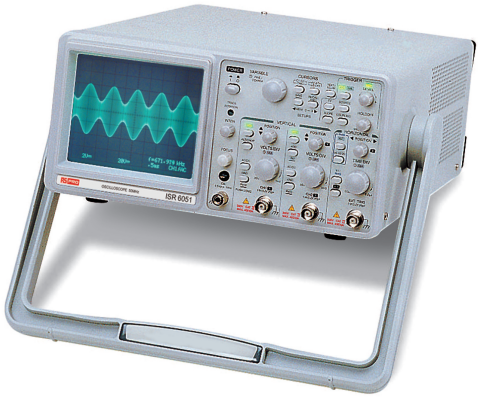
Instruction Manual

ISR-6051

Dual Channel Oscilloscope

EN



Dual Channel Oscilloscope
ISR-6051

Operation Manual

The information in this manual was correct at the time of printing. Due to product improvements, RS Components reserves the rights to change specification, equipment, and maintenance procedures at any time without notice.

82SR-60510MC1

CONTENTS **PAGE**

SAFETY TERMS AND SYMBOLS

These terms may appear in this manual or on the product:

WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

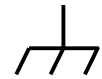
Measurement category I is for measurements performed on circuits not directly connected to the low voltage installation.
Measurement category II is for measurements performed on circuits directly connected to the low voltage installation.
Measurement category III is for measurements performed in the building installation.
Measurement category IV is for measurements performed at the source of the low-voltage installation.

The following symbols may appear in this manual or on the product:

DANGER High Voltage

ATTENTION refer to Manual

Protective Conductor Terminal



Earth(ground) Terminal

FOR UNITED KINGDOM ONLY

NOTE: This lead/appliance must only be wired by competent persons

WARNING: THIS APPLIANCE MUST BE EARTHED

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

Green/ Yellow:	**Earth**
Blue:	**Neutral**
Brown:	**Live (Phase)**

As the colours of the wires in main leads may not correspond with the colour markings identified in your plug/appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⏚ or coloured Green or Green & Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse: refer to the rating information on the equipment and/or user instructions for details. As a guide, cable of 0.75mm^2 should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal /replacement must be destroyed by removal of any fuse & fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if a engaged in live socket. Any re-wiring must be carried out in accordance with the information detailed on this label and local regulations.

1. PRODUCT INTRODUCTION

1-1. Description

The ISR-6051 oscilloscope is a 50 MHz, two-channel, portable oscilloscopes for general purpose use. A microprocessor-based operating system controls most of the functions of the instrument, including cursor readout and digitized panel setting. On-screen alphanumeric readout and cursor functions for voltage, time and frequency measurement provide operational convenience. It also has the function of auto measurement for frequency and counter. Ten different user defined instrument settings can be saved and recalled.

The vertical deflection system has two input channels. Each channel has 14 basic deflection settings from 1mV to 20V per division. The horizontal deflection system provides sweep times from 0.5s to 0.2 μs per division. The trigger system provides stable triggering over the full bandwidth of the vertical deflection system.

1-2. Features

The oscilloscope offers several additional features:

1) High intensity and internal graticule CRT;
   The oscilloscope employs a high intensity 6-inch rectangular screen cathode-ray tube with red internal graticule. It displays clear readable traces even at high sweep speeds. Internal graticule lines eliminate parallax-viewing error between the trace and the graticule line.
2) Frequency counter:
   An in-built 6-digit frequency counter is accurate to ±0.01% when measuring frequencies between 1kHz to 50MHz and ±0.05% when measuring 50Hz to 1kHz.
3) ALT-MAG function:
   The primary sweep waveform together with the magnified sweep waveform can be displayed simultaneously using the ALT-MAG function. The magnification ratio can be selected from three levels of ×5, ×10 or ×20 to allow detailed inspection of the displayed waveform in the centre of the CRT.
4) Convenient VERT-MODE triggering:
   The sync signal source is determined automatically when the vertical axis mode is changed, thereby removing the need to change the trigger source every time the VERT-MODE is changed.
5) TV triggering:
   A TV sync-separator circuit permits stable TV signal measurements on field, frame and line signals.
6) Hold-off:
   The function allows the stable synchronization of complex waveforms that are difficult to synchronize by adjusting the trigger level alone.

7) CH1 Signal output:
   The CH1 signal output is obtained by splitting the input signal in the middle of the signal line. As the connector provides the input signal at a level of 50mV/div, connecting a frequency counter makes it possible to measure the frequency of a very low-level signal while observing its waveform.
8) Z-axis intensity modulation:
   For applying a blanking signal from an external source. The trace displayed on the screen may be intensity-modulated where pulse signal or time-scale marks are required.
9) LED indicator and buzzer alarm:
   The LED's located in the front panel assist operation and indicate additional information. Incorrect operation and the electrical end-of-travel of control knobs are indicated by a warning beep.
10) SMD manufacturing technology:
    The instrument is built using advanced SMD technology to reduce the amount of internal wiring and shorten the foil route on the printed circuit boards. This increases the high frequency performance and the reliability of the product.
11) Compact size (275W×130H×370D)mm and logically grouped front panel controls provide ease of use.

2. TECHNICAL SPECIFICATIONS

<table>
<tr><td rowspan="6">CRT</td><td>Type</td><td>6-inch rectangular type with internal graticule; 0%, 10%, 90% and 100% markers.
8 x 10 DIV (1 DIV = 1 cm)</td></tr>
<tr><td>Accelerating potential</td><td>Approx. 10kV</td></tr>
<tr><td>INTEN and FOCUS</td><td>Front panel control.</td></tr>
<tr><td>Illumination</td><td>Provided</td></tr>
<tr><td>Trace rotation</td><td>Provided.</td></tr>
<tr><td>Z-axis Input</td><td>Sensitivity: at least 5V
Polarity : positive going input decrease intensity
Usable frequency range: DC to 2MHz.
Max. input voltage: 30V (DC +AC peak) at 1kHz or less.
Input impedance: approx. 33kΩ</td></tr>
<tr><td rowspan="9">VERTICAL SYSTEM</td><td>Sensitivity accuracy</td><td>1mV~2mV/DIV ± 5%, 5mV~20V/DIV ± 3%, 14 calibrated steps in 1-2-5 sequence.</td></tr>
<tr><td>Vernier vertical sensitivity</td><td>Continuously variable to 1/2.5 or less of panel indicated value.</td></tr>
<tr><td>Bandwidth(-3dB) and rise time</td><td><table><tr><td></td><td>Bandwidth(-3dB)</td><td>Rise time</td></tr><tr><td>5mV~20V/DIV</td><td>DC~50MHz</td><td>Approx. 7ns</td></tr><tr><td>1mV~2mV/DIV</td><td>DC~7MHz</td><td>Approx. 50ns</td></tr></table></td></tr>
<tr><td>Maximum input voltage</td><td>400V (DC + AC peak) at 1kHz or less.</td></tr>
<tr><td>Input coupling</td><td>AC, DC, GND</td></tr>
<tr><td>Input impedance</td><td>Approx. 1MΩ±2% // approx. 25pF</td></tr>
<tr><td>Vertical modes</td><td>CH1, CH2, DUAL (CHOP/ALT), ADD, CH2 INV.</td></tr>
<tr><td>CHOP frequency</td><td>Approx. 250kHz.</td></tr>
<tr><td>Dynamic range</td><td>6DIV at 50MHz,</td></tr>
<tr><td rowspan="5">HORIZONTAL SYSTEM</td><td>Sweep time</td><td>0.2 μs/DIV~0.5s/div, 20 steps selectable in 1-2-5 sequence, continuous variable control between steps at least 1:2.5.</td></tr>
<tr><td>Accuracy</td><td>±3%, ±5% at ×5 and ×10 MAG, ±8% at ×20 MAG</td></tr>
<tr><td>Sweep magnification</td><td>×5, ×10, ×20 MAG</td></tr>
<tr><td>Maximum sweep time (at MAG)</td><td>20ns/DIV (10ns/DIV uncalibrated)</td></tr>
<tr><td>ALT-MAG function</td><td>Available.</td></tr>
</table>

