5MHz OSCILLOSCOPE

CO-1305

INSTRUCTION MANUAL

SAFETY

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 does 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.

Voltage Change

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

A product of

KENWOOD CORPORATION

14-6 Dogenzaka 1-chome, Shibuya-ku Tokyo 150 Japan

PRECAUTIONS FOR HANDLING

1. Inspect for the supply voltage before using the product. The rated voltage of the product is indicated on its rear panel. Note that use on improper voltage will cause troubles or damages. If you make sure that the supply voltage is proper, connect the power cord plug to the wall socket.
2. The product has internal circuits that carry high voltage. Never detach the case.
3. Do not use the product in the following places:
   - A place exposed to the direct sunlight
   - A place exposed to high temperature and/or high humidity
   - Near equipment or device which produces strong magnetic force and/or impulse voltage
4. Do not apply voltage that exceeds the rating to any input terminal.
   Between VERT. INPUT terminals ③ and ⑦ :
   ⚠ 300V (DC+AC peak) or 600Vp-p
   Between EXT. SYNC. and HOR. INPUT terminals ④ and ⑤ : 50V (DC+AC peak) or 100Vp-p
5. The trace line is subject to tilt under the influence of the earth magnetism, depending on in what direction the product is places. Adjust the angle of the trace line in the condition where the product is used.

SPECIFICATIONS

[CRT] : 75ARB31

[VERTICAL AXIS]

Deflection sensitivity	: Approx. 10mV/div.
Frequency response	: DC:DC to 5MHz or more (-3dB) AC:2Hz to 5MHz or more (-3dB)
Input resistance & capacitance	: 1MΩ ±2%, 50pF or less
Attenuator	: 1, 1/10, 1/100 and GND (Step-to-step error: 5% or less)
Gain control	: Step-less control over 22dB
Max. input voltage	: 300V (DC+AC peak) or 600Vp-p

[HORIZONTAL AXIS]

Deflection sensitivity	: 300mV/div. or more
Frequency response	: DC to 250kHz (with EXT.GAIN at the maximum) DC to approx. 30kHz (with EXT.GAIN at the 1/2 point)
Input resistance & capacitance	: 1MΩ (±20%), 40pF or less (Provided the SYNC switch is set to INT)
Attenuator (EXT.GAIN)	: Step-less attenuation to 0
Max. input voltage	: 50V (DC+AC peak) or 100Vp-p

[SWEEP CIRCUIT]

Sweep frequency	: 10Hz to 100kHz (4 ranges plus fine adjustment)
Sweep linearity	: 5% or less
Synchronization	: Synchronous sweep, internal negative synchronization and external synchronization
Synchronization amplitude	: Internal: Wave amplitude on CRT over 1 division (4MHz to 5MHz: 2 divisions or more) External: 2Vp-p or more

[INTENSITY MODULATION]

Sensitivity	: 25Vp-p or more

[SUPPLY VOLTAGE]

100/120/220/240VAC±10%, 50/60Hz (Max. 250VAC)

[POWER CONSUMPTION] Approx. 14.5W

[DIMENSIONS AND WEIGHT]

Width : 130mm (130mm)
Height: 190mm (213mm)
Depth : 280mm (307mm)
Values enclosed in parentheses indicate the dimensions including protrusions.
Weight: Approx. 3.5kg

[ACCESSORIES] Instruction manual: 1 copy
Input cord (CA-46): 1
Replacement Fuse : 2

FEATURES

- ○The vertical axis has high sensitivity of 10mV/div. A wide frequency response ranges over 5MHz.
- ○DC amplifiers used for both the vertical and horizontal axis enable external low-speed sweep below 1kHz.
- ○Low power consumption and heat generation offer stable operation.
- ○The angle of the trace line may be controlled easily on the rear panel.
- ○Small in size and light in weight for portability.
- ○Provided with an external synchronization signal input terminal.

