Online User Manual

Tektronix

80SJNB Advanced Jitter, Noise, and BER Analysis Software

077-0011-00

Adapted from the 80SJNB Online
Help Version 076-0022-00

www.tektronix.com

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For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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Preface

Welcome to the Jitter, Noise, and BER Analysis Software

The 80SJNB Advanced Jitter, Noise, and BER Analysis Software enhances the capabilities of the CSA/TDS8000B and CSA/TDS8200 series Tektronix oscilloscopes. The analysis software includes the following features:

- Advanced jitter and noise analysis
- Separation of jitter and noise
- Perform random and deterministic jitter analysis including BER estimation
- Show results as graphical displays including histograms, spectra, and bathtub curves
- 2-D eye diagrams that include Correlated Eye, Probability Density Function (PDF) Eye, and Bit Error Rate (BER) Eye
- Save statistical results to a data file

Related Documentation

In addition to the online help, you can access other information on how to operate the oscilloscope and application through the following related documents.

- Relevant Web Sites
- GPIB Information
- Types of Online Help Information

GPIB Information

For information on how to operate the oscilloscope and use the application-specific GPIB commands, refer to the following items:

- The online programmers guide for your oscilloscope can provide details on how to use GPIB commands to control the oscilloscope.
- The programming example.

Relevant Web Sites

The Tektronix web site offers the following information:

- Understanding and Characterizing Jitter Primer, literature number 55W-16146-x.
- Jitter analysis details on the www.tektronix.com/jitter web page.

You can also find useful information in the *Fibre Channel - Methodologies for Jitter and Signal Quality Specification – MJSQ* on the www.t11.org web site.

Conventions

Online help topics use the following conventions:

- The terms “80SJNB application” or “application” refer to the 80SJNB Jitter, Noise and BER Analysis software.
- The term “oscilloscope” refers to the product on which this application runs.
- The term “select” is a generic term that applies to the two mechanical methods of choosing an option: with a mouse or with the Touch Screen.
- The term “DUT” is an abbreviation for Device Under Test.
- User interface screen graphics are from a CSA8200 Communications Signal Analyzer. There may be minor differences depending on the instrument model and software versions.
- When steps require a sequence of selections using the application interface, the “>” delimiter marks each transition between a menu and an option. For example, one of the steps to recall a setup file would appear as File > Recall Settings.

Types of Online Help Information

The online help contains the following topics:

- Getting Started topics briefly describes the application and its requirements.
- Operating Basics topics cover basic operating principles of the application. The sequence of topics reflects the steps you perform to operate the application.
- Parameters topics cover the User and Configuration default settings.

- Application Examples topics demonstrates how to use jitter measurements to identify a problem with a waveform. This should give you ideas on how to solve your own measurement problems.
- GPIB Command Syntax topics contain a list of arguments and values that you can use with the remote commands and their associated parameters.

Using Online Help

Online help has many advantages over a printed manual because of advanced search capabilities. The main (opening) Help screen shows a series of book icons and three tabs along the top menu, each of which offers a unique mode of assistance:

- Table of Contents (TOC) tab – organizes the Help into book-like sections. Select a book icon to open a section; select any of the topics listed under the book.
- Index tab – enables you to scroll a list of alphabetical keywords. Select the topic of interest to display the corresponding help page.
- Find tab – allows a text-based search. Follow these steps:

1. Type the word or phrase you want to find in the search box.
2. If the word or phrase is not found, try the Index tab.
3. Select some matching words in the next box to narrow your search.
4. Choose a topic in the lower box, and then select the Display button.

***NOTE**. The Find tab function does not include words found in graphics.*

***NOTE**. Green-underlined text indicates a hyperlink to another topic. For example, select the green text to jump to the topic on Feedback to contact Tektronix.*

When you use a mouse, you can tell when the cursor is over an active hyperlink because the arrow cursor changes to a small pointing hand cursor.

Feedback

Tektronix values your feedback on our products. To help us serve you better, please send us suggestions, ideas, or other comments you may have about your application or oscilloscope.

You can email your feedback to techsupport@tektronix.com, FAX at (503)627-5695, or by phone. Please be as specific as possible and include the following information:

General Information

- Oscilloscope model number, firmware version number, and hardware options, if any.
- Module and probe configuration. Include model numbers and the channel/slot location.
- Serial data standard.
- Signaling rate.
- Your name, company, mailing address, phone number, FAX number.

***NOTE**. Please indicate if you would like Tektronix to contact you regarding your suggestion or comments.*

Application-Specific Information

- 80SJNB Software version number.
- Description of the problem such that technical support can duplicate the problem.
- If possible, save the oscilloscope waveform file as a .wfm file.
- If possible, save the oscilloscope and application .stp setup files. Refer to Saving a Setup File.

Once you have gathered this information, you can contact technical support by phone or through e-mail. If using e-mail, be sure to enter ”80SJNB Problem” in the subject line, and attach the .stp and .wfm files.

To include screen shots, from the oscilloscope menu bar, select File > Export. Waveform… In the Export dialog box, enter a file name with a .bmp extension and select Save. The file is saved in the C:\My Documents\TDSCSA8000\UI directory.

Getting Started

Product Description

The 80SJNB software application enhances the capabilities of the CSA/TDS8000B and CSA/TDS8200 series Tektronix oscilloscopes by providing Jitter, Noise, and BER analysis.

You can use this application to do the following tasks:

- Jitter and noise analysis from 0.5 Gb/s to greater than 60 Gb/s
- Jitter and noise separation (see the importance of jitter and noise separation)
- Perform random and deterministic jitter analysis including BER estimation
- Show results as graphical displays
- 2–D eye diagrams that include Correlated Eye, Probability Density Function (PDF) Eye, and Bit Error Rate (BER) Eye
- Save results to a data file
- Save and recall instrument setups

Requirements and Restrictions

Operating System. This application requires the Microsoft Windows 2000 operating system. Contact Tektronix about purchasing the necessary upgrades for your instrument.

Memory. This application requires 512 MB of memory (minimum) to perform. To verify the amount of installed memory, minimize the Tekscope application, then select Start > Control Panel > System. If less than 512 MB is reported, contact Tektronix about purchasing the necessary upgrades for your instrument.

Keyboard and Mouse. You will need to use a keyboard to enter new names for some file save operations. A mouse is not required but simplifies screen selections.

Accessories

There are no standard accessories for this product. However, you can refer to the product datasheet available on the Tektronix web site for information on optional accessories relevant to your application.

Connecting to a Device Under Test (DUT)

You can use any compatible probe or cable interface to connect between your DUT and the instrument.

WARNING. *To avoid electric shock, remove power from the DUT before attaching probes. Do not touch exposed conductors except with the properly rated probe tips. Refer to the probe manual for proper use.*

Refer to the General Safety Summary in your oscilloscope manual.

Deskewing Probes and Channels

To ensure accurate results for two-channel measurements, it is important to first deskew the probes or cables and oscilloscope channels before you take measurements.

NOTE. *Deskewing is performed from the CSA/TDS8000 series instrument application, not from the 80SJNB application. Refer to the CSA8000 & TDS8000 User Online Help for information and procedures for deskewing probes and channels.*

The Importance of Jitter and Noise Separation

Jitter is an important characteristic to analyze for serial data links, but the analysis should not stop at just jitter. To properly evaluate a data link, it is necessary to analyze both jitter and noise.

Two components need to be added to the traditional jitter analysis:

- The noise/vertical eye closure should be considered in a manner very similar to that of jitter/horizontal eye closure.
- Jitter measurements based on the threshold crossing of a finite-speed transition should include vertical noise influence.

Depending on the magnitude of the vertical noise and the transient response of the transmitter and transmission channel, the magnitude of this influence can vary widely. Ultimately the jitter and noise analysis allows for accurate BER projections for the targeted communication link.

Tektronix has written a detailed document explaining the importance of jitter and noise separation.

Go to the Tektronix Web site:

www.tektronix.com

At the Tektronix home page, select oscilloscopes > sampling

You can download a pdf of the white paper titled:

Tektronix CSA/TDS8200 Jitter Analysis Application: Jitter and Noise Analysis, BER Estimation Descriptions

Operating Basics

The Operating Basics book covers the following tasks:

- Navigating the user interface
- User interface information
- Using oscilloscope functions
- Setting up the application
- Viewing the measurement results as plots
- Exporting Plot Files
- Saving and recalling setup files

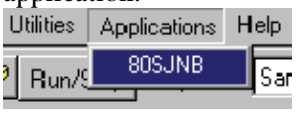
General Information

Starting the 80SJNB Application

There are several ways to start the 80SJNB application.

- If the TDS/CSA8000 Series application is minimized, you can start the 80SJNB application by selecting the shortcut located on the Windows desktop area.

- If the TDSCSA8000 Series oscilloscope application is running and open, you can use the Applications menu on the menu bar and select the 80SJNB application.



- Use the Windows Start menu by selecting Start > Programs > Tektronix TDSCSA8000 > 80SJNB > 80SJNB.

Returning to the Oscilloscope Application

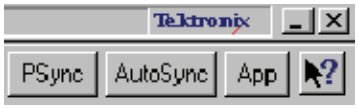
The 80SJNB application fills the entire screen and hides the oscilloscope application. To return to the oscilloscope display, press the Back to Scope button  in the toolbar.

You can also minimize the 80SJNB application or exit the 80SJNB application entirely.

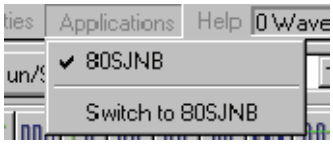
Returning to the 80SJNB Application

The CSA/TDS8000 oscilloscope application fills the entire screen. If the 80SJNB application is already running but the oscilloscope application is displayed on top, bring the 80SJNB application to the front using the following methods.

- Press the **App** button on the oscilloscope toolbar.



- Select **Switch to 80SJNB** from the Applications pull-down file menu.



Tip If you have a keyboard attached, you can switch between running applications by pressing the Alt + Tab keys.

Minimizing and Maximizing the Application

To minimize the application to the Windows task bar, select the command button in the application menu bar.

To maximize the application, select the minimized application from the Windows task bar. Alternately, if you have a keyboard attached, you can switch between displayed applications by pressing Alt + Tab keys.

Exiting the Application

To exit the application, select File > Exit or the command button in the application menu bar.

Directory Structure for the 80SJNB Application

Installation Directory

The 80SJNB software is installed in the following directory:

C:\Program Files\TekApplications\80SJNB

Save and Recall Directory

The directory structure used for saving and recalling setup files and exporting data depends on how the Windows operating system is configured for networking and login purposes.

- If users are required to log in, the save, recall, and export default location is:

C:\Documents and Settings\username\My Documents.

- If no login requirements are set, the default location is:

  C:\My Documents.

File Name Extensions

Extension	Description
.bmp	File that uses a bitmap format
.csv	File that uses a comma separated value format
.stp	80SJNB application setup file
.jpg	File that uses a joint photographic experts group format
.mat	File that uses native MATLAB binary format
.png	File that uses a portable network graphics format
.txt	File that uses an ASCII format

File Menus

You can use the File menus to save and recall different application setups and recently accessed files.

CAUTION. *Do not edit a setup file or recall a file not generated by the application.*

Menu/function	Description or function
Save Settings	Saves the current application settings in a .stp file
Recall Settings	Browse to select an application setup (.stp) file to recall; restores the application and oscilloscope to the values saved in the setup file
Export Waveform	Exports the underlying waveform correlated pattern data used for processing
Print	Prints the displayed plots and the detailed statistics list
Print to File	Creates a .prn file of the displayed plots and a detailed statistics list
Exit	Exits the application

Tips on the 80SJNB User Interface

Here are some tips to help you with the application user interface.

The toolbar provides you with most of the functions you need to configure the settings, start the acquisition, and control the numerical and plot displays.

- The Configure button  displays a dialog box to configure the target source for measurement and controlling the most relevant oscilloscope setups.
- Pressing the Run button  first clears all current measurement data and plot displays, and then starts the acquisition and processing cycle.

- The Free Run button toggles between blue  for Free Run Off (single sequence) and orange  for Free Run On.
- Use the plot selection button in the plot displays  to access the drop-down menu for tasks to perform for that plot window, such as assigning a new type of plot display.

Oscilloscope Settings

You should return the oscilloscope to its default state before launching the 80SJNB Configuration dialog box. All other acquisitions and math waveforms should be off, as well as all measurements, waveform databases, masks, and histograms. You should not have to make changes to the oscilloscope settings via the oscilloscope UI to successfully acquire data with the 80SJNB application. The most relevant oscilloscope settings are accessible using the Configuration dialog box of the 80SJNB application.

Some test setups require oscilloscope settings (such as wavelength and external attenuation). Make changes to the oscilloscope settings before running the analysis.

