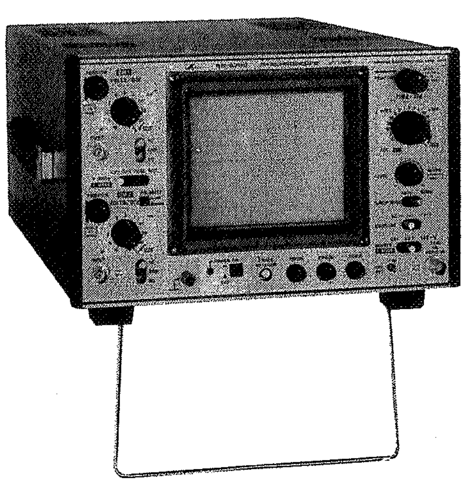

INSTRUCTION MANUAL

OSCILLOSCOPE

SS-5702

G5066-421751(I)

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General

The SS-5702 is a compact and lightweight oscilloscope which covers a frequency bandwidth from DC to 20 MHz. The SS-5702 is designed for dual-trace measurement respectively.

The vertical deflection factor is from 5 mV/div to 10 V/div in a 1-2-5 sequence.

The trigger system provides an internal triggering, external triggering and TV triggering for TV composite signal.

The horizontal deflection system provides sweep rates from 0.5 μS/div to 0.2 S/div in a 1-2-5 sequence, 5 times sweep magnification (maximum sweep rate becomes 0.1 μS/div) and external horizontal/X-Y operation for Lissajou's pattern.

The cathode-ray tube has a viewing area of 8 divisions (vertical) by 10 divisions (horizontal)and high intensity quantitative measurement is possible by means of the stable accerelating voltage of 2 kV.

Internal circuit are designed as a full solid-state structure, and stability and reliability are ensured.

Specification

Cathode-Ray Tube (CRT)

Graticule: 8 div X 10 div (1 div = 10 mm)
Internal graticule parallax free

Phosphor: B31 (standard)
P7, B11 (option)

Accelerating Potential
Apporoximately 2kV

Vertical Deflection System

Display Mode: Channel1, Channel2, Dual display of Channel 1 and Channel 2, Added display of Channel 1 and Channel 2
(In the dual mode, setting the sweep rate to a range lower than 1 mS/div allows chopped display and setting it to a range higher than 0.5 mS/div permits alternate display
Chopped repetition rate:
100 kHz ±50%

Deflection Factor: POSITION is pushed (X 1):
5 mV/div to 10 V/div in 11 calibrated steps in a 1-2-5 sequence
5 mV/div to 25 V/div continuously variable with control
Accuracy : ± 4% (10 °C to 35° C)
POSITION is pulled (PULL X 5 GAIN):
1 mV/div, 2 mV/div
1 mV/div to 5 mV/div continuously variable with control
Accuracy : ± 5% (10°C to 35°C)

Frequency Response
DC to 20 MHz –3dB
(in center 6 divisions and ranges from 5 mS/div to 0.2 V/div. The AC-coupled lower –3 dB frequency is 4 Hz or less.)

Rise Time: 17.5 nS or less

Input Coupling: AC, GND, DC

Input RC: Direct: 1M Ω± 3%//30 pF ± 3pF
X 1 position of probe:
1 M Ω± 3%//170 pF ±10pF
X 10 position of probe:
10 M Ω±5%//23pF ± 3pF

Maximum Input Voltage
Direct: 250V (dc + peak ac)
X 1 position of probe:
250 V (dc + peak ac)
X 10 position of probe:
600V (dc + peak ac)

Polarity Inversion: Provided only for Channel 2

Triggering

Source: Internal (CH1, CH2), External

Coupling: AC (internal only), DC (external only), TV-V

Slope: Positive-going, Negative-going

External Input RC: 1 M Ω ±10%//30 pF ±5pF

External Maximum Input Voltage
150V (dc + peak ac)

Sensitivity: Shown in Table 1-1.

Table 1-1

Frequency range	Level	
	Internal (displayed amplitude)	External (input voltage)
DC to 20 Hz	–	0.5V
20 Hz to 50 Hz	2.0div	0.5V
50 Hz to 5 MHz	0.5div	0.5V
5 MHz to 15 MHz	1.5div	1.5V
15MHz to 20 MHz	2.0div	2.0V

Notes:

1. Signals below 20 Hz are attenuated in the internal triggering.
2. In the automatic sweep mode, the lower end of triggarable frequency is 50 Hz.
3. In the TV-V triggering, the trigger level is 1 division or more with displayed amplitude of sync signal portion of composite signal.

Horizontal Deflection System

Sweep Mode	Automatic, Triggered
Sweep Rate	0.5 μS/div to 0.2S/div in 18 calibrated steps in a 1-2-5 sequence 0.5μS/div to 0.5S/div continuously variable with control Accuracy I (over center 8 divisions): (10°C to 35°C) 0.5μ S/div to 5mS/div ± 4% 10 mS/div to 0.2S/div ±5% Accuracy II (over any 2 divisions within center 8 divisions): ±10% (10°C to 35°C)
Sweep Magnification	5 times (Maximum sweep rate: 0.1 μ S/div) Accuracy I (over center 8 divisions): (10°C to 35°C) 0.1 μS/div to 1mS/div ±5% 2mS/div to 40mS/div ±7% Accuracy II (over any divisions within center 8 divisions): (10°C to 35°C) 0.1μ s/div to 1mS/div ± 15% 2mS/div to 40mS/div ± 10%

X-Y Operation

Input	X: SOURCE (X MODE) Y: V MODE (Y MODE)
X-Axis	
Sensitivity	Same as Channel 1, Channel 2 or EXT which is selected by SOURCE (X MODE) Accuracy: ±5% (10°C to 35°C)
Frequency Response	DC to 500 kHz –3dB
Input RC	Same as Channel 1, Channel 2 or EXT which is selected by SOURCE (X MODE)
Maximum Input Voltage	Same as Channel 1, Channel 2 or EXT which is selected by SOURCE (X MODE)
Y-axis	V MODE (Same as Y MODE)
X-Y Phase Difference	3° or less DC to 20kHz (When SOURCE is set to CH1 or CH2) DC to 10 kHz (When SOURCE is set to EXT)

Z Axis

Input Voltage	3 Vp-p for noticeable intensity modulation. Positive-going signal decreases intensity
Frequency Range	DC to 1 MHz
Input Resistance	Approximately 20 kΩ
Maximum Input Voltage	50 V (dc + peak ac)

Calibrator

Waveshape	Square wave
Repetition Rate	1 kHz Accuracy : ± 50%
Output Voltage	0.3 V p-p Accuracy: ±3% (10° C to 35° C)
Duty Ratio	40% to 60%

Power Supply

Line Voltage	90 to 110/104 to 128/194 to 238/207 to 257 Vac Selected by the Line Voltage selector

Line Frequency 50 to 400 Hz

Power Consumption

Approximately 30W (at 100 Vac)

Physical Characteristics

Weight Approximately 6 kg

Dimensions (260 ±2) W x (160 ±2) H x (400± 2) L mm

Refer to Figure 1-1.

