accurate measurement of frequencies as low as 2 to 3 Hz can be realized at AC.

8 — 6 Measuring Signals with High Frequency Components

Always use a probe when measuring pulses or signals of a few hundred kHz or above. This is because distortion will occur in the waveform's high frequency component due to the use of long leads. This makes it difficult to conduct accurate waveforms. This is also true for probes with long ground leads, so keep them as short as possible. In addition, ensure the ground lead clip is connected to a ground potential close to the signal to be measured.

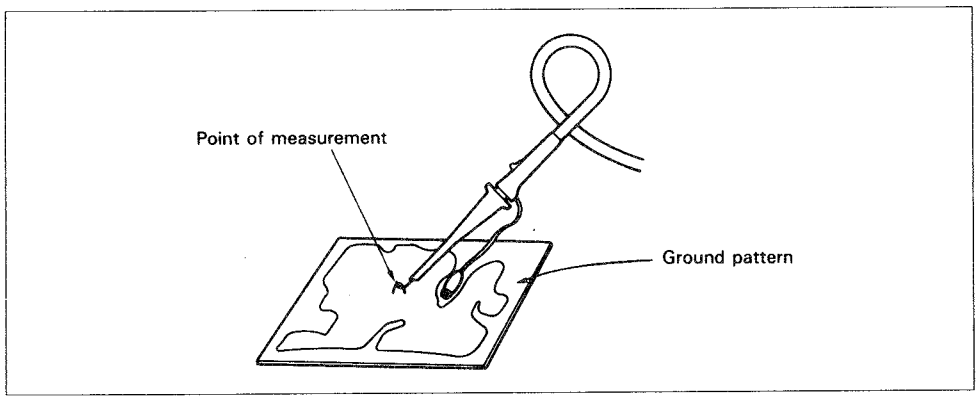


Figure 14 Measuring Signals with High Frequency Components

8 — 7 Measuring Time Between Two Points

When measuring time between two points, measurements can be determined from SWEEP TIME/DIV and horizontal distance.

1) Display the waveform by adjusting each control. Set all the VARIABLE controls to the CAL position.

2) Use the ◀▶ POSITION control to bring one point to be measured in line with a Vertical graduation line. Then, use the ▲▼ POSITION control to bring the other point to be measured in line with the horizontal scale in the middle of the CRT.

3) Measure the horizontal distance between the two points. Multiply this value by the SWEEP TIME/DIV setting value. If the ×10 MAG function is activated, multiply the value by 1/10.

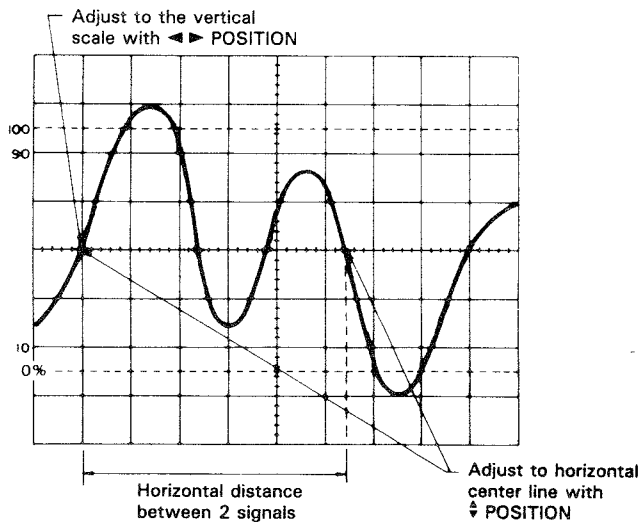


Figure 15-1 Measuring Time Between Two Points

Example : In the case of Figure 15, the horizontal distance between the two points is 5.4 div. The time between the two points is found as follows, provided the SWEEP TIME/DIV setting is 0.2 ms/div.

