Contents

1.1 Features

< Compact, lightweight and unique design >
7.5 litter
4.5 kg

< High quality waveform display >
10.4 inch large screen and High speed refresh color TFT LCD ,
Waveform, setting values and measured values of each channel are classified by color : Easy channel identification,

< User friendly operation panel and menu>
Keys and controls frequently used are independently provided for each function and each channel,
Friendly Menu and HELP function.
Direct setting function by Alpha-Numeric input key .

< High performance and various function >
High speed sampling, Wide bandwidth, Large capacity of acquisition memory.
A variety of automatic measurement functions :
Autosetup, pulse parameter measurements, GO-NOGO judgment, cursor measurement, panel setup, search function etc.

< A variety of input output functions >
GPIB, RS232C, parallel output (centronix) ,PC card slot, VGA signal output etc.

< Optional function >
Expanded memory function
Expanded trigger function
FDD

1.2 Composition

(1) Oscilloscope 1 unit
(2) Accessories
Probe 2 pcs.
Operation manual 1 copy
Fuse (2A) 1 pc.
AC power cable (3-wire) 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 40C.
* Do not use the instrument outdoors for a long time on a cold winter day.
The operating ambient temperature is 0C 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.

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

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 20C 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 10C) 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 7.12 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.

The operating voltage range for this oscilloscope is 90 to 132V AC, or 216 to 264V AC. Before turning on the power switch, check the line voltage. When using the oscilloscope on voltage higher than the specified voltage of the standard power cable ,it is necessary to replace the power cable. Contact your nearest Hitachi Denshi representative.

Do not apply an excessive voltage.

The connector a and probe input voltages are specified as follows.

Do not apply higher voltages.

Input direct : 400V(DC+AC peak, up to 1kHz)

Probe used with X10 : 500V(DC+AC peak, up to 1kHz)

CAUTION

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

2.1 Panel Drawing

Fig 2-1 Outside View

Fig 2-2 Rear panel

Fig 2-3 Left-hand side panel

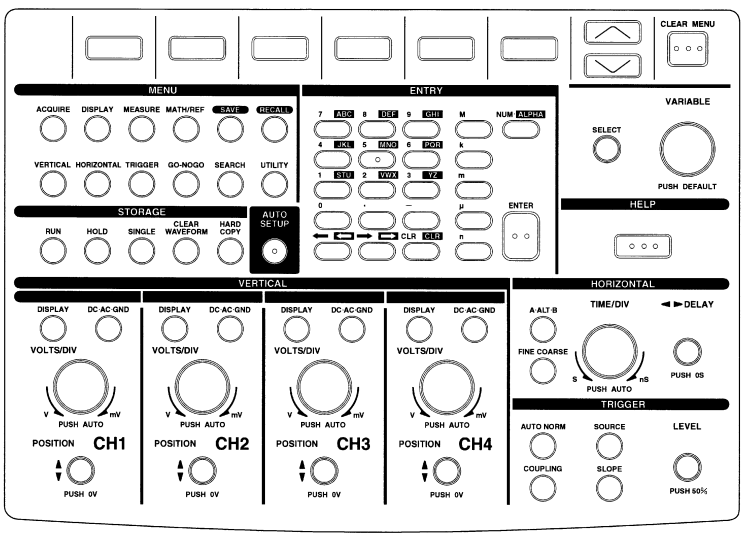

Fig 2-4 Operation panel

NOTE) The operation panel arrangement of VC-5810 is shown in Fig 2-1 and Fig 2-4.
For VC-5850, two channels only exist at vertical axis setting section.

2.2 Function of each section

2.2.1 Operation panel

Vertical axis setting section

Controls and keys for setting the vertical axis a range are provided in this section.
The controls and keys are provided independently for channel.

DISPLAY T his key turns on or off waveform display. The readout of the channels displayed on the screen while a waveform is displayed (ON).

DCACGND This key switches input coupling. Whenever pressing this key, the mode changes in the order of DC-AC-GND .

VOLTS/DIV This control selects the vertical axis range. Turn this control clockwise for a high sensitivity range, and turn this control counterclockwise for a low sensitivity range.
Pressing this key starts the auto function optimizing only the channel's display waveform amplitude.

POSITION This control moves the displayed waveform in the vertical direction. Turn this control clockwise to move the waveform upward, and turn this control counterclockwise to move the waveform downward.

PUSH 0V This key returns the waveform which is moved by the POSITION control to the original position. When pressing this key during RUN, POSITION is reset to 0V and the GND marker. When pressing this key in the HOLD mode, the portion of B sweep waveform is moved to center of A sweep waveform.

Horizontal axis setting section

TIME/DIV This control sets the sweep time. Turn this control clockwise for a high speed sweep range, and turn this control counterclockwise for a low speed sweep range.
Pressing this key starts the auto time function optimizing the display sweep time for the signal of the smallest number of channel.

DELAY This control sets the delayed quantity of a signal to be observed which is delayed from the trigger point of the signal used as a reference. Turn this control clockwise to move the waveform so that the forward portion of the waveform is displayed, and turn this control counterclockwise to move the waveform so that the backward portion of the waveform is

PUSH 0s displayed.
Pressing this key resets the quantity of delay made by the DELAY control to 0 sec. Press this key to display the trigger point on the center of the screen.

AALTB This key switches the display mode of a waveform . Each pressing this key switches the display mode of a waveform to A (all sampled waveform data are compressed horizontally so that they are displayed on one screen) to ALT (all waveform data and the magnified waveform data are displayed on different scales) to B (a waveform magnified horizontally is displayed).

FINECOARSE
This key switches the resolution of horizontal movement amount by the DELAY control when the H HOME key is at ALT. When this key is set to FINE, movement amount is small. When this key is set to COARSE, movement amount is large.

Trigger setting section

AUTONORM
Each pressing this key alternates the AUTO trigger mode and the NORMAL trigger mode.

AUTO: When a signal is triggered, the screen is updated by each trigger signal. When no signal is connected or trigger is unlocked, the screen is automatically updated.

NORM: The waveform on the screen is updated only when a signal is triggered. When no signal is connected or trigger is unlocked, the screen is not updated until trigger is applied. Use this mode to apply trigger to a very low frequency signal (30Hz or less) or to measure a single shot signal.

SOURCE This key selects the trigger signal source. Each pressing this key selects the trigger signal source in the order of CH1-CH2-CH3-CH4-EXT. (for VC-5850, CH1-CH2-EXT)

COUPLING This key switches and sets trigger coupling. Each pressing this key selects, the coupling mode in the order of DC-AC-LFrej-HFrej.

SLOPE This switch selects the trigger signal leading edge or trailing edge that triggers the sweep.

LEVEL This control sets the trigger level. Turn this control clockwise to move the level upward on the screen, and turn this control counterclockwise to move the level downward on the screen.

PUSH 50% Pressing this switch sets automatically to the mid-level (50% level) between the maximum and minimum values of the trigger input signal.

STORAGE operation setting section

RUN Pressing this key starts acquiring data and continues to update the displayed waveform (that is, establishes the RUN status).

HOLD Pressing this key stops updating the displayed waveform and keeps displaying the last waveform (that is, establishes the HOLD status).

SINGLE Pressing this key starts a SINGLE sweep .

CLEAR WAVEFORM Pressing this key clears the displayed waveform once. The waveforms which are cleared can be selected at DISPLAY menu . This function is convenient for use along with "overwrite", etc.

Note: When pressing this key in the HOLD status, the waveform is kept cleared.

HARD COPY Pressing this key starts up externally connected printer, plotter , optional FDD or internal PC card slot to produce hard copy of displayed image on screen . Pressing this key again during operation for hardcopy stops the operation. The object device to copy and the format of hardcopy etc. can be selected at UTILITY menu.

AUTO SETUP Pressing this key starts the auto setup function. This function automatically turns on or off display (turns on the display only on the channels having input signals) and optimizes the display waveform amplitude, the position, the trigger source and the sweep time.

Menu keys section (MENU)

There are several keys to display menu. Pressing any key displays the corresponding menu on screen.

Menu's soft keys section

This is a keys section including several keys to select a menu item, a parameter among a selection list and to clear a menu when menu is displayed.

menu .

Soft keys (6 keys)
When menu is displayed, pressing any key of this section selects the item which is above the pressed key and the selecting or setting of the item can be enable.
A white and black marker is displayed over the selected item.

When a menu item is selected, the selection list of the menu item is displayed above this key. Selected item of the selection list is indicated with a black marker. The item can be changed by using this key to move the marker.

CLEAR MENU
Pressing this key erases the displayed menu.

VARIABLESELECT key

VARIABLE Turn this knob to change a value in the selected item among the selection list.
Turn it until the changed value reaches the desired value.
Pressing this knob changes the value to the default (factory) setting.

PUSH DEFAULT

SELECT Use this key to select the language in the default screen at shipment, or use it to select a moving cursor for the cursor measurement function.

HELP key

HELP Pressing this key displays the HELP screen.
In the HELP screen, the features and the way to use the menu or the keys and knobs on the control panel are explained.

Alpha-numeric keys section (ENTRY)
This is a section of keys using to directly enter a value or name to the selected menu item. Alpha-numeric keys, comma, minus, moving character position, clear a letter, unit keys, NUM.ALPHA selection key and ENTER key are included in this section.

Input terminal section
These are NBC connectors for input of a signal.

CAL output, GND terminal
CAL output : This is an output terminal for the 1kHz, 5V square wave for probe calibration.
GND terminal : This is a ground terminal.

Display section
10.4-inch TFT type color LCD is used.

2.2.2 Rear panel

AC input / FUSE
Connect the power cable to this input. A fuse is installed inside the fuse holder.
CAUTION : When the fuse is blown, contact your nearest Hitachi Denshi representative.

Input Output interface connectors section
GPIB connector : This connector is used to connect a personal computer, a plotter or a printer with the GPIB interface.
RS-232C connector: This connector is used to connect a personal computer, a plotter or a printer

with the RS-232C interface.

PARALLEL : This connector is used to connect a plotter or a printer with the Centronix interface.

VGA : The analog RGB video signal which can be connected to a VGA type display is fed out from this connector.
To enlarge the display screen, connect the oscilloscope to an external monitor through this connector.

GO/NOGO : When the GO-NOGO judgment function is used, this connector is used to output the judgment results. This is open collector output.

2.2.3 Left side

Power switch

This switch turns on or off power. Pressing the side printed "1" turns on power, and pressing the side printed "0 " turns off power.

PC card slot

This is a PC card slot of type.
Optional SRAM cards or Card disk can be inserted into this slot to save waveforms etc .

Slot for FDD

An optional FDD is installed here.

3.1 How to start up instrument

3.1.1 Connection to power source

(1) Connect the supplied power cable to the AC input on the rear panel.
(2) Check that the POWER switch on the left- hand side is set to OFF (the side printed 0 is pressed) , then connect the power cable to an AC outlet. If a three-wire outlet is available, be sure to connect the power cable to the three-wire outlet. If a three-wire outlet is unavailable, connect the power cable to a two-wire outlet using the supplied three-wire-two-wire conversion adapter. In the case of the two-wire outlet, be sure to connect the ground cable running from the adapter to an external ground.

3.1.2 Power on

Set the POWER switch to ON (the side printed 1 is pressed).
The display will appear in four to five seconds.

3.2 Setting by factory and selection of language

3.2.1 Setting by factory

When turning on the oscilloscope for the first time after purchase, the following screen is displayed. This display asks you to select language to use on screen

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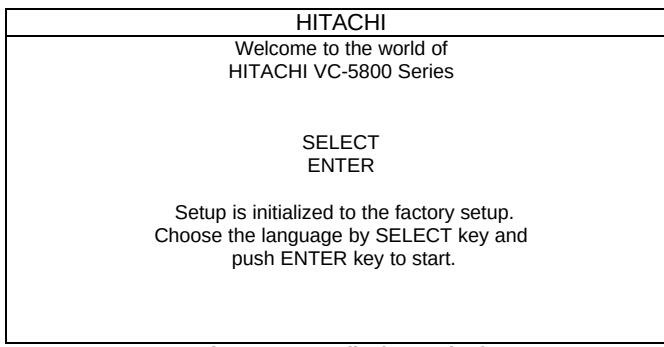


Fig 3-1 Screen display set by factory

To select the English language , push SELECT key and shift the square marker to ENGLISH display then push ENTER key to determine. After the operation , the scale display for waveform observation will appear. The panel settings are those set by the factory. For the settings by the factory, refer to Appendix .

3.2.2 Selection of language

The following operation using **UTILITY** menu can exchange the language after you select a language once. Refer to Chapter 5 about how to use menu.

Push **UTILITY** key of Menu section on operation panel. Then **UTILITY** menu appears.
Push soft key below the **UTILITY** item, and select the LANGUAGE from selection list.
Select **LANGUAGE** item at the second column in bottom menu, then select ENGLISH or JAPANESE from selection list.

3.3 Panel backup

When turning on the oscilloscope again after using the instrument, the oscilloscope goes into the state of the last panel setting. This oscilloscope is thus provided with the function which backs up setups by a

battery, so that measurement can be carried out on the same setup as the previous setup by turning on the instrument which has been turned off during being not in use.

3.4 How to obtain desired setup for measurement

When the previous operator used the oscilloscope with complicated panel setting, you may not know what setup is available when turning on the instrument. In this case, you can obtain the desired setup for your measurement speedily using the following three methods.

(1) Use of setup save memory

This oscilloscope is provided with the save memory which is capable of saving and recalling maximum ten pairs of set ups. By saving the desired setups for measurement using some of these setups, you can recall and return to the desired setup for measurement anytime. For the details of setup save and recall, refer to section 7.16.

(2) Use of auto setup function

This function automatically establishes setups in accord once with the signal so that the waveform display of the input signal is optimum for measurement. Waveform display ON/OFF, the vertical axis, the horizontal axis and the trigger are optimized in accordance with the signal, and several setups are set to fixed values. Carry out this operation first to know the setup status, then change setups as necessary. For the details and operation of auto setup, refer to section 7.2.

(3) Setting after restoring to setups by factory

When restoring to the setups (default) by the factory the setups shown in Appended Table are obtained. In some cases, It may be faster to restore to the setups by the factory once and change a setup as necessary. For how to restore to the default setups, refer to section 7.17.

(NOTICE)

When no waveform is displayed on the screen but the message "FULL CALIBRATION" is displayed to start auto calibration, contact your nearest Hitachi Denshi representative because the following causes will be considered.

The built-in battery is dead.(In this case the message "Battery Empty" is displayed.)

Data in the backup memory is destroyed for one cause or another.

3.5 Method for connecting signals

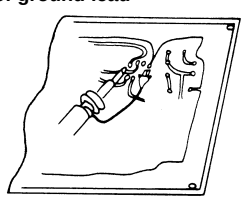
The first step of measurement is to connect the signal to the instrument properly. Do it with utmost care.

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.
If not, 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.

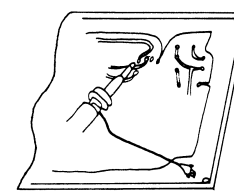
(1) Using probes
Use the supplied probe to measure a high frequency signal accurately.
When this probe is used with the X10/ X1 select switch set to X10, the input signal to the oscilloscope is attenuated to 1/10. This setting is convenient to measure a long signal because a measuring range is extended, though it is inconvenient for a small signal.
When a signal is too small to be measured with X10, use the mode X1. In this case, note that the input impedance of X1 is different from that of X10, and the measurable frequency band becomes very low. (For details, refer to the operation manual of the supplied probe.)

NOTES:
a) Do not apply a signal in excess of 500V (DC + peak AC at 1kHz or less) to the probe.
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.

Connection of ground lead



Proper



Improper

Fig 3-2

c) To avoid effect of the ground lead in high frequency measurement, it is recommended to use the standard ground lead attachment with the 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 overshoot 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

(2) 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. Howeverin 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 measuring 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 terminate 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 X10 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 length or its multiples (1/4 wave length is about 0.5 meter or 0.25 meter when using a coaxial cable at 150MHz or 300MHz respectively), 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 connecting the cable or shield wire to the input connector by the resistors from 100 to 1k connected in series, or by performing measurements at another VOLTS/DIV range.

4.1 Help functions

The oscilloscope includes a help function display. The operation panel keys (except Menu key), control knob and menu functions during the help screen are described. The help text is displayed in language selected.

4.2 Help screen display and extinguish

Press the HELP key to display the help screen. Again press the HELP key to extinguish the help display.

4.3 Help of operation panel keys and control knobs

During help screen display, operating a key or control knob (other than the Menu key of the operation panel) produces a description of that key or knob. However, if the menu is displayed, first press the CLEAR MENU key to clear the menu display before proceeding.

4.4 Menu help

Pressing the HELP key during a menu is selected, or sellecting the menu during the help screen produces a description of the selected menu item.

HELP
Help screen display : Press key.
HELP
Help screen extinguish: Again press key.

Fig. 4-1 Help screen example

5.1 Menu

During normal waveform observation, nearly all operations, such as range setting, waveform display, extinguish and shift, are conducted with the operation panel keys and knobs. The menu is used for setting the operating mode, display layout, external interface and recording media.
Following are descriptions of the menu composition and operation.

(1) Menu display

Pressing a key of the Menu section produces the corresponding menu screen display.

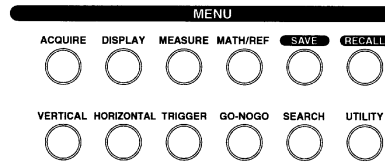


Fig. 5-1 Menu section keys

(2) Menu selection and setting

Item selection

Press the soft key below the desired menu item to select the item. The black and white marker indicated the selected item.

List selection

Most menu items have a selection list indicated on the screen. Use the and keys to shift the marker amongst the selection list.

Value setting

If necessary to change a menu item setting, the numerical value is indicated in the menu selection list. The value can be changed by turning the VARIABLE knob.

Direct setting

The numerical entry indication (Fig. 5-3) appears when the setting value of a menu item is large.

Fig. 5-3 Display when direct numerical input enabled

When the indication appears, use the numerical keys of the ENTRY section to input the value directly, then press the ENTER key.

Title setting

Each pressing of NUMALPHA key toggles between the NUM (Fig. 5-3) and ALPHA(Fig. 5-4) ENTRY. When ALPHA ENTRY (Fig.5-4) is displayed on screen, a title can be input with the alphabet keys of the ENTRY section.

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Fig. 5-4 Display when direct alphabet input enabled

Each pressing of an alphabet key toggles among the letters of that key, e.g., pressing the ABC key toggles among the letters A, B and C (observe the screen display).
Shift to the next letter with the left and right arrow keys.
When the menu selection list allows inputting mixed alphabet and numbers, toggle by pressing the NUMALPHA key.

Menu page selection

Some menus have items covering several pages. In such cases, proceed to the next page by pressing the soft key below the NEXT PAGE indication.

(3) Menu extinguish

To extinguish a displayed menu, press the CLEAR MENU key.

5.2 Menu composition

The menu system of this oscilloscope has following items. Refer to the HELP description displayed on screen of the equipment.

(1) ACQUIRE menu This is a menu for selecting the way to acquire input signal.

Table 5-1 ACQUIRE menu

Item	Outline of each item	Selection list
MODE	Signal sampling and display systems are selected	NORMAL, PEAK DETECT, ENVELOPE(Event times), AVERAGE(Attenuating coefficient), MOMENTARY
LENGTH	Select length of memory for storing waveform data	VC-5810 : 500w to 64kw VC-5850 : 500w to 256kw
SPLIT	Selection of memory split function and number of divisions.	OFFONNo.of divisions

The memory length selection range is extended as following table when optional extended memory is installed

Item	Specification of optional memory	Elective subject
LENGTH	in case of 256kw (for VC-5810 only)	500w to 256kw
LENGTH	in case of 2Mw	500w to 2Mw

(2) DISPLAY menu This is a menu for selecting the way to display on screen.

Table 5-2 DISPLAY menu

Item	Outline of each item	Selection list
DOT JOIN	Selection of dot join display	OFFON
PERSISTENCE	Selection of persistence display function and overwrite time.	OFFONOverwrite time, INFINITE
GRATICULE	Selecting waveform display frame	GRIDFRAMEAXES
WAVE CLEAR	Selecting waveform to be cleared by using CLEAR WAVEFORM key (STORAGE section	ALL, CURRENT, RECALL
INTERPOLATE	Interpolation on/off and method of interpreting	OFF, LINEAR, SINE
WINDOW	Number of windows	OFF, DUAL, QUAD, H-MODE (QUAD is available for VC-5810 only)
DUAL ZOOM	On/off selecting 2 locations magnification function	OFFON
ZOOM ESL	Select a part of waveform for shifting the expanded waveform position between 2 parts	FIRSTSECOND
A/B SEP	Shifting the expanded waveform vertically	OFFONV.position

(3) MEASURE menu This is a menu for selecting the cursor function or pulse parameter measuring function.

Table 5-3 MEASURE menu

Item	Outline of each item	Selection list
MEASURE	Selection of measure function	OFF, V CURSOR, T CURSOR, + CURSOR, PARAMETERS
SOURCE	Selecting the channel for measurement.	CH1 to CH4 (CH1,CH2 for VC-5850)MATH1 to MATH4AUTO
PARAMETER1 PARAMETER4	Selection of measuring parameters from among 17 items	OFF, 17 parameter items

(4) MATH/REF menu This is a menu for selecting the mathematics function or controlling the display of recalled waveforms

Table 5-4 MATH/REF menu

When one of MATH1MATH4 is selected at WAVEFORM item.

Item	Outline of each item	Selection list
FUNCTION	Selection of mathematics function	OFF, ABS, ADD, SUB, MULT, VERSUS, FFT
SOURCE1	Original signal channel for mathematics	CH1 to CH4 (CH1,CH2 for VC-5850)
SOURCE2	Second original signal channel for mathematics which needs 2 original signals	CH1 to CH4 (CH1,CH2 for VC-5850)
VOLTS/DIV	Vertical sensitivity of the computed waveform	
V.POSITION	Vertical position of the computed waveform	

When one of REF1REF4 is selected at WAVEFORM item.

Item	Outline of each item	Selection list
DISPLAY	Display ON/OFF for waveform in specified REF memory	OFFON
VOLTS/DIV	Vertical sensitivity of the memory waveform	
V.POSITION	Vertical position of the memory waveform	

(5)SAVE menu This is a menu for setting of waveform save or panel setting save function.

Table 5-5 SAVE menu

When internal MEMORY is selected at DEVICE item.

Item	Outline of each item	Selection list
OBJECT	Data to be saved	SETUP, ALL, CH1 to CH4 (CH1,CH2 for VC-5850)
NUMBER	Assign number to file for saving	for SETUP1 to 10 for WAVEFORMMEMORY1 to 4
EXEC	Execution of save function	

When one of PC CARD1, PC CARD2 or FLOPPY DISK(*1) is selected at DEVICE item.

Item	Outline of each item	Selection list
OBJECT	Data to be saved	SETUP, ALL, CH1 to CH4 (CH1,CH2 for VC-5850) CH1 to CH4 ACQUISITION (CH1,CH2 ACQUISITION for VC-5850)
DIRECTORY	Selection of directory to save the file	
FILE NAME	Select the file to save the data	
FORMAT	Data format of the save file	UBYTE, CSV, PRN, TXT
EXEC	Execution of save function	

(*1) FLOPPY DISK is listed up only when optional FDD (DV-505) is installed.

