Tektronix®

Optical Signal Plug-in Application

Printable Help Document

077-1249-00

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Printable Help Document

www.tek.com
077-1249-00

Supports High Speed Serial Plug-in application Version 1.0 and above.

Help part number: 076–0397–00

PDF of Help system part number: 077–1249–00

Contacting Tektronix

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

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

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Welcome

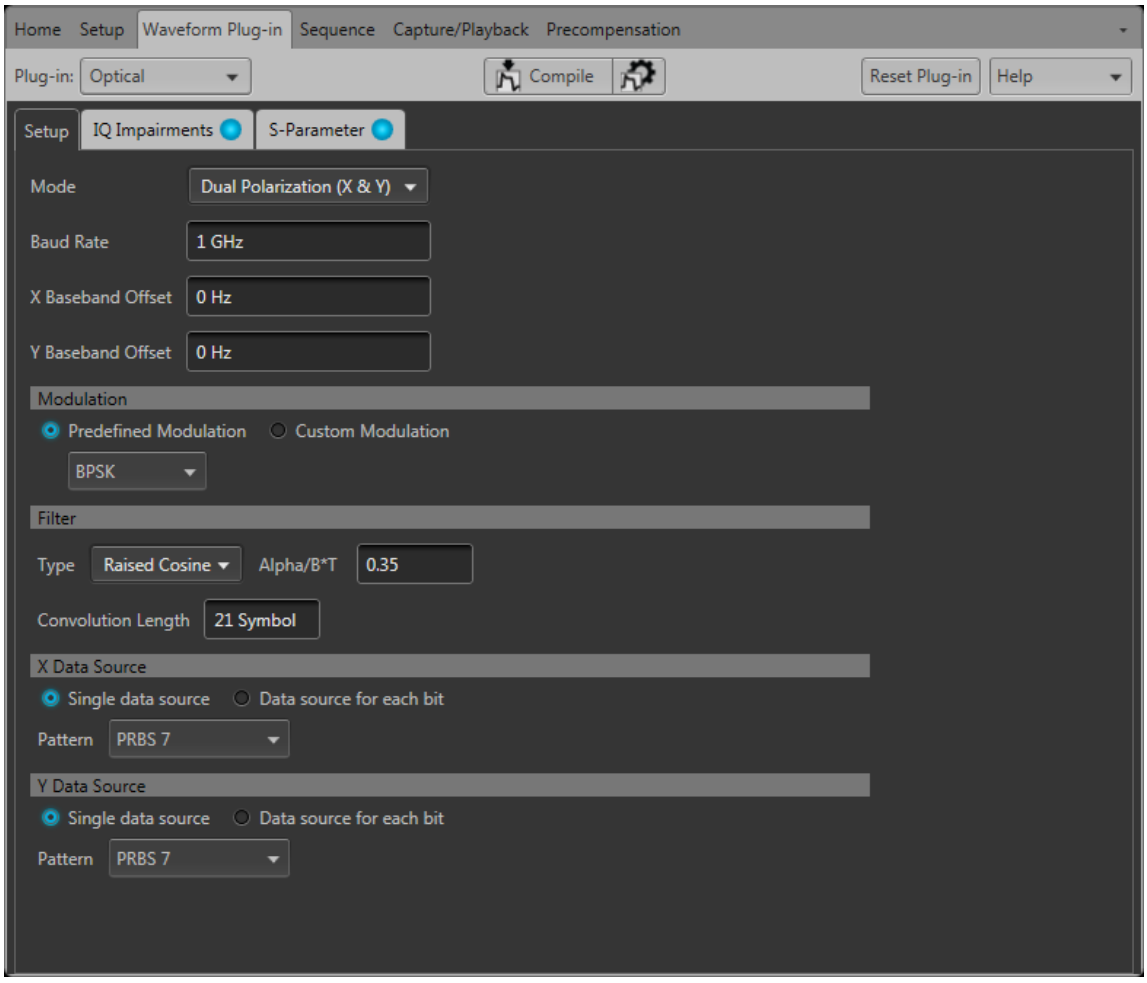
The Optical Signal plug-in is a waveform creation application that is used to create various kinds of waveforms and modulation schemes to test the communication paths between optical components.

The Optical Signals are typically output via an AWG connected to an optical module, converting the electrical signal to an optical signal. The optical signal is then transmitted to a Devise Under Test (DUT).

The Optical Signal plug-in is designed to integrate and operate seamlessly as an enhancement to the SourceXpress waveform creation software application or to an AWG70000A series arbitrary waveform generator.

Once installed, the plug-in becomes available as another waveform plug-in application.

This illustration shows the Optical Signal plug-in viewed from the SourceXpress application. The plug-in is identical whether it is used from SourceXpress or from an AWG70000A series instrument.



Key features

- Allows users to create waveforms for either single or dual polarization.
- Along with commonly used modulations like QAM and PAM, users can also define their own modulation scheme.
- Users have the option to use a single data source for the carrier or use multiple data sources.

Documentation

In addition to this application Help system, the following documentation is available for the software.

All documentation is available on the Tektronix Web site (www.tek.com/manual/downloads).

To read about	Use these documents
Optical plug-in operation and user interface help	Access the plug-in application help from the plug-in Help menu for information on all controls and elements on screen. The Optical plug-in help system is also available in PDF format located in the program's installation folder and also available on the Tektronix web site.
Optical plug-in programmer commands	Access the plug-in programmer manual for the syntax of remote commands specific to the plug-in. This is available on the Tektronix web site.
SourceXpress operation and user interface help	Access the SourceXpress application help from the Help menu for information on all controls and elements on screen. The SourceXpress help system is also available in PDF format, available on the Tektronix web site.
SourceXpress programmer commands	Access the SourceXpress programmer manual for the syntax of remote commands. This document is available in PDF format located in the program's installation folder and also available on the Tektronix web site.
Connected instrument operation and user interface help (such as an AWG70002A)	For operation and interface help of a connected instrument, refer to the instrument's documentation. This is available with the instrument or on the Tektronix web site.
Connected instrument programmer commands (such as an AWG70002A)	For programming information of a connected instrument, refer to the instrument's documentation. This is available with the instrument or on the Tektronix web site.