Time between two points = 5.4 (div)×0.2 (ms/div) = 1.08 (ms)

If the ×10 MAG function is used:

Time between two points = 5.4 (div)×0.2 (ms/div)×1/10

= 0.108 (ms) = 108 (μs)

• Cursor measurement [CS-5230, 5260, 5270]

(1) Display the waveform to be measured in an easy-to-see position.

(2) Press the CURSOR MODE switch to select the time and frequency mode. Bring the ΔREF and Δ cursors in contact with the points to be measured. Read the measurement.

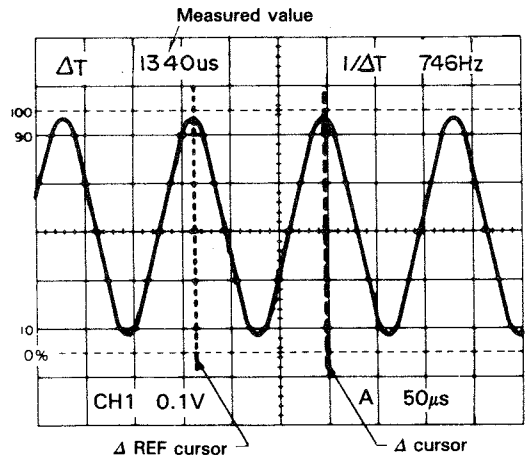


Figure 15-2 Measuring Time between Two Points (Cursor measurement)

8 — 8 Measuring Time Ratio with Cursors [CS-5230, 5260, 5270]

The duty of a square wave can easily be measured with the cursors.

1) Apply the signal to the INPUT terminal. Use the VOLTS/DIV and SWEEP TIME/DIV controls to display the waveform at an easy-to-see positon.

2) Adjust the width of a cycle to 5 divisions with the H. VARI control.

3) Press the CURSOR MODE switch to select the time and frequency measurement mode. Align the ΔREF cursor to the trailing edge of the square wave and the Δ cursor to the leading edge.

4) When the H. VARI control is set to UNCAL, ratio/phase measurement is selected and accordingly the displayed data represents the duty of the square wave.

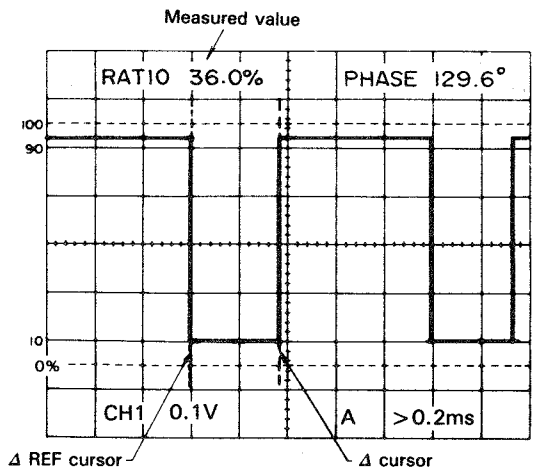


Figure 16 Measuring Time Ratio with Cursors

8 — 9 Measuring Frequencies

Since the frequency is found as a reciprocal of a period, measure the time (period) of one cycle and calculate its reciprocal value.

1) Measure the time of one cycle.

2) Find the reciprocal value of the period found.

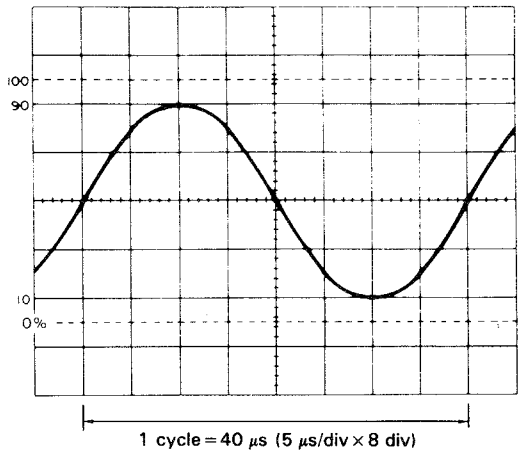


Figure 17-1 Measuring Frequency

Example : In the case of Figure 17, the frequency is found as shown below, provided the period is 40 μs.

$$\text{Freqyency} = \frac{1}{40\times10^{-6}} = 25\times10^{3} = 25 \text{ kHz}$$

• Cursor measurement [CS-5230, 5260, 5270]

(1) Display the waveform to be measured in an easy-to-see position.