<table>
<tr><td rowspan="8">TRIGGER SYSTEM</td><td>Trigger modes</td><td colspan="4">AUTO, NORM, TV</td></tr>
<tr><td>Trigger source</td><td colspan="4">VERT-MODE, CH1, CH2, LINE, EXT.</td></tr>
<tr><td>Trigger coupling</td><td colspan="4">AC, HFR, LFR, TV-V(-), TV-H(-).</td></tr>
<tr><td>Trigger slope</td><td colspan="4">“+” or “- ” polarity.</td></tr>
<tr><td rowspan="5">Trigger sensitivity</td><td></td><td>CH1, CH2</td><td>VERT-MODE</td><td>EXT</td></tr>
<tr><td>20Hz~5MHz</td><td>0.5 DIV</td><td>2.0 DIV</td><td>200mV</td></tr>
<tr><td>5MHz~40MHz</td><td>1.5 DIV</td><td>3.0 DIV</td><td>800mV</td></tr>
<tr><td>40MHz~50MHz</td><td>2.0 DIV</td><td>3.5 DIV</td><td>1V</td></tr>
<tr><td colspan="4">TV sync pulse more than 1 DIV (CH1, CH2, VERT-MODE) or 200mV (EXT).</td></tr>
<tr><td>External trigger input</td><td colspan="4">Input impedance: Approx. 1MΩ//25pF (AC coupling)
Max. input voltage: 400V (DC + AC peak) at 1kHz.</td></tr>
<tr><td>Hold-off time</td><td colspan="4">Variable.</td></tr>
<tr><td rowspan="4">X-Y OPERATION</td><td>Input</td><td colspan="4">X-axis : CH1, Y-axis : CH2</td></tr>
<tr><td>Sensitivity</td><td colspan="4">1mV/DIV~20V/DIV.</td></tr>
<tr><td>Bandwidth</td><td colspan="4">X-axis: DC~500kHz (-3dB)</td></tr>
<tr><td>Phase difference</td><td colspan="4">3° or less from DC to 50kHz</td></tr>
<tr><td rowspan="2">OUTPUT SIGNAL</td><td>CH1 signal output</td><td colspan="4">Voltage: approx. 20mV/DIV (with 50Ω termination)
Bandwidth: 50Hz to at least 5MHz.</td></tr>
<tr><td>Calibrator output</td><td colspan="4">Voltage: 0.5V±3%,
Frequency: approx. 1kHz, square wave.</td></tr>
<tr><td rowspan="4">CRT READOUT</td><td>Panel setting display</td><td colspan="4">CH1/CH2 sensitivity, sweep time, trigger condition</td></tr>
<tr><td>Panel setting save & recall</td><td colspan="4">10 sets</td></tr>
<tr><td>Cursor measurement</td><td colspan="4">Cursor measurement function: ΔV, ΔT, 1/ΔT.
Cursor resolution: 1/25 DIV.
Effective cursor range: Vertical:±3 DIV,
Horizontal: ±4 DIV</td></tr>
<tr><td>Frequency counter</td><td colspan="4">Display digits: Max. 6-digits decimal.
Frequency Range: 50Hz~50MHz
Accuracy: ±0.05%: 50Hz~1kHz.
±0.01%: 1kHz~50MHz.
Measuring sensitivity: The satisfied value of the above-mentioned trigger sensitivity plus 1 DIV. (measuring source selected from CH1 or CH2 as synchronizing signal source).</td></tr>
</table>

LINE POWER REQUIREMENT	Voltage	AC100V, 120V, 230V ±10% selectable.
	Frequency	50Hz or 60Hz.
	Power Consumption	Approx. 60VA, 50W(max).
MECHANICAL SPEC.	Dimensions	275(W)x130(H)x370(D) mm.
	Weights	8 kg
OPERATING ENVIRONMENT	Indoor use Altitude up to 2000 m Ambient temperature : To satisfy specifications : 10℃ to 35℃ (50° F to 95°F) Maximum operating ranges: 0℃ to 40℃(32°F to 104°F) Relative humidity: 85% RH(max.) non-condensing Installation Category : II 300V Pollution degree 2	
STORAGE TEMPERATURE & HUMIDITY	-10° to 70℃, 70%RH(maximum)	
ACCESSORIES	Power cord……1 Instruction manual……1 Probe (x1/x10)……2	

3. PRECAUTIONS BEFORE OPERATION

3-1. Unpacking the oscilloscope

The product has been inspected and tested before shipment from the factory. Upon receiving the instrument, please unpack and inspect it to check for any damage caused during transportation. If any sign of damage is found, notify the bearer and/or the supplier immediately.

3-2. Checking the supply voltage

The oscilloscope can be powered by any supply voltage listed in the table below. Before connecting the power plug to an AC supply, ensure the voltage selector on the rear panel is set to the correct position corresponding to the supply voltage. The instrument may be damaged if connected to an incorrect supply voltage.

WARNING. **To avoid electrical shock the power cord protective ground conductor must be connected to ground.**

When supply voltages are changed, replace the fuses with the as shown as below:

Line voltage	Range	Fuse	Line voltage	Range	Fuse
100V 120V	90-110V 108-132V	T 1A 250V	230V	207-250V	T 0.4A 250V

WARNING. **To avoid the risk of electric shock, disconnect the power cord before removing the fuse holder.**

3-3. Environment

The normal operating ambient temperature range of this instrument is from 0° to 40°C (32° to 104°F). Operation outside this temperature range may cause damage to the instrument.

Do not use the instrument where strong magnetic or electric fields exist, as it may disturb the operation and measurement. Do not use the instrument in a place where it is subject to direct sunlight.

3-4. Equipment installation and operation

Ensure there is proper ventilation for the vents in the oscilloscope case.

If this equipment is used in a manner not specified in these instructions, the protection afforded by the equipment may be impaired.

3-5. CRT intensity

To prevent permanent damage to the CRT phosphor, do not make the CRT trace excessively bright or leave the spot in the same place on the screen for a long time.

3-6. Maximum withstand voltage of input terminals

The maximum input voltages which can be applied to the instrument input terminals and probe input terminals are shown in the following table. Do not apply voltages higher than these limits.

Input terminal	Maximum input voltage
CH1, CH2, inputs	400V (DC + AC peak)
EXT TRIG input	400V (DC + AC peak)
Probe inputs	600V (DC + AC peak)
Z AXIS input	30V (DC + AC peak)

CAUTION. **To avoid damaging the instrument, do not apply input voltages at a frequency above 1 kHz to the instrument.**

4. FRONT AND REAR PANELS

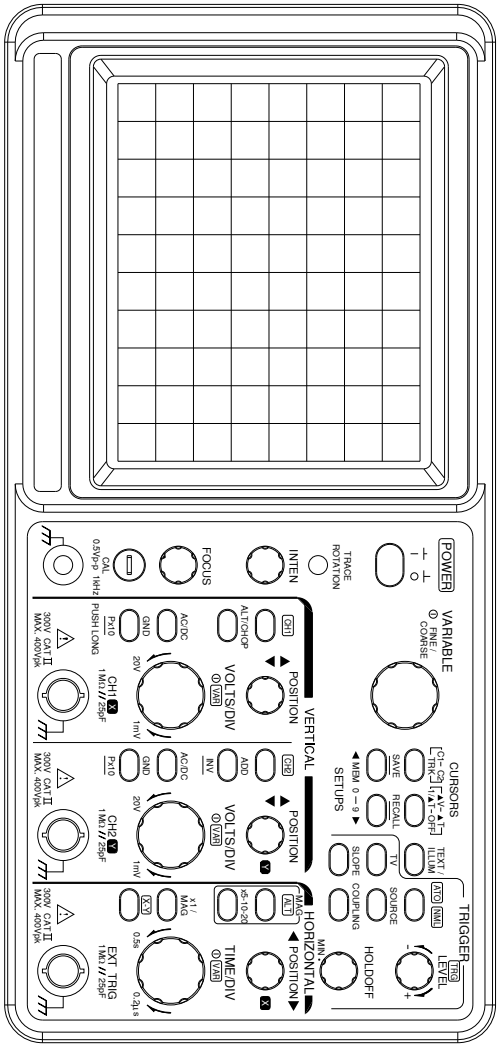
When the instrument is switched on, all significant settings are displayed on the CRT screen. The LED's located on the front panel assist operation and indicate additional information. Incorrect operation and the electrical end position of control knobs is indicated by a warning beep.