Environmental Characteristics

Operating Temperature

0°C to 40°C

Operating Humidity 90% RH, 40°C

Storage Temperature

–20°C to 70°C

Storage Humidity 80% RH, 70°C

Altitude Operating: 5,000 m maximum (balometric pressure: 405 mmHg)

Non-operating: 15,000m maximum (balometric pressure: 90.4mmHg)

Vibration (non-operating)

Vibrate for 15 minutes along each axis at a total displacement of 0.67 mm p-p with the frequency varied from 10-55 Hz in one-minute cycle.

Shock (non-operating)

Lift one bottom edge of the instrument 10 cm over a hard bench, and drop.

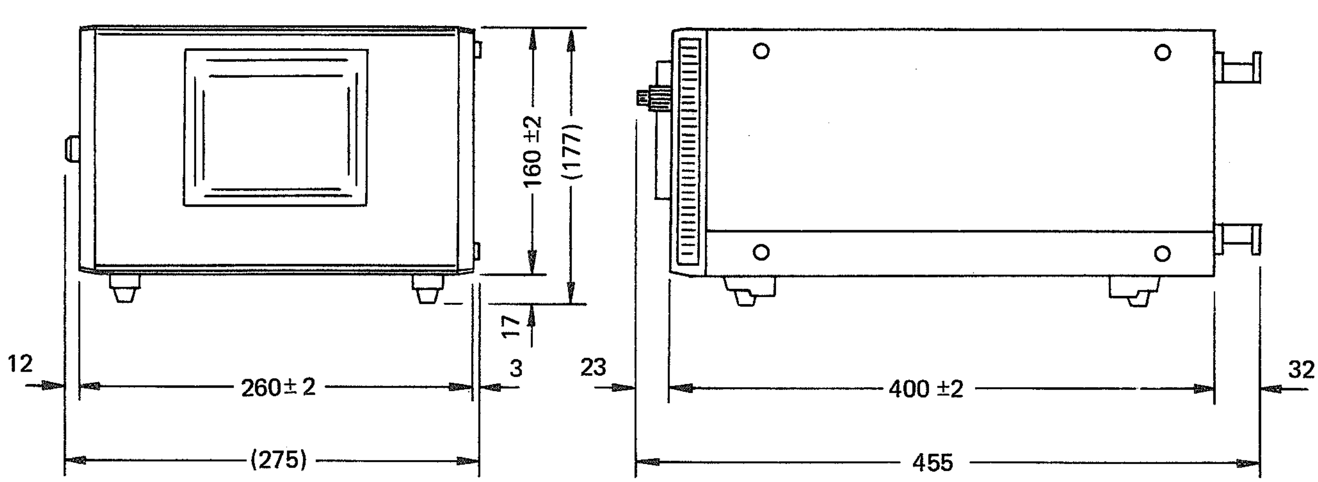
(45° maximum in elevation angle)

Repeat 3 times for each edge.

Drop (package drop)

Drop from a height of 75 cm on one corner, all edges radiating from that corner and all flat surfaces.

Figure 1-1. Dimensions



NOTES

Operating Information

Precautions

Ambient Temperature and Air Ventilation

The ambient temperature range of this instrument performing normal operation is from 0 ° C to 40 ° C. The use of this instrument with the temperature exceeding this range may result in trouble; therefore, the operation in this range is essential,. Moreover, do not place other devices or apparatus on the ventilation hole of the cover in order to improve the efficiency of the heat radiation.

Line Voltage

Desired operating voltage can be selected from four voltage ranges shown in Table 2-1 by the line voltage selector located on the rear panel. Check the line voltage prior to connection of the power cord and set the selector so that its arrow mark can be lined with a voltage range indication on the panel which covers the line voltage. Note that mis-setting may result in trouble of the instrument.

Before changing the voltage range, check that a fuse shown in Table 2-1 is set in the fuse holder on the rear panel.

Table 2-1

Selector setting position	Voltage range	
A	90 to 110V	0.5A slow-blow
B	104 to 128V	
C	194 to 238V	0.3A slow-blow
D	207 to 257V	

Do not Intensify Unnecessarily

The brightness of the spots or traces on the viewing area must not be increased excessively. Excessively intensified spots or traces may irritate an operator. If such spots or traces are stopped at the same position for a long time, it may result in burning of phosphorescence coating of the CRT.

Do not Apply an Excessively High Input Voltage

The rated maximum allowable input voltage for each input connector is as follows. Observe this restriction on voltage.

INPUT	250 V (dc + peak ac)
Input of probe	
x 1 position:	250V (dc + peak ac)
x 10 position:	600 V (dc + peak ac)
EXT INPUT	150 V (dc + peak ac)
Z AXIS INPUT	50 V (dc + peak ac)

Use in a Vertical Elevation Setting

This instrument can be used in the vertical elevation setting, namely, in positioning with the screen up. In this case, do not bring the instrument down by pulling a probe forcefully or by striking with other devics or apparatus.

Replace the Fuse with Specified Type

To prevent the damage in the circuit with excessive current, the fuses shown in Table 2-2 are used.

In case of fusing, thoroughly check the cause and replace with the specified fuse after repairing any defects.

Use of fuse other than the specified fuses may cause the serious trouble as well as being exremely dangerous.

Table 2-2

Circuit number	Standard of fuse	Function	Position of the fuse holder
F 701	0.5A slow-blow	With the Line voltage selector set at A or B	Rear panel
	0.3A slow-blow	With the Line voltage selector set at C or D	
F702	1A slow-blow	CRT circuit protection	Refer to
F703	0.2A fast-blow	+240V circuit protection	Figure 2-1

Stand

A bail-type stand is mounted on the bottom cover. This stand permits the instrument to be positioned for convenient operation. The instrument may also be set on the rear or right feet either for operation or storage.

CONTROLS AND CONNECTORS

The major controls and connectors for operation of the SS-5702 are located on the front panel of the instrument. A few auxiliary functions are provided on the rear panel. Figure 2-2 show the front and rear panels. A brief description of each control and connector is given here. More detailed operating information is given in later section "OPERATING INSTRUCTION"

Front Panel

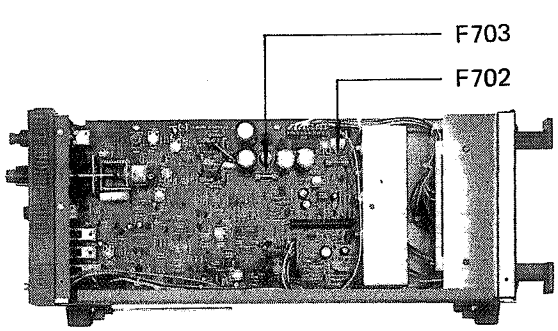
POWER

Power line switch. Power is supplied to the instrument when this switch is turned on and the pilot light glows.

INTEN

Controls brightness of the display.

Figure 2-1. Installed position of foses



FOCUS

Provides adjustment for optimum definition.

SCALE

Controls brightness of the scale illumination.

TRACE ROTATION

Control to align the trace with the horizontal graticule lines mechanically.