Support information

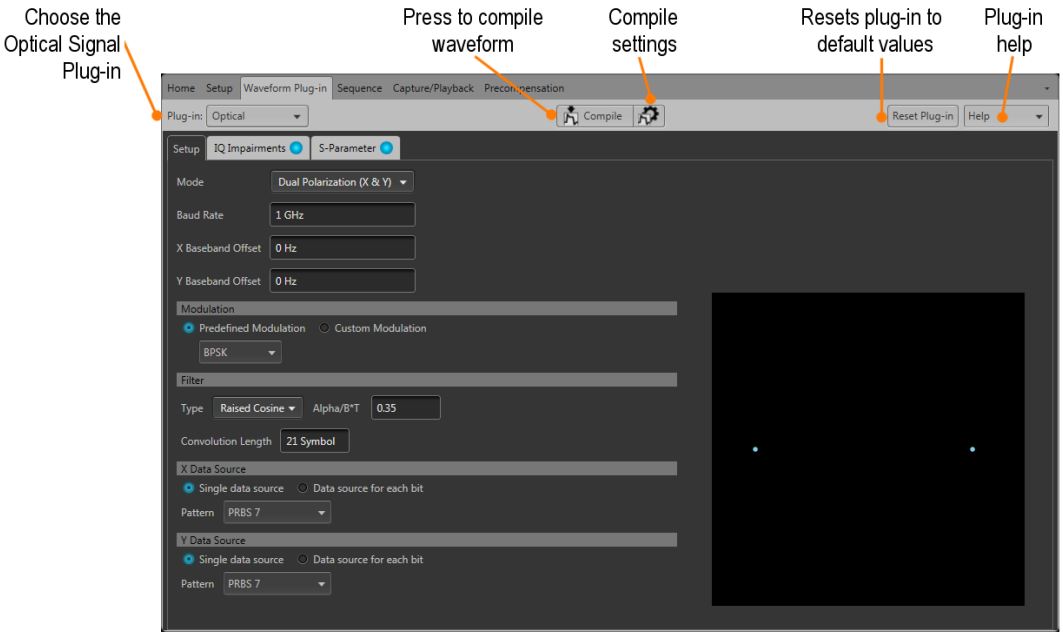
Tektronix offers the following services in support of their products:

- **Technical Support**. For application-related questions about a Tektronix product, contact us by telephone or email).
- **Service Support**. For service-related questions about a Tektronix product, contact us by telephone or email).

Tektronix also offers extended warranty and calibration programs as options on many products. Contact your local Tektronix distributor or sales office.

Elements of the display

The main areas of the application window are shown in the following figure.



Plug-in selection

Use the Plug-in pull-down menu to select the Optical Signal plug-in application. The plug-in pull-down menu varies depending the installed applications.

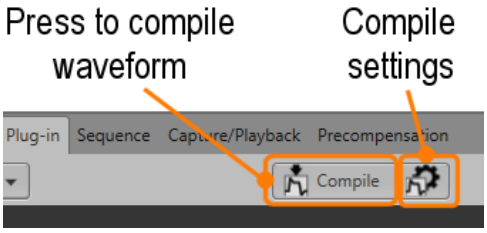
NOTE. *Optical Signal plug-in requires a license to create waveforms.*

Refer to *Licensing (see page 31)**.*

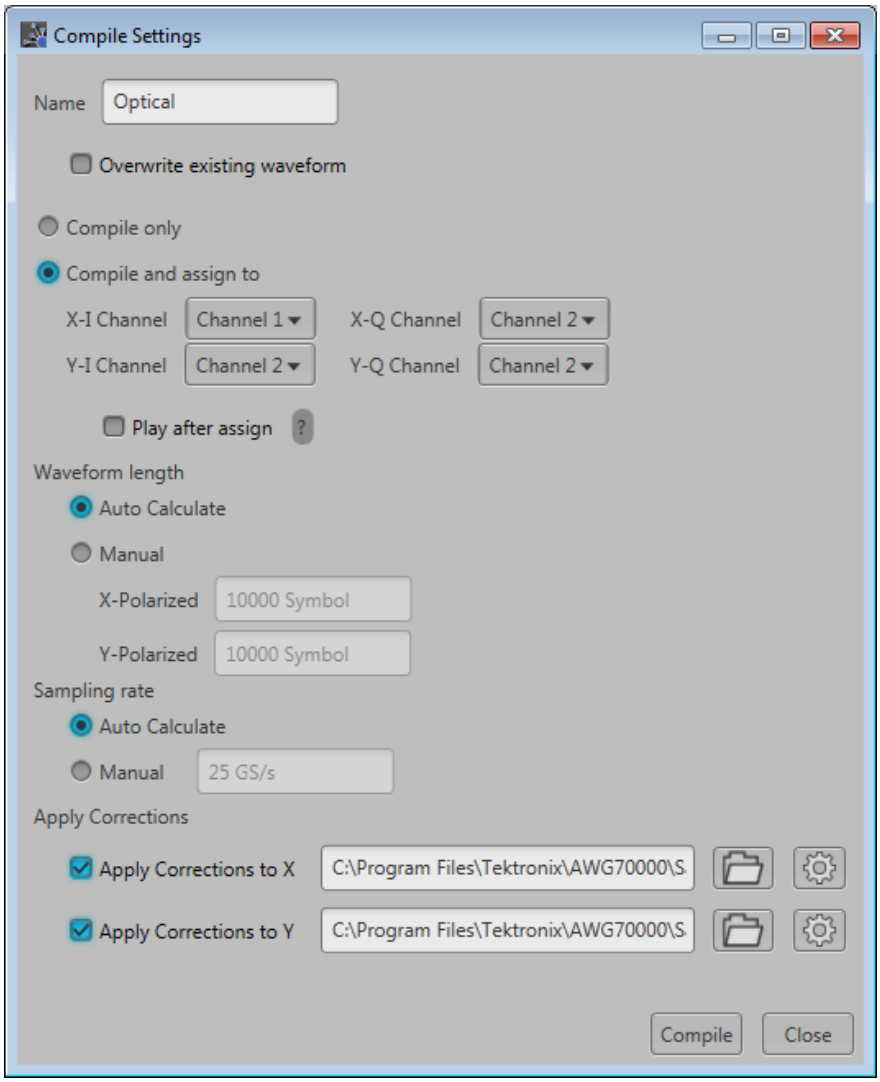
Compile button

Use the Compile button to create the waveforms and place the waveforms into the Waveforms list of the host application.

Use the Compile settings (see page 7) button to edit the compilation settings.