All of the buttons, the VOLTS/DIV and TIME/DIV control knobs have electronic operation and their functions and settings can be stored in the internal memories.

The front panel is subdivided into four sections as follows:

- Display controls
- Vertical controls
- Horizontal controls
- Trigger controls

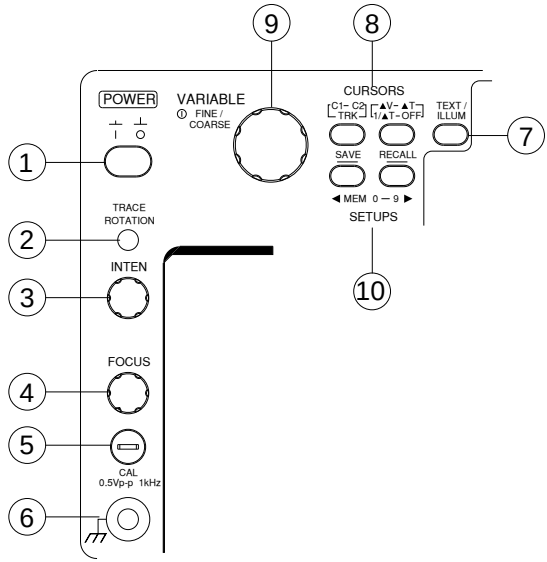
- **Front panel**


POWER
INTEN
TRACE ROTATION
FOCUS
CAL 0.5Vp-p 1kHz
VARIABLE
FINE
COARSE
CURSORS
SAVE
RECALL
SETUPS
MEM 0 ~ 9
TRIGGER
LEVEL
HOLDOFF
SOURCE
COUPLING
SLOPE
TV
TEXT/ILLUM
AUTO
NML
VERTICAL
CH1
CH2
ALT/CHOP
ADD
INV
AC/DC
GND
PULL 10
PUSH LONG
VOLTS/DIV
POSITION
HORIZONTAL
TIME/DIV
MAG
ALT
x5-10-20
X-Y
x1 / MAG
EXT TRIG
300V CAT II
MAX. 400Vpk
1MΩ // 25pF

4-1. Front panel

Display controls

The display controls adjust the on-screen appearance of the waveform and provide a probe compensation signal source.



(1) POWER – Button

When the oscilloscope is first switched on, all LEDs light as the instrument carries out a self-test routine. After a few seconds, most LEDs will extinguish and the instrument will enter normal operation mode. The instrument will revert to its last used state.

(2) TRACE ROTATION

The TRACE ROTATION allows alignment of the horizontal trace parallel with the graticule lines. Use a small screwdriver to adjust this potentiometer.

(3) INTEN—Control knob

This control knob is used for adjusting the intensity of the traces. Turn the knob clockwise to increase the intensity and turn it anti-clockwise to decrease the intensity.

(4) FOCUS

This control knob allows the trace and other information on the CRT to be focussed for best resolution. Turn the knob clockwise or anti-clockwise to obtain the sharpest image.

(5) CAL

The terminal provides a square-wave reference signal of 0.5Vp-p at 1kHz for probe adjustment.

(6) Ground Socket—Banana socket galvanically connected to safety and chassis earth

This socket can be used as a reference potential connection for DC and low frequency signal measurement purposes.

(7) TEXT/ILLUM— Double function control knob.

This button is for alternately selecting the text readout intensity function or scale illumination function. Either “TEXT” or “ILLUM” will appear on the CRT.

The TEXT/ILLUM function can be adjusted with the VARIABLE(9) control knob. Turn the knob clockwise to increase the text intensity or scale illumination, or turn the knob anti-clockwise to decrease it. Press the knob to switch the TEXT/ILLUM on or off.

(8) CURSORS MEASUREMENT FUNCTION

Two button and the VARIABLE(9) control knob are used to select and adjust the cursors and their positions on the CRT screen.

△V—△T—1/△T—OFF Button

When the button is pressed, the three measurement functions will be selected in the sequence as follows:

△V: Two horizontal cursors appear. The voltage between the two cursors is calculated according to the setting of VOLTS/DIV, and displayed with △V at the top of the CRT.

△T: Two vertical cursors appear. The time difference between the two cursors is calculated according to the setting of TIME/DIV, and displayed with △T at the top of the CRT.

1/△T: Two vertical cursors appear. The reciprocal of the time difference (frequency) between the two cursors is calculated and displayed with 1/△T at the top of the CRT.

C1—C2—TRK Button

Cursor 1, cursor 2 and tracking can be selected. Press the button to select the functions in the following sequence:

C1: Moves cursor 1 on the CRT(▼ or ► symbol is displayed)

C2: Moves cursor 2 on the CRT(▼or ► symbol is displayed)

TRK: Simultaneously moves both cursor 1 and cursor 2 with the interval between the two cursors unchanged (both symbols are displayed above the two cursors.)

(9) VARIABLE—

Turn or press the VARIABLE knob to set the cursor position, TEXT/ILLUM level etc.

In cursor mode, press the VARIABLE control knob to select the cursor position between FINE and COARSE adjustment mode. When FINE adjustment is selected, the cursor lines will move slowly when turning the VARIABLE control. Conversely, if COARSE adjustment mode is selected, the cursor will move fast.

In TEXT/ILLUM mode, this control knob can be used to set the text intensity or illumination. Please refer to TXT/ILLUM (7) for details.

(10) ◄MEMO- 9►—SAVE/RECALL

The instrument contains 10 non-volatile memories which can be used to save instrument setting and to recall them. The memories will store all controls settings that are electronically selected.

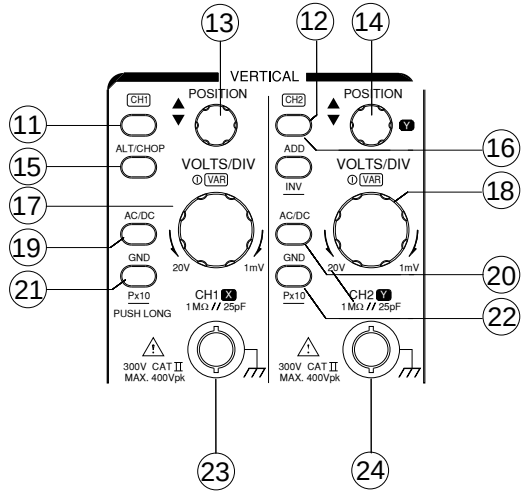
Press the ◄ or ► button to select the required memory location. The display then indicates the letter "M" followed by a digit between 0 and 9. Each time the button ► is momentarily pressed, the memory location digit increases until the number 9 is reached. The ◄ button operates in a similar manner, but decreases the memory location digit until the number 0 is reached.

Press and hold SAVE for approx. 3 seconds to write the instrument settings into the selected memory location and indicate the associated readout information with "◄┘ ".

To recall a front panel setup, select a memory location as described above. Recall the settings by pressing and holding the RECALL button for approx. 3 seconds. The readout then indicates the associated readout information with " ┌► ".

Vertical controls

The vertical controls select the displayed signals and control the amplitude characteristics.



(11) CH1—Button

(12) CH2—Button

Press the CH1 (CH2) button momentarily to select the channel 1 (or channel 2) of the instrument to on. The deflection coefficient will be displayed on the CRT to indicate the current settings.

(13) CH1 POSITION—Control knob

(14) CH2 POSITION—Control knob

The vertical trace position of channel 1 (or channel 2) can be set with this control knob.

In X-Y mode, the CH2 POSITION control knob is used for the Y deflection.

(15) ALT/CHOP

This button has two functions, which are required and available only when both channels are active.

ALT—Displays in the readout and indicates alternate channel switching. After each time base sweeps, the instrument internally switches over from channel 1 and channel 2 and vice versa.

CHOP—Indicates chopper

The channel switching constantly occurs between channel 1 and channel 2 during each sweep.

(16) ADD-INV—Button with double functions.

ADD– Displays the "+" symbol in the readout and indicates additional mode.

Whether the algebraic sum (addition) or the difference (subtraction) of both input signals is displayed depends on the phase relationship and the INV setting. As a result, both signals are displayed as one signal. For correct measurements, the deflection coefficients for both channels must be equal.

INV—Press and hold the button to set the channel 2 invert function on or off. The invert on condition is indicated by the " ↓ " symbol in the readout. The invert function causes the signal display of channel 2 to be inverted by 180^{o}.

