

80SJNB
Jitter, Noise, BER, and Serial Data Link Analysis Software
Printable Online Help



077-0641-01

Tektronix

80SJNB
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Printable Online Help

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This document supports 80SJNB software version 3.0.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:

- Performs 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)
- Acquires complete pattern waveform at 100 Samples/UI
- Performs random and deterministic jitter analysis including BER estimation
- Isolates and measures crosstalk in form of bounded uncorrelated jitter (BUJ)
- Displays results graphically including histograms, spectra, and bathtub curves
- Displays 2-D eye diagrams (correlated eye, probability density function (PDF) eye, and bit error rate (BER) eye)
- Saves complete acquisition results to a data file
- Analysis of 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 \(see page 11\).](#)

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 \(see page 75\)](#)

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 Online Help Information

The online help contains the following topics:

- Getting Started topics briefly describes the application and its requirements.
- Operating Basics topics cover basic operating principles of the application. The sequence of topics reflects the steps you perform to operate the application.
- Parameters topics cover the 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 \(see page 5\)](#)

Online Help Use

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

- 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 0.5 Gb/s to greater than 60 Gb/s
- 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)
- Supports FFE and DFE equalization
- Allows user defined linear arbitrary filters
- Supports Channel Emulation (from TDR/TDT and S-parameter based channel descriptions)
- Analysis of 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 \(see page 8\)](#)

[An Application Example \(see page 65\)](#)

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.

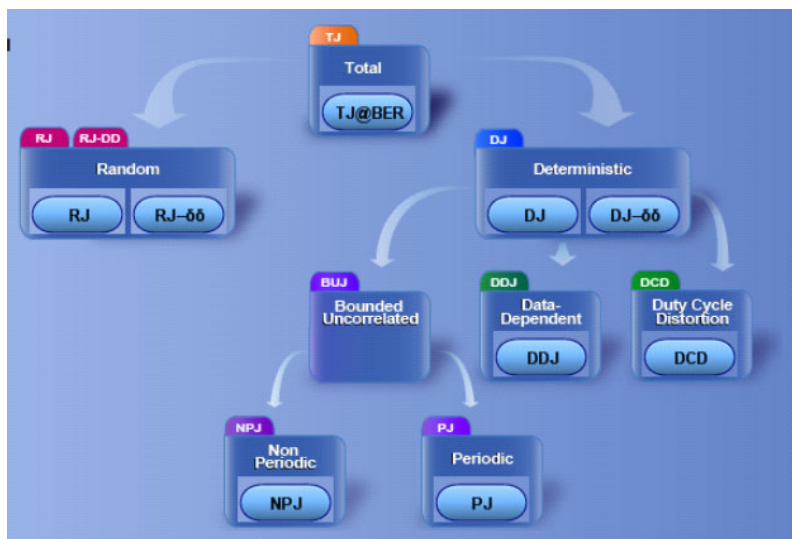
Two components need to be added to the traditional jitter analysis:

- 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.

For information on the separation and analysis techniques used for jitter and noise analysis, download the Tektronix white paper *Tektronix CSA/TDS8200 Jitter Analysis Application: Jitter and Noise Analysis, BER Estimation Descriptions with 80SJNB*. Additional jitter analysis and timing analysis information is available at www.tek.com/jitter.

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 \(see page 21\)](#)
- [User interface information \(see page 19\)](#)
- [Using oscilloscope functions \(see page 18\)](#)
- [Setting up the application \(see page 24\)](#)
- [Viewing the measurement results as plots \(see page 19\)](#)
- [Exporting Plot Files \(see page 54\)](#)
- [Saving \(see page 50\)](#) and [recalling \(see page 50\)](#) setup files
- [Saving \(see page 51\)](#) and [recalling \(see page 51\)](#) data files

What do you want to do?

- [Start the 80SJNB Application \(see page 11\)](#)

See Also:

[File Name Extensions \(see page 15\)](#)

[File Menus \(see page 16\)](#)

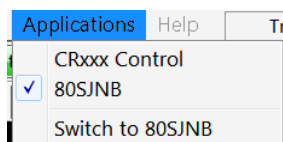
Starting the 80SJNB Application

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 \(see page 13\)](#)

[Returning to the Oscilloscope Application \(see page 12\)](#)

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 \(see page 13\)](#)

[Exiting the Application \(see page 14\)](#)

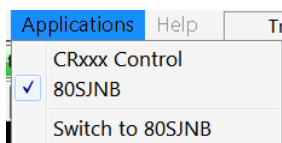
Returning to the 80SJNB Application

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

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.

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

See Also:

[File Name Extensions \(see page 15\)](#)

File Name Extensions

Extension	Description
.bmp	File that uses a bitmap format
.csv	File that uses a comma separated value format
.stp	80SJNB application setup file
.jpg	File that uses a joint photographic experts group format
.mat	File that uses native MATLAB binary format to store data acquired by 80SJNB
.png	File that uses a portable network graphics format
.txt	File that uses an ASCII format
.flt	80SJNB application filter file
.tap	80SJNB application equalization tap file
.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
.s1p	Files that define 1-port, 2-port, and 4-port frequency domain S-parameters
.s2p	
.s4p	

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 \(see page 22\)](#)

[Saving a Setup File \(see page 50\)](#)

[Recalling a Saved Setup File \(see page 50\)](#)

[Saving a Data File \(see page 51\)](#)

[Recalling a Saved Data File \(see page 51\)](#)

[About Exporting Plot Files \(see page 54\)](#)

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	Hides all numeric data, expanding the displayed plot(s) to fill the entire screen
Summary - SSC	Displays the summary SSC numeric data below the plot display(s)
Summary - Signal Path	Displays the summary Signal Path numeric data below the plot display(s)
Full Numeric Results	Displays the complete list of numeric data with plots displayed

See Also:

[About the 80SJNB Tool Bar \(see page 22\)](#)

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
Default Setup	Returns the Acquisition, Signal Path, and Analysis settings to their default values See About Application Parameters (see page 71) to view the default settings for each configuration menu

[About the 80SJNB Tool Bar \(see page 22\)](#)

Oscilloscope Settings

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

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

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 \(see page 24\)](#)

[Returning to the Application \(see page 12\)](#)

[Minimizing and Maximizing the Application \(see page 13\)](#)

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.

