

80SJNB
Jitter, Noise, BER, and Serial Data Link Analysis (SDLA)
Software

Printable Application Help



077-0641-02

Tektronix

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Jitter, Noise, BER, and Serial Data Link Analysis (SDLA)
Software

Printable Application Help

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This document supports 80SJNB software version 3.3.X and greater for the DSA8300 only.

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

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Welcome to the 80SJNB jitter, noise, BER, and serial data link analysis software

The 80SJNB analysis software enhances the capabilities of the DSA8300 Digital Serial Analyzer. Two versions are available: 80SJNB Essentials and 80SJNB Advanced.

80SJNB Essentials provides the following features:

- Perform advanced jitter and noise analysis (RJ, DDJ, PJ, DCD, TJ@BER, and RN, DDN(high) and DDN(low), TN@BER, vertical and horizontal eye opening at BER)
- Perform mask testing on PDF eyes and BER contours
- Acquire complete pattern waveform at 100 Samples/UI
- Perform random and deterministic jitter analysis including BER estimation
- Isolate and measure crosstalk in form of bounded uncorrelated jitter (BUJ)
- Display results graphically including histograms, spectra, and bathtub curves
- Display 2-D eye diagrams (correlated eye, probability density function (PDF) eye, and bit error rate (BER) eye)
- Save complete acquisition results to a data file
- Analyze jitter, noise, and BER in the presence of spread spectrum clocking (SSC)

80SJNB Advanced adds:

- Signal path emulation, allowing you to emulate the environment your signal encounters from the transmitter to the receiver. Feature include:
 - Supports FFE and DFE equalization
 - Allows user-defined arbitrary filters (use for de-embedding and other applications)
 - Supports channel emulation (TDR/TDT and S-parameter based channel descriptions)
 - Other features commonly known as SDLA (Serial Data Link Analysis)

What do you want to do?

[Read the product description \(see page 7\).](#)

[Go to Operating Basics \(see page 13\).](#)

Related documentation

The following links contain other information on how to operate the oscilloscope and applications:

- [Relevant Web Sites \(see page 3\)](#)
- [GPIB Information \(see page 3\)](#)
- [Types of Online Help Information \(see page 4\)](#)

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 [80SJNB remote control functions \(see page 85\)](#)

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 site
- Information on fixture de-embedding, channel emulation, equalization, pre-emphasis, and de-emphasis on the www.tektronix.com/sdla Web site

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” or “TekScope” 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.
- 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 application 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 Analysis and Configuration default settings.
- Application Examples topics show 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.

See also:

[Using Online Help \(see page 5\)](#)

Application help use

Application 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:

- Contents 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.
- Search tab - enables you to search the entire help contents for keywords. Select the topic of interest to display the corresponding help page. Search results do not include text contained within illustrations or screen shots.

NOTE. Blue-underlined text indicates a hyperlink to another topic. For example, select the blue text to jump to the topic on [Feedback to Tektronix. \(see page 6\)](#)

TIP. When you use a mouse, the normal cursor changes to a link cursor when over an active hyperlink.

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. Send your feedback to techsupport@tektronix.

Please be as specific as possible and include the following information:

General information

- Oscilloscope model number, firmware version number, and hardware/software options, if any.
- Module and probe configuration. Include model numbers and the channel/slot location.
- Serial data standard.
- Signaling rate.
- Pattern type and length.
- 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 80SJNB data to a .mat file (**File > Save Data**).
- If possible, save the 80SJNB and oscilloscope settings to a .stp file (**File > Save Settings**).

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

Product description

The 80SJNB software application enhances the capabilities of the DSA8300 Digital Serial Analyzer by providing Jitter, Noise, and BER analysis (Essentials) and features for de-embedding the fixture, channel emulation, and FFE/DFE equalizer support (Advanced).

You can use this application to do the following tasks:

- Jitter and noise analysis from DC to 400 Gb/s and beyond
- Jitter and noise separation (see the [Importance of Jitter and Noise Separation \(see page 9\)](#))
- Perform random and deterministic jitter and noise analysis, and TJ@BER, TN@BER and BER estimation
- Isolate jitter and noise due to crosstalk, and make random and deterministic estimations in the presence of crosstalk
- Show results as numeric and graphical displays
- Display 2-D eye diagrams (Correlated Eye, Probability Density Function (PDF) Eye, and Bit Error Rate (BER) Eye)
- Perform mask testing on PDF eyes and BER contours
- Support for FFE and DFE equalization
- Allow user-defined linear arbitrary filters
- Support for Channel Emulation (from TDR/TDT and S-parameter based channel descriptions)
- Analyze jitter, noise, and BER in the presence of Spread Spectrum Clocking (SSC)
- Save results to a data file
- Save and recall instrument setups

See also:

[Review Requirements and Restrictions \(see page 7\)](#)

Requirements and restrictions

Operating system. Microsoft Windows 7 Ultimate (32 bit) operating system operating on the DSA8300 Digital Serial Analyzer oscilloscope.

ADVTRIG option. 80SJNB requires the Advanced Trigger option (ADVTRIG). Contact Tektronix about purchasing this option.

82A04 Phase Reference module. For acquisition in the presence of Spread Spectrum Clocking (SSC), this application requires that the sampling oscilloscope be equipped with a Tektronix 82A04 Phase Reference module. The 82A04 also lowers the jitter floor to 200 fs. Contact Tektronix about purchasing the module for your sampling oscilloscope.

Keyboard and mouse. You must use a keyboard to enter names for some save and export operations. A mouse is not required but simplifies screen selections.

Accessories

There are no standard accessories for this product. Refer to the product data sheet available on the Tektronix Web site for information on optional accessories relevant to your application.

A second monitor connected to the TekScope is recommended for simultaneous viewing of the oscilloscope screen and the 80SJNB application screen.

Refer to [Requirements and Restrictions \(see page 7\)](#) for additional items required to use the 80SJNB application.

Connecting to a device under test (DUT)

You can use any compatible probe or cable interface to connect 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.

See also:

[Deskewing Probes and Channels \(see page 9\)](#)

[An Application Example \(see page 71\)](#)

Deskewing probes and channels

To be sure of 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 TekScope application, not from the 80SJNB application. Refer to the DSA8300 Quick Start User Manual and the DSA8300 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.

Go to www.tek.com/jitter for additional jitter and timing analysis information.

Jitter and noise separation methods



Bit error rates (BER) of a serial data stream are impacted by both jitter and noise. An accurate decomposition of jitter and noise in the sources of impairments is critical to correctly estimate the signal path behavior at larger BER. The jitter and noise maps are critical to help debugging the devices under test.

Since jitter and noise analysis follows a similar path, this discussion covers just the jitter decomposition.

The basic separation of jitter in data-dependent and uncorrelated elements is accomplished by two targeted acquisition steps:

- **Correlated Acquisition Step:** the application filters a high resolution acquisition of the full pattern to eliminate the uncorrelated elements. The analysis of the filtered pattern yields the data dependent characteristics, such as Data Dependent Jitter (DDJ) and Duty Cycle Distortion (DCD).
- **Uncorrelated Acquisition Step:** the uncorrelated elements of jitter are isolated by acquiring on well defined single spots in the pattern, thus eliminating the dependency on the pattern itself. The data acquired in the uncorrelated acquisition step is then further analyzed to isolate random unbounded components from the bounded deterministic components. This extended analysis is critical to help predict long term behavior of the DUT.

Historically only spectral separation was used for separation (available still as the **Spectral (Legacy)** analysis method). This method improperly qualifies certain complex bounded uncorrelated components as unbounded, which inflates the random jitter (RJ) measurement result.

Spectral separation with isolation of bounded uncorrelated jitter (**Spectral + BUJ**) works by also analyzing the cumulative distribution function (CDF) of the uncorrelated non periodic jitter data. In the spectral separation of Periodic Jitter from the Random Jitter, the distinct spectral lines are removed from the frequency domain representation of the global uncorrelated jitter data to quantify the periodic jitter components, PJ. In the legacy method, the spectral method evaluated the remaining spectral data as Random Jitter (RJ).

The presence of complex bounded uncorrelated impairments (for example, originating from crosstalk) requires significant additional steps to isolate the bounded, uncorrelated jitter (BUJ) from the periodic jitter (PJ), nonperiodic jitter (NPJ), and random jitter (RJ) components.

The CDF analysis is performed in two steps: before and after the spectral separation that identifies the periodic spectral components. The first analysis step yields the total bounded uncorrelated jitter, while the second analysis step yields the nonperiodic elements, and finally the random jitter components.

A parallel analysis track develops the noise map, and a combination of the two analysis tracks characterizes the behavior of the link in terms of bit error rate (BER).

About operating basics

These topics cover the following tasks:

- [Navigating the user interface \(see page 23\)](#)
- [User interface information \(see page 21\)](#)
- [Using oscilloscope functions \(see page 20\)](#)
- [Setting up the application \(see page 27\)](#)
- [Viewing the measurement results as plots \(see page 21\)](#)
- [Exporting Plot Files \(see page 61\)](#)
- [Saving \(see page 57\)](#) and [recalling \(see page 57\)](#) setup files
- [Saving \(see page 58\)](#) and [recalling \(see page 58\)](#) data files

What do you want to do?

- [Start the 80SJNB Application \(see page 13\)](#)

See also:

[File Name Extensions \(see page 17\)](#)

[File Menus \(see page 18\)](#)

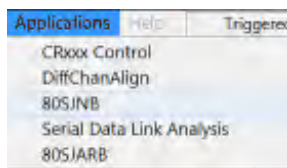
Starting the 80SJNB application

There are several ways to start the 80SJNB application.

- If the TekScope application is minimized, double-click the 80SJNB application icon on the Windows desktop to start the 80SJNB application.



- If the TekScope application is running and open, select **Applications > 80SJNB**.



- In Windows, select **Start > All Programs > Tektronix Applications > 80SJNB > 80SJNB**.

TIP. With a second monitor connected to the TekScope, you can move the 80SJNB application display to the second monitor, allowing you to view both screens at the same time.

See also:

[Returning to the 80SJNB Application \(see page 15\)](#)

[Returning to the Oscilloscope Application \(see page 14\)](#)

Returning to the oscilloscope application

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

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

See also:

[Minimizing and Maximizing the Application \(see page 15\)](#)

[Exiting the Application \(see page 16\)](#)

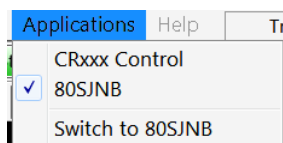
Returning to the 80SJNB application

The TekScope application fills the entire screen. If the 80SJNB application is already running but the TekScope application is displayed on top, bring the 80SJNB application to the front using one of the following methods.

- Click the **App** button on the TekScope toolbar.




- Select **Applications > Switch to 80SJNB**.



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

Minimizing and maximizing the application window

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, 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.

Software and file installation directory

The 80SJNB software is installed in the following directory:

C:\Program Files\TekApplications\80SJNB

Save and recall directory

The directory structure for saving and recalling setup and data files and exporting data is:

C:\Users\<user name>\Documents

The default user name is:

Tek_Local_Admin

Standard masks are installed at:

C:\Users\Public\Documents\Tektronix\Masks

See also:

[File Name Extensions \(see page 17\)](#)

File name extensions

| Extension | Description |
|-----------|---|
| .bmp | File that uses a bitmap format |
| .csv | File that uses a comma separated value format |
| .flt | 80SJNB application filter file |
| .jpg | File that uses a joint photographic experts group format |
| .mat | File that uses native MATLAB binary format to store data acquired by 80SJNB |
| .msk | Tektronix mask file (Mask file structure (see page 80)) |
| .png | File that uses a portable network graphics format |
| .s1p | Files that define 1-port, 2-port, and 4-port frequency domain S-parameters |
| .s2p | |
| .s4p | |
| .stp | 80SJNB application setup file |
| .tap | 80SJNB application equalization tap file |
| .txt | File that uses an ASCII format |
| .wfm | File that defines time domain waveforms or a frequency domain 1-port S-parameter (created by IConnect) for channel emulation 80SJNB accepts both DSA8300 and IConnect .wfm files |

File menu

The File menu lets you save and recall application setups, data files, and recently accessed files.



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

| Menu item | Description |
|-----------------|---|
| 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 |
| Save Data | Saves the current acquired data in a .mat file for later analysis Saving is disabled if there is no acquired data to save or an acquisition is now in process |
| Recall Data | Recall a saved data file for analysis All plots and results are based on the recalled data Recalling is disabled if an acquisition is now in process |
| Export Results | Exports jitter and noise analysis results to a csv format user specified file. Signal attributes and analysis configuration parameters are added to the report to qualify the measurement results. |
| Export Waveform | Acquired exports the raw acquired pattern before processing of the data Correlated exports the acquired waveform after filtering out the uncorrelated components |
| Print | Prints the displayed plots and the detailed statistics list |
| Print to File | Creates a file of the displayed plots and a detailed statistics list |
| Exit | Exits the application |

See also:

[About the 80SJNB Tool Bar \(see page 24\)](#)

[Saving a Setup File \(see page 57\)](#)

[Recalling a Saved Setup File \(see page 57\)](#)

[Saving a Data File \(see page 58\)](#)

[Recalling a Saved Data File \(see page 58\)](#)

[About Exporting Plot Files \(see page 61\)](#)

View menu

The View menu lets you configure the display of plots and/or numerical data.

| Menu item | Description |
|----------------------|---|
| 1-up | Displays a single plot on the screen |
| 2-up | Displays two plots on the screen |
| 4-up | Displays the maximum of four plots on the screen |
| Plots Only | Hides all numeric data, expands the displayed plot(s) to fill the screen |
| Numeric Summary | Displays the plots and a summary of the analysis results |
| Full Numeric Results | Displays the plots and the full results table (JNB or Mask) |
| JNB Results Tab | Displays the JNB Results tab, which contains the JNB results table |
| Mask Results Tab | Displays the Mask Results tab, which contains the Mask test results table |

See also:

[About the 80SJNB Tool Bar \(see page 24\)](#)

Setup menus


The Setup menus provide access to the various configuration menus.

| Menu item | Description |
|---------------|--|
| Acquisition | Displays the Acquisition setup dialog screen to select and configure the source for measurements and control key oscilloscope setups |
| Signal Path | Displays the Signal Path dialog screen to define the signal path characteristics to simulate the actual conditions your signal may encounter |
| Analysis | Displays the Analysis dialog screen to change settings that affect how measurements are made and displayed |
| Mask Test | Displays the Mask Test Setup dialog screen to load a mask and define the mask test parameters |
| Default Setup | Returns the Acquisition, Signal Path, and Analysis settings to their default values See About Application Parameters (see page 77) to view the default settings for each configuration menu |

[About the 80SJNB Tool Bar \(see page 24\)](#)

Oscilloscope settings

All relevant oscilloscope settings are accessible using the Acquisition dialog box of the 80SJNB application.

To bring the TekScope application to the front of the display, click 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.

See also:

[About Configuring the Application for Analysis \(see page 27\)](#)

[Returning to the Application \(see page 14\)](#)

[Minimizing and Maximizing the Application \(see page 15\)](#)

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.

There are two results tables: one for the jitter, noise and BER analysis results, and one for the mask testing results.

See also:


[Working with Results \(see page 69\)](#)

[Clearing Results \(see page 21\)](#)

[Exporting Plot Files \(see page 61\)](#)

[Exporting Results from the File Menu \(see page 18\)](#)

Clearing results

Click 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.*

About plotting

The application displays the results as 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.

See also:

[Working with Plots \(see page 59\)](#)

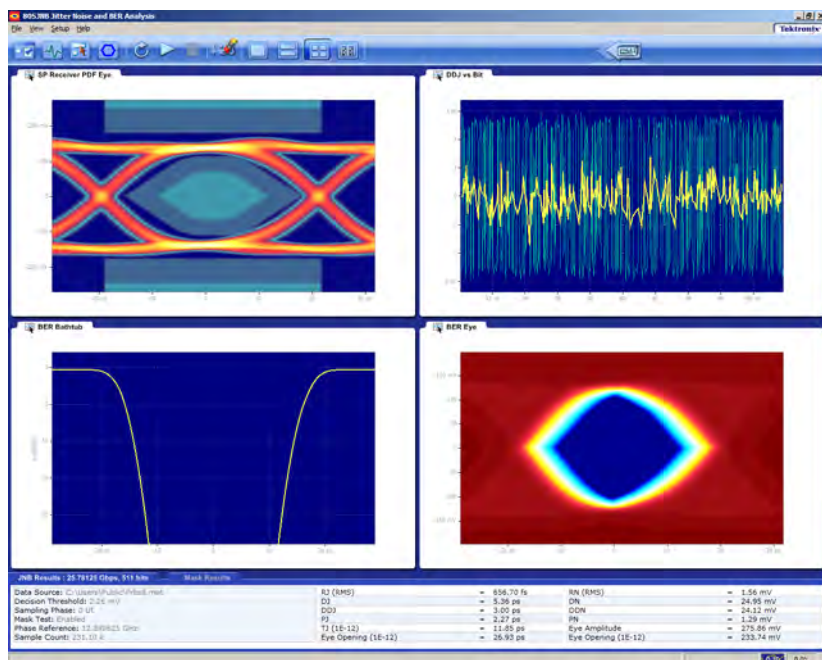
[Plot Type Definitions \(see page 59\)](#)

[About Working with Results \(see page 69\)](#)

About the user interface

The application uses a Microsoft Windows-based user interface.