NOTE. *Changing oscilloscope settings while the 80SJNB application is acquiring data may cause errors, unpredictable results, or failure.*

To bring the CSA/TDS application to the front of the display, press the Back to Scope button  or minimize the 80SJNB application. Alternately, you can use the Alt + Tab keys to switch between applications if you have a keyboard attached.

About the Results

There are two ways to view analysis results: as numeric data and as graphical plots.

You can log the results data to .csv files for viewing in a spreadsheet, database, text editor or data analysis program.

Clearing Results

Press the Clear Data  button to remove the existing plot displays and results. You may want to clear the data before acquiring new data or between cycles when the Sequence mode is set to free-run.

NOTE. *The numeric results and plot files are erased each time a new acquisition cycle is started by the user.*

About Plotting

The application displays the results as 2-dimensional plots for more comprehensive analysis. Before or after you take measurements, you can select to display a single plot, two plots or four plots. You can select the type of data you want to view in each plot window.

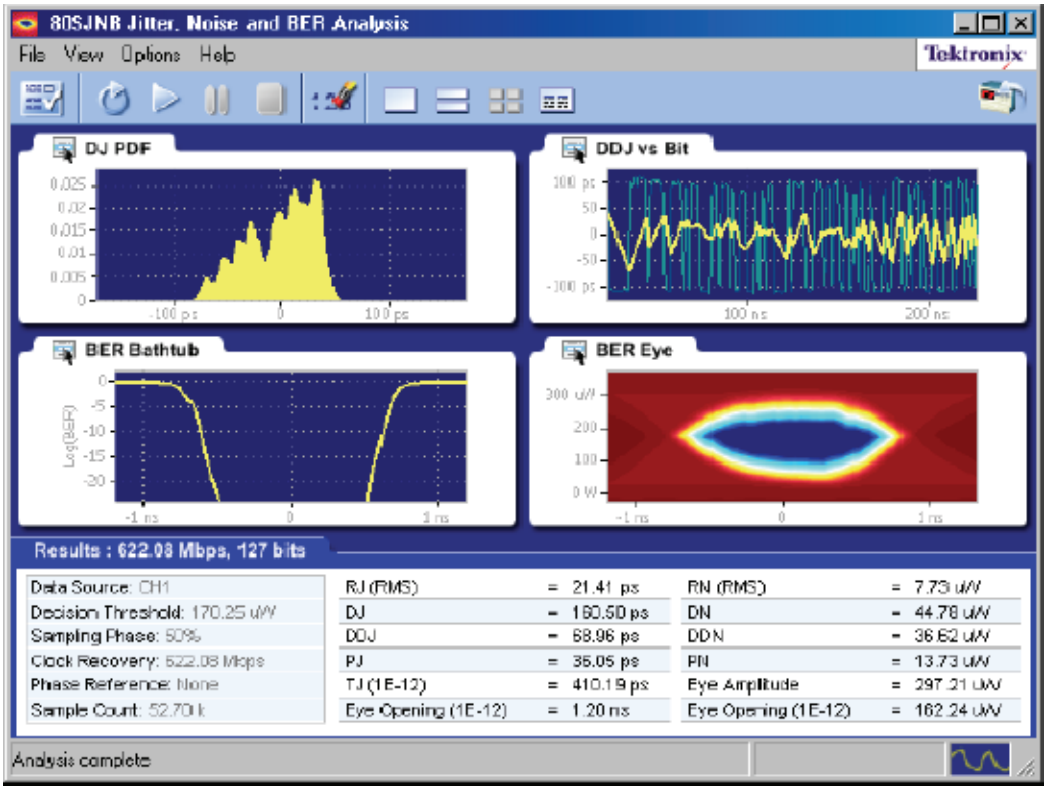
Navigating the User Interface

Windows User Interface

About the User Interface

The application uses a Microsoft Windows-based user interface.

***NOTE**. The oscilloscope application is hidden when the 80SJNB application is running and not minimized.*



User Interface Items Definitions

Item	Description
Area	Visual frame that encloses a set of related options
Box	Use to define an option; enter a value with the Keypad or a Multipurpose knob
Browse	Displays a window where you can look through a list of directories and files
Check box	Use to select or clear an option
Command button	Initiates an immediate action, such as the Start command button in the Control panel
Keypad	On-screen keypad that you can use to enter numeric values
Menu	All options in the application window (except the Control panel) that display when you select a menu bar item
Menu bar	Located along the top of the application display and contains application menus
Status bar	Line located at the bottom of the application display that shows the acquisition status and the latest Warning or Error message
Virtual keyboard	On-screen keyboard that you can use to enter alphanumeric strings, such as for file names

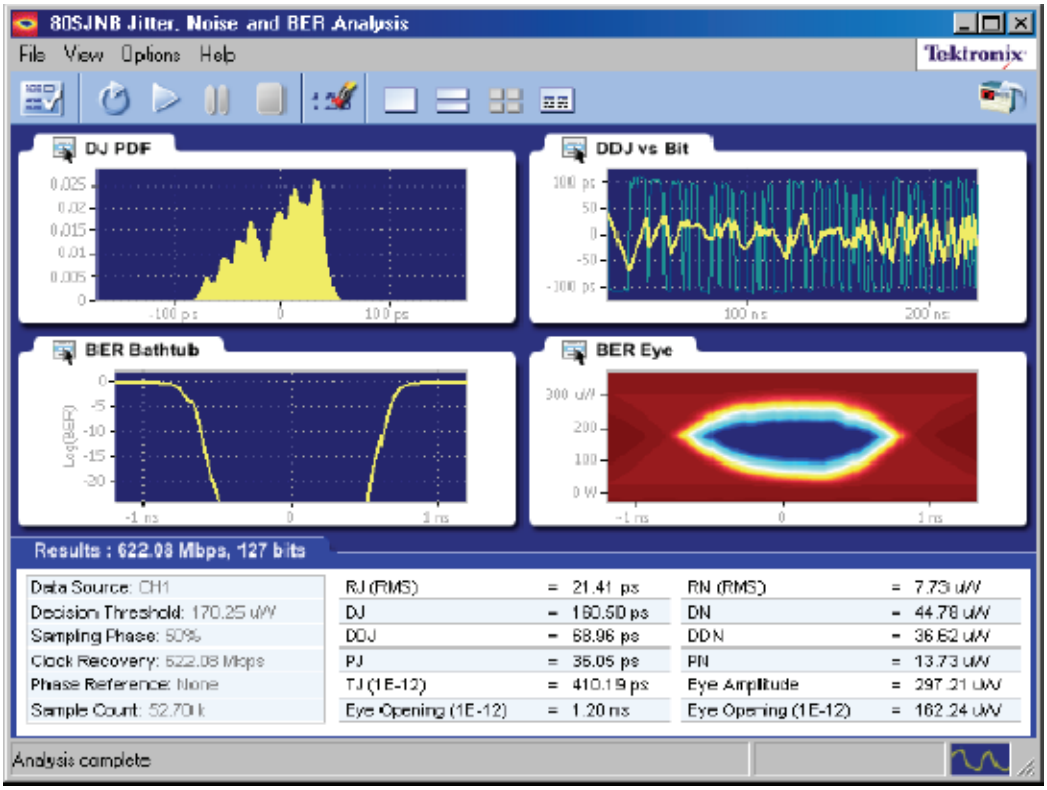
Item	Description
Scroll bar	Vertical or horizontal bar at the side or bottom of a display area that you use to move around in that area
Tool bar	Located along the top of the application display and contains application quick launch buttons

80SJNB User Interface Information

About Navigation

The application provides you with several means to display the results:

- The drop-down menus available in the menu bar allows for screen configuration (one, two, or four plots, summary or full numeric results table)
- The buttons in the tool bar allow for screen configuration
- The drop-down menus available in the plot display windows allow you to choose from the available plots, as well as Copy, Examine, and Export plots
- The status bar at the bottom of the screen contains progress information and displays error conditions detected
- Double clicking on a displayed graph opens the plot in a Matlab window. Matlab provides additional display capabilities such as panning, zooming, data cursors, and 3D rotation. The Examine… button from the drop-down menu of the plot also opens the Matlab window.



About the 80SJNB Tool Bar

The toolbar provides you with most of the functions you need to configure the settings, start the acquisition, and control the numerical and plot displays. Most tasks are also available using the drop-down lists from the File menu bar.

- Configure button  . Use the Configure button to display the Configuration dialog box, allowing you to select and configure the source for measurements and control key oscilloscope setups. The Configuration button is disabled during the acquisition and processing cycle.
- Free Run on/off button  . Use the Free Run button to select the sequence mode (free run on or off).

  When OFF, the button remains blue and the acquisition and processing cycle completes one pass over the entire pattern. Off is the default mode.

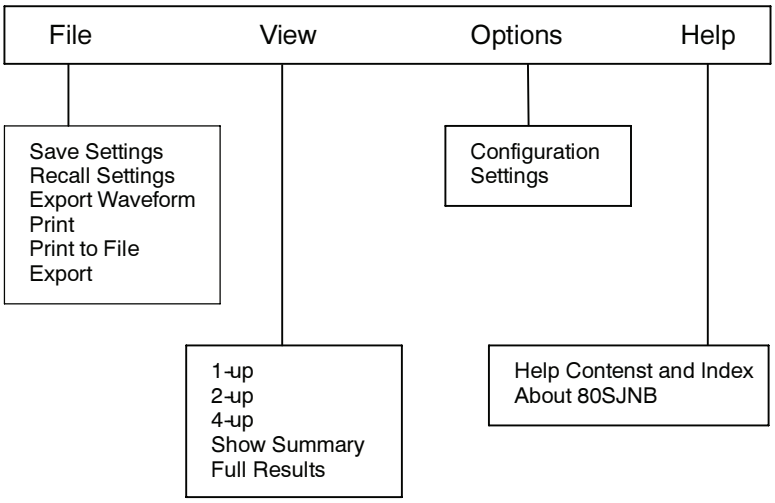
  When Free Run is ON, the button turns orange  indicating that the acquisition and processing cycle will repeat until stopped by the user. The

correlated components are averaged with previous data while the uncorrelated components are accumulated for increased statistical content. At the completion of each acquisition cycle, the plots and measurements are updated.

If you want to halt a Free Run cleanly, select the  button. This converts the Free Run mode to Single Sequence mode, so that the acquisition stops when the cycle is complete.

- Run button  . Use the Run button to start the acquisition and processing cycle. Once the run button is pressed, do not change any instrument settings. When the Run button is pressed, all current measurement data and plot displays are cleared. During the acquisition and processing cycle the Configuration and Run buttons are disabled.
- Pause button  . Use the Pause button to interrupt the current acquisition and processing cycle. Press the button again to resume the cycle. This can be useful when the acquisition is set to Free Run, allowing you to halt the acquisition and processing cycle so you can view and save the measurement data between cycles.
- Stop button  . Use the Stop button to end the acquisition and processing cycle. While in Single Sequence mode, stopping the cycle produces no results and you must press the Start button to start a new cycle.
- Clear Data button  . Use the Clear Data button to clear all results and plot displays. If Free Run is set to ON (cumulating previous data with new), you can clear the existing results and plots during the processing cycle, thus starting a new acquisition and processing cycle.
- Plot Display  . Use the window pane buttons to display between 1, 2, or 4 plots. The number of plot displays can be changed at any time.
- Numeric Results Display  . The results button changes the display to a complete list of statistics with no plots displayed.
- Return to Scope  . Use this button to bring the CSA/TDS 8000 oscilloscope display to the front of the screen.

Menu Bar Navigation Tree



Matlab User Interface Information

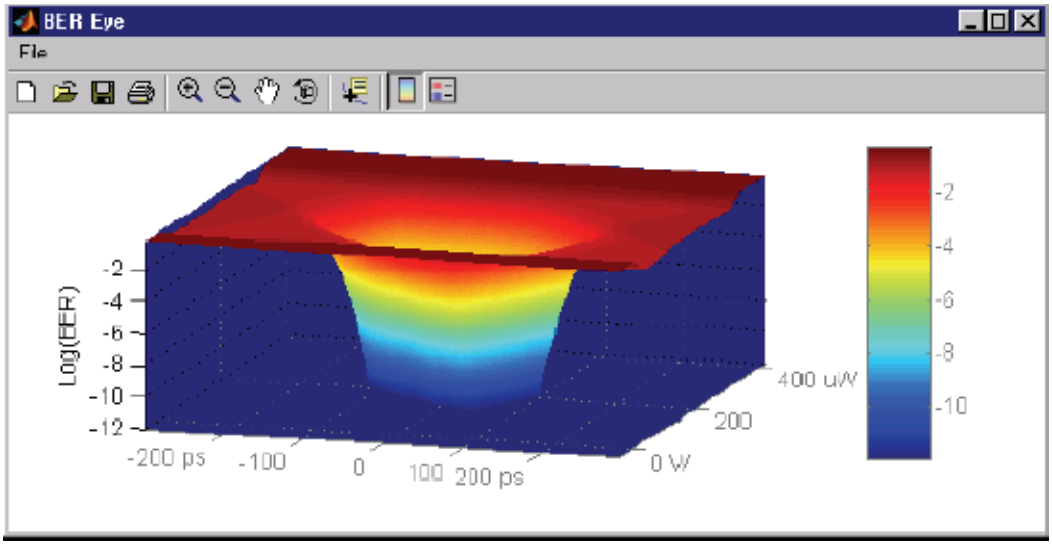
Matlab® User Interface

The 80SJNB application includes Matlab plots to provide further data analysis and visualization of the plot displays.

