Instruction Manual

DL1540CL
Digital Oscilloscope
I^2C-Bus Analysis Function

IM 701540-61E
2nd Edition

YOKOGAWA
Yokogawa Electric Corporation

IM 701540-61E
2nd Edition

Foreword

Thank you for purchasing the Digital Oscilloscope DL1540CL/F5 with the I^2C-bus analysis function.
This User's Manual describes only the I^2C-bus analysis function. For information about other functions, operating procedures, and handling precautions of the DL1540CL, see the following manuals:

Manual Name	Manual No.	Description
DL1540C/1540CL User's Manual	IM701530-01E	Explains all functions and procedures of the DL1540CL excluding the communication functions.
DL1540C/1540CL Communication Interface User's Manual	IM701530-11E	Describes the communication functions of the GP-IB and RS-232-C interface.

Notes

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

About the I^2C-Bus Analysis Function

- By using this function, you will be able to analyze data while displaying the bus signal waveform--a function that is not available with conventional I^2C-bus analyzers.
- Signals can be captured by using the Start condition, address (7 bits + R/W), and data as trigger conditions. Triggers can also be activated by combining CH3 and CH4 signals.
- You can display the captured waveform in hexadecimal or binary notation for each data set, search data that match a specified data pattern, and display the resultant data expanded on the ZOOM display.

Trademarks

- PostScript is a registered trademark of Adobe Systems Incorporated.
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Contents

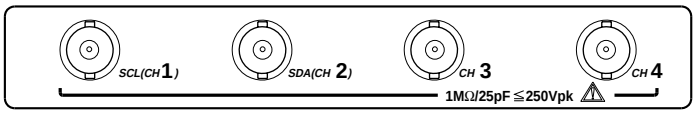
1. Connecting the Probe

Input Terminals

A probe must be connected to one of the input terminals located at the lower section of the front panel. The input impedance is 1 MΩ ±1.5% and approximately 25 pF.

CAUTION

The maximum input voltage is 250 V (DC + ACpeak) or 177 Vrms when the frequency is 1 kHz or less. Never input a voltage exceeding this level, as it could damage the input section of the instrument. If the frequency is above 1 kHz, the input section may be damaged even when the voltage is below 250 V.

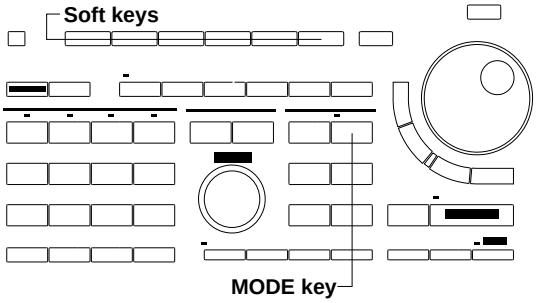


Precautions to Be Taken When Connecting a Probe

- When analyzing the I^2C-bus, apply the clock and data signals to the SCL (Serial Clock) and SDA (Serial Data) input terminals, respectively.
- When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in section 3.6, “Compensating the Probe (Phase Correction)” in the User’s Manual IM701530-01E. Failure to do so may result in unstable gain across different frequencies, thereby preventing correct measurement. Calibration must be performed for each channel.
- If the object being measured is directly connected to the instrument without using a probe, correct measurements may not be possible due to the load effect.

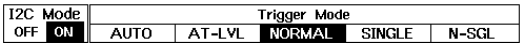
2. Turning ON the I²C-Bus Analysis Function

Keys



Procedure

1. Press the **MODE** key.
2. Press the "**I2C Mode**" soft key to select OFF or ON.
3. Press the "**Trigger Mode**" soft key to select the trigger mode.



Explanation

I²C-bus analysis function

The following functions become available when the I²C-bus analysis function is turned ON:

- START, Non-Ack, ADRS, and Byte Count triggers (page 8).
- Analyze waveforms at the byte level and list the results (page 19).
- Search the analysis results at the byte level (page 19).
- Display the search results to the ZOOM display (page 19).

When the I²C-bus analysis function is turned ON, the waveform display automatically switches to "Main&Zoom."

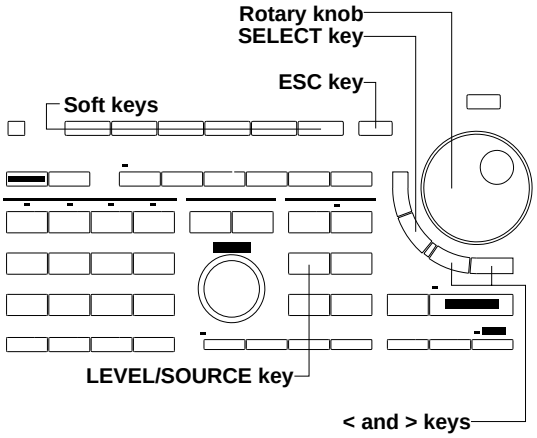
When the function is turned OFF, the DL1540CL operates as a normal 4-channel digital oscilloscope.

Precautions to be taken when using the I²C-bus analysis function

- When the I²C analysis function is turned ON, FFT and GO/NO-GO zone determination cannot be used.
- When FFT or GO/NO-GO zone determination is being used, the I²C analysis function cannot be turned ON.
- Analysis cannot be performed (hexadecimal/binary display for each data set or search) when the trigger mode is set to Auto-mode (AUTO) or Auto-level mode (AT-LVL) and the display mode is set to roll mode.

3. Setting the Trigger Level and Trigger Source

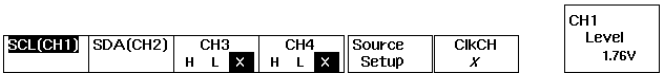
Keys



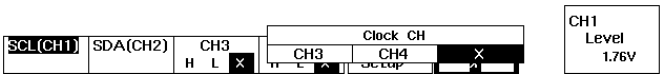
Procedure

Setting the trigger level of the SCL and SDA channels

1. Press the **LEVEL/SOURCE** key to display the trigger source/level selection menu.
2. Press the "**SCL(CH1)**" or "**SDA(CH2)**" soft key.
3. Turn the rotary knob to set the trigger level. To activate the trigger by combining with the CH3 and CH4 conditions, proceed to step 4.

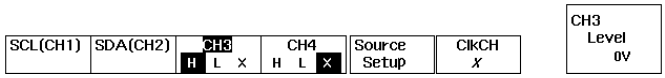


4. Press the "**ClkCH**" soft key to display the clock channel selection menu. The default value is "**X**."



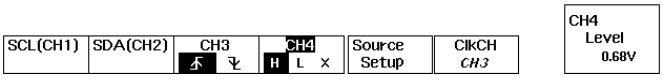
Activating the trigger on the state pattern

5. Press the "**X**" soft key.
6. Press the "**CH3**" or "**CH4**" soft key to select the trigger state.
   If you selected "**H**" or "**L**," turn the rotary knob to set the trigger level. Proceed to step 8.



Activating the trigger in synchronization with the clock channel

5. Continuing from step 4, press the desired clock channel soft key.
6. Select the trigger slope by pressing the clock channel soft key, and then turn the rotary knob to set the trigger level.
7. Press the trigger source soft key for the channel that is not set to be the clock channel, and select the trigger state. If you selected "**H**" or "**L**," turn the rotary knob to set the trigger level.



Selecting the trigger condition

8. Press the "**Source Setup**" soft key to display the setup menu.

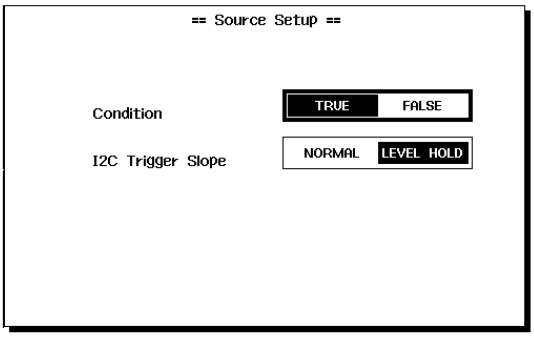
9. Turn the rotary knob to move the cursor onto the "**Condition**" item.

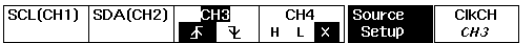
10. Press the **SELECT** key to select the condition.

Selecting the I2C trigger slope

11. Turn the rotary knob to move the cursor onto the "**I2C Trigger Slope**" item.

12. Press the **SELECT** key to select "**NORMAL**" or "**LEVEL HOLD**."





Explanation

Trigger level

The trigger level can be set in the voltage range corresponding to ±10 divisions of the vertical sensitivity. However, it must be within the waveform display frame.
The resolution is 1/50 of the vertical sensitivity.

Setting the trigger source and trigger state

The following three trigger states are available for the trigger source:
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.

Selecting the clock channel (ClkCH)

- Select "X" when the trigger is not to be activated in synchronization with the signal.
- To activate the trigger in synchronization with the signal, select CH3 or CH4 for the clock channel.
- The following trigger slopes are available:
  - ⌐ : Rising edge of the slope (changes from a level below the trigger level to a level greater than or equal to the trigger level).
  - ⌙ : Falling edge of the slope (changes from a level above the trigger level to a level less than or equal to the trigger level).

Selecting the trigger condition (Condition)

- **Activating the trigger on the state pattern**

  ENTER: Activates a trigger when the specified pattern is met.

  EXIT: Activates a trigger when the specified pattern is no longer met.

- **Activating the trigger in synchronization with the clock channel**

  TRUE: Activates a trigger on the rising or falling edge of the clock channel slope while the state pattern is met.

  FALSE: Activates a trigger on the rising or falling edge of the clock channel slope while the state pattern is not met.

I^2C trigger slope (I2C Trigger Slope)

When activating the trigger (state trigger or trigger in synchronization with the clock channel) by combining with the CH3 and CH4 conditions, select whether or not to hold the trigger satisfied condition until the trigger conditions of CH3 and CH4 are met.

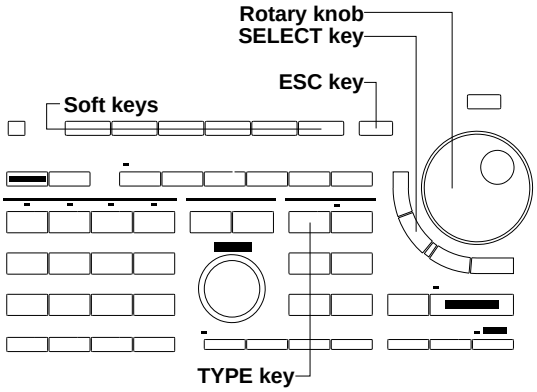
NORMAL: Does not hold the trigger satisfied condition of the SCL and SDA channels (no level hold).

LEVEL HOLD: Holds the trigger satisfied condition of the SCL and SDA channels (use level hold).

For examples related to the level hold settings, see chapter 5, “Trigger Setting Examples.”