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



See also:

[Starting the Application \(see page 13\)](#)

[Minimizing and Maximizing the Application \(see page 15\)](#)

[Exiting the Application \(see page 16\)](#)

[Definitions of the application user interface items \(see page 22\)](#)

User interface items definitions

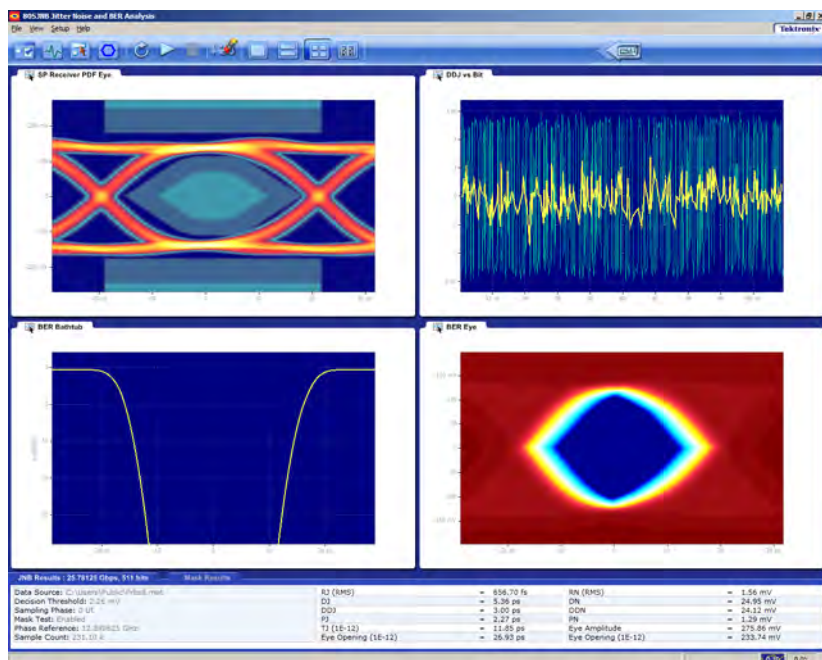
| Item | Description |
|----------------|---|
| Area | Visual frame that encloses a set of related options |
| Box | Use to define an option; enter a value with the Keypad or a Multipurpose knob |
| Browse | Displays a window where you can look through a list of directories and files |
| Check box | 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 |

| Item | Description |
|------------------|---|
| 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 |
| 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 |

About navigation

The application provides you with several ways 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, and 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.



See also:

[Windows User Interface \(see page 21\)](#)



[About the 80SJNB Toolbar \(see page 24\)](#)

[About Configuring the Application for Analysis \(see page 27\)](#)




About the 80SJNB tool bar

The toolbar provides quick access to the most common 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.




-  **Acquisition** button. Use the Acquisition button to select and configure the source for measurements and control key oscilloscope setups. Any change in the Acquisition settings clears all the data. The Acquisition button is disabled during the acquisition and processing cycle.
-  **Signal Path** button. Use the Signal Path button to define the signal path characteristics to simulate the actual conditions your signal may encounter. Changes made in the signal path settings

does not clear the data, only the results. The Signal Path button is disabled during the acquisition and processing cycle.

-  **Analysis Setup** button. Use the Analysis Setup button to change settings that affect how measurements are made and displayed. Changes made in the analysis settings does not clear the data, only the results. The Analysis Setup button is disabled during the acquisition and processing cycle.
-  **Mask test** button. Use the Mask Test button to select a mask and configure the mask test.
-  **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 green  indicating that the acquisition and processing cycle repeats until stopped. 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.


Free Run mode is recommended when:


There is a doubt that one acquisition cycle is enough. A change in the results indicate that additional acquisition cycles was needed.





The correlated waveform shows irregular disturbances. It is possible that uncorrelated information can leak into the single-pass correlated filtering. Acquiring a larger statistical sample improves analysis in the presence of crosstalk.

To halt a Free Run cleanly, deselect the  button. This converts the Free Run mode back 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 Signal Path, Analysis, Acquisition, and Run buttons are disabled.

During the acquisition and processing cycle, the Run button is replaced with the Pause button . Click Pause to interrupt the current acquisition and processing cycle. Click the button again to resume the cycle. This is 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 click 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** buttons. Use the window pane buttons to display between 1, 2, or 4 plots. You can change the number of plot displays at any time.
-  **Numeric Results Display** button. The results button changes the display to a complete list of statistics. If the application is displayed on a larger screen, the numeric results display shows all the results at once.
-  **Back to Scope** button. Use this button to bring the TekScope display to the front of the screen.

See also:

[About Configuring the Application for Analysis \(see page 27\)](#)

[About Analysis Settings \(see page 48\)](#)

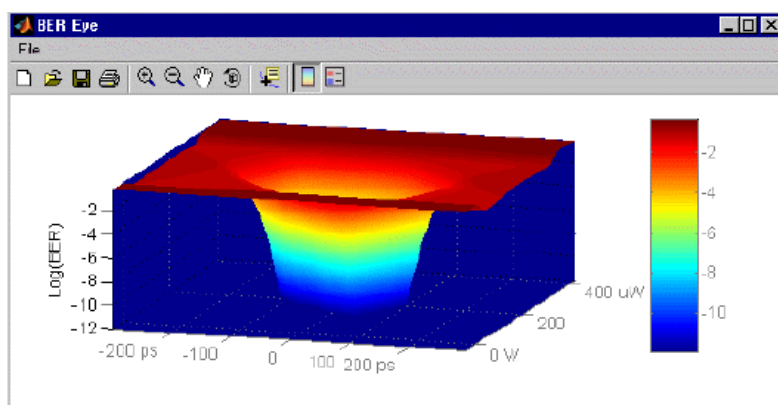
MATLAB user interface

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 Web site: <http://www.mathworks.com>




About configuring the application for analysis

The tool bar provides an [Acquisition \(see page 28\)](#) button  to configure the application to acquire data, a [Signal Path \(see page 38\)](#) button  to set signal path conditions, an [Analysis \(see page 48\)](#) button  to change settings that affect how measurements are made and displayed, and a [Mask test \(see page 80\)](#) button  to set the mask test parameters.

NOTE. The Acquisition settings must be set before starting an acquisition cycle. You can modify the Signal Path and Analysis settings without the need to reacquire data. You can also change the Mask Test without the need to reacquire data.

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 \(see page 69\)](#) statistics or [graphically \(see page 21\)](#).

A typical scenario to setup the 80SJNB application and acquire data involves the following steps:

1. Set the Source, Data Rate, and Pattern Length.
2. Select a Stop on Condition.
3. Set the required Count.
4. From the tool bar, select Free Run mode.
5. Issue a Run command.
6. Wait until the 80SJNB application finishes running and then stops.

See also:

[About Acquiring Data \(see page 28\)](#)

About acquiring data

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

Use the Acquisition button  to display the Acquisition dialog box.

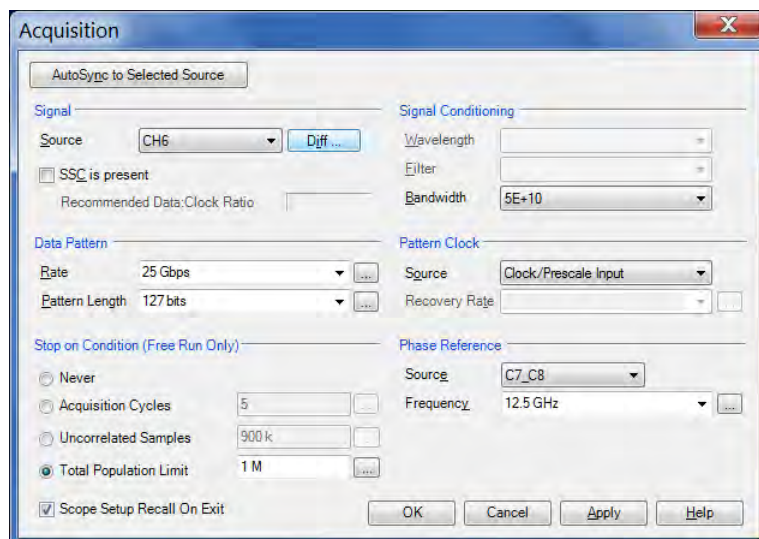
In the Acquisition dialog box, select the signal source and define the acquisition parameters. Some parameters (such as the Clock Recovery, Phase Reference Sources, and the optical signal conditioning) are copied from the oscilloscope state.

Click the AutoSync to Selected Source 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
- Recommended Data:Clock Ratio (when Spread Spectrum Clocking (SSC) signaling is used)

NOTE. Acquisition in the presence of SSC requires certain cabling propagation delays to be preserved. Please contact Tektronix for an up-to-date diagram of cabling lengths.

NOTE. Tektronix recommends running this functionality in the oscilloscope (the equivalent menu exists in Setup > Mode/Trigger > Pattern Sync/FrameScan Setup). The important difference is that the oscilloscope UI/PI allows manual entry of some of the parameters of the AutoSync, which dramatically improves the success rate of AutoSync. For example, manually entering the Data Pattern Length, and then unchecking the pattern length item from the AutoSync search, makes the data pattern length much more likely to succeed. Refer to the DSA8300 TekScope application online help for details about the Pattern Sync settings.



See also:

[Selecting a Stop on Condition \(see page 30\)](#)

[Selecting Scope Setup Recall On Exit \(see page 31\)](#)

[Selecting Clock Recovery \(see page 32\)](#)

[Selecting Phase Reference \(see page 33\)](#)

[Selecting the Data Pattern \(see page 34\)](#)

[Selecting the Signal Conditioning \(see page 34\)](#)


[Selecting the Pattern Clock \(see page 35\)](#)

[Selecting the Source \(see page 35\)](#)

[Analysis Settings \(see page 48\)](#)

Selecting a Stop on Condition

The Stop on Condition selections allow you to control the amount of data to be acquired and processed before stopping.

NOTE. *The Free Run mode has to be selected for the Stop on Conditions to be active. Use the Sequence button  to select the continuous acquisition and processing mode.*

There are four options to control the stop condition:

Never. This is the default condition. The acquisition and processing of data runs continuously until explicitly stopped by user by clicking on the Stop button.

Acquisition cycles. Acquisition Cycles instructs the 80SJNB application to continue acquiring and processing data until the defined number of cycles have completed. Note that changing the number of Acquisition Cycles coerces the numbers associated with the other two options. Each acquisition cycle includes a number of uncorrelated samples, selected by design, and a number of samples correlated with the data pattern, which depends on the pattern length and the number of samples per data bit – which is also selected by design.

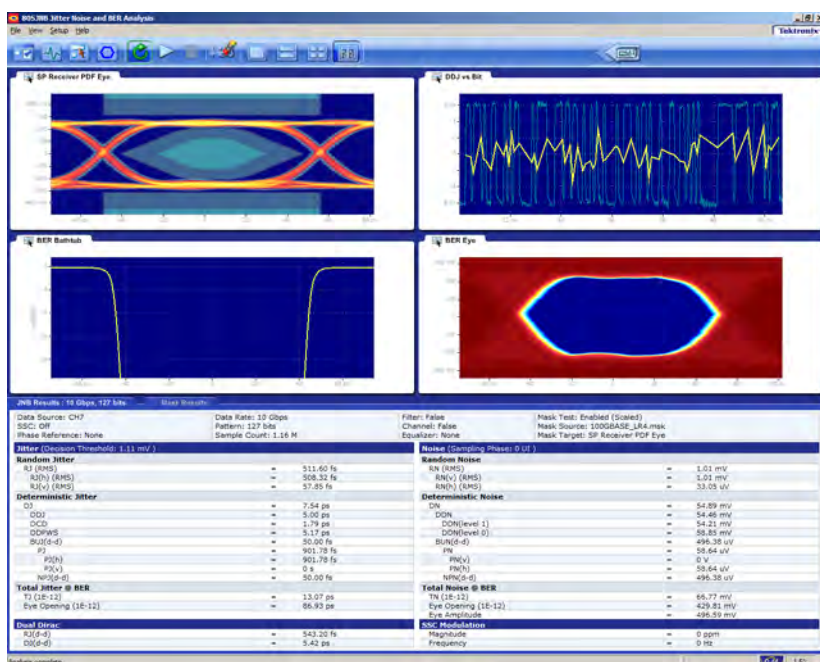
The following equation describes the relationship between these parameters:

$$\text{Total Population Limit} = \text{Acquisition Cycles} * (\text{Uncorrelated_Samples_Per_Cycle} + \text{Samples_Per_Bit} * \text{Pattern_Length})$$

Uncorrelated samples. Uncorrelated Samples instructs the 80SJNB application to continue acquiring and processing data until the data required for jitter and noise processing exceeds the specified number. The default count is a number that represents 2 acquisition cycles.

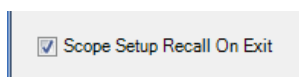
Total population limit. Total Population Limit instructs the 80SJNB application to continue acquiring and processing data until the total number of samples exceeds the specified number. The default count is a number that represents 2 acquisition cycles, and reflects the selected Pattern Length.

The actual number of acquired and processed samples is displayed in Sample Count (see below), and corresponds to the nearest integer number of acquisition and processing cycles.



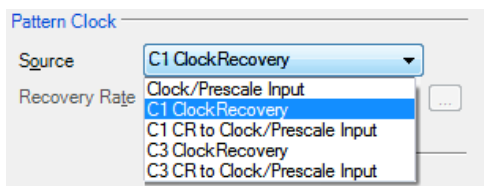
Selecting scope setup recall on exit

Acquiring data for jitter and noise analysis requires the 80SJNB application to fully control the oscilloscope state. When this control is checked, exiting the 80SJNB application (File > Exit) restores the oscilloscope to the state which was stored when 80SJNB application was launched.



Selecting clock recovery

The Advanced Trigger option (ADVTRIG) that generates the pattern synchronous triggers requires a clock source synchronous with the signal. When using a clock derived from a clock-recovery module installed in the oscilloscope (such as optical sampling modules), use the Pattern Clock fields to select the source module, the configuration and its frequency.



All native clock recovery modules support two different configurations: one that connects the recovered clock from the back of the module to the internal pattern synchronous trigger generator; and, for optimal jitter performance, the module full rate clock output can be connected to the front panel Clock/Prescale Input.

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 can accept USER defined rates.

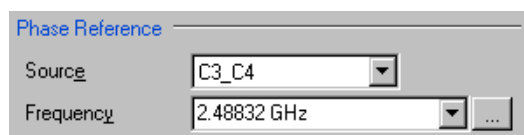
Selecting phase reference

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 analyzing a signal using Spread Spectrum Clocking (SSC), a Phase Reference module is required.

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.

TIP. *Selecting a Phase Reference module dramatically improves the accuracy of DDJ (Data Dependent Jitter) and the correlated waveforms. However, the throughput is lowered in this mode.*



NOTE. *When using a recalled data file, the Phase Reference Frequency field is updated to indicate the frequency when the data was acquired. The Source field remains unchanged regardless if phase reference was used when the recalled data file was created.*

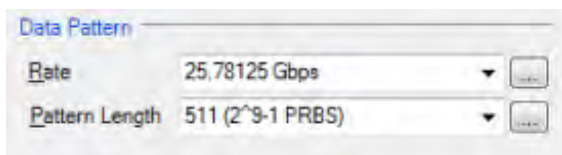
Selecting the data pattern

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 lengths or enter a value with the numeric 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.*

When selecting the pattern length, only the length is important. The precise bit sequence is unimportant if it is repetitive.

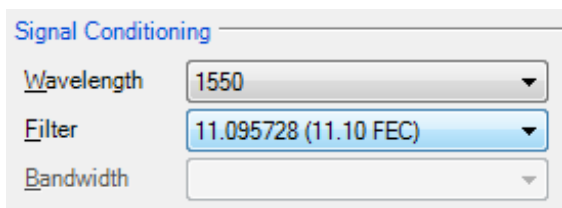
To analyze a clock pattern, select a 2 bits pattern (or a multiple). The analysis is performed on both edges.



NOTE. *When using a recalled data file, the Data Pattern fields are updated to indicate the state of the settings when the data was acquired.*

Selecting the signal conditioning

Use this control to select what type of filtering, if any, you want performed on the selected channel. The available filters depend on the capabilities of the 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 module. Refer to the documentation for the module about its filter or bandwidth settings.

Selecting the pattern clock

The Pattern Sync built-in capability provides user pattern synchronous triggers. The feature, enabled by the Advanced Trigger Option (ADVTRIG), is driven by the Pattern Clock.

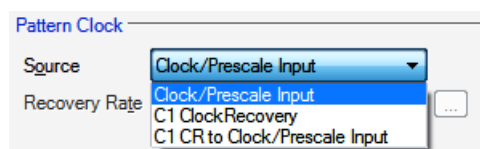
The available Pattern Clock sources depend on the instrument configuration. The default selection is Clock/Prescale Input, and this selection is available for all configurations. Connect the clock source to the CLOCK INPUT/PRESCALE TRIGGER front-panel connector.

When the oscilloscope is equipped with one or more clock recovery capable modules, the CR units are also available as sources for the Pattern Clock.

Each native clock recovery source appears on the Pattern Clock source list twice to allow for two different configurations:

- Selecting **Cx Clock Recovery** sets the instrument to pick up the recovered clock from the back of the module using and internal signal path.
- Selecting **Cx CR to Clock/Prescale Input** sets the instrument clock recovery signal source to the CLOCK INPUT/PRESCALE TRIGGER connector on the front panel. Connect the output of the clock recovery module to the front panel CLOCK INPUT/PRESCALE TRIGGER input.

Depending on the data rate, choosing one configuration over the other could result in different intrinsic jitter performance. See [Selecting Clock Recovery \(see page 32\)](#). In general, if there is SSC then a particular cabling setup is necessary; only external Clock Recovery (such as with a Tektronix CR286A) can be used. If the Tektronix 82A04/B Phase Reference module is used in the absence of SSC, the 82A04B setup determines the jitter performance. The intrinsic jitter of the pattern trigger circuit becomes invisible.



Selecting the source

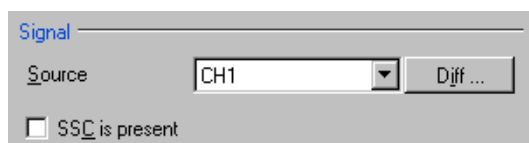
The application takes measurements on waveforms specified as sources (also called signal sources). The source can be a channel (CH1 through CH8) or a math waveform (if one is defined). You can use any defined math waveform, whether it is defined in the 80SJNB configuration as a differential setup or in the TekScope application.

If your signal source uses Spread Spectrum Clocking (SSC), select the check box so that the application can make accurate measurements that account for clock rate modulation.