Matlab provides multiple capabilities to display and annotate the plot diagrams, including:

- Pan and Zoom
- 2D and 3D visualization
- Rotation
- Data Cursors
- Color enhancements

Matlab is a product distributed by MathWorks. You can view the Matlab documentation and tutorials on their website: http://www.mathworks.com



Setting up the Application for Analysis

The tool bar provides a Configuration button to set up the application.

Use the Sequence button to have the acquisition and processing of data run continuously (free run) or stop after one cycle is complete.

After setting up the application, you can select the Run button to start the acquisition and processing cycle.

After the acquisition and processing cycle has completed, you can view the results as numerical statistics or graphically.

Configuring Sources

Before making jitter and noise measurements, you need to select and configure the signal source.

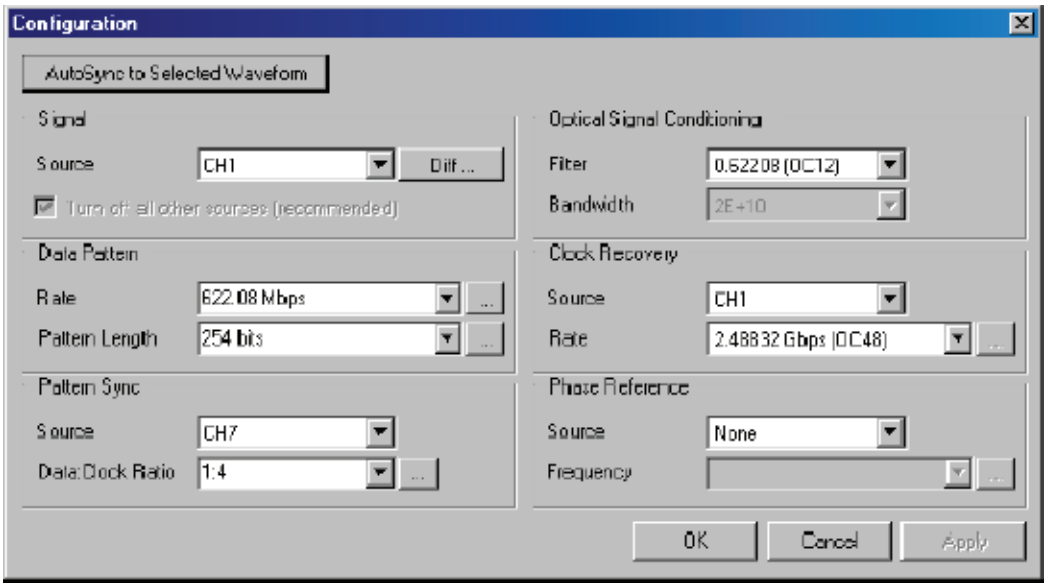
Use the Configure button to display the Configuration dialog box.

In the Configuration dialog box, select the signal source and define the acquisition parameters. Some parameters (such as the Clock Recovery, Phase Reference Sources, and the optical signal conditioning) are pre-loaded by reading the oscilloscope's module installation record.

Press the **AutoSync to Selected Waveform** button to have the 80SJNB application automatically obtain and enter the following information from the signal applied to the channel defined as the Signal Source:

- Data Pattern Rate
- Data Pattern Length
- Data:Clock Ratio

***NOTE**. The extent of the auto discovery depends on the configuration of the Pattern Sync setup in the oscilloscope. Refer to the 8000 Series online help system for details about the Pattern Sync settings.*

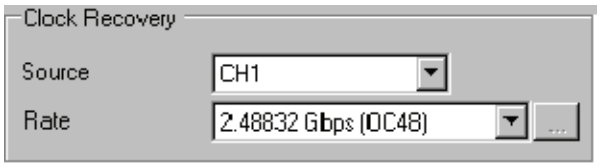


Selecting Clock Recovery

The PatternSync Trigger module requires a data synchronous clock input. When using a clock derived from a module that provides a clock recovery output, use this dialog box to select the channel source and its frequency.

These settings are grayed out if no modules with clock recovery are detected at application startup.

The Rate setting is limited to the capabilities of the selected module. The numeric keypad is unavailable for use unless the module is capable of USER defined rates.

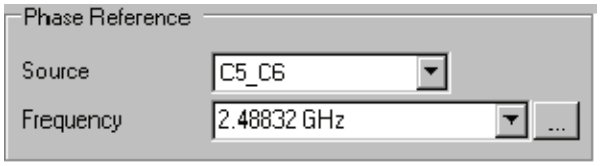


Selecting Phase Reference

You can use a Phase Reference module (such as the 82A04) to reduce the trigger jitter of the signal source, thus increasing the jitter measurement accuracy.

If using a Phase Reference module, set the channel source and the frequency of the applied clock.

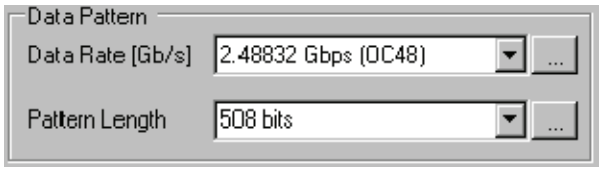
These settings are grayed out if a Phase Reference module is not detected at application startup. If a Phase Reference module is detected, you have the option to not use the module by selecting None as the Source.



Selecting the Data Pattern

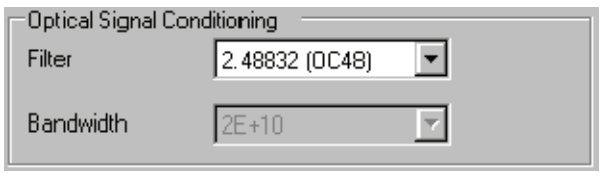
Defining the Data Pattern requires that you define both the data rate of the signal source and the pattern length in bits. You can choose the data rate from a predefined set of communication standards or enter a value with the numerical keypad.

***NOTE**. Selecting a data rate that does not match the communication standard that is set in the instrument's Horizontal Communication Standard setting dialog box causes the oscilloscope setting to change to User.*

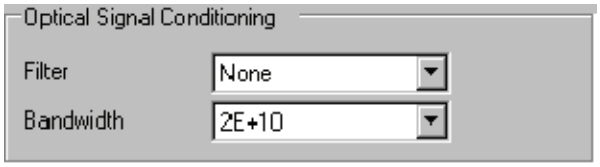


Selecting the Optical Signal Conditioning

You can apply an optical filter to optical input signals. Use this control to select what type of filtering, if any, you want performed on the selected optical channel. The available filters depend on the capabilities of the optical module.



If the Filter is set to None, you can use the Bandwidth box to select the bandwidth of the channel. The available bandwidth selections depend on the capabilities of the optical module.

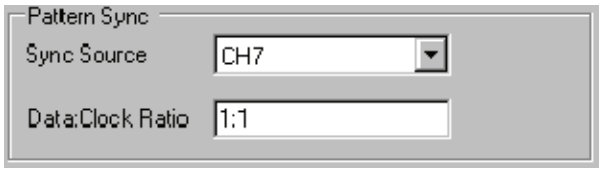


Selecting the Pattern Sync

The Pattern Sync area is where you set the location of the PatternSync Trigger module and the data-to-clock ratio.

Upon starting the 80SJNB application, the Sync Source is preset to the first location (lowest numbered channel) of an installed PatternSync Trigger module.

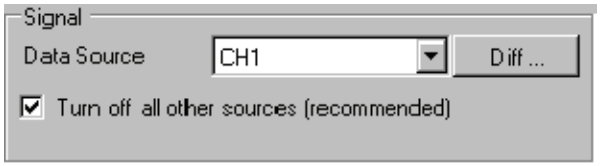
The default value for the data-to-clock ratio is 1:1. The first value represents the data rate and the second value represents the clock rate. The Data to Clock valid rates range from 128:1 to 1:8, with one of the references values always being 1.



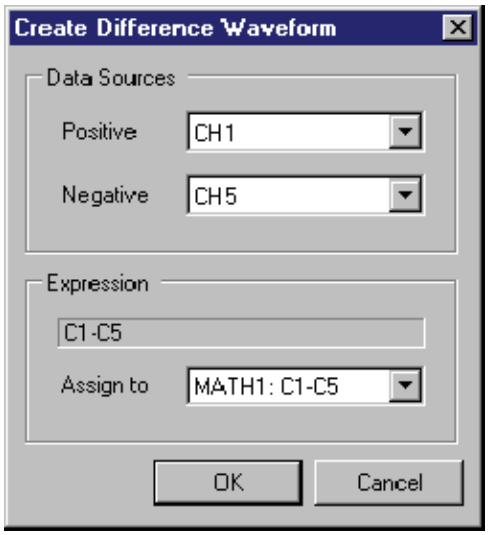
Selecting the Source

The application takes measurements on waveforms specified as sources (also called input sources). The source can be a channel (CH1 through CH8) or a math waveform (if one has been defined). Any defined math waveform can be used, whether it's defined in the 80SJNB configuration as a differential setup or in the CSA/TDS8000 instrument setups. (Defining a math waveform in the CSA/TDS8000 application must be done before launching the 80SJNB application.)

When selecting a Data Source, all other channels and Math waveforms will be turned off. If any channels or Math, other than the Data Source are activated after launching the 80SJNB application, an error message will prompt the user to deactivate all additional waveforms before running the application. All other waveform databases, measurements, histograms and masks on the base scope need to be turned off, as well. If any of these conditions exist when starting the acquisition and processing cycle, you will be prompted to turn these off before you can continue.



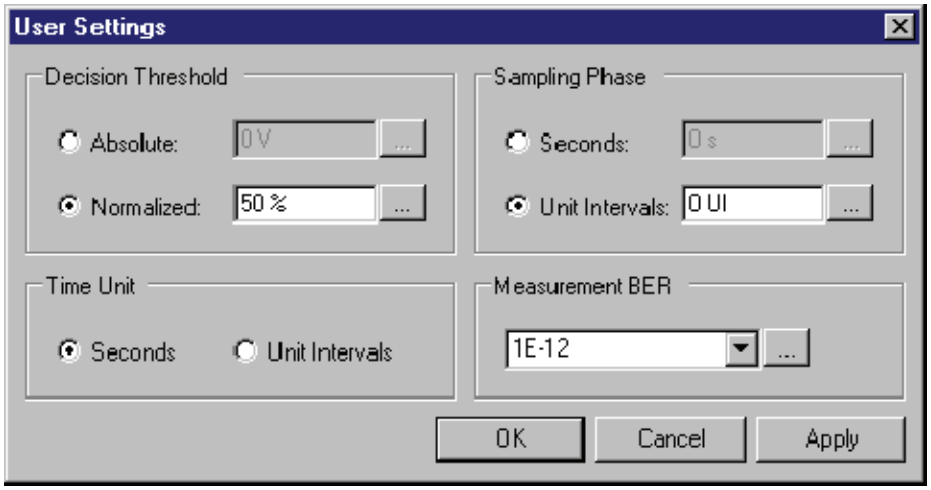
Selecting the **Diff** … button displays the dialog box to create a differential Math waveform by defining a positive and negative waveform source (the negative waveform source is subtracted from the positive waveform source). This generates a single mathematical waveform that the 80SJNB application can use as the waveform measurement source.



More complex math expressions are available using the CSA/TDS8000 series instrument math dialog box. Refer to the instruments online help. These must be defined before launching the 80SJNB application.

Configuring User Settings

The User Settings affect how measurements are made and displayed. The User Settings are saved with the 80SJNB application whenever it is closed so that restarting the application results in using the same User Settings.



Tip Changes to User Settings are reflected in the current plots and results.

Setting the Decision Threshold

The Decision Threshold specifies the level at which to determine the crossing points on the edges of the measured waveform.

When set to Absolute, the decision threshold uses the absolute value provided in volts (electrical) or watts (optical).

When set to Normalized, the decision threshold is calculated based on waveform data according to the percent value of the signal amplitude.

Setting the Time Unit

The Time Unit sets the units (Seconds or Unit Intervals) used when displaying the measurement results.

Setting the Sampling Phase

The Sampling Phase determines where the sampling point is located within the bit interval.

