Tektronix®

RF Generic Signal Plug-in Application

Printable Help Document

Revision A

077-1247-00

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Revision A

www.tek.com
077-1247-00

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

Help part number: 076–0396–00

PDF of Help system part number: 077–1247–00

Contacting Tektronix

Tektronix, Inc.
14150 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

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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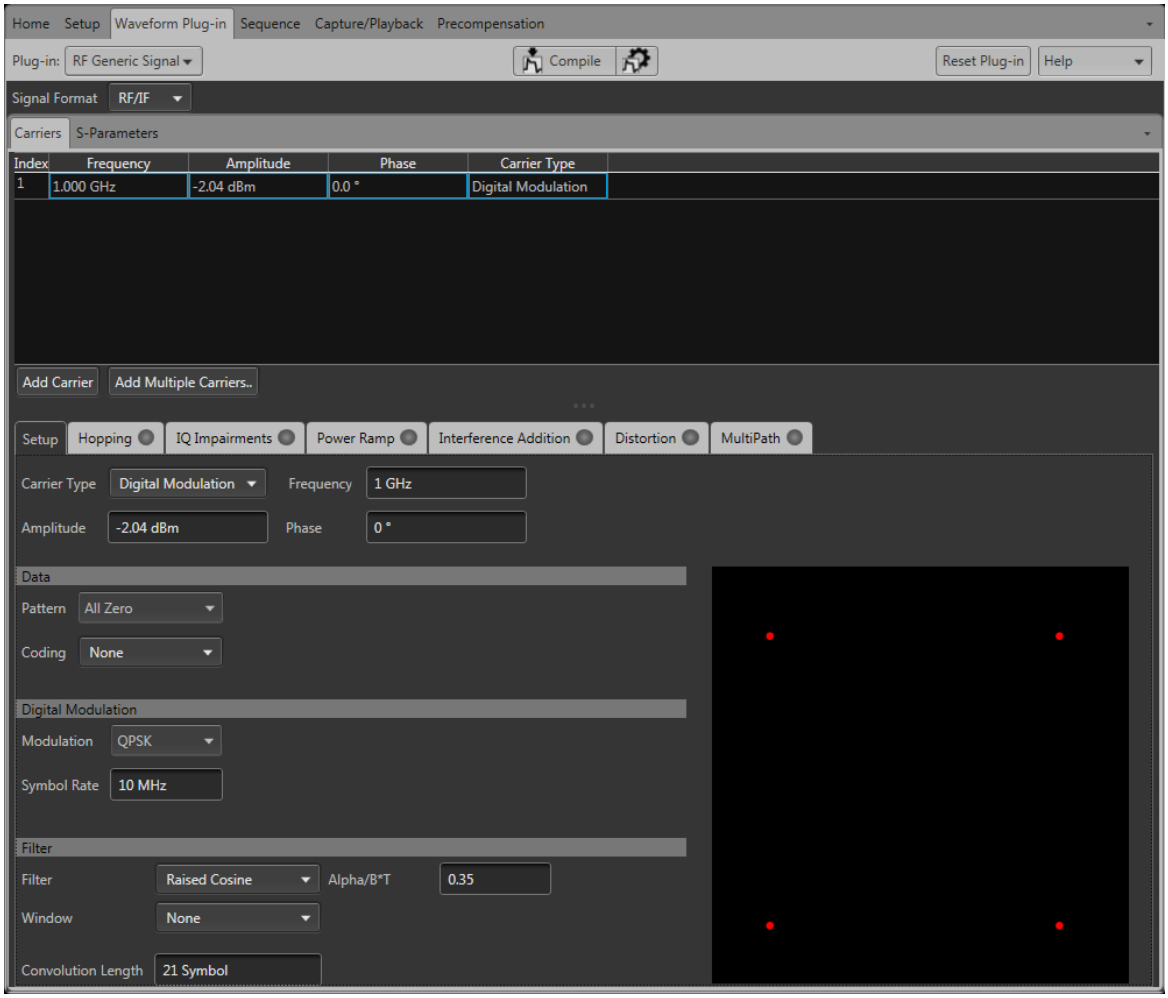
Welcome

The RF Generic Waveform plug-in is a waveform creation application that is used to create digitally modulated signals with multiple carriers.

The RF Generic Waveform 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 RF Generic Waveform 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

- Define different kinds of waveforms. Create a variety of signals, such as: signals with Digital Modulation, signals with Analog Modulation, Noise signals, and signals with Custom Modulation.
- Multi-carrier setup. Define multiple RF/IF or IQ carriers in a single waveform. Each carrier can be independently defined with parameters.
- Baseband data generation. Define baseband I and Q signals using a variety of modulation schemes.
- Substantial list of modulation types supported. For example, digital modulation types such as PSK, APSK, QAM, GMSK, FSK, CPM, ASK, and OOK are supported.
- IQ impairments. Apply impairments including quadrature error and quadrature imbalance.
- Noise/interference generation and addition. Generate and add interference for waveforms.
- Eliminates the wrap-around effects found in arbitrary waveform generators, providing seamless signals that can be played back continuously.
- Provide S-parameter emulation of RF components.
- Add Impairments. Multipath, Sinusoidal Interference, Frequency offset, and Non Linear Amplifier Distortion.
- Define frequency hopping.

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
RF Generic 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 RF Generic 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.
RF Generic 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

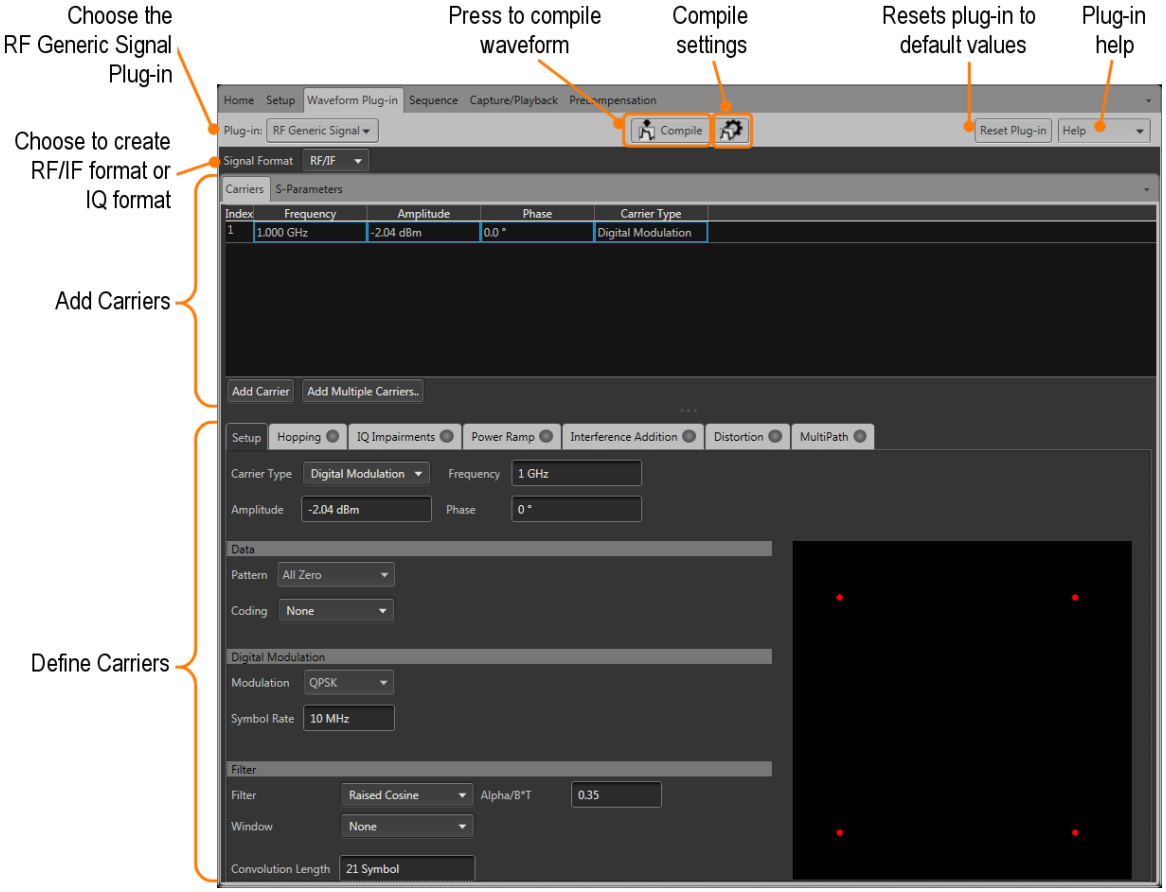
Tektronix offers the following services in support of their products:

- **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 RF Generic Signal plug-in application. The plug-in pull-down menu varies depending the installed applications.