Compile settings

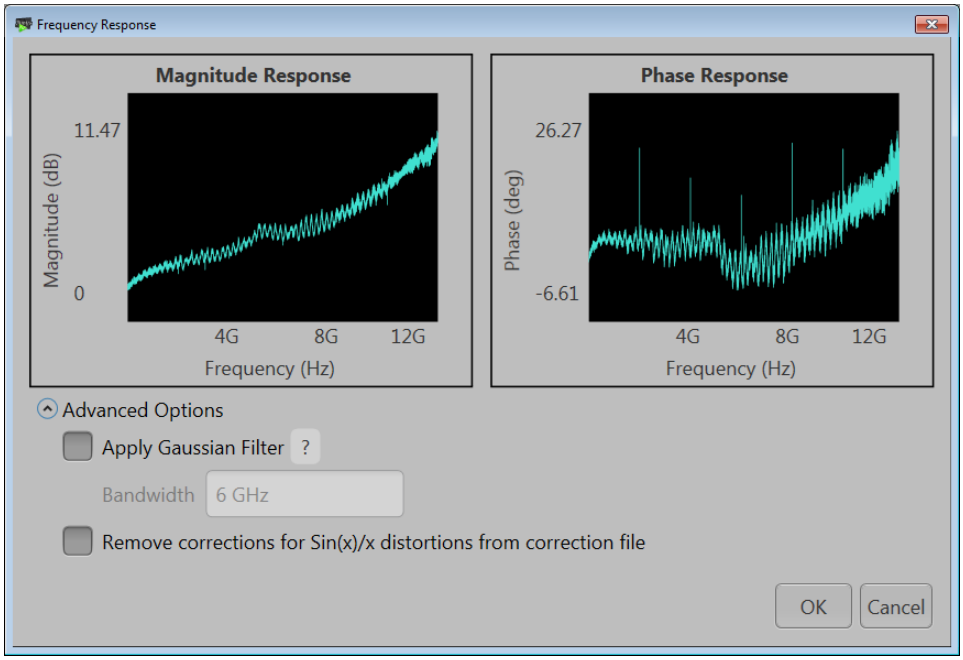


Item	Description
Name	The application provides a base name for compiled waveforms. You can edit the field with a name of your choice. The waveform is added to the Waveforms list. If the name already exists, the name is incremented with a numerical value (unless the overwrite option is selected). The Reset Plug-in button resets the Name field to the default name.
Overwrite existing waveform	If checked, a waveform with the same name (in the waveforms list) is overwritten with no warnings.
Compile only	The compiled waveforms are simply entered into the Waveforms list.

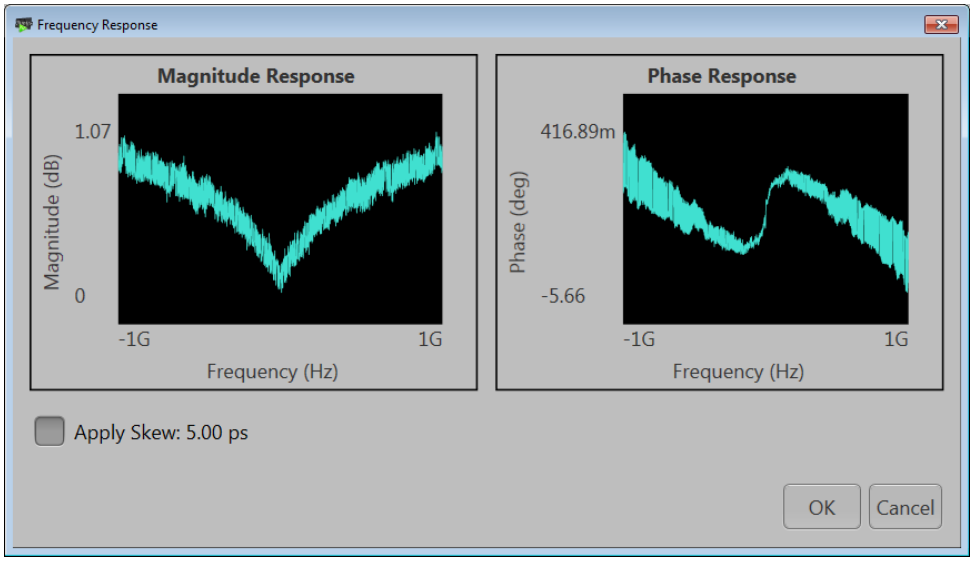
Item	Description
Compile and assign	The compiled waveforms are entered into the Waveforms list and automatically assigned to a selected channel.
Play after assign	If checked, the waveform starts to play out immediately after compiling. The instrument's sample rate and amplitude will change based on the compiled waveform's properties.
Waveform length	
Auto Calculate	This is the default method to set the waveform length. The application creates a waveform length based on the settings chosen for the waveform.
Manual	Select to define a specific waveform length. Directly enter the waveform length of the compiled waveform. The length is defined as number of Symbols.
Sampling Rate	
Auto Calculate	This is the default method to set the sampling rate. The application creates a sampling rate based on the settings chosen for the waveform.
Manual	Select to enter a specific sampling rate.
Apply Corrections	You can apply a correction file directly to the waveform when compiling. You can apply corrections to either the X or Y polarizations or both.
Correction file Path:	When applying a correction file, navigate to the location of the file. Use the browse folder icon  to navigate to a saved correction file. Once a valid file path is entered, the Correction Settings icon  is enabled. Select to display the Frequency Response screen.
Compile	Compiles the waveform.

Correction file frequency response

If applying an RF correction file, the Frequency Response screen shows plot information and provides Advanced options to apply a Gaussian filter and remove Sin(x)/x distortions.



If applying an I/Q correction file (to a pair of I and Q waveforms), the Frequency Response screen shows plot information and provides Advanced options to apply a skew.



Reset Plug-in button

Returns all plug-in settings to their default values.