When set to Seconds, the sampling point uses the absolute value entered. Zero seconds is at the center of the bit interval.

When set to Unit Intervals, the sampling point is calculated based on the bit interval. Zero UI is the center of the unit interval.

Setting the Measurement Bit Error Rate

The Measurement BER determines the rate for which the measurements are predicted.

About Measurements

About Displaying Measurements

You can use the tool bar to select how the results are displayed: numeric results, plots (up to four), or a combination.

What do you want to do?

Display the definitions of Jitter measurements.

Display the definitions of Noise measurements

Measurement Algorithms

Go to Working with Numeric Results

Go to Working with Plots

Jitter Measurement Definitions

Jitter Measurements	Description
Random Jitter	
RJ (RMS)	Measured Random Jitter
RJ(h) (RMS)	Horizontal component of random jitter
RJ(v) (RMS)	Vertical component of random jitter induced by noise converted to jitter through an average slew rate
Deterministic Jitter	
DJ	Measured Deterministic Jitter
DDJ	Data Dependant Jitter
DCD	Duty Cycle Distortion
PJ	Measured Periodic Jitter (peak-to-peak)
PJ(h)	Horizontal component of periodic jitter (peak-to-peak)
PJ(v)	Vertical component of periodic jitter (peak-to-peak) induced by noise converted to jitter through an average slew rate
Total Jitter @ BER	
TJ (1E-12)	Total Jitter at user-specified BER
Eye Opening (1E-12)	Horizontal Eye Opening at user specified BER
Dual Dirac	
RJ(d-d)	Random Jitter computed in the Dual Dirac model
DJ(d-d)	Deterministic Jitter computed in the Dual Dirac model

Noise Measurement Definitions

Noise Measurements	Description
Random Noise	
RN (RMS)	Measured Random Noise
RN(v)	Vertical component of random noise
RN(h)	Horizontal component of random noise induced by jitter converted to noise through an average slew rate
Deterministic Noise	
DN	Measured Deterministic Noise
DN	Data Dependant Noise
DDN(level 1)	Data Dependant Noise on logical level 1
DDN(level 0)	Data Dependant Noise on logical level 0
PN	Measured Periodic Noise
PN(v)	Vertical component of periodic noise (peak-to-peak)
PN(h)	Horizontal component of periodic noise (peak-to-peak) induced by jitter converted to noise through an average slew rate
Total Noise @ BER	
TN (1E-12)	Total Noise at user-specified BER
Eye Opening (1E-12)	Eye Opening at user-specified BER
Eye Amplitude	The amplitude of the eye computed as the mean-to-mean of logical 1 and logical 0 bit levels sampled at the user defined Sampling Phase.
	Data Dependant Noise

About Taking Measurements

You should return the oscilloscope to its default state before launching the 80SJNB. All other acquisitions and math waveforms should be off, as well as all measurements, waveform databases, masks, and histograms. You should not have to make changes to the oscilloscope settings via the oscilloscope UI to successfully acquire data with the 80SJNB application. The most relevant oscilloscope settings are accessible using the Configuration dialog box of the 80SJNB application.

Some test setups require oscilloscope settings (such as wavelength and external attenuation). Make changes to the oscilloscope settings before running the analysis.

Acquiring Data

Steps to Acquire Data

To acquire data from waveforms and take measurements, follow these steps:

1. Select  to display the Configuration dialog box and configure the application according to your setup and signal type.
2. Select  to toggle the acquisition mode between free run (continuous) and single acquisitions and processing cycles. When in Free Run mode, the data correlated acquisition continues until converging, while the uncorrelated data acquisition, processing, and accumulation of results continues until stopped by the user.
3. Select  to start the acquisition and processing cycle.

To stop the acquisition, do one of the following:

- If you wish to stop the acquisition and processing cycle before it completes, select  . This may be useful if you have started a sequence on a long waveform and then realize you would like to change the configuration.
- If you wish to interrupt the acquisition and processing cycle, select  . Select a second time to resume the acquisition.
- If you wish to halt a Free Run mode cleanly, toggle the Sequence  button. This will convert the Free Run mode (indicated by the orange button) to Single cycle mode (indicated by the blue button) so that the acquisition stops when the cycle is complete. Single cycle is the default mode.

 Use the Clear Data  button to delete all measurement results and plots.

Saving and Recalling Setup Files

You can use the File menus to save and recall different oscilloscope and application setups. Setup files store the oscilloscope and application settings.

CAUTION. *Do not edit a setup file or recall a file not generated by the application.*

Saving a Setup File

To save the 80SJNB application and oscilloscope settings to a setup file, follow these steps:

1. Select File > Save Settings to open the Save dialog box.
2. In the file browser, select the directory in which to save the setup file.
3. Use the keyboard to enter a new file name.

   The application appends a ".STP" extension to the name of the file.
4. Save the setup file. If the selected filename already exists, a confirmation dialog appears that allows you to cancel the operation.

NOTE*. The application saves the oscilloscope setup.*

Recalling a Saved Setup File

To recall the application and oscilloscope settings from saved setup files, follow these steps:

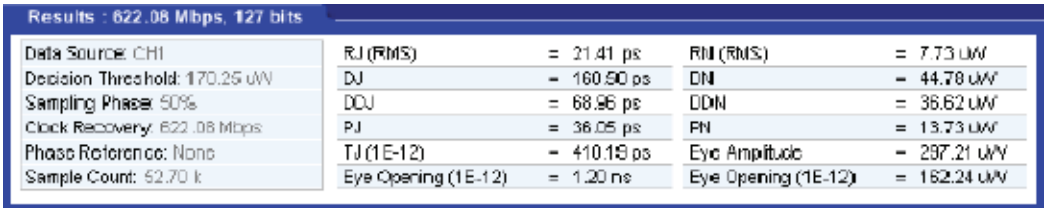
1. Select File > Recall Settings to open the Recall dialog box.
2. In the Recall dialog box, select the directory from which to recall the setup file.
3. Select a setup file name, and then select Open.

CAUTION. *Do not edit setup files. If you try to recall a setup file that has been edited, the recall operation fails.*

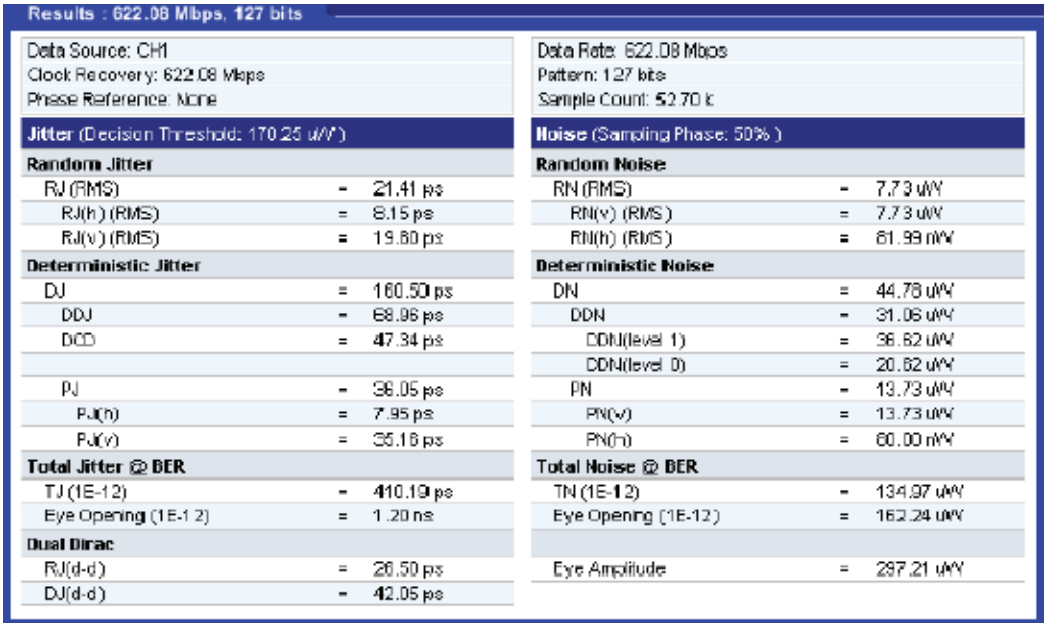
Working with Numeric Results

After an analysis is complete, you can display the results as numeric data in either a summary or detailed table.

The summary table contains the noise and jitter measurements but not the breakdown of the measurements, allowing room for the plot displays.

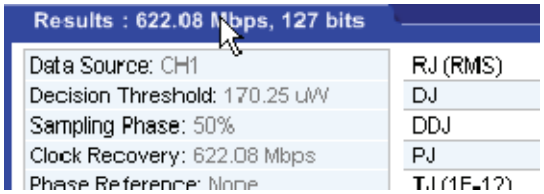


The detailed table (when selected) expands to fill the entire screen, removing any plot displays.

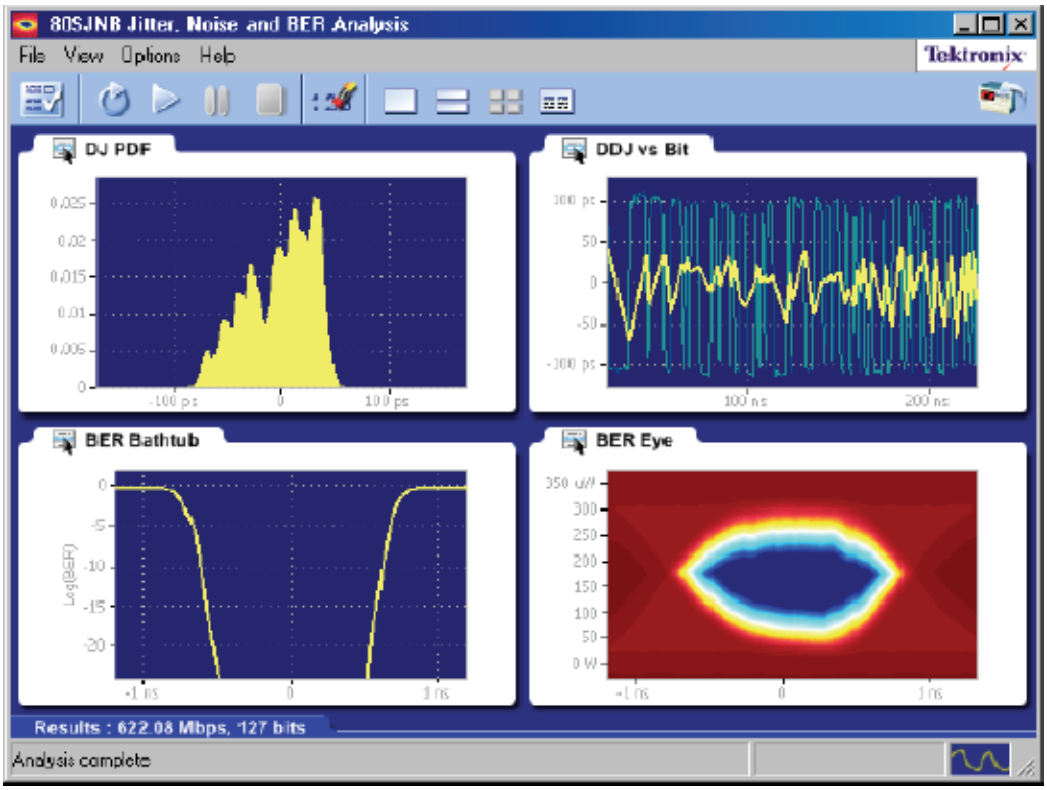


You can easily switch between summary and detailed numeric displays with the use of the numeric results button  and the plot window buttons  .

To hide the summary table and provide more room for the plot displays, click on the tab of the numeric data table. Clicking the tab again redisplays the summary data table.



Here you can see that the plot windows fill the entire screen and the tab for the numeric details is showing at the bottom of the screen.



Working with Plots

You can display plots in a variety of layouts using the tool bar. One, two, or four plots can be displayed using the plot display buttons  in the toolbar. When displaying plots, the results data table changes to a summary table of data. To remove the plots entirely from the display, select the Show Numeric Results button  on the tool bar.

If the plots have been removed from the display, redisplay the plots by either selecting one of the plot display buttons or click on the tab of the data table.

