MODEL VC-5460/VC-5430/VC-5410

DIGITAL OSCILLOSCOPE

OPERATION MANUAL

Hitachi Denshi, Ltd.

NOTES FOR A SAFETY OPERATION

This operation manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.
The instrument has been designed for indoor use. It may occasionally be subjected to temperatures between +5℃ and -10℃ without degradation of its safety.

Before connecting the specified AC adaptors, make sure that the AC adaptor corresponds with your local line voltage.

⚠Use only the specified AC adaptor.

No.1801 : 90-110V AC, 50/60Hz
No.1802 : 108-132V AC, 60Hz
No.1803 : 198-253V AC, 50Hz
No.1804 : 216-264V AC, 50Hz

When the instrument is connected to its power supply via the specified AC adaptor, terminals may be live, and the opening of covers is likely to expose live parts.

Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by our authorized service person who is aware of the hazard involved.
Whenever it is likely that the protection has been impaired, the instrument must be powered off and be secure against any unintended operation.

The protection is likely to be impaired if, for example, the instrument:

- shows visible damage,
- fails to perform the intended measurements,
- has been subjected to prolonged storage under unfavorable condition,
- has been subjected to severe transport stresses.

Do not use or store the instrument in an extremely warm or cold place.

- The operating ambient temperature is between 0°C and +40°C.
- The storage ambient temperature is between -20°C and +60°C.

Do not use or store the instrument in an extremely wet or dry place.

- The operating relative humidity is between 45% and 80%.
- The storage relative humidity is between 35% and 85%.

Do not apply a heavy shock to the instrument.

READ THE IMPORTANT SAFETY-RELATED MARKINGS CAREFULLY BEFORE USE.

NOTE THE FOLLOWING SAFETY RELATED MARKINGS AND SYMBOLS.

(1) Terms

DANGER:	Risk of hazard which causes serious injury to persons.
WARNING:	Risk of hazard which may cause serious injury to persons.
CAUTION:	Risk of hazard which may cause injury to persons, fire hazard or serious damage to the oscilloscope.
IMPORTANT:	Important note not related to risk of hazard directly
NOTICE:	Important note not related to risk of hazard, but observed for installation, operation, maintenance, etc.

(2) Symbols

DANGER : DANGER
WARNING : WARNING
CAUTION : CAUTION

Note: The model and serial numbers of your OSCILLOSCOPE are important for you to keep for your convenience and protection. These numbers appear on the nameplate located on the rear of the oscilloscope. Please record these numbers in the spaces provided below, and **retain this manual for future reference.**

Model No _____ **Serial No.** _____

SAFETY CONTENTS

IMPORTANT
SAFETY INSTRUCTIONS

CAUTION

RISK OF ELECTRIC SHOCK
DO NOT OPEN

CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER. NO USER – SERVICEABLE PARTS INSIDE.REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

Explanation of Graphical Symbols

The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the oscilloscope's enclosure; that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the oscilloscope.

WARNING : TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS OSCILLOSCOPE TO RAIN OR MOISTURE.

IMPORTANT

SAFEGUARDS

Read Instructions

All the safety and operating instructions must be read before the oscilloscope is operated.

Retain Instructions

The safety and operating instructions must be retained for future reference.

Heed Warnings

All warnings on the oscilloscope and in the operating instructions must be adhered to.

Follow Instructions

All operating and use instructions must be followed.

Cleaning

Unplug this oscilloscope from the power source before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

⚠ **CAUTION**

Attachments

Do not use attachments not recommended by the oscilloscope manufacturer as they may cause hazards.

⚠ **WARNING**

Water and Moisture

Do not use this oscilloscope near water - for example , near a bath tub, wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool, and the like.

⚠ **WARNING**

Accessories

Do not place this oscilloscope on an unstable cart, stand, tripod, bracket, or table. **The oscilloscope may fall, causing serious injury to a person, and serious damage to the oscilloscope.** Any mounting of the oscilloscope should follow the manufacturer's instructions, and must use a mounting accessory recommended by the manufacturer.

⚠ **CAUTION**

Ventilation

Slots and openings in the cabinet are provided for ventilation and to ensure reliable operation of the oscilloscope and to protect it from over-heating, and these openings must not be blocked or covered.

The openings must never be blocked by placing the oscilloscope on a bed, sofa, rug, or similar surface. This oscilloscope should never be placed in a built-in installation such as a bookcase or rack unless proper ventilation is provided or the manufacturer's instructions have been adhered to.

⚠ **WARNING**

Power Sources

The AC-DC conversion adaptor should be operated only from the type of power source indicated on the marking label. If you are not sure of the type of power supply to your home,

consult your oscilloscope dealer or local power company. The oscilloscopes are intended to operate from battery power.

⚠**WARNING**

Power-Cord Protection

Power-supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the oscilloscope.

Lightning

For added protection for this oscilloscope during a lightning storm, of when it is left unattended and unused for long periods of time, unplug it from the power source. This will prevent damage to the oscilloscope due to lightning and power-line surges.

⚠**WARNING**

Overloading

Do not overload power source and extension cords **as this can result in a risk of fire or electric shock.**

⚠**WARNING**

Object and Liquid Entry

Never push objects of any kind into this oscilloscope through openings as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Never spill liquid of any kind on the oscilloscope.

⚠**WARNING**

Flammable and Explosive Substance

Avoid using this oscilloscope where there are gases, and also where there are flammable and explosive substances in the immediate vicinity.

Heavy Shock or Vibration

When carrying this oscilloscope around, do not subject the oscilloscope to heavy shock or vibration.

⚠**WARNING**

Servicing

Do not attempt to service this oscilloscope yourself as opening or removing covers may expose you to dangerous voltage or other hazards. Refer all servicing to qualified service personnel.

⚠**WARNING**

Damage Requiring Service

Unplug this oscilloscope from the power source and refer servicing to qualified service personnel under the following conditions:

a. When the AC-DC conversion adaptor cord or plug is damaged.
b. If liquid has been spilled, or objects have fallen into the oscilloscope.
c. If the oscilloscope has been exposed to rain or water.
d. If the oscilloscope does not operate normally by following the operating instructions. Adjust only those

controls that are covered by the operating instructions as an improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the oscilloscope to its normal operation.

⚠ **WARNING**

Replacement Parts

When replacement parts are required, be sure the service technician has used replacement parts specified by the manufacturer or have the same characteristics as the original part. **Unauthorized substitutions may result in fire, electric shock or other hazards.**

Safety Check

Upon completion of any service or repairs to this oscilloscope, ask the service technician to perform safety checks to determine that the oscilloscope is in proper operating condition.

IMPORTANT

SAFETY OPERATIONS

Before operating the oscilloscope, be sure to check the following items.

⚠ **DANGER**

Operation in gas

Do not use the oscilloscope in flammable gas or vapor to avoid possible explosion.

POWER switch

Before plugging in the AC-DC conversion adaptor be sure to check that the POWER switch is set to OFF for protection of the oscilloscope.

⚠ **WARNING**

Removal of the chassis cover

Do not remove the chassis cover to avoid the risk of electric shock since a high voltage presents inside the oscilloscope.

⚠ **WARNING**

Line voltage

Use the AC-DC conversion adaptor within the specified line voltage. (90 to 110V AC at 50/60Hz, 108 to 132V AC at 60Hz, 198 to 253V AC at 50Hz or 216 to 264V AC at 50Hz)

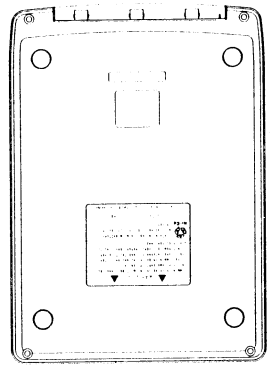
If an abnormal operation occurs, turn off the power for a short time and check the line voltage. If the line voltage is the

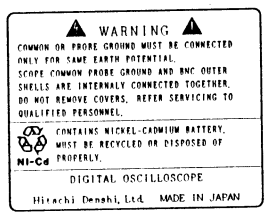
specified voltage, turn on the power back.
The oscilloscope operates normally with the 90 to 110V AC at 50/60Hz, 108 to 132V AC at 60Hz, 198 to 253V AC at 50Hz or 216 to 264V AC at 50Hz line voltage. If the line voltage is out of the above range (especially low voltage), the normal operation may not be retored after the correct line voltage is applied.

IMPORTANT

WARNING MARKING

The caution label is printed on the bottom of the oscilloscope. (Refer to Fig. A.)
The caution label is shown in Fig. B.
Observe the caution to assure proper handling





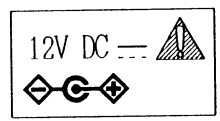


Fig. A and **Fig. B**

INSTRUCTIONS BEFORE USE

Introduction

Thank you for purchasing Hitachi Denshi oscilloscope. In order to be able to use the instrument for a long time, read the manual carefully. Keep the manual together with the guarantee policy.

1. Guarantee range

The oscilloscope has strictly been quality controlled and inspected. If it has troubled at a normal operating status, it will be repaired according to the "Guarantee policy for Hitachi Denshi measuring instrument" furnished with the manual. If the policy is not provided, contact your local Hitachi Denshi sales office or sales agent.

2. After-sale service

The oscilloscope has been designed, manufactured and in spected so as to operate at a good condition upon different environmental tests taking into account various working circumstances on the user side. In case of fault, contact your local HItachi Denshi sales office or sales agent.

3. Safety terms and marks

(1) Terms in manual

Warning ... If you do not observe a warning, an accident might injure the human body or affect the life.

Caution ... The caution covers matters which might damage the instrument or other devices connected to it.

(2) Marks

DANGER

The section marked "DANGER" may damage the human body or affect the life.

DANGER

High voltage in the instrument.

CAUTION

Refer to corresponding section in the manual.

SAFETY CAUTION

⚠ **WARNING**

The instrument has high voltage sections. To avoid electric shock, do not remove the cover. Internal adjustment or part replacement must be done by qualified service personal.

⚠ **WARNING**

When conecting a probe or a signal input cable to the circuit under test, connect the ground side of the probe or the signal input connector to the ground of the signal source.
At a floating status, a potential might be produced with respect to other devices or ground, resulting in damaging the oscilloscope, probe, other measuring instruments, etc., and causing serious injury to a person.

⚠ **WARNING**

Do not operate the instrument in atmosphere containing combustible gas. There is a risk of explosion.

⚠ **WARNING**

Do not try to insert metallic wire, pin or other metal pieces into the instrument. There is a risk of electric shock.

NOTES TO USERS

① Caution for line voltage fluctuation

Use the instrument within the line voltage ranging from 108 to 132V AC at 60Hz from, 90 to 110V AC at 50/60Hz, from 198 to 253V AC at 50Hz or from 216 to 264V AC at 50Hz to ensure proper operation. If the line voltage is out of the specified range (when lower particularly), a normal operation could not be recovered even when a specified voltage is resumed.

② Notice for proper measurement

It is recommended to allow about 20 minutes after power on as warm-up time before starting measurement. Traces may drift a little just after power on.
When measuring a signal with high accuracy or caring about trace displacement in particular, you can corrent the trace position using the automatic calibration function. Before starting up this function, allow enough warm-up time (about one hour).

③ Caution when built-in battery is consumed

This instrument is provided with a built-in battery and keeps calibration data, setup data, save data, etc. even after power off.
When the battery is consumed, the instrument will no longer keep data and will perform the following operation.

(1) Automatic calibration is performed without fail at power

on.

(2) Setup is set to default when power is turned on.

(3) Saved waveform data and setup data are lost when power is turned off.

If this operation is performes, contact your nearest Hitachi Denshi representative for replacement of the battery. The battery is consumed also when this instrument is turned off.

ATTENTION

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of it's useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with you local solid waste officials for details in your area for recycling options or proper disposal.

Ni-Cd

Hitachi Denshi, Ltd. MADE IN JAPAN

④ Caution when connecting plotter and personal computer

(1) When connecting a plotter and a personal computer, be sure to turn off this instrument, the plotter and the personal computer, and connect them.

(2) Before operation, be sure to carry out the settings necessary for the plotter and the personal computer. (For the settings of the plotter and the personal computer, refer to the operation manual for each.)

If you should operate the plotter and the personal computer which are improperly set, abnormal operation will be caused.

In this case, turn off this instrument, the plotter and the personal computer once, and set them properly again and operate them.

Chapter 1 Introduction

1.1 Features

1) Compact, lightweight and unique design

- B5 size
- 2kg
- Notebook type

2) High quality waveform display

- High speed refresh display : TFT LCD equal to CRT
- Waveform, setting values and measured values of each channel are classified by color : Easy channel identification
- Sharp, clear screen display : High brightness fluorescent lamp backlight
- High resolution and high fidelity display using raw data of 1500W(1200W) per waveform

3) User friendly operation panel

- Switches and controls frequently used are conveniently arranged.
- Five rotary switches are provided for analog settings such as position and level.

4) Battery operation

- Standard builtin battery operation
  Measurable time: 1 hour(VC-5460)
  2 hours(VC-5430/VC-5410)
- Rechargable by AC adaptor during operation

5) Differential measurement function

- Differential input/differential trigger function for measurements of non-grounded communication networks such as LAN and telephone line: Usable in wide range applications

6) High performance and various functions

- High speed samplings:60Ms/s(VC-5460(single channel)) : 30Ms/s (VC-5430), 15Ms/s (VC-5410)
- Wide band equivalent sampling : 150MHz(VC-5460), 50MHz (VC-5430), 20MHz (VC-5410)
- Large capacity data acquisition : 2KW/CH
- Remote control through RS-232C : Full programmable
- A variety of automatic measurement functions : Autosetup, pulse parameter measurements, GO-NOGO judgment (VC-5460/VC-5430), cursor measurement, panel setup, etc.
- Waveform save capability : 100 waveforms (VC-5460/VC-5430), 10 waveforms (VC-5410)
- Hardcopy functions : Printer and plotter outputs

7) New functions most suitable for field use

- Resume function
- Intermittent data acquisition by timer (VC-5460/VC-5430)
- Auto power off
- Divide triggering
- TV LINE triggering (VC-5460 only)

1.2 Composition

(1) Oscilloscope, VC-5430 or VC-5410 ..... 1 unit
(2) Accessories
Probe, AT-10AW1.5(VC-5460), AT-10AK1.5 or AT-10AY1.5 (VC-5430/VC-5410) ..... 2 pcs.
Operation manual ..... 1 copy
Operation guide ..... 1 copy
AC-DC conversion adaptor ..... 1 pc.

1.3 Precautions

≪Installation≫

- Avoid installing the instrument in an extremely warm or cold place.
- Avoid placing the instrument in a place exposed directly to sunlight for a long time, in a car in mid-summer, or near a room heating device.
- The maximum operating ambient temperature is 40°C.
- * Do not use the instrument outdoors for a long time on a cold winter day. The operating ambient temperature is 0°C or more.
- * Avoid moving the instrument from a cold place to a warm place and vice versa, or condensation may form inside the instrument.
- * Keep the instrument away from damp air, water, and dust. Unexpected trouble may be caused when the instrument is placed in a damp or dusty place. The operating ambient humidity is 45 to 80%. Do not place a liquid-filled container on the instrument. An accidental intrusion of liquid may also cause troubles.
- * Do not place or use the instrument in a place subject to vibration.
- * Do not place the instrument near a magnet or a magnetic body. Do not bring a magnet close to the instrument or do not use the instrument near an equipment generating strong magnetic force.

≪Operating considerations≫

- * Do not put a heavy object on the instrument.
- * Do not block ventilation holes.
- * Do not apply a heavy shock to the instrument.
- * Do not insert a wire, pin, etc. through ventilation holes.
- * Do not drag the instrument with a probe connected.
- * Do not leave a hot soldering iron on or around the cabinet or the screen.
- * Do not try to turn the instrument upside down. Otherwise, knobs may be broken.

≪Care≫

- * Removal of stain from the case
- When the outside of the case is stained, wipe it lightly using a neutral detergent and then clean the surface with a dry cloth.

«Maintenance and storage method»

- This instrument uses many transistors, diodes, ICs and precision parts.
- Wipe the display filter from time to time by a clean and soft cloth.
- Ideal ambient temperature and relative humidity for storing the instrument are 20°C and 65%.

≪Calibration period of this Instrument≫

The calibration is classified into the software calibration resorting to the automatic calibrating function in the menu and the hardware calibration for optimizing the internal circuitry in a wide range.

The software calibration is recommended when the ambient temperature has excessively changed (beyond 10°C) or when 1,000 operating hours or 6 months has been attained. If the trace is displayed excessively or when it is desired to optimize the measurement, execute it referring to the section 6.10 automatic calibration.

The hardware calibration is necessary to keep the instrument to a stable operation status. It is recommended to adjust the instrument every 2,000 operating hours or every year.

≪Caution before measurement≫

- Check the line voltage.

  When using the supplied AC adaptor, the operating voltage range for this oscilloscope is 90 to 110V AC, 108 to 132V AC, 207 to 253V AC or 216 to 264V AC.

  Before turning on the power switch, check the line voltage.

  When using the oscilloscope on a commercial AC source, connect the supplied AC adaptor to the instrument.

- Do not apply an excessive voltage.

  The connector and probe input voltages are specified as follows.

  Do not apply higher voltages.

  Input direct: 42Vpk (DC + ACpeak + floating voltage)

  AT-10AK1.5 probe used:

  400V (DC + AC peak + floating voltage)

CAUTION

A higher voltage applied might damage the instrument.
Never apply excessive input voltages.

Chapter 2 Panel Description

2.1 Panel

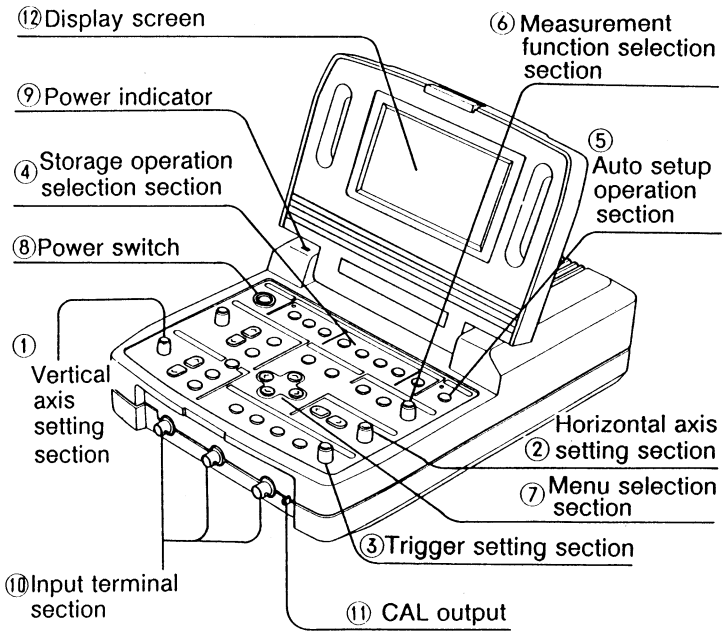


Fig.2-1 Front view

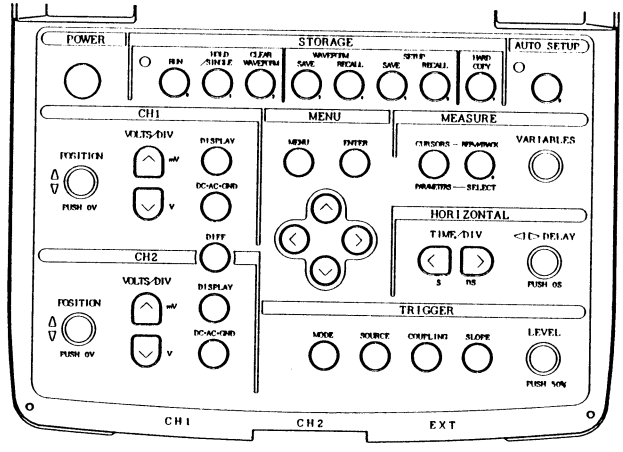


Fig.2-2 Operation panel

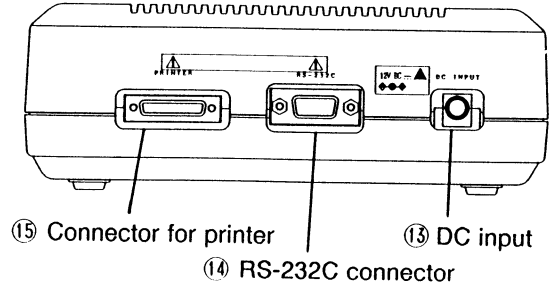


Fig.2-3 Rear view

2.2 Function of each section

2.2.1 Front Panel

① Vertical axis setting section (CH1, CH2)

The controls and switches for setting the vertical axis range are provided independently for channels 1 and 2.

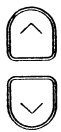
DISPLAY

With this switch, a waveform can be displayed on the screen. When a waveform is displayed, the vertical axis setting read-outs of the corresponding channel are also displayed.

DC·AC·GND

With this switch, the coupling mode is changed to DC to AC to GND in this sequence.

VOLTS/DIV



Pressing the mV switch changes the vertical axis range to the high sensitivity range, while pressing the V switch changes to the low sensitivity range.

For the VC-5430 or VC-5410, continuous pressing establishes the uncalibrated variable mode, and a signal can be magnified or compressed vertically.

(VC-5460 is not provided with the variable mode.)

POSITION

PUSH 0V

Clockwise rotation moves a displayed waveform upward, while counterclockwise rotation moves the waveform downward.

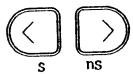
Pressing this control resets the waveform to the original position.

When this switch is pressed in the RUN mode, the position is reset to zero volts, and the ground point is displayed at the center of the screen.

When this switch is pressed in the HOLD mode, the waveform is reset to the original position.

② Horizontal axis setting section (HORIZONTAL)

TIME/DIV



Pressing the nS switch changes a sweep time to the high speed sweep range, while pressing the S switch changes to the low speed sweep range.

DELAY

PUSH 0S

With this control, the trigger point of the waveform to be measured can be set with the current trigger point as a reference.

Clockwise rotation displays the waveform at the left side of the set trigger point, while counterclock wise rotation displays the waveform at the right side of the set trigger point.

Pressing this switch reset the moved waveform to the original position.

When this switch is pressed in the RUN mode, the delay time is reset to 0s., and the

trigger point is displayed at the center of the screen.
When this switch is pressed in the HOLD mode, the delay amount after HOLD is reset.

③ Trigger setting section (TRIGGER)

MODE

With this switch, a trigger mode can be changed to AUTO to NORMAL to TV-V to TV-H to TV-L (VC-5460 only)in this sequence.

SOURCE

When CH1 or CH2 is displayed, a trigger signal source can be set to CH1, CH2 or EXT.

When DIFF is displayed, DIFF and EXT are switched alternately.

COUPLING

With this switch, a trigger coupling mode can be changed to DC to AC to HFrej to LFrej in this sequence.
In the TV Line trigger mode, the desired field can be selected (VC-5460 only)

SLOPE

The rising or falling edge of the trigger signal can be selected to apply triggering .
The slope mode is fixed to the negative polarity in the TV trigger mode.

LEVEL

Clockwise rotation moves the trigger level to the upper part of the screen, while counterclockwise rotation moves to the lower part of the screen.
In the TV Line trigger mode, the number of line can be selected (VC-5460 only)

PUSH 50%

Pressing this switch sets automatically to the mid-level (50% level) between the maximum and minimum values of the trigger input signal.
The trigger level is fixed in the TV-H or TV-V mode, and this switch becomes invalid.

④ Storage operation selection section (STORAGE)

○ RUN

Pressing this switch starts to acquire and measure a signal.
The pilot lamp lights in the RUN mode.

HOLD /SINGLE

Pressing this switch stops data acquisition, and the final waveform remains displayed. (The pilot lamp goes off.)
Pressing this switch again in the HOLD mode performs a single sweep.

CLEAR WAVEFORM

Pressing this switch erases the displayed waveform.
This feature is convenient for "Overwrite".
Note : When this switch is pressed in the HOLD mode, the waveform remains erased.

WAVEFORM SAVE

With this switch, waveform data and measurement condition data can be memorized to the save memory.
To specify the desired memory number directly, press the desired number on the numeric pad immediately after this switch has been pressed.

WAVEFORM RECALL

With this switch, waveform data memorized to the save memory can be recalled on the screen.
To specifiy the desired memory number directly, press the desired number on the numeric pad immediately after this switch has been pressed.

SETUP SAVE

Pressing this key memorizes the current setup conditions to the setup memory.
Ten sets of setup conditions can be memorized to the setup memory, and each pressing this switch changes the memory numbers from #0 to #9, while data is memorized to the corresponding memory.
To specify the desired memory number directly, press the desired number on the numeric pad immediately after this switch has been pressed.

SETUP RECALL

Pressing this switch recalls the setup conditions memorized to the setup memory and accordingly the instrument is set. Each pressing decrements the memory numbers.
To specifiy the desired memory number directly, press the desired number on the numeric pad immediately after this switch has been pressed.

HARD COPY

Pressing this switch activates the plotter or printer connected.
To stop recording, press this switch again.

⑤ Auto setup operation section

○AUTO SETUP

With this switch, the channel to which a signal is connected can be turned on. Further, the amplitude and position of the displayed waveform, a trigger source and a sweep time can be set optimally.

⑥ Measurement function selection section (MEASURE)

CURSORS

Select the desired cursor measurement function or the pulse parameter measurement function.

PARAMETERS REF· Δ ·TRACK SELECT

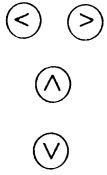
To perform the ΔV, ΔT or cursor measurement, press this key. Each pressing this key selects the REF cursor, Δcursor or both cursors.

For the pulse parameter measurement, select the desired parameter.

⑦ Menu selection section (MENU)

MENU

Each pressing this switch allows the menu to appear or disappear.



Pressing the ⟨ switch allows the previous page to appear, while pressing the ⟩ switch allows the next page to appear.
Pressing the ∧ switch moves the menu selection marker (inverted video) upward, while pressing the ∨ switch moves the marker downward.

ENTER

Pressing this switch increments the set value of the menu item selected by-the marker.

VARIABLES

Use this control in conjunction with the measurement function selection section and the menu selection section.
For the cursor measurements, move the cursor with this switch.
For the pulse parameter measurements, use this switch to select the desired parameter for the parameter selected by the SELECT key.
When the menu is displayed, use this key to change the data of the option selected by the marker.

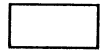
⑧ Power switch

POWER

Power is turned on or off.

⑨ Power indicator

POWER
EXTDC



This indicator lights as follows according to the state of the power supply and the external power supply.

Power switch status	Ext.power input	Illuminated color
ON	Yes	Orange
	No	Red
OFF	Yes	Green
	No	Not lit

⑩ Input terminal section

- CH1 INPUT
- CH2 INPUT
- EXT INPUT

—BNC connectors

⑪ CAL output

- CAL

Output terminal for the 1kHz, 5V square waveform for calibration.
Use for probe calibration.

⑫ **Display screen**

4" TFT color LCD

2.2.2 Rear panel

⑬ **DC Input**

Plug the DC output plug of the supplied AC-DC conversion adaptor to this input.

When using the optional battery pack, plug its plug to this input.

Note : Do not use a power plug other than specified.

Warning When a power supply unit other than specified is used, the instrument can be damaged, and hazard can be caused, and Hitachi Denshi is not respon sible for such damage or failure.

⑭ **RS-232C connector**

Connect a personal computer or a plotter via the RS-232C interface.

⑮ **Connector for printer**

Connect a printer via Centronix interface.

Chapter 3 How to start up instrument

3.1 How to startup instrument

3.1.1 Power connection

The power can be supplied to the instrument in the two ways as described below.

(1) Use of commercial AC source

1) Connect the DC output plug of the supplied AC adaptor to the DC INPUT connector on the rear.
2) Connect the AC input plug of the AC adaptor to the commercial AC source, and confirm that the power indicator (POWER EXT DC) is lit green.

(2) Use of built-in battery

Unplug the AC input plug of the AC adaptor from the commercial AC source, or unplug the DC output plug of the AC adaptor from the DC INPUT connector on the rear. Then, the instrument is placed in the built-in battery operation mode.

Note:Before operating the instrument by battery, supply power to the instrument through the AC adaptor for 16 hours with the power switch turned off. Use the fully charged battery.

It will take about 32 hours to charge the battery with the instrument turned on.

3.1.2 Power on

Press the POWER switch, then the power indicator is lit orange to indicate that the power is supplied. The scale screen for waveform measurement is displayed in 4 or 5 seconds.

Note:When the power indicator is lit red with the AC adaptor used, the instrument or the AC adaptor may be defective.
In this case, contact your nearest Hitachi Denshi sales representative.

3.1.3 System reset

The instrument is controlled by key operation through the built-in microprocessor. When the POWER switch is pressed, the built-in microprocessor turns on or off the instrument.

When a personal computer is connected to the instrument and wrong operation is performed from the personal computer, it is possible that the microprocessor built in the instrument haugs up, and the instrument cannot be turned off by the POWER switch. A similar phenomenon may occur due to external high voltage noise, etc.

In such cases, press the POWER switch while pressing the TRIGGER MODE key. Then, system reset is applied to the instrument, and the normal state is restored. In this case, note that the setting values and waveform data except for calibration data are reset to the factory setting values.

3.2 Setting at factory

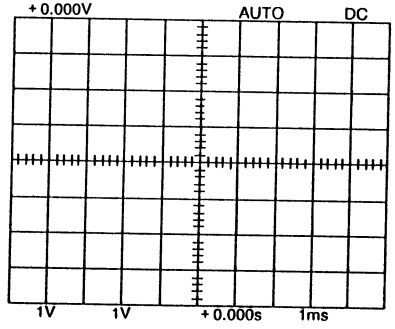


Fig. 3-1 Screen display set at factory

When the instrument is first turned on, the screen as shown in Fig. 3-1 is displayed. The panel settings as set at factory are available. For the panel settings at factory, see Appendix. A.

3.3 Panel backup

When the resume function is turned on, the settings set before power off are available at power on.

When power is turned off with the resume function turned off, the same setup conditions as the previous settings except for some items are available. For the contents of settings, see Appendix. A.

3.4 How to obtain desired setup conditions

When the instrument is started up after a different person used the instrument in complicated panel setting conditions, the instrument is set up with the same condition.

In this case, the contents of setting conditions are not known.

In such case, use any of the following three methods to set the desired setup conditions quickly.

(1) Use of setup save memory

The instrument is provided with the save memory capable of saving and recalling up to 10 sets of setup conditions. If the desired setup conditions are saved to the save memory, they can be recalled to establish the desired setup.

For details, see item 6.14.

(2) Use of auto setup function

With this function, setup conditions can be automatically set according to the input signal so that the waveform display becomes optimum for measurements.

The waveform display on-off, vertical axis, horizontal axis and trigger are set optimally according to the input signal, and other items are set to the respective fixed values.

Perform the desired setting changes after understanding the setup conditions.

For details, see item 6.2.

(3) Initialization of settings

When the settings are returned to the default values (see item 6.15), the setup conditions as set at factory are obtained.

To set to the desired setting conditions, this method may be sometimes convenient.

NOTE: When the message "Calibration" is displayed after power up and the automatic calibration is performed, it is possible that the built -in battery has run down.

In this case, connect the AC adaptor to recharge the battery for 16 hours with the instrument turned off.

In this case, note that the setting values and the waveform data are all reset to the default values set at factory.

To perform more accurate measurement suitable for the use environment, perform the automatic calibration approximately 20 minutes after power on.

If the same phenomenon should occurs after recharging the battery, contact your nearest Hitachi Denshi sales representative.

3.5 Power-saving modes

The instrument is provided with the standby mode and the auto power off mode for power-saving purpose. When these modes are established, the operation time by the built-in battery can be extended.

Therefore, it is recommended to use these modes.

(1) Standby mode

When a certain time passes without performing any panel operation, the backlight of the LCD display automatically goes off.

In this case, sampling operation is performed in succession, when panel operation is performed, the backlight lights again.

(2) Auto power off mode

When a certain time passes without performing any panel operation, the instrument is automatically turned off. When the instrument is turned on with the resume function turned on, the settings immediately before power off are established.

For operation method, see item 4.3

3.6 Method for connecting signals

The first step of measurement is to connect the signal to the instrument properly.

WARNING

: When connecting the probe or the signal input cable to the circuit to be measured, be sure to connect the ground side of the probe or the signal input connector to the ground side of the signal source. Otherwise, potential difference between the instrument and other equipment or earth ground may result in shock hazard and damage the instrument, the probe, and other equipment.

(1) Using probes

Use the supplied probe to measure a high frequency signal accurately.

Supplied probe : AT-10AW1.5(VC-5460), AT-10AK1.5 or AT-10AY1.5(VC-5430/VC-5460)

When this probe is used with the x 10 / x 1 select switch set to x 10, the input signal to the oscilloscope is attenuated to 1/10.

When a signal is too small to be measured with x 10, use the mode x 1. In this case, note that the input impedance of x 1 is different from that of x 10, and the measurable frequency band becomes very low. (For details, refer to THE AppendixC or the operation manual of the supplied probe.)

Notes :

a) Do not apply a signal in excess of 400V (DC + peak AC at 1kHz + floating voltage) to the input.

b) Connect the probe ground lead as close as possible to the point being measured especially when measuring a signal with a fast rise time or a high frequency signal. Long probe ground leads may cause waveform distortions, such as ringing and overshoot.