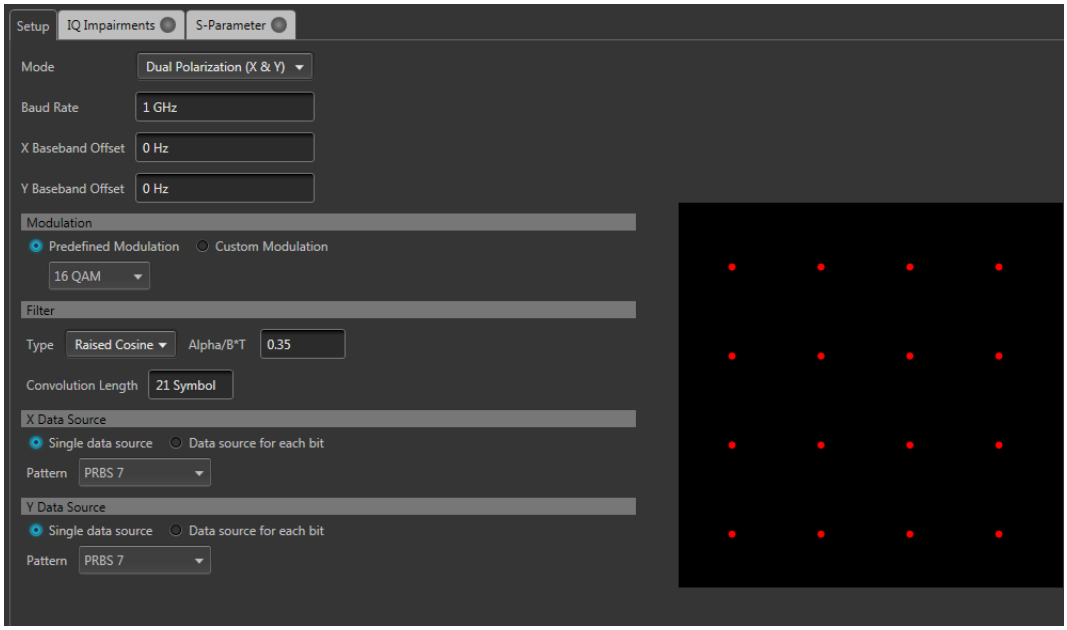
Help button

Help button: Provides links where you can obtain additional product help and documentation.

Item	Description
User manual	Opens the plug-in help system.
About ...	Provides you with information about your plug-in application. This information is helpful when contacting Tektronix about your application.

Setup tab

The setup tab provides all the basic parameters to generate the waveform.

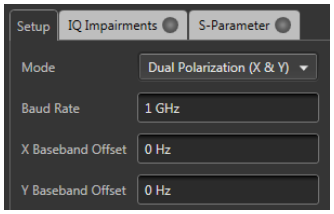


Refer to the following sections about the waveform setup.

- Basic Setup parameters (see page 11)
- Modulation parameters (see page 12)
- Filter parameters (see page 17)
- X Data Source parameters (see page 18)
- Y Data Source parameters (see page 18)

Basic Setup parameters

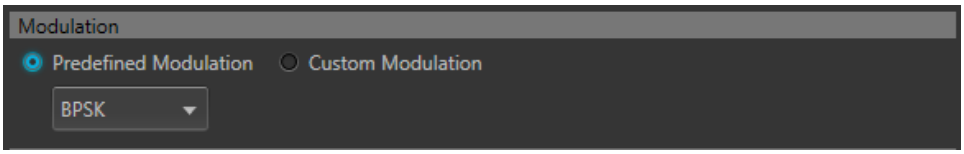
The following settings in the Setup tab define the basic waveform parameters.



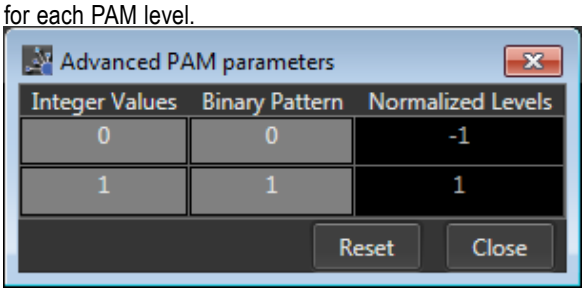
Item	Description
Mode	Use the Mode selection to set the polarization. Polarization is the direction in which the signal oscillates as it propagates through space In the case of Optical signals, it oscillates in two distinct directions, the horizontal axis 'X' is X-Polarization and the orthogonal vertical axis 'Y' is the Y-Polarization.
Single Polarization (X)	Select to create single X-Polarized signals. Depending on the Modulation selection, selecting Single Polarization generates either one or two X-Polarized waveforms.
Dual Polarization (X & Y)	Select to create both X-Polarized signals. and Y-Polarized signals. Depending on the Modulation selection, selecting Dual Polarization generates either one or two X-Polarized waveforms and one or two Y-Polarized waveforms
Baud Rate	Set the baud rate of the compiled waveforms. The range is dependent on the selected instrument minimum and maximum sampling rate.
X Baseband Offset	The baseband offset can be used to provide a frequency offset from 0 (or baseband) for the X polarized signal.
Y Baseband Offset	The baseband offset can be used to provide a frequency offset from 0 (or baseband) for the Y polarized signal. Enabled when Mode is set to Dual Polarization.

Modulation parameters

The Modulation section provides two methods of defining the digital modulation. Predefined Modulation provides a pull-down list to select from the available modulation types. Custom Modulation provides the ability to create specific modulation parameters.

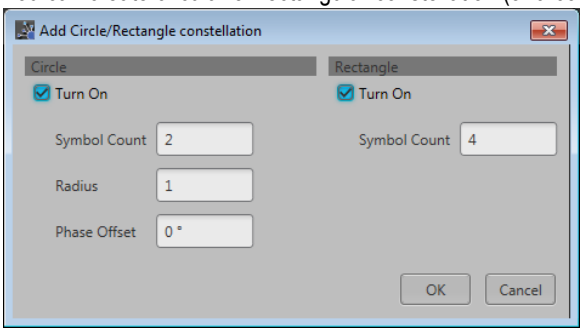
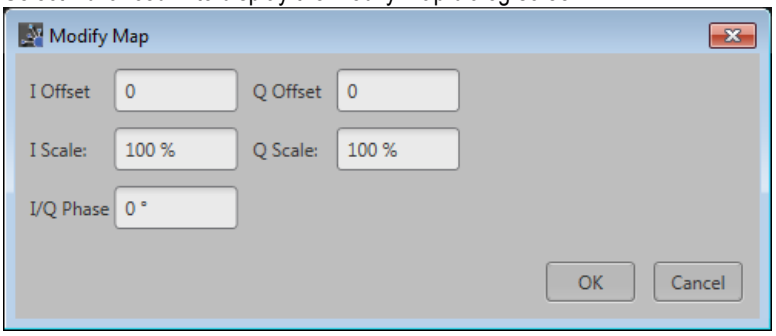