⏊

Ground terminal for connection between input signal source and this instrument.

V MODE (Y MODE)

Selects the vertical operation mode and X-Y operation mode. The following modes can be selected.

CH1: displays Channel 1 only. In the X-Y opetation, the Channel 1 function is decided by source switch.

CH2: Displays Channel 2 only. In the X-Y operation, the Channel 2 function is decided by the SOURCE switch too.

DUAL: Dual-trace display of signals on both channels. In this mode, setting the sweep rate to a range lower than 1 mS/div allows chopped display and setting it to a range higher than 0.5 mS/div permits alternate display.

ADD: Signals applied to the CH 1 and CH 2 INPUT connectors are algebraically added and the sum is displayed on the CRT screen. The CH 2 POLARITY switch alows the display to be CH 1 + CH 2 or CH 1 – CH 2.

⇕ POSITION (PULL X 5 GAIN)

Controls vertical position of the displayed waveform. This control also functions as the push-pull switch to magnify the sensitivity by 5 times.

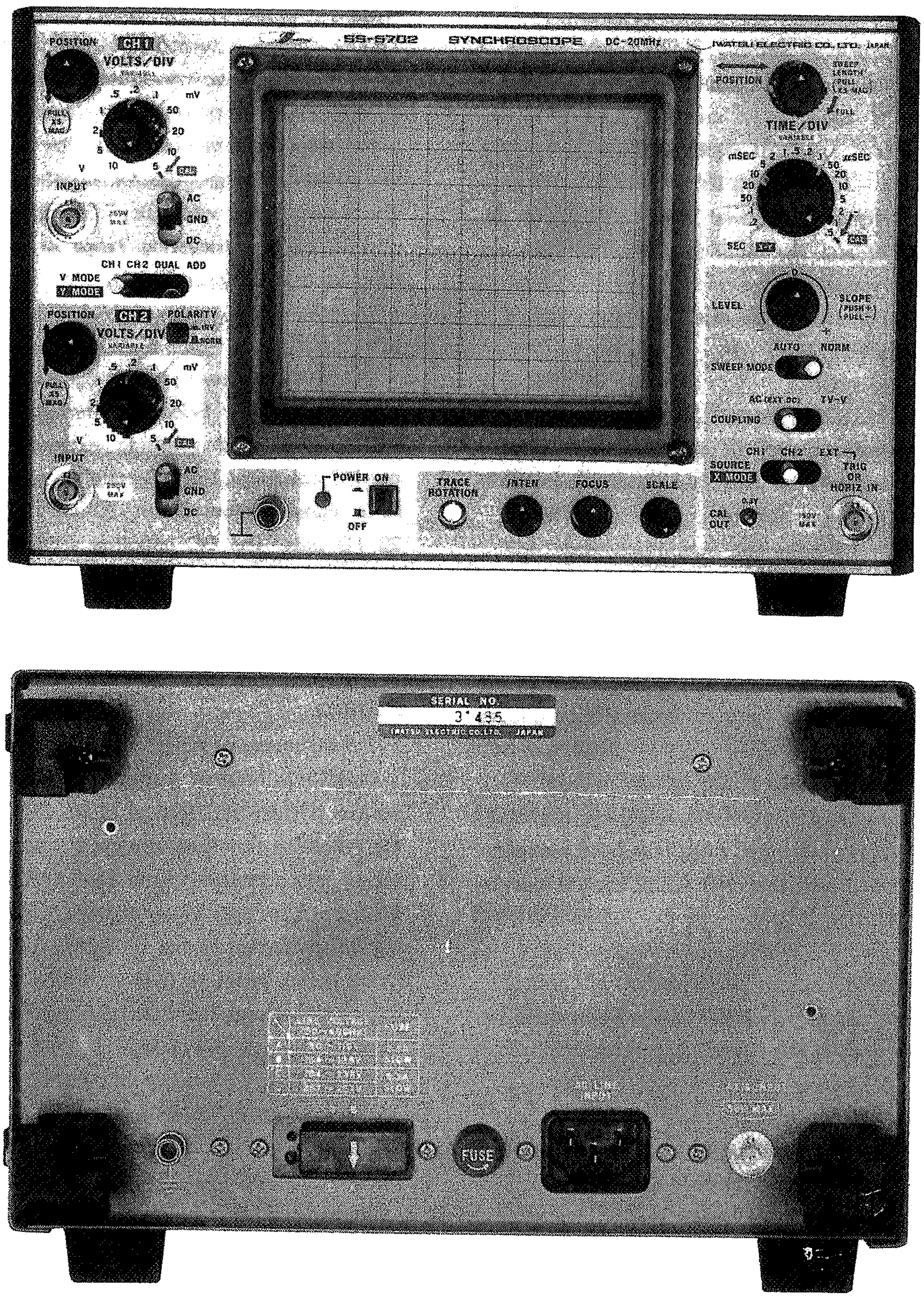
VOLTS/DIV (Black knob)

Selects vertical deflection factor in 11 steps in a 1-2-5 sequence. For calibrated deflection factor, the VARIABLE control must be set to the CAL position.

VARIABLE (Red Knob)

Provides continuously variable uncalibrated deflection factors between the calibrated settings of the VOLTS/DIV switch.

Figure 2-2. SS-5702 front and rear panels



CH1 CH2 INPUT

Input connector for Channel 1/Channel 2 deflection signals or Y-axis/X-axis deflection signals in the X-Y mode of operation.

AC-GND-DC

Selects the following input coupling.

AC: Signal is capacitively coupled to the Vertical Amplifier. DC component of signal is blocked. Low-frequency limit (low –3dB point) is about 4 Hz.

GND: Input signal is removed from the input of the Vertical Amplifier and the input is grounded. Does not ground the input singal.

DC: All components of the input signal are passed to the Vertical Amplifier.

POLARITY

Switch to invert polarity of the channel 2 display. The polarity is inverted by setting the button to in-position.

⇔ POSITION

Controls horizontal position of the display.

SWEEP LENGTH (PULL X 5 MAG)

Controls the sweep length of the display. This control functions also as the pull switch that increases the displayed sweep rate by a factor of 5.

TIME/DIV (Black Knob)

Selects the sweep rate in 18 steps in a 1-2-5 sequency. For calibrated sweep rate, the VARIABLE control must be set to the CAL position.

VARIABLE (Red Knob)

Provides continuously variable sweep rates between the calibrated settings of the TIME/DIV switch.

LEVEL/SLOPE

Controls trigger level. This control also functions as the push-pull switch for selection of trigger slope. Positive-going slope is selected in the pushed state of the knob and pulling it allows negative-going slope.

SWEEP MODE

Selects the following modes.

AUTO: Sweep can be initiated by signals that have repetition rates above 50 Hz and are within the frequency range selected by the COUPLING switch. When the LEVEL control is turned to outside of the triggering range or no trigger signal is supplied to the Trigger Circuit, the sweep free-runs to produce a reference trace.

NORM: Sweep can be initiated by signals that are within the frequency range selected by the COUPLING switch. The sweep stops when the LEVEL control is turned to outside of the triggering range or no trigger signal is supplied to the Trigger Circuit.