(6) RECALL menu This is a menu for setting of waveform recall or panel setting recall function.

Table 5-6 RECALL menu

When internal MEMORY is selected at DEVICE item.

Item	Outline of each item	Selection list
OBJECT	Data to be recalled	SETUP, WAVEFORM
NUMBER	Select file number to recall	for SETUP1 to 10

		for WAVEFORMMEMORY 1 to 4
RESTORE	REF memory where recalled waveform is restored (When OBJECT=WAVEFORM)	REF1 to REF4
EXEC	Execution of recall function	

When one of PC CARD1, PC CARD2 or FLOPPY DISK(*1) is selected at DEVICE item.

Item	Outline of each item	Selection list
FORMAT	Data format of file to be recalled	SETUP, UBYTE, CSV, PRN, TXT
DIRECTORY	Selection of directory where the file to be recalled is exist	
FILE NAME	Select the file to be recalled	
RESTORE	REF memory where recalled waveform is restored	REF1 to REF4
EXEC	Execution of recall function	

(*1) FLOPPY DISK is listed up only when optional FDD (DV-505) is installed.

(7) VERTICAL menu This is a menu to control vertical setting.

Table 5-7 VERTICAL menu

Item	Outline of each item	Selection list
CHANNEL	Select channel for vertical axis setting	CH1 to CH4 (CH1,CH2 for VC-5850)
INVERT	ON/OFF selection of invert display for selected channel signal	OFFON
BW.LIMIT	ON/OFF selection of BW. limit for selected channel signal	OFFON
PROBE	Scale factor of vertical sensitivity correspond to probe for selected channel signal.	X1, X10, X100, X1000
V.POSITION	Control of vertical position for selected channel signal.	

(8) HORIZONTAL menu This is a menu to control horizontal setting.

Table 5-8 HORIZONTAL menu

Item	Outline of each item	Selection list
EQUIVALENT	ON/OFF selection of equivalent sampling mode at high-rate time range.	OFFON
ROLL	ON/OFF selection of roll mode at slow-rate time range.	OFFON
DELAY	Control horizontal position of waveform display	
A TIME/DIV	Setting TIME/DIV of A sweep	
B1 SEGMENT	Selection of segment number of divided waveform to display in first zoom	
B2 SEGMENT	Selection of segment number of divided waveform to display in second zoom	

(9) TRIGGER menu This is a menu to control trigger setting.

Table 5-9 TRIGGER menu

Without option (extended trigger function is not installed) : TRIGGER = EDGE only

Item	Outline of each item	Selection list
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
SLOPE	Pole of trigger edge	RISE, FALL
LEVEL	Trigger level control	USER, AUTO, TTL, ECL

With option (extended trigger function is installed) :

in case TRIGGER=DELAY

Item	Outline of each item	Selection list
SELECT	Trigger signal to be set condition	A, BDelay time
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
SLOPE	Pole of trigger edge	RISE, FALL
LEVEL	Trigger level control	USER, AUTO, TTL, ECL

in case TRIGGER=WINDOW

Item	Outline of each item	Selection list
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
WHEN	Triggering condition	ENTER, LEAVE
UPPER LEVEL	Setting upper level of window	
LOWER LEVEL	Setting lower level of window	

in case TRIGGER=DROPOUT

Item	Outline of each item	Selection list
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
SLOPE	Pole of trigger edge	RISE, FALL
LEVEL	Trigger level control	USER, AUTO, TTL, ECL
TIME	Setting the absent period of trigger signal for triggering	60ns to 20s

in case TRIGGER=TV

Item	Outline of each item	Selection list
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
FORMAT	Selection of TV format by number of lines	525, 625
FIELD	Selection of field to be triggered	1,3 2,4
TRIGGER ON	Triggering sync. signal	TV-V, TV-H, TV LINE
LINE	Triggering line number	

in case TRIGGER=EVENT

Item	Outline of each item	Selection list
SELECT	Trigger signal to be set condition	A, BNumber of events
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
SLOPE	Pole of trigger edge	RISE, FALL
LEVEL	Trigger level control	USER, AUTO, TTL, ECL

in case TRIGGER=PATTERN

Item	Outline of each item	Selection list
PATTERN	Selection of logic pattern for triggering	CH1 to CH4 (CH1,CH2 for VC-5850) EXT HLX

LEVEL	Trigger level control	USER, AUTO, TTL, ECL
TIME	Setting the triggering time condition of the logic pattern	

in case TRIGGER=STATE

Item	Outline of each item	Selection list
CLK SOURCE	Strobe signal source	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
CLK SLOPE	Strobing polarity of clock source signal	RISE, FALL
PATTERN	Selection of logic pattern for triggering	CH1 to CH4 (CH1,CH2 for VC-5850), EXT HLX
LEVEL	Trigger level control	USER, AUTO, TTL, ECL

in case TRIGGER=PULSE WIDTH

Item	Outline of each item	Selection list
SOURCE	Trigger source channel	CH1 to CH4 (CH1,CH2 for VC-5850) EXT
COUPLING	Link type between trigger signal and circuit	DC, AC, LFrej, HFrej
SLOPE	Pole of trigger edge	RISE, FALL
POLARITY	Polarity of triggering pulse	POSITIVE, NEGATIVE
PULSE WIDTH	Setting the pattern duration to trigger	, : 50ns to 1s

(10) GO-NOGO menu This is a menu to set for GO-NOGO judge function .

Table 5-10 GO-NOGO menu

Item	Outline of each item	Selection list
WIZARD	Use or not wizard of GO-NOGO operation	START, END
GO-NOGO	Execute GO-NOGO judgment operation	OFF, ON
REACT WHEN	Condition under which NO GOOD decision is made	PART IN, PART OUT,ALL IN, ALL OUT
OF	Subject signal to be judged	CH1 to CH4 (CH1,CH2 for VC-5850) MATH1 to MATH4, ALL
REACTION	Reaction when NO-GOOD decision is made	NONE, BEEP, HOLD, SAVE, PRINT
EDITING	Execute editing of decision boundary	START, END
BASE ON	Selecting original signal to create the boundary	CH1 to CH4 (CH1,CH2 for VC-5850) MATH1 to MATH4
BOUNDARY	Moving upper line or lower line of boundary to create the decision boundary	
RANGE	Setting horizontal range where judgment is done	

(11) SEARCH menu This is a menu to search the specified portion of large capacity data of waveform.

Table 5-11 SEARCH menu

in case **SEARCH** = RISING EDGE or FALLING EDGE

Item	Outline of each item	Selection list
SOURCE	Subject signal channel to search	CH1 to CH4 (CH1,CH2 for VC-5850)
LEVEL	Vertical level which determines the rising or falling edge	
DIRECTION	Direction to execute the searching	FORWARD, BACKWARD
EXEC	Execution of the searching	
MARK	Execution of marking to the block which is searched and Jumping search to the marked block	MARKINGMark number SEARCH MARKMark number

in case **SEARCH** = SCROLL

Item	Outline of each item	Selection list
BACK	Scrolling in the direction of left	OFF, ON
FRONT	Scrolling in the direction ofright	OFF,ON
MARK	Execution of marking to the block which is searched and Jumping search to the marked block	MARKINGMark number SEARCH MARKMark number

(12) Utility menu This is a menu setting for input output interface, external memory devices etc.

Table 5-12 UTILITY menu

in case **UTILITY** = HARDCOPY

When HPGL is selected at FORMAT item (Menu for PLOT output)

Item	Outline of each item	Selection list
PAPER	Size of paper	A3, A4, US letter
PLOT SIZE	Picture size to be plotted	1/1, 1/2, 1/4
INTERFACE	Interface to connect the plotter	RS-232CGPIBCENTRONIX
POSITION	Plotting position on paper	AUTO, (position number)
PLOT	Select what is to be plotted	ALL, WAVEFORM, FACTORS
PEN CHANGE	ON/OFF control of pen change function	OFF, ON

When one form ESC/P - DESK JET C is seleced at FORMAT item (Menu for PRINT output)

Item	Outline of each item	Selection list
FORMFEED	Feed or not a paper after each printing	OFF, ON
PRINT	Select what is to be printed	ALL, WAVEFORM, FACTORS
INTERFACE	Interface to connect the printer	RS-232CGPIBCENTRONIX

When one of BMP - TIFF, HPL(*2) is selected at FORMAT item (Menu for copy to file)

Item	Outline of each item	Selection item
DEVICE	Selection the storage media to make hardcopy	PC CARD1,PC CARD2, FLOPPY DISK (*1)
COLOR (*3)	Selecting color of output image	NORMAL, REVERS

in case **UTILITY** = FILE TOOLS

Item	Outline of each item	Selection list
DEVICE	Selection the storage media to make the process	PC CARD1, PC CARD2, FLOPPY DISK (*1)
COMMANDS	Selection of the process to execute	FORMAT, RENAME, DELETE, COPY, MAKE DIR
CARD TYPE	(When FORMAT is selected)Size of formatting	64k to 16M
FDD TYPE (*1)	(When FORMAT is selected)Size of formatting	720k1.21M, 1.44M
DIRECTORY	(When command except FORMAT is selected)	
FILE NAME	(When command except FORMAT is selected)	
EXEC	Execution of command	

(*1) FLOPPY DISK is listed up only when optional FDD (DV-505) is installed.
(*2)HPL is available for VC-5850 only.
(*3)COLOR is available for VC-5850 only.

in case **UTILITY** = INTERFACE

When RS-232C is selected at INTERFACE item (Menu for RS232C interface setting)

Item	Outline of each item	Selection list
BIT RATE	Selection of transmission rate	300 to 19200 BPS
STOP BIT	Stop bit length selection	1, 2
PARITY BIT	Select necessity of parity bit	NONE, ODD, EVEN
HAND SHAKE	Selection of hand shake style	HARDWIRED, XON/XOFF

When GPIB is selected at INTERFACE item (Menu for GPIB interface setting)

Item	Outline of each item	Selection list
MODE	Selection of communication mode for GPIB	TALK ONLY, TALK LISTEN
MY ADDRESS	Setting the GPIB address on this unit	1 to 30
EOI	Select whether EOI is output or not with delimiter	OFFON

in case **UTILITY** = CALIBRATION Menu to execute calibration

Item	Outline of each item	Selection list
CALIBRATE	Selection of calibrated item	FULL, VERT OFFSET, TRIG(*4), SKEW(*4)
CAL EXEC	Execution of calibration	
CHANNEL (*4)	Selection of object channel for trigger or skew calibration.	CH1 / CH2 / EXT / CH1-CH2

in case **UTILITY** = LANGUAGE (*4)Menu to select a language.

Item	Outline of each item	Selection list
LANGUAGE (*4)	Selection of language to use	JAPANESE, ENGLISH

in case **UTILITY** = OTHERS Menu of setting other several items

Item	Outline of each item	Selection list
LANGUAGE	Selection of language to use	JAPANESE, ENGLISH
SET CLOCK	Setting calendar and clock	
BUZZER	On/OFF control of buzzer	OFFON
DISP. CLOCK	On/OFF control of clock display	OFFON
OVER WRITE	On/OFF control of overwriting to file	OFFON
DEFAULT	Operation to set all setting to the default setup	OFFON

(*4) The selections are available for VC-5850 only.

The readout display is described below.

6.1 Setting display

The display used for setting with the operation panel or menus is shown in Fig. 6-1.
Fig. 6-1A shows an example of the screen and setting arrangement for normal monitoring.
Fig. 6-1B illustrates an example of the menu screen. In this case, the vertical axis and trigger settings are indicated within the waveform display area. Also, the date and time is not shown.
Pressing the Clear Menu key to extinguish the menu produces the Fig. 6-1A screen.

(1) Vertical axis setting

The vertical axis settings of the respective channels are shown in order (except for channels with Display set to Off). The indicated settings are coupling, vertical axis range and probe multiple.

(2) Time axis setting

The delay time and time axis range are indicated.

Delay time : The delay time from the trigger point to the screen center vertical axis is shown.

Time axis range: The Time/Div setting is shown.

(3) Operation mode

Acquisition selected from the ACQUIRE menu is indicated.

Blank : Normal
PD : Peak detect
En : Envelope
Av : Average
Mo : Momentary

(4) Sampling status

Data compiling status is indicated.

RUNNING: Data being compiled and processed for display or other operation.

PRETRIGGER ACQUISITION: Indicates data required prior to trigger enable are being acquired in the low speed range.

WAITING FOR TRIGGER: Indicates trigger waiting status when the trigger is not obtained within the designated time.

FILLING MEMORIES: Indicates when data are compiled after trigger input.

(5) Trigger setting

Indicates present trigger setup.

(6) Date and Time

There is **DISP CLOCK** item at the menu which is got by selecting **OTHERS** at **UTILITY** item in **UTILITY** menu. Setting ON there displays the date and time on screen.

(7) Sampling mode

Indicates sampling short time when the time axis range is changed.

Normal : Real-time sampling
Equivalent : Equivalent sampling
Roll : Roll mode

(8) Waveform indicator

Indicates the amount of data used for waveform display of the selected memory length at the **ACQUIRE** menu.

6.2 Measurement display

Fig. 6-2 shows an example of a measured value when cursor or pulse parameter is selected at the **MEASURE** menu. However, the measurement is not indicated while the menu is displayed. Be sure to press the CLEAR MENU key in order to extinguish the menu.

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 5.

7.1 RUN, HOLD and SINGLE operations

(1) RUN function

When the RUN mode is selected, the acquired data is displayed repeatedly.
Pressing the RUN key in the STORAGE section displays "RUN " at the upper left side of screen to indicate that the RUN mode is activated. When the "RUN" is displayed in the average mode or the GO-NOGO judgment mode, 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

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 key is pressed in the RUN mode, the waveform acquired last is displayed stationary, and "HOLD" is displayed at upper left corner of screen. Though a new waveform is not acquired in the HOLD mode, the displayed waveform can be moved or magnified for close observation.

(3) SINGLE operation

When the SINGLE key is pressed, a single shot sweep is performed. In the SINGLE mode, a waveform is acquired once after the SINGLE key 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 even though 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.

7.2 Auto setup function (AUTO SETUP)

Function

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

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

Operating procedure

Connect the signals to be measured to the input BNC connectors. At this time, connect the signal to be used as the reference of the time axis to the youngest channel.
Press the AUTO SETUP key .

Conditions

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

Frequency: 20Hz to 50MHz
Duty factor: 20 to 80%
Amplitude: 10mV to 50V (20mV or more for 20 to 100Hz)

For example, when a input signals a 20MHz square wave, the pulse width must be 10ns or more. In

This instrument has RS-232C, GPIB, Centronix(8BIT PARALLEL) interfaces.
Through these interfaces, the instrument transmits data to plotter or printer to make hardcopy.
And RS-232C or GPIB is used for transmitting and receiving data between the instrument and the personal computer. VGA output connector is mounted also.
In this chapter, hardware specifications about these interfaces are described.

8.1 RS-232C

(1) Specifications

Electrical : Conforms to the EIA RS-232C.
Type of transmission : Asynchronous
Length of stop bit : 1bit or 2 bits
Character length : 8 bits
Parity bit : NONE/ODD/EVEN
Delimiter : C/R L/F
Transmission rate : 300, 600, 1200, 2400, 4800, 9600 or 19200bps
Communication protocol : X-ON/X-OFF handshake or hard wired handshake

(2) Connector Pin Arrangement and Signal Description

Fig. 8-1 illustrates the pin arrangement of the RS-232C connector, and Table 8-1 lists the pin functions.

Fig.8-1 Pin arrangement

NOTE: Connector DB-9P (female) applicable for connection cable is used.

Table 8-1 Terminals of the RS-232C connector

Pin No.	Signal	Function		Pin No.	Signal	Function
1	FG	Ground line for chassis			NC	Non connect
2	RXD	Receive data input signal			RTS	Request To Send
3	TXD	Transmit data output signal			CTS	Clear To Send
4	NC	Non connect			NC	Non connect
5	SG	Ground line for signal				

(3) Connection

Connect the instrument with a personal computer, printer or plotter by the RS-232C interface cable. Prior to connection, read the related manual carefully and use the appropriate interface cable, because interface is changed in accordance with types of those equipment. The hard wired handshake using the RTS/CTS wire or the XON/XOFF handshake can be selected. Select the handshake system suitable for the connected equipment.

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

(a) Wiring diagram of the RS-232C interface cable using the XON/XOFF handshake

Fig. 8-2(a) Wiring diagram of the RS-232C interface cable [Using the XON/XOFF handshake]

Note: Use optional RS-232C cable No. 4314 , when connecting to printer or plotter by XON/XOFF handshake.
Use optional RS-232C cable No. 4315 , when connecting to personal computer PC-AT compatibles by XON/XOFF handshake.

(a) Wiring diagram of the RS-232C interface cable using the hard wired handshake

In case connection of the printer or plotter In case connection of the personal computer PC-AT compatibles

Fig.8-2(a) Wiring diagram of the RS-232C interface cable [Using the hard wired handshake]

Note: Use optional RS-232C cable No. 4321 , when connecting to printer or plotter by hard wired handshake.
Use optional RS-232C cable No. 4320 , when connecting to personal computer PC-AT compatibles by hard wired handshake.

8.2 Centronix (8BIT PARALLEL)

Centronix interface is used for connecting of printer or plotter and the instrument.
Fig. 8-3 illustrates the pin arrangement of the Centronix connector

Fig. 8-3 Pin arrangement

Table 8-2 Terminals of the Centronix connector

Pin No.	Signal	Function	Pin No.	Signal	Function
1	GND	Ground	11	DB7	Data bit 7
2	NC	Non connect	12	DB6	Data bit 6
3	DB5	Data bit 5	13	GND	Ground
4	DB4	Data bit 4	14	NC	Non connect
5	DB3	Data bit 3	15	NC	Non connect
6	GND	Ground	16	RTS	Request to transmit
7	NC	Non connect	17	DB2	Data bit 2
8	DB0	Data bit 0	18	DB1	Data bit 1
9	BUSY	Data busy	19	NC	Non connect
10	STB	Data strobe	20	GND	Ground

Note: Use optional Centronix cable No. 4316 , when connecting to printer or plotter by Centronix interface.

8.3 GPIB

The GPIB is a general purpose interface bus which conforms to the IEEE-488 (1978) GPIB standards, which provides an interface between printer, plotter or personal computer and the instrument by using exclusive connectors and cables. The GPIB is used for transmitting and receiving data of different transfer rates between self-contained instruments or devices and the GPIB can support up to 15 independent devices connected in parallel.

(1) GPIB connector and cable

Physical arrangement of the 24-conductor GPIB connector (located on the rear panel) meets the IEEE-488 (1978) GPIB standards. A contact assignments of the cable connector and the device connector shall be as shown in Fig.8-4. 16 pins are for signal lines and the remaining 8 pins are for ground. The voltage and current conform to TTL standard and; the voltage shall be less than +5.5V against GND.
When the voltage is low level of +0.8V or lower, the signal is set to logic "1" in the TRUE mode.
When the voltage is high level of +2V or higher, the signal is set to logic "0" in the FALSE mode.
Use a double shielded GPIB which especially meets the following conditions in the IEEE-488 (1978) GPIB standards.

a) Total cable length: 20m max. (Total of each cable length)
b) Single cable length: 4m max. (One span connection)
c) Connectable equipment number: 15 sets max. (Including a controller)

Fig. 8-4 GPIB interface connector

Table 8-2 Terminals of the GPIB connector

Pin No.	Signal	Function	Pin No.	Signal	Function
1	DIO1	Data Input Output 1	13	DIO5	Data Input Output 5
2	DIO2	Data Input Output 2	14	DIO6	Data Input Output 6
3	DIO3	Data Input Output 3	15	DIO7	Data Input Output 7
4	DIO4	Data Input Output 4	16	DIO8	Data Input Output 8
5	EOI	End Or Identify	17	REN	Remote Enable
6	DAV	Data Valid	18	GND	Ground
7	NRFD	Not Ready For Data	19	GND	Ground
8	NDAC	Not Data Accepted	20	GND	Ground
9	IFC	Interface Clear	21	GND	Ground
10	SRQ	Service Request	22	GND	Ground
11	ANT	Attention	23	GND	Ground
12	SHIELD	Shielded line	24	LOGIC GND	Ground

Note: Use optional GPIB cable No. 4274 , when connecting to external equipment by GPIB interface.

8.4 VGA video out

This oscilloscope is provided with the VGA video output (Analog R. G. B) on the real panel for output to an external monitor. This connector (D sub type, 15-pin) can be connected to a VGA type color display.

Fig 8-5 VGA output connector

Table 8-4 Pin connection of VGA output connector

Pin No.	Signal	Function	Pin No.	Signal	Function
1	R	RED signal		NC	Non connect
2	G	Green signal		GND	Ground
3	B	Blue signal		GND	Ground
4	GND	Ground		NC	Non connect
5	NC	Non connect		VSYNC	Vertical synchronize signal
6	GND	Ground		HSYNC	Horizontal synchronize signal
7	GND	Ground		NC	Non connect
8	GND	Ground			

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. A waveform is not displayed for the channel of no signal.
(2) When effective signals are connected to several 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 any channel, all channels are displayed on .

Setting

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

Table 7-1 Settings changed automatically

Item	Name	Setting
Storage mode	RUN, HOLD	RUN
Input coupling	DC-AC-GND	DC
Trigger mode	AUTO/NORM	AUTO
Trigger coupling	COUPLING	DC
Delay time	DELAY	0sec (center of screen)
Trigger type	TYPE	EDGE
Trigger setup	SLOPE	RISE
Trigger slope	LEVEL	

7.3 Vertical axis operation

(1) Channel ON-OFF

The waveform display of an input signal can be turned on or off by the DISPLAY key. Only the waveform and the settings of channel selected by the DISPLAY key is displayed on screen.
The marking " " colored same as the waveform is displayed at the right of the scale, and it indicates the ground level of the channel.

(2) Input coupling setting

Three input coupling modes are available. Select the desired coupling mode by the DCACGND key. The selected coupling mode is displayed at the vertical axis setting value section at the right side on the screen.

DC (No symbol) : An input signals 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 amplifiers grounded.

(3) Vertical axis sensitivity setting

The vertical axis sensitivity can be set by the VOLTS/DIV knob of each channel. The set sensitivities is displayed at the vertical axis setting value section .

Setting range (1-2-5 sequence)
When probe factor is x1 : 1mV5V
When probe factor is x10 : 10mV50V
When probe factor is x100 : 100mV500V
When probe factor is x1000 : 1V5kV

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

(4) Vertical movement of waveform

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

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.

Vertical movement after HOLD and reset of movement amount

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

The movement amount changed after HOLD is not affected when the RUN mode is established again.

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.

VERTICAL menu includes the probe factor setting menu.

Operation

Push VERTICAL key at the MENU section and display the **VERTICAL** menu.

Then select the subject channel to be set probe factor at **CHANNEL** item and set the probe factor at **PROBE** item.

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

(6) Waveform magnification

When a waveform is held on the screen, it can be magnified vertically up to 2 steps more sensitive range. This mode is effective to magnify the change of a small signal.(A held waveform cannot be compressed.)