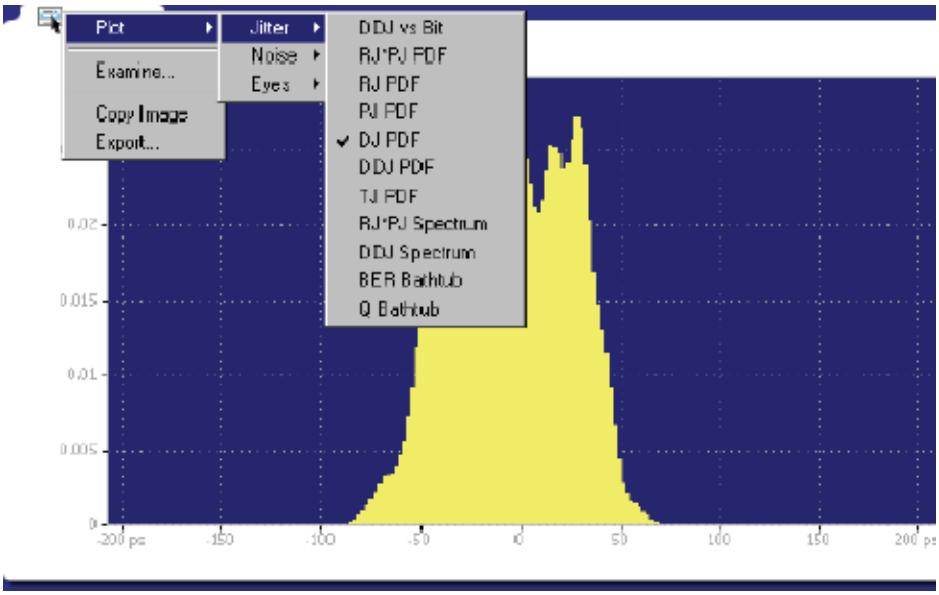
Selecting and Viewing Plots

To select and view a plot, follow these steps:

1. Select one of the plot views  , (single plot, two plots, or four plots).

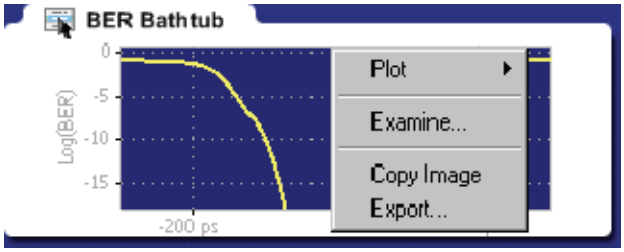
2. For each plot window, select a type of plot to display. Each plot display is based on the current analysis results. Plots are updated as new results are acquired.

   To select a plot type for display in the plot window, click  on the tab of the plot window. From the drop-down menu, use the Plot menu to select a plot from the plot categories (Jitter, Noise, Eyes).



Examining Plots

You can examine plots in greater detail by either double-clicking in the plot window or selecting **Examine**… from the drop-down list in the plot window. Either of these actions launches a Matlab plot window which provides advanced tools to examine graphical displays of data.



Plot Type Definitions

Plot types are divided into the following categories:

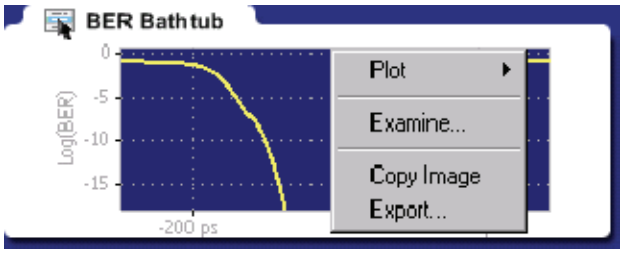
- Jitter: See Jitter Plots for a list of the types of jitter plots and their descriptions.
- Noise: See Noise Plots for a list of the types of noise plots and their descriptions.
- Eyes: See Eye Plots for a list of the types of eye plots and their descriptions.

Copying Plot Images

You can copy the plot image displayed in any one of the plot windows. The copy is placed in the Windows clipboard so it can be used to paste into other Windows programs. This is convenient for creating reports and engineering records to share with others.

To create an image file of a plot, follow these steps:

1. Touch the  area of the plot window of the plot you copy. (If using a mouse attached to the instrument, right-click anywhere within the plot window of the plot you intend to copy.)
2. Select **Copy Image** from the drop-down list. This copies the image to the Windows clipboard.



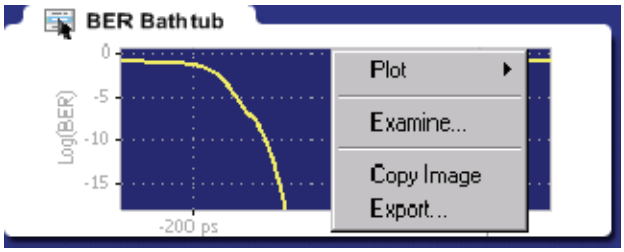
3. Open your destination program (such as WordPad or Paint) and paste the image into the application.

Exporting Plot Data

There are two ways to export plot information from the 80SJNB application for use in other applications:

- You can export the numerical data that is represented in the plot figure. This may be useful for performing additional data processing.
- You can create an image file that captures the current plot view. This is a useful way to document your results.

The application offers the following choices from the drop-down list (right-mouse click over the selected plot).



- Plot lets you select a different plot to display in the window. The window displays the new plot based on the acquired data.
- Examine… opens a Matlab plot window which provides additional tools to more closely examine plot characteristics.
- Copy Image saves the contents of the plot window as an image file.
- Export… saves the numerical values from the plot window in text or MATLAB format.

***NOTE**. Export plot functions are disabled whenever the application is actively sequencing.*

Exporting Raw Plot Data

The 80SJNB provides two methods to export the raw plot data.

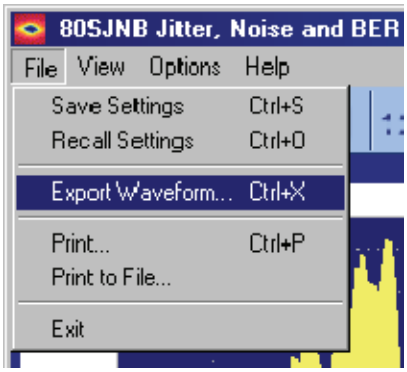
- Export Waveform…. accessed from the File menu, exports the underlying waveform correlated pattern data used for processing.
- Export… accessed from the plot window, exports the data used to create the plot image.

***NOTE**. The 80SJNB application can produce files that are too large for some spreadsheet programs to load completely. However, you can use a text editor to view the entire file.*

Export Waveform

To export the waveform data used for processing, follow these steps:

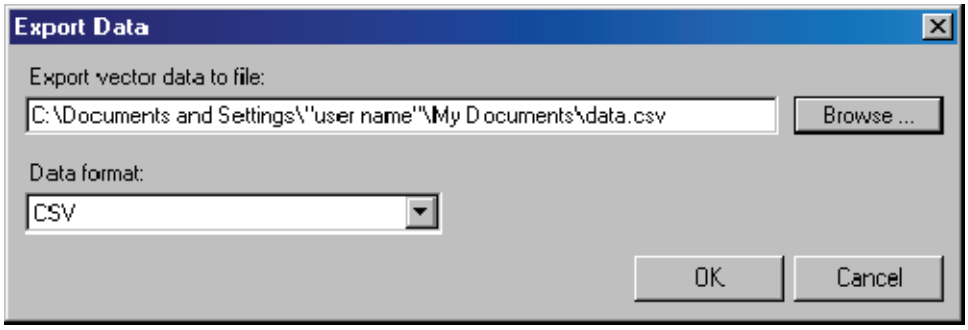
1. Select File > **Export Waveform**… to display the Export Data dialog box.



2. Select the directory where you would like to save the data and name the file.

   By default, the selection list defaults to the filename “data”, and offers to place the data in the My Documents folder. The default data type is Comma Separated Values (.csv).

   If you have a keyboard attached, you can change the filename.



3. Use the drop-down list for Data Format and select the file type. The choices are:

- Comma Separated Values (.csv) – ASCII text that can be loaded into a spreadsheet.
- ASCII Text (.txt) – ASCII text that is readable by an editor such as WordPad.
- MATLAB (.mat) – Binary data in the native MATLAB 7.0 format.

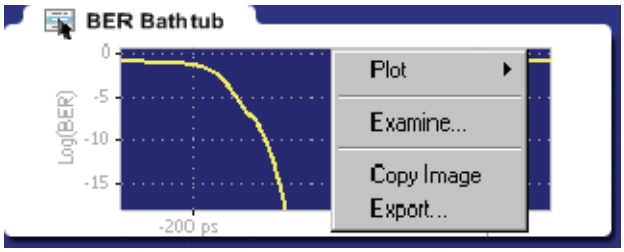
Tip Binary files typically use about 40% more disk space as text files.

Export

To export the numeric data used to create a specific plot, follow these steps:

1. Touch the  area of the plot window of the plot you want to export. (If using a mouse attached to the instrument, right-click anywhere within the plot window of the plot you intend to export.)

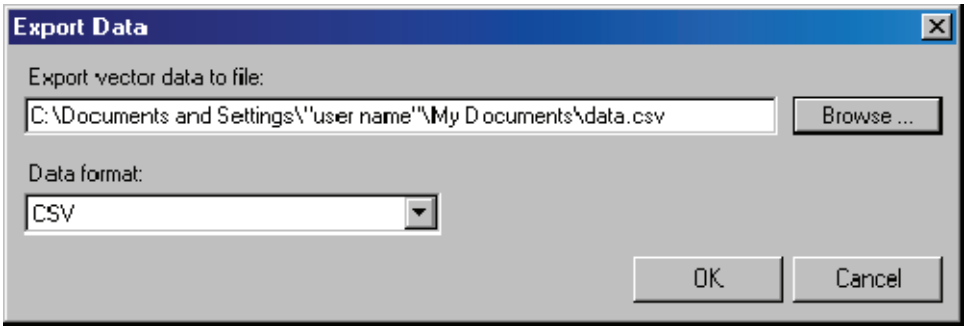
2. Select **Export**… from the drop-down menu.



3. Use the Export Data dialog box to select the directory where you would like to save the data and name the file.

   By default, the selection list defaults to the filename “data”, and offers to place the data in the My Documents folder. The default data type is Comma Separated Values (.csv).

   If you have a keyboard attached, you can change the filename.



4. Use the drop-down list Data Format to select the file type. The choices are:

- Comma Separated Values (.csv) – ASCII text that can be loaded into a spreadsheet.
- ASCII Text (.txt) – ASCII text that is readable by an editor such as WordPad.
- MATLAB (.mat) – Binary data in the native MATLAB 7.0 format.

Binary files typically use about 40% more disk space as text files.

***NOTE**. Files with .txt and .csv extensions are identical except for the extension.*

Plot Types

Jitter Plots

Jitter Plots	Description
DDJ vs Bit	Data Dependent Jitter versus Bit displays the deviation of edge crossings at the user-specified Decision Threshold for each bit of the entire pattern. The pattern itself is shown in the background for cross reference. If the pattern is very long, the bits will be visible only when opening the graph with Examine…
DDJ PDF	Data Dependent Jitter Probability Density Function is the histogram of the data pattern correlated jitter, including Duty Cycle Distortion. The PDF is composed of the crossing deviations at the user specified Decision Threshold of all edges of the data pattern.
DDJ Spectrum	The Data Dependent Jitter Spectrum is the result of the time domain to frequency domain transformation of the series of crossing deviations of data pattern edges at the user specified Decision Threshold.
RJ PDF	Random Jitter Probability Density Function shows the Gaussian distribution of the random, unbounded, uncorrelated jitter component. It is computed from data acquired on a single edge of the bit stream.
PJ PDF	Periodic Jitter Probability Density Function represents the histogram of the uncorrelated, bounded, periodic jitter component. It is computed by spectral separation of the jitter data acquired on a single edge of the bit stream.
RJ Spectrum	Random and Periodic Jitter Spectrum represents the spectral distribution of the uncorrelated jitter acquired on a single edge. The spurs represent the periodic jitter spectral lines, and the rest of the evenly distributed spectral lines compose the random jitter spectrum.
RJ*PJ PDF	Random Jitter and Periodic Jitter Probability Density Function is the histogram of the uncorrelated jitter data acquired on a single edge of the pattern.
DJ PDF	Deterministic Jitter Probability Density Function shows the distribution of the bounded jitter component. The histogram is computed by convolving the DDJ PDF with the PJ PDF.
TJ PDF	Total Jitter Probability Density Function represents the computed histogram derived from all jitter components, correlated and uncorrelated, bounded and unbounded. The convolution of DJ PDF and RJ PDF yields the Total Jitter histogram.
BER Bathtub	The BER Bathtub curve is computed as a horizontal slice of the 3-dimensional BER Eye at the Decision Threshold. It represents the extrapolated total jitter and horizontal eye opening limits at projected bit error rates.
Q Bathtub	The Q-scaled curve is a linearized scale version of the BER Bathtub curve. It represents the extrapolated total jitter and horizontal eye opening limits at projected bit error rates.

Eye Plots

Eye Plots	Description
Correlated Eye	The Correlated Eye is a color graded eye pattern built by folding the correlated pattern at clock rates. The correlated pattern is computed from the acquired full length data pattern by filtering out the uncorrelated components.
PDF Eye	The PDF Eye is a color graded Probability Density Function representing the eye pattern, constructed from the convolution of the Correlated Eye with uncorrelated jitter and noise probability distributions.