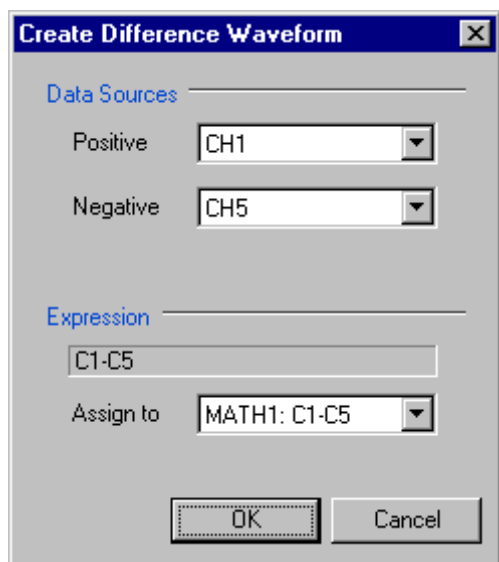
NOTE. If a saved data file is recalled, the signal source selection remains unchanged but all result panels will indicate the recalled data file as the source. The “SSC is present” field is updated to match the setting from the recalled data file.

See also:

[About Spread Spectrum Clocking \(SSC\) \(see page 36\)](#)



Clicking 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.



About spread spectrum clocking (SSC)

Spread Spectrum Clocking (SSC) is the technique of modulating the clock frequency to minimize EMI effects. SSC affects the analysis process and the results of jitter, noise and BER measurements. If SSC is not corrected for its effects, the results show as a large amount of periodic jitter components that are reflected in the total jitter and noise, and ultimately in the BER estimates.

When SSC is present, 80SJNB measures the attributes of SSC and corrects the results.

Configuration Requirements

If using clock recovery, the clock recovery unit must be able to handle SSC. Use one of the Tektronix BERTScope clock recovery instruments if SSC is present in the signal.

The TekScope must have an 82A04 Phase Reference Module installed. The module minimizes the effect of the SSC on the data by sampling synchronously the data and clock. Also, by acquiring the clock in the 82A04 module, 80SJNB characterizes the SSC present in the clock and uses that information to correct the jitter, noise, and BER measurements performed on the data.

TIP. The “SSC is present” check box is disabled if the Phase Reference module is not installed in the instrument.

Use the following settings to optimize the SSC phase correction for the signal you are measuring:

| Data rate range | Clock recovery frequency ² | Clock recovery output rate ^{1, 2} | Data:Clock ratio (JNB) | Phase reference frequency (JNB) |
|--------------------|---------------------------------------|--|------------------------|---------------------------------|
| 500 Mbps – 1 Gbps | Data Rate * 4 | Standard | 1:4 | Data Rate * 4 |
| 1 Gbps – 2 Gbps | Data Rate * 2 | Standard | 1:2 | Data Rate * 2 |
| 2 Gbps – 4 Gbps | Data Rate | Standard | 1:1 | Data Rate |
| 4 Gbps – 8 Gbps | Data Rate | Subrate (1/2) | 2:1 | Data Rate/2 |
| 8 Gbps – 12.5 Gbps | Data Rate | Subrate (1/4) | 4:1 | Data Rate/4 |

¹ The Clock Recovery unit clock output is either Standard or Subrate Clock.

² Clock recovery is typically provided from a CR125A, CR175A, or CR286A BERTScope Clock Recovery Instrument.

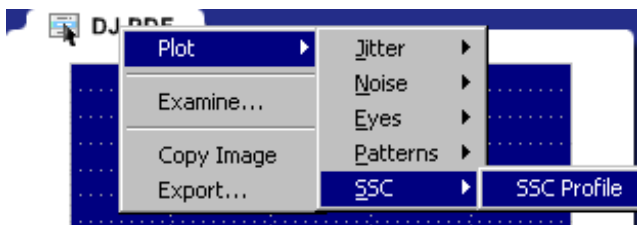
When you instruct 80SJNB that the data has SSC (by checking the “SSC is present” check box), the following constraints are enforced based on the current Data Rate:

- Phase Reference source is selected.
- Phase Reference frequency is set to the recommended value in the table *Configuration Settings for SSC*.
- A recommended Data:Clock Ratio is displayed to suggest the recommended subrate clock.

NOTE. Changes to the Data Rate are reflected in the Phase Reference Frequency and Data:Clock Ratio. You must make the appropriate changes to the Clock Recovery unit parameters.

The Full Numeric Results page shows the status (on or off) of the SSC setting. The results of the SSC analysis are presented in two forms, numeric results and a plot. When viewing the full numeric results table, the SSC Modulation section has two fields: Magnitude and Frequency. Magnitude represents the depth of the SSC clock modulation in parts-per-million (ppm) and Frequency reflects the SSC modulation frequency.

To view the plot of the SSC modulation profile, select the Plot>SSC>SSC Profile.



TIP. The configuration settings are also available through the GPIB programming interface of the oscilloscope. Refer to the information provided with the oscilloscope.

About Serial Data Link Analysis (SDLA) Signal Path Settings

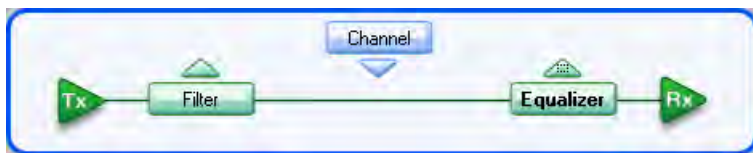
The Signal Path Settings are available for use with the 80SJNB Advanced version. If you are using the 80SJNB Essentials version, you're allowed to use the dialog boxes but are not allowed to place any of the functions into the signal path.

The Signal Path settings allow you to emulate the environment your signal encounters, all the way from the transmitter to the receiver. With the Signal Path dialog box, your signal path is represented by a line from the transmitter (Tx) to the Receiver (Rx). Along this line, you have the ability to emulate an arbitrary filter and/or a channel. You can then define an equalizer to compensate for the effects the filter and channel introduce. Also, fixture de-embed is supported.



Selecting a signal path arrow (Filter, Channel, or Equalizer) inserts or removes the function from the signal path. When inserting a function into the signal path, its dialog box automatically displays.

Selecting a signal path button (Filter, Channel, or Equalizer) displays the dialog box for that function without inserting or removing the function from the signal path.



By simulating the signal environment, you can effectively emulate probing the signal at the receiver rather than the output of the transmitter. With the use of the Equalizer, you can then design compensations to improve the signal quality at the receiver.

TIP. You can move a function in and out of the signal path without affecting any settings.

To learn more about each of the signal path settings, select the following:

[Filter \(see page 39\)](#)

[Channel \(see page 39\)](#)

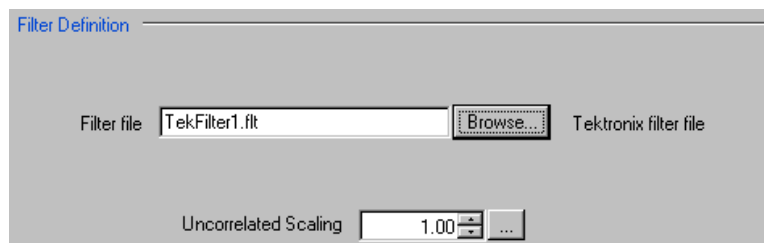
[Equalizer \(see page 42\)](#)

Setting Filter Conditions

The Signal Path Filter allows you to specify an arbitrary linear FIR filter to be applied to the acquired data pattern. For instance, the transmitter may artificially enhance the signal at certain frequencies to overcome known problems in the channel. You can use a filter to emulate this action or compensate for transmitter signal pre-emphasis.

To use the filter, move the Filter function into the signal path and use the Filter file box or browse button to specify the filter file. The default location for the filter files is in the Windows/Documents folder. A few filter files are provided as examples, but you are responsible for providing the filter files.

To use the Filter block for de-embedding, you will need an additional software tool to create a de-embedding filter from the S-parameters of the fixture. Please visit the www.tektronix.com/sdla Web site, or contact Tektronix Support for details.



See [Uncorrelated Scaling \(see page 47\)](#) for information about this setting.

The following is an example of the filter file format:

```
# This is a sample filter file. The '@' means that it is valid for all frequencies.  
# Up to 20,000 coefficients may be specified.  
@ 5.7e-005, 2.4e-005, 5.4e-005, 2.1e-005, 5.1e-005
```

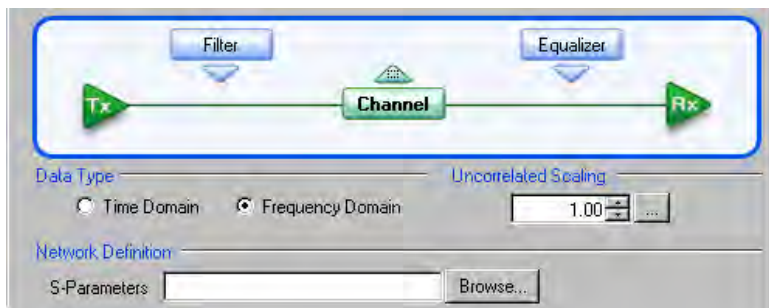
Setting Channel Conditions

The Signal Path Channel allows you to emulate the channel (interconnect or lane) carrying the signal. There are two ways to define the channel, with [Time Domain \(see page 42\)](#) waveforms and [Frequency Domain \(see page 40\)](#) S-parameters.

See [Uncorrelated Scaling \(see page 47\)](#) for information about this setting.

Frequency Domain

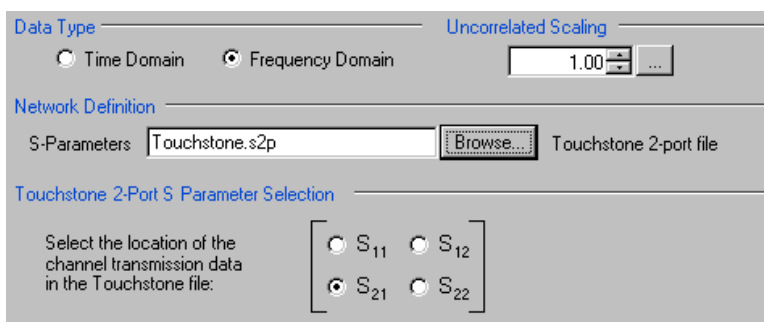
With Frequency Domain selected, the channel is defined with an S-parameters file. Use the file selection box or Browse button to select the file. The default location for the files are in the Windows/Documents folder. You are responsible for providing the S-parameters file.



The S-parameters file can contain data for 1-port, 2-port, or 4-port devices. Once a file is selected, the application reads its contents and generates the appropriate dialog for you to select the particular S-parameter in the file to use.

1-Port. Files with 1 port of data contain only 1 S-parameter so they do not require any further input. These files may be IConnect 1-port files or Touchstone 1-port files.

2-Port. Files with data for 2 ports contain 4 S-parameters as a 2x2 matrix. These are Touchstone 2-port files. When the application recognizes such an S-parameter file, a dialog is created for you to select the S-parameter representing channel transmission. The typical selection is S_{21} , and is the default selection, but this may need to be changed if the file contains a 2x2 subset of the 4x4 matrix of S parameters defining a 4-port system.



4-Port. Files with data for 4 ports may contain single-ended or mixed-mode data. These are Touchstone 4-port files.

If the data is single ended, you must map the port numbers as used in the file to physical locations in your link. A default mapping is assumed. The application will use this mapping to compute the S_{dd21} parameter (for transmission of a differential signal) from the appropriate four S-parameters measured using single ended data.

Network Definition

S-Parameters: Touchstone 4-port file

Touchstone 4-Port Data Type

☒ Single Ended ☐ Differential

Touchstone Port Assignment

Select the port in the Touchstone file corresponding to each physical location in your link:

Tx+ Rx+

Tx- Rx-

If the data is mixed mode, you must select the data layout in the file. The most common layout is DC12 and is the default selection. The application always uses the S_{dd21} parameter for computing the transmitted waveform no matter which mapping is selected.

Touchstone 4-Port Data Type

☐ Single Ended ☒ Differential

Touchstone 4-Port Layout

☒ DC12 (most common)
☐ CD12
☐ 12DC
☐ 12CD

| | | | |
|------------|------------|------------|------------|
| S_{dd11} | S_{dd12} | S_{dc11} | S_{dc12} |
| S_{dd21} | S_{dd22} | S_{dc21} | S_{dc22} |
| S_{od11} | S_{od12} | S_{oo11} | S_{oo12} |
| S_{od21} | S_{od22} | S_{oo21} | S_{oo22} |

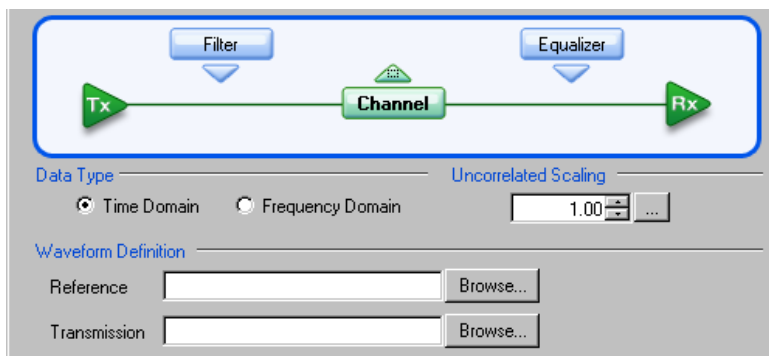
NOTE. 80SJNB Advanced uses the 'insertion loss' information only.

Time Domain

With Time Domain selected, the Reference waveform and Transmitted waveform generate the channel behavior. Use the file boxes or browse buttons to select the files you want to use. The default location for the files is in the Windows/Documents folder. You are responsible for providing the time domain waveform files.

NOTE. We recommend that the waveform file be a measurement of the channel from a Tektronix TDR/TDT system. Required raw oscilloscope waveforms are:

- a. A reference throughput (no DUT is inserted, just a throughput connection between the TDR step source and the acquisition channel on the TDT end).
 - b. A DUT throughput measurement (the TDR step source and the TDT acquisition channel are connected through the DUT).
-

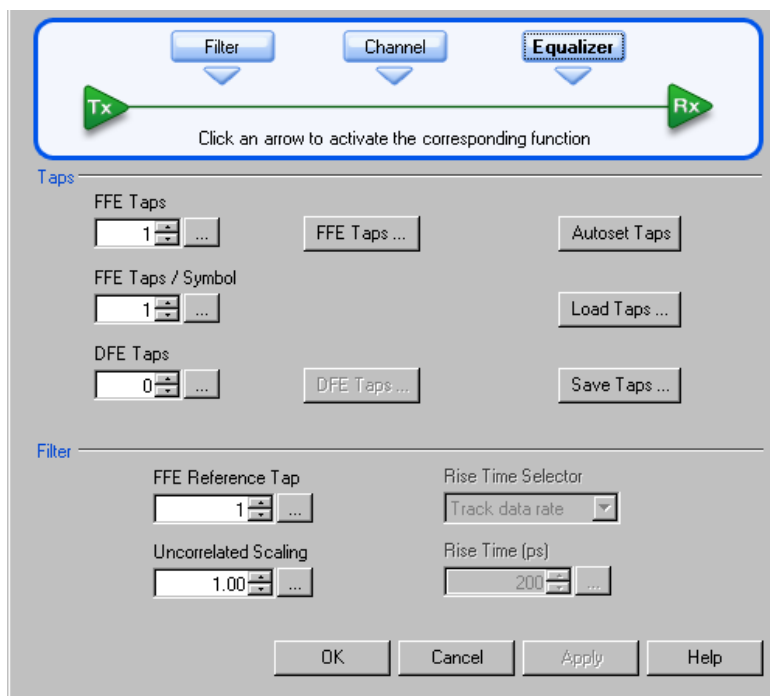


About the Equalizer

The equalizer compensates for transmission channel impairments in the form of frequency-dependent amplitude and phase distortions resulting in intersymbol interference (ISI) in the communication data stream.

80SJNB provides tools to define an equalizer by a set of Taps or weights. The linear feed-forward equalizer (FFE) is defined by a user specified number of taps, taps per symbol (or unit interval), and the weight of each tap. The equalizer becomes a decision-feedback equalizer (DFE) when the number of DFE taps is set to a number larger than 0.

NOTE. Tap values and weights are used interchangeably.



To learn about setting up the Equalizer, see:

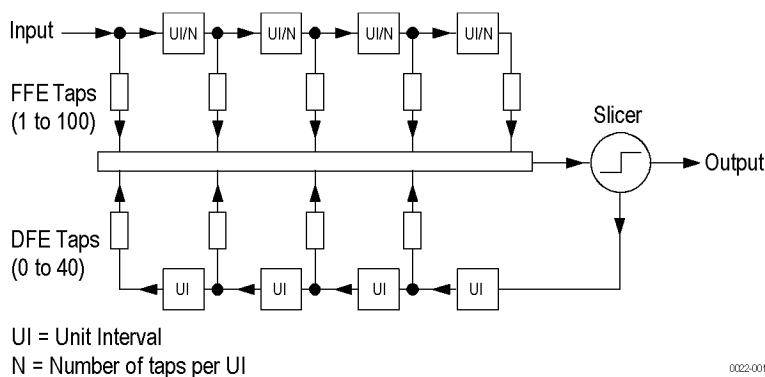
[Equalizer Taps \(see page 43\)](#)

[Uncorrelated Scaling \(see page 47\)](#)

Equalizer Taps

The behavior of the equalizer is controlled by the number of taps and the tap values. Using the equalizer requires that you specify the number of FFE and DFE taps, and the FFE spacing of the taps. You can also incorporate an equalizer filter delay by specifying a reference tap to compensate for precursor channel effects.

You can manually set the FFE and DFE tap values, or you can use the Autoset Taps button to let the application calculate the tap values.