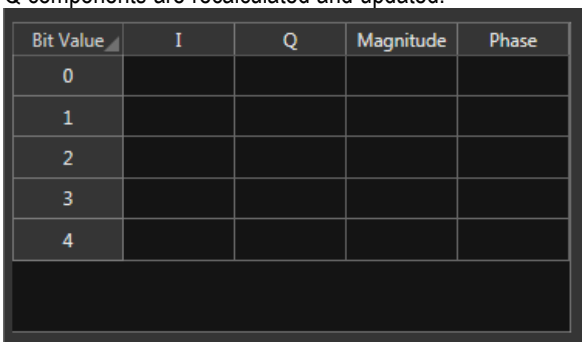
Predefined Modulation

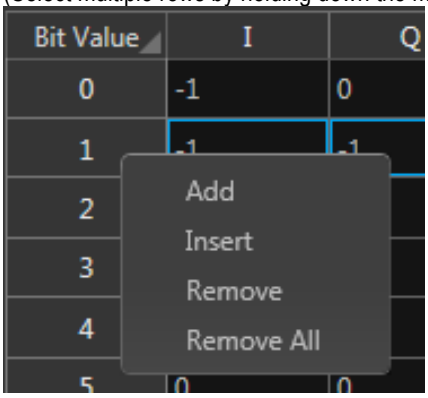
Item	Description
Predefined Modulation	Select a modulation type from the pull-down list. Some modulation types have additional parameters that are displayed upon selection. Below are descriptions of the various additional parameters. See Symbol Mapping (see page 29) for values of the modulations.
Digital modulation types	PSK BPSK, QPSK, OQPSK QAM 8 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM, 512 QAM, 1024 QAM PAM 2 PAM, 4 PAM, 8 PAM PAM selection displays Advanced... button to set advanced PAM parameters. See below. OOK NRZ
	Advanced PAM parameters
	The Advanced PAM parameters dialog screen allows you to further set the Normalized values for each PAM level. 

Custom Modulation

Item	Description
Modulation mode	Select the modulation mode: Normal Differential
Offset modulation	Indicates whether to apply offset modulation or not: Yes, No. Selecting Yes applies offset modulation.
Add predefined symbols	Provides a dropdown list of modulation types to pre-populate the symbol table. There are three choices: BPSK, QPSK, and Circle/Rectangle. When selecting BPSK or QPSK, a set of default values are placed in the symbol table. Each subsequent selection (of either) adds and additional set of values. When selecting Circle/Rectangle... , the Add Circle/Rectangle constellation dialog box is displayed to create a unique symbol map.

Item	Description
	Use the Add Circle/Rectangle constellation dialog box to create a symbol map. You can create circular or rectangular constellation (or a combination).  **Circle** Select Circle to define a constellation window that allows you to create equally spaced symbols in a circle of a specified radius. You can define an offset angle to rotate the constellation. Symbol Count: Enter number of symbols (2 to 512) to create the constellation. Radius: Enter the radius (–5 to 5) of the circle. Phase Offset: Enter a phase offset (–180° to +180°) to rotate the constellation. **Rectangle** Select Rectangular to define constellation points which are distributed in a rectangular shape, akin to QAM modulations. Symbol Count: Enter number of symbols (4 to 512, in powers of 2) to create the constellation.
Advanced...	Select Advanced... to display the Modify Map dialog screen.  Adjust Offset, Scale, and Phase for I and Q. The modifications are applied to all Bit Values currently in the Symbol table.

Item	Description
Symbol table editing	Use the Symbol table to edit the values in a cell. Double-click a cell to enter the edit mode for the cell. I component: Specify the I component of the modulation. Range: –141.421 to 141.421. Q component : Specify the Q component of the modulation. Range: –141.421 to 141.421. Magnitude: Specify the magnitude of the modulation. Range: 0 to 141.421. Phase: Specify the phase of the modulation. Range: –180° to +180° The Magnitude and Phase parameters depend on the value of the I and Q components. If you change the value of the I and Q components, the Magnitude and Phase values are recalculated and updated. Similarly, if you change the Magnitude and Phase values, the values of the I and Q components are recalculated and updated. 

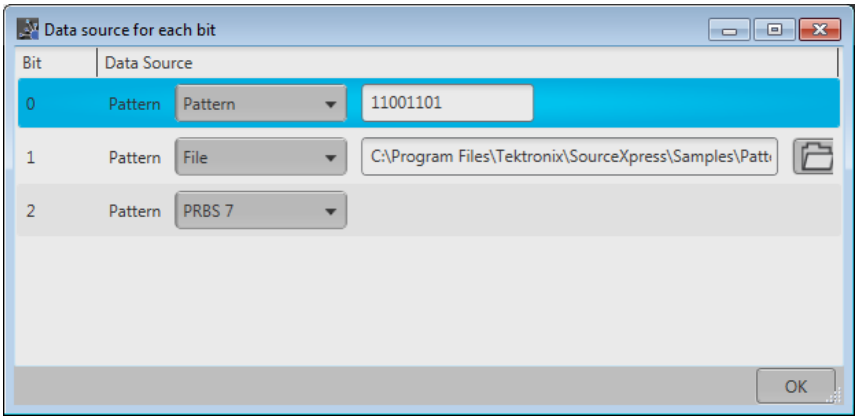
Item	Description
	To manage entire rows within the Symbol table, right-click on a row to display the editor menu. (Select multiple rows by holding down the mouse key and sliding to select contiguous rows.)  Add: Adds a single empty row to the end of the table. Insert: Inserts a single empty row above the currently selected row. Remove: Removes the selected rows. (The row must be selected from the Bit Value column.) Remove All: Deletes then entire contents of the table.
	Copy and Paste in the Symbol table You can copy and paste entire rows within the Symbol table using Ctrl-c (copy) and Ctrl-v (paste) keys. • Highlight the rows (or contiguous rows) you wish to copy and press Ctrl-c. • Highlight the row where you want paste the row or rows and press Ctrl-v. **Copy and Paste Using Excel** You can also copy and paste data from the Symbol table an Excel spreadsheet. You can also copy data from an Excel spreadsheet into the Symbol table. Ensure that the data in the Excel spreadsheet is formatted properly to match the Symbol table columns.

Filter parameters

Item	Description
Filter	Select the filter Type from the following options: Raised Cosine, Root Raised Cosine, Rectangular, and User Defined. **User Defined** Selecting User Defined provides a filename dialog box to enter a path to a user defined filter file (or use the folder icon to browse to a filter file). A filter file allows users to provide the filter coefficients. The file should have header information containing Samples to be considered per symbol followed by filter coefficients. For example: SamplesPerSymbol = 50 -0.000007 -0.000014 -0.000021 -0.000028 -0.000034 -0.000041 -0.000048 ....
Alpha/B*T	Enabled for Raised Cosine and Root Raised Cosine filters. Alpha defines the rolls of the filters to smooth the data.
Convolution Length	Enter the convolution length. Convolution length defines the number of symbols to consider for creating filter taps.

