SB5000 Series
Vehicle Serial Bus Analyzer

USER'S MANUAL

YOKOGAWA
Yokogawa Electric Corporation

IM 701361-01E
1st Edition

Product Registration

Thank you for purchasing YOKOGAWA products.

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Foreword

Thank you for purchasing the SB5000 Series Vehicle Serial Bus Analyzer (SB5310/SB5710, hereafter referred to as the SB5000). This user's manual contains useful information about the functions, operating procedures, and handling precautions of the SB5000. To ensure correct use, please read this manual thoroughly before beginning operation. After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation. The following two manuals, including this one, are provided as manuals for the SB5000. Read them along with this manual.

Manual Title	Manual No.	Description
SB5000 Series Vehicle Serial Bus Analyzer User's Manual	IM 701361-01E	This manual. Explains all functions and procedures of the SB5000 series excluding the communication functions.
SB5000 Series Vehicle Serial Bus Analyzer Communication Interface User's Manual (in CD)	IM 701361-17E	Explains the communication interface functions of the SB5000 series.
DL9000 Series Digital Oscilloscope/ SB5000 Series Vehicle Serial Bus Analyzer Power Supply Analysis Function User's Manual	IM 701310-61E	Explains the operating procedures of the optional power supply analysis function.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from the actual screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of Yokogawa Electric Corporation is strictly prohibited.

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- Other company and product names are trademarks or registered trademarks of their respective companies.

Revisions

- 1st Edition: January 2008

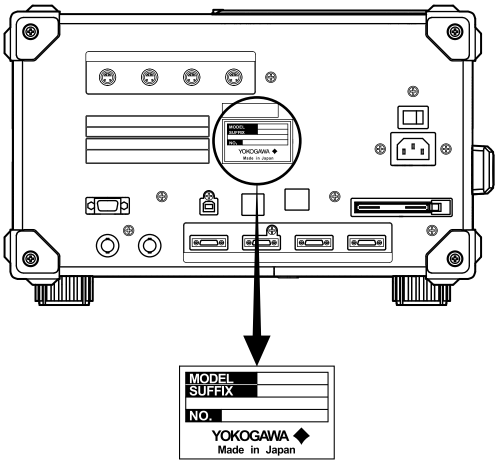
1st Edition : January 2008 (YK)

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If some of the contents are not correct or missing or if there is physical damage, contact the dealer from whom you purchased them.

SB5000

Check that the product that you received is what you ordered. The table below contains information about the available models, suffix codes, and options for your reference.



MODEL	SUFFIX	Specifications
701351		SB5310 Vehicle Serial Bus Analyzer, 4 channels + 8-bit logic, 5 GS/s, 1 GHz, max. 6.25 MW/channel
701361		SB5710 Vehicle Serial Bus Analyzer, 4 channels + 8-bit logic, 5 GS/s, 1 GHz, max. 6.25 MW/channel
Power cord	-D	UL/CSA Standard power cord (Part No.: A1006WD) [Maximum rated voltage: 125 V]
	-F	VDE Standard Power Cord (Part No.: A1009WD) [Maximum rated voltage: 250 V]
	-Q	BS Standard Power Cord (Part No.: A1054WD) [Maximum rated voltage: 250 V]
	-R	AS Standard Power Cord (Part No.: A1024WD) [Maximum rated voltage: 250 V]
	-H	GB Standard Power Cord (Part No.: A1064WD) [Maximum rated voltage: 250 V]
Help language	-HE	English
	-HJ	Japanese
	-HC	Chinese
	-HK	Korean
Options	/B5	Built-in printer
	/P4	Rear panel probe power
	/C8[1]	Built-in hard disk drive + Ethernet interface
	/C10[1]	Ethernet interface
	/G2[2]	User-defined computation
	/G4[2]	Power supply analysis function

1 /C8 and /C10 options cannot be specified simultaneously.
2 /G2 and /G4 options cannot be specified simultaneously. /G4 includes /G2.

No. (Instrument Number)

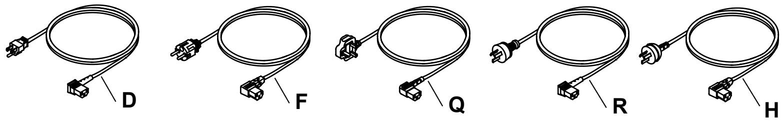
When contacting the dealer from which you purchased the instrument, please give them the instrument number.

Standard Accessories

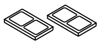
The standard accessories below are supplied with the instrument. Check that all contents are present and that they are undamaged.

Power Cord (one of the following power cords is supplied according to the instrument's suffix codes)

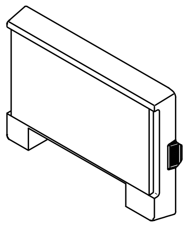
UL/CSA Standard A1006WD | **VDE Standard A1009WD** | **BS Standard A1054WD** | **AS Standard A1024WD** | **GB Standard A1064WD**



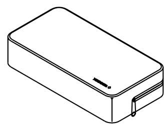
Rubber feet (4 pieces)
(2 A9088ZM sheets)



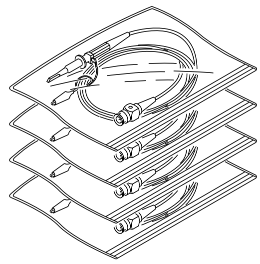
Front panel protection cover
B8080EM



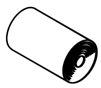
Soft case
B8081HG



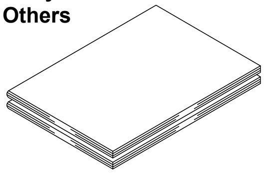
500 MHz Passive Probe PB500
701943 4 probes



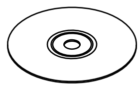
Printer roll paper[1]
B9850NX 1 roll



A set of manuals
- **This manual**
- **User's manual for the power supply analysis function[2]**
- **Others**



Communication interface User's manual[3]
B8081RF(CD)



1 When using the optional built-in printer (/B5)
2 Included with the /G4 option.
3 Printed manual IM701361-17E can be purchased separately. Contact your nearest YOKOGAWA dealer.

Optional Accessories (Sold Separately)

The optional accessories below are available for purchase separately. For information and ordering, contact your nearest YOKOGAWA dealer.

Name		Model	Remarks
With the YOKOGAWA probe interface			
Active probe	PBA2500	701913	DC to 2.5 GHz bandwidth, 100 kΩ, 0.9 pF
	PBA1500	701914	DC to 1.5 GHz bandwidth, 100 kΩ, 0.9 pF
	PBA1000	701912	DC to 1 GHz bandwidth, 100 kΩ, 0.9 pF
Differential probe	PBD2000	701923	DC to 2 GHz bandwidth, 50 kΩ, 1.1 pF
	PBDH1000 (available soon)	701924	DC to 1 GHz bandwidth, 1 MΩ, max. ±35 V
Current probe	PBC100	701928	DC to 100 MHz bandwidth, 30 A_{rms}
	PBC050	701929	DC to 50 MHz bandwidth, 30 A_{rms}
Passive probe	PB500	701943	DC to 500 MHz bandwidth, 10 MΩ
Passive probe for 50 Ω			
Low Capacitance Probe	PBL5000	701974	DC to 5GHz bandwidth, 500 Ω/1 kΩ, 0.25 pF/0.4 pF, with an SMA-BNC adapter
DC Block		701975	For 50 Ω input, SMA, 30 MHz to 6 GHz
Passive probe for high voltage			
100:1 probe		701944	DC to 400 MHz bandwidth, 1000 V_{rms}, 1.2 m in length
		701945	DC to 250 MHz bandwidth, 1000 V_{rms}, 3 m in length
Logic probe		701980	1MΩ, toggle frequency 100 MHz, 8 bits
		701981	10kΩ, toggle frequency 250 MHz, 8 bits
FET probe		700939	900MHz bandwidth, 2.5 MΩ, 1.8 pF
Differential probe		700924	DC to 100 MHz bandwidth, max. ±1400 V
		700925	DC to 15 MHz bandwidth, max. ±500 V
		701920	DC to 500 MHz bandwidth, max. common mode ±30 V
		701921	DC to 100 MHz bandwidth, max. ±700 V
		701922	DC to 200 MHz bandwidth, max. common mode ±60 V
Current probe		701932	DC to 100 MHz bandwidth, 30 A_{rms}
		701933	DC to 50 MHz bandwidth, 30 A_{rms}
Deskew correction signal source		701935	Approx. 0 to 5 V, Approx. −100 to 0 mA, Approx. 15 kHz
Dedicated GO/NO-GO cable		366973	—
Rack mount kit		701983-01	For EIA
		701983-02	For JIS

Spare Parts (Sold Separately)

The spare parts below are available for purchase separately.

For information about the spare parts and ordering, contact your dealer.

Part Name	Part No.	Minimum Q’ty	Remarks
Printer roll paper	B9850NX	5	Thermo-sensible paper, 111 mm × 30 m

Safety Precautions

This instrument is an IEC protection class I instrument (provided with terminal for protective earth grounding).
The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. Yokogawa Electric Corporation assumes no liability for the customer’s failure to comply with these requirements.

The Following Symbols Are Used on This Instrument.

Warning: handle with care. Refer to the user’s manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.

Protective ground terminal

Functional ground terminal (do not use this terminal as a protective ground terminal.)

Alternating current

Direct current

ON (power)

OFF (power)

Stand-by

In-position of a bi-stable push control

Out-posotion of a bi-stable push control

Make sure to comply with the precautions below. Not complying might result in injury or death.

WARNING

Use the Correct Power Supply
Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the SB5000 and that it is within the maximum rated voltage of the provided power cord.

Use the Correct Power Cord and Plug
To prevent the possibility of electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. Do not invalidate this protection by using an extension cord without protective earth grounding.

Connect the Protective Grounding Terminal
Make sure to connect the protective earth to prevent electric shock before turning ON the power. The power cord that comes with the instrument is a three-pin type power cord. Connect the power cord to a properly grounded three-pin outlet.

Do Not Impair the Protective Grounding
Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so poses a potential shock hazard.

Do Not Operate with Defective Protective Grounding or Fuse
Do not operate the instrument if the protective earth or fuse might be defective. Make sure to check them before operation.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such environments constitutes a safety hazard.

Do Not Remove Covers
The cover should be removed by YOKOGAWA’s qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.

Ground the Instrument before Making External Connections
Securely connect the protective grounding before connecting to the item under measurement or an external control unit. If you are going to touch the circuit, make sure to turn OFF the circuit and check that no voltage is present. To prevent the possibility of electric shock or an accident, connect the ground of the probe and input connector to the ground of the item being measured.

See below for operating environmental limitations.

CAUTION

This product is a Class A (for industrial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference.

Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is only valid in the EU.)
This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Symbols and Notations Used in This Manual

Safety Markings

The following markings are used in this manual.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attentions to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for proper operation of the instrument.

Subheadings

On pages that describe the operating procedures in chapters 3 through 19, the following symbols are used to distinguish the procedures from their explanations.

Procedure Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind; experienced users may not need to carry out all the steps.

Explanation This section describes the setup items and the limitations regarding the procedures. It may not give a detailed explanation of the function. For a detailed explanation of the function, see chapter 2.

Notation of Characters

- Bold characters used in the procedural explanations indicate characters that are marked on the panel keys or the characters of the soft keys displayed on the screen menu.
- The SHIFT+xxx key refers to first pressing the SHIFT key (the SHIFT key indicator lights), and then pressing the xxx key. The menu marked in purple above the pressed key appears on the screen.

Unit

k: Denotes 1000. Example: 100 kS/s (sample rate)
K: Denotes 1024. Example: 720 KB (storage capacity of a floppy disk)

Contents

Chapter 6 Vertical and Horizontal Axes

Chapter 7 Triggering

Chapter 8 Acquisition and Display

Chapter 9 Display

Chapter 10 Computation

Chapter 11 Analysis and Search

Chapter 20 Specifications

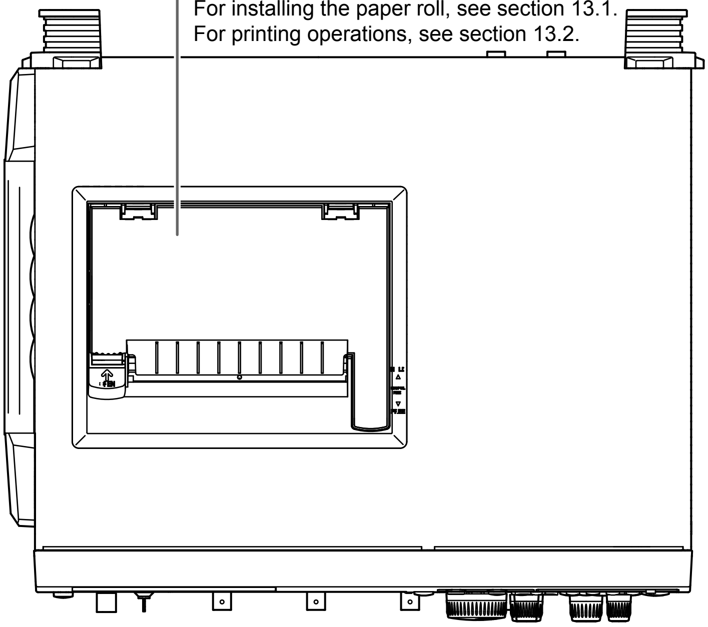
Appendix

Index

1.1 Top Panel, Front Panel, and Rear Panel

Top Panel

Built-in printer
Prints the display contents.
For installing the paper roll, see section 13.1.
For printing operations, see section 13.2.



Front Panel

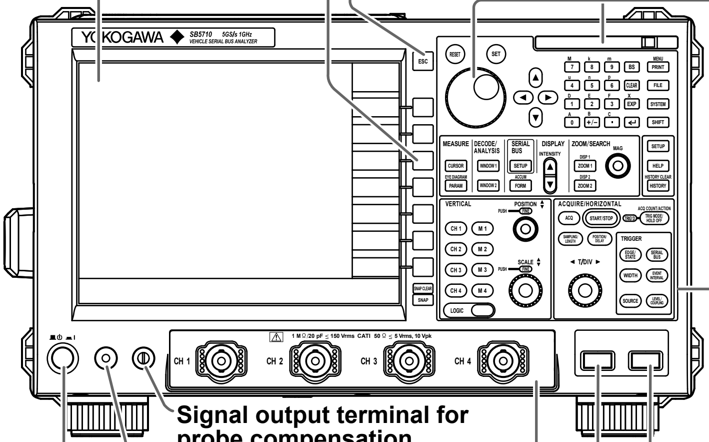
Soft keys
Used to select items on the soft key menu that appears on the screen during setup.

LCD display
For a description of the display contents, see chapter 9.

ESC key
Used to clear the soft key menu and the pop-up menu.

PC card slot
Used when saving data to a PC card. See section 14.1.

Rotary knob
Used to change setup values and move the cursor.



Operation keys and knobs
For a description of each, see page 1–3.

Signal output terminal for probe compensation adjustment (1 kHz/1 Vp-p) ⚠
Outputs the phase compensation signal for the probe. For the phase compensation procedure of the probe, see section 3.5.

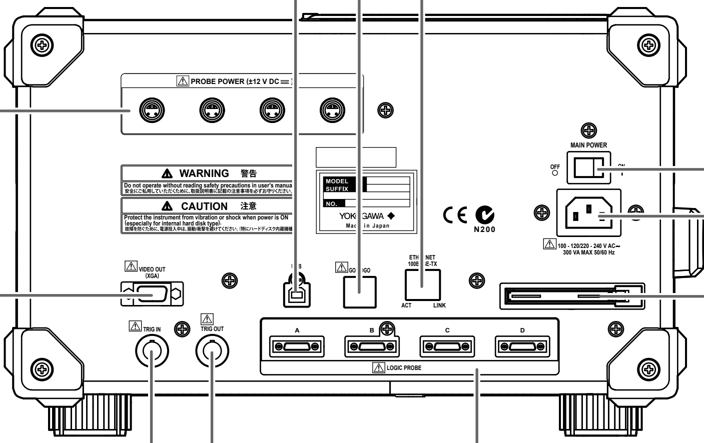
USB connectors for connecting peripheral devices ⚠
Used when connecting a USB printer, USB keyboard, USB mouse, or USB media. See sections 4.3 and 13.3.

Power switch
See section 3.3.

Functional ground terminal
Connect the ground cable when compensating the phase of a probe.

Measurement input terminals (terminals with aprobe interface function) ⚠
Connect a probe to observe analog signals. See section 3.4.

Rear Panel



USB connector for connecting to a PC
Used when connecting a PC with a USB interface. See the *Communication Interface User's Manual (IM701361-17E)*.

GO/NO-GO output connector ⚠
Outputs the GO/NO-GO determination output signal.
See section 17.4.

Ethernet port (optional)
Used when connecting to a network.
See section 16.1.

Main power switch
See section 3.3.

Power connector ⚠
See section 3.3.

PC card slot
Used when saving data to a PC card.
See section 13.1.

Trigger output terminal ⚠
Used when outputting the trigger signal externally.
See section 17.2.

Logic signal input port ⚠
Connect a logic probe to observe logic signals.
See section 3.6
- **SB5310**
  Equipped with POD A
- **SB5710**
  Equipped with POD A, POD B, POD C, and POD D

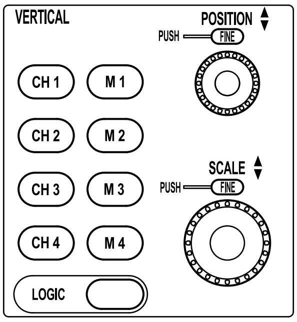
External trigger input terminal ⚠
Used when inputting an external trigger signal.
See section 17.1.

Video signal output connector
Used when displaying the DL9500/DL9700 display image on an external display. See section 17.3.

Probe power terminal (option) ⚠
Used to supply power to an FET probe or a current probe made by YOKOGAWA.
See section 3.4.

1.2 Operating Keys and Knobs

Vertical Axis, Channel, and Computation



CH1 to CH4 keys (Sections 6.1 to 6.13, 9.6)

These display menus for switching the display of analog signal input channel ON/OFF, vertical position, coupling, probe type, offset voltage, bandwidth limit, expansion or reduction of the vertical axis, linear scaling, and signal labels. Pressing one of these keys before using the SCALE knob assigns the corresponding channel to the SCALE knob operation. Each CH key lights when the corresponding channel is ON.

M1 to M4 keys (Chapter 10, Chapter 15)

These keys are used for waveform computation settings, and settings relating to reference waveforms. Each M key lights when the corresponding channel is ON.

LOGIC key (Sections 6.15 to 6.19, 9.6)

Displays a menu used to set the logic signal display (grouping, displayed order, bus display, and state display), skew adjustment, threshold level, label, etc. Pressing this key and then operating the POSITION knob sets the vertical display position of the logic signal. Pressing this key and then operating the SCALE knob sets the vertical display size of the logic signal.

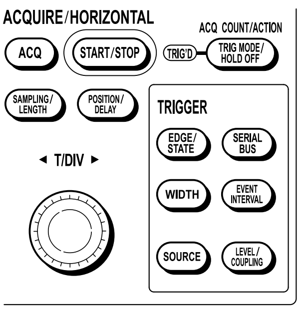
POSITION knob

Changes the center position when you change the voltage range. This knob has a push switch feature. You can press the knob to switch the setting resolution. If you press the knob and Fine lights, the setting resolution is set to fine.

SCALE knob

This sets the vertical axis sensitivity. Before turning this knob, press one of the CH1 to CH4, or M1 to M4 keys, to select the waveform adjusted. If you change this while signal acquisition is stopped, the change takes effect when signal acquisition is restarted. This knob includes a push switch, and can be pressed to change the resolution of the setting. When the knob is pressed, lighting the Fine indicator, the resolution is finer.

Signal acquisition and Horizontal Axis



ACQ key (Sections 8.1, 8.2)

Displays a menu for setting the method of signal acquisition.

START/STOP key (Section 4.7)

Depending on the trigger mode, this starts/stops signal acquisition. During signal acquisition, the key lights.

TRIG MODE/HOLD OFF key (Sections 7.1, 7.4, 8.8)

Displays a menu for seting the trigger mode and hold-off. Pressing the SHIFT key before pressing the MODE key displays the action on trigger menu.

SAMPLING/LENGTH key (Sections 8.3 to 8.6)

Displays a menu for record length, equivalent time sampling, interleave, and interpolation setting.

POSITION/DELAY key (Sections 7.2, 7.3)

Displays a menu for the trigger position and trigger delay settings.

EDGE/STATE key (Sections 7.13 to 7.16)

Displays a menu for Edge/State trigger settings.

Press one of four keys, including the following ENHANCED key, WIDTH key, and EVENT INTERVAL key, to select the trigger type. The pressed key lights, indicating that it is selected.

WIDTH key (Sections 7.17 to 7.19)

Sets the Width trigger.

SERIAL BUS key (Section 7.6 to 7.12)
Displays a menu for serial bus trigger settings.

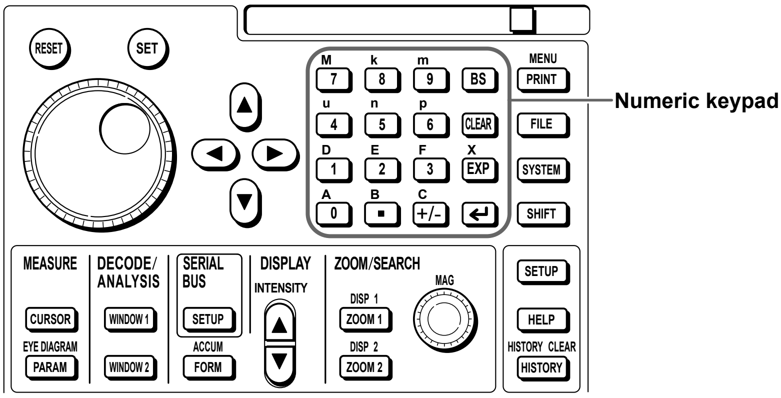
EVENT INTERVAL key (Sections 7.20)
Displays a menu for event trigger settings.

SOURCE key (Chapter 7)
Displays a menu for trigger sources setting.

LEVEL/COUPLING key (Section 7.5)
Displays a menu for trigger coupling, HF rejection, Window comparator, and other settings.

T/DIV knob (Section 6.8)
Sets the time axis scale. If you change this while signal acquisition is stopped, the change takes effect when signal acquisition is restarted.

Analysis/Screen Display/Screen Image Printing/Data Saving/History Waveform/ etc.



SETUP key under SERIAL BUS (Chapter 5)
Displays a menu for serial bus signal auto setup and detailed trigger, analysis, and search settings.

Analysis

CURSOR key (Section 11.6)
Displays a menu for cursor measurement.

PARAM key (Sections 11.1 to 11.3)
Displays a menu for automatic waveform parameter measurement and statistics processing.

(SHIFT + PARAM) EYE DIAGRAM key (Sections 11.4, 11.5)
Pressing the SHIFT key, followed by the PARAM key displays a menu for eye daiagram and telecom test.

WINDOW 1 key/WINDOW 2 key (Sections 11.7 to 11.17)
Display a menu for serial bus signals analysis, XY display, FPT analysis, waveform parameter histogram and list, and other settings. When the display is ON, the key lights.

Screen Display

FORM key (Sections 9.2 to 9.6, 9.8)
Displays a menu relating to screen display.

(SHIFT + FORM) ACCUM key (Section 8.7)
Pressing the SHIFT key, followed by the FORM key displays a menu for waveform overwriting display.

INTENSITY key (Section 8.7)
Pressing this key changes the intensity when the gradation mode is set to intensity gradation in accumulated display.

ZOOM 1 key/ZOOM 2 key (Sections 9.1, 11.18 to 11.27)

Display a menu for waveform zoom display and data search functions.

(SHIFT + ZOOM 1/ZOOM 2) DISP 1 key/DISP 2 key (Sections 9.1)

Pressing the SHIFT key, followed by the ZOOM key displays a menu relating to zoom waveform positioning.

MAG knob (Section 9.1)

In a zoom display, turn this knob to change the zoom ratio on the applicable vertical/horizontal axis.

Screen Image Printing/Data Saving/History Waveform/etc.

RESET key

Returns a numeric input value to its default.

SET key

Confirms a menu item selected with the rotary knob.

Arrow keys (◀ ▶ ▲ ▼ keys)

The left and right arrow keys move the digit cursor sideways when entering a numeric value.

Use the up and down arrow keys to enter a numeric value.

Numeric keys

Use this for entering numeric values, file names, and so on.

PRINT key (Sections 13.2 to 13.4, 14.9)

Prints the screen image data.

(SHIFT + PRINT) MENU key (Sections 13.2 to 13.4, 14.9)

Pressing the SHIFT key, followed by the PRINT key displays a menu when printing the screen image data to the internal printer or USB printer.

FILE key (Sections 14.4 to 14.8, 14.10 to 14.13)

Displays a menu for data saving and recall operations using a PC card or USB memory, and for file operations.

SYSTEM key

Displays a menu relating to calibration, network, computer interface settings, date and time, message language, click sound, self-test, and storage media formatting.

Displays system information (which options are installed, and firmware version).

SHIFT key

Pressing this once lights the key, and enables the functions indicated on each key by a purple legend above the key. Pressing the key once more returns to the normal functions.

SETUP key (Sections 4.4, 4.5)

Displays a menu for the initialization function returning settings to their factory defaults, the auto setup function automatically setting values according to input signals, and for storing and recalling setting information.

On models with the /G4 option, a menu related to power supply analysis function appears.

For a description of the power supply analysis function, see the *Power Supply Analysis Function User's Manual IM701310-61E*.

HISTORY key (Chapter 12)

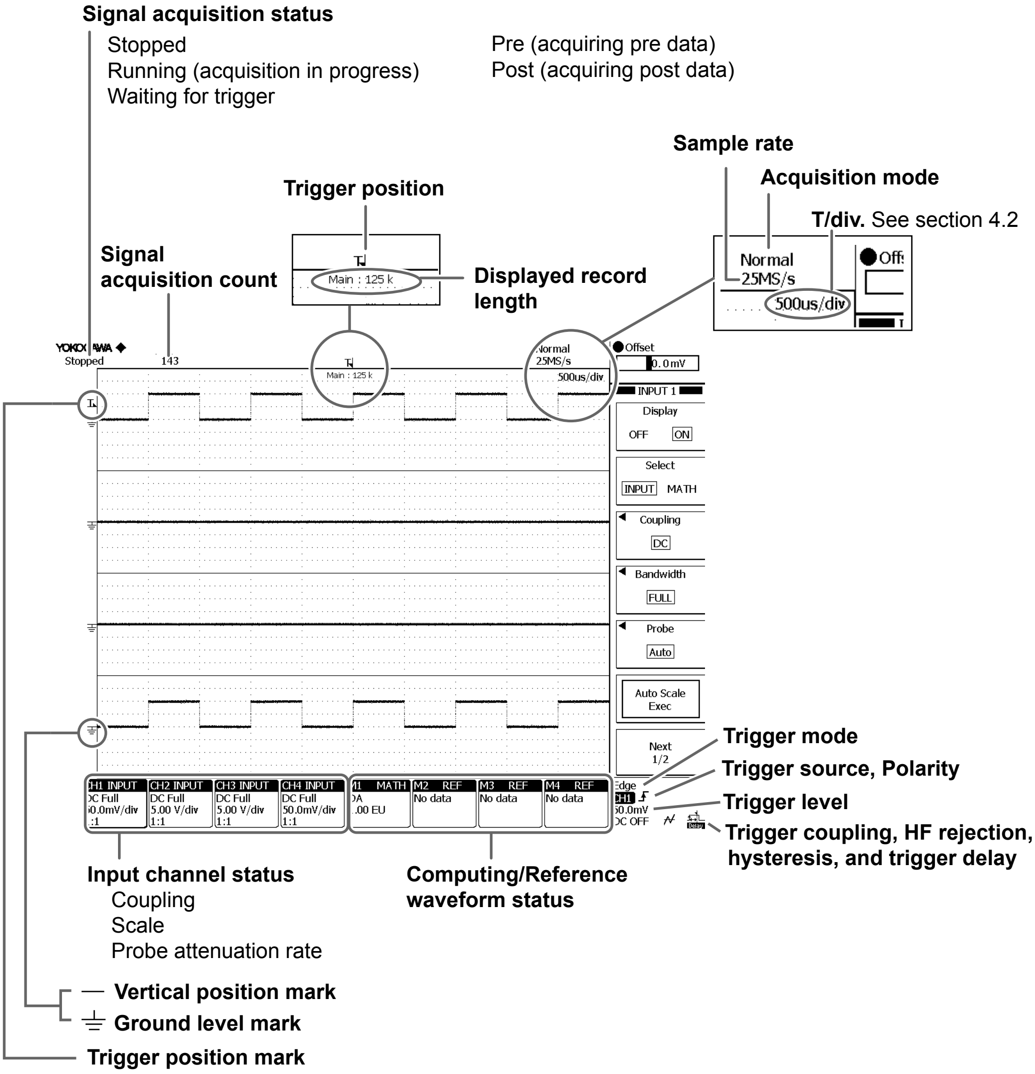
Displays a menu for displaying waveforms using the history memory function, and when searching.

(SHIFT + HISTORY) HISTORY CLEAR key (Section 12.1)

Pressing the SHIFT key, followed by the HISTORY key clears the displayed history waveform.

1.3 Screen Display

Normal Waveform Display Screen of the Analog Signal



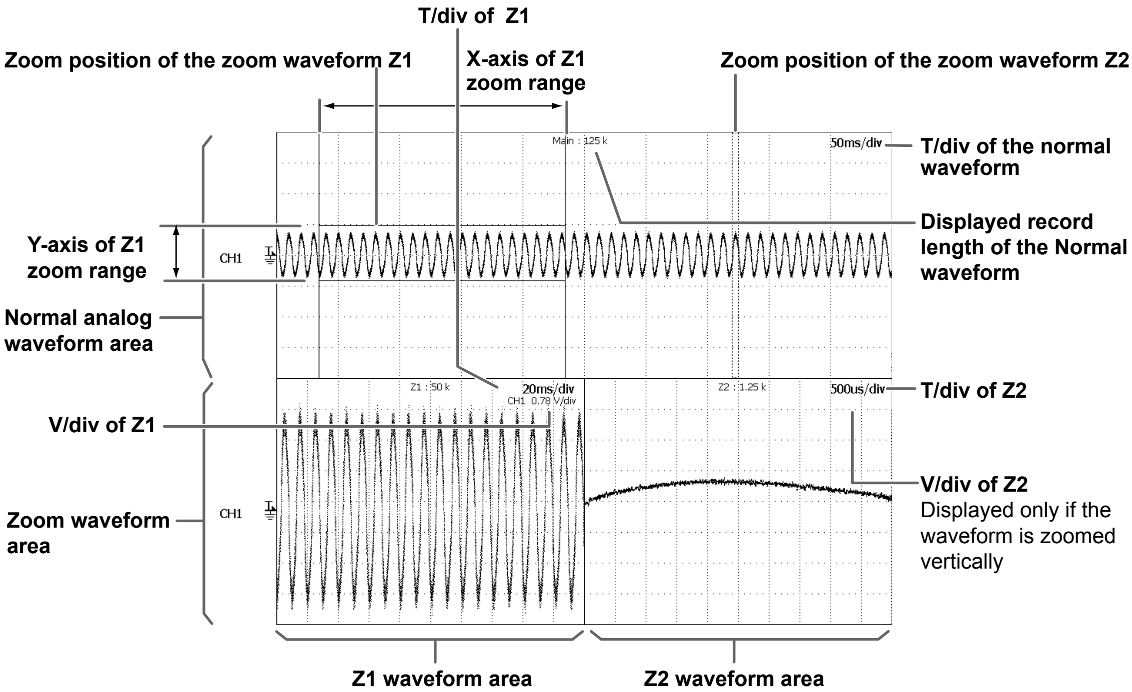
Acquisition Mode Display

Normal:	Normal mode
Envelope:	Envelope mode
Average:	Average mode

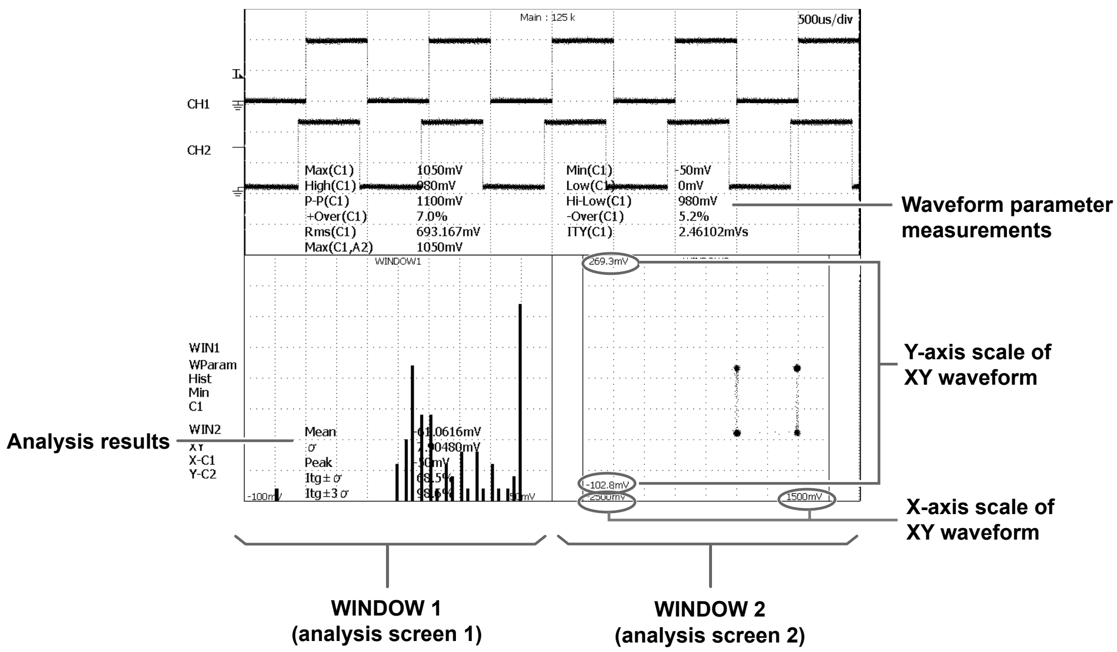
Note

The LCD screen of this instrument may have a number of defective pixels.

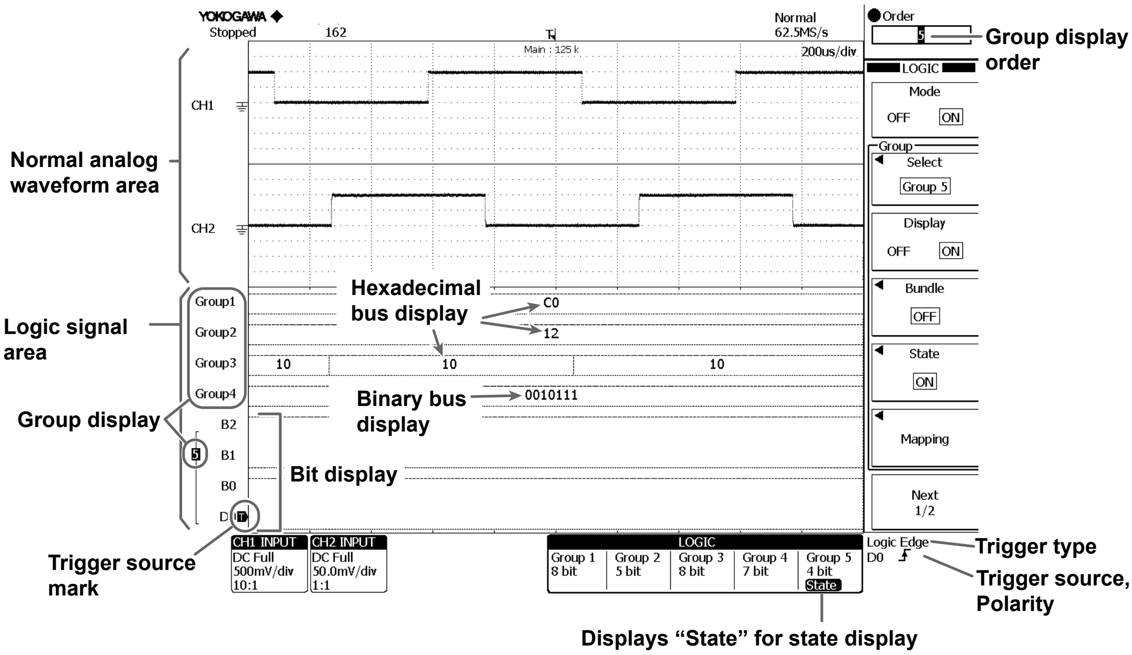
Screen Displaying Zoom Waveforms



Screen Displaying the Analysis Result

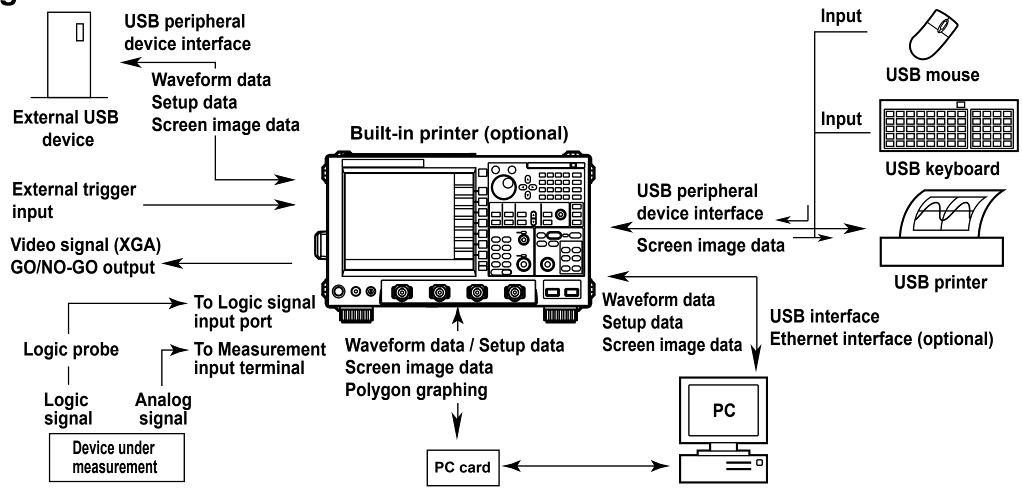


Logic Signal Display Screen

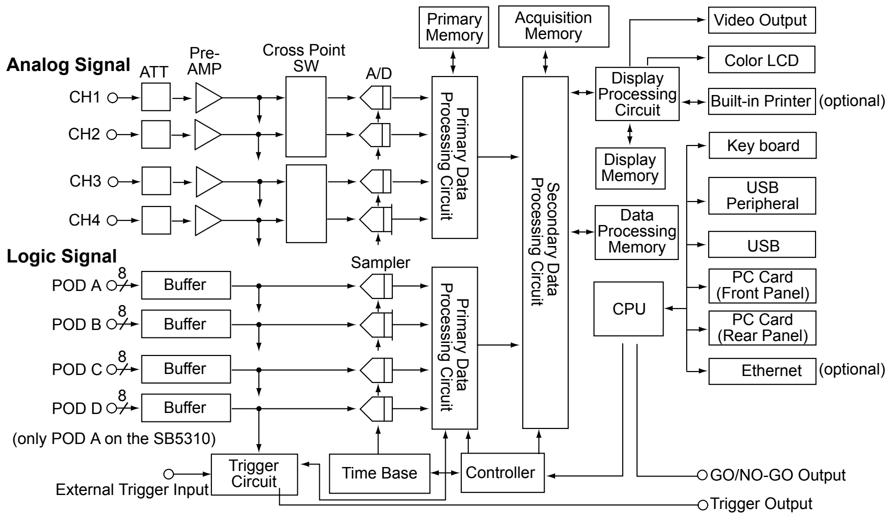


2.1 Block Diagram

System Configuration



Block Diagram



Signal Flow

The analog signal applied to the measurement input terminal on the front panel first enters the vertical control circuit consisting of an attenuator (ATT) and pre-amplifier. At the attenuator and pre-amplifier, the amplitude of each input signal is adjusted according to the settings such as the input coupling, voltage sensitivity (scale), and offset voltage. The adjusted input signal is then passed to the cross-point switch. The signal input to the cross-point switch is passed to the A/D converter according to the interleave setting.

At the A/D converter, the received voltage levels are converted into digital values. The digital data is written to the primary memory by the primary data processing circuit at the sample rate that matches the time axis setting.

The logic signal applied to a logic signal input port on the rear panel via a logic probe is binarized using a specified threshold level and written to the primary memory by the sampler at a sample rate synchronized to the A/D converter.

If a trigger occurs, the data written in the primary memory is transferred to the acquisition memory. The data transferred to the acquisition memory is converted into waveform display data by the secondary data processing circuit, transferred to the waveform processing circuit, and stored in the display memory. The waveforms are displayed on the LCD using the data stored in the display memory.

2.2 Channels and Displayed Waveforms

There are four types of waveform that can be displayed on the SB5000.
- Analog signal input waveform
- Computed waveform
- Reference waveform
- Logic signal input waveform

The reference waveform is a waveform selected from analog signal input waveforms, computed waveforms, and analog signal input/computed waveforms that has been stored in the past. In addition, the SB5000 has the following channels.
- Analog signal input channels (CH1 to CH4)
- Computation channels (M1 to M4)

By assigning a waveform to each channel, the assigned waveforms can be displayed. Depending on the channel type, different waveforms can be assigned as follows.
Analog signal input channels: Analog signal waveforms currently being acquired and computed waveforms
Computation channels: Computed waveforms and reference waveforms

Note

If computed waveforms are assigned to the analog signal input channels, the channels are displayed as MATH5 to MATH8.

Analog Signal Input Waveforms

These are measurement source waveforms applied to the analog signal input channels.

Computed Waveforms

These are waveforms computed from analog signal input waveforms or reference waveforms. Source 1 of the computing equation that can be assigned using the CH1 to CH4 menu is fixed to the input waveform of the specified analog signal input channel.
When a calculation is set in the menu for channels 1 to 4, the data of the channel for which the calculation is set is the calculation value.
For details of computations, see page 2-25.

Note

To use a calculated result as a source for a different calculation equation, set the calculation equation in the menu for channels 1 to 4, then use that result (one of channels 1 to 4) as the source in the separate calculation formula.

Reference Waveforms

Any of the analog signal input waveforms, other computed waveforms, and previously stored analog signal input or computed waveform can be selected and displayed. The history information for the selected waveform is also read in. It is also possible to make a separate selection from the history waveforms to display only one, or to display all of the history waveforms superimposed.
History waveforms are past waveforms that are stored in the acquisition memory.
For details of history waveforms, see chapter 12.

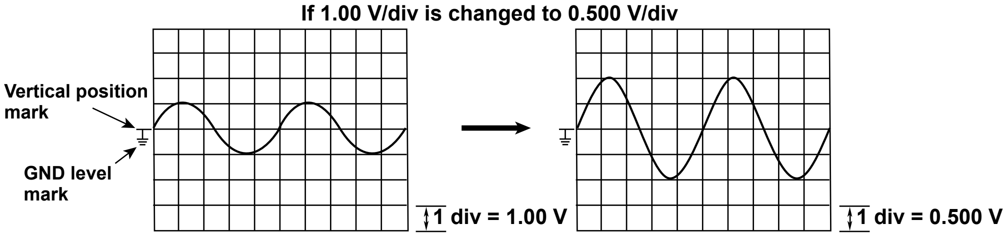
Logic Signal Input Waveforms

These are the measurement source logic signal waveforms that are applied to the logic signal input ports of the SB5000. The input ports are located on the rear panel of the SB5000. Logic signals cannot be used as reference waveforms. Computed waveforms can be D/A-converted. For a description of the logic signal measurement function, see section 2.5, “Displaying Logic Signals and Setting Trigger Conditions.”

2.3 Vertical and Horizontal Axes

The vertical sensitivity setting is used to adjust the displayed amplitude of the waveform for easy viewing of the signal (see section 2.5 for logic signals). The vertical sensitivity is set by assigning a voltage or a current value to one grid square (1 division) on the screen.

By switching attenuators with different attenuation and changing the amplification of the pre-amplifier, the sensitivity changes in steps (for example, voltage sensitivity changes in steps as in 1 V/div, 2 V/div, and 5 V/div).



Note

Vertical Sensitivity Setting and Measurement Resolution

To measure a voltage with high precision, the vertical sensitivity should be adjusted so that the input signal is measured with as large an amplitude as possible.

The SB5000 uses 8-bit A/D converters to sample the input signal at a resolution of 250 levels (LSB). The waveforms are displayed using 25 levels per division.

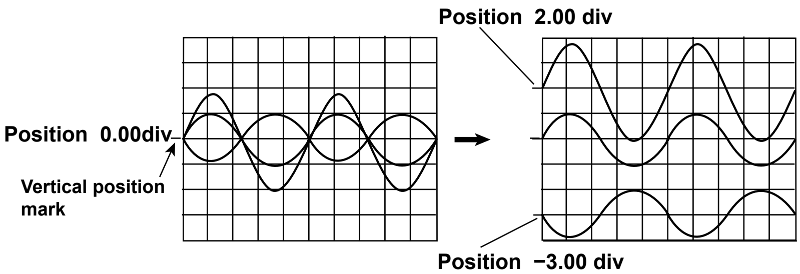
Valid Data Range

The output with 250 levels as described above is displayed at 25 levels per division, and therefore the effective display range is ±5 divisions from the center of the screen. However, if the vertical axis position is moved after stopping data (signal) acquisition, the valid data range also moves by the same amount.

Vertical Position of the Waveform <<For the procedure, see section 6.3>>

Since the SB5000 can display eight waveform channels, including computation channels, the waveforms are displayed superimposed, and can be difficult to read.

In this case, you can change the display position of waveforms on the vertical axis (vertical position) in the range of ±4 divisions for easier viewing. The vertical sensitivity switches around the vertical position (mark).



Input Coupling <<For the procedure, see section 6.4>>

If you want to observe just the amplitude of an AC signal, it is best to remove the DC component from the analog signal. On the other hand, there are times when you want to check the ground level or observe the entire analog signal (both the DC and AC components). In these cases, you can change the input coupling setting. By changing the input coupling, the method used to input the analog signal to the vertical control circuit (voltage axis) is switched. The following types of input coupling are available.

AC1 MΩ

The analog signal is coupled to the attenuator of the vertical control circuit through a capacitor. This setting is used when you want to observe only the amplitude of the AC signal, eliminating the DC component from the analog signal.

DC1 MΩ

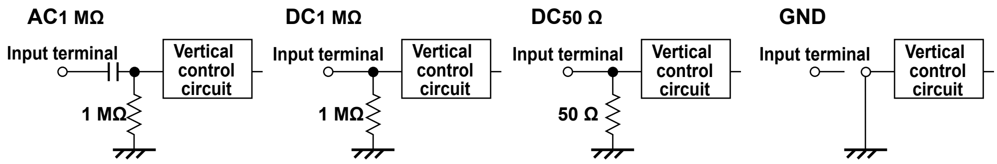
The analog signal is directly coupled to the attenuator of the vertical control circuit. Use this setting if you want to observe the entire input signal (DC component and AC component).

DC50 Ω

The same as for DC1 MΩ above, except that the input impedance is 50 Ω. Care is required, as this reduces the maximum input voltage.

GND

The analog signal is coupled to the ground not to the attenuator of the vertical control circuit. You can use this setting to check the ground level on the screen.



Probe Attenuation/Current-to-Voltage Conversion Ratio <<For the procedure, see section 6.6>>

Normally a probe is used in connecting the circuit being measured to the measurement input terminal. Using a probe has the following advantages.

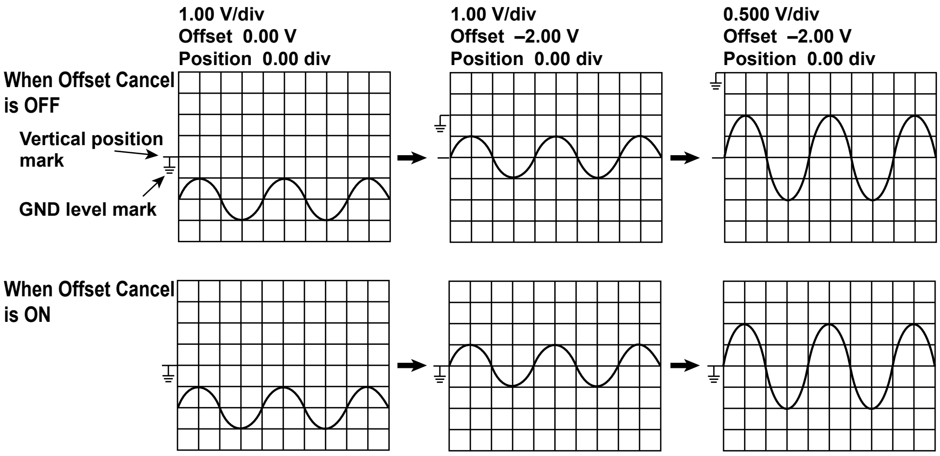
- Avoids disturbing the voltage and current of the circuit being measured.
- Inputs the signal with no distortion.
- Expands the voltage range that the SB5000 can measure.

The SB5000 is supplied with 500 MHz passive probes. The supplied probe attenuates the measured voltage signal by a factor of 1/10. When using the probe, in order to read the measurement voltage correctly, the attenuation setting on the SB5000 must be set to match the probe attenuation. The SB5000 automatically recognizes when the supplied 500 MHz passive probes (voltage probes) are connected, and sets the attenuation ratio to 10 : 1.
In addition to the 10 : 1 setting, the SB5000 has settings for a voltage probe of 1 : 1, 100 : 1, and 1000 : 1, and for a current probe settings of 1 A : 1 V, 10 A : 1 V, and 100 A : 1 V. When using probes, set the attenuation ratio to match that of the probe.

For the procedure to connect the logic probe for measuring logic signals, see section 3.6.

Offset Voltage <<For the procedure, see section 6.2>>

To observe an analog signal riding on top of a predetermined voltage, an offset voltage can be applied to subtract the predetermined voltage so that only the changes in the signal can be observed with higher vertical sensitivity.
Usually, the offset voltage does not affect the cursor measurement values, the result of the automated measurement of waveform parameters, or the computed values. However, by setting Offset Cancel to ON (see section 6.10), you can calculate with the offset voltage subtracted from cursor measurement values, results of the automated measurement of waveform parameters, and computed values.



Inverted Waveform Display

This inverts the waveform display about the Position value as center. The inversion applies to the display only, and does not affect the measurement value. Setting the inverted display ON/OFF does not affect waveform parameter automatic measurement values or calculations.

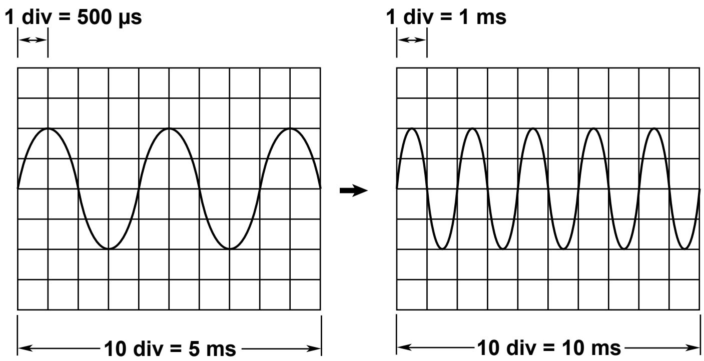
Bandwidth Limit <<For the procedure, see section 6.5>>

You can set a upper bandwidth limit on the analog signal for each channel. You can observe signals with the noise components above the specified frequency eliminated. The frequency can be selected from FULL, 200 MHz, 20 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125 kHz, 62.5 kHz, 32 kHz, 16 kHz, and 8 kHz.

Horizontal Axis (Time Axis)

Time Axis Setting <<For the procedure, see section 6.8>>

The time axis scale (T/div) is set as time per grid square (1 div). The setting range is from 500ps/div to 50s/div. Since horizontal axis display range is 10 div, the waveform display time is T/div × 10.



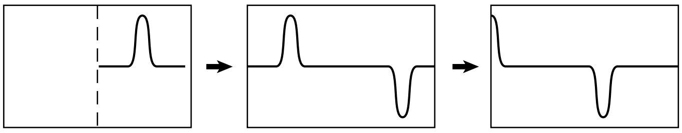
Relationship between the Specified Record Length, Time Axis Setting, Sample Rate, and Display Record Length

If you change the time axis setting with respect to the specified record length of the acquisition memory, the sample rate and display record length change. For more details about this relationship, see Appendix 1.

Time Axis Setting and Roll Mode Display

If T/div is set to a certain range (see Appendix 1), instead of the displayed waveform being updated by a trigger (update mode), the waveform is displayed in roll mode. In roll mode, as new data is captured, the oldest values are deleted from the screen, as the waveform scrolls from right to left. Thus roll mode display allows waveforms to be observed in the same way as on a pen recorder. It is useful in observing low frequency signals or signals that change slowly. It is also useful in detecting glitches (spikes in the waveform) that occur intermittently.

* Roll mode display is also used when the trigger mode is set to single. However, the displayed waveforms stop when a trigger is activated.



2.4 Triggers

A trigger is a cue used to display the waveform on the screen. A trigger is activated when the specified trigger condition is met. At this point, the waveform is ready to be displayed on the screen.

Trigger Source, Trigger Slope, and Trigger Level

Trigger source

Trigger source refers to the signal that is used in checking the trigger condition.

Trigger slope

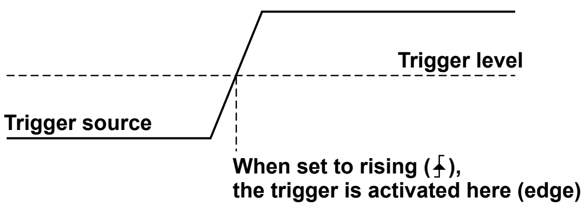
Trigger slope refers to the movement of the signal from a low level to a high level (rising edge) or from a high level to a low level (falling edge). When a slope is used as one of the trigger conditions, it is called a trigger slope.

Edge

The term “edge” is used to refer to the point at which the trigger source slope passes the trigger level (or if trigger hysteresis is set, the point at which it has passed the level by the hysteresis amount).

Trigger level

Trigger level refers to the level at which a trigger is activated when the trigger source passes the certain level.
With simple triggers such as the edge trigger described later, a trigger is activated when the level of the trigger source passes through the specified trigger level.



Trigger Type <<For the procedure, see sections 7.6 to 7.20>>

The SB5000 provides three basic trigger types: “Edge/State,” “Width,” and “Enhanced.” Then by setting “Event Interval,” a trigger can be applied that is dependent on the period of a recurring trigger condition, or the time interval between two triggers.

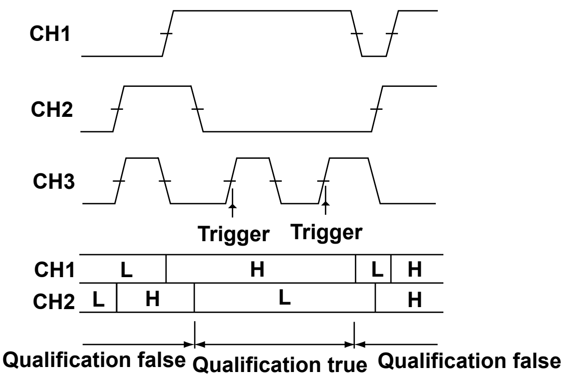
Edge/State trigger

There are four types of Edge/State trigger, as follows.

- **Edge**
  When the trigger source passes through the specified trigger level on a rising or falling edge, a trigger is activated. You can select the trigger source from input signals, the external trigger signal, and the commercial power supplied to the SB5000. In the case of commercial power, a trigger is activated only on the rising edge.

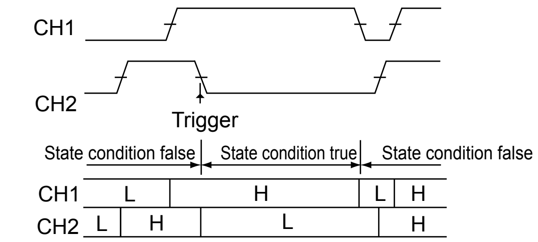
- **Edge (Qualified)**
  Activates a trigger on the edge of a single trigger source while the input signal states meet the specified qualification requirements.

Qualify: CH1 = H, CH2 = L, AND, Trigger source: CH3, rising
L: low level, H: high level

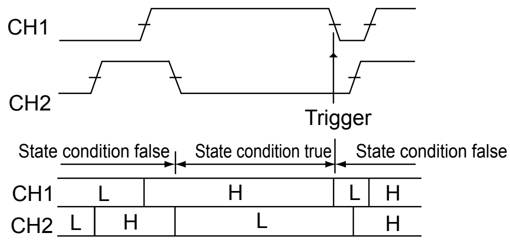


- **State**
  A trigger is activated in any of the following cases.
  - When the state condition is met or ceases to be met.
  - The SB5000 checks the state condition at the rising or falling edge of the specified signal (clock signal) and normalizes the result (high if the state condition is met or low if not). A trigger is activated when the normalized condition changes.

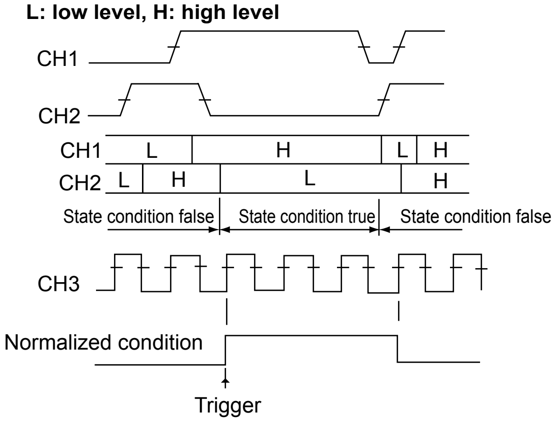
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: Enter
L: low level, H: high level



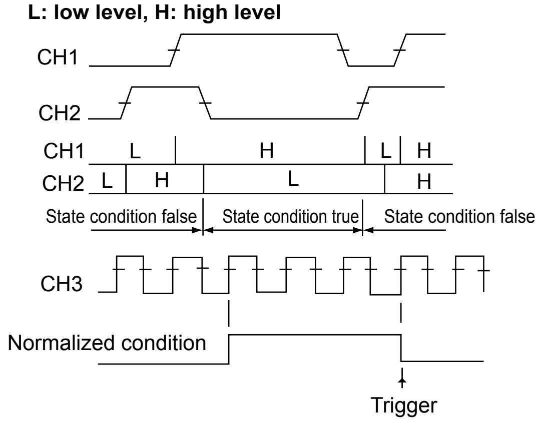
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: Exit
L: low level, H: high level



State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: Enter
L: low level, H: high level



State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: Exit
L: low level, H: high level



- **Edge OR**

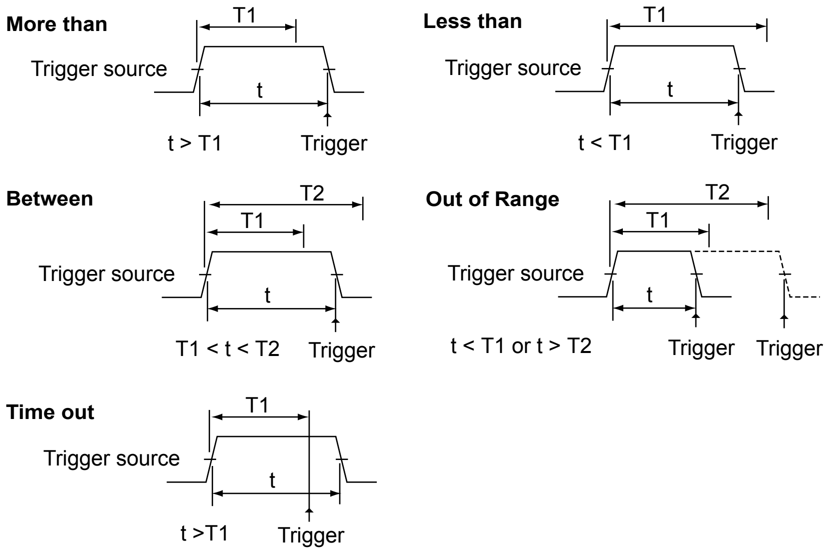
  A trigger is activated by an edge on multiple trigger sources. When an Edge OR trigger is used, the frequency of the trigger sources is limited to 200 MHz or less.

Width trigger

A trigger is activated by the duration of a pulse (pulse width). There are three types of width trigger, as follows.

- **Pulse**

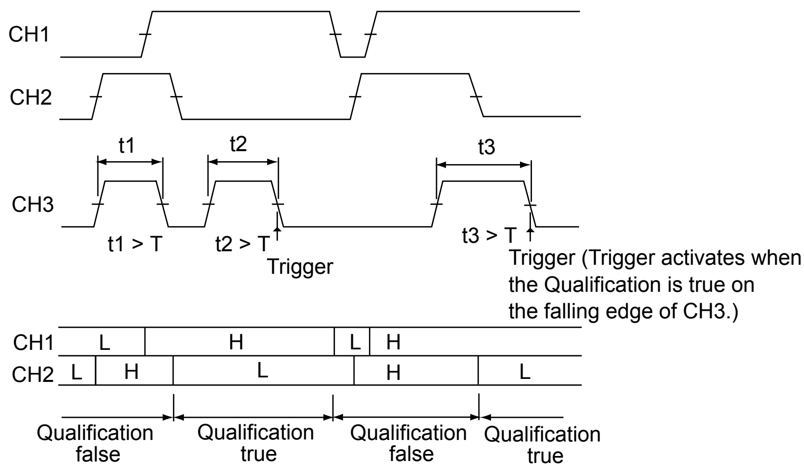
  A trigger is activated according to the relationship of the pulse width of the single trigger source and the specified time.
  - At the end of a pulse longer than the specified time (More than)
  - At the end of a pulse shorter than the specified time (Less than)
  - At the end of a pulse longer than specified time T1 and shorter than specified time T2 (Between)
  - At the end of a pulse either shorter than specified time T1 or longer than specified time T2 (Out of range)
  - A trigger when the pulse width exceeds the specified time (Time out)



- **Pulse (Qualified)**

  A trigger is activated on the relationship between the pulse width of a single trigger source and a specified time while the input signal states meet the specified qualifications. The timing at which the trigger is activated is the same as for Pulse trigger.

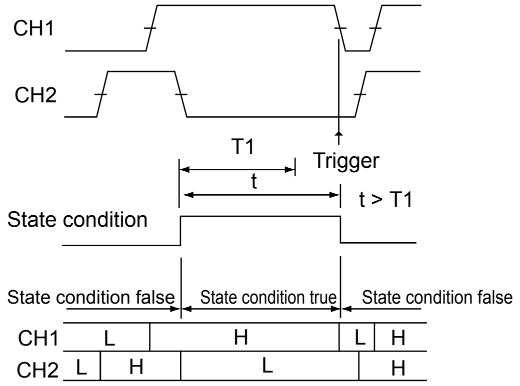
State: CH1 = H, CH2 = L, AND, Trigger source: CH3, falling, More than
L: low level, H: high level



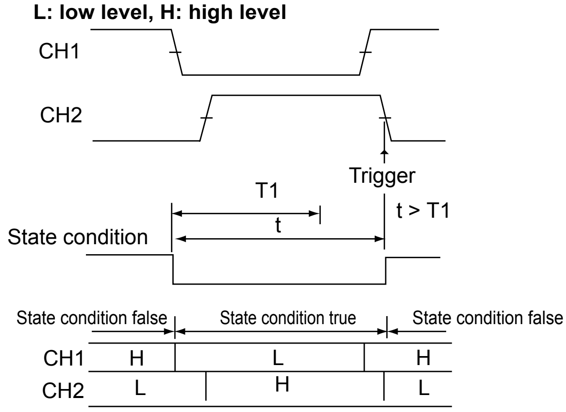
- **Pulse State**

  A trigger is activated in any of the following cases.
  - When the time during which the state condition is met or not met satisfies the relationship with the specified determination time.
  - The SB5000 checks and normalizes the state condition on the rising or falling edge of the specified signal (clock source). A trigger is activated when the time during which the normalized condition is met or not met first satisfies the relationship with the specified time.

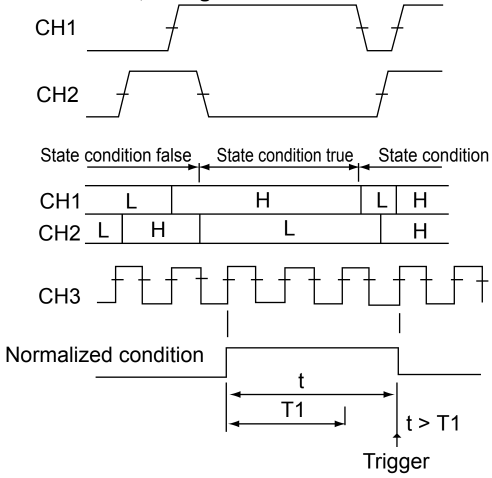
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: True, More than
L: low level, H: high level



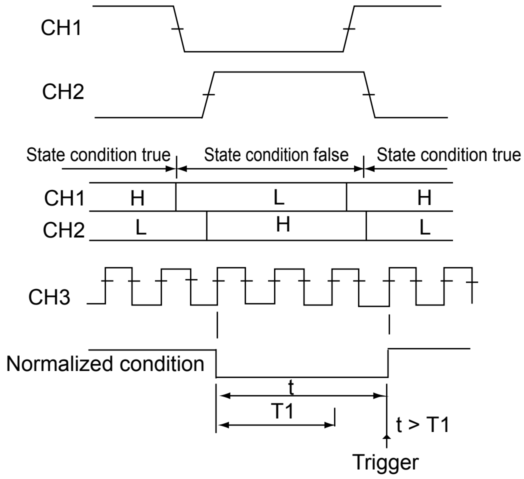
State: CH1 = H, CH2 = L, CH3/CH4 = X, AND
Clock: None, Polarity: False, More than
L: low level, H: high level



State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: True
L: low level, H: high level



State: CH1 = H, CH2 = L, CH4 = X, AND
Clock: CH3, rising, Polarity: False
L: low level, H: high level



Serial Bus trigger

- **FlexRay**
  A trigger function for capturing FlexRay bus signals.
  FlexRay is an in-vehicle LAN communication protocol developed by the FlexRay Consortium.

- **CAN**
  A trigger function for capturing CAN bus signals.
  Controller Area Network (CAN) is a serial communication protocol that has been standardized internationally by the ISO (International Organization for Standardization).
  Symbolic triggering is also available.*

  * Using YOKOGAWA free software, you can convert a CANdb file (.dbc) to a physical value/symbol definition file (.sbl)and load the file into the SB5000 for use as trigger conditions. You can obtain the free software from YOKOGAWA website (http://www.yokogawa.com/tm/). Search for the software name “Symbol Editor” on the website to access the download page.
  A CANdb file (.dbc) is a signal definition database file created using CANdb or CANdb++ by Vector Informatik.

- **LIN**
  A trigger function for capturing LIN bus signals.
  Local Interconnect Network (LIN) is a serial communication protocol mainly used in vehicles.

- **UART**
  A trigger function for capturing UART bus signals.
  Universal Asynchronous Receiver Transmitter (UART) is an integrated circuit that performs serial-to-parallel conversion and parallel-to-serial conversion.

- **I^2C**
  A trigger function for capturing I^2C bus signals.
  Five trigger modes are available.
  Inter Integrated Circuit (I^2C) bus is a bi-directional bus for inter-IC communications.

- **SPI**
  A trigger function for capturing SPI bus signals.
  Serial Peripheral Interface (SPI) is a synchronous serial bus that is widely used for inter-IC communications and data communications.

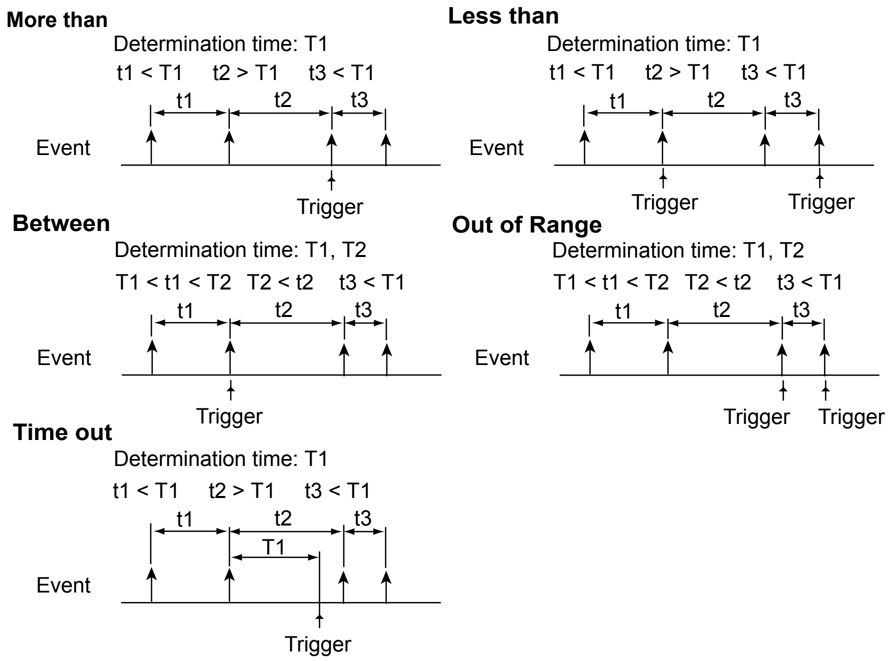
- **Serial**
  A trigger function for capturing serial pattern signals.
  The SB5000 synchronizes to the selected clock signal and detects a serial data pattern. You can specify up to 128 bits for the serial data pattern used for triggering. You can set the CS signal, which controls the period over which the data source is checked, and the latch source, which specifies the timing for comparing patterns.

Event Interval trigger

Taking the trigger condition, excluding OR trigger and TV trigger, as an event, the trigger is activated when the event period, or the interval between two events meets preset time conditions. The time condition is the same as the time condition for the Width trigger.

- **Event Cycle**

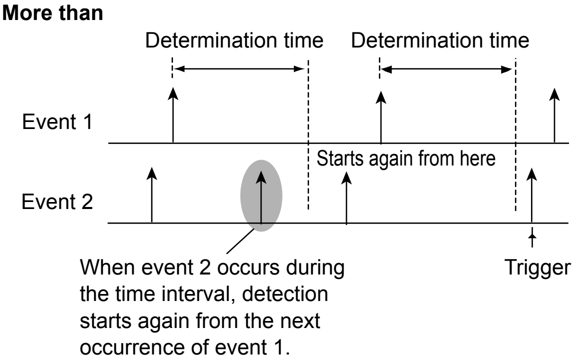
  When the event period is within the specified time range



- **Event Delay**

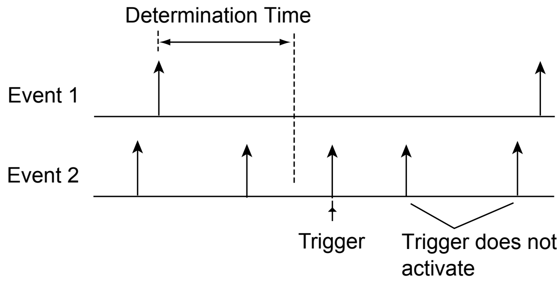
  When the time interval between event 1 occurring and the first occurrence of event 2 meets the specified time condition. If the condition is not met, the decision is restarted the next time event 1 is met.

  The following shows More than as an example.



- **Event Sequence**
  When the time interval between event 1 occurring and the first occurrence of event 2 meets the specified time condition. If the condition is not met, the SB5000 ignores event 2 that occurred and activates a trigger on event 2 that occurs while the specified time conditions are met.
  The following shows More than as an example.

More than



Trigger Mode <<For the procedure, see section 7.1>>

Sets the conditions for updating the displayed waveforms. The following five trigger modes are available.

Auto Mode

If a trigger is not activated within a specified time (approximately 100 ms, referred to as the timeout time), the displayed waveforms are automatically updated.

Auto Level Mode

The displayed waveforms are updated in the same way as in auto mode.
In the case of an Edge trigger, if the trigger is not activated when the timeout time has elapsed, the amplitude of the trigger source is detected, and the trigger level is automatically updated to the center value of the amplitude.

Normal Mode

The displayed waveforms are updated only when the trigger condition holds. The displayed waveforms are not updated if a trigger does not occur.

Single Mode

When the trigger condition holds, the displayed waveforms are updated once only, and signal acquisition is stopped. This mode is useful when you are observing a single-shot signal.

N Single Mode

The SB5000 acquires signals to different memory areas each time the trigger condition is met for the specified number of counts. Then, the SB5000 stops acquisition and displays the waveform of all acquired signals.

Trigger Position <<For the procedure, see section 7.2>>

After signal acquisition is started, the SB5000 triggers on the specified trigger condition and displays the waveform of the acquired signal. When the trigger delay described in the next item is set to 0 s, the trigger position coincides with the point at which the trigger condition becomes true. By moving the trigger position on the screen, the display ratio of the signal data (“pre-” data) before the trigger point which has been captured to acquisition memory (the pre-trigger part), and data (“post-” data) after the trigger point (the post-trigger part) can be changed.

Trigger Delay <<For the procedure, see section 7.3>>

The SB5000 normally displays the waveform before and after the trigger point. You can set a trigger delay so that the SB5000 displays the waveform of the signal acquired the specified time after the trigger or the specified number of edges after the trigger.

By time:	Set a delay time after the trigger occurs. The delay is from 0 to 10 s.
First Edge after time:	After the set time has elapse from the trigger occurring, delay until the specified edge is detected. The set time is from 0 to 10 s.
Edge Count:	After the trigger occurs, delay until the specified edge has been detected a certain number of times.

Trigger Hold-off <<For the procedure, see section 7.4>>

The trigger hold-off function temporarily stops detection of the next trigger once a trigger has been activated. This function is useful when observing a pulse train signal, such as a PCM code or when using the history memory function described later (see page 2-20) and you want to change the signal acquisition period.

Trigger Coupling <<For the procedure, see section 7.5>>

As with the analog signal to be measured, you can change the input coupling for the trigger source (excluding logic signals). Select the input coupling that is suitable for the trigger source signal.

The following two types of input coupling are available for the trigger source signal.

DC

Select this setting when using the source as is with no processing of the signal.

AC

Select this setting when using the signal with the DC components removed for the trigger source.

HF Rejection <<For the procedure, see section 7.5>>

Turn HF rejection ON to eliminate high frequency components above 15 kHz or 20 MHz from the trigger source. This prevents triggers from being activated at unexpected points due to the effect of high frequency noise (excluding logic signals).

Trigger Hysteresis <<For the procedure, see section 7.5>>

If there is insufficient trigger level width and noise is present in the trigger source, the trigger point fluctuates each time a trigger is activated. This causes the displayed waveforms to be unstable. Again, even with a slope of the polarity opposite to that specified, noise near the threshold value can cause the trigger to be activated. To prevent this from happening, a certain width (hysteresis) is assigned to the specified trigger level (excluding logic signals).

The SB5000 provides a selection between (narrow hysteresis) and (wide hysteresis). When is selected, the hysteresis is increased, and fluctuation in the trigger point due to noise can be reduced, giving a more stable waveform display. However, this setting can make the trigger point less precise, reducing the trigger sensitivity, so that a trigger source of low amplitude may fail to activate. With a stable signal free of noise, or a low amplitude trigger signal, set the hysteresis to .

Window Comparator <<For the procedure, see section 7.5>>

This determines whether a trigger condition based on a waveform rising edge or falling edge, or High/Low, or a Qualify or State condition falls within (IN) or outside (OUT) a specified range (Window).

The Window comparator can be enabled or disabled for each channel separately. The trigger condition changes according to the Window comparator setting for the channel set for a trigger source and so on.

For example, if the source channel of an Edge trigger has the Window comparator enabled, the trigger can be activated according as the source channel waveform is within or outside the specified area.

2.5 Displaying Logic Signals and Setting Trigger Conditions

The SB5000 can display the 32-bit logic signals (8-bit on the SB5310) that it receives through the rear panel logic signal I/O port. You can set trigger conditions on the logic signals.

Displaying Logic Signals <<For the procedure, see sections 6.15 to 6.17>>

If you turn ON the logic signal display, the screen is divided into top and bottom halves. The logic signal area is displayed below the normal analog waveform area.

Grouping

The 32-bit (8-bit on the SB5310) can be assigned to five groups.

Display Order

You can set the display order at the group level.

Display Size

You can set the vertical display size of the logic signal.

Vertical Position

You can set the vertical display position of the logic signal in the logic signal area.

Bus Display

The bus display shows logic signals that have been assigned to groups. You can select hexadecimal, binary, or symbolic display.

State Display

This function acquires the status of a logic signal on the point of polarity change (edge) of a specified clock signal when displaying the input logic signal. The state is held until the next clock occurs even if the input logic signal changes.

Threshold Level <<For the procedure, see section 6.18>>

You can set a threshold level that detects the high or low state (polarity) of the logic signal for each logic signal input port. You can select the threshold level from CMOS (5 V), CMOS (3.3 V), CMOS (2.5 V), CMOS (1.8 V), ECL, or User (user-defined).

Adjusting the Skew <<For the procedure, see section 6.19>>

You can observe the signal by correcting the time offset (skew) of the logic signal with respect to another signal.

Trigger Type <<For the procedure, see sections 7.6 to 7.15, 7.17, 7.19, 7.20>>

As with analog signals, triggers can be activated using the logic signal. You can specify edge trigger, edge (qualified) trigger, state trigger, pulse trigger, pulse state trigger, event cycle trigger, event delay trigger, and event sequence trigger. For details on the trigger functions, see section 2.4 or the respective operation procedure.

2.6 Acquisition Conditions

Acquisition Mode <<For the procedure, see section 8.1>>

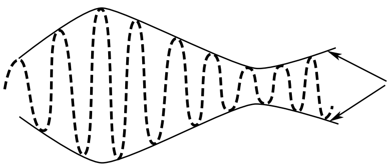
When storing sampled data in the acquisition memory (see "Signal Flow" in section 2.1), it is possible to perform processing on data and display waveforms based on the processed data (excluding logic signals). The following three types of data processing are available.

Normal Mode

In this mode, sampled data is stored in the acquisition memory without special processing.

Envelope Mode

In normal mode or averaging mode, the sample rate (the number of times data is acquired per second in the acquisition memory) drops if T/div is increased (see Appendix 1). However, in envelope mode, the maximum and minimum values are determined from the data sampled at 2.5 GS/s at time interval one half that of the sampling period (inverse of the sample rate) of normal mode regardless of the interleave mode setting (ON or OFF). The maximum and minimum values are stored as pairs in the acquisition memory. Envelope mode is useful when you want to avoid aliasing (see next page), since the sample rate remains high irrespective of the time axis setting. It is also useful when you want to detect glitches (narrow pulse signals) or display an envelope of a modulating signal.



Averaging Mode

In the averaging mode, signals are acquired repeatedly to obtain the average of sampled data at the same time point (the same time in relation to the trigger point). The SB5000 takes the exponential or simple average of the sampled data and writes the results to the acquisition memory. The averaged data is then used to generate the display. When the trigger mode is auto mode, auto level mode, or normal mode then exponential averaging is used, and in the single mode, simple averaging. This mode is useful such as when eliminating random noise superimposed on the signal.
For exponential averaging, you set the attenuation constant. For simple averaging, you set the sampling data acquisition count.

Exponential averaging
(When trigger mode is set to Auto, Auto Level, or Normal)

$$A_n = \frac{1}{N}\{(N-1)A_{n-1} + X_n\}$$

An: n^{th} averaged value
Xn: n^{th} measured value
N: Attenuation constant (2 to 1024, 2^n steps)

Simple average
(When trigger mode is set to Single or N Single)

$$A_N = \frac{\sum_{n=1}^{N} X_n}{N}$$

Xn: n^{th} measured value
N: Acquisition count (2 to 65536 2^n steps)

High Resolution Mode <<For the procedure, see section 8.2>>

Normally, this unit takes digital values from the 8-bit A/D converter, applies specified processing, and then stores 8-bit values in primary memory.
On the other hand, the resolution of the A/D converter can be improved equivalently by placing a bandwidth limit on the analog signal.
In high resolution mode, the effective number of bits per data value in the primary memory is expanded to 12 bits, and data is stored by maintaining the improved resolution through bandwidth limiting.

Record Length <<For the procedure, see section 8.3>>

The term record length refers to the number of data points acquired per channel in the acquisition memory. The record lengths that can be set are: 2.5 k words (2500 points), 6.25 k words, 12.5 k words, 25 k words, 62.5 k words, 125 k words, 250 k words, 625 k words, 1.25 M words, 2.5 M words, and 6.25 M words (the maximum record length that can be set varies from model to model). Basically, if you change the time axis setting, the sample rate is changed to maintain the set record length at the same value. However, in some cases the record length is changed as a result, for example, of a changed time axis setting (see Appendix 1).

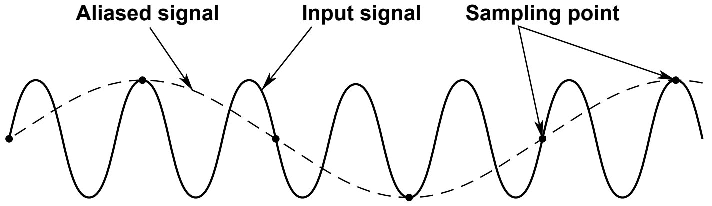
Sampling Mode <<For the procedure, see sections 8.4 to 8.6>>

Depending on the time axis setting, you can switch the mode for sampling the analog signal (sampling mode). The time axis ranges that allow the sampling mode to be changed vary depending on the acquisition mode and other settings. For details, see Appendix 1.

Realtime sampling mode

Changing the time axis setting causes the sample rate to change. Data can be sampled at up to 5 GS/s (2.5 GS/s when interleave mode is OFF). The input signal is sampled sequentially, and the data is stored in the acquisition memory.
In this mode, according to the sampling theorem*, the signal can only be correctly displayed up to a frequency which is one-half of the sample rate (samples per second, or S/s). Therefore, an appropriate sample rate for a signal is such that the frequency of the signal is comparatively lower.

* If the sample rate is relatively low compared with the input signal frequency, then higher harmonic content of the signal will be lost. In this case, according to the Nyquist sampling theorem, the high frequency components may be transformed into low frequencies, by the process known as aliasing. By setting the mode to envelope signal acquisition, aliasing can be avoided.



Repetitive Sampling Mode

In repetitive sampling mode, you can set a time axis that exceeds the maximum sample rate of 5 GS/s (2.5 GS/s if the interleave mode is OFF). This excludes logic signals. In this mode, one waveform is created from several cycles of a repeating signal. This is equivalent to sampling the signal at a higher sample rate than the actual sample rate. The SB5000 enables an apparent maximum sample rate up to 2.5 TS/s.
If repetitive sampling mode is OFF and the sample rate exceeds the maximum selectable sample rate due to the relationship between the time axis and display record length, the display record length is reduced according to the time axis setting and sample rate.
There are two types of repetitive sampling. One is sequential sampling in which the data is sampled by intentionally offsetting the sampling points by a certain time with respect to the trigger point. The other is random sampling in which the data that is offset randomly from the trigger point is sampled and resorted with respect to the trigger point. The SB5000 employs random sampling which enables the signal before the trigger point (trigger position, see section 2.4) to be observed.

Interleave Mode

The sample rate in realtime sampling mode can be increased to 5 GS/s (excluding logic signals) by sampling a single signal using two A/D converters with offset phases.
For the relation between the interleave mode and time axis, record length, and sample rate, see Appendix 1.

Interpolation

The practical sample rate can be increased up to 2.5 TS/s by interpolating the actual sampled data 1000 times (2000 times during high resolution mode).

Action On Trigger <<For the procedure, see section 8.8>>

Conditions can be determined at the zone through which the result of the automated measurement of waveform parameters or waveform passes. If the conditions are met, a given action can be executed at the same time as the signal acquisition (excluding logic signals). The action to be carried out can be selected from a number of possibilities, including sounding an alarm, saving measurement data or a screen image, or printing a screen image, or sending E-mail.
The action on trigger operation is carried out with Exec on the menu screen. It cannot be carried out with the START/STOP key. Additionally, when the action on trigger is carried out, the trigger mode becomes the normal mode.

GO/NO-GO Determination <<For the procedure, see sections 8.9 to 8.16>>

This is used as a criteria for the action-on-trigger. This function determines whether the acquired signal meets the criteria (GO) or not (NO-GO). Logic signals are excluded. The SB5000 can transmit GO/NO-GO results through the rear panel GO/NO-GO I/O terminal. The GO/NO-GO result can be used to trigger an action-on-trigger.
This feature is useful for signal testing on electronic device production lines and tracking down abnormal phenomena.
The following eight GO/NO-GO types are available.

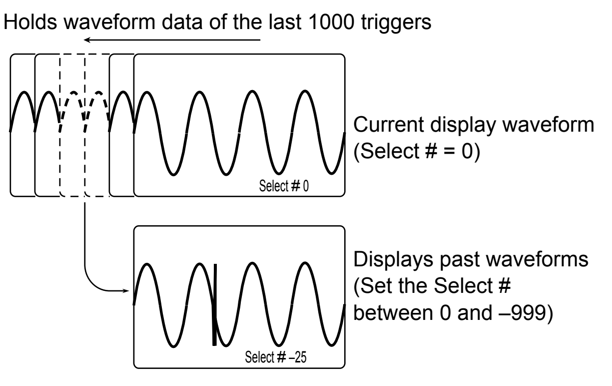
- Waveform zone on the screen
- Rectangular zone on the screen
- Polygonal zone on the screen
  Creating a polygon on a computer with the supplied software.
- Range of a waveform parameter
- Rrange of a periodic statistics parameter
- Range of an FFT parameter
- Range of an XY waveform parameter
- Range of a telecom test item

History Memory <<For the procedure, see chapter 12>>

When signals are being measured, the signal stored in the acquisition memory as a result of a trigger being activated is displayed as waveforms on the SB5000 screen, and can be viewed. When triggers are successively activated and signals are acquired, it is impossible to stop the measurement in time when an abnormal waveform appears (newer waveforms appear on the screen). Normally, abnormal waveforms in the past cannot be displayed. By using the history memory function, the past signal data (history waveforms including the current displayed waveform) stored in the acquisition memory can be displayed when signal acquisition is stopped.
You can select the display mode from below.

- Display any single waveform
- Display all waveforms with a color or intensity gradation
- Display all waveforms with no gradation, highlighting a single specified waveform
- Displaying the simple arithmetic mean of all waveforms

You can also automatically replay from the oldest waveform to the newest waveform, and vice versa.
The number of waveforms N that can be acquired and held as history waveforms varies from 1 to 2000 depending on the record length setting. If the number of waveforms N that can be acquired and held is exceeded, the oldest history waveform is cleared. The waveform currently displayed on the screen (newest waveform) is counted as the 1st waveform, and up to N-1 waveforms in the past can be displayed. The following figure indicates an example when N = 1000.



History Search

When signal acquisition is stopped, you can search for history waveforms that meet specified conditions.

Zone Search <<For the procedure, see sections 12.2 to 12.4>>

You can search for history waveforms that pass or do not pass a specified search zone. There are three types of search zone, as follows.

- **Waveform Zone**
  Set a zone on the screen using a waveform.
- **Rectangular zone**
  Set a rectangular zone on the screen.
- **Polygonal zone**
  Load a polygonal zone created on a computer.

Waveform Parameter Search <<For the procedure, see sections 12.5 to 12.7>>

From the history waveforms, you can search for waveform meeting or not meeting specified search parameter conditions. There are three types of search parameter, as follows.

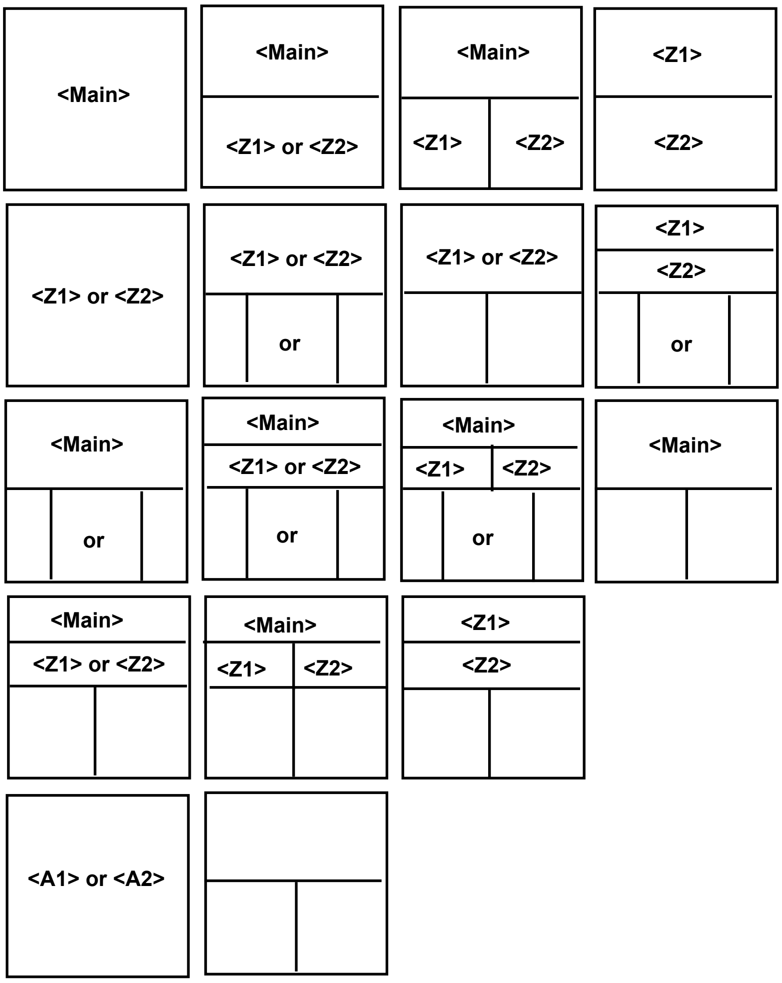
- **Waveform Parameter**
  Search by values of the automated measurement of waveform parameters.
- **FFT Parameter**
  Search for FFT waveform marker measurement values, maximum values in a specified sector, or computation values using FFT measurement values.
- **XY Waveform Measurement Value**
  Search for a computation value using the area of an XY waveform or an area.

2.7 Display

Waveform Zooming <<For the procedure, see section 9.1>>

Displayed waveforms can be enlarged in both the time axis and the voltage axis directions. This function is useful when the signal acquisition time is set long and you wish to observe a particular section of the waveform closely. The zoom position can be set in grid div units.

The zoom waveform can be displayed at up to two positions simultaneously (dual zoom). The display combinations of the normal waveform, zoom waveform, and analysis screen windows are as follows, with the normal waveform area identified as Main, the zoom waveform areas as Z1 and Z2, and the analysis areas as A1 and A2.



When the Main (normal waveform) and Zoom 1 or Zoom 2 waveforms are displayed simultaneously, a zoom box appears in the normal waveform area to indicate the zoom position. The center of the zoom is the center of this box. For details of display examples, see section 1.3, “Screen Displaying Zoom Waveforms.”

You can select the display format of the zoom waveform area, and whether a trace is on or off, independently of the Main waveform area.

When zooming in the voltage axis direction, you can select a waveform to enlarge, and set it to 1.05 to 10 times normal size.

When zooming in the time axis direction, you can enlarge until there are ten data points in the zoom waveform area.

You can also set a point meeting a set trigger condition as the zoom center, or automatically move the zoom center.

Display Format <<For the procedure, see section 9.2>>

Splitting the Screen

The screen can be split evenly so that analog signal input waveforms and computed waveforms can be easily viewed. The screen can be divided in the following ways: Single (no split), Dual (two ways), Triad (three ways), Quad (four ways)

Waveform Assignment

You can assign channels to the divided windows.

- **Auto**
  Waveforms whose display is turned ON are assigned in order from the top.
- **Manual**
  Regardless of whether the display is ON or OFF, waveforms can be assigned freely to each window.

Display Interpolation <<For the procedure, see section 9.3>>

If a given size of data is not available in 10 divisions along the time axis, the data can be interpolated (pulse interpolation only for logic signals) to display the waveform.

Sine Interpolation

Interpolated data is created with the function (sin x)/x, to interpolate between two points with a sine wave. Sine interpolation is suitable for observing sine waves or similar waves.

Linear Interpolation

Linearly interpolates between two points.

Pulse Interpolation

Interpolates between two points in a step pattern.

Interpolation OFF

Displays discrete dots without performing interpolation.

Accumulated Display <<For the procedure, see section 8.7>>

The display time of old waveforms can be set longer than the waveform update period, so that newer waveforms appear overlapped (accumulated) on older waveforms. There are two modes, as follows:

- **Count**
  The specified number of waveforms are superimposed. A gradation is applied according to the data frequency. There is no change in the gradation for logic signals.
- **Time**
  Waveforms for the specified time are superimposed. A gradation is applied from older data to new. There is no change in the gradation for logic signals.

For each of these modes, there are two types of display, as follows:

- **Inten**
  Display using different intensity levels.
- **Color**
  Display with a color gradation.

The accumulated display is useful when observing noise, jitter, and transient phenomena in waveforms. The accumulated waveforms can also be saved.

Displaying Signal Labels <<For the procedure, see section 9.6>>

A label of up to eight characters can be assigned to each signal and displayed.

Snapshot and Snap Clear <<For the procedure, see section 9.7>>

By using the snapshot function, you can temporarily hold the waveform (snapshot waveform) that would be cleared when the screen is updated on the screen. The snapshot waveform is displayed in white, allowing for easy comparison against the updated waveform. The snapshot waveform can be printed as screen image data, but cannot be used for cursor measurement, automated measurement of waveform parameters, zoom, and computation functions.

Snap Clear
Press the SHIFT key, then press the SNAP SHOT key, to clear the snapshot waveform.

Translucent Display <<For the procedure, see section 9.8>>

Configuration dialog boxes are displayed translucently, so the contents underneath it can be seen.

Scale Value Display <<For the procedure, see section 6.12>>

The upper and lower limits (scale values) of the vertical and horizontal axes of each waveform can be displayed.

2.8 Computation

Prescaling and Rescaling <<For the procedure, see sections 10.2 to 10.7>>

Prescaling linearly scales the source waveform before carrying out computation. The computation uses the scaled values.
Rescaling linearly scales the results of the computation.

Computed Waveform Display

By setting a computation equation for each of CH1 to CH4, and M1 to M4, a maximum of eight computed waveforms can be displayed.

Through (Linear Scaling) <<For the procedure, see section 10.2>>

By setting Through, linear scaling only can be carried out.

Addition, Subtraction, and Multiplication <<For the procedure, see section 10.3>>

Addition, subtraction, and multiplication can be applied to any of CH1 to CH4, using the input waveform of the channel itself together with the waveform of any of CH1 to CH4 and REF1 to REF4 as operands, and can be applied to M1 to M4, using any two waveforms of CH1 to CH4 and REF1 to REF4 as operands. The computation result is used as the waveform (computed waveform) for CH1 to CH4 or M1 to M4.
The addition (+) and subtraction (–) functions are convenient for comparison with a reference signal, checking signal logic, or phase comparison, and multiplication (×) can be used to check the power waveform when inputting a voltage signal and current signal.

Integration <<For the procedure, see section 10.4>>

This integrates the selected waveform. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.

Phase Shift <<For the procedure, see section 10.5>>

A waveform can be displayed phase-shifted. To advance the phase, set a positive value, and to delay the phase, set a negative value.

IIR Filter <<For the procedure, see section 10.6>>

High-frequency noise can be filtered out (with a low-pass filter), or low-frequency noise can be filtered out (with a high-pass filter).
You can select a first-order filter or a second-order filter. When a second-order filter is selected, there is no phase delay.

Smoothing <<For the procedure, see section 10.7>>

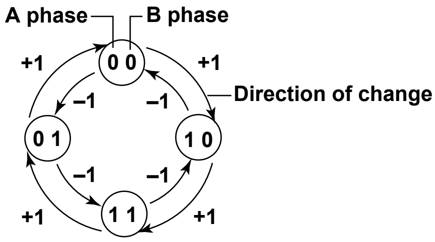
A waveform can be displayed smoothed, by removing noise with a sliding average.

Edge Count <<For the procedure, see section 10.8>>

This counts edges of a selected waveform. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.

Rotary Count <<For the procedure, see section 10.9>>

Phase changes between phase A (Source 1) and phase B (Source 2) are counted up or down, taking a rise above a specified level as 1, and a fall below the level as 0. Taking the specified integration start point as 0, the entire region is calculated, counting up toward the newest data, and counting down toward the oldest data. For CH1 to CH4 the computation applies to the input waveform of the channel itself, and for M1 to M4 applies to any of CH1 to CH4 and REF1 to REF4.



D/A Conversion <<For the procedure, see section 10.10>>

D/A conversion can be performed on the logic signal for each group. The conversion result can be displayed in the M1 to M4 channels.

Scale Conversion of a Computed Waveform (Ranging) <<For the procedure, see section 10.1>>

When displaying a computed waveform, normally auto scaling is carried out, but manual scaling can also be selected.
Auto scaling automatically determines from the computed waveform the center line level[1] (Center) in the vertical axis direction of the screen area and the sensitivity[2] (Sensitivity), to display the computed waveform.
Manual scaling allows both Center and Sensitivity to be set as required.

1 For a voltage waveform this is a voltage value.
2 For a voltage waveform, this is a voltage value per 1 div.

User Defined Math (Option) <<For the procedure, see section 10.11>>

Available for the SB5000 with the /G4 or /G2 option.
You can define equations arbitrarily by combining the following functions.

Operators

+, -, *, /, ABS (absolute value), SQRT (square root), LOG, LN (natural logarithm), EXP (exponents), - (inverse), P2 (squares), DELAY (phase shift), BIN (binary), SIN (sine), ASIN (arcsine), COS (cosine), TAN (tangent), ATAN (arctangent), DIFF (differential), INTEG (integral),

Constants

Napier’s constant (e), PI (π), sample rate (fs), Exp (exponent display), waveform parameters (measure item), constants (K1-K4)

Waveforms

CH1 to CH4, REF1 to REF4

2.9 Analyzing and Searching

Cursor Measurements <<For the procedure, see section 11.6>>

Cursors can be placed on the displayed waveform from signal data held in acquisition memory (within the range of the display record length - see Appendix 1), and various measurement values at the intersection of the cursor and waveform can be displayed. There are six types of cursor.

Horizontal Cursors

Two broken lines (horizontal cursors) are displayed parallel to the horizontal axis, and the Y-axis values at the cursor positions can be measured. The level difference between cursors can also be measured.
A computation formula using the cursor measurement values can also be set, and the result displayed.

Vertical Cursors

Two broken lines (vertical cursors) are displayed parallel to the vertical axis, and the times from the trigger position to each vertical cursor, the time difference between the vertical cursors, and the reciprocal of the time difference can be measured.
A computation formula using the cursor measurement values can also be set, and the result displayed.

H&V cursors

The horizontal cursors and vertical cursors are displayed simultaneously.

VT cursor

A broken line (VT cursor) is displayed on the vertical axis, and the time from the trigger position to the VT cursor, and the VT cursor position measurement value are displayed.
A computation formula using the cursor measurement values can also be set, and the result displayed.
The VT cursor can also be applied to logic signals. The value of each group at the cursor position is displayed.

Marker Cursors

Four markers are displayed on the selected waveform. The level at each marker, the time from the trigger position, and the level difference and time difference between markers can be measured.
A computation formula using the marker measurement values can also be set, and the result displayed.

Serial cursors

A broken line (serial cursor) is displayed on the vertical axis, showing a two-valued function of the waveform from the cursor position, according to the bitrate, bit length, and threshold settings.

Automated Measurement of Waveform Parameters

Automated Measurement of Waveform Parameters <<For the procedure, see section 11.2>>

Automated measurement can be performed on various measurement parameters of the displayed waveform stored in the acquisition memory.
Up to a maximum of 100,000 automatic measurement results can be saved in a file.
There are 27 different measurement items. A maximum of 16 items can be displayed from the selected items for all channels together. A computation formula using the automatic measurement values can also be set, and the result displayed.

Statistical Processing <<For the procedure, see section 11.3>>

Statistical processing can be performed on the automated measurement values described above. The following five statistics can be determined on the two measured values of automated measurement parameters.

- Maximum value (Max)
- Minimum value (Min)
- Mean value (Mean)
- Standard deviation (σ)
- Count of measurement values subjected to statistics processing (Cnt)

The following three statistical processing methods are available.

- **Normal Statistical Processing**
  Statistical processing is carried out while acquiring waveforms, on the specified number of waveforms from the most recently captured. If waveform acquisition is stopped, then restarted, the statistical processing from before stopping is continued. Carrying out a Restart in the menus resets the statistical processing up to that point. It is also possible to set the number of data values used in statistical processing.
- **Statistical Processing Over One Cycle of Measurement or Within Measurement Range**
  In the displayed waveforms, the period is found sequentially from the oldest data, and data within that period is used for measurement of the selected automatic measurement item, then statistical processing is carried out. The method of finding the period is the same as for Period in the normal waveform parameters.
- **Statistical Processing of History Waveforms**
  Automated measurement is performed on the history waveforms in the selected range and statistical processing is performed. The statistical processing is carried out from the oldest waveforms first.

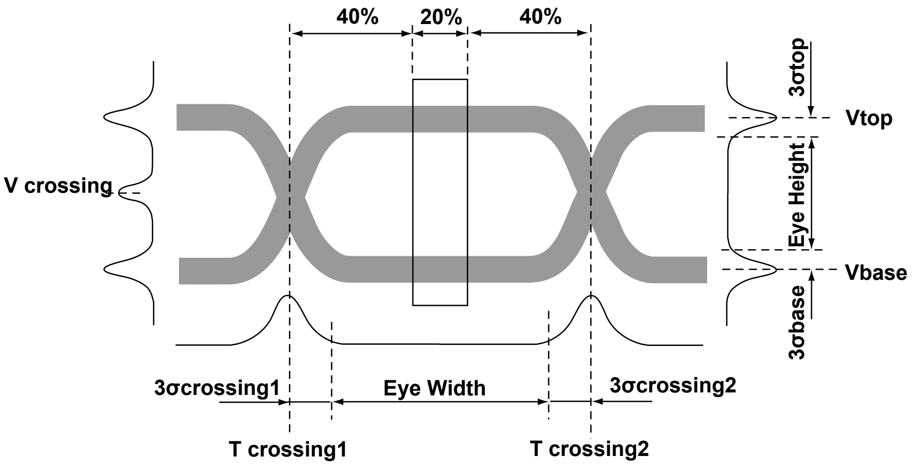
Telecom Test <<For the procedure, see section 11.5>>

There are two available tests. The mask test is used to analyze the communication signal. The other test automatically measures the waveform parameters of the eye pattern.

Measurement is performed on the accumulated waveform when the mode is set to Count.

In the mask test, a mask pattern created with the software supplied free of charge by Yokogawa is read into the SB5000, and the waveforms passing through the mask are counted.

In the eye pattern test, the following items are measured in the eye pattern.



Vtop	Vertical histogram top peak average voltage.
Vbase	Vertical histogram bottom peak average voltage.
σ top	Vertical histogram top peak standard deviation.
σ base	Vertical histogram bottom peak standard deviation.
Tcrossing1	First crossing point average time value.
Tcrossing2	Second crossing point average time value.
Vcrossing	Voltage at the point of intersection of the rising edge and falling edge.
Crossing %	Level of the point of intersection of the rising edge and falling edge of the eye pattern as a proportion of the difference between Vtop and Vbase.
Eye Height	Height of the opening in the eye diagram.
Eye Width	Width of the opening in the eye diagram.
Q Factor	Quality factor for the eye diagram showing the height of the eye pattern opening, with respect to the noise at both high and low voltage levels.
Jitter	Magnitude of the fluctuation in the time position of the crossing point.
Duty Cycle Distortion %	The percentage of full bit width of time difference between the intermediate point of the falling edge and the intermediate point of the rising edge at the intermediate threshold value.
Ext Rate dB	Extinction rate dB.
Rise	Rise time from the specified lower to upper threshold level.
Fall	Fall time from the specified upper to lower threshold level.

The following formulas are used to calculate each item.

$$\text{Crossing\%} = 100\ \frac{\text{V crossing} - \text{V base}}{\text{Vtop} - \text{Vbase}}$$

$$\text{Duty Cycle Distortion\%} = 100\ \frac{\left|\text{Trising50\%} - \text{Tfalling50\%}\right|}{\text{T crossing2} - \text{Tcrossing1}}$$

$$\text{EyeHeight} = (\text{Vtop} - 3\sigma\text{top}) - (\text{Vbase} + 3\sigma\text{base})$$

$$\text{EyeWidth} = (\text{T crossing2} - 3\sigma\text{crossing2}) - (\text{Tcrossing1} + 3\sigma\text{crossing1})$$

$$\text{Jitter} = \sigma\ \text{crossing1}$$

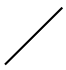
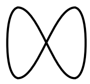
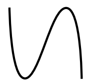
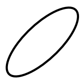
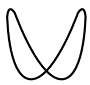
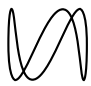
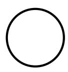
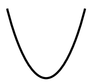
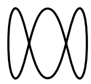
$$\text{QFactor} = \frac{\text{Vtop} - \text{Vbase}}{\sigma\text{top} + \sigma\text{base}}$$

$$\text{ExtRatedB} = 10\log\left(\frac{\text{Vtop} - \text{Vdark}}{\text{Vbase} - \text{Vdark}}\right)$$

X-Y Analysis <<For the procedure, see section 11.14>>

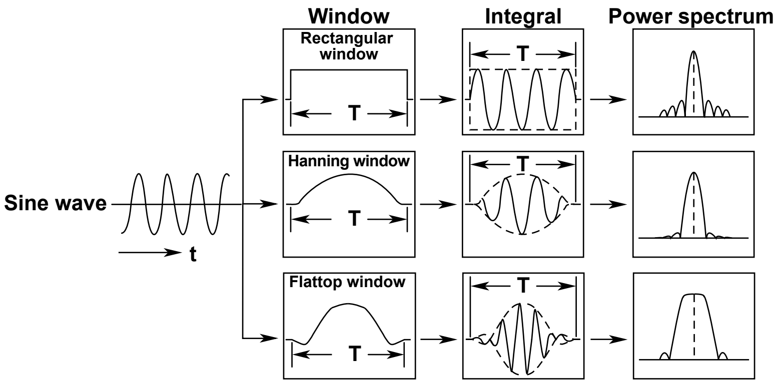
With one signal level applied to the X-axis (horizontal axis), and a second signal level applied to the Y-axis (vertical axis), the phase relationship between the two input signals can be observed. Simultaneous observation of X-Y waveforms and normal T-Y waveforms (waveform display using time axis and level) is possible.
It is also possible to specify the ranges for X-Y analysis, or carry out analysis depending on the specified signal level.
The X-Y analysis results can be used for cursor measurement, and also the area can be computed. For details of the computation of area, see Appendix 2, "Waveform Area Computation."
You can use the X-Y waveform display function to measure the phase angle between two sine wave signals. For example, an X-Y display of two sine waves produces a so-called Lissajous figure, from which the phase angle can be read.

Lissajous waveform

Phase angle 0°			
Phase angle 45°			
Phase angle 90°			
Frequency ratio (X : Y)	**1 : 1**	**1 : 2**	**1 : 3**

FFT Analysis <<For the procedure, see section 11.15>>

This executes a Fast Fourier Transform (FFT), and displays the power spectrum.
You can select the trace for the real part or the trace for the imaginary part. If the trace for the imaginary part is not set, the real part only is used for calculation, and negative frequencies are not displayed.
You can select the time window from Rectangular, Hanning, and Flattop.
The rectangular window is best suited to transient signals, such as impulse waves, which attenuate completely within the time window. The Hanning and flattop windows allow continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the zero level. Hence, it is best suited to continuous signals. With the Hanning window, the frequency resolution is higher than that of the flattop window. However, the flattop window has a higher spectral level accuracy. When the waveform being analyzed is a continuous signal, select the whichever of the Hanning window and flattop window is more suitable for the application.
The number of points in the FFT can be selected from 2.5 k, 6.25 k, 12.5 k, 25 k, 62.5 k, 125 k, and 250 k. The FFT range is specified in the waveform area (Main/Zoom 1/Zoom 2). If the waveform area record length is more than the number of FFT points, the data is downsampled for computation.
Marker measurement or peak value measurement can be used on the FFT waveform.



Rectangular window $W(t)=u(t)-u(t-T)$ U(t) : Step function

Hanning window: $W(t)=0.5-0.5\cos(2\pi\frac{t}{T})$

Flattop window: $W(t)=\{0.54-0.46\cos(2\pi\frac{t}{T})\}\frac{\sin\{2\pi(1-2t/T)\}}{2\pi(1-2t/T)}$

FFT Function

Given that the complex function resulting after the FFT is G = R + jI, the power spectrum can be expressed as follows:

DC component $10\log(R^2 + I^2)$

AC component $10\log\left(\frac{R^2 + I^2}{2}\right)$

R: Real Part, I: Imaginary Part
Reference value (0 dB) of the logarithmic magnitude (Log mag): 1 $Vrms^2$

Waveform Parameter Histogram, Trend and List Displays <<For the procedure, see section 11.16>>

You can display a selected waveform parameter as a histogram or trend. In the histogram display, the average value, standard deviation, peak value, and distributed integration value of a waveform parameter can be measured. In the trend display, time series changes in the waveform parameter can be observed, and a cursor displayed to measure the level.

Results of automated measurement of waveform parameters can be displayed in a list.

Accumulated Histogram Display <<For the procedure, see section 11.17>>

For a repeatedly captured signal, a frequency distribution histogram (Vertical, Horizontal) is shown for the specified region. On the histogram, the average value, standard deviation, maximum value, minimum value, peak value, intermediate value, and distributed integration value can be measured, and with the cursors, X-axis values or times can be measured. Using these measurement values, further calculation can be carried out.

This is useful for measuring jitter.

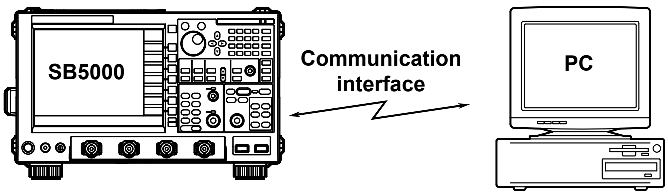
Signal Searching <<For the procedure, see sections 11.20 to 11.27>>

You can perform searches on analog signals, logic signals, or serial bus signals that the SB5000 has acquired. You can expand a point that is found or select a point if many points are found.

2.10 Communications

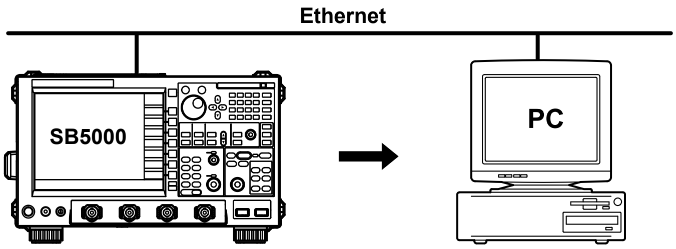
Command-Based Communications (USB/Ethernet) <<For the procedure, refer to the CD Communications Interface User's Manual>>

A USB interface is provided as standard equipment, and an Ethernet interface is available as an option. Using communication commands, you can output measurement data to a computer for data analysis or control the SB5000 using an external controller to carry out waveform measurements.



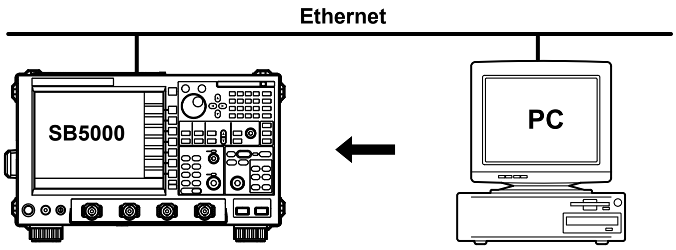
Saving and Recalling Data on a Network Drive <<For the procedure, see section 16.3>>

In the same way as on the internal storage media, measurement and setting data can be saved to or recalled from a computer on the network, and screen image data can also be saved.



Accessing the SB5000 from a Computer <<For the procedure, see section 16.6, 16.7>>

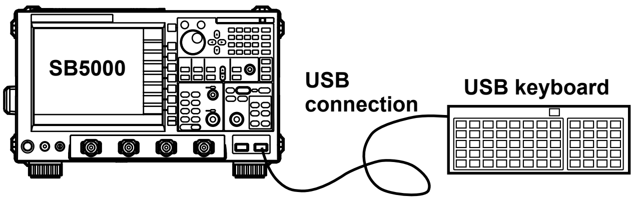
By accessing the SB5000 from a computer on the network, you can extract files from the SB5000 internal storage media (FTP server function).
Also, you can display the instrument's screen on a PC for monitoring (Web server function).



2.11 Other Useful Functions

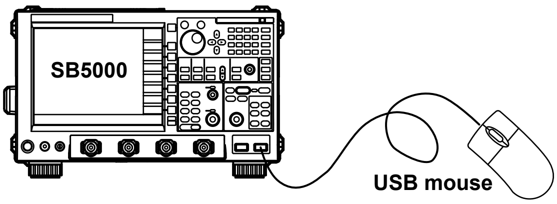
Entering Numeric and Text Data from a USB Keyboard <<For the procedure, see section 4.3>>

A USB keyboard can be connected, and used for entering file names and comments. Since the functions of the keys on the SB5000 front panel are also assigned to keys on the keyboard, the keyboard can be used in the same way as the keys on the SB5000 itself.



Operating the SB5000 Using a USB Mouse <<For the procedure, see section 4.3>>

You can use a USB mouse to operate the SB5000 as you would using the front panel keys. In addition, you can point to a desired item on a menu and click the item. This is analogous to pressing a soft key corresponding to a menu and pressing the SET key.



Initialization <<For the procedure, see section 4.4>>

You can return all settings to their default values. However, some of the settings are not initialized (see section 4.4). To initialize all settings excluding the date/time setting (display ON/OFF is initialized) to their factory defaults, turn ON the power while holding down the RESET key. Release the RESET key after a beep sounds.

Auto Setup <<For the procedure, see section 4.5>>

This function automatically sets the voltage axis, time axis, trigger settings, and other settings to suit the analog signal. This is useful when the characteristics of the input signal are unknown. The auto setup function may not work depending on the input signal.

Serial Bus Auto Setup <<For the procedure, see section 5.1>>

This feature automatically configures trigger, decode, and search settings based on a serial bus signal. The auto setup feature may not work properly for some input signals.

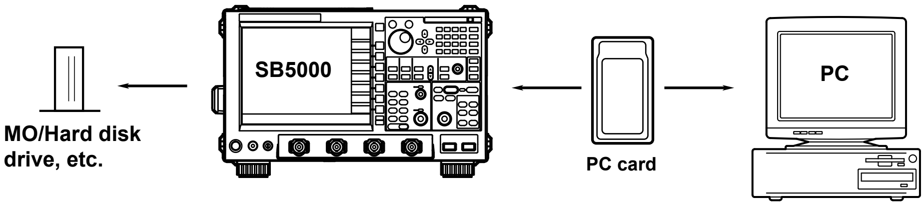
Screen Image Printing <<For the procedure, see chapter 13 and section 16.8>>

Screen images can be printed on the built-in printer (option), USB printer, or network printer (when the Ethernet interface option is installed).

Saving and Loading Data from a Storage Medium <<For the procedure, see chapter 14>>

The SB5000 allows various data to be stored to and loaded from the following storage media.

- PC card (standard equipment)
- External USB device (USB memory/MO disk drive/hard disk drive etc.)
- Network drive (when the Ethernet interface option is installed)



Saving and Loading Setting Data, Measurement Data, and Waveforms <<For the procedure, see sections 14.4 to 14.6>>

Setup data, measurement data, and snapshot/accumulated waveforms can be saved to or loaded from a selected storage medium.

Saving Screen Image Data <<For the procedure, see section 14.9>>

Screen image data can be stored to a selected storage medium. The formats that can be saved are BMP, PNG, and JPEG and these can be used to incorporate the screen image data in a document using DTP software.

Saving Analysis Results <<For the procedure, see section 14.10>>

The values from automated measurement of waveform parameters, accum histogram, FFT analysis, and analysis results of serial bus signal can be saved to a selected storage medium.

3.1 Handling Precautions

Safety Precautions

If you are using this instrument for the first time, make sure to thoroughly read the safety precautions given on pages v and vi.

Do Not Remove the Case

Do not remove the case from the instrument. Some sections inside the instrument have high voltages and are extremely dangerous. For internal inspections or adjustments, contact your dealer.

Unplug If Abnormal Behavior Occurs

If you notice smoke or unusual odors coming from the instrument, immediately turn OFF the power and unplug the power cord. If such an irregularity occurs, contact your dealer.

Do Not Damage the Power Cord

Nothing should be placed on the power cord. The cord should be kept away from any heat sources. When unplugging the power cord from the outlet, never pull by the cord itself. Always hold and pull by the plug. If the power cord is damaged, contact your dealer for replacement. Refer to page iii for the part number when placing an order.

General Handling Precautions

Do Not Place Objects on Top of the Instrument

Never place other instruments or objects containing water on top of the instrument, otherwise a breakdown may occur.

Do Not Apply Shock to the Input Section

Shocks to the input connectors or probes may turn into electrical noise and enter the instrument via the signal lines.

Do Not Damage the LCD

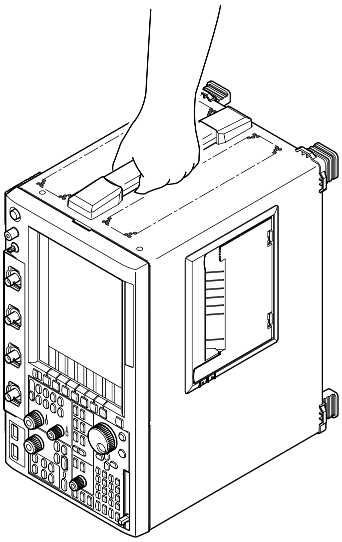
Since the LCD screen is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also it should not be exposed to vibrations and shocks.

Unplug during Extended Non-Use

Unplug the power cord from the outlet.

When Carrying the Instrument

Remove the power cord and connecting cables. Hold the handle to carry the SB5000.



Cleaning

When cleaning the case or the operation panel, first remove the power cord from the AC outlet. Then, wipe with a dry, soft, clean cloth Do not use chemical such as benzene or thinner. These can cause discoloring and deformation.

3.2 Installing the Instrument

Installation Conditions

Install the instrument in a place that meets the following conditions.

Flat, Even Surface

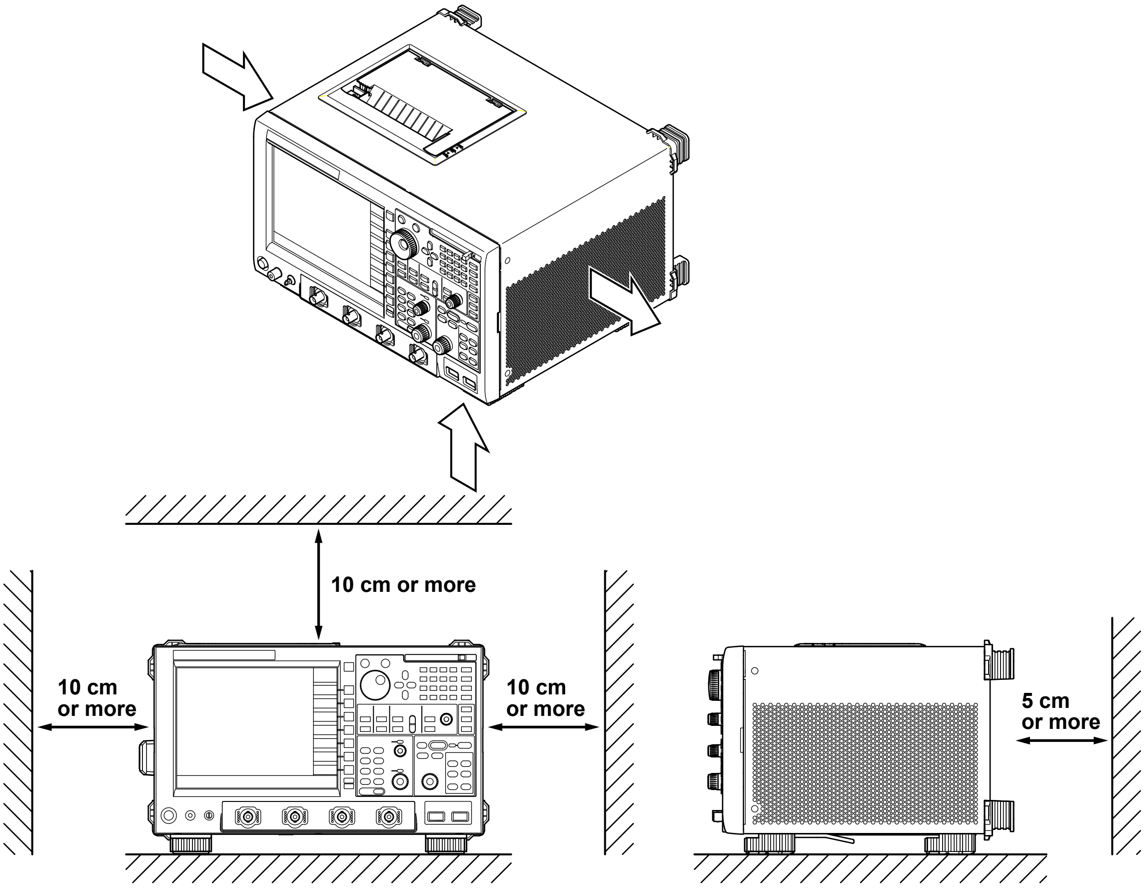
Install the instrument with the correct orientation on a stable, horizontal surface. The recording quality of the printer may be hindered when the instrument is placed in an unstable or inclined place.

Well-Ventilated Location

Inlet holes are located on the top and bottom of the instrument. There are also exhaust holes on the right side. To prevent internal overheating, allow for enough space around the instrument (see the figure below) and do not block the inlet and exhaust holes.

CAUTION

If the inlets on the left and bottom side of the instrument, and exhaust holes on the right side are blocked, the temperature of the instrument will rise, and can result in damage.



Including the spaces shown in the drawing above, allow for plenty of space to connect the cables and to open and close the cover of the built-in printer.

Ambient Temperature and Humidity

Ambient temperature	5 - 40°C
Ambient humidity	20 to 80% RH when the printer is not used. (No condensation) 35 to 80% RH when using the printer. (No condensation)

Note

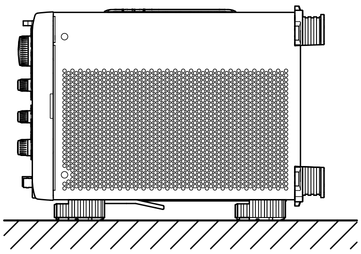
- To ensure high measurement accuracy, operate the instrument in the 23 ±5°C temperature range and 55 ±10% RH.
- Condensation may occur if the instrument is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. In such cases, allow the instrument adjust to the new environment for at least an hour before using the instrument.

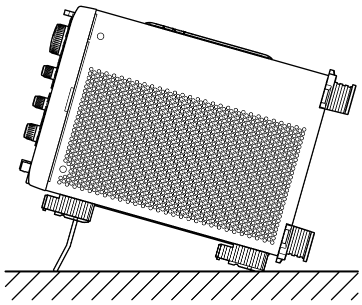
Do not install the instrument in the following places.

- In direct sunlight or near heat sources.
- Where an excessive amount of soot, steam, dust, or corrosive gas is present.
- Near strong magnetic field sources.
- Near high voltage equipment or power lines.
- Where the level of mechanical vibration is high.
- On an unstable surface.

Installation position

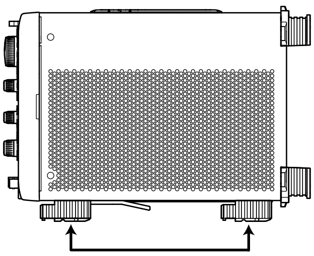
Place the instrument in a horizontal position or inclined position using the stand (see the figure below). When using the stand, pull it forward until it locks. To retract it, set the stand back to its original position. Do not install the SB5000 in a position other than those indicated below.





Rubber Feet

Rubber stoppers can be attached to the four feet on the bottom of the SB5000. Four rubber stoppers are included with the SB5000.



3.3 Connecting the Power

Before Connecting the Power

Make sure that you observe the following points before connecting the power. Failure to do so may cause electric shock or damage to the instrument.

WARNING

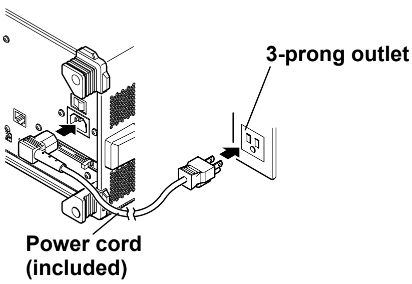
- Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Check that both the main power switch and power switch of the SB5000 are off before connection the power cord.
- To prevent the possibility of electric shock or fire, be sure to use the power cord for the instrument that was supplied by YOKOGAWA.
- Make sure to perform protective earth grounding to prevent electric shock. Connect the power cord to a three-prong power outlet with a protective earth terminal.
- Do not use an extension cord without a protective earth ground. Otherwise, the protection function will be compromised.
- If an AC outlet that conforms to the accessory power cord is unavailable and protective grounding cannot be furnished, do not use the instrument.

Connecting the Power Cord

1. Check that both the main power switch and power switch of the SB5000 are off.
2. Connect the power cord plug to the power connector on the rear panel.
3. Connect the other end of the cord to an outlet that meets the conditions below.
   Use the three-prong power outlet equipped with a protective earth terminal.

Rated supply voltage*	100 to 120 VAC/220 to 240 VAC (automatic switching)
Permitted supply voltage range	90 to 132 VAC/198 to 264 VAC
Rated supply voltage frequency	50/60 Hz
Permitted supply voltage frequency range	48 to 63 Hz
Maximum power consumption	Max. approx. 300 VA

* The SB5000 can use a 100-V or a 200-V system for the power supply. The maximum rated voltage differs according to the type of power cord. Check that the voltage supplied to the SB5000 is less than or equal to the maximum rated voltage of the provided power cord (see page ii) before using it.



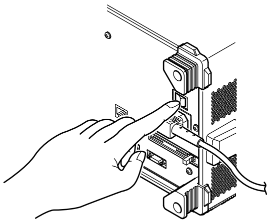
Turning ON the Power Switch

Items to Be Checked before Turning ON the Power

- The instrument is properly installed.: “3.2 Installing the Instrument”
- The power cord is properly connected.: Previous page

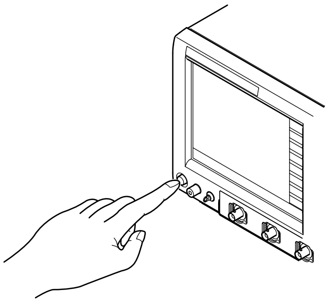
Turning ON the Main Power Switch

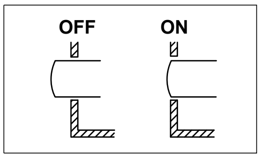
1. Switch the rear panel power switch to the ON (|) position.



Turning ON the Power Switch

2. Press the power switch on the front panel.





Powering off

CAUTION

Abruptly turning the main power switch off or unplugging the power cord while saving data or printing with the built-in printer, may damage the built-in printer or corrupt the media (PC card, internal hard disk, USB storage, and so on) on which data is being saved. The data being saved is also not guaranteed. Always complete data saving before turning off the main power switch.

Turning the Power Switch OFF

1. Press the power switch on the front panel.

Turning the Main Power Switch OFF

2. Check that the SB5000 internal fan has stopped, and that the screen is blank, then switch the power switch on the rear panel to the OFF (○) position.

Power Up Operation

A self-test and calibration start automatically when the power switch is turned ON. That lasts approximately 30 seconds. If the check results are satisfactory, the normal waveform display screen will appear.

Note

- Allow at least 10 seconds before turning ON the power switch after turning it OFF.
- If self-test and calibration do not start when the power is turned ON, or if the normal waveform display screen does not appear, turn OFF the power switch and check the following points.
  - That the power cord is plugged in properly.
  - That the correct voltage is coming to the power outlet (see page 3-5).
  - The settings are initialized (they are returned to factory default settings) by turning on the power switch while holding down the RESET key. For details on the initialization of the settings, see section 4.4, "Initializing Settings."

  If the instrument still fails to power up when the power switch is turned ON after checking these points, contact your dealer.
- It takes several seconds for the startup screen to appear.

For Taking Accurate Measurements

- To ensure accurate measurements, allow the instrument to warm up for at least 30 minutes after turning ON the power switch.
- After warm-up is complete, perform calibration (see section 4.8). If Auto Calibration is on, it will be executed automatically when T/div is changed and signal acquisition is started.

Power Down Operation

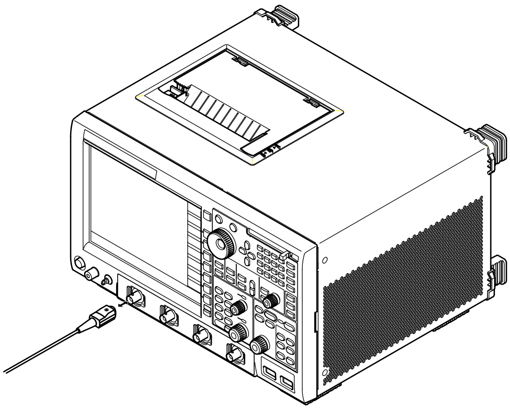
The settings just prior to turning OFF the power (or when the power cord is unplugged) are stored. Therefore, the next time the power is turned ON, waveforms are measured using those settings.

Note

- A built-in lithium battery powers the memory that stores the settings. It has a life-span of approximately 5 years when kept at an ambient temperature of 23°C. When the lithium battery voltage falls below a certain level, a message is displayed on the screen (error 900) when the power switch is turned ON. Whenever you see this message, you must have the lithium battery replaced immediately. The user cannot replace the battery. Contact your dealer to have a new battery installed.
- If you turn OFF the main power switch of the rear panel when the power switch of the front panel is ON, the settings immediately before the power is turned OFF may not be stored correctly. An error message (error 900) may appear on the screen the next time you turn the power switch ON. This is not a malfunction. When turning the power OFF, turn OFF the power switch of the front panel, and then turn OFF the main power switch of the rear panel.

3.4 Connecting the Probe

Connect a probe (or measurement input cable such as a BNC cable) to the input terminal on the bottom of the front panel. The input impedance is 1 MΩ ± 1% and approximately 20 pF or 50 Ω ± 1.5%.



WARNING

- Always turn OFF the power of the object to be measured when connecting it to this instrument. Connecting or disconnecting a measuring lead while the power of the object to be measured is ON is extremely dangerous.
- Do not input excessive voltages that exceed maximum input voltage, withstand voltage, or tolerance surge voltage.
- Always use a protect ground (earth) for the instrument to prevent electric shocks.
- Avoid continuous connections in environments where there is the possibility that tolerance surge voltages can be generated.

CAUTION

- The probe interface terminal is located near the input terminal on this instrument. When connecting the probe, make sure to prevent an excessive voltage due to static electricity, etc., from being applied to the probe interface terminal, as this may damage it.
- The probe interface terminal is located near the input terminal on this instrument. Do not short the probe interface terminal.
- The maximum input voltage for 1 MΩ- input is 150 Vrms when the frequency is 1 kHz or less. Applying a voltage exceeding the value can damage the input section. If the frequency is above 1 kHz, damage may occur even when the voltage is below the value.
- The maximum input voltage for 50 Ω-input is 5 Vrms and 10 Vpeak. Applying a voltage exceeding either of these values can damage the input section.

Precautions to Be Taken When Connecting Cables

- When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in section 3.5, “Compensating the Probe (Phase Correction).” If you do not, frequency characteristics will not be flat, and measurements will not be correct. Perform the phase correction on each channel to which a probe is to be connected.
- Note that if the object being measured is directly connected to the instrument without using a probe, correct measurements may not be possible because of the effect of input impedance on the instrument. Use caution.

About Probes

Specification of standard supplied probe (model 701943), after probe phase compensation

Item	Specification	Conditions
Overall probe length	1.5 m	—
Connector type	BNC	—
Input impedance	10 MΩ ±2%	Together with an oscilloscope of input impedance 1 MΩ ±1%
Input capacitance	Approx. 14 pF	
Attenuation ratio	Not exceeding 10 : 1 ±2%	
Bandwidth	DC to 500 MHz (not exceeding –3 dB)	
Rise time	700 ps or less (typical*)	
Maximum input voltage	600 V (DC+ACpeak) or 424 Vrms	When AC does not exceed 100 kHz

* Typical values are typical or mean values. They are not strictly guaranteed.

Precautions to Be Taken When Using Voltage Probes Other Than Those Provided with the Instrument

- When measuring a signal including a frequency close to 500 MHz, use a probe with a frequency range above 500 MHz.
- Measurement will only be correct if the attenuation ratio is set properly. Check the attenuation ration of the probe that you are using and set it properly.

Setting the Probe Attenuation Ratio or Voltage-Current Conversion Factor

When using a probe not supported by the probe interface connector, follow the procedure described in Section 6.6 to set the SB5000 attenuation ratio or voltage-current conversion factor to match the probe attenuation ratio or voltage-current conversion factor. If this setting is not carried out, correct measurement values will not be displayed.

Connecting a Probe Supported by the Probe Interface Connector

- If you connect a probe* supported by the probe interface connector to the SB5000, the probe type is automatically recognized, and the attenuation ratio set. Power is supplied to the probe through the probe interface, and therefore it is not necessary to connect the probe power cable to the probe power terminals.
- You can execute automatic zero adjustment (see section 6.14) on a current probe that is compatible with the probe interface connector.

* For a list of compatible probes, see “Optional Accessories” on page iv.

Connecting FET Probe, Current Probe, Differential Probe, or Deskew Correction Signal Source

If you are using the YOKOGAWA’s FET Probes, Current Probes, Differential Probes, or Deskew Correction Signal Source, use the Probe Power (option) on the SB5000 rear panel for the power supply. For details on the connection procedure, see the manual that comes with the respective product.

* For a list of probes and signal sources, see “Optional Accessories” on page iv.

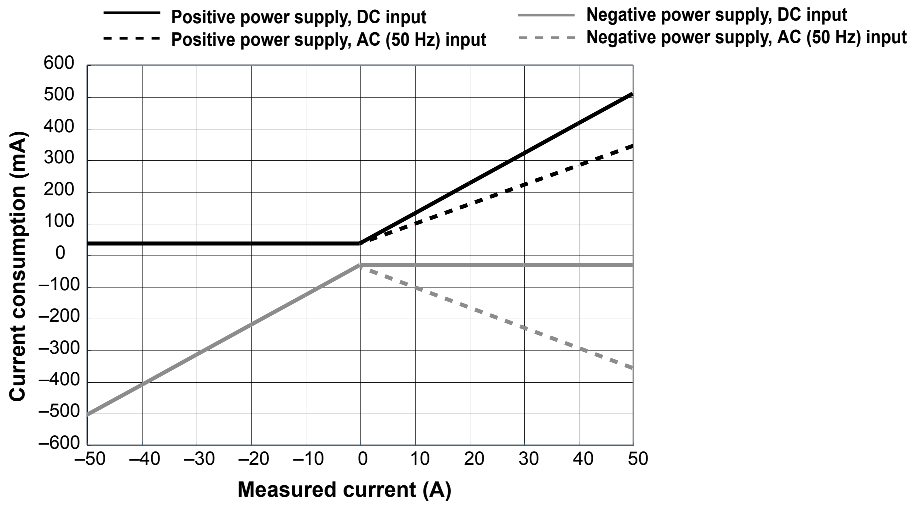
CAUTION

Do not use the Probe Power Terminal (option) on the SB5000 rear panel for purposes other than supplying power to the FET Probe, Current Probe, Differential Probe, or Deskew Correction Signal Source. Also, be sure that the total current of the four Probe Power Terminals and the four Probe Interface Terminals does not exceed 1.2 A. Otherwise, the device connected to the Probe Power Terminals or to the SB5000 may break.

Handling Precautions of the Probe Interface Terminals and Probe Power Terminals

If you are connecting the YOKOGAWA's FET Probes, Current Probes, Differential Probes, or Deskew Correction Signal Source to the Probe Power Terminals (Option) on the rear panel, be sure that the total current of the four Probe Power Terminals and the four Probe Interface Terminals does not exceed 1.2 A. Otherwise, the SB5000 operation may become unstable due to the activation of the excessive current protection circuit of the power supply.

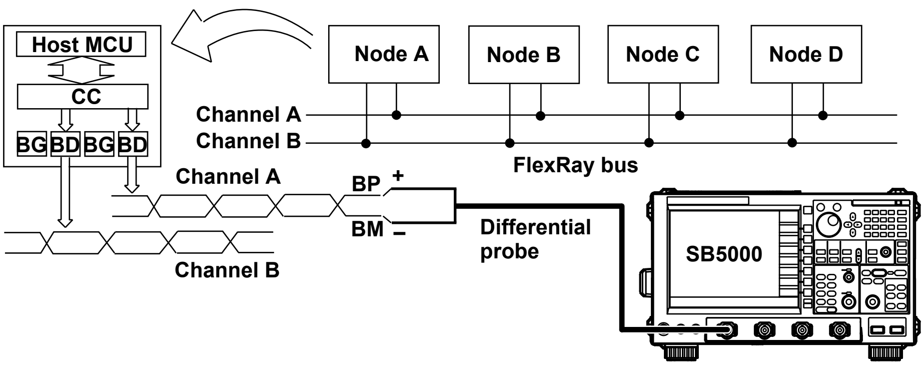
- When using current probes (701932/701933), the number of probes is limited, depending on the measured current (the current measured by the current probes). The characteristics of measured current versus current consumption for active probes that can be connected to the SB5000 are as follows.



- The current consumption of the FET probe (700939) and differential probe (700924, 700925, 701920, 701921, or 701922) should be calculated as a maximum of 125 mA for both negative and positive.
- Calculate the power consumption of the Deskew Correction Signal Source (701935) as 150 mA (positive power supply).

Connecting a Differential Probe to a FlexRay Bus

Connect the differential probe's negative and positive inputs to the BM and BP pins of the FlexRay bus, respectively.



3.5 Compensating the Probe (Phase Correction)

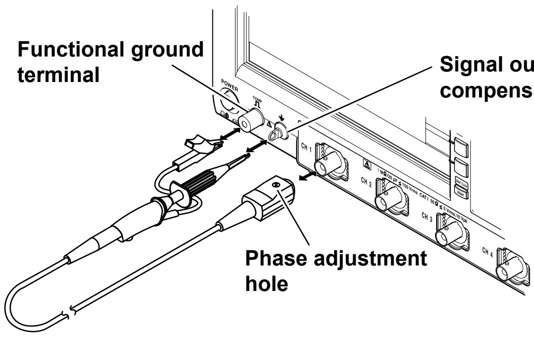
Be sure to perform phase correction of the probe first when using a probe to make measurements.

CAUTION

Do not apply external voltage to the signal output terminal for probe compensation adjustment. This may cause damage to the internal circuitry.

Procedure

1. Turn ON the power switch.
2. Connect the probe to the input terminal to which the signal is to be applied.
3. Connect the tip of the probe to the signal output terminal for probe compensation adjustment on the front panel of the instrument and to the ground wire to the functional ground terminal.
4. Perform auto setup according to the procedures given in section 4.5, “Performing Auto Setup.”
5. Insert a flat-head screwdriver to the phase adjustment hole and turn the variable capacitor to make the displayed waveform a correct rectangular wave.



Explanation

Necessity of Phase Correction of the Probe

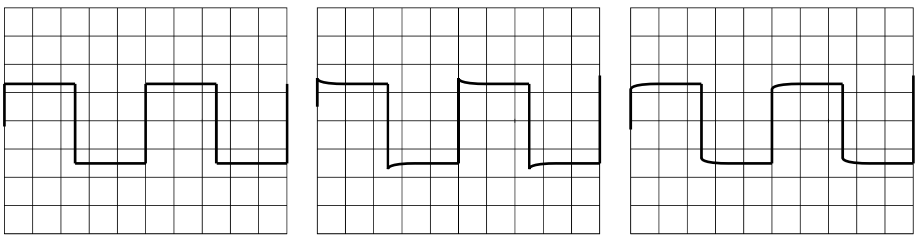
The probe comes with its phase corrected approximately to match the input capacitance of the relevant oscilloscope. However, there is variance in the input resistance and input capacitance of each input channel of individual oscilloscopes. This results in a mismatch in the voltage divider ratio between low and high frequency signals and causes uneven frequency characterstics.
There is a variable capacitor for adjusting the division ratio (trimmer) for high frequency signals on the probe. The phase is corrected by adjusting this trimmer so that even frequency characteristics are obtained.
When using the probe for the first time, make sure to perform phase correction.
Because the input capacitance varies on each channel, probe compensation is required when the probe is switched from one channel to another.

Phase Compensation Signal

The following square wave signal is output from the signal output terminal for probe compensation adjustment.
Frequency: Approx. 1 kHz
Amplitude: Approx. 1 V

Differences in the Waveform due to the Phase Correction of the Probe

Correct waveform | **Over compensated (The gain in the high-frequency region is too high.)** | **Under compensated (The gain in the high-frequency region is too low.)**



3.6 Connecting Logic Probes

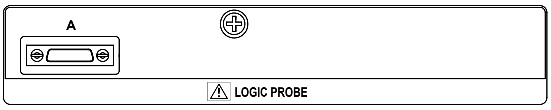
CAUTION

- The maximum input voltage for the logic probe input is ±40 V (DC+ACpeak) or 28 Vrms for frequencies up to 1 kHz. Applying a voltage exceeding either of these values may damage the logic probe or the SB5000. For frequencies above 1 kHz, damage may occur even if the voltage is below the values specified above.
- The 8 input lines on each port have a common ground. In addition, the ground for the SB5000 and the ground for each port are also common. Do not connect inputs that have different common voltages, as doing so may cause damage to the SB5000, logic probe, or other connected instruments.
- Make sure to turn OFF the power to the SB5000 before connecting or disconnecting a logic probe cable.

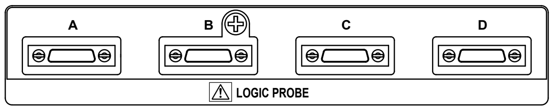
Logic Signal Input Ports

Connect the logic probe (701980/701981) to any of the four logic signal input ports (POD A, POD B, POD C, and POD D) on the rear panel.

SB5310



SB5710



About the Logic Probe

The logic probe (701980/701981) is designed exclusively for the logic signal input ports of the SB5000. Use the connection lead (accessory, see the next page) to connect to the point of measurement. Do not alter the connection lead, as it may cause the lead from satisfying the specifications.

Each port has 8 lines of logic input terminals. You can set the threshold level from the SB5000 menu (see section 6.18).

Logic Input Specifications When Used on the SB5000

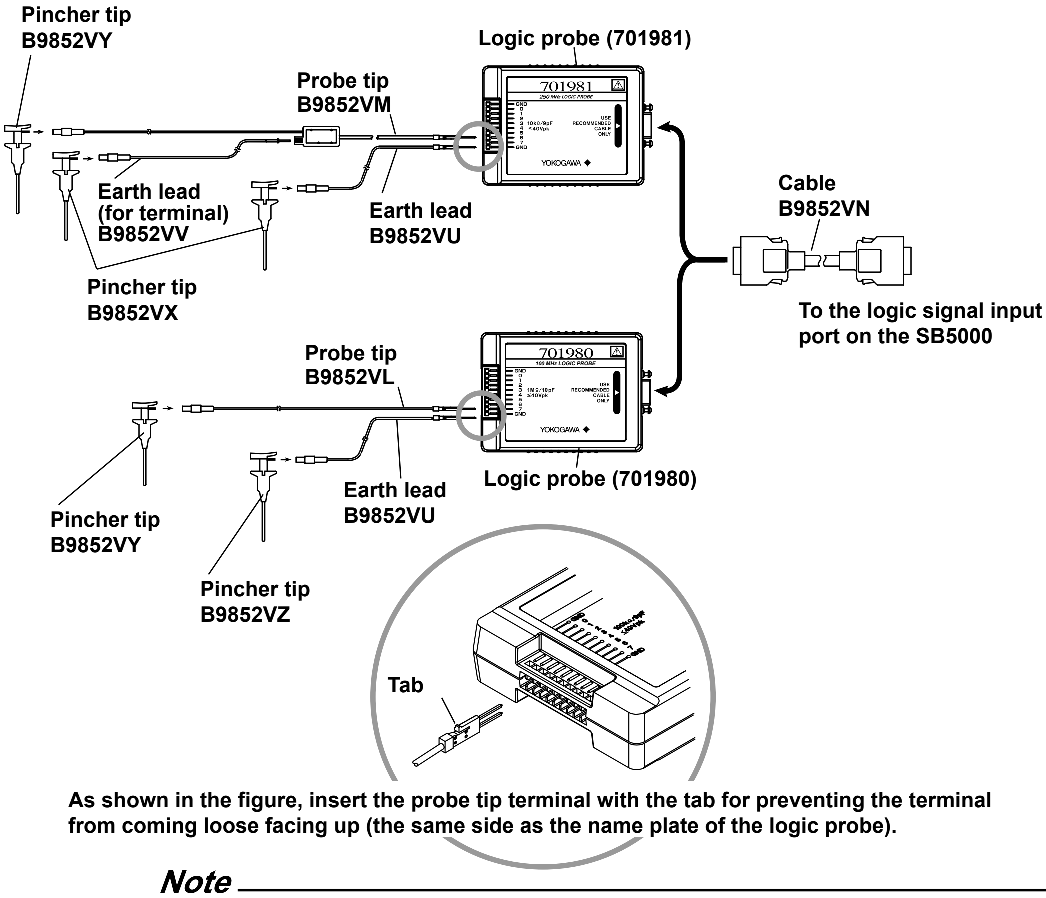
Item	When using the 701981	When using the 701980
Maximum toggle frequency[1]	250 MHz	100 MHz
Number of inputs	32 (when using four logic probes)	Same as the 701981
Maximum input voltage[2]	±40 V(DC + ACpeak) or 28 Vrms	Same as the 701981
Input range	±10 V	±40 V
Maximum sample rate	2.5 GS/s (interleave mode OFF) 5 GS/s (interleave mode ON)	Same as the 701981
Threshold level	±10 V (resolution: 0.1 V)	±40 V (resolution: 0.1 V)
Threshold accuracy[1]	±(100 mV + 3% of setting)	Same as the 701981
Minimum input voltage[1]	500 mVp-p	Same as the 701981
Input impedance	Approx. 10 kΩ, approx. 9 pF	Approx. 1 MΩ, approx. 10 pF
Preset threshold levels	CMOS (5 V) = 2.5 V, CMOS (3.3 V) = 1.6 V, CMOS (2.5 V) = 1.2 V, CMOS (1.8 V) = 0.9 V, and ECL = –1.3 V	Same as the 701981

1 Under standard operating conditions (see section 20.12) after warm-up.
2 For frequencies up to 1 kHz.

Connection Procedure

1. Turn the power switch OFF.
2. Connect the B9852VN cable to the logic probe.
3. Connect the B9852VM probe tip (B9852VL if the logic probe is 701980) and the B9852VU earth lead to the logic probe.
   To observe high-speed signals, connect the B9852VV earth lead (for terminal) to the GND terminal of the B9852VM probe tip.
4. If the logic probe is 701981, connect the B9852VY pincher tip to the tip of the B9852VM probe tip and the B9852VX pincher tip to the tip of the B9852VU or B9852VV earth lead.

   If the logic probe is 701980, connect the B9852VY pincher tip to the tip of the B9852VL probe tip and the B9852VZ pincher tip to the tip of the B9852VU earth lead.
5. Connect the other end of the B9852VN cable to the logic signal input port of the SB5000.
6. Turn the power switch ON.
7. Connect the other end of the B9852VU or B9852VV (only when the logic probe is 701981) earth lead to the ground potential of the circuit being measured.
   To observe high-speed signals, connect the B9852VV earth lead (for terminal) to the ground potential of the circuit being measured.
8. Connect the B9852VY pincher tip that was connected to the probe tip to the item being measured.



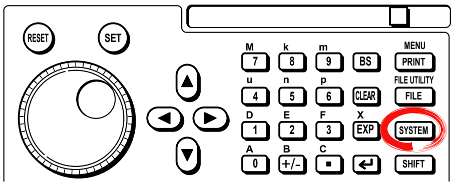
As shown in the figure, insert the probe tip terminal with the tab for preventing the terminal from coming loose facing up (the same side as the name plate of the logic probe).

Note

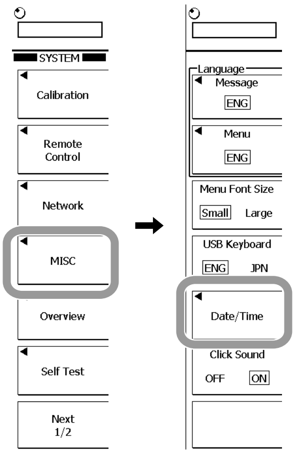
If the logic probe is not connected to the SB5000, the logic probe input is at low level.

3.7 Setting the Date and Time

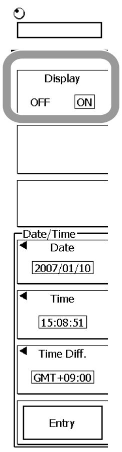
Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **MISC** > **Date/Time**.
   The Date/Time setup dialog box appears.



3. Press the **Display** soft key to select ON or OFF.
   - ON: Displays the date and time at the upper left of the screen.
   - OFF: Does not display the date or time.

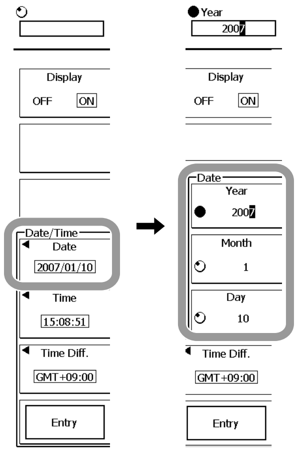


Setting the Date and Time

If you are not using the SNTP function (see section 16.5) to set the SB5000 date and time and want to set them manually, carry out the steps below.

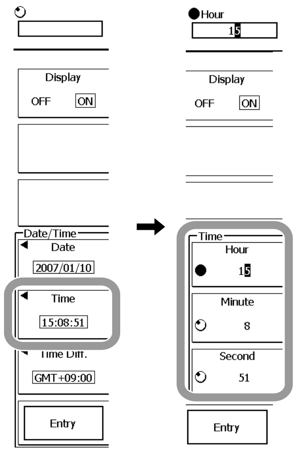
- **Setting the Date**

4. Press the **Date** soft key.
5. Press the **Year** soft key.
6. Use the **rotary knob** to set the year.
7. Likewise, set the month and day.
8. Press **ESC**.



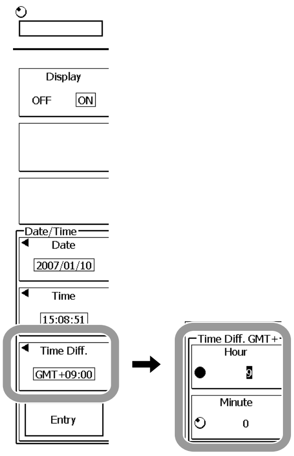
- **Setting the Time**

4. Press the **Time** soft key.
5. Press the **Hour** soft key.
6. Use the **rotary knob** to set the hour.
7. Likewise, set the minute and second.
8. Press **ESC**.



Setting the Time Difference from GMT

4. Press the **Time Diff.** soft key.
5. Press the **Hour** soft key.
6. Use the **rotary knob** to set the time difference from GMT.
7. Likewise, set the minute.
8. Press **ESC**.



Applying the Settings

9. Press the **Entry** soft key. The specified date, time, and time difference take effect.
   The specified settings only take effect when you press Entry.

Explanation

Date and Time

- **Day (Year/Month/Day)**
  Enter the year using four digits.
- **Time (Hour:Minute:Second)**
  Set the hour using a 24-hour clock.

Time Difference from GMT

Set the time difference from GMT* according to the region where you are using the SB5000. Set the time difference properly so that the following functions work properly.

- Mail transmission using the SMTP function (section 16.4)
- Monitoring of the SB5000 using the Web server function (section 16.7)

  * GMT information can be obtained from an SNTP server (section 16.5).

- **Time Difference from GMT**
  Set the time difference from –12 hours 00 minutes to 13 hours 00 minutes.
  For example, set Time Hour to 9 and Minute to 00 for Japan standard time.
- **Checking the Standard Time**
  You can check the standard time for your region in the following ways.
  - Check the Date, Time, Language, Regional Options on your Windows PC.
  - Check the following website.http://www.worldtimeserver.com/

Note

- The SB5000 does not support Daylight Savings time. Adjust the time difference from GMT to obtain the same effect.
- The date and time settings are backed up with the internal Lithium battery. The settings remain even if you turn the SB5000 OFF.
- The SB5000 manages leap years.

4.1 Operations and Functions of Keys and the Rotary Knob

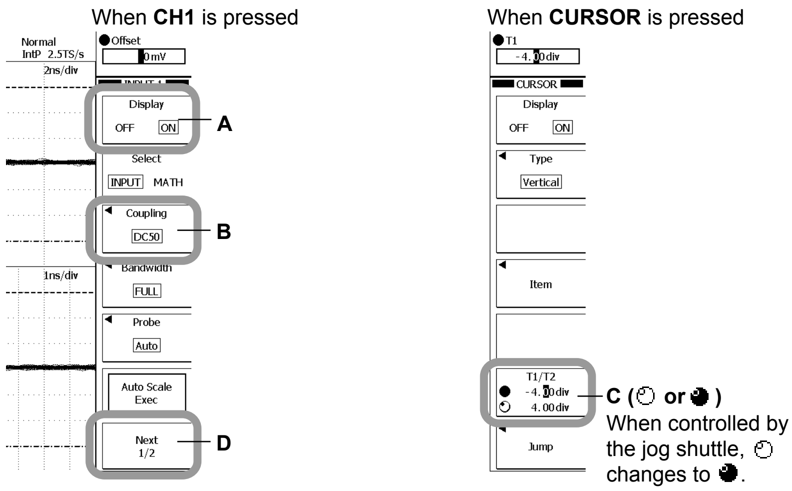
Basic Key Operations

Using the Setup Menu That Appears When You Press a Front Panel Key

The setup menu that appears when you press CH1 or CURSOR is used as an example to explain the procedure.

1. Press **CH1** or **CURSOR** to display the respective setup menu.
2. Press the soft key that corresponds to each item.
   Menu setup operations can be grouped into one of four patterns, A to D, as described below.

Setup menu



A: Press the corresponding soft key to switch the selected item.

B: Press the corresponding soft key to display the selection menu.
To make a selection, press the soft key corresponding to the selection.

C: Press the corresponding soft key to set the item under jog shuttle control.
Turn the jog shuttle to set the value. Press the arrow keys to move between digits.
You can directly enter the value using the keys on the front panel or a USB keyboard.

D: Appears when there are 2 pages of the setup menu.
Press the corresponding soft key to display page 2/2 (2 of 2) of the setup menu.
The name changes to "Back (2/2)." To return to page 1/2 (1 of 2), press the corresponding soft key again.
If there are 3 pages, the pages advance in the following order: page 1 → page 2 → page 3 → page 1 → page 2, and so on.

Note

For setup menus with multiple pages, the unit keeps the last setup menu that was open before the power was turned off. As a result, if you open the setup menu again after switching screens by pressing another panel key, the page you had been setting previously is displayed.
Explanations in this manual proceed on the assumption that the first page of the setup menu appears when the panel key is pressed.
The actual screen that appears when you press the panel key may differ from the explanations in this manual.

Displaying the Setup Menu Marked in Purple above the Panel Keys

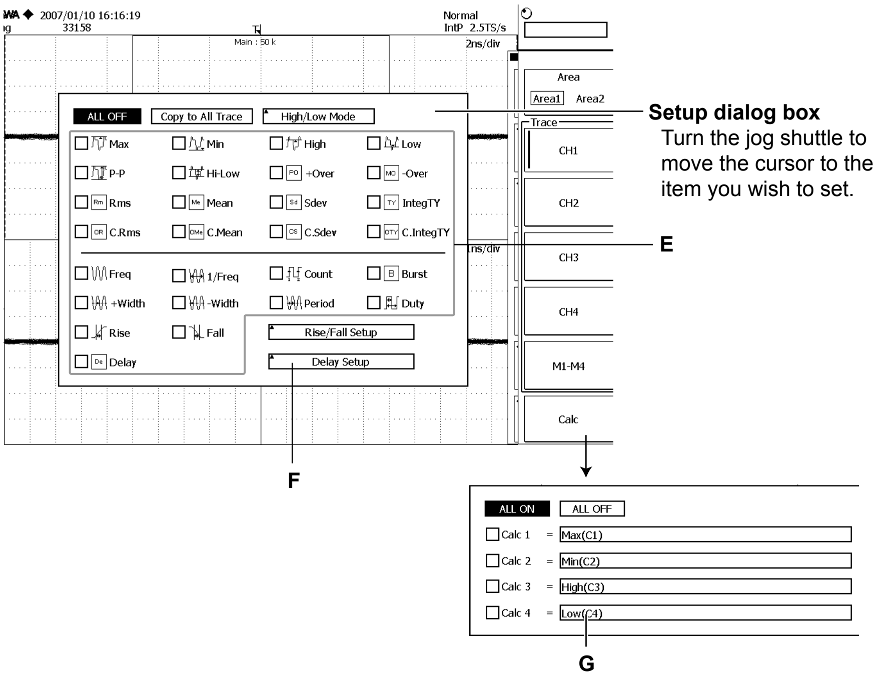
In the explanations in this manual, "**SHIFT + panel key name (purple text)**" refers to the following operation.

1. Press the **SHIFT** key. The SHIFT key illuminates to indicate the shifted state. The setup menu marked in purple above the panel keys can be selected.
2. Press the panel key corresponding to the setup menu you wish to display.

Operations on the Setup Dialog Box

1. Open the setup dialog box using key operations.
2. Use the **rotary knob** or **arrow keys** to move the cursor to an appropriate item.
3. Press **SET**.
   Depending on the item you are setting, the SET key operates in one of four ways, E to G, as described below.

In this manual, the phrase "use the **rotary knob** and **SET**" is used to describe steps 1 to 3 above.



E: Press SET to confirm the selection. Press SET again to release the selection.

F: Press SET to switch the soft key menu to the settings for the item.

G: Press SET to display the value entry box.
Turn the jog shuttle or use the numeric keypad to set the value.
Press the arrow keys to move the cursor or the selected digit.
You can directly enter the value from a USB keyboard.

Clearing the Setup Menu and Setup Dialog Box Displays

Press **ESC**. The setup menu or the dialog box shown on top is cleared from the screen.

Note

In the procedural explanations in this manual, the operation of clearing the setup menu or setup dialog box may not be given.

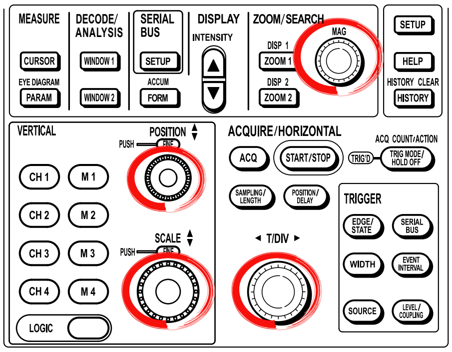
4.2 Entering Values and Strings

Entering Values

Entering Values Directly Using the Dedicated Knobs

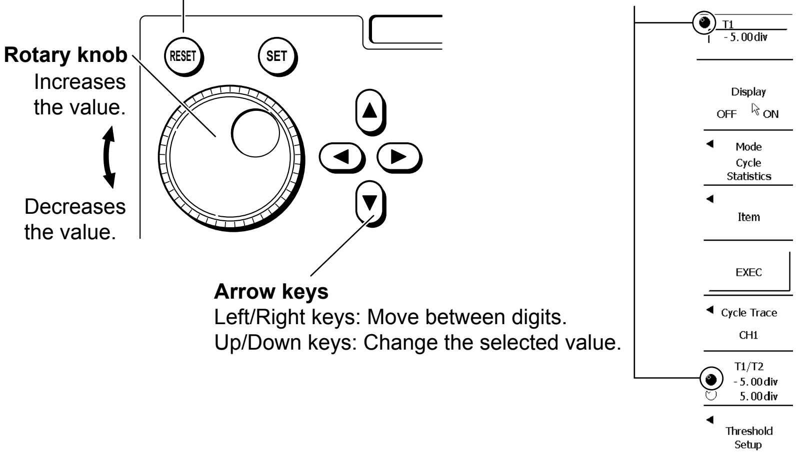
The dedicated knobs indicated below can be turned to directly enter values.

- POSITION knob
- SCALE knob
- T/DIV knob
- MAG knob



Entering Values Using the Rotary Knob

After selecting the item you want to set by using soft keys, change its value using the rotary knob and arrow keys. In this manual, this operation may be simply described as "using the **rotary knob**."



Note

The items that can be changed using the rotary knob are reset to their default values when the RESET key is pressed.

Entering Strings

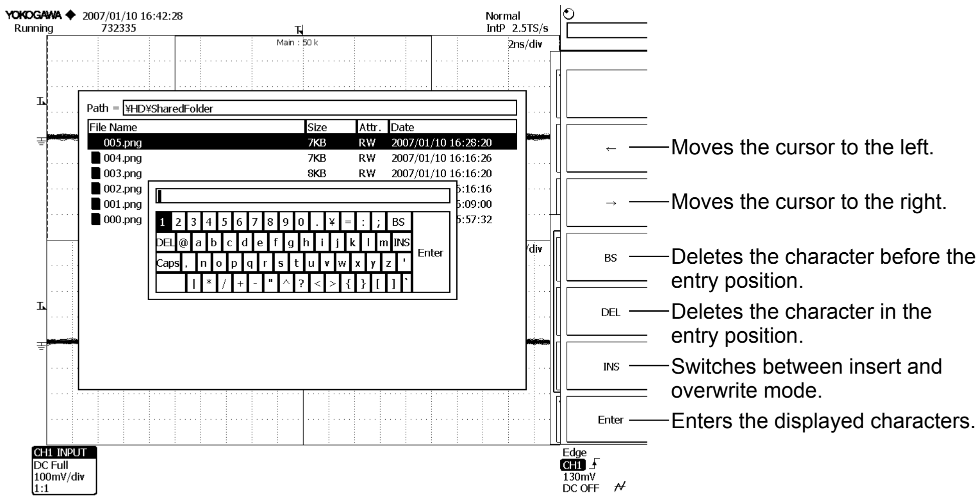
The keyboard displayed on the screen is used to enter character strings such as file names and comments. The rotary knob, SET, and arrow keys are used to operate the keyboard to enter the character strings.