NOTE. *RF Generic Signal requires a license to create waveforms.*

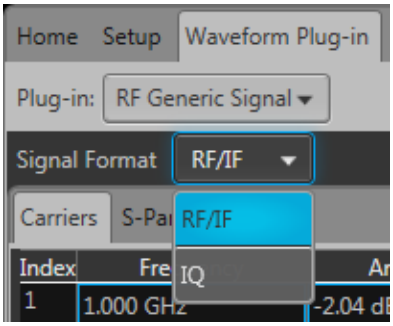
Refer to Licensing (see page 47).

Signal Format selection

The RF Generic Signal plug-in provides the capability to create digitally modulated signals in either RF/IF format or IQ format.

With RF/IF selected, a single waveform is created. With IQ selected, two waveforms are created, one for I and one for Q.

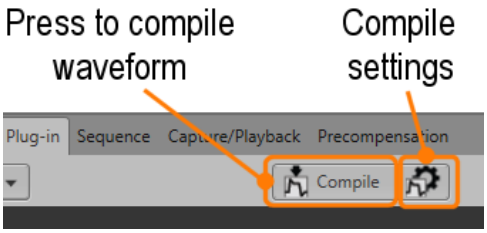
Use the Signal Format pull-down list to select.



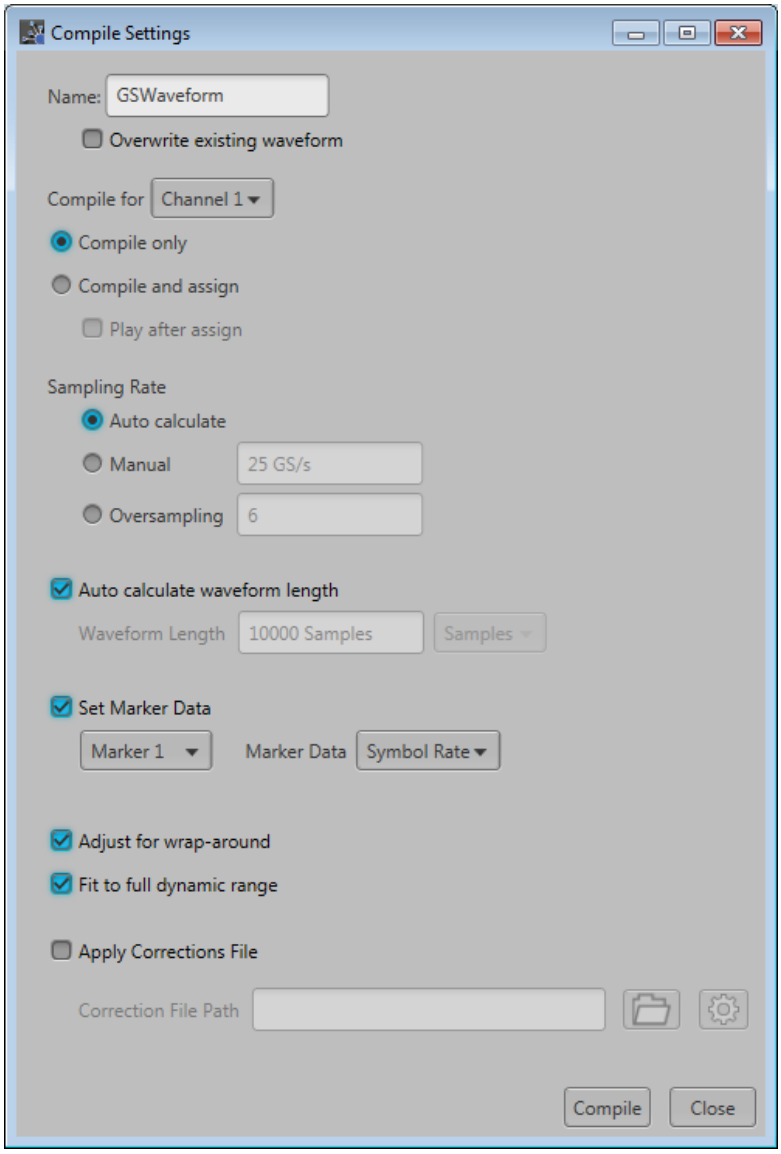
Compile button

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

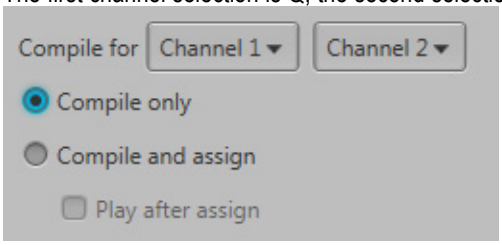
Use the Compile settings button to edit the compilation settings.



Compile settings



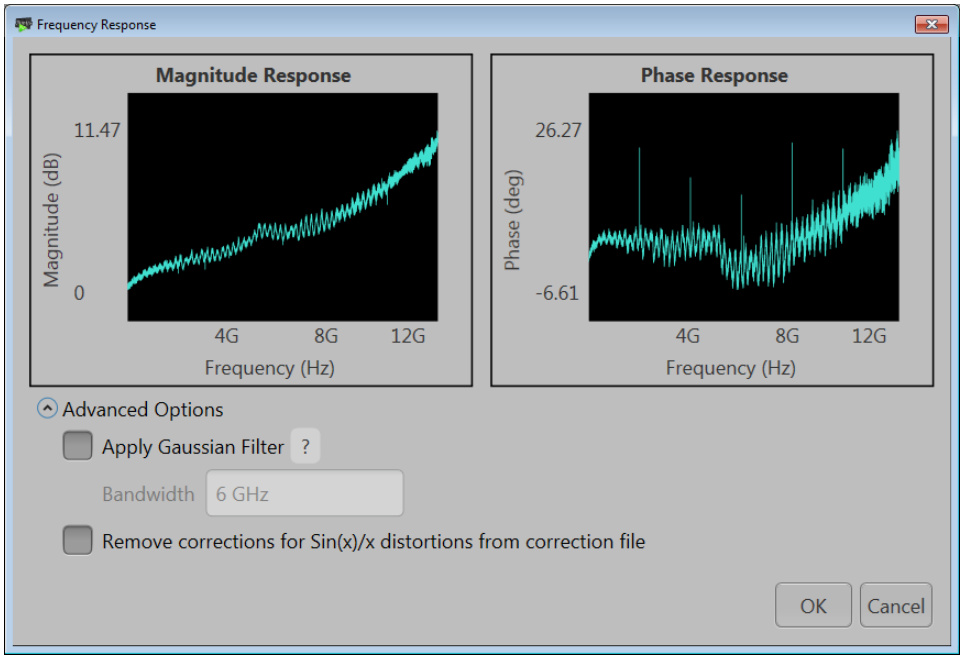
Item	Description
Name	The application provides a base name for compiled waveforms. You can edit the field with a name of your choice. The waveform is added to the Waveforms list. If the name already exists, the name is incremented with a numerical value (unless the overwrite option is selected). RF waveforms are appended with _RF. IQ waveforms are appended with _I and _Q. 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.