4. Selecting the Trigger Type

Keys

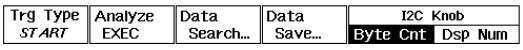


Procedure

1. Press the **TYPE** key to display the trigger type selection menu.
To set a byte-count trigger, proceed to step 2 on the next page.

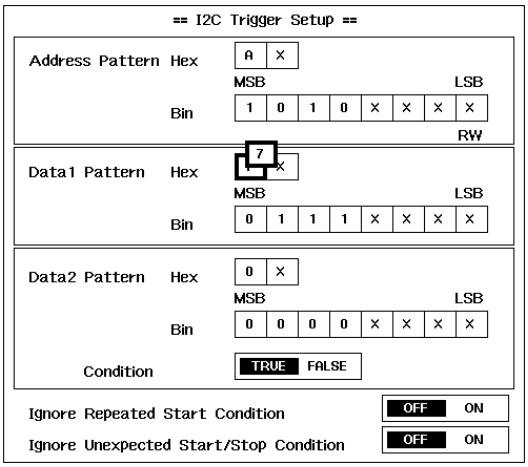
Selecting the trigger type

2. Press the "**Trg Type**" soft key to display the "**I2C Trigger Type**" selection menu.



3. Press the soft key corresponding to the desired trigger type.

When "**ADRS**" is selected, the following menu appears. Proceed to step 4.



Setting the address (Address Pattern)

4. Turn the rotary knob to move the cursor onto the box corresponding to the desired "**Address Pattern**" item.

5. Press the **SELECT** key to display the setting box (setting screen).

6. Turn the rotary knob to set the value. Bits set to "**X**" will not be used as a trigger condition. Press the **SELECT** key or the **ESC** key to close the setting box (setting screen). The value will be confirmed.

Setting the data pattern (Data1 Pattern/Data2 Pattern)

7. Turn the rotary knob to move the cursor onto the box corresponding to the desired "**Data1 Pattern**" or "**Data2 Pattern**" item. Set the value in a similar fashion as in step 5 and 6.

Setting the condition (Condition)

8. Turn the rotary knob to move the cursor onto the "**Condition**" item.

9. Press the **SELECT** key to select "**TRUE**" or "**FALSE**."

Setting whether or not to ignore Repeated Start conditions (Ignore Repeated Start Condition)

10. Turn the rotary knob to move the cursor onto the "**Ignore Repeated Start Condition**" item.

11. Press the **SELECT** key to select "**OFF**" or "**ON**."

Setting whether or not to ignore Start/Stop conditions (Ignore Unexpected Start/Stop Condition)

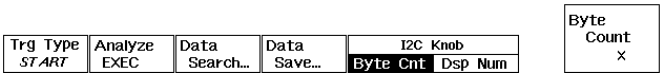
9. Turn the rotary knob to move the cursor onto the "**Ignore Unexpected Start/Stop Condition**" item.

10. Press the **SELECT** key to select "**OFF**" or "**ON**."

Setting the byte-count trigger (Byte Count)

2. Press the "**Byte Cnt**" soft key of the "**I2C Knob**"

3. Turn the rotary knob to set the byte count number.



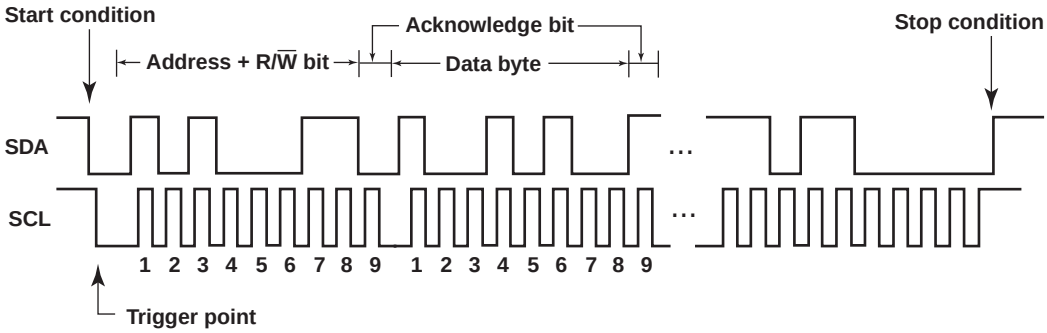
Explanation

Trigger type

The following three types are available:

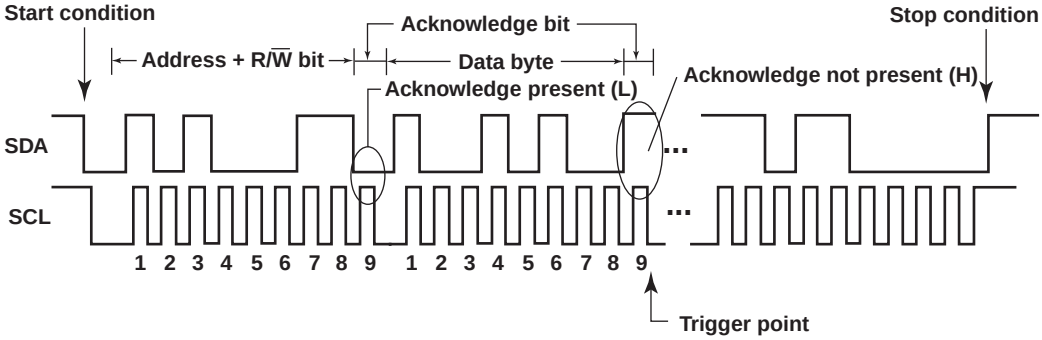
- **START**

  When a Start condition is detected, a trigger is activated on the first falling edge of the SCL signal.



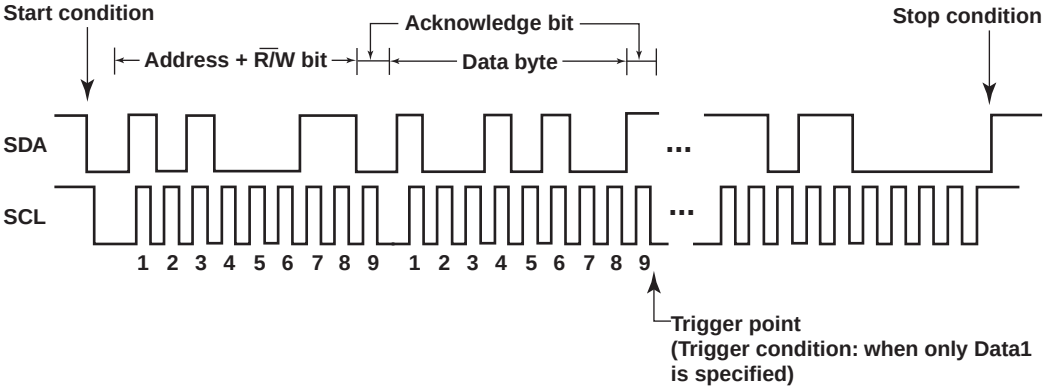
- **Non-ACK**

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



- **ADRS**

  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 data matches the specified pattern.
- Data1 Pattern: Set an 8-bit data pattern. Searches until the data match the specified pattern when the byte count is set to “X.” For all other cases, a trigger is activated when the data immediately after the specified number of byte counts match the specified pattern.
- Data2 Pattern: Set an 8-bit data pattern. Searches until the data match the specified pattern.

The trigger conditions can be specified using binary or hexadecimal values.

Determines whether the data match the specified conditions in the following order: “Address Pattern,” “Data1 Pattern,” and “Data2 Pattern.” When all conditions are met, a trigger is activated.

For the combination of settings, see chapter 5, “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 condition (for “ADRS” only)

Select from the following list of choices. The condition setting applies only to the Data2 Pattern setting.

- TRUE: Activates a trigger when the specified pattern is met.
- FALSE: Activates a trigger when the specified pattern is not met.

Setting whether or not to ignore Repeated Start conditions (for “ADRS” only)

You can select whether or not to ignore the Repeated Start condition that occurs after starting the trigger detection upon detecting the Start condition.

- ON: Ignores the Repeated Start condition and continues with the trigger detection.
- OFF: Restarts the trigger detection when a Repeated Start condition is detected.

Setting whether or not to ignore Start/Stop conditions (for “ADRS” only)

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.

- ON: Ignores the Start/Stop condition and continues with the trigger detection.
- OFF: Restarts or stops the trigger detection when a Start/Stop condition is detected.

Setting the byte-count trigger

A trigger is activated after skipping the specified number of byte counts.

The range is “X” or from 0 to 8191.

Select “X” when the byte-count trigger is not to be used.

The operation varies depending on the combined trigger types. For details, see chapter 5, “Trigger Setting Example.” If the trigger type is set to “Non-Ack,” the byte-count setting is void.

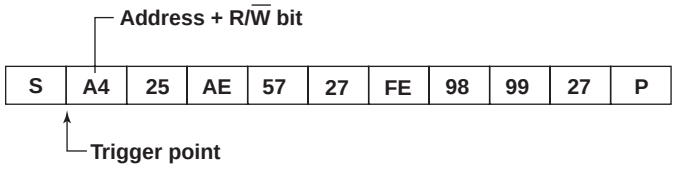
5. Trigger Setting Examples

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

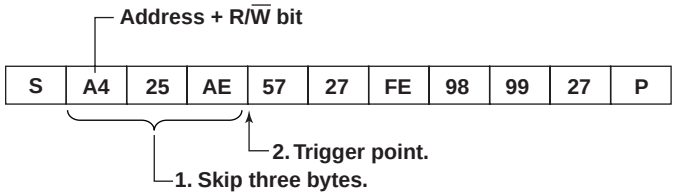
S : Start condition
Sr : Repeated Start condition
P : Stop condition
Shaded area : Byte pattern to be compared

Start Trigger

Byte Count = X or 0

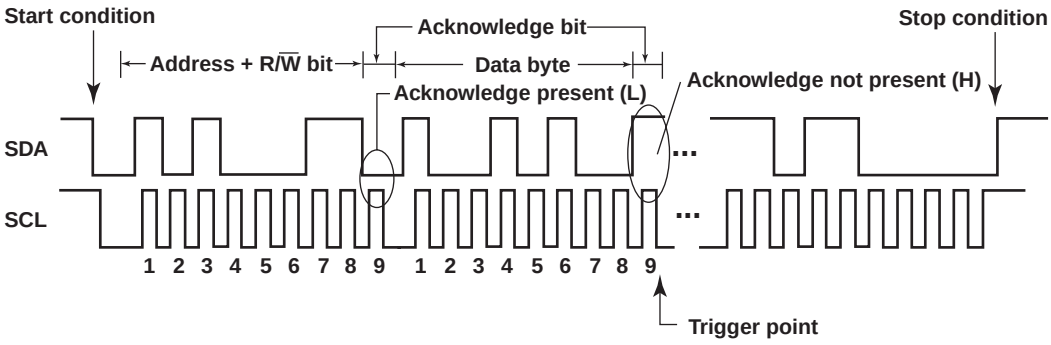


Byte Count = 3



Non-Ack Trigger

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



Note

The Acknowledge bit is never present in the Start byte. However, it is not considered to be a Non-Ack trigger.