See Also:

[Working with Results \(see page 63\)](#)

[Clearing Results \(see page 19\)](#)

[Exporting Plot Files \(see page 54\)](#)

[Exporting Results from the File Menu \(see page 16\)](#)

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 \(see page 52\)](#)

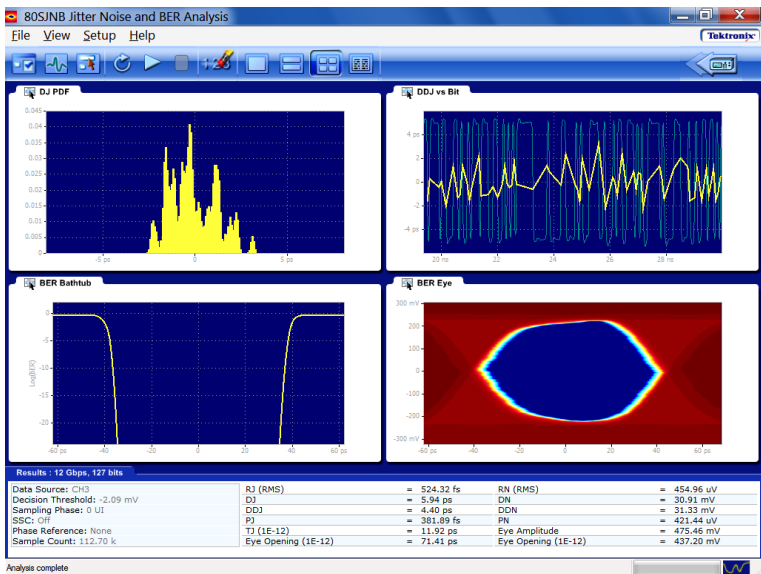
[Plot Type Definitions \(see page 52\)](#)

[About Working with Results \(see page 63\)](#)

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 \(see page 11\)](#)

[Minimizing and Maximizing the Application \(see page 13\)](#)

[Exiting the Application \(see page 14\)](#)

[Definitions of the application user interface items \(see page 20\)](#)

User Interface Items Definitions

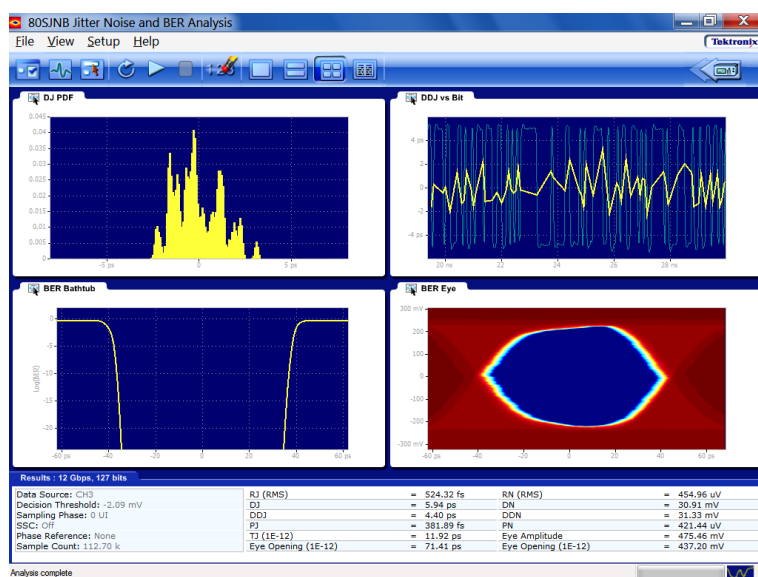
Item	Description
Area	Visual frame that encloses a set of related options
Box	Use to define an option; enter a value with the Keypad or a Multipurpose knob
Browse	Displays a window where you can look through a list of directories and files
Check box	Use to select or clear an option
Command button	Initiates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

Item	Description
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 \(see page 19\)](#)

[About the 80SJNB Toolbar \(see page 22\)](#)

[About Configuring the Application for Analysis \(see page 24\)](#)

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.
- **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** . 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** . 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** . Use this button to bring the TekScope display to the front of the screen.

See Also:

[About Configuring the Application for Analysis \(see page 24\)](#)

[About Analysis Settings \(see page 45\)](#)

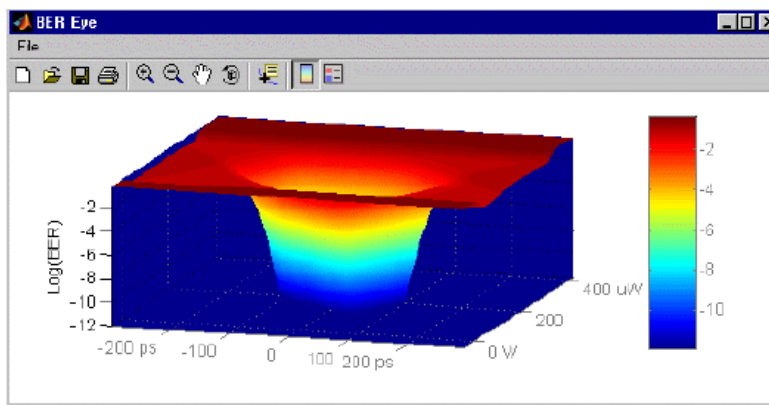
MATLAB User Interface

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 \(see page 25\)](#) button  to configure the application to acquire data, a [Signal Path \(see page 35\)](#) button  to set signal path conditions, and an [Analysis \(see page 45\)](#) button  to change settings that affect how measurements are made and displayed.

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.

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 \(see page 63\)](#) statistics or [graphically \(see page 19\)](#).

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 \(see page 25\)](#)

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.

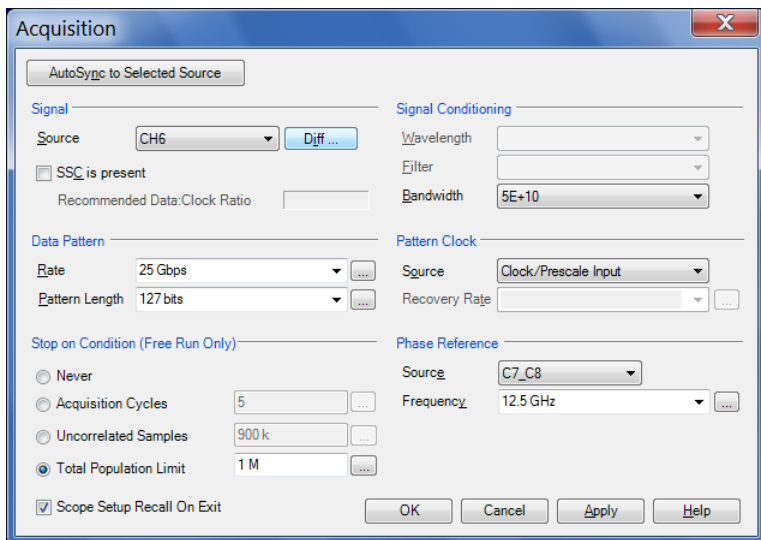
In the Acquisition dialog box, select the signal source and define the acquisition parameters. Some parameters (such as the Clock Recovery, Phase Reference Sources, and the optical signal conditioning) are copied from the oscilloscope state.

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 \(see page 27\)](#)

[Selecting Scope Setup Recall On Exit \(see page 28\)](#)

[Selecting Clock Recovery \(see page 29\)](#)

[Selecting Phase Reference \(see page 30\)](#)

[Selecting the Data Pattern \(see page 31\)](#)

[Selecting the Signal Conditioning \(see page 31\)](#)

[Selecting the Pattern Clock \(see page 32\)](#)

[Selecting the Source \(see page 32\)](#)

[Analysis Settings \(see page 45\)](#)

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.