7.4 Acquisition mode selection (MODE)

This model has five acquisition modes: Normal, Peak Detect, Envelope, Average and Momentary .

(1) Acquisition mode

Setting

Display **ACQUIRE** menu, pressing ACQUIRE key of MENU section. Select acquisition mode from among the selection list of **MODE** item.

NORMAL mode : Standard observation mode. In this mode, the sampling frequency varies in correspondence with the time range. This mode is useful for normal waveform monitoring

PEAK DETECT mode : In this mode, input signals are sampled maximum sampling rate the maximum and minimum values between disply point extracted and displayed. This mode is convenient to measure a signal containing a minute pulse above 10 ns in width . Peak detect does not operate at Equivalent sampling mode time range.

ENVELOPE mode : In this mode, the maximum and minimum sampling values over triggers of many times are acquired and displayed. This mode is convenient to measure the change of a waveform for each trigger. In this mode,the accumulation event times of data can be specified: 2 to 2048 ( ). The maximum and minimum values at each point are obtained and displayed on the screen by comparing the sampled value with the values acquired previously for the period. In the envelope mode, although the peak detect function operates for each trigger, the peak detect function does not operate at Equivalent sampling mode time range. At Roll mode range Envelope mode does not work.

AVERAGE : When random noise (asynchronous noise) is included in an input signal, use the

mode 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 attenuating coefficient constant and weighting applied to the past data is made smaller in sequence in term of the exponential function.
Attenuating coefficient : 2 to 256 ( )

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

k :Average value until Kth sample data string (Kth sweep)
k : Kth sample data string
: Specified attenuating coefficient

NOTE 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.
At ROLL mode range, Average mode does not work. It works as NORMAL mode is selected

MOMENTARY mode : Event having the shortest period is picked up and repeatedly displayed. The mode allows tracking and displaying the fastest signal variation.
This mode is not capable of computing or processing.

(2) Data acquisition

VC-5810 has standard 64kw, VC-5850 has standard 256kw acquisition memory, the memory length storing one waveform can be selected according to applications.

Operation

Display **ACQUIRE** menu, pressing ACQUIRE key of MENU section. Select memory length from among the selection list of **LENGTH** item.

NOTE The selectable memory length range differs when using the optional memory expansion board.
Long signal storage: Select a long memory length to permit detailed correction for long term events. However, waveform display refresh can be delayed when displaying large amounts of data.
Fast refresh observation: A short memory length is effective.

(3) SPLIT mode

The waveform record memory is split, and the single shot signal which occurs several times is acquired in sequence to the split record memories. The acquired data are compressed horizontally to 1kW and displayed on the screen.
However, the SPLIT operation is not available in the equivalent sampling mode or the roll mode.

Operation

Display **ACQUIRE** menu, pressing ACQUIRE key of MENU section. Select **ON** at SPLIT item.

Selection of split numbers

Select by the VARIABLE control or directly by the number and ENTER key.
Selectable number of divisions changes according to the selection of memory length. Selection of the shorter length enables the lager number of divisions.
Selectable maximum number of divisions:
for VC-5810 : 32 max. when standard 64kw/ch memory is installed.
128 max., 1024 max. when optional 256kw/ch or 2Mw/ch memory is installed respectively.
for VC-5850 : 128 max. when standard 256kw/ch memory is installed.
1024 max. when optional 2Mw/ch memory is installed.

NOTE) VC-5850 has the following restriction in data acquisition memory length and split numbers of SPLIT mode when PEAK DETECT mode is executed.

for VC-5850 : Maximum data aquire memory length in PEAK DETECT mode.
in case standard 256kw/CH : 32kw/CH
in case optional 2Mw/CH : 256kw/CH

for VC-5850 : Selectable maximum split numbers of SPLIT mode.
in case standard 256kw/CH : 128 max. at NORMAL mode.
32 max. at PEAK DETECT mode.
in case optional 2Mw/CH : 1024 max. at NORMAL mode.
256 max. at PEAK DETECT mode.

7.5 Time axis operation (HORIZONTAL)

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

The time axis range is set by the TIME/DIV knob.
The high speed sweep range is selected by the clockwise rotation, and the low speed sweep range is selected by the counterclockwise rotation.
The read-out of the time axis range is displayed at the top right of the screen.
When TIME/DIV is operated, the sampling mode of the range is momentarily displayed at the top left in the scale.

NOTE) When the memory length is set to 1 Mw and 2 Mw, in order to effectively utilize the memory length, in some cases, the change of time axis range is not 1 - 2 - 5 (e.g., 4 ms).

(2) Sampling mode and time range

(a) Sampling mode selecting

This unit has three types of sampling modes, real time sampling, equivalent sampling and roll mode. On - off setting of equivalent mode and roll mode can be controlled using menu.

Setting : Press the HORIZONTAL key of the Menu section, then **HORIZONTAL** menu is displayed.
Select the **EQUIVALENT** item for equivalent sampling mode setting.
Select the **ROLL** item for roll mode setting.
The relationship between TIME/DIV settings and sampling modes is described as following figure.

	50s	10s	1s	100ms	10ms	1ms	100s	10s	1s	100ns	10ns	1ns
Equi-valent	**Roll**											

Fig.7-1 Relationship between TIME/DIV settings and sampling modes

(b) Sampling mode

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. When time range is switched, the word "NORMAL" and sampling speed are momentarily displayed on screen at real time sampling range. As sampling speeds depend on the selected time range and the selected memory length, check the sampling speed by the display.

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. This sampling mode is activated only when equivalent mode is turned on at the **HORIZONTAL** menu.

In case of the time range of the equivalent sampling mode, "EQUIVALENT" is displayed on screen at the moment time range is switched. 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.

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 **HORIZONTAL** menu .
In case of the time range of the roll mode, “ROLL” and sampling speed are displayed on screen at the moment time range is switched.
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 key. The SINGLE sweep cannot be selected in the ROLL mode.

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 aliasing 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

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.

Setting way 1 : Setting with delay control

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 waveform to be observed depends on the time axis range, the maximum range is 10000 DIV.
The read-out data of the DELAY time is displayed at the center top of the screen. This value indicates how much the center of the screen is delayed with the trigger point as a reference.

Setting way 2 Direct setting with numerical keys

Press the HORIZONTAL key of the Menu section, then **HORIZONTAL** menu is displayed.
Select the **DELAY** item, then set delay amount by numerical keys directly. It is useful when large delay amount needs to be set.

When a high speed range is set by the TIME/DIV control 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.

(4) Horizontal movement after HOLD mode

Only when whole waveform is not displayed on screen , the held waveform can be moved horizontally by the DELAY control. The relationship between the whole data of acquisition memory and waveform displayed on screen is indicated at waveform indicator. Whole bar indicates the memory length selected, a blue colored part corresponds to the waveform displayed on screen while white part shows the data not displayed on screen.

(5) Horizontal magnification and movement

The horizontal magnification of a waveform is made by pressing **AALT B** key and setting H MODE to ALT or B. In case of A or B sweep, A TIME/DIV or B TIME/DIV is displayed at top right of screen respectively. In ALT mode, both TIME/DIV are displayed there. This display shows the state of sweep mode.

(a) ALT

The original waveforms which almost whole the acquired data are compressed horizontally, and a part of the original waveforms which are magnified are displayed simultaneously. As both waveforms overwritten on screen normally, it is hard to distinguish each waveform. Following operations are recommended to separate each waveform.

Position separating of magnified waveform

() Separation by A/B separation control

This way enables to move magnified waveform position only, so magnified waveform position can be separated from original waveform.

Select **A/B SEP** item at DISPLAY menu and control **VARIABLE** knob.

() Separation by dual window

Selecting **H-MODE** at **WINDOW** item of **DISPLAY** menu makes two scales display at ALT mode. Original (A sweep) waveform is displayed in upper scale and magnified (B sweep) waveform displayed in lower scale. In this case , only the magnified portion of original waveform is colored. Time scale factor and horizontal position of magnified (B sweep) waveform is changed by TIME/DIV control and Horizontal POSITION control respectively.

Dual zoom

Two portions of a original waveform are horizontal magnified simultaneously.

Operation : Select **ON** at **DUAL ZOOM** item of **DISPLAY** menu.

Vertical and Horizontal position control :

Horizontal position of magnified waveform is controlled by VARIABLE control when selecting A/B SEP item at DISPLAY menu. Vertical position is controlled by the correspond channel vertical POSITION knob.

Waveform of which position control is effective is selected at **ZOOM SEL** item of **DISPLAY** menu.

The TIME/DIV of dual zoomed waveforms are same.

(b) B

Only magnified waveforms are displayed while original waveforms are distinguished.

Operation for the magnified waveform is same as case of ALT mode.

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

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

Linear interpolation (LINEAR) and sinusoidal interpolation (SINE) can be selected at the item INTERPOLATE on DISPLAY menu.

Select SINE for sinusoidal waveform observation and LINEAR for a pulse waveform generally.

(6) Horizontal magnify in SPLIT mode

In SPLIT mode, each divided waveform can be magnified by following operation.

Select the segment number of divided waveform to be magnified at item B1 SEGMENT of HORIZONTAL menu. When dual zoom mode is selected, select one segment number to be magnified as first zoom at item **B1 SEGMENT** of **HORIZONTAL** menu and select another segment number magnified at second zoom at **B2 SEGMENT**. Other operation is nearly same as normal waveform magnification.

7.6 Waveform search function

The specified portion is automatically searched from held waveform using this function when ALT or B mode is selected.

There are following three ways to search.

Rising edge : Searches and displays the magnified waveform having a rising edge which crosses the specified vertical level.

Falling edge : Searches and displays the magnified waveform having a falling edge which crosses the specified vertical level.

Scroll : The magnified waveform displayed on one screen is scrolled as one block to left or right.

Operation

Hold the waveform which is applied search function.

Select ALT mode display pressing **AALTB** key

Select the way at **SEARCH** item of **SEARCH** menu .

When rise edge or fall edge is selected at **SEARCH** item, select the subject signal channel at **SOURCE** item and control the vertical level selecting **LEVEL** item and controlling VARIABLE knob also.

Pressing soft key correspond to **EXEC** item searches the specified block and the magnified waveform including the searched portion is displayed

Pressing the soft key again starts searching next portion.

(1) Searching direction :

Select the direction to execute the searching on the subject waveform.

FORWARD or **BACKWARD** is selected at **DIRECTION** item.

(2) Marking

The waveform can be marked with the number that is obtained through the searching execution , and the search for this marker can be done directly later.

Marking :After displaying the block of waveform to be marked, select **MARKING** at **MARK** item, then set the mark number by using numerical keys in the ENTRY section and ENTER key .

Number 0 to 4 are used for marking.

Search mark: Before using search mark function, marking described at must be done.

Select **SEARCH MARK** at **MARK** item, then set the searching mark number by using numerical keys in ENTRY section and ENTER key.

7.7 Operation of trigger function (TRIGGER)

This instrument has Edge trigger function as standard.

When optional extended trigger function is installed , the following trigger functions can be used.

Extended trigger functions (OPTION) : Delay trigger
Window trigger
Dropout trigger
TV trigger
Event trigger
Pattern trigger
State trigger
Pulse width trigger

Concern with these optional trigger functions, Refer to chapter 10.

7.7.1 Edge trigger function

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

Selection of edge trigger

In case of standard instrument without optional trigger function
As only edge trigger is effective, No selection is needed.

In case optional trigger function is installed
Select **EDGE** at **TRIGGER** item of **TRIGGER** menu.

Setting

Trigger setting status is displayed at lower right of screen.

(1) Setting using keys in TRIGGER section

AUTONORM key

Select AUTO trigger mode or NORMAL trigger mode by this key.

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 key

Select the desired trigger source channel.

SLOPE key

Select a rising edge or a falling edge .

COUPLING key

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.

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

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

LEVEL knob

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.

(2) Setting by TRIGGER menu

Same setting of source, coupling, slope can be done at the **TRIGGER** menu.
Trigger level : there are four kind of setting selectable at **LEVEL** item.

USER :In case of selection this list, the trigger level is set by VARIABLE knob.
A direct setting using numerical keys is enabled
AUTO : It works same as pressing PUSH 50% knob.
TTL : TTL level (1.6V) is set
ECL : ECL level (-1.3V) is set

7.8Display format of waveform

The horizontal display resolution of this model is 500 dots/10div.
When 500w is selected at LENGTH item , one data is displayed per dot on the horizontal axis.
When length is selected as more than 500w, the maximum value and minimum value are detected from several data and one maximum data and one minimum data are displayed per dot on the horizontal axis.

7.8.1 Persistent display

Three waveform display formats, refresh, persistence and infinite persistence, are available.

(1) Refresh display

Selecting **OFF** at **PERSISTENCE** item on **DISPLAY** menu establishes 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.

(2) Persistence display

For this mode, select **ON** and set the overwrite time at **PERSISTENCE** item on the menu.
In this mode, a new waveform is overwritten onto old waveforms in sequence during specified period.
When specified period passed, the prior whole data is extinguished then new overwrite starts.
The overwrite time is set by using VARIABLE knob or numerical keys.

(3) Infinite persistence display

For this mode, select **INFINITE** at **PERSISTENCE** item on the menu.
In this mode, a new waveform is overwritten onto old waveforms in sequence till this mode is stopped.
This mode is effective to measure the magnitude of jitters 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.

7.8.2 CLEAR WAVEFORM

To clear an overwritten waveform etc. , press the **CLEAR WAVEFORM** key.
Waveforms are cleared according to the contents set by the **WAVE CLEAR** item on **DISPLAY** menu.
Selection
Select the desired modes of clearing waveforms.
WAVE CLEAR : ALL All waveforms are cleared.
WAVE CLEAR : CURRENT Clears all the waveforms other than the recalled waveform.
WAVE CLEAR : RECALL Only the recalled waveform is cleared.
Note : Use care to press this key , because the waveforms cleared by this key cannot be displayed again. It is recommended to save data or produce hardcopy.

7.8.3 Dot join display

Select the display modes of acquired waveforms.
Selection
Select the desired mode on **DOT JOIN** item of **DISPLAY** menu.

DOT JOIN :ON The dots of the acquired waveform data are connected by lines.
DOT JOIN : OFF Only the dots of the acquired 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.

7.9 Switching of scales (GRATICULE)

Operation

Select a displayed scale from **GRID**, **FRAME** and **AXES** on **GRATICULE** item of **DISPLAY** menu.

GRID

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

FRAME

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

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.

7.10 Window

It is hard to distinguish each waveform when many waveforms are displayed in a scale.
We recommend to display the several scales using window function when you need to display many waveforms on screen.

Operation

Select the followings on **WINDOW** item of **DISPLAY** menu.

OFF Displaying single scale on screen, all waveforms are displayed in it.

DUAL Displaying dual scales , channel 1 and channel 3 waveforms are displayed in upper window while channel 2 and channel 4 are in lower scale.
(for VC-5850, CH3 and CH4 are absent)

QUAD Displaying four scales and each waveform of four channel are displayed in each.
(QUAD is not available for VC-5850)

H-MODE The number of displayed scales changes according to **AALTB** selecting.
In case of A or B : One scale is displayed.
In case of ALT : Two scales are displayed and A mode waveform is displayed in upper window an B mode waveform in other window.

7.11 Waveform operation function (MATHEMATIC)

Description

Absolute value (ABS) and FFT waveform of a waveform and Addition (ADD), Subtraction (SUB), Multiplication waveform (MULT) and X-Y display (VERSUS) of two waveforms are displayed. Four kinds of operations can be done at the same time.

Operation

When operation is executed, four resultant waveforms are named as MATH1 to MATH4.

Selection of operation function

At first, select the **MATH** number which will keep the result of desired operation on **WAVEFORM** item of **MATH/REF** menu.

Then select operation function at **FUNCTION** item of the **MATH** number.

Selection of subject signal

Select subject signal channel of the operation at the **SOURCE1** item and **SOURCE 2** item.

Operation to need two subject signals: ADD, SUB , MULT, VERSUS

Set the two subject channels at **SOURCE1** and **SOURCE2**.

For VERSUS, set the channel correspond to X axis to **SOURCE1**.

For SUB, set the channel which is subtracted to **SOURCE1**.

Operation to need one subject signal : ABS, FFT

Set a subject channel to **SOURCE1**. In this case **SOURCE2** is not used.

Vertical control of MATH waveforms

Vertical sensitivity and position can be controlled at **VOLTS/DIV** item and **V.POSITION** item of **MATH/REF** menu. The controlled waveform is indicated by setting at the **WAVEFORM** item. Set VOLT/DIV value is displayed at the vertical axis setting displaying position, and each value of MATH1 to MATH4 is displayed in each CH1 to CH4 vertical setting displaying frame respectively.

(1) Mathematics method

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

(2) Color display of calculated waveform

The waveform obtained by operation and its ground level are classified by colors.

MATH1: Cyan, MATH2: Yellow, MATH3: Green, MATH4: Magenta

(3) 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

7.12 Calibration function (CALIBRATION)

Description

The changes in measurement accuracy due to use environments (temperature, humidity etc.) can be optimally corrected by activating the calibration.

It is recommended to perform calibration when any of the following cases applies.

Before a customer starts to use this instrument first.
When an ambient temperature changes more than 10, compared with that at the time of the previous calibration.
Every six months or 1000 operating hours
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) VERT OFFSET CALIBRATION

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

(3) TRIG CALIBRATION (for VC-5850 only)

The time-related changes of the trigger inside the instrument can be calibrated manually.
This calibration must be performed for each channel.

(4) SKEW CALIBRATION (for VC-5850 only)

The time-related changes of the trigger inside the instrument and for the cable length of a probe can be calibrated manually.

This calibration must be performed between CH1 and another channel.

Operation

(1) Selection of calibration function

Display **UTILITY** menu by pressing **UTILITY** key in MENU section , then select **CALIBRATION** on **UTILITY** item. Select one calibration item at **CALIBRATE** menu.

NOTE) Before start to execute FULL calibration or VERT OFFSET calibration, disconnect all inputs from input terminals.

(2) Execution of FULL CALIBRATION

When the soft key below the **CAL EXEC** item of menu is pressed 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 cyan, and calibration ends unsatisfactorily, graphics “X” is displayed at the corresponding indicator’s position.

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 VERT OFFSET CALIBRATION

When the soft key below the **CAL EXEC** item of menu is pressed after **VERT OFFSET** has been selected, VERT OFFSET CALIBRATION is executed. When VERT OFFSET CALIBRATION is completed, the graphics "**Pass**" is displayed and data are backed up.
As "**Push any key**" is displayed, press any key.

NOTE)

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

NOTE)

In case of equivalent sampling mode works, in order to maintain optimum time axis accuracy, the status is checked at constant period after power on, and necessary calibration is conducted automatically.
During this calibration, the message: **Calibrating for Equivalent Sampling**, is displayed and operation is temporarily inhibited for a few seconds when the function is started.

(4) Execution of TRIG CALIBRATION

The deviation of waveform trigger point with respect to the DELAY=0.000s point (center of graticule) on the screen is adjusted.
After **CALIBRATION** is selected at **UTILITY** item and **TRIG** is selected at **CALIBRATE** item, pressing soft key corresponding to **CAL EXEC** item starts TRIG CALIBRATION.
At this time, this instrument is automatically set for calibration.

Selection of a channel to be calibrated

After the start of TRIG CALIBRATION, the channel to be calibrated can be selected at CHANNEL item.

Change of Trig skew

After the desired channel is selected, the trig skew of the channel can be changed by the VALIABLE knob. Thus, adjust so that the rising edge of the channel comes to the center (T mark) of the screen.

(5) Execution of SKEW CALIBRAION

Prior to execution of this calibration, be sure to perform the trig skew correction described under (4).
In a high speed sweep range, the time difference between channels can cause due to the length of the cable or probe from the circuit under measurement. With the SKEW CALIBRATION function, the time difference between the reference channel CH1 and other channels can be corrected to ensure accurate measurement.
After **CALIBRATION** is selected at **UTILITY** item and **SKEW** is selected at **CALIBRATE** item, pressing soft key corresponding to **CAL EXEC** item starts SKEW CALIBRATION.
At this time, this instrument is automatically set for calibration.

Selection of a channel to be calibrated

After the start of SKEW CALIBRATION, the channel to be calibrated can be selected at CHANNEL item.

Change of channel skew

After the desired channel is selected, the channel skew of the channel can be changed by the VALIABLE knob. Thus, adjust so that the rising edges of the two calibrated channels coincide.

(6) Connection in TRIG CALIBRATION and SKEW CALIBRATION mode

Example of connection to execute CH1 or CH2 TRIG CALIBRATION

To correct the trig skew of CH1, connect the units as following figure.

Connect a square wave having excellent rise characteristics to CH1 and set as follows.

VOLTS/DIV: Amplitude of 4 to 6 DIV on screen
V.POSITION: Half amplitude at horizontal center scale line
TRIGGER level: At horizontal center scale line

Example of connection to execute EXT TRIG CALIBRATION

To correct the trig skew of EXT, connect the units as following figure.

Connect a square wave having excellent rise characteristics to CH1 and EXT simultaneously via the distributor and set as follows.

VOLTS/DIV: Amplitude of 4 to 6 DIV on screen
V.POSITION: Half amplitude at horizontal center scale line
TRIGGER level: At horizontal center scale line

Example of connection in SKEW CALIBRATION

To correct the channel skew between CH1 and CH2, connect the units as follows.

Connect a square wave having excellent rise characteristics to CH1 and CH2 simultaneously via the distributor and set as follows.

VOLTS/DIV: Amplitude of 4 to 6 DIV on screen (Same setting for CH1 and CH2)
OFFSET: Half amplitude at horizontal center scale line (Same setting for CH1 and CH2)
TRIGGER level: At horizontal center scale line

7.13 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 on the screen.

Kinds of cursors

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

Voltage measurement cursors (V CURSOR)

Voltage measurement is performed by two horizontal cursors.

Time measurement cursors (T CURSOR)

Time measurement is performed by two vertical cursors.

Cross cursor (+ CURSORS)

Voltages between two points where the two vertical cursors intersect a waveform are measured simultaneously.

Operation

Take the following procedure for measurement.

(1) Selection of cursor function

Select desired cursor function from among **V CURSOR**, **T CURSOR**, **+ CURSOR** at **MEASURE** item of **MEASURE** menu.

(2) Specify the measuring subject channel

Select desired subject channel from among **CH1** to **CH4**, **MATH1** to **MATH4**, **AUTO** at **SOURCE** item of the menu. When AUTO is selected, the youngest number of channel among of displayed waveforms is measured by cursors.

(3) Move the two cursors to the desired position.

Pressing **SELECT** key displays arrow at the one end of one cursor, and indicate the cursor can be moved. Press until the arrow is displayed at the end of desired cursor to move. Then turn the **VARIABLE** knob. When arrows are displayed at both cursors, both cursors are moved keeping the distance between those cursors.

(4) Read the cursor read out values displayed on the screen.

Pressing **CLEAR MENU** key extinguishes menu displayed, then cursor read-outs is displayed at the bottom of screen. The cursor read outs displayed is classified by same colors as waveforms.

Cursor read-outs

REF	: Voltage level or time at REF cursor
DEL	: Voltage level or time at cursor
V	: Voltage of cursor - Voltage of REF cursor
T	: Time of cursor - Time of REF cursor

7.14 Pulse parameter measurement function (PARAMETERS)

Functional description

The pulse parameters of the waveform displayed on the screen are automatically measured.