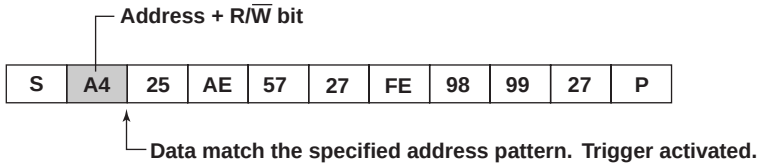
Address Trigger

Trigger only on the Address Pattern

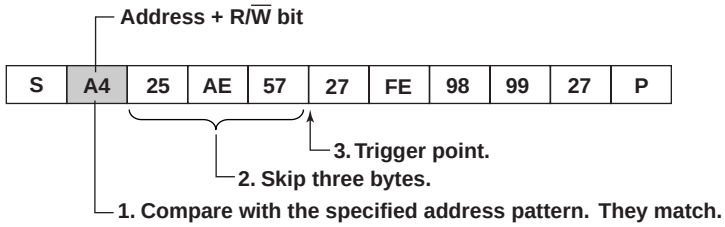
Trigger condition

Address Pattern	: A4
Data1 Pattern	: XX
Data2 Pattern	: XX
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF

- **Byte Count = X or 0**



- **Byte Count = 3**

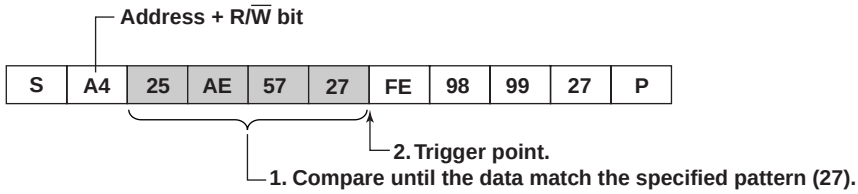


Trigger only on the Data1 Pattern

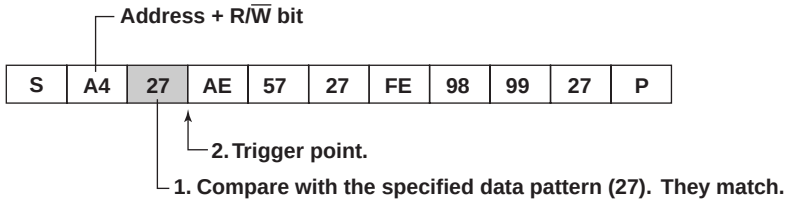
Trigger condition

Address Pattern	: XX
Data1 Pattern	: 27
Data2 Pattern	: XX
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF

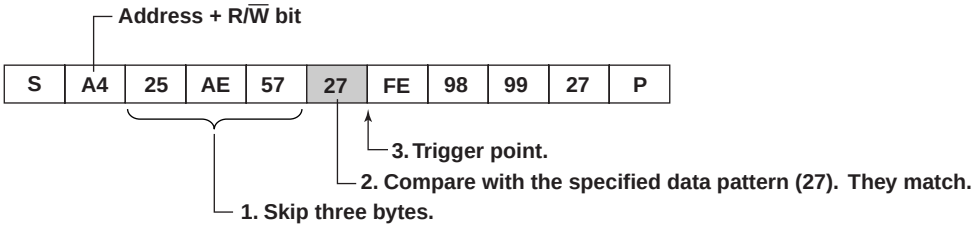
- **Byte Count = X**



- **Byte Count = 0**



- **Byte Count = 3**

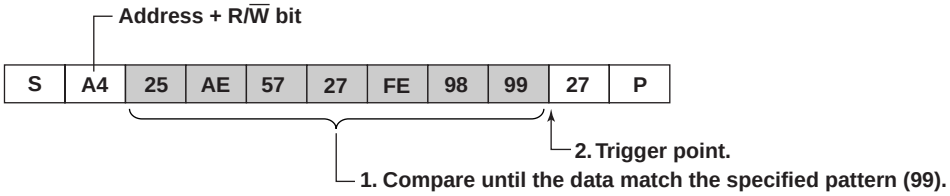


Trigger only on the Data2 Pattern

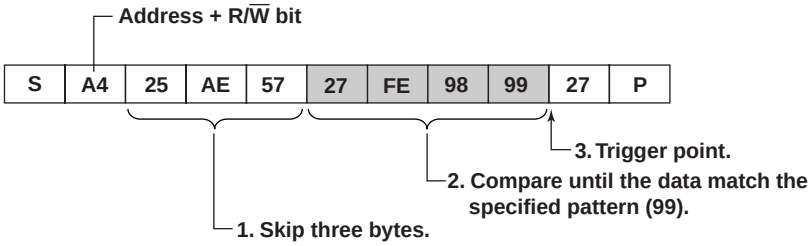
Trigger condition

Address Pattern	: XX
Data1 Pattern	: XX
Data2 Pattern	: 99
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF

- **Byte Count = X or 0**



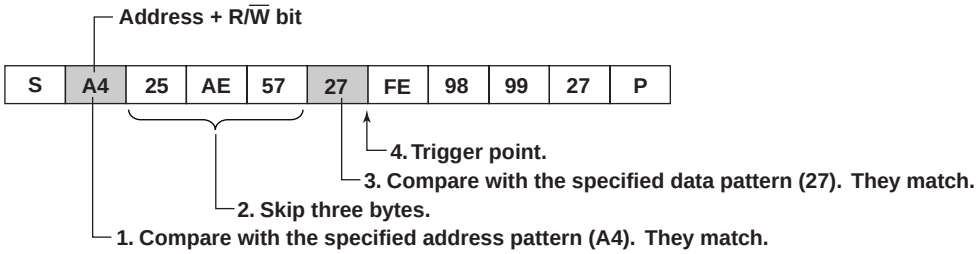
- **Byte Count = 3**



A combination of Address Pattern, Data1 Pattern, and byte-count trigger

Trigger condition

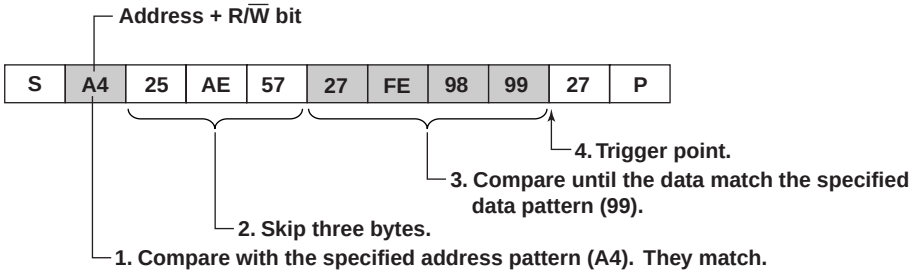
Address Pattern	: A4
Data1 Pattern	: 27
Data2 Pattern	: XX
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF
Byte Count	: 3



A combination of Address Pattern, Data2 Pattern, and byte-count trigger

Trigger condition

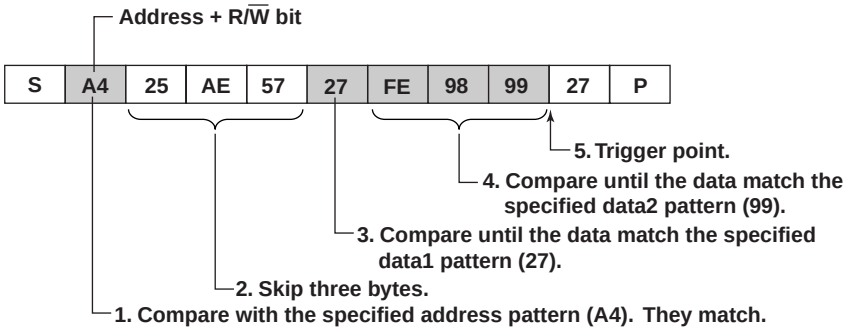
Address Pattern	: A4
Data1 Pattern	: XX
Data2 Pattern	: 99
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF
Byte Count	: 3



A combination of Address Pattern, Data1 Pattern, Data2 Pattern, and byte-count trigger

Trigger condition

Address Pattern	: A4
Data1 Pattern	: 27
Data2 Pattern	: 99
Condition	: TRUE
Ignore Repeated Start Condition	: OFF
Ignore Unexpected Start/Stop Condition	: OFF
Byte Count	: 3

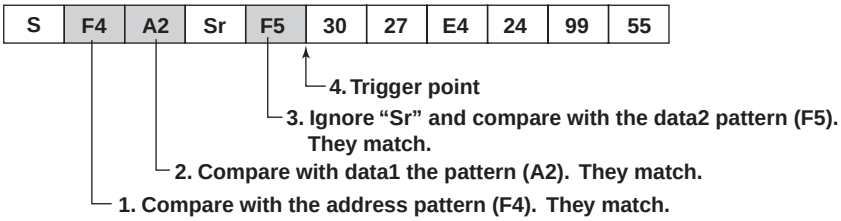


Ignore or not ignore the Repeated Start condition

Trigger condition

Address Pattern : F4
Data1 Pattern : A2
Data2 Pattern : F5
Condition : TRUE
Ignore Unexpected Start/Stop Condition : OFF

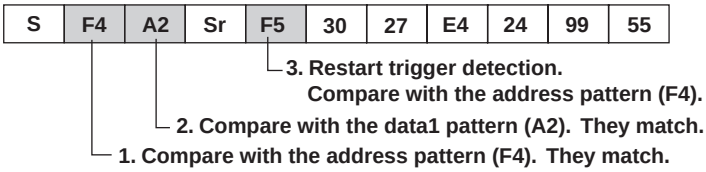
- **When the Ignore Repeated Start Condition = ON**



Note

The trigger condition in the above figure can be used to activate a trigger on 10-bit address data. However, if the trigger condition is met before the "Sr," a trigger is activated at that point.