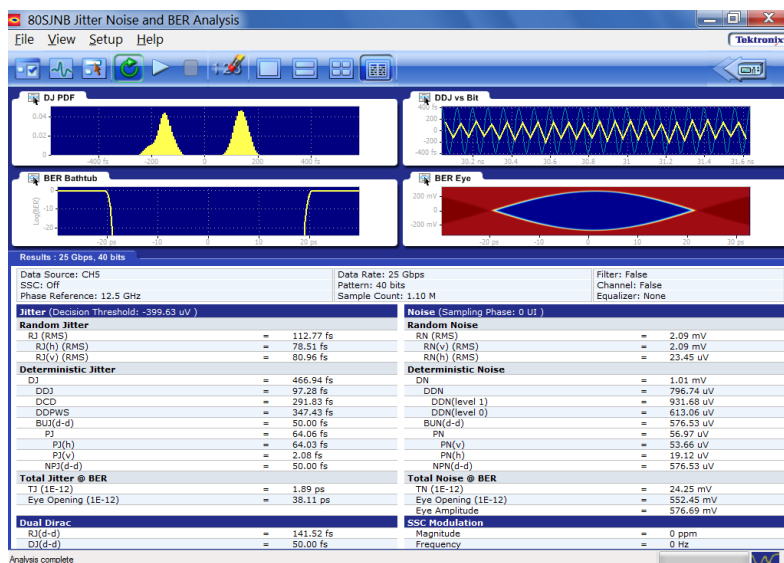
The following equation describes the relationship between these parameters:

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

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.

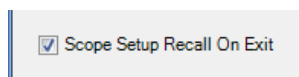
Total Population Limit. Total Population Limit instructs the 80SJNB application to continue acquiring and processing data until the total number of samples exceeds the specified number. The default count is a number that represents 2 acquisition cycles, and reflects the selected Pattern Length.

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.



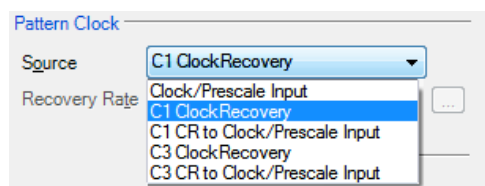
Selecting Scope Setup Recall On Exit

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 modules and the 80A05), 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.

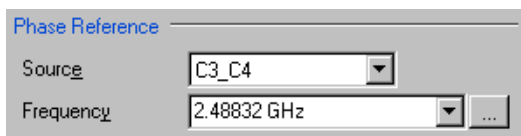
Selecting Phase Reference

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.*

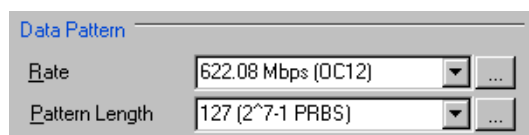
Selecting the Data Pattern

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.



Data Pattern

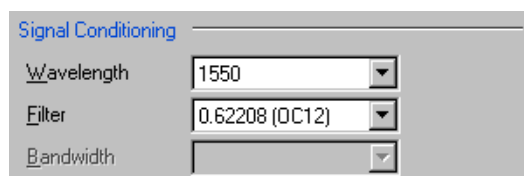
Rate 622.08 Mbps (OC12) ...

Pattern Length 127 (2⁷-1 PRBS) ...

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.



Signal Conditioning

Wavelength 1550

Filter 0.62208 (OC12)

Bandwidth

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.

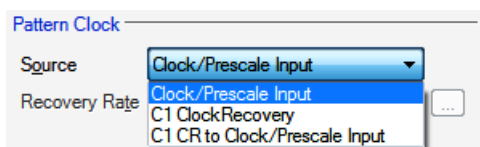
The available Pattern Clock sources depend on the instrument configuration. The default selection is Clock/Prescale Input, and this selection is available for all configurations. Connect the clock source to the CLOCK INPUT/PRESCALE TRIGGER front-panel connector.

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 an 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 \(see page 29\)](#). In general, if there is SSC then a particular cabling setup is necessary; only external Clock Recovery (such as with a CR125A) can be used. If the PhaseRef 82A04 module is used in the absence of SSC, the 82A04 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. (Defining a math waveform in the TekScope application must be done before launching the 80SJNB application.)

When selecting a Data Source, all other channels and Math waveforms should be turned off. If any channels or Math, other than the Data Source are activated after launching the 80SJNB application, an error message will prompt you to deactivate all additional waveforms before starting the acquisition and processing cycle. All other waveform databases, measurements, histograms and masks on the oscilloscope

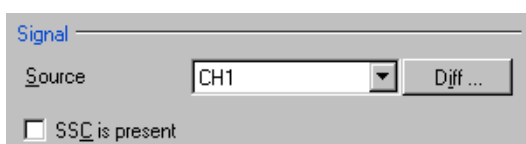
need to be turned off, as well. If any of these conditions exist when starting the acquisition and processing cycle, you are prompted to turn these off before you can continue.

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

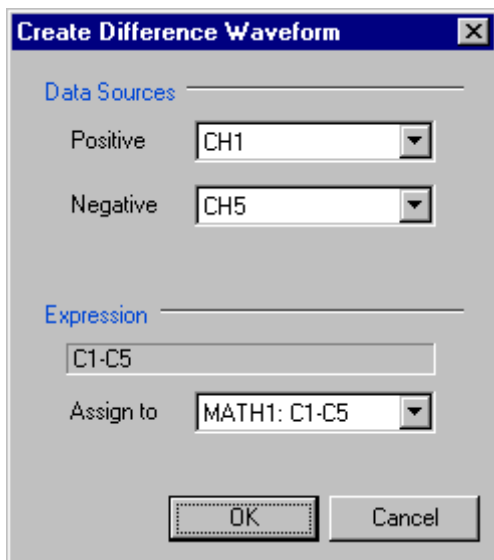
NOTE. If a saved data file is recalled, the signal source selection remains unchanged but all result panels will indicate the recalled data file as the source. The “SSC is present” field is updated to match the setting from the recalled data file.

See Also:

[About Spread Spectrum Clocking \(SSC\) \(see page 34\)](#)



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.



TIP. You can use the DSA8300 TekScope Define Math dialog box (Edit > Define Math) to define more complex math expressions. You must define the math expression in the DSA8300 before launching the 80SJNB application. Refer to the online help for your oscilloscope.

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.

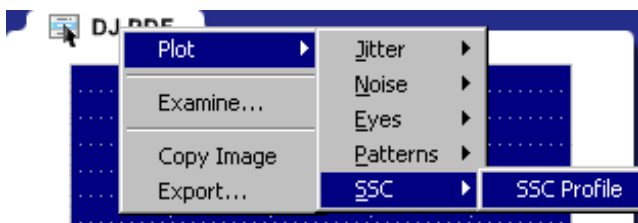
When you instruct 80SJNB that the data has SSC (by checking the “SSC is present” check box), the following constraints are enforced based on the current Data Rate:

- 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 status (on or off) of the SSC setting is displayed in both the Summary – SSC view and the Full Numeric Results page. 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

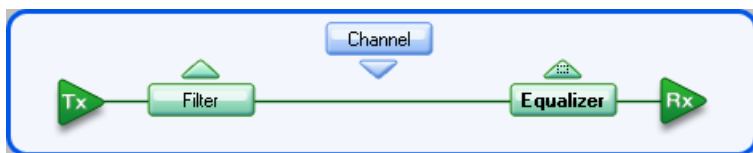
The Signal Path Settings are available for use with the 80SJNB Advanced version. If you are using the 80SJNB Essentials version, you're allowed to use the dialog boxes but are not allowed to place any of the functions into the signal path.

