MX210001A
Jitter Analysis Software
Operation Manual

Sixth Edition

For safety and warning information, please read this manual before attempting to use the equipment.
Keep this manual with the equipment.

ANRITSU CORPORATION

Document No.: M-W3569AE-6.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

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This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

MX210001A
Jitter Analysis Software
Operation Manual

10 August 2011 (First Edition)
25 October 2018 (Sixth Edition)

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Anritsu Corporation guarantees that this equipment was inspected at shipment and meets the published specifications.

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- During the warranty period, Anritsu Corporation will repair or exchange this software free-of-charge if it proves defective when used as described in the operation manual.
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   iii) Recovery of lost or damaged data.
   iv) If this Software or the Equipment has been modified, repaired, or otherwise altered without Anritsu's prior approval.
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Prior to the software installation

Before installing this software or any other software recommended or approved by Anritsu, run a virus scan on your computer, including removable media (e.g. USB memory stick and CF memory card) you want to connect to your computer.

When using this software and connecting with the measuring instrument

- Copying files and data
  On your computer, do not save any copies other than the following:
  - Files and data provided by Anritsu
  - Files created by this software
  - Files specified in this document

  Before copying these files and/or data, run a virus scan, including removable media (e.g. USB memory stick and CF memory card).
- Connecting to network
  Connect your computer to the network that provides adequate protection against computer viruses.

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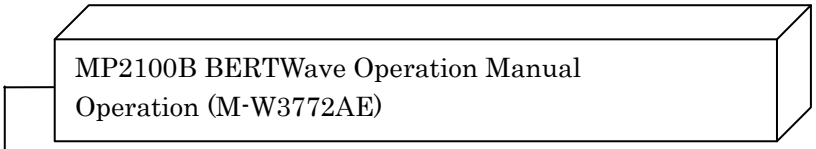
This software may not operate normally if any of the following operations are performed on your computer:

- Simultaneously running any software other than that recommended or approved by Anritsu
- Closing the lid (Laptop computer)
- Turning on the screen saver function
- Turning on the battery-power saving function (Laptop computer)

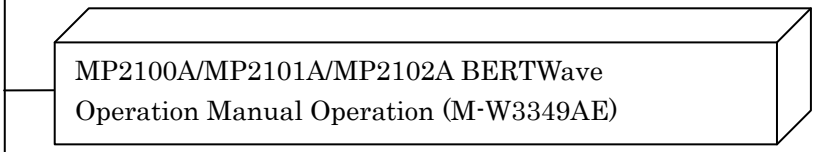
For how to turn off the functions, refer to the operation manual that came with your computer.

About This Manual

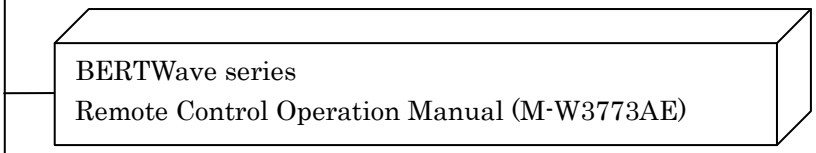
The BERTWave Series has five operation manuals as below.



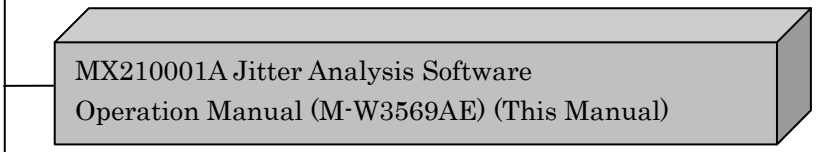
This manual explains the setting method, operating cautions, connection methods for connectors, panel operation, maintenance, specifications, and other functions.



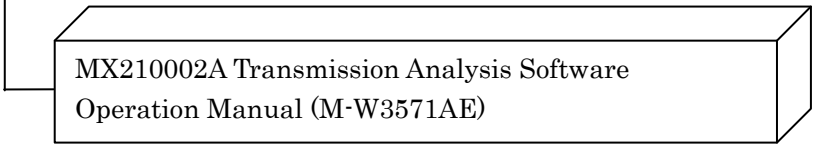
This manual explains the setting method, operating cautions, connection methods for connectors, panel operation, maintenance, specifications, and other functions.



This manual explains the commands to control the MP2100A/MP2101A/MP2102A, status register configuration, and sample programs.



This manual explains the operation method and remote control commands for the MX210001A Jitter Analysis Software.



This manual explains the operation method and remote control commands for the MX210002A Transmission Analysis Software.

For the startup procedure and panel operation of the BERT Wave, refer to *MP2100A BERT Wave, MP2101A BERT Wave PE, MP2102A BERTWave SS Operation Manual* (W3349AE) or *MP2100B BERT Wave Operation Manual* (W3372AE).
For the remote control operation of the BERT Wave, refer to *BERTWave series Remote Control Operation Manual* (W3773AE).

This operation manual assumes the reader has the following basic knowledge of:

- Operations of BERT Wave
- Basic knowledge of Jitter

Convention Used In This Manual

The MX210001A Jitter Analysis Software is referred to as "MX210001A" in the main text.

The names of panel and function keys are in bold.
Example: **Power**

The user interface such as button and tag names are in angled parentheses.
Example: [Jitter], [Start]

Table of Contents

Table of Command

Chapter 1 Outline

This chapter explains the outline, features, and technical terms of MX210001A Jitter Analysis Software.
For the product configuration and specifications, refer to Appendix A "Specifications."

1.1 MX210001A Jitter Analysis Software Outline

The MX210001A Jitter Analysis Software is for jitter analysis and WDP measurement with the use of the sampling oscilloscope function of the MP2100A/MP2102A/MP2100B BERTWave.

Display of jitter elements

The waveform jitter can be measured with the use of the sampling oscilloscope histogram function.
However, the jitter measured with the sampling oscilloscope is the combined values of jitters with various occurrence factors. Actually occurred jitters consist of various jitter elements.

The types of jitter elements which compose actual signals are explained below.

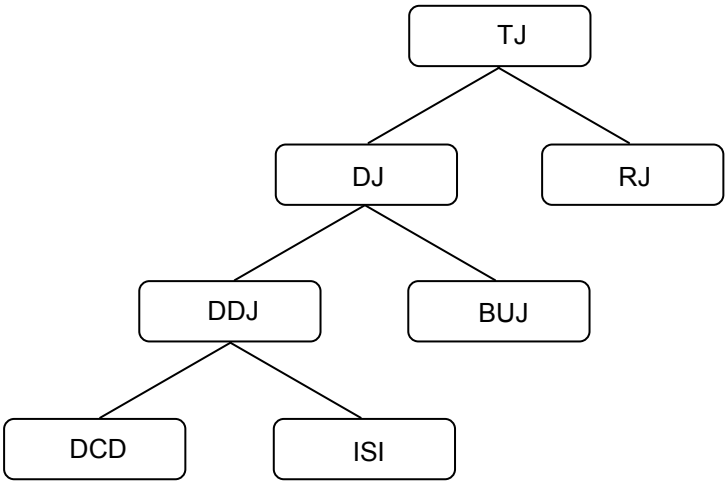


Figure 1.1-1 Jitter Classification

Table 1.1-1 Jitter Type

Name	Description
TJ: Total Jitter	Jitter of combined RJ and DJ Not a simple sum of RJ and DJ
RJ: Random Jitter	Jitter which occurs with external factors such as thermal noise. It has a characteristic to spread unlimitedly which approaches Gaussian distribution. It is indicated with rms (root mean square) because it spreads unlimitedly.
DJ: Deterministic Jitter	Jitter with upper limit of amount relative to the Random Jitter
BUJ: Bounded Uncorrelated Jitter	Jitter which occurs with external factors such as cross talk effects from adjacent signal lines. It has a random nature like the Random Jitter; however, it is indicated with p-p (peak to peak) because its spreading is limited.

Table 1.1-1 Jitter Type (Cont'd)

Name	Description
DDJ: Data Dependant Jitter	Jitter which is DJ and the occurrence amount depends on data.
DCD: Duty Cycle Distortion	Occurs with transmission/reception circuit offset distortion difference of High pulse width and Low pulse width
ISI: Inter Symbol Interference	Phenomenon which occurs with transmission path band lack, reflection with impedance mismatch, and others, and difference between the earliest rising and the latest rising or difference between rising and falling after removal of elements without relativity to data
PJ: Period Jitter	Jitter which is DJ and occurs periodically.

With the communications standards such as SFF-8431*, for the transceiver used for 10 Gigabit communications, specifications for DDPWS (Data Dependant Pulse Width Shrinkage) and WDP (Waveform Distortion Penalty) have been decided as well as the jitters above.

*: For the formal name, refer to Appendix C "Bibliography."

The MX210001A displays the measurement results by jitter element with the format below.

- Numeric values (Unit: ps and UI)
- Histogram
- Spectrum
- Display of patterns for each bit

In addition, with the use of the algorithm released with communications standards, WDP is calculated from the waveform of EYE/Pulse Scope.

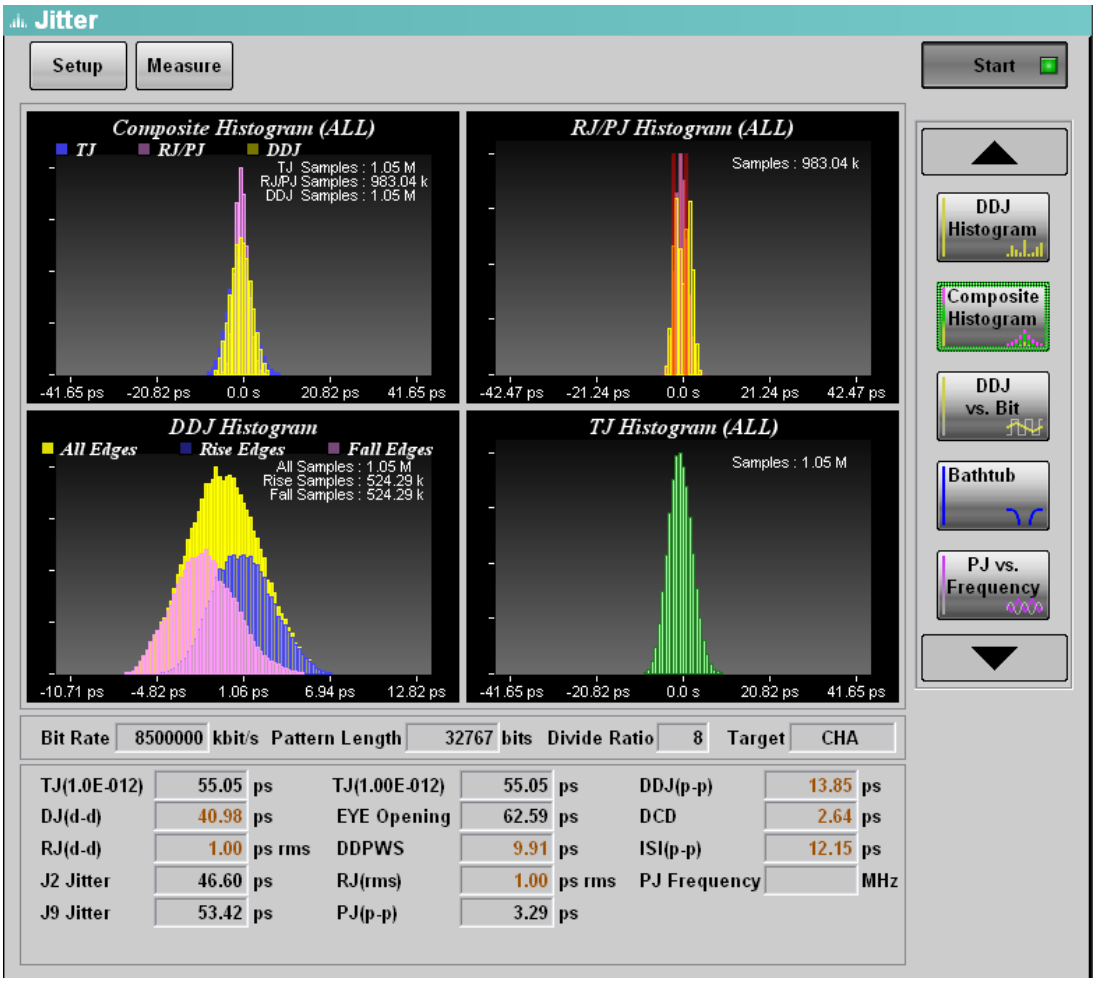


Figure 1.1-2 Display Example of Jitter Measurement Result

Display of histogram

The histogram is a graph to display the occurrence distribution of jitter amount.

The analysis results for waveforms measured with the EYE/Pulse Scope are displayed.

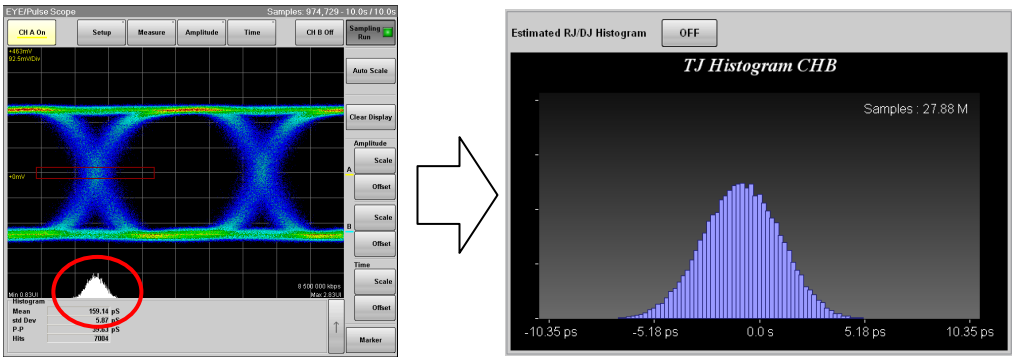


Figure 1.1-3 Display Example of Histogram

DDJ vs Bit

The results of jitter amount measured for each bit with pattern change are displayed with a graph.

The time difference of a clock and waveform is measured at the cross point level, and the result is plotted on the pattern location.

When the waveform time is slower than the clock, the value is positive, and when the waveform time is faster than the clock, the value is negative.

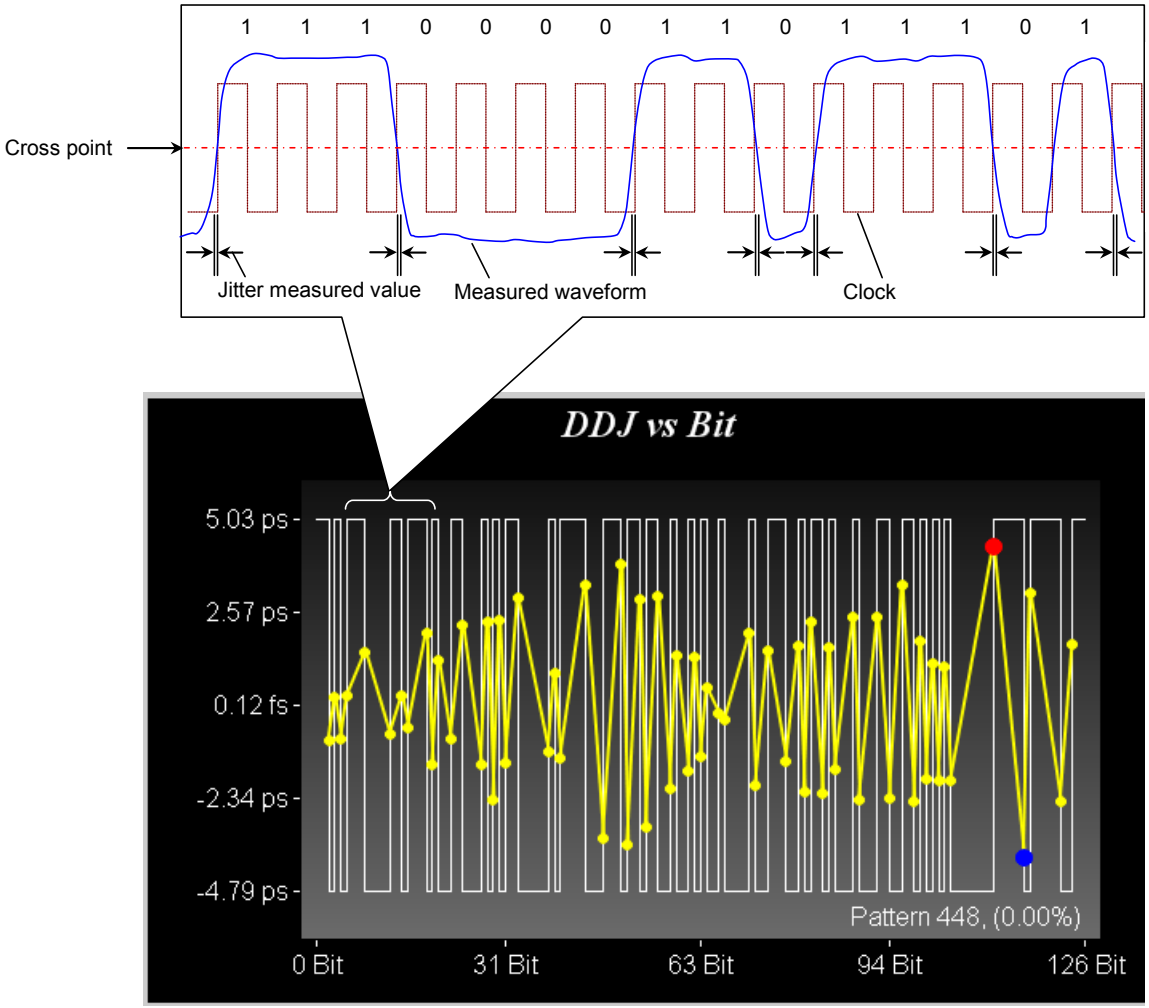


Figure 1.1-4 DDJ Vs Bit Measurement Method

Display of bathtub graph

There is a graph with a horizontal axis of time and a vertical axis of bit error rate to display the measurement results as one of the evaluation methods for eye pattern waveforms. The left and right ends of the graph are the cross point of the eye pattern waveform and have large bit error rates. The center part of the graph is the center part of the eye pattern waveform and has small bit error rate. This graph is called a Bathtub graph or Bathtub curve line from the form of the graph.
The MX210001A displays the bathtub graph estimated from the total jitter histogram. The time with 99% jitter (J2) BER specified in communications standards and with the specified bit error rate such as 10–12 or less is displayed.

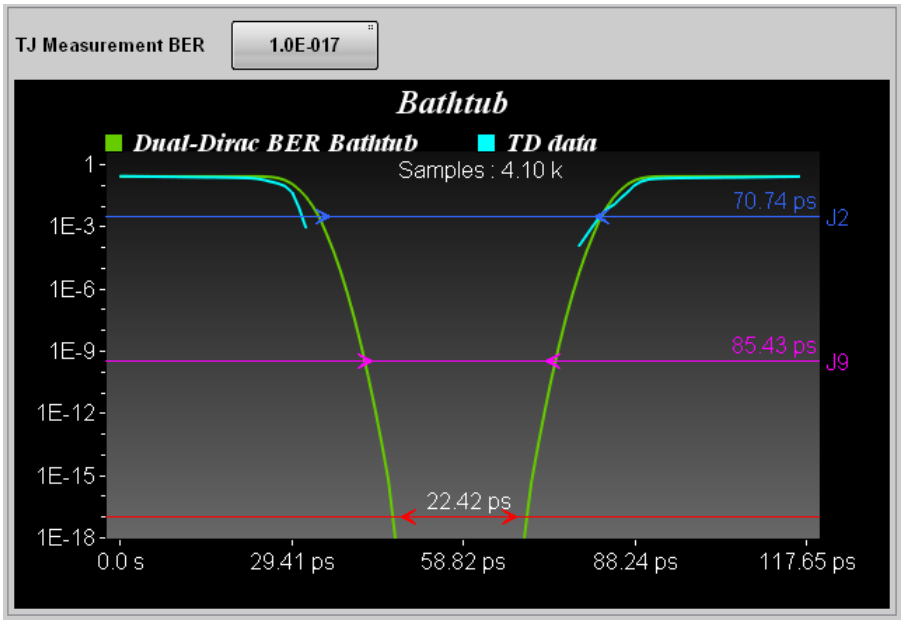


Figure 1.1-5 Display Example of Bathtub Curve Line

Display of WDP

WDP (Waveform Distortion Penalty) is an estimated value of signal degradation and obtained from computed waveform data. The transmission signal degradation estimate value is sometimes referred to as TWDP (Transmitter Waveform and Distortion Penalty).
The eye amplitude of waveforms transmitted to communications paths is degraded because the jitters increase and waveforms distort when passing the paths.
With SFF-8431 and IEEE802.3, the algorithm to estimate the waveform degradation amount has been released. The difference between the waveform SN ratio calculated with the algorithm and the original waveform SN ratio is WDP.
The MX210001A computes the waveform data obtained with the EYE/Pulse Scope to obtain WDP.

Note:

To compute the WDP, MATLAB by MathWorks is required in addition to the MX210001A.

1.2 Features

The MX210001A has the following features:

- Supports evaluation items such as 99% jitter, WDP, and DDPWS specified in communications standards.
- Simplified operations due to interaction with a pulse pattern generator and sampling oscilloscope (MP2100A, MP2100B)
- Measurement of arbitrary waveforms including PRBS31 is available.
- Simultaneous measurement of two channels is available (during histogram measurement).
- Jitter measurement is available at the same time with EYE Mask measurement.
- Remote control is available.

1.3 Terms

1.3.1 Terms

Dual Dirac Estimation

If the jitter elements include DJ, the histogram has multiple peaks at the waveform cross point. Dual Dirac Estimation is a method to estimate RJ and DJ using Dual Dirac function as the fitting curve of this histogram.

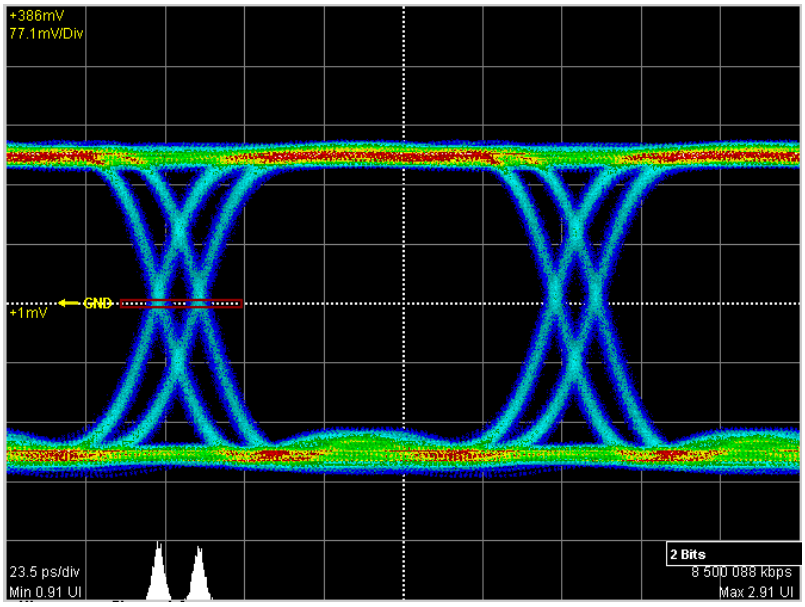


Figure 1.3.1-1 Histogram of Jitter with DJ

The Dual Dirac distribution is expressed as the combined formula of two normal distributions.

$$PDF(x) = \frac{1}{\sqrt{2\pi}\sigma}\left[\exp\left(-\frac{(x-\mu_L)^2}{2\sigma^2}\right) + \exp\left(-\frac{(x-\mu_R)^2}{2\sigma^2}\right)\right]$$

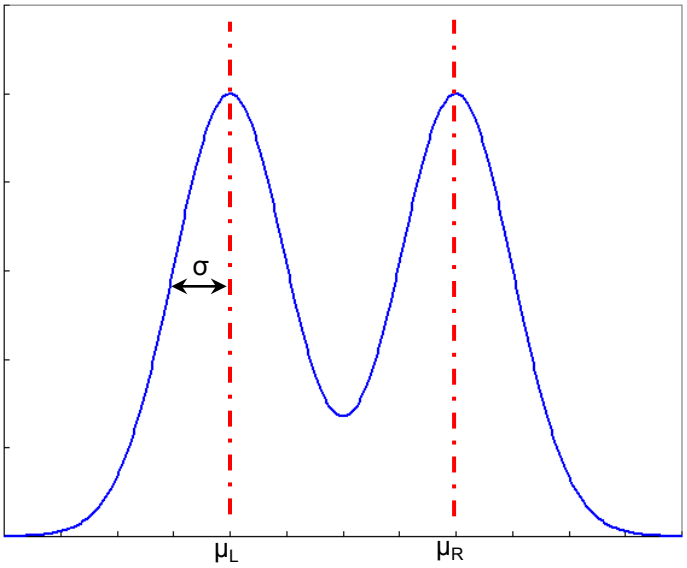


Figure 1.3.1-2 Dual Dirac Distribution

The Dual Dirac distribution assumes that RJ is the normal distribution and DJ is a constant value. The MX210001A displays σ and μR–μL of the Dual Dirac distribution approximated from the measured histogram to RJ (d-d) and DJ (d-d) respectively.

WDP (Waveform Distortion Penalty)

The waveforms transmitted to communications paths have jitters increased and waveforms distorted when passing the paths.

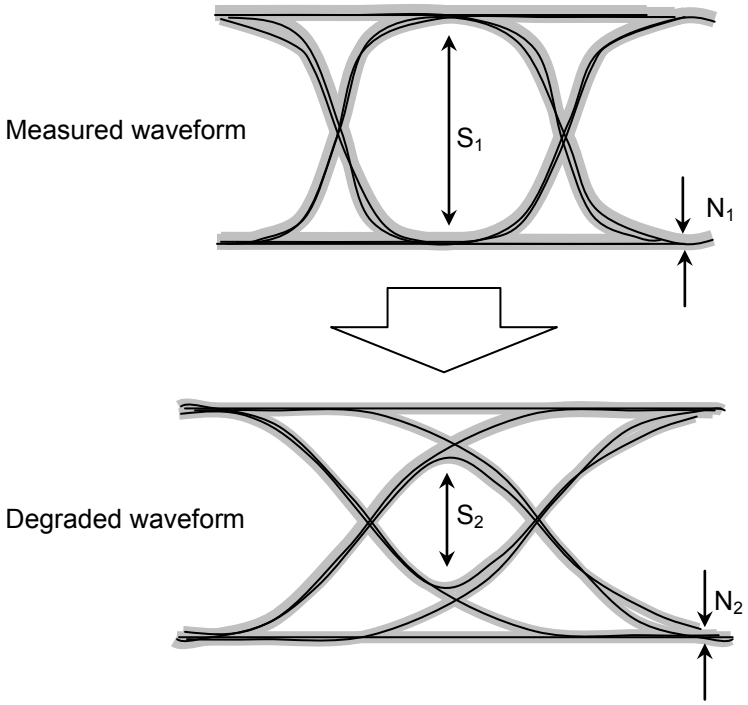


Figure 1.3.1-3 Waveform Degradation Due to Communication Path

With SFF-8431 and IEEE802.3, the algorithm to estimate the waveform degradation amount has been released.

