

**KENWOOD**

20MHz DUAL TRACE OSCILLOSCOPE

**CS-4125**

40MHz DUAL TRACE OSCILLOSCOPE

**CS-4135**

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INSTRUCTION MANUAL

KENWOOD CORPORATION

© B63-0302-08

96/12 11 10 9 8 7 6 5 4 3 2

# S A F E T Y

## Symbol in This Manual

⚠ This symbol indicates where applicable cautionary or other information is to be found.

## Power Source

This equipment operates from a power source that not apply more than 250V 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.

If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired.

## SICHERHEIT

Symbol in dieser Anleitung

 Dieses Symbol zeigt an, wo Sicherheitshinweise und andere wichtige Informationen zu finden sind.

Spannungsquelle

Dieses Gerät ist mit einer Spannungsquelle zu betreiben, bei der nicht mehr als 250 Veff Zwischen den Versorgungsleitern bzw. zwischen Versorgungsleiter und Erde anliegen. Eine ordnungsgemäße Erdung über den Schutzleiter des Netzkabels ist für sicheren Betrieb erforderlich.

Erdung des Geräts

Das Gerät wird über den Schutzleiter des Netzkabels geerdet. Zur Verhütung elektrischer Schläge zunächst den Netzstecker in eine entsprechende Steckdose mit Schutzkontakt stecken und erst dann die Ein- bzw. Ausgangsbuchsen des Geräts beschalten.

Geeignetes Netzkabel verwenden

Stets ein Netzkabel verwenden, dessen Ausführung und Stecker der Gerätespezifikation entspricht.

Geeignete Sicherung verwenden

Zur Verhütung eines Brandes stets eine Sicherung mit den korrekten Kennwerten verwenden.

Nicht in explosionsgefährlicher Umgebung betreiben

Zur Verhütung einer Explosion das Gerät nicht in explosionsgefährlicher Umgebung betreiben.

Deckel und Abdeckungen nicht entfernen

Zur Verhütung eines Personenschadens weder Deckel noch Abdeckungen entfernen. Alle Wartungs- und Instandsetzungsarbeiten stets qualifiziertem Fachpersonal überlassen.

## SICHERHEIT

Wenn das Gerät auf eine nicht spezifizierte Weise benutzt wird, ist der von dem Gerät gelieferte Schutz beeinträchtigt.

# C O N T E N T S

<b>SAFETY</b> .....	2
<b>SAFETY AND EQUIPMENT PROTECTION PRECAUTIONS</b> .....	5
<b>FEATURES</b> .....	7
<b>PREFACE</b> .....	8
<b>PANEL EXPLANATION</b> .....	9
FRONT PANEL .....	9
REAR PANEL .....	14
<b>USE OF HANDLE</b> .....	15
<b>SUPPLIED PROBE</b> .....	15
<b>CHECKING AND ADJUSTMENTS PRIOR TO MEASUREMENT</b> .....	16
<b>OPERATING PROCEDURES</b> .....	18
SINGLE TRACE OPERATION .....	18
Alternating Current Display .....	18
Composite Video Signal Display .....	19
DUAL TRACE OPERATION .....	19
Switching Vertical Operation Modes .....	19
Switching Trigger Source .....	19
External Trigger .....	20
Line Trigger .....	20
SWEEP MAGNIFIED OPERATION .....	20
X-Y OPERATION .....	20
<b>APPLICATIONS</b> .....	21
Measuring Voltage Between Two points on a Waveform .....	21
Common-Mode Rejection .....	22
Measuring Direct Current (DC) Voltage .....	23
Measuring Signal with Low Frequency Components .....	24
Measuring Signal with High Frequency Components .....	24
Measuring Time Between Two Points .....	25
Measuring Frequencies .....	26
<b>MAINTENANCE</b> .....	27
FUSE REPLACEMENT .....	27
CHANGING VOLTAGE REQUIREMENTS .....	27
CLEANING .....	28
<b>SPECIFICATIONS</b> .....	29
<b>OPTIONAL EQUIPMENT</b> .....	33
How to Attach the Accessory Bag .....	33

## SAFETY AND EQUIPMENT PROTECTION PRECAUTIONS

1. Check your line voltage before use. The oscilloscope voltage rating appears on the back of the set. If your line voltage is different from the oscilloscope's rating, there is a danger of malfunctioning. You should plug in the cord only after making sure that the two voltage ratings are the same.
2. The oscilloscope is equipped with internal components that are highly charged electrically. For your own protection, do not for any reason remove the set's casing.
3. Use this oscilloscope indoors.  
This oscilloscope is designed for indoor use only. Do not use it outdoors. If it is used outdoors, water penetrates into the oscilloscope through the vent holes when it rains or snows, causing short circuit, electric shocks, electrocution or other dangerous accidents.
4. Do not lock the vent holes.  
Do not place this oscilloscope close to the wall, other instruments or the like. Do not place any object on this oscilloscope. If the vent holes of the casing are blocked, the temperature inside the oscilloscope rises excessively, resulting in the possibility of smoke, fire or other accidents.
5. 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 force or impulse voltage.
  - A place where explosive gas or vapor is produced or stored.
6. Make sure that the voltage applied to each input terminal does not exceed the maximum amounts specified.
  - △ CH1, CH2 and EXT.TRIG input terminals: 800Vp-p or 400V(DC+ACpeak)
  - △ Z.AXIS input terminals: 84Vp-p or 42 V(DC+ACpeak)Moreover, do not under any circumstances apply voltage to the output terminals from external power sources.

7. In order to prevent the CRT's fluorescent screen from scorching, do not adjust the brightness higher than necessary and do not leave the spotting function on for long periods of time.
8. The set has been equipped with handle, so that you can position it in either horizontal or diagonal positions. However, do not place any objects on top of the set or position it in areas where the ventilation holes in the casing are blocked in any way. Such blockage will cause the temperature of the internal components to increase, resulting in possible damage to the unit. Do not put liquid, metal or other foreign matters through the vent hole, etc.
9. Do not use  $\times 10\text{MAG}$  during X-Y operation. Wave pattern noise tends to occur when  $\times 10\text{MAG}$  is used.
10. The probe has been manufactured with the same level of delicate precision as the oscilloscope itself. Be very careful when handling it.