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 \(see page 36\)](#)

[Channel \(see page 37\)](#)

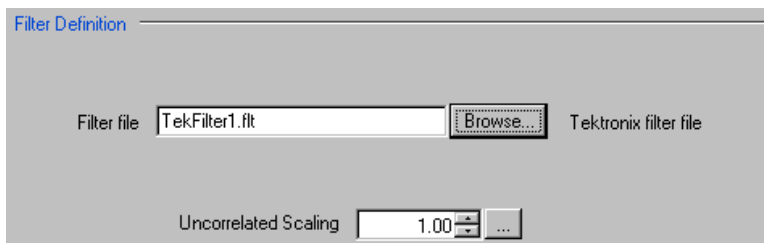
[Equalizer \(see page 39\)](#)

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 \(see page 44\)](#) 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
```

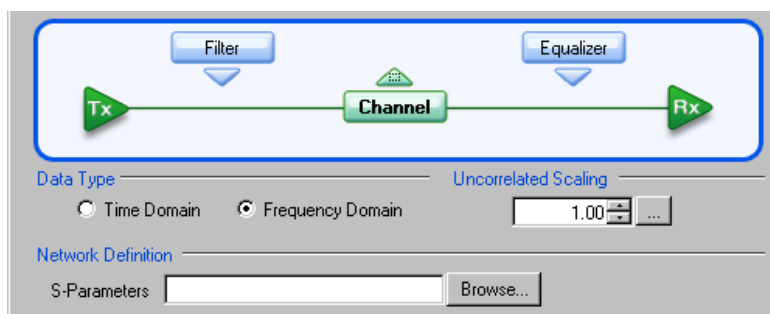
Setting Channel Conditions

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 \(see page 39\)](#) waveforms and [Frequency Domain \(see page 37\)](#) S-parameters.

See [Uncorrelated Scaling \(see page 44\)](#) 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.

Data Type **Uncorrelated Scaling**

☐ Time Domain ☒ Frequency Domain 1.00

Network Definition

S-Parameters: Touchstone 2-port file

Touchstone 2-Port S Parameter Selection

Select the location of the channel transmission data in the Touchstone file:

☐ S_{11}	☐ S_{12}
☒ S_{21}	☐ S_{22}

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:

	1	Tx+		Px+	2
	3	Tx-		Px-	4

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)

S_{dd11}	S_{dd12}	S_{dc11}	S_{dc12}
S_{dd21}	S_{dd22}	S_{dc21}	S_{dc22}
S_{od11}	S_{od12}	S_{oc11}	S_{oc12}
S_{od21}	S_{od22}	S_{oc21}	S_{oc22}

☐ CD12

☐ 12DC

☐ 12CD

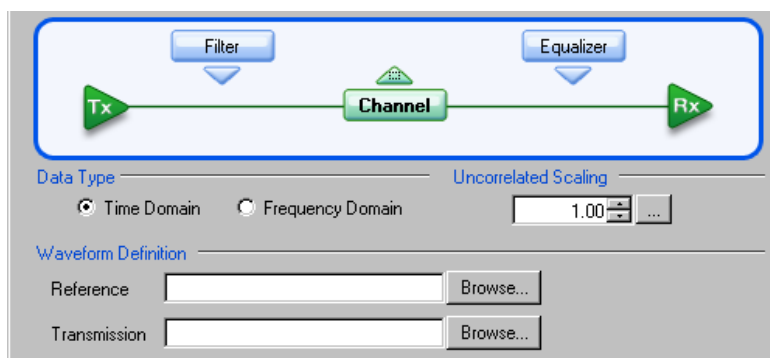
NOTE. 80SJNB Advanced uses the 'insertion loss' information only.

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).
-

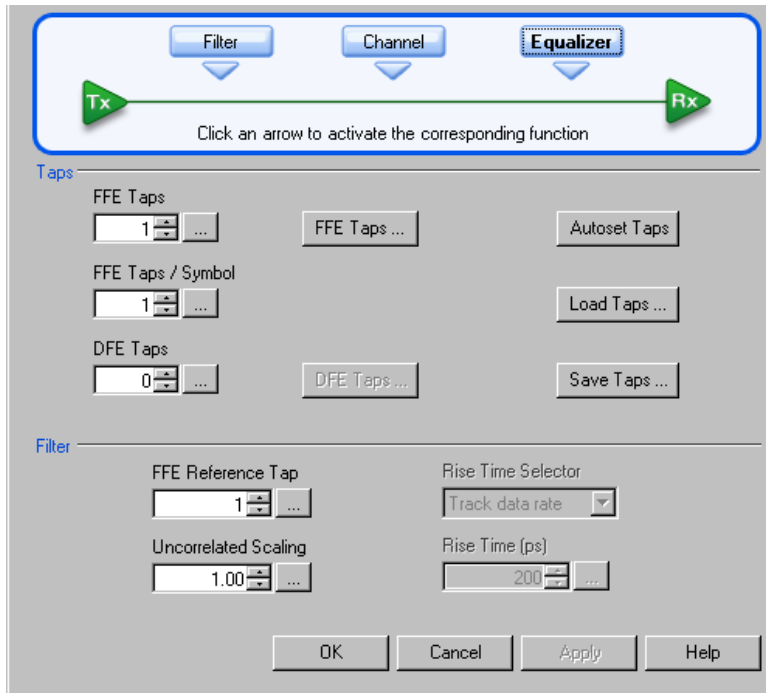


About the Equalizer

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:

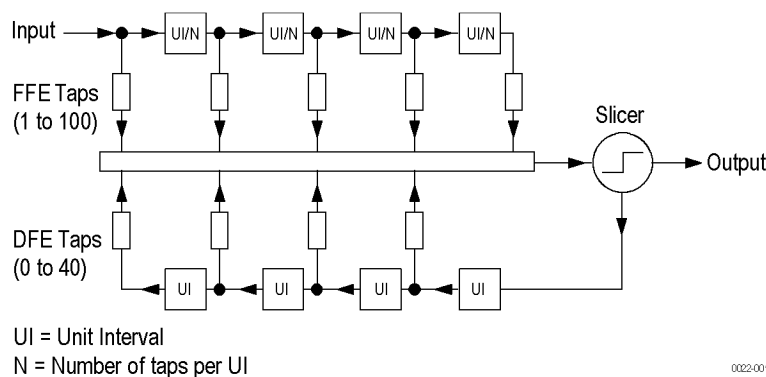
[Equalizer Taps \(see page 40\)](#)

[Uncorrelated Scaling \(see page 44\)](#)

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 \(see page 41\)](#)

[Go to DFE Taps description \(see page 42\)](#)

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.

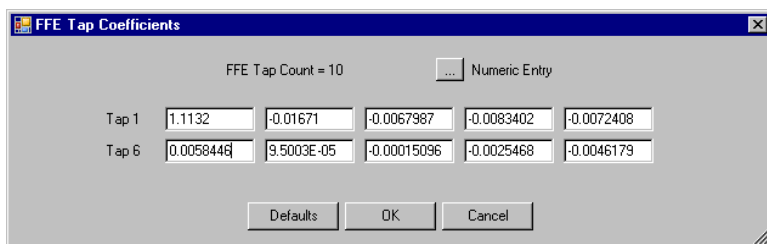
The FFE Tap values could be specified by you using the FFE Taps dialog, or computed by the application with the Autoset Taps button.

[Go to Autoset Taps description \(see page 43\)](#)

[Go to Saving and Loading Taps \(see page 44\)](#)



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.



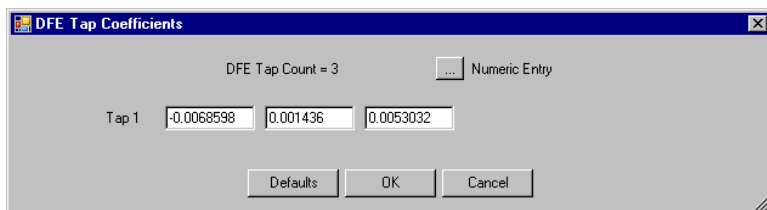
You can use the Save Taps button to save a set of coefficients to a file. Use the Load Taps button to load saved Tap files.

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 \(see page 43\)](#) for a description about using the autoset taps function.

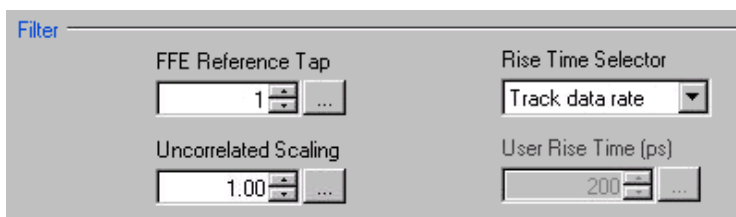
Pressing the DFE Taps button displays a dialog showing the current DFE tap values. You can specify each DFE tap coefficient individually. Pressing the Defaults button sets all DFE tap values to 0.



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 \(see page 44\)](#) 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

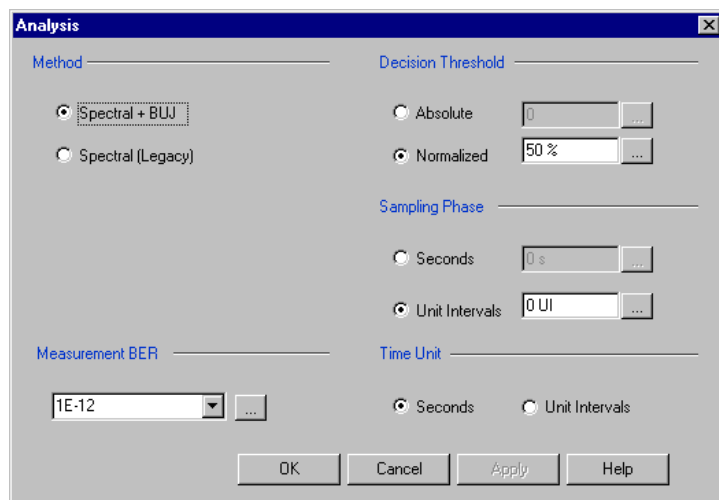
The signal path settings (Filter, Channel, Equalizer) each have an uncorrelated scaling setting. The Uncorrelated Scaling value multiplies the uncorrelated random noise RMS and uncorrelated periodic noise values. Uncorrelated noise scaling affects the uncorrelated jitter as projected through the average 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

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

Taking Measurements

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

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 \(see page 47\)](#)

[Display the definitions of Noise measurements \(see page 48\)](#)

[Measurement Algorithms \(see page 95\)](#)