Eye Plots	Description
BER Eye	The BER Eye is a three-dimensional color graded map representing the predicted bit error rates at all decision thresholds and sampling phases in the unit bit interval.
Q Eye	The Q Eye is a three-dimensional color graded map representing the predicted bit error rates at all decision thresholds and sampling phases in the unit bit interval with a linearized Q-scale, rather than the BER logarithmic scale.
BER Contour	The BER Contours show the boundaries of the eye opening at the projected bit error levels.

Noise Plots

Noise Plots	Description
DDN vs Bit	Data Dependent Noise versus Bit displays the data levels sampled at the user specified Sampling Phase through the entire pattern. The pattern itself is shown in the background for cross reference. If the pattern is very long, the pattern bits will be visible only when opening the graph with Examine…
DDN PDF	Data Dependent Noise Probability Density Function is the histogram of the data pattern correlated noise distribution on both logic levels 1 and 0. It includes the data levels at all user specified unit bit interval Sampling Phase.
DDN Spectrum	The Data Dependent Noise Spectrum is the result of the time domain to frequency domain transformation of the series of level samples taken on all bits at the user specified Sampling Phase of the unit bit interval.
RN PDF	Random Noise Probability Density Function shows the Gaussian distribution of the random, unbounded, uncorrelated noise component. It is computed from data acquired on a single flat spot of logic level 1 of the bit stream.
PN PDF	Periodic Noise Probability Density Function represents the histogram of the uncorrelated, bounded, periodic noise component. It is computed by spectral separation of the noise data acquired on a single flat spot of logic level 1 of the data stream.
RN*PN Spectrum	Random and Periodic Noise Spectrum represents the spectral distribution of the uncorrelated noise acquired on a single flat spot of logic level 1. The spurs represent the periodic noise spectral lines, and the rest of the evenly distributed spectral lines compose the random noise spectrum.
RN*PN PDF	Random and Periodic Noise Probability Density Function is the histogram of the uncorrelated noise distribution on data acquired on a single flat spot of logic level 1 of the bit stream.
DN PDF	Deterministic Noise Probability Density Function shows the distribution of the bounded noise component. The histogram is computed by convolving the DDN PDF with the PN PDF.
TN PDF	Total Noise Probability Density Function represents the computed histogram derived from all noise components, correlated and uncorrelated, bounded and unbounded. The convolution of DN PDF and RN PDF yields the Total Noise histogram.
BER Bathtub	The BER Bathtub curve is computed as a vertical slice of the 3-dimensional BER Eye at the user specified unit bit interval Sampling Phase. It represents the extrapolated total noise and vertical eye opening limits at projected bit error rates.
Q Bathtub	The Q-scaled curve is a linearized scale version of the BER Bathtub curves. It represents the extrapolated total noise and vertical eye opening limits at projected bit error rates.

Parameters

These topics list the 80SJNB application parameters and include the menu default settings. You should refer to the documentation for your oscilloscope for operating details of oscilloscope controls, such as front-panel buttons.

The parameter tables list the selections and startup values for each option.

Refer to the GPIB topics for a list of the GPIB Command Syntax along with the arguments, variables, and variable values that correspond to the 80SJNB parameters.

User Settings

This table lists the default values of the User Settings when the 80SJNB application is first started. If you change these settings, they remain in effect for all successive sessions of the application.

Control	Startup Settings
Decision Threshold	Normalized 50%
Time Unit	Seconds
Sampling Phase	Unit Intervals 0 UI
Measurement BER	1E-12

Configuration Settings

This table lists the default status of the Configuration Settings when the 80SJNB application is first started. If you change these settings, they remain in effect for all successive sessions of the application.

Control	Startup Settings
Source	First valid input channel
Difference Waveform	
Positive	First valid input channel
Negative	blank
Turn off all other channels	On
Data Pattern	
Rate	User defined
Pattern Length	User defined

Control	Startup Settings
Pattern Sync	
Source	First channel with a PatternSync Trigger module
Data:Clock Ratio	1:1
Optical Signal Conditioning	
Filter	None
Bandwidth	blank
Clock Recovery	
Source	First channel containing a module with clock recovery
Rate	None
Phase Reference	
Source	None
Frequency	blank

GPIB

You can use remote GPIB commands to communicate with the 80SJNB application. Your GPIB program should comply with the following guidelines:

- The application startup must complete before sending additional GPIB commands to the application. Querying the variable *application* returns `“80SJNB”` when the application startup is complete.
- The measurements cycle must complete before you query data. Querying the variable *DataReady* returns `"True"` when the data is ready.

Program Example

The program example shows how to communicate with the 80SJNB application using VARIABLE:VALUE remote GPIB commands. The program includes the following steps:

1. Starting the application.
2. Configuration and setting analysis state variables.
3. Starting and checking the state of the acquisition and processing cycle.
4. Check for errors.
5. Query measurement results.
6. Export data.

GPIB Commands

GPIB Reference Materials

To use GPIB commands with your oscilloscope, you can refer to the following materials:

- The GPIB Program Example topic for guidelines to use while designing a GPIB program.
- The online Programmer Guide for the CSA8000 and TDS8000 instruments.

Starting and Setting Up the Application Using GPIB

To start the 80SJNB application, you must send the oscilloscope the following GPIB command:

```
APPlication:ACTivate "80SJNB"
```

The application uses the GPIB VARIABLE:VALUE command with arguments to control execution and return status of the 80SJNB.

Variable:Value Command

The VARIABLE:VALUE command accepts string arguments for a control or data variable and a value to which to set the argument.

Syntax

To set a variable to a value:

```
VARIABLE:VALUE "<Variable Name>","<Variable Value>"
```

NOTE. *The arguments <variable name> and <variable value> are required in the order indicated with no spaces allowed.*

To query the value in a variable:

```
VARIABLE:VALUE? <variable name>
```

CAUTION. *Commands are case and space sensitive. Your program will not operate correctly if you do not follow the capitalization and spacing precisely.*

Variable:Value Command Arguments and Queries 1

Name	Value	Function	Query form returns …
Application	Exit	Exits the application.	Done
SequencerState	{Run|Pause|Stop}	Sets or returns the Measurement Sequencing or the Stop Sequencing command.	Running, Paused, Stopped
SequencerMode	{SingleSequence, FreeRun}	Sets the sequencer mode; startup default is Free Run.	Sequencer mode
DataSource	{CH1|CH2|CH3|CH4|CH5|CH6|CH7|CH8 |MATH1|MATH2|MATH3|MATH4|MATH5|MATH6 |MATH7|MATH8}	Sets or returns the data source. Note: *Math expressions must be programmed through the CSA/TDS8000 Series instrument GPIB interface commands.*	Current value.
ScopeSync		Autosyncs the signal source, data pattern rate, data pattern length, and data:clock ratio to the signal applied to the oscilloscope.	
DecisionThresholdAbs	Any valid floating point value	Sets or returns the absolute decision threshold value.	Current value.
DecisionThresholdPct	Any valid floating point value between 0.0 and 1.0 inclusive.	Sets or returns the normalized decision threshold value.	Current value.

Name	Value	Function	Query form returns …
DecisionThresholdUnits	{Absolute, Normalized}	Sets or returns the desired decision threshold value to use. By setting the units to Absolute, the DecisionThresholdAbs value is used. If the units are set to Normalized, the decision threshold is calculated based on waveform data according to the DecisionThresholdPct normalized value.	Current value.
SamplingPhaseAbs	Any valid floating point value.	Sets or returns the absolute sampling point value.	Current value.
SamplingPhase	Any valid floating point value between 0.0 and 1.0 inclusive.	Sets or returns the normalized sampling point value.	Current value.
SamplingPhaseUnits	{Absolute, Normalized}	Sets or returns the desired sampling point value to use. By setting the units to Absolute, the SamplingPhaseAbs value is used. If the units are set to Normalized, the sampling point is calculated based on waveform data according to the SamplingPhase normalized value.	Current value.
PatternLength	Any positive real integer value.	Sets or returns the data pattern length in bits.	Current value.
DataClockRatio	Accepts a ratio of 1:8 to 1:1 or 1:1 to 128:1.	Sets or returns the data pattern Data:Clock ratio.	Current value.
DataRate	{FC266|FC266E| OC9|FC531|FC531E| OC12|OC18 |FC1063E|FC1063|OC24|ENET1250|OC36|FC2125 |OC48|ENET2500|INFIniband|FEC2666|ENET3125 |XAUINEAR|XAUIFAR|FC4250|ENET9953|OC192 |ENET10313|FC10519|FEC10664|FEC10709|ENET1109 |OC768|FEC42657|FEC43018} Any valid positive floating point value or communication standard.	Sets or returns the expected data rate.	Communication standard or current value.

Variable:Value Command Arguments and Queries 2

Name	Value	Function	Query form returns …
BER	Any valid floating point value between 1e-3 and 1e-24 inclusive.	Sets or returns the current BER value.	Current value.
TimeUnits	{S|UI}	Sets or returns the units for the time scale.	S, UI
PhaseReferenceSource	{C1C2 -or- C1_C2, C3C4 -or- C3_C4, C5C6 -or- C5_C6, C7C8 -or- C7_C8}	Sets or returns the phase reference source module.	Current value.
PhaseReferenceFrequency	Any valid phase reference frequency as defined by the selected phase reference source module.	Sets or returns the phase reference frequency.	Current value.
PatternSyncSource	{CH1|CH2|CH3|CH4| CH5|CH6|CH7|CH8| TRIGPROBE}	Sets or returns the pattern sync source channel.	CH1, CH2, CH3, CH4, CH5, CH6, CH7, CH8
ClockRecoverySource	{CH1|CH2|CH3|CH4| CH5|CH6|CH7|CH8}	Sets or returns the clock recovery source.	Current value.
ClockRecoveryRate	Valid values include any communication standard token for communication standards supported by the clock recovery module or a positive floating point value if the clock recovery unit supports user rates.	Sets or returns the clock recovery rate.	Current value.

Name	Value	Function	Query form returns …
DataReady	{True, False}	Sets or returns a value indicating if sequencing is complete and data is ready to be read. Note: Setting this value to False before beginning a sequence prevents accidentally reading the DataReady value from a previous sequence before it is reset by the application.	True, False
NegativeDataSource	{CH1|CH2|CH3|CH4| CH5|CH6|CH7|CH8}	Sets or returns the negative data source used for differential math waveform.	Current value.

Variable:Value Command Arguments and Queries 3

Name	Value	Function	Query form returns …
SaveFilename	<filename>[1]	Sets the filename used when saving setup files.	
RecallFilename	<filename>[1]	Specifies the name of the file when recalling a setup.	
Setup	Recall|Save|Default	Performs the Save/Recall/Default setup action	DONE, ERROR Error is returned if un-successful.
ExportFormat	{CSV, MAT}	Sets or returns the current plot diagram export format.	Current value.
ExportType	{CORRWFM|RJPDF|PJPDF|RJPJPDF|RJPJSPEC |DDJPDF|DJPDF|DDJSPEC|TJPDF|HBATH|QHBATH |RNPDF|PNPDF|RNPNPDF|RNPNSPEC|DDNPDF |DNPDF|DDNSPEC|TNPDF|VBATH|QVBATH |CORREYE|PDFEYE|BEREYE|QEYE}	Sets or returns the type of export to perform.	Current value.
ExportFilename	<filename>[1]	Sets the filename used when exporting data.	
ExportCurve	{GO}	Sets or returns the export action.	DONE, ERROR Error is returned is export is unsuccessful.
ErrorMessage		Returns the last error message.	Current value.

[1] <filename> is a string of from 1 to 40 characters that are valid for filenames according to Windows file system standards.

Measurements Results Queries

Variable:Value Results Queries

These values, when used with the Variable:Value command, return the results for the individual measurement results.

Value	Function
DJ	Returns the measured Deterministic Jitter.
DDJ	Returns the Data Dependant Jitter.
DCD	Returns the Duty Cycle Distortion.
RJ	Returns the measured Random Jitter (RMS).
RJH	Returns the Horizontal component of random jitter (RMS).
RJV	Returns the Vertical component of random jitter induced by noise converted to jitter through an average slew rate (RMS).
PJ	Returns the measured Periodic Jitter (peak-to-peak).
PJH	Returns the Horizontal component of periodic jitter (peak-to-peak).
PJV	Returns the Vertical component of periodic jitter (peak-to-peak) induced by noise converted to jitter through an average slew rate.
TJ	Returns the Total Jitter at user-specified BER.
EOH	Returns the Horizontal Eye Opening at user specified BER.
RJDD	Returns the Random Jitter computed in the Dual Dirac model.
DJDD	Returns the Deterministic Jitter computed in the Dual Dirac model.
DN	Returns the Measured Deterministic Noise.
DDN	Returns the Data Dependant Noise.
DDN1	Returns the Data Dependant Noise on logical level 1.
DDN0	Returns the Data Dependant Noise on logical level 0.
RN	Returns the measured Random Noise.
RNV	Returns the Vertical component of random noise.
RNH	Returns the Horizontal component of random noise induced by jitter converted to noise through an average slew rate.
PN	Returns the measured Periodic Noise.
PNH	Returns the Horizontal component of periodic noise (peak-to-peak) induced by jitter converted to noise through an average slew rate.
PNV	Returns the Vertical component of periodic noise (peak-to-peak).
TN	Returns the Total Noise at user-specified BER.
EOV	Returns the Eye Opening at user-specified BER.
EA	Returns the amplitude of the eye computed as the mean-to-mean of logical 1 and logical 0 bit levels sampled at the user defined Sampling Phase.