The MX210001A assumes the difference between the measured waveform S/N ratio and the calculated waveform S/N ratio as WDP (Waveform Distortion Penalty).

WDP is obtained from the formula below with S1, N1, S2, and N2 in Figure 1.3.1-3.

$$WDP = 10 * \log(\frac{S_1}{N_1}) - 10 * \log(\frac{S_2}{N_2}) \quad \text{(dB)}$$

1.3.2 Abbreviations

The abbreviations used in this manual are listed below.

Table 1.3.2-1 Abbreviations

Abbreviations	Formal name
BER	Bit Error Rate
CHA	Channel A
CHB	Channel B
DCD	Duty Cycle Distortion
d-d	dual dirac model estimation
DDJ	Data Dependant Jitter
DDP	Data Dependant Pulse
DDPWS	Data Dependant Pulse Width Shrinkage
DJ	Deterministic Jitter
dWDP	difference of Waveform Distortion Penalty
dWDPc	difference of Waveform Distortion Penalty of an electrical cable assembly
HP	High Pass
ISI	Inter Symbol Interference
LP	Low Pass
PDJ	Pattern Dependant Jitter
PJ	Periodic Jitter
p-p	peak to peak
RJ	Random Jitter
rms	root mean square
TD	Time Domain
TJ	Total Jitter
TWDP	Transmitter Waveform Distortion Penalty
TWDPc	Transmitter Waveform Distortion Penalty of host transmitter Supporting an electrical cable assembly
WDP	Waveform Distortion Penalty
WDPc	Waveform Distortion Penalty of an electrical cable assembly
wfms	waveforms

Chapter 2 Preparation

This chapter explains the installation method and restrictions of MX210001A.

2.1 Installation

Before installation, check if the version of MX210000A BERTWave control software is Ver. 3.00 or later.
If the earlier version is used, obtain the latest version and update the MX210000A BERTWave control software. Refer to 10.5 “Updating Software” in *MP2100A/MP2101A/MP2102A BERT Wave Operation Manual* (W3349AE) or *MP2100B BERT Wave Operation Manual* (W3772AE) for how to upload.
The latest version of the MX210000A BERTWave control software can be checked and obtained at:
https://www.anritsu.com/en-US/test-measurement/support/downloads

2.1.1 Installing MX210001A

The method to install the MX210001A to the MP2100A/MP2102A/MP2100B BERTWave is explained.

1. After loading the application, touch [System Menu].
2. Touch [Exit].
3. Touch  on the Selector screen to close.
4. Using the USB memory, copy MX210001A_(serial number)_License.txt from CD-ROM to the hard disk of BERTWave. The actual file name comprises of a ten-digit number such as “6260012345”, which indicates the serial number.

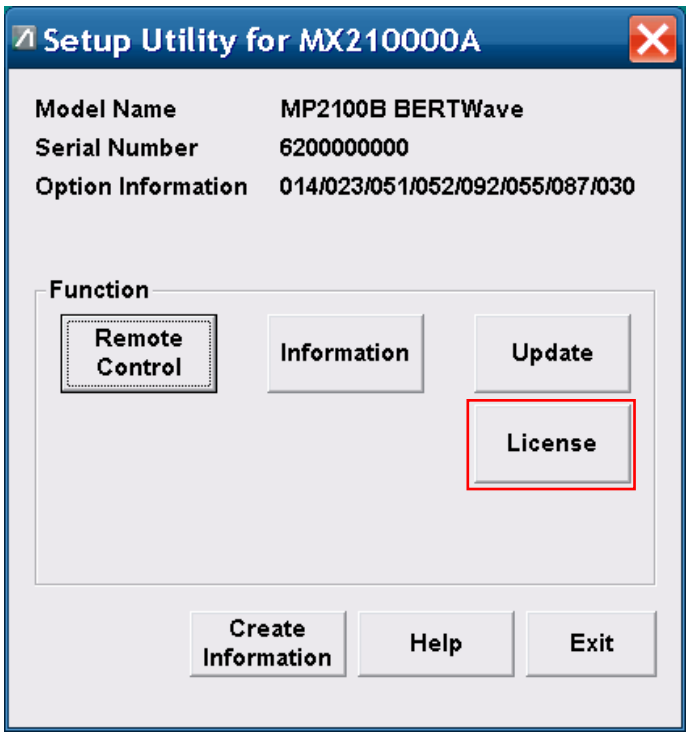
   Copy source folder

   CD-ROM:\MX210001A

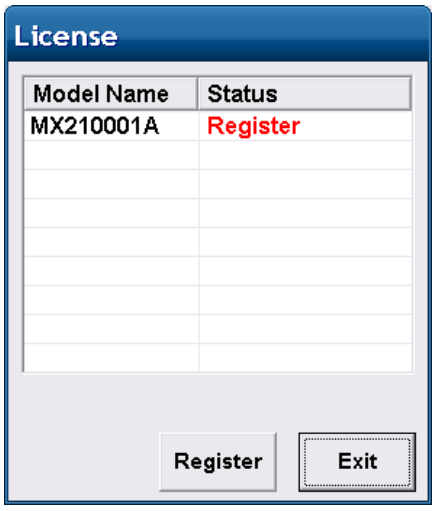
   Copy destination folder

   C:\Program Files\Anritsu\MP2100A\MX210000A
5. Touch twice the MX210000A desktop shortcut.

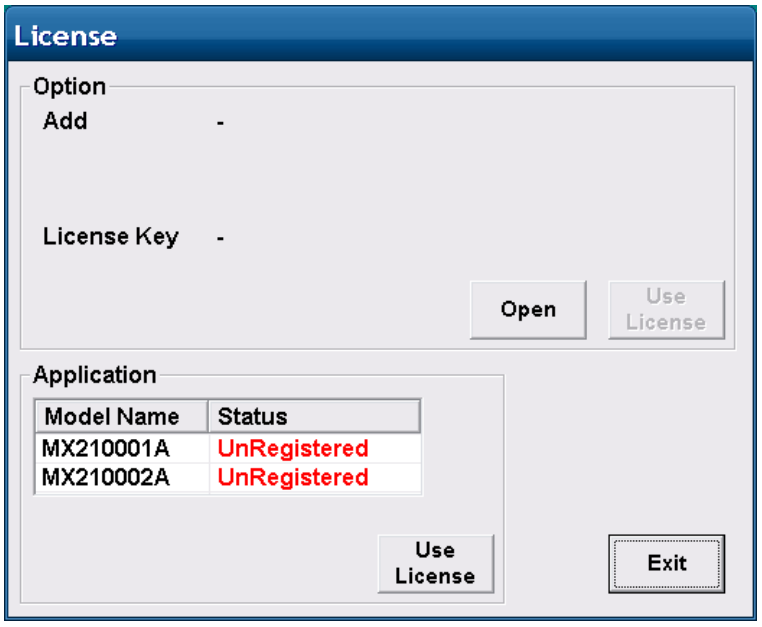
6. Touch [Setup Utility] at the Selector screen.
   The Setup Utility screen is displayed.



7. Touch [License] at the Setup Utility screen.
   The License screen is displayed.



MP2100A, MP2101A



MP2100B

If an error message is displayed, check the following.

- 0x00024: File cannot be read. License key is wrong.
  Wrong license key

Check the context of text file as described in Step 4, and confirm if ModelName, SerialNumber, and Key is listed.

- 0x00025: File cannot be read. Serial number is wrong.

  The serial number of BERTWave is not correct.

  Check the serial number in the text file as described in Step 4, against the serial number of BERTWave.

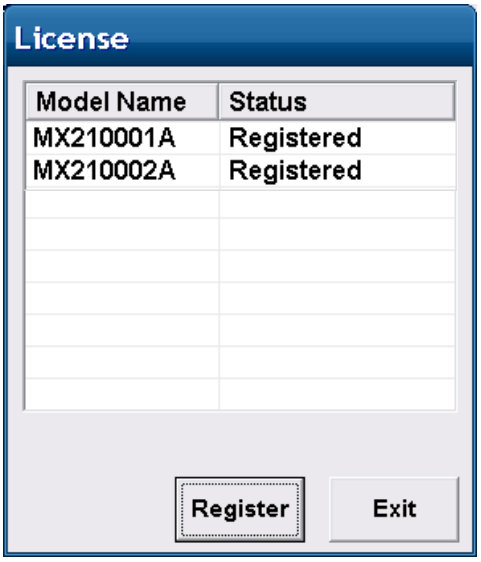
When the error messages are displayed even after the handling above, contact the Anritsu Technical Support Center or your local Anritsu representative.

8. Touch [MX210001A] to select.
   If MX210001A is not displayed, check the copy destination folder in Step 4.

   Any of the following messages will be displayed in Status.

Register (Red Letter):	License not authorized (MP2100A, MP2101A)
UnRegisterd (Red Letter):	License not authorized (MP2100B)
Register:	License authorized
Certification Error:	Failed to authorize the license

9. Touch [Register] if the “Register (Red Letter)” is displayed. Or touch [Use License] if the “UnRegisterd (Red Letter)” is displayed.
10. When Registered is displayed in Status of MX210001A, the installation is completed.

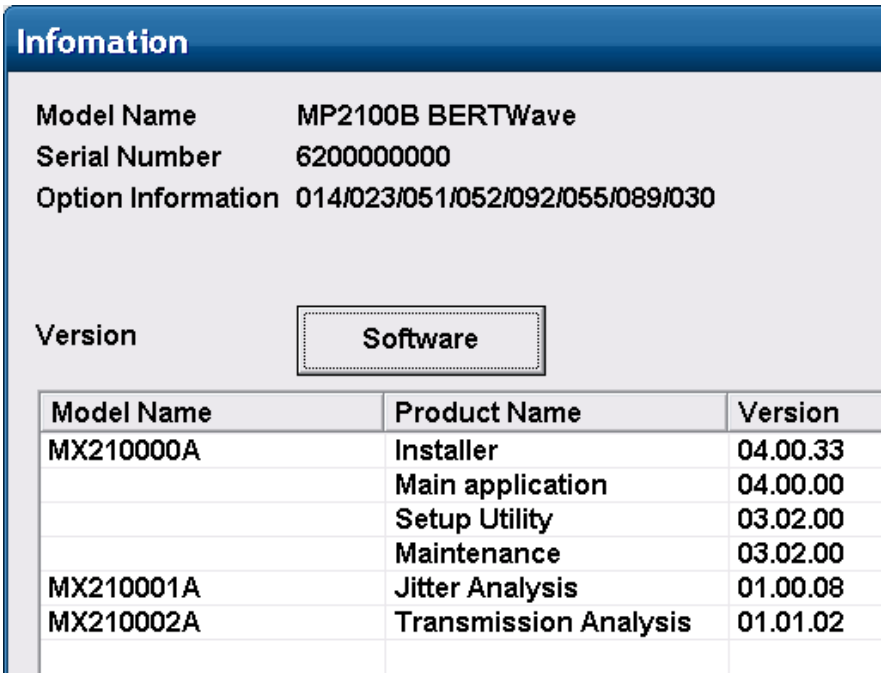


If [Certification Error] is displayed in Status of MX210001A, contact the Anritsu Technical Support Center or your local Anritsu representative.

11. Touch [Exit].

Confirmation of installation

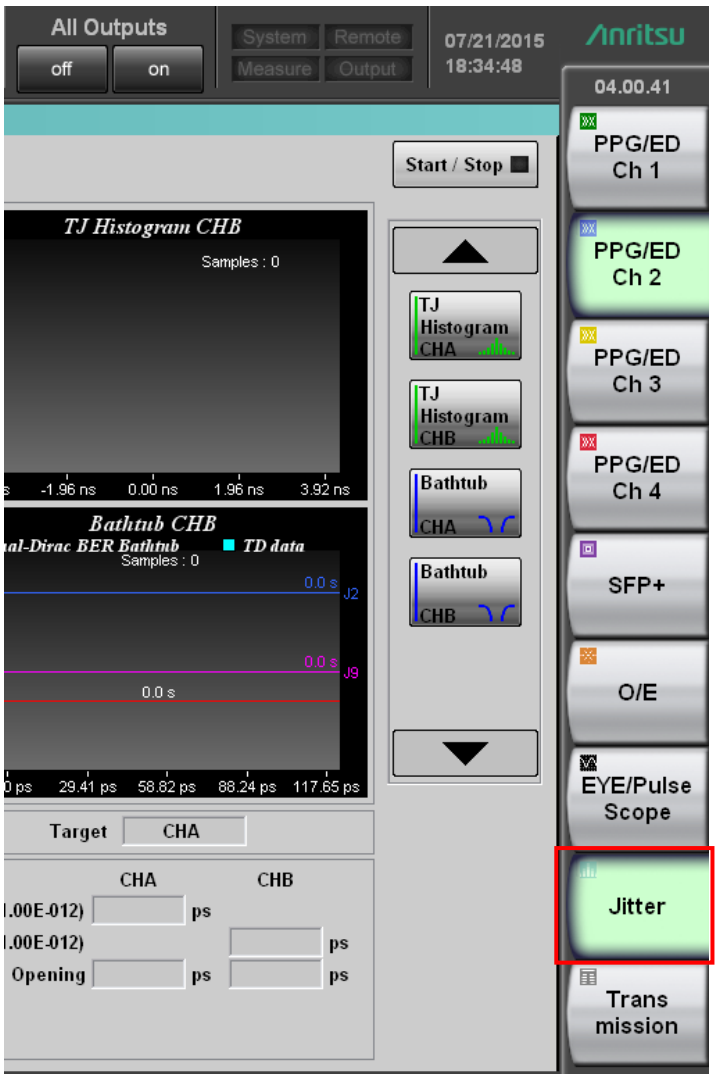
1. Touch [Information] at the Setup Utility screen. The Information screen is displayed.
2. Touch the button to change display to [Software], if the "Firmware/FPGA" is displayed.
   Check that MX210001A is displayed.



3. Touch [Exit] at the Information screen.
4. Touch [Exit] at the Setup Utility screen.
5. Touch [Main Application] at the Selector screen.

   When MX210001A is installed, [Backup:Error] is displayed, indicating that the software status is different from the backup. This is not a malfunction, touch [OK].

6. Check that [Jitter] is displayed on the top menu at the Application screen.



2.1.2 Installing WDP calculation program

To display WDP with the MX210001A, execute the following.

- Installing MATLAB
- Creating WDP calculation program

Installing MATLAB

Use the Windows version MATLAB, Version R2010b or later.

1. Install MATLAB to BERTWave according to the MATLAB manual.

   For the installation destination folder, designate the default value of the MATLAB installer (C:\Program Files\MATLAB\R2010bSP1).
2. Load the Windows of BERTWave.

Creating WDP calculation program

1. Obtain IEEE802.3-2008 from the following URL:

   http://standards.ieee.org/about/get/802/802.3.html
2. Copy the source code of Clause 68.6.6.2 to a text file, and save it with the file name (TWDP802_3clause68.m).
3. Obtain SFF-8431 Revision 4.1 from the following URL:

   ftp://ftp.seagate.com/sff/SFF-8431.PDF
4. Copy the source code of Appendix G to a text file, and save it with the file name (SFF8431xWDP.m).
5. Copy the files created in Step 2 and 4 to the hard disk of BERTWave.
   Copy destination folder
   C:\Program Files\Anritsu\MP2100A\MX210000A\UserData\MATLAB

2.2 Restrictions

The MX210001A has the following restrictions.

- To use the MX210001A, it must be installed to MP2100A/MP2102A/MP2100B BERTWave. It cannot be installed to a personal computer.
- The MX210001A cannot be installed to MP2100A/MP2102A/MP2100B BERTWave with the serial number different from the contracted number.
- When using MP2100A-001, MP2102A-021 or MP2100B-021 with Channel Math set to [On], Jitter analysis is applied to the calculation result of Channel A and B.
  "CHA" will be displayed on the screen. This is not the waveform output to the Channel A of EYE/Pulse Scope.
- When using MP2100A-001, MP2102A-021 or MP2100B-021 with Channel Math set to [On], the pattern length that can be analyzed is less than 32768 (equivalent of PRBS15).

Chapter 3 Panel Operation and Measurement Procedure

This chapter explains the panel operation and measurement procedure of the MX210001A. For the startup procedure and panel operation of the BERT Wave, refer to *MP2100A/MP2101A/MP2102A BERTWave Operation Manual* (W3349AE) or *MP2100B BERTWave Operation Manual* (W3772AE).

3.1 Screen Explanation

When the MX210001A is installed to the BERTWave, [Jitter] is displayed on the function menu.

Touching [Jitter] on the top menu displays the Jitter screen of the MX210001A.

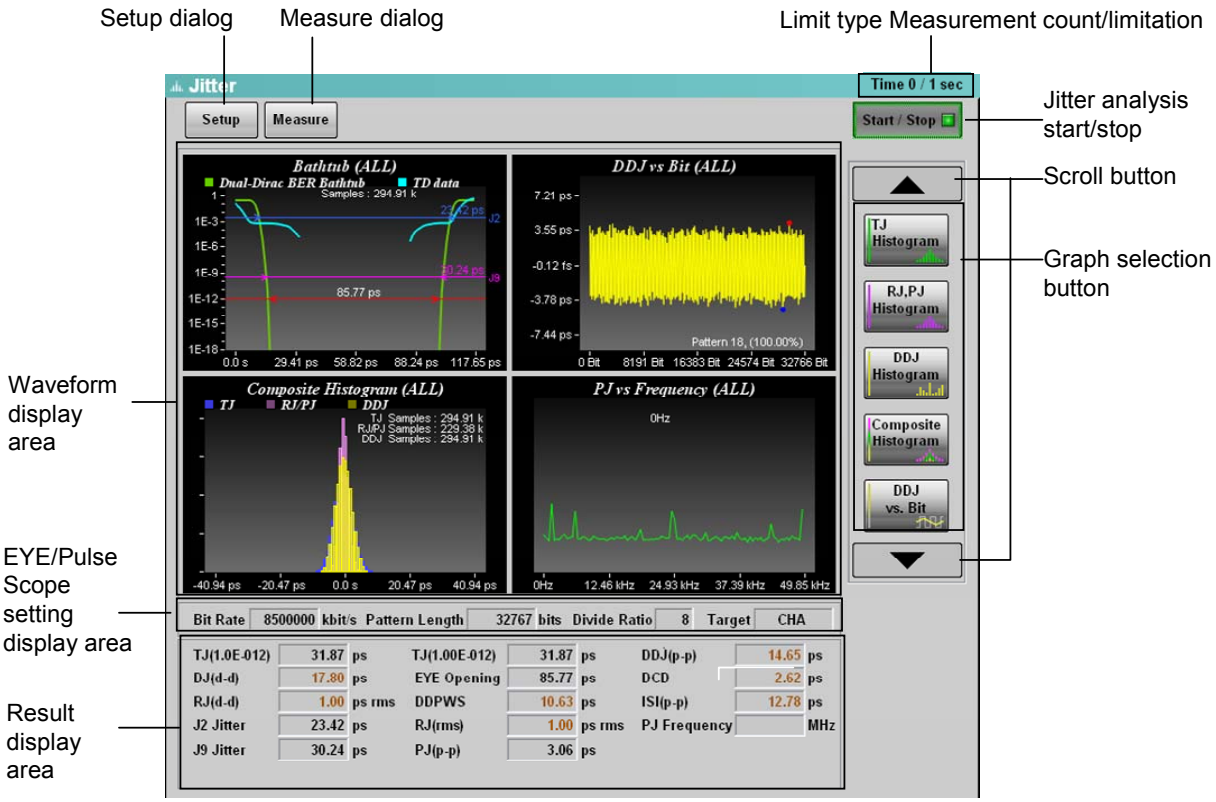


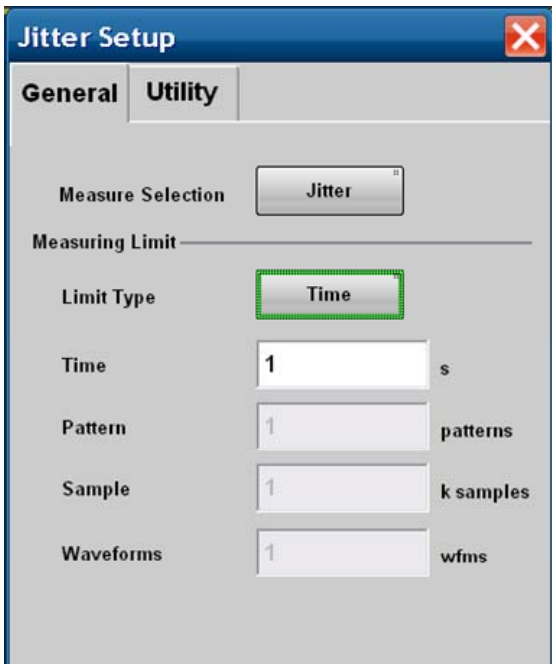
Figure 3.1-1 Jitter Window

Touching [Setup] or [Measure] displays the dialog box.

Jitter Setup dialog

Touching [Setup] in Figure 3.1-1 displays the Jitter Setup dialog.

Measure Select: Jitter



Measure Select: WDP

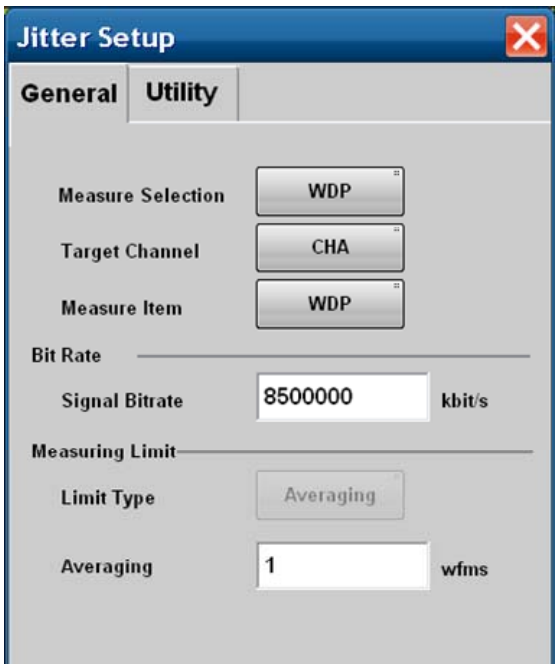


Figure 3.1-2 Jitter Setup Dialog (General Tab)

Figure 3.1-3 Jitter Setup Dialog - Utility Tab (Common to Jitter/WDP)

Table 3.1-1 Jitter Setup Dialog Item

Tab	Name	Description
General	Measure Selection	Switches the jitter analysis method to Jitter or WDP. Display items on Jitter Setup dialog and Jitter Measure dialog depend on this setting. WDP is available only when WDP is installed.
	Target Channel*1	Selects the analysis target channel when Measure Select is WDP.
	Measure Item*1	Sets the calculation method when Measure Select is WDP. Refer to Table 3.3.1-1.
	Signal Bitrate*1	Sets the analysis waveform bit rate when Measure Select is WDP.*2
	Limit Type	Selects Time, Pattern (the number of pattern repetitions), Samples (the number of samples), Waveforms (the number of waveforms),or none for the sampling completion condition when Measure Select is Jitter.*3 Average is fixed when Measure Select is WDP.*4
	Time*5	Sets the sampling time.
	Pattern*5	Sets the number of pattern repetitions.
	Sample*5	Sets the number of samples.
	Waveform*5	Sets the number of waveforms.
	Averaging*1	Sets the number of waveforms to be averaged.
Utility	Screen Copy	Saves the waveform display area and measurement result display area screens to a file.

*1: Displayed when Measure Select is WDP.

*2: The bit rate of EYE/Pulse Scope is changed to the value set here. The bit rates of PPG/ED1 and PPG/ED2 are not affected by the value set here.

*3: When Measure Algorithm is Histogram, the Limit Type set here and the Limit Type of EYE/Pulse Scope operate independently. When Limit Type of EYE/Pulse Scope is specified, reaching to the limit stops the jitter analysis.
When the jitter analysis is executed continuously, set as follows:
Accumulation Type of EYE/Pulse Scope: Other than Limited
Limit Type of Jitter Setup: None
When Measure Algorithm is Pattern Search, Limit Type of EYE/Pulse Scope is set to Infinite during measurement.

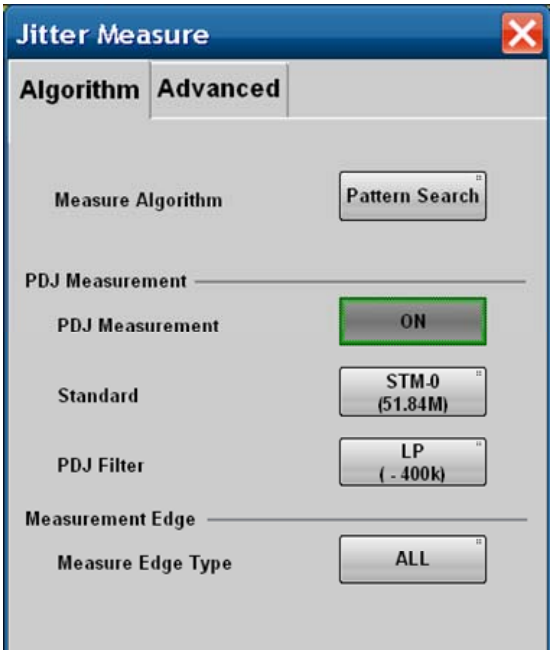
*4: Limit Type of EYE/Pulse Scope is set to None during measurement.

*5: Displayed when Measure Select is Jitter.

Jitter Measure dialog

Touching [Measure] in Figure 3.1-1 displays the Jitter Measure dialog .