[Go to Working with Numeric Results \(see page 63\)](#)

[Go to Working with Plots \(see page 52\)](#)

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.

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 \(see page 50\)](#)

[Recalling a Saved Setup File \(see page 50\)](#)

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 \(see page 51\)](#)

[Recalling a Saved Data File \(see page 51\)](#)

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 \(see page 52\)](#)

[Functions in Plot Windows \(see page 54\)](#)

[About Exporting Plot Files \(see page 54\)](#)

[Selecting and Viewing Plots \(see page 53\)](#)

Plot Type Definitions

Plot types are divided into the following categories:

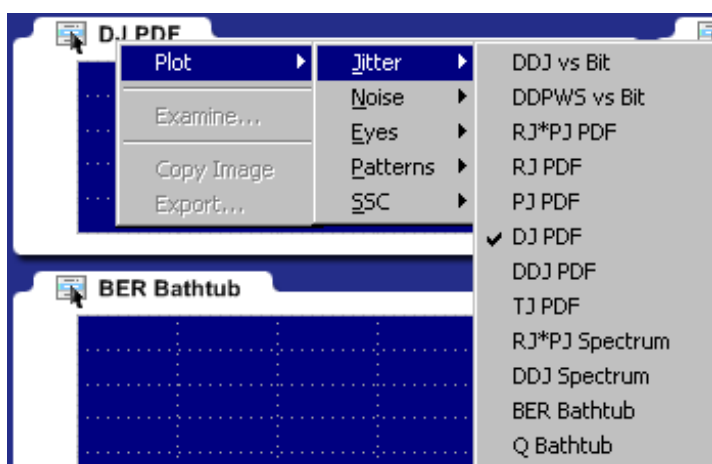
- Jitter: See [Jitter Plots \(see page 58\)](#) for a list of the types of jitter plots and their descriptions.
- Noise: See [Noise Plots \(see page 61\)](#) for a list of plot types and descriptions.
- Eyes: See [Eye Plots \(see page 59\)](#) for a list of plot types and descriptions.
- Patterns: See [Pattern Plots \(see page 62\)](#) for a list of plot types and descriptions.
- SSC: See [SSC Plot \(see page 62\)](#) 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).

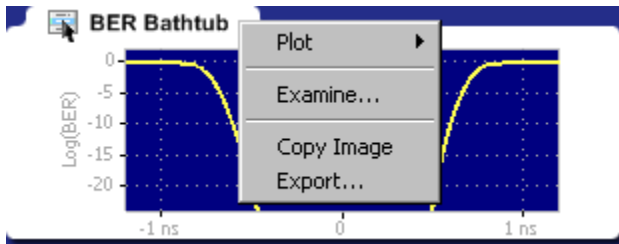


See Also:

[About Exporting Plot Files \(see page 54\)](#)

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:

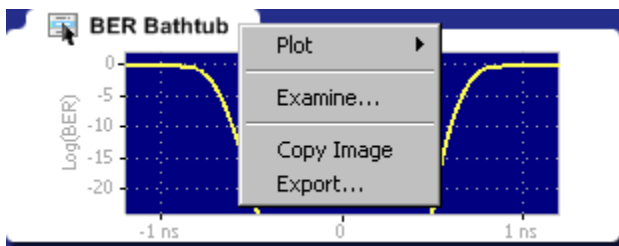
[MATLAB User Interface \(see page 24\)](#)

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 \(see page 56\)](#)

[Exporting Plot Images \(see page 55\)](#)

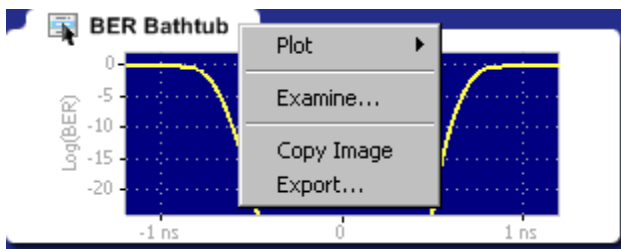
[File Name Extensions \(see page 15\)](#)

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 \(see page 56\)](#)

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.

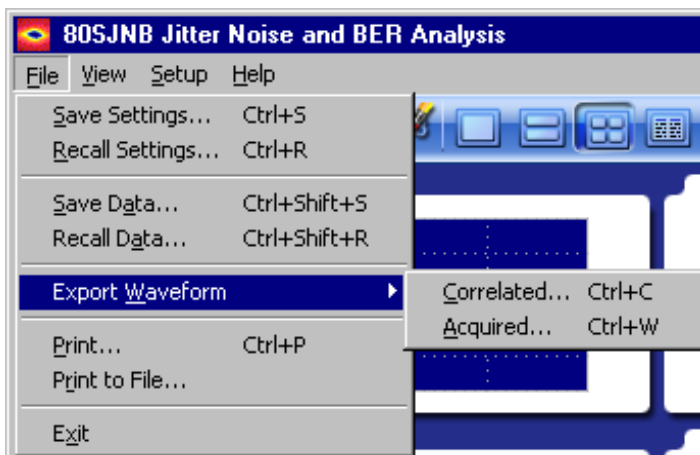
Export Waveform

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.

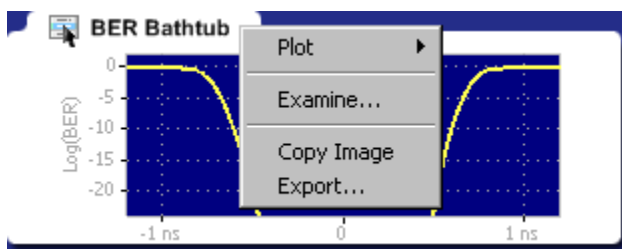
4. Use the drop-down **Save as type** list to select the file type. The choices are:
 - Comma Separated Values (.csv): ASCII text that can be loaded into a spreadsheet. This is the default selection.
 - MATLAB (.mat): Binary data in the native MATLAB 7.0 format.
5. Click **Save**.

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 \(see page 55\)](#)

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 Equalizer ²	The SP Equalizer 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. 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.

Eye plots	Description
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. 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

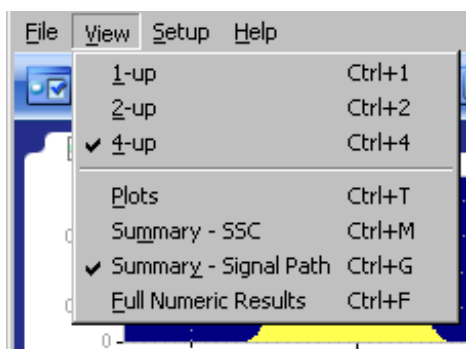
SSC plot	Description
SSC Profile ¹	The Spread Spectrum Clocking profile displays the function used for modulating the serial link clock frequency. If the "SSC is present" check box is checked in the Acquisition setup dialog, the profile plot is displayed.

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.

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.



There are two views of the summary table: SSC and Signal Path. Both summary selections contain the noise and jitter measurements but not the breakdown of the measurements. The two summaries differ by displaying relevant application settings.

Results : 622.08 Mbps, 127 bits			
Data Source: CH3	RJ (RMS) = 2.86 ps	RN (RMS) = 676.65 uV	
Filter: gaussfilt0p5BW.flt	DJ = 111.34 ps	DN = 97.73 mV	
Channel: IB 5m Fxt SE.s4p	DDJ = 91.69 ps	DDN = 95.62 mV	
Equalizer: DFE (10/5)	PJ = 7.57 ps	PN = 2.09 mV	