Item	Description
Compile for	Choose the channel to associate with the compiled waveform. Single channel instruments default to the single channel. **IQ signals** When compiling IQ signals (Signal Format set to IQ), you are presented with two channel selections. The amplitude ranges for the carrier in the setup tab is dependent upon the selected channel. The first channel selection is Q, the second selection is I. 
Compile only	The compiled waveforms are simply entered into the Waveforms list.
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.
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.
Oversampling	Select to increase the apparent sampling rate. The Sampling Rate is calculated by multiplying Oversampling with the maximum frequency of the signal to be generated.
Auto calculate waveform length	When checked, the waveform length is calculated based on all settings chosen for the waveform. Uncheck to enter the waveform length manually.
Waveform length	Directly enter the waveform length of the compiled waveform. The length can be defined as: Samples Symbols Time Symbols can be defined only if the first carrier Type is set to Digitally Modulation or Custom Modulation.
Set Marker Data	Select to include markers in the compiled waveform. Marker can be set to: Symbol Rate Bit Rate Clock Frequency (when selected, enter the clock frequency from 1 Hz to the maximum sampling rate)

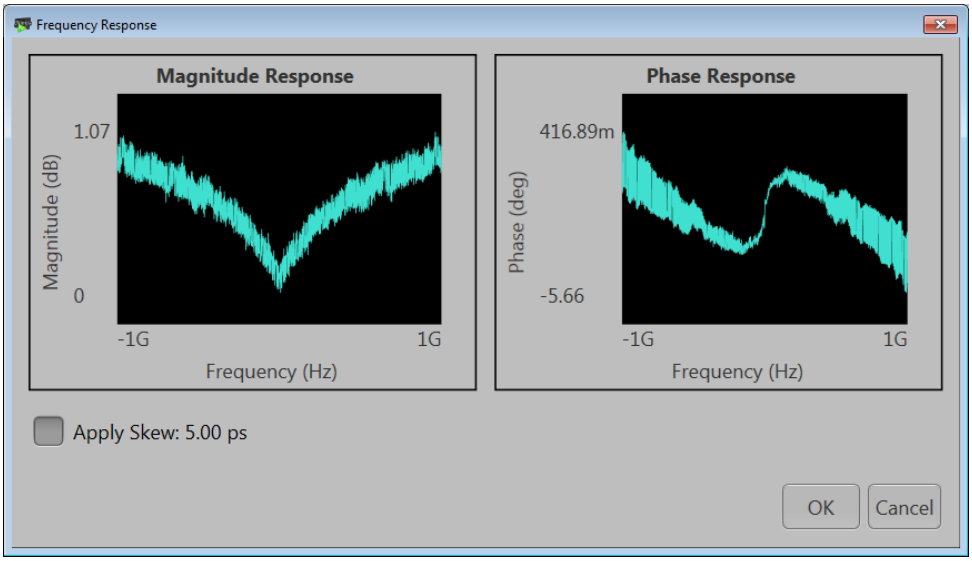
Item	Description
Adjust for wrap-around	When a waveform is in continuous play mode, it repeats when the end is reached. It is important to take care of the phase continuity between the start and end of the waveform. Discontinuity in the waveform produces frequency spurs. The application might adjust the Sampling Rate, waveform length, and other waveform properties to make the phase continuous at the end and beginning of the waveform.
Fit to full dynamic range	When checked, the waveform is normalized to make use of the full dynamic range of the DAC. You might not get the set amplitude in cases where the set amplitude requires the waveform to be scaled.
Apply Corrections File	You can apply a correction file directly to the waveform when compiling.
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 or 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.

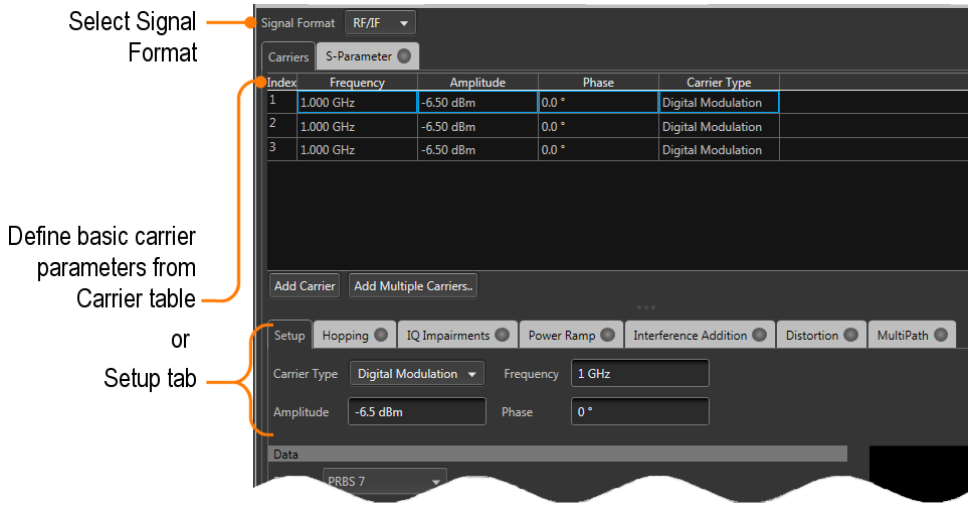
Carrier list

Initially, the RF Generic Plug-in contains one default carrier in the list of carriers. You can create additional carriers using the Add Carrier button (see page 12) or the Add Multiple Carriers... button (see page 12).

The maximum number of carriers you can have in the table is 1024. Each row in the table corresponds to one carrier.

Each carrier has a basic set of parameters (Frequency or Baseband Offset, Amplitude, Phase, and Carrier Type). Frequency or Baseband Offset is available based on the Signal Format of RF/IF or IQ, respectively. There are two ways to set these parameters: within the Carriers table by double clicking in a table cell or by selecting a Carrier and use the Setup tab.

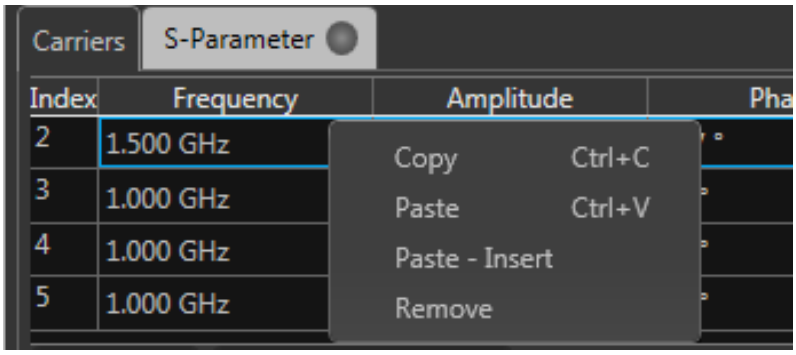
As you can see in the User Interface, the Setup tab has the same settings as the column heads in the Carrier index list.



The Parameters shown in the Setup tab reflect the selected (Highlighted).

Menu operations

With any carrier selected, a right-mouse click displays a menu of operations.



Item	Description
Copy	Copies the selected carrier (or carriers) in preparation to paste into the carrier list. Carriers can only be selected in a contiguous manner.
Paste	Select the carrier to replace with the copied carrier. If pasting multiple carriers, the selected carrier is replaced and the remaining carriers are inserted below.
Paste-Insert	The copied carrier (or carriers) are inserted above the selected carrier.
Remove	The selected carrier (or carriers) are deleted. You can also press Delete on the keyboard. To select multiple carriers, left-mouse click on a carrier, continue to hold the left-mouse button and slide the selection either up or down to highlight the carriers. You can also select multiple carriers by highlighting a carrier, hold the Shift key, and scroll up or down to the next carrier you want to select. Carriers can only be selected in a contiguous manner.

Add Carrier button

Selecting Add Carrier creates a single carrier, adding it to the list of carriers. The new carrier is placed at the bottom of the existing carriers. All features and parameters of the new carrier are set to their default values.

Add Multiple Carriers... button

The Add Multiple Carriers... button displays a dialog box that allows you to easily create many carriers. All carriers are created using the same basic setup parameters except for the capability to vary frequency and phase parameters between each carrier.

The Signal Format selection (RF/IF or IQ) determines the dialog display.

Item	Description
Number of carriers	Select the number of carriers to add. The total number of carries possible is 1024.