Operating the Keyboard

1. Use the **rotary knob** to move the cursor to the character to be entered. Press the arrow keys on the front panel to move the cursor left/right and up/down.
2. Press **SET** key to enter the character.

   To enter a numeric value, you can use the numeric keypad on the front panel.

   To enter letters, press the INS soft key, then enter the characters. In insertion mode, the cursor appears between characters.
3. Repeat steps 1 and 2 to enter all the characters in the string.
4. You can press the **Enter** soft key or ↵ key on the front panel to confirm the string and clear the keyboard.



Note

- Multiple @ characters cannot be entered consecutively.
- File names are not case-sensitive. Comments are case-sensitive. In addition, the following file names cannot be used due to limitations of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, COM1 to COM9, and LPT1 to LPT9

4.3 Operating the SB5000 Using a USB Keyboard or a USB Mouse

Connecting a USB Keyboard

You can connect a USB keyboard for entering file names, comments, and other information.

Keyboards That Can Be Used

The following keyboards that conform to USB Human Interface Devices (HID) Class Version 1.1 can be used.

- When the USB keyboard language is English: 104 keyboard
- When the USB keyboard language is Japanese: 109 keyboard

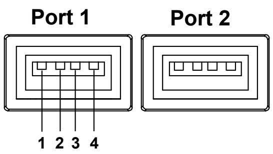
Set the USB keyboard language according to the instructions in section 18.3.

Note

- Connect only the keyboards that are allowed.
- The operation of USB keyboards connected to a USB hub or those that have mouse connectors is not guaranteed.
- For USB keyboards that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

USB Connector for Peripheral Devices

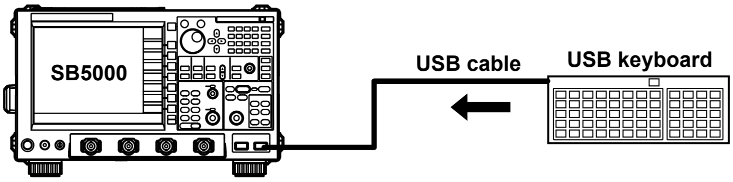
Connect the USB keyboard to the USB connector for connecting peripheral devices on the front panel. Two ports are available.



Pin No.	Signal Name	
1	VBUS:	+5 V
2	D–:	–Data
3	D+:	+Data
4	GND:	Ground

Connection Procedure

When connecting a USB keyboard, directly connect the keyboard to the SB5000 using a USB cable as shown below. You can connect the USB cable regardless of whether the power to the SB5000 is ON or OFF (supports hot-plugging). Connect the type A connector of the USB cable to the SB5000; connect the type B connector to the keyboard. When the power switch is ON, the keyboard is detected and enabled approximately six seconds after it is connected.



Note

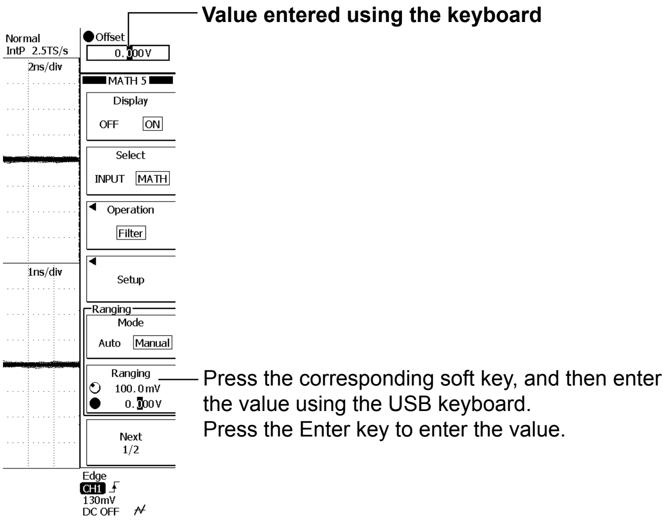
- Do not connect USB devices other than a compatible USB keyboard, USB mouse, USB printer, and USB storage to the USB connector for connecting peripheral devices.
- Do not connect multiple keyboards. Only 1 keyboard, 1 mouse, and 1 printer can be connected.
- Do not connect and disconnect multiple USB devices successively. Allow at least ten seconds between the connection and disconnection of a USB device and the connection and disconnection of the next USB device.
- Do not disconnect the USB cable after the power is turned ON until key operation becomes possible (approximately 20 to 30 s).

Entering File Names, Comments, and Other Items

When a keyboard is displayed on the screen, you can enter the file name, comment, and other items using a USB keyboard.

Entering Values from a USB Keyboard

You can enter values from a USB keyboard for items with the ● or ⟲ mark.



Operations Using a USB Mouse

You can use a USB mouse to operate the SB5000 as you would use the front panel keys. In addition, you can point to a desired item on a menu and click the item. This is analogous to pressing a soft key corresponding to a menu and pressing the SET key.

USB Connector for Connecting Peripheral Devices

Connect a USB mouse to the USB connector for connecting peripheral devices on the front panel of the SB5000. For details on the USB connector for connecting peripheral devices, see page 4-5.

Compatible USB Mouse

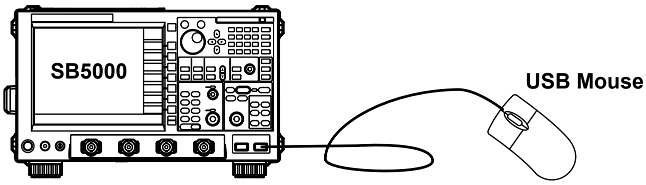
A USB mouse conforming to USB HID Class Version 1.1 can be used.

Note

For USB mouse devices that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

If you want to connect a USB mouse to the SB5000, connect the mouse to the USB connector for connecting peripheral devices. You can connect/disconnect the USB mouse connector regardless of the power ON/OFF state of the SB5000 (supports hot-plugging). When the power switch is turned ON, the mouse is detected approximately six seconds after it is connected, and a pointer ( ) is displayed.



Note

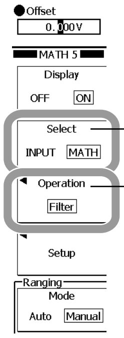
- Do not connect USB devices other than a compatible USB keyboard, USB mouse, USB printer, and USB storage to the USB connector for connecting peripheral devices.
- There are two USB connectors for connecting peripheral devices. However, do not connect mouse devices to both connectors at the same time.

USB Mouse Operation

- **Setup Menu Operation (Similar to the Soft Key Operation)**

  Selecting an Item on the Setup Menu

  Left-click the item you wish to select on the setup menu.
  If another menu appears when you select an item, move the pointer to the new menu displaying the item you wish to select and left-click the item.
  If an item such as ON or OFF appears when you select an item, move the pointer to the new frame and left-click within the frame to switch the selected item.
  For menus in which items are selected using the **rotary knob** and **SET** (see page 4-3), left-click the desired item. Left-click again to confirm the new setting and close the selection dialog box.

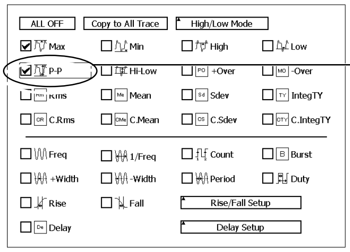


Left-click within this frame to switch the selected item with each click.

Left-click within this frame to show the selection menu.
Point to the item you wish to select and left-click the item to confirm the selection.

- **Selecting Toggle Box Items on the Dialog Box**

  Move the pointer to the item you wish to select and then left-click the item.
  The item is selected. Click the selected item again to deselect it.
  To close the dialog box, press the **ESC** key.



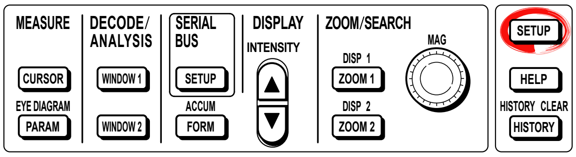
Move the pointer over the item you wish to select and left-click.

Note

To close an error dialog box, press the ESC key on the front panel.

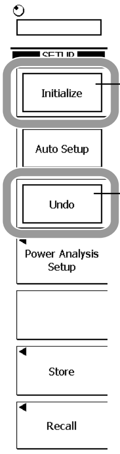
4.4 Initializing Settings

Procedure



Executing Initialization

1. Press **SETUP**.
2. Press the **Initialize** soft key. Initialization is executed.



Canceling Initialization

3. Press the **Undo** soft key. The settings return to the conditions that existed immediately before initialization.

Explanation

You can restore the factory default settings. This is useful when you wish to clear previous settings or start measurement from scratch.

Initialization

Initialization refers to the act of restoring the factory default settings.

Items That Cannot Be Initialized

- Date/Time setting
- Settings related to communications
- English/Japanese language setting

Canceling Initialization

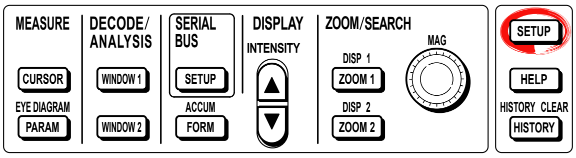
If you initialize the settings by mistake, you can press the Undo Initialize soft key to return to the settings that existed before the initialization. When you turn OFF the power switch, the settings that existed immediately before initialization are cleared. Therefore, the Undo operation is not possible in this case.

Initializing All the Settings

When the power is turned ON while holding down the RESET key, all settings excluding the date/time setting (display ON/OFF is initialized) are initialized to factory default settings.

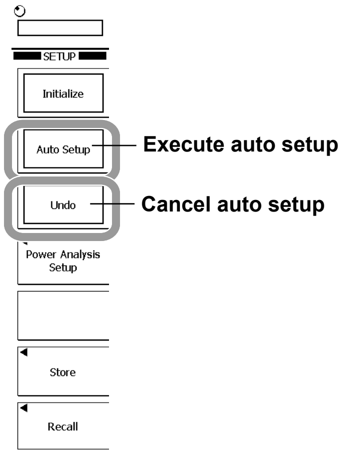
4.5 Performing Auto Setup

Procedure



Executing Auto Setup

1. Press **SETUP**.
2. Press the **Auto Setup** soft key. Auto setup is executed.
   When auto setup is executed, signal acquisition starts automatically.

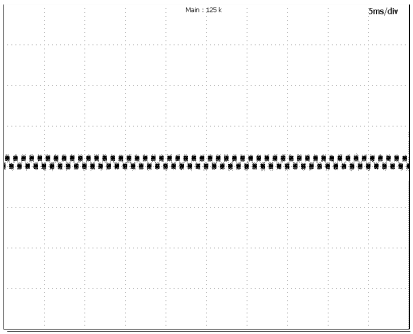


Canceling Auto Setup

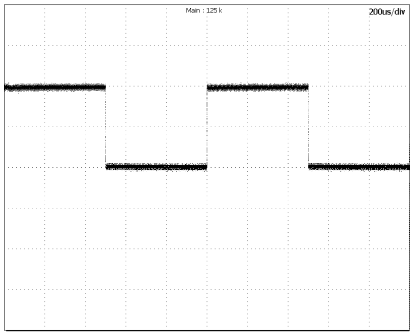
3. Press the **Undo** soft key. The settings are set back to their original condition.

Explanation

The auto setup function automatically sets the key settings such as V/div, T/div, and trigger level that are appropriate for the input signal.



Before auto setup



After auto setup

Center Position after Auto Setup

The center position after auto setup is 0 V.

Applicable Channels

Auto setup is performed on all channels.

Waveforms That Were Displayed before Auto Setup

If you execute auto setup, data in the acquisition memory will be overwritten, and waveforms that were displayed before auto setup will be cleared.

Canceling Auto Setup

Pressing the Undo soft key to sets the SB5000 back to the settings that existed before auto setup. However, when you turn OFF the power switch, the settings that existed immediately before auto setup are clear. Therefore, the Undo operation is not possible in this case.

Applicable Signals for Auto Setup

Frequency	Approx. 50 Hz or higher
Absolute value of the input voltage	Maximum value is greater than or equal to approximately 20 mV (1:1)
Type	Repetitive signal (that is not complex)

Note

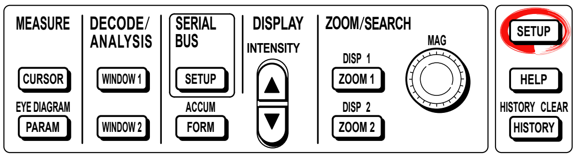
The auto setup function may not work properly if the signal includes DC components or high-frequency components.

Setup Data after Executing Auto Setup

Related CH1 to CH4	
Select	INPUT
Position	0 div
Coupling	DC1 MΩ except DC50 Ω No change for DC50 Ω
BW	FULL
Offset	0 V
Invert	OFF
M1 to M4	
Display	OFF
Acquisition	
Mode	Normal
Hireso	OFF
SAMPLING/LENGTH	
Interp	ON
Repetitive	OFF
Interleave	OFF
Length	125 kW
Trigger	
Mode	Auto
HoldOff	Min (20 ns)
Delay	OFF
Position	50%
Type	Edge
Polarity	Rise
Coupling	DC
Hysteresis	Small
HF Rej	OFF
Window	OFF
Accumulation	
Mode	OFF
Screen display	
Mapping	Auto
Dot Connect	Sine
Intensity	10 (Default)
Brightness	8 (Default)
Zoom	
Zoom	OFF
Main	ON
Cursor	
Display	OFF
Waveform parameter	
Display	OFF
Telecom Test	
Display	OFF
Analysis	
Display	OFF
Items depending on input signals	
CH On/Off	ON when detecting voltage of ±7 mV or higher, OFF when detecting less than ±7 mV
V/div	Select the highest range of sensitivity that does not exceed ±3.5 div
Trigger Level	Center
Trigger Source	Channel whose input amplitude (Max-Min) is 1 division or greater with the lowest frequency
T/Div	The fastest sweep range that exceeds 5 ms/div whose input amplitude is 1 division or greater and which the fastest frequency can be observed with 2 cycles or greater
FORM VT Form	1 to 4 windows based on the active channels

4.6 Storing and Recalling Setup Data

Procedure



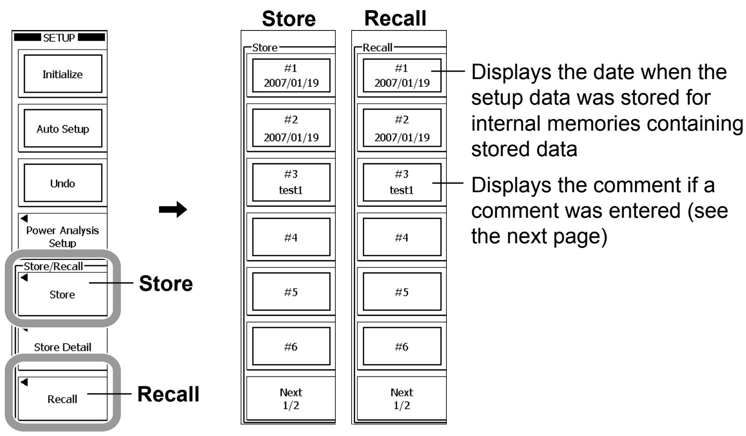
1. Press **SETUP**.

Storing the Setup Data

2. Press the **Store** soft key.
3. Press any of the **#1** to **#12** soft keys to select the storage destination in the internal memory. Press the Next 1/2 soft key to select #7 to #12.

Recalling the Setup Data

2. Press the **Recall** soft key.
3. Press any of the **#1** to **#12** soft keys to select the setup data to be recalled from the internal memory. Press the Next 1/2 soft key to select #7 to #12.



Store Data Details

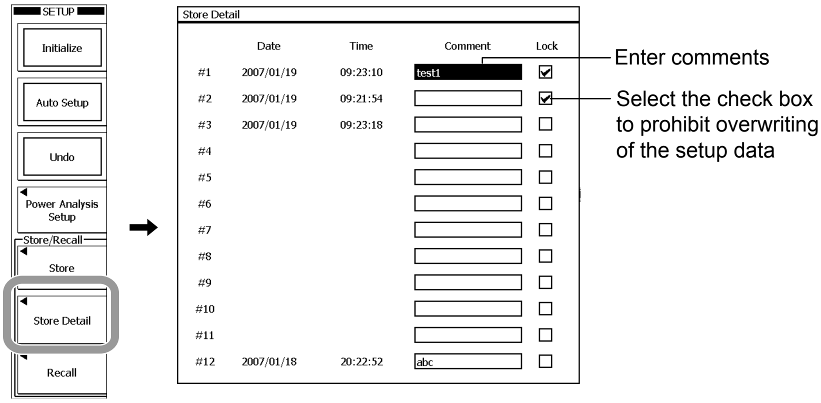
2. Press the **Store Detail** soft key. The Store Detail dialog box appears.

- **Entering a Comment**

3. Use the **rotary knob** to move the cursor to Comment, and press **SET**. A keyboard appears.
4. Enter a comment according to the procedure given in section 4.2. Then, press **Enter**.

- **Prohibiting the Overwriting of the Setup Data**

5. Use the **rotary knob** to move the cursor to Lock. Press **SET** to enter a check mark. Press **SET** again to clear the check mark.



Explanation

Up to 12 sets of setup data can be stored to the internal memory. You can load setup data stored in the past to produce the same settings.

Stored Items

All items set using the soft key menu or rotary knob and the channel ON/OFF state are stored.

Storing the Setup Data

You can store the setup data in any of the 12 internal memories, #1 to #12.
If data is already stored in the internal memory of the specified number, the data is overwritten. However, if the memory is locked in the detail menu of the store data, the data cannot be overwritten.

Recalling the Setup Data

You can recall the setup data that is stored in any of the 12 internal memories, #1 to #12. You can only select memories that have setup data stored.

Store Data Details

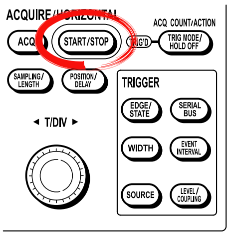
The date when the data was stored to the internal memory is displayed.
You can enter a comment using up to 16 alphanumeric characters. The comment that you enter appears below the internal memory number in the Store/Recall menu.
Internal memories with a check mark under Lock are read-only.

Note

- The stored setup data are not cleared even if you initialize the settings on the SB5000.
- If you recall setup data while signals are being acquired, signal acquisition is restarted.

4.7 Starting/Stopping Signal Acquisition

Procedure



Starting/Stopping Signal Acquisition

Press **START/STOP**. Signal acquisition starts/stops.

Signal is being acquired when the key illuminates.

Explanation

Signal Acquisition and Indicator Display

- Signal is being acquired when START/STOP illuminates. “Running” is displayed on the upper left corner of the screen.
- Signal stops being acquired when START/STOP does not illuminate. “Stopped” is displayed on the upper left corner of the screen.

Operation When the Acquisition Mode Is Set to Averaging Mode

- Averaging is stopped when signal acquisition is stopped.
- Averaging starts again when signal acquisition is restarted.

START/STOP Operation during Accumulation

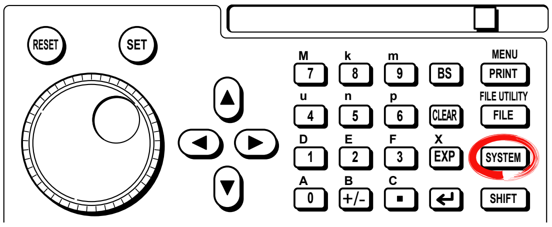
Accumulation is temporarily aborted when acquisition is stopped.
When restarting the acquisition, the SB5000 clears signal that was already acquired and restarts accumulation.

Note

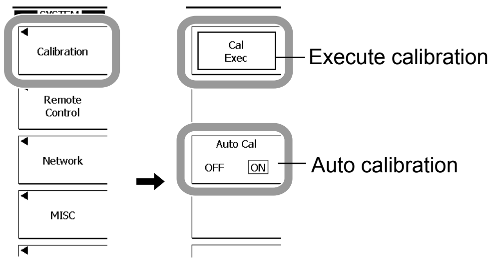
- When the trigger mode is other than Single, starting signal acquisition clears data already stored in acquisition memory.
- A snapshot function that keeps the current displayed waveform on the screen is also available. You can update the display without stopping signal acquisition (see section 9.7).

4.8 Performing Calibration

Procedure



1. Press **SYSTEM**.
2. Press the **Calibration** soft key.
3. Press the **Cal Exec** soft key. Calibration is executed.
4. To set auto calibration press the **Auto Cal** soft key to select ON or OFF.



Explanation

Calibration

The following items are calibrated. Perform calibration when you wish to measure signals with high accuracy.

- Ground level and gain of the vertical axis
- Trigger threshold level
- Time measurement value during repetitive sampling

Note

The calibration described above is performed automatically when the power switch is turned ON.

Precautions to Be Taken When Performing Calibration

- Always allow the instrument to warm up for at least 30 minutes after the power is turned ON before starting calibration. If calibration is performed immediately after the power is turned ON, the calibration may be inaccurate due to drift caused by fluctuation in the temperature of the instrument.
- Calibration must be performed when the temperature of the instrument is stable and is between 5°C and 40°C (preferably at 23°C ±5°C).
- Do not apply a signal when performing calibration. Calibration may be executed incorrectly when an input signal is being applied.

Auto Calibration

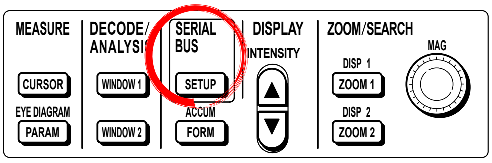
Calibration is automatically performed when T/div is changed and signal acquisition is started for the first time after the following time elapses after turning ON the power.

- 3 minutes
- 10 minutes
- 30 minutes
- 1 hour and every hour thereafter

If calibration is executed while a signal is applied to the SB5000, it is recommended that the SB5000 be recalibrated without applying a signal.

5.1 Executing Serial Bus Signal Auto Setup

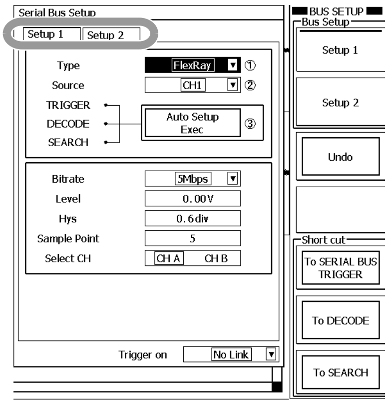
Procedure



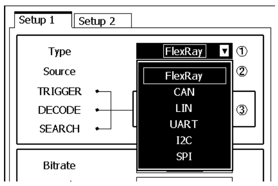
Selecting a Serial Bus Signal and Executing Auto Setup

Selecting a Serial Bus Signal

1. Press **SETUP** under SERIAL BUS.
   The BUS SETUP menu and a dialog box appear.
2. Use the **rotary knob** and **SET** to select the Setup 1 or Setup 2 tab.
   You can also press the Setup 1 or Setup 2 soft key.

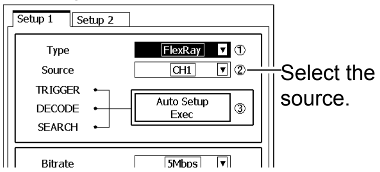


3. Use the **rotary knob** and **SET** to select the serial bus signal type from FlexRay to SPI.

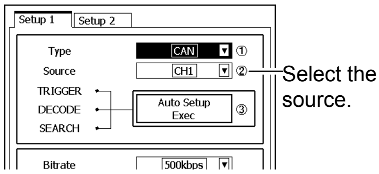


4. Use the **rotary knob** and **SET** to set the items according to the selected serial bus signal type.
   The selectable sources vary depending on the serial bus signal type.

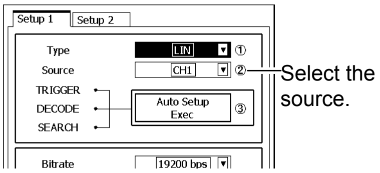
FlexRay



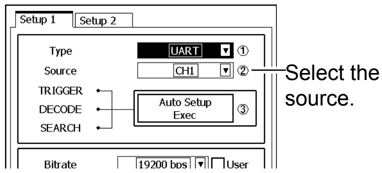
CAN



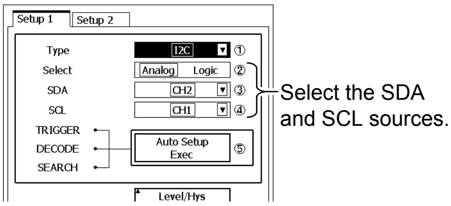
LIN



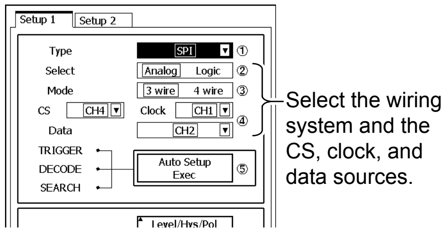
UART



I2C

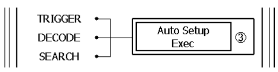


SPI



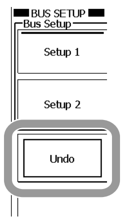
Executing Auto Setup

5. Use the **rotary knob** and **SET** to select Auto Setup Exec.
   - The serial bus signal auto setup is executed. Auto Setup Exec changes to Auto Setup Abort. To stop auto setup, select this using the **rotary knob** and **SET**.
   - When you execute auto setup, a link will automatically be established between the trigger function and the serial bus setup that you select in step 2 (Setup 1 or Setup 2).



Undoing Auto Setup

6. Press the **Undo** soft key to set the settings back to the original values.

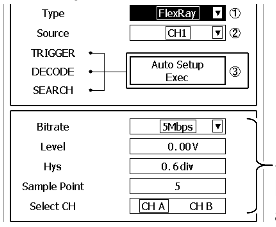


Adjusting the Settings after Auto Setup

7. Use the **rotary knob** and **SET** to adjust the items.

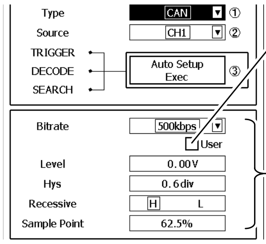
The adjustable items vary depending on the serial bus signal type.

FlexRay



Set the bit rate, level, hysteresis, sample point, and bus channel.

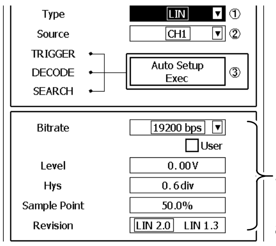
CAN



Select this check box to set any bit rate in the given range.

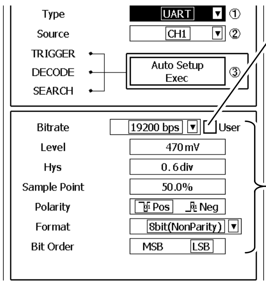
Set the bit rate, level, hysteresis, recessive level, and sample point.

LIN



Set the bit rate, level, hysteresis, sample point, and revision.

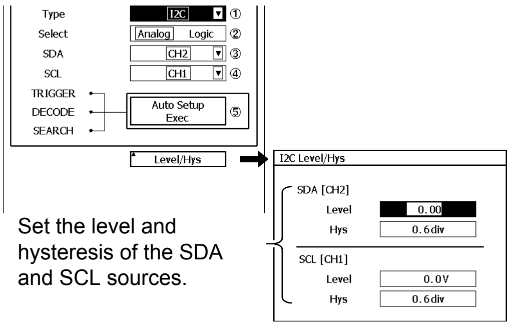
UART



Select this check box to set any bit rate in the given range.

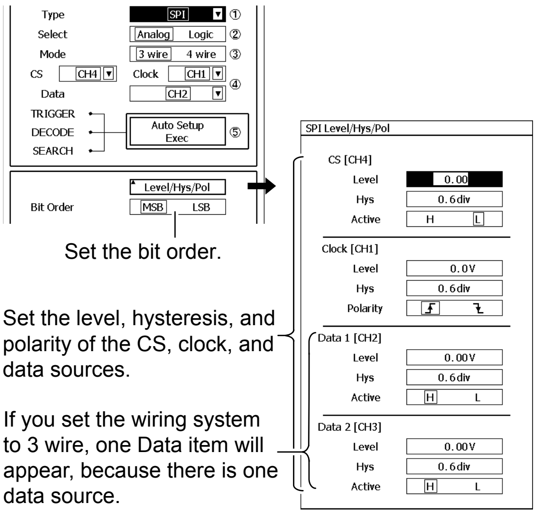
Set the bit rate, level, hysteresis, sample point, polarity, format, and bit order.

I2C



Set the level and hysteresis of the SDA and SCL sources.

SPI



Set the bit order.

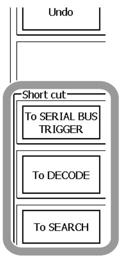
Set the level, hysteresis, and polarity of the CS, clock, and data sources.

If you set the wiring system to 3 wire, one Data item will appear, because there is one data source.

Using a Short Cut to Move to the Trigger, Analysis, or Search Menu

8. Press the appropriate soft key from **To SERIAL BUS TRIGGER** to **To SEARCH** to select the function you want to set in more detail.

The respetive function menu appears. For a detailed explanation of each function, see the respective section indicated in “Explanation” in this section.

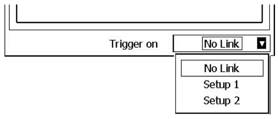


Linking the Seiral Bus Setup to the Trigger Function

Carry out the step below to link the trigger function to the serial bus setup.

Use the **rotary knob** and **SET** to set Trigger on to No Link, Setup 1, or Setup 2.

- If you select No Link, the link will be cut.
- If you select Setup 1 or Setup 2, the settings will be applied to the trigger settings.



Explanation

Some of the trigger, analysis, and search settings of the FlexRay, CAN, LIN, UART, I^2C, and SPI serial bus signals can be automatically set up.
If you execute auto setup and the SB5000 detects a serial bus signal, the trigger, analysis, and search settings will automatically be set to values appropriate for the input signal.

Settings Necessary for Auto Setup

- **Source**

  Select source signals* on which to perform auto setup according to the serial bus signal type.

FlexRay	Select a source from CH1 to CH4.
CAN	Select a source from CH1 to CH4.
LIN	Select a source from CH1 to CH4 or from A0 to A7.
UART	Select a source from CH1 to CH4 or from A0 to A7.
I^2C	Select an SDA (serial data) source and an SCL (serial clock) source. If you set the Select box to Analog, select from CH1 to CH4. If you set the Select box to Logic, select from A0 to A7.
SPI	Select a CS (chip select) source, a clock source, and a data source. If you set the Select box to Analog, select from CH1 to CH4. If you set the Select box to Logic, select from A0 to A7.

* If you select a source from A0 to A7, set the threshold level. For the setup procedure, see section 6.18.
If you select a source from M1 to M4, you will not be able to execute auto setup.

- **Wiring System**

  Select the wiring system only in the case of an SPI serial bus signal.

3 wire	One data line
4 wire	Two data lines

Executing Auto Setup

If the SB5000 detects a serial bus signal, the trigger, analysis, and search settings will automatically be set to values appropriate for the input signal.

- If you select Setup 1 and execute auto setup, the settings in Decode Setup in the WINDOW 1 menu (Analysis 1) and the settings in Search Setup in the ZOOM 1 menu (Search 1) are set to the serial bus signal's type, source, and detection value (see the next page). The same holds true for Setup 2, the settings in Decode Setup in the WINDOW 1 menu (Analysis 2), and the settings in Search Setup in the ZOOM 2 menu (Search 2).
  If you execute auto setup using Setup 1 or Setup 2, the trigger settings are also changed accordingly.
  For details on the settings that are shared by auto setup, trigger, analysis, and search functions, see section 5.2.
- The "Trigger on" box at the bottom of the dialog box displays the auto setup name (Setup 1 or Setup 2) that has been executed.

- For details on the trigger function, see chapter 7. For details on the analysis and search functions, see chapter 11.
- An error message will appear if the SB5000 fails to detect a serial bus signal.

- **Center Position after Auto Setup**
  The center position after auto setup will be 0 V.

- **Waveforms That Were Displayed before Auto Setup**
  If you execute auto setup, data in the acquisition memory will be overwritten, and waveforms that were displayed before auto setup will be cleared.

Undoing Auto Setup

You can revert to the settings before auto setup by pressing the Undo soft key. However, you cannot undo auto setup if you turn OFF the power, because the settings before auto setup will be discarded.

Items That Are Set to Default Values and Items That Are Set to Detected Values

When you execute auto setup, the items are set to default values or set to values that are detected from the signal as shown in the following table. Items that are not in the table maintain their current values.

FlexRay		
Items set to default values	Mode	Frame Start
	Hysteresis	0.6div
	Sample point	5
Items that are set to detected values	Bit rate	
	Source level	
	Bus channel	
CAN		
Items set to default values	Mode	SOF
	Hysteresis	0.6div
	Sample point	62.5%
Items that are set to detected values	Bit rate	
	Source level	
	Recessive level	
LIN		
Items set to default values	Mode	Break Synch
	Hysteresis	0.6div
	Sample point	50.0%
Items that are set to detected values	Bit rate	
	Source level	
	Revision	
UART		
Items set to default values	Mode	Data (the data pattern remains at the current setting)
	Hysteresis	0.6div
	Sample point	50.0%
Items that are set to detected values	Bit rate	
	Source level	
	Polarity	
I^2C		
Items set to default values	Mode	Every Start
	Hysteresis	0.6div
	Qualification	Don’t care
Items that are set to detected values	SDA and SCL source levels	
SPI		
Items set to default values	Hysteresis	0.6div
Items that are set to detected values	CS, clock, and data source levels	

Signals That Auto Setup Can Be Used

Auto setup is possible on a serial bus signal when the following conditions are met.

Voltage	Amplitude greater than or equal to 200 mV
Bit rate	Greater than or equal to 1200 bps
Frames	At least 5 frames over 10 seconds

Note

Measurement will only be correct if the probe attenuation ratio is set properly. Be sure to set the probe attenuation ratio properly before executing auto setup. For the setup procedure, see section 6.6.

Adjusting Settings after Auto Setup

You can adjust the items according to the serial bus signal type. For the selectable ranges, see the referenced sections.

FlexRay	Source signal's bit rate, level, hysteresis, sample point, and bus channel See "Explanation" in section 11.8 (page 11-60).
CAN	Source signal's bit rate, level, hysteresis, recessive level, and sample point See "Explanation" in section 11.9 (page 11-63).
LIN	Source signal's bit rate, level, hysteresis, sample point, and revision See "Explanation" in section 11.10 (page 11-66).
UART	Source signal's bit rate, level, hysteresis, sample point, polarity, format, and bit order See "Explanation" in section 11.11 (page 11-68).
I^{2}C	SDA and SCL source levels and hystereses See "Explanation" in section 11.12 (page 11-70).
SPI	Bit order; CS, clock, and data source levels, hystereses, and polarities See "Explanation" in section 11.13 (page 11-72).

Trigger, Analysis, and Search Functions

For the procedure on how to use the trigger, analysis, and search functions, see the referenced sections below.

	Trigger	Analysis	Search
FlexRay	Section 7.6	Section 11.8	Section 11.19
CAN	Section 7.7	Section 11.9	Section 11.20
LIN	Section 7.8	Section 11.10	Section 11.21
UART	Section 7.9	Section 11.11	Section 11.22
I^{2}C	Section 7.10	Section 11.12	Section 11.23
SPI	Section 7.11	Section 11.13	Section 11.24

Linking the Auto Setup, Analysis, and Search Settings to the Trigger Function

To share auto setup, analysis, and search settings with the trigger function, you must link the trigger function to the auto setup.

- If you execute auto setup, a link will automatically be established to Setup 1 or Setup 2, whichever auto setup that you executed.
- If you select No Link, the settings will not be linked between the trigger function and the auto setup, analysis, and search functions.

For details, see section 5.2.

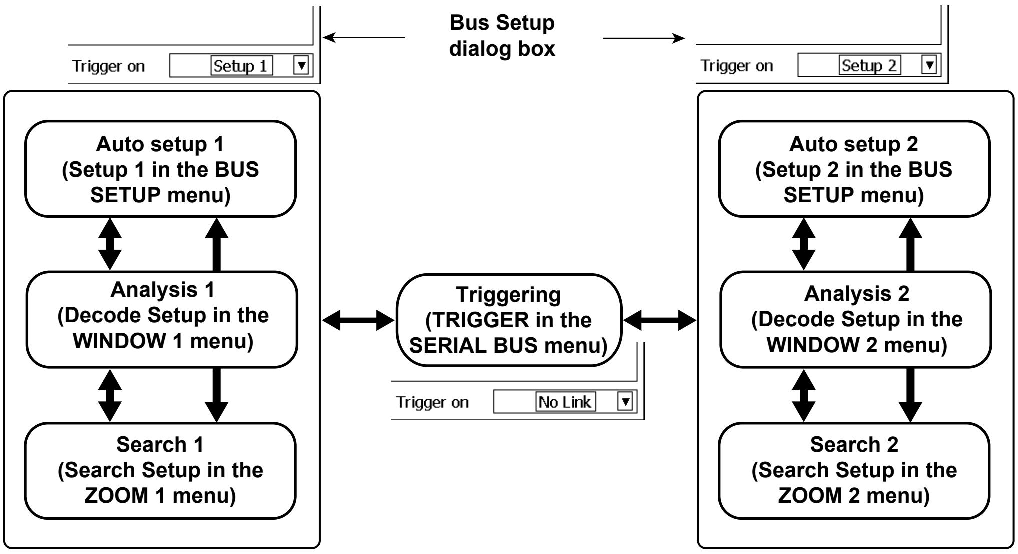
5.2 Sharing of the Serial Bus Signal's Trigger, Analysis, Search Settings

The SB5000 shares the trigger, analysis, and search settings. If you change a setting in one function, the corresponding setting will also change in the other functions.

How Auto Setup Affects Trigger, Analysis, and Search Settings

- **How Auto Setup Affects Analysis and Search Settings**
  - If you select Setup 1 and execute auto setup, the settings in Decode Setup in the WINDOW 1 menu (Analysis 1) and the settings in Search Setup in the ZOOM 1 menu (Search 1) will be set to the serial bus signal's type, source, and detection value (see the page 5-5). The same holds true for Setup 2, the settings in Decode Setup in the WINDOW 1 menu (Analysis 2), and the settings in Search Setup in the ZOOM 2 menu (Search 2).

- **How Auto Setup Affects Trigger Settings**
  - If you select Setup 1 and execute auto setup, the trigger settings (SERIAL BUS menu under TRIGGER) will be set to the serial bus signal's type, source, and detected values (see page 5-5). At the same time, the Trigger on box at the bottom of the Bus Setup dialog box will display the auto setup name Setup 1. The same holds true for Setup 2.
  - If you select Setup 1 from the Trigger on list, the trigger settings will be set to the auto setup 1 settings. The same holds true for Setup 2.



How Analysis and Search Settings Affect Auto Setup and Trigger Settings

- **How Analysis and Search Settings Affect Auto Setup Settings**
  If you change settings for Analysis 1 or Search 1, the corresponding settings in auto setup 1 will change. The same holds true for Analysis 2 and Search 2.

- **How Analysis and Search Settings Affect Trigger Settings**
  - If Setup 1 is selected in the Trigger on list and you change the settings for Analysis 1 or Search 1, the corresponding trigger settings will change. Changing the settings for Analysis 2 or Search 2 will not affect the trigger settings. Likewise, If Setup 2 is selected in the Trigger on list and you change the settings for Analysis 2 or Search 2, the corresponding trigger settings will change. Changing the settings for Analysis 1 or Search 1 will not affect the trigger settings.
  - If No Link is selected in the Trigger on list, changing the settings for Analysis 1 or 2 or for Search 1 or 2 will not affect the trigger settings.

How Trigger Settings Affect Auto Setup, Analysis, and Search Settings

- If Setup 1 is selected in the Trigger on list and you change the trigger settings, the corresponding Auto Setup 1, Analysis 1, and Search 1 settings will change. Auto Setup 2, Analysis 2, and Search 2 settings will not be affected. Likewise, If Setup 2 is selected in the Trigger on list and you change the trigger settings, the corresponding Auto Setup 2, Analysis 2, and Search 2 settings will change. Auto Setup 1, Analysis 1, and Search 1 settings will not be affected.
- If No Link is selected in the Trigger on list, changing the trigger settings will not affect any of the Auto Setup, Analysis, and Search settings.

Note

Even if Setup 1 or Setup 2 is selected in the Trigger on list, if you select a trigger type other than FlexRay, CAN, LIN, UART, I^2C, or SPI, the Trigger on list will be set to No Link. In particular, Trigger on will change to No Link if

- You select Serial in the SERIAL BUS menu under TRIGGER.
- You press EDGE/STATE, WIDTH, or EVENT INTERVAL on the front panel.

Common Items

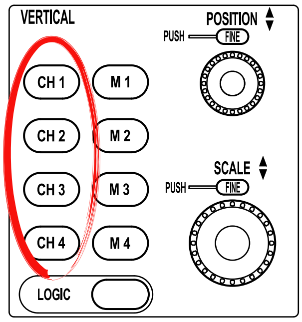
The table below indicates the shared serial bus signal items by trigger type.

Trigger Type	FlexRay	CAN	LIN	UART	I^2C	SPI
Trigger type (Type)	Changes to the selected trigger type menu.					
Source	Yes	Yes	Yes	Yes	Yes	Yes
Bit rate (Bitrate)	Yes	Yes	Yes	Yes	No	No
Level	Yes	Yes	Yes	Yes	Yes	Yes
Hysteresis (Hys)	Yes	Yes	Yes	Yes	Yes	Yes
Sample point	Yes	Yes	Yes	Yes	No	No
Bus channel (Select CH)	Yes	No	No	No	No	No
Recessive level	No	Yes	No	No	No	No
Revision	No	No	Yes	No	No	No
Polarity/active	No	No	No	Yes	No	Yes
Format	No	No	No	Yes	No	No
Bit order	No	No	No	Yes	No	Yes
Parity	No	No	No	Yes	No	No
Wiring system (Mode)	No	No	No	No	No	Yes

Yes: Shared item; No: Item not available

6.1 Switching the Display of Input Waveforms ON and OFF

Procedure



Switching the Display ON

1. Press the key for the channel to be displayed, from **CH1** to **CH4**. The key lights, and the waveform appears.

   The menu for the channel settings appears.

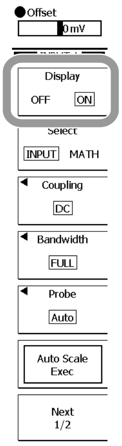
2. Press the Select soft key, and select Input.

Switching the Display OFF

1. Press the key for the channel to be turned off, from **CH1** to **CH4**.

   The menu for the channel settings appears.

2. Press the **Display** soft key, and select OFF.



Explanation

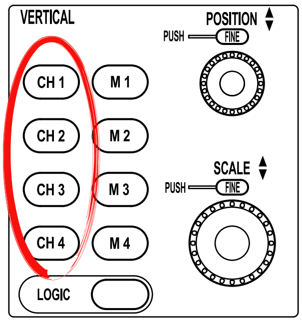
The channel keys (CH1 to CH4) set to ON light.
When a channel key is off, press the key once to change the indication to ON, lighting the key.
When a channel key is lit, press the key twice in succession, changing the indication to OFF, and turning off the key.

Note

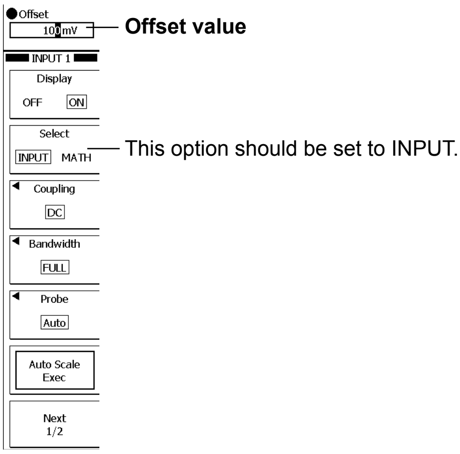
- Scale values (section 6.12) and signal labels (section 9.6) can also be displayed using the DISPLAY menu.
- If interleave mode (see section 8.5) is ON, CH2 and CH4 cannot be displayed.

6.2 Setting the Offset Voltage

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Use the **rotary knob** to set the offset value.



Explanation

The setting of the offset voltage is effective for all the input couplings: AC1 MΩ, DC1 MΩ, DC50 Ω, and GND.
An offset voltage can be set on analog signal input waveforms (the Select setting set to Input).

Selectable Range of Offset Voltage

Voltage Sensitivity (Probe = 1 : 1)	Offset Voltage Selectable Range
2 mV/div to 50 mV/div	–1.0 V to 1.0 V
0.1 V/div to 0.5 V/div	–10.0 V to 10.0 V (–5.0 V to 5.0 V for DC 50 Ω)
1 V/div to 5 V/div	–100.0 V to 100.0 V

The resolution is 0.01 divisions. For 2 mV/div, the resolution is 0.02 mV.

Resetting the Offset Value

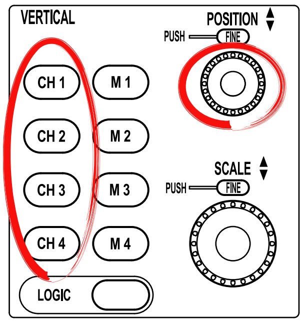
Pressing the **RESET** key resets the offset value to 0 V.

Note

- If you change the probe attenuation, the offset changes proportionally to reflect the new attenuation rate.
- The offset voltage does not change, even if you change the voltage sensitivity. However, an offset voltage outside the above selectable range is set to the maximum or minimum value that could be selected for the voltage sensitivity. If the voltage sensitivity is returned to its previous value without changing the offset voltage then the offset voltage also returns to its previous value.

6.3 Setting the Vertical Position of the Waveform

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.

2. Use the **POSITION knob** to set the vertical position.
By pressing the POSITION knob, lighting the FINE indicator, you can make settings with a higher resolution.

Explanation

Range of Movement

The vertical position can be moved within a range of ±4 divisions from the center of the waveform area.

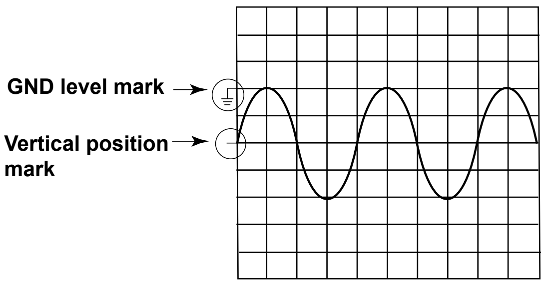
Resolution

0.5 div (or 0.02 div for FINE)

Confirming the Vertical Position

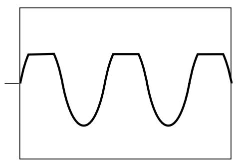
For analog signal input waveforms and computed waveforms, the ground level and vertical position are marked to the left of the waveform area.

500 mV/div, Offset: –1 V, Position: 0 div



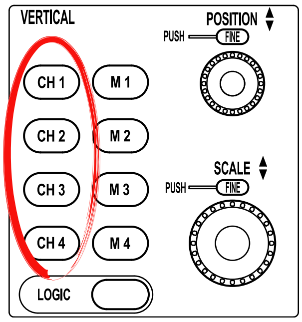
Note

If the position is changed after the signal is acquired then data that is beyond the measurement range is handled as overflow data. Overflow data may result in a chopped waveform, as in the following figure.

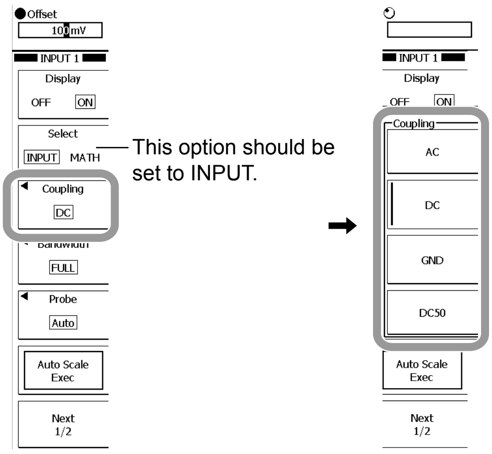


6.4 Setting the Input Coupling

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Coupling** soft key.
3. Press the soft key corresponding to the desired coupling.



Note

When a probe supported by the SB5000 probe interface is used, the input coupling is set automatically.

Explanation

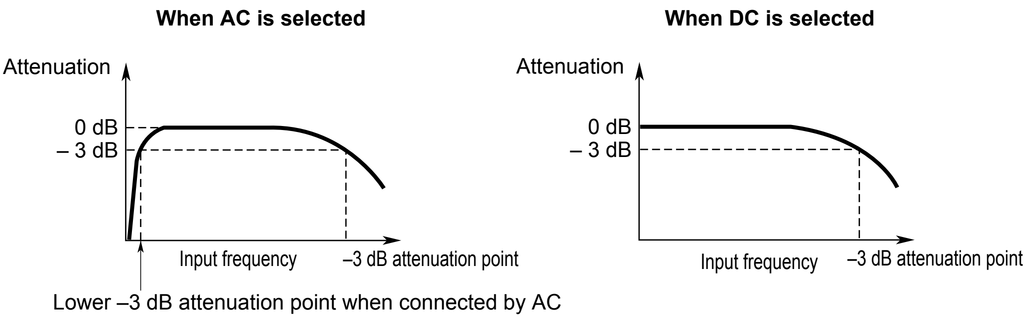
Selecting the Input Coupling

You can select the method of coupling the input signal to the vertical control circuit in the following ways.

AC	Acquires and displays only the AC component of the input signal.
DC	Acquires and displays all the components (DC and AC) of the input signal (1 MΩ input). This can only be selected when measuring voltage.
GND	Checks the ground level.
DC50	Acquires and displays all the components (DC and AC) of the input signal (50 Ω input).

Input Coupling and Frequency Characteristics

The following shows the frequency characteristics when AC or DC are selected.
Note that when AC is selected, low frequency signals or signal components are not acquired (as shown in the figure below).

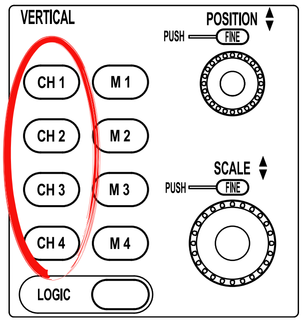


CAUTION

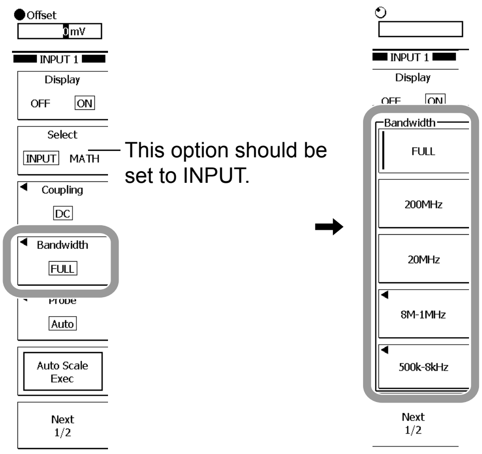
- The maximum input voltage for the 1-MΩ input is 150 Vrms when the frequency is 1 kHz or less. Applying a voltage exceeding this maximum can damage the input section. If the frequency is above 1 kHz, the input section may be damaged even when the voltage is below the values specified above.
- The maximum input voltage for the 50-Ω input is 5 Vrms and 10 Vpeak. Applying a voltage exceeding either of these voltages can damage the input section.

6.5 Setting Bandwidth Limits

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Bandwidth** soft key.
3. Press the soft key corresponding to the desired bandwidth.
   If "8 M - 1 MHz" or "500 - 8 kHz" is selected, another Bandwidth menu appears. Press a soft key to select the bandwidth.



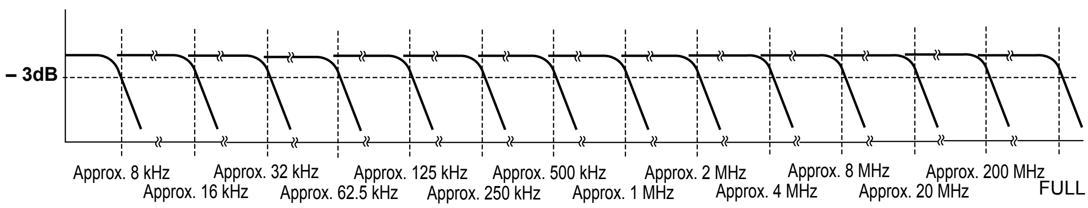
Note

The bandwidth limit is set for each channel. Set the bandwidth limit for all desired channels.

Explanation

Bandwidth

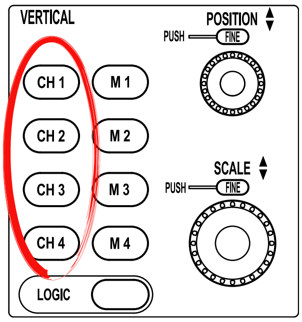
It is possible to remove the high frequency components from the input signal.
The frequency characteristics when the bandwidth has been given limits are shown below. If you select FULL, the largest bandwidth is selected.



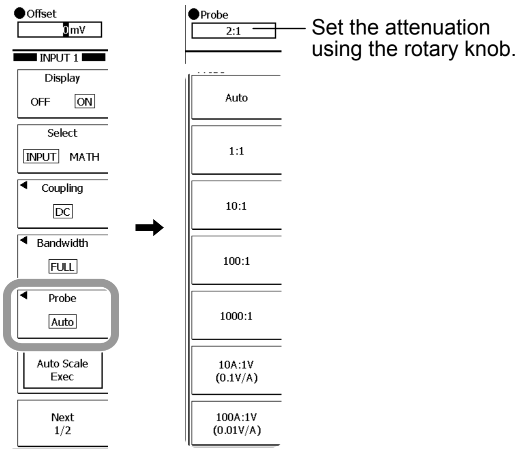
In high resolution mode, a 200 MHz filter is used internally even for FULL.

6.6 Setting the Probe Attenuation

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Probe** soft key.
3. Press the soft key corresponding to the desired type (attenuation ratio).



Explanation

The following probe types can be selected for each channel:

AUTO, 1 : 1, 10 : 1, 100 : 1, 1000 : 1, 10 A : 1 V, 100 A : 1 V.

- 1 : 1 to 1000 : 1 are probe attenuation settings.
- 10 A : 1 V and 100 A : 1 V are probe output current rates.
- If AUTO is selected then the attenuation is automatically selected when the probe is connected to the corresponding probe interface.

In addition to using the soft keys, you can now select the probe attenuation using the rotary knob. When using the rotary knob, you can select from the choices below. The menu corresponding to the attenuation that you select with the rotary knob is highlighted.

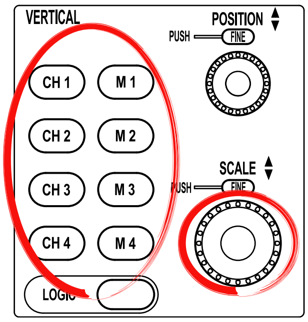
Auto, 1:1, 2:1, 5:1, 10:1, 20:1, 50:1, 100:1, 200:1, 500:1, 1000:1, 1A : 1V,10A:1V, or 100A:1V

Note

If the probe type is not set correctly, the voltage and scale values of the input signals will not be displayed correctly. For example, if you set the attenuation to 1 : 1 when you are using a 10 : 1 voltage probe, the automatically determined waveform amplitude will be displayed as 1/10th the actual value.

6.7 Setting the Scale

Procedure



1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Turn the **SCALE knob** to set the V/div value.
   By pressing the SCALE knob, lighting the FINE indicator, you can make settings with a higher resolution.

Explanation

Setting V/div

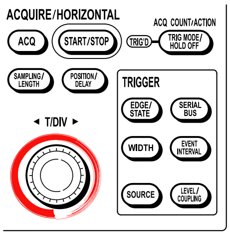
The V/div (voltage sensitivity) setting is used to adjust the displayed amplitude of the waveform for easy measurement. You can set the value in terms of the voltage per division of the screen grid. V/div is set in steps of 1-2-5 (i.e., 1 V/div, 2 V/div, and 5 V/div).

Note

- The displayed waveforms do not change if you turn the SCALE knob while signal acquisition is stopped. The new V/div value takes effect the next time signal acquisition is restarted.
- Turning the SCALE knob while acquisition is stopped has no effect on cursor measurement values and automated measurement values of waveform parameters. The displayed values are for the determined V/div setting.

6.8 Setting Time Axis (T/div)

Procedure



Turn the **T/DIV knob** to set the T/div value.

Note

- If the T/DIV knob is turned while acquisition is stopped, the new T/div value appears in the upper center of the screen and takes effect when acquisition is restarted.
- See Appendix 1, "Relationships between the Time Setting, Sample Rate, and Record Length" for the relationship between T/div and the sample rate.

Explanation

You can set the value in terms of the time per division of the screen grid.

Selectable T/div Range

500 ps/div to 50 s/div

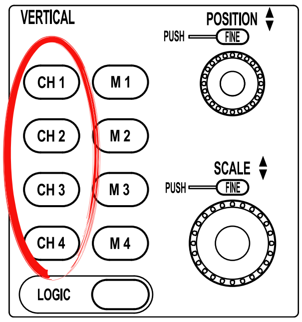
T/div and Roll Mode

Roll mode is used if T/div is set to a value between 100 ms/div and 50 s/div under the following conditions:

- Acquisition mode is set to a mode other than averaging.
- Trigger mode is set to auto, auto level, or single.

6.9 Using the Auto Scale Function

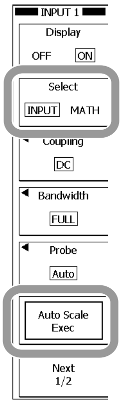
Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Select** soft key to select INPUT or MATH.

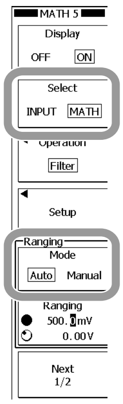
For INPUT:

3. Press the **Auto Scale EXEC** soft key.



For MATH:

3. Press the **Ranging** soft key to select Auto.



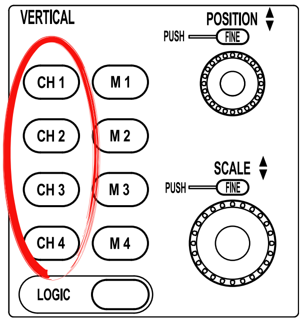
Explanation

Auto Scale can be set for each channel.
The following are set in the following ways when Auto Scale EXEC is used:

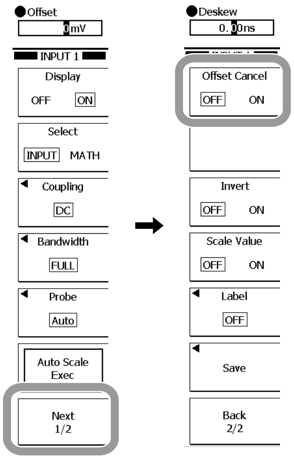
V/div	Displayed so that the entire amplitude of the waveform can be seen without changing the vertical position.
Offset	0 V when the input coupling is AC. Center = (Max – Min)/2 when the input coupling is DC.
Trig Level	DC offset position.

6.10 Canceling the Offset Value

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Offset Cancel** soft key to select ON or OFF.



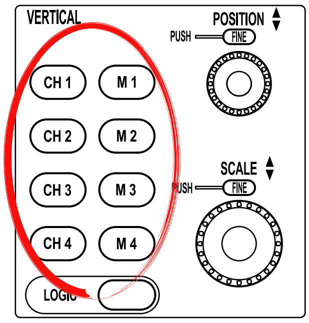
Explanation

Offset cancel can be set to ON or OFF for each channel. The default setting is OFF.

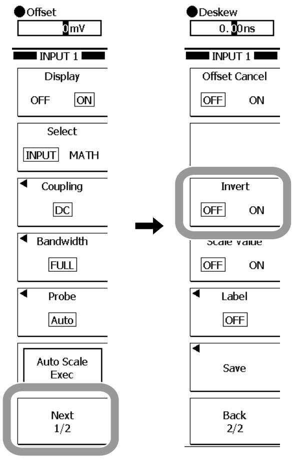
OFF	The offset value is not applied to computations and the results of automated measurements. The waveform is observed without subtracting the offset voltage (DC voltage) from the input signal. The vertical position of the screen corresponds to the offset voltage.
ON	The offset value is applied to computations and the results of automated measurements. The offset value specified for each channel can be used to subtract an unneeded offset voltage (DC voltage) from the input signal for waveform observation. The vertical position is set to 0 V

6.11 Displaying the Waveform Inverted

Procedure



1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Invert** soft key to select ON.



Explanation

Inverted Objects

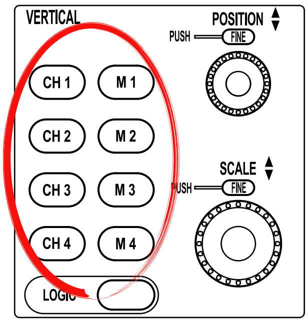
The waveforms of CH1 to CH4 and M1 to M4 can be individually inverted.
The display is inverted with respect to the center of the vertical position.

Inverted Display

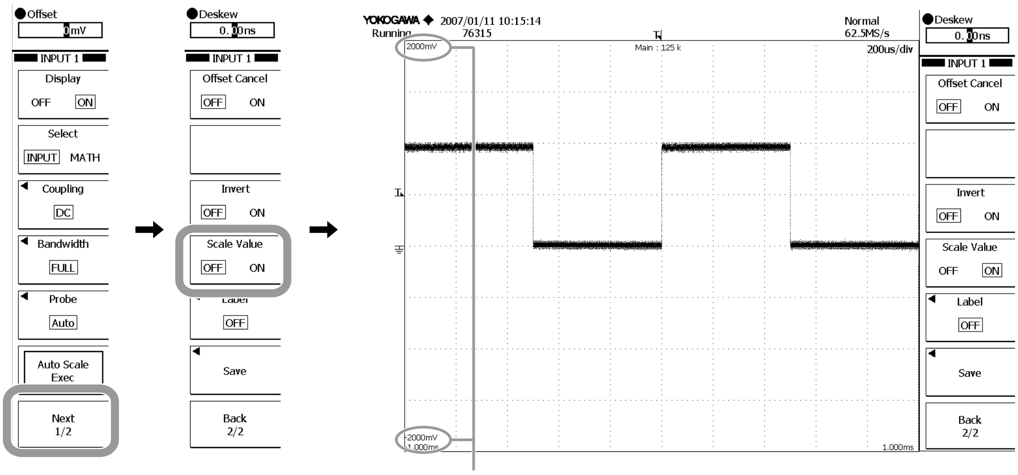
- Cursor measurements, automated measurement of waveform parameters, and computations are performed on the original waveform.
- Trigger functions are performed on the original waveform even when the display is inverted.

6.12 Turning the Display of the Scale Value ON/OFF

Procedure



1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Scale Value** soft key to select ON or OFF.



Scale Value

Explanation

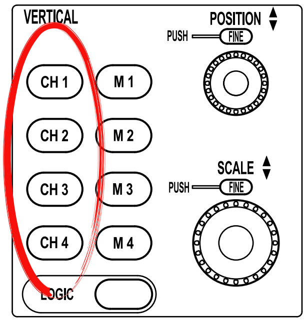
You can turn ON and OFF the upper and lower limits (scale values) on the vertical and horizontal axes of each channel.

Note

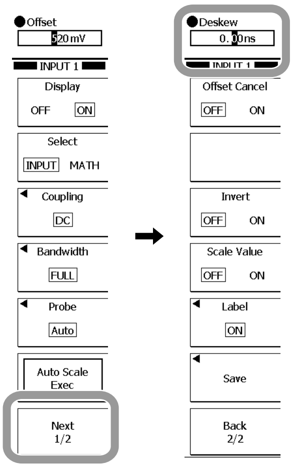
The scale value is displayed to the left of the waveform. Or, if there is no space to the left of the waveform, it is displayed to the right.

6.13 Correcting the Skew

Procedure



1. Press one of the **CH1** to **CH4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Use the **rotary knob** to set the screw correction value of the analog signal.



Explanation

Correcting the Skew

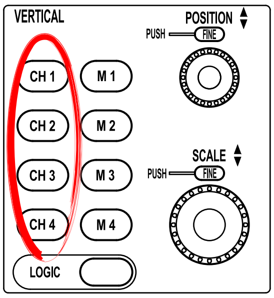
You can observe the signal by correcting the time offset (skew) of the analog signal with respect to another signal. You can make corrections on each channel, CH1 to CH4.

Selectable range	–80.00 to 80.00 ns (the default value is 0.00 ns)
Resolution	0.01 ns

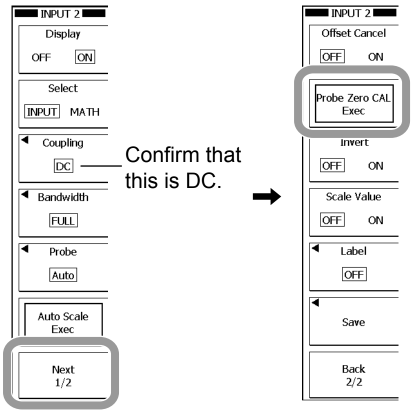
6.14 Automatic Zero Adjustment of the Current Probe

Procedure

Connect a current probe that supports the probe interface. This procedure cannot be performed if the probe does not support the probe interface.



1. Press one of the **CH1** to **CH4** keys to select the channel on which the current probe that supports the probe interface is connected.
2. Confirm that the input coupling is DC.
3. Press the **Next 1/2** soft key.
4. Press the **Probe Zero CAL Exec** soft key. Automatic zero adjustment of the current probe is executed.



Explanation

Automatic Zero Adjustment of the Current Probe

Automatic zero adjustment of the current probe can be executed when the following conditions are met.

- When a current probe that supports the probe interface† is connected to the instrument's signal input terminal.

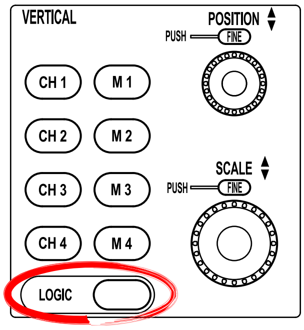
  † Supported probes are the Yokogawa PBC100 (model 701928) and PBC050 (model 701929).
- When the input coupling is set to DC (see section 6.4).

Note

- For a description of the handling of current probes, see the user's manual that came with your current probe.
- If the current probe's residual offset is large, an error may occur when executing automatic zero adjustment. In this case, perform zero adjustment of the current probe's residual offset.

6.15 Turning ON/OFF the Display of Logic Signal and Setting the Display Order

Procedure



Turning ON/OFF the Logic Signal Display

- **Displaying the Logic Signal Area**

1. Press **LOGIC**. The key illuminates.
The screen is divided into top and bottom halves, and the logic signal area is displayed in the bottom half.

- **Turning ON/OFF the Logic Signal Display (in Groups)**

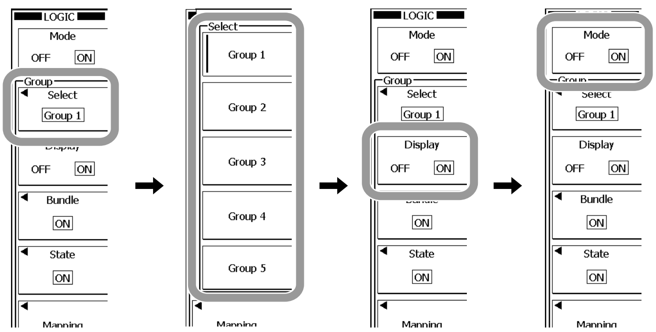
2. Press the **Select** soft key.

3. Press any of the **Group 1** to **Group 5** soft keys to select the group for turning ON/OFF the display.

4. Press the **Display** soft key to select ON or OFF.
ON: Display. OFF: Hide.

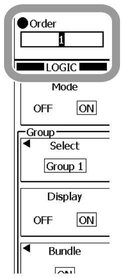
- **Hiding the Logic Signal Area**

5. Press the **Mode** soft key to select OFF.
You can also press the LOGIC key twice after step 1 to turn the area OFF.



Setting the Display Order

4. In step 3, select the group.
5. Use the **rotary knob** to set the display order of the selected group.
   - The Order value above the menu indicates the display order. The value 1 indicates top, and 5 indicates bottom.
   - Press RESET to reset the display order. The order values of Group 1, 2, 3, 4, and 5 become 1, 2, 3, 4, and 5, respectively.



Explanation

Displaying Logic Signals

- **Displaying the Logic Signal Area**
  The logic signal area is displayed in the bottom half of the screen below the normal analog waveform area.

- **Displaying Logic Signals**
  The logic signals are displayed in groups. For the assignment of logic signals to groups, see section 6.17.

Note

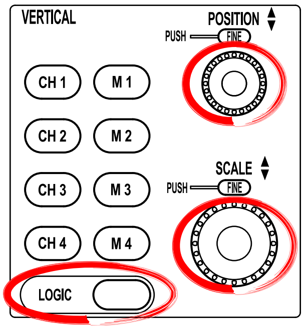
- Groups without logic signals (bits) assigned are not displayed.
- Logic signals (bits) that are not assigned to a group are not displayed.

Setting the Display Order

You can set the display order of the five groups in the logic signal area.

6.16 Setting the Display Size and Vertical Position of Logic Signals

Procedure



1. Press **LOGIC**.

Setting the Display Size

2. Turn the **SCALE** knob to set the vertical display size of logic signals.

Setting the Vertical Position

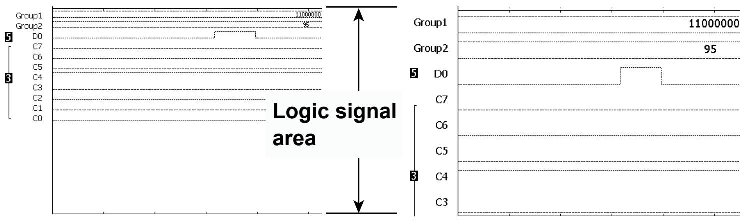
2. Turn the **POSITION** knob to set the vertical display position of logic signals.

Explanation

Setting the Display Size

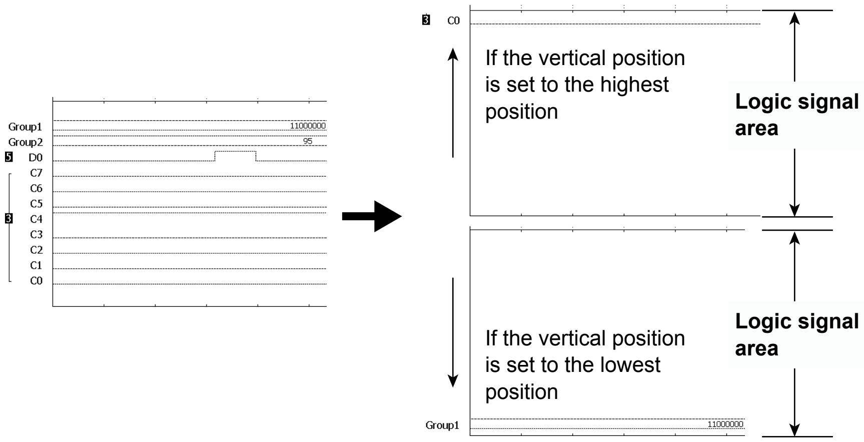
You can set the vertical display size of the logic signal. Five settings are available.

Display size: Minimum **Display size: Maximum**



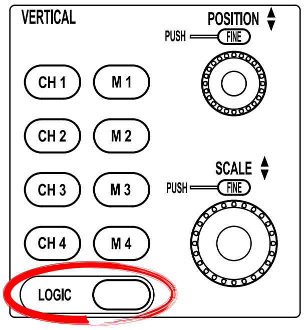
Setting the Vertical Position

You can move the logic signals vertically until only the top or bottom displayed logic signal is displayed.



6.17 Enabling the Bus Display, Displaying the State, Mapping Bits to Groups

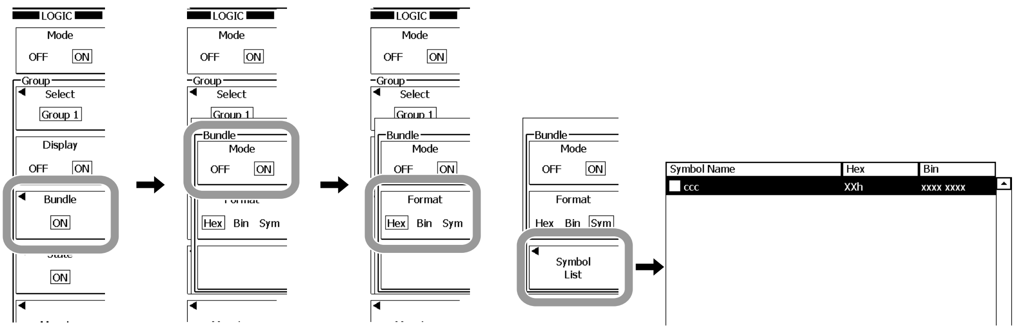
Procedure



1. Press **LOGIC**.
2. Select the group you want to set according to steps 2 and 3 in section 6.15.

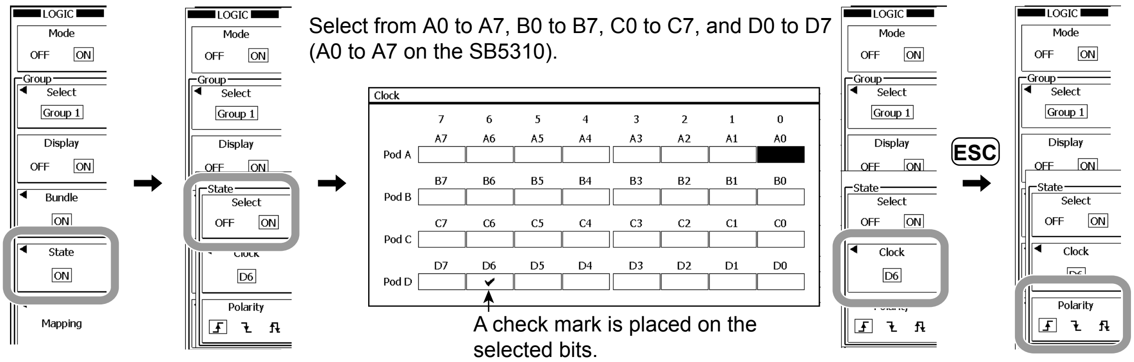
Setting the Bus Display

3. Press the **Bundle** soft key.
4. Press the **Mode** soft key to select ON or OFF.
   ON: Bus display. OFF: Bit display.
   If you select ON, proceed to the next step.
5. Press the **Format** soft key to select Hex, Bin, or Sym.
   Hex: Hexadecimal display; Bin: Binary display; Sym: Symbolic display
   If you select Sym, the Symbol List menu appears. Proceed to step 6.
6. Press the **Symbol List** soft key.
   The Select Symbol dialog box appears.
7. Use the **rotary knob** and **SET** to select the symbol.



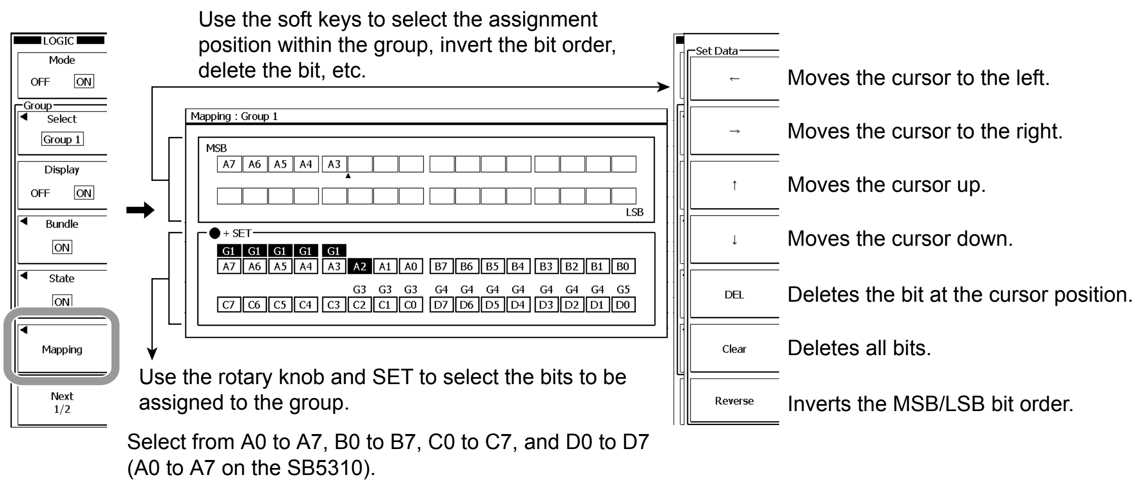
Setting the State Display

3. Press the **State** soft key.
4. Press the **Select** soft key to select ON or OFF.
   ON: State display. OFF: No state display.
   If you select ON, proceed to the next step.
5. Press the **Clock** soft key to display the Clock dialog box.
6. Use **rotary knob** and **SET** to select the clock signal for the state display.
7. Press **ESC** to return to the previous screen.
8. Press the **Polarity** soft key to select the polarity of the clock signal from ↑, ↓, and ↑↓.



Mapping Bits to Groups

3. Press the **Mapping** soft key to display the Mapping dialog box.
4. Assign bits to the groups according to the explanation in the figure below.
   If you assign a bit to a group, a symbol indicating the group (for example G1 for Group 1) is displayed above the bit symbol.



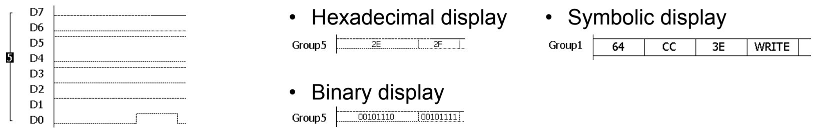
Explanation

Setting the Bus Display

The logic signals (bits) that are displayed for each group can be shown in a bus display. If you enable the bus display, you can select hexadecimal display, binary display, or symbolic* display. For a description of how bits are handled in the hexadecimal display, see “Mapping Bits to Groups” below.

* Symbolic representation of a bit sequence that includes X. A physical value/symbol definition file (.sbl) that is created using Symbol Editor can be loaded through file operation.

Bus display OFF **Bus display ON**



Setting the State Display

This function acquires the status of a logic signal on the point of polarity change (edge) of a specified clock signal when displaying the input logic signal. The state is held until the next clock occurs even if the input logic signal changes.
The state is held until the next clock occurs even if the input logic signal changes.

- **Clock Signal**

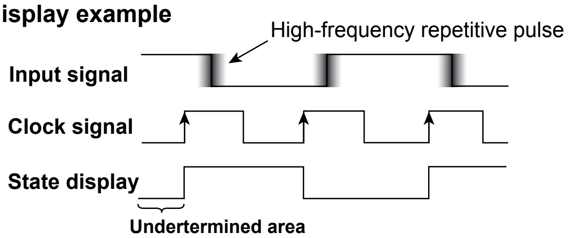
  Select from bits A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310).

- **Polarity**

  You can select how the clock signal state is to change for detecting and displaying the logic signal states.

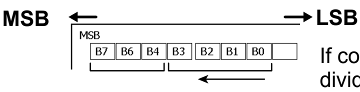
↑	When the clock signal changes from low to high
↓	When the clock signal changes from high to low
↑↓	When the clock signal changes from low to high or from high to low

State display example



Mapping Bits to Groups

- You can assign bits A0 to A7, B0 to B7, C0 to C7, and D0 to D7 (A0 to A7 on the SB5310) of the logic signals to Group 1 to Group 5.
- From the assigned signals, the signal assigned closest to the LSB end of the Mapping dialog box is the LSB. Higher digits are arranged from the LSB logic signal toward the MSB end. If counting or displaying in hexadecimal notation, the bits are divided every 4 bits from the LSB toward MSB.

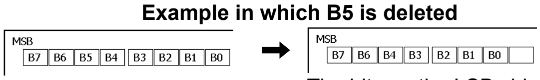


If counting or displaying in hexadecimal notation, the bits are divided every 4 bits from the LSB. The highest digit may contain less than 4 bits.

Note

- A given bit cannot be assigned multiple times to a same group.
- A given bit cannot be assigned to multiple groups. If you assign a bit that is assigned to another group to the group that you are editing, the bit is deleted from the other group.

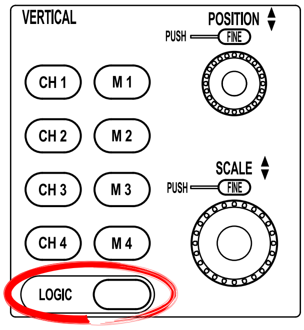
Example in which B5 is deleted



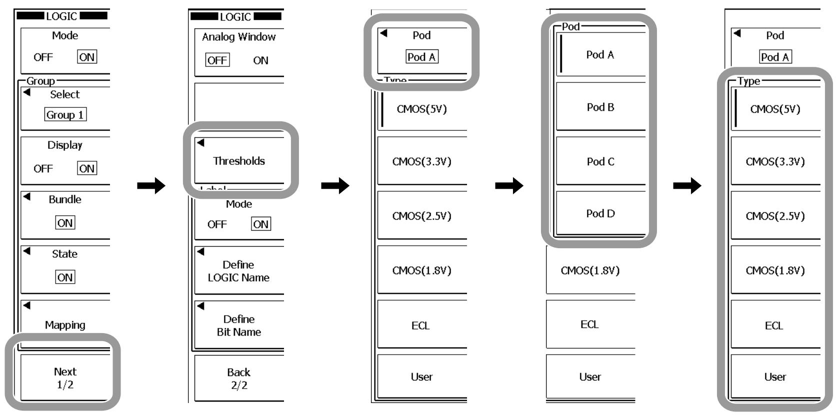
The bits on the LSB side of the deleted bit shifts toward the MSB by 1 bit.

6.18 Setting the Threshold Level

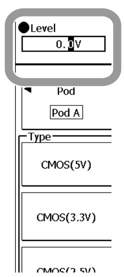
Procedure



1. Press **LOGIC**.
2. Press these soft keys: **Next 1/2** > **Thresholds** > **Pod**.
3. Press the soft key corresponding to the logic signal input port on which to set the threshold level from **Pod A** to **Pod D** (**Pod A** on the SB5310).
4. Press any of the **CMOS(5V)** to **User** soft keys to select the threshold level.
   If you select User, proceed to step 5.
   If you select a threshold level other than User, you are done.



5. Use the **rotary knob** to set the threshold level.



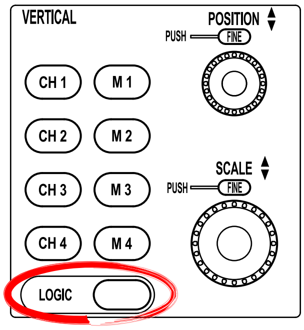
Explanation

You can set a threshold level for each logic signal input port (Pod A to Pod D). You can select or set from the threshold levels below. The threshold level is used to detect the high and low states (polarities) of the logic signals.

Setting	Threshold Level
CMOS(5V)	2.5 V
CMOS(3.3V)	1.6 V
CMOS(2.5V)	1.2 V
CMOS(1.8V)	0.9 V
ECL	–1.3 V
User	User-defined setting Selectable range: ±10 V when using the 701981 Logic Probe and ±40 V when using the 701980 Logic Probe. Resolution: 0.1 V

6.19 Changing the Simultaneous Display Format of Analog Waveforms and Logic Signals, and Correcting the Skew

Procedure



1. Press **LOGIC**.

2. Press the **Next 1/2** soft key.

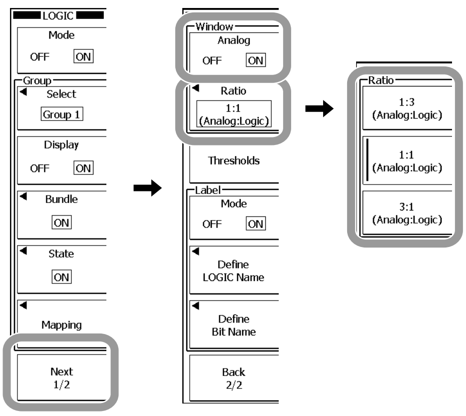
Changing the Display Ratio of Analog Waveforms and Logic Signals

3. Press the **Ratio** soft key.

4. Press the soft key corresponding to the desired display ratio (analog waveform area:logic signal area) from **1:3 (Analog:Logic)** to **3:1 (Analog:Logic)**.

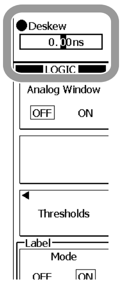
Turning ON/OFF the Simultaneous Display of Analog Waveforms

5. Press the **Analog** soft key to select ON or OFF.
ON: Simultaneously display the analog waveform area. OFF: Hide the analog waveform area.



Adjusting the Skew

3. Use the **rotary knob** to set the screw correction value of the logic signal.
You can move between the digits using the arrow keys.
Press RESET to reset the delay time to 0.00 ns.



Explanation

Changing the Display Ratio of Analog Waveforms and Logic Signals

You can select the display ratio of the analog waveform area to the logic signal area from the following:

Analog Waveform Area: Logic Signal Area
1 : 3
1 : 1 (default setting)
3 : 1

Turning ON/OFF the Simultaneous Display of Analog Signals

By default, the analog waveform area and the logic signal area are displayed simultaneously. If you want to observe only the logic signals, you can hide the analog waveform area and display the logic signal area on a full screen.

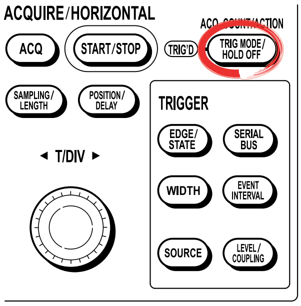
Adjusting the Skew

You can observe the signal by correcting the time offset (skew) of the logic signal with respect to another signal. The logic signal is corrected collectively. It cannot be corrected at the group or bit level.

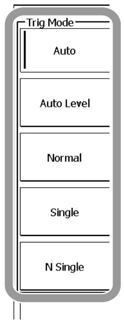
Selectable range	–80.00 to 80.00 ns (the default value is 0.00 ns)
Resolution	0.01 ns

7.1 Setting the Trigger Mode

Procedure



1. Press **TRIG MODE/HOLD OFF**.
2. Press the appropriate trigger mode soft key.



Explanation

Auto mode

If the trigger condition is met before a 100-ms timeout, the SB5000 updates the displayed waveform on each trigger occurrence. If not, the SB5000 automatically updates the displayed waveform. If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled (see page 2-6 for details).

Auto Level mode

If a trigger occurs before a timeout, the SB5000 updates the waveform in the same way as Auto mode. If a trigger does not occur, the SB5000 detects the center value of the trigger source amplitude, automatically changes the trigger to the center value, triggers on that value, and updates the displayed waveform. Auto Level mode is valid when the trigger source is set to a channel from CH1 to CH4. For all other cases, Auto Level mode operates in the same way as Auto mode.

If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Normal mode

The SB5000 only updates the waveform display when the trigger condition is met. If no triggers occur, the display is not updated. If you want to view a waveform that the SB5000 cannot trigger on, or if you want to check the ground level, use Auto mode.

Single mode

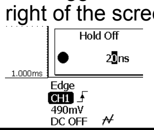
When the trigger condition is met, the SB5000 updates the displayed waveform once and stops signal acquisition. If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled. When a trigger occurs and the SB5000 acquires the specified record length of data, the waveform display stops.

N Single mode

The SB5000 acquires signals each time the trigger condition is met for the specified number of counts. Then, the SB5000 stops acquisition and displays the waveform of all acquired signals.

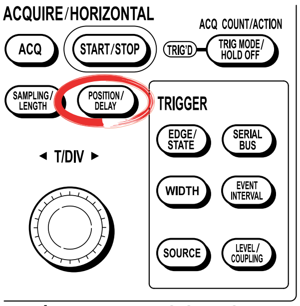
Note

- The trigger mode setting applies to all trigger types.
- The trigger conditions that were used to acquire the displayed signal appear at the lower right of the screen.

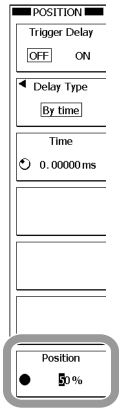


7.2 Setting the Trigger Position

Procedure



1. Press **POSITION/DELAY**.
2. Press the **Position** soft key.
3. Use **rotary knob** to set the trigger position.

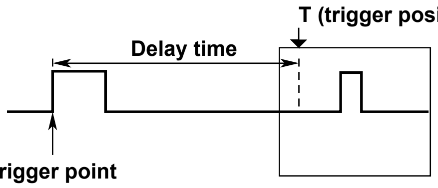


Explanation

Trigger Position

Trigger position = Trigger point + trigger delay (delay time)

You can set where to display the trigger position on the screen.
When the trigger delay is 0 s, the trigger point is the same as the trigger position. For the procedure to set the trigger delay, see section 7.3.



Selectable Trigger Position Range

By taking the display record length (see appendix 1 for details) to be 100%, you can set the trigger position from 0 to 100% in 1% steps.

Trigger Position Indication

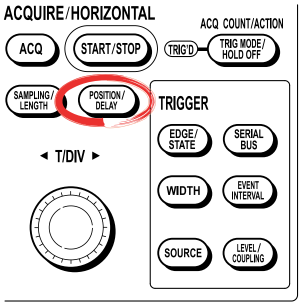
The T mark at the top section of the screen indicates the trigger position.

Note

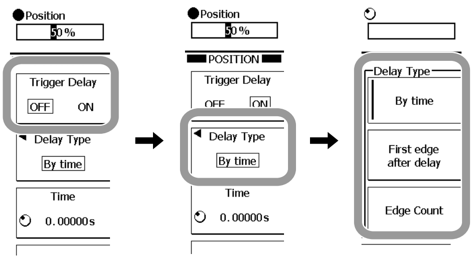
- If you change the trigger position while signal acquisition is stopped, the setting does not take effect until you start signal acquisition, and the waveform is updated.
- Because the time measurement value during cursor measurement is based on the trigger position, changing the trigger position will change the measurement value (not applicable during roll mode display).
- The trigger position remains in the same place on the display if you change the T/div setting.

7.3 Setting the Trigger Delay

Procedure



1. Press **POSITION/DELAY**.
2. Press the **Trigger Delay** soft key to select ON.
3. Press the **Delay Type** soft key.
4. Press the appropriate trigger type soft key.



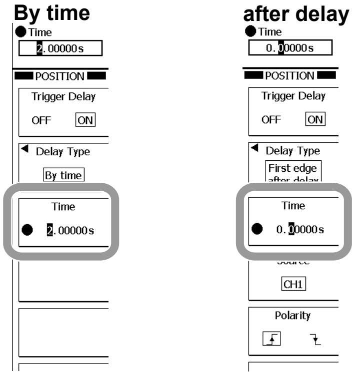
Setting the Delay Time

If you select By time or First edge after delay, set the delay time.

5. Press the **Time** soft key.
6. Use the **rotary knob** to set the delay time.

By time

First edge after delay

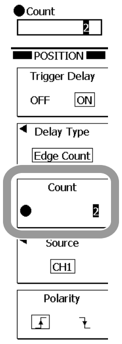


Setting the Count

If you select Edge Count, set the count.

7. Press the **Count** soft key.

8. Use the **rotary knob** to set the Count value.



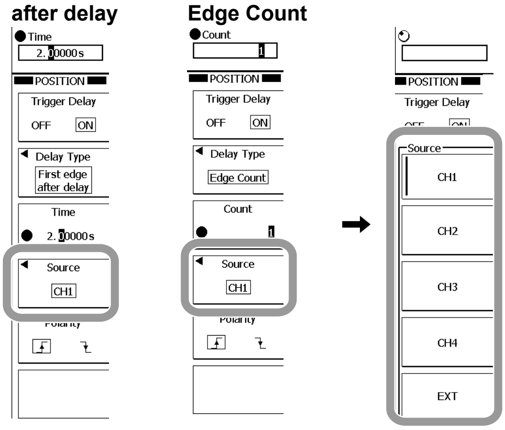
Setting the Source

If you select First edge after delay or Edge Count, set the source.

9. Press the **Source** soft key.

10. Press the appropriate channel soft key.

First edge after delay **Edge Count**

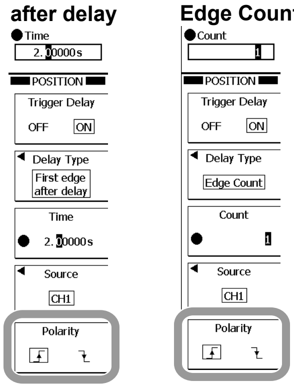


Selecting the Rising or Falling Edge

If you select First edge after delay or Edge Count, select rising or falling edge.

11. Press the **Polarity** soft key to select or .

First edge after delay **Edge Count**



Explanation

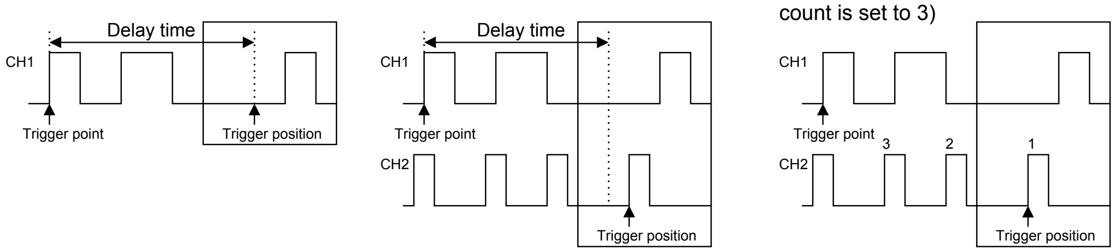
Normally, the SB5000 displays the waveform before and after the trigger point. If you want to monitor the waveform the specified time after the trigger point, you can set a trigger delay (delay time).

Delay Type

The following three delay types are available.

- **By time**
  The specified amount of delay is inserted after the trigger occurrence.
- **First edge after delay**
  A delay is inserted until the first specified edge after the specified time of trigger occurrence.
- **Edge Count**
  A delay is inserted the specified number of edges after the trigger occurrence.

By time **First edge after delay** **Edge Count**
(Example when the trigger edge count is set to 3)



Selectable Delay Time Range

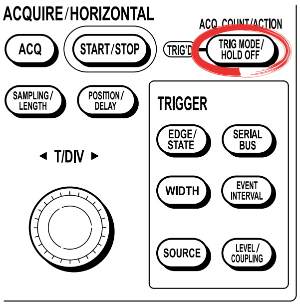
Delay Type	Selectable Range	Resolution
By time	0 to 10 s	5 ps
First edge after delay	0 to 10 s	2 ns
Edge Count	1 to 10^9	1 step

Note

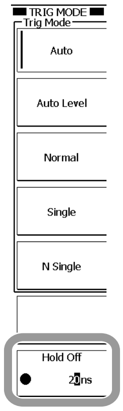
Even if you change the T/div setting, the delay time before the change is retained.

7.4 Setting the Hold-Off Time

Procedure

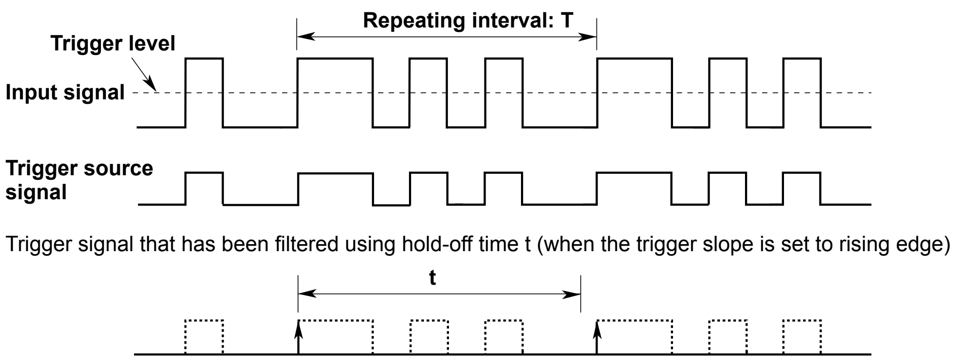


1. Press **TRIG MODE/HOLD OFF**.
2. Press the **Hold off** soft key.
3. Use the **rotary knob** to set the hold-off time.



Explanation

This setting is used to prevent the SB5000 from triggering the specified time after a trigger occurrence. This is useful when you want the SB5000 to trigger in sync with a repeating signal.



Selectable Hold-Off Time Range

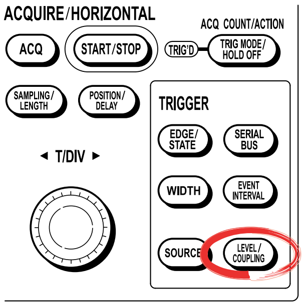
The selectable range is 20 ns to 10.0000 s in 5-ns steps (the default value is 20 ns).

Note

- Waveform updating may slow down during equivalent time sampling. If this happens, reduce the hold-off time.
- If you are setting the hold-off time to 100 ms or longer, set the trigger mode to Normal.

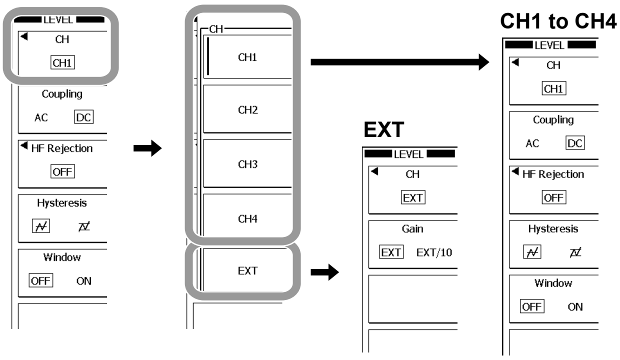
7.5 Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator

Procedure



Setting the Trigger Coupling

1. Press **LEVEL/COUPLING**.
2. Press the **CH** soft key.
3. Press the appropriate soft key from **CH1** to **CH4** or **EXT**.
   If you select EXT, proceed to step 10.
4. Press the **Coupling** soft key to select DC or AC.

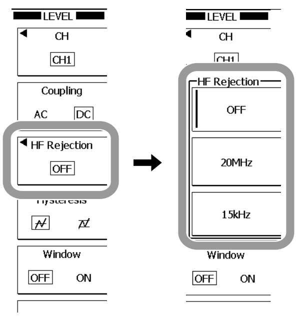


Note

The trigger coupling setting applies to all trigger types.

Setting HF Rejection

5. Press the **HF Rejection** soft key.
6. Press the appropriate frequency soft key.

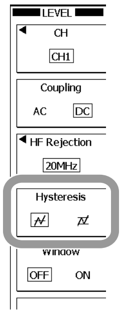


Note

The HF rejection setting applies to all trigger types.

Setting the Hysteresis

7. Press the **Hysteresis** soft key to select or .



Note

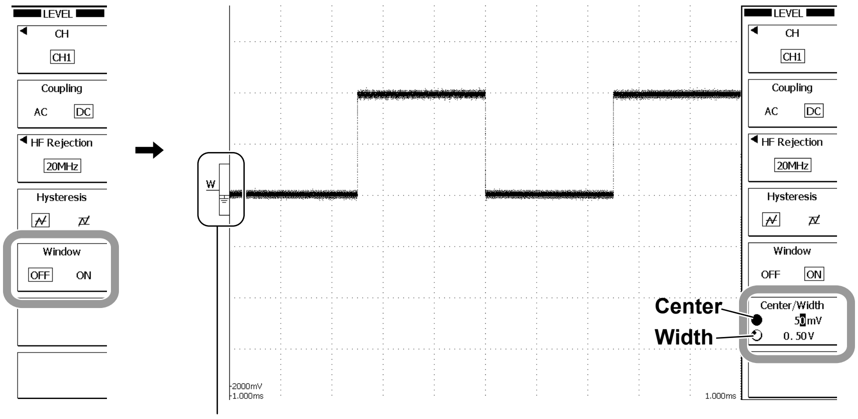
The hysteresis setting applies to all trigger types.

Setting the Window Comparator

8. Press the **Window** soft key to switch ON.

9. Use the **rotary knob** to set the window's center voltage and range.

- Press the Center/Width soft key to switch between Center and Width.
- If the trigger coupling is DC, and you press RESET when the rotary knob is controlling the center level, the center level will be set to the current offset voltage (see section 6.2 for details).
  If the trigger coupling is AC, the center level will be set to 0 V.
- If you press RESET when the rotary knob is controlling the window width, the width will be set to a voltage that corresponds to 1 division.



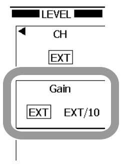
Window indicator

Note

The window comparator setting applies to all trigger types.

Setting the Attenuation Ratio When EXT Is Selected

10. Press the **Gain** soft key to select EXT or EXT/10.



Explanation

You can set the trigger coupling, HF rejection, trigger hysteresis, and window comparator on signals applied to input channels CH1 to CH4 and EXT.

Trigger Coupling

You can select the trigger coupling.

AC	Sets the trigger source to the signal that is obtained by removing the DC component from the trigger source signal.
DC	Uses the trigger source signal directly.

Note

The trigger coupling is fixed to DC when the trigger source is EXT.

HF Rejection

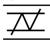
Set the HF rejection to 15 kHz or 20 MHz if you are setting the trigger source to the signal that is obtained by removing high frequency components (frequency components greater than 15 kHz or 20 MHz) from the trigger source signal.

Note

You cannot set HF rejection when the trigger source is EXT.

Hysteresis

Hysteresis specifies a voltage range above and below the trigger level to prevent the SB5000 from triggering on minute voltage fluctuations.

	Specifies a hysteresis of approximately 0.3 divisions around the trigger level.*
	Specifies a hysteresis of approximately 1 division around the trigger level.*

* The values above are typical. They are not strictly warranted.

Window Comparator

Determines whether the trigger condition (which had been determined by the waveform's rising or falling edge or high or low condition), the Qualify condition, or the state condition is inside or outside the window.

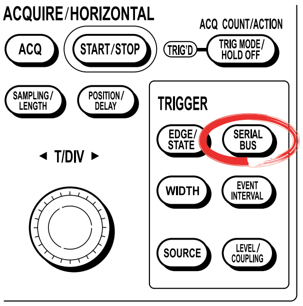
You can enable or disable the window comparator for each channel. A channel's trigger condition will change based on the window comparator setting.

For example, if you enable the window comparator on an edge-trigger source channel, the SB5000 will be able to trigger based on whether or not the source channel waveform enters the specified area.

Setting	Selectable Range	Resolution
Center	±4 divisions from the screen center	0.01 divisions
Width	±4 divisions above and below the center level	0.02 divisions

7.6 Triggering on a FlexRay Bus Signal

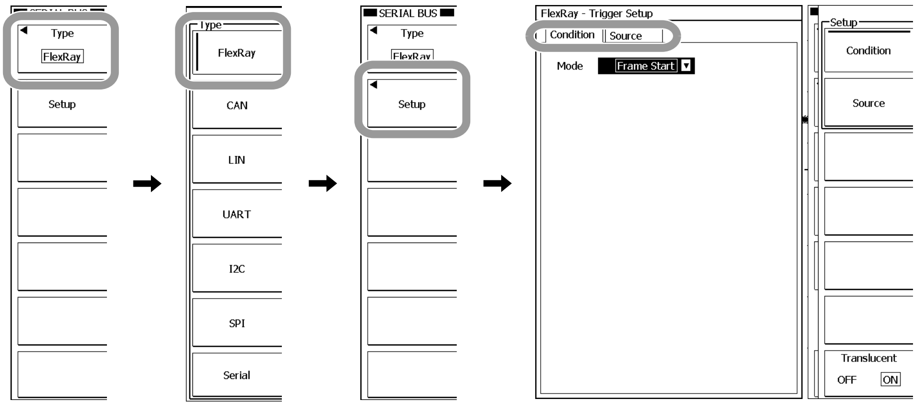
Procedure



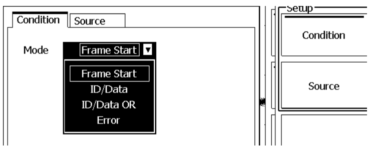
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **FlexRay** > **Setup**.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the the **rotary knob** and **SET** to select the mode from Frame Start to Error.



Proceed to the steps on the pages indicated below according to the selected mode.

- Frame Start: Step 17 on page 7-14
- ID/Data: Step 5 on page 7-11
- ID/Data OR: Step 5 on page 7-13
- Error: Step 5 on page 7-14

When the Mode Is ID/Data

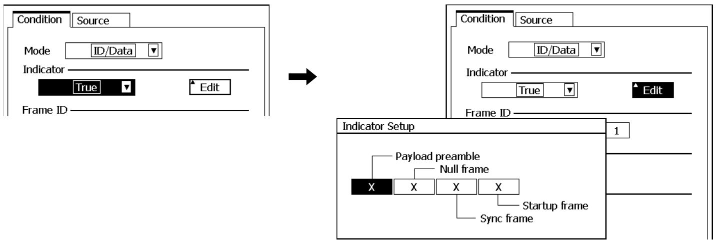
- **Setting the Indicator Trigger Condition**

5. Use the **rotary knob** and **SET** to select the indicator comparison condition from Don’t care to False.
If you select Don’t care, proceed to step 9.

6. Use the **rotary knob** and **SET** to select Edit.
The Indicator Setup dialog box appears.

7. Use the **rotary knob** and **SET** to set the four indicator bit patterns from Payload preamble to Startup frame.

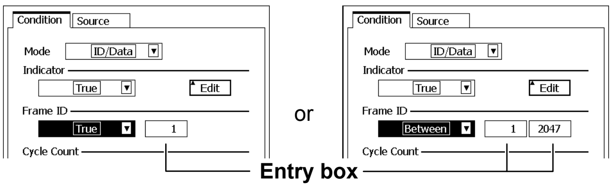
8. Press **ESC** to return to the previous screen.



- **Setting the Frame ID Trigger Condition**

9. Use the **rotary knob** and **SET** to select the Frame ID comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 11.

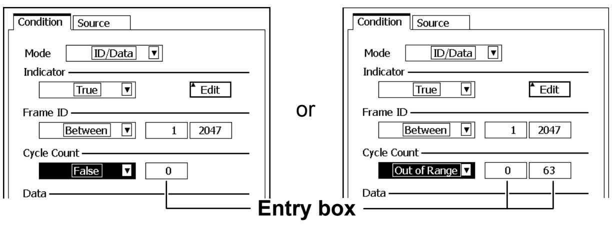
10. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



- **Setting the Cycle Count Trigger Condition**

11. Use the **rotary knob** and **SET** to select the Cycle Count comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 13.

12. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



- **Setting the Data Trigger Condition**

13. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.
If you select Don't care, proceed to step 17 on page 7-14.

14. Use the **rotary knob** and **SET** to set the position and size.
If you select a condition from Greater to Out of Range in step 13, proceed to step 16.

15. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

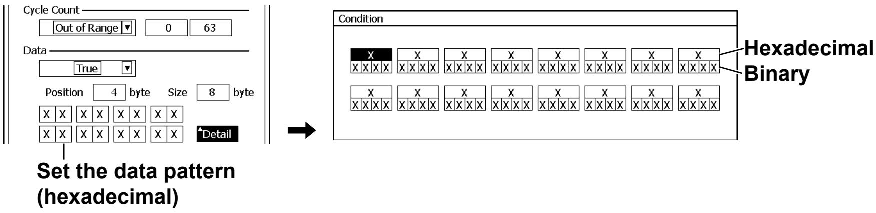
16. Use the **rotary knob** and **SET** to set the data to compare in each entry box.
Set each item according to the comparison condition you selected in step 13.

Comparison	Setting						
Condition	**Position**	**Size**	**Detail**	**Data(Dec)**	**Byte Order**	**Sign**	**MSB/LSB**
True, False	Yes	Yes	Yes	–	–	–	–
Greater/Equal, Less/Equal	Yes	Yes	–	Yes[1]	Yes	Yes	Yes
Between, Out of Range	Yes	Yes	–	Yes[2]	Yes	Yes	Yes

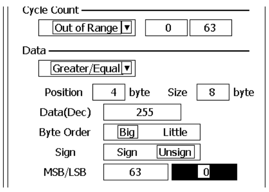
Yes: Set, –: Not set

- Position: Comparison start point
- Size: Data length to compare
- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

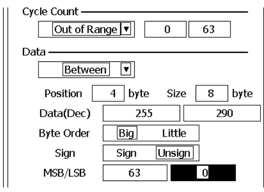
True, False



Greater/Equal, Less/Equal



Between, Out of Range



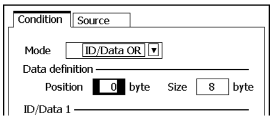
Proceed to step 17 on page 7-14.

When the Mode Is ID/Data OR

- **Setting the Data Definition Trigger Condition**

  Set the common compared data items.

  5. Use the **rotary knob** and **SET** to set the comparison start position and data size.



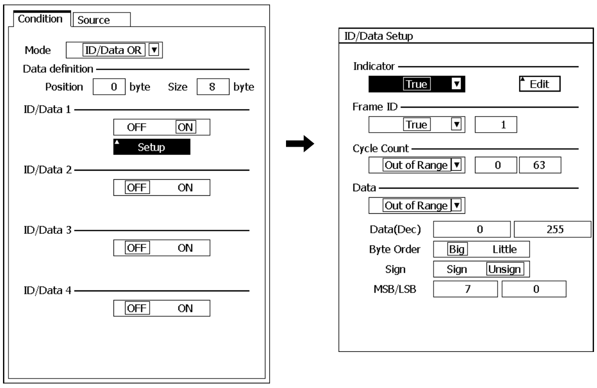
- **Setting the ID/Data 1 to ID/Data 4 Trigger Conditions**

  6. Use the **rotary knob** and **SET** to set ID/Data 1 to ON or OFF.
  Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
  If you select OFF, proceed to step 10.

  7. Use the **rotary knob** and **SET** to select ID/Data 1 Setup.
  The ID/Data Setup dialog box appears.

  8. Use the **rotary knob** and **SET** to set the Indicator, Frame ID, Cycle Count, and Data trigger conditions.
  For the procedure to set each condition, see pages 7-11 and 7-12.

  9. Press **ESC** to return to the previous screen.



  10. Likewise, set ID/Data2 to ID/Data4 according to steps 6 to 9.

Proceed to step 17 on page 7-14.

When the Mode Is Error

- **Selecting the Detection Source**

5. Use the **rotary knob** and **SET** to set the source to Single or Dual.

- **Selecting the Error Type**

6. Use the **rotary knob** and **SET** to select Error Type from BSS to CRC.
- You can select all error types using the OR logic.
- The CRC Calculation item appears when you select CRC.

- **Assigning the Source (when CRC is selected in step 6)**

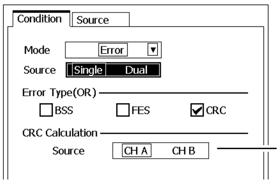
When Single is selected in step 5

7. Use the **rotary knob** and **SET** to set the CRC calculation source to CH A or CH B.

When Dual is selected in step 5

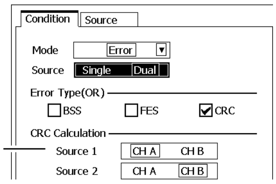
7. Use the **rotary knob** and **SET** to set the CRC calculation sources 1 and 2 to CH A or CH B.

When Single is selected in step 5



The CRC Calculation item appears when you select CRC.

When Dual is selected in step 5



Proceed to step 17.

Setting the Source Bit Rate, Trigger Level, and Hysteresis

17. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Selecting the Bit Rate

18. Use the **rotary knob** and **SET** to select the bit rate from 10Mbps to 2.5Mbps.

Setting the Trigger Level and Hysteresis

When Single is selected in step 5

19. Use the **rotary knob** and **SET** to select the source from CH1 to CH4.

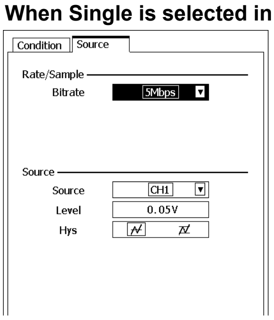
20. Use the **rotary knob** and **SET** to set the level and hysteresis.

When Dual is selected in step 5

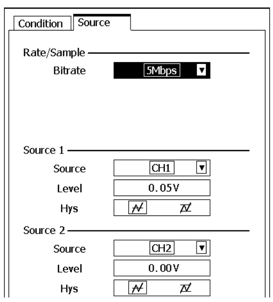
19. Use the **rotary knob** and **SET** to select Source 1 and Source 2 from CH1 to CH4.

20. Use the **rotary knob** and **SET** to set the level and hysteresis.

When Single is selected in step 5

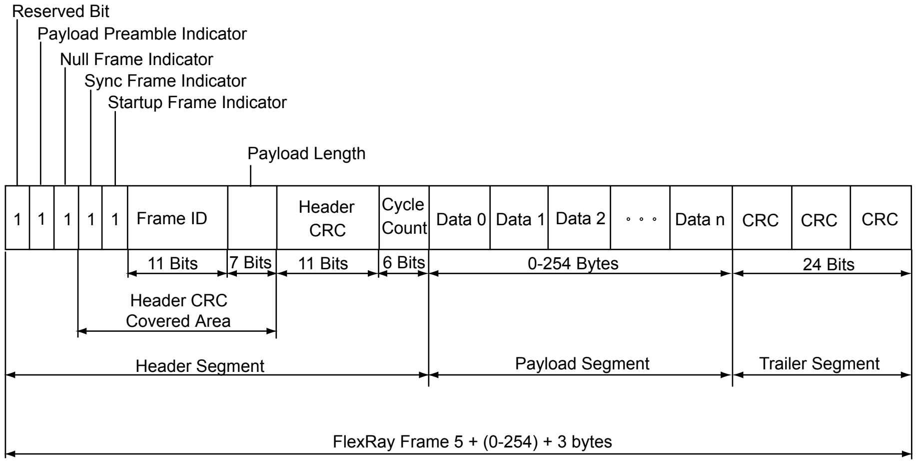


When Dual is selected in step 5



Explanation

This function triggers on FlexRay bus signals. The following figure shows the frame format of FlexRay bus signals.



Mode

Select the FlexRay trigger mode from Frame Start, ID/Data, ID/Data OR, and Error.

Frame Start Mode

Triggers on the start of a FlexRay bus signal frame.

ID/Data Mode

Triggers on the AND logic of Indicator, Frame ID, Cycle Count, and Data conditions.

- **Indicators**

  You can use the four indicator statuses as trigger conditions.

  - Comparison Condition

    The Indicator trigger condition is met when the result of comparing the input signal indicator pattern with the specified bit pattern meets the selected comparison condition.

Don't care	Not used as a trigger condition
True	When the input signal bit pattern matches the specified bit pattern
False	When the input signal bit pattern does not match the specified bit pattern

  - Bit Pattern

    Select the four Indicator bit patterns from the following:

X	Not used as a trigger condition (Don't care)
0	See below.
1	

The four Indicators indicate the following information.

Payload preamble

0 No option vector in the payload segment.

1 Includes a network managment vector in the static payload segment.
Includes a message ID in the dynamic payload segment.

Null Frame

0 Includes invalid data in the payload segment.

1 Includes valid data in the payload segment.

Sync Frame

0 The frame is not a sync frame.

1 The frame is a sync frame.

Startup frame

0 The frame is not a startup frame.

1 The frame is a startup frame.

- **Frame ID**
  You can use the 11-bit frame ID as a trigger condition.
  - Comparison Condition
    The Frame ID trigger condition is met when the result of comparing the input signal Frame ID value with the reference value meets the selected comparison condition.

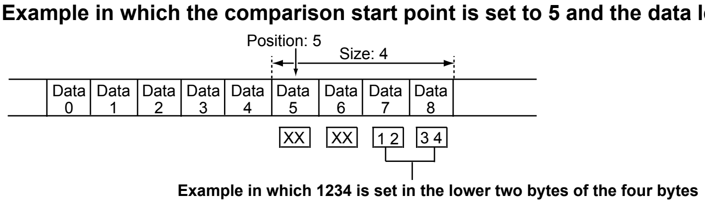
Don't care	Not used as a trigger condition
True	When the input signal value matches the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

  - Reference Values
    - If you select a condition from True to Less/Equal, set one reference value.
    - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
    - Selectable range: 1 to 2047

- **Cycle Count**
  You can use the 6-bit cycle count as a trigger condition.
  - Comparison Condition
    The cycle count trigger condition is met when the result of comparing the input signal cycle count value with the reference value meets the selected comparison condition. The comparison condition is the same as with the frame ID.
  - Reference Values
    - The procedure to set the reference values is the same as with the frame ID.
    - Selectable range: 0 to 63

- **Data**
  You can use the Data 0 to Data 253 values as a trigger condition.
  - Comparison Condition
    The data trigger condition is met when the result of comparing the input signal data values with the reference values meets the selected comparison condition. The comparison condition is the same as with the frame ID.
  - Comparison Start Position
    Set the comparison start position. To start comparing from payload segment data 1, set 1.
    Selectable range: 0 to 253
  - Data Size
    Set how many consecutive payload segment data bytes you want to compare.
    Selectable range: 1 to 8 bytes
  - Data Pattern
    Set the data pattern for the specified size in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to True or False.
    - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
    - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Example in which the comparison start point is set to 5 and the data length is set to 4



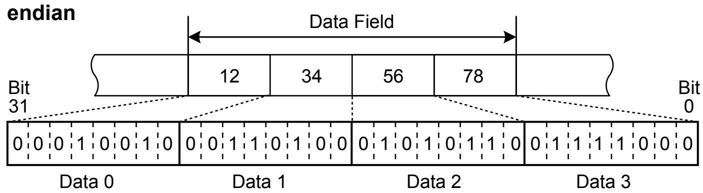
- Reference Value Data(Dec)
  - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
  - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
  - If the comparison condition is True or False, the data pattern is used as the reference value.
  - Selectable range
    Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.

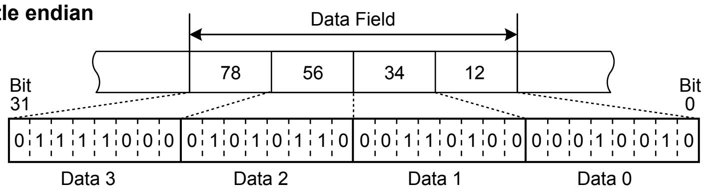
The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

- Byte Order
  Set the data byte order to big endian or little endian. For example, the following figure shows a 4-byte data stream on the bus (12345678 in hexadecimal notation).

Big endian



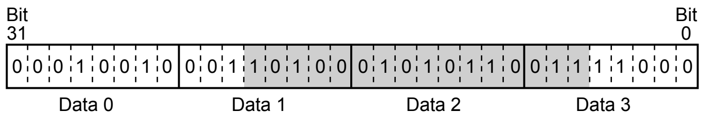
Little endian



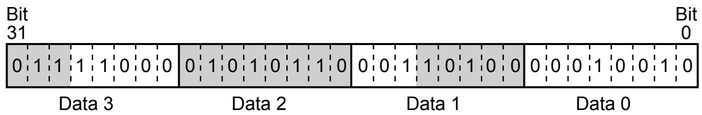
- Sign
  Select whether or not to add a sign to the data.
  The selectable range for the data reference value varies depending on this setting.

- MSB/LSB
  Set the MSB and LSB positions in the data to compare. For example, to compare bits 5 to 20 in a 4-byte data stream (12345678 in hexadecimal notation), set the MSB to 20 and the LSB to 5. The shaded sections in the following figure indicate the bits that will be compared depending on the byte order setting.
  Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

Big endian



Little endian



ID/Data OR Mode

The SB5000 triggers on the OR logic of multiple ID/Data conditions. You can set up to four ID/Data conditions.

- You can select whether or not to use each ID/Data condition as a trigger condition.
- The trigger conditions and settings of each ID/Data condition are the same as those described on pages 7-15 to 7-17. See the respective page for details.

Note

When using the ID/Data OR mode, set the conditions so that the trigger point will be the same. If you don't, the SB5000 may not trigger at the correct position.

Error Mode

The SB5000 triggers on detected errors.

- Detection Source
  If you set the detection source to Dual, you can select two FlexRay bus signal sources. If you set the detection bus to Single, you can select one source.
- Assigning Bus Channels
  Assign FlexRay bus CH A or CH B to each detection source. This setting is used when the error type is set to CRC error.
- Error Type
  You can select the type of errors to detect from the table below.
  - You can select multiple error types.
  - The SB5000 will trigger if any of the selected errors occurs.

CRC	When the SB5000 detects a header CRC or frame CRC error
BSS	When the SB5000 detects a BSS error
FES	When the SB5000 detects an FES error

Source Bit Rate, Trigger Level, and Hysteresis

Bit Rate

You can set the FlexRay bus signal transfer rate to 10 Mbps, 5 Mbps, or 2.5 Mbps.

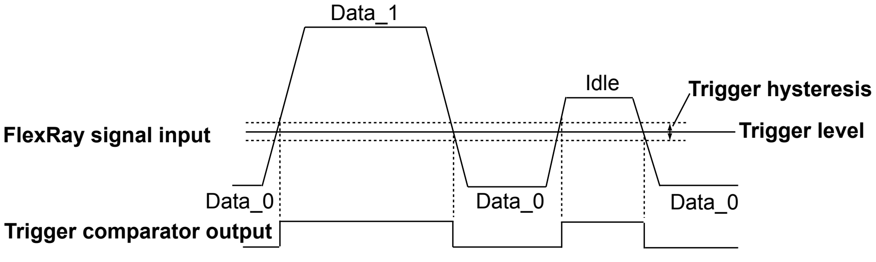
Trigger Level

You can set the FlexRay bus signal trigger level for CH1 to CH4 separately.
Set the trigger level between the idle level and the Data_0 level. This will enable the trigger circuit to recognize Data_1 and Idle as high level and Data_0 as low level.

- The selectable range is 8 divisions within the screen. The resolution will be 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.

Hysteresis

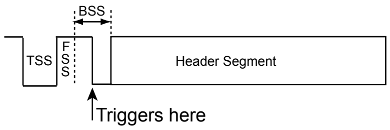
See section 7.5 for details.



Trigger Point

The trigger point is near the falling edge of BSS immediately after all the trigger conditions are met. However, when using the error trigger mode, if a CRC error occurs only in the FlexRay frame and not in the header, the trigger point is near the rising edge of FES.

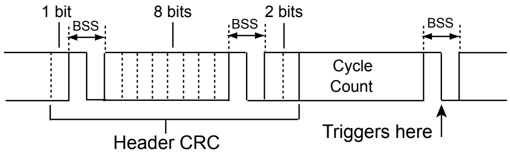
Frame Start Mode



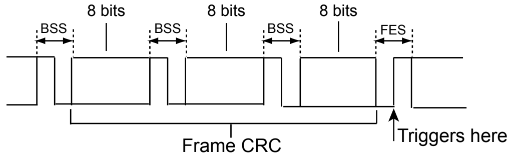
BSS: Byte Start Sequence
FES: Frame End Sequence

Error Mode

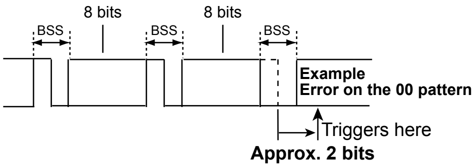
- **When there is a CRC error in the header**



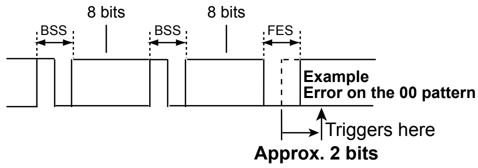
- **When there is a CRC error in the frame**



- **When there is a BSS error**



- **When there is a FES error**

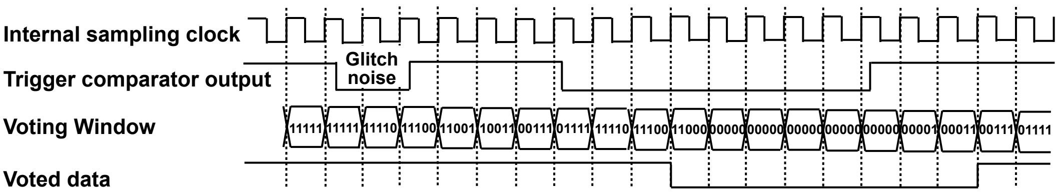


Note

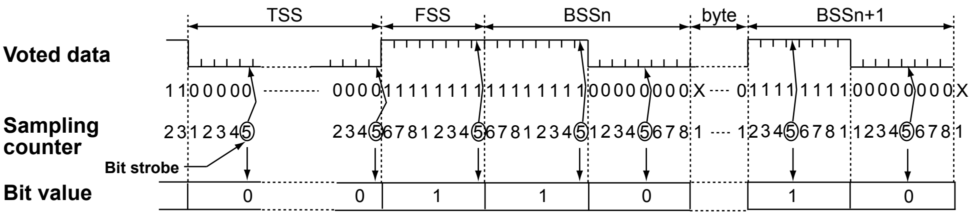
In error trigger mode, data is sampled using the internal sampling clock. Therefore, one sampling clock of trigger jitter will occur. One cycle is equal to 1/8th of the bit width at the specified bit rate. For example, the jitter is 25 ns if the bit rate is 5 Mbps.

Trigger Circuit Bit Sampling

The input signal from the FlexRay bus is converted to binary values by the trigger comparator. Then, the values are sampled using the internal sampling clock in the trigger circuit and goes through a majority voting process to filter out noise.

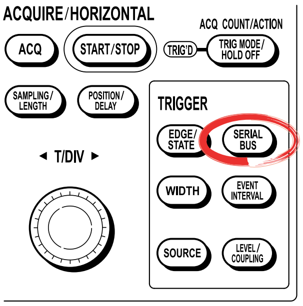


The length of one bit is eight sampling clocks. The sampling counter is reset on the falling edge of BSS in the voted data. The bit value is the voted data value when the counter reaches 5, and this value is used to detect the trigger condition.



7.7 Triggering on a CAN Bus Signal

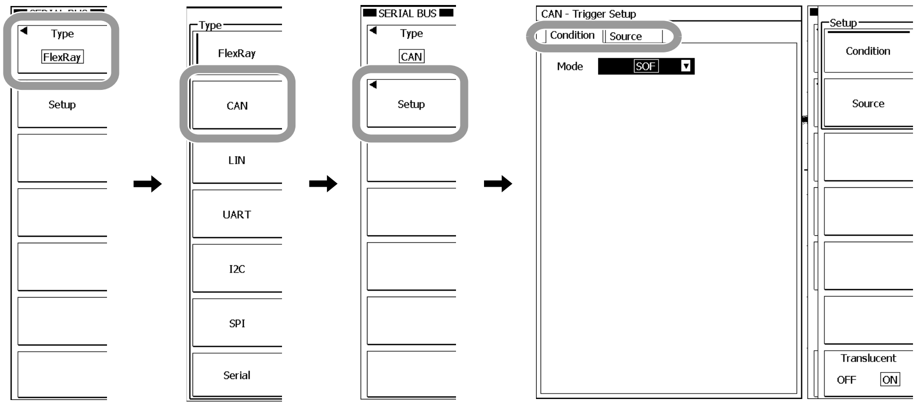
Procedure



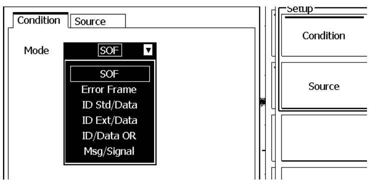
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **CAN** > **Setup**.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from SOF to Msg/Signal.



Proceed to the steps on the pages indicated below according to the selected mode.

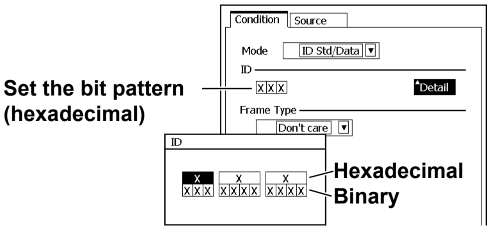
- SOF: Step 16 on page 7-25
- Error Frame: Step 16 on page 7-25
- ID Std/Data: Step 5 on page 7-21
- ID Ext/Data: Step 5 on page 7-21
- ID/Data OR: Step 5 on page 7-23
- Msg/Signal: Step 5 on page 7-24

When the Mode Is ID Std/Data or ID Ext/Data

This section will explain the procedure using ID Std/Data mode as an example. The procedure is the same for ID Ext/Data mode.

- **Setting the ID Bit Pattern Trigger Condition**

5. Use the **rotary knob** and **SET** to set the bit pattern to compare with.
You can also set the bit pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the bit pattern, press **ESC** to return to the previous screen.



- **Setting the Frame Type Trigger Condition**

6. Use the **rotary knob** and **SET** to select the Frame Type comparison condition from Don't care to Data.
If you select Don't care or Remote, proceed to step 11 on page 7-22.

7. Use the **rotary knob** and **SET** to set the DLC.

- **Setting the Data Trigger Condition**

8. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.
- If you select Don't care, proceed to step 11 on page 7-22.
- If you select a condition from Greater to Out of Range, proceed to step 10.

9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

10. Use the **rotary knob** and **SET** to set the data to compare in each entry box.

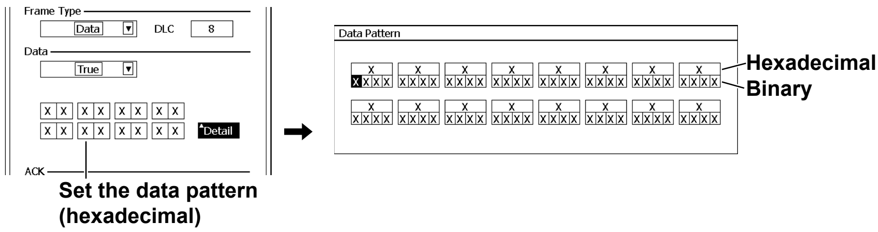
Set each item according to the comparison condition you selected in step 8.

Comparison Condition	Setting				
	Detail	**Data(Dec)**	**Byte Order**	**Sign**	**MSB/LSB**
True, False	Yes	–	–	–	–
Greater/Equal, Less/Equal	–	Yes[1]	Yes	Yes	Yes
Between, Out of Range	–	Yes[2]	Yes	Yes	Yes

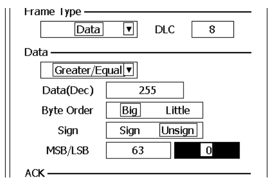
Yes: Set, –: Not set

- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

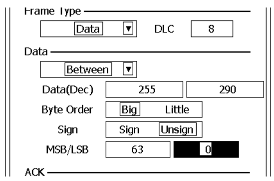
True, False



Greater/Equal, Less/Equal



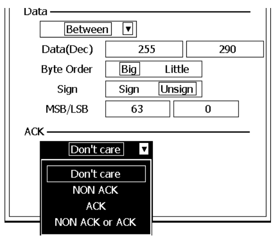
Between, Out of Range



- **Setting the ACK Trigger Condition**

11. Use the **rotary knob** and **SET** to select the ACK condition from Don’t care to NON ACK or ACK.

If you select Don’t care, it will not be used as a trigger condition.



Proceed to step 16 on page 7-25.

When the Mode Is ID/Data OR

Setting the ID/Data 1 to ID/Data 4 Trigger Conditions

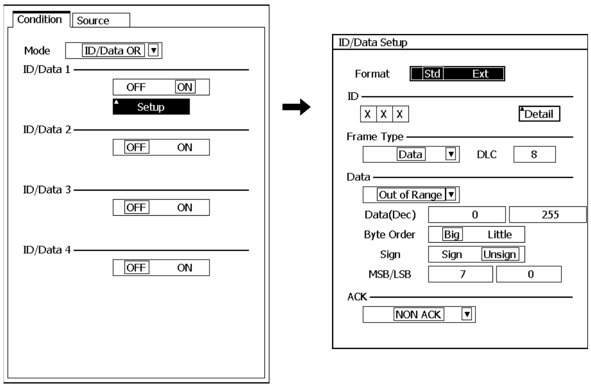
5. Use the **rotary knob** and **SET** to set ID/Data 1 to ON or OFF.
Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
If you select OFF, proceed to step 10.

6. Use the **rotary knob** and **SET** to select ID/Data 1 Setup.
The ID/Data Setup dialog box appears.

7. Use the **rotary knob** and **SET** to set the format to Std or Ext.

8. Use the **rotary knob** and **SET** to set the ID, Frame Type, Data, and ACK trigger conditions.
For the procedure to set each condition, see pages 7-21 and 7-22.

9. Press **ESC** to return to the previous screen.



10. Likewise, set ID/Data2 to ID/Data4 according to steps 5 to 9.

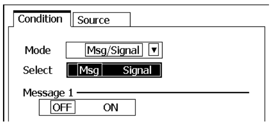
Proceed to step 16 on page 7-25.

When the Mode Is Msg/Signal

Load an SBL file to the SB5000 and then carry out the steps below. The items in the Message and Signal dialog boxes in the explanation are examples.

- **Selecting the Trigger Condition You Want to Set**

5. Use the **rotary knob** and **SET** to set Select to Msg or Signal.
If you select Signal, proceed to step 10.

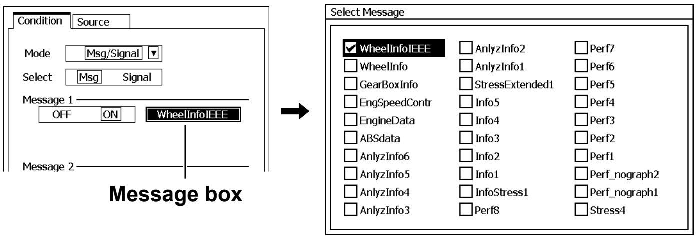


- **Selecting the Message to Use as a Trigger Condition**

6. Use the **rotary knob** and **SET** to set Message 1 to ON or OFF.
Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
If you select OFF, proceed to step 9.

7. Use the **rotary knob** and **SET** to select the message box.
The Select Message dialog box appears.

8. Use the **rotary knob** and **SET** to select a message.
The Select Message dialog box closes.



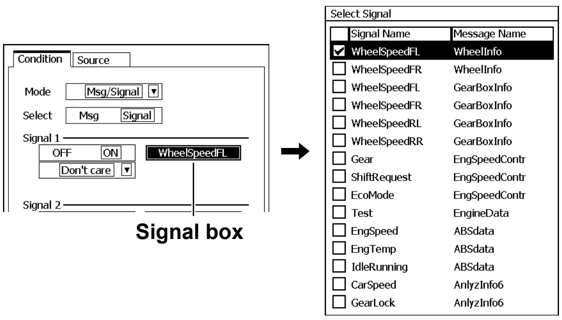
9. Likewise, set Message 2 to Message 4 according to steps 6 to 8.

- **Selecting the Signal to Use as a Trigger Condition**

10. Use the **rotary knob** and **SET** to set Signal 1 to ON or OFF.
Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
If you select OFF, proceed to step 15.

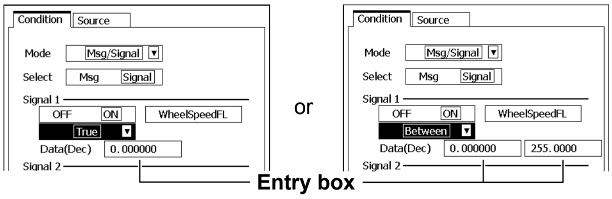
11. Use the **rotary knob** and **SET** to select the signal box.
The Select Signal dialog box appears.

12. Use the **rotary knob** and **SET** to select a signal.
The Select Signal dialog box closes.



13. Use the **rotary knob** and **SET** to select the data comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 16.

14. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



15. Likewise, set Signal 2 to Signal 4 according to steps 10 to 14.

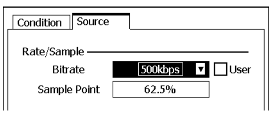
Setting the Source Bit Rate, Sample Point, Trigger Level, Hysteresis, and Recessive Level

16. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Setting the Bit Rate and Sample Point

17. Use the **rotary knob** and **SET** to select the bit rate from 1Mbps to 33.3kbps.
If you select the **User** check box, you will be able to set the bit rate from 10.0kbps to 1.000Mbps using the **rotary knob** and **SET**.

18. Use the **rotary knob** and **SET** to set the sample point to a value from 18.8 to 90.6%.

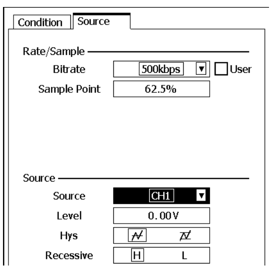


Setting the Trigger Level, Hysteresis, and Recessive Level

19. Use the **rotary knob** and **SET** to select the source from CH1 to CH4.

20. Use the **rotary knob** and **SET** to set the level and hysteresis.

21. Use the **rotary knob** and **SET** to set Recessive to H or L.



Explanation

This function triggers on CAN bus signals. For details on the CAN bus signal frame format, see page 7-30.

Mode

Set the CAN trigger mode to SOF, Error Frame, ID Std/Data, ID Ext/Data, ID/Data OR, or Msg/Signal.

SOF Mode

Triggers on the start of a CAN bus signal frame.

SOF: Start of Frame

Error Frame Mode

The SB5000 triggers when the error frame's error flag is active.

ID Std/Data and ID Ext/Data Modes

ID Std/Data mode is used to trigger on the data frame or remote frame in standard format.

ID Ext/Data mode is used to trigger on the data frame or remote frame in extended format.

The SB5000 triggers on the AND logic of ID, Frame Type, Data, and ACK conditions.

The settings in ID Std/Data mode are shared with the settings in ID Ext/Data mode.

- **ID**

  Set the ID bit pattern in hexadecimal or binary notation. The ID bit pattern is 11 bits in standard format and 29 bits in extended format. The ID trigger condition is met when the specified bit pattern matches the input signal ID bit pattern.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Frame Type**

  The SB5000 can be configured to trigger on the remote frame or data frame.
  - Selecting the Frame

    A CAN bus signal frame contains a Remote Transmission Request (RTR) bit that indicates whether the frame is a remote frame or a data frame. Select the frame that the SB5000 will trigger on.

Don't care	The SB5000 will trigger on both remote frames and data frames.
Remote	The SB5000 will trigger on remote frames.
Data Frame	The SB5000 will trigger on data frames.

    If you select Don't care or Remote, the DLC and Data trigger conditions in the next section will be ignored.

  - DLC (Data Length Code)

    Set the data field length. The DLC trigger condition is met when the input signal DLC value matches the reference value. Set this value only when the frame type is set to Data Frame.

    Selectable range: 0 to 8 bytes

    If you set this value to zero, the data trigger conditions in the next section will be ignored.

- **Data**

  You can use the Data Field value as a trigger condition. Set this value only when the frame type is set to Data Frame.

  - Comparison Condition

    The data trigger condition is met when the result of comparing the input signal Data Field value with the reference value meets the selected comparison condition.

Don't care	Not used as a trigger condition
True	When the input signal value meets the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

  - Data Pattern

    Set the data pattern for the length specified by DLC in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to True or False.

    - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
    - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

  - Reference Value Data(Dec)

    - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
    - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
    - If the comparison condition is True or False, the data pattern is used as the reference value.
    - Selectable range

      Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the DLC and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the DLC and MSB/LSB settings, respectively.

      The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

  - Byte Order

    Set the data byte order to big endian or little endian. For an example, see page 7-17.

  - Sign

    Select whether or not to add a sign to the data.

    The selectable range for the data reference value varies depending on this setting.

  - MSB/LSB

    Set the MSB and LSB positions in the data to compare. For an example, see page 7-17.

    Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

- **ACK**
  You can use the ACK slot status as a trigger condition. The ACK trigger condition is met when the selected status matches the input signal ACK slot status.

Don't care	Not used as a trigger condition
NON ACK	When the status is recessive
ACK	When the status is dominant
NON ACK or ACK	When the status is recessive or dominant

ID/Data OR Mode

The SB5000 triggers on the OR logic of multiple ID Std/Data conditions or multiple ID Ext/Data conditions. You can set up to four ID Data conditions. The ID Std/Data settings are shared with the ID Ext/Data settings.

- You can select whether or not to use each ID/Data condition as a trigger condition.
- The trigger conditions and settings of each ID/Data condition are the same as those described on pages 7-26 to 7-28. See the respective page for details.

Note

When using the ID/Data OR mode, set conditions so that the trigger point will be the same. If you don't, the SB5000 may not trigger at the correct position.

Msg/Signal Mode

This mode uses the message or signal data that is contained in a physical value/symbol definition file (.sbl) that is loaded into the SB5000 as a trigger condition. You can also change the trigger condition based on the loaded data.

* The physical value/symbol definition file (.sbl) is derived by converting a CANdb file (.dbc). For the procedure to load a file, see section 14.8.

The trigger condition settings of Msg/Signal mode are as follows:

Msg mode	
ID	Load from an sbl file
Other conditions	Don't care
Signal mode	
ID	Load from an sbl file
Frame type	Fixed to data frame
Data	
Comparison Condition	A selected condition
Reference value	A set value
Byte order	Load from an sbl file
Sign	Load from an sbl file
MSB/LSB	Load from an sbl file
ACK	Don't care

Source Bit Rate, Sample Point, Trigger Level, Hysteresis, and Recessive Level

Bit Rate

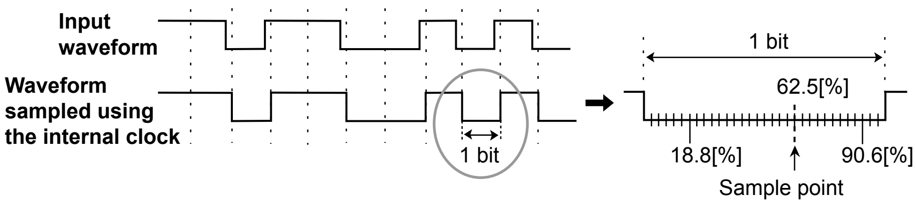
You can select the CAN bus signal transfer rate from the following:
1 Mbps, 500 kbps, 250 kbps, 125 kbps, 83.3 kbps, and 33.3 kbps

If you select the User check box, you can set the transfer rate from 10.0 kbps to 1.000 Mbps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level (recessive or dominant) from 18.8 to 90.6% in 3.1% steps.
The SB5000 CAN bus signal trigger circuit samples the input CAN bus signal using the internal clock and detects the point of change from recessive to dominant. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate.

If the sample point is set to 62.5%



Trigger Level

You can set the CAN bus signal trigger level for CH1 to CH4 separately.

- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.

Hysteresis

See section 7.5 for details.

Recessive Level

Set the recessive level to high (H) or low (L). The logical value of the recessive level is 1 and that of the dominant level is 0 in either setting.

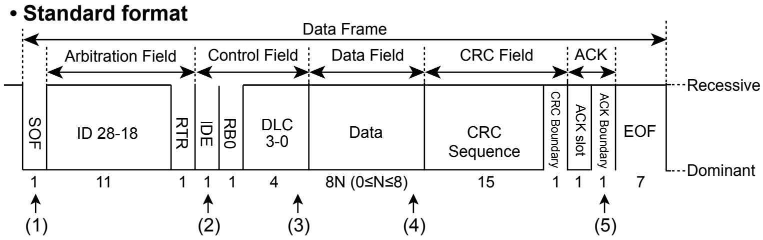
H	The recessive level is higher than the dominant level.
L	The recessive level is less than the dominant level.

Frame Format and Trigger Point

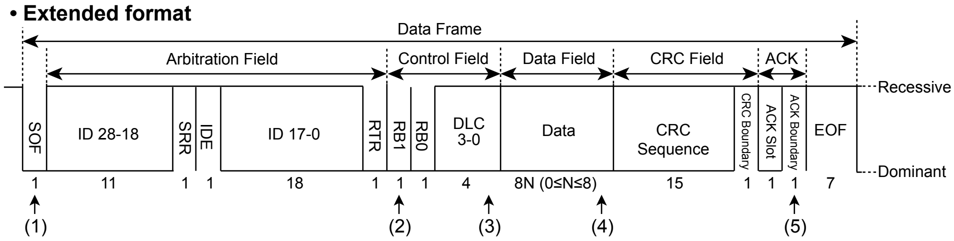
The following figure shows the frame and trigger point of each frame.

Data Frame

• Standard format



• Extended format

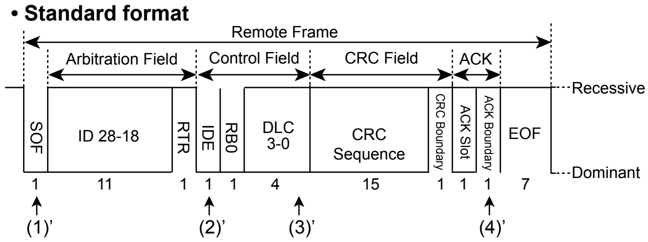


Positions (1) to (5) above are trigger points for the following conditions.
(1) Mode: SOF
(2) Mode: ID X*, Frame (RTR): Don't care, ACK: Don't care
(3) Mode: ID X*, Frame (RTR): Data, Data Field: Don't care, ACK: Don't care
(4) Mode: ID X*, Frame (RTR): Data, Data Field: Not Don't care, ACK: Don't care
(5) ACK: Not Don't care

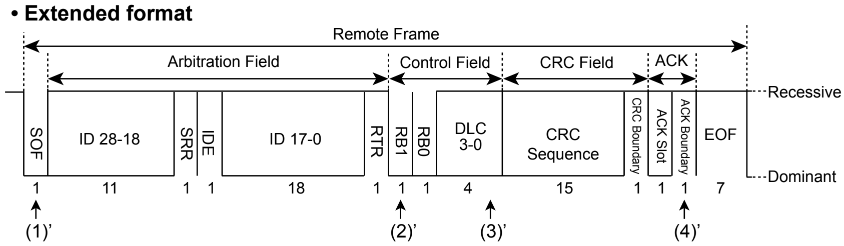
* ID X: ID Std/Data, ID Ext/Data, or ID/Data OR

Remote Frame

• Standard format



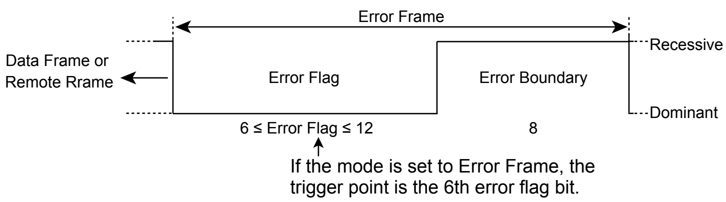
• Extended format



Positions (1)' to (5)' above are trigger points for the following conditions.
(1)' Mode: SOF
(2)' Mode: ID X*, Frame(RTR): Don't care, ACK: Don't care
(3)' Mode: ID X*, Frame(RTR): Remote, ACK: Don't care
(4)' ACK: Not Don't care

* ID X: ID Std/Data, ID Ext/Data, or ID/Data OR

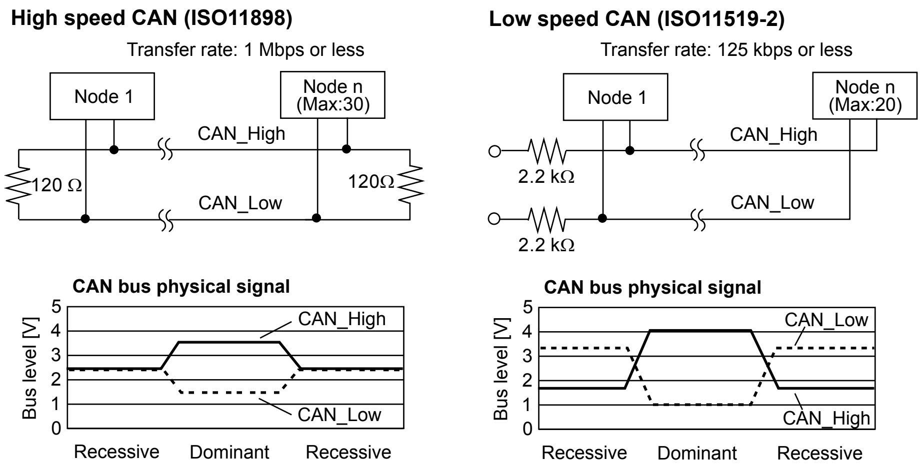
Error Frame



High-speed CAN (ISO11898) and Low-speed CAN (ISO11519-2)

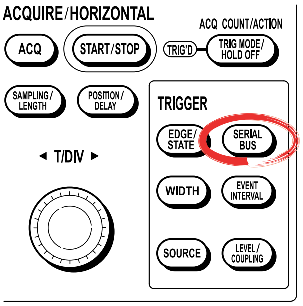
Representative standards for the CAN physical layer are High-speed CAN (ISO 11898) and Low-speed CAN (ISO 11519-2).

As shown in the following figure, the bus level is determined by the potential difference between two buses, CAN_High and CAN_Low, in either standard.



7.8 Triggering on a LIN Bus Signal

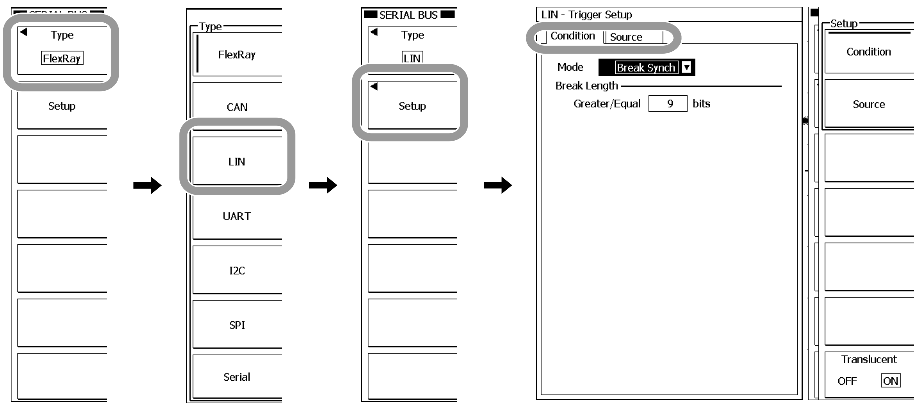
Procedure



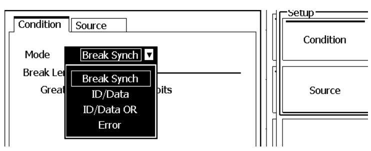
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **LIN** > **Setup**.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from Break Synch to Error.

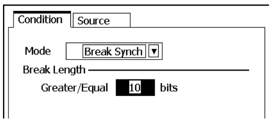


Proceed to the steps on the pages indicated below according to the selected mode.

- Break Synch: Step 5 on pate 7-33
- ID/Data: Step 6 on page 7-33
- ID/Data OR: Step 5 on page 7-35
- Error: Step 5 on page 7-36

When the Mode is Break Synch

5. Use the **rotary knob** and **SET** to select the break field data length from 10 to 13 bits.

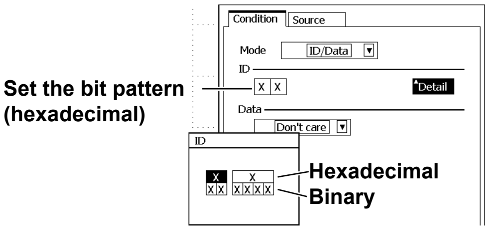


Proceed to step 11 on page 7-36.

When the Mode Is ID/Data

- **Setting the ID Bit Pattern Trigger Condition**

6. Use the **rotary knob** and **SET** to set the bit pattern to compare with.
   You can also set the bit pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the bit pattern, press **ESC** to return to the previous screen.



- **Setting the Data Trigger Condition**

7. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.
   If you select Don't care, proceed to step 11 on page 7-36.
8. Use the **rotary knob** and **SET** to set the size (data length).
   If you select a condition from Greater to Out of Range in step 7, proceed to step 10.
9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
   You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

10. Use the **rotary knob** and **SET** to set the data to compare in each entry box.

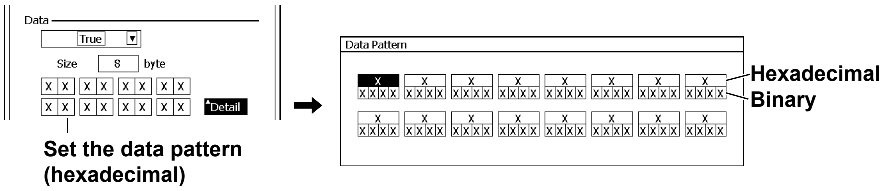
Set each item according to the comparison condition you selected in step 7.

Comparison Condition	Setting					
	Size	Detail	Data(Dec)	Byte Order	Sign	MSB/LSB
True, False	Yes	Yes	–	–	–	–
Greater/Equal, Less/Equal	Yes	–	Yes[1]	Yes	Yes	Yes
Between, Out of Range	Yes	–	Yes[2]	Yes	Yes	Yes

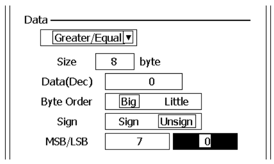
Yes: Set, –: Not set

- Size: Data length to compare
- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

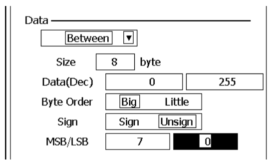
True, False



Greater/Equal, Less/Equal



Between, Out of Range



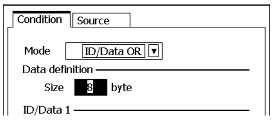
Proceed to step 11 on page 7-36.

When the Mode Is ID/Data OR

- **Setting the Data Definition Trigger Condition**

  Set the common compared data items.

  5. Use the **rotary knob** and **SET** to set the size (data length).



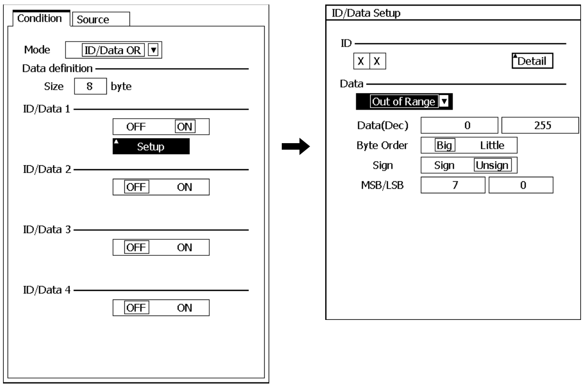
- **Setting the ID/Data 1 to ID/Data 4 Trigger Conditions**

  6. Use the **rotary knob** and **SET** to set ID/Data 1 to ON or OFF.
  Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
  If you select OFF, proceed to step 10.

  7. Use the **rotary knob** and **SET** to select ID/Data 1 Setup.
  The ID/Data Setup dialog box appears.

  8. Use the **rotary knob** and **SET** to set the ID and data trigger conditions.
  For the procedure to set the ID and data conditions, see pages 7-33 and 7-34.

  9. Press **ESC** to return to the previous screen.



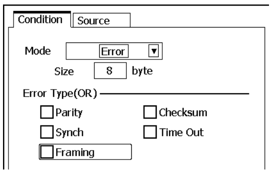
  10. Likewise, set ID/Data2 to ID/Data4 according to steps 6 to 9.

Proceed to step 11 on page 7-36.

When the Mode Is Error

5. Use the **rotary knob** and **SET** to set the size (data length).

6. Use the **rotary knob** and **SET** to select the error type from Parity to Framing.
You can select all error types using the OR logic.



Proceed to step 11.

Setting the Source Bit Rate, Sample Point, Revision, Trigger Level, and Hysteresis

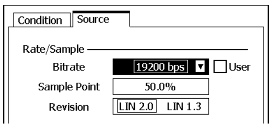
11. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Setting the Bit Rate, Sample Point, and Revision

12. Use the **rotary knob** and **SET** to select the bit rate from 19200bps to 1200bps.
If you select the **User** check box, you will be able to set the bit rate from 1000bps to 20000bps using the **rotary knob** and **SET**.

13. Use the **rotary knob** and **SET** to set the sample point to a value from 18.8 to 90.6%.

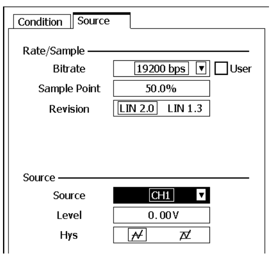
14. Use the **rotary knob** and **SET** to set the revision to LIN 2.0 or LIN 1.3.



Setting the Trigger Level and Hysteresis

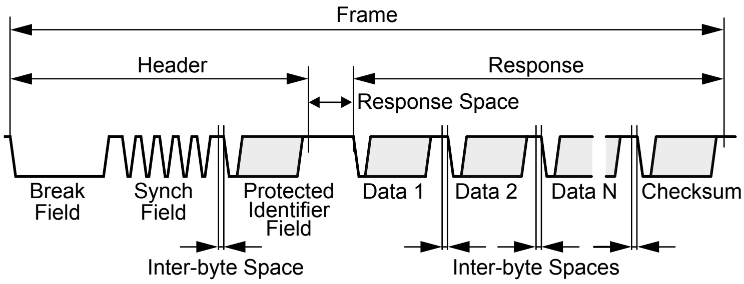
15. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from A0 to A7.

16. Use the **rotary knob** and **SET** to set the level and hysteresis.
If you select a source from A0 to A7 in step 15, the level and hysteresis settings are not available.



Explanation

This function triggers on LIN bus signals. The following figure shows the frame format of LIN bus signals.



Mode

Select the LIN trigger mode from Break Synch, ID/Data, ID/Data OR, and Error.

Break Synch Mode

The SB5000 triggers when break field + synch field are detected.
Select the break field data length from the following:
Greater then equal to 10, 11, 12, or 13

Note

If the SB5000 detects break field + synch field in the middle of a LIN bus frame, it discards the frame and triggers on the next protected identifier field.

ID/Data Mode

The SB5000 triggers on the AND logic of ID and Data conditions.

- **ID**
  Set the 6-bit protected ID (ID0 to ID5) bit pattern in the protected identifier field in hexadecimal or binary notation. The ID trigger condition is met when the specified bit pattern matches the input signal ID bit pattern.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

- **Data**
  You can use the Data 1 to Data 8 values as a trigger condition.
  - Comparison Condition
    The data trigger condition is met when the result of comparing the input signal data values with the reference values meets the selected comparison condition.

Don’t care	Not used as a trigger condition
True	When the input signal value meets the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 8 bytes

Note

If the data length on the measured bus is different from the specified data length, the SB5000 will consider the checksum field and Break field as data and may not trigger at the correct position.

- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to true or false.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”
- Reference Value Data(Dec)
  - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
  - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
  - If the comparison condition is True or False, the data pattern is used as the reference value.
  - Selectable range
    Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the Data Size and MSB/LSB settings, respectively.

The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

- Byte Order
  Set the data byte order to big endian or little endian. For an example, see page 7-17.
- Sign
  Select whether or not to add a sign to the data.
  The selectable range for the data reference value varies depending on this setting.
- MSB/LSB
  Set the MSB and LSB positions in the data to compare. For an example, see page 7-17.
  Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

ID/Data OR Mode

The SB5000 triggers on the OR logic of multiple ID/Data conditions. You can set up to four ID/Data conditions.

- You can select whether or not to use each ID/Data condition as a trigger condition.
- The trigger conditions and settings of each ID/Data condition are the same as those described on pages 7-15 to 7-17. See the respective page for details.

Note

When using the ID/Data OR mode, set conditions so that the trigger point will be the same. If you don’t, the SB5000 may not trigger at the correct position.

Error Mode

The SB5000 triggers on detected errors.

- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 8 bytes

- Error Type
  You can select the type of errors to detect from the table below.
  - You can select multiple error types.
  - The SB5000 will trigger if any of the selected errors occurs.

Parity	The SB5000 calculates the parity of the protected identifier field. If the result does not meet the following equations, the SB5000 triggers on the protected identifier field stop bit position. • Even parity check: ID0 xor ID1 xor ID2 xor ID4 xor P0 = 0 P0 = ID0 xor ID1 xor ID2 xor ID4 • Odd parity check: ID1 xor ID3 xor ID4 xor ID5 xor P1 = 1 P1 = ID1 xor ID3 xor ID4 xor ID5
Checksum	Revision LIN 2.0 (enhanced checksum) If the total value*1 of the protected identifier field, all data fields, and checksum is not 0xFF, the SB5000 triggers on the checksum field stop bit position. However, if the protected identifier field ID is from 0x60 to 0x63, the SB5000 triggers based on the calculated result of the classic checksum. Revision LIN 1.3 (classic checksum) If the calculated result of all data fields and checksum is not 0xFF, the SB5000 triggers on the checksum field stop bit position.
Synch	If the synch field is not 0x55, the SB5000 triggers on the synch field stop bit position. Even if the synch field is 0x55, if the input signal bit rate is not within –5.6% to 6.3% of the specified bit rate (see the next section for details), the SB5000 triggers.
Timeout	The SB5000 will trigger if any of the three errors occurs. Slave Not Responding Error, Header Timeout Error, or Response Timeout Error • Slave Not Responding Error If the frame has not ended by the time defined by the following equation elapses after a break detection, the SB5000 triggers. $1.4 \times (T_{Header}{}^{*2} + T_{Response}{}^{*3})$ • Header Timeout Error If the header has not ended by the time defined by the following equation elapses after a break detection, the SB5000 triggers. $1.4 \times T_{Header}{}^{*2}$ • Response Timeout Error If the response has not ended by the time defined by the following equation elapses after a break detection, the SB5000 triggers. $1.4 \times T_{Response}{}^{*3}$ where 34 is the header data length, n is the number of data points, and 1 is the checksum.
Framing	When the SB5000 detects that the field, data, or stop bit is at low level, it triggers. The SB5000 may trigger if it detects break field + synch field in the middle of a frame.

*1 If the value exceeds 255, it is carried over.
*2 Nominal header length $T_{Header} = 34 \times T_{BIT}{}^{*4}$
*3 Nominal response length $T_{Response} = 10 \times (N + 1) \times T_{BIT}{}^{*4}$ (where N is the data length)
*4 Nominal time needed to transmit one bit defined in the physical layer.

