User's Manual

DL1640/DL1640L Digital Oscilloscope I²C-Bus Signal Analysis Function

(Includes the SPI Bus Signal Analysis Function)

YOKOGAWA
Yokogawa Electric Corporation

IM 701610-61E
2nd Edition

Foreword

Thank you for purchasing the Digital Oscilloscope DL1640/DL1640L/F5 with the I^2C-bus signal analysis function and the SPI bus signal analysis function.
This User's Manual describes the I^2C-bus signal analysis function and SPI bus signal analysis function. For information about other functions, operating procedures, and handling precautions of the DL1740, see the following manuals:

Manual Name	Manual No.	Description
DL1620/DL1640/DL1640L User's Manual	IM 701610-01E	Describes all functions (except for the communications function) and their operation procedures for the instrument.
DL1620/DL1640/DL1640L Communication Interface User's Manual	IM 701610-17E	Describes the communications functions of the GP-IB, RS-232, USB, and network interface.
DL1620/DL1640/DL1640L Operation Guide	IM 701610-02E	Explains basic operations only.

Notes

- The contents of this manual are subject to change without prior notice as a result of improvements in the instrument's performance and functions. Display contents illustrated in this manual may differ slightly from what actually appears on your screen.
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Revisions

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2nd Edition: July 2005

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How to Use this Manual

Structure of the Manual

This user's manual consists of 3 chapters, and an Index as described below.

Chapter	Title	Content
1	I^2C-Bus Signal Analysis Function	Explains I^2C-bus signal analysis function.
2	SPI-Bus Signal Analysis Function	Explains SPI bus signal analysis function.
3	Specifications	Lists the I^2C-bus signal analysis function and SPI bus signal analysis function specifications.
	Index	Index of contents.

Conventions Used in this Manual

Units

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

Bolded Items

Characters written in bold mainly refer to characters or setting values that are displayed on the screen or panel.

Symbols

The following symbols are used in to this manual.

Affixed to the instrument. Indicates danger to personnel or instrument and the operator must refer to the user's manual. The symbol is used in the user's manual to indicate the reference.

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

Provides information that is important for proper operation of the instrument.

Terms Used for Descriptions of Operations

The following terms are used in chapters 1 and 2 to distinguish certain features in descriptions.

Relevant Keys

Indicates the relevant panel keys which are necessary to carry out the operation.

Procedure

Carry out steps in the order shown. The operating procedures are given with the assumption that you are not familiar with the operation. Thus, it may not be necessary to carry out all the steps when changing settings.

Explanation

Describes settings and restrictions relating to the operation.

Contents

1.1 Overview of the I²C-Bus Signal Analysis Function

About the I²C-Bus Signal Analysis Function

By using this function, you will be able to analyze data while displaying the I²C-bus signal waveform. The main functions are as follows:

- **Trigger Function**
  Captures signals using various trigger conditions such as when a start condition is detected, when an Acknowledge bit is not detected, when the specified address (7 bits + R/W) pattern is met, or when the data pattern is met or not met (start trigger, Non-Ack trigger, or address trigger).
  Triggers can also be activated by combining the I²C trigger condition (SCL/SDA signal) and the CH3/CH4 signal (combination trigger).

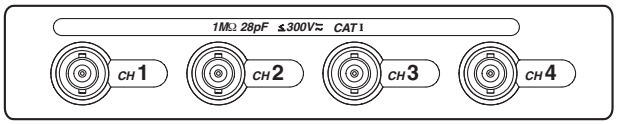
- **Analysis Function**
  You can analyze the data and other information that are displayed when the acquisition of historical data, acquisition data, or waveform is stopped.
  The analysis results are listed on the right side of the screen. In addition, the analysis results can be displayed using hexadecimal and binary notation. The analysis results and waveforms can be displayed simultaneously.

- **Search Function**
  From the acquired data (the currently displayed data), you can search in the forward or reverse direction for data that matches a specified address pattern, data pattern, or Acknowledge bit condition, and display the matched data expanded on the ZOOM display. You can specify the address pattern or data pattern using binary or hexadecimal values. You can also search indefinite data.

1.2 Connecting the Probe

Input Terminals

Connect the probe to one of the input terminals located at the lower section of the front panel. The input impedance is 1 MΩ±1.0% and approximately 28 pF.



WARNING

To prevent fire or electric shock, do not use this instrument for category II, III, or IV measurements.

CAUTION

The maximum input voltage for 1 MΩ input is 300 VDC or 300 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 this value.

Precautions to Be Taken When Connecting a Probe

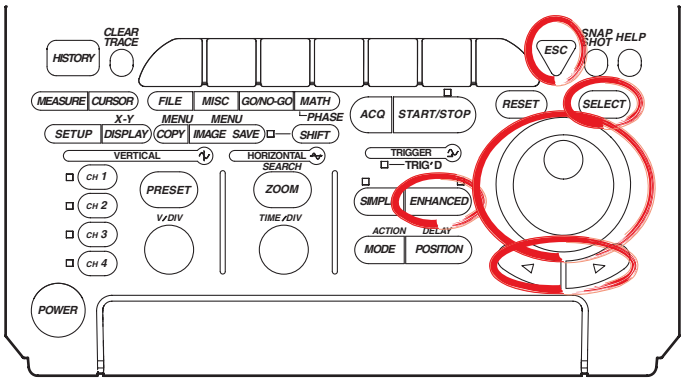
- When using the I^2C-bus trigger function, apply the SCL (serial clock) signal and SDA (serial data) signal to the CH1 and CH2 input terminals, respectively.
- When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in section 3.5, “Compensating the Probe (Phase Correction)” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*. Failure to do so may result in unstable gain across different frequencies, thereby preventing correct measurement. Calibration must be performed for each channel.
- Note that if the object being measured is directly connected to the instrument without using a probe, correct measurements may not be possible due to loading effects.

Note

The data analysis function and the data search function of the I^2C bus can be used against the CH3 and CH4 signals. For details, see section 1.5, “Analyzing/Searching Data.”

1.3 Setting the Trigger Conditions

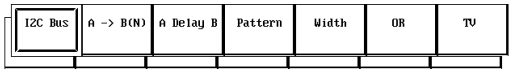
Relevant Keys



Procedure

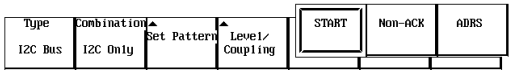
1. Press **ENHANCED**.
2. Press the **Type** soft key. The trigger type selection menu appears.

3. Press the **I2C Bus** soft key.



Selecting the I²C Trigger Type

4. Press the **I2C Type** soft key and then the **START**, **Non-ACK**, or **ADRS** soft key.



- **When START Is Selected**

  If you selected the START trigger, proceed to step21.

- **When Non-ACK Is Selected**

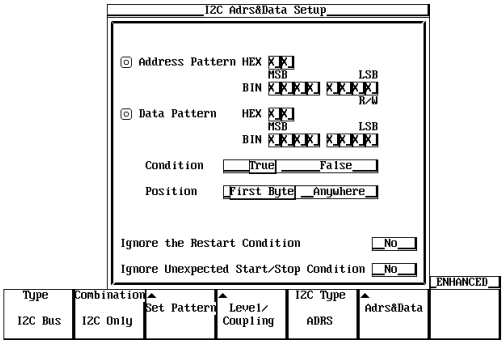
  If you selected the Non-ACK trigger, proceed to step 21.

- **When ADRS Is Selected**

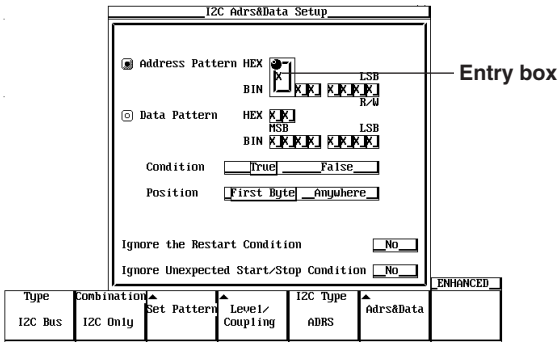
  5. Press the **Adrs&Data** soft key. The I2C Adrs&Data Setup dialog box appears.

Setting the Address Pattern

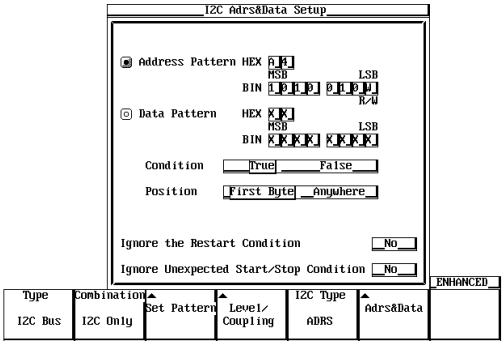
6. Turn the jog shuttle to select Address Pattern.



7. Press **SELECT**. The button to the left of Address Pattern is highlighted, and the address pattern becomes the trigger target.
8. Turn the jog shuttle to move the cursor to the item you wish to set the pattern.
9. Press **SELECT** to display the entry box.



10. Turn the jog shuttle to set the value. Bits set to “X” will not be used as a trigger condition. The trigger conditions can be specified using binary (BIN) or hexadecimal (HEX) values.
    Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.



Note

When using binary (BIN) display, set the LSB using “R” (Read), “W” (Write), and “X.”

Setting the Data Pattern

11. Turn the jog shuttle to select Data Pattern.
12. Set the value in a similar fashion as described in steps 7 through 10.
13. Turn the jog shuttle to move the cursor to Condition of Data Pattern.
14. Press **SELECT** to select True or False.
15. Turn the jog shuttle to move the cursor to Position of Data Pattern.
16. Press **SELECT** to select First Byte or Anywhere.

Setting Whether to Ignore Restart Conditions

17. Turn the jog shuttle to move the cursor to Ignore the Restart Condition.
18. Press **SELECT** to select YES or NO.

Setting Whether to Ignore Start/Stop Conditions That Do Not Conform to the Protocol

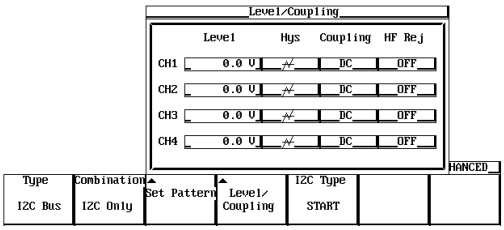
19. Turn the jog shuttle to move the cursor to Ignore Unexpected Start/Stop Condition.
20. Press **SELECT** to select Yes or No.
    Press **ESC** to close the dialog box.

- **Setting the Trigger Level, Hysteresis, Trigger Coupling, and HF Rejection**

21. Press the **Level/Coupling** soft key. The Level/Coupling dialog box appears.

Setting the Trigger Level

22. Turn the jog shuttle to move the cursor to the desired channel for setting the trigger level (Level).



23. Press **SELECT** to display the level setup menu.
24. Turn the jog shuttle to set the value.
    You can move between the digits using the arrow keys. Pressing **RESET** resets the trigger level to 0.00 V.
25. Press **SELECT** to confirm the value.

Setting the Hysteresis

26. Turn the jog shuttle to move the cursor to the desired channel for setting the hysteresis (Hys).
27. Press **SELECT** to select  or .

Setting the Trigger Coupling

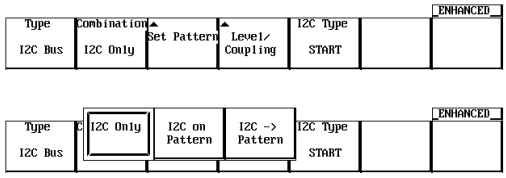
28. Turn the jog shuttle to move the cursor to the desired channel for setting the coupling.
29. Press **SELECT** to select DC or AC.

Setting the HF Rejection

30. Turn the jog shuttle to move the cursor to the desired channel for setting the HF rejection (HF Rej).
31. Press **SELECT** to select ON, or OFF.
    Press **ESC** to close the dialog box.

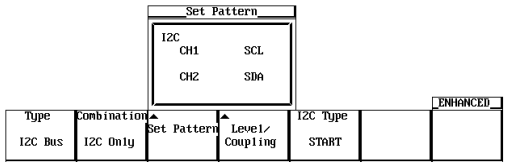
- **Selecting the Combination Trigger**

32. Press the **Combination** soft key and then press the **I2C Only**, **I2C on Pattern**, or **I2C → Pattern** soft key.



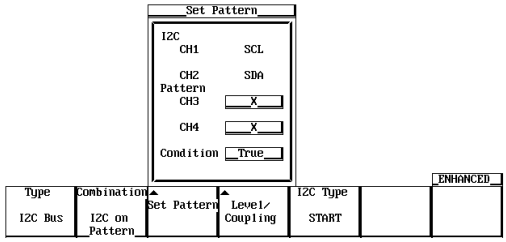
- **When I2C Only Is Selected**

33. Press the **Set Pattern** soft key. The Set Pattern dialog box appears. If you selected I2C Only, you do not have to set this item.
    Press **ESC** to close the box.



- **When I2C on Pattern Is Selected**

33. Press the **Set Pattern** soft key. The Set Pattern dialog box appears.



Setting the CH3 and CH4 Pattern

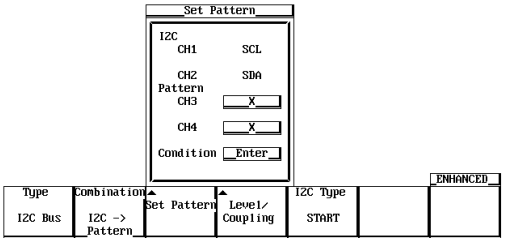
34. Turn the jog shuttle to move the cursor to Pattern CH3 or CH4.
35. Press **SELECT** to select H, L, or X.

Setting the Trigger Condition

36. Turn the jog shuttle to move the cursor to Condition.
37. Press **SELECT** to select True or False.
    Press **ESC** to close the dialog box.

- **When I2C → Pattern Is Selected**

  33. Press the **Set Pattern** soft key. The Set Pattern dialog box appears.



Setting the CH3 and CH4 Pattern

34. Turn the jog shuttle to move the cursor to Pattern CH3 or CH4.
35. Press **SELECT** to select H, L, or X.

Setting the Trigger Condition

36. Turn the jog shuttle to move the cursor to Condition.
37. Press **SELECT** to select Enter or Exit.
    Press **ESC** to close the dialog box.

Note

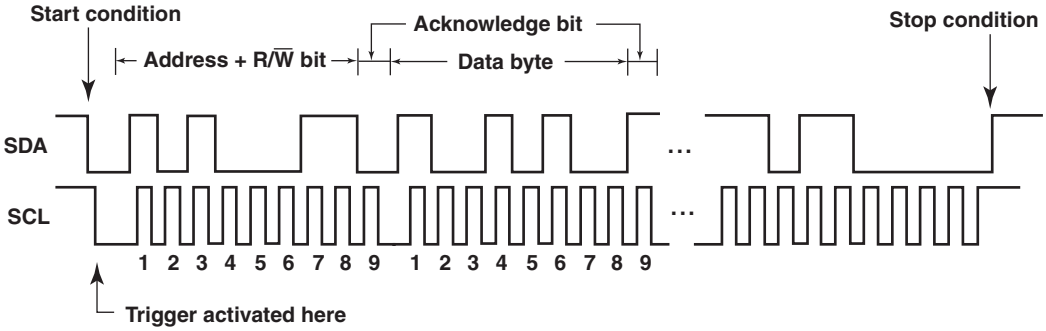
If you selected "I2C → Pattern" for Combination and set the patterns of CH3 and CH4 to "X," triggers will not be activated.

Explanation

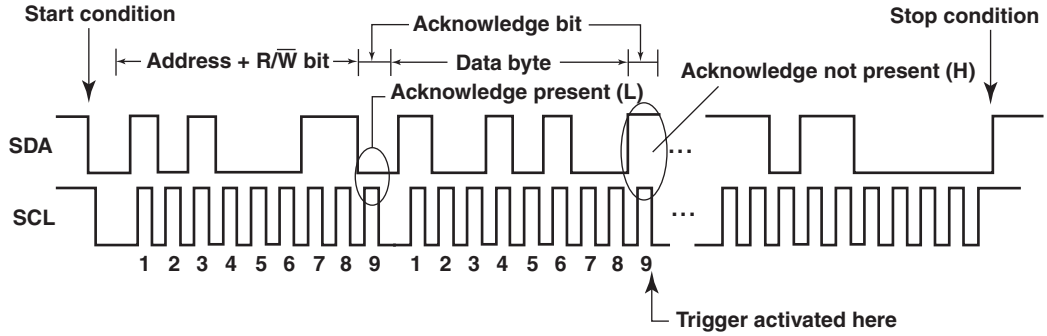
I^2C Trigger Type

You can select from the following three types.

- **START (Start Trigger)**
  When a Start condition is detected, a trigger is activated on the first falling edge of the SCL signal.

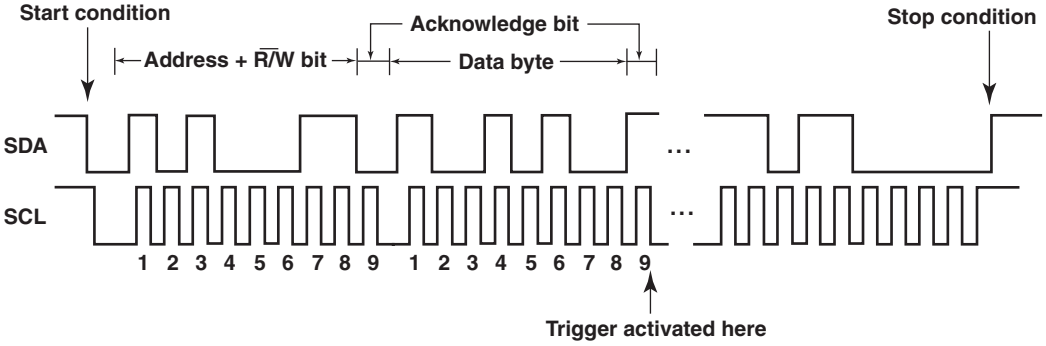


- **Non-ACK (Non-Ack Trigger)**
  When the Acknowledge bit is not present (when the SDA signal is set to “H”), a trigger is activated on the 9th falling edge of the SCL (clock) signal.



The Acknowledge bit of the start byte and Hs mode master code is not applicable.

- **ADRS (Address Trigger)**
  When the specified address and data pattern match, a trigger is activated on the 9th falling edge of the SCL (clock) signal.



Setting the Address Trigger

When the trigger type is set to “ADRS,” a trigger can be activated when the combination of the following three trigger conditions is met.

- Address Pattern: Set the 7-bit address and the R/W bit. A trigger is activated when the 7-bit address and the R/W bit matches the specified pattern.
- Data Pattern: Set an 8-bit data pattern. When the position is set to “First Byte,” compares to the byte immediately following the address and activates a trigger on a match. When the position is set to “Anywhere,” seaches until a match is found.

The trigger conditions can be specified using binary or hexadecimal values.
Determines whether the data matches the specified conditions in the following order: “Address Pattern,” and “Data Pattern.” When all conditions are met, a trigger is activated.
For the combination of settings, see section 1.4, “Trigger Setting Examples.”

Note

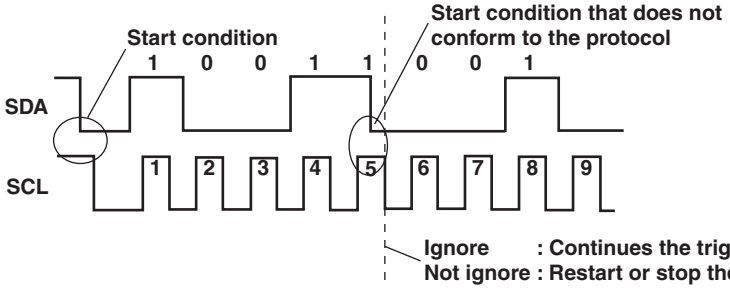
If there is at least one “X” bit in a group of four bits in the binary display, the corresponding hexadecimal display will show an “X.”

- **Setting the Data Pattern Condition**
  Select the condition from the following. The condition can be specified on Data1 Pattern and Data2 Pattern, separately.
  - True: Activates a trigger when the specified pattern is met.
  - False: Activates a trigger when the specified pattern is not met.

- **Setting the Data Pattern Posotion**
  You can select the location of the byte data for comparison with the data pattern.
  - First Byte: Compares with the first byte after the address.
  - Anywhere: Compares bytes after the address until a match is found.

- **Setting Whether to Ignore Restart Conditions**
  You can select whether to ignore the restart condition that occurs after starting the trigger detection upon detecting the Start condition.
  - Yes: Ignores the restart condition and continues with the trigger detection.
  - No: Restarts the trigger detection when a restart condition is detected.