Measure Select: Jitter



Measure Select: WDP

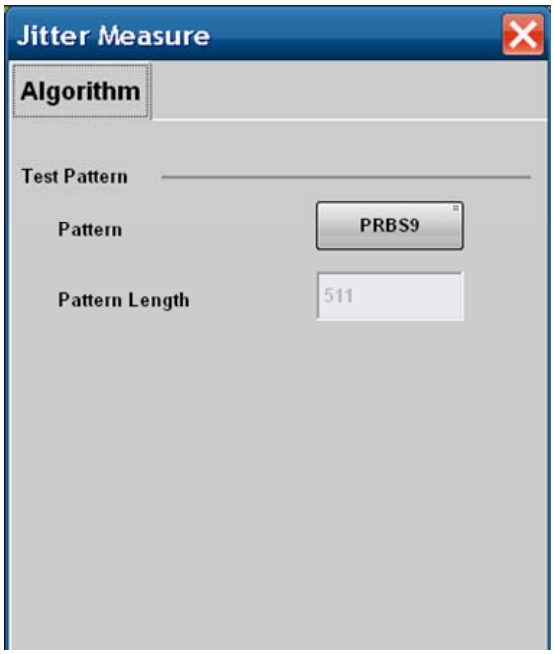


Figure 3.1-4 Jitter Measure Dialog (Algorithm Tab)

When Measure Select of Jitter Setup dialog is [Jitter], the following items are displayed on Algorithm tab.

Table 3.1-2 Jitter Measure Dialog (Algorithm Tab) Item

Name	Description
Measure Algorithm	Switches the jitter analysis method to Pattern Search or Histogram. These settings and graph types to be displayed are shown in Table 3.1-4.
PDJ Measurement*	Sets PDJ measurement execution. Setting to ON displays PDJ vs Bit graph.
Standard*	Sets the bit rate standard to be used for PDJ measurement from the following: STM-0, STM-1, STM-4, STM-16, STM-64, or STM-256
PDJ Filter*	Sets the combination of filters to be used for PDJ measurement from the following: LP, HP0+LP, HP1+LP, HP1'+LP, HP2+LP, HP+LP, HP'+LP, LP', or HP0+LP' Filter names and frequency ranges are shown in Table 3.1-5.
Measurement Edge Type*	Sets the edge detection method for pattern data to All, Falling, or Rising. The set name is displayed on the graph.

*: Displayed when Measure Algorithm is Pattern Search.

When Measure Select of Jitter Setup dialog is [WDP], the following items are displayed on Algorithm tab.

Table 3.1-3 Jitter Measure Dialog (Algorithm Tab) Item

Name	Description
Pattern	[PRBS9]: Selected when WDP analysis is executed based on IEEE 802.3 Clause 68 or SFF-8431. [Variable]: Selected when WDP analysis is executed with the arbitrary pattern length.
Pattern Length	Sets the pattern length within 64 to 2048 when Pattern is Variable. The value set here is set to Pattern Length of EYE/Pulse Scope. The pattern length is set to the value same as the PPG output pattern length.

Table 3.1-4 Measure Algorithm Setting and Graph

Measure Algorithm	Histogram	Pattern Search
Graph to be displayed	Bathtub (CHA) TJ Histogram (CHA) Bathtub (CHB) TJ Histogram (CHB)	Bathtub DDJ Histogram Composite Histogram DDJ vs Bit PJ vs Frequency RJ/PJ Histogram TJ Histogram

Table 3.1-5 List of Standards and Filters Settable for PDJ Measurement (Unit: Hz)

	PDJ Filter							
Standard	HP0	HP1	HP1'	HP2	HP'	HP	LP	LP'
STM-0	10	100	–	20 k	–	12 k	400 k	–
STM-1	10	500	–	65 k	–	12 k	1.3 M	500
STM-4	10	1 k	–	250 k	–	12 k	5 M	1 k
STM-16	10	5 k	–	1 M	–	12 k	20 M	5 k
STM-64	10	20 k	10 k	4 M	50 k	12 k	80 M	20 k
STM-256	–	80 k	20 k	16 M	–	–	320 M	–

When Measure Select of Jitter Setup dialog is [Jitter], Advanced tab is displayed on Jitter Measure dialog.

When Measure Algorithm of Jitter Measure dialog is [Histogram], Channel A (Ch A) and Channel B (Ch B) tab are displayed on Advanced tab.

Measure Select: Jitter

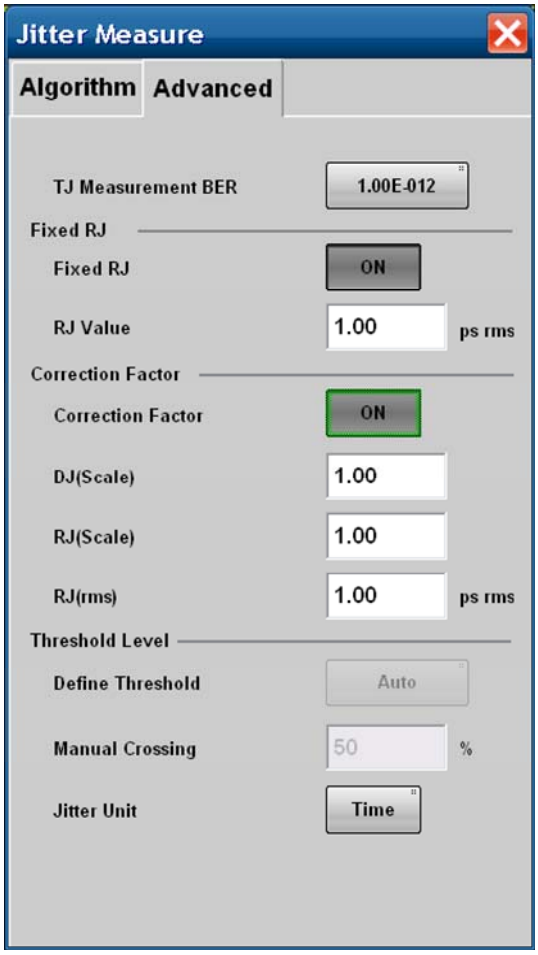


Figure 3.1-5 Jitter Measure Dialog (Advanced Tab)

Table 3.1-6 Jitter Measure Dialog (Advanced Tab) Item

Name	Description
TJ Measurement BER	Sets the bit error rate to measure the eye aperture with the Bathtub graph.
Fixed RJ	Set to [OFF] for graph display with the use of RJ obtained from the measured waveform. Set to [ON] for TJ graph display with RJ set to an arbitrary value. It is used to simulate TJ change with RJ value change.
RJ Value	TJ is calculated with the use of the value entered here when Fixed RJ is set to [ON].
Correction Factor	Can be operated when Start/Stop] is lit on the Jitter screen. Values can be entered to DJ (Scale), RJ (Scale), and RJ (rms) when the display is [ON]. In addition, values corrected with these correction factors are displayed on the measurement result display area in brown. Refer to Figure 3.1-1 Jitter Window.
DJ (Scale)	DJ correction factor The value computed by multiplying the value calculated from the waveform by this numeric value is displayed as the measurement result. Set to 1.00 for no correction.
RJ (Scale)	RJ correction factor The value computed by multiplying the value calculated from the waveform by this numeric value is displayed as the measurement result. Set to 1.00 for no correction.
RJ (rms)	RJ (d-d) and RJ (rms) correction factor Corrected with the formula below: $RJ = \sqrt{\sigma_m{}^2 - \sigma_r{}^2}$ σ_m: Measured RJ standard deviation σ_r: Correction factor RJ: RJ (d-d) and RJ (rms) after correction Set Correction Factor to [OFF] for no correction.
Define Threshold	Sets the location detection method for the cross point to the eye pattern amplitude. Set to [Auto] for automatic detection and [Manual] to specify the location.
Manual Crossing	Sets the cross point location within 30 to 70 % of amplitude when Threshold Define (Crossing) is [Manual].
Jitter Unit	Sets the horizontal axis of the graph and display unit of measurement result area to [Time] or [UI].

3.2 Jitter Measurement

There are two types of Jitter Measurement: histogram measurement and pattern search measurement.

Histogram measurement

Jitter analysis is executed for the waveform measured in EYE mode of EYE/Pulse Scope.
TJ for channel A and B and Bathtub can be measured simultaneously.

In addition, the eye mask can be tested simultaneously with the EYE/Pulse Scope.

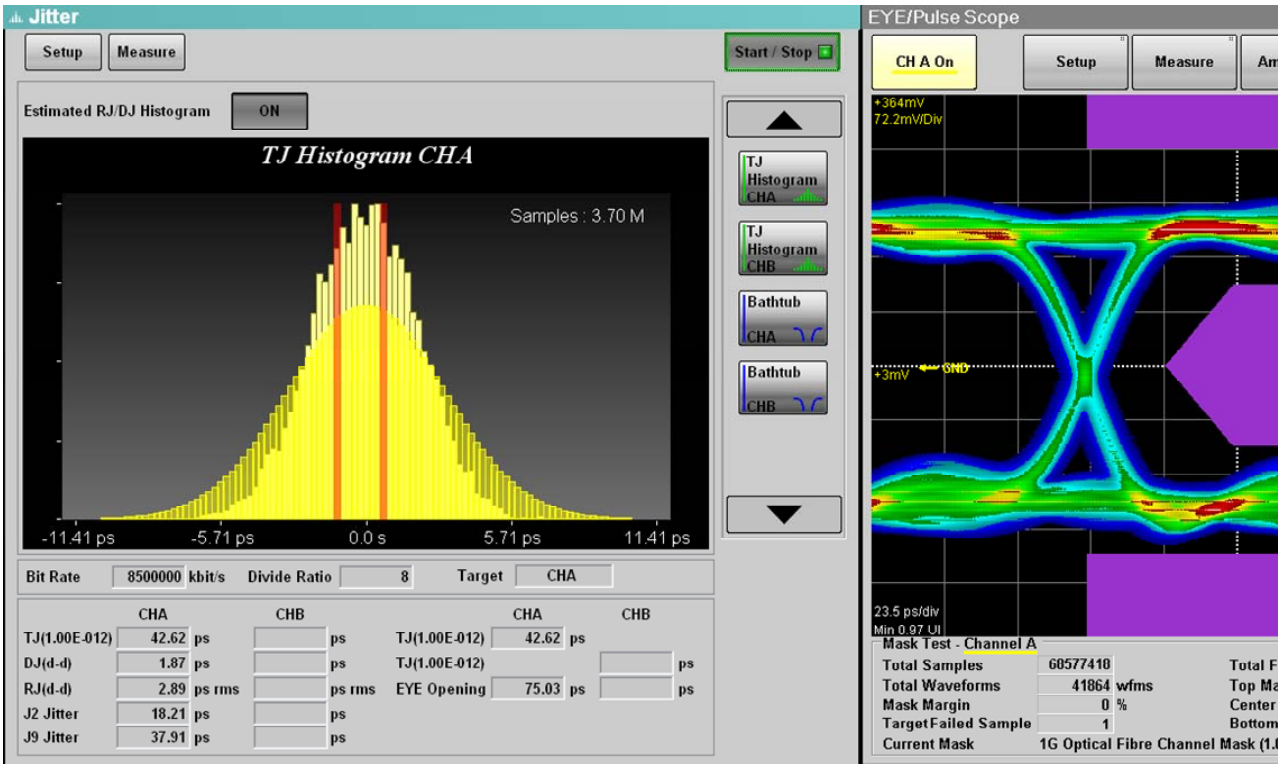


Figure 3.2-1 Display Example of Histogram Measurement and Eye Mask Test

Pattern search measurement

Jitter analysis is executed for the waveform measured in Pulse mode of EYE/Pulse Scope.
Jitter is measured for each point of bit rising and falling.
Therefore, TJ, Bathtub, RJ/PJ Histogram, DDJ Histogram, Composite Histogram, Jitter Spectrum Display (PJ vs Frequency), and Jitter Display for each bit (DDJ vs Bit) can be measured.

Pattern search measurement allows jitter analysis for waveforms up to 32768 of pattern length.

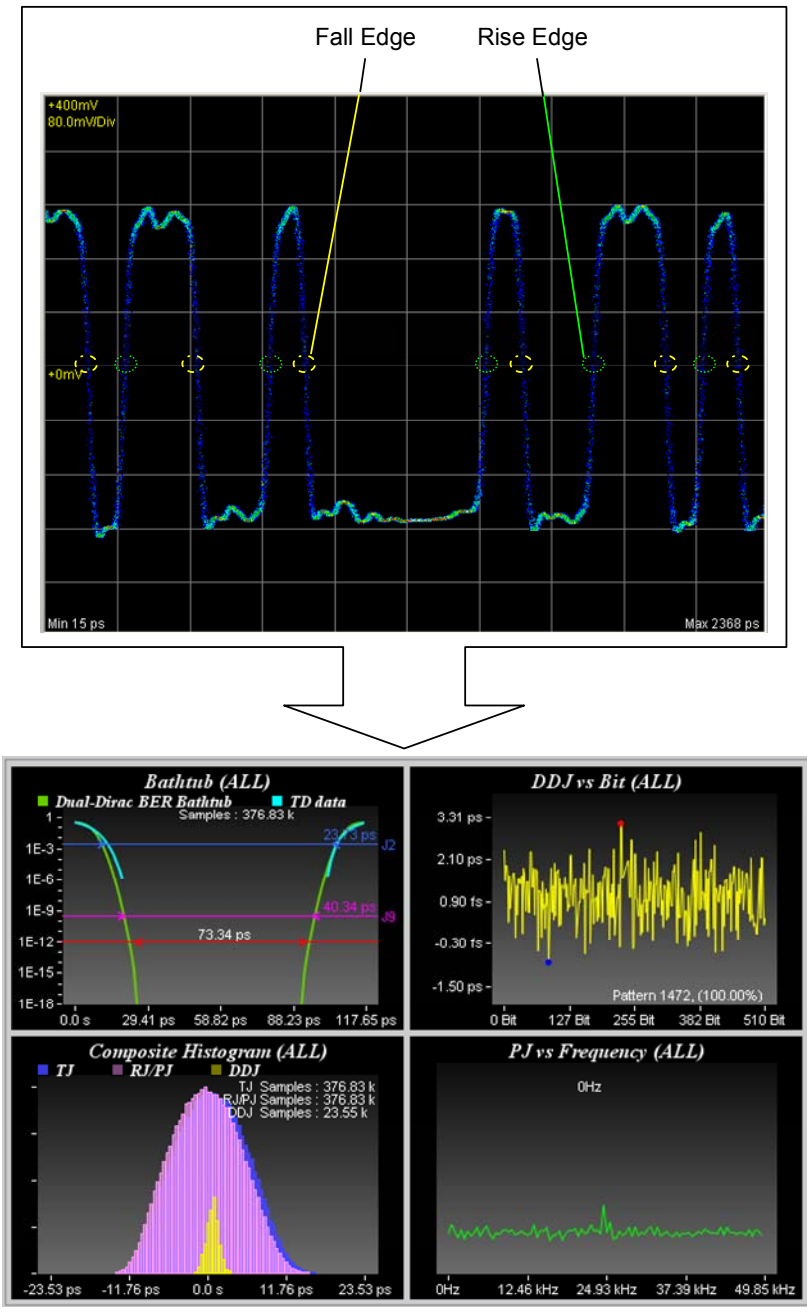


Figure 3.2-2 Measurement Points for Pattern Search Measurement and Display Example

3.2.1 Graph display method

For jitter measurement, the measurement values such as TJ, RD, and DJ are displayed, and the analysis results are displayed with histograms, bathtub curve lines, spectrums, and others.

Selection buttons of graphs which can be displayed appears on the scroll bar.

Touching the graph selection button displays the graph at the graph display area.

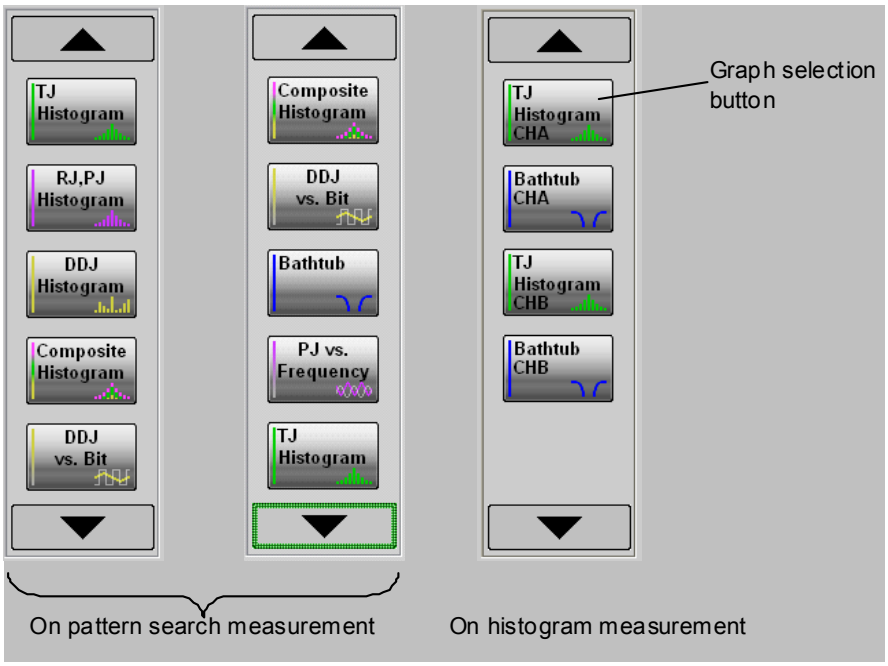


Figure 3.2.1-1 Display Example of Scroll Bar

Switching to enlarged display or reduced (four screens) display of graphs is available.

Touching the graph switches the graph display.

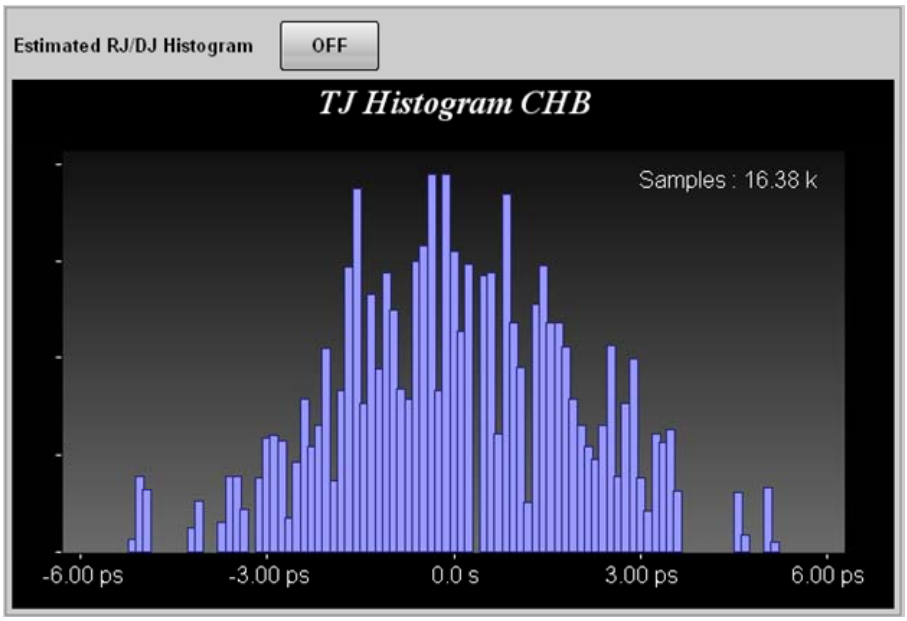


Figure 3.2.1-2 Graph Enlarged Display

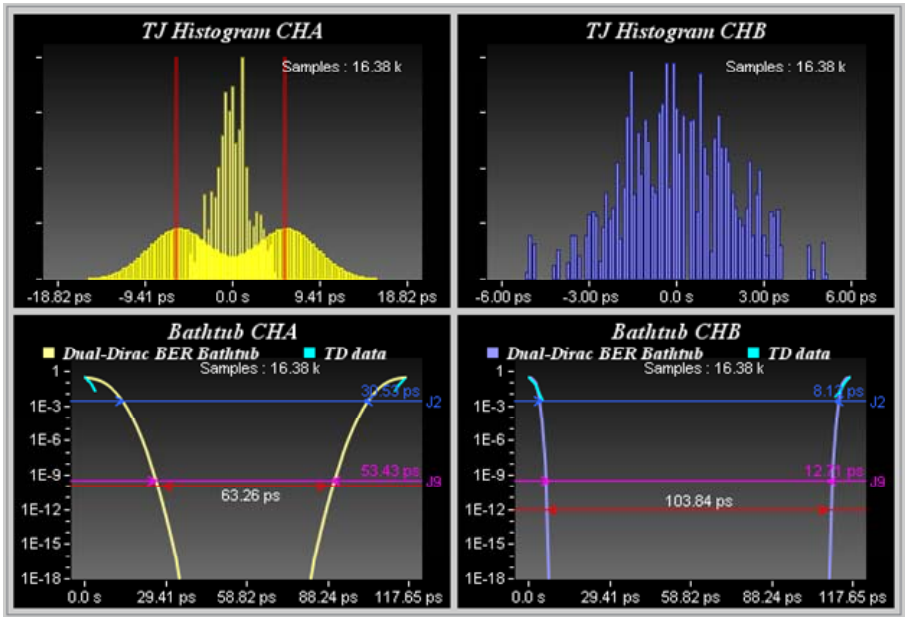


Figure 3.2.1-3 Graph Reduced Display

3.2.2 Display on histogram measurement

TJ Histogram

Touching [TJ Histogram CHA] or [TJ Histogram CHB] on the scroll bar displays the histogram of channel A and channel B on another screen.

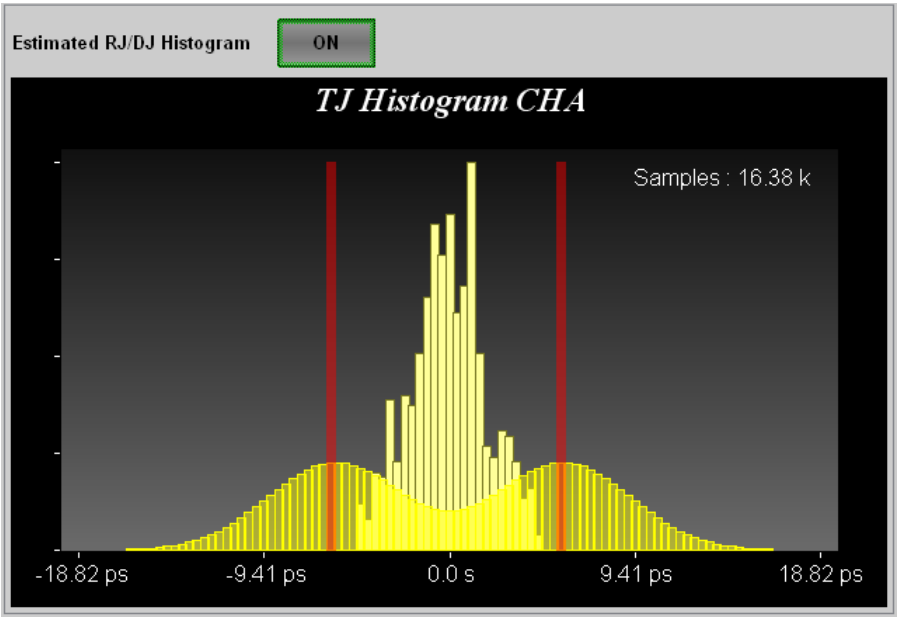


Figure 3.2.2-1 TJ Histogram CHA

Table 3.2.2-1 TJ Histogram CHA/CHB Item

Name	Description
Estimate RJ/DJ Histogram	Displayed on histogram measurement. Switches the histogram display for RJ and DJ estimated with dual dirac function. DJ amplitude is displayed with red lines.
Samples	The number of samples for the histogram

Bathtub

Touching [Bathtub CHA] or [Bathtub CHB] on the scroll bar displays the bathtub of channel A and channel B on another screen.

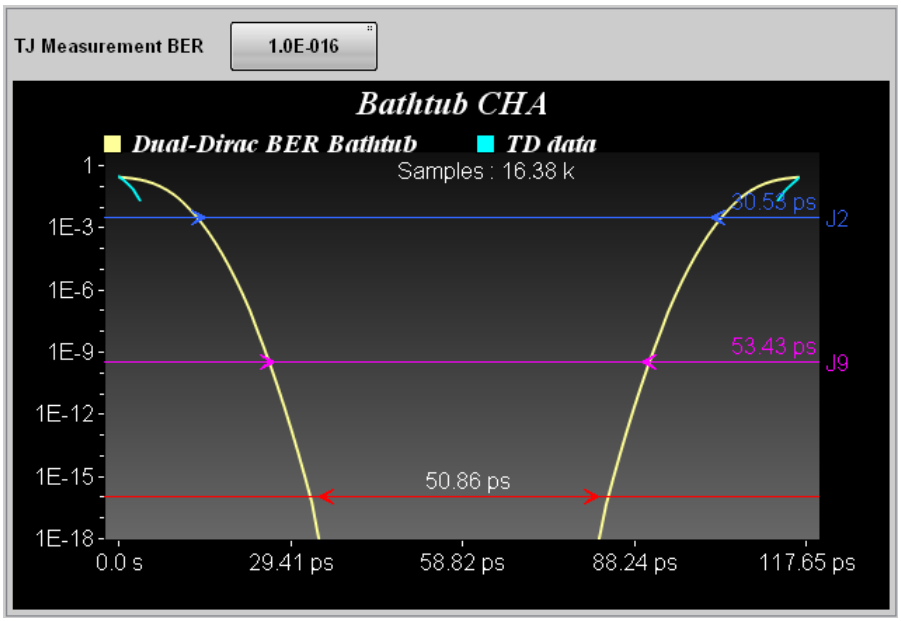


Figure 3.2.2-2 Bathtub CHA

Table 3.2.2-2 Bathtub CHA/CHB Item

Name	Description
TJ Measurement BER	Sets the BER to measure the TJ and eye aperture. The red line and eye aperture are displayed at the location of specified BER. The eye aperture is displayed at the measurement result area.
TD data	BER curve line measured with EYE/Pulse Scope
Dual-Dirac BER Bathtab	BER curve line approximated with the dual dirac function from TD data
J2	The location of 2.5×10^{-3} BER and TJ are displayed.
J9	The location of 2.5×10^{-10} BER and TJ are displayed.
Samples	The number of samples for the histogram

3.2.3 Pattern search measurement graph

For the pattern search measurement, excluding DDJ Histogram and DDJ vs Bit graph, measurement edge types (All, Fall, and Rise) are displayed with the graph name. The measurement edge types are specified with the Jitter Measure dialog (Algorithm tab).

TJ Histogram

Touching [TJ Histogram] on the scroll bar displays the TJ histogram.