[Go to FFE Taps description \(see page 44\)](#)

[Go to DFE Taps description \(see page 45\)](#)

FFE Taps

The FFE Taps are weights applied to a set of samples taken from the data stream to compensate for channel impairments manifested in the form of ISI. The number of FFE Taps represent the length of history in data samples that contribute to the computation of a current bit. Data stream samples could be distanced at unit intervals, in which case the number of FFE taps represents the number of preceding bits that contribute to the correction of the current bit. Alternatively, the data stream could be sampled at a higher rate per bit, yielding a fractionally-spaced FFE tap set.

The number of FFE taps defaults to 1, with the capability to specify up to 100 taps. The default FFE tap spacing is at unit intervals. You can configure up to 10 taps per symbol.

The FFE Tap values could be specified by you using the FFE Taps dialog, or computed by the application with the Autoset Taps button.

[Go to Autoset Taps description \(see page 46\)](#)

[Go to Saving and Loading Taps \(see page 47\)](#)



Pressing the FFE Taps button displays a dialog showing the current FFE tap values. You can specify each FFE tap coefficient individually. Pressing the Defaults button sets the first FFE tap to 1 and the rest to 0.

You can use the Save Taps button to save a set of coefficients to a file. Use the Load Taps button to load saved Tap files.

DFE Taps

DFE taps are weights applied to the previous digital decisions made by the slicer (comparator + latch). The number of DFE Taps specifies the number of bits contributing to the current input to the slicer. The default number of DFE Taps is 0, in which case the equalizer is a linear FFE one. The maximum number of DFE Taps is 40. Weights are scalars specified by you or computed by the Autoset Taps function.

See [Autoset Taps \(see page 46\)](#) for a description about using the autoset taps function.

Pressing the DFE Taps button displays a dialog showing the current DFE tap values. You can specify each DFE tap coefficient individually. Pressing the Defaults button sets all DFE tap values to 0.

You can use the Save Taps button to save a set of coefficients to a file. Use the Load Taps button to recall saved Tap files.

TIP. When using the Equalizer, you are required to always have at least 1 FFE tap. DFE taps are optional.

Filter

FFE Reference Tap. The FFE Reference Tap is a filter delay in unit intervals that should be set to compensate for the delay between the transmitter output and the equalizer input. The value of the Reference Tap is constrained by the number of FFE Taps and the number of taps per symbol.

Rise Time Selector. The Rise Time Selector specifies the Gaussian filter used to emulate the DFE feedback path band-limited behavior. The rise time defaults to Track Data Rate, in which the configuration is set to 1/5 of the unit interval equivalent with the data rate. Track tap interval designs a Gaussian filter with a rise equal to 1/5 of the spacing between taps. Selecting User allows you to specify the rise time from 1 ps to 4 ns.

Uncorrelated Scaling. See [Uncorrelated Scaling \(see page 47\)](#) for a description of this control.

Autoset Taps

The tap autoset function computes a set of tap values that optimize the eye opening for the data pattern applied to the input of the equalizer. If the DFE tap number is 0, the algorithm yields an optimal set of FFE taps, while if the equalizer is specified as a DFE by a positive DFE tap number, the Autoset Taps algorithm jointly optimizes the forward and feedback loop tap coefficients. The optimization algorithm is the least-mean-square error (LMS) and the optimization targets the signal to noise ratio at the sampling phase.

The Autoset Taps will account for the FFE Taps/Symbol and Reference Tap specifications.

The autoset algorithm assumes the availability of a training sequence, thus it supports only a known set of patterns: PRBS3 to PRBS15 with the following generator polynomial equations:

PRBS3: x^3+x^2+1

PRBS4: x^4+x^3+1

PRBS5: $x^5+x^4+x^2+x^1+1$

PRBS6: $x^6+x^5+x^3+x^2+1$

PRBS7: x^7+x^6+1

PRBS8: $x^8+x^7+x^3+x^2+1$

PRBS9: x^9+x^5+1

PRBS10: $x^{10}+x^7+1$

PRBS11: $x^{11}+x^9+1$

PRBS12: $x^{12}+x^9+x^8+x^5+1$

PRBS13: $x^{13}+x^{12}+x^{10}+x^9+1$

PRBS14: $x^{14}+x^{13}+x^{10}+x^9+1$

PRBS15: $x^{15}+x^{14}+1$

The tap autoset algorithms computes a set of FFE and DFE taps using a least-mean-square optimization algorithm. The optimization algorithm is the least-mean-square error (LMS) and the optimization targets the signal to noise ratio at the sampling phase.

NOTE. You can autoset tap values even if the Equalizer is not inserted in the signal path.

Saving and loading taps

Use these controls to save or load a set of taps from a file. The browse directory defaults to Windows/My Documents and the file extension is .tap.

The file format is the following:

```
<Tektronix>
  <TapFile>
    <FFE>
      <TapsPerSymbol>value<\TapsPerSymbol>
      <ReferenceTap>value<\ReferenceTap>
      <Tap1>value<\Tap1>
      <Tap2>value<\Tap2>
      ...
      <Tapn>value<\Tapn>
    </FFE>
    <DFE>
      <Tap1>value<\Tap1>
      <Tap2>value<\Tap2>
      ...
      <Tapn>value<\Tapn>
    </DFE>
  </TapFile>
</Tektronix>
```

Uncorrelated scaling

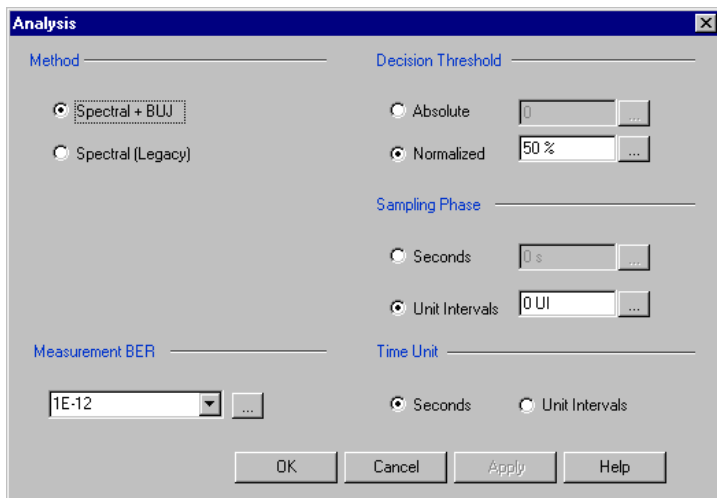
The signal path settings (Filter, Channel, Equalizer) each have an uncorrelated scaling setting. The Uncorrelated Scaling value multiplies the uncorrelated random noise RMS and uncorrelated periodic noise values. Uncorrelated noise scaling affects the uncorrelated jitter as projected through the average slew rate. The 80SJNB Signal Path does not process uncorrelated noise in any other way.

If you insert a default equalizer (an FFE Tap 1 value equal to 1, and zero DFE taps) in the Signal Path and set the Uncorrelated Scaling factor to its minimal value (0.01), the configuration will isolate the effects of noise on jitter measurements. This configuration produces results that correlate with “jitter only” type analysis tools.

NOTE. The overall Signal Path uncorrelated scaling factor is the product of all signal path uncorrelated scalar values of the active functions.

About analysis settings

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



TIP. Changes to Analysis settings are reflected in the current plots and results.

Setting the analysis method

The Method selection sets which analysis methodology to use for the Jitter and Noise breakdown:

- The Spectral + BUJ (Bounded Uncorrelated Jitter) is using a combination of spectral isolation of the periodic components and the analysis of the cumulative distribution function (CDF) of the uncorrelated jitter and noise data, before and after spectral separation. The presence of crosstalk dictates the selection of this method.
- The Spectral (Legacy) mode relies on spectral separation of the periodic and random components.

The default setting is Spectral + BUJ. When switching the analysis method between the two options, the acquisition data is preserved, and new results are recomputed, displayed, and plots made available.

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 the location of the sampling point for the Vertical Eye Opening and all correlated noise measurements 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 (BER)

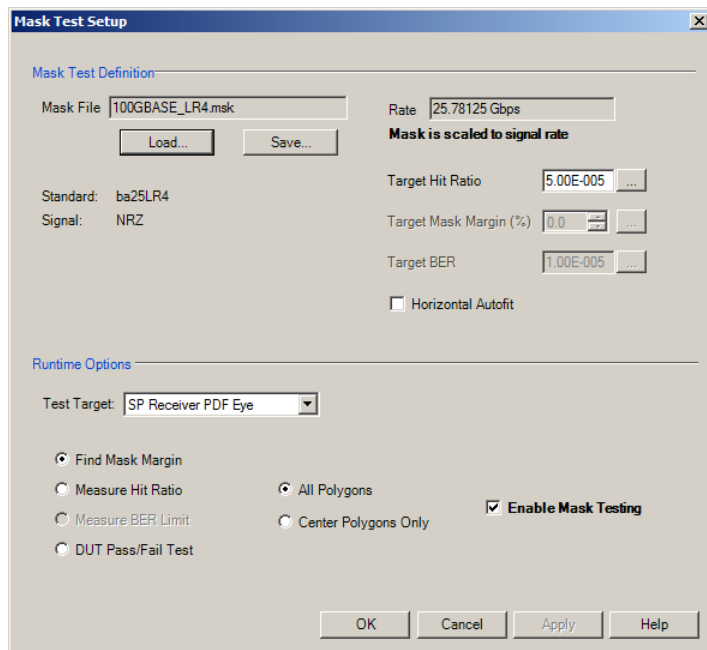
The Measurement BER determines the rate for which the measurements (such as TJ@BER) are predicted.

About mask test settings

The Mask Test setup dialog defines the target and parameters of mask testing.

There are two 80SJNB statistical analysis products on which mask testing can be performed, the SP Receiver PDF Eye and the BER Contours. Both of these are defined at the receiver side of the Signal Path emulator.

The mask definitions are loaded from Tektronix standard format mask files. These files include parameters that define the signal, the mask polygons, and the mask testing qualifiers.



NOTE. Changes to mask test settings are reflected in the current plots and results.

Selecting the mask test

Click the Load button and browse to select a mask file, which has the extension .msk. Parsing the file fills in the Mask Test Definition fields of the setup dialog. These values can be edited and, by using the Save button, saved in another mask file.

A mask file contains the following information:

- The name of the standard for which the mask was defined
- Signal type (NRZ or PAM)
- Standard data rate. This rate can be edited, and if the acquired signal rate and mask file data rate do not match, a message “Mask is scaled to signal rate” is displayed
- The polygons that define the mask testing area, which are visible on the target plots
- Target Hit Ratio, defined as the sum of probabilities that the modeled signal is within the mask
- Target Mask Margin, defined as a positive or negative percentage of the specified mask size
- Target BER value that defines the curve of constant BER that will be used for the BER Contour mask testing

Checking Horizontal Autofit causes the mask test to be evaluated at all horizontal positions to obtain the best test result in terms of maximum mask margins or minimum hit ratios.

Selecting the runtime options

Check Enable Mask Testing button to perform mask testing.

The Test Target pull down list specifies the JNB analysis products to which the mask can be applied: SP Receiver PDF Eye or the BER Contour.

When changing the Mask Test Target the relevant plot with the Mask will be displayed. If the target plot is displayed already, the mask will be added to the plot. If the plot is not displayed, the test target plot will replace the upper left corner plot.

Consider the use cases for mask testing on the PDF Eye:

- Given a target Hit Ratio, find the largest mask margin that does not exceed that hit ratio.
- Given a target Mask Margin, find the actual hit ratio.
- Given a Target Hit Ratio and Mask Margin, determine the Pass or Fail status.

The use cases for mask testing on BER Contours are:

- Given a target BER, find the largest mask margin that does not exceed that BER.
- Given a target Mask Margin, find the BER Limit, which is the lowest BER contour that contains the mask.
- Given a target BER and Mask Margin, determine the Pass or Fail status.

For PDF Eye mask testing, there are three polygon areas to consider: overshoot, center and undershoot. You can choose to test against all regions or only the center polygon.

The settings are saved with the 80SJNB application whenever it is closed so that restarting the application results in using the same settings. Using the File > SaveSettings control saves the settings for later use.

Taking measurements

The most relevant oscilloscope measurement settings are accessible using the Configuration dialog box of the 80SJNB application.

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 \(see page 53\)](#)

[Display the definitions of Noise measurements \(see page 54\)](#)

[Measurement Algorithms \(see page 105\)](#)

[Go to Working with Numeric Results \(see page 69\)](#)

[Go to Working with Plots \(see page 59\)](#)

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 Dependent Jitter |
| DCD | Duty Cycle Distortion |
| DDPWS | Data Dependent Pulse Width Shrinkage |
| BUJ(d-d) | Measured Bounded Uncorrelated Jitter, Dual Dirac model |
| 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 |
| NPJ(d-d) | Measured NonPeriodic Jitter, Dual Dirac model |
| Total Jitter @ BER | |
| TJ (1E-12) | Total Jitter at user-specified BER |
| Eye Opening (1E-12) | Horizontal Eye Opening at user specified BER |

NOTE. J2 Jitter: For a BER specified as 2.5E-3, the Total Jitter becomes J2 Jitter. J2 Jitter measures all but 1% of the statistical total jitter distribution.

J9 Jitter: For a BER specified as 2.5E-10, the Total Jitter becomes J9 Jitter. J9 Jitter represents an estimation of all but 10E-9 of the statistical total jitter distribution.

Dual Dirac measurement definitions

| Dual Dirac | Description |
|------------|---|
| 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) ¹ | Measured Random Noise |
| RN(v) (RMS) | Vertical component of random noise |
| RN(h) (RMS) | Horizontal component of random noise induced by jitter converted to noise through an average slew rate |
| Deterministic Noise | |
| DN | Measured Deterministic Noise |
| DDN | Data Dependent Noise |
| DDN(level 1) | Data Dependent Noise on logical level 1 |
| DDN(level 0) | Data Dependent Noise on logical level 0 |
| BUN(d-d) | Measured Bounded Uncorrelated Noise, Dual Dirac model |
| PN ¹ | 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 |
| NPN(d-d) | Measured NonPeriodic Noise, Dual Dirac model |
| 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. |

¹ Uncorrelated random noise (RN) and periodic noise (PN) measurements are performed on both logical levels 1 and 0 to account for significant differences, which may be the case when the measurements are performed on optical signals.

SSC Modulation Measurement Definitions

| SSC modulation measurements | Description |
|-----------------------------|---|
| Magnitude | Spread spectrum clock modulation magnitude of the clock in parts-per-million (ppm) units. |
| Frequency | Spread spectrum clock modulation frequency. |

Mast test measurement definitions

| Mast test measurements | Description |
|--------------------------|--|
| PDF Hit Ratio Per Region | |
| Overshoot | Measured hit ratio in the overshoot polygon |
| Center | Measured hit ratio in the center polygons |
| Undershoot | Measured hit ratio in the undershoot polygon |
| Results Over All Regions | |
| PDF Mask Margin | Measured mask margin given a target hit ratio |
| PDF Hit Ratio | Measured hit ratio over all tested polygons given a target mask margin |
| BER Mask Margin | Measured mask margin given a target BER |
| BER Limit | Measured BER Limit given a target mask margin |
| Pass/Fail | |
| Status | Pass or Fail given a target mask margin and either hit ratio or BER |
| Horizontal Shift | Amount the mask was shifted in time |

Sample Count




Both results tables, Summary and Full Results are displaying the Sample Count of the data used for the derivation of the measurements.

The Sample Count field represents the amount of statistical data acquired and analyzed, and contains the full pattern acquisition, the jitter and noise characterizing data.




When in Free Run, the count is continuously incremented with the newly acquired and processed data.


Steps to Acquire Data

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

1. Select  to display the Acquisition 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 following acquisition and processing continues until you stop it:
 - acquisition and averaging of data-correlated patterns
 - acquisition, accumulation and statistical analysis of uncorrelated data
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 green 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.

TIP. 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 that was not generated by the application.

See also:

[Saving a Setup File \(see page 57\)](#)

[Recalling a Saved Setup File \(see page 57\)](#)

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 file name.
4. Save the setup file. If the selected file name 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 manually edit setup files. If you try to recall a setup file that was manually edited, the recall operation fails.

Saving and Recalling Data Files

You can use the File menus to save acquired data and then recall it later for analysis.



CAUTION. *Do not edit a data file or recall a data file that was not generated by the application.*

See also:

[Saving a Data File \(see page 58\)](#)

[Recalling a Saved Data File \(see page 58\)](#)

Saving a Data File

To save the data acquired by the 80SJNB application, follow these steps:

1. Select File > Save Data to open the Save dialog box.
2. In the file browser, select the directory in which to save the data file.
3. Use the keyboard to enter a new file name. The application appends a .mat extension to the file name.
4. Save the data file. If the selected file name already exists, a confirmation dialog appears that allows you to cancel the operation.

Recalling a Saved Data File


To recall the acquisition data from saved data files, follow these steps:

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



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

About 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 the tab of the data table.

See also:

[Plot Type Definitions \(see page 59\)](#)

[Functions in Plot Windows \(see page 61\)](#)

[About Exporting Plot Files \(see page 61\)](#)

[Selecting and Viewing Plots \(see page 60\)](#)


Plot type definitions


Plot types are divided into the following categories:

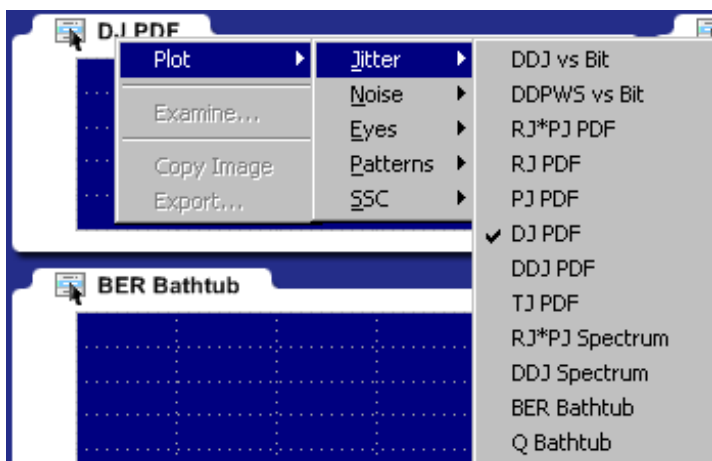
- Jitter: See [Jitter Plots \(see page 65\)](#) for a list of the types of jitter plots and their descriptions.
- Noise: See [Noise Plots \(see page 67\)](#) for a list of plot types and descriptions.
- Eyes: See [Eye Plots \(see page 66\)](#) for a list of plot types and descriptions.
- Patterns: See [Pattern Plots \(see page 68\)](#) for a list of plot types and descriptions.
- SSC: See [SSC Plot \(see page 68\)](#) for a description.