Note

If the bus contains a frame with a different data length and you set the error type to Checksum, Timeout, or Framing, the SB5000 may not trigger at the correct position.

Source Bit Rate, Sample Point, Revision, Trigger Level, and Hysteresis

Bit Rate

You can select the LIN bus signal transfer rate from the following:
19200 bps, 9600 bps, 4800 bps, 2400 bps, 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 20000 bps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level from 18.8 to 90.6% in 3.1% steps. The SB5000 LIN bus signal trigger circuit samples the input LIN bus signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Revision

You can select revision 2.0 or 1.3.

LIN 2.0	The enhanced checksum that includes the protection ID is used. (However, if the ID is a value from 60 (0x3c) to 63 (0x3f), the classic checksum is used.)
LIN 1.3	The classic checksum that includes only the data field is used.

Trigger Level

You can set the LIN bus signal trigger level for CH1 to CH4 separately.

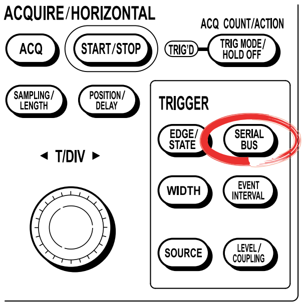
- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.
- When the source is A0 to A7, the trigger level is the threshold level that you set in section 6.18.

Hysteresis

See section 7.5 for details.

7.9 Triggering on a UART Signal

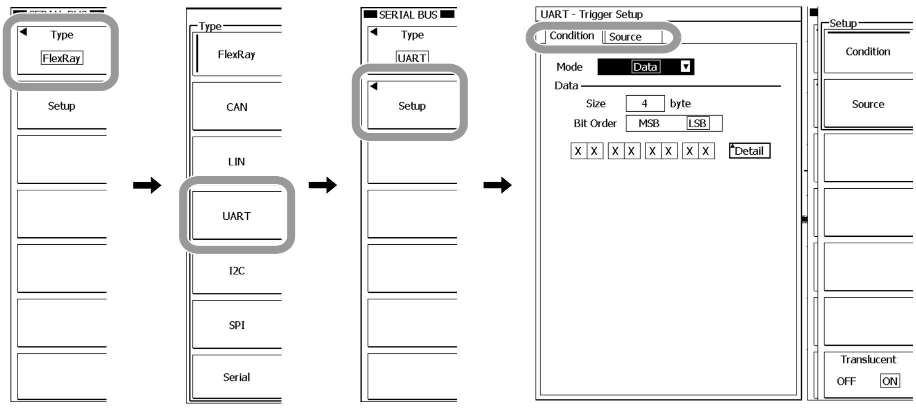
Procedure



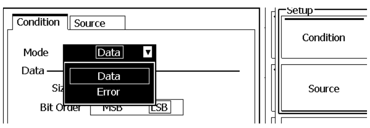
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **UART** > **Setup**.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to set the mode to Data or Error.



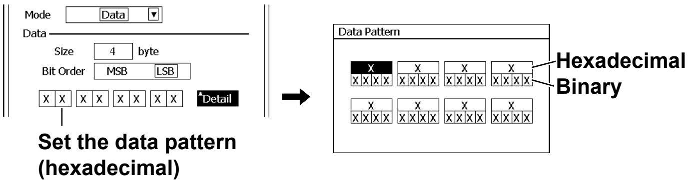
Proceed to the steps on the pages indicated below according to the selected mode.
- Data: Step 5 on page 7-42
- Error: Step 8 on page 7-42

7

Triggering

When the Mode Is Data

5. Use the **rotary knob** and **SET** to set the size (data length).
6. Use the **rotary knob** and **SET** to set the bit order to MSB first or LSB first.
7. Use the **rotary knob** and **SET** to set the data pattern to compare with.
   You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

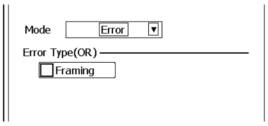


Proceed to step 10.

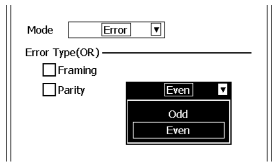
When the Mode Is Error

8. Use the **rotary knob** and **SET** to set the error type to Framing or Parity.
   - You can select all error types using the OR logic.
   - If Format under the Source tab (see the figure in step 13) is set to 8bit(NonParity), only Framing will appear.
9. If Format under the Source tab is 8bit + Parity or 7bit + Parity, set the error type parity to Odd or Even using the **rotary knob** and **SET**.

If Format under the Source tab is set to 8bit(NonParity)



If Format under the Source tab is set to 8bit + Parity or 7bit + Parity



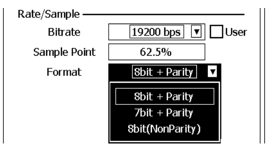
Proceed to step 10.

Setting the Source Bit Rate, Sample Point, Format, Trigger Level, and Hysteresis

10. Use the **rotary knob** and **SET** to select the Source tab.
    You can also press the Source soft key to select the tab.

Setting the Bit Rate, Sample Point, and Format

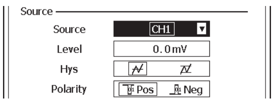
11. Use the **rotary knob** and **SET** to select the bit rate from 115200bps to 1200bps.
    If you select the **User** check box, you will be able to set the bit rate from 1000bps to 200000bps using the **rotary knob** and **SET**.
12. Use the **rotary knob** and **SET** to set the sample point to a value from 18.8 to 90.6%.
13. Use the **rotary knob** and **SET** to select the format from 8bit + Parity to 8bit(NonParity).



Setting the Trigger Level, Hysteresis, and Polarity

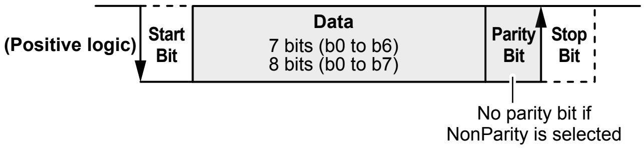
14. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from A0 to A7.

15. Use the **rotary knob** and **SET** to set the level, hysteresis, and polarity.
If you select a source from A0 to A7 in step 14, the level and hysteresis settings are not available.



Explanation

This function triggers on UART bus signals. The figure below shows the UART data format for positive logic.



Mode

Set the UART trigger mode to Data or Error.

Data Mode

The SB5000 triggers on a data pattern.

- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 4

- Bit Order
  Select the bit order used to read the data pattern when comparing the input signal data pattern to the specified data pattern.

MSB	Reads the data pattern MSB first.
LSB	Reads the data pattern LSB first.

- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Error Mode

The SB5000 triggers on detected errors.
You can select the type of errors to detect from the table below.

- You can select multiple error types.
- The SB5000 will trigger if any of the selected errors occurs.

Framing	The SB5000 triggers when the logical stop bit value is zero.
Parity	When the SB5000 detects a parity error in a received character, the SB5000 triggers on the stop bit position. • You can select which parity to check, odd or even. • Errors will not occur if the parity bit is set to none.

Source Bit Rate, Sample Point, Format, Trigger Level, Hysteresis, and Polarity

Bit Rate

You can select the CAN bus signal transfer rate from the following:
115200 bps, 57600 bps, 38400 bps, 19200 bps, 9600 bps, 4800 bps, 2400 bps, and 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 200000 bps in 100-bps steps.

Sample Point

You can set the point for determining the signal level from 18.8 to 90.6% in 3.1% steps. The SB5000 UART signal trigger circuit samples the input UART signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Format

You can select the format from the following:

8bit + Parity	8-bit data + parity bit
7bit + Parity	7-bit data + parity bit
8bit(NonParity)	8-bit data with no parity bit

Trigger Level

You can set the UART signal trigger level for CH1 to CH4 separately.

- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.
- When the source is A0 to A7, the trigger level is the threshold level that you set in section 6.18.

Hysteresis

See section 7.5 for details.

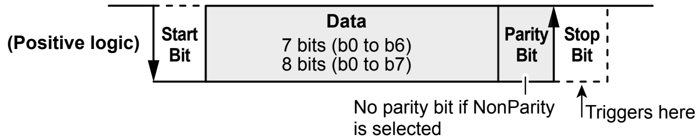
Polarity

You can select the bit state that will be considered logical 1.

Pos	Positive logic
Neg	Negative logic

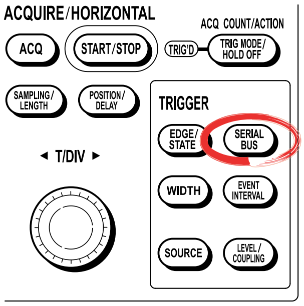
Trigger Point

For all formats in all modes, the trigger point is the stop bit after the trigger condition is met. If multiple data bytes are specified, the trigger point is the stop bit of the last data byte.



7.10 Triggering on an I^{2}C Bus Signal

Procedure

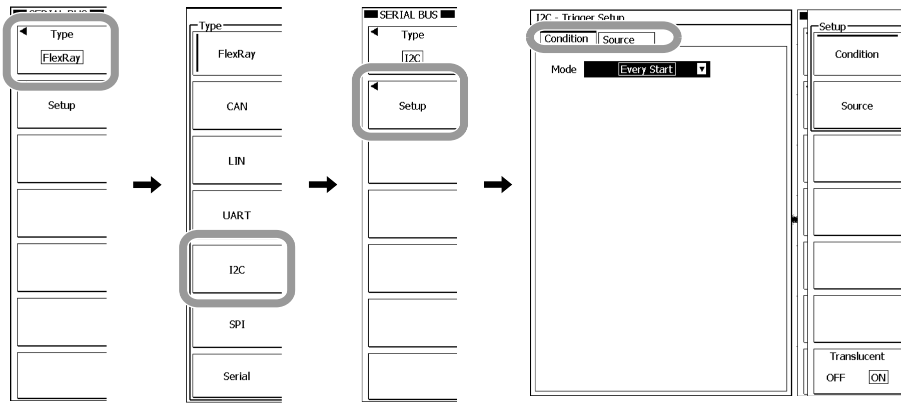


1. Press **SERIAL BUS**.

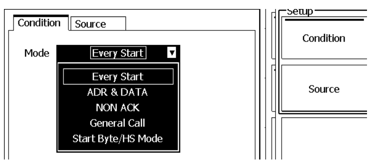
2. Press these soft keys: **Type** > **I2C** > **Setup**.
The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from Every Start to Start Byte/ HS Mode.



Proceed to the steps on the pages indicated below according to the selected mode.

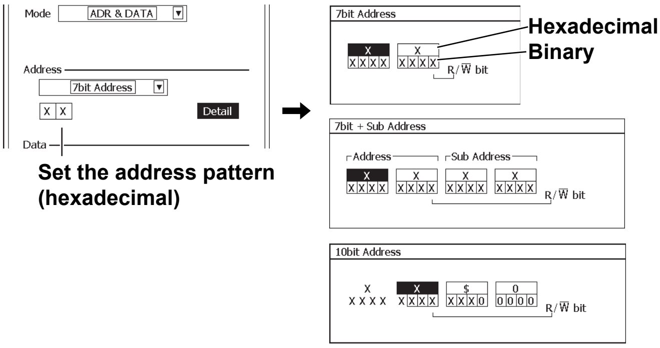
- Every Start: Step 10 on page 7-48
- ADR & DATA: Step 5 on page 7-46
- NON ACK: Step 5 on page 7-47
- General Call: Step 6 on page 7-47
- Start Byte/HS Mode: Step 8 on page 7-47

When the Mode Is ADR & DATA

- **Setting the Address Trigger Condition**

5. Use the **rotary knob** and **SET** to select the address type from 7bit Address to 10bit Address.

6. Use the **rotary knob** and **SET** to set the address pattern to compare with.
You can also set the address pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the address pattern, press **ESC** to return to the previous screen.

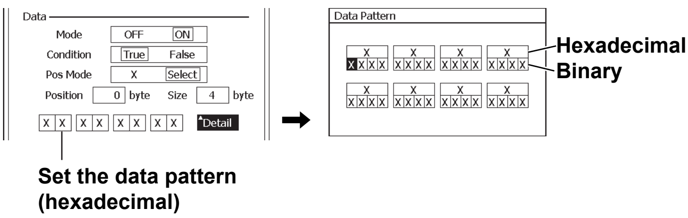


- **Setting the Data Trigger Condition**

7. Use the **rotary knob** and **SET** to set the mode to ON or OFF.
Select ON to enable the trigger condition. Select OFF to disable the trigger condition.
If you select OFF, proceed to step 10 on page 7-48.

8. Use the **rotary knob** and **SET** to set the condition to True or False, set Pos Mode to X or Select, and set the position and size.

9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

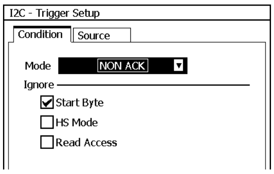


Proceed to step 10 on page 7-48.

When the Mode Is NON ACK

5. Use the **rotary knob** and **SET** to select the Nack bits to ignore from Start Byte to Read Access.

The Nack bits whose check box is selected will not be used as trigger conditions. The trigger condition is met when the SB5000 detects any of the Nack bits whose check box is not selected.



Proceed to step 10 on page 7-48.

When the Mode Is General Call

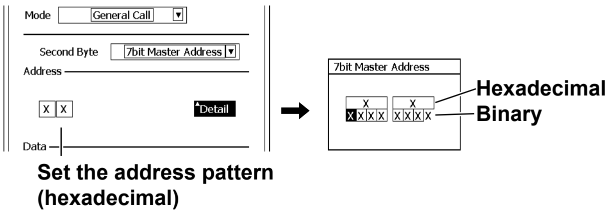
- **Setting the Second Byte Trigger Condition**

6. Use the **rotary knob** and **SET** to select the second byte format from X to 7bit Master Address.

If you select X, 0000 0100, or 0000 0110, proceed to step 10 on page 7-48.

7. Use the **rotary knob** and **SET** to set the address pattern to compare with.

You can also set the address pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the address pattern, press **ESC** to return to the previous screen.



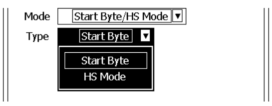
- **Setting the Data Trigger Condition**

  Set the trigger condition according to steps 7 to 9 on the previous page.

Proceed to step 10 on page 7-48.

When the Mode Is Start Byte/HS Mode

8. Use the **rotary knob** and **SET** to set the type (master code) to Start Byte or HS Mode.



Proceed to step 10 on page 7-48.

Setting the SDA, SCL, and Qualification

10. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

11. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the SDA Source

12. Use the **rotary knob** and **SET** to select the SDA (serial data) source.
- If you select Analog in step 11, select the source from CH1 to CH4.
- If you select Logic in step 11, select the source from A0 to A7.

Setting the SCL Source

13. Use the **rotary knob** and **SET** to select the SCL (serial clock) source.
- If you select Analog in step 11, select the source from CH1 to CH4.
- If you select Logic in step 11, select the source from A0 to A7.

Setting the Qualification

14. Use the **rotary knob** and **SET** to set the logic to AND or OR.

15. Use the **rotary knob** and **SET** to set the state of signals other than those selected for the SDA and SCL to H, L, or X.
If you select Logic in step 11, select Qualification. In the dialog box that appears, use the **rotary knob** and **SET** to select H, L, or X. When you are done setting the states, press **ESC** to return to the previous screen.

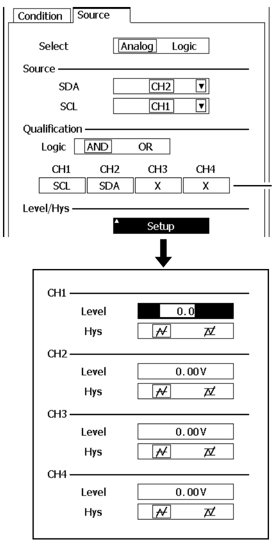
Setting the Trigger Level and Hysteresis

Set the level and hysteresis only if you select Analog in step 11.

16. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

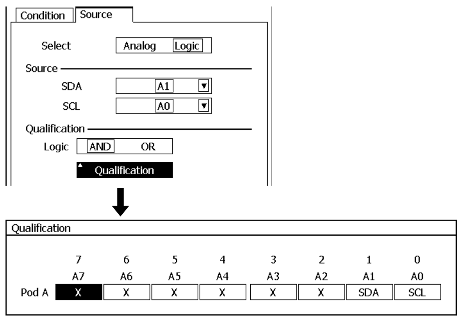
17. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.

When Analog is selected in step 11



You can select the status of the CH1 to CH4 signals except for the channels selected for SDA and SCL.

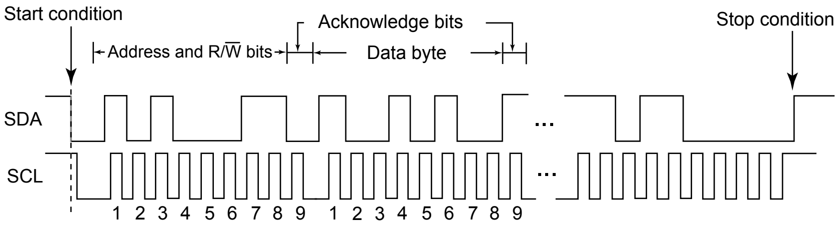
When Logic is selected in step 11



You can select the status of the A0 to A7 signals excluding the signals selected for SDA and SCL sources.

Explanation

This function triggers on I^{2}C bus signals. The following figure shows the data format of I^{2}C bus signals.

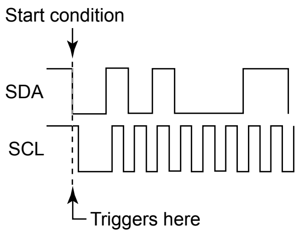


Mode

Select the I^{2}C trigger mode from Every Start, ADR & DATA, NON ACK, General Call, and Start Byte/HS Mode.

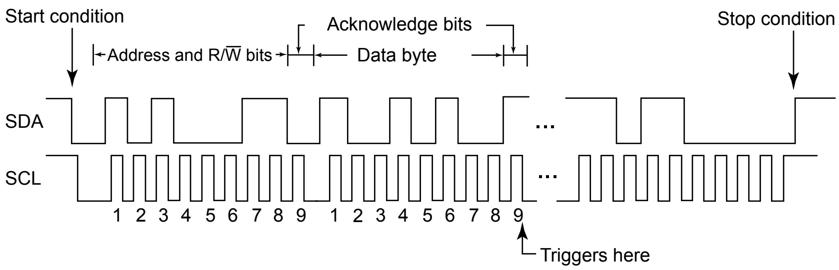
Every Start Mode

When a start condition is detected, the SB5000 triggers on the falling edge of the SDA signal.



ADR & DATA Mode

When the address and data values match, the SB5000 triggers on the falling edge of the 9th SCL signal clock.



- **Address**
  - You can set the address type to 7bit Address, 7bit + Sub Address, or 10bit Address.
  - Set the address pattern in hexadecimal or binary notation. The address trigger condition is met when the specified address pattern matches the input signal address pattern.
    - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
    - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

- **Data**

  You can select whether or not to use the data pattern as a trigger condition.

  - Comparison Condition

    The data trigger condition is met when the result of comparing the input signal pattern with the specified pattern meets the selected comparison condition.

True	When the patterns match
False	When the patterns don't match

  - Comparison Start Position

    In the Pos Mode setting, you can set the comparison start point to the specified point (Select) or don't care (X). If you select Select, the SB5000 skips the specified number of bytes and starts comparing from the next data byte.

    Selectable range: 0 to 9999 bytes
  - Data Size

    Set how many consecutive data bytes you want to compare.

    Selectable range: 1 to 4 bytes
  - Data Pattern

    Set the data pattern for the specified size in hexadecimal or binary notation.
    - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
    - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- **Example**

  This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.

  S: Start condition, P: Stop condition, Shading: Compared pattern

Trigger only on the address pattern

Mode	ADR & DATA
Address	7bit address, A4
Data	Mode: OFF

Address and R/$\overline{W}$ bits

S	A4	25	AE	57	27	FE	98	99	27	P

Matches the specified address pattern. Triggers here.

Trigger only on the data pattern

Mode	ADR & DATA
Address	Don't care
Data	Mode: ON, Condition: True, Size: 2 bytes, Data pattern: 27 and AE

< Pos Mode: X >

Address and R/$\overline{W}$ bits

S	A4	27	AE	57	27	FE	98	99	27	P

2. Triggers here

1. Matches the specified size of data pattern (27 and AE)

< Pos Mode: Select, Position: 3 >

Address and R/$\overline{W}$ bits

S	A4	27	FE	57	27	AE	98	99	27	P

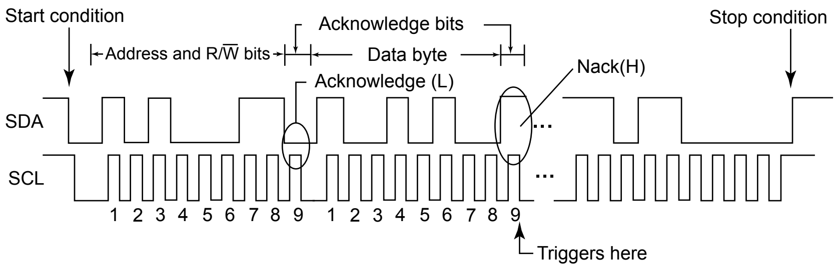
3. Triggers here

2. Matches the specified size of data pattern (27 and AE)

1. Skips 3 bytes

NON ACK Mode

The SB5000 triggers when the acknowledge bit is Nack (when the SDA signal is high). You can select whether use or ignore the following acknowledge bits for triggering: start byte, HS mode master code, and read access byte.



General Call Mode

The SB5000 triggers on the general call address (0000 0000).

- **Second Byte**

  You can use the second byte address pattern (the byte after the general call address) as a trigger condition. The second byte trigger condition is met when the specified pattern matches the input signal pattern.

X	Not used as a trigger condition
0000 0100	When the input signal pattern matches the pattern 0000 0100 (0x04)
0000 0110	When the input signal pattern matches the pattern 0000 0110 (0x06)
7bit Master Address	When the input signal pattern matches the specified pattern If you select 7bit Master Address, you can use the data pattern as a trigger condition as described in the next section.

- **Data**

  The conditions and settings are the same as those explained on page 7-50. See the respective item for details.

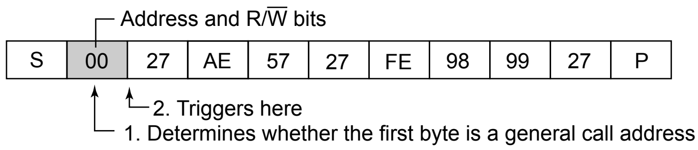
- **Example**

  This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.

  S: Start condition, P: Stop condition, Shading: Compared pattern

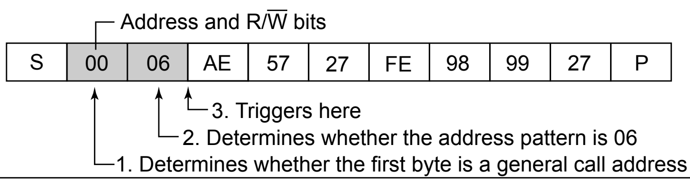
Trigger only on the general call address

Mode	General Call
Second Byte	X



Trigger when the second byte address is 06

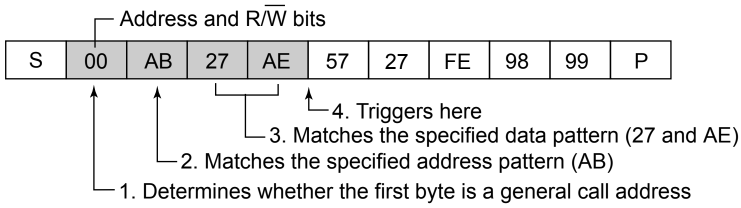
Mode	General Call
Second Byte	0000 0110



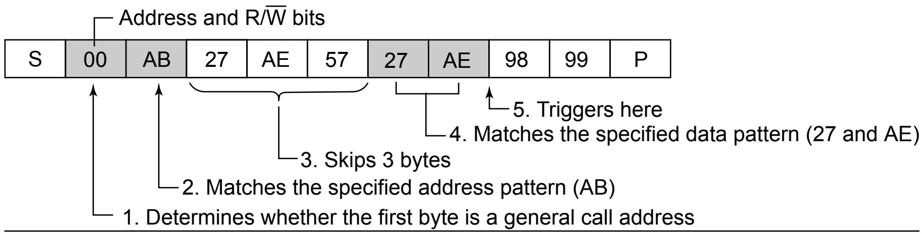
Trigger when the second byte address matches the specified pattern

Mode	General Call
Second Byte	7bit Master Address, address pattern: 1010 1011 (0xAB)
Data	Mode: ON, Condition: True, Size: 2 bytes, Data pattern: 27 and AE

< Pos Mode: X >



< Pos Mode: Select, Position: 3 >

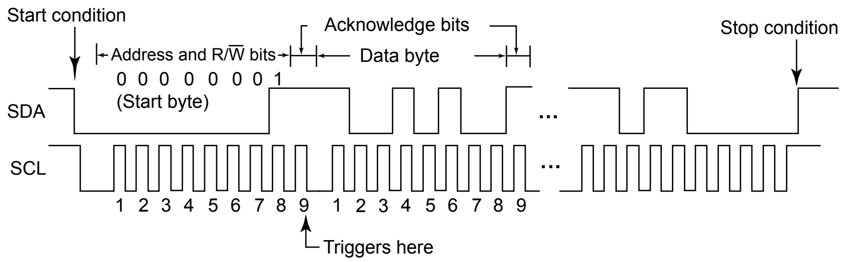


Start Byte/HS Mode

The SB5000 triggers on the start byte or the HS mode master code.

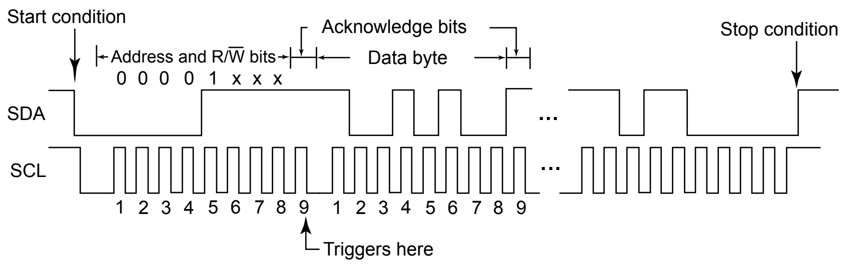
- **Start Byte**

  The SB5000 triggers on a start byte (pattern: 0000 0001).



- **HS Mode**

  The SB5000 triggers on the HS (high-speed) mode master code (pattern: 0000 1XXX).



- **Example**

  This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position. The following notations are used in the figure.

  S: Start condition, P: Stop condition, Shading: Compared pattern

Trigger on a start byte

Mode	Start Byte/HS Mode
Type	Start byte

S	01	Sr	AE	57	27	FE	98	99	27	P

Triggers here

Sr: Restart

SDA, SCL, and Qualification

SDA and SCL Sources

You can select the SDA (serial data) and SCL (serial clock) sources from CH1 to CH4 or from A0 to A7.

Trigger Level

You can set the I²C bus signal trigger level for CH1 to CH4 separately.

- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.
- When the source is A0 to A7, the trigger level is the threshold level that you set in section 6.18.

Hysteresis

See section 7.5 for details.

Qualification and Logic

- **Qualification**

  Set the state of signals other than those selected for the SDA and SCL to H, L, or X. This trigger requirement is called qualification requirement. The qualification requirement is met when the selected state matches the input signal state.

H	When the input signal is high
L	When the input signal is low
X	Not used as a trigger condition (Don’t care)

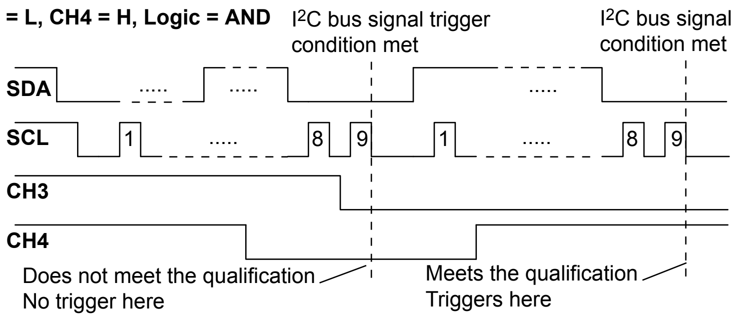
* The level for determining high or low is the trigger level that you set above when you set the signal to a channel from CH1 to CH4. When you set the signal to a bit from A0 to A7, the level is the threshold level that you set in section 6.18.

- **Logical Condition**

  You can select the logical condition for the qualification and the trigger condition for the I^{2}C bus signal that you set in each mode. When the logical condition is met, the SB5000 triggers.

AND	When the qualification and the I^{2}C bus signal trigger condition are both met
OR	When either the qualification or the I^{2}C bus signal trigger condition is met

CH3 = L, CH4 = H, Logic = AND



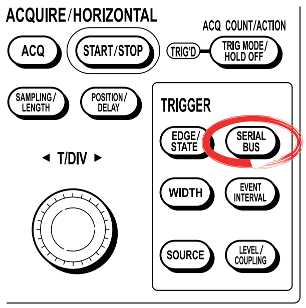
Note

To trigger only on the I^{2}C bus signal trigger condition (SDA and SCL signals), specify the settings as follows:

- The state of signals other than those selected for the SDA and SCL: X (don't care)
- Logic: AND

7.11 Triggering on a SPI Bus Signal

Procedure



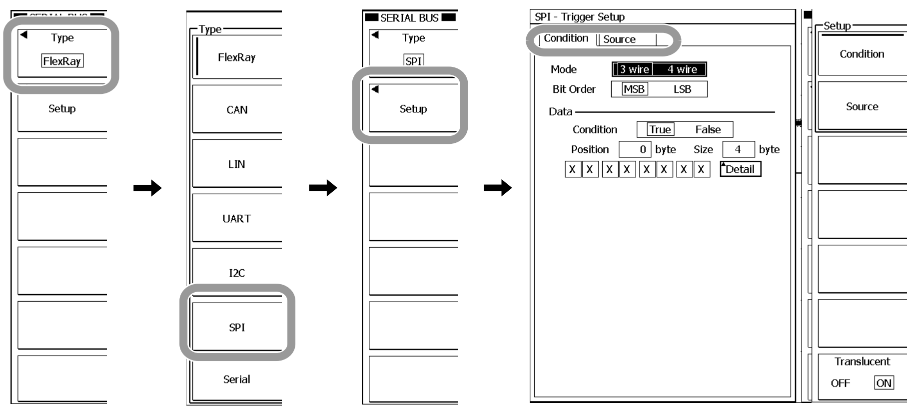
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **SPI** > **Setup**.
   The Setup dialog box appears.

Setting the Wiring System, Bit Order, and Data

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.

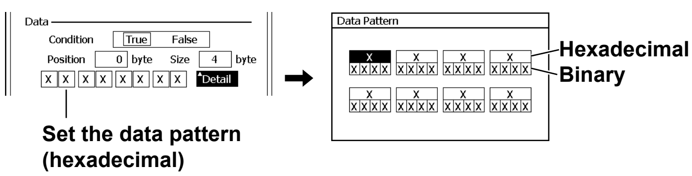
Selecting the Wiring System and Bit Order

4. Use the **rotary knob** and **SET** to set the mode to 3 wire or 4 wire and the bit order to MSB or LSB.



Setting the Data Trigger Condition

5. Use the **rotary knob** and **SET** to set the condition to True or False, and set the position and size.
6. Use the **rotary knob** and **SET** to set the data pattern to compare with.
   - You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the address pattern, press **ESC** to return to the previous screen.
   - If you select 4 wire in step 4, set Data 1 and Data 2.



Setting the CS, Clock, and Data Sources

7. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

8. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the CS Source

9. Use the **rotary knob** and **SET** to select the CS (chip select) source.
- If you select Analog in step 8, select the source from CH1 to CH4.
- If you select Logic in step 8, select the source from A0 to A7.

10. Use the **rotary knob** and **SET** to set Active to H or L.

Setting the Clock Source

11. Use the **rotary knob** and **SET** to select the clock source.
- If you select Analog in step 8, select the source from CH1 to CH4.
- If you select Logic in step 8, select the source from A0 to A7.

12. Use the **rotary knob** and **SET** to set the polarity to or .

Setting the Data Source

13. Use the **rotary knob** and **SET** to select the data source.
- If you select 4 wire in step 4 on the previous page, select the source for Data1 and Data 2 separately.
- If you select Analog in step 8, select the source from CH1 to CH4.
- If you select Logic in step 8, select the source from A0 to A7.

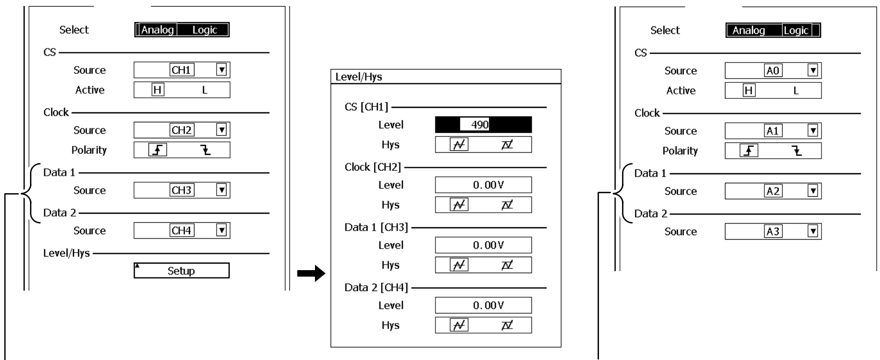
Setting the Trigger Level and Hysteresis

Set the trigger level and hysteresis only if you select Analog in step 8.

14. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

15. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.

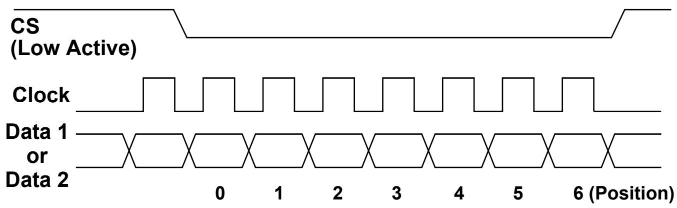
When Analog is selected in step 8 **When Logic is selected in step 8**



If you selected 3 wire in step 4 on the previous page, one data item will appear, because there is only one data source.

Explanation

This function triggers on SPI bus signals. The following figure shows the SPI bus signal timing chart.



Wiring System

Select the wiring system from the following:

Three-wire	The SB5000 triggers on the data pattern condition of one data line.
Four-wire	The SB5000 triggers on the data pattern conditions of Data 1 and Data 2 lines. You can also use one of the two data lines as a trigger condition.

Bit Order

You can select the bit order based on the data stream.

- If you are setting the data in binary notation, set the pattern in the order of the data stream, regardless of the bit order setting.
- If you are setting the data in hexadecimal notation, set the pattern in 4-bit segments according to the bit order setting.

MSB	When the data stream is MSB first
LSB	When the data stream is LSB first

Data

You can use a data pattern as a trigger condition.

- Comparison Condition
  The data trigger condition is met when the result of comparing the input signal pattern with the specified pattern meets the selected comparison condition.

True	When the patterns match
False	When the patterns don’t match

- Comparison Start Position
  Set the comparison start position. For example, to start comparing from the first data byte after the CS signal is activated, specify zero.
  Selectable range: 0 to 9999 bytes
- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 4 bytes
- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

7

Triggering

CS, Clock, and Data

You can select the CS (chip select), clock, and data from CH1 to CH4 or from A0 to A7.

- **CS**

  You can select the CS level for activating the data.

H	When the signal is high
L	When the signal is low

- **Clock**

  You can select the clock edge that specifies when the data patterns are compared.

↑	On the rising edge
↓	On the falling edge

Trigger Level

When the CS, clock, or data* is set to analog (CH1 to CH4), you can set the trigger level for each source.

- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.

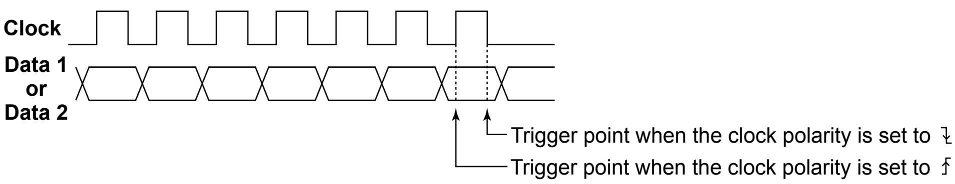
* When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

Hysteresis

See section 7.5 for details.

Trigger Point

The trigger point is determined by the clock polarity setting as follows:



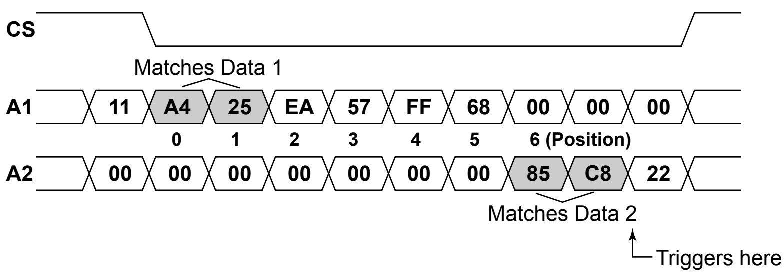
Example

This example displays the data sequence at the byte level (hexadecimal notation) and indicates the trigger position.

The Data 1 and Data 2 pattern references are set to A1 and A2, respectively.

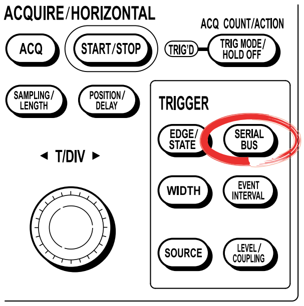
Shading: Pattern to compare

CS	Active: L
Data 1	Condition: True, Position: 0, Size: 2 bytes, data pattern: A4 and 25
Data 2	Condition: True, Position: 6, Size: 2 bytes, data pattern: 85 and C8



7.12 Triggering on a Serial Pattern Signal

Procedure



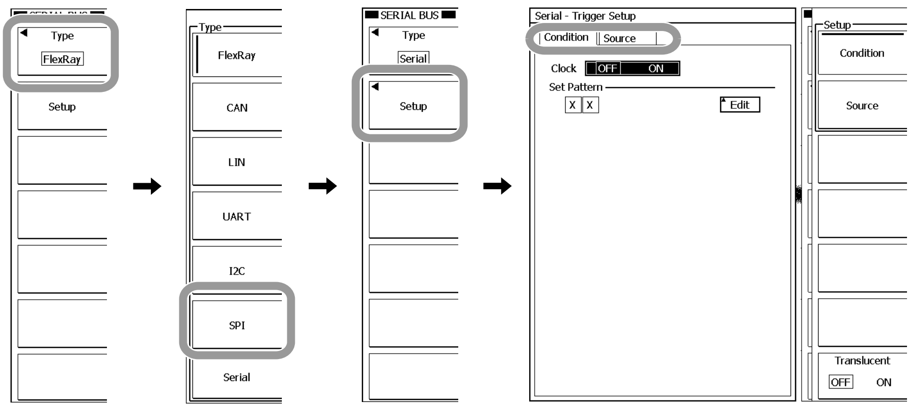
1. Press **SERIAL BUS**.
2. Press these soft keys: **Type** > **Serial** > **Setup**.
   The Setup dialog box appears.

Setting the Trigger Condition

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.

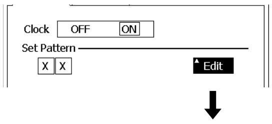
Turning the Clock ON and OFF

4. Use the **rotary knob** and **SET** to set the clock to ON or OFF.
   For the procedure to set the bit rate, clock source, CS state condition, and latch source, see pages 7-61 and 7-62.

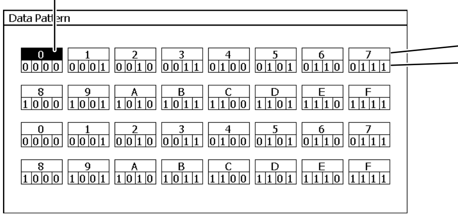


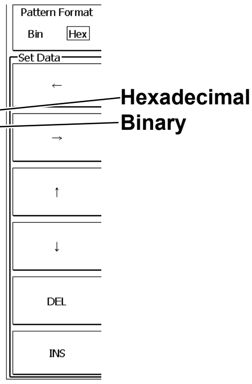
Setting the Data Pattern

5. Use the **rotary knob** and **SET** to set the data pattern to compare with.
- You can also set the data pattern by selecting Edit to open a dialog box and use the **rotary knob** and **SET**, **numeric keys**, and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.
- To expand the pattern, you have to open the dialog box by selecting Edit.
- You can set a pattern consisting of up to 128 bits. Bits exceeding 128 bits will be cleared.



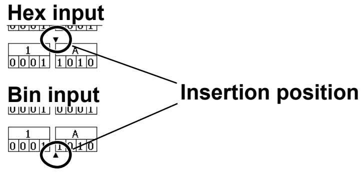
The cursor position is the input position.





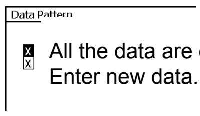
Soft keys

Bin Hex	Selects binary or hexadecimal.
←	Moves the cursor to the left.
→	Moves the cursor to the right.
↑	Moves the cursor up.
↓	Moves the cursor down.
DEL	Deletes the data.
INS	Switches between insert and overwrite modes.



Numeric keys

0 to F	Use 0 to F for hexadecimal and 0 and 1 for binary. (Enter X to discard the data.)
BS	Backspace.
CLEAR	Clears all of the entered data. You cannot recover data that has been cleared.



All the data are cleared.
Enter new data.

Setting the Data, Clock, CS, Latch, and Bit Rate

6. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

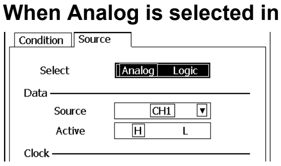
7. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the Data Source

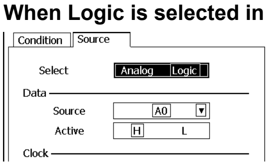
8. Use the **rotary knob** and **SET** to select the data source.
- If you select Analog in step 7, select the source from CH1 to CH4.
- If you select Logic in step 7, select the source from A0 to A7.

9. Use the **rotary knob** and **SET** to set Active to H or L.

When Analog is selected in step 7



When Logic is selected in step 7



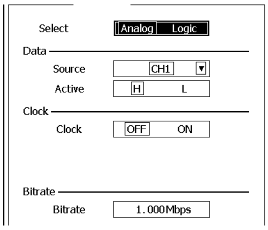
Setting the Clock Source

10. Use the **rotary knob** and **SET** to set the clock to ON or OFF.
- If you select ON, proceed to step 12.
- If you select OFF, set the bit rate.

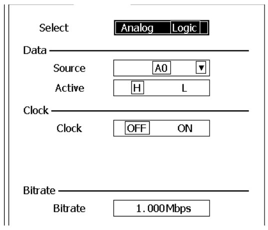
• Setting the Bit Rate

11. Use the **rotary knob** and **SET** to select the bit rate from 1kbps to 50Mbps.

When Analog is selected in step 7



When Logic is selected in step 7



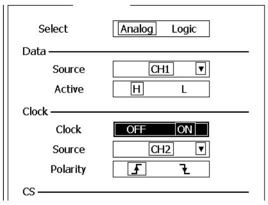
Proceed to step 20 on page 7-62.

• Setting the Clock Source

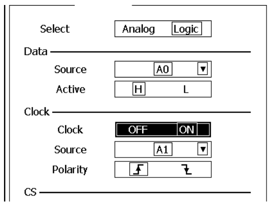
12. Use the **rotary knob** and **SET** to select the clock source.
- If you select Analog in step 7 on page 7-60, select the source from CH1 to CH4.
- If you select Logic in step 7 on page 7-60, select the source from A0 to A7.

13. Use the **rotary knob** and **SET** to set the polarity to ↗ or ↘.

When Analog is selected in step 7



When Logic is selected in step 7



Setting the CS

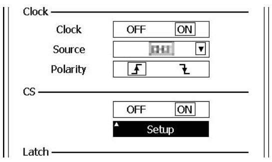
14. Use the **rotary knob** and **SET** to set the CS to ON or OFF.
- If you select ON, set the CS state condition.
- If you select OFF, proceed to step 18 on page 7-62.

• Setting the State Condition

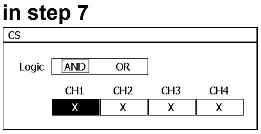
15. Use the **rotary knob** and **SET** to select Setup under CS.
The CS dialog box appears.

16. Use the **rotary knob** and **SET** to set the logic to AND or OR.

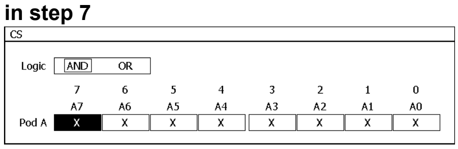
17. Use the **rotary knob** and **SET** to set the state condition to compare with.
Set each signal state to H, L, or X. When you are done setting the states, press **ESC** to return to the previous screen.



When Analog is selected in step 7



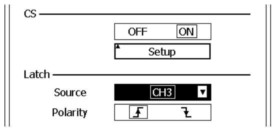
When Logic is selected in step 7



Setting the Latch Source

18. Use the **rotary knob** and **SET** to select Source under Latch.
- If you select Analog in step 7 on page 7-60, select the source from CH1 to CH4 and X.
- If you select Logic in step 7 on page 7-60, select the source from A0 to A7 and X.
- If you select X, proceed to step 20.

19. Use the **rotary knob** and **SET** to set the polarity to ↑ or ↓.

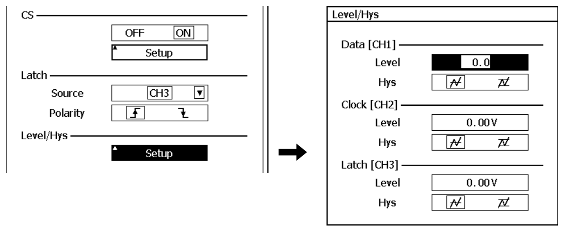


Setting the Trigger Level and Hysteresis

Only set the trigger level and hysteresis if you select Analog in step 7 on page 7-60.

20. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

21. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.



Explanation

This function triggers on serial pattern signals.

Data, Clock, CS, and Latch Sources

You can select the data, clock, CS, and latch sources from CH1 to CH4 or from A0 to A7.

Clock

- **Clock ON/OFF**

  You can select whether or not to sample the data source in sync with the selected clock source.

ON	Samples in sync with the clock source.
OFF	Does not synchronize to the clock source.

- **Sampling Timing**

  You can select the clock edge that specifies when the data patterns are sampled.

↑	On the rising edge
↓	On the falling edge

Data Pattern

You can use a data pattern as a trigger condition. The data pattern trigger condition is met when the specified pattern matches the sampled data source pattern.
- You can set a pattern consisting of up to 128 bits. Set the pattern in hexadecimal or binary notation.
- If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
- If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Bit Rate

If the clock is set to OFF, the SB5000 samples the data source at the specified bit rate.
Selectable range: 1 kbps to 50 Mbps in 1-kbps steps

CS

If the clock is set to ON, the period that the SB5000 tests the data source can be controlled using the CS state condition.

ON	Tests the data source while the state condition is met.
OFF	Tests the data source at all times.

- **State Condition**
  Set each signal state to H, L, or X. The state condition is true when the selected state and the input signal state meet the following condition.

H	When the signals are high
L	When the signals are low
X	Not used as a trigger condition (Don't care)

* The level for determining high or low is the trigger level that you set below when you set the signal to a channel from CH1 to CH4. When you set the signal to a bit from A0 to A7, the level is the threshold level that you set in section 6.18.

- **Logic**
  You can select the state condition logic. The state condition is true when the logic condition is met.

AND	When the state of all signals matches
OR	When the state of any signal matches

Latch

If the clock is set to ON, you can specify the timing when the sampled data source pattern is compared with the specified pattern. If the source is set to X, comparison is made on each clock.
You can select the latch source edge that specifies when the data patterns are compared.

↑	On the rising edge
↓	On the falling edge

Trigger Level

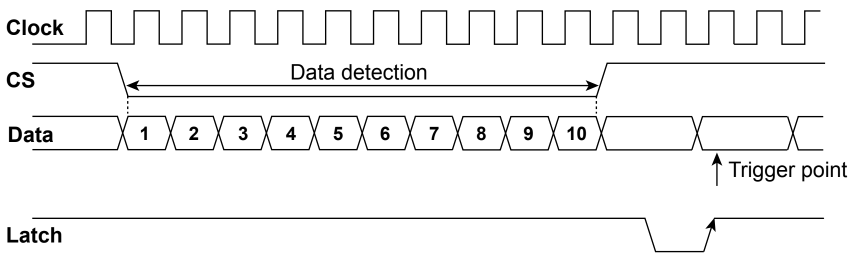
When the data, clock, CS, or latch source* is set to analog (CH1 to CH4), you can set the trigger level for each source.
- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.

* When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

Hysteresis

See section 7.5 for details.

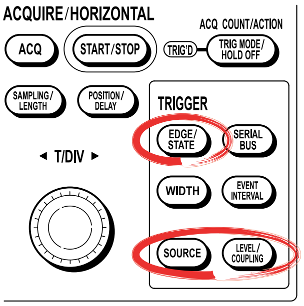
Example



The latch signal specifies the time when data is compared.

7.13 Activating an Edge Trigger

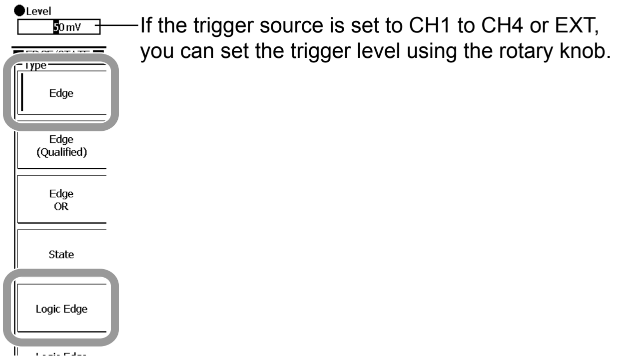
Procedure



Selecting the Trigger Type

1. Press **EDGE/STATE**.

2. Press the **Edge** or **Logic Edge** soft key.
- If you select Edge, proceed to step 3.
- If you select Logic Edge, proceed to step 3 on page 7-66.

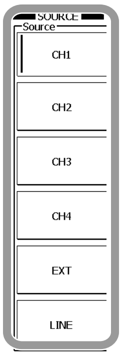


When Triggering on CH1 to CH4, EXT, or LINE

Selecting the Trigger Source

3. Press **SOURCE**.

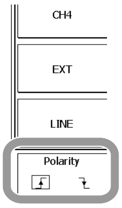
4. Press the appropriate trigger source soft key.
To trigger using an external signal, select EXT. To trigger using the SB5000 commercial power supply signal, select LINE.
- To trigger using an external signal, you must specify the following settings.
  Trigger level, trigger slope, probe attenuation ratio, holdoff time, window comparator (if necessary)
- To trigger using the SB5000 power supply signal, you must specify the following settings.
  Holdoff time



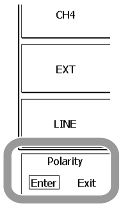
Selecting the Trigger Slope (when the trigger source is CH1 to CH4 or EXT)

5. Press the **Polarity** soft key to select ⨍ or ⨍̸.
If the trigger source is set to a signal that a window comparator is applied to, select Enter or Exit.

Window comparator: OFF



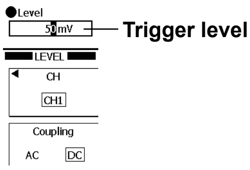
Window comparator: ON



Selecting the Trigger Level (when the trigger source is CH1 to CH4 or EXT)

6. Press **LEVEL/COUPLING**.

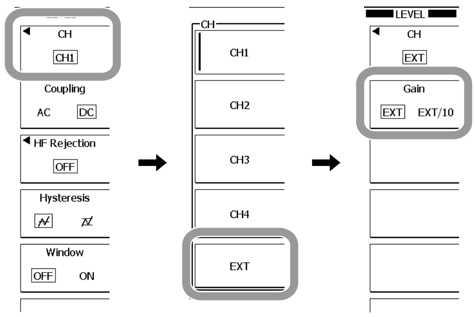
7. Use the **rotary knob** to set the trigger level.
When the window comparator is ON, the trigger level is set to the window's center position.



Setting the Attenuation Ratio (when the trigger source is EXT)

8. Press these soft keys: **CH** > **EXT**.

9. Press the **Gain** soft key to select EXT or EXT/10.



Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator (when the trigger source is CH1 to CH4)

10. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

11. Set the items according to the procedure given in section 7.4.

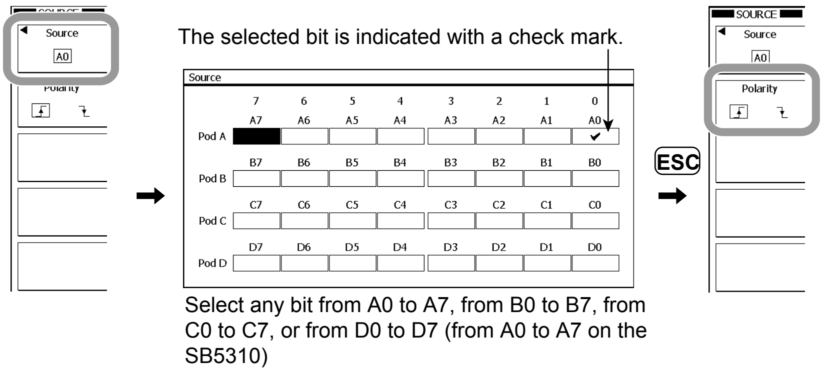
When Triggering on a Logic Bit A0 to D0

Selecting the Trigger Source

3. Press **SOURCE**.
4. Press the **Source** soft key.
5. Use the **rotary knob** and **SET** to set the trigger source to the appropriate logic signal.
6. Press **ESC** to return to the previous screen.

Selecting the Polarity

7. Press the **Polarity** soft key to select ↑ or ↓.



Explanation

This function enables the SB5000 to trigger when the input signal level passes through the trigger level.

CH1 to CH4, EXT, or LINE

Trigger Source

You can set the trigger source to CH1 to CH4, EXT, or LINE.

External Signal

To trigger on an external signal received through the rear panel TRIG IN terminal, set the trigger source to EXT.

Commercial Power Supply

To trigger on the commercial power supply that the SB5000 receives, set the trigger source to LINE.

Trigger Slope

You can set when to activate a trigger based on how the trigger source signal passes the trigger level.

↑	Triggers when the trigger source signal passes the trigger level from below the trigger level to above the trigger level (rising edge)
↓	Triggers when the trigger source signal passes the trigger level from above the trigger level to below the trigger level (falling edge)
Enter	Triggers when the trigger source level enters the specified voltage range (when window comparator is ON)
Exit	Triggers when the trigger source level exits from the specified voltage range (when window comparator is ON)

Trigger Level

- The selectable range is 8 divisions within the screen. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- You can reset the trigger level to the current offset voltage by pressing RESET.

Logic A0 to D0

Trigger Source

You can select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310).

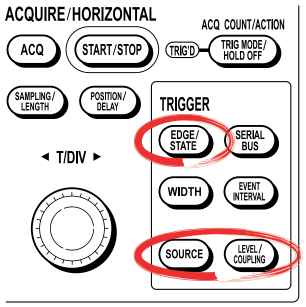
Polarity

You can select to activate a trigger when the trigger source signal changes to high or low polarity. The SB5000 determines the high and low polarities based on the set threshold level (see section 6.18).

↑	When the trigger source signal changes from low to high
↓	When the trigger source signal changes from high to low

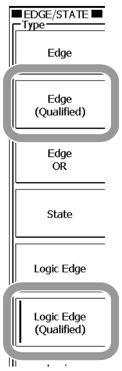
7.14 Activating a Conditional Edge Trigger

Procedure



Setting the Trigger Type

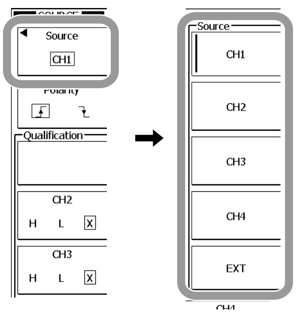
1. Press **EDGE/STATE**.
2. Press the **Edge (Qualified)** or **Logic Edge (Qualified)** soft key.
   - If you select Edge (Qualified), proceed to step 3.
   - If you select Logic Edge (Qualified), proceed to step 3 on page 7-70.



When Triggering on CH1 to CH4 or EXT

Selecting the Trigger Source

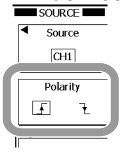
3. Press **SOURCE**.
4. Press the **Source** soft key.
5. Press the appropriate trigger source soft key.



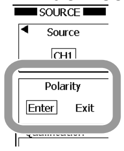
Selecting the Trigger Slope

6. Press the **Polarity** soft key to select ↑ or ↓.
If the trigger source is set to a signal that a window comparator is applied to, select Enter or Exit.

Window comparator: OFF

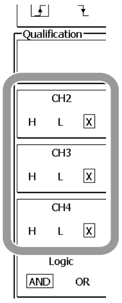


Window comparator: ON



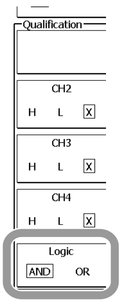
Setting the Qualification

7. Press the appropriate channel soft key to select H, L, or X.
When the window comparator is ON, select IN, OUT, or X.



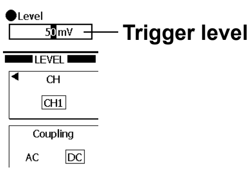
Selecting the Logic

8. Press the **Logic** soft key to select AND or OR.



Setting the Trigger Level

9. Press **LEVEL/COUPLING**.
10. Use the **rotary knob** to set the trigger level.
When the window comparator is ON, the trigger level is set to the window's center position.



Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator (when the trigger source is CH1 to CH4)

11. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

12. Set the items according to the procedure given in section 7.4.

When Triggering on a Logic Bit A0 to D0

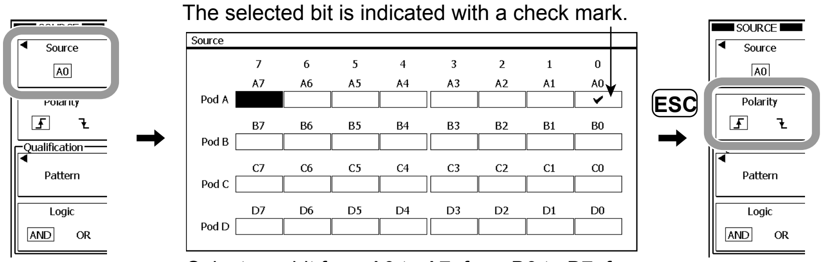
Selecting the Trigger Source

3. Press **SOURCE**.
4. Press the **Source** soft key.
5. Use the **rotary knob** and **SET** to set the trigger source to the appropriate logic signal.
6. Press **ESC** to return to the previous screen.

Selecting the Timing

7. Press the **Polarity** soft key to select ⨍ or ⨍ (falling).

The selected bit is indicated with a check mark.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

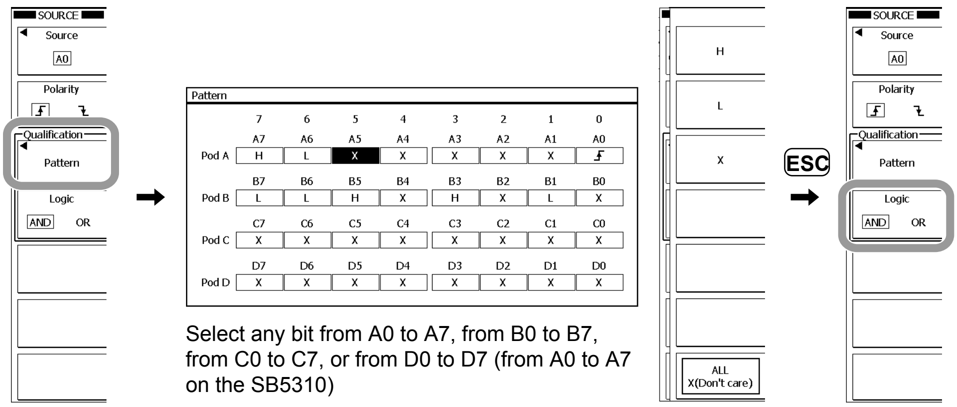
Setting the Qualification

- **Setting the Pattern**

8. Press the **Pattern** soft key.
9. Use the **rotary knob** and **SET** to set each bit to H, L, or X.
   You can also use the soft keys. The ALL X (Don't care) soft key is available to collectively set all bits to X.
10. Press **ESC** to return to the previous screen.

- **Selecting the Logic**

11. Press the **Logic** soft key to select AND or OR.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

Explanation

This function enables the SB5000 to trigger on a trigger source edge when the input signal level meets the specified qualifications.

CH1 to CH4 or EXT

Trigger Source

You can set the trigger source to a channel from CH1 to CH4 or EXT.

Triggering on an External Signal

To trigger on an external signal received through the rear panel TRIG IN terminal, set the trigger source to EXT.

Trigger Slope

You can set when to activate a trigger based on how the trigger source signal passes the trigger level.

	Triggers when the trigger source signal passes the trigger level from below the trigger level to above the trigger level (rising edge)
	Triggers when the trigger source signal passes the trigger level from above the trigger level to below the trigger level (falling edge)
Enter	Triggers when the trigger source level enters the specified voltage range (when window comparator is ON)
Exit	Triggers when the trigger source level exits from the specified voltage range (when window comparator is ON)

Qualification

Set the state of each signal to H, L, or X that is used to enable the trigger function.

H	When the signal is high
L	When the signal is low
IN	When the signal level is within the set voltage range (when the window comparator is ON)
OUT	When the signal level is outside the set voltage range (when the window comparator is ON)
X	Not used as a trigger condition (Don’t care)

Logic

Select the logic to apply to the signal states: AND or OR.

AND	When the states of all set signals match
OR	When the state of any set signal matches

Trigger Level

This is the same as the edge trigger. See section 7.13 for details.

Note

You cannot set the qualification for the trigger source signal.

Logic A0 to D0

Trigger Source

You can select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310).

Timing

You can set when to activate a trigger based on which polarity, high or low, the trigger source signal changes to. The SB5000 determines the high and low polarities based on the set threshold level (see section 6.18).

↑	When the trigger source signal changes from low to high
↓	When the trigger source signal changes from high to low

Qualification

This is the same as with CH1 to CH4 and EXT. See page 7-71 for details.

Logic

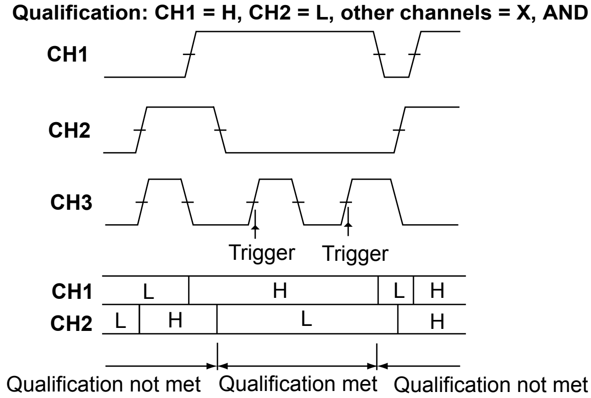
This is the same as with CH1 to CH4 and EXT. See page 7-71 for details.

Note

- You cannot set the qualification for trigger source bits.
- When triggering in sync with the trigger source, the SB5000 may not operate properly if the pattern setup time for the trigger source is less than 1 ns or the hold time is less than 1 ns.

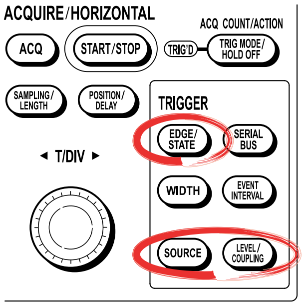
Example

Trigger source: CH3, ↑
Qualification: CH1 = H, CH2 = L, other channels = X, AND logic



7.15 Activating a Trigger on a State Condition

Procedure

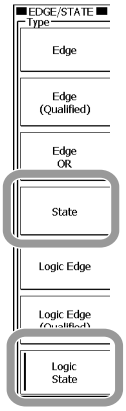


Setting the Trigger Type

1. Press **EDGE/STATE**.

2. Press the **State** or **Logic State** soft key.

- If you select State, proceed to step 3.
- If you select Logic State, proceed to step 3 on page 7-75.



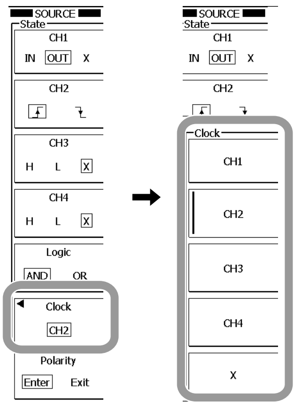
When Triggering on CH1 to CH4

Selecting the Clock Source

3. Press **SOURCE**.

4. Press the **Clock** soft key.

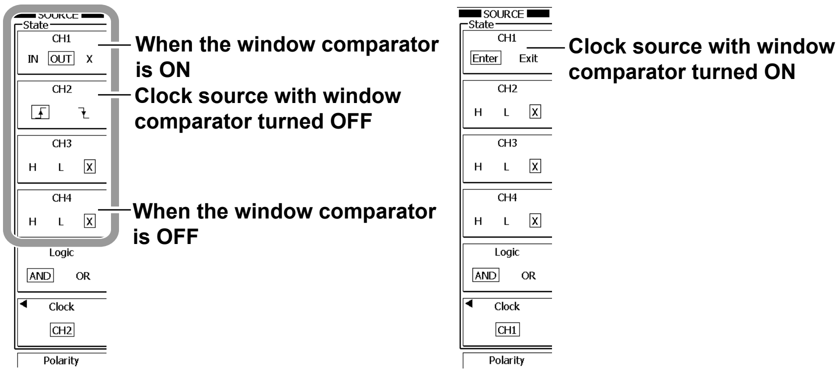
5. Press the appropriate clock source soft key.



Setting the State Condition

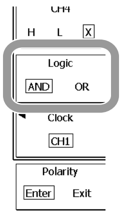
6. Press each signal soft key to select H, L, or X.

- When the window comparator is ON, select IN, OUT, or X.
- For the clock source signal, select ↑ or ↓. When the window comparator is ON, select Enter or Exit.



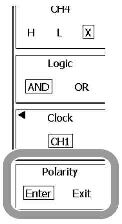
Selecting the Logic

7. Press the **Logic** soft key to select AND or OR.



Selecting the False-to-True Condition Change or the True-to-False Condition Change

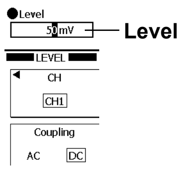
8. Press the **Polarity** soft key to select Enter or Exit.



Setting the Level

9. Press **LEVEL/COUPLING**.

10. Use the **rotary knob** to set the level for detecting the clock source high and low levels or the state condition.
When the window comparator is ON, the trigger level is set to the window's center position.



Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator

11. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

12. Set the items according to the procedure given in section 7.4.

When Triggering on a Logic Bit A0 to D0

Selecting the Clock Source

3. Press **SOURCE**.

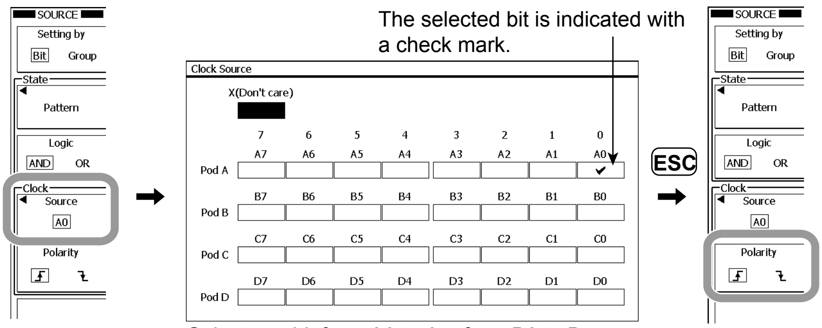
4. Press the **Source** soft key under Clock.

5. Use the **rotary knob** and **SET** to set the clock source to the appropriate logic signal.

6. Press **ESC** to return to the previous screen.

Select the Timing to Check the State Condition

7. Press the **Polarity** soft key to select ⨍ or ⊥.
If the clock source is not selected in step 5, the Polarity soft key will not appear.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

Setting the State Condition of Each Bit

- **Setting the Pattern**

8. Press the **Setting by** soft key to select Bit.

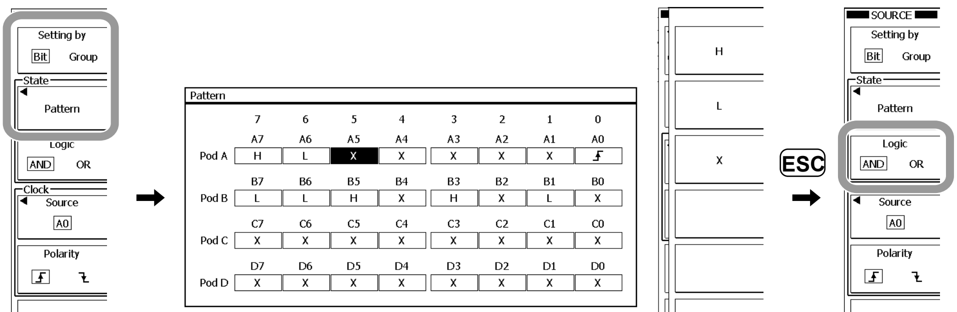
9. Press the **Pattern** soft key.

10. Use the **rotary knob** and **SET** to set each bit to H, L, or X.
You can also use the soft keys. The ALL X (Don't care) soft key is available to collectively set all bits to X.

11. Press **ESC** to return to the previous screen.

- **Selecting the Logic**

12. Press the **Logic** soft key to select AND or OR.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

Proceed to step 16 on page 7-76.

Setting the State Condition of Each Group

- **Setting the Pattern**

8. Press the **Setting by** soft key to select Group.

9. Press the **Pattern** soft key.

10. Press the appropriate group soft key from **Group 1** to **Group 5**.

11. Press the **Don't care** or **True** soft key.
If you select True, the Pattern Setup dialog box will appear. Proceed to step 12.
If you select Don't care, proceed to step 13.

> **Note**
> Groups that do not contain logic signals and groups that contain the clock source logic signal are always set to don't care.

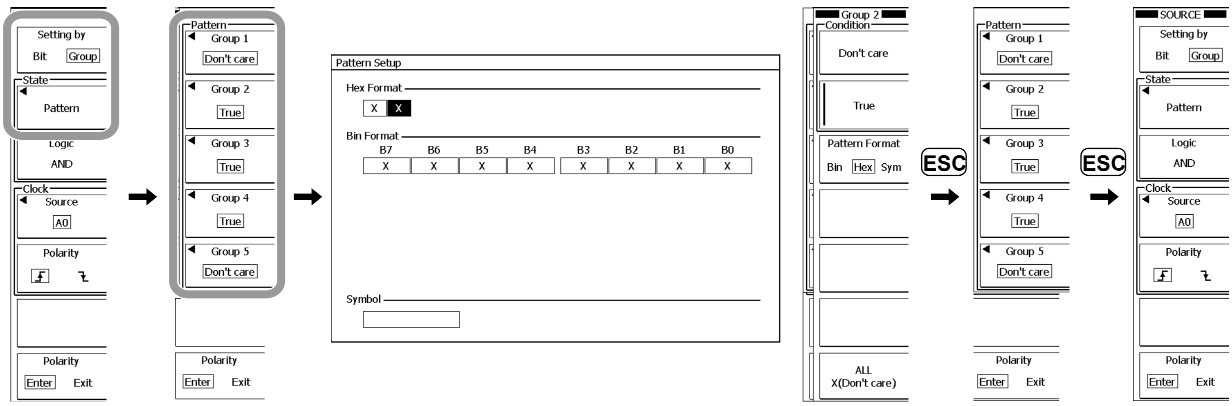
12. Use the **rotary knob** and **SET** to set the state of each bit in hexadecimal or binary notation or by using symbols.
- You can also use the Pattern Format soft key to select Bin, Hex, or Sym.
- The ALL X (Don't care) soft key is available to collectively set all bits to X.

> **Note**
> If any of the bits in the 4-bit binary boxes is set to X, the corresponding hexadecimal boxes will display "$."

13. Press **ESC** to return to the previous screen.

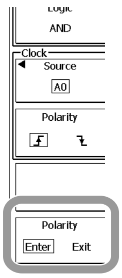
14. To set other groups, repeat steps 10 to 13.

15. When you are done setting the patterns, press **ESC** to return to the previous screen.



Selecting the False-to-True Condition Change or the True-to-False Condition Change

16. Press the **Polarity** soft key to select Enter or Exit.



Explanation

This function enables the SB5000 to trigger in the following conditions.

- When the state condition is met or not met
- The SB5000 checks the state condition on the rising or falling edge of the specified clock source signal. The SB5000 triggers when the normalized condition (high when the state condition is true and low when the state condition is low) changes.

CH1 to CH4

Clock Source

You can select the clock source from CH1 to CH4. If you do not specify the clock source, the SB5000 only triggers based on the state condition.
If you specify the clock source, the SB5000 triggers on the relationship between the clock source rising and falling edge and the specified state condition.

Timing to Check the State Condition

You can set when to check the state condition based on how the clock source signal changes.

↑	When the clock source signal changes from below the set level to above the set level (rising edge)
↓	When the clock source signal changes from above the set level to below the set level (falling edge)
Enter	When the clock source level enters the specified voltage range (when window comparator is ON)
Exit	When the clock source level exits from the specified voltage range (when window comparator is ON)

State Condition

Set each signal state to H, L, or X. The state condition is true when the selected state and the input signal state meet the following logic.

H	When the signal is high
L	When the signal is low
IN	When the signal level is within the set voltage range (when the window comparator is ON)
OUT	When the signal level is outside the set voltage range (when the window comparator is ON)
X	Not used as a trigger condition (Don't care)

Note

You cannot set the qualification for the clock source signal.

Logic

Select the logic to apply to the state conditions: AND or OR. The state condition is true when the logic is true.

AND	When the state of all signals matches
OR	When the state of any signal matches

False-to-True Condition Change or the True-to-False Condition Change

Select when to activate a trigger based on how the normalized condition changes.

Enter	When the normalized condition changes from false to true
Exit	When the normalized condition changes from true to false

Level

The selectable range is the same as that of the edge trigger. See section 7.13 for details.

Logic A0 to D0

Clock Source

You can select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310). If you do not specify the clock source, the SB5000 only triggers based on the true or false state condition.

Timing to Check the State Condition

You can set when to activate a trigger based on which polarity, high or low, the clock source signal changes to. The SB5000 determines the high and low polarities based on the set threshold level (see section 6.18).

↑	Checks the state condition when the clock source signal changes from low to high
↓	Checks the state condition when the clock source signal changes from high to low

Note

- You cannot set the qualification for the clock source bit.
- When checking the state condition in sync with the clock source, the SB5000 may not operate properly if the pattern setup time for the clock source is less than 1 ns or the hold time is less than 1 ns.

State Condition of Each Bit

- **Pattern**

  Set the state of each state condition bit to H, L, or X.

H	High level
L	Low level
X	Not used as a trigger condition (Don’t care)

- **Logic**

  Select the logic to apply to the bit states: AND or OR.

AND	When the states of all set bits match
OR	When the state of any set bit matches

State Condition of Each Group

- **Pattern**

  Set the state of each state condition bit for each group in hexadecimal or binary notation or by using symbols.

  - Hex

0 to F	For information on how to handle bits when using hexadecimal notation, see the explanation in section 6.17.
X	Not used as a trigger condition (Don’t care)

  - Bin

0	Low level
1	High level
X	Not used as a trigger condition (Don’t care)

  - Symbol

    Symbol is a symbolic representation of a bit sequence that includes X. A physical value/symbol definition file (.sbl) that is created using Symbol Editor can be loaded through file operation.

- **Logic**
  When the state conditions are set in groups, the logic is fixed to AND. The condition is true when the states of all set bits match.

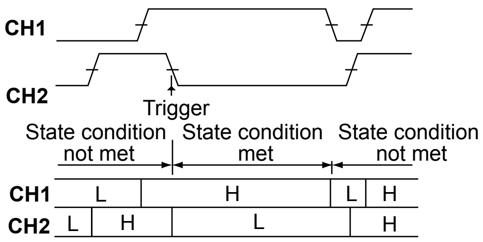
False-to-True Condition Change or the True-to-False Condition Change

Select when to activate a trigger based on how the normalized condition changes.

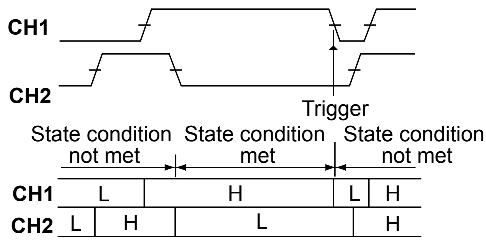
Enter	When the normalized condition changes from false to true
Exit	When the normalized condition changes from true to false

Example

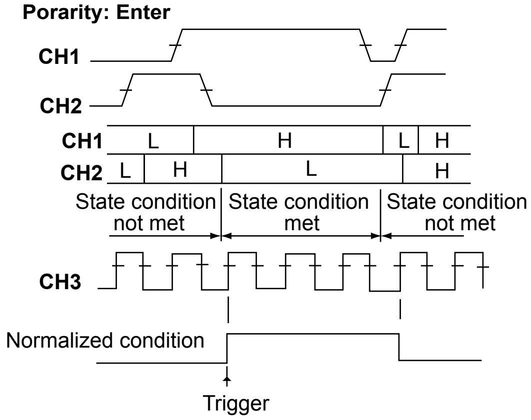
Clock source: None
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: Enter



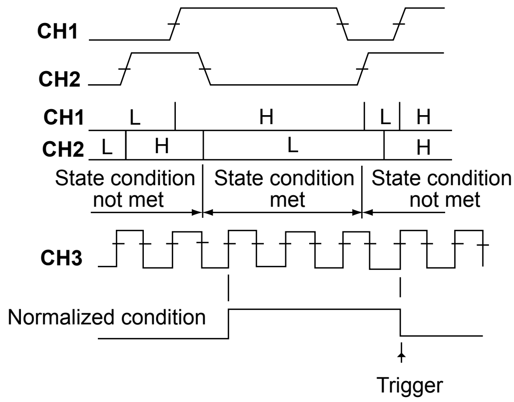
Clock source: None
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: Exit



Clock source: CH3,
State: CH1 = H, CH2 = L, CH4 = X, AND logic
Porarity: Enter



Clock source: CH3,
State: CH1 = H, CH2 = L, CH4 = X, AND logic
Porarity: Exit

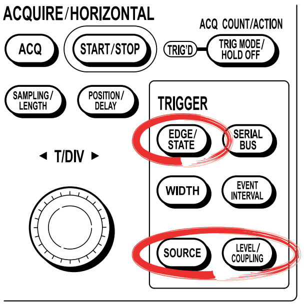


7

Triggering

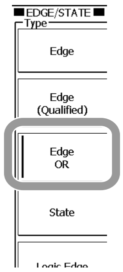
7.16 Activating a Trigger on the OR Logic of Multiple Edge Triggers

Procedure



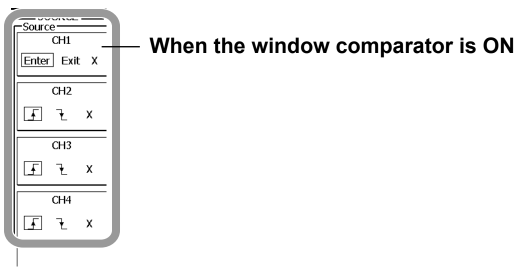
Setting the Trigger Type

1. Press **EDGE/STATE**.
2. Press the **Edge OR** soft key.



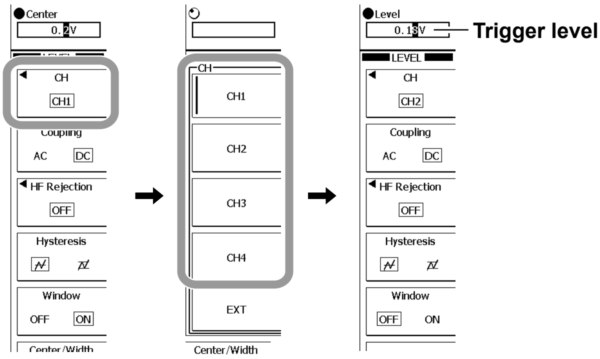
Selecting the Trigger Slope

3. Press **SOURCE**.
4. Press the appropriate channel soft key to select $\uparrow$, $\downarrow$, or X.
   For channels whose window comparator is set to ON, select Enter, Exit, or X.



Setting the Trigger Level

5. Press **LEVEL/COUPLING**.
6. Press the **CH** soft key.
7. Press the appropriate signal soft key.
8. Use the **rotary knob** to set the trigger level.
   When the window comparator is ON, the trigger level is set to the window's center position.



Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator

9. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

10. Set the holdoff time according to the procedure given in section 7.4.

Explanation

This function enables the SB5000 to trigger on multiple trigger source edges.

Trigger Source

You can select multiple trigger sources from CH1 to CH4.

Trigger Slope

You can set when to activate a trigger based on how the trigger source signal passes the trigger level.

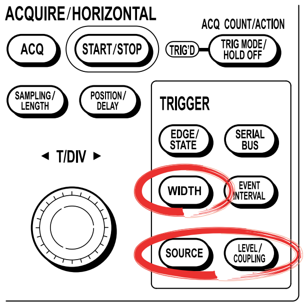
↑	Triggers when the trigger source signal passes the trigger level from below the trigger level to above the trigger level (rising edge)
↓	Triggers when the trigger source signal passes the trigger level from above the trigger level to below the trigger level (falling edge)
Enter	Triggers when the trigger source level enters the specified voltage range (when window comparator is ON)
Exit	Triggers when the trigger source level exits from the specified voltage range (when window comparator is ON)
X	Not used as a trigger condition (Don't care)

Trigger Level

This is the same as the edge trigger. See section 7.13 for details.

7.17 Activating a Trigger on a Pulse Width

Procedure



Selecting the Trigger Type

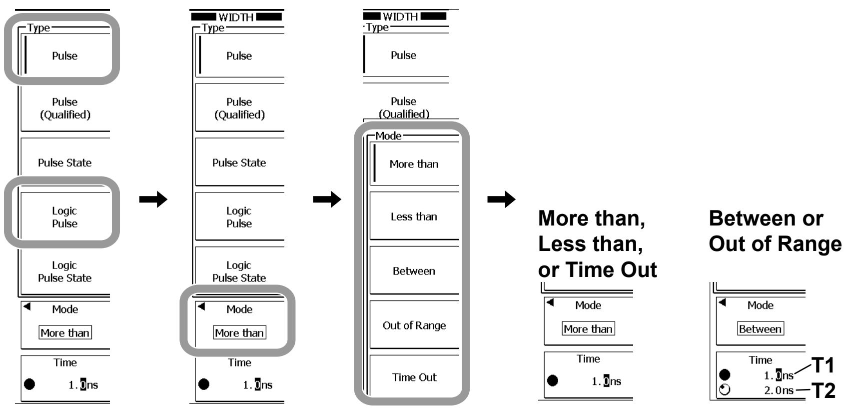
1. Press **WIDTH**.
2. Press the **Pulse** or **Logic Pulse** soft key.

Selecting the Time Span Mode

3. Press the **Mode** soft key.
4. Press the appropriate mode soft key from **More than** to **Time Out**.

Setting the Reference Time

5. Use the **rotary knob** to set the reference time.
   If you set the time span mode to Between or Out of Range, set two reference times.
   Press the soft key to switch between the reference times that you set using the rotary knob.



If you select Pulse in step 2, proceed to step 6 on page 7-83.
If you select Logic Pulse in step 2, proceed to step 6 on page 7-84.

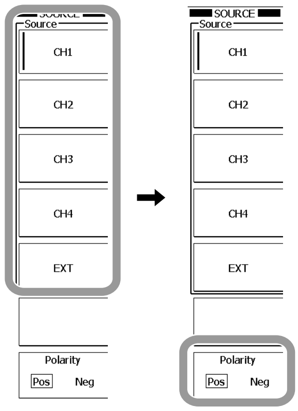
When Triggering on CH1 to CH4 or EXT

Selecting the Trigger Source

6. Press **SOURCE**.

7. Press the appropriate trigger source soft key.

8. Press the **Polarity** soft key to select Pos or Neg.
When the window comparator is ON, select IN or OUT.



Setting the Trigger Level

9. Set the trigger level according to the procedure given in section 7.13.

Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator

10. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

11. Set the holdoff time according to the procedure given in section 7.4.

When Triggering on a Logic Bit A0 to D0

Selecting the Trigger Source

6. Press **SOURCE**.

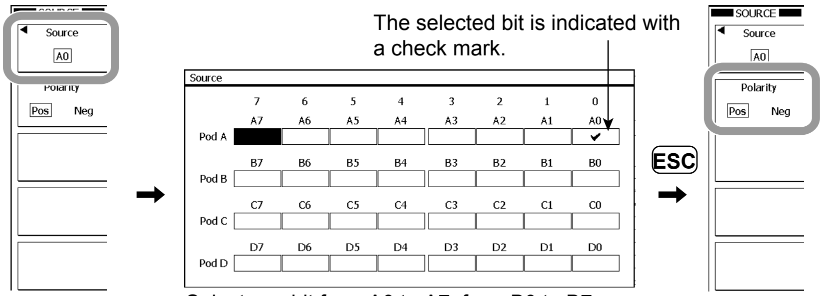
7. Press the **Source** soft key.

8. Use the **rotary knob** and **SET** to set the trigger source to the appropriate logic signal.

9. Press **ESC** to return to the previous screen.

Selecting the Polarity

10. Press the **Polarity** soft key to select Pos or Neg.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

Explanation

This function enables the SB5000 to trigger when the relationship between the condition-true or condition-false period and the specified reference time meets a certain condition.

Time Span Mode

The SB5000 triggers on the relationship between a single trigger source pulse width and the specified time. You can select the relationship for activating a trigger.

More than	The SB5000 triggers when the state changes after the pulse width becomes longer the specified reference time.
Less than	The SB5000 triggers when the state changes after the pulse width becomes shorter than the specified reference time.
Between	The SB5000 triggers when the state changes after the pulse width becomes longer than reference time T1 and shorter than reference time T2.
Out of Range	The SB5000 triggers when the state changes after the pulse width becomes shorter than reference time T1 or longer than reference time T2.
Time Out	The SB5000 triggers when the pulse width becomes longer the specified reference time.

Reference Time

The selectable range is 1.0 ns to 10.0000 s in 0.5-ns steps.

Note

The trigger may not operate properly if the spacing between signals or the signal pulse width is less than 2 ns. The pulse width accuracy is ±(0.2% of set value + 1 ns) in standard operating conditions after calibration. The set value is equal to the T2 value when the pulse width is greater than T1 and less than T2.

CH1 to CH4 or EXT

Trigger Source

You can set the trigger source to a channel from CH1 to CH4 or EXT.

Triggering on an External Signal

To trigger on an external signal received through the rear panel TRIG IN terminal, set the trigger source to EXT.

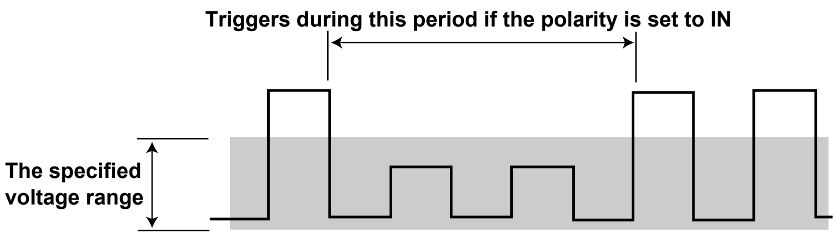
Polarity

You can select when to compare the pulse width with the reference time, based on the trigger source signal polarity with respect to the trigger level.

Pos	When the signal is high
Neg	When the signal is low
IN	When the trigger source level is within the specified voltage range (when window comparator is ON)
OUT	When the trigger source level is outside the specified voltage range (when window comparator is ON)

Window Comparator

If you set the trigger source to a signal whose window comparator is ON, the SB5000 can be triggered when the waveform is within or outside the specified voltage range.



Trigger Level

This is the same as the edge trigger. See section 7.13 for details.

Logic A0 to D0

Trigger Source

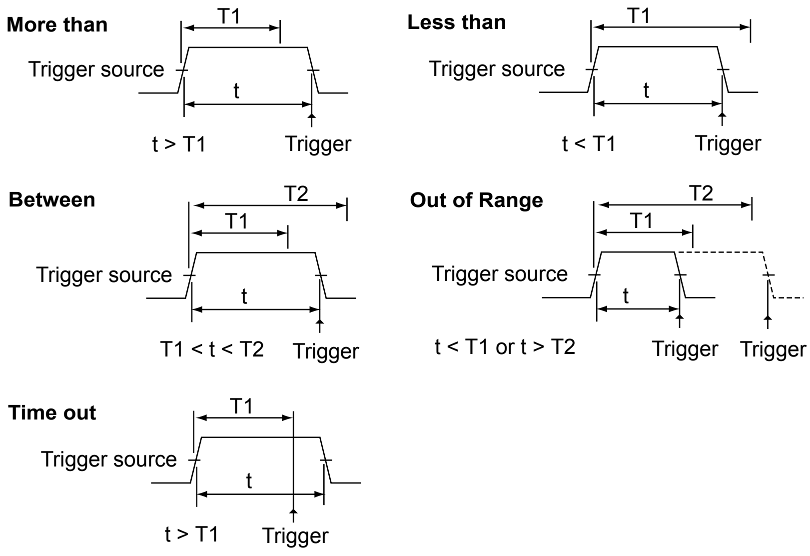
You can select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310).

Polarity

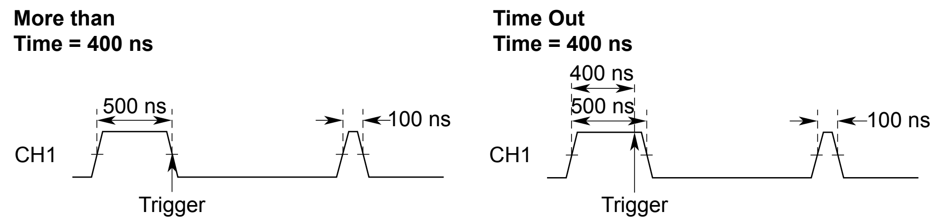
You can select which polarity of the time span to test, high or low. The SB5000 determines the high and low polarities based on the set threshold level (see section 6.18).

Pos	When the signal is high
Neg	When the signal is low

Example

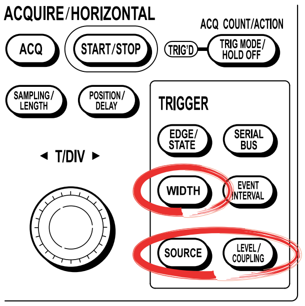


The following figure shows how the trigger point differs between More than and Time Out.



7.18 Activating a Trigger on a Conditional Pulse Width

Procedure



Selecting the Trigger Type

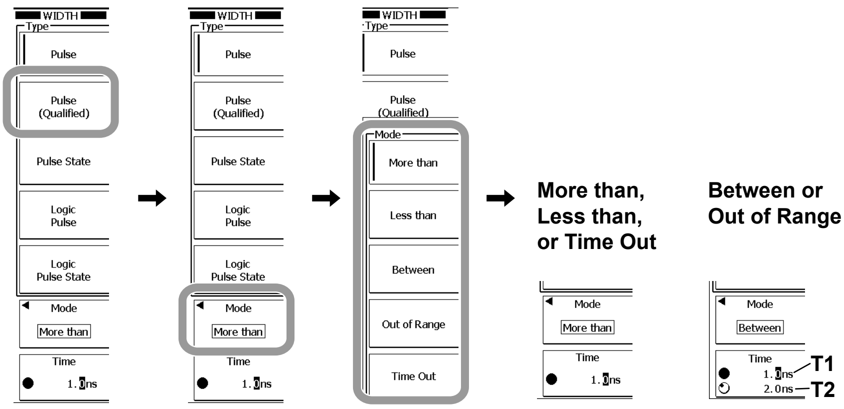
1. Press **WIDTH**.
2. Press the **Pulse (Qualified)** soft key.

Selecting the Time Span Mode

3. Press the **Mode** soft key.
4. Press the appropriate mode soft key from **More than** to **Time Out**.

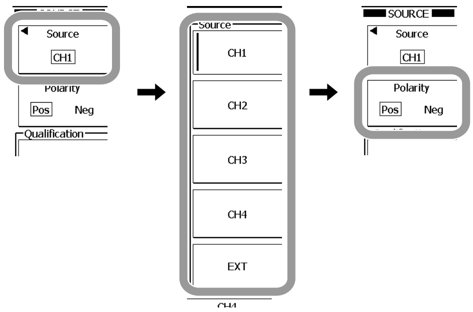
Setting the Reference Time

5. Use the **rotary knob** to set the reference time.
   If you set the time span mode to Between or Out of Range, set two reference times.
   Press the soft key to switch between the reference times that you set using the rotary knob.



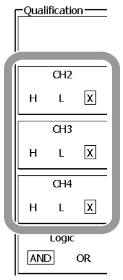
Selecting the Trigger Source

6. Press **SOURCE**.
7. Press the **Source** soft key.
8. Press the appropriate trigger source soft key.
9. Press the **Polarity** soft key to select Pos or Neg.
   When the window comparator is ON, select IN or OUT.



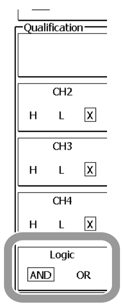
Setting the Qualification

10. Press the appropriate channel soft key to select H, L, or X.
    When the window comparator is ON, select IN, OUT, or X.



Selecting the Logic

11. Press the **Logic** soft key to select AND or OR.



Setting the Trigger Level

12. Set the items according to the procedure given in section 7.13.

Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator (when the trigger source is CH1 to CH4)

13. Set the items according to the procedure given in section 7.5.

Setting the Holdoff

14. Set the holdoff according to the procedure given in section 7.4.

Explanation

This function enables the SB5000 to trigger if the relationship between the condition-true or condition-false period of a single trigger source and the specified reference time is true, when the input signal level meets the specified qualifications.

Time Span Mode and Reference Time

These are the same as with the pulse width trigger. See section 7.17 for details.

Trigger Source

You can set the trigger source to a channel from CH1 to CH4 or EXT.

Triggering on an External Signal

To trigger on an external signal received through the rear panel TRIG IN terminal, set the trigger source to EXT.

Polarity

You can select when to compare the pulse width with the reference time, based on the trigger source signal polarity with respect to the trigger level.

Pos	When the signal is high
Neg	When the signal is low
IN	When the trigger source level is within the specified voltage range (when window comparator is ON)
OUT	When the trigger source level is outside the specified voltage range (when window comparator is ON)

Window Comparator

This is the same as with the pulse width trigger. See section 7.17 for details.

Qualification

Set the state of each signal to H, L, or X that is used to enable the trigger function.

H	When the signal is high
L	When the signal is low
IN	When the signal level is within the specified voltage range (when the window comparator is ON)
OUT	When the signal level is outside the specified voltage range (when the window comparator is ON)
X	Not used as a trigger condition (Don’t care)

Logic

Select the logic to apply to the signal states: AND or OR.

AND	When the states of all set signals match
OR	When the state of any set signal matches

Trigger Level

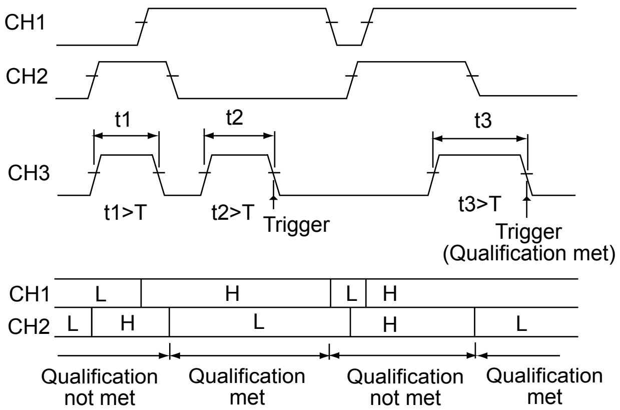
This is the same as the edge trigger. See section 7.13 for details.

Note

You cannot set the qualification for the trigger source signal.

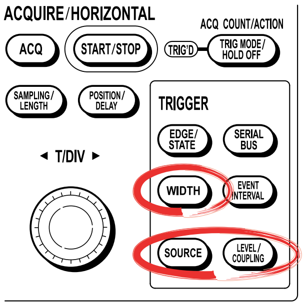
Example

Trigger source: CH3, More than
Qualification: CH1 = H, CH2 = L, other channels = X, AND logic



7.19 Activating a Trigger on a State Condition True Period

Procedure



Selecting the Trigger Type

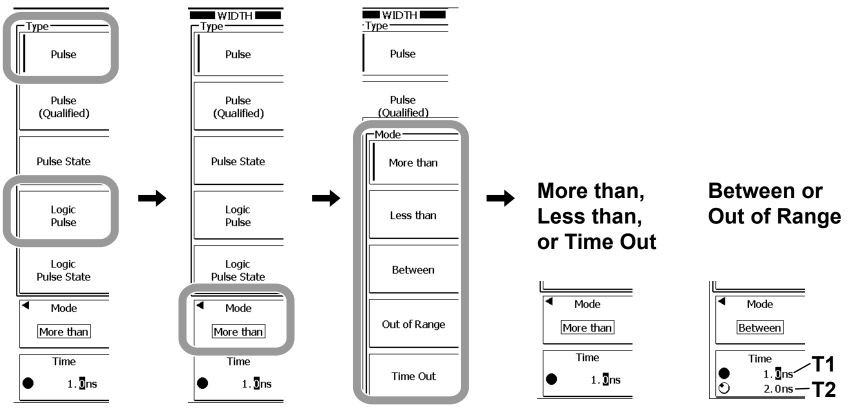
1. Press **WIDTH**.
2. Press the **Pulse State** or **Logic Pulse State** soft key.

Selecting the Time Span Mode

3. Press the **Mode** soft key.
4. Press the appropriate mode soft key from **More than** to **Time Out**.

Setting the Reference Time

5. Use the **rotary knob** to set the reference time.
   If you set the time span mode to Between or Out of Range, set two reference times.
   Press the soft key to switch between the reference times that you set using the rotary knob.



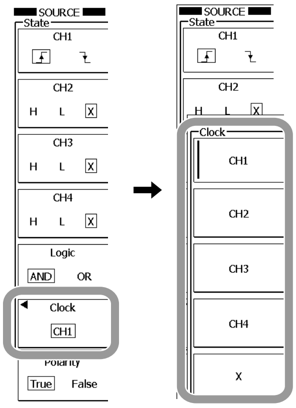
If you select Pulse State in step 2, proceed to step 6 on page 7-92.
If you select Logic Pulse State in step 2, proceed to step 6 on page 7-93.

Selecting the Clock Source

6. Press **SOURCE**.

7. Press the **Clock** soft key to display the Clock menu.

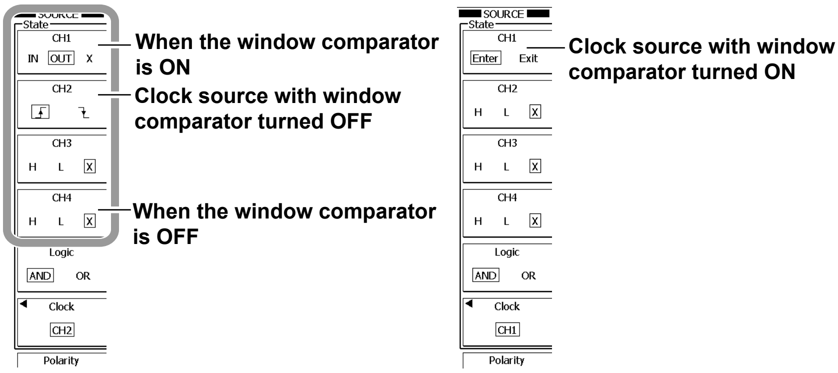
8. Press the appropriate clock source soft key.



Setting the State Condition

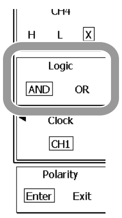
9. Press each signal soft key to select H, L, or X.

- When the window comparator is ON, select IN, OUT, or X.
- For the clock source signal, select ↑ or ↓. When the window comparator is ON, select Enter or Exit.



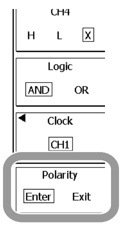
Selecting the Logic

10. Press the **Logic** soft key to select AND or OR.



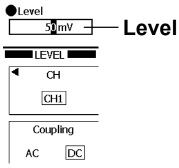
Selecting the False-to-True Condition Change or the True-to-False Condition Change

11. Press the **Polarity** soft key to select Enter or Exit.



Setting the Level

12. Press **LEVEL/COUPLING**.
13. Use the **rotary knob** to set the level for detecting the clock source high and low levels or the state condition.
    When the window comparator is ON, the trigger level is set to the window's center position.



Setting the Trigger Coupling, HF Rejection, Trigger Hysteresis, and Window Comparator

14. Set the these items according to the procedure given in section 7.5.

Setting the Holdoff

15. Set the holdoff according to the procedure given in section 7.4.

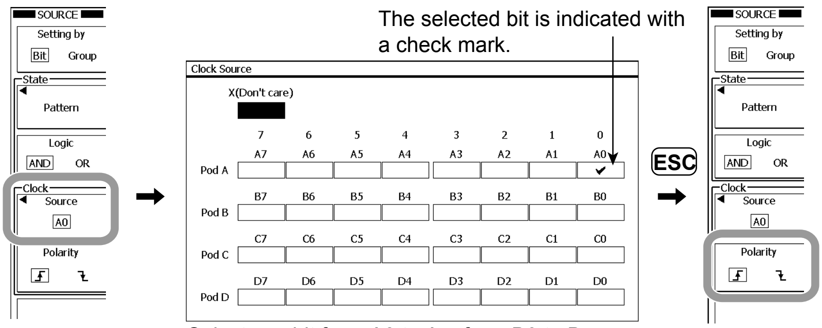
When Triggering on a Logic Bit A0 to D0

Selecting the Clock Source

6. Press **SOURCE**.
7. Press the **Source** soft key under Clock.
8. Use the **rotary knob** and **SET** to set the clock source to the appropriate logic signal.
9. Press **ESC** to return to the previous screen.

Select the Timing to Check the State Condition

10. Press the **Polarity** soft key to select ⨍ or ⨍.
    If the clock source is not selected in step 8, the Polarity soft key will not appear.



Select any bit from A0 to A7, from B0 to B7, from C0 to C7, or from D0 to D7 (from A0 to A7 on the SB5310)

7

Triggering

Setting the State Condition of Each Bit

- **Setting the Pattern**

11. Press the **Setting by** soft key to select Bit.

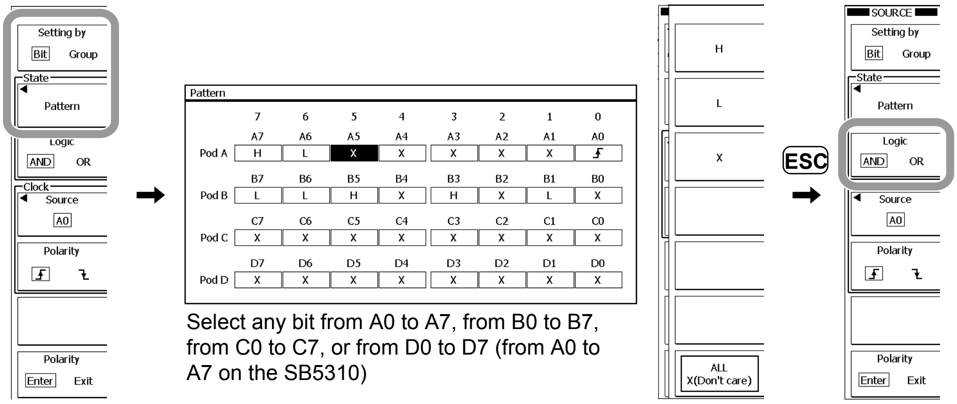
12. Press the **Pattern** soft key.

13. Use the **rotary knob** and **SET** to set each bit to H, L, or X.
You can also use the soft keys. The ALL X (Don't care) soft key is available to collectively set all bits to X.

14. Press **ESC** to return to the previous screen.

- **Selecting the Logic**

15. Press the **Logic** soft key to select AND or OR.



Proceed to step 19 on page 7-95.

Setting the State Condition of Each Group

- **Setting the Pattern**

11. Press the **Setting by** soft key to select Group.

12. Press the **Pattern** soft key.

13. Press the appropriate group soft key from **Group 1** to **Group 5**.

14. Press the **Don't care** or **True** soft key.
If you select True, the Pattern Setup dialog box will appear. Proceed to step 15.
If you select Don't care, proceed to step 16.

> ***Note***
> Groups that do not contain logic signals and groups that contain the clock source logic signal are always set to don't care.

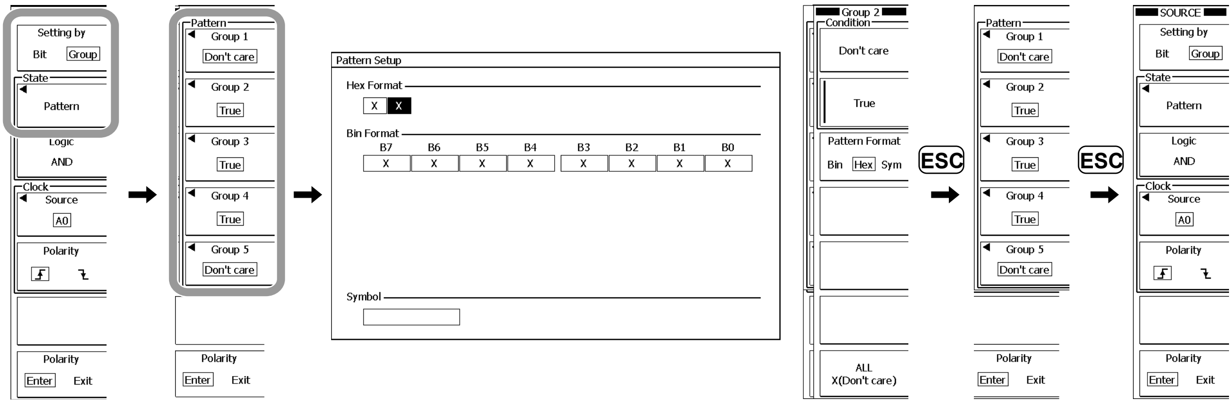
15. Use the **rotary knob** and **SET** to set the state of each bit in hexadecimal or binary notation or by using symbols.
- You can also use the Pattern Format soft key to select Bin, Hex, or Sym.
- The ALL X (Don't care) soft key is available to collectively set all bits to X.

> ***Note***
> If any of the bits in the 4-bit binary boxes is set to X, the corresponding hexadecimal boxes will display "$."

16. Press **ESC** to return to the previous screen.

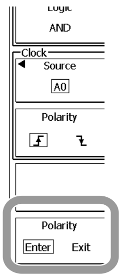
17. To set other groups, repeat steps 13 to 16.

18. When you are done setting the patterns, press **ESC** to return to the previous screen.



Selecting the False-to-True Condition Change or the True-to-False Condition Change

19. Press the **Polarity** soft key to select Enter or Exit.



Explanation

This function enables the SB5000 to trigger in the following conditions.

- When the relationship between the state condition true or false period and the specified reference time meets a certain condition
- The SB5000 checks the state condition on the rising or falling edge of the specified clock source signal. The SB5000 triggers the first time the relationship between the period during which the normalized condition (high when the state condition is true and low when the state condition is low) is true or false and the specified reference time meets a certain condition.

Time Span Mode

The SB5000 triggers on the relationship between the state condition true or false period and the specified time. You can select the relationship for activating a trigger.

More than	The SB5000 triggers when the state changes after the state condition true or false period becomes longer the specified reference time.
Less than	The SB5000 triggers when the state changes after the state condition true or false period becomes shorter the specified reference time.
Between	The SB5000 triggers when the state changes after the state condition true or false period becomes longer than reference time T1 and shorter than reference time T2.
Out of Range	The SB5000 triggers when the state changes after the state condition true or false period becomes shorter than reference time T1 or longer than reference time T2.
Time Out	The SB5000 triggers when the state condition true or false period becomes longer the specified reference time.

Setting the Reference Time

The selectable range is 1.0 ns to 10.0000 s in 0.5-ns steps.

Note

The trigger may not operate properly if the spacing between signals or the signal pulse width is less than 2 ns. The time span accuracy is ±(0.2% of set value + 1 ns) in standard operating conditions after calibration. The set value is equal to the T2 value when the pulse width is greater than T1 and less than T2.

CH1 to CH4

Clock Source, Timing to Check the State Condition, State Condition, Logic, False-to-True Condition Change or the True-to-False Condition Change, and Level

These items are the same as when triggering on a state condition. See section 7.15 for details.

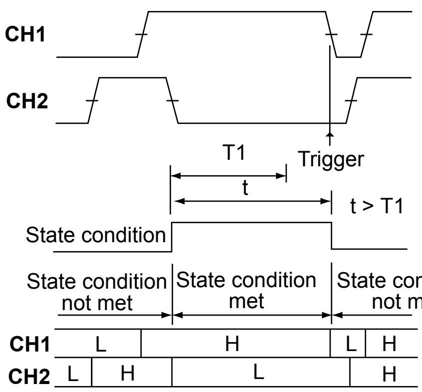
Logic A0 to D0

Clock Source, State Condition of Each Bit, State Condition of Each Group, False-to-True Condition Change or the True-to-False Condition Change

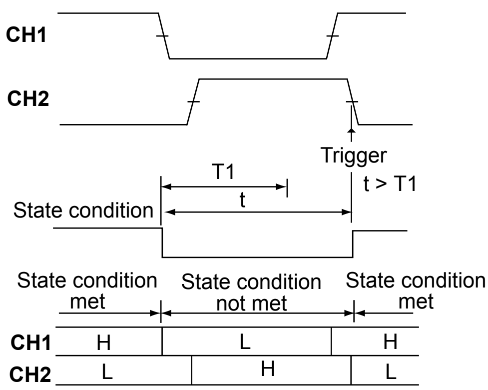
These items are the same as when triggering on a state condition. See section 7.15 for details.

Example

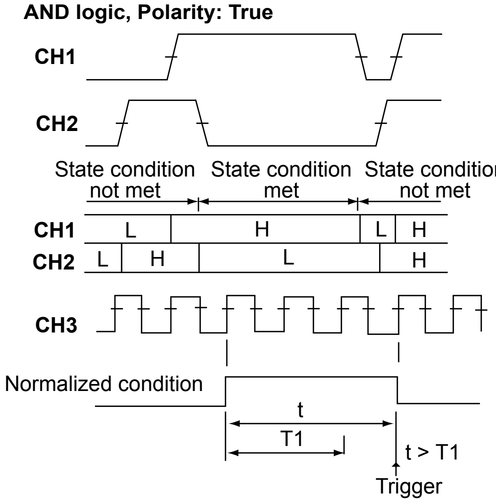
Mode: More than; Clock source: None
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: True



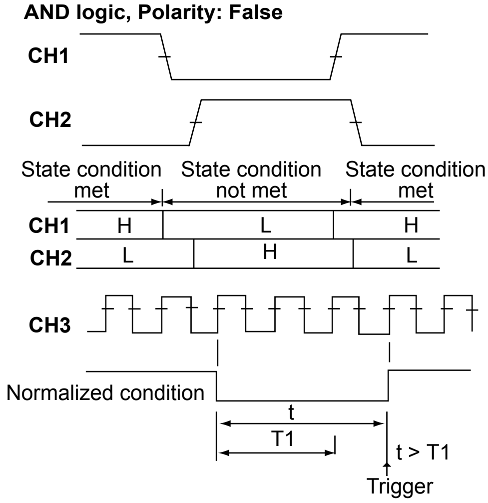
Mode: More than; Clock source: None
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: False



Mode: More than; Clock source: CH3, ↑
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: True

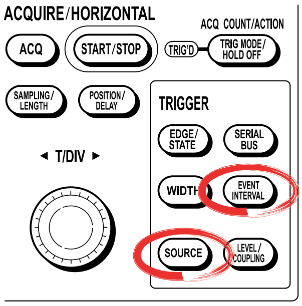


Mode: More than; Clock source: CH3, ↑
State: CH1 = H, CH2 = L, other channels = X,
AND logic, Polarity: False



7.20 Activating a Trigger on an Event Cycle, Delay, or Sequence

Procedure



Selecting the Trigger Type

1. Press **EVENT INTERVAL**.
2. Press the **Type** soft key.
3. Press the **Event Cycle**, **Event Delay**, or **Event Sequence** soft key.

Selecting the Event Mode

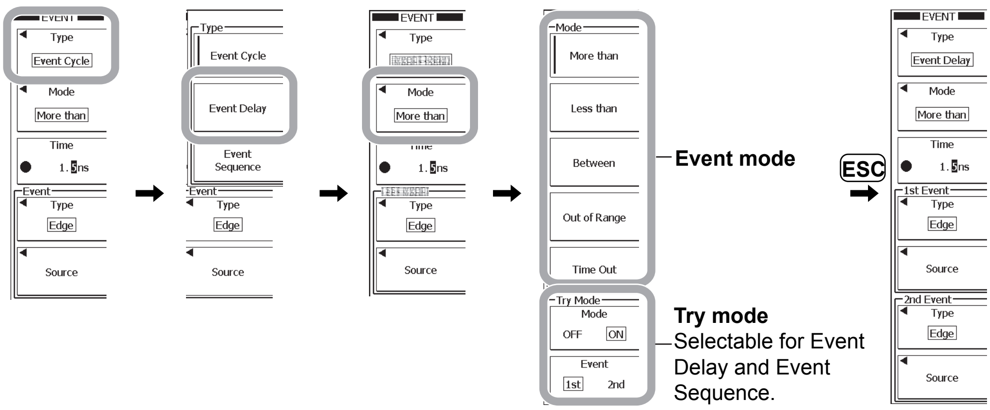
4. Press the **Mode** soft key.
5. Press the appropriate mode soft key from **More than** to **Time Out**.

If you select Event Cycle in step 3, proceed to step 9 on page 7-98.

Selecting the Try Mode

(If you select Event Delay or Event Sequence in step 3)

6. Press the **Mode** soft key under Try Mode to select ON or OFF.
   If you select ON, the SB5000 triggers on the 1st or 2nd event that you will set in the next step.
   Set Try Mode to ON to check whether triggering will occur on the 1st and 2nd events separately.
7. Press the **Event** soft key to select 1st or 2nd.
8. Press **ESC** to return to the previous screen.



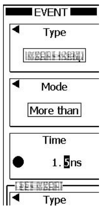
Setting the Event Reference Time

9. Use the **rotary knob** to set the reference time.

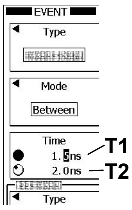
If you set the time span mode to Between or Out of Range, set two reference times.

Press the soft key to switch between the reference times that you set using the rotary knob.

More than, Less than, or Time Out



Between or Out of Range



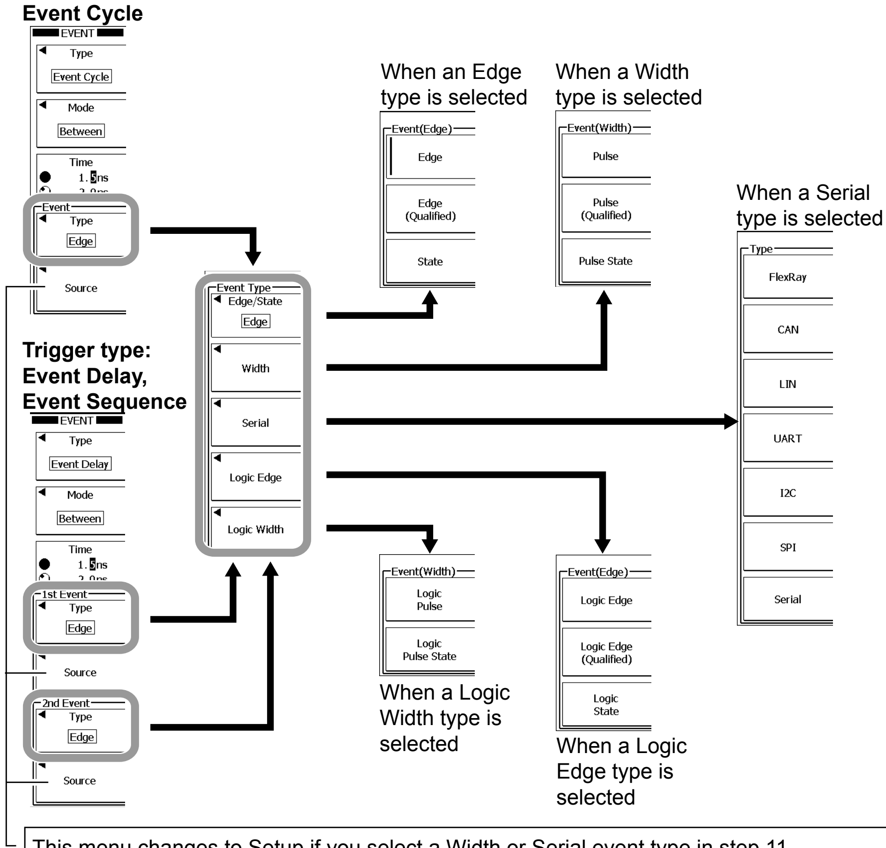
Selecting the Event Type

10. Press the **Type** soft key.

If the trigger type is Event Delay or Event Sequence, press the Type soft key under 1st Event and 2nd Event separately.

11. Press the appropriate event type soft key.

Trigger type: Event Cycle



This menu changes to Setup if you select a Width or Serial event type in step 11.

- Width or Logic Width type
  Proceed to step 12.
- Serial type
  Press the Setup soft key and then set the trigger conditions for the serial bus. For the configuration procedure, see the sections below.
  FlexRay: Section 7.6; CAN: Section 7.7; LIN: Section 7.8; UART: Section 7.9; I2C: Section 7.10; SPI: Section 7.11; Serial: Section 7.12

Setting the Time Span Mode and Reference Time for the Pulse Width or True Period

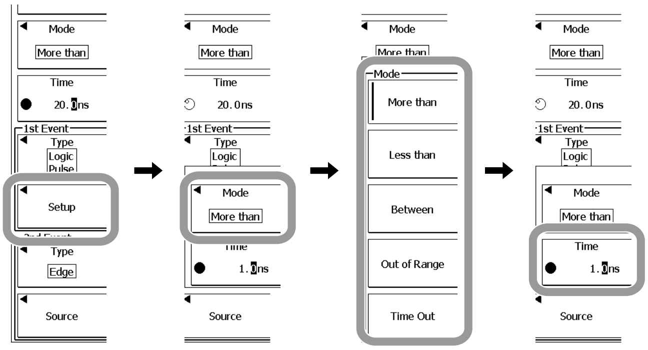
When the event is set to a width type or logic width type

12. Press these soft keys: **Setup** > **Mode**.

13. Press the appropriate time span mode soft key from **More than** to **Time Out**.

14. Set the reference time for the pulse width or true period according to the time span mode.

15. Press **ESC** to return to the previous screen.



Setting the Event Source

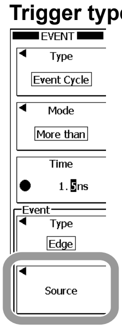
When the event is set to an edge type or logic edge type

16. Press the **Source** soft key.

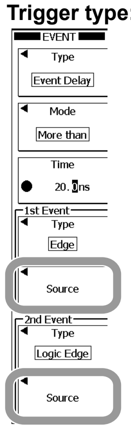
The event source setup menu appears.

(You can also press **SOURCE** on the front panel to display a menu and press the **Setup** soft key.)

Trigger type: Event Cycle



Trigger type: Event Delay, Event Sequence

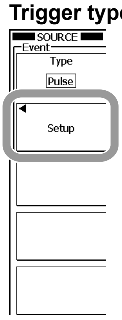


When the event is set to a width type or logic width type

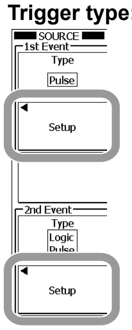
16. Press **SOURCE** on the front panel, and press the **Setup** soft key in the menu that appears.

The event source setup menu appears.

Trigger type: Event Cycle



Trigger type: Event Delay, Event Sequence



The subsequent steps vary depending on the event type. See the source settings in the sections indicated below.

Event Type		See	Event Type		See
Edge/ State type	Edge	Step 4 on page 7-64	Logic Edge type	Logic Edge	Step 4 on page 7-66
	Edge (Qualified)	Step 4 on page 7-68		Logic Edge (Qualified)	Step 4 on page 7-70
	State	Step 4 on page 7-73		Logic State	Step 4 on page 7-75
Width type	Pulse	Step 7 on page 7-83	Logic Width type	Logic Pulse	Step 7 on page 7-84
	Pulse (Qualified)	Step 7 on page 7-88		Logic Pulse State	Step 7 on page 7-93
	Pulse State	Step 7 on page 7-92			

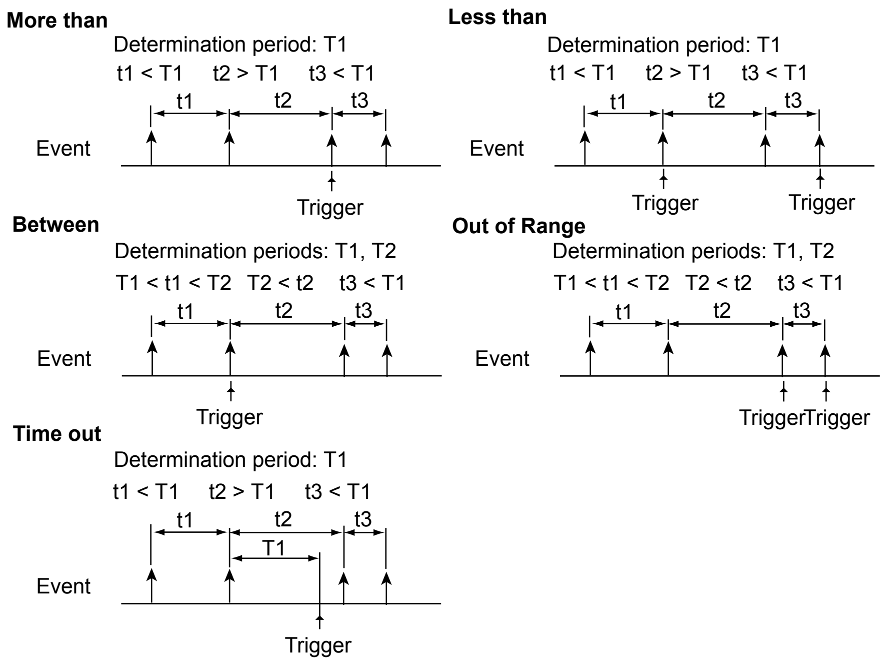
Explanation

This function enables the SB5000 to trigger on events based on trigger conditions (excluding the Edge OR trigger).

Trigger Type

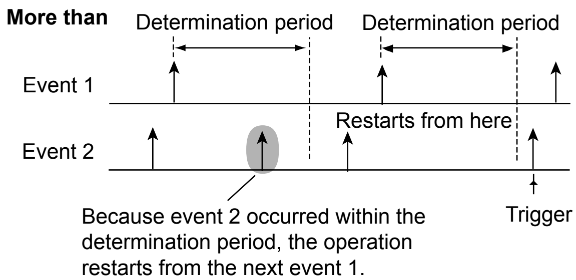
- **Event Cycle**

  The SB5000 triggers when the event cycle meets the specified time condition.



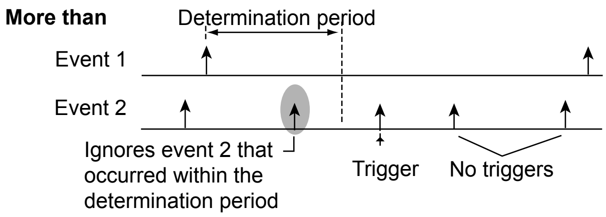
- **Event Delay**

  Normally, the SB5000 displays the waveform before and after the event. If you want to view the waveform the specified time after the event, set the trigger delay.
  The SB5000 triggers when the time between Event 1 and Event 2 meets the specified time condition. If the time between Event 1 and Event 2 does not meet the specified time condition, the SB5000 starts the detection process again from the next Event 1.
  The following example is for More than.



- **Event Sequence**

Normally, the SB5000 displays the waveform before and after the event. If you want to view the waveform by setting the event order, set the event sequence.
The SB5000 triggers when the time between Event 1 and Event 2 meets the specified time condition. If the time between Event 1 and Event 2 does not meet the specified time condition, the SB5000 discards Event 2 and triggers on Event 2 that occurs when the specified time condition is met. The following example is for More than.



Event Mode

- **Event Cycle**

More than	The SB5000 triggers at the end of a cycle that is longer than the specified reference time.
Less than	The SB5000 triggers at the end of a cycle that is shorter than the specified reference time.
Between	The SB5000 triggers at the end of a cycle that is longer than reference time T1 and shorter than T2.
Out of Range	The SB5000 triggers at the end of a cycle that is shorter than reference time T1 or longer than T2.
Time out	The SB5000 triggers when a cycle exceeds the specified reference time.

- **Event Delay and Event Sequence**

More than	The SB5000 triggers when Event 2 occurs if the time between Event 1 and Event 2 is longer than the specified time.
Less than	The SB5000 triggers when Event 2 occurs if the time between Event 1 and Event 2 is shorter than the specified time.
Between	The SB5000 triggers when Event 2 occurs if the time between Event 1 and Event 2 is longer than T1 and shorter than T2.
Out of Range	The SB5000 triggers when Event 2 occurs if the time between Event 1 and Event 2 is shorter than T1 or longer than T2.
Time out	The SB5000 triggers the specified time after Event 1 if the time between Event 1 and Event 2 is longer than the specified time.

Try Mode

The try mode feature is available only when the trigger type is Event Delay or Event Sequence.
Turn this mode ON to check whether triggering will occur on each event before triggering on the combination of the 1st and 2nd events.

7 Triggering

Event Reference Time

- **Event Cycle**
  The selectable range is 1.5 ns to 10.00 s in 0.5-ns steps.

Note

The trigger may not operate properly if the spacing between signals or the signal pulse width is less than 2 ns. The time span accuracy is ±(0.2% of set value + 1 ns) in standard operating conditions after calibration. The set value is equal to the T2 value when the pulse width is greater than T1 and less than T2.

- **Event Delay and Event Sequence**
  - When the 1st and 2nd events are both set to analog signals or both set to logic signals
    The selectable range is 1.5 ns to 10.00 s in 0.5-ns steps.
  - When the 1st and 2nd events are mixture of analog and logic signals
    The selectable range is 20.0 ns to 10.00 s in 0.5-ns steps.

Note

- If the 1st and 2nd events are both set to analog signals or both set to logic signals, the trigger may not operate properly if the spacing between signals or the signal pulse width is less than 2 ns. The time span accuracy is ±(0.2% of set value + 1 ns) in standard operating conditions after calibration. The set value is equal to the T2 value when the pulse width is greater than T1 and less than T2.
- If the 1st and 2nd events are mixture of analog and logic signals, the accuracy is ±(0.2% of the set value + 10 ns). The set value is equal to the T2 value when the pulse width is greater than T1 and less than T2.
- FlexRay, LIN, and UART triggers can only be set to the 1st or 2nd event when using event delay or event sequence. You can only set the 1st or 2nd event when the trigger source is set to LINE.
- If you select the following serial trigger for the event trigger, a trigger output delay will occur. Take the delay into consideration when you set the reference time.
  FlexRay: Approx. 30 ms, LIN or UART: Approx. 150 ms

Event Type

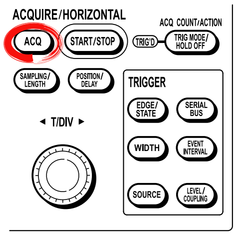
Set a trigger excluding the Edge OR trigger as an event. For details, see the respective section on each trigger.

Event Source

Set a trigger excluding the Edge OR trigger as an event source. For details, see the respective section on each trigger.

8.1 Setting the Acquisition Mode

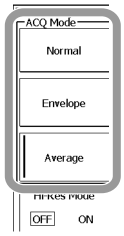
Procedure



Selecting the Acquisition Mode

1. Press **ACQ**.

2. Press a soft key from **Normal** to **Envelope** to select the mode.
If you select Average, proceed to step 3.



Setting the Attenuation Constant of the Exponential Average

(When the acquisition mode is Average and the trigger mode is Auto, Auto Level, or Normal)

3. Use the **rotary knob** to set the attenuation constant (Weight).

Setting the Simple Average Acquisition Count

(When the acquisition mode is Average and the trigger mode is Single)

3. Use the **rotary knob** to set the acquisition count.

(When the acquisition mode is Average and the trigger mode is N Single)

3. Press the **TrigMode** soft key to display the trigger mode menu.

4. Press the **N** soft key so that turning the rotary knob will adjust the value of N.

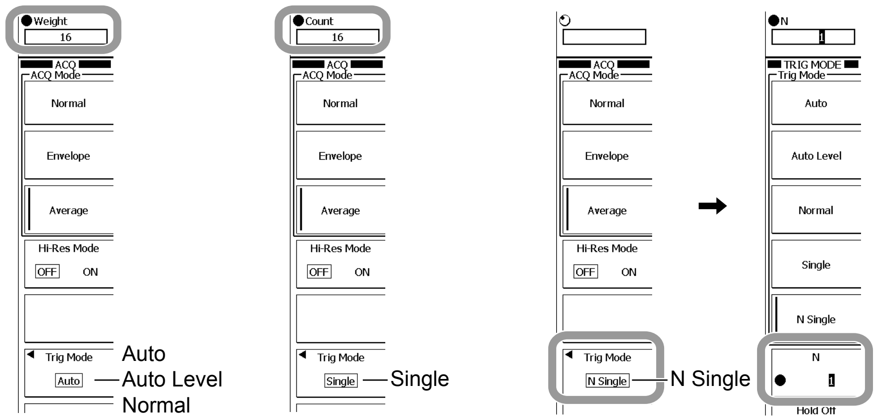
5. Use the **rotary knob** to set the acquisition count.

Acquisition mode: Average

When the trigger mode is Auto, Auto Level, or Normal

When the trigger mode is Single

When the trigger mode is N Single



8
Acquisition and Display

Explanation

Acquisition Modes

You can select the acquisition mode from one of the following. The default setting is Normal.

- **Normal Mode**
  The SB5000 saves sampled data to the acquisition memory without performing any special data processing.

- **Envelope Mode**
  The SB5000 samples data at 2.5 GS/s. It determines the highest and lowest values from the sampled data stream at each acquisition interval, saves those values to the acquisition memory, and displays the values in an envelope waveform.

- **Averaging Mode**
  The SB5000 averages the sampled data and saves it to the acquisition memory. The averaging method varies depending on the trigger mode.
  - When the trigger mode is Auto, Auto Level, or Normal, exponential averaging is used. Set the attenuation constant to a value from 2 to 1024.
  - When the trigger mode is Single or N Single, simple averaging is used. Set the sampled data acquisition count to a value from 2 to 65536.
    - In Single mode, set the acquisition count from the acquisition mode menu.
    - In N Single mode, set the acquisition count from the trigger mode menu.

Exponential average
(When the trigger mode is Auto, Auto Level, or Normal)

$$A_n = \frac{1}{N}\{(N-1)A_{n-1} + X_n\}$$

A_n: n^{th} average
X_n: n^{th} measured value
N: Attenuation constant
(2 to 1024, in powers-of-2 increments)

Simple average
(When the trigger mode is Single or N Single)

$$A_N = \frac{\sum_{n=1}^{N} X_n}{N}$$

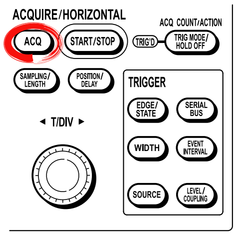
X_n: n^{th} measured value
N: Acquisition count
(2 to 65536, in powers-of-2 increments)

Notes about Averaging

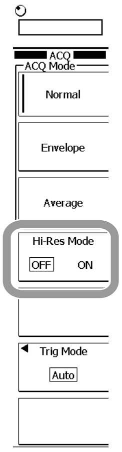
- Only repeating signals are averaged.
- Logical signals are not averaged.
- If the trigger is not consistent, and the waveform is not completely synchronized, the signal will not be averaged correctly, and the waveform will be distorted.
- Roll mode is not valid when averaging is used.
- If you stop acquisition by pressing START/STOP, averaging will also stop. When you restart acquisition, values will be averaged from the beginning.
- With simple averaging, acquisition stops when the signal has been acquired for the number of times set by the acquisition count.
- When a signal is acquired in averaging mode, the following data is saved to the history memory.
  - Exponential averaging when the trigger mode is Auto, Auto Level, or Normal
    Each waveform averaged over a set time interval is saved to a separate record.
  - Simple averaging when the trigger mode is Single
    The SB5000 averages the set number of waveforms, and saves the averaged waveform to the most recent history memory record.
  - Simple averaging when the trigger mode is N Single
    The SB5000 saves the set number of waveforms to the history memory and saves the waveform that is the average of those waveforms to a separate section in the history memory.
- The maximum record length for an averaged waveform is 1.25 MW. Even if you set the record length to a value greater than 1.25 MW, the SB5000 will change the record length to 1.25 MW when it averages waveforms.

8.2 Turning High Resolution Mode ON/OFF

Procedure



1. Press **ACQ**.
2. Press the **Hi-Res Mode** soft key to select ON or OFF.

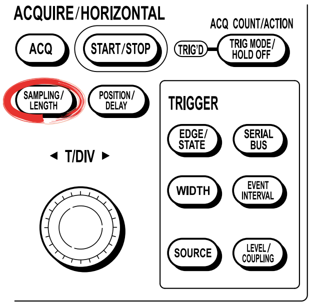


Explanation

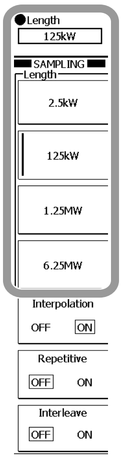
Bandwidth filtering reduces data quantization noise and enables the SB5000 to produce high resolution data that is greater than 8 bits. Normally, data is stored to the acquisition memory using 8 bits, and higher resolution data is converted to 8-bit data before it is saved. When you turn high resolution mode ON, the SB5000 saves data using 16 bits (12 effective bits). This enables the SB5000 to save high resolution data as is.
If you turn high resolution mode ON, the maximum record length will change from 6.25 MW to 2.5 MW.
If you turn high resolution mode ON when the bandwidth limit is set to FULL, the bandwidth limit will automatically change to 200 MHz.

8.3 Setting the Record Length

Procedure



1. Press **SAMPLING/LENGTH**.
2. Use the **rotary knob** to set the record length.

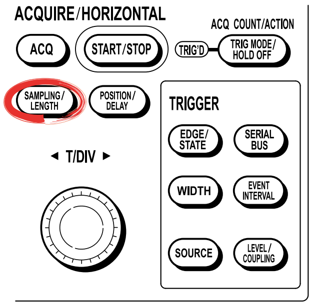


Explanation

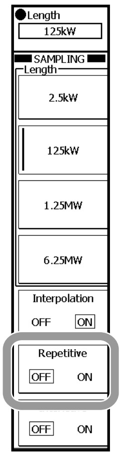
This setting determines the length of the record (amount of data) stored to the acquisition memory. The available lengths are:
2.5 kW, 6.25 kW, 12.5 kW, 25 kW, 62.5 kW, 125 kW. 25 kW, 62.5 kW, 125 kW, 250 kW, 625 kW, 1.25 MW, 2.5 MW, 6.25 MW

8.4 Turning Repetitive Sampling Mode ON/OFF

Procedure



1. Press **SAMPLING/LENGTH**.
2. Press the **Repetitive** soft key to select ON or OFF.



Explanation

In repetitive sampling mode, the SB5000 increases the effective sample rate by taking multiple samples of a repeating signal, using the trigger point as a reference. When repetitive sampling mode and interpolation are both ON, interpolation takes precedence if the sampling rate is less than 500 GS/s. Repetitive sampling mode takes precedence if the time axis setting is less than 50 ns/div and the sample rate is greater than or equal to 500 GS/s.
Even if you turn repetitive sampling mode OFF, if interpolation is also OFF and the time axis setting is such that the record length is less than 100 points, the SB5000 will automatically use repetitive sampling.

Note about Repetitive Sampling

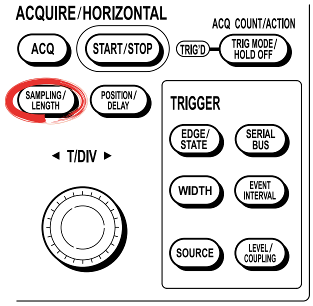
Exponential averaging is used with repetitive sampling. Even if the trigger mode is Single or N Single, simple averaging will not be used.

8

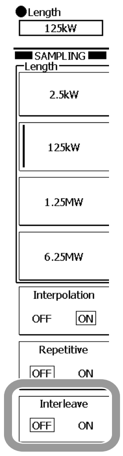
Acquisition and Display

8.5 Turning Interleave Mode ON/OFF

Procedure



1. Press **SAMPLING/LENGTH**.
2. Press the **Interleave** soft key to select ON or OFF.

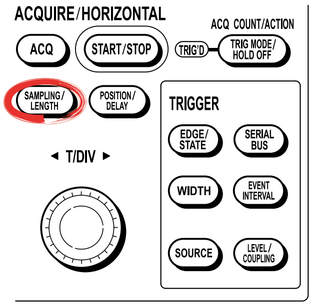


Explanation

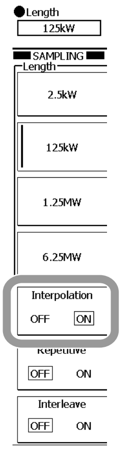
When you turn interleave mode ON, the number of usable channels decreases, but you are able to set the sample rate to 5 GS/s in realtime sampling mode.
When you set the sample rate to 5 GS/s, channels 2 and 4 automatically become unusable.
For information on the record length and sample rate limitations that accompany interleave mode, see Appendix 1, “Relationship between the Time Axis Setting, Sample Rate, and Record Length.”

8.6 Turning Interpolation ON/OFF

Procedure



1. Press **SAMPLING/LENGTH**.
2. Press the **Interpolation** soft key to select ON or OFF.



Explanation

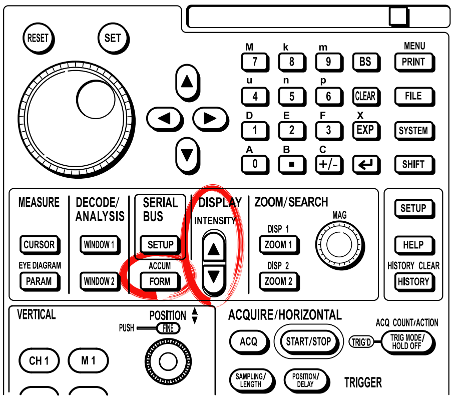
Interpolation adds up to 1000 times more data to the actual sampled data, and increases the effective sampling rate to up to 2.5 TS/s (adds up to 2000 times more data in high resolution mode).

At the maximum sample rate, the relationship between interpolation and repetitive sampling is as follows:

- When interpolation and repetitive sampling mode are both ON, if T/div is greater than 50 ns and the sample rate is less than 500 GS/s, the SB5000 uses interpolation. If T/div is less than or equal to 50 ns and the sample rate is greater than or equal to 500 GS/s or greater, the SB5000 uses repetitive sampling.
- When interpolation is ON and repetitive sampling mode is OFF, the SB5000 interpolates at the set record length.
- When interpolation is OFF and repetitive sampling is ON, the SB5000 performs repetitive sampling at a record length of 1.25 MW or less.
- When interpolation and repetitive sampling are both OFF, if the sample rate is set higher than the maximum sample rate for the current record length, the record length will be shortened. When the record length is less than 100 W, repetitive sampling is performed.

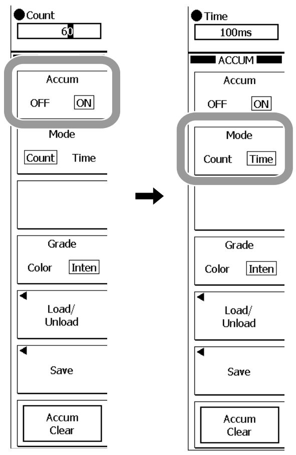
8.7 Displaying Accumulated Waveforms

Procedure



Setting the Accumulation Mode

1. Press **SHIFT**+**FORM** (ACCUM).
2. Press the **Accum** soft key to switch accumulation ON.
3. Press the **Mode** soft key to select the accumulation mode.

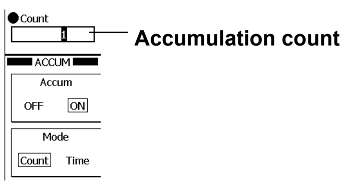


Setting the Accumulation Count or the Accumulation Time

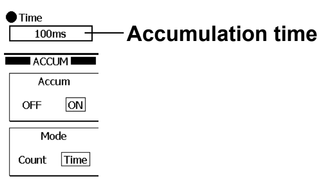
4. Use the **rotary knob** to set the value.

Count	0 (infinite) 1 to the number of history waveforms
Time	Infinite 100 ms to 1 s, set in 100-ms intervals 1 s to 10 s, set in 0.2-s intervals 10 s to 100 s, set in 2-s intervals

When the accumulation mode is Count

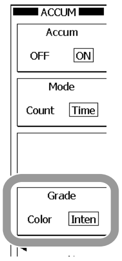


When the accumulation mode is Time



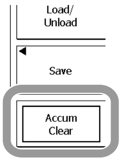
Setting the Gradation (Grade) Mode.

5. Press the **Grade** soft key to select Color or Inten.
You can use the **INTENSITY** arrow keys on the front panel to change the brightness level of the screen.



Clearing Accumulated Waveforms

6. Press the **Accum Clear** soft key to clear the accumulated waveforms.
When waveform accumulation is set to ON using the Accum soft key, waveforms will begin re-accumulating immediately after the previously accumulated waveforms are cleared.



Saving and Loading Accumulated Waveforms

- **Saving an Accumulated Waveform**

7. Press these soft keys: **Save** > **Trace**.
A menu for selecting the waveform will appear.

8. Press the soft key that corresponds to the waveform that you want to save.

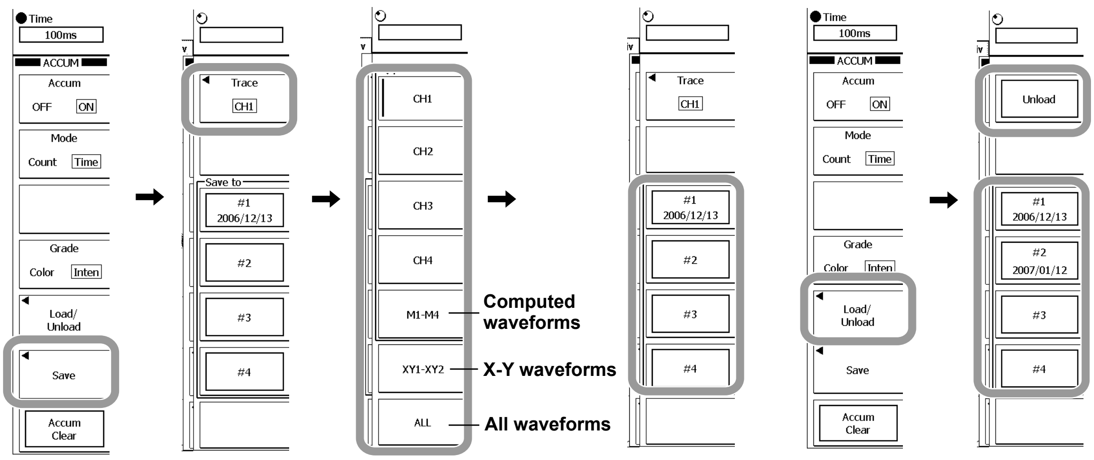
9. Press the soft key that corresponds to the internal memory number that you want to save to.

- **Loading an Accumulated Waveform**

10. Press the **Load/Unload** soft key.

11. Press the soft key that corresponds to the internal memory number that the waveform you want to view is saved to.
- If another waveform is currently loaded, it will be overwritten by the newly loaded waveform.
- To unload the currently loaded accumulated waveform, press the Unload soft key.

Save **Load**



Explanation

Ordinarily, momentary waveform anomalies are difficult to recognize because the display is updated whenever the trigger is activated. The accumulated waveform display allows you to observe momentary anomalies by continuing to display each acquired data waveform for a set time.

Modes

- Count
  Displays an accumulated waveform that consists of the current waveform and a set number of waveforms before it.
- Time
  Continues to display acquired waveforms for a set period of time. A waveform's intensity decreases as time passes.

Gradation Modes

- Color
  Waveforms are divided into 15 levels based on their frequency of occurrence, starting with blue for the lowest frequency and shifting to green, yellow, red, and then white as the frequency increases.
- Inten
  The frequency of occurrence of a waveform is indicated using intensity.

Accumulation Count

When the accumulation mode is Count, set the number of waveform accumulations to a number from 0 to the number of history waveforms. Waveforms will accumulate infinitely if you choose 0. The default value is the maximum number of history waveforms.

Accumulation Time

When the mode is Time, you can choose to accumulate waveforms infinitely, or for a period of time between 100 ms and 100 s. The default value is 100 ms.
Waveforms will accumulate infinitely if you choose Infinite.

Notes about Displaying Accumulated Waveforms

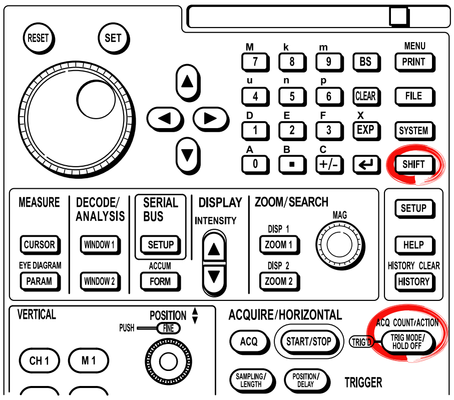
- The SB5000 performs GO/NO-GO determinations and automated measurements of waveform parameters on the most recent waveform.
- If you stop acquisition by pressing START/STOP, accumulation will also stop. When you restart, accumulation will also restart, but the previously accumulated waveforms will be cleared.
- If you change the display format while the SB5000 is displaying accumulated waveforms, it will perform the following operations.
  - During accumulation
    The SB5000 will clear the accumulated waveforms and show the new display.
  - When accumulation has been stopped in Time mode
    The SB5000 will not clear accumulated waveforms.
  - When accumulation has been stopped in Count mode
    If the accumulation is infinite, the SB5000 will display however many accumulated history waveforms have been maintained. The display may change. If the accumulation is not infinite, the SB5000 will display the set number of accumulated history waveforms.

Saving and Loading Accumulated Waveforms

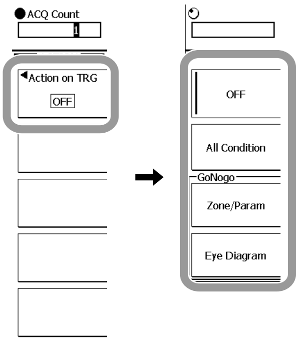
You can save accumulated waveforms to four internal memory locations.
Saved accumulated waveforms can be loaded and displayed. Loaded accumulated waveforms will be displayed in white.

8.8 Setting the Action-On-Trigger Function

Procedure



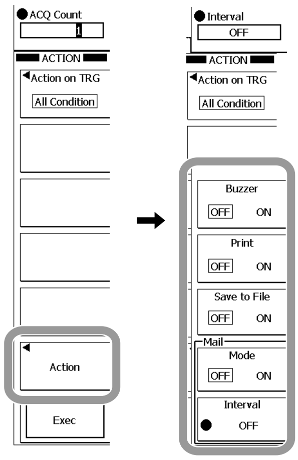
1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press the **Action on TRG** soft key.
3. Press the soft key that corresponds to the appropriate mode.



- OFF
  Acquires the set number of signals. No action is performed.
- All Condition
  When a trigger is activated, the signal is acquired and the specified actions are performed. This stops when the signal has been acquired a set number of times.
- Zone/Param
  See sections 8.10 to 8.15.
- Eye Diagram
  See section 8.16.

Setting the Triggered Actions

4. Press the **Action** soft key.
5. Press an individual action's soft key to turn it ON or OFF.
   If you turn Mail-Mode ON, set the Interval with the rotary knob.
6. Press **ESC** to return to the previous screen.

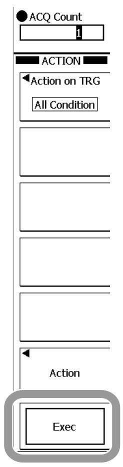


Setting the Signal Acquisition Count

7. Use the **rotary knob** to set the signal acquisition count.

Activating the Action-On-Trigger Function

8. Press the **EXEC** soft key to begin acquiring the signal and to activate the action-on-trigger function.
   The Exec soft key changes to the Abort soft key.



Stopping the Action-On-Trigger Function

9. Press the **Abort** soft key or **START/STOP** to stop the action-on-trigger function and the acquisition of the signal.

Explanation

Modes

You can choose one of the methods listed below for triggering an action. Pressing the Exec soft key will temporarily switch the trigger mode to Normal and cause the selected actions to be executed. This does not affect the trigger mode set according to the procedure outlined in section 7.1.

- **OFF**
  The SB5000 will acquire the number of signals specified by ACQ Count and then stop.
- **All Condition**
  The SB5000 executes the specified actions whenever a trigger is activated. The SB5000 will acquire the number of signals specified by ACQ Count and then stop.
- **Zone/Parameter(GoNogo)**
  The SB5000 returns GO/NO-GO results based on zone and parameter conditions. The SB5000 executes the specified actions whenever the returned result is no-go. You can set up to four zone and parameter conditions. You can also set the logic between the conditions (AND/OR). The SB5000 will stop after it has acquired the number of signals specified by ACQ Count, or after the set conditions are met for the number of times specified by Nogo Count.
- **Eye Diagram (GoNogo)**
  The SB5000 returns GO/NO-GO results based on a FlexRay Eye Diagram or a Telecom Test. The SB5000 executes the specified actions whenever the result is no-go. You can set up to four FlexRay Eye Diagram and Telecom Test conditions. You can also set the logic between the conditions (AND/OR). The SB5000 will stop after it has acquired the number of signals specified by ACQ Count, or after the conditions are met for the number of times specified by Nogo Count.

Trigger Actions

You can select the following actions to be performed when a trigger is activated.

- **Buzzer**
  The SB5000 generates an alarm.
- **Print**
  Prints or saves the display image data using the printer or storage medium set by the Copy to option in the PRINT menu. (Set the Copy to option in the PRINT menu to Printer to print to the internal printer. Set it to USB to print to a USB printer).
- **Save to File**
  Saves the measured data to the save destination specified in the FILE menu (PC card or USB storage). You can choose to save the data in binary, ASCII, or floating point format. The data format is determined by the data type option in the FILE menu (see section 14.5).
- **Mail-Mode/Interval**
  Sends an e-mail to the specified address (if the SB5000 is equipped with the Ethernet interface option).
  To set the e-mail address, see section 16.4.

Note

When you set e-mail transmission as a trigger action, we recommend that you set a limit on the mail transmission number to avoid overloading the mail server. You can set the upper limit for mail transmissions to the ACQ Count or to the Nogo Count (Nogo Count can only be set when GO/NO-GO determination is used).

Action Count

- 1 to 1000000
  The SB5000 performs the specified action for the set number of times.
- Infinite
  The SB5000 continues performing the specified actions until signal acquisition is stopped.

Operations Performed for the Print and Save to File Actions

Operations are performed in accordance with the settings made in the PRINT and FILE menus. To access these menus and their settings, see chapter 13, “Printing Screen Images,” section 14.5, “Saving/Loading the Measurement Data,” and section 14.9, “Saving Screen Image Data.” When the File Menu’s automatic naming function is OFF, file names will be assigned through numbering. If automatic naming is not OFF, file names will be assigned according to the specified method.

Trigger Mode

The trigger mode is always Normal.
This is independent from the trigger mode set according to the procedures described in chapter 7.

GO/NO-GO Determination

For information about GO/NO-GO determination, see sections 8.10 to 8.16.

Mail Transmission Operations

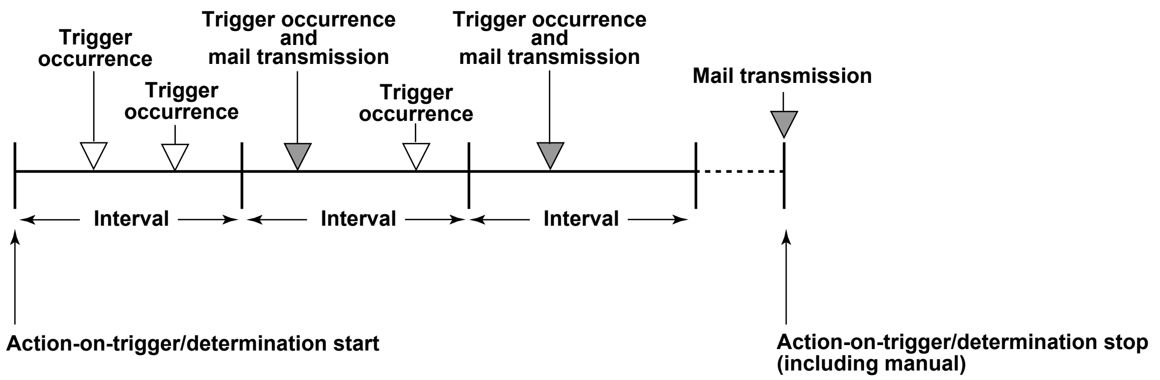
Mail-Mode ON/OFF

When Mode is ON, e-mails will be sent to the address specified in: SYSTEM menu > Network > E-mail Setup > Address (To Address/From Address).

Interval

The SB5000 will send an e-mail at the first trigger activation after the interval specified here elapses. An e-mail will also be sent when GO-NOGO determination or the action-on-trigger function stops (stopping includes manual stops).
The e-mail transmission interval can be set to a value from OFF to 1440 min, in 1-min steps. If you select OFF, an e-mail will be sent whenever a trigger is activated.

- **An example of e-mail transmission with a set interval:**



E-Mail Content

The e-mail content varies depending on the selected actions and GO/NO-GO conditions. For information about e-mail content when Nogo is set as an action, see page 8-19.

- **When All Condition Is Set as an Action**

<Subject>:	The subject of the e-mail. It may be labeled differently depending on the e-mail software (as “title” for example). The content of the subject is as follows: All Condition Triggered Report (No.) or All Condition Interval Report (No.). The number in parentheses is the number of returned no-go results.
[Comment]:	Comments
[Trigger Date and Time]:	The trigger date and time
[ACQ Count]:	The action count

Example of a Typical E-Mail

<Subject> All Condition Interval Report 2

---Body

[Comment]	Sample-All Condition
[Trigger Date and Time]	2006/03/01 16:47:04
[ACQ Count]	1367

Note

Points to Consider When Setting the Action-on-Trigger Function

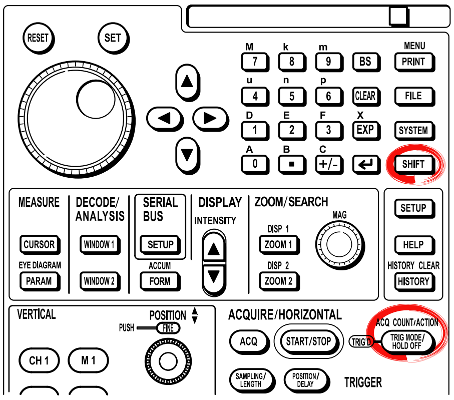
- You cannot change settings while the action-on-trigger function is active.
- Exponential averaging is used.
- When repetitive sampling mode is ON, the SB5000 performs GO/NO-GO determination on each history waveform.

Points to Consider When Setting Save to File as an Action

- Do not set the storage medium’s root directory as the save destination.(The SB5000 can only store 512 files to the root directory of a storage medium that it uses.)
- If you set sequential numbering as the automatic naming method (using the FILE menu), as the number of saved files increases, the amount of time required to save a file will also increase. Also, the maximum number of files that can be saved using sequential numbering is 1000. To save more than 1000 files, set the automatic naming function to name files by date.
- If you use the automatic naming function to save data to files, GO/NO-GO determination will stop if the same file name exists in the same directory. To prevent this from happening, you can either create a new empty directory before you start GO/NO-GO determination, or you can make sure that there are no files in the destination directory.
- Up to 2500 files and directories can be displayed in the file list. If there are more than a total of 2500 files and directories in a given directory, the file list for that directory will only display 2500 files and directories. There is no way to set which files and directories are displayed.

8.9 Activating the Action-On-Trigger Function Using GO/NO-GO Results

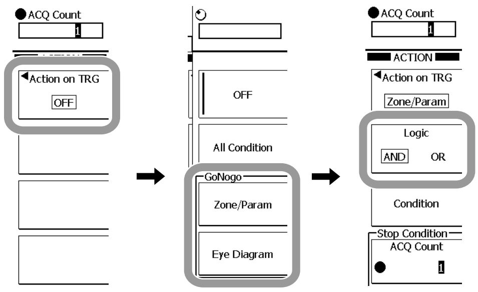
Procedure



1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press the **Action on TRG** soft key.
3. Press the **Zone/Param** or **Telecom Test** soft key.

Selecting the Logic to Apply to the Results

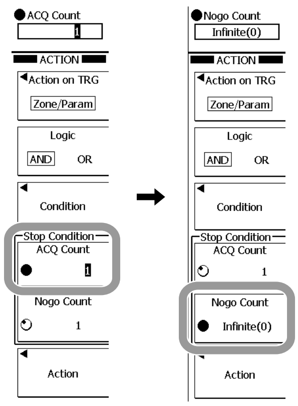
4. Press the **Logic** soft key to select AND or OR.



You can set up to four GO/NO-GO conditions. You can set the SB5000 to return a no-go result when all of the conditions are met (AND) or when one of the conditions is met (OR).

Setting the Number of Determinations

5. Press the **ACQ Count** soft key.
6. Use the **rotary knob** to set ACQ Count (the number of determinations).
7. Press the **Nogo Count** soft key.
8. Use the **rotary knob** to set Nogo Count.

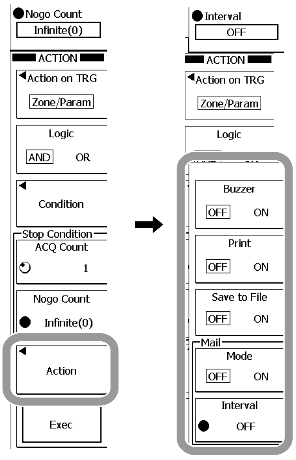


Setting the Action

9. Press the **Action** soft key.

10. Press the **Buzzer**, **Print**, and **Save** soft keys to turn them ON or OFF.

11. Press **ESC**.

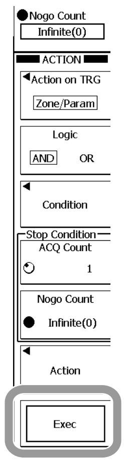


Initiating GO/NO-GO Determination

12. Press the **Exec** soft key.

The Exec soft key changes to the Abort soft key. When determination finishes, acquisition will stop automatically.

To stop determination manually, press the Abort soft key or START/STOP.



Stopping Determination

13. When determination stops, acquisition will also automatically stop.

To stop determination manually, press the **Abort** soft key or **START/STOP**.

Explanation

When the SB5000 detects the specified GO/NO-GO conditions, it activates an action-on-trigger.
To set GO/NO-GO conditions, see sections 8.10 to 8.16.

Modes

You can select one of the following modes.

- **Zone/Param**

  If you select Zone/Param, you must further specify the GO/NO-GO conditions by selecting one of the following determination modes. For details, see section 8.10 to 8.15.

Wave	The SB5000 returns GO/NO-GO results based on a waveform zone. For information about configuring this mode, see section 8.10.
Rect	The SB5000 returns GO/NO-GO results based on a rectangular zone. For information about configuring this mode, see section 8.11.
Polygon	The SB5000 returns GO/NO-GO results based on a polygonal zone. For information about configuring this mode, see section 8.12.
Parameter	The SB5000 returns GO/NO-GO results based on waveform parameters, XY waveform parameters, or FFT parameters. To set waveform parameters, see section 8.13. To set FFT parameters, see section 8.14. To set XY waveform parameters, see section 8.15.

- **Eye Diagram**

  The SB5000 returns GO/NO-GO results based on a FlexRay Eye Diagram or a Telecom Test. For information about configuring this mode, see section 8.16.

Setting the Logic to Apply to the GO/NO-GO Conditions

You can set up to four GO/NO-GO conditions. You can set each condition to one of the modes listed above, and you can set the logic that you want to apply to the conditions that you set.

AND	The SB5000 returns a no-go result when all of the conditions are met.
OR	The SB5000 returns a no-go result when any of the conditions is met.

Test Count

Signal acquisition stops when the specified ACQ Count or Nogo Count is reached.

- **ACQ Count**

  Set the signal acquisition count.

1 to 1000000	After the set number of signals has been acquired, acquisition stops.
Infinite (0)	Acquisition continues until you press the Abort soft key or START/STOP.

- **Nogo Count**

  The SB5000 stops acquisition after it returns the set number of no-go results.

1 to 1000	Acquisition stops after the set number of no-go results are returned.
Infinite (0)	Acquisition continues until you press the Abort soft key or START/STOP.

Actions

The following four actions can be triggered in response to GO/NO-GO results.

- **Beep**

  The SB5000 generates an alarm.

- **Print/Save Display Data**

  The SB5000 prints or saves the display image data with or to the printer or storage medium set by the Copy to option in the PRINT menu. (Set the Copy to option in the PRINT menu to Printer to print to the internal printer. Set it to USB to print to a USB printer).

- **Save Measured Data**

  The SB5000 saves the measured data to the save destination specified in the FILE menu (PC card or USB storage). You can choose to save the data in binary, ASCII, or floating point format. The data format is determined by the data type option in the FILE menu (see section 14.5).