Error Messages

GPIB Commands Error Codes

Error Code	Description
-1	Unknown error code
1	The channel does not support bandwidth
2	Phase characterization failed
3	No data to export
4	Not allowed to change setting while sequencing
5	Invalid value
6	Argument cannot be null
7	Value is outside the range of acceptable values
8	Query curve returned no data
9	Unexpected GPIB response
10	No data source selected
11	One or more WfmDBs are enabled, turn them off to continue
12	Trigger failure, check your configuration
13	The pattern is not synchronized or is too small
14	Can't export the curve
15	Couldn't analyze edge
16	Histogram testing is enabled; turn it off to continue
17	Mask testing is enabled; turn it off to continue
18	One or more measurements are enabled; turn them off to continue
19	Waveforms other than 80SJNB signal source are enabled; turn them off to continue
20	Save setup failed
21	Recall setup failed

GPIB Program Example

The following sequence of commands demonstrates the GPIB commands used to configure and operate the 80SJNB jitter analysis application. All commands are sent to the instrument which hosts the programmable interface for the 80SJNB.

NOTE. *All words within quotes are case sensitive and must be entered exactly as shown, including spaces and quotes.*

1. Send the command to start the 80SJNB application.

   ```
   APPLICATION:ACTIVATE "80SJNB"
   ```

2. Set the signal source channel, data rate, pattern length, and data-to-clock ratio to be analyzed.

   ```
   VARIABLE:VALUE "DataSource","C1"

   VARIABLE:VALUE "DataRate","10.3125e9"

   VARIABLE:VALUE "PatternLength","32767"

   VARIABLE:VALUE "DataClockRatio","1:1"
   ```

3. Set the following variables before starting the analysis. The application updates these values to signal the application's analysis state.

   ```
   VARIABLE:VALUE "DataReady","False"

   VARIABLE:VALUE "ErrorCode",""
   ```

4. Start the acquisition and processing cycle.

   ```
   VARIABLE:VALUE "SequencerState","Run"
   ```

5. Check the state of the acquisition and processing cycle.

   Query the following variable:

   ```
   VARIABLE:VALUE? "DataReady"
   ```

   When the application has finished acquiring and processing the data, it will set the DataReady value to True.

   Check the SequencerState variable to check for errors.

   ```
   VARIABLE:VALUE? "SequencerState"
   ```

   If there is an error, the DataReady variable will not be set to True but the sequencer state will be set to Stop.

Loop on querying these values (with a time delay so the instrument is not overloaded handling programmable interface queries) until one of them changes.

***NOTE**. If the SequencerState variable is set to stop and DataReady is not true, this likely indicates an error.*

6. Check the ErrorCode variable to see if an error has been reported

   ```
   VARIABLE:VALUE? "ErrorCode"
   ```

   If the ErrorCode value has a numeric value greater than 0, query the ErrorMessage variable to get the corresponding error message:

   ```
   VARIABLE:VALUE? "ErrorMessage"
   ```

7. If the DataReady variable is set to True (queried in step 3), you can query for measurement results. For example to query the deterministic jitter:

   ```
   VARIABLE:VALUE? "DJ"
   ```

8. You can also export the plot data. The following commands set the format, data to export, filename, and then exports the data.

   ```
   VARIABLE:VALUE "ExportFormat","CSV"

   VARIABLE:VALUE "ExportType","DJPDF"

   VARIABLE:VALUE "ExportFilename","C:\My Documents\MyDJPDF.csv"

   VARIABLE:VALUE "ExportCurve","GO"
   ```

9. Query the ExportCurve variable to determine when the data export has completed:

   ```
   VARIABLE:VALUE? "ExportCurve"
   ```

   The application will set the ExportCurve value to `"Done"` when the data has been exported.

Application Example

About Application Example

This simplified application example gives you a sample on how to setup and use the application. This may help you when setting up your own test situation.

Requirements:

- TDS/CSA8000B or TDS/CSA8200 series oscilloscope
- 80SJNB Jitter Analysis software
- 80A06 PatternSync Trigger Module
- Optical module with clock recovery
- SMA cables

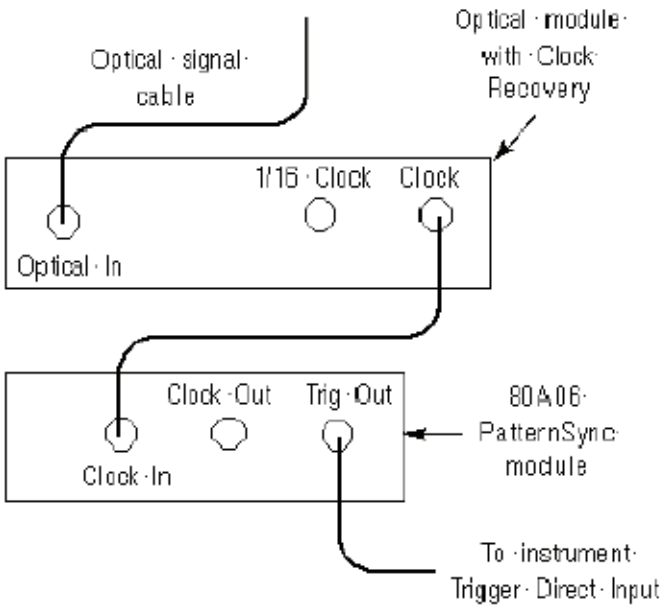
***NOTE**. If your oscilloscope setup includes a second monitor, you can select and drag the title bar of the online help window to position it in the second monitor. This allows you to display these application examples in the second monitor, and still view the waveform (or a plot) and the 80SJNB measurement results on the oscilloscope.*

Example

Setup the Oscilloscope

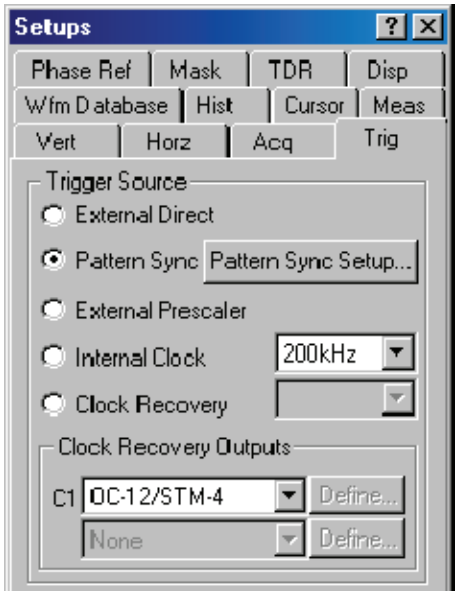
This quick demo demonstrates the TDS/CSA8000 80SJNB Jitter Noise BER application on an *Optical* signal for fast analysis of BER, Jitter, and Noise.

1. Install the modules and make the signal connections.



2. Turn on the instrument. After startup, perform the following setup steps:
   a. Press the **Default Setup** button on the instrument.
   b. Select **CH1** on the instrument.
   c. Press the **SETUP DIALOGS** button on the instrument.
   d. Set the Horizontal scale to 5 ns.
   e. In the Setups dialog box, select the **Trig** tab.
   f. Select Pattern Sync as the trigger source

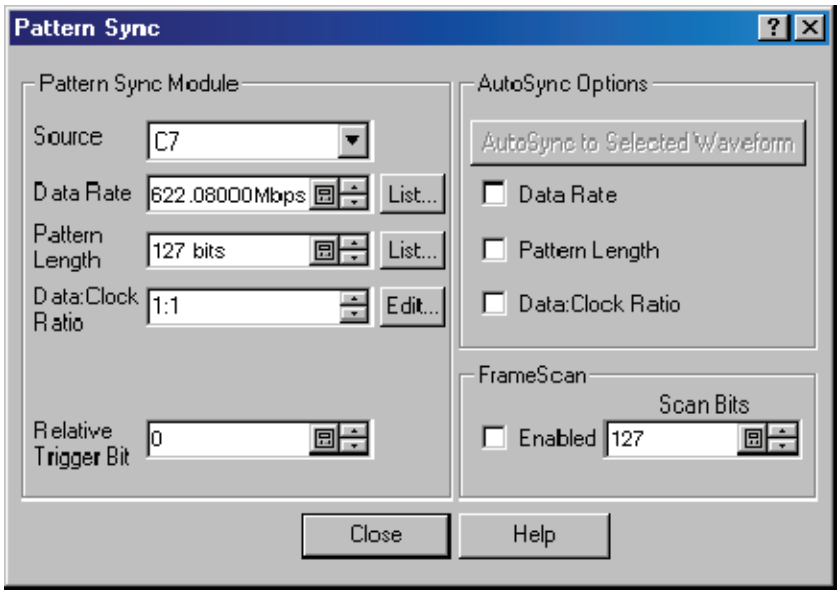
g. Press the **Pattern Sync Setup….** button.



3. Enter the Data Rate and Pattern Length.

a. Set the Data Rate to 622.08 Mbps.

b. Set the Pattern Length to 127 bits.



c. Close the dialog box.

You should now have a stable signal display. If not, the 80SJNB application may fail to acquire data. Recheck all settings, signal source, and connections.

Setup the 80SJNB Application

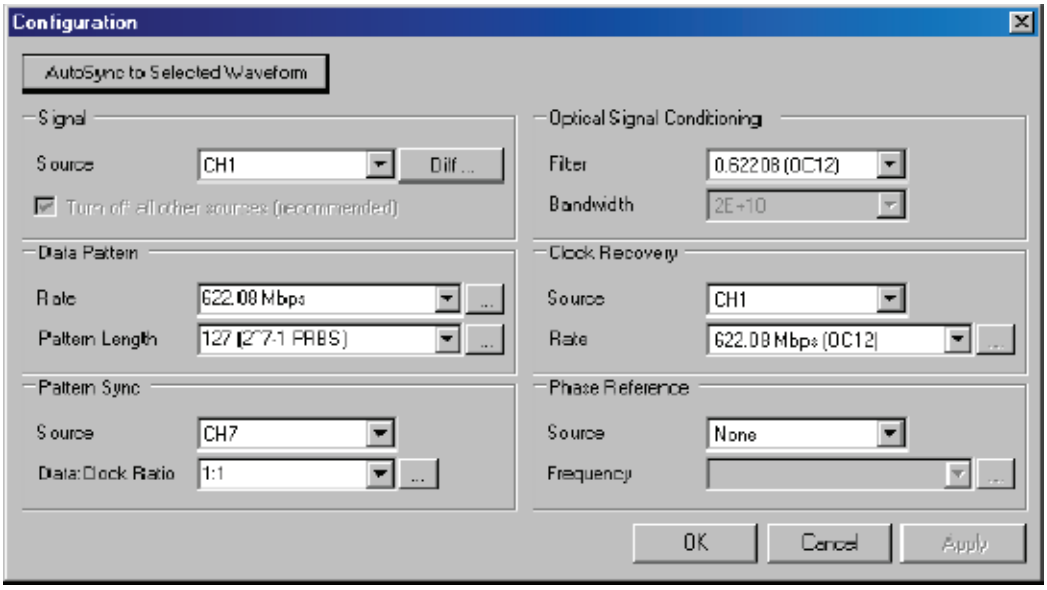
1. Start the 80SJNB application. With the oscilloscope application displayed, use the Applications menu on the toolbar bar and select the 80SJNB application.

   You can also use the Windows desktop shortcut or the Windows Start menu by selecting Start > Programs > Tektronix TDSCSA8000 > 80SJNB > 80SJNB.

2. Wait for the 80SJNB application to finish loading.
3. Display the configuration dialog box by pressing  .
4. Most of the configuration settings will most likely be filled at this time since it read the oscilloscope configuration. If not, you can press the **AutoSync to Selected Waveform** button to sync the Source, Data Pattern, and Pattern Sync settings to the oscilloscope.

   Since this is an optical signal and we're using the clock recovery signal, you'll need to select the optical signal filter and select the clock recovery settings.

   The setup we're using doesn't include a Phase Reference module so set this to None.