- **Setting Whether to Ignore Start/Stop Conditions That Do Not Conform to the Protocol**
  You can select whether or not to ignore the start or stop condition that occurs in the middle of the address or data bit while detecting the trigger.
  - Yes: Ignores the start/stop condition and continues with the trigger detection.
  - No: Restarts or stops the trigger detection when a start/stop condition is detected.



Setting the Trigger Level, Hysteresis, Trigger Coupling, and HF Rejection

- **Setting the Trigger Level**

  Selectable range: 8 divisions within the screen

  Resolution: 0.01 divisions (For example, the resolution for 2 mV/div is 0.02 mV.)

- **Setting the Hysteresis**

  Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

  : Approximately 0.3 divisions* of hysteresis around the trigger level.

  : Approximately 1 division* of hysteresis around the trigger level.

  * The value above is an approximate value. It is not strictly warranted.

- **Setting the Trigger Coupling**

  Select the trigger coupling from the following.

  AC: Uses a signal that is obtained by removing the DC component from the trigger source signal.

  DC: Uses the trigger source signal as-is.

- **Setting the HF Rejection**

  Specify “ON” if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz) from the trigger source signal as the trigger source.

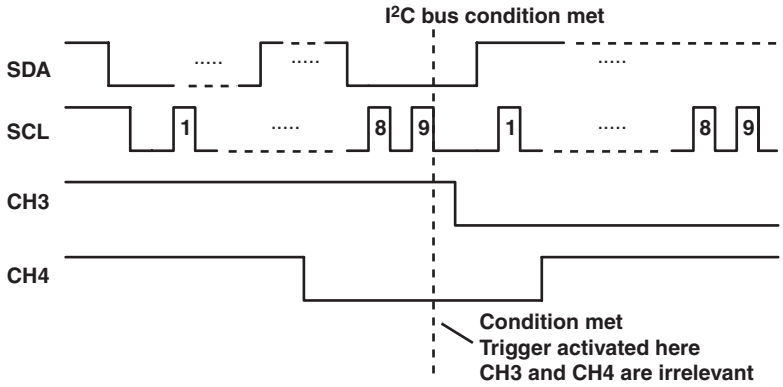
Combination Trigger (Combination)

A trigger can be activated on the combination of the trigger selected for the I^2C trigger type (I^2C bus trigger condition) and the CH3/CH4 trigger condition.

You can select from the following three types.

- **I2C Only**

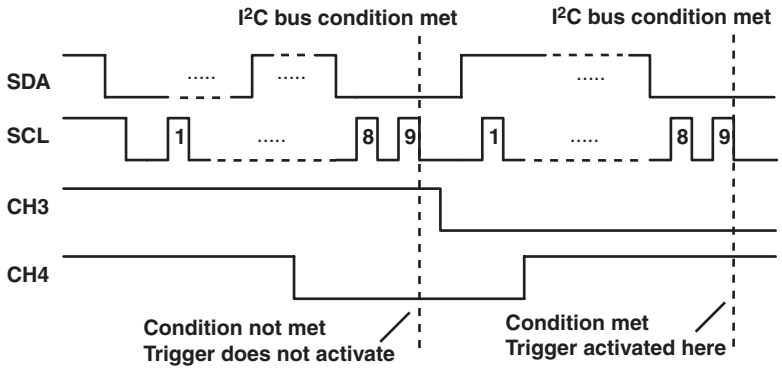
  This setting is used when activating the trigger based only on the SCL/SDA signal (the I^2C bus trigger condition).



- **I2C on Pattern**

  This setting is used when activating the trigger based on the SCL/SDA signal and CH3/CH4 pattern. The trigger is activated only when the I²C bus trigger condition is met while the CH3/CH4 trigger condition is met.

  CH3=L, CH4=H



  Setting the CH3 and CH4 Pattern

  H: The trigger source level is above the preset trigger level.

  L: The trigger source level is below the preset trigger level.

  X: Not used as the trigger source.

  Setting the Trigger Condition

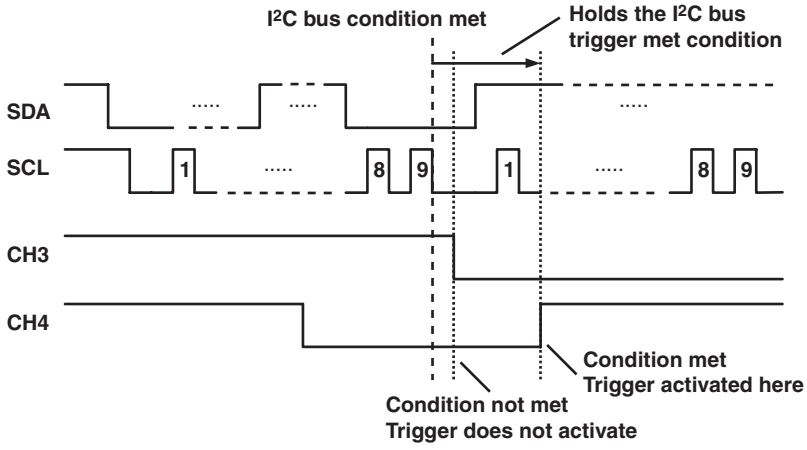
  True: Activates a trigger when the specified CH3/CH4 pattern is met.

  False: Activates a trigger when the specified CH3/CH4 pattern is no longer met.

- **I2C → Pattern**

  This setting is used when activating the trigger based on the SCL/SDA signal and a preset CH3/CH4 pattern. The SCL/SDA trigger met condition is held until the CH3/CH4 trigger condition is met.

  CH3=L, CH4=H, Enter



Setting the CH3 and CH4 Pattern

H: The trigger source level is above the preset trigger level.

L: The trigger source level is below the preset trigger level.

X: Not used as the trigger source.

Setting the Trigger Condition

Select the condition from the following.

Enter: Activates a trigger when the specified CH3/CH4 pattern is met.

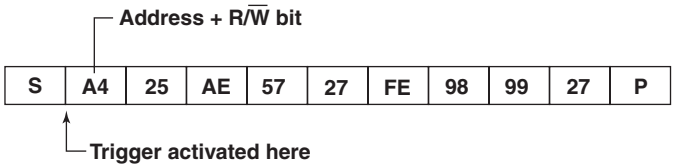
Exit: Activates a trigger when the specified CH3/CH4 pattern is no longer met.

1.4 Trigger Setting Examples

This section will display the data sequence in bytes (hexadecimal notation) and indicate the position where the trigger will occur. The following symbols will be used in the figures:

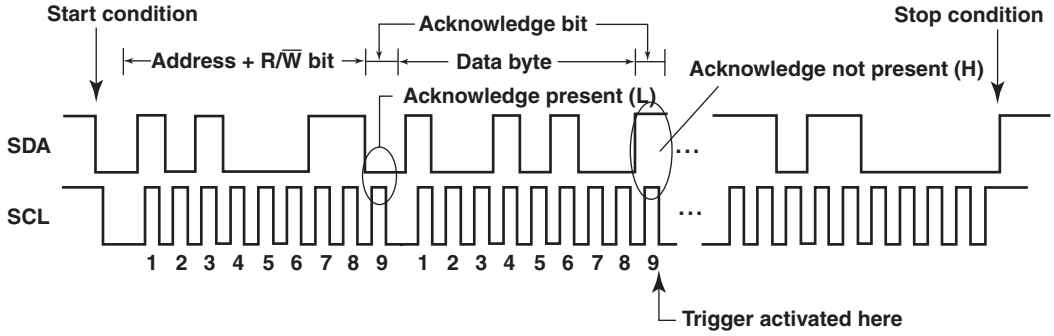
S: Start condition
Sr: Restart condition
P: Stop condition
Shaded area: Byte pattern to be compared

Start Trigger



Non-Ack Trigger

A trigger is activated when the Acknowledge bit is not present (when the SDA signal is set to “H”).



Note

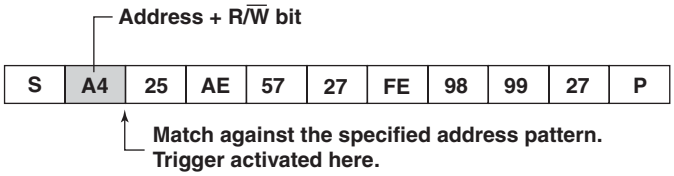
The Acknowledge bit of the start byte and Hs mode master code is not applicable.

Address Trigger

Trigger Only on the Address Pattern

Trigger Condition

Address Pattern:	A4
Data Pattern:	Not applicable
Condition:	True
Ignore the Restart Condition:	No
Ignore Unexpected Start/Stop Condition:	No

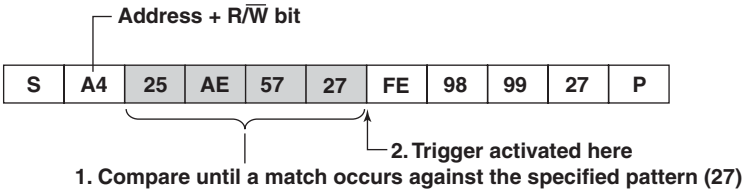


Trigger Only on the Data Pattern

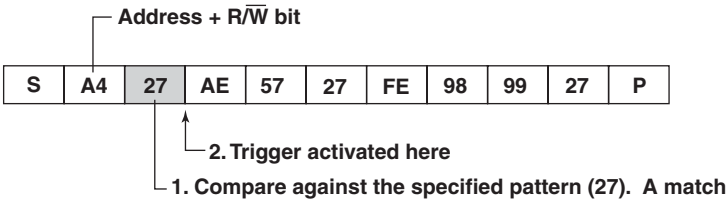
Trigger Condition

Address Pattern:	Not applicable
Data Pattern:	27
Condition:	True
Ignore the Restart Condition:	No
Ignore Unexpected Start/Stop Condition:	No

- **Position = Anywhere**



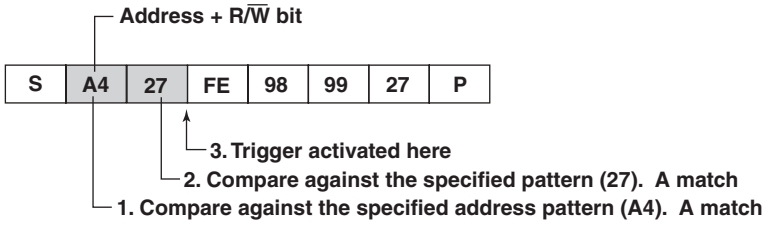
- **Position = First Byte**



Combination of Address Pattern, and Data Pattern

Trigger Condition

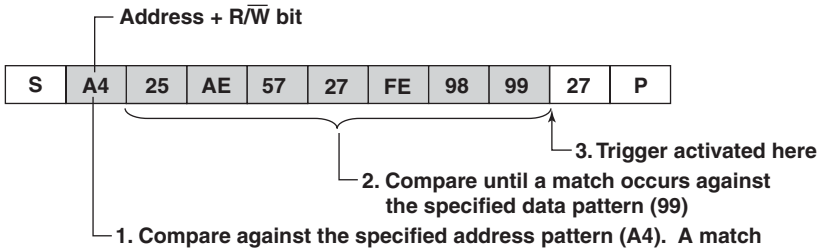
Address Pattern:	A4
Data Pattern:	27
Condition:	True
Ignore the Restart Condition:	No
Ignore Unexpected Start/Stop Condition:	No
Position:	First Byte



Combination of Address Pattern, Data Pattern, and Position = Anywhere

Trigger Condition

Address Pattern:	A4
Data Pattern:	99
Condition:	True
Ignore the Restart Condition:	No
Ignore Unexpected Start/Stop Condition:	No
Position:	Anywhere

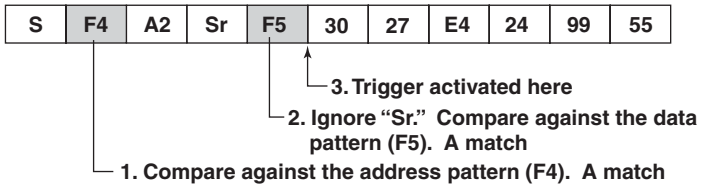


Whether to Ignore the Restart Condition

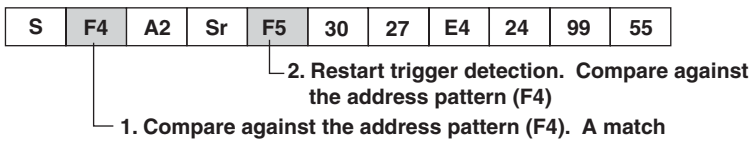
Trigger Condition

Address Pattern:	F4
Data Pattern:	F5
Condition:	True
Ignore Unexpected Start/Stop Condition:	No

- **When Ignore the Restart Condition = Yes**



- **When Ignore the Restart Condition = No**

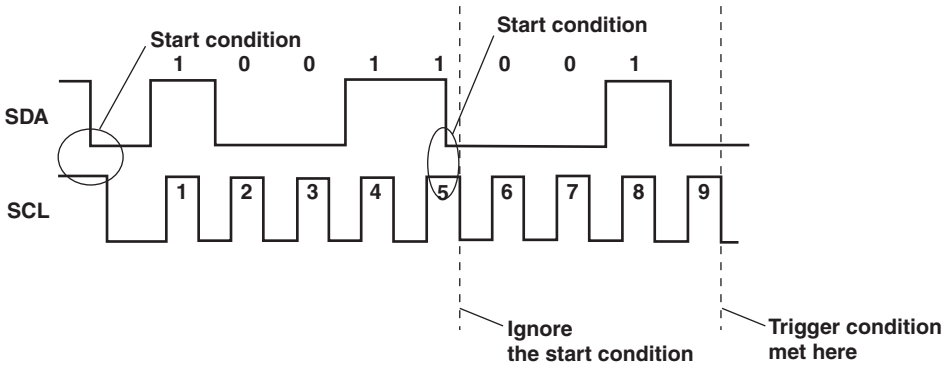


Whether to Ignore Start/Stop Conditions That Do Not Conform to the Protocol

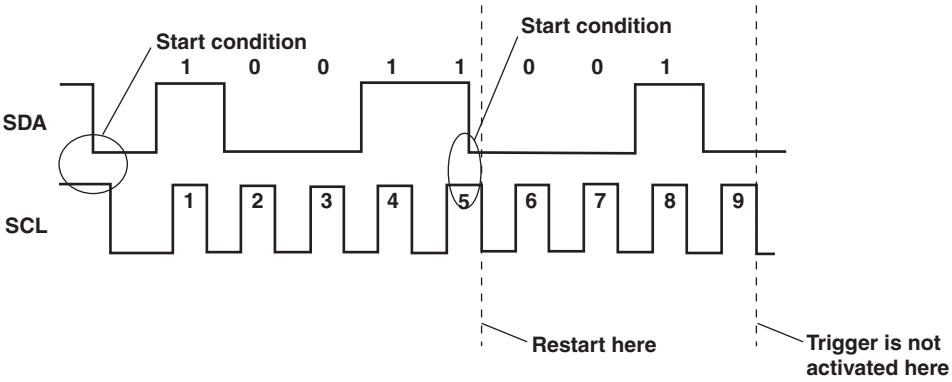
Trigger condition

Address Pattern:	99
Data Pattern:	Not applicable
Condition:	True
Ignore the Restart Condition:	No

- **When Ignore Unexpected Start/Stop Condition = Yes**

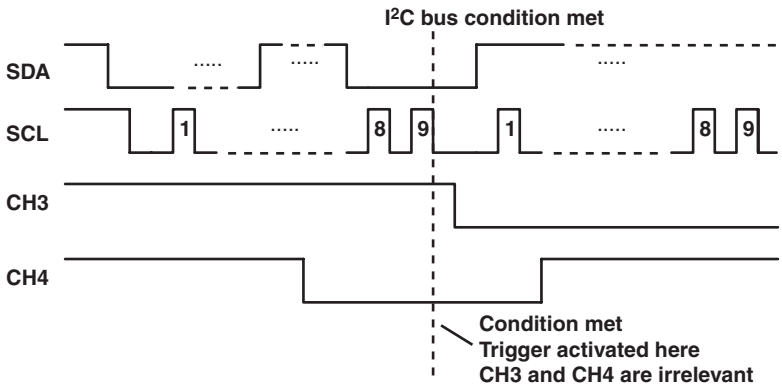


- **When Ignore Unexpected Start/Stop Condition = No**



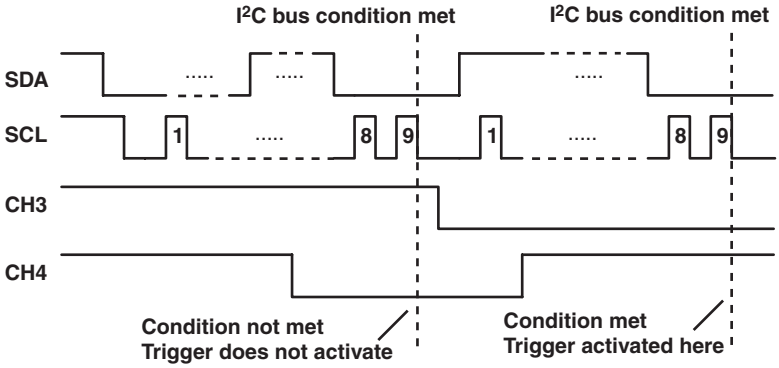
Combination Trigger

I2C Only



I2C on Pattern

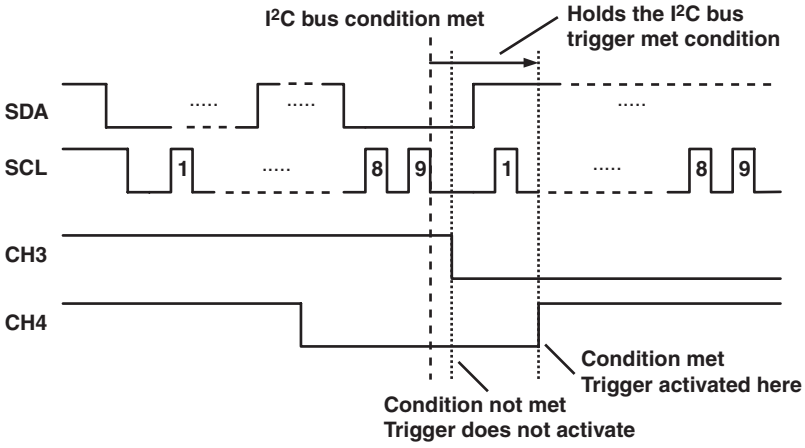
CH3=L, CH4=H



I2C → Pattern

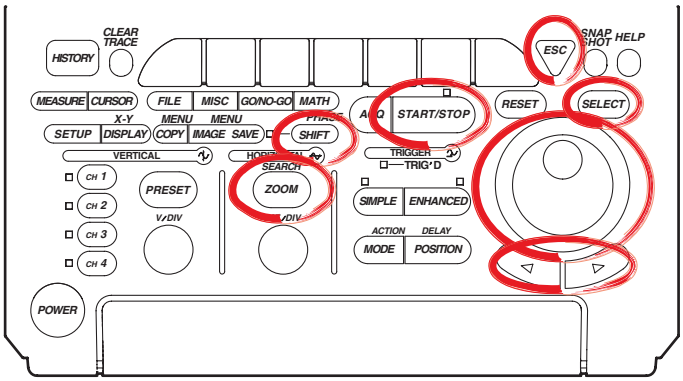
- **When the Clock Channel Is Set to "None"**

  CH3=L, CH4=H, Enter



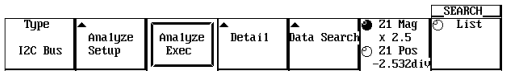
1.5 Analyzing/Searching Data

Relevant Keys



Procedure

1. Press **SHIFT** to set the keys in the shifted condition.
   Functions marked in purple on the panel become active.
2. Press **ZOOM**.
3. Press the **Type** soft key to display the analysis type selection menu.

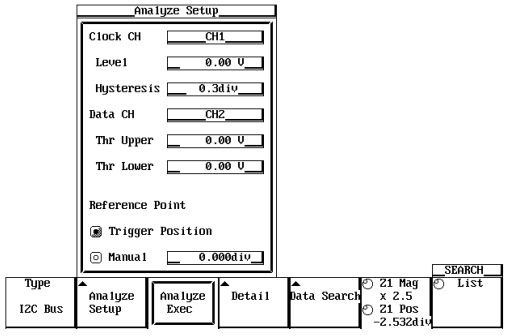


4. Press the **I2C Bus** soft key.

5. When waveform acquisition is in progress, press **START/STOP** to stop the operation.

Setting the Analysis Conditions

6. Press the **Analyze Setup** soft key. The Analyze Setup dialog box appears.



- **Setting the Clock Channel**
  7. Turn the jog shuttle to select Clock CH.
  8. Press **SELECT** to display the entry box.
  9. Turn the jog shuttle to select CH1 or CH3.
  10. Press **SELECT** or **ESC** to close the entry box. The setting will be confirmed.