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. (Alternatively, you can right-click anywhere on the existing plot display.) From the drop-down menu, use the Plot menu to select a plot from the plot categories (Jitter, Noise, Eyes, Patterns, SSC).

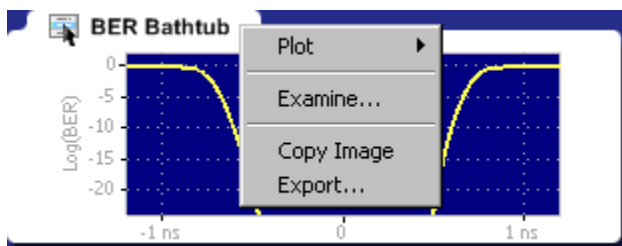


See also:

[About Exporting Plot Files \(see page 61\)](#)

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.



See also:

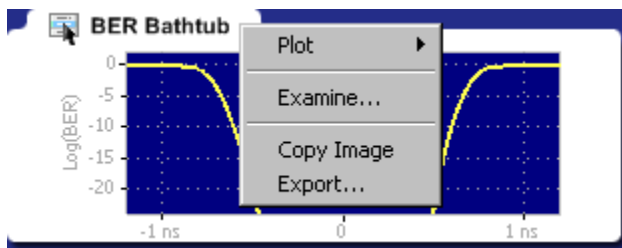
[MATLAB User Interface \(see page 27\)](#)

About exporting plot files

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.

See also:

[Exporting Raw Plot Data \(see page 63\)](#)


[Exporting Plot Images \(see page 62\)](#)

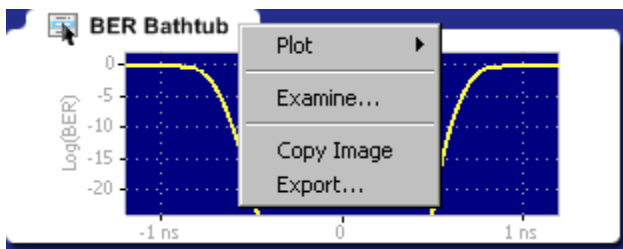
[File Name Extensions \(see page 17\)](#)

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 you can paste the image 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. Tap the  area of the plot window of the plot that you want to 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.

See also:

[Exporting Raw Plot Data \(see page 63\)](#)

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 acquired waveform and correlated pattern data used for processing.
- **Export.** Accessed from the plot window, exports the data used to create the plot image. This method allows access to any node along the signal path.

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.

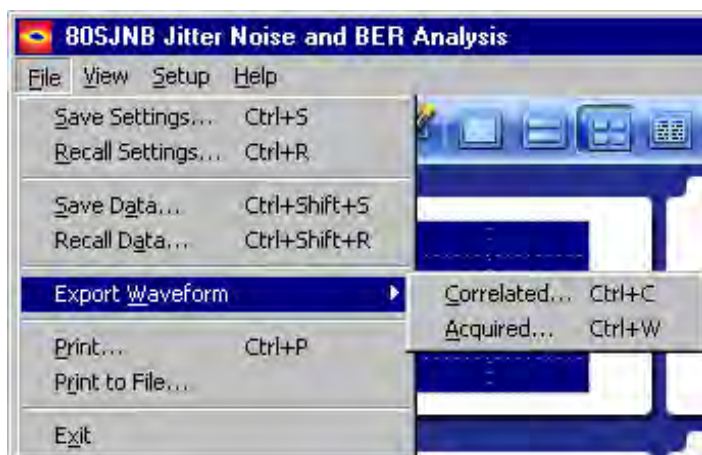
Export Waveform

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

1. Select **File > Export Waveform > Acquired** or **File > Export Waveform > Correlated**:

The **Acquired** waveform contains the raw acquired pattern before any processing is done on it. (The only processing on the raw data is interpolation for NULL points.)

The **Correlated** waveform is the result of filtering the Acquired Waveform to eliminate uncorrelated components (such as random and periodic jitter and noise).



3. Use the **Export Waveform** dialog box to specify the file name and path. The file name default is “Correlated” or “Acquired” (depending on the selection), with the default file location at Windows/Documents. Enter a new file name and/or directory location as needed.


4. Use the drop-down **Save as type** list to select the file type. The choices are:
 - Comma Separated Values (.csv): ASCII text that can be loaded into a spreadsheet. This is the default selection.
 - MATLAB (.mat): Binary data in the native MATLAB 7.0 format.

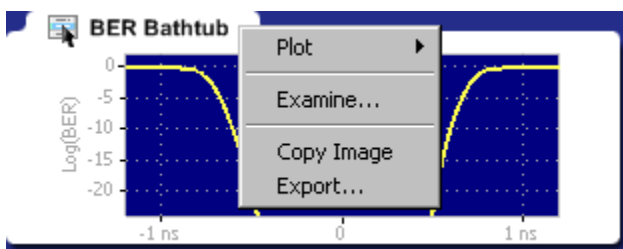
5. Click **Save**.

TIP. Binary files typically use about 40% more disk space than .csv files.

Export graph (Plot)

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 that you want to export.)
2. Select **Export** from the drop-down menu.



3. Use the **Export Graph** dialog box to specify the file name and path. The file name default is “Graph,” with the default file location at Windows/Documents. Enter a new file name and/or storage location as needed.
4. Select the file type from the **Save as type**. The choices are:
 - Comma Separated Values (.csv): ASCII text that can be loaded into a spreadsheet. This is the default format.
 - MATLAB (.mat): Binary data in the native MATLAB 7.0 format.

See also:

[Copying Plot Images \(see page 62\)](#)

Jitter plots

| Jitter plots | Description |
|-----------------------------|---|
| DDJ vs Bit ¹ | 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 are visible only when opening the graph with Examine. |
| DDPWS vs Bit ¹ | Data Dependent Pulse Width Shrinkage versus Bit displays the pulse width shrinkage for each isolated one and zero in the pattern. |
| 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 ¹ | 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*PJ Spectrum ¹ | 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. |

| Jitter plots | Description |
|--------------|---|
| 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. |

¹ The zoom feature defaults to horizontal zoom only.

Eye plots

| Eye plots | Description |
|----------------------------------|--|
| Correlated Eye ¹ | 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 Eyes | PDF Eye plots can be computed at various stages of the signal path emulator when using the 80SJNB Advanced version. When using the Essentials version of the 80SJNB, all PDF Eye plots are identical. If a signal path component is not inserted into the signal path, the PDF Eye plot for the output of the component is identical to the upstream PDF Eye plot. For example, if computing the PDF Eye plot for the output of the Channel function, but the Channel function is not inserted into the signal path, the PDF Eye plot will be identical to the PDF Eye plot of the output of the Filter function. |
| SP In | The SP In PDF Eye is a color graded Probability Density Function representing the eye pattern at the transmission side of the signal path. It is constructed from the convolution of the Correlated Eye with uncorrelated jitter and noise probability distributions. |
| SP Filter ² | The SP Filter PDF Eye is a color graded Probability Density Function representing the eye pattern at the output of the filter if the filter function is inserted in the signal path. It is constructed from the convolution of the Correlated Eye with uncorrelated jitter and noise probability distributions. |
| SP Channel ² | The SP Channel PDF Eye is a color graded Probability Density Function representing the eye pattern at the output of the channel emulator if the Channel function is inserted in the signal path. It is constructed from the convolution of the Correlated Eye with uncorrelated jitter and noise probability distributions. |
| SP Receiver PDF Eye ² | The PDF Eye is a color graded Probability Density Function representing the eye pattern at the output of the Equalizer if the Equalizer function is inserted in the signal path at the receiver side of the link. It is constructed from the convolution of the Correlated Eye with uncorrelated jitter and noise probability distributions. This selection was displayed as PDF Eye in 80SJNB application versions before version 2.1. |
| BER Eye ¹ | 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 ¹ | 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 ¹ | The BER Contours show the boundaries of the eye opening at the projected bit error levels. |

¹ Eye plot is computed at the end of the signal path, regardless of using the 80SJNB Advanced or Essentials version.

² The 80SJNB Advanced version (with Signal Path emulator) provides PDF Eye plots at the various stages (functions) of the emulator. If the function is not inserted, the PDF Eye plot is identical to the upstream plot.

Noise plots

| Noise plots | Description |
|-----------------------------|--|
| DDN vs Bit ¹ | 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 are visible only when opening the graph with Examine. |
| 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. |
| 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. |
| 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. |
| 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. |
| 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. |
| RN*PN Spectrum ¹ | 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. |
| DDN Spectrum ¹ | 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. |
| 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. |

¹ The zoom feature defaults to horizontal zoom only.

Pattern plots

Pattern plots can be computed at various stages of the signal path emulator when using the 80SJNB Advanced version. When using the Essentials version of the 80SJNB, all Pattern plots are identical.

If a signal path component is not inserted into the signal path, the plot for the output of the component is identical to the upstream plot. For example, if computing the pattern plot for the output of the Channel function, but the Channel function is not inserted into the signal path, the pattern plot will be identical to the pattern plot of the output of the Filter function.

| Pattern plots | Description |
|---------------------------|---|
| SP_In ¹ | The Signal Path Input signal plots the correlated pattern at the transmission side of the Signal Path, the input to the simulated serial link. The correlated pattern results when the acquired pattern is filtered for the removal of the uncorrelated jitter and noise components. For closer examination of the pattern, use Examine which provides pan and zoom capabilities, and data cursors. |
| SP_Filter ¹ | The Signal Path Filter output plots the correlated pattern at the output of Filter, if the Filter function is inserted in the signal path. The selected Filter file determines the effects of the Filter function on the waveform. If the Filter function is not inserted in the signal path, The SP_Filter displays the upstream waveform, in this case SP_In. |
| SP_Channel ¹ | The Signal Path Channel output plots the correlated pattern at the output of the Channel emulator if the Channel function is inserted in the signal path. The selected S-parameter or time domain waveform set determines the attributes of the signal at the output of Channel. If the Channel function is not inserted in the signal path, SP_Channel displays the upstream waveform which could be the SP_Filter or SP_In function of signal path configuration. |
| SP_Equalizer ¹ | The Signal Path Equalizer output plots the correlated pattern at the output of the Equalizer if the Equalizer function is inserted in the signal path at the receiver side of the data link. The configuration of tap numbers and tap values determines the attributes of the equalizer and shapes the signal at the output. If the Equalizer function is not inserted, SP_Equalizer plot displays the upstream signal which could be any of the previous patterns, depending on the signal path configuration. |

¹ The zoom feature defaults to horizontal zoom only.

SSC plot

| SSC plot | Description |
|--------------------------|--|
| SSC Profile ¹ | The Spread Spectrum Clocking profile displays the function used for modulating the serial link clock frequency. If the "SSC is present" check box is checked in the Acquisition setup dialog, the profile plot is displayed. |

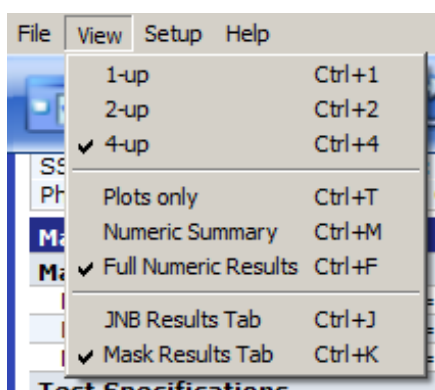
¹ The zoom feature defaults to horizontal zoom only.

Working with numeric results

After an analysis is complete, you can display the results as numeric data in either a summary or detailed (full) table. Use the View menu in the file menu bar to select how to display the data. A summary of data allows room to display the plots while the full results replaces the plot display entirely.

In both the summary and detailed views, the numeric panel has two tabs; one for the jitter, noise and BER results and the second for the mask test results.

TIP. Using a second monitor (connected to the TekScope) to display the 80SJNB application allows the numeric results display to show all results at once.



The summary selections list the noise and jitter measurements but not the breakdown of the measurements. The two results tabs select relevant jitter or mask test results.



| JNB Results - 10 Gbps, 127 bits | | | | |
|---------------------------------|---------------------|-------------|---------------------|-------------|
| Metric Results | | | | |
| Data Source: CH1 | RJ (RMS) | = 519.77 fs | RN (RMS) | = 950.17 uV |
| Decision Threshold: 1.08 mV | DJ | = 7.47 ps | DN | = 52.30 mV |
| Sampling Phase: 0.5 UI | DOJ | = 4.73 ps | DDN | = 52.08 mV |
| Mask Test: Enabled (Scaled) | DJ | = 865.89 fs | PN | = 37.79 uV |
| Phase Reference: None | T1 (1E-12) | = 13.05 ps | Eye Amplitude | = 497.04 mV |
| Sample Count: 127.70 k | Eye Opening (1E-12) | = 86.95 ps | Eye Opening (1E-12) | = 433.15 mV |

| Mask Results | | | |
|------------------------------------|------------------|------------|--|
| Test Type: Transmitter | PDF Mask Margin | = 88.27% | |
| Target Hit Ratio: 9.999998 | PDF Hit Ratio | = 2.96E-05 | |
| Target Mask Margin: 0.5% | BER Mask Margin | = N/A | |
| Target BER: 1.0E-05 | BER Limit | = N/A | |
| Test For Polygon Set: All | Pass/Fail Status | = N/A | |
| Horizontal Shifting Allowed: false | Horizontal Shift | = 0 s | |

The detailed table (when selected) expands to fill most of the screen.

| JNB Results - 10 Gbps, 127 bits | | | |
|--------------------------------------|------------------------|-------------------|----------------------------------|
| Data Source: CH1 | Data Rate: 10 Gbps | Filter: False | Mask Test: Enabled (Scaled) |
| SDC: Off | Pattern: 127 bits | Channel: False | Mask Filename: 100GBASE_L84.msk |
| Phase Reference: None | Sample Count: 127.70 k | Equalizer: None | Mask Target: SR Receiver PDF Eye |
| Jitter (Decision Threshold: 1.08 mV) | | | |
| Random Jitter | | | |
| RJ (RMS) | = 519.77 fs | Random Noise | |
| RJN (RMS) | = 517.15 fs | RN (RMS) | = 950.17 uV |
| RJNv (RMS) | = 32.13 fs | RNv (RMS) | = 949.90 uV |
| Deterministic Jitter | | | |
| DJ | = 7.47 ps | DDN | = 22.57 uV |
| DOJ | = 4.73 ps | DDN (level 1) | = 52.30 mV |
| DOJN | = 1.92 ps | DDN (level 2) | = 52.08 mV |
| DOJNv | = 4.50 ps | DDN (level 3) | = 55.11 mV |
| DOJNv (level 1) | = 50.00 fs | DDN (level 4) | = 496.95 uV |
| DOJNv (level 2) | = 865.89 fs | DDN (level 5) | = 37.79 uV |
| DOJNv (level 3) | = 865.89 fs | DDN (level 6) | = 0 V |
| DOJNv (level 4) | = 0 s | DDN (level 7) | = 27.79 uV |
| DOJNv (level 5) | = 95.00 fs | DDN (level 8) | = 496.95 uV |
| Total Jitter @ BER | | | |
| T1 (1E-12) | = 13.05 ps | Total Noise @ BER | = 63.89 mV |
| Eye Opening (1E-12) | = 86.95 ps | TN (1E-12) | = 433.15 mV |
| | | Eye Amplitude | = 497.04 mV |
| Load Data | | | |
| LJ (RMS) | = 569.36 fs | DC Modulation | = 0 ppm |
| LJN (RMS) | = 5.03 ps | Magnitude | = 0 mV |
| | | Frequency | = 0 Hz |

| Mask Results | | | |
|-----------------------------|-----------------|----------------------------------|------------|
| Data Source: CH1 | | Data Rate: 10 Gbps | |
| SQC: Off | | Pattern: 127 bits | |
| Phase Reference: None | | Sample Count: 232.79 k | |
| Filter: False | | Mask Test: Enabled (Scaled) | |
| Channel: False | | Mask File: 100BASE_XLR.msk | |
| Equalizer: None | | Mask Target: SP Receiver PDF Eye | |
| Mask Test Definitions | | Mask Test Results | |
| Name | = 8b2B4R4 | PDF Hit Ratio Per Region | = 0.0E+00 |
| Data Rate | = 25.78127 Gbps | Overshoot | = 2.96E-05 |
| Modulation | = NRZ | Center | = 0.0E+00 |
| Test Type | = MaskMargin | Undershoot | = 0.0E+00 |
| Target Hs Ratio | = 5.0E-05 | Results Over All Regions | |
| Target Mask Margin | = 0.0% | PDF Hit Ratio | = 66.27% |
| Target BER | = 1.0E-05 | PDF Hs Ratio | = 2.96E-05 |
| Run Time Options | = All | BER Limit | = N/A |
| Test For Polysyn Set | = False | Pass/Fail | = N/A |
| Horizontal Shifting Allowed | = False | Status | = 0.0 |
| | | Horizontal Shift | = 0.0 |

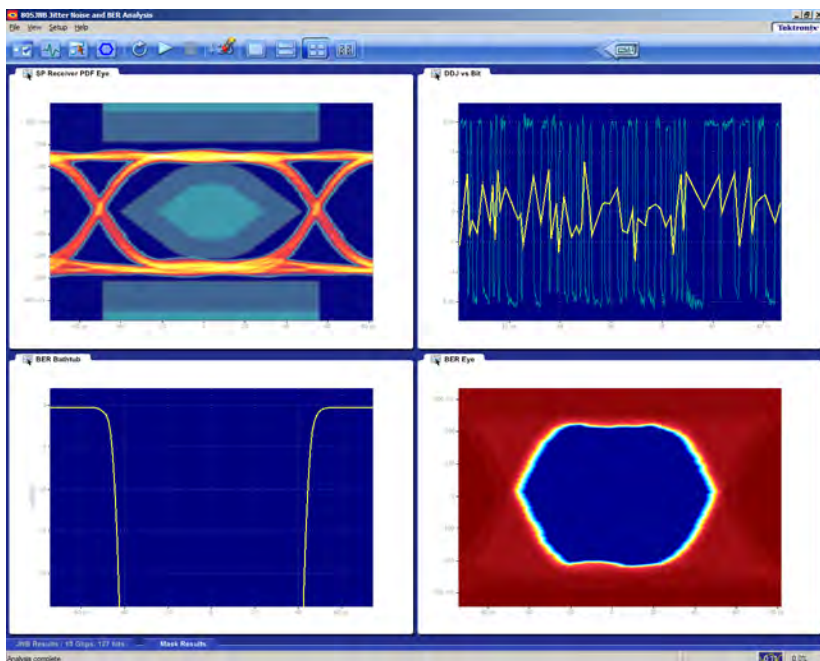
You can easily switch between summary and detailed numeric displays by clicking the numeric results button  and the plot window buttons .