Phase Reference: None	TJ (1E-12) = 145.11 ps	Eye Amplitude = 350.73 mV	
Sample Count: 52.70 k	Eye Opening (1E-12) = 1.46 ns	Eye Opening (1E-12) = 244.50 mV	

Results : 3 Gbps, 127 bits			
Data Source: CH3	RJ (RMS) = 743.60 fs	RN (RMS) = 785.51 uV	
Decision Threshold: -160.34 mV	DJ = 10.85 ps	DN = 20.44 mV	
Sampling Phase: 0 UI	DDJ = 8.43 ps	DDN = 18.65 mV	
SSC: On	PJ = 1.65 ps	PN = 1.50 mV	
Phase Reference: 3 GHz	TJ (1E-12) = 19.04 ps	Eye Amplitude = 294.24 mV	
Sample Count: 52.70 k	Eye Opening (1E-12) = 314.29 ps	Eye Opening (1E-12) = 264.26 mV	

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

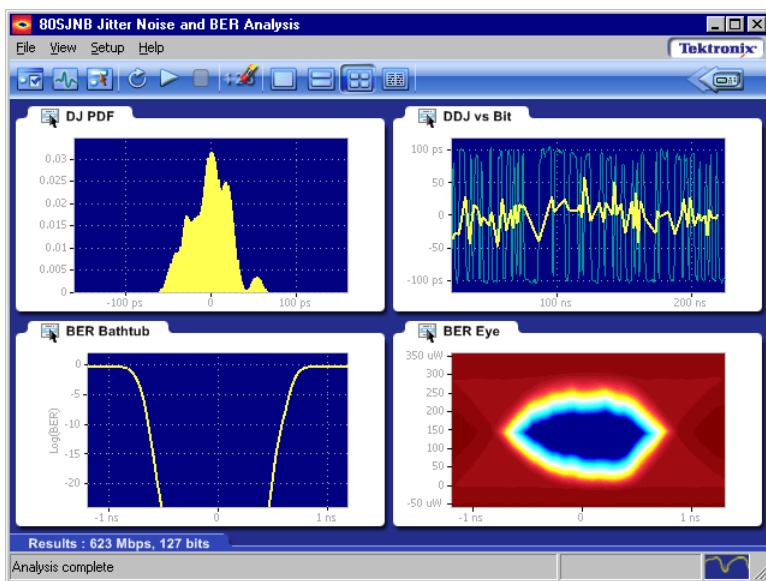
Data Source: CH1	Data Rate: 10 Gbps	Filter: False
SSC: Off	Pattern: 127 bits	Channel: False
Phase Reference: None	Sample Count: 132.70 k	Equalizer: None
Jitter (Decision Threshold: -2.32 mV)		
Random Jitter		
RJ (RMS)	= 853.96 fs	
RJ(h) (RMS)	= 851.51 fs	
RJ(v) (RMS)	= 64.60 fs	
Deterministic Jitter		
DJ	= 14.58 ps	
DDJ	= 10.96 ps	
DCD	= 2.00 ps	
DDPWS	= 11.19 ps	
BUJ(d-d)	= 50.00 fs	
PJ	= 1.34 ps	
PJ(h)	= 1.27 ps	
PJ(v)	= 400.02 fs	
NPJ(d-d)	= 50.00 fs	
Total Jitter @ BER		
TJ (1E-12)	= 23.79 ps	
Eye Opening (1E-12)	= 76.21 ps	
Dual Dirac		
RJ(d-d)	= 929.75 fs	
DJ(d-d)	= 10.69 ps	
Noise (Sampling Phase: 0 UI)		
Random Noise		
RN (RMS)	= 468.34 uV	
RN(v) (RMS)	= 461.40 uV	
RN(h) (RMS)	= 80.38 uV	
Deterministic Noise		
DN	= 101.02 mV	
DDN	= 98.22 mV	
DDN(level 1)	= 89.84 mV	
DDN(level 0)	= 104.34 mV	
BUN(d-d)	= 1.77 mV	
PN	= 2.86 mV	
PN(v)	= 2.86 mV	
PN(h)	= 120.24 uV	
NPN(d-d)	= 1.24 mV	
Total Noise @ BER		
TN (1E-12)	= 105.97 mV	
Eye Opening (1E-12)	= 278.92 mV	
Eye Amplitude	= 384.89 mV	
SSC Modulation		
Magnitude	= 0 ppm	
Frequency	= 0 Hz	

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

To hide the summary table and provide more room for the plot displays, click the numeric data table 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 \(see page 52\)](#)

[Noise Measurement Definitions \(see page 48\)](#)

[Jitter Measurement Definitions \(see page 47\)](#)

[Dual Dirac Measurement Definitions \(see page 47\)](#)

[SSC Modulation Measurement Definitions \(see page 48\)](#)

An Application Example

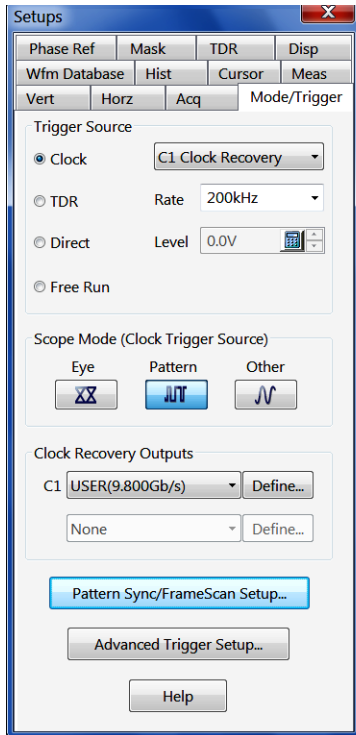
The following example uses the 80SJNB application on an optical signal for fast analysis of BER, Jitter, and Noise. This simplified application example shows how to configure and use the application. This may help you when setting up your own test situation.

Requirements:

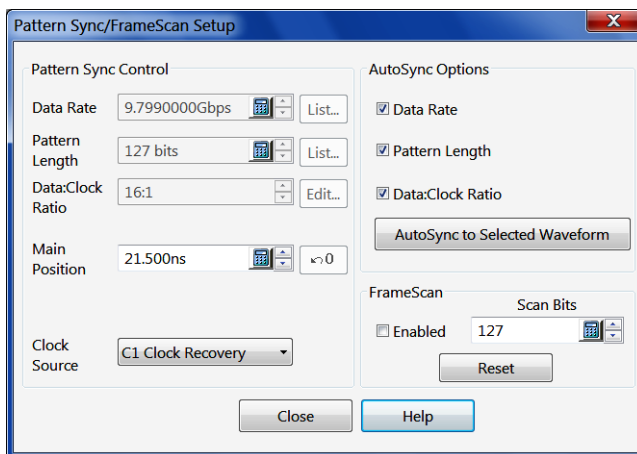
- DSA8300 oscilloscope
- 80SJNB software
- ADVTRIG Advanced Trigger Option installed
- Optical module with clock recovery. The following example uses the 80C11-CR4 Optical Sampling Module.
- SMA cables

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.

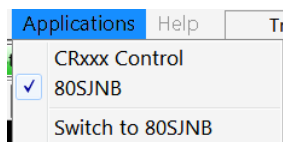


12. Enter the **Data Rate** parameter (for example, 9.8 Gbps).
13. Set the **Pattern Length** parameter (for example, 127 bits).
14. Click **Close**.

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.

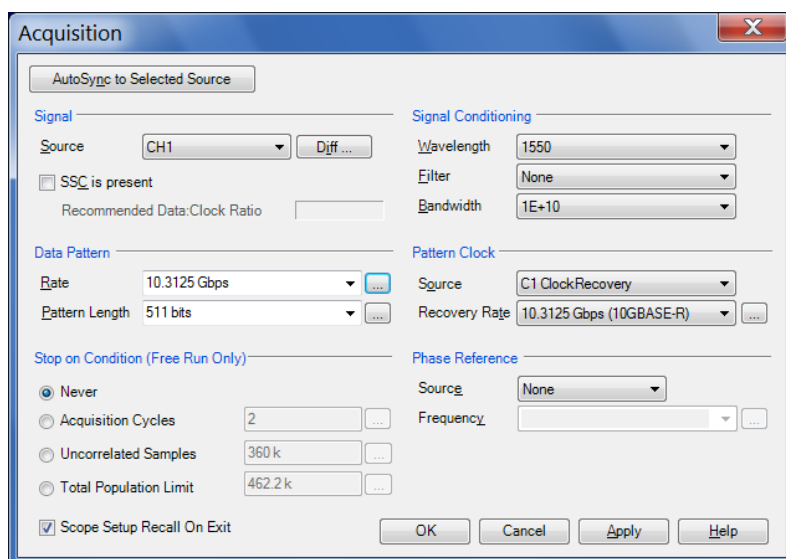


You can also use the Windows 80SJNB desktop shortcut or the Windows Start menu **Start > Programs > Tektronix Applications > 80SJNB > 80SJNB** to start the 80SJNB application.

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**.

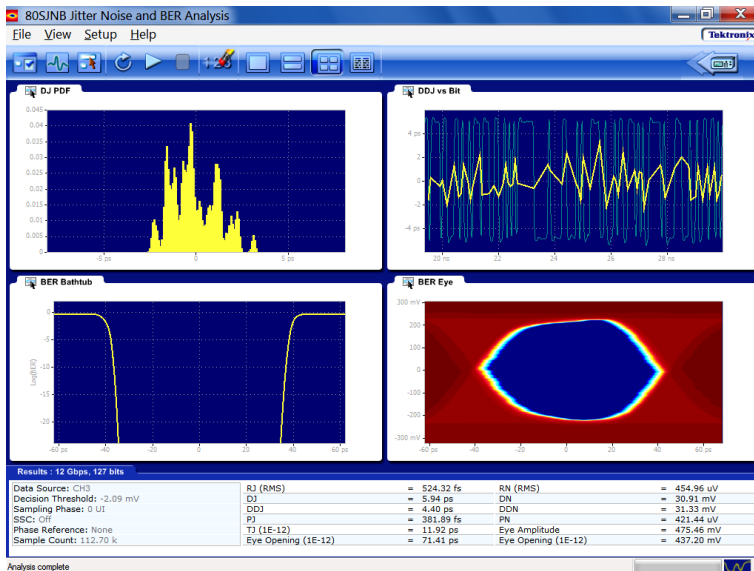


Click **OK** to apply the settings and close the dialog box.

- Click  to start the acquisition and processing cycle.

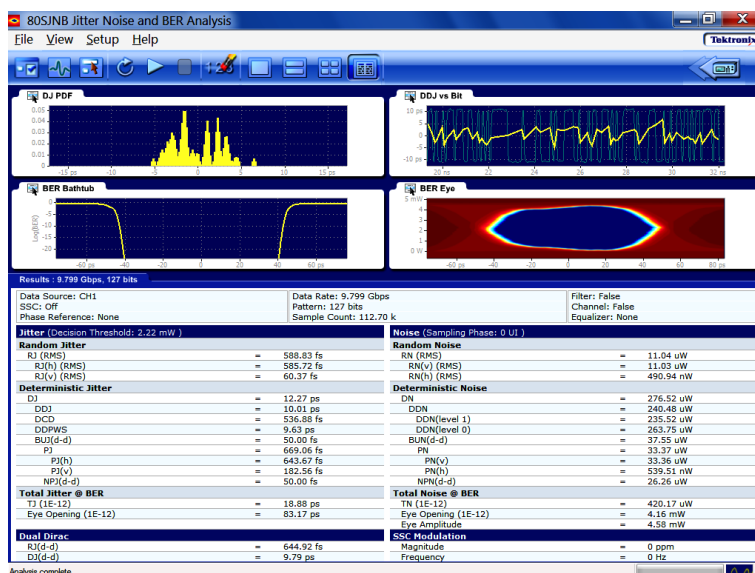