This 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.

Measured items

Table 7-2 lists the measurable pulse parameters.

The definition of each parameter conforms to IEEE std.194-1977 IEEE Standard Pulse Terms and Definitions. (See Fig. 7-2.)

Note: Pulse parameter measurement is performed for the pulse of the first cycle within the calculation range. As this measurement is performed with the reference to the edge crossing the 10% and 90% points of the amplitude of the pulse, an effective value is not obtained if a waveform of more than one cycle is not available for a sine wave or the like.

When a whole pulse is not displayed on the screen or when an effective value is not calculated for the measured parameter, the messageNOT FOUND" is displayed.
In the equivalent sampling mode, measurement cannot be performed until the data are converged and all data are displayed. In this case, the message NOT AVAILABLE" is displayed.

Table 7-2 Measurable pulse parameter

No.	Parameter	Definition
	FREQUENCY	The reciprocal of the time of the first period of a waveform.
	PERIOD	The time of the first period of a waveform.
	RISETIME	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.
	FALLTIME	The time interval between 10% point and 90% point of the amplitude(difference between TOP value and BASE value) at the first falling edge of a waveform.
	PWIDTH	The time interval between two points where the first positive pulse of a waveform crosses the 50% level of the amplitude (difference between TOP value and BASE value).
	NWIDTH	The time interval between two points where the first negative pulse of a waveform crosses the 50% level of the amplitude (difference between TOP value and BASE value).
	DUTYCYCLE	The ratio of a positive pulse width to a period at the first period.
	MIN	The minimum value of a waveform.
	MAX	The maximum value of a waveform.
	PEAK to PEAK	The difference between the maximum value and minimum value (MAX - MIN).
	BASE	The value of the highest frequency point above 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.
	TOP	The value of the highest frequency point above 5 % frequency among the points which are above 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.
	AMPLITUDE	The difference between TOP and BASE of a waveform.
	PRESHOOT	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 : BaseMinimum When the first edge is falling : MaximumTop
	OVERSHOOT	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 : MaximumTop When the first edge is falling : BaseMinimum
	RMS	The RMS voltage of the first period of a waveform.
	AVERAGE	The average voltage of the first period of a waveform.

FIG 7- 2

Operation

(1) Selection of pulse parameter measurement function

Select **PARAMETER** at the **MEASURE** item of **MEASURE** menu.

(2) Specification of the measurement channel and selection of parameter measurement items

Measurement channel can be selected from among **CH1** to **CH4**, **MATH1** to **MATH4** and **AUTO**. When **AUTO** is selected, the youngest number of channel among of displayed waveforms is measured.

Parameter measurement items are selected at **PARAMETER1** to **PARAMETER4** items.

When the selection of parameter measurement is executed at **PARAMETER** item, channel being selected in **SOURCE** item is recognized to be subject channel of the parameter measurement.

(3) 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** key and the **VARIABLE** knob. Pressing the **SELECT** key makes arrow be displayed at the top of the vertical cursor, and this cursor can be moved by **VARIABLE** control.

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.

7.15 GO-NOGO judgment function

Functional 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 hardcopy, or the waveform data are saved to the memory device. The processes are performed automatically.

This function is used to monitor abnormal phenomena which will occur not so frequently, or to detect undesired samples which will output signals different from the reference signal. Thus, only the signals which satisfy some conditions can be recorded.

The functions as listed below are available to select and set the conditions for judgment, process performed after judgment, etc. so that the GO-NOGO judgment function can be used for various applications.

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

When a waveform is within the judgment domain, or

When a waveform is out of the judgment domain.

(3) Selection function of process performed after judgment

If the result is GOOD, an L level signal is delivered from the BNC connector (GO/NOGO) on the rear. If NO GOOD, an H level signal is delivered. This signal is delivered at any time when the GO-NOGO judgment function is activated.

In addition to this signal output, the processes listed below can be performed simultaneously.

BUZZER, HOLD, WAVEFORM SAVE, Print output

Operation

There are two ways to set the judgment domain and judgment conditions then to start GO-NOGO judgment function.

1) A way to operate by using each menu

It is a way to set the judgment domain and judgment conditions and to execute the GONOGO judgment by using each menu for GO-NOGO function. This way is convenient when judgment domain and judgment conditions were set already, and several changes of them are needed prior to GO-NOGO judgment execution.

2) A way to operate by using wizard function

Starting the wizard displays several description and questions needed to set the judgment domain and judgment conditions and to execute the GONOGO judgment in succession. Operating in accordance with the description enables to execute GO-NOGO judgment under the desired conditions. This way is convenient to use GO-NOGO judgment or to build make the judgment domain and judgment conditions

for the first time.

In this section only the explanation about “1) a way to operate by using each menu” is written.
When using the wizard , operate in nearly same procedure according to the description displayed on screen.
(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 page 2/2 of GO-NOGO menu.

< Explanation of each menu of judgment domain edit menu >

EDITING: When START is selected, edit mode of the boundary and range is established. When END is selected, the edit mode ends.
BASE ON: The reference channel signal used to edit boundary can be selected.
BOUNDARY: The judgment boundary in the can be created and edited by moving the reference signal in the vertical and horizontal direction.
RANGE : The horizontal judgment range can be selected here.

< 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.
To edit judgment domain operate in accordance with the following procedure.

Selection of the reference channel signal

Select reference signal channel at **BASE ON** item of **GO-NOGO** menu.
The waveform which remains on the screen when EDITING is started is used as a source of edit.
When editing is started in the RUN mode, a source waveform must be selected while the waveform on the screen change in sequence. To use the desired waveform as a source, determine the waveform in the HOLD mode, first, and then, perform edit.

Starting Edit

START is selected at the **EDITING** item, the EDIT mode starts, and the waveform of the channel selected at the **BASE ON** item is displayed on the screen.
The reference channel signal used to edit boundary can be selected.
To edit the boundary (judgment boundary in the vertical direction) or to set the range (judgment boundary in the horizontal direction) can be selected.

NOTE: The reference channel can not be changed after editing has started. To change the channel, make editing stop once and restart it after changed the reference channel

Setting the boundary

Create a boundary by selecting the **BOUNDARY** item and moving the original waveform vertically and horizontally. To move the waveform, specify the moving directions from the selection list of **BOUNDARY** item, and turn the VARIABLE knob. The movement amount of the area for the referenced waveform is displayed on the screen.

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. Select RANGE item and select the bar which is needed to move by selecting from selection list of RANGE item then rotate VARIABLE knob to set the two bars.

Finish of edit

After completion of the boundary and range creation, selecting END at the EDITING item to finish editing and to register the boundary and range.

(2) Selection of NO-GOOD judgment conditions

Select the conditions to perform the NO GOOD judgment for the set domain by using the judgment condition selection menu items. These items are on the page 1/2 of GO-NOGO menu.

< Explanation of each menu of Judgment condition selection menu >

REACT WHEN : Condition under which NO GOOD decision is made.

OF : Subject signal to be judged.

Selection of judgment condition

Select the condition to issue NO GOOD from the following four options at **REACT WHEN** item.

When a part of waveform is within the judgment domain, or
When whole of waveform is within the judgment domain, or
When a part of waveform is out of the judgment domain, or
When whole of waveform is out of the judgment domain.

Selection of subject signal

Select the signal which is judged by GO-NOGO at **OF** item.

The signal can be selected from among **CH1 to CH4** and **MATH1 to MATH4**, but the signal must be displayed on screen. When selected **ALL**, all signals displayed on screen are under the judgment

(3) Selection of processes required after judgment

While the GO-NOGO judgment function is being executed, the TTL signal is delivered at all times according to the result of judgment.

Further the functions performed together with the GO-NOGO judgment function are available.

The selection of processes performed according to the result of judgment is performed at **REACTION** item of **GO-NOGO** menu.

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

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

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.

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.

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

(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 GO-NOGO item.

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.

7.16 Save and recall of setup data (Internal memory)

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.

Setup data can be saved to not only the built-in memory, also optional memory devices (Floppy disk or memory card, card disk inserted to PC card slot). Refer to Section 10.3 about description of save and recall function to/from optional memory devices.

Operation

(1) How to save setup data

Before starting execution of SAVE function Select **MEMORY** at **DEVICE** item and select **SETUP** at **OBJECT** item of **SAVE** menu

Decide desired setting to save, and set the setup to the Oscilloscope.

10 sets of save memory for setup are numbered from 1 to 10.

Set the save memory number where setup be saved at **NUMBER** item of the menu.

Pressing the soft key below the EXEC item saves the setup data to selected numbered save memory.

Later, each execution of setup save counts up a save memory number to save the setup data in succession.

NOTE Even when there are setup previously saved to the selected save memory, the selected setup is overwritten.

(2) How to recall setup data

Use the RECALL Menu to recall the setup data from the setup save memories.

As same as save function, select **MEMORY** at **DEVICE** item and select **SETUP** at **OBJECT** item of **RECALL** menu.

Set the setup memory number from where setup must be recalled at **NUMBER** item of the menu.

Pressing the soft key below the EXEC item recalls the setup data from the selected numbered memory.

The recalled setup data is set to the instrument and measurements can be performed under the same conditions as the saved data. In this case, each execution of setup recall counts down a save memory number to recall the setup data in succession.

7.17 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

Select **OTHERS** at **UTILITY** item of **UTILITY** menu, then set **ON** at **DEFAULT** item in 2/2 page of **UTILITY** menu, the setting before shipment are restored.
For the setup contents before shipment, see Appendix Table A-1.

7.18 Waveform save and recall function (Internal memory)

Description

The waveform data displayed on the screen can be saved to the built-in backup, memory. The saved data can be recalled and displayed on the screen.
Waveform data can be saved to not only the built-in memory, also optional memory devices (Floppy disk or memory card, card disk inserted to PC card slot). Refer to Section 10.3 about description of save and recall function to/from optional memory devices.

(1) Waveform data save function

Memory : Built-in backup memory
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. 4 waveforms can be saved.

Operation

At first, the desired waveform to save needs to be displayed on screen in normal observation status. Select **MEMORY** at **DEVICE** item of **SAVE** menu.
Select the channel number from among ALL and CH1 to CH4 at **OBJECT** item of **SAVE** menu.
In case selecting ALL : All waveform data displayed on screen are saved.
In case selecting from CH1 to CH4: Only selected waveform is saved.
There are 4 save memories for waveform numbered as 1 to 4.
Set the save memory number where selected waveform be saved at **NUMBER** item of the menu.
When one waveform is save : The waveform is saved to selected numbered memory.
When all waveforms are saved : Each waveform displayed on screen is saved to each memory numbered from selected number upwards in succession.
Pressing the soft key below the **EXEC** item saves the waveform data to save memory.
Later, each execution of waveform save counts up a save memory number to save the waveform data in succession.

NOTE Even when there are waveform previously saved to the selected save memory, the selected Waveform is overwritten.

(2) Waveform data recall function

Select **MEMORY** at **DEVICE** item of **RECALL** menu.
Select **WAVEFORM** at **OBJECT** item of **RECALL** menu.
Set the waveform save memory number from where waveform must be recalled at **NUMBER** item of the menu. And set the reference memory number where the recalled waveform is temporarily restored at **RESTORE** item.
Pressing the soft key below the **EXEC** item recalls the waveform data from the selected numbered memory. The recalled waveform data is stored to the selected reference memory and displayed on screen.
Each execution of waveform recall counts down a save memory number to recall the waveform data in succession.

<How to clear recalled waveform>

Case of all recalled waveforms clear

Select **RECALL** or **ALL** at **WAVE CLEAR** item on **DISPLAY** menu.
When this selection is in operation, pressing **CLEAR WAVEFORM** key extinguishes all recalled waveform.

Case of specified recalled waveform clear

After displaying **MATH/REF** menu, select the reference memory from among **REF1** to **REF4** at **WAVEFORM** item which includes the recalled waveform to be cleared. Changing **ON** to **OFF** at **DISPLAY** item clears the specified waveform.

<Magnification or reduction of recalled waveform>

Select **VOLTS/DIV** item on **MATH/REF** menu while selecting the subject reference memory number at **WAVEFORM** item, and rotate the **VARIABLE** control. Then, the specified recalled waveform can be magnified or reduced vertically up to two steps of neighbor range.

<Vertical move of recalled waveform>

Select **V.POSITION** item on **MATH/REF** menu while selecting the subject reference memory number at **WAVEFORM** item, and rotate the **VARIABLE** control. Then, the specified recalled waveform can be moved 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.
(Note) A recalled waveform can be magnified or moved horizontally only in the ALT or B sweep mode. For operating procedure, see 7.5 (5) Horizontal magnification and movement.

7.19 HARDCOPY function

General

The instrument has following three kind of hardcopy functions.
(1) Plot output function
(2) Print output function
(3) Filing function to recording device

Using the filing function (3) , the image or every information on screen are filed into Floppy Disk or PC card slot , but any following optional accessory is needed to use this function.
Floppy Disk Drive (FDD type DV-505),
SRAM card 512kB (type ML-512TB4N) , 1MB type ML-1M-TB4N),
2MB type ML-2M-TB4N) , 4MB type ML-4M-TB4N)

Card disk (type HT-4085-26(B))
This filing function is described in section 10.3.1, so refer to the section.

In this chapter, plot function and printer function are described.

7.19 1 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. RS-232C, Centronix(8 Bit Parallel) and GPIB are used for plotter interface.

(1) Connection with usable plotter

The following Hitachi graph plotters or equivalent are usable.

Connect the RS-232C, Centronix or GPIB connector on the rear and an X-Y plotter with the cable dedicated for the interface to use.

		Usable Interface marked by		
		RS-232C	Centronix	GPIB
Usable HITACHI plotter	HG-730			(option)
	682-XA			
	681-XA			
Exclusive cable (option)		No. 4314	No. 4316	No. 4274

(2) Setting for plot output

Selection of plot function

For selecting plot output function from hardcopy functions make selection as follows.

() Select **HARDCOPY** at **UTILITY** item on **UTILITY** menu.

() Select **HPGL** at **UTILITY** item on **UTILITY** menu.

Setting of paper size, plot size

The instrument is provided with the mode to plot data on A4, A3 or US letter size paper.

Table 7-5 shows the relationship between the sizes of usable paper and the plottable size per plotting operation.

Any of the plotting formats shown in Table 7-5 can be done by performing the following settings.

(a) Set the paper size at **PAPER** item on **UTILITY** menu while selecting **HARDCOPY** at **UTILITY** item and **HPGL** at **FORMAT** item.

(b) Set the plot size at PLOT SIZE item on **UTILITY** menu while selecting **HARDCOPY** at **UTILITY** item and **HPGL** at **FORMAT** item.

Table 7-5 Plot sizes, paper sizes and plot positions

Paper size / Plot size	A3	A4	US letter
1/1			
1/2			

1/4			

Setting of plot position

Select AUTO or one figure form 1 through 4 at **POSITION** item on **UTILITY** menu while selecting **HARDCOPY** at **UTILITY** item and **HPGL** at **FORMAT** item.

In case of AUTO : Plotting is performed on the plot positions from 1 to 4 in sequence as shown in Table 7-5.

In case of 1 through 4 : Plotting is performed on the specified plot position.

Setting of pen change mode

Set whether or not to change a pen (i.e., change of color) according to the kinds of data at **PEN CHANGE** item on **UTILITY** menu while selecting **HARDCOPY** at **UTILITY** item and **HPGL** at **FORMAT** item.

PEN CHANGE: **ON** Pens are changed according to the kinds of data.

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

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

Note : When the number of pens of the plotter in use is 7 or less, the corresponding pen numbers are different from plotter to plotter.

Select the data to be plotted

Select the data to be plotted at **PLOT** item on **UTILITY** menu while selecting **HARDCOPY** at **UTILITY** item and **HPGL** at **FORMAT**

PLOT : **ALL** Plots all information.

PLOT : **WAVEFORM** Plots waveform data only.
PLOT: **FACTORS** Plots set values and measured data.

(3) Setting of interface

Selection of interface

Select the interface to connect a plotter by menu.
Displaying **UTILITY** menu and selecting **HARDCOPY** at **UTILITY**, **HPGL** at **FORMAT** item enables to select interface at **INTERFACE** item.

Selection of interface specifications

Set the hardware-related settings of interface.
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.

Interface specification can be set when displaying the **UTILITY** menu and selecting **INTERFACE** at **UTILITY** menu. When using **RS-232C** interface , select **RS-232C** at **INTERFACE** item. When using **GPIB** interface, select **GPIB** at **INTERFACE** item. After the selecting, select each specification at each item according to Table 7-6.
If you use Centronix interface, no setting needed for interface specification.

Table 7-6 Setting of interface specification

Using interface	Setting menu item	Setting
RS-232C	BIT RATE	Set same setting as the connecting plotter.
	STOP BIT	
	PARITY BIT	
	HAND SHAKE	XON/XOFF, Set same to plotter too.
GPIB	MODE	Talk only
	ADDRESS	Setting is not needed because it is not used.
	EOI	Set same setting as the connecting plotter.

(4) Execution of plotting

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

7.19.2 Print output function

Description

The information related to the waveform displayed on the screen can be output only by connecting an printer to the instrument. RS-232C, Centronix(8 Bit Parallel) and GPIB are used for printer interface.

(1) Selection of print function

For selecting print output function from hardcopy functions do selection as follows.

() Select **HARDCOPY** at **UTILITY** item on **UTILITY** menu.

() Selecting each item listed in table 7-7 at **UTILITY** item on **UTILITY** menu enable to print out to the corresponding printer.

Table 7-7 Selection of FORMAT item to print output

FORMAT item	Usable printer
ESC/P	Monochrome printer having ESC/P commands.
PC-PR-201	NEC's PC-201 or compatible.
LASER JET	Hewlett Packard's LASER JET6L or compatible
ESC/P COLOR	Epson's MJ-700V2C or compatible having ESC/P color commands.
DESKJET COLOR	Hewlett Packard's DESKJET850C color printer or compatible.

(2) Connection with usable printer

Connect the RS-232C, Centronix or GPIB connector on the rear and an printer with the cable dedicated for the interface to use.

	Interface		
	RS232C	Centronix	GPIB
Exclusive cable (option)	No. 4314	No.4316	No.4274

(3) Setting for print mode

Selection of data to be printed

Select the data to be printed at **PRINT** item on **UTILITY** menu displayed during selection indicated at section (1)

PRINT : **ALL** Prints all information.
PRINT : **WAVEFORM** Prints waveform data only.
PRINT : **FACTORS** Prints set values and measured data.

Formfeed

Select whether send formfeed command after every print of screen is finished or not to printer. If printer receives this command, feeds out the printed paper.
Select **ON** or **OFF** at **FORMFEED** item on **UTILITY** menu displayed during selection indicated at section (1)

FORMFEED = ON Printed paper is fed out after print of one screen is finished.
FORMFEED = OFF Paper is not fed out until whole of one page is printed.

(4) Setting of interface

Selection of interface

Select the interface to connect a printer by menu.
Select interface at **INTERFACE** item on **UTILITY** menu displayed during selection indicated at section (1)

Selection of interface specifications

Set the hardware-related settings of interface.
Also, set the printer to be used to comply with the specifications and setting of the instrument. Refer to the operation manual of the printer.

Interface specification can be set when displaying the **UTILITY** menu and selecting **INTERFACE** at **UTILITY** menu. When using RS-232C interface , select **RS-232C** at **INTERFACE** item. When using GPIB interface, select **GPIB** at **INTERFACE** item. After the selecting, select each specification at each item according to Table 7-8.
If you use Centronix interface, no setting needed for interface specification.

Table 7-8 Setting of interface specification

Using interface	Setting menu item	Setting
RS-232C	BIT RATE	Set same setting as the connecting printer.
	STOP BIT	
	PARITY BIT	
	HAND SHAKE	XON/XOFF, Set same to printer too.
GPIB	MODE	Talk only
	ADDRESS	Setting is not needed because it is not used.
	EOI	Set same setting as the connecting printer.

(5) Execution of printing

Check that the connections and setting described above are performed appropriately.
Check that recording paper are loaded appropriately. Press the **HARDCOPY** key on the front panel, then printing starts.

(Note1) When the **HARDCOPY** key is pressed again during printing, printing is interrupted. The time needed to stop printing after the **HARDCOPY** key has been pressed is changed from printer to printer.

7.20 Clock function

The instrument has the built-in clock function. This clock can be set and displayed in the following operations.

(1) Setting of clock

Display **UTILITY** menu then select **OTHERS** at **UTILITY** item.
Select **SET CLOCK** item and set date and time in each selection list.

(2) Display of internal clock

Display **UTILITY** menu then select **OTHERS** at **UTILITY** item.
Select **ON** or **OFF** at **DISP CLOCK** item.

If **ON** is selected, the date and time are displayed at lower right on screen only when menu is cleared.

9.1 Function outline

9.1.1 General

The basic operations between the controller and oscilloscope via the GPIB or RS-232C interface are as follows.

1. Equipment setting and measurement start
2. Compiling setting data and measurement results
3. Waveform data transfer to controller
4. Measurement data transfer to equipment

Other complex functions are derived by combining these basic functions.

Note: Equipment limitation
During hold, expansion, scroll and V position shift cannot be operated from the controller.

9.1.2 Equipment setting

The interface to be used needs to be set in order to utilize the programming functions. Refer to the interface hardware specifications of Chapter 8.

9.2 Programming

9.2.1 GPIB interface functions

The oscilloscope GPIB functions are SH1, AH1, T5, L4, SR1, RL0, DC1, DT0 and C0, defined by IEEE488.1.

9.2.2 Programming syntax

A programming example is indicated in Fig 9.1. The output command, device address, mnemonic header, mnemonic, separator and program data are written in sequence. These can be sent as an ASCII format word string via GPIB to the equipment. (Only long form commands are effective.)

Fig 9. 1 Program format

9.3.6 Display sub-system command programming grammar

The display functions are controlled by these commands. The following Display sub-system commands can be used with this model.

header	command / query	program data
:DISPLAY:GRID	c/q	“GRID”, “FRAME”, “AXES”
:DISPLAY:PERSISTENCE	c/q	“OFF”, “100ms”.....”10s”, “INFINITE”
:DISPLAY:DOTJOIN	c/q	“OFF”, “ON”
:DISPLAY:INTERPOLATE	c/q	“LINEAR”, “SINE”, “OFF”
:DISPLAY:HORIZONTAL	c/q	“A”, “ALT”, “B”
:DISPLAY:ZOOM	c/q	“SINGLE”, “DUAL”
:DISPLAY:ZOOMSELECT	c/q	“1”, “2”
:DISPLAY:SCROLL<N>	c/q	Seconds... exponential(NR3)
:DISPLAY:SEGMENT<N>	c/q	1- 1024
:DISPLAY:WINDOW	c/q	“OFF”, “2”, “4”, “HMODE”
	Note)	“4” is not used for VC-5850
:DISPLAY:CLEAR	c/q	“CURRENT”, “RECALL”, “ALL”

The Display sub-system command syntax is indicated below.

(1) GRID Command/query

The scale is set for grid, axes or frame.

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

Programming example
```
PRINT @1;":DISPLAY:GRID AXES"
```

The scale is set for axes.