SWITCHES AND CONTROLS

1. PANELS

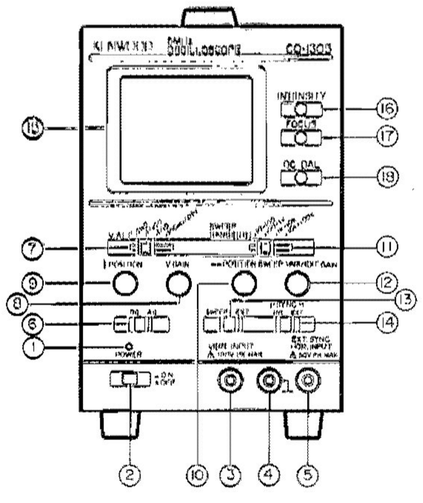
The following describes the switches and controls on the panels. See the profile shown in Figure 1.

[Front Panel]

① Pilot lamp The pilot lamp is on when the CO-1305 is ready for operation.

② POWER ▂ ON/ ▀ OFF switch Press the switch to turn on the power (button depressed). Press it again to turn off the power (button released).

③ VERT. INPUT terminal Input vertical signal to this terminal.



④ ⏚ (GND) terminal Connect this terminal to the the ground.

⑤ EXT. SYNC/HOR. INPUT terminal Input external synchronization signal and external horizontral signal to these terminals. Connect the GND line to the GND terminal ④.

⑥ AC-DC selector switch Selects vertical signal coupling. If this switch is set to DC, input signals are DC coupled, allowing observation of signals with DC components. If it is set to AC, input signals are AC coupled, allowing observation of AC signals only containing no DC components.

⑦ V.ATT A vertical attenuator. Attenuation may be selected from 1/1, 1/10 and 1/100. At the GND position, input signal to the vertical amplifier is grounded and terminal ③ opens.

⑧ V. GAIN control Controls the gain of the vertical axis. Adjust the wave amplitude on the CRT properly with this control. If it may not be adjusted completely, use the V. GAIN and V. ATT ⑦ together.

⑨ ▲▼ POSITION control Vertical position controls, which move the waveform up and down on the CRT.

⑩ ◀▶ POSITION control Horizontal position controls, which move the waveform to the right and left on the CRT.

⑪ SWEEP RANGE selector switch Selects the sweep frequencies. Adjust the number of wave peaks displayed on the CRT for easy observation using the SWEEP RANGE and SWEEP VARI ⑫. Values such as "10~100", "100~1k", etc. indicate the sweep frequencies.

⑫ SWEEP VARI/EXT. GAIN control A fine control of the sweep frequency and gain control of the external horizontal signals. If the SWEEP/EXT. ⑬ is set to the SWEEP position, the SWEEP VARI/EXT. GAIN control serves as a fine control of the sweep frequency. If the SWEEP/EXT. ⑬ is set to the EXT position, it controls the gain of the signal input to terminal ⑤ and varies the horizontal amplitude on the CRT. Note that the horizontal frequency

response differs with the position of this control. (Refer to SPECIFICATIONS above.)

⑬ SWEEP/EXT. At the SWEEP position, internal sweep mode is selected. At the EXT position, the horizontal amplifier is connected with terminal ⑤ via EXT. GAIN ⑫ for horizontal input operation, regardless of the position of the SWEEP RANGE switch ⑪.

⑭ SYNC INT./EXT. At the INT position, synchronization is made with the input voltage. At the EXT position, synchronization is made with a signal input through terminal ⑤.

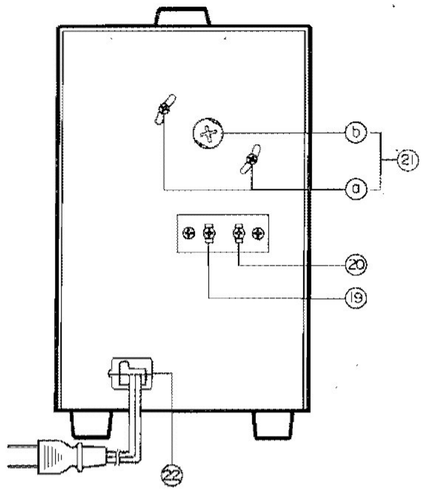
⑮ Scale The scale has divisions of 0, -3dB, -6dB, -10dB and -20dB, which are convenient for measuring frequency responses of amplifiers, etc. An amplitude of 6 divisions corresponds to 0dB, with respect to the REF mark as the reference point.