- **E-Mail Transmission**
  The SB5000 sends an e-mail to the specified address (if it is equipped with the Ethernet interface option).
  To set the e-mail address, see section 16.4, “Configuring E-Mail Transmission.”

Operations Performed for the Print and Save to File Actions

Operations are performed in accordance with the settings made in the PRINT and FILE menus. To access these menus and their settings, see chapter 13, “Printing Screen Images,” section 14.5, “Saving/Loading the Measurement Data,” and section 14.8, “Saving Screen Image Data.” When the File Menu’s automatic naming function is OFF, file names will be assigned through numbering. If automatic naming is not OFF, filenames will be assigned according to the specified method.

Mail Transmission Operations

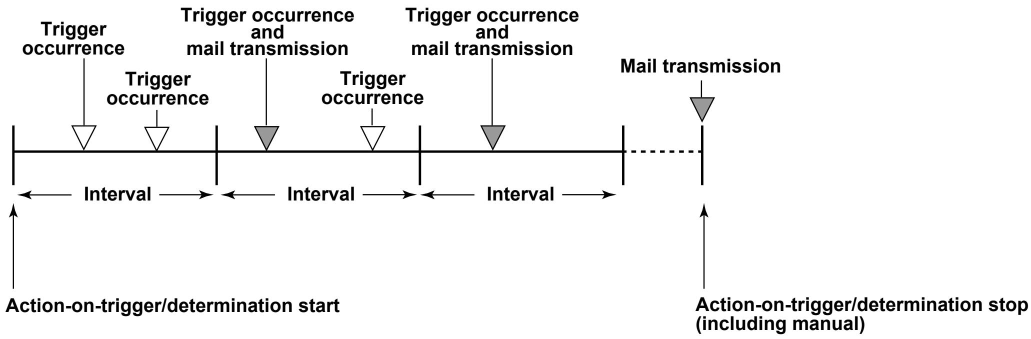
Mail-Mode ON/OFF

When Mode is ON, e-mails will be sent to the address specified in: SYSTEM menu > Network > E-mail Setup > Address (To Address/From Address).

Transmit Interval

The SB5000 will send an e-mail at the first trigger activation after the interval specified here elapses. An e-mail will also be sent when GO-NOGO determination or the action-on-trigger function stops (stopping includes manual stops).
The mail transmission interval can be set to a value from OFF to 1440 min, in 1-min steps. If you select OFF, an e-mail will be sent whenever a trigger is activated.

- **An example of e-mail transmission with a set interval.**



E-Mail Content

- **When Nogo Is Set as an Action and Interval Is Set to OFF**

<Subject>:	The subject of the e-mail. The content of the subject is as follows: GoNogo Triggered Report (No.). The number in parentheses is the number of returned no-go results.
[Comment]:	Comments
[Setup Information]:	Parameter and maximum and minimum value information about GO/NO-GO conditions 1 to 4. Logic (AND/OR) Stop Nogo/ACQ Count (The number of no-go results/the acquisition count)
[Trigger Date and Time]:	The trigger date and time
[Nogo/Exec Count]:	The number of no-go results/the number of determinations
[Nogo Factor]:	Information, including measured values, about the conditions that returned no-go results*

* Measured values are only sent for GO/NO-GO determination based on waveform parameters.

- **When Nogo Is Set as an Action and Interval Is Not Set to OFF**

<Subject>:	The subject of the e-mail. The content of the subject is as follows: GoNogo Interval Report (No.). The number in parentheses is the number of returned no-go results.
[Comment]:	Comments
[Setup Information]:	Information about GO/NO-GO conditions 1 to 4. Logic (AND/OR) Stop Nogo/ACQ Count (The number of no-go results/the acquisition count)
[TimeRange]:	The amount of time that has elapsed since the start of data acquisition
[Nogo/ExecCount]:	The number of no-go results/the number of determinations
[EachNogoCount]:	The number of no-go results for each GO/NO-GO condition (when using OR logic). This is not displayed when AND logic is used.

Example of a Typical E-Mail

```
Subject                  GoNogo Triggered Report 23
--------------------------------------------------Body
[Comment]                Sample -GoNogo
[Setup Information]      Select1:Rect(C1,Main)      (Left:-3.0000E+00,Right:-2.5000E+00,Upper: 500.00E-03,Lower:-500.00E-03,Condition:In)
                         Select2:Wave(C2,Z1)            (Range1:-5.0000E+00,Range2: 5.0000E+00,Condition:Out)
                         Select3:Polygon(C3,Z2)         (Condition:In)
                         Select4:Measure(Max(C4))       (Upper: 1.0000E+00,Lower:-1.0000E+00,Condition:Out)

                         Logic:OR
                         Stop Nogo/ACQ Count:100/100

[Trigger Date and Time]       2006/03/06 13:53:46

[Nogo/Exec Count]             23/56

[Nogo Factor]                 Select1:Rect(C1,Main)
                              Select2:Wave(C2,Z1)
                              Select3:Polygon(C3,Z2)
```

Note

Notes about GO/NO-GO Determination

- The SB5000 displays the determination results on the screen (the total number of results and the number of no-go results).
- During GO/NO-GO determination, only the Abort soft key and START/STOP are valid. (When Remote is turned ON, the Exec(One Shot) soft key is also valid.)
- The SB5000 automatically changes the trigger mode to Normal when it executes GO/NO-GO determination.

Points to Consider When Setting Save to File as an Action

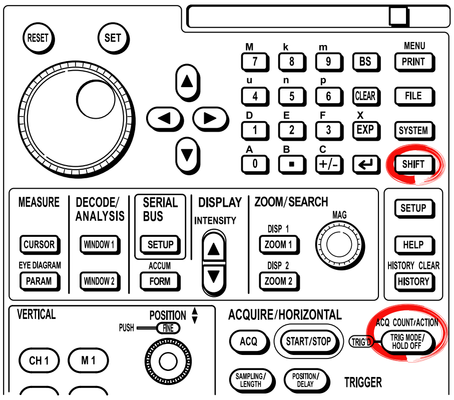
- Do not set the storage medium’s root directory as the save destination.(The SB5000 can only store 512 files to the root directory of a storage medium that it uses.)
- If you set sequential numbering as the automatic naming method (using the FILE menu), as the number of saved files increases, the amount of time required to save a file will also increase. Also, the maximum number of files that can be saved using sequential numbering is 1000. To save more than 1000 files, set the automatic naming function to name files by date.
- If you use the automatic naming function to save data to files, GO/NO-GO determination will stop if the same file name exists in the same directory. To prevent this from happening, you can either create a new empty directory before you start GO/NO-GO determination, or you can make sure that there are no files in the destination directory.
- Up to 2500 files and directories can be displayed in the file list. If there are more than a total of 2500 files and directories in a given directory, the file list for that directory will only display 2500 files and directories. There is no way to set which files and directories are displayed.

Points to Consider when Setting Mail as an Action

- We recommend that you set a limit on the mail transmission number to avoid overloading the mail server. You can set the upper limit for mail transmissions to the ACQ Count or to the Nogo Count (Nogo Count can only be set when GO/NO-GO determination is used).
- The SB5000 can attach a screen image to an e-mail when Interval is set to OFF, but it cannot attach a screen image when Interval is set to a period of time.

8.10 Setting Waveform Zone GO/NO-GO Determination Conditions

Procedure

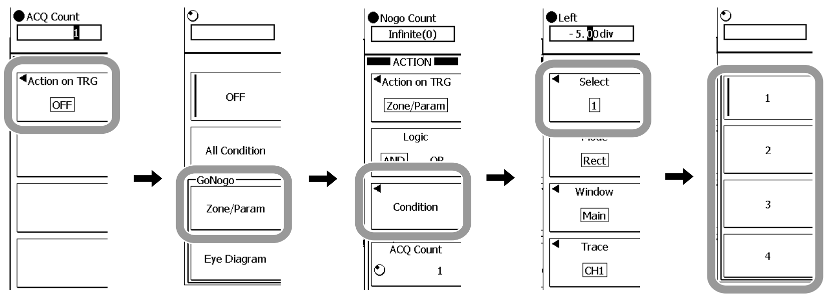


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

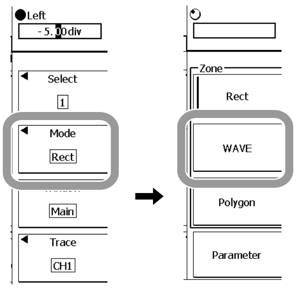
Setting a GO/NO-GO Condition Number

3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



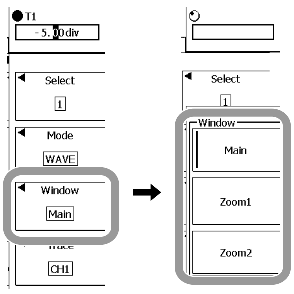
Setting the Determination Mode

5. Press these soft keys: **Mode** > **WAVE**.
   This sets the determination mode to WAVE (waveform zone).



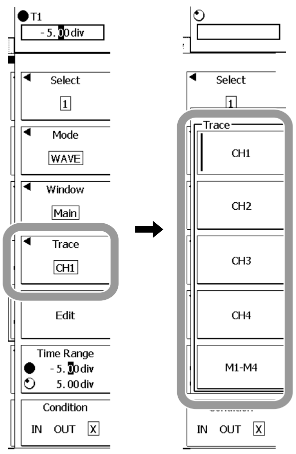
Selecting the Source Window

6. Press the **Window** soft key.
7. Select a soft key from **Main** to **Zoom2** to select the window that you want to apply the test to.



Selecting the Source Waveform

8. Press the **Trace** soft key.
9. Press the soft key that corresponds to the channel you want to determine the GO/NO-GO results for.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.

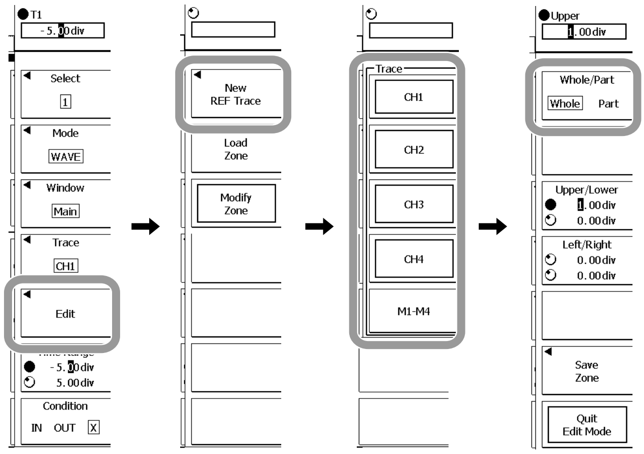


Creating a New GO/NO-GO Determination Zone

10. Press these soft keys: **Edit** > **New REF Trace**.

11. Press the soft key that corresponds to the channel that contains the waveform that will be used to create the zone.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

12. Press the **Whole/Part** soft key to select the type of zone you want to create.
- If you want to create a whole zone, select Whole and proceed to step 13.
- If you want to create a partial zone, select Part and proceed to step 21.



- **Editing a Whole Zone**

13. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the direction of the zone that you will set.

14. Use the **rotary knob** to set the boundaries of the zone.

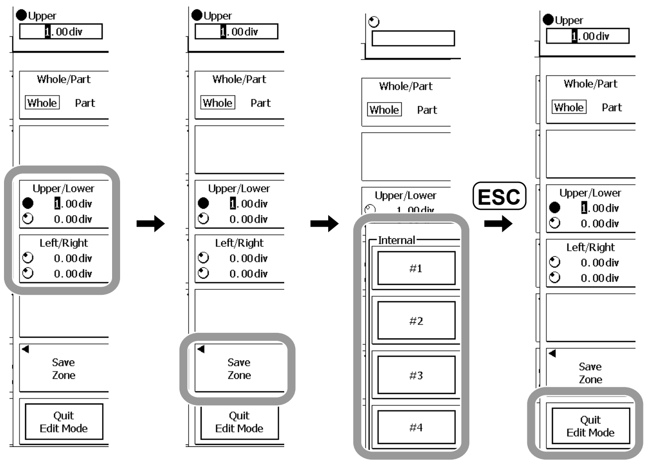
15. Repeat steps 13 and 14 to edit the zone.

16. Press the **Save Zone** soft key to open the menu for selecting the save destination for the edited zone.

17. Press the soft key from **#1** to **#4** that corresponds to the appropriate save destination number.

18. Press **ESC** to return to the previous screen.
To edit a partial zone, proceed to step 20.

19. Press the **Quit Edit Mode** soft key to leave editing mode.
When you have finished editing zones, proceed to step 34.



- **Editing a Partial Zone**

20. Press the **Whole/Part** soft key to select Part.

21. Press the **Edit Range** soft key, and then select the left or right cursor.

22. Use the **rotary knob** to set the left and right edges of the partial zone.

23. Press the **Upper/Lower** soft key to select the direction of the zone that you will set.

24. Use the **rotary knob** to set the boundaries of the zone.
You can use the rotary knob to edit the boundaries of the zone within the range that you have already set.

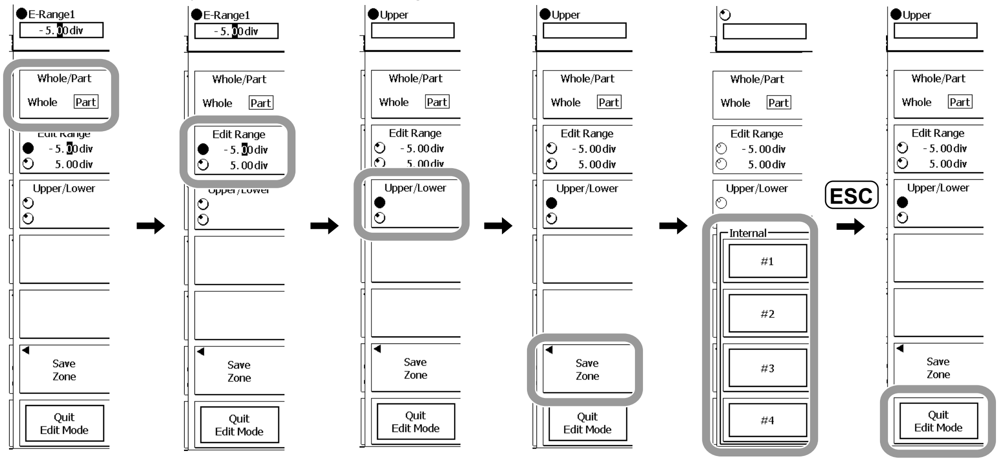
25. Repeat steps 21 to 24 to edit the zone.

26. Press the **Save Zone** soft key to open the menu for selecting the save destination for the edited zone.

27. Press the soft key from **#1** to **#4** that corresponds to the appropriate save destination number.

28. Press **ESC** to return to the previous screen.

29. Press the **Quit Edit Mode** soft key to leave editing mode.
When you have finished editing zones, proceed to step 34.



- **Editing a Zone**

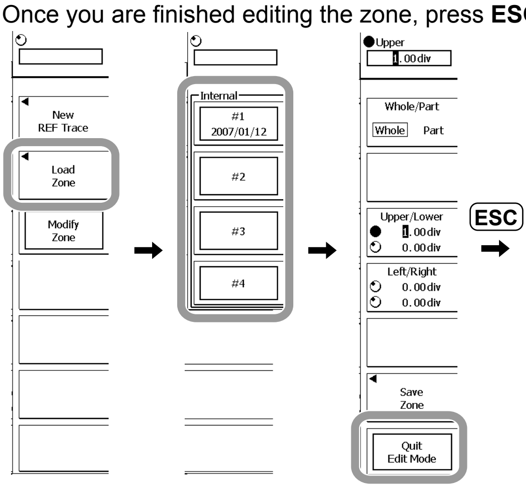
30. To edit a previously saved zone, press the **Load Zone** soft key.
If you are editing a zone that you are currently using, proceed to step 32.

31. Press the soft key from **#1** to **#4** that corresponds to the appropriate save destination number.
Proceed to step 33.

32. Press the **Modify Zone** soft key.

33. Edit the zone by following steps 13 to 29.

34. Once you are finished editing the zone, press **ESC**.



Selecting a GO/NO-GO Determination Condition

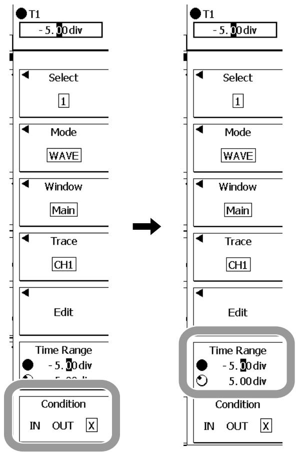
35. Press the **Condition** soft key to select IN, OUT, or X.

- If you select IN or OUT, a zone will be displayed on the screen, and in steps 36 and 37, cursors will appear to indicate the GO/NO-GO determination area.
- If you select X, the zone will not be used for GO/NO-GO determination, and the cursors indicating the GO/NO-GO determination area will not appear.

Setting the GO/NO-GO Determination Area

36. Press the **Time Range** soft key.

37. Use the **rotary knob** to set the GO/NO-GO determination area.



Repeat steps 3 to 37 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results based on whether or not the source waveform falls within the zone that you set using a reference waveform.

Reference Waveform

Select the waveform that you will use as a basis for the GO/NO-GO determination zone. You can select the reference waveform from CH1 to CH4 or from M1 to M4. You cannot select a waveform that is not displayed.

Creating a GO/NO-GO Determination Zone

You can create a maximum of four GO/NO-GO determination zones. The boundaries of the zones can be set within the following ranges:

- Upper and lower boundaries: ±8 divisions from the reference waveform
- Left and right boundaries: ±5 divisions from the reference waveform

You can choose to apply the GO/NO-GO determination zones assigned to GO/NO-GO condition numbers 1 to 4 to input signal waveforms (CH1 to CH4) and computed waveforms (M1 to M4). Any zone whose condition setting is either IN or OUT appears on the display.

Source Waveform

You can choose a waveform from CH1 to CH4 or from M1 to M4.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

GO/NO-GO Determination Area

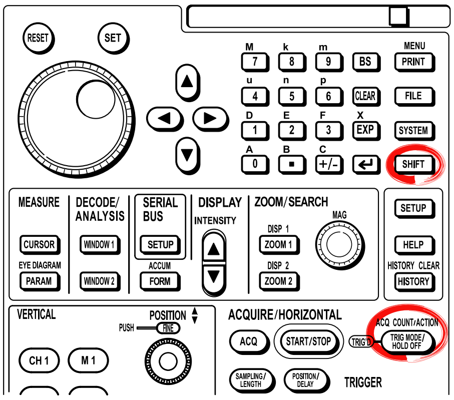
You can set the GO/NO-GO determination area to less than or equal to ±5 divisions from the time axis.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the source waveform is within the GO/NO-GO determination zone.
- OUT: The SB5000 returns a no-go result when the source waveform is outside of the GO/NO-GO determination zone.
- X: GO/NO-GO determination does not take place.

8.11 Setting Rectangular Zone GO/NO-GO Determination Conditions

Procedure

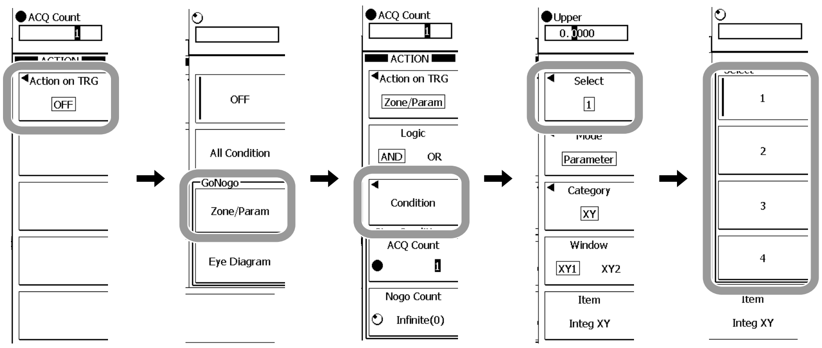


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

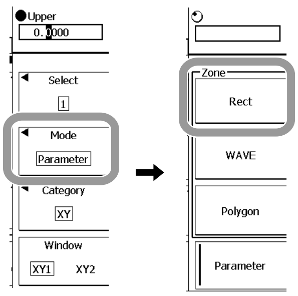
Selecting a GO/NO-GO Condition Number

3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



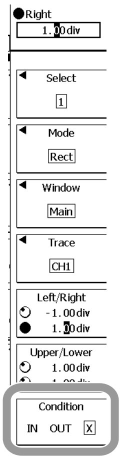
Setting the Determination Mode

5. Press these soft keys: **Mode** > **RECT**.
   This sets the determination mode to RECT (rectangular zone).



Selecting a GO/NO-GO Determination Condition

6. Press the **Condition** soft key to select IN, OUT, or X.
- If you select IN or OUT, a rectangular zone appears on the display.
- If you select X, a rectangular zone will not appear on the display, and the zone will not be used for GO/NO-GO determination.

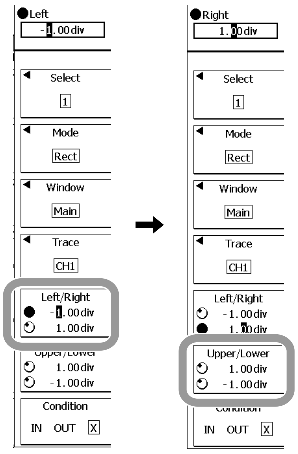


Setting the GO/NO-GO Determination Zone

7. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the direction of the zone that you will set.

8. Use the **rotary knob** to set the boundaries of the zone.

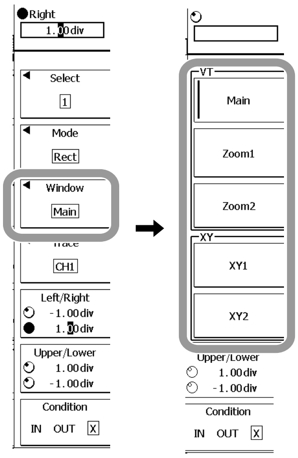
9. Repeat steps 7 to 8 to edit the zone.



Selecting the Source Window

10. Press the **Window** soft key.

11. Press a soft key from **Main** to **XY2** to select the window that you want to apply the test to.

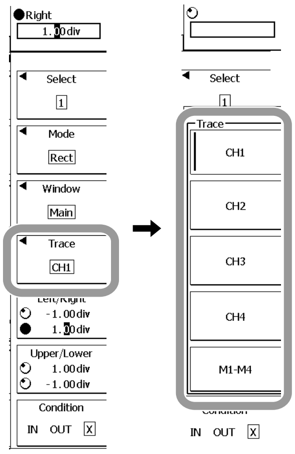


Selecting the Source Waveform

12. Press the **Trace** soft key.

13. Press the soft key that corresponds to the channel you want to determine the GO/NO-GO results for.

To select a channel from M1 to M4, press the **M1-M4** soft key first.



Repeat steps 3 to 13 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results based on whether or not the source waveform is in the rectangular zone that you set by specifying the zone's lower, upper, left, and right boundaries.

GO/NO-GO Determination Zone

You can set the area used for GO/NO-GO determination. The selectable boundaries are as follows:

- Left and right boundaries: ±5 divisions from the center of the display; the boundaries can be set in 0.01-division steps.
- Upper and lower boundaries: ±4 divisions from the center of the display; the boundaries can be set in 0.01-division steps.

Note

Rectangular zones will disappear if you set their Condition setting to X or if you turn the display for their source waveform OFF.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

Source Window

- Main: Sets the main waveform as the source.
- Zoom1: Sets the waveform in zoom box 1 as the source.
- Zoom2: Sets the waveform in zoom box 2 as the source.
- XY1: Sets the waveform in the XY1 window as the source.
- XY2: Sets the waveform in the XY2 window as the source.

Source Waveform

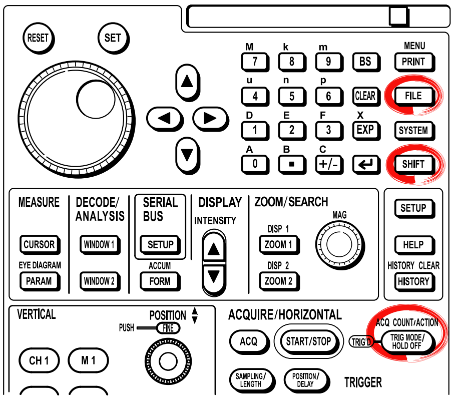
You can choose a waveform from CH1 to CH4 or from M1 to M4.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the source waveform is within the GO/NO-GO determination zone.
- OUT: The SB5000 returns a no-go result when the source waveform is outside of the GO/NO-GO determination zone.
- X: GO/NO-GO determination does not take place.

8.12 Setting Polygonal Zone GO/No-Go Determination Conditions

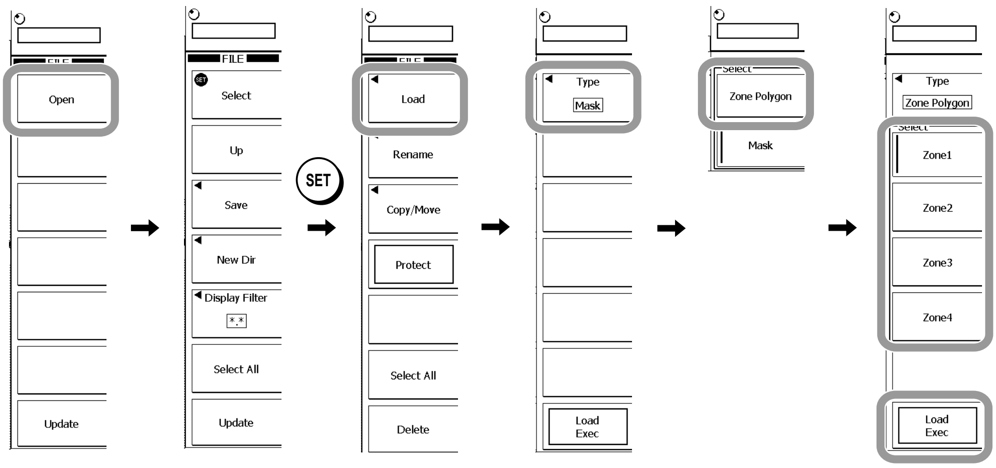
Procedure



Loading a Polygon

Follow these steps to load a polygon image file.

1. Press **FILE**.
2. Select the directory on the PC card, USB, or other storage media that the polygon image file is saved to.
3. Press the **OPEN** soft key.
4. Select the file you want to open, and press **SET**.
5. Press the **LOAD** soft key.
6. Press the **Type** soft key.
7. Press the **Zone Polygon** soft key.
8. Press the soft key that corresponds to zone number that you want to load into.
9. Press the **Load EXEC** soft key.
   The SB5000 will load the selected file.



Setting the GO/NO-GO Determination Mode

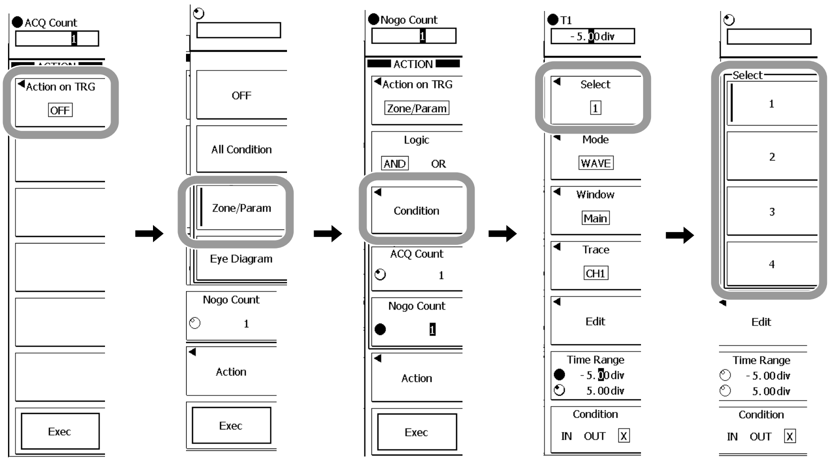
10. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).

11. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

Selecting a GO/NO-GO Condition Number

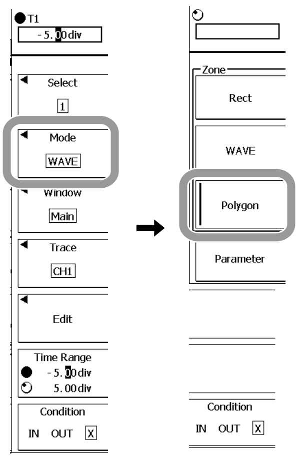
12. Press the **Select** soft key.

13. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



Setting the Determination Mode

14. Press these soft keys: **Mode** > **Polygon**.
This sets the determination mode to Polygon.



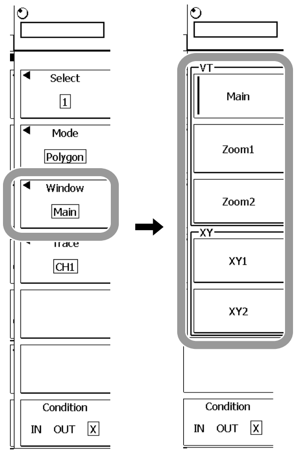
8

Acquisition and Display

Selecting the Source Window

15. Press the **Window** soft key.

16. Press a soft key from **Main** to **XY2** to select the window that you want to apply the test to.

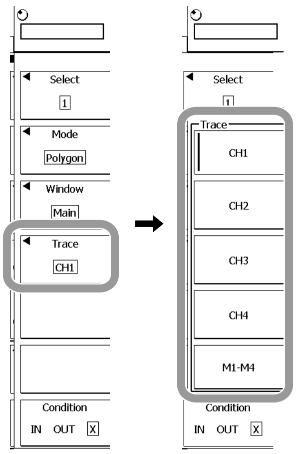


Selecting the Source Waveform

17. Press the **Trace** soft key.

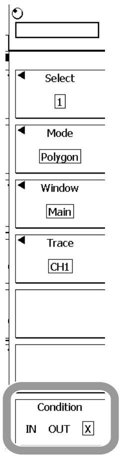
18. Press the soft key that corresponds to the channel you want to determine the GO/NO-GO results for.

To select a channel from M1 to M4, press the **M1-M4** soft key first.



Selecting a GO/NO-GO Determination Condition

19. Press the **Condition** soft key to select IN, OUT, or X.



Repeat steps 12 to 19 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results depending on whether or not the source waveform is in the polygonal zone you created on a PC and loaded onto the SB5000.

Loading a Polygon Image

You must create a polygon image file on a PC using the appropriate software, and then load it onto the SB5000 before you can use a polygonal zone for GO/NO-GO determination.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

Source Window

- Main: Sets the main waveform as the source.
- Zoom1: Sets the waveform in zoom box 1 as the source.
- Zoom2: Sets the waveform in zoom box 2 as the source.
- XY1: Sets the waveform in the XY1 window as the source.
- XY2: Sets the waveform in the XY2 window as the source.

Source Waveform

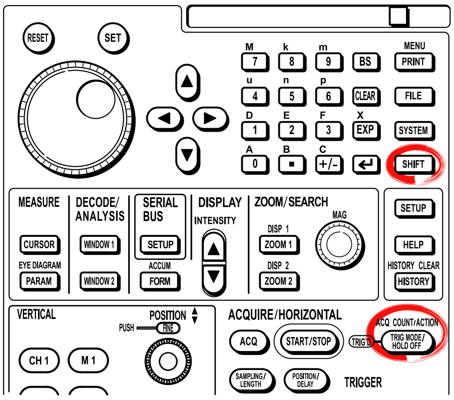
You can choose a waveform from CH1 to CH4 or from M1 to M4.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the source waveform is within the GO/NO-GO determination zone.
- OUT: The SB5000 returns a no-go result when the source waveform is outside of the GO/NO-GO determination zone.
- X: GO/NO-GO determination does not take place.

8.13 Setting Waveform Parameter GO/NO-GO Determination Conditions

Procedure

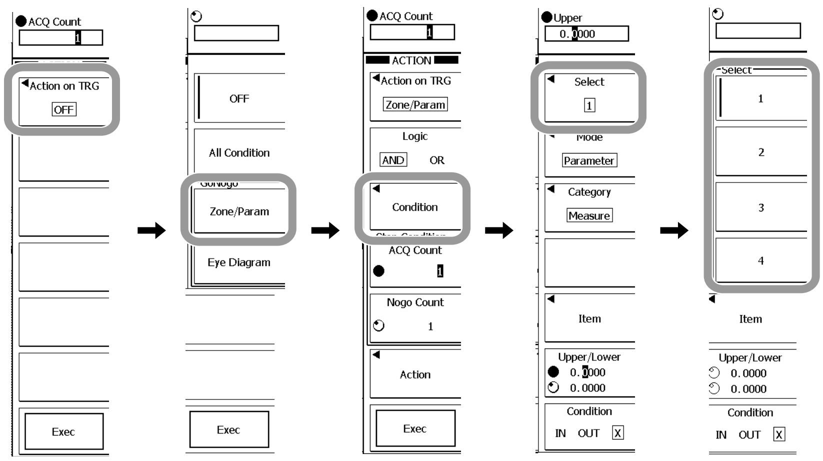


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

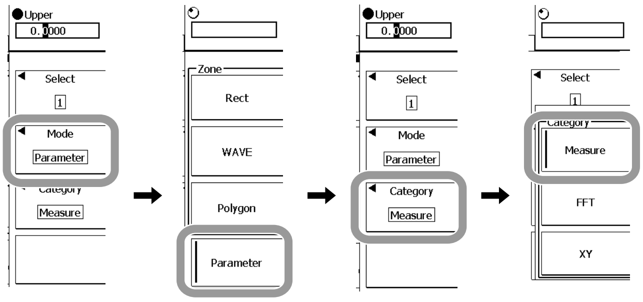
Selecting a GO/NO-GO Condition Number

3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



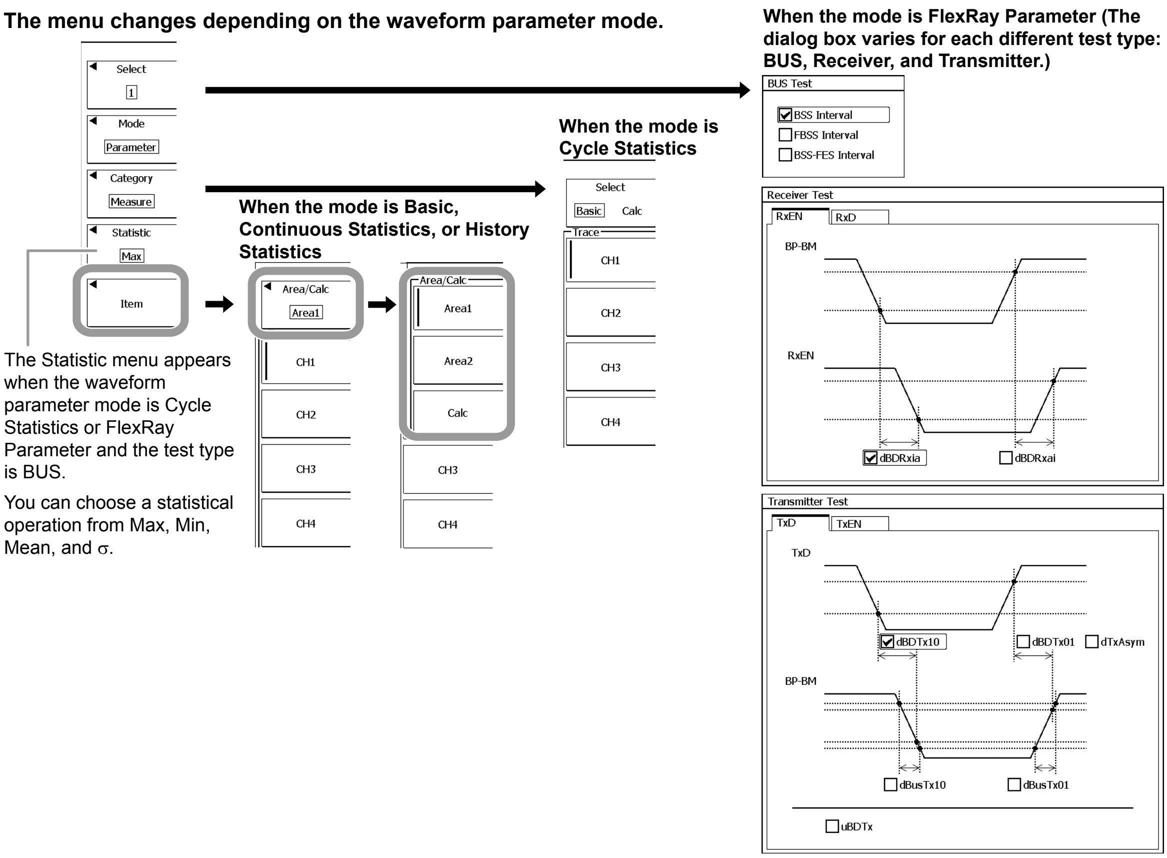
Setting the Determination Mode and Category

5. Press these soft keys: **Mode** > **Parameter**.
   This sets the determination mode to Parameter.
6. Press these soft keys: **Category** > **Measure**.
   This sets the parameter category to the automatically measured waveform parameters.



Selecting the Target Parameters

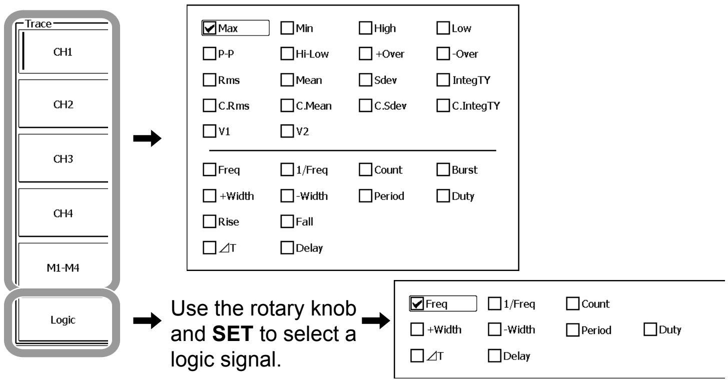
7. Press the **Item** soft key.
8. The menu that appears varies depending on the set waveform parameter mode (see sections 11.1 and 11.2 for details). Follow the instructions that correspond to the menu that appears.
   - If the waveform parameter mode is Basic, Continuous Statistics, or History Statistics, and you select Area 1 or 2, proceed to step 9.
   - If the waveform mode is Cycle Statistics and you select Basic, proceed to step 9.
   - If the waveform parameter mode is Basic, Continuous Statistics, History Statistics, or Cycle Statistics and you select Calc, proceed to step 11.
   - If the waveform parameter mode is FlexRay Parameter, set the parameter using the **rotary knob** and **SET**, and then proceed to step 12.



- **Selecting a Signal and a Waveform Parameter**

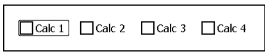
9. Press the soft key that corresponds to the appropriate signal.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- To select Logic, press the **Logic** soft key, and then press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the **rotary knob** and **SET**, and then press **ESC**.

10. Select a waveform parameter using the **rotary knob** and **SET**.
Proceed to step 12.



- **Selecting a Calculation**

11. Use the **rotary knob** and **SET** to select a calculation from Calc1 to Calc4.
You can select calculations that you set using the procedure described in section 11.2.

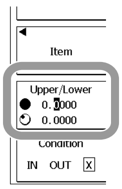


12. Press **ESC**.

Setting the GO/NO-GO Determination Range

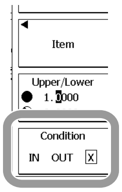
13. Press the **Upper/Lower** soft key to select the direction of the range that you will set.

14. Use the **rotary knob** to set the range's maximum and minimum values.



Selecting a GO/NO-GO Determination Condition

15. Press the **Condition** soft key to select IN, OUT, or X.



Repeat steps 3 to 15 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results depending on whether or not the automatically measured waveform parameters (see section 11.2 for details) are within the range that you set.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

GO/NO-GO Target Parameters

The SB5000 bases GO/NO-GO determination on the waveform parameters and calculated values measured in all modes.

GO/NO-GO Determination Range

You set the range by specifying its maximum and minimum values.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the waveform parameters are in the set range.
- OUT: The SB5000 returns a no-go result when the waveform parameters are outside of the set range.
- X: GO/NO-GO determination does not take place.

Note

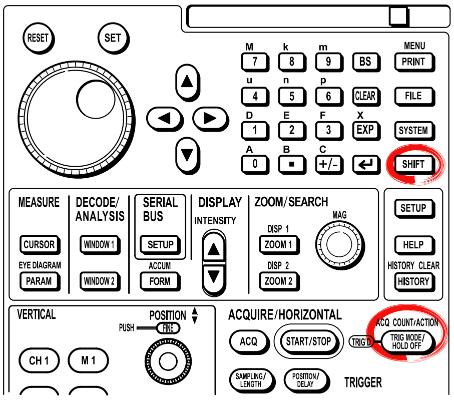
In the following circumstances, the Statistic soft key appears in the soft key menu in step 2 (when you press the Condition soft key), and the Area/Calc soft keys do not appear in step 7.

- When the waveform parameter mode is FlexRay and the test type is BUS (PARAM > Mode > FlexRay Parameter > Type > BUS; see section 11.1)
- When the waveform parameter mode is Cycle Statistics (PARAM > Mode = Cycle Statistics; see section 11.3)

Press the Statistic soft key and choose one of the following statistical operations.
Max (maximum value), Min (minimum value), Mean (mean value), σ (standard deviation)

8.14 Setting FFT Parameter GO/NO-GO Determination Conditions

Procedure

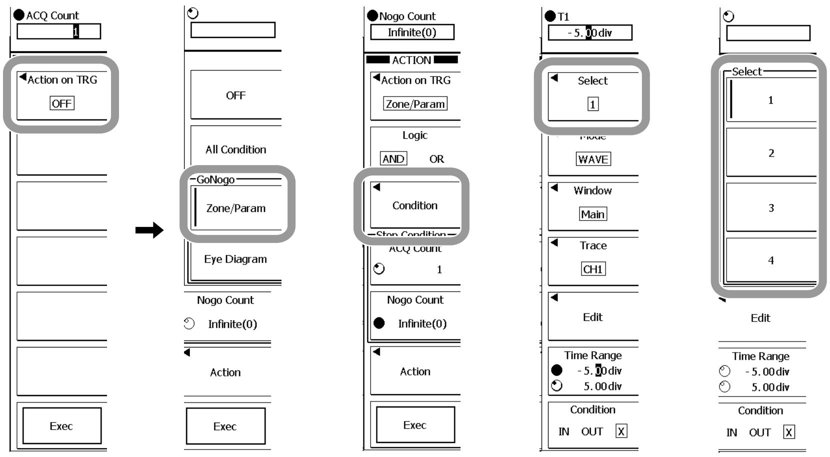


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

Selecting a GO/NO-GO Condition Number

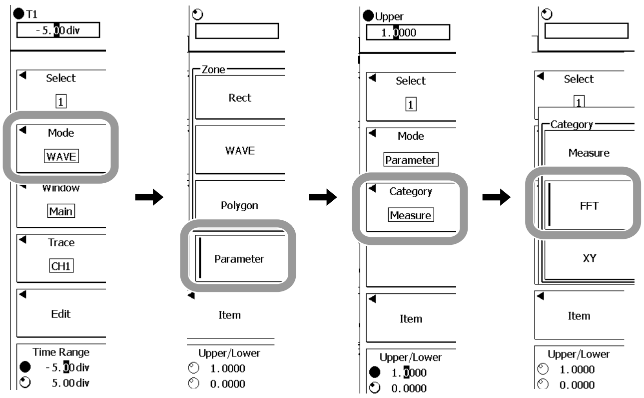
3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



Setting the Determination Mode and Category

5. Press these soft keys: **Mode** > **Parameter**.
   This sets the determination mode to Parameter.

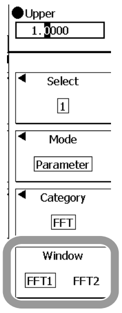
6. Press these soft keys: **Category** > **FFT**.
   This sets the parameter category to FFT.



Selecting the Analysis Item/Calculation

- **Selecting the Source Window**

7. Press the **Window** soft key to select FFT1 (the results of the analysis of Window1) or FFT2 (the results of the analysis of Window2).

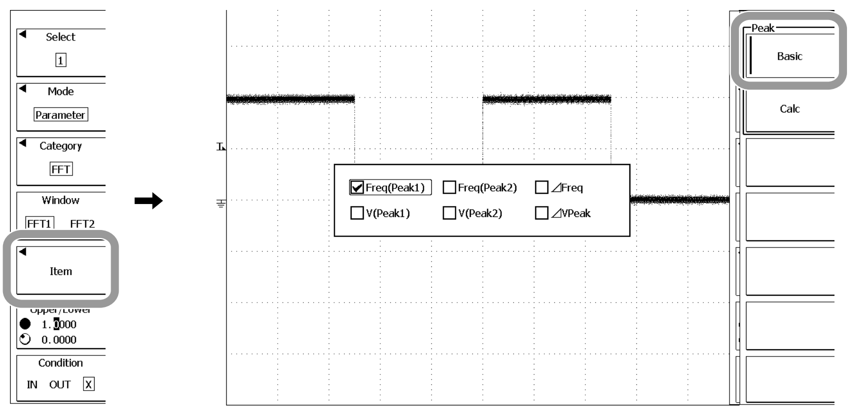


- **Selecting the Analysis Item**

8. Press the **Item** soft key.

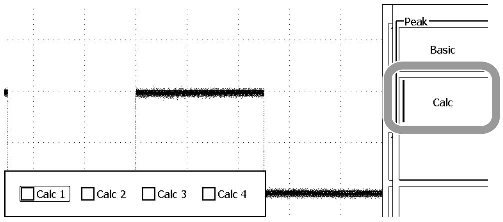
9. Press the **Basic** or **Calc** soft key.
   - If you select Basic, proceed to step 10.
   - If you select Calc, proceed to step 11.

10. Use the **rotary knob** and **SET** to select the waveform parameters.
    Proceed to step 12.



- **Selecting a Calculation**

11. Use the **rotary knob** and **SET** to select a calculation.

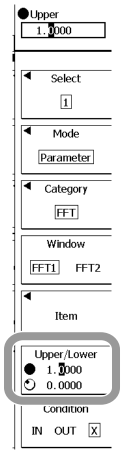


12. Press **ESC**.

Setting the GO/NO-GO Determination Range

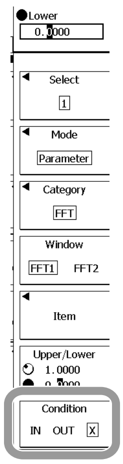
13. Press the **Upper/Lower** soft key to select the direction of the range that you will set.

14. Use the **rotary knob** to set the range's maximum and minimum values.



Selecting a GO/NO-GO Determination Condition

15. Press the **Condition** soft key to select IN, OUT, or X.



Repeat steps 3 to 15 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results depending on whether or not the FFT analysis results (see section 11.15 for details) are within the range that you set.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

Analysis Item/Calculation

- **Source Window**
  You can set the source analysis window to FFT1 (the FFT of Window1) or FFT2 (the FFT of Window2).
- **Analysis Item**
  Select the analysis that the SB5000 will apply GO/NO-GO determination to.
  - Basic: The SB5000 applies GO/NO-GO determination to the FFT analysis result (Peak).
  - Calc: The SB5000 applies GO/NO-GO determination to the result of the calculation that you set in section 11.15.

GO/NO-GO Determination Range

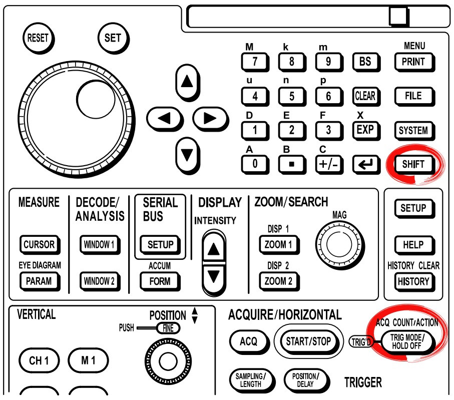
You set the range by specifying its maximum and minimum values.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the FFT parameters are in the set range.
- OUT: The SB5000 returns a no-go result when the FFT parameters are outside of the set range.
- X: GO/NO-GO determination does not take place.

8.15 Setting X-Y Waveform Parameter GO/NO-GO Determination Conditions

Procedure

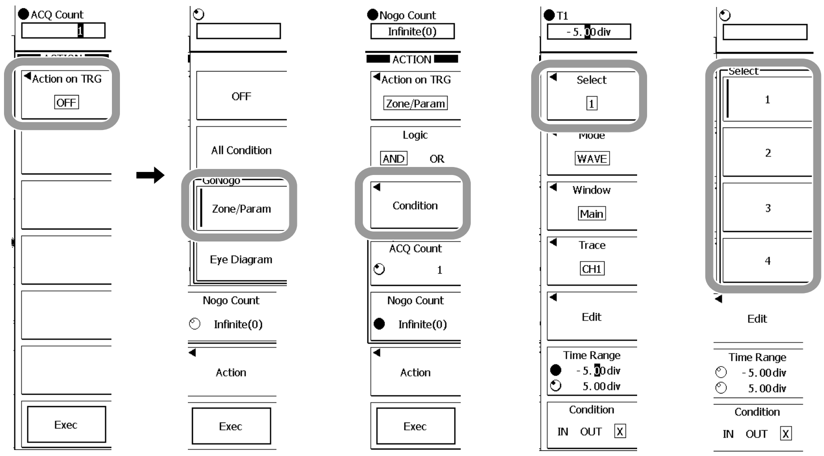


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT+TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Zone/Param** > **Condition**.

Selecting a GO/NO-GO Condition Number

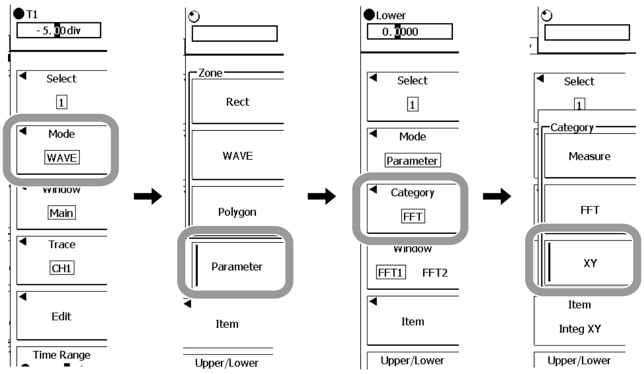
3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



Setting the Determination Mode and Category

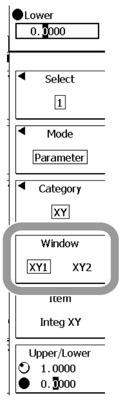
5. Press these soft keys: **Mode** > **Parameter**.
   This sets the determination mode to Parameter.

6. Press these soft keys: **Category** > **XY**.
   This sets the parameter category to X-Y waveform parameters.



Selecting the Source Window

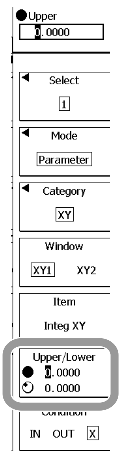
7. Press the **Window** soft key to select XY1 (the X-Y waveform of Window1) or XY2 (the X-Y waveform of Window2).



Setting the GO/NO-GO Determination Range

8. Press the **Upper/Lower** soft key to select the direction of the range that you will set.

9. Use the **rotary knob** to set the range's maximum and minimum values.

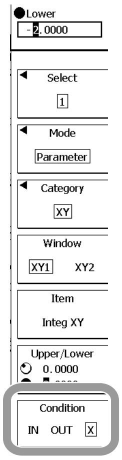


8

Acquisition and Display

Selecting a GO/NO-GO Determination Condition

10. Press the **Condition** soft key to select IN, OUT, or X.



Repeat steps 3 to 10 for GO/NO-GO conditions 1 to 4 as necessary.

Explanation

The SB5000 returns GO/NO-GO results depending on whether or not the computed values of the XY waveform area are within the range that you set.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

Source Window

You can set the source analysis window to XY1 (the area of the XY waveform of Window1) or XY2 (the area of the XY waveform of Window2).

GO/NO-GO Determination Range

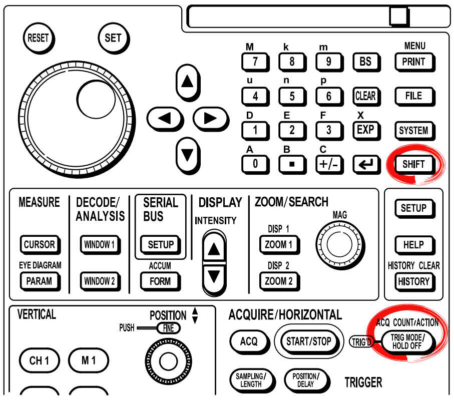
You set the range by specifying its maximum and minimum values.

GO/NO-GO Determination Condition

- IN: The SB5000 returns a no-go result when the value of the XY waveform’s area is in the set range.
- OUT: The SB5000 returns a no-go result when the value of the XY waveform’s area is outside of the set range.
- X: GO/NO-GO determination does not take place.

8.16 Setting Eye Diagram GO/NO-GO Determination Conditions

Procedure

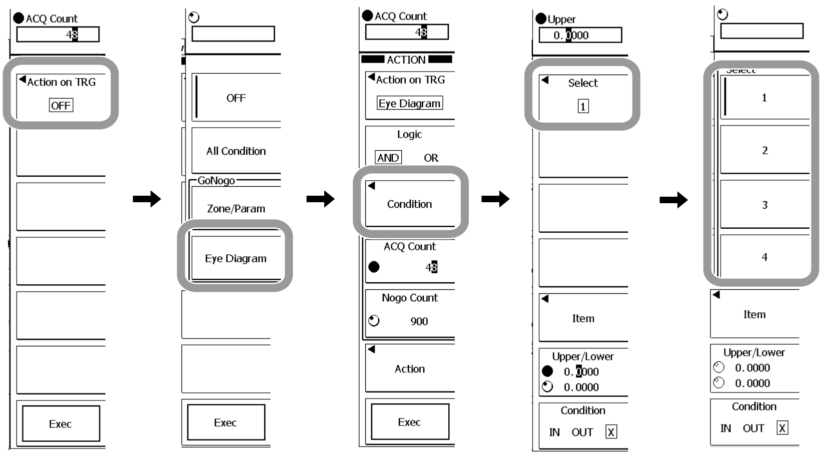


Setting the GO/NO-GO Determination Mode

1. Press **SHIFT**+**TRIG MODE/HOLD OFF** (ACQ COUNT/ACTION).
2. Press these soft keys: **Action on TRG** > **Eye Diagram** > **Condition**.

- **Selecting a GO/NO-GO Condition Number**

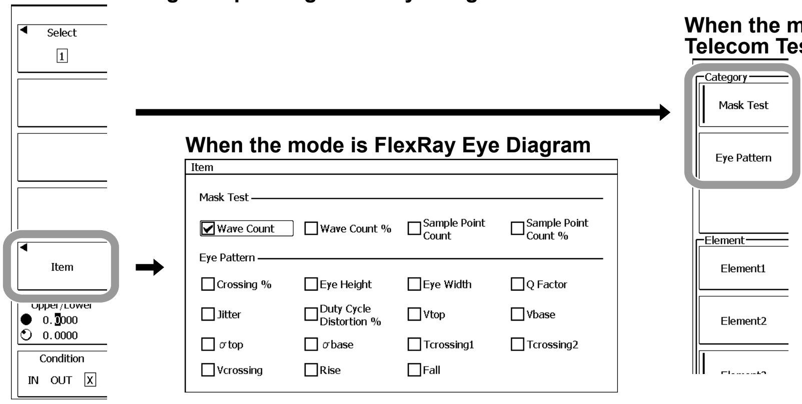
3. Press the **Select** soft key.
4. Press the soft key that corresponds to the appropriate GO/NO-GO condition number.



Setting the Target

5. Press the **Item** soft key.
6. The menu that appears varies depending on the set eye diagram mode (see sections 11.4 and 11.5 for details). Follow the instructions that correspond to the menu that appears.
   - If the eye diagram mode is FlexRay, set the parameter using the **rotary knob** and **SET**, and then proceed to step 11.
   - If the eye diagram mode is Telecom Test and you select Mask Test, proceed to step 7. If you select Eye Pattern, proceed to step 10.

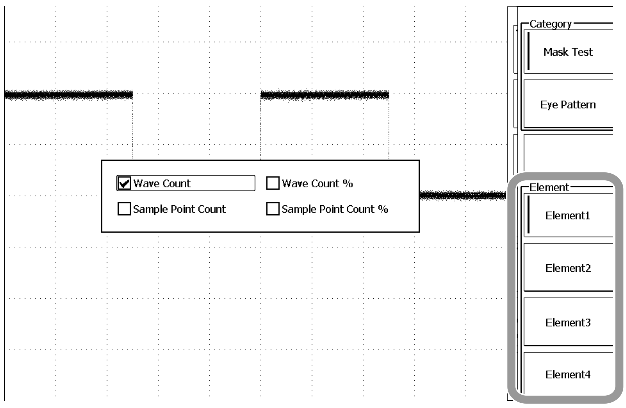
The menu changes depending on the eye diagram mode.



- **Setting Mask Test Options**

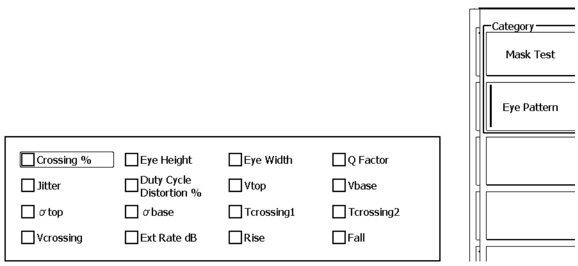
7. Press the soft key that corresponds to the appropriate element.
8. Use the **rotary knob** and **SET** to select the test items.

Proceed to step 11.



- **Setting Eye Pattern Options**

10. Use the **rotary knob** and **SET** to set the eye pattern options.

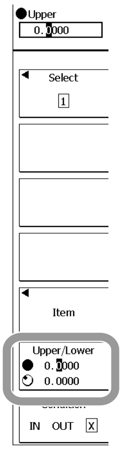


11. Press **ESC**.

Setting the GO/NO-GO Determination Range

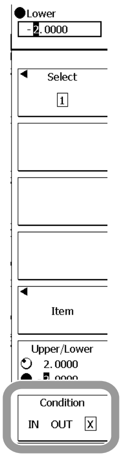
12. Press the **Upper/Lower** soft key to select the direction of the range that you will set.

13. Use the **rotary knob** to set the range’s maximum and minimum values.



Selecting a GO/NO-GO Determination Condition

14. Press the **Condition** soft key, to select IN, OUT, or X.



Repeat steps 3 to 14 for GO/NO-GO conditions 1 to 4 as necessary.

8

Acquisition and Display

Explanation

The SB5000 returns GO/NO-GO results depending on whether or not the eye diagram test parameters are within the range that you set.

GO/NO-GO Condition Number

You can choose to configure a GO/NO-GO condition from 1 to 4.

GO/NO-GO Target Parameters

- **FlexRay Eye Diagram Mask Test/Eye Pattern Results**
  You can select Mask Test or Eye Pattern. For details about these options, see section 11.4.

- **Telecom Test Mask Test/Eye Pattern Results**
  - Mask Test
    You can set Mask Test options for Element1 to Element4. For details about these options, see section 11.5.
  - Eye Diagram
    You can set Eye Pattern options. For details about these options, see section 11.5.

GO/NO-GO Determination Range

You set the range by specifying the maximum and minimum values for the specified test items.

GO/NO-GO Determination Condition

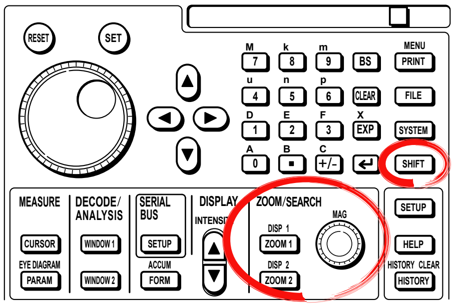
- IN: The SB5000 returns a no-go result when the test items are in the set range.
- OUT: The SB5000 returns a no-go result when the test items are outside of the set range.
- X: GO/NO-GO determination does not take place.

Note

Because the sample point count is calculated using interpolated data, the value returned for it may not correspond to the record length.

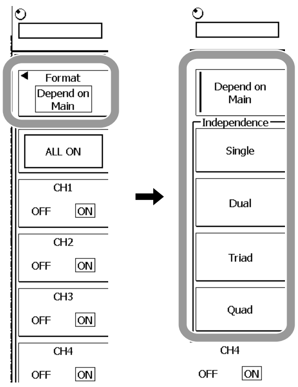
9.1 Zooming the Waveform

Procedure



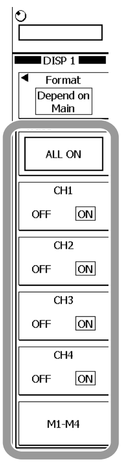
Setting the Display Format for Zoomed Waveforms

1. Push **SHIFT + ZOOM 1 (DISP 1)** or **ZOOM 2 (DISP 2)**.
2. Press the **Format** soft key.
3. Press the soft key corresponding to the desired format.



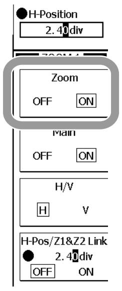
Specifying the Zoom Source Waveform

4. Press the soft key for the desired waveform and select ON or OFF.
   To select M1 to M4, first press the **M1-M4** soft key.



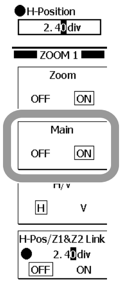
Displaying a Zoomed Waveform

5. Push **ZOOM 1** or **ZOOM 2**.
   - The key that you pressed illuminates, and the zoomed waveform and menu appear. The **Zoom** soft key will be in a condition in which ON is selected.
   - If you select OFF, only the normal waveform will be displayed, and the menu will disappear. You will not be able to carry out the subsequent steps.



Selecting Whether or Not to Display the Main Window

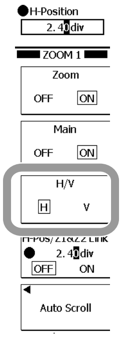
6. Press the **Main** soft key to select ON or OFF.



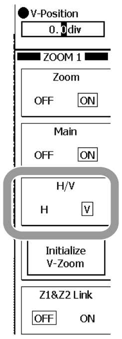
Selecting the Zoom Method

7. Press the **H/V** soft key to select the zoom method.
   H: horizontal direction
   V: vertical direction

Horizontal direction



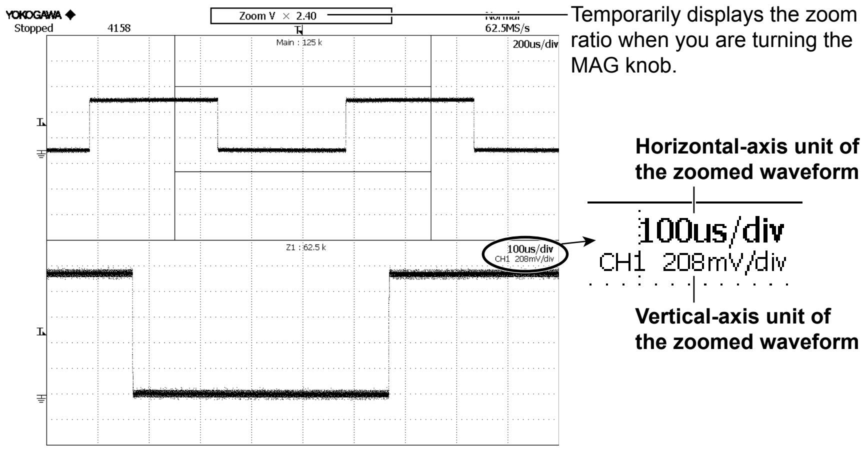
Vertical direction



Zooming into a Waveform

8. Use the **MAG** knob to zoom into a waveform.

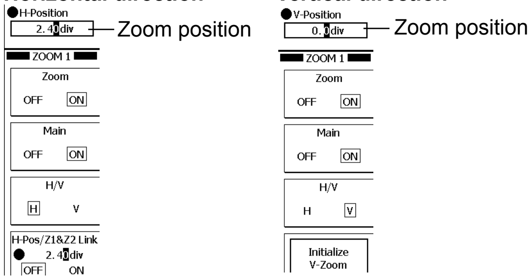
- The zoom ratio appears at the top center of the screen while you are turning the MAG knob. It disappears after a few seconds.
- The horizontal-axis unit (T/div) and vertical-axis unit (V/div) of the zoomed waveform appear at the upper right of the zoom waveform area.



Setting the Zoom Position

9. Set the zoom position with the **rotary knob**.

Horizontal direction **Vertical direction**



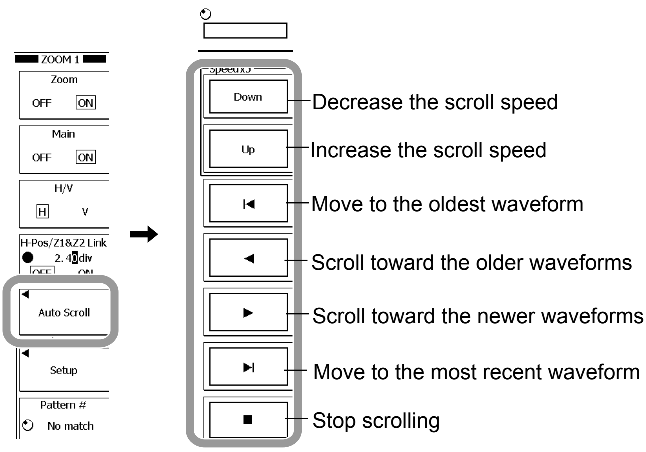
Automatically Scrolling a Zoomed Waveform

The procedure after selecting H for the zoom method in step 7 on previous page.

10. Press the **Auto Scroll** soft key.

11. Press the **Down** or **Up** soft key to switch the scroll speed.

12. Press the ⏮, ◀, ▶, ⏭, ■ soft key to execute or stop the auto scroll operation.



9

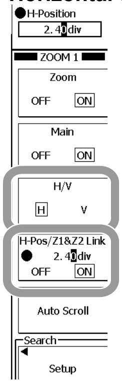
Display

Linking Zoom Boxes Z1 and Z2

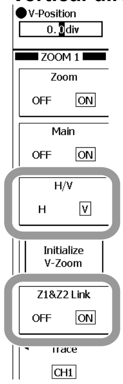
13. Press the **H/V** soft key and set it to H or V.

14. When H is selected press the **H-Pos/Z1&Z2 Link** soft key, and when V is selected press the **Z1&Z2 Link** soft key, to select ON or OFF.

Horizontal direction



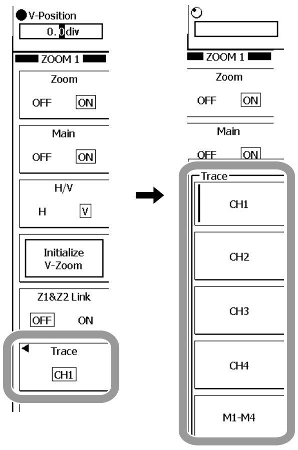
Vertical direction



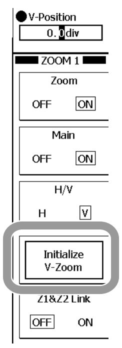
Initializing the Vertical Zoom

15. Press the **Trace** soft key.

16. Press the soft key corresponding to the desired channel.
To select M1 to M4, first switch by pressing the **M1-M4** soft key.



17. Press the **Initialize V-Zoom** soft key.



Explanation

Zoomed waveforms in two locations can be displayed simultaneously (dual zoom). You can also specify which channels to zoom. Zooming is not possible if there are less than ten points displayed on the screen (or less than 50 points for FFT waveforms).

Zoomed Waveform Display Format

You can set the waveform area's vertical display format to Depend on Main or one of these four formats: Single, Dual, Triad or Quad.

- If you select Depend on Main, the display format will be set to that selected according to the procedure in section 9.2.
- If you select Single, Dual, Triad, or Quad, the display will be set to one area, two areas, three areas, or four areas.

Zoom Source Waveform

The zoom source can be set to any of the channels that are turned ON in step 4. If you select ALL ON, the zoom source is set to all channels.

Zoom Ratio

You can set the horizontal and vertical zoom ratios separately for ZOOM1 or ZOOM2 using the MAG knob. The time and vertical axes in the zoom waveform area change automatically according to the set zoom ratio.

- You can zoom in horizontally until the number of data points in the window falls to 10. You can zoom in vertically up to 10 times.
- The horizontal zoom applies to all waveforms displayed in the window.
- The vertical zoom only applies to the specified waveform in the window.

Zoom Position

- You can set the zoom center position in the range of –5 to +5 divisions with the center of the waveform area taken to be 0 divisions.
- Zoom box Z1 is displayed using solid lines, and Z2 is displayed using broken lines.

Zoom Link

You can select whether or not to keep the relative positions of Z1 and Z2 when you change the zoom position.

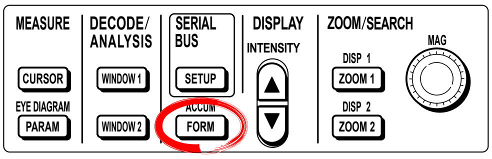
- H-Pos/Z1&Z2 Link
  Select whether or not to keep the relative horizontal positions.
- Z1&Z2 Link
  Select whether or not to keep the relative vertical positions.

Initializing the Vertical Zoom

You can initialize the vertical zoom ratio and position.

9.2 Changing the Display Format

Procedure



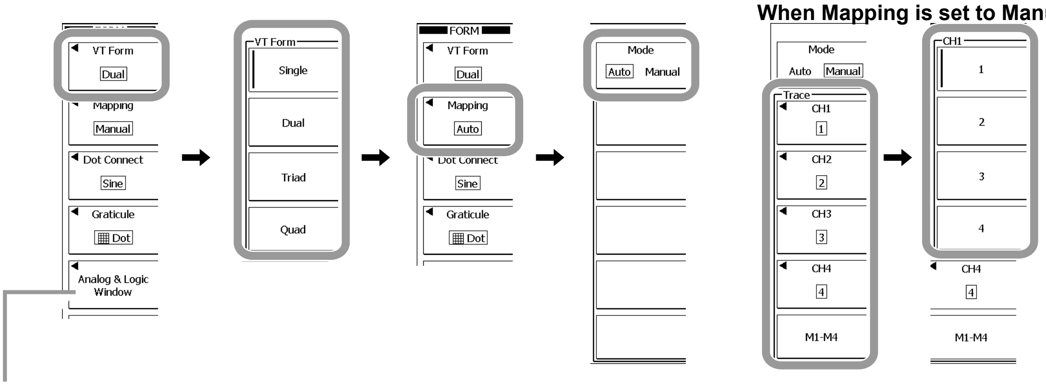
Setting the Display Format

1. Press **FORM**.
2. Press the **VT Form** soft key.
3. Press the appropriate soft key from **Single** to **Quad** to select the format.

Setting the Waveform Mapping

4. Press the **Mapping** soft key.
5. Press the **Mode** soft key to select Auto or Manual.
   If you select Manual, proceed to the next step.
6. Press the appropriate waveform soft key.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
7. Select the mapping destination from **1** to **4**.

When Mapping is set to Manual



You can set the ratio between the analog waveform area and the logic signal area using the Analog & Logic Window menu. For details on the function and the procedure, see section 6.19.

Explanation

Select the number of windows for displaying the analog waveforms. The position for the waveform of each channel varies depending on the display format.

Display Format

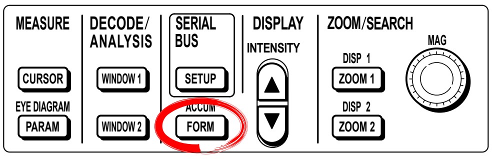
Single: 1 window, Dual: 2 windows, Triad: 3 windows, Quad: 4 windows

Waveform Mapping

- Auto
  The waveforms are mapped in the order CH1, CH2, CH3, CH4, M1, M2, M3, and M4, from the top of the divided screen. When the mapping reaches the bottom of the divided screen it begins again from the top. Channels with displays that are turned OFF are excluded.
- Manual
  Specify where to map CH1 to CH4 and M1 to M4. The number of points that can be displayed within 8 div vertically depends on the display format (when the Main window only is displayed). The vertical resolution remains unchanged.
  Single(□): 640 points, Dual(⊟): 320 points,
  Triad(☰): 208 points, Quad(☰): 160 points

9.3 Setting the Interpolation Method

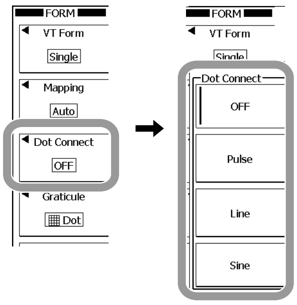
Procedure



1. Press **FORM**.

Setting the Interpolation Method

2. Press the **Dot Connect** soft key.
3. Press a soft key from **OFF** to **Sine** to select the interpolation method.



Explanation

Interpolation Method

Set the method by which sampled data are connected to display the waveform. If the Main and ZOOM1 or ZOOM2 display record length is as follows, the sampled data are only connected in the vertical direction. There is no difference between Pulse, Line, and Sine.

- 4 kWord, 5 kWord
- 10 kWord or higher

If the display record length is higher than the above, new interpolation points are generated between sampled data according to the specified interpolation method, and the interpolation points are connected in the vertical axis direction.

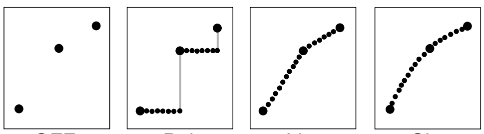
OFF: No interpolation.

Pulse: Interpolates between two points by drawing a horizontal line to the time of the next data point, then connecting the end of the horizontal line to the next data point with a vertical line.

Line: Linearly interpolates between two points.

Sine: Interpolates between two points using the (sin x)/x function.

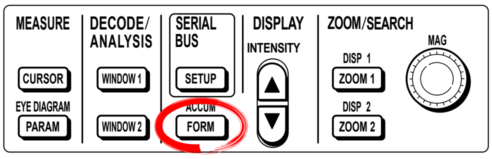
Interpolation Image



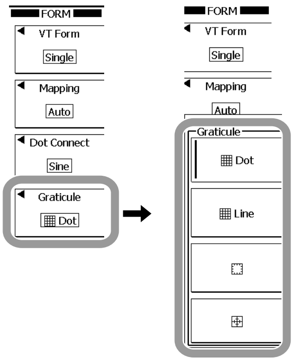
OFF Pulse Line Sine

9.4 Changing the Graticule

Procedure

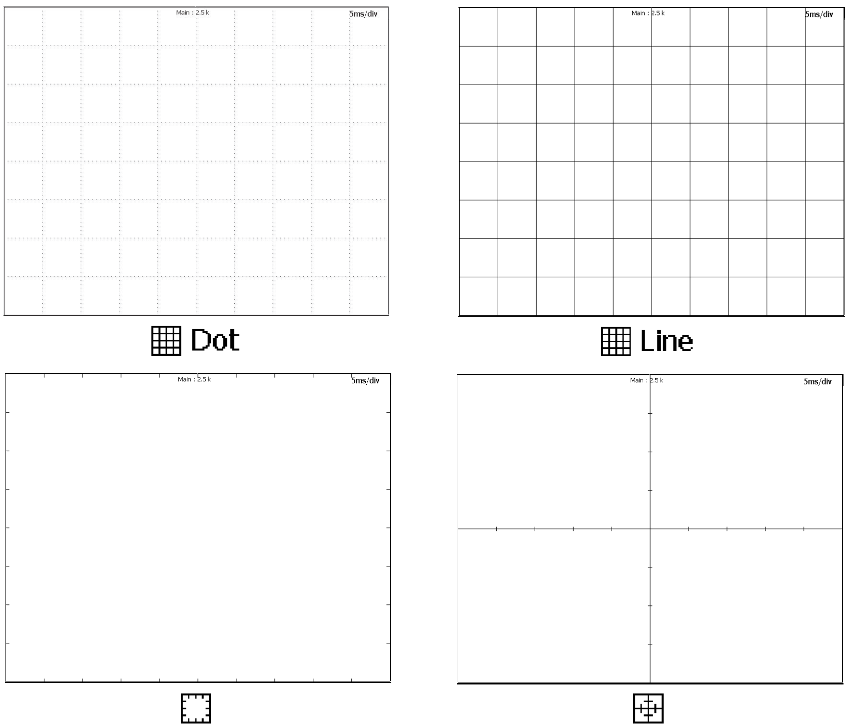


1. Press **FORM**.
2. Press the **Graticule** soft key.
3. Press the appropriate graticule soft key.



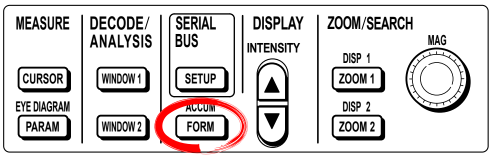
Explanation

Select from the following four types.



9.5 Adjusting the Backlight

Procedure



1. Press **FORM**.
2. Press these soft keys: **Next 1/2** > **Back Light**.

Setting Auto OFF for the Backlight

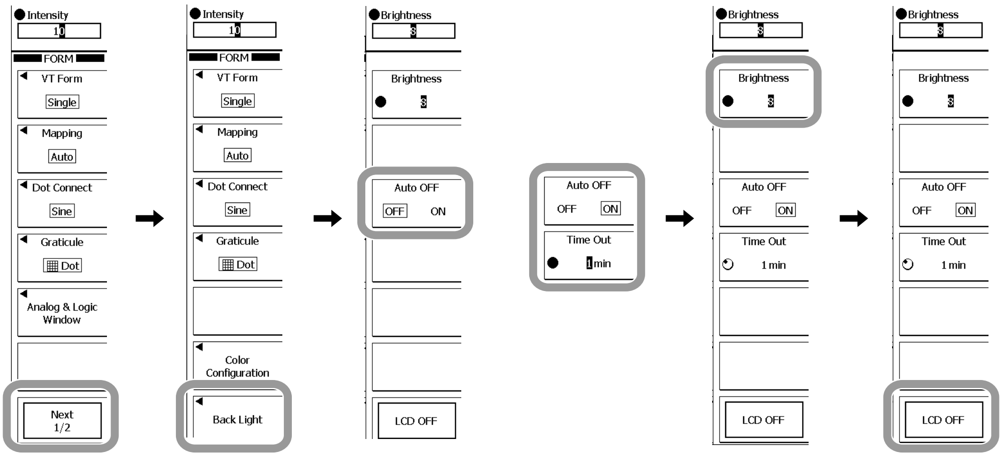
3. Press the **Auto OFF** soft key to select ON or OFF.
   If you select ON, continue with step 4.
4. Push the **Time Out** soft key to view the rotary knob.
5. Use the **rotary knob** to set the time when the backlight automatically goes off.

Setting the Backlight Brightness

6. Push the **Brightness** soft key.
7. Use the **rotary knob** to set the backlight brightness.

Turning the Backlight OFF

8. Press the **LCD OFF** soft key. The backlight turns OFF.
   Press any key to turn the backlight back ON.



Explanation

Auto OFF for the Backlight

The backlight automatically turns OFF if there is no panel key operation for the specified time. If any key is pressed the backlight turns ON.

Backlight Brightness

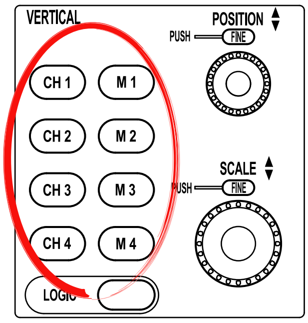
You can change the brightness of the backlight. Set it in the range from 1 (dark) to 8 (bright). You can prolong the lifetime of the backlight by setting it to dark or turning it off when screen observation is not necessary.

Turning the Backlight OFF

You can turn the backlight OFF. If any key is pressed when the backlight is turned OFF, it turns ON.

9.6 Setting Waveform Labels

Procedure



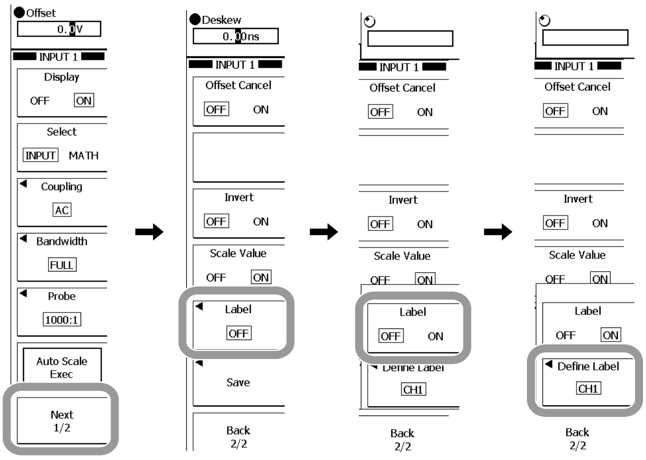
1. Press one of the **CH1** to **CH4** or **M1** to **M4** keys to select the channel.
2. Press the **Next 1/2** soft key.
3. Press the **Label** soft key.

Selecting Whether or Not to Display Labels

4. Press the **Trace Label** (waveform label) soft key to select ON or OFF.

Setting the Label

5. Press the **Define Label** soft key. A keyboard appears.
6. Input the label according to the procedure given in section 4.2.



Explanation

Label

You can set the label of each channel using up to eight characters.

Displaying Labels

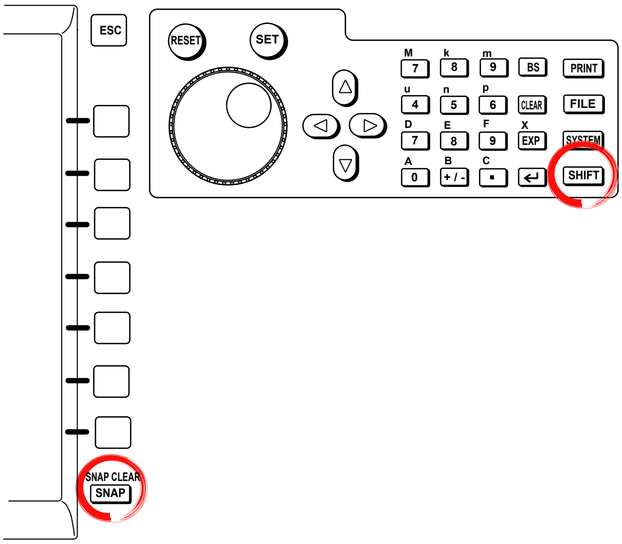
You can select whether or not to display labels.

Note

The label may not be displayed if the waveform area is small, depending on the display format and zoom format.

9.7 Taking and Clearing Snapshots

Procedure



Taking a Snapshot

Press **SNAP**. The snapshot is taken.

Clearing a Snapshot

Press **SHIFT** + **SNAP (SNAP CLEAR)**. The snapshot waveform is cleared.

Explanation

Snapshot

The snapshot function keeps the current displayed waveform on the screen. You can update the display without stopping the signal acquisition. This function is useful in situations such as when you wish to compare waveforms.

- You cannot perform the following operations on snapshot waveforms.
  Cursor measurements, automated measurement of waveform parameters, zoom, and computation
- Snapshot waveforms can be saved and loaded in bitmap format. (See section 14.9.)

Clearing Snapshots

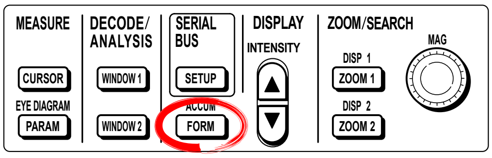
Clears all the snapshot waveforms that are currently displayed on the screen.

Conditions That Disable the SNAP and SNAP CLEAR Keys

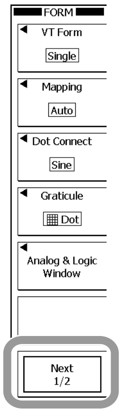
- When printing, during auto setup, and while the storage medium is being accessed.
- When GO/NO-GO determination, action-on-trigger, or search is in progress.

9.8 Setting the Translucent Display, Waveform Display Colors, and Brightness

Procedure

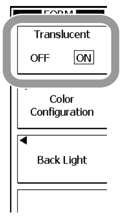


1. Press **FORM**.
2. Press the **Next 1/2** soft key.



Turning the Translucent Display ON and OFF

3. Press the **Translucent** soft key to select ON or OFF.
   ON: Enable translucent display; OFF: Disable translucent display



9

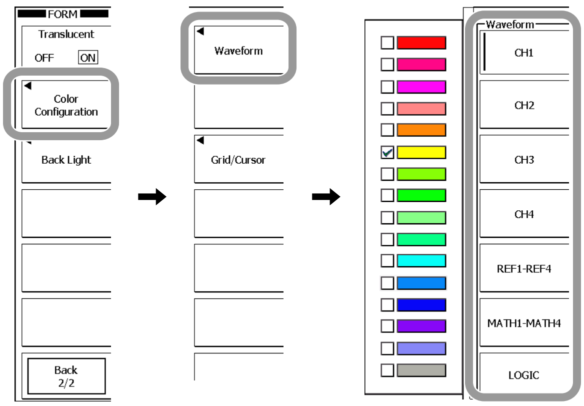
Display

Setting the Display Color and Brightness

3. Press the **Color Configuration** soft key.

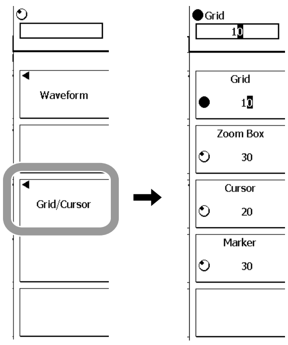
- **Setting the Waveform Display Color**

4. Press the **Waveform** soft key.
5. Press the appropriate waveform soft key.
    - To select a channel from REF1 to REF4, press the **REF1-REF4** soft key first.
    - To select a channel from MATH1 to MATH4, press the **MATH1-MATH4** soft key first.
    - To select a LOGIC or LOGIC(State) channel, press the **LOGIC** soft key first.
6. Use the **rotary knob** and **SET** to select the color.
7. Press **ESC** to return to the previous screen.



- **Setting the Brightness of the Grid, Zoom Box, Cursor, and Marker**

8. Press the **Grid/Cursor** soft key.
9. Press a soft key from **Grid** to **Marker** soft key to select the item you want to change the brightness of.
10. Use the **rotary knob** to set the brightness.



Explanation

You can set the following dialog box properties: translucent display; waveform display colors; grid, zoom box, cursor, and marker brightness.

Translucent Display

When translucent display is turned ON, configuration dialog boxes are displayed translucently, so the contents underneath it can be seen.

Waveform Display Colors and Brightness

- **Waveform Display Color**
  - The waveform color of analog signal input waveforms CH1 to CH4,* reference waveforms REF1 to REF4, computation waveforms MATH1 to MATH4, and logic signals LOGIC/LOGIC (State) can be selected from 16 colors.
    * If computation waveforms are assigned to analog signal input channels, CH1 to CH4 correspond to MATH5 to MATH8, respectively. And, the colors of CH1 to CH4 are assigned to the corresponding computation channels.
  - This waveform color setting also applies to the title bar color of the menu that appears when a channel key is pressed.

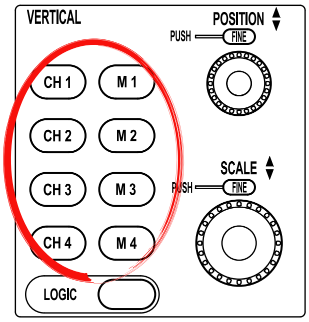
- **Brightness of the Grid, Zoom Box, Cursor, and Marker**
  You can set the brightness of the grid, zoom box, cursor, and marker.
  Selectable range: 0 to 31

Resetting

Press RESET to reset the waveform display color or the brightness of the grid, zoom box, cursor, or marker to the default value.

10.1 Setting Computation Channels, Operators, Units, and Display Ranges

Procedure

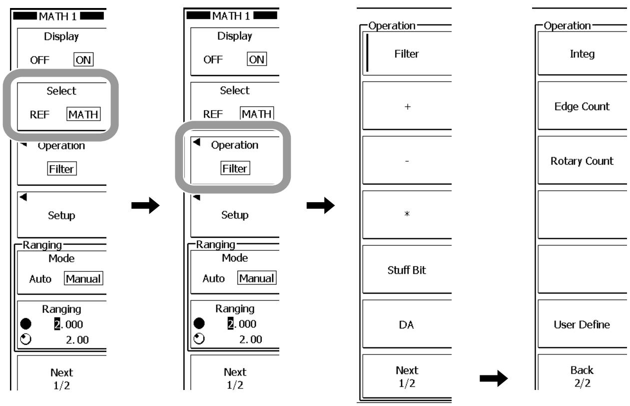


Selecting a Computation Channel

1. Press a key from **CH1** to **CH4** or from **M1** to **M4** to select the channel on which to set up computation.
   A channel setup menu appears.
   To select Stuff Bit, DA (D/A conversion), or User Define (user-defined computation) in step 4, select a channel from **M1** to **M4**.
2. Press the **Select** soft key to select MATH.

Selecting an Operator

3. Press the **Operation** soft key.
4. Select an operator from the displayed menu.
   Press the Next1/2 soft key to view other available operators.
5. Proceed to the appropriate section indicated below according to the selected operator, and then set the computation.
   - Filter: Section 10.2 (linear scaling), section 10.5 (phase shift), section 10.6 (IIR filter), section 10.7 (smoothing)
     The procedural explanation for each filter type is given separately.
   - +, –, * (×): Section 10.3
   - Stuff bit: Section 11.9
   - DA (D/A conversion): Section 10.10
   - Integ (integration): Section 10.4
   - Edge Count: Section 10.8
   - Rotary Count: Section 10.9
   - User Define (user-defined computation): Section 10.11



After setting the computation in step 5 on the previous page, return to the channel setup menu, and proceed with the following steps.

Setting the Scaling

If necessary, set the scaling that you want to apply to the computed results. Scaling is not available if the computation is set to edge count, rotary count, or user-defined computation.

6. Press the **Setup** soft key.

7. Use the **rotary knob** to set the values for a and b in the linear scaling equation y = ax + b.

Setting the Unit

If necessary, set the unit.

8. Press the **Mode** soft key to select Auto or User.
If you select Auto, proceed to step 11.

9. Press the **User Unit** soft key.

10. Refer to section 4.2 and enter the unit, and the press the **Enter** soft key.

11. Press **ESC**.

Setting the Display Range

- **When the computation is not D/A conversion or user-defined computation**

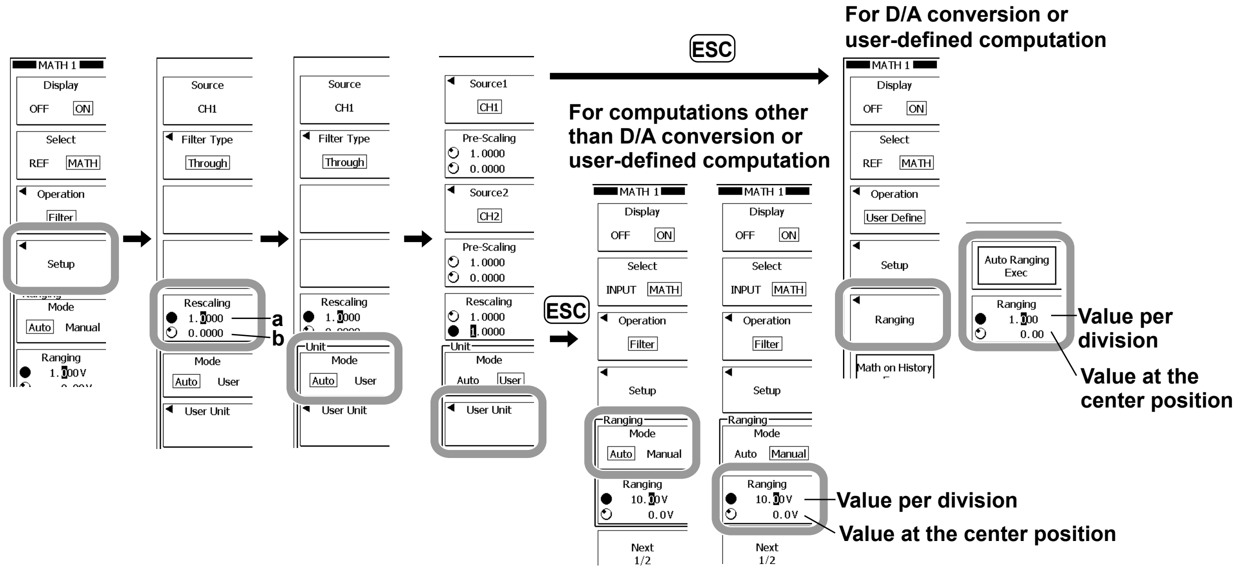
12. Press the **Mode** soft key to select Auto or Manual.
If you select Manual, proceed to the next step.

13. Use the **rotary knob** to set the value per division and the center position value.

- **When the computation is D/A conversion or user-defined computation**

12. Press the **Ranging** soft key.

13. To automatically set the range, press the **Auto Ranging Exec** soft key.
To set the range manually, use the **Ranging** soft key and the **rotary knob** to set the value per division and the center position value.



Explanation

Computation Channels

Select a channel on which to set up computation from CH1 to CH4 or from M1 to M4.

Operators

Select from the following operators.

- Filter
  Through (linear scaling), Delay (phase shift), Moving Avg (smoothing), IIR Low Pass (IIR filter), IIR High Pass (IIR filter)
- +, –, *: Addition, subtraction, and multiplication
- Integ: Integration
- Edge Count
- Rotary Count
- Stuff Bit (for CAN bus)
- DA: D/A conversion of logic signals
- User-defined computation (option)

Set the computation according to the selected operator.

Scaling

Set the values for a and b in the linear scaling equation y = ax + b that will be applied to the computed result. Scaling is not available if the computation is set to edge count, rotary count, or user-defined computation.

Unit

Set the unit for the computed result. There is no unit setting for a stuff bit.

- Auto
  Uses the default value. The value varies depending on the computation.

Filter; addition, subtraction, and multiplication	V, A, VV, AA, VA
Integration	Vs, As, VVs, AAs, VAs
Edge count and rotary count	Blank
D/A conversion and user-defined computation	EU

- User
  You can define an original unit using up to four characters.

Display Range)

Set the waveform display range.

- **For computations other than D/A conversion or user-defined computation**

Auto	Automatically determines the waveform display range based on the V/div, operator, and offset values of the source waveform.
Manual	Set the waveform display range by specifying the value per division and the screen center position value. A unit may appear depending on the computation such as V. If you change the operator, the display range will change to auto for the new operator. The mode will remain in Manual.

- **For D/A conversion or user-defined computation**

Auto Ranging Exec	Displays the entire amplitude of the waveform. The value per division and the screen center position value affect the Ranging value. The VT cursor reads the top 14 bits of the measured value.
Ranging	Set the waveform display range by specifying the value per division and the screen center position value.

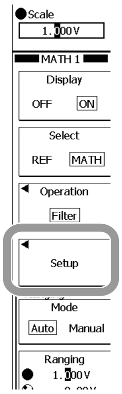
10.2 Performing Linear Scaling

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Filter.

Setting the Operation

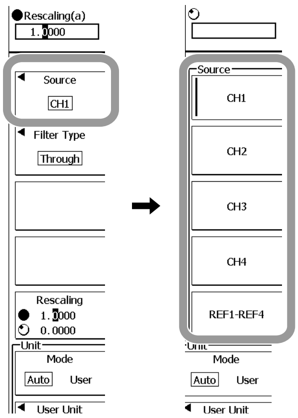
2. Press the **Setup** soft key.



Setting the Waveform To Be Computed

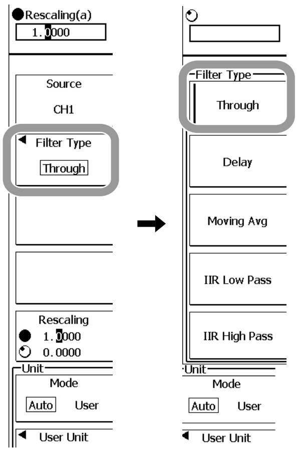
3. Press the **Source** soft key. A menu used to select the waveform to be computed appears.
When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don’t appears. Proceed to step 5.

4. Press the soft key corresponding to the source waveform.
To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



Setting the Filter Type

5. Press the **Filter Type** soft key.
6. Press the **Through** soft key.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

Using the set scaling factor A and offset value B, the following expression is evaluated, and the scaled value obtained is used to display cursor measurement values and values from automatic waveform parameter measurement. It is also possible to add a unit indication to the scaled value.

Y = AX + B (X = measured value; Y = linear scaling result)

Setting Scaling Coefficient A and Offset Value B

Selectable range of A and B	–10.000E+30 to +10.000E+30
Default settings	A 1.0000E+00 B 0.0000E+00

Waveform to Be Computed

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

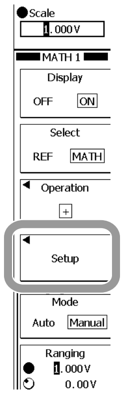
10.3 Performing Arithmetic Functions

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to +, –, or * (×).

Setting the Operation

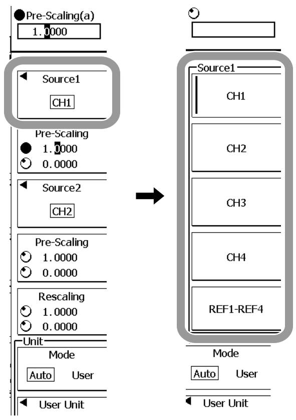
2. Press the **Setup** soft key.



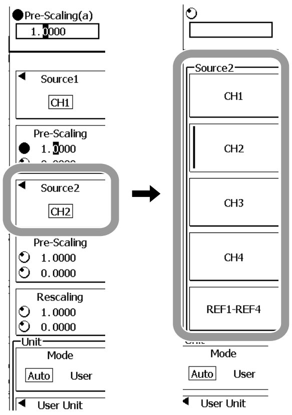
Selecting the Source Waveform

3. Press the **Source1** soft key. A menu used to select the waveform to be computed appears.
When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don't appears. Proceed to step 5.

4. Press the soft key corresponding to the source waveform.
To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.

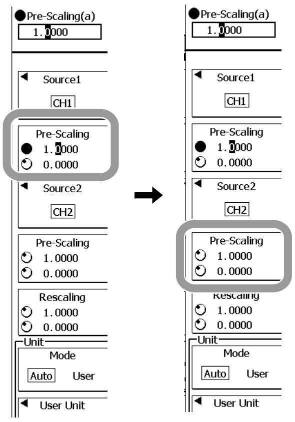


5. Press the **Source2** soft key.
6. Press the soft key corresponding to the source channel.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



Setting Pre-Scaling

7. Press the **Pre-Scaling** soft key corresponding Source 1 or Source 2 as necessary in order to set the rotary knob target.
8. Use the **rotary knob** and set a and b in the scaling equation y = ax + b.
9. Repeat steps 10 and 11 as necessary, setting Source 1 and Source 2.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

The arithmetic operation is performed on the specified trace waveform.

Waveform to Be Computed

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Scaling Prior To the Operation

This sets scaling on pre-operation values for individual sources.

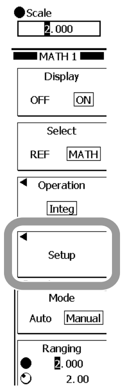
10.4 Performing Integration

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Integ.

Setting the Operation

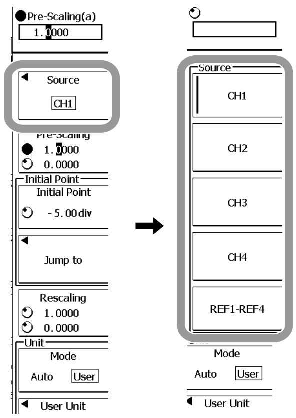
2. Press the **Setup** soft key.



Setting the Source Waveform for the Operation

3. Press the **Source** soft key. A menu used to select the waveform to be computed appears.
When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don't appears. Proceed to step 5.

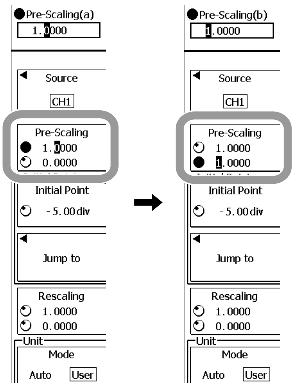
4. Press the soft key corresponding to the source waveform.
To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



Setting the Input Source Scaling Prior to the Operation

5. Press the **Pre-Scaling** soft key and change the rotary knob target.

6. Use the **rotary knob** to set pre-scaling.



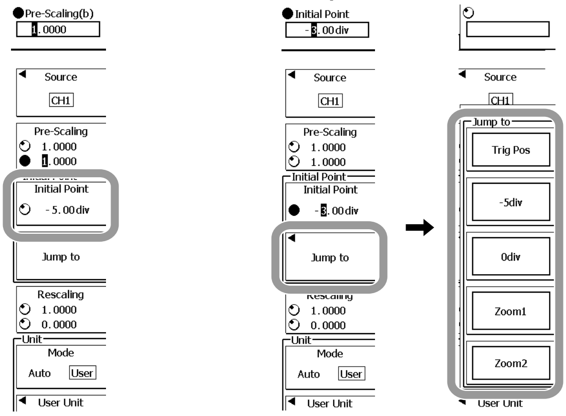
Setting the Operation Initial Point

7. Press the **Initial Point** soft key.

8. Use the **rotary knob** to set the initial point, or else press the Jump to soft key.

9. If you pressed the Jump to soft key, select the Jump destination. Press the Jump destination soft key.

Setting the initial point **Selecting the Jump destination**



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

The specified trace waveform is integrated.

Operation Source Waveform

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Operation Initial Point

Set the initial point of the operation.

- Item: –5 div to 5 div
- Initial value for div resolution: –5 div

The following points can be set directly (Jump to).

Trig Pos (trigger position), –5 div, 0 divisions, Zoom1 (Center of Zoom 1 enlarged position), Zoom2 (Center of Zoom 2 enlarged position)

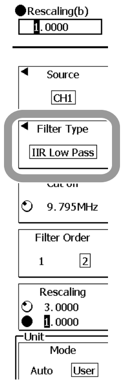
10.5 Shifting the Phase

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Filter.

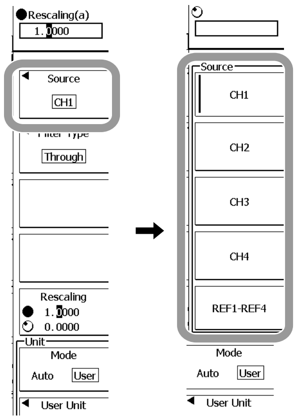
Setting the Operation

2. Press the **Setup** soft key.



Selecting the Source Waveform

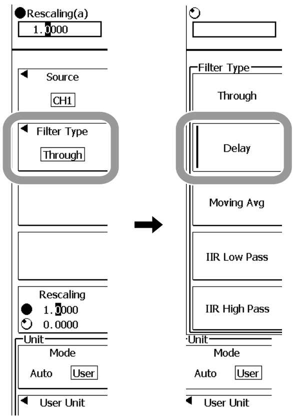
3. Press the **Source** soft key. A menu used to select the waveform to be computed appears.
When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don't appears. Proceed to step 5.
4. Press the soft key corresponding to the source waveform.
To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



Setting the Filter Type

5. Press the **Filter Type** soft key.

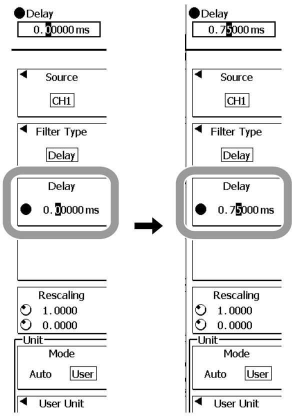
6. Press the **Delay** soft key.



Setting the Time for Shifting the Phase

7. Press the **Delay** soft key and change the rotary knob target.

8. Use the **rotary knob** and set the time for shifting the waveform phase.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

The source waveform can be displayed with phase shift.

Waveform to Be Computed

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Delay Time: Delay

The delay can be set over a range equivalent to ±5 divisions.

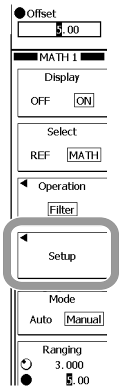
10.6 Setting a Filter (IIR Filter)

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Filter.

Setting the Operation

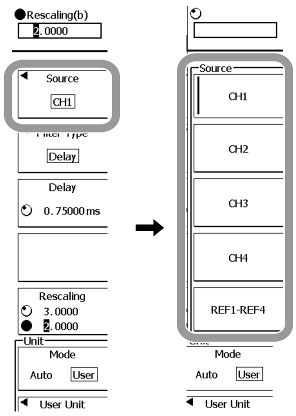
2. Press the **Setup** soft key.



Selecting the Source Waveform

3. Press the **Source** soft key. A menu used to select the waveform to be computed appears.
   When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don’t appears. Proceed to step 5.

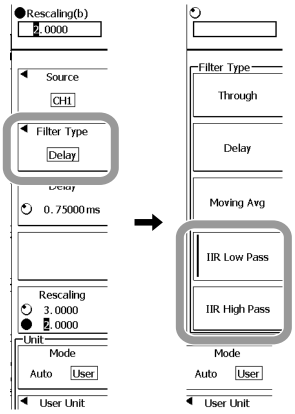
4. Press the soft key corresponding to the source waveform.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



Setting the Filter Type

5. Press the **Filter Type** soft key.

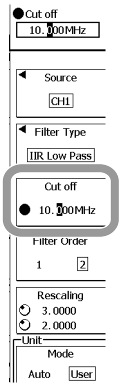
6. Press the **IIR Low Pass** or **IIR High Pass** soft key.



Setting the Cutoff Frequency

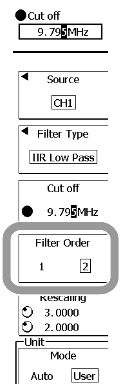
7. Press the **Cut off** soft key and change the rotary knob target.

8. Use the **rotary knob** to set the cutoff frequency.



Selecting the Filter Order

9. Press the **Filter Order** soft key to select 1 or 2.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

Low Pass Filter and High Pass Filter can be set by combining a temporary low pass filter and a differentiator.

Waveform to Be Computed

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

Setting the Cutoff Frequency

Can be set to a value up to 1 GHz.

Selecting the Filter Order: Filter Order

The setting differs, depending on the specified filter type.

Filter Type	Filter order	Phase change
High Pass	1	The phase advances.
Low Pass	1	The phase is delayed.
High Pass/Low Pass	2	Phase 0

Note

In the filter calculation (IIR filter), since the initial value is indeterminate, correct calculation is not possible immediately after the start of calculation. With a first-order filter the left end of the waveform is not shown, and with a second-order filter, both ends of the waveform are not shown.

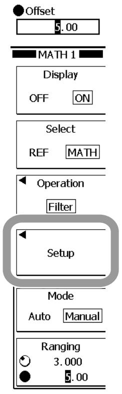
10.7 Smoothing Waveforms (Using a Moving Average)

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Filter.

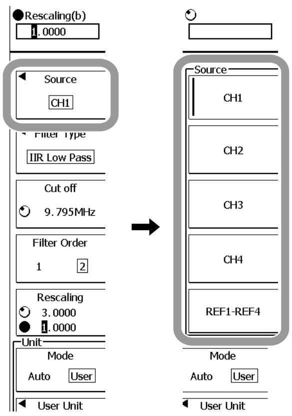
Setting the Operation

2. Press the **Setup** soft key.



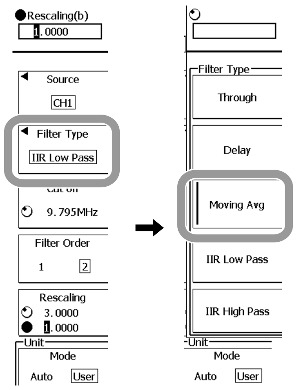
Selecting the Source Waveform

3. Press the **Source** soft key. A menu used to select the waveform to be computed appears.
   When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don’t appears. Proceed to step 8.
4. Press the soft key corresponding to the source waveform.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.



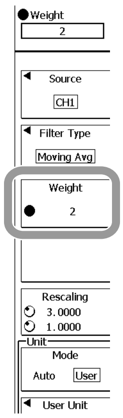
Setting the Filter Type

5. Press the **Filter Type** soft key.
6. Press the **Moving Avg** soft key.



Setting Weighted Points

7. Use the **rotary knob** to set the number of weighted points used to calculate the weighted moving average.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

Moving Average (Smoothing)

The averaging is carried out using the following formula.

$$\mathbf{x_n} = \left(\sum_{i=n-N}^{n+N-1} x_i + \sum_{i=n-N+1}^{n+N} x_i\right)/(2N \times 2)$$

(When Weight is set to 2N)

Weighted Points

Sets the number of points to be smoothed.

A value ranging from 2 to 128(2^7) can be set.

Waveform to Be Computed

Select from CH1 to CH4 or from REF1 to REF4. When CH1 to CH4 on the front panel are used for operation, the waveform to be computed is fixed to the channel that is being operated.

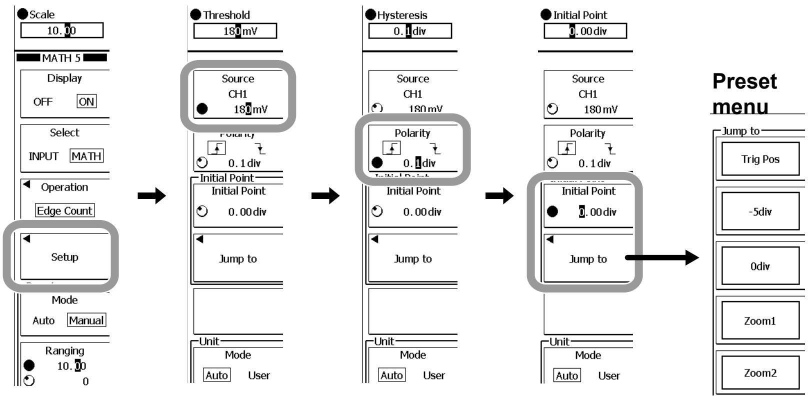
10.8 Counting Edges

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Edge Count.

Setting the Count Conditions

2. Press the **Setup** soft key.
3. Press the **Source** soft key. A menu used to select the waveform to be computed appears. Press the soft key corresponding to the source waveform.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
   When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don’t appears.
4. Use the **rotary knob** to set the threshold level for detecting edges.
5. Press the **Polarity** soft key to select ↑ or ↓.
6. Use the **rotary knob** to set the hysteresis.
7. Press the **Initial Point** soft key.
8. Use the **rotary knob** to set the count start point. Or, press the **Jump to** soft key to show a preset menu, and set the count start point.



Setting the Unit and Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

The waveform edge can be counted.

Setting the Count Conditions

- **Waveform to Be Computed (Source)**
  Select from CH1 to CH4 or from REF1 to REF4. If you press a key from CH1 to CH4 on the front panel, the selected channel becomes the waveform to be computed.

- **Detection Level**
  When the waveform passes through the specified level, it is detected as an edge.

- **Polarity**
  Select the slope of the waveform on which to detect the edge.
  ↑ : Detects edges when the waveform slope is rising.
  ↓ : Detects edges when the waveform slope is falling.

- **Hysteresis**
  Sets a width to the detection level so that edges are not detected by small changes.
  Selectable range: 0.0 divisions to 4.0 divisions
  Resolution: 0.1 division

- **Setting the Count Start Point**
  Sets the start point for counting edges.
  Selectable range: –5.00 divisions to 5.00 divisions
  Resolution: 0.01 division
  You can also set the following points (Jump to).
  Trig Pos (trigger position), –5div, 0div, Zoom1 (center position of Zoom1), or Zoom2 (center position of Zoom2)

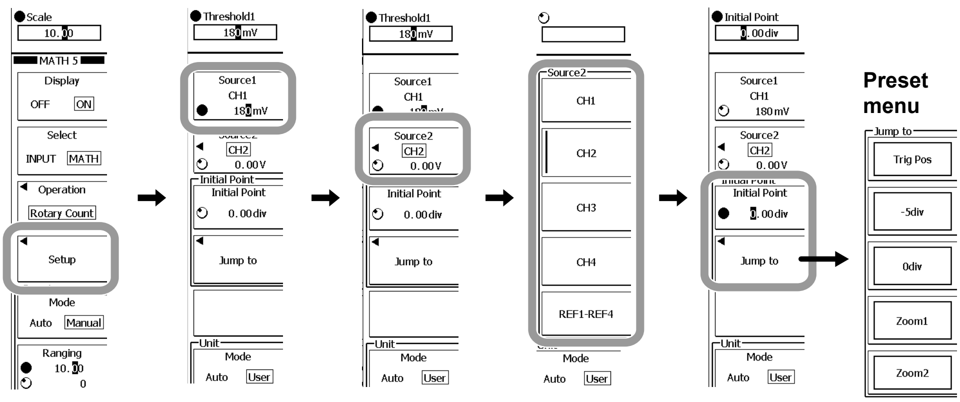
10.9 Counting Rotations

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Rotary Count.

Setting the Count Conditions

2. Press the **Setup** soft key.
3. Press the **Source1** soft key. A menu used to select the waveform to be computed appears. Press the soft key corresponding to the source waveform.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key. When CH1 to CH4 on the front panel are set, the waveform to be computed is fixed to the channel that is set. A menu used to select the waveform to be computed don't appears.
4. Use the **rotary knob** to set the determination level of phase A.
5. Press the **Source2** soft key twice to display the Source2 menu.
6. Press any of the **CH1** to **CH4** and **REF1-REF4** soft keys to select Source2.
   To select REF1 to REF4, first switch to **REF1-REF4** by pressing the corresponding soft key.
7. Use the **rotary knob** to set the determination level of phase B.
8. Press the **Initial Point** soft key.
9. Use the **rotary knob** to set the count start point. Or, press the **Jump to** soft key to show a preset menu, and set the count start point.



Setting the Unit and Display Range

Carry out steps 6 to 13 in section 10.1.

Explanation

Rotary count can be used. The counter is increased or decreased according to the phase change of phase A and B.

Setting the Count Conditions

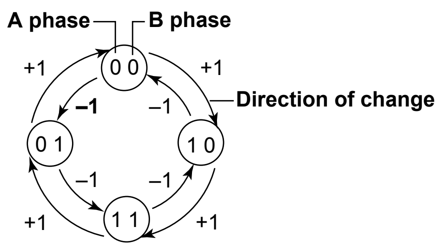
- **Waveform to be Computed of Phase A**
  Select from CH1 to CH4 or from REF1 to REF4. If you press a key from CH1 to CH4 on the front panel, the selected channel becomes the waveform to be computed.

- **Determination Level of Phase A**
  The state in which the waveform of phase A exceeds the specified level is 1 and 0 otherwise.

- **Waveform to be Computed of Phase B**
  Select from CH1 to CH4 or from REF1 to REF4.

- **Determination Level of Phase B**
  The state in which the waveform of phase B exceeds the specified level is 1 and 0 otherwise.

- **Changes in the Phase of Phase A and Phase B**
  The counter is increased or decreased according to the phase change (change in the 0 and 1 states) in phase A and phase B as shown below.



- **Setting the Count Start Point**
  Sets the start point of counting.
  Selectable range: –5.00 divisions to 5.00 divisions
  Resolution: 0.01 division
  You can also set the following points (Jump to).
  Trig Pos (trigger position), –5div, 0div, Zoom1 (center position of Zoom1), or Zoom2 (center position of Zoom2)

10.10 Performing D/A Conversion on Logic Signals

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to DA.

Setting the Computation

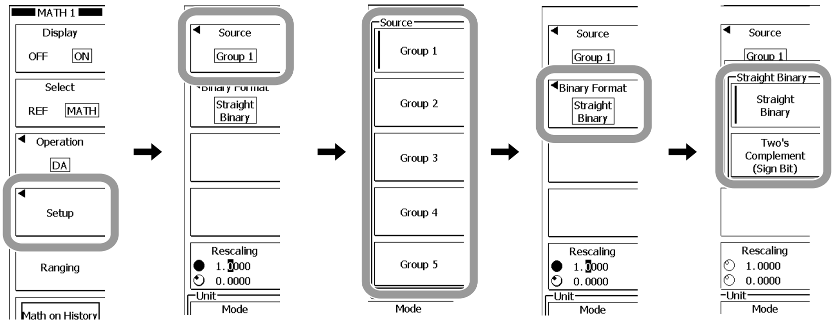
2. Press the **Setup** soft key.

Selecting the Source Signal

3. Press the **Source** soft key.
4. Press any of the **Group 1** to **Group 5** soft keys to select the source group.

Selecting the Binary Display Format

5. Press the **Binary Format** soft key.
6. Press the **Straight Binary** or **Two's Complement (Sign Bit)** soft key to select the display format.



Setting the Scaling to Apply to Computed Results, the Unit, and the Display Range

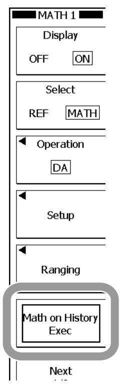
Carry out steps 6 to 13 in section 10.1.

7. Press **ESC** to return to the previous screen.

Executing the Conversion on All History Waveforms

8. To perform the specified D/A conversion on all history waveforms, press the **Math on History Exec** soft key. The conversion is executed, and the Math on History Exec display changes to Abort.

   To cancel the conversion, press the **Abort** soft key. The conversion is aborted, and the Abort display changes to Math on History Exec.



Explanation

The logic signal can be D/A converted for each specified group (see section 7.3). The conversion result can be displayed in the M1 to M4 channels.

D/A Conversion Source Signal

The logic signals assigned to Group1 to Group 5.

- Conversion is performed at the group level.
- Conversion is performed with the MSB as the highest digit.

Display Format

You can select the binary display format.

Straight Binary	The normal display format. For example, FF in hexadecimal notation will be 255 in binary notation.
Two’s Complement (Sign Bit)	Two’s complement display format. For example, FF in hexadecimal notation will be –1 in binary notation.

Computing on All History Waveforms

If you press the Math on History Exec soft key while the signal acquisition is stopped, D/A conversion is performed on all history waveforms of the source signal.

Note

- D/A conversion cannot be performed on all history waveforms while signals are being acquired.
- The computation-in-progress icon appears at the lower left of the screen, and a progress bar is displayed in the center of the screen while the D/A conversion on all history waveforms is in progress. All operations other than the Abort soft key are disabled.
- If you set the trigger mode to N Single and start the signal acquisition, D/A conversion is performed only on the latest signal after the acquisition is stopped. To perform D/A conversion on all history waveforms, carry out the procedure given in “Executing the Conversion on All History Waveforms.”
- If you change a setting that affects the D/A conversion result, recomputation is performed only on the selected history waveform.
- The Average display of HISTORY or PARAM of History Statistics appears only if all history waveforms exist. If the Average display of History or PARAM of History Statistics is not performed, carry out the procedure given in “Executing the Conversion on All History Waveforms.”

10.11 User-Defined Computation (Optional)

Procedure

1. Carry out steps 1 to 5 in section 10.1 to set the operator to User Define.

Setting Up Computation

2. Press the **Setup** soft key.
3. Press the **Edit** soft key. The equation definition dialog box opens.
4. Enter an equation (of 128 characters or fewer) following the information in section 4.2, and then press the **Enter** soft key.

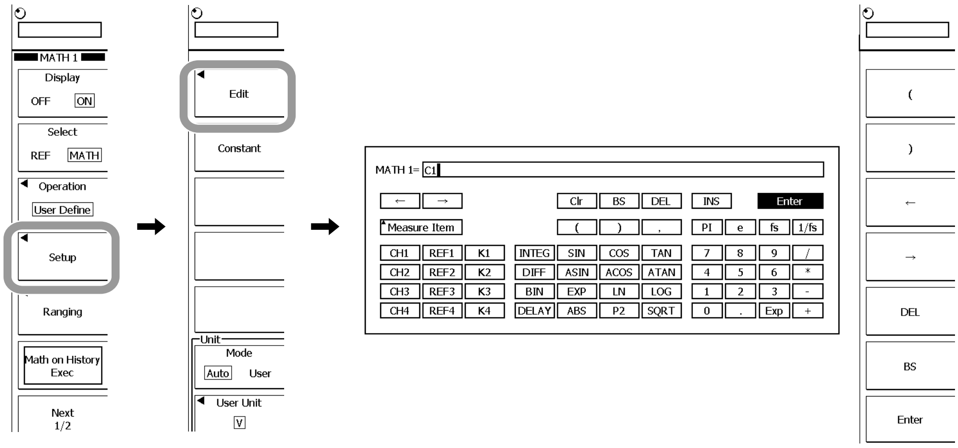
   To enter a waveform parameter, select Measure Item in the dialog box to display the waveform parameter selection dialog box, and then select the area, channel, and parameter.

Note

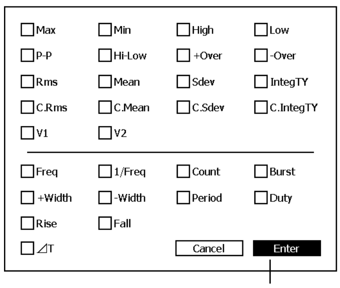
Waveform parameters are displayed in the following format.

- "P." is added to the front of the selected waveform parameter.
- The source channel and area of the waveform parameter are shown in parentheses ( ). If the target area is Area 1, the target area display is omitted.
  P.Max(C1):CH1, maximum value of Area 1
  P.Max(C1, A2):CH1, maximum value of Area 2

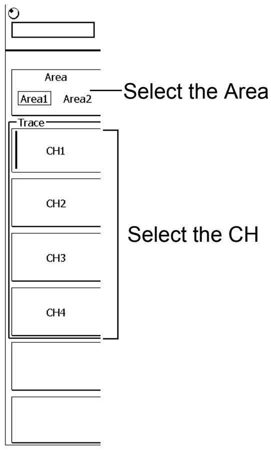
5. Press **ESC** to return to the previous screen.



Measure Item Setting Screen

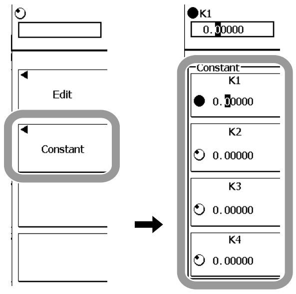


Enter the item



Setting Constants

6. Press the **Constant** soft key.
7. Press a soft key from **K1** to **K4** to assign the jog shuttle for the constant you wish to set.
8. Use the **rotary knob** to set the constant.
9. Press **ESC** to return to the previous screen.



Setting the Unit and Display Range

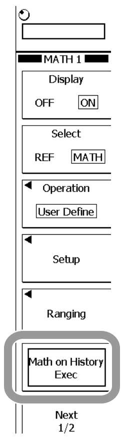
Carry out steps 6 to 13 in section 10.1.

10. Press **ESC** to return to the previous screen.

Executing the Computation on All History Waveforms

11. To perform the specified computation on all history waveforms, press the **Math on History Exec** soft key. The computation is executed, and the Math on History Exec soft key changes to Abort.

    To cancel the computation, press the **Abort** soft key. The computation is aborted, and the Abort soft key changes to Math on History Exec.



Explanation

This section describes the setting operations in User-Defined Math (option) mode.

Waveforms That Can Be Used in Expressions

The following waveform data can be used in equations.

Menu Symbols	Description
CH1–CH4	Channel waveforms. Displayed as C1 through C4 in equations
REF1–REF4	Reference waveforms. Displayed as R1 through R4 in equations

Operators

You can define equations by combining the following functions.

Menu Symbols	Setting Example	Description
+, -, *, /	CH1+CH2-C3	Arithmetic operations for the input value
ABS	ABS(C1)	Absolute value of the input value
SQRT	SQRT(C2)	Square root of the input value
LOG	LOG(C1)	Logarithm of the input value
LN	LN(C1)	Natural logarithm of the input value
EXP	EXP(C1)	Exponent of the input value
P2	P2(C1)	Square of the input value
-	-(C1)	Inverts the input values around the center level
SIN	SIN(C1)	Sine of the input value
ASIN	ASIN(C1)	Arcsine of the input value
COS	COS(C1)	Cosine of the input value
ACOS	ACOS(C1)	Arccosine of the input value
TAN	TAN(C1)	Tangent of the input value
ATAN	ATAN(C1)	Arctangent of the input value
DIFF	DIFF(C1)	Differential of the input value
INTEG	INTEG(C1)	Integral of the input value
DELAY	DELAY(C1,K1)	Phase shift of the input value
BIN	BIN(CH1, K1, K2)	Binary representation of the input value

Constants

Menu Symbols	Description
K1–K4	Specified constants The setting range is -10E+30 to 10E+30 M1 through M4 can be set to constants K1 through K4.
0–9	Can be entered with the numeric key pad
Exp	Exponent input Used in conjunction with the keyboard when entering exponents in equations (1E+3=1000, 2.5E-3=0.0025) Displayed with an E to differentiate it from the EXP operator in equations
PI	π
e	Napier's constant Base of the natural logarithm (e=2.718...). Displayed with an "eul" in equations to differentiate it from the E for exponents.
fs	Sample rate The sample rate value on the instrument when performing computations. Linked with (changes with) changes in the T/div value or record length.
Measure Item	Specified waveform parameter

Waveform Parameters

Computations can be made using measured values of waveform parameters. Power supply analysis parameters can also be used if the power supply analysis function (/G4 option) is installed.

- Displayed waveform parameters are preceded with a P. in equations.
- Waveform parameter values cannot be acquired when display of the waveform under test is turned OFF.
- If the area is omitted, Area 1 is used.

Examples of Entering Equations

Example of input other than DIFF, INTEG, DELAY, or BIN

Equations can be defined by combining waveforms and constants with operators.

SIN(PI)	Using a constant with an operator
COS(C1)	Using a waveform with an operator
ABS(C1+C2*2)	Waveform and constant expressions referenced in an operator
SQRT(ABS(C1+C2*2))	Referencing an operator within another operator

Entering Differentials and Integrals

Waveforms or expressions including waveforms can be referenced by the DIFF and INTEG operators.

DIFF(5)	Invalid because 5 is a constant
INTEG(K1+10)	Invalid because K1+10 includes a constant
DIFF(C1/3)	C1/3 part
INTEG(INTEG(C3))	Double integral of C3
DIFF(DIFFC4))	Double differential of C4

Entering DELAY (Phase Shift)

DELAY is set in the format DELAY (waveform, constant).

Waveform: The waveform to be phase-shifted. Entered using a monomial of 1 waveform

Constant: The amount of shifting. Entered using a constant or a constant expression.

DELAY(C1,C2)	Invalid because the phase shift amount is a constant or a constant expression
DELAY(C1+C2,5)	Invalid because the phase shifted waveform is not a monomial of 1 waveform
DELAY(C1,5E-3)	Phase-shifts waveform C1 by 0.005
DELAY(C2,P.Period(C2)*2)	Phase-shifts waveform C2 by “2 periods of waveform C2”)

Entering BIN (Binarization)

BIN is set in the format BIN(waveform, constant1, constant2).

Waveform: The waveform to be binarized. Entered using a constant or a constant expression.

Constant1: Specifies the threshold level (Level). Entered using a constant or a constant expression.

Constant2: Specifies the hysteresis (Hys). Entered using a constant or a constant expression.

BIN(5,10,2)	Invalid because the source waveform is not a waveform
BIN(C1,C2,C3)	Invalid because the Level and Hys are not constants or constant expressions
BIN(C1+C2)	Binarizes C1 + C2 with Level = 0 and Hys = 0
BIN(C2,P.Mean(C2))	Binarizes C2 with Level = “mean of waveform C2” and Hys = 0
BIN(C1,1,P.PP(C1)/10)	Binarizes C1 with Level = 1 and Hys = “1/10 of the P-P value of waveform C1”

Computation on All History Waveforms

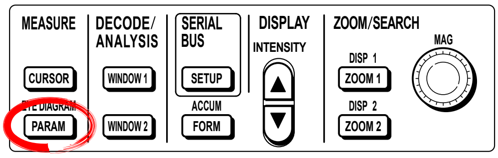
If you press the Math on History Exec soft key while the waveform acquisition is stopped, the user-defined computation is performed on all history waveforms of the source channel.

Note

- User-defined computation cannot be performed on all history waveforms while waveforms are being acquired.
- The computation-in-progress icon appears at the lower left of the screen, and a progress bar is displayed in the center of the screen while the user-defined computation on all history waveforms is in progress. All operations other than the Abort soft key are disabled.
- If you set the trigger mode to N Single and start the waveform acquisition, user-defined computation is performed only on the latest waveform after the acquisition is stopped. To perform user-defined computation on all history waveforms, carry out the procedure given in “Executing the Computation on All History Waveforms.”
- If you change a setting that affects the user-defined computation result, recomputation is performed only on the selected history waveform.
- The Average display of HISTORY or PARAM of History Statistics appears only if all history waveforms exist. If the Average display of History or PARAM of History Statistics is not performed, carry out the procedure given in “Executing the Computation on All History Waveforms.”

11.1 Automatically Measuring FlexRay Waveform Parameters

Procedure



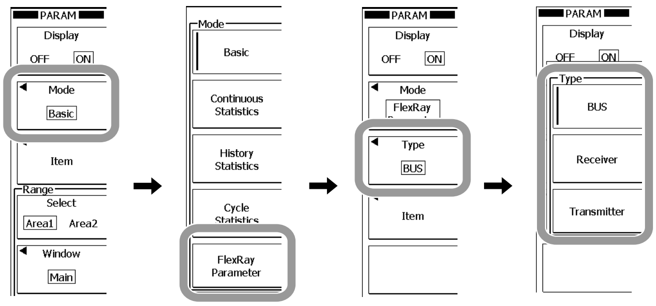
1. **PARAM**.
If waveform parameters are already set, their measured values will appear.

2. Press these soft keys: **Mode** > **FlexRay Parameter**.

Selecting the Test Type

3. Press the **Type** soft key.

4. Press the appropriate test type soft key from **BUS** to **Transmitter**.



Proceed to the steps on the pages indicated below according to the selected test type.

- BUS: Step 5 on page 11-2
- Receiver: Step 5 on page 11-3
- Transmitter: Step 5 on page 11-4

When the Test Type Is BUS

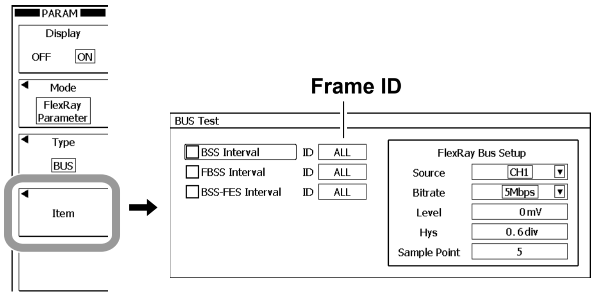
5. Press the **Item** soft key.
   The BUS Test dialog box appears.

Configuring Measurement Items

6. Use the **rotary knob** and **SET** to select measurement items from BSS Interval to BSS FES Interval.
7. Use the **rotary knob** and **SET** to select the frame ID that you want to measure.
   - If you select ALL, all intervals of measurement items will be measured.
   - If you specify a frame ID, the interval between frames with the specified ID will be measured.

Setting the Source Bit Rate, Level, Hysteresis, and Sample Point

8. Use the **rotary knob** and **SET** to set the source, bit rate, level, hysteresis, and sample point.



9. Press **ESC** to return to the previous screen.

Proceed to step 13 on page 11-5.

When the Test Type Is Receiver

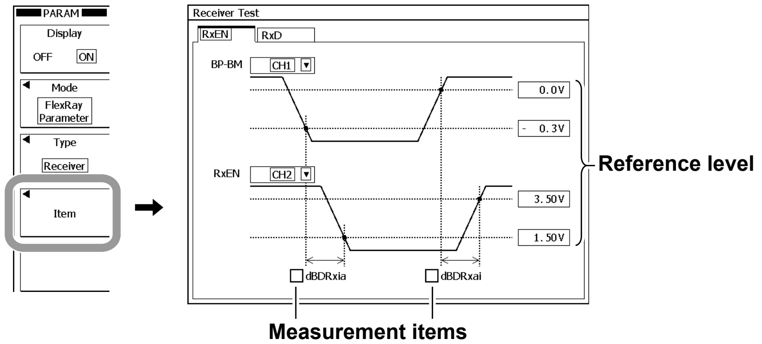
5. Press the **Item** soft key.
The Receiver Test dialog box appears.

Configuring Measurement Items

6. Use the **rotary knob** and **SET** to select the RxEN tab.
You can also press the RxEN soft key.

7. Use the **rotary knob** and **SET** to set the BP-BM and RxEN sources and the status reference levels.

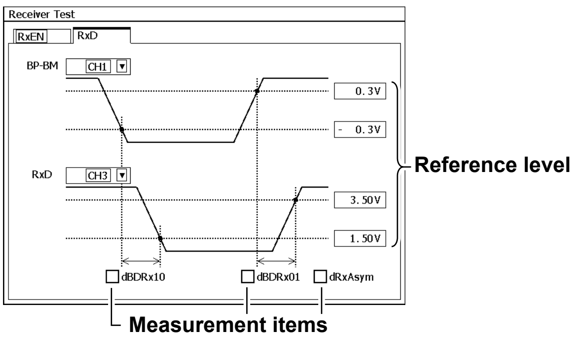
8. Use the **rotary knob** and **SET** to select measurement items.



9. Use the **rotary knob** and **SET** to select the RxD tab.
You can also press the RxD soft key.

10. Use the **rotary knob** and **SET** to set the BP-BM and RxD sources and the status reference levels.
The BP-BM source is shared with the source that you select in step 7.

11. Use the **rotary knob** and **SET** to select measurement items.



12. Press **ESC** to return to the previous screen.

Proceed to step 13 on page 11-5.

When the Test Type Is Transmitter

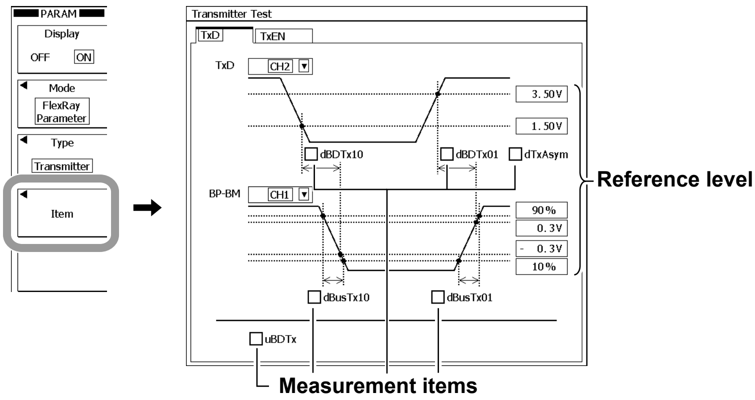
5. Press the **Item** soft key.
The Transmitter Test dialog box appears.

Configuring Measurement Items

6. Use the **rotary knob** and **SET** to select the TxD tab.
You can also press the TxD soft key.

7. Use the **rotary knob** and **SET** to set the TxD and BP-BM sources and the status reference levels.

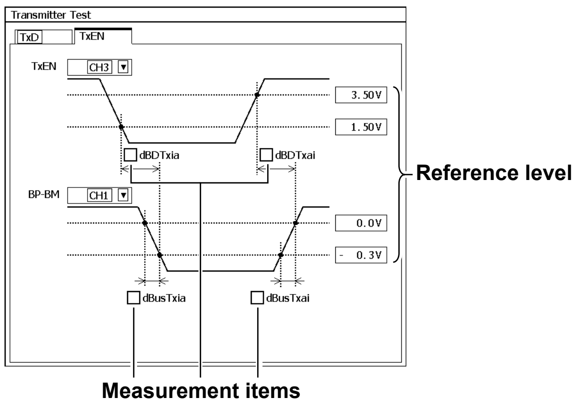
8. Use the **rotary knob** and **SET** to select measurement items.



9. Use the **rotary knob** and **SET** to select the TxEN tab.
You can also press the TxEN soft key.

10. Use the **rotary knob** and **SET** to set the TxEN and BP-BM sources and the status reference levels.
The BP-BM source is shared with the source that you select in step 7.

11. Use the **rotary knob** and **SET** to select measurement items.



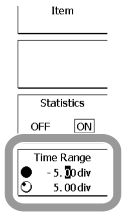
12. Press **ESC** to return to the previous screen.

Proceed to step 13 on page 11-5.

Setting the Time Range

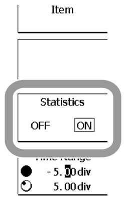
13. Press the **Time Range** soft key.

14. Use the **rotary knob** to set the time range start point (T1) and end point (T2).
Press the soft key to select the point that you want to set using the rotary knob.



Executing Statistical Processing

15. Press the **Statistics** soft key to turn statistical processing ON or OFF.
Selecting ON executes the statistical processing.



Explanation

Source Waveform

Select the source waveform from CH1 to CH4 or from M1 to M4.
Measurements cannot be made on a snapshot waveform or an accumulated waveform that is not the most recent waveform.

Bit Rate

You can set the FlexRay bus signal transfer rate to:
10Mbps, 5Mbps, or 2.5Mbps

Reference level

Set the reference level used to determine high or low source level.

- The selectable range is ±10 divisions. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
- To measure the transmitter characteristics dBusTx10 and dBusTx01, set the reference level as a percentage of the differential voltage amplitude (absolute value). The selectable range is from 0 to 100%. The resolution is 1%.

Hysteresis

The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Sample Point

The SB5000 samples data at a rate that is eight times the bit rate. This setting specifies which of the eight points to make the sampling point.
The selectable range is 1 to 8.

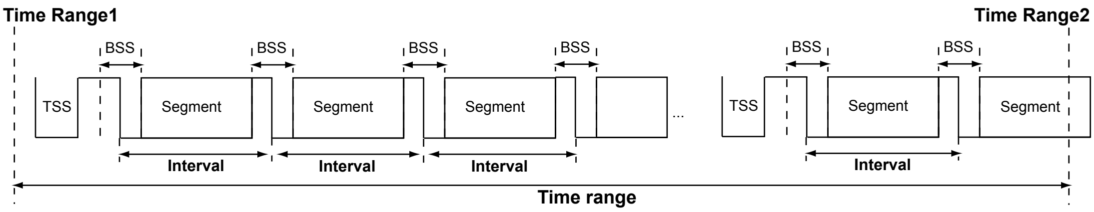
Measurement Items

Set the test type to BUS, Receiver, or Transmitter. The SB5000 measures the measurement items for the selected test type and displays the results.
Due to screen limitations, the SB5000 displays up to two of the selected items.

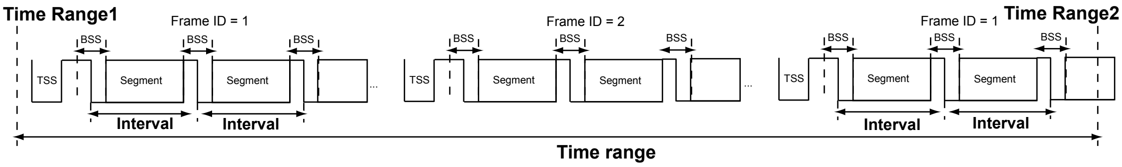
BUS

Select BSS Interval, FBSS Interval, or BSS-FES Interval.

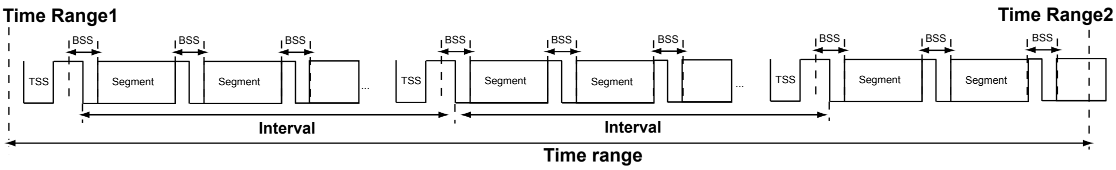
- **BSS Interval**
  - If you set Frame ID to ALL, the SB5000 measures the BSS intervals of all frames in the time range.



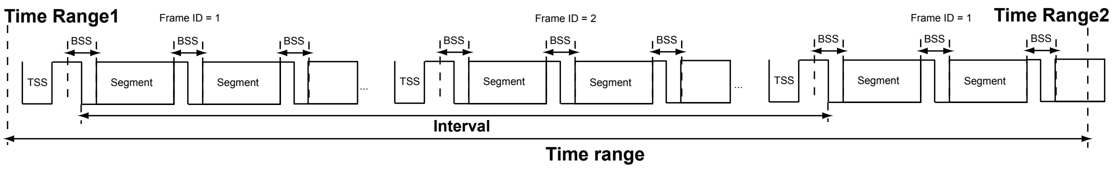
  - If you select a frame ID, the SB5000 measures the BSS intervals for the selected frame in the time range.



- **FBSS Interval**
  - If you set Frame ID to ALL, the SB5000 measures the interval of the frame's first BSS for all frames in the time range.

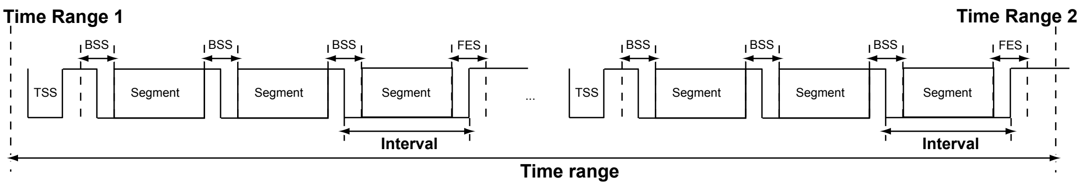


  - If you select a frame ID, the SB5000 measures the interval of the first BSS in the selected frame in the time range.

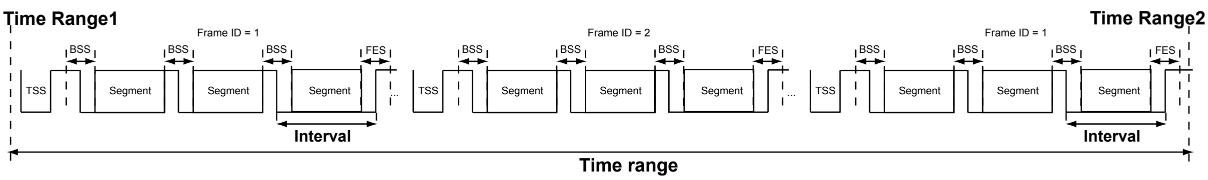


BSS-FES Interval

  - If you set Frame ID to ALL, the SB5000 measures the BSS and FES intervals of all frames in the time range.



  - If you select a frame ID, the SB5000 measures the BSS and FES intervals for the selected frame in the time range.



Bus Driver Electrical Charactersistics

The SB5000 can measure the electrical characteristics of bus drivers that comply with the conformance test standard FlexRay EPL Specifications V2.1.

- **Receiver**

  Measures the selected receiver characteristics.

Measures the following items from the BP-BM and RxEN waveforms.	
dBDRxia	Activity reaction time
dBDRxai	Idle reaction time
Measures the following items from the BP-BM and RxD waveforms.	
dBDRx10	Receiver delay, negative edge
dBDRx01	Receiver delay, positive edge
dRxAsym	Receiver delay mismatch |dBDRx10 – dBDRx01|

- **Transmitter**

  Measures the selected transmitter characteristics.

Measures the following items from the TxD and BP-BM waveforms.	
dBDTx10	Transmitter delay, negative edge
dBusTx10	Fall time differential voltage.
dBDTx01	Transmitter delay, positive edge
dBusTx01	Rise time differential voltage.
dTxAsym	Transmitter delay mismatch |dBDTx10 – dBDTx01|
uBDTx	Absolute differential voltage at TP1 |BP – BM|, when sending/when idle
Measures the following items from the TxEN and BP-BM waveforms.	
dBDTxia	Propagation delay idle → active
dBusTxia	Transition time idle → active
dBDTxai	Propagation delay active → idle
dBusTxai	Transition time active → idle

Time Range

The selectable range is ±5 divisions by taking the center of the waveform area to be 0 divisions. The resolution is 0.01 divisions.

Statistical Processing

While acquiring signals, the SB5000 calculates statistics on the signals that it has acquired so far. Cnt is the number of measured values of an item used to calculate statistics. It is equal to the number of signals that the SB5000 has acquired up to that point.
If you add a measurement item to the statistical calculation, the Cnt value is reset to 1 regardless of whether or not the SB5000 is acquiring signals.

The SB5000 calculates and displays the following statistics on the selected measurement items.

Max	Maximum value
Min	Minimum Value
Mean	Mean value
σ	Standard deviation
Cnt	The number of measured values that statistics were calculated for

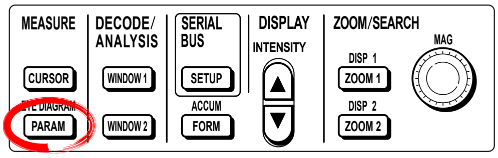
If you select more than three measurement items, the statistics of the first two selected items are displayed. You can view the statistics of other items in the following way.
- Load the items into a PC using the communication function.
- Save the statistics as automatically measured waveform items (see section 14.10) and load the data into a PC.

When the Test Type Is BUS

If statistical processing is ON, the SB5000 determines statistics on all acquired signals up to that point as explained above. If statistical processing is OFF, the SB5000 determines intervals sequentially from the oldest data for the displayed waveform and determines the statistics.

11.2 Performing Automated Measurement of Waveform Parameters

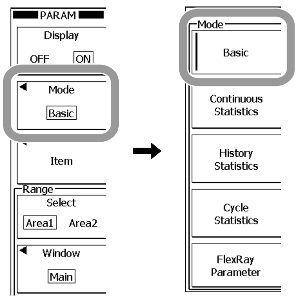
Procedure



1. **PARAM**.

If waveform parameters are already set, their measured values will appear.

2. Press these soft keys: **Mode** > **Basic**.



Configuring Measurement Items

3. Press the **Item** soft key.

The measurement item setup menu and dialog box appear.

Selecting the Measurement Area in Which to Set the Measurement Item

4. Press the **Area/Calc** soft key.

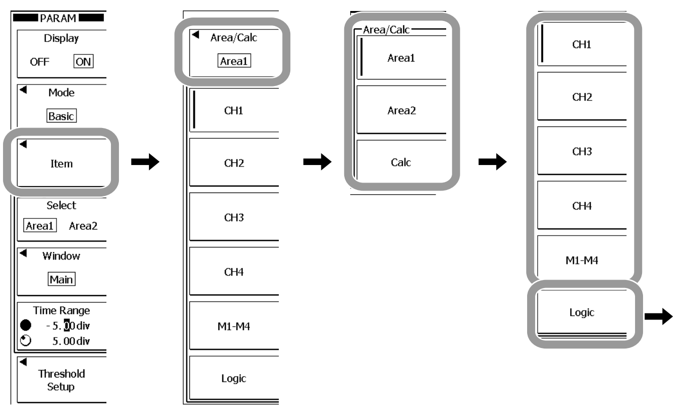
5. Press the **Area1** or **Area2** soft key to select the measurement area.

If you select Calc, proceed to step 25 on page 11-11.

Selecting the Source Waveform

6. Press the appropriate waveform soft key.

- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- To select Logic, press the **Logic** soft key, and then press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the **rotary knob** and **SET**, and then press **ESC**

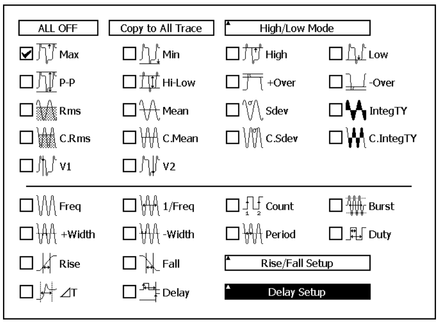


Use the rotary knob and **SET** to select a logic signal.

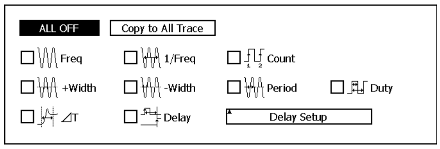
Selecting Measurement Items

7. Use the **rotary knob** and **SET** to select measurement items.
   If you select ALL OFF and press **SET**, you can turn OFF all items at once.
   If you select Copy to All Trace and press **SET**, you can copy the settings to all traces (sources) in the same area.

When a channel from CH1 to CH4 or from M1 to M4 is selected in step 6



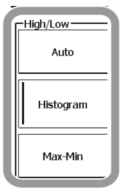
When Logic is selected in step 6



8. If necessary, repeat steps 6 and 7.

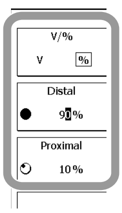
- **Set the High/Low Mode (how high and low is determined)**

9. Use the **rotary knob** and **SET** to select High/Low Mode.
10. Press the **Auto**, **Histogram**, or **Max-Min** soft key to select how high and low values will be determined.



- **Setting the Distal and Proximal Values**
  (Defines the measurement points that are used to determine Rise and Fall.)

11. Use the **rotary knob** and **SET** to select Rise/Fall Setup.
12. Press the **V/%** soft key to set the unit to V or %.
    The distal and proximal unit displayed on the screen changes to the specified unit.
13. Press the **Distal** soft key. Use the **rotary knob** to set the distal value.
14. Press the **Proximal** soft key. Use the **rotary knob** to set the proximal value.
15. Press **ESC** to return to the previous screen.



- **Setting the Delay by Specifying the Edge Count and Reference Waveform**

16. Use the **rotary knob** and **SET** to select Delay Setup.

17. Press the **Polarity** soft key to set the edge that will be counted to ↑ or ↓.

18. Press the **Count** soft key. Use the **rotary knob** to set the edge detection count that defines the edge used to measure the delay.

19. Press the **Reference** soft key to set the reference point to Trig Pos (trigger position) or Edge.
If you select Trig Pos, proceed to step 24.

- **Setting the Reference Point**

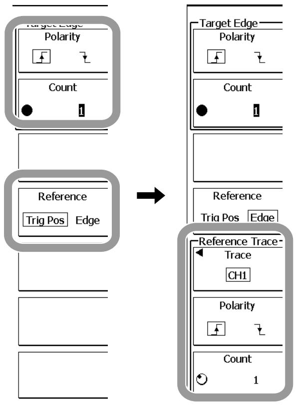
20. Press the **Trace** soft key.

21. Press the appropriate soft key to select the reference waveform.

22. Press the **Polarity** soft key to set the reference edge to ↑ or ↓.

23. Press the **Count** soft key. Use the **rotary knob** to set the edge detection count that defines the reference edge.

24. Press **ESC** to return to the previous screen.



Setting a Calculation

Set the calculation only when you want to perform waveform parameter calculations.

25. On the **Area/Calc** menu, press the **Calc** soft key.

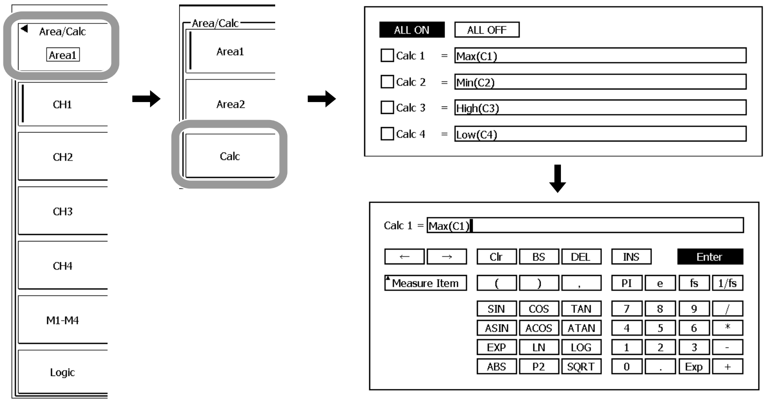
26. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

27. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
The dialog box for entering the expression appears.

28. Use the **rotary knob** and **SET** to select functions and operators.
- You can also use the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
- You can enter numbers using the numeric keys.

29. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
The dialog box closes, and the screen for selecting the calculation number reappears.

30. Press **ESC** to return to the PARAM menu.



Setting a Measurement Area's Time Range

Selecting a Measurement Area

31. Press the **Select** soft key to select Area1 or Area2.

Selecting a Measurement Window

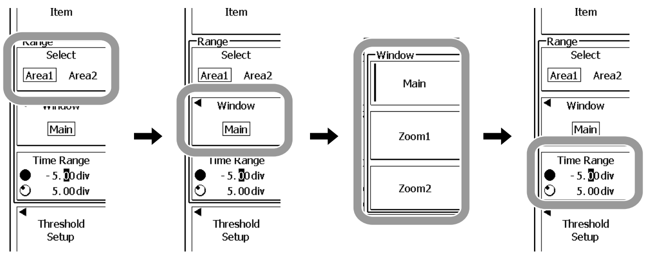
32. Press the **Window** soft key.

33. Press the appropriate soft key from **Main** to **Zoom4** to select a window.

Setting the Time Range

34. Press the **Time Range** soft key.

35. Use the **rotary knob** to set the time range start point (T1) and end point (T2).
Press the soft key to select the point that you want to set using the rotary knob.



Setting the Threshold Levels for Measurement Items Other Than Rise and Fall

36. Press the **Threshold Setup** soft key.

Selecting the Source Waveform

37. Press the source waveform soft key.

Selecting the Method for Setting the Threshold Level

38. Press the **Threshold** soft key.

39. Press the Auto, Level/Hys, or Upper/Lower soft key to select method.
- If you select Auto, proceed to step 40.
- If you select Level/Hys, proceed to step 41.
- If you select Upper/Lower, proceed to step 43.

- **Auto**

40. Press the **Center of** soft key to select P-P or High-Low.

- **Level/Hys**

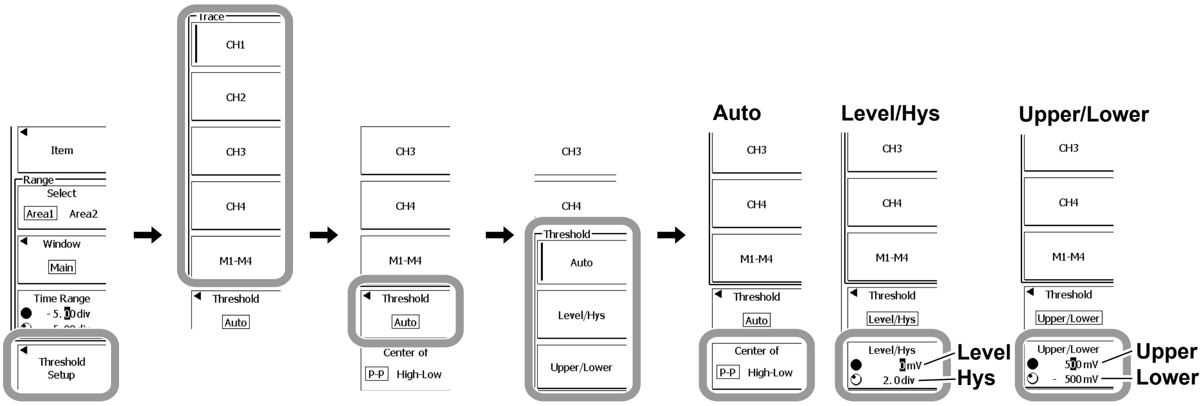
41. Press the **Level/Hys** soft key.

42. Use the **rotary knob** to set the threshold level and hysteresis.
Press the soft key to select the setting that you want to set using the rotary knob.

- **Upper/Lower**

43. Press the **Upper/Lower** soft key.

44. Use the **rotary knob** to set the upper and lower limits.
Press the soft key to select the limit that you want to set using the rotary knob.



Explanation

Source Waveform

Select the source waveform from CH1 to CH4, from M1 to M4, or from Logic A0 to D7 (from A0 to A7 on the SB5310).
Measurements cannot be made on a snapshot waveform or an accumulated waveform that is not the most recent waveform.

Measurement Items

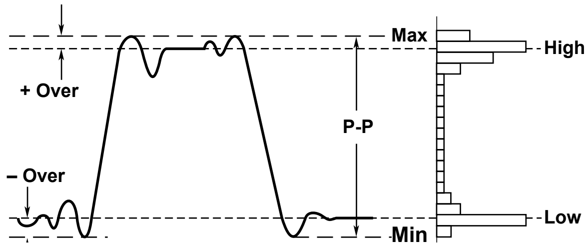
Select any of the 29 measurement items or the delay item. The abbreviations used to display the items on the screen are indicated in parentheses.

- The SB5000 can store a total of up to 100000 data values for all traces (CH1 to CH4, M1 to M4, and Logic) in measurement areas 1 and 2.
- The SB5000 can display up to 16 waveforms on the screen.
- The measurement items for a logic signal are Freq, 1/Freq, Count, +Width, -Width, Period, Duty, ∆T, and Delay

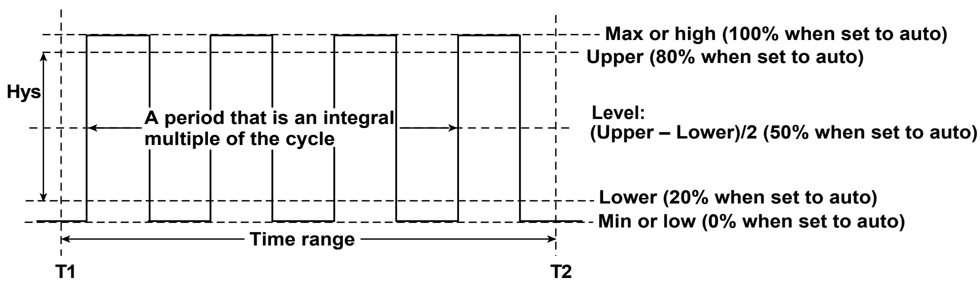
- **Voltage Measurement Items**

Max: Maximum voltage [V]
Min: Minimum voltage [V]
High: High voltage [V]
Low: Low voltage [V]
P-P: Peak-to-peak value (Max – Min) [V]
Hi-Low: High voltage – low voltage [V]
+ Over: Overshoot [%]
(Max – High)/(High – Low)×100
– Over: Undershoot [%]
(Low – Min)/(High – Low)×100

Rms: Rms voltage [V] $(1/\sqrt{n})(\Sigma(xI^2))^{1/2}$
Mean: Mean voltage [V] $(1/n)\Sigma xI$
Sdev: Standard deviation [V] $((\Sigma xI^2 – (\Sigma xI)^2/n)/n)^{1/2}$
IntegTY (ITY): Sum of the areas under the positive and negative curves [Vs]



C.Rms (CRms): Rms value over a period that is an integral multiple of the cycle within the time range [V]
C.Mean (CMean): Mean value over a period that is an integral multiple of the cycle within the time range [V]
C.Sdev (CSdev): Standard deviation over a period that is an integral multiple of the cycle within the time range [V]
C.IntegTY (CITY): Average area under the positive and negative curves per cycle [Vs]

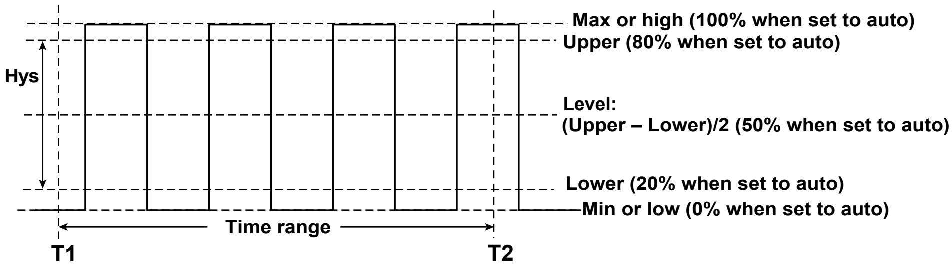


V1(x) : Voltage at the crossing point of the specified trace and T1 (the left edge of the time range)
V2(x) : Voltage at the crossing point of the specified trace and T2 (the right edge of the time range)
∆T(x) : Time difference between T1 and T2
* The x in parentheses is the trace name. For example, it is C1 for CH1, M1 for M1, and LA0 for logic signal A0.

- **Time Measurement Items**

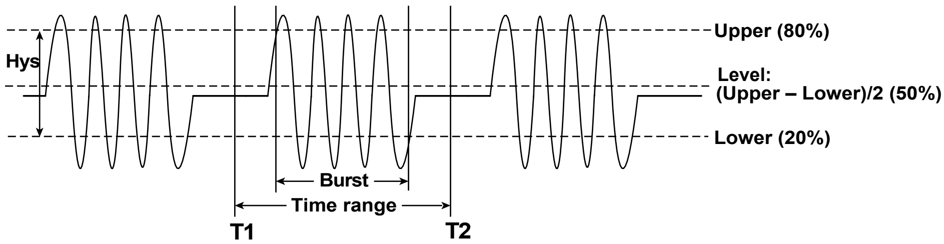
Freq: Average frequency in the time range [Hz]
1/Freq: Average period in the time range [s]
Count: Edge count [no unit]

When count = 4

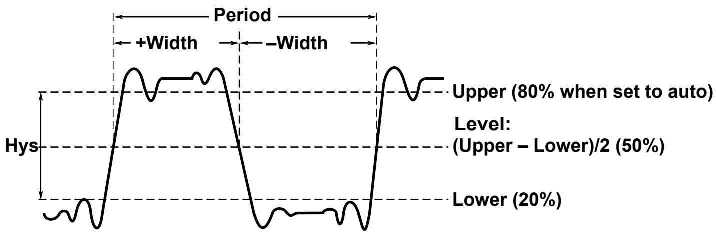


Burst: Burst width [s]

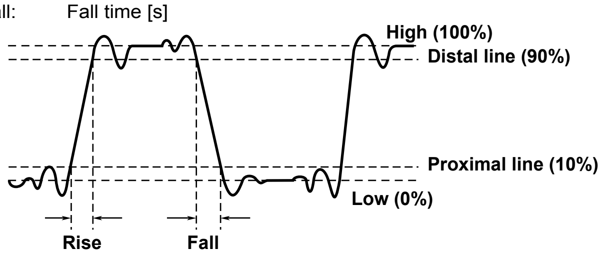
Set the appropriate time range for the burst width that you want to measure.