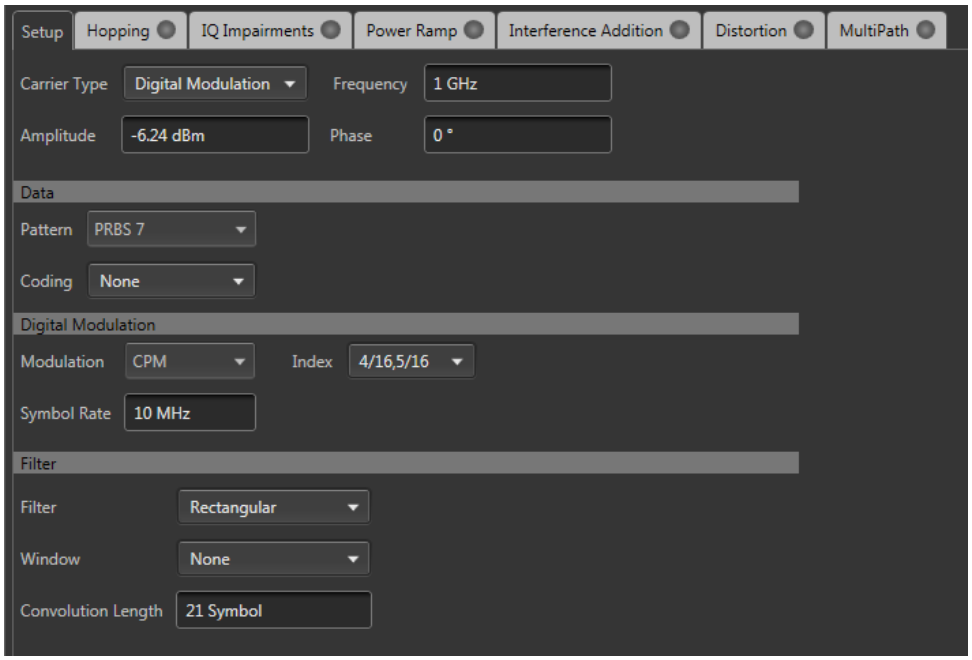
RF/IF signal format	
Center Frequency	Choose between Center Frequency settings or Base Frequency settings.
Frequency	Enter the center frequency of the carrier. Range: 1 Hz to the maximum supported by the AWG.
Bandwidth	Enter the bandwidth of the carrier. Range: 1 Hz to the maximum supported by the AWG.
Base Frequency	Choose between Base Frequency settings or Center Frequency settings.
Frequency	Enter the base frequency of the carriers. Range: 1 Hz to the maximum supported by the AWG.
Carrier Spacing	Enter the spacing between carriers. Range: 1 Hz to the maximum supported by the AWG.
Use Random Phases	If selected, the carriers will each have a random phase value. If not selected, enter a phase value to be used by all new carriers. Range: –180° to +180°.
IQ signal format	
Initial Offset	Enter the initial baseband frequency. Each additional carrier created will have its frequency incremented by the carrier spacing.
Carrier Spacing	Enter the spacing between carriers. Range: 1 Hz to the maximum supported by the AWG.
Common elements for RF/IF and IQ signal formats	
Use Random Phases	If selected, each carrier is created with a random phase value. If not selected, enter a phase value to be used by all new carriers. Range: –180° to +180°.
Setup for the new carriers to be added Refer to Setup (see page 15) for descriptions of each carrier type and the specific carrier type parameters.	
Add Carriers button	Select to add the carriers to the end of the existing list of carriers.
Replace Carriers button	Select to delete all existing carriers and add the new carriers.

Setup tab

The setup tab provides all the basic parameters for each carrier. As you highlight carriers in the carrier list, the Setup tab changes to match the highlighted carrier.

NOTE. *When adding a carrier (with the Add Carrier (see page 12) button), the new carrier is created with default settings. After the new carrier is created, you can then change it's carrier type and associated setup parameters.*

To create carriers with settings other than the default settings, use the Add Multiple Carriers... (see page 12) button.



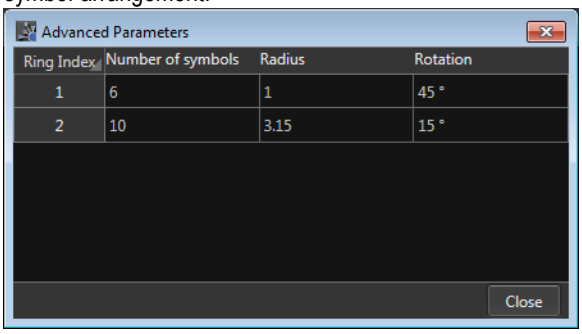
Common Setup parameters

The following settings are common setup parameters for carriers. As the Carrier Type changes, the Setup tab changes to include parameters specific to the selected Carrier Type.

Item	Description
Carrier Type	The Carrier Type determines the available setup parameters. For setup information specific to the Carrier Type, refer to the following topics: Digital Modulation (see page 16) Analog Modulation (see page 19) Noise (see page 20) Custom Modulation (see page 20)
Offset or Frequency	Frequency for RF/IF signal format. Offset for IQ signal format.
Amplitude or Amplitude (Vrms)	Amplitude for RF/IF signal format. Amplitude (rms) for IQ signal format. The amplitude ranges depend upon the channel selected in the compile settings.
Phase	When the Signal Format is set to RF/IF, this sets the starting phase of the carrier. When the Signal Format is set to IQ, this shifts the IQ phase.

Digital Modulation setup

Item	Description
Digital Modulation setup parameters	
Data	
Pattern	Select the data source:
All Zero	Sends a sequence of binary 0 symbols.
All One	Sends a sequence of binary 1 symbols.
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 23) dialog screen.
Pattern	Enter a pattern of 0s and 1s up to a maximum of 80 digits in the text field that appears.
File	Select the base data file to be used by entering the path or browsing to the file. The supported formats are .txt.
Coding	Depending on how the receiver is set to receive the information bits, coding can be applied on the bit stream. Specify the coding type: None, Gray, Differential.

Digital Modulation	
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 39) for values of the modulations.
n DPSK	Available when modulation is set to n DPSK.
Phase Rotation	Set the phase in degrees for the Differential PSK Modulation.
n	Set the n value of n-DPSK modulation. n must be a power of 2.
APSK (16, 32, 64)	Available when modulation is set to one of the APSK types.
Advanced Parameters	The Advanced Parameters displays how the symbols are arranged. Use the fields to define the symbol arrangement.  The number of symbols must equal the APSK type selected.
FSK	Available when modulation is set to one of the FSK types.
FSK Peak Deviation	Enter the FSK peak deviation value in Hz.
CPM	Continuous Phase Modulation uses a multi-h phase coded scheme, where h is the modulation index.
Index	Choose one of the predefined modulation index pairs.
ASK	Available when modulation is set to ASK.
ASK Mod Index	Enter the ASK modulation index from 0 to 200%.
Symbol Rate	Enter the symbol rate for modulation.

Filter	
Filter	The filter selection is dependent on the Modulation selection. Select the filter from the following options: Rectangular, Raised Cosine, Root Raised Cosine, Gaussian, Triangular, Edge, Half-Sine, 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 ....
Window	Select the window type from the following: None, Triangular, Hamming, Hanning, Blackman, Kaiser, Blackman Harris, Exact Blackman, Flat Top, Tapered Cosine, and Chebyshev Ripple.
Convolution Length	Enter the convolution length. Convolution Length defines the number of adjacent symbols to consider while filtering the symbol. This in turn defines the number of filter taps.

Analog Modulation setup

Item	Description
Analog Modulation setup parameters	
Analog Modulation	
Modulation	Select the Modulation from the following options: AM, PM, and FM.
AM	
AM Index	Defines the Modulation depth in percentage
PM	
PM Deviation	Defines the Phase deviation in degrees.
FM	
Frequency Deviation	Defines the Frequency deviation in Hz.
Modulating Signal	
Modulating Signal	Select the Modulating Signal from the following options: Sinusoidal, Triangular, Square, and User Defined.
Modulating Frequency	Available for Sinusoidal, Triangular, and Square modulation signals. Define the frequency of the baseband/modulating signal in Hz.
Filename	Selecting User Defined provides a filename dialog box to enter a path to a user defined filter or use the folder icon to browse to a filter file.
Sampling Rate	Available for User Defined modulation signals. Define the Sampling Rate at which the signal is created.
Interpolation	Available for User Defined modulation signals.
Sinc Nearest Neighbor	The User defined signals will have to interpolated to sampling rate as required by the software. Type of interpolation depends on the users signals. If the signal is bandlimited, Sinc interpolation can be used. If the signal is rectangular or square type, Nearest Neighbor interpolation can be used.