X Data Source parameters

Item	Description
Single data source	Select a data source to be used for all X Data bits.
Pattern	Select the data source:
All One	Sends a sequence of binary 1 symbols.
All Zero	Sends a sequence of binary 0 symbols.
File	Select the base data file to be used by entering the path or browsing to the file. The supported formats are .txt.
PRBS	Select the PRBS type from the following: 7, 9, 15, 16, 20, 21, 23, 29, 31, and User Defined. To edit the bit sequence, select User Defined. This displays the PRBS Editor icon  . Select to display the PRBS Editor (see page 19) dialog screen.
Pattern	Enter a pattern of 0s and 1s up to a maximum of 256 digits in the text field that appears.
Data source for each bit	Select a data pattern that is unique to each bit.
Define Data bits...	Displays the dialog screen to select the data sources for each bit.



The selected modulation type determines the number of bits presented in the dialog screen.

The selections available for each bit are the same available as described for the Single data source selection.

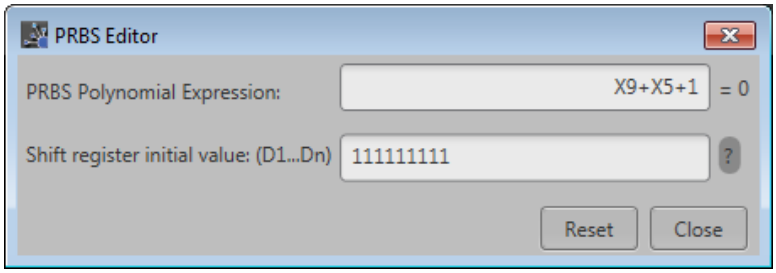
Y Data Source parameters

Y Data Source is only available when the polarization mode is set to Dual Polarization (X & Y).

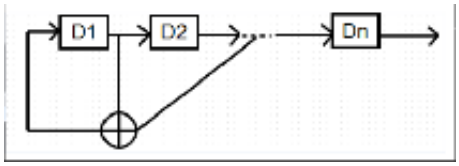
The Y Data Source has identical parameter selections as the X Data Source. Refer to the X Data Source parameters for descriptions.

PRBS Editor

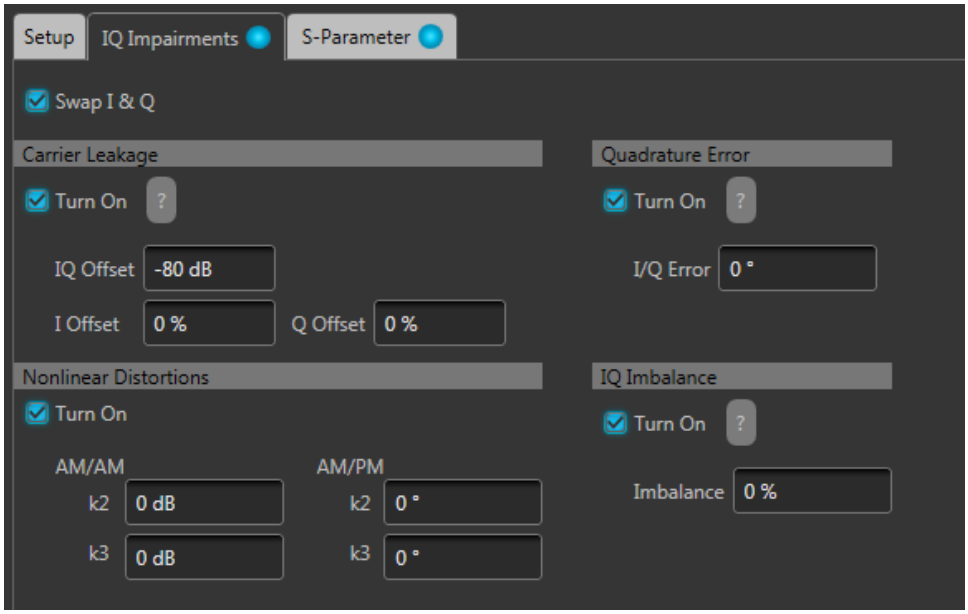
This dialog box is displayed when clicking PRBS Editor icon when PRBS is set to User Defined in the X or Y Data field (Setup tab).



PRBS sequences are generated by a feedback shift register. The number (#) following PRBS indicates the length of the generating shift register. For instance, a shift register with 16 memory cells is required to generate a PRBS 16 sequence. The pseudo-random sequence of a PRBS generator is determined by the number of registers and the feedback.



IQ Impairments



Item	Description
Swap I & Q	Select to interchange I and Q signal outputs.
Carrier Leakage	
Turn on	Select to add carrier leakage (I and Q) impairments to the carrier.
IQ Offset	Adds equal offset to I and Q signals based on the dB value provided.
I Offset Q Offset	Adjust the percentage of offset for I and Q based on the IQ Offset dB value.
Nonlinear Distortions	
Turn on	Select to add nonlinear distortions to the carrier.
AM/AM	k2: Enter the 2nd order coefficient for the magnitude (dB). k3: Enter the third order coefficient for the magnitude (dB). Range: –3 dB to +3 dB.
AM/PM	k2: Enter the 2nd order coefficient for the phase (degrees). k3: Enter the third order coefficient for the phase (degrees).
Quadrature Error	
Turn on	Select to add quadrature error to the carrier.
I/Q Error	Enter the phase angle between the I and Q signals. Range: –30° to +30°.
IQ Imbalance	
Turn on	Select to add IQ imbalance to the carrier.
Imbalance	Enter the imbalance between the I and Q signals. Range: –30% to 30% (–2.28 dB to 3.1 dB).

S-Parameter license

A license is required to use the S-Parameter feature.

S-Parameters is available when a license is detected by the application. With the license installed on the host PC where SourceXpress is installed, S-Parameters is available regardless of connecting to a virtual generator or a real instrument.

Refer to Licensing (see page 31) for information about obtaining a license file.

S-Parameter

Select Turn on to enable adding S-Parameters to the compiled waveforms.

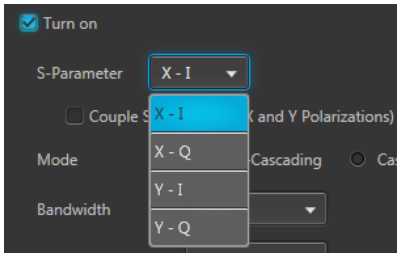
Select the waveform(s) to apply S-Parameters

S-Parameters are applied to each compiled waveform. The available waveforms depends on the Mode and the Modulation selections.

When the Mode is set to Single Polarization, you can apply S-Parameters to the X plane.