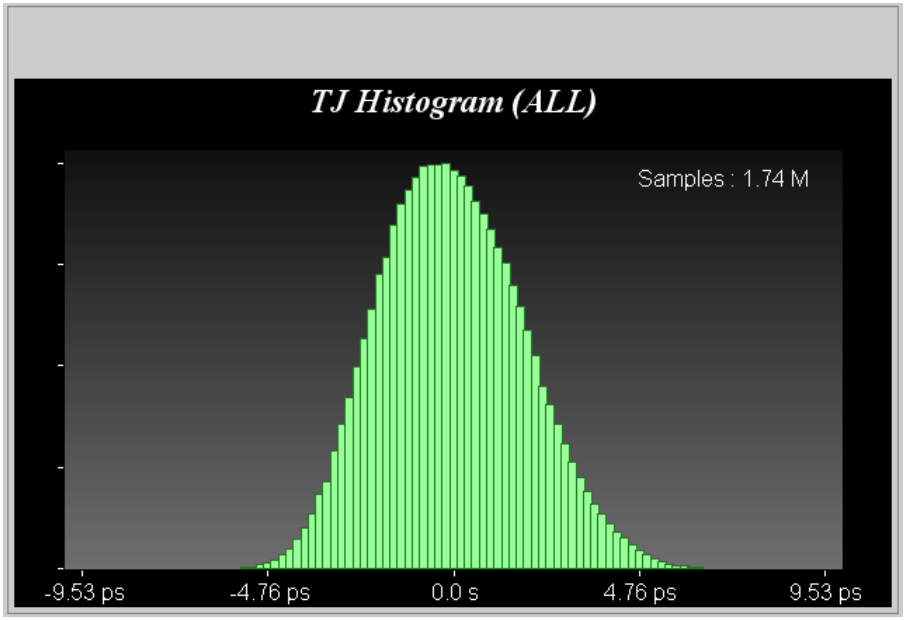


Figure 3.2.3-1 TJ Histogram

Table 3.2.3-1 TJ Histogram Item

Name	Description
Samples	The number of samples for the histogram

Bathtub

Touching [Bathtub] on the scroll bar displays the graph.

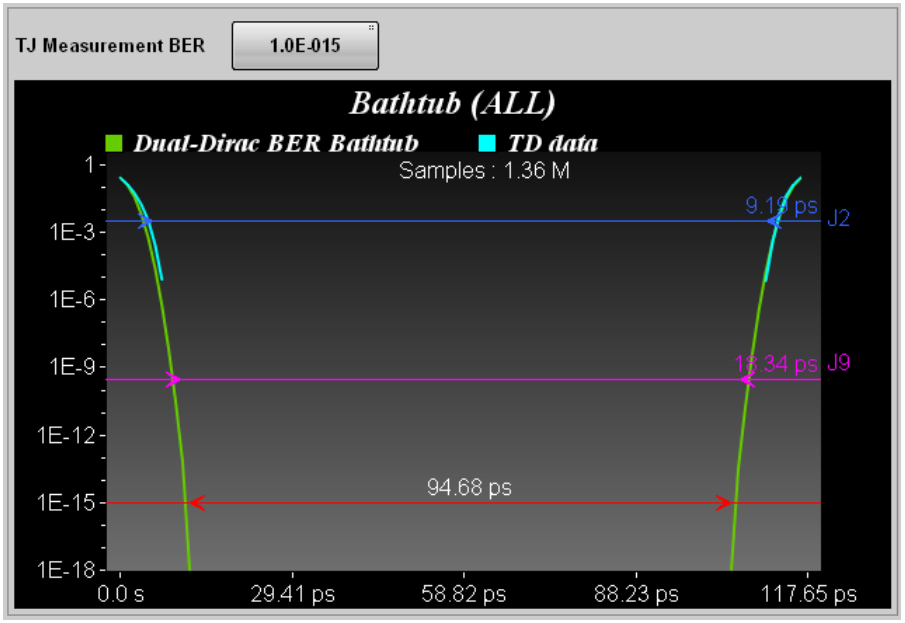


Figure 3.2.3-2 Bathtub

Table 3.2.3-2 Bathtub Item

Name	Description
TJ Measurement BER	Sets the BER to measure the TJ and eye aperture. The red line and eye aperture are displayed at the location of specified BER. The eye aperture is displayed at the measurement result area.
TD data	BER curve line measured with EYE/Pulse Scope
Dual-Dirac BER Bathtab	BER curve line approximated with the dual dirac function from TD data
J2	The location of 2.5×10^{-3} BER and TJ are displayed.
J9	The location of 2.5×10^{-10} BER and TJ are displayed.
Samples	The number of samples for the histogram

RJ/PJ Histogram

Touching [PJ/RJ Histogram] on the scroll bar displays the TJ histogram.

Setting Estimate RJ/PJ Histogram to [ON] displays the histogram approximated with the dual dirac function in yellow.

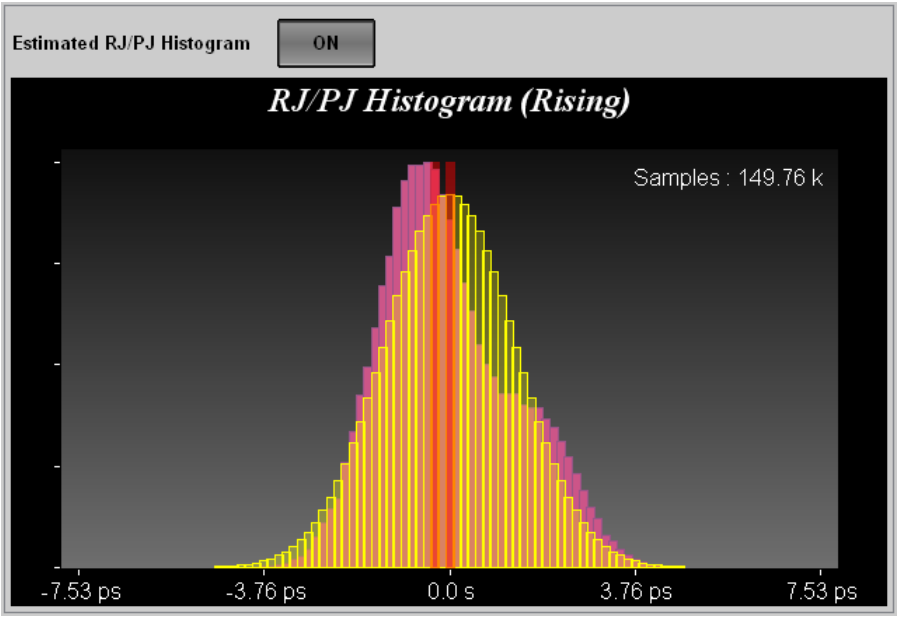


Figure 3.2.3-3 PJ/RJ Histogram

Table 3.2.3-3 PJ/RJ Histogram Item

Name	Description
Estimate RJ/PJ Histogram	Switches the histogram display for RJ and PJ estimated with dual dirac function. PJ amplitude is displayed with red lines.
Samples	The number of samples for the histogram

Composite Histogram

Touching [Composite Histogram] on the scroll bar displays the TJ, RJ/PJ, and DDJ histograms.

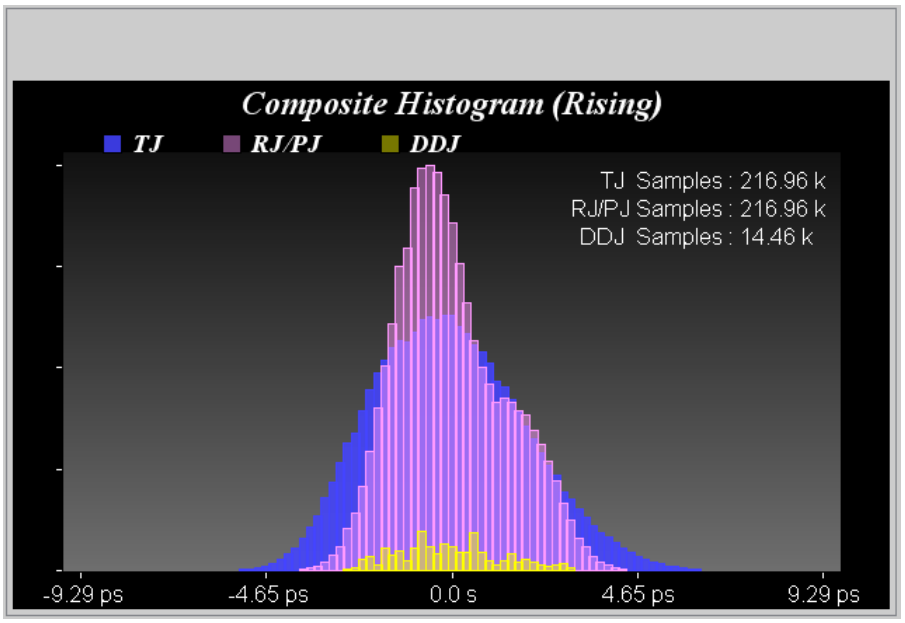


Figure 3.2.3-4 Composite Histogram

Table 3.2.3-4 Composite Histogram Item

Name	Description
TJ Samples RJ/PJ Samples DDJ Samples	The number of samples for the histogram

DDJ Histogram

Touching [DDJ Histogram] on the scroll bar displays the DDJ histogram by edge.

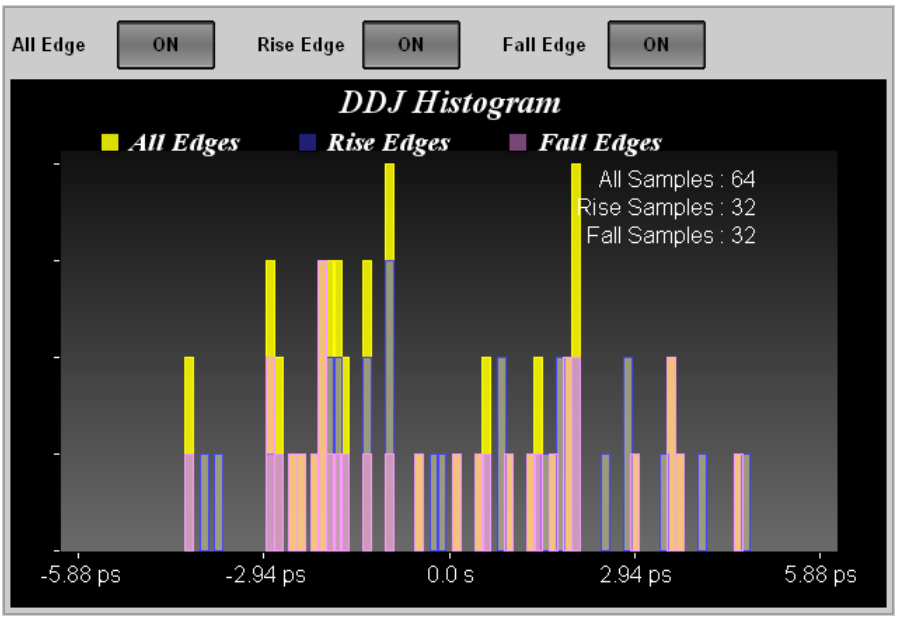


Figure 3.2.3-5 DDJ Histogram

Table 3.2.3-5 DDJ Histogram Item

Name	Description
All Edge	When the button display is [ON], the histogram is displayed.
Rise Edge	
Fall Edge	
All Samples	The number of samples for the both edges histogram
Rise Samples	The number of samples for the rising edge histogram
Fall Samples	The number of samples for the falling edge histogram

PJ vs Frequency

Touching [PJ vs Frequency] on the scroll bar displays the jitter spectrum.

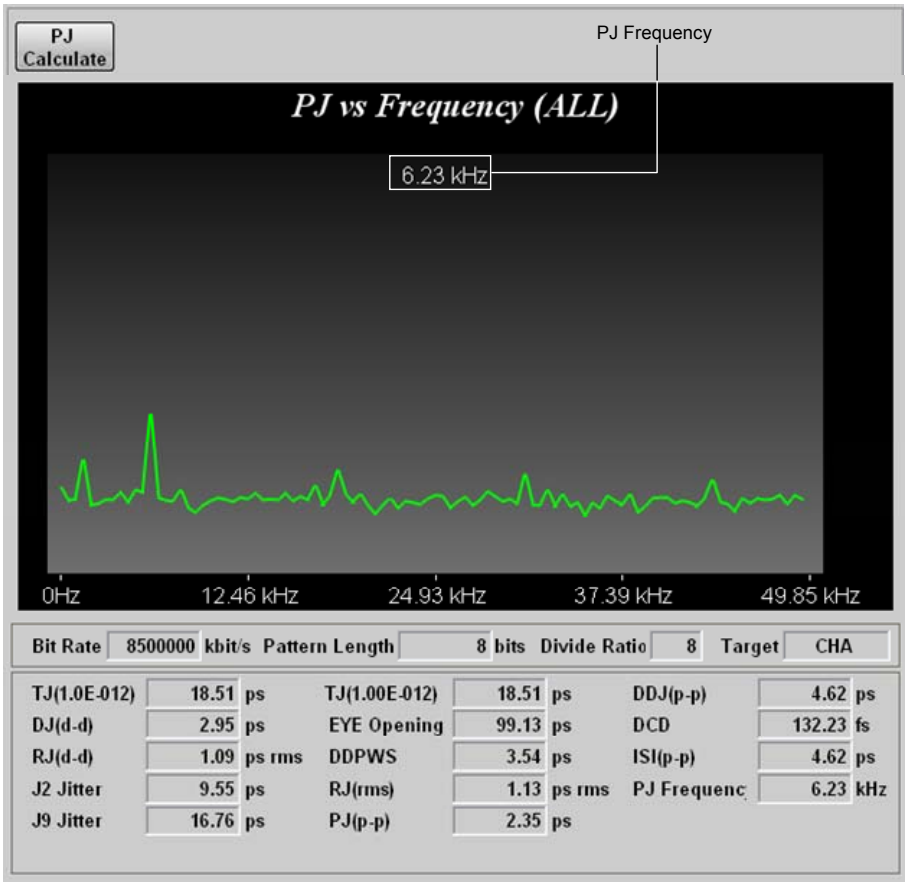


Figure 3.2.3-6 PJ vs Frequency

Table 3.2.3-6 PJ vs Frequency Item

Name	Description
PJ Calculate	Calculates the jitter peak spectrum frequency. Operatable when [Start] is displayed.
(PJ Frequency)	Spectrum peak frequency

DDJ vs Bit

Touching [DDJ vs Bit] on the scroll bar displays the pattern and DDJ graph.

Note:

When PDJ measurement is [ON], the display of [DDJ vs Bit] is changed to [PDJ vs Bit].

When the display range of horizontal axis is 193 bits or more, the pattern graph (white line) is not displayed.

A red circle and blue circle markers are displayed at maximum DDJ and minimum DDJ respectively.

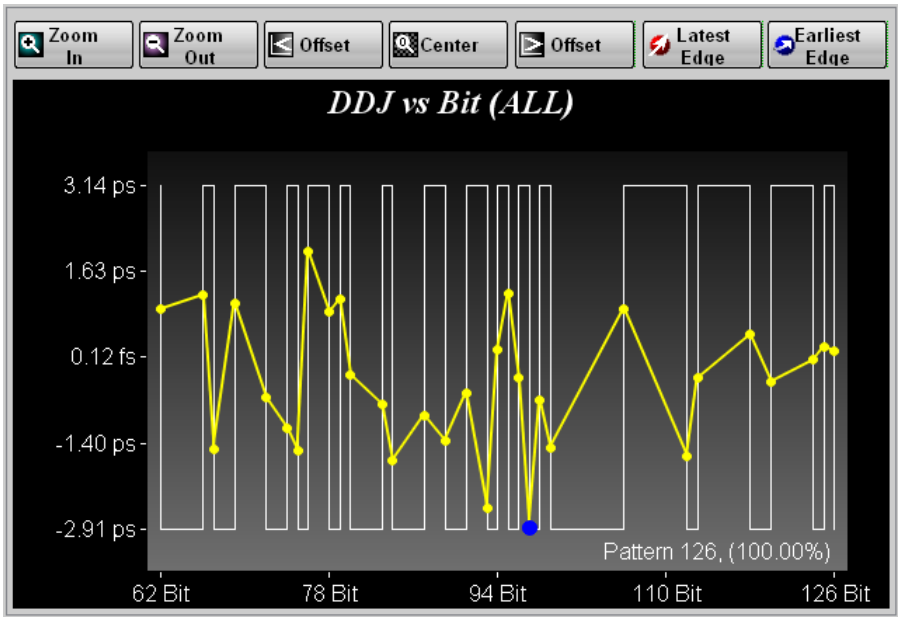


Figure 3.2.3-7 DDJ vs Bit

Table 3.2.3-7 DDJ vs Bit Item

Name	Description
Zoom In	Makes the display range of the graph half.
Zoom Out	Doubles the display range of the graph.
< Offset	Moves the display area of the graph to the left.
Center	Displays the entire range of the graph.
Offset >	Moves the display area of the graph to the right.
Latest Edge	Zooms in the location with the maximum jitter amount
Earliest Edge	Zooms in the location with the minimum jitter amount
Pattern	Displays the number of measured patterns and acquisition rate.

3.2.4 Measurement procedures

⚠ Caution

With the MX210001A, Bit Rate, Divide Ratio, and Pattern Length cannot be set.

Set these values with the EYE/Pulse Scope.

Signal input

1. Input a signal to be measured to the EYE/Pulse Scope.
2. Input a clock to Trigger Clk In of the EYE/Pulse Scope.

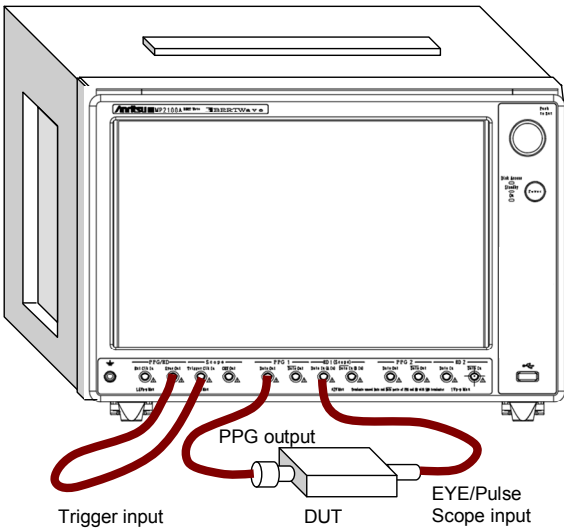


Figure 3.2.4-1 Connection for Use of MP2100A PPG

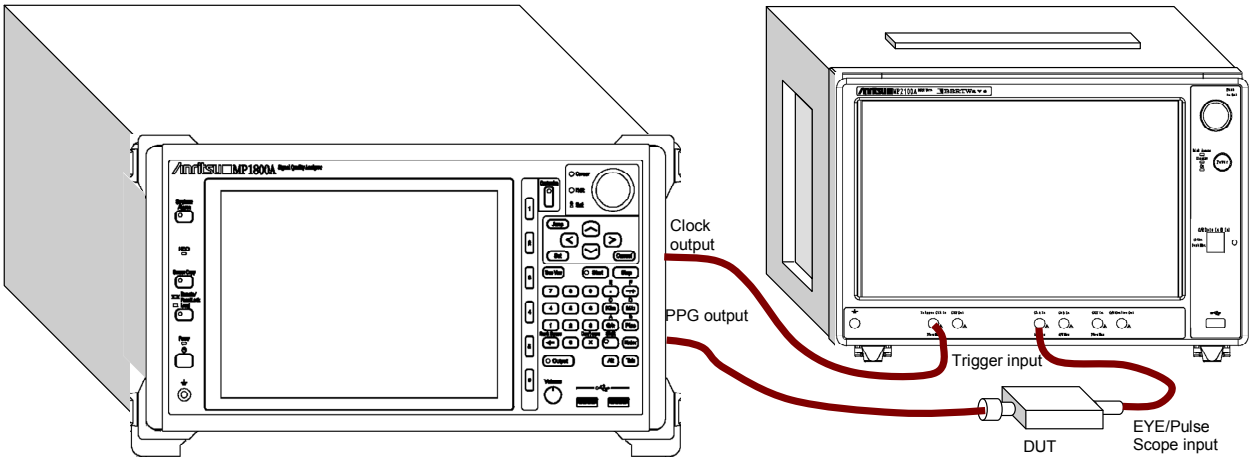


Figure 3.2.4-2 Connection for Use of External PPG with MP2102A

EYE/Pulse Scope setting

The MX210001A is software to analyze waveforms measured with the EYE/Pulse Scope. Display the waveform to be measured with the EYE/Pulse Scope before starting jitter measurement with the MX210001A.

The following are items which require settings with the EYE/Pulse Scope.

During histogram measurement

Channel to be measured, Channel Math, Scale (Amplitude, Time), Bitrate, Divide Ratio, Pattern Length

During pattern search measurement

Channel to be measured, Channel Math, Bitrate, Divide Ratio, Pattern Length

Channel to be measured

CHA ON, CHB OFF: CHA is the channel to be measured.

CHA OFF, CHB ON: CHB is the channel to be measured.

CHA ON, CHB ON:

Histogram measurement CHA and CHB are the channels to be measured.

Pattern search measurement CHA is the channel to be measured.

CHA ON, CHB ON, CH Math ON:

Regardless of Define Function setting, CHB–CHA is the measurement target.

1. Touch [EYE/Pulse Scope].
2. Touch [Setup] to set [EYE] to Sampling Mode.
3. Touch [Time] to set Data Clock Rate and Pattern Length.
4. Touch [Sampling] to change the button display to [Sampling Run].
5. Touch [Auto Scale].
6. Touch [Measure] to change Measure Item to [Amp/Time] for EYE? error check.
7. Check that the eye pattern is displayed at the center of screen and EYE? error is not displayed.
8. When the histogram measurement is executed with the MX210001A, touch [Measure] to change Measure Item to item to be measured.

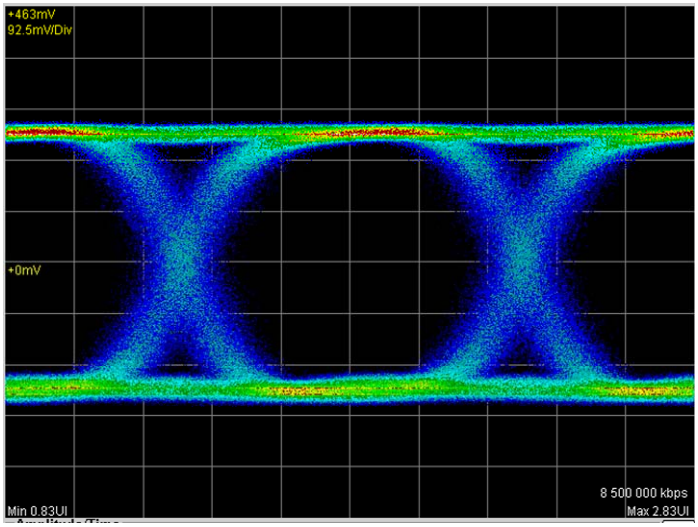


Figure 3.2.4-3 Display Example of Waveform

Setting measurement conditions

1. Touch [Jitter] on Top Menu.
2. Touch [Setup].
3. Touch [General] tab.
4. Touch the Measure Select button to display [Jitter].
5. Touch [Measure].
6. Touch [Algorithm] tab.
7. Touch the Measure Algorithm button to set the algorithm.
8. Touch [Setup].
9. Touch [General] tab.
10. Touch the Limit Type button to set the limitation method for data to be measured. Proceed to Step 12 when [None] is set.
11. With the setting in Step 10, set Time, Pattern, Sampling, or Waveforms.
12. Touch [Measure]. Proceed to Step 18 when [Histogram] is set to Measure Algorithm.
13. Touch [Algorithm] tab.
14. When PDJ measurement is executed, touch the PDJ measurement button to set the display to [ON].Proceed to Step 17 when [OFF] is set.
15. Touch the Standard button to specify the standard to be applied to the PDJ measurement.
16. Touch the PDJ Filter button to specify the filter to be applied to the PDJ measurement.
    For the combination of standards and filters, refer to Table 3.1-5 List of Standards and Filters Settable for PDJ Measurement (Unit: Hz)".

17. Touch the Measurement Edge Type button to set the edge for jitter measurement.

    All: Rising edge and falling edge

    Falling: Only falling edge

    Rising: Only rising edge

18. Touch [Advanced] tab.
19. Touch the TJ Measurement BER button to specify the BER to measure the eye aperture with the Bathtub graph.
20. Touch the Jitter Unit BER button to specify the unit to be used for the measurement results.

Set the following items in [Advanced] tab as needed.

Fixed RJ, RJ Value, Correction Factor, DJ (Scale), RJ (Scale), RJ (rms), Define Threshold, and Manual Crossing

Starting/finishing measurement

To start the jitter measurement, touch [Start/Stop] on the Jitter screen. The button lamp lights green during the analysis..

When touching [Start/Stop] during the analysis, the button lamp is lit off and then the analysis is finished.

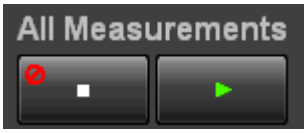
For [Pattern], [Sample], or [Time] of the Limit Type on General tab of Jitter Setup dialog, when jitter analysis data reaches to the limitation, the measurement is finished.

Note:

Operations of selection items [All], [PPG/ED Ch1], [O/E] and [EYE] under [Open] and [Save] of System Menu are disabled.

All Measurements: [■]

⊘ is displayed on the button.



The following message dialogs are displayed when analysis errors occur.

Table 3.2.4-1 Jitter Analysis Error Message

Message	Description
Illegal Error	An unexpected error has occurred.
EYE?	EYE? error has occurred in EYE/Pulse Scope. Change settings of EYE/Pulse Scope so that EYE? error will not occur.
Pattern Lost	The set pattern length does not meet the actual pattern length. Set Pattern Length of EYE/Pulse Scope correctly.
TIE Error*	The jitter has exceeded 1 UI.
Time Out	Data cannot be acquired from EYE/Pulse Scope. Confirm that waveform displays in EYE/Pulse Scope.

*: Time Interval Error

3.3 WDP (Waveform Distortion Penalty) Measurement

3.3.1 WDP screen

With the WDP measurement, S/N degradation amount of waveforms obtained with the EYE/Pulse Scope is calculated.