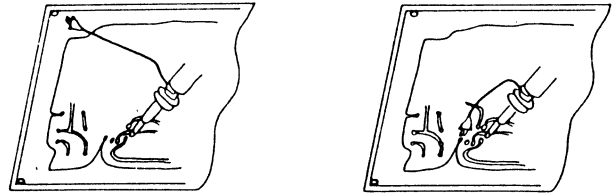


Fig. 3-2 Connection of ground lead

c) To avoid effect of the ground lead in high frequency measurement, it is recommended to use the standard ground lead attachment with the AT-10AK1.5 or AT-10AY1.5 probe.

d) To avoid a measurement error, probe compensation must be done especially when probes are changed. Connect the probe tip to the CAL 5V output terminal and the probe ground lead to the GND terminal. A 1kHz square wave should be displayed with flat tops. Any distortion in the presentation is caused by incorrect probe compensation. If over shoot or undershoot is present, turn the screwdriver adjustment in the probe for a flat-top presentation.

(a) Optimum (b)Capacity too small (c) Capacity too large

Fig. 3-3

(12) Direct connections

When connecting signals without using the supplied probe, pay attention to the following points in order to minimize a measurement error.

- When using an unshielded lead, there should be no trouble, provided the circuit under measurement is of low impedance source and high level. However, in most cases, measurement errors may be caused by stray coupling with other circuits or power line interference. This can cause errors even at low frequencies. In general, avoid measurement with an unshielded lead.

- When using a shielded wire, it is desirable to use a coaxial cable with a BNC type connector. If a BNC type connector is not available, connect one end of the shield to the ground terminal of the instrument and the other end to the ground of the circuit to be measured.

- The following precautions must be observed when performing a wide bandwidth measurement.
  It is necessary to terminal the cable with a characteristic impedance, when measuring a fast rise waveform or a high frequency wave.
  The absence of a termination resistor will result in a measurement error due to a ringing phenomenon when a long cable is used. Some measuring circuits require a termination resistor equal to the characteristic impedance of the cable. (A BNC type termination resistor is recommended for this purpose).

- In order to perform measurements with the circuit in a proper operating state, it is sometimes necessary to terminate the cable with an impedance which corresponds to the circuit being measured.

- The stray capacity of the shield wire must be taken into account when performing measurements with a long shield wire. Since a shield wire has a capacity of about 100pF per meter, its effect on the test circuit cannot be ignored. Use a x 10 probe to minimize the effect on the circuit.

- When a shield wire or a non-terminated cable is used, and the cable length reaches 1/4 the wave lenght or its multiples (1/4 the wave lenght is about 1.5 meter when using a coaxial cable at 50MHz), oscillation may be caused in the 1 to 5mV/DIV ranges.
  This is caused by the resonance between the externally connected high -Q inductance and the input capacity. Reduce the Q by connection the cable or shield wire to the input connector via the resistors rated from 100Ω to 1kΩ connected in series, or by performing measurements at another VOLTS/DIV range.

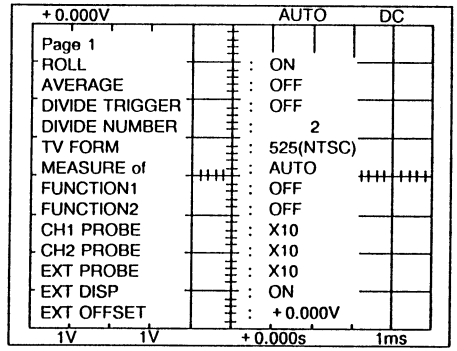
Chapter 4 Configuration and Operation of Menus

4.1 Menu display

In general, normal waveform measurements can be performed using the controls and switches on the front panel. However, menus are used for special operation modes or for setting the operational environments including an interface.
The terms used in this chapter are used in the relevant chapters, so read the following description carefully.

4.2 Menu screen

When the MENU switch in the MENU area on the front panel is pressed, the menu screen as shown in Fig.4-1 is displayed.
When the MENU switch is pressed again, the waveform measurement screen is displayed.



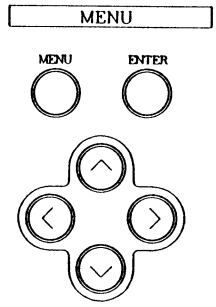


Fig.4-1 Example of menu screen [VC-5460] **Keys in MENU area**

4.3 Operation of menu

(1) Page menus

Six page menus (Five page menus for the VC-5410) are available. When the > switch is pressed with a menu displayed, the next page menu is displayed. With the < switch, the previous page is displayed.

(2) Selection of setting item in menu

When a page menu is displayed, a highlight marker is displayed before an item to indicate that the setting value of the item can be changed.
Select the desired menu item, using the ∧ or ∨ switch.

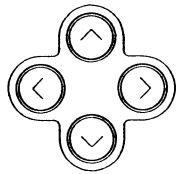


Fig.4-2 Selection of page menu and desired item

(3) Change of setting value

To change a setting value, use the ENTER switch or the VARIABLES control in the MENU area.

Each pressing the ENTER switch increments the value.

Clockwise rotation of the VARIABLES control increments the value, while counterclockwise rotation decrements the value.

Upon exit from the menu screen, the last value is used as a set value, which is effective for following measurements.

4.4 Description of each item in menus

The kinds and meanings of the options for each item are listed below.

(1) Menu page 1 = Processing functions, special triggering, probe factors

< Setting of ROLL mode >

ROLL :
- OFF : Inhibits the ROLL mode operation. In a low speed range, real-time sampling is performed up to 1s/div.
- ON : In a low speed range, the ROLL mode operation is performed. Up to 0.1s/div : Real-time sampling 0.2s/div to 50s/div : ROLL mode operation.

< Setting of average function >

AVERAGE :
- OFF : Averaging is turned off.
- 2~256 : Averaging (exponential averaging) is turned on. Set an attenuation constant of exponential averaging by a figure.

< Setting of divide trigger function >

DIVIDE TRIGGER :
- ON : The divide trigger function which is a special trigger function is turned on.
- OFF : The divide trigger function is turned off.

DIVIDE NUMBER : ——2~4096 : Set the number of divide triggers.

< Selection of TV format >

TV FORM (VC-5460 only) ——525(NTSC): Set to NTSC format.
625(PAL): Set to PAL format.

< Setting of cursor measurement channels and pulse parameter measurement channels >

MEASURE of : ┬AUTO
├CH1
└CH2 : Select the channel to which cursor measurements and pulse parameter measurements are performed.
When AUTO is selected, the waveform on the youngest channel among the channels displayed on the screen is measured.

< Setting of operation functions >

Up to two operations, FUNCTION1 and FUNCTION2 can be selected and displayed simultaneously.

FUNCTION1 : ┬OFF : Calculation and display of FUNCTION1 are turned off.
├INV (CH1) : Inversed CH1 waveform is displayed.
├CH1 + CH2 : The waveform which CH1 and CH2 are added is displayed.
├CH1-CH2 : The waveform which CH2 is subtracted from CH1 is displayed.
└CH1 $_{VS}$ CH2 : Voltage vs voltage (X-Y) is displayed, using CH1 as X-axis and CH2 as Y-axis.

FUNCTION2 : ┬OFF : Calculation and display of FUNCTION2 are turned off.
├INV(CH2) : Inversed CH2 waveform is displayed.
├CH1 + CH2 : The waveform which CH1 and CH2 are added is displayed.
├CH2-CH1 : The waveform which CH1 is subtracted from CH2 is displayed.
└CH2 $_{VS}$ CH1 : Voltage vs voltage (X-Y) is displayed, using CH2 as X-axis and CH1 as Y-axis.

Note : When DIFF is selected at the vertical axis setting section, DIFF and EXT are selected and displayed instead of CH1 and CH2, respectively.

< Setting of probe factors >

CH1 PROBE ——— X1, X10, X100, X1000 : Select the desired probe factor of CH1.

CH2 PROBE ——— X1, X10, X100, X1000 : Select the desired probe factor of CH2.

EXT PROBE ——— EX1, X10, X100, X1000 : Select the desired probe factor of EXT.

< Setting of EXT input display >

EXT DISP :
- OFF : Inhibits the EXT input display functions.
- ON : When the DIFF mode is selected, the EXT input is displayed.

EXT OFFSET : Set the DC offset level of an EXT input.

(2) Menu page 2 = Save and recall of waveform, and display functions.

< Setting of save and recall waveforms >

SAVE TYPE : (VC-5460/ VC-5430)
- UBYTE : Select to save data in the units of a waveform, using unsigned byte data.
- PIXEL : Select to save all the wave forms displayed on the screen as pixel data to internal memory. (The VC-5410 is provided only with UBYTE. So setting is unnecessary.)

SAVE NO : Select the desired file number for save or recall. 0 to 99(0 to 9 for the VC-5410)

OVERWRITE
- ON: Even when there are waveforms previously saved to the selected file, the selected waveform is overwritten.
- OFF: When the selected file is empty, the waveform is saved. When the previous waveforms are saved to the file, the waveform is saved to other empty file.

MEMORY1 :
- OFF : Turns off the recall buffer memory M1 from the save memory to inhibit recall and display of the data from the memory.
- ON : Turns on the recall buffer memory M1 from the save memory to enable recall and display of the data from the memory.

VOLTS: POS: Magnifies the waveform recalled from Memory 1 or moves it vertically.

MEMORY2 :
- OFF : Turns off the recall buffer memory M2 from the save memory to inhibit recall and display of the data from the memory.
- ON : Turns on the recall buffer memory M2 from the save memory to enable recall and display of the data from the memory.

VOLTS : POS : Magnifies the waveform recalled from Memory 2 or moves it vertically.

< Setting of display functions >

PERSISTENCE:
- OFF : Erases previous waveforms and displays new waveforms.
- ON : Overwrites waveforms in succession without erasing previous waveforms.

GRATICULE :
- GRID : Displays the frame, axes and scales.
- FRAME : Displays the frame only.
- AXES : Displays the frame and the axes.

DOTJOIN :
- ON : Displays data connected by lines.
- OFF : Displays data by dots.

INTERPOLATE :
- LIN : Inserts linear interpolation data to waveform data in the magnification mode.
- SIN : Inserts sinusoidal interpolation data to waveform data in the magnification mode.

CLEAR
- CURRENT : Clears all the waveforms other than the recalled waveform.
- RECALL : Clears the recalled waveform only.
- ALL : Clears all the waveforms.

(3) Menu page 3 = Timer functions

< Setting of standby mode, auto power off and resume functions >

STANDBY MODE :
- OFF : Inhibits the standby mode functions.
- 1-60 : Set the time until the standby mode is established. When any panel operation is performed within the set time, the backlight of the LCD screen goes out. (Settable to 1, 2, 3, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 or 60 minutes.)

AUTO POWER OFF :
- OFF : Inhibits the auto power off function.
- ON : Set the time until the auto power off function is effective. When any panel operation is performed within the set time, power is automatically turned off. (Settable to 1, 2, 3, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 or 60 minutes.)

RESUME :
- OFF : Inhibits the resume function.
- ON : When power is turned on, the measurement conditions set before previous power off are set again. The conditions are displayed on the screen, and measurements are started.

< Setting of time >

MONTH-DAY-YEAR : Set date to the built-in clock.

CLOCK TIME : HOUR :MINUTE : Set time to the built-in clock.

< Setting of alarm function > (VC-5460/VC-5430)

ALARM :
- OFF : Inhibits the alarm function.
- ON : Enables the alarm function and turns on power at the time set in the following item.

ALARM TIME : 01DAY12:00 : Set the date and time needed to turn on the power by the alarm function.

ALARM INTERVAL : 00DAY12:00 : Set the time interval needed to turn on the power by the alarm function.

(4) Menu page 4 = GO-NOGO judgment, and setup save and recall functions. (VC-5460/VC-5430)

< Setting of GO-NOGO judgment conditions >

GO-NOGO :
- OFF : Turns off the GO-NOGO function.
- ON : Turns on the GO-NOGO function.

WHEN :
- A PART : If part of the measured data meet the conditions, NO GOOD results.
- ALL : If all of the measured data meet the conditions, NO GOOD results.

of :
- ANY : The waveforms on the channels displayed are processed.
- CH1,CH2,F1,F2 : Select CH1, CH2, F1 or F2 for judgment.

is :
- OUT : When the waveform moves out from the judgment domain, NO GOOD results.
- IN : When the waveform moves into the judgment domain, NO GOOD results.

< Setting of processings required for the result of GO-NOGO judgment >

Two kinds of proceedings are available after GO-NOGO judgment.

REACTION1 :
- NONE : Does not react for the occurance of GO-NOGO phenomenon.
- BEEP : Sounds the buzzer for the occurance of GO-NOGO phenomenon.
- HOLD : Holds the waveform on the screen for the occurance of GO-NOGO phenomenon.
- SAVE : Saves the waveform for the occurance of GO-NOGO phenomenon.
- PRINT : Produces a hard copy of the waveform from the printer for the occurance of GO-NOGO phenomenon.

REACTION2 :
- NONE : Does not react for the occurance of GO-NOGO phenomenon.
- NEXT-SETUP : Recalls the setup conditions from the setup memory for the occurance of GO-NOGO phenomenon and performs measurements.
- POWER-OFF : Turns off power for the occurance of GO-NOGO phenomenon.
- SETUP & OFF : Recalls the setup conditions from the setup memory for the occurance of GO-NOGO phenomenon, and updates the measurement conditions. Then, POWER is turned off.

< Setting of warm-up time >

WARMUP TIME : Set the warm-up time. (Set to 1, 2, 3, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 or 60 minutes.)

< Setting of setup save or recall >

NEXT-SETUP : Select the desired setup condition number (0 to 9).

< Setting of GO-NOGO judgment domain >

EDITING : ON : Select ON to create a GO-NOGO judgment domain.
OFF : After the domain has been created, rotate the VARIABLES control, then the editing function is turned off.

of : BOUNDARY : Select to create the GO-NOGO judgment boundary.
RANGE : Select to create the boundary in the horizontal direction of the GO-NOGO domain.

SOURCE : CH1,CH2,DIFF,EXT : Select the reference waveform to create the boundary.
Select CH1 or CH2 when CH1 or CH2 is displayed.
Select DIFF or EXT when DIFF or EXT is displayed.

(5) Menu page 5 = Hard copy functions (menu page 4 for the VC-5410)

< Setting of device >

DEVICE : PRINTER : Select to use an external printer.
PLOTTER : Select to use an external plotter.

< Selection of interface >

INTERFACE : CENTRONIX : Select Centronix interface.
RS-232C : Select RS-232C interface.

< Setting of plotter output specifications >

HARDCOPY : ALL : Plots all data.
WAVEFORM : Plots waveform data.
GRATICULE : Plots scales and cursor.
FACTORS : Plots the setting and measured data.

PRINTER TYPE : ESC/P : Selects the printer corresponding to the ESC/P command.
PC-PR201 : Selects PC-PR201 Printer.
DPU-201G : Selects DPU-201G Printer.
THINKJET : Selects THINKJET Printer.

FORMFEED : OFF : Inhibits formfeed
ON : Excutes formfeed after printing a screen.

SIZE : A3-A6 : Select an appropriate size.

PAPER : A3,A4 : Select an appropriate

size.

POSITION : ┬ AUTO : Plots data to each plot position in sequence.
└ 1 - 8 : Plots data to one position specified.

PEN CHANGE: ┬ ON : Changes pens automatically.
└ OFF : Fixed to pen No.1.

(6)Menu page 6 = Input/output interface and automatic calibration. (menu page 5 for the VC-5410)

< Setting of RS-232C interface >

BAUD RATE: ── 300 - 9600 : Select an appropriate baud rate (300, 600, 1200, 2400, 4800 or 9600).

STOP BITS : ── 1, 2 : Select an appropriate stop bit.

PARITY : ┬ NONE : Does not add a stop bit.
├ ODD : Adds an odd parity.
└ EVEN : Adds an even parity.

HANDSHAKE: ┬ HARDWIRED: Performs handshake with the RTS/CTS wire.
(VC-5460 only) └ XON/XOFF: Performs handshake with XON/XOFF.

< Setting of automatic calibration >

CALIBRATE : ┬ FULL : Calibrates all items automatically.
└ VPOSI : Select to calibrate the offset voltage of the vertical.

CAL EXEC : When this item is started, the calibration specified by CALIBRATE is executed. When the calibration is completed, END is displayed.

DEFAULT : When ENTER switch is pressed after selecting DEFAULT by the ∧ or ∨ switch, the setup conditions set at factory are recalled and set.

Chapter 5 Read-out display

This chapter describes the contents of the read-out display on the screen.

The values set on the operation panel and the menus are displayed as illustrated below.

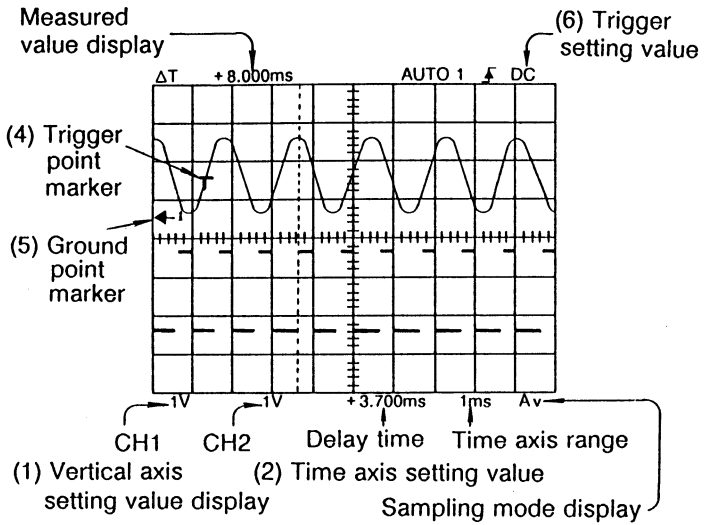


Fig. 5-1 Example of setting value display

5.1 Setting value display

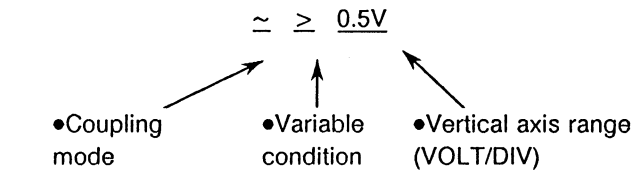
(1) Vertical axis setting value display

The vertical axis setting values of CH1 and CH2 are displayed in this sequence.

The contents are the coupling mode, the variable condition and the vertical axis range.

The variable function is not provided for the VC-5460.

Example of display:



Blank	: DC coupling	Blank:	Calibration range
~	: AC coupling	> :	Uncalibrated waveform compression
⏚	: GND	< :	Uncalibrated waveform magnification range

(2) Time axis setting display

The delay time and the time axis range are displayed in the sequence.

Delay time : Indicates the delay time from the trigger point on the vertical axis at the center of the screen.

Time axis range : Indicates the value set by the TIME/DIV control.

(3) Sampling mode display

A sampling mode used for the displayed waveform is indicated.

Blank : Real-time sampling mode
Eq : Equivalent sampling mode
Ro : ROLL mode
Av : Average mode

(4) Trigger point marker

This marker indicates the horizontal position and level of the trigger point.

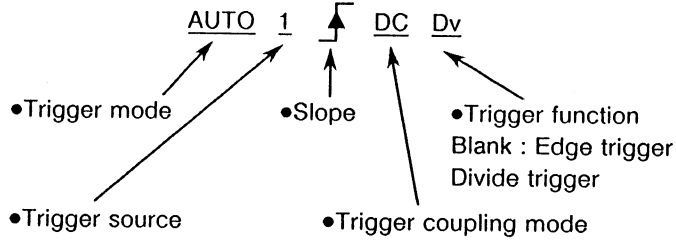
(5) Ground point marker

This marker indicates the ground level point on the screen, and is displayed for the channel whose waveform is displayed.

(6) Trigger setting display

The trigger setup conditions are indicated.
The trigger mode, trigger source, slope, trigger coupling mode and trigger function are displayed in this sequence.

Example of display:



5.2 Measured value display

When the cursor measurement function or the pulse parameter measurement function is selected by the switches in the MEASURE area on the operation panel, the corresponding measured value is displayed at the Measured Value position at the top left of the screen.
When a set value is changed by the POSITION or LEVEL control, the changed value is also displayed at the Measured Value position at the top left of the screen.
This value indicates the set value of the channel operated last.

Chapter 6 Functional Description and Operation

This chapter describes various functions and operating procedures. For the switches and controls on the operation panel, see Chapter 2. For the configuration and operation of menus, see Chapter 4.

6.1 RUN,HOLD and SINGLE operations

(1) RUN function

When the RUN mode is selected, the acquired data is displayed repeatedly.
Pressing the RUN switch in the STORAGE section lights the RUN indicator to indicate that the RUN mode is activated. When the RUN indicator is lit in the average mode or the GO-NOGO judgment mode(VC-5460/VC-5430), data is acquired repeatedly and the displayed waveform is updated.
If a waveform is not updated in the RUN mode, it is possible that the instrument is waiting for a trigger signal with the trigger not applied. In this case, check for the correct relationship between the trigger setting and the signal.

(2) HOLD function and SINGLE operation

1 HOLD function

The HOLD function is used to stop the updating of the waveform displayed on the screen for close observation of the waveform. When the HOLD/SINGLE switch is pressed in the RUN mode, the waveform acquired last is displayed stationary, and the RUN indicator goes off.
Though a new waveform is not acquired in the HOLD mode, the displayed waveform can be moved or magnified for close observation.

2 SINGLE operation

When the HOLD/SINGLE switch is pressed in the HOLD mode, a single shot sweep is performed. In the SINGLE mode, a waveform is acquired once after the HOLD/SINGLE switch has been pressed, and the acquired waveform is displayed. Then, the HOLD mode is established again.
When a single shot sweep is performed with the trigger mode set to AUTO, a signal is acquired if trigger is not applied. Therefore, this mode is effective to check the normal level of a DC signal.
When a single shot mode is activated with

the trigger mode set to NORM, the instrument is in the wait mode until trigger is applied. The acquisition of a signal is completed when trigger is applied, and the displayed waveform is updated. This mode is effective for observation of mechanical vibration, shock, explosion or single shot phenomenon of electrical signal.

6.2 Auto setup function (AUTO SETUP)

Function

The front panel settings are automatically performed so that the optimum waveform is displayed for an input signal.
With this function, the following items are automatically set according to the characteristics of an input signal.

(1) Waveform display ON-OFF (DISPLAY)
(2) Horizontal axis (TIME/DIV)
(3) Vertical axis (VOLTS/DIV, POSITION)
(4) Trigger (SOURCE, LEVEL)

Operating procedure

Connect the signal to be measured to the input BNC connector. At this time, connect the signal to be used as the reference of the time axis to the youngest channel.

AUTO SETUP

Press the AUTO SETUP switch.

Conditions

(1) The auto setup function is available only for a stable, repetitive input signal.
For stable operation, an input signal is essential to meet the following conditions.

Frequency: 20Hz to 50MHz(VC-5460)
20Hz to 20MHz
(VC-5430/VC-5410)
Duty factor: 20 to 80%
Amplitude: 10mV to 50V (20mV or more for 20 to 100Hz)

In case an input signal is a 20MHz square wave, the pulse width must be 10ns or more.
In case a signal whose amplitude is less than 10mV is connected, the signal is judged as no signal.

Operation

(1) When an effective signal is connected to a channel, the waveform is displayed.
Awaveform is not displayed for the channel of no signal.
(2) When effective signals are connected to both channels, the horizontal axis scale and trigger are set to CH1.
The vertical axis sensitivity is set optimally for the signal of each channel.
(3) When no signal is connected to both channels, no signal traces are displayed

on both channels.

Setting When the auto setup function is activated, the items listed below are automatically changed to the respective fixed values.

Table 6-1 Settings changed automatically

Item	Name	Setting
Storage mode	RUN, HOLD	RUN
Input coupling	DC·AC·GND	DC
Trigger mode	TRIGGER MODE	AUTO
Trigger coupling	COUPLING	DC
Delay time	DELAY	0 sec (Center of screen)
Divided trigger	DIVIDE TRIGGER	OFF
Trigger slope	SLOPE	Rising Edge
Variable	V. VARIABLE	OFF
Differential input	DIFF	OFF
Automatic 50% trigger level	50%	OFF

6.3 Vertical axis operation (CH1, CH2)

(1) Channel ON-OFF

DISPLAY

The waveform display of an input signal can be turned on or off by the DISPLAY switch. Only the waveform selected by the DISPLAY switch is displayed. The marking "← 1" displayed at the left of the scale indicates the ground level of the channel indicated by the figure.

The EXT waveform display of DIFF mode can be turned on or off by menu page 1 EXT DISP.

(Note) The bandwidth of the EXT waveform display of VC-5460 is limited at 50MHz.

(2) Input coupling setting

DC·AC·GND

Three input coupling modes are available. Select the desired coupling mode by the DC·AC·GND switch. The selected coupling mode is displayed at the vertical axis setting value section at the bottom left of the screen.

DC (No symbol): An input signal is directly connected to the amplifier, and the signal including a DC component is displayed.

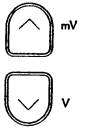
AC(~): An input signal is connected to the amplifier via a capacitor. Its DC component is cut

and only AC component is displayed.

GND(⏚) : An input signal is separated and the input of the vertical amplifier is grounded.

(3) Vertical axis sensitivity setting

VOLTS/DIV



The vertical axis sensitivity can be set by the VOLTS/DIV switch of each channel. The set sensitivities of CH1 and CH2 are displayed at the bottom left of the screen in this sequence.

Settable range (1-2-5 sequence)

Probe factor	Range
x1	1mV to 5V
x10	10mV to 50V
x100	100mV to 500V
x1000	1V to 5kV

For the VC-5430 or the VC-5410 continuous pressing the VOLTS/DIV switch magnifies or compresses a waveform in the range from approx. 0.6 to 2 times (maximum value is subject to change by sensitivity setting). Therefore, two different waveforms can be compared.

The variable function is not provided for the VC-5460.

Note : In the 1mV and 2mV ranges, data sampled at the 5mV range are magnified in the vertical direction by software. Therefore, a waveform may be thick. In this case, use the average function together, then a waveform does not become thick.

(4) Vertical movement of waveform

POSITION

PUSH 0V

The displayed waveform can be moved up and down by the POSITION control.

① Read-out of vertical position

When the POSITION control is rotated, the vertical position of the corresponding chan nel is displayed in figure at the top left of the screen. This figure indicates the ground position with the center of the screen as a reference. When the ground level is upper than the center of the screen, a positive figure is indicated.

When the ground level is lower than the center of the screen, a negative figure is indicated.

Note : When the cursor measurement or the pulse parameter measurement of the MEASURE function is performed, the read-out data are not displayed.

② Reset of vertical movement

When the PUSH 0V is pressed in the RUN mode with the vertical position set to other than zero volts, the POSITION is reset to zero volts and the ground point is displayed at the center of the screen.

③ Vertical movement after HOLD and reset of movement amount

The waveform held on the screen can be moved up and down.

When the waveform is moved after HOLD, the read-out data of the vertical position is displayed in inverse video.

The movement amount changed after HOLD is affected when the RUN mode is established.

When the vertical position is moved after HOLD, the waveform can be reset to the original position by pressing the PUSH 0V control.

(5) Probe factor setting

The probe factor must be set correctly according to the magnification of the probe in use to read the read-out data and measured data displayed on the screen.

In case the probe factor is not correct, read-out data do not meet the actual signal values.

Menu page 1 includes the probe factor setting menu.

For CH1, set as follows.

CH1 PROBE : x1	Use when a 1:1 probe is used or when signal is directly connected.
CH1 PROBE : x10	Use when a 10:1 probe is used.
CH1 PROBE : x100	Use when a 100:1 probe is used.
CH1 PROBE : x1000	Use to attenuate a signal to be input to the instrument to 1/1000.

Similarly, set CH2 and EXT.

(6) Waveform magnification

When a waveform is held on the screen, it can be magnified vertically. This mode is effective to magnify the change of a small signal.(A held waveform cannot be compressed.)

(7) Differential input

To measure the difference signal between two points, press the DIFF switch. Then the difference signal between CH1 and CH2 is

displayed.
In case of a differential input, DIFF or EXT can be selected as a trigger source. When DIFF is selected, trigger is applied by the input differential signal.
When the DIFF mode is established with input coupling modes and VOLTS/DIV setting of both channels set differently, the setting of CH2 become the same settings as CH1.
When the settings of CH1 or CH2 are changed in the DIFF mode, the settings of both channels are changed at the same time.

6.4 Time axis operation (HORIZONTAL)

(1) Time axis range setting (TIME/DIV)

TIME/DIV

A time axis range can be set by the TIME/DIV switches.
Pressing the nS switch establishes the high speed sweep range, while pressing the S switch establishes the low speed sweep range.
The read-out data of the time axis is displayed at the bottom right of the screen.
Sampling modes are changed as follows by the values selected by the TIME/DIV switches.

Two sampling modes are available by the selection of the ROLL item on menu page 1.

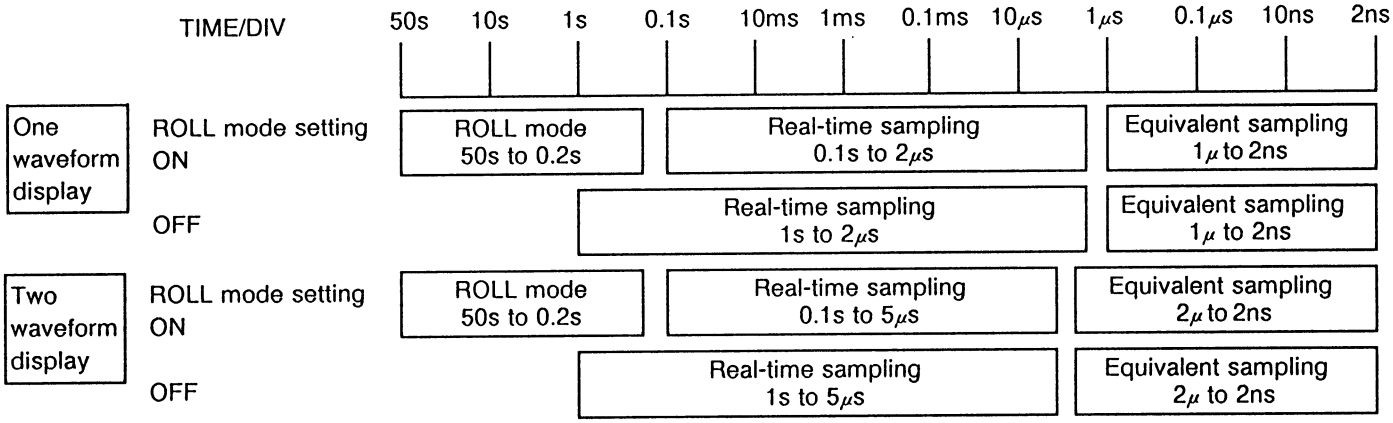


Fig. 6-1 (a) Relationship between TIME/DIV settings and sampling modes [VC-5460]

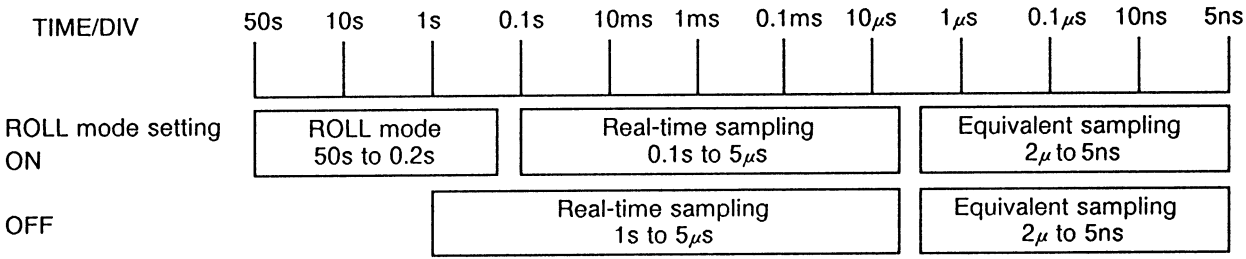


Fig. 6-1 (b) Relationship between TIME/DIV settings and sampling modes [VC-5430]

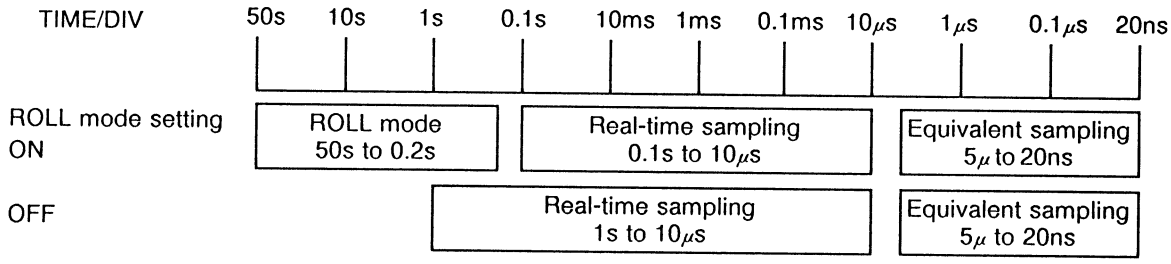


Fig. 6-1 (c) Relationship between TIME/DIV settings and sampling modes [VC-5410]

(A) Real-time sampling mode

An input signal is sampled in succession in this mode, and a single shot waveform and repetitive waveforms can be stored.