  Setting the Level
  11. Turn the jog shuttle to select Level.
  12. Press **SELECT** to display the entry box.
  13. Turn the jog shuttle to set the value.
  14. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.

  Setting the Hysteresis
  15. Turn the jog shuttle to select Hysteresis.
  16. Set the hysteresis in a similar fashion as described in steps 12 through 14.

- **Setting the Data Channel**

  If you set the clock channel to CH1 in step 7, the data channel is CH2; if you set the clock channel to CH3, the data channel is CH4.
  17. Turn the jog shuttle to select Data CH.
  18. Press **SELECT** to display the entry box.
  19. Turn the jog shuttle to select CH2 or CH4.
  20. Press **SELECT** or **ESC** to close the entry box. The setting will be confirmed.

  Setting the Threshold Level
  21. Turn the jog shuttle to select Thr Upper.
  22. Press **SELECT** to display the entry box.
  23. Turn the jog shuttle to set the value.
  24. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.
  25. Set Thr Lower in a similar fashion as described in steps 21 through 24.

- **Setting the Reference Point**

  When Setting the Trigger Position to the Analysis Reference Point
  26. Turn the jog shuttle to select Trigger Position.
  27. Press **SELECT**. The button to the left of Trigger Position is highlighted and the analysis reference point is set to the trigger position.
      Press **ESC** to close the dialog box. Proceed to step 30.

  When Manually Setting the Analysis Reference Point
  26. Turn the jog shuttle to select Manual.
  27. Press **SELECT**. The button to the left of Manual is highlighted.
  28. Turn the jog shuttle to select the box to the right Manual.
  29. Set the value in a similar fashion as described in steps 12 through 14.
      Press **ESC** to close the dialog box. Proceed to step 30.

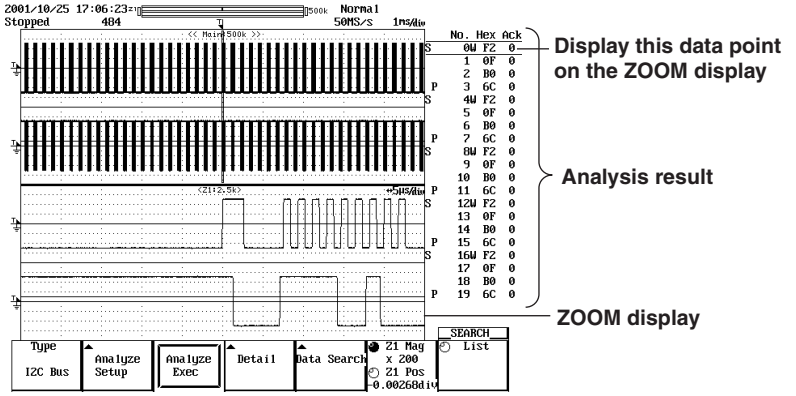
Note

If you set the display to translucent mode when manually setting the analysis reference point, you can set the analysis reference point while viewing the waveform display. For details on the translucent mode display, see section 8.7, "Turning Translucent Mode ON/OFF" in the *DL1620/DL1640/DL1640L User's Manual IM 701610-01E*.

Executing the Analysis

30. Press the **Analyze Exec** soft key. The waveform is analyzed, and the result is displayed on the right side of the screen.

If you select the analysis number by pressing the **List** soft key and turning the jog shuttle, the data corresponding to the selected analysis number is displayed expanded on the ZOOM display.

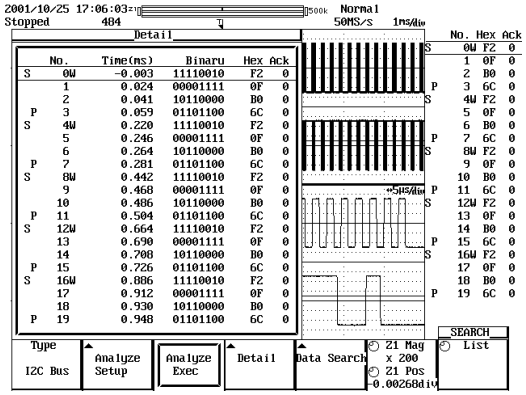


Note

If the analysis result contains indefinite data, "*" is displayed in the Data box.

Detailed Display of the Analysis Results

31. Press the **Detail** soft key. The detailed display of analysis results appears.



Press **ESC** to close the detailed display.

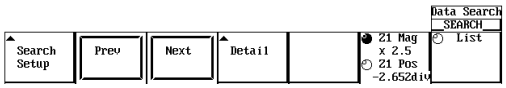
Note

- If you select the analysis number by turning the jog shuttle, the data corresponding to the selected analysis number is displayed expanded on the ZOOM display.
- The analysis number of the detailed display corresponds to the analysis number of the analysis result display on the right side of the screen.

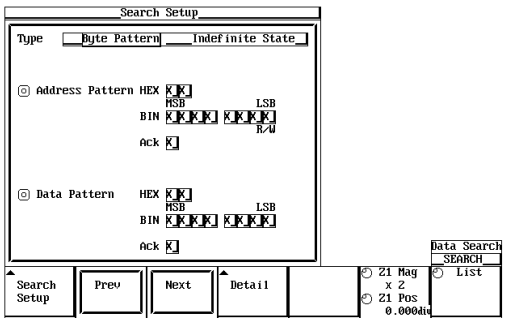
Setting the Search Conditions

32. Press the **Data Search** soft key.

33. Press the **Search Setup** soft key. The Search Setup dialog box appears.



34. Turn the jog shuttle to move the cursor to Type.



35. Press **SELECT** to select Byte Pattern or Indefinite State.

- **When Byte Pattern (Pattern Search) Is Selected**

  Setting the Address Pattern

  36. Turn the jog shuttle to select Address Pattern.
  37. Press **SELECT**. The button to the left of Address Pattern is highlighted.
  38. Turn the jog shuttle to move the cursor to the box you wish to set the Address Pattern.
  39. Press **SELECT** to display the entry box.
  40. Turn the jog shuttle to set the value. Bits set to “X” will not be used as a search condition. The search conditions can be specified using binary (BIN) or hexadecimal (HEX) values. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.
  41. Turn the jog shuttle to select Ack.
  42. Press **SELECT** to set the Ack to “X,” “1,” or “0”.

  Setting the Data Pattern

  43. Turn the jog shuttle to select Data Pattern.
  44. Set the data pattern in a similar fashion as described in steps 37 through 40. Press **ESC** to close the dialog box. Proceed to step 45.

Note

- When using binary (BIN) display, set the LSB of the address pattern using “R” (Read), “W” (Write), and “X.”
- When setting the pattern by using binary (BIN) display, the entry box is not displayed.

- **When Indefinite State (Indefinite Data Search) Is Selected**

  You do not have to set any items.

  Press **ESC** to close the dialog box. Proceed to step 45.

Executing the Search

45. Press the **Prev** soft key to search data existing before the current position. Press the **Next** soft key to search data existing after the current position. When a match is found in a pattern search, the corresponding data in the analysis result display on the right side of the screen is highlighted, and the ZOOM display moves accordingly. In an indefinite data search, Data of the analysis number in which indefinite data is present is highlighted.

Explanation

Analyzing Data

Setting the Analysis Conditions

Analyzes the data of CH2 or CH4 by setting CH1 or CH3 to a clock channel.

- **Setting the Clock Channel**

  Set the clock channel to CH1 or CH3. When the clock channel is set to CH1, the data channel is CH2; when the clock channel is set to CH3, the data channel is CH4.

  Setting the Level

  Set the level used to determine the rising or falling edge of the clock signal.
  Selectable range: 8 divisions within the screen
  Resolution: 0.01 divisions (For example, the resolution for 2 mV/div is 0.02 mV.)

  Setting the Hysteresis

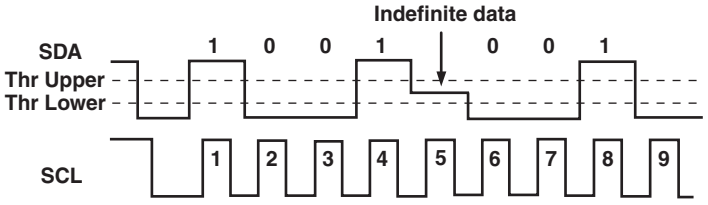
  Selectable range: 0.3 divisions to 4.0 divisions

- **Setting the Data Channel**

  Set the data channel to CH2 or CH4. When the data channel is set to CH2, the clock channel is CH1; when the data channel is set to CH4, the clock channel is CH3.

  Setting the Threshold Level

  Set the level used to determine the data channel signal level (0, 1, or indefinite).
  Thr Upper: Signal exceeding this level is determined to be 1.
  Thr Lower: Signal below this level is determined to be 0.
  If Thr Lower ≤ data signal level ≤ Thr Upper, the signal level is determined to be "indefinite data."
  If indefinite data is found, "*" is displayed in the hexadecimal display box at the byte where the indefinite data exists on the display screen of analysis results.



- **Setting the Reference Point**

  Select the reference point used to start the analysis from the following:
  Trigger Position: Set the reference point to the trigger position.
  Manual: Set the reference point in the range of –5 to 5 divisions.

Items to Be Analyzed

The following data can be analyzed:

- Historical data.
- Data that are displayed when the waveform acquisition is stopped.
- Loaded acquisition data (ACQ data).

Analysis is performed only on the waveform selected by “Select Record” for historical data.

Analysis Range

Analysis is performed on the acquisition data within the display screen. Up to 40000 bytes of the analysis results can be displayed. The displayed result varies depending on the number of bytes analyzed as follows:

- When the total analysis result is less than or equal to 40000 bytes
  All points are displayed regardless of the position of the Reference Point.
- When the total analysis result is greater than 40000 bytes
  The displayed result varies depending on the number of analysis results on the Pre* and Post* sides as follows:
  - When the Pre side = 30000 and the Post side = 30000 → Pre side = 20000 and Post side = 20000
  - When the Pre side = 10000 and the Post side = 50000 → Pre side = 10000 and Post side = 30000
  - When the Pre side = 50000 and the Post side = 10000 → Pre side = 30000 and Post side = 10000

  * Pre: Start from the reference point and display back (to the left)
    Post: Start from the reference point and display forward (to the right)

Notes When Performing Analysis

- Analysis and search cannot be performed while the waveform acquisition is started.
- Analysis and search cannot be performed on accumulated waveforms.

Executing the Analysis

When analysis is performed, the results are listed on the right side of the screen.

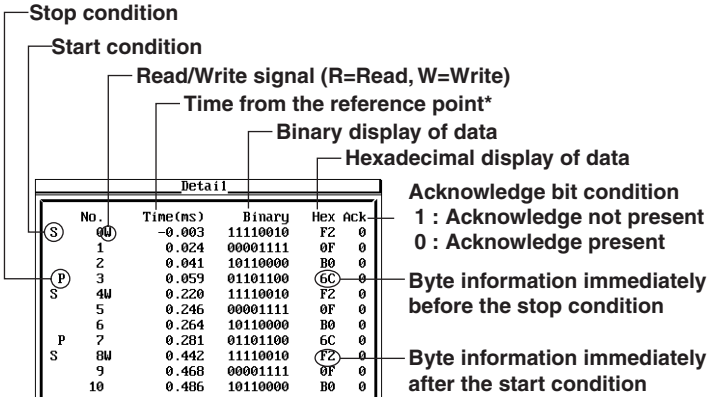
- **List of Analysis Results**
  The following items are displayed.
  No.: Up to 40000 points can be displayed.
  Hex: The analyzed data is displayed using hexadecimal notation. However, if a byte of data is less than 8 bits, the data is not displayed. If indefinite data exists, “*” is displayed. Indefinite data is considered the same value as the previous bit for the analysis. If the first data is indefinite, it is considered 0 for the analysis.
  Ack: Displays the Acknowledge bit condition.

Note

If you execute the analysis and select (highlight) an arbitrary byte in the list of analysis results, the Zoom Position moves to the head of that byte. In addition, if you move the Zoom Position, the highlighting moves to the corresponding byte in the list of analysis results.

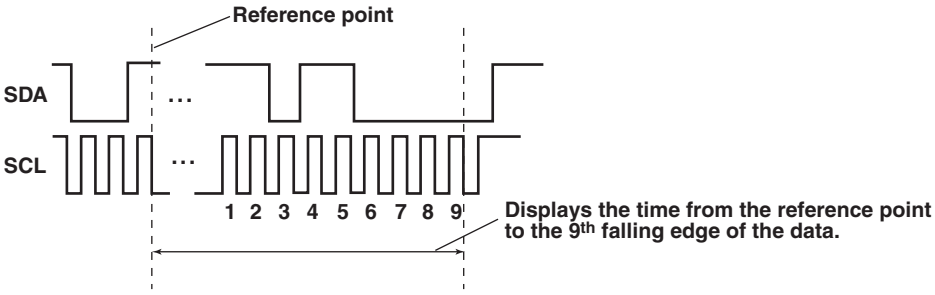
Detailed Display of the Analysis Results

The figure below shows the detailed display of the analysis results.



In the detailed display screen, the data corresponding to the specified number is highlighted. In the waveform display screen, the data corresponding to the specified number is displayed in the ZOOM display.

*** About the Time(ms) Display**



Searching Data

Setting the Search Conditions

- **Pattern Search (Byte Pattern)**
  Set the byte pattern to be searched in binary or hexadecimal notation. You can set the address pattern, data pattern, and Acknowledge bit condition. Bits set to “X” are not searched.

Note

If there is at least one “X” bit in a group of four bits in the binary display, the corresponding hexadecimal display will show an “X.”

- **Indefinite Data Search (Indefinite State)**
  Searches indefinite data from the analysis result. You cannot perform a pattern search and an indefinite data search simultaneously.

Note

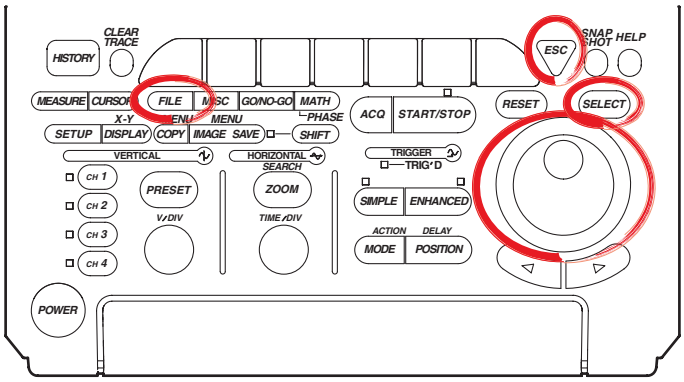
Indefinite data is always considered matched to the specified status.

Executing the Search

Searches data that matches the specified search condition in forward (Prev) and reverse (Next) directions. When the data matches the search pattern, the corresponding data in the detailed analysis display on the right side of the screen is highlighted. In addition, the matched data is displayed expanded in the ZOOM display.

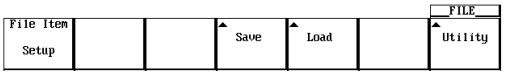
1.6 Saving the Detailed Analysis Results

Relevant Keys

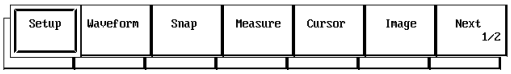


Procedure

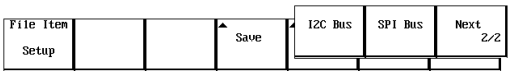
1. Press **FILE**.
2. Press the **File Item** soft key. The File Item selection menu appears.



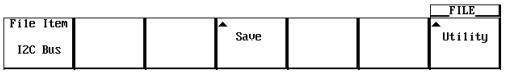
3. Press the **Next 1/2** soft key to display the Next 2/2 menu.



4. Press the **I2C Bus** soft key.



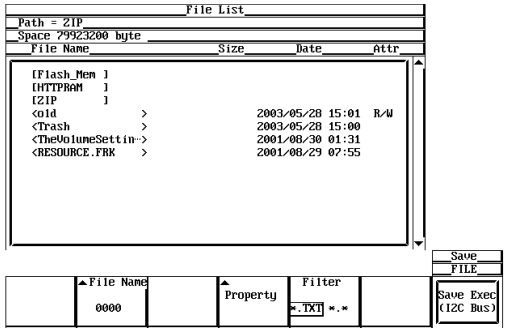
5. Press the **Save** soft key.



Selecting Save Destination Medium

6. Press the **File List** soft key. The File List box appears.

7. Turn the jog shuttle to select the save destination medium (indicated by [ ]).



8. Press **SELECT** to confirm the new medium.

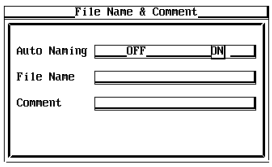
Select the Destination Directory

(Perform this operation when directories are present on the medium.)

9. Turn the jog shuttle to select the save destination directory (indicated by < >).
10. Press **SELECT** to confirm the new directory.
    The selected medium/directory is displayed in “Path=.....” located above and to the left of the File List menu.
    Select <..> to move to the parent directory.

Setting the File Name

11. Press the **File Name** soft key. The File Name & Comment dialog box appears.
12. Turn the jog shuttle to move the cursor to the Auto Naming box.



13. Press **SELECT** to select ON or OFF.
14. Turn the jog shuttle to move the cursor to the File Name box.
15. Press **SELECT**. A keyboard appears.
16. Enter the file name according to section 4.1, “Entering Values and Character Strings” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*.
    Press **ESC** to close the dialog box.

Note

Comments are not saved along with detailed analysis results so it is not necessary to enter any.

Executing the Save Operation

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 an Abort soft key.

Aborting the Save Operation

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to a Save Exec soft key.

Specifying the Files to Be Displayed in the File List Menu and Displaying Properties

19. On the display showing the File List menu, press the **Filter** soft key to select *.TXT or *.*.
20. Turn the jog shuttle to select the files in the File List menu.
21. Press the **Property** soft key. The property box about the selected file is displayed.
    Press **ESC** to close the box.

Explanation

Saving the Detailed Analysis Results

You can store the analysis results of the I^2C bus signal to the storage medium that is selected in the FILE menu in ASCII format.