## FEATURES

- High Sensitivity : Sensitivity as 1 mV/div.
- Wide Bands : The frequency band is DC to 5MHz (-3dB) at 1, 2 mV/div and DC to 40MHz [CS-4125: 20MHz] (-3dB) from 5mV/div.
- Continuous Switching Attenuator : A rotary switch enables vertical axis sensitivity to be adjusted continuously from 1mV/div to 5V/div.
- High Speed Sweep : High speed sweeping is possible at a time base of 20 ns/div (during  $\times 10$ MAG).
- High Accuracy : Accuracy is within 3% for both vertical axis sensitivity and sweep time.
- Large Aperture : The 150 mm rectangular CRT monitor features an internal graticule easy visual recognition of waveforms. The waveforms displayed in high brightness can be monitored with no parallax. Acceleration voltage: [CS-4135: 12kV, CS-4125: 2kV].
- Trace Rotation : The horizontal trace angle is easily corrected.
- Auto Free Run : The trace can be checked even when there are no trigger signals to be input.
- Television Trigger Signal Selection : With a specially designed circuit, adjustment-free, stable synchronization for both frames and lines can be realized over the whole range from large to small amplitudes.
- One Touch X-Y : Switching to X-Y operation at the touch of a lever switch.
- Automatic Trigger Signal Selection : Trigger signals can be selected automatically according to the VERT MODE control setting by simply switching the SOURCE control to VERT.
- CH1 OUTPUT : A channel 1 output terminal has been added for CH1 input signal monitoring.
- VERT MODE Trigger : CH1 and CH2 input signals are triggered separately even if they have different frequencies.
- Fixed Triggering : Fix triggering exempts the user from troublesome triggering operations.
- Automatic Focusing : Out-of-focus is automatically corrected when the intensity is changed.
- Handle : A convenient handle adjustable to two tilt angles.
- Variable Attenuation Probe : The variable attenuation probe provides attenuation at a ratio of 1/1, helpful for measurement of quite low level signals.

## PREFACE

- This manual describes the functions and operations of the CS-4135 and CS-4125.

Most descriptions about the panels and operations are common to these models. Different functions and operations are enclosed in brackets [ ] by designating the models.

Read the descriptions for the model you purchased.

- Description of symbol displayed on the equipment.

Symbol	Explanation/Description
~	Alternating Current
⊕	Protective Conductor Terminal
≡	Frame or chassis terminal
F	Quick acting fuse
T	Time lag fuse

## PANEL EXPLANATION

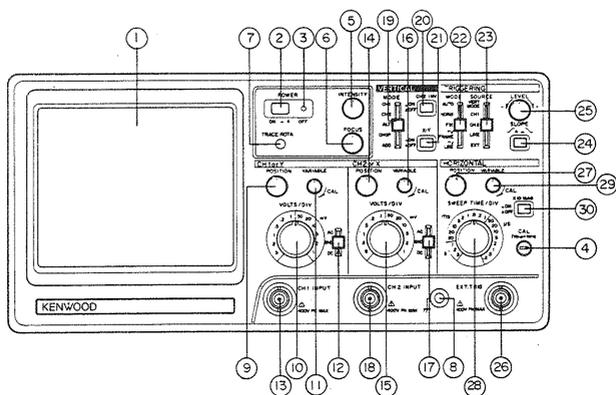


Figure 1. Front Panel

### FRONT PANEL

(1) **Cathode Ray Tube (CRT)**

The effective display screen surface runs over an area of eight 1cm divisions along the vertical axis and ten 1cm divisions along the horizontal axis. With an inner graticule etched right onto the tube face, the chance of measurement errors due to parallax occurring between the trace and the graticule have been significantly reduced. There is also a % display for measuring rise time on the left edge of the graticule.

(2) **POWER Switch (  ON/  OFF)**

A push-button type switch that turns the power source on and off. Pressing the switch turns the power on. Pressing it again turns power off.

(3) **Pilot Lamp**

Light ups when the power is turned on.

(4) **CAL Terminal**

A voltage terminal for calibration. To be used for adjusting the probe. Capable of 1 volt peak to peak, positive polarity, square wave signals with approx. 1kHz is enabled.

(5) **INTENSITY Control**

For adjusting the brightness of the trace line.

(6) **FOCUS Control**

For adjusting the focus and attaining the clearest displays possible. The automatic focusing corrects out-of-focus automatically even when the INTEN control is turned. However, it may result in slight out-of-focus.

In such a case, carry out adjustment again.

(7) **TRACE ROTA Control**

For adjusting the slope of the horizontal trace line. The slope of the line will change due to such influences as the earth's magnetic force. Use a screw-driver to keep the trace line parallel with the horizontal axis graticule.

(8) **GND Terminal**

This is the ground terminal to be used when setting up a common ground with other equipment.

(9) **◆ POSITION Control**

For adjusting the vertical position of the CH1 waveform displayed on the CRT screen. During X-Y operation it is used to adjust the position of Y-axis.

(10) **VOLTS/DIV Control**

For setting the vertical axis sensitivity with the CH1 vertical axis attenuator. It can be set in steps of 1,2 and 5. Setting the VARIABLE control all the way to the right at CAL enables calibrated vertical sensitivity. During X-Y operation, it becomes the attenuator control for the Y-axis.

(11) **VARIABLE Control**

For fine adjustment of CH1 vertical axis sensitivity. Allows continuous variable adjustment within the VOLTS/DIV range. When set to the right at CAL, the attenuator can be calibrated. During X-Y operation, it becomes the fine adjustment control for the Y axis.

(12) **AC-GND-DC Switch**

For selecting the CH1 vertical axis input signal coupling mode.

**A C** : The input signal will be capacitively coupled, and all DC components will be eliminated. The low range -3dB attenuation point will be 10 Hz or less when using either a 1:1 probe or a coaxial cable, and 1Hz or less when using a corrected 10:1 probe.

**G N D** : Vertical amplifier input is grounded, and the ground potential can be checked. At an input resistance of  $1M\Omega$  relative to the ground, the input signal is not grounded. In this mode, the anti-trace line jump circuit prevents the trace position from changing suddenly when switching from GND to AC.

**D C** : Provides direct coupling of the input signal, and measurement can be carried out with the direct current component intact.

(13) **INPUT Jack**

The CH1 vertical axis input jack.

During X-Y operation, it becomes the Y-axis input jack.

(14) **◆ POSITION Control**

For adjusting the vertical position of the CH2 waveform when displayed on the CRT screen.

(15) **VOLTS/DIV Control**

The vertical attenuator CH2. It is operated in the same way as the CH1 VOLTS/DIV control.

During X-Y operation, it becomes the X-axis attenuator.

(16) **VARIABLE Control**

For fine adjustment of CH2 vertical axis sensitivity. It is operated in the same way as the CH1 VARIABLE control.