COUPLING

Selects the following trigger signal couplings.

AC (EXT DC): Selecting internal triggering allows the AC coupling and selecting external triggering permits the DC coupling. The AC coupling rejects DC and attenu-attes signals below about 20 Hz. Signals above about 20 Hz pass. The DC coupling accepts all trigger signals from DC to 20 MHz.

TV-V: This coupling is suitable for measurement of TV composite signal.

SOURCE

Selects source of trigger signal.

CH1/CH2: Internal triggering is obtained in these two positions. When the Vertical Mode switch is set to DUAL, the following signals are used as a trigger signal; a sample of the signal connected to the CH1 INPUT connector in the CH 1 position; a sample of the signal connected to the CH2 INPUT connector in the CH2 position. When the Vertical Mode switch is set to CH1 or CH2 its setting selects the trigger signal and the SOURCE switch setting makes no effect.

EXT: Trigger signal is obtained from signal which is connected to the INPUT connector.

INPUT

Input connector for external trigger signal or external horizontal signal.

CAL OUT

Output connector for 0.3V calibration voltage signal.

Rear Panel

Z AXIS INPUT

Input connector for external intensity modulation signal.

AC LINE INPUT

Connector to connect the accessory power cord.

FUSE

Fuse holder which contains a 0.5 A or 0.3 A slow-blow fuse according to the line voltage used.

LINE VOLTAGE

Selects the operating voltage range of the instrument in accordance with the line voltage used.

⏚

Ground terminal to connect earth.
Make sure to ground to prevent any danger.

OPERATING INSTRUCTIONS

Basic Operation

Power and Sweeping

1. Make sure of the line voltage used and the LINE VOLTAGE selector setting.
2. Turn off the POWER switch and connect the accessory power cord between the AC LINE INPUT connector and the line receptacle.
3. Set the controls as follows.

Vertical POSITION	Mid-range
Horizontal POSITION	Mid-range
INTEN	Fully clockwise
V MODE	CH 1
SWEEP MODE	AUTO
TIME/DIV	1mSEC
SWEEP LENGTH	Fully clockwise

4. Turn on the POWER switch. The trace appears after about 15 seconds.

Focusing

1. Shift the trace to the center of the viewing area with the vertical POSITION control.
2. Set brightness of the trace to desired degree with the INTEN control.
3. Adjust the FOCUS control to make thin and clear trace.

Triggering by Signal Apply

1. Set the controls as follows.

V MODE	CH1
AC-GND-DC (CH 1)	DC
VOLTS/DIV (CH 1)	5 mV
VARIABLE (CH 1)	CAL
COUPLING	AC (EXT DC)
SOURCE	CH 1

2. Connect the CAL OUT signal to the CH1 INPUT connector using the accessory probe.
3. Set the attenuation ratio of the probe to x10 and adjust the LEVEL control for triggering.

The above-mentioned operation allows most ordinary type triggering (AUTO operation by internal triggering and AC coupling) and a six divisions signal is displayed on the CRT. For details of triggering, see the later section "Triggering".

Obtaining Spot

Setting the MODE switch to NORM and the AC-GND-DC switch to GND allows a spot to be appeared.

Single-Trace

Setting the Vertical Mode switch, CH1-CH2-DUAL-ADD to CH1 or CH2 allows the single-trace display of channel 1 or channel 2.

Signal Connection

The signal to be measured is connected to the CH1 and/or CH2 INPUT connectors. A Probe is generally used as the means to connect the signal source with the INPUT connector. The Type 1036 probe is used for this instrument. This probe is convenient to measurements as 1 : 1 (x1) and 10 : 1 (x10) of the attenuation ratio can be selected by a switch.

The probes can protect the signal to be measured from the interference caused by the external electrical field. The x 10 position of the 1036 probe provides a higher input impedance and decrease the load effect to the signal source. So, signals from higher output impedance source and at higher frequencies can be correctly measured with the x 10 position. As the x 10 position attenuates the signal to 1/10, the value indicated by the VOLTS/DIV switch must be multiplied by 10

The x 1 position of the probe does not attenuate low frequency signals. However, the x 1 position increases the input impedance and gives bigger load effect to a high frequency signal source. So, the x 1 position is useful for measurements of lower frequency signals at lower output impedance sources.

For the details, see the instruction manual of the probe.

Signal Input Coupling

Many kinds of signals are measured; DC, AC and mixed signals. To measure these signals correctly, an adequate signals input coupling must be selected with the AC-GND-DC switch.

This switch selects the input coupling mode of the vertical deflection system. In the AC mode, the input connector and the input of the vertical amplifier are connected with a capacitor, in the DC mode, they are connected directly, and in the GND mode, they are disconnected together and the input of the vertical amplifier is grounded.

In the AC coupling, the capacitor blocks the DC component of the signal, and the displayed signal can be magnified without being deflected outside of the viewing area by the DC component. The AC coupling, however, produces sags in low frequency square waves, or displays the decreased amplitude of sine waves. The amplitude decreases appoximately 3 dB at 4 Hz. The DC coupling passes all components of the signal. The DC coupling is generally used if the DC component is not need to be blocked.

In the GND mode, the input of the vertical amplifier is grounded, and the ground level is traced on the viewing area. The level is used as the reference level in measurements.

Deflection Factor

For accurate measurement of signal waveforms, it is essential to display adequate amplitude of the waveforms on the viewing area. An excessively small or large signal compared with the viewing area enables no adequate measurement. If the signal to be measured is small, it need to be amplified, and if large, need to be attenuated.

The deflection factor is selected by the VOLTS/DIV switch and finely adjusted by the VARIABLE control. Each deflection factor becomes equal to the value indicated by the VOLTS/DIV switch when the VARIABLE control is set to the fully clockwise position. The values show the voltage for one division on the viewing area. The sensitivity is decreased when the VARIABLE control is turned counterclockwise and becomes less than 1/2.5 of each indicated value at the fully counterclockwise position.

Triggering

This section describes the triggering procedures briefly and in detail explains the operating method of controls used for triggering.

Trigger Procedure I (Internal Triggering)

1. Set the SOURCE switch to CH 1 or CH 2.
2. Select a trigger coupling mode with the COUPLING switch according to trigger signals (input signals).
3. Select a trigger mode with the MODE switch according to measurement object.
4. Adjust the displayed amplitude of the input signals to a value higher than the prescribed one shown in Table 1-1.
5. Select a trigger slope and a trigger level with the LEVEL/SLOPE control.

Triggering Procedure II (External Triggering)

1. Set the SOURCE switch to EXT.
2. Connect an external trigger signal, which has amplitude higher than the prescribed one shown in Table 1-1, to the EXT INPUT connector.
3. Select a trigger coupling mode with the COUPLING switch according the external trigger signal.
4. Select a trigger mode with the MODE switch according

to measurement object.