Extension: .txt

Data size: (Number of analysis results × 47) + 47 bytes

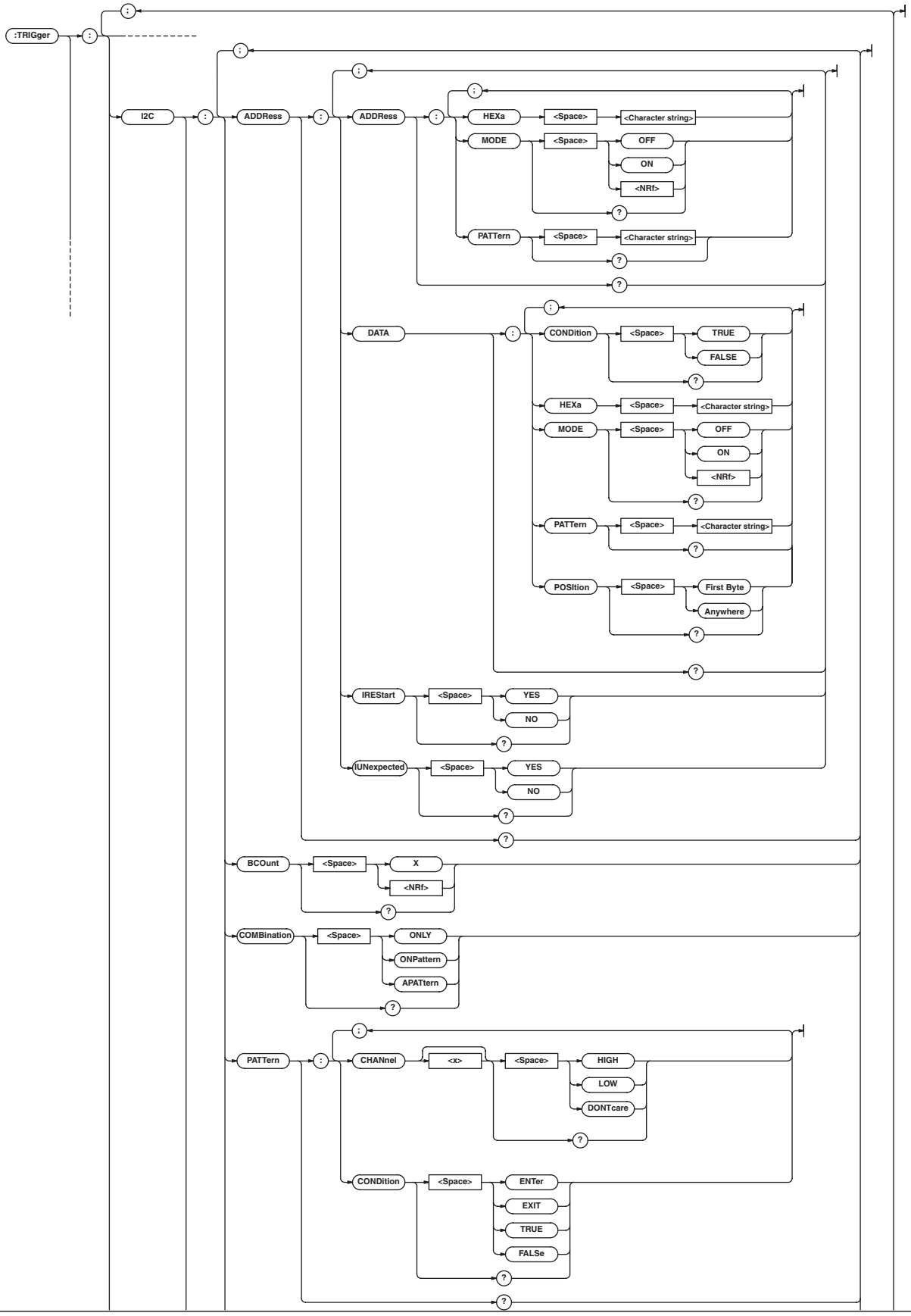
1.7 Communication Commands

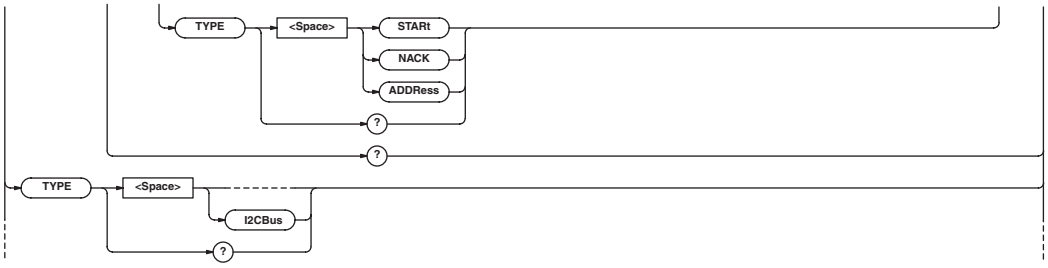
Command	Function	Page
I²C Trigger Group		
:TRIGger:I2C?	Queries all settings related to the I²C trigger.	1-31
:TRIGger:I2C:ADDRess?	Queries all settings when the I²C trigger type is set to Address&Data.	1-31
:TRIGger:I2C:ADDRess:ADDRess?	Queries all settings related to the Address pattern when the I²C trigger type is set to Address&Data.	1-31
:TRIGger:I2C:ADDRess:ADDRess:HEXa	Sets the Address pattern in hexadecimals when the I²C trigger type is set to Address&Data.	1-31
:TRIGger:I2C:ADDRess:ADDRess:MODE	Sets the valid/invalid setting of the Address pattern when the I²C trigger type is set to Address&Data or queries the current setting.	1-31
:TRIGger:I2C:ADDRess:ADDRess:PATTern	Sets the Address pattern in binary when the I²C trigger type is set to Address&Data or queries the current setting.	1-31
:TRIGger:I2C:ADDRess:DATA?	Queries all settings related to the Data pattern when the I²C trigger type is set to Address&Data.	1-31
:TRIGger:I2C:ADDRess:DATA:CONDition	Sets the trigger condition of the Data pattern when the I²C trigger type is set to Address&Data or queries the current setting.	1-32
:TRIGger:I2C:ADDRess:DATA:HEXa	Sets the Data pattern in hexadecimals when the I²C trigger type is set to Address&Data.	1-32
:TRIGger:I2C:ADDRess:DATA:MODE	Sets the valid/invalid setting of the Data pattern when the I²C trigger type is set to Address&Data or queries the current setting.	1-32
:TRIGger:I2C:ADDRess:DATA:PATTern	Sets the Data pattern in binary when the I²C trigger type is set to Address&Data or queries the current setting.	1-32
:TRIGger:I2C:ADDRess:DATA:POSItion	Sets the comparison position of the Data Pattern when the I²C trigger type is set to Address&Data.	1-32
:TRIGger:I2C:ADDRess:IREStart	I²C Sets whether to ignore the restart condition (YES/NO) of the Address trigger condition or queries the current setting.	1-32
:TRIGger:I2C:ADDRess:IUNexpected	I²C Sets whether to ignore the start/stop conditions (YES/NO) that do not conform to the protocol of the Address trigger condition or queries the current setting.	1-32
:TRIGger:I2C:COMBination	Sets the I²C trigger combination or queries the current setting.	1-32
:TRIGger:I2C:PATTern?	Queries all settings related to the I²C trigger pattern setting.	1-32
:TRIGger:I2C:PATTern:CHANnel<x>	Sets the channel condition of the I²C trigger pattern condition or queries the current setting.	1-33
:TRIGger:I2C:PATTern:CONDition	Sets the trigger condition of the I²C trigger pattern condition or queries the current setting.	1-33
:TRIGger:I2C:TYPE	Sets the I²C trigger type or queries the current setting.	1-33
:TRIGger:TYPE	Sets the trigger type or queries the current setting.	1-33
I²C Analyze Group		
:SEARch:I2C?	Queries all settings related to the I²C analysis function.	1-35
:SEARch:I2C:ANALyze?	Queries all settings related to the I²C analysis execution.	1-35
:SEARch:I2C:ANALyze:ABORt	Aborts the I²C analysis execution.	1-35
:SEARch:I2C:ANALyze:EXECute	Executes the I²C analysis.	1-35
:SEARch:I2C:ANALyze:SETup?	Queries all settings related to the I²C analysis condition.	1-35
:SEARch:I2C:ANALyze:SETup:CLOCk?	Queries all settings related to the clock channel of the I²C analysis condition.	1-35

Command	Function	Page
:SEARch:I2C:ANALyze:SETup:CLOCk:HYSTeresis	Sets the clock channel hysteresis of the I²C analysis condition or queries the current setting.	1-35
:SEARch:I2C:ANALyze:SETup:CLOCk:LEVel	Sets the clock channel level of the I²C analysis condition or queries the current setting.	1-36
:SEARch:I2C:ANALyze:SETup:CLOCk:SOURce	Sets the clock channel source waveform of the I²C analysis condition or queries the current setting.	1-36
:SEARch:I2C:ANALyze:SETup:DATA?	Queries all settings related to the data channel of the I²C analysis condition.	1-36
:SEARch:I2C:ANALyze:SETup:DATA:LEVel	Sets the data channel threshold level of the I²C analysis condition or queries the current setting.	1-36
:SEARch:I2C:ANALyze:SETup:DATA:SOURce	Sets the data channel source waveform of the I²C analysis condition or queries the current setting.	1-36
:SEARch:I2C:ANALyze:SETup:MPOSition	Sets the reference position when the I²C reference position is set to manual or queries the current setting.	1-36
:SEARch:I2C:ANALyze:SETup:RPOint	Sets the reference position when the I²C reference position is set to manual or queries the current setting.	1-36
:SEARch:I2C:LIST? {<NRf>}	Outputs one byte of I²C analysis result as a character string.	1-36
:SEARch:I2C:SEARch?	Queries all settings related to the I²C analysis result search.	1-37
:SEARch:I2C:SEARch:ADDRess?	Queries all settings related to the Address search of the I²C analysis result.	1-37
:SEARch:I2C:SEARch:ADDRess:ACK	Sets the Ack condition of the Address search of the I²C analysis result or queries the current setting.	1-37
:SEARch:I2C:SEARch:ADDRess:HEXa	Sets the searched Address pattern of the I²C analysis result in hexadecimal.	1-37
:SEARch:I2C:SEARch:ADDRess:MODE	Sets the valid/invalid setting of the Address pattern when searching the I²C analysis result or queries the current setting.	1-37
:SEARch:I2C:SEARch:ADDRess:PATTern	Sets the searched Address pattern of the I²C analysis result in binary or queries the current setting.	1-37
:SEARch:I2C:SEARch:DATA?	Queries all settings related to the Data search of the I²C analysis result.	1-37
:SEARch:I2C:SEARch:DATA:ACK	Sets the Ack condition of the Data search of the I²C analysis result or queries the current setting.	1-37
:SEARch:I2C:SEARch:DATA:HEXa	Sets the searched Data pattern of the I²C analysis result in hexadecimal.	1-37
:SEARch:I2C:SEARch:DATA:MODE	Sets the valid/invalid setting of the Data pattern when searching the I²C analysis result or queries the current setting.	1-37
:SEARch:I2C:SEARch:DATA:PATTern	Sets the searched Data pattern of the I²C analysis result in binary or queries the current setting.	1-38
:SEARch:I2C:SEARch:NEXT?	Performs the I²C analysis result search after the current byte and returns the search position.	1-38
:SEARch:I2C:SEARch:PREVious?	Performs the I²C analysis result search before the current byte and returns the search position.	1-38
:SEARch:I2C:SEARch:TYPE	Sets the type of I²C analysis result search or queries the current setting.	1-38
:SEARch:TYPE	Sets the search type or queries the current setting.	1-38
I²C File Group		
:FILE:SAVE:I2C[:EXECute]	Executes the save operation of the I²C analysis result. This is an overlap command.	1-38
:FILE:SAVE:I2C:ABORt	Aborts the save operation of the I²C analysis result.	1-38

I²C Trigger Group

Commands in the I²C Trigger group can be used to make the same settings and inquiries as when the I²C bus menu under the ENHANCED key on the front panel is used.





:TRIGger:I2C?

Function Queries all settings related to the I²C trigger.

Syntax :TRIGger:I2C?

Example :TRIGGER:I2C? -> :TRIGGER:I2C:
TYPE START;ADDRESS:ADDRESS:MODE 0;
PATTERN "X0X10X10";:TRIGGER:I2C:
ADDRESS:DATA:MODE 0;
PATTERN "10X10X10";CONDITION
FALSE;POSITION FIRSTBYTE;:
TRIGGER:I2C:ADDRESS:IRESTART NO;
IUNEXPECTED NO;:TRIGGER:I2C:PATTERN:
CLOCK NONE;CHANNEL3 DONTCARE;
CHANNEL4 DONTCARE;CONDITION ENTER

:TRIGger:I2C:ADDRess?

Function Queries all settings when the I²C trigger type is set to Address&Data.

Syntax :TRIGger:I2C:ADDRess?

Example :TRIGGER:I2C:ADDRESS? -> :TRIGGER:
I2C:ADDRESS:ADDRESS:MODE 0;
PATTERN "X0X10X10";:TRIGGER:I2C:
ADDRESS:DATA:MODE 0;
PATTERN "10X10X10";CONDITION
FALSE;POSITION FIRSTBYTE;:
TRIGGER:I2C:ADDRESS:IRESTART NO;
IUNEXPECTED NO

:TRIGger:I2C:ADDRess:ADDRess?

Function Queries all settings related to the Address pattern when the I²C trigger type is set to Address&Data.

Syntax :TRIGger:I2C:ADDRess:ADDRess?

Example :TRIGGER:I2C:ADDRESS:ADDRESS? ->
:TRIGGER:I2C:ADDRESS:ADDRESS:MODE 0;
PATTERN "X0X10X10"

:TRIGger:I2C:ADDRess:ADDRess:HEXa

Function Sets the Address pattern in hexadecimals when the I²C trigger type is set to Address&Data.

Syntax :TRIGger:I2C:ADDRess:ADDRess:HEXa
{<string>}
<string>=2 characters by combining
'0' to 'F' and 'X'

Example :TRIGGER:I2C:ADDRESS:ADDRESS:
HEXA "1A"

:TRIGger:I2C:ADDRess:ADDRess:MODE

Function Sets the valid/invalid setting of the Address pattern when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax :TRIGger:I2C:ADDRess:ADDRess:MODE
{<Boolean>}
:TRIGger:I2C:ADDRess:ADDRess:MODE?

Example :TRIGGER:I2C:ADDRESS:ADDRESS:MODE ON
:TRIGGER:I2C:ADDRESS:ADDRESS:MODE?
-> :TRIGGER:I2C:ADDRESS:ADDRESS:
MODE 1

:TRIGger:I2C:ADDRess:ADDRess:PATTern

Function Sets the Address pattern in binary when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax :TRIGger:I2C:ADDRess:ADDRess:PATTern
{<string>}
:TRIGger:I2C:ADDRess:ADDRess:
PATTern?
<string>=8 characters by combining '0,'
'1,' and 'X'
(The 8th character is the R/W bit.)

Example :TRIGGER:I2C:ADDRESS:ADDRESS:
PATTERN "X0X10X10"
:TRIGGER:I2C:ADDRESS:ADDRESS:
PATTERN? -> :TRIGGER:I2C:ADDRESS:
ADDRESS:PATTERN "X0X10X10"

:TRIGger:I2C:ADDRess:DATA?

Function Queries all settings related to the Data pattern when the I²C trigger type is set to Address&Data.

Syntax :TRIGger:I2C:ADDRess:DATA?

Example :TRIGGER:I2C:ADDRESS:DATA? ->
:TRIGGER:I2C:ADDRESS:DATA:MODE 0;
PATTERN "10X10X10";CONDITION FALSE

:TRIGger:I2C:ADDRess:DATA:CONDition

Function Sets the trigger condition of the Data pattern when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:DATA:
CONDition {TRUE|FALSE}
:TRIGger:I2C:ADDRess:DATA:
CONDition?
```

Example
```
:TRIGGER:I2C:ADDRESS:DATA:
CONDITION TRUE:
TRIGGER:I2C:ADDRESS:DATA:
CONDITION? -> :TRIGGER:I2C:ADDRESS:
DATA:CONDITION TRUE
```

:TRIGger:I2C:ADDRess:DATA:HEXa

Function Sets the Data pattern in hexadecimals when the I²C trigger type is set to Address&Data.

Syntax
```
:TRIGger:I2C:ADDRess:DATA:HEXa
{<string>}
<string>=2 characters by combining
‘0’ to ‘F’ and ‘X’
```

Example
```
:TRIGGER:I2C:ADDRESS:DATA:HEXA “2B”
```

:TRIGger:I2C:ADDRess:DATA:MODE

Function Sets the valid/invalid setting of the Data pattern when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:DATA:MODE
{<Boolean>}
:TRIGger:I2C:ADDRess:DATA:MODE?
```

Example
```
:TRIGGER:I2C:ADDRESS:DATA:MODE ON
:TRIGGER:I2C:ADDRESS:DATA:MODE? ->
:TRIGGER:I2C:ADDRESS:DATA:MODE 1
```

:TRIGger:I2C:ADDRess:DATA:PATTern

Function Sets the Data pattern in binary when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:DATA:PATTern
{<string>}
:TRIGger:I2C:ADDRess:DATA:
PATTern?
<string>=8 characters by combining
‘0,’ ‘1,’ and ‘X’
```

Example
```
:TRIGGER:I2C:ADDRESS:DATA:PATTERN
“10X10X10”
:TRIGGER:I2C:ADDRESS:DATA:PATTERN? ->
:TRIGGER:I2C:ADDRESS:DATA:
PATTERN “10X10X10”
```

:TRIGger:I2C:ADDRess:DATA:POSItion

Function Sets the comparison position of the Data pattern when the I²C trigger type is set to Address&Data or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:DATA:POSItion
{FIRStbyte|ANYWhere}
```

Example
```
:TRIGGER:I2C:ADDRESS:DATA:POSITION
FIRSTBYTE:
:TRIGGER:I2C:ADDRESS:DATA:POSITION?
-> :TRIGGER:I2C:ADDRESS:DATA:
POSITION FIRSTBYTE
```