(17) CH1 VOLTS/DIV

(18) CH2 VOLTS/DIV– Control knob for channel 1/channel 2 has double functions.

Turn the knob clockwise to increase the sensitivity in a 1-2-5 sequence and turn it in the opposite direction (CCW) to decrease. The available range is from 1mV/div up to 20V/div. The knob is automatically inactive if the related channel is switched off.

The deflection coefficients and additional information regarding the active channels are displayed in the CRT readout.

VAR

Press the VOLTS/DIV control knob to select the VOLTS/DIV function between attenuator and vernier (variable). The current setting is displayed by the ">" symbol in the CRT readout.

After switching on VAR, turn the VOLTS/DIV control knob anti-clockwise to reduce the signal height, and the deflection coefficient becomes uncalibrated.

(19) CH1 AC/DC

(20) CH2 AC/DC

Press the button briefly to switch over from AC (~ symbol) to DC (⎓ symbol) input channel coupling. The setting is displayed in the CRT readout with the deflection coefficient.

(21) CH1 GND– P×10

(22) CH2 GND – P×10 –Button with two functions.

GND

Each time the button is momentarily pressed, the input of the vertical amplifier is grounded. It is displayed in the readout as an earth (ground) symbol "⏚".

P×10

Press and hold the button to select the indicated deflection coefficient of the channel displayed in the readout between 1:1 and 10:1. The probe factor of 10:1 is displayed in the readout with the probe symbol "P×10" in front of channel indication. When cursor voltage measurement are made, the probe factor will be automatically included. The symbol must not be activated unless a 10:1 attenuator probe is being used, otherwise incorrect measurements will be made.

(23) CH1-X—Input BNC socket

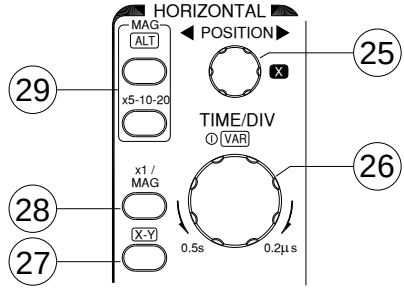
This BNC socket is the signal input for channel 1. In X-Y mode, signals at this input are used for the X deflection. The outer (ground) connection is galvanically connected to the instrument ground and consequently to the safety earth contact of the mains plug.

(24) CH2-Y—Input BNC socket

This BNC socket is the signal input for channel 2. In X-Y mode, signals at this input are used for the Y deflection. The outer (ground) connection is galvanically connected to the instrument ground and consequently to the safety earth contact of the mains plug.

Horizontal controls:

The horizontal controls select the time base operation mode and adjust the horizontal scale, position and magnification of the signal.



(25) H POSITION

This control knob enables a horizontal position shift of the signals. In combination with the MAG control, the function makes it possible to shift any part of the signal on to the screen.

In X-Y mode, the control knob is used for the X deflection.

(26) TIME/DIV-VAR– Control knobs

Turn the knob clockwise to reduce the deflection coefficient in a 1-2-5 sequence and turn it in the opposite direction (CCW) to increase. The time coefficient(s) will be displayed in the CRT readout.

The time deflection coefficients between 0.5s/div and 0.2 μs/div can be chosen in 1-2-5 sequence if the MAG function is not activated.

VAR

Press the button to alternate the TIME/DIV control knob function between time base switch and vernier (variable). After switching to the VAR function, the time deflection coefficient remains calibrated until further adjustments are made. Turn the TIME/DIV control knob counter clockwise to increase the time deflection coefficient (reduce the deflection speed) and the deflection coefficient becomes uncalibrated. The current setting is displayed by the “>” symbol in the CRT readout.

(27) X-Y

Press the button when using the instrument as an X-Y oscilloscope and the time deflection coefficient is replaced by the “X-Y” symbol in the CRT readout.

In this mode, the X (horizontal) signal is connected to the input of CH1; the Y (vertical) signal is applied to the input of CH2 and has a deflection range from less than 1mV to 20V/div, but at a reduced bandwidth of 500kHz.

(28) ×1/MAG

Press the button the select the sweep time between ×1 (normal) and MAG (magnify). If the MAG function is selected, the signal display will be expanded and consequently only a part of the signal trace is visible on the CRT. The portion of the signal of interest can be made visible with the aid of the H POSITION control.

(29) MAG FUNCTION

×5-×10-×20 MAG

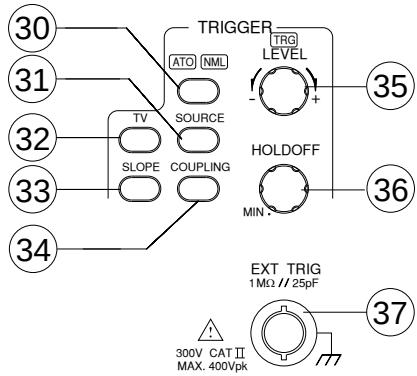
When MAG has been selected, the displayed waveform will be expanded to the right and left with the centre of the waveform displayed on the CRT. The magnification ratio can be selected from three levels of ×5-×10-×20 MAG by pressing this button.

ALT MAG

Press the button to display the primary sweep waveform together with the magnified sweep waveform. The magnified portion can be displayed simultaneously using the ALT-MAG function. The magnified sweep waveform appears 3 divisions below the primary sweep waveform.

Trigger controls

The trigger controls determine the sweep start timing for both signals.



(30) ATO/NML – Button and indicator LEDs.

Press the button to alternately select auto or normal trigger mode. The actual setting is indicated by a LED.

ATO (Auto)

Select the automatic mode and the sweep free-runs. A baseline trace will be displayed when there is no trigger signal. The setting of the trigger level changes only when the TRIGGER LEVEL control is adjusted to a new level setting.

NML (Normal)

Select normal mode and the input signal will trigger the sweep when the TRIGGER LEVEL control is set within the peak-to-peak limits of an adequate trigger signal. When the sweep is not triggered, no baseline trace will be displayed.

Use this mode when synchronizing to a very low frequency signal (25Hz or less).

(31) SOURCE—Button

Press the button to select the trigger signal source. The actual setting is indicated in the CRT readout (“SOURCE”, slope, coupling).

Each time the button is pressed, the trigger source changes in the sequence:

VERT—CH1—CH2—LINE—EXT—VERT

VERT (Vertical Mode)

For observing two waveforms simultaneously, the sync signal changes alternately corresponding to the signals on CH1 and CH2 to trigger the sweep.

CH1

The signal applied to the channel 1 input connector is the source of the trigger signal.

CH2

The signal applied to the channel 2 input connector is the source of the trigger signal.

LINE

The triggering signal is obtained from a sample of the AC power source waveform. The trigger source is useful when the displayed waveform frequency is time related to the AC power source frequency.

EXT

The external signal applied through the EXT input connector is used for the external triggering source signal.

(32) TV—Button for video sync signal selection

Separates the video sync signal from the composite waveform and directs it to the triggering circuit. The horizontal or vertical sync signals are selected by the TV button. The current setting is displayed in the CRT readout under item (source, video polarity, “TVV or TVH”). Each time the button is pressed, the video sync signal is displayed in the sequences as follows:

TV-V—TV-H—OFF—TV-V

TV-V

Start the main trace at the beginning of a video signal field. The polarity must match the composite sync polarity (i.e, “ ⌐¬ ” for negative sync) to obtain TV field triggering on the vertical sync pulse.

TV-H

Start the main trace at the beginning of a video signal line. The polarity must match the composite sync polarity to obtain TV line triggering on the horizontal sync pulse.

(33) SLOPE—Button for the triggering slope.

Briefly press the button to select the slope of the signal which is used for triggering the time base generator. Each time when the button is briefly pressed, the slope direction will switch from falling edge to rising edge, and vice versa.

The current setting is displayed in the CRT readout under item “source, SLOPE, coupling”.

If in the TV trigger mode, it is synchronized only when the sync signal is negative. A “ ⌐¬ ” symbol is displayed in the readout.

(34) COUPLING—

Press the button to select the trigger coupling. The actual setting is indicated in the CRT readout (source, slope “COUPLING”).

Each time the COUPLING button is pressed, the trigger coupling changes in the sequence:

AC—HFR—LFR—AC

AC

Attenuates trigger signal frequency components below 20Hz and blocks the DC component of the signal.