5. Select a trigger slope and a trigger level with the LEVEL/SLOPE control.

Trigger Source

In order to observe the input signal waveform in the viewing area by triggering, the input signal itself or a signal having an integer relationship with respect to the input signal in frequency (which is called a trigger signal) must be supplied to the trigger circuit in order to actuate the trigger generator which sends a trigger pulses and conducts the horizontal sweeping of display.

The internal triggering is obtained by setting the SOURCE switch to CH1 or CH 2. In this case, a portion of input signals applied to the INPUT connector is supplied to the trigger circuit through a stage in the vertical deflection system.

The external triggering is obtained by setting the SOURCE switch to EXT. In this case, the trigger signals from the external devices are supplied to the trigger circuit.

Internal Triggering: In this operation, the input signals applied to the INPUT connector are amplified because a portion of the signals in the vertical deflection system is supplied to the trigger circuit as a trigger signals. Therefore, the display can be suitably triggered even if the input signal amplitude is small. The internal triggering is simple in operation and is popular for ordinary measurements.

External Triggering: This operation offers the following unique features.

First, the external triggering is free from influence of vertical deflection settings. In the internal triggering, as changing the deflection factor allows trigger signal amplitude to vary, the readjustment of the LEVEL control is often required to resume proper triggering level. On the other hand, the external triggering needs no readjustment of the LEVEL control against any changing of vertical deflection setting so long as the external trigger signal amplitude is retained unchanged.

Second, when it is desired to start the sweep a certain time before or after the input signal the desired waveform can be displayed by using a signal of such timing as the external trigger signal, provided such signal is available.

Internal Trigger Signal

In the internal triggering mode, the trigger signals are selected in the following way.

When the Vertical Mode switch is set to CH1 or CH2 the trigger signal supplied from the channel which must be selected by the SOURCE switch.

When the Vertical Mode switch is set to DUAL, setting the SOURCE switch to CH1 allows the selection of the CH1 trigger signal, while setting it to CH2 permits the selection of the CH2 trigger signal. Therefore, when the input signal frequencies are the same, selecting the channel to which the signal having higher amplitude and lesser noise component is applied allows stable triggering.

When the input signal frequencies differ from each other (but, there is no phase shift between these signals), the one of the lower frequency should be used as the trigger signal. If the other signal having the higher frequency is used as the trigger signal, the one of the lower frequency is displayed in duplication. When the dual-trace display is intended for measurement of phase difference between two signals, the one with the leading phase must be selected as the trigger signal.

Trigger Coupling

The COUPLING switch is designed to select the coupling mode between the trigger signal and the trigger circuit. Two coupling modes are available: AC (EXT DC) and TV-V.

These couplings are selected to obtain a stable triggering in accordance with kind of the trigger signals, e.g, DC signals, AC signals, AC signals superimposed on DC signals and signals superimposed by high frequency noise.

AC (EXT DC): In this position, selecting the internal triggering allows the AC coupling and selecting the external triggering permits the DC coupling.

The AC coupling passes the trigger signal to the trigger circuit through a capacitor, therefore DC and a low frequency component are rejected and attenuated respectively. This coupling is advantageous for ordinal signal measurements as the triggering is free from DC, but the triggering is difficult when the trigger signal frequency is below about 20 Hz.

The DC coupling passes all trigger signals to the trigger circuit, so the triggering is possible from DC.

TV-V: This coupling gives a stable triggering for measurement of composite video signals.

Sweep Mode and Trigger Level

Two sweep modes, AUTO and NORM, can be selected by the sweep MODE switch. Each mode has the following features, so use one mode which is suitable for measurement object.

In both modes, triggering is obtained in a certain range from the center of the LEVEL control and range width varies according to the trigger signal amplitude.

In the AUTO mode, 'free-running' sweep occurs when triggering is not accomplished, in other word, the LEVEL control is set to outside of the triggering range or no trigger signal is supplied to the trigger circuit. So, the trace of ground level is provided by setting the AC-GND-DC switch to GND. Triggering, however, is not obtained in signals below 50 Hz. In such case, use the NORM mode.

In the NORM mode, the triggering is possible form DC, but the sweep stops when the triggering is not obtained.

Trigger Slope

The trigger slope can be selected by push-pull switching of the LEVEL control. In the pushed state of the LEVEL control, the positive-going slope is selected, and pulling it permits the negative-going slope.

Sweep Rate

The signals to be measured varies in many ways, from high to low repetition frequencies, or from fast to slow rise time pulses. In order to measure such signals, a suitable sweep rate must be selected according to the repetition frequencies or the rise time.

The sweep rate is selected by the TIME/DIV switch. Each setting value is slowed down when turning the VARIABLE control counterclockwise and set less than 1/2.5 of the value at the fully clockwise position, CAL.

Application Operation

Oscilloscope has many convenience functions to display the provided signal. Here, the application operation is described to ovserve the input signal with operating functions.

Dual-Trace

Setting the vertical Mode switch to DUAL permits the dual-trace display of channel 1 and channel 2. The alternate mode and chopped mode for the dual-trace display are changed by the TIME/DIV switch setting ie., setting the TIME/DIV switch to a position faster than or equal to 0.5 mS/div allows the alternate mode and setting it to a position slower than or equal to 1 mS/div permits the chopped mode. By changing of these modes, dual-trace display for phenomena over a wide range from low speed up to high speed is made.

ADD Operation

A signal showing the sum of difference of the signals applied to CH1 and CH2 can be observed by setting the vertical mode to ADD and switching the POLARITY switch. When observing the signal showing the sum, push out POLARITY switch, and push it in when observing the signal showing the difference.

<Cautions>

(1)When performing in differentical input (POLARITY is set to INV), equalize the input coupling of the both channels.

(2)In ADD operation, the trace position can be moved by POSITION (PULL x5 GAIN) controls of both channels, For accurate observation, set both POSITION (PULL x5 GAIN) controls at approximately mid position.

(3)Set the trace in the center of viewing area when switching the POLARITY switch. As the polarity inversion of this instrument is performed symmetrically against the center line of the viewing area, if the polarity is switched over with the trace not in the center area, its vertical position will changed.

Sweep Magnifying

A part of the input waveform can be magnified with ragard to time by the use of faster sweep rate. However, the part which is far from the sweep start position may be out of the viewing area when the sweep rate is increased.

The part to be measured can be magnified 5 times by shifting its part to the center of the viewing area with the horizontal POSITION control and then pulling the POSITION (PULL x5 MAG) knob. Entire length of the trace is magnified to approximately 50 divisions wide though only the center 10 divisions part is displayed in the viewing area. The magnified trace can be fully observed by sequenctially adjusting the horizontal POSITION control.

The sweep rate at 5 magnification can be calculated by multiplying the TIME/DIV setting value by 1/5. Therefore, the available maximum sweep rate can be obtained by the following calculation: 0.5 μS/div (the maximum sweep rate at no magnification) x 1/5 = 100nS/div.

X-Y Scope

Setting the controls as follows allows the SS-5702 to be operated as an X-Y scope.

TIME/DIV X-Y

In the X-Y scope of operation, the signals applied to the INPUT connectors of the Channel 1 and Channel 2 drive the Y and X axis respectively to make a Lissajou's pattern. The display can be shifted vertically and horizontally by the vertical and horizontal POSITION controls.