During X-Y operation it is used for fine adjustment of X-axis sensitivity.

(17) **AC-GND-DC Switch**

For selecting the CH2 vertical axis input signal coupling mode. It is operated in the same way as the CH1 AC-GND-DC switch.

During X-Y operation, it becomes the X-axis input switch.

(18) **INPUT Jack**

The CH2 vertical axis input jack.

During X-Y operation, it becomes the X-axis input jack.

(19) **VERTICAL MODE Switch**

For selecting the vertical axis operation mode.

**CH 1** : For displaying the CH1 input signal on the CRT screen.

**CH 2** : For displaying the CH2 input signal on the CRT screen.

**ALT** : Switches between CH1 and CH2 input signals for each sweep and displays them on the CRT screen.

**CHOP** : For displaying CH1 and CH2 input signals one after the other on the CRT screen, irregardless of sweep and at an occurrence rate of about 150kHz.

**ADD** : For displaying combined waveform of CH1 and CH2 input signals on the CRT screen. However, when CH2 is set at INV, the difference between CH1 and CH2 will be displayed.

Alternate (ALT) and Chop (CHOP) Modes:

When using these modes during dual trace operation, the display will be divided up according to time.

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

In the alternate mode, each channel will be displayed one after the other as soon as one sweep has been made. Therefore, each channel display appears much clearer. Normally, a faster sweep is employed.

(20) **CH2 INV Switch**

When the button is pushed all the way in, the polarity of the CH2 input signal display will be inverted.

(21) **X-Y Oscilloscope Setting Switch**

When the button is pushed all the way in, ignores the **VERTICAL** MODE setting and commences operation as an X-Y oscilloscope with CH1 as Y-axis and CH2 as X-axis.

(22) **TRIGGERING MODE Selector Switch**

For selecting trigger operation modes.

**AUTO**

: Sweep is performed by a trigger signal.

However, in the absence of a trigger signal, free run will commence and a trace will appear.

**NORN**

: Sweep is performed by a trigger signal. In the absence of a suitable trigger signal, a trace will not appear.

**FIX**

: Sweep trigger level is fixed. In this case, triggering is made regardless of LEVEL control (25) setting.

**TV-FRAME**

: Composite video signal vertical sync pulses are selected out and coupled to the trigger circuit.

**TV-LINE**

: Composite video signal horizontal sync pulses are selected out and coupled to the trigger circuit.

Note : The trigger signal is capacitively coupled to the trigger circuit in this oscilloscope.

(23) **SOURCE Selector Switch**

For selecting the trigger signal source.

VERT MODE : The trigger signal source will be selected by the

**VERTICAL** Mode setting. (See table 1)

VERTICAL MODE	Trigger Signal Source
CH1	CH1
CH2	CH2
ALT	Switches between CH1 and CH2 input signals for each sweep and selected for trigger signal source.
CHOP	CH1
ADD	Combined signal of CH1 and CH2 input signal.

Table 1 Setting to the Trigger Signal Source By the VERTICAL MODE

CH1 : The CH1 input signal will become the trigger signal source.

CH2 : The CH2 input signal will become the trigger signal source.

- LINE : The commercial-use power source voltage waveform will become the trigger signal source.
- EXT : The signal being input into the EXT. TRIG jack will become the trigger signal source.
- (24) **SLOPE Control** (  $\int$   $\blacksquare$   $\blacksquare$   $\setminus$  )  
 For selecting the slope polarity of the triggered sweep signal. When the push-button is out (  $\int$   $\blacksquare$  ), triggering will be performed with the trigger source signal rising. When the push-button is pressed in (  $\blacksquare$   $\setminus$  ), triggering will be performed with the trigger source signal falling.
- (25) **LEVEL Control**  
 For adjusting the trigger threshold level. This will determine at what point on the signal waveform slope sweep will commence.
- (26) **EXT. TRIG Input Jack**  
 The input terminal for externally generated trigger signals. When the SOURCE switch is set at EXT, signals input through this terminal will become the trigger signal source.
- (27) **◀▶ POSITION Control**  
 For adjusting the horizontal position of waveform displayed on the CRT screen.
- (28) **SWEEP TIME/DIV Control**  
 For setting the sweep time. Setting can be carried out over 20 steps between  $0.2 \mu\text{s}/\text{div}$  and  $0.5\text{s}/\text{div}$  in 1-2-5 step sequence. When the VARIABLE control is set all the way to the right at CAL, sweep rate values will become calibrated.
- (29) **VARIABLE Control**  
 Continuous sweep time adjustment can be carried out within the SWEEP TIME/DIV range by this fine control. The sweep time becomes compensated by turning the CAL all the way clockwise.
- (30) **× 10MAG Switch**  
 Press this switch to magnify the display  $10 \times$  left and right from the center of CRT screen.

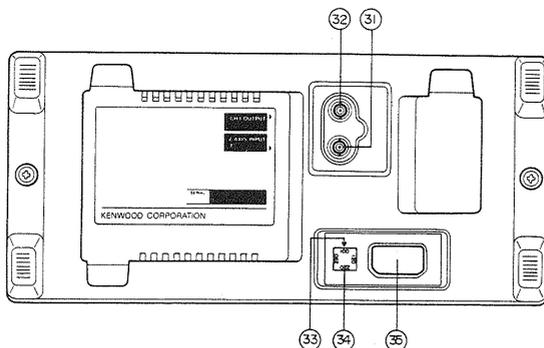


Figure 2. Rear Panel

## REAR PANEL

### (31) **Z.AXIS INPUT Jack**

Input jack for intensity modulation of CRT electron beam. Positive voltage decreases intensity. TTL level intensity modulation possible.

### (32) **CH1 OUTPUT Jack**

CH1 vertical output terminal. Output occurs at AC coupling. For connecting a counter when measuring frequencies. When using a counter to measure frequencies, there is the possibility that accurate measurements will not displayed due to noise interference. When this occurs, either set the CH1 VOLTS/DIV to another range, or set the VARIABLE control to a position other than CAL. Cascade connection of the CH1 and CH2 is impossible.

### (33) **▼ (Indicate for Line Voltage Rating)**

The factory delivered voltage rating. The line voltage rating below the ▼ mark shows the line voltage setting of your oscilloscope.

### (34) **Fuse Holder, Line Voltage Selector**

Changing the voltage rating should be done strictly according to the directions in the section entitled "MAINTENANCE" and after disconnecting the power cord from the power source inlet.

### (35) **Power Cord Receptacle**

A commercial-use power source input connector.