Query grammar
:DISPLAY:GRID?

Return format
{GRID|FRAME|AXES}

Programming example
```
PRINT @1;":DISPLAY:GRID?"
INPUT @1;GRID$
```

The present scale setting is returned.

(2) PERSISTENCE Command/query

The persistence setting is changed.

Command grammar
:DISPLAY:PERSISTENCE{OFF|100ms-10s|INFINITE}

Programming example
PRINT @1;":DISPLAY:PERSISTENCE INFINITE"

The persistence is set for infinite.

Query grammar
:DISPLAY:PERSISTENCE?

Return format
{OFF|100ms-10s|INFINITE}

Programming example
PRINT @1;":DISPLAY:PERSISTENCE?"
INPUT @1;PERSISTENCE$

The present persistence setting is returned.

(3) DOTJOIN Command/query

Dot join on/off setting.

Command grammar
:DISPLAY:DOTJOIN{ON|OFF}

Programming example
```
PRINT @1;":DISPLAY:DOTJOIN ON"
```

Dot join is set to on.

Query grammar
:DISPLAY:DOTJOIN?

Return format
{ON|OFF}

Programming example
```
PRINT @1;":DISPLAY:DOTJOIN?"
INPUT @1;DOTJOIN$
```

The present dot join status is returned.

(4) INTERPOLATE Command/query

The interpolation setting is changed.

Command grammar
DISPLAY:INTERPOLATE {LINEAR|SINE|OFF}

Programming example
```
PRINT @1;":DISPLAY:INTERPOLATE SINE"
```

Interpolation is set to sine.

Query grammar
DISPLAY:INTERPOLATE?

Return format
{LINEAR|SINE|OFF}

Programming example
```
PRINT @1;":DISPLAY:INTERPOLATE?"
INPUT @1;INTERPOL$
```

The present setting is returned.

(5) HORIZONTAL Command/query

Selects the horizontal axis display for A, alternate or B.

Command grammar
:DISPLAY:HORIZONTAL: {A|ALT|B}

Query grammar
:DISPLAY:HORIZONTAL?

Return format
{A|ALT|B}

(6) ZOOM Command/query

Selects waveform expansion display for single or dual.

Command grammar
:DISPLAY:ZOOM{SINGLE|DUAL}

Query grammar
:DISPLAY:ZOOM

Return format
{SINGLE|DUAL}

(7) ZOOMSELECT Command/query

Selects waveform expansion.

Command grammar
:DISPLAY:ZOOMSELECT{1|2}

Programming example
PRINT @1;":DISPLAY:ZOOMSELECT 1"

ZOOM SEL FIRST is selected.

Query grammar
:DISPLAY:ZOOMSELECT?

Return format
{1|2}

Programming example
PRINT @1;":DISPLAY:ZOOMSELECT?"
INPUT @1;ZOOMSELECT$
The presently selected ZOOM SEL is returned.

(8) SCROLL<N>_____Command/query
Sets the position where waveform expansion is displayed.

Command grammar
:DISPLAY:SCROLL{1|2} <scroll>

<scroll>::=delay time(sec)(NR3)

Query grammar
:DISPLAY: SCROLL{1|2}?

Return format
<scroll>

(9) SEGMENT<N>_____Command/query
Sets the segment number of displayed waveform in SPLIT mode.

Command grammar
:DISPLAY:SEGMENT{1|2}

::=1 to 1024

Query grammar
:DISPLAY: SEGMENT{1|2}?

Return format

(10) WINDOW_____Command/query
Number of window setting.

Command grammar
for VC-5810
DISPLAY:WINDOW{OFF|2|4|HMODE}
for VC-5850
DISPLAY:WINDOW{OFF|2|HMODE}

Programming example
PRINT @1;":DISPLAY:WINDOW OFF"

Split screen is off.

Query grammar
:DISPLAY:WINDOW?
Return format
for VC-5810
{OFF|2|4|HMODE}
for VC-5850
{OFF|2|HMODE}
Programming example
PRINT @1;":DISPLAY:WINDOW?"
INPUT @1;WINDOW$

The present screen setting is returned.

(11) CLEAR_____Command/query
Designates waveform to be cleared.

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

Programming example
PRINT @1;":DISPLAY:CLEAR ALL"

All waveforms are designated.

Query grammar
:DISPLAY:CLEAR?
Return format
{CURRENT|RECALL|ALL}
Programming example
PRINT @1;":DISPLAY:CLEAR?"
INPUT @1;CLEAR$

Presently designated waveforms are returned

9.3.7 Measure sub-system command programming grammar

The Measure sub-system commands control the measuring functions. When a Measure command is executed, the equipment performs that measurement every time.

The following commands can be used with this equipment.

header	command / query	program data
:MEASURE:ALL	q	-
:MEASURE:DUTYCYCLE	q	-
:MEASURE:FALLTYME	q	-
:MEASURE:FREQUENCY	q	-
:MEASURE:MODE	c/q	“OFF”, “VCURSOR”, “TCURSOR” “CROSSCURSOR”, “PULSE_PARAMETER”
:MEASURE:NWIDTH	q	-
:MEASURE:OVERSHOOT	q	-
:MEASURE:PERIOD	q	-
:MEASURE:PRESHOOT	q	-
:MEASURE:PWIDTH	q	-
:MEASURE:RISETIME	q	-
:MEASURE:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “MATH1”, “MATH2”, “MATH3”, “MATH4”
:MEASURE:TSTART	c/q	-250 to 250
:MEASURE:TSTOP	c/q	-250 to 250
:MEASURE:TDELTA	q	Volts...expornential(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	-200 to 200
:MEASURE:VSTOP	c/q	-200 to 200
:MEASURE:VDELTA	q	Volts...expornential(NR3)
:MEASURE:VTOP	q	-
:MEASURE:PSTART	c/q	-250 to 250
:MEASURE:PSTOP	c/q	-250 to 250

Note: Channels 3 and 4 are absent in 2 channel models.

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

(1) ALL Query

The ALL command returns all the pulse parameter measured values.

Query grammar
:MEASURE:ALL?
Return format
<DUTY CYCLE result>, <FALLTIME 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>

In the above, <result>::=result of individual measurement (NR3)

Programming example
```
PRINT  @1;":MEASURE:ALL?"
LINE INPUT  @1;ALL$
```
The present measuring results are returned.

(2) DUTYCYCLE Query

The duty cycle measurement is returned.

Query grammar
:MEASURE:DUTYCYCLE?
Return format
<value>
In the above, <value>::=measured duty cycle (%) (NR3)

Programming example
```
PRINT  @1;":MEASURE:DUTYCYCLE?"
INPUT  @1;VALUE$
```

(3) FALLTIME Query

The falltime measurement is returned.

Query grammar
:MEASURE:FALLTIME?
Return format
<value>
In the above, <value>::=measured falltime (s) (NR3)

Programming example
```
PRINT  @1;":MEASURE:FALLTIME?"
INPUT  @1;VALUE$
```

(4) FREQUENCY Query

The frequency measurement is returned.

Query grammar
:MEASURE:FREQUENCY?
Return format
<value>
In this, <value>::=measured frequency (Hz) (NR3)

Programming example
```
PRINT @1;":MEASURE:FREQUENCY?"
INPUT @1;VALUE$
```

(5) MODE Command/query

Selects the measuring mode (off, V cursor, T cursor, + cursor, pulse parameter).

Command grammar
:MEASURE:MODE {OFF/VCURSOR/TCURSOR/CROSSCURSOR/PULSE_PARAMETER}

Programming example
```
PRINT @1;":MEASURE:MODE TCURSOR"
```

The above sets the measuring mode to T cursor.

Query grammar
:MEASURE:MODE?
Return format
OFF/VCURSOR/TCURSOR/CROSSCURSOR/PULSE_PARAMETER}

Programming example
```
PRINT @1;"MEASURE:MODE?"
INPUT @1;MODE$
```

The present measuring mode is returned.

(6) NWIDTH Query

The negative pulse width is returned.

Query grammar
:MEASURE:NWIDTH?
Return format
<value>
In the above, <value>::=measured negative pulse width (s) (NR3)

Programming example
PRINT @1;":MEASURE:NWIDTH?"
INPUT @1;VALUE$

(7) OVERSHOOT Query

Measured overshoot is returned.

Query grammar
:MEASURE:OVERSHOOT?
Return format
<value>

In the above, <value>::=measured overshoot (volts) (NR3)

Programming example
PRINT @1;":MEASURE:OVERSHOOT?"
INPUT @1;VALUE$

(8) PERIOD Query

Period measurement is returned.

Query grammar
MEASURE:PERIOD?
Return format
<value>

In the above, <value>::=measured period (s) (NR3)

Programming example
PRINT @1;":MEASURE:PERIOD?"
INPUT @1;VALUE$

(9) PRESHOOT Query

The preshoot measurement is returned.

Query grammar
:MEASURE:PRESHOOT?
Return format
<value>

In the above, <value>::=measured preshoot (volts) (NR3)

Programming example
PRINT @1;":MEASURE:PRESHOOT?"
INPUT @1;VALUE$

(10) PWIDTH Query

The positive pulse width measurement is returned.

Query grammar
:MEASURE:PWIDTH?
Return format
<value>

In the above, <value>::=measured positive pulse width (s) (NR3)

Programming example
PRINT @1;":MEASURE:PWIDTH?"
INPUT @1;VALUE$

(11) RISETIME Query

The measured risetime is returned.

Query grammar
:MEASURE:RISETIME?
Return format
<value>

In the above, <value>::=measured risetime (s) (NR3)

Programming example
PRINT @1;":MEASURE:RISETIME?"
INPUT @1;VALUE$

(12) SOURCE Command/query

Selects channel to be measured (2 channel models do not have channels 3 and 4).

Command grammar
:MEASURE:SOURCE CHANNEL{1|2|3|4}|MATH{1|2|3|4}

Programming example
":MEASURE:SOURCE CHANNEL4"

The above sets CH4 for measurement.

Query grammar
:MEASURE:SOURCE?
Return format
CHANNEL{1|2|3|4}|MATH{1|2|3|4}

Programming example
PRINT @1;":MEASURE:SOURCE?"
INPUT @1;SOURCE$

(13) TSTART Command/query

Sets the T reference cursor position.

Command grammar
:MEASURE:TSTART <position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":MEASURE:TSTART 50"
The above sets the T reference cursor position to 50.

Query grammar
:MEASURE:TSTART?
Return format
<position>

Programming example
PRINT @1;"MEASURE:TSTART?"
INPUT @1;TSTART$
The present T reference cursor position is returned.

(14) TSTOP Command/query

Sets the T delta cursor position.

Command grammar
:MEASURE:TSTOP <position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":MEASURE:TSTOP 100"
The above sets the T delta cursor position to 100.

Query grammar
:MEASURE:TSTOP?
Return format
<position>

Programming example
PRINT @1;"MEASURE:TSTOP?"
INPUT @1;TSTOP$
The present T delta cursor position is returned.

(15) TDELTA Query

The measured time difference between the two T cursors is returned.

Query grammar
:MEASURE:TDELTA
Return format
<value>

In the above, <value>::=time difference between cursors (s) (NR3)

Programming example
PRINT @1;":MEASURE:TDELTA?"
INPUT @1;TDELTA$

The present time difference between the 2 cursors is returned.

(16) VAMPLITUDE Query

Voltage difference between base and top is returned.

Query grammar
:MEASURE:VAMPLITUDE?
Return format
<value>

In the above, <value>::=measure difference (volts) between base and top voltages (NR3)

Programming example
PRINT @1;":MEASURE:VAMPLITUDE?"
INPUT @1;VALUE$

(17) VAVERAGE Query

The average voltage measurement is returned.

Query grammar
:MEASURE:VAVERAGE?
Return format
<value>

In the above, <value>::=average measured voltage (NR3)

Programming example
PRINT @1;";MEASURE:VAVERAGE?"
INPUT @1;VALUE$

(18) VBASE **Query**

The measured base voltage is returned.

Query grammar
:MEASURE:VBASE?
Return format
<value>

In the above, <value>::=measured base voltage (NR3)

Programming example
PRINT @1;":MEASURE:VBASE?"
INPUT @1;VALUE$

(19) VMAX **Query**

The measured maximum voltage is returned.

Query grammar
:MEASURE:VMAX?
Return format
<value>

In the above, <value>::=measured maximum voltage (NR3)

Programming example
PRINT @1;":MEASURE:VMAX?"
INPUT @1;VALUE$

(20) VMIN **Query**

The measured minimum voltage is returned.

Query grammar
:MEASURE:VMIN?
Return format
<value>

In the above, <value>::=measured minimum voltage (NR3)

Programming example
PRINT @1;":MEASURE:VMIN?"
INPUT @1;VALUE$

(21) VPP Query

The difference between maximum and minimum voltages is returned.

Query grammar
:MEASURE:VPP?
Return format
<value>

In the above, <value>::=measured peak-to-peak voltage (NR3)

Programming example
PRINT @1;":MEASURE:VPP?"
INPUT @1;VALUE$

(22) VRMS Query

Measured effective voltage is returned.

Query grammar
:MEASURE:VRMS?
Return format
<value>

In the above, <value>::=measured effective voltage (NR3)

Programming example
PRINT @1;":MEASURE:VRMS?"
INPUT @1;VALUE$

(23) VSTART Command/query

Sets the V reference cursor position.

Command grammar
:MEASURE:VSTART <position>

In the above, <position>::=-200 to 200

Programming example
PRINT @1;":MEASURE:VSTART 50"

The above sets the V reference cursor position to 50.

Query grammar
:MEASURE:VSTART?
Return format
<position>

Programming example
PRINT @1;":MEASURE:VSTART?"
INPUT @1;VSTART$

The present V reference cursor position is returned.

(24) VSTOP Command/query

Sets the V delta cursor position.

Command grammar
:MEASURE:VSTOP <position>

In the above, <position>::=-200 to 200

Programming example
PRINT @1;":MEASURE:VSTOP 100"

The above sets the V delta cursor position to 100.

Query grammar
:MEASURE:VSTOP?

Return format
<position>

Programming example
PRINT @1;":MEASURE:VSTOP?"
INPUT @1;VSTART$

The present V delta cursor position is returned.

(25) VDELTA Query

The measured voltage difference between the two cursors is returned.

Query grammar
:MEASURE:VDELTA?

Return format
<value>

In the above, <value>::=measured voltage difference (NR3)

Programming example
PRINT @1;":MEASURE:VDELTA?"
INPUT @1;VDELTA$

The present voltage difference between the two cursors is returned.

(26) VTOP Query

Measured top voltage is returned.

Query grammar
:MEASURE:VTOP?

Return format
<value>

In the above, <value>::=measured top voltage (NR3)

Programming example
PRINT @1;":MEASURE:VTOP?"
INPUT @1;VALUE$

(27) PSTART_____Command/query
Sets the start cursor position for pulse parameter calculation.

Command grammar
:MEASURE:PSTART<position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":MEASURE:PSTART 50"
The above sets the start cursor position to 50.

Query grammar
:MEASURE:PSTART?
Return format
<position>

Programming example
PRINT @1;":MEASURE:PSTART?"
INPUT @1;PSTART$
The present start cursor position is returned.

(28) PSTOP_____Command/query
Sets the stop cursor position for pulse parameter calculation.

Command grammar
:MEASURE:PSTOP<position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":MEASURE:PSTOP 100"
The above sets the stop cursor position to 100.

Query grammar
:MEASURE:PSTOP?
Return format
<position>

Programming example
PRINT @1;":MEASURE:PSTOP?"
INPUT @1;PSTOP$
The present stop cursor position is returned.

9.3.8 Timebase sub-system command programming grammar

The Timebase sub-system commands control horizontal axis functions.
The following commands can be used with this model.

header	command / query	program data
:TIMEBASE:DELAY	c/q	Seconds...exponential(NR3)
:TIMEBASE:RANGE	c/q	Seconds...exponential(NR3)
:TIMEBASE:BRANGE	c/q	Seconds...exponential(NR3)

The TIMEBASE sub-system command syntax is indicated below.

(1) DELAY_____Command/query

The delay time is selected.

Command grammar
:TIMEBASE:DELAY <delay>
In the above, <delay>::=delay time (s) (NR3)

Programming example
PRINT @1;":TIMEBASE:DELAY 1E-3"
The above sets the delay time to 1 ms.

Query grammar
:TIMEBASE:DELAY?
Return format
<delay>

Programming example
PRINT @1;":TIMEBASE:DELAY?"
INPUT @1;DELAY$
The present delay time is returned.

(2) RANGE Command/query

Full scale time of the A sweep is changed.

Command grammar
:TIMEBASE:RANGE <range>
In the above, <range>::=full scale time setting (s) (NR3)

Programming example
PRINT @1;":TIMEBASE:RANGE 100E-3"
The time range is set to 10 ms/div.

Query grammar
:TIMEBASE:RANGE?
Return format
<range>

Programming example
PRINT @1;":TIMEBASE:RANGE?"
INPUT @1;RANGE$

The present time range is returned.

(3) BRANGE Command/query

The B sweep (enlarged waveform) time setting is changed.

Command grammar
:TIMEBASE:BRANGE <range>
In the above, <range>::=full scale time setting (s) (NR3)

Programming example
PRINT @1;":TIMEBASE:BRANGE 100E-3"
The time range is set to 10 ms/div.

Query grammar
:TIMEBASE:BRANGE?
Return format
<range>

Programming example
PRINT @1;":TIMEBASE:BRANGE?"
INPUT @1;BRANGE$

The present B sweep time range is returned.

(1) Output commands
The output commands differ according to the controller language. The individual command examples of this volume are for using N88-BASIC of the PC-9801 series. If using other languages, correspondence to N88-BASIC commands, such as PRINT and INPUT, needs to be determined and the program converted.

(2) Device address
The device address position also differs according to the controller language being used. In PC-9801 N88-BASIC, the device address is always following PRINT. In the example of this volume, the oscilloscope device address is taken as 1.

(3) Header
The header is composed of one or more mnemonics separated by colons (:) and indicates the equipment operation. A query (return command such as equipment setting) is indicated by a question mark (?) after the header.

(4) Mnemonic
The mnemonic is a character string for equipment operation. See Section 9.3.

(5) Separator
The separator is used to divide the mnemonic header and mnemonic from the program data. If the mnemonic does not need the program data, the separator is not required. In this volume, the separator is defined as one or more spaces. A space is defined in ASCII as character code 32 (in decimal).

(6) Program data
Program data are used to clarify the meaning of the command or query. For example, the program data provide necessary information on the setting of instrument or which waveform is to be displayed.

(7) End code
The equipment recognizes line feed (LF) or EOI as the end code. During return, the end code is LF for GPIB and for RS-232C, carriage return (CR) and LF.
In ASCII, LF is defined as 10 (in decimal) and CR as 13 (in decimal).

9.2.3 Setting command syntax

A single command is composed of a header, data and an end code. The header types are described below.

(1) Compound command header
A compound command header is a succession of multiple mnemonics. The command is analyzed into subsystem selection and function selection within the subsystem by the mnemonics.

For example, execute a particular function within the subsystem by the following.
:<SUBSYSTEM>:<FUNCTION><SEPARATOR><PROGRAM DATA><END CODE>

Example)
:CHANNEL1:COUPLING AC

The above sets the channel 1 input coupling to AC.

The subsystem name is required for all commands and cannot be omitted. Thus, if two or more commands are sent at one time, two or more complete commands, separated by a semicolon (;), are required.
For example, two commands are sent as follows.

:<SUBSYSTEM>:<FUNCTION><SEPARATOR><PROGRAM DATA>;
:<SUBSYSTEM>:<FUNCTION><SEPARATOR><PROGRAM DATA><END CODE>

Example)
:CHANNEL1:RANGE 800M;:CHANNEL1:OFFSET 2

The above sets the channel 1 vertical range to 100 mV/div and the offset to 2 V.

(2) Common command header

The common command header controls IEEE488.2 functions, including status clear.
The syntax is as follows.
*<COMMAND HEADER><END CODE>
A space or separator is not inserted between the asterisk and command header. See Section 9.3.1.

9.2.4 Question command syntax

Commands with a question mark (?) immediately following the mnemonic are questions, termed queries below.
When a query is received, the machine responds to the interrupted device and enters the response on the output queue. The response stays on the queue until read or another command is issued. When the read interrupt is produced, the response is sent via GPIB to the specified listener (usually the controller).

Example)
:TIMEBASE:RANGE?

The time base setting is sent to the queue buffer.
When the controller executes INPUT@<DEVICE ADDRESS>;Range, the setting is sent to the controller via GPIB.

Note:
The program message can be sent as a mixed upper and lower case ASCII character string, but the response is returned in upper case.

9.2.5 Unit abbreviations

A number of command headers require numerical values as data.
For example, a numerical value can be expressed as
:TIMEBASE:RANGE 1E-1.
Numerical abbreviations are indicated in Table 9-1.

Note: the example 1E-3 refers to 10^{-3}.

Table 9-1 Index units

Value	Mnemonic	Value	Mnemonic
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

9.2.6 Waveform data send/receive

Waveform data are sent via GPIB as 8 bit binary data in fixed length blocks.
The syntax is comprised of a Command grammar symbol(#), followed in succession by a base 10 numeral indicating the number of digits, another base 10 numeral indicating the number of data bytes, then the actual data block.
When transmitting 512 bytes of data, the syntax is
#800000512<DATA BLOCK 512 BYTES><END CODE>.
The 8 indicates the number of digits to follow, while 00000512 is the number of transmitted bytes.

Waveform data have 1 to 255 values, with 0 indicating absence of data. When waveform data are absent, such as when the return source channel is off, the data byte number is 0 and the data block is not returned.

9.3 Programming grammar

9.3.1 Common command programming

Common commands are defined by IEEE488.2 and can be used by equipment based on IEEE488.4. The following common commands can be used by this system.

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 common command syntax is indicated below.

(1) *CLS (Clear Status)_____Command

This command clears the data of the event register which generates the status byte summary bits. Consequently, the summary bits of the status byte, which is the logic sum of the events, are also cleared. However, the output queue is not affected by the *CLS command.

Command grammar
*CLS

Programming example
PRINT @1;"*CLS"

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

Standard event status enable register request.
The command sets the standard event status enable register mask pattern. The mask pattern is specified as a base 10 integer in the range of 0 to 255. If specified outside this range, error is produced. (See Table 9-2.)

Command grammar
*ESE <mask>

Query grammar
*ESE?

Return format
<mask>

In the above, <mask>::=0 to 255

Programming example
PRINT @1;"*ESE 32"

Programming examples
PRINT @1;"*ESE?"
INPUT @1;ESE$

In the above examples, if a command error is produced, a service request is prepared.

Table 9-2 Standard event status enable register

Bit	Weight	Enable
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 end

Refer to Section 9.4 for status report function data composition.

(3) *ESR (Event Status Register)_____Query

Standard event status register check.
Standard event status register contents are read.

Query grammar
*ESR?

Return format
<status>

In the above, <status>::=0 to 255

Programming example
```
PRINT  @1;"*ESR?"
INPUT  @1;ESR$
```

Table 9-3 Standard event status register

Bit	Weight	Enable
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 end

Refer to Section 9.4 for status report function data composition.