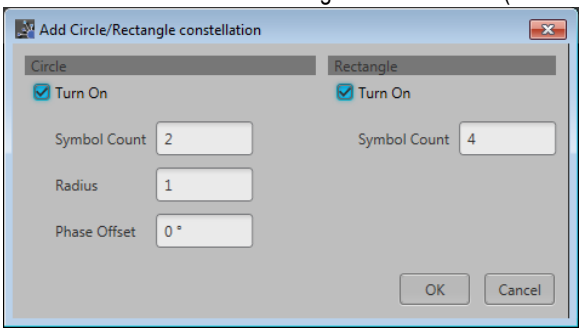
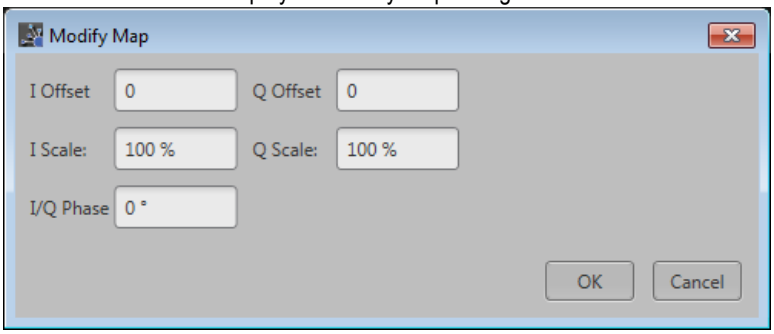
Noise setup

Item	Description
Noise setup parameters	
Bandwidth	Defines the Bandwidth of the Noise to be generated.
Filter	
Filter	Select the filter from the following options: Rectangular, Raised Cosine, Root Raised Cosine, Gaussian, Triangular, Edge, Half-Sine, and User Defined. Selecting User Defined provides a filename dialog box to enter a path to a user defined filter or use the folder icon to browse to a filter file.
Window	Select the window type from the following: None, Triangular, Hamming, Hanning, Blackman, Kaiser, Blackman Harris, Exact Blackman, Flat Top, Tapered Cosine, and Chebyshev Ripple.
Convolution Length	Enter the convolution length. The Convolution Length defines the number of adjacent samples to consider while filtering. This in turn defines the number of filter taps.

Custom Modulation setup

Item	Description
Custom Modulation setup parameters	
Data	
Pattern	Select the data source:
All Zero	Sends a sequence of binary 0 symbols.
All One	Sends a sequence of binary 1 symbols.
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 23) dialog screen.
Pattern	Enter a pattern of 0s and 1s up to a maximum of 80 digits in the text field that appears.
File	Select the base data file to be used by entering the path or browsing to the file. The supported format is .txt.
Coding	Depending on how the receiver is set to receive the information bits, coding can be applied on the bit stream. Specify the coding parameter: None, Gray, Differential.
Custom Modulation	
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.

Custom 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.
	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) 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.

Custom Modulation

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.

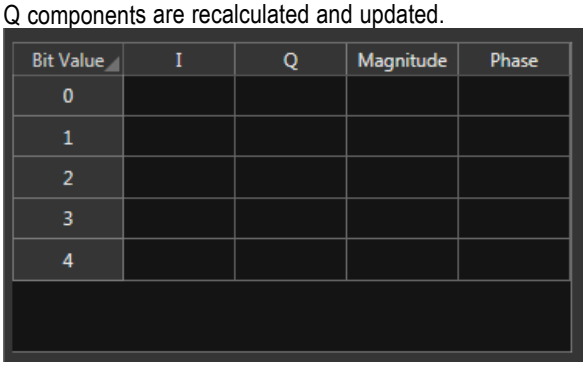
I component: Specify the I component of the modulation. Range: –141.421 to 141.421.

Q component : Specify the Q component of the modulation. Range: –141.421 to 141.421.

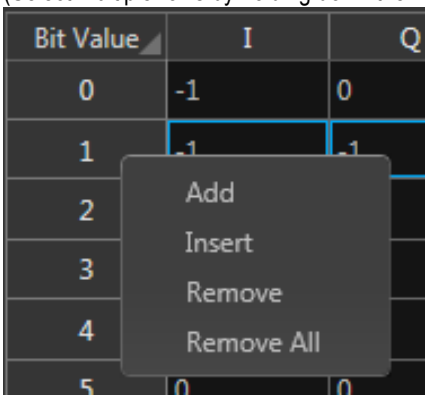
Magnitude: Specify the magnitude of the modulation. Range: 0 to 141.421.

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.



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.

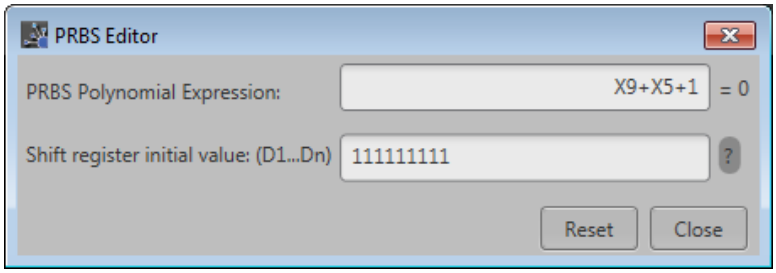
Remove: Removes the selected rows. (The row must be selected from the Bit Value column.)

Remove All: Deletes then entire contents of the table.

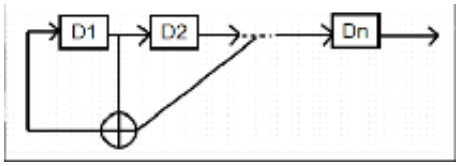
Filter	
Filter	The filter selection is dependent on the Modulation selection. Select the filter from the following options: Rectangular, Raised Cosine, Root Raised Cosine, Gaussian, Triangular, Edge, Half-Sine, and User Defined. Selecting User Defined provides a filename dialog box to enter a path to a user defined filter or use the folder icon to browse to a filter file.
Window	Select the window type from the following: None, Triangular, Hamming, Hanning, Blackman, Kaiser, Blackman Harris, Exact Blackman, Flat Top, Tapered Cosine, and Chebyshev Ripple.
Convolution Length	Enter the convolution length. The Convolution Length defines the number of adjacent samples to consider while filtering. This in turn defines the number of filter taps.

PRBS Editor

This dialog box is displayed when clicking PRBS Editor icon when PRBS is set to User Defined in the 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.



Modulation types supported

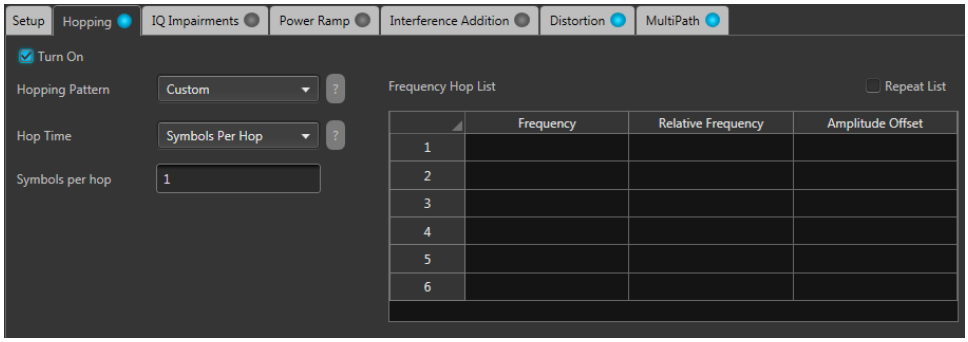
Item	Description
Digital modulation types	PSK, QPSK π/2 QPSK π/4 QPSK π/4 DQPSK OQPSK BPSK π/2 BPSK n DPSK 8 PSK π/2 8 PSK O-8PSK SDPSK SBPSK SOQPSK DQPSK APSK, 16 APSK, 32 APSK, 64 APSK QAM, 16 QAM, P/2 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM, 512 QAM, 1024 QAM GMSK, FSK, 2 FSK, 4 FSK, 8 FSK, 16 FSK, 32 FSK CPM, {4/16, 5/16} {5/16, 6/16} {6/16, 7/16} {7/16, 10/16} {12/16, 13/16} {8/16, 8/16} ASK, OOK.
Analog modulation types	AM PM FM

Hopping

Hopping is only available for use with Digital Modulation and Custom Modulation Carrier Types.

Hopping allows you to add frequency and amplitude hopping for a selected carrier.