(2) Press the CURSOR MODE switch to select the time and frequency mode. Bring the ΔREF and Δ cursors in contact with the points to be measured. Read the measurement.

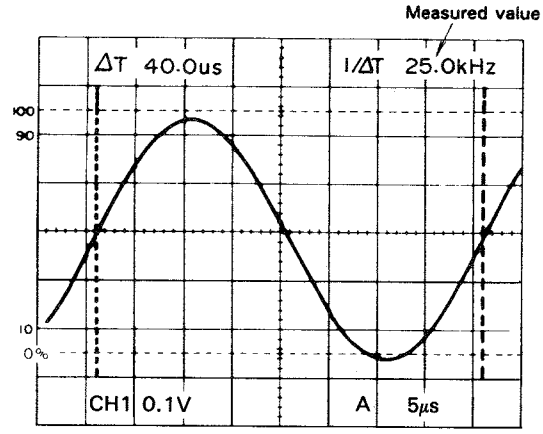


Figure 17-2 Measuring Frequency (Cursor measurement)

8 −10 Measuring Pulse Rise and Fall Times

The rise (fall) time is found by measuring the time between 10% and 90% of the peak value. For this purpose, the oscilloscope has additional graduations at 10% and 90%.

1) Apply the signal. Adjust the VOLTS/DIV and V. VARI controls so that the amplitude is 5 divisions. Set the H. VARI control to CAL. Press the ×10 MAG switch if necessary.

2) Use the ▲▼ POSITION control to move the waveform between 10% and 90%. Then, move the 10% point to a vertical graduation line with the ◀▶ POSITION. Measure the horizontal distance between the 10% and 90% points. The time is found from the horizontal distance.

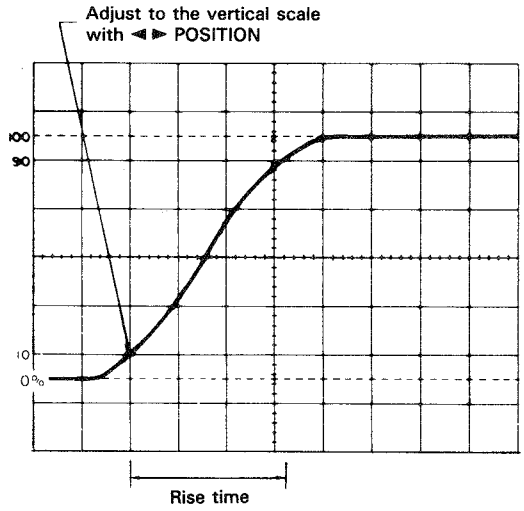


Figure 18-1 Measuring Rise Time

3) When measuring high speed rise (fall) time, you must allow for the oscilloscope's inherent time factor. The true rise time for a measurement of 20 ns is found as follows:

$$to = \sqrt{t^2m - t^2r}$$

tm: Actually measured value
tr: Oscilloscope's inherent rise time

$$= \sqrt{20^2 - 8.8^2} = 18.0\text{ns}$$ [CS-5230, 5235]

However, this correction factor is not significant when the actually measured value is above 30 ns.

• Cursor measurement [CS-5230, 5260, 5270]

(1) Carry out step 1 of observation with the scale on the CRT.

(2) Press the CURSOR MODE switch to select the time and frequency mode. Align the ΔREF cursor to the 10% point and the Δ cursor to the 90% point. Read the measurement.