:TRIGger:I2C:ADDRess:IREStart

Function I²C Sets whether to ignore the restart condition (YES/NO) of the Address trigger condition or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:IREStart
{YES|NO}
:TRIGger:I2C:ADDRess:IREStart?
```

Example
```
:TRIGGER:I2C:ADDRESS:IRESTART YES
:TRIGGER:I2C:ADDRESS:IRESTART? ->
:TRIGGER:I2C:ADDRESS:IRESTART YES
```

:TRIGger:I2C:ADDRess:IUNexpected

Function I²C Sets whether to ignore the start/stop conditions (YES/NO) that do not conform to the protocol of the Address trigger condition or queries the current setting.

Syntax
```
:TRIGger:I2C:ADDRess:IUNexpected
{YES|NO}
:TRIGger:I2C:ADDRess:IUNexpected?
```

Example
```
:TRIGGER:I2C:ADDRESS:IUNEXPECTED YES
:TRIGGER:I2C:ADDRESS:IUNEXPECTED? ->
:TRIGGER:I2C:ADDRESS:IUNEXPECTED YES
```

:TRIGger:I2C:COMBination

Function Sets the I²C trigger combination or queries the current setting.

Syntax
```
:TRIGger:I2C:COMBination {ONLY|
ONPattern|APATtern}
:TRIGger:I2C:COMBination?
```

Example
```
:TRIGGER:I2C:COMBIMATION ONLY
:TRIGGER:I2C:COMBIMATION? ->
:TRIGGER:I2C:COMBIMATION ONLY
```

:TRIGger:I2C:PATTern?

Function Queries all settings related to the I²C trigger pattern setting.

Syntax
```
:TRIGger:I2C:PATTern?
```

Example
```
:TRIGGER:I2C:PATTERN? -> :TRIGGER:
I2C:PATTERN:CHANNEL3
DONTCARE;CHANNEL4 DONTCARE;
CONDITION ENTER
```

:TRIGger:I2C:PATTern:CHANnel<x>

Function Sets the channel condition of the I²C trigger pattern condition or queries the current setting.

Syntax
```
:TRIGger:I2C:PATTern:CHANnel {HIGH|LOW|DONTcare}
:TRIGger:I2C:PATTern:CHANnel?
<x>=3, 4
```

Example
```
:TRIGGER:I2C:PATTERN:CHANNEL3 HIGH
:TRIGGER:I2C:PATTERN:CHANNEL3? ->
:TRIGGER:I2C:PATTERN:CHANNEL3 HIGH
```

:TRIGger:I2C:PATTern:CONDition

Function Sets the trigger condition of the I²C trigger pattern condition or queries the current setting.

Syntax
```
:TRIGger:I2C:PATTern:CONDition {ENTer|EXIT|TRUE|FALSe}
:TRIGger:I2C:PATTern:CONDition?
```

Example
```
:TRIGGER:I2C:PATTERN:CONDITION ENTER
:TRIGGER:I2C:PATTERN:CONDITION? ->
:TRIGGER:I2C:PATTERN:CONDITION ENTER
```

:TRIGger:I2C:TYPE

Function Sets the I²C trigger type or queries the current setting.

Syntax
```
:TRIGger:I2C:TYPE {STARt|NACK|ADDRess}
:TRIGger:I2C:TYPE?
```

Example
```
:TRIGGER:I2C:TYPE START
:TRIGGER:I2C:TYPE? -> :TRIGGER:I2C:TYPE START
```

:TRIGger:TYPE

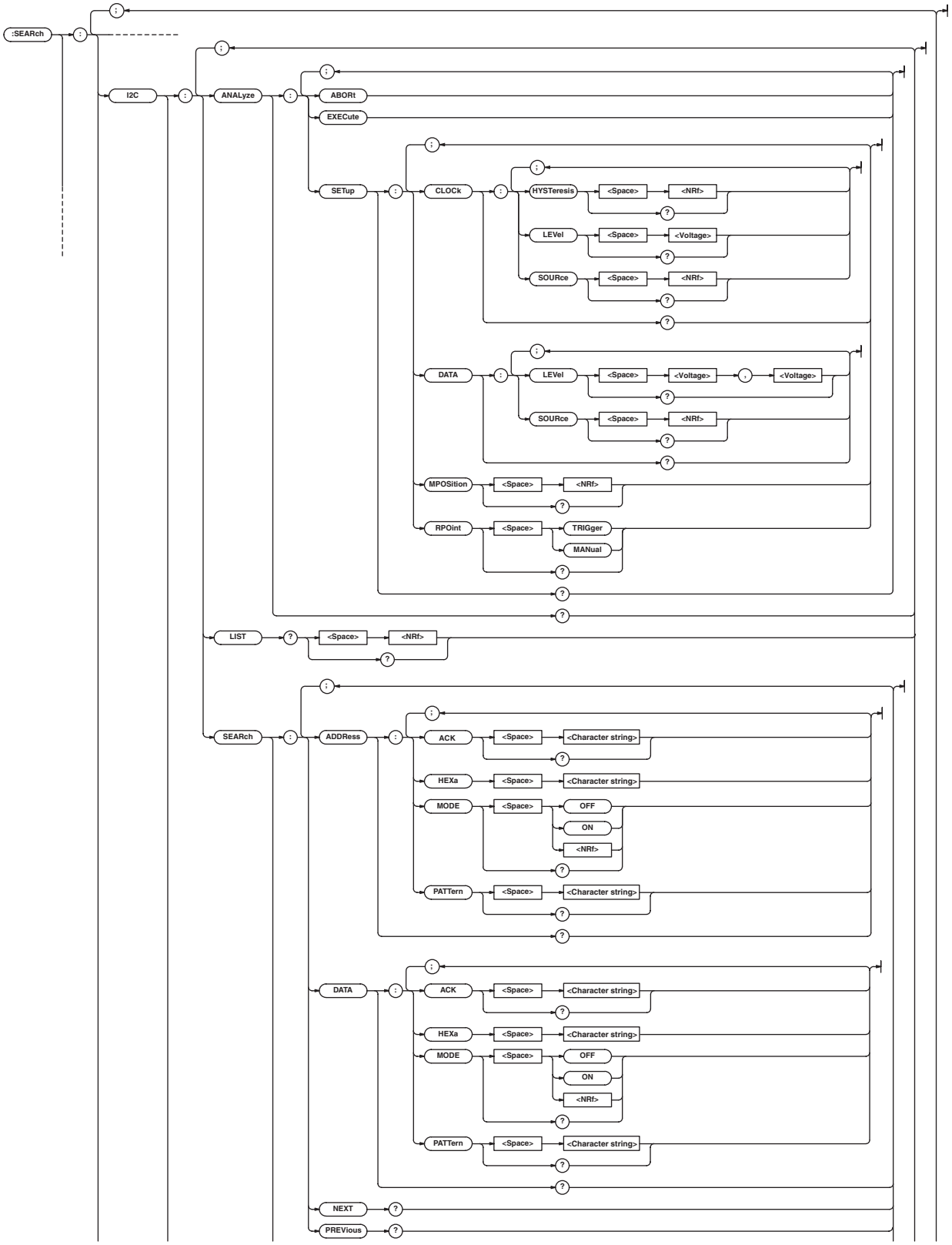
Function Sets the trigger type or queries the current setting.

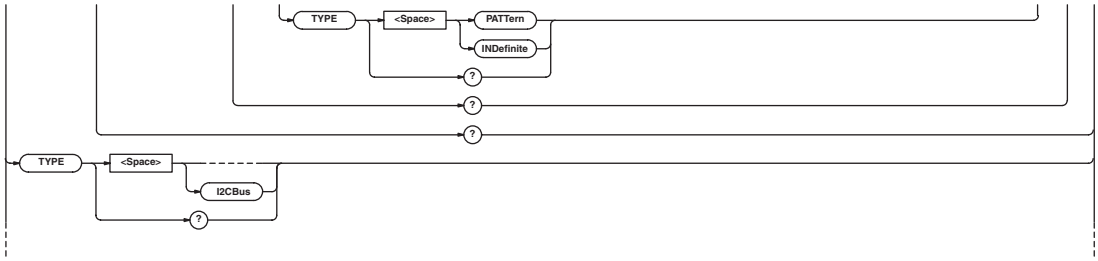
Syntax
```
:TRIGger:TYPE {ABN|ADB|PATTern|WIDTh|OR|TV|SIMPle|I2CBus}
:TRIGger:TYPE?
```

Example
```
:TRIGGER:TYPE I2CBUS
:TRIGGER:TYPE? -> :TRIGGER:TYPE I2CBUS
```

I²C Analyze Group

Commands in the I²C Analyze group can be used to make the same settings, inquiries, and executions as when the I²C bus menu under the SHIFT + ZOOM key on the front panel is used.





:SEARch:I2C?

Function Queries all settings related to the I²C analysis function.

Syntax :SEARch:I2C?

Example :SEARCH:I2C? -> :SEARCH:I2C:ANALYZE:SETUP:CLOCK:SOURCE 1;LEVEL 1.000E+00;HYSTERESIS 0.3;:SEARCH:I2C:ANALYZE:SETUP:DATA:SOURCE 2;LEVEL 1.000E+00,0.000E+00;:SEARCH:I2C:ANALYZE:SETUP::RPOINT TRIGGER;MPOSITION -4.00000;:SEARCH:I2C:SEARCH:TYPE PATTERN;ADDRESS:MODE 1;PATTERN "X0X10X10";ACK "X";:SEARCH:I2C:SEARCH:DATA:MODE 1;PATTERN "10X10X10";ACK "X"

:SEARch:I2C:ANALyze?

Function Queries all settings related to the I²C analysis execution.

Syntax :SEARch:I2C:ANALyze?

Example :SEARCH:I2C:ANALYZE? -> :SEARCH:I2C:ANALYZE:SETUP:CLOCK:SOURCE 1;LEVEL 1.000E+00;HYSTERESIS 0.3;:SEARCH:I2C:ANALYZE:SETUP:DATA:SOURCE 2;LEVEL 1.000E+00,0.000E+00;:SEARCH:I2C:ANALYZE:SETUP::RPOINT TRIGGER;MPOSITION -4.00000

:SEARch:I2C:ANALyze:ABORt

Function Aborts the I²C analysis execution.

Syntax :SEARch:I2C:ANALyze:ABORt

Example :SEARCH:I2C:ANALYZE:ABORT

:SEARch:I2C:ANALyze:EXECute

Function Executes the I²C analysis.

Syntax :SEARch:I2C:ANALyze:EXECute

Example :SEARCH:I2C:ANALYZE:EXECUTE

:SEARch:I2C:ANALyze:SETup?

Function Queries all settings related to the I²C analysis condition.

Syntax :SEARch:I2C:ANALyze:SETup?

Example :SEARCH:I2C:ANALYZE:SETUP? -> :SEARCH:I2C:ANALYZE:SETUP:CLOCK:SOURCE 1;LEVEL 1.000E+00;HYSTERESIS 0.3;:SEARCH:I2C:ANALYZE:SETUP:DATA:SOURCE 2;LEVEL 1.000E+00,0.000E+00;:SEARCH:I2C:ANALYZE:SETUP::RPOINT TRIGGER;MPOSITION -4.00000

:SEARch:I2C:ANALyze:SETup:CLOCk?

Function Queries all settings related to the clock channel of the I²C analysis condition.

Syntax :SEARch:I2C:ANALyze:SETup:CLOCk?

Example :SEARCH:I2C:ANALYZE:SETUP:CLOCK? -> :SEARCH:I2C:ANALYZE:SETUP:CLOCK:SOURCE 1;LEVEL 1.000E+00;HYSTERESIS 0.3

:SEARch:I2C:ANALyze:SETup:CLOCk:HYSTeresis

Function Sets the clock channel hysteresis of the I²C analysis condition or queries the current setting.

Syntax :SEARch:I2C:ANALyze:SETup:CLOCk:HYSTeresis {<NRf>}
:SEARch:I2C:ANALyze:SETup:CLOCk:HYSTeresis?
<NRf>=0.3 to 4.0 (divisions, 0.1 steps)

Example :SEARCH:I2C:ANALYZE:SETUP:CLOCK:HYSTERESIS 0.5
:SEARCH:I2C:ANALYZE:SETUP:CLOCK:HYSTERESIS? -> :SEARCH:I2C:ANALYZE:SETUP:CLOCK:HYSTERESIS 0.5

:SEARch:I2C:ANALyze:SETup:CLOCk:LEVel

Function Sets the clock channel level of the I²C analysis condition or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:CLOCk:
LEVel {<voltage>}
:SEARch:I2C:ANALyze:SETup:CLOCk:
LEVel?
<voltage>=8 divisions within the
screen (0.01 division steps).
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:CLOCK:
LEVEL 1V
:SEARCH:I2C:ANALYZE:SETUP:CLOCK:
LEVEL? -> :SEARCH:I2C:ANALYZE:
SETUP:CLOCK:LEVEL 1.000E+00
```

:SEARch:I2C:ANALyze:SETup:CLOCk:SOURce

Function Sets the clock channel target waveform of the I²C analysis condition or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:CLOCk:
SOURce {<NRf>}
:SEARch:I2C:ANALyze:SETup:CLOCk:
SOURce?
<NRf>=1, 3
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:CLOCK:
SOURCE 1
:SEARCH:I2C:ANALYZE:SETUP:CLOCK:
SOURCE? -> :SEARCH:I2C:ANALYZE:
SETUP:CLOCK:SOURCE 1
```

:SEARch:I2C:ANALyze:SETup:DATA?

Function Queries all settings related to the data channel of the I²C analysis condition.

Syntax
```
:SEARch:I2C:ANALyze:SETup:DATA?
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:DATA? ->
:SEARCH:I2C:ANALYZE:SETUP:DATA:
SOURCE 2;LEVEL 1.000E+00,0.000E+00
```

:SEARch:I2C:ANALyze:SETup:DATA:LEVel

Function Sets the data channel threshold level of the I²C analysis condition or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:DATA:LEVel
{<voltage>,<voltage>}
:SEARch:I2C:ANALyze:SETup:DATA:}
LEVel?
<voltage>=8 divisions within the
screen (0.01 division steps).
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:DATA:LEVEL
1V,0V
:SEARCH:I2C:ANALYZE:SETUP:DATA:
LEVEL? -> :SEARCH:I2C:ANALYZE:SETUP:
DATA:LEVEL 1.000E+00,0.000E+00
```

:SEARch:I2C:ANALyze:SETup:DATA:SOURce

Function Sets the data channel source waveform of the I²C analysis condition or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:DATA:
SOURce {<NRf>}
:SEARch:I2C:ANALyze:SETup:DATA:
SOURce?
<NRf>=2, 4
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:DATA:
SOURCE 2
:SEARCH:I2C:ANALYZE:SETUP:DATA:
SOURCE? -> :SEARCH:I2C:ANALYZE:
SETUP:DATA:SOURCE 2
```

:SEARch:I2C:ANALyze:SETup:MPOSition

Function Sets the reference position when the I²C reference position is set to manual or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:MPOSition
{<NRf>}
:SEARch:I2C:ANALyze:SETup:MPOSition?
<NRf>=–5 to 5 divisions (10
divisions/displayed record length
steps)
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:
MPOSITION -4.000
:SEARCH:I2C:ANALYZE:SETUP:
MPOSITION? -> :SEARCH:I2C:ANALYZE:
SETUP:MPOSITION -4.00000
```

:SEARch:I2C:ANALyze:SETup:RPOint

Function Sets the reference position when the I²C reference position is set to manual or queries the current setting.

Syntax
```
:SEARch:I2C:ANALyze:SETup:RPOint
{TRIGger|MANual}
:SEARch:I2C:ANALyze:SETup:RPOint?
```

Example
```
:SEARCH:I2C:ANALYZE:SETUP:
RPOINT TRIGGER
:SEARCH:I2C:ANALYZE:SETUP:RPOINT? ->
:SEARCH:I2C:ANALYZE:SETUP:
RPOINT TRIGGER
```

:SEARch:I2C:LIST? {<NRf>}

Function Outputs one byte of I²C analysis result as a character string.

Syntax
```
:SEARch:I2C:LIST? {<NRf>}
<NRf>=–40000 to 40000
```

Example
```
:SEARCH:I2C:LIST? 1 -> “      1
0.024   00001111  0F 0”
```

:SEARch:I2C:SEARch?

Function Queries all settings related to the I²C analysis result search.

Syntax :SEARch:I2C:SEARch?

Example :SEARCH:I2C:SEARCH? -> :SEARCH:I2C:SEARCH:TYPE PATTERN;ADDRESS:MODE 1;PATTERN “X0X10X10”;ACK “X”;:SEARCH:I2C:SEARCH:DATA:MODE 1;PATTERN “10X10X10”;ACK “X”

:SEARch:I2C:SEARch:ADDRess?

Function Queries all settings related to the Address search of the I²C analysis result.

Syntax :SEARch:I2C:SEARch:ADDRess?

Example :SEARCH:I2C:SEARCH:ADDRESS? ->
:SEARCH:I2C:SEARCH:ADDRESS:MODE 1;
PATTERN “X0X10X10”;ACK “X”

:SEARch:I2C:SEARch:ADDRess:ACK

Function Sets the Ack condition of the Address search of the I²C analysis result or queries the current setting.

Syntax :SEARch:I2C:SEARch:ADDRess:ACK {<string>}
:SEARch:I2C:SEARch:ADDRess:ACK?
<string>='0,' '1,' or 'x'

Example :SEARCH:I2C:SEARCH:ADDRESS:ACK "X"
:SEARCH:I2C:SEARCH:ADDRESS:ACK?
->:SEARCH:I2C:SEARCH:ADDRESS:ACK "X"

:SEARch:I2C:SEARch:ADDRess:HEXa

Function Sets the search Address pattern of the I²C analysis result in hexadecimal.

Syntax :SEARch:I2C:SEARch:ADDRess:HEXa {<string>}
<string>=2 characters by combining ‘0’ to ‘F’ and ‘X’

Example :SEARCH:I2C:SEARCH:ADDRESS:HEXA “1A”

:SEARch:I2C:SEARch:ADDRess:MODE

Function Sets the valid/invalid setting of the Address pattern when searching the I²C analysis result or queries the current setting.

Syntax :SEARch:I2C:SEARch:ADDRess:MODE {<Boolean>}
:SEARch:I2C:SEARch:ADDRess:MODE?

Example :SEARCH:I2C:SEARCH:ADDRESS:MODE ON
:SEARCH:I2C:SEARCH:ADDRESS:MODE? ->
:SEARCH:I2C:SEARCH:ADDRESS:MODE 1

:SEARch:I2C:SEARch:ADDRess:PATTern

Function Sets the search Address pattern of the I²C analysis result in binary or queries the current setting.

Syntax :SEARch:I2C:SEARch:ADDRess:PATTern {<string>}
:SEARch:I2C:SEARch:ADDRess:PATTern?
<string>=8 characters by combining ‘0,’ ‘1,’ and ‘X’
(The 8th character is the R/W bit.)

Example :SEARCH:I2C:SEARCH:ADDRESS:PATTERN “X0X10X10”
:SEARCH:I2C:SEARCH:ADDRESS:PATTERN? -> :SEARCH:I2C:SEARCH:ADDRESS:PATTERN “X0X10X10”

:SEARch:I2C:SEARch:DATA?

Function Queries all settings related to the Data search of the I²C analysis result.

Syntax :SEARch:I2C:SEARch:DATA?

Example :SEARCH:I2C:SEARCH:DATA? -> :SEARCH:I2C:SEARCH:DATA:MODE 1;PATTERN “10X10X10”;ACK “X”

:SEARch:I2C:SEARch:DATA:ACK

Function Sets the Ack condition of the Data search of the I²C analysis result or queries the current setting.

Syntax :SEARch:I2C:SEARch:DATA:ACK {<string>}
:SEARch:I2C:SEARch:DATA:ACK?
<string>=’0,’ ‘1,’ or ‘X’

Example :SEARCH:I2C:SEARCH:DATA:ACK “X”
:SEARCH:I2C:SEARCH:DATA:ACK? ->
:SEARCH:I2C:SEARCH:DATA:ACK “X”

:SEARch:I2C:SEARch:DATA:HEXa

Function Sets the searched Data pattern of the I²C analysis result in hexadecimal.

Syntax :SEARch:I2C:SEARch:DATA:HEXa {<string>}
<string>=2 characters by combining ‘0’ to ‘F’ and ‘X’

Example :SEARCH:I2C:SEARCH:DATA:HEXA “2B”
:SEARCH:I2C:SEARCH:DATA:HEXA? ->
:SEARCH:I2C:SEARCH:DATA:HEXA “2B”

:SEARch:I2C:SEARch:DATA:MODE

Function Sets the valid/invalid setting of the Data pattern when searching the I²C analysis result or queries the current setting.

Syntax :SEARch:I2C:SEARch:DATA:MODE {<Boolean>}
:SEARch:I2C:SEARch:DATA:MODE?

Example :SEARCH:I2C:SEARCH:DATA:MODE ON
:SEARCH:I2C:SEARCH:DATA:MODE? ->
:SEARCH:I2C:SEARCH:DATA:MODE 1

:SEARch:I2C:SEARch:DATA:PATTern

Function Sets the searched Data pattern of the I²C analysis result in binary or queries the current setting.

Syntax
```
:SEARch:I2C:SEARch:DATA:PATTern {<string>}
:SEARch:I2C:SEARch:DATA:PATTern?
<string>=8 characters by combining '0,' '1,' and 'X'
(The 8th character is the R/W bit.)
```

Example
```
:SEARCH:I2C:SEARCH:DATA:PATTERN "10X10X10"
:SEARCH:I2C:SEARCH:DATA:PATTERN? ->
:SEARCH:I2C:SEARCH:DATA:PATTERN "10X10X10"
```

:SEARch:I2C:SEARch:NEXT?

Function Performs the I²C analysis result search after the current byte and returns the search position.

Syntax `:SEARch:I2C:SEARch:NEXT?`

Example `:SEARCH:I2C:SEARCH:NEXT? -> 10`

Description When the search is successful, a value in the range of –40000 to 40000 is returned. If it fails, "NAN" is returned.

:SEARch:I2C:SEARch:PREVious?

Function Performs the I²C analysis result search before the current byte and returns the search position.

Syntax `:SEARch:I2C:SEARch:PREVious?`

Example `:SEARCH:I2C:SEARCH:PREVIOUS? -> -10`

Description When the search is successful, a value in the range of –5000 to 5000 is returned. If it fails, "NAN" is returned.

:SEARch:I2C:SEARch:TYPE

Function Sets the type of I²C analysis result search or queries the current setting.

Syntax
```
:SEARch:I2C:SEARch:TYPE {PATTern|INDefinite}
:SEARch:I2C:SEARch:TYPE?
```

Example
```
:SEARCH:I2C:SEARCH:TYPE PATTERN
:SEARCH:I2C:SEARCH:TYPE? -> :SEARCH:I2C:SEARCH:TYPE PATTERN
```

:SEARch:TYPE

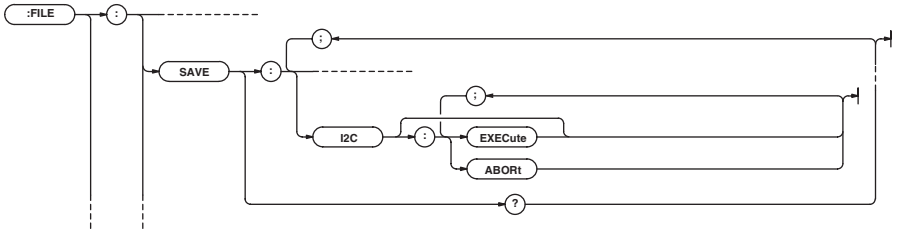
Function Sets the search type or queries the current setting.

Syntax
```
:SEARch:TYPE {SPATtern|WIDTh|EDGE|PPATtern|ASCRoll|I2CBus|SPIBus}
:SEARch:TYPE?
```

Example
```
:SEARCH:TYPE I2CBUS
:SEARCH:TYPE? -> :SEARCH:TYPE I2CBUS
```

I²C File Group

Commands in the I²C File group can be used to make the same settings, inquiries, and executions as when the I²C bus menu under the FILE key on the front panel is used.



:FILE:SAVE:I2C[:EXECute]

Function Executes the save operation of the I²C analysis result. This is an overlap command.

Syntax `:FILE:SAVE:I2C[:EXECute]`

Example `:FILE:SAVE:I2C:EXECUTE`

:FILE:SAVE:I2C:ABORt

Function Aborts the save operation of the I²C analysis result.

Syntax `:FILE:SAVE:I2C:ABORt`

Example `:FILE:SAVE:I2C:ABORT`

1.8 Error Messages

This section lists only the error messages related to the I^2C bus signal analysis function. There are other error messages related to the DL1640/DL1640L and communications. These messages are described in the *DL1620/DL1640/DL1640L User's Manual IM 701610-01E* and the *Communication Interface User's Manual IM 701610-17E*.

Warnings

Code	Message
37	Analysis aborted.
38	Data not detected. Execute again after changing the settings or reacquiring the waveform.

Errors

Code	Message
779	Specified data does not exist. Execute the analysis.

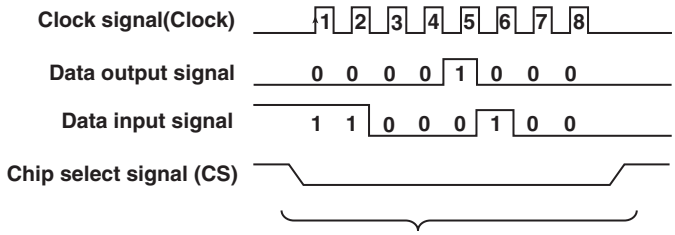
2.1 Overview of the SPI Bus Signal Analysis Function

About the SPI Bus Signal Analysis Function

By using this function, you will be able to analyze data while displaying the SPI bus signal waveform. The main functions are as follows:

- **Analysis Function**
  You can analyze the data and other information that are displayed when the acquisition of historical data, acquisition data, or waveform is stopped.
  The analysis results are listed on the right side of the screen. In addition, the analysis results can be displayed using hexadecimal or binary notation. The analysis results and waveforms can be displayed simultaneously.