+ Width: Time span where the waveform is above the reference level [s]
– Width: Time span where the waveform is below the reference level [s]
Period: Period [s]
Duty: Duty cycle (+Width/Period×100) [%]



Rise: Rise time [s]
Fall: Fall time [s]



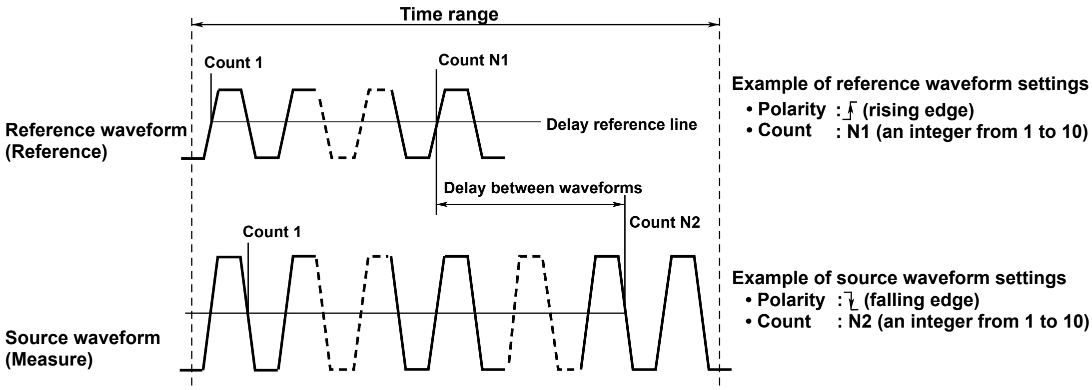
- **Other Measurement Items**

Delay (Dly): Delay [s]

Setting the Delay

Measures the delay between waveforms or the delay from the trigger point to the rising or falling edge.

The following figure shows the case when the reference waveform polarity is set to rising edge and the reference point is set to Edge.



- The reference point that is used to measure the delay between waveforms varies depending on the Reference setting.

Edge	Based on the reference waveform edge
Trig Pos	Based on the trigger position

- Set the detected edge to (rising) or (falling) using the Edge Polarity item. The default setting is rising edge.
- Set the number of edges to specify the detection point (reference point or measurement point) using the Count item. Set an integer value from 1 to 10. The default value is 1.
- The voltage level at the detection point defines the delay reference line.
- The delay reference line varies depending on the threshold level setting as follows:

Auto	50% of the peak-to-peak value or high-low value
Level/Hys	The specified threshold level
Upper/Lower	(Upper – Lower)/2

- The measured delay is displayed using the name “Dly.”

How to Determine the High and Low Values

You can select how the SB5000 determines the high level (100%) and the low level (0%) for the high, low, hi-low, and rise/fall measurement items.

Auto

Sets the high value to the high amplitude level and the low value to the low amplitude level to low based on the voltage level frequency of the source waveform in the time range taking into account the effects from ringing, spikes, etc. This method is suitable for measuring square waves and pulse waves.

Histgram

Sets the levels of the two highest frequencies on a histogram to high and low.
This method is suitable for waveforms whose maximum frequency of a given level is extremely high compared to frequencies of other levels, such as in a rectangular waveform.

MAX-MIN

Sets high and low values to the maximum and minimum values in the time range. This method is suitable for measuring sinusoidal and saw waves. It is not suitable for waveforms that have ringing and spikes.

Time Range

The selectable range is ±5 divisions by taking the center of the waveform area to be 0 divisions. The resolution is 0.01 divisions.

Threshold Level

You can set the threshold level in the following ways.

Auto	The SB5000 automatically determines the threshold level from the peak-to-peak or high-low value.
Level/Hys	Set the values using the rotary knob.
Upper/Lower	Set the values using the rotary knob.

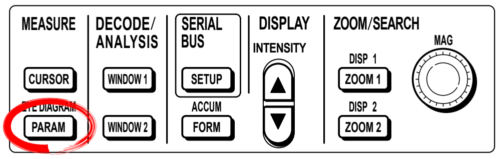
* The threshold value is applied to a channel selected from CH1 to CH4 or from M1 to M4.

Notes about Automated Measurement of Waveform Parameters

- The SB5000 displays "*****" for values that cannot be measured.
- The SB5000 may not be able to measure correctly if the waveform amplitude is small.
- If there are two or more periods of the waveform in the time range, the SB5000 measures time measurement parameters (+Width, –Width, Period, Duty) on the first period.
- To cancel automated measurement, turn the mode OFF. Measurement will stop immediately.

11.3 Calculating Statistics on the Measured Waveform Parameter Values

Procedure



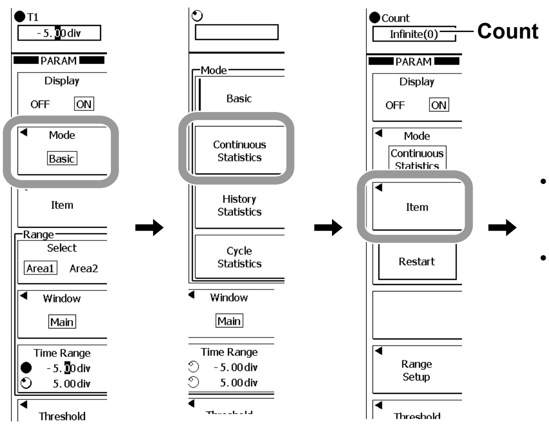
Configuring Normal Statistical Processing

1. **PARAM**.
2. Press these soft keys: **Mode** > **Continuous Statistics** > **Item**.
3. Set the measurement items according to steps 4 to 24 in section 11.2.
4. Press **ESC** to return to the PARAM menu.
5. Use the **rotary knob** to set the Count value that specifies the number of times to calculate statistics.

For the procedure to set other items, see the procedure from step 25 in section 11.2.

Executing Statistical Processing

6. Press **START/STOP** to start signal acquisition. The SB5000 calculates statistics the number of times specified by Count.
   - To start calculating statistics as you clear the statistical results, press the **Restart** soft key.
   - If you press **START/STOP** to stop signal acquisition in progress, the SB5000 will stop calculating statistics and display the statistics up to that point.



- Set the measurement items according to steps 4 to 24 in section 11.2.
- Press **ESC** to return to the PARAM menu.

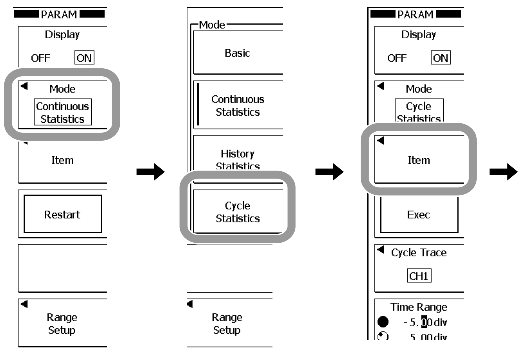
Configuring Cycle Statistical Processing

1. **PARAM**.
2. Press these soft keys: **Mode** > **Cycle Statistics** > **Item**.
3. Set the measurement items according to steps 4 to 24 in section 11.2.
   In place of the Area/Calc menu described in steps 4 and 5 in section 11.2, a menu for selecting whether to set the measurement items (Basic) or to set the calculation (Calc) appears.
4. Press **ESC** to return to the PARAM menu.
5. Press the **Cycle Trace** soft key.
6. Press the appropriate waveform soft key.
   - To select a channel from M1 to M4, press the **M1-M4** soft key first.
   - To select Logic, press the **Logic** soft key, and then press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the the **rotary knob** and **SET**, and then press **ESC**

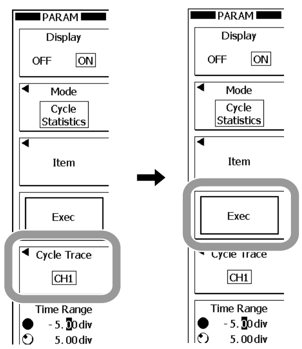
For the procedure to set other items, see the procedure from step 25 in section 11.2.

Executing Statistical Processing

7. Press the **EXEC** soft key.
   Statistical processing is executed.
   The Exec soft key changes to the Abort soft key. To abort measurement and statistical processing, press the **Abort** soft key. Measurement and statistical processing are aborted, and the Abort soft key changes to the EXEC soft key.



- Set the measurement items according to steps 4 to 24 in section 11.2 that describes the automated measurement of waveform parameters.
- Press **ESC** to return to the PARAM menu.



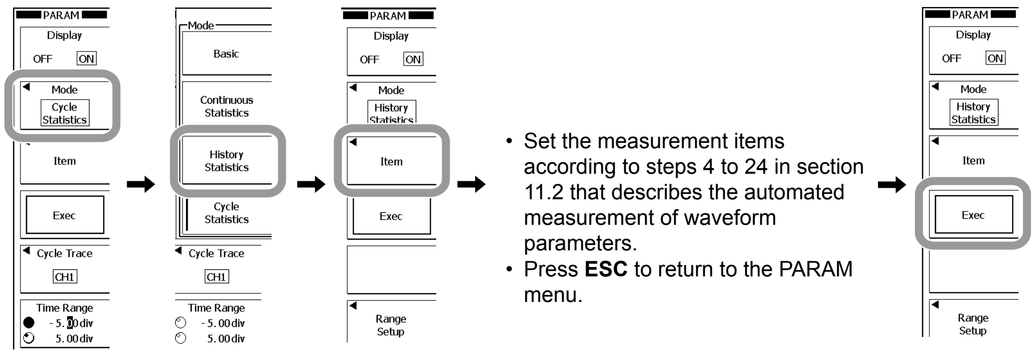
Configuring Statistical Processing on History Data

1. **PARAM**.
2. Press these soft keys: **Mode** > **History Statistics** > **Item**.
3. Set the measurement items according to steps 4 to 24 in section 11.2.
4. Press **ESC** to return to the PARAM menu.

The procedure to set other items are the same as with automated measurement of waveform parameters (see the procedure from step 10 in section 11.2 for details).
However, the time range menu described in steps 31 to 35 in section 11.2 will be different. Press the Range Setup soft key, and then set the time range of Area1 and Area2.

Executing Statistical Processing

5. Press the **EXEC** soft key.
   Statistical processing is executed.
   The Exec soft key changes to the Abort soft key. To abort measurement and statistical processing, press the **Abort** soft key. Measurement and statistical processing are aborted, and the Abort soft key changes to the EXEC soft key.



Explanation

There are three statistical processing types: normal, cycle, and history.
The SB5000 calculates statistics on the same measurement items as those of automated measurement of waveform parameters described in section 11.2. The SB5000 calculates and displays the following statistics on the selected automatically measured items. For example, if you select CH1 P-P for the automatically measured item, statistics such as the maximum, minimum, mean, and standard deviation values as well as the number of measured values used to calculate the statistics appear at the bottom of the screen.

Max	Maximum value
Min	Minimum Value
Mean	Mean value
σ	Standard deviation
Cnt	The number of measured values that statistics were calculated for

The SB5000 can display the statistical results of two automatically measured items. If three or more automatically measured items are selected, the SB5000 displays the first two items in ascending order by channel number and in the order that the items appear in the automatic measurement item selection dialog box (Max, Min, ..., ΔT, Delay).

Example 1:	If CH1: Max, High, CH2: Max, Min, CH3: Max, and Min are selected, the SB5000 displays CH1: Max and CH1: High
Example 2:	If CH1: Max, CH2: Max, Min, CH3: Max, and Min are selected, the SB5000 displays CH1: Max and CH2: Max

You can view the statistics of other items in the following way.
- Load the items into a PC using the communication function.
- Save the statistics as automatically measured waveform items (see section 14.10) and load the data into a PC.

Normal Statistical Processing

While acquiring signals, the SB5000 calculates statistics on the signals that it has acquired so far. The number of measured values that statistics were calculated for, expressed as Cnt, corresponds to the number of signals that the SB5000 has acquired up to that point. If you add an automatically measured item to the statistical calculation, the Cnt value is reset to 1 regardless of whether or not the SB5000 is acquiring signals.

Cycle Statistical Processing

In cycle statistical processing, the SB5000 determines periods in order from the oldest data of the displayed waveform, measures the selected automatically measured items on the data within each period, and calculates statistics. The method of determining the period is the same as the method for determining the normal waveform period. The period of the specified signal is applied to all measurement source waveforms.
The following parameters cannot be selected.

Freq (average frequency) 1/Freq (average period), Count (edge count), ΔT, and Delay

Statistical Processing on History Data

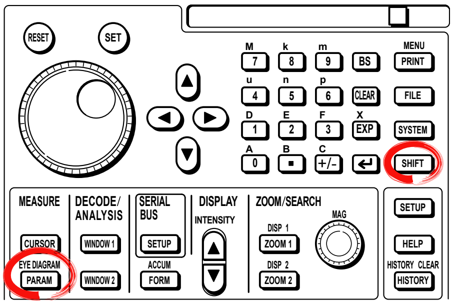
In history statistical processing, the SB5000 measures automatically measured items on the waveform acquired using the history memory function. The SB5000 calculates statistics from the oldest waveform. Statistics are calculated on the waveforms displayed in ShowMap.

Notes about Statistical Processing

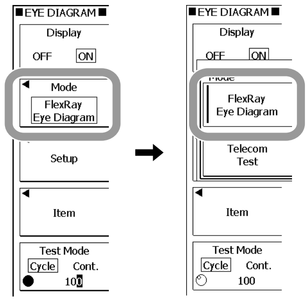
All soft keys except the Abort soft key are disabled while statistical processing is in progress. The **START/STOP** key can be used for normal statistical processing.

11.4 Measuring a FlexRay Eye Diagram (Mask Test and Eye Pattern Measurement)

Procedure

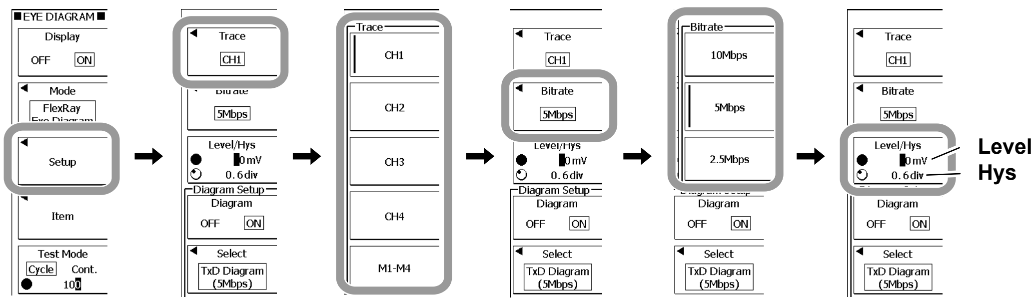


1. Press **SHIFT**+**PARAM** (EYE DIAGRAM).
   The EYE DIAGRAM menu appears.
   If measurement items are already set, their measured values will appear.
2. Press these soft keys: **Mode** > **FlexRay Eye Diagram**.



Setting the Bit Rate, Level, and Hysteresis of the Source FlexRay Waveform

3. Press these soft keys: **Setup** > **Trace**.
4. Press the appropriate waveform soft key.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
5. Press the **Bitrate** soft key.
6. Press the appropriate bit rate soft key from **10Mbps** to **2.5Mbps**.
7. Press the **Level/Hys** soft key.
8. Use the **rotary knob** to set the reference level and hysteresis of the edge used to draw the eye waveform.
   - Press the soft key to select the setting that you want to set using the rotary knob.
   - These settings take effect when the test mode is set to Cycle as described on page 11-24.



Configuring the Diagram

9. Press the **Diagram** soft key to select ON or OFF.
If you select OFF, the diagram display will disappear.
Select ON and carry out the procedure below.

Selecting the Measurement Point

10. Press the **Select** soft key.

11. Press the **TxD Diagram** or **RxD Diagram** soft key to select the measurement point.

Configuring the Diagram

12. Press the **Edit Diagram** soft key.

- **Setting the Reference Point**

13. Press the **Reference Point** soft key.

14. Use the **rotary knob** to set the eye waveform reference point.
- Set the reference point by specifying the distance from the center of the screen taken to be 0 divisions.
- The diagram will move accordingly.

- **Setting the Left and Right Edges**

15. Press the **Left/Right** soft key.

16. Use the **rotary knob** to set the left and right edges of the diagram.
- Press the soft key to select the edge that you want to set using the rotary knob.
- If you select both the left and right edges, the entire diagram will move horizontally.

- **Setting the Width**

17. Press the **Eye Width** soft key.

18. Use the **rotary knob** to set the time span of the diagram.

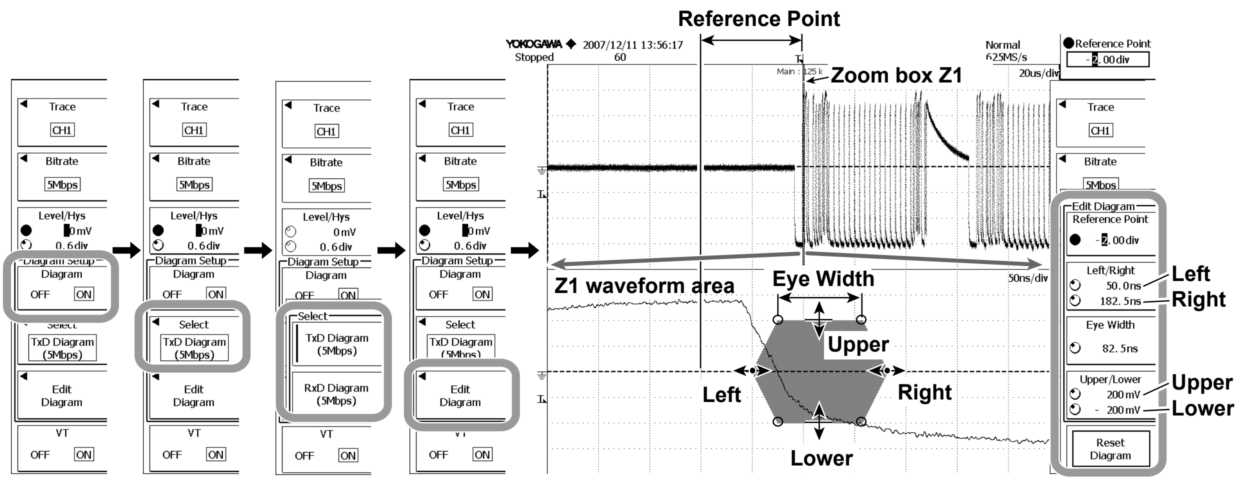
- **Setting the Top and Bottom Edges**

19. Press the **Upper/Lower** soft key.

20. Use the **rotary knob** to set the top and bottom edges of the diagram.
- Press the soft key to select the edge that you want to set using the rotary knob.
- If you select both the top and bottom edges, the entire diagram will move vertically.

- **Resetting the Settings**

Press the **Reset Diagram** soft key to reset the diagram values.
You cannot undo a reset.



21. Press **ESC**.

Turning the T-Y Waveform (VT) ON and OFF

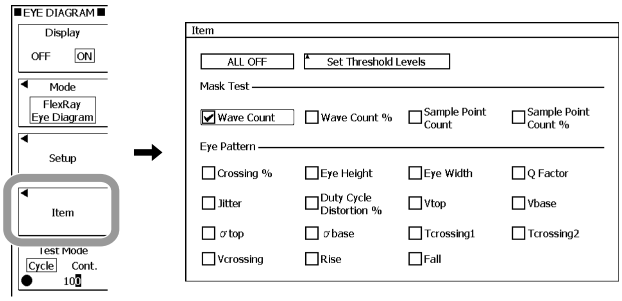
22. If necessary, press the **VT** soft key to turn the T-Y waveform ON and OFF.
If you select OFF, the T-Y waveform will disappear, and the Z1 waveform area will be expanded.

23. Press **ESC** to return to the EYE DIAGRAM menu.

Selecting Measurement Items

24. Press the **Item** soft key.

25. Use the **rotary knob** and **SET** to select measurement items.
If you select ALL OFF and press **SET**, you can turn OFF all items at once.



Setting the Threshold Levels

26. Use the **rotary knob** and **SET** to select Set Threshold Levels.

27. Press the **V/%** soft key to set the level unit to V or %.

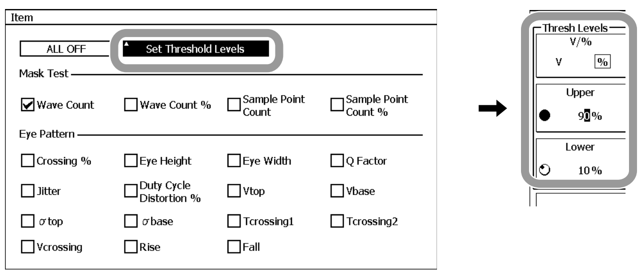
- V: You can set the level in the range of ±10 divisions in steps 29 and 31. The unit changes depending on the set conditions.
- %: You can set the level from 0 to 100% in steps 29 and 31. The difference between Vtop and Vbase is taken to be 100%.

28. Press the **Upper** soft key.

29. Use the **rotary knob** to set the high threshold level.

30. Press the **Lower** soft key.

31. Use the **rotary knob** to set the low threshold level.



32. Press **ESC** twice to return to the EYE DIAGRAM menu.

Selecting the Test Mode and Executing the Test

33. Press the **Test Mode** soft key to select Cycle or Cont.
- If you select Cycle, proceed to step 34.
- If you select Cont., proceed to step 38.

- **Displaying the Eye Waveform and Measuring the Selected Items**

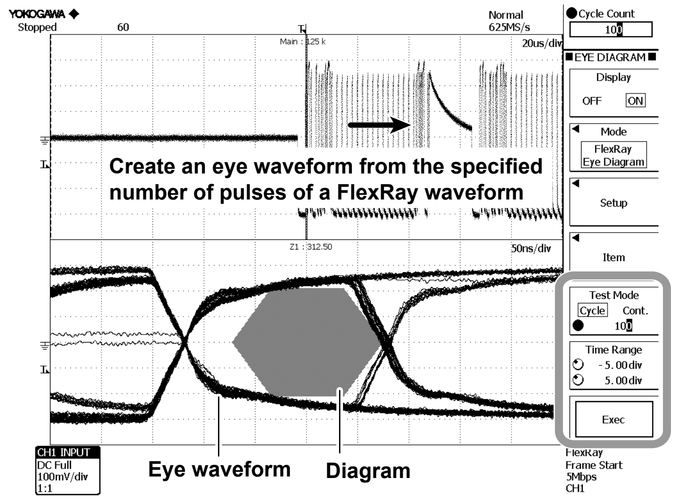
Stop signal acquisition to make these measurements.

34. Use the **rotary knob** to set the FlexRay waveform pulse count.

35. Press the **Time Range** soft key.

36. Use the **rotary knob** to set the time range start point (T1) and end point (T2).
Press the soft key to select the point that you want to set using the rotary knob.

37. Press the **Exec** soft key.
The SB5000 generates and displays the eye waveform and measures the selected items.



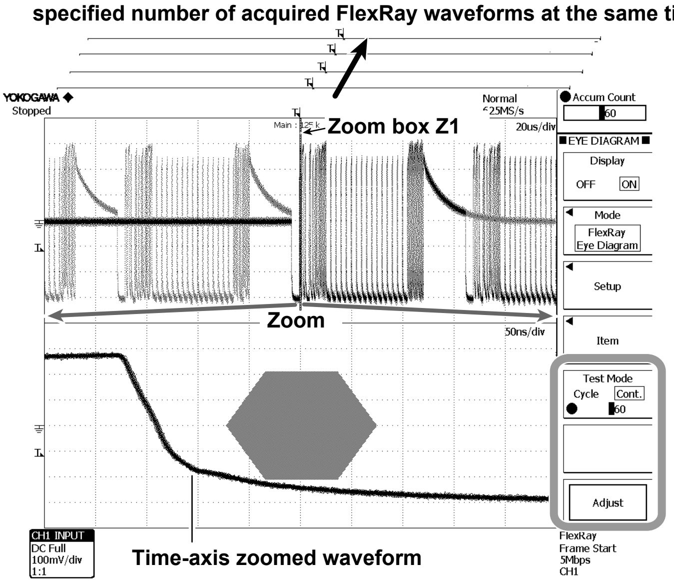
- **Displaying the Time-Axis Zoomed Waveform and Measuring the Selected Items**

There is no need to stop signal acquisition.

38. Use the **rotary knob** to set the FlexRay waveform accumulation count.

39. Press the **Adjust** soft key.
The SB5000 displays the time-axis zoomed waveform and measures the selected items.

Displays the time-axis zoomed waveform which is obtained by expanding the specified number of acquired FlexRay waveforms at the same time point.



Explanation

The SB5000 can perform FlexRay serial bus mask test and eye pattern measurement.
By default, the SB5000 automatically displays the T-Y waveform and the Z1 waveform area when the EYE DIAGRAM menu is opened. Z1 waveform area displays the diagram.

FlexRay Waveform

Select the FlexRay waveform from CH1 to CH4 or from M1 to M4.
However, snapshot waveforms cannot be measured.

Bit Rate

You can set the FlexRay bus signal transfer rate to:
10Mbps, 5Mbps, or 2.5Mbps

Reference Level

Set the edge reference level for drawing the eye waveform.
The selectable range is ±100 V. The resolution is 0.1 V.

Hysteresis

The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Measurement Point

Set the measurement point to:
- TxD Diagram for transmission
- RxD Diagram for reception

Diagram

You can edit the diagram (zone) that is displayed in the Z1 waveform area. The SB5000 calculates the reciprocal of the selected bit rate and sets the time axis in the Z1 waveform area so that two to three periods of the waveform are displayed.

- **Reference Point**
  Set the eye waveform reference point (the position of the first edge point) by specifying the distance from the trigger point.
  The selectable range is ±5 divisions. The resolution is 0.01 divisions.

- **Left and Right Edges**
  The selectable range is the Z1 waveform area display range. The unit is determined based on the time axis in the Z1 waveform area that is calculated from the bit rate.

- **Time Span**
  The selectable range is up to the left and right edges within the Z1 waveform area display range.

- **Top and Bottom Edges**
  The selectable range is ±10 divisions. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

- **Default Diagram**
  The default diagram when the bit rate is 10 Mbps complies with “FlexRay Electrical Physical Layer Specification” that is disclosed by the FlexRay consortium.

Measurement Items

Select the measurement items from the following table.

• Mask Test	
Wave Count	Acquisition error count
Wave Count %	Acquisition error rate (%)
Sample Point Count	Sampling error count/total data count
Sample Point Count %	Sampling error rate (%)

• Eye Pattern Measurement	For definitions of measurement items and their formulas, see “Telecom Test” in section 2.9.
Crossing %	Level where the rising edge and the falling edge of the eye pattern cross, expressed as a percentage with respect to the difference between Vtop and Vbase.
Eye Height	Height of the eye
Eye Width	Width of the eye
Q Factor	Quality factor of the eye diagram expressed as a ratio of the eye height with respect to the noise at both the high and low voltage levels.
Jitter	Magnitude of the time fluctuation of the crossing point
Duty Cycle Distortion %	Time difference between the falling edge intermediate point and the rising edge intermediate point determined by the intermediate threshold level, expressed as a percentage with respect to the full bit width.
Vtop	Vertical histogram top peak average voltage
Vbase	Vertical histogram bottom peak average voltage
σ top	Vertical histogram top peak standard deviation
σ base	Vertical histogram bottom peak standard deviation
Tcrossing1	Average time of the first crossing point
Tcrossing2	Average time of the second crossing point
Vcrossing	Voltage where the rising edge and the falling edge cross
Rise	Rise time from the specified lower threshold level to the upper threshold level
Fall	Fall time from the specified upper threshold level to the lower threshold level

Setting the Upper and Lower Threshold Levels

Set the threshold levels in percentage or by using physical values. Threshold level settings are used to measure the eye pattern rise and fall items.

%	You can set the level from 0 to 100%. The difference between Vtop and Vbase is taken to be 100%.
V	You can set the level within ±10 divisions. The unit changes depending on the set conditions.

Test Mode

Select the test mode from:

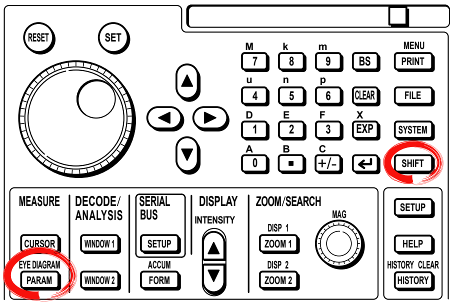
- Cycle

  The SB5000 can test the electrical characteristics of bus drivers that comply with the conformance test standard FlexRay EPL Specifications V2.1.
  Creates and displays an eye waveform from the specified number of pulses of a FlexRay waveform. Measures the selected items.
  The selectable range is 1 to 5000.
- Cont.

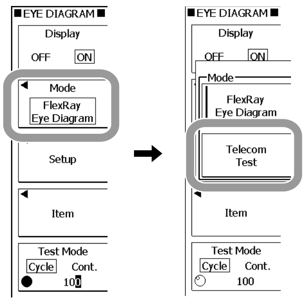
  Displays the time-axis zoomed waveform derived from the specified number of acquired FlexRay waveforms at the same time point. Measures the selected items.
  The selectable range is infinite (0) or from 1 to 60.

11.5 Performing a Telecom Test (Mask Test and Eye Pattern Measurement)

Procedure

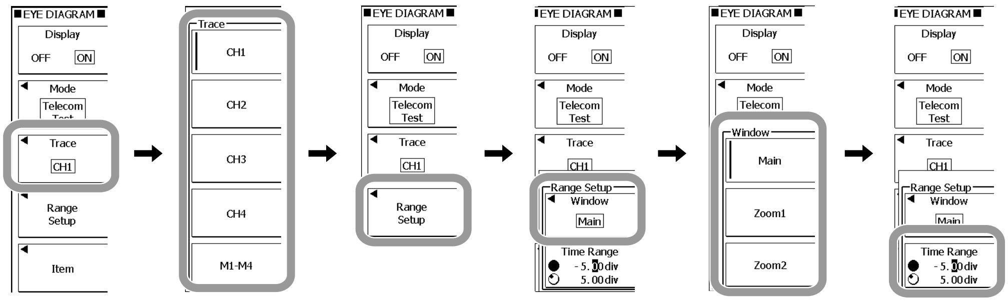


1. Press **SHIFT**+**PARAM** (EYE DIAGRAM).
   The EYE DIAGRAM menu appears.
   If measurement items are already set, their measured values will appear.
2. Press these soft keys: **Mode** > **Telecom Test**.



Setting the Source Waveform, Window, and Time Range

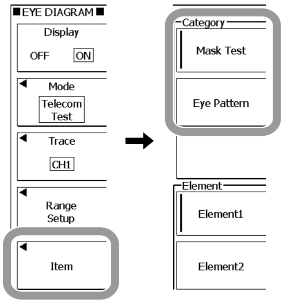
3. Press the **Trace** soft key.
4. Press the appropriate waveform soft key.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
5. Press these soft keys: **Range Setup** > **Window**.
6. Press a soft key from **Main** to **Zoom2** to select the window.
7. Press the **Time Range** soft key.
8. Use the **rotary knob** to set the time range start point (T1) and end point (T2).
   Press the soft key to select the point that you want to set using the rotary knob.
9. Press **ESC** to return to the previous screen.



Selecting Measurement Items

10. Press the **Item** soft key.

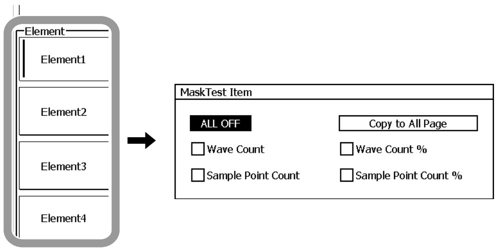
11. Press the **Mask Test** or **Eye Pattern** soft key.
- If you select Mask Test, proceed to step 12.
- If you select Eye Pattern, proceed to step 14.



Selecting Mask Test Items

12. Press the appropriate soft key from **Element1** to **Element4** to select the element.

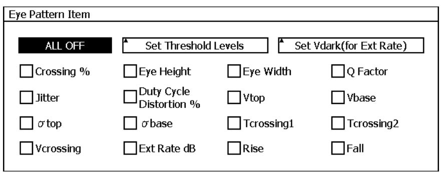
13. Use the **rotary knob** and **SET** to select the test items.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.
- If you select Copy to All Page and press **SET**, the test items selected in step 12 will be copied to all other elements.



Proceed to step 25 on page 11-29.

Selecting Eye Pattern Measurement Items

14. Use the **rotary knob** and **SET** to select measurement items.
If you select ALL OFF and press **SET**, you can turn OFF all items at once.



- **Setting the Threshold Levels**

15. Use the **rotary knob** and **SET** to select Set Threshold Levels.

16. Press the **V/%** soft key to set the level unit to V or %.
- V: You can set the level in the range of ±10 divisions in steps 18 and 20. The unit changes depending on the set conditions.
- %: You can set the level from 0 to 100% in steps 18 and 20. The difference between Vtop and Vbase is taken to be 100%.

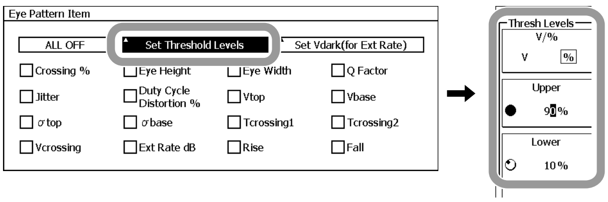
17. Press the **Upper** soft key.

18. Use the **rotary knob** to set the high threshold level.

19. Press the **Lower** soft key.

20. Use the **rotary knob** to set the low threshold level.

21. Press **ESC** to return to the previous screen.

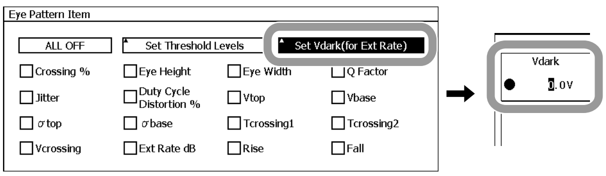


- **Setting the Dark Level**

22. Use the **rotary knob** and **SET** to select Set Vdark(for Ext Rate).

23. Use the **rotary knob** to set the dark level (zero light level).

24. Press **ESC** to return to the previous screen.



25. Press **ESC** to return to the EYE DIAGRAM menu.

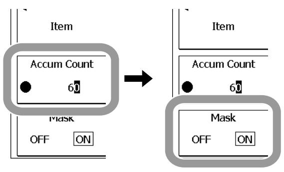
Setting the Accumulation Count

26. Press the **Accum Count** soft key.

27. Use the **rotary knob** to set the accumulation count.

Turning the Mask Display ON and OFF

28. If necessary, press the **Mask** soft key to turn the mask images ON or OFF.



Explanation

The SB5000 can perform a telecom test, which consists of a mask test and eye pattern measurement, and display the results. The mask test detects an error if the source trace enters any of the four masks (elements) that have been created on a PC. For the procedure to load mask patterns, see section 14.7.

Source Waveform

Select the source waveform from CH1 to CH4 or from M1 to M4.

Measurement Source Window

Select Main, Z1, or Z2.

Time Range

The selectable range is ±5 divisions by taking the center of the waveform area to be 0 divisions. The resolution is 0.01 divisions.

Measurement Items

Select the measurement items from the table below.

• **Mask Test**	
Wave Count	Acquisition error count
Wave Count %	Acquisition error rate (%)
Sample Point Count	Sampling error count/total data count
Sample Point Count %	Sampling error rate (%)

• **Eye Pattern Measurement**	For definitions of measurement items and their formulas, see “Telecom Test” in section 2.9.
Crossing %	Level where the rising edge and the falling edge of the eye pattern intersect, expressed as a percentage with respect to the difference between Vtop and Vbase.
Eye Height	Height of the eye
Eye Width	Width of the eye
Q Factor	Quality factor of the eye diagram expressed as a ratio of the eye height with respect to the noise at both the high and low voltage levels.
Jitter	Magnitude of the time fluctuation of the crossing point
Duty Cycle Distortion %	Time difference between the falling edge intermediate point and the rising edge intermediate point determined by the intermediate threshold level, expressed as a percentage with respect to the full bit width.
Vtop	Vertical histogram top peak average voltage
Vbase	Vertical histogram bottom peak average voltage
σ top	Vertical histogram top peak standard deviation
σ base	Vertical histogram bottom peak standard deviation
Tcrossing1	Average time of the first crossing point
Tcrossing2	Average time of the second crossing point
Vcrossing	Voltage where the rising edge and the falling edge cross
Ext Rate dB	Extinction rate dB
Rise	Rise time from the specified lower threshold level to the upper threshold level
Fall	Fall time from the specified upper threshold level to the lower threshold level

Upper and Lower Threshold Levels

Set the threshold levels in percentage or by using physical values. Threshold level settings are used to measure the eye pattern rise and fall items.

V	You can set the level within ±10 divisions. The unit changes depending on the set conditions.
%	You can set the level from 0 to 100%. The difference between Vtop and Vbase is taken to be 100%.

Dark Level

Set the dark level (zero light level). The dark level setting is used to measure the eye pattern extinction rate dB.
You can set the level within ±10 divisions. The unit changes depending on the set conditions.

Accumulation Count

Set the accumulation count for the acquired signal. For details on the accumulation function, see section 8.7.

Mask Display

You can select whether or not to display the mask images that have been created on a PC.

Notes about the Telecom Test

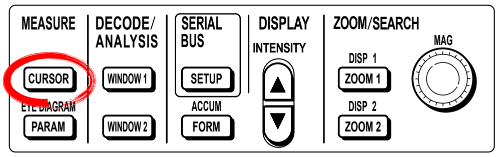
- When you execute a telecom test, all waveforms other than the source waveform are displayed as follows:
  - Waveforms are not displayed if the display interpolation is turned OFF (see section 9.3 for details).
  - Waveforms are displayed at low intensity if the display interpolation is not OFF.
- You cannot execute a mask test, if GO/NOGO or history search is in progress.
- When you turn the telecom test ON (open the setup menu), accumulation will turn ON. The accumulation mode is set to Count.

Note

Because the sample point count is calculated using interpolated data, the value returned for it may not correspond to the record length.

11.6 Measuring Using Cursors

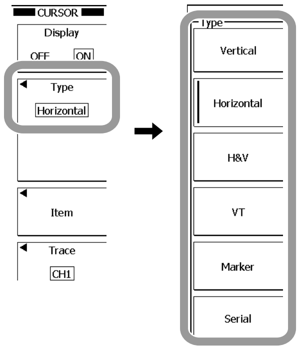
Procedure



1. Press **CURSOR**.
   Cursors appear.

Selecting the Cursor Type

2. Press the **Type** soft key.
3. Press the appropriate soft key from **Vertical** to **Serial** to select the cursor type.



Proceed to the steps on the pages indicated below according to the selected cursor.

- Vertical: Step 4 on page 11-33
- Horizontal: Step 4 on page 11-34
- H&V (horizontal & vertical): Step 4 on page 11-36
- VT: Step 4 on page 11-38
- Marker: Step 4 on page 11-40
- Serial: Step 4 on page 11-42

Vertical Cursors

Selecting Measurement Items

4. Press the **Item** soft key.

- **Selecting Basic Measurement Items**

5. Press the **Basic** soft key.

6. Use the **rotary knob** and **SET** to select the items you want to measure.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.

- **Configuring Calculations When Using Cursor Measurement Values in Calculations**

7. Press the **Calc** soft key.

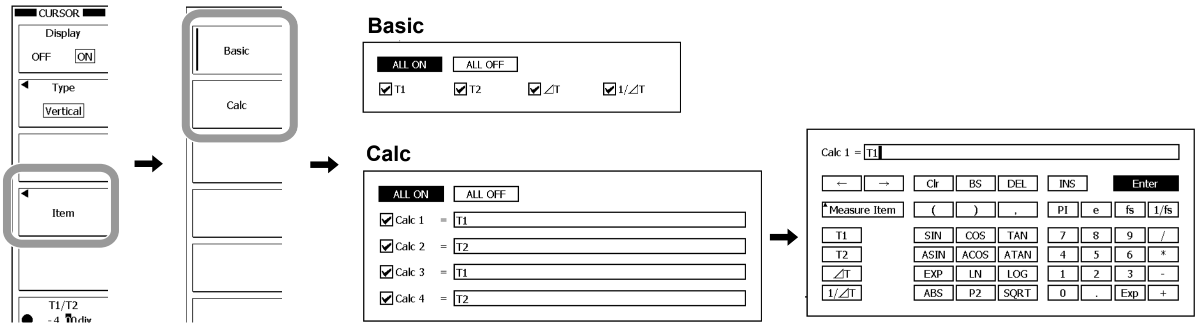
8. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

9. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
The dialog box for entering the expression appears.

10. Use the **rotary knob** and **SET** to select functions and operators.
- You can also use the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
- You can enter numbers using the numeric keys.

11. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
The dialog box closes, and the screen for selecting the calculation number reappears.

12. Press **ESC** to return to the previous screen.



Moving a Cursor

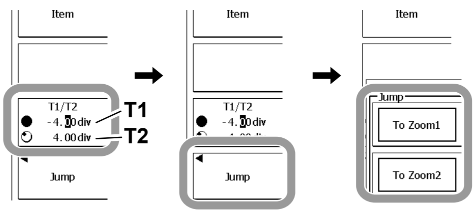
13. Press the **T1/T2** soft key.

14. Use the **rotary knob** to move the T1 or T2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

Selecting the Jump Destination

15. Press the **Jump** soft key.

16. Press the **To Zoom1** or **To Zoom2** soft key to select the jump destination zoom window.



Horizontal Cursors

Selecting Measurement Items

4. Press the **Item** soft key.

- **Selecting Basic Measurement Items**

5. Press the **Basic** soft key.

6. Use the **rotary knob** and **SET** to select the items you want to measure.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.

- **Configuring Calculations When Using Cursor Measurement Values in Calculations**

7. Press the **Calc** soft key.

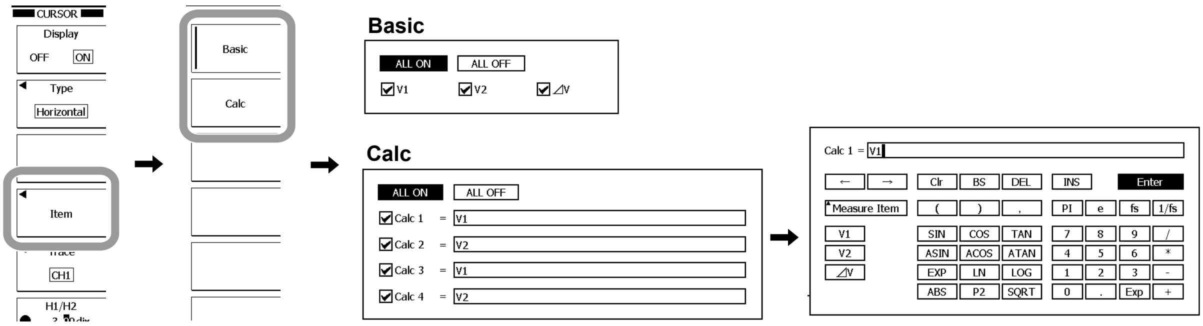
8. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

9. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
The dialog box for entering the expression appears.

10. Use the **rotary knob** and **SET** to select functions and operators.
- You can also use the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
- You can enter numbers using the numeric keys.

11. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
The dialog box closes, and the screen for selecting the calculation number reappears.

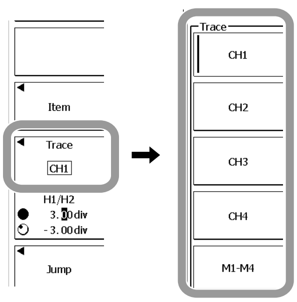
12. Press **ESC** to return to the previous screen.



Selecting the Source Waveform

13. Press the **Trace** soft key.

14. Press the appropriate waveform soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.



Moving a Cursor

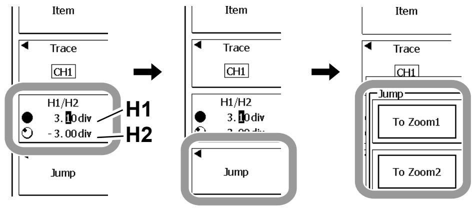
15. Press the **H1/H2** soft key.

16. Use the **rotary knob** to move the H1 or H2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

Selecting the Jump Destination

17. Press the **Jump** soft key.

18. Press the **To Zoom1** or **To Zoom2** soft key to select the jump destination zoom window.



H & V Cursors

Selecting Measurement Items

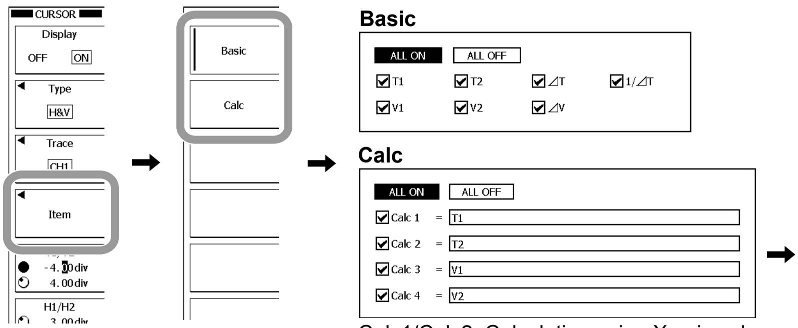
4. Press the **Item** soft key.

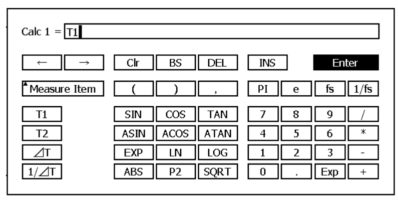
- **Selecting Basic Measurement Items**

5. Press the **Basic** soft key.
6. Use the **rotary knob** and **SET** to select the items you want to measure.
   - If you select ALL ON and press **SET**, you can turn ON all items at once.
   - If you select ALL OFF and press **SET**, you can turn OFF all items at once.

- **Configuring Calculations When Using Cursor Measurement Values in Calculations**

7. Press the **Calc** soft key.
8. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.
   You can set calculations that use X-axis values for Calc1 and Calc2 and Y-axis values for Calc3 and Calc4.
9. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
   The dialog box for entering the expression appears.
10. Use the **rotary knob** and **SET** to select functions and operators.
    - You can also use the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
    - You can enter numbers using the numeric keys.
11. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
    The dialog box closes, and the screen for selecting the calculation number reappears.
12. Press **ESC** to return to the previous screen.

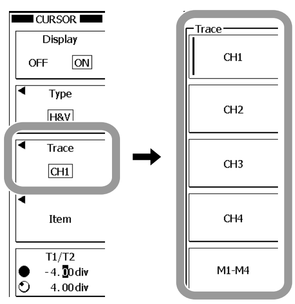




Calc1/Calc2: Calculation using X-axis values
Calc3/Calc4: Calculation using Y-axis values

Selecting the Source Waveform

13. Press the **Trace** soft key.
14. Press the appropriate waveform soft key.
    To select a channel from M1 to M4, press the **M1-M4** soft key first.



Moving a Cursor

- **Moving the Vertical Cursors**

15. Press the **T1/T2** soft key.

16. Use the **rotary knob** to move the T1 or T2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

- **Moving the Horizontal Cursors**

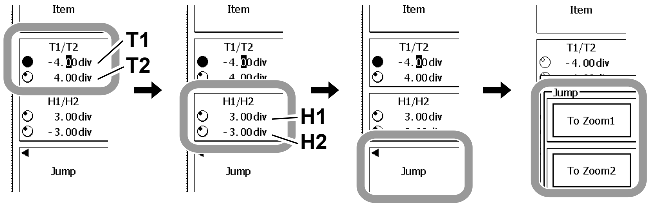
17. Press the **H1/H2** soft key.

18. Use the **rotary knob** to move the H1 or H2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

Selecting the Jump Destination

19. Press the **Jump** soft key.

20. Press the **To Zoom1** or **To Zoom2** soft key to select the jump destination zoom window.



VT Cursor

Selecting Measurement Items

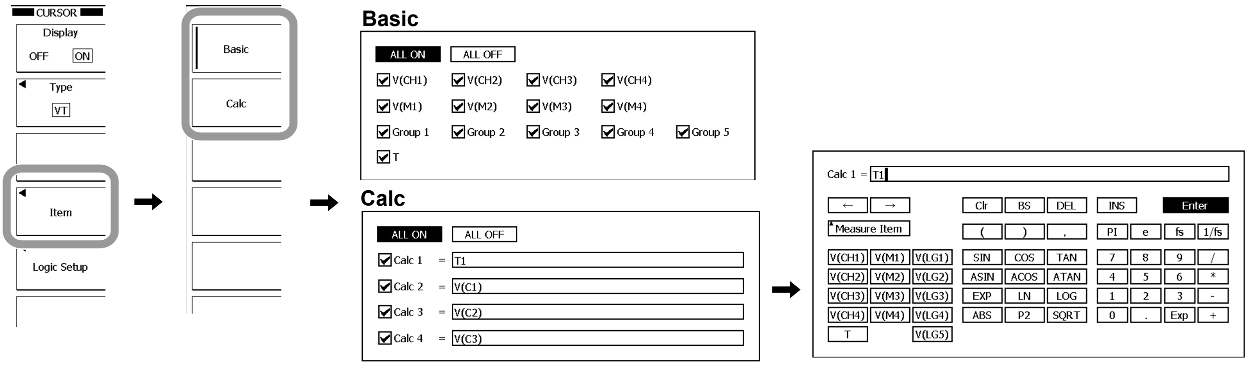
4. Press the **Item** soft key.

- **Selecting Basic Measurement Items**

5. Press the **Basic** soft key.
6. Use the the **rotary knob** and **SET** to select the items you want to measure.
   - If you select ALL ON and press **SET**, you can turn ON all items at once.
   - If you select ALL OFF and press **SET**, you can turn OFF all items at once.

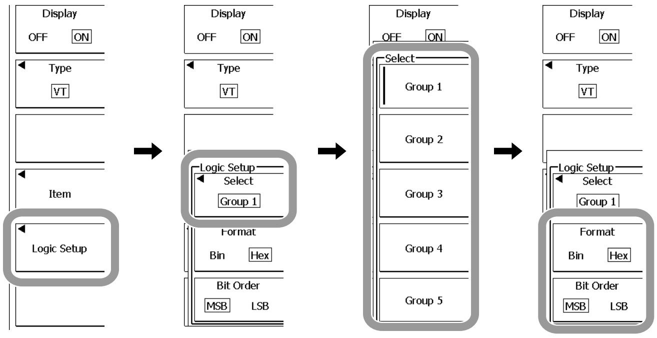
- **Configuring Calculations When Using Cursor Measurement Values in Calculations**

7. Press the **Calc** soft key.
8. Use the the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.
9. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
   The dialog box for entering the expression appears.
10. Use the the **rotary knob** and **SET** to select functions and operators.
    - You can also use the the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
    - You can enter numbers using the numeric keys.
11. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
    The dialog box closes, and the screen for selecting the calculation number reappears.
12. Press **ESC** to return to the previous screen.



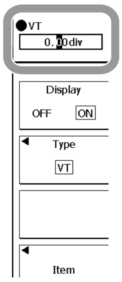
Selecting the Logic Signal Notation and Bit Order

13. Press the **Logic Setup** soft key.
14. Press the **Select** soft key.
15. Press the appropriate group soft key from **Group 1** to **Group 5**.
16. Press the **Format** soft key to select binary or hexadecimal notation.
17. Press the **Bit Order** soft key to set the data bit order to MSB or LSB.
18. Press **ESC** to return to the previous screen.



Moving the Cursor

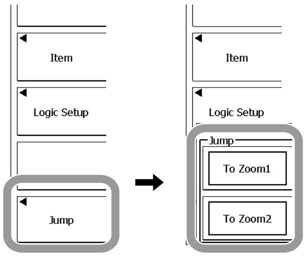
19. Use the **rotary knob** to move the cursor.



Selecting the Jump Destination

20. Press the **Jump** soft key.

21. Press the **To Zoom1** or **To Zoom2** soft key to select the jump destination zoom window.



Marker Cursors

Selecting the Marker Form

4. Press the **Marker Form** soft key to select Mark or Line.

Selecting Measurement Items

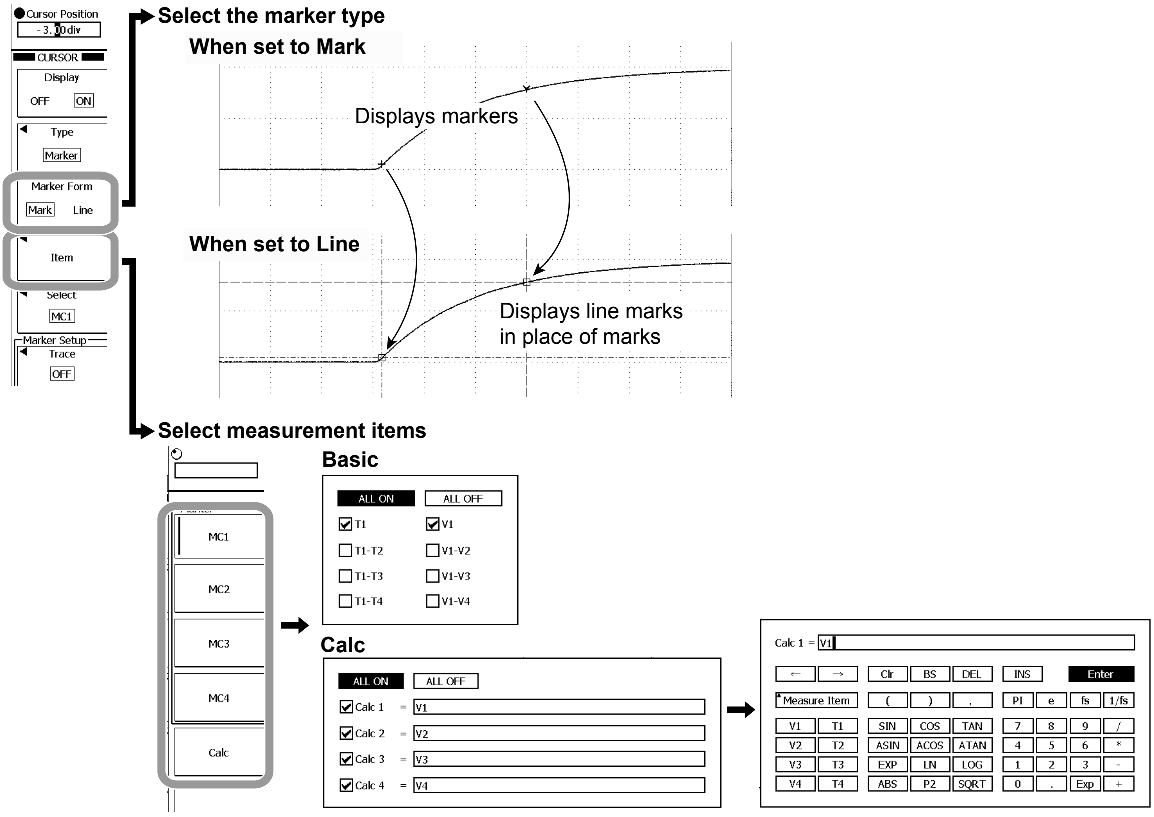
5. Press the **Item** soft key.

- **Selecting Basic Measurement Items**

6. You can set measurement items for each marker. Press the appropriate soft key from **MC1** to **MC4** to select a marker.
7. Use the the **rotary knob** and **SET** to select the items you want to measure.
   - If you select ALL ON and press **SET**, you can turn ON all items at once.
   - If you select ALL OFF and press **SET**, you can turn OFF all items at once.

- **Configuring Calculations When Using Cursor Measurement Values in Calculations**

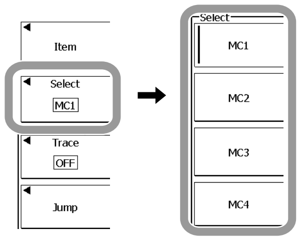
8. Press the **Calc** soft key.
9. Use the the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.
10. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
    The dialog box for entering the expression appears.
11. Use the the **rotary knob** and **SET** to select functions and operators.
    - You can also use the the **rotary knob** and **SET** to select Measure Item and then select measurement items from the displayed menu.
    - You can enter numbers using the numeric keys.
12. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
    The dialog box closes, and the screen for selecting the calculation number reappears.
13. Press **ESC** to return to the previous screen.



Selecting a Marker

14. Press the **Select** soft key.

15. Press the appropriate soft key from **MC1** to **MC4** to select a marker.
Select the source waveform, move the cursor, and select the jump destination for the marker selected here.



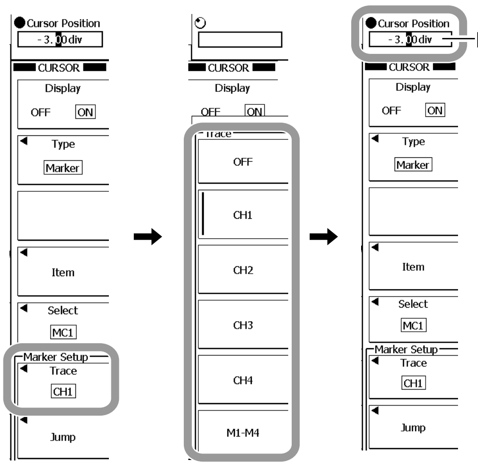
- **Selecting the Source Waveform**

16. Press the **Trace** soft key.

17. Press the appropriate waveform soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

- **Moving the Marker**

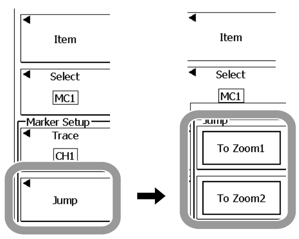
18. Use the **rotary knob** to move the marker.



- **Selecting the Jump Destination**

19. Press the **Jump** soft key.

20. Press the **To Zoom1** or **To Zoom2** soft key to select the jump destination zoom window.



Serial Cursors

Selecting a Serial Cursor

4. Press the **Select** soft key to select SC1 or SC2.
You can set two serial cursors: SC1 and SC2.

5. Press the **Setup** soft key.

Selecting the Source Waveform

6. Press the **Trace** soft key.

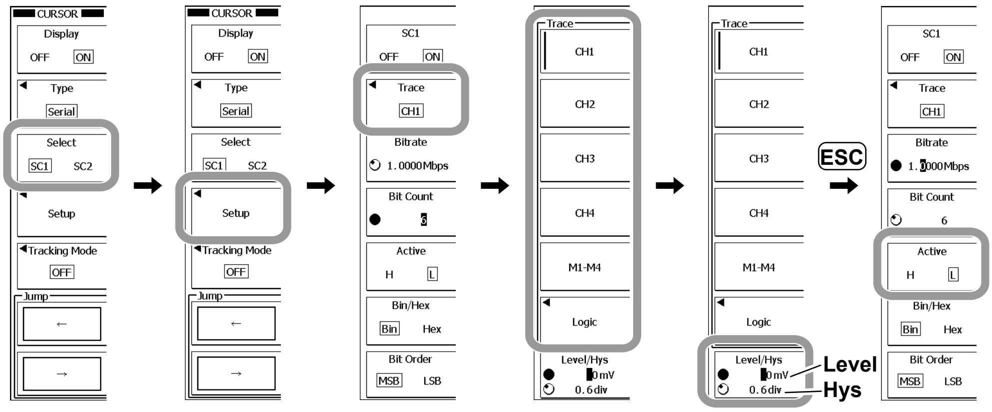
7. Press the appropriate waveform soft key.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- To select Logic, press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the the **rotary knob** and **SET**, and then press **ESC**

8. Press the **Level/Hys** soft key.

9. Use the **rotary knob** to set the threshold level and hysteresis.
Press the soft key to select the setting that you want to set using the rotary knob.

10. Press **ESC** to return to the previous screen.

11. Press the **Active** soft key to select H or L.



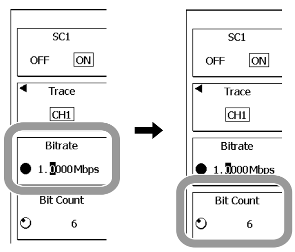
Setting the Bit Rate and Bit Count

12. Press the **Bitrate** soft key.

13. Use the **rotary knob** to set the bit rate from 1bps to 1Gbps.

14. Press the **Bit Count** soft key.

15. Use the **rotary knob** to set the bit count from 1 to 128.

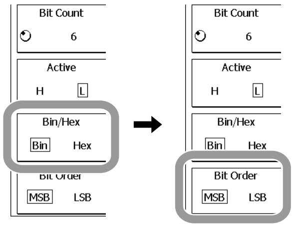


Selecting the Notation and Bit Order

15. Press the **Bin/Hex** soft key to select Bin or Hex.

16. Press the **Bit Order** soft key to select MSB or LSB.

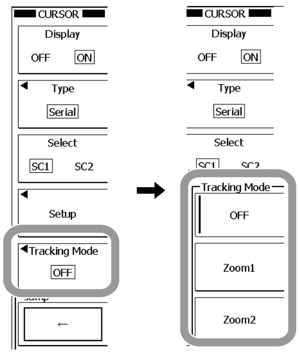
17. Press **ESC** to return to the previous screen.



Selecting the Tracking Mode

18. Press the **Tracking Mode** soft key.

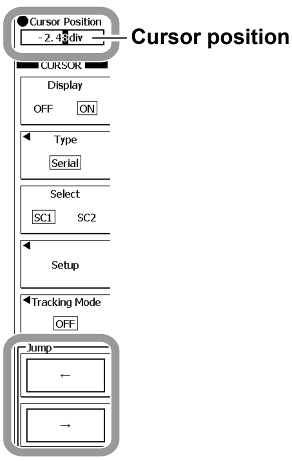
19. Press a soft key from **OFF** to **Zoom2** to select the tracking mode.



Moving the Cursor

23. Use the **rotary knob** to move the cursor.

You can also use the ← and → soft keys to move the cursor. The movement span varies depending on the bit rate and bit count set in steps 12 to 15.



Explanation

Source Waveform

Select the source waveform from CH1 to CH4, from M1 to M4, or from Logic A0 to D7 (from A0 to A7 on the SB5310).

Measurements cannot be made on a snapshot waveform or an accumulated waveform that is not the most recent waveform.

For logic signals, only the VT cursor can be used.

Cursor Types and Measurement Items

- **Vertical (V) Cursors**

  Measures the X-axis values at the cursor positions.

T1	T1 cursor X-axis value
T2	T2 cursor X-axis value
ΔT	Difference between the X-axis values of the T1 and T2 cursors
1/ΔT	Reciprocal of the difference between the X-axis values of the T1 and T2 cursors

- **Horizontal (H) Cursors**

  Measures the Y-axis values at the cursor positions.

V1	V1 cursor Y-axis value
V2	V2 cursor Y-axis value
ΔV	Difference between the Y-axis values of the V1 and V2 cursors.

- **Horizontal&Vertical (H&V) Cursors**

  Measures the X-axis value and the Y-axis value at the cursor positions.

  X-axis

T1	T1 cursor X-axis value
T2	T2 cursor X-axis value
ΔT	Difference between the X-axis values of the T1 and T2 cursors
1/ΔT	Reciprocal of the difference between the X-axis values of the T1 and T2 cursors

  Y-axis

V1	V1 cursor Y-axis value
V2	V2 cursor Y-axis value
ΔV	Difference between the Y-axis values of the V1 and V2 cursors.

- **Vertical Time (VT) Cursor**

  Measures the time from the trigger position to the VT cursor and the selected waveform data value at the VT cursor.

  - CH1 to CH4

V(CH1)	CH1 Y-axis value
V(CH2)	CH2 Y-axis value
V(CH3)	CH3 Y-axis value
V(CH4)	CH4 Y-axis value
V(M1)	M1 Y-axis value
V(M2)	M2 Y-axis value
V(M3)	M3 Y-axis value
V(M4)	M4 Y-axis value
T	X-axis value

  - Logic A0 to D0 (A0 to 7 on the SB5310)

V(LG1)	Logic group 1 Y-axis value
V(LG2)	Logic group 2 Y-axis value
V(LG3)	Logic group 3 Y-axis value
V(LG4)	Logic group 4 Y-axis value
V(LG5)	Logic group 5 Y-axis value
T	X-axis value

- **Marker Cursors**
  Marker cursors move on the waveform data. The SB5000 measures the data values at the cursor positions. MC1 (marker 1) to MC4 (marker 4) can be set on separate waveforms.

T1	MC1 X-axis value
T1-T2	Difference between the X-axis values of MC1 and MC2
T1-T3	Difference between the X-axis values of MC1 and MC3
T1-T4	Difference between the X-axis values of MC1 and MC4
V1	MC1 Y-axis value
V1-V2	Difference between the Y-axis values of MC1 and MC2
V1-V3	Difference between the Y-axis values of MC1 and MC3
V1-V4	Difference between the Y-axis values of MC1 and MC4

- **Serial Cursors**
  Searches for waveform serial patterns (1s and 0s) at the specified bit rate from the serial cursor positions. The search range is the display range (10 divisions). You can set the threshold level for determining 1s or 0s and select which level, H or L, to assign the value 1. There are two serial cursors: SC1 and SC2. The two cursors cannot be displayed simultaneously, but the serial patterns can be.

Cursor Movement Range

- **H Cursors and the H Cursors of H&V Cursors**
  You can set the cursor positions from –4 to 4 divisions in 0.01-division steps with the center of the waveform area taken to be 0 divisions.
- **V Cursors, the V Cursors of H&V Cursors, Marker Cursors, VT Cursor, and Serial Cursors**
  You can set the cursor positions from –5 to 5 divisions in 0.01-division steps with the center of the waveform area taken to be 0 divisions. If a zoom window is displayed and the cursor moves within the zoom window, the resolution is set to 0.01 divisions of the zoom window.

Serial Cursor Display Format

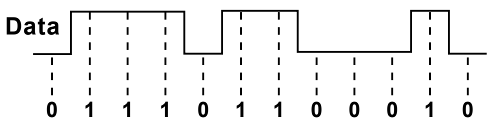
Set the items below when measuring using serial cursors. You can set these items per group for logic signals when the VT cursor is selected.

- **Selecting the Notation for the Cursor Measurement Values**
  Select the notation for displaying the cursor measurement values.

Bin	Display in binary notation
Hex	Display in hexadecimal notation

- **Data Bit Order**
  Select the bit order according to the signal.

MSB First	Select this when the input data signal flow is MSB first.
LSB First	Select this when the input data signal flow is LSB first.



762 for MSB first
46E for LSB first

- **Handling of Hidden Bits**
  - In binary notation, hidden bits are displayed as “x.”
  - In hexadecimal notation, values are displayed as though hidden bits do not exist.

Serial Cursor Tracking Mode

Set how the SB5000 will handle the case when the cursor moves outside the zoom range.

OFF	The zoom window will not track the cursor even if the cursor moves out of the zoom range.
Zoom1/Zoom2	When the cursor moves out of the Zoom1 or Zoom2 range, the zoom window scrolls so that the Zoom1 or Zoom2 center position is at the cursor position.

Cursor Jump

You can move a cursor to the center of the zoom waveform area. You can move a cursor in the following ways.

- **Vertical Cursors, Horizontal Cursors, H&V Cursors, VT Cursor, Marker Cursors**

To Zoom1	Moves the selected cursor to the Zoom1 window
To Zoom2	Moves the selected cursor to the Zoom2 window

- **Serial Cursors**

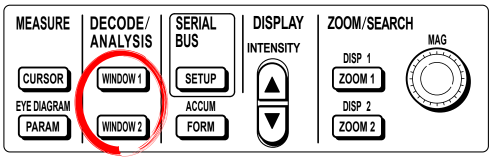
← and →	Moves in the specified direction by the specified bit count

Notes about Cursor Measurements

- Time-axis values are measured from the trigger position.
- The SB5000 displays "***" for values that cannot be measured.
- If the main, Zoom1, or Zoom2 display record length is less than 10 kW (excluding 4 k and 5 k) and Dot Connect is not OFF, the SB5000 will interpolate between sampled data points. Consequently, there may not be a sampled point at a vertical cursor position.
  You can always read a sampled data point when using a marker, because markers move on sampled data points.
- If the sample rate (S/s) or bit rate (bit/s) exceeds 1 M, the measured result of all bits will be X when using serial cursors.

11.7 Selecting the Analysis Type and Displaying and Saving Analysis Results

Procedure



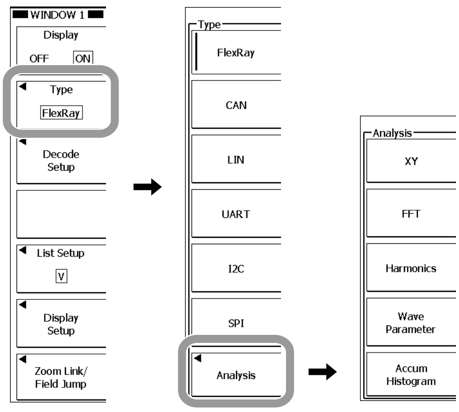
1. Press **WINDOW 1** or **WINDOW 2**.
The WINDOW menu appears.

Selecting the Analysis Type

2. Press the **Type** soft key.

3. From the menu that appears, press the appropriate soft key to select the analysis type.

4. Proceed to the appropriate section indicated below according to the selected analysis type, and set the analysis options.
- FlexRay: Section 11.8
- CAN: Section 11.9
- LIN: Section 11.10
- UART: Section 11.11
- I2C: Section 11.12
- SPI: Section 11.13
- XY: Section 11.14
- FFT: Section 11.15
- Harmonics: An optional power supply analysis function. See the option manual *IM 701310-51E*.
- Wave Parameter: Section 11.16
- Accum Histogram: Section 11.17



11

Analysis and Search

After setting the analysis options according to step 4 on the previous page, return to the WINDOW menu, and proceed with the following steps.

Displaying Analysis Results

This section explains how to use the FlexRay, CAN, LIN, UART, I^{2}C, and SPI analysis result displays. For a description of other analysis types, see the respective section.

FlexRay, CAN,* LIN, UART, I^{2}C, and SPI

* If the analysis type is CAN and the Window Type in the WINDOW menu is set to Trend, proceed to step 5 on page 11-50.

- **Setting the Scroll Options**

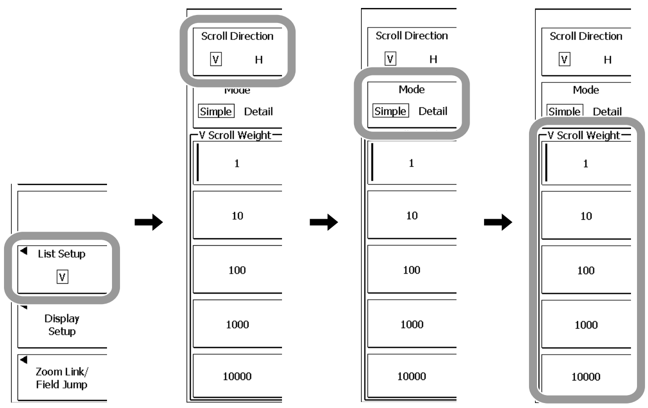
5. Press the **List Setup** soft key.

6. Press the **Scroll Direction** soft key to select V (vertical) or H (horizontal).

7. Press the **Mode** soft key to select Simple or Detail.

8. Press the appropriate soft key from **1** to **10000** to select how many numbers to scroll vertically by.

9. Press **ESC** to return to the previous screen.



- **Turning the T-Y Waveform, Decoded Field Display, and List Display ON and OFF**

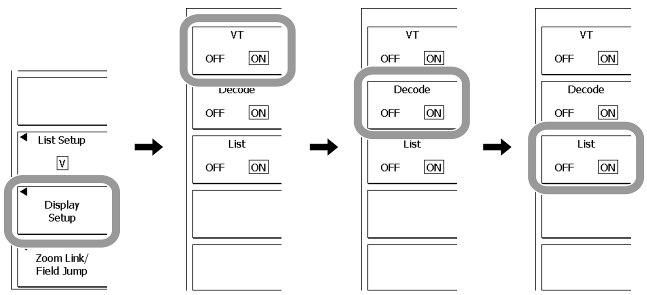
10. Press the **Display Setup** soft key.

11. Press the **VT** soft key to turn the T-Y waveform display ON or OFF.

12. Press the **Decode** soft key to turn the decoded field display ON or OFF.

13. Press the **List** soft key to turn the list display ON or OFF.

14. Press **ESC** to return to the previous screen.



If the analysis type is FlexRay, CAN, or LIN, proceed to 15. If the analysis type is UART, I^{2}C, or SPI, proceed to step 19.

- **Setting the Zoom Link and Field Jump Options**

For FlexRay, CAN, or LIN

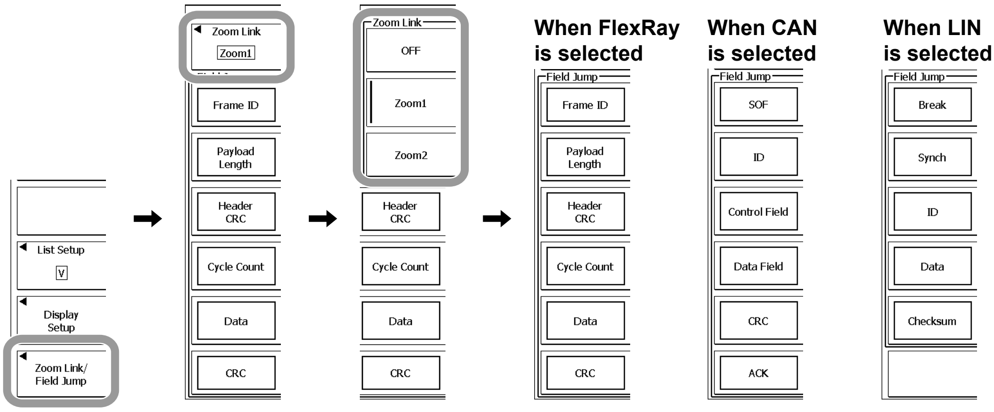
15. Press these soft keys: **Zoom Link/Field Jump** > **Zoom Link**.

16. Press the appropriate soft key from **OFF** to **Zoom2** to select the zoom waveform area to link to.

If you select OFF, the field jump menu will not appear.

17. From the menu that appears, press the appropriate soft key to select the jump destination field.

If you select Zoom1 or Zoom2, set the scroll direction to V, and use the rotary knob, the zoom position (the center of the zoom box) moves to the head of the frame highlighted in the list. If you press the Field Jump soft key, the zoom position will move to the head of the corresponding field in the highlighted frame.



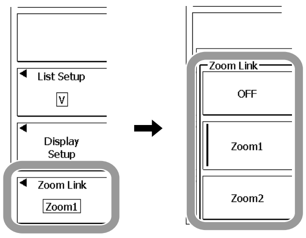
- **Selecting the Zoom Link**

For UART, I^{2}C, or SPI

18. Press the **Zoom Link** soft key.

19. Press the appropriate soft key from **OFF** to **Zoom2** to select the zoom waveform area to link to.

If you select Zoom1 or Zoom2, set the scroll direction to V, and use the rotary knob, the zoom position (the center of the zoom box) moves to the head of the frame highlighted in the list.



11

Analysis and Search

If the Analysis Type Is CAN* and the Window Type Is Trend

- **Turning the T-Y Waveform and Trend Display ON and OFF**

5. Press the **Display Setup** soft key.

6. Press the **VT** soft key to turn the T-Y waveform display ON or OFF.

7. Press the **Trend** soft key to turn the trend display ON or OFF.

- **Selecting the Time Range**

8. Press the **Mode** soft key to select Auto or Manual.
If you select Manual, proceed to the next step.

9. Use the **rotary knob** to set the display upper and lower limits.

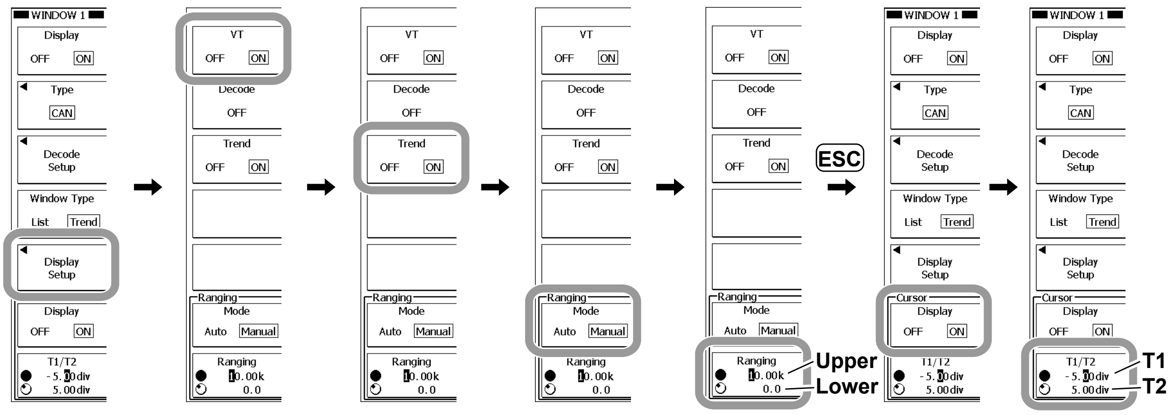
10. Press **ESC** to return to the previous screen.

- **Displaying and Measuring with Vertical Cursors**

11. Press the **Display** soft key to select ON or OFF.

12. Press the **T1/T2** soft key.

13. Use the **rotary knob** to move the T1 or T2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.



Saving Analysis Results

To save a serial bus list such as FlexRay, CAN, LIN, UART, I²C, and SPI, set the data type to Serial Bus in section 14.10.

Explanation

Analysis Type

- The SB5000 can analyze FlexRay, CAN, LIN, UART, I²C, and SPI signals.
- It analyzes XY, FFT, harmonics,* wave parameter, and accumulated histogram items.
  - * An optional power supply analysis function. See the option manual *IM 701310-51E*.

Data Analyzed

The SB5000 can analyze the following data displayed on the screen.

- Waveform data
  The SB5000 can analyze data any time regardless of whether or not it is acquiring data. If acquiring signals, the SB5000 updates the analysis results in sync with the displayed waveform.
  The SB5000 can also analyze waveform data saved to the history memory (the waveform data at the record number selected using HISTORY menu > Select).
- Loaded acquisition data (ACQ data)

Displaying Analysis Results

This section describes the contents of the FlexRay, CAN, LIN, UART, I^{2}C, and SPI analysis results. For information about XY, FFT, harmonics, wave parameter, and accumulated histogram items, see the respective section indicated on page 11-47.

FlexRay

- **Number of Analyzable Frames**

  Up to 600 frames (300 frames before and after the analysis reference point)

- **Segments Analyzed**

  Header segment, payload segment, and trailer segment

- **Simple Display**

No.	Analysis Number
ID	Frame ID in decimal notation
Data (Hex)	Data in hexadecimal notation

For a description of these items, see “Detail Display.”

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –299 to 300 (up to 600 frames). Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position to the head of the frame in milliseconds.
S/D	Displays the frame type. Displays “S” for static frame and “D” for dynamic frame.
IND	Displays the four header segment indicator states as a bit pattern in the following order. Payload preamble indicator, null frame indicator, sync frame indicator, and Startup frame indicator
ID	Displays the 11-bit frame ID value in decimal notation.
PLEN	Displays the payload segment data length in decimal notation.
CC	Displays the cycle count in decimal notation.
Data (Hex)	Displays payload segment data 0 to data n (where n = 0 to 253 bytes) in hexadecimal notation.
Information	Displays the following errors. If multiple errors are detected in one frame, the error with the highest precedence in the list below appears. BSS Error: BSS not detected, FES Error: FES not detected, Header CRC Error: Invalid Header CRC, CRC Error: Invalid CRC

Simple display

No.	ID	Data (Hex)
0	8	01 01 01 01 02 02 02 02 03 03 03 03
1		
2	2	02 02 02 02 02 02 02 02
3	3	03 03 03 03 03 03 03 03
4	4	01 02 03 04 05 06 07 08

Detail display

No.	Time(ms)	S/D	IND	ID	PLEN	CC	Data (Hex)	Information
0	0.040272	D	1111	8	6	0	01 01 01 01 02 02 02 02 03 03 03 03	
1	0.053972							BSS Error
2	0.134672	S	0011	2	4	1	02 02 02 02 02 02 02 02	
3	0.185872	S	0010	3	4	1	03 03 03 03 03 03 03 03	
4	0.237072	S	1111	4	4	1	01 02 03 04 05 06 07 08	

- **Decoded Field Display**

  Decodes each field value and displays the value in color.

Indicator	Yellow
Frame ID	Light Green
Payload	Pink
Header CRC	Light Blue
Cycle Count	Orange
Data	Cyan
CRC	Light Blue
BSS	Gray fill
Error	Red • BSS Error, FES Error: Displays “BSS Error” or “FES Error” using black characters on a red background in the field in which an error occurs. • Header CRC Error, CRC Error: Displays the characters of the field in which an error occurs using black charactes on red background.

Note

The SB5000 is equipped with a filtering function that eliminates noise (voting). Therefore, the decoded display will shift approximately 3/8 bits to the right of the input signal.

CAN

- **Number of Analyzable Frames**

  Up to 3000 frames (1500 frames before and after the analysis reference point)

- **Frames Analyzed**

Remote frame	Detects whether or not the ID, data, CRC, and ACK values are present.
Data frame	Detects whether or not the ID, CRC, and ACK values are present.
Error frame	Detects error flags.
Overload frame	Detects an overload flag.

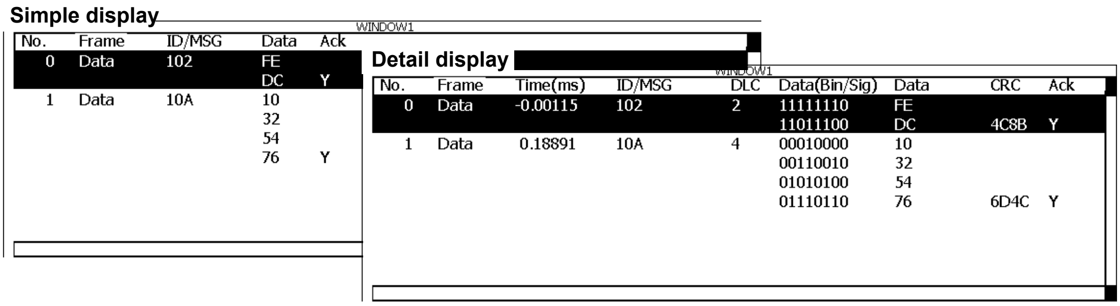
- **Simple Display**

No.	Analysis Number
Frame	Frame type
ID/MSG	Hexadecimal or symbolic ID display
Data	Data in hexadecimal notation or physical value display
Ack	ACK slot state

For a description of these items, see “Detail Display.”

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –1499 to 1500 (up to 3000 frames). Pressing the RESET key highlights frame number zero.
Frame	Displays the frame type. The SB5000 can analyze the following four frame types: data frame, remote frame, error frame, and overload frame.
Time(ms)	Displays the time from the trigger position to the head of the frame in milliseconds.
ID/MSG	Displays the 11-bit standard format ID value or the 29-bit extended format ID value in hexadecimal notation. If CANdb is enabled, the value will be displayed using symbols.
DLC	Displays the effective number of bytes in hexadecimal notation.
Data (Bin/Sig)	Displays data in binary notation when the frame type is data. Each byte is displayed in a separate line. If CANdb is enabled, the data will be displayed using symbols.
Data	Displays data in hexadecimal notation when the frame type is data. Each byte is displayed in a separate line. If CANdb is enabled, the data will be displayed using symbols.
CRC	Displays the CRC sequence in hexadecimal notation when the frame type is data or remote.
Ack	Displays “Y” when an ACK bit is detected and “N” when it is not.



- **Decoded Field Display**

  Decodes each field value and displays the value in color.

ID	Light green
DLC	Pink
Data	Cyan
CRC sequence	Light blue
Alarm frame	Red
Overload frame	Green
Frame background	Gray

LIN

- **Number of Analyzable Frames**

  Up to 3000 frames (1500 frames before and after the analysis reference point)

- **Fields Analyzed**

  Break, Synch, ID, Data, Checksum

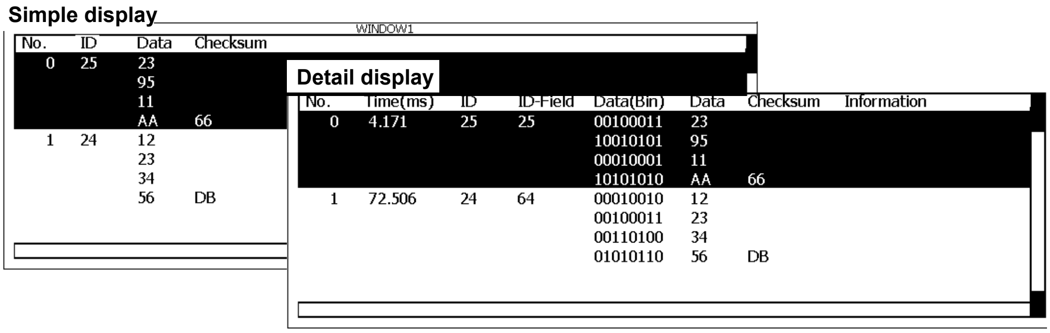
- **Simple Display**

No.	Analysis Number
ID	ID in hexadecimal notation
Data	Data in hexadecimal notation
Checksum	Checksum in hexadecimal notation

For a description of these items, see "Detail Display."

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –1499 to 1500 (up to 3000 frames). Pressing the RESET key highlights frame number zero.
Time(ms)	Displays the time from the trigger position to the head of the frame in milliseconds.
ID	Displays the ID value in hexadecimal notation.
ID-Field	Displays the ID value including the two parity bits in hexadecimal notation.
Data(Bin)	Displays data in binary notation. Each byte is displayed in a separate line.
Data	Displays data in hexadecimal notation. Each byte is displayed in a separate line.
Checksum	Displays the checksum value in hexadecimal notation.
Information	Detects and displays the following words. If a WakeUp signal is detected, WakeUp appears. If multiple errors are detected in one frame, the error with the highest precedence in the list below appears. Timeout Error, Framing Error, Checksum Error, Synch Error, Parity Error



- **Decoded Field Display**

  Decodes each field value and displays the value in color.

Break	Orange	
Synch	Pink	
ID	Light green	
Data	Cyan	
Checksum	Light blue	
WakeUp	Green	
Start Bit	Gray fill	
Stop Bit	Gray fill	
Error	Red	
	• Timeout Error	Displays a thick red link line in the area that errors occurred.
	• Framing Error	Displays "Framing Error" using black characters on a red background in the field in which an error occurs. It is displayed with a higher precedence than Checksum Error, Synch Error, or Parity Error.
	• Checksum Error, Synch Error, Parity Error	Displays the characters of the synch, ID, or checksum field in which an error occurs using black charactes on red background.

UART

- **Number of Analyzable Data Values**

  Up to 3000 bytes (1500 bytes before and after the analysis reference point)

- **Fields Analyzed**

  Data

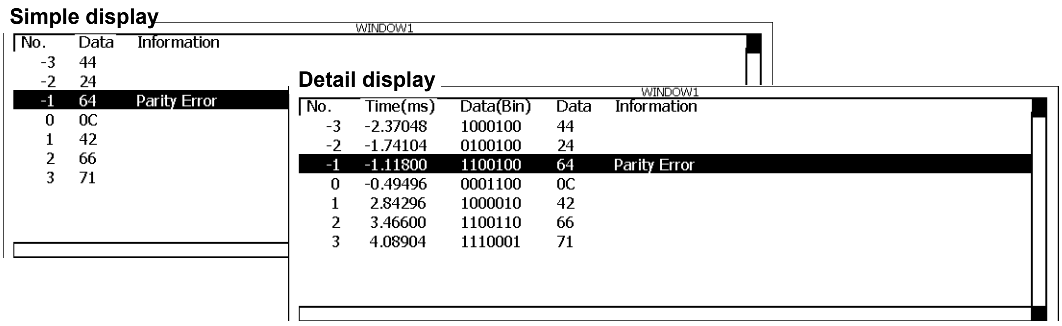
- **Simple Display**

No.	Analysis number
Data	Hexadecimal data display
Information	Displays errors

For a description of these items, see “Detail Display.”

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –1499 to 1500 (up to 3000 data bytes). Pressing the RESET key highlights data number zero.
Time(ms)	Displays the time from the trigger position to the head of the byte in milliseconds.
Data(Bin)	Displays data in binary notation.
Data	Displays data in hexadecimal notation.
Information	Displays the following errors. If multiple errors are detected in one data byte, the error with the highest precedence in the list below appears. Framing Error, Parity Error



- **Decoded Field Display**

  Decodes each field value and displays the value in color.

Data	Cyan
Parity	Yellow
Start Bit	Gray fill
Stop Bit	Gray fill
Error	Red • Framing Error Displays “Framing Error” using black characters on a red background in the field in which an error occurs. It is displayed with higher precedence than Parity Error. • Parity Error Displays the characters of the field in which an error occurs using black charactes on red background.

I^2C

- **Number of Analyzable Data Values**

  Up to 40000 bytes (20000 bytes before and after the analysis reference point)

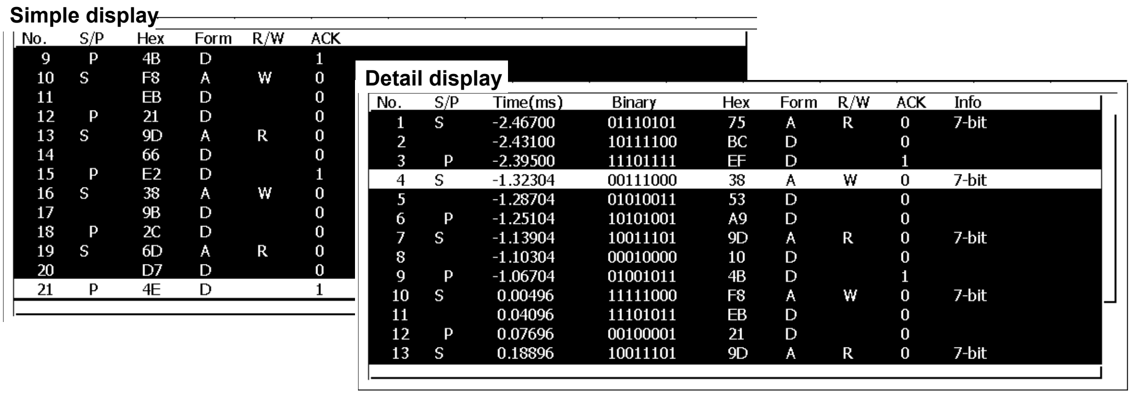
- **Simple Display**

No.	Analysis Number.
S/P	Display the data condition. S: Start condition, P: Stop condition
Hex	Data in hexadecimal notation
Form	Address or data
R/W	Signal type
ACK	Acknowledge bit state

For a description of these items, see “Detail Display.”

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –19999 to 20000 (up to 40000 data bytes). Pressing the RESET key highlights data number zero.
S/P	Display the data condition. S: Start condition, P: Stop condition
Time(ms)	Displays the time from the trigger position to the head of the byte in milliseconds.
Binary	Displays data in binary notation.
Hex	Displays data in hexadecimal notation.
Form	Indicates “A” for address and “D” for data.
R/W	Displays “R” for a read signal and “W” for a write signal.
ACK	Displays “1” when an acknowledge bit is detected and “0” when it is not.
Info	Display the data type.



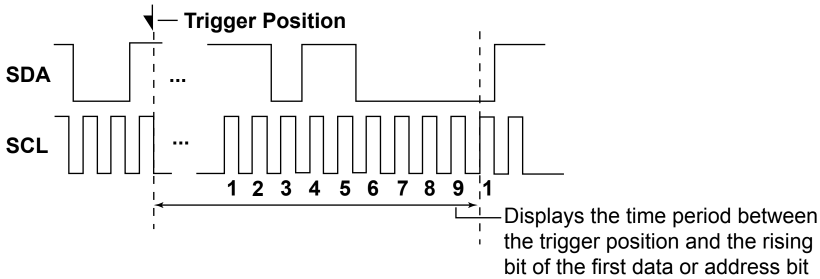
Simple display

No.	S/P	Hex	Form	R/W	ACK
9	P	4B	D		1
10	S	F8	A	W	0
11		EB	D		0
12	P	21	D		0
13	S	9D	A	R	0
14		66	D		0
15	P	E2	D		1
16	S	38	A	W	0
17		9B	D		0
18	P	2C	D		0
19	S	6D	A	R	0
20		D7	D		0
21	P	4E	D		1

Detail display

No.	S/P	Time(ms)	Binary	Hex	Form	R/W	ACK	Info
1	S	-2.46700	01110101	75	A	R	0	7-bit
2		-2.43100	10111100	BC	D		0	
3	P	-2.39500	11101111	EF	D		1	
4	S	-1.32304	00111000	38	A	W	0	7-bit
5		-1.28704	01010011	53	D		0	
6	P	-1.25104	10101001	A9	D		0	
7	S	-1.13904	10011101	9D	A	R	0	7-bit
8		-1.10304	00010000	10	D		0	
9	P	-1.06704	01001011	4B	D		1	
10	S	0.00496	11111000	F8	A	W	0	7-bit
11		0.04096	11101011	EB	D		0	
12	P	0.07696	00100001	21	D		0	
13	S	0.18896	10011101	9D	A	R	0	7-bit

Time (ms) Display



11

Analysis and Search

- **Decoded Field Display**

  Decodes each data value and displays the value in color. This feature can be used when the source signal is set to a channel from CH1 to CH4 or from M1 to M4.

Adr	Hexadecimal value in light green
Data	Hexadecimal value in cyan
R/W	Pink
Ack	Yellow
General Call	Green
Start Byte	Orange
HS Mode	Orange

SPI

- **Number of Analyzable Data Values**

  Up to 40000 bytes (20000 bytes before and after the analysis reference point)

- **Simple Display**

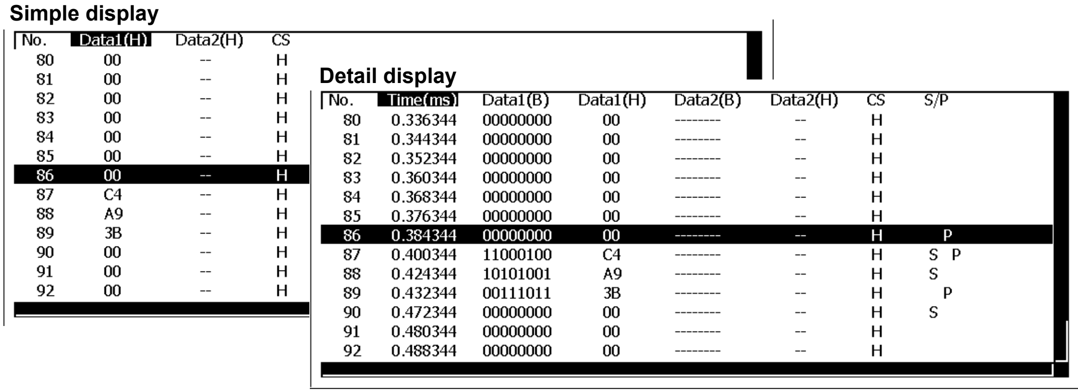
No.	Analysis Number.
Data 1(H)	Data 1 in hexadecimal notation
Data 2(H)	Data 2 in hexadecimal notation
CS	Displays the CS status.

For a description of these items, see “Detail Display.”

- **Detail Display**

No.	Analysis Number. Negative numbers are assigned to frames before the analysis reference point, and positive numbers are assigned to frames after the reference point. The SB5000 can display the analysis result numbers from –19999 to 20000 (up to 40000 data bytes). Pressing the RESET key highlights data number zero.
Time(ms)	Displays the time from the trigger position to the head of the byte in milliseconds.
Data 1(B)	Displays data 1 in binary notation.
Data 1(H)	Displays data 1 in hexadecimal notation.
Data 2(B)	Displays data 2 in binary notation.
Data 2(H)	Displays data 2 in hexadecimal notation.
CS	Displays the CS status.
S/P	Indicates the active period by displaying “S” for the start position and “P” for the stop position.

Simple display



No.	Data1(H)	Data2(H)	CS
80	00	--	H
81	00	--	H
82	00	--	H
83	00	--	H
84	00	--	H
85	00	--	H
86	00	--	H
87	C4	--	H
88	A9	--	H
89	3B	--	H
90	00	--	H
91	00	--	H
92	00	--	H

Detail display

No.	Time(ms)	Data1(B)	Data1(H)	Data2(B)	Data2(H)	CS	S/P
80	0.336344	00000000	00	--------	--	H	
81	0.344344	00000000	00	--------	--	H	
82	0.352344	00000000	00	--------	--	H	
83	0.360344	00000000	00	--------	--	H	
84	0.368344	00000000	00	--------	--	H	
85	0.376344	00000000	00	--------	--	H	
86	0.384344	00000000	00	--------	--	H	P
87	0.400344	11000100	C4	--------	--	H	S P
88	0.424344	10101001	A9	--------	--	H	S
89	0.432344	00111011	3B	--------	--	H	P
90	0.472344	00000000	00	--------	--	H	S
91	0.480344	00000000	00	--------	--	H	
92	0.488344	00000000	00	--------	--	H	

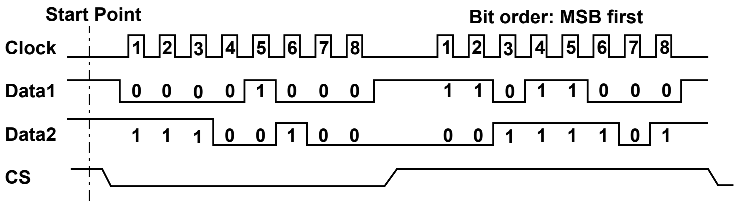
- **Decoded Field Display**

  Decodes each data value and displays the value in color. This feature can be used when the source signal is set to a channel from CH1 to CH4 or from M1 to M4.

Data	Hexadecimal value in cyan
Group background	Gray

- **Display Example**

  Examples for two analysis conditions are given below.



Analysis Conditions when clock (CH1) = ↑ and CS (CH4) = L	
Item	Display
Analysis number (No.)	0
Data 1 in hexadecimal notation	08
Data 2 in hexadecimal notation	E4
CS signal status	
Analysis Conditions when clock (CH1) = ↑ and CS (CH4) = H	
Item	Display
Analysis number (No.)	0
Data 1 in hexadecimal notation	D8
Data 2 in hexadecimal notation	3D
CS signal status	H

Note

If there is no change in the CS signal from high to low or low to high, the SB5000 will not analyze the I/O data.

Zoom Link

Select the zoom link from the following:

OFF	Disables the zoom link feature.
Zoom1	Links to Zoom1.
Zoom2	Links to Zoom2.

The default setting for WINDOW 1 is Zoom1 and WINDOW 2 is Zoom2. If Zoom1 or Zoom2 is selected and you select (highlight) any byte in the analysis result list, the zoom position (the center of the zoom box) will move to the head of the byte. On the contrary, if you move the zoom position, the corresponding byte in the analysis result list in the Zoom1 or Zoom2 box will be highlighted.

Field Jump

If the analysis type is FlexRay, CAN, or LIN and the zoom link feature is enabled, you can move the zoom position to the head of the specified field in the highlighted frame in the analysis result list.

Saving Analysis Results

You can save analysis results (simple and detail) in CSV format to an external storage medium. The extension is .csv.
To save a serial bus list such as FlexRay, CAN, LIN, UART, I^2C, and SPI, set the data type to Serial Bus in section 14.10.
The list will be saved in the appropriate format.

Data Saved

Select the data that you want to save in the menu that appears when you set the data type to Serial Bus as described in section 14.10. Select Ana1 or Ana2.

Ana1	Saves the analysis results that are determined under the conditions specified using the menu that appears when the WINDOW 1 key is pressed.
Ana2	Saves the analysis results that are determined under the conditions specified using the menu that appears when the WINDOW 2 key is pressed.

Data Size

FlexRay	(The number of analyzed frames + 4) × 170 [bytes]
CAN	(The number of analyzed frames + 4) × 155 [bytes]
LIN	(The number of analyzed frames + 4) × 170 [bytes]
UART	(The number of analyzed frames + 4) × 40 [bytes]
I^2C	(The number of analyzed bytes + 4) × 65 [bytes]
SPI	(The number of analyzed bytes + 4) × 79 [bytes]

* The data sizes are reference values. They are not strictly warranted. Use them as a guideline when you save data.

11.8 Analyzing a FlexRay Bus Signal

Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to FlexRay.
2. Press the **Decode Setup** soft key.
   The Decode Setup dialog box appears.

Setting the Bit Rate, Sample Point, and Bus Channel

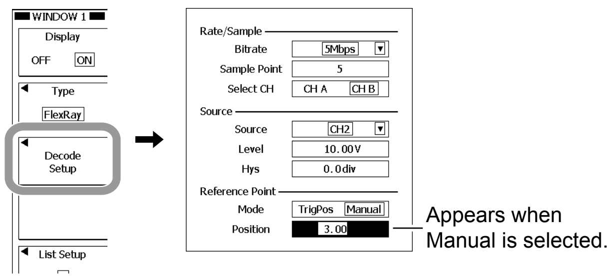
3. Use the **rotary knob** and **SET** to select the bit rate from 10Mbps to 2.5Mbps.
4. Use the **rotary knob** and **SET** to select the sample point from 1 to 8.
5. Use the **rotary knob** and **SET** to set the bus channel to CH A or CH B.

Setting the Source

6. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from M1 to M4.
7. Use the **rotary knob** and **SET** to set the level and hysteresis.

Setting the Analysis Reference Point

8. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
   If you select TrigPos, proceed to step 10.
9. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.
10. Press **ESC** to return to the previous screen.



Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

11

Analysis and Search

Explanation

Bit Rate

You can set the FlexRay bus signal transfer rate to:
10Mbps, 5Mbps, or 2.5Mbps

Sample Point

The SB5000 samples data at a rate that is eight times the bit rate. This setting specifies which of the eight points to make the sampling point.
The selectable range is 1 to 8.

Bus Channel

Set the bus channel to FlexRay bus CH A or CH B.

Source

Select the source waveform from CH1 to CH4 or from M1 to M4.

- **Level**
  Set the level for determining whether the signal level is 0 or 1.
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

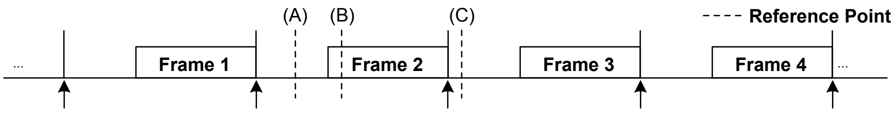
- **Hysteresis**
  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Analysis Reference Point

Select the analysis reference point from the following:

Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

Frame No. 0 in the analysis result list varies depending on the reference point position as follows:



(A): Frame No. 0 → Frame 2 (frame 1 is No. -1, frame 3 is No. 1, and frame 4 is No. 2)
(B): Frame No. 0 → Frame 2 (frame 1 is No. -1, frame 3 is No. 1, and frame 4 is No. 2)
(C): Frame No. 0 → Frame 3 (frame 1 is No. -2, frame 2 is No. -1, and frame 4 is No. 1)

11.9 Analyzing a CAN Bus Signal

Procedure

This section explains how to perform computations and analysis on a CAN signal based on the operator selected in section 10.1 and the analysis type selected in section 11.7.

Performing Analysis

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to CAN.
2. Press the **Decode Setup** soft key.
   The Decode Setup dialog box appears.

Selecting the Signal

3. Use the **rotary knob** and **SET** to set CAN to Value to ON or OFF.
   If you select OFF, proceed to step 7.
4. Use the **rotary knob** and **SET** to select Select Signal.
   The Select Signal dialog box appears.
   An error will occur if a physical value/symbol definitions file (.sbl) is not loaded.
5. Use the **rotary knob** and **SET** to select the signal.
6. Press **ESC** to close the Select Signal dialog box.

Setting the Bit Rate and Sample Point

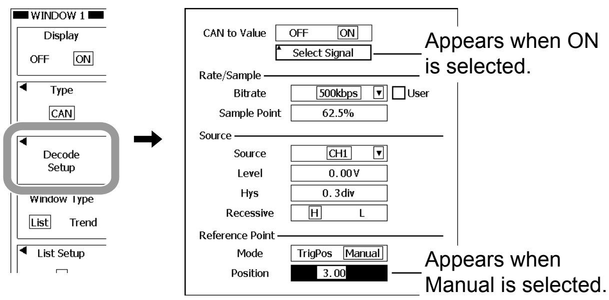
7. Use the **rotary knob** and **SET** to select the bit rate from 1Mbps to 33.3kbps.
   If you select the **User** check box, you will be able to set the bit rate from 10.0kbps to 1.000Mbps using the **rotary knob** and **SET**.
8. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.

Setting the Source

9. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from M1 to M4.
10. Use the **rotary knob** and **SET** to set the level and hysteresis.
11. Use the **rotary knob** and **SET** to set Recessive to H or L.

Setting the Analysis Reference Point

12. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
    If you select TrigPos, proceed to step 14.
13. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.
14. Press **ESC** to return to the previous screen.



Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

Performing Stuff Bit Computation

1. Carry out steps 1 to 5 in section 10.1 to set the operator to Stuff Bit.

2. Press the **Setup** soft key.

Selecting the Computation Source Waveform

3. Press the **Source** soft key to display the computation source waveform selection menu.

4. Press the appropriate waveform soft key.
To select a channel from REF1 to REF4, press the REF1-REF4 soft key first.

Setting the Bit Rate and Sample Point

5. Press the **Rate/Sample** soft key.

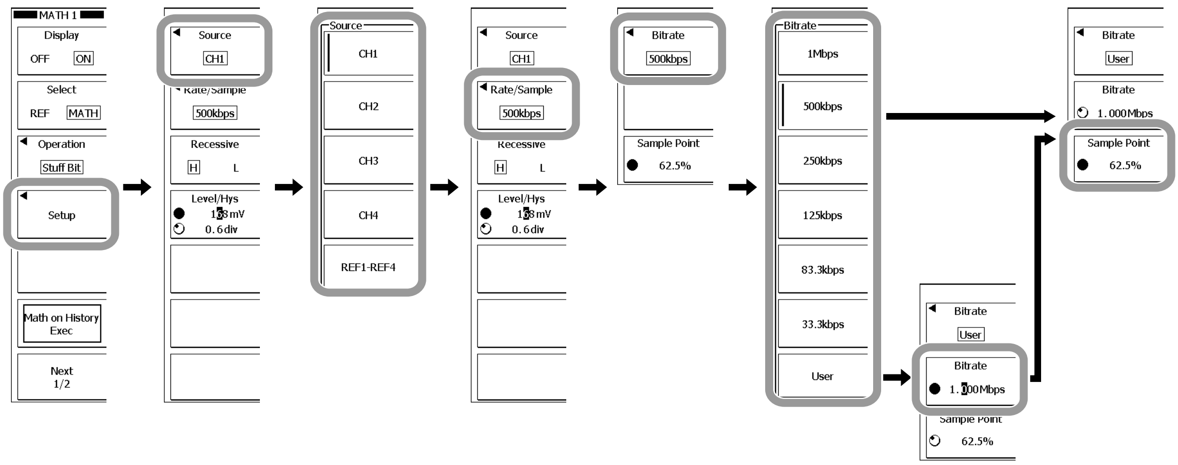
6. Press the **Bitrate** soft key.

7. Press the appropriate bit rate soft key from **1Mbps** to **33.3kbps**.
If you select the User check box, press the **Bitrate** soft key and use the **rotary knob** to set the bit rate from 10.0 kbps to 1.000 Mbps.

8. Press the **Sample Point** soft key.

9. Use the **rotary knob** to set the sample point from 18.8 to 90.6%.

10. Press **ESC** to return to the previous screen.



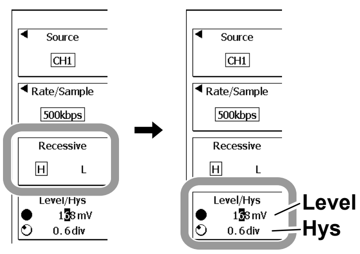
Setting the Bus Level

11. Press the **Recessive** soft key to select H or L.

12. Press the **Level/Hys** soft key.

13. Use the **rotary knob** to set the reference level and hysteresis.
Press the soft key to select the setting that you want to set using the rotary knob.

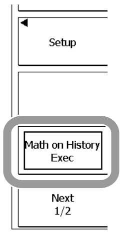
14. Press **ESC** to return to the previous screen.



Performing Computation on All History Waveforms

15. To perform computation on all history waveforms, press the **Math on History Exec** soft key. Computation is executed, and the Math on History Exec soft key changes to the Abort soft key.

To abort computation, press the **Abort** soft key. Computation is aborted, and the Abort soft key changes to the Math on History Exec soft key.



Explanation

Analysis

Signal

The signal data that is contained in a physical value/symbol definition file (.sbl) that is loaded into the SB5000 can be used as analysis conditions.

* The physical value/symbol definition file (.sbl) is derived by converting a CANdb file (.dbc). For the procedure to load a file, see section 14.8.

Bit Rate

You can select the CAN bus signal transfer rate from the following:
1 Mbps, 500 kbps, 250 kbps, 125 kbps, 83.3 kbps, and 33.3 kbps

If you select the User check box, you can set the transfer rate from 10.0 kbps to 1.000 Mbps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level (recessive or dominant) from 18.8 to 90.6% in 3.1% steps.
The SB5000 CAN bus signal trigger circuit samples the input CAN bus signal using the internal clock and detects the point of change from recessive to dominant. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Source

Select the source waveform from CH1 to CH4 or from M1 to M4.

- **Level**
  Set the level for determining whether the signal level is 0 or 1.
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

- **Hysteresis**
  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

- **Recessive Level**
  Set the recessive level to high (H) or low (L). The logical value of the recessive level is 1 and that of the dominant level is 0 in either setting.

H	The recessive level is higher than the dominant level.
L	The recessive level is less than the dominant level.

Analysis Reference Point

Select the analysis reference point from the following:

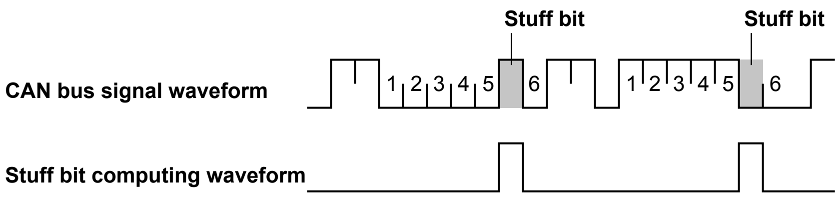
Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

For details on the analysis reference point and the numbers in the analysis result list, see page 11-60.

Stuff Bit Computation

In CAN communications, whenever a transmitter detects five consecutive bits of identical value in the Start of Frame to CRC bit sequence, it automatically inserts a complementary bit called a *stuff bit* in the sixth bit.

The SB5000 can extract stuff bits from the CAN bus signal waveform and display them as a MATH waveform.



Computation Source Waveform

Select the source waveform from CH1 to CH4 or from REF1 to REF4.

Bit Rate, Sample Point, Bus Level

See the respective description in “Analysis” on the previous page.

11.10 Analyzing a LIN Bus Signal

Analysis

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to LIN.
2. Press the **Decode Setup** soft key.
   The Decode Setup dialog box appears.

Setting the Bit Rate, Sample Point, and Revision

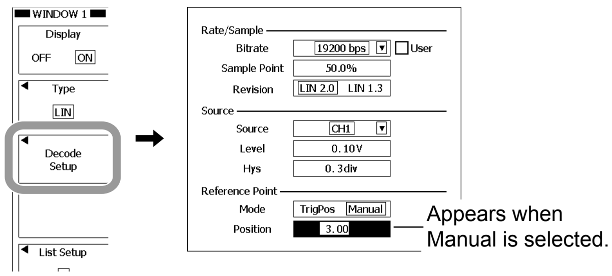
3. Use the **rotary knob** and **SET** to select the bit rate from 19200bps to 1200bps.
   If you select the User check box, you will be able to set the bit rate from 1000bps to 20000bps using the **rotary knob** and **SET**.
4. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.
5. Use the **rotary knob** and **SET** to set the revision to LIN 2.0 or LIN 1.3.

Setting the Source

6. Use the **rotary knob** and **SET** to select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.
7. Use the **rotary knob** and **SET** to set the level and hysteresis.
   If you select a source from A0 to A7 in step 6, the level and hysteresis settings are not available.

Setting the Analysis Reference Point

8. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
   If you select TrigPos, proceed to step 10.
9. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.
10. Press **ESC** to return to the previous screen.



Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

Explanation

Bit Rate

You can select the LIN bus signal transfer rate from the following:
19200 bps, 9600 bps, 4800 bps, 2400 bps, 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 20000 bps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level from 18.8 to 90.6% in 3.1% steps. The SB5000 LIN bus signal trigger circuit samples the input LIN bus signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Revision

You can select revision 2.0 or 1.3.

LIN 2.0	The enhanced checksum that includes the protection ID is used. (However, if the ID is a value from 60 (0x3c) to 63 (0x3f), the classic checksum is used.)
LIN 1.3	The classic checksum that includes only the data field is used.

Source

Select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **Level**

  Set the level for determining whether the signal level is 0 or 1.*
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Analysis Reference Point

Select the analysis reference point from the following:

Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

For details on the analysis reference point and the numbers in the analysis result list, see page 11-60.

11.11 Analyzing an UART Signal

Analysis

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to UART.
2. Press the **Decode Setup** soft key.
   The Decode Setup dialog box appears.

Setting the Bit Rate, Sample Point, Format, Bit Order, and Parity

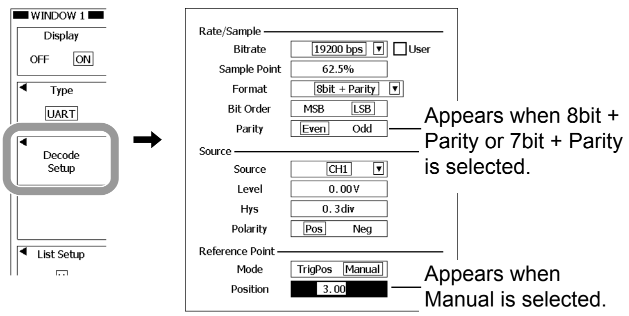
3. Use the **rotary knob** and **SET** to select the bit rate from 115200bps to 1200bps.
   If you select the User check box, you will be able to set the bit rate from 1000bps to 200000bps using the **rotary knob** and **SET**.
4. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.
5. Use the **rotary knob** and **SET** to select the format from 8bit + Parity to 8bit(NonParity).
6. Use the **rotary knob** and **SET** to set the bit order to MSB or LSB.
7. If the format is 8bit + Parity or 7bit + Parity, set the parity to Even or Odd using the **rotary knob** and **SET**.

Setting the Source

8. Use the **rotary knob** and **SET** to select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.
9. Use the **rotary knob** and **SET** to set the level, hysteresis, and polarity.
   If you select a source from A0 to A7 in step 8, the level and hysteresis settings are not available.

Setting the Analysis Reference Point

10. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
    If you select TrigPos, proceed to step 12.
11. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.
12. Press **ESC** to return to the previous screen.



Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

Explanation

Bit Rate

You can set the CAN bus signal transfer rate to
115200 bps, 57600 bps, 38400 bps, 19200 bps, 9600 bps, 4800 bps, 2400 bps, or 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 200000 bps in 100-bps steps.

Sample Point

You can set the point for determining the signal level from 18.8 to 90.6% in 3.1% steps. The SB5000 UART signal trigger circuit samples the input UART signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Format

You can select the format from the following:

8bit + Parity	8-bit data + parity bit
7bit + Parity	7-bit data + parity bit
8bit(NonParity)	8-bit data with no parity bit

Bit Order

Select the input signal bit order.

MSB	Reads the data pattern MSB first.
LSB	Reads the data pattern LSB first.

Parity

Set the parity bit to even or odd.

Source

Select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **Level**

  Set the level for determining whether the signal level is 0 or 1.*
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

- **Polarity**

  You can select the bit state that will be considered logical 1.

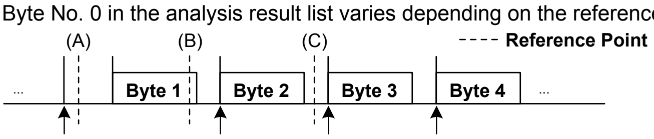
Pos	Positive logic
Neg	Negative logic

Analysis Reference Point

Select the analysis reference point from the following:

Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

Byte No. 0 in the analysis result list varies depending on the reference point position as follows:



(A): Byte No. 0 → Byte 1 (Byte 2 is No. 1, byte 3 is No. 2, and so on)
(B): Byte No. 0 → Byte 1 (Byte 2 is No. 1, byte 3 is No. 2, and so on)
(C): Byte No. 0 → Byte 2 (byte1 is No. -1, byte 3 is No. 1, and byte 4 is No. 2, and so on)

11.12 Analyzing an I^2C Signal

Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to I2C.
2. Press the **Decode Setup** soft key.
   The Decode Setup dialog box appears.
3. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the SDA Source

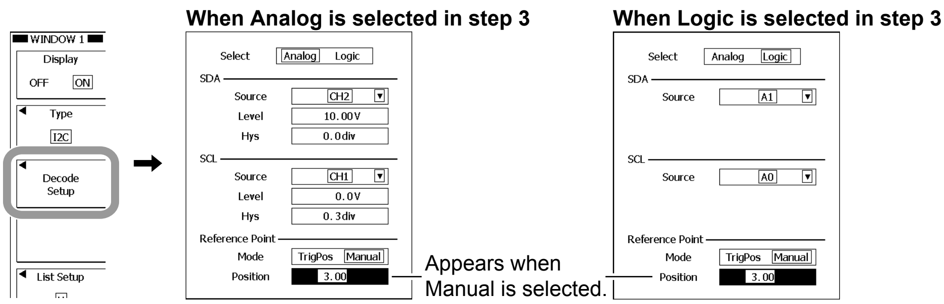
4. Use the **rotary knob** and **SET** to select the SDA source.
   - If you select Analog in step 3, select the source from CH1 to CH4 or from M1 to M4.
   - If you select Logic in step 3, select the source from A0 to A7.
5. Use the **rotary knob** and **SET** to set the level and hysteresis.
   If you select Logic in step 3, the level and hysteresis settings are not available.

Setting the SCL Source

6. Use the **rotary knob** and **SET** to select the SCL source.
   - If you select Analog in step 3, select the source from CH1 to CH4 or from M1 to M4.
   - If you select Logic in step 3, select the source from A0 to A7.
7. Use the **rotary knob** and **SET** to set the level and hysteresis.
   If you select Logic in step 3, the level and hysteresis settings are not available.

Setting the Analysis Reference Point

8. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
   If you select TrigPos, proceed to step 10.
9. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.
10. Press **ESC** to return to the previous screen.



Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

Explanation

SDA and SCL Sources

You can select the SDA (serial data) and SCL (serial clock) sources from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **Level**

  Set the level for determining whether the signal level is 0 or 1 for CH1 to CH4 and M1 to M4.*

  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**

  Set the hysteresis for CH1 to CH4 and M1 to M4.

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.

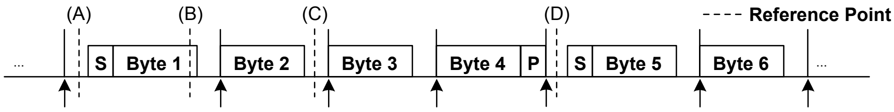
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Analysis Reference Point

Select the analysis reference point from the following:

Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

Byte No. 0 in the analysis result list varies depending on the reference point position as follows:



(A): Byte No. 0 → Byte 1 (Byte 2 is No. 1, byte 3 is No. 2, and so on)
(B): Byte No. 0 → Byte 1 (Byte 2 is No. 1, byte 3 is No. 2, and so on)
(C): Byte No. 0 → Byte 2 (byte1 is No. -1, byte 3 is No. 1, and byte 4 is No. 2, and so on)
(D): Byte No. 0 → Byte 5 (byte1 is No. -4, ..., byte 4 is No. -1, and byte 6 is No. 1, and so on)

S: Start condition, **P:** Stop condition

11.13 Analyzing a SPI Bus Signal

Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to SPI.

2. Press the **Decode Setup** soft key.
The Decode Setup dialog box appears.

Selecting the Wiring System and Bit Order

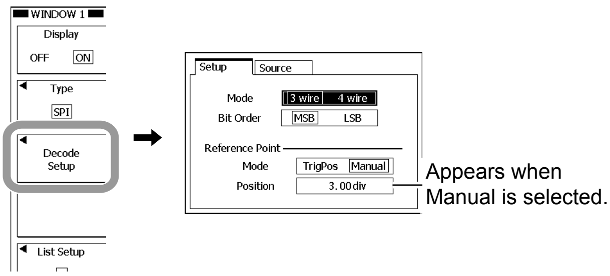
3. Use the **rotary knob** and **SET** to select the Setup tab.
You can also press the Setup soft key.

4. Use the **rotary knob** and **SET** to set the mode to 3 wire or 4 wire and the bit order to MSB or LSB.

Setting the Analysis Reference Point

5. Use the **rotary knob** and **SET** to set the analysis reference point to TrigPos or Manual.
If you select TrigPos, proceed to step 7.

6. Use the **rotary knob** and **SET** to set the analysis reference point in the range of ± 5.00 divisions.



Setting the CS, Clock, and Data Sources

7. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

8. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

- **Setting the CS Source**

9. Use the **rotary knob** and **SET** to select the CS (chip select) source.
- If you select Analog in step 8, select the source from CH1 to CH4.
- If you select Logic in step 8, select the source from A0 to A7.

10. Use the **rotary knob** and **SET** to set Active to H or L.

- **Setting the Clock Source**

11. Use the **rotary knob** and **SET** to select the clock source.
- If you select Analog in step 8, select the source from CH1 to CH4.
- If you select Logic in step 8, select the source from A0 to A7.

12. Use the **rotary knob** and **SET** to set the polarity to ↑ or ↓.

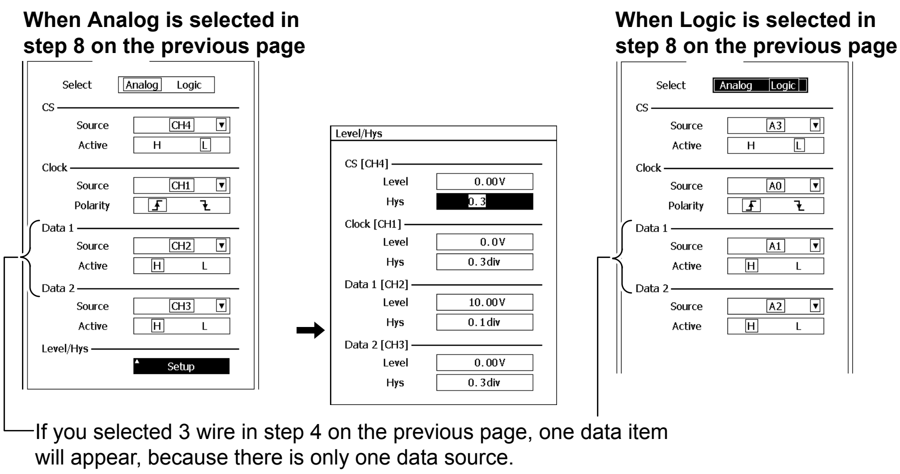
- **Setting the Data Source**

13. Use the **rotary knob** and **SET** to select the data source.
    - If you select 4 wire in step 4 on the previous page, select the source for Data1 and Data 2 separately.
    - If you select Analog in step 8 on the previous page, select the source from CH1 to CH4.
    - If you select Logic in step 8 on the previous page, select the source from A0 to A7.
14. Use the **rotary knob** and **SET** to set Active to H or L.

Setting the Level and Hysteresis

Set the level and hysteresis only if you select Analog in step 8 on the previous page.

15. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
    The Level/Hys dialog box appears.
16. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.
17. Press **ESC** to return to the previous screen.



18. Press **ESC** to return to the previous screen.

Displaying Analysis Results

Carry out steps 5 to 19 in section 11.7.

Explanation

Wiring System

Select the wiring system from the following:

Three-wire	Analyzes the data on a single data line.
Four-wire	Analyzes the data on Data 1 and Data 2 lines.

Bit Order

You can set the bit order to MSB or LSB based on the data stream.

CS, Clock, and Data

You can select the CS (chip select), clock, and data from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **CS**

  You can select on which CS level to analyze the data.

H	When the signal is high
L	When the signal is low

- **Clock**

  You can select on which clock edge to determine the data status.

	On the rising edge
	On the falling edge

- **Data 1 and Data 2**

  You can select which data status to assign to 1 (active) or 0.

H	Set to 1 when the data status is greater than or equal to the specified level or 0 otherwise.
L	Set to 1 when the data status is less than or equal to the specified level or 0 otherwise.

Level

Set the reference level for CH1 to CH4 and M1 to M4.*

The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

* When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

Hysteresis

Set the hysteresis for CH1 to CH4 and M1 to M4.

The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.

Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Analysis Reference Point

Select the analysis reference point from the following:

Trig Pos	Sets the analysis reference position to the trigger position.
Manual	Set the analysis reference position manually. The selectable range is ±5.00 divisions, and the resolution is 0.01 divisions.

For details on the analysis reference point and the numbers in the analysis result list, see page 11-70.

11.14 Viewing the Phase between Measured Waveforms on the XY Display

Procedure

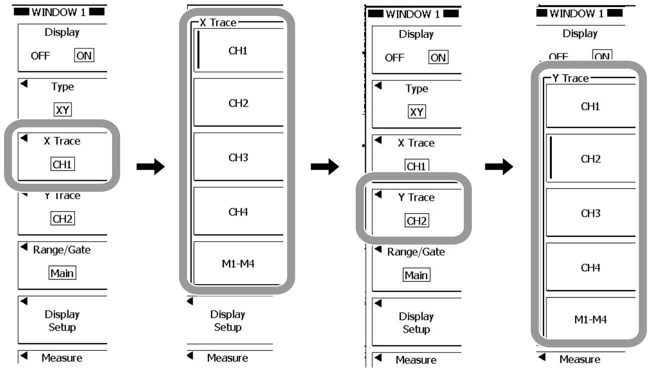
1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to XY.

Selecting the X-Axis Waveform

2. Press the **X Trace** soft key.
3. Press the appropriate waveform soft key to select the X trace.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.

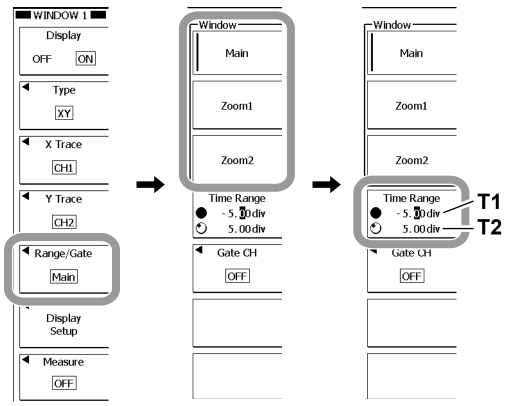
Selecting the Y-Axis Waveform

4. Press the **Y Trace** soft key.
5. Press the appropriate waveform soft key to select the Y trace.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.



Setting the Time Range

6. Press the **Range/Gate** soft key.
7. Press the appropriate soft key from **Main** to **Zoom2** to select the window that you want to set the time range for.
8. Press the **Time Range** soft key.
9. Use the **rotary knob** to set the start point (T1) and end point (T2).
   Press the soft key to select the point that you want to set using the rotary knob.



Selecting the Gate Channel

10. Press the **Gate CH** soft key.

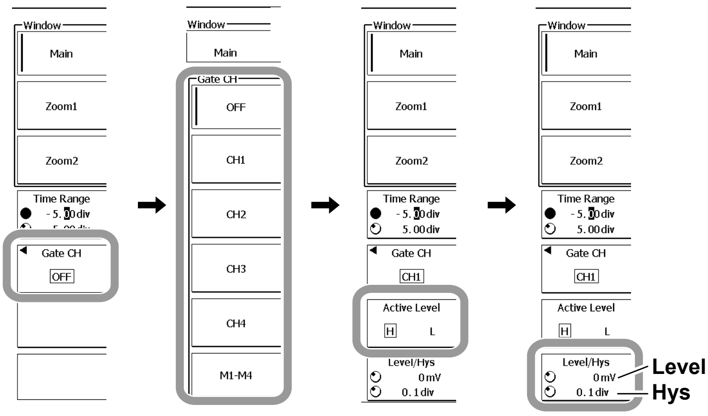
11. Press the appropriate waveform soft key to select the gate channel.
To select a channel from M1 to M4, press the **M1-M4** soft key first.
If you select OFF, proceed to step 15.

12. Press the **Active Level** soft key to select H or L.

13. Press the **Level/Hys** soft key.

14. Use the **rotary knob** to set the active reference level and hysteresis.
Press the soft key to select the setting that you want to set using the rotary knob.

15. Press **ESC**.



Turning the T-Y Waveform Display ON and OFF and Selecting the Analysis Function

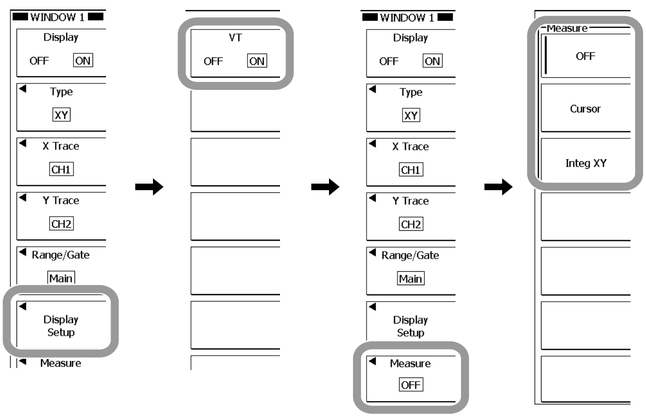
16. Press the **Display Setup** soft key.

17. Press the **VT** soft key to select ON or OFF.

18. Press **ESC**.

19. Press the **Measure** soft key.

20. Press the appropriate soft key from **OFF** to **Integ XY** to select the analysis function.
If you select OFF, you are done with the settings.
If you select Cursor, proceed to step 21.
If you select Integ XY, proceed to step 25.



Analyzing by Using Cursors

21. Press the **X1/X2** soft key.

22. Use the **rotary knob** to move the X1 or X2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

23. Press the **Y1/Y2** soft key.

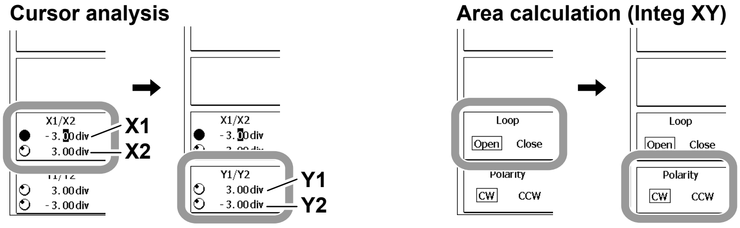
24. Use the **rotary knob** to move the Y1 or Y2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

Computing the Area

25. Press the **Loop** soft key to select Open or Close.

26. Press the **Polarity** soft key to select CW or CCW.

Cursor analysis **Area calculation (Integ XY)**



Explanation

X-Axis and Y-Axis Waveforms

Select the waveform from CH1 to CH4 or from M1 to M4.

Time Range

You can set the source window to Main, Zoom1, or Zoom2.
Set the time range within the selected window.
The selectable range is ±5.00 divisions.

Gate Channel

The SB5000 displays an XY waveform when the selected gate channel signal is greater than or equal to the reference level or when the signal is less than or equal to the reference level.

- **Active Level**
  Select whether to display an XY waveform when the signal is greater than or equal to or less than or equal to the reference level.

H	Greater than or equal to the reference level
L	Less than or equal to the reference level

- **Reference Level and Hysteresis**
  Set the level used to determine high or low and the hysteresis.

Analysis Function

OFF
Disables the analysis function.

Cursor
The two X-axis cursors and the two Y-axis cursors can be used at the same time.

X1/X2:	Measures the X-axis values for the X1 and X2 cursors. The selectable range is ±4 divisions, and the resolution is 0.01 divisions.
Y1/Y2:	Measures the Y-axis values for the Y1 and Y2 cursors. The selectable range is ±4 divisions, and the resolution is 0.01 divisions.

Integ XY
Determines the total area of the XY waveform. See appendix 2 for details.

Loop:	Select how to determine the area: Open (trapezoidal area) or Close (triangular area).
Polarity:	Set the positive direction to CW (clockwise) or CCW (counterclockwise).

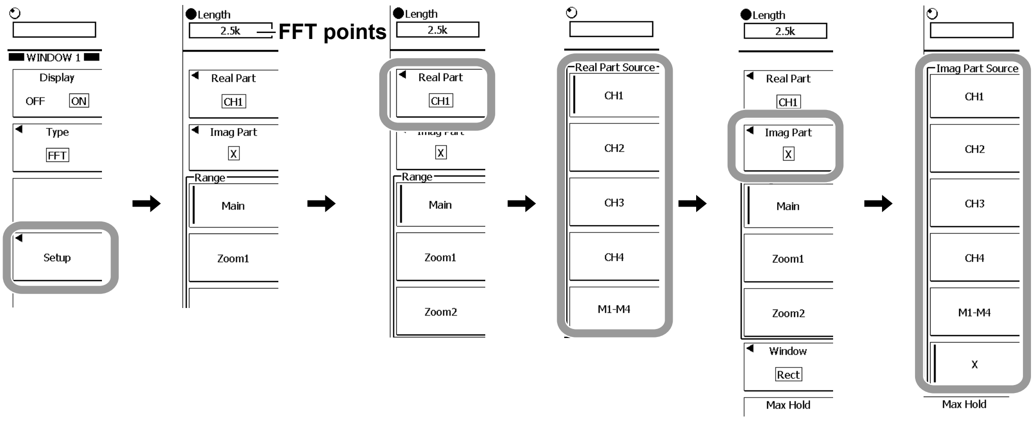
11.15 Performing FFT Analysis

Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to FFT.

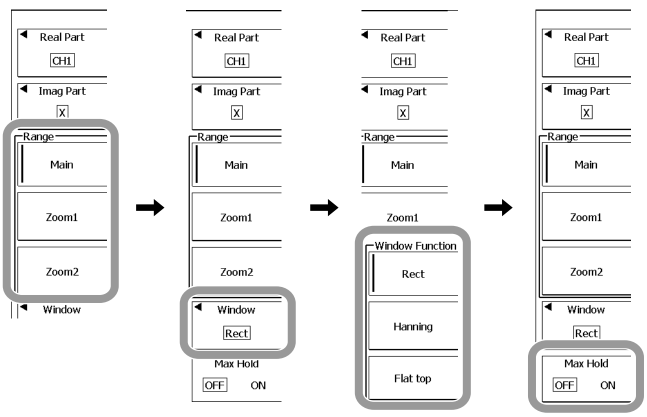
Selecting the Number of FFT Points and Selecting the Real-Part and Imaginary-Part Waveforms

2. Press the **Setup** soft key.
3. Use the **rotary knob** to select the number of FFT points from 2.5k to 250k.
4. Press the **Real Part** soft key.
5. Press the appropriate waveform soft key to select the real-part waveform.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
6. Press the **Imag Part** soft key.
7. Press the appropriate waveform soft key to select the imaginary-part waveform.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.



Selecting the Source Window, Time Window, and Maximum-Hold Mode

8. Press the **Main**, **Zoom1**, or **Zoom2** soft key to select the source window.
9. Press the **Window** soft key.
10. Press the appropriate soft key from **Rect** to **Flat top** to select the time window.
11. Press the **Max Hold** soft key to select ON or OFF.
12. Press **ESC** to return to the previous screen.



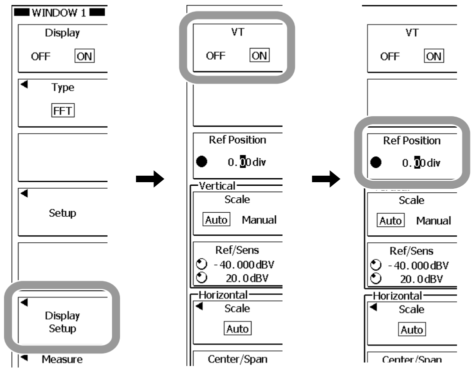
Turning the T-Y Waveform Display ON and OFF and Selecting the Reference Position

13. Press the **Display Setup** soft key.

14. Press the **VT** soft key to select ON or OFF.

15. Press the **Ref Position** soft key.

16. Use the **rotary knob** to set the reference position.



Configuring the Vertical and Horizontal Axes

17. Press the **Scale** soft key under Vertical to select Auto or Manual.
If you select Auto, proceed to step 20.

18. Press the **Ref/Sens** soft key.

19. Use the **rotary knob** to set the reference level and sensitivity.
Press the soft key to select the setting that you want to set using the rotary knob.

20. Press the **Scale** soft key under Horizontal.

21. Press a soft key from **Auto** to **Left/Right** to select the horizontal axis.
- If you select Auto, proceed to step 26.
- If you select Center/Span, proceed to step 22.
- If you select Left/Right, proceed to step 24.

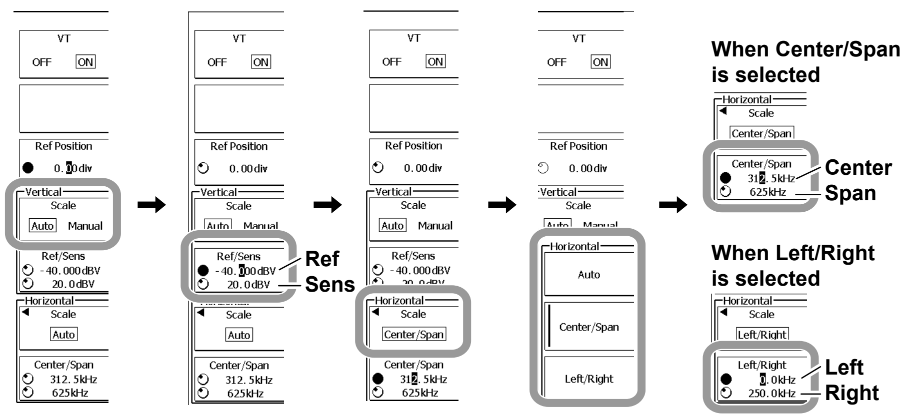
22. Press the **Center/Span** soft key.

23. Use the **rotary knob** to set the center and span.
Proceed to step 26.

24. Press the **Left/Right** soft key.

25. Use the **rotary knob** to set the left and right edges.

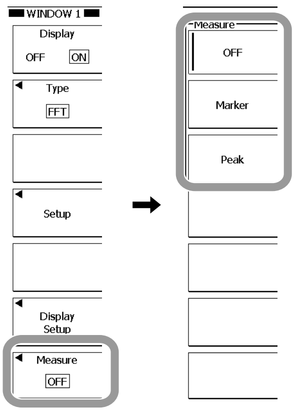
26. Press **ESC** to return to the previous screen.



Setting the Analysis Function

27. Press the **Measure** soft key.

28. Press a soft key from **OFF** to **Peak** to select the analysis function.
If you select Marker or Peak, proceed to step 29.
If you select OFF, you are done with the settings.



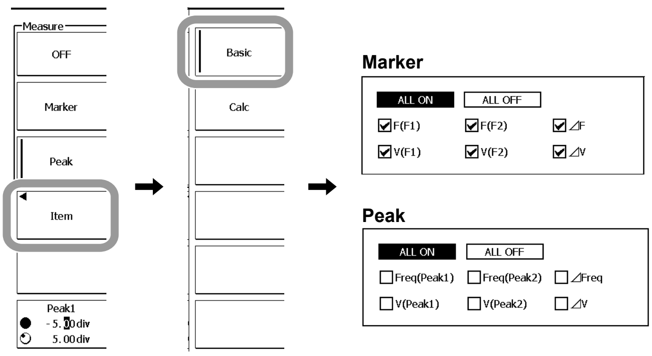
Selecting Analysis Items

29. Press the **Item** soft key.

- **Selecting Basic Analysis Items**

30. Press the **Basic** soft key.

31. Use the **rotary knob** and **SET** to select the items you want to analyze.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.



- **Setting a Calculation**

  32. Press the **Calc** soft key.

  33. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

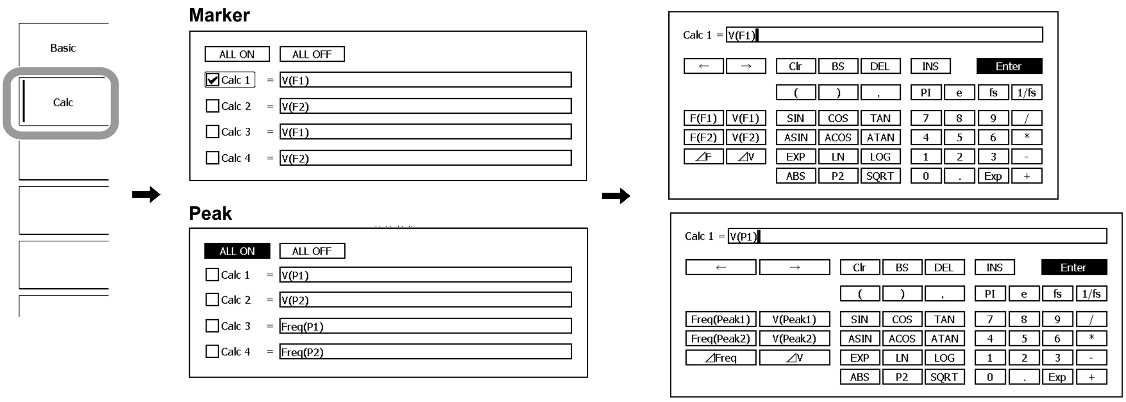
  34. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
  The dialog box for entering the calculation appears.

  35. Use the **rotary knob** and **SET** to select functions and operators.
  You can enter numbers using the numeric keys.

  36. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
  The dialog box closes, and the screen for selecting the calculation number reappears.

  37. Press **ESC** to return to the previous screen.

If you select Marker in step 28, proceed to step 38.
If you select Peak in step 28, proceed to step 42.



Analyzing by Using Markers (when Measure is set to Marker)

38. Press the **F1 Position** soft key.

39. Use the **rotary knob** to move the F1 cursor.

40. Press the **F2 Position** soft key.

41. Use the **rotary knob** to move the F2 cursor.

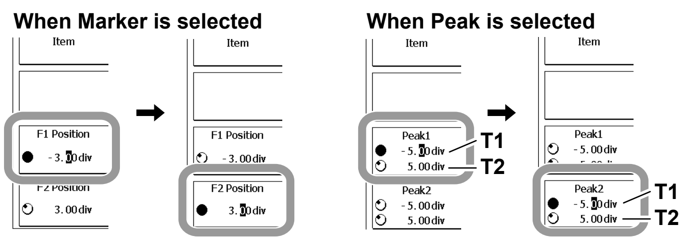
Setting the Peak Analysis Time Range (when Measure is set to Peak)

42. Press the **Peak1** soft key.

43. Use the **rotary knob** to set the Peak1 start point (T1) and end point (T2).
Press the soft key to select the point that you want to set using the rotary knob.

44. Press the **Peak2** soft key.

45. Use the **rotary knob** to set the Peak2 start point (T1) and end point (T2).
Press the soft key to select the point that you want to set using the rotary knob.



Explanation

FFT Points
Set the number of FFT points to 2.5k, 6.25k, 12.5k, 25k, 62.5k, 125k, or 250k.

Real-Part Waveform
Select the waveform from CH1 to CH4 or from M1 to M4.

Imaginary-Part Waveform
Select the waveform from CH1 to CH4, from M1 to M4, or X.

Source Window
Set the FFT analysis range to Main, Zoom1, or Zoom2.

Time Window
Select the time window for the FFT.
Rect (Rectangular), Hanning, or Flat top

Maximum-Hold Mode
Select whether to hold the maximum frequency up to that point from the start of computation.

Reference Position
Set the vertical axis reference position. The selectable range is ±4.00 divisions.

Vertical Axis

Auto	Automatically sets the axis.
Manual	Manually set the axis.

Horizontal Axis

Auto	Automatically sets the center and span.
Center/Span	Manually set the axis center value and span.
Left/Right	Manually set the left and right edges.

Analysis Items

OFF

Disables the analysis function.

Marker

Set the F1 (X) marker and F2 (+) marker positions. The SB5000 measures the FFT values (frequency and level) at the marker positions and the difference between the markers.

FFT frequency	F(F1) and F(F2)
FFT level	V(F1) and V(F2)
Difference between markers	ΔF = F(F1) – F(F2)
	ΔV = V(F1) – V(F2)
F1 Position and F2 Position	Sets each marker position.
Selectable range	±5.00 divisions

Peak

Set two frequency ranges (horizontal axis). The SB5000 measures the peak FFT values (frequency and level) in the two ranges and the difference between the peak values.

FFT frequency	Freq(Peak1) and Freq(Peak2)
FFT level	V(Peak1) and V(Peak2)
Difference between peak values	ΔFreq = Freq(Peak1) – Freq(Peak2)
	ΔV = V(Peak1) – V(Peak2)
Peak1 and Peak 2	Set each analysis range.
Selectable range	±5.00 divisions

Mapping Table of Analysis Item Settings and Names Displayed in Analysis Results

Analysis Item Setting		Name Displayed in Analysis Results
Marker		
FFT frequency	F(F1)	F1
	F(F2)	F2
FFT level	V(F1)	V1
	V(F2)	V2
Difference between markers	ΔF	ΔF
	ΔV	ΔV
Peak		
FFT frequency	Freq(Peak1)	Freq(P1)
	Freq(Peak2)	Freq(P2)
FFT level	V(Peak1)	V(P1)
	V(Peak2)	V(P2)
Difference between peak values	ΔFreq	ΔPeak(Hz)
	ΔV	ΔPeak(V)

11.16 Displaying a Histogram, Trend, or List of the Automatically Measured Waveform Parameters

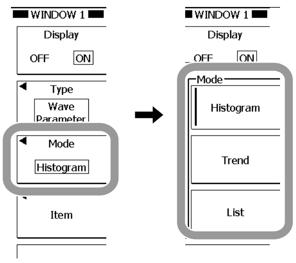
Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to Wave Parameter.

Selecting the Display Mode

2. Press the **Mode** soft key.

3. Press a soft key from **Histogram** to **List** to select the display mode.



Proceed to the steps on the pages indicated below according to the selected dislay mode.

- Histogram: Step 4 on page 11-84
- Trend: Step 4 on page 11-87
- List: Step 4 on page 11-88

11

Analysis and Search

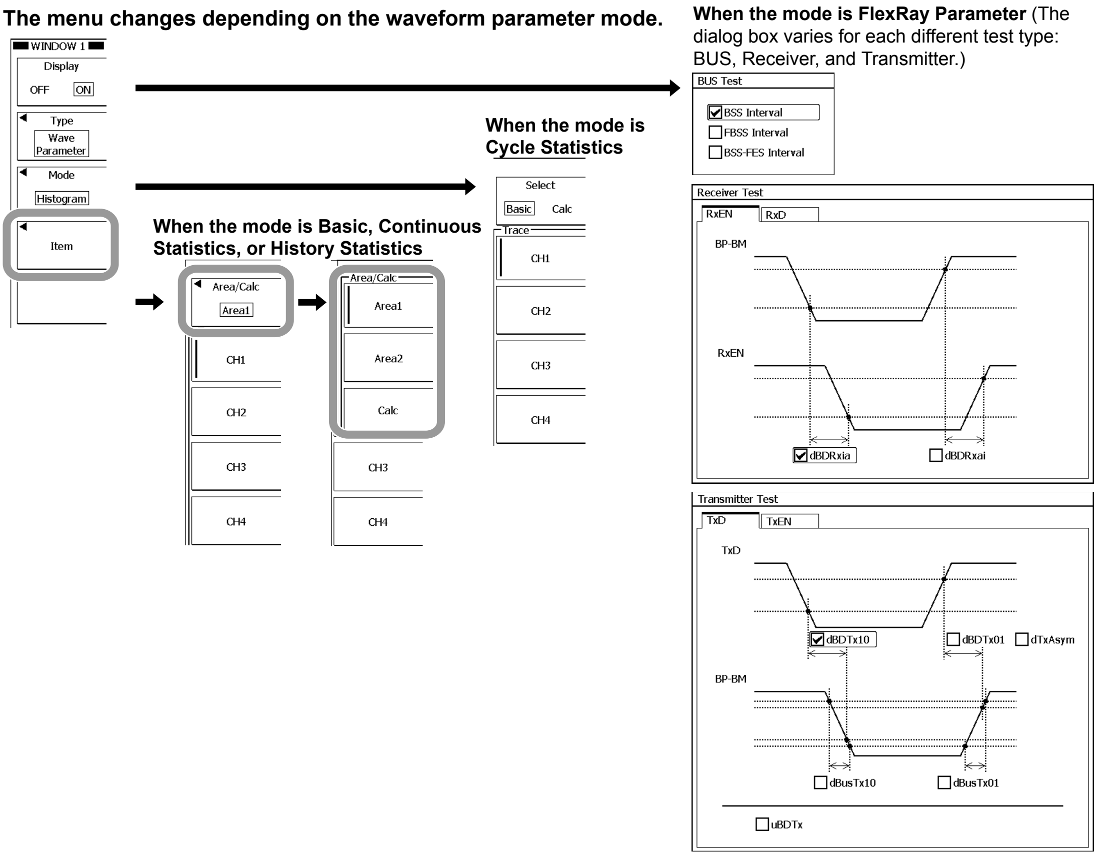
Displaying the Histogram

Selecting the Displayed Items

4. Press the **Item** soft key.

5. The menu that appears varies depending on the set waveform parameter mode (see sections 11.1 and 11.2 for details). Follow the instructions that correspond to the menu that appears.

- If the mode is Basic, Continuous Statistics, or History Statistics, and you select Area 1 or Area2, proceed to step 6.
- If the mode is Cycle Statistics and you select Basic, proceed to step 6.
- If the mode is Basic, Continuous Statistics, History Statistics, or Cycle Statistics and you select Calc, proceed to step 8.
- If the mode is FlexRay Parameter, select the parameter using the **rotary knob** and **SET**, and then proceed to step 9.

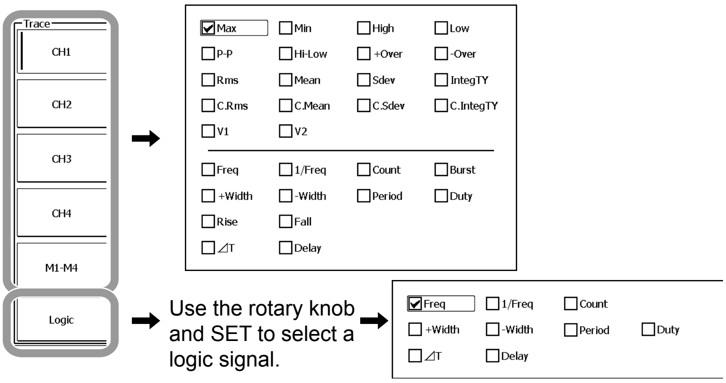


- **Selecting a Signal/Waveform Parameter**

6. Press the appropriate signal soft key.

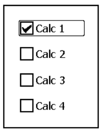
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- To select Logic, press the **Logic** soft key, and then press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the **rotary knob** and **SET**, and then press **ESC**

7. Use the **rotary knob** and **SET** to select a waveform parameter.
Proceed to step 9.



- **Selecting a Calculation**

8. Use the **rotary knob** and **SET** to select a calculation number from Calc 1 to Calc 4.
You can select a calculation that you set using the procedure described in section 11.2.



9. Press **ESC**.

Turning the T-Y Waveform Display ON and OFF and Selecting the Analysis Function

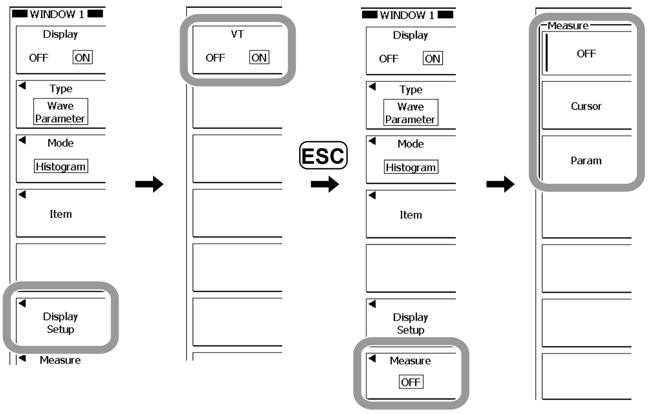
10. Press the **Display Setup** soft key.

11. Press the **VT** soft key to select ON or OFF.

12. Press **ESC**.

13. Press the **Measure** soft key.

14. Press a soft key from **OFF** to **Param** to select the analysis function.
If you select OFF, you are done with the settings.
If you select Cursor, proceed to step 15.
If you select Param, proceed to step 20.



Analyzing by Using Cursors

15. Press the **Item** soft key.

16. Use the **rotary knob** and **SET** to select the items you want to analyze.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.

17. Press **ESC** to return to the previous screen.

18. Press the **Cursor** soft key.

19. Use the **rotary knob** to move the C1 or C2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.

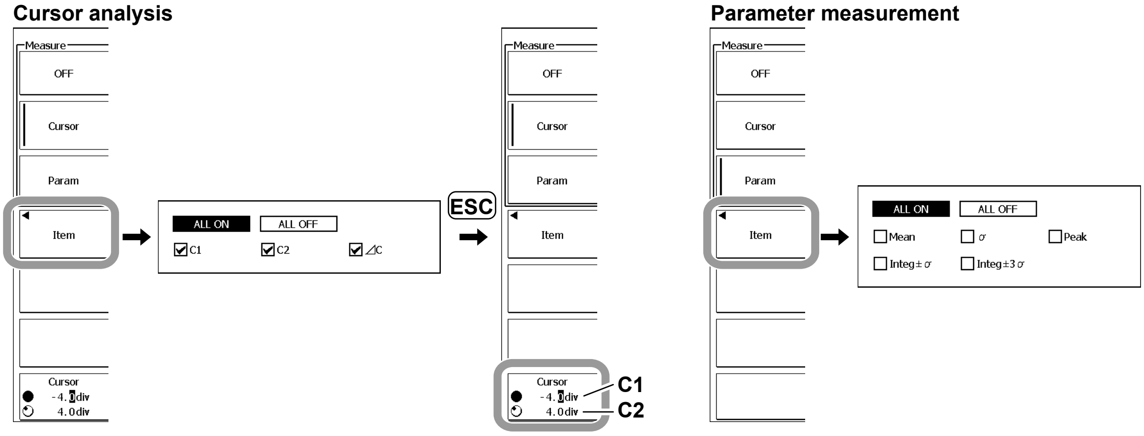
Analyzing by Using Parameters

20. Press the **Item** soft key.

21. Use the **rotary knob** and **SET** to select parameters.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.

22. Press **ESC** to return to the previous screen.

Cursor analysis **Parameter measurement**



Displaying a Trend

Selecting the Displayed Items

4. Select the displayed items according to steps 4 to 9 on page 11-84 and 11-85.

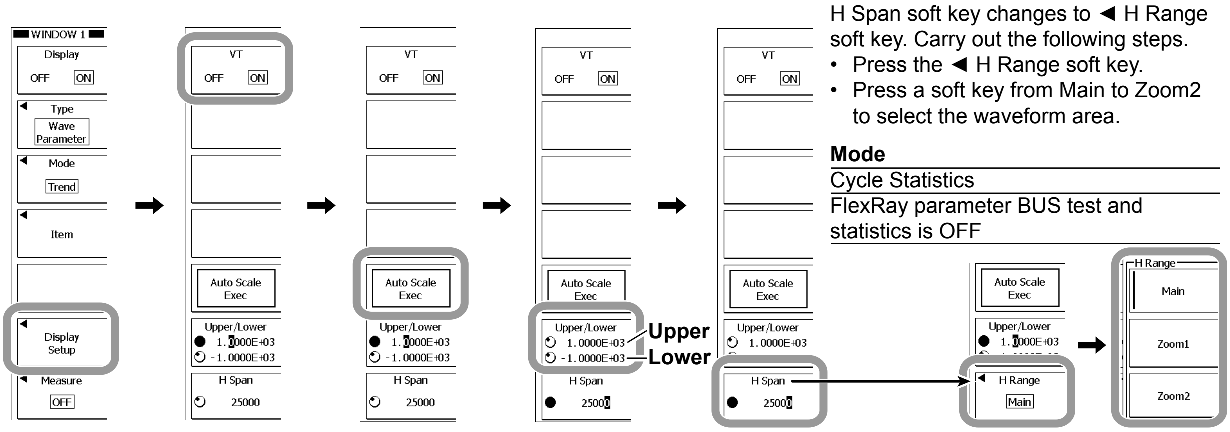
Turning the T-Y Waveform Display ON and OFF and Setting the Display Range

5. Press the **Display Setup** soft key.
6. Press the **VT** soft key to select ON or OFF.
7. Press the **Auto Scale EXEC** soft key to automatically set the display range.
   Upper/Lower and H Span menu items are updated with the automatically set values.
8. Press the **Upper/Lower** soft key.
9. Use the **rotary knob** to set the upper and lower limits.
   Press the soft key to select the limit that you want to set using the rotary knob.
10. Press the **H Span** soft key.
11. Use the **rotary knob** to set the number of displayed horizontal points.
12. Press **ESC**.

When the waveform parameter mode is one of the modes in the table below, the H Span soft key changes to ◄ H Range soft key. Carry out the following steps.

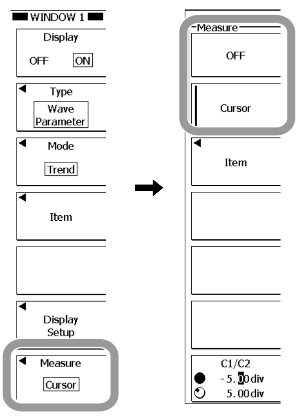
- Press the ◄ H Range soft key.
- Press a soft key from Main to Zoom2 to select the waveform area.

Mode
Cycle Statistics
FlexRay parameter BUS test and statistics is OFF



Analyzing by Using Cursors

13. Press the **Measure** soft key.
14. Press the **OFF** or **Cursor** soft key to select the analysis function.
    If you select OFF, you are done with the settings.
    If you select Cursor, proceed to step 15.

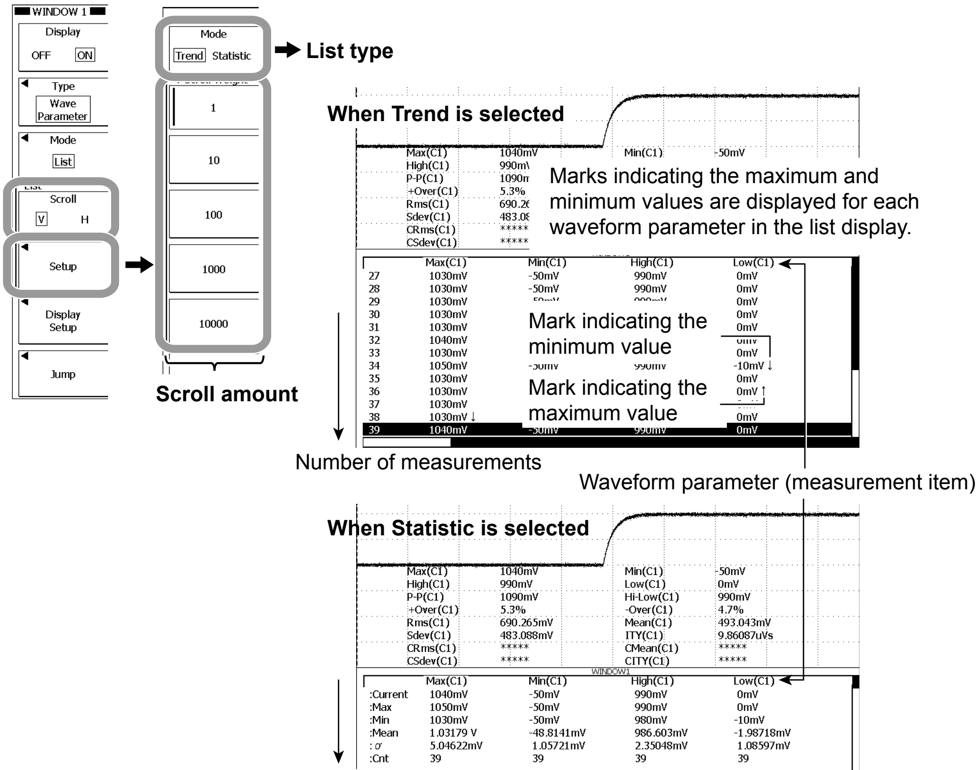


15. Perform analysis using cursors according to steps 15 to 19 on page 11-86.

Displaying a List

Selecting the Scroll Direction and Selecting the List Type

4. Press the **Scroll** soft key to select V (vertical) or H (horizontal).
   - V: You can scroll through the list vertically using the rotary knob and up and down keys.
   - H: You can scroll through the list horizontally using the rotary knob and left and right keys.
5. Press the **Setup** soft key.
6. Press the **Mode** soft key to select Trend or Statistic.
7. Press the appropriate soft key from **1** to **10000** to select how many numbers to scroll by.
8. Press **ESC** to return to the previous screen.



Statistical items

Current: • Measured value of the displayed waveform when the waveform parameter mode is Basic or Continuous Statistics
• Measured value of the last waveform when the waveform parameter mode is History Statistics or Cycle Statistics

Max: Maximum value

Min: Minimum value

Mean: Mean value

σ: Standard deviation

Cnt: The number of measured values that statistics were calculated for

Turning the T-Y Waveform Display ON and OFF

9. Turn the T-Y waveform display ON or OFF according to steps 10 to 12 on page 11-85.

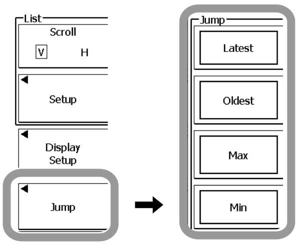
Moving to the Maximum or Minimum Value for the Selected Item or to the Latest or Oldest Data in the List

10. Press the **Jump** soft key.

11. Press the appropriate jump destination soft key from **Latest** to **Min**.

The jump destination data is highlighted.

- Latest: The latest data in the list
- Oldest: The oldest data in the list
- Max: The maximum value for the selected item in the list
- Min: The minimum value for the selected item in the list



Explanation

Display Mode

Select from the following modes.

Histogram	Displays a histogram of the results.
Trend	Displays a trend of the results.
List	Displays a list of the results. All selected items in the automated measurement of waveform parameters are displayed.