Click on a tab to switch between the Results tab and the Mask tab.

To hide the summary table and provide more room for the plot displays, click the displayed tab. Click the tab again to show the summary data table.

| Results : 622.08 Mbps, 127 bits | |
|---------------------------------|----------|
| Data Source: CH1 | RJ (RMS) |
| Decision Threshold: 170.25 uV | DJ |
| Sampling Phase: 50% | DDJ |

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.



See also:

[Working with Plots \(see page 59\)](#)

[Noise Measurement Definitions \(see page 54\)](#)

[Jitter Measurement Definitions \(see page 53\)](#)

[Dual Dirac Measurement Definitions \(see page 53\)](#)

[SSC Modulation Measurement Definitions \(see page 54\)](#)

An application example

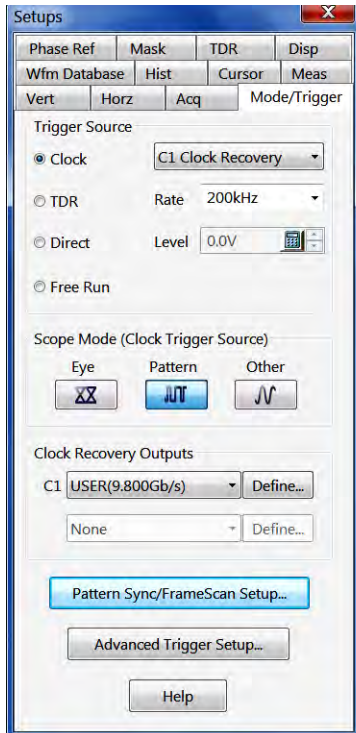
The following example uses the 80SJNB application on an optical signal for fast analysis of BER, Jitter, and Noise. This simplified application example shows how to configure and use the application. This may help you when setting up your own test situation.

Requirements:

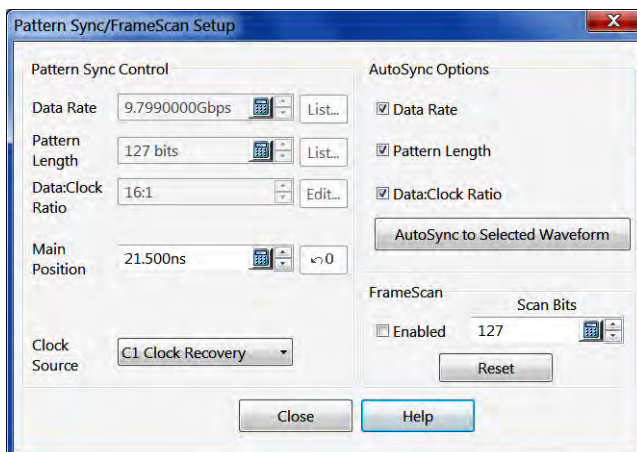
- DSA8300 oscilloscope
- 80SJNB software
- ADVTRIG Advanced Trigger Option installed
- Optical module with clock recovery. The following example uses the 80C11-CR4 Optical Sampling Module.
- SMA cables

Set up the oscilloscope

1. Install the modules and make the signal connections (the example assumes using channel 1 as the signal source).
2. Turn on the instrument and wait for instrument and application startup to complete.
3. Push the **Default Setup** front panel button.
4. Select **Channel 1**.
5. Push the **SETUP DIALOGS** button.
6. Click the **Horz** tab.
7. Set the Horizontal scale to **5 ns**.
8. Click the **Mode/Trigger** tab.



9. Verify that Trigger Source is set to **Clock** and select **C1 Clock Recovery** as the clock source.
10. Click the **Pattern** button in the Scope Mode (Clock Trigger Source) area.
11. Click the **Pattern Sync/FrameScan Setup** button.

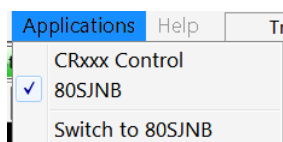


12. Enter the **Data Rate** parameter (for example, 9.8 Gbps).
13. Set the **Pattern Length** parameter (for example, 127 bits).
14. Click **Close**.


NOTE. You should now have a stable signal display on the DSA8300. If not, recheck all settings, signal source, and connections. The 80SJNB application requires a stable signal to acquire data for accurate measurements.

Set up the 80SJNB application

1. Click **Applications > 80SJNB** in the DSA8300 menu to start the 80SJNB application.

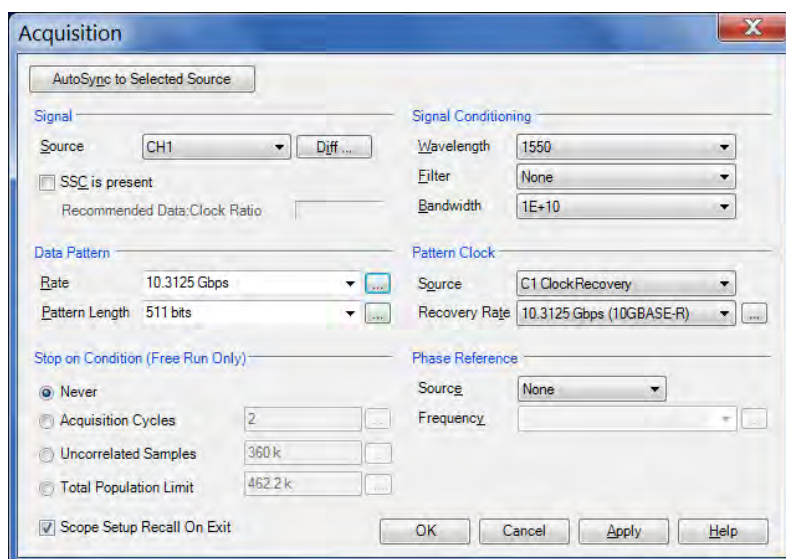


You can also use the Windows 80SJNB desktop shortcut or the Windows Start menu **Start > Programs > Tektronix Applications > 80SJNB > 80SJNB** to start the 80SJNB application.


1. Wait for the 80SJNB application to finish loading.
2. Click the Acquisition button () to open the acquisition dialog box.
3. Most of the configuration settings are already filled in, as the 80SJNB application acquired the values from the oscilloscope configuration. If not, click 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 in this example does not include a Phase Reference module, so set this to **None**.

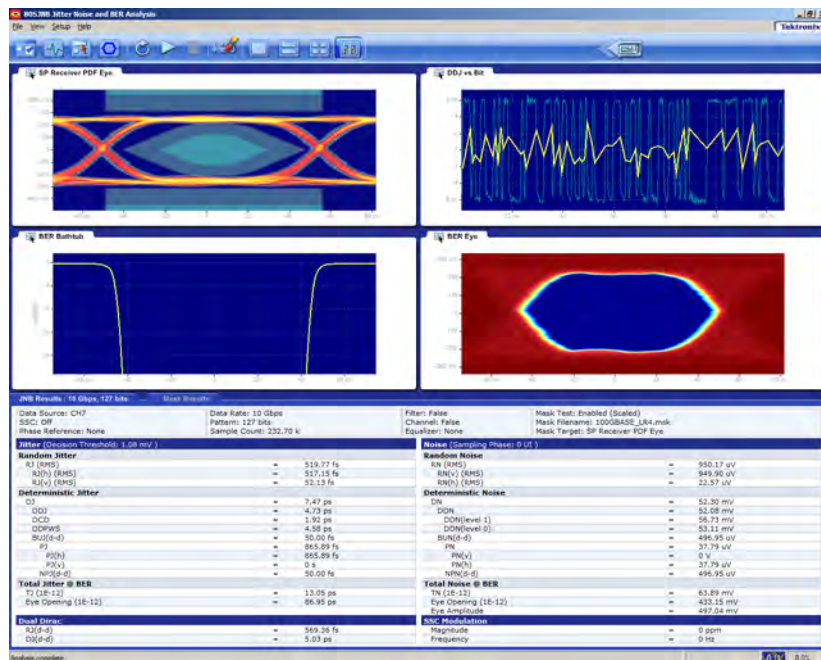


Click **OK** to apply the settings and close the dialog box.

- Click  to start the acquisition and processing cycle.

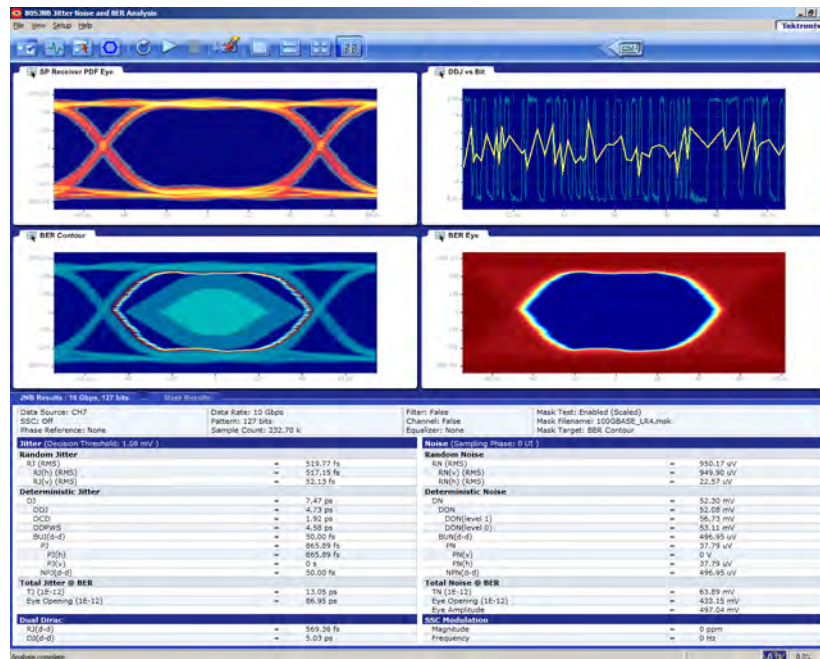
While the cycle is running, you'll see the sequence of events displayed at the bottom of the application display. When the cycle is complete, the application displays the message "Analysis Complete."

- 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


- Click  to minimize the plot displays and show the detailed results table.

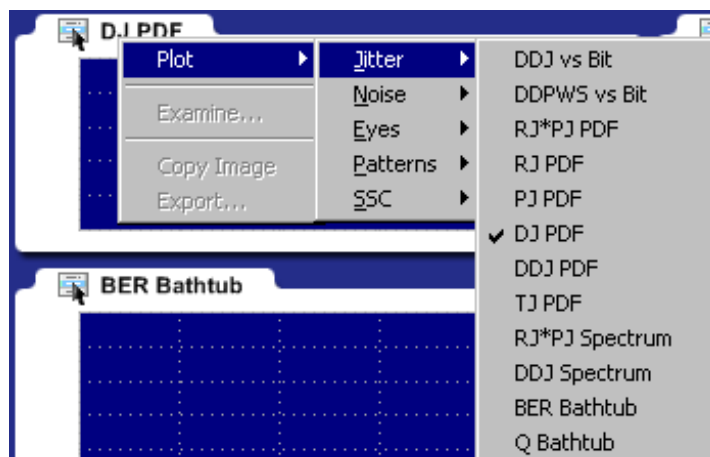


2. Redisplay the plot (or plots) by selecting one of the plot display buttons


Click the **Results** tab to minimize the detailed list to a summary list.

| Jitter Results: 10 Gbps, 127 bits | | | | |
|-----------------------------------|---------------------|-------------|---------------------|-------------|
| Mask Results | | | | |
| Data Source: CH7 | RJ (RMS) | = 519.77 fs | RN (RMS) | = 950.17 uV |
| SSC: OFF | RJ(h) (RMS) | = 517.15 fs | RN(v) (RMS) | = 949.90 uV |
| Phase Reference: None | RJ(v) (RMS) | = 93.13 fs | RND (RMS) | = 23.57 uV |
| Decision Threshold: 1.08 mV | DJ | = 7.47 ps | DN | = 52.50 mV |
| Sampling Phase: 0 UI | DOJ | = 4.73 ps | DOJ | = 52.50 mV |
| Mask Test: Enabled (Scaled) | DOJ1 | = 1.92 ps | DOJ1(level 1) | = 58.73 mV |
| Phase Reference: None | DOJ2 | = 4.58 ps | DOJ2(level 2) | = 53.11 mV |
| Sample Count: 232,70 k | DOJ3 | = 30.00 fs | DOJ3(level 3) | = 496.95 uV |
| | DOJ4 | = 865.89 fs | DOJ4 | = 27.79 uV |
| | DOJ5 | = 0 fs | DOJ5 | = 0 V |
| | DOJ6 | = 50.00 fs | DOJ6 | = 296.95 uV |
| | Total Jitter @ BER | | Total Noise @ BER | |
| | TJ (IE-12) | = 13.05 ps | TN (IE-12) | = 63.89 mV |
| | Eye Opening (IE-12) | = 66.95 ps | Eye Opening (IE-12) | = 433.15 mV |
| | Load Error | | SSC Modulations | |
| | RJ(D-4) | = 565.26 fs | Magnitude | = 0 ppm |
| | DOJ(D-4) | = 5.03 ps | Frequency | = 0 Hz |

3. With the plots now redisplayed, click the Configure Plot icon () on the plot tab to display a drop-down menu for that plot. 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 is displayed based on the data based on the results of the last processing cycle.

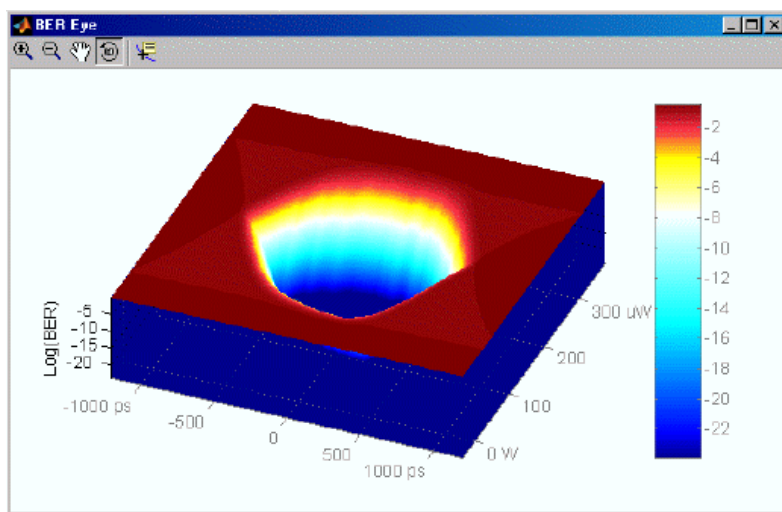
4. To further examine a plot, you can display any plot in a MATLAB window, providing you with more tools to work with the data. Click the Configure Plot () icon and choose **Examine**.

The plot opens in a 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

The following figure shows a 3D BER Eye plot using the rotate function.



Close the window to return 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.

About application parameters

These topics list the 80SJNB application parameters and include the menu default settings. The parameter tables list the selections and startup values for each option.

[Analysis Settings \(see page 77\)](#)

[Acquisition Settings \(see page 78\)](#)

[Signal Path Settings \(see page 79\)](#)

[Mask test settings \(see page 80\)](#)

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

You should refer to the documentation for your TekScope for operating details of the oscilloscope controls.