Sampling speeds depend on the selected time range as shown in Table 6-2.

In case of the VC-5460, the sampling speed is 60Msps at 2μs/div when only one waveform is displayed on CH1, CH2, DIFF, or EXT. When two waveforms (ex. CH1 and CH2) are displayed, note that the upper limit of the real-time sampling becomes 5μs/div as shown in Fig. 6-1 (a) and the sampling speed becomes 30Msps.

(B) Equivalent sampling mode

Several times of sampling are performed, using the repetitivity of an input signal, and one waveform is produced by composing these sampled data. The resultant waveform is displayed on the screen.

In case of the time range of the equivalent sampling mode, the graphics Eq is displayed at the bottom right of the screen.

In this sampling mode, only the repetitive waveforms can be stored. (This mode is not used for a single shot signal.)

When a low frequency signal is observed, it takes time to converge a waveform be cause of its nature.

(C) ROLL mode

In the ROLL mode, a waveform is displayed just as it flows from right to left.

The right edge of the trace is an update point of data, and newly sampled data are added in succession. The ROLL mode is effective only when the ROLL function is turned on the menu screen.

In case of the time range of the ROLL mode, the graphics Ro is displayed at the bottom right of the screen.

This mode is effective for observation of a low speed signal of approx.100Hz or less.

To hold the last waveform on the screen after stopping the ROLL mode, press the HOLD/SINGLE switch. The SINGLE sweep cannot be selected in the ROLL mode.

Table 6-2 Relationship between time ranges and sample frequencies (In real-time sampling mode and ROLL mode)

	Time range TIME/DIV	Sample frequency fs(S/s)	Time range TIME/DIV	Sample frequency fs(S/s)
*1	2μs	60M	20ms	7.5k
*2	5μs	30M	50ms	3k
	10μs	15M	0.1s	1.5k
	20μs	7.5M	0.2s	750
	50μs	3M	0.5s	300
	0.1ms	1.5M	1s	150
	0.2ms	750k	2s	75
	0.5ms	300k	5s	30
	1ms	150k	10s	15
	2ms	75k	20s	7.5
	5ms	30k	50s	3
	10ms	15k		

*1 The equivalent sampling for two waveforms display on VC-5460, VC-5430 and VC-5410

*2 The equivalent sampling for the VC-5410

Note : Aliasing error

When a signal having the frequency of 1/2 or more of the sample frequency for a certain time range is connected, an aliasing error occurs. When an aliasing error occurs, the waveform expressed as (Input signal frequency minus sample clock frequency) is displayed, and this waveform is sometimes misunderstood as a correct waveform.

The waveform produced by an alising error has the following characteristics.

Therefore, when such phenomena are observed, check the waveform carefully.

- Though a correct trigger setting is performed, the waveform appears as not being triggered.
- When the sweep range is changed to a higher range, the waveform appears as not being magnified horizontally, and quite a different waveform appears.

(2) Delay setting (DELAY) and set amount reset

DELAY

PUSH 0s

The display position of a waveform can be moved horizontally. When DELAY is set to zero, the trigger point is displayed at the center of the screen.

Clockwise rotation of the DELAY control moves the trigger point rightward, and the waveform before trigger (pre-trigger section) can be observed up to 10 DIV.

Counterclockwise rotation of the DELAY control moves the trigger point leftward, and the waveform after trigger (post-trigger

section) can be observed. Though the post-trigger wave form to be observed depends on the time axis range, the maximum range is 400DIV.

The read-out data of the DELAY time is displayed at the left side of TIME/DIV at the bottom of the screen. This value indicates how much the center of the screen is delayed with the trigger point as a reference.

When a high speed range is set by the TIME/DIV switch with the delay time set, the delayed portion of the waveform from the trigger point is closely observed.

To clear the delayed time to zero, press the PUSH 0s control.

(3) Horizontal magnification and movement after HOLD mode

When a high speed range is set by the TIME/DIV switch after holding the waveform on the screen, the waveform can be magnified horizontally. Magnification is performed with the center of the screen as a reference.

The held waveform can be moved horizontally by the DELAY control. At the time range before magnification, the waveform can be moved by 1.3div horizontally.

When the TIME/DIV switch or the DELAY control setting is changed after holding the waveform, these read-out data are displayed in inverse video.

The delay amount set after holding the waveform can be reset to the original value by pressing the 0s control.

(4) Selection of interpolation modes for horizontally magnified waveform.

When a waveform is magnified horizontally after holding it on the screen, data between displayed points are lost. For easy observation of the data, interpolation modes are available.

Linear interpolation (LIN) and sinusoidal interpolation (SIN) can be selected at the item INTERPOLATION on menu page 2.

Select LIN for sinusoidal waveform observation and LIN for a pulse waveform.

6.5 Operation of trigger function (TRIGGER)

The trigger functions of the instrument includes the edge, the divide trigger and the TV trigger.

6.5.1 Edge trigger function

Trigger is applied at the point where the trigger source signal intersects the set trigger level.

* Selection of edge trigger

Select DIVIDE TRIGGER : OFF at the DIVIDE TRIGGER item on menu page 4.

Setting Fig. 6-2 is an example of the display when the edge trigger is selected.
In this example , the trigger source is CH1, slope is rising edge, and trigger coupling mode is DC (For read-out data, see section 5.1.)

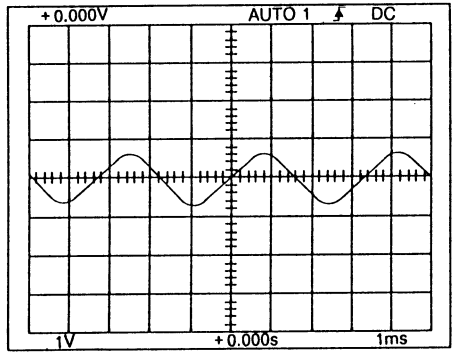


Fig. 6-2 Example of display in EDGE trigger mode

MODE

Set to AUTO or NORM.
TV-V, TV-H and TV-L (VC-5460 only) are used only for TV signal observation.

AUTO : When triggered, display is updated for every triggering. When no trigger signal is applied or when a trigger signal is not locked, the screen is automatically updated.

NORM : A waveform on the screen is updated only when a signal is triggered.
When no trigger signal is applied or when a signal is not locked, the screen is not updated, and the instrument waits for a trigger signal.

Select this mode to apply triggering to a very low frequency signal (30Hz or less) or to observe a single shot signal.

SOURCE

Select the desired trigger source channel.

SLOPE

Select a rising edge or a falling edge.

COUPLING

Select the desired mode to couple a trigger source signal and the trigger circuit.

DC : A trigger signal including DC component is coupled. Trigger is applied when the DC level of the signal intersects the set trigger level.

AC : The DC component of a trigger signal is cut and only the AC component is coupled.

HFrej : The high frequency component of a trigger signal is cut. The cut-off frequency is approx. 50kHz.

LFrej : The low frequency component of a trigger signal is cut. The cut-off frequency is approx. 50kHz.

LEVEL

PUSH 50%

Meet a trigger level to a trigger signal level before application of trigger.

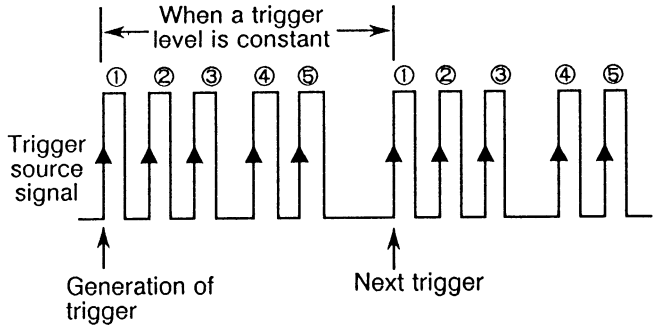
* When COUPLING is selected to DC or HFrej.
  THe T-shape marking is displayed on the screen. The vertical level of this marking indicates the trigger level.
  Adjust this level to the measured signal.
  In this case, read-out data of the trigger level is expressed as volts (V), which indicates a voltage value of the trigger level referenced to the ground level of the trigger source signal.
* When COUPLING is selected to AC or LFrej.
  In this case, the T-shape marking is not displayed.
  The read-out data of the trigger level is expressed in the units of percent(%).
  A trigger level setting range is ± 8div referenced to the center of the screen.
  This range is displayed in 0% to 100%.
  In other words, the center of the screen corresponds to 50%, the position below 8 div from the screen center to 0%, and the position above 8 div from the screen center to 100%.
  When this control is pressed, the automatic 50% trigger level setting mode

is established. In this mode, a trigger level is automatically set to the mid-position of the amplitude of the trigger source signal when the amplitude is constant. This function tracks the trigger source. Therefore, when an amplitude changes, the trigger level changes accordingly, and it becomes hard to measure waveforms.
In this mode, the T-shape marking which indicates a trigger point is not displayed.
This mode can be released by turning the LEVEL control. In this case, a trigger level changes from the trigger level before the automatic 50% trigger level setting mode has been established.

6.5.2 Divided trigger function (DIVIDED TRIGGER)

Function

This function counts the points where a trigger source signal intersects a trigger level with a specified slope, and generates a trigger whenever the counts reach to the specified figure (DIVIDED NUMBER : 2 to 4096)



(When DIVIDED NUMBER is set to 5, trigger are generated each 5 pulses.)

Fig. 6-3 Explanatory illustration of divided trigger

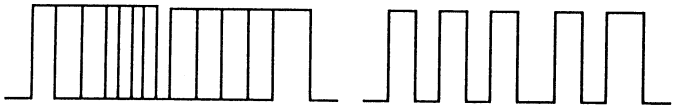
Operation

① Select "DIVIDE TRIGGER : ON" on menu page 1.
Dv is displayed at the top right of the screen, and the divide trigger function is activated.

② Select the number of divided triggers.
DIVIDE NUMBER : 2 to 4096

③ Setting procedure (MODE, SOURCE, SLOPE, COUPLING, LEVEL, PUSH 50%) of the divided trigger function is the same as that of item 6.5.1 Edge trigger function. Fig. 6-4 illustrates an example of waveform observation with

the divided trigger function, compared with the edge trigger function.



(a) EDGE trigger (b) Divide trigger

Fig. 6-4

NOTE : The divided trigger function operates normally only when a trigger signal frequency is 10MHz or less. When the frequency exceeds 10MHz, a displayed waveform jitters or the instrument remains in the trigger wait mode.

6.5.3 V trigger function

Function

The TV-V, TV-H and TV-L (VC-5460 only) trigger modes are available for a TV signal.

TV-V : Trigger is applied by a vertical sync signal.

TV-H : Trigger is applied by a horizontal sync signal.

TV-L(VC-5460 only): Trigger is applied by specifying the desired scanning line.

Operation

MODE

(1) TV-V trigger mode

Press the MODE switch until TV-V is displayed.

Fig. 6-5 is an example of observation in the TV-V trigger mode.

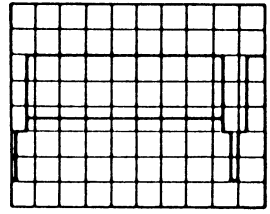


Fig. 6-5

MODE

(2) TV-H trigger mode

Press the MODE switch until TV-H is displayed.

Fig. 6-6 is an example of observation in the TV-H trigger mode.

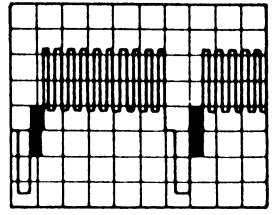


Fig. 6-6

MODE

(3) TV-L trigger mode (VC-5460 only)

Press the MODE switch until TV-L is displayed.

Further, select the desired TV format on menu page 1.

For NTSC, set to TV FORM:525.

For PAL, set to TV FORM:625.

Fig 6-7 is an example of observation in the TV-L trigger mode.

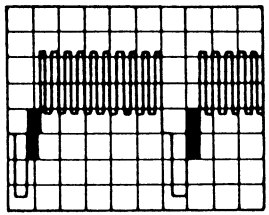


Fig. 6-7

SOURCE

Specify a trigger source channel like the edge trigger mode.

COUPLING

This control is null in the TV-V or TV-H

In the TV-L mode (VC-5460 only), fields 2 and 4, or fields 1 and 3 are selected. When fields 1 and 3 are selected, Fld1 is displayed, while when fields 2 and 4 are selected, Fld2 is displayed.

(**Note**) Fields 1 and 3, and fields 2 and 4 are not discriminated.

SLOPE

The slope mode is fixed to the negative polarity in the TV trigger mode, and setting cannot be changed.

LEVEL

PUSH 50%

This control is null in the TV-V or TV-H mode. In the TV-L mode (VC-5460 only), the desired line number can be set.

A line number can be set in the ranges listed below according to the selected TV signal.

- When TV FORM:525 is selected
  - 1 to 263 lines for Fld1
  - 1 to 262 lines for Fld2
- When TV FORM:625 is selected
  - 1 to 313 lines for Fld1
  - 314 to 625 lines for Fld2

When this control is pressed, line number 1 is selected.

NOTE

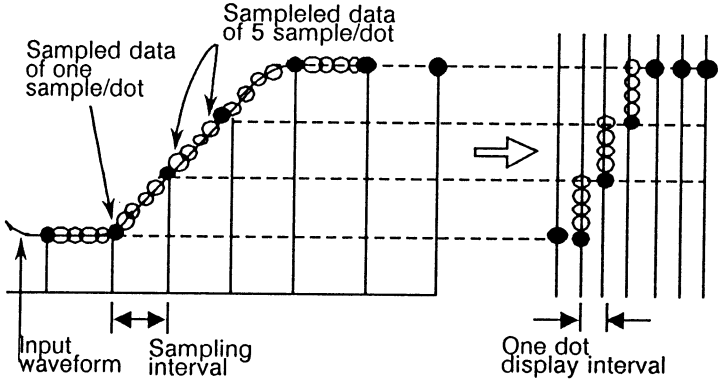
For observation of the TV trigger function, the polarity of a TV sync signal needs to be negative, and the VOLTS/DIV range where the amplitude of the sync signal is indicated more than 1div.

As a TV signal consists of four fields, the differences of these fields cannot be discriminated even if the signal is synchronized in the TV-V mode, and waveforms seem to be over lapped. In this case, set the DIVIDED NUMBER to 4, using

the divide trigger function described in 6.5.2, and select DIVIDED TRIGGER : ON. Then, the waveforms are synchronized at the respective predetermined fields.

6.6 Display format of waveform

The horizontal axis of the instrument is displayed at the resolution of 300dots/10div.
On the other hand, waveform data of 5 times (1500w/10div), or 4 times (1200w/10div in the range faster than 5μs), the display resolution is acquired and 5(or 4) data are displayed in the one coordinate (one dot) of the horizontal axis.
Therefore, a waveform changing abruptly can be displayed more accurately.



(a) Data acquisition (b) Data display

Fig. 6-8

6.6.1 Overwrite display (PERSISTENCE)

Two waveform display formats, refresh and overwrite, are available.

Selection Use menu page 2.

(1) Refresh display

Select "PERSISTENCE : OFF" on the menu to establish the refresh display mode.
In this mode, only a new waveform acquired is displayed in sequence.
This mode is effective to observe the newest waveform at all time.

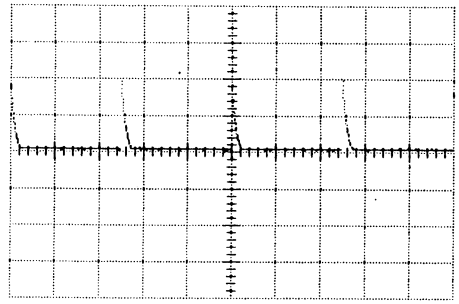


Fig. 6-9 Example of refresh waveform display

(2) Overwrite display

Select "PERSISTENCE : ON" on the menu to establish the overwrite display mode.

In this mode, a new waveform is overwritten onto old waveforms in sequence.

This mode is effective to measure the magnitude of a jitter of a signal or timing margin between two signals.

Note : A hard copy of an overwritten waveform can be available from a printer.

The plotter produces a hardcopy of only the waveform acquired last.

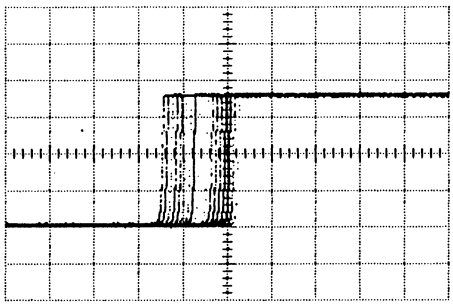


Fig. 6-10 Overwrite display

6.6.2 How to clear waveform (CLEAR WAVEFORM)

CLEAR WAVEFORM

To clear an overwritten waveform (PERSISTENCE : ON), press the CLEAR WAVEFORM switch. For VC-5430 or VC-5410 all the waveforms except for the waveform recalled from the save memory are cleared at once.

For VC-5460, waveforms are cleared according to the contents set by the CLEAR item on menu page 2.

Selection Select the desired modes of clearing waveforms.

CLEAR: CURRENT: Clears all the waveforms other than the recalled waveform.

CLEAR: RECALL: Clears the recalled waveform only.

CLEAR: ALL: Clears all the waveforms.

Note : Use care to press this switch, because the waveforms cleared by this switch cannot be displayed again. It is recommended to save data or produce hardcopy.

6.6.3 Dot join display (DOT JOIN)

Select the display modes of acquired waveforms.

Selection Select the desired mode on menu page 2.

DOTJOIN :ON The dots of the acquired waveform data are connected by lines.

DOTJOIN : OFF Only the dots of the acquiredred waveform data are displayed.

With the dot join function, it becomes easy to observe the rising edge of a signal or a small pulse, because dots are interpolated by lines.

However, the refresh speed of a waveform is lowered, because the number of displayed dots increases.

6.7 Average mode (AVERAGE)

Description When random noise (asynchronous noise) is included in an input signal, use the average mode to obtain the waveform from which noise is reduced.

The instrument performs the exponential averaging.

In this mode, averaging is made so that the largest weighting is applied to the newest data by the specified attenuation constant and weighting applied to the past data is made smaller in sequence in term of the exponential function.

Operation Select the desired function on menu page 1.

AVERAGE: OFF: Averaging is not performed.

AVERAGE: 2-256: Waveforms are displayed in the average mode.

Select an attenuation constant in 2^n steps in the range from 2 to 256.

Algorithm In the average mode, the following calculation is performed and the result is displayed.

$$\overline{X_K} = \frac{N-1}{N}\overline{X_{K-1}} + \frac{1}{N}X_K$$

Weight Weight

$\overline{x_k}$: Average value until Kth sample data string (Kth sweep)

Xk : Kth sample data string

N : Specified attenuation constant

NOTE

(1) When the HOLD/SINGLE switch is pressed in the average mode, new processing is interrupted, and the results up to that time are held on the screen.
When the RUN switch is pressed, the data up to that time are cleared and processing starts from first.

(2) The average mode is effective only for the repetitive signal.
If trigger for acquiring a signal is insufficient, a waveform is distorted. To perform averaging correctly, set the trigger mode to NORMAL and connect a trigger signal to other channel.

6.8 Switching of scales (GRATICULE)

Operation

Select a displayed scale from GRID, FRAME and AXES on menu page 2.

① GRID
The frame, axes and scale are all displayed.
Use this scale to measure waveform data value by matching a waveform to the scale.

② FRAME
Only the frame is displayed.
When it is not needed to use the scale on the screen like GO-NOGO function (VC-5460/VC-5430) or when the cursor or domain display are not desirable for measurement, select the FRAME mode.

③ AXES
The frame and axes (horizontal, vertical and center) are displayed.
Use this scale to measure a waveform by positioning on the center of the screen.

6.9 Waveform operation function (MATHEMATIC)

Description

Inverted waveforms (INVERT) and the addition and subtraction of waveforms are displayed.
The VERSUS display (X-Y display of two waveforms) is also available.
Two kinds of operations can be done at the same time.

Operation

Select the desired operation function at the FUNCTION 1 and FUNCTION 2 items.
FUNCTION 1: Operation 1 is selected.
FUNCTION 2: Operation 2 is selected.

FUNCTION1:
- OFF : Operation and display of FUNCTION 1 are turned off.
- INV CH1 : The inverted CH1 signal is calculated.
  - (INV DIFF) : (When DIFF is ON) The DIFF signal is inverted.
- CH1 + CH2 : The CH1 and CH2 signals are added.
  - (DIFF + EXT): (When DIFF is ON) The DIFF and EXT signals are added.
- CH1-CH2 : The CH2 signal is subtracted from the CH1 signal.
  - (DIFF-EXT) : (When DIFF is ON) The EXT signal is subtracted from the DIFF signal.
- CH1vsCH2 : X-Y display of CH1 (X) and CH2 (Y).
  - (DIFFvsEXT): (When DIFF is ON) X-Y display of DIFF (X) and EXT (Y) is made.

FUNCTION2:
- OFF : Operation and display of FUNCTION 2 are turned off.
- INV CH2 : The inverted CH2 signal is calculated.
  - (INV DIFF) : (When DIFF is ON) The DIFF signal is inverted.
- CH1 + CH2 : The CH1 and CH2 signals are added.
  - (DIFF + EXT): (When DIFF is ON) The DIFF and EXT signals are added.
- CH2-CH1 : The CH1 signal is subtracted from the CH2 signal.
  - (EXT-DIFF) : (When DIFF is ON) THe DIFF signal is subtracted from the EXT signal.
- CH2vsCH1 : X-Y display of CH2 (X) and CH1 (Y).
  - (EXTvsDIFF): (When DIFF is ON) X-Y display of EXT (X) and DIFF (Y) is made.

(1) Ground mark display of operated waveforms

In the same way as the signal of each channel, the ground levels are displayed as follows together with the waveform as the result of operations.

Ground level of inverted waveform: "I" mark
Ground level of added waveform: " + " mark
Ground level of subtracted waveform: "-" mark
Ground level of X-Y waveform: No display

Note: The ground marks of the added or subtracted waveforms of CH1 and CH2 are displayed only when VOLTS/DIV of CH1 and VOLTS/DIV of CH2 are equal.
When they are not equal, only waveforms are displayed.

(2) Operation method

Calculation between waveforms is made with the center of the screen as a reference (0).

(3) Color display of operated waveform

The waveform obtained by operation and its ground level are classified by colors.
Results of FUNCTION 1: Sky blue
Results of FUNCTION 2: Yellow

(4) Observation of operated waveforms only

An operated waveform can be displayed without displaying the source signal of operation. To observe the operated waveform only, turn off the display of the source signal channel.

6.10 Automatic calibration (CALIBRATION)

Description The changes in measurement accuracy due to use environments (temperature, humidity, cable length of a probe, etc.) can be optimally corrected automatically by activating the calibration.
It is recommended to perform calibration when any of the following cases applies.

① Before a customer starts to use this instrument first.
② When an ambient temperature changes more than 10°C, compared with that at the time of the previous calibration.
③ Every six months or 1000 operating hours
④ Optimization of measurement accuracy is required.

The following two kinds of calibration functions are available.

(1) FULL CALIBRATION

The changes in measurement accuracy of the vertical axis and trigger system caused by the change in use environments are all calibrated automatically.

(2) VPOS CALIBRATION

The V POSITION of the vertical axis which is apt to be changed due to the change in temperature, etc. is calibrated automatically.

Operation

(1) Selection of calibration function

Use menu page 6. (Page 5 for the VC-5410)
When CALIBRATE: FULL is selected, FULL CALIBRATION is executed.
When CALIBRATE: VPOSI is selected, VPOSI CALIBRATION is executed.

(2) Execution of FULL CALIBRATION

When CAL EXEC on menu page 6(Page 5 for the VC-5410) is set to START after FULL has been selected, FULL CALIBRATION is executed. FULL CALIBRATION consists of some calibration items, and calibration is executed for all the items. While calibration is executed, graphics "calibrating" is displayed, and some indicators corresponding to the some items are displayed after the graphics.
Whenever one calibration item is completed, the result is indicated by the corresponding indicator. The indicator corresponding to the item being executed is lit yellow. When calibration ends satisfactorily, the corresponding indicator is lit green, and calibration ends unsatisfactorily, the corresponding indicator is lit red.
When FULL CALIBRATION is completed, the graphics "PASS" is displayed and data are backed up Then, as "PUSH ANY KEY" is displayed, press any key. When all the items end satisfactorily, the instrument can be used in the calibrated state.

(3) Execution of VPOSI CALIBRATION

When CAL EXEC on menu page 6(Page 5 for the VC-5410) is set to START after VPOSI has been selected, VPOSI CALIBRATION is executed.
When VPOSI CALIBRATION is completed, the graphics "PASS" is displayed and data are backed up Then, as "PUSH ANY KEY" is displayed, press any key.

NOTE

When the graphics "FAIL" is displayed while CALIBRATION is being executed, try to execute alibration from the beginning.
In case correct calibration cannot be executed, contact your nearest Hitachi Denshi Sales representative.

6.11 Cursor measurement function (CURSORS)

Description

The voltage and time of the displayed waveform can be measured automatically only by setting the position of cursors, and the results (cursor read outs) are displayed at the top left of the screen.

Kinds of cursors

Four kinds of cursors are available for the cursor measurement function.

- Voltage measurement cursors (ΔV CURSORS)
  Voltage measurement is performed by two horizontal cursors.
- Time measurement cursors (ΔT CURSORS)
  Time measurement is performed by two vertical cursors.
  Frequency measurement cursor (1/ΔT CURSORS)
  Frequency (reciprocal of time) between two vertical cursors is measured.
- Cross cursor (+ CURSORS) (VC-5460/VC-5430)
  Voltages between two points where the two vertical cursors intersect a waveform are measured simultaneously.

Operation Take the following procedure for measurement.

(1) Select the desired cursors.
(2) Specify the desired channel.
(3) Move the two cursors to the desired position.
(4) Read the cursor read-out values displayed at the top left of the screen.

(1) Selection of the desired cursors

CURSORS

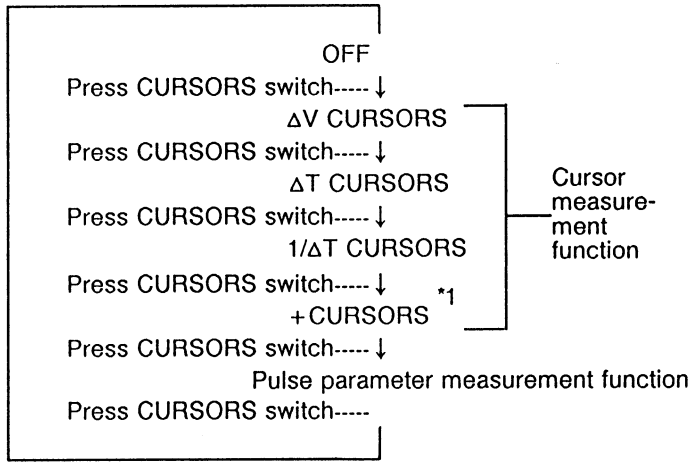
◯

PARAMETERS

Each pressing the CURSORS switch of the MEASURE section selects cursor function and pulse parameter function in the following order.

For the pulse parameter function, see Section 6.12.

The following switching can be done by the menu key Ⓐ or Ⓥ.



*1 The VC-5410 is not provided with +CURSORS. Press the CURSORS switch in the 1/ΔT CURSORS mode to measure pulse parameters with the VC-5410.

(2) Specification of measurement channel

Specification Use menu page 1.

MEASURE of: CH1-CH2 Specify the desired channel.

The cursor read-outs displayed at the top left of the screen is classified by colors.

Sky blue: CH1 or DIFF
Yellow: CH2 or EXT

The color classification of each parameter indicates the measurement channel number. For correct cursor measurement, specify the desired channel, and meet the color classification to the color of the desired waveform.

(3) Cursor movement

In case of ΔV CURSORS, the cursor marked ▲at the left can be moved. In case of ΔT CURSORS and + CURSORS, the cursor marked ▼at the top can be moved.

REF. ⊿.TRACK Select the cursor to be moved by the REF. ⊿. TRACK switch in the MEASURE area.

Each pressing this switch changes a cursor to be selected.

SELECT VARIABLES Move the marked cursor by the VARIABLES control.

When two cursors are marked, two cursors can be moved in parallel with the distance between two cursors unchanged.

Cursor read-outs

The measured values as listed below are displayed according to the selected cursors.

(1) In case of voltage measurement cursors (ΔV CURSORS)

Symbol	Content
⊿V	Voltage of ⊿ cursor-Voltage of REF cursor

(2) In case of time measurement cursors (ΔT CURSORS)

Symbol	Content
⊿T	Time of ⊿ cursor-Time of REF cursor
1/⊿T	Reciprocal of ⊿T (Frequency)

(3) In case of cross cursors (+ CURSORS) (VC-5460/VC-5430)

Symbol	Content
⊿V	Voltage of ⊿ cursor-Voltage of REF cursor

Example of cursor displays

(1) When OFF is selected
No cursor is displayed.

(2) When ΔV CURSORS is selected
Two horizontal cursors (REF and⊿cursors) are displayed.

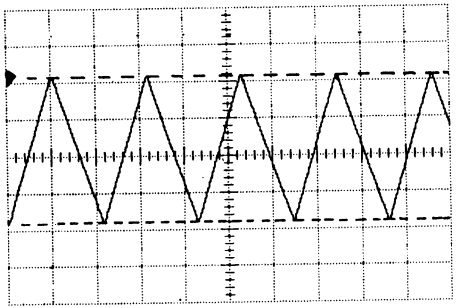


Fig. 6-11

Note: Clockwise rotation of the VARIABLES control moves the △V CURSORS upward, while counterclockwise rotation of the control moves the cursors downward.

(3) When △T CURSORS is selected
Two vertical cursors (REF and△cursors) are displayed.

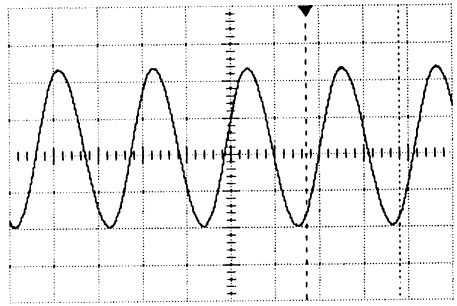


Fig. 6-12

Note: Clockwise rotation of the VARIABLES control moves the △T CURSORS rightward while counterclockwise rotation of the control moves the cursors leftward.

(4) When + CURSORS (VC-5460/VC-5430) is selected
Four cursors (two horizontal cursors and two vertical cursors) are displayed.

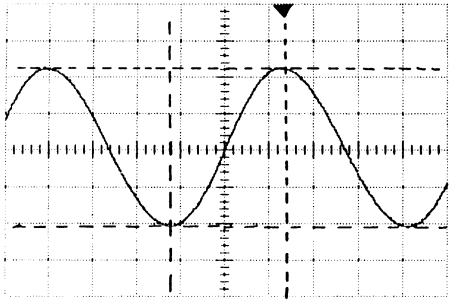


Fig. 6-13

6.12 Pulse parameter measurement function (PARAMETERS)

Description

The pulse parameters of the waveform displayed on the screen are automatically measured.
The instrument has the calculation function for 17 kinds of pulse parameters, and the results of four pulse parameters are displayed simultaneously on the screen.
Measured results are updated whenever waveforms are updated.

(Note) Pulse parameter measurement is performed for the first cycle pulse within the calculation range. The measurement is performed with the reference to the edges crossing the 10% and 90% points of the amplitude. Therefore, a valid value may not be obtained if, in case of a sine wave or the like, a waveform of more than one cycle is not present.

Measured items

Table 6-3 lists the measurable pulse parameters.
The definition of each parameter conforms to IEEE Std. 194-1977 IEEE Standard Pulse Terms and Definitions. (See Fig. 6-14.)

(Note) When part of a waveform is not displayed on the screen, or when the effective value of the parameter to be measured is not calculated, "not found" is displayed.
Further, measurement cannot be performed in the equivalent sampling mode until all data are displayed. In this case, "Data Not Available" is displayed.

Table 6-3

No.	Parameter	Abbr.	Unit	Definition
1	Frequency	FREQ	Hz	The reciprocal of the time of the first period of a waveform.
2	Period	PER	Sec	The time of the first period of a waveform.
3	Rise-time	RISE	Sec	The time interval between 10% point and 90% point of the amplitude (difference between TOP value and Base value) at the first rising edge of a waveform.
4	Fall-time	FALL	Sec	The time interval between 90% point and 10% point of the amplitude (difference between TOP value and Base value) at the first falling edge of a waveform.
5	Positive-width	+WID	Sec	The time interval between two points where the first positive pulse of a waveform intersects the 50% level of the amplitude (difference between TOP value and Base value).
6	Negative-width	-WID	Sec	The time interval between two points where the first negative pulse of a waveform intersects the 50% level of the amplitude (difference between TOP value and Base value).
7	Duty-cycle	DUTY	%	The ratio of a positive pulse width to a period at the first period of a waveform.
8	Minimum	MIN	Volt	The minimum value of a waveform.
9	Maximum	MAX	Volt	The minimum value of a waveform.
10	Peak-to-peak	VP-P	Volt	The difference between the maximum value and the minimum value (MAX-MIN).