### USE OF HANDLE

Expand the portion ② of the handle to both sides, and turn the handle to the intended position. Make sure that the handle is locked securely before use.

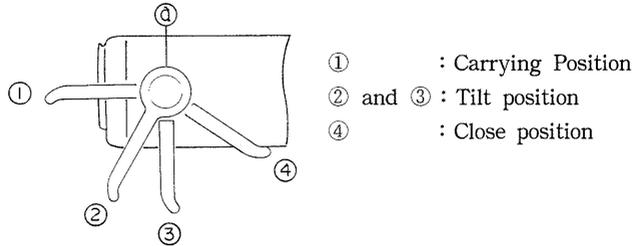


Figure 3. Handle Position

Do not set the handle to any position not shown above. Be sure to set it to position ① when carrying the oscilloscope.

### SUPPLIED PROBE

The probe PC-41 supplied with the CS-4125 has two attenuation ratios: 1/1 and 1/10.

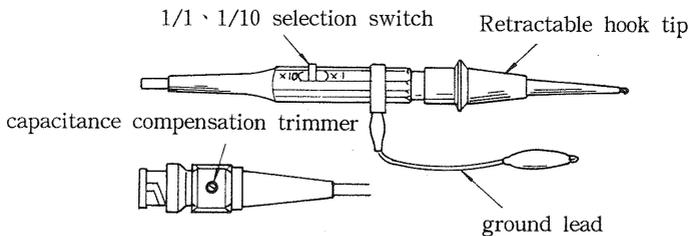


Figure 4. PC-41 Probe

For adjustment of probe, see item 3 in section "CHECKING AND ADJUSTMENTS PRIOR TO MEASUREMENT".

**⚠ Maximum Input Voltage: 600V<sub>DC</sub>**

# CHECKING AND ADJUSTMENT PRIOR TO MEASUREMENT

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

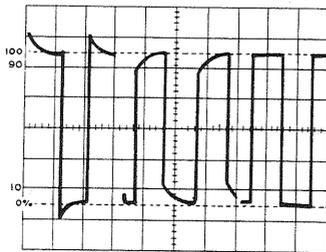
1. Adjust the control panel to the following settings.

MODE	-----	AUTO
SOURCE	-----	VERT MODE
<b>VERTICAL</b> MODE	-----	CH1 (INV:OFF)
SLOPE	-----	+
LEVEL	-----	12 O'CLOCK
CH1 (Y); CH2 (X)		
◆ POSITION	-----	12 O'CLOCK
VARIABLE	-----	CAL
VOLTS/DIV	-----	5V/DIV
AC-GND-DC	-----	GND
HORIZONTAL		
◀▶ POSITION	-----	12 O'CLOCK
VARIABLE	-----	CAL
SWEEP TIME/DIV	-----	0.2ms/DIV
× 10MAG	-----	OFF

Next, after checking the power source voltage ratings, switch the POWER control on. The pilot lamp will light up, and a trace line will appear in 10 to 15 seconds. Check to see that rotating the INTENSITY control to the right increases trace brightness, and rotating it to the left decreases brightness. Then rotate the INTENSITY control all way to left and extinguish the trace line to being preheating. For the most accurate measurement results, it is necessary to preheat the oscilloscope for about 30 minutes. However, if you intend only to display waveforms, preheating is not necessary.

2. After preheating, adjust the INTENSITY control so that the trace line is easy to see, and adjust the FOCUS control to attain the clearest display image possible. Then use the TRACE ROTA control to bring the trace line parallel with the horizontal graduation lines.

3. Plug the probe into the INPUT jacks of each channel. Set the AC-GND-DC control at DC and the **VERTICAL** MODE control at CH1. Plug the CH1 probe to the CAL terminal and set the VOLTS/DIV control at 20mV/DIV. Adjust the  $\blacktriangle$  POSITION control so that all of the waveform can be seen. With the waveform in this position, carry out probe compensation adjustment using Figure 5 and see section "USE OF PROBE".



- ① Left wave shape: over modified
- ② Middle wave shape: modified inadequately
- ③ Right side wave shape: proper

Please properly adjust capacitance compensation trimmer of probe to obtain shape wave ③

Figure 5. Probe Compensation Adjustment

Set the **VERTICAL** MODE control to CH2 and carry out compensation adjustment of the Channel 2 probe. After compensating the 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 probes will cause changes in compensation adjustments.

4. Return the **VERTICAL** MODE control to CH1, each channel's AC-GND-DC control to the AC setting, each channel's VOLTS/DIV control to 5V/DIV.  $\blacktriangle$  POSITION and  $\blacktriangleleft \blacktriangleright$  POSITION controls to 12 o'clock. This is what we refer to as the "initial setting" condition.

## OPERATING PROCEDURES

### SINGLE TRACE OPERATION

#### Alternating Current Display

With the oscilloscope in the initial setting condition (refer to Section 5 of CHECKING AND ADJUSTMENT PRIOR TO MEASUREMENT), display on the CRT screen the signal applied to the CH1 INPUT terminal. Adjust the signal amplitude to an easy to measure size by changing the VOLTS/DIV control setting. The CH1 VARIABLE control may be rotated to change the amplitude in continuous fashion. However, if this is not necessary leave the setting at CAL.

Next, adjust the horizontal SWEEP TIME/DIV control to attain an easy to measure display. Make sure to leave the VARIABLE control setting at CAL.

Whenever the waveform begins to destabilize, it is necessary to use the triggering operation. Rotating the trigger LEVEL control left or right will stabilize the waveform.

Depending on the type of signal, switching the SLOPE control will also give you clearer displays. These kinds of operations using the trigger LEVEL and SLOPE control are referred to as Setting the Trigger Point. The oscilloscope begins sweeping from pre-set trigger points.

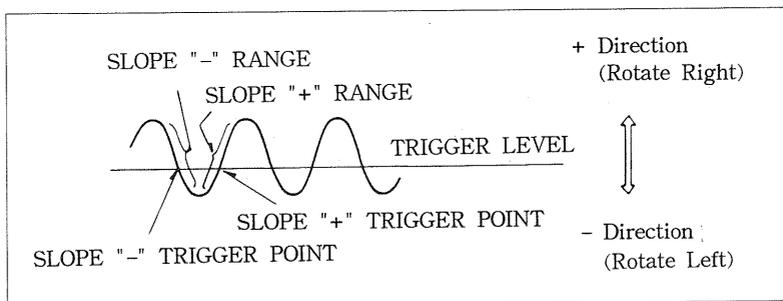


Figure 6. Relationships LEVEL and SLOPE

When inputting low frequency signals or slow occurrence rate signals, switch the **TRIGGERING** MODE control to the NORM setting. Even though the waveform display may disappear from the CRT screen when signal amplitudes are relatively small or the trigger point setting is inappropriate. The NORM setting will allow more stable triggering than can be attained in the AUTO setting.