- **When the Ignore Repeated Start Condition = OFF**

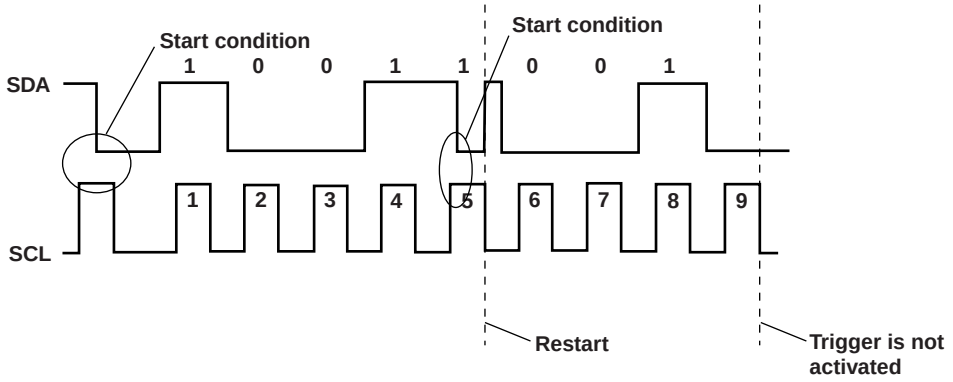


Ignore or not ignore the Start/Stop condition

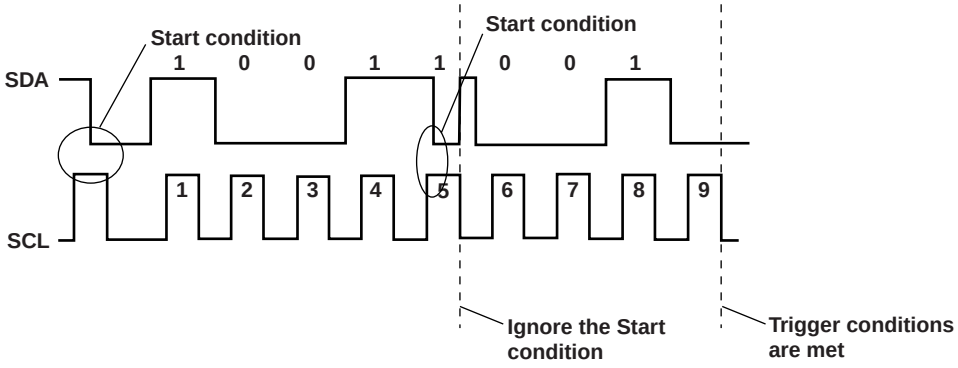
Trigger condition

Address Pattern	:	99
Data1 Pattern	:	XX
Data2 Pattern	:	XX
Condition	:	TRUE
Ignore Repeat Start Condition	:	OFF

- **When the Ignore Start/Stop Condition = OFF**



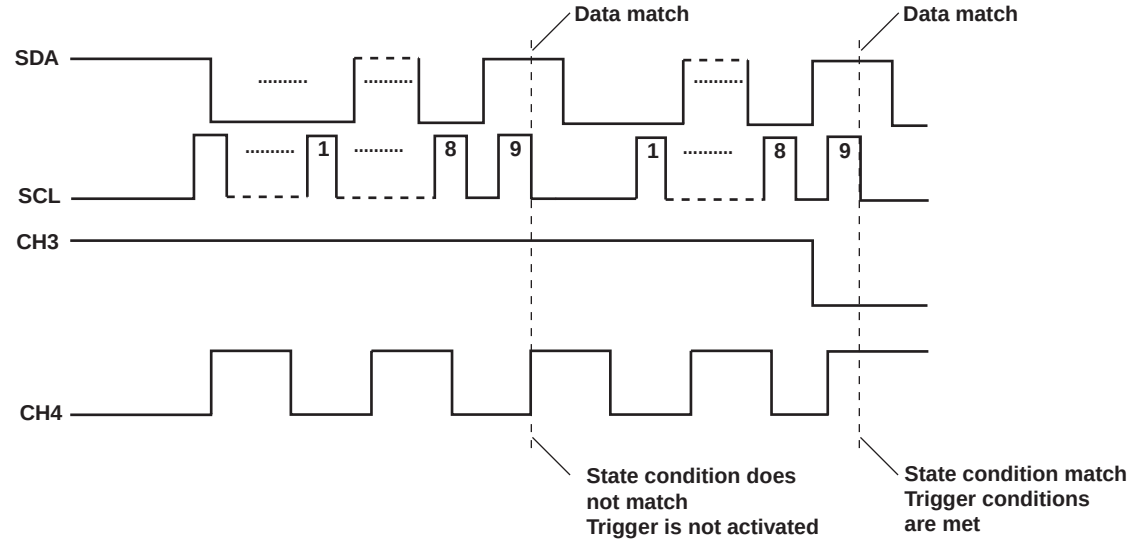
- **When the Ignore Start/Stop Condition = ON**



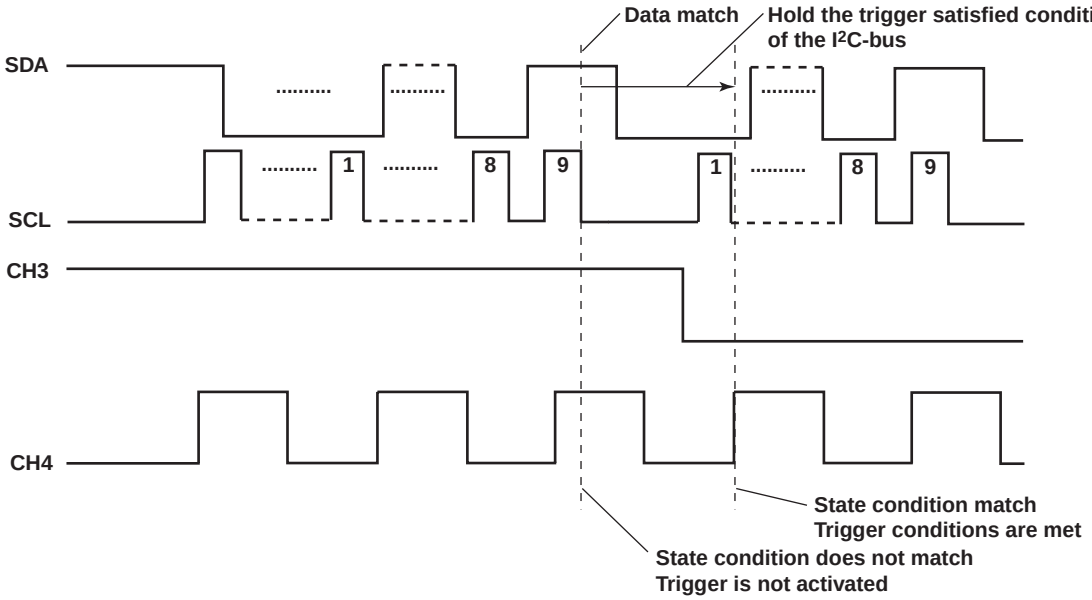
A Combination with the State Trigger

Data pattern trigger, CH3 = L, and CH4 = H

- **No level hold (NORMAL)**



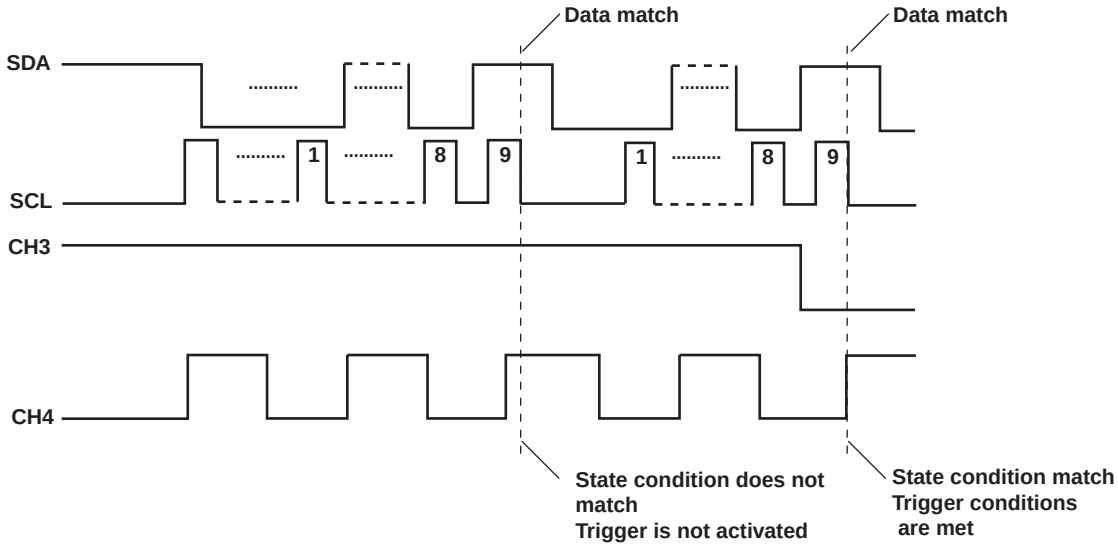
- **Use level hold (LEVEL HOLD)**



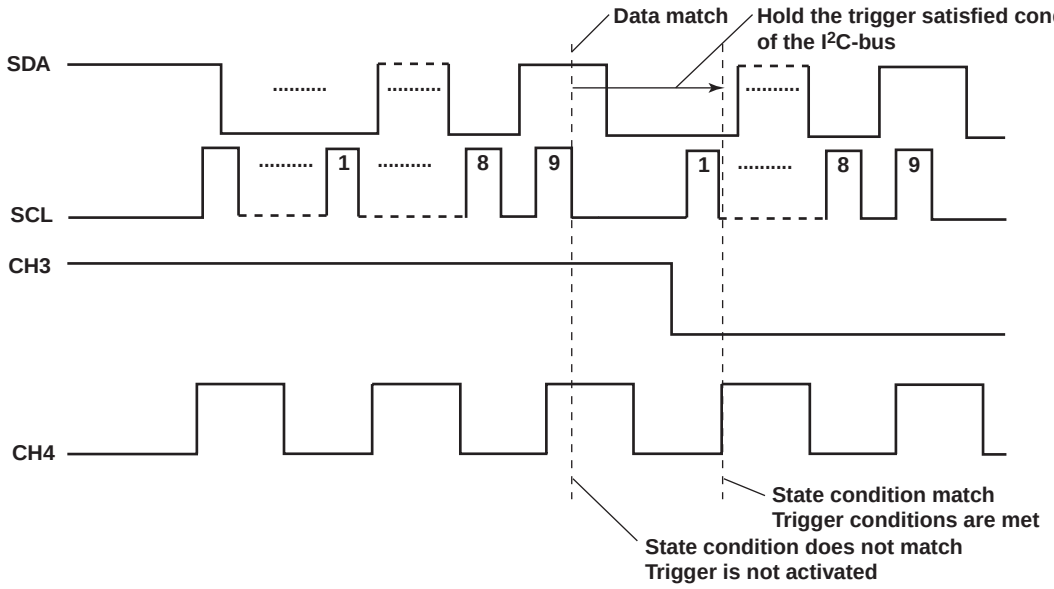
A Trigger Synchronized to the Clock Signal