Table 6-3 (Continued)

No.	Parameter	Abbr.	Unit	Definition
11	Base	BASE	Volt	The value of the highest frequency point below 5% frequency among the points which are below the middle point between the maximum value and the minimum value of a waveform. If the maximum frequency is below 5%, the Minimum value becomes the Base value.
12	Top	TOP	Volt	The value of the highest frequency point below 5% frequency among the points which are below the middle point between the maximum value and the minimum value of a waveform. If the maximum frequency is below 5%, the maximum value becomes the TOP value.
13	Amplitude	AMP	Volt	The difference between TOP and Base of a waveform.
14	Preshoot	PRE	Volt	The amount of the transient of a waveform which occurs immediately before the first rising or falling edge of a waveform. When the first edge is rising: Base-Minimum When the first edge is falling : Maximum-TOP
15	Overshoot	OVER	Volt	The amount of the transient of a waveform which occurs immediately after the first rising or falling edge of a waveform. When the first edge is rising: Maximum-TOP When the first edge is falling: Base-Minimum
16	RMS	RMS	Volt	The RMS voltage of the first period of a waveform.
17	Average	AVG	Volt	The average voltage of the first period of a waveform.

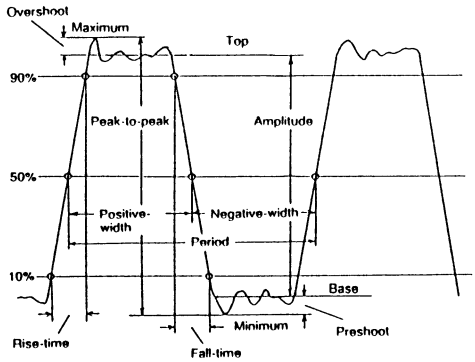


Fig. 6-14

Operation

(1) Selection of pulse parameter measurement function

CURSORS

PARAMETERS

Pulse parameter functions can be selected by pressing the CURSORS switch of the MEASURE section.

The MEASURE function includes the cursor measurement functions and the pulse parameter function.

The pulse parameter measurement function mode is established by pressing the PARAMETER switch after the + CURSOR has been selected.

While the pulse parameters are being selected, four formulas after the respective pulse parameter's abbreviations are displayed as shown in Fig. 6-15 and Table 6-3 (pulse parameter readouts).

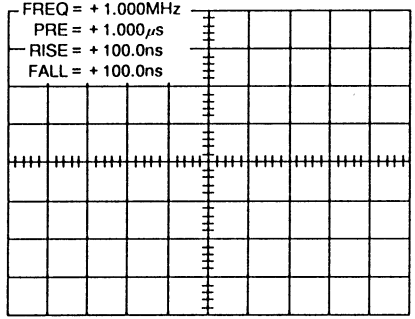


Fig. 6-15 Example of pulse parameter measurement function

(2) Specification of the measurement channel

The color classification of each parameter indicates the measurement channel number. For correct pulse parameter measurements, specify the desired channel, and meet the color classification to the color of the desired waveform.

Specification Use menu page 1
MEASURE of: CH1-CH2 Specify the desired measurement channel.

(3) Selection of parameter measurement items

REF.⊿.TRACK

SELECT

Four parameters among the parameter item listed in Table 6-3 can be measured simultaneously.
Select the desired parameters by the SELECT switch and the VARIABLES control.

① Pressing the SELECT switch inverses the first parameter item at the pulse parameter read-out display to indicate that this item can be changed.
Second pressing inverses the second parameter item.
Move the inversed mark to the desired item.

VARIABLES

② Rotate the VARIABLES control. Then, the items with inversed mark are changed. Select the desired item.

(4) Selection of parameter measurement and calculation ranges

Before shipment, the instrument is set so that the parameters of the first cycles of all the displayed waveforms are measured. When the pulse parameter measurement and calculation ranges are changed, parameters can be calculated for the desired portion of the displayed waveforms. The pulse parameter calculation range can be selected by the SELECT switch and the VARIABLE control.

REF.⊿.TRACK

SELECT

① Press the SELECT switch until the item at the bottom of the pulse parameter read-out screen, and press the SELECT switch. Then, the ▼ mark is displayed at the top of the vertical cursor, and this cursor can be moved.

VARIABLES

② The vertical cursor with the ▼ mark can be moved by rotation the VARIABLRS control, and the calibration range can be selected.

For example, when it is needed to measure the pulse at the second cycle on the displayed waveform, set the cursor to the immediate before its rising (or falling) edge so that the entire pulse at the second cycle is included in the calculation range between the cursors.

6.13 GO-NOGO judgment function (VC-5460/VC-5430)

Description The GO-NOGO judgment function is used to judge if the acquired signal is in the judgment domain (Boundary) set on the screen.
The input signals collected in sequence are compared with the boundary. When the results satisfy the conditions, the waveform is sent to the printer to produce a hard copy, or the waveform data are saved to the memoryand so on.
These processings are performed automatically.

(1) Edit function of boundary

The judgment domain can be created simply by using the waveform acquired previously as the reference waveform and by moving it horizontally and vertically.

(2) Selection function of GO-NOGO judgment conditions

The condition to issue NO GOOD can be selected. Select the condition to issue NO GOOD from the following two options.

① When a waveform is within the judgment domain, or

② When a waveform is out of the judgment domain.

(3) Selection function of processing performed after judgment

According to the result of judgment, the processings as listed below can be per formed.

①BEEP ②HOLD ③ SAVE ④PRINT
⑤NEXT-SETUP ⑥ POWER-OFF
⑦SETUP&OFF

Operation

(1) Edit of judgment domain

A judgment domain can be determined by editing the judgment boundary (Boundary) in the vertical direction and the boundary (Range) in the horizontal direction.
The menu (judgment domain edit menu) to perform this edit is on menu page 4.

< Explanation of each menu of judgment domain edit menu >

EDITING : To edit a domain, select ON. After completion of editing, select OFF.

of To edit the boundary (judgment boundary in the vertical direction) or to set the range (judgment boundary in the horizontal direction) can be seletced.

SOURCE : The reference channel signal used to edit boundary can be selected.

< Edit of Boundary >

The boundary represents the boundary of the domain used to judge a signal in the vertical direction. Take the following procedure to perform this edit.

① Select boundary at the "of :" item on menu page 4.

② Select a channel whose signal is to be used as a reference at the boundary at the "SOURCE :" item.
When the waveform acquired on a channel is used. it is convenient to edit a boundary in the HOLD mode.

③ ON is selected at the "EDITING : " item, the EDIT mode starts, and the waveform of the channel selected at the SOURCE item is displayed on the screen.

④ Create a boundary by moving the original waveform vertically and horizontally.

DELAY

To move the waveform, specify the moving directions by the four switched of the MENU section, first, and then rotate the DELAY control of the HORIZONTAL section.
When the up and down switches are pressed, the boundary of the domain is moved upward by rotating the DELAY control clockwise and downward by rotating the control counterclockwise.
When the left and right switches are pressed, the boundary is moved rightward by rotating the DELAY control clockwise and leftward by rotating the control counterclockwise.
Slant lines appear in the region enclosed by the upper and lower boundaries to indicate the NO GOOD judgment domain.
The amount of move in the domain is displayed as the value for the referenced waveform.
UPPER indicates the amount of upward move. LOWER indicates the amount of the downward move. RIGHT indicates the amount of rightward move. LEFT indicates the amount of leftward move. The amount of move displayed in inverse video can be changed by the DELAY control.

⑤ When OFF is specified at the "EDITING : " item after completion of boundary creation, the boundary is registered.

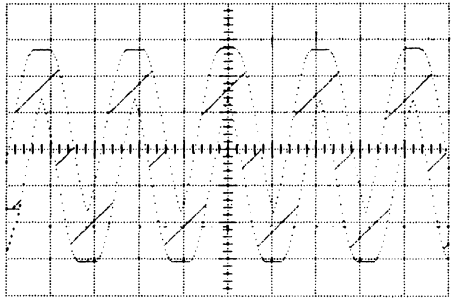


Fig. 6-16 Example of boundary editing

< Setting of Range >

Range is used to limit and compare the width in the direction of the time axis within the set boundary range.
The time width is limited by using two bars (LEFT and RIGHT bars).
The comparison judgment range is specified by the two bars.
Take the following procedure to set the two bars.

① Select range at the "of : " item on the menu page 4.

② When ON is selected at the "EDITING : " item, the edit mode starts and the two vertical bars appear.
Determine the range by moving the two bars left and right.
Specify the bar to be moved by the left and right switches of the MENU section, and move the specified bar by the DELAY control of the HORIZONTAL section.
The bar above which▼ is marked can be moved by the left and right switches

③ When OFF is specified at the "EDITING : " item after completion of range creation, range is registered.

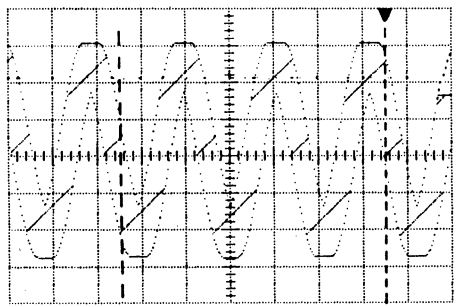


Fig. 6-17 Example of range setting

(2) Selection of NO GOOD judgment conditions

This menu is on menu page 4.

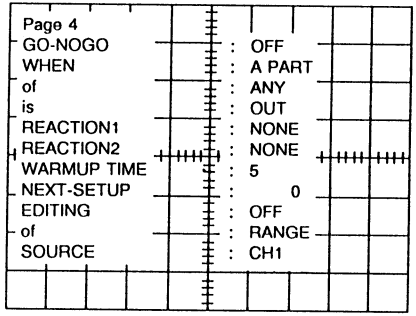


Fig. 6-18 Judgment condition selection menu

Judgment conditions can be specified by completion the following statement.

WHEN ***** OF *** IS ***
① ② ③

①, ② and ③ indicate options. Select the desired options by rotating the VARIABLES control after moving the highlighted marker to these positions.

The following options can be selected.

① : A PART or ALL

② : CH1, CH2, F1, F2 or ANY

③ : OUT or IN

Note : For ②, select a channel whose signal is to be judged.
In case of VERSUS display (X-Y display of two waveforms), judgment for F1 and F2 is not performed.

Four kinds of conditions can be selected by combination of the options of ① and ②.
Following is an example of judging the signal of CH1.

(A) WHEN A PART OF CH1 IS OUT
① ② ③

If any part of the measured waveform (CH1) between the LEFT and RIGHT bars is out of boundary, NO GOOD judgment is issued.

(B) WHEN ALL OF CH1 IS IN
① ② ③

If all of the measured waveforms (CH1) between the LEFT and RIGHT bars are in the boundary, NO GOOD judgment is issued.

(3)Selection of processings required after judgment

The selection of processings performed according to the results of judgment is performed on menu page 4.
One of the following options can be selected for FUNCTION1.

① BEEP ····· If the acquired signal is judged to be
NO GOOD, the buzzer sounds.

② HOLD ····· If the acquired signal is judged to be
NO GOOD, its waveform is held on the screen.

③ SAVE ····· If the acquired signal is judged to be
NO-GOOD, the waveform data is saved to the internal memory, the next sampling starts automatically, and the GO NOGO judgment is repeated.

④ PRINT ····· If the acquired signal is judged to be
NO GOOD, the waveform is displayed and also sent to the external printer to produce a hard copy. After a hard copy is produced, the next sampling starts automatically, and the GO NOGO judgment is repeated.
While a hard copy is being produced, judgment cannot be performed for the signal entered.

Cantion : As hard copies are produced in succession, use care for shortage of recording paper.

One of the following options can be selected for FUNCTION2.

⑤ NEXT-SETUP ····· If the acquired signal is judged to be NO GOOD, the next setup is set.

⑥ POWER-OFF ····· If the acquired signal is judged to be NO GOOD, power is turned off.

⑦ SETUP&OFF ····· If the acquired signal is judged to be NO GOOD, the next setup is set and power is turned off.

When NONE is selected for both FUNCTION1 and FUNCTION2, no processing is performed even if the result is NO GOOD.

(4) Execution of GO NOGO judgment function

When the desired settings and selection of the above items (1)-(3) are performed correctly, execute the GO NOGO judgment function according to the first line menu on

menu page 4.
When GO-NOGO : ON is selected, the GO-NOGO judgment function is executed.
When GO-NOGO : OFF is selected, GO-NOGO judgment function ends, and the normal operation mode is established.
When POWER-OFF is selected for REACTION2 and the signal is judged to be NO-GOOD, power is turned off. When the POWER switch is turned on in this state, NO-GOOD judgment is performed and power is turned off again. To prevent this phenomenon, the judgment function is not activated for a while after power on. The GO-NOGO judgment function can be interrupted by pressing the HOLD switch.

6.14 Save and recall of setup data (SETUP SAVE/RECALL)

Description Up to 10 sets of setup data can be saved to the built-in memory. The saved data can be recalled at any time to perform measurements under the same conditions. As the saved data is battery- backed up, it is retained after power off.

Operation

(1) How to save setup data

Press the SETUP SAVE switch.

SETUP SAVE

When the SETUP SAVE switch is pressed , the message "Saved to setup #0" is displayed, and the setup data is saved to memory #0.
Later, each pressing the SETUP SAVE switch counts up a save memory number to save the setup data in succession.

(2) How to recall setup data

SETUP RECALL

Press the SETUP RECALL switch to recall the setup data from the setup memories.
When the setup data is recalled from the memory (for example, memory #1), the message "Recalled setup #1" is displayed.
The recalled setup data is set to the instrument and measurements can be performed under the same conditions as the

saved data.
When the memory to which setup data is not saved is recalled, the message "Could not recall setup #1" is displayed and the setup data saved before pressing this key is retained. In this case, pressing this key counts down the memory number.

(3) How to save setup data to the desired memory

Press the SETUP SAVE switch, then press the number (for example, 6) of the desired setup memory, using the numeric pad, before the message "Saved to setup #1" is displayed. Then, the message "Save to setup #6" is displayed and the data is saved to memory No.6.

(4) How to recall setup data from the desired memory

Press the SETUP RECALL switch, then press the number (for example, 9) of the desired setup memory, using the numeric pad, before the message "Recall to setup #1" is displayed. Then, the message "Recall to setup #9" is displayed and the data is recalled from memory No.9.

NOTE: Each key on the key pad corresponds to the operation key followed by the same figure at its bottom right side at the storage operation selection section, Auto setup operation selection section and Menu selection section.

6.15 Restoration to the settings before shipment

As the instrument has the panel backup function, setup data before power off is retained.
To restore the setting before shipment, take the following procedure.

Operation Use menu page 6.(Page 5 for the VC-5410)
Set the DEFAULT : When ENTER switch is pressed after selecting DEFAULT by the ∧ or ∨ switch, the setting before shipment are restored.
For the setup contents before shipment, see Appendix.

6.16 Waveform save function (WAVEFORM SAVE/RECALL)

Description The waveform data (CH1/CH2) displayed on the screen can be saved to the built-in backup, memory. The saved data can be recalled and displayed on the screen.
Two waveform save functions are available : picture data (PIXEL) save function (VC-5460/VC-5430) and waveform data (UBYTE) save function. Each function has the features as described below.

(1) Picture data save function (PIXEL)(VC-5460/VC-5430)

① Memory : Built-in backup memory

② Features : As the waveform data displayed on the screen can be saved as is, this function is convenient to save overwritten waveforms and operated waveforms.
However, it is impossible to discriminate a waveform in the recalled screen data.
The factors of the saved data of each channel cannot be saved.
Only one screen data can be saved.

(2) Waveform data function (UBYTE)

① Memory : Built-in backup memory

② Features : As the newest waveform of each channel displayed on the screen can be saved as an independent data, this function is convenient to analyze or process waveform data, using a personal computer.
The factors of the saved data can be saved together. 100 (10 for the VC-5410) waveforms can be saved.

Operation

Select PIXEL or UBYTE at the "SAVE TYPE" item on menu page 2. (Selection is not necessary for the VC-5410.)
The built-in backup memory stores the data for 100 (10 for the VC-5410) display screens. Therefore, waveforms are saved repeatedly, old data are erased and the newest data is saved for the VC-5430/VC-5410.
Whether to store the previously saved waveform or to store the latest data can be selected by the contents set by the OVERWRITE item on menu page 2.

OVERWRITE:ON

Even when there are waveforms previously saved to the selected file, the selected waveform is overwritten.

OVERWRITE:OFF

When the selected file is empty, the waveform is saved. When the previous waveforms are saved to the file, the waveform is saved to other empty file.
WHen 100 waveforms are alredy stored, new data cannot be stored, and "Memory Full" is displayed.

< How to save waveform >

WAVEFORM SAVE

① Select PIXEL (VC-5430 only) or UBYTE at the "SAVE TYPE" item on menu page 2. (Selection is not necessary for the VC-5410.)

② Press the WAVEFORM SAVE switch on theoperation panel.

* When PIXEL (VC-5430 only) is selected, the data on the screen is saved to the built-in backup memory, and the message "Saved to pixel memory" is displayed.
* When UBYTE is selected, the following message is displayed.
  "Channel 1 Save to #00 (#0 for the VC-5410)" (In case of channel 1 only)
  "Channel 1 2 Save to #01 02 (#1 2 for the VC-5410)" (In case of channels 1 and 2)

To specify the desired memory, press the desired number on the numeric pad immediately after the WAVEFORM SAVE switch is pressed.

Note : Specified figures are 00 thru 99. (0 thru 9 for the VC-5410)
Be sure to specify two digits. (a digit for the VC-5410)

< How to recall waveform >

WAVEFORM RECALL

① Select PIXEL or UBYTE at the "SAVE TYPE" item on menu page 2. (Selection is not necessary for the VC-5410.)

② Press the WAVEFORM RECALL switch on the operation panel.

* When PIXEL is selected by the VC-5460 or VC-5430, the data on the screen is recalled from the built-in backup memory, and the message "Recalled from pixel memory" is displayed.
* When UBYTE is selected, the message "#00 (#0 for the VC-5410) Recall to MEMORY1" is displayed.
  To specify the desired memory, press the desired number on the numeric pad immediately after the WAVEFORM RECALL switch is pressed.

Note : Specified figures are 00 thru 99. (0 thru 9 for the VC-5410)
Be sure to specify two digits. (a digit for the VC-5410)

< How to clear recalled waveform >

Select the "MEMORY1" or "MEMORY2" on menu page 2 to OFF. Then, the recalled waveforms of the desired channel can be

cleared.
Otherwise, select RECALL or ALL at the CLEAR item on menu page 2, and press the CLEAR WAVEFORM switch. Then, the recalled waveform is cleared.

< Vertical move of recalled waveform >

Select "POS" on menu page 2, and rotate the VARIABLES control.Then, the recalled waveform can be moved vertically.

< Magnification of recalled waveform >

Select "VOLTS" on menu page 2, and rotate the VARIABLES control. Then, the recalled waveform can be magnified vertically.

(**Note**) The original data cannot be updated by moving or magnifying the recalled waveform vertically. Therefore, the same waveform is not always displayed when the waveform is recalled again.
When a waveform is not recalled, "******" is displayed.

Note: A recalled waveform can be magnified or moved horizontally only in the HOLD mode. For operating procedure, see 6.4(3) Horizontal magnification and movement after HOLD mode.

6.17 Plot output function (PLOT)

Description The information related to the waveform displayed on the screen can be output only by connecting an X-Y plotter to the instrument.

Usable Plotters Hitachi graph plotter HG-730
681-XA
or equivalent

Connection Connect the RS-232C or Centronics connector on the rear and an X-Y plotter with the cable dedicated for the interface to use.
The pin arrangement of the RS-232C connector of the instrument is shown under Section 7.1.
There are various types of plotters and their interfaces are different. When using a plot ter, read its manual and check the interface cable to be used.
The hard wired handshake using the RTS/CTS wire or the XON/XOFF handshake can be selected on the VC-5460. Select the handshake system suitable for the connected equipment. VC-5430 or VC-5410 is not provided with the hand wired handshake.

(Note) In case wrong handshake system and cable are selected, correct communication cannot be performed.

Fig. 6-19 illustrates an example of the wiring or the RS-232C cable used for connection of the instrument and the Hitachi graph plotter 681-XA.

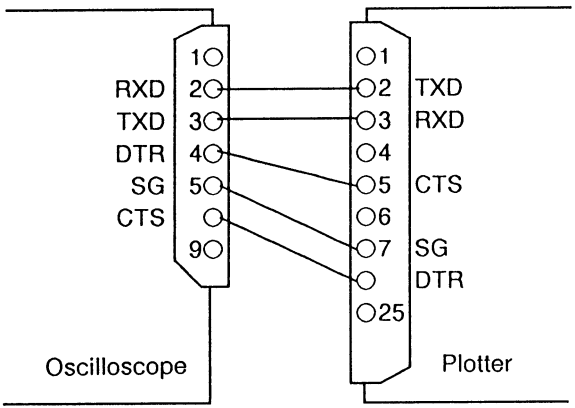


Fig. 6-19(a) Wiring diagram of RS-232C cable [Using the hand wired handshake]

Note : RS-232C cable for Hitachi plotter 681-XA by the hard wired handshake : No.4321 (option)

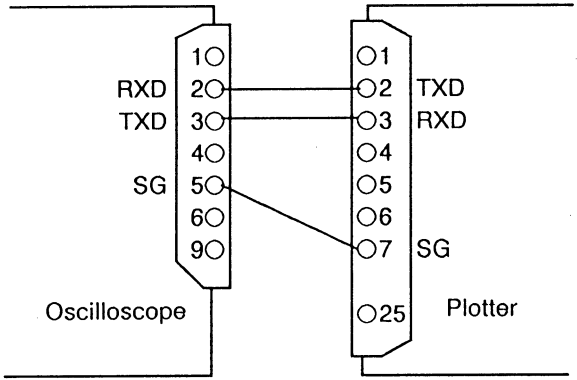


Fig. 6-19(b) Wiring diagram of RS-232C cable [Using XON/XOFF handshake]

Note : RS-232C cable for Hitachi plotter 681-XA by the XON/XOFF handshake : No.4314 (option)

Setting of hardware

Set the hardware-related settings, using menus.

Also, set the X-Y plotter to be used to comply with the specifications and setting of the instrument. Refer to the operation manual of the X-Y plotter.

(1) Setting of hard copy device(on menu page 5) (Page 4 for the VC-5410)
Set the DEVICE item to PLOTTER.

(2) Setting of baud rate (on menu page 6.) (Page 5 for the VC-5410)

Set BAUD RATE to 300, 600, 1200, 2400, 4800, or 9600.

(3) Setting of stop bit (on menu page 6.)
(Page 5 for the VC-5410)
Set the stop bit of the communication format of the RS-232C to that of the used plotter.
STOP BIT : 1 or 2

(4) Setting of parity bit (on menu page 6.)
(Page 5 for the VC-5410)
Set the parity bit of the communication format of the RS-232C to that of the used plotter.
PARITY : NONE, ODD or EVEN

Setting of plot mode

(1) Setting of paper size, plot size and plot position
The instrument is provided with the mode to plot data on A4 or A3 size paper.
Table 6-4 shows the relationship between the sizes of usable paper and the plottable size per plotting operation.
Any of the plotting formats shown in Table 6-4 can be done by performing the following settings.

(a) Setting of plot size (on menu page 5.)
(Page 4 for the VC-5410)
SIZE : Set to A3, A4, A5 or A6

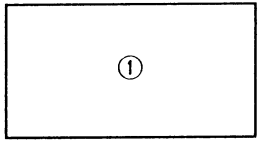
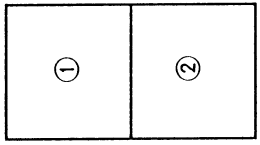
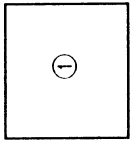
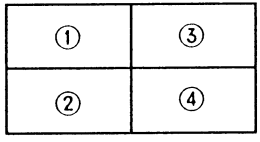
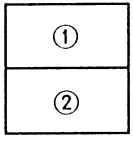
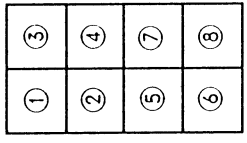
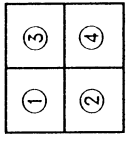
(b) Setting of page size (on menu page 5)
(Page 4 for the VC-5410)
SIZE : Set to A3 or A4

(c) Setting of plot position
POSITION: Select AUTO or one figure form 1 thru 8.

① In case of AUTO
Plotting is performed on the plot positions from 1 to 8 in sequence as shown in Table 6-4.

② In case of 1 thru 8
Plotting is performed on the specified plot position.

Table 6-4 Plot sizes, paper sizes and plot positions

Plot size \ Paper	A3	A4
A3		
A4		
A5		
A6		

(2) Setting of pen change mode (menu page 5.)
(Page 4 for the VC-5410)

Set whether or not to change a pen (i.e., change of color) according to the kinds of data.

PEN CHANGE: ON : Pens are changed according to the kinds of data (see Table 6-5).

OFF : Pens are not changed only when a pen No.1 is used.

When PEN CHANGE:ON is selected, five kinds of colors are usable.

Note : When the number of pens of the plotter in use is 5 or less, the corresponding pen numbers are different from plotter to plotter.

Table 6-5 Plotter data and pen number

Plotted data		Pen No.
GRATICULE	Grid, scale	1
	ΔT 1/ΔT cursor	2
	ΔV +cursor	Specified channel
WAVEFORM	CH1	3
	CH2	4
	EXT	4
	DIFF	3
	FUNCTION 1	3
	FUNCTION 2	4
FACTORS	Vertical information	Number corresponding to specified channel
	Horizontal information	Number corresponding to specified channel
	Waveform parameters	Number corresponding to specified channel
	ΔT cursor measurement value	2
	ΔV, + cursor (VC-5460/VC-5430) measurement value	Number corresponding to specified channel
	BOUNDARY (VC-5460/VC-5430)	5 (1)

Specified channel and corresponding pen No.

Note : Figure in parentheses applies to Hitachi 681-XA plotter.

(3) Selection of data (Second row on menu page 5) (Page 4 for the VC-5410)

Select the data to be plotted.
HARDCOPY:ALL Plots all information.
HARDCOPY:WAVEFORM Plots waveform data only.
HARDCOPY:GRATICULE Plots grid, scale and cursors.
HARDCOPY:FACTORS Plots set values and measured data.

Execution of plotting

Check that the connections and setting described above are performed appropriately.
Check that recording paper and pens are loaded appropriately.

HARDCOPY

Press the HARDCOPY key on the front panel, then, plotting starts.
(Note1) When the HARDCOPY key is pressed again during plotting, plotting is interrupted.
The time needed to stop plotting after the HARDCOPY key has been pressed is changed from plotter to plotter.

(**Note2**) The keys other than the HARDCOPY key are invalid during plotting.

Major causes of trouble

In case plotting is not performed correctly, check the following items.

(1) Check if cables are connected correctly securely.
(2) Check if the X-Y plotter is turned on.
(3) Check if the X-Y plotter is in the error mode.
(See the operation manual of the X-Y plotter.)
(4) Check if the baud rate and data format of the instrument conform to those of the X-Y plotter.
(5) Check if the interface cable is correct.

Note : Be sure to use an X-Y plotter for which the HP-GL* commands can be used.
* HP-GL : Registered Trademark of Hewlett-Packard

6.18 Print output function

Description When a printer is connected to the instrument, the data related to the waveform displayed on the screen is printed out at a touch of a switch.

Operation

(1) Setting of hardcopy device (menu page 5) (Page 4 for the VC-5410)
Set the "DEVICE : "item to PRINTER.
(2) Setting of interface
Set the "INTERFACE : "item to CENTRONIX or RS-232C.
(3) Setting of type
Set the "PRINTER TYPE : "item to ESC/P, PC-PR201, DPU-201G or THINKJET.
(4) Execution of printing

HARDCOPY

Press the HARDCOPY switch on the operation panel to produce a hardcopy.
When the HARDCOPY switch is pressed again during printing, printing operation is interrupted.

For interface with a printer, see section 7.2.
For plotting mode, see section 6.17.
Fig.6-20 is an example of hardcopy.

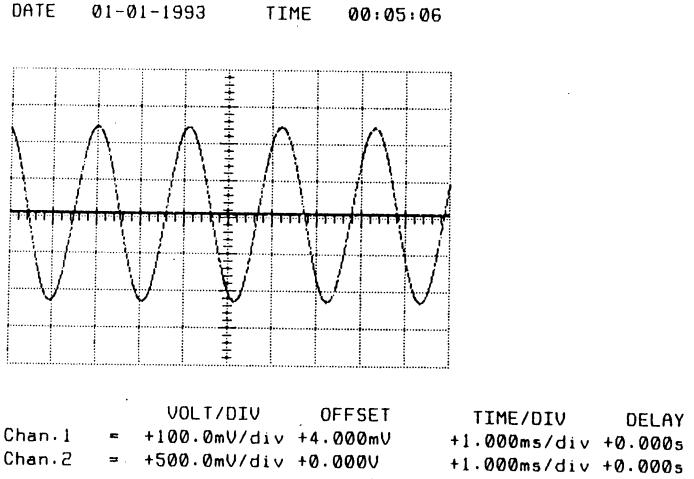


Fig. 6-20

6.19 Clock function

Description The instrument has the built-in clock function.

This clock function can be used in the following operations.

① The time when the time setting menu is opened is displayed in the menu.

② The time when plotting is made is plotted.

③ AUTO POWER OFF function

④ STANDBY MODE function

⑤ Intermittent measurement function (VC-5460/VC-5430)

Setting procedure (Menu page 3)

(1) Check of time of internal clock

The time setting menu is provided on menu page 3.
When this menu is opened, the time is displayed.

Note : The displayed time is not updated if the menu is opened continously.
To check the current time, close the menu once, and open it again.

(2) Setting of date and time

When the time of the internal clock is not correct, set the figures in the menu to the correct time.
When the menu is closed, the time is set to the internal clock.

(3) Standby mode (STANDBY MODE)
When this mode is established, the screen diaplay iserased if any operation is not performed for a given duration.
Such duration can be set in units of minute.
The screen display erased in this mode can be displayed again by pressing any switch on the operation panle.

(4) Auto power off mode (AUTO POWER OFF)
When this mode is established, the instrument is turned off if any operation is performed for a given duration.
Such duration can be set in units of minute.

(5) Intermittent measurement function (VC-5460/VC-5430) (ALARM/ALARM TIME/ ALARM INTERVAL)
Automatic intermittent measurements can be performed by combining the alarm function and the GO-NOGO judgment function.
1) Set a judgment domain by the GO-NOGO judgment function (see 6.13).
2) Select "REACTION2 : POWER-OFF" and "GO-NOGO : ON" on the menu.
Then, power is turned off when NOGOOD is judged.
3) Set the desired time interval until power is turned on again by "ALARM INTERVAL : " on menu page 3, and set to "ALARM : ON".
When "ALARM TIME : " is set, power is turned on at the preset time.
When the above settings are performed, the instrument is turned off each time when NO GOOD is judged, and when the preset time interval passes, the instrument is automati cally turned on.
Automatic intermittent measure-ments are thus available.
Further, when "REACTION1 : " is set to SAVE or PRINT by the GO-NOGO judgment function, wave-forms can be saved or hardcopies of data can be produced each time when NO GOOD is judged.

Chapter 7 Input-Output Interface

7.1 RS-232C

(1) General

The RS-232C is the serial communication interface standardized by the Electronic Industries Association in the United States of America. The instrument can transmit and receive digital data through the RS-232C interface.

(2) Specifications

①Electrical	:	Conforms to the EIA RS-232C.
②Type of transmission	:	Asynchronous
③Length of stop bit	:	1 bit or 2 bits
④Character length	:	8 bits
⑤Parity bit	:	NONE/ODD/EVEN
⑥Delimiter	:	C/R L/F
⑦Transmission rate	:	300, 600, 1200, 2400, 4800 or 9600 baud
⑧Communication protocol	:	X-ON/X-OFF handshake or hand wired handshake(VC-5460 only)

(3) Pin arrangement and signal description

①Fig. 7-1 illustrates the pin arrangement of the RS-232C connector.

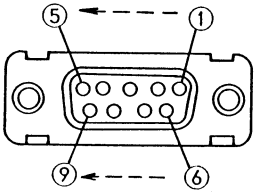


Fig. 7-1 Pin arrangement

Note: Connector DB-9P (female) is used.

②Each signal of the RS-232C interface is described below.

(1) TXD : Transmit Data
Transmit data output signal
Normally set in the mark state *1

(2) RXD : Receive Data
Receive data input signal
Normally set in the mark state *1

(3) RTS : This output signal indicates the request-to-send state.
This signal is used to control the transmission function of data transfer at the modem transmission section.
"0" (space): Carrier transmission request.
"1" (mark) Carrier stop request

(4) CTS : Clear To Send
This input signal controls the modem

transmission section
This signal becomes in the mark state when the modem transmission section is in the Clear-To-Send state.

(5) SG : Signal Ground
Graund line for signal
*1 -9 V level---"0" (space), +9 V level---"1" (mark)

(4) Connection

Connect the instrument with a personal computer by the RS-232C interface cable. Prior to connection of a personal computer, read the related manual carefully and use the appropriate interface cable, because interface is changed in accordance with types of personal computers.
The hard wired handshake using the RTS/CTS wire or the XON/XOFF handshake can be selected on the VC-5460. Select the handshake system suitable for the connected equipment. VC-5430 or VC-5410 is not provided with the hand wired handshake.

(Note) In case wrong handshake system and cable are selected, correct communication cannot be performed.

Fig. 7-2 illustrates the wiring of the RS-232C interface cable used for the connection of the personal computer PC-AT compatibles and the instrument.