⑯ INTENSITY control Controls the intensity of waveform displayed on the CRT. Use the adjusting screwdriver to adjust this control.

⑰ FOCUS control Controls the focus of waveform displayed on the CRT. Use the adjusting screwdriver to adjust this control for clear waveform display.

⑱ DC BAL control A DC balance control. Set the V. ATT ⑦ to the GND position, and adjust this control with the adjusting screwdriver so that the trace line does not move by rotating the V. GAIN control ⑧ clockwise and counterclockwise.

[Rear Panel]



⑲&⑳ Z AXIS INPUT terminals Intensity modulation terminals. Intensity modulation operates on the peak voltage of approx. 25V. Positive signal increases intensity. Negative signal decreases intensity or extinguishes the trace line. Intensity modulation does not operate on DC voltage. Terminal ㉒ is a GND terminal.

㉑ TRACE ROTATION control Controls the tilt of the horizontal trace line. If the trace line is tilted by the earth magnetism, etc., loosen the screw ⓐ, place the CO-1305 in the direction in which it is used actually, insert a screwdriver into the slit ⓑ, and adjust the trace line to the scale. Then, tighten the screw ⓐ with care not to tilt the adjusted horizontal trace line.

㉒ Power cord

2. GENERAL OPERATIONS

Input a signal whose waveform is to be observed into the VERT. INPUT terminals ③ and ④. Connect the red wire of the cable to ③ and the black wire to ④. Adjust the amplitude of the displayed waveform to approx. 6 divisions with ⑦ and ⑧. Set ⑪ to the range in which the frequency of the signal is included or the next range on the left. Rotate ⑫ to increase or decrease the number of peaks for easy observation. (Three peaks or so are easy to observe, generally.) If the wave consists of a single peak, the time axis frequency is the same as the signal frequency. If the wave consists of five peaks, the time axis frequency is 1/5 the signal frequency. If DC components of the input signal shall be measured or a signal below 10Hz shall be observed, set switch ⑥ to the DC position. If only AC components shall be observed, set the switch to the AC position. The polarity of the displayed wave is positive (+) in the upper part of the CRT vertically and positive (+) on the left horizontally. Adjust the wave position to the CRT center with ⑨ and ⑩. If the signal contains DC components, the wave moves up or down, depending on the polarity of the DC components. If it may not be moved into the display area by rotating ⑨, the DC component voltage is too high. In such a case, change ⑦ or ⑧ to the left position or rotate counterclockwise to a proper position.

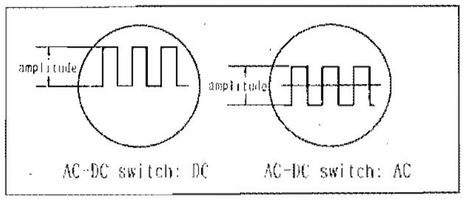


Figure 1 Measurement of DC and AC components

To find voltage, set the sensitivity of the CO-1305 to 10mV/div., 50mV/div., or 100mV/div. and read the amplitude of the wave on the scale. The voltage may be found from the distance using the following equation:

Amplitude × sensitivity = voltage

(For example, 3.8 divisions × 10mV/div. = 38mVp-p)

Or, adjust the amplitude of the wave properly, measure the sensitivity of the CO-1305 in that condition, and find the voltage from the amplitude and sensitivity using the equation [amplitude×sensitivity =voltage] likewise. The third way is finding voltage through proportional calculation using a wave of know voltage. For example, if a signal of 3Vp-p has an amplitude of 4 divisions (at that time, the sensitivity of the CO-1305 is 3Vp-p÷4 divisition= 0.75V/division) and the amplitude of an unknown wave is 6 divisions, the voltage of the unknown wave is found as follows:

$$\frac{3Vp\text{-}p}{4\ div.} = \frac{xVp\text{-}p}{6\ div.} \quad \text{or.} \quad \frac{3Vp\text{-}p \times 6\ div.}{4\ div.} = xVp\text{-}p$$

Thus, x=4.5Vp-p

All the voltages found as shown above are peak-to-peak values. In general, voltages are indicated in effective values. If necessary, voltages shall be converted into effective values. However, note that the relationship between amplitudes and effective values differs with the shapes of waveforms. If DC voltage shall be measured, move the trace line.