AC coupling is useful for triggering on AC waveforms that have a large DC offset.

HFR (High frequency reject)

Attenuates high-frequency triggering signal components above 50kHz. HFR coupling is useful for providing a stable display of low-frequency components of complex waveforms and eliminates high-frequency interference to the trigger signal.

LFR (Low frequency reject)

Attenuates low-frequency triggering signal components below 30kHz and blocks the DC component of the trigger signal.

LFR coupling is useful for producing stable triggering on the high-frequency components of complex waveforms and rejecting low-frequency interference or power-supply hum to the trigger signal.

(35) TRIGGER LEVEL—Control knob with TRG LED

Turn the control knob to change the trigger point (voltage) and set to a suitable position for the start of triggered sweep of the waveform. Rotate the control knob clockwise and the trigger point moves toward the positive peak of the trigger signal. Rotate it anti-clockwise to move the trigger point toward the negative peak of the trigger signal.

When the setting (voltage) value is greater or less than the highest or lowest value of the waveform, the synchronization sweep stops.

TRG LED

The TRG LED is lit if the triggering conditions are met. Whether the LED flashes or is lit constantly depends on the frequency of the trigger signal.

(36) HOLD-OFF—Control knob

Use when the signal waveform is complex and stable triggering cannot be attained with the TRIGGER LEVEL(35) knob alone. Rotate this control knob to adjust hold-off time (trigger inhibit period beyond sweep duration). When the control is rotated fully clockwise, the hold-off period is at minimum (normal). The hold-off period increases progressively with anti-clockwise rotation.

(37) TRIG EXT—This BNC socket is the external trigger signal input.

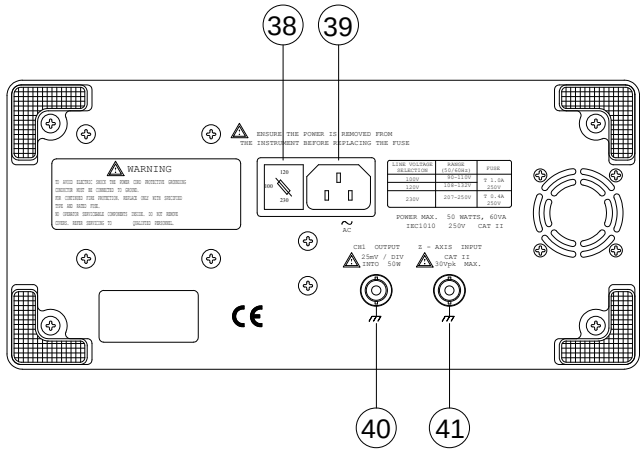
Press the TRIG. SOURCE (31) button until “EXT, slope, coupling” appears on the CRT readout and the input is switched on.

The outer (ground) connection is galvanically connected to the instrument ground and consequently to the safety earth contact of the line/mains plug.

The maximum input voltage of the input terminal is given in section 3-6. “Withstand voltage of input terminals”. Do not apply voltages above the specified limit, otherwise damage will be caused to the instrument.

4-2. Rear Panel

The rear panel provides input power and additional signal connections.



(38) Line voltage selector and input fuse holder—Allows selection of the power source voltage and contain the primary power fuse

The fuse rating is shown in the section of 3-2 “Checking the supply voltage”.

(39) AC power input connector

Allows connection of the AC mains power cord to the power supply of the instrument. The power cord protective-ground connection is connected to the exposed metal parts of the instrument. The power cord must be connected to a suitable and reliable earth connection for safety.

(40) CH1 Output—BNC socket

This output may be used to connect to a frequency counter or other instrument.

(41) Z-Axis Input—BNC socket

Connect external signals to the Z-axis amplifier for intensity modulating the CRT display. This terminal is DC-coupled. The intensity is reduced by a positive signal, while it is increased by a negative signal.

5. OPERATION

This section contains basic operation information and techniques that should be considered before proceeding with any measurements. For the location and function of instrument controls, connectors, and indicators, refer to the instructions for “Front Panel” and “Rear Panel” of this manual.

5-1. Readout display

The CRT display indicates how to set up the instrument controls. No physical markings are shown on the rotary switches to indicate the control settings. A key to the location and type of information displayed on the CRT is illustrated in figure 5-1 below:

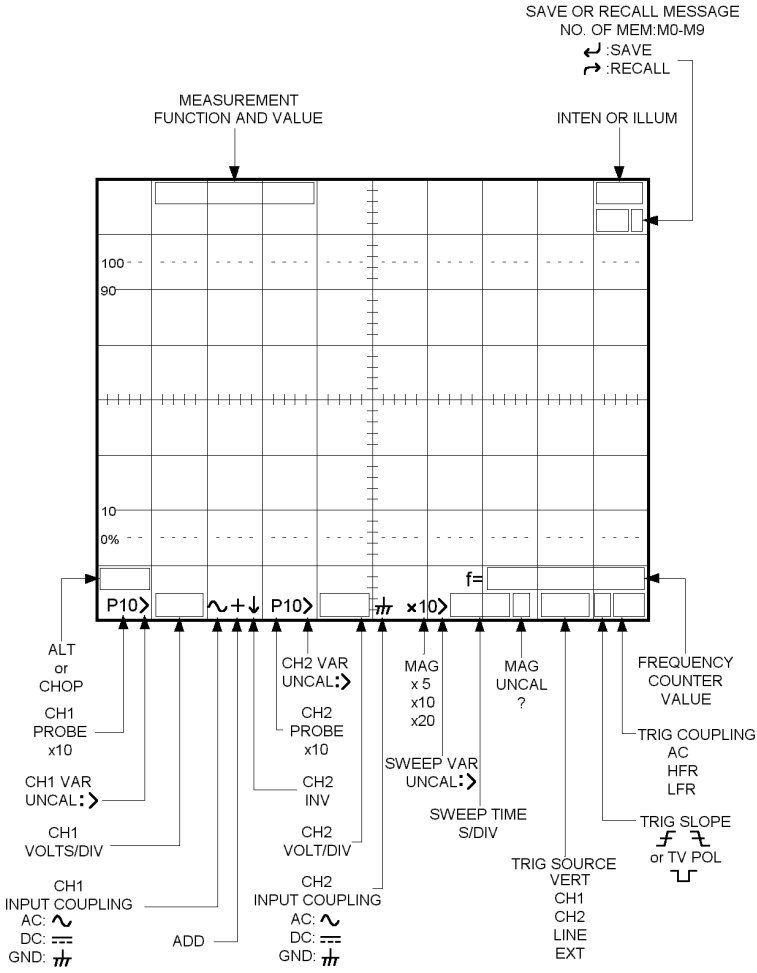


Figure 5-1 Readout Layout

5-2. Connecting input signals

Grounding

The most reliable signal measurements are made when the oscilloscope and the unit under test are connected by a common reference (ground lead) in addition to the signal lead or probe. The ground lead of the probe provides the best grounding method for signal interconnection and ensures the maximum amount of signal-lead shielding in the probe cable. A separate ground lead (with a banana plug) can also be connected from the unit under test to the oscilloscope ground jack on the front panel.

Probes

A probe provides the most convenient way to connect an input signal to the oscilloscope. The standard ×1/×10 probes supplied with the oscilloscope are shielded against electromagnetic interference and have high input impedance for low circuit loading.

***CAUTION*. To obtain the best waveform display, keep probe ground and signal leads as short as possible.**

Incorrect probe compensation can cause measurement errors. Check and adjust probe compensation whenever a probe is moved to a different channel or oscilloscope. For the probe compensation adjustment procedure, refer to the “Probe compensation” section.

Coaxial cables

Signal input cables can greatly affect the accuracy of a displayed waveform. To maintain original frequency characteristics of the input signal, use only high-quality, low-loss coaxial cables. Coaxial cables must be terminated at both ends with their characteristic impedance to prevent signal reflections within the cable. Use suitable impedance-matching devices.

5-3.Adjustments and checks

Trace rotation adjustment

Normally, when the trace is in parallel with the centre horizontal graticule line, there will be no need to adjust the TRACE ROTATION. If necessary, adjust the TRACE ROTATION to make the baseline trace parallel to the centre horizontal graticule line by using a small straight-blade screwdriver or alignment tool.