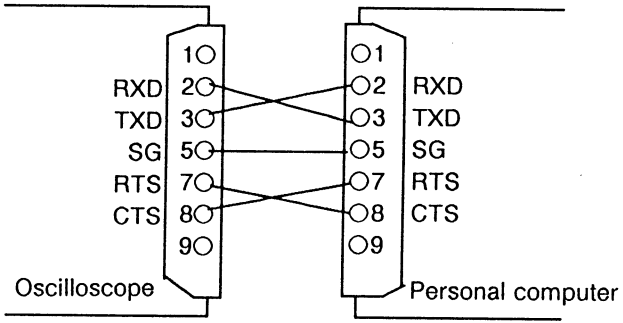


Fig. 7-2(a) Wiring diagram of the RS-232C interface cable [Using the hard wired handshake]

Note: RS-232C cable for the PC-AT compatibles by the hard wired handshake:No. 4320 (option)

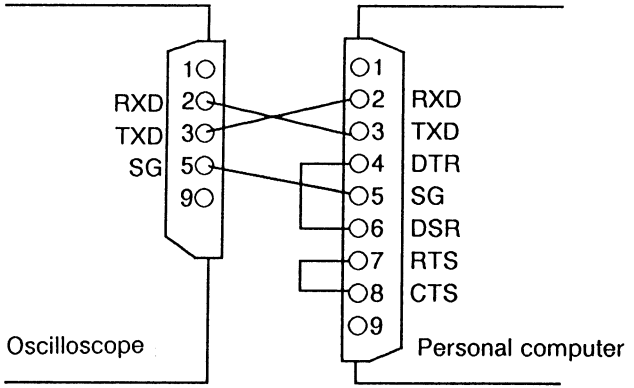


Fig. 7-2(b) Wiring diagram of the RS-232C interface cable [Using the XON/XOFF handshake]

Note: RS-232C cable for the PC-AT compatibles by XON/XOFFhandshake:No. 4315

7.2 Printer interface

(1) Settings of printer interface

The printer interface used with the instrument is Centronix.

1) Select the desired interface on menu page 5.
   INTERFACE: CENTRONIX
2) Select the type of the printer to be used on the "PRINTER TYPE:" menu.
   Select ESC/P, PC-PR201, DPU-201G or THINKJET.
   Some models cannot be connected.

(2) Pin arrangement of connector for printer

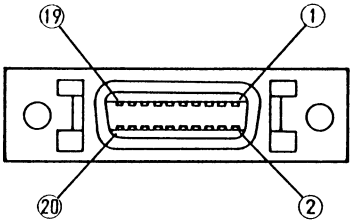


Fig. 7-3 Pin arrangement

Note: Centronix cable for the printer : No. 4316 (or No. 4317 for DPU-201G use only) (option)

Chapter 8 Programming functions

8.1 General of programming functions

8.1.1 General

The four basic operations which can be done with a controller and the oscilloscope through the RS-232C interface are as follows:

1. Set the instrument and start measurements.
2. Acquire information and measurement results.
3. Send waveform data to the controller.
4. Send measurement data to the instrument.

Other complex tasks are accomplished by combining these basic functions.

Note: Restriction of these functions

Magnification, scroll and V position movement process in the HOLD mode cannot be controlled from the controller.

8.1.2 Setting of instrument

To run the programming functions, set the interface to be used.

For selection of the interface to be used and the setting of a protocol, refer to 7.1 Input/Output interface (RS-232C) of the operation manual.

8.2 Programming

8.2.1 Programming syntax

The description of the program is shown in Fig. 8.1. The program is described in the order of an output command, a file No. a mnemonic header, a mnemonics, a separator, and a program data. These data can be sent to the instrument as character strings of the ASCII system through RS-232C. (Commands are valid only in the long form.)

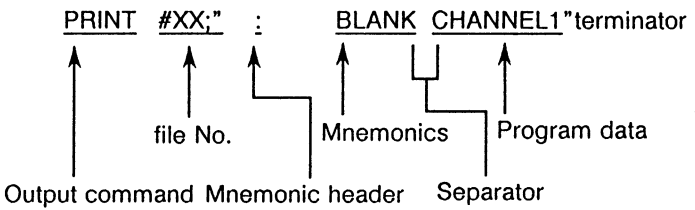


Fig. 8.1 Program format

(1) Output command

The output command varies according to the language of the controller which you use.

In the example of each command described in this manual, the PC-9801 series N88-BASIC is used.

When using other languages, find commands equivalent to the N88-BASIC commands like PRINT and INPUT in order to convert the program.

(2) File number

The location where the file number. must be specified also varies according to the controller language which you use.

In PC-9801 N88-BASIC, the file No. is always specified after PRINT.

The examples in this manual assume the file number of RS-232C is 1.

(3) Mnemonic header

The mnemonics consists of one or more mnemonics separated by colons (:) that represent the operation to be performed by the instrument. Queries are indicated by adding a question mark (?) to the end of the header.

(4) Mnemonics

The mnemonics is a character string specifying the operation of the instrument. For details, refer to section 8.3.

(5) Separator

The separator is used to separate the mnemonic header and the mnemonics from the program data.

If the mnemonic does not require any program data, it is not necessary to include any separator.

In this manual, the separator is defined as one or more spaces.

ASCII defines a space to be character code 32 (in decimal).

(6) Program data

Program data are used to clarify the meaning of the command or query. The program data provide necessary information on the setting of instrument or which waveform is to be displayed.

(7) Terminator

This oscilloscope recognizes the carriage return and the line feed code as a terminator. In the return mode, the carriage return and the line feed code are used as terminators. ASCII defines the line feed code to be character code 10 (in decimal) and the carriage restart to be character code 13 (in decimal).

8.2.2 Setting of command syntax

One command consists of one header, some data and the terminator.

The types of headers are described below.

(1) Compound command header

Compound command heads are a combination of plural mnemonics. To analyze a command, select the subsystem and select the function within that subsystem with the mnemonics.

For example, to execute a single function in a subsystem:

:< subsystem >:< function >< separator >< program data >< terminator >

Example:

:CHANNEL1:COUPLING AC

This means that the input coupling on channel 1 is set to AC.

A subsystem name, or the like, cannot be omitted for all the commands. Thus, to send two or more commands at a time, separate two complete commands with ";".

:<subsystem>:<function><separator><program data>;

:<subsystem>:<funciton><separator><program data><terminator>

Example:

:CHANNEL 1:RANGE 800M;:CHANNEL1:OFFSET 2

This means that the vertical axis range on channel 1 is set to 100mV/div and the offset is set to 2V.

(2) Common command header

Common command headers control functions defined by IEEE488.2 including the control of status clear, etc. Their syntax is:

* <command header><terminator>

No space or separator is allowed between the asterisk (*) and the command header.

For details of the common command, refer to section 8.3.1 Common command programming grammar.

8.2.3 Query command syntax

Commands with a question mark (?) just after the mnemonics are query commands. They are called queries hereinafter.

After receiving a query, the instrument interrogates the requested function and places the answer in its output queue. The answer remains in the output queue until it is read or another command is issued.

When read, the answer is transmitted to the controller through RS-232C.

Example:

:TIME BASE:RANGE?

This command feeds the setting of the time base to the queue buffer. When the controller executes LINE INPUT # <file number>;Range, the setting data is sent to the controller through RS-232C.

Follow either of the following steps to perform the successive queries to input the answer properly.

(1) Read the answer at every query transmission.

(2) Transmit plural queries divided with ";" at once, then read answers also at once.

(For reference)

Concerning the program message, the character strings in the ASCII form can be sent in combination of upper-case and lower-case letters. However, when receving responses, upper-case letters are used exclusively.

8.2.4 Mnemonic of unit

Some command headers require values as data.

Example:

:TIMEBASE:RANGE 1E-3

Table 8.1 shows mnemonic of units.

Note: For example, 1E-3 represents 10^{-3}.

Table 8.1 Exponent unit

Value	Mnemonics	Value	Mnemonics
1E18	EX	1E-3	M
1E15	PE	1E-6	U
1E12	T	1E-9	N
1E9	G	1E-12	P
1E6	MA	1E-15	F
1E3	K	1E-18	A

8.2.5 Sending and receiving waveform data

When sending waveform data as 8-bit binary data through RS-232C, blocked fixed-length data can be used. Concerning syntax, the number after the symbol # represents the number of digits in decimal number. Decimal numbers sent after the number represent the number of data bytes. After the numbers, the actual data block follows.

When data of 512 bytes is sent, the syntax is as follows:
#800000512<data block 512 bytes><terminator>
"8" means that an 8-digit number follows after the number, and
"00000512" represents the number of bytes of the data block to be sent.

Waveform data has a value of 1 to 125, Zero data represents no data. When there is no data, for example, when the source channel to be returned is off, the data byte count becomes zero and the data block is not returned.

8.3 Programming grammar

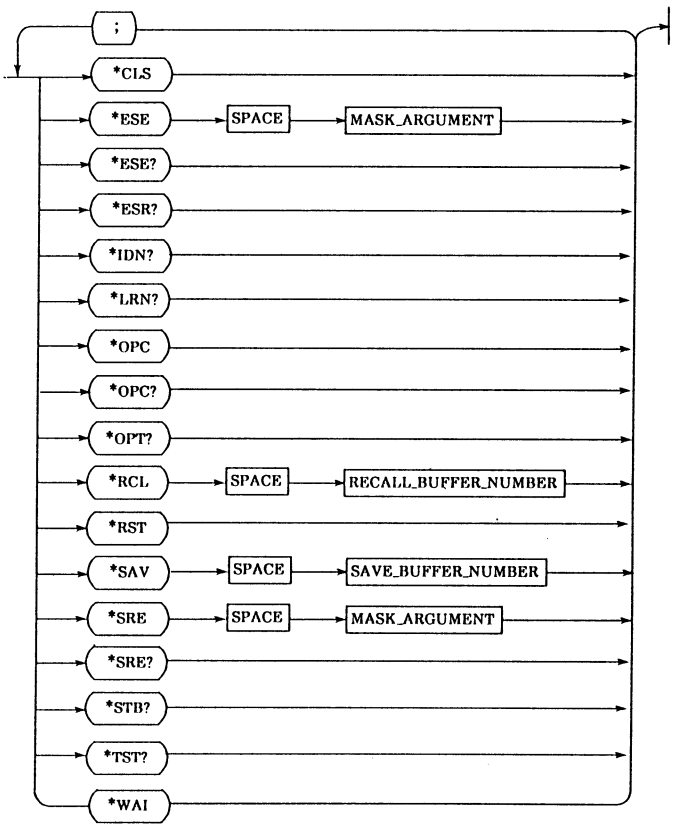
8.3.1 Common command programming grammar

The common commands are defined by the IEEE488.2 standard.

The following common commands can be used in the oscilloscope:

command header	command/ query	program data
*CLS	c	-
*ESE	c/q	-
*ESR	q	-
*IDN	q	-
*LRN	q	-
*OPC	c/q	-
*OPT	q	-
*RCL	c	-
*RST	c	-
*SAV	c	-
*SRE	c/q	-
*STB	q	-
*TST	q	-
*WAI	c	-

The command syntax of the common commands is described below.



(1)*CLS (Clear Status)_____Command

The *CLS command clears the event register generating each summary bit of status byte.
Also they are cleared by the error queue.
As a result, the summary bit corresponding to the status byte which is logical OR of these events is also cleared. However, the output queue is not affected by the *CLS command.

Command syntax
*CLS

Example:
PRINT #1,"*CLS"

(2) *ESE (Event Status Enable)____command/query

This command is permission request of the Standard Event Status Enable Register.
This command sets the mask pattern of the Standard Event Status Enable Register. The mask pattern is specified by a decimal number (integer) in the range of 0 to 255. (Refer to the weight column in Table 8.2.)
If a decimal number out of the range is specified, an execution error will occur.

Command syntax
*ESE <mask>

Query syntax
*ESE?

Returned forma
<mask>

Where: <mask> :: = 0-255

Example:
PRINT #1,"*ESE3 2"

Example:
PRINT #1,"*ESE?"
LINE INPUT #1,ESE$

This example shows that when an execution occurs, the service request is prepared for issue.

Table 8.2 Standard Event Status Enable Register

Bit	Weight	Enables
7	128	Power on
6	64	Not Used
5	32	Command Error
4	16	Not Used
3	8	Not Used
2	4	Not Used
1	2	NOGO Request
0	1	Operation Complete

For the status, refer to Fig. 8.2 Data strucure of status report function.

(3)*ESR (Event Status Register)_____query

Check of Standard Event Status Register.
The *ESR command reads the contents of the Standard Event Status Register.
The event status register is cleared by the query.

Query syntax
*ESR?

Returned format
< status >

Where: < status > :: = 0-255

Example
PRINT #1;"*ESR?"
LINE INPUT #1;ESR$

Table 8.3 Standard event status register

Bit	Weight	Enables
7	128	Power on
6	64	Not Used
5	32	Command Error
4	16	Not Used
3	8	Not Used
2	4	Not Used
1	2	Not used
0	1	Operation Complete

For the status, refer to Fig. 8.2 Data structure of status report function.

(4)*IDN (Identification Number)_____query

Query about ID (manufacturer, model number, etc.) of instument.
Use the *IDN command to detect the instrument to which the controller is connected on RS-232C when starting up the system.

Query syntax
*IDN?

Returned format
HITACHI DENSHI LTD.,VC-5460,X.X
[Example of VC-5460]

Where, < X. X > :: = Version No. of device

Example
PRINT #1,"*IDN?"
LINE INPUT #1,IDN$

(5)*LRN (Learn)_____query

Query about setup information on instrument.
The *LRN command performs the same function as the : SYSTEM:SETUP? query.

Query syntax
*LRN

Returned format
<setup>

Where: <setup> :: = #80000 × × × × <binary data>

Example
PRINT #1,"*LRN?"
LINE INPUT #1,LRN$

(6)*OPC (Operation Complete)_____command/query

When the pocess under execution is completed, the *OPC command places bit 0 in the Standard Event Status Register.

Command syntax
*OPC

Query syntax
*OPC?

Returned format
1

Example
PRINT #1,"*OPC"

Example
PRINT #1,":RUN;*OPC?"
LINE INPUT#1,OPC$

(7)*OPT (Option)_____query

Query about information on options connected to the instrument. This command always returns "0".

Query syntax
*OPT?

Returned format
0

Example
PRINT #1,"*OPT?"
LINE INPUT #1,OPT$

(8)*RCL (Recall)_____command

The *RCL command reads setup information from the specified panel save area, and sets the instrument.

Command syntax
*RCL {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 }

Example
PRINT #1,"*RCL 3"

(9)*RST (Reset)_____command

The *RST command places the instrument in the state set at the factory.

Command syntax
*RST

Example
PRINT #1,"*RST"

(10)*SAV (Save)_____command

The *SAV command stores the setting information to the specified panel save area.
The setup information stored by the *SAV command can be set again by the *RCL command.

Command syntax
*SAV {0|1|2|3|4|5|6|7|8|9}

Example
PRINT #1,"*SAV 3"

(11)*SRE (Service Request Enable)_____command/query

Permission request of Service Request Enable Register.
The *SRE command sets the mask pattern for generating the mask summary status (MSS) bit in the Service Reguest Enable Register.
The mask pattern is specified by a decimal number (integer) in the range from 0 to 191 .
If a value out of the range is specified, an execution error will occur.

Command syntax
*SRE <mask>

Query syntax
*SRE?

Returned format
<mask>

Where: <mask> :: = 0-255

Example
PRINT #1,"*SRE 32"

Example
PRINT #1,"*SRE?"
LINE INPUT#1,SRE$

Table 8.4 Service Reguest Enable Register

Bit	Weight	Enables
7	128	Not Used
6	64	MSS Master Summary Bit
5	32	ESB Event Status Bit
4	16	Not Used
3	8	Not Used
2	4	Not Used
1	2	Not Used
0	1	Not Used

For the status, refer to Fig. 8.2 Data structure of status report function.

(12)*STB (Status Byte)_____query

Check of status byte

Query syntax
*STB?

Returned format
<status>

Where: <status> :: = 0-255

Example
PRINT #1,"*STB?"
LINE INPUT #1,STB$

Table 8.5 Status Byte Register

Bit	Weight	Enables
7	128	Not Used
6	64	MSS Master Summary Bit
5	32	ESB Event Status Bit
4	16	Not Used
3	8	Not Used
2	4	Not Used
1	2	Not Used
0	1	Not Used

For the status, refer to Fig. 8.2 Data structure of status report function.

(13)*TST (Test)_____query

Query about self test (self diagnosis) results
The *TST command performs a self test on the instrument and returns the results.
A zero indicates the test passed and a non-zero value indicates the test failed.

Query syntax
*TST?

Returned format
<result>

Where: <result> :: = 0-255

Example
PRINT #1,"*TST?"
LINE INPUT #1,TST$

(14) *WAI (Wait)_____command

The *WAI command has no function in the instrument.

Command syntax
*WAI

Example
PRINT #1,"*WAI"

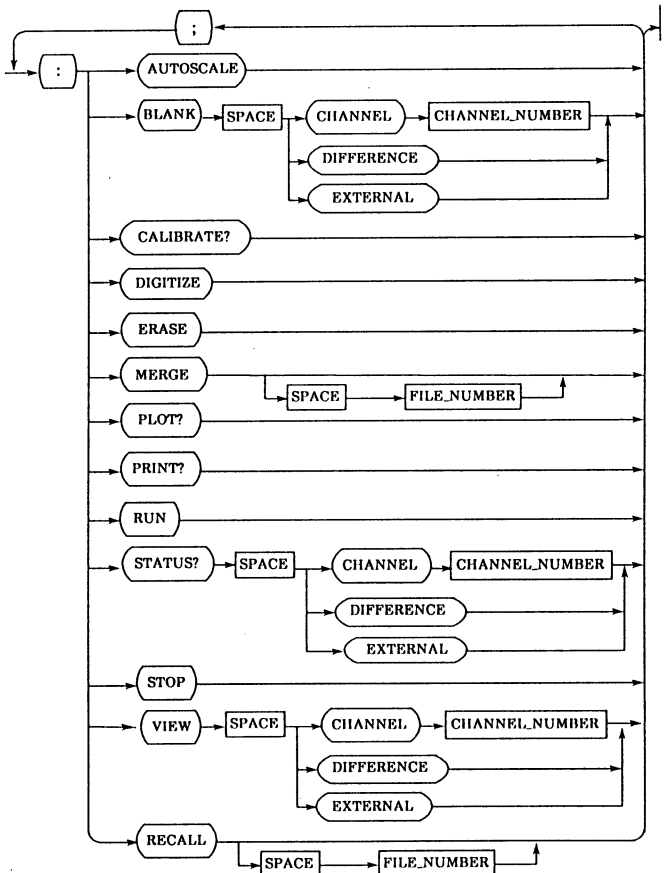
8.3.2 Root Level Commands

The root level commands control basic functions of the instrument.

The following root level commands can be used in the instrument.

command header	command/ query	program data
:AUTOSCALE	c	–
:BLANK	c	"CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL"
:CALIBRATE	q	–
:DIGITIZE	c	–
:ERASE	c	–
:MERGE	c	0~99(VC-5460/VC-5430) 0~9(VC-5410)
:PLOT	q	–
:PRINT	q	–
:RUN	c	–
:STATUS	q	"CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL"
:STOP	c	–
:VIEW	c	"CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL"
:RECALL	c	0~99(VC-5460/VC-5430) 0~9(VC-5410)

The command syntax of the root level commands is shown below.



(1)AUTOSCALE _____ command

Execution of AUTOSETUP.

Command syntax
:AUTOSCALE

Example
PRINT #1,":AUTOSCALE"

The AUTO SETUP is executed.

(2)BLANK _____ command

The BLANK command turns OFF the specified channel. Assign the CHANNEL 1 to turn off the difference channel in the DIFF mode.

Command syntax
:BLANK {CHANNEL{1 | 2 }| DIFFERENCE | EXTERNAL }

Example
PRINT #1,":BLANK CHANNEL1"

Input to CH1 is turned off.

(3)CALIBRATE _____ query

Execution of FULL CALIBRATION.

Query syntax
:CALIBRATE?

Returned format
{PASS | FAIL}

Example
PRINT #1,":CALIBRATE?"
LINE INPUT #1,CALIB$

The CALIBRATE command executes FULL CALIBRATION and returns the results.

(4)DIGITIZE _____ command

The DIGITIZE command performs acquisition once on the channels with input ON in the HOLD status. In the RUNNING status, the command holds the status

Command syntax
:DIGITIZE

Example
PRINT #1,":DIGITIZE"

(5)ERASE _____ command

The ERASE command erases waveform display. This command performs the same function as that of pressing the WAVEFORM CLEAR key on the panel.

Command syntax
:ERASE

Example
PRINT #1,":ERASE"

(6)MERGE _____ command

The MERGE command executes the save of a waveform. This command performs the same function as that of pressing the WAVEFORM SAVE key on the panel.

Command syntax
:MERGE < file-no >

Where, < file-no > := 0 - 99 (VC-5460/VC-5430)
0- 9(VC-5410)

Example
PRINT #1,":MERGE 9"

(7)PLOT _____ query

The PLOT command plots the CRT display.
Set an interface in the menu to feed out the PLOT data to desired output equipment. Select the CENTRONIX for equipment connected to it, or the RS-232C for a personal computer.

Query syntax
:PLOT?

Example
PRINT #1,":PLOT?"

The address = 2 plotter is made to plot.

(8)PRINT _____ command

The PRINT command makes the built-in printer print the CRT dislay.
Set an interfece in the menu to feed out the PRINT data to desired output equipment. Select the CENTRONIX for equipment connected to it, or the RS-232C for a personal computer.

Command syntax
:PRINT

Example
PRINT #1,":PRINT?"

(9)RUN _____ command

The RUN command places the instrument in the RUN state.

Command syntax
:RUN

Example
PRINT #1,":RUN"

The status is changed to the RUNNING status.

(10)STATUS _____ query

The STATUS command returns the information on whether the specified channel is on or off.
To turn on a channel, use the VIEW command and to turn off a channel, use the BLANK command.

Query syntax
:STATUS? {CHANNEL{1 | 2 } | DIFFERENCE | EXTERNAL}

Returned format
{ON | OFF}

Example
PRINT #1,":STATUS? CHANNEL1"
INPUT #1,STATUS$

The display setting on channel 1 is returned.

(11)STOP command

The STOP command places the instrument in the HOLD state.

Command syntax
:STOP

Example
PRINT #1,":STOP"

The status is changed to the HOLD status.

(12)VIEW command

The VIEW command turns on the specified channel.
Assign the CHANNEL 1 to turn on the difference channel in the DIFF mode.

Command syntax
:VIEW {CHANNEL{1 | 2 } | DIFFERENCE | EXTERNAL}

Example
PRINT #1,":VIEW CHANNEL1"

Input to CH1 is turned on.

(13)RECALL command

The RECALL command recalls waveform data from the specified file.
When <file-no> is omitted, the same function as pressing the WAVEFORM RECALL is obtained.
When data is recalled from the internal pixel memory, the specified number is ignored.

Command syntax
:RECALL <file-no>

Where, <file-no> := 0 - 99(VC-5460/VC-5430)
0- 9(VC-5410)

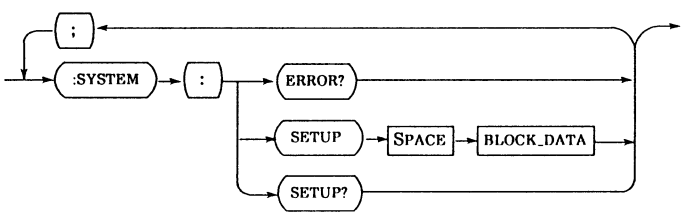
Example
PRINT #1,":RECALL 10"

8.3.3 SYSTEM Commands

The SYSTEM subsystem commands change and return the setup state of the instrument and control the return of error information for each command.
The following SYSTEM subsystem commands can be used in the instrument.

command header	command/ query	program data
:SYSTEM:ERROR	q	–
:SYSTEM:SETUP	c/q	–

The command syntax of the SYSTEM subsystem commands is shown below.



(1)ERROR _____ query

The ERROR command returns error information during command execution.
Maximum 15 pieces of error information are stored in the error queue.
Pieces of error information in the error queue are read out one by one by this command.
When the error queue is empty, "0" is returned.

Query syntax
:SYSTEM:ERROR?

Returned format:
<error>

Where: Error information of <error>::=integer

Example
```
PRINT #1,":SYSTEM:ERROR?"
LINE INPUT #1,ERROR$
```

The returned error codes are as follows:

	Error code
Normal end	0
Comand error	–100

(2)SETUP _____ command/query

Command syntax
:SYSTEM:SETUP <setup>

Query syntax
:SYSTEM:
SETUP?

Returned format
<setup>

Where, <setup> ::=
#8000XXXX<binarydata>

≪Quick Basic≫

Example

```
DIM ISETUP$(1500)              'Definition of array.
SCREEN 2                       'Sets the screen mode.
CLS 0                          'Clear screen.
WINDOW (0, 0)-(2048, 356)      'Set the window.
OPEN "COM1:
9600,N,8,1,LF,RS"
FOR RANDOM AS #1               'Open the RS-232C (COM1).
PRINT #1, ":SYSTEM:SETUP?;"
DAT$ = INPUT$(1, #1)           'Reads "#".
PRINT DAT$                     'Print "#" to display.
STRLEN# = INPUT$(1, #1)        'Reads "8"
PRINT STRLEN$                  'Prints "8" to display.
STRLEN = VAL(STRLEN$)          'Converts characters to
                               figures.
FOR I = 1 TO STRLEN            'Starts to read block length.
    BLEN$ = INPUT$(1, #1)      'Reads one character.
    BLOCKLEN$ = BLOCKLEN
    + BLEN$                    'Adds acquire characters to
                               'character-string one by one.
NEXT
PRINT BLOCKLEN#                'Prints block length to display.
BLOCKLEN = VAL(LEFT$
(BLOCKLEN$, STRLEN) )          'Converts characters to
                               figures.
FOR I = 1 TO BLOCKLEN + 1      'Starts to read setup data.
    ISETUP$(I) =
    INPUT$(1, #1)              'Reads one byte.
NEXT
PRINT "Push any key"           'Prints message to display.
LOPJMP: A$ = INKEY$: IF A$ =
""THEN GOTO LOPJMP             'Waits key input.
COMD$ = ":SYSTEM:SETUP #"
 + STRLEN$ + BLOCKLEN$         'The setup command is set to
                               'setup header.
PRINT #1, COMD$;               'Transfers the setup command
                               'and header.
FOR I = 1 TO BLOCKLEN-1        'Starts to transfer setup data.
    PRINT #1, ISETUP$(I);      'Transfers one byte.
    PRINT ASC(ISETUP$(I) );    'Converts setup data to
                               'character code.
NEXT
PRINT #1, ISETUP$(I)           'Transfers delimiters.
PRINT ASC(ISETUP$(I) )         'Prints delimiters to display.
CLOSE #1                       'Close the RS-232C (COM1).
END                            'End.
```

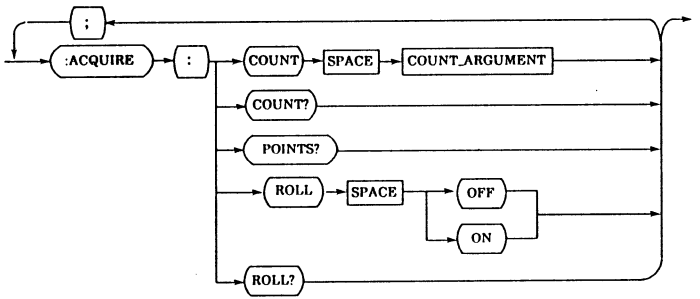
8.3.4 ACQUIRE Commands

The ACQUIPE subsystem commands control the operation mode for entering data.

The following ACQUIRE subsystem commands can be used in the instrument.

command header	command/ query	program data
:ACQUIRE:COUNT	c/q	"OFF", "2", "4","8", "16","32", "64", "128", "256"
:ACQUIRE:POINTS	q	"2048"
:ACQUIRE:ROLL	c/q	"OFF", "ON"

The command syntax of the ACQUIRE subsystem command is shown below.



(1)COUNT _____ command/query

The COUNT command executes average and changes the times.

Command syntax
:ACQUIRE:COUNT
{OFF | 2 | 4 | 8 | 16 | 32 | 64
|128 | 256}

Example
PRINT
#1,":ACQUIRE:COUNT 64"

Average is turned on and the average times are set to 64.

Query syntax
:ACQUIRE:COUNT?

Returned format
{OFF | 2 | 4 | 8 | 16 | 32 | 64
| 128 | 256}

Example
PRINT #1,":ACQUIRE:
COUNT?"
LINE INPUT#1,COUNT$

The present average times are returned.

(2)POINTS _____ query

The POINTS command returns the number of data to be entered by one sampling.

Query syntax
:ACQUIRE:POINTS?

Returned format
< points argument1 >

Example
PRINT #1,":ACQUIRE:POINTS?"
LINE INPUT #1,POINTS$

The present number of data to be entered is returned.

(3)ROLL _____ command/query

D-2 switch {OFF, ON}

Command syntax
:ACQUIRE:ROLL {OFF,
ON}

Example
PRINT #1,":ACQUIRE:
ROLL ON"

Query command
:ACQUIRE:ROLL?

Returned format
{OFF | ON}

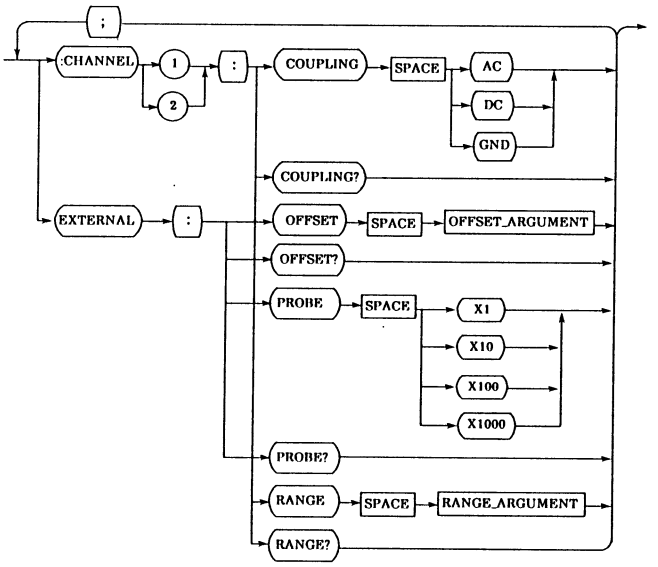
Example
PRINT
1,":ACQUIRE:ROLL?"
LINE INPUT #1,ROLL$

8.3.5 CHANNEL Commands

The CHANNEL subsystem commands control the functions related to the vertical axis of the instrument.
The following CHANNEL subsystem commands can be used in the instrument.

command header	command/ query	program data
:CHANNEL<N> : COUPLING	c/q	AC", "DC", "GND"
:CHANNEL<N> : OFFSET	c/q	Volts... exponential(NR3)
:CHANNEL<N> : PROBE	c/q	"X1", "X10", "X100", "X1000"
:CHANNEL<N> : RANGE	c/q	Volts...exponential(NR3)
:EXTERNAL : OFFSET	c/q	Volts...exponential(NR3)
:EXTERNAL : PROBE	c/q	X1", "X10", "X100", "X1000"

The command syntax of the CHANNEL subsystem commands is shown below.



(1)COUPLING _____ command/query

The COUPLING command switches the coupling on the input channel to any one of AC/DC/GND.

Command syntax
:CHANNEL{1 I 2 }:
COUPLING
{AC I DC IGND}

Query syntax
:CHANNEL
{1 I 2 }:COUPLING?

Returned format
{AC | DC | GND}

Example
PRINT #1,":CHANNEL2:
COUPLING AC"

The coupling on CH2 is switched to AC.

Example
PRINT #1,":CHANNEL2:
COUPLING?"
LINE INPUT#1,COUPLING$

The coupling information on CH2 is returned.

(2)OFFSET command/query

The OFFSET command changes the V position of a waveform by switching the offset voltage.

Command syntax
:CHANNEL{1 | 2}:OFFSET
<offset-data>

Query syntax
:CHANNEL
{1 | 2}:OFFSET?

Returned format
<offset-data>

Where, <offset data> :: =
offset voltage (NR3)

Example
PRINT #1,":CHANNEL2:
OFFSET 1"

The offset voltage on CH1 is switched to 1 volt.

Example
PRINT #1,":CHANNEL2:
OFFSET?"
LINE INPUT #1,OFFSET$

The offset voltage value on CH2 is received and displayed.

(3)PROBE command/query

The PROBE command switches the probe factor value for the input channel.

Command syntax
:CHANNEL{1 | 2 :PROBE
{X1 | X10 | X100 |
×1000}

Query syntax
:CHANNEL
{1 | 2 |}:PROBE?

Returned format
{X1 | X10 | X100 | ×1000}

Example
PRINT #1,":CHANNEL2:
PROBE X1"

The probe factor value on CH2 is switched to X1.

Example
PRINT
1,":CHANNEL2:PROBE?"
LINE INPUT #1,PROBE$

The probe factor value on CH2 is returned.

(4)RANGE command/query

The RANGE command sets the full-scale input sensitivity for the specified channel.

Command syntax
:CHANNEL{1 | 2}:
RANGE <range data>

Query syntax
:CHANNEL{1 | 2}:
RANGE?