(4) *IDN (Identification Number)_____Query

Esquire equipment ID (maker, model, etc.).
The command is used by the controller during system startup for detecting the equipment connected on the GPIB.

Query grammar
*IDN?

Return format
HITACHI DENSHI LTD.,VC-5810,0,x,x

Programming example
```
PRINT  @1;"*IDN?"
LINE INPUT  @1;IDN$
```

(5) *LRN (Learn)_____Query

Esquire equipment setup data.
The command produces the same function as :SYSTEM:SETUP?

Query grammar
*LRN?

Return format
<setup>

In the above, <setup>::=#80000xxxx<binary data>

Programming example
```
PRINT  @1;"*LRN?"
INPUT  @1;LRN$
```

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

At the end of an operation in progress, the standard event status register bit 0 is set.

Command grammar	Query grammar
*OPC	*OPC?

Return format
1

Programming example
```
PRINT  @1;"*OPC"
```

Programming example
```
PRINT  @1;":RUN;*OPC?"
INPUT  @1;OPC$
```

(7) *OPT (Option)_____Query

Esquire equipment option connection data. The return for this command is always 0.

Query grammar
*OPT?

Return format
0

Programming example
```
PRINT  @1;"*OPT?"
INPUT  @1;OPT$
```

(8) *RCL (Recall) _____Command
Read setup data from specified panel save area and set equipment.

Command grammar
*RCL {1|2|3|4|5|6|7|8|9|10}

Programming example
PRINT @1;"*RCL 3"

(9) *RST (Reset) _____Command
Returns equipment to factory settings.

Command grammar
*RST

Programming example
PRINT @1;"*RST"

(10) *SAV (Save) _____Command
Stores equipment settings in specified panel save area. The setup data stored by this command can be corrected by using the *RCL command.

Command grammar
*SAV {1|2|3|4|5|6|7|8|9|10}

Programming example
PRINT @1;"*SAV 3"

(11) *SRE (Service Request Enable)_____Command/query
The command sets the mask pattern for generating the mask summary status (MSS) bit in the service request enable register. The mask pattern is specified as a base 10 integer in the range of 0 - 191. If the specified value is outside this range, error is produced.

Command grammar	Query grammar
*SRE <mask>	*SRE?

Return format
<mask>
In the above, <mask>::=0 - 191

Command example	Query example
PRINT @1;"*SRE 32"	PRINT @1;"*SRE?"
	INPUT @1;SRE$

Table 9-4 Service Reguest Enable Register

Bit	Weight	Enable
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

(12) *STB (Status Byte) _____Query

Status byte check.

Query grammar
*STB?

Return format
<status>

In the above, <status>::=0 - 255

Programming example
```
PRINT @1;"*STB?"
INPUT @1;STB$
```

Table 9-5 Status Byte Register

Bit	Weight	Enable
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

(13) *TST (Test) _____Query

Inquire self test results. At this command, the equipment conducts self-test and returns the results. A zero return result indicates normal; other than 0 indicates a malfunction.

Query grammar
*TST?

Return format
<result>
In the above, <result>::=0 - 255

Programming example
PRINT @1;"*TST?"
INPUT @1;TST$

(14) *WAI (Wait)_____Command

At this command, nothing is executed.

Command grammar
*WAI
Programming example
PRINT @1;"*WAI"

9.3.2 Root level command programming grammar

Root level commands control the basic functions of the equipment.
The following root level commands can be used with this model.

header	command / query	program data
:AUTOSCALE	c	-
:BLANK	c	“CHANNEL1”, “CHANNEL2”,”CHANNEL3”, “CHANNEL4”
:CALIBRATE	q	-
:DIGITIZE	c	-
:ERASE	c	-
:MERGE	c	1 - 4
:HARDCOPY	c	-
:RUN	c	-
:STATUS	q	“CHANNEL1”, “CHANNEL2”,”CHANNEL3”, “CHANNEL4”
:STOP	c	-
:VIEW	c	“CHANNEL1”, “CHANNEL2”,”CHANNEL3”, “CHANNEL4”
:RECALL	c	1 - 4

Note: Two channel models do not include channels 3 and 4.
The root level command sequence is indicated below.

(1) AUTOSCALE_____Command

Executes AUTOSETUP.

Command grammar
:AUTOSCALE

Programming example
PRINT @1;":AUTOSCALE"

The AUTO SETUP is executed.

(2) BLANK Command

Turns off the designated channels (channels 3 and 4 are absent in 2 channel models).

Command grammar
:BLANK CHANNEL{1|2|3|4}

Programming example
PRINT @1;":BLANK CHANNEL1"

Turn off CH1 input.

(3) CALIBRATE Query

Execute FULL CALIBRATION.

Query grammar
:CALIBRATE?

Return format
{PASS|FAIL}

Programming example
PRINT @1;":CALIBRATE?"
INPUT @1;CALIB$

FULLCALIBRATION is executed and results are returned.

(4) DIGITIZE Command

When the status is hold, the input on channels are acquired once. If the status is running, the status is set to hold.

Command grammar
:DIGITIZE

Programming example
PRINT @1;":DIGITIZE"

(5) ERASE Command

Erase the waveform display.
The command has the same function as pressing the panel Waveform Clear key.

Command grammar
:ERASE

Programming example
PRINT @1;":ERASE"

(6) MERGE Command

Waveform save to internal memory having designated number.

Command grammar
:MERGE<number> <number>:=1-4

Programming example
PRINT @1;":MERGE 1"

(7) HARDCOPY Command

A hard copy is made of the screen display.

Command grammar
:HARDCOPY

Programming example
PRINT @1;":HARDCOPY"

(8) RUN Command

The equipment is changed to the RUN mode.

Command grammar
:RUN

Programming example
PRINT @1;":RUN"

The status is changed to running.

(9) STATUS Query

The return indicates whether the designated channel is on or off (2 channel models do not have channels 3 and 4). A channel can be set to on by the View command and to off by the Blank command.

Query grammar
:STATUS? CHANNEL{1|2|3|4}

Return format
{ON|OFF}

Programming example
PRINT @1;":STATUS? CHANNEL1"
INPUT @1;STATUS$

The channel 1 display setting is returned.

(10) STOP Command

The equipment is changed to the HOLD mode.

Command grammar
:STOP

Programming example
PRINT @1;":STOP"

The status is changed to hold.

(11) VIEW Command

Sets the designated channels to on (2 channel models do not have channels 3 and 4).

Command grammar
:VIEW CHANNEL{1|2|3|4}

Programming example
PRINT @1;":VIEW CHANNEL1"

The channel 1 input is set to on.

(12) RECALL Command

Waveform data are recalled from the internal memory having the designated number.

Command grammar
:RECALL<number> <number>:=1-4

Programming example
PRINT @1;":RECALL 1"

9.3.3 System sub-system command programming grammar

The System sub-system commands control setup mode changes, return and error message return for each command.

The following System sub-system commands can be used with this equipment.

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

The System sub-system command syntax is indicated below.

(1) ERROR _____Query

Error data are returned in response to this command. Data for up to 15 errors are stored on the error queue. The command allows reading the data for each error one at a time. If the error queue is empty, 0 is returned.

Query grammar
:SYSTEM:ERROR?

Return format
<error>

In the above, <error>::=integer error data

Programming example
```
PRINT @1;"*STSTEM:ERROR?"
INPUT @1;ERROR$
```

The returned error code is as follows.

	Error code
Normal end	0
Command error	-100

(2) SETUP Command/query

Command grammar		Query grammar
:SYSTEM:SETUP	<setup>	:SYSTEM:SETUP?

Return format
<setup>

In the above, <setup>::=#80000XXXX<binarydata>

Example

```
PRINT @1;"SYSTEM:SETUP?;"@
RBYTE &H3F,&H5F,&H41,&H20;DAT
RBYTE ;SLEN
STRLEN$=CHR$(SLEN)
STRLEN=VAL(STRLEN$)
FOR I=1 TO STRLEN
RBYTE ;BLEN
BLEN$=BLEN$+CHR$(BLEN)
NEXT
BLOCKLEN=VAL(LEFT$(BLEN$,STRLEN))
FOR I=1 TO BLOCKLEN+1
RBYTE ;ISETUP(I)
NEXT
PRINT  “Push any key”
*LOOP:A$=INKEY$:IF A$=“”THEN GOTO *LOOP
COMMAND$=“:SYSTEM:SETUP #” +STRLEN$+BLEN$
PRINT @1;COMMAND$
FOR I=1 TO BLOCKLEN-1
WBYTE ;ISETUP(I)
NEXT
WBYTE ;ISETUP(BLOCKLEN)@
END
```

9.3.4 Acquire sub-system command programming grammar

The Acquire sub-system commands control the operating mode for data input. The following Acquire sub-system commands can be used with this equipment.

header	command / query	program data
:ACQUIRE:COUNT	c/q	“2”, “4”, “8”, “16”, “32”, “64”, “128”, “256”
:ACQUIRE:POINTS	c/q	“500”, “5k”, “10k”, “32k”, “64k”, “128k”, “256k”, “500k”, “1M”, “2M”
:ACQUIRE:TYPE	c/q	“NORMAL”, “PEAK_DETECT”, “ENVELOPE”, “AVERAGE”, “MOMENTARY”
:ACQUIRE:SEGMENTS	c/q	21024
:ACQUIRE:ENVELOPE	c/q	“2”, “4”, “8”, “16”, “32”, “64”, “128”, “256”, “512”, “1024”, “2048”, “INFINITE”
:ACQUIRE:SPLIT	c/q	“OFF”, “ON”
:ACQUIRE:ROLL	c/q	“OFF”, “ON”
:ACQUIRE:EQUIVALENT	c/q	“OFF”, “ON”

The Acquire sub-system command syntax is indicated below.

(1) COUNT Command/query

Changes the averaging number.

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

Programming example
```
PRINT @1;":ACQUIRE:COUNT 64"
```
Set averaging number to 64.

Query grammar
:ACQUIRE:COUNT?

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

Programming example
```
PRINT @1;":ACQUIRE:COUNT?"
INPUT @1;COUNT$
```
Present averaging count is returned.

(2) POINTS Command/query

Sets the acquisition memory length of one sampling input. The settable memory length differs according to options.

Command grammar
:ACQUIRE:POINTS <points argument>

In the above, <points argument>::={500|5k|10k|32k|64k|128k|256k|500k|1M|2M}

Programming example
```
PRINT @1;":ACQUIRE:POINTS 500"
```
Sets the acquisition memory length to 500w.

Query grammar
:ACQUIRE:POINTS?

Return format
<points argument>

Programming example
```
PRINT @1;":ACQUIRE:POINTS?"
INPUT @1;POINTS$
```
The present input memory length is returned.

(3) TYPE Command/query

Sets acquisition mode.

Command grammar
:ACQUIRE:TYPE {NORMAL|PEAK_DETECT|ENVELOPE|AVERAGE|MOMENTARY}

Programming example
```
PRINT @1;":ACQUIRE:TYPE NORMAL"
```

Query grammar
:ACQUIRE:TYPE?

Return format
{NORMAL|PEAK_DETECT|ENVELOPE|AVERAGE|MOMENTARY}

Programming example
```
PRINT @1;":ACQUIRE:TYPE?"
INPUT @1;TYPE$
```

(4) SEGMENTS Command/query

Sets the maximum number of segments when splitting the memory.

Note) The settable number of segments differs according to the options.

Command grammar
:ACQUIRE:SEGMENTS <segments argument>

In the above, <segments argument>::=2-1024

Query grammar
:ACQUIRE:SEGMENTS?

Return format
<segments argument>

(5) ENVELOPE Command/query

Changes the number of envelopes.

Command grammar

:ACQUIRE:ENVELOPE{2|4|8|16|32|64|128|256|512|1024|2048|INFINITE}

Programming example

```
PRINT @1;":ACQUIRE:ENVELOPE 64"
```

The above sets the number of envelopes to 64.

Query grammar

:ACQUIRE:ENVELOPE

Return format

{2|4|8|16|32|64|128|256|512|1024|2048|INFINITE}

Programming example

```
PRINT @1;":ACQUIRE:ENVELOPE?"
INPUT @1;ENVELOPE$
```

The present number of envelopes is returned.

(6) SPLIT Command/query

Sets memory split.

Command grammar

:ACQUIRE:SPLIT {OFF|ON}:

Programming example

```
PRINT @1;":ACQUIRE:SPLIT ON"
```

The above sets the memory split to on.

Query grammar

ACQUIRE:SPLIT?

Return format

{OFF/ON}

Programming example

```
PRINT @1;"*ACQUIRE:SPLIT?"
INPUT @1;SPLIT$
```

The present memory split setting is returned.

(7) ROLL Command/query

Roll on/off setting.

Command grammar

:ACQUIRE:ROLL {OFF|ON}

Programming example

```
PRINT @1;":ACQUIRE:ROLL ON"
```

Roll is set to on.

Query grammar

:ACQUIRE:ROLL?

Return format

{OFF|ON}

Programming example

```
PRINT @1;":ACQUIRE:ROLL?"
LINEINPUT #1;ROLL$
```

Roll status is returned.

(8) EQUIVALENT **Command/query**

Equivalent sampling on/off.

Command grammar

:ACQUIRE:EQUIVALENT {OFF|ON}

Programming example

```
PRINT @1;":ACQUIRE:EQUIVALENT ON"
```

Equivalent sampling is set to on.

Query grammar

:ACQUIRE:EQUIVALENT?

Return format

{OFF|ON}

Programming example

```
PRINT @1;":ACQUIRE:EQUIVALENT?"
INPUT @1;EQUIVALENT$
```

Equivalent sampling mode is returned.

9.3.5 Channel sub-system command programming grammar

The Channel sub-system commands control vertical axis functions. The following commands can be used with this model.

header	command / query	program data
:CHANNEL<N>:BWLIMIT	c/q	“OFF”, “ON”
:CHANNEL<N>:COUPLING	c/q	“AC”, “DC”, “GND”
:CHANNEL<N>:INVERT	c/q	“OFF”, “ON”
: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)

The Channel sub-system command syntax is indicated below.

(1) BWLIMIT Command/query

Selects input channel BW limit for on or off. (2 channel models do not have channels 3 and 4).

Command grammar
:CHANNEL{1|2|3|4}:BWLIMIT{OFF|ON}
Programming example
PRINT @1;":CHANNEL2:BWLIMIT ON"
The above selects channel 2 BW limit to ON.

Query grammar
:CHANNEL{1|2|3|4}:BWLIMIT?
Return format
{OFF|ON}
Programming example
PRINT @1;":CHANNEL3:BWLIMIT?"
INPUT @1;BWLIMIT$
Channel 3 BW limit selecting is returned.

(2) COUPLING Command/query

Selects input channel coupling for AC, DC, or ground (2 channel models do not have channels 3 and 4).
Command grammar
:CHANNEL{1|2|3|4}:COUPLING {AC|DC|GND}
Programming example
PRINT @1;":CHANNEL2:COUPLING AC"
The above selects channel 2 coupling to AC.

Query grammar
:CHANNEL{1|2|3|4}:COUPLING?
Return format
{AC|DC|GND}
Programming example
PRINT @1;":CHANNEL3:COUPLING?"
INPUT @1;COUPLING$
Channel 3 coupling data are returned.

(3) INVERT Command/query

The pole of waveform is switched to normal or invert.

Command grammar
:CHANNEL{1|2|3|4}:INVERT{OFF|ON}

Programming example
PRINT @1;":CHANNEL2:INVERT ON"
The above sets the channel 2 signal to invert.

Query grammar
:CHANNEL{1|2|3|4}:INVERT?
Return format
{OFF|ON}
Programming example
PRINT @1;":CHANNEL2:INVERT?"
INPUT @1;INVERT$
On/off status of channel2 inverting is returned.

(4) OFFSET Command/query

The waveform vertical position is changed by changing the input channel offset voltage. The offset code is the reverse of the V display position. (Two channel models do not have channels 3 and 4.)

Command grammar
:CHANNEL{1|2|3|4}:OFFSET <offset_data>
In the above <offset data>::=offset voltage (NR3)
Programming example
PRINT @1;":CHANNEL2:OFFSET 1"
The above sets the channel 2 offset voltage to 1 volt.

Query grammar
:CHANNEL{1|2|3|4}:OFFSET?
Return format
<offset_data>
Programming example
PRINT @1;":CHANNEL2:OFFSET?"
INPUT @1;OFFSET$
The CH2 offset voltage is compiled and displayed.

(5) PROBE Command/query

Selects input channel probe factor. (Two channel models do not have channels 3 and 4.)

Command grammar
:CHANNEL{1|2|3|4}:PROBE {X1|X10|X100|X1000}
Programming example
PRINT @1;"CHANNEL2:PROBE X1"
The above sets the CH2 probe factor to X1.

Query grammar
:CHANNEL{1|2|3|4}:PROBE?
Return format
{X1|X10|X100|X1000}
Programming example
PRINT @1;":CHANNEL2:PROBE?"
INPUT @1;PROBE$

(6) RANGE_____Command/query

Sets the full scale input sensitivity of the designated channel. (Two channel models do not have channels 3 and 4.)

Command grammar
:CHANNEL{1|2|3|4}:RANGE <RANGE DATA>

In the above, <range data>::=full scale voltage (NR3)

Programming example
PRINT @1;":CHANNEL2:RANGE 8"

The above sets the CH2 sensitivity to 1V/DIV.

Query grammar
:CHANNEL{1|2|3|4}:RANGE?

Return format
<range data>

Programming example
PRINT @1;"CHANNEL2:RANGE?:
INPUT @1;RANGE$

The present CH2 sensitivity is returned.

9.3.9 Trigger sub-system command code programming grammar

The Trigger sub-system commands control the trigger functions.
The following commands can be used with this equipment.

header	command / query	program data
:TRIGGER:MODE	c/q	“EDGE”, “DELAY”, “DROPOUT”, “EVENT”, “PATTERN”, “PULSE”, “STATE”, “TV”, ”WINDOW”
Note: Option required for modes other than EDGE		
:TRIGGER:AUTO	c/q	“ON”, “OFF”
:TRIGGER:DELAY:COUPLING<N>	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:DELAY:LEVEL<N>	c/q	Volts...exponential(NR3)
:TRIGGER:DELAY:PRESET<N>	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:DELAY:SLOPE<N>	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:DELAY:SOURCE<N>	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “EXTERNAL”
:TRIGGER:DELAY:TIME	c/q	Second...exponential(NR3)
:TRIGGER:DROPOUT:COUPLING	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:DROPOUT:LEVEL	c/q	Volts...exponential(NR3)
:TRIGGER:DROPOUT:PRESET	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:DROPOUT:SLOPE	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:DROPOUT:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “EXTERNAL”
:TRIGGER:DROPOUT:TIME	c/q	Second...exponential(NR3)
:TRIGGER:EDGE:COUPLING	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:EDGE:LEVEL	c/q	Volts...exponential(NR3)
:TRIGGER:EDGE:PRESET	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:EDGE:SLOPE	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:EDGE:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “EXTERNAL”
:TRIGGER:EVENT:COUNT	c/q	3 - 65000
:TRIGGER:EVENT:COUPLING<N>	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:EVENT:LEVEL<N>	c/q	Volts...exponential(NR3)
:TRIGGER:EVENT:PRESET<N>	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:EVENT:SLOPE<N>	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:EVENT:SOURCE<N>	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “EXTERNAL”

header	command / query	program data
:TRIGGER:PATTERN:CHANNEL<N>	c/q	“HIGH”, “LOW”, “X”
:TRIGGER:PATTERN:EXTERNAL	c/q	“HIGH”, “LOW”, “X”
:TRIGGER:PATTERN:LEVEL<N>	c/q	Volts...exponential(NR3)
:TRIGGER:PATTERN:PRESET<N>	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:PATTERN:TIME	c/q	Seconds...exponential(NR3)
:TRIGGER:PULSE:COUPLING	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:PULSE:LEVEL	c/q	Volts...exponential(NR3)
:TRIGGER:PULSE:PRESET	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:PULSE:POLARITY	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:PULSE:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “EXTERNAL”
:TRIGGER:PULSE:TIME	c/q	Seconds...exponential(NR3)
:TRIGGER:PULSE:WHEN	c/q	“OUTSIDE”, “WITHIN”
:TRIGGER:STATE:CLOCK	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4” , “EXTERNAL”
:TRIGGER:STATE:CHANNEL<N>	c/q	“HIGH”, “LOW”, “X”
:TRIGGER:STATE:EXTERNAL	c/q	“HIGH”, “LOW”, “X”
:TRIGGER:STATE:LEVEL<N>	c/q	Volts...exponential(NR3)
:TRIGGER:STATE:PRESET<N>	c/q	“USER”, “AUTOLEVEL”,“TTL”, “ECL”
:TRIGGER:STATE:SLOPE	c/q	“POSITIVE”, “NEGATIVE”
:TRIGGER:STATE:TIME	c/q	Seconds...exponential(NR3)“
:TRIGGER:TV:FIELD	c/q	“1”, “2”
:TRIGGER:TV:MODE	c/q	“TV_V”, “TV_H”, “TVLINE”
:TRIGGER:TV:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4” , “EXTERNAL”
:TRIGGER:TV:STANDARD	c/q	“525”, “625”
:TRIGGER:TV:LINE	c/q	1 625
:TRIGGER:WINDOW:ACTION	c/q	“IN”, “OUT”
:TRIGGER:WINDOW:COUPLING	c/q	“DC”, “AC”, “LFREJ”, “HFREJ”
:TRIGGER:WINDOW:LOWERLEVEL	c/q	Volts...exponential(NR3)
:TRIGGER:WINDOW:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4” , “EXTERNAL”
:TRIGGER:WINDOW:UPPERLEVEL	c/q	Volts...exponential(NR3)

Note) Two channel models do not have channels 3 and 4

The Trigger sub-system command syntax is indicated below.

(1) MODE Command/query

Sets the trigger mode.

Command grammar
:TRIGGER:MODE{EDGE|DELAY|DROPOUT|EVENT|PATTERN|PULSE|STATE|TV|WINDOW}

Programming example
PRINT @1;":TRIGGER:MODE EDGE"

The above sets the trigger mode to edge.

Query grammar
:TRIGGER:MODE?

Return format
{EDGE|DELAY|DROPOUT|EVENT|PATTERN|PULSE|STATE|TV|WINDOW}

Programming example
PRINT @1;":TRIGGER:MODE?"
LINE INPUT @1;MODE$

The present trigger mode setting is returned.

(2) AUTO Command/query

Sets trigger for auto sweep.

Command grammar
:TRIGGER:AUTO {ON|OFF}

Programming example
PRINT @1;":TRIGGER:AUTO ON"

The above sets the trigger to auto sweep.

Query grammar
:TRIGGER:AUTO?

Return format
{ON|OFF}

Programming example
PRINT @1;":TRIGGER:AUTO?"
LINE INPUT @1;AUTO$

The present setting is returned.

(3) DELAY:COUPLING<N>_____Command/query
Sets trigger delay coupling.

Command grammar
:TRIGGER:DELAY:COUPLING{1|2} {DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:DELAY:COUPLING1 DC"
The trigger coupling of A trigger is set to DC

Query grammar
:TRIGGER:DELAY:COUPLING{1|2}?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:DELAY:COUPLING1?"
LINE INPUT @1;COUPLING$
The present trigger coupling of A trigger is returned.