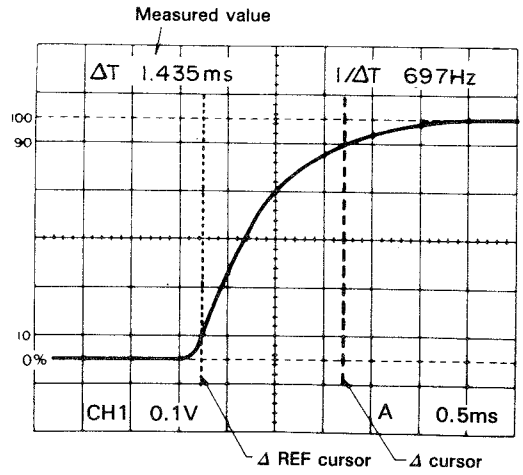


Figure 18-2 Measuring Rise (Fall) Time

8 − 11 Measuring Pulse Jitter

Pulse jitter with a relatively long cycle may be measured using the B sweep function.

1) Apply the signal to the INPUT terminal. Adjust the amplitude to 5 divisions with the VOLTS/DIV and V. VARI controls. Set the VOLTS/DIV and H. VARI to CAL. Display the waveform in an easy-to-see position with the SWEEP TIME/DIV control.
Press the ×10 MAG switch if necessary.

2) Set the H. MODE control to ALT or AFTER' D. Adjust the B SWEEP TIME/DIV and DELAY POSITION controls so that the pulse edge to be measured is intensity-modulated.

NOTE

If the magnification of A sweep and B sweep is higher than several hundred magnifications when the AFTER. D functin is used, delay jitter is produced. The delay jitter level of the oscilloscope is less than 0.1 V at 100 maginifications.

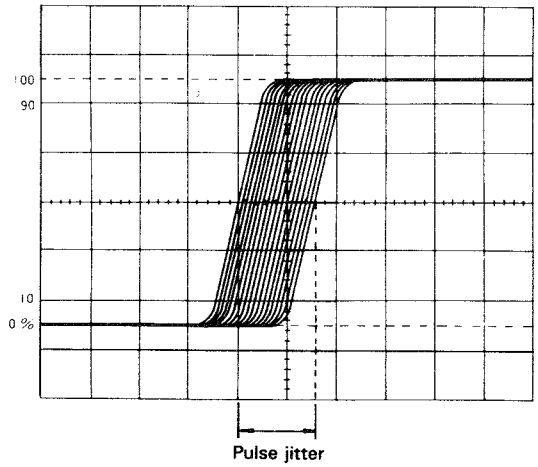


Figure 19 Measuring Pulse Jitter

3) Set the H. MODE control to B. Measure the jitter width at the edge of the jitter. The jitter is found by multiplying the jitter width by the reading of the B SWEEP TIME/DIV.

Example : The jitter time is found by multiplying the jitter width by a reading of the B SWEEP TIME/DIV. If the jitter width is 1.6 div and the reading of the B SWEEP TIME/DIV is 0.2 μs, the jitter time is found as shown below:

Jitter time = 1.6 (div)$\times$0.2 (μs) = 0.32 μs

8 — 12 Measuring Phase Differences

With the dual-trace function, phase difference can be measured between, for example, two sine wave signals of identical frequency.

1) Apply two signals to the respective INPUT terminals. Adjust the VOLTS/DIV and V. VARI controls so that the two signals have identical amplitude.

2) Adjust the SWEEP TIME/DIV and H. VARI controls so that one period of the waveforms is 8 div.

3) Use the ▲▼ POSITION controls of both channels to bring the waveforms to the center of the CRT.

4) Measure the horizontal distance between corresponding points on both signals. There is a phase difference of 45 degrees for every division.