Returned format
<range data>

Where, <range data> :: =
Voltage value of full scale (NR3)

Example
```
PRINT #1,":CHANNEL2:
 RANGE 8"
```

The sensitivity on CH2 is switched to 1 VOLT/DIV.

Example
```
PRINT #1,":CHANNEL2:
 RANGE?"
LINE INPUT#1,RANGE$
```

The present sensitivity on CH2 received and displayed.

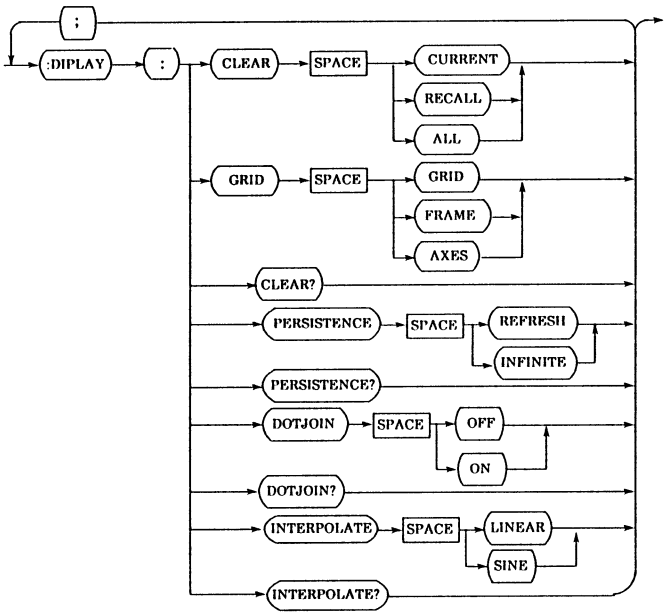
8.3.6 DISPLAY Commands

The DISPLAY subsystem commands control the functions related to display.

The following DISPLAY subsystem commands can be used in the instrument.

command header	command/ query	program data
:DISPLAY:CLEAR (VC-5460 only)	c/q	"CURRENT", "RECALL", "ALL"
:DISPLAY:GRID	c/q	"GRID", "FRAME", "AXES"
:DISPLAY: PERSISTENCE	c/q	"REFRESH", "INFINITE"
:DISPLAY:DOTJOIN	c/q	"ON", "OFF"
:DISPLAY: INTERPOLATE	c/q	"LINEAR", "SINE"

The command syntax of the DISPLAY subsystem commands is shown below.



(1)CLEAR _____ command/query

The CLEAR command selects the waveform to be cleared (VC-5460 only)

Command syntax
:DISPLAY:CLEAR
{CURRENT | RECALL | ALL}

Query syntax
:DISPLAY:CLEAR?

Returned format
{CURRENT | RECALL | ALL}

Example
```
PRINT #1,":DISPLAY:
 CLEAR ALL"
```

All waveform is select

Example
```
PRINT #1,":DISPLAY:
 CLEAR?"
 LINE INPUT#1,CLEAR$
```

The present setting is returned

(2)GRID _____ command/query

The GRID command switches the scale to any one of GRID/AXES/FRAME.

Command syntax
:DISPLAY:
GRID {GRID | FRAME | AXES}

Query syntax
:DISPLAY:GRID?

Returned format
{GRID | FRAME | AXES}

Example
```
PRINT #1,":DISPLAY:
 GRID AXES"
```

The scale is set to AXES.

Example
```
PRINT #1,":DISPLAY:
 GRID?"
LINE INPUT#1,GRID$
```

The present scale setting is returned.

(3)PERSISTENCE_____command/query

The PERSISTENCE command switches the setting of overwrite.

Command syntax
```
:DISPLAY:
 PERSISTENCE
{REFRESH I INFINITE}
```

Query syntax
```
:DISPLAY:
 PERSISTENCE?
```

Returned format
{REFRESH I INFINITE}

Example
```
PRINT #1,":DISPLAY:
 PERSISTENCE INFINITE"
```

Overwrite is set to INFINITE.

Example
```
PRINT #1,":DISPLAY:
 PERSISTENCE?"
LINE
 INPUT#1,PERSISTENCE$
```

The present overwrite setting is returned.

(4)DOTJOIN_____command/query

The DOTJOIN command turns on or off the dotjoin.

Command syntax
```
:DISPLAY:
 DOTJOIN {ON I OFF}
```

Query syntax
```
:DISPLAY:DOTJOIN?
```

Returned format
{ON I OFF}

Example
```
PRINT #1,":DISPLAY:
 DOTJOIN ON"
```

The dotjoin is set to ON.

Example
```
RPINT
 #1,":DISPLAY:DOTJOIN?"
 LINE INPUT#1,DOTJOIN$
```

The present dotjoin setting is returned.

(5)INTERPOLATE_____command/query

The INTERPOLATE command switches the setting of interpolation.

Command syntax
```
:DISPLAY:
 INTERPOLATE
 {LINEAR I SINE}
```

Query syntax
```
:DISPLY:INTERPOLATE?
```

Returned format
{LINEAR I SINE}

Example
```
PRINT #1,":DISPLAY:
 INTERPOLATE SINE"
```

SIN interpolation is turned on.

Example
```
PRINT #1,":DISPLAY:
 INTERPOLATE?"
LINE INPUT#1,INTERPOL$
```

The present interploation setting is returned.

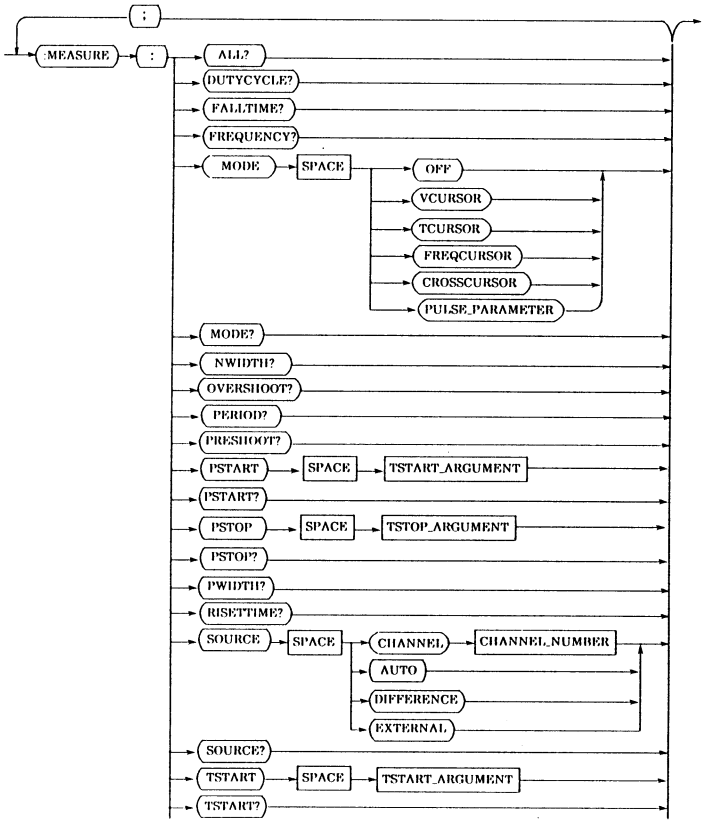
8.3.7 MEASURE Commands

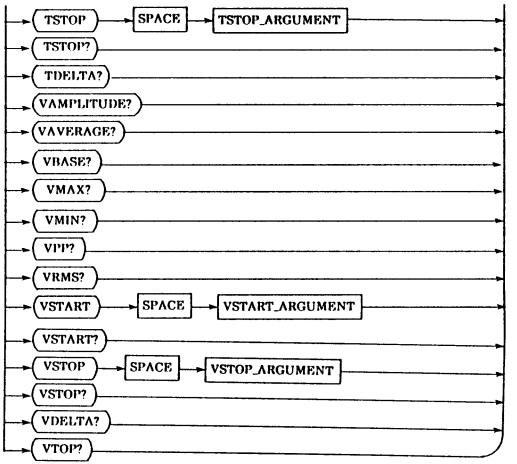
The MEASURE subsystem commands control the measuring function of the instrument. Each executing a MEASURE command makes the instrument perform measurements.

The following MEASURE subsystem commands can be used in the instrument.

command header	command/ query	program data
:MEASURE:ALL	q	–
:MEASURE:DUTYCYCLE	q	–
:MEASURE:FALLTIME	q	–
:MEASURE:FREQUENCY	q	–
:MEASURE:MODE	c/q	"OFF", "VCURSOR", "TCURSOR", "FREQCURSOR", "CROSSCURSOR", "PULSE-PARAMETER"
:MEASURE:NWIDTH	q	–
:MEASURE:OVERSHOOT	q	–
:MEASURE:PERIOD	q	–
:MEASURE:PRESHOOT	q	–
:MEASURE:PSTART	c/q	–150~150
:MEASURE:PSTOP	c/q	–150~150
:MEASURE:PWIDTH	q	–
:MEASURE:RISETIME	q	–
:MEASURE:SOURCE	c/q	"AUTO", "CHANNEL1", "CHANNEL2","DEFERENCE", "EXTERNAL"
:MEASURE:TSTART	c/q	–150~150
:MEASURE:TSTOP	c/q	–150~150
:MEASURE:TDELTA	q	Volts... exponential(NR3)
:MEASURE:VAMPLITUDE	q	–
:MEASURE:VAVERAGE	q	–
:MEASURE:VBASE	q	–
:MEASURE:VMAX	q	–
:MEASURE:VMIN	q	–
:MEASURE:VPP	q	–
:MEASURE:VRMS	q	–
:MEASURE:VSTART	c/q	–100~100
:MEASURE:VSTOP	c/q	–100~100
:MEASURE:VDELTA	q	Volts... exponential(NR3)
:MEASURE:VTOP	q	–

The command syntax of the MEASURE subsystem commands is shown below.





(1)ALL _____ query

The ALL command returns all the measured pulse parameter values.

Query syntax
:MEASURE:ALL?

Returned format
<DUTY CYCLE result>, <FALL TIME result>, <FREQUENCY result>, <NWIDTH result>, <OVERSHOOT result>, <PERIOD result>, <PRESHOOT result>, <PWIDTH result>, <RISETIME result>, <VAMPLITUDE result>, <VAVERAGE result>, <VBASE result>, <VMAX result>, <VMIN result>, <VPP result>, <VRMS result>, <VTOP result>

Where, <result> :: = each measurement result (NR3)

Example
PRINT #1,":MEASURE:ALL?"
LINE INPUT #1,ALL$

The present number of data to be entered is returned.

(2)DUTYCYCLE _____query

The DUTYCYCLE command returns the measured duty cycle value.

Query syntax
:MEASURE:DUTYCYCLE?

Returned format
<value>

Where, <value> :: = Measured duty cycle value (%)
(NR3)

Example
PRINT #1,":MEASURE:DUTYCYCLE?"
LINE INPUT #1,VALUE$

(3)FALLTIME_____query

The FALLTIME command returns the measured fall time value.

Query syntax
:MEASURE:FALLTIME?

Returned format
<value>

Where, <value> :: =
Measured fall time value (second) (NR3)

Example
PRINT #1,":MEASURE:FALLTIME?"
LINE INPUT #1,VALUE$

(4)FREQUENCY_____query

The FREUENCY command returns the measured frequency value.

Query syntax
:MEASURE:FREQUENCY?

Returned format
<value>

Where, <value> :: = Measured frequency value (Hz)
(NR3)

Example
PRINT #1,":MEASURE:FREQUENCY?"
LINE INPUT #1,VALUE$

(5)MODE _____command/query

The MODE command selects the measuring function from OFF/V cursor/T cursor/F cursor/ + cursor/pulse parameter.

Command syntax
:MEASURE:MODE
{OFF | VCURSOR |
TCURSOR |
FREQCURSORI
CROSSCURSOR | (VC-5430 only)
PULSE-PARAMETER}

Example
PRINT #1,":MEASURE:
MODE TCURSOR"

The measuring function is set to TCOUSOR.

Query syntax
:MEASURE:MODE?

Returned format
{OFF | VCURSOR |
TCURSOR |
FREQCURSOR |
CROSSCURSOR | (VC-5430 only)
PULSE-PARAMETER}

Example
PRINT #1,":MEASURE:
MODE?"
LINE INPUT #1,MODE$

The measuring function presently selected is returned.

(6)NWIDTH _____query

The measured negative pulse width value is returned.

Query syntax
:MEASURE:NWIDTH?

Returned format
< value >

Where, < value > :: = Measured negative pulse width value(second) (NR3)

Example
PRINT #1,":MEASURE:NWIDTH?"
LINE INPUT #1,VALUE$

(7)OVERSHOOT _____query

The OVERSHOOT command returns the measured overshoot value.

Query syntax
:MEASURE:OVERSHOOT?

Returned format
< value >

Where, < value > :: = Measured overshoot value (Volt) (NR3)

Example
PRINT #1,":MEASURE:OVERSHOOT?"
LINE INPUT #1,VALUE$

(8)PERIOD _____ query

The PERIOD command returns the measured period value.

Query syntax
:MEASURE:PERIOD?

Returned format
< value >

Where, < value > :: = Measured period value (second)
(NR3)

Example
PRINT #1,":MEASURE:PERIOD?"
LINE INPUT #1,VALUE$

(9)PRESHOOT _____ query

The PRESHOOT command returns the measured preshoot value.

Query syntax
:MEASURE:PRESHOOT?

Returned format
< value >

Where, < value > :: = Measured preshoot value (Volt)
(NR3)

Example
PRINT #1,":MEASURE:PRESHOOT?"
LINE INPUT #1,VALUE$

(10)PSTART _____ command/query

The PSTART command sets the start cursor position.(VC-5460 only)

Command syntax
:MEASURE:PSTART
< position >

Query syntax
:MEASURE:PSTART?

Returned format
< position >

Where, < position > :: =
-150~150

Example
PRINT
#1,":MEASURE:
PSTART 50"

Example
PRINT
#1,":MEASURE:
PSTART?"
LINE INPUT #1,PSTART$

The start cursor position is set to 50. The present start cursor position is returned.

(11)PSTOP _____ command/query

The PSTOP command sets the stop cursor position.

Command syntax
:MEARSURE:PSTOP
< position >

Query syntax
:MEASURE:PSTOP?

Returned format
< position >

Where, < position > :: =
-150~150

Example
```
PRINT #1,":MEASURE:
 PSTOP 100"
```

Example
```
PRINT
 #1,":MEASURE:PSTOP?"
 LINE INPUT #1,PSTOP$
```

The stop cursor position is set to 100.
The present stop cursor position is returned.

(12)PWIDTH _____ query

The PWIDTH command returns the measured positive pulse width value.

Query syntax
:MEASURE:PWIDTH?

Returned format
< value >

Where, < value > :: = Measured position pulse width value (second) (NR3)

Example
```
PRINT #1,":MEASURE:PWIDTH?"
LINE INPUT #1,VALUE$
```

(13)RISETIME _____ query

The RISETIME command returns the measured rise time value.

Query syntax
:MEASURE:RISETIME?

Returned format
< value >

Where, < value > :: = Measured rise time value (second) (NR3)

Example
```
PRINT #1,":MEASURE:RISETIME?"
LINE INPUT #1,VALUE$
```

(14)SOURCE _____ command/query

The SOURCE command sets the channel to be measured.

Command syntax
```
:MEASURE:SOURCE CHANN
EL{1 | 2 | AUTO |
DIFFERENCE |
EXTERNAL }
```

Example
```
PRINT
 #1,":MEASURE:SOURCE
 CHANNEL2"
```

The channel to be measured is set to CH2.

Query syntax
```
:MEASURE:SOURCE?
```

Returned format
```
CHANNEL{1 | 2 | AUTO |
 DIFFERENCE |
 EXTERNAL}
```

Example
```
PRINT #1,":MEASURE:
 SOURCE?"
 LINE INPUT
 #1,SOURCE$
```

The present channel to be measured is returned.

(15)TSTART_____command/query

The TSTART command sets the reference T cursor position.

Command syntax
:MEASURE:TSTART
< position >

Query syntax
:MEASURE:TSTART?

Returned format
< position >

Where, < position > :: =
–150~150

Example
PRINT
#1,":MEASURE:TSTART 50"

Example
PRINT
#1,":MEASURE:TSTART?"
LINE INPUT #1,TSTART$

The reference T cursor position is set to 50. The present T reference cursor position is returned.

(16)TSTOP_____command/query

The TSTOP command sets the delta T cursor position.

Command syntax
:MEARSURE:TSTOP
< position >

Query syntax
:MEASURE:TSTOP?

Returned format
< position >

Where, < position > :: =
–150~150

Example
PRINT #1,":MEASURE:
TSTOP 100"

Example
PRINT
#1,":MEASURE:TSTOP?"
LINE INPUT #1,TSTOP$

The delta T cursor position is set to 100.
The present delta T cursor position is returned.

(17)TDELTA_____query

The TDELTA command returns the measured value of time difference.

Query syntax
:MEASURE:TDELTA?

Returned format
< value >

Where, < value > :: = Measured value of voltage difference (Volt) (NR3)

Example
PRINT #1,":MEASURE:TDELTA?"
LINE INPUT #1,TDELTA$

The measured value of time difference between two present T cursors is returned.

(18)VAMPLITUDE _____ query

The VAMPLITUDE command returns the measured value of voltage difference between the base voltage and the top voltage.

Query syntax
:MEASURE:VAMPLITUDE?

Returned format
<value>

Where, <value>::= Measusred value of voltage difference between the base voltage and the top voltage (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VAMPLITUDE?"
LINE INPUT #1,VALUE$
```

(19)VAVERAGE _____ query

The VAVERAGE command returns the voltage measured average value.

Query syntax
:MEASURE:VAVERAGE?

Returned format
<value>

Where, <value>::= Measured average voltage value (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VAVERAGE?"
LINE INPUT #1,VALUE$
```

(20)VBASE _____ query

The VBASE command returns the measured base voltage value.

Query syntax
:MEASURE:VBASE?

Returned format
<value>

Where, <value>::= Measured base voltage value (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VBASE?"
LINE INPUT #1,VALUE$
```

(21)VMAX _____ query

The VMAX command returns the measured maximum voltage value.

Query syntax
:MEASURE:VMAX?

Returned format
<value>

Where, <value> :: = Measured maximum voltage value (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VMAX?"
LINE INPUT #1,VALUE$
```

(22)VMIN _____ query

The VMIN command returns the measured minimum voltage value.

Query syntax
:MEASURE:VMIN?

Returned format
<value>

Where, <value> :: = Measured minimum voltage value (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VMIN?"
LINE INPUT #1,VALUE$
```

(23)VPP _____ query

The VPP command returns the measured value of voltage difference between the maximum voltage and the minimum voltage.

Query syntax
:MEASURE:VPP?

Returned format
<value>

Where, <value> :: = Measured value of voltage difference between maximum voltage and minimum voltage. (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VPP?"
LINE INPUT #1,VALUE$
```

(24)VRMS _____ query

The VRMS command returns the measured effective voltage value.

Query syntax
:MEASURE:VRMS?