When the Mode is set to Dual Polarization, you can apply S-Parameters to both the X and Y planes.

The Modulation setting determines I and Q choices.



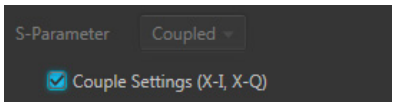
NOTE. *This is a sample of the S-Parameter pull-down menu.*

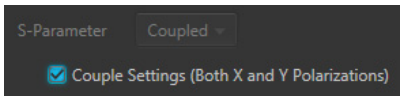
- Single polarization mode:
  - Modulation set to PAM or NRZ: S-Parameter choice is X. (Couple S-Parameters is disabled.)
  - Modulation set to QAM or PSK: S-Parameter choices are X-I and X-Q.
- Dual polarization mode:
  - Modulation set to PAM or NRZ: S-Parameter choices are X and Y.
  - Modulation is set to QAM or PSK: S-Parameter choices are X-I, X-Q, Y-I, and Y-Q.

Couple Settings

You can apply S-Parameters to the each available waveform or apply the same S-Parameters all waveforms. The couple settings action changes depending on the Mode and Modulation settings.

In the cases where only one waveform is generated, the Couple Settings selection is not available.





In the case where I and Q waveforms are generated, the I (or X-I) waveform S-Parameters are applied to all waveforms. In the case where X and Y waveforms are generated, the X waveform S-Parameters are applied to the Y waveform.

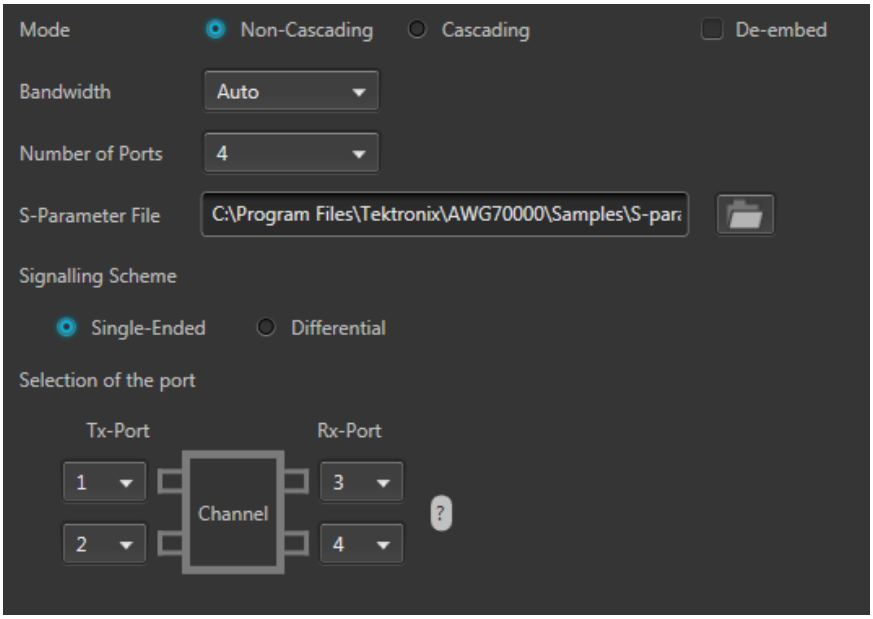
CAUTION. *When initially selecting Couple Settings, parameters are instantly replaced.*

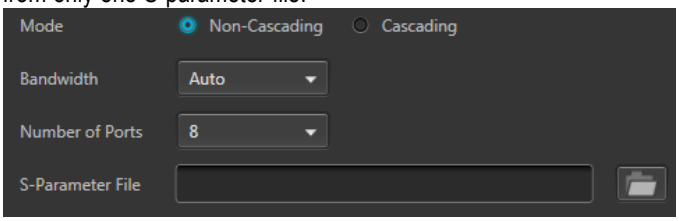
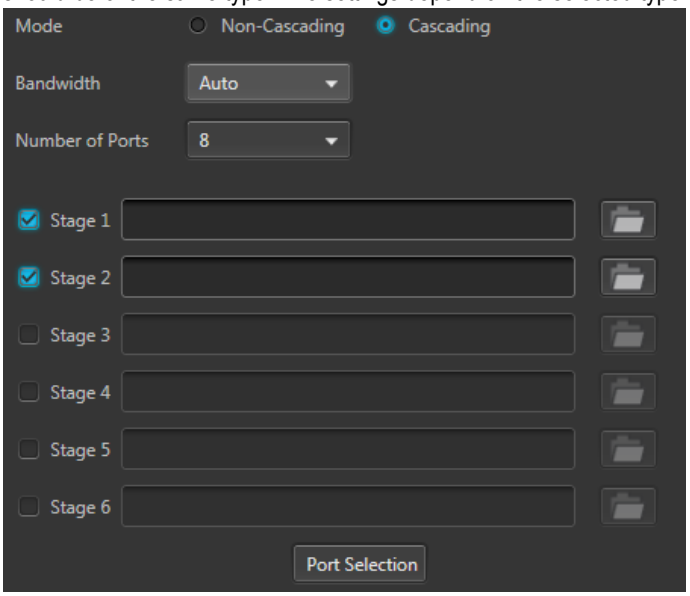
S-Parameter parameters

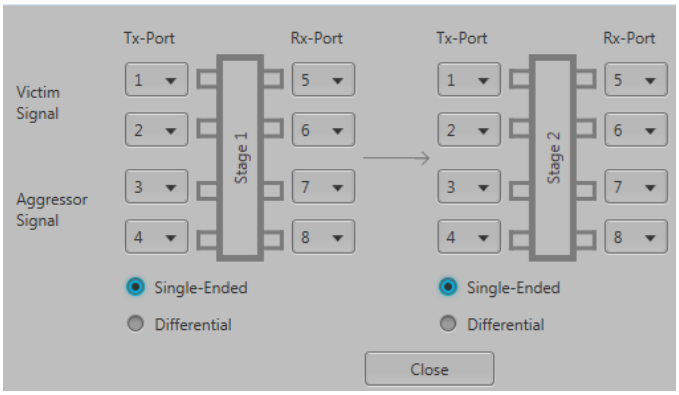
Below is a sample S-Parameter dialog screen with the Number of Ports set to 4. The dialog screen changes to accommodate the Number of Ports selected.

The available S-Parameter settings are identical regardless of the selected waveform.

The information provided for S-Parameters applies to both the Non-Cascading and Cascading modes.