See also:

[GPIB Reference Materials \(see page 85\)](#)

Analysis settings

This table lists the default Analysis 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 |
|--------------------|----------------------|
| Method | Spectral + BUJ |
| Decision Threshold | Normalized: 50% |
| Time Unit | Seconds |
| Sampling Phase | Unit Intervals: 0 UI |
| Measurement BER | 1.00E-12 |

Acquisition settings

This table lists the default Acquisition 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 |
|----------------------------|--|
| Signal | |
| Source | First valid input channel |
| SSC is present | Checked |
| Difference Waveform | |
| Positive | First valid input channel |
| Negative | blank |
| Data Pattern | |
| Rate | User defined |
| Pattern Length | User defined |
| Stop on Condition | Never |
| Scope Setup Recall On Exit | Checked |
| Signal Conditioning | |
| Wavelength | None |
| Filter | None |
| Bandwidth | blank |
| Pattern Clock | |
| Source | CLOCK INPUT/PRESCALE TRIGGER front panel connector |
| Recovery Rate | blank |
| Phase Reference | |
| Source | None |
| Frequency | blank |

Signal path settings

This table lists the default Signal Path 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 |
|----------------------|------------------|
| Filter | |
| Uncorrelated Scaling | 1.00 |
| Channel | |
| Data Type | Frequency Domain |
| Uncorrelated Scaling | 1.00 |
| Equalizer | |
| Taps | |
| FFE Taps | 1 |
| FFE Taps/Symbol | 1 |
| DFE Taps | 0 |
| Filter | |
| FFE Reference Tap | 1 |
| Uncorrelated Scaling | 1.00 |
| Rise Time Selector | Track Data Rate |
| User Rise Time (ps) | 200 |

Mask test settings

This table lists the default Mask test settings. If you change these settings, they remain in effect for all successive sessions of the applications.

| Control | Startup settings |
|----------------------|---|
| Mask Test Definition | |
| Mask File | None |
| Load browser | C:\Users\Public\Documents\Tektronix\Masks |
| Save browser | C:\Users\Public\Documents\Tektronix\Masks |
| Rate | 10 Gbps |
| Target Hit Ratio | 5.00E-005 |
| Target Mask Margin | 0 |
| Target BER | 1.00E-005 |
| Horizontal Autofit | unchecked |
| Runtime Options | |
| Test Target | SP Receiver PDF Eye |
| Find Mask Margin | selected |
| Measure Hit Ratio | unchecked |
| Measure Hit Ratio | disabled |
| DUT Pass/Fail Test | unchecked |
| All Polygons | checked |
| Center Polygons Only | unchecked |
| Enable Mask Testing | unchecked |

Mask file structure

Tektronix mask files have extension .msk and are in XML format. This table describes the meaning of each field.

| XML element | Description | Status |
|--|------------------------------------|----------|
| <?xml version="1.0" encoding="utf-8"?> | Standard xml header | Required |
| <Tektronix> | Root node of the file | Required |
| <FileVersion> Version x.y.z </FileVersion> | Version of the file | Required |
| <FileCreated>mm/dd/yyyy hh:mm:ss [AM PM]</FileCreated> | Date and time the file was created | Required |

| XML element | Description | Status |
|---|--|----------|
| <StandardName>StandardName</StandardName> | Name of the standard in this file | Required |
| <StandardVersion>StandardVersion</StandardVersion> | Version of the standard in this file | Required |
| <StandardDate>StandardDate</StandardDate> | Date of the standard for this file | Required |
| <StandardSub>Sub</StandardSub> | Additional standard subdivisions | Optional |
| <StandardData> | Data specific to the standard used for multiple sub-elements | Required |
| <SymbolRate>SymbolRate</SymbolRate> | Data (symbol) rate for this standard [numeric] | Required |
| <ModulationScheme>PAM4</ModulationScheme> | Modulation scheme for this standard [NRZ/PAM4] | Required |
| <Pattern>PRBS-7</Pattern> | Data pattern for this standard | Optional |
| </StandardData> | Close for StandardData | Required |
| <MaskTest> | Identifies a mask test set of elements | Required |
| <UIReadoutString>ReadoutString</UIReadoutString> | String displayed in the mask readout area (ex: SATA G2 Tx) | Required |
| <UISelectionString>SelectionString</UISelectionString> | String displayed in the selector or menu (ex: SATA G2 Tx (3.0 Gb/s)) | Required |
| <PIToken>PIToken</PIToken> | String for standard selection from the PI (ex: ATATXG2) | Required |
| <TestParameters> | Standard specified parameters related to the mask | Optional |
| <TargetHitRatio>TargetHitRatio</TargetHitRatio> | | Optional |
| <TargetHits>TargetHits</TargetHits> | Target number of hits for this standard [numeric] (ex: 100) | Optional |
| <UnitIntervalSamples>UIS</UnitIntervalSamples> | Required number of UI samples for this standard [numeric] (ex:1000000) | Optional |
| <TargetBER>TargetBER</TargetBER> | Target BER for this standard [numeric] (ex: 1e-12) | Optional |
| <BERTargetEnabled>bool</BERTargetEnabled> | Whether Target BER is used [True/False] | Optional |
| <HorizontalAdjustAllowed>bool</HorizontalAdjustAllowed> | Whether horizontal adjustment of the mask is allowed during testing | Optional |
| <VerticalAdjustAllowed>bool</VerticalAdjustAllowed> | Whether vertical adjustment of the mask is allowed during testing | Optional |
| </TestParameters> | Close for TestParameters | Optional |
| <Mask> | Identifies a set of mask polygons | Required |
| <Name>Rx Mask</Name> | Name of this mask | Optional |
| <MaskType>MaskType</MaskType> | Type of mask: Relative Absolute | Required |

| XML element | Description | Status |
|--|--|----------|
| <VerticalScale>VerticalScale</VerticalScale> | Vertical scale to use if mask is absolute [numeric] | Required |
| <PolygonGroup> | Groups of polygons for this mask | Required |
| <Name>GroupName</Name> | Name for this polygon group | Optional |
| <NumPolygons>n</NumPolygons> | Number of polygons in this group [numeric ≥ 1] | Required |
| <Polygon0> | First polygon definition | Required |
| <Name>PolygonName</Name> | Name of this polygon | Optional |
| <PolygonType>Overshoot</PolygonType> | Overshoot, Center, or Undershoot | Required |
| <Symmetry>VerticalAxisReflection</Symmetry> | HorizontalAxisReflection, VerticalAxisReflection, BothAxesReflection or None | Required |
| <NumVertices>m</NumVertices> | Number of vertices in this polygon [numeric] | Required |
| <PointX0>p</PointX0> | X value for the first vertex [numeric] | Required |
| <PointY0>p</PointY0> | Y value for the first vertex [numeric] | Required |
| <PointX1>p</PointX1> | X value for the second vertex [numeric] | Required |
| <PointY1>p</PointY1> | Y value for the second vertex [numeric] | Required |
| ... | Additional vertices as needed | Optional |
| </Polygon0> | Close for Polygon0 | |
| ... | Additional polygons as needed | Optional |
| </PolygonGroup> | Close for PolygonGroup | Required |
| </Mask> | Close for Mask | Required |
| </MaskTest> | Close for MaskTest | Required |
| <Source> | Specification data for sources for this standard | Optional |
| <Amplitude>A</Amplitude> | Source amplitude specification for this standard | Optional |
| </Source> | Close for Source | Optional |
| </Tektronix> | Close for Root | Required |

Notes:

- **MaskType:** For Relative masks the X and Y coordinates of Center polygons are in the range [0-1], this being both the horizontal and vertical ranges of a unit interval.
- **PolygonType:** A mask can have at most one Undershoot polygon and one Overshoot polygon. A PAM4 mask will usually have 3 Center polygons.

- **Symmetry:** This field for a polygon is an indicator for a polygon editor as to the symmetry imposed on the polygon by the standard. It is up to the polygon editor to enforce this.
- **NumVertices:** This field for a polygon must be at least 2 for an Overshoot or Undershoot polygon and at least 3 for a Center polygon.

Remote control introduction

The 80SJNB software application can be controlled programmatically through the programmatic interface of the sampling oscilloscope on which it is running. Communication with the application is accomplished using VARIABLE:VALUE remote GPIB commands.

Your 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.

Because the oscilloscope software hosts the GPIB interface for the 80SJNB application, there is some additional information that is helpful for successful programming.

See also:

[GPIB Reference Materials \(see page 85\)](#)

[Programming Tips \(see page 86\)](#)

[Variable:Value Commands \(see page 87\)](#)

[Results Queries \(see page 95\)](#)

[Programming Examples \(see page 98\)](#)

GPIB reference materials

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

- The [Programming Examples \(see page 98\)](#) topic for guidelines to use while designing a GPIB program.
- The online Programmer Guide for the TekScope.

See also:

[Starting and Setting Up the Application Using GPIB \(see page 85\)](#)

Programming tips

Launching 80SJNB

Use the following command (issued for the DSA8300 instrument) to launch the 80SJNB application:

APPLI CATI ON: ACTI VATE "80SJNB"

How the variable value table works

Programmable Interface (PI) commands for the 80SJNB software package (JNB) are implemented using a variable/value table. This table associates named variables with text values. These values can be set (variable:value "VariableName","VariableValue") or queried (variable:value? "VariableName") from the PI. When a set command is received, if the variable does not already exist in the table, it is created and the specified value is associated with that variable. If the variable is already in the table, the specified value will replace the existing value. There is no checking done by the table on variable names or values. Since both items are strings, any arbitrary pair of strings can be associated with each other in this table.

Polling and limit of variable values

Each time a change is made to a variable's value in the table, an event is generated. The 80SJNB software application polls the oscilloscope software application every 200 ms to see if an event occurred. If so, JNB queries for the event information which tells JNB which variable changed and the new value. JNB parses this information to find the variables pertinent to its operation and reads the new values for those variables. These new values can change the state of JNB (for example selecting a new data source channel) or can cause JNB to perform an operation (for example, setting "SequencerMode" to "Run").

Because JNB polls for changes at a fixed rate, the oscilloscope application might indicate that a list of variables has changed since the last time JNB polled for changes. There are two consequences of this operation.

- First, when JNB receives a list of changes, it does not necessarily execute those changes in the order in which they were sent to the oscilloscope from the PI. This means that sending a command to change the data source (for example, "DataSource","C1") followed immediately by starting sequencing ("SequencerState","Run") does not guarantee that the source channel is changed before JNB begins the sequencing operation. To be sure of proper execution order of these commands, a delay of at least 400 ms should be inserted before starting certain JNB operations.

Commands that should be preceded by a delay include:

- “SequencerState”, ”Run”
 - “ExportCurve”, ”GO”
 - “SaveRecallData”, ”Save”
 - “SaveRecallData”, ”Recall”
 - “Setup”, ”Save”
 - “Setup”, ”Recall”
- Second, there is a limit of 15 variable/value table changes that can be reported for any one polling event. If more than 15 changes have occurred between JNB polls of the oscilloscope software, the later changes will not be seen by JNB so it will not respond to those commands.

How the variable value table is updated

JNB only updates table entries when it has new data to report. For example, if an error occurs during sequencing, the variables “ErrorCode” and “ErrorMessage” are updated by JNB with the appropriate values. However, JNB will only update those variables if another error occurs. If a subsequent sequence is run without errors, the “ErrorCode” and “ErrorMessage” variables will continue to report the old values. The user program must be written to explicitly clear these variables, setting the variables to null strings (“”) before starting a new sequence.

Variables that should be set to null strings (“”) before starting a sequence operation include:

- ErrorCode
- ErrorMessage
- DataReady

Determining if 80SJNB is running

The “Application” variable shows whether 80SJNB is running or not. When it is running, this variable is set to “80SJNB”. When JNB exits normally, the variable is set to “Done”. However, if JNB encounters an error and exits abnormally, it will not set the “Application” variable to “Done”, leaving the variable set to “80SJNB”. In this circumstance, it is not possible to use this variable to determine if JNB is running. One way to reliably determine if JNB is running is to set the “PatternLength” variable to “1”. If JNB is running, it will set this variable to “2” since 2 is the minimum allowable value for “PatternLength”. If JNB is not running, the variable value will remain at “1”. Be sure to wait at least 400 ms after setting the value to “1” before querying the status of this variable.

Syntax

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

To set a variable to a value:

VARIABLE: VALUE "<VariableName>", "<VariableValue>"

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>

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

See also:

[Variable:Value Command Arguments and Queries \(see page 88\)](#)

[GPIB Commands Error Codes \(see page 97\)](#)

[Programming Examples \(see page 98\)](#)

Arguments and queries

| Name | Value | Function | Query form returns |
|--------------------------|---|--|--|
| AcqCycleCount | Positive integer number larger than 2 | Sets or returns the acquisition cycle count | Current value |
| AnalysisMethod | {CDF Spectral} | Sets the jitter and noise analysis method. Spectral is legacy. Default is CDF (Cumulative Distribution Function) | Current value |
| Application | Exit | Exits the application | Done |
| Application (Query only) | | Returns which application is running | "80SJNB" if the application is running, or "Done" if application has exited. |
| Bandwidth | Any valid bandwidth as defined by the selected source module | Sets or returns the bandwidth in Hertz for use when Filter is set to None | Current value |
| BER | Any valid floating point value between 1e-3 and 1e-24 inclusive | Sets or returns the current BER value | Current value |
| CeActive | {True False} | Activates or deactivates the channel emulator | True, False |

| Name | Value | Function | Query form returns |
|-------------------------|--|--|---|
| CeDomain | Time Frequency | Sets the domain in which the channel characteristics are defined | Current value |
| CeFdSParametersFile | Full path name of a file name | Defines the channel's S-parameter | Current value |
| CeFd2PortMatrixSelector | {11 12 21 22} | Selects an S-parameter when using a 2-port Touchstone file | Current value |
| CeFd4PortDataType | {SingleEnded Differential} | Selects the type of data when using a 4-port Touchstone file | Current value |
| CeFd4PortLayout | {DC21 CD21 12DC 12CD} | Sets the data arrangement used by a 4-port Touchstone file containing Differential data | Current value |
| CeFd4PortMapping | Any permutation of 1234 (for example, 1234, 1324 or 2143) | Sets the port mapping used by a 4-port Touchstone file containing SingleEnded data | Current value |
| CeTdReferenceFile | Full path name of a file name | Defines the time domain reference waveform | Current value |
| CeTdTransmissionFile | Full path name of a file name | Defines the time domain transmission waveform | Current value |
| CeUncorrelatedScaling | Any number in the range 0.01-100.0 | Sets the Channel uncorrelated scaling factor Overall signal path uncorrelated scaling factor is a product of all active uncorrelated scaling values | 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 |
| ClockSource | {ClockPrescale C1ClockRecovery C1CRClockPrescale C3ClockRecovery C3CRClockPrescale} | Sets or returns the clock source | Current value |
| DataRate | Any valid positive floating point value or communication standard | Sets or returns the expected data rate | Communication standard or 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 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 |
| DataSource | {CH1 CH2 CH3 CH4 CH5 CH6 CH7 CH8 MATH1 MATH2 MATH3 MATH4 MATH5 MATH6 MATH7 MATH8 <file name >} | Sets or returns the data source Math expressions must be programmed through the oscilloscope GPIB interface commands | Current value file name is the name of the file recalled |
| 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 |
| 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 |
| EqActive | {True False} | Activates or deactivate the equalizer | True or False |
| EqAutosetTaps | {Run} | Automatically computes the equalization coefficients SpCompute must be run first | Current value or Done, Error |
| EqDFETaps | An integer in the range 1-40 | Sets the number of DFE taps | Current value |
| EqDFETapCoefficient<n> where <n> is in the range 1-40 | Any number in the range -100.0 to +100.0 | Sets the value of a DFE tap coefficient | Current value |
| EqDefaultDFETaps ² | {Run} | Sets the DFE taps to default values | Current value or Done, Error values |

| Name | Value | Function | Query form returns |
|--|--|--|---|
| EqDefaultFFETaps ² | {Run} | Sets the FFE taps to default values | Current value or Done, Error values |
| EqFFEReferenceTap | An integer in the range 1 – EqFFETaps | Selects the FFE reference tap EqFFEReferenceTap-1 must be an integer (possibly 0) multiple of EqFFETapsPerSymbol | Current value |
| EqFFETaps | An integer in the range 1-100 | Sets the number of FFE taps | Current value |
| EqFFETapsPerSymbol | One of 1, 2, 5, 10 but not larger then EqFFETaps | Sets the number of FFE taps per symbol or unit interval | Current value |
| EqFFETapCoefficient<n> where <n> is in the range 1–100 | Any number in the range -100.0 to +100.0 | Sets the value of an FFE tap coefficient | Current value |
| EqLoadTaps ² | {Run} | Loads the equalizer configuration from a file | Current value or Done, Error |
| EqRiseTimeSelector | {DataRate TapInterval User} | Defines how the equalizer rise time is determined | Current value |
| EqSaveTaps ² | {Run} | Saves the equalizer configuration to a file | Current value or Done, Error |
| EqTapsFilename | Full path name of a file | Sets the file used for EqLoadTaps and EqSaveTaps | Current value |
| EqUncorrelatedScaling | Any number in the range 0.01-100.0 | Sets the Equalizer uncorrelated scaling factor Overall signal path uncorrelated scaling factor is a product of all active uncorrelated scaling values | Current value |
| EqUserRiseTime | An integer in the range 1-4000 | When EqRiseTimeSelector is set to User, this defines the rise time in picoseconds | Current value |
| ErrorCode | | Returns a numeric code corresponding to the last error or 0 if no error | Current value |
| ErrorMessage | | Returns the last error message | Current value |
| ExportCurve ^{2 3} | {GO} | Sets or returns the export action | Current value or Done, Error Error is returned if export is unsuccessful |
| ExportFilename | <file name > ¹ | Sets the file name used when exporting data | |

| Name | Value | Function | Query form returns |
|-----------------------|---|---|-------------------------------------|
| ExportFormat | {CSV, MAT} | Sets or returns the current plot diagram export format | Current value |
| ExportResults | {GO} | Initiates the export results action to the file specified by ExportFilename | Export action status: Done or Error |
| ExportType | ACQWFM CORRWFM, RJPDF PJPDF RJPJPDF RJPJSPEC DDJPDF DJPDF DDJSPEC TJPDF DDJ HBATH QHBATH RNPDF PNPDF RNPNPDF RNPNSPEC DDNPDF DNPDF DDNSPEC TNPDF DDN VBATH QVBATH BEREYE QEYE PDFEYE CORREYE BERCONTOUR SPCHANPDFEYE SPCHANWFM SPFILTWFM SPFILTPDFEYE SPINPDFEYE SPINWFM SPEQWFM SSCPROFILE | Sets or returns the type of export to perform | Current value |
| FiActive | {True False} | Activates or deactivates the filter | True, False |
| FiFilename | Full path name of a file name | Defines the filter file | Current value |
| FiUncorrelatedScaling | Any number in the range 0.01-100.0 | Sets the Filter uncorrelated scaling factor Overall signal path uncorrelated scaling factor is a product of all active uncorrelated scaling values | Current value |
| Filter | Any valid communication standard as defined by the selected source module | Sets or returns the communication standard of the source | Current value |
| GraphSelection1 | name of graph to display | Sets or returns the graph in box 1 | Current value |
| GraphSelection2 | name of graph to display | Sets or returns the graph in box 2 | Current value |
| GraphSelection3 | name of graph to display | Sets or returns the graph in box 3 | Current value |
| GraphSelection4 | name of graph to display | Sets or returns the graph in box 4 | Current value |
| MaskFilename | path+name | Sets or returns the mask file being used | Current file |
| MaskHorShiftAllowed | "True" or "False" | Turn mask shifting on or off | Current setting |