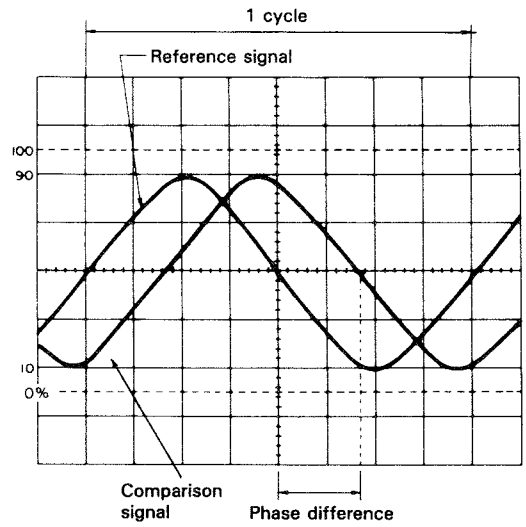


Figure 20-1 Measuring Phase Difference

5) If phase difference is negligible and the horizontal distance is short, press the ×10 MAG switch in this condition.
With the ×10 MAG switch pressed, the phase difference is 4.5 degrees for every division.

• Cursor measurement [CS-5230, 5260, 5270]

(1) Carry out step 1 of observation with the scale on the CRT.

(2) Adjust the SWEEP TIME/DIV nad H. VARI controls so that one period of the waveform is 5 div.

(3) Press the CURSOR MODE switch to select the time and frequency mode. Align the ΔREF cursor and Δ cursor to the corresponding points of two waveforms. Read the measurement.

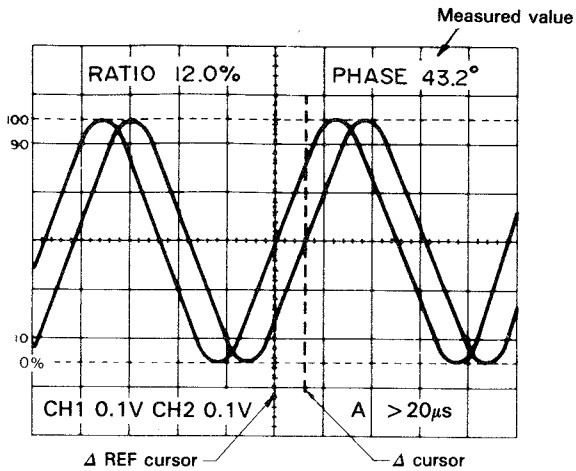


Figure 20-2 Measuring Phase Difference (Cursor measurement)

8 — 13 Applications of X-Y Operation

When operating the oscilloscope in the X-Y mode, Lissajous patterns can be displayed. With Lissajous patterns, it is possible to find even the slightest phase difference or signal distortion and relative frequency proportions.

1) Apply the signal to be measured to the CH1 INPUT terminal. Apply the reference signal to the CH2 INPUT terminal.

2) Set the H. MODE control to X-Y.

3) Adjust the VOLTS/DIV and V. VARI controls of both channels to obtain an acceptable display.

4) In phase difference measurement with Lissajous patterns, measured values will not change by turning the V. VARI control. Use an easy-to-see display for measurement.

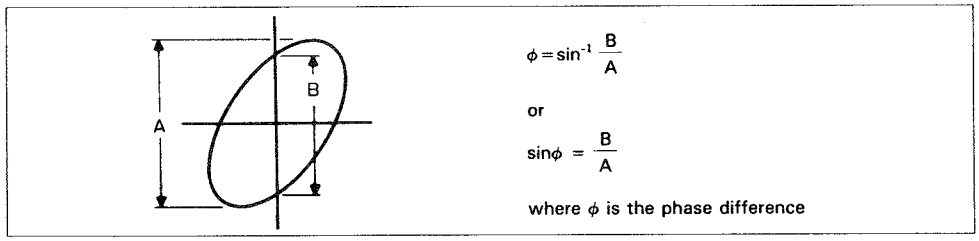


Figure 21 Measuring Phase Difference with Lissajous Patterns

The following represent Lissajous patterns indicating the presence of signal distortion or phase difference.