Data pattern trigger, CH3 = L, ClkCH = CH4, and

- **No level hold (NORMAL)**

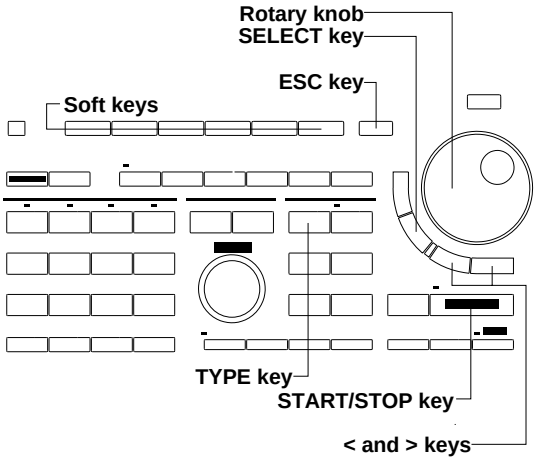


- **Use level hold (LEVEL HOLD)**



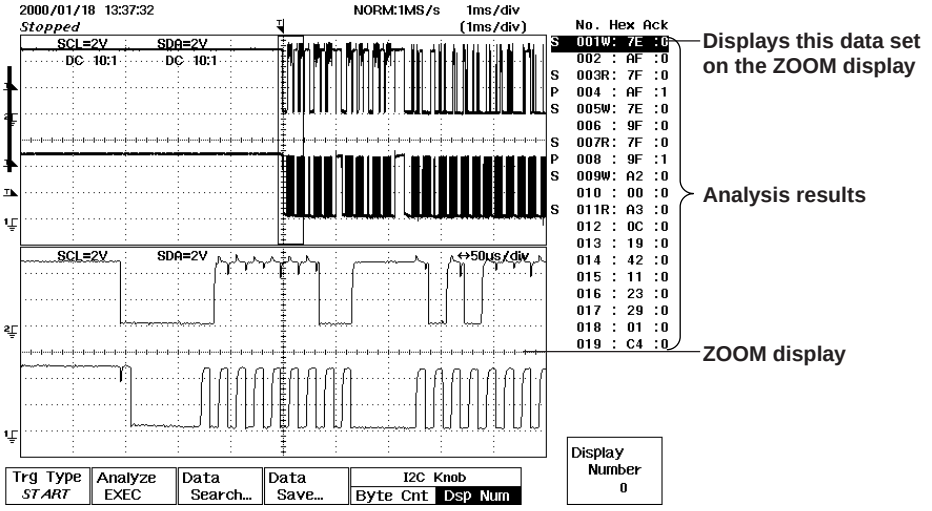
6. Performing Analysis

Keys



Procedure

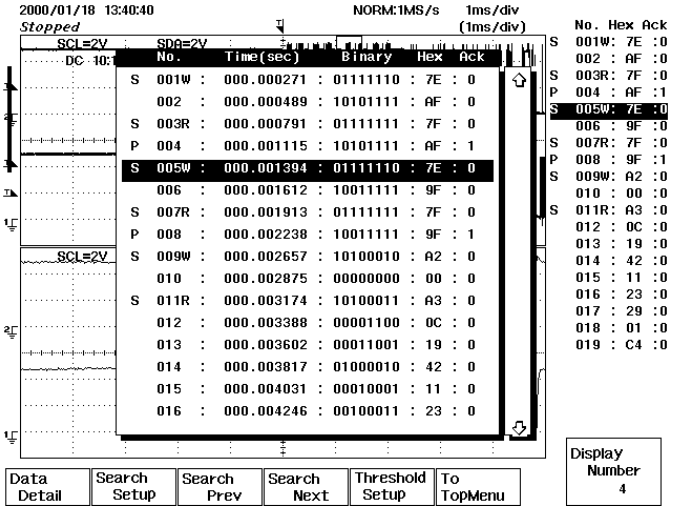
1. Press the **TYPE** key.
2. Press the **START/STOP** key to stop the waveform acquisition.
3. Press the "**Analyze EXEC**" soft key to analyze the waveform and display the results to the right side of the screen.



Detailed display of the analysis results

4. Press the "**Data Search**" soft key to display the search setting menu.

5. Press the "**Data Detail**" soft key to display the detailed display of the analysis results.



Setting the search pattern

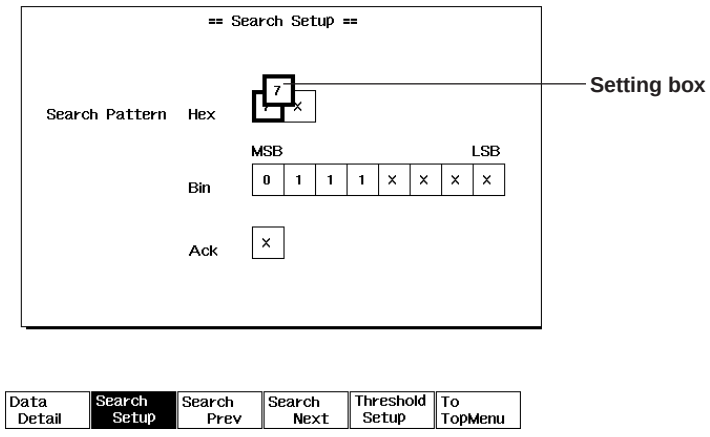
6. Press the "**Search Setup**" soft key to display the setup menu.

7. Turn the rotary knob to move the cursor to the box in which to set the search pattern.

8. Press the **SELECT** key to display the setting box (setting screen).

9. Turn the rotary knob to set the value. Press the **SELECT** key or the **ESC** key to close the setting box (setting screen). The value will be confirmed.

10. Display the setting box (setting screen) in a similar fashion for the "**Ack**" pattern. Turn the rotary knob to select "**X**," "**1**," or "**0**," and press the **SELECT** key to confirm the value.

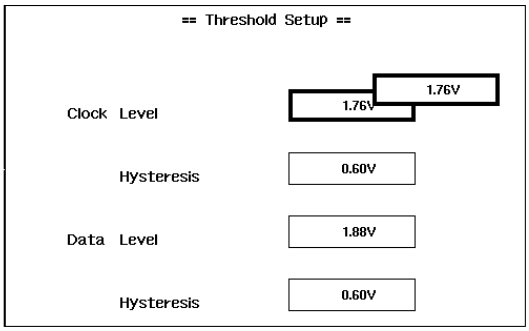


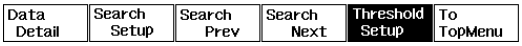
Executing the search

11. Press the "**Search Prev**" soft key to search data existing before the current position.
Press the "**Search Next**" soft key to search data existing after the current position.
When the data match the search pattern, the corresponding data in the detailed display are highlighted.

Setting the threshold level and hysteresis

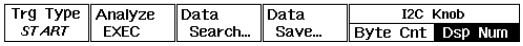
12. Press the "**Threshold Setup**" soft key to display the setup menu.
13. Turn the rotary knob to move the cursor onto the desired item.
14. Press the **SELECT** key to display the setting box (setting screen).
15. Set the value according to step 9.
16. Press the "**To TopMenu**" soft key and then the "**Analyze EXEC**" soft key to analyze the data using the new threshold level.

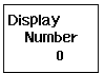




Specifying the display number of the analysis results

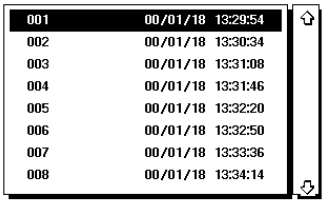
2. Press the "**Dsp Num**" soft key.
3. Turn the rotary knob to set the display number.





Saving the analysis results

3. Press the "**Data Save**" soft key to display the save setting menu.
4. Press the "**Filename**" soft key to display the keyboard and enter the filename. As necessary, turn ON/OFF the auto naming function (AutoFile).
5. Press the "**EXEC**" soft key to save the analysis results.



Explanation

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).
- Sequentially stored data.

Analysis is performed only on the selected waveform for historical data and sequentially stored data.

Analysis range

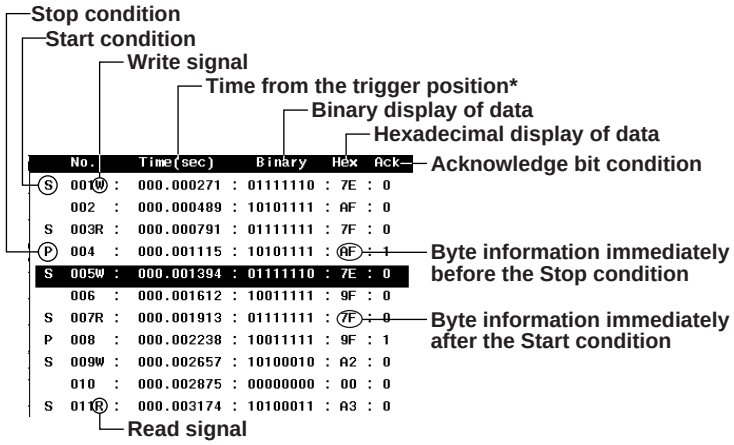
Analysis is performed on the acquisition data within the display screen. However, the analysis results that can be displayed are from -999 to 999 from the trigger position.

Performing the analysis

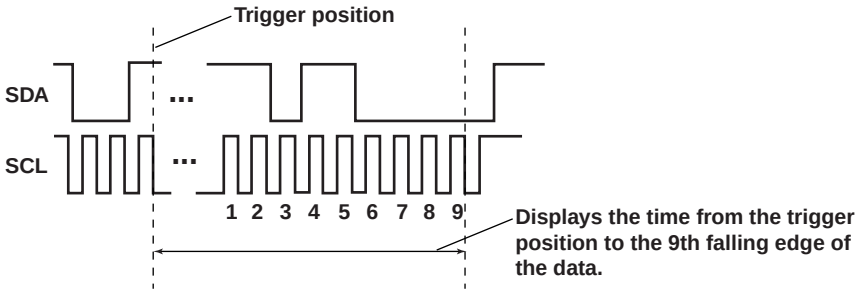
When analysis is performed, the results are listed on the right side of the screen.
In addition, one byte of data corresponding to the analysis number specified with the “Display Number” parameter is displayed expanded in the ZOOM display.
If the analysis is performed when the horizontal position is not at 0 division, the horizontal position is first changed to 0 division, the waveform is displayed, and the analysis is performed.

Detailed display of the analysis results

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



*** About the Time (sec) display**



Specifying the display number of the analysis results

In the detailed display screen, the data corresponding to the specified number are highlighted.
In the waveform display screen, the data corresponding to the specified number are displayed in the ZOOM display. The expansion rate is automatically set to a value that displays one byte from the top of the data.

Setting the search pattern

Set the byte pattern to be searched in binary or hexadecimal notation.
You can also set the condition of the Acknowledge bit.
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.”

Executing the search

Searches data that match the specified search pattern in forward and backward directions. When the data match the search pattern, the corresponding data in the detailed display of the analysis results are highlighted. In addition, the matched data are displayed expanded in the ZOOM display.