Displayed Items

You can select the items you want to display from the automatically measured waveform parameters.

Number of Displayed Trend Points (H Span)

Set the number of trend points when using the trend display. The specified number of measured values from the latest measured result are displayed on a trend. The maximum value is equal to 100000/(the number of selected items).

Executing Auto Scale

If you execute auto scale for a trend, the upper, lower, and H span values are set as follows:

Upper/Lower	Set so that the difference between the maximum and minimum values for the waveform parameter is 80% of the waveform area.
H Span	Set so that all waveform parameters that have been measured before executing auto scale are displayed. If the waveform parameter mode is Basic or Continuous Statistics, and the number of measured waveform parameters is less than 100, the H span value is set to 100.

Display Source Waveform Area

When the display mode is Trend and the waveform parameter mode is one of the following modes, set the display source waveform area to Main, Zoom1, or Zoom2.

Cycle Statistics
FlexRay parameter BUS test and statistics is OFF

Analysis Function

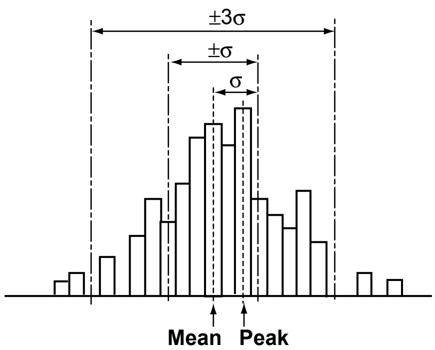
OFF

Disables the analysis function.

Param

You can select parameters.

Mean	
σ	Standard deviation of the histogram
Peak	Peak value of the histogram
Integ±σ	The percentage of measured values that fall within ±σ
Integ±3σ	The percentage of measured values that fall within ±3σ



Cursor (Histogram and Trend)

C1	Displays the measured value at cursor C1
C2	Displays the measured value at cursor C2
ΔC	Difference in the measured values at cursors C1 and C2

11.17 Displaying the Frequency Distribution of a Specified Area (Accum Histogram)

Procedure

1. Carry out steps 1 to 4 in section 11.7 to set the analysis type to Accum Histogram.
2. Press the **Setup** soft key.

Selecting the Axis

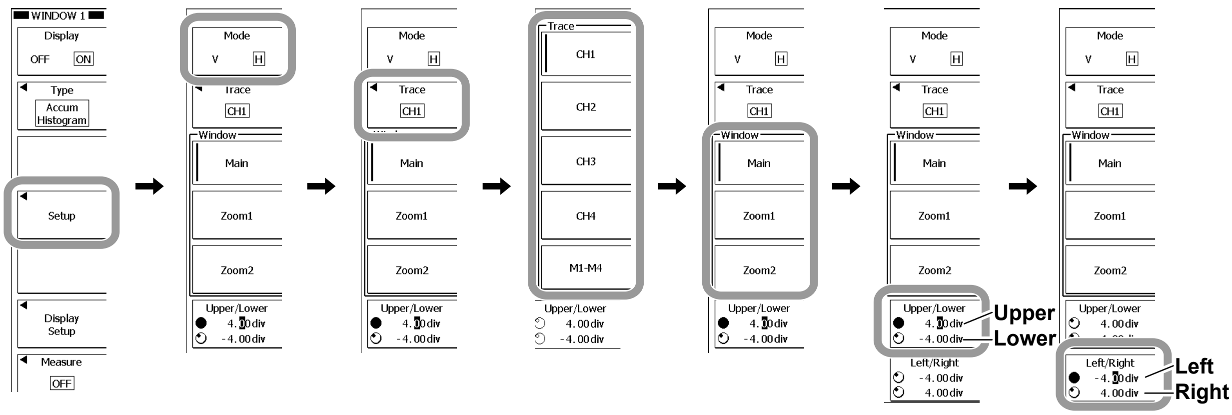
3. Press the **Mode** soft key to select V or H.
   If you select V, a vertical histogram appears. If you select H, a horizontal histogram appears.

Selecting the Display Source Waveform

4. Press the **Trace** soft key.
5. Press the soft key that corresponds to the waveform to display the frequency distribution of.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.

Setting the Source Range

6. Press the appropriate soft key from **Main** to **Zoom2** to select the window that you want to set the time range for.
7. Press the **Upper/Lower** soft key.
8. Use the **rotary knob** to set the source range upper and lower limits.
   Press the soft key to select the limit that you want to set using the rotary knob.
9. Press the **Left/Right** soft key.
10. Use the **rotary knob** to set the source range left and right edges.
    Press the soft key to select the edge that you want to set using the rotary knob.
11. Press **ESC** to return to the previous screen.



Turning the T-Y Waveform Display ON and OFF and Selecting the Analysis Function

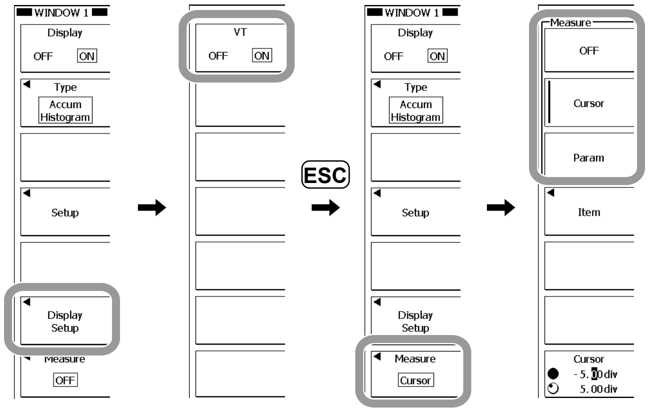
12. Press the **Display Setup** soft key.

13. Press the **VT** soft key to select ON or OFF.

14. Press **ESC**.

15. Press the **Measure** soft key.

16. Press a soft key from **OFF** to **Param** to select the analysis function.
If you select OFF, you are done with the settings.
If you select Cursor, proceed to step 17.
If you select Param, proceed to step 28.



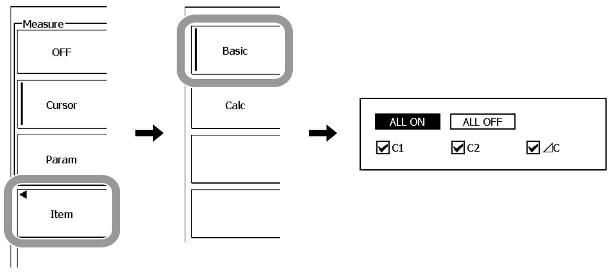
Analyzing by Using Cursors

17. Press the **Item** soft key.

- **Selecting Basic Analysis Items**

18. Press the **Basic** soft key.

19. Use the **rotary knob** and **SET** to select the items you want to analyze.
- If you select ALL ON and press **SET**, you can turn ON all items at once.
- If you select ALL OFF and press **SET**, you can turn OFF all items at once.



- **Setting a Calculation**

20. Press the **Calc** soft key.

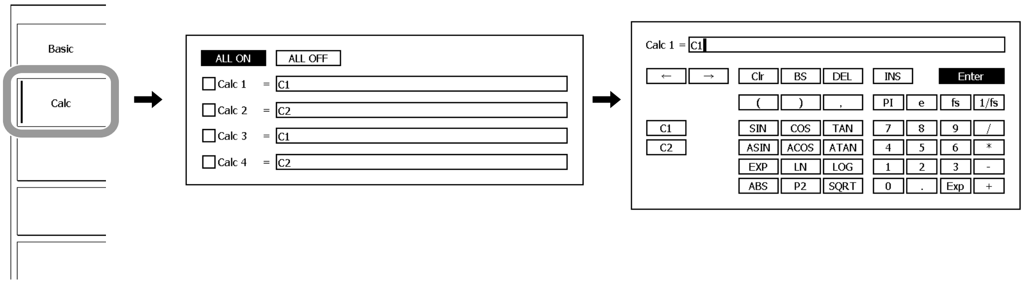
21. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

22. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
The dialog box for entering the expression appears.

23. Use the **rotary knob** and **SET** to select functions and operators.
You can enter numbers using the numeric keys.

24. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
The dialog box closes, and the screen for selecting the calculation number reappears.

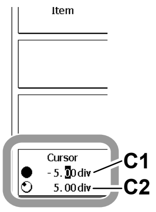
25. Press **ESC** to return to the previous screen.



- **Moving a Cursor**

26. Press the **Cursor** soft key.

27. Use the **rotary knob** to move the C1 or C2 cursor.
Press the soft key to select the cursor that you want to move using the rotary knob.



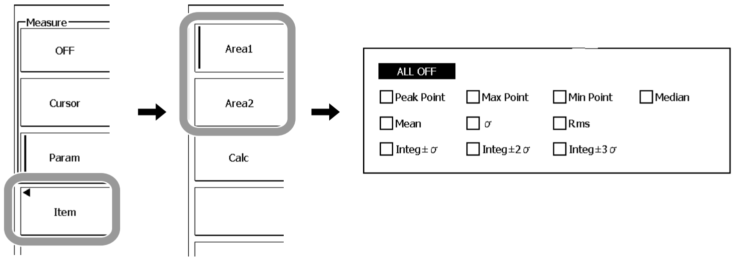
Analyzing by Using Parameters

28. Press the **Item** soft key.

- **Selecting Parameters**

29. Press the **Area1** or **Area2** soft key to select the area in which to set parameters.

30. Use the **rotary knob** and **SET** to select parameters.
If you select ALL OFF and press SET, you can turn OFF all items at once.



- **Setting a Calculation**

31. Press the **Calc** soft key.

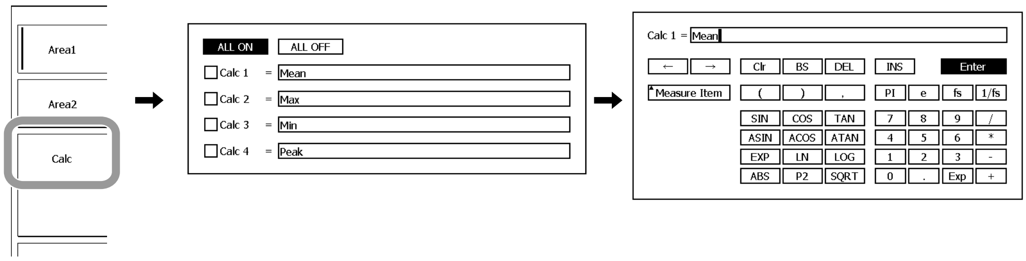
32. Use the **rotary knob** and **SET** to select the calculation number from Calc 1 to Calc 4.

33. Use the **rotary knob** and **SET** to select the expression box to the right of the selected number.
The dialog box for entering the expression appears.

34. Use the **rotary knob** and **SET** to select functions and operators.
You can enter numbers using the numeric keys.

35. When you are done entering the expression, press the **Enter** soft key. To cancel the entered expression, press **ESC**.
The dialog box closes, and the screen for selecting the calculation number reappears.

36. Press **ESC** to return to the previous screen.



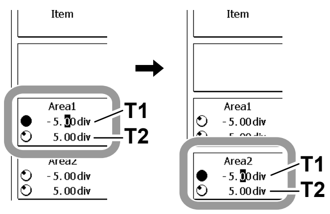
- **Defining an Area**

37. Press the **Area1** soft key.

38. Use the **rotary knob** to set the Area1 range (T1 and T2).
Press the soft key to select the setting that you want to set using the rotary knob.

39. Press the **Area2** soft key.

40. Use the **rotary knob** to set the Area2 range (T1 and T2).
Press the soft key to select the setting that you want to set using the rotary knob.



Explanation

Axis

Select the histogram axis.

V	Vertical Axis
H	Horizontal Axis

Display Source Waveform

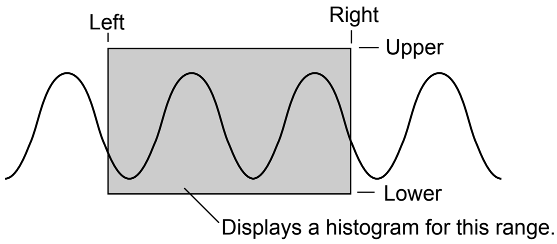
Select the waveform from CH1 to CH4 or from M1 to M4.

Source Window

You can set the source window to Main, Zoom1, or Zoom2.

Upper/Lower
Set the horizontal axis range for the box used to specify the range to generate the histogram of. The selectable range is ±4 divisions.

Left/Right
Set the vertical axis range for the box used to specify the range to create the histogram of. The selectable range is ±4 divisions.



Analysis Function

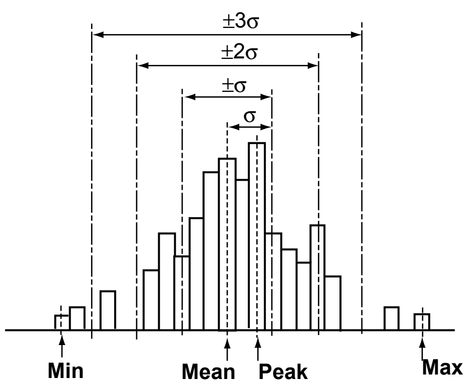
OFF
Disables the analysis function.

Cursor
When the mode is H, you move the two vertical cursors to measure the vertical values at the cursors.
When the mode is V, you move the two horizontal cursors to measure the horizontal values at the cursors.

Param
You can select parameters.

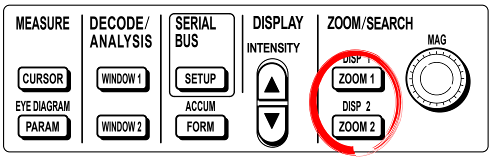
Peak Point	Peak value
Max Point	Maximum value
Min Point	Minimum value
Median	Median*
Mean	Mean value
σ	Standard deviation of the histogram
Rms	
Integ±σ	The percentage of measured values that fall within ±σ
Integ±2σ	The percentage of measured values that fall within ±2σ
Integ±3σ	The percentage of measured values that fall within ±3σ

* The value at the halfway point when the samples are arranged in ascending order.



11.18 Selecting the Search Type and Skip Mode, Executing the Search, and Displaying the Results

Procedure

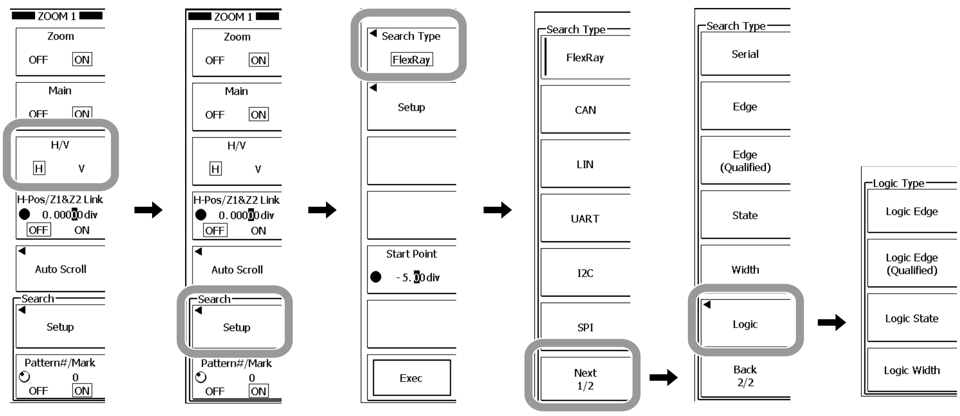


1. Press **ZOOM1** or **ZOOM2**.
   The ZOOM menu appears.
2. Press the **H/V** soft key to select H.

Selecting a Search Type

3. Press these soft keys: **Setup** > **Search Type**.
   The Search Type menu appears.
4. From the menu that appears, press the appropriate soft key to select the search type.
5. Proceed to the appropriate section indicated below according to the selected search type, and then set the search options.
   - FlexRay: Section 11.19
   - CAN: Section 11.20
   - LIN: Section 11.21
   - UART: Section 11.22
   - I2C: Section 11.23
   - SPI: Section 11.24
   - Serial: Section 11.25
   - Edge, Edge (Qualified), State, Width: Section 11.26
   - Logic*: Section 11.27

   * There are four Logic search types: Logic Edge, Logic Edge (Qualified), Logic State, and Logic Width.



After setting the search options according to step 5 on the previous page, return to the Search Type menu, and proceed with the following steps.

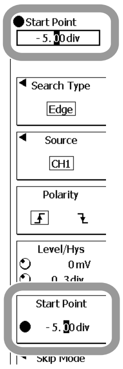
Setting the Search Start Point

6. If the search type is Edge, Width, Logic Edge, or Logic Edge (Qualified), press the **Start Point** soft key.

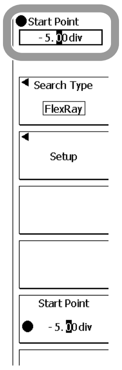
- If the search type is FlexRay, CAN, LIN, UART, I2C, SPI, or Serial, you can simply use the rotary knob to set the start point. The Start Point menu will appear, but you do not have to press the soft key.
- If the search type is Edge (Qualified), State, Logic State, or Logic Width, you can simply use the rotary knob to adjust the start point. The Start Point menu will not appear in this case.

7. Use the **rotary knob** to set the search start point.

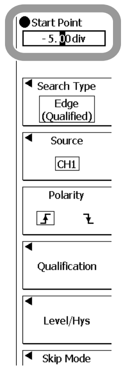
When Edge, Width, Logic Edge, or Logic Edge (Qualified) is selected



When FlexRay, CAN, LIN, UART, I2C, SPI, or Serial is selected



When Edge (Qualified), State, Logic State, or Logic Width is selected



Selecting a Skip Mode

If necessary, select a skip mode.

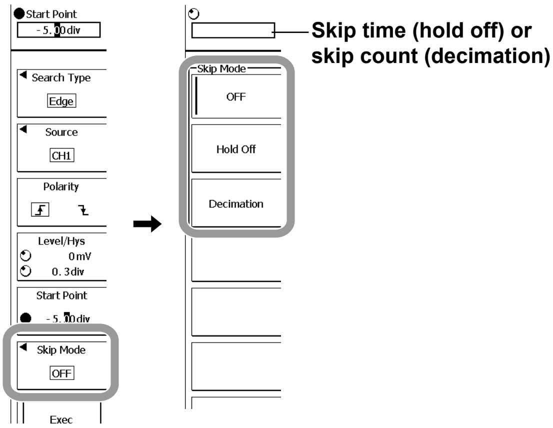
The skip mode feature is not available for FlexRay, LIN, or UART.

8. Press the **Skip Mode** soft key.

9. Press a soft key from **OFF** to **Decimation** to select the skip mode.

10. Use the **rotary knob** to set the time or search count to skip.

11. Press **ESC** to return to the previous screen.



Executing the Search

12. Press the **Exec** soft key. A section that meets the search conditions appears in the zoom window.

The Exec soft key changes to the Abort soft key. To stop the search, press the **Abort** key.

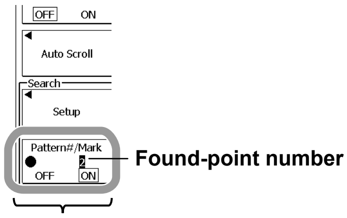
Displaying Analysis Results

13. Use the **rotary knob** to select a found-point number.

The waveform that corresponds to the number appears in the zoom waveform area.

Turning a Found-Point Mark ON and OFF

14. Press the **Pattern#/Mark** soft key to select ON or OFF.



Turn found-point marks ▼ON and OFF
You can display found-point marks at the top edge of the main and zoom windows. Found-point marks indicate the waveform positions that were found. The found-point mark that matches the found-point number is highlighted.

Explanation

The SB5000 searches the displayed waveform for sections that meet certain conditions and displays the found results in the zoom window.

Search Type

- The SB5000 can search a serial bus signal (FlexRay, CAN, LIN, UART, I2C, SPI, or Serial).
- You can set edge, edge (qualified), state, and width conditions to search an analog signal.
- You can set logic edge, logic edge (qualified), logic state, and logic width conditions to search a logic signal.

Search Start Point

The selectable range is ±5.00 divisions. The resolution is 0.01 divisions.

Skip Mode

After finding a point that meets the search conditions, the SB5000 skips searching for the specified time or count.

OFF	Searches all found points.
Hold Off	Skips searching for the specified time. The selectable range is 0.1 ns to 1.00000 s (six significant digits). The resolution is 0.1 ns.
Decimation	Skips searching for the specified count. The selectable range is 1 to 9999.

Displaying Search Results

Numbers are assigned to the points that are found. Zero is assigned to the first found point, one is assigned to the second found point, and so on.

- The maximum found-point number is 4999.
- You can display the waveform that corresponds to the selected found-point number in the zoom waveform area.

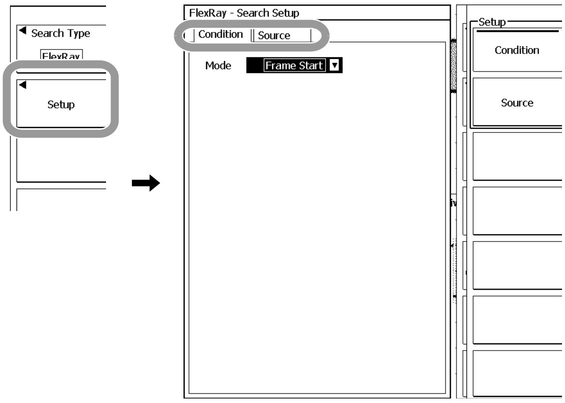
11.19 Searching FlexRay Bus Signals

Procedure

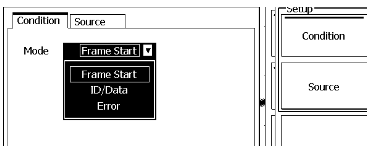
1. Carry out steps 1 to 5 in section 11.18 to set the search type to FlexRay.
2. Press the **Setup** soft key.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from Frame Start to Error.



Proceed to the steps on the pages indicated below according to the selected mode.

- Frame Start: Step 17 on page 11-102
- ID/Data: Step 5 on page 11-100
- Error: Step 5 on page 11-102

When the Mode Is ID/Data

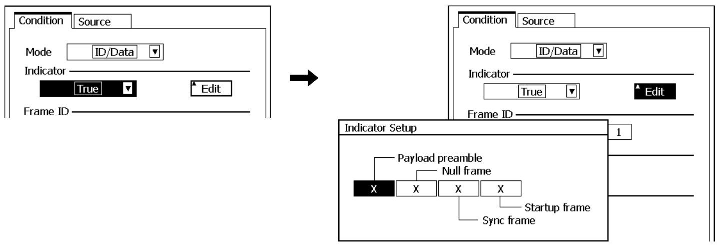
- **Setting the Indicator Search Condition**

5. Use the **rotary knob** and **SET** to select the indicator comparison condition from Don’t care to False.
If you select Don’t care, proceed to step 9.

6. Use the **rotary knob** and **SET** to select Edit.
The Indicator Setup dialog box appears.

7. Use the **rotary knob** and **SET** to set the four indicator bit patterns from Payload preamble to Startup frame.

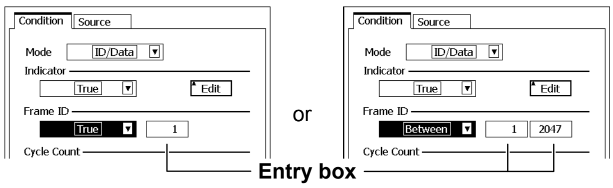
8. Press **ESC** to return to the previous screen.



- **Setting the Frame ID Search Condition**

9. Use the **rotary knob** and **SET** to select the Frame ID comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 11.

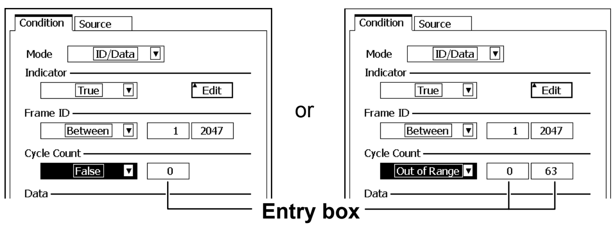
10. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



- **Setting the Cycle Count Search Condition**

11. Use the **rotary knob** and **SET** to select the Cycle Count comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 13.

12. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



- **Setting the Data Search Condition**

13. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.

If you select Don't care, proceed to step 17 on page 11-102.

14. Use the **rotary knob** and **SET** to set the position and size.

If you select a condition from Greater to Out of Range in step 13, proceed to step 16.

15. Use the **rotary knob** and **SET** to set the data pattern to compare with.

You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

16. Use the **rotary knob** and **SET** to set the data to compare in each entry box.

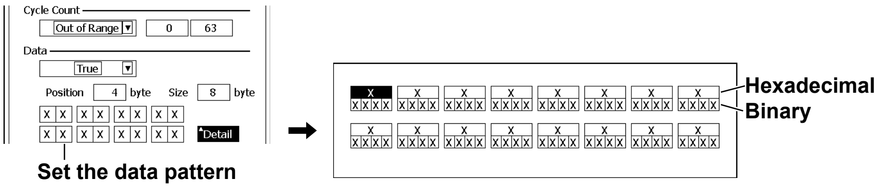
Set each item according to the comparison condition you selected in step 13.

Comparison Condition	Setting						
	Position	Size	Detail	Data(Dec)	Byte Order	Sign	MSB/LSB
True, False	Yes	Yes	Yes	No	No	No	No
Greater/Equal, Less/Equal	Yes	Yes	No	Yes[1]	Yes	Yes	Yes
Between, Out of Range	Yes	Yes	No	Yes[2]	Yes	Yes	Yes

Yes: Set, –: Not set

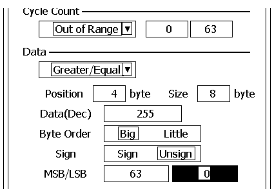
- Position: Comparison start point
- Size: Data length to compare
- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

True, False

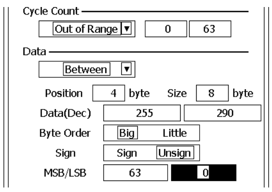


Set the data pattern (hexadecimal)

Greater/Equal, Less/Equal



Between, Out of Range



Proceed to step 17 on page 11-102.

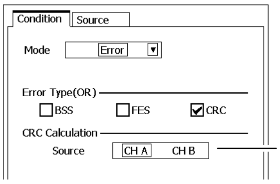
When the Mode Is Error

- **Selecting the Error Type**

5. Use the **rotary knob** and **SET** to select Error Type from BSS to CRC.
- You can select all error types using the OR logic.
- The CRC Calculation item appears when you select CRC.

- **Assigning the Source (when CRC is selected in step 5)**

6. Use the **rotary knob** and **SET** to set the CRC calculation source to CH A or CH B.



The CRC Calculation item appears when you select CRC.

Proceed to step 17.

Setting the Bit Rate, Sample Point, Level, and Hysteresis

17. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Selecting the Bit Rate and Sample Point

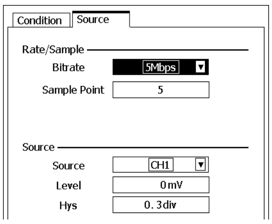
18. Use the **rotary knob** and **SET** to select the bit rate from 10Mbps to 2.5Mbps.

19. Use the **rotary knob** and **SET** to select the sample point from 1 to 8.

Setting the Level and Hysteresis

20. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from M1 to M4.

21. Use the **rotary knob** and **SET** to set the level and hysteresis.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches FlexRay bus signals. For details on the FlexRay bus signal frame format, see "Explanation" in section 7.6.

Modes

Select the FlexRay search mode from Frame Start, ID/Data, ID/Data OR, and Error.

Frame Start Mode

Searches for the frame start point of a FlexRay bus signal.

ID/Data Mode

Searches using the AND logic of Indicator, Frame ID, Cycle Count, and Data conditions.

- **Indicator**

  You can use the four indicator statuses as search conditions.

  - Comparison Condition

    The Indicator search condition is met when the result of comparing the input signal indicator pattern with the specified bit pattern meets the selected comparison condition.

Don't care	Not used as a search condition
True	When the input signal bit pattern matches the specified bit pattern
False	When the input signal bit pattern does not match the specified bit pattern

  - Bit Pattern

    Select the four Indicator bit patterns from the following:

X	Not used as a search condition (Don't care)
0	See below.
1	

  The four Indicators indicate the following information.

Payload preamble	
0	No option vector in the payload segment.
1	Includes a network management vector in the static payload segment. Includes a message ID in the dynamic payload segment.
Null Frame	
0	Includes invalid data in the payload segment.
1	Includes valid data in the payload segment.
Sync Frame	
0	The frame is not a sync frame.
1	The frame is a sync frame.
Startup frame	
0	The frame is not a startup frame.
1	The frame is a startup frame.

- **Frame ID**

  You can use the 11-bit frame ID as a search condition.

  - Comparison Condition

    The Frame ID search condition is met when the result of comparing the input signal Frame ID value with the reference value meets the selected comparison condition.

Don't care	Not used as a search condition
True	When the input signal value meets the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

  - Reference Values
    - If you select a condition from True to Less/Equal, set one reference value.
    - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
    - Selectable range: 1 to 2047

- **Cycle Count**

  You can use the 6-bit cycle count as a search condition.

  - Comparison Condition

    The cycle count search condition is met when the result of comparing the input signal cycle count value with the reference value meets the selected comparison condition. The comparison condition is the same as with the frame ID.
  - Reference Values
    - The procedure to set the reference values is the same as with the frame ID.
    - Selectable range: 0 to 63

- **Data**

  You can use the Data 0 to Data 253 values as a search condition.

  - Comparison Condition

    The data search condition is met when the result of comparing the input signal data values with the reference values meets the selected comparison condition. The comparison condition is the same as with the frame ID.
  - Comparison Start Position

    Set the comparison start position. To start comparing from payload segment data 1, set 1.

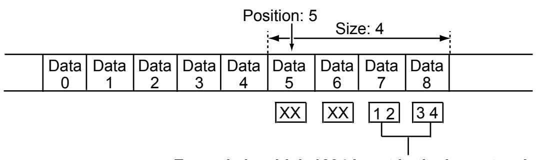
    Selectable range: 0 to 253
  - Data Size

    Set how many consecutive payload segment data bytes you want to compare.

    Selectable range: 1 to 8 bytes
  - Data Pattern

    Set the data pattern for the specified size in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to true or false.
    - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
    - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Example in which the comparison start point is set to 5 and the data length is set to 4



Example in which 1234 is set in the lower two bytes of the four bytes

- Reference Value Data(Dec)
  - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
  - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
  - If the comparison condition is True or False, the data pattern is used as the reference value.
  - Selectable range
    Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.

The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

- Byte Order
  Set the data byte order to big endian or little endian. For an example, see page 7-17.

- Sign
  Select whether or not to add a sign to the data.
  The selectable range for the data reference value varies depending on this setting.

- MSB/LSB
  Set the MSB and LSB positions in the data to compare. For an example, see page 7-17.
  Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

Error Mode

Searches for points where errors occurred.

- Search Source
  Select the FlexRay bus signal input.

- Assigning Bus Channels
  Assign FlexRay bus CH A or CH B to each source. This setting is used when the error type is set to CRC error.

- Error Type
  Select from the following error types.
  - You can select multiple error types.
  - The SB5000 will search for all selected errors.

CRC	When the SB5000 detects a header CRC or frame CRC error
BSS	When the SB5000 detects a BSS error
FES	When the SB5000 detects an FES error

Bit Rate, Sample Point, Level, and Hysteresis

Bit Rate

You can set the FlexRay bus signal transfer rate to:
10Mbps, 5Mbps, or 2.5Mbps

Sample Point

The SB5000 samples data at a rate that is eight times the bit rate. The sampled data is passed through a filter to eliminate noise and converted to binary values. Set the sample point of this binary data (bit strobe point).
The selectable range is 1 to 8.

Bus Channel

Select CH A or CH B.

Source

Select the source from CH1 to CH4 or from M1 to M4.

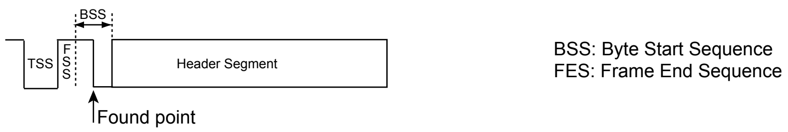
- **Level**
  Set the level for determining whether the signal level is 0 or 1.
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

- **Hysteresis**
  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

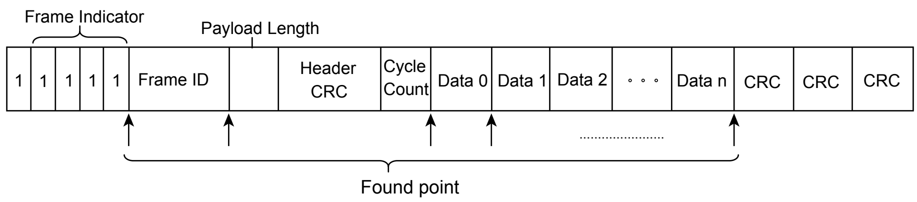
Found Point

The found point is the last point of the field that met the search conditions.

Frame Start Mode

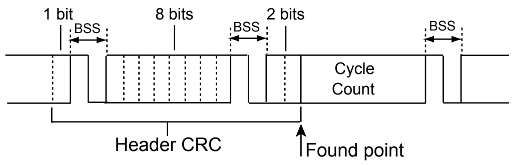


ID/Data Mode

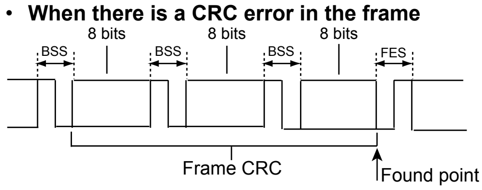


Error Mode

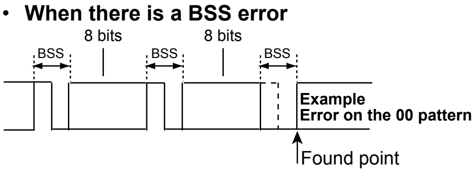
- **When there is a CRC error in the header**



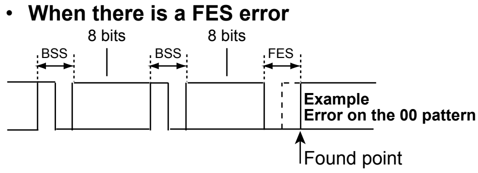
- **When there is a CRC error in the frame**



- **When there is a BSS error**



- **When there is a FES error**



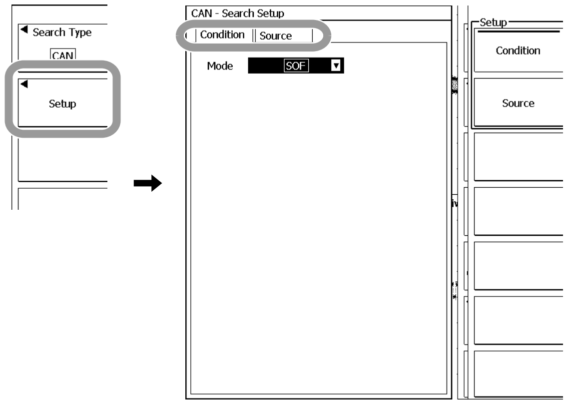
11.20 Searching CAN Bus Signals

Procedure

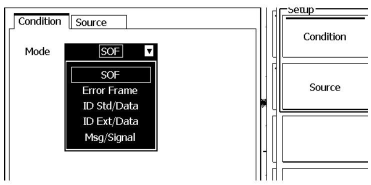
1. Carry out steps 1 to 5 in section 11.18 to set the search type to CAN.
2. Press the **Setup** soft key.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from SOF to Msg/Signal.



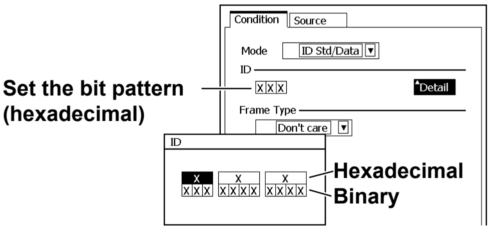
Proceed to the steps on the pages indicated below according to the selected mode.
- SOF: Step 14 on page 11-111
- Error Frame: Step 14 on page 11-111
- ID Std/Data: Step 5 on page 11-108
- ID Ext/Data: Step 5 on page 11-108
- Msg/Signal: Step 5 on page 11-110

When the Mode Is ID Std/Data or ID Ext/Data

This section will explain the procedure using ID Std/Data mode as an example. The procedure is the same for ID Ext/Data mode.

- **Setting the ID Bit Pattern Search Condition**

5. Use the **rotary knob** and **SET** to set the bit pattern to compare with.
You can also set the bit pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the bit pattern, press **ESC** to return to the previous screen.



- **Setting the Frame Type Search Condition**

6. Use the **rotary knob** and **SET** to select the Frame Type comparison condition from Don't care to Data.
If you select Don't care or Remote, proceed to step 11 on page 11-109.

7. Use the **rotary knob** and **SET** to set the DLC.

- **Setting the Data Search Condition**

8. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.
- If you select Don't care, proceed to step 11 on page 11-109.
- If you select a condition from Greater to Out of Range, proceed to step 10.

9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

10. Use the **rotary knob** and **SET** to set the data to compare in each entry box.

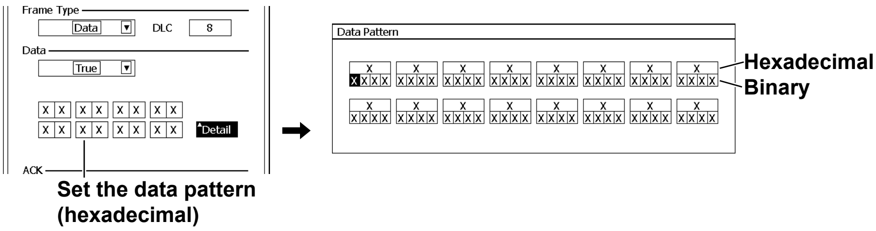
Set each item according to the comparison condition you selected in step 8.

Comparison Condition	Setting				
	Detail	Data(Dec)	Byte Order	Sign	MSB/LSB
True, False	Yes	No	No	No	No
Greater/Equal, Less/Equal	No	Yes[1]	Yes	Yes	Yes
Between, Out of Range	No	Yes[2]	Yes	Yes	Yes

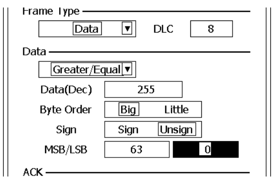
Yes: Set, –: Not set

- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

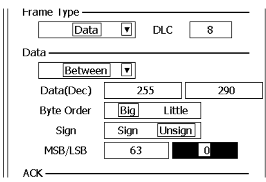
True, False



Greater/Equal, Less/Equal



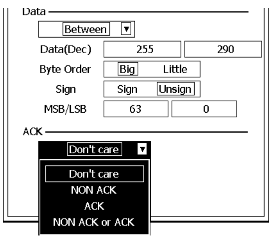
Between, Out of Range



- **Setting the ACK Search Condition**

11. Use the **rotary knob** and **SET** to select the ACK condition from Don’t care to NON ACK or ACK.

If you select Don’t care, it will not be used as a search condition.



Proceed to step 14 on page 11-111.

11

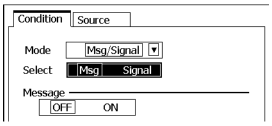
Analysis and Search

When the Mode Is Msg/Signal

Load an SBL file to the SB5000 and then carry out the steps below. The items in the Message and Signal dialog boxes in the explanation are examples.

- **Selecting the Search Condition to Configure**

5. Use the **rotary knob** and **SET** to set Select to Msg or Signal.
If you select Signal, proceed to step 10.

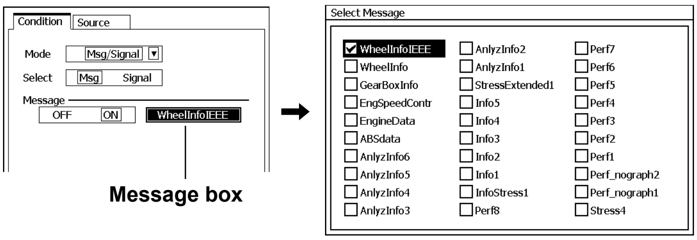


- **Selecting the Message to Use as a Search Condition**

6. Use the **rotary knob** and **SET** to set the message to ON or OFF.
Select ON to use the message as a search condition. Select OFF to not use it as a search condition.
If you select OFF, proceed to step 14.

7. Use the **rotary knob** and **SET** to select the message box.
The Select Message dialog box appears.

8. Use the **rotary knob** and **SET** to select a message.
The Select Message dialog box closes.



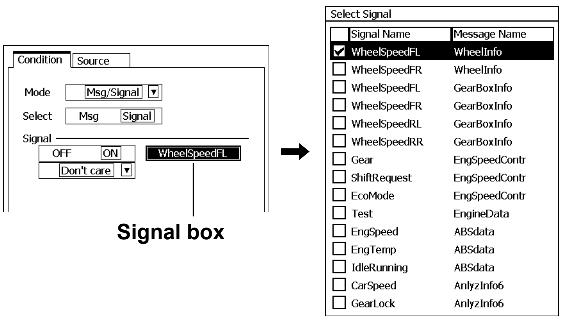
Proceed to step 14.

- **Selecting the Signal to Use as a Search Condition**

9. Use the **rotary knob** and **SET** to set Signal 1 to ON or OFF.
Select ON to use the signal as a search condition. Select OFF to not use it as a search condition.
If you select OFF, proceed to step 14.

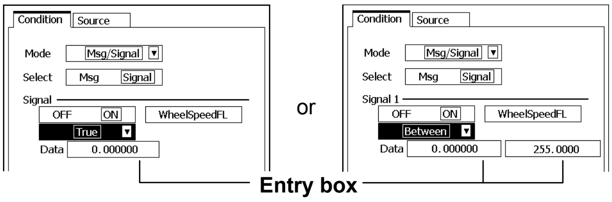
10. Use the **rotary knob** and **SET** to select the signal box.
The Select Signal dialog box appears.

11. Use the **rotary knob** and **SET** to select the signal.
The Select Signal dialog box closes.



12. Use the **rotary knob** and **SET** to select the data comparison condition from Don't care to Out of Range.
If you select Don't care, proceed to step 14.

13. Use the **rotary knob** and **SET** to set the reference value in the entry box.
- If you select a condition from True to Less/Equal, set one reference value.
- If you select Between or Out of Range, set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.



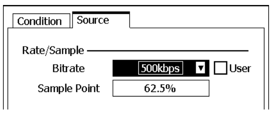
Setting the Bit Rate, Sample Point, Level, Hysteresis, and Recessive Level

14. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Setting the Bit Rate and Sample Point

15. Use the **rotary knob** and **SET** to select the bit rate from 1Mbps to 33.3kbps.
If you select the **User** check box, you will be able to set the bit rate from 10.0kbps to 1.000Mbps using the **rotary knob** and **SET**.

16. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.

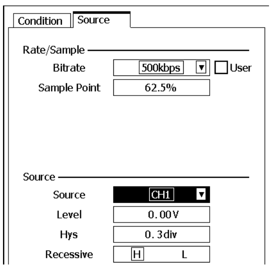


Setting the Level, Hysteresis, and Recessive Level

17. Use the **rotary knob** and **SET** to select the source from CH1 to CH4 or from M1 to M4.

18. Use the **rotary knob** and **SET** to set the level and hysteresis.

19. Use the **rotary knob** and **SET** to set Recessive to H or L.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches CAN bus signals. For details on the CAN bus signal frame format, see “Explanation” in section 7.7.

Modes

Set the CAN search mode to SOF, Error Frame, ID Std/Data, ID Ext/Data, or Msg/Signal.

SOF Mode

Searches for the frame start point of a CAN bus signal.

SOF: Start of Frame

Error Frame Mode

The SB5000 searches for the point of error when the error frame’s error flag is active.

ID Std/Data and ID Ext/Data Modes

ID Std/Data mode is used to search the data frame or remote frame in standard format. ID Ext/Data mode is used to search the data frame or remote frame in extended format. The SB5000 searches using the AND logic of ID, Frame Type, Data, and ACK conditions. The settings in ID Std/Data mode are shared with the settings in ID Ext/Data mode.

- **ID**

  Set the ID bit pattern in hexadecimal or binary notation. The ID bit pattern is 11 bits in standard format and 29 bits in extended format. The ID search condition is met when the specified bit pattern matches the input signal ID bit pattern.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

- **Frame Type**

  The SB5000 can be configured to search the remote frame or data frame.
  - Selecting the Frame

    A CAN bus signal frame contains a Remote Transmission Request (RTR) bit that indicates whether the frame is a remote frame or a data frame. Select the frame to search.

Don’t care	Searches both remote frames and data frames.
Remote	Searches remote frames.
Data Frame	Searches data frames.

    If you select Don’t care or Remote, the DLC and Data search conditions in the next section will be ignored.

  - DLC (Data Length Code)

    Set the data field length. The DLC search condition is met when the input signal DLC value matches the reference value. Set this value only when the frame type is set to Data Frame.

    Selectable range: 0 to 8

    If you set this value to zero, the data search conditions in the next section will be ignored.

- **Data**

You can use the Data Field value as a search condition. Set this value only when the frame type is set to Data Frame.

- Comparison Condition

The data search condition is met when the result of comparing the input signal data field values with the reference values meets the selected comparison condition.

Don't care	Not used as a search condition
True	When the input signal value meets the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

- Data Pattern

Set the data pattern for the length specified by DLC in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to true or false.

- If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
- If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- Reference Value Data(Dec)
  - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
  - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
  - If the comparison condition is True or False, the data pattern is used as the reference value.
  - Selectable range

Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the DLC and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the DLC and MSB/LSB settings, respectively.

The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

- Byte Order

Set the data byte order to big endian or little endian. For an example, see page 7-17.

- Sign

Select whether or not to add a sign to the data.
The selectable range for the data reference value varies depending on this setting.

- MSB/LSB

Set the MSB and LSB positions in the data to compare. For an example, see page 7-17.
Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

- **ACK**

  You can use the ACK slot state as a search condition. The ACK search condition is met when the selected state matches the input signal ACK slot state.

Don’t care	Not used as a search condition
NON ACK	When the status is recessive
ACK	When the status is dominant
NON ACK or ACK	When the status is recessive or dominant

Msg/Signal Mode

This mode uses the message or signal data that is contained in a physical value/symbol definition file (.sbl) that is loaded into the SB5000 as a search condition. You can also change the search conditions based on the loaded data. The Msg/Signal mode search conditions settings are the same as the trigger condition settings. See the explanation in section 7.7 for details.

* The physical value/symbol definition file (.sbl) is derived by converting a CANdb file (.dbc). For the procedure to load a file, see section 14.8.

Bit Rate, Sample Point, Level, Hysteresis, and Recessive Level

Bit Rate

You can select the CAN bus signal transfer rate from the following:
1 Mbps, 500 kbps, 250 kbps, 125 kbps, 83.3 kbps, and 33.3 kbps

If you select the User check box, you can set the transfer rate from 10.0 kbps to 1.000 Mbps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level (recessive or dominant) from 18.8 to 90.6% in 3.1% steps.
The SB5000 CAN bus signal trigger circuit samples the input CAN bus signal using the internal clock and detects the point of change from recessive to dominant. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Source

Select the source from CH1 to CH4 or from M1 to M4.

- **Level**

  Set the level for determining whether the signal level is 0 or 1.
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

- **Hysteresis**

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

- **Recessive Level**

  Set the recessive level to high (H) or low (L). The logical value of the recessive level is 1 and that of the dominant level is 0 in either setting.

H	The recessive level is higher than the dominant level.
L	The recessive level is less than the dominant level.

Found Point

The found-point position is the same as the trigger point position. For a description of the trigger point, see “Explanation” in section 7.7.

11.21 Searching LIN Bus Signals

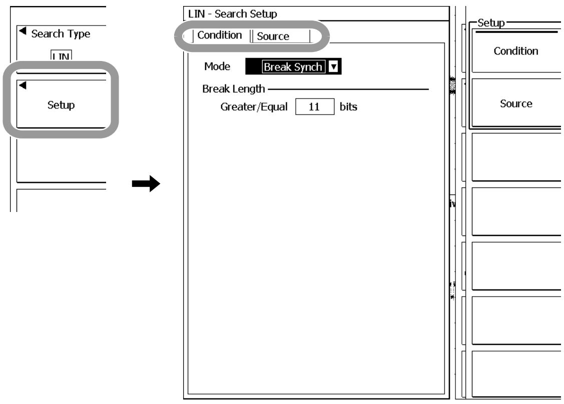
Procedure

1. Carry out steps 1 to 5 in section 11.18 to set the search type to LIN.

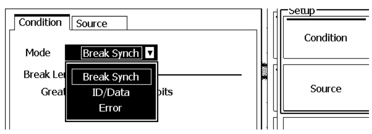
2. Press the **Setup** soft key.
The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from Break Synch to Error.



Proceed to the steps on the pages indicated below according to the selected mode.

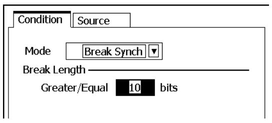
- Break Synch: Step 5 on pate 11-116
- ID/Data: Step 6 on page 11-116
- Error: Step 5 on page 11-118

11

Analysis and Search

When the Mode is Break Synch

5. Use the **rotary knob** and **SET** to select the break field data length from 10 to 13 bits.



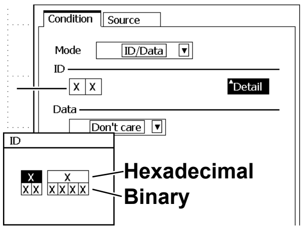
Proceed to step 11 on page 11-118.

When the Mode Is ID/Data

- **Setting the ID Bit Pattern Search Condition**

6. Use the **rotary knob** and **SET** to set the bit pattern to compare with.
You can also set the bit pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the bit pattern, press **ESC** to return to the previous screen.

Set the bit pattern (hexadecimal)



Hexadecimal
Binary

- **Setting the Data Search Condition**

7. Use the **rotary knob** and **SET** to select the data comparison condition from Don’t care to Out of Range.
If you select Don’t care, proceed to step 11 on page 11-118.

8. Use the **rotary knob** and **SET** to set the size (data length).
If you select a condition from Greater to Out of Range in step 7, proceed to step 10.

9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.

10. Use the **rotary knob** and **SET** to set the data to compare in each entry box.

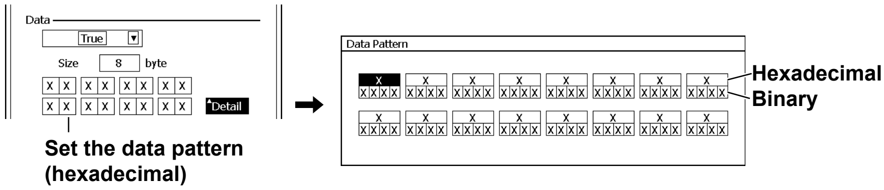
Set each item according to the comparison condition you selected in step 7.

Comparison Condition	Setting					
	Size	Detail	Data(Dec)	Byte Order	Sign	MSB/LSB
True, False	Yes	Yes	No	No	No	No
Greater/Equal, Less/Equal	Yes	No	Yes[1]	Yes	Yes	Yes
Between, Out of Range	Yes	No	Yes[2]	Yes	Yes	Yes

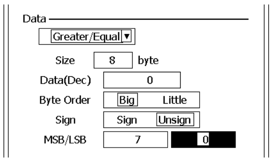
Yes: Set, –: Not set

- Size: Data length to compare
- Detail: Data pattern (hexadecimal or binary)
- Data(Dec): Reference value (decimal)
  1 Set one reference value.
  2 Set two reference values to define a reference range. Set the lower limit in the left entry box and the upper limit in the right entry box.
- Byte Order: Data order
- Sign: Signed or unsigned
- MSB/LSB: Most significant and least significant bit positions
  Set the MSB in the left entry box and the LSB in the right entry box.

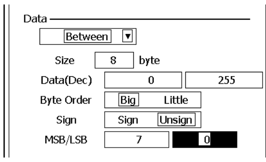
True, False



Greater/Equal, Less/Equal



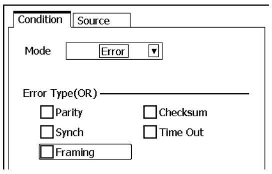
Between, Out of Range



Proceed to step 11 on page 11-118.

When the Mode Is Error

5. Use the **rotary knob** and **SET** to select the error type from Parity to Framing.
You can select all error types using the OR logic.



Proceed to step 11.

Setting the Bit Rate, Sample Point, Revision, Level, and Hysteresis

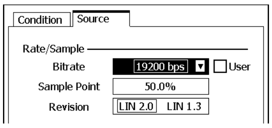
11. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Setting the Bit Rate, Sample Point, and Revision

12. Use the **rotary knob** and **SET** to select the bit rate from 19200bps to 1200bps.
If you select the **User** check box, you will be able to set the bit rate from 1000bps to 20000bps using the **rotary knob** and **SET**.

13. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.

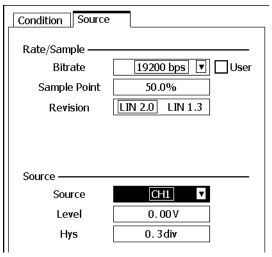
14. Use the **rotary knob** and **SET** to set the revision to LIN 2.0 or LIN 1.3.



Setting the Level and Hysteresis

15. Use the **rotary knob** and **SET** to select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

16. Use the **rotary knob** and **SET** to set the level and hysteresis.
If you select a source from A0 to A7 in step 15, the level and hysteresis settings are not available.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches LIN bus signals. For details on the LIN bus signal frame format, see “Explanation” in section 7.8.

Modes

Set the LIN search mode to Break Synch, ID/Data, and Error.

Break Synch Mode

The SB5000 searches for points where break field + synch field are detected.
Select the break field data length from the following:
Greater then equal to 10, 11, 12, or 13

ID/Data Mode

The SB5000 searches using the AND logic of ID and Data conditions.

- **ID**
  Set the 6-bit protected ID (ID0 to ID5) bit pattern in the protected identifier field in hexadecimal or binary notation. The ID search condition is met when the specified bit pattern matches the input signal ID bit pattern.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be “$.”

- **Data**
  You can use the Data 1 to Data 8 values as a search condition.
  - Comparison Condition
    The data search condition is met when the result of comparing the input signal data values with the reference values meets the selected comparison condition.

Don’t care	Not used as a search condition
True	When the input signal value meets the reference value
False	When the input signal value does not match the reference value
Greater/Equal	When the input signal value is greater than or equal to the reference value
Less/Equal	When the input signal value is less than or equal to the reference value
Between	When the input signal value is within the reference range that includes the boundary reference values
Out of Range	When the input signal value is outside the reference range that excludes the boundary reference values

  - Data Size
    Set the data length to search.
    Selectable range: 1 to 8 bytes

- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation. The data pattern is valid only when the comparison condition is set to true or false.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

- Reference Value Data(Dec)
  - If you set the comparison condition to Greater/Equal or Less/Equal, set one reference value.
  - If you select Between or Out of Range, set two reference values to define a reference range. The values are automatically adjusted so that the lower limit is less than or equal to the upper limit.
  - If the comparison condition is True or False, the data pattern is used as the reference value.
  - Selectable range
    Set the selectable range in decimal notation.

Unsigned	0 to 9E+18 The selectable maximum value is limited by the data length and bit position that are determined by the Size and MSB/LSB settings, respectively.
Signed	–9E+18 to 9E+18 The selectable minimum and maximum values are limited by the data length and bit position that are determined by the Data Size and MSB/LSB settings, respectively.

The value is displayed in exponential notation when it exceeds 7 digits (example: 1234567E+10).

- Byte Order
  Set the data byte order to big endian or little endian. For an example, see page 7-17.

- Sign
  Select whether or not to add a sign to the data.
  The selectable range for the data reference value varies depending on this setting.

- MSB/LSB
  Set the MSB and LSB positions in the data to compare. For an example, see page 7-17.
  Selectable range: 0 to the data size bytes × 8 – 1. The maximum value is 63.

Error Mode

Searches for points where errors occurred.
You can select the error types to be detected. For details on the error types, see page 7-39.

- You can select multiple error types.
- The SB5000 will search for all selected errors.

Bit Rate, Sample Point, Revision, Level, and Hysteresis

Bit Rate

You can select the LIN bus signal transfer rate from the following:
19200 bps, 9600 bps, 4800 bps, 2400 bps, 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 20000 bps in 0.1-kbps steps.

Sample Point

You can set the point for determining the bus level from 18.8 to 90.6% in 3.1% steps. The SB5000 LIN bus signal trigger circuit samples the input LIN bus signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Revision

You can select revision 2.0 or 1.3.

LIN 2.0	The enhanced checksum that includes the protection ID is used. (However, if the ID is a value from 60 (0x3c) to 63 (0x3f), the classic checksum is used.)
LIN 1.3	The classic checksum that includes only the data field is used.

Source

Select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

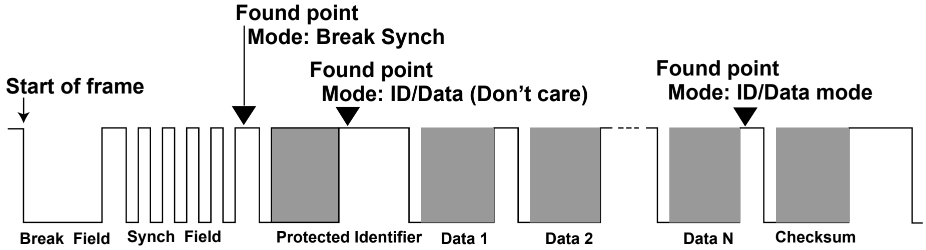
- **Level**
  Set the level for determining whether the signal level is 0 or 1.*
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.
  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**
  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Found Point

Break Synch, ID, and Data Modes

Below is an example.



Error Mode

The found-point position is the same as the trigger point position. See "Explanation" in section 7.8 for details.

11.22 Searching UART Signals

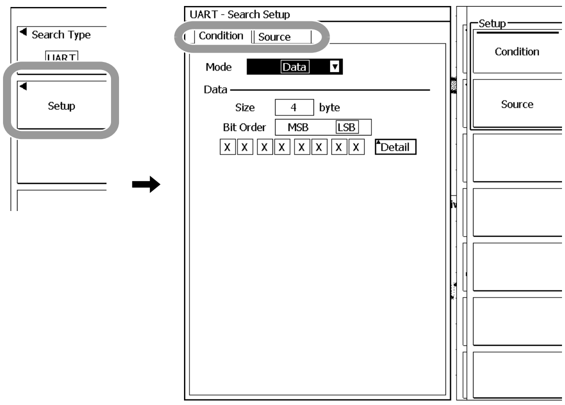
Procedure

1. Carry out steps 1 to 5 in section 11.18 to set the search type to UART.

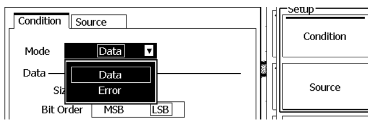
2. Press the **Setup** soft key.
The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to set the mode to Data or Error.



Proceed to the steps indicated below according to the selected mode.

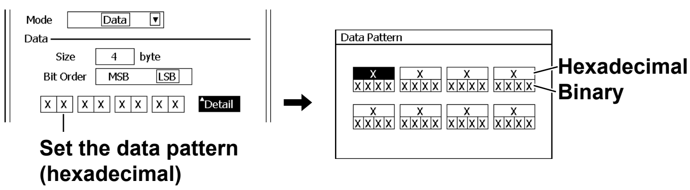
- Data: Step 5
- Error: Step 8

When the Mode Is Data

5. Use the **rotary knob** and **SET** to set the size (data length).

6. Use the **rotary knob** and **SET** to set the bit order to MSB first or LSB first.

7. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.



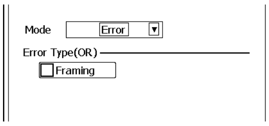
Proceed to step 10.

When the Mode Is Error

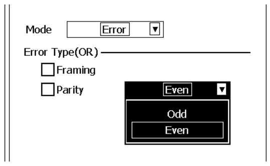
8. Use the **rotary knob** and **SET** to set the error type to Framing or Parity.
- You can select all error types using the OR logic.
- If Format under the Source tab (see the figure in step 13) is set to 8bit(NonParity), only Framing will appear.

9. If Format under the Source tab is 8bit + Parity or 7bit + Parity, set the error type parity to Odd or Even using the **rotary knob** and **SET**.

If Format under the Source tab is set to 8bit(NonParity)



If Format under the Source tab is set to 8bit + Parity or 7bit + Parity



Proceed to step 10.

Setting the Bit Rate, Sample Point, Format, Level, Hysteresis, and Polarity

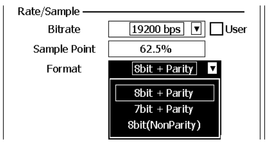
10. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

Setting the Bit Rate, Sample Point, and Format

11. Use the **rotary knob** and **SET** to select the bit rate from 115200bps to 1200bps.
If you select the User check box, you will be able to set the bit rate from 1000bps to 200000bps using the **rotary knob** and **SET**.

12. Use the **rotary knob** and **SET** to set the sample point from 18.8 to 90.6%.

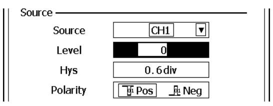
13. Use the **rotary knob** and **SET** to select the format from 8bit + Parity to 8bit(NonParity).



Setting the Level, Hysteresis, and Polarity

14. Use the **rotary knob** and **SET** to select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

15. Use the **rotary knob** and **SET** to set the level, hysteresis, and polarity.
If you select a source from A0 to A7 in step 14, the level and hysteresis settings are not available.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

11
Analysis and Search

Explanation

This feature searches UART signals. For details on the UART signal data format, see "Explanation" in section 7.9.

Modes

Set the UART search mode to Data or Error.

Data Mode

Searches for a data pattern.

- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 4

- Bit Order
  Select the bit order used to read the data pattern when comparing the input signal data pattern to the specified data pattern.

MSB	Reads the data pattern MSB first.
LSB	Reads the data pattern LSB first.

- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Error Mode

Searches for points where errors occurred.
You can select the type of errors to detect from the table below.

- You can select multiple error types.
- The SB5000 will search for all selected errors.

Framing	Searches for a position where the logic value of the stop bit is zero.
Parity	When the SB5000 detects a parity error in a received character, the SB5000 searches for the stop bit position. • You can select which parity to check, odd or even. • Errors will not occur if the parity bit is set to none.

Bit Rate, Sample Point, Format, Level, Hysteresis, and Polarity

Bit Rate

You can set the UART signal transfer rate to
115200 bps, 57600 bps, 38400 bps, 19200 bps, 9600 bps, 4800 bps, 2400 bps, or 1200 bps

If you select the User check box, you can set the transfer rate from 1000 bps to 200000 bps in 100-bps steps.

Sample Point

You can set the point for determining the signal level from 18.8 to 90.6% in 3.1% steps. The SB5000 UART signal trigger circuit samples the input UART signal using the internal clock and detects the point of level change. Taking the detected point of change to be 0% and the point that is bit time after the point of change to be 100%, you set the sample point in percentage. The bit time is the reciprocal of the set bit rate. See the illustration on page 7-29.

Format

You can select the format from the following:

8bit + Parity	8-bit data + parity bit
7bit + Parity	7-bit data + parity bit
8bit(NonParity)	8-bit data with no parity bit

Source

Select the source from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **Level**

  Set the level for determining whether the signal level is 0 or 1.*
  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

- **Polarity**

  You can select the bit state that will be considered logical 1.

Pos	Positive logic
Neg	Negative logic

Found Point

The found-point position is the same as the trigger point position. See “Explanation” in section 7.9 for details.

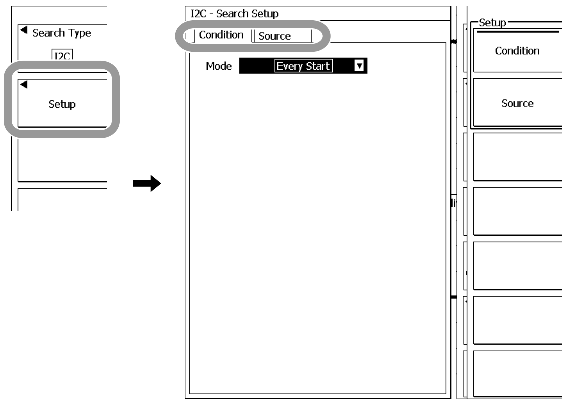
11.23 Searching I^2C Bus Signals

Procedure

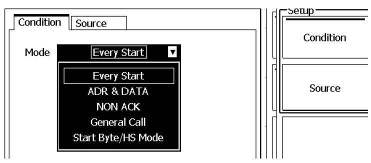
1. Carry out steps 1 to 5 in section 11.18 to set the search type to I2C.
2. Press the **Setup** soft key.
   The Setup dialog box appears.

Selecting the Mode

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.



4. Use the **rotary knob** and **SET** to select the mode from Every Start to Start Byte/HS Mode.



Proceed to the steps on the pages indicated below according to the selected mode.

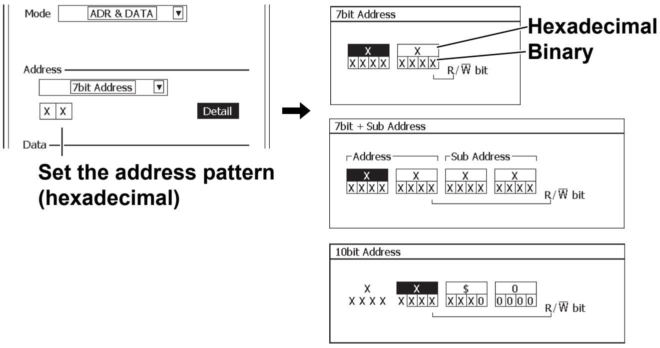
- Every Start: Step 10 on page 11-129
- ADR & DATA: Step 5 on page 11-127
- NON ACK: Step 5 on page 11-128
- General Call: Step 6 on page 11-128
- Start Byte/HS Mode: Step 8 on page 11-128

When the Mode Is ADR & DATA

- **Setting the Address Search Condition**

5. Use the **rotary knob** and **SET** to select the address type from 7bit Address to 10bit Address.

6. Use the **rotary knob** and **SET** to set the address pattern to compare with.
You can also set the address pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the address pattern, press **ESC** to return to the previous screen.

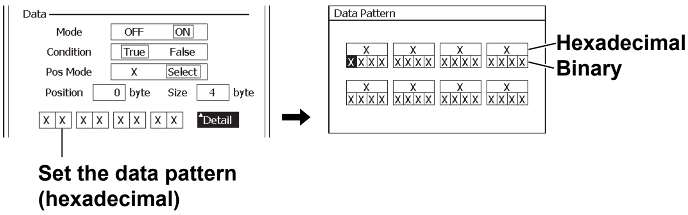


- **Setting the Data Search Condition**

7. Use the **rotary knob** and **SET** to set the mode to ON or OFF.
Select ON to use the data as a search condition. Select OFF to not use it as a search condition.
If you select OFF, proceed to step 10 on page 11-129.

8. Use the **rotary knob** and **SET** to set the condition to True or False, set Pos Mode to X or Select, and set the position and size.

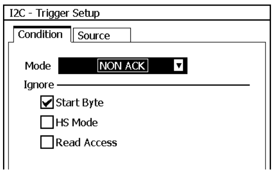
9. Use the **rotary knob** and **SET** to set the data pattern to compare with.
You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.



Proceed to step 10 on page 11-129.

When the Mode Is NON ACK

5. Use the **rotary knob** and **SET** to select whether or not to ignore these Nack bits: Start Byte, HS Mode, and Read Access.
The Nack bits whose check box is selected will not be used as search conditions. The search condition is met when the SB5000 detects any of the Nack bits whose check box is not selected.



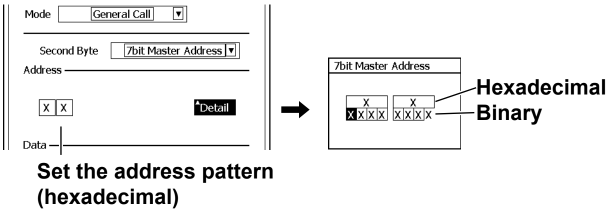
Proceed to step 10 on page 11-129.

When the Mode Is General Call

- **Setting the Second Byte Search Condition**

6. Use the **rotary knob** and **SET** to select the second byte format from X to 7bit Master Address.
If you select X, 0000 0100, or 0000 0110, proceed to step 10 on page 11-129.

7. Use the **rotary knob** and **SET** to set the address pattern to compare with.
You can also set the address pattern by selecting Detail to open a dialog box and use the **rotary knob** and **SET** and soft keys. When you are done setting the address pattern, press **ESC** to return to the previous screen.

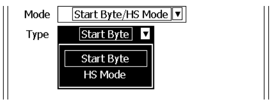


- **Setting the Data Search Condition**
  Set the search condition according to steps 7 to 9 on the previous page.

Proceed to step 10 on page 11-129.

When the Mode Is Start Byte/HS Mode

8. Use the **rotary knob** and **SET** to set the type (master code) to Start Byte or HS Mode.



Proceed to step 10 on page 11-129.

Setting the SDA, SCL, and Qualification

10. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

11. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the SDA Source

12. Use the **rotary knob** and **SET** to select the SDA (serial data) source.
- If you select Analog in step 11, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 11, select the source from A0 to A7.

Setting the SCL Source

13. Use the **rotary knob** and **SET** to select the SCL (serial clock) source.
- If you select Analog in step 11, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 11, select the source from A0 to A7.

Setting the Qualification

14. Use the **rotary knob** and **SET** to set the logic to AND or OR.

15. Use the **rotary knob** and **SET** to set the state of signals other than those selected for the SDA and SCL to H, L, or X.
If you select Logic in step 11, select Qualification. In the dialog box that appears, use the **rotary knob** and **SET** to select H, L, or X. When you are done setting the states, press **ESC** to return to the previous screen.

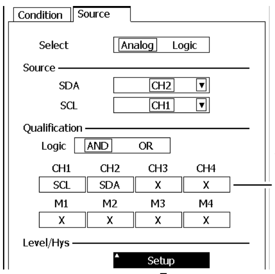
Setting the Trigger Level and Hysteresis

Set the level and hysteresis only if you select Analog in step 11.

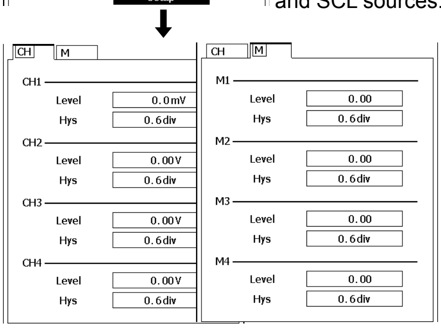
16. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

17. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.

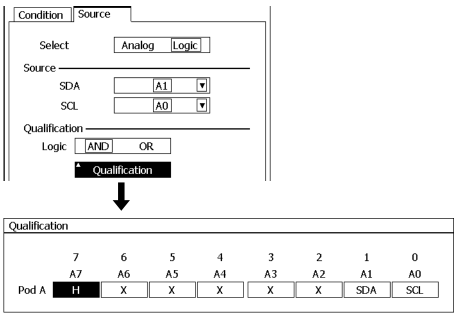
When Analog is selected in step 11



You can select the status of the CH1 to CH4 and M1 to M4 signals excluding the signals selected for SDA and SCL sources.



When Logic is selected in step 11



You can select the status of the A0 to A7 signals excluding the signals selected for SDA and SCL sources.

Executing the Search

Carry out steps 6 to 14 in section 11.18.

11

Analysis and Search

Explanation

This feature searches I^{2}C bus signals. For details on the I^{2}C bus signal data format, see "Explanation" in section 7.10.

Modes

Set the I^{2}C search mode to Every Start, ADR & DATA, NON ACK, General Call, or Start Byte/HS Mode.

Address

- You can set the address type to 7bit Address, 7bit + Sub Address, or 10bit Address.
- Set the address pattern in hexadecimal or binary notation. The address search condition is met when the specified address pattern matches the input signal address pattern.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Data

You can select whether or not to use the data pattern as a search condition.

- Comparison Condition
  The data search condition is met when the result of comparing the input signal pattern with the specified pattern meets the selected comparison condition.

True	When the patterns match
False	When the patterns don't match

- Comparison Start Position
  In the Pos Mode setting, you can set the comparison start point to the specified point (Select) or don't care (X). If you select Select, the SB5000 skips the specified number of bytes and starts comparing from the next data byte.
  Selectable range: 0 to 9999

- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 4

- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

SDA, SCL, and Qualification

SDA and SCL Sources

You can select the SDA (serial data) and SCL (serial clock) sources from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **Level**

  Set the level for determining whether the signal level is 0 or 1 for CH1 to CH4 and M1 to M4.*

  The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

  * When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

- **Hysteresis**

  Set the hysteresis for CH1 to CH4 and M1 to M4.

  The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.

  Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Qualification and Logic

- **Qualification**

  Set the state of signals other than those selected for the SDA and SCL to H, L, or X. This search requirement is called qualification requirement. The qualification requirement is met when the selected state matches the input signal state.

H	When the signal is high
L	When the signal is low
X	Not used as a search condition (Don't care)

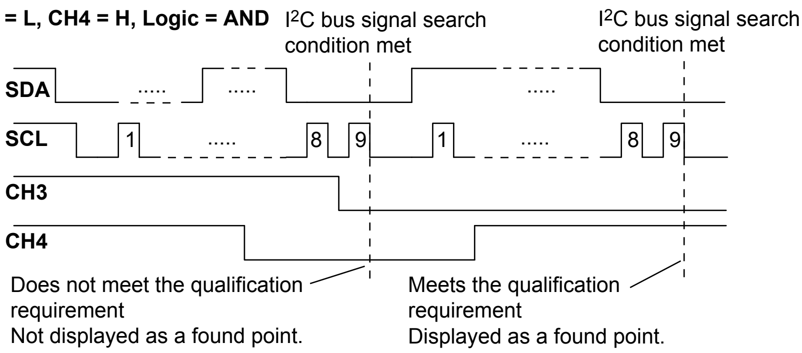
* The level for determining high or low is the level that you set above when you set the signal to a channel from CH1 to CH4 or from M1 to M4. When you set the signal to a bit from A0 to A7, the level is the threshold level that you set in section 6.18.

- **Logical Condition**

  You can select the logical condition for the qualification and the search condition for the I^2C bus signal that you set in each mode. The SB5000 searches for points where the logic condition is met.

AND	When the qualification requirement and the I^2C bus signal search condition are both met
OR	When either the qualification requirement or the I^2C bus signal search condition is met

CH3 = L, CH4 = H, Logic = AND



Note

To search using only the I^2C bus signal search condition (SDA and SCL signals), specify the settings as follows:

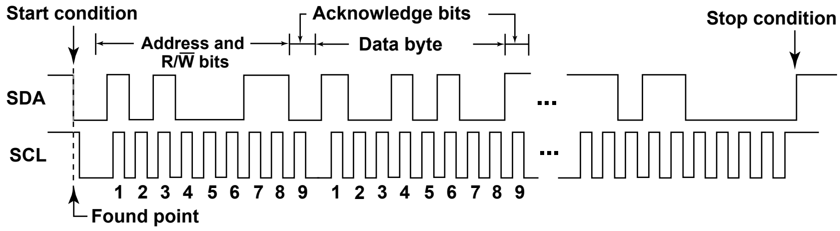
- The state of signals other than those selected for the SDA and SCL: X (don't care)
- Logic: AND

Found Point

The points that the SB5000 finds vary depending on the mode as follows:

• Every Start mode

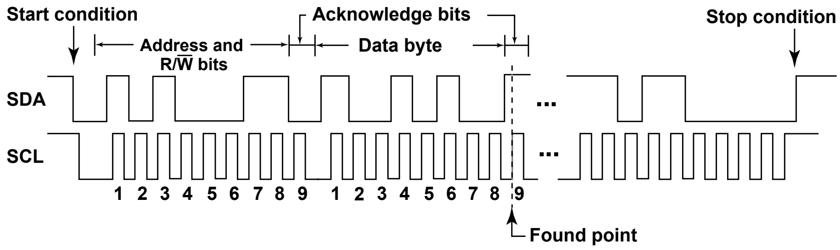
Like the trigger point, the found point will be at the falling edge of the SDA signal.



• A mode other than Every Start

The found point will be at the rising edge of the acknowledge bit after the specified condition is met.

The following example is for the case when the mode is ADR & DATA, but it applies to other search modes as well.



11.24 Searching SPI Bus Signals

Procedure

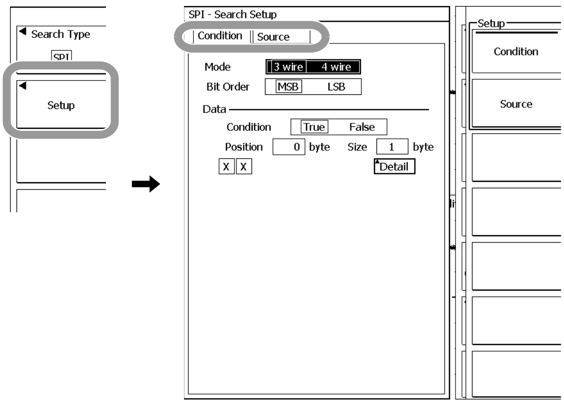
1. Carry out steps 1 to 5 in section 11.18 to set the search type to SPI.
2. Press the **Setup** soft key.
   The Setup dialog box appears.

Setting the Wiring System, Bit Order, and Data

3. Use the **rotary knob** and **SET** to select the Condition tab.
   You can also press the Condition soft key to select the tab.

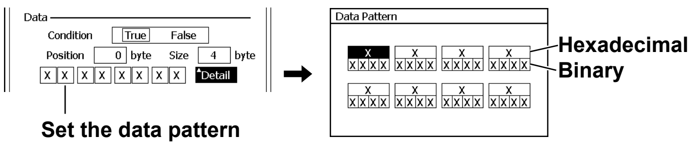
Selecting the Wiring System and Bit Order

4. Use the **rotary knob** and **SET** to set the mode to 3 wire or 4 wire and the bit order to MSB or LSB.



Setting the Data Search Conditions

5. Use the **rotary knob** and **SET** to set the condition to True or False and set the position and size.
6. Use the **rotary knob** and **SET** to set the data pattern to compare with.
   - You can also set the data pattern by selecting Detail to open a dialog box and use the **rotary knob** the **SET** and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.
   - If you select 4 wire in step 4, set Data 1 and Data 2.



Setting the CS, Clock, and Data Sources

7. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

8. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the CS Source

9. Use the **rotary knob** and **SET** to select the CS (chip select) source.
- If you select Analog in step 8, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 8, select the source from A0 to A7.

10. Use the **rotary knob** and **SET** to set Active to H or L.

Setting the Clock Source

11. Use the **rotary knob** and **SET** to select the clock source.
- If you select Analog in step 8, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 8, select the source from A0 to A7.

12. Use the **rotary knob** and **SET** to set the polarity to ⨍ or ⮧.

Setting the Data Source

13. Use the **rotary knob** and **SET** to select the data source.
- If you select 4 wire in step 4 on the previous page, select the source for Data1 and Data 2 separately.
- If you select Analog in step 8, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 8, select the source from A0 to A7.

Setting the Level and Hysteresis

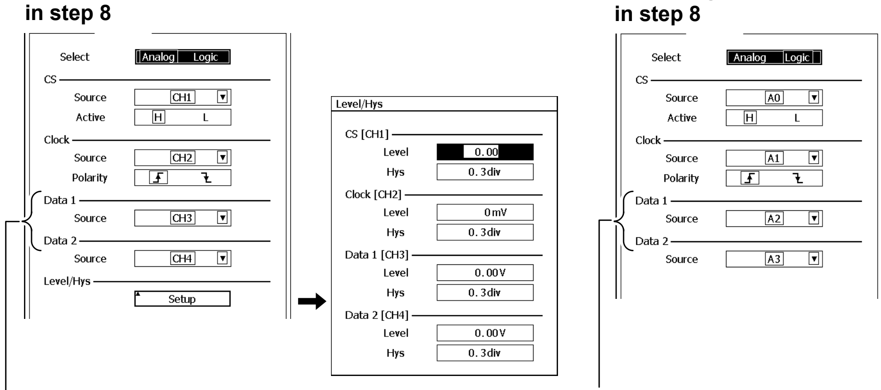
Set the level and hysteresis only if you select Analog in step 8.

14. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

15. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.

When Analog is selected in step 8

When Logic is selected in step 8



If you selected 3 wire in step 4 on the previous page, one data item will appear, because there is only one data source.

Executing the Search

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches SPI bus signals. For the SPI bus signal time chart, see "Explanation" in section 7.11.

Wiring System

Select from the following modes.

Three-wire	The SB5000 searches using the data pattern condition of one data line.
Four-wire	The SB5000 searches using the data pattern conditions of Data 1 and Data 2 lines. You can also use one of the two data lines as a search condition.

Bit Order

You can set the bit order to MSB or LSB based on the data stream.

- If you are setting the data in binary notation, set the pattern in the order of the data stream, regardless of the bit order setting.
- If you are setting the data in hexadecimal notation, set the pattern in 4-bit segments according to the bit order setting.

MSB	When the data stream is MSB first
LSB	When the data stream is LSB first

Data

You can use a data pattern as a search condition.

- Comparison Condition
  The data search condition is met when the result of comparing the input signal pattern with the specified pattern meets the selected comparison condition.

True	When the patterns match
False	When the patterns don't match

- Comparison Start Position
  Set the comparison start position. For example, to start comparing from the first data byte after the CS signal is activated, specify zero.
  Selectable range: 0 to 9999
- Data Size
  Set how many consecutive data bytes you want to compare.
  Selectable range: 1 to 4
- Data Pattern
  Set the data pattern for the specified size in hexadecimal or binary notation.
  - If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
  - If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

CS, Clock, and Data

You can select the CS (chip select), clock, and data from CH1 to CH4, from M1 to M4, or from A0 to A7.

- **CS**

  You can select the CS level for activating the data.

H	When the signal is high
L	When the signal is low

- **Clock**

  You can select the clock edge that specifies when the data patterns are compared.

	On the rising edge
	On the falling edge

Level

Set the reference level for CH1 to CH4 and M1 to M4.*

The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

* When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

Hysteresis

Set the hysteresis for CH1 to CH4 and M1 to M4.

The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.

Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Found Point

The found-point position is the same as the trigger point position. For a description of the trigger point, see “Explanation” in section 7.11.

11.25 Searching Serial Pattern Signals

Procedure

1. Carry out steps 1 to 5 in section 11.18 to set the search type to Serial.

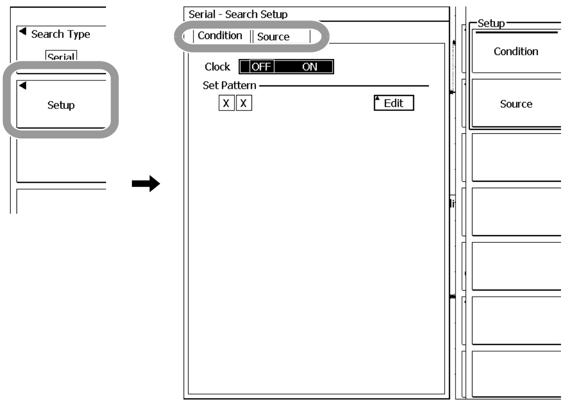
2. Press the **Setup** soft key.
The Setup dialog box appears.

Setting the Search Conditions

3. Use the **rotary knob** and **SET** to select the Condition tab.
You can also press the Condition soft key to select the tab.

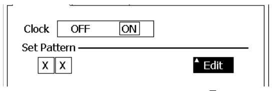
Turning the Clock ON and OFF

4. Use the **rotary knob** and **SET** to set the clock to ON or OFF.
For the procedure to set the bit rate, clock source, CS state condition, and latch source, see pages 11-139 and 11-140.

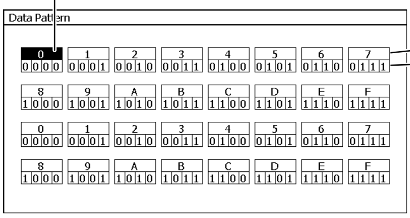


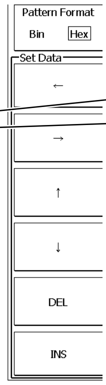
Setting the Data Pattern

5. Use the **rotary knob** and **SET** to set the data pattern to compare with.
- You can also set the data pattern by selecting Edit to open a dialog box and use the **rotary knob** and **SET**, numeric keys, and soft keys. When you are done setting the data pattern, press **ESC** to return to the previous screen.
- To expand the pattern, you must open the dialog box by selecting Edit.
- You can set a pattern consisting of up to 128 bits. Bits exceeding 128 bits will be cleared.

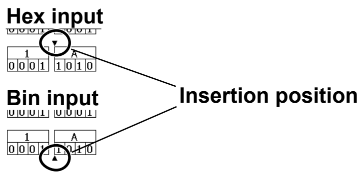


The cursor position is the input position.

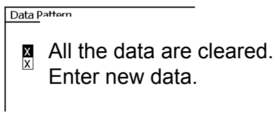




Soft keys
Bin Hex Selects binary or hexadecimal.
← Moves the cursor to the left.
→ Moves the cursor to the right.
↑ Moves the cursor up.
↓ Moves the cursor down.
DEL Deletes the data.
INS Switches between insert and overwrite modes.



Numeric keys
0 to F Use 0 to F for hexadecimal and 0 and 1 for binary.
(Enter X to discard the data.)
BS Backspace.
CLEAR Clears all of the entered data.
You cannot recover data that has been cleared.



Setting the Data, Clock, CS, Latch, and Bit Rate

6. Use the **rotary knob** and **SET** to select the Source tab.
You can also press the Source soft key to select the tab.

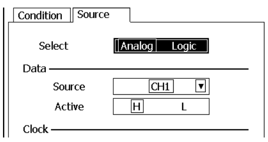
7. Use the **rotary knob** and **SET** to set Select to Analog or Logic.

Setting the Data Source

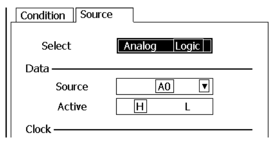
8. Use the **rotary knob** and **SET** to select the data source.
- If you select Analog in step 7, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 7, select the source from A0 to A7.

9. Use the **rotary knob** and **SET** to set Active to H or L.

When Analog is selected in step 7



When Logic is selected in step 7



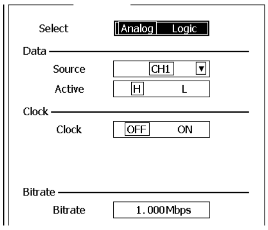
Setting the Clock Source

10. Use the **rotary knob** and **SET** to set the clock to ON or OFF.
- If you select ON, proceed to step 12.
- If you select OFF, set the bit rate.

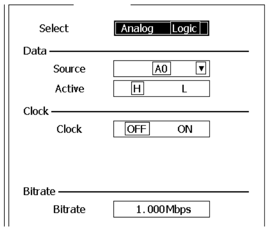
- **Setting the Bit Rate**

11. Use the **rotary knob** and **SET** to select the bit rate from 1bps to 1Gbps.

When Analog is selected in step 7



When Logic is selected in step 7



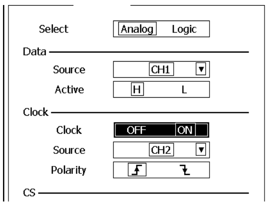
Proceed to step 20 on page 11-140.

- **Setting the Clock Source**

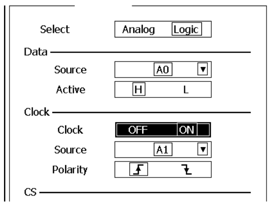
12. Use the **rotary knob** and **SET** to select the clock source.
- If you select Analog in step 7 on page 11-138, select the source from CH1 to CH4 or from M1 to M4.
- If you select Logic in step 7 on page 11-138, select the source from A0 to A7.

13. Use the **rotary knob** and **SET** to set the polarity to ↑ or ↓.

When Analog is selected in step 7



When Logic is selected in step 7



Setting the CS

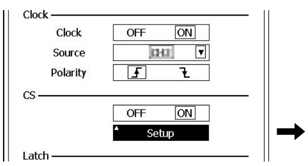
14. Use the **rotary knob** and **SET** to set the CS to ON or OFF.
- If you select ON, set the CS state condition.
- If you select OFF, proceed to step 18 on page 11-140.

- **Setting the State Condition**

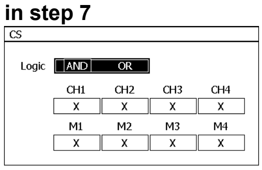
15. Use the **rotary knob** and **SET** to select Setup under CS.
The CS dialog box appears.

16. Use the **rotary knob** and **SET** to set the logic to AND or OR.

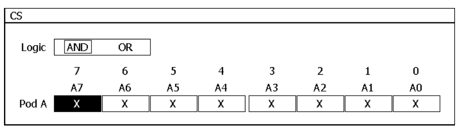
17. Use the **rotary knob** and **SET** to set the state condition to compare with.
Set each signal state to H, L, or X. When you are done setting the states, press **ESC** to return to the previous screen.



When Analog is selected in step 7



When Logic is selected in step 7



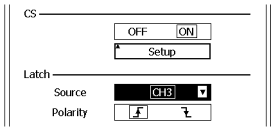
11

Analysis and Search

Setting the Latch Source

18. Use the **rotary knob** and **SET** to select the latch source.
- If you select Analog in step 7 on page 11-138, select the source from CH1 to CH4, from M1 to M4, or X.
- If you select Logic in step 7 on page 11-138, select the source from A0 to A7 or X.
- If you select X, proceed to step 20.

19. Use the **rotary knob** and **SET** to set the polarity to ↑ or ↓.

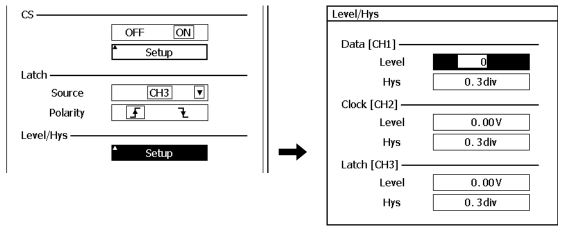


Setting the Level and Hysteresis

Set the level and hysteresis only if you select Analog in step 7 on page 11-138.

20. Use the **rotary knob** and **SET** to select Setup under Level/Hys.
The Level/Hys dialog box appears.

21. Use the **rotary knob** and **SET** to set the level and hysteresis for each source.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches serial pattern signals.

Data, Clock, CS, and Latch Sources

You can select the data, clock, CS, and latch sources from CH1 to CH4, from M1 to M4, or from A0 to A7.

Clock

- **Clock ON/OFF**

  You can select whether or not to sample the data source in sync with the selected clock source.

ON	Samples in sync with the clock source.
OFF	Does not synchronize to the clock source.

- **Sampling Timing**

  You can select the clock edge that specifies when the data patterns are sampled.

↑	On the rising edge
↓	On the falling edge

Data Pattern

You can use a data pattern as a search condition. The data pattern search condition is met when the specified pattern matches the sampled data source pattern.

- You can set a pattern consisting of up to 128 bits. Set the pattern in hexadecimal or binary notation.
- If you specify X, the condition is assumed to be met regardless of the corresponding bit status.
- If a binary pattern contains any Xs, the corresponding hexadecimal display will be "$."

Bit Rate

If the clock is set to OFF, the SB5000 samples the data source at the specified bit rate.
Selectable range: 1 bps to 1 Gbps

CS

If the clock is set to ON, the period that the SB5000 tests the data source can be controlled using the CS state condition.

ON	Tests the data source while the state condition is met.
OFF	Tests the data source at all times.

- **State Condition**

  Set each signal state to H, L, or X. The state condition is true when the selected state and the input signal state meet the following condition.

H	When the signal is high
L	When the signal is low
X	Not used as a search condition (Don't care)

* The level for determining high or low is the level that you set below when you set the signal to a channel from CH1 to CH4 or from M1 to M4. When you set the signal to a bit from A0 to A7, the level is the threshold level that you set in section 6.18.

- **Logic**

  You can select the state condition logic. The state condition is true when the logic condition is met.

AND	When the state of all signals matches
OR	When the state of any signal matches

Latch

If the clock is set to ON, you can specify the timing when the sampled data source pattern is compared with the specified pattern. If the source is set to X, comparison is made on each clock.

You can select the latch source edge that specifies when the data patterns are compared.

↑	On the rising edge
↓	On the falling edge

Level

Set the reference level for CH1 to CH4 and M1 to M4.*

The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

* When you set the signal to Logic (A0 to A7), the level is the threshold level that you set in section 6.18.

Hysteresis

Set the hysteresis for CH1 to CH4 and M1 to M4.

The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.

Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Found Point

The found-point position is the same as the trigger point position. For a description of the trigger point, see the example in “Explanation” in section 7.12.

11.26 Searching Analog Signals

Explanation

1. Carry out steps 1 to 5 in section 11.18 to set the search type to Edge, Edge (Qualified), State or Width.

Proceed to the steps on the pages indicated below according to the selected search type.

- Edge: Step 2 on this page
- Edge (Qualified): Step 2 on page 11-144
- State: Step 2 on page 11-145
- Width: Step 2 on page 11-146

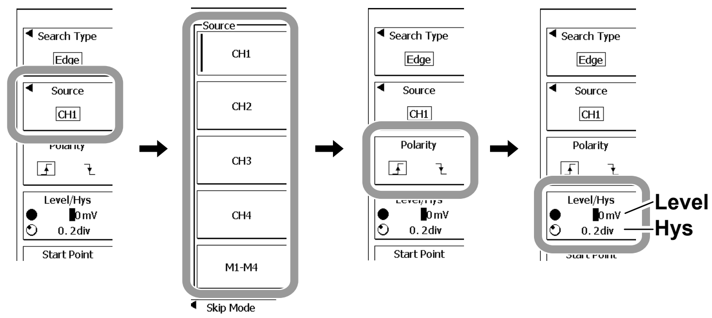
When the Search Type Is Edge

Selecting the Search Source Waveform and Slope

2. Press the **Source** soft key.
3. Press the appropriate waveform soft key.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
4. Press the **Polarity** soft key to select ⎍ or ⎍.

Setting the Level and Hysteresis

5. Press the **Level/Hys** soft key.
6. Use the **rotary knob** to set the slope edge reference level and hysteresis.
   Press the soft key to select the setting that you want to set using the rotary knob.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

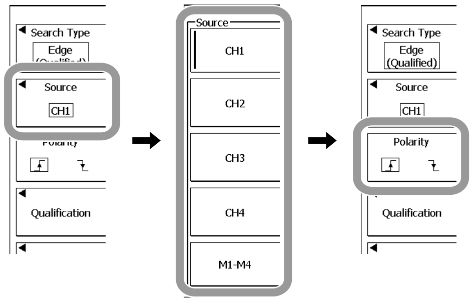
When the Search Type is Edge (Qualified)

Selecting the Search Source Waveform and Slope

2. Press the **Source** soft key.

3. Press the appropriate waveform soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

4. Press the **Polarity** soft key to select ↑ or ↓.



Setting the Qualification

5. Press the **Qualification** soft key.

6. Press the appropriate waveform soft key to select the status.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- The search source waveform selected in step 3 is not displayed.
- H: High. L: Low. X: Don't care

7. Press the **Logic** soft key to select AND or OR.

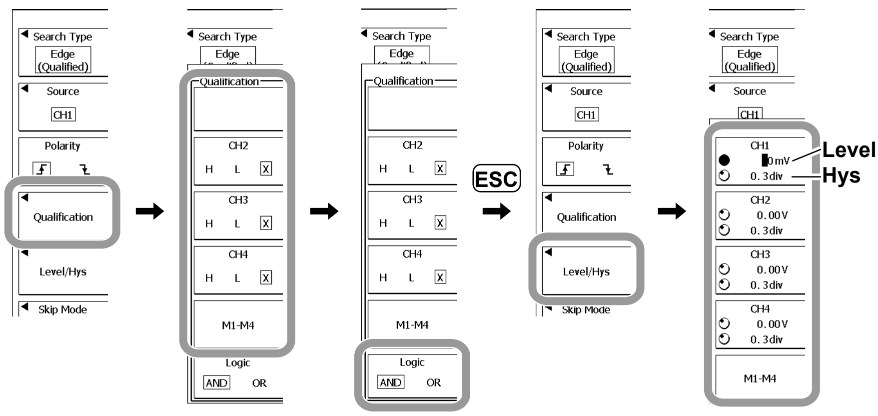
8. Press **ESC** to return to the previous screen.

Setting the Level and Hysteresis

9. Press the **Level/Hys** soft key.

10. Press the appropriate waveform soft key, and then use the **rotary knob** to set the polarity as well as the status reference level and hysteresis.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- Press the soft key to select the setting that you want to set using the rotary knob.

11. Press **ESC** to return to the previous screen.



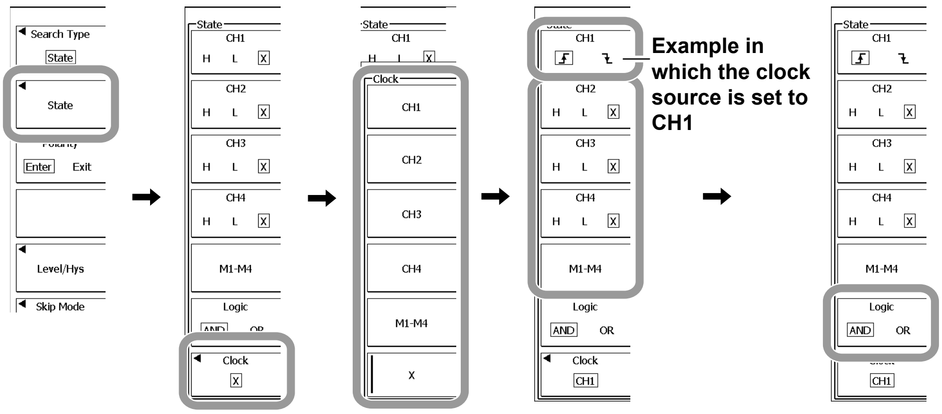
Executing the Search

Carry out steps 6 to 14 in section 11.18.

When the Search Type Is State

Setting the Clock Source, State Condition, and Logic

2. Press the **State** soft key.
3. Press the **Clock** soft key.
4. Press the soft key that corresponds to the appropriate clock source waveform.
   To select a channel from M1 to M4, press the **M1-M4** soft key first.
5. Press the appropriate waveform soft key to select the status.
   - To select a channel from M1 to M4, press the **M1-M4** soft key first.
   - If the waveform is selected for the clock source in step 4, select the slope.
   - H: High. L: Low. X: Don’t care
6. Press the **Logic** soft key to select AND or OR.
7. Press **ESC** to return to the previous screen.

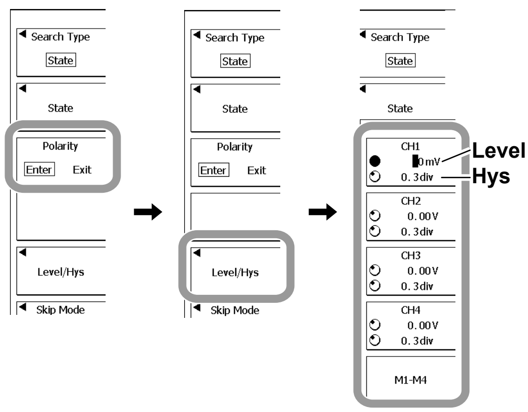


Selecting the False-to-True Condition Change or the True-to-False Condition Change

8. Press the **Polarity** soft key to select Enter or Exit.

Setting the Level and Hysteresis

9. Press the **Level/Hys** soft key.
10. Press the appropriate waveform soft key, and then use the **rotary knob** to set the status reference level and hysteresis.
    - To select a channel from M1 to M4, press the **M1-M4** soft key first.
    - Press the soft key to select the setting that you want to set using the rotary knob.
11. Press **ESC** to return to the previous screen.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

When the Search Type Is Width

Setting the Width Type, Time Span Mode, and Reference Time

2. Press the **Setup** soft key.

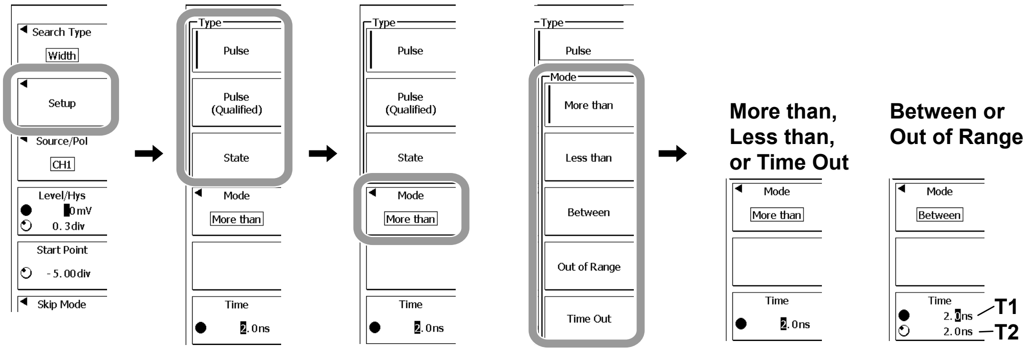
3. Press the appropriate mode soft key from **Pulse** to **State** to select the width type.

4. Press the **Mode** soft key.

5. Press the appropriate mode soft key from **More than** to **Time Out**.

6. Use the **rotary knob** to set the reference time.
If you set the time span mode to Between or Out of Range, set two reference times.
Press the soft key to select the time that you want to set using the rotary knob.

7. Press **ESC** to return to the previous screen.



Proceed to the steps on the pages indicated below according to the width type selected in step 3.

- If you select Pulse, proceed to step 8.
- If you select Pulse (Qualified), proceed to step 8 on page 11-147.
- If you select State, proceed to step 8 on page 11-148.

When the Width Type Is Pulse

- **Selecting the Search Source Waveform and Polarity**

8. Press the **Source/Pol** soft key.

9. Press the appropriate waveform soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

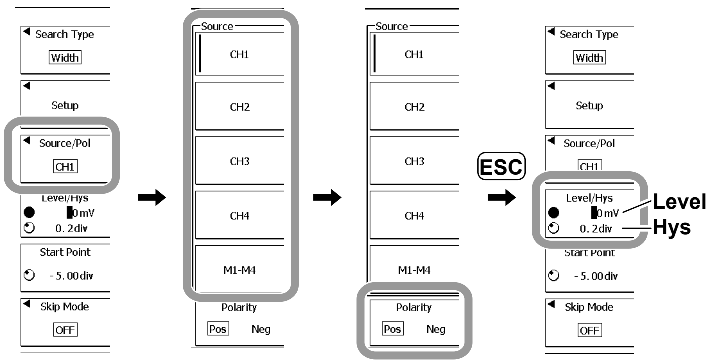
10. Press the **Polarity** soft key to select Pos or Neg.

11. Press **ESC** to return to the previous screen.

- **Setting the Level and Hysteresis**

12. Press the **Level/Hys** soft key.

13. Use the **rotary knob** to set the polarity reference level and hysteresis.
Press the soft key to select the setting that you want to set using the rotary knob.



- **Executing the Search**
Carry out steps 6 to 14 in section 11.18.

When the Width Type Is Pulse (Qualified)

- **Selecting the Search Source Waveform and Polarity**

8. Press the **Source/Pol** soft key.

9. Press the appropriate waveform soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

10. Press the **Polarity** soft key to select Pos or Neg.

11. Press **ESC** to return to the previous screen.

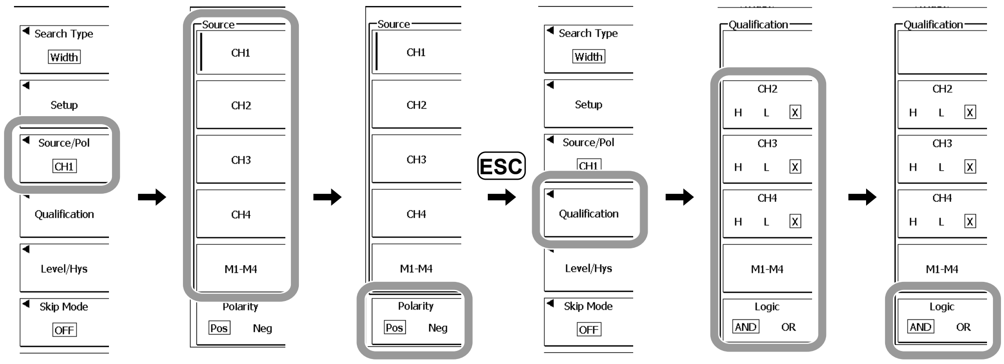
- **Setting the Qualification**

12. Press the **Qualification** soft key.

13. Press the appropriate waveform soft key to select the status.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- The search source waveform selected in step 9 is not displayed.
- H: High. L: Low. X: Don’t care

14. Press the **Logic** soft key to select AND or OR.

15. Press **ESC** to return to the previous screen.

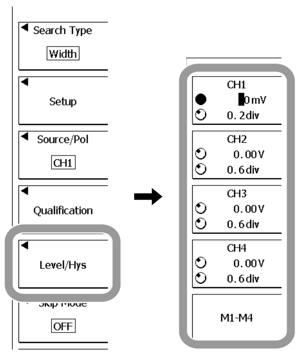


- **Setting the Level and Hysteresis**

16. Press the **Level/Hys** soft key.

17. Press the appropriate waveform soft key, and then use the **rotary knob** to set the polarity as well as the status reference level and hysteresis.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- Press the soft key to select the setting that you want to set using the rotary knob.

18. Press **ESC** to return to the previous screen.



- **Executing the Search**

Carry out steps 6 to 14 in section 11.18.

11

Analysis and Search

When the Width Type Is State

- **Setting the Clock Source, State Condition, and Logic**

8. Press the **State** soft key.

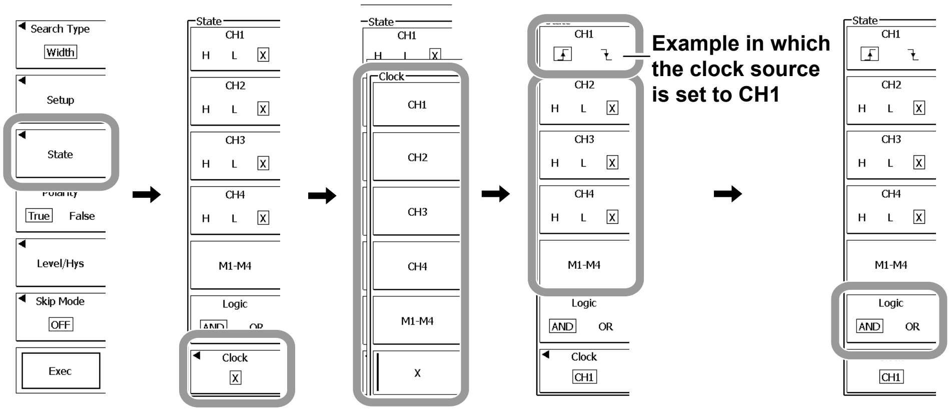
9. Press the **Clock** soft key.

10. Press the soft key that corresponds to the appropriate clock source waveform.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

11. Press the appropriate waveform soft key to select the status.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- If the waveform is selected for the clock source in step 9, select the slope.
- H: High. L: Low. X: Don’t care

12. Press the **Logic** soft key to select AND or OR.

13. Press **ESC** to return to the previous screen.



- **Selecting the False-to-True Condition Change or the True-to-False Condition Change**

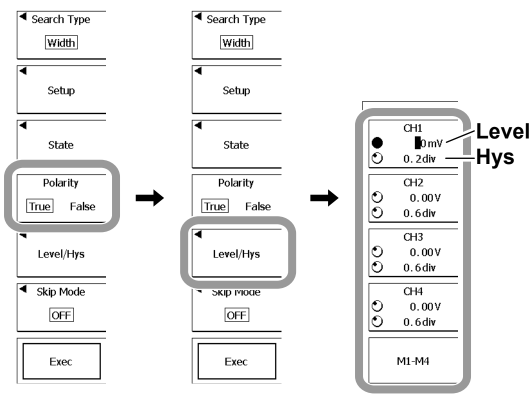
14. Press the **Polarity** soft key to select True or False.

- **Setting the Level and Hysteresis**

15. Press the **Level/Hys** soft key.

16. Press the appropriate waveform soft key, and then use the **rotary knob** to set the status reference level and hysteresis.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- Press the soft key to select the setting that you want to set using the rotary knob.

17. Press **ESC** to return to the previous screen.



- **Executing the Search**
Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches CH1 to CH4 and M1 to M4 analog signals.

Search Type

The following search types are available. The search conditions of each search type are the same as the trigger conditions for each trigger type. For details, see sections 7.13 to 7.15 and 7.17 to 7.19.

- **Edge**
  Searches for points where the specified waveform passes through a certain level on the rising or falling edge.

- **Edge (Qualified)**
  Searches for points where the specified waveform passes through a certain level on the rising or falling edge while the qualification requirement is met.

- **State**
  Searches for points where the logical AND or the logical OR of each waveform status is met or not met.

- **Width**
  Searches for points where the pulse width of the specified waveform meets a given condition. The following five conditions are available.

More than	Searches for trailing edges of pulses that are longer than the specified time.
Less than	Searches for trailing edges of pulses that are shorter than the specified time.
Between	Searches for trailing edges of pulses that are longer than the specified time T1 but that are shorter than T2.
Out of Range	Searches for trailing edges of pulses that are shorter than the specified time T1 or that are longer than T2.
Time Out	Searches for points where the pulse width exceeds the specified time.

The following three conditions are added further to the pulse width conditions.

Pulse	Makes searches based on the relationship between the specified waveform pulse width and the specified time.
Pulse(Qualified)	Makes searches based on the relationship between the specified waveform pulse width and the specified time while the qualification requirement is met.
State	Searches for either of the points described below.
	• Points where the relationship between the state condition true or false time and the specified time is met
	• The SB5000 checks the state condition on the rising or falling edge of the specified clock source. The SB5000 searches for the position where the relationship between the period during which the normalized condition (high when the state condition is true and low when the state condition is low) is true or false and the specified reference time meets a certain condition for the first time.

Level

Set the reference level for CH1 to CH4 and M1 to M4.
The selectable range is ±10 divisions from the vertical position. The resolution is 0.01 divisions. For example, if the T/div setting is 2 mV/division, the resolution is 0.02 mV.

Hysteresis

Set the hysteresis for CH1 to CH4 and M1 to M4.
The selectable range is from 0.0 to 4.0 divisions. The resolution is 0.1 divisions.
Trigger hysteresis settings and correspond to 0.6 divisions and 1.0 division.

Found Point

The found-point position is the same as the trigger point position. For details on the trigger point, see sections 7.13 to 7.15 and 7.17 to 7.19.

11.27 Searching Logic Signals

Procedure

1. Carry out steps 1 to 5 in section 11.18 to set the search type to Logic Edge, Logic Edge (Qualified), Logic State or Logic Width.

Proceed to the steps on the pages indicated below according to the selected search type.

- Logic Edge: Step 2 on this page
- Logic Edge (Qualified): Step 2 on page 11-151
- Logic State: Step 2 on page 11-152
- Logic Width: Step 2 on page 11-154

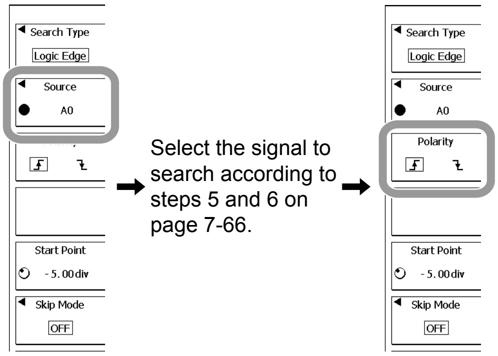
When the Search Type Is Logic Edge

Selecting the Search Source Signal and Polarity

2. Press the **Source** soft key.

3. Select the signal to search according to steps 5 and 6 on page 7-66.

4. Press the **Polarity** soft key to select ⨍ or ⤵.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

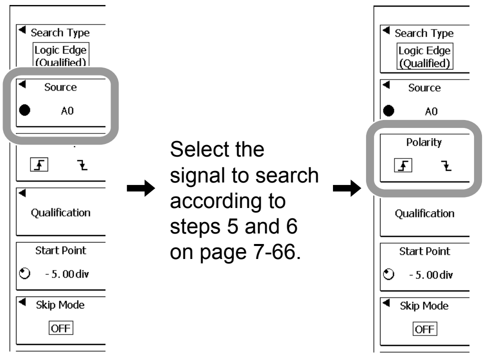
When the Search Type is Logic Edge (Qualified)

Selecting the Search Source Signal and Polarity

2. Press the **Source** soft key.

3. Select the signal to search according to steps 5 and 6 on page 7-66.

4. Press the **Polarity** soft key to select ↑ or ↓.



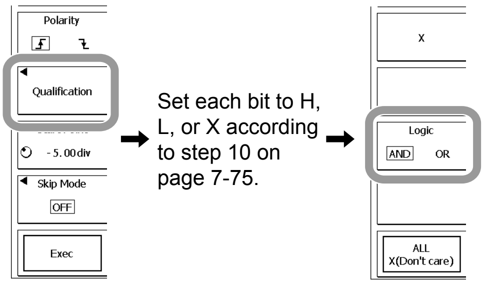
Setting the Qualification

5. Press the **Qualification** soft key.

6. Set each bit to H, L, or X according to step 10 on page 7-75.

7. Press the **Logic** soft key to select AND or OR.

8. Press **ESC** to return to the previous screen.



Executing the Search

Carry out steps 6 to 14 in section 11.18.

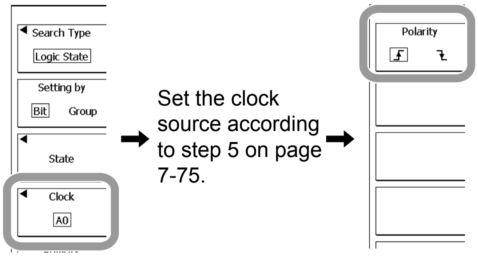
11

Analysis and Search

When the Search Type Is Logic State

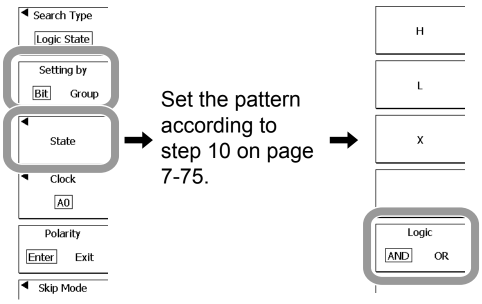
Selecting the Clock Source

2. Press the **Clock** soft key.
3. Select the clock source according to step 5 on page 7-75.
4. Press the **Polarity** soft key to select ↑ or ↓.
5. Press **ESC** to return to the previous screen.



Setting the State Condition of Each Bit

6. Press the **Setting by** soft key to select Bit.
7. Press the **State** soft key.
8. Set the pattern according to step 10 on page 7-75.
9. Press the **Logic** soft key to select AND or OR.
10. Press **ESC** to return to the previous screen.



Proceed to step 17.

Setting the State Condition of Each Group

6. Press the **Setting by** soft key to select Group.
7. Press the **State** soft key.
8. Press the appropriate soft key from **Group 1** to **Group 5** to select the group that you want to set the state condition for.
9. Press the **Condition** soft key.
10. Press the appropriate condition soft key from **Don't care** to **Out of Range**.
    - If you select Don't care, proceed to step 13.
    - If you select True or False, the Pattern Setup dialog box will appear. Proceed to step 11.
    - If you select Greater/Equal, Less/Equal, Between, or Out of Range, set the reference value. Proceed to step 12.

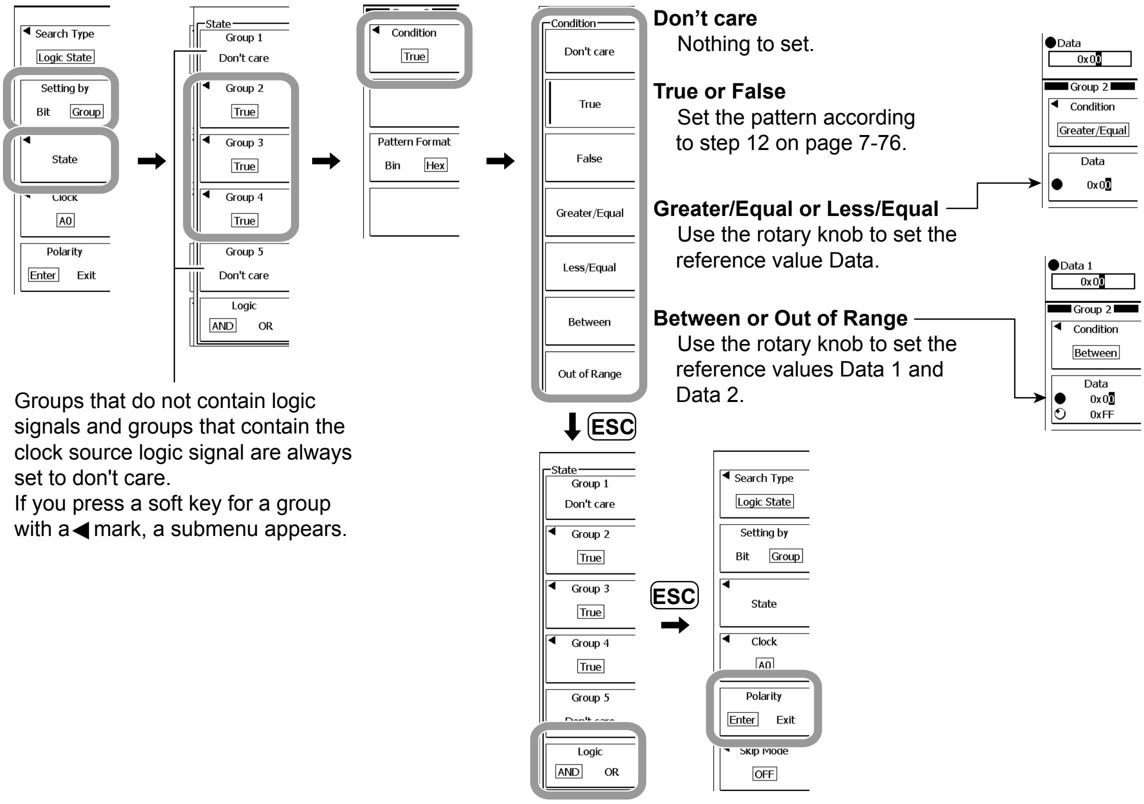
Note

Groups that do not contain logic signals and groups that contain the clock source logic signal are always set to don't care.

11. Set the pattern according to step 12 on page 7-76. Proceed to step 13.
12. Use the **rotary knob** to set the reference value.
    If you set the condition to Between or Out of Range in step 10, set two reference values.
13. Press **ESC** to return to the previous screen.
14. To set other groups, repeat steps 8 to 13.
15. Press the **Logic** soft key to select AND or OR.
16. Press **ESC** to return to the previous screen.

Selecting the False-to-True Condition Change or the True-to-False Condition Change

17. Press the **Polarity** soft key to select Enter or Exit.



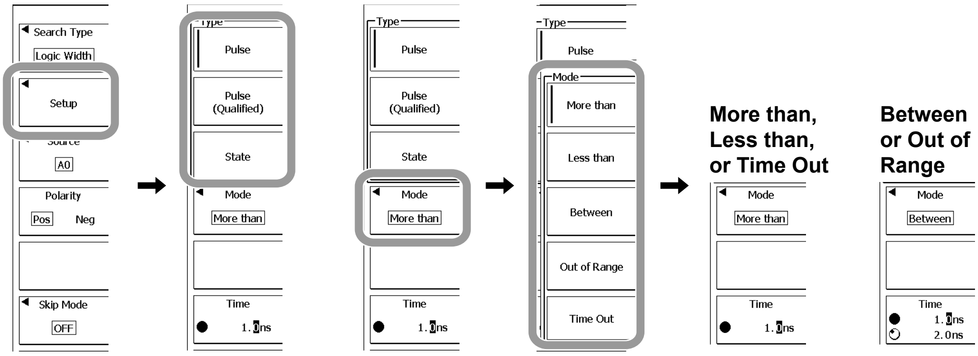
Executing the Search

Carry out steps 6 to 14 in section 11.18.

When the Search Type Is Logic Width

Setting the Width Type, Time Span Mode, and Reference Time

2. Press the **Setup** soft key.
3. Press the appropriate mode soft key from **Pulse** to **State** to select the width type.
4. Press the **Mode** soft key.
5. Press the appropriate mode soft key from **More than** to **Time Out**.
6. Use the **rotary knob** to set the reference time.
   If you set the time span mode to Between or Out of Range, set two reference times.
   Press the soft key to select the time that you want to set using the rotary knob.
7. Press **ESC** to return to the previous screen.



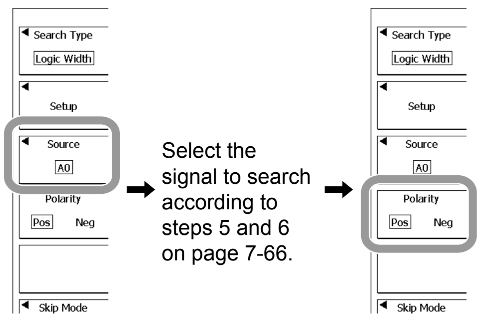
Proceed to the steps on the pages indicated below according to the width type selected in step 3.

- If you select Pulse, proceed to step 8.
- If you select Pulse (Qualified), proceed to step 8 on page 11-155.
- If you select State, proceed to step 8 on page 11-156.

When the Width Type Is Pulse

- **Selecting the Search Source Signal and Polarity**

8. Press the **Source** soft key.
9. Select the signal to search according to steps 5 and 6 on page 7-66.
10. Press the **Polarity** soft key to select Pos or Neg.



- **Executing the Search**
  Carry out steps 6 to 14 in section 11.18.

When the Width Type Is Pulse (Qualified)

- **Selecting the Search Source Signal and Polarity**

  8. Press the **Source** soft key.

  9. Select the signal to search according to steps 5 and 6 on page 7-66.

  10. Press the **Polarity** soft key to select Pos or Neg.

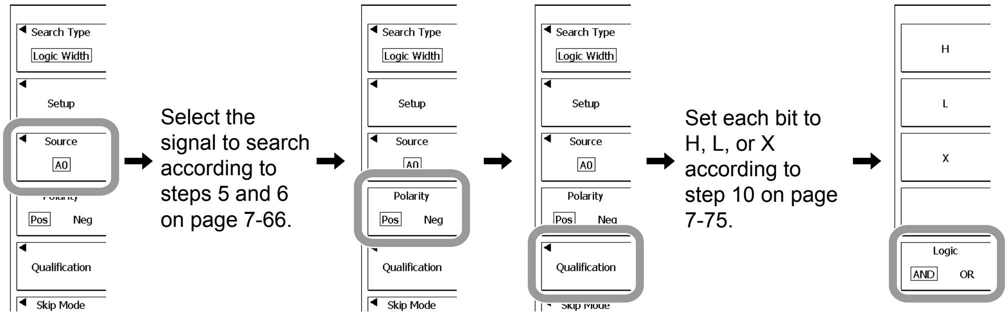
- **Setting the Qualification**

  11. Press the **Qualification** soft key.

  12. Set each bit to H, L, or X according to step 10 on page 7-75.

  13. Press the **Logic** soft key to select AND or OR.

  14. Press **ESC** to return to the previous screen.



- **Executing the Search**

  Carry out steps 6 to 14 in section 11.18.

When the Width Type Is State

- **Setting the State Condition of Each Bit**

8. Press the **Setting by** soft key to select Bit.

9. Press the **State** soft key.

10. Press the **Clock** soft key.

11. Select the clock source according to step 5 on page 7-75.

12. Press the **Polarity** soft key to select ↑ or ↓.

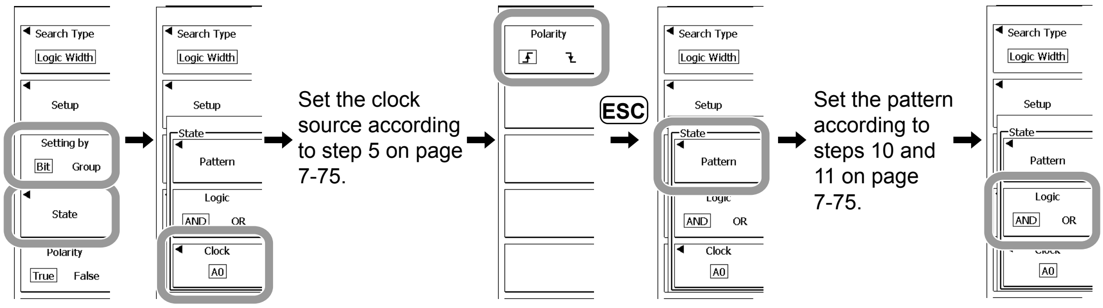
13. Press **ESC** to return to the previous screen.

14. Press the **Pattern** soft key.

15. Set the pattern according to steps 10 and 11 on page 7-75.

16. Press the **Logic** soft key to select AND or OR.

17. Press **ESC** to return to the previous screen.



Proceed to step 23.

- **Setting the State Condition of Each Group**

8. Press the **Setting by** soft key to select Group.

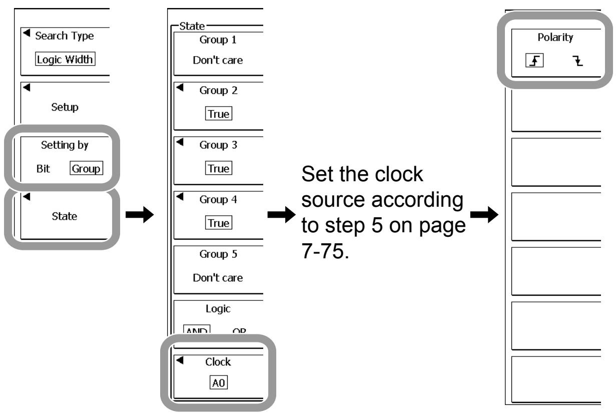
9. Press the **State** soft key.

10. Press the **Clock** soft key.

11. Select the clock source according to step 5 on page 7-75.

12. Press the **Polarity** soft key to select ↑ or ↓.

13. Press **ESC** to return to the previous screen.



14. Press the appropriate soft key from **Group 1** to **Group 5** to select the group that you want to set the state condition for.

15. Press the **Condition** soft key.

16. Press the appropriate condition soft key from **Don't care** to **Out of Range**.
- If you select Don't care, proceed to step 17.
- If you select True or False, the Pattern Setup dialog box will appear. Proceed to step 17.
- If you select Greater/Equal, Less/Equal, Between, or Out of Range, set the reference value. Proceed to step 18.

Note

Groups that do not contain logic signals and groups that contain the clock source logic signal are always set to don't care.

17. Set the pattern according to step 12 on page 7-76. Proceed to step 19.

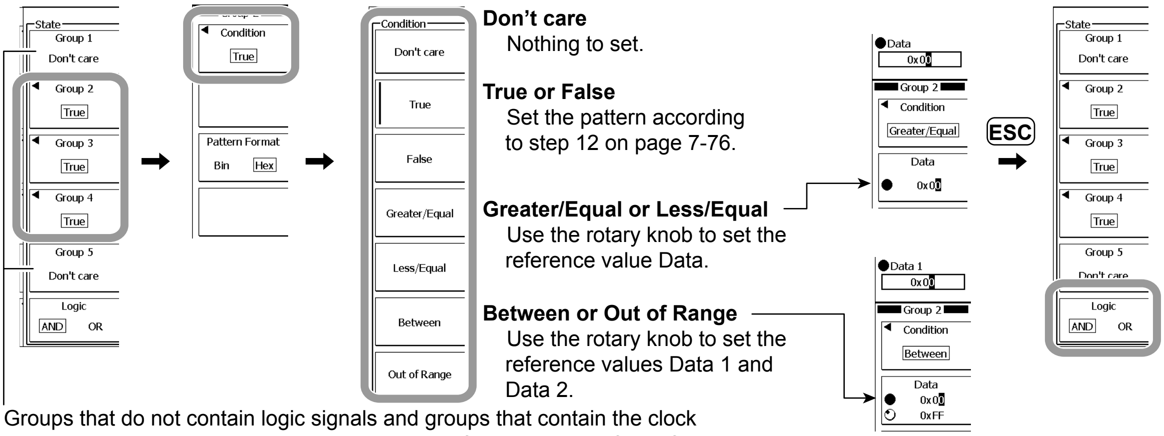
18. Use the **rotary knob** to set the reference value.
If you set the condition to Between or Out of Range in step 20, set two reference values.

19. Press **ESC** to return to the previous screen.

20. To set other groups, repeat steps 14 to 19.

21. Press the **Logic** soft key to select AND or OR.

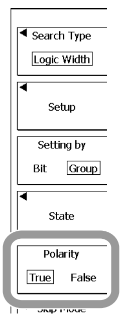
22. Press **ESC** to return to the previous screen.



Groups that do not contain logic signals and groups that contain the clock source logic signal are always set to don't care. If you press a soft key for a group with a ◀ mark, a submenu appears.

- **Selecting the False-to-True Condition Change or the True-to-False Condition Change**

23. Press the **Polarity** soft key to select True or False.



- **Executing the Search**

Carry out steps 6 to 14 in section 11.18.

Explanation

This feature searches logic signals that consists of bits A0 to A7, B0 to B7, C0 to C7, and D0 to D7 (A0 to A7 on the SB5310).

Search Type

The following search types are available. The search conditions of each search type are the same as the trigger conditions for each trigger type. For details, see sections 7.13 to 7.15, 7.17, and 7.19.

- **Logic Edge**
  Searches for points where the specified bit is at the selected polarity, high or low.
- **Logic Edge (Qualified)**
  Searches for points where the specified bit is at the selected polarity, high or low, while the qualification requirement is met.
- **Logic State**
  Searches for points where the logical AND or the logical OR of each bit status is met or not met.
- **Logic Width**
  Searches for points where the pulse width of the specified bit meets a given condition. The following five conditions are available.

More than	Searches for trailing edges of pulses that are longer than the specified time.
Less than	Searches for trailing edges of pulses that are shorter than the specified time.
Between	Searches for trailing edges of pulses that are longer than the specified time T1 but that are shorter than T2.
Out of Range	Searches for trailing edges of pulses that are shorter than the specified time T1 or that are longer than T2.
Time Out	Searches for points where the pulse width exceeds the specified time.

The following three conditions are added further to the pulse width conditions.

Pulse	Makes searches based on the relationship between the specified bit pulse width and the specified time.
Pulse(Qualified)	Makes searches based on the relationship between the specified bit pulse width and the specified time while the qualification requirement is met.
State*	Searches for either of the points described below. • Points where the relationship between the state condition true or false time and the specified time is met • The SB5000 checks the state condition when the polarity of the specified logic signal (clock source) changes. The SB5000 searches for the position where the relationship between the period during which the normalized condition (high when the state condition is true and low when the state condition is low) is true or false and the specified reference time meets a certain condition for the first time.

* When setting the state condition of each group, you can select the state of each bit for each group from below.

Don’t care	Not used as a search condition
True	Pattern true
False	Pattern false
Greater/Equal	Greater than or equal to the reference value
Less/Equal	Less than or equal to the reference value
Between	Within the reference value range defined by Data1 and Data2
Out of Range	Less than reference value Data1 or greater than Data 2

Level

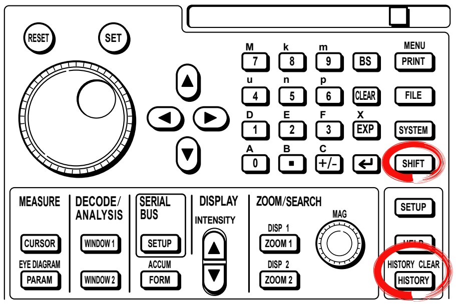
The level for determining the logic signal polarity is the threshold level set in section 6.18.

Found Point

The found-point position is the same as the trigger point position. For details on the trigger point, see sections 7.13 to 7.15 and 7.17 to 7.19.

12.1 Displaying History Waveforms

Procedure

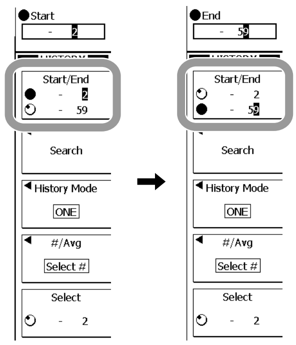


1. Press **HISTORY**.

   If you press HISTORY while signal acquisition is in progress, signal acquisition will stop.

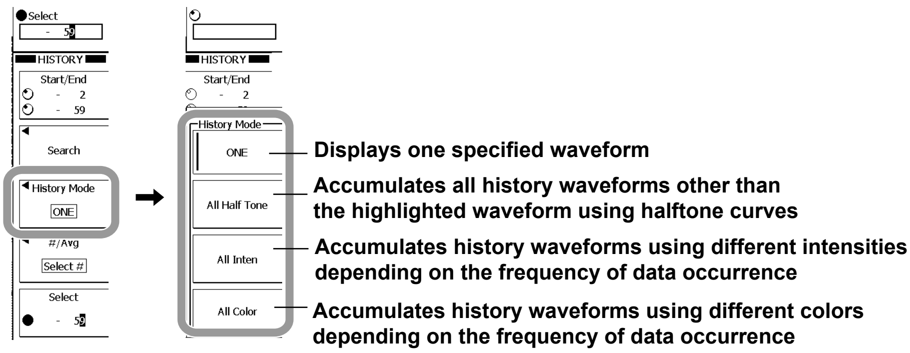
Selecting History Waveforms to Display

2. Press the **Start/End** soft key to select the setting you want to adjust using the rotary knob.
3. Use the **rotary knob** to set the first and the last record numbers of history waveforms you want to display.



Selecting a Display Mode

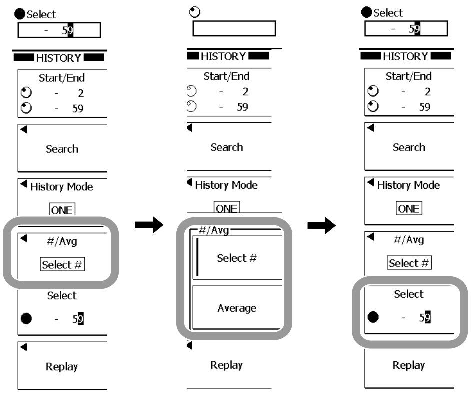
4. Press the **History Mode** soft key.
5. Press the soft key that corresponds to the display mode you want to use for the history waveforms.



Selecting a Waveform to Highlight

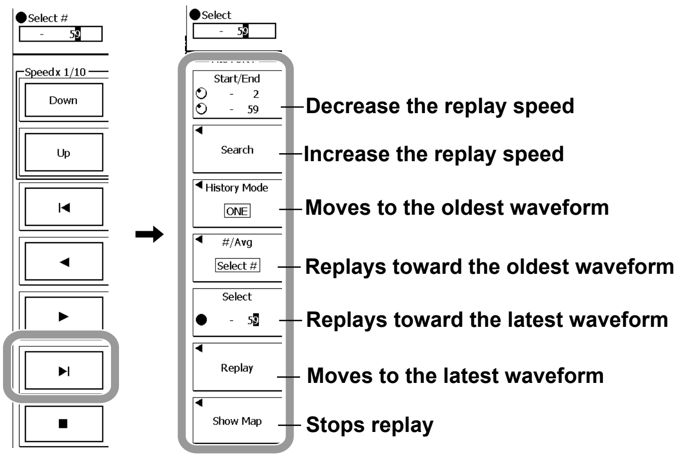
6. Press the **#/Avg** soft key.
7. Press the **Select #** or **Average** soft key to select the waveform you want to highlight.
   If you select Select #, select a history number.
   If you select Average, the average value of the displayed history waveforms will be highlighted.
8. If you select Select # in step 7, press the **Select** soft key.
9. Use the **rotary knob** to enter the record number of the waveform you want to highlight.

When Select # is selected



Replaying History Waveforms

10. Press the **Replay** soft key.
11. Press the **Down** or **Up** soft key to change the display speed.
12. Use the **rotary knob** to select the first history waveform to replay. The waveform number appears at the top section of the menu as Select #.
    ⏮ soft key to select the oldest history waveform.
    ⏭ soft key to select the latest history waveform.
13. Press the ◀ soft key to replay toward the oldest waveform.
    Press the ▶ soft key to replay toward the latest waveform.
    ■ soft key to stop replay.
14. Press **ESC** to return to the previous menu.



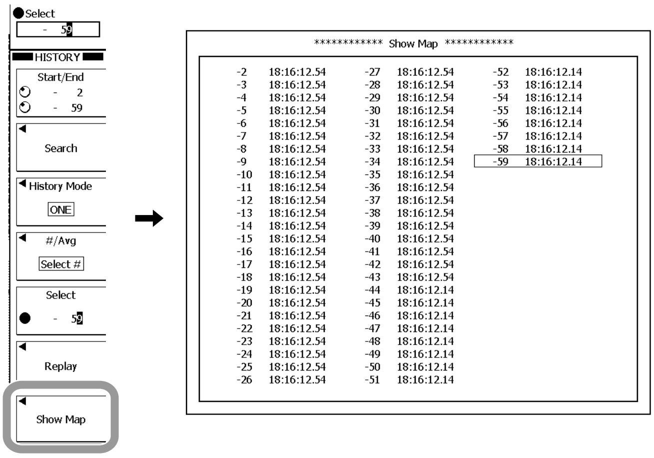
Note

- If you press ⏮ or ⏭ while replaying, the display will jump to the oldest or the latest history waveform, and the SB5000 will continue replaying. The replay direction will not change.
- You can change the replay speed while the SB5000 is replaying.
- The SB5000 cannot replay signals that have been acquired in Average mode.

Displaying a List of Timestamps

15. Press the **Show Map** soft key.

16. Use the **rotary knob** and **SET** to select the waveform you want to view.
ESC to clear the list.



Clearing the History Memory

17. Press **SHIFT**+**HISTORY** (HISTORY CLEAR).
If signal acquisition is in progress, the history memory will be cleared immediately. If signal acquisition is stopped, the history memory will be cleared the next time you start signal acquisition.

Note

The only operations that you can carry out when signal acquisition is in progress are displaying of a list of timestamps and clearing of the history memory.

Explanation

Display Mode

ONE	Displays only the selected waveform.
All Half tone	Accumulates all selected waveforms. All waveforms other than the highlighted waveform are displayed using halftone curves.
All Inten	Accumulates all selected waveforms by expressing the frequency of data occurrence using different intensities.
All Color	Accumulates all selected waveforms by displaying the frequency of data occurrence using different colors.

Waveform to Highlight

Select #	Waveform that corresponds to the specified history number
Average	Average value

Waveform to Display

The selectable range is 0 to – (the signal acquisition count – 1). The latest waveform is assigned the record number zero, and older waveforms are assigned numbers in descending order as –1, –2, –3, and so on. Specify the appropriate waveform number. The number of waveforms that can be held varies depending on the record length.

Record Length	Number of Waveforms	Record Length	Number of Waveforms
2.5kW	2000	125kW	60
6.25kW	1000	250kW	30
12.5kW	500	625kW	10
25kW	250	1.25MW	5
62.5kW	120	2.5MW	2
125kW	60	6.25MW	1

* The number of waveforms does not depend on whether the interleave or high-resolution mode is ON or OFF.

Replay

Displays waveforms in order from the specified waveform to the oldest or the latest waveform.

A List of Timestamps

- You can display a list of acquired waveform data numbers and their corresponding trigger timestamps.
- One screen displays up to 75 data values. You can scroll through the list using the rotary knob.

Clearing the History Memory

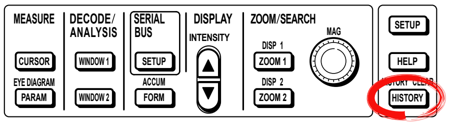
- Clears all the waveforms in the acquisition memory.
- You cannot recover waveforms that have been cleared.

- **Notes about Setting the History Memory Function**
  - In Averaging, Roll Mode, or Repetitive Sampling mode, the SB5000 acquires signals at the display update interval.
  - In Averaging or Repetitive Sampling mode when the trigger mode is Single, the SB5000 acquires multiple signals while it completes one waveform. Only the completed waveform is saved to the history memory.
  - If you stop waveform acquisition, the SB5000 will only display waveforms that have been acquired in their entirety.
  - If the trigger mode is not Single and you start waveform acquisition after changing the waveform acquisition conditions, data that is in the history memory before you changed the conditions will be cleared.
    For details on the signal acquisition conditions, see section 4.7.

- **Notes about Recalling Data Using the History Memory Function**
  - If you display the history memory menu, signal acquisition will stop. The SB5000 cannot display history waveforms while signal acquisition is in progress.
  - You can start signal acquisition even when the history memory menu is displayed. However, you cannot change the history memory settings while signal acquisition is in progress.
  - The record number that you can select is limited by the start and end record numbers.
  - If you load measurement data from the specified storage medium, the history waveforms will be cleared. The loaded measurement data is always placed in history memory record number zero. If you load a measurement data file containing multiple waveforms, the latest waveform is loaded in record number zero, the next latest waveform in record number –1, and so on.
  - Computation and automated measurement of waveform parameters are carried out on the waveform that corresponds to the selected record number. You can analyze old data as long as you don’t restart acquisition and overwrite the contents in the history memory. Analysis can be performed on the averaged waveform when average display is enabled.
  - The history waveforms will clear if you turn the power OFF.

12.2 Searching History Waveforms Using Waveform Zones (Wave History Search)

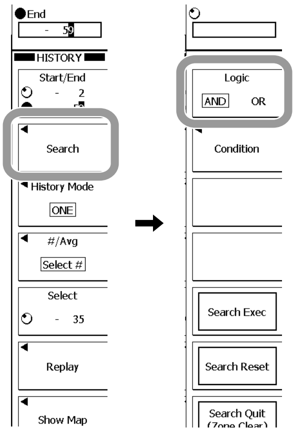
Procedure



1. Press **HISTORY**.

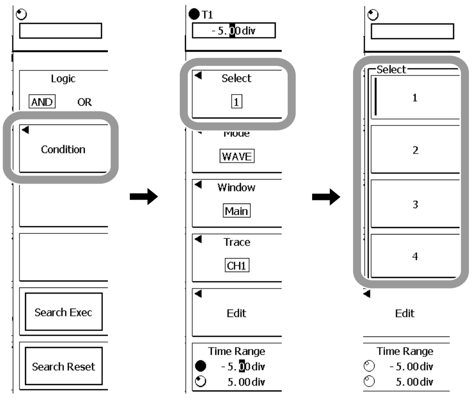
Selecting a Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.



Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Press the appropriate condition number soft key.

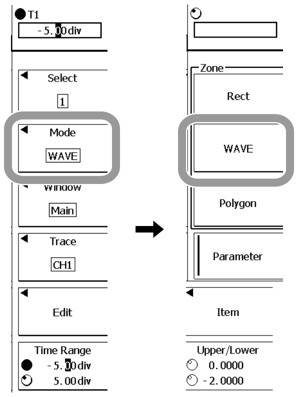


12

Displaying and Searching History Waveforms

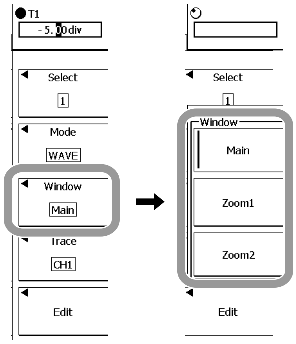
Setting the Search Mode

7. Press these soft keys: **Mode** > **WAVE**.
   The search mode is set to waveform zone.



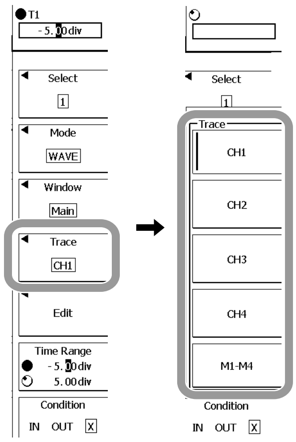
Selecting a Search Source Window

8. Press the **Window** soft key.
9. Press a soft key from **Main** to **Zoom2** to select the window you want to search.



Selecting a Search Source Waveform

10. Press the **Trace** soft key.
11. Press the appropriate channel soft key.
    To select a channel from M1 to M4, press the **M1-M4** soft key first.

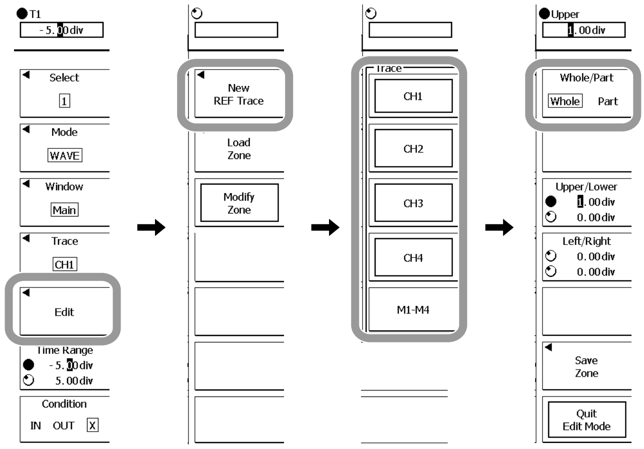


Creating a New Search Zone

12. Press these soft keys: **Edit** > **New REF Trace**.

13. Press the soft key that corresponds to the channel that contains the waveform that will be used to create the zone.
To select a channel from M1 to M4, press the **M1-M4** soft key first.

14. Press the **Whole/Part** soft key to select the type of zone you want to create.
- To create a whole zone, select Whole, and then proceed to step 15.
- To create a partial zone, select Part, and then proceed to step 23.



- **Editing a Whole Zone**

15. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the direction of the zone that you will set.

16. Use the **rotary knob** to set the boundaries of the zone.

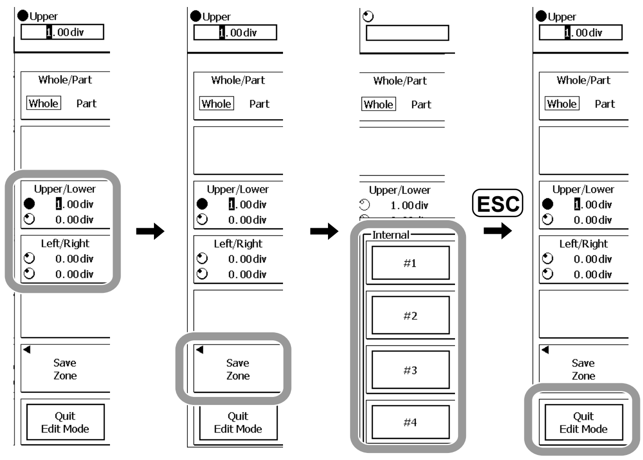
17. Repeat steps 15 and 16 to edit the zone.

18. Press the **Save Zone** soft key to open the menu for selecting the save destination for the edited zone.

19. Press the soft key that corresponds to the appropriate save destination number (1 to 4).

20. Press **ESC** to return to the previous screen.
To edit a partial zone, proceed to step 22.

21. Press the **Quit Edit Mode** soft key to leave editing mode.
When you have finished editing zones, proceed to step 36.



12

Displaying and Searching History Waveforms

- **Editing a Partial Zone**

22. Press the **Whole/Part** soft key to select Part.

23. Press the **Edit Range** soft key, and then select the left or right cursor.

24. Use the **rotary knob** to set the left and right edges of the partial zone.

25 Press the **Upper/Lower** soft key to select the direction of the zone that you will set.

26. Use the **rotary knob** to set the boundaries of the zone.
You can use the rotary knob to edit the boundaries of the zone within the range that you have already set.

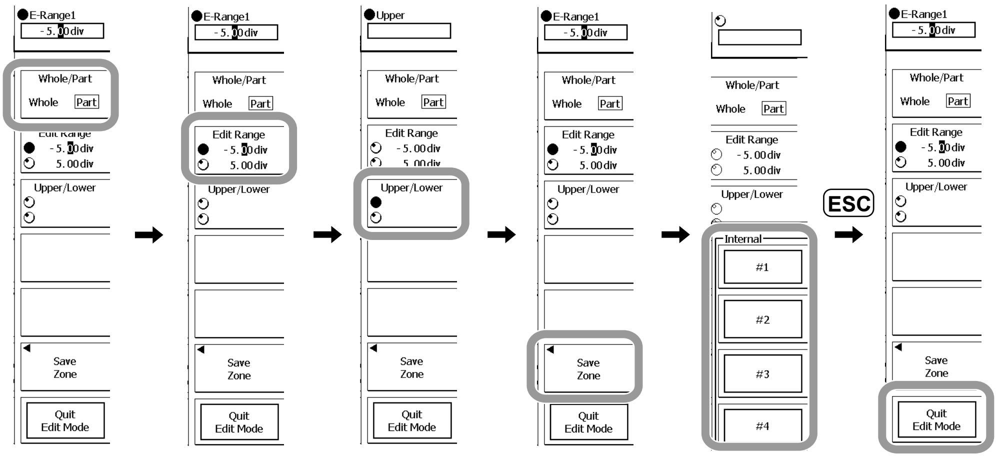
27. Repeat steps 22 and 26 to edit the zone.

28. Press the **Save Zone** soft key to open the menu for selecting the save destination for the edited zone.

29. Press the soft key that corresponds to the appropriate save destination number (1 to 4).

30. Press **ESC** to return to the previous screen.

31. Press the **Quit Edit Mode** soft key to leave editing mode.
When you have finished editing zones, proceed to step 36.



- **Editing a Zone**

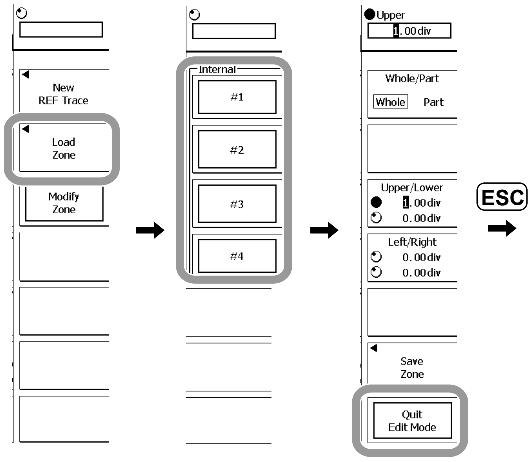
32. To edit a previously saved zone, press the **Load Zone** soft key.

33. Press the soft key that corresponds to the appropriate save destination number (1 to 4).
Proceed to step 35.

34. Press the **Modify Zone** soft key.

35. Edit the zone by following steps 15 to 31.

36. Once you are finished editing the zone, press **ESC**.



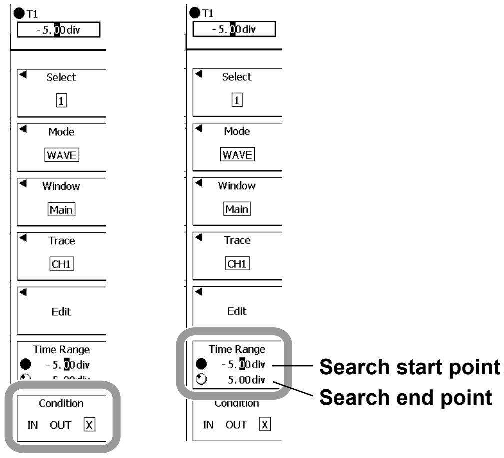
Selecting a Search Criterion

37. Press the **Condition** soft key, to select IN, OUT, or X.
- If you select IN or OUT, a zone will be displayed on the screen, and in steps 38 and 39, cursors will appear to indicate the search area.
- If you select X, the zone will not be used for searching, and the cursors indicating the search area will not appear.

Setting the Search Area

38. Press the **Time Range** soft key.

39. Use the **rotary knob** to set the search area.



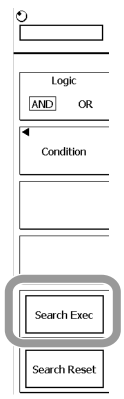
Repeat steps 5 to 39 for search conditions 1 to 4 as necessary.

40. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

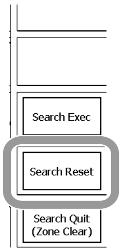
41. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

42. Press the **Search Abort** soft key to stop the search.



Resetting the Search

43. Press the **Search Reset** soft key to reset all search conditions.



Explanation

The SB5000 searches waveforms depending on whether or not the source waveform is in the zone that you set using a reference waveform.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Waveform

You can choose a waveform from CH1 to CH4 and from M1 to M4.

Search Zone

Set the search range.

- Upper and lower boundaries: ±8 divisions from the reference waveform
- Left and right boundaries: ±5 divisions from the reference waveform

You can choose to apply the search zones assigned to search condition numbers 1 to 4 to input signal waveforms (CH1 to CH4) and computed waveforms (M1 to M4). Any zone whose condition setting is enabled appears on the display.

Search Area

You can set the search area to less than or equal to ± 5 divisions from the time axis.

Search Criterion

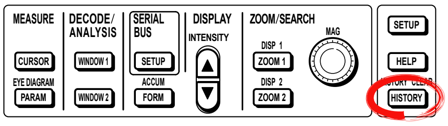
- IN: Searches for history waveforms that are in the search zone.
- OUT: Searches for history waveforms that are outside the search zone.
- X: Not used for the search.

Note

If you press the Search soft key and then press the Search Quit (Zone Clear) soft key, the search zone will be cleared, and the top menu for the HISTORY key will appear.

12.3 Searching History Waveforms Using a Rectangular Zone (RECT History Search)

Procedure

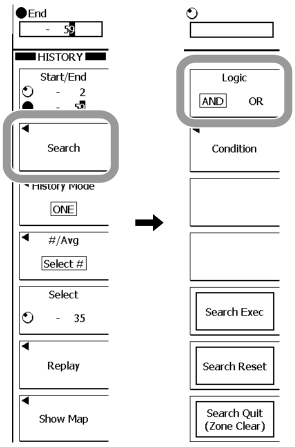


1. Press **HISTORY**.

Selecting a Search Logic

2. Press the **Search** soft key.

3. Press the **Logic** soft key to select AND or OR.

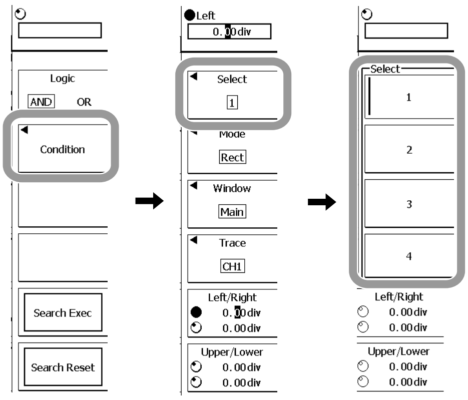


Selecting the Search Condition Number

4. Press the **Condition** soft key.

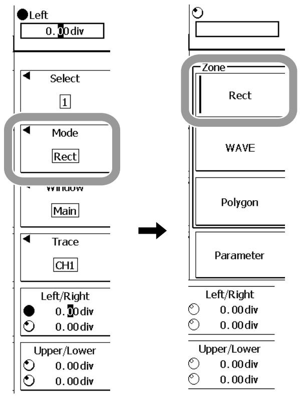
5. Press the **Select** soft key.

6. Press the appropriate condition number soft key.



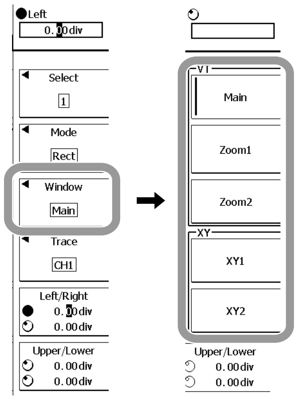
Setting the Search Mode

7. Press these soft keys: **Mode** > **Rect**.
   This sets the search mode to RECT (rectangular zone).



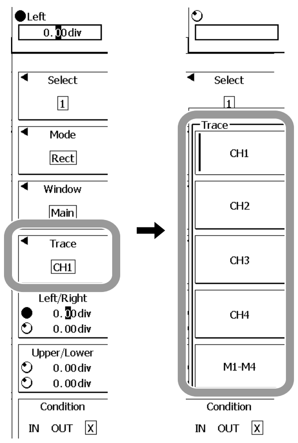
Selecting a Search Source Window

8. Press the **Window** soft key.
9. Press the appropriate soft key from **Main** to **XY2** to select the window you want to search.



Selecting a Search Source Waveform

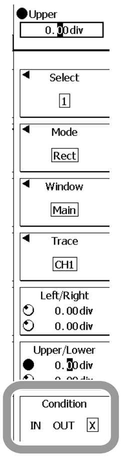
10. Press the **Trace** soft key.
11. Press the appropriate channel soft key.
    To select a channel from M1 to M4, press the **M1-M4** soft key first.



Selecting a Search Criterion

12. Press the **Condition** soft key, to select IN, OUT, or X.

- If you select IN or OUT, a rectangular zone will appear on the display.
- If you select X, the zone will not be used for searching, and the rectangular zone will not appear.

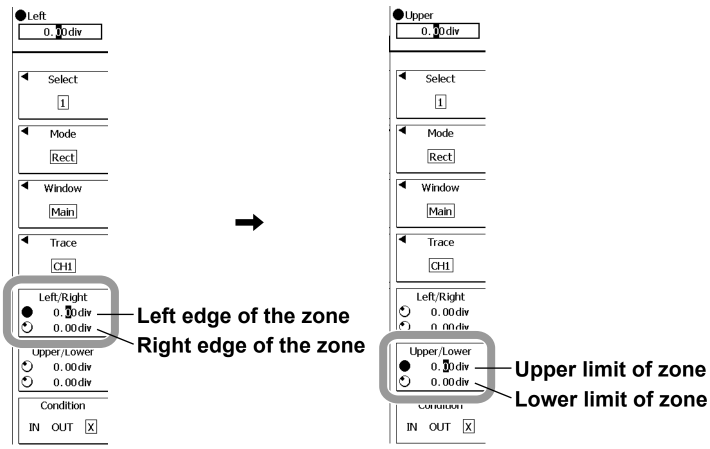


Setting the Search Zone

13. Press the **Upper/Lower** soft key or the **Left/Right** soft key to select the direction of the zone that you will set.

14. Use the **rotary knob** to set the boundaries of the zone.

15. Repeat steps 13 and 14 to edit the zone.



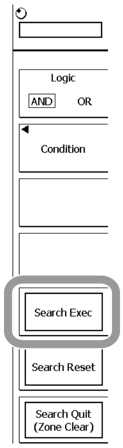
Repeat steps 5 to 15 for search conditions 1 to 4 as necessary.

16. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

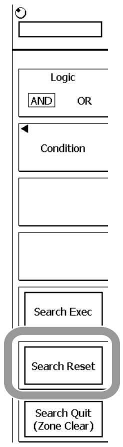
17. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

18. Press the **Search Abort** soft key to stop the search.



Resetting the Search

19. Press the **Search Reset** soft key to reset all search conditions.



Explanation

The SB5000 searches waveforms depending on whether or not the source waveform is in the rectangular zone that you set by specifying the zone's lower, upper, left, and right boundaries.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Window

- Main: Sets the main waveforms as the source.
- Zoom1: Sets the waveforms in zoom box 1 as the source.
- Zoom2: Sets the waveforms in zoom box 2 as the source.
- XY1: Sets the waveforms in XY window 1 as the source.
- XY2: Sets the waveforms in XY window 2 as the source.

Search Source Waveform

You can choose a waveform from CH1 to CH4 and from M1 to M4.

Search Zone

Set the search range.

- Left and right boundaries: ±5 divisions from the center of the display; the boundaries can be set in 0.01-division steps.
- Upper and lower boundaries: ±4 divisions from the center of the display; the boundaries can be set in 0.01-division steps.

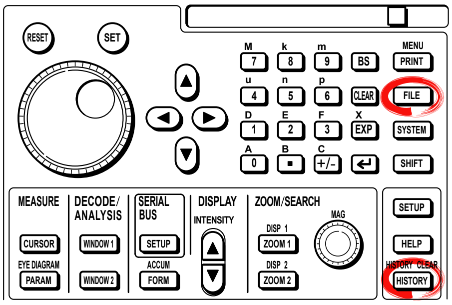
You can choose to apply the search zones assigned to search condition numbers 1 to 4 to input signal waveforms (CH1 to CH4) and computed waveforms (M1 to M4). Any zone whose condition setting is enabled appears on the display.

Search Criterion

- IN: Searches for history waveforms that are in the search zone.
- OUT: Searches for history waveforms that are outside the search zone.
- X: Not used for the search.

12.4 Searching History Waveforms Using a Polygon Waveform (POLYGON History Search)

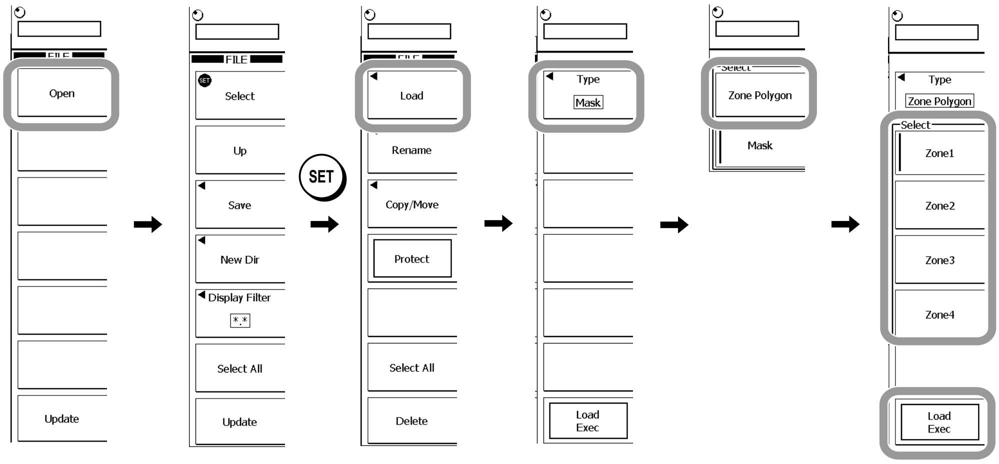
Procedure



Loading a Polygon

Follow these steps to load a polygon image file.

1. Press **FILE**.
2. Select the directory on the PC card, USB, or other storage media that the polygon image file is saved to.
3. Press the **OPEN** soft key.
4. Select the file you want to open, and press **SET**.
5. Press the **LOAD** soft key.
6. Press the **Type** soft key.
7. Press the **Zone Polygon** soft key.
8. Press the soft key that corresponds to zone number that you want to load into.
9. Press the **Load EXEC** soft key.
   The SB5000 will load the selected file.