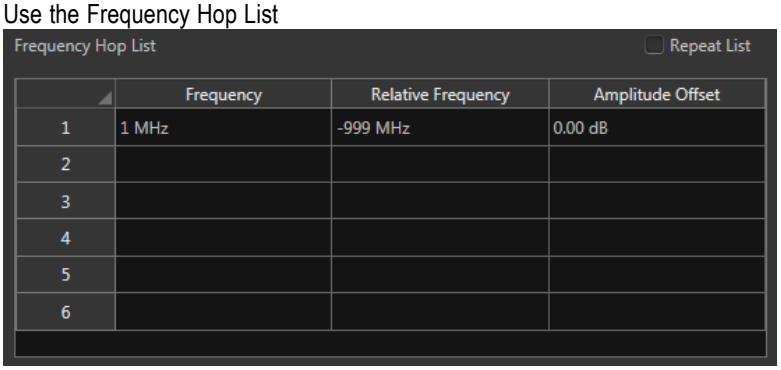
Frequency hopping can used to create frequency agile waveforms. Frequency hopping is used in electronic counter measures by rapidly switching the frequency of the transmitted energy, and receiving only that frequency during the receiving time window.



Item	Description
Hopping Pattern	Three hopping patterns are available. Custom: Hops are based on the Frequency Hop List. Pseudo Random List: Hops are chosen randomly (based on PRBS selection) from the Frequency Hop List. Pseudo Random Range: Hops are chosen randomly (based on PRBS selection) from frequencies between a minimum and maximum frequency with a minimum frequency spacing Frequencies included in the Frequency Avoid List will be skipped.
Custom Hopping Pattern	
Hop Time	Select the method to define the Hop Time Symbols Per Hop Hops Per Second Symbol Start Index Hop Duration
Symbols Per Hop	Symbols per Hop determines how many Symbols occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.

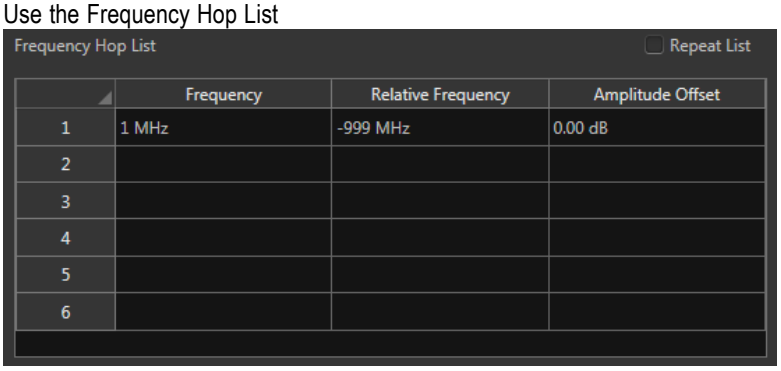
Custom Hopping Pattern

Use the Frequency Hop List

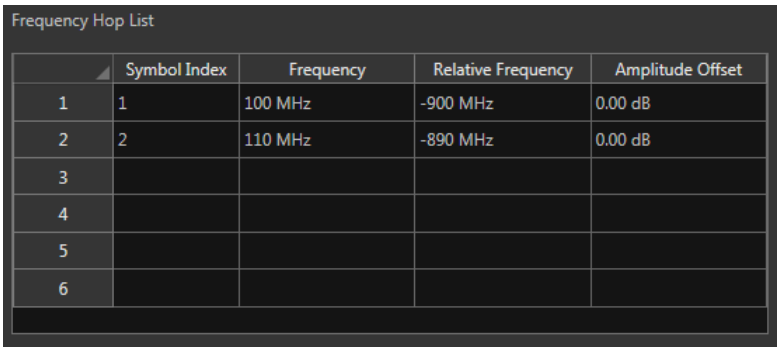


Hops Per Second	Hops Per Second determines how many hops occur for each second. Range: 1 to 1000000000.

Use the Frequency Hop List

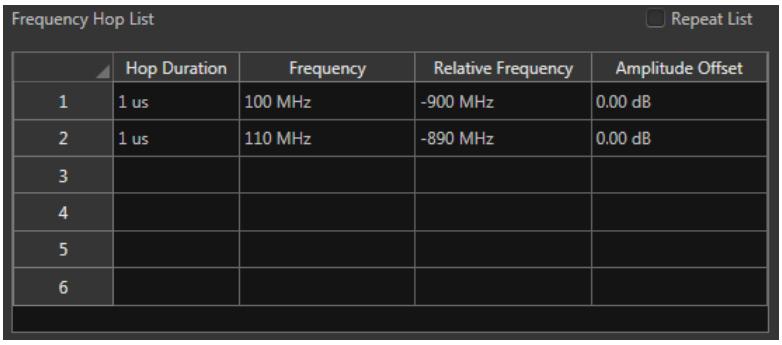


Symbol Start Index	Defines the index the specific hop starts. Each hop must contain a unique start index.



Custom Hopping Pattern

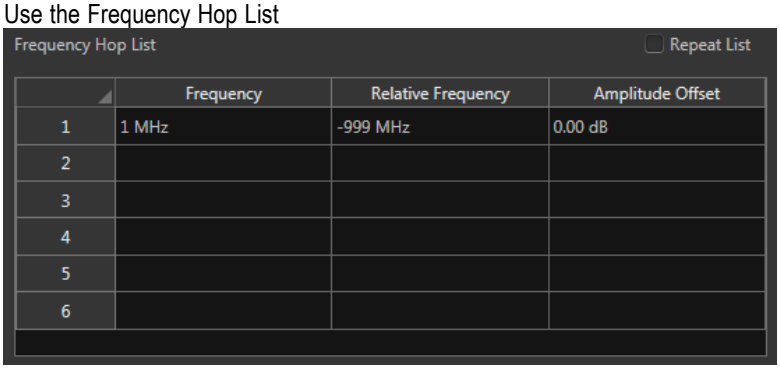
Hop Duration	Defines the amount of hop time the pattern will play each hop. Each hop must have its own duration.



Pseudo Random List Hopping Pattern

Hop Time	Select the method to define the Hop Time Symbols Per Hop Hops Per Second
Symbols Per Hop	Symbols per Hop determines how many Symbols occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.

Use the Frequency Hop List



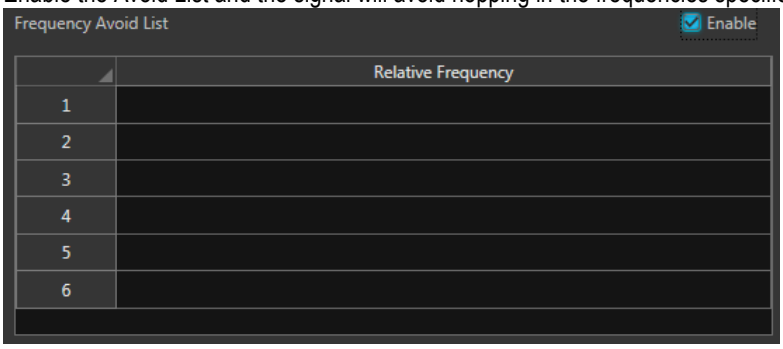
PRBS Pattern	Select the PRBS pattern for hopping.

Pseudo Random Range Hopping Pattern

Hop Time	Select the method to define the Hop Time Symbols Per Hop Hops Per Second
Symbols Per Hop	Symbols per Hop determines how many Symbols occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.
Minimum Frequency	Enter the frequency range within which to hop. Specify the start frequency for the range.
Maximum Frequency	Specify the end frequency for the range.
Frequency Spacing	Specify the minimum frequency intervals for hopping. The signal will hop avoiding the frequencies specified in the table in this interval or at multiples of this interval.

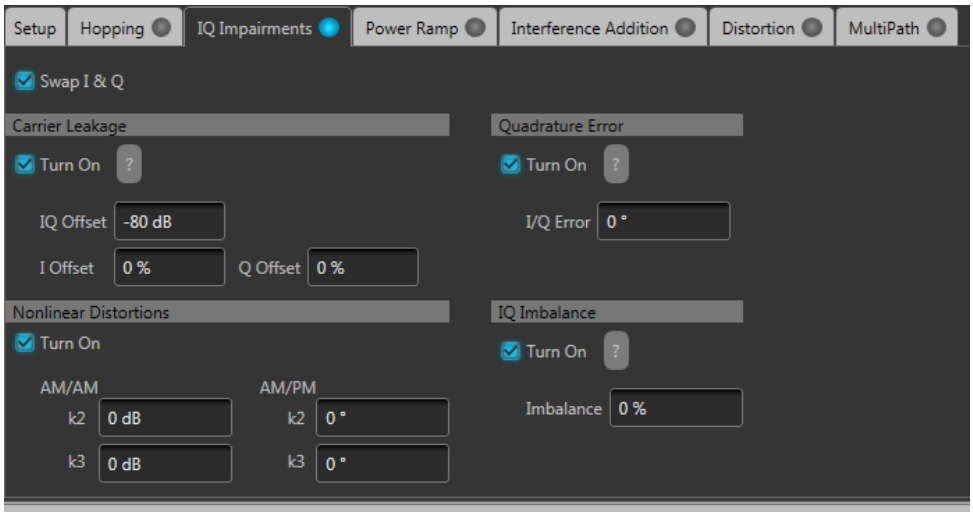
Pseudo Random Range Hopping Pattern

PRBS Pattern	Select the PRBS pattern for hopping:
Frequency Avoid List	Enable the Avoid List and the signal will avoid hopping in the frequencies specified in the table.