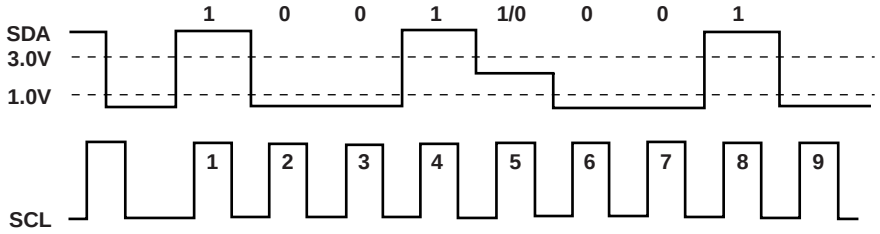
Setting the threshold level and hysteresis

You can change the threshold level and hysteresis used to analyze the waveforms on the SCL and SDA channels.
If you change the level of the SCL and SDA channels in the SOURCE/LEVEL key menu, the threshold in this menu also changes.
The range is as follows:

- Threshold level: 8 divisions within the screen (0.02 division steps).
- Hysteresis: Voltage value corresponding to 0.3 divisions to 2.0 divisions on the selected V/div setting (0.02 division steps).

Threshold level setting example

- When the threshold level = 1.0 V: Analyzed as “10011001.”
- When the threshold level = 3.0 V: Analyzed as “10010001.”



Saving the analysis results

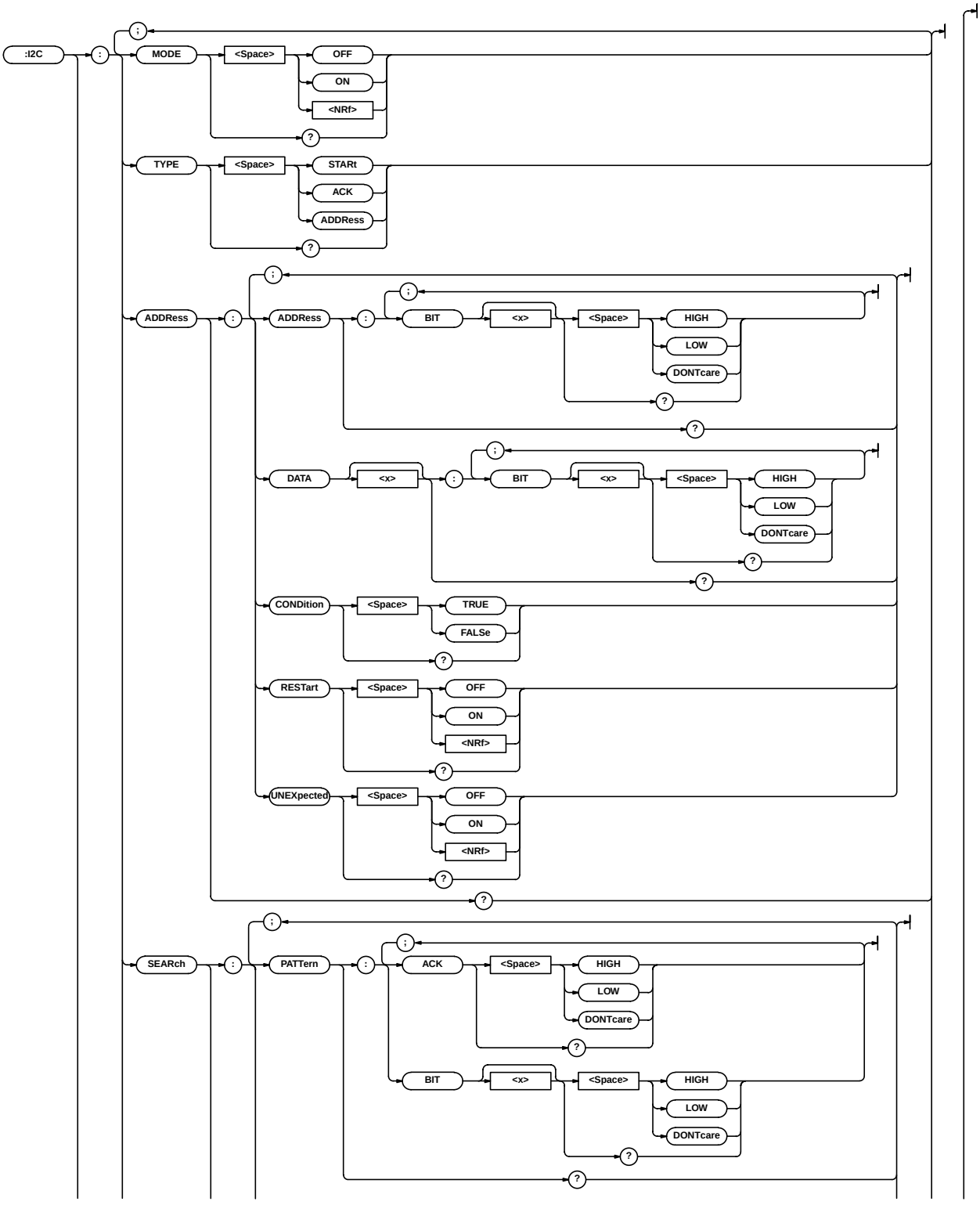
- **Save destination and data format**
  The data are saved in ASCII format to the “DL_MISC” directory in the storage medium selected with the “**Media***” soft key in the menu that appears when the **SHIFT+STORE/RECALL(FILE)** key is pressed.
  * Appears if you are using the SCSI interface unit (sold separately) or a model with a built-in hard disk. For all other models, the floppy disk is the save destination.
- **File extension and data size**
  The file extension is “txt.” The data size is (the number of analysis results × 42) + 119 bytes.
- **Entering the filename and auto naming function**
  For details, see section 13 in the User’s Manual IM701530-01E.