## Composite Video Signal Display

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

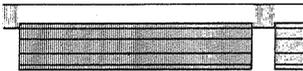
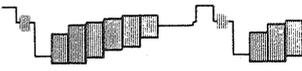
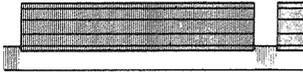
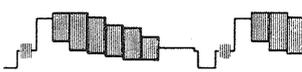
SLOPE	TV-FRAME	TV-LINE
+		
-		

Figure 7. Relationship between TRIGGERING MODE and SLOPE

## DUAL TRACE OPERATIONS

### Switching Vertical Operation Modes

When the **VERTICAL** MODE control is set at CH2, the CRT screen will display the signal applied to the channel 2 INPUT terminal. The amplitude can be altered using the channel 2 VOLTS/DIV control. The procedures for switching the sweep time and setting the trigger point are the same as for channel 1.

When the **VERTICAL** MODE control is set at ALT, the CH1 and CH2 signals are displayed one after the other for each sweep.

When the **VERTICAL** MODE control is set at CHOP, the CH1 and CH2 signals are sub-divided according to time and displayed on the screen.

When the **VERTICAL** MODE control is set at ADD, CH1 and CH2 signals will be combined (CH1+CH2) on the CRT display screen. If the CH2 INV control is pressed in this condition the differential (CH1-CH2) of the two channels will be displayed. In order to measure displayed waveforms at the ADD setting, it is necessary that the VOLTS/DIV control settings be the same for both channels.

### Switching Trigger Source

When the **VERTICAL** MODE control is set at CH1, ALT, CHOP, or ADD and the SOURCE control is set at VERT MODE, the signal source for the trigger becomes channel 1. At this time, if the CH1 signal is too complicated, making the trigger point too difficult, switch the SOURCE control to the CH2 setting. The CH2 signal will be simple enough for a stable trigger point setting. However, when the waveforms of both channels are too complicated, use an external source to set the trigger point.

If signals having different frequencies are input to CH1 and CH2, set the **VERTICAL** MODE selector to ALT and SOURCE selector to VERT MODE. Input signals to CH1 and CH2 are used as the trigger signal sources, which alternate in every sweeping. Thus, both signals are triggered.

### External Trigger

Set the Source control at EXT and apply a signal to the EXT.TRIG terminal. It is necessary that this signal have a fixed timing relationship to either CH1 or CH2. Also, in order to simplify the trigger point setting process, you should use as simple an external signal as possible.

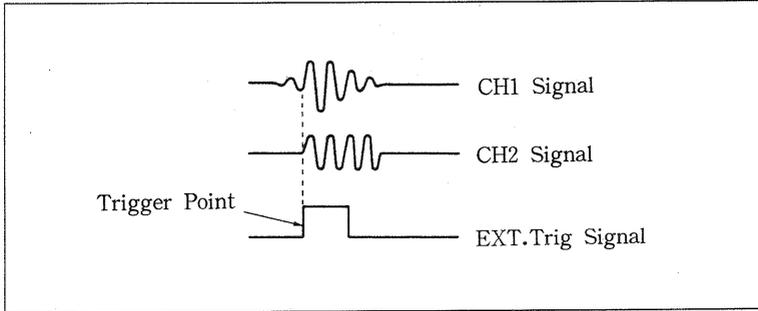


Figure 8. EXT.TRIG

### Line Trigger

When the CH1 or CH2 signal is synchronized with a commercial-use power source frequency, setting the SOURCE control at LINE will stabilize the trigger.

## SWEEP MAGNIFICATION OPERATION

When carrying out measurement by magnifying a portion of the displayed waveform in terms of time, increasing sweep speed may cause the waveform portion to be measured to disappear from the screen. When this happens, waveform measurement can still be done by magnifying the sweep.

Work the ◀▶ POSITION control to move the waveform portion to be magnified to the middle of the CRT display screen. Then press the × 10MAG control to magnify the waveform 10 times in the horizontal direction.

## 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. With X-Y operation, signals applied to the CH1 INPUT terminal are deflected on the Y-axis, signals applied to the CH2 INPUT terminal are deflected on the X-axis, and Lissajous patterns makes it possible to find out phase differences between the two signals and find out their relative frequency proportion.

## APPLICATIONS

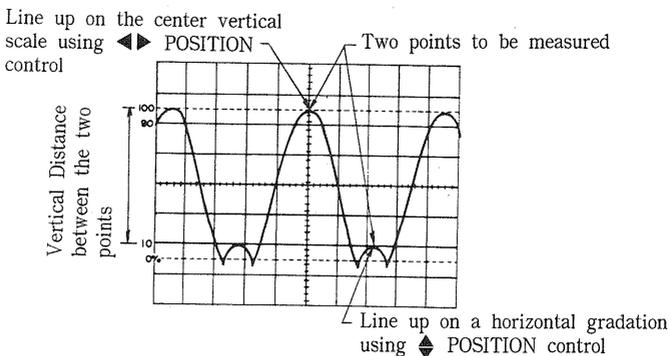
Because both the vertical and horizontal axis of the oscilloscope are calibrated, the oscilloscope is capable of not only displaying waveforms but can also quantitatively measuring voltage or time. When performing these latter measurements, rotate the three VARIABLE controls (CH1 [Y-axis], CH2 [X-axis] and horizontal) all the way in the clockwise direction to the CAL setting. All the oscilloscope's VARIABLE controls will click when rotated into their CAL settings.

In addition, the oscilloscope comes with probes. These probes should all be plugged into their proper jacks in order to assure a minimum of interference to the signals you want to measure.

### Measuring Voltage Between Two Points on a Waveform

Use the following procedures for measuring voltage, etc. between two points or from peak to peak on a waveform.

1. Apply a signal to the INPUT terminal and adjust the VOLTS/DIV and SWEEP TIME/DIV controls. Also reset the trigger point if necessary. Set the AC-GND-DC control at AC.
2. Work the  $\blacklozenge$  POSITION control so that one of the points (A) to be measured falls on one of the horizontal graduation lines, while the other points (B) can still be observed on the CRT screen.
3. Work the  $\blacktriangleleft\blacktriangleright$  POSITION control so that point B falls on the vertical scale at the center of the CRT screen.
4. Measure the vertical distance between the two points and multiply that value by the VOLTS/DIV setting. When using a probe, also multiply the value by the probe's attenuation rate.