The deflection factor is selected by the VOLTS/DIV switch and finely adjusted by the VARIABLE control. The deflection factor becomes equal to the value indicated by the VOLTS/DIV switch when the VARIABLE control is set to the fully clockwise position.

The vertical and horizontal deflection factor is multipled to five when the Vertical and Horizontal POSITION controls are pulled (PULL x5 MAG). When use the CH1 or CH2 input signal as X axis deflection signal, the x5 GAIN is never used, because at the X-Y operation the x5 GAIN is not warranted.

The deflection factor is set to 0.5V/div when the signal is applied to the EXT INPUT connector, and is set to 0.1V/div when the PULL x5 is pulled.

NOTES

Measuring Instruction

Probe Phase Adjustment

Proper adjustment of the probe phasing is required before measurements as the incorrect phasing results in erroneous measurements when the x10 position is selected.

1. Set the controls as follows:

VOLTS/DIV	5mV
VARIABLE	CAL
TIME/DIV	0.5 mSEC
VARIABLE	CAL
Horizontal POSITION	Mid-range

2. Set the probe switch to x10 and connect the probe between the input connector and the CAL OUT terminal.
3. Display the calibration voltage waveform with six divisions amplitude.
4. Adjust the variable capacitor of the probe (located in a hole of the input connector side) using the accessory adjusting driver, and set the top of the waveform to the correct phasing shown in Figure 3-1.

Voltage Measurement

Quantitative Measurement

The quantitative measurement of voltage can be made by setting the VOLTS/DIV VARIABLE control to the CAL position. The measured value can be calculated by Equation (1) or (2).

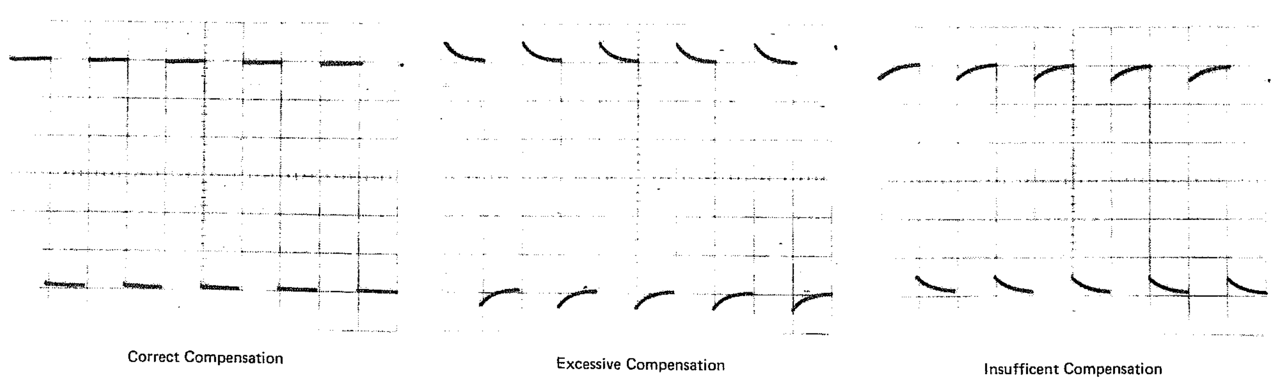
a. Measurement with the x1 position of the probe:
Voltage (V) = VOLTS/DIV setting value (V/div) x Displayed amplitude of input signal (div). . . . . .(1)
b. Measurement with the x10 position of the probe:
Voltage (V) = VOLTS/DIV setting value (V/div) x Displayed amplitude of input signal (div) x 10 . .(2)

DC Voltage Measurement

This instrument functions as a high input resistance, high sensitivity, quick response DC volt meter in order to measure DC voltage. Measurement procedure is as follows:

1. Set the sweep MODE switch to AUTO, and select a sweep rate so that the trace may not flicker.
2. Set the AC-GND-DC switch to GND. The vertical position of the trace in this case is used as 0-volt reference line as shown in Figure. 3-2. Adjust the vertical POSITION control in order to place the trace exactly on a hori-

Figure 3-1. Phasing of probe and displayed waveform



zontal graticule, which facilitates the reading of signal voltage.

3. Set the AC-GND-DC switch to DC, and apply the voltage to be measured to the input connector. The vertical diaplacement of the trace gives the voltage amplitude of the signal. When the trace shifts upward, the measured voltage is positive with regard to the ground potential. When the trace shifts downward, the voltage is negative. The voltage can be obtained by Equation (1) or (2).

AC Voltage Measurement

The measurement of the voltage waveform is performed as follows: Set the VOLTS/DIV switch in order to obtain the amplitude for easy reading, read the amplitude as shown in Figure 3-3, and calculate by Equation (1) or (2).

Figure 3-2. DC Voltage measurement

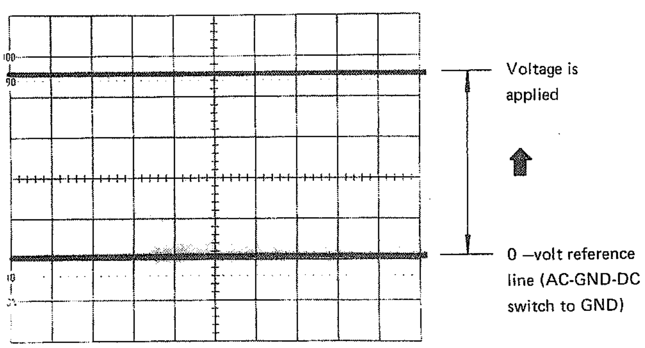
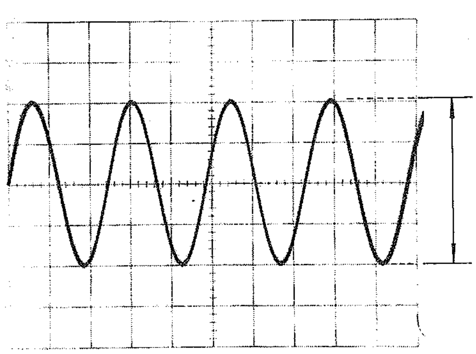


Figure 3-3. AC Voltage measurement



When the waveform superimposed on DC current is measured, set the AC-GND-DC switch to DC in order to measure the value including DC component, or set this switch to AC in order to measure AC component only.