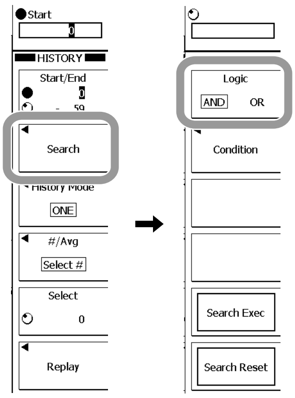


10. Press **HISTORY**.

Selecting a Search Logic

11. Press the **Search** soft key.

12. Press the **Logic** soft key to select AND or OR.

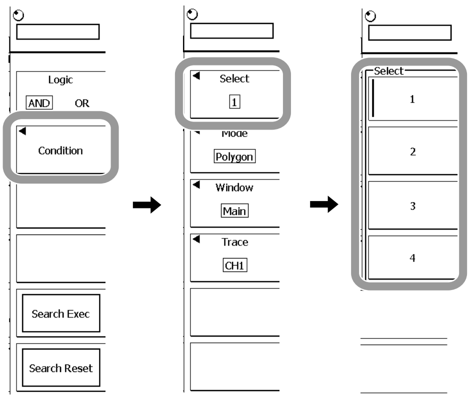


Selecting the Search Condition Number

13. Press the **Condition** soft key.

14. Press the **Select** soft key.

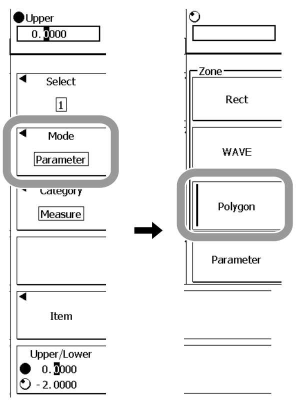
15. Press the appropriate condition number soft key.



Setting the Search Mode

16. Press these soft keys: **Mode** > **Polygon**.

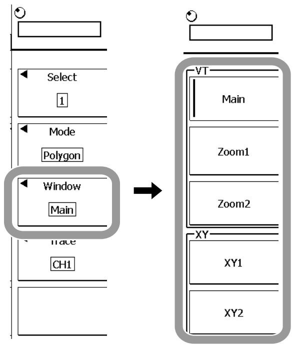
This sets the search mode to Polygon.



Selecting a Search Source Window

17. Press the **Window** soft key.

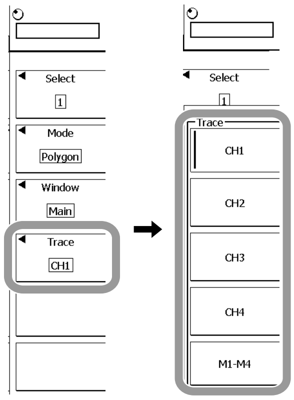
18. Press the appropriate soft key from **Main** to **XY2** to select the window you want to search.



Selecting a Search Source Waveform

19. Press the **Trace** soft key.

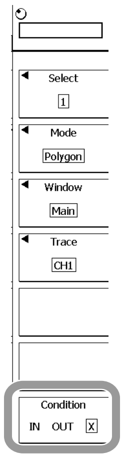
20. Press the appropriate channel soft key.
To select a channel from M1 to M4, press the **M1-M4** soft key first.



Selecting a Search Criterion

21. Press the **Condition** soft key, to select IN, OUT, or X.

22. Press **ESC** to return to the history search menu.



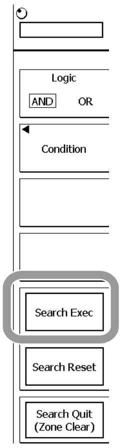
Repeat steps 14 to 22 for search conditions 1 to 4 as necessary.

23. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

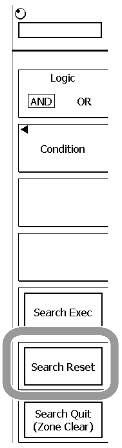
24. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

25. Press the **Search Abort** soft key to stop the search.



Resetting the Search

26. Press the **Search Reset** soft key to reset all search conditions.



12
Displaying and Searching History Waveforms

Explanation

The SB5000 searches waveforms depending on whether or not the source waveform is in the polygonal zone you created on a PC and loaded onto the SB5000.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Window

- Main: Sets the main waveform as the source.
- Zoom1: Sets the waveforms in zoom box 1 as the source.
- Zoom2: Sets the waveforms in zoom box 2 as the source.
- XY1: Sets the waveforms in XY window 1 as the source.
- XY2: Sets the waveforms in XY window 2 as the source.

Search Source Waveform

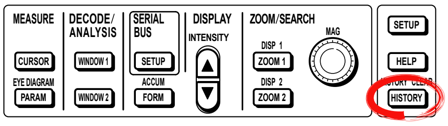
You can choose a waveform from CH1 to CH4 and from M1 to M4.

Search Criterion

- IN: Searches for history waveforms that are in the search zone.
- OUT: Searches for history waveforms that are outside the search zone.
- X: Not used for the search.

12.5 Searching History Waveforms Using Waveform Parameters (MEASURE History Search)

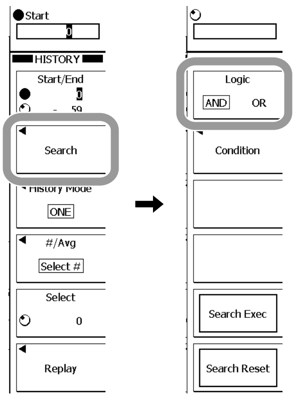
Procedure



1. Press **HISTORY**.

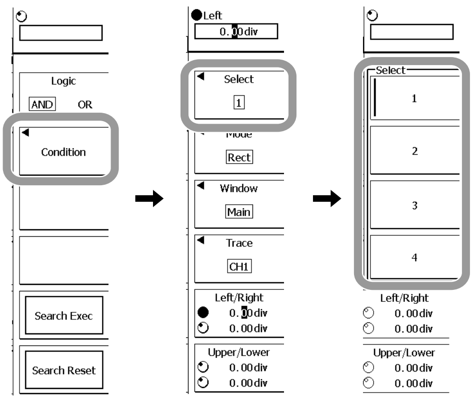
Selecting a Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.



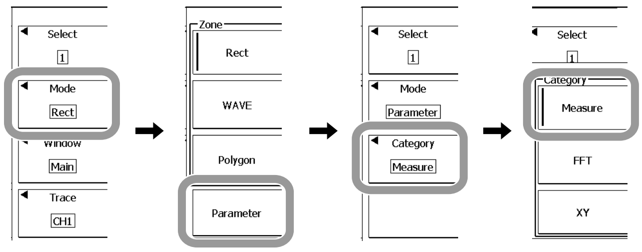
Selecting the Search Condition Number

4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Press the appropriate condition number soft key.



Setting the Search Mode and Category

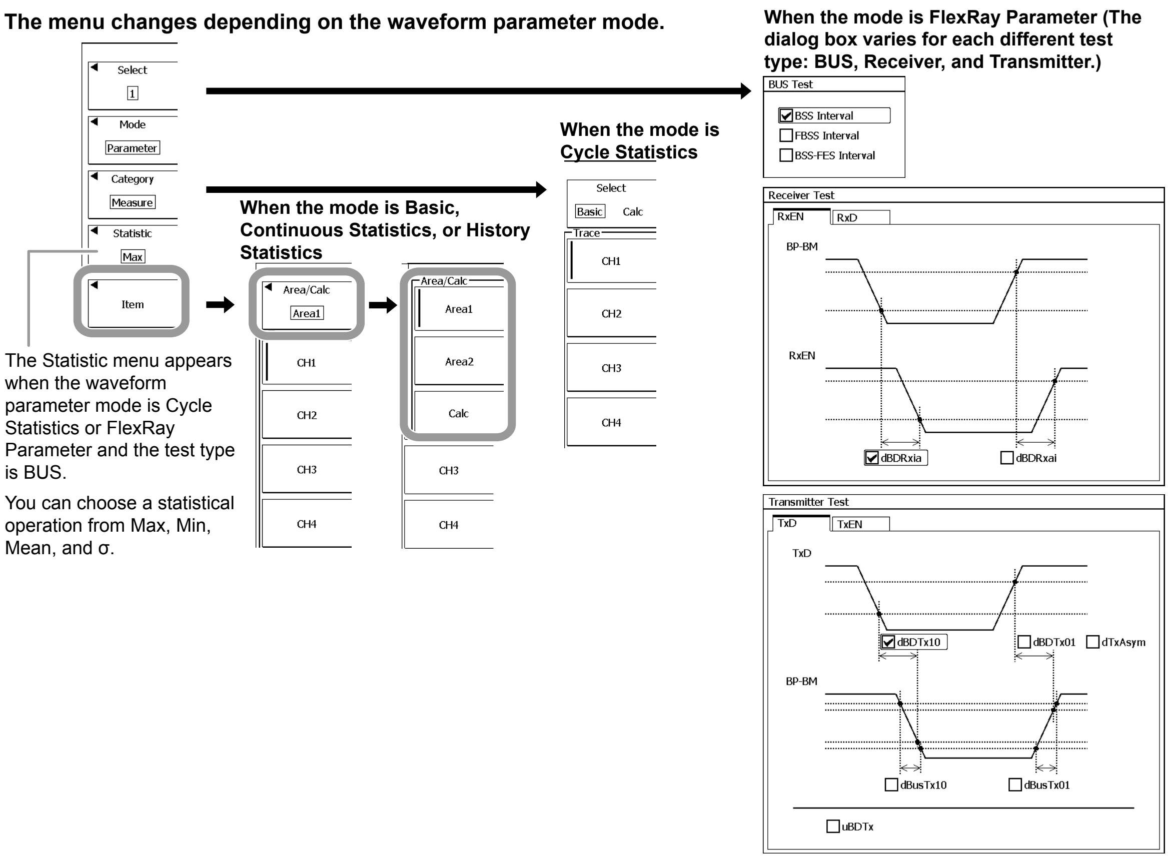
7. Press these soft keys: **Mode** > **Parameter**.
   This sets the search mode to Parameter.
8. Press these soft keys: **Category** > **Measure**.
   This sets the category to waveform parameter.



Selecting a Search Source

9. Press the **Item** soft key.
10. The menu that appears varies depending on the set waveform parameter mode (see sections 11.1 and 11.2 for details). Follow the instructions that correspond to the menu that appears.
    - If the mode is Basic, Continuous Statistics, or History Statistics, and you select Area 1 or Area2, proceed to step 11.
    - If the mode is Cycle Statistics and you select Basic, proceed to step 11.
    - If the mode is Basic, Continuous Statistics, History Statistics, or Cycle Statistics and you select Calc, proceed to step 13.
    - If the mode is FlexRay Parameter, select the parameter using the **rotary knob** and **SET**, and then proceed to step 14.

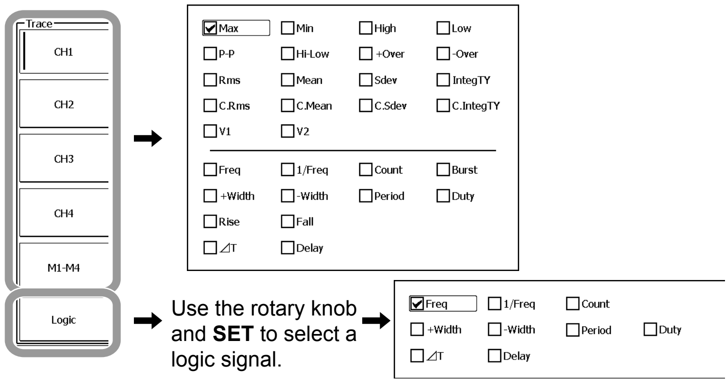
The menu changes depending on the waveform parameter mode.



- **Selecting a Signal/Waveform Parameter**

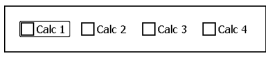
11. Press the appropriate signal soft key.
- To select a channel from M1 to M4, press the **M1-M4** soft key first.
- To select Logic, press the **Logic** soft key, and then press the **◄Logic** soft key. A dialog box appears. Select a logic signal using the **rotary knob** and **SET**, and then press **ESC**

12. Use the **rotary knob** and **SET** to select a waveform parameter.
Proceed to step 14.



- **Selecting a Calculation**

13. Use the **rotary knob** and **SET** to select a calculation number from Calc 1 to Calc 4.
You can select a calculation that you set using the procedure described in section 11.2.

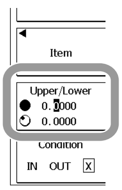


14. Press **ESC**.

Setting the Upper and Lower Limits for the Selected Waveform Parameters

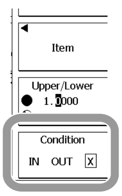
15. Press the **Upper/Lower** soft key to select the limit that you will set.

16. Use the **rotary knob** to set the upper and lower limits.



Selecting a Search Criterion

17. Press the **Condition** soft key, to select IN, OUT, or X.



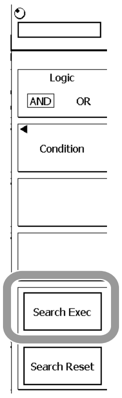
Repeat steps 5 to 17 for search conditions 1 to 4 as necessary.

18. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

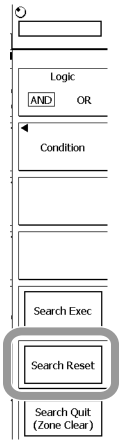
19. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

20. Press the **Search Abort** soft key to stop the search.



Resetting the Search

21. Press the **Search Reset** soft key to reset all search conditions.



Explanation

The SB5000 searches waveforms depending on whether or not the automatically measured waveform parameters (see section 11.2 for details) are within the range that you set.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Area and Calculation

- Area1 or Area2: Searches waveform parameter values.
- Calc: Searches values determined by calculations set in section 11.2.

Measurement Item

The selectable measurement items vary depending on the selected waveform parameter mode.

- When the Waveform Parameter Mode Is FlexRay Parameter
  See the explanation in section 11.1 for details.
- When the Waveform Parameter Mode is Basic, Continuous Statistics, History Statistics, or Cycle Statistics
  See the explanation in section 11.2 for details.

Upper and Lower Limits of the Waveform Parameters to Search

Selectable range of upper and lower limits: –1.0E+31 to 1.0E+31

Search Criterion

- IN: Searches for history waveforms whose waveform parameters are within the upper and lower limits.
- OUT: Searches for history waveforms whose waveform parameters are outside the upper and lower limits.
- X: Not used for the search.

Note

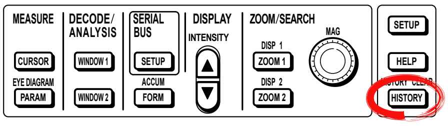
In the following circumstances, the Statistic soft key appears in the soft key menu in step 4 (when you press the Condition soft key), and the Area/Calc soft keys do not appear in step 9.

- When the waveform parameter mode is FlexRay and the test type is BUS (PARAM > Mode > FlexRay Parameter > Type > BUS; see section 11.1)
- When the waveform parameter mode is Cycle Statistics (PARAM > Mode = Cycle Statistics; see section 11.3)

Press the Statistic soft key and choose one of the following statistical operations.
Max (maximum value), Min (minimum value), Mean (mean value), σ (standard deviation)

12.6 Searching History Waveforms Using FFT Parameters (FFT History Search)

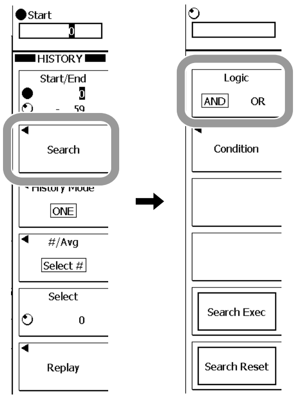
Procedure



1. Press **HISTORY**.

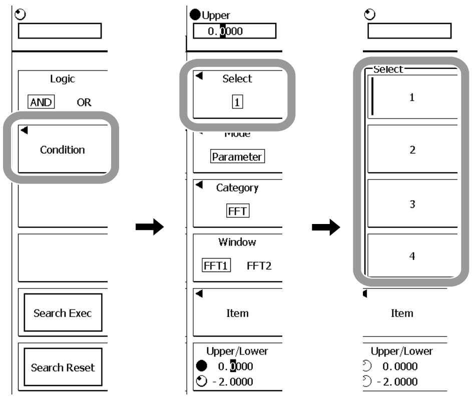
Selecting a Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.



Selecting the Search Condition Number

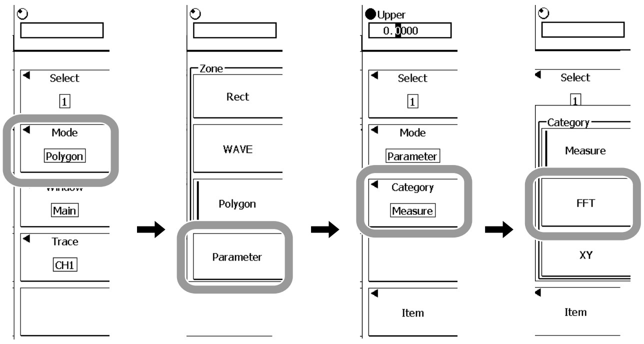
4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Press the appropriate condition number soft key.



Setting the Search Mode and Category

7. Press these soft keys: **Mode** > **Parameter**.
This sets the search mode to Parameter.

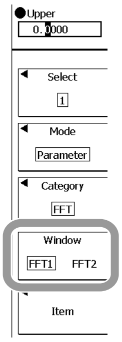
8. Press these soft keys: **Category** > **FFT**.
This sets the parameter category to FFT.



Selecting a Search Source Item and Calculation

- **Selecting the Source Window**

9. Press the **Window** soft key to select FFT1 (the results of the analysis of Window1) or FFT2 (the results of the analysis of Window2).

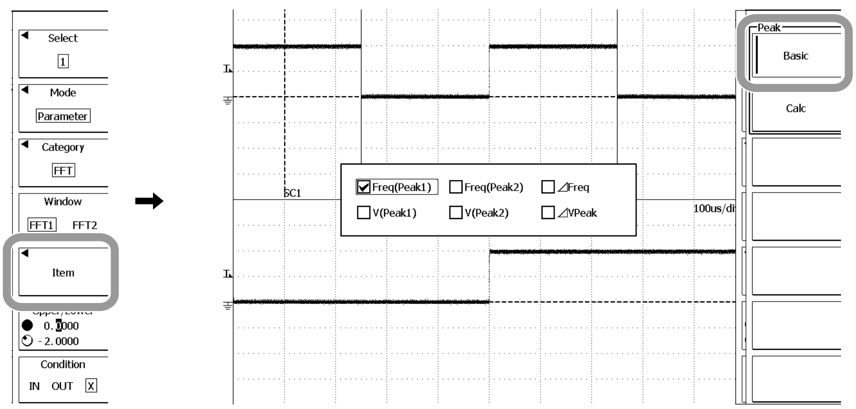


- **Selecting an Analysis Item**

10. Press the **Item** soft key.

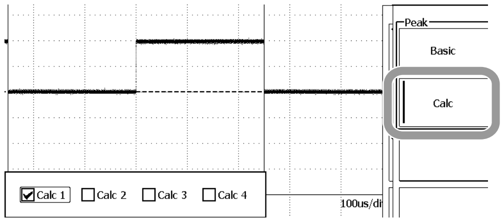
11. Press the **Basic** or **Calc** soft key.
- If you select Basic, proceed to step 12.
- If you select Calc, proceed to step 13.

12. Use the **rotary knob** and **SET** to select an analysis item.
Proceed to step 14.



- **Selecting a Calculation**

13. Use the **rotary knob** and **SET** to select a calculation.

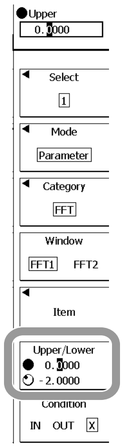


14. Press **ESC**.

Setting the Upper and Lower Limits for the Selected FFT Parameters

15. Press the **Upper/Lower** soft key to select the limit that you will set.

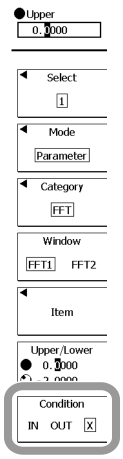
16. Use the **rotary knob** to set the upper and lower limits.



Selecting a Search Criterion

17. Press the **Condition** soft key, to select IN, OUT, or X.

18. Press **ESC** to return to the history search menu.



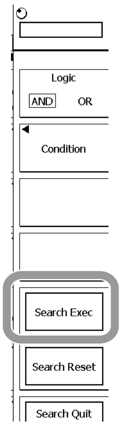
Repeat steps 5 to 18 for search conditions 1 to 4 as necessary.

19. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

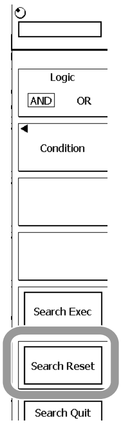
20. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

21. Press the **Search Abort** soft key to stop the search.



Resetting the Search

22. Press the **Search Reset** soft key to reset all search conditions.



Explanation

The SB5000 searches waveforms depending on whether or not the FFT analysis results (see section 11.15 for details) are within the range that you set.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Item and Calculation

- **Source Window**
  You can set the search window to FFT1 (the FFT of Window1) or FFT2 (the FFT of Window2).
- **Analysis Item**
  Select an analysis items that you want to use in the search.
  - Basic: Searches an FFT analysis result (Peak).
  - Calc: Searches a value determined by a calculation set in section 11.15.

Upper and Lower Limits of the FFT Parameters to Search

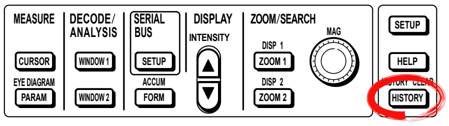
Selectable range of upper and lower limits: –1.0E+31 to 1.0E+31

Search Criterion

- IN: Searches for history waveforms whose FFT parameters are within the upper and lower limits.
- OUT: Searches for history waveforms whose FFT parameters are outside the upper and lower limits.
- X: Not used for the search.

12.7 Searching History Waveforms Using XY Waveform Parameters (XY History Search)

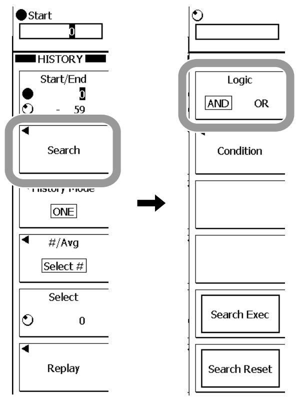
Procedure



1. Press **HISTORY**.

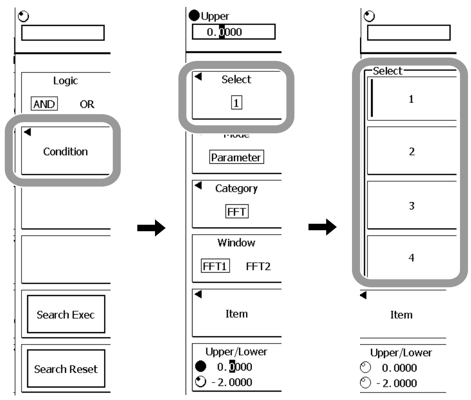
Selecting a Search Logic

2. Press the **Search** soft key.
3. Press the **Logic** soft key to select AND or OR.



Selecting the Search Condition Number

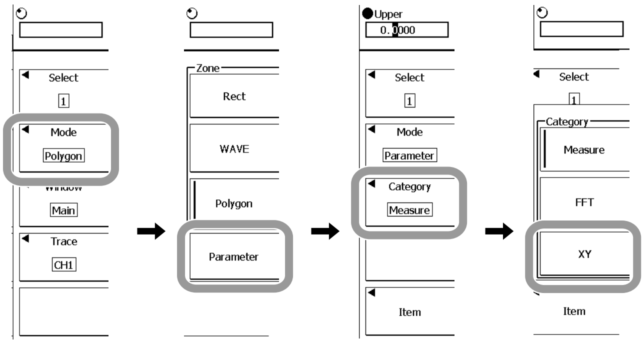
4. Press the **Condition** soft key.
5. Press the **Select** soft key.
6. Press the appropriate condition number soft key.



Setting the Search Mode and Category

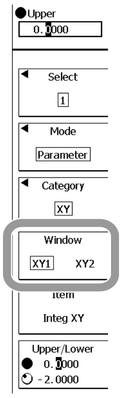
7. Press these soft keys: **Mode** > **Parameter**.
This sets the search mode to Parameter.

8. Press these soft keys: **Category** > **XY**.
This sets the parameter category to XY waveform parameters.



Selecting a Search Source Window

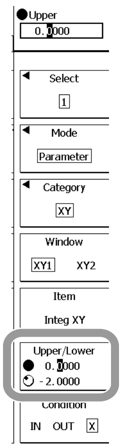
9. Press the **Window** soft key to select XY1 (the X-Y waveform of Window1) or XY2 (the X-Y waveform of Window2).



Setting the Upper and Lower Limits for the Selected XY Waveform Parameters

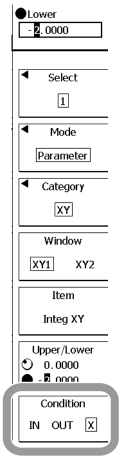
10. Press the **Upper/Lower** soft key to select the limit that you will set.

11. Use the **rotary knob** to set the upper and lower limits.



Selecting a Search Criterion

12. Press the **Condition** soft key, to select IN, OUT, or X.



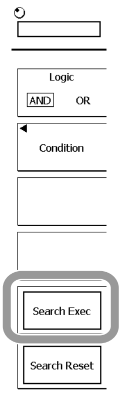
Repeat steps 5 to 12 for search conditions 1 to 4 as necessary.

13. Press **ESC** to return to the search execution menu.

Executing and Stopping the Search

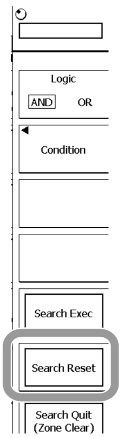
14. Press the **Search Exec** soft key to start the search.
The **Search Exec** soft key changes to the **Search Abort** soft key.

15. Press the **Search Abort** soft key to stop the search.



Resetting the Search

16. Press the **Search Reset** soft key to reset all search conditions.



12

Displaying and Searching History Waveforms

Explanation

The SB5000 searches waveforms depending on whether or not the computed values of the XY waveform area are within the range that you set.

Search Logic

- AND: Searches for history memory waveforms that meet all search conditions 1 to 4.
- OR: Searches for history memory waveforms that meet any of the search conditions from 1 to 4.

Search Condition Number

You can choose to configure a search condition from 1 to 4.

Search Source Window

You can set the search window to XY1 (the area of the XY waveform of Window1) or XY2 (the area of the XY waveform of Window2).

Upper and Lower Limits of the FFT Parameters to Search

Selectable range of upper and lower limits: –1.0E+31 to 1.0E+31

Search Criterion

- IN: Searches for history waveforms whose XY waveform area are within the upper and lower limits.
- OUT: Searches for history waveforms whose XY waveform area are outside the upper and lower limits.
- X: Not used for the search.

13.1 Installing the Roll Paper into the Built-in Printer (Optional)

Printer Roll Paper

Use a dedicated roll paper provided by YOKOGAWA. Do not use other types of roll paper. When you are using the printer for the first time, use the roll paper that came with the package. Order extra rolls from your nearest YOKOGAWA dealer.

Part No.:	B9850NX
Specifications:	Thermalsensible paper, 30 m
Minimum Quantity:	5 rolls

Handling the Roll Paper

The paper is a thermalsensible paper that changes color with the application of heat. Take note of the following points.

Storage Precautions

The paper starts changing color at around 70°C. It is affected by heat, humidity, light, and chemicals regardless of whether the paper has been used.

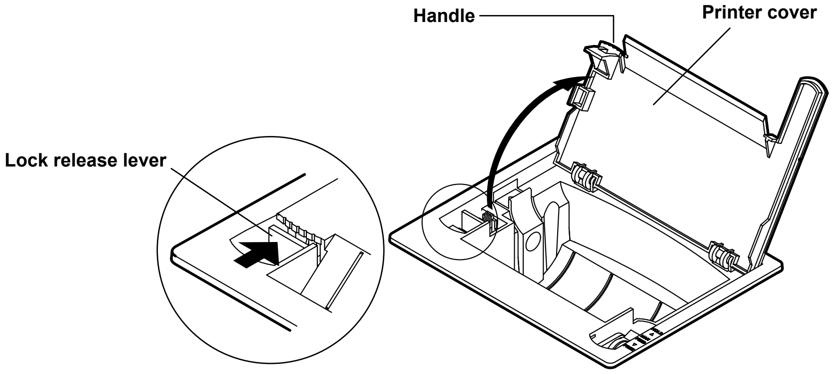
- Store the paper rolls in a cool, dry, and dark place.
- After opening the package, use it quickly.
- If the paper is left in contact with plastic film (such as a vinyl chloride film or Scotch tape) containing plasticizers for an extended time, the paper will lose some of its ability to reproduce color. If you are going to store the paper in a folder, for example, use a folder made of polypropylene or wood fiber.
- When using glue on the paper, do not use glue containing organic solvents such as alcohol or ether, as they will change the color of the paper.
- For prolonged storage, we suggest you make copies of the results printed on the roll paper. Due to the characteristics of the thermalsensible paper, it may lose color over time.

Handling Precautions

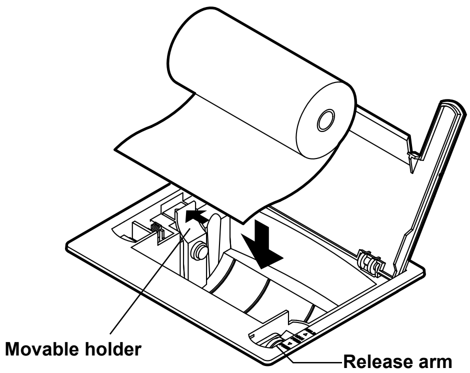
- Be sure to use only genuine paper rolls provided by YOKOGAWA.
- Touching the paper with sweaty hands can leave finger print marks or blur the printing.
- Rubbing the surface with a hard object can cause the paper to change color due to the heat caused by friction.
- If chemicals, oil, or other liquids come in contact with the paper, the paper may change color or the printing may fade.

Installing the Roll Paper

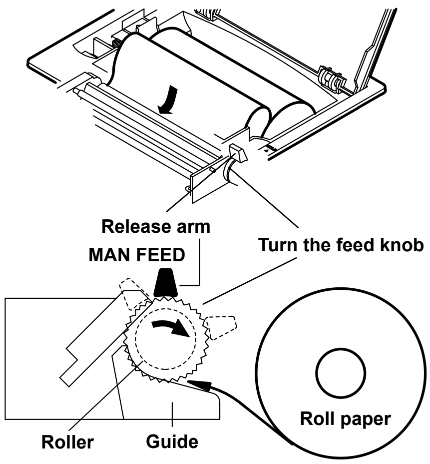
1. Open the printer cover by pulling up on the handle on the left side of the printer while pressing the lock release lever towards the arrow indicated by "OPEN."



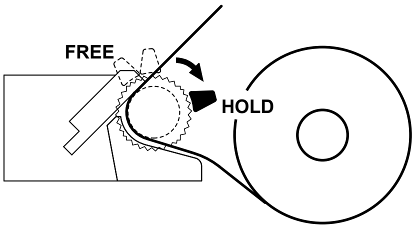
2. Move the release arm located near the right front to the "MAN FEED" position. Hold the roll of paper so that the inside of the paper (not the glossy side) is facing up. While pressing the movable holder on the left side of the roll storage space to the left, set the core in the right holder. Then, release the movable holder.



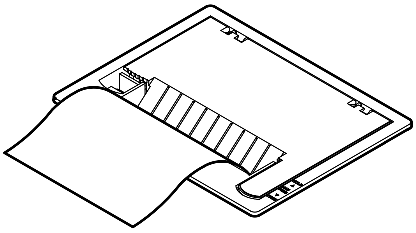
3. Insert the tip of the roll chart evenly in the space between the roller and the black guide and turn the feed knob away from you until 10 cm of the roll chart is showing at the top of the roller



4. Move the release arm to the "Free" position and straighten the roll chart. Then, move the release arm to the "HOLD" position. If the release arm is not in the "HOLD" position, an error message will be displayed at the time of printing. In this case, you will not be able to print



5. Move the printer cover from the back to the front and close the cover. Make sure that the tip of the roll sheet is showing from the opening in the printer cover. When closing the printer cover, press the cover firmly until it clicks

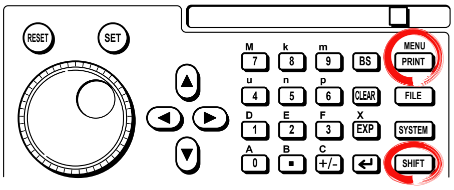


Note

Make sure to move the release arm to the HOLD position when closing the printer cover.

13.2 Printing Using the Built-in Printer (Optional)

Procedure

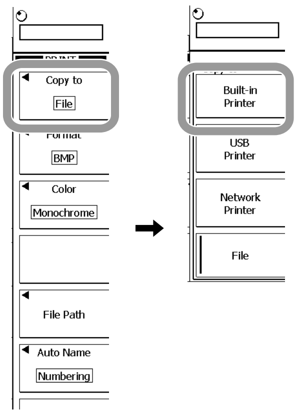


1. Press the **SHIFT + PRINT (MENU)**.

Selecting a Printer

2. Press the **Copy to** soft key.

3. Press the **Built-in Printer** soft key.



Setting the Print Resolution

4. Press the **High Reso (high resolution)** soft key to select ON or OFF.

Printing

5. Press **PRINT**.

The screen image is printed on the built-in printer.

To abort printing, press PRINT while printing is in progress.

While the data is being printed, the  is displayed at the lower left corner of the screen.

Explanation

Print Resolution

The High Reso setting allows the following pixel sizes to be printed.

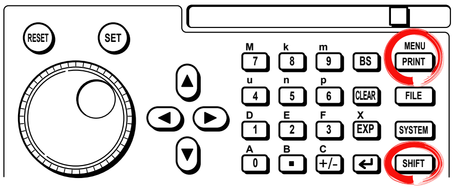
ON: 2048 × 768 monochrome printing

OFF: 1024 × 768 (XGA size) monochrome printing

Switching High Reso on or off does not affect the printing dimensions, and therefore when ON, the horizontal resolution is twice normal.

13.3 Printing Using a USB Printer

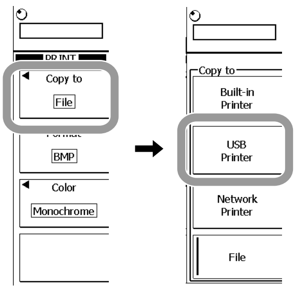
Procedure



1. Connect the SB5000 and a USB printer using a USB cable.

Selecting a Printer

2. Press the **SHIFT + PRINT (MENU)**.
3. Press the **Copy to** soft key.
4. Press the **USB printer** soft key.



Checking the Connected Printer

5. Press the **Printer** soft key.
6. Press the soft key corresponding to the connected printer.

Setting the Color

7. Press the **Color** soft key to select ON or OFF.

Printing

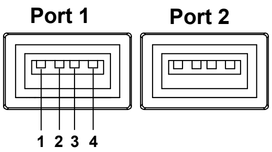
8. Press **PRINT**.
   The screen image is printed on the USB printer.
   To abort printing, press PRINT while printing is in progress.
   While the data is being printed, the  is displayed at the lower left corner of the screen.

Explanation

You can print the screen image to a USB printer with the USB interface.

USB Peripheral Connectors

To connect a USB printer to the SB5000, connect a USB cable to the USB Peripheral connector. There are two USB peripheral connectors (ports).



Pin No.	Signal Name
1	VBUS: + 5 V
2	D –: – Data
3	D +: + Data
4	GND: Ground

Printers That Can Be Used

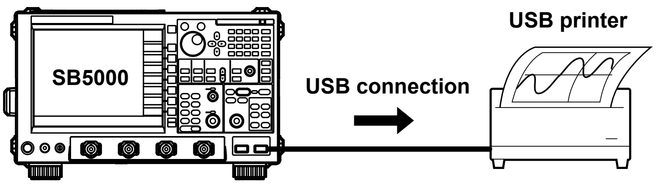
USB printers conforming to USB Printer Class Version 1.0.

Note

- Connect only the printers that are allowed.
- For details on USB printers that have been tested for compatibility, contact your nearest YOKOGAWA dealer.

Connection Procedure

When connecting a USB printer, directly connect the printer to the SB5000 using a USB cable as shown below. You can connect the USB cable regardless of whether the power to the SB5000 is ON or OFF (supports hot-plugging). Connect the type A connector of the USB cable to the SB5000; connect the type B connector to the printer. When the power switch is ON, the printer is detected and enabled after it is connected.



Note

- Connect the printer directly without going through a hub.
- Do not connect USB devices other than a compatible USB keyboard, USB mouse, USB printer, and USB storage to the USB connector for connecting peripheral devices.
- Do not connect multiple printers to the USB connector for connecting peripheral devices.
- Never turn OFF the printer or remove the USB cable while the printer is printing.
- Do not connect or disconnect the USB cable after the power is turned ON until key operation is ready (approximately 20 to 30 s).

Color

Select one from the following.

ON: Prints the image using same colors as the screen (no background color and grid printed in black).

OFF: Prints the image using the same colors as the image printed using the built-in printer.

Precautions When Printing with a USB Printer

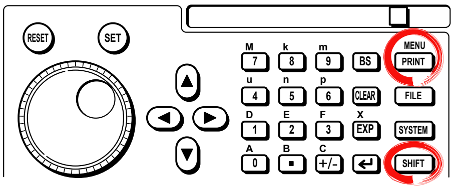
- Images may not print properly on some printers. Use USB printers that have been tested for compatibility.
- You can print with a USB printer connected to a computer. In section 14.9, save the screen image data to a storage medium, read the data into a computer, and then print.

Note

The SB5000 may not be able to detect “out of paper” and printer errors on the USB printer. If an error occurs, press PRINT again to stop the printing.

13.4 Printing Using a Network Printer(Optional)

Procedure



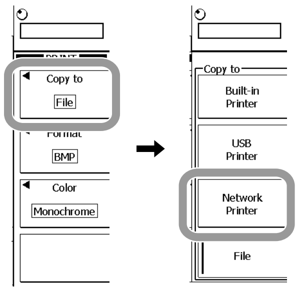
1. Connect the instrument to the network. For details, see section 16.1.

Selecting a Printer

2. Press **SHIFT + PRINT (MENU)**.

3. Press the **Copy to** soft key.

4. Press the **Network Printer** soft key.



Setting Up the Connected Printer

5. Press the **Printer** soft key.

6. Press the soft key corresponding to connected printer.

Setting Colors (for Color Printers)

7. Press the **Color** soft key and select ON or OFF.

Printing

8. Press **PRINT**.
The screen is printed on the network printer.
To cancel printing, press PRINT again during printing.
During printing,  is displayed in the lower left part of the screen.

Explanation

This function is supported when an Ethernet option (/C8 or /C10) is installed. You can print out an image of the screen on a network printer.

Connecting to a Network Printer

The network printer must be set up in advance according to the instructions in section 16.8.

Supported Printers

The following printers can be connected.
HP Inkjet printers
HP Laser printers (monochrome)

14.1 Flash ATA Memory Card

PC Cards That Can Be Used

The SB5000 supports flash ATA cards (PC card TYPE II) and compact flash (using the PC card TYPE II adapter). In addition, some of the Flash ATA HDD cards can be used. For details, contact your nearest YOKOGAWA dealer.

Note

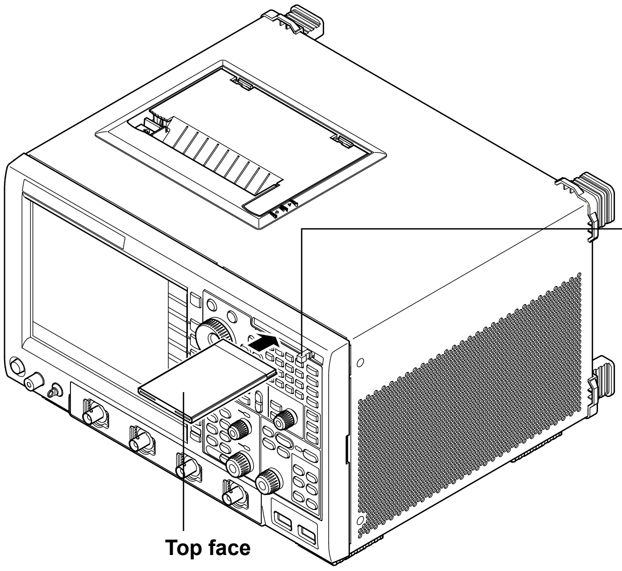
Make sure that the PC (personal computer) card that you use is compatible with the PC that you are using. The PC cards mentioned above may not work properly with all PCs. Check it beforehand.

Inserting the PC Card

With the front side of the PC card facing up, insert the PC card into the drive.
There is a PC card drive is located on the front panel and the rear panel of the SB5000.

Ejecting the PC Card

Check that the PC card is not being accessed, and press the PC card eject button to the right of the drive.



CAUTION

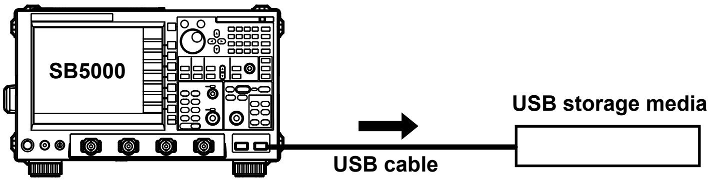
- The SB5000 may malfunction if the PC card is inserted and ejected within a 1-second time period.
- Removing the PC card while it is being accessed may destroy the data on the PC card.

General Handling Precautions of PC Cards

For the general handling precautions of the PC card, read the instruction manual that came with the PC card.

14.2 Connecting a USB Storage Medium to the USB Port

When connecting a USB storage medium, directly connect the device to the USB port of SB5000 using a USB cable as described below. You can connect/disconnect the USB cable at any time, regardless of the power ON/OFF state of the SB5000 (supports hot-plugging). Connect the type A connector of the USB cable to the SB5000; connect the type B connector to the USB storage. When the power switch is ON, the USB storage is detected and enabled.



Note

- Connect the MO disk drive or hard disk directly without going through a USB hub.
- Do not connect USB devices other than a compatible USB keyboard, USB mouse, USB printer, and USB storage to the USB connector for connecting peripheral devices.
- Do not connect and disconnect multiple USB devices in succession. Wait at least 10 seconds between devices.
- Do not connect or disconnect the USB cable after the power is turned ON until key operation is ready (approximately 20 to 30 s).
- USB storage that is compliant with USB Mass Storage Class Ver 1.1 can be used.
- The total number of PC cards and USB storage media that the SB5000 can handle is up to four. If the storage media is partitioned, the total number includes each partition. This is because each partition is handled as a separate storage medium.

Checking the Connected USB Storage Medium

Press **FILE**. The available media are displayed.

14.3 Connecting to a Network Drive

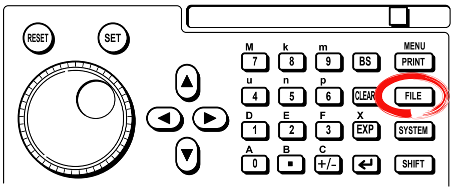
You can connect the SB5000 to a network drive for storing and loading data such as setup data, measurement data, analysis data, and screen image data.
For details on connecting the SB5000 to a network drive, see section 16.3

14.4 Saving/Loading the Setup Data

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

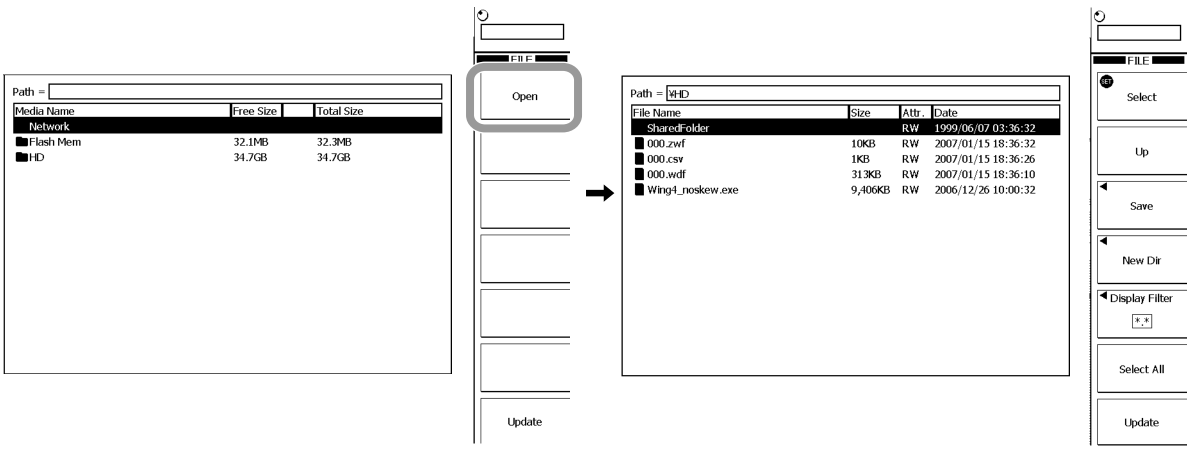


Saving the Setup Data

1. Press **FILE**.

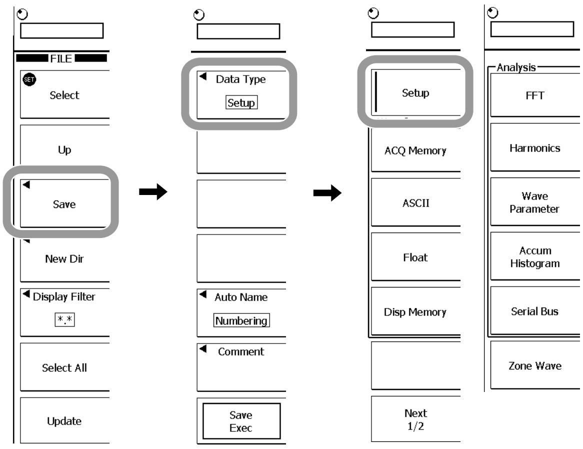
Selecting the Save Destination Storage Medium/Directory

2. Using the **rotary knob**, select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
   The selected medium/directory is displayed in “Path=......” located in the upper-left of the File List window.
   Press the Up soft key to move to the parent directory.



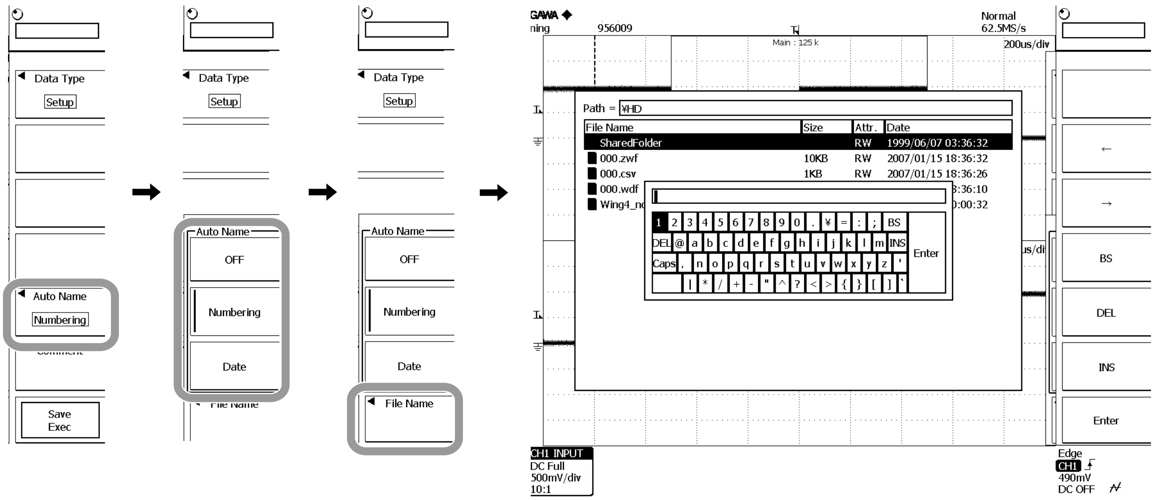
Setting the Data Type

4. To set the data type to setup, press these soft keys: **Save** > **Data Type** > **Setup**.



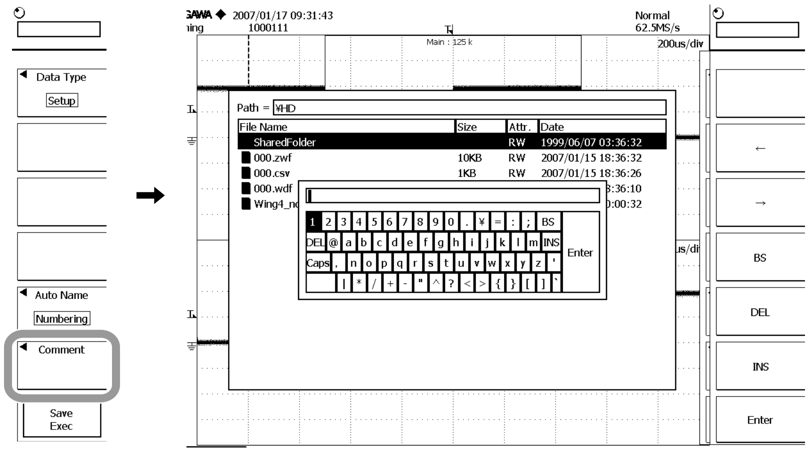
Setting the File Name

5. Press the **Auto Name** soft key. A menu used to select the file name setting method appears.
6. Press a soft key from **OFF** to **Date** to select the auto naming function.
   If you select Date, the date on which the file is saved becomes the file name. If you select Numbering, a sequential number is automatically added after the file name that was specified.
   If you select Date, proceed to step 10.
7. Press the **File Name** soft key.
8. Enter the file name as described in section 4.2.
9. Press **Enter**. Confirm the file name that was entered.
10. Press **ESC**.



Setting a Comment

11. Press the **Comment** soft key.
12. Enter a comment up to 160 characters long as described in section 4.2, and then press Enter.
13. Press **ESC** to return to the previous screen.



Executing the Save

14. Press the **Save Exec** soft key.
   The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Save Abort soft key.
   While the data is being saved, the media access icon is displayed at the lower left corner of the screen.

Aborting a Save

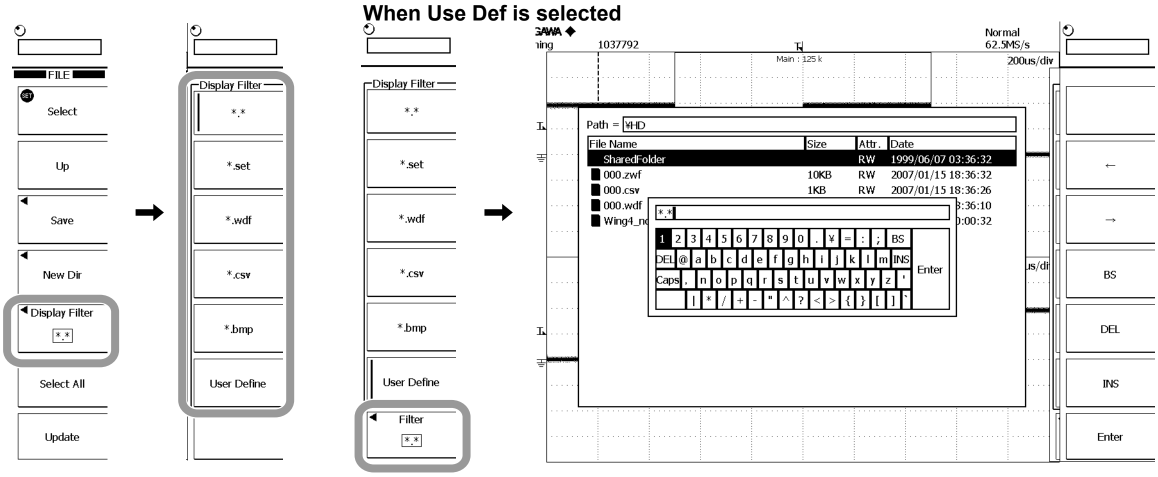
15. Press the **Save Abort** soft key.
   The save operation is aborted. At the same time, the Save Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

You can specify the format of files to be displayed in the file list. Set it as necessary.

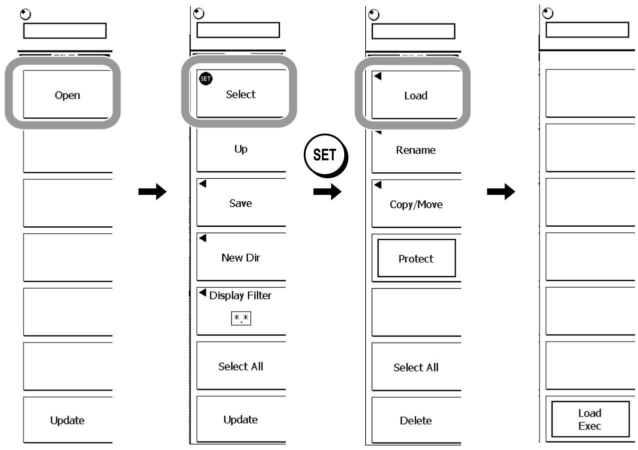
16. On a screen that displays the File List dialog box, press the **Display Filter** soft key.
17. Press the soft key that corresponds to the extension of the files you want to view.
   To specify a user-defined file type, press the **User Def** soft key.
18. Press the **Filter** soft key.
19. Enter the file type as described in section 4.2, and then press Enter.

When Use Def is selected



Loading the Setup Data

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the **rotary knob**, select the file to be loaded.
3. Press the **Select** soft key or **SET**.
   A menu of file operations appears.
4. Press the **Load** soft key.



Executing the Load

5. Press the **Load EXEC** soft key.
   The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Load Abort soft key.

Aborting a Load

6. Press the **Load Abort** soft key.
   The load operation is aborted. At the same time, the Load Abort soft key changes to the Load EXEC soft key.

14

Saving and Loading Measurement Data

Explanation

Setup Data That Are Saved

The current setup data can be saved. However, setup data such as the date/time and communications settings are not saved.

Number of Bytes Required for a Save

Approx. 64 KB

Storage Medium and Directory

Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media

[Flash Mem]:	Internal Memory
[Storage Card]:	PC card
[HD]:	Built-in Hard Disk (Optional)
[Network]:	Network drive (when the Ethernet interface option is installed)
[USB Storage]:	USB Storage

File Name

The number of characters that can be used for a file or directory name is up to 64 characters from the beginning of the entered characters. However, the following conditions apply.

- The types of characters that can be used are 0 to 9, A to Z, a to z, _, -, =, (,), {, }, [,], #, $, %, &, ~, !, ', and @ on the keyboard that appears on screen.
  † Multiple @ characters cannot be entered consecutively.
- The following character strings cannot be used due to the limitation of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, and COM9.
- Make sure that the full path name (absolute path name from the root directory) is within 260 characters. If 260 characters is exceeded, an error occurs when you execute a file operation (save, copy, rename, create directory, etc.).
  Full path name: If you are operating a directory, specify up to the directory name.
  If you are operating a file, specify up to the file name.
- The length of the character string displayed in the entry box of the keyboard that is shown on the screen is 36.

If you use the auto naming function of file names, the following conditions are added.

- If you set auto naming to Numbering, eight-character file names are used consisting of the first five characters entered as the file name and a three-digit serial number.
- If auto naming is set to Date (date/time), the characters entered as the file name are not used. The file name will only consist of the date information.

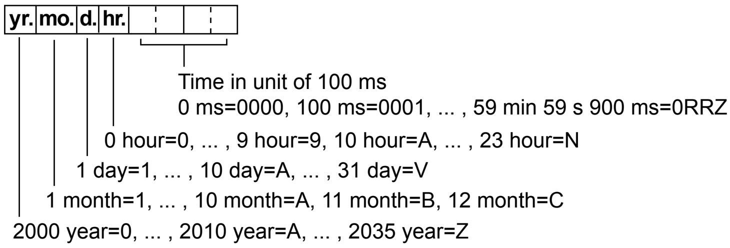
Auto Naming Function

Select one of the following three:

OFF: The name specified in File Name is assigned to the file.

Numbering: The file is saved with a three-digit number from 000 to 999 that is assigned automatically. You can specify a common name (up to five characters, specified through File Name) that is placed before the number.

Date: An 8-character file name based on the date and time is assigned using the numbers 0 to 9 and the letters A to Z as shown below. (Any file name specified for File Name is ignored.)



Comments

A comment of up to 160 characters can be added and saved. Comments are optional. All characters (including spaces) can be used.

Caution When Saving Data

A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

Extensions for Setup Data

The .set extension is automatically added to the file name.

Specifying the Files to Be Displayed in the File List Dialog Box

Specify the type of files to be displayed.

*.set: Displays only setup data files.

*.wdf: Displays only measurement data files (ACQ Memory).

*.csv: Displays only csv files.

*.bmp: Displays only bitmap files.

User Def: Displays files with user-defined content.
“*” and “?” can be used as wildcard characters.

.: Displays all the files in the storage medium/directory.

Note

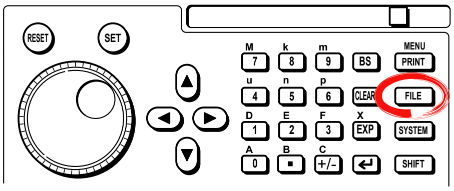
- An error occurs if a key other than the Abort key is pressed while saving or loading a file.
- Saving and Loading is not possible while data acquisition is in progress.
- If you change the extension of the file (using a PC, for example), the file can no longer be loaded.
- Up to 36 characters can be displayed in the path.
- If the setup data that is saved to a file is loaded, the settings of the keys are changed to the loaded information and cannot be undone. It is recommended that you first save the current setup data and then load the setup data from a file.
- Setup data concerning the date and time, communications, menu language, message language and USB keyboard language is not saved Therefore, loading setup data from a file will not change these settings.

14.5 Saving/Loading the Measurement Data

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

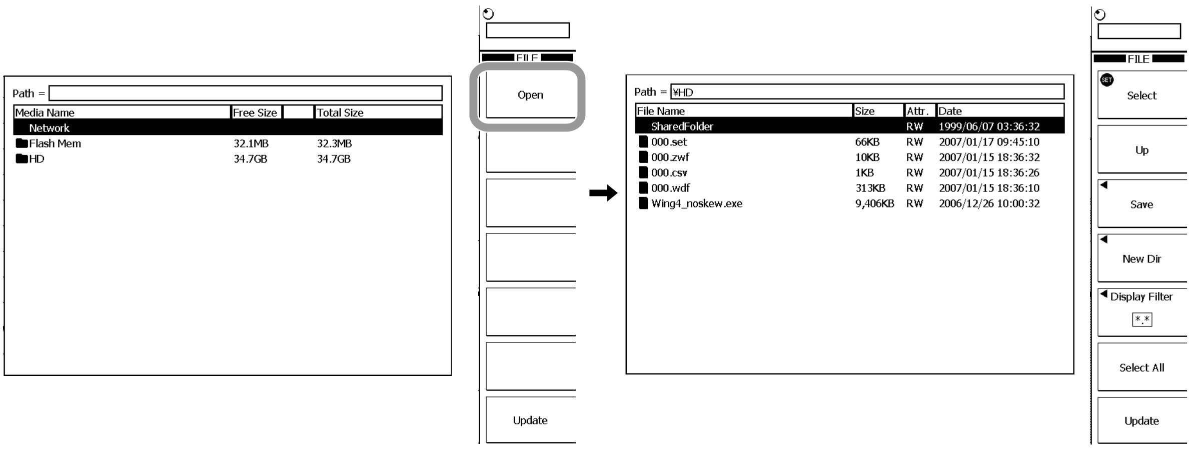


Saving the Measurement Data

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

2. Use the **rotary knob** to select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
   The selected medium/directory is displayed in “Path=......” located in the upper-left of the File List window.
   Press the Up soft key to move to the parent directory.



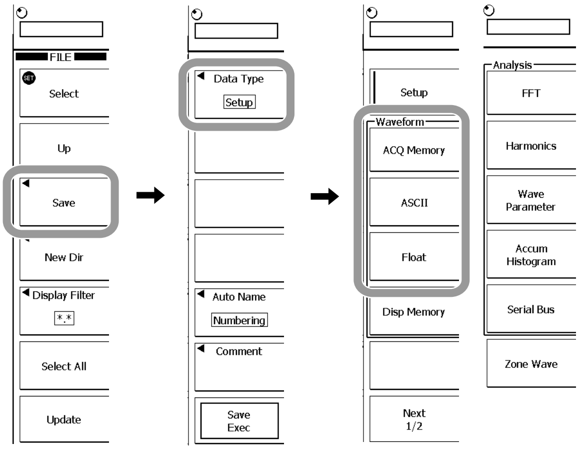
Setting the Data Type

4. Press these soft keys: **Save** > **Data Type**.

5. Press the **ACQ Memory**, **ASCII**, or **Float** soft key to select the data type.

Note

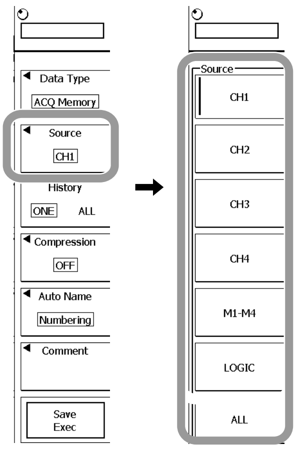
ACQ Memory data can be saved and loaded, ASCII data and floating point data can only be saved.



Selecting a Measurement data to be Saved

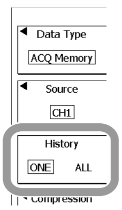
6. Press the **Source** soft key.

7. Press the appropriate channel soft key.
To specify M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.
LOGIC appears only if ACQ Memory or ASCII is selected in step 5.



Selecting the History Waveform

8. Press the **History** soft key to save all the data in the history memory (ALL) or save only the single displayed waveform (ONE).



If you select ASCII in step 5, proceed to step 9. Otherwise, proceed to step 13.

Selecting the Save Range and Selecting Compression or Decimation

(If ASCII is selected in step 5)

9. Press the **Compression & Range** soft key.

10. Press **Main**, **Z1**, or **Z2** soft key to select the waveform to be saved.

11. To save the data using compression, press the **P-P** soft key. To save the data using decimation, press the **Decim** soft key.

If you select LOGIC in step 7, “State” appears in place of Decim. If you select State, only the state data (see page 14-15) is saved.

12. Press **ESC** to return to the previous screen.

Proceed to step 15.

Compressing or Decimating the Data and Saving the Data

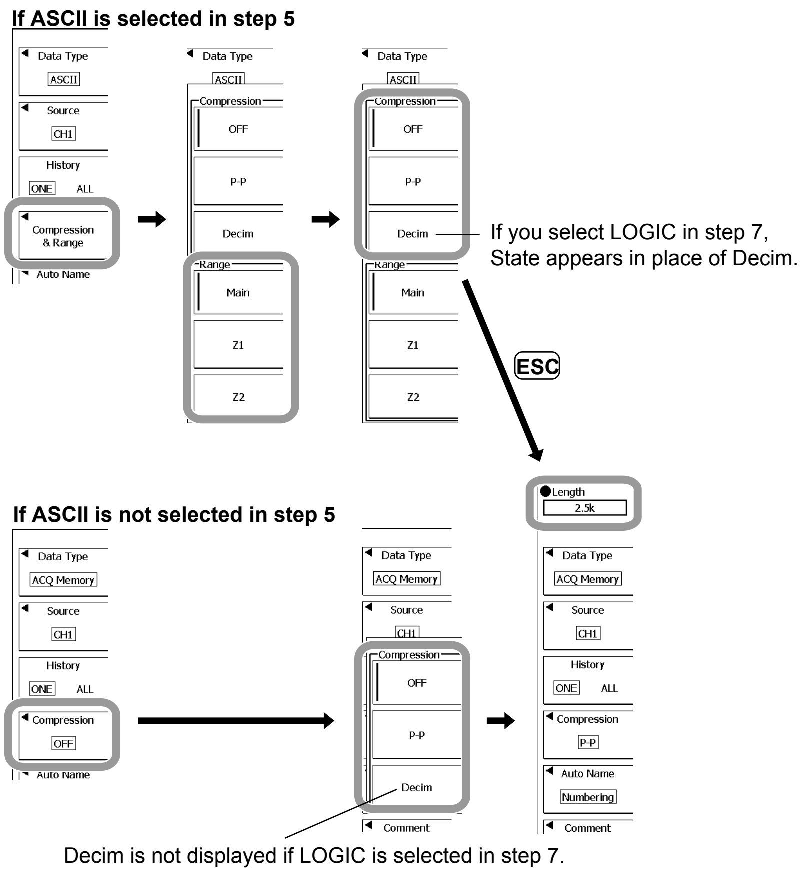
(If ASCII is not selected in step 5)

13. Press the **Compression** soft key.

14. To save the data using compression, press the **P-P** soft key. To save the data using decimation, press the **Decim** soft key.

Decim is not displayed if LOGIC is selected in step 7.

15. Use the **rotary knob** to set the record length after compression or decimation. The data is compressed or decimated so that the record length is set to the specified value and saved.



Setting a File Name and Comments

16. Set the file name and comments according to steps 5 to 13 in section 14.4.

Executing the Save

17. Press the **Save Exec** soft key.
The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Save Abort soft key.
While the data is being saved, the file access icon is displayed at the lower left corner of the screen.

Aborting a Save

18. Press the **Save Abort** soft key.
The save operation is aborted. At the same time, the Save Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

19. Specify the files you want to display according to steps 16 to 19 in section 14.4.

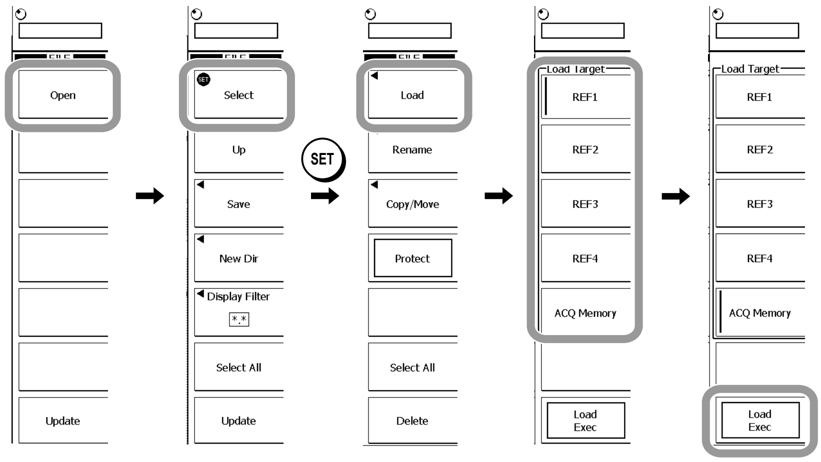
Loading Measurement Data

1. Press **FILE**.

2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.

3. Press the **Select** soft key or **SET**.
A menu of file operations appears.

4. Press the **Load** soft key.



Selecting the Load Destination

5. Select the acquisition memory (ACQ Memory) or a reference waveform number for the measurement data to be loaded.
- When a reference waveform number is selected, the measurement data is loaded as a reference waveform.
- Select ACQ Memory to load data saved using LOGIC or ALL.

Executing the Load

6. Press the **Load EXEC** soft key.
The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Load Abort soft key.

Aborting a Load

7. Press the **Load Abort** soft key.
The load operation is aborted. At the same time, the Load Abort soft key changes to the Load EXEC soft key.

Explanation

Data Type

- **ACQ Memory**
  - The sampled data in the acquisition memory is saved in binary format.
  - The data that is saved can be loaded into the SB5000. Then, the SB5000 can display the waveform and compute the numeric data.
  - You can use the Xviewer software application by YOKOGAWA to analyze waveforms on a PC. For details, contact your nearest YOKOGAWA dealer. A trial version is available at the YOKOGAWA's Website.
  - The extension is .wdf.

- **ASCII**
  - The units of the sampled data in the acquisition memory are converted per the specified range and saved in ASCII format. The data can be used to analyze the waveform on a PC.
  - The file cannot be loaded into the SB5000.
  - The extension is .csv.

- **Float**
  - The units of the sampled data in the acquisition memory are converted per the specified range and saved in 32-bit floating format. The data can be used to analyze the waveform on a PC.
  - The order of the data is little-endian (Intel format).
  - The file cannot be loaded into the SB5000.
  - The extension is .fld.

Data Size

The following table shows the data size when the record length is set to 125 kW, measurement data of CH1 to CH4 and LOGIC are saved, and using history waveform 1 condition.

Data Type	Extension	Data Size (Bytes)
ACQ Memory	.wdf	Approx. 1.5 to 2 M ((125 kW + 12) × 4 channels × the number of history waveforms × 2 + 150 K + data size of LOGIC*) * (125 kW + 12) × 2 if state (see section 6.17) is OFF or (125 kW + 12) × 4 if state is ON.
ASCII	.csv	15 to 20 M
Float	.fld	Approx. 2 M (((125 kW + 12) × 4) × the number of history waveforms × 4)

Waveforms to Be Saved

- You can save all waveforms or select waveforms from CH1 to CH4, M1 to M4, and LOGIC. The LOGIC waveform can only be saved if the data type is set to ACQ Memory or ASCII.
- The setup data including vertical axis, horizontal axis, and trigger of the waveform to be saved is also saved.
- For waveforms that are loaded using the history memory function, you can select whether to save all of the history data, or save just the current displayed waveform on the screen. You can also save only the results obtained by searching the history memory data. For details on searching history memory data, see Chapter 12.
- If you select all waveforms, the displayed waveforms from CH1 to CH4, M1 to M4, and LOGIC are saved. However, computed waveforms that use CH2 or CH4 as sources cannot be saved in interleave mode.

Decimating and Saving Data

Saves the data by decimating the data.

The data that has been decimated and saved cannot be loaded to the acquisition memory of the SB5000.

Decimation is not supported for logic measurement data. If ALL is selected for the waveform to be saved, the logic measurement data is P-P compressed.

Compressing and Saving Data

You can select whether to P-P compress the waveform data before saving.

The data that has been compressed and saved cannot be loaded to the acquisition memory of the SB5000.

Compressed Size

You can select the compressed size from the following:

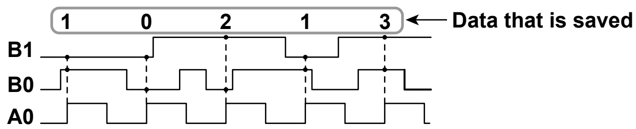
2.5 k, 6.25 k, 12.5 k, 62.5 k, 125 k, 250 k, 625 k, 1.25 M, 2.5 M, 6.25 M

If the record length and the compressed size are the same, the data is saved without compression.

State Data of the Logic Signal

If the logic signal is to be saved and the data type is set to ASCII, the state of the logic signal that is acquired at the edge of the specified clock signal is saved as data.

Example Clock: A0, data: B0 and B1, polarity:



Storage Medium and Directory

Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media

Same as the explanation given in “Display Examples of Storage Media” of section 14.4.

File Name/Comment

See the explanations for “File Name” and “Comment” in section 14.4.

Specifying the Files to Be Displayed in the File List Dialog Box

See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

Note

- An error occurs if a key other than the Abort key is pressed while saving or loading a file. When measurement data is loaded, the accumulation setting is always OFF.
- If you change the extension of the saved data (using a PC, for example), the file can no longer be loaded.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

Data Format When Storing Multiple Records

When multiple records are stored (history memory, for example), the following data format is used.

ASCII Format: CR+LF is inserted between records.

<Header>
Measured data 1-1 of CH1, Measured data 1-1 of CH2, Measured data 1-1 of CH3, ... , [CR+LF]
Measured data 1-2 of CH1, Measured data 1-2 of CH2, Measured data 1-2 of CH3, ... , [CR+LF]
⋮
Measured data 1-m of CH1, Measured data 1-m of CH2, Measured data 1-m of CH3, ... , [CR+LF]
Record 1
[CR+LF]
Measured data 2-1 of CH1, Measured data 2-1 of CH2, Measured data 2-1 of CH3, ... , [CR+LF]
Measured data 2-2 of CH1, Measured data 2-2 of CH2, Measured data 2-2 of CH3, ... , [CR+LF]
⋮
Measured data 2-n of CH1, Measured data 2-n of CH2, Measured data 2-n of CH3, … , [CR+LF]
Record 2
[CR+LF]
⋮

Float Format: Stored in blocks of channels.

Measured data of record 1 of CH1
Measured data of record 2 of CH1
⋮
Measured data of record N of CH1
Measured data of record 1 of CH2
Measured data of record 2 of CH2
⋮
Measured data of record N of CH2
⋮

Loading Measurement Data

Measurement data saved on a storage media or in internal memory can be loaded and displayed. Reference waveforms or the acquisition memory can be used as the load destination. Data that was saved with the Source set to ALL or LOGIC cannot be loaded as a reference waveform. Also, data that has been compressed for storage cannot be loaded into the acquisition memory.

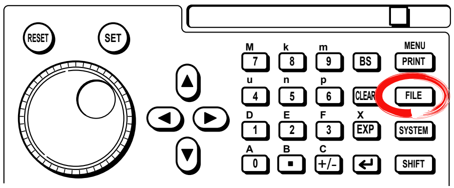
When waveform acquisition is started, any data loaded into the acquisition memory will be overwritten.

14.6 Saving and Loading Accumulated and Snapshot Waveforms

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

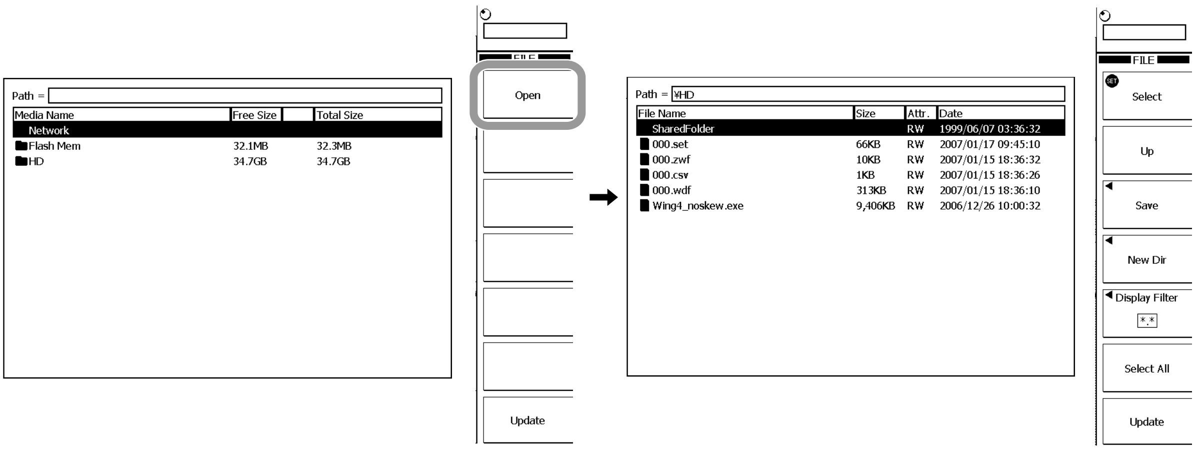


Saving Waveforms

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

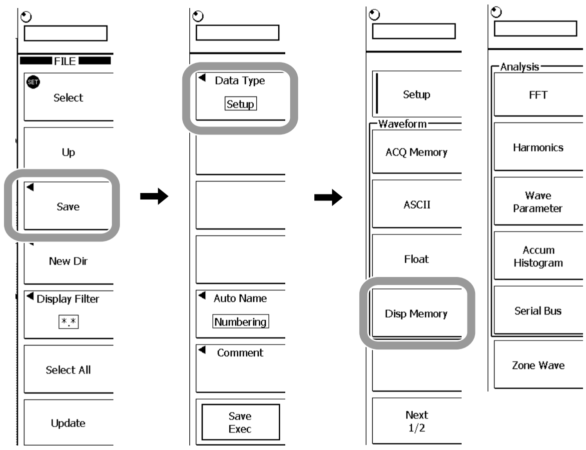
2. Use the **rotary knob** to select the save destination storage medium.
3. Press the **Open** soft key to confirm the storage medium.
   When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
   The selected medium/directory is displayed in "Path=......" located in the upper-left of the File List window.
   Press the Up soft key to move to the parent directory.



14 Saving and Loading Measurement Data

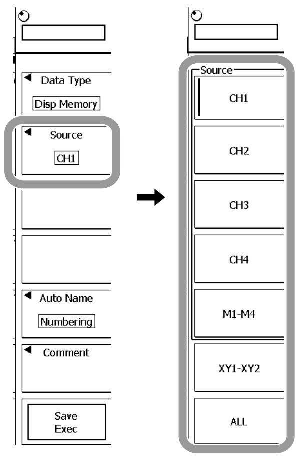
Setting the Data Type

4. To set the data type to displayed waveform, press these soft keys: **Save** > **Data Type** > **Disp Memory**.



Selecting a Waveform to be Saved

5. Press the **Source** soft key.
6. Press the appropriate channel soft key.
   To specify M1 to M4, first switch to **M1-M4** by pressing the corresponding soft key.
   To save the XY display of an waveform, first switch to XY1 to XY2 by pressing the **XY1-XY2** soft key and then specify the soft key corresponding to the desired storage location.
   Logic signals are saved only if ALL is specified.



Setting a File Name and Comments

7. Set the file name and comments according to steps 5 to 13 in section 14.4.

Executing the Save

8. Press the **Save Exec** soft key.
The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Save Abort soft key.
While the data is being saved, the file access icon is displayed at the lower left corner of the screen.

Aborting a Save

9. Press the **Save Abort** soft key.
The save operation is aborted. At the same time, the Save Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

10. Specify the files you want to display according to steps 16 to 19 in section 14.4.

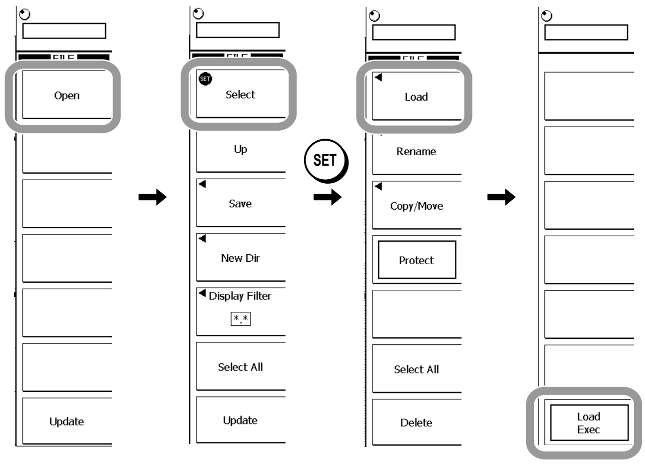
Loading Accumulated Waveform

1. Press **FILE**.

2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.

3. Press the **Select** soft key or **SET**.
A menu of file operations appears.

4. Press the **Load** soft key.



Executing the Load

5. Press the **Load EXEC** soft key.
The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Load Abort soft key.

Aborting a Load

6. Press the **Load Abort** soft key.
The load operation is aborted. At the same time, the Load Abort soft key changes to the Load EXEC soft key.

Unloading Waveforms

7. To unload waveforms that have been loaded, press **ACCUM** on the front panel, and then press the **Load/Unload** soft key.

In the menu that appears, press the **Unload** soft key to clear the waveforms from the screen.

Explanation

Storage Medium and Directory

Storage media in which saving and loading are possible are displayed on the File List window.

Display Examples of Storage Media

Same as the explanation given in “Display Examples of Storage Media” of section 14.4.

File Name and Comments

See the explanations for “File Name” and “Comment” in section 14.4.

Specifying the Files to Be Displayed in the File List Dialog Box

See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

Note

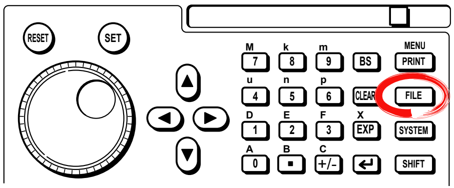
- An error occurs if a key other than the Abort key is pressed while saving or loading a file.
- When measurement data is loaded, the accumulate setting is always OFF.
- If you change the extension of the saved data (using a PC, for example), the file can no longer be loaded.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

14.7 Saving/Loading Waveform Zones, Polygon Zones, and Mask Patterns

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure



Saving a Zone

1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

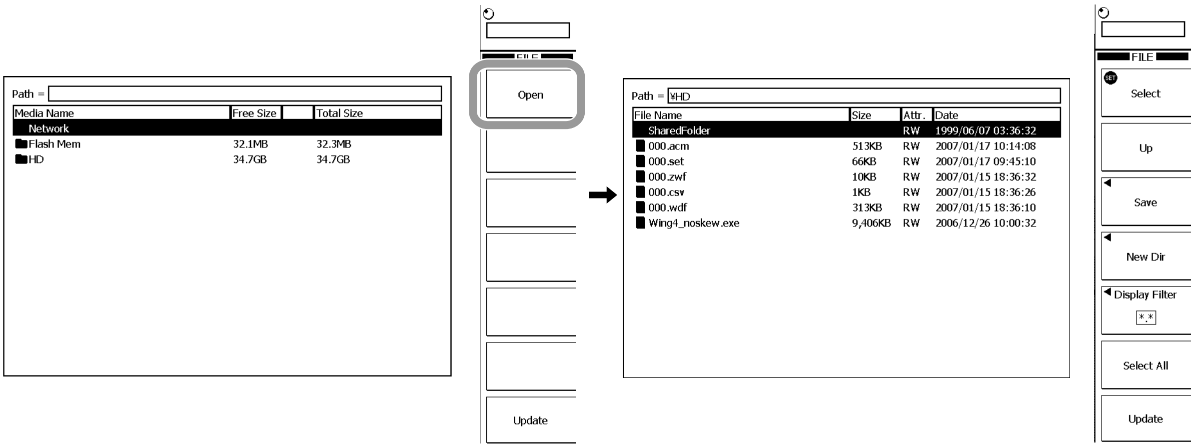
2. Use the **rotary knob** to select the save destination storage medium.

3. Press the **Open** soft key to confirm the storage medium.

When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.

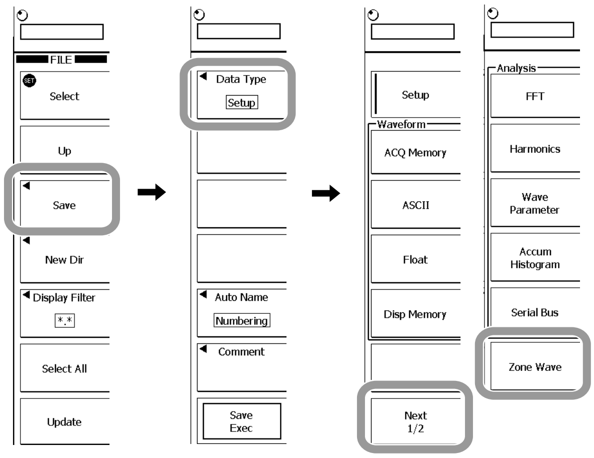
The selected medium/directory is displayed in “Path=......” located in the upper-left of the File List window.

Press the Up soft key to move to the parent directory.



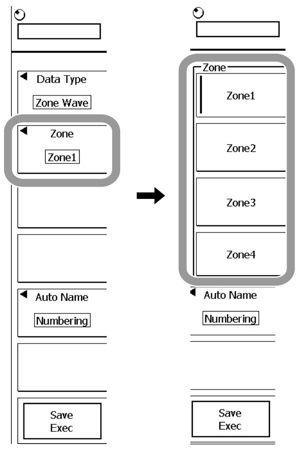
Setting the Data Type

4. To set the data type to zone, press these soft keys: **Save** > **Data Type** > **Next 1/2** > **Zone Wave**.



Selecting a Zone To Be Saved

5. Press the **Zone** soft key.
6. Press a zone number soft key to select the zone you want to save.



Setting a File Name and Comments

7. Set the file name and comments according to steps 5 to 13 in section 14.4.

Executing the Save

8. Press the **Save Exec** soft key.
   The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Save Abort soft key.
   While the data is being saved, the file access icon is displayed at the lower left corner of the screen.

Aborting a Save

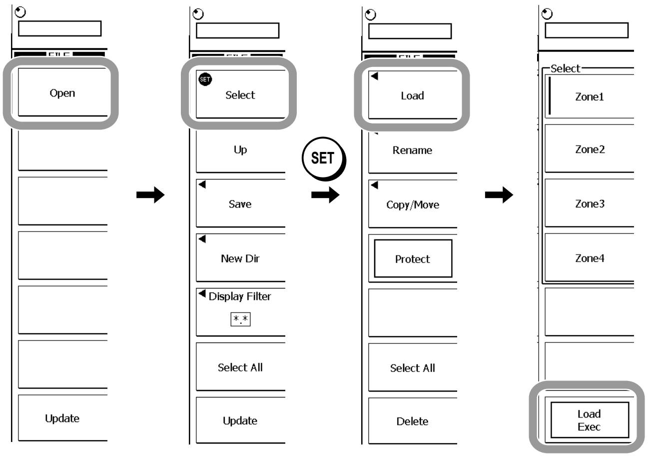
9. Press the **Save Abort** soft key.
   The save operation is aborted. At the same time, the Save Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

10. Specify the files you want to display according to steps 16 to 19 in section 14.4.

Loading the Waveform Zone

1. Press **FILE**.
2. Using the **Up** and **Open** soft keys and the rotary knob, select the file to be loaded.
3. Press the **Select** soft key or **SET**. A menu of file operations appears.
4. Press the **Load** soft key.



Selecting the Load Destination

5. Press the soft key that corresponds to zone number that you want to load into.

Executing the Load

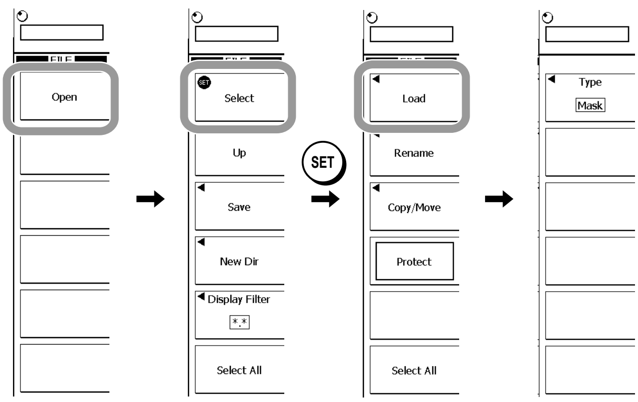
6. Press the **Load EXEC** soft key.
   The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Load Abort soft key.

Aborting a Load

7. Press the **Load Abort** soft key.
   The load operation is aborted. At the same time, the Load Abort soft key changes to the Load EXEC soft key.

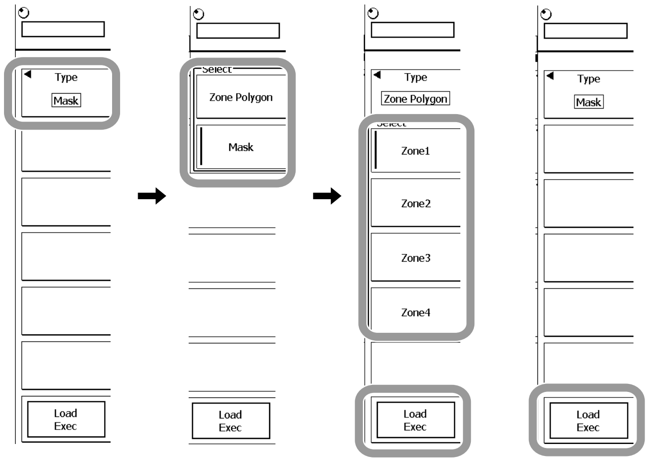
Loading the Polygon Zone or Mask Pattern

1. Select the file to be loaded in the same manner as for Loading the Waveform Zone above.
2. Press **Select** soft key or **SET**.
   A menu of file operations appears.
3. Press the **Load** soft key.



Selecting the Data Type

4. Press the **Type** soft key.
5. Press the **Zone Polygon** or **Mask** soft key to select the data type.
6. If you select Zone Polygon in step 5, select a zone number.



Executing the Load

7. Press the **Load EXEC** soft key.
   The selected file is read from the directory indicated in Path=...... At the same time, the Load EXEC soft key changes to the Load Abort soft key.

Aborting a Load

8. Press the **Load Abort** soft key.
   The load operation is aborted. At the same time, the Load Abort soft key changes to the Load EXEC soft key.

Explanation

You can search for GO/NO-GO determination and history waveform, and save and load waveform zones that are used for zoom and search. The waveform zone can be saved in Zone 1 through Zone 4.

Savable waveform zones

Waveform zones

Loadable zones and pattern

Waveform zones, polygon zones, and mask patterns

Data File Name Extensions

Waveform zones: .ZWF

Mask patterns; polygon zones: .MSK

Note

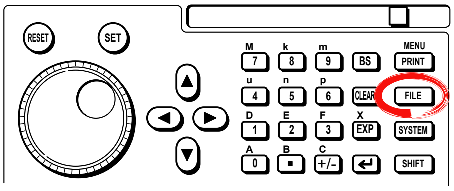
Pressing a key other than the Abort key while the save is in progress will cause an error.

14.8 Loading an SBL File

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

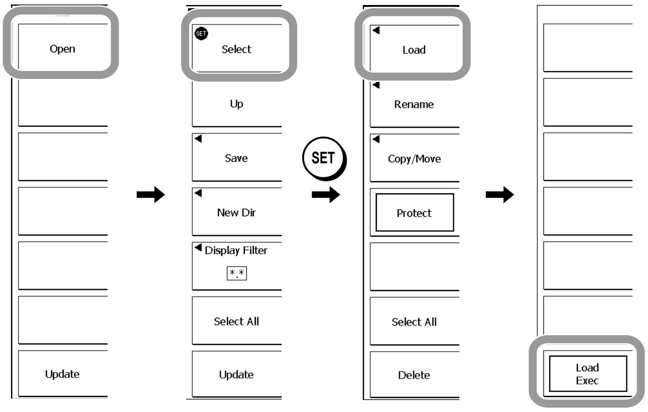
Procedure



1. Press **FILE**.
2. Use the **Up** and **Open** soft keys and the rotary knob to select the file you want to load.
   Select a file with the .sbl extension.
3. Press the **Select** soft key or press **SET**.
   The file menu appears.
4. Press the **Load** soft key.

Executing the Load Operation

5. Press the **Load EXEC** soft key.
   The selected file is loaded from the directory indicated in Path =. The Load EXEC soft key changes to the Load Abort soft key.



Aborting the Load Operation

6. Press the **Load Abort** soft key to abort the load operation.
   The Load Abort soft key changes to the Load EXEC soft key.

Explanation

You can load a definition file (.sbl) that is used to display logic signal patterns using symbols.

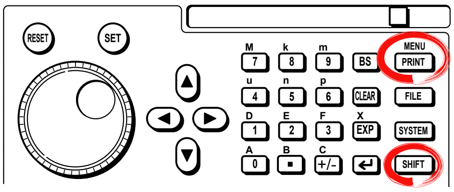
* An .sbl file is a physical value/symbol definition file that is obtained by converting and editing a CANdb file (.dbc) using YOKOGAWA freeware Symbol Editor. You can obtain Symbol Editor from YOKOGAWA website (http://www.yokogawa.com/tm/).
A CANdb file (.dbc) is a signal definition database file created using CANdb or CANdb++ by Vector Informatik.

14.9 Saving Screen Image Data

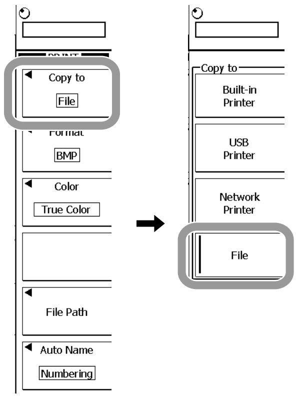
CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

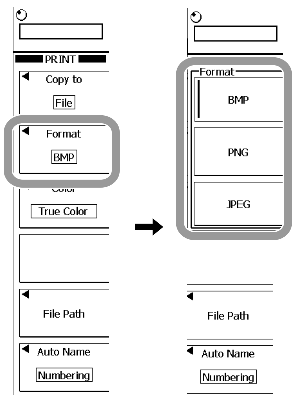


1. Press the **SHIFT + PRINT (MENU)** key.
2. Press these soft keys: **Copy to** > **File**.



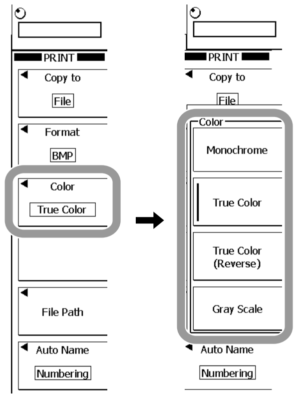
Selecting the Data Format

3. Press the **Format** soft key.
4. Press a soft key from **BMP** to **JPEG** to select the data type.



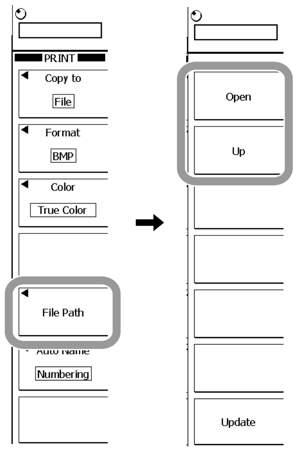
Selecting the Color Mode

5. Press the **Color** soft key.
6. Press the soft key that corresponds to the desired color mode selection.



Selecting the Save Destination

7. Press the **File Path** soft key.
8. Use the **rotary knob** to select the storage medium and directory where the data is to be saved and then press the **Open** soft key.
   You can move to the parent directory by pressing the Up soft key.
9. Press **ESC**.



Setting a File Name

10. Set the file name according to steps 5 to 10 in section 14.4.

Executing the Save Operation

11. When a screen that you want to save is displayed, press **PRINT**.
    The screen image data is saved in the specified save destination.

Explanation

The screen image data can be stored in a specified storage medium.
A PC card, external USB device, internal hard drive (optional), or network drive (when the optional Ethernet interface is installed) can be selected as the storage medium. For details on saving data to the network drive see section 16.3.

Data Format and Extensions

Data in the following formats can be saved to a specified storage medium. The extension that is automatically attached and the data size (reference value) are indicated below.

Data Format	Extension	Data Size[1]
BMP	.bmp	Approximately 100 KB (approximately 1.6 MB)[2]
PNG	.png	Approximately 11 KB (approximately 52 KB)[2]
JPG	.jpg	Approximately 255 KB[3]

1 For monochrome data
2 The file size indicated in parentheses is the size for True Color data.
3 When saved in JPG format, all data are about the same size.

Color Mode

You can select the color mode.

True Color	Output using 65536 colors.
True Color(Reverse)	Do not output the background of the screen in color.
Gray Scale	Output the data using a tint of 32 gray levels.
Monochrome	Output in black and white. This mode cannot be selected with JPG format.

Save Destination

The available storage medium is displayed in the File List window.

Display Examples of Storage Media

Same as the explanation given in “Display Examples of Storage Media” of section 14.4.

File Name

Same as the explanation given in “File Name” in section 14.4.

Note

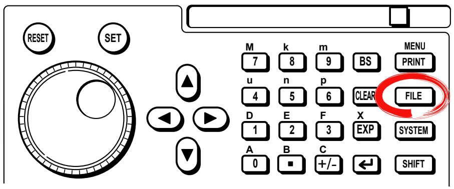
A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

14.10 Saving Analysis Results

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

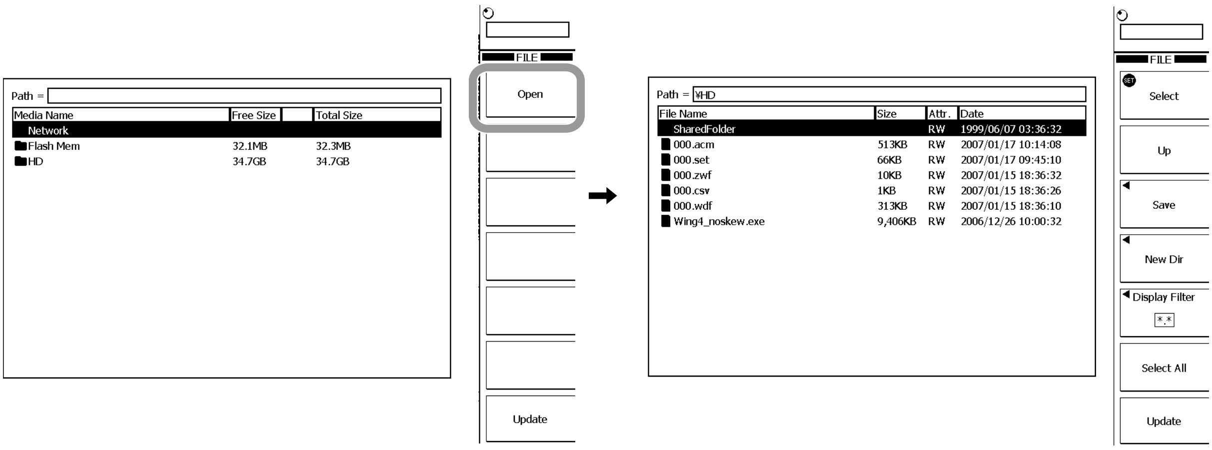


1. Press **FILE**.

Selecting the Save Destination Storage Media/Directory

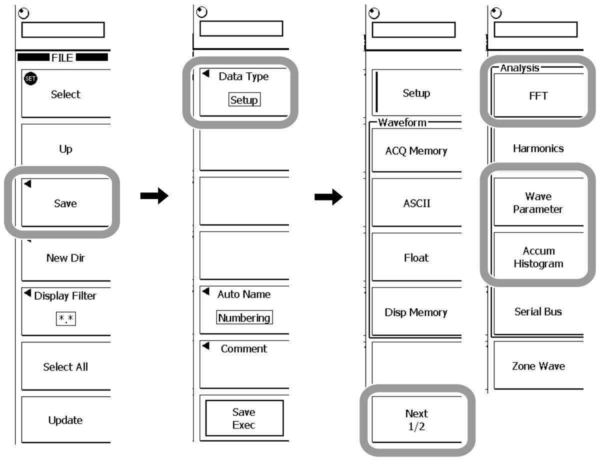
2. Use the **rotary knob** to select the save destination storage medium.

3. Press the **Open** soft key to confirm the storage medium.
When saving to a directory in the storage medium, select the directory in the same manner as described above, and then press the **Open** soft key to confirm the directory.
The selected medium/directory is displayed in “Path=......” located in the upper-left of the File List window.
Press the Up soft key to move to the parent directory.



Setting the Data Type

4. Press these soft keys: **Save** > **Data Type** > **Next 1/2**.
5. Press either the **Wave Parameter**, **Accum Histogram** or **FFT** soft key.



Setting a File Name

6. Set the file name according to steps 5 to 10 in section 14.4.

Executing the Save

7. Press the **Save Exec** soft key.
   The data is saved to the directory indicated by Path=...... At the same time, the Save Exec soft key changes to the Save Abort soft key.
   While the data is being saved, the file access icon is displayed at the upper left corner of the screen.

Aborting a Save

8. Press the **Save Abort** soft key.
   The save operation is aborted. At the same time, the Save Abort soft key changes to the Save EXEC soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

9. Specify the files you want to display according to steps 16 to 19 in section 14.4.

Explanation

The analysis results are stored in CSV format in the specified storage medium. The extension is .CSV. A CSV-format data file is a comma-delimited, text-based file. It is one common data format that is used for sharing data between different spreadsheet and database applications.
A PC card, external USB device, or network drive (when the optional Ethernet interface is installed) can be selected as the storage medium.

Data Type

Select one of the following three data types.

Wave Parameter: Saves the measured results for items specified for automatic measurement of waveform parameters. (See section 11.2 and section 11.3.)
Accum Histogram: Saves a histogram of the distribution frequency of the specified region. (See section 11.17.)
FFT: Saves the results of the FFT analysis. (See section 11.15.)

Wave Parameter

Saves the maximum number of data items (either 100,000/(the number of items set to ON)) back from the point at which the save was executed.

- **Data Size**
  Data size (bytes) = the number of measurement parameters × 15 × the number of history waveforms

- **Output example**

Analysis Type	WaveParameter								
Model Name	SB5000								
Model Version	*.**								
	Rms(C1)	Mean(C1)	Sdev(C1)	ITY(C1)	CRms(C1)	CMean(C1)	CSdev(C1)	Dly(C1)	Calc1(A2)
	V	V	V	Vs	V	V	V	s	
:Max	7.12E-01	5.05E-03	7.12E-01	5.05E-05	7.12E-01	5.33E-03	7.12E-01	1.13E-03	1.13E+00
:Min	7.10E-01	-4.44E-03	7.10E-01	-4.44E-05	7.10E-01	-4.46E-03	7.10E-01	-8.99E-04	1.08E+00
:Mean	7.11E-01	1.07E-03	7.11E-01	1.07E-05	7.11E-01	1.05E-03	7.11E-01	3.44E-04	1.10E+00
:Sigma	2.47E-04	2.04E-03	2.48E-04	2.04E-05	3.42E-04	2.11E-03	3.42E-04	9.68E-04	8.23E-03
:Cnt	134	134	134	134	134	134	134	134	134
7021	7.11E-01	2.29E-03	7.11E-01	2.29E-05	7.12E-01	2.33E-03	7.12E-01	1.11E-03	1.10E+00
7031	7.11E-01	1.43E-03	7.11E-01	1.43E-05	7.11E-01	1.41E-03	7.11E-01	1.11E-03	1.11E+00
7040	7.11E-01	3.51E-03	7.11E-01	3.51E-05	7.11E-01	3.01E-03	7.11E-01	1.11E-03	1.10E+00
7050	7.11E-01	1.73E-03	7.11E-01	1.73E-05	7.12E-01	1.86E-03	7.12E-01	1.11E-03	1.11E+00
7059	7.11E-01	1.80E-03	7.11E-01	1.80E-05	7.11E-01	1.99E-03	7.11E-01	-8.86E-04	1.11E+00
7069	7.11E-01	1.15E-03	7.11E-01	1.15E-05	7.11E-01	1.13E-03	7.11E-01	1.11E-03	1.10E+00
7078	7.11E-01	1.45E-04	7.11E-01	1.45E-06	7.11E-01	-1.77E-04	7.11E-01	-8.82E-04	1.12E+00
7088	7.11E-01	2.98E-03	7.11E-01	2.98E-05	7.11E-01	3.18E-03	7.11E-01	1.11E-03	1.10E+00
7098	7.11E-01	3.27E-03	7.11E-01	3.27E-05	7.10E-01	3.69E-03	7.10E-01	-8.92E-04	1.09E+00
7107	7.11E-01	3.12E-03	7.11E-01	3.12E-05	7.11E-01	2.92E-03	7.11E-01	-8.83E-04	1.12E+00

Accum Histogram

A maximum of 640 data items are saved in Horizontal mode, and a maximum of 800 data items are saved in Vertical mode.

- **Data Size**
  Data size (bytes) = Number of analyses × 15

- **Output example**

Analysis Type	AccumHistogram
Model Name	SB5000
Model Version	*.**
8	
150	
9	
154	
6	
154	
8	
156	
9	
153	

FFT

Saves data for a maximum of 250 K points.

- **Data Size**
  Data size (bytes) = Number of data points × 15

- **Output example**

Analysis Type	FFT
Model Name	SB5000
Model Version	*.**
-3.10E+01	
-5.43E+01	
-4.16E+01	
-6.69E+01	
-4.80E+01	
-5.26E+01	
-6.39E+01	
-5.11E+01	
-5.17E+01	
-5.87E+01	

Target of Save: Source

Select either Ana1 or Ana2.

File Name

Same as the explanation given in “File Name” in section 14.4.

Specifying the Files to Be Displayed in the File List Dialog Box

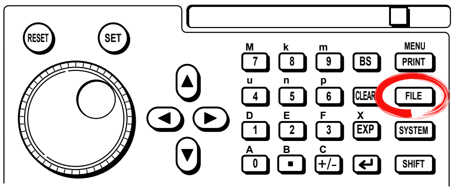
See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

14.11 Changing the File Attributes and Deleting Files

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure

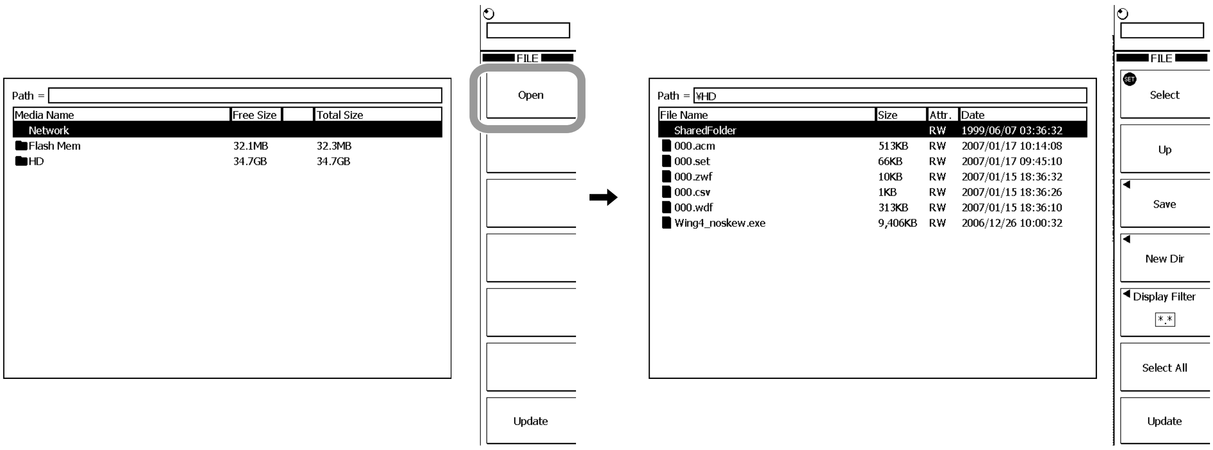


1. Press **FILE**. The File List window appears.

Selecting the File

2. Select the storage medium, directory, and file according to steps 2 and 3 in section 14.4.

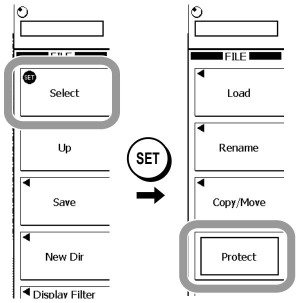
3. Using the **rotary knob**, select the file.
To select all files, press the Select All soft key. To remove the selection, press RESET.



Changing the File Attributes

4. Press **Select** soft key or **SET**.
A menu of file operations appears.

5. Press the **Protect** soft key.



Changes the Attr parameter of the list to RW (readable/writeable) or RA (not writeable).

The Protect soft key changes to the Abort soft key.

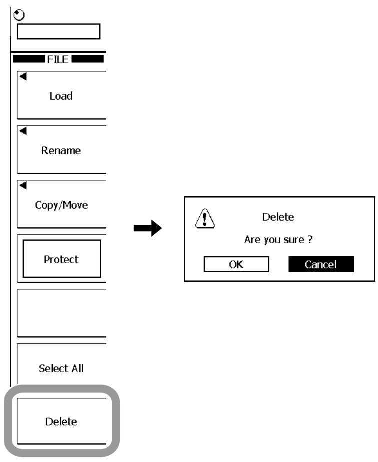
Aborting Attribute Changes

6. Press the **Abort** soft key.
The attribute changes are aborted. At the same time, the Abort soft key changes to the Protect soft key.

Deleting Files

7. Press the **Delete** soft key. A confirmation message appears.

8. Use the **rotary knob** to select either OK or Cancel and then press **SET**.
If OK was selected, the file is deleted.
The Delete soft key changes to the Abort soft key.



Aborting File Deletion

9. Press the **Abort** soft key.
File deletion is aborted. At the same time, the Abort soft key changes to the Delete soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

10. Specify the files you want to display according to steps 16 to 19 in section 14.4.

Explanation

Storage Medium and Directory: File

Storage media in which saving and loading are possible are displayed in the File List dialog box.

Display Examples of Storage Media

Same as the explanation given in “Display Examples of Storage Media” of section 14.4.

Changing the File Attribute (Except for Net Drive)

Select the file attribute of each file from the following.

- **RW**
  Read and write possible.
- **RA**
  Read only. Cannot be written. Cannot be erased.

Files to Be Deleted

All highlighted files can be deleted. There are two methods in selecting the files to be deleted.

- **Selecting the files one at a time: Set**
  Press the Set soft key to select files one at a time.
- **Selecting all files at once: Select All**
  Press the Select All soft key to select all files.
  Selecting a file or directory and pressing the Select All soft key selects every file and directory in the directory containing the selected file or directory.

Specifying the Files to Be Displayed in the File List Dialog Box

See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

Note

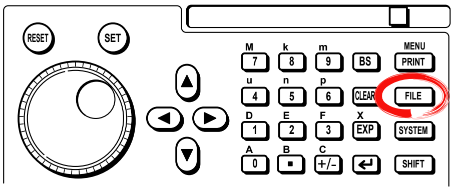
- Data that is deleted cannot be recovered. Be sure you erase the correct files.
- If an error occurs while deleting multiple files, the files after the error occurrence are not deleted.
- You cannot change a directory attribute.

14.12 Copying/Moving Files

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

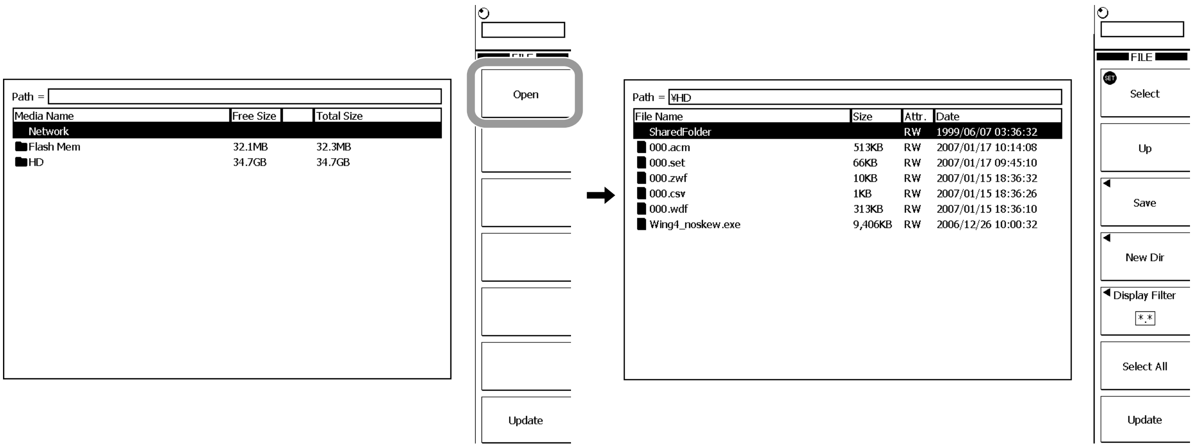
Procedure



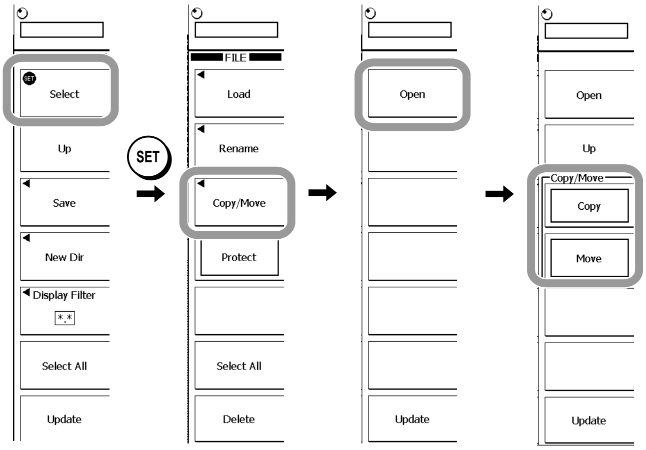
1. Press **FILE**. The File List window appears.

Selecting the File

2. Select the storage medium, directory, and file according to steps 2 and 3 in section 14.4.
3. Using the **rotary knob**, select the file.
   To select all files, press the Select All soft key.



4. Press the **Select** soft key or **SET**.
A menu of file operations appears.



Setting the File Copy/Move Destination

5. Press the **Copy/Move** soft key.

6. Select the storage medium/directory in the same manner as described in step 2.
To update the file list with the most recent data, press the **Update** soft key.

Copying/Moving Files

7. Press the **Copy** or **Move** soft key.
The file that was selected in step 3 is moved or copied.
The Copy or Move soft key changes to the Abort soft key.

Aborting File Copying/Moving

8. Press the **Abort** soft key.
File copying or moving is aborted. At the same time, the Abort soft key changes to the Copy or Move soft key.

Specifying the Files to Be Displayed in the File List Dialog Box

9. Specify the files you want to display according to steps 16 to 19 in section 14.4.

Explanation

Files To Be Moved/Copied

Highlighted files can be copied or moved. There are two ways to select the files to be copied or moved.

- **Selecting the files one at a time**
  Press the Set soft key to select files one at a time.

- **Selecting all files at once**
  Press the Select All soft key to select all files.
  Selecting a file or directory and pressing the Select All soft key selects every file and directory in the directory containing the selected file or directory.

Specifying the Files to Be Displayed in the File List Dialog Box

See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

Note

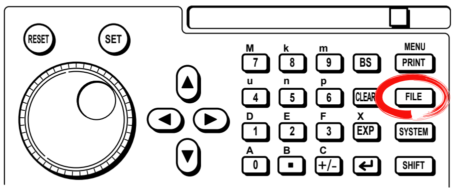
- If an error occurs while copying/moving multiple files, the files after the error occurrence are not copied/moved.
- You cannot copy/move files if files with the same file name exist at the copy/move destination.
- You cannot copy/move the same files to another directory after copying/moving the files. Select the files to be copied again and then copy them.
- A total of 2500 directories and files can be displayed in the file list. If there are more than 2500 directories and files in a single directory, a total of 2500 files and directories will be displayed, but it is not possible to specify which directories and files are displayed.

14.13 Changing the Directory Name or File Name of the Storage Medium/Creating Directories

CAUTION

Do not remove the storage medium (disk) or turn OFF the power when the access indicator is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure



Renaming a Storage Medium Directory or File

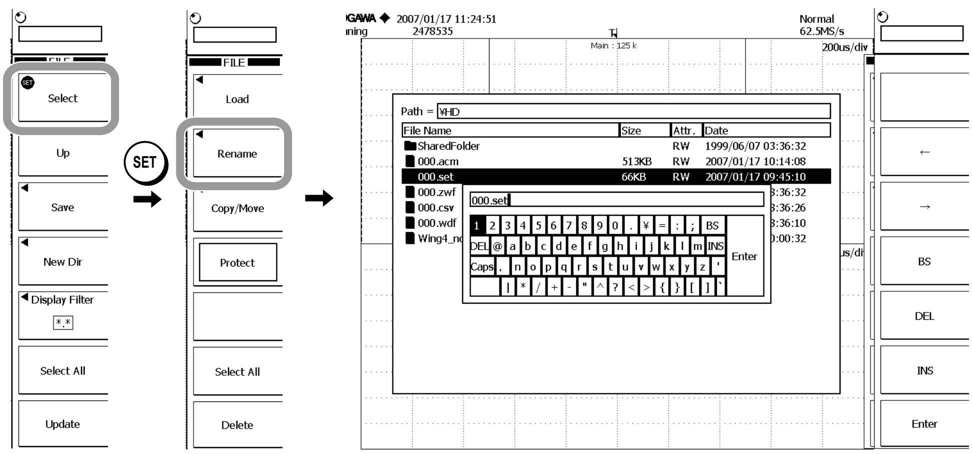
1. Press **FILE**.

Selecting the Storage Medium/Directory

2. Select the storage medium, directory, and file according to steps 2 and 3 in section 14.4.

Renaming the Storage Medium Directory/File (Except Net Drive)

3. Using the **rotary knob**, select the directory name/file name.
4. Press the **Select** soft key or **SET**.
   A menu of file operations appears.
5. Press the **Rename** soft key.
   The keyboard is displayed, and the name of the selected directory or file is displayed in the entry box of the keyboard.
6. Enter the directory name/file name as described in section 4.2.



Creating a Directory

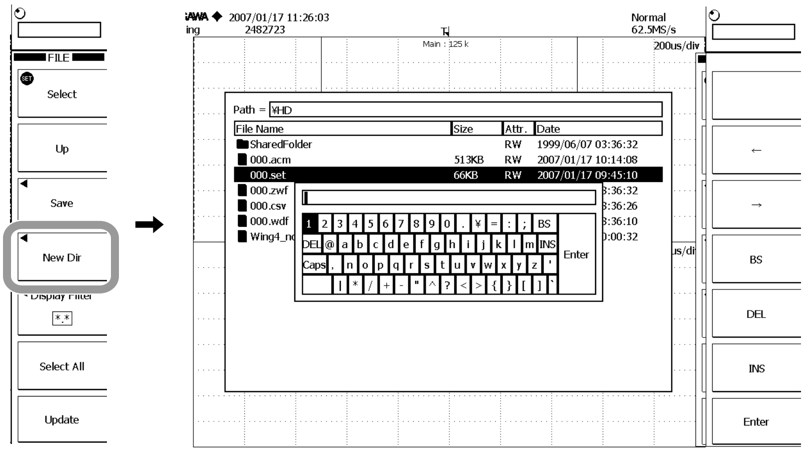
1. Press **FILE**.

Selecting the Storage Medium/Directory

2. Select the storage medium and directory according to steps 2 and 3 in section 14.4.

Creating a Directory

3. Press the **Open** soft key.
   A directory is created in the storage medium/directory that is currently open.
4. Press the **New Dir** soft key.
   A keyboard appears.
5. Enter the directory name/file name as described in section 4.2.



Specifying the Files to Be Displayed in the File List Dialog Box

6. Specify the files you want to display according to steps 16 to 19 in section 14.4.

Explanation

Storage Medium and Directory

Storage media in which saving and loading are possible are displayed in the File List dialog box.

Display Examples of Storage Media

Same as the explanation given in “Display Examples of Storage Media” of section 14.4.

Renaming a Storage Medium Directory or File

The number of characters that can be used for a file or directory name is up to 64 characters from the beginning of the entered characters. However, the following conditions apply.

- The types of characters that can be used are 0 to 9, A to Z, a to z, _, -, =, (,), {, }, [,], #, $, %, &, ~, !, ’, and @ on the keyboard that appears on screen.
  † Multiple @ characters cannot be entered consecutively.
- The following character strings cannot be used due to the limitation of MS-DOS.
  AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, and COM9
- Make sure that the full path name (absolute path name from the root directory) is within 260 characters. If 260 characters is exceeded, an error occurs when you execute a file operation (save, copy, rename, create directory, etc.).
  Full path name: If you are operating a directory, specify up to the directory name.
  If you are operating a file, specify up to the file name.
- The length of the character string displayed in the entry box of the keyboard that is shown on the screen is 36.

Creating a Directory

You can create a new directory on the storage medium. See above for the assignment of the directory name when creating a new directory.

Specifying the Files to Be Displayed in the File List Dialog Box

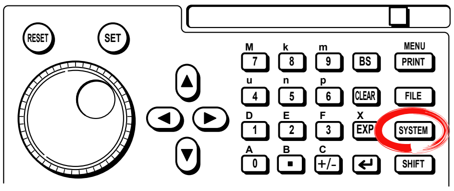
See the explanation “Specifying the Files to Be Displayed in the File List Dialog Box” in section 14.4.

Note

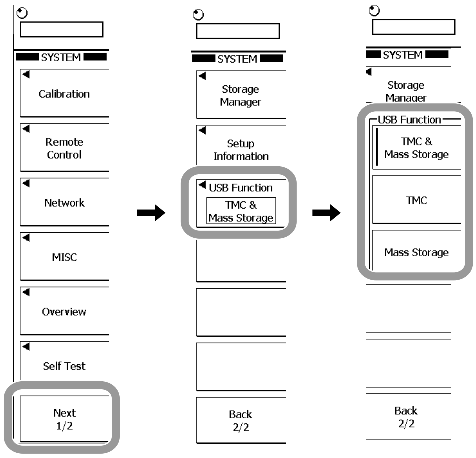
- You cannot change a directory attribute.
- If a file with the same name already exists in the same directory, the file cannot be renamed.
- If a directory with the same name already exists in the same directory, the directory cannot be created.
- This unit can recognize a maximum of 26 media.

14.14 Connecting to a PC Using the USB Port

Procedure



1. Press the **SYSTEM**.
2. Press these soft keys: **Next 1/2** > **USB Function**.
3. Press a soft key from **TMC & Mass** to **Mass Storage** to select the communication function.
4. Restart the SB5000 to activate the settings.
   Wait at least 10 seconds after you turn the power switch OFF, and then turn the switch back ON.



Explanation

You can connect the SB5000 to a PC through the USB port, and control the SB5000 from the PC.

USB Communication Function

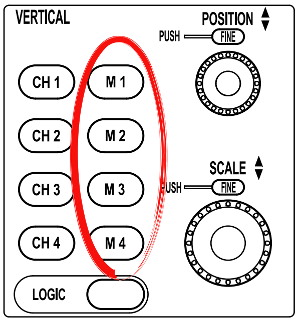
- TMC
  - Allows communication with the PC using the USB TMC (Test and Measurement Class).
  - You must install YOKOGAWA's USB TMC driver in the PC to use the USB TMC function.
  - Only use the USB TMC driver (or software) provided by YOKOGAWA.
- Mass Storage
  - The SB5000 functions as a USB mass storage device as viewed from the PC.
  - There is no need to install the USB TMC driver into your PC.
- TMC & Mass Storage
  - Allows communication with the PC using both USB TMC and USB Mass Storage.
  - You must install Yokogawa's USB TMC driver into your PC to use the USB TMC function in the same manner as when TMC is selected above.
  - Only use the USB TMC driver (or software) provided by YOKOGAWA.

Note

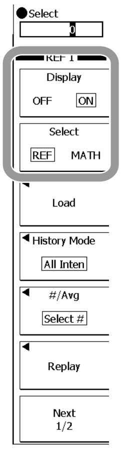
- To obtain YOKOGAWA's USB TMC driver, contact your nearest YOKOGAWA dealer or access the following USB driver page at our Web site and download it.
  http://www.yokogawa.com/tm/tm-softdownload.htm
- You must restart the SB5000 to activate the TMC, Mass Storage, or TMC & Mass Storage setting. Wait at least 10 seconds after you turn the power switch OFF, and then turn the switch back ON.
- To use the USB port as a remote control port (control using communication commands), activate the TMC or TMC & Mass Storage setting. For the procedure to select the remote control port, see the *Communication Interface User's Manual IM701331-17E*.
- File operation using the SB5000 keys is not possible, if the Mass Storage or TMC & Mass Storage is activated and the SB5000 is connected to a PC. File operation is also not possible using communication commands. Disconnect the PC or activate the TMC setting and connect the SB5000 to the PC.

15.1 Turning ON/OFF the Reference Waveform Display

Procedure



1. Press the key from **M1** to **M4** to select the waveform to be set.
   The key lights, and the waveform appears.
2. Press the **Select** soft key to select to REF.



Switching the Display OFF

1. Press the key to be turned off, from **M1** to **M4**.
2. Press the **Display** soft key, and select OFF.

Explanation

A history waveform of input channels, a computed waveform and a waveform saved in the internal memory can be displayed as reference waveforms of 1 to 4.
The SB5000 also allows you to perform computation with data of displayed reference waveform.
When the reference waveform is set to ON, a computed waveform corresponding to the reference number cannot be displayed.

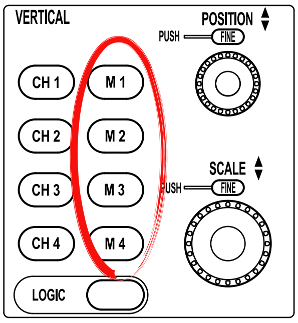
Reference waveforms are backed up in the internal memory even if the SB5000 is turned OFF. They are displayed the next time the power is turned ON. To delete all the data that are backed up, turn the power ON while holding down the Reset key.

Note

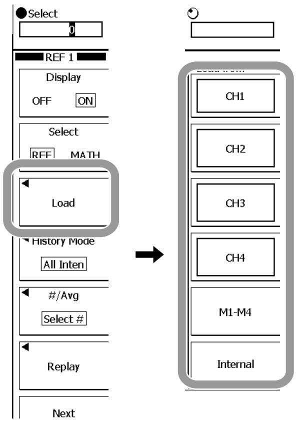
- Only the latest waveform is backed up for history waveforms.
- Waveforms whose record length exceeds 125 kW are not backed up.

15.2 Displaying Stored Data as Reference Waveform

Procedure

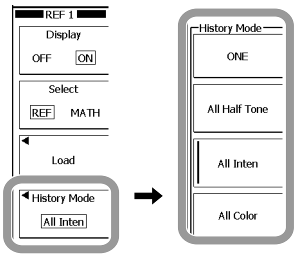


1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Load** soft key.
3. Press the soft key corresponding to the waveform to be loaded.



Selecting History Mode

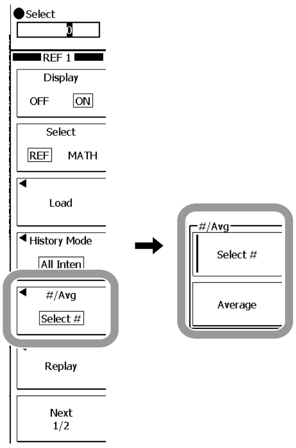
4. Press the **History Mode** soft key
5. Press one of the following soft keys.
   ONE: Displays only highlight waveforms selected in the following procedure
   All Half Tone: Displays waveforms other than highlight waveforms in neutral color
   All Inten: Displays the frequency of data appearance at intensity
   All Color: Displays the frequency of data appearance in color



Selecting Highlight Waveform

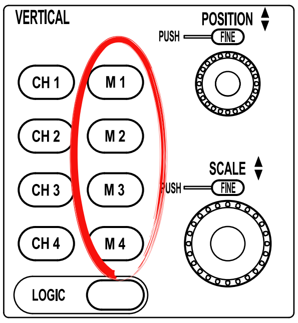
6. When you select ONE or All Halftone in Step 5, select highlight waveforms.

- Select the **#/Avg** soft key to select either the history number (#) or the average value (Avg).
- When you select a highlight waveform with history numbers (#), select the number with the rotary knob.

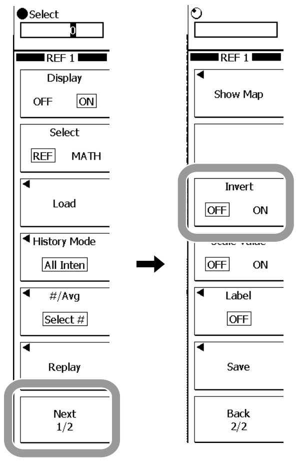


15.3 Displaying Waveforms Inverted

Procedure

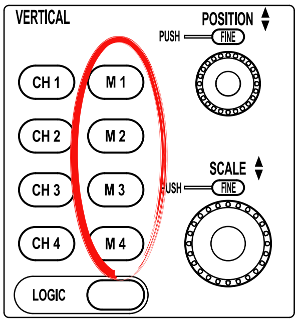


1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.
3. Press the **Invert** soft key.

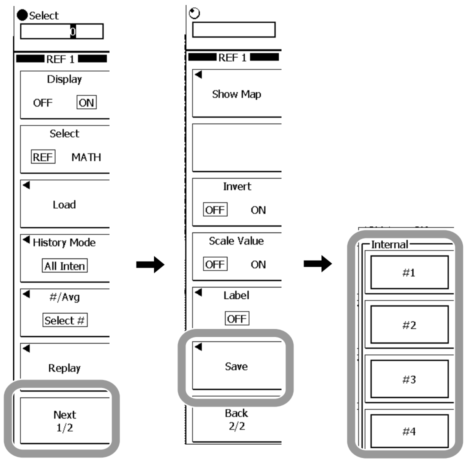


15.4 Saving Data

Procedure



1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.
3. Press the **Save** soft key.
4. Press one of the soft keys of the internal memory **#1** to **#4**.
   The reference waveform is stored in the selected internal memory.

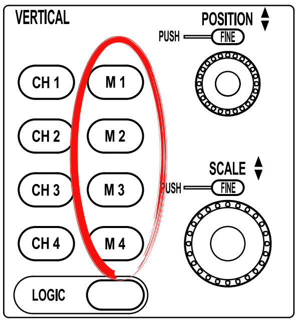


Note

A waveform exceeding 1.25 MW is saved with P-P compression to 1.25 MW.

15.5 Displaying Scale Values and Labels

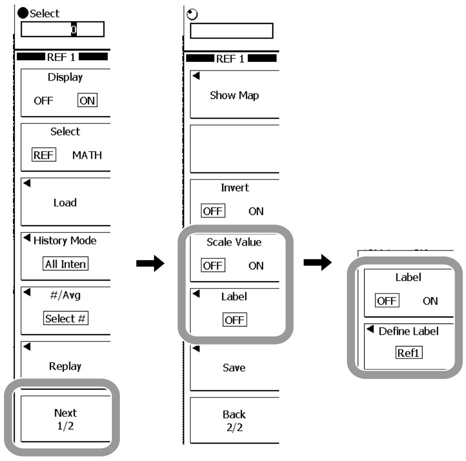
Procedure



1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Next 1/2** soft key.

Displaying the Scale Value

3. Press the **Scale Value** soft key to select ON or OFF.

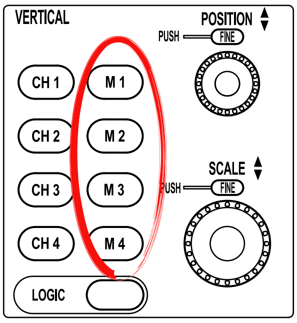


Displaying the Label

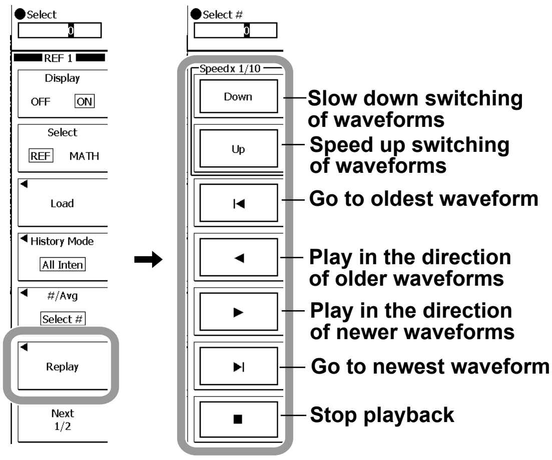
4. Press the **Label** soft key.
5. Press the **Label** soft key to select ON or OFF.
6. Press the **Define Label** soft key. A keyboard appears.
7. Enter the contents of label as described in section 4.2.

15.6 Displaying History Waveforms Automatically

Procedure



1. Press the key from **M1** to **M4** to display reference waveforms.
2. Press the **Replay** soft key. A menu appears, allowing you to display history waveforms automatically.
3. Press the ◄ or ► soft key to display history waveforms automatically.

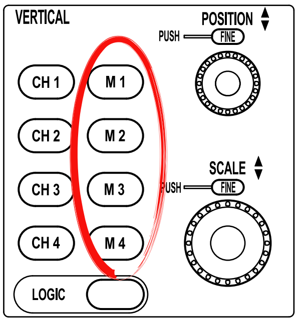


Explanation

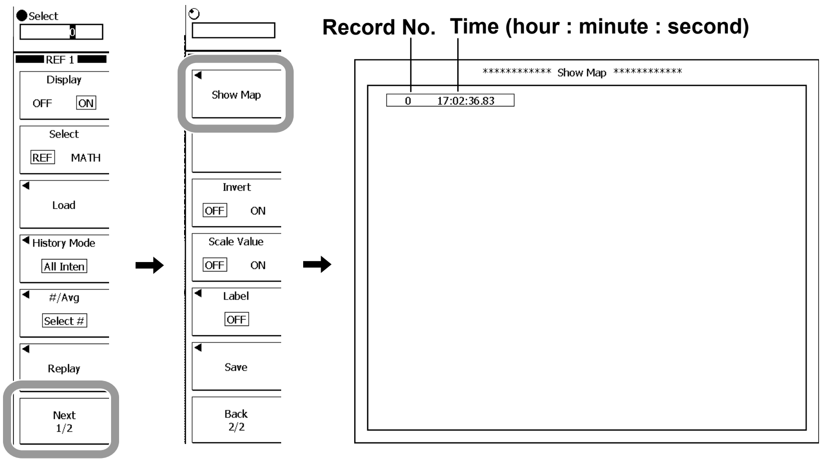
History waveforms are displayed individually in sequence.

15.7 Displaying the Acquisition Time of a Loaded Waveform

Procedure



1. Press one of **M1** to **M4** to display the reference waveform.
2. Press the **Next 1/2** soft key.
3. Press the **Show Map** soft key.

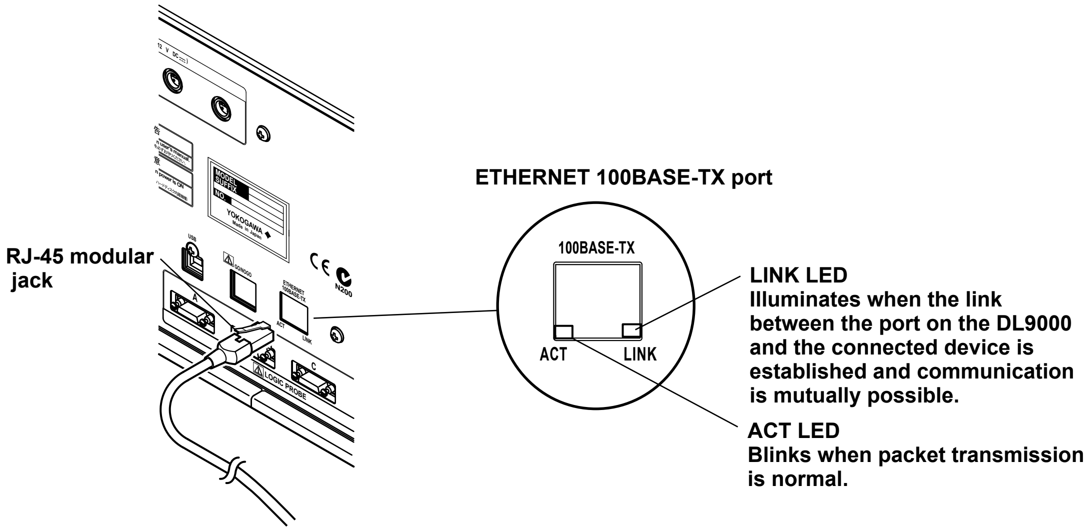


16.1 Connecting the SB5000 to the Network

Ethernet Interface Specifications

A 100BASE-TX port is provided on the rear panel of the SB5000.

Item	Specifications
Number of communication ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Transmission rate	100 Mbps max.
Communication protocol	TCP/IP
Supported service	DHCP, DNS, Microsoft network file shared client/server
Connector type	RJ-45 connector



Items Necessary for Connection

Cable

Be sure to use one of the following cables for connection.

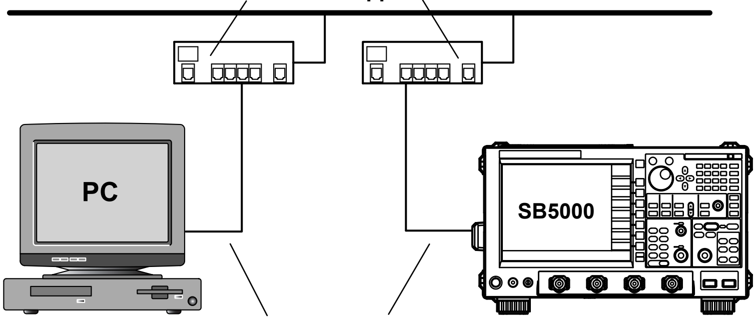
- UTP (Unshielded Twisted-Pair) cable (category 5 or better)
- STP (Shielded Twisted-Pair) cable (category 5 or better)

Connection Procedure

When Connecting to a PC on the Network

1. Turn OFF the SB5000.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Turn ON the SB5000.

Hub or router that supports 100BASE-TX

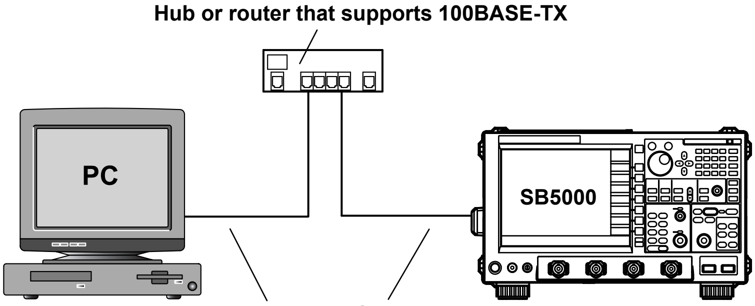


UTP cable or STP cable
(Straight cable)

When Establishing a One-to-One Connection to a PC

1. Turn OFF the SB5000 and the PC.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 100BASE-TX terminal on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Likewise, connect the PC to a hub or router.
5. Turn ON the SB5000.

Hub or router that supports 100BASE-TX



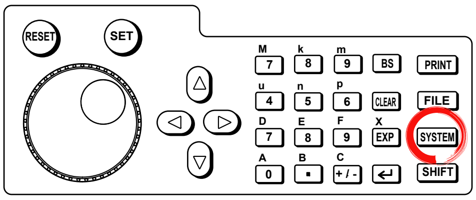
UTP cable or STP cable
(Straight cable)

Note

- When connecting the PC one-to-one, a NIC (a 10BASE-T/100BASE-TX autoswitching card) is required for the PC.
- When using a UTP cable or STP cable (both are straight cables), be sure to use a category 5 or better cable.
- Avoid connecting the PC directly to the SB5000 without going through the hub or router. Operations are not guaranteed for communications using direct connection.

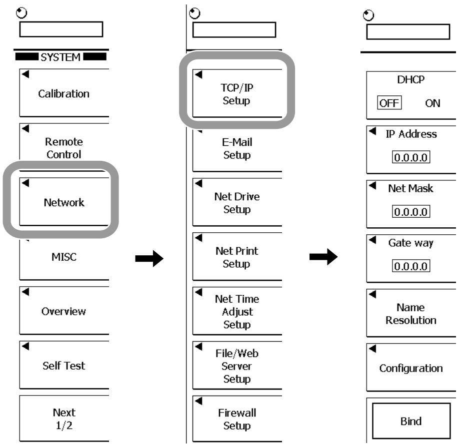
16.2 Setting Up the TCP/IP

Procedure



1. Press **SYSTEM**.

2. Press these soft keys: **Network** > **TCP/IP Setup**.
The TCP/IP setup menu appears.



DHCP ON/OFF

3. Press the **DHCP** soft key to select ON or OFF.
If you set the DHCP to OFF, proceed to step 5.
If you set the DHCP to ON, you do not have to set the IP address, subnet mask and default gateway.

- To set the DNS, proceed to step 11.
- If you do not wish to set up the DNS, check the network cable connection and restart the SB5000. The IP address, subnet mask, and default gateway are automatically configured.

Setting up IP Address

If DHCP was set to OFF, set the IP address.

4. Press the **IP Address** soft key.
5. Enter a value in the range of 0 to 255 as described in section 4.2.

Setting up Subnet Mask

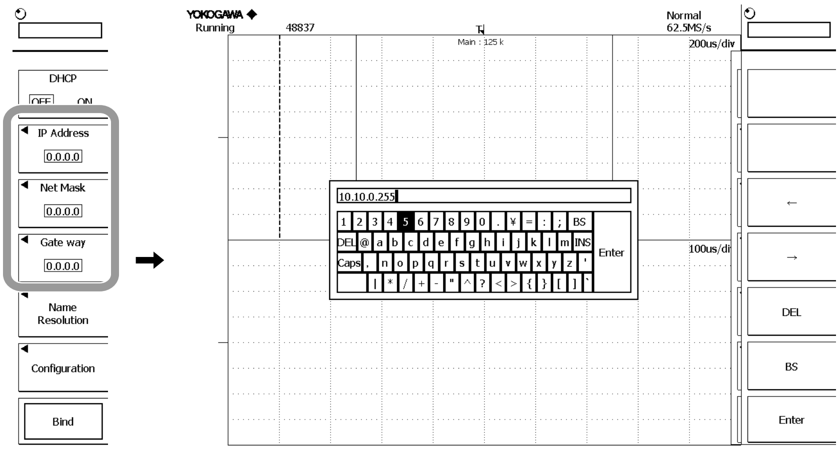
If DHCP was set to OFF, set the subnet mask.

6. Press the **Net Mask** soft key.
7. Enter a value in the range of 0 to 255 as described in section 4.2.

Setting up Default Gateway

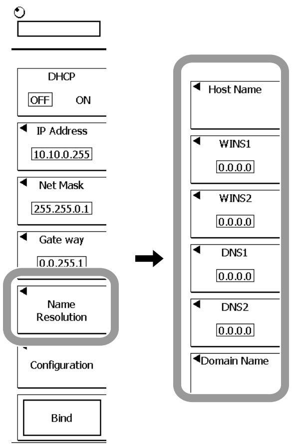
If DHCP was set to OFF, set the default gateway.

8. Press the **Gate way** soft key.
9. Enter a value in the range of 0 to 255 as described in section 4.2.



Setting up DNS and WINS

10. Press the **Name Resolution** soft key.
    The DNS/WINS setup menu appears.
11. Press the **Host Name** soft key.
    A screen appears, allowing you to set up the host name of the DL 9710L.
12. Set up the host name of the instrument as described in section 4.2.



- **When Using WINS**

13. Press the **WINS1** soft key.
A screen appears, allowing you to set up the WINS address.

14. Set up the primary address of WINS as described in section 4.2.

15. Likewise, set up the secondary address of WINS.

- **When Using DNS**

16. Press the **DNS1** soft key.
A screen appears, allowing you to set up the DNS address.

17. Set up the primary address of DNS as described in section 4.2.

18. Likewise, set up the secondary address of DNS.

19. Press the **Domain Name** soft key.
A screen appears, allowing you to set up the domain name.

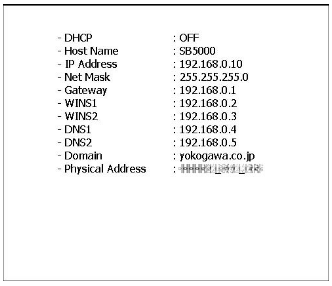
20. Set up the domain name as described in section 4.2.

Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Checking Setup Items

21. Press the **Configuration** soft key. Setup data appears.
To clear the setup data, press **ESC**.
MAC address is a value that appears on the right side of Physical Address.



Executing the Bind

22. Press the **Bind** soft key to enable setup data.

Explanation

The following TCP/IP settings must be entered to use the Ethernet communications functions on the SB5000.

- IP address
- Subnet mask
- Default gateway

IP Address (Internet Protocol Address)

You can assign an IP address to the SB5000. The default setting is 0.0.0.0.
The IP address is an ID that is assigned to each device on an IP network such as the internet or an intranet. The address is a 32-bit value expressed using four octets (each 0 to 255), each separated by a period as in 192.168.111.24.
Obtain an IP address from your network administrator. The setting is automatically configured in environments using DHCP.

Subnet mask: Net Mask

You can set the mask value used when determining the subnet network address from the IP address. The default setting is 0.0.0.0.
Huge TCP/IP networks such as the Internet are often divided up into smaller networks called sub networks. The subnet mask is a 32 bit value that specifies the number of bits of the IP address used to identify the network address. The portion other than the network address is the host address that identifies individual computers on the network.
Consult your network administrator for the subnet mask value. The setting is automatically configured in environments using DHCP.

Default gateway: Gate Way

You can set the IP address of the gateway (default gateway) used to communicate with other networks. The default setting is 0.0.0.0.
The default gateway has a function to enable the smooth transfer of data when communicating with multiple networks.
Consult your network administrator for the default gateway value. The setting is automatically configured in environments using DHCP.

DHCP (Dynamic Host Configuration Protocol): DHCP

DCHP is a protocol that allocates setup information that is needed temporarily to PCs connecting to the network. When DHCP is turned ON, the following settings are automatically assigned.

- IP address
- Subnet mask
- Default gateway
- DNS
- WINS
- Domain name

To use DHCP, the network must have a DHCP server. Consult your network administrator to see if DHCP can be used.
If DHCP is set to ON, when the power is turned on for example, each time a Bind operation is executed different values may be assigned. To connect a PC to the SB5000, you need to check the configuration such as the IP address of the instrument on the PC every time the device is turned on or every time a Bind operation.

DNS (Domain Name System)

DNS is a system used to associate names used on the Internet called host names and domain names with IP addresses. Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name.
Instead of using the IP address, which is a sequence of numbers, the host name and domain name can be used to access the network.
The SB5000 allows you to specify the host by name, instead of by IP address.
You set the domain name, and the DNS server address (0.0.0.0 by default). For details, consult your network administrator.

- **DNS Server: DNS1/DNS2**
  Up to two DNS server addresses can be specified (primary and secondary). If query processing fails with the primary DNS server, the secondary DNS server is automatically looked up for the mapping of the host name/domain name and IP address.

- **Domain name: DomainName**
  Domain name is a piece of information to be added to a host name on query to the DNS server.

WINS(Windows Internet Name Service)

WINS is a service that associates a NetBIOS name with an IP address of computer on the Windows network. WINS allows you to connect the SB5000 to the network in the various segments.

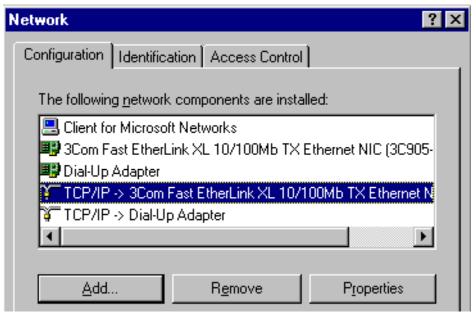
Note

- Execute the Bind operation when you change the configuration on Ethernet.
- **Configuring the TCP/IP Settings of the PC**
  Communication parameters such as the IP address must be specified also on the PC side. Communication parameters are specified for each Ethernet NIC that is installed in the PC. Here, the settings of the NIC for connecting your PC and the SB5000 are explained.
  When using the DHCP server, and automatically allocating an IP address, in [TCP/IP Properties]-[IP Address Setting], select [Automatically Assign IP Address].
  For example, if you are connecting a PC and the SB5000 to an Ethernet network on a one-to-one basis, you can specify parameters as indicated in the next table.
  For details on the parameters, consult your system or network administrator.

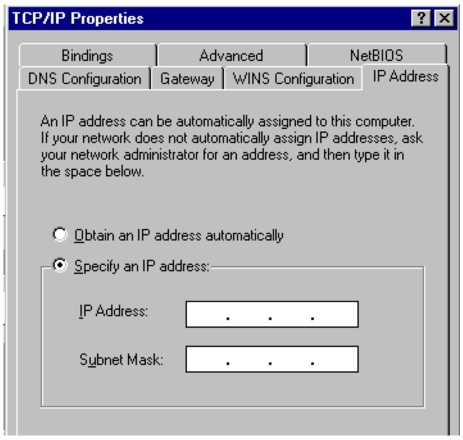
Parameter	Value	Remarks
IP address	(Ex) 192.168.0.128	IP address for the PC
Subnet mask	(Ex) 255.255.255.0	Set the same value as the subnet mask that was specified for the SB5000.
Gateway	0.0.0.0 (Default)	
DNS	Disable	
WINS	Disable	

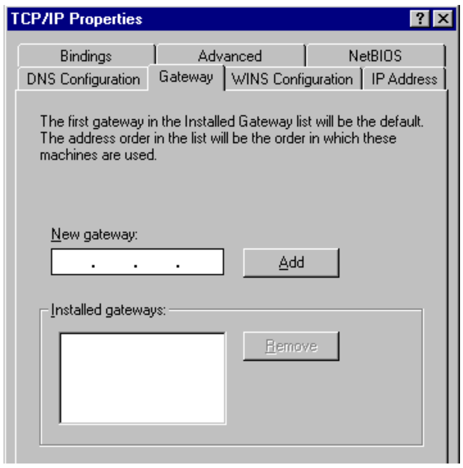
The following procedure describes the steps for Windows 2000. For other OS including Windows XP, carry out equivalent steps accordingly.

1. Choose Settings > Control Panel from the Start menu to open the Control Panel folder.
2. Double-click the Network and Dial-up icon.
3. Right-click the Local Area Connection to select the Properties.
4. After selecting Internet Protocol (TCP/IP), click the Properties button to display the TCP/IP Properties dialog box.



5. Set the parameters such as the IP address according to the table on the previous page and click OK.



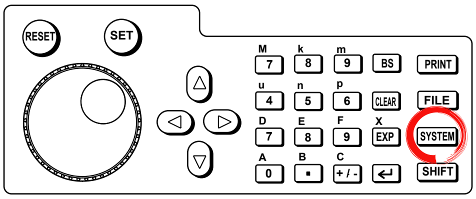


MAC Address

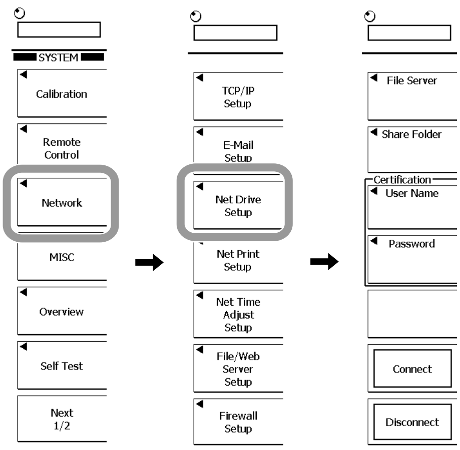
MAC address is a unique (single) address that is pre-assigned to each Ethernet device. The address is necessary to physically identify the Ethernet devices on the network. Data can be transferred between nodes based on the MAC address.

16.3 Saving and Loading Measurement/Setup/Image Data on a Network Drive

Procedure

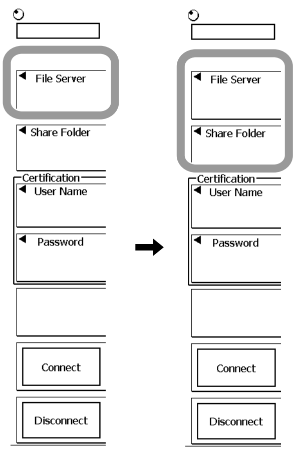


1. Press **SYSTEM**.
2. Press these soft keys: **Network** > **Net Drive Setup**.
   The Net Drive setup menu for that key appears.



Setting a Network Drive to Be Connected

3. Press the **File Server** soft key.
   A screen appears, allowing you to set up server name for the file server.
4. Enter the server name for the file server as described in section 4.2.
   The IP address cannot be used to set up the file server.



5. Press the **Share Folder** soft key.
   A screen appears, allowing you to set up the shared folder name.
6. Set up the folder name as described in section 4.2.

Setting User Name/Password

7. Press the **User Name** soft key.
A screen appears, allowing you to set up a user name.

8. Enter a user name using up to 30 characters as described in section 4.2.

9. Press the **Password** soft key.
A screen appears, allowing you to set up a password.

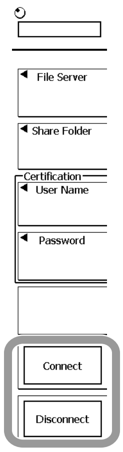
10. Enter a password using up to 30 characters for the user name as described in section 4.2.

Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Connecting to/Disconnecting from the Network Drive

11. Press the **Connect** soft key.
The SB5000 is now connected to the network drive.
When pressing the **Disconnect** soft key, the SB5000 is disconnected.



Saving Screen Images and Saving/Loading Measurement/Setup Data

- **Saving the Screen Image Data**

12. Press the **SHIFT** + **PRINT (MENU)** key.

13. Select a network drive with the **rotary knob** in the File Path setup.
The procedure is similar to that in section 14.9.

- **Saving/Loading Measurement Data/Setup Data**

12. Press **FILE**.

13. Select a network drive with the **rotary knob**.
The procedure afterward is similar to those in sections 14.4 and 14.5.

Explanation

As with the PC card drive, you can save screen image data, measurement data or setup data to a network drive via the Ethernet network.

File Server

Enter the host name of file server (the PC running the file server) on the network to which measurement/setup data will be saved. The IP address cannot be used to set up the file server.

User Name

Enter a user name using up to 30 characters.
The characters that can be used are all the ASCII characters on the keyboard.

Password

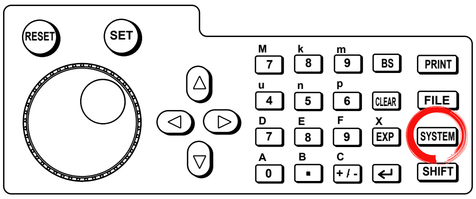
Enter the password corresponding to the user name using up to 30 characters.
The characters that can be used are all the ASCII characters on the keyboard.

Note

- A shared service should be run on a personal computer to which the SB50001 is connected.
- To use this function, you must configure TCP/IP according to the procedure given in section 16.2.
- When the power is turned to ON, the connection to the file server is restored.

16.4 Setting the Mail Transmission (SMTP Client Function)

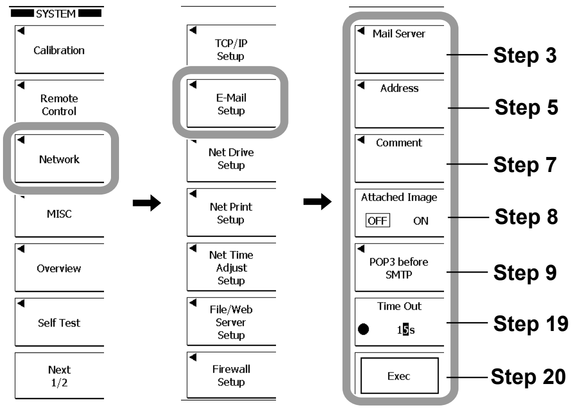
Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Network** > **E-Mail Setup**.
   The mail transmission setup menu appears.

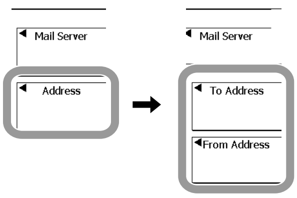
Setting the Mail Server

3. Press the **Mail Server** soft key.
4. Enter the host name or IP address of the mail server.



Setting the Mail Address

5. Press the **Address** soft key.
6. Press the **To Address** and **From Address** soft keys and enter the sender and recipients mail addresses.



Setting a Comment

7. As necessary, press the **Comment** soft key and enter a comment.

Selecting Whether to Attach a Screen Image

8. Press the **Attached Image** soft key to select ON or OFF.

Setting the User Authentication

9. Press the **POP3 before SMTP** soft key.
The user authentication setup menu appears.

10. Press the **Mode** soft key to select ON or OFF.
If you select ON, proceed to step 11. If you select OFF, proceed to step 18.

11. Press the **Type** soft key to select U/P or APOP.

12. Press the **POP3 Server** soft key.

13. Enter the host name or IP address of the POP3 server.

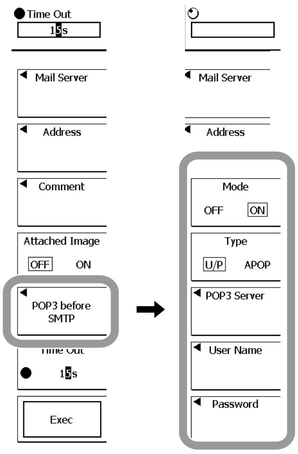
14. Press the **User Name** soft key.
A screen appears for you to enter the user name.

15. Enter the user name using up to 30 characters.

16. Press **Password** soft key.
A screen appears for you to enter the password.

17. Enter the password corresponding to the user name using up to 30 characters.

18. Press the **ESC** to return to the previous screen.



Setting the Timeout Value

19. Use the **rotary knob** to set the Time Out value.

Sending the Mail

20. Press the **Exec** soft key. The mail is sent to the specified address.

Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Explanation

Information such as the trigger time can be sent to a specified mail address on the network as an action of action-on-trigger or GO/NO-GO determination.

Mail Server

Specify the IP address of the network mail server. On networks supporting WINS/DNS, you can specify the name (NetBIOS name or domain name) instead of the IP address.

Mail Address

To Address: Set multiple recipients mail addresses using up to 100 characters. Separate each address with a comma.

From Address: Set the sender address using up to 40 characters. If you do not specify the sender address, the recipient address is set.

Comment

The comment is written on the first line of the transmitted mail. Enter it as necessary. You can enter a comment using up to 100 characters.

Attached Image

The screen image shown at the time of mail transmission can be attached to the mail.

- File format: PNG
- File name: DL_image[date/time].png (example: DL Image0802171158.png → data at 11 hour 58 minutes on February 17, 2008)
- Resolution: XGA (1024 × 768 dots)
- File size (estimate)
  - Normal screen: Approx. 50 KB
  - Maximum: Approx. 1.6 MB*

    * When there is a lot of color information

User Authentication

POP3 user authentication is carried out before sending mail.

- **Mode**

  ON: Carry out user authentication before sending mail

  OFF: Do not carry out user authentication before sending mail
- **Encryption type**

  U/P: Send authentication data in plain text.

  APOP: Send authentication data by encrypting
- **Server Name**

  Enter the host name or IP address of the POP3 server using up to 30 characters.
- **User Name**

  Set the user name using up to 30 characters that is required when accessing the POP3 server from the SB5000.
- **Password**

  Set the password using up to 30 characters that is required when accessing the POP3 server from the SB5000.

Time Out

Set the transmission/reception timeout value. The selectable range is 1 to 60 s (default: 15 s, 1 s steps).

Sending the Mail

Send the mail to the specified mail address. If Attached Image is ON, the screen image that was shown when the Exec was pressed is attached.

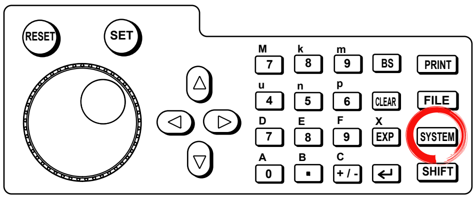
Note

- To use this function, you must configure TCP/IP according to the procedure given in section 16.2.
- The SB5000 supports two authentication methods as user authentication methods of the POP3 server: plain authentication (U/P) and encrypted authentication (APOP*).

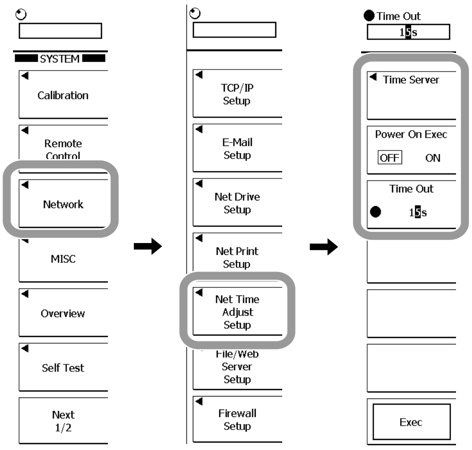
  * APOP uses the MD5 algorithm (RSA Data Security, Inc. MD5 Message Digest Algorithm).

16.5 Using SNTP to Set the Date and Time

Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Network** > **Net Time Adjust Setup**.
   A menu appears for adjusting the time using SNTP.
3. Press the **Time Server** soft key.
   A window appears for setting the NTP/SNTP server IP address or host name.
4. Enter the IP address or host name of the NTP/SNTP server.
5. Press the **Power On Exec** soft key, to select ON or OFF.
6. With the **rotary knob**, set Time Out in the range 1 to 60 (s).
7. To set the date and time, Press the **Exec** soft key.
   The necessary information is obtained from the NTP/SNTP server to set the date and time on this unit.



Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Explanation

Time data is obtained over the network from an NTP/SNTP server, and used to set the date and time on this unit.

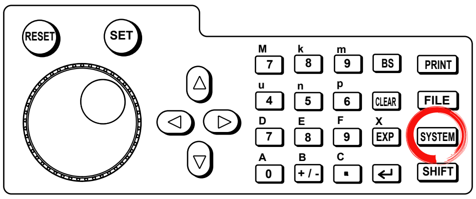
If Power On Exec is set to ON, the date and time information is obtained from the NTP/SNTP server connected to the network each time the unit is powered on.

Note

The time difference from universal time (GMT) must be correctly set.

16.6 Accessing the SB5000 from a PC (File Server)

Procedure



1. Press **SYSTEM**.

2. Press these soft keys: **Network** > **File/Web Server Setup** > **Type**.
The Type menu appears.

Selecting the File Server Function and Enabling/Disabling the Authentication Function

3. Press the **Microsoft Network** or **FTP** soft key to select the file server function.

4. Press the **Mode** soft key to select ON or OFF.

Setting the User Name and Password for Connecting to the SB5000 (When the Mode Is ON)

5. Press the **User Name** soft key.
A screen appears for you to enter the user name.

6. Enter the user name using up to 30 characters.

7. Press the **Password** soft key.
A screen appears for you to enter the password.

8. Enter the password corresponding to the user name using up to 15 characters.

If FTP is selected step 3, proceed to step 9.
If Microsoft Network is selected step 3, proceed to step 10.