Voltage between 2 points = Vertical distance (div) x VOLTS/DIV setting x Probe attenuation rate

Figure 9. Measuring the Voltage Between Two Points

### EXAMPLE

In Figure 9, the vertical distance between the two points is 4.4 div. If the VOLTS/DIV control is set at 0.2V/div and a PC-41 probe ( $\times 10$  setting) is used, the voltage is calculated as follows:

$$\text{Voltage between 2 points} = 4.4(\text{div}) \times 0.2(\text{V/div}) \times 10 = 8.8\text{V}$$

### Common-Mode Rejection

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

1. Apply the whole signal (including its unnecessary components) to the CH1 INPUT terminal. Now apply the component you want eliminated to the CH2 INPUT terminal.
2. Set the **VERTICAL** MODE control to ALT or CHOP. Set the SOURCE control at CH2. Set the trigger point at the CH2 signal, and verify that CH2 contains the unnecessary component of CH1.
3. Press the CH2 INV switch, and verify that the CH2 signal represents the unnecessary component in reverse polarity. When the **VERTICAL** MODE control is set at ADD under these conditions, only the necessary signal components will be displayed on the CRT screen.

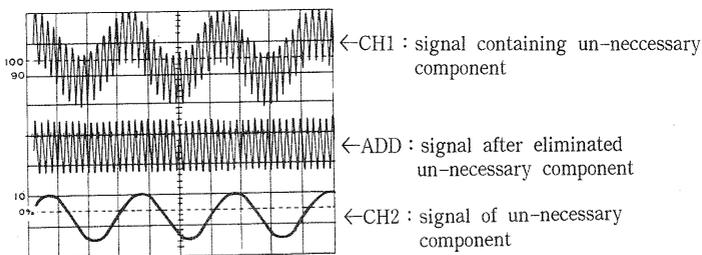


Figure 10. Common-Mode Rejection

Note:

Elimination capabilities vary with the size of the unnecessary component. In order to attain the best results, display the CH2 signal with a slightly higher VOLTS/DIV setting. After pressing the CH2 INV switch, and activating the ADD function, adjust the VARIABLE control of CH2 to get a good waveform. Also, after pressing the CH2 INV control and switching to the ADD setting, the displayed waveform may move up or down. Move it back to the display position using the  $\blacklozenge$  POSITION control for CH2.

## Measuring Direct Current (DC) Voltage

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

1. Apply the signal to the INPUT terminal. Work the VOLTS/DIV and SWEEP TIME/DIV controls to display the waveform at an easy to see size. Also adjust the LEVEL control if necessary.
2. Set the **TRIGGERING** MODE control to AUTO, and then set AC-GND-DC to GND. The trace will be displayed on the CRT screen. This trace will become the ground potential. Work the  $\blacktriangle$  POSITION control to bring the trace in line with one of the horizontal graduation lines. Usually signals with positive potential are lined up at the 0% graduation and signals of negative potential at the 100% graduation. Once lined up, the trace's position will become the reference potential, so do not touch the  $\blacktriangle$  POSITION control during the measurement process.
3. Set the AC-GND-DC control at DC. The signal will be displayed on the CRT screen with the direct current component intact. If in this case either the VOLTS/DIV or reference potential setting is inappropriate, the waveform may disappear from the display screen. Make sure to check these settings.
4. Measure the potential using the procedure for measuring the voltage between two points. The potential sign will be plus if above the reference and minus if below the reference.

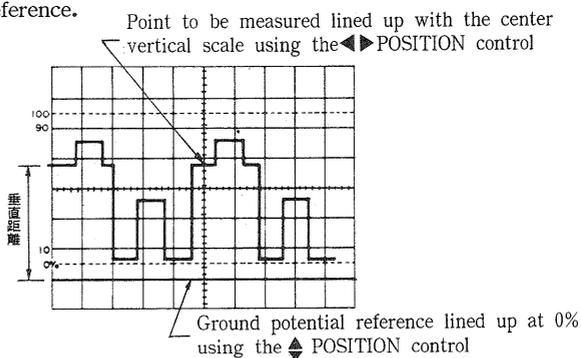


Figure 11. DC Voltage Measurement

5. If there is only signal to be measured, apply it to CH1, and work the CH2  $\blacktriangle$  POSITION control so that CH2 displays the ground potential. If the **VERTICAL** MODE control is set at either ALT or CHOP after this adjustment is made, 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.

### Measuring Signals with Low Frequency Components

When the oscilloscope's AC-GND-DC control is set at 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 40 to 50Hz range. Therefore, when measuring frequencies below this range switch the AC-GND-DC control to the DC setting.

If, however, you are using a probe, accurate measurements of frequencies as low as 4 to 5Hz can be realized at AC.

### Measuring Signals with High Frequency Components

Always use a probe (  $\times 10$  position) 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, make sure to connect the ground lead clip to the ground potential lying closest to the signal to be measured.

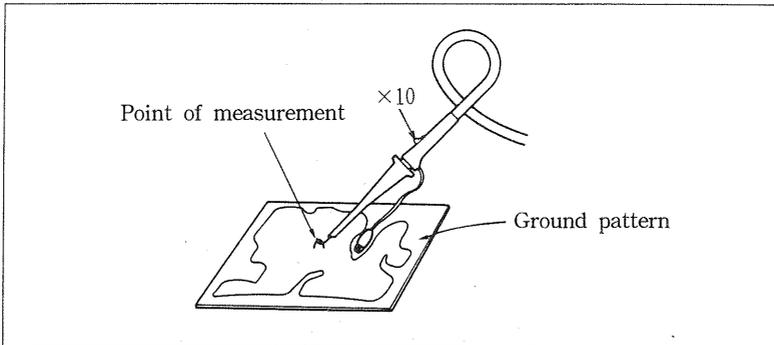
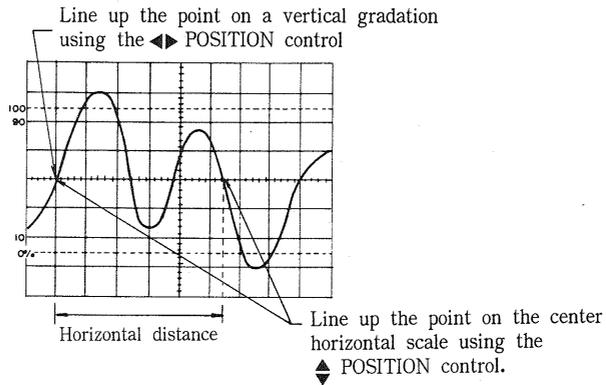


Figure 12. Measuring Signals with High Frequency Components

### 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. Work the ◀ ▶ POSITION control to bring one point to be measured in line with a vertical graduation line. Then work the ◀ ▶ POSITION control to bring the other point to be measured in line with the horizontal scale in the middle of the CRT display screen.
3. Measure the horizontal distance between the two points. Multiply this value by the SWEEP TIME/DIV setting value. If the × 10MAG function has been activated, multiply the value by 1/10.