(4) DELAY:LEVEL<N>_____Command/query

Sets the trigger delay level.

Command grammar
:TRIGGER:DELAY:LEVEL{1|2} <level>

In the above, <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:DELAY:LEVEL1 IE-3"
The above sets the A trigger level to 1 mV.

Query grammar
:TRIGGER:DELAY:LEVEL{1|2}?
Return format
<level>

Programming example
PRINT @1;":TRIGGER:DELAY:LEVEL1?"
LINE INPUT @1;LEVEL$
The presently set trigger level of A trigger is returned.

(5) DELAY:PRESET<N>_____Command/query
Selects the delay trigger level.

Command grammar
:TRIGGER:DELAY:PRESET{1|2}{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:DELAY:PRESET1 TTL
The above selects the A trigger level for TTL.

Query grammar
TRIGGER:DELAY:PRESET{1|2}?
Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:DELAY:PRESET1?"
LINE INPUT @1;PRESET$

The present A trigger level setting is returned.

Note: AUTO LEVEL can be selected only for A trigger.

(6) DELAY:SLOPE<N>_____Command/query
Sets the trigger delay slope.

Command grammar
:TRIGGER:DELAY:SLOPE{1|2} {POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:DELAY:SLOPE1 POSITIVE
The above sets the A trigger slope to rising.

Query grammar
:TRIGGER:DELAY:SLOPE{1|2}?
Return format
{POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:DELAY:SLOPE1?"
LINE INPUT @1;SLOPE$

The present A trigger slope setting is returned.

(7) DELAY:SOURCE<N>_____Command/query
Sets the trigger delay source.

Command grammar
:TRIGGER:DELAY:SOURCE{1|2}
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:DELAY:SOURCE1 CHANNEL1"
The above sets the A trigger source to channel 1.

Query grammar
:TRIGGER:DELAY:SOURCE{1|2}?

Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:DELAY:SOURCE1?"
LINE INPUT @1;SOURCE$
The present source setting of A trigger is returned.

(8) DELAY:TIME_____Command/query
Sets the trigger delay time.

Command grammar
:TRIGGER:DELAY:TIME <time>
In the above, <time>::=delay time (s) (NR3)

Programming example
PRINT @1;":TRIGGER:DELAY:TIME 1E-3"
The above sets the trigger delay time to 1 ms.

Query grammar
:TRIGGER:DELAY:TIME?
Return format
<time>

Programming example
PRINT @1;":TRIGGER:DELAY:TIME?"
LINE INPUT @1;TIME$

The present delay time setting is returned.

(9) DROPOUT:COUPLING Command/query

Sets the dropout trigger coupling.

Command grammar
:TRIGGER:DROPOUT:COUPLING {DC|AC|LFREJ|HFREJ}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:COUPLING DC"
```
The above sets the trigger coupling to DC.

Query grammar
:TRIGGER:DROPOUT:COUPLING?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:COUPLING?"
LINE INPUT @1;COUPLING$
```

The presently set trigger coupling is returned.

(10) DROPOUT:LEVEL Command/query

Sets the dropout trigger level.

Command grammar
:TRIGGER:DROPOUT:LEVEL <level>
In the above, <level>::=trigger level voltage (NR3)

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:LEVEL 1E-3
```
The above sets the trigger level to 1 mV.

Query grammar
:TRIGGER:DROPOUT:LEVEL?
Return format
<level>

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:LEVEL?"
LINE INPUT @1;LEVEL$
```

The present trigger level setting is returned.

(11) DROPOUT:PRESET Command/query

Selects the dropout trigger level.

Command grammar
:TRIGGER:DROPOUT:PRESET {USER|AUTOLEVEL|TTL|ECL}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:PRESET TTL
```
Sets the trigger level for TTL.

Query grammar
:TRIGGER:DROPOUT:PRESET?
Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:PRESET?"
LINE INPUT @1;PRESET$
```
The presently selected trigger level is returned.

(12) DROPOUT:SLOPE Command/query

Sets the dropout trigger slope.

Command grammar
:TRIGGER:DROPOUT:SLOPE {POSITIVE|NEGATIVE}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:SLOPE POSITIVE"
```
The above sets the trigger slope to rising.

Query grammar
:TRIGGER:DROPOUT:SLOPE?
Return format
{POSITIVE|NEGATIVE}

Programming example
```
PRINT @1;":TRIGGER:DROPOUT:SLOPE?"
LINE INPUT @1;SLOPE$
```
The present trigger slope setting is returned.

(13) DROPOUT:SOURCE Command/query

Selects the dropout trigger source.

Command grammar
:TRIGGER:DROPOUT:SOURCE
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:DROPOUT:SOURCE CHANNEL1"

The above sets the trigger source to channel 1.

Query grammar
:TRIGGER:DROPOUT:SOURCE?

Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:DROPOUT:SOURCE?"
LINE INPUT @1;SOURCE$

The presently selected trigger source is returned.

(14) DROPOUT:TIME Command/query

Sets the dropout trigger decision time.

Command grammar
:TRIGGER:DROPOUT:TIME <time>

In the above, <time>::=decision time (s) (NR3)

Programming example
PRINT @1;":TRIGGER:DROPOUT:TIME 1E-3"

The above sets the decision time to 1 ms.

Query grammar
:TRIGGER:DROPOUT:TIME?

Return format
<time>

Programming example
PRINT @1;":TRIGGER:DROPOUT:TIME?"
LINE INPUT @1;TIME$

The presently set decision time is returned.

(15) EDGE:COUPLING Command/query

Sets the edge trigger coupling.

Command grammar
:TRIGGER:EDGE:COUPLING {DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:EDGE:COUPLING DC"

Sets the coupling to DC.

Query grammar
:TRIGGER:EDGE:COUPLING?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:EDGE:COUPLING?"
LINE INPUT @1;COUPLING$

The presently set coupling is returned.

(16) EDGE:LEVEL Command/query

Sets the edge trigger level.

Command grammar
:TRIGGER:EDGE:LEVEL <level>

In the above <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:EDGE:LEVEL 1E-3"

The trigger level is set to 1 mV.

Query grammar
:TRIGGER:EDGE:LEVEL?
Return format
<level>

Programming example
PRINT @1;":TRIGGER:EDGE:LEVEL?"
LINE INPUT @1;LEVEL$

The present trigger level setting is returned.

(17) EDGE:PRESET Command/query

Selects the edge trigger level.

Command grammar
:TRIGGER:EDGE:PRESET {USER|AUTOLEVEL|TTL|ECL}

Programming example
```
PRINT @1;":TRIGGER:EDGE:PRESET1 TTL"
```
The edge trigger level is set for TTL.

Query grammar
:TRIGGER:EDGE:PRESET?

Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
```
PRINT @1;":TRIGGER:EDGE:PRESET?"
LINE INPUT @1;PRESET$
```
The presently set edge trigger level is returned.

(18) EDGE:SLOPE Command/query

Sets the edge trigger slope.

Command grammar
:TRIGGER:EDGE:SLOPE {POSITIVE|NEGATIVE}

Programming example
```
PRINT @1;":TRIGGER:EDGE:SLOPE POSITIVE"
```
The above sets the trigger slope to rising.

Query grammar
:TRIGGER:EDGE:SLOPE?

Return format
{POSITIVE|NEGATIVE}

Programming example
```
PRINT @1;":TRIGGER:EDGE:SLOPE?"
LINE INPUT @1;SLOPE$
```
The present trigger slope setting is returned.

(19) EDGE:SOURCE Command/query

Selects the edge trigger source.

Command grammar
:TRIGGER:EDGE:SOURCE
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:EDGE:SOURCE CHANNEL1"

The above sets the trigger source to channel 1.

Query grammar
:TRIGGER:EDGE:SOURCE?
Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:EDGE:SOURCE?"
LINE INPUT @1;SOURCE$

The presently selected trigger source is returned.

(20) EVENT:COUNT Command/Query

Sets the event trigger count.

Command grammar
:TRIGGER:EVENT:COUNT <count>

In the above, <count>::=event count

Programming example
PRINT @1;":TRIGGER:EVENT:COUNT 10"

The above sets the event trigger count to 10.

Query grammar
:TRIGGER:EVENT:COUNT?

Return format
<count>

Programming example
PRINT @1;":TRIGGER:EVENT:COUNT?"
LINE INPUT @1;COUNT$

The present event count setting is returned.

(21) EVENT:COUPLING<N>_____Command/query

Command grammar
:TRIGGER:EVENT:COUPLING{1|2} {DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:EVENT:COUPLING1 DC"

Sets the A trigger coupling to DC.

Query grammar
:TRIGGER:EVENT:COUPLING{1|2}?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:EVENT:COUPLING1?"
LINE INPUT @1;COUPLING$

The presently set A trigger coupling is returned.

(22) EVENT:LEVEL<N>_____Command/query

Sets the event trigger level.

Command grammar
:TRIGGER:EVENT:LEVEL{1|2} <level>
In the above <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:EVENT:LEVEL1 1E-3"

The A trigger level is set to 1 mV.

Query grammar
:TRIGGER:EVENT:LEVEL{1|2}?

Return format
<level>

Programming example
PRINT @1;":TRIGGER:EVENT:LEVEL1?"
LINE INPUT @1;LEVEL$

The present A trigger level setting is returned.

(23) EVENT:PRESET<N>_____Command/query
Selects the event trigger level.

Command grammar
:TRIGGER:EVENT:PRESET{1|2} {USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:EVENT:PRESET1 TTL
Sets the A trigger level for TTL.

Query grammar
:TRIGGER:EVENT:PRESET{1|2}?

Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:EVENT:PRESET1?"
LINE INPUT @1;PRESET$
The presently selected trigger level of A trigger is returned.

Note: AUTOLEVEL can be selected only for the A trigger.

(24) EVENT:SLOPE<N>_____Command/query
Sets the event trigger slope.

Command grammar
:TRIGGER:EVENT:SLOPE{1|2} {POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:EVENT:SLOPE1 POSITIVE"
The above sets the trigger slope of A trigger to rising.

Query grammar
:TRIGGER:EVENT:SLOPE{1|2}?

Return format
{POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:EVENT:SLOPE1?"
LINE INPUT @1;SLOPE$

The present A trigger slope setting is returned.

(25) EVENT:SOURCE<N>_____Command/query
Selects the event trigger source.

Command grammar
:TRIGGER:EVENT:SOURCE{1|2}
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:EVENT:SOURCE1 CHANNEL1"
The above sets the A trigger source to channel 1.

Query grammar
:TRIGGER:EVENT:SOURCE{1|2}?

Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:EVENT:SOURCE1?"
LINE INPUT @1;SOURCE$

The presently selected A trigger source is returned.

(26) PATTERN:CHANNEL<N>_____Command/query
Sets the pattern trigger state for each channel.

Command grammar
:TRIGGER:PATTERN:CHANNEL {1|2|3|4} {HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:PATTERN:CHANNEL1: HIGH”

Sets the channel 1 trigger state to High level.

Query grammar
:TRIGGER:PATTERN:CHANNEL{1|2|3|4}?

Return format
{HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:PATTERN:CHANNEL1?"
LINE INPUT @1;CHANNEL$

The present channel 1 trigger state is returned.

(27) PATTERN:EXTERNAL Command/query

Sets the external pattern trigger input state.

Command grammar
:TRIGGER:PATTERN:EXTERNAL {HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:PATTERN:EXTERNAL HIGH"

Sets the external input trigger state to High level.

Query grammar
:TRIGGER:PATTERN:EXTERNAL?

Return format
{HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:PATTERN:EXTERNAL?"
LINE INPUT @1;EXTERNAL$

The present external input trigger state is returned.

(28) PATTERN:LEVEL<N> Command/query

Sets the pattern trigger level.

Command grammar
:TRIGGER:PATTERN:LEVEL{1|2|3|4|E} <level>

In the above, <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:PATTERN:LEVEL1 1E-3

Sets the trigger level of channel 1 to 1 mV.

Query grammar
:TRIGGER:PATTERN:LEVEL{1|2|3|4|E}?

Return format
<level>

Programming example
PRINT @1;":TRIGGER:PATTERN:LEVEL1?"
LINE INPUT @1;LEVEL$

The presently set trigger level of channel 1 is returned.

(29) PATTERN:PRESET<N>_____Command/query
Selects the pattern trigger level.

Command grammar
:TRIGGER:PATTERN:PRESET{1|2|3|4|E} {USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:PATTERN:PRESET1 TTL"

Sets the trigger level of channel 1 for TTL.

Query grammar
:TRIGGER:PATTERN:PRESET{1|2|3|4|E}?
Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:PATTERN:PRESET1?"
LINE INPUT @1;PRESET$
The presently selected trigger level of channel 1 is returned.

(30) PATTERN:TIME_____Command/query
Sets the pattern trigger decision time.

Command grammar
:TRIGGER:PATTERN:TIME <time>
In the above, <time>::=decision time (s) (NR3)

Programming example
PRINT @1;":TRIGGER:PATTERN:TIME 1E-3"
Sets the decision time to 1 ms.

Query grammar
:TRIGGER:PATTERN:TIME?
Return format
<time>

Programming example
PRINT @1;":TRIGGER:PATTERN:TIME?"
LINE INPUT @1;TIME$

The present pattern trigger decision time is returned.

(31) PULSE:COUPLING Command/query

Sets the pulse width trigger coupling.

Command grammar
:TRIGGER:PULSE:COUPLING {DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:PULSE:COUPLING DC"

Sets the coupling of pulse width trigger to DC.

Query grammar
:TRIGGER:PULSE:COUPLING?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:PULSE:COUPLING?"
LINE INPUT @1;COUPLING$

The presently set coupling is returned.

(32) PULSE:LEVEL Command/query

Sets the pulse width trigger level.

Command grammar
:TRIGGER:PULSE:LEVEL <level>

In the above <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:PULSE:LEVEL 1E-3"

The trigger level is set to 1 mV.

Query grammar
:TRIGGER:PULSE:LEVEL?
Return format
<level>

Programming example
PRINT @1;":TRIGGER:PULSE:LEVEL?"
LINE INPUT @1;LEVEL$

The present trigger level setting is returned.

(33) PULSE:PRESET Command/query

Selects the pulse width trigger level.

Command grammar
:TRIGGER:PULSE:PRESET {USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:PULSE:PRESET TTL"

The pulth trigger level is set for TTL.

Query grammar
:TRIGGER:PULSE:PRESET?

Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:PULSE:PRESET?"
LINE INPUT @1;PRESET$

The presently set pulth width trigger level is returned.

(34) PULSE:POLARITY Command/query

Sets the pulse width trigger polarity.

Command grammar
:TRIGGER:PULSE:POLARITY {POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:PULSE:POLARITY POSITIVE"

The above sets the trigger polarity to positive.

Query grammar
:TRIGGER:PULSE:POLARITY?

Return format
{POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:PULSE:POLARITY?"
LINE INPUT @1;POLARITY$

The present trigger POLARITY setting is returned.

(35) PULSE:SOURCE Command/query

Selects the pulse width trigger source.

Command grammar
:TRIGGER:PULSE:SOURCE
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:PULSE:SOURCE CHANNEL1"

The above sets the trigger source to channel 1.

Query grammar
:TRIGGER:PULSE:SOURCE?
Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:PULSE:SOURCE?"
LINE INPUT @1;SOURCE$

The presently selected trigger source is returned.

(36) PULSE:TIME Command/query

Sets the pulse width trigger decision time.

Command grammar
:TRIGGER:PULSE:TIME <time>

In the above, <time>::=decision time (s) (NR3)

Programming example
PRINT @1;":TRIGGER:PULSE:TIME 1E-3"

Sets the decision time to 1 ms.

Query grammar
:TRIGGER:PULSE:TIME?
Return format
<time>

Programming example
PRINT @1;":TRIGGER:PULSE:TIME?"
LINE INPUT @1;TIME$

The present pulse trigger decision time is returned.

(37) PULSE:WHEN Command/query

Sets the pulse width trigger decision condition.

Command grammar
:TRIGGER:PULSE:WHEN {OUTSIDE|WITHIN}

Programming example
PRINT @1;":TRIGGER:PULSE:WHEN OUTSIDE"

In the case the trigger occurs when pulse width is longer than set time.

Query grammar
:TRIGGER:PULSE:WHEN?

Return format
{OUTSIDE|WITHIN}

Programming example
PRINT @1;":TRIGGER:PULSE:WHEN?"
LINE INPUT @1;WHEN$

The decision condition is returned.

(38) STATE:CLOCK Command/query

Sets the clock source signal for state trigger.

Command grammar
:TRIGGER:STATE:CLOCK {CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:STATE:CLOCK:CHANNEL1"

In the case channel1 signal is selected as clock souce.

Query grammar
:TRIGGER:STATE:CLOCK?

Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:STATE:CLOCK?"
LINE INPUT @1;CLOCK$

The trigger clock setting is returned.

(39) STATE:CHANNEL<N>_____Command/query
Sets the trigger condition of each channel.

Command grammar
:TRIGGER:STATE:CHANNEL{1|2|3|4} {HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:STATE:CHANNEL1 HIGH"
In the case channel1 trigger level is set to HIGH.

Query grammar
:TRIGGER:STATE:CHANNEL{1|2|3|4}?

Return format
{HIGH|LOW|X}

Programming example
PRINT @1;" :TRIGGER:STATE:CHANNEL1?
LINE INPUT @1;CHANNEL$
The trigger level of channel1 is returned.

(40) STATE:EXTERNAL_____Command/query
Sets the trigger condition of external channel.

Command grammar
:TRIGGER:STATE:EXTERNAL{HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:STATE: EXTERNAL HIGH"
In the case trigger level of external channel signal is set to high.

Query grammar
:TRIGGER:STATE:EXTERNAL?

Return format
{HIGH|LOW|X}

Programming example
PRINT @1;":TRIGGER:STATE:EXTERNAL?"
LINE INPUT @1;EXTERNAL$
The trigger level of external channel signal is returned.

(41) STATE:LEVEL<N>_____Command/query
Sets the STATE trigger level.

Command grammar
:TRIGGER:STATE:LEVEL{1|2|3|4|E} <level>

In the above, <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:STATE:LEVEL1 1E-3"

Sets the channel1 trigger level to 1 mV.

Query grammar
:TRIGGER:STATE:LEVEL{1|2|3|4|E}?

Return format
<level>

Programming example
PRINT @1;":TRIGGER:STATE:LEVEL1?"
LINE INPUT @1;LEVEL$

The presently set channel1 trigger level is returned.

(42) STATE:PRESET<N>_____Command/query
Selects the STATE trigger level.

Command grammar
:TRIGGER:STATE:PRESET{1|2|3|4|E} {USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:STATE:PRESET1 TTL"

Sets the channel1 trigger level to TTL.

Query grammar
:TRIGGER:STATE:PRESET{1|2|3|4|E}?
Return format
{USER|AUTOLEVEL|TTL|ECL}

Programming example
PRINT @1;":TRIGGER:STATE:PRESET1?"
LINE INPUT @1;PRESET$
The presently selected channel1 trigger level is returned.

(43) STATE:SLOPE<N>_____Command/query
Sets the STATE trigger clock slope.

Command grammar
:TRIGGER:STATE:SLOPE {POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:STATE:SLOPE POSITIVE"
The above sets the state trigger clock slope to rising.

Query grammar
:TRIGGER:STATE:SLOPE?

Return format
{POSITIVE|NEGATIVE}

Programming example
PRINT @1;":TRIGGER:STATE:SLOPE?"
LINE INPUT @1;SLOPE$

The present trigger clock slope setting is returned.

(44) TV:FIELD_____Command/query
Sets the field for TV LINE trigger mode.

Command grammar
:TRIGGER:TV:FIELD {1|2}

Programming example
PRINT @1;":TRIGGER:TV:FIELD 1"
The above sets the field to 1.

Query grammar
:TRIGGER:TV:FIELD?

Return format
{1|2}

Programming example
PRINT @1;":TRIGGER:TV:FIELD?"
LINE INPUT @1;FIELD$

The present field setting of TV LINE trigger is returned.

(45) TV:MODE Command/query

Sets the mode of TV trigger.

Command grammar
:TRIGGER:TV:MODE {TV_V|TV_H|TVLINE}

Programming example
PRINT @1;":TRIGGER:TV:MODE TV_V"

The above sets mode of trigger to TV_V.

Query grammar
:TRIGGER:TV:MODE?

Return format
{TV_V|TV_H|TVLINE}

Programming example
PRINT @1;":TRIGGER:TV:MODE?"
LINE INPUT @1;MODE$

The present mode setting of TV trigger is returned.

(46) TV:SOURCE Command/query

Selects the TV trigger source.

Command grammar
:TRIGGER:TV:SOURCE
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:TV:SOURCE CHANNEL1"

The above sets the trigger source to channel 1.

Query grammar
:TRIGGER:TV:SOURCE?

Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:TV:SOURCE?"
LINE INPUT @1;SOURCE$

The presently selected trigger source is returned.

(47) TV:STANDARD_____Command/query
Selects the type of TV signal in the TV LINE mode of TV trigger function.

Command grammar
:TRIGGER:TV:STANDARD{525|625}

Programming example
PRINT @1;":TRIGGER:TV:STANDARD 525"

The above sets the type of TV signal to 525 TV lines.

Query grammar
:TRIGGER:TV:STANDARD?
Return format
{525|625}

Programming example
PRINT @1;":TRIGGER:TV:STANDARD?"
LINE INPUT @1;STANDARD$
The presently selected type of TV signal is returned.

(48) WINDOW:ACTION_____Command/query
Selects window trigger condition.

Command grammar
:TRIGGER:WINDOW:ACTION{IN|OUT}

Programming example
PRINT @1;":TRIGGER:WINDOW:ACTION IN"

Query grammar
:TRIGGER:WINDOW:ACTION?

Return format
{IN|OUT}

Programming example
PRINT @1;":TRIGGER: WINDOW:ACTION?"
LINE INPUT @1;ACTION$

(49) WINDOW:COUPLING Command/query

Command grammar
:TRIGGER:WINDOW:COUPLING{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:WINDOW:COUPLING DC"

Sets the trigger coupling to DC.

Query grammar
:TRIGGER:WINDOW:COUPLING?
Return format
{DC|AC|LFREJ|HFREJ}

Programming example
PRINT @1;":TRIGGER:WINDOW:COUPLING?"
LINE INPUT @1;COUPLING$

The presently set trigger coupling is returned.

(50) WINDOW:LOWERLEVEL Command/query

Sets the lower level of trigger boundary of WINDOW trigger.

Command grammar
:TRIGGER:WINDOW:LOWERLEVEL <level>
In the above <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:WINDOW:LOWERLEVEL 1E-3"

The window trigger lower level is set to 1 mV.

Query grammar
:TRIGGER:WINDOW:LOWERLEVEL?

Return format
<level>

Programming example
PRINT @1;":TRIGGER:WINDOW:LOWERLEVEL?"
LINE INPUT @1;LOWERLEVEL$

The present lowerlevel setting is returned.

(51) WINDOW:SOURCE Command/query

Selects the window trigger source.

Command grammar
:TRIGGER:WINDOW:SOURCE
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:WINDOW:SOURCE CHANNEL1"

The above sets the trigger source to channel 1.

Query grammar
:TRIGGER:WINDOW:SOURCE?
Return format
{CHANNEL1|CHANNEL2|CHANNEL3|CHANNEL4|EXTERNAL}

Programming example
PRINT @1;":TRIGGER:WINDOW:SOURCE?"
LINE INPUT @1;SOURCE$

The presently selected trigger source is returned.

(52) WINDOW:UPPERLEVEL Command/query

Sets the upper level of trigger boundary of WINDOW trigger.

Command grammar
:TRIGGER:WINDOW:UPPERLEVEL <level>

In the above <level>::=trigger level voltage (NR3)

Programming example
PRINT @1;":TRIGGER:WINDOW:UPPERLEVEL 1E-3"

The window trigger upper level is set to 1 mV.

Query grammar
:TRIGGER:WINDOW:UPPERLEVEL?

Return format
<level>

Programming example
PRINT @1;":TRIGGER:WINDOW:UPPERLEVEL?"
LINE INPUT @1;UPPERLEVEL$

The present upperlevel setting is returned.

9.3.10 Waveform sub-system command code programming grammar

The waveform sub-system commands control the transmission of acquired waveform data.
The following commands can be used with this equipment.

header	command / query	program data
:WAVEFORM:DATA	q	-
:WAVEFORM:FORMAT	c/q	“BYTE”, “ASCII”
:WAVEFORM:POINTS	c/q	-
:WAVEFORM:SOURCE	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”, “DISPLAY1_A”, “DISPLAY1_B1”, “DISPLAY1_B2”, “DISPLAY2_A”, “DISPLAY2_B1”, “DISPLAY2_B2”, “DISPLAY3_A”, “DISPLAY3_B1”, “DISPLAY3_B2”, “DISPLAY4_A”, “DISPLAY4_B1”, “DISPLAY4_B2”, “MATH1_A”, “MATH1_B1”, “MATH1_B2” “MATH2_A”, “MATH2_B1”, “MATH2_B2” “MATH3_A”, “MATH3_B1”, “MATH3_B2” “MATH4_A”, “MATH4_B1”, “MATH4_B2”
:WAVEFORM:XINCREMENT	q	-
:WAVEFORM:XORIGIN	q	-
:WAVEFORM:XREFERENCE	q	-
:WAVEFORM:YINCREMENT	q	-
:WAVEFORM:YORIGIN	q	-
:WAVEFORM:YREFERENCE	q	-
:WAVEFORM:SEGMENT	c/q	11024
:WAVEFORM:START	c/q	01999999

Note) Two channel models do not include “CHANNEL3”,”CHANNEL4”,”DISPLAY3”,”DISPLAY4”.

The command syntax of the WAVEFORM sybsystem is shown below.

(1) DATA Query

The DATA command returns the waveform data.

Query grammar
:WAVEFORM:DATA?
Returned format
<block_data>

Where, <block_data>::=#80000 XXXX<binarydata>

(2) FORMAT Command/query

The FORMAT command sets the waveform format.
When data of acquisition memory is selected as source, BYTE format is selected automatically.

Command grammar
:WAVEFORM:FORMAT {BYTE| ASCII}

Query grammar
:WAVEFORM:FORMAT?

Returned format
{BYTE | ASCII}

Programming example
PRINT @1;":WAVEFORM:FORMAT BYTE"

The waveform data format is set to BYTE.

Programming example
PRINT @1;":WAVEFORM:FORMAT?"
INPUT @1;FORMAT$

The present data format is returned.

(3) POINTS Command/query

The POINTS command sets the number of returned waveform data.

Command grammar
:WAVEFORM:POINTS <point>

Query grammar
:WAVEFORM:POINTS?

Returned format
<point>

Example
PRINT @1;":WAVEFORM:POINTS 1024"

The number of returned waveform data is set to 1024.

Example
PRINT @1;":WAVEFORM:POINTS?"
INPUT @1;POINTS$

(4) SOURCE Command/query

The SOURCE command sets the source channel of the returned waveform data.

Command grammar

:WAVEFORM:SOURCE{CHANNEL{1|2|3|4}|DISPLAY{1|2|3|4}_ {A|B1|B2}|
MATH{1|2|3|4}_{A|B1|B2}}

Example

PRINT @1;":WAVEFORM:SOURCE CHANNEL1"

Query grammar

:WAVEFORM:SOURCE?

Returned format

{CHANNEL{1|2|3|4}|DISPLAY{1|2|3|4}_{A|B1|B2}|MATH{1|2|3|4}_{A|B1|B2}}

Example

PRINT @1;":WAVEFORM:SOURCE?"
INPUT @1;SOURCE$

(5) XINCREMENT Query

The XINCREMENT command returns the sample period per point of waveform data in the memory area.

Query grammar

:WAVEFORM:XINCREMENT?

Returned format

<value>

Where, <value>::=Sample period (second) (NR3)

Example

PRINT @1;":WAVEFORM:XINCREMENT?"
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 grammar
:WAVEFORM:XORIGIN?
Returned format
<value>

Where, <value>::=DELAY time (second) (NR3)

Example
```
PRINT  @1;":WAVEFORM:XORIGIN?"
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 grammar
: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 returns GAIN per point of waveform data in the memory area.