The measured value by means of this procedure is peak value (Vp-p). Effective value (Vrms) of a sine wave signal can be given by Equation (3).

$$\text{Effective voltage (Vrms)} = \frac{\text{Peak voltage (V p-p)}}{2\sqrt{2}} \quad \cdots\cdots (3)$$

Time Measurement

The time interval of two points on a signal waveform can

Figure 3-4. Pulseswitch measurement

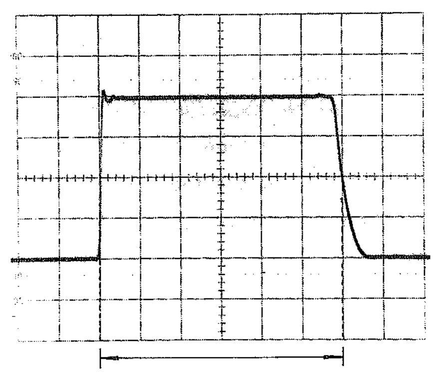
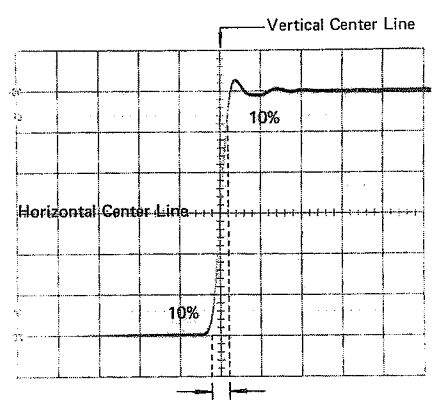


Figure 3-5. Rise (or fall) time measurement



be calculated as follows: Set the TIME/DIV VARIABLE control to CAL, read the setting values of the TIME/DIV and x5 MAG switches and calculate the time by Equation(4)

Time (s) = TIME/DIV setting value (s/div)
x Length corresponding to the time to be measured (div)
x Reciprocal number of x5 MAG setting value . . . .(4)

Where, the reciprocal number of the x5 MAG setting value is 1 when the sweep is not magnified, and 1/5 when the sweep is magnified.

Pulsewidth Measurement

The basic pulsewidth measurement procedure is as follows:

1. Display the pulse waveform vertically so that the distance between the top part of the pulse waveform and the horizontal center line of the graticule may be equal to the distance between the bottom part of the pulse and the horizontal center line as shown in Figure 3-4.
2. Set the TIME/DIV switch in order to make the easy observation of the signal.
3. Read the distance between centers of rising and falling edges, i.e., the distance between two points at which pulse edges cross the horizontal center line of the graticule. Calculate the pulsewidth by Equation (4).

Rise (or Fall) Time Measurement

The rise (or fall) time measurement of the pulses is obtained as follows.

1. Display the pulse waveform vertically and horizontally in the same manner as for the pulsewidth measurement procedure.
2. Turn the horizontal POSITION control in order to set the upper 10% point of the waveform on the vertical center line of the graticule. (In Figure 3-5, the upper 10% point is 0.4 division below the top of the pulse since the displayed amplitude is 4 divisions.) Read the distance T_1 between the vertical center line and the point at which the rising (or falling) edge crosses the horizontal center line.
3. Shift and set the lower 10% point of the waveform to the vertical center line of the graticule as shown by the dotted line in Figure 3-5. Read the distance T_2 between the vertical center line and the point at which the rising (or falling)edge crosses the horizontal center line.
4. Calculate the rise (or fall) time by substituting the sum of T_1 and T_2 for Equation (4).

Frequency Measurement

Of the frequency measurement procedure, there are the following methods.

The first method: Calculate the one-cycle time (interval) of the input signal by Equation (4) as shown in Figure 3-6, and obtain the frequency by Equation (5).

$$\text{Frequency (Hz)} = \frac{1\ \text{(c)}}{\text{Period}\ \text{(s)}} \cdots\cdots\cdots\cdots (5)$$

Figure 3-6. Frequency measurement (1)

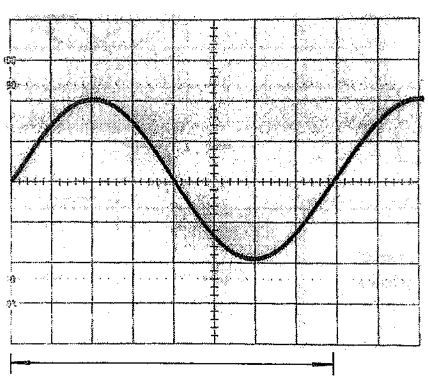
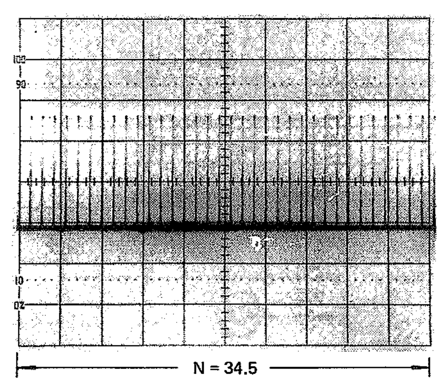


Figure 3-7. Frequency measurement (2)



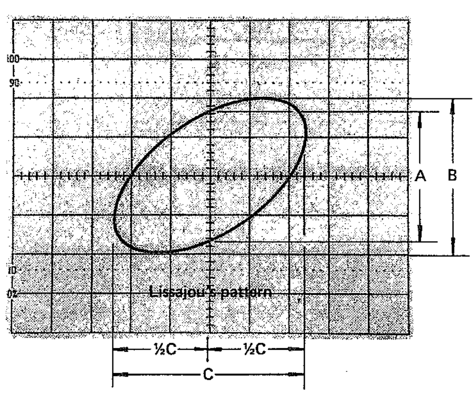
The second method: Count the repetition number N per 10 divisions in the viewing area, and calculate the frequency by Equation (6).

$$\text{Frequency (Hz)} = \frac{\text{N (c)}}{\text{TIME/DIV setting value (s/div) x 10 (div)}} \cdot\cdot(6)$$

When N is large (30 to 50), the second method can give a higher accuracy level than that obtained with the first method. This accuracy is approximately equal to the rated accuracy of sweep rate. However, when N is small, the count below decimal point becomes very ambiguous, which results in considerable error.

For the measurement of comparatively low frequencies having a simple pattern such as sine wave, square wave, triangle wave, and sawtooth wave, measurement with high accuracy can be effected by the following method: Operate the oscilloscope as an X-Y scope, make the Lissajou's pattern by applying the signal of which frequency is known, and read the necessary value.

Figure 3-8. Phase difference measurement using



Phase Measurement

Of the measurement of phase difference between two signals, there are the following two methods:

The first one is the Lissajou's pattern method by using the instrument as an X-Y scope. The phase differnce of signals can be calculated form the amplitudes A and Bof the pattern shown in Figure 3-8 and by Equation (7).

$$\text{Phase defference (deg)} = \sin^{-1}\frac{A}{B} \ldots\ldots\ldots\ldots(7)$$

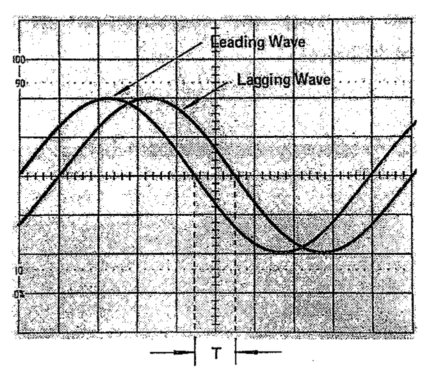
The second method is an application of dual-trace function Figure 3-9 shows an example of dual-trace display of leading and lagging sine wave signals having the same frequency. In this case, the SOURCE switch must be set to a channel which is connected to the leading signal, and set the TIME/DIV switch so that the length of 1-cycle of the displayed sine wave may be 9 divisions.