IQ Impairments

IQ Impairments is only available for use with Digital Modulation and Custom Modulation Carrier Types.

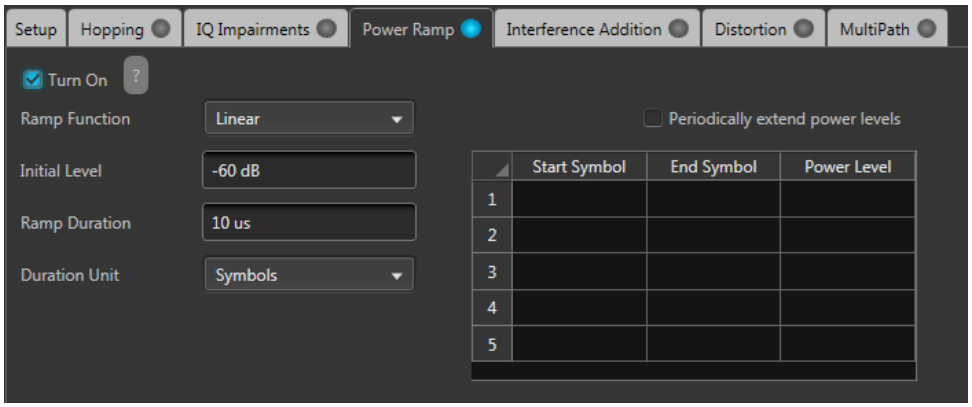


Item	Description
Swap I & Q	Select to interchange I and Q signal outputs.
Carrier Leakage	
Turn on	Select to add carrier leakage (I and Q) impairments to the carrier.
IQ Offset	Adds equal offset to I and Q signals based on the dB value provided.
I Offset Q Offset	Adjust the percentage of offset for I 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).

Power Ramp

Power ramp allows the user to define the power (amplitude) profile for the signal to be created.

Power Ramp is only available for use with Digital Modulation and Custom Modulation Carrier Types.



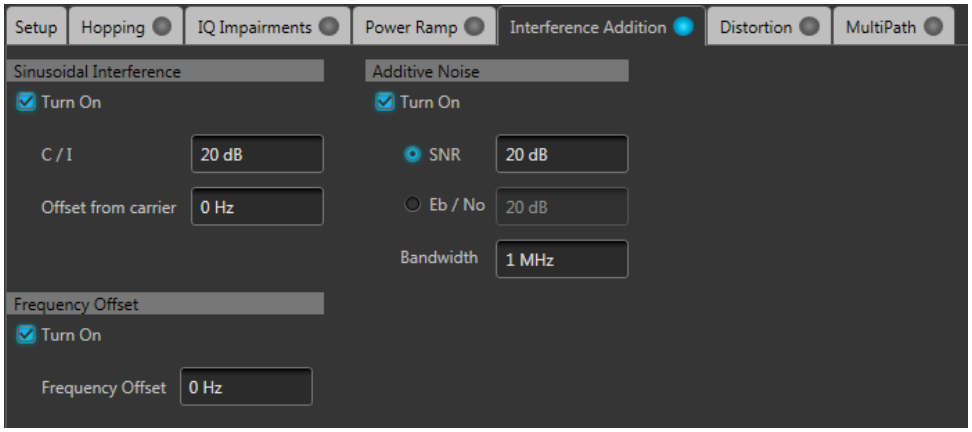
Item	Description
Ramp Function	Select the power ramping function from the following: Linear and Cosine.
Initial Level	Enter the level of the power ramping. Range: –100 dB to 0 dB.
Ramp Duration	Enter the duration of ramp. Range: 1 ns to 1 sec.
Duration Unit	Define the duration of time in the defined power level. Time: The duration is set in units of time. Symbols: The duration is set by choosing a start symbol and an end symbol. The Power ramp table adjusts to accommodate using Time or Symbols.
Periodically extend power levels	When selected, the time characteristic of the power ramping is continued periodically until the end of the signal. If the total defined Durations of power ramp is less than the waveform duration, the signal power during the rest of the duration not defined by the table is set to –200 dB. If Periodically Extend is selected, the Power ramp table is circularly selected to repeat the pattern in the table.

Interference Addition

The Interference Addition tab has three types of interference to add to the signal:

- Sinusoidal Interference
- Frequency Offset
- Additive Noise

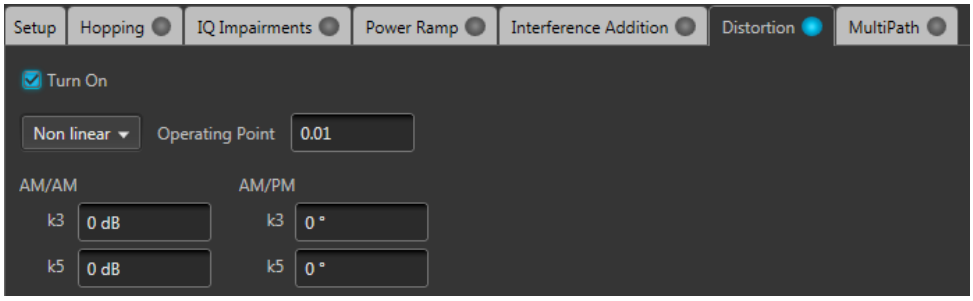
Each interference type is independently controlled, allowing to select any combination of interference types



Item	Description
Sinusoidal Interference	Turn on to include sinusoidal interference for the carrier
C / I	Enter the carrier-to-interference ratio. Range: –100.00 dB to 100 dB.
Offset from carrier	Enter the offset from the carrier frequency.
Frequency Offset	Turn on to include a frequency offset.
Frequency Offset	Enter the frequency offset from the carrier frequency.
Additive Noise	Turn on to simulate additive Gaussian noise by defining the noise in terms of Signal to Noise Ratio (SNR) or bit Energy per Noise power (Eb/No). You can also define the bandwidth of the noise. A rectangular filter of bandwidth is applied on the noise signal. • SNR: Select this to specify the signal to noise ratio. Range: –80.00 dB to 80 dB. • Eb / No: Select this to specify the energy or Noise power. Range: –80.00 dB to 80 dB.
Bandwidth	Enter the bandwidth of the noise to be added. Range: 1 Hz to the maximum supported by the active instrument.

Distortion

Distortion is only available for use with Digital Modulation and Custom Modulation Carrier Types.



Item	Description
Non linear	Nonlinear Distortions allow you to simulate the nonlinearity of IQ modulators.
Operating Point	Enter the operating point of the nonlinear amplifier
AM/AM	The variation of the signal amplitude with respect to the original amplitude is called AM/AM conversion.
k3 dB	Enter the third order coefficient for the magnitude.
k5 dB	Enter the fifth order coefficient for the magnitude.
AM/PM	The variation of the phase with respect to the original amplitude is called AM/PM conversion.
k3 dB	Enter the third order coefficient for the magnitude.
k5 dB	Enter the fifth order coefficient for the magnitude.
Soft Limiting	Use Soft limit to limit the signal when the magnitude is beyond the operating point. Note that the operating point is normalized to the signal amplitude.
Limiting Level	Set a Soft limit level.
Hard Limiting	Use hard limiting to limit the signal when the magnitude is greater than zero.