Probe compensation

To minimize the distortion of measured waveforms, check the compensation of probes before using them. The probe compensation should be checked periodically whenever the probes are used on different input channels or instruments.

1) Connect the probe to the oscilloscope (Push the BNC connector onto the required channel input socket and rotate the collar to lock it into place).
2) Set the probe slide switch to the ×10 position.
3) Briefly press the CH1/CH2 button to set the oscilloscope to channel 1 and channel 2.
4) Press and hold the P×10 button to set the indicated deflection coefficient of the channel displayed in the readout as a symbol “P10”.
5) Attach the probe tip to the CAL connection in the front of the oscilloscope.
6) Set the oscilloscope controls to display both channels:

VERTICAL:	VOLTS/DIV	0.2V
	COUPLING	DC
	ALT/CHOP	CHOP
HORIZONTAL:		
	TIME/DIV	0.5ms
TRIGGER:	MODE	ATO
	SOURCE	VERT
	COUPLING	AC
	SLOPE	

7) Observe the displayed waveform and compare it with the waveforms shown in figure 5-2. If the probe needs to be adjusted, proceed as detailed in step 8. If either probe does not need to be adjusted, proceed with "Function Check".

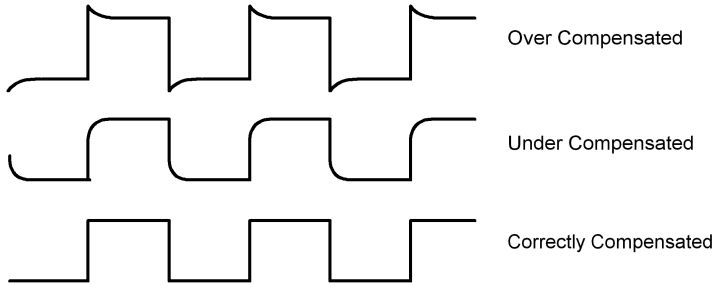


Figure 5-2 Typical compensation waveform

8) Use a small insulated screwdriver to adjust the probe. Slowly rotate the adjustment control until the probe is properly compensated.

5-4. Function check

Before using the oscilloscope to make measurements, check the instrument operates correctly as follows:

1) Connect the ×10 probes to CH1 and CH2 inputs.
2) Connect the probe tips to the CAL test point of the oscilloscope.
3) Set the oscilloscope controls to display both channels:

VERTICAL:	VOLTS/DIV	0.2V
	COUPLING	DC
	ALT/CHOP	CHOP
HORIZONTAL:		
	TIME/DIV	0.5ms
TRIGGER:	MODE	ATO
	SOURCE	VERT
	COUPLING	AC
	SLOPE	⊣⊢

The figure 5-3 below illustrates a satisfactory display. The waveform should be approximately 0.5Vp-p with a frequency of 1kHz, which confirms the correct operation of the vertical and horizontal deflection functions of the oscilloscope.

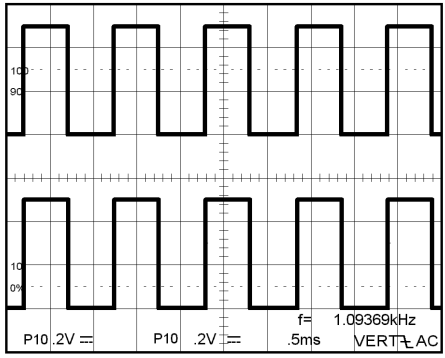


Figure 5-3

4) Set both CH1 and CH2 COUPLING to GND.
5) Use the CH1 and CH2 POSITION controls to align both traces on the centre graticule.
6) Operate the CH2 INV by pressing and holding the button.
7) Set to the ADD mode by pressing the ADD button briefly.
8) Set both CH1 and CH2 COUPLING to DC.
9) The figure 5-4 below shows a satisfactory display. The display will show a flat trace located on the centre gracticule that confirms the correct operation of channel balance and ADD offset function.

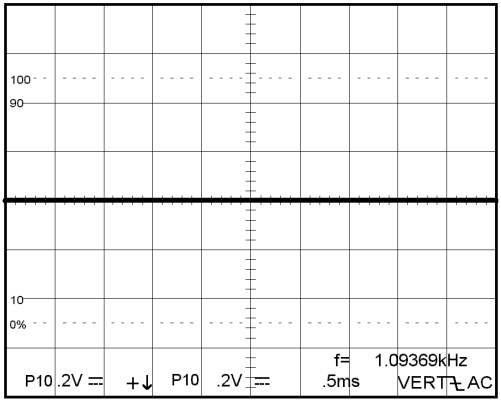


Figure 5-4 ADD mode

10) Turn off the ADD mode by pressing the ADD button briefly.
11) Turn off the CH2 INV by pressing and holding the button.

5-5. Basic operation

Displaying CH1 or CH2

To display the signal from a signal channel, briefly press the CH1 or CH2 button to set the oscilloscope to channel 1 or channel 2 mode.

Displaying CH1 and CH2

To display both signals at the same time, proceed as following:

1) Set the CH1 and CH2 on. The figure 5-5 below shows two synchronous waveforms in both modes.
2) Adjust the CH1 or CH2 POSITION control to position the two waveforms.
3) Set the ALT/CHOP button to CHOP mode if the waveforms are flickering.

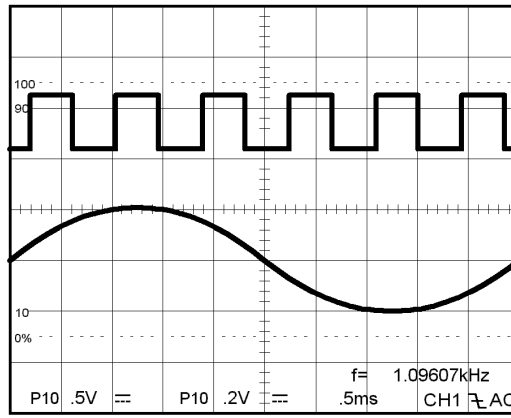


Figure 5-5 Both typical waveforms

Displaying the sum or difference of CH1 and CH2

To display the algebraic sum or difference of CH1 and CH2, proceed as follows:

1) Set the ADD button to ADD mode. Figure 5-6 below shows the sum of the waveforms from figure 5-5.
2) Set the CH2 INV to on by pressing and holding the button, if necessary, to display the different waveform.
3) Press and hold one of the VOLTS/DIV control knobs to set it to vernier (variable) mode. Adjust one channel to match the other in the event of gain difference.

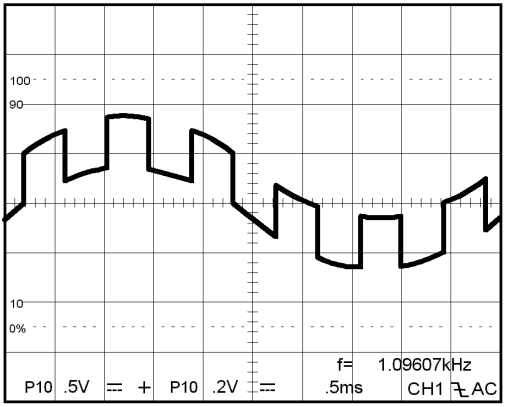


Figure 5-6 Typical ADD waveform

Comparing frequency and phase (X-Y Operation)

Comparison of the frequency and phase of two signals can be made by using the X-Y mode. The X-Y waveform displays different amplitude, frequency, and phase. The figure 5-7 shows a typical waveform made up of two signals that are of the same frequency and amplitude, but approximately 45^{o} out of phase.

To use the oscilloscope in the X-Y mode, proceed as follows:

1) Connect the horizontal or X-axis signal to the CH1 input.
2) Connect the vertical or Y-axis signal to the CH2 input.
3) Set the X-Y button to X-Y operation (shown as Fig. 5-7 below).

Use the HORIZONTAL POSITION control to adjust the X-axis.

Note: When high frequency signals are displayed in the X-Y mode, the frequency bandwidths and phase difference between X and Y axis may be altered by the characteristics of the input circuits of the amplifiers. Refer to "2. SPECIFICATION" section for details.