While the cycle is running, you'll see the sequence of events displayed at the bottom of the application display. When the cycle is complete, the application displays the message "Analysis Complete."

- 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.

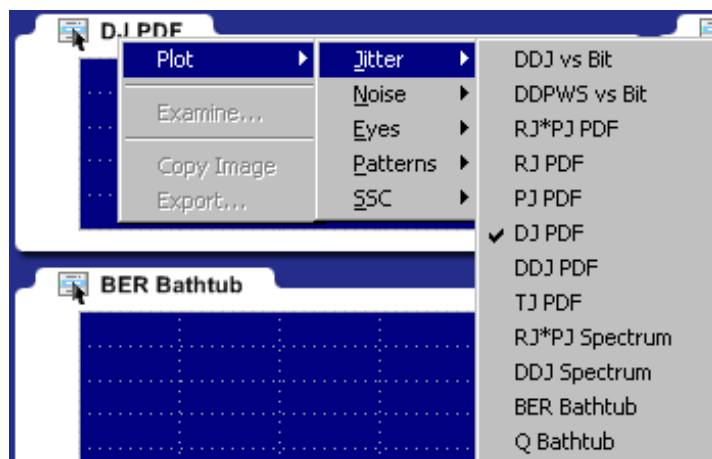


2. Redisplay the plot (or plots) by selecting one of the plot display buttons

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

Results : 9.799 Gbps, 127 bits		
Data Source: CH1	RJ (RMS)	= 588.83 fs
Decision Threshold: 2.22 mW	DJ	= 12.27 ps
Sampling Phase: 0 UI	DDJ	= 10.01 ps
SSC: Off	PJ	= 669.06 fs
Phase Reference: None	TJ (1E-12)	= 18.88 ps
Sample Count: 112.70 k	Eye Opening (1E-12)	= 83.17 ps

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.

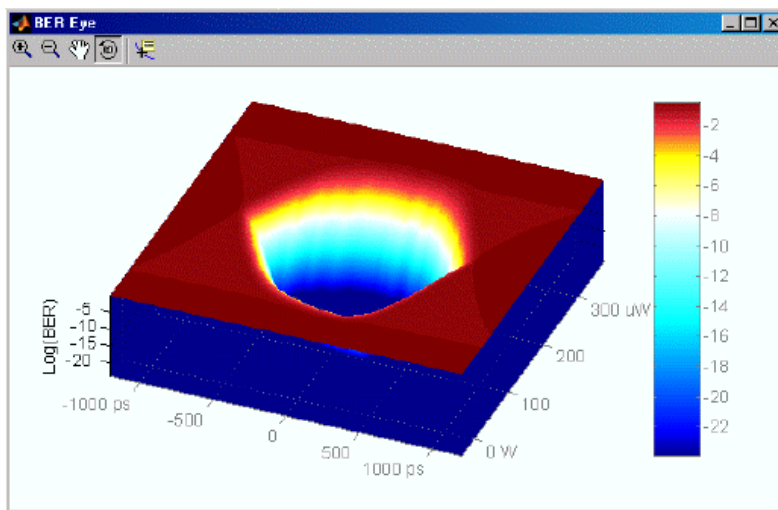
4. To further examine a plot, you can display any plot in a MATLAB window, providing you with more tools to work with the data. Click the Configure Plot () icon and choose **Examine**.

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 \(see page 71\)](#)

[Acquisition Settings \(see page 72\)](#)

[Signal Path Settings \(see page 73\)](#)

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 \(see page 75\)](#)

Analysis Settings

This table lists the default values of the 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 status of the 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 status of the 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

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 \(see page 75\)](#)

[Programming Tips \(see page 76\)](#)

[Variable:Value Commands \(see page 77\)](#)

[Results Queries \(see page 84\)](#)

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

GPIB Reference Materials

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

- The [Programming Examples \(see page 86\)](#) 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 \(see page 75\)](#)

Programming Tips

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 \(see page 78\)](#)

[GPIB Commands Error Codes \(see page 86\)](#)

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

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
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
CeDomain	Time Frequency	Sets the domain in which the channel characteristics are defined	Current value
CeFdSPParametersFile	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

Name	Value	Function	Query form returns
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
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

Name	Value	Function	Query form returns
DecisionThresholdUnits	{Absolute, Normalized}	Sets or returns the desired decision threshold value to use By setting the units to Absolute, the DecisionThresholdAbs value is used. If the units are set to Normalized, the decision threshold is calculated based on waveform data according to the DecisionThresholdPct normalized value.	Current value
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
EqDefaultFFETaps ²	{Run}	Sets the FFE taps to default values	Current value or Done, Error
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

Name	Value	Function	Query form returns
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	
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

Name	Value	Function	Query form returns
ExportType	ACQWFM CORRWFM, RJPDF PJPDF RJPJPDF RJPJSPEC DDJPDF DJPDF DDJSPEC TJPDF DDJ HBATH QHBATH RNPWF PNPWF RNPNPWF RNPNSPEC DDNPWF DNPWF DDNSPEC TNPWF 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
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