Then, 1-division graticule represents a waveform phase of 40° (1cycle $=2\pi=360°$). The phase difference between the two signals can be easily calculated by Equation (8).

Phase difference (deg) =T (div) x 40° . . . .(8)

Where, T is the distance between two points at which the leading and lagging signals cross the horizontal center line of the graticule.

Figure 3-9 Phase difference measurement by dual-trace display



Section 4

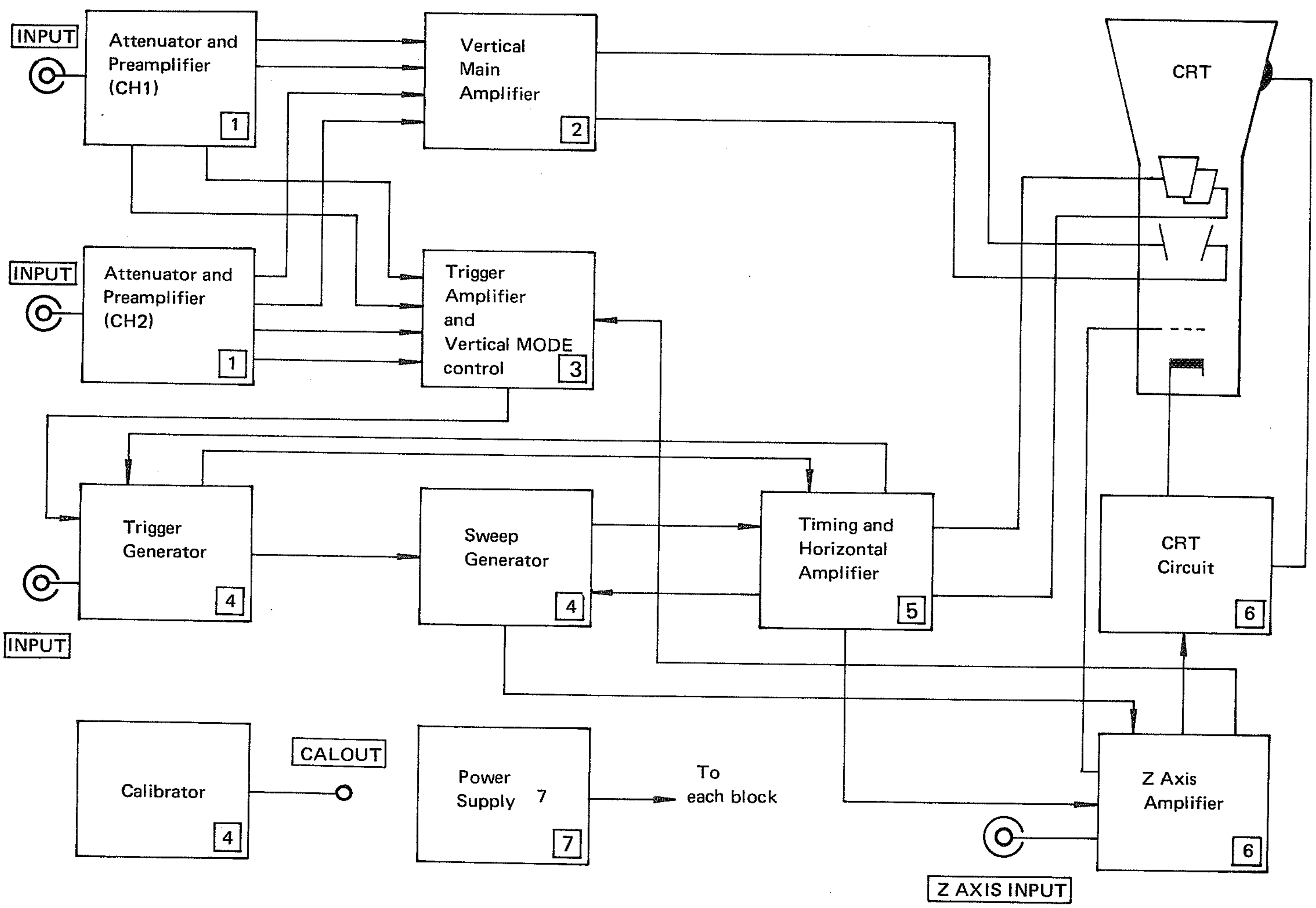
Operating Principle

A basic block diagram of the SS-5702 is shown in Figure 4-1.

The Vertical Deflection System consists of two independent Attenuators and Preamplifiers and one Main Amplifier. Signal to be displayed on the CRT is applied to the INPUT connector, converted into a push-pull output signal and amplified in the Preamplifier, and connected to the Main amplifier.

The Vertical MODE switch, CH1-CH2-DUAL-ADD selects the following three modes; Either Channel 1 or Channel 2 alone (CH1 or CH2) or two signals electonically switched (DUAL) or the algebraic sum (ADD). In the DUAL mode, setting the TIME/DIV switch to a position faster than or equal to 0.5 mS/div allows the alternate mode

Figure 4-1 Overall block diagram



and setting it to a position slower than or equal to 1 mS/div permits the chopped mode. In the alternate mode, the Vertical Mode Switching circuit in the Main Amplifier is driven by the alternate signal from the Sweep Generator, resulting in an alternalte display of the Channel 1 and Channel 2 signals as complet sweeps. In the chopped mode, the Vertical Mode Switching circuit oscillates on a free-running basis at a repetition rate of approximately 100kHz which switches the Diode Gate (opens or closes) causing the output signals from the two channels to be chop-displayed at a repetition rate of approximately 100kHz regardless of the sweep rate. In this mode, the chop blanking signal is supplied from the Vertical Mode Switching circuit to the Z Axis Amplifier to blank the transients of the switching action.

A sampling of the input signal is supplied from the Pre-amplifier to the Trigger Amplifier and Selector circuit where it is amplified and supplied to the Trigger Generator circuit.

The Main Amplifier provides the final amplication and deflects the beam vertically in the CRT.

The main Amplifier provides the final amplication and deflects the beam vertically in the CRT.

The Trigger Generator circuit converts trigger signal of its input into a first-rise trigger pulse which initiate the sawtooth signal produced by th Sweep Generator circuit.

The Sweep Generator circuit produces a linear sawtooth signal of which the slope is determined by the TIME/DIV switch. The Sweep Generator circuit also produces an un-blanking gate signal to unblank the CRT.

The Horizontal Amplifier provides the amplification of the sawtooth signal or the X-axis signal in the X-Y mode and deflects the beam horizontally in the CRT.

The Z Axis Amplifier circuit determines the CRT intencity and blanking. This circuit sums current inputs from the INTEN control, Gate circuit of the Sweep Generator and external Z AXIS binding post. The output of this circuit is connected to the control grid of the CRT.

The Power Supply circuit produces the 6.3 V AC supply used for the graticule illumination lamps and the low DC voltage supplies to operate each circuit of this instrument.

The Calibrator circuit produces a square-wave signal with accurate amplitude which can be used to check the deflection factor and compensation of the probes.