Allowing/Prohibiting Anonymous Login (FTP Server Only)

9. Press the **Allow Anonymous** soft key to select ON or OFF.

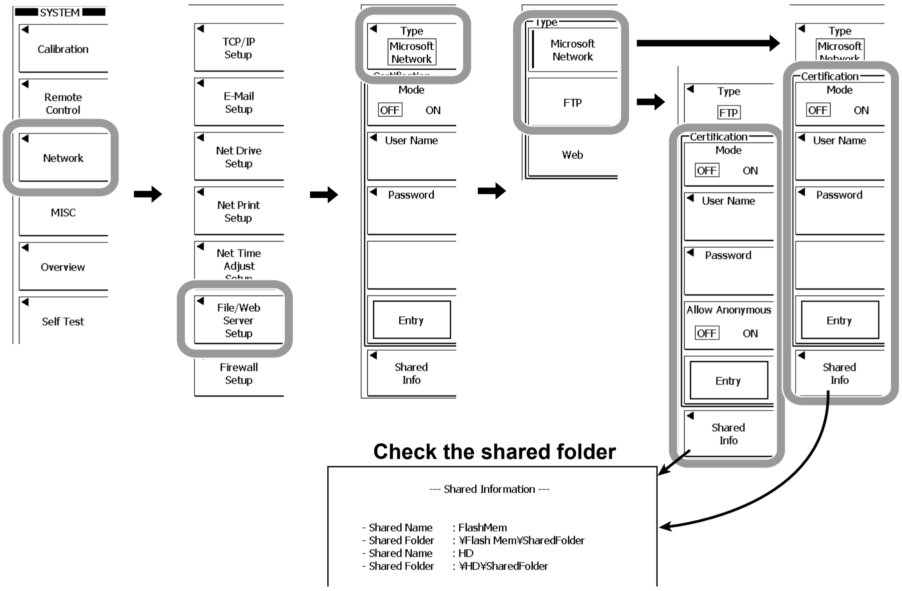
Activating the Settings

10. Press the **Entry** soft key to enable the settings.
The specified settings are activated only when you press Entry.

Checking the Shared Folder

11. Press the **Shared Info** soft key.
A list of shared storage media and folder names is displayed.

12. Press **ESC** to close the list.



Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Explanation

The internal memory and internal hard disk (option) of the SB5000 can be accessed from a PC via the Ethernet network.

File Server Function

Select from the following:.

- Microsoft Network: Access the internal memory or internal hard disk (option) of the SB5000 from a PC using the Microsoft Network function available on the PC.
- FTP: Access the internal memory or internal hard disk (option) of the SB5000 from a PC using an FTP client.

Enabling/Disabling Authentication

Set whether to authenticate the access from the PC to the SB5000. If set to OFF, the SB5000 can be accessed without entering the user name and password.

User Name

Enter the user name that is required when accessing the SB5000 from a PC using up to 30 characters. The characters that can be used are all the ASCII characters on the keyboard.

Password

Enter the password that is required when accessing the SB5000 from a PC using up to 15 characters. The characters that can be used are all the ASCII characters on the keyboard.

Allow Anonymous

This function is configured only when the FTP server function is set to FTP. Set whether to allow anonymous users to log into the SB5000.

- ON: Allows anonymous logins. The only file operation allowed is reading.
- OFF: Prohibits anonymous logins.

The table below shows the relationship between file server settings and the login access.

Setting						
File server function	Microsoft Network		FTP			
Authentication enable/disable	Disable	Enable	Disable		Enable	
User name and password	Not required	Required	Not required		Required	
Anonymous login allow/prohibit	—	—	Prohibit	Allow	Prohibit	Allow
Login access						
User login access	Yes	Yes	Yes	Yes	Yes	Yes
Anonymous login access	Yes	No	No	Yes	No	Yes
Login access only for anonymous (all other user names not allowed)	No	No	No	No	No	Yes*

* Anonymous login is possible only when both user name and password are not set.

Activating the Settings

The specified settings are activated only when you press Entry.

Shared Folder

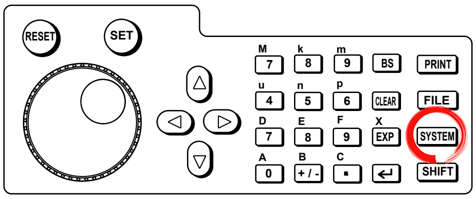
The same shared folder is provided for both the Microsoft Network and FTP file server functions.

Note

- The PC must be running Microsoft Windows XP Home Edition or Professional to access the SB5000 using the Microsoft Network server function.
  If the following security update program (MS05-011) installed, problems may occur such as the file list display taking a long time or the SB5000 files not being able to copied to the PC.
  Patch: Windows XP security update program (KB885250), Date published: February 7, 2005, Version: 885250
  To work around this problem, contact Microsoft Customer Information Center, and install the following correction program in your PC.
  Correction program
  Article ID: 895900, Last Review: June 1, 2005, Revision: 2.0
  The information above does not pertain to the FTP server function.
- The FTP server function on the SB5000 supports two authentication methods: plain authentication and encrypted authentication. The encrypted authentication uses OTP* (One Time Password). FFFTP is a free FTP client that supports encrypted authentication.
  * OTP uses the MD5 algorithm (RSA Data Security, Inc. MD5 Message Digest Algorithm).
- Up to three clients can simultaneously use the Microsoft Network server function of the SB5000. Likewise, up to three clients can simultaneously use the FTP server function.

16.7 Monitoring the SB5000's Screen from a PC (Web Server)

Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Network** > **File/Web Server Setup** > **Type** > **Web**.
   The Certification menu appears.

Selecting the Web Server and Enabling (ON)/Disabling (OFF) the Verification Function

3. Press the **Mode** soft key and select ON or OFF.

Setting Up the User Name and Password for Connecting to the Instrument (When Mode is ON)

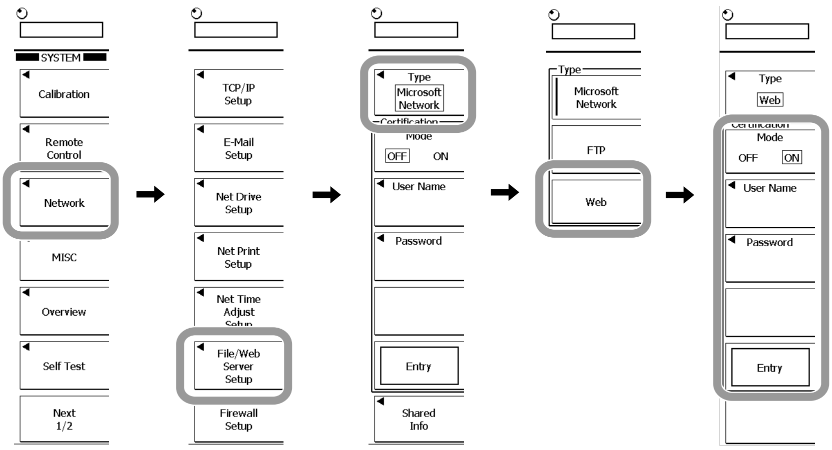
4. Press the **User Name** soft key.
   The user name entry screen appears.
5. Specify a user name using 30 characters or fewer.
6. Press the **Password** soft key.
   The password entry screen appears.
7. Specify a password corresponding to the user name using 15 characters or fewer.

Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.

Applying the Settings

8. Press the **Entry** soft key.
   This settings are applied.
   If you do not press Entry, the settings will not take effect.

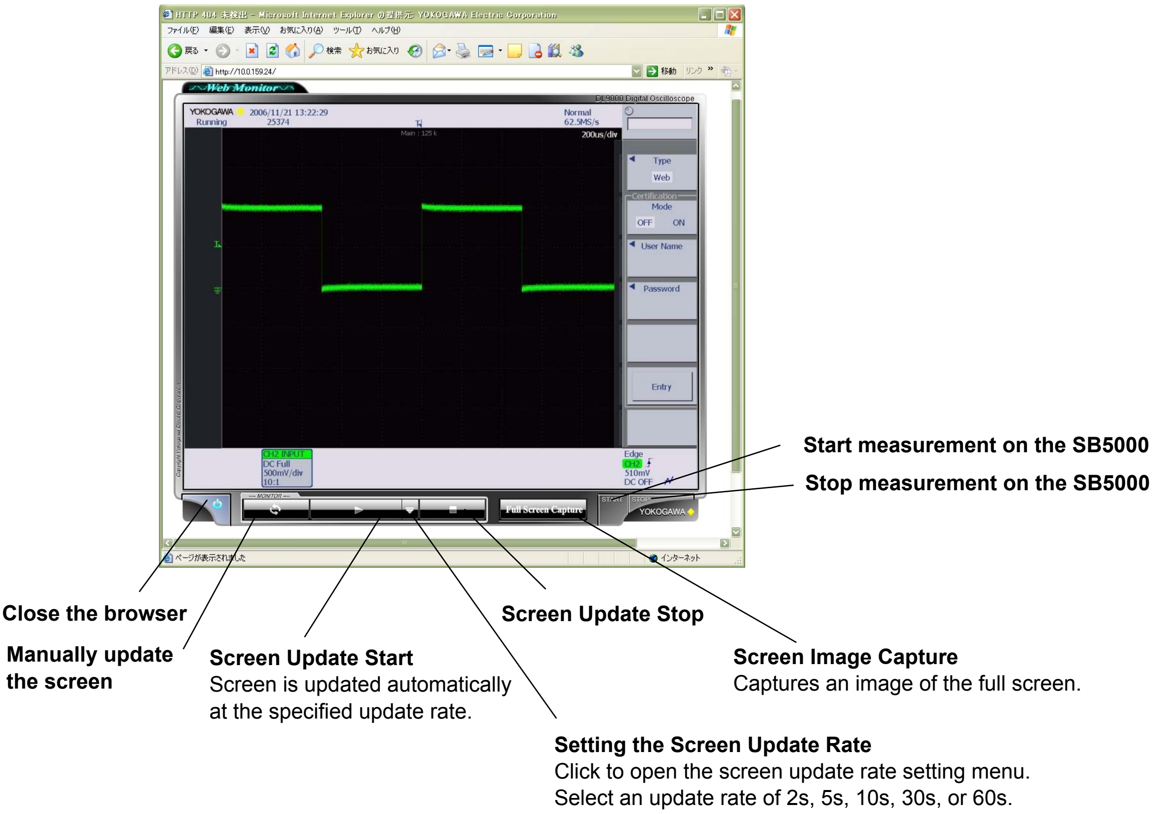


Connecting from a PC

Start the Web browser on a PC connected to the network.

Enter http://xxx.xxx.xxx.xxx/ (where "xxx.xxx.xxx.xxx" is the IP address of the SB5000) in the browser's URL/Address box.

If verification is enabled on the SB5000, the user name and password entry dialog box appear. Enter the user name and password set in steps 4 through 7.



Explanation

You can display the instrument's screen and start or stop measurement from a PC on the network via Ethernet. You can also update the displayed screen or capture a screen image.

Enabling/Disabling Verification

You can set whether or not to verify users attempting to access the instrument from a PC. When turned OFF, the instrument can be accessed without entering a user name and password.

User Name

You can set the user name required to access the instrument from a PC, using 30 characters or fewer. All ASCII characters available on the keyboard can be used.

Password

You can set the password required to access the instrument from a PC, using 15 characters or fewer. All ASCII characters available on the keyboard can be used.

Applying the Settings

If you do not press Entry, the settings will not take effect.

Recommended Operating Systems and Browsers

OS	Web Browser
Windows XP Professional	Internet Explorer 6.0, Firefox 2.0
Windows 2000	Internet Explorer 6.0, Firefox 2.0
Macintosh OS/X (10.4.8)	Safari (2.0.4)

Connection to the PC

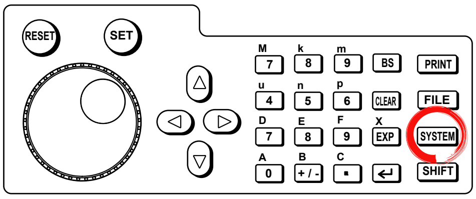
When connecting to the SB5000 from a PC using the Web server function, connect to the network via a hub or router. Do not connect the PC to the SB5000 in a one-to-one configuration.

Note

- Flash® Player by Adobe (version 8 or later) is required when using the Web server function. When visiting this Web site, the most recent Flash Player is automatically downloaded. If the download does not begin, please obtain the latest Flash Player from the Adobe Web site.
- When using the full screen capture function, be sure to disable pop-up blockers on your browser.
- The Web server function is unavailable when printing on the instrument or manipulating files.
- The Web server function can also not be used if the instrument is connected to a PC while the Mass Storage or TMC & Mass Storage setting is enabled on the PC. After disconnecting the PC or enabling the TMC setting, restart the SB5000.

16.8 Setting Up the Network Printer

Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Network** > **Net Print Setup**.

Set the Printer Server Name and Share Name

3. Press the **Print Server** soft key.
   A dialog box is displayed for setting the printer server name.
4. Set the printer server name.
5. Press the **Share Name** soft key.
   A dialog box is displayed for setting the printer server's share name.
6. Set the printer server's share name.

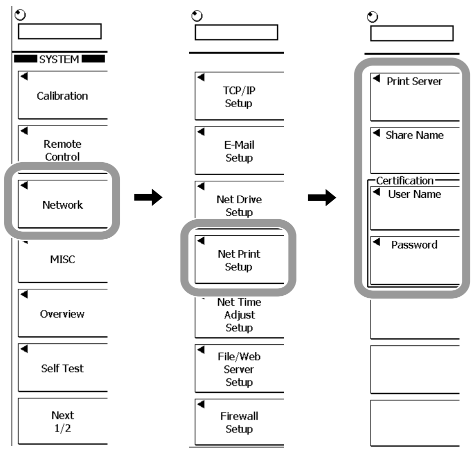
Setting the User Name and Password for Connecting to the Network Printer

7. Press the **User Name** soft key.
   The user name entry screen appears.
8. Specify a user name using 30 characters or fewer.
9. Press the **Password** soft key.
   The password entry screen appears.
10. Specify a password corresponding to the user name using 30 characters or fewer.

For how to print out an actual SB5000 screen, see section 13.4.

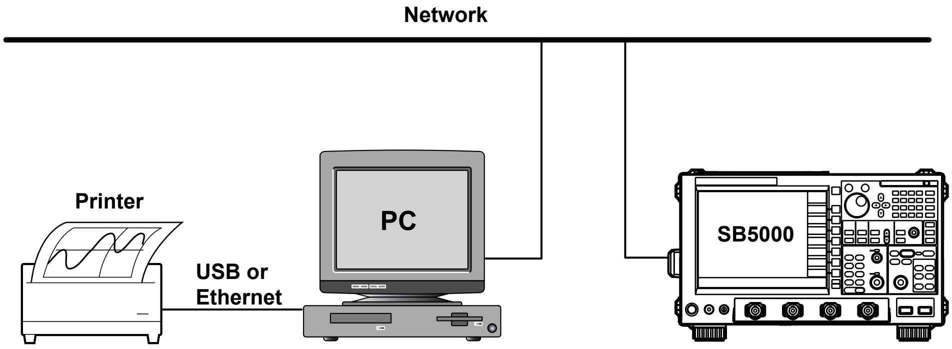
Note

For the operating procedure of the keyboard (software keyboard), see section 4.2.



Explanation

You can connect to a Windows-based PC and print out data on a shared printer. Connections are shown in the following diagram.



The supported PC operating systems are as follows.

Windows 2000

Windows XP Professional

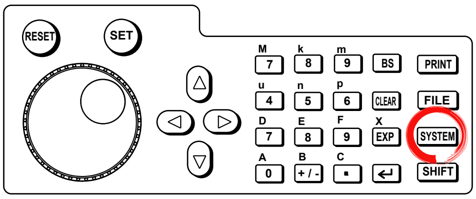
Note

To use a network printer, the printer must be set for sharing on the PC. The following are instructions on how to share a printer using a PC running Windows XP Professional.

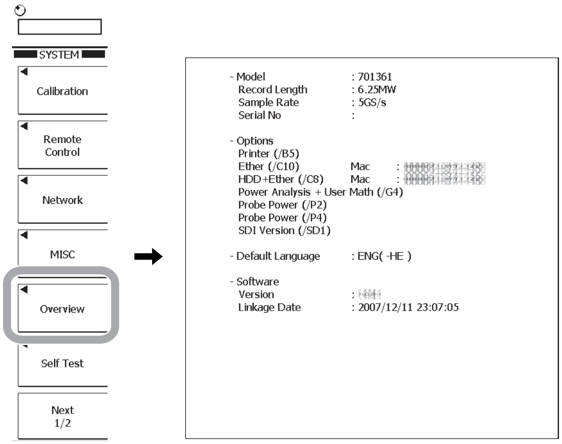
- From the Start menu, click Settings, and then click Printers and FAX.
- Right-click the icon of the printer to share, and click Share.
  The following printers can be shared.
  HP Inkjet printers
  HP Laser printers (monochrome)
- Select the Share this printer option.
- Enter a share name (and enter this name as the share name in the SB5000).
- Click OK.

16.9 Checking the Availability of the Ethernet Interface

Procedure



1. Press **SYSTEM**.
2. Press the **Overview** soft key.
   The Overview screen appears.



Explanation

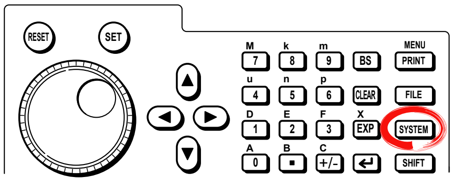
This function allows you to check the Presence of the Ethernet Interface.

Presence of Ethernet Interface

Ether (/C10) or HDD+Ether (/C8) appears in the Overview screen.

16.10 Configuring a Firewall

Procedure



1. Press the **SYSTEM** soft key to display the SYSTEM menu.

2. Press these soft keys: **Network** > **Firewall Setup**.

Enabling/Disabling the Firewall

3. Press the **Mode** soft key to select ON or OFF.

Allowing/Blocking Various Functions

- **Server Function**

4. Press the **Microsoft Network** soft key to select Allow or Block.

5. Press the **FTP** soft key to select Allow or Block.

6. Press the **Control** soft key to select Allow or Block.

7. Press the **Web** soft key to select Allow or Block.

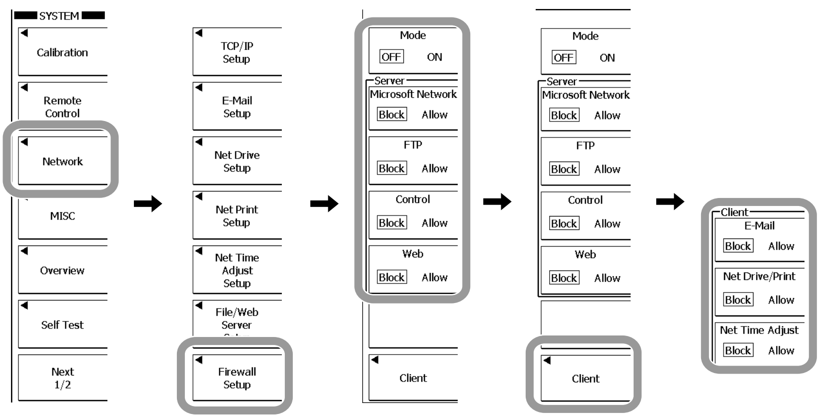
- **Client Function**

8. Press the **Client** soft key.

9. Press the **E-Mail** soft key to select Allow or Block.

10. Press the **Net Drive/Print** soft key to select Allow or Block.

11. Press the **Net Time Adjust** soft key to select Allow or Block.



Explanation

You can block access from other devices on the network to the SB5000 or access from the SB5000 to other devices.

Enabling/Disabling the Firewall

- ON
  Applies a firewall to the individual functions set to Block and prohibits access. (See the next subheading "Allowing/Blocking Various Functions" for the individual functions.) In addition ping an ICMP messages are blocked.
- OFF
  Allows access regardless of the settings explained in the next subheading. The following ports are used.

List of Used Ports

Port	Service	Function Type [Client/Server]
21/tcp	File Transfer [Control]	Client, Server
25/tcp	Simple Mail Transfer	Client
53/udp	Domain Name Server	Client
67/udp	Bootstrap Protocol Server	Client
110/tcp	Post Office Protocol Version3	Client
80/tcp	World Wide Web HTTP Server	Server
123/udp	Network Time Protocol	Client
137/udp	NETBIOS Name Service	Client, Server
138/udp	NETBIOS Datagram Service	Client, Server
139/tcp	NETBIOS Session Service	Client
445/tcp	Microsoft-DS	Server
10001/tcp	Control Server	Server

Allowing/Blocking Various Functions

A firewall can be set up for each function used in the Ethernet communication.

- Microsoft Network
  Allow or block access to the SB5000 using the Microsoft Network client function.
- FTP
  Allow or block access to the SB5000 using the FTP client function.
- Web
  Allow or block access to the SB5000 using the Web client function
- Control
  Allow or block access to the SB5000 using the remote control client function.
- Web
  Allow or block access to the SB5000 using the web client function.
- Net Drive/Print
  Allow or block access the Microsoft Network server from the SB5000 network drive.
- Net Time Adjust
  Allow or block the SB5000 from accessing the NTP or SNTP server.
- E-Mail
  Allow or block the SB5000 from accessing the SMTP or POP server.

Note

Limitation when Allow is selected for the FTP function

Clients cannot access the SB5000 using passive mode.

17.1 External Trigger Input (TRIG IN)

CAUTION

Do not input any signal not meeting the specification below. An excessive voltage, for example, may damage the SB5000.

External Trigger Input Connector

This connector is used when an external signal is used as a trigger source (see section 7.13).

Item	Specifications
Connector type	BNC
Maximum input voltage	±40 V (DC + ACpeak) or 28 Vrms when the frequency is 10 kHz or less
nput frequency bandwidth	DC to 100 MHz
Input impedance	Approx. 1 MΩ, approx. 18 pF
Trigger sensitivity	0.1 Vp-p
Trigger level	±2 V (setting resolution 5 mV)

17.2 Trigger Output (TRIG OUT)

CAUTION

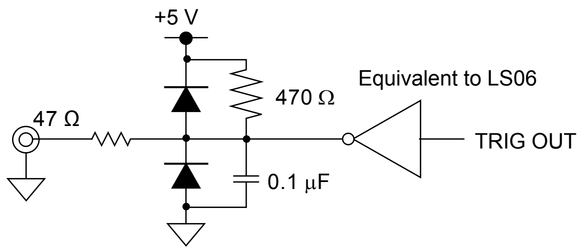
Do not apply an external voltage to TRIG OUT output connector. Doing so can cause damage to the SB5000.

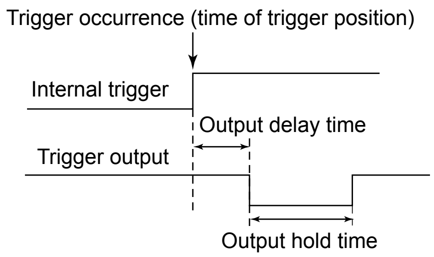
External Trigger Output Connector

A TTL level signal is output when a trigger is activated. The signal level is normally high and goes low when a trigger is activated.

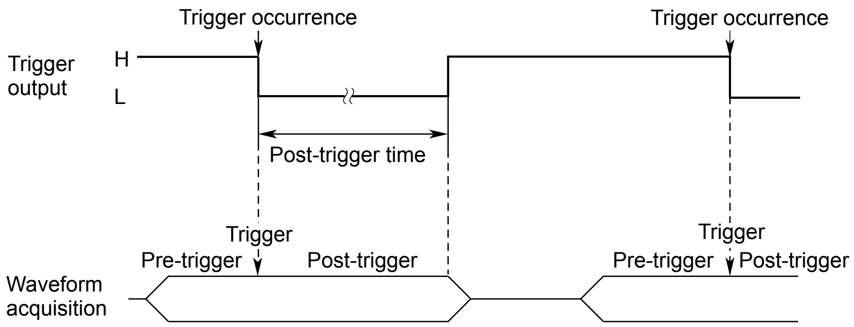
Item	Specifications
Connector type	BNC
Output levels	5 V TTL
Logic	Goes low when trigger is activated, goes high when acquisition is completed
Output delay time	50 ns or less
Output hold time	Low level: 50 ns Minimum, High level: 50 ns Minimum

Trigger Output Circuit Diagram/Timing Chart





Low Level and High Level Hold Times



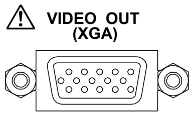
17.3 RGB Video Signal Output (RGB VIDEO OUT)

CAUTION

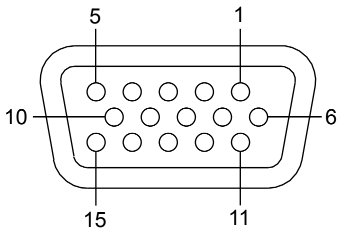
- Power off the SB5000 and monitor before making the connection.
- Do not short the VIDEO OUT connector, or apply an external voltage. Doing so can cause damage to the SB5000.

Video Signal Output Connector

With the video signal output, the SB5000 screen display can be shown on a monitor. Any multisync monitor supporting XGA display can be connected.



Item	Specifications
Connector type	D-sub 15-pin
Output format	Analog RGB output
Output resolution	1024 × 768 pixels, approx. 60 Hz Vsync



D-Sub 15-pin receptacle

Pin No.	Signal name	Specifications
1	Red	0.7 Vp-p
2	Green	0.7 Vp-p
3	Blue	0.7 Vp-p
4	—	
5	—	
6	GND	
7	GND	
8	GND	
9	—	
10	GND	
11	—	
12	—	
13	Horizontal sync signal	Approx. 36.4 kHz, TTL positive logic
14	Vertical sync signal	Approx. 60 Hz, TTL positive logic
15	—	

Connection to a Monitor

1. Power off the SB5000 and monitor.
2. Connect the SB5000 and the monitor using an analog RGB cable.
3. Power on the SB5000 and monitor.

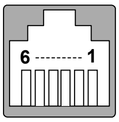
17.4 GO/NO-GO Signal Output

The SB5000 can output a signal indicating a GO/NO-GO determination.

Input/Output Connector

The connector uses a modular jack (RJ-12). A cable is available as optional accessory 366973.

GO/NO-GO



Connector on the DL9500/DL9700

Pin No.	Signal
1	NC (Not connected)
2	NC (Not connected)
3	GO OUT (Negative logic)
4	NO-GO OUT (Negative logic)
5	GND
6	NC (Not connected)

Input levels: TTL (0 to 5 V)

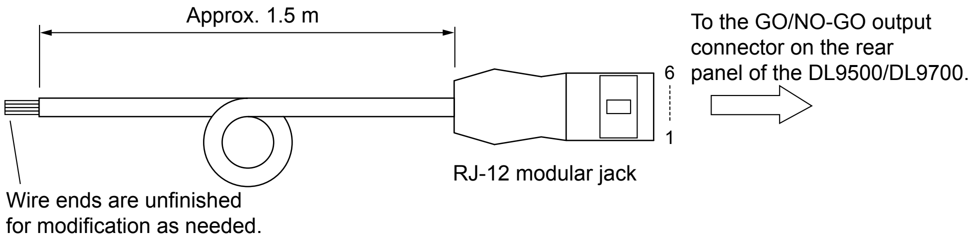
GO/NO-GO Output Signal

CAUTION

- Do not apply an external voltage to the NO-GO OUT output pin or GO OUT output pin. Doing so can cause damage to the SB5000.
- When making the external connection to the GO/NO-GO determination signal output, be careful not to connect to a different signal pin. A wrong connection could result in damage to the SB5000 or to other connected equipment.
- Do not connect a USB cable to the GO/NO-GO output connector. Doing so can cause damage to the SB5000.

For connection to an external device, use the special-purpose optional accessory GO/NO-GO cable (part no.: 366973).
Do not use the special-purpose optional accessory GO/NO-GO cable (part no.: 366973) for any purpose other than a GO/NO-GO determination from the SB5000.

Specifications of the GO/NO-GO cable (model 366973)



Wire color	Pin No.	Signal	Logic
White	3	GO OUT	Negative logic
Green	4	NO-GO OUT	Negative logic
Blue	5	GND	

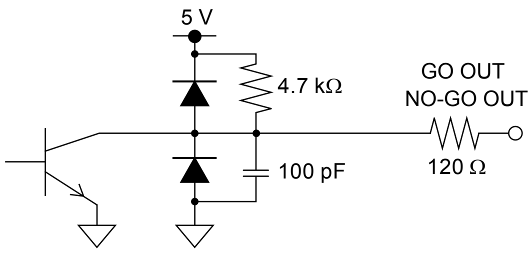
NO-GO OUT Signal

When the determination result is “NO-GO”, the output signal level (TTL levels) goes temporarily from high level to low level.

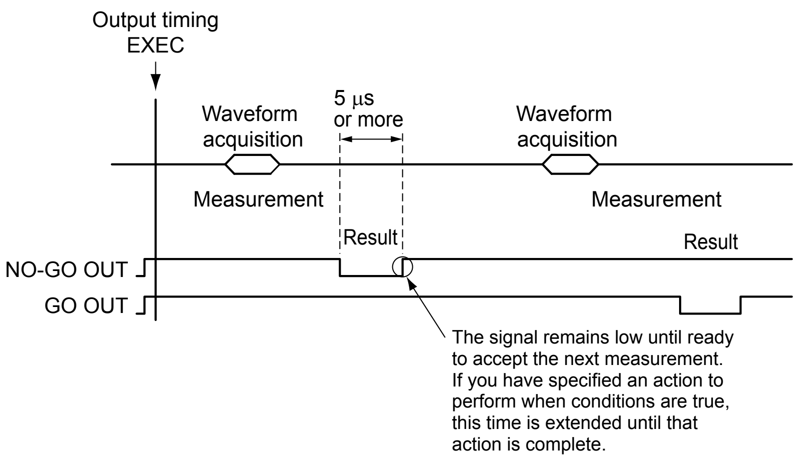
GO OUT signal

When the determination result is “GO”, the output signal level (TTL levels) goes temporarily from high level to low level.

Signal Output Circuit Diagram

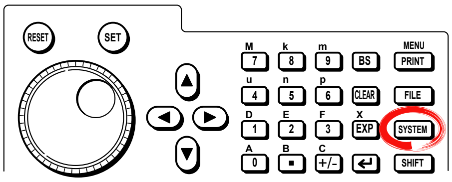


GO/NO-GO Output Timing

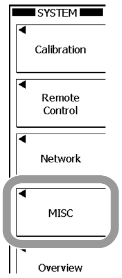


18.1 Changing the Message Language, Menu Language, and Font Size, and Turning ON/OFF the Click Sound

Procedure

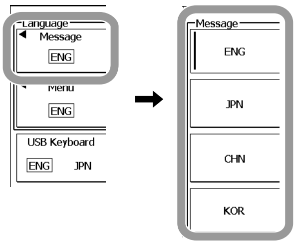


1. Press **SYSTEM**.
2. Press the **MISC** soft key.



Selecting the Message Language

3. Press the **Message** soft key to display the Message menu.
4. Press the **ENG**, **JPN**, **CHN,** or **KOR** soft key to select the language.



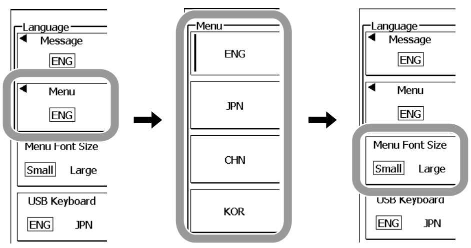
Selecting the Menu Language and Font Size

- **Selecting the Menu Language**

3. Press the **Menu** soft key to display the Menu menu.
4. Press the **ENG**, **JPN**, **CHN,** or **KOR** soft key to select the language.

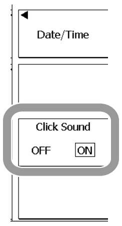
- **Selecting the Font Size**

5. Press the **Menu Font Size** soft key to select Small or Large.
   The font size of the alphanumeric characters on the menu changes.



Turning the Click Sound ON/OFF

3. Press the **Click Sound** soft key to select ON or OFF.



Explanation

Selecting the Message Language

A message appears when an error occurs or when you press the HELP key. You can select the message language from English (ENG), Japanese (JPN), Chinese (CHN), and Korean (KOR). The messages codes are common in all languages. For a description of the messages, see section 19.2.

Selecting the Menu Language

Select the menu language from English (ENG), Japanese (JPN), Chinese (CHN) and Korean (KOR).

Selecting the Font Size

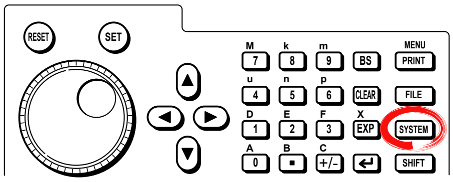
You can set the size of the alphanumeric characters on the menu to small or large. You can change the font size of the alphanumeric characters even if the menu language is set to a language other than English.

Turning the Click Sound ON/OFF

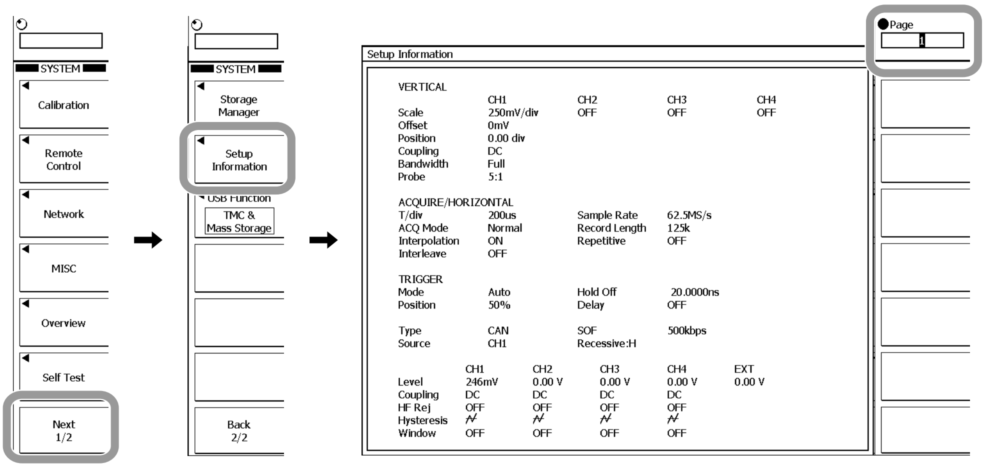
You can enable or disable the click sound that is generated when the rotary knob is turned. The default setting is ON.

18.2 Listing the Setup Data

Procedure



1. Press the **SYSTEM** soft key.
2. Press these soft keys: **Next 1/2** > **Setup Information**.
   A list of setup information appears.
3. Use the **rotary knob** to select the page you want to display in the list.

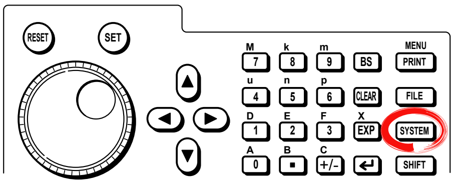


Explanation

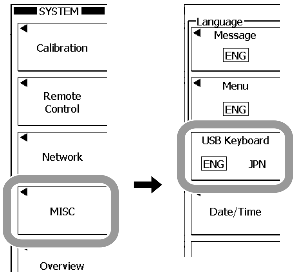
A list of setup data can be displayed. The list is displayed across multiple pages.

18.3 Changing the USB Keyboard Language

Procedure



1. Press **SYSTEM**.
2. Press the **MISC** soft key.
3. Press the **USB Keyboard** soft key to select ENG or JPN



Explanation

You can select the language of the USB keyboard that is used to enter items such as file names and comments (see section 4.3).

Keyboards conforming to USB Human Interface Devices (HID) Class Version 1.1 can be used.

- ENG: 104 keyboard
- JPN: 109 keyboard

The character that is entered through each key of the 104 keyboard varies depending on the keyboard type. For details of 104 keyboard, see appendix 3.

19.1 If a Problem Occurs

Faults and Corrective Action

- If a message appears on the screen, read the following pages.
- If service is required, or the corrective action does not solve the problem, refer to your supplier.

Description	Probable Cause	Corrective Action	Reference Section
The power cannot be turned ON.	Using a power supply outside the ratings.	Use a correct power supply.	3.3
Nothing is displayed.	The backlight is turned OFF.	Press any key.	9.8
	The screen colors are not appropriate.	Turn the power OFF, and then turn the power ON again while pressing the **RESET** key.	4.4
The display is odd.	The system is not operating properly.	Power-cycle the SB5000.	3.3
Keys do not work.	The keys are malfunctioning.	Perform a key test. If the test fails, servicing is required.	19.3
Trigger does not activate.	The trigger settings are not appropriate.	Set the trigger conditions correctly.	Chapter 7
Measured values are not correct.	Insufficient warm-up.	Warm up the SB5000 for 30 minutes after turning on the power.	–
	Not calibrated.	Execute calibration.	4.8
	The probe's phase has not been corrected.	Perform phase correction correctly.	3.5
	The probe attenuation is not correct.	Set an appropriate value.	6.6
	An offset voltage is added.	Set the offset voltage to 0 V.	6.10
	Other causes.	Execute calibration. If the measured value is still odd servicing is required.	4.8
Cannot output to the built-in printer.	The printer head is damaged or worn out.	Servicing required.	–
Cannot save to the specified medium.	The medium is not formatted.	Format the medium.	19.6
	No more free space on the medium.	Delete unneeded files or use another storage medium.	–
Cannot change settings or control the operation of the SB5000 via the communication interface.	The address of the SB5000 used by the program is different from the specified address.	Match the address used in the program to the address of the SB5000.	Communication Interface User's Manual (IM 701361-17E)
	The interface is not used in a way that conforms to the electrical or mechanical specifications.	Use it in a way that conforms to the specifications.	

19.2 Messages and Corrective Actions

Messages

Messages may appear on the screen during operation, and this section explains these messages, and corrective action to take. Note that the messages can be displayed in either Japanese or English (See Section 18.1). If the corrective action requires service refer to your supplier.

In addition to the following messages, there are also communications related messages. These are described in the separate *Communications Interface User's Manual (IM 701361-17E)*.

Information

Code	Message and corrective action	Section
51	Turned on pressing the RESET key. All the settings will be initialized.	4.4
52	Firmware is updated. All the settings are initialized.	–
53	Hardcopy is aborted.	–
54	File access is aborted.	–
55	Action-on-trigger is aborted.	8.8
56	Search aborted.	–
57	Search execution is completed, but no record was found that matched the conditions.	–
58	Search execution is completed, but no record was found that matched the pattern.	–
59	Statistical measurement is aborted.	Chapter 11
62	The corresponding field was not found.	–
63	Action-on-trigger is completed.	8.8
64	The instrument is set to remote mode by the communication control. Press the CLEAR key tochange to local mode.	–
65	Local lockout is set by the communication control. To operate using the keys, release the lockout using the communication control.	–
66	Firmware will be updated. Do you want to proceed? Note: It will take approx. 5 minutes. Please DO NOT power off the unit until the completion. Once the procedure is completed, the unit will reboot itself. We recommend you to save the setups before updating the firmware.	–
67	Updating Firmware. Note: Please DO NOT power off the unit. Once the procedure is completed, the unit will reboot itself.	–
68	Firmware is updated. Will be rebooted.	–
69	Any serial bus signal can not be detected.	–
70	Serial bus automatic setting was aborted.	–
71	The symbol/physical value file(.sbl) has not been loaded.	14.8
72	A contradiction in bit numbers of logic setting and symbol definition was detected. Check the symbol/ physical value file(.sbl).	–

File Errors

Code	Message and corrective action	Section
500	Data size larger than remaining capacity in media. Delete unnecessary files or use other media.	Chapter 14
501	File does not exist. Check the file name.	Chapter 14
502	Assigned path does not exist or no media. Check the path name and media.	Chapter 14
503	Writing prohibited in the media. Unlock write protection of the media.	Chapter 14
504	Insufficient remaining capacity in media. Delete unnecessary files or use other media.	Chapter 14

Code	Message and corrective action	Section
505	File not compatible. Check the file, firmware version of the unit or model name of the unit.	–
506	Save data do not exist. Check the content to be saved.	–
507	Save data do not exist. Check the content to be saved.	–
508	Unable to open file. The may be opened by other process. Try to open file later. If the problem still exist, service may be necessary.	Chapter 16
509	Access denied.	Chapter 14
510	File system error. Service is required.	–
511	Media error. Service is required.	–
512	Directory can not be deleted.	Chapter 14
513	File or Directory can not be moved to other media. If the problem occurs on other media, service may be required.	Chapter 14
514	Directory entry does not exist.	–
515	Media error. Service is required.	–
516	Media error. Service is required.	–
517	End of the file.	–
518	The same file or directory name exist. Remove the file/directory or change the current path.	Chapter 14
519	Target file of Move or Copy has a read only property.	Chapter 14
520	Assigned path does not exist or no media. Check the path name and media.	Chapter 14
521	Destination folder assigned to Copy / Move is the same as the origin or sub folder. Change the destination folder.	Chapter 14
522	No file name. Type in file name.	Chapter 14
523	Auto file name failure. Change the type of auto file name or change the header of the auto name.	Chapter 14
524	Auto file name failure. Change the type of auto file name or change the header of the auto name.	Chapter 14
525	Improper file or path name. Check file/path name.	Chapter 14
526	File is disintegrated. Check the file.	–
527	File system error. Service is required.	–
528	Illegal file name. The name contains prohibited characters. Change it to a different name.	Chapter 14
529	Illegal file name. The name is reserved by the system. Change it to a different name.	Chapter 14
530	Load failure. Number of vortex exceeded the maximum. Redefine the mask data.	–
531	Unable to open file. The may be opened by other process. Try to open file later. If the problem still exist, service may be necessary.	–
532	Unable to save. Compressed record size exceeded current record size. Change the compressed record size and execute again.	–
533	Assigned path does not exist. Check the network setting and configuration.	Chapter 16

Code	Message and corrective action	Section
534	Assigned path does not exist. Check the network setting and configuration.	Chapter 16
535	Assigned path does not exist. Check the network setting and configuration.	Chapter 16
539	Unable to load a logic waveform to the reference waveform.	15.2
540	Unable to load a file containing logic waveforms.	14.5

Printer Errors

Code	Message and corrective action	Section
550	Printer error. Confirm the printer status.	–
551	Cannot detect printer. Turn ON the printer. Check connections.	–
552	Communication error. Check all connections and make sure all devices are on.	–
553	Paper not loaded correctly. Set the paper correctly.	13.1
554	Printer over heat. Power off immediately.	–
555	Move the release arm to the “HOLD” position.	13.1
556	No built-in printer on this model. Check the specifications to see whether or not the optional printer is provided.	Page ii
557	Image creation failure. Working memory space may be insufficient. Maintenance service is required.	–

Network Errors

Code	Message and corrective action	Section
600	Invalid network parameter settings. Check the network parameters.	Chapter 16
601	Unable to connect to the server. Check the network settings and configuration.	Chapter 16
602	Invalid file server settings. Check the file server settings.	Chapter 16
603	Invalid fire wall settings. Check the fire wall settings.	Chapter 16

Execution Errors

Code	Message and corrective action	Section
650	Running. Stop and execute again.	4.7
651	Accessing file. Abort or wait until it is completed, and execute again.	–
652	Printing. Abort or wait until it is completed, and execute again.	–
653	Processing action-on-trigger. Abort or wait until it is completed, and execute again.	8.8
654	Processing zoom search. Abort or wait until it is completed, and execute again.	11.18
655	Processing auto scroll. Abort or wait until it is completed, and execute again.	–
656	Processing history search. Abort or wait until it is completed, and execute again.	Chapter 12
657	Processing history replay. Abort or wait until it is completed, and execute again.	Chapter 12
658	Processing statistical measurement. Abort or wait until it is completed, and execute again.	11.3
660	Zone edit in process. Terminate editing.	Chapter 8
661	Processing self test. Wait until it is completed.	–
662	Acquisition in process in N Single trigger mode. Press Start/Stop key or wait until the process is completed.	Chapter 7
663	Retrievable settings does not exist. The settings is created by either Initialize or Auto Setup.	–
664	Failed to execute statistical measurement. Waveform data may not exist. In Cycle statistic mode, improper setting may result in failure to recognize the cycle.	11.3
665	Search target data does not exist. The search after analysis is completed.	–
666	Improper action setting. The saved data type is either Waveform group or Analysis group. This can be assigned from File menu.	Chapter 14
667	Retrievable data not found.	–
669	Sending E-Mail. Wait until it is completed.	–
670	The corresponding field was not found.	–
674	Cannot store because the data is locked. Release the lock through Store Detail.	4.6

Setting Errors

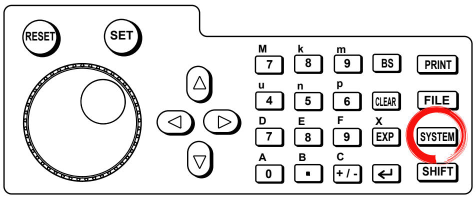
Code	Message and corrective action	Section
800	Improper Date/Time setting.	3.7
801	Not allowed unless waveforms are shown. Display waveforms.	Chapter 5
802	Source waveforms do not exist. Display source waveforms.	Chapter 8
803	Zone waveforms do not exist.	Chapter 8
804	Illegal expression.	Chapter 10
805	Not allowed in Telecom test mode. Turn off the Telecom test mode.	11.5
806	Invalid bit assignment in the logic group.	6.17
807	Unable to enable the trigger conditions. Set the clock source to another group or assign bits to the group.	7.3, 7.9, 7.11

System Errors

Code	Message and corrective action	Section
900	Failed to backup setup data. Initializing will be executed. Backup battery may be low. Maintenance service is required to replace the back-up battery.	19.7
901	Fan stopped. Power off immediately. Maintenance service is required.	19.7
902	Backup battery is low. Maintenance service is required to replace the back-up battery.	19.7
903	Calibration failure. Disconnect the input and execute again. If it fails again, service is necessary.	–
904	Invalid Command.	–

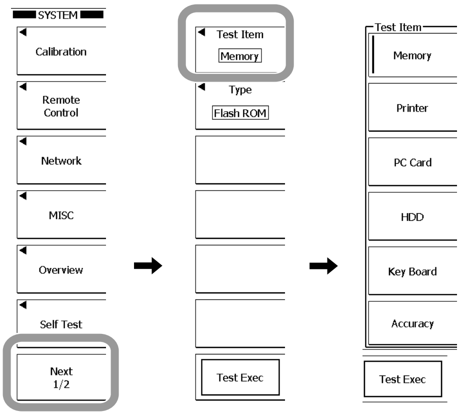
19.3 Carrying Out a Self-Test

Procedure



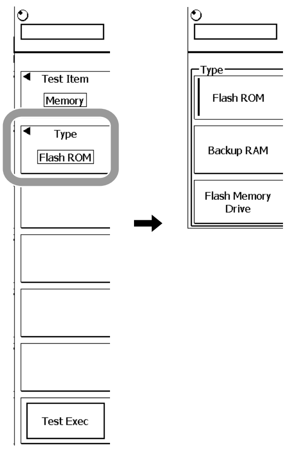
Displaying the Self-Test Menu

1. Press **SYSTEM**.
2. Press these soft keys: **Self Test** > **Test Item**.
3. Press the soft key that corresponds to the item you want to test.



Memory Test Execution

4. In step 3, select Memory.
5. Press the **Type** soft key.
6. Press the soft key that corresponds to the memory you want to test.
7. Press the **Test Exec** soft key. This executes the memory test.



Printer/PC Card/Internal HDD/Accuracy Test Execution

4. In step 3, select one of Printer, PC Card, HDD, and Accuracy.
5. Press the **Test Exec** soft key. This executes the respective test.

Note

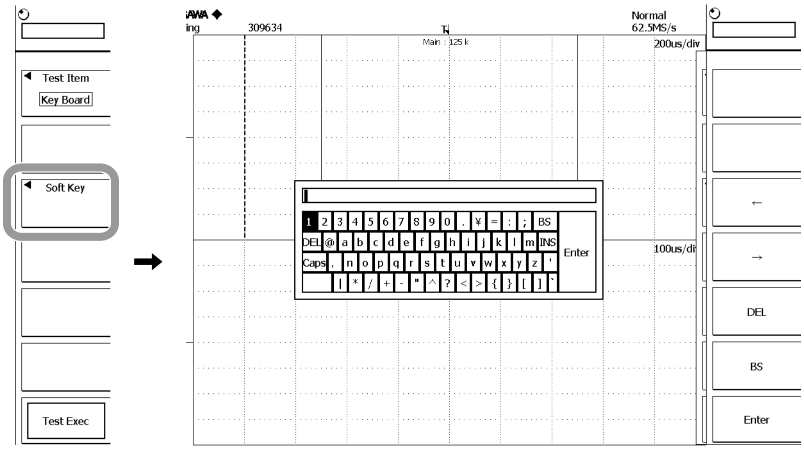
Before carrying out the PC card drive test, insert a PC card.

Panel Key Test

4. In step 34, select Key Board.
5. Press the **Test Exec** soft key. The panel key test screen appears.
6. Pressing an operating key shows the corresponding key on the screen in reverse video.
7. Press all of the keys, or press **ESC** twice in succession. This ends the key test.

Soft Key Test

4. In step 3, select Key Board.
5. Press the **Soft Key** soft key.
6. Use the **rotary knob** and **SET** to check that keyboard characters can be entered correctly.



Note

The Accuracy test item is a test item for servicing.

Explanation

Memory test: Memory

This tests whether the RAM/ROM on the internal CPU board is operating correctly. A "Success" indication means that the result is normal.
If there is an error, "Fail" appears.

Printer test: Printer

Tests whether the optional built-in printer is operating correctly. If the test pattern is printed correctly, then the printer is normal. If there is an error, the test pattern will not print correctly.

PC card: PC Card

Tests whether the PC card slot is functioning correctly. If there is an error, after test execution, "Fail" appears.

Built-in hard disk drive (option /C8): HDD

Tests whether the built-in hard disk drive is functioning correctly. If there is an error, after test execution, "Fail" appears.

Key test: Key Board

Tests whether the front panel operating keys are functioning correctly. If the name of a pressed key appears in reverse video, it is normal.

Soft key test: Key Board

Tests whether the soft keyboard is providing normal input. If the selected characters appear, then input is normal.

Accuracy test: Accuracy

This appears as a result of system autocalibration. If there is an error, "Fail" appears.

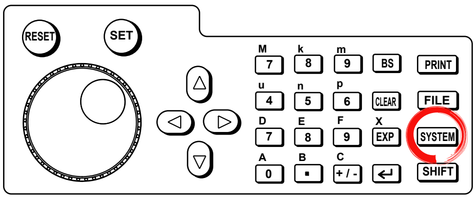
If an error occurs in the self-test

If the error persists after trying the following, refer to your supplier.

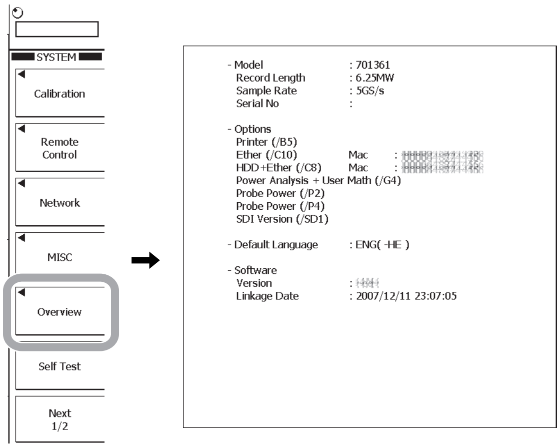
- Try running the self-test a number of times.
- Check that the media being tested is in place.
- Check that paper is correctly loaded in the built-in printer, and that there is no paper jam (Section 13.1).

19.4 System Overview

Procedure



1. Press **SYSTEM**.
2. Press the **Overview** soft key.
   The overview screen appears.
   Press any key to exit the overview screen.



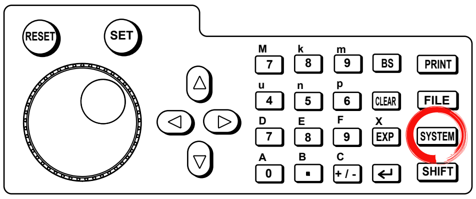
Explanation

The screen appears as above, with the following information.

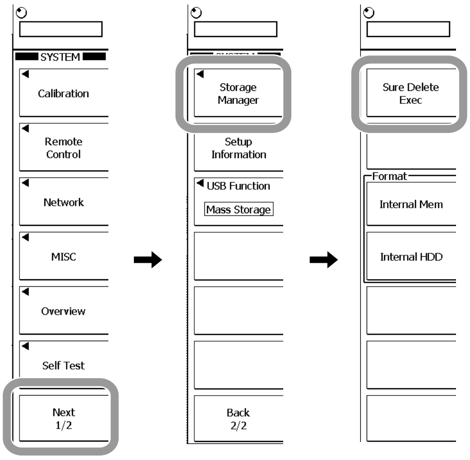
Model	Model
Record Length	Record length
Sample Rate	Maximum sample rate
Serial No.	Serial No.
Options	Installed options
Default Language	Default language
Software Version	Firmware version number
Linkage Date	Firmware version date

19.5 Collectively Deleting the Data in the Internal Memory and Built-in Hard Disk

Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Next 1/2** > **Storage Manager** > **Sure Delete Exec**.
   A message to confirm erasing the data appears.
3. Use the **rotary knob** and **SET** to select OK or Cancel.
   If you select OK, all data in the internal memory and built-in hard disk is erased. The name of the Sure Delete Exec soft key changes to Abort while the data is being deleted.



Aborting Data Deletion

4. Press the **Abort** soft key.
   Data deletion is aborted. At the same time, the Abort soft key changes to the Sure Delete Exec soft key.

Explanation

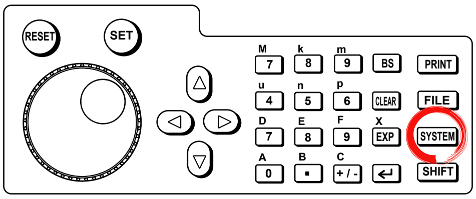
This function erases all data from the internal memory and built-in hard disk. Save required data on a PC card or other media.

Note

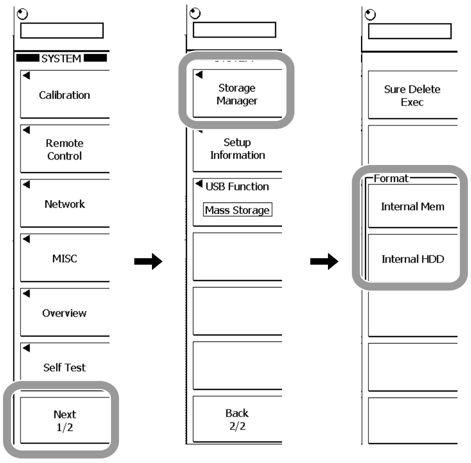
To erase all data from the built-in hard disk takes approximately 2 hours 40 minutes.

19.6 Formatting Internal Memory and Built-in Hard Disk

Procedure



1. Press **SYSTEM**.
2. Press these soft keys: **Next 1/2** > **Storage Manager**.
3. Press the **Internal Mem** or **Internal HDD** soft key.
   A message to confirm formatting appears.
4. Use the **rotary knob** and **SET** to select OK or Cancel.
   If you select OK, the internal memory or built-in hard disk is formatted.



Explanation

This formats the internal memory or built-in hard disk. Save required data on a PC card or other media.

19.7 Recommended Replacement Parts

Yokogawa guarantees the SB5000 for the period and under the conditions of the product warranty.
Under the conditions of the guarantee, the following components are excluded from the three-year warranty. For replacements, refer to your supplier.

Part name	Lifetime
Built-in printer	Under normal conditions of use, equivalent of 120 rolls of printer paper (part number: B9850NX)
LCD backlight	Under normal conditions of use, approx. 25,000 hours

Part name	Guarantee period
Built-in hard disk	One year from date of purchase (warranty does not cover loss of data).

The following parts are consumables. We recommend replacing them at the following intervals. For replacement parts, refer to your supplier.

Part name	Recommended replacement interval
Cooling fan	3 years
Backup battery (lithium battery)	5 years

20.1 Models

Item	Specifications			
Model name)	Maximum sample rate	Frequency bandwidth	Max. record length	Input terminal
SB5310(701351)	5 GS/s	1 GHz	6.25 MW	4 analog channels + 8-bit logic
SB5710(701361)	5 GS/s	1 GHz	6.25 MW	4 analog channels + 32-bit logic

20.2 Input Section

Analog Signal Input

Item	Specifications	
Input channels	4(CH1 to CH4)	
Input coupling setting	AC, DC, GND, DC50 Ω	
Input connector	BNC connector	
Input impedance	1 MΩ ± 1.0% approx.20 pF (10 MΩ ± 2.0% approx. 14 pF when using the PB500 passive probe) 50 Ω ± 1.5%	
Voltage axis sensitivity range	For 1 MΩ input:	2 mV/div to 5 V/div (1-2-5 steps)
	For 50 Ω input:	2 mV/div to 500 mV/div (1-2-5 steps)
Maximum input voltage	For 1 MΩ input (at a frequency of 1 kHz or less):	150 Vrms CAT I
	For 50 Ω input:	Not to exceed 5 Vrms or 10 Vpeak.
Max. DC offset setting range (With the probe attenuation is set to 1:1)	For 1 MΩ input	
	2 mV/div to 50 mV/div:	±1 V
	100 mV/div to 500 mV/div:	±10 V
	1 V/div to 5 V/div:	±100 V
	For 50 Ω input	
	2 mV/div to 50 mV/div:	±1 V
	100 mV/div to 500 mV/div:	±5 V
Vertical (voltage) axis accuracy		
DC accuracy[1]	For 1 MΩ input:	±(1.5% of 8 div + offset voltage accuracy)
	For 50 Ω input:	±(1.5% of 8 div + offset voltage accuracy)
Offset Voltage Accuracy[1]	2 mV/div to 50 mV/div:	±(1% of setting + 0.2 mV)
	100 mV/div to 500 mV/div:	±(1% of setting + 2 mV)
	1 V/div to 5 V/div:	±(1% of setting + 20 mV)
Voltage standing wave ratio (VSWR)	1.5 or less within frequency bandwidth (typical value[4])	
Frequency characteristics[1,2] (–3 dB attenuation point when sine wave with amplitude ±2 div equivalent is applied)	For 50 Ω input	
	0.5 V/div to 10 mV/div:	DC to 1 GHz
	5 mV/div:	DC to 750 MHz
	2 mV/div:	DC to 600 MHz
	For 1 MΩ input (using PB500, measured from probe tip)	
	5 V/div to 10 mV/div:	DC to 500 MHz
	5 mV/div to 2 mV/div:	DC to 400 MHz
–3 dB low band attenuation point for AC coupling	10 Hz or below (1 Hz or below using the supplied 10:1 probe)	
Skew between channels (with same setting conditions)	1 ns or less	
Residual noise level[3]	0.4 mVrms or 0.05 div rms, whichever is greater (typical value[4])	
Isolation between channels (Same voltage sensitivity)	–30 dB at 1 GHz (typical value[4])	
A/D conversion resolution	8 bits (25 LSB/div) Max. 12 bits (in high resolution mode)	
Probe attenuation settings	1:1, 10:1, 100:1, 1000:1, 10A:1V, 100A:1V (Attenuation selectable using the rotary knob only 2:1, 5:1, 20:1, 50:1, 200:1, 500:1, 1A:1V)	

Specifications
20

Item	Specifications	
Probe attenuation settings	1:1, 10:1, 100:1, 1000:1, 10A:1V, 100A:1V (Attenuation selectable using the rotary knob only 2:1, 5:1, 20:1, 50:1, 200:1, 500:1, 1A:1V)	
Bandwidth limit	For each channel, selectable from: FULL, 200 MHz, 20 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz, 125 kHz, 62.5 kHz, 32 kHz, 16 kHz, and 8 kHz Achieved by combining the analog filter (200 MHz, 20 MHz) and digital filter (IIR + FIR)	
Maximum sample rate	Realtime sampling mode	
	When interleave mode is ON:	5 GS/s
	When interleave mode is OFF:	2.5 GS/s
	Repetitive sampling mode:	2.5 TS/s
Max. record length	6.25 MW	
Maximum acquisition rate	For 1.25 MW record length	60 waveforms/s/channel
	For 12.5 kW record length	9,000 waveforms/s/channel
	For 2.5 kW record length	25,000 waveforms/s/channel
Dead time for N single[5]	400 ns or less (equivalent to 2,500,000 waveforms/s for each channel)	

1 Values measured under standard operating conditions (see page 20-17) after 30-minute warm-up and calibration with the time base set to internal clock.

2 Values for a repeating phenomena.
The frequency bandwidth of a single burst frequency bandwidth is the smaller of the two values, DC to the sampling frequency/2.5 and the frequency bandwidth of the repeating phenomena.

3 With the input section shorted, acquisition mode normal, interleave mode OFF, accumulate OFF, and probe attenuation set to 1:1.

4 Typical value represents a typical or average value. It is not strictly warranted.

5 No change in the acquisition rate with an increase or decrease in the number of channels.

Logic Signal Input

Item	Specifications	
Compatible probes	701980 and 701981 (8-bit input)	
Maximum toggle frequency[1]	When using the 701980:	100 MHz
	When using the 701981:	250 MHz
Number of inputs	SB5310: 8 (when one logic probes are used) SB5710: 32 (when four logic probes are used)	
Maximum input voltage	±40 V (DC+ACpeak) or 28 Vrms at a frequency of 1 kHz or less	
Minimum input voltage	500 mVp-p	
Input range	When using the 701980:	±40 V
	When using the 701981:	±10 V
Input impedance	When using the 701980:	Approx. 1 MΩ, approx. 10 pF
	When using the 701981:	Approx. 10 kΩ, approx. 9 pF
Minimum pulse width	When using the 701980:	5 ns
	When using the 701981:	2 ns
Hysteresis voltage	When using the 701980:	Approx. 80 mV
	When using the 701981:	Approx. 50 mV
Maximum sample rate	When interleave mode is ON:	5 GS/s
	When interleave mode is OFF:	2.5 GS/s
Max. record length	6.25 MW	
Maximum acquisition rate	For 1.25 MW record length	60 waveforms/s/input
	For 12.5 kW record length	9,000 waveforms/s/input
	For 2.5 kW record length	25,000 waveforms/s/input
Dead time for N single[2]	400 ns or less (equivalent to 2,500,000 waveforms/s for each input)	

1 Under standard operating conditions (see page 20-17) after 30-minute warm-up.

2 No change in the acquisition rate with an increase or decrease in the number of inputs.

20.3 Trigger Section

Item	Specifications		
Trigger mode	Auto, Auto Level, Normal, Single, and N-Single		
Trigger source[1]	CH1 to CH4:	Signal applied to each input terminal	
	LINE:	Connected commercial power signal (can only be used with Edge trigger)	
	EXT:	Signal applied to the TRIG IN terminal	
	A0 to A7, B0 to B7,: C0 to C7, D0 to D7[2]	Signal applied to each terminal of the logic signal input port	
Trigger coupling	CH1 to CH4:	DC/AC	
	EXT:	DC	
HF rejection	Bandwidth limit with respect to the trigger source (OFF, 15 kHz (DC to approx. 15 kHz), 20 MHz (DC to approx. 20 MHz)) (CH1 to CH4)		
Trigger hysteresis	Select the trigger level hysteresis width (CH1 to CH4).		
	High:	Apply a hysteresis of approx. 1.0 division around the trigger level	
	Low:	Apply a hysteresis of approx. 0.3 division around the trigger level	
Trigger level setting range	CH1 to CH4:	±4 divisions from the screen center	
	EXT:	±2 V (using the 1:1 probe), ±20 V (using the 10:1 probe)	
Trigger level setting resolution	CH1 to CH4:	0.01 division	
	EXT:	5 mV (using the 1:1 probe), 50 mV (using the 10:1 probe)	
Trigger level accuracy	CH1 to CH4[3]:	±(0.2 divisions + 10% of the trigger level)	
	EXT[4]:	±(50 mV + 10% of the trigger level)	
Logic threshold level	When using the 701980:	±40 V (resolution: 0.1 V)	
	When using the 701981:	±10 V (resolution: 0.1 V)	
Logic threshold level accuracy[3]	±(100 mV + 3% of the setting)		
Preset logic thresholds	CMOS(5V) = 2.5 V, CMOS(3.3V) = 1.6 V, CMOS(2.5V) = 1.2 V, CMOS(1.8V) = 0.9 V, ECL = –1.3 V		
Window comparator	Selectable for each channel (CH1 to CH4)		
	Center:	±4 divisions from the screen center	
	Width:	±4 divisions around the center	
Probe attenuation setting for external trigger	1:1 or 10:1		
Trigger sensitivity			
	CH1 to CH4[3]:	1 div_{P-P}	For DC to 1 GHz
	EXT[4]:	100 mV_{P-P}	For DC to 100 MHz
	Except Edge OR[3]:	1 div_{P-P}	For DC to 50 MHz
Trigger position	Can be set in 0.1% increments of the display record length		
Trigger delay	By time:	Delay for a specified time after the trigger condition is met	
		0 to 10 s, minimum resolution 5 ps (depending on the sample rate)	
	First edge after delay:	Delay until the first specified edge after the specified time after the trigger condition is met	
		0 to 10 s, resolution 2 ns	
	Edge Count:	Delay until the specified number of specified edges after the trigger condition is met	
		1 to 10E9, in steps of 1	
Hold-off time range	20 ns to 10 s, resolution 5 ns		
Trigger slope	Rising or falling		

1 Whether a channel can be used as a trigger source depends on the trigger type. For details, see “Trigger type” on the next page or section 20.7, “Serial Bus Signal Specifications.”
2 The logic signal input ports that comes installed vary depending on the model. The SB5310 can use A0 to A7, and the SB5710 can use A0 to D0.
3 Under standard operating conditions (see page 20-17) after warm-up and calibration.
4 Under standard operating conditions after warm-up.

20.3 Trigger Section

Item	Specifications	
Trigger types		
Edge/State	CH1 to CH4 signal as a source	
	Edge:	Activate a trigger on the edge of a single trigger source
	Edge(Qualified):	Activate a trigger on the edge of a single trigger source while the qualification requirement is met
	Edge OR:	Activate a trigger on the logical OR of the edge conditions of multiple trigger sources (max. 50 MHz)
	State:	Activate a trigger on the ENTER or EXIT condition when the state condition is met
	PodA to PodD[1] signal as a source	
	Logic Edge:	Activate a trigger on the edge of a single trigger source
	Logic Edge(Qualified):	Activate a trigger on the edge of a single trigger source while the qualification requirement is met
	Logic State:	Activate a trigger on the ENTER or EXIT condition when the state condition is met
Width	CH1 to CH4 signal as a source	
	Pulse:	Activate a trigger on the width of a single trigger source
	Pulse(Qualified):	Activate a trigger on the width of a single trigger source while the qualification requirement is met
	Pulse State:	Activate a trigger on the width when the state condition is met
	PodA to PodD[1] signal as a source	
	Logic Pulse:	Activate a trigger on the width of a single trigger source
	Logic Pulse State:	Activate a trigger on the width when the state condition is met
	Time width setting mode	
	More than:	Activate a trigger when the condition changes when the time during which the condition is met is longer than T1
	Less than:	Activate a trigger when the condition changes when the time during which the condition is met is shorter than T1
	Between:	Activate a trigger when the condition changes when the time during which the condition is met is longer than T1 and shorter than T2
	Out of Range:	Activate a trigger when the condition changes when the time during which the condition is met is shorter than T1 or longer than T2
	Time out:	Activate a trigger when the time during which the condition is met exceeds T1
	Setting time (T1 and T2):	1 ns to 10 s, resolution 500 ps
	Time accuracy:	±(0.2% of setting value + 1 ns)
Event Interval	Event:	FlexRay[2, 3], CAN[2], LIN[2, 3], UART[2, 3], I2C[2], SPI[2], Serial pattern[2], Edge, Edge(Qualified), State, Pulse, Pulse(Qualified), Pulse State, Logic Edge, Logic Edge(Qualifed), Logic State, Logic Pulse, Logic Pulse State (selectable as an event except Edge OR)
	Event Cycle:	Activate a trigger when the event cycle is within the specified time range
	Event Delay:	Activate a trigger if the time interval between the event 1 occurrence and the first event 2 occurrence is within the specified time range
	Event Sequence:	Activate a trigger when the first event 2 occurs within the specified time range after the event 1 occurrence
	Time width setting mode:	Same as the time width setting mode of Width
	Setting time (T1 and T2) and time accuracy:	

Event Cycle

Setting time	1.5 ns to 10 s, resolution 500 ps
Time accuracy	±(0.2% of setting + 1 ns)

Event Delay or Event Sequence

Event 1	Event 2	Setting time	Time accuracy[4]
CH1 to CH4	CH1 to CH4	1.5 ns to 10 s, Resolution 500 ps	±(0.2% of setting + 1 ns)
PodA to PodD[1]	PodA to PodD[1]	1.5 ns to 10s, Resolution 500 ps	±(0.2% of setting + 1 ns)
CH1 to CH4[1]	PodA to PodD[1]	20 ns to 10 s, Resolution 500 ps	±(0.2% of setting + 10 ns)
PodA to PodD[1]	CH1 to CH4[1]	20 ns to 10 s, Resolution 500 ps	±(0.2% of setting + 10 ns)

Serial Bus[5]	FlexRay[2, 3]	Triggers on a FlexRay bus signal
	Mode:	Frame Start, ID/Data, ID/Data OR, Error
	CAN[2]	Triggers on a CAN bus signal
	Mode:	SOF, Error Frame, ID Std/Data, ID Ext/Data, ID/Data OR, Msg/Signal
	LIN[2, 3]	Triggers on a LIN bus signal
	Mode:	Break Synch, ID/Data, ID/Data OR, Error
	UART[2, 3]	Triggers on a UART bus signal
	Mode:	Data, Error
	I2C[2]	Triggers on an I2C bus signal
	Mode:	Every Start, ADR&DATA, NON ACK, General Call, Start byte, HS Mode
	SPI[2]	Triggers on an SPI (Serial Peripheral Interface) bus signal
	Mode:	3wire, 4wire
	Serial Pattern[2]	Triggers on a general-purpose serial interface signal
	Maximum bit rate:	50 Mbps
	Maximum bit length:	128 bits

1 The logic signal input ports that come installed vary depending on the model. You can use PodA on the SB5310 and PodA to PodD on the SB7510.
2 The SB5000 does not support signals received through the logic signal input ports for FlexRay or CAN. From the logic signal input ports that are available, you can only select input signals received through PodA for LIN, UART, I2C, SPI, and serial pattern.
3 You can only specify either event 1 or event 2 for the Event Delay and Event Sequence settings. You can only set the event 1 or event 2 when the trigger source is set to LINE.
4 When the event 1 and event 2 trigger types are edge.
5 For details on the anlaysis function, see section 20.7.

20.4 Time Axis

Item	Specifications
Time axis setting range	500 ps/div to 50 s/div (1-2-5 steps)
Timebase accuracy*	±0.001%
Time axis measurement accuracy*	±(0.001% + 10 ps + 1 sample time)

* Under standard operating conditions (see page 20-17) after warm-up.

20.5 Display Section

Item	Specifications
Display	8.4-inch (21.3 cm) color TFT liquid crystal display*
Display size	170.5 mm (width) × 127.9 mm (height)
Total number of pixels	1024 × 768 (XGA)
Waveform display pixels	800 × 640

* The liquid crystal display may include few defective pixels (within 6 ppm with respect to the total number of pixels including RGB).
There may be few pixels on the liquid crystal display that do not turn ON all the time or remains ON all the time. Note that these are not malfunctions.

20.6 Features

Vertical and Horizontal Axes

Item	Specifications
Channel ON/OFF	CH1 to CH4 and LOGIC can be turned ON/OFF independently
Input filter	Place bandwidth limit on CH1 to CH4 independently
Vertical position setting	Move the waveform vertically by ±4 div from the center of the analog waveform area. Move the waveform until only the top signal or the bottom signal is displayed in the logic signal area.
Roll mode	Roll mode display is enabled when the trigger mode is set to Auto, Auto Level, or Single at the following time axis settings. 100 ms/div to 50 s/div

Signal Acquisition and Display

Item	Specifications
Acquisition mode	Selectable from normal, average, and envelope acquisition modes
High resolution mode	Vertical axis resolution increased up to 12 bits
Record length	2.5 kW, 6.25 kW, 12.5 kW, 25 kW, 62.5 kW, 125 kW, 250 kW, 625 kW, 1.25 MW, 2.5 MW, 6.25 MW
Sampling mode	Switch between realtime sampling and repetitive sampling for some time axis settings.
Interleave mode	Analog signal input One input signal is sampled with two A/D converters, doubling the maximum sample rate. Logic signal input One input signal is sampled with two logic signal conversion circuit, doubling the maximum sample rate.
Interpolation	Actual sampled data can be interpolated by a maximum factor of 1000 (2000 in high resolution mode), increasing the time resolution (max. 2.5 TS/s).
Accumulation	Waveform accumulation possible. Count mode and time mode selectable. Save and load are also possible.
Zoom	Expand the analog waveform in the voltage axis (vertical) or time axis (horizontal) direction 2 locations at independent zoom ratios Voltage axis magnification: ×1 to ×10 Time axis magnification: ×1 to 1 data value/div
Logic signal display size	Vertically expand the display size of the logic signal: 5 levels
Display format	Analog waveform divided into 1, 2, 3, or 4 displays Bus display of logic signals (hexadecimal or binary display for each group) Display ratio of analog waveforms and logic signals selectable
Display interpolation	Selectable from dot display of sample points, sine interpolation display, linear interpolation display, and pulse interpolation display
Graticule	Selectable from four types for analog waveforms
Auxiliary display ON/OFF	Turn ON/OFF the scale values, waveform labels, and trigger marks
Snapshot	Retains the current displayed waveform on the screen

Analysis and Search

Item	Specifications
Cursor measurement	Selectable from six cursor types Vertical, Horizontal, VT, H&V, Marker, and Serial. Only VT for logic signals.
Automated measurement of waveform parameters	Following waveform parameters can be measured automatically. For details on FlexRay waveform parameters, see section 20.7. Items applicable to all setting range data, regardless of period: Max, Min, High, Low, P-P, Hi-Low, +Over, -Over, Rms, Mean, Sdev, IntegTY, V1, V2, ∆T Items applicable to all setting range data, related to period: C.Rms, C.Mean, C.Sdev, C.IntegTY, Freq, 1/Freq, Count, Burst Items applicable to the first data found in setting range: +Width, -Width, Period, Duty, Rise, Fall, Delay Only the following items are selectable for logic signals. Freq, 1/Freq, Count, +Width, -Width, Period, Duty, ∆T, Delay

Item		Specifications
Search & zoom		Search a part of the displayed waveform and display expanded Auto scroll function: Automatically scrolls the zoom screen in the time axis direction Search function: Search a specified part of currently displayed waveform from a specified time, and display in zoom window Search Type: FlexRay[1], CAN[1], LIN[2], UART[2], I^2C[2], SPI[2], Serial pattern[2], Edge, Edge(Qualified), State, Pulse, Pulse(Qualified), Pulse State, Logic Edge, Logic Edge(Qualifed), Logic State, Logic Pulse, Logic Pulse State
History memory		Max. images: When using the history 2000 (with a record length of 2.5 kW) When using N-Single 1600 (with a record length of 2.5 kW) The number of history images do not change even if interleave mode is ON. History search: Search for and display waveforms from the history memory that satisfy specified conditions. Search type: Rect, WAVE, POLYGON, Parameter(Measure, FFT, XY) Replay: Automatically displays the history waveforms sequentially
Telecom test		Mask Test or Eye Pattern measurement. For the FlexRay eye diagram specifications, see section 20.7.
XY analysis		Display the phase relationship between two trace signals by specifying a trace for the X-axis (horizontal axis) and a trace for the Y-axis (vertical axis)
FFT analysis		FFT (Fast Fourier Transform) (max. 250 k points)
Waveform parameter analysis		Display a waveform parameter in the histogram, trend, or list format
Frequency distribution analysis		Displays a histogram of accumulated waveform data within the specified range
Serial bus signal analysis		Analyzes and displays the data on the FlexRay[1], CAN[1], LIN[2], UART[2], I^2C[2], SPI[2], Serial pattern[2] (For the FlexRay, CAN, LIN, UART, I2C, and SPI specifications, see section 20.7.)
Computation	CH1 to CH4, M1 to M4	Analog signal +, –, *, Integ, Edge Count, Rotary Count, Filter (Through, Delay, Moving Avg, IIR Low Pass, IIR High Pass)
	M1 to M4	Analog signal CAN Stuff Bit User-defined computation (option) Set equations by arbitrarily combining the following operators and constants. Operators: +, –, *, /, ABS, SQRT, LOG, LN, EXP, P2, -(negation), DELAY, BIN, SIN, ASIN, COS, ACOS, TAN, ATAN, DIFF, INTEG Constants: K1 to K4, 0 to 9, PI, e, fs, 1/fs, Exp, Measure Item Power supply analysis function (option) Standard computation, power, Z, I^2t, and user-defined computation are possible Logic signal DA
Reference function		Displays and analyzes (computation and cursor) up to 4 traces (M1 to M4) of saved waveform data. Load and replay history waveforms
Action-on-trigger		Acquire the waveform, perform determination using automated measurement of waveform parameters or waveform zone, and execute the selected action each time the the specified number of triggers is activated
Mode		OFF Not execute the action. All Condition Acquire the waveform and execute the action GoNogo Zone/Param Determine whether the acquired waveform passes a specified zone or whether a specified parameter of the waveform enters within a specified range and execute the action Zone type: Rect, WAVE, and Polygon Param type: Measure, FFT, and XY GoNogo Eye Diagram Determine whether the conditions specified in the Eye Diagram is met and execute the action Category type: Mask Test and Eye Pattern
Action		Beep, save/print the screen image, save the waveform data, or send mail (/C8 or /C10 option)

1 Signals received through the logic signal input ports are not supported.

2 From the logic signal input ports that are available, only the input signal received through PodA is selectable.

Screen Image Data Printing/Storage

Item	Specifications
Built-in printer (option)	Print the screen image
External printer	Output the screen image to an external printer via the USB or the Ethernet interface[2] Supports EPSON and HP (PCL) inkjet printers Only HP (PCL) supported for the Ethernet interface
PC card, internal memory, internal hard disk,[1] USB storage medium, Network drive[2]	Output data format: PNG, BMP, and JPEG

1 Internal HDD is an option.
2 When the Ethernet interface option is installed.

Data Storage

Item	Specifications
History memory	Automatically stores up to 2000 history waveforms (with a record length of 2.5 kW)
PC card, internal memory, internal hard disk,[1] USB storage medium, Network drive[2]	Saves measurement data, setup data, and various data

1 Internal HDD is an option.
2 When the Ethernet interface option is installed.

Miscellaneous

Item	Specifications	
Setup	Initialize:	Reset the settings to factory default values.
	Auto setup:	Automatically set to the optimal settings for the input signal.
	Serial bus auto setup:	Automatically configures the settings suitable for the trigger, decode, and search functions of FlexRay, CAN, LIN, UART, I2C, or SPI.
	CH auto scale:	Automatically set only the voltage axis of the source trace to the optimal setting for the input signal.
	Store/recall:	Store and recall up to 12 arbitrary setup data using the internal memory.
Calibration	Auto calibration and manual calibration available.	
Environmental settings	Set the screen color, date/time, message language, and click sound ON/OFF.	
Overview	View system specifications.	
Self-test	Perform a memory test, key test, printer test, etc.	
Numeric keypad	Allows values to be entered directly.	
Arrow keys	Move the cursor in all four directions.	
Probe compensation signal output	Output a signal (square wave of approx. 1 Vp-p and approx. 1 kHz) from the probe compensation signal output terminal on the front panel.	
Help function	Display explanation of the settings	

20.7 Serial Bus Signals

FlexRay Bus

Item	Specifications
Version	FlexRay Protocol Version2.1
Bit rate	10 Mbps, 5 Mbps, or 2.5 Mbps
Triggering	
Trigger Source	Selectable from CH1 to CH4. FlexRay bus signal (receives BP and BM signals through a differential probe)
Mode	Frame start: Triggers on the start of a frame ID/Data: Triggers on the indicator, ID, cycle count, or data ID/Data OR: Triggers on the OR logic of the four settings: indicator, ID, cycle count, and data Error: Trigger on a frame with a CRC, BSS, or FES error Triggers on the OR logic of the trigger error conditions
Analysis	
Signal	Select from CH1 to CH4 or from M1 to M4.
Analyzable frames	Up to 600 frames (300 frames before and after the analysis reference point)
Analyzable sample rate	Eight times the FlexRay bit rate or higher
Analyzed segments	Header segment, payload segment, and trailer segment
Analysis result display	Simple display Simultaneously displays the analysis number (No.), frame ID, and data value. Detail display Analysis number (No.), time from the trigger point to the start of the frame, frame type (static or dynamic), indicator (payload preamble, null frame, sync frame, or startup frame), frame ID and payload length (in bytes), cycle count, information (error type), and payload segment data sequence.
Zoom link	Zoom link Zoom position (the center of the zoom box) movable to the start of the highlighted frame in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list. Field jump When zoom link is enabled, the zoom position can be moved to the start of the specified field of the highlighted frame in the analysis result list. Selectable fields are frame ID, payload length, header CRC, cycle count, data, and CRC.
Automated measurement of waveform parameters	Waveform parameters: BSS Interval, FBSS Interval, BSSFES Interval Statistical items: Max, Min, Mean, σ, Cnt Automated measurement of bus driver electrical characteristics Supports conformance test standard (FlexRay EPL-Specification V2.1) Receiver characteristics@TP4: Measures the following items from the BP-BM and RxEN waveforms dBDRxia (activitity reaction time) dBDRxai (idle reaction time) Measures the following items from the BP-BM and RxD waveforms dBDRx10 (receiver delay, negative edge) dBDRx01 (receiver delay, positive edge) dRxAsym (receiver delay mismatch |dBDRx10 – dBDRx01|) Transmitter characteristics @ TP1: Measures the following items from the TxD and BP-BM waveforms dBDTx10 (transmitter delay, negative edge) dBusTx10 (fall time differential voltage) dBDTx01 (transmitter delay, positive edge) dBusTx01 (rise time differential voltage) dTxAsym (transmitter delay mismatch |dBDTx10 – dBDTx01|) uBDTx (absolute differential voltage at TP1 |BP – BM|, when sending/when idle) Measures the following items from the TxEN and BP-BM waveforms. dBDTxia (propagation delay idle → active) dBusTxia (transition time idle → active) dBDTxai (propagation delay active → idle) dBusTxai (transition time active → idle)

Item	Specifications
Eye diagram test	Mask test or eye pattern measurement Mask Test: Wave Count, Wave Count %, Sample Point Count, Sample Point Count % Eye Pattern: Crossing %, Eye Height, Eye Width, Q Factor, Jitter, Duty Cycle Distortion%, Vtop, Vbase, σ top, σ base, Tcrossing1, Tcrossing2, Vcrossing, Rise, Fall
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for specified field or frame conditions. When a waveform that meets the conditions is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.

CAN Bus

Item	Specifications
Version	CAN Version 2.0B
Bit rate	Settable to1 M, 500 k, 250 k, 125 k, 83.3 k, 33.3 kbps or to any bit rate from 10 k to 1 Mbps in 0.1-kbps steps. Supports High-speed CAN (ISO11898) and Low-speed CAN (ISO11519-2).
Triggering	
Trigger source	Selectable from CH1 to CH4.
Mode	SOF: Triggers on SOF (Start of Frame) Error Frame: Triggers on an error frame ID Std/Data: Triggers on a data frame or remote frame (ID: standard format) ID Ext/Data: Triggers on a data frame or remote frame (ID: extended format) ID/Data OR: Triggers on the OR logic of four data frame and remote frame types Standard or extended format selectable for each ID Msg/Signal: Triggers on a CAN message (ID) or signal (ID/data)
Analysis	
Signal	Select from CH1 to CH4 or from M1 to M4.
Analyzable frames	Up to 3000 frames (1500 frames before and after the analysis reference point)
Analyzed frames	Data frame, remote frame, error frame, and overload frame
Analysis result display	Simple display Analysis number (No.), frame type, hexadecimal ID display[1], hexadecimal data display[3], ACK slot state Detail display Analysis number (No.), frame type, time from the trigger position (ms), hexadecimal ID display,[1] hexadecimal DLC display, binary data display,[2], hexadecimal data display,[3], hexadecimal CRC sequence display, ACK slot state
Zoom link	Zoom link Zoom position (the center of the zoom box) movable to the start of the highlighted frame in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list. Field jump When zoom link is enabled, the zoom position can be moved to the start of the specified field of the highlighted frame in the analysis result list. Selectable fields are SOF, ID, control field, data field, CRC, and ACK.
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for specified field or frame conditions. When a waveform that meets the conditions is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.
Stuff bit computation	Extracts stuff bits from the CAN bus signal waveform and displays them as a MATH waveform (from MATH1 to MATH4).

1 If CANdb is enabled, the value will be displayed using symbols.
2 If CANdb is enabled, the data will be displayed using symbols.
3 If CANdb is enabled, the data will be displayed using symbols.

LIN Bus

Item	Specifications
Revision	LIN 1.3 or LIN 2.0
Bit rate	Settable to 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps or to any bit rate from 1 k to 20 kbps in 0.1-kbps steps.
Triggering	
Trigger source	Selectable from CH1 to CH4 or PodA (A0 to A7).
Mode	Break Synch: Triggers on the synch byte after break ID/Data: Triggers on the combination of ID and data ID/Data OR: Triggers on the OR logic of the four ID and data settings Error: Triggers on an error frame Triggers on the OR logic of error conditions Parity, checksum, synch, timeout (Slave Not Responding/Header Timeout/ Response Timeout), framing
Analysis	
Signal	Selectable from CH1 to CH4, PodA (A0 to A7), or from M1 to M4.
Analyzable frames	Up to 3000 frames (1500 frames before and after the analysis reference point)
Analyzed fields	Break, Synch, ID, Data, Checksum
Analysis result display	Simple display Analysis number (No.), hexadecimal ID display, hexadecimal data display, hexadecimal checksum display Detail display Analysis number (No.), time from the trigger position (ms), hexadecimal ID display, hexadecimal ID-Field display, binary data display, hexadecimal data display, hexadecimal checksum display, additional information
Zoom link	Zoom link Zoom position (the center of the zoom box) movable to the start of the highlighted frame in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list. Field jump When zoom link is enabled, the zoom position can be moved to the start of the specified field of the highlighted frame in the analysis result list. Selectable fields are break, synch, ID, data, and checksum.
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for specified field or frame conditions. When a waveform that meets the conditions is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.

UART

Item	Specifications
Bit rate	Settable to 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps or to any bit rate from 1 k to 200 kbps in 0.1-kbps steps.
Data format	8-bit data (no parity bit) 7-bit data + parity bit (selectable only for error trigger) 8-bit data + parity bit (selectable only for error trigger)
Triggering	
Trigger source	Selectable from CH1 to CH4 or PodA (A0 to A7).
Mode	Data: Compares with the 1 to 4-byte data and triggers on the frame with matching conditions Error: Triggers on a parity or framing error Triggers on the OR logic of error conditions
Analysis	
Signal	Selectable from CH1 to CH4, PodA (A0 to A7), or from M1 to M4.
Analyzable frames	Up to 3000 bytes (1500 bytes before and after the analysis reference point)
Analyzed fields	Data, additional information (parity error and framing error)
Analysis result display	Simple display Analysis number (No.) and hexadecimal data display Detail display Analysis number (No.), time from the trigger position (ms), binary data display, hexadecimal data display, additional information
Zoom link	Zoom position (the center of the zoom box) movable to the start of the highlighted frame in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list.
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for specified field or frame conditions. When a waveform that meets the conditions is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.

I²C Bus

Item	Specifications
Bus transfer rate	Up to 3.4 Mbit/s
Address mode	7 bits or 10 bits
Triggering	
Trigger source	Selectable from CH1 to CH4 or PodA (A0 to A7).
Mode	Every Start: Triggers on a start condition ADR&DATA: Triggers by comparing with the specified address or data Address type • 7-bit address • 7-bit + sub address • 10-bit address NON ACK: Triggers on a Nack bit General Call: Triggers by comparing with the second byte pattern of the general call address Start Byte/HS Mode: Triggers on a start byte or an HS moe master address
Analysis	
Signal	Selectable from CH1 to CH4, PodA (A0 to A7), or from M1 to M4.
Analyzable data bytes	Up to 40000 bytes (20000 bytes before and after the analysis reference point)
Analysis result display	Simple display Analysis number (No.), start condition/stop condition (S/P), hexadecimal data display, address/data (form), read/write signal (R/W), acknowledge bit Detail display Analysis number (No.), start condition/stop condition (S/P), time from the trigger position (ms), binary data display, hexadecimal data display, address/data (form), read/write signal (R/W), acknowledge bit, data info
Zoom link	Zoom position (the center of the zoom box) movable to the highlighted byte in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list.
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for specified address pattern, data pattern, or acknowledge bit state. When a waveform that meets the conditions is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.

SPI Bus

Item	Specifications
Triggering	
Trigger source	Selectable from CH1 to CH4 or PodA (A0 to A7).
Mode	Three-wire or four-wire Triggers by comparing the data the specified number of bytes after the CS assertion. Data length to be compared is selectable from 1 to 4 bytes.
Analysis	
Signal	Selectable from CH1 to CH4, PodA (A0 to A7), or from M1 to M4.
Analyzable data bytes	Up to 40000 bytes (20000 bytes before and after the analysis reference point)
Analyzed frames	Data
Analysis result display	Simple display Analysis number (No.), hexadecimal data 1 display, hexadecimal data 2 display, CS status Detail display Analysis number (No.), time from the trigger position to the start bit of each data byte (ms), binary data 1 display, hexadecimal data 1 display, binary data 2 display, hexadecimal data 2 display, CS status, start position/stop position of the active period (S/P)
Zoom link	Zoom position (the center of the zoom box) movable to the highlighted byte in the analysis result list. Changing the zoom position also changes the highlighed frame in the analysis result list.
Data storage of the analysis result list	Saves the simple or detail display data of the analysis result list in CSV format (.csv extension).
Data search	Searches waveforms for the specified data pattern. When a waveform that meets the pattern is found, the zoom box moves to that point, and the SB5000 displays the specified waveform in the zoom waveform area.

20.8 Built-in Printer (/B5 Option)

Item	Specifications
Print system	Thermal line dot system
Dot density	8 dots/mm
Paper width	112 mm

20.9 Auxiliary I/O Section

External Trigger Input (TRIG IN)

Item	Specifications
Connector type	BNC
Input bandwidth[1]	DC to 100 MHz
Input impedance	Approx. 1 MΩ, approx. 18 pF
Maximum input voltage	±40 V (DC+ACpeak) or 28 Vrms at a frequency of 10 kHz or less
Trigger level	±2 V (resolution: 5 mV)

1 Under standard operating conditions (see page 20-17) after warm-up.

External Trigger Output (TRIG OUT)

Item	Specifications
Connector type	BNC
Output level	TTL (0 to 5 V)
Output logic	Negative
Output delay	50 ns max
Output hold time	Low level 50 ns min, High level 50 ns min

Probe Interface Terminal

Item	Specifications
Output terminals	4
Output voltage	±12 V (up to total 1.2 A together with probe power terminal), ±5 V (up to total 800 mA)
Compatible probes	Active probe (701912/701913/701914), differential probe (701923)

Probe Power Terminal (/P4 Option)

Item	Specifications
Output terminals	4
Output voltage	±12 V (up to total 1.2 A together with probe power terminal)
Compatible probes and deskew correction signal source	FET probe (700939), current probe (701932/701933), differential probe (700924/700925/701920/701921/701922), and deskew correction signal source (701935)

GO/NO-GO Output

Item	Specifications
Connector type	RJ-12 modular jack
Output signal	GO OUT and NO-GO OUT
Output level	TTL (0 to 5 V)
Compatible cable	Four-wire modular cable (366973)

Video Signal Output (VIDEO OUT)

Item	Specifications
Connector type	15-pin D-Sub receptacle
Output format	Analog RGB output
Output resolution	Sub-XGA output 1024 × 768 pixels, approx. 60 Hz Vsync (dot clock frequency 62.5 MHz)

20.10 Storage

Internal Memory

Item	Specifications
Media type	Compact Flash
Capacity[1]	90 MB

1 The capacity may change.

Built-in Hard Disk (/C8 Option)

Item	Specifications
Number of drives	1
Size	2.5 inch
Available HDD capacity[1]	40 GB FAT32
File name	Long file names (up to 256 ASCII characters) supported

1 The capacity may change.

USB Peripheral Interface

Item	Specifications
Connector type	USB type A connector (receptacle)
Electrical and mechanical specifications	USB Rev. 2.0 compliant
Supported transfer standards	LS (Low Speed) mode (1.5 Mbps) and FS (Full Speed) mode (12 Mbps)
Supported devices[1]	USB HID Class Ver. 1.1 compliant mouse and 109-key keyboard (Japanese), 104-key keyboard (US) USB Printer Class Ver. 1.0 compliant, EPSON/HP (PCL) inkjet printers supported USB Mass Storage Class Ver. 1.1 compliant mass-storage devices USB HUB Device (one only) Up to four devices can be connected.
Number of ports	2
Power supply	5 V, 500 mA (per port)

1 For details on compatible devices, contact your nearest YOKOGAWA dealer.

20.11 Computer Interfaces

PC Card Interface

Item	Specifications
Number of ports	2 (front panel × 1, rear panel × 1)
Compatible cards[1]	GP-IB card (option support) National Instruments NI PCMCIA-GPIB cards supported Storage cards Flash ATA memory cards (PC card TYPE II) CF card + adapter card HDD-type PC cards

1 For details on compatible devices, contact your nearest YOKOGAWA dealer.

USB-PC Connection

Item	Specifications
Connector type	USB type B connector (receptacle)
Electrical and mechanical specifications	USB Rev. 2.0 compliant
Supported transfer standards	HS (High Speed) mode (480 Mbps) and FS (Full Speed) mode (12 Mbps)
Number of ports	1
Supported protocols	Acts as a composite device simultaneously supporting the following two protocols. USBTMC-USB488 (USB Test and Measurement Class Ver. 1.0)[1] USB bus can be used with GPIB commands. Mass Strage Class Ver. 1.1 Access from a PC to the internal memory, built-in hard disk, PC card,[2,3] USB mass-storage device[3] is possible (reading and writing). However, formatting is not possible.
Compatible PC systems	A PC running Windows XP/2000 English/Japanese version, equipped with a USB port.

1 A separate driver is required.

2 No drivers are required.

3 For details on compatible devices, contact your nearest YOKOGAWA dealer.

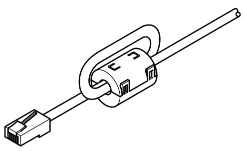
Ethernet Interface (/C8 or /C10 Option)

Item	**Specifications**
Connector type	RJ-45 connector
Number of ports	1
Electrical and mechanical specifications	IEEE 802.3 compliant
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Communication protocol	TCP/IP
Supported services	DHCP, DNS, Microsoft network file sharing server and client, SMTP client, SNTP client, FTP server, Web server, network printer, and firewall
LED indicators	2 indicators. Link (Yellow: lit when link is established), Activity (Green: lit while packets being transferred)

20.12 General Specifications

Item	Specifications	
Standard operating conditions	Ambient temperature:	23 ± 5°C
	Ambient humidity:	55 ± 10% RH
	Power supply voltage and frequency tolerance:	Within 1% of rated value
Warm-up time	At least 30 minutes	
Storage conditions	Temperature:	–20 to 60°C
	Humidity:	20 to 80%RH (no condensation)
Operating conditions	Temperature:	5 to 40°C
	Humidity:	20 to 80%RH (not using the printer) (no condensation) 35 to 80%RH (using the printer) (no condensation)
Recommended calibration period	1 year	
Storage altitude	3000 m or less	
Operating altitude	2000 m or less	
Rated supply voltage	100 to 120 VAC or 220 to 240 VAC (automatic switching)	
Permitted supply voltage range	90 to 132 VAC or 198 to 264 VAC	
Rated supply frequency	50/60 Hz	
Permitted power supply frequency range	48 to 63 Hz	
Power supply fuse	Internal (not replaceable)	
Maximum power consumption	300 VA	
Withstand voltage (between power supply and case)	1.5 kVAC for one minute	
Insulation resistance (between power supply and case)	500 VDC, at least 10 MΩ	
External dimensions	350 (W) × 200 (H) × 285 (D) mm (with printer cover put away, excluding handle and other projections)	
Weight	Approx. 7.7 kg (SB5000 only without options)	
Cooling method	Forced air cooling, side ventilation	
Installation orientation	Horizontal (stand may be used) or vertical. Stacking not allowed.	
Battery backup	Setup data and clock are backed up with the internal lithium battery Battery life: Approx. 5 years (at ambient temperature 25°C)	

20.12 General Specifications

Item	Specifications
Safety standards	Complying standards EN61010-1 Overvoltage category of the signal input section: I (150 Vrms)[1] Pollution degree 2[2]
Emission	Complying standards EN61326 Class A, C-Tick AS/NZS CISPR11 (applies to 701351, 701361, 701913, 701923, 701943, 701974 with 701975, 701980, 701981, and 701935[3]) EN61000-3-2 EN61000-3-3 This product is a Class A (for industrial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference.
	Cable condition Logic signal input port Attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to one end (SB5000 end) of the logic probe cable. Probe power terminal Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end of the B9852MJ, a power supply cable dedicated to the 701935.[3] External trigger input terminal (TRIG IN) Use a BNC cable[4] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (SB5000 end). Trigger output terminal (TRIG OUT) Same as the external trigger input terminal above. Video signal output connector (VIDEO OUT) Use a 15-pin D-Sub VGA shielded cable[4] and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (SB5000 end). USB connector for connecting peripheral devices Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end (SB5000 end) of the USB cable.[4] USB connector for connecting to a PC Attach a ferrite core (TDK: ZCAT1325-0530A, YOKOGAWA: A1181MN) to one end (SB5000 end) of the USB cable.[4] GO/NO-GO output terminal Use a GO/NO-GO cable (YOKOGAWA model 366973, sold separately) and wind the cable twice around the ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (SB5000 end). See the figure below. Ethernet interface connector Use a Ethernet interface cable[4] and wind the cable twice around the ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) on one end (SB5000 end). See the figure below. 

1 The instrument's expected transient overvoltage is 1500 V. Do not use the instrument for overvoltage category II, III, or IV measurements.

2 Pollution Degree applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).

3 The 701935 is YOKOGAWA's Deskew Correction Signal Source.

4 Use cables of length 3 m or less.

Item	Specifications
Immunity	Complying standards EN61326 industrial environment (applies to 701351, 701361, 701913, 701923, 701943, 701974 with 701975, 701980, 701981, and 701935[1])
	Influence in the immunity environment (performance criterion A) Noise increase: Within ±200 mV (when using the 701943) Within ±200 mV (when using the 701974 with the 701975) Within ±2 V (when using the 701913, 701923) No polarity inversion of the logic signal (when using the 701980, 701981) Test conditions: When using the 701913, 701923, 701943, or 701974 with 701975 2.5 GS/s, envelope mode, 20 MHz BWL (10:1 probe attenuation setting), and 50-Ω termination at the probe tip. When using the 701980 or 701981 2.5 GS/s, envelope mode, and 50-Ω termination at the probe tip. Cable condition: Same as the cable conditions for emission. Test item: 1. Electrostatic discharge: EN61000-4-2 Air discharge: ±8 kV, contact discharge: ±4 kV, criteria B 2. Radiated immunity: EN61000-4-3 80 M to 1 GHz, 1.4 G to 2 GHz, 10 V/m Criteria A 3. Conducted immunity: EN61000-4-6 3 V, criteria A 4. Electrical fast transient/burst : EN61000-4-4 Power line: ±2 kV, signal line: ±1 kV, criteria B 5. Power frequency magnetic field: EN61000-4-8 30 A/m, 50 Hz, criteria A 6. Surge immunity: EN61000-4-5 Between lines: ±1 kV, common: ±2 kV, criteria B 7. Voltage dip and interruption: EN61000-4-11 0.5 cycle, both polarities, 100%, criteria A Definitions of criteria A and B Criteria A: Aforementioned “Influence in the immunity environment” is met during the test. Criteria B: This apparatus continues to operate without hang-up or falling into uncontrollable conditions during the test. No change of actual operating state or stored data is allowed.

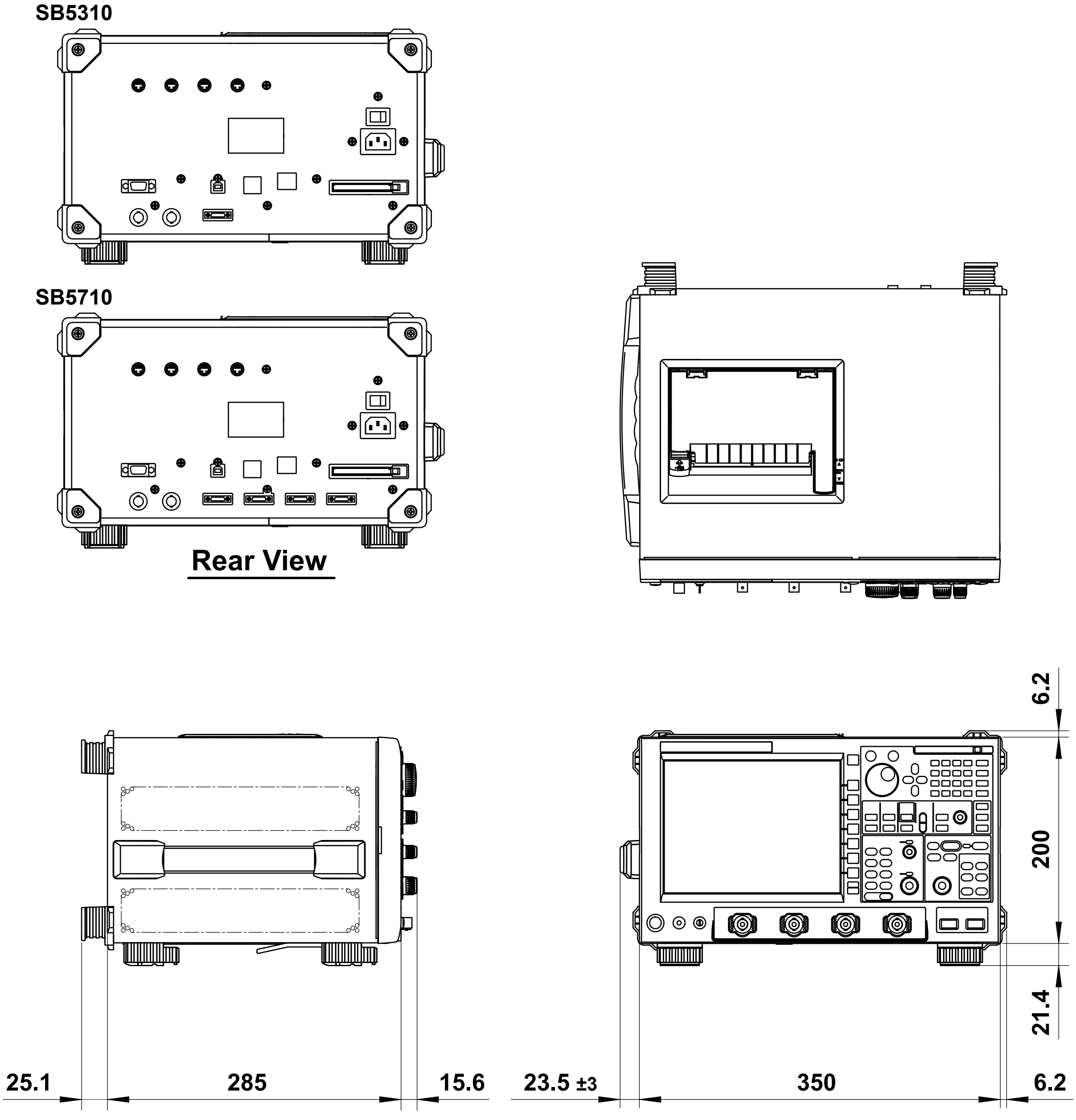
1 The 701935 is YOKOGAWA’s Deskew Correction Signal Source.

20.13 External Dimensions

SB5310/SB5710

Unit: mm

Unless otherwise specified, tolerance is ±3% (however, tolerance is ±0.3 mm when below 10 mm).



Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Overview

The sample rate and record length depend on the time axis setting, and whether repetitive sampling mode, interleave mode, data interpolation, and high resolution mode are on or off.
The SB5000 uses repetitive sampling and data interpolation to increase the effective sample rate above the maximum sample rate. When the maximum sample rate is exceeded, the following processing is carried out.

When data interpolation is on

- When the repetitive sampling mode is off, the data is interpolated to increase the sample rate.
- When the repetitive sampling mode is on, if the time axis setting is 50 ns/div or below, and the sample rate is 500 G/s or more, then repetitive sampling is carried out, and otherwise data interpolation is carried out.
- If the sample rate exceeds 2500 GS/s, 2500 GS/s is maintained, and the record length is reduced.

When data interpolation is off

- When the repetitive sampling mode is off, the record length is reduced to increase the sample rate. If the record length is less than 100 words, repetitive sampling is carried out.
- When the repetitive sampling mode is on, repetitive sampling is carried out with the record length 1.25 M words or below.
- When the settings are such that the sample rate exceeds 2500 GS/s, 2500 GS/s is maintained, and the record length is reduced.

Regardless of whether data interpolation is on or off, the minimum sample rate is 50 S/s.

The following pages show examples of the relationship between the time axis setting, sample rate, and record length.

Interpolation ON (Max: 1.25GS/s)

Interleave mode OFF, High resolution mode ON

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	
10ns	25GS/s	2.5k	62.5GS/s	6.25k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	
20ns	12.5GS/s	2.5k	31.25GS/s	6.25k	62.5GS/s	12.5k	125GS/s	25k	312.5GS/s	62.5k	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	
50ns	5GS/s	2.5k	12.5GS/s	6.25k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	
100ns	2.5GS/s	2.5k	6.25GS/s	6.25k	12.5GS/s	12.5k	25GS/s	25k	62.5GS/s	62.5k	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	2500GS/s	2.5M	
200ns	1.25GS/s	2.5k	2.5GS/s	5k	6.25GS/s	12.5k	12.5GS/s	25k	31.25GS/s	62.5k	62.5GS/s	125k	125GS/s	250k	312.5GS/s	625k	625GS/s	1.25M	1250GS/s	2.5M	
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	12.5GS/s	62.5k	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	500GS/s	2.5M	
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	6.25GS/s	62.5k	12.5GS/s	125k	25GS/s	250k	62.5GS/s	625k	125GS/s	1.25M	250GS/s	2.5M	
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5Gps	50k	6.25GS/s	125k	12.5GS/s	250k	31.25GS/s	625k	62.5GS/s	1.25M	125GS/s	2.5M	
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	12.5GS/s	625k	25GS/s	1.25M	50GS/s	2.5M	
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	6.25GS/s	625k	12.5GS/s	1.25M	25GS/s	2.5M	
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	2.5Gps	500k	6.25GS/s	1.25M	12.5GS/s	2.5M	
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M	
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	
5ms	50kS/s	2.5k	125kS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	
10ms	25kS/s	2.5k	62.5kS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	
20ms	12.5kS/s	2.5k	31.25kS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	
50ms	5kS/s	2.5k	12.5kS/s	6.25k	25kS/s	12.5k	50kS/s	25k	125kS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	
100ms	2.5kS/s	2.5k	6.25kS/s	6.25k	12.5kS/s	12.5k	25kS/s	25k	62.5kS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	
200ms	1.25kS/s	2.5k	3.125kS/s	6.25k	6.25kS/s	12.5k	12.5kS/s	25k	31.25kS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	
500ms	500S/s	2.5k	1.25k	6.25k	2.5kS/s	12.5k	5kS/s	25k	12.5kS/s	62.5k	25kS/s	125k	50kS/s	250k	125kS/s	625k	250kS/s	1.25M	500kS/s	2.5M	
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5kS/s	25k	6.25kS/s	62.5k	12.5kS/s	125k	25kS/s	250k	62.5kS/s	625k	125kS/s	1.25M	250kS/s	2.5M	
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25kS/s	25k	31.25kS/s	62.5k	6.25kS/s	125k	12.5kS/s	250k	31.25kS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25kS/s	62.5k	2.5kS/s	125k	5kS/s	250k	12.5kS/s	625k	25kS/s	1.25M	50kS/s	2.5M	
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5kS/s	250k	6.25kS/s	625k	12.5kS/s	1.25M	25kS/s	2.5M	
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25kS/s	250k	31.25kS/s	625k	6.25kS/s	1.25M	12.5kS/s	2.5M	
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125kS/s	62.5k	250S/s	125k	500S/s	250k	1.25kS/s	625k	2.5kS/s	1.25M	5kS/s	2.5M	

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

Interpolation or repetitive sampling (when repetitive sampling mode is ON)

Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available

Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation ON (Max: 2.5GS/s)

a) Interleave mode OFF, High resolution mode OFF b) Interleave mode ON, High resolution mode ON,

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k
10ns	25GS/s	2.5k	62.5GS/s	6.25k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k
20ns	12.5GS/s	2.5k	25GS/s	5k	62.5GS/s	12.5k	125GS/s	25k	312.5GS/s	62.5k
50ns	5GS/s	2.5k	12.5GS/s	6.25k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k
100ns	2.5GS/s	2.5k	5GS/s	5k	12.5GS/s	12.5k	25GS/s	25k	62.5GS/s	62.5k
200ns	1.25GS/s	2.5k	2.5GS/s	5k	5GS/s	10k	12.5GS/s	25k	25GS/s	50k
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	12.5GS/s	62.5k
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	5GS/s	50k
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5Gps	50k
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k
5ms	50kS/s	2.5k	125kS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k
10ms	25kS/s	2.5k	62.5kS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k
20ms	12.5kS/s	2.5k	31.25kS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k
50ms	5kS/s	2.5k	12.5kS/s	6.25k	25kS/s	12.5k	50kS/s	25k	125kS/s	62.5k
100ms	2.5kS/s	2.5k	6.25kS/s	6.25k	12.5kS/s	12.5k	25kS/s	25k	62.5kS/s	62.5k
200ms	1.25kS/s	2.5k	3.125kS/s	6.25k	6.25kS/s	12.5k	12.5kS/s	25k	31.25kS/s	62.5k
500ms	500S/s	2.5k	1.25k	6.25k	2.5kS/s	12.5k	5kS/s	25k	12.5kS/s	62.5k
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5kS/s	25k	6.25kS/s	62.5k
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25kS/s	25k	31.25kS/s	62.5k
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25kS/s	62.5k
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125kS/s	62.5k

T/div(s/div)	125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**
1ns	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**
5ns	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**
10ns	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**
20ns	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**
50ns	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	**2500GS/s**	**1.25M**
100ns	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	2500GS/s	2.5M	2500GS/s	2.5M
200ns	62.5GS/s	125k	125GS/s	250k	312.5GS/s	625k	625GS/s	1.25M	1250GS/s	2.5M	2500GS/s	5M
500ns	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	500GS/s	2.5M	1250GS/s	6.25M
1us	12.5GS/s	125k	25GS/s	250k	62.5GS/s	625k	125GS/s	1.25M	250GS/s	2.5M	625GS/s	6.25M
2us	5GS/s	100k	12.5GS/s	250k	25GS/s	500k	62.5GS/s	1.25M	125GS/s	2.5M	312.5GS/s	6.25M
5us	2.5GS/s	125k	5GS/s	250k	12.5GS/s	625k	25GS/s	1.25M	50GS/s	2.5M	125GS/s	6.25M
10us	1.25GS/s	125k	2.5GS/s	250k	5GS/s	500k	12.5GS/s	1.25M	25GS/s	2.5M	62.5GS/s	6.25M
20us	625MS/s	125k	1.25GS/s	250k	2.5Gps	500k	5GS/s	1M	12.5GS/s	2.5M	25GS/s	5M
50us	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M	12.5GS/s	6.25M
100us	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	5GS/s	5M
200us	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	25kS/s	125k	50kS/s	250k	125kS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	12.5kS/s	125k	25kS/s	250k	62.5kS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	6.25kS/s	125k	12.5kS/s	250k	31.25kS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	2.5kS/s	125k	5kS/s	250k	12.5kS/s	625k	25kS/s	1.25M	50kS/s	2.5M	125kS/s	6.25M
10s	1.25kS/s	125k	2.5kS/s	250k	6.25kS/s	625k	12.5kS/s	1.25M	25kS/s	2.5M	62.5kS/s	6.25M
20s	625S/s	125k	1.25kS/s	250k	31.25kS/s	625k	6.25kS/s	1.25M	12.5kS/s	2.5M	31.25kS/s	6.25M
50s	250S/s	125k	500S/s	250k	1.25kS/s	625k	2.5kS/s	1.25M	5kS/s	2.5M	12.5kS/s	6.25M

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

Interpolation or repetitive sampling (when repetitive sampling mode is ON)

Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available (a, b) Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation ON (Max: 5GS/s)

Interleave mode ON, High resolution mode OFF

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	125GS/s	2.5k	250GS/s	5k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**
10ns	25GS/s	2.5k	50GS/s	5k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**
20ns	10GS/s	2k	25GS/s	5k	50GS/s	10k	125GS/s	25k	250GS/s	50k	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**
50ns	5GS/s	2.5k	10GS/s	5k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	**2500GS/s**	**1.25M**
100ns	2.5GS/s	2.5k	5GS/s	5k	10GS/s	10k	25GS/s	25k	50GS/s	50k	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	2500GS/s	2.5M	2500GS/s	2.5M
200ns	1.25GS/s	2.5k	2.5GS/s	5k	5GS/s	10k	10GS/s	20k	25GS/s	50k	50GS/s	100k	125GS/s	250k	250GS/s	500k	625GS/s	1.25M	1250GS/s	2.5M	2500GS/s	5M
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	10GS/s	50k	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	500GS/s	2.5M	1250GS/s	6.25M
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	5GS/s	50k	10GS/s	100k	25GS/s	250k	50GS/s	500k	125GS/s	1.25M	250GS/s	2.5M	625GS/s	6.25M
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5GS/s	50k	5GS/s	100k	10GS/s	200k	25GS/s	500k	50GS/s	1M	125GS/s	2.5M	250GS/s	5M
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	10GS/s	500k	25GS/s	1.25M	50GS/s	2.5M	125GS/s	6.25M
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	5GS/s	500k	10GS/s	1M	25GS/s	2.5M	50GS/s	5M
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	2.5Gps	500k	5GS/s	1M	10GS/s	2M	25GS/s	5M
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M	10GS/s	5M
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	5GS/s	5M
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	50kS/s	2.5k	125kS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	25kS/s	2.5k	62.5kS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	12.5kS/s	2.5k	31.25kS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	5kS/s	2.5k	12.5kS/s	6.25k	25kS/s	12.5k	50kS/s	25k	125kS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	2.5kS/s	2.5k	6.25kS/s	6.25k	12.5kS/s	12.5k	25kS/s	25k	62.5kS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	1.25kS/s	2.5k	3.125kS/s	6.25k	6.25kS/s	12.5k	12.5kS/s	25k	31.25kS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	500S/s	2.5k	1.25k	6.25k	2.5kS/s	12.5k	5kS/s	25k	12.5kS/s	62.5k	25kS/s	125k	50kS/s	250k	125kS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5kS/s	25k	6.25kS/s	62.5k	12.5kS/s	125k	25kS/s	250k	62.5kS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25kS/s	25k	31.25kS/s	62.5k	6.25kS/s	125k	12.5kS/s	250k	31.25kS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25kS/s	62.5k	2.5kS/s	125k	5kS/s	250k	12.5kS/s	625k	25kS/s	1.25M	50kS/s	2.5M	125kS/s	6.25M
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5kS/s	250k	6.25kS/s	625k	12.5kS/s	1.25M	25kS/s	2.5M	62.5kS/s	6.25M
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25kS/s	250k	31.25kS/s	625k	6.25kS/s	1.25M	12.5kS/s	2.5M	31.25kS/s	6.25M
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125kS/s	62.5k	250S/s	125k	500S/s	250k	1.25kS/s	625k	2.5kS/s	1.25M	5kS/s	2.5M	12.5kS/s	6.25M

Bold: Expanded interpolation or expanded repetitive sampling (variable record length)

Interpolation or repetitive sampling (when repetitive sampling mode is ON)

Interpolation

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation

Envelope mode availab

Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation OFF Repetitive sampling OFF (Max: 1.25GS/s)
Interleave mode OFF, High resolution mode ON

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	
10ns	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	1.25GS/s	125	
20ns	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	1.25GS/s	250	
50ns	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	1.25GS/s	625	
100ns	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	1.25GS/s	1.25k	
200ns	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	1.25GS/s	2.5k	
500ns	500MS/s	2.5k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	1.25GS/s	6.25k	
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	1.25GS/s	12.5k	
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	1.25GS/s	25k	1.25GS/s	25k	1.25GS/s	25k	1.25GS/s	25k	1.25GS/s	25k	1.25GS/s	25k	
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	1.25GS/s	62.5k	1.25GS/s	62.5k	1.25GS/s	62.5k	1.25GS/s	62.5k	1.25GS/s	62.5k	
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	1.25GS/s	125k	1.25GS/s	125k	1.25GS/s	125k	1.25GS/s	125k	
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	1.25GS/s	250k	1.25GS/s	250k	1.25GS/s	250k	
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	1.25GS/s	625k	1.25GS/s	625k	
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	1.25GS/s	1.25M	
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	
5ms	50kS/s	2.5k	125KS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	
10ms	25kS/s	2.5k	62.5KS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	
20ms	12.5kS/s	2.5k	31.25KS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	
50ms	5kS/s	2.5k	12.5KS/s	6.25k	25kS/s	12.5k	50KS/s	25k	125KS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	
100ms	2.5kS/s	2.5k	6.25KS/s	6.25k	12.5kS/s	12.5k	25KS/s	25k	62.5KS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	
200ms	1.25kS/s	2.5k	3.125KS/s	6.25k	6.25kS/s	12.5k	12.5KS/s	25k	31.25KS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	
500ms	500S/s	2.5k	1.25KS/s	6.25k	2.5kS/s	12.5k	5KS/s	25k	12.5KS/s	62.5k	25kS/s	125k	50KS/s	250k	125KS/s	625k	250kS/s	1.25M	500kS/s	2.5M	
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5KS/s	25k	6.25KS/s	62.5k	12.5kS/s	125k	25KS/s	250k	62.5KS/s	625k	125kS/s	1.25M	250kS/s	2.5M	
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25KS/s	25k	3.125KS/s	62.5k	6.25kS/s	125k	12.5KS/s	250k	31.25KS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25KS/s	62.5k	2.5kS/s	125k	5KS/s	250k	12.5KS/s	625k	25kS/s	1.25M	50KS/s	2.5M	
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5KS/s	250k	6.25KS/s	625k	12.5kS/s	1.25M	25KS/s	2.5M	
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25KS/s	250k	3.125KS/s	625k	6.25kS/s	1.25M	12.5KS/s	2.5M	
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k	250S/s	125k	500S/s	250k	1.25KS/s	625k	2.5kS/s	1.25M	5KS/s	2.5M	

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation OFF Repetitive sampling ON (Max: 1.25GS/s)
Interleave mode OFF, High resolution mode ON

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	
10ns	25GS/s	2.5k	62.5GS/s	6.25k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	
20ns	12.5GS/s	2.5k	31.25GS/s	6.25k	62.5GS/s	12.5k	125GS/s	25k	312.5GS/s	62.5k	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	
50ns	5GS/s	2.5k	12.5GS/s	6.25k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	
100ns	2.5GS/s	2.5k	6.25GS/s	6.25k	12.5GS/s	12.5k	25GS/s	25k	62.5GS/s	62.5k	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	**1250GS/s**	**1.25M**	
200ns	1.25GS/s	2.5k	3.125GS/s	6.25k	6.25GS/s	12.5k	12.5GS/s	25k	31.25GS/s	62.5k	62.5GS/s	125k	125GS/s	250k	312.5GS/s	625k	625GS/s	1.25M	**625GS/s**	**1.25M**	
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	12.5GS/s	62.5k	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	**250GS/s**	**1.25M**	
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	6.25GS/s	62.5k	12.5GS/s	125k	25GS/s	250k	62.5GS/s	625k	125GS/s	1.25M	**125GS/s**	**1.25M**	
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	3.125GS/s	62.5k	6.25GS/s	125k	12.5GS/s	250k	31.25GS/s	625k	62.5GS/s	1.25M	**62.5GS/s**	**1.25M**	
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	12.5GS/s	625k	25GS/s	1.25M	**25GS/s**	**1.25M**	
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	6.25GS/s	625k	12.5GS/s	1.25M	**12.5GS/s**	**1.25M**	
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	3.125GS/s	625k	6.25GS/s	1.25M	**6.25GS/s**	**1.25M**	
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	**2.5GS/s**	**1.25M**	
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	1.25GS/s	1.25M	
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	
5ms	50kS/s	2.5k	125KS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	
10ms	25kS/s	2.5k	62.5KS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	
20ms	12.5kS/s	2.5k	31.25KS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	
50ms	5kS/s	2.5k	12.5KS/s	6.25k	25kS/s	12.5k	50KS/s	25k	125KS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	
100ms	2.5kS/s	2.5k	6.25KS/s	6.25k	12.5kS/s	12.5k	25KS/s	25k	62.5KS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	
200ms	1.25kS/s	2.5k	3.125KS/s	6.25k	6.25kS/s	12.5k	12.5KS/s	25k	31.25KS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	
500ms	500S/s	2.5k	1.25KS/s	6.25k	2.5kS/s	12.5k	5KS/s	25k	12.5KS/s	62.5k	25kS/s	125k	50KS/s	250k	125KS/s	625k	250kS/s	1.25M	500kS/s	2.5M	
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5KS/s	25k	6.25KS/s	62.5k	12.5kS/s	125k	25KS/s	250k	62.5KS/s	625k	125kS/s	1.25M	250kS/s	2.5M	
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25KS/s	25k	3.125KS/s	62.5k	6.25kS/s	125k	12.5KS/s	250k	31.25KS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25KS/s	62.5k	2.5kS/s	125k	5KS/s	250k	12.5KS/s	625k	25kS/s	1.25M	50KS/s	2.5M	
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5KS/s	250k	6.25KS/s	625k	12.5kS/s	1.25M	25KS/s	2.5M	
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25KS/s	250k	3.125KS/s	625k	6.25kS/s	1.25M	12.5KS/s	2.5M	
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k	250S/s	125k	500S/s	250k	1.25KS/s	625k	2.5kS/s	1.25M	5KS/s	2.5M	

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available   Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation OFF   Repetitive sampling OFF (Max: 2.5GS/s)

a) Interleave mode OFF, High resolution mode OFF,   b) Interleave mode ON, High resolution mode ON

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**
5ns	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125	2.5GS/s	125
10ns	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250	2.5GS/s	250
20ns	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500	2.5GS/s	500
50ns	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k	2.5GS/s	1.25k
100ns	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k	2.5GS/s	2.5k
200ns	1.25GS/s	2.5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k	2.5GS/s	5k
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k	2.5GS/s	12.5k
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k	2.5GS/s	25k
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5GS/s	50k	2.5GS/s	50k	2.5GS/s	50k	2.5GS/s	50k	2.5GS/s	50k	2.5GS/s	50k	2.5GS/s	50k
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	2.5GS/s	125k	2.5GS/s	125k	2.5GS/s	125k	2.5GS/s	125k	2.5GS/s	125k
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	2.5GS/s	250k	2.5GS/s	250k	2.5GS/s	250k	2.5GS/s	250k
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	2.5GS/s	500k	2.5GS/s	500k	2.5GS/s	500k	2.5GS/s	500k
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	2.5GS/s	1.25M	2.5GS/s	1.25M
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	2.5GS/s	2.5M
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	50kS/s	2.5k	125KS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	25kS/s	2.5k	62.5KS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	12.5kS/s	2.5k	31.25KS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	5kS/s	2.5k	12.5KS/s	6.25k	25kS/s	12.5k	50KS/s	25k	125KS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	2.5kS/s	2.5k	6.25KS/s	6.25k	12.5kS/s	12.5k	25KS/s	25k	62.5KS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	1.25kS/s	2.5k	3.125KS/s	6.25k	6.25kS/s	12.5k	12.5KS/s	25k	31.25KS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	500S/s	2.5k	1.25KS/s	6.25k	2.5kS/s	12.5k	5KS/s	25k	12.5KS/s	62.5k	25kS/s	125k	50KS/s	250k	125KS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5KS/s	25k	6.25KS/s	62.5k	12.5kS/s	125k	25KS/s	250k	62.5KS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25KS/s	25k	3.125KS/s	62.5k	6.25kS/s	125k	12.5KS/s	250k	31.25KS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25KS/s	62.5k	2.5kS/s	125k	5KS/s	250k	12.5KS/s	625k	25kS/s	1.25M	50KS/s	2.5M	125kS/s	6.25M
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5KS/s	250k	6.25KS/s	625k	12.5kS/s	1.25M	25KS/s	2.5M	62.5kS/s	6.25M
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25KS/s	250k	3.125KS/s	625k	6.25kS/s	1.25M	12.5KS/s	2.5M	31.25kS/s	6.25M
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k	250S/s	125k	500S/s	250k	1.25KS/s	625k	2.5kS/s	1.25M	5KS/s	2.5M	12.5kS/s	6.25M

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available (a, b)   Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation OFF   Repetitive sampling ON (Max: 2.5GS/s)

a) Interleave mode OFF, High resolution mode OFF,   b) Interleave mode ON, High resolution mode ON

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	500GSps	2.5k	1250GSps	6.25k	2500GSps	12.5k	**2500GSps**	**12.5k**	**2500GSps**	**12.5k**	**2500GSps**	**12.5k**	**2500GSps**	**1.25k**	**2500GSps**	**12.5k**	**2500GSps**	**12.5k**	**2500GSps**	**1.25k**	**2500GSps**	**12.5k**
1ns	250GSps	2.5k	625GSps	6.25k	1250GSps	12.5k	2500GSps	25k	**2500GSps**	**25k**	**2500GSps**	**25k**	**2500GSps**	**25k**	**2500GSps**	**25k**	**2500GSps**	**25k**	**2500GSps**	**25k**	**2500GSps**	**25k**
2ns	125GSps	2.5k	312.5GSps	6.25k	625GSps	12.5k	1250GSps	25k	**2500GSps**	**50k**	**2500GSps**	**50k**	**2500GSps**	**50k**	**2500GSps**	**50k**	**2500GSps**	**50k**	**2500GSps**	**50k**	**2500GSps**	**50k**
5ns	50GSps	2.5k	125GSps	6.25k	250GSps	12.5k	500GSps	25k	1250GSps	62.5k	2500GSps	125k	**2500GSps**	**125k**	**2500GSps**	**125k**	**2500GSps**	**125k**	**2500GSps**	**125k**	**2500GSps**	**125k**
10ns	25GSps	2.5k	62.5GSps	6.25k	125GSps	12.5k	250GSps	25k	625GSps	62.5k	1250GSps	125k	2500GSps	250k	**2500GSps**	**250k**	**2500GSps**	**250k**	**2500GSps**	**250k**	**2500GSps**	**250k**
20ns	12.5GSps	2.5k	31.25GSps	6.25k	62.5GSps	12.5k	125GSps	25k	312.5GSps	62.5k	625GSps	125k	1250GSps	250k	**2500GSps**	**500k**	**2500GSps**	**500k**	**2500GSps**	**500k**	**2500GSps**	**500k**
50ns	5GSps	2.5k	12.5GSps	6.25k	25GSps	12.5k	50GSps	25k	125GSps	62.5k	250GSps	125k	500GSps	250k	1250GSps	625k	2500GSps	1.25M	**2500GSps**	**1.25M**	**2500GSps**	**1.25M**
100ns	2.5GSps	2.5k	6.25GSps	6.25k	12.5GSps	12.5k	25GSps	25k	62.5GSps	62.5k	125GSps	125k	250GSps	250k	625GSps	625k	1250GSps	1.25M	**1250GSps**	**1.25M**	**1250GSps**	**1.25M**
200ns	1.25GSps	2.5k	2.5GSps	5k	6.25GSps	12.5k	12.5GSps	25k	31.25GSps	62.5k	62.5GSps	125k	125GSps	250k	312.5GSps	625k	625GSps	1.25M	**625GSps**	**1.25M**	**625GSps**	**1.25M**
500ns	500MSps	2.5k	1.25GSps	6.25k	2.5GSps	12.5k	5GSps	25k	12.5GSps	62.5k	25GSps	125k	50GSps	250k	125GSps	625k	250GSps	1.25M	**250GSps**	**1.25M**	**250GSps**	**1.25M**
1us	250MSps	2.5k	625MSps	6.25k	1.25GSps	12.5k	2.5GSps	25k	6.25GSps	62.5k	12.5GSps	125k	25GSps	250k	62.5GSps	625k	125GSps	1.25M	**125GSps**	**1.25M**	**125GSps**	**1.25M**
2us	125MSps	2.5k	312.5MSps	6.25k	625MSps	12.5k	1.25GSps	25k	2.5GSps	50k	6.25GSps	125k	12.5GSps	250k	31.25GSps	625k	62.5GSps	1.25M	**62.5GSps**	**1.25M**	**62.5GSps**	**1.25M**
5us	50MSps	2.5k	125MSps	6.25k	250MSps	12.5k	500MSps	25k	1.25GSps	62.5k	2.5GSps	125k	5GSps	250k	12.5GSps	625k	25GSps	1.25M	**25GSps**	**1.25M**	**25GSps**	**1.25M**
10us	25MSps	2.5k	62.5MSps	6.25k	125MSps	12.5k	250MSps	25k	625MSps	62.5k	1.25GSps	125k	2.5GSps	250k	6.25GSps	625k	12.5GSps	1.25M	**12.5GSps**	**1.25M**	**12.5GSps**	**1.25M**
20us	12.5MSps	2.5k	31.25MSps	6.25k	62.5MSps	12.5k	125MSps	25k	312.5MSps	62.5k	625MSps	125k	1.25GSps	250k	2.5GSps	500k	6.25GSps	1.25M	**6.25GSps**	**1.25M**	**6.25GSps**	**1.25M**
50us	5MSps	2.5k	12.5MSps	6.25k	25MSps	12.5k	50MSps	25k	125MSps	62.5k	250MSps	125k	500MSps	250k	1.25GSps	625k	2.5GSps	1.25M	2.5GSps	1.25M	2.5GSps	1.25M
100us	2.5MSps	2.5k	6.25MSps	6.25k	12.5MSps	12.5k	25MSps	25k	62.5MSps	62.5k	125MSps	125k	250MSps	250k	625MSps	625k	1.25GSps	1.25M	2.5GSps	2.5M	2.5GSps	2.5M
200us	1.25MSps	2.5k	3.125MSps	6.25k	6.25MSps	12.5k	12.5MSps	25k	31.25MSps	62.5k	62.5MSps	125k	125MSps	250k	312.5MSps	625k	625MSps	1.25M	1.25GSps	2.5M	2.5GSps	5M
500us	500kSps	2.5k	1.25MSps	6.25k	2.5MSps	12.5k	5MSps	25k	12.5MSps	62.5k	25MSps	125k	50MSps	250k	125MSps	625k	250MSps	1.25M	500MSps	2.5M	1.25GSps	6.25M
1ms	250kSps	2.5k	625kSps	6.25k	1.25MSps	12.5k	2.5MSps	25k	6.25MSps	62.5k	12.5MSps	125k	25MSps	250k	62.5MSps	625k	125MSps	1.25M	250MSps	2.5M	625M	6.25M
2ms	125kSps	2.5k	312.5kSps	6.25k	625kSps	12.5k	1.25MSps	25k	3.125MSps	62.5k	6.25MSps	125k	12.5MSps	250k	31.25MSps	625k	62.5MSps	1.25M	125MSps	2.5M	312.5M	6.25M
5ms	50kSps	2.5k	125KSps	6.25k	250kSps	12.5k	500kSps	25k	1.25MSps	62.5k	2.5MSps	125k	5MSps	250k	12.5MSps	625k	25MSps	1.25M	50MSps	2.5M	125MSps	6.25M
10ms	25kSps	2.5k	62.5KSps	6.25k	125kSps	12.5k	250kSps	25k	625kSps	62.5k	1.25MSps	125k	2.5MSps	250k	6.25MSps	625k	12.5MSps	1.25M	25MSps	2.5M	62.5MSps	6.25M
20ms	12.5kSps	2.5k	31.25KSps	6.25k	62.5kSps	12.5k	125kSps	25k	312.5kSps	62.5k	625kSps	125k	1.25MSps	250k	3.125MSps	625k	6.25MSps	1.25M	12.5MSps	2.5M	31.25MSps	6.25M
50ms	5kSps	2.5k	12.5kSps	6.25k	25kSps	12.5k	50KSps	25k	125KSps	62.5k	250kSps	125k	500kSps	250k	1.25MSps	625k	2.5MSps	1.25M	5MSps	2.5M	12.5MSps	6.25M
100ms	2.5kSps	2.5k	6.25KSps	6.25k	12.5kSps	12.5k	25KSps	25k	62.5KSps	62.5k	125kSps	125k	250kSps	250k	625kSps	625k	1.25MSps	1.25M	2.5MSps	2.5M	6.25MSps	6.25M
200ms	1.25kSps	2.5k	3.125KSps	6.25k	6.25kSps	12.5k	12.5KSps	25k	31.25KSps	62.5k	62.5kSps	125k	125kSps	250k	312.5kSps	625k	625kSps	1.25M	1.25MSps	2.5M	3.125MSps	6.25M
500ms	500Sps	2.5k	1.25KSps	6.25k	2.5kSps	12.5k	5KSps	25k	12.5KSps	62.5k	25kSps	125k	50KSps	250k	125KSps	625k	250kSps	1.25M	500kSps	2.5M	1.25MSps	6.25M
1s	250Sps	2.5k	625Sps	6.25k	1.25kSps	12.5k	2.5KSps	25k	6.25KSps	62.5k	12.5kSps	125k	25KSps	250k	62.5KSps	625k	125kSps	1.25M	250kSps	2.5M	625kSps	6.25M
2s	125Sps	2.5k	312.5Sps	6.25k	625Sps	12.5k	1.25KSps	25k	3.125KSps	62.5k	6.25kSps	125k	12.5KSps	250k	31.25KSps	625k	62.5kSps	1.25M	125kSps	2.5M	312.5kSps	6.25M
5s	50Sps	2.5k	125Sps	6.25k	250Sps	12.5k	500Sps	25k	1.25KSps	62.5k	2.5kSps	125k	5KSps	250k	12.5KSps	625k	25kSps	1.25M	50KSps	2.5M	125kSps	6.25M
10s	*50 Sps*	*5k*	62.5Sps	6.25k	125Sps	12.5k	250Sps	25k	625Sps	62.5k	1.25kSps	125k	2.5KSps	250k	6.25KSps	625k	12.5kSps	1.25M	25KSps	2.5M	62.5kSps	6.25M
20s	*50 Sps*	*10k*	*50 Sps*	*10k*	62.5Sps	12.5k	125Sps	25k	312.5Sps	62.5k	625Sps	125k	1.25KSps	250k	3.125KSps	625k	6.25kSps	1.25M	12.5KSps	2.5M	31.25kSps	6.25M
50s	*50 Sps*	*25k*	*50 Sps*	*25k*	*50 Sps*	*25k*	50Sps	25k	125Sps	62.5k	250Sps	125k	500Sps	250k	1.25KSps	625k	2.5kSps	1.25M	5KSps	2.5M	12.5kSps	6.25M

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available (a, b)   Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Interpolation OFF   Repetitive sampling OFF (Max: 5GS/s)
Interleave mode ON, High resolution mode OFF

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**
2ns	5GS/s	100	5GS/s	100	5GS/s	100	5GS/s	100	5GS/s	100
5ns	5GS/s	250	5GS/s	250	5GS/s	250	5GS/s	250	5GS/s	250
10ns	5GS/s	500	5GS/s	500	5GS/s	500	5GS/s	500	5GS/s	500
20ns	5GS/s	1k	5GS/s	1k	5GS/s	1k	5GS/s	1k	5GS/s	1k
50ns	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k
100ns	2.5GS/s	2.5k	5GS/s	5k	5GS/s	5k	5GS/s	5k	5GS/s	5k
200ns	1.25GS/s	2.5k	2.5GS/s	5k	5GS/s	10k	5GS/s	10k	5GS/s	10k
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	5GS/s	25k
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	5GS/s	50k
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5GS/s	50k
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k
5ms	50kS/s	2.5k	125KS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k
10ms	25kS/s	2.5k	62.5KS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k
20ms	12.5kS/s	2.5k	31.25KS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k
50ms	5kS/s	2.5k	12.5KS/s	6.25k	25kS/s	12.5k	50KS/s	25k	125KS/s	62.5k
100ms	2.5kS/s	2.5k	6.25KS/s	6.25k	12.5kS/s	12.5k	25KS/s	25k	62.5KS/s	62.5k
200ms	1.25kS/s	2.5k	3.125KS/s	6.25k	6.25kS/s	12.5k	12.5KS/s	25k	31.25KS/s	62.5k
500ms	500S/s	2.5k	1.25KS/s	6.25k	2.5kS/s	12.5k	5KS/s	25k	12.5KS/s	62.5k
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5KS/s	25k	6.25KS/s	62.5k
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25KS/s	25k	3.125KS/s	62.5k
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25KS/s	62.5k
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k

T/div(s/div)	125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**
1ns	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	5GS/s	100	5GS/s	100	5GS/s	100	5GS/s	100	5GS/s	100	5GS/s	100
5ns	5GS/s	250	5GS/s	250	5GS/s	250	5GS/s	250	5GS/s	250	5GS/s	250
10ns	5GS/s	500	5GS/s	500	5GS/s	500	5GS/s	500	5GS/s	500	5GS/s	500
20ns	5GS/s	1k	5GS/s	1k	5GS/s	1k	5GS/s	1k	5GS/s	1k	5GS/s	1k
50ns	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k	5GS/s	2.5k
100ns	5GS/s	5k	5GS/s	5k	5GS/s	5k	5GS/s	5k	5GS/s	5k	5GS/s	5k
200ns	5GS/s	10k	5GS/s	10k	5GS/s	10k	5GS/s	10k	5GS/s	10k	5GS/s	10k
500ns	5GS/s	25k	5GS/s	25k	5GS/s	25k	5GS/s	25k	5GS/s	25k	5GS/s	25k
1us	5GS/s	50k	5GS/s	50k	5GS/s	50k	5GS/s	50k	5GS/s	50k	5GS/s	50k
2us	5GS/s	100k	5GS/s	100k	5GS/s	100k	5GS/s	100k	5GS/s	100k	5GS/s	100k
5us	2.5GS/s	125k	5GS/s	250k	5GS/s	250k	5GS/s	250k	5GS/s	250k	5GS/s	250k
10us	1.25GS/s	125k	2.5GS/s	250k	5GS/s	500k	5GS/s	500k	5GS/s	500k	5GS/s	500k
20us	625MS/s	125k	1.25GS/s	250k	2.5GS/s	500k	5GS/s	1M	5GS/s	1M	5GS/s	1M
50us	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5GS/s	2.5M	5GS/s	2.5M
100us	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	5GS/s	5M
200us	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	25kS/s	125k	50KS/s	250k	125KS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	12.5kS/s	125k	25KS/s	250k	62.5KS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	6.25kS/s	125k	12.5KS/s	250k	31.25KS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	2.5kS/s	125k	5KS/s	250k	12.5KS/s	625k	25kS/s	1.25M	50KS/s	2.5M	125kS/s	6.25M
10s	1.25kS/s	125k	2.5KS/s	250k	6.25KS/s	625k	12.5kS/s	1.25M	25KS/s	2.5M	62.5kS/s	6.25M
20s	625S/s	125k	1.25KS/s	250k	3.125KS/s	625k	6.25kS/s	1.25M	12.5KS/s	2.5M	31.25kS/s	6.25M
50s	250S/s	125k	500S/s	250k	1.25KS/s	625k	2.5kS/s	1.25M	5KS/s	2.5M	12.5kS/s	6.25M

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

Envelope mode available   Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Appendix 1 Relationship between the Time Axis Setting, Sample Rate and Record Length

Interpolation OFF Repetitive sampling ON (Max: 5GS/s)
Interleave mode ON, High resolution mode OFF

T/div(s/div)	2.5k		6.25k		12.5k		25k		62.5k		125k		250k		625k		1.25M		2.5M *1		6.25M *1	
500ps	500GS/s	2.5k	1250GS/s	6.25k	2500GS/s	12.5k	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**	**2500GS/s**	**12.5k**	**2500GS/s**	**1.25k**	**2500GS/s**	**12.5k**
1ns	250GS/s	2.5k	625GS/s	6.25k	1250GS/s	12.5k	2500GS/s	25k	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**	**2500GS/s**	**25k**
2ns	125GS/s	2.5k	312.5GS/s	6.25k	625GS/s	12.5k	1250GS/s	25k	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**	**2500GS/s**	**50k**
5ns	50GS/s	2.5k	125GS/s	6.25k	250GS/s	12.5k	500GS/s	25k	1250GS/s	62.5k	2500GS/s	125k	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**	**2500GS/s**	**125k**
10ns	25GS/s	2.5k	62.5GS/s	6.25k	125GS/s	12.5k	250GS/s	25k	625GS/s	62.5k	1250GS/s	125k	2500GS/s	250k	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**	**2500GS/s**	**250k**
20ns	12.5GS/s	2.5k	31.25GS/s	6.25k	62.5GS/s	12.5k	125GS/s	25k	312.5GS/s	62.5k	625GS/s	125k	1250GS/s	250k	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**	**2500GS/s**	**500k**
50ns	5GS/s	2.5k	12.5GS/s	6.25k	25GS/s	12.5k	50GS/s	25k	125GS/s	62.5k	250GS/s	125k	500GS/s	250k	1250GS/s	625k	2500GS/s	1.25M	**2500GS/s**	**1.25M**	**2500GS/s**	**1.25M**
100ns	2.5GS/s	2.5k	5GS/s	5k	12.5GS/s	12.5k	25GS/s	25k	62.5GS/s	62.5k	125GS/s	125k	250GS/s	250k	625GS/s	625k	1250GS/s	1.25M	**1250GS/s**	**1.25M**	**1250GS/s**	**1.25M**
200ns	1.25GS/s	2.5k	2.5GS/s	5k	5GS/s	10k	12.5GS/s	25k	31.25GS/s	62.5k	62.5GS/s	125k	125GS/s	250k	312.5GS/s	625k	625GS/s	1.25M	**625GS/s**	**1.25M**	**625GS/s**	**1.25M**
500ns	500MS/s	2.5k	1.25GS/s	6.25k	2.5GS/s	12.5k	5GS/s	25k	12.5GS/s	62.5k	25GS/s	125k	50GS/s	250k	125GS/s	625k	250GS/s	1.25M	**250GS/s**	**1.25M**	**250GS/s**	**1.25M**
1us	250MS/s	2.5k	625MS/s	6.25k	1.25GS/s	12.5k	2.5GS/s	25k	5GS/s	50k	12.5GS/s	125k	25GS/s	250k	62.5GS/s	625k	125GS/s	1.25M	**125GS/s**	**1.25M**	**125GS/s**	**1.25M**
2us	125MS/s	2.5k	312.5MS/s	6.25k	625MS/s	12.5k	1.25GS/s	25k	2.5GS/s	50k	5GS/s	100k	12.5GS/s	250k	31.25GS/s	625k	62.5GS/s	1.25M	**62.5GS/s**	**1.25M**	**62.5GS/s**	**1.25M**
5us	50MS/s	2.5k	125MS/s	6.25k	250MS/s	12.5k	500MS/s	25k	1.25GS/s	62.5k	2.5GS/s	125k	5GS/s	250k	12.5GS/s	625k	25GS/s	1.25M	**25GS/s**	**1.25M**	**25GS/s**	**1.25M**
10us	25MS/s	2.5k	62.5MS/s	6.25k	125MS/s	12.5k	250MS/s	25k	625MS/s	62.5k	1.25GS/s	125k	2.5GS/s	250k	5GS/s	500k	12.5GS/s	1.25M	**12.5GS/s**	**1.25M**	**12.5GS/s**	**1.25M**
20us	12.5MS/s	2.5k	31.25MS/s	6.25k	62.5MS/s	12.5k	125MS/s	25k	312.5MS/s	62.5k	625MS/s	125k	1.25GS/s	250k	2.5GS/s	500k	5GS/s	1M	**6.25GS/s**	**1.25M**	**6.25GS/s**	**1.25M**
50us	5MS/s	2.5k	12.5MS/s	6.25k	25MS/s	12.5k	50MS/s	25k	125MS/s	62.5k	250MS/s	125k	500MS/s	250k	1.25GS/s	625k	2.5GS/s	1.25M	5Gssp	2.5M	5GS/s	2.5M
100us	2.5MS/s	2.5k	6.25MS/s	6.25k	12.5MS/s	12.5k	25MS/s	25k	62.5MS/s	62.5k	125MS/s	125k	250MS/s	250k	625MS/s	625k	1.25GS/s	1.25M	2.5GS/s	2.5M	5GS/s	5M
200us	1.25MS/s	2.5k	3.125MS/s	6.25k	6.25MS/s	12.5k	12.5MS/s	25k	31.25MS/s	62.5k	62.5MS/s	125k	125MS/s	250k	312.5MS/s	625k	625MS/s	1.25M	1.25GS/s	2.5M	2.5GS/s	5M
500us	500kS/s	2.5k	1.25MS/s	6.25k	2.5MS/s	12.5k	5MS/s	25k	12.5MS/s	62.5k	25MS/s	125k	50MS/s	250k	125MS/s	625k	250MS/s	1.25M	500MS/s	2.5M	1.25GS/s	6.25M
1ms	250kS/s	2.5k	625kS/s	6.25k	1.25MS/s	12.5k	2.5MS/s	25k	6.25MS/s	62.5k	12.5MS/s	125k	25MS/s	250k	62.5MS/s	625k	125MS/s	1.25M	250MS/s	2.5M	625M	6.25M
2ms	125kS/s	2.5k	312.5kS/s	6.25k	625kS/s	12.5k	1.25MS/s	25k	3.125MS/s	62.5k	6.25MS/s	125k	12.5MS/s	250k	31.25MS/s	625k	62.5MS/s	1.25M	125MS/s	2.5M	312.5M	6.25M
5ms	50kS/s	2.5k	125KS/s	6.25k	250kS/s	12.5k	500kS/s	25k	1.25MS/s	62.5k	2.5MS/s	125k	5MS/s	250k	12.5MS/s	625k	25MS/s	1.25M	50MS/s	2.5M	125MS/s	6.25M
10ms	25kS/s	2.5k	62.5KS/s	6.25k	125kS/s	12.5k	250kS/s	25k	625kS/s	62.5k	1.25MS/s	125k	2.5MS/s	250k	6.25MS/s	625k	12.5MS/s	1.25M	25MS/s	2.5M	62.5MS/s	6.25M
20ms	12.5kS/s	2.5k	31.25KS/s	6.25k	62.5kS/s	12.5k	125kS/s	25k	312.5kS/s	62.5k	625kS/s	125k	1.25MS/s	250k	3.125MS/s	625k	6.25MS/s	1.25M	12.5MS/s	2.5M	31.25MS/s	6.25M
50ms	5kS/s	2.5k	12.5KS/s	6.25k	25kS/s	12.5k	50KS/s	25k	125KS/s	62.5k	250kS/s	125k	500kS/s	250k	1.25MS/s	625k	2.5MS/s	1.25M	5MS/s	2.5M	12.5MS/s	6.25M
100ms	2.5kS/s	2.5k	6.25KS/s	6.25k	12.5kS/s	12.5k	25KS/s	25k	62.5KS/s	62.5k	125kS/s	125k	250kS/s	250k	625kS/s	625k	1.25MS/s	1.25M	2.5MS/s	2.5M	6.25MS/s	6.25M
200ms	1.25kS/s	2.5k	3.125KS/s	6.25k	6.25kS/s	12.5k	12.5KS/s	25k	31.25KS/s	62.5k	62.5kS/s	125k	125kS/s	250k	312.5kS/s	625k	625kS/s	1.25M	1.25MS/s	2.5M	3.125MS/s	6.25M
500ms	500S/s	2.5k	1.25KS/s	6.25k	2.5kS/s	12.5k	5KS/s	25k	12.5KS/s	62.5k	25kS/s	125k	50KS/s	250k	125KS/s	625k	250kS/s	1.25M	500kS/s	2.5M	1.25MS/s	6.25M
1s	250S/s	2.5k	625S/s	6.25k	1.25kS/s	12.5k	2.5KS/s	25k	6.25KS/s	62.5k	12.5kS/s	125k	25KS/s	250k	62.5KS/s	625k	125kS/s	1.25M	250kS/s	2.5M	625kS/s	6.25M
2s	125S/s	2.5k	312.5S/s	6.25k	625S/s	12.5k	1.25KS/s	25k	3.125KS/s	62.5k	6.25kS/s	125k	12.5KS/s	250k	31.25KS/s	625k	62.5kS/s	1.25M	125kS/s	2.5M	312.5kS/s	6.25M
5s	50S/s	2.5k	125S/s	6.25k	250S/s	12.5k	500S/s	25k	1.25KS/s	62.5k	2.5kS/s	125k	5KS/s	250k	12.5KS/s	625k	25kS/s	1.25M	50KS/s	2.5M	125kS/s	6.25M
10s	*50S/s*	*5k*	62.5S/s	6.25k	125S/s	12.5k	250S/s	25k	625S/s	62.5k	1.25kS/s	125k	2.5KS/s	250k	6.25KS/s	625k	12.5kS/s	1.25M	25KS/s	2.5M	62.5kS/s	6.25M
20s	*50S/s*	*10k*	*50S/s*	*10k*	62.5S/s	12.5k	125S/s	25k	312.5S/s	62.5k	625S/s	125k	1.25KS/s	250k	3.125KS/s	625k	6.25kS/s	1.25M	12.5KS/s	2.5M	31.25kS/s	6.25M
50s	*50S/s*	*25k*	*50S/s*	*25k*	*50S/s*	*25k*	50S/s	25k	125S/s	62.5k	250S/s	125k	500S/s	250k	1.25KS/s	625k	2.5kS/s	1.25M	5KS/s	2.5M	12.5kS/s	6.25M

Repetitive sampling

Expanded normal mode (variable record length)

Bold: Expanded repetitive sampling (variable record length)

Italics: Minimum sample rate is set at 50 S/s. Record length settings are by reservation.

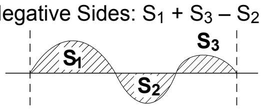
Envelope mode available   Roll mode available

*1 Maximum record length in high resolution mode is 2.5 MW.

Appendix 2 How to Calculate the Area of a Waveform

IntegTY

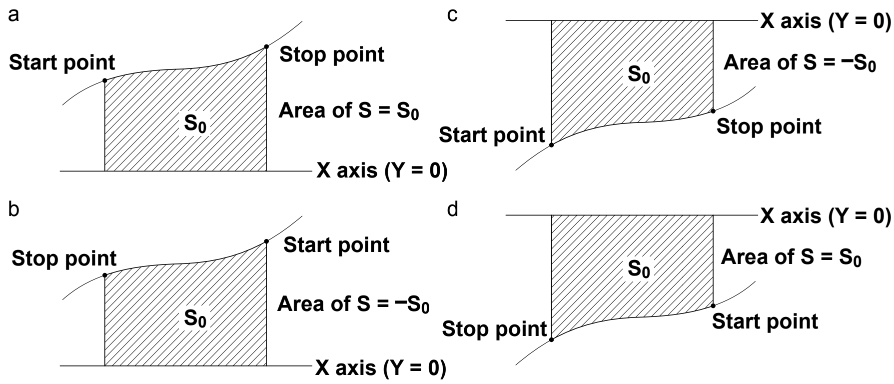
Total Area for both Positive and Negative Sides: $S_1 + S_3 - S_2$



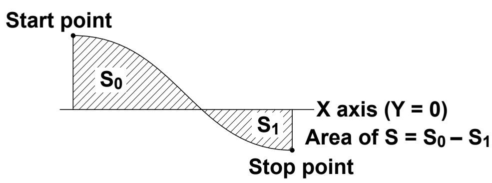
XY display: IntegXY

Open

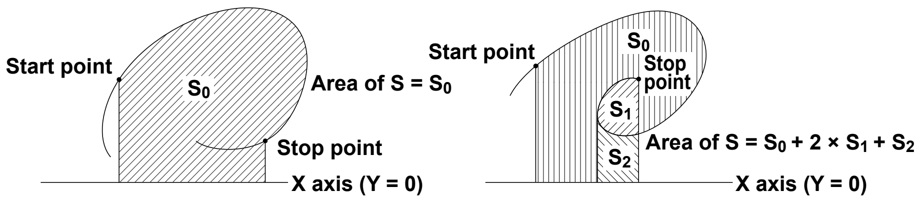
(1) When Only One Y Data Corresponds to X Data



(2) When the Waveform Extends into the Negative Side

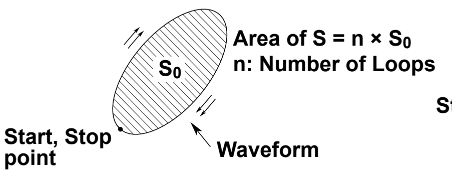


(3) When Two or more Y Data Correspond to X Data

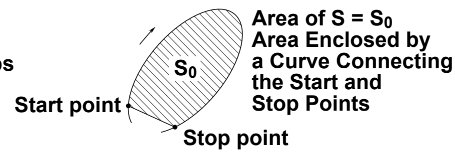


Close

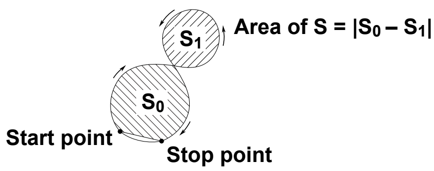
(1) Multiple Loops



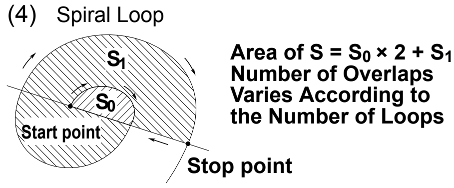
(2) Non-Closed Curve



(3) Loop Tracinga Figure Eight



(4) Spiral Loop



Appendix

App

Appendix 3 Key Assignments for the USB104 Keyboard

SB5000 Panel Key	USB Key Board
CH1	Hold down the Ctrl key and press 1
CH2	Hold down the Ctrl key and press 2
CH3	Hold down the Ctrl key and press 3
CH4	Hold down the Ctrl key and press 4
M1	Hold down the Ctrl key and press 5
M2	Hold down the Ctrl key and press 6
M3	Hold down the Ctrl key and press 7
M4	Hold down the Ctrl key and press 8
LOGIC	Hold down the Ctrl key and press 9
START/STOP	F12
ACQ	Hold down the Ctrl key and press a
SAMPLING/LENGTH	Hold down the Ctrl key and press g
POSITION/DELAY	Hold down the Ctrl key and press p
TRIG MODE/HOLD OFF	Hold down the Ctrl key and press t
ACQ COUNT/ACTION	Hold down the Ctrl + Shift key and press t
EDGE/STATE	Hold down the Ctrl key and press e
SERIAL BUS	Hold down the Ctrl key and press o
WIDTH	Hold down the Ctrl key and press w
EVENT INTERVAL	Hold down the Ctrl key and press I
SOURCE	Hold down the Ctrl key and press u
LEVEL/COUPLING	Hold down the Ctrl key and press l
CURSOR	Hold down the Ctrl key and press c
PARAM	Hold down the Ctrl key and press m
EYE DIAGRAM	Hold down the Ctrl + Shift key and press m
WINDOW1	Hold down the Ctrl key and press v
WINDOW2	Hold down the Ctrl key and press b
SERIAL BUS SETUP	Hold down the Ctrl key and press n
FORM	Hold down the Ctrl key and press d
ACCUM	Hold down the Ctrl key and press q
INTENSITY △	Hold down the Ctrl key and press Page Up
INTENSITY ▽	Hold down the Ctrl key and press Page Down
ZOOM1	Hold down the Ctrl key and press z
DISP1	Hold down the Ctrl + Shift key and press z
ZOOM2	Hold down the Ctrl key and press x
DISP2	Hold down the Ctrl + Shift key and press x
SETUP	Hold down the Ctrl key and press s
HELP	Hold down the Ctrl key and press F1
HISTORY	Hold down the Ctrl key and press h
HISTORY CLEAR	Hold down the Ctrl + Shift key and press h
PRINT	PrintScreen, or hold down the Ctrl key and press PrintScreen
PRINT MENU	Hold down the Shift key and press PrintScreen, or hold down the Ctrl + Shift key and press PrintScreen
FILE	Hold down the Ctrl key and press f
SYSTEM	Hold down the Ctrl key and press /
ESC	Esc
F1	F1
F2	F2
F3	F3

SB5000 Panel Key	USB Key Board
F4	F4
F5	F5
F6	F6
F7	F7
SNAP	Pause
SNAP CLEAR	Hold down the Shift key and press Pause
RESET	Hold down the Ctrl key and press r
SET	Hold down the Ctrl key and press Enter
△	↑
▽	↓
◁	←
▷	→
Numeral key	
1 (D)	Num'1' (Hold down the Shift key and press Num'1')
2 (E)	Num'2' (Hold down the Shift key and press Num'2')
3 (F)	Num'3' (Hold down the Shift key and press Num'3')
4 (u)	Num'4' (Hold down the Shift key and press Num'4')
5 (n)	Num'5' (Hold down the Shift key and press Num'5')
6 (p)	Num'6' (Hold down the Shift key and press Num'6')
7 (M)	Num'7' (Hold down the Shift key and press Num'7')
8 (k)	Num'8' (Hold down the Shift key and press Num'8')
9 (m)	Num'9' (Hold down the Shift key and press Num'9')
0 (A)	Num'0' (Hold down the Shift key and press Num'0')
B	Hold down the Shift key and press Num'.'
C	Hold down the Ctrl+Shift key and press Num'+', or hold down the Ctrl+Shift key and press Num'-'
±	Hold down the Ctrl key and press Num'+', or hold down the Ctrl key and press Num'-'
.	Num'.'
BS	Back Space
CLEAR	Hold down the Ctrl key and press Delete
EXP	F10
Enter	Enter
X	Hold down the Shift key and press F10
Knob	
V POSITION	
Right	Page Up
Left	Page Down
Fine/Coarse	F8
V SCALE	
Right	Home
Left	End
Fine/Coarse	F9
T/DIV	
Right	Hold down the Ctrl key and press →
Left	Hold down the Ctrl key and press ←
MAG	
Right	Hold down the Ctrl key and press ↑
Left	Hold down the Ctrl key and press ↓
Rotary Knob	
Right	Hold down the Ctrl key and press Home
Left	Hold down the Ctrl key and press End

Appendix 4 Waveform Parameter Integrals and Derivatives

Differentiation (DIFF)

The computation of the first order and second order differentiation uses the 5th order Lagrange interpolation formula to derive a point of data from the 5 points around the point. The data f0 to fn and I0 to In corresponde to sampling time x0 to xn.

Point xk $fk' = \frac{1}{12h}[fk\text{-}2 - 8fk\text{-}1 + 8fk\text{+}1 - fk\text{+}2]$

h = Δx is the sampling interval (sec) (example h = 200 × 10^{-6} at 5 kHz)

Integration (INTEG)

Point x0 $I_0 = 0$

Point x1 $I_1 = \frac{1}{2}(f_0 + f_1)h$

Point x2 $I_2 = \frac{1}{2}(f_0 + f_1)h + \frac{1}{2}(f_1 + f_2)h = I_1 + \frac{1}{2}(f_1 + f_2)$

Point xn $I_n = I_{n-1} + \frac{1}{2}(f_{n-1} + f_n)h$

Appendix 5 ASCII Data File Format

The format of the data file when analog signals and logic signals are stored in ASCII format is shown below.

	A	B	C	D	E	F	G	H	I	J
1	Header Size	15								
2	Model Name	SB5000								
3	Comment									
4	BlockNumber	1	1	1	1	1	1	1	1	1
5	TraceName	CH1	CH2	CH3	CH4	Group1	Group2	Group3	Group4	Group5
6	BlockSize	2500	2500	2500	2500	2500	2500	2500	2500	2500
7	VUnit	V	V	V	V					
8	SampleRate	250000	250000	250000	250000	250000	250000	250000	250000	250000
9	HResolution	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06	4.00E-06
10	HOffset	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03	-5.00E-03
11	HUnit	s	s	s	s	s	s	s	s	s
12	DisplayBlockSize	2500	2500	2500	2500	2500	2500	2500	2500	2500
13	DisplayPointNo.	0	0	0	0	0	0	0	0	0
14	Date	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26	2007/1/26
15	Time	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6	41:25.6
16										
17		-1.00E-02	2.00E-02	2.00E-02	2.00E-02	78	133	199	12	0
18		4.00E-02	4.00E-02	4.00E-02	3.00E-02	78	149	199	12	0
19		5.00E-02	1.00E-02	1.00E-02	-1.00E-02	78	133	199	12	0
20	Data	3.00E-02	-2.00E-02	-3.00E-02	0.00E+00	78	133	199	12	0
21		4.00E-02	1.00E-02	5.00E-02	9.00E-02	78	133	199	12	0
22		-1.00E-02	5.00E-02	2.00E-02	2.00E-02	78	133	199	12	0
23		4.00E-02	2.00E-02	-4.00E-02	-4.00E-02	78	133	199	12	0
24		8.00E-02	3.00E-02	6.00E-02	9.00E-02	78	133	199	12	0
25		-4.00E-02	8.00E-02	4.00E-02	6.00E-02	78	133	199	12	0
26		5.00E-02	0.00E+00	1.00E-02	2.00E-02	94	149	199	12	0

Header Size	The number of header lines.
Model Name	Model name.
Comment	The comment that was entered when the data was saved.
BlockNumber	The number of blocks in this group. The maximum number of blocks if the number of blocks varies between waveforms.
TraceName	Name of each waveform.
BlockSize	The number of data points in a single block of each waveform.
VUnit	The unit used on the Y-axis of each waveform (no effect on the data).
Sample Rate	The sample rate used to acquire the signal.
HResolution	The value of coefficient HResolution of the X-axis conversion equation of each waveform. X-axis value = HResolution × (Data No. – 1) + HOffset
HOffset	The value of coefficient HOffset of the X-axis conversion equation of each waveform. X-axis value = HResolution × (Data No. – 1) + HOffset
HUnit	The unit used on the X-axis of each waveform (no effect on the data).
DisplayBlockSize	The length of the data displayed on the screen (display record length).
DisplayPointNo.	A value indicating the memory position (n^{th} point in the memory) corresponding the left end of the display record length.
Date	The date when signal acquisition was completed.
Time	The time when signal acquisition was completed.

Index

Symbols

A

B

C Page

D Page

E

Page

F

Page

G Page

H Page

I Page

N

O

P

Q

R

S Page

T Page