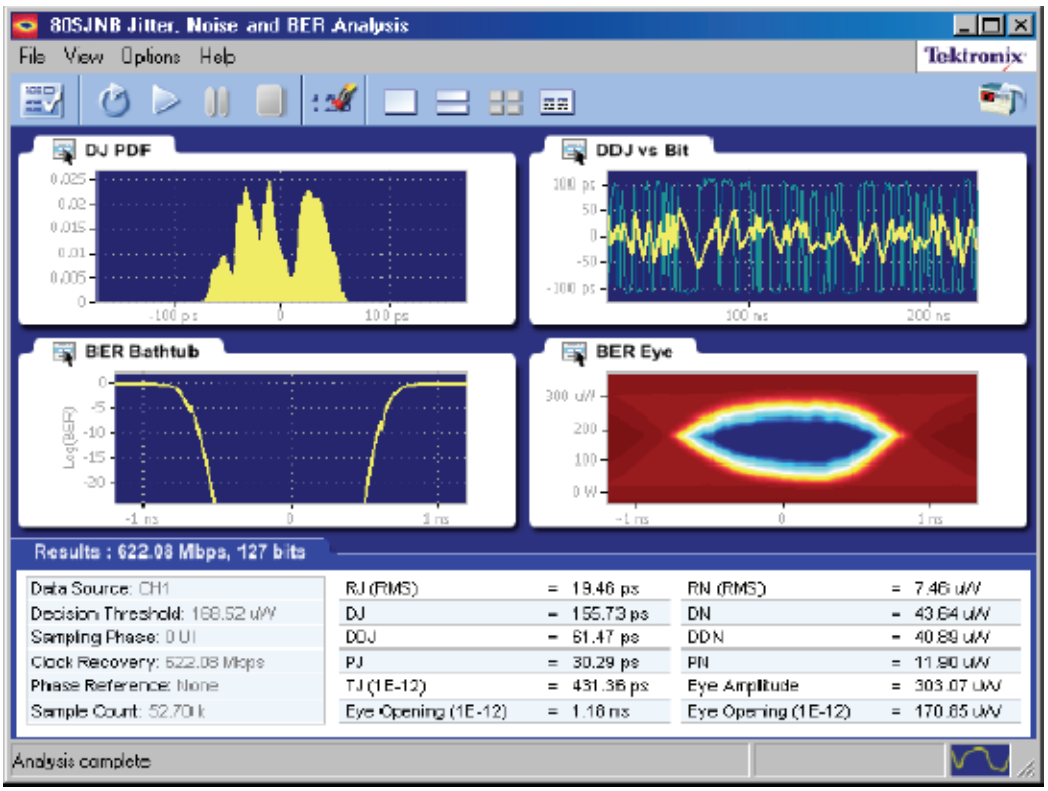


Close the dialog box.

5. Press  to start the acquisition and processing cycle.

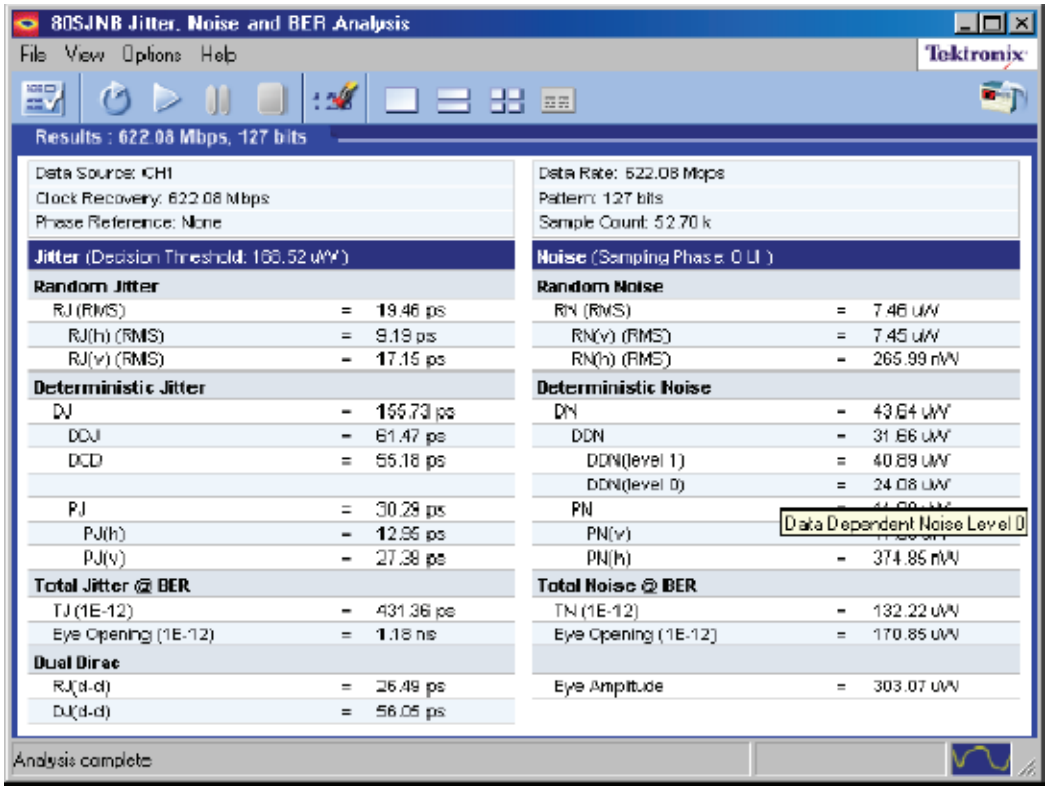
   While the cycle is running, you'll see the sequence of events displayed at the bottom of the application display. When the cycle is complete, the message "Analysis Complete" is displayed.

6. Once the cycle is complete, you'll see the displayed results. The example below shows a four plot display with the summary table of the numerical results.



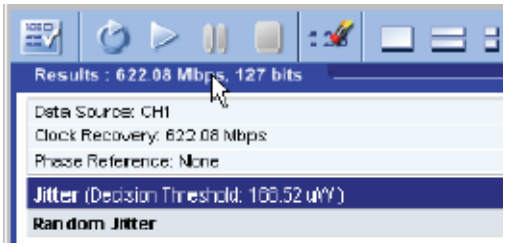
Working with the Results

1. Press  to remove the plot displays and show the detailed table of results.

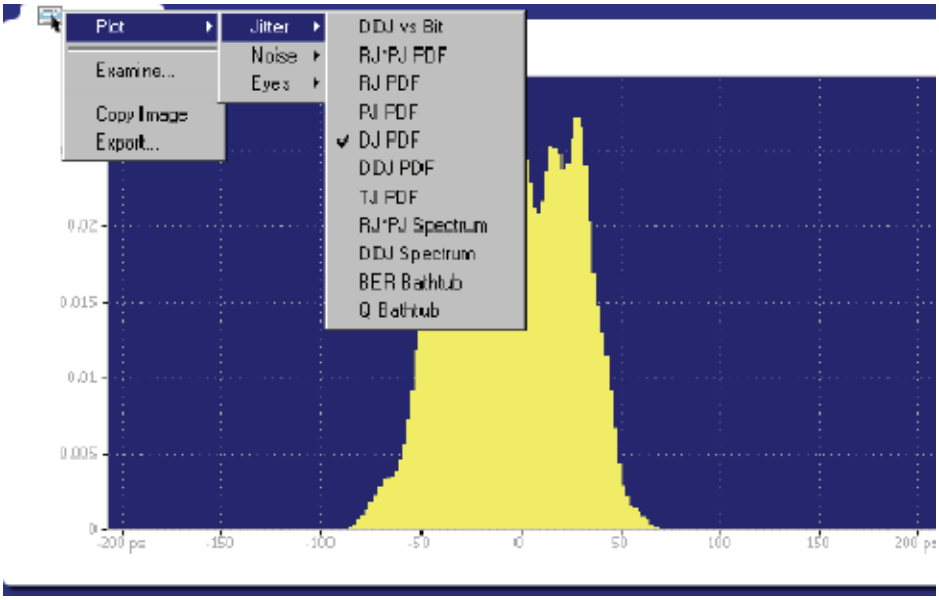


2. Redisplay the plot (or plots) by selecting one of the plot display buttons  .

   You can click on the Results tab to minimize the detailed list to summary list.



3. With the plots now redisplayed, click on one of the  icons to display the drop-down menu. The menu provides several functions, one of which is to select a different type of plot to display in that window.



You can select any plot type. The plot will be displayed based on the data based on the results of the last processing cycle.

4. To further examine a plot, you can display any plot in a MatLab window, providing you with more tools to work with the data. Use the

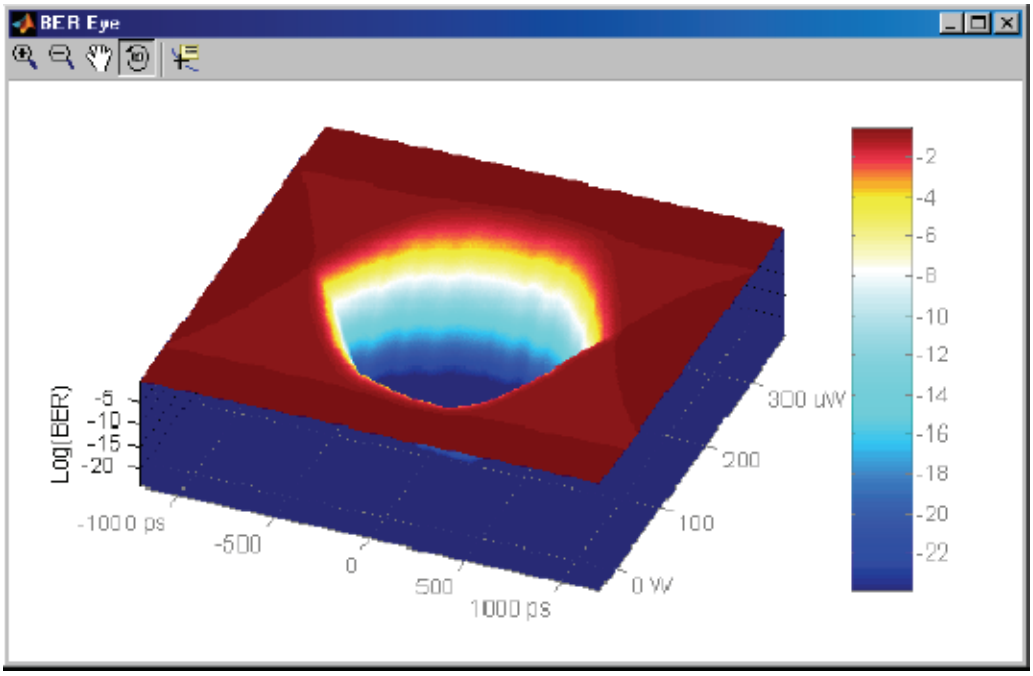
5.  icon and choose **Examine**…

   The plot opens in the new window to provide further data analysis and visualization of the plot displays.

   Matlab provides multiple capabilities to display and annotate the plot diagrams, including:

   - Pan and Zoom
   - 2D and 3D visualization
   - Rotation
   - Data Cursors
   - Color enhancements

   Here, the BER Eye plot was selected to examine in a 3D view by using the rotate function.



Close the window, returning to the 80SJNB display.

This is the end of the example. You can continue on by acquiring new data, displaying various types of plots, and examine the plots with the various tools available.

Algorithms

About Measurement Algorithms

Tektronix has developed a white paper detailing the algorithms used by the 80SJNB application to make the measurements.

Go to the Tektronix web site to view the white papers.

www.tektronix.com

At the Tektronix home page, select oscilloscopes > sampling

Test Methodology

The application performs the measurement according to the following steps:

1. Configures the oscilloscope and jitter application according to the Configuration settings and User settings.
2. Performs an Autoset.
3. Scans part of the pattern.
4. Analyzes the edge.
5. Acquires the jitter data.
6. Acquires the noise data.
7. Scans the full pattern.
8. Analyzes the acquired data.
9. Displays the results as statistics. You can also log the results or data points to a .csv file.
10. Displays the plots if selected.

Correlations

Correlation to Real-Time Oscilloscope Jitter Measurements

The 80SJNB Advanced Jitter, Noise, and BER Analysis application is designed to make measurements in companion with the CSA8000 and TDS8000 Series Sampling Oscilloscopes.

The methodology to make these measurements on a sampling oscilloscope is quite different than the methodology to make similar measurements on a real-time oscilloscope.

Tektronix has developed a white paper that provides a correlation of measurements between the 80SJNB application and the TDSJIT3 application.

Go to the Tektronix web site to view the white papers.

www.tektronix.com

At the Tektronix home page, select oscilloscopes > sampling

You can download a pdf of the white paper titled:

80SJNB Jitter Measurement Results Correlation

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