Time between two points = horizontal distance (div) × SWEEP TIME/DIV setting value

When using the × 10 MAG function:

Time between two points = horizontal distance (div) × SWEEP TIME/DIV setting value × 1/10

Figure 13. Time Measurement

#### EXAMPLE:

In the case of Figure 13, the horizontal distance between the two points is 5.4 div. If the SWEEP TIME/DIV setting value is 0.2 ms/div, the time between the two points may be calculated as follows.

$$\text{Time between two points} = 5.4\text{div} \times 0.2\text{ms/div} = 1.08\text{ms}$$

If the × 10MAG function is in use:

$$\begin{aligned} \text{Time between two points} &= 5.4\text{div} \times 0.2\text{ms/div} \times 1/10 = 0.108\text{ms} \\ &= 108 \mu\text{s} \end{aligned}$$

## Measuring Frequencies

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

1. Measure the time of one cycle
2. Calculate the reciprocal value of the period found.

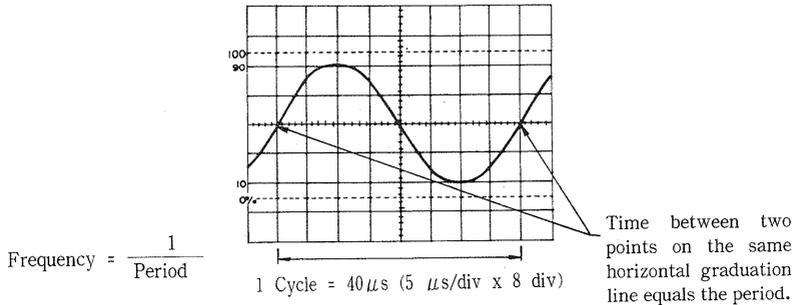


Figure 14. Measuring Frequency

EXAMPLE:

In the case of Figure 14, the period found comes to  $40 \mu\text{s}$ . This frequency is calculated as follows:

$$\text{Frequency} = \frac{1}{40 \times 10^{-6}} = 25 \times 10^3 = 25\text{kHz}$$

## MAINTENANCE

### WARNING

Before performing the following procedures, always unplug the power cord.

### 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 Figure15.)

[CS-4125]

100V, 120V areas: F800mA

220V, 230V areas: F500mA

(F: Quick acting fuse)

[CS-4135]

100V, 120V areas: T500mA

220V, 230V areas: T315mA

(T: Time lag fuse)

### CHANGING VOLTAGE REQUIREMENTS

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 120V is to be changed into 220 or 230V:

[CS-4125]: 800mA quick acting fuse should be replaced with a 500mA quick acting fuse.

[CS-4135]: 500mA time lag fuse should be replaced with a 315mA time lag fuse. (See Figure 15.)

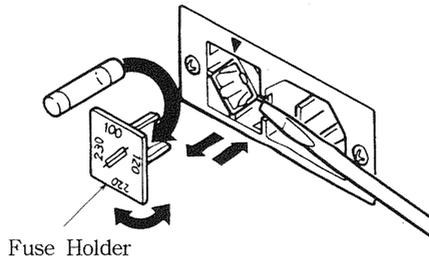


Figure 15. Fuse Replacement and Changing Voltage Requirements

## CLEANING

The panel, knobs, cover and other parts of this oscilloscope will become dirty as this oscilloscope is used for long. When they become dirty, clean them as shown below.

1. Disconnect the power cord plug from the AC outlet.
2. Wipe dirty parts lightly with gauze or soft cloth moistened with neutral detergent diluted with water.
3. Moisten cloth with diluted neutral detergent, then wring detergent from the cloth lightly by hand. If the cloth is soaked with too much detergent, the panel or case remains wet after cleaning and residual detergent may penetrate into the product, causing damages to the inner parts.
4. After wiping the oscilloscope, leave it until it dries completely. Do not attempt to turn on the power immediately after wiping.
5. Never use thinner or organic solvent.

## SPECIFICATIONS

I T E M	CS-4125	CS-4135	
CRT :			
Type :	Rectangular with internal graticule		
Acceleration Voltage:	Approx. 2 kV	Approx. 12 kV	
Display Area :	$8 \times 10$ div (1 div = 10mm)		
VERTICAL AXIS (CH1 and CH2) :			
Sensitivity :	$1\text{mV}, 2\text{mV/div} \pm 5\%, 5\text{mV/div to } 5\text{V/div} \pm 3\%$		
Attenuator :	1-2-5 step, 12 ranges with fine adjustment		
Input Impedance :	$1\text{M}\Omega \pm 2\%$ , Approx. 22 pF	$1\text{M}\Omega \pm 2\%$ , Approx. 23 pF	
Frequency Response :			
5 mV/div to 5 V/div	DC	DC to 20 MHz, within - 3 dB	DC to 40 MHz, within - 3 dB
	AC	10 Hz to 20 MHz, within - 3 dB	10 Hz to 20 MHz, within - 3 dB
1 mV/div , 2 mV/div	DC	DC to 5 MHz, within - 3dB	
	AC	5 Hz to 5 MHz, within - 3dB	
Rise Time :			
5 mV/div to 5 V/div : 1 mV/div, 2mV/div :	Approx. 17.5 ns (20 MHz)	Approx. 8.75 ns (40 MHz)	
	Approx. 70 ns (5 MHz)		
Crosstalk :	- 40 dB maximum		
Operating Modes :	CH1 : CH1 single trace CH2 : CH2 single trace ALT : Alternating display of two signals CHOP : Chopped display of two signals ADD : Display of combined CH1 + CH2 waveforms		
CHOP Frequency :	Approx. 150 kHz		
Channel Polarity :	Normal or inverted, channel 2 only inverted		
$\Delta$ Maximum Input Voltage:	$800\text{Vp-p}$ or 400 V (DC + ACpeak)		
HORIZONTAL AXIS :			
Sensitivity :	Same as vertical axis (CH2)		
Input impedance :	Same as vertical axis (CH2)		
Frequency response :	DC : DC to 500 kHz, within - 3 dB		
	AC : 10Hz to 500kHz, within - 3 dB		
X-Y Phase Difference :	$3^\circ$ or less (at 50 kHz or less)		
Operating Modes :	X-Y operation is selectable with MODE switch CH1 : Y-axis CH2 : X-axis		
$\Delta$ Maximum Input Voltage :	Same as vertical axis (CH2)		