Set ⑥ to the DC position. The amplitude represents the effective voltage without any conversion.

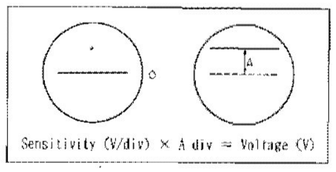


Figure 2 Position of Trace Line in DC Voltage Measurement

3. MEASUREMENT USING LISSAJOUS' PATTERNS

1) Frequency Measurement

Frequency of a signal may be measures using Lissajous' patterns. Set ⑬ to the EXT position, connect a signal generator between ④ and ⑤ and adjust the signal amplitude to approx. 6 divisions. Input a signal of unknown frequency between ③ and ④, and adjust the amplitude displayed on the CRT to approx. 6 divisions. As the frequency of the signal generator is changed gradually, the waveform shown is Figure 3 appearts at a certain point.

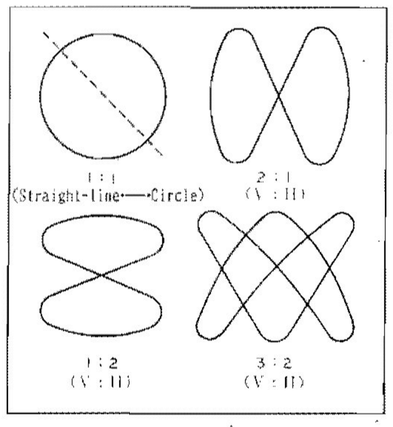


Figure 3 Lissajous' Patterns

In principle, if the line is formed into a circle, both frequencies have the ratio of 1:1, that is, the frequency of the signal generator is the same as the frequency of the input signal. Figures displayed on the CRT become stationary only when one frequency is a multiple of the other. Find the frequency through calculation.

2) Measurement of Phase Difference

Like 1) above, input two signals of the same frequency (R and L stereophonic signals, for example) into HOR. and VERT. If they have the same phase, a straight line from the upper left position is displayed on the CRT. As their phases shift, the straight line is made into an ellipse. If the phase shift is 90°, a circle is displayed. Provided the horizontal amplitude is B and the horizontal distance of the waveform at the center is A, the phase difference θ is expressed as follows:

$\sin\theta = A/B$

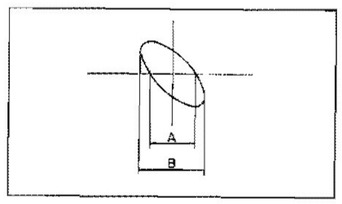


Figure 4 Phase Difference Measurement using Lissajous' Pattern

If the EXT. GAIN control ⑫ is rotated fully clockwise in phase difference measurement, the vertical and horizontal phase difference of the CO-1305 itself is zeroed up to approx. 2kHz. Note that the frequency range over 2kHz is subject to phase shift. If ⑫ is changed, the range where the vertical and horizontal phase difference is zeroed is reduced to approx. 500Hz at the 1/2 point.

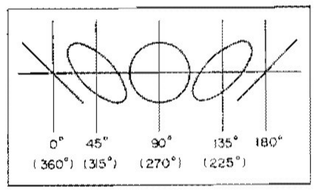


Figure 5 Representative Lissajous Patterns

MAINTENANCE

1. Replacing Fuse

If the pilot lamp does not go on and no trace line is displayed on the CRT though the POWER switch of the CO-1305 is set ON, the fuse may have blown out.

The fuse of the CO-1305 is incorporated inside. If it has blown out, the user cannot replace it. We are sorry to trouble you, but please contact your dealer or our distributor.

2. Changing Supply Voltage

The factory delivered voltage rating. Marked in the SET table on rear panel of this oscilloscope.

Voltage requirements cannot be changed in this oscilloscope. If you need to change voltage requirements, contact your dealer or our distributer.