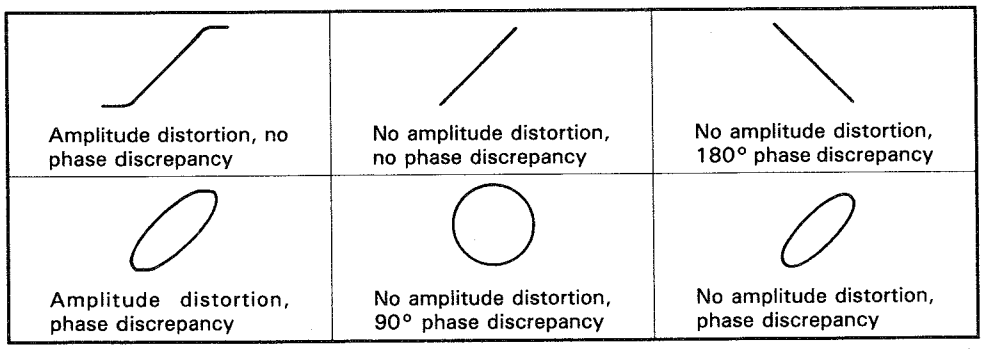


Figure 22 Typical Lissajous Patterns

The following represent Lissajous patterns when input frequency proportions are changed.

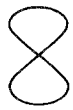
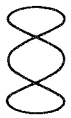
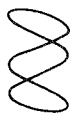
0°	45°	90°	135°	180°	Frequency Proportion (CH1[Y]:CH2[X])
					1 : 1
					1 : 2
					1 : 3

Figure 23 Lissajous Patterns when Frequency Proportions Are Changed

9. FUSE REPLACEMENT, LINE VOLTAGE SELECTION

Before conducting the following operation, turn the power off and unplug the power cord from the wall socket.

Fuse Replacement

If the fuse blows, the oscilloscope will not operate. Locate the cause. If the oscilloscope is not defective, remove the cap from the fuse holder on the rear panel with a standard type screwdriver, then replace the fuse with a new fuse. (See Figure 24.)

100 or 120 V : 1 A (Time lag)

220, 230 or 240 V : 630 mA (Time lag)

NOTE

If any of the following cases apply, please contact your dealer, or our distributor.

- It is not clear why the fuse has blown, or the oscilloscope seems to be defective.
- The oscilloscope uses a time lag type fuse. If a time lag type fuse of the above-shown rating is not available.

Changing Voltage Selection

Remove the fuse holder and voltage selector from the rear panel with a standard type screwdriver. Fit the line voltage selector to match the supply voltage rating (▼ mark). If 100 or 120 V is to be changed into 220, 230 or 240 V, the 1 A fuse should be replaced with a 630 mA fuse. (See Figure 24.)

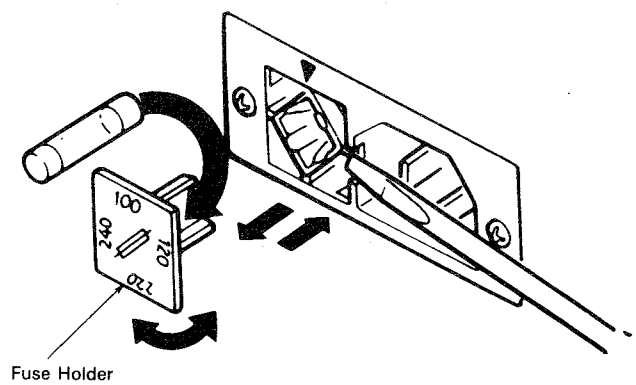


Figure 24 Changing Voltage Requirements

10. OPTIONAL EQUIPMENT

The oscilloscope has an optional accessory bag. This bag attaches to the oscilloscope and provides a storage space for probes, etc.

How to Attach Accessory Bag (MC-78)

1) Separate the accessory bag from the mounting plate.