| Name | Value | Function | Query form returns |
|-------------------------|--|---|--|
| MaskTestEnabled | "True" or "False" | Turn mask testing on or off | Current setting |
| MaskPolygonSet | "All" or "Center" | Select mask polygons to use with PDF eyes | Current polygon set |
| MaskTarget | either "BER Contour" or "SP Receiver PDF Eye" | Select graph to apply mask to | Current graph |
| MaskTargetBER | number in range [0,1] | Set target BER | Current value |
| MaskTargetHitRatio | number in range [0,1] | Set target hit ratio | Current value |
| MaskTargetMaskMargin | number in range [-99,+100], not necessarily an integer | Set target mask margin | Current value |
| MaskTestType | "PassFail", "MaskMargin" or "HitRatio" | Select type of mask test | Current mask test |
| PatternLength | Any integer value between 2 and 100,000 | Sets or returns the data pattern length in bits | Current value |
| PhaseReferenceEnabled | | Indicates whether the data was acquired with a phase reference unit active or not for both acquired and recalled data | True, False |
| PhaseReferenceFrequency | Any valid phase reference frequency as defined by the selected phase reference source module | Sets or returns the phase reference frequency | Current value |
| 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 |
| PrintToFile | path\file | Print an image of all results to a file | "Run" when busy, "Done" or "Error" when complete |
| RecallDataFilename | <file name > ¹ | Specifies the name of the file when recalling a saved data file | |
| RecallFilename | <file name > ¹ | Sets the name of the file when recalling a setup | |
| SamplingPhase | Any valid floating point value between -0.5 and +0.5 inclusive | Sets or returns the normalized sampling point value | Current value |
| SamplingPhaseAbs | Any valid floating point value | Sets or returns the absolute sampling point value | Current value |

| Name | Value | Function | Query form returns |
|-----------------------------|--|--|---|
| SamplingPhaseUnits | {Absolute, Normalized} | Sets or returns the desired sampling point value to use. If the units are set 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 |
| SaveDataFilename | <file name > ¹ | Sets the file name used when saving data files | |
| SaveFilename | <file name > ¹ | Sets the file name used when saving setup files | |
| SaveRecallData ³ | {Save, Recall} | Save saves the acquired data to the file name specified by the command SaveDataFilename Recall recalls the acquired data from the file name specified by the command RecallDataFilename | Done, Error Error is returned if unsuccessful |
| ScopeSettingRecall | {True False} | Sets or returns the option of recalling scope setup stored when starting the application | Current value |
| SequencerMode | {SingleSequence, FreeRun} | Sets the sequencer mode Startup default is Free Run | Sequencer mode |
| SequencerState ³ | {Run Pause Stop} | Sets or returns the Measurement Sequencing or the Stop Sequencing command | Sequencer state |
| Setup ³ | {Recall Save Default} | Performs the Save/Recall/Default setup action | Current value or Done, Error Error is returned if unsuccessful |
| SpCompute ² | {Run} | Recomputes results with the latest Signal Path definition on the acquired data | Current value or Done, Error |
| SSC | {True False} | Selects whether SSC is present in the signal Setting to True requires a phase reference module to be installed and configured | Current value |
| StopOnCondition | {Never AcqCycle UncorrCount TotalPopulation} | Sets or returns the selected Stop on Condition when in Free Run | Current value |

| Name | Value | Function | Query form returns |
|----------------------|---|--|------------------------|
| TimeUnits | {S UI} | Sets or returns the units for the time scale | S, UI |
| TotalPopCount | Positive integer number | Sets or returns the total sample count | Current value |
| UncorrCount | Positive integer number | Sets or returns the uncorrelated sample count | Current value |
| Version (Query only) | | Returns the version number of the installed 80SJNB application | Current version number |
| WLength | Any valid wavelength as defined by the selected source module | Sets or returns the wavelength of the sources | Current value |

- ¹ <file name > is a string of 1 to 40 characters that are valid for file names according to the Windows file system standards.
- ² After running the default setup command, this argument is not initialized and a query returns an empty string "".
- ³ Command should be preceded by a delay of at least 400 ms.

Variable:Value results queries

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

| Value | Function |
|-------------|---|
| Application | Returns 80SJNB or 80SJARB |
| BUJDD | Returns the Bounded Uncorrelated Jitter |
| BUNDD | Returns the Bounded Uncorrelated noise. |
| DCD abc | Returns the Duty Cycle Distortion. |
| DDJ | Returns the Data Dependent Jitter. |
| DDN | Returns the Data Dependent Noise. |
| DDN0 | Returns the Data Dependent Noise on logical level 0. |
| DDN1 | Returns the Data Dependent Noise on logical level 1. |
| DDPWS | Returns the measured Data Dependent Pulse Width Shrinkage. |
| DJ | Returns the measured deterministic jitter. |
| DJDD | Returns the Deterministic Jitter computed in the Dual Dirac model. |
| DN | Returns the measured deterministic noise. |
| 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. |
| EOH | Returns the Horizontal Eye Opening at user specified BER. |
| EOV | Returns the Eye Opening at user-specified BER. |

| Value | Function |
|-----------------------|--|
| MaskBERLimit | Returns a number in the range 1e-24 to 1.0. |
| MaskBERMaskMargin | Returns the BER mask margin in the range -99.0 to +100.0. |
| MaskCenterPolygon | Returns the hit ratio in the range 0-1. |
| MaskDataDefined | Returns ("True" or "False") whether the mask test is defined. |
| MaskGlobalHitRatio | Returns the global hit ratio in the range 0-1. |
| MaskGlobalMaskMargin | Returns the mask margin in the range -99.0 to +100.0. |
| MaskHorizontalShift | Returns the mask shift in seconds. |
| MaskModulation | Returns "NRZ" or "PAM". |
| MaskOvershootPolygon | Returns the hit ratio in the range 0-1. |
| MaskPassFailStatus | Returns "Pass", "Fail" or "N/A" |
| MaskStandardName | Returns the standard for which the mask was defined. |
| MaskUndershootPolygon | Returns the hit ratio in the range 0-1. |
| NPJDD | Returns non periodic jitter |
| NPNDD | Returns non periodic noise |
| 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. |
| 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). |
| 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). |
| RJDD | Returns the Random Jitter computed in the Dual Dirac model. |
| 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. |
| SampleCount | Returns the total sample count acquired and processed while running. |
| TJ | Returns the Total Jitter at user-specified BER. |
| TN | Returns the Total Noise at user-specified BER. |

| Value | Function |
|---------|---|
| SSCfreq | Returns the spread spectrum clock modulation frequency. |
| SSCmag | Returns the spread spectrum clock modulation magnitude. |

GPIB commands error codes

| Error code | Description |
|------------|--|
| -1 | Read error message, no error code available NOTE. If an error code of -1 is returned, use the Error Message query for error condition details. |
| 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 on; turn them off to continue |
| 12 | Trigger failure, check your configuration |
| 13 | The pattern is not synchronized or is too small |
| 14 | Cannot export the curve |
| 15 | Could not analyze edge |
| 16 | Histogram testing is on; turn it off to continue |
| 17 | Mask testing is on; turn it off to continue |
| 18 | One or more measurements are on; turn them off to continue |
| 19 | Waveforms other than 80SJNB signal source are on; turn them off to continue |
| 20 | Save setup failed |
| 21 | Recall setup failed |
| 22 | The channel does not support wavelength |
| 23 | Curve has multiple components |
| 24 | A Mag View is on; turn it off to continue |
| 25 | SSC activation failed; phase reference module required |
| 26 | SSC activation failed; setup phase reference module |
| 27 | Save data failed |
| 28 | Recall data failed |

Programming examples introduction

An example of communicating with the 80SJNB application using VARIABLE:VALUE remote GPIB commands is to simply start the application by sending the following command:

APPL i cati on: ACTi vate "80SJNB"

A more extensive program example steps you through the following actions:

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.

Program examples:

[Configure and Operate the 80SJNB \(see page 98\)](#)

[Measuring Jitter in Presence of SSC \(see page 100\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 102\)](#)

See also:

[About the GPIB Program and Guidelines \(see page 85\)](#)

[GPIB Reference Materials \(see page 85\)](#)

[Variable:Value Command \(see page 87\)](#)

[Results Queries \(see page 95\)](#)

Program example: configure and operate 80SJNB

The following sequence of commands shows 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. *The examples presume that you are familiar with designing GPIB programs.*

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.
APPLI CATI ON: ACTI VATE "80SJNB"
2. Set the signal source channel, data rate, and pattern length to be analyzed.
VARI ABLE: VALUE "DataSource", "CH1"
VARI ABLE: VALUE "DataRate", "10. 3125e9"
VARI ABLE: VALUE "PatternLength", "32767"
3. Set the following variables before starting the analysis. The application updates these values to signal the application's analysis state.
VARI ABLE: VALUE "DataReady", "Fal se"
VARI ABLE: VALUE "ErrorCode", ""
4. Start the acquisition and processing cycle.
VARI ABLE: VALUE "SequencerState", "Run"
5. Check the state of the acquisition and processing cycle.
Query the following variables:
VARI ABLE: VALUE? "DataReady"
VARI ABLE: VALUE? "SequencerState"
Loop until DataReady is True or SequencerState is Stop.
6. Check to see if there were errors.
VARI ABLE: VALUE? "ErrorCode"
If the response for ErrorCode is not 0 then an error has occurred. Query
VARI ABLE: VALUE? "ErrorMessage"
to retrieve the error message.
7. If the DataReady variable is set to True (queried in step 5), you can query for measurement results. For example to query the deterministic jitter:
VARI ABLE: VALUE? "DJ"
8. You can also export the plot data. The following commands set the format, data to export, file name, and then exports the data.
VARI ABLE: VALUE "ExportFormat", "CSV"
VARI ABLE: VALUE "ExportType", "DJPDF"
VARI ABLE: VALUE "ExportFi l e name", "C: \Users\<username>\Documents\
myDJPDF. csv"
VARI ABLE: VALUE "ExportCurve", "GO"
9. Query the ExportCurve variable to determine when the data export has completed:

VARIABLE: VALUE? "ExportCurve"

The application sets the ExportCurve value to "Done" when the data is exported.

Program examples:

[Measuring Jitter in Presence of SSC \(see page 100\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 102\)](#)

Program example: measuring jitter in presence of SSC

The following instruction sequence shows jitter analysis in the presence of SSC and the measurement of the SSC characteristics.

NOTE. *The examples presume that you are familiar with designing GPIB programs.*

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

NOTE. *The measurement system configuration should include a correctly set up and configured Tektronix BERTScope CR series instrument (clock recovery instrument, or CRI) that supports SSC.*

An 82A04 Phase Reference module is required for measuring signals that contain SSC.

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

VARIABLE: VALUE "DataSource", "CH1"

VARIABLE: VALUE "DataRate", "3e9"

VARIABLE: VALUE "PatternLength", "127"

3. Initialize analysis state and error code.

VARIABLE: VALUE "DataReady", "False"

VARIABLE: VALUE "ErrorCode", ""

4. Tell 80SJNB to look for SSC.

VARIABLE: VALUE "SSC", "True"

5. Set up the phase reference module source and frequency since it is required for SSC analysis

VARIABLE: VALUE "PhaseReferenceSource", "C7_C8"

VARIABLE: VALUE "PhaseReferenceFrequency", "3e9"

6. Set up the BERTScope clock recovery unit that supports SSC. Set clock frequency to **3e9**. Refer to the documentation for the BERTScope for more details.

The following table lists recommended settings:

| Data rate range | Clock recovery frequency (CRI) | Clock recovery output rate (CRI) | Recommended Data:Clock ratio (JNB) | Phase reference frequency (JNB) |
|--------------------|--------------------------------|----------------------------------|------------------------------------|---------------------------------|
| 500 Mbps – 1 Gbps | Data Rate * 4 | Standard | 1:4 | Data Rate * 4 |
| 1 Gbps – 2 Gbps | Data Rate * 2 | Standard | 1:2 | Data Rate * 2 |
| 2 Gbps – 4 Gbps | Data Rate | Standard | 1:1 | Data Rate |
| 4 Gbps – 8 Gbps | Data Rate | Subrate (1/2) | 2:1 | Data Rate/2 |
| 8 Gbps – 12.5 Gbps | Data Rate | Subrate (1/4) | 4:1 | Data Rate/4 |

7. Clear the error code to prepare for starting the application.

VARIABLE: VALUE "ErrorCode", ""

8. Start the acquisition and processing cycle.

VARIABLE: VALUE "SequencerState", "Run"

9. Check the state of the acquisition and processing cycle. Query the following variables:

VARIABLE: VALUE? "DataReady"

VARIABLE: VALUE? "SequencerState"

Loop until DataRead is True or SequencerState is Stop.

10. Check if there were errors:

VARIABLE: VALUE? "ErrorCode"

If the response for ErrorCode is not 0, then an error has occurred. Query:

VARIABLE: VALUE? "ErrorMessage"

11. If the DataReady variable is set to True, and no errors have occurred, you can query for measurement results.

For example to query the periodic jitter and total jitter:

VARIABLE: VALUE? "PJ"

VARIABLE: VALUE? "TJ"

12. Query for SSC measurements, magnitude and frequency.

VARIABLE: VALUE? "SSCmag"

VARIABLE: VALUE? "SSCfreq"

13. You can also export the SSC profile. The following commands set the format, data to export, file name, and then export the data.

VARIABLE: VALUE "ExportFormat", "CSV"

VARIABLE: VALUE "ExportType", " SSCPROFILE "

VARIABLE: VALUE "ExportFilename", "C:\Users\<username>\Documents\mySSCprofile.csv"

VARIABLE: VALUE "ExportCurve", "GO"

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

VARIABLE: VALUE? "ExportCurve"

The application sets the ExportCurve value to "Done" when the data is exported.

Program examples:

[Configure and Operate the 80SJNB \(see page 98\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 102\)](#)

Program example: compensating for signal path impairments with equalization

The following programming example shows a sequence of commands that configures the Signal Path with a Channel emulator that causes severe ISI. Then an Equalizer is inserted and configured to compensate for the effects of the ISI and assess the results of equalization by measuring data dependent jitter and vertical eye opening.

NOTE. The examples presume that you are familiar with designing GPIB programs.

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

NOTE. The 80SJNB Advanced option must be enabled. The S-parameter file is available from examples, *Sdd21.s1p*, located in My Documents.

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.

VARIABLE: VALUE "DataSource", "CH1"

VARIABLE: VALUE "DataRate", "9.95328e9"

VARIABLE: VALUE "PatternLength", "127"

3. Initialize the analysis state and error code.

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 variables:

VARIABLE: VALUE? "DataReady"

VARIABLE: VALUE? "SequencerState"

Loop until DataReady is True or SequencerState is Stop.

6. Check if there were errors.

VARIABLE: VALUE? "ErrorCode"

If the response for ErrorCode is not 0, then an error has occurred. Query:

VARIABLE: VALUE? "ErrorMessage"

7. If the DataReady variable is set to True and no error has occurred, you can query for measurement results. Query the data dependent jitter and vertical eye opening:

VARIABLE: VALUE? "DDJ"

VARIABLE: VALUE? "EOV"

8. Select an S-parameter file from the examples provided, and insert the Channel emulator into the Signal Path.

VARIABLE: VALUE "CeDomain", "Frequency"

VARIABLE: VALUE "CeFdSParametersFile", "C:\Users\<username>\Documents\Sdd21.s1p"

VARIABLE: VALUE "CeActive", "True"

9. Recompute the Signal Path and measure DDJ and vertical eye opening again.

VARIABLE: VALUE "SpCompute", "Run"

Wait and query the recomputation state for completion. When completed, SpCompute query will return Done, unless an error is encountered, in which case state will return Error.

VARIABLE: VALUE? "SpCompute"

VARIABLE: VALUE? "DDJ"

VARIABLE: VALUE? "EOV"

NOTE. Note the values of DDJ and EOV.

10. Compute an optimal set of tap coefficients for a specified number of FFE and DFE taps by running Autoset Taps.

VARIABLE: VALUE "EqFFETaps", "20"

VARIABLE: VALUE "EqDFETaps", "10"

VARIABLE: VALUE "EqAutosetTaps", "Run"

Test for completion by querying the state of autoset. It will return Run before completion, then Done or Error. If data is not recognized as a PRBS pattern, an error condition is returned.

VARIABLE: VALUE? "EqAutosetTaps"

11. Save the taps in a file.

VARIABLE: VALUE "EqTapsFilename", "C:\Users\<user name>\Documents\myTaps.tap"

VARIABLE: VALUE "EqSaveTaps", "Run"

Check for completion by querying:

VARIABLE: VALUE? "EqSaveTaps"

12. Insert the Equalizer in the Signal Path with the newly configured equalization taps.

VARIABLE: VALUE "EqActive", "True"

13. Recompute the Signal Path again with the Equalizer inserted.

VARIABLE: VALUE "SpCompute", "Run"

Wait and query the recomputation state for completion. When completed, query SpCompute until it is not Run. Then check to see if the result is Done or Error.

VARIABLE: VALUE? "SpCompute"

14. If SpCompute query is Done, ask for measurement results.

VARIABLE: VALUE? "DDJ"

VARIABLE: VALUE? "EOV"

NOTE. Record the values of DDJ and EOV and compare with the previous two sets, looking for the effects of the Channel and the Equalizer.

Program examples:

[Configure and Operate the 80SJNB \(see page 98\)](#)

[Measuring Jitter in Presence of SSC \(see page 100\)](#)

About measurement algorithms

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

1. Go to the Tektronix Web site www.tektronix.com.
2. Enter “Jitter and Noise Analysis” in the Downloads **Enter Model Number** field.
3. Click **GO**.

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 Analysis 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.

Correlation to real-time oscilloscope jitter measurements

Recent correlation studies are available upon request. Please contact your Tektronix Customer Support representative for more information. Jitter measurement and timing analysis information is available at www.tek.com (enter jitter in the **Enter Model Number** field, and select **Application Notes** as the document type).

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