Query grammar
:WAVEFORM:YINCREMENT?
Returned format
<value>

Where, <value>::=GAIN (Volt) (NR3)

Example
```
PRINT  @1;":WAVEFORM:YINCREMENT?"
INPUT  @1;VALUE$
```

The GAIN per point of present waveform data in the memory area is returned.

(9) YORIGIN Query

The YORIGIN command returns OFFSET of waveform data in the memory area.

Query grammar
:WAVEFORM:YORIGIN?
Returned format
<value>
Where, <value>::=OFFSET (Volt) (NR3)

Example
```
PRINT @1;":WAVEFORM:YORIGIN?"
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 grammar
:WAVEFORM:YREFERENCE?
Returned format
<value>
Where, <value>::=Data value

Example
```
PRINT @1;":WAVEFORM:YREFERENCE?"
INPUT @1;YREFERENCE$
```
The data value corresponding to present YORIGIN is returned.

(11) SEGMENT Command/query

Set the segment of the waveform returned in the memory split mode.

Command grammar
:WAVEFORM:SEGMENT<seg>

Where: <seg>::=1 to 1024

Query grammar
:WAVEFORM:SEGMENT?
Returned format
<seg>

(12) START command/query

Set the start point of the returned waveform.

Command syntax
:WAVEFORM:START<point>

Where: <point>::=0 to 1999999

Query syntax
:WAVEFORM:START?
Returned format
<point>

9.3.11 Math sub-system command code programming grammar

The following Math sub-system commands can be used with this equipment.

header	command / query	program data
:MATH<N>:OPERAND<N>	c/q	“CHANNEL1”, “CHANNEL2”, “CHANNEL3”, “CHANNEL4”
:MATH<N>:OPERATOR	c/q	“OFF”, “ABSOLUTEI”, “ADD”, “SUBTRACT”, ”MULTIPLY”, “VERSUS”, “FFT”

Note: Two channel models do not have channels 3 and 4.

The Math sub-system command syntax is indicated below.

(1) OPERAND<N>_____Command/query
Sets the operand of the selected function (channels 3 and 4 absent is 2 channel models).

Command grammar
MATH{1|23|4}:OPERAND{1|2} CHANNEL{1|2|3|4}

Programming example
PRINT @1;":MATH1:OPERAND2 CHANNEL4"

Math 1 operand 2 is set for channel 4.

Query grammar
: MATH{1|2|3|4}:OPERAND{1|2}?

Return format
CHANNEL{1|2|3|4}

Programming example
PRINT @1;":MATH1:OPERAND1?"
INPUT @1;OPERAND1$

The present Math 1 operand 1 is returned.

(2) OPERATOR_____Command/query
Sets the operator for the selected function.

Command grammar
:MATH{1|2|3|4}:OPERATOR {OFF|ABSOLUTE|ADD|SUBTRACT|MULTIPLY|VERSUS|FFT}

Programming example
PRINT @1;":MATH1:OPERATOR ADD"

Sets the Math 1 operator to Add.

Query grammar
:MATH{1|2|3|4}:OPERATOR?

Return format
{INVERT|ABSOLUTE|ADD|SUBTRACT|MULTIPLY|VERSUS|FFT}

Programming example
PRINT @1;":MATH1:OPERATOR?"
INPUT @1;OPERATOR$

The present Math 1 operator is returned.

9.3.12 HARDCOPY sub-system command code programming grammar

The HARDCOPY subsystem commands control the plot output function of the instrument. The following HARDCOPY subsystem commands can be used in the instrument.

header	command / query	program data
:HARDCOPY:FORMFEED	c/q	“OFF”, “ON”
:HARDCOPY:MODE	c/q	“ALL”, “WAVEFORM”, “FACTOR”, “SCREEN”(for ESC/P_COLOR, DESKJET_COLOR only)
:HARDCOPY:PAPER	c/q	“A3”, “A4”, ”US_LETTER”
:HARDCOPY:PENCHANGE	c/q	“ON”, “OFF”
:HARDCOPY:POSITION	c/q	“AUTO”, “1”, “2”, “3”, “4”
:HARDCOPY:SIZE	c/q	“1/1”, “1/2”, “1/4”
:HARDCOPY:TYPE	c/q	“HPGL”, “ESC/P”, “PC_PR201”, “ESC/P_COLOR”, “DESKJET_COLOR”, “LASERJET”
:HARDCOPY:INTERFACE	c/q	“RS-232C”, “GPIB”, “CENTRONIX”

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

(1) FORMFEED Command/query

Sets form feed.

Command grammar
:HARDCOPY:FORMFEED{OFF|ON}

Programming example
PRINT @1;":HARDCOPY:FORMFEED ON"

Sets form feed to on during hard copy.

Query grammar
:HARDCOPY:FORMFEED?

Return format
{OFF|ON}

Programming example
```
PRINT  @1;":HARDCOPY:FORMFEED?"
LINE INPUT  @1;FORMFEED$
```

Present form feed setting is returned.

(2) MODE Command/query

Sets hard copy output object.

Command grammar
:HARDCOPY:MODE{ALL|WAVEFORM|FACTOR|SCREEN}
(SCREEN is for ESC/P_COLOR|DESKJET_COLOR only)

Programming example
```
PRINT  @1;":HARDCOPY:MODE  ALL"
```

Sets plot output object to all.

Query grammar
:HARDCOPY:MODE?

Return format
{ALL|WAVEFORM|FACTOR|SCREEN}
(SCREEN is for ESC/P_COLOR|DESKJET_COLOR only)

Programming example
```
PRINT  @1;":HARDCOPY:MODE?"
INPUT  @1;MODE$
```

The present output object is returned.

(3) PAPER Command/query

Sets the paper size for plot output.

Command grammar
:HARDCOPY:PAPER (A3|A4|US_LETTER)

Programming example
```
PRINT @1;":HARDCOPY:PAPER A4"
```

The paper size is set for A4.

Query grammar
:HARDCOPY:PAPER?

Return format
{A3|A4|US_LETTER}

Programming example
```
PRINT @1;":HARDCOPY:PAPER?"
INPUT @1;PAPER$
```

The present paper size is returned.

(4) PENCHANGE Command/query

Sets the pen change mode during plot output.

Command grammar
:HARDCOPY:PENCHANGE {ON|OFF}

Programming example
```
PRINT @1;":HARDCOPY:PENCHANGE ON"
```

Sets the pen change mode to on.

Query grammar
:HARDCOPY:PENCHANGE?

Return format
{ON|OFF}

Programming example
```
PRINT @1;":HARDCOPY:PENCHANGE?"
INPUT @1;PENCHANGE$
```

Present pen change mode setting is returned.

(5) POSITION Command/query

Sets plot position.

Command grammar
:HARDCOPY:POSITION {AUTO|1|2|3|4}

Programming example
PRINT @1;":HARDCOPY:POSITION AUTO"

Sets plot position to auto.

Query grammar
:HARDCOPY:POSITION?

Return format
{AUTO|1|2|3|4}

Programming example
PRINT @1;":HARDCOPY:POSITION?"
INPUT @1;POSITION$

The present position is returned.

(6) SIZE Command/query

Sets plot size.

Command grammar
:HARDCOPY:SIZE {1/1|1/2|1/4}

Programming example
PRINT @1;":HARDCOPY:SIZE 1/2"

Sets plot size to 1/2.

Query grammar
:HARDCOPY:SIZE?

Return format
{1/1|1/2|1/4}

Programming example
PRINT @1;":HARDCOPY:SIZE?"
INPUT @1;SIZE$

Present plot size is returned.

(7) TYPE Command/query

Sets hardcopy printer type.

Command grammar
:HARDCOPY:TYPE {HPGL| ESC/P|PC_PR201|ESC/P_COLOR|DESKJET_COLOR|LASERJET}

Programming example
PRINT @1;":HARDCOPY:TYPE ESC/P"

Query grammar
:HARDCOPY:TYPE?

Return format
{HPGL|ESC/P|PC-PR201|ESC/P_COLOR|DESKJET_COLOR|LASERJET}

Programming example
PRINT @1;":HARDCOPY:TYPE?"
LINE INPUT @1;PRINTER$

(8) INTERFACE Command/query

Designates hardcopy output.

Command grammar
:HARDCOPY:INTERFACE {RS_232C|GPIB|CENTRONIX}

Query grammar
:HARDCOPY:INTERFACE?

Return format
{RS_232C|GPIB|CENTRONIX}

9.3.13 GO-NOGO sub-system command code programming grammar

These commands control the GO-NOGO decision functions.
The following commands can be used with this equipment.

header	command / query	program data
:GO-NOGO:MODE	c/q	“OFF”, “ON”
:GO-NOGO:SOURCE	c/q	“ANY”, “CHANNEL1”, “CHANNEL2”, “CHANNEL3”, ”CHANNEL4”, “MATH1”, “MATH2”, “MATH3”, ”MATH4”
:GO-NOGO:CONDITION	c/q	“APART_IN”, “APART_OUT”, “ALL_IN”, “ALL_OUT”
:GO-NOGO:REACTION	c/q	“NONE”, “BEEP”, “HOLD”, “SAVE”, “HARDCOPY”
:GO-NOGO:START	c/q	-250 to 250
:GO-NOGO:STOP	c/q	-250 to 250

Note: Two channel models do not have channels 3 and 4.

The GO-NOGO sub-system command syntax in indicated below.

(1) MODE Command/query

Sets GO-NOGO function on/off.

Command grammar
:GO-NOGO:MODE {ON|OFF}

Programming example
PRINT @1;":GO-NOGO:MODE ON"

Sets GO-NOGO function on.

Query grammar
:GO-NOGO:MODE?

Return format
{ON|OFF}

Programming example
PRINT @1;":GO-NOGO:MODE?"
INPUT @1;MODE$

Present setting is returned.

(2) SOURCE Command/query

Selects waveform for GO-NOGO decision.

Command grammar
:GO-NOGO:SOURCE {CHANNEL{1|2|3|4}|MATH{1|2|3|4}|ANY}

Programming example
PRINT @1;":GO-NOGO:SOURCE CHANNEL1"

Selects channel 1 waveform.

Query grammar
:GO-NOGO:SOURCE?

Return format
{CHANNEL{1|2|3|4}|MATH{1|2|3|4}|ANY}

Programming example
PRINT @1;":GO-NOGO:SOURCE?"
INPUT @1;SOURCE$

The present setting is returned.

(3) CONDITION Command/query

Sets GO-NOGO function for a part or all.

Command grammar
:GO-NOGO:CONDITION {APART_IN|APART_OUT|ALL_IN|ALL_OUT}

Programming example
PRINT @1;":GO-NOGO:CONDITION APART_IN"

Setting " a part is in " is selected.

Query grammar
:GO-NOGO:CONDITION?

Return format
{APART_IN|APART_OUT|ALL_IN|ALL_OUT}

Programming example
PRINT @1;":GO-NOGO:CONDITION?"
INPUT @1;CONDITION$

Present setting is returned.

(4) REACTION Command/query

Sets process following GO-NOGO function.

Command grammar
:GO-NOGO:REACTION (NONE|BEEP|HOLD|SAVE|HARDCOPY}

Programming example
PRINT @1;":GO-NOGO:REACTION HARDCOPY"

Selects printer output to follow GO-NOGO decision.

Query grammar
:GO-NOGO:REACTION?

Return format
{NONE|BEEP|HOLD|SAVE|HARDCOPY}

Programming example
PRINT @1;":GO-NOGO:REACTION?"
INPUT @1;REACTION$

The subsequent process is returned.

(5) START **Command/query**

Sets the left position of the GO-NOGO range.

Command grammar
:GO-NOGO:START <position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":GO-NOGO:START -200"

The left bar is set to -200.

Query grammar
:GO-NOGO:START?

Return format
<position>

Programming example
PRINT @1;":GO-NOGO:START?"
INPUT @1;START$
The present left bar position is returned.

(6) STOP **Command/query**

Sets the right position of the GO-NOGO range.

Command grammar
:GO-NOGO:STOP <position>
In the above, <position>::=-250 to 250

Programming example
PRINT @1;":GO-NOGO:STOP 200"
The right bar is set to 200.

Query grammar
:GO-NOGO:STOP?

Return format
<position>

Programming example
PRINT @1;":GO-NOGO:STOP?"
INPUT @1;STOP$

The present right bar position is returned.

9.3.14 CLOCK sub-system command code programming grammar

The CLOCK subsystem commands set the calender and clock of the instrument.
The following CLOCK subsystem commands can be used in the instrument.

header	command / query	program data
:DATE:YEAR	c/q	0 to 99
:DATE:MONTH	c/q	1 to 12
:DATE:DAY	c/q	1 to 31
:TIME:HOUR	c/q	0 to 23
:TIME:MINUTE	c/q	0 to 59

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

DATE

(1) YEAR Command/query

Sets the present year.

Command grammar
":DATE:YEAR <number>
In the above, <number>::=0 to 99

Programming example
PRINT @1,":DATE:YEAR 98"
The year is set to 98.

Query grammar
:DATE:YEAR?

Return format
<number>

Programming example
PRINT @1,":DATE:YEAR?"
LINE INPUT @1,YEAR$

The present year is returned.

(2) MONTH Command/query

Sets the present month.

Command grammar
":DATE:MONTH <number>
In the above, <number>::=1 to 12

Programming example
PRINT @1,":DATE:MONTH 1"
Sets the month to 1.

Query grammar
:DATE:MONTH?

Return format
<number>

Programming example
PRINT @1,":DATE:MONTH?"
LINE INPUT @1,MONTH$
The present month is returned.

(3) DAY **Command/query**

Sets the present day.

Command grammar
":DATE:DAY <number>
In the above, <number>::=1 to 31

Programming example
PRINT @1,":DATE:DAY 1"
Sets the day to 1.

Query grammar
:DATE:DAY?

Return format
<number>

Programming example
PRINT @1,":DATE:DAY?"
LINE INPUT @1,DAY$
The present day is returned.

TIME

(1) HOUR **Command/query**

Sets the present hour.

Command grammar
":TIME:HOUR <number>
In the above, <number>::=0 to 23

Programming example
PRINT @1,":TIME:HOUR 10"
Sets the hour to 10.

Query grammar
:TIME:HOUR?
Return format
<number>

Programming example
PRINT @1,":TIME:HOUR?"
LINE INPUT @1,HOUR$
The present hour is returned.

(2) MINUTE **Command/query**

Sets the present minute.

Command grammar
":TIME:MINUTE <number>

Programming example
PRINT @1,":TIME:MINUTE 10"
Sets the minutes to 10.

Query grammar
:TIME:MINUTE?

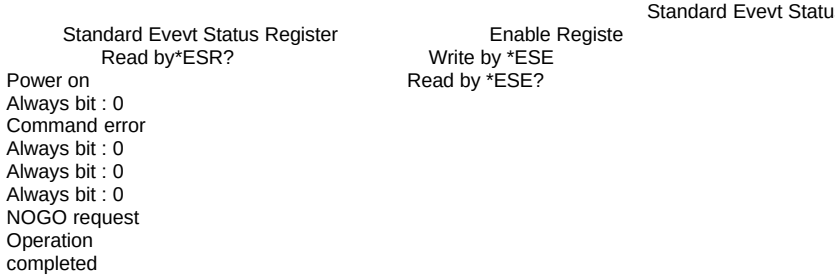
Return format
<number>

Programming example
```
PRINT  @1,":TIME:MINUTE?"
LINE INPUT  @1,MINUTE$
```
The present minutes are returned.

9.4 Status report function

For the situation of errors caused by a programming function, refer to following figure: Data structure of status report function.

Each register in the figure can be set/returned by a common command.



Data structure of status report function

9.5 Programming example of receiving waveform data

```
10      DIM  IWAVE$(512)
20      WINDOW(0,0) - (1256,1258)
30      SCREEN  3,0  :  CLS  3
40      VIEW(5,5) - (600,340),,0
50      LINE(0,0) - (512,255),,B
60      ISET     IFC
70      CMD      DELIM=2
80      PRINT    @1;":TIMEBASE:RANGE 10M; "@
90      PRINT    @1;":VIEW CHANNEL2; "@
100     PRINT    @1;":WAVEFORM:SOURCE CHANNEL2; "@
110     PRINT    @1;":WAVEFORM:POINTS 512; "@
```

```
120       PRINT   @1;":DIGITIZE; "@
130       PRINT   @1;":WAVEFORM:DATA?; "@
140       RBYTE  &H3F,&H5F,&H41.&H20;DAT
150       RBYTE  ;SLEN :  STRLEN = VAL( CHR$ (SLEN) )
160       FOR      I=1  TO  STRLEN
170       RBYTE  ;BLEN
180       BLEN$ = BLEN$ + CHR$(BLEN)
190       NEXT
200       BLOCKLEN = VAL(BLEN$)
210       FOR      I=1  TO  BLOCKLEN
220       RBYTE  ;DAT
230       LINE(I,255-DAT) - (I + 1 , 255 - DAT+1) , 6
240       NEXT
250       END
```

Description of program

Line 20	Screen setting
Line 60	GPIB interface clear
Line 70	Delimiter setting = L/F
Line 80	Time range setting to 1ms
Line 90	Change to CHANNEL1 in the case of CHANNEL1
Line 100	Waveform data source channel
Line 110	Specifying number of waveform data
Line 120	Single shot
Line 130	Waveform data receive command
Line 140	UNL, UNT, T1, L0, ' # ' is read
Line 150	' 8' is read
Line 160	Reading 00000512
Line 220	Receiving waveform data
Line 230	Displaying waveform data

9.6 Major causes for improper data transfer

(1) The cable is not connected, or the system is not turned on. (*1)
(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) Delimiter 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 a controller receives data. (Example: sending: C/R, EOI, receiving: C/R, L/F)
(5) A function which is not available with this oscilloscope is attempted to execute. (Example: PPC, GET, TCT, etc.)
(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) In serial pole, the address of the status register for detecting SRQ of the controll line is specified in error.
(8) There is an error in the program statement, or the use of hexadecimal and decimal.

*1 When the instrument is turned off, it naturally does not work. When more than one instrument is connected through GPIB and an instrument which is not in use is turned off, the noise margine of the bus line may lower to cause misoperation. It is recommended to remove the instrument not in use from the system or turn on the instrument even not in use.

When data transfer is not successful, check the above again.