Name	Value	Function	Query form returns
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
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
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

Name	Value	Function	Query form returns
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
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
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
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.

Value	Function
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.
NPJDD	Returns non periodic jitter
NPND	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.
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:

`APPLiCation:ACTivate "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 \(see page 87\)](#)

[Measuring Jitter in Presence of SSC \(see page 89\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 91\)](#)

See Also:

[About the GPIB Program and Guidelines \(see page 75\)](#)

[GPIB Reference Materials \(see page 75\)](#)

[Variable:Value Command \(see page 77\)](#)

[Results Queries \(see page 84\)](#)

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.

`APPLICATION:ACTIVATE "80SJNB"`

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

```
VARIABLE:VALUE "DataSource", "CH1"
```

```
VARIABLE:VALUE "DataRate", "10.3125e9"
```

```
VARIABLE:VALUE "PatternLength", "32767"
```

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

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

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

4. Start the acquisition and processing cycle.

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

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

Query the following variables:

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

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

Loop until DataReady is True or SequencerState is Stop.

6. Check to see if there were errors.

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

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

```
VARIABLE: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:

```
VARIABLE: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.

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

```
VARIABLE:VALUE "ExportType", "DJPDF"
```

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

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

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

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

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

Program Examples:

[Measuring Jitter in Presence of SSC \(see page 89\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 91\)](#)

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 \(see page 87\)](#)

[Compensating for Signal Path Impairments with Equalization \(see page 91\)](#)

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 "CeFdSPParametersFile", " C:\Users\<username>\Documents\Sdd21.slp"

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 EOJ and compare with the previous two sets, looking for the effects of the Channel and the Equalizer.

Program Examples:

[Configure and Operate the 80SJNB \(see page 87\)](#)

[Measuring Jitter in Presence of SSC \(see page 89\)](#)

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, BER Estimation Descriptions with 80SJNB” 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

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

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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