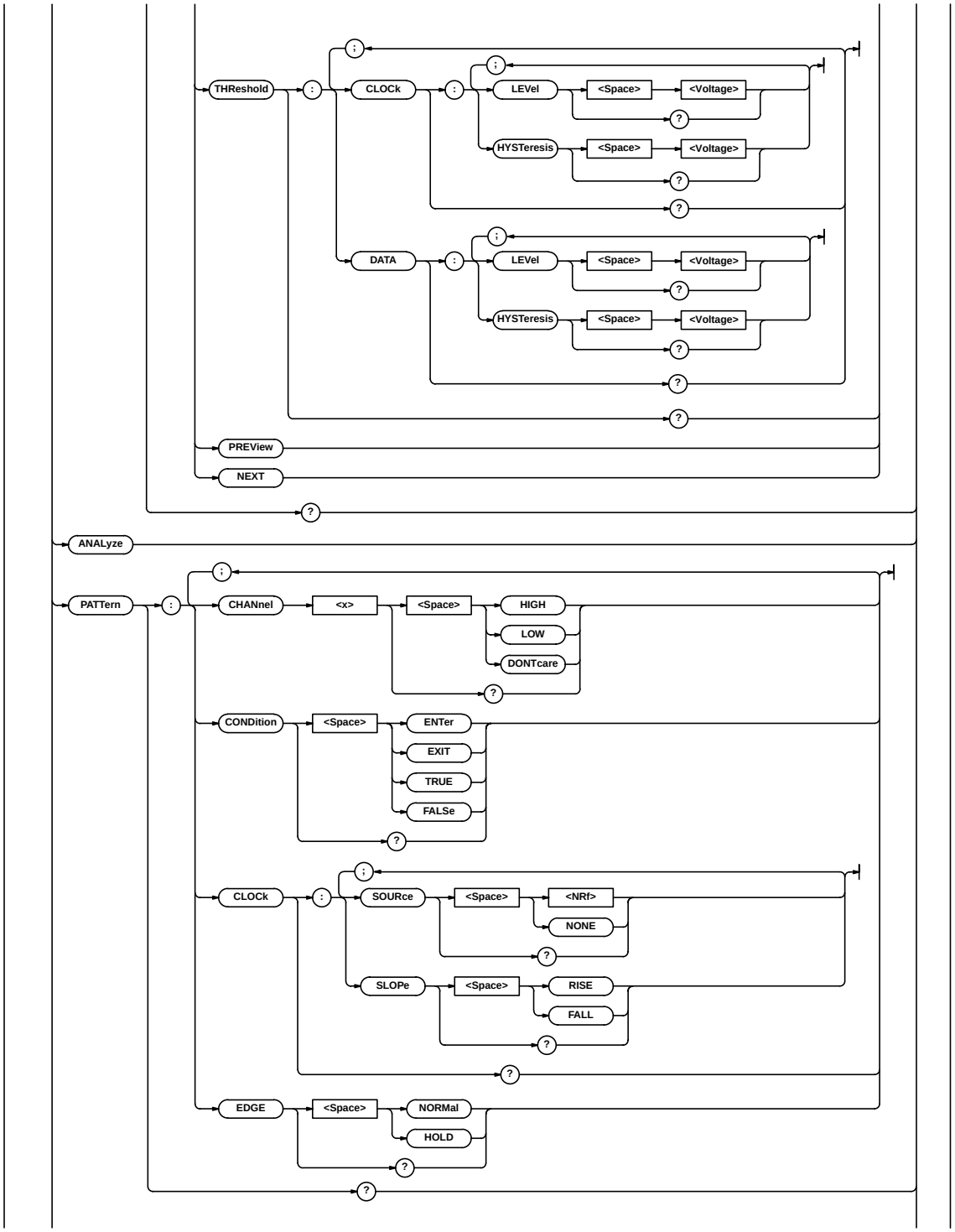
Notes When Performing Analysis

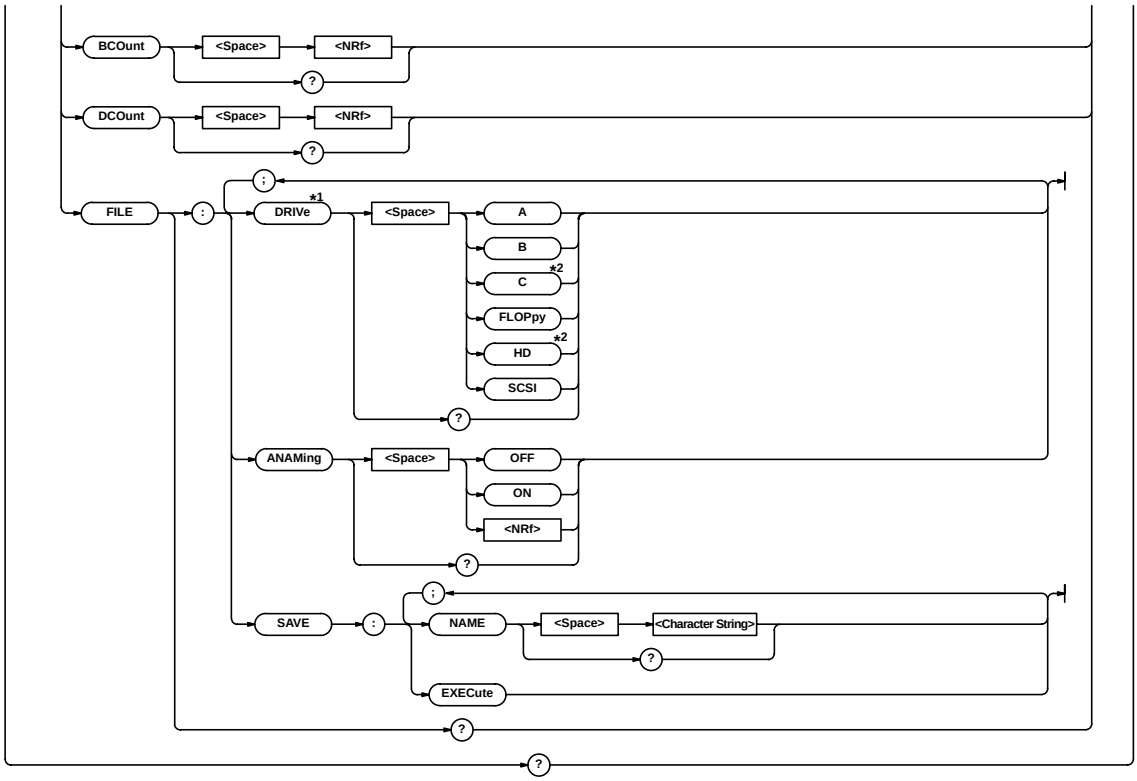
- Analysis and search cannot be performed while the waveform acquisition is started.
- Analysis and search cannot be performed when the trigger mode is set to Auto-mode (AUTO) or Auto-level mode (AT-LVL) and the display mode is set to roll mode.
- If the horizontal position is changed from the 0 division position after performing the analysis, the ZOOM display will not be able to automatically display the data specified by "**Display Number**" and the searched data.
- Analysis and search cannot be performed on accumulated waveforms.

7. Communication Commands (I^2C-Bus Analysis Group)

The commands in the I^2C-bus analysis group are used to make settings related to, and inquiries about the I^2C-bus analysis function. You can make the same settings and inquiries as when the MODE key, TYPE key, and SOURCE/LEVEL key of the TRIGGER group on the front panel are used.




THReshold
CLOCk
LEVel
HYSTeresis
DATA
<Space>
<Voltage>
PREView
NEXT
ANALyze
PATTern
CHANnel
<x>
HIGH
LOW
DONTcare
CONDition
ENTer
EXIT
TRUE
FALSe
SOURce
<NRf>
NONE
SLOPe
RISE
FALL
EDGE
NORMal
HOLD



* The trigger level of SCL and SDA channels are set by setting <x> to 1 and 2, respectively, using the "TRIGger:SOURce:CHANnel<x>:LEVel" command.

*1 Available on models with a built-in hard disk (/C8 option) or through the SCSI interface unit 700930 (sold separately).

*2 Available on models with a built-in hard disk (/C8 option).

I2C?

Function Queries all settings related to the I²C Trigger.

Syntax `I2C?`

Example
```
I2C?→:I2C:MODE 1;TYPE ADDRESS;ADDRESS:
ADDRESS:BIT1 DONTCARE;BIT2 DONTCARE;
BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;
BIT6 DONTCARE;BIT7 DONTCARE;
BIT8 DONTCARE;:I2C:ADDRESS:DATA1:
BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;
BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;
BIT7 DONTCARE;BIT8 DONTCARE;:I2C:ADDRESS:
DATA2:BIT1 DONTCARE;BIT2 DONTCARE;
BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;
BIT6 DONTCARE;BIT7 DONTCARE;
BIT8 DONTCARE;:I2C:ADDRESS:CONDITION TRUE;
RESTART 0;UNEXPECTED 0;:I2C:SEARCH:
PATTERN:BIT1 DONTCARE;BIT2 DONTCARE;
BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;
BIT6 DONTCARE;BIT7 DONTCARE;BIT8 DONTCARE;
ACK DONTCARE;:I2C:SEARCH:THRESHOLD:CLOCK:
LEVEL 0.0E+00;HYSTERESIS 15.0E+00;:I2C:
SEARCH:THRESHOLD:DATA:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00;:I2C:BCOUNT -1;
DCOUNT 0;PATTERN:CLOCK:SOURCE NONE;:I2C:
PATTERN:CONDITION ENTER;CHANNEL3 DONTCARE;
CHANNEL4 DONTCARE;EDGE NORMAL;:I2C:FILE:
ANAMING 0
```

I2C:ADDRess?

Function Queries all settings when the I²C Trigger type is set to Address.

Syntax `I2C:ADDRess?`

Example
```
I2C:ADDRESS?→:I2C:ADDRESS:ADDRESS:
BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;
BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;
BIT7 DONTCARE;BIT8 DONTCARE;:I2C:ADDRESS:
DATA1:BIT1 DONTCARE;BIT2 DONTCARE;
BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;
BIT6 DONTCARE;BIT7 DONTCARE;
BIT8 DONTCARE;:I2C:ADDRESS:DATA2:
BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;
BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;
BIT7 DONTCARE;BIT8 DONTCARE;:I2C:ADDRESS:
CONDITION TRUE;RESTART 0;UNEXPECTED 0
```

I2C:ADDRess:ADDRess?

Function Queries all settings related to the Address pattern when the I²C Trigger type is set to Address.

Syntax `I2C:ADDRess:ADDRess?`

Example
```
I2C:ADDRESS:ADDRESS?→:I2C:ADDRESS:
ADDRESS:BIT1 DONTCARE;BIT2 DONTCARE;
BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;
BIT6 DONTCARE;BIT7 DONTCARE;BIT8 DONTCARE
```

I2C:ADDRess:ADDRess:BIT<x>

Function Sets the bit conditions of the Address pattern when the I²C Trigger type is set to Address, or queries the current setting.

Syntax
```
I2C:ADDRess:ADDRess:BIT<x> {HIGH|LOW|DONTcare}
I2C:ADDRess:ADDRess:BIT<x>?
```
<x>=1 to 8 (1 is RW)

Example
```
I2C:ADDRESS:ADDRESS:BIT1 HIGH
I2C:ADDRESS:ADDRESS:BIT1?→:I2C:ADDRESS:ADDRESS:BIT1 HIGH
```

I2C:ADDRess:CONDition

Function Sets the trigger condition for Data2 when the I²C Trigger type is set to Address, or queries the current setting.

Syntax
```
I2C:ADDRess:CONDition {TRUE|FALSe}
I2C:ADDRess:CONDition?
```

Example
```
I2C:ADDRESS:CONDITION TRUE
I2C:ADDRESS:CONDITION?→:I2C:ADDRESS:CONDITION TRUE
```

I2C:ADDRess:DATA<x>?

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

Syntax
```
I2C:ADDRess:DATA<x>?
```
<x>=1, 2

Example
```
I2C:ADDRESS:DATA1?→:I2C:ADDRESS:DATA1:BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;BIT7 DONTCARE;BIT8 DONTCARE
```

I2C:ADDRess:DATA<x>:BIT<y>

Function Sets the bit conditions of the Data pattern when the I²C Trigger type is set to Address, or queries the current setting.

Syntax
```
I2C:ADDRess:DATA<x>:BIT<y> {HIGH|LOW|DONTcare}
I2C:ADDRess:DATA<x>:BIT<y>?
```
<x>=1, 2
<y>=1 to 8

Example
```
I2C:ADDRESS:DATA1:BIT1 HIGH
I2C:ADDRESS:DATA1:BIT1?→:I2C:ADDRESS:DATA1:BIT1 HIGH
```

I2C:ADDRess:RESTart

Function Sets whether or not to ignore the restart bit of the I²C Trigger condition, or queries the current setting.

Syntax
```
I2C:ADDRess:RESTart {<Boolean>}
I2C:ADDRess:RESTart?
```

Example
```
I2C:ADDRESS:RESTART ON
I2C:ADDRESS:RESTART?→:I2C:ADDRESS:RESTART 1
```

I2C:ADDRess:UNEXpected

Function Sets whether or not to ignore unexpected start and stop bits of the I²C Trigger condition, or queries the current setting.

Syntax
```
I2C:ADDRess:UNEXpected {<Boolean>}
I2C:ADDRess:UNEXpected?
```

Example
```
I2C:ADDRESS:UNEXPECTED ON
I2C:ADDRESS:UNEXPECTED?→:I2C:ADDRESS:UNEXPECTED 1
```

I2C:ANALyze

Function Executes the I²C data analysis.

Syntax
```
I2C:ANALyze
```

Example
```
I2C:ANALYZE
```

I2C:BCOunt

Function Sets the byte count of the I²C Trigger, or queries the current setting.

Syntax
```
I2C:BCOunt {<NRf>}
I2C:BCOunt?
```
<NRf>=-1 to 8191 (-1 is X)

Example
```
I2C:BCOUNT 1
I2C:BCOUNT?→:I2C:BCOUNT 1
```

I2C:DCOunt

Function Sets the displayed data number after the I²C data analysis, or queries the current setting.

Syntax
```
I2C:DCOunt {<NRf>}
I2C:DCOunt?
```
<NRf>=-9999 to 9999

Example
```
I2C:DCOUNT 1
I2C:DCOUNT?→:I2C:DCOUNT 1
```

I2C:FILE?

Function Queries all settings related to saving the I²C analysis data to a file.

Syntax
```
I2C:FILE?
```

Example
```
I2C:FILE?→:I2C:FILE:ANAMING 0
```

I2C:FILE:ANAMing

Function Sets the auto naming function of filenames, or queries the current setting.

Syntax
```
I2C:FILE:ANAMing {<Boolean>}
I2C:FILE:ANAMing?
```

Example
```
I2C:FILE:ANAMING ON
I2C:FILE:ANAMING?→:I2C:FILE:ANAMING 1
```

I2C:FILE:DRIVe

Function Sets the storage medium on which to save the I²C analysis data or queries the current setting. FLOPpy or A specifies the floppy disk; SCSI or B specifies the SCSI; HD or C specifies the built-in hard disk.
A, B, or C is returned in response to a query.

Syntax
```
I2C:FILE:DRIVe {A|B|C|FLOPpy|SCSI|HD}
I2C:FILE:DRIVe?
```

Example
```
I2C:FILE:DRIVE FLOPPY
I2C:FILE:DRIVE?→:FILE:DRIVE A
```

Description
- SCSI can be used through the SCSI interface unit 700930 (sold separately).
- HD can be used when the built-in hard disk (option) is present.
- An error occurs if a SCSI device is not connected or the built-in hard disk is not present.

I2C:FILE:SAVE:EXECute

Function Saves the I²C analysis data.

Syntax
```
I2C:FILE:SAVE:EXECute
```

Example
```
I2C:FILE:SAVE:EXECUTE
```

I2C:FILE:SAVE:NAME

Function Sets the name of the file in which the I²C analysis data are to be saved.