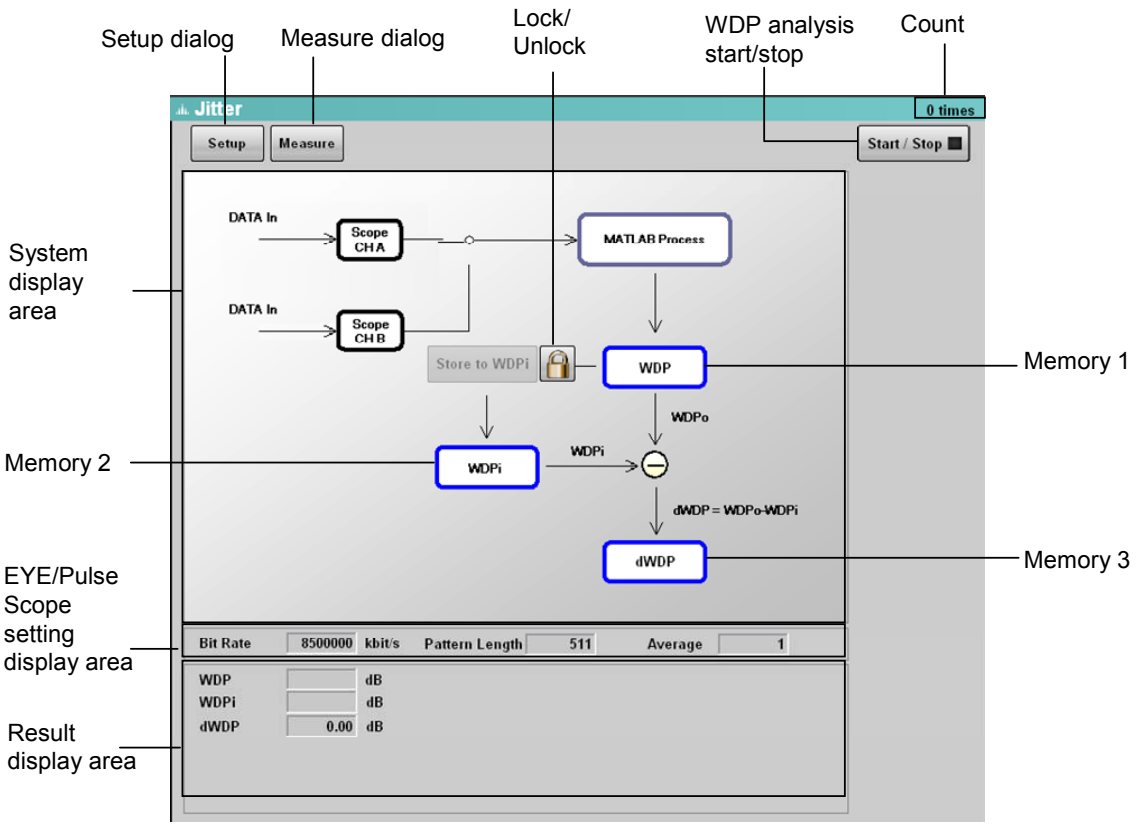


Figure 3.3.1-1 Jitter Window (WDP)

Table 3.3.1-1 Jitter Window (WDP) Item

Name	Description
Setup	Displays the Jitter Setup dialog. Refer to Figure 3.1-2 "Jitter Setup Dialog (General Tab)".
Measure	Displays the Jitter Measure dialog. Refer to Figure 3.1-4 "Jitter Measure Dialog (Algorithm Tab)".
Start/Stop	Displays the WDP analysis status. Touching [Start/Stop] changes the display in dark gray and opens the WDP analysis. The lamp lights green during the analysis.
Count	Displays the number of waveform analyses.
System display area	Displays the processing block diagram for WDP measurement.

Table 3.3.1-1 Jitter Window (WDP) Item (Cont'd)

Name	Description
MATLAB Process	Block for calculation The calculation standard to be complied with depends on the setting of Measurement Item on the Jitter Setup dialog.
Store to WDPi	Touching it copies the value in Memory 1 to Memory 2. The icon for Lock/Unlock changes to  .
Lock/Unlock	Touching  locks the operation of Store to WDPi button. Touching  unlocks the Store to WDPi button.
Memory 1	Stores the MATLAB Process output. The characters to be displayed depend on the setting of Measurement Item on the Jitter Setup dialog.
Memory 2	Touching [MATLAB Process] copies the value in Memory 1.
Memory 3	Displays the difference between the value in Memory 1 and the value in Memory 2. The characters to be displayed depend on the setting of Measurement Item on the Jitter Setup dialog.
Measurement result display area	Displays the values in Memory 1, Memory 2, and Memory 3.

The table below shows displayed characters for Memory 1 and Memory 3 and standards to be complied with for settings of Measurement Item on the Jitter Setup dialog.

Table 3.3.1-2 Displayed Characters for Memory 1 and Memory 3 and Standards to be Complied With

Setting of Measurement Item	Displayed characters		Standard to be complied with
	Memory 1	Memory 3	
TWDP	TWDP	dTWDP	IEEE 802.3 Clause 68
TWDPc	TWDPc	dTWDPc	SFF-8431
WDP	WDP	dWDP	SFF-8431
WDPc	WDPc	dWDPc	SFF-8431

Memory 3 is used for evaluation of parts such as filters.
WDP of waveforms input to parts is written to Memory 1, and the value is saved in Memory 2.
Next WDP of waveforms after passing parts is measured, and the change amount of WDP due to passing parts is displayed in Memory 3.

3.3.2 Measurement procedures

⚠ CAUTION

With the MX210001A, Divide Ratio cannot be set.

Set it with the EYE/Pulse Scope.

Signal input

1. Input a signal to be measured to the EYE/Pulse Scope.
2. Input a clock to Trigger Clk In of the EYE/Pulse Scope.

Refer to Figure 3.2.4-1 "Connection for Use of MP2100A PPG" and Figure 3.2.4-2 "Connection for Use of External PPG with MP2102A".

EYE/Pulse Scope setting

Before WDP is measured with the MX210001A, display waveforms to be measured on the EYE/Pulse Scope
The following are items which require settings with the EYE/Pulse Scope.

Scale (Amplitude and Time) and Divide Ratio

Refer to EYE/Pulse Scope setting in Section 3.2.4 "Measurement procedures" to display the eye pattern at the center of the screen.
Confirm that the EYE? error is not displayed.

WDP measurement

1. Touch [Setup].
2. Touch [General] tab.
3. Touch the Measure Select button to display [WDP].
4. Touch the Target Channel button to set the channel to be measured.
5. Touch the Measurement Item button to set the WDP type.
6. Touch the Signal Bitrate text box to set the bit rate.
7. Touch the Averaging text box to set the averaging count.
8. Touch [Measure].
9. Touch [Pattern] button to set the pattern.

   For SFF-8431-compliant measurement, select [PRBS9].

   When PPG is connected externally, select [Variable].
10. When Pattern is set to [Variable], set the Pattern Length to the same value as the pattern length of PPG.

    The settable range is 64 to 2048.
11. Touch [Start/Stop]. The button lamp lights green during the measurement.

12. "Measuring" is displayed until the analysis is finished. When the analysis is finished, results are displayed at the measurement result area.

Note:

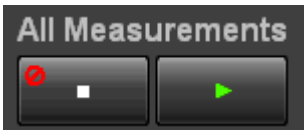
[O/E] and [EYE/Pulse Scope] on the top menu and [PPG/ED] button used for the measurement are unavailable during the measurement.

Operations of selection items [All], [PPG/ED Ch1], [O/E] and [EYE] under [Open] and [Save] of System Menu are disabled.

Operations of items below are limited while "Processing" is displayed.

System Menu : [Save], [Open], [Screen Copy], [Initialize], [System Alarm], [Block Diagram], [Exit]

All Measurements: [■]
⊘ is displayed on the button.



The following message dialogs are displayed when analysis errors occur.

Table 3.3.2-1 Jitter Analysis Error Message

Message	Description
Illegal Error	An unexpected error has occurred.
EYE?	EYE? error has occurred in EYE/Pulse Scope.
Time Out	Data cannot be acquired from EYE/Pulse Scope.
MATLAB Error	The MATLAB processing has failed.

WDP change amount (dWDP) measurement

1. Input a signal as the reference to BERTWave.
2. Measure TWDP/TWDPc/WDP/WDP according to the procedure in "WDP measurement."
3. Touch [Stored WDPi].The value is displayed in WDPi at the measurement result area.
4. Input a signal to be compared to BERTWave.
5. Measure TWDP/TWDPc/WDP/WDPc according to the procedure in "WDP measurement."
6. The WDP change amounts are displayed in dTWDP/dTWDPc/dWDP/dWDPc at the measurement result area.

3.4 Saving Measurement Results

Saving text files

1. Touch [System Menu].
2. Touch [Save].
3. Touch [Jitter].
4. Touch [Result].
5. The File Name "Module" dialog is displayed. When changing the file name, touch [Screen Keyboard] to input a file name.
6. Touching [OK] on the File Name "Module" dialog saves the measurement results to a text file and CSV file.

Figure 3.4-1 to Figure 3.4-4 show the text file example.":" in the figures indicates line omission.

Saving image files

1. Touch [Setup] at the Jitter screen.
2. Touch [Utility] tab.
3. Touch [Screen Copy].
4. The Files dialog is displayed.

   Specify the destination and file name, and touch [OK].

   Image files can be saved with [Screen Copy] of [System Menu].

```
Anritsu;MP2100A;01.00;TXT----------------------------------------
Option  01,05,90

[Setup]
Measure Selection                Jitter
Signal Bitrate                   10312576 kbit/s
Divide Ratio                     8
Pattern Length                   32767
Target Channel                   CHA&B
Measuring Limit                  None
Measure Algorithm                Histogram
TJ Measurement BER (CHA)         1.00E-012
TJ Measurement BER (CHB)         1.00E-012
Fixed RJ (CHA)                   OFF
Fixed RJ (CHB)                   OFF
RJ Value (CHA)                   1.00 ps rms
RJ Value (CHB)                   1.00 ps rms
Correction Factor (CHA)          OFF
Correction Factor (CHB)          OFF
DJ(Scale) (CHA)                  1.00
DJ(Scale) (CHB)                  1.00
RJ (Scale) (CHA)                 1.00
RJ (Scale) (CHB)                 1.00
RJ (rms) (CHA)                   1.00 ps
RJ (rms) (CHB)                   1.00 ps
Define Threshold (CHA)           Auto
Define Threshold (CHB)           Auto
Manual Crossing (CHA)            50 %
Manual Crossing (CHB)            50 %
Jitter Unit                      UI

[Jitter Measurement Results]
TJ(1.0E-12) (CHA)                3.255751e-001
TJ(1.0E-12) (CHB)                4.190451e-001
TJ(1.00E-012) (CHA)              3.255751e-001
TJ(1.00E-012) (CHB)              4.190451e-001
DJ(d-d) (CHA)                    3.011466e-002
DJ(d-d) (CHB)                    7.199632e-003
RJ(d-d) (CHA)                    2.100030e-002
RJ(d-d) (CHB)                    2.927809e-002
EYE Opening (CHA)                6.744249e-001
EYE Opening (CHB)                5.809549e-001
J2Jitter (CHA)                   1.480081e-001
J2Jitter (CHB)                   1.713838e-001
J9Jitter (CHA)                   2.913236e-001
J9Jitter (CHB)                   3.712829e-001

        [TJ Histogram][CHA]
Total Samples                    1752767
Edge Deviation                   Number Hits
-9.600000e-002                   0
-9.408000e-002                   0
-9.216000e-002                   0
-9.024000e-002                   0
-8.832000e-002                   0
-8.640000e-002                   0
-8.448000e-002                   0
-8.256000e-002                   0
-8.064000e-002                   59
-7.872000e-002                   497
-7.680000e-002                   85
-7.488000e-002                   214
-7.296000e-002                   1028
-7.104000e-002                   437
                :
                :
```

```
[TJ Histogram][CHB]
Total Samples                    1752767
Edge Deviation                   Number Hits
-1.090000e-001                   0
-1.068200e-001                   0
-1.046400e-001                   0
-1.024600e-001                   0
-1.002800e-001                   0
-9.810000e-002                   0
-9.592000e-002                   0
-9.374000e-002                   0
-9.156000e-002                   0
-8.938000e-002                   0
-8.720000e-002                   0
-8.502000e-002                   0
-8.284000e-002                   0
-8.066000e-002                   0
                :
                :
[Bathtub][CHA]
Measure Edge Type                Rising
Total Samples                    1752767
Unit Interval    BER(Estimate)   BER(Actual)
0.000000e+000    3.398478e-005   1.085531e-005
1.000000e-002    4.442292e-005   1.538000e-005
2.000000e-002    5.775320e-005   2.160986e-005
3.000000e-002    7.467780e-005   3.011141e-005
4.000000e-002    9.604032e-005   4.160981e-005
5.000000e-002    1.228465e-004   5.702273e-005
6.000000e-002    1.562855e-004   7.749799e-005
7.000000e-002    1.977526e-004   1.044542e-004
8.000000e-002    2.488704e-004   1.396231e-004
9.000000e-002    3.115099e-004   1.850925e-004
1.000000e-001    3.878095e-004   2.433460e-004
1.100000e-001    4.801900e-004   3.172988e-004
1.200000e-001    5.913655e-004   4.103240e-004
1.300000e-001    7.243481e-004   5.262665e-004
                :
                :
[Bathtub][CHB]
Measure Edge Type                Rising
Total Samples                    1752767
Unit Interval    BER(Estimate)   BER(Actual)
0.000000e+000    1.085531e-005   3.191090e-005
1.000000e-002    1.538000e-005   4.182492e-005
2.000000e-002    2.160986e-005   5.451969e-005
3.000000e-002    3.011141e-005   7.067959e-005
4.000000e-002    4.160981e-005   9.112915e-005
5.000000e-002    5.702273e-005   1.168540e-004
6.000000e-002    7.749799e-005   1.490228e-004
7.000000e-002    1.044542e-004   1.890103e-004
8.000000e-002    1.396231e-004   2.384194e-004
9.000000e-002    1.850925e-004   2.991035e-004
1.000000e-001    2.433460e-004   3.731860e-004
1.100000e-001    3.172988e-004   4.630772e-004
1.200000e-001    4.103240e-004   5.714863e-004
1.300000e-001    5.262665e-004   7.014276e-004
1.400000e-001    6.694403e-004   8.562185e-004
                :
                :
```

Figure 3.4-1 File Example for Jitter Measurement (Histogram)

```
Anritsu;MP2100A;01.00;TXT----------------------------------------
Option    01,05,90

[Setup]
Measure Selection                Jitter
Signal Bitrate                   10312500 kbit/s
Divide Ratio                     8
Pattern Length                   32767
Target Channel                   CHA
Measuring Limit                  None
Measure Algorithm                Pattern Search
PDJ Measurement                  OFF
Standard                         STM-0     (51.84M)
PDJ Filter                       LP     ( - 400k)
Measure Edge Type                Rising
TJ Measurement BER               1.00E-012
Fixed RJ                         OFF
RJ Value                         1.90 ps rms
Correction Factor                OFF
DJ(Scale)                        999.99
RJ (Scale)                       500.01
RJ (rms)                         999.99 ps
Define Threshold                 Auto
Manual Crossing                  50 %
Jitter Unit                      UI

[Jitter Measurement Results]
TJ(1.0E-12)                      2.656822e-001
TJ(1.00E-012)                    2.656822e-001
DJ(d-d)                          5.680618e-002
RJ(d-d)                          1.484610e-002
RJ(rms)                          1.050169e-002
PJ(p-p)                          2.900000e-002
DDJ(p-p)                         1.499106e-001
DCD                              5.867236e-003
ISI(p-p)                         1.499106e-001
EYE Opening                      7.343178e-001
J2Jitter                         1.401535e-001
J9Jitter                         2.414684e-001
DDPWS                            8.112348e-002
PJ Frequency                     -

[TJ Histogram]
Measure Edge Type                Rising
Total Samples                    98304
Edge Deviation                   Number Hits
-1.220000e-001                   0
-1.195600e-001                   0
-1.171200e-001                   0
-1.146800e-001                   0
-1.122400e-001                   0
-1.098000e-001                   0
-1.073600e-001                   0
-1.049200e-001                   0
-1.024800e-001                   1
-1.000400e-001                   0
-9.760000e-002                   2
-9.516000e-002                   6
-9.272000e-002                   10
                :
                :

Measure Edge Type                Rising
Total Samples                    65536
Edge Deviation                   Number Hits
-7.200000e-002                   0
-7.056000e-002                   0
-6.912000e-002                   0
-6.768000e-002                   0
-6.624000e-002                   0
-6.480000e-002                   0
-6.336000e-002                   0
-6.192000e-002                   0
-6.048000e-002                   0
-5.904000e-002                   0
-5.760000e-002                   0
-5.616000e-002                   0
                :
                :
[DDJ Histogram]
Measure Edge Type                ALL
Total Samples                    196608
Edge Deviation                   Number Hits
-1.000000e-001                   0
-9.780000e-002                   0
-9.560000e-002                   0
-9.340000e-002                   0
-9.120000e-002                   1
-8.900000e-002                   2
-8.680000e-002                   1
-8.460000e-002                   2
-8.240000e-002                   5
-8.020000e-002                   5
-7.800000e-002                   21
                :
                :
[DDJ Histogram]
Measure Edge Type                RISE
Total Samples                    98304
Edge Deviation                   Number Hits
-1.000000e-001                   0
-9.780000e-002                   0
-9.560000e-002                   0
-9.340000e-002                   0
-9.120000e-002                   1
-8.900000e-002                   2
-8.680000e-002                   1
-8.460000e-002                   2
-8.240000e-002                   5
-8.020000e-002                   5
-7.800000e-002                   21
                :
                :
[DDJ Histogram]
Measure Edge Type                FALL
Total Samples                    98304
Edge Deviation                   Number Hits
-1.000000e-001                   0
-9.780000e-002                   0
-9.560000e-002                   0
-9.340000e-002                   0
-9.120000e-002                   0
-8.900000e-002                   0
-8.680000e-002                   0
-8.460000e-002                   0
-8.240000e-002                   0
-8.020000e-002                   0
-7.800000e-002                   0
                :
                :
```

Figure 3.4-2 File Example for Jitter Measurement (Pattern Search)

[Composite Histogram(TJ)]
Measure Edge Type Rising
Total Samples 98304
Edge Deviation Number Hits
-1.220000e-001 0
-1.195600e-001 0
-1.171200e-001 0
-1.146800e-001 0
-1.122400e-001 0
-1.098000e-001 0
-1.073600e-001 0
-1.049200e-001 0
-1.024800e-001 1
-1.000400e-001 0
-9.760000e-002 2
-9.516000e-002 6
:
:

[Composite Histogram(RJ/PJ)]
Measure Edge Type Rising
Total Samples 65536
Edge Deviation Number Hits
-1.220000e-001 0
-1.195600e-001 0
-1.171200e-001 0
-1.146800e-001 0
-1.122400e-001 0
-1.098000e-001 0
-1.073600e-001 0
-1.049200e-001 0
-1.024800e-001 0
-1.000400e-001 0
-9.760000e-002 0
:
:

[Composite Histogram(DDJ)]
Measure Edge Type Rising
Total Samples 98304
Edge Deviation Number Hits
-1.220000e-001 0
-1.195600e-001 0
-1.171200e-001 0
-1.146800e-001 0
-1.122400e-001 0
-1.098000e-001 0
-1.073600e-001 0
-1.049200e-001 0
-1.024800e-001 0
-1.000400e-001 0
-9.760000e-002 0
:
:

[DDJ vs. bit]
Pattern Length 32767
Measure Edge Type Rising
DDJ/PDJ vs Bit Current Pattern 1.200000e+001 patterns

Bit Number	Pattern	DDJ
0	0	-
1	1	2.013448e-002
2	0	-
3	0	-
4	0	-
5	0	-
6	1	-6.493278e-003
7	1	-
8	0	-
9	1	1.502857e-003

:
:

32751	1	-1.918428e-002
32752	1	-
32753	0	-
32754	0	-
32755	1	-2.396353e-002
32756	0	-
32757	1	1.438613e-002
32758	0	-
32759	0	-
32760	0	-
32761	1	3.045619e-002
32762	1	-
32763	1	-
32764	0	-
32765	0	-
32766	1	-6.311832e-002

:

[Bathtub]
Measure Edge Type Rising
Total Samples 98304

Unit Interval	BER(Estimate)	BER(Actual)
0.000000e+000	2.510852e-001	2.313659e-001
1.000000e-002	2.259852e-001	1.701407e-001
2.000000e-002	1.815823e-001	1.164434e-001
3.000000e-002	1.176519e-001	7.304605e-002
4.000000e-002	5.683967e-002	4.152552e-002
5.000000e-002	1.940395e-002	2.121036e-002
6.000000e-002	4.521348e-003	9.079257e-003
7.000000e-002	7.034841e-004	3.011160e-003
8.000000e-002	7.206772e-005	7.375306e-004
9.000000e-002	4.816242e-006	9.155553e-005
1.000000e-001	1.488224e-007	5.086418e-006
1.100000e-001	3.982300e-009	-
1.200000e-001	6.854109e-011	-
1.300000e-001	7.570607e-013	-
1.400000e-001	5.357015e-015	-

:
:

[PJ vs. Frequency]
Measure Edge Type Rising

Frequency	PJ
0	-7.056575e+001
499	-8.971501e+001
998	-9.717738e+001
1498	-8.429145e+001
1997	-1.051295e+002
2496	-9.457721e+001
2995	-9.016926e+001
3494	-8.248915e+001
3993	-8.653555e+001
4493	-9.194856e+001
4992	-8.974889e+001
5491	-8.599299e+001
5990	-8.453524e+001
6489	-8.795926e+001
6988	-8.725369e+001

:
:

Figure 3.4-3 File Example for Jitter Measurement (Pattern Search) (Cont'd)

```
Anritsu;MP2100A;01.00;TXT----------------------------------------------
Option    01,05,90,55

[Setup]
Measure Selection                    WDP
Signal Bitrate(WDP)                  8500000 kbit/s
Pattern Length(WDP)                  511
Pattern                              PRBS9
Target Channel(WDP)                  CHA
Measuring Limit                      Averaging
Averaging                            1 wfms

[Jitter Measurement Results]
WDP                                  1.024000e+001 dB
WDPi                                 9.660000e+000 dB
dWDP                                 5.800000e-001 dB
```

Figure 3.4-4 File Example for WDP Measurement

Chapter 4 Remote Control Commands

This chapter describes commands to control the MX210001A.
For the connection method for BERTWave and a control PC and operation check method, refer to Chapter 2 "Before Use" in *BERTWave Series Remote Control Operation Manual (W3773AE)*.

When the MX210001A is controlled, transmit :MODule:ID 6 first.

4.1 Description of Message Explanations

The following table shows the rules for describing messages.

Table 4.1-1 Rules for Describing Messages

Symbols	Usage
[]	Messages or parameters enclosed in square brackets can be omitted.
|	Choose one from multiple choices. A | B | C | D means choose from A, B, C, and D.
{}	Groups choice in braces. A | B ({C | D}) means choose one of A, B (C), and B (D).
<character>	Short alphabet or alphanumeric
<integer>	Decimal integer value Example: –100, 12500000
<numeric>	Decimal numeric value Example: 0,–0.00062, 2.35

Specifying channels

When the channel of BERTWave is specified as the remote control target, describe CHA or CHB to the first parameter of the command or query.

Example:

Set Fixed RJ Factor of Channel A.

```
:SENSe:JITTer:MEASure:RJ CHA,ON
```

Query RJ (d-d) of Channel B.

```
SENSe:JITTer:RESult:RJ? CHB
```

Omitting characters

Some part of the header character string can be omitted.

Describe the non-omissible part in uppercase and the omissible part in lowercase.

Example: `:SENSe:MEASure:CROSsing?`

This header can be described as follows:

```
:SENS:MEAS:CROS?
:SENS:MEAS:CROSSING?
:SENSE:MEASURE:CROS?
:SENSE:MEAS:CROSS?
:SENSE:MEASURE:CROSSING?
```

The BERTWave interprets these messages as the same meaning.

4.2 Register

The MX210001A controls the PPG and EYE/Pulse Scope via the MX210000A BERTWave control software.
The status of the PPG and EYE/Pulse Scope which are running the MX210001A can be checked with the execution status register or device-unique register.

For the explanation of registers, refer to Section 2.6 "Checking Instrument Status" in *BERTWave Series Remote Control Operation Manual (W3773AE)*.

The execution status (frequency characteristics data acquisition and waveform prediction processing completion) of the MX210001A is not reflected to the BERTWave execution status register.

The message processing of the MX210001A is reflected to the standard event register of the BERTWave.

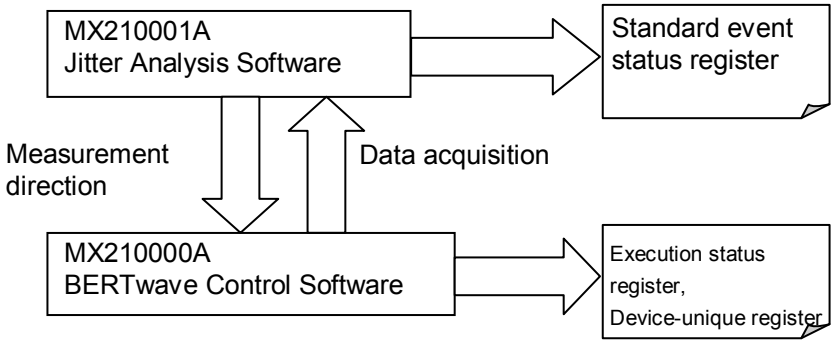


Figure 4.2-1 Relationship between Software and Register

4.3 Correspondence between Panel Operation and Message

This section explains correspondence between panel operation and message.