- **Search Function**
  From the acquired data (the currently displayed data), you can search in the forward or reverse direction for data that matches a specified data pattern and display the matched data expanded on the ZOOM display. You can specify the data pattern using binary or hexadecimal values and set the data length to a value between 1 and 8 bytes. You can also search indefinite data.



Analysis result	Byte number:	0
	Data output signal:	08(HEX)
	Data input signal:	C4(HEX)
	Chip select signal:	L
	Bit order:	MSB First

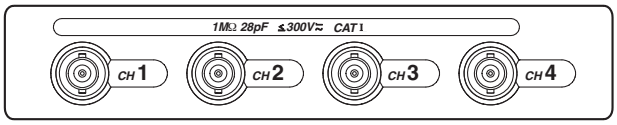
Note

- On the DL1640/DL1640L, the clock signal is input to CH1; the data input signal (Data1 and Data2) to CH2 and CH3; and the chip select signal (CS) to CH4.
- Data is transmitted in units of bytes (8 bits) by synchronizing to the clock signal. Consequently, the SPI signal is analyzed or searched at the byte level.
- The SPI bus analysis function does not have a dedicated trigger.

2.2 Connecting the Probe

Input Terminals

Connect the probe to one of the input terminals located at the lower section of the front panel. The input impedance is 1 MΩ±1.0% and approximately 28 pF.



WARNING

To prevent fire or electric shock, do not use this instrument for category II, III, or IV measurements.

CAUTION

The maximum input voltage for 1 MΩ input is 300 VDC or 300 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 this value.

Precautions to Be Taken When Connecting a Probe

- When performing SPI bus signal analysis, connect the signals to the input terminals as follows:
  CH1: Clock signal
  CH2: Data input/output signal (Data1)*
  CH3: Data input/output signal (Data2)*
  CH4: Chip select signal (CS)

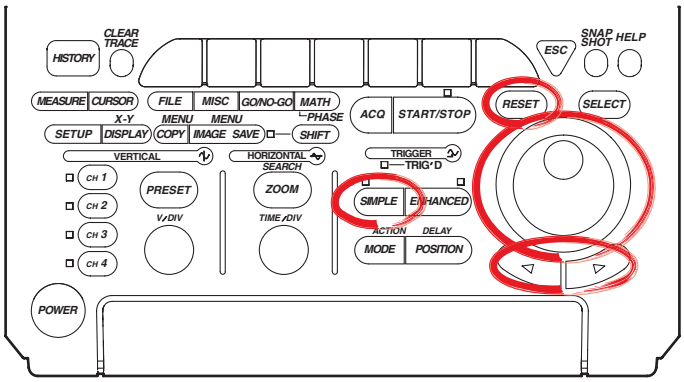
  * CH2 and CH3 can be connected to either the data input signal or the data output signal. The DL1640/DL1640L handles the data of the signal connected to CH2 and CH3 as Data1 and Data2, respectively.

- 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)” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*. Failure to do so may result in unstable gain across different frequencies, thereby preventing correct measurement. Calibration must be performed for each channel.
- Note that if the object being measured is directly connected to the instrument without using a probe, correct measurements may not be possible due to loading effects.

2.3 Displaying the Signals to Be Analyzed

The SPI bus signal analysis function does not have a dedicated trigger. Therefore, the following section will describe the method of activating the trigger on the falling edge of the CS signal (CH4). For details, see section 6.5, “Setting the Edge Trigger (SIMPLE)” in the *User’s Manual IM 701610-01E*. If you are activating the trigger using other conditions, see chapter 6, “Triggering” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*.

Relevant Keys

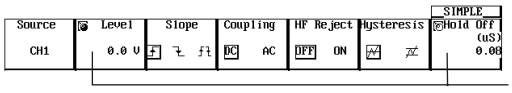


Procedure

1. Press **SIMPLE**.

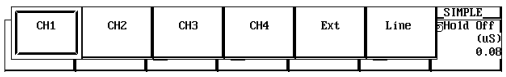
Setting the Trigger Source

2. Press the **Source** soft key to display the trigger source selection menu.



Settings for these items can be input directly using a USB keyboard.

3. Press the **CH4** soft key.



Setting the Trigger Level

4. Press the **Level** soft key.

5. Turn the jog shuttle to set the trigger level.
   You can move between the digits using the arrow keys. Pressing **RESET** resets the trigger level to the current offset voltage.

Setting the Trigger Slope

6. Press the **Slope** soft key to select ↴.

Setting the Trigger Coupling

7. Press the **Coupling** soft key to select DC.

Setting the HF Rejection

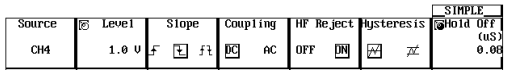
8. Press the **HF Reject** soft key to select ON or OFF.

Setting the Hysteresis

9. Press the **Hysteresis** soft key to select ⊿▽⊿ or ⊿▲⊿.

Setting the Hold Off Time

10. Press the **Hold Off** soft key.



11. Turn the jog shuttle to set the hold off time.
    You can move between the digits using the arrow keys. Pressing **RESET** resets the value to 0.08 μs.

Explanation

Selecting the Trigger Source

To activate the trigger on the falling edge of the CS signal (CH4), set the trigger source to CH4.

Setting the Trigger Level

Selectable range: 8 divisions within the screen
Resolution: 0.01 divisions (For example, the resolution for 2 mV/div is 0.02 mV.)

Setting the Trigger Slope

Select how the trigger source is to cross the specified level for activating the trigger from the following three choices. To activate the trigger on the edge falling of the CS signal (CH4), set the trigger slope to ↓.

⎍: Trigger when the signal changes from below the trigger level to above the trigger level (rising)
↓: Trigger when the signal changes from above the trigger level to below the trigger level (falling)
⎍↓: Trigger on either the rising or falling edge.

Setting the Trigger Coupling

Select the trigger coupling from the following. To activate the trigger on the edge falling of the CS signal (CH4), set the trigger coupling to DC.

AC: Uses a signal that is obtained by removing the DC component from the trigger source signal.
DC: Uses the trigger source signal as-is.

Setting the HF Rejection

Specify “ON” if you wish to use a signal that is obtained by removing the high frequency components (frequency components greater than 15 kHz) from the trigger source signal as the trigger source.

Setting the Hysteresis

Sets a width to the trigger level so that triggers are not activated by small changes in the trigger signal.

: Approximately 0.3 divisions* of hysteresis around the trigger level.

: Approximately 1 divisions* of hysteresis around the trigger level.

* The value above is an approximate value. It is not strictly warranted.

Setting the Hold Off Time

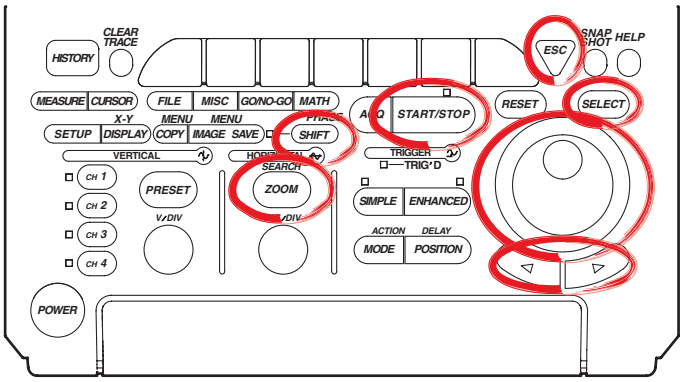
Selectable range: 80 ns to 10 s (the initial value is 80 ns)

Resolution: 20 ns

For details, see section 6.4, “Setting the Hold Off Time” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*.

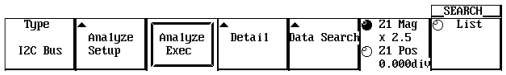
2.4 Analyzing/Searching Data

Relevant Keys



Procedure

1. Press **SHIFT** to set the keys in the shifted condition.
   Functions marked in purple on the panel become active.
2. Press **ZOOM**.
3. Press the **Type** soft key. The analysis type selection menu appears.

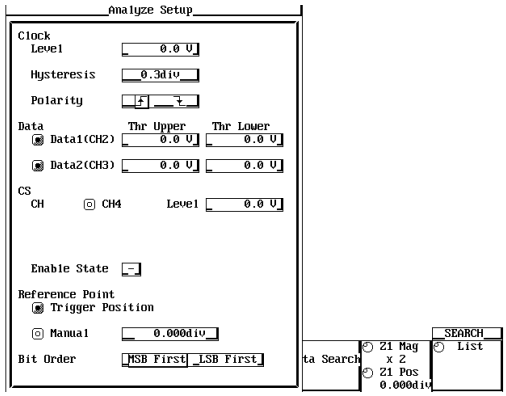


4. Press the **SPI Bus** soft key.

5. If waveform acquisition is in progress, press **START/STOP** to stop the operation.

Setting the Analysis Conditions

6. Press the **Analyze Setup** soft key. The Analyze Setup dialog box appears.



- **Setting Clock (CH1)**

  Setting the Level

  7. Turn the jog shuttle to select Clock Level.
  8. Press **SELECT** to display the entry box.
  9. Turn the jog shuttle to set the level.
  10. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.

  Setting the Hysteresis

  11. Turn the jog shuttle to select Hysteresis.
  12. Set the hysteresis in a similar fashion as described in steps 8 through 10.

  Setting the Polarity

  13. Turn the jog shuttle to move the cursor to Polarity.
  14. Press **SELECT** to select ⎍ or ⎎.

- **Setting Data1 (CH2)**

  15. Turn the jog shuttle to select Data1(CH2).
  16. Press **SELECT**. The button to the left of Data1 (CH2) is highlighted.

  Setting the Threshold Level

  17. Turn the jog shuttle to select Thr Upper of Data1 (CH2).
  18. Press **SELECT** to display the entry box.
  19. Turn the jog shuttle to set the value.
  20. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.
  21. Set Thr Lower of Data1 (CH2) in a similar fashion as described in steps 17 through 20.

- **Setting Data2 (CH3)**

  22. Set Thr Upper and Thr Lower of Data2 (CH3) in a similar fashion as described in steps 15 through 21.

Note

In the factory default condition, the buttons to the left of Data1 (CH2) and Data2 (CH3) are highlighted.

- **Setting CS (CH4)**

  23. To set CH4 to the CS signal, turn the jog shuttle to select CS CH4.
  24. Press **SELECT**. The button to the left of CH4 is highlighted.

  Setting the Level

  25. Turn the jog shuttle to select CS Level.
  26. Set the level in a similar fashion as described in steps 8 through 10.

  Setting the CS Signal State

  27. Turn the jog shuttle to select Enable State.
  28. If you had set CH4 to the CS signal in steps 23 and 24, press **SELECT** to select L, H, or X.
      If you did not set CH4 to the CS signal, "-" is displayed in the Enable State box.

- **Setting the Reference Point**

  When Setting the Trigger Position to the Analysis Reference Point

  29. Turn the jog shuttle to select Trigger Position.
  30. Press **SELECT**. The button to the left of Trigger Position is highlighted and the analysis reference point is set to the trigger position. Proceed to step 33.

  When Manually Setting the Analysis Reference Point

  29. Turn the jog shuttle to select Manual.
  30. Press **SELECT**. The button to the left of Manual is highlighted.
  31. Turn the jog shuttle to select the box to the right Manual.
  32. Set the value in a similar fashion as described in steps 8 through 10. Proceed to step 33.

Note

If you set the display to translucent mode when manually setting the analysis reference point, you can set the analysis reference point while viewing the waveform display. For details on the translucent mode display, see section 8.7, "Turning Translucent Mode ON/OFF" in the *DL1620/DL1640/DL1640L User's Manual IM 701610-01E*.

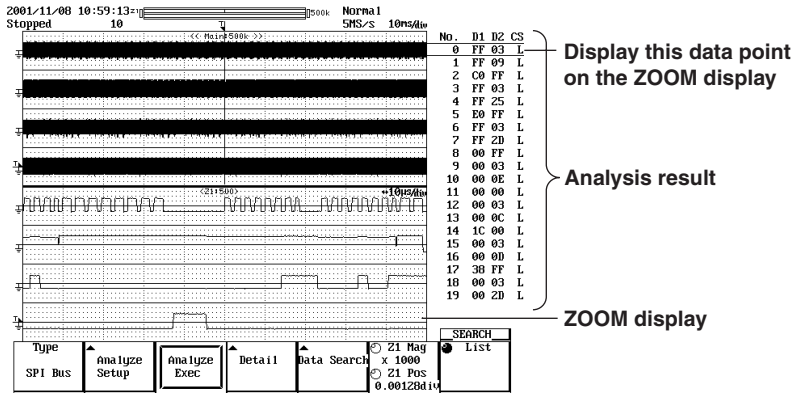
- **Setting the Bit Order**

  33. Turn the jog shuttle to select Bit Order.
  34. Press **SELECT** to select MSB First or LSB First.
      Press **ESC** to close the dialog box.

- **Executing the Analysis**

  35. Press the **Analyze Exec** soft key. The waveform is analyzed, and the result is displayed on the right side of the screen.

If you select the analysis number by pressing the **List** soft key and turning the jog shuttle, the data corresponding to the selected analysis number is displayed expanded on the ZOOM display.

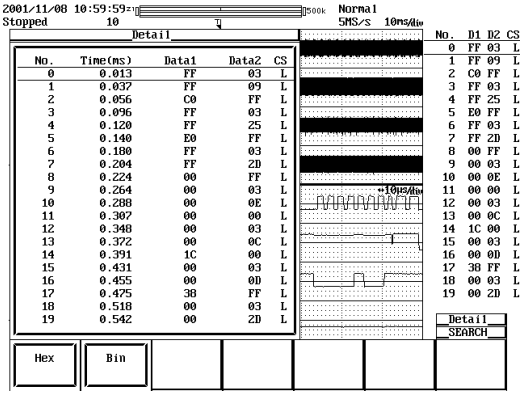


Note

If the analysis result contains indefinite data, "*" is displayed in the Data1 and Data2 boxes.

Detailed Display of the Analysis Results

36. Press the **Detail** soft key. The detailed display of analysis results appears.



37. Press the **Hex** or **Bin** soft key to select the data format. Data1 and Data2 are displayed in the selected data format.
Press **ESC** to close the detailed display.

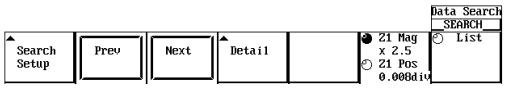
Note

- If you select the analysis number by turning the jog shuttle, the byte corresponding to the selected analysis number is displayed expanded on the ZOOM display.
- The analysis number of the detailed display corresponds to the analysis number of the analysis result display on the right side of the screen.

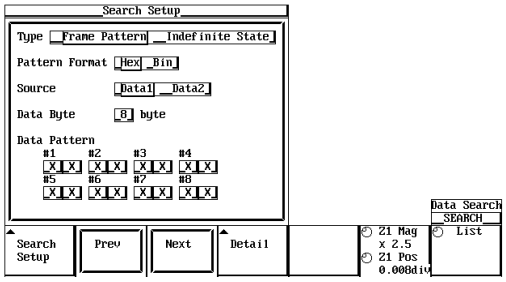
Setting the Search Conditions

38. Press the **Data Search** soft key.

39. Press the **Search Setup** soft key. The Search Setup dialog box appears.



40. Turn the jog shuttle to move the cursor to Type.



41. Press **SELECT** to select Frame Pattern or Indefinite State.

- **When Frame Pattern (Pattern Search) Is Selected**

  Setting the Pattern Format

  42. Turn the jog shuttle to move the cursor to Pattern Format.
  43. Press **SELECT** to select Hex or Bin.

  Setting the Source

  44. Turn the jog shuttle to move the cursor to Source.
  45. Press **SELECT** to select Data1 or Data2.

  Setting the Data Byte

  46. Turn the jog shuttle to move the cursor to Data Byte.
  47. Press **SELECT** to display the entry box.
  48. Turn the jog shuttle to set a value between 1 and 8. Pressing **RESET** resets the number to "8."

  Setting the Data Pattern

  49. Turn the jog shuttle to move the cursor to the bit for setting the Data Pattern.
  50. Press **SELECT** to display the entry box.
  51. Turn the jog shuttle to set the value. Bits set to "X" will not be used as a search condition. Press **SELECT** or **ESC** to close the entry box. The value will be confirmed.
      Press **ESC** to close the dialog box. Proceed to step 52.

- **When Indefinite State (Indefinite Data Search) Is Selected**

  You do not have to set any items.
  Press **ESC** to close the dialog box. Proceed to step 52.

Executing the Search

52. Press the **Prev** soft key to search data existing before the current position. Press the **Next** soft key to search data existing after the current position. When a match is found in a pattern search, the corresponding byte in the analysis result display on the right side of the screen is highlighted, and the ZOOM display moves accordingly. In an indefinite data search, the byte in which indefinite data is present in Data1 or Data2 is highlighted.

Explanation

Analyzing Data

Setting the Analysis Conditions

- **Setting Clock (CH1)**

  Setting the Level

  Set the level used to determine the rising or falling edge of the clock signal.

  Selectable range: 8 divisions within the screen

  Resolution: 0.01 divisions (For example, the resolution for 2 mV/div is 0.02 mV.)

  Setting the Hysteresis

  Selectable range: 0.3 divisions to 4.0 divisions

  Setting the Polarity

  ⎍: Reads the data input/output signal when the signal changes from below the specified level to above the specified level.

  ⎎: Reads the data input/output signal when the signal changes from above the specified level to below the specified level.

- **Setting Data1 (CH2) and Data2 (CH3)**

  Setting the Threshold Level

  Set the level used to determine the data channel signal level (0, 1, or indefinite).

  Thr Upper: Signal exceeding this level is determined to be 1.

  Thr Lower: Signal below this level is determined to be 0.

  If Thr Lower ≤ data signal level ≤ Thr Upper, the signal level is determined to be "indefinite data."

  If indefinite data is found, "*" is displayed in the Data1 or Data2 display box at the byte where the indefinite data exists on the display screen of analysis results.

- **Setting the Chip Select Signal (CS)**

  To set the CS signal, specify CH4.

  Setting the Level

  Set the level used to determine whether the CH4 signal is high or low as follows:

  Selectable range: 8 divisions within the screen

  Resolution: 0.01 divisions (For example, the resolution for 2 mV/div is 0.02 mV.)

  Selecting the CS Signal State (Enable State)

  Select the state from the following:

  H: Analyzes the data input/output signal when the CS signal is high.

  L: Analyzes the data input/output signal when the CS signal is low.

  X: All data input/output signals are analyzed. The byte boundary of the analyzed signal is the point where the CS signal changes from high to low or low to high.

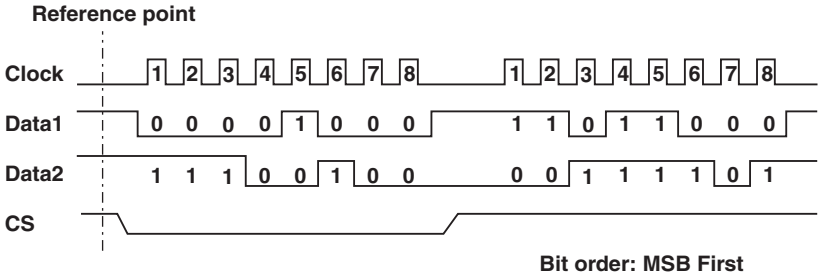
  –: This can be used when the CS signal is not selected. All data input/output signals are analyzed. The data input/output signal that is delimited byte-wise is analyzed from the Reference Point.

- **Setting the Reference Point**

  Select the reference point used to start the analysis from the following:

  Trigger Position: Set the reference point to the trigger position.

  Manual: Set the reference point in the range of –5 to +5 divisions.



Bit order: MSB First

When Clock (CH1) = ↓ and CS (CH4) = L

Analysis number (No.): 0
Data1 hexadecimal display (Dt1): 08
Data2 hexadecimal display (Dt2): E4
Enable state of the CS signal (CS): L

When Clock (CH1) = ↓ and CS (CH4) = H

Analysis number (No.): 0
Data1 hexadecimal display (Dt1): D8
Data2 hexadecimal display (Dt2): 3D
Enable state of the CS signal (CS): H

When Clock (CH1) = ↓ and CS (CH4) = X

Analysis number (No.):	0	1
Data1 hexadecimal display (Dt1):	08	D8
Data2 hexadecimal display (Dt2):	E4	3D
Enable state of the CS signal (CS):	L	H

- **Setting the Bit Order**

  Select MSB or LSB according to the data flowing through the bus.