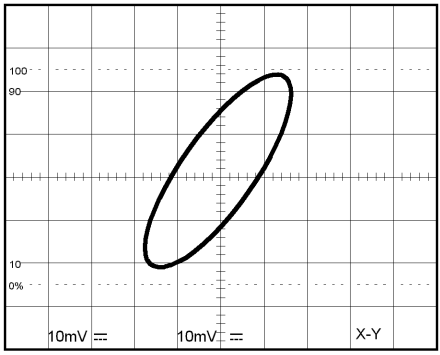


Figure 5-7 Typical single X-Y display.

Magnifying waveform events

Use the MAG button to view small portions of a waveform which are too far from the starting point to view by using the TIME/DIV control. To use the MAG button, proceed as follows:

1) Adjust the TIME/DIV to the fastest sweep that displays the event.
2) Rotate the HORIZONTAL POSITION control to move the event to be visible on the centre of screen.
3) Press the MAG button.
4) Select MAG ×5, MAG ×10, or MAG ×20 for MAG function as required.

The displayed waveform will be expanded 10 times to the right and left from the centre of screen as centre of expansion.

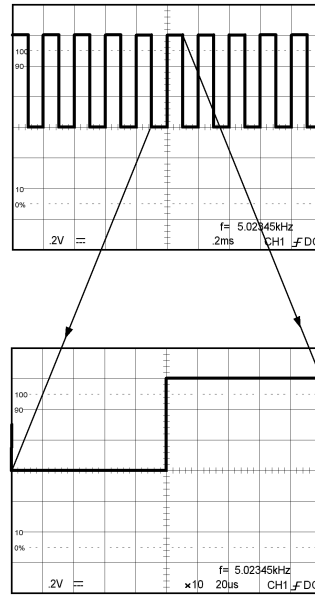


Figure 5-8 Magnified Waveform

MAG-ALT function

The input signal is displayed by pressing MAG(magnify) and MAG-ALT(LED lit) buttons:

1) Set the required portion of the waveform to the centre of the screen for magnification.
2) The magnified waveform appears approximately 3 divisions below the normal (×1) waveform.
3) When the MAG-ALT button is pressed, all text and other characters will disappear from the screen.

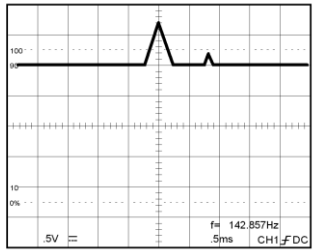
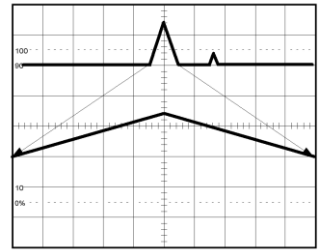


Figure 5-9(a) Mag.×1 waveform



igure 5-9(b) Mag.×10 waveform

Operating hold-off time control

When the measured signal is a complex waveform with two or more repetition frequencies (period), triggering with the LEVEL control alone may not be sufficient to attain a stable waveform display. A stable sweep can be obtained if synchronized to the measured signal waveform by adjusting the hold-off time of the sweep waveform.

Figure 5-10(a) shows several different waveforms which overlap on the screen, making the signal observation difficult when the hold off is set to minimum.

Figure 5-10(b) shows the nuisance portion of the signal is held off. The same waveforms are displayed on the screen without overlap.

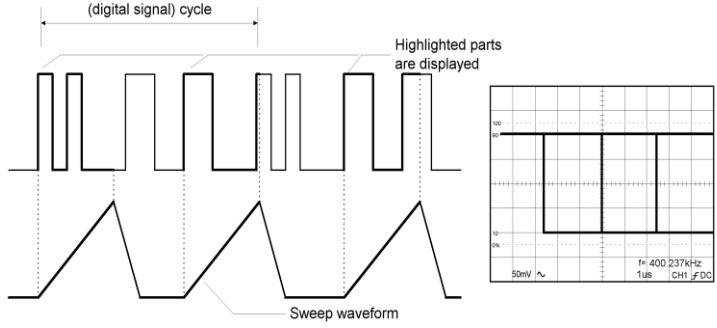


Figure 5-10(a)

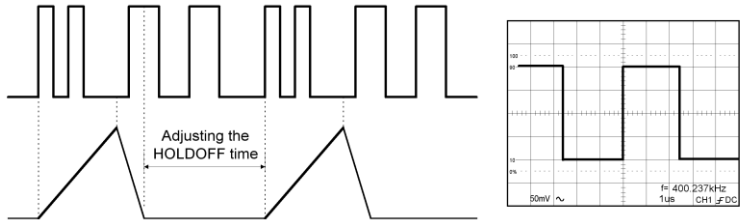


Figure 5-10(b)

Observing the synchronization of two waveforms

When two signals of CH1 and CH2 have the same frequencies with an integral number, or a specific time difference, the SOURCE selects either CH1 or CH2 as a reference signal. Select CH1 signal from CH1 position and select CH2 signal from CH2 position as a reference.

Set the SOURCE to VERT-MODE for observing the signal of different frequencies. Switch the sync signal alternately to each channel and a stable waveform of each channel will appear.

When SOURCE is set to VERT-MODE and the ALT/CHOP is set to ALT, the input signals applied to CH1 and CH2 will become trigger sources alternately during the sweep. Consequently, waveforms of different frequencies will appear stable on the CRT as each is triggered seperately.

Apply a sine wave to CH1 and a square wave to CH2. Figure 5-11 shows the portions of the signals indicated by "A" which are at an acceptable level to provide synchronization.

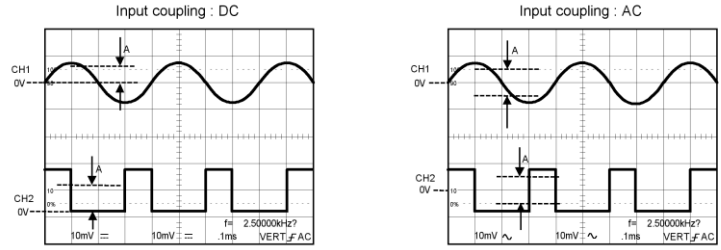


Figure 5-11 Trig. Source on VERT

Apply AC coupling to CH2 in order to expand the synchronization range.

If the input signal of CH1 or CH2 becomes small, adjust the VOLT/DIV control knob to obtain sufficient amplitude.

The VERT-MODE triggering requires 2.0 divisions, which is larger than the amplitude of CH1 or CH2.

The VERT-MODE triggering is not possible when the signal is applied only to one channel as shown in Figure 5-12 below:

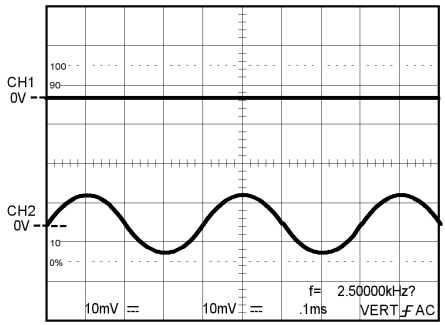


Figure 5-12 Trig. Source on VERT. one channel

ALTERNATE TRIGGER

The jittering wave as shown in Figure 5-13 may appear on the screen when a gently-sloping signal displays approximately 10 cycles or less by setting VERT-MODE to SOURCE, and setting ALT/CHOP button to ALT. For detailed and clear observation of each signal, set VERTICAL mode to CH1 or CH2.

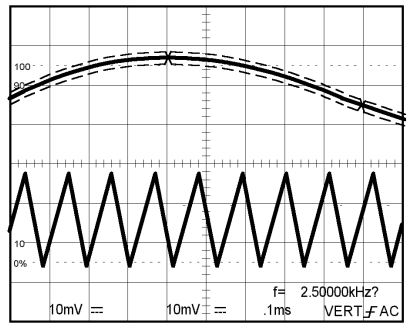


Figure 5-13 Alternate Trig.

Triggering of video signal

In television related applications, complex waveforms containing video signals, blanking, pedestal and synchronizing signal often require measurement

Press the TV button to set to TV mode. The built-in active TV sync-separator separates the frame or line sync-pulses from the video signal. To trigger the oscilloscope at the vertical (frame) rate, press the TV button to set TV-V and TV-H triggering. Figure 5-14(a) shows the vertical signal of TV-V and Figure 5-14(b) shows the horizontal signal of TV-H.