I T E M	CS-4125	CS-4135	
SWEEP SYSTEM :			
Sweep Modes :	NORM : Triggered sweep		
	AUTO : Auto free run with no signal input		
Sweep Time :	0.5 $\mu$ s/div to 0.5 s/div $\pm$ 3%, (0.2 $\mu$ s/div : UNCAL)	0.5 $\mu$ s/div to 0.5 s/div $\pm$ 3%, (0.2 $\mu$ s/div : UNCAL)	
	1-2-5 step, 20 ranges with fine adjustment		
Sweep Magnification :	10 $\times$ magnification, $\pm$ 5% (20ns/div : UNCAL)	10 $\times$ magnification, $\pm$ 5%	
Linearity	$\pm$ 3%, (0.2 $\mu$ s/div : UNCAL) ( $\pm$ 5% at $\times$ MAG, 20 ns/div : UNCAL)	$\pm$ 3%, ( $\pm$ 5% at $\times$ 10 MAG)	
TRIGGERING :			
Triggering Source :	VERT MODE : Input signal selection with VERTICAL MODE control		
	CH1 : CH1 input signal		
	CH2 : CH2 input signal		
	LINE : Commercial-use power source		
	EXT : Signal input through EXT. TRIG terminal		
External Trigger :			
Input impedance :	1M $\Omega$ , Approx. 22 pF		
$\Delta$ Maximum input voltage:	800 Vp-p or 400 V(DC + ACpeak)		
Trigger Coupling Modes :	AUTO, NORM and FIX are capacitively coupled		
	TV-FRAME : Vertical sync pulses of a composite video signal are selected for triggering.		
	TV-LINE : Horizontal sync pulses of a composite video signal are selected for triggering.		
Trigger Sensitivity :			
CS-4135			
		SOURCE	
MODE	SIGNAL FREQ.	VERT, CH1, CH2	EXT
NORM	10Hz to 20 MHz	1.5 div	0.25 V p-p
	20MHz to 40MHz	2 div	0.3 V p-p
AUTO	Same as above specs at 50 Hz or above		
TV-F,TV-L	Composite video Signal	1 div	0.2 Vp-p
FIX	50 Hz to 40 MHz	2 div	0.5 Vp-p



I T E M	CS-4125	CS-4135
ENVIRONMENTAL :		
	Indoor Use Only	
	Altitude up to 2000 m	
	OVERVOLTAGE CATEGORY II	
	POLLUTION DEGREE 2	
LINE VOLTAGE/FREQUENCY :		
	AC 100 V (90V to 110V), AC 120 V (108V to 132V), AC 220 V (198V to 242V), AC 230V (207V to 253V), 50/60Hz	
POWER CONSUMPTION :		
	Max. 35 W	Max. 40 W
ACCESSORIES :		
Probe :	PC-41 × 2	
Instruction manual :	1	
Power cord :	1	
Replacement fuse :	1	
REGULATORY INFORMATION :		
EMI :	EN55011(1991) CLASS B	
Immunity :	IEC801-2(1991) 8kVAD	
	IEC801-3(1984) 3V/m	
	IEC801-4(1988)	

PC-41 probe specifications :

(The table below shows the specifications when an input resistance of  $1M\Omega \pm 1\%$  is connected to the oscilloscope.)

I T E M S	× 1	× 10
Input resistance	$1M\Omega \pm 2\%$	$10M\Omega \pm 2\%$
Input capacitance	200 pF or less (Probe only)	$22\text{ pF} \pm 10\%$
Attenuation ratio	1/1	$1/10 \pm 3\%$
Frequency range	DC to 6 MHz ( $\pm 3\text{ dB}$ )	DC to 60 MHz ( $\pm 3\text{ dB}$ )
Applicable capacitance	—	20 to 45 pF
Input withstand voltage	DC 600 V	

■ The above specifications are subject to change without notice.

## OPTIONAL EQUIPMENT

The oscilloscope offers an optional accessory bag. This bag attaches to the top side of the oscilloscope housing and provides a storage space for two probes and the instruction manual. Install the probe pouch as follows:

### How to Attach the Accessory Bag(MC-78)

1. Unsnap the probe pouch from the retainer plate.
2. Align the retainer plate with 4 holes on the top side of the case, with 4 snaps at the top.
3. Attach the 4 corners of the retainer plate to the oscilloscope case with the 4 nylon rivets supplied.
4. Attach the pouch to the retainer plate using the snap fastener.

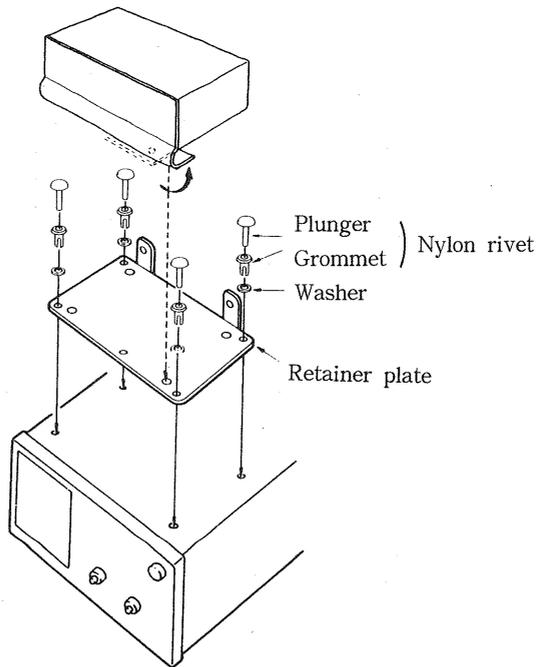


Figure 16. Attaching the Accessory Bag

KENWOOD CORPORATION  
14-6 Dogenzaka 1-chome, Shibuya-Ku, Tokyo 150, Japan

KENWOOD CORPORATION  
14-6 Dogenzaka 1-chome, Shibuya-Ku, Tokyo 150, Japan