  MSB First: Select this when the data input/output signal is flowing through the bus MSB first.

  LSB First: Select this when the data input/output signal is flowing through the bus LSB first.

When set to MSB First: E831
When set to LSB First: 71C8

Items to Be Analyzed

The following data can be analyzed:

- Historical data.
- Data that is displayed when the waveform acquisition is stopped.
- Loaded acquisition data (ACQ data).

  Analysis is performed only on the waveform selected by “Select Record” for historical data.

Analysis Range

Analysis is performed on the acquisition data within the display screen. Up to 40000 bytes of the analysis results can be displayed. The displayed result varies depending on the number of bytes analyzed as follows:

- When the total analysis result is less than or equal to 40000 bytes
  All points are displayed regardless of the position of the Reference Point.
- When the total analysis result is greater than 40000 bytes
  The displayed result varies depending on the number of analysis results on the Pre* and Post* sides as follows:
  - When the Pre side = 30000 and the Post side = 30000 → Pre side = 20000 and Post side = 20000
  - When the Pre side = 10000 and the Post side = 50000 → Pre side = 10000 and Post side = 30000
  - When the Pre side = 50000 and the Post side = 10000 → Pre side = 30000 and Post side = 10000

* Pre: Start from the reference point and display back (to the left)
Post: Start from the reference point and display forward (to the right)

Notes When Performing Analysis

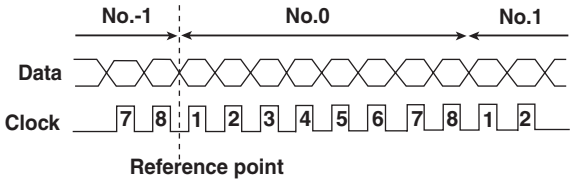
- Analysis and search cannot be performed while the waveform acquisition is started.
- Analysis and search cannot be performed on accumulated waveforms.

Executing the Analysis

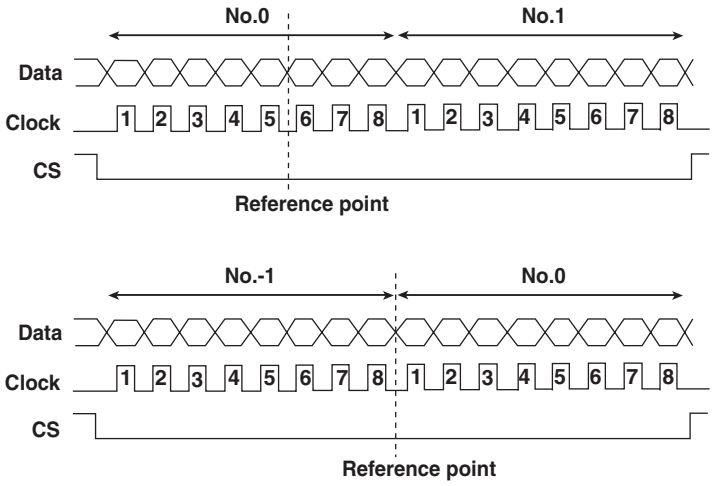
When analysis is performed, the results are listed on the right side of the screen.

- **List of Analysis Results**
  The following four items are displayed.
  No.*: Up to 40000 points can be displayed.
  Dt1 and Dt2: The data of Data1 and Data2 is displayed using hexadecimal notation. However, if a byte of data is less than 8 bits, the data is not displayed. If indefinite data exists, "*" is displayed. Indefinite data is considered the same value as the previous bit for the analysis. If the first data is indefinite, it is considered 0.
  CS: Displays the CS signal state. Displays blank when the CS signal is not set. Displays "H" or "L" when the CS signal is set.

  Depending on whether the CS signal is set, the 0th byte varies as follows:
  - When the CS signal is not set:
    The first detected byte after the reference point



- When the CS signal is set:
  Byte containing the reference point (However, if the reference point is located between two bytes, the first detected byte after the reference point)

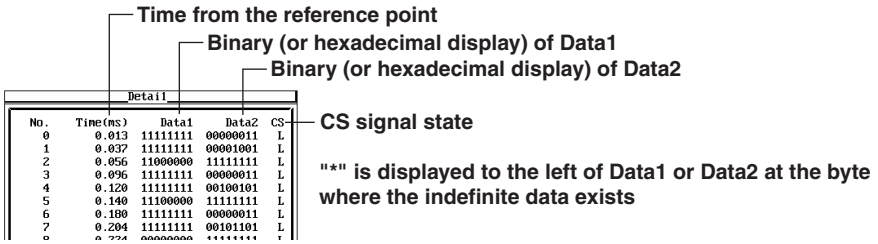


Note

- If you execute the analysis and select (highlight) an arbitrary byte in the list of analysis results, the Zoom Position moves to the head of that byte. In addition, if you move the Zoom Position, the highlighting moves to the corresponding byte in the list of analysis results.
- If the CS signal is set and the CS signal waveform on the Main screen does not contain points of change from H to L or L to H, the data input/output signal is not analyzed.

Detailed Display of the Analysis Results

The figure below shows the detailed display of the analysis results.



In the detailed display screen, the data corresponding to the specified number is highlighted.
In the waveform display screen, the data corresponding to the specified number is displayed in the ZOOM display.

Searching Data

Setting the Search Conditions

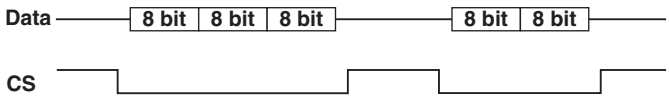
- **Pattern Search (Frame Pattern)**
  You can specify a data pattern of Data1 or Data2 in units of bytes and search the waveform. When a waveform that matches the specified pattern is found, the Zoom Position moves to that point and displays the searched waveform in the Zoom window. Set the pattern to be searched in binary or hexadecimal notation. Bits set to "X" are not searched.
  The items to be specified are as follows:

Pattern Format:	Specify the pattern display format. Select Hex (hexadecimal display) or Bin (binary display).
Source:	Set the target waveform to perform the pattern search to Data1 or Data2.
Data Byte:	Set the number of data bytes from 1 to 8 (bytes).
Data Pattern:	Set the search pattern using hexadecimal or binary format. The bit order is set to the format that was specified for the analysis. If the specified bit contains an X, it is displayed as "$" in hexadecimal format.

- **Indefinite Data Search (Indefinite State)**
  Searches indefinite data from the analysis result. You cannot perform a pattern search and an indefinite data search simultaneously.

Note

- Indefinite data is always considered matched to the specified status.
- If analysis is performed on a channel of which a CS signal is selected, the data is considered to be delimited at the point where the state of the CS signal changes. In this case, data search is also performed by considering the data to be delimited at that point. For example, when a 5-byte data shown in the following figure is analyzed, the search operation varies depending on the CS channel specification during the analysis.
  - When analysis is performed by specifying a CS channel
    Data search across two CS intervals cannot be performed. Therefore, search is not possible by setting Data Byte to 4 or 5. (Cannot conclude from the analyzed data.)
  - When analysis is performed without specifying the CS channel
    Independent of the chip select interval. Search can be performed by setting Data Byte to 4 or 5.
    Example (Enable State = L)

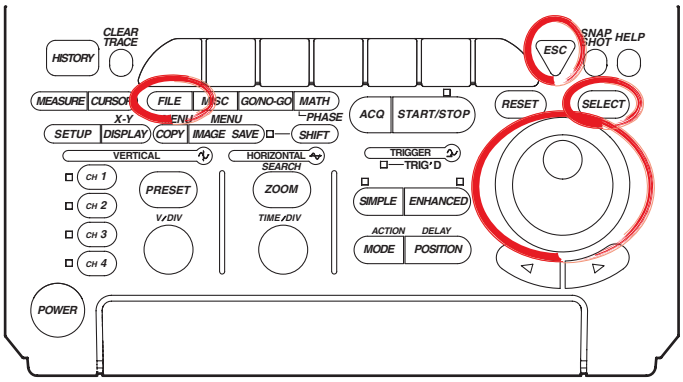


Executing the Search

Searches data that matches the specified search condition in forward (Prev) and reverse (Next) directions. When the data matches the search pattern, the corresponding data in the detailed analysis display on the right side of the screen is highlighted. In addition, the matched data is displayed expanded in the ZOOM display.

2.5 Saving the Detailed Analysis Results

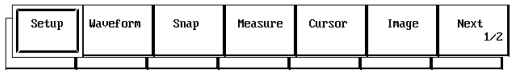
Relevant Keys



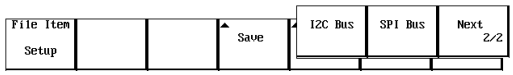
Procedure

1. Press **FILE**.
2. Press the **File Item** soft key. The File Item selection menu appears.

3. Press the **Next 1/2** soft key to display the Next 2/2 menu.



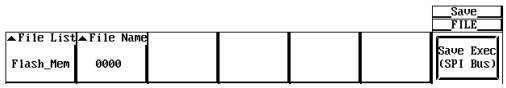
4. Press the **SPI Bus** soft key.



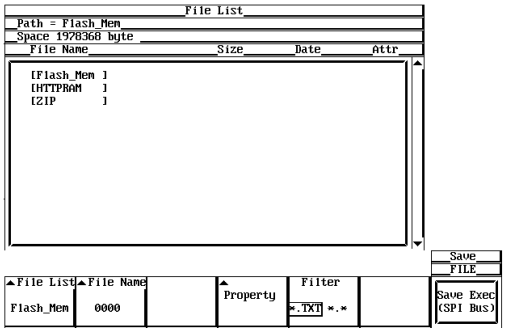
5. Press the **Save** soft key.

Selecting Save Destination Medium

6. Press the **File List** soft key. The File List box appears.



7. Turn the jog shuttle to select the save destination medium (indicated by [ ]).



8. Press **SELECT** to confirm the new medium.

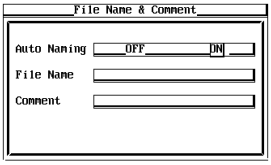
Select the Destination Directory

(Perform this operation when directories are present on the medium.)

9. Turn the jog shuttle to select the save destination directory (indicated by < >).
10. Press **SELECT** to confirm the new directory.
    The selected medium/directory is displayed in “Path=.....” located above and to the left of the File List menu.
    Select <..> to move to the parent directory.

Setting the File Name

11. Press the **File Name** soft key. The File Name & Comment dialog box appears.
12. Turn the jog shuttle to move the cursor to the Auto Naming box.



13. Press **SELECT** to select ON or OFF.
14. Turn the jog shuttle to move the cursor to the File Name box.
15. Press **SELECT**. A keyboard appears.
16. Enter the file name according to section 4.1, “Entering Values and Character Strings” in the *DL1620/DL1640/DL1640L User’s Manual IM 701610-01E*.
    Press **ESC** to close the dialog box.

Note

Comments are not saved along with detailed analysis results so it is not necessary to enter any.

Executing the Save Operation

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 an Abort soft key.

Aborting the Save Operation

18. Press the **Abort** soft key. The save operation is aborted. At the same time, the Abort soft key changes to a Save Exec soft key.

Specifying the Files to Be Displayed in the File List Menu and Displaying Properties

19. On the display showing the File List menu, press the **Filter** soft key to select *.TXT or *.*.
20. Turn the jog shuttle to select the files in the File List menu.
21. Press the **Property** soft key. The property box about the selected file is displayed.
    Press **ESC** to close the box.

Explanation

Saving the Detailed Analysis Results

You can store the analysis results of the SPI bus signal to the storage medium that is selected in the FILE menu in ASCII format.

Extension: .TXT

Data size: (Number of bytes per data point × number of analysis results) + 44 bytes*2

*1 The number of bytes per data varies depending on the data.
- Analysis data without CS: 40 bytes minimum.
- Analysis data with CS set to CH4: 44 bytes maximum.

*2 The data size of the title is 44 bytes.

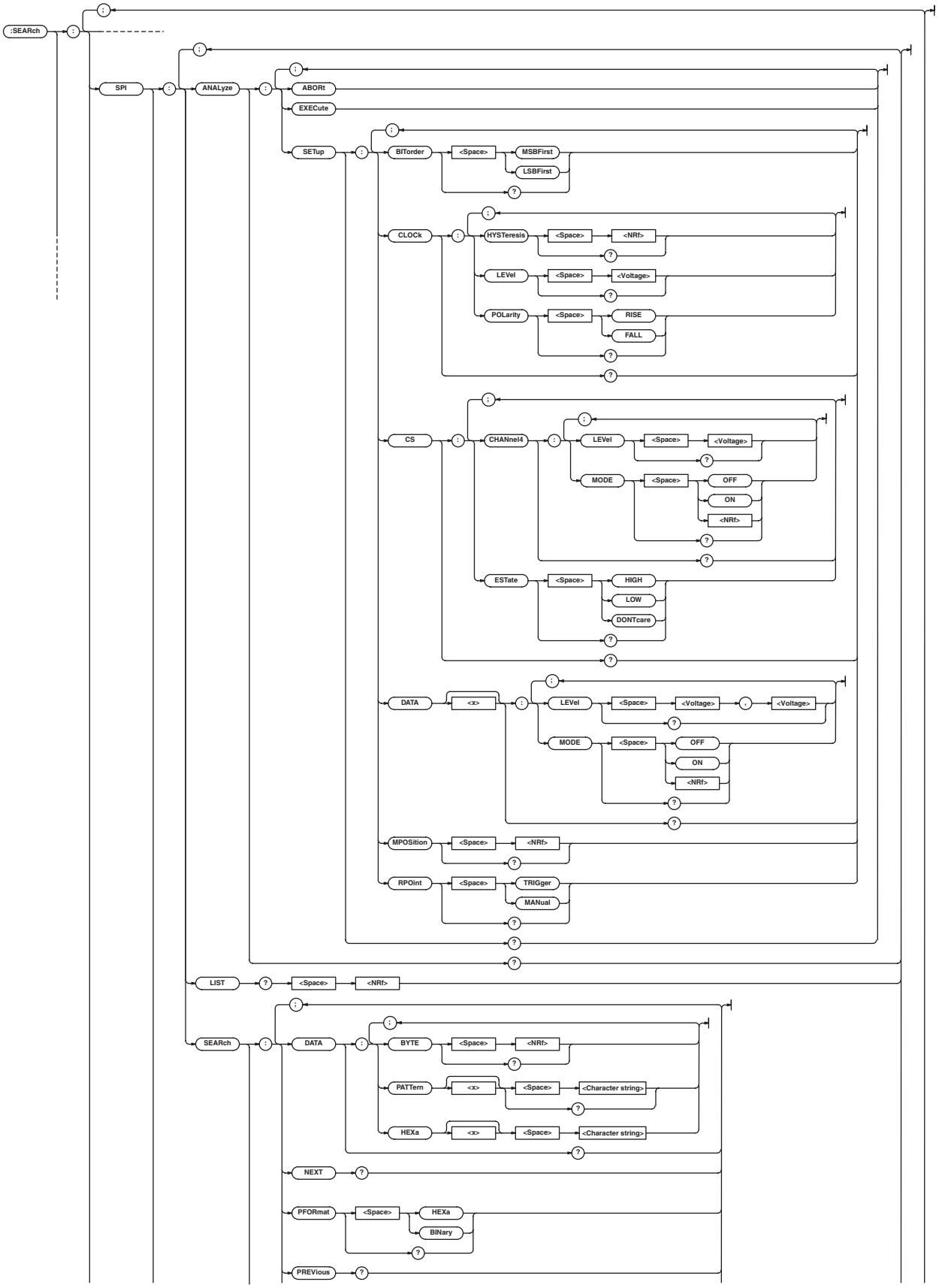
2.6 Communication Commands

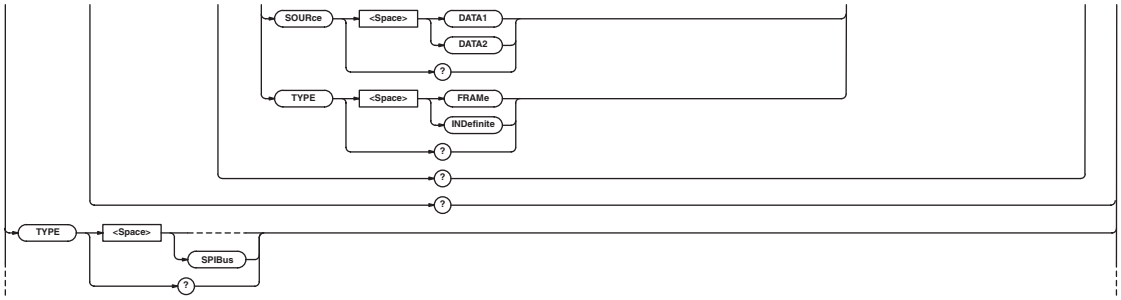
Command	Function	Page
SPI Analyze Group		
:SEARch:SPI?	Queries all settings related to the SPI analysis function.	2-22
:SEARch:SPI:ANALyze?	Queries all settings related to the SPI analysis execution.	2-22
:SEARch:SPI:ANALyze:ABORt	Aborts the SPI analysis execution.	2-22
:SEARch:SPI:ANALyze:EXECute	Executes the SPI analysis.	2-22
:SEARch:SPI:ANALyze:SETup?	Queries all settings related to the SPI analysis conditions.	2-22
:SEARch:SPI:ANALyze:SETup:BITorder	Sets the bit order of the display of the SPI analysis data results or queries the current setting.	2-22
:SEARch:SPI:ANALyze:SETup:CLOCk?	Queries all settings related to the clock channel of the SPI analysis conditions.	2-23
:SEARch:SPI:ANALyze:SETup:CLOCk:HYSTeresis	Sets the clock channel hysteresis of the SPI analysis conditions or queries the current setting.	2-23
:SEARch:SPI:ANALyze:SETup:CLOCk:LEVel	Sets the clock channel level of the SPI analysis conditions or queries the current setting.	2-23
:SEARch:SPI:ANALyze:SETup:CLOCk:POLarity	Sets the edge of the clock channel to be analyzed of the SPI analysis conditions or queries the current setting.	2-23
:SEARch:SPI:ANALyze:SETup:CS?	Queries all settings related to the CS signal of the SPI analysis conditions.	2-23
:SEARch:SPI:ANALyze:SETup:CS:CHANnel4?	Queries all settings related to CH4 of the SPI analysis CS signal conditions.	2-23
:SEARch:SPI:ANALyze:SETup:CS:CHANnel4:LEVel	Sets the level of CH4 of the SPI analysis CS signal conditions.	2-23
:SEARch:SPI:ANALyze:SETup:CS:CHANnel4:MODE	Sets whether to handle CH4 as a CS signal (ON/OFF) in the SPI analysis conditions or queries the current setting.	2-23
:SEARch:SPI:ANALyze:SETup:CS:ESTate	Sets the enable state of the CS signal of the SPI analysis conditions or queries the current setting.	2-24
:SEARch:SPI:ANALyze:SETup:DATA<x>?	Queries all settings related to the data channel of the SPI analysis conditions.	2-24
:SEARch:SPI:ANALyze:SETup:DATA<x>:LEVel	Sets the threshold level of the data channel of the SPI analysis conditions or queries the current setting.	2-24
:SEARch:SPI:ANALyze:SETup:DATA<x>:MODE	Enables or disables the data channel (ON/OFF) of the SPI analysis conditions or queries the current setting.	2-24
:SEARch:SPI:ANALyze:SETup:MPOSition	Sets the reference position when the SPI reference position is set to manual or queries the current setting.	2-24
:SEARch:SPI:ANALyze:SETup:RPOint	Sets the SPI analysis reference position to the trigger position or manual or queries the current setting.	2-24
:SEARch:SPI:LIST?	Outputs one byte of SPI analysis result as a character string.	2-24
:SEARch:SPI:SEARch?	Queries all settings related to the SPI analysis result search.	2-24
:SEARch:SPI:SEARch:DATA?	Queries all settings related to the Data search of the SPI analysis results.	2-25
:SEARch:SPI:SEARch:DATA:BYTE	Sets the number of data bytes to be searched for the Data search of the SPI analysis results.	2-25
:SEARch:SPI:SEARch:DATA:HEXa<x>	Sets the Data search pattern of the SPI analysis results in hexadecimals.	2-25
:SEARch:SPI:SEARch:DATA:PATTern<x>	Sets the Data search pattern of the SPI analysis results in binary or queries the current setting.	2-25
:SEARch:SPI:SEARch:NEXT?	Performs the SPI analysis result search after the current byte and returns the search position.	2-25

Command	Function	Page
:SEARch:SPI:SEARch:PFORmat	Sets the format of the search pattern of the SPI analysis results or queries the current setting.	2-25
:SEARch:SPI:SEARch:PREVious?	Performs the SPI analysis result search before the current byte and returns the search position.	2-25
:SEARch:SPI:SEARch:SOURce	Sets the data source for performing the SPI analysis result search or queries the current setting.	2-25
:SEARch:SPI:SEARch:TYPE	Sets the type of SPI analysis result search or queries the current setting.	2-25
:SEARch:TYPE	Sets the search type of queries the current setting.	2-26
SPI File Group		
:FILE:SAVE:SPI[:EXECute]	Executes the store operation of SPI analysis results (overlap command).	2-26
:FILE:SAVE:SPI:ABORt	Aborts the store operation of SPI analysis results.	2-26

SPI Analyze Group

Commands in the SPI Analyze group can be used to make the same settings, inquiries, and executions as when the SPI bus menu under the SHIFT + ZOOM key on the front panel is used.