Syntax
```
I2C:FILE:SAVE:NAME <character string>
<character string>=Up to 8 characters.
                   See User's Manual
                   IM701530-01E.
```

Example
```
I2C:FILE:SAVE:NAME "I2C_1"
```

I2C:MODE

Function Sets whether or not to select the I²C Trigger (ON/OFF), or queries the current setting.

Syntax
```
I2C:MODE {<Boolean>}
I2C:MODE?
```

Example
```
I2C:MODE ON
I2C:MODE?→:I2C:MODE 1
```

I2C:PATTern?

Function Queries all settings related to the I²C Trigger pattern.

Syntax
```
I2C:PATTern?
```

Example
```
I2C:PATTERN?→:I2C:PATTERN:CLOCK:
SOURCE NONE;:I2C:PATTERN:CONDITION ENTER;
CHANNEL3 DONTCARE;CHANNEL4 DONTCARE;
EDGE NORMAL
```

I2C:PATTern:CHANnel<x>

Function Sets the state of the I²C Trigger pattern for the channel, or queries the current setting.

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

Example
```
I2C:PATTERN:CHANNEL3 HIGH
I2C:PATTERN:CHANNEL3?→:I2C:PATTERN:
CHANNEL3 HIGH
```

I2C:PATTern:CLOCk?

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

Syntax
```
I2C:PATTern:CLOCk?
```

Example
```
I2C:PATTERN:CLOCK→:I2C:PATTERN:CLOCK:
SLOPE RISE;SOURCE 3
```

I2C:PATTern:CLOCk:SLOPe

Function Sets the slope of the clock channel of the I²C Trigger, or queries the current setting.

Syntax
```
I2C:PATTern:CLOCk:SLOPe {FALL|RISE}
I2C:PATTern:CLOCk:SLOPe?
```

Example
```
I2C:PATTERN:CLOCK:SLOPE RISE
I2C:PATTERN:CLOCK:SLOPE?→:I2C:PATTERN:
CLOCK:SLOPE RISE
```

Description An error occurs if `"I2C:PATTern:CLOCK:SOURce NONE"` is specified.

I2C:PATTern:CLOCk:SOURce

Function Sets the clock channel of the I²C Trigger, or queries the current setting.

Syntax
```
I2C:PATTern:CLOCk:SOURce {<NRf>|NONE}
I2C:PATTern:CLOCk:SOURce?
<NRf>=3, 4
```

Example
```
I2C:PATTERN:CLOCK:SOURCE 3
I2C:PATTERN:CLOCK:SOURCE?→:I2C:PATTERN:
CLOCK:SOURCE 3
```

I2C:PATTern:CONDition

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

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

Example
```
I2C:PATTERN:CONDITION ENTER
I2C:PATTERN:CONDITION?→:I2C:PATTERN:
CONDITION ENTER
```

Description Select from `{ENTer|EXIT}` when `"I2C:PATTern:CLOCk:SOURce NONE"` is specified. For all other cases, select from `{FALSe|TRUE}`.

I2C:PATTern:EDGE

Function Sets the edge mode of the I²C Trigger, or queries the current setting.

Syntax
```
I2C:PATTern:EDGE {NORMal|HOLD}
I2C:PATTern:EDGE?
```

Example
```
I2C:PATTERN:EDGE HOLD
I2C:PATTERN:EDGE?→:I2C:PATTERN:EDGE HOLD
```

I2C:SEARch?

Function Queries all settings related to the search function of the I²C data.

Syntax
```
I2C:SEARch?
```

Example
```
I2C:SEARCH?→:I2C:SEARCH:PATTERN:
BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;
BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;
BIT7 DONTCARE;BIT8 DONTCARE;ACK DONTCARE;:
I2C:SEARCH:THRESHOLD:CLOCK:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00;:I2C:SEARCH:
THRESHOLD:DATA:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00
```

I2C:SEARch:NEXT

Function Moves to the next section that matches the search pattern in the analysis results of the I²C data.

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

Example
```
I2C:SEARCH:NEXT
```

I2C:SEARch:PATTern?

Function Queries all settings related to the search Pattern of the I²C data.

Syntax
```
I2C:SEARch:PATTern?
```

Example
```
I2C:SEARCH:PATTERN?→:I2C:SEARCH:PATTERN:
BIT1 DONTCARE;BIT2 DONTCARE;BIT3 DONTCARE;
BIT4 DONTCARE;BIT5 DONTCARE;BIT6 DONTCARE;
BIT7 DONTCARE;BIT8 DONTCARE;ACK DONTACRE
```

I2C:SEARch:PATTern:ACK

Function Sets the Ack condition of the search pattern of the I²C data, or queries the current setting.

Syntax
```
I2C:SEARch:PATTern:ACK {HIGH|LOW|DONTcare}
I2C:SEARch:PATTern:ACK?
```

Example
```
I2C:SEARCH:PATTERN:ACK HIGH
I2C:SEARCH:PATTERN:ACK?→:I2C:SEARCH:
PATTERN:ACK HIGH
```

I2C:SEARch:PATTern:BIT<x>

Function Sets the bit condition of the search pattern of the I²C data, or queries the current setting.

Syntax
```
I2C:SEARch:PATTern:BIT<x>
{HIGH|LOW|DONTcare}
I2C:SEARch:PATTern:BIT<x>?
<x>=1 to 8
```

Example
```
I2C:SEARCH:PATTERN:BIT1 HIGH
I2C:SEARCH:PATTERN:BIT1?→:I2C:SEARCH:
PATTERN:BIT1 HIGH
```

I2C:SEARch:PREView

Function Moves to the previous section that matches the search pattern in the analysis results of the I²C data.

Syntax
```
I2C:SEARch:PREView
```

Example
```
I2C:SEARCH:PREVIEW
```

I2C:SEARch:THReshold?

Function Queries all settings related to the threshold level of the I²C data.

Syntax
```
I2C:SEARch:THReshold?
```

Example
```
I2C:SEARCH:THRESHOLD?→:I2C:SEARCH:
THRESHOLD:CLOCK:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00;:I2C:SEARCH:THRESHOLD:
DATA:LEVEL 0.0E+00;HYSTERESIS 15.0E+00
```

I2C:SEARch:THReshold:CLOCk?

Function Queries all settings related to the threshold level on the clock side of the I²C data.

Syntax
```
I2C:SEARch:THReshold:CLOCk?
```

Example
```
I2C:SEARCH:THRESHOLD:CLOCK?→:I2C:SEARCH:
THRESHOLD:CLOCK:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00
```

I2C:SEARch:THReshold:CLOCk:HYSTeresis

Function Queries the hysteresis of the threshold level on the clock side of the I²C data, or queries the current setting.

Syntax
```
I2C:SEARch:THReshold:CLOCk:HYSTeresis
{<voltage>}
I2C:SEARch:THReshold:CLOCk:HYSTeresis?
<voltage>= Page 22
```

Example
```
I2C:SEARCH:THRESHOLD:CLOCK:HYSTERESIS 1V
I2C:SEARCH:THRESHOLD:CLOCK:HYSTERESIS?→
:I2C:SEARCH:THRESHOLD:CLOCK:
HYSTERESIS 1.0E+00
```

I2C:SEARch:THReshold:CLOCk:LEVel

Function Queries the level of the threshold level on the clock side of the I²C data, or queries the current setting.

Syntax
```
I2C:SEARch:THReshold:CLOCk:LEVel
{<voltage>}
I2C:SEARch:THReshold:CLOCk:LEVel?
<voltage>= Page 22
```

Example
```
I2C:SEARCH:THRESHOLD:CLOCK:LEVEL 1V
I2C:SEARCH:THRESHOLD:CLOCK:LEVEL?→
:I2C:SEARCH:THRESHOLD:CLOCK:LEVEL 1.0E+00
```

I2C:SEARch:THReshold:DATA?

Function Queries all settings related to the threshold level on the data side of the I²C data.

Syntax
```
I2C:SEARch:THReshold:DATA?
```

Example
```
I2C:SEARCH:THRESHOLD:CLOCK?→:I2C:SEARCH:
THRESHOLD:DATA:LEVEL 0.0E+00;
HYSTERESIS 15.0E+00
```

I2C:SEARch:THReshold:DATA:HYSTeresis

Function Queries the hysteresis of the threshold level on the data side of the I^2C data, or queries the current setting.

Syntax
```
I2C:SEARch:THReshold:DATA:HYSTeresis
{<voltage>}
I2C:SEARch:THReshold:DATA:HYSTeresis?
```
<voltage>= Page 22

Example
```
I2C:SEARCH:THRESHOLD:DATA:HYSTERESIS 1V
I2C:SEARCH:THRESHOLD:DATA:HYSTERESIS?→
:I2C:SEARCH:THRESHOLD:DATA:
HYSTERESIS 1.0E+00
```

I2C:SEARch:THReshold:DATA:LEVel

Function Queries the level of the threshold level on the data side of the I^2C data, or queries the current setting.

Syntax
```
I2C:SEARch:THReshold:DATA:LEVel
{<voltage>}
I2C:SEARch:THReshold:DATA:LEVel?
```
<voltage>= Page 22

Example
```
I2C:SEARCH:THRESHOLD:DATA:LEVEL 1V
I2C:SEARCH:THRESHOLD:DATA:LEVEL?→:I2C:
SEARCH:THRESHOLD:DATA:LEVEL 1.0E+00
```

I2C:TYPE

Function Sets the trigger type of the I^2C Trigger, or queries the current setting.

Syntax
```
I2C:TYPE {ACK|ADDRess|STARt}
I2C:TYPE?
```

Example
```
I2C:TYPE ADDRESS
I2C:TYPE?→:I2C:TYPE ADDRESS
```

8. Error Messages

No.	Message
732	It is not possible to use the Data Detail during acquisition.
733	It is not possible to use the Data Search during acquisition.
734	It is not possible to use the Data Analyze during acquisition.
736	Not found.
737	It is not possible to use the Data Analyze when roll mode acquisition is ON and trigger mode is set to AUTO/AT-LVL at the same time.
839	The operation is not possible in I^2C trigger mode.
840	It is not possible to set I^2C trigger mode in FFT mode.

9. Specifications

Applicable Bus

I^2C-bus

Bus transfer rate Up to 400 kbits/s

Address mode 7 bits

SM bus

Conforms to the System Management Bus

Analysis Function

Detailed data display mode

The time from the trigger 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

1000 bytes before or after the trigger point

Trigger

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. Two bytes can be specified.

Byte-count trigger

Up to 8191 counts can be specified.

Combination trigger

Set the trigger condition by combining the address, data, and byte-count conditions.

Mixed pattern trigger

Parallel pattern trigger is possible between the analog signals of CH3 and CH4 and the I^2C-bus analysis trigger.

10. Index