Figure 4.3-1 Message Corresponding to Jitter Panel [1]

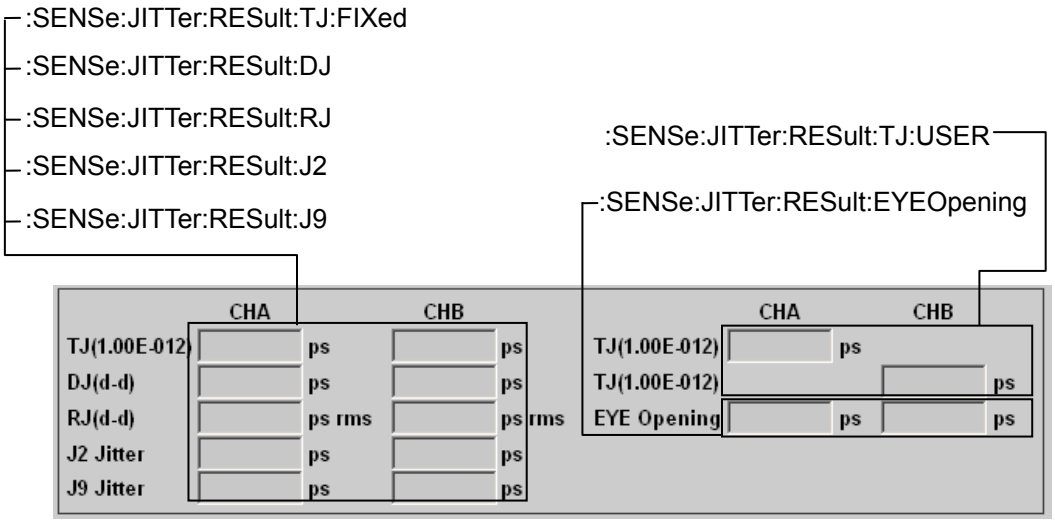


Figure 4.3-2 Message Corresponding to Measurement Result (Histogram)

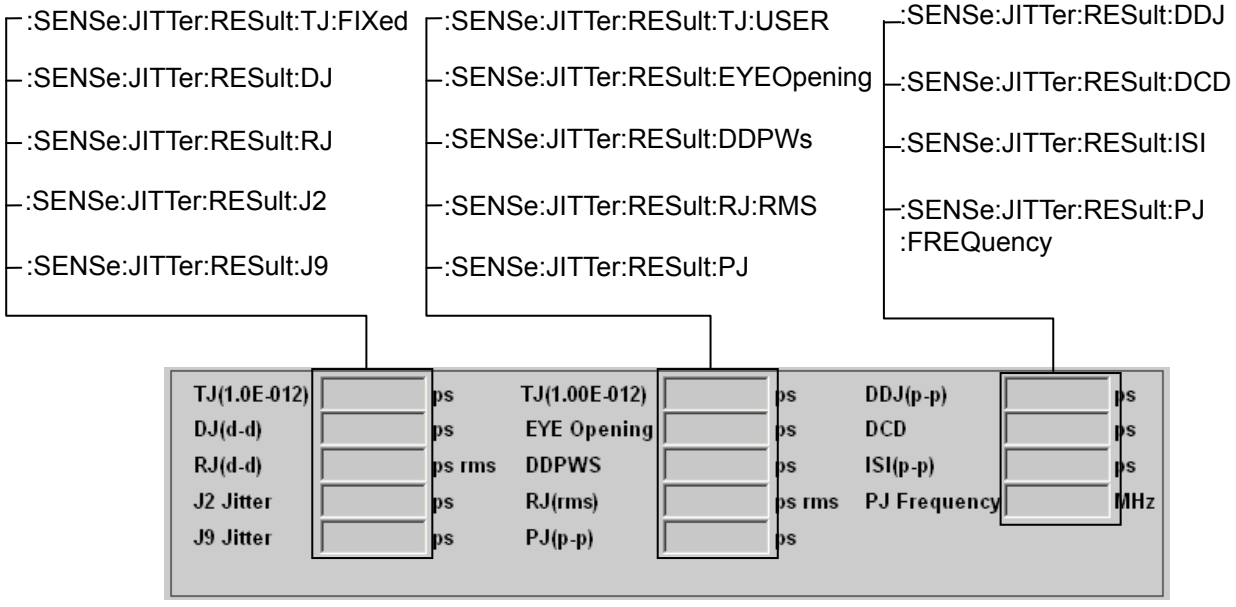


Figure 4.3-3 Message Corresponding to Measurement Result (Pattern Search)

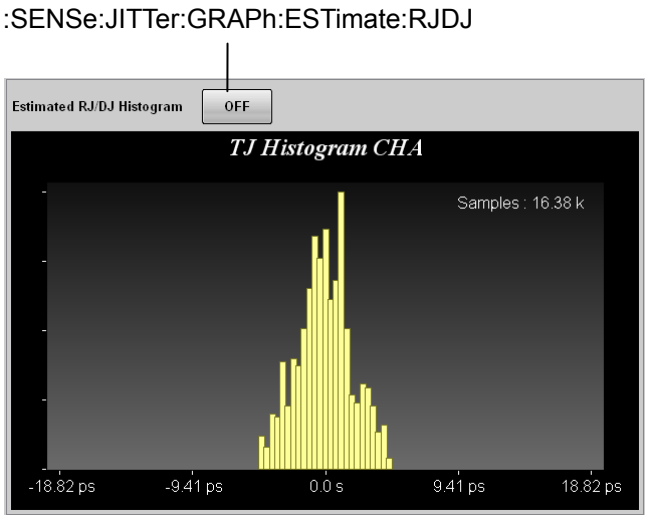


Figure 4.3-4 Message Corresponding to TJ Histogram (Histogram)

Note:

With the histogram measurement, the number of samples in TJ Histogram cannot be read.

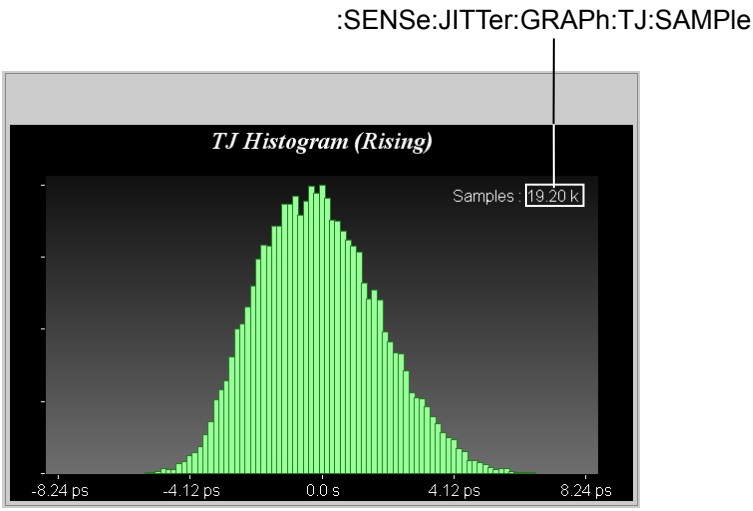


Figure 4.3-5 Message Corresponding to TJ Histogram (Pattern Search)

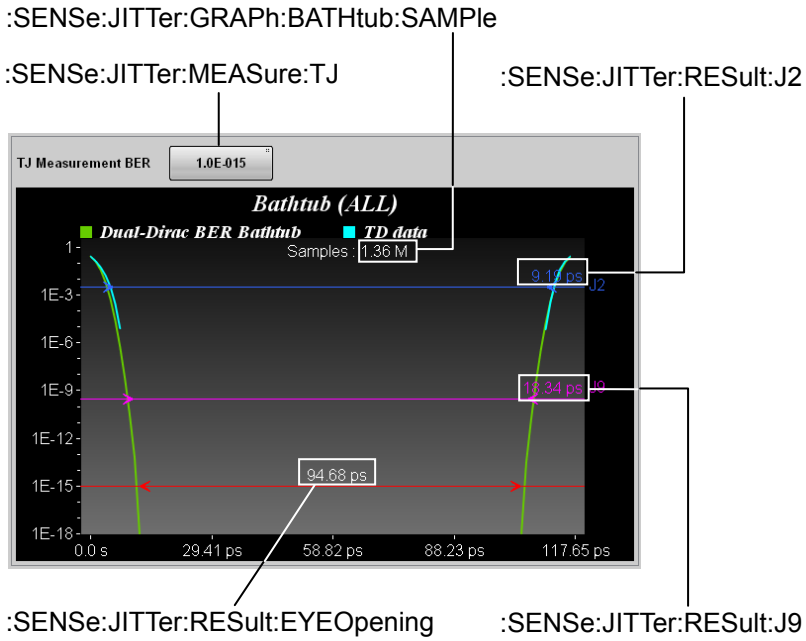


Figure 4.3-6 Message Corresponding to Bathtub

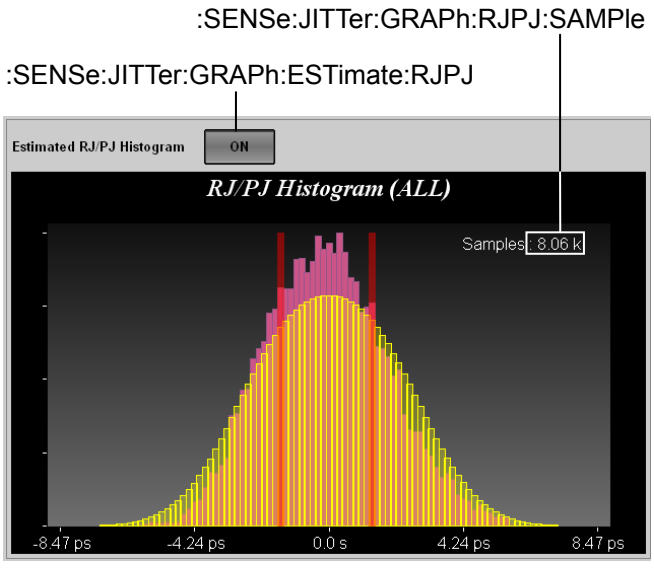


Figure 4.3-7 Message Corresponding to RJ/PJ Histogram Measurement Result

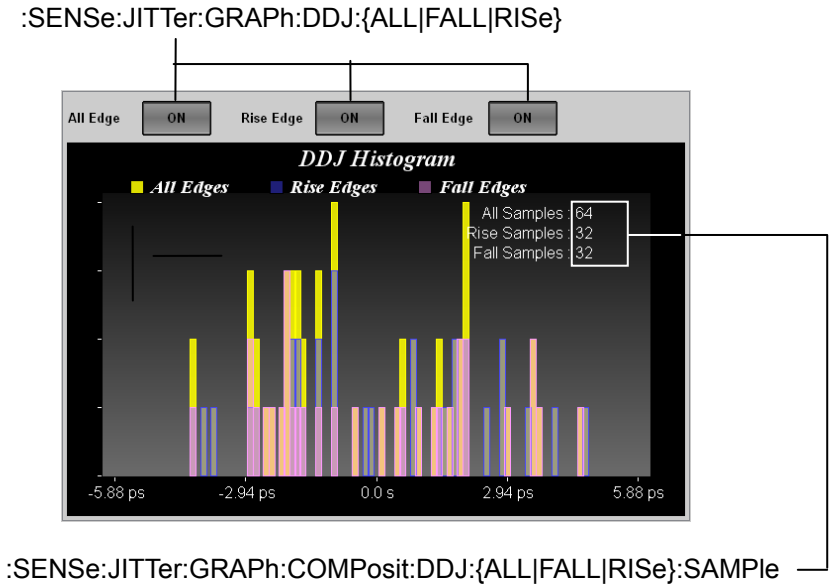


Figure 4.3-8 Message Corresponding to DDJ Histogram Display

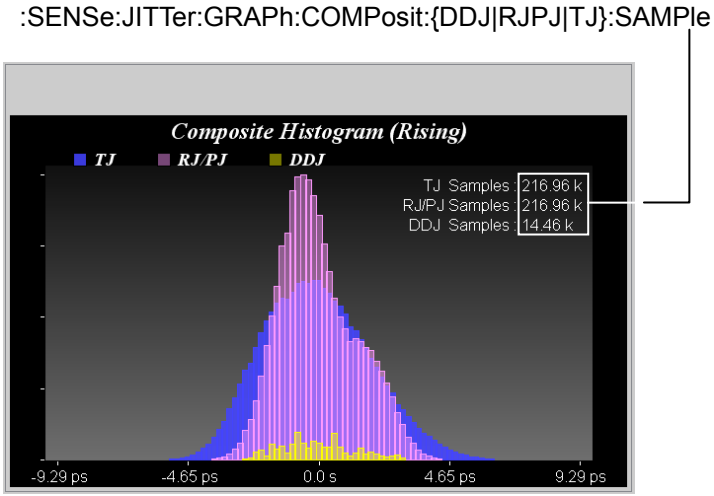


Figure 4.3-9 Message Corresponding to Composite Histogram Display

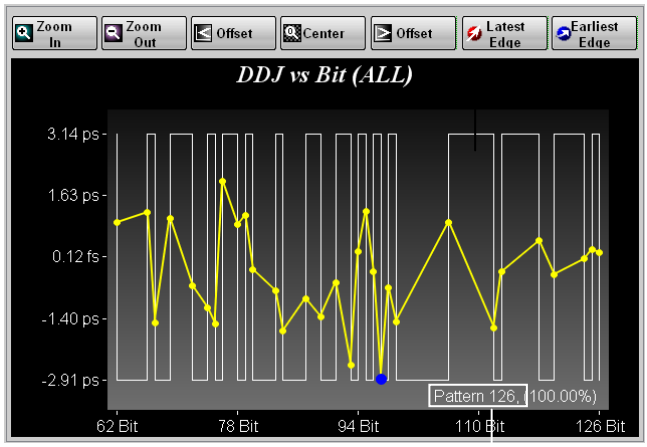


Figure 4.3-10 Message Corresponding to DDJ vs Bit Display

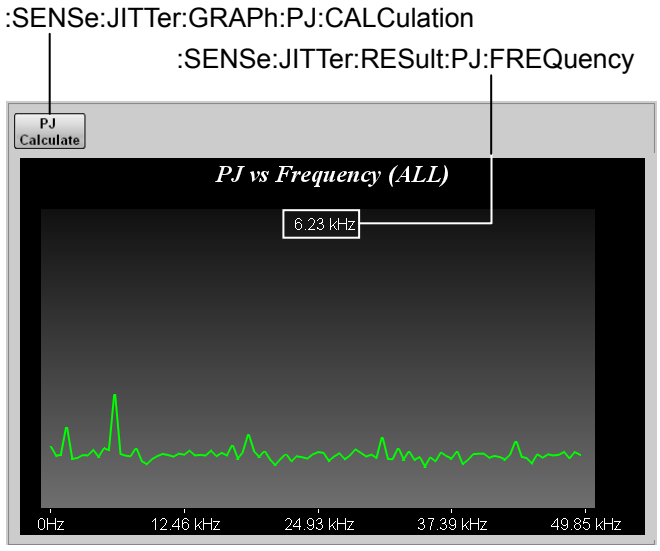


Figure 4.3-11 Message Corresponding to PJ vs Frequency Display

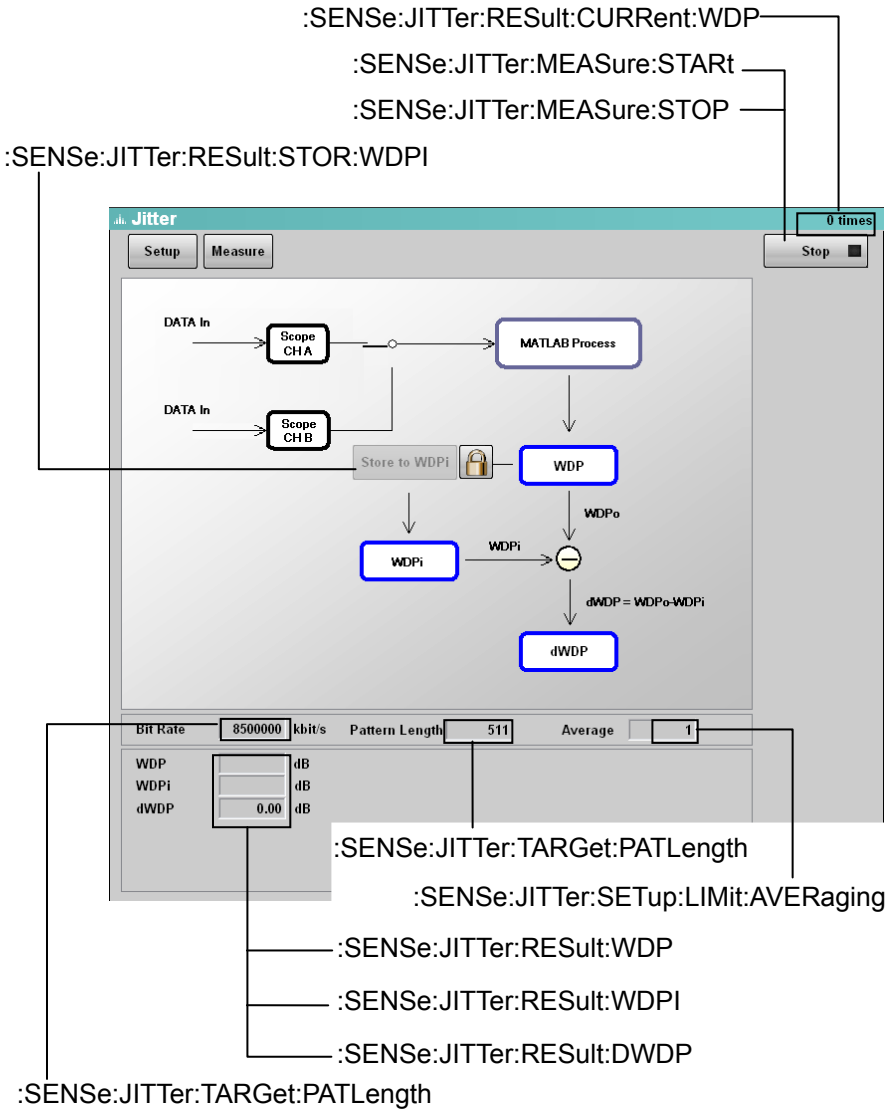


Figure 4.3-12 Message Corresponding to WDP Display

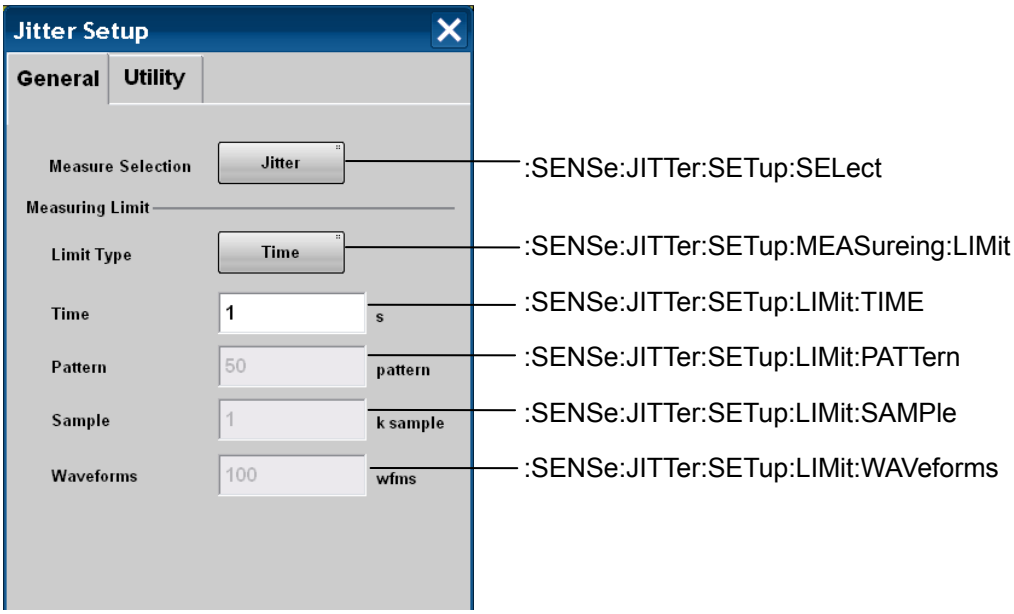


Figure 4.3-13 Message Corresponding to Jitter Setup Dialog (General-Jitter)

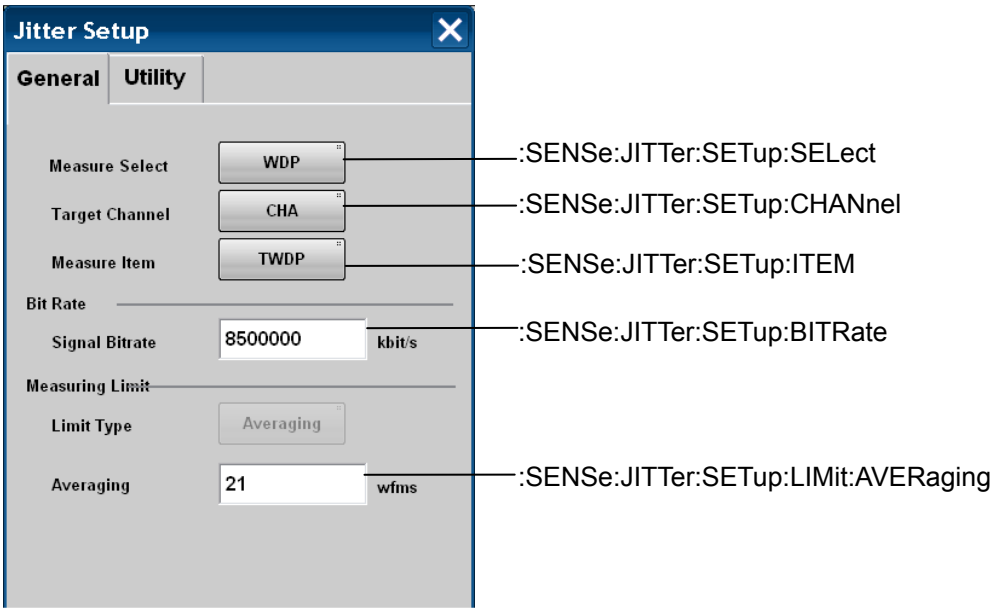


Figure 4.3-14 Message Corresponding to Jitter Setup Dialog (General- WDP)

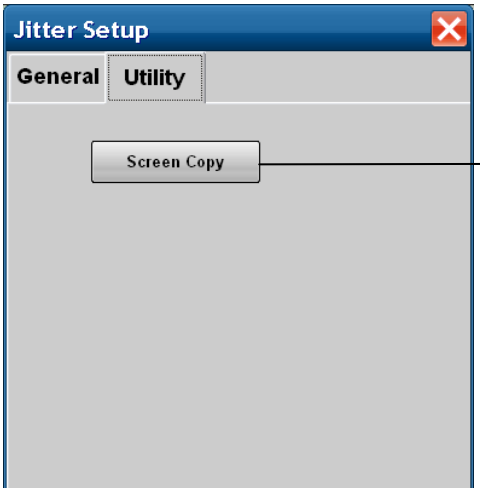


Figure 4.3-15 Message Corresponding to Jitter Setup Dialog (Utility)

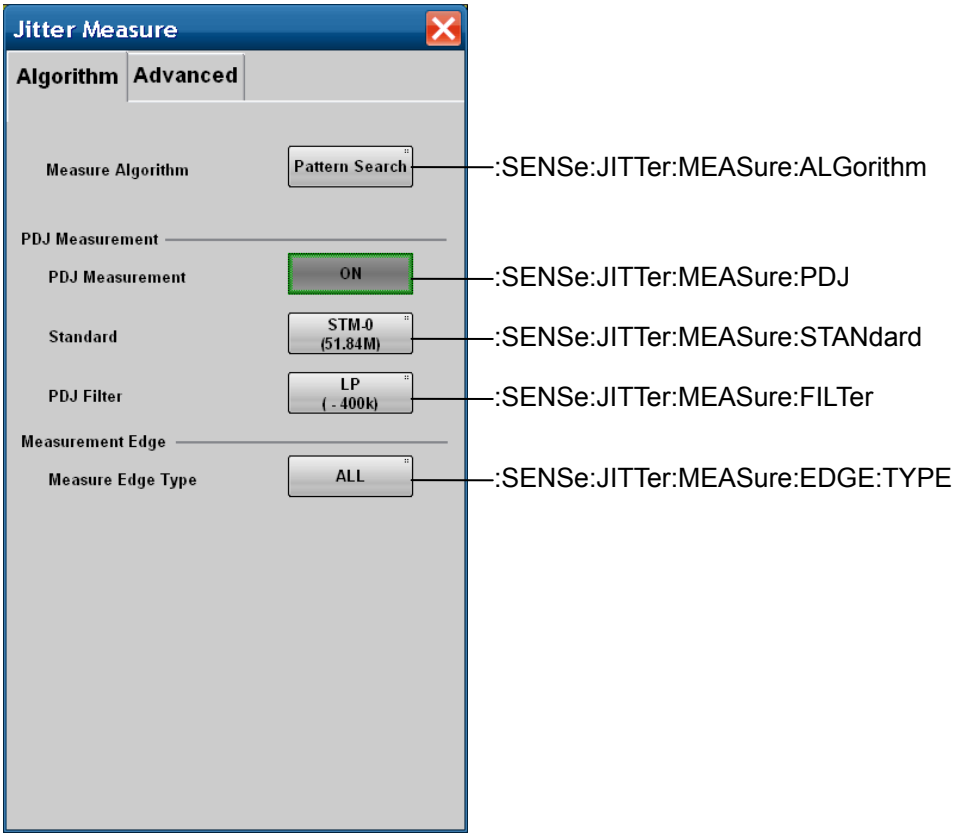


Figure 4.3-16 Message Corresponding to Jitter Measure Dialog (Algorithm-Jitter)

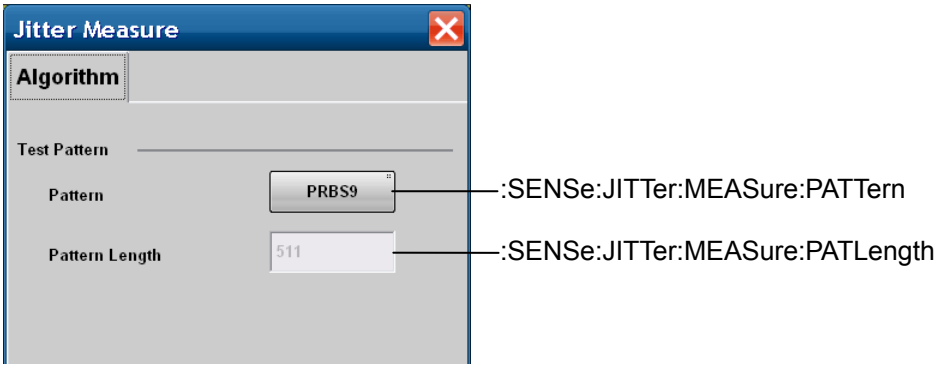


Figure 4.3-17 Message Corresponding to Jitter Measure Dialog (Algorithm- WDP)

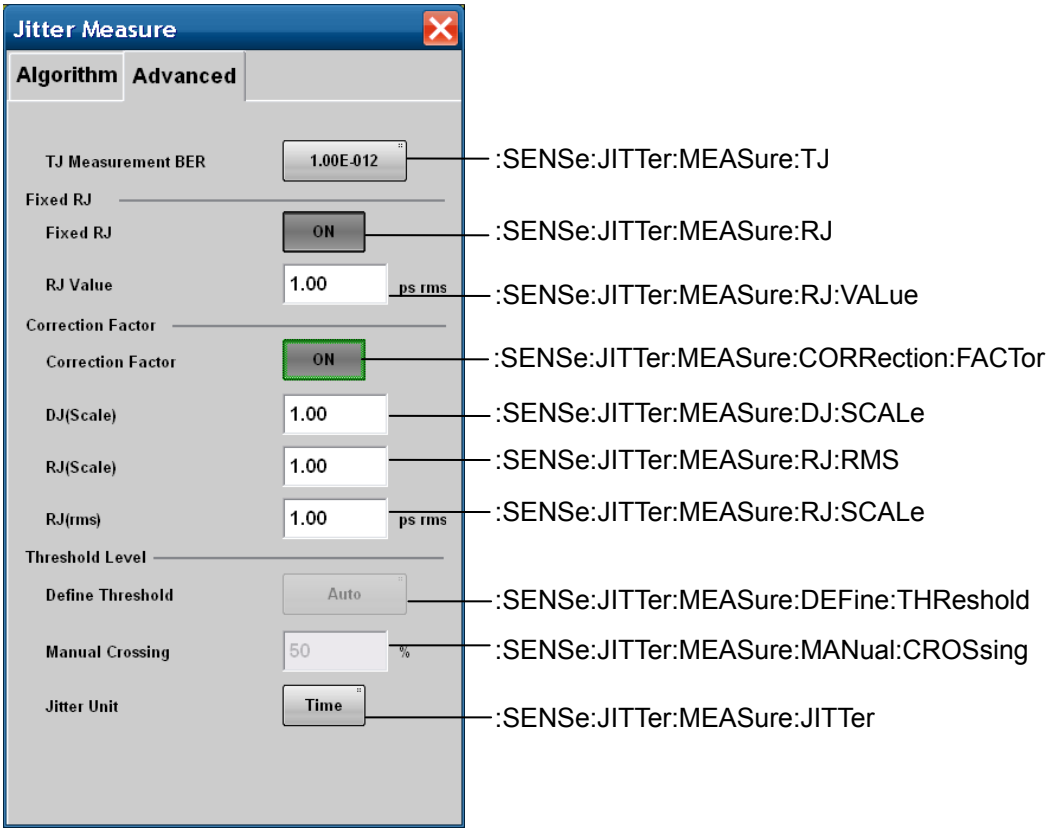


Figure 4.3-18 Message Corresponding to Jitter Measure Dialog (Advanced-Jitter)

There is no corresponding panel operation for the following messages.