:SEARch:SPI?

Function Queries all settings related to the SPI analysis function.

Syntax :SEARch:SPI?

Example
```
:SEARCH:SPI? -> :SEARCH:SPI:ANALYZE:
SETUP:CLOCK:LEVEL 1.000E+00;
HYSTERESIS 0.3;POLARITY RISE;:
SEARCH:SPI:ANALYZE:SETUP:DATA1:
MODE 1;LEVEL 1.000E+00,0.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:DATA2:
MODE 1;LEVEL 1.000E+00,0.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:CS:CHANNEL4:
MODE 1;ESTATE LOW;LEVEL 1.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:CS:
ESTATE LOW;:SEARCH:SPI:ANALYZE:
SETUP:RPOINT TRIGGER;
MPOSITION 0.00000;
BITORDER MSBFIRST;:SEARCH:SPI:
SEARCH:TYPE FRAME;PFORMAT BINARY;
SOURCE DATA1;DATA:BYTE 8;
PATTERN1 “10X10X10”;
PATTERN2 “0X10X10X”;
PATTERN3 “X10X10X1”;
PATTERN4 “01X01X01”;
PATTERN5 “1X01X01X”;
PATTERN6 “X01X01X0”;
PATTERN7 “X10X10X1”;
PATTERN8 “11010101”
```

:SEARch:SPI:ANALyze?

Function Queries all settings related to the SPI analysis execution.

Syntax :SEARch:SPI:ANALyze?

Example
```
:SEARCH:SPI:ANALYZE? -> :SEARCH:SPI:
ANALYZE:SETUP:CLOCK:LEVEL 1.000E+00;
HYSTERESIS 0.3;POLARITY RISE;:
SEARCH:SPI:ANALYZE:SETUP:DATA1:
MODE 1;LEVEL 1.000E+00,0.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:DATA2:
MODE 1;LEVEL 1.000E+00,0.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:CS:CHANNEL4:
MODE 1;ESTATE LOW;LEVEL 1.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:CS:
ESTATE LOW;:SEARCH:SPI:ANALYZE:
SETUP:RPOINT TRIGGER;
MPOSITION 0.00000;BITORDER MSBFIRST
```

:SEARch:SPI:ANALyze:ABORt

Function Aborts the SPI analysis execution.

Syntax :SEARch:SPI:ANALyze:ABORt

Example :SEARCH:SPI:ANALYZE:ABORT

:SEARch:SPI:ANALyze:EXECute

Function Executes the SPI analysis.

Syntax :SEARch:SPI:ANALyze:EXECute

Example :SEARCH:SPI:ANALYZE:EXECUTE

:SEARch:SPI:ANALyze:SETup?

Function Queries all settings related to the SPI analysis conditions.

Syntax :SEARch:SPI:ANALyze:SETup?

Example
```
:SEARCH:SPI:ANALYZE:SETUP? ->
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
LEVEL 1.000E+00;HYSTERESIS 0.3;
POLARITY RISE;:SEARCH:SPI:ANALYZE:
SETUP:DATA1:MODE 1;
LEVEL 1.000E+00,0.000E+00;:SEARCH:
SPI:ANALYZE:SETUP:DATA2:MODE 1;
LEVEL 1.000E+00,0.000E+00;:SEARCH:
SPI:ANALYZE:SETUP:CS:CHANNEL4:
MODE 1;ESTATE LOW;LEVEL 1.000E+00;:
SEARCH:SPI:ANALYZE:SETUP:CS:
ESTATE LOW;:SEARCH:SPI:ANALYZE:
SETUP:RPOINT TRIGGER;
MPOSITION 0.00000;BITORDER MSBFIRST
```

:SEARch:SPI:ANALyze:SETup:BITorder

Function Sets the bit order of the display of the SPI analysis data results or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:BITorder
{MSBFirst|LSBFirst}
:SEARch:SPI:ANALyze:SETup:BITorder?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:
BITORDER MSBFIRST
:SEARCH:SPI:ANALYZE:SETUP:BITORDER?
-> :SEARCH:SPI:ANALYZE:SETUP:
BITORDER MSBFIRST
```

:SEARch:SPI:ANALyze:SETup:CLOCk?

Function Queries all settings related to the clock channel of the SPI analysis conditions.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CLOCk?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CLOCK? ->
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
LEVEL 1.000E+00;HYSTERESIS 0.3;
POLARITY RISE
```

:SEARch:SPI:ANALyze:SETup:CLOCk:HYSTeresis

Function Sets the clock channel hysteresis of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CLOCk:
HYSTeresis {<NRf>}
:SEARch:SPI:ANALyze:SETup:CLOCk:
HYSTeresis?
<NRf> = 0.3 to 4.0 (div, 0.1 steps)
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
HYSTERESIS 0.5
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
HYSTERESIS? -> :SEARCH:SPI:ANALYZE:
SETUP:CLOCK:HYSTERESIS 0.5
```

:SEARch:SPI:ANALyze:SETup:CLOCk:LEVel

Function Sets the clock channel level of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CLOCk:
LEVel {<voltage>}
:SEARch:SPI:ANALyze:SETup:CLOCk:
LEVel?
<voltage>=8 divisions within the
screen (0.01 division steps).
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
LEVEL 1V
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
LEVEL? -> :SEARCH:SPI:ANALYZE:SETUP:
CLOCK:LEVEL 1.000E+00
```

:SEARch:SPI:ANALyze:SETup:CLOCk:POLarity

Function Sets the edge of the clock channel to be analyzed of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CLOCk:
POLarity {RISE|FALL}
:SEARch:SPI:ANALyze:SETup:CLOCk:
POLarity?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
POLARITY RISE
:SEARCH:SPI:ANALYZE:SETUP:CLOCK:
POLARITY? -> :SEARCH:SPI:ANALYZE:
SETUP:CLOCK:POLARITY RISE
```

:SEARch:SPI:ANALyze:SETup:CS?

Function Queries all settings related to the CS signal of the SPI analysis conditions.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CS?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CS? ->
:SEARCH:SPI:ANALYZE:SETUP:CS:CHANNEL4:
MODE 1;LEVEL 1.000E+00;:SEARCH:SPI:
ANALYZE:SETUP:CS:ESTATE LOW
```

:SEARch:SPI:ANALyze:SETup:CS:CHANnel4?

Function Queries all settings related to CH4 of the SPI analysis CS signal conditions.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CS:
CHANnel4?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CS:
CHANNEL4? -> :SEARCH:SPI:ANALYZE:
SETUP:CS:CHANNEL4:MODE 1;
LEVEL 1.000E+00
```

:SEARch:SPI:ANALyze:SETup:CS:CHANnel4:LEVel

Function Sets the level of CH4 of the SPI analysis CS signal conditions.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CS:
CHANnel4:LEVel {<voltage>}
:SEARch:SPI:ANALyze:SETup:CS:
CHANnel4:LEVel?
<voltage>=8 divisions within the
screen (0.01 division steps).
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CS:
CHANNEL4:LEVEL 1V
:SEARCH:SPI:ANALYZE:SETUP:CS:
CHANNEL4:LEVEL? -> :SEARCH:SPI:
ANALYZE:SETUP:CS:CHANNEL4:
LEVEL 1.000E+00
```

:SEARch:SPI:ANALyze:SETup:CS:CHANnel4:MODE

Function Sets whether to handle CH4 as a CS signal (ON/OFF) in the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CS:
CHANnel4:MODE {<Boolean>}
:SEARch:SPI:ANALyze:SETup:CS:
CHANnel4:MODE?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CS:
CHANNEL4:MODE ON
:SEARCH:SPI:ANALYZE:SETUP:CS:
CHANNEL4:MODE? -> :SEARCH:SPI:
ANALYZE:SETUP:CS:CHANNEL4:MODE 1
```

:SEARch:SPI:ANALyze:SETup:CS:ESTate

Function Sets the enable state of the CS signal of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:CS:ESTate
{HIGH|LOW|DONTcare}
:SEARch:SPI:ANALyze:SETup:CS:ESTate?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:CS:
ESTATE LOW
:SEARCH:SPI:ANALYZE:SETUP:CS:
ESTATE? -> :SEARCH:SPI:ANALYZE:
SETUP:CS:ESTATE LOW
```

:SEARch:SPI:ANALyze:SETup:DATA<x>?

Function Queries all settings related to the data channel of the SPI analysis conditions.

Syntax
```
:SEARch:SPI:ANALyze:SETup:DATA<x>?
<x>=1, 2
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:DATA1? ->
:SEARCH:SPI:ANALYZE:SETUP:DATA1:
MODE 1;LEVEL 1.000E+00,0.000E+00
```

:SEARch:SPI:ANALyze:SETup:DATA<x>:LEVel

Function Sets the threshold level of the data channel of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:DATA<x>:
LEVel {<voltage>,<voltage>}
:SEARch:SPI:ANALyze:SETup:DATA<x>:
LEVel?
<voltage>=8 divisions within the
screen (0.01 division steps).
<x>=1, 2
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:DATA1:
LEVEL 1V,0V
:SEARCH:SPI:ANALYZE:SETUP:DATA1:
LEVEL? -> :SEARCH:SPI:ANALYZE:
SETUP:DATA1:
LEVEL 1.000E+00,0.000E+00
```

:SEARch:SPI:ANALyze:SETup:DATA<x>:MODE

Function Enables or disables the data channel (ON/OFF) of the SPI analysis conditions or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:DATA<x>:
MODE {<Boolean>}
:SEARch:SPI:ANALyze:SETup:DATA<x>:
MODE?
<x>=1, 2
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:DATA1:
MODE ON
:SEARCH:SPI:ANALYZE:SETUP:DATA1:
MODE? -> :SEARCH:SPI:ANALYZE:SETUP:
DATA1:MODE 1
```

:SEARch:SPI:ANALyze:SETup:MPOSition

Function Sets the reference position when the SPI reference position is set to manual or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:MPOSition
{<NRf>}
:SEARch:SPI:ANALyze:SETup:MPOSition?
<NRf>=–5 to 5 divisions (10
divisions/displayed record length
steps)
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:
MPOSITION -4.000
:SEARCH:SPI:ANALYZE:SETUP:
MPOSITION? -> :SEARCH:SPI:ANALYZE:
SETUP:MPOSITION -4.00000
```

:SEARch:SPI:ANALyze:SETup:RPOint

Function Sets the SPI analysis reference position to the trigger position or manual or queries the current setting.

Syntax
```
:SEARch:SPI:ANALyze:SETup:RPOint
{TRIGger|MANual}
:SEARch:SPI:ANALyze:SETup:RPOint?
```

Example
```
:SEARCH:SPI:ANALYZE:SETUP:
RPOINT TRIGGER
:SEARCH:SPI:ANALYZE:SETUP:RPOINT? ->
:SEARCH:SPI:ANALYZE:SETUP:
RPOINT TRIGGER
```

:SEARch:SPI:LIST?

Function Outputs one byte of SPI analysis result as a character string.

Syntax
```
:SEARch:SPI:LIST? {<NRf>}
<NRf>=–40000 to 40000
```

Example
```
:SEARCH:SPI:LIST? 1 -> “      1
0.024 01010101  00000010  L”
```

:SEARch:SPI:SEARch?

Function Queries all settings related to the SPI analysis result search.

Syntax
```
:SEARch:SPI:SEARch?
```

Example
```
:SEARCH:SPI:SEARCH? -> :SEARCH:SPI:
SEARCH:TYPE FRAME;PFORMAT BINARY;
SOURCE DATA1;DATA:BYTE 8;
PATTERN1 “10X10X10”;
PATTERN2 “0X10X10X”;
PATTERN3 “X10X10X1”;
PATTERN4 “01X01X01”;
PATTERN5 “1X01X01X”;
PATTERN6 “X01X01X0”;
PATTERN7 “X10X10X1”;
PATTERN8 “11010101”
```

:SEARch:SPI:SEARch:DATA?

Function Queries all settings related to the Data search of the SPI analysis results.

Syntax :SEARch:SPI:SEARch:DATA?

Example :SEARCH:SPI:SEARCH:DATA? -> :SEARCH:SPI:SEARCH:DATA:BYTE 8;
PATTERN1 “10X10X10”;
PATTERN2 “0X10X10X”;
PATTERN3 “X10X10X1”;
PATTERN4 “01X01X01”;
PATTERN5 “1X01X01X”;
PATTERN6 “X01X01X0”;
PATTERN7 “X10X10X1”;
PATTERN8 “11010101”

:SEARch:SPI:SEARch:DATA:BYTE

Function Sets the number of data bytes to be searched for the Data search of the SPI analysis results.

Syntax :SEARch:SPI:SEARch:DATA:BYTE {<NRf>}
:SEARch:SPI:SEARch:DATA:BYTE?
<NRf>=1 to 8

Example :SEARCH:SPI:SEARCH:DATA:BYTE 8
:SEARCH:SPI:SEARCH:DATA:BYTE? ->
:SEARCH:SPI:SEARCH:DATA:BYTE 8

:SEARch:SPI:SEARch:DATA:HEXa<x>

Function Sets the Data search pattern of the SPI analysis result in hexadecimals.

Syntax :SEARch:SPI:SEARch:DATA:HEXa<x>
{<string>}
<string>=2 characters by combining ‘0’ to ‘F’ and ‘X’
<x>=1 to 8

Example :SEARCH:SPI:SEARCH:DATA:HEXA1 “1A”

:SEARch:SPI:SEARch:DATA:PATTern<x>

Function Sets the Data search pattern of the SPI analysis results in binary or queries the current setting.

Syntax :SEARch:SPI:SEARch:DATA:PATTern<x>
{<string>}
:SEARch:SPI:SEARch:DATA:PATTern<x>?
<string>=8 characters by combining ‘0,’ ‘1,’ and ‘X’
<x>=1 to 8

Example :SEARCH:SPI:SEARCH:DATA:
PATTERN1 “10X10X10”
:SEARCH:SPI:SEARCH:DATA:PATTERN1? ->
:SEARCH:SPI:SEARCH:DATA:
PATTERN1 “10X10X10”

:SEARch:SPI:SEARch:NEXT?

Function Performs the SPI analysis result search after the current byte and returns the search position.

Syntax :SEARch:SPI:SEARch:NEXT?

Example :SEARCH:SPI:SEARCH:NEXT? -> 10

Description When the search is successful, a value in the range of –40000 to 40000 is returned. If it fails, “NAN” is returned.

:SEARch:SPI:SEARch:PFORmat

Function Sets the format of the search pattern of the SPI analysis results or queries the current setting.

Syntax :SEARch:SPI:SEARch:PFORmat
{HEXa|BINary}
:SEARch:SPI:SEARch:PFORmat?

Example :SEARCH:SPI:SEARCH:PFORMAT BINARY
:SEARCH:SPI:SEARCH:PFORMAT? ->
:SEARCH:SPI:SEARCH:PFORMAT BINARY

:SEARch:SPI:SEARch:PREVious?

Function Performs the SPI analysis result search before the current byte and returns the search position.

Syntax :SEARch:SPI:SEARch:PREVious?

Example :SEARCH:SPI:SEARCH:PREVIOUS? -> -10

Description When the search is successful, a value in the range of –40000 to 40000 is returned. If it fails, “NAN” is returned.

:SEARch:SPI:SEARch:SOURce

Function Sets the data source for performing the SPI analysis result search or queries the current setting.

Syntax :SEARch:SPI:SEARch:SOURce
{DATA1|DATA2}
:SEARch:SPI:SEARch:SOURce?

Example :SEARCH:SPI:SEARCH:SOURCE DATA1
:SEARCH:SPI:SEARCH:SOURCE? ->
:SEARCH:SPI:SEARCH:SOURCE DATA1

:SEARch:SPI:SEARch:TYPE

Function Sets the type of SPI analysis result search or queries the current setting.

Syntax :SEARch:SPI:SEARch:TYPE
{FRAMe|INDefinite}
:SEARch:SPI:SEARch:TYPE?

Example :SEARCH:SPI:SEARCH:TYPE FRAME
:SEARCH:SPI:SEARCH:TYPE? ->
:SEARCH:SPI:SEARCH:TYPE FRAME

:SEARch:TYPE

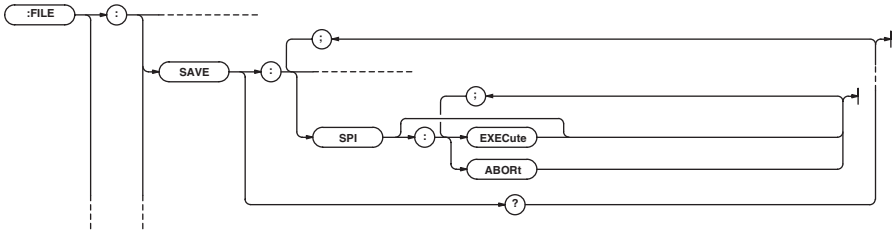
Function Sets the search type or queries the current setting.

Syntax `:SEARch:TYPE {SPATtern|WIDTh|EDGE|PPATtern|ASCRoll|I2CBus|SPIBus}`
`:SEARch:TYPE?`

Example `:SEARCH:TYPE SPIBUS`
`:SEARCH:TYPE? -> :SEARCH:TYPE SPIBUS`

SPI File Group

Commands in the SPI File group can be used to make the same settings, inquiries, and executions as when the SPI bus menu under the FILE key on the front panel is used.



:FILE:SAVE:SPI[:EXECute]

Function Executes the store operation of SPI analysis results. This is an overlap command.

Syntax `:FILE:SAVE:SPI[:EXECute]`

Example `:FILE:SAVE:SPI:EXECUTE`

:FILE:SAVE:SPI:ABORt

Function Aborts the store operation of SPI analysis results.

Syntax `:FILE:SAVE:SPI:ABORt`

Example `:FILE:SAVE:SPI:ABORT`

2.7 Error Messages

This section lists only the error messages related to the SPI bus signal analysis function. There are other error messages related to the DL1640/DL1640L and communications. These messages are described in the *DL1620/DL1640/DL1640L User's Manual IM 701610-01E* and the *Communication Interface User's Manual IM 701610-17E*.

Warnings

Code	Message
37	Analysis aborted.
38	Data not detected. Execute again after changing the settings or reacquiring the waveform.

Errors

Code	Message
779	Specified data does not exist. Execute the analysis.
950	Cannot be specified. Invalid byte or bit.
951	Cannot be set when CS channels are not specified.

3.1 I²C-Bus Signal Analysis Function

Applicable Bus

I²C-Bus

Bus transfer rate: Up to 3.4 Mbits/s
Address mode: 7 bits

SM Bus

Conforms to the System Management Bus

Trigger Function

Trigger Source

CH1: SCL
CH2: SDA
CH3, CH4: Analog signal input

Start Trigger

Activates a trigger on a Start condition.

Non-ACK Trigger

Activates a trigger when an acknowledge is not present.

Address Trigger

Compares with the specified address.

Data Trigger

Compares with the specified data.

Combination Trigger

Set the trigger condition by combining the analog signals of CH3/CH4 and the SCL/SDA signals.

Analysis Function

Detailed Data Display Mode

The time from the Reference Position, the data (simultaneously displays binary and hexadecimal values), and the presence of an acknowledge

Waveform and Data Display Mode

Simultaneously displays the data (hexadecimal) and the waveform

Number of Data Points That Can Be Analyzed

Up to 40000 bytes (20000 bytes before and after the reference point)

Search Function

Pattern Search

Searches data that matches the specified address pattern, data pattern, or Acknowledge bit condition.

Indefinite Data Search

Searches indefinite data.

3.2 SPI Bus Signal Analysis Function

Analysis Function

Signal Input

CH1: Clock signal (SCK)
CH2: Data1 (MOSI)
CH3: Data2 (MISO)
CH4: CS signal (SS)

Detailed Data Display Mode

Displays the time from the Reference Point, the data (select binary or hexadecimal display), and the CS signal state.

Waveform and Data Display Mode

Simultaneously displays the data (hexadecimal) and the waveform

Number of Data Points That Can Be Analyzed

Up to 40000 bytes (20000 bytes before and after the reference point)

Search Function

Pattern Search

Searches data that matches the specified data pattern.

Indefinite Data Search

Searches indefinite data.

Index

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