2) Line up the four holes on the right side (viewed from the front) of the oscilloscope with the corresponding four holes in the mounting plate. Fix the mounting plate to the oscilloscope case with the four nylon rivets and washers provided. Be sure that the mounting plate is in the vertical position as shown in Figure 25. Insert the grommet into the holes first, then press the plungers.
(When removing, just pry the plungers out with a standard type screwdriver.)

3) Attach the bag to the mounting plate with the hooks.

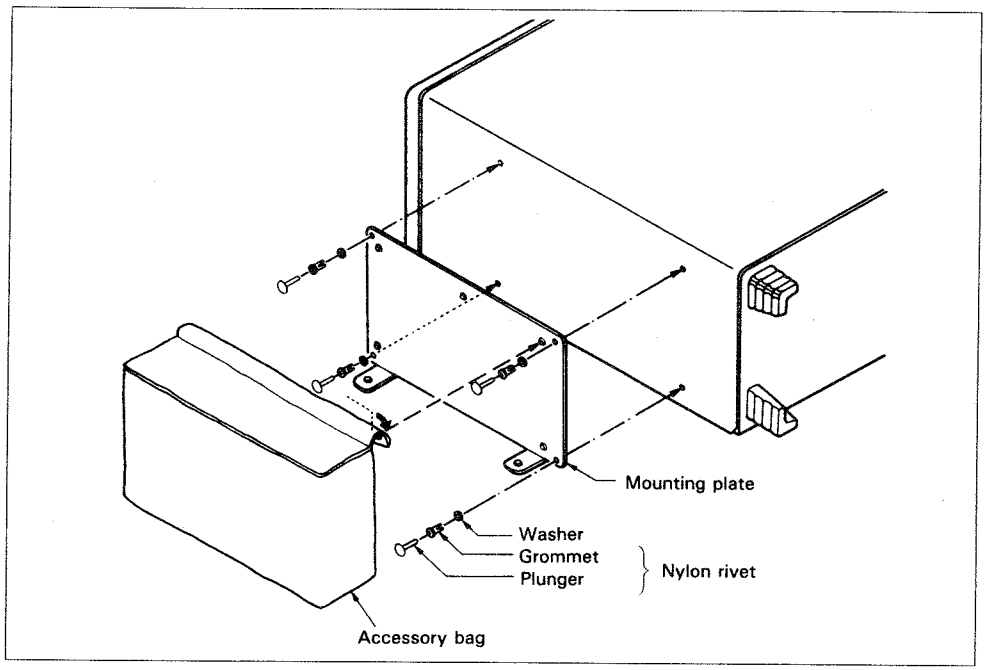


Figure 25 Attaching Accessory Bag

CORRECTION

This correction is for : CS－5200 SERIES OSCILLOSCOPE
Title : CS-5200 SERIES OSCILLOSCOPE INSTRUCTION MANUAL
Manual Part No. : B63-0219-00
Dated : 12/93

Page. 17 5. PANEL EXPLANATION

㉛ COUPLING switch

[ERROR]

TV LINE : ····· from the composite video

[CORRECT]

TV LINE : Horizontal synchronization pulses are extracted from the composite video signals and input to the trigger circuit.

Page. 50 9. FUSE REPLACEMENT, LINE VOLTAGE SELECTION

Fuse Replacement

[ERROR]

100 or 120 V : 1 A (Time lag)
220, 230 or 240 V : 630 mA (Time lag)

[CORRECT]

100 or 120 V : 1 A
220, 230 or 240 V : 630 mA

[ERROR]

Note
If any of the ·····
distributor.
・It is not clear why the fuse ·····
➡ ・The oscilloscope uses a time lag type fuse. If a time lag type fuse of the above-shown rating is not available.

[CORRECT]

Note
If any of the ·····
distributor.
・It is not clear why the fuse ·····
➡ ・If a fuse of the above shown rating is not available.

A product of
KENWOOD CORPORATION
2-5, 1-chome Shibuya, Shibuya-ku, Tokyo 150, Japan