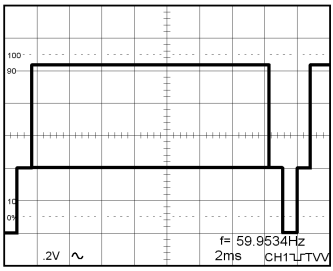


Figure 5-14(a) TV-V

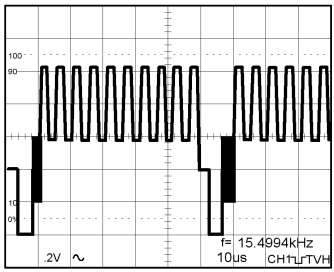


Figure 5-14(b) TV-H

Figure 5-15 shows examples of TV polarity synchronization signals.

Note: This oscilloscope synchronizes with only (⌐¦¬) synchronizing signal.

REFERENCE:

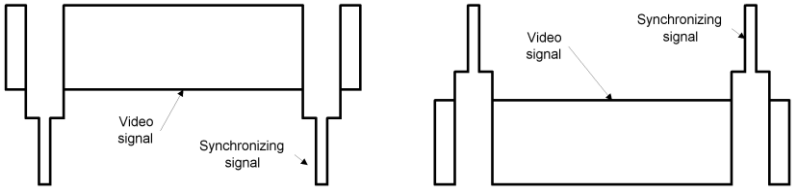


Figure 5-15 TV Signal

5-6. Measurement applications

The oscilloscope has a cursor measurement system for making accurate, direct-readout voltage, time and frequency measurements. The measurements described in this section are examples of typical applications using this measurement system. After becoming familiar with the controls, indicators, and capabilities of the instrument, you can develop techniques to make measurement in specific applications.

To make a measurement using the cursor, proceed as follows:

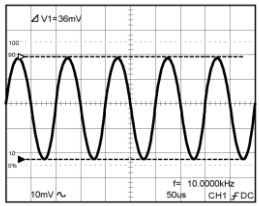
1) Press the [△V—△T, 1/△T—OFF] buttons to turn on the cursor and measurement readout.
2) Press the button to select the seven measurement functions in the sequence as below:

   △V —△T —1/△T—OFF
3) Press the [C1—C2 TRK] button to select C1(▼) cursor, C2(▽) cursor and tracking cursor.
4) Rotate the VARIABLE control knob to position the selected cursor. Press one of the VARIABLE control knobs to select FINE or COARSE cursor movement rate.
5) Read the measurement value on the screen. Typical measurement readouts and applications are shown in Figure 5-16. The measurement values are automatically controlled by the VOLTS/DIV and TIME/DIV control settings.

Figure 5-16: Cursor Measurement

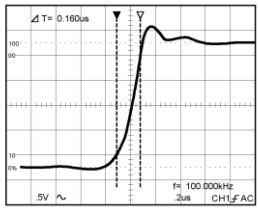
(a).Typical △V (Voltage difference) for AC voltage.

When both CH1 and CH2 are turned on, the measurement value is with reference to CH1(△V1).



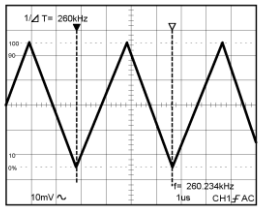
(b).Typical △T (Time difference) cursor measurement for rise time.

Before making measurement of rise or fall-times, some additional signal scaling by use of the graticule rise-time measurement aids is required. The values 0, 10, 90 and 100% are etched near the left vertical graticule line. Use the following method as a guide to making rise-time measurement:



(c).Typical 1/ △ T cursor function for frequency measurement.

When the two cursors are superimposed at two edge points of the one period waveform by the [C1—C2 TRK] and VARIABLE controls, the measurement value is displayed in frequency units at the top of the screen.



NOTE. When the VOLTS/DIV or the TIME/DIV controls are in uncalibrated setting, the △V and △T measurement values will be displayed with divisions.

When the vertical mode is set to the ADD mode, and the CH1 and CH2 VOLTS/DIV controls are set to different scales, the △V measurement values will be displayed with divisions.

6. MAINTENENCE

Maintenance should only be carried out by qualified personnel, using the correct components, equipment and procedures. To avoid electrical shock, do not perform any servicing other than that detailed in these instructions. For repair and maintenance other than as detailed in these instructions, contact the supplier or RS Components, the address is given at the end of these instructions.

6-1. Fuse Replacement

WARNING. Disconnect power cord before replacing the fuse. For continued protection, replace the fuse only with the specified type and rating.

If the fuse blows, the power indicator will not light and the oscilloscope will not operate. The fuse should not normally fail unless a problem has developed in the instrument. Determine and correct the cause of the problem, before replacing with a fuse of the correct rating and type as detailed on the rear panel.

6-2. Line voltage conversion

The primary winding of the power transformer is tapped to permit operation from 100, 120, or 230V, 50/60Hz AC. Conversion to a different voltage is achieved by changing the voltage selector switch as shown in page 7. The rear panel identifies the voltage to which the unit was factory set. To convert to a different voltage, perform the following procedure:

1) Ensure the power cord is unplugged.
2) Remove the line voltage selector and refit it in the required position for the new voltage.

Note: A change in line voltage may also require a corresponding change of fuse value. Install the correct fuse as listed on the rear panel.

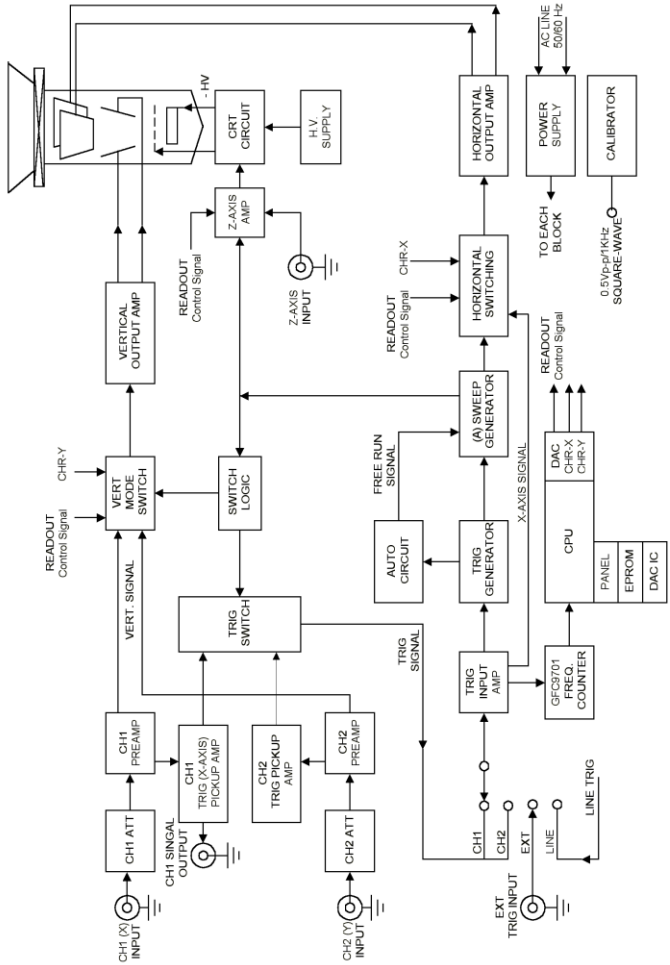
3) Reconnect the power cord, turn the instrument on and check for correct operation.

6-3. Cleaning

To clean the oscilloscope, use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the oscilloscope, as it may leak into the cabinet and cause damage.

Do not use chemicals containing benzine, benzene, toluene, xylene, acetone, or similar solvents. Do not use abrasive cleaners on any portion of the oscilloscope.

7. Block diagram



Limited Warranty

This meter is warranted to the original purchaser against defects in material and workmanship for 3 years from the date of purchase. During this warranty period, RS Components will, at its option, replace or repair the defective unit, subject to verification of the defect or malfunction. This warranty does not cover fuses, disposable batteries, or damage from abuse, neglect, accident, unauthorized repair, alteration, contamination, or abnormal conditions of operation or handling. Any implied warranties arising out of the sale of this product, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited to the above. RS Components shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim or claims for such damage, expense or economic loss. Some states or countries laws vary, so the above limitations or exclusions may not apply to you. For full terms and conditions, refer to the RS PRO website.

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