Item	Description
Mode	Select Non-Cascading or Cascading S-parameter mode. In the Non-Cascading mode, you apply S-parameter characteristics on the signal from only one S-parameter file.  In the Cascading mode, you can cascade up to six S-parameter files in Stages and apply the characteristics on the signal. You can select the files to apply by turning on or turning off the corresponding Stages shown in the display. All the selected files should be of the same type. The settings depend on the selected type of file.  The files supported are s1p, s2p, s4p, s6p, s8p, and s12p.
De-embed (Non-Cascading mode) Cascading De-embed (Cascading mode)	Check the box to invert the S-Parameters from the signal. This removes the effects of the component (for which the S-Parameters were created) from the signal path.
Bandwidth	Auto – The bandwidth is defined at the point where the signal rolls off to -60 dB. If this results in a bandwidth greater than the instrument supports, the bandwidth is set to ½ of the waveform's sample rate (i.e. Nyquist Frequency). Full Bandwidth – The bandwidth is set to ½ of the waveform's sample rate (i.e. Nyquist Frequency). Manual – The bandwidth can set by the user from 1 Hz to ½ of the maximum sample rate of the instrument. If the set Bandwidth is greater than the Nyquist (Sample rate of the waveform/2), then the software limits the bandwidth to ½ of the waveform's sample rate. A warning message is provided.

Item	Description
Number of Ports	Choose the number of ports. The port matrixes supported are 1, 2, 4, 6, 8, and 12. The number of ports selected determines: • The type of S-Parameter file to apply • The Signaling Scheme choice • The port matrixes available
S-Parameter File	Navigate to the Touchstone file to apply to the signal. The type of Touchstone files that you are able to open is dependent on the number of ports selected. For instance, only .s4p files can be opened if the Number of Ports is set to 4. The files supported are s1p, s2p, s4p, s6p, s8p, and s12p.
Signaling Scheme (Only for 4, 8, and 12 ports)	Single-Ended: If the data is single-ended, you must map the port numbers as used in the file to physical locations in your link. Differential: If the data is differential, you must select the data layout in the file.
Selection of the port (No port selection for 1 Port environments)	Use the diagrams to map the ports for the transmitter ports (Tx-Port) and the receiver ports (Rx-Port). When choosing the number of Ports, you are presented with an active diagram of the ports. The diagram presented reflects the Number of Ports selected and the Signaling Scheme (if appropriate for the ports selected).
Victim Aggressor and Both (Only for 8 and 12 ports)	Victim: The default setting with no cross-talk effects. Aggressor: Select this to activate aggressor signal parameters, adding the effect of cross-talk.
Port Selection	The Port Selection button is available only when in Cascading mode. Press the Port Selection button to display an active dialog screen to map the ports for the transmitter ports (Tx-Port) and the receiver ports (Rx-Port) for each stage. 

S-Parameter file descriptions

1-port

Files with one port of data contain only one S-parameter file (s1p) so they do not require any further input.

2-port

Files with data for two ports contain four S-parameters as a 2x2 matrix. These are Touchstone 2-port files (s2p). A dialog box is created to define the 2-port mapping.

4-Port

Files with data for four ports contain 16 S-parameters as a 4x4 matrix. These are Touchstone 4-port files (s4p). They may contain single-ended or differential data. A dialog box is created to define the 4-port mapping for either single-ended or differential data.

- If the data is single-ended, you must map the port numbers as used in the file to physical locations in your link.

  You can select the port for both transmitter and receiver from the drop-down list. Each drop-down list has ports from 1 to 2.

- If the data is differential, you must select the data layout in the file.

6-port

Files with data for six ports contain 36 S-parameters as a 6x6 matrix. These are Touchstone 6-port files (s6p). A dialog box is created to define the 6-port mapping.

8-Port

Files with data for eight ports contain 64 S-parameters as an 8x8 matrix. These are Touchstone 8-port files (s8p). They may contain single-ended or differential data. A dialog box is created to define the 8-port mapping for either single-ended or differential data.

- If the data is single-ended, you must map the port numbers as used in the file to physical locations in your link.

  You can select the port for both transmitter and receiver from the drop-down list. Each drop-down list has ports from 1 to 4.

- If the data is differential, you must select the data layout in the file.

12-Port

Files with data for 12 ports contain 144 S-parameters as an 12x12 matrix. These are Touchstone 12-port files (s12p). They may contain single-ended or differential data. A dialog box is created to define the 12-port mapping for either single-ended or differential data.

- If the data is single-ended, you must map the port numbers as used in the file to physical locations in your link.

  You can select the port for both transmitter and receiver from the drop-down list. Each drop-down list has ports from 1 to 6.

- If the data is differential, you must select the data layout in the file.

Aggressor signals

8 and 12 port S-parameters allows you to activate aggressor signal parameters and to add the effect of cross-talk. 12 port S-parameters allows 2 Aggressor signal parameters.

Aggressors can be added in either Non-Cascading Mode or Cascading Mode.

The Aggressor signal parameters include:

Item	Description
Signal	Choose the type of aggressor signal with the dropdown list: • Clock: Indicates that the aggressor signal is a clock pattern. • PBRS: Also choose the number of bits • File: Indicates that the aggressor signal is another pattern file. Navigate to the Pattern file • Same as victim: The signal flow of the aggressor is same as the victim.
Data Rate	Specify the data rate (in bps) of the signal. This is not available when the Aggressor signal is set to be the same as the victim.
Aggressor Amplitude	Enter the signal amplitude. This is not available when the Aggressor signal is set to be the same as the victim.
Crosstalk Type	Choose the type of crosstalk of the aggressor signal. • Near-End Crosstalk • Far-End Crosstalk • Both

Symbol mapping

The RF Generic Signal plug-in supports many Digital modulation types. Diagrams are available for many of the more common types to illustrate the Bit mapping of the symbols.

Many of these mapping diagrams are too complex to show within this help system, or from a printed document. Because of this, the symbol maps are only available by downloading the PDF version of this help system from the Tektronix web site.

The symbol maps are in the form of an Excel spreadsheet that is attached to the PDF file.

All documentation is available on the Tektronix Web site (www.tek.com/manual/downloads). Search for the RF Generic Signal User documentation.

Licensing

A license is required for this plug-in to become operational. The plug-in must be licensed for use with the host application from where you want to use the plug-in.

For example, to use the plug-in from SourceXpress, SourceXpress must have a license. To use the plug-in from an instrument, the instrument must have a license.

Refer to the application help (for either SourceXpress or the AWG70000A series instruments) for complete information about obtaining and installing license files.

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