:SENSe:JITTer:MEASure:STATus
:SENSe:JITTer:RESult:ERRor

For the messages corresponding to the following panel operations, refer to Chapter 3 "Message Details" in *BERTWave Series Remote Control Operation Manual (W3773AE).*

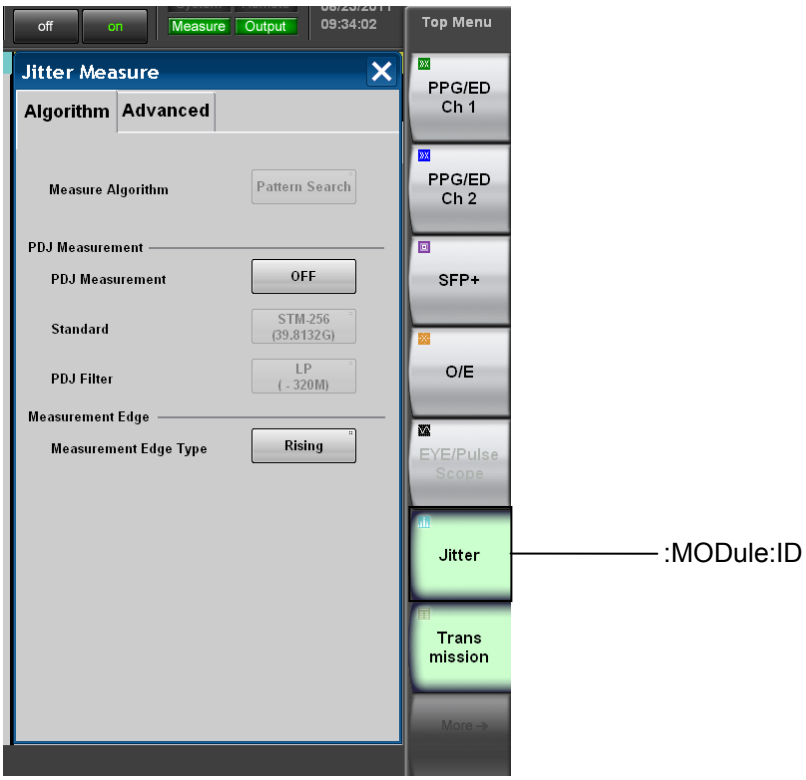


Figure 4.3-19 Message Corresponding to Top Menu

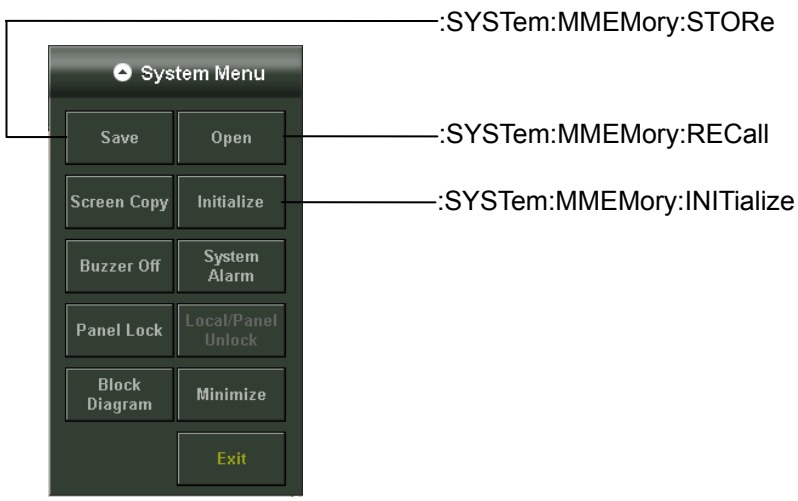


Figure 4.3-20 Message Corresponding to System Menu

4.4 Device Message Details

:SENSe:JITTer:COPY

Function

This command saves the measurement result screen and graph.

Syntax

```
:SENSe:JITTer:COPY
```

:SENSe:JITTer:GRAPh:BATHtub:SAMPle

Function

This command queries the number of samples in Bathtub graph.

Syntax

```
:SENSe:JITTer:GRAPh:BATHtub:SAMPle? [CHA|CHB]
```

Response Data

<integer>: 0 to 99 999 999 999 990 (sample)

Example of Use

```
:SENSe:JITTer:GRAPh:BATHtub:SAMPle?
> 8688
```

:SENSe:JITTer:GRAPh:COMPosit:DDJ:{ALL|FALL|RISe}:SAMPle

Function

This command queries the number of samples in Composite DDJ Histogram graph.
It specifies the target edge with ALL, FALL, and RISe.

Syntax

```
:SENSe:JITTer:GRAPh:COMPosit:DDJ:{ALL|FALL|RISe}:SAMPle?
```

Response Data

<integer>: 0 to 99 999 999 999 990 (sample)

Example of Use

To query the sample number of All.

```
:SENSe:JITTer:GRAPh:COMPosit:DDJ:ALL:SAMPle?
> 7896
```

To query the sample number of Fall.

```
:SENSe:JITTer:GRAPh:COMPosit:DDJ:FALL:SAMPle?
> 3919
```

To query the sample number of Rise.

```
:SENSe:JITTer:GRAPh:COMPosit:DDJ:RISe:SAMPle?
> 3977
```

:SENSe:JITTer:GRAPh:COMPosit:{DDJ|RJPJ|TJ}:SAMPle

Function

This command queries the number of samples in Composite Histogram graph.
It specifies the target graph with DDJ, RJPJ, and TJ.

Syntax

```
:SENSe:JITTer:GRAPh:COMPosit:{DDJ|RJPJ|TJ}:SAMPle?
```

Response Data

<integer>: 0 to 99 999 999 999 990 (sample)

Example of Use

To query the sample number of DDJ.

```
:SENSe:JITTer:GRAPh:COMPosit:DDJ:SAMPle?
> 220
```

To query the sample number of RJ, PJ.

```
:SENSe:JITTer:GRAPh:COMPosit:RJPJ:SAMPle?
> 906
```

To query the sample number of TJ.

```
:SENSe:JITTer:GRAPh:COMPosit:TJ:SAMPle?
> 1127
```

:SENSe:JITTer:GRAPh:DDJ:{ALL|FALL|RISe}

Function

This command sets/queries the status of All Edge, Fall Edge, or Rise Edge in the DDJ Histogram graph screen.

Syntax

```
:SENSe:JITTer:GRAPh:DDJ:ALL 0|1|OFF|ON
:SENSe:JITTer:GRAPh:DDJ:ALL?
```

0|OFF: OFF
1|ON: ON

Response Data

0|1

Example of Use

To set/query the All Edge setting.

```
:SENSe:JITTer:GRAPh:DDJ:ALL OFF
:SENSe:JITTer:GRAPh:DDJ:ALL?
> 0
```

To set/query the Fall Edge setting.

```
:SENSe:JITTer:GRAPh:DDJ:FALL 0
:SENSe:JITTer:GRAPh:DDJ:FALL?
> 0
```

To set/query the Rise Edge setting.

```
:SENSe:JITTer:GRAPh:DDJ:RISe ON
:SENSe:JITTer:GRAPh:DDJ:RISe?
> 1
```

:SENSe:JITTer:GRAPh:ESTimate:RJDJ

Function

This command sets/queries the Estimated RJ/DJ Histogram setting in the TJ Histogram screen.

Syntax

```
:SENSe:JITTer:GRAPh:ESTimate:RJDJ [{CHA|CHB},]0|1|OFF|ON
:SENSe:JITTer:GRAPh:ESTimate:RJDJ? [CHA|CHB]
```

0|OFF: OFF
1|ON: ON

Response Data

0|1

Example of Use

```
:SENSe:JITTer:GRAPh:ESTimate:RJDJ OFF
:SENSe:JITTer:GRAPh:ESTimate:RJDJ?
> 0
```

:SENSe:JITTer:GRAPh:ESTimate:RJPJ

Function

This command sets/queries the Estimated RJ/PJ Histogram setting in the RJ/PJ Histogram screen.

Syntax

```
:SENSe:JITTer:GRAPh:ESTimate:RJPJ 0|1|OFF|ON
:SENSe:JITTer:GRAPh:ESTimate:RJPJ?
```

0|OFF: OFF
1|ON: ON

Response Data

0|1

Example of Use

```
:SENSe:JITTer:GRAPh:ESTimate:RJPJ 1
:SENSe:JITTer:GRAPh:ESTimate:RJPJ?
> 1
```

:SENSe:JITTer:GRAPh:PJ:CALCulation

Function

This command executes PJ Calculation in the PJ vs Frequency screen. This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:GRAPh:PJ:CALCulation
```

:SENSe:JITTer:GRAPh:RJPJ:SAMPle

Function

This command queries the number of samples in the RJ/PJ Histogram screen.

Syntax

```
:SENSe:JITTer:GRAPh:RJPJ:SAMPle?
```

Response Data

<integer>: 0.00 to 99 999 999 999 990 (sample)

Example of Use

```
:SENSe:JITTer:GRAPh:RJPJ:SAMPle?
> 0.00
```

:SENSe:JITTer:GRAPh:TJ:SAMPle

Function

This command queries the number of samples in the TJ Histogram screen.

Syntax

```
:SENSe:JITTer:GRAPh:TJ:SAMPle? [CHA|CHB]
```

Response Data

<integer>: 0 to 99 999 999 999 990 (sample)

Example of Use

```
:SENSe:JITTer:GRAPh:TJ:SAMPle?
> 999999
```

:SENSe:JITTer:MEASure:ALGorithm

Function

This command sets/queries the Measure Algorithm for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:ALGorithm HIST|PATS
:SENSe:JITTer:MEASure:ALGorithm?
```

HIST: Histogram
PATS: Pattern Search

Response Data

HIST|PATS

Example of Use

```
:SENSe:JITTer:MEASure:ALGorithm PATS
:SENSe:JITTer:MEASure:ALGorithm?
> PATS
```

:SENSe:JITTer:MEASure:CORRection:FACTor

This command sets/queries the Correction Factor for Jitter Measure. This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:MEASure:CORRection:FACTor
[{CHA|CHB},]{0|1|OFF|ON}
:SENSe:JITTer:MEASure:CORRection:FACTor? [CHA|CHB]
```

0|OFF: OFF
1|ON: ON

Response Data

1|0

Example of Use

```
:SENSe:JITTer:CORRection:FACTor CHA,ON
:SENSe:JITTer:CORRection:FACTor? CHA
> 1
```

:SENSe:JITTer:MEASure:DEFine:THReshold

Function

This command sets/queries the Define Threshold setting of Sampling Level for Jitter Measure.

Syntax

```
:SENSe:JITTer:DEFine:THReshold [{CHA|CHB},]AUTO|MANual
:SENSe:JITTer:DEFine:THReshold? [CHA|CHB]
```

AUTO: Auto
MANual: Manual

Response Data

AUTO|MAN

Example of Use

```
:SENSe:JITTer:DEFine:THReshold AUTO
:SENSe:JITTer:DEFine:THReshold?
> AUTO
```

:SENSe:JITTer:MEASure:DJ:SCALe

Function

This command sets/queries the DJ (Scale) of Correction Factor.
This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:MEASure:DJ:SCALe [{CHA|CHB},]<numeric>
:SENSe:JITTer:MEASure:DJ:SCALe? [CHA|CHB]
```

<numeric>: 0.01 to 999.99

Response Data

<numeric>: 0.01 to 999.99

Example of Use

```
:SENSe:JITTer:MEASure:DJ:SCALe CHA,5.00
:SENSe:JITTer:MEASure:DJ:SCALe? CHA
> 5.00
```

:SENSe:JITTer:MEASure:EDGE:TYPE

Function

This command sets/queries the Measure Edge Type for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:EDGE:TYPE ALL|FALL|RISE
:SENSe:JITTer:MEASure:EDGE:TYPE?
```

ALL:	All
FALL:	Fall
RISE:	Rise

Response Data

ALL|FALL|RISE

Example of Use

```
:SENSe:JITTer:MEASure:EDGE:TYPE ALL
:SENSe:JITTer:MEASure:EDGE:TYPE?
> ALL
```

:SENSe:JITTer:MEASure:FILTer

Function

This command sets/queries the PDJ Filter setting of PDJ Measurement for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:FILTer 0|1|2|3|4|5|6|7|8
:SENSe:JITTer:MEASure:FILTer
```

0:	LP
1:	HP0+LP
2:	HP1+LP
3:	HP1'+LP
4:	HP2+LP
5:	HP+LP
6:	HP'+LP
7:	LP'
8:	HP0+LP'

Response Data

0|1|2|3|4|5|6|7|8

Example of Use

```
:SENSe:JITTer:MEASure:FILTer 0
:SENSe:JITTer:MEASure:FILTer?
> 0
```

:SENSe:JITTer:MEASure:JITTer

Function

This command sets/queries the unit of Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:JITTer TIME|UI
:SENSe:JITTer:MEASure:JITTer?
```

TIME: Time
UI: UI

Response Data

TIME|UI

Example of Use

```
:SENSe:JITTer:MEASure:JITTer TIME
:SENSe:JITTer:MEASure:JITTer?
> TIME
```

:SENSe:JITTer:MEASure:MANual:CROSsing

Function

This command sets/queries the Manual Crossing setting of Threshold Level for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:MANual:CROSsing
[{CHA|CHB},]<integer>
:SENSe:JITTer:MEASure:MANual:CROSsing? [CHA|CHB]
```

<integer>: 30 to 70 %

Response Data

<integer>: 30 to 70

Example of Use

```
:SENSe:JITTer:MEASure:MANual:CROSsing 55
:SENSe:JITTer:MEASure:MANual:CROSsing?
> 55
```

:SENSe:JITTer:MEASure:PATLength

Function

This command sets/queries the Pattern Length User Define setting for WDP measurement.

Syntax

```
:SENSe:JITTer:MEASure:PATLength <integer>
:SENSe:JITTer:MEASure:PATLength?
```

<integer>: 64 to 2048 bits

Response Data

<integer>: 64 to 2048

Example of Use

```
:SENSe:JITTer:MEASure:PATLength 511
:SENSe:JITTer:MEASure:PATLength?
> 511
```

:SENSe:JITTer:MEASure:PATTern

This command sets/queries the Pattern for WDP measurement.

Syntax

```
:SENSe:JITTer:MEASure:PATTern PRBS9|VAR
:SENSe:JITTer:MEASure:PATTern?
```

PRBS9: PRBS9
VAR: Variable

Response Data

PRBS9|VAR

Example of Use

```
:SENSe:JITTer:MEASure:PATTern VAR
:SENSe:JITTer:MEASure:PATTern?
> VAL
```

:SENSe:JITTer:MEASure:PDJ

Function

This command sets/queries the PDJ Measurement setting for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:PDJ 0|1|OFF|ON
:SENSe:JITTer:MEASure:PDJ?
```

0|OFF: OFF
1|ON: ON

Response Data

1|0

Example of Use

```
:SENSe:JITTer:MEASure:PDJ ON
:SENSe:JITTer:MEASure:PDJ?
> 1
```

:SENSe:JITTer:MEASure:RJ

This command sets/queries the Fixed RJ setting for Jitter Measure.
This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:MEASure:RJ [{CHA|CHB},]{0|1|OFF|ON}
:SENSe:JITTer:MEASure:RJ? [CHA|CHB]
```

0|OFF: OFF
1|ON: ON

Response Data

1|0

Example of Use

```
:SENSe:JITTer:MEASure:RJ CHA,ON
:SENSe:JITTer:MEASure:RJ? CHA
> 1
```

:SENSe:JITTer:MEASure:RJ:RMS

Function

This command sets/queries the RJ (Scale) of Correction Factor.
This command is available when the [Start/Stop] lamp is lit.
When the algorithm is [Pattern Search], the first parameter is omitted.
Even when specifying the first parameter, this software ignores the first parameter and then sets the second parameter only.

Syntax

```
:SENSe:JITTer:MEASure:RJ:RMS [{CHA>|CHB},]<numeric>
:SENSe:JITTer:MEASure:RJ:RMS? [CHA|CHB]
```

<numeric>: 0.01 to 999.99 (ps rms)

Response Data

<numeric>: 0.01 to 999.99

Example of Use

```
:SENSe:JITTer:MEASure:RJ:RMS 2.50
:SENSe:JITTer:MEASure:RJ:RMS?
> 2.50
```

:SENSe:JITTer:MEASure:RJ:SCALe

Function

This command sets/queries the RJ (Scale) of Correction Factor.
This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:MEASure:RJ:SCALe [{CHA|CHB},]<numeric>
:SENSe:JITTer:MEASure:RJ:SCALe? [CHA|CHB]
```

<numeric>: 0.01 to 999.99

Response Data

<numeric>: 0.01 to 999.99

Example of Use

```
:SENSe:JITTer:MEASure:RJ:SCALe 20.00
:SENSe:JITTer:MEASure:RJ:SCALe?
> 20.00
```

:SENSe:JITTer:MEASure:RJ:VALue

Function

This command sets/queries the RJ Value for Jitter Measure.
This command is available when the algorithm is [Pattern Search] and the [Start/Stop] lamp is lit.

Syntax

```
:SENSe:JITTer:MEASure:RJ:VALue [{CHA|CHB},]<numeric>
:SENSe:JITTer:MEASure:RJ:VALue? [CHA|CHB]
```

<numeric>: 0.01 to 999.99 ps

Response Data

<numeric>: 0.01 to 999.99

Example of Use

```
:SENSe:JITTer:MEASure:RJ:VALue 2.50
:SENSe:JITTer:MEASure:RJ:VALue?
> 2.50
```

:SENSe:JITTer:MEASure:STANdard

Function

This command sets/queries the PDJ Measurement standard for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:STANdard 0|1|2|3|4|5
:SENSe:JITTer:MEASure:STANdard
```

0: STM-0
1: STM-1
2: STM-4
3: STM-16
4: STM-64
5: STM-256

Response Data

0|1|2|3|4|5

Example of Use

```
:SENSe:JITTer:MEASure:STANdard 5
:SENSe:JITTer:MEASure:STANdard?
> 5
```

:SENSe:JITTer:MEASure:STARt

Function

This command starts jitter measurement.

Syntax

```
:SENSe:JITTer:MEASure:STARt
```

Example of Use

```
:SENSe:JITTer:MEASure:STARt
```

:SENSe:JITTer:MEASure:STATus

Function

This command queries the status of jitter measurement.

Syntax

```
:SENSe:JITTer:MEASure:STATus?
```

Response Data

0 | 1

0: Measurement stops
1: Measurement in progress

Example of Use

```
:SENSe:JITTer:MEASure:STARTus?
> 0
```

:SENSe:JITTer:MEASure:STOP

Function

This command stops the jitter measurement.

Syntax

```
:SENSe:JITTer:MEASure:STOP
```

:SENSe:JITTer:MEASure:TJ

Function

This command sets/queries the TJ Measurement BER setting for Jitter Measure.

Syntax

```
:SENSe:JITTer:MEASure:TJ [{CHA|CHB},]<character>
:SENSe:JITTer:MEASure:TJ? [CHA|CHB]
```

<character>: Select the bit error rate from the following:

<character>	Bit error rate	<character>	Bit error rate
E_1	10^{-1}	E_10	10^{-10}
E_2	10^{-2}	E_11	10^{-11}
E_3	10^{-3}	E_12	10^{-12}
E_4	10^{-4}	E_13	10^{-13}
E_5	10^{-5}	E_14	10^{-14}
E_6	10^{-6}	E_15	10^{-15}
E_7	10^{-7}	E_16	10^{-16}
E_8	10^{-8}	E_17	10^{-17}
E_9	10^{-9}	E_18	10^{-18}

Response Data

E_1|E_2|E_3|E_4|E_5|E_6|E_7|E_8|E_9|E_10|E_11|E_12|E_13|E_14|E_15|E_16|E_17|E_18

Example of Use

```
:SENSe:JITTer:MEASure:TJ E_9
:SENSe:JITTer:MEASure:TJ?
> E_9
```

:SENSe:JITTer:RESult:CURRent:LIMit:PATTern

Function

This command queries the number of measured patterns when Limit Type is Pattern.

Syntax

```
:SENSe:JITTer:RESult:CURRent:LIMit:PATTern?
```

Response Data

<integer>: 1 to 2 147 483 647

Example of Use

```
:SENSe:JITTer:RESult:CURRent:LIMit:PATTern?
> 1024
```

:SENSe:JITTer:RESult:CURRent:LIMit:SAMPle

Function

This command queries the number of measured samples when Limit Type is Sample.

Syntax

```
:SENSe:JITTer:RESult:CURRent:LIMit:SAMPle?
```

Response Data

<integer>: 1 to 99 999 999 999 (k sample)

Example of Use

```
:SENSe:JITTer:RESult:CURRent:LIMit:SAMPle?
> 62533
```

:SENSe:JITTer:RESult:CURRent:LIMit:TIME

Function

This command queries the measurement duration when Limit Type is Time.

Syntax

```
:SENSe:JITTer:RESult:CURRent:LIMit:TIME?
```

Response Data

<integer>: 1 to 99999 seconds

Example of Use

```
:SENSe:JITTer:RESult:CURRent:LIMit:TIME?
> 35
```

:SENSe:JITTer:RESult:CURRent:LIMit:WAVeforms

Function

This command queries the number of measured waveforms when Limit Type is Waveforms.

Syntax

```
:SENSe:JITTer:RESult:CURRent:LIMit:WAVeforms?
```

Response Data

<integer>: 1 to 999 999

Example of Use

```
:SENSe:JITTer:RESult:CURRent:LIMit:WAVeforms?
> 120
```

:SENSe:JITTer:RESult:CURRent:PATTern

Function

This command queries the DDJ/PDJ vs Bit Current Pattern.

Syntax

```
:SENSe:JITTer:RESult:CURRent:PATTern?
```

Response Data

<integer>: 0 to 99 999 999 999

Example of Use

```
:SENSe:JITTer:RESult:CURRent:PATTern?
> 1234567890
```

:SENSe:JITTer:RESult:CURRent:WDP

Function

This command queries the number of analyses for WDP measurement.

Syntax

```
:SENSe:JITTer:RESult:CURRent:WDP?
```

Response Data

<integer>: 0 to 99 999 999 999

Example of Use

```
:SENSe:JITTer:RESult:CURRent:WDP?
> 1234567890
```

:SENSe:JITTer:RESult:DCD

Function

This command queries the DCD of measurement result.

Syntax

```
:SENSe:JITTer:RESult:DCD?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:DCD?
> 12.345678
```

:SENSe:JITTer:RESult:DDJ

Function

This command queries the DDJ (p-p) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:DDJ?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:DDJ?
> 0.050505
```

:SENSe:JITTer:RESult:DDPWs

Function

This command queries the DDPWS of measurement result.

Syntax

```
:SENSe:JITTer:RESult:DDPWs?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:DDPWs?
> 55.36
```

:SENSe:JITTer:RESult:DJ

Function

This command queries the DJ (d-d) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:DJ? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:DJ?
> 10.200569
```

:SENSe:JITTer:RESult:DWDP

Function

This command queries the value of dTWDP/dTWDPc/dWDP/dWDPc, which is the WDP measurement result.

Syntax

```
:SENSe:JITTer:RESult:DWDP?
```

Response Data

<numeric> 0.001 to 99.999 [dB]

Example of Use

```
:SENSe:JITTer:RESult:DWDP?
> 22.356
```

:SENSe:JITTer:RESult:ERRor

Function

This command queries error that occurred during measurement. Error information, if there is any, will be displayed on the software screen.

Syntax

```
:SENSe:JITTer:RESult:ERRor?
```

Response Data

<integer> Total of values corresponding to error indications

Error display	Value
EYE?	1
TIE Error	2
Pattern Lost	4
Time Out	8
MATLAB Error	256
Illegal Error	32768

If multiple errors occur simultaneously, values of errors are added. When Pattern Lost and Illegal Error occur, the response data is 4+32768=32772.

Example of Use

When Pattern Lost is occurred

```
:SENSe:JITTer:RESult:ERRor?
> 4
```

:SENSe:JITTer:RESult:EYEOpening

Function

This command queries the EYE Opening for measurement result.

Syntax

```
:SENSe:JITTer:RESult:EYEOpening? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:EYEOpening?
> 653.890002
```

:SENSe:JITTer:RESult:ISI

Function

This command queries the ISI (p-p) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:ISI?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:ISI?
> 5.369925
```

:SENSe:JITTer:RESult:J2

Function

This command queries the J2 Jitter of measurement result.

Syntax

```
:SENSe:JITTer:RESult:J2? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:J2?
> 10.963702
```

:SENSe:JITTer:RESult:J9

Function

This command queries the J9 Jitter of measurement result.

Syntax

```
:SENSe:JITTer:RESult:J9? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:J9?
> 21.871255
```

:SENSe:JITTer:RESult:PJ

Function

This command queries the PJ (p-p) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:PJ?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:PJ?
> 0.000153
```

:SENSe:JITTer:RESult:PJ:FREQuency

Function

This command queries the PJ Frequency of PJ vs Freq measurement result.