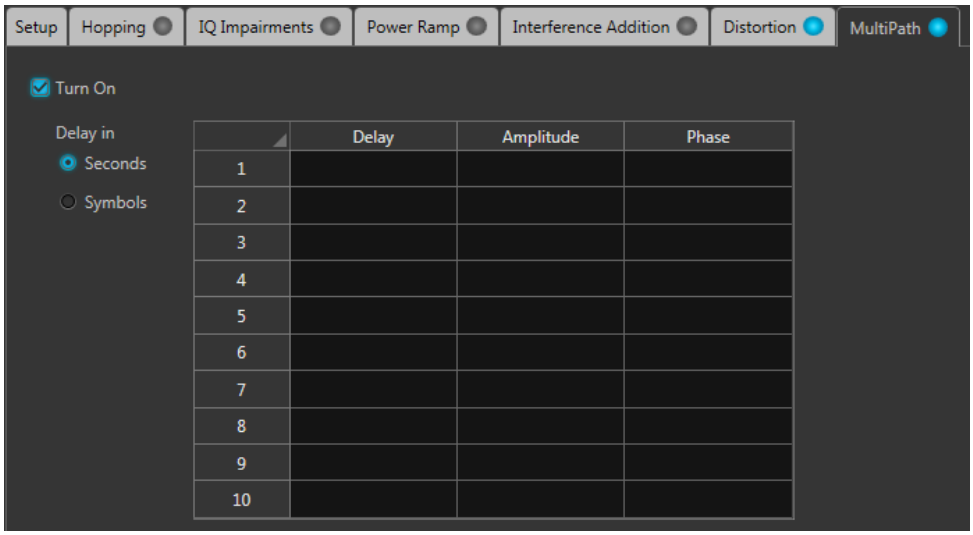
Distortion is only available for use with Digital Modulation and Custom Modulation Carrier Types.

MultiPath

Multipath can be used to simulate the reflected signals which arrive with different delays.

You can define a maximum of ten multipaths, setting the delay, amplitude and phase values for each path. No two paths can have the same delay value.

MultiPath is only available for use with Digital Modulation and Custom Modulation Carrier Types.



Item	Description
Delay in Seconds Symbols	Enter the delay in seconds or symbols from the reference path. The delay can be positive or negative. Delay values cannot be repeated.
Amplitude (dB)	Enter the amplitude in dB from the reference path. The amplitude for each path can be set to zero dB or reduced.
Phase (deg)	Enter the phase in degrees from the reference path. The phase can be positive or negative.

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.

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 47) for information about obtaining a license file.

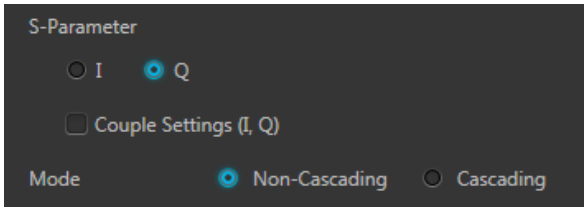
S-Parameter tab

Enable S-Parameters to apply scattering parameters to the waveform.

S-Parameters can be applied to the RF/IF waveform or to the I and Q data, depending on the selected Signal Format.

All S-Parameter features apply whether the Signal Format is set to RF/IF or IQ. The only exception is that an additional control is available for the IQ signal format to choose how the S-Parameters are applied to the I and Q components.

For the IQ Signal Format, select to apply unique S-Parameters to the individual I and Q components or apply the same S-Parameters to both I and Q.



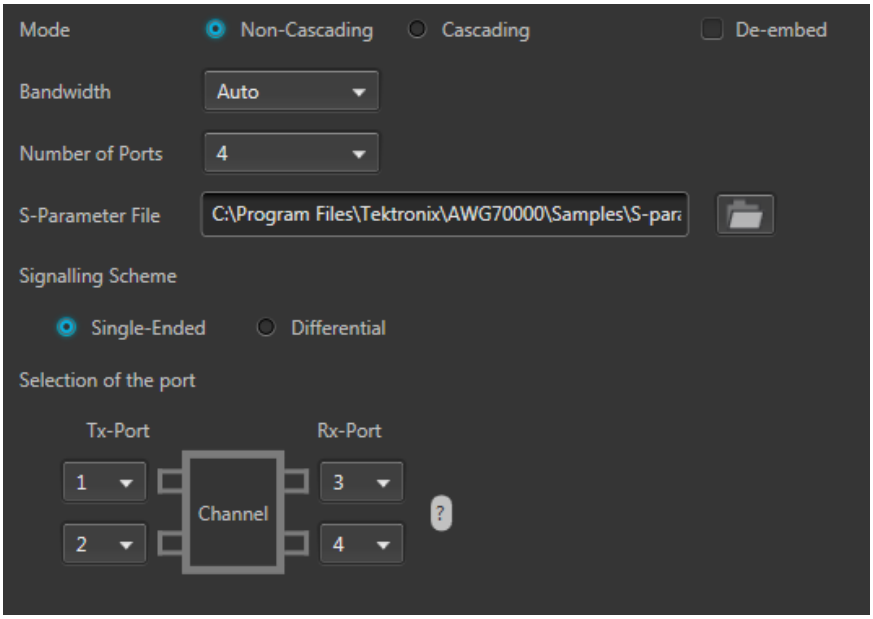
For instance, to apply unique parameters to I and Q, select I and set the parameters. Then select Q and set it's parameters. The application retains the settings for both I and Q.

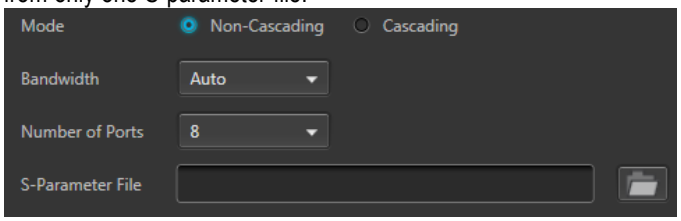
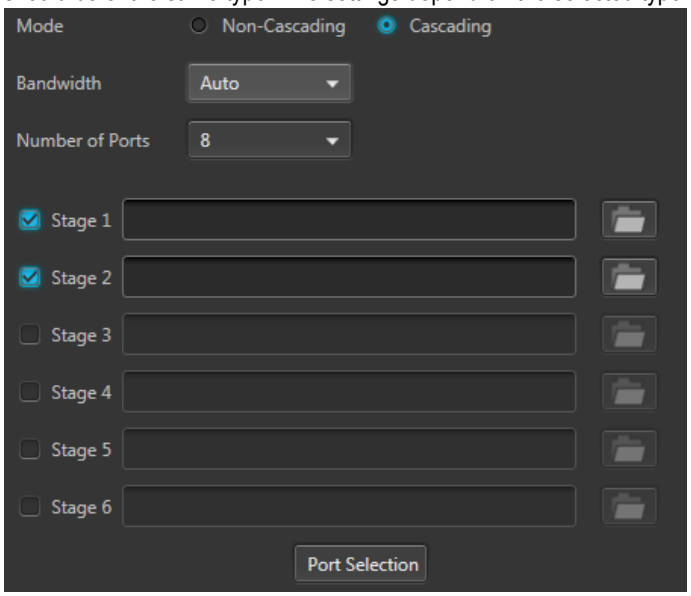
If you select Couple Settings, the parameters you set are applied to both I and Q.

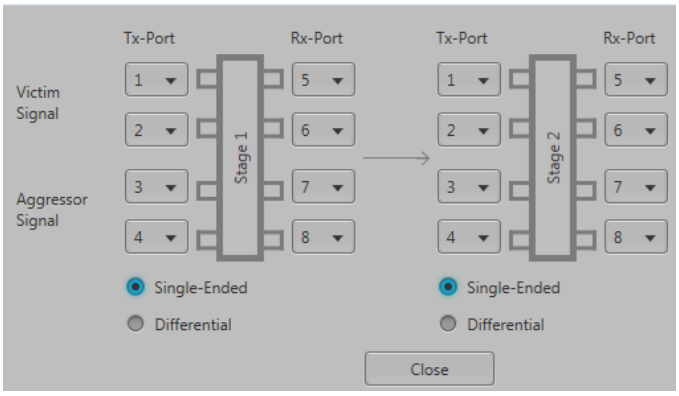
CAUTION. *When selecting Couple Settings (I,Q), the Q parameters are instantly replaced with the I parameters.*

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


Mode
Non-Cascading
Cascading
De-embed
Bandwidth
Auto
Number of Ports
4
S-Parameter File
C:\Program Files\Tektronix\AWG70000\Samples\S-para
Signalling Scheme
Single-Ended
Differential
Selection of the port
Tx-Port
Rx-Port
1
2
Channel
3
4
?

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 Signalling 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

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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