Returned format
<value>

Where, <value> :: = Measured effective voltage value (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VRMS?"
LINE INPUT #1,VALUE$
```

(25)VSTART _____ command/query

The VSTART command sets the reference V cursor position.

Command syntax
:MEARSURE:VSTART
<position>

Query syntax
:MEASURE:VSTART?

Returned format
<position>

Where, <position>::=
-100~100

Example
```
PRINT #1,":MEASURE:
 VSTART 50"
```

Example
```
PRINT
 #1,":MEASURE:VSTART?"
LINE INPUT
 #1,VSTART$
```

The V reference cursor position is set to 50. The present V reference cursor position is returned.

(26)VSTOP _____ command/query

The VSTOP command sets the delta V coursor position.

Command syntax
:MEASURE:VSTOP
<position>

Query syntax
:MEASURE:VSTOP?

Returned format
<position>

Where, <position>::=
-100~100

Example
```
PRINT #1,":MEASURE:
 TSTOP 100"
```

Example
```
PRINT
 #1,":MEASURE:VSTOP?"
LINE INPUT #1,VSTOP$
```

The delta V cursor position is set to 100. The present data V cursor position is returned.

(27)VDELTA _____ query

The VDELTA command returns the measured value of voltage difference between two V cursors.

Query syntax
:MEASURE:VDELTA?

Returned format
<value>

Where, <value>::= Measured value of voltage difference (Volt) (NR3)

Example
```
PRINT #1,":MEASURE:VDELTA?"
LINE INPUT #1,VDELTA$
```

The measured value of voltage diffenence between two V cursors is returned.

(28)VTOP _____ query

The VTOP command returns the measured top voltage value.

Query syntax
:MEASURE:VTOP?

Returned format
<value>

Where, <value>::= Measured top voltage value (Volt) (NR3)

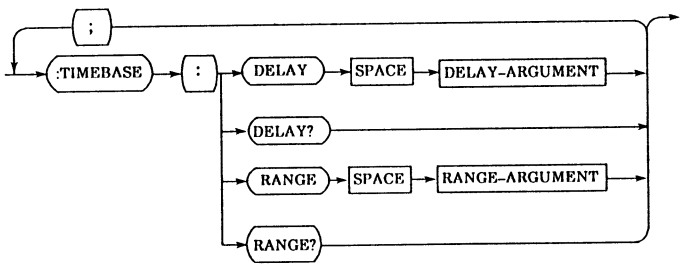
Example
```
PRINT #1,":MEASURE:VTOP?"
LINE INPUT #1,VALUE$
```

8.3.8 TIMEBASE Commands

The TIMEBASE subsystem commands control the functions related to the horizontal axis of the instrument.
The following TIMEBASE subsystem commands can be used in the instrument.

command header	command/ program data query	
:TIMEBASE:DELAY	c/q	Seconds... exponential(NR3)
:TIMEBASE:RANGE	c/q	Seconds... exponential(NR3)

The command syntax of the TIMEBASE subsystem commands is shown below.



(1)DELAY_____command/query

The DELAY command switches the delay time.

Command syntax
:TIMEBASE:DELAY
<delay>

Query syntax
:TIMEBASE:DELAY?

Returned format
<delay>

Where, <delay>::=Delay time (second) (NR3)

Example
PRINT #1,":TIMEBASE:
DELAY 1e-3"

The delay time is switched to 1ms.

Example
PRINT #1,":TIMEBASE:
DELAY?"
LINE INPUT #1,DELAY$

The present delay time is received and displayed.

(2)RANGE_____command/query

The RANGE command switches the full scale time.

Command syntax
:TIMEBASE:RANGE
<range>

Query syntax
:TIMEBASE:RANGE?

Returned format
<range>

Where, <range>::=Set full scale time value (second) (NR3)

Example
PRINT #1,":TIMEBASE:
RANGE 100e-3"

The time range is switched to 100ms/div.

Example
PRINT #1,":TIMEBASE:
RANGE?"
LINE INPUT #1,RANGE$

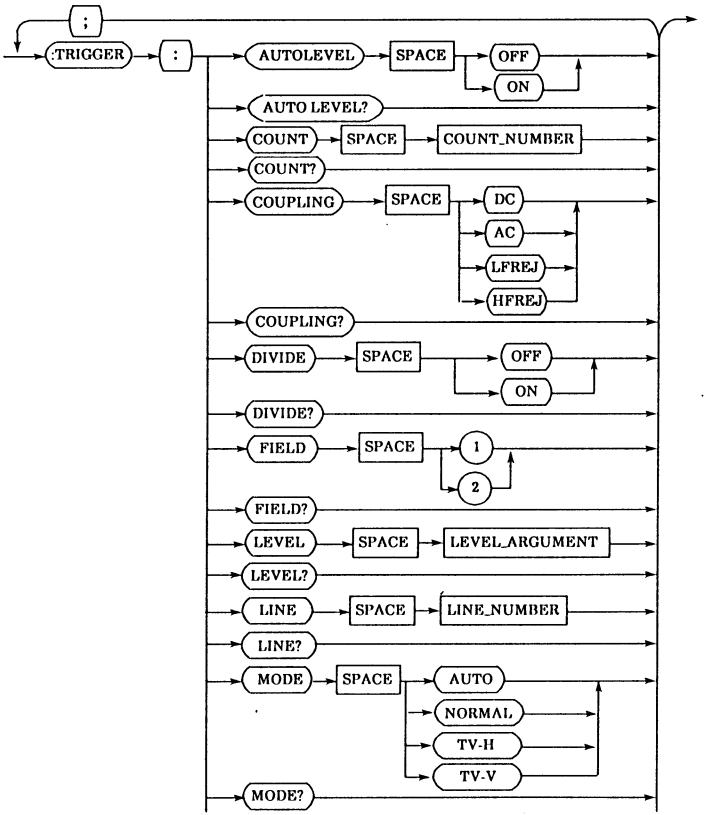
The present time range value is received and displayed.

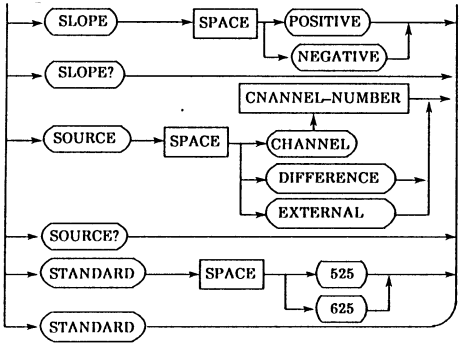
8.3.9 TRIGGER Commands

The TRIGGER subsystem commands control the trigger function of the instrument.

command header	command/ query	program data
:TRIGGER:AUTOLEVEL	c/q	"ON", "OFF"
:TRIGGER:COUNT	c/q	2~4096
:TRIGGER:COUPLING	c/q	"DC", "AC", "LFREJ", "HFREJ"
:TRIGGER:DIVIDE	c/q	"OFF", "ON"
:TRIGGER:FIELD (VC-5460 only)	c/q	"1", "2"
:TRIGGER:LEVEL	c/q	Volts... exponential(NR3)
:TRIGGER:LINE (VC-5460 only)	c/q	1~625
:TRIGGER:MODE	c/q	"AUTO", "NORMAL", "TV-V", "TV-H", "TV LINE"(VC-5460 only)
:TRIGGER:SLOPE	c/q	"POSITIVE", "NEGATIVE"
:TRIGGER:SOURCE	c/q	"CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL"
:TRIGGER:STANDARD (VC-5460 only)	c/q	"525", "625"

The command syntax of the TRIGGER subsystem commands is shown below.





(1)AUTO LEVEL command/query

The AUTO command turns on/off auto trigger level.

Command syntax
:TRIGGER:AUTO LEVEL
{ON | OFF}

Query syntax
:TRIGGER:AUTO LEVEL?

Returned format
{ON | OFF}

Example
```
PRINT #1,":TRIGGER:AUTO
 LEVEL ON"
```

Example
```
PRINT #1,":TRIGGER:
 AUTO LEVEL?"
LINE INPUT #1,AUTO$
```

Auto trigger is turned on.

(2)COUPLING command/query

The COUPLING command sets the coupling system connecting the trigger source signal to the trigger circuit in the edge trigger function mode.

Command syntax
:TRIGGER:COUPLING {DC | AC | LFREJ | HFREJ}

Query suntax
:TRIGGER:COUPLING ?

Returned format
{DC | AC | LFREJ | HFREJ}

Example
```
PRINT#1,":TRIGGER:
 COUPLING DC"
```

Example
```
PRINT #1,":TRIGGER:
 COUPLING?"
LINE INPUT
 #1,COUPLING$
```

The coupling system of the trigger is set to DC.

(3)COUNT command/query

The COUNT command sets the number of divided triggers.

Command syntax
:TRIGGER:COUNT <number>

Where, <number> ::= 2~4096

Query syntax
:TRIGGERCOUNT ?

Returned format
<number>

Example
PRINT #1,":TRIGGER COUNT 10"

Example
PRINT #1,":TRIGGER:COUNT ?"
LINE INPUT #1,COUNT$

(4)DEVIDE command/query

The DEVIDE command sets divided trigger.

Command syntax
:TRIGGER:DIVIDE {OFF | ON }

Query syntax
:TRIGGER:DIVIDE?

Returned format
{OFF | ON }

Example
PRINT #1,":TRIGGER:DIVIDE ON"

Example
PRINT #1,":TRIGGER:DIVIDE ?"
LINE INPUT #1,DIVIDE$

(5)FIELD command/query

The FIELD command sets the field in the TV LINE mode of the TV trigger function.

Command syntax
:TRIGGER:FIELD {1 | 2}

Query syntax
:TRIGGER:FIELD?

Returned fomat
{1 | 2}

Example
PRINT #1,":TRIGGER:FIELD 1"

The field in the TV LINE mode is set to field 1.

Example
PRINT #1,":TRIGGER:FIELD ?"
LINE INPUT #1,FIELD$

The present field is returned.

(6)LEVEL command/query

The LEVEL command switches the trigger level voltage.

Command syntax
:TRIGGER:LEVEL <level>

Query syntax
:TRIGGER:LEVEL?

Returned fomat
<level>

Where, <level>::=Trigger level voltage (Volt) (NR3)

Example
PRINT #1,":TRIGGER:LEVEL 1E-3"

Example
PRINT #1,":TRIGGER:LEVEL?"
LINE INPUT#1,LEVEL$

The trigger level voltage is switched to 1mV.

The present trigger level voltage is returned.

(7)LINE command/query

The LINE command sets the line number in the TV LINE mode of the TV trigger function.

Command syntax
:TRIGGER:LINE <level>

Query syntax
:TRIGGER:LINE?

Returned fomat
<line>

Where, <line>::=Line number (1~625)

Example
PRINT #1,":TRIGGER:LINE 123"

The line number is set to 123.

Example
PRINT #1,":TRIGGER:LINE?"
LINE INPUT #1,LINE$

The present line number is returned.

(8)MODE command/query

The MODE command switches the trigger mode.

Command syntax
:TRIGGER:MODE {AUTO | NORMAL | TV-H | TV-V | TVLINE}
TV LINE is available only for the VC-5460

Query syntax
:TRIGGER:MODE?

Returned format
{AUTO | NORMAL | TV-H | TV-V | TVLINE}

Example
PRINT #1,":TRIGGER:MODE NORMAL"

The trigger mode is switched to NORMAL.

Example
PRINT #1,":TRIGGER:MODE?"
LINE INPUT#1,MODE$

The present trigger mode is returned.

(9)SLOPE command/query

The SLOPE command switches the trigger slope.

Command syntax
:TRIGGER:SLOPE {POSITIVE | NEGATIVE}

Query syntax
:TRIGGER:SLOPE?

Returned format
{POSITIVE | NEGATIVE}

Example
PRINT #1,":TRIGGER:SLOPE POSITIVE"

The trigger slope is switched to " + ".

Example
PRINT #1,":TRIGGER:SLOPE?"
LINE INPUT#1,SLOPE$

The present trigger slope is returned.

(10)SOURCE command/query

The SOURCE command switches the trigger source.

Command syntax
:TRIGGER:SOURCE CHANNEL{1 | 2 | DIFFERENCE | EXTERNAL}

Query syntax
:TRIGGER:SOURCE?

Returned format
CHANNEL{1 | 2 | DIFFERENCE | EXTERNAL }

Example
PRINT #1,":TRIGGER:SOURCE CHANNEL2"

Example
PRINT #1,":TRIGGER:SOURCE?"
LINE INPUT#1,SOURCE$

The trigger source is switched to CH2.

The present trigger source is returned.

(11)STANDARD_____command/query

The STANDARD command sets the type of the TV signal in the TV LINE mode of the TV trigger function.

Command syntax
:TRIGGER:STANDARD
{525 | 625 }

Query syntax
:TRIGGER:STANDARD?

Returned format
{525 | 625 }

Example
PRINT #1,":TRIGGER:
STANDARD 525"

Example
PRINT #1,":TRIGGER:
STANDARD?"
INPUT #1,STANDARD$

The type of the TV signal is switched to the 525 TV lines.

The type of the present TV signal is returned.

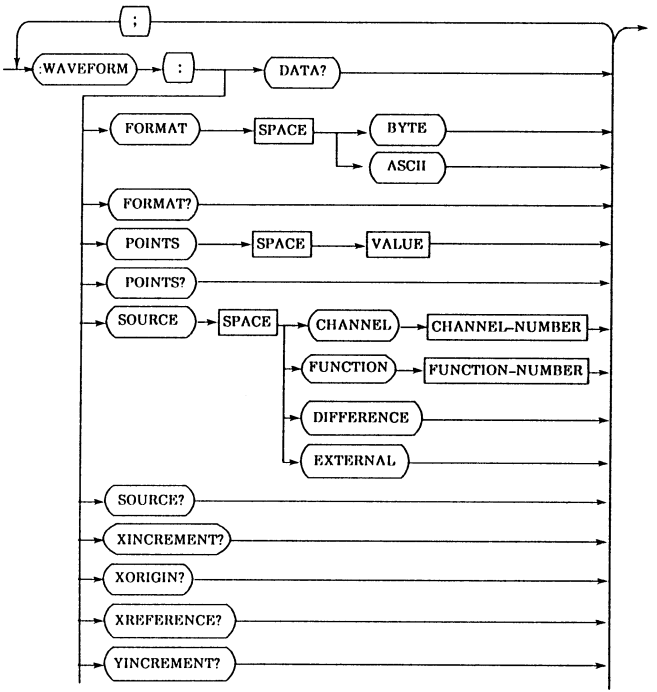
8.3.10 WAVEFORM Commands

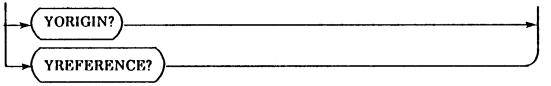
The WAVEFORM subsystem commands control the transmission of waveform data acquired by the instrument. The following WAVEFORM subsystem commands can be used in the instrument.

command header	command/ query	program data
:WAVEFORM:DATA	q	-
:WAVEFORM:FORMAT	c/q	"BYTE","ASCII"
:WAVEFORM:POINTS	c/q	-
:WAVEFORM:SOURCE	c/q	"CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL", "FUNCTION1", "FUNCTION2", "MAX-BOUNDARY", "MIN-BOUNDARY"
:WAVEFORM: XINCREMENT	q	
:WAVEFORM: XORIGIN	q	-
:WAVEFORM: XREFERENCE	q	-
:WAVEFORM: YINCREMENT	q	-

:WAVEFORM: YORIGIN	q	-
:WAVEFORM: YREFERENCE	q	-

The command syntax of the WAVEFORM sybsystem is shown below.





(1)DATA_____query

The DATA command returns the waveform data.

Query syntax
:WAVEFORM:DATA?

Returned format
<block-data>
Where, <block_data> :: = #80000 XXXX <binarydata>
Example
Refer to item 5.

(2)FORMAT_____command/query

The FORMAT command sets the waveform format.

Command syntax
:WAVEFORM:FORMAT
{BYTE | ASCII}

Example
PRINT #1,":WAVEFORM:
FORMAT
BYTE"

Query syntax
:WAVEFORM:FORMAT?

Returned format
{BYTE | ASCII}

Example
PRINT #1,":WAVEFORM:
FORMAT?"
LINE INPUT #1,FORMAT$

The waveform data format is set to BYTE.

The present data format is returned.

(3)POINTS command/query

The POINTS command sets the number of returned waveform data.

Command syntax
:WAVEFORM:POINTS
<point>

Query syntax
:WAVEFORM:POINTS?

Returned format
<point>

Where, <point>::=1 to 2048

Example
PRINT #1,":WAVEFORM:
POINTS 1024"

Example
PRINT #1,":WAVEFORM:
POINTS?"
LINE INPUT #1,POINTS$

The number of returned waveform data is set to 1024.

The present number of returned waveform data is returned.

(4)SOURCE command/query

The SOURCE command sets the source channel of the returned waveform data.

Command syntax
:WAVEFORM:SOURCE
{CHANNEL{1|2}|
FUNCTION{1|2}|
MAX-BOUNDARY|MIN_BAUNDARY} (VC-5460/VC-5430)

Query syntax
:WAVEFORM:SOURCE?

Returned format
{CHANNEL{1|2}|
FUNCTION{1|2}|
MAX_BOUNDARY|MIN_BAUNDARY} (VC-5460/VC-5430)

Example
PRINT #1,":WAVEFORM:
SOURCE CHANNEL1"

Example
PRINT #1,":WAVEFORM:
SOURCE?"
LINE INPUT #1,SOURCE$

The source channel is set to channel 1.

The present source channel is returned.

(5)XINCREMENT query

The XINCREMENT command returns the sample period per point of waveform data in the memory area.

Query syntax
:WAVEFORM:XINCREMENT?

Returned format
<value>

Where, <value>::=Sample period (second) (NR3)

Example
PRINT #1;,":WAVEFORM:INCREMENT?"
LINE INPUT #1,XINCREMENT$

The present sample period is returned.

(6)XORIGIN _____ query

The XORIGIN command returns the DELAY time of waveform data in the memory area.

Query syntax
:WAVEFORM:XORIGIN?

Returned format
<value>

Where, <value>::=DELAY time (second) (NR3)

Example
PRINT #1;,":WAVEFORM:XORIGIN?"
LINE INPUT #1,XORIGIN$

The delay time of present waveform data in the memory area is returned .

(7)XREFERENCE _____ query

The XREFERENCE command returns the data position corresponding to XORIGIN.

Query syntax
:WAVEFORM:XREFERENCE?

Returned format
<value>

Where, <value>::=Data position (second)

Example
PRINT #1,WAVEFORM:XREFERENCE?"

The data position corresponding to the present XORIGIN is returned.

(8)YINCREMENT _____ query

The YINCREMENT command sets GAIN per point of waveform data in the memory area set by the SOURCE command.

Query syntax
:WAVEFORM:YINCREMENT?

Returned format
<value>

Where, <value>::=GAIN (Volt) (NR3)

Example
PRINT #1,":WAVEFORM:YINCREMENT?"
LINE INPUT #1,VALUE$

The GAIN per point of present waveform data in the memory area is returned.

(9) YORIGIN _____ query

The YORIGIN command sets OFFSET of waveform data in the memory area.

Query syntax
:WAVEFORM:YORIGIN?

Returned format
<value>

Where, <value>::=OFFSET (Volt) (NR3)

Example
```
PRINT #1,":WAVEFORM:YORIGIN?"
LINE INPUT #1,VALUE$
```

The OFFSET of present waveform data in the memory area is returned.

(10)YREFERENCE _____ query

The YREFERENCE command returns the data value corresponding to YORIGIN.

Query syntax
:WAVEFORM:YREFERENCE?

Returned format
<value>

Where, <value>::=Data value

Example
```
PRINT #1,WAVEFORM:YREFERENCE?"
LINE INPUT #1,YREFERENCE$
```

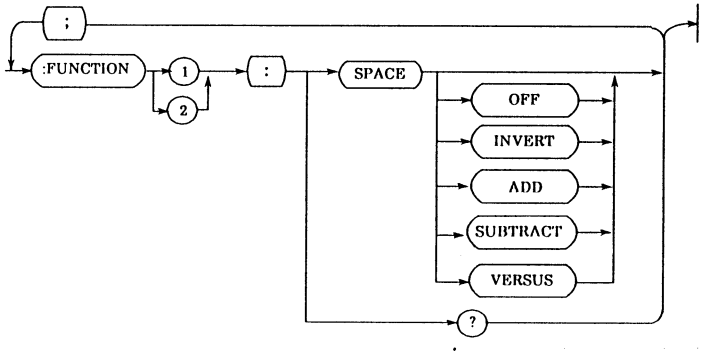
The data value corresponding to present YORIGIN is returned.

8.3.11 FUNCTION Commands

The FUNCTION subsystem commands control the waveform operation function of the instrument.
The following FUNCTION subsystem commands can be used in the instrument.

command header	command /query	program data
:FUNCTION<N>:	c/q	"OFF", "INVERT", "ADD","SUBTRACT", "VERSUS"

The command syntax of the FUNCTION subsystem command is shown below.



(1)FUNCTION<N>_____command/query

The FUNCTION<N> command sets the operand of the specified function.

Command syntax	Query syntax
:FUNCTION{1 | 2}: {OFF | INVERT | ADD | SUBTRACT | VERSUS}	:FUNCTION{1 | 2}?
	Returned format {OFF | INVERT | ADD | SUBTRACT | VERSUS}
Example PRINT #1,":FUNCTION1: ADD"	Example PRINT # 1,":FUNCTION1?" LINE INPUT #1,OPERATOR$
The function 1 is set to ADD.	The operand of the present function 1 is returned.

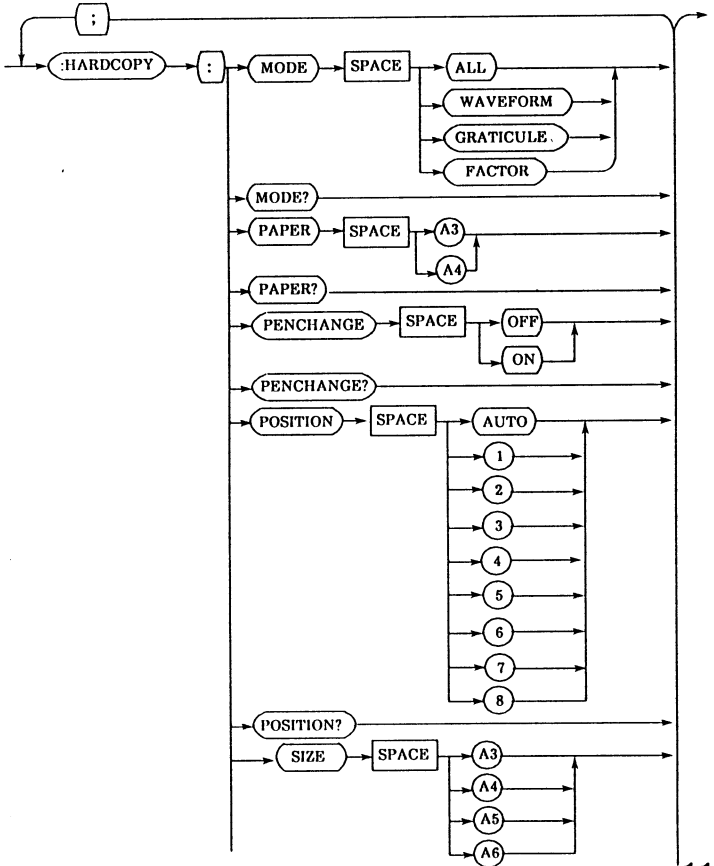
8.3.12 HARDCOPY Commands

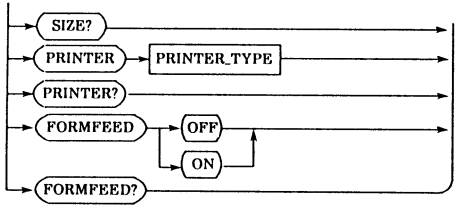
The HARDCOPY subsystem commands control the plot output function of the instrument.

The following HARDCOPY subsystem commands can be used in the instrument.

command header	command/ query	program data
:HARDCOPY: FORMFEED	c/q	"OFF", "ON"
:HARDCOPY:MODE	c/q	"ALL", "WAVEFORM", "GRATICULE", "FACTOR"
:HARDCOPY:PAPER	c/q	"A3", "A4"
:HARDCOPY: PENCHANGE	c/q	"ON", "OFF"
:HARDCOPY:POSITION	c/q	"AUTO", "1", "2", "3", "4", "5", "6", "7", "8"
:HARDCOPY:PRINTER	c/q	"ESC/P", "PC-PR201", "DPU-201G", "THINKJET"
:HARDCOPY:SIZE	c/q	"A3", "A4", "A5", "A6"

The command syntax of the HARDCOPY subsystem commands is shown below.





(1)FORMFEED command/query

The FORMFEED command sets the from feed mode.

Command syntax
:HARDCOPY:FORMFEED {OFF | ON}

Query syntax
:HARDCOPY:FORMFEED?

Returned format
{OFF | ON}

Example
```
PRINT #1,":HARDCOPY:
FORMFEED ON"
```

Example
```
PRINT #1,":HARDCOPY:
FORMFEED?"
LINE INPUT
#1,FORMFEED$
```

(2)MODE command/query

The MODE command sets the items to be plotted in the plot output function mode.

Command syntax
:HARDCOPY:MODE {ALL | WAVEFORM | GRATICULE | FACTOR}

Query syntax
HARDCOPY:MODE?

Returned format
{ALL | WAVEFORM | GRATICULE | FACTOR}

Example
```
PRINT#1,":
HARDCOPY:MO
DE ALL"
```

Example
```
PRINT #1,":HARDCOPY:
MODE?"
LINE INPUT#1,MODE$
```

The items to be plotted are set to "all" in the plot output function mode.

(3)PAPER command/query

The PAPER command sets the paper size in the plot output function mode.

Command syntax
:HARDCOPY:PAPER {A3 | A4 | A5 | A6}

Query syntax
:HARDCOPY:PAPER?

Returned format
{A3 | A4 | A5 | A6}

Example
```
PRINT
#1,":HARDCOPY:PAPER
A4"
```
The paper size is set to A4.

Example
```
PRINT
#1,":HARDCOPY:PAPER?"
LINE INPUT#1,PAPER$
```
The present paper size is returned.

(4)PENCHANGE command/query

The PENCHANGE command establishes the pen change mode in the plot output function mode.

Command syntax
:HARDCOPY:PENCHANGE
{ON | OFF}

Query syntax
:HARDCOPY:PENCHANGE?

Returned format
{ON | OFF}

Example
```
PRINT #1,":HARDCOPY:
PENCHANGE ON"
```
The pen change mode is turned on.

Example
```
PRINT #1,":HARDCOPY:
PENCHANGE?"
LINE INPUT
#1,PENCHANGE$
```
The present pen change mode is returned.

(5)POSITION command/query

The POSITION command sets the plot position in the plot output function mode.

Command syntax
:HARDCOPY:POSITION
{AUTO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}

Query syntax
:HARDCOPY:POSITION?

Returned format
{AUTO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}

Example
```
PRINT #1,":HARDCOPY:
POSITION AUTO"
```
The plot position is set to AUTO.

Example
```
PRINT #1,":HARDCOPY:
POSITION?"
LINE INPUT#1,POSITION$
```
The present plot position is returned.

(6)PRINTER command/query

The PRINTER command sets the printer.

Command syntax
:HARDCOPY:PRINTER
{"ESC/P", "PC-PR201",
"DPU-201G","THINKJET"}

Query syntax
:HARDCOPY:PRINTER?

Example
```
PRINT #1,":HARDCOPY:
PRINTER THINKJET"
```

Returned format
{"ESC/P", PC-PR201",
"DPU-201G", "THINKJET"}

Example
PRINT #1,":HARDCOPY:
PRINTER?"
LINE INPUT #1,PRINTER$

(7)SIZE_____command/query

The SIZE command sets the plot size in the plot output function mode.

Command syntax	Query syntax
:HARDCOPY:SIZE {A3 I A4 I A5 I A6}	:HARDCOPY:SIZE?
	Returned format {A3 I A4 I A5 I A6}
Example PRINT #1,":HARDCOPY:SIZE A3"	Example PRINT #1,":HARDCOPY:SIZE?" LINE INPUT#1,SIZE$
The plot size is set to A3.	The present plot size is returned.

8.3.13 GO-NOGO Commands

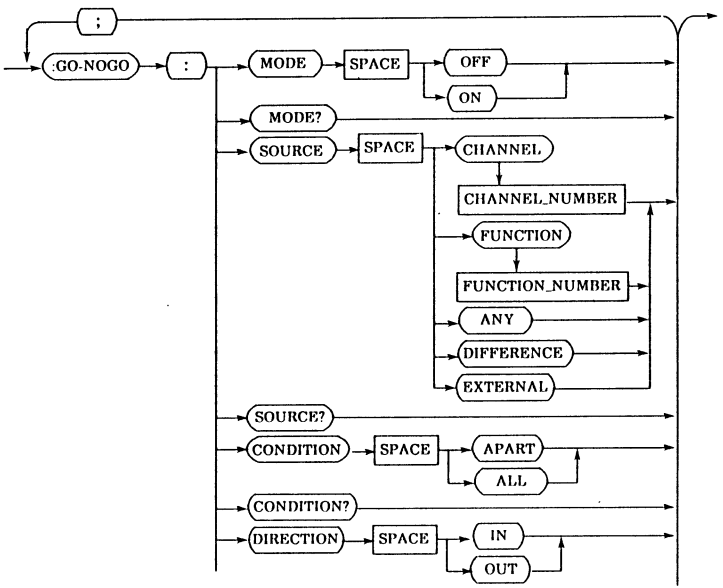
(VC-5460/VC-5430)

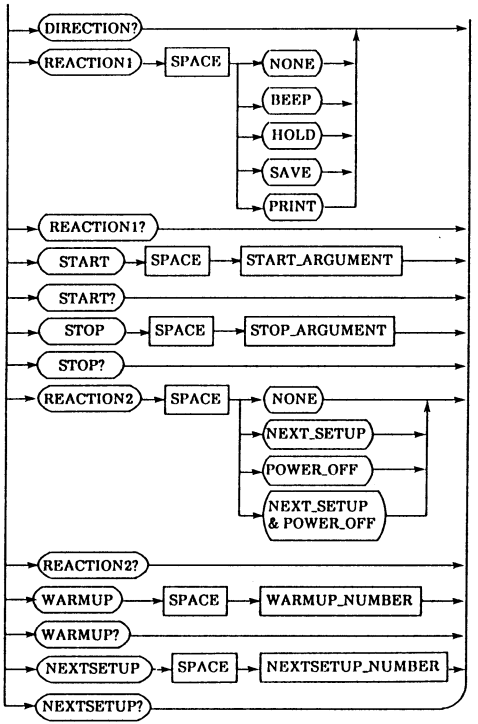
The GO－NOGO subsystem commands control the GO－NOGO judgment function of the instrument.
The following GO－NOGO subsystem commands can be used in the instrument.

command header	command/ query	program data
:GO－NOGO:MODE	c/q	"ON", "OFF"
:GO－NOGO:SOURCE	c/q	"ANY", "CHANNEL1", "CHANNEL2", "DIFFERENCE", "EXTERNAL", "FUNCTION1", "FUNCTION2"
:GO－NOGO: CONDITION	c/q	"APART", "ALL"
:GO－NOGO: DIRECTION	c/q	"IN", "OUT"
:GO－NOGO: NEXTSETUP	c/q	0~9
:GO－NOGO: REACTION1	c/q	"NONE", "BEEP", "HOLD","SAVE","PRINT"
:GO－NOGO: REACTION2	c/q	"NONE", "NEXT-SETUP", "POWER-OFF", "NEXT-SETUP & POWER-OFF"

command header	command/ query	program data
:GO−NOGO:START	c/q	−150~150
:GO−NOGO:STOP	c/q	−150~150
:GO−NOGO: WARMUP	c/q	1~60

The command syntax of the GO−NOGO subsystem command is shown below.





(1)MODE command/query

The MODE command sets the GO −NOGO judgment function to ON/OFF.

Command syntax
:GO−NOGO:
MODE{ON | OFF}

Query syntax
:GO−NOGO:MODE?

Returned format
{ON | OFF}

Example
PRINT #1,":
GO−NOGO:MODE ON"

Example
PRINT #1,":
GO−NOGO:MODE?"
LINE INPUT#1,MODE$

The GO−NOGO judgment function is set to ON.

The setting of present GO−NOGO judgment function is returned.

(2)SOURCE command/query

The SOURCE command sets a waveform to be measured of the GO−NOGO judgment function.

Command syntax
:GO−NOGO:SOURCE{ ANY | CHANNEL{1 | 2} | DIFFERENCE | EXTERNAL | FUNCTION{1 | 2}}

Query syntax
:GO−NOGO:SOURCE?

Returned format
{ANY | CHANNEL{1 | 2} | DIFFERENCE | EXTERNAL | FUNCTION{1 | 2} }

Example
PRINT #1,":
GO−NOGO:SOURCE
CHANNEL1"

Example
PRINT #1,":
GO−NOGO:SOURCE?"
LINE INPUT#1,SOURCE$

The waveform to be measured is set to channel 1.

The setting of the present waveform to be measured is returned.

(3)CONDITION command/query

The CONDITION command switches between APART and ALL of the GO-NOGO judgment function.

Command syntax
:GO−NOGO:CONDITION
{APART | ALL}

Query syntax
:GO−NOGO:CONDITION?

Returned format
{APART | ALL}

Example
PRINT #1,":
GO−NOGO:CONDITION
APART"

Example
PRINT #1,":
GO−NOGO:CONDITION?"
LINE INPUT#1,
CONDITION$

The mode is set to APART.

The setting of present APART/ALL is returned.

(4)DIRECTION_____command/query

The DIRECTION command switches between going out of (OUT) the GO −NOGO function and coming into (IN) the GO-NOGO function.

Command syntax
:GO−NOGO:DIRECTION
{IN | OUT}

Query syntax
:GO−NOGO:DIRECTION?

Returned format
{IN | OUT}

Example
PRINT #1,":
GO−NOGO:DIRECTION IN"

Example
PRINT #1,":
GO−NOGO:DIRECTION?"
LINE INPUT#1,DIRECTION$

The mode is set to coming into (IN) the function.

The present setting of going out of (OUT) the function/coming into (IN) the function is returned.

(5)NEXTSETUP_____command/query

The NEXTSETUP command sets the panel setup after GO-NOGO judgement.

Command syntax
:GO−NOGO:NEXTSETUP
<number>

Where <number> ::=0~9

Query syntax
:GO−NOGO:
REWACTION2?

Returned format
<number>

Example
PRINT #1,":GO−NOGO:
NEXTSETUP 1"

Example
PRINT #1,":GO−NOGO:
NEXTSETUP?"
LINE INPUT #1,SETUP$

(6)REACTION_____command/query

The REACTION command sets the process after performing the GO−NOGO judgment function.

Command syntax
:GO−NOGO:REACTION
{NONE | BEEP |
HOLD | SAVE | PRINT |
SRQ}

Query syntax
:GO−NOGO:REACTION?

Returned format
{NONE | BEEP | HOLD |
SAVE | PRINT | SRQ}

Example
PRINT #1,":GO−
NOGO:REACTION PRINT"

Example
PRINT #1,":
GO−NOGO:REACTION1?"
LINE INPUT#1,REACTION$

The process after judgment is set to printer output.

The present process after judgment is returned.

(7)REACTION2_____command/query

The REACTION2 command sets processing required after GO−NOGO judgement.

Command syntax
:GO–NOGO:REACTION2
{NONE | NEXT-SETUP |
POWER-OFF | NEXT-
SETUP & POWER-OFF}

Query syntax
:GO–NOGO:REACTION2?

Returned format
{NONE | NEXTSETUP |
POWER-OFF | NEXT-
SETUP & POWER-OFF}

Example
PRINT #1,":GO–NOGO:
REACTION2 POWEROFF"

Example
PRINT #1,":GO–NOGO:
REACTION2?"
LINE INPUT
#1,REACTION2$

(8)START command/query

The START command sets the LEFT bar position of the Range of the GO–NOGO judgment function.

Command syntax
:GO–NOGO:START
<position>

Query syntax
:GO–NOGO:STOP?

Returned format
<position>

Where, <position>::=–150 to 150

Example
PRINT #1,":
GO–NOGO:START-
150

The LEFT bar position is set to –150.

Example
PRONT #1,":
GO–NOGA:START?"
LINE INPUT#1,START$

The present LEFT bar position is returned.

(9)STOP command/query

The STOP command sets the RIGHT bar position of the Range of the GO–NOGO judgment function.

Command syntax
:GO–NOGO:STOP
<position>

Query syntax
:GO–NOGO:STOP?

Returned format
<position>

Where, <position>::=150 to 150

Example
PRINT #1,":
GO–NOGO:STOP 150"

The RIGHT bar position is set to 150.

Example
PRINT#1,":
GO–NOGA:STOP?"
LINE INPUT#1,STOP$

(10)WARMUP_____command/query

The WARMUP command sets a warmup time at power on.

Command syntax
:GO−NOGO:WARMUP
<number>

Query syntax
:GO−NOGO:WARMUP?

Returned format
<number>

Where, <number>::=1~60

Example
PRINT #1,":GO−NOGO:
WARMUP 1"

Example
PRINT#1,":GO−NOGO:
WARMUP?"
LINE INPUT#1,WARMUP$

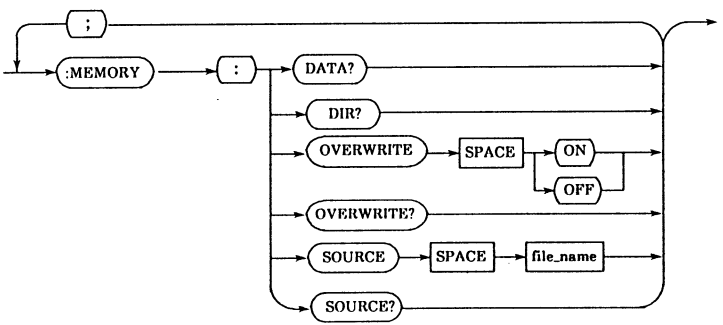
8.3.14 MEMORY Commands

Memory sub-system commands are used to store data to the memory of the instrument or to read data from the memory.

The following memory sub-system commands are used.

command header	command/ query	program data
:MEMORY:DATA	q	−
:MEMORY:DIR	q	−
:MEMORY:OVERWRITE (VC-5460 only)	c/q	"ON", "OFF"
:MEMORY:SOURCE	c/q	−

The command syntax of the memory sub-system commands is shown below.



(1) DATA_____query

Returns the data in the memory

Query syntax
:MEMORY:DATA?
Return format
{block data}

Example
≪Quick Basic≫

```
DIM IWAVE$(3000)          'Definition of array.
OPEN "COM1:9600,N,8,1,LF,RS,"
FOR RANDOM AS #1          'Open the RS-232C (COM1).
PRINT #1, "MEMORY:
SOURCE WAVE0.DAT;"        'The memory source is set to
                          'wave0.dat.
PRINT #1,
":MEMORY:DATA?;"          'Transmits memory data
                          'receive command.
DAT$ = INPUT$(1, #1)      'Reads "#".
PRINT DAT$                'Prints "#" to display.
STRLEN$ = INPUT$(1, #1)   'Reads "8".
PRINT STRLEN$             'Prints "8" to display.
STRLEN = VAL(STRLEN$)     'Converts characters to figures.
FOR I = 1 TO STRLEN       'Starts to read block length.
  BLEN$ = INPUT$(1, #1)   'Reads one character.
  BLOCKLEN$ =
  BLOCKLEN$ + BLEN$       'Adds acquire characters to
                          'character-string one by one.
NEXT
PRINT BLOCKLEN$           'Prints block length to display.
BLOCKLEN = VAL(LEFT$
(BLOCKLEN$, STRLEN) )     'Converts block length to
                          figures.
FOR I = TO BLOCKLEN       'Starts to read memory data.
  IWAVE$(I) = INPUT$(1, #1) 'Reads one byte.
NEXT
CLOSE #1                  'Close the RS-232C (COM1).
END                       'End.
```

< Header formats of UBYTE file >

When UBYTE is selected, the header formats are as listed below.

```
DATASET HITACHI
VERSION 1
SIGNAL WAVE1
DATE 01-01-1992
TIME 00:00:00.00
FILE- TYPE UBYTE
NUM- SAMPS 2048
INTERVAL 3.333333e-06
VERT- UNITS 0.2 Volts
HORZ- UNITS Sec
COMMENT HORZ- OFFSET 0, VERT- OFFSET -6.4,
VERT- INTERVAL 0.2
COMMENT Signal acquired by Channel 1 of Hitachi VC-
```

5430(or VC-5410)
DATA

The above formats are compatible with the software "DADiSPTM" by DSP.
The contents of the header files are as follows

DATASET	'HITACHI' fixed
VERSION	'1' fixed
SIGNAL	Same as file name
DATE	Collected data
TIME	Collected time
FILE-TYPE	'UBYTE' fixed
NUM-SAMPS	Number of data
INTERVAL	Interval of sampling
VERT- UNITS	Range/25 volts
HORZ-UNITS	'Sec' fixed
COMMENT	Information to recall data by this instrument. (i) HORZ-OFFSET ... Delay value at the head of data (ii) VERT- OFFSET .... Offset value (iii) VERT- INTERVAL .. Range/25
COMMENT	Indicates the channel from which data is acquired.
DATA	Provided at the head of waveform data

(2) DIR query

Returns the content of directory in the memory.

Query syntax
:MEMORY:DIR?

Return format
<block data>
Where, <block data>
: : =#80000XXXX<directorydata>
<directorydata>

①	②	③	④	⑤
WAVE1	DAT	2332	03-31-93	12:48
WAVE9	DAT	2332	03-31-93	2:10
.				
.				
.				

15 File(s) 102400 bytes
Returned with the above formats
①File name
②Extension
③File size
④Data
⑤Time (24 hours)