Syntax

```
:SENSe:JITTer:RESult:PJ:FREQuency?
```

Response Data

<numeric> 0.000000 to 999.999999 [MHz]

Example of Use

```
:SENSe:JITTer:RESult:PJ:FREQuency?
> 0.896100
```

:SENSe:JITTer:RESult:RJ

Function

This command queries the RJ (d-d) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:RJ? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:RJ? CHB
> 33.089149
```

:SENSe:JITTer:RESult:RJ:RMS

Function

This command queries the RJ (rms) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:RJ:RMS?
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:RJ:RMS?
> 30.001066
```

:SENSe:JITTer:RESult:STOR:WDPI

Function

This command executes Store to WDP at WDP screen.

Syntax

```
:SENSe:JITTer:RESult:STOR:WDPI
```

:SENSe:JITTer:RESult:TJ:FIXed

Function

This command queries the TJ (1.0E-12) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:TJ:FIXed? [CHA|CHB]
```

Sets the target channel.

CHA: Channel A

CHB: Channel B

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:TJ:FIXed?
> 10.005566
```

:SENSe:JITTer:RESult:TJ:USER

Function

This command queries the TJ (TJ Measurement BER) of measurement result.

Syntax

```
:SENSe:JITTer:RESult:TJ:USER? [CHA|CHB]
```

Response Data

<numeric> 0.000001 to 999. 999999

The unit is the value set in :SENSe:JITTer:MEASure:JITTer

Example of Use

```
:SENSe:JITTer:RESult:TJ:USER?
> 188.238965
```

:SENSe:JITTer:RESult:WDP

Function

This command queries the value of TWDP/TWDPc/WDP/WDPc, which is the WDP measurement result.

Syntax

```
:SENSe:JITTer:RESult:WDP?
```

Response Data

<numeric> 0.001 to 99.999 [dB]

Example of Use

```
:SENSe:JITTer:RESult:WDP?
> 0.237
```

:SENSe:JITTer:RESult:WDPI

Function

This command queries the value of WDPi, which is the WDP measurement result.

Syntax

```
:SENSe:JITTer:RESult:WDPI?
```

Response Data

<numeric> 0.001 to 99.999 [dB]

Example of Use

```
:SENSe:JITTer:RESult:WDPI?
> 0.033
```

:SENSe:JITTer:SETup:BITRate

Function

This command queries the Signal Bit rate for Jitter Setup.
This is available for WDP analysis.

Syntax

```
:SENSe:JITTer:SETup:BITRate <integer>
:SENSe:JITTer:SETup:BITRate?
```

<integer>: 100 000 to 60 000 000 kbit/s

Response Data

<integer>: 100 000 to 60 000 000 kbit/s

Example of Use

```
:SENSe:JITTer:SETup:BITRate 10312500
:SENSe:JITTer:SETup:BITRate?
> 10312500
```

:SENSe:JITTer:SETup:CHANnel

This command sets/queries the Measure Target for Jitter Setup.
This is available for WDP analysis.

Syntax

```
:SENSe:JITTer:SETup:CHANNel CHA|CHB|DIFF
:SENSe:JITTer:SETup:CHANNel?
```

CHA: Channel A
CHB: Channel B
DIFF: Difference
(Only MP2100A-001, MP2102A-021, MP2100B-021)

Response Data

CHA|CHB|DIFF

Example of Use

```
:SENSe:JITTer:SETup:CHANNel CHB
:SENSe:JITTer:SETup:CHANNel?
> CHB
```

:SENSe:JITTer:SETup:ITEM

Function

This command sets/queries the Measurement Item for Jitter Setup.

Syntax

```
:SENSe:JITTer:SETup:ITEM TWDP|TWDPC|WDP|WDPC
:SENSe:JITTer:SETup:ITEM?
```

WDP: WDP
WDPC: WDPc
TWDP: TWDP
TWDPC: TWDPc

Response Data

TWDP|TWDPC|WDP|WDPC

Example of Use

```
:SENSe:JITTer:SETup:ITEM WDP
:SENSe:JITTer:SETup:ITEM?
> WDP
```

:SENSe:JITTer:SETup:LIMit:AVERaging

Function

This command sets/queries the Averaging setting for Jitter Setup-Measuring Limit.
This is available for WDP analysis.

Syntax

```
:SENSe:JITTer:SETup:LIMit:AVERaging <integer>
:SENSe:JITTer:SETup:LIMit:AVERaging?
```

<integer>: Averaging count 1 to 99

Response Data

<integer>: 1 to 99

Example of Use

```
:SENSe:JITTer:SETup:LIMit:AVERaging 10
:SENSe:JITTer:SETup:LIMit:AVERaging?
> 10
```

:SENSe:JITTer:SETup:LIMit:PATTern

Function

This command sets/queries the Pattern for Jitter Setup-Measuring Limit.

Syntax

```
:SENSe:JITTer:SETup:LIMit:PATTern <integer>
:SENSe:JITTer:SETup:LIMit:PATTern?
```

<integer>: Number of patterns 1 to 2 147 483 647

Response Data

<integer>: 1 to 2 147 483 647

Example of Use

```
:SENSe:JITTer:SETup:LIMit:PATTern 2147483647
:SENSe:JITTer:SETup:LIMit:PATTern?
> 2147483647
```

:SENSe:JITTer:SETup:LIMit:SAMPle

Function

This command sets/queries the Sample for Jitter Setup-Measuring Limit.

Syntax

```
:SENSe:JITTer:SETup:LIMit:SAMPle <integer>
:SENSe:JITTer:SETup:LIMit:SAMPle?
```

<integer>: Number of samples 1 to 99 999 999 999 (k sample)

Response Data

<integer>: 1 to 99 999 999 999

Example of Use

```
:SENSe:JITTer:SETup:LIMit:SAMPle 1000000
:SENSe:JITTer:SETup:LIMit:SAMPle?
> 1000000
```

:SENSe:JITTer:SETup:LIMit:TIME

Function

This command sets/queries the Time for Jitter Setup-Measuring Limit.

Syntax

```
:SENSe:JITTer:SETup:LIMit:TIME <integer>
:SENSe:JITTer:SETup:LIMit:TIME?
```

<integer>: Time 1 to 99999 seconds

Response Data

<integer>: 1 to 99999 seconds

Example of Use

```
:SENSe:JITTer:SETup:LIMit:TIME 60
:SENSe:JITTer:SETup:LIMit:TIME?
> 60
```

:SENSe:JITTer:SETup:LIMit:WAVeforms

Function

This command sets/queries the Waveforms for Jitter Setup-Measuring Limit.

Syntax

```
:SENSe:JITTer:SETup:LIMit:WAVeforms <integer>
:SENSe:JITTer:SETup:LIMit:WAVeforms?
```

<integer>: 1 to 999 999 Waveform

Response Data

<integer>: 1 to 999 999

Example of Use

```
:SENSe:JITTer:SETup:LIMit:WAVeforms 100
:SENSe:JITTer:SETup:LIMit:WAVeforms?
> 100
```

:SENSe:JITTer:SETup:MEASureing:LIMit

Function

This command sets/queries the Limit Type for Jitter Setup.

Syntax

```
:SENSe:JITTer:SETup:MEASureing:LIMit <character>
:SENSe:JITTer:SETup:MEASureing:LIMit?
```

NONE: None
PATT: Pattern
SAMP: Sampling
TIME: Time
WAV: Waveforms

Response Data

AVER | NONE | PATT | SAMP | TIME | WAV

AVER: Averaging

Example of Use

```
:SENSe:JITTer:SETup:MEASureing:LIMit SAMP
:SENSe:JITTer:SETup:MEASureing:LIMit?
> SAMP
```

:SENSe:JITTer:SETup:SELect

Function

This command sets/queries the Measure Selection for Jitter Setup.

Syntax

```
:SENSe:JITTer:SETup:SELect JITT|WDP
:SENSe:JITTer:SETup:SELect?
```

JITT: Jitter
WDP: WDP

Response Data

JITT | WDP

Example of Use

```
:SENSe:JITTer:SETup:SELect WDP
:SENSe:JITTer:SETup:SELect?
> WDP
```

:SENSe:JITTer:TARGet:BITRate

Function

This command queries the Signal Bitrate when Measure Selection is Jitter.

Syntax

```
:SENSe:JITTer:TARGet:BITRate?
```

<integer>: 100 000 to 60 000 000 kbit/s

Response Data

<integer>: 100 000 to 60 000 000 kbit/s

Example of Use

```
:SENSe:JITTer:TARGet:BITRate?
> 8500000
```

:SENSe:JITTer:TARGet:CHANnel

This command queries the Measure Target when Measure Selection is Jitter.

Syntax

```
:SENSe:JITTer:TARGet:CHANNel?
```

Response Data

CHA | CHB | CHAB | DIFF

CHA:	Channel A
CHB:	Channel B
CHAB:	Channel A & Channel B
DIFF: Difference	Only MP2100A-001, MP2102A-021 and MP2100B-021

Example of Use

```
:SENSe:JITTer:TARGet:CHANNel CHA
:SENSe:JITTer:TARGet:CHANNel?
> CHA
```

:SENSe:JITTer:TARGet:DIVRatio

Function

This command queries the Divide Ratio for EYE/Pulse Scope.

Syntax

```
:SENSe:JITTer:TARGet:DIVRatio?
```

Response Data

<integer>: 1 to 99

Example of Use

```
:SENSe:JITTer:TARGet:DIVRatio?
> 8
```

:SENSe:JITTer:TARGet:PATLength

Function

This command queries the Pattern when Measure Selection is Jitter.

Syntax

```
:SENSe:JITTer:TARget:PATLength?
```

Response Data

<integer>: 2 to 32768

Example of Use

```
:SENSe:JITTer:TARGet:PATLength?
> 511
```

Appendix A Specifications

Table A-1 Configuration

Model	Product name	Q'ty	Remarks
Z1557A	CD-ROM	1	License file, Operation Manual
W3569AE	MX210001A Jitter Analysis Software Operation Manual	1	PDF file, included in CD-ROM

Table A-2 Operating Environment

Item	Specifications
Hardware	MP2100A, MP2102A or MP2100B BERTWave
Software	MX210000A Ver 3.00 or later MATLAB R2010bSP1

Table A-3 Jitter Measurement

Item	Specifications
Limit Type	None, Pattern, Samples, Time, Waveforms
Pattern	1 to 2 147 483 647 patterns
Samples	1 to 99 999 999 999 k sample
Time	1 to 99 999 s
Waveforms	1 to 999 999 wfms
Common Settings*1	
TJ Measurement BER	BER to measure TJ (User Define) and Eye Opening with the measurement results Selectable up to 1.0E–001 to 1.0E–018, in 1.0E+001Step
Fixed RJ	Function to use User-specified value for RJ results ON/OFF switching available
Fixed RJ Value	Enabled when Fixed RJ is ON. 0.01 to 999.99 ps rms/ Step 0.01 ps rms
Correction Factor	Function to correct results by Users ON/OFF switching available
DJ (Scale)	Function to adjust Scale of DJ DJ = DJ (Scale)*1 Measurement result 0.01 to 999.99 / Step 0.01
RJ (Scale)	Function to adjust Scale of RJ RJ = RJ (Scale)*1 Measurement result 0.01 to 999.99 / Step 0.01
RJ (rms)	Function to adjust rms of RJ RJ = sqrt (Measurement result^2 – RJ (rms)^2) sqrt and ^2 indicate a square root and square respectively. 0.01 to 999.99 ps rms / Step 0.01 ps rms
Define Threshold	Definition of Crossing value to measure jitter Auto: Automatic adjustment with the use of Crossing value of Scope Manual: User input of Crossing to be measured
Manual Crossing	Crossing value to measure jitter 30 to 70% / Step 1%
Jitter Unit	Unit for results: UI/Time switching available
Screen Copy	Function to store only the image of MX210001A screen. Store destination folder and file names can be set.

*1: For the histogram measurement, independent settings for Channel A and Channel B are available.

Table A-3 Jitter Measurement (Cont'd)

Item	Specifications
Measurement algorithm	Selected from the histogram measurement or pattern search measurement
Histogram measurement	
Measurement target	The following measurement channels of EYE/Pulse Scope are targets. The setting corresponds to the setting of EYE/Pulse Scope, and cannot be executed from the MX210001A. Channel A, Channel B, Channel A&B, Differential*2
Measurement item	TJ (1.0E-12), TJ (User Define)*3, RJ (d-d), DJ (d-d), J2 Jitter, J9 Jitter, Eye Opening*3
Graph	Display order and size change (no division or in quarters) switching of the following graphs are available TJ Histogram CHA, TJ Histogram CHB, Bathtub CHA, Bathtub CHB
Setting item	
Estimated RJ/DJ Histogram	Estimated DJ/RJ Histogram display ON/OFF switching function For ON, displayed on TJ Histogram.
Monitor item	
Bitrate	Displays EYE/Pulse Scope Bitrate.
Divide Ratio	Displays EYE/Pulse Scope Divide Ratio.
Target	Displays measurement target channel.
Pattern search measurement	
Measurement target	The following measurement channels of EYE/Pulse Scope are targets. The setting corresponds to the setting of EYE/Pulse Scope, and cannot be executed from the MX210001A. Channel A, Channel B, Differential*2
Measurement item	TJ (1.0E-12), TJ (User Define)*3, RJ (d-d), RJ (rms), DJ (d-d), PJ (p-p), DDJ (p-p), DCD, ISI (p-p), Eye Opening*3, J2 Jitter, J9 Jitter, DDPWS, PJ Frequency
Graph	Display order and size change (no division or in quarters) switching of the following graphs are available TJ Histogram, RJ/PJ Histogram, DDJ Histogram, Composite Histogram, DDJ vs Bit, Bathtub, PJ vs Frequency

*2: Only for MP2100A-001, MP2102A-021 or MP2100B-021

*3: Values at BER specified with TJ Measurement BER of the setting item

Table A-3 Jitter Measurement (Cont'd)

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Pattern search measurement (continued)
Setting item
PDJ Measurement

PDJ Standard
PDJ Filter

Measurement Edge Type

DDJ Histogram

PJ Calculate

Supported pattern length

Monitor item
Bitrate
Pattern Length
Divide Ratio
Target</td><td>

Measurement switching function on Pattern Dependent Jitter measurement
ON/OFF switching available
Filter used on Pattern Dependent Jitter measurement
Corresponding standards and filters are as the table below (Unit: Hz)
<table><tr><th></th><th colspan="8">PDJ Filter</th></tr><tr><th>Standard</th><th>HP0</th><th>HP1</th><th>HP1'</th><th>HP2</th><th>HP'</th><th>HP</th><th>LP</th><th>LP'</th></tr><tr><td>STM-0</td><td>10</td><td>100</td><td>–</td><td>20 k</td><td>–</td><td>12 k</td><td>400 k</td><td>–</td></tr><tr><td>STM-1</td><td>10</td><td>500</td><td>–</td><td>65 k</td><td>–</td><td>12 k</td><td>1.3 M</td><td>500</td></tr><tr><td>STM-4</td><td>10</td><td>1 k</td><td>–</td><td>250 k</td><td>–</td><td>12 k</td><td>5 M</td><td>1 k</td></tr><tr><td>STM-16</td><td>10</td><td>5 k</td><td>–</td><td>1 M</td><td>–</td><td>12 k</td><td>20 M</td><td>5 k</td></tr><tr><td>STM-64</td><td>10</td><td>20 k</td><td>10 k</td><td>4 M</td><td>50 k</td><td>12 k</td><td>80 M</td><td>20 k</td></tr><tr><td>STM-256</td><td>–</td><td>80 k</td><td>20 k</td><td>16 M</td><td>–</td><td>—</td><td>320 M</td><td>—</td></tr></table>
Switching of Edge to measure jitter
Selectable from All/Rise/Fall
Individual jitter display of All Edge/Rise Edge/Fall Edge and individual display ON/OFF switching available
Function to estimate the frequency with maximum PJ elements
The results are displayed on PJ Frequency screen.*4
2 to 32768
Common with the Pattern Length parameters of EYE/Pulse Scope

Displays EYE/Pulse Scope Bitrate.
Displays EYE/Pulse Scope Pattern Length.
Displays EYE/Pulse Scope Divide Ratio.
Displays measurement target channel.</td></tr>
</table>

*4: Available only when target is CHA or CHB.

Table A-4 WDP Measurement

Item	Specifications
Measurement target	The following measurement channels of EYE/Pulse Scope are targets. Channel A, Channel B
Measurement item	WDP/WDPc/TWDP/TWDPc
Bitrate	0.1 to 12.5 Gbit/s (1 kbit/s step)
Number of Average	The number of Averaging times executed on waveform acquisition 1 to 99 wfms / 1 wfms step
Store WDPi function	Function to set measurement results to WDPi Enable/Disable function for Store WDPi function is available.
Input pattern	Selected from PRBS9/Variable.
Input pattern length	For Variable, the pattern length is set. 64 to 2048 / Step 1

Appendix B Default Value List

Table B-1 Jitter Setup-General

Item	Defaults
Measure Selection	Jitter
Target Channel	CHA
Measurement Item	WDP
Signal Bitrate	8 500 000
Limit Type	None
Averaging	1 wfms
Time	1 s
Pattern	1 pattern
Sample	1 k sample
Waveforms	1 wfms

Table B-2 Jitter Measure-Algorithm

Item	Default
Measure Algorithm	Histogram
PDJ Measurement	OFF
Standard	STM-0
PDJ Filter	LP
Measurement Edge Type	ALL
Pattern	PRBS9
Pattern Length User Define	511

Table B-3 Jitter Measure-Advanced

Item	Default
TJ Measurement BER	1.00E–012
Fixed RJ	OFF
RJ Value	1.00 ps rms
Correction Factor	OFF
DJ (Scale)	1.00
RJ (Scale)	1.00
RJ (rms)	1.00
Define Threshold	Auto
Manual Crossing	50%
Jitter Unit	Time

Table B-4 Graph Display

Item	Default
TJ Histogram CHA/CHB	
Estimated RJ/DJ Histogram	ON
RJ/PJ Histogram	
Estimated RJ/PJ Histogram	OFF
DDJ Histogram	
All Edge	ON
Rise Edge	ON
Fall Edge	ON

Appendix C Sample Program

This appendix describes the sample program using the Tera Term macro function.

C.1 Executing sample Programs

1. Start the test editor such as the Windows memo pad.
2. Copy the sample program in this manual.
3. Past the copied sample program to the test editor.
4. The file can be saved in Tera Term macro format (with ttl extension).
5. Start Tera Term.
6. Confirm that it can be communicated with the BERTWave referring to Section "2.4.2 When using Ethernet (Windows 7/Vista) " in *BERTWave Series Remote Control Operation Manual (W3773AE)*
7. Click [Control] → [Macro] from the menu of Tera Term.
8. Open the file selection window.
   Select the file saved at step 4.

For the other execution method of macro, refer to the help of Tera Term.

C.2 Example 1: Jitter Analysis

This sample program sets the parameters of Jitter analysis, queries the measurement status, and then saves the measured result to file.

Processing Flow

1. Send :MODULE:ID 5 to set the control target to EYE/Pulse Scope
2. Set the Measure Item to [Off].
3. Set the Sampling Mode to [Pulse].
4. Set the CHA to [ON].
5. Execute Auto Scale.
6. Set the Measure Item to [Amp/Time].
7. Send :MODULE:ID 6 to set the control target to Jitter.
8. Set the Measure Selection to [Jitter].
9. Set the Limit Type to [Time], 10 seconds.
10. Set the Measure Algorithm to [Pattern Search].
11. Set the PDJ measurement to [Off].
12. Set the Measurement Edge Type to [All].
13. Set the TJ Measurement BER to [E–15].
14. Set the Define Threshold to [Auto].
15. Start Jitter measurement.
16. Set the Fixed RJ to [Off] .
17. Query the measurement state every one second. If analysis does not finish within 300 seconds, the program will stop processing.
18. Query the TJ (1E–15), and RJ (d-d).
19. Save result data to file.

Note:

When Averaging is set to 10, the average value of WDP waveform data that was previously measured 10 times. The measurement does not automatically stop after measuring 10 times.

```
; sample program for MX210001A ver 1.0
; Anritsu Corporation August,2011
;
; set local echo to on
setecho 1
flushrecv
; time out 3 second
timeout=3

; set top menu to EYE/Pulse Scope
sendln ':MOD:ID 5'

; set Sampling Mode to Off
sendln ':CONFigure:MEASure:TYPe OFF'
call check_error_code
; set Sampling Mode to Pulse
sendln ':DISPlay:MODE PULSe'
call check_error_code
; set Channel A display to on
sendln ':INPut:CHA ON'
call check_error_code
messagebox  'Input signal to BERTWave.' 'Confirm connection'
; execute Auto Scale
sendln ':DISPlay:WINDow:AUTOscale'
call check_error_code
; set Sampling Mode to Amp/Time
sendln ':CONFigure:MEASure:TYPe AMPTIME'
call check_error_code

; set top menu to MX210001A
sendln ':MOD:ID 6'

; set Measure Selection to 'Jitter'
sendln ':SENSe:JITTer:SETup:SELect JITT'
call check_error_code

; set Limit Type to Time
sendln ':SENSe:JITTer:SETup:MEASuring:LIMit TIME'
call check_error_code
sendln ':SENSe:JITTer:SETup:LIMit:TIME 10'
call check_error_code
; set Measure Algorithm to Pattern Search
sendln ':SENSe:JITTer:MEASure:ALGorithm PATS'
call check_error_code
```

```
; set PDJ measurement
sendln ':SENSe:JITTer:MEASure:PDJ OFF'
call check_error_code
; set Measurement Edge Type
sendln ':SENSe:JITTer:MEASure:EDGE:TYPE ALL'
call check_error_code
; set TJ Measurement BER
sendln ':SENSe:JITTer:MEASure:TJ E_15'
call check_error_code
; set Define Threshold
sendln ':SENSe:JITTer:MEASure:DEFine:THReshold AUTO'
call check_error_code

; Start measuring
sendln ':SENSe:JITTer:MEASure:STARt'
call check_error_code
pause 1
; set Fixed RJ
sendln ':SENSe:JITTer:MEASure:RJ OFF'
call check_error_code

; query measurement status
for id 1 300
  sendln ':SENSe:JITTer:MEASure:STATus?'
  pause 1; wait 1 second
  waitln '0' '1'
  cal_stat=result
  if result=0 goto _timeout
  if result=1 break
  call check_error_code
next

if cal_stat=2 then
  messagebox  'Measurement did not stop within 300 seconds.' 'Time over !'
  end
endif

; data acquisition
sendln ':SENSe:JITTer:RESult:TJ:USER?'
call check_error_code
sendln ':SENSe:JITTer:RESult:RJ?'
call check_error_code
sendln ':SYSTem:MMEMory:STORe "Jitter_sample_program.TXT",6,JIR,TXT'
call check_error_code
```

```
messagebox  'Macro end successfully' 'Finish'

End

;       ------------ subroutines -----------

:_timeout
  messagebox  'No response from BERTWave.' 'Time out!'
  call check_error_code
  End

return

:check_error_code
  ; query error
  sendln ':SYSTem:ERRor?'
  waitln 'No error'

  ; in case of timeout
  if result=0 goto _timeout
  ; in case of error occurring
  if result=2 then
         e_message='Error code = '
         strconcat e_message inputstr
         messagebox  e_message 'Command Error occurred'
         end
  endif

  ; in case of no error

return

:check_response

  ;for debug
  messagebox inputstr 'debug1'
  int2str result_str result
  messagebox result_str 'debug2'

  return
```

C.3 Example 2: WDP Analysis

This sample program sets the parameters of WDP analysis, and then saves the measured result to file.

Processing Flow

1. Send :MODULE:ID 6 to set the control target to Jitter.
2. Set the Measure Selection to [WDP].
3. Set the Target Channel to [CHA].
4. Set the Measurement Item to [WDP].
5. Set the Averaging to 10.
6. Set the Pattern to [PRBS9].
7. Start WDP analysis.
8. Query the measure times every one second. When the measurement count reaches ten or more, stop the WDP analysis. If the measurement count is less than ten when 300 seconds elapses, the program stops processing.
9. Query the measured WDP.

```
; sample program for MX210001A ver 1.0
; Anritsu Corporation August,2011
;
; set local echo to on
setecho 1
flushrecv
; time out 3 second
timeout=3

; set top menu to MX210001A
sendln ':MOD:ID 6'

; set Measure Selection to 'WDP'
sendln ':SENSe:JITTer:SETup:SELect WDP'
call check_error_code

; set Target Channel to A
sendln ':SENSe:JITTer:SETup:CHANNel CHA'
call check_error_code
; set Measurement Item to WDP
sendln ':SENSe:JITTer:SETup:ITEM WDP'
call check_error_code
; set Averaging
sendln ':SENSe:JITTer:SETup:LIMit:AVERaging 10'
call check_error_code
; set Pattern
sendln ':SENSe:JITTer:MEASure:PATTern PRBS9'
call check_error_code

; Start measuring
sendln ':SENSe:JITTer:MEASure:STARt'
call check_error_code
pause 1

; query measurement status
for id 1 300
  sendln ':SENSe:JITTer:RESult:CURRent:WDP?'
  pause 1; wait 1 second
  recvln
  recvln

  ;call check_response

  if result=1 then
```

```
            str2int wdp_times inputstr
            if wdp_times>9  then
                  sendln ':SENSe:JITTer:MEASure:STOP'
                  call check_error_code
                  break
            endif
  endif
  call check_error_code

next

if wdp_times<10 then
  messagebox  'Measurement did not stop within 300 seconds.' 'Time over !'
  end
endif

; data acquisition
sendln ':SENSe:JITTer:RESult:WDP?'
call check_error_code

messagebox  'Macro end successfully' 'Finish'

End

;       ------------ subroutines -----------

:_timeout
  messagebox  'No response from BERTWave.' 'Time out!'
  call check_error_code
  End

:check_error_code
  ; query error
  sendln ':SYSTem:ERRor?'
  waitln 'No error'

  ; in case of timeout
  if result=0 goto _timeout
  ; in case of error occurring
  if result=2 then
          e_message='Error code = '
          strconcat e_message inputstr
          messagebox  e_message 'Command Error occurred'
          end
```

```
  endif

  ; in case of no error

return

:check_response

  ;for debug
  messagebox inputstr 'debug1'
  int2str result_str result
  messagebox result_str 'debug2'

  return
```

Appendix D Bibliography

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