```
Example
OPEN "COM1:9600,N,8,1,LF,RS,"
FOR RANDOM AS #1            'Open the RS-232C (COM1).
PRINT #1,":MEMORY:DIR?;"  'Transmits receive command
                            'of content of directory.
DAT$ "INPUT$(1, #1)         'Reads "#".
STRLEN$ = INPUT$(1,#1)      'Reads "8".
STRLEN = VAL(STRLEN$)       'Converts characters to figures.
FOR I = 1 TO STRLEN         'Starts to read block length.
  BLEN$ = INPUT$(1,#1)      'Reads one character.
  BLOCKLEN$ =
  BLOCKLEN$ + BLEN$         'Adds acquire characters to
                            'character-string one by one.
NEXT
BLOCKLEN = VAL(LEFT$
(BLOCKLEN$,STRLEN) )        'Converts block length to figures.
FOR I = 0 TO BLOCKLEN       'Starts to read block data.
  FONT$ = INPUT$(1,#1)      'Reads one byte.
  PRINT FONT$;              'Display receive data.
NEXT
CLOSE #1                    'Close the RS-232C (COM1).
END                         'End.
```

(3)OVERWRITE command/query

The OVERWRITE command switches overwrite mode.

Command syntax	Query syntax
:MEMORY:OVERWRITE {ON | OFF}	:MEMORY:OVERWRITE?
	Returned format {ON | OFF}
Example PRINT #1,":MEMORY: OVERWRITE ON"	Example PRINT#1,":MEMORY: OVERWRITE?" LINE INPUT#1, OVERWRITE$
Memory overwrite set to ON.	The setting of memory overwrite is returned.

(4) SOURCE command/query

Designates the name of data to be stored to or read from the memory.

Command syntax	Query syntax
:MEMORY:SOURCE <file-name>	:MEMORY:SOURCE?
	Return format <file-name>

Where, <file-name> : : =
① ②
XXXXXXXX . XXX
①File name : Up to 8 characters
②Extension : Up to 3 characters
(Extension can be omitted.)

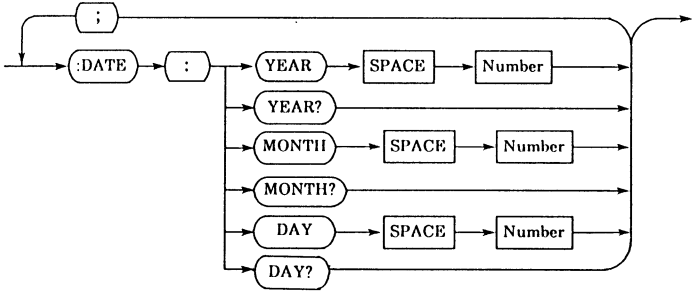
Example of programming
```
PRINT#1 ," :
MEMORY:
SOURCE
WAVE1 .DAT"
```

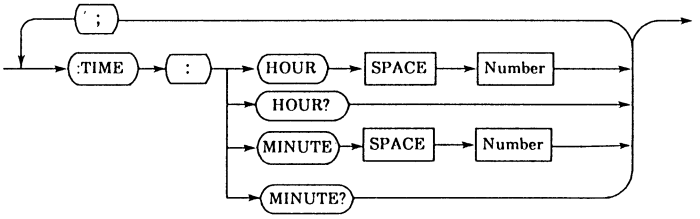
Example of programming
```
PRINT# 1 , " :MEMORY:
SOURCE?"
LINE  INPUT#1 ,SOURCE$
```

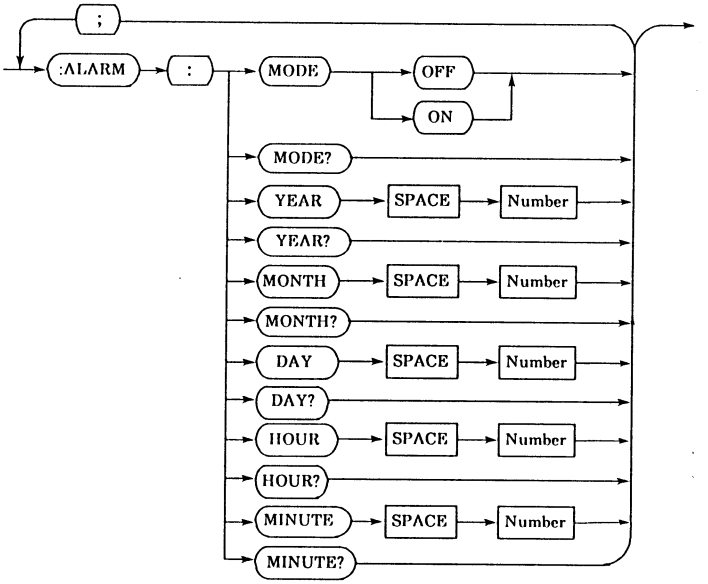
8.3.15 CLOCK Commands

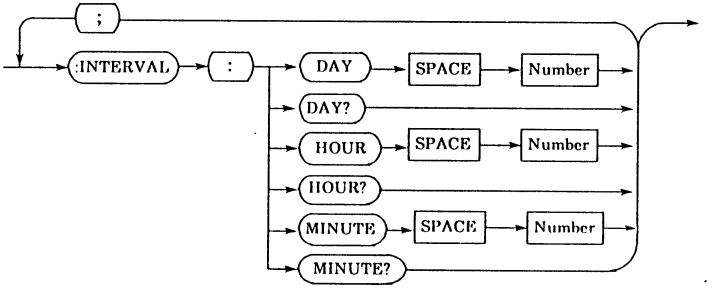
command header	command/ query	program data	
:DATE:YEAR	c/q	0~99	
:DATE:MONTH	c/q	1~12	
:DATE:DAY	c/q	1~31	
:TIME:HOUR	c/q	0~23	
:TIME:MINUTE	c/q	0~59	
:ALARM:MODE	c/q	"OFF", "ON"	(VC-5460/ VC-5430)
:ALARM:MONTH	c/q	1~12	
:ALARM:DAY	c/q	0~31	
:ALARM:HOUR	c/q	0~23	
:ALARM:MINUTE	c/q	0~59	
:INTERVAL:DAY	c/q	0~31	
:INTERVAL:HOUR	c/q	0~23	
:INTERVAL:MINUTE	c/q	0~59	

The command syntax of the clock sub-system commands is shown below.









DATE

(1)YEAR _____ command/query

The YEAR command sets the current year.

Command syntax	Query syntax
:DATE:YEAR <number>	:DATE:YEAR?
Where, <number>::=0~99	Returned format <number>
Example PRINT #1,":DATE: YEAR 93"	Example PRINT#1,":DATE: YEAR?" LINE INPUT#1,YEAR$

(2)MONTH _____ command/query

The MONTH commands sets the current month.

Command syntax	Query syntax
:DATE:MONTH <number>	:DATE:MONTH?
Where, <number>::=1~12	Returned format <number>
Example PRINT #1,":DATE: MONTH 1"	Example PRINT#1,":DATE: MONTH?" LINE INPUT#1,MONTH$

(3)DAY _____ command/query

The DAY command sets the current day.

Command syntax	Query syntax
:DATE:DAY <number>	:DATE:DAY?
Where, <number>::=1~31	Returned format <number>
Example PRINT #1,":DATE:DAY 1"	Example PRINT#1,":DATE:DAY?" LINE INPUT#1,DAY$

TIME

(1)HOUR _____ command/query

The HOUR command sets the current hour.

Command syntax	Query syntax
:TIME:HOUR <number>	:TIME:HOUR?
Where, <number>::=0~23	Returned format <number>
Example PRINT #1,":TIME: HOUR 10"	Example PRINT#1,":TIME:HOUR?" LINE INPUT#1,HOUR$

(2)MINUTE _____ command/query

The MINUTE command sets the current minute.

Command syntax
:TIME:MINUTE <number>
Where, <number> :: = 0~59

Example
PRINT #1,":TIME:
MINUTE 10"

Query syntax
:TIME:MINUTE?
Returned format
<number>

Example
PRINT#1,":TIME:
MINUTE?"
LINE INPUT#1,MINUTE$

ALARM (VC-5460/VC-5430)

(1)MODE_____command/query

The MODE command sets the alarm switch.

Command syntax
:ALARM:MODE
{OFF | ON }

Example
PRINT #1,":ALARM:
MODE ON"

Query syntax
:ALARM:MODE?

Returned format
{OFF | ON }

Example
PRINT #1,":ALARM:
MODE?"
LINE INPUT #1,MODE?

(2)MONTH_____command/query

The MONTH command sets the month, when alarm is issued.

Command syntax
:ALARM:
MONTH <number>

Where, <number> :: = 1~12

Example
PRINT #1,":ALARM:
MONTH 1"

Query syntax
:ALARM:MONTH?

Returned format
<number>

Example
PRINT #1,":ALARM:
MONTH?"
LINE INPUT #1,MONTH$

(3)DAY_____command/query

The DAY command sets the day, when alarm is issued.

Command syntax
:ALARM:DAY <number>

Where, <number> :: = 1~31

Example
PRINT #1,":ALARM:DAY 1"

Query syntax
:ALARM:DAY?

Returned format
<number>

Example
PRINT #1,":
ALARM:DAY?"
LINE INPUT #1,DAY$

(4)HOUR_____command/query

The HOUR command set the hour, when alarm is issued.

Command syntax
:ALARM:HOUR <number>
Where, <number> :: = 0~23

Query syntax
:ALARM:HOUR?
Returned format
<number>

Example
PRINT #1,":ALRM:HOUR 10"

Example
PRINT #1,":ALARM:HOUR?"
LINE INPUT #1,HOUR$

(5)MINUTE_____command/query

The MINUTE command set the current minute, when alarm is issed.

Command syntax
:ALARM:MINUTE
<number>

Query syntax
:ALARM:MINUTE?

Where, <number>::=0~59

Returned format
<number>

Example
PRINT #1,":ALARM:MINUTE 10"

Example
PRINT #1,":DATE:MINUTE?"
LINE INPUT #1,MINUTE$

INTERVAL (VC-5460/VC-5430)

(1)DAY_____command/query

The DAY command sets the time interval (days) for automatic measurements.

Command syntax
:INTERVAL:DAY <number>

Query syntax
:INTERVAL:DAY?

Where, <number>::=1~31

Returned format
<number>

Example
PRINT #1,":INTERVAL:DAY 1"

Example
PRINT#1,":INTERVAL:DAY?"
LINE INPUT#1,DAY$

(2)HOUR_____command/query

The HOUR command sets the time interval (hours) for automatic measurements.

Command syntax
:INTERVAL:HOUR
<number>

Query syntax
:INTERVAL:HOUR?

Where, <number>::=0~23

Returned format
<number>

Example
PRINT #1,":INTERVAL:HOUR 10"

Example
PRINT#1,":INTERVAL:HOUR?"
LINE INPUT#1,HOUR$

(3)MINUTE_____command/query

The MINUTE command sets the time interval (minutes) for automatic measurements.

Command syntax
:INTERVAL:MINUTE
<number>

Where, <number>::=0~59

Example
PRINT #1,":INTERVAL:
MINUTE 10"

Query syntax
:INTERVAL:MINUTE?

Returned format
<number>

Example
PRINT#1,":INTERVAL:
MINUTE?"
LINE INPUT#1,MINUTE$

8.4 Status report function

For the situation of errors caused by a programming function, refer to Fig. 2 Data structure of status report function.
Each register in the figure can be set/returned by a common command.

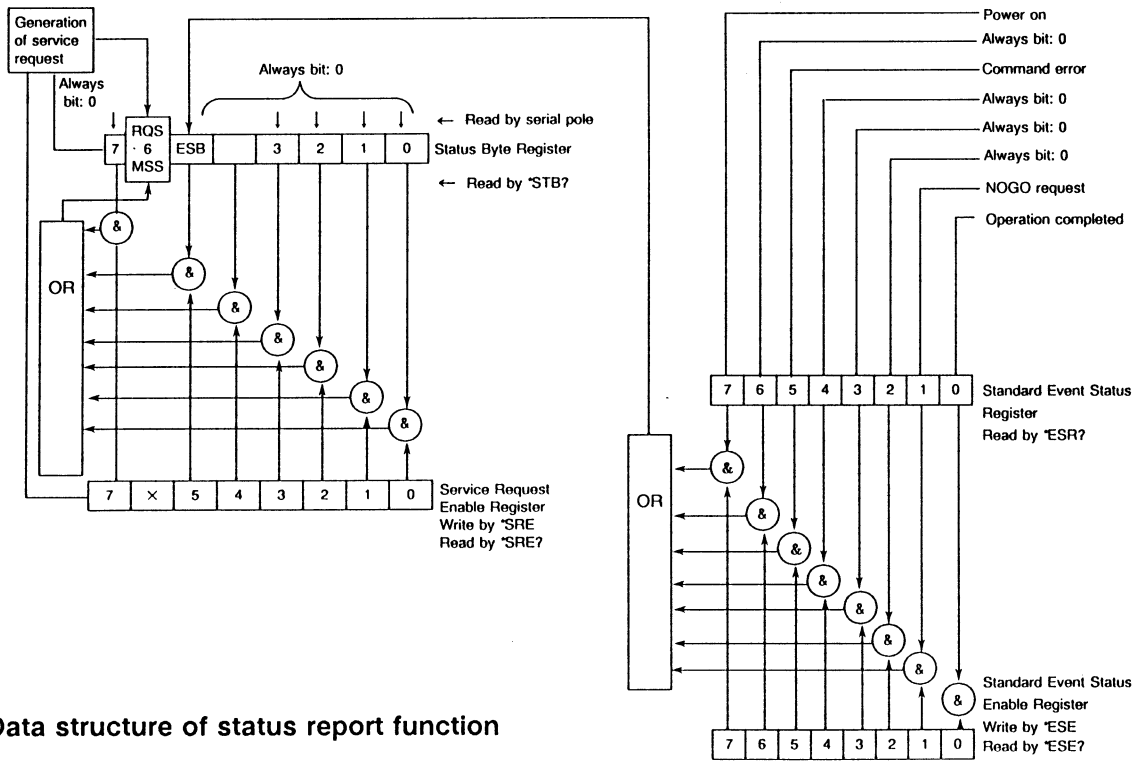


Fig. 2 Data structure of status report function

8.5 Programming example of receiving waveform data

≪Quick Basic≫

```
DIM IWAVE$(3000)                'Definition of array.
SCREEN 2                        'Sets the screen mode.
CLS 0                           'Clear screen.
WINDOW (0, 0)-(2048, 356)       'Sets the window.
LINE (0, 100)-(2048, 356), , B  'Sets the grid.
OPEN "COM1:9600,N,8,1,LF,
RS,"FOR RANDOM AS #1            'Open the RS-232C (COM1).
PRINT #1, ":TIMEBASE:
RANGE 10M;                      '1ms/div
PRINT #1, ":VIEW CHANNEL2;      'Change to CHANNEL2.
PRINT #1, ":WAVEFORM:
SOURCE CHANNEL2;                'The source channel is set to
                                'channel2.
PRINT #1, ":WAVEFORM:
POINTS 2048;                    'Specifying number of
                                'waveform data.
PRINT #1, ":DIGITIZE;"          'Setting for single shot mode.
PRINT #1, ";WAVEFORM:
DATA;?                          'Transmits waveform data
                                receive command.
DAT$ = INPUT$(1, #1)            'Reads "#".
PRINT DAT$                      'Prints "#" to display.
STRLEN$ = INPUT$(1, #1)         'Reads "8".
PRINT STRLEN$                   'Prints "8" to display.
STRLEN = VAL(STRLEN$)           'Converts characters to
                                figures.
FOR I = 1 TO STRLEN             'Starts to read block length.
    BLEN$ = INPUT$(1, #1)       'Reads one character.
    BLOCKLEN$ =
    BLOCKLEN$ + BLEN$           'Adds acquire characters to
                                'character-string one by one.
NEXT
PRINT BLOCKLEN$                 'Prints block length to display.
BLOCKLEN = VAL(LEFT$
(BLOCKLEN$, STRLEN) )           'Converts block length to
                                figures.
FOR I = 0 TO BLOCKLEN           'Starts to read waveform data.
    IWAVE$(I) = INPUT$(1, #1)   'Reads one byte.
NEXT
CLOSE #1                        'Close the  RS-232C (COM1).
FOR I = 0 TO BLOCKLEN           'Starts to print waveform data
                                'to display.
    DAT = ASC(IWAVE$(I) )       'Converts waveform data to
                                'character code.
LINE (I, 100 + DAT)-(I + 1, 100
+ DAT + 1), , B                 'Prints waveform data to
                                display
NEXT
END                             'End.
```

8.6 Major causes for improper data transfer

(1) The cable is not connected, or the system is not turned on.

(2) The function command does not agree with the command of this oscilloscope.

(3) The set address of this oscilloscope does not agree with the address specified from the controller, or there is the same address of another instrument.

(4) Delimiters do not agree with each other, or the delimiter is not in the format of this oscilloscope. The delimiter used when a controller sends data (message) does not agree with the delimiter used when the controller receives data.

(5) A function which is not available with this oscilloscope is attempted to execute.

(6) There is no enough buffer area for data. (A large amount of data is requested to transfer to this oscilloscope even if the listener has only a small buffer area.)

(7) There is an error in the program statement, or the use of hexadecimal and decimal.
When data transfer is not successful, check the above again.

Chapter 9 Specifications

9.1 Electrical

	VC-5460	VC-5430	VC-5410
Vertical axis			
Resolution	8 bits	←	←
Sensitivity	1mV/div to 5V/div, 12 steps	←	←
Accuracy	± 3% (± 5% for 1mV/div and 2mV/div)	←	←
Variable	Not available	Continuous between ranges	←
Bandwidth (-3dB)	DC to 150MHz	DC to 50MHz	DC to 20MHz
Low frequency limit in AC coupling	10Hz	←	←
Input channels	CH1, CH2, EXT	←	←
Max safe input voltage	42Vpk (DC + AC peak at 1kHz + Flating voltage)	←	←
Input coupling	DC, AC, GND	←	←
Input impedance	1MΩ 1.5%/25pF± 3pF	1MΩ 1.5%/23pF± 3pF	←
Operating system	CH1 and CH2 can be turned on or off independently. EXT input waveform can be displayed in DIFF mode.	←	←
Horizontal axis			
Max. sampling speed	60MS/s (Single channel) 30MS/s (Simultaneous on 2 channels)	30Ms/s (Simultaneous on 2channels)	15Ms/s (Simultaneous on 2channels)

	VC-5460	VC-5430	VC-5410
Acquisition memory	2kW/CH	←	←
Sweep time			
Equivalent sampling	2ns/div-1μs/div± 1%(Single channel), 2ns/div-2μs/div± 1%(2channels)	5ns/div-2μs/div±1%	20ns/div-5μs/div±1%
Realtime sampling	2μs/div-1s/div± 0.04%(Single channel), 5μs/div-1s/div± 0.04%(2channels)	5μs/div-1s/div±0.04%	10μs/div-1s/div±0.04%
Roll mode	0.2s/div-50s/div± 0.25%	←	←
Pre-trigger	Max. 10div	←	←
Post-trigger	Max. 400div	←	←
Trigger			
Source	CH1, CH2, DIFF, EXT	←	←
Mode	AUTO, NORM, TV-V, TV-H, TV-L	AUTO, NORM, TV-V, TV-H	←
Coupling	DC, AC, HFrej, LFrej	←	←
Slope	+ or –	←	←
Level	Manual setting or automatic 50% setting	←	←
Sensitivity			

VC-5460

Trigger	Frequency	Sensitivity	
		5mV to 5V/div	1mV, 2mV/div
CH1, CH2 DIFF	DC to 20MHz	0.5div or more	2.5mVp-p or more
	20MHz to 150MHz	1.5div or more	7.5mVp-p or more
EXT	DC to 150MHz	0.1Vp-p or more	

VC-5430

Frequency	Sensitivity	
	5mV to 5V/div	1mV, 2mV /div
DC to 10MHz	0.5div or more	2.5mVp-p or more
10MHz to 50MHz	1.5div or more	7.5mVp-p or more
DC to 50MHz	0.1Vp-p or more	

VC-5410

Frequency	Sensitivity	
	5mV to 5V/div	1mV, 2mV /div
DC to 5MHz	0.5div or more	2.5mVp-p or more
5MHz to 20MHz	1.5div or more	7.5mVp-p or more
DC to 20MHz	0.1Vp-p or more	

	VC-5460	VC-5430	VC-5410
TV trigger			
sensitiviy	SYNC section: 1div or more, negative	←	←
AC cutoff frequency	10Hz approx. (-3dB)	←	←
HF/LF cutoff frequency	50kHz approx. (-3dB)	←	←
AUTO lower frequency	20Hz approx.	←	←
Trigger function			
Divide trigger	No. of divide triggers: 2 to 4096 Trigger frequency: 10MHz or less	←	←
Display function			
Display function	Waveforms, measurement condition setting data and calculated results are classified by color for each channel. Scales, menus, waveforms, etc, are classified by up to 8 colors.	←	←
Waveform display	Refresh mode/infinity persistence mode Waveform clear Dot display/linear display Interpolation display (Sin, linear) X-Y display Horizontal magnification/movement Vertical magnification/movement	←	←
Others	Ground point display Trigger level display	←	←

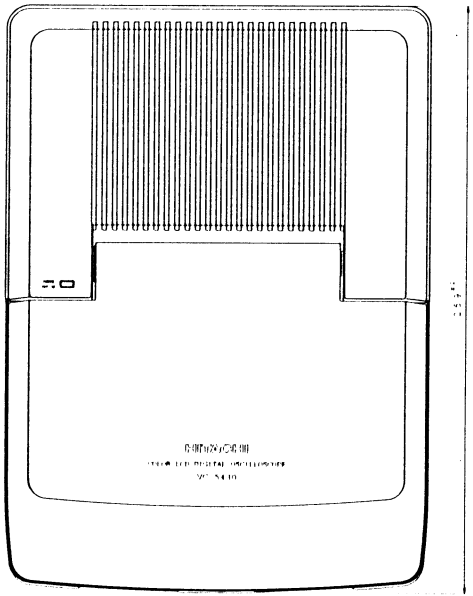
	VC-5460	VC-5430	VC-5410
	Graticule (grids, axes, frames)		
No. of displayed data	1500 data/10div 1200 data/10div	←	←
Processing functions			
Average mode	Exponential average Weighting factor: 2 to 256 (2^n)	←	←
Waveform operations	addition, subtraction, inversion	←	←
Measurement function			
Cursor readout		←	←
Mode	Between cursors, ΔV with Auto cursor.	←	Between Cursors
Item	ΔV, Δ T, 1/Δ T	←	←
parameter	Any 4 parameters out of the following 17 parameters can be measured simultaneously. Frequency, Period, Rise time/Fall time, Pulse width (positive, negative), Duty cycle, MIN, MAX, Peak-to-Peak, Base, Top, Amplitude, PRE-shoot, Over-shoot, RMS, Average.	←	←
Automatic measurement	Auto setup	←	←
	GO-NOGO judgment Processings after GO-NOGO judgment Buzzer sound, HOLD, save, hard copy, power off, setup recall	←	Not provided

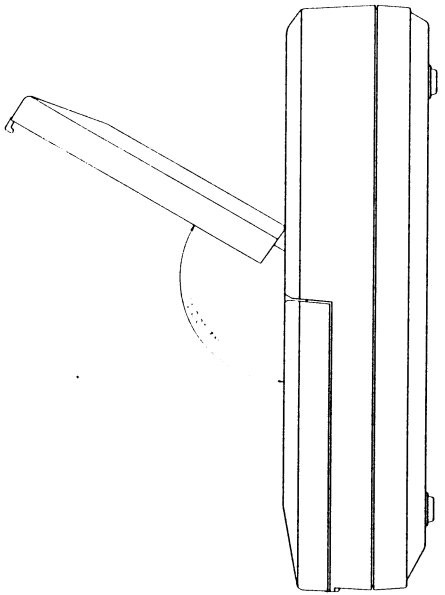
	VC-5460	VC-5430	VC-5410
	Intermittent data collectionfunction Data can be collected at the specified interval (in units of minute). (Max, 100 waveforms)	←	Not provided
Save function			
Waveform save/recall Waveform memory	Waveform data and measurement conditions can be saved and recalled.	←	Waveform data and measurement conditions can be saved and recalled.
	Max. 100 waveforms (2kw/waveform)	←	Max. 10 waveforms (2kw/waveform)
Pixel memory	The waveforms on one display screen can be saved and recalled.	←	Not provided
Setup save/recall	10 setup data (setup data in SAVE mode can be recalled.)	←	←
Resume	The setup data before power off and all the displayed information are retained. At power on, these data are displayed and used as setup data.	←	←
Timer function			
Timer display	Time and data can be printed on a hard copy.	←	←
Timer function	The instrument can be turned on at the specified time.	←	Not provided

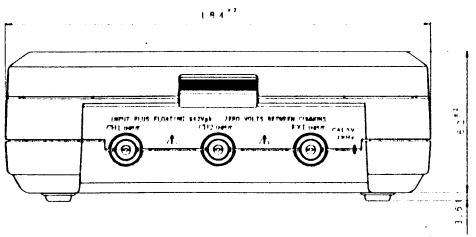
	VC-5460	VC-5430	VC-5410
Auto power off	The instrument is turned off when any switch or control is not operated for the specified duration.	←	←
Input/output functions			
Interface	RS-232C (X-ON/X-OFF handshake or hand wired handshake) Centronix	RS-232C (XON/XOFF handshake) Centronix	←
Panel control	Programmable Remote control from a PC through RS-232C	←	←
Printer output function	ESC/P, PC-PR201, DPU-201G or HP THINKJET printer	←	←
Plotter output function	Plotter conforming to HP-GL format Available pen colors : five colors Plot size : A6, A5, A4, A3 Paper size : A4, A3	←	←
Calibration output			
Frequency	1kHz ± 20%	←	←
Output voltage	5V± 1%	←	←
Display			
Display	4" color TFT LCD (CFL backlight)	←	←
Resolution	(160× 3 colors) dots (H)× 220 dots(V)	←	←
Scale	10div(H)× 8div(V)	←	←
Waveform display resolution	30 dots/div(H)× 25 dots/div(V)	←	←

	VC-5460	VC-5430	VC-5410
Miscellaneous			
Dimensions	184(W)×259(D)×62(H)mm	←	←
Weight	2kg approx.	←	←
Power supply			
Power supply	Exclusive AC adaptor, built-in battery or external battery pack(option) Rated external input voltage : 12V Power consumption for external power input : 1A (typ)	←	←
Power consumption	12W (typ)	10W(typ)	←
Built-in battery	NiCd battery, automatically rechargeable (voltage drop is automatically detected.)	←	←
Operation	One hour (typ)	Two hours (typ)	←
Recharge time	16 hours (typ) (at power off)	←	←
	32 hours (typ) (at power on)	←	←
Ambient conditions			
Specification	10 to 35°C (when automatic calibration is performed within the range of 25± 5°C)	←	←
Operating	0 to 40°C, 45 to 80%		
Storage	–20 to 60°C, 35 to 85% (70% for 50°C or more)	←	←
EMI	VDE0871 (CLASS B) & Vfg243/1991	←	←

9.2 Dimensions







Appendix A : Settings at factory (default values)

Setting item	Name	Default value	Initial settings at Resume off
Operation system			
Operation mode	RUN, HOLD	RUN status	RUN state
Roll mode	ROLL	ON	ON
Average	AVERAGE	OFF	OFF
Vertical axis-related items		(Common to all channels)	(Common to all channels)
Waveform display	DISPLAY	ON	ON
Probe factor	PROBE	×10	No change
Vertical axis range	VOLTS/DIV	1V	0.1V×PROBE
Display position	POSITION	0V	0V
Input coupling	DC, AC, GND	DC	DC
Variable(VC-5430/VC-5410)		OFF	OFF
Differential input	DIFF	OFF	OFF
EXT display	EXT DISP	OFF(VC-5460) ON(VC-5430/VC-5410)	OFF(VC-5460) ON(VC-5430/VC-5410)
Horizontal axis-related items			
Time base range	TIME/DIV	1ms	1ms
Delay time	DELAY	0s	0s
Trigger-related items			
Divide trigger	DIVIDE TRIGGER	OFF	OFF
No. of divide trigger	DIVIDE NUMBER	2	No change
Trigger mode	MODE	AUTO	AUTO
Source	SOURCE	CH1	CH1

Setting item	Name	Default value	Initial settings at Resume off
Coupling	COUPLING	DC	DC
Slope	SLOPE	Rising edge	Rising edge
Level	LEVEL	0V	0V
Automatic 50% level setting	50%	OFF	No change
TV format (VC-5460 only)	TV FORM	525(NTSC)	No change
TV line number (VC-5460 only)		1	No change
TV field (VC-5460 only)		Fld	No change
Display-related items			
Persistence	PERSISTENCE	OFF	No change
Display scale	GRATICULE	Grid	No change
Dot join	DOTJOIN	OFF	No change
Interpolation	INTERPOLATE	LIN	No change
Waveform clear mode	CLEAR	CURRENT	No change
Save and recall-related items			
Type of save (VC-5460/ VC-5430)	SAVE TYPE	Byte data	No change
Save memory number	SAVE NO.	0	0
Save memory display	MEMORY1	OFF	OFF
	MEMORY2	OFF	OFF
Waveform over write mode	OVERWRITE	ON	No change
Memory 1 Vertical range	VOLTS	*****	No change
MEmory 1 Position	POS	*****	No change
Memory 2 Vertical range	VOLTS	*****	No change
Memory 2 Position	POS	*****	No change
Measurement and operation-related items			
Source of measurement	MEASURE of	AUTO	No change

Setting item	Name	Default value	Initial settings at Resume off
Pulse parameter measurement		Frequency (FREQ) Cycle (PER) Rising edge(RISE) Falling edge(FALL)	No change No change No change No change
Operation 1	FUNCTION1	OFF	OFF
Operation 2	FUNCTION2	OFF	OFF
Cursor position	CURSORS	1div inside from each side of frame	No change
RS-232C			
Baud rate	BAUD RATE	4800 baud	No change
Stop bit	STOP BITS	1	No change
Parity bit	PARITY	No default value	No change
Hand shake(VC-5460 only)	HANDSHAKE	XON/XOFF	No change
Hardcopy-related items			
Copy device	DEVICE	PRINTER	No change
Interface	INTERFACE	CENTRONIX	No change
Information to be printed	HARDCOPY	ALL	No change
Printer type	PRINTER TYPE	ESC/P	No change
Form feed	FORMFEED	OFF	No change
Plot size	SIZE	A4	No change
Paper size	PAPER	A4	No change
Plot position	POSITION	AUTO	No change
Pen replacement	PEN CHANGE	ON	No change
GO-NOGO judgment function (VC-5460/VC-5430)			
GO-NOGO judgment	GO-NOGO	OFF	No change
Judgment condition	WHEN	A PART of ANY is OUT	No change
Processing 1	REACTION1	NONE	No change
Processing 2	REACTION2	NONE	No change

Setting item	Name	Default value	Initial settings at Resume off
Warmup time	WARMUP TIME	5	No change
Processing setup	NEXT-SETUP	0	No change
Edit execution	EDITING	OFF	OFF
Edit of boundary	of	BOUNDARY	No change
Boundary creation source	SOURCE	Channel 1	No change
Automatic calibration			
Calibration range	CALIBRATE	FULL	No change
Execution of calibration	CAL EXEC	END	No change
Auto setup			
Default setting	DEFAULT	OFF	OFF
Power save functions			
Standby mode	STANDBY MODE	OFF	No change
Auto power off	AUT OPOWER OFF	OFF	No change
Resume	RESUME	OFF	No change
Timer functions			
Clock date (VC-5460/ VC-5430)	CLOCK DATE	JAN-1-1993 (*)	No change
Clock time (VC-5460/ VC-5430)	CLOCK TIME	00:00 (*)	No change
Alarm (VC-5460/ VC-5430)	ALARM	OFF	No change
Alarm time	ALARM TIME	00DAY12:00	No change
Alarm interval	ALARM INTERVAL	00DAY01:00	No change

* : DEFAULT : Not changed even at ON.

Appendix B MENU List

Page 1

- ROLL : OFF / ON
- AVERAGE : OFF / 2 to 256(2^n)
- DIVIDED TRIGGER : ON / OFF
- DIVIDED NUMBER : 2 to 4096
- TV FORM (VC-5460) only) : 525 / 625
- MEASURE of: AUTO, CH1, CH2
- FUNCTION1 : OFF / INV(CH1) / CH1 + CH2 / CH1− CH2 / CH1 vs CH2
- FUNCTION2 : OFF / INV(CH2) / CH1 + CH2 / CH2− CH1 / CH2 vs CH1
- CH1 PROBE: ×1 / ×10 / ×100 / ×1000
- CH2 PROBE: ×1 / ×10 / ×100 / ×1000
- EXT PROBE: ×1 / ×10 / ×100 / ×1000
- EXT DISP : OFF / ON
- EXT OFFSET :

Page 2

- SAVE TYPE : (VC-5460/ VC-5430) UBYTE / PIXEL
- SAVE NO : 0~99 (VC-5460/ VC-5430) 0~9 (VC-5410)
- OVERWRITE: ON / OFF
- MEMORY1 : OFF / ON
- VOLTS : POS :
- MEMORY2 : OFF / ON
- VOLTS : POS:
- PERSISTENCE: OFF / ON
- GRATICULE : GRID / FRAM / AXES
- DOTJOIN : ON / OFF
- INTER-POLATE : LIN / SIN
- CLEAR : CURRENT / RECALL / ALL

Page 3

STANDBY MODE : OFF / 1 to 60

AUTO POWER: OFF / 1 to 60

RESUME : OFF / ON

CLOCK DATE : MONTH-DAY-YEAR

CLOCK TIME: HOUR:MINUTE

ALARM (VC-5460/ VC-5430) : OFF / ON

ALARM TIME: (VC-5460/ VC-5430) 00DAY12:00

ALERM INTERVAL (VC-5460/ VC-5430) : 00DAY12:00

Page 4 (VC-5460/VC-5430)

GO-NOGO : OFF / ON

WHEN : A PART / ALL

of : ANY / CH1, CH2, F1, F2

is : OUT / IN

REACTION1 : NONE / BEEP / HOLD / SAVE / PRINT

REACTION2 : NONE / NEXT-SETUP / POWER-OFF / SETUP & OFF

WARMUP TIME : 0 to 60

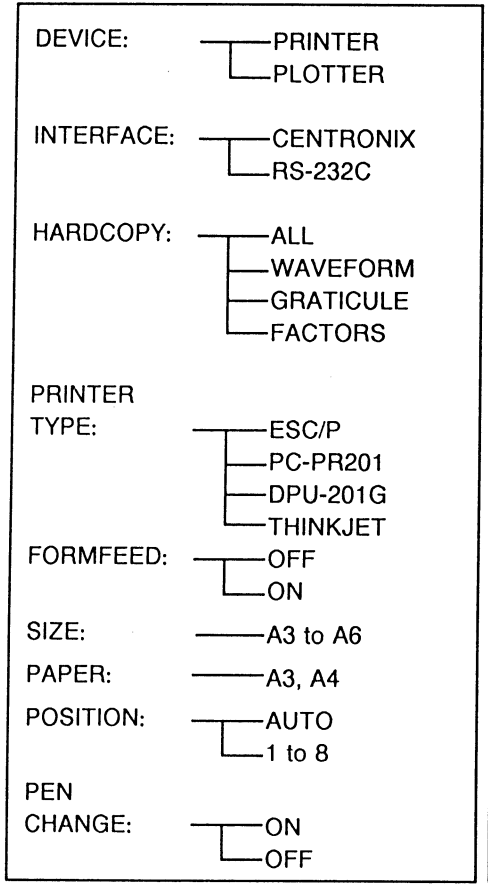
NEXT-SETUP 0~9

EDITING : ON / OFF

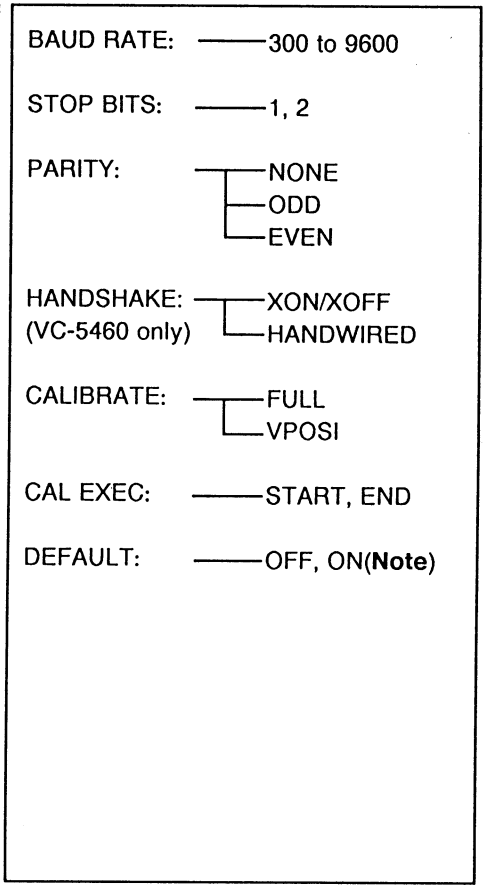
of : BOUNDARY / RANGE

SOURCE : CH1, CH2, DIFF, EXT

Page 5 (page 4 for the VC-5410)



Page 6 (page 5 for the VC-5410)

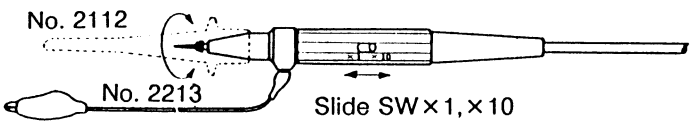


Note
ON display is invisible.

AppendixC:Probe specifications

MODEL AT-10AY

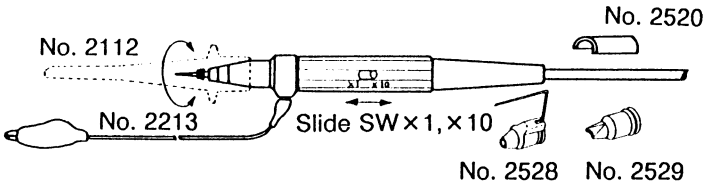
OSCILLOSCOPE INPUT R//C:1MΩ//20~45pF



ITEM	10:1	1:1	ACCES-SORIES
Bandwidth	DC-60MHz (±3dB)	DC-6MHz (±3dB)	Pincher tip No. 2112 Ground lead No. 2213
Input R	≈10MΩ	1MΩ (Oscilloscope)	
Input C	≈22pF	≈180pF	
	at oscilloscope input 20pF		
ATT Ratio	1/10	1/1	
MAX Input voltage	DC 600V		

MODEL AT-10AW

OSCILLOSCOPE INPUT R//C:1MΩ//13~35pF



ITEM	×10	×1	ACCES-SORIES
Bandwidth	DC-150MHz ($+1_{-0.5}$dB)	DC-3MHz(±1dB) DC-6MHz(±3dB)	Pincher tip No. 2112 Ground lead No. 2213 Cable marker No. 2520 Ground attachment No. 2528 IC tip No. 2529
Input R	≈10MΩ	1MΩ (Oscilloscope)	
Input C	≈14pF	<200pF	
	at oscilloscope input 23pF		
ATT Ratio	1/10	1/1	
MAX Input voltage	DC 600V		