



**High Speed Serial Waveform
Plug-in Application
Printable Help Document**



077-1245-00



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Plug-in Application
Printable Help Document**

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

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

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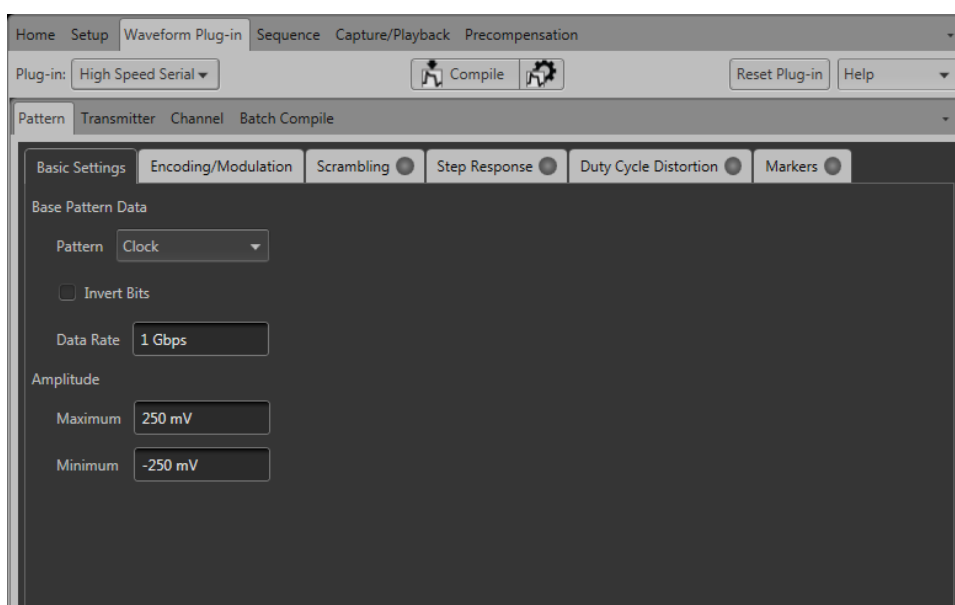
Welcome

The High Speed Serial (HSS) plug-in is a waveform creation application that takes an input pattern and creates pre-distorted waveforms to test a device's conformance to standards.

The High Speed Serial 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 High Speed Serial 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

- Jitter Generation: Up to four different sinusoidal jitters with different amplitudes, frequencies and phases can be added to a base pattern. Three independent band-limited random jitters can also be added to the base pattern.
- Inter Symbol Interference (ISI) Creation: Directly create ISI.
- S-Parameters: Scattering parameters can be directly convolved with the base pattern to recreate the channel characteristics. S-Parameters can be entered directly from an S-Parameter file captured from a Tektronix sampling oscilloscope. By applying an inverse filter, the effects of the channel can be

de-embedded from the circuit. Cascading S-Parameters allows you to cascade up to six Touchstone files of the same format to emulate a cascaded channel.

- Noise: Vertical noise can be added at both near and far ends of the channel.
- Idle State: Standards like SATA call for OOB signaling which requires an idle state followed by a burst. You can directly create this idle state without using additional power dividers. Noise can also be added to these idle state waveforms.
- Batch Processing: When more than one pattern needs to be synthesized, you can use batch processing to create multiple waveforms with a combination of one random and maximum of 2 sinusoidal jitter
- Sequencing: You can add compiled waveforms directly to existing sequences or create sequences using the Batch Compile feature.
- Marker outputs: Marker outputs can be configured to be the same as the input base pattern or to generate clocks at a user-defined frequency. You can also set the marker output to all high, all low, or trigger.
- Pre/de-emphasis and Preshoot: Provides flexibility to program the Pre/De-emphasis and Preshoot sample by sample. The preview feature facilitates you to arrive at the most optimized Pre/de-emphasis for a particular channel quickly.
- Scrambling and 8B10B encoding: The input data pattern can be scrambled by defining a polynomial. You can also encode using the 8B10B encoding option. 8B10B encoding works with D and K symbol pattern only.
- NRZ, NRZ-I, PAM, and PWM: Allows you to define the pattern duty cycle using the Pulse Width Modulation (PWM), and alternatively encode the bit stream to 4- 8- 16-PAM, NRZ, or NRZ-I.

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.tektcom/manual/downloads).

| To read about | Use these documents |
|---|--|
| High Speed Serial 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 High Speed Serial 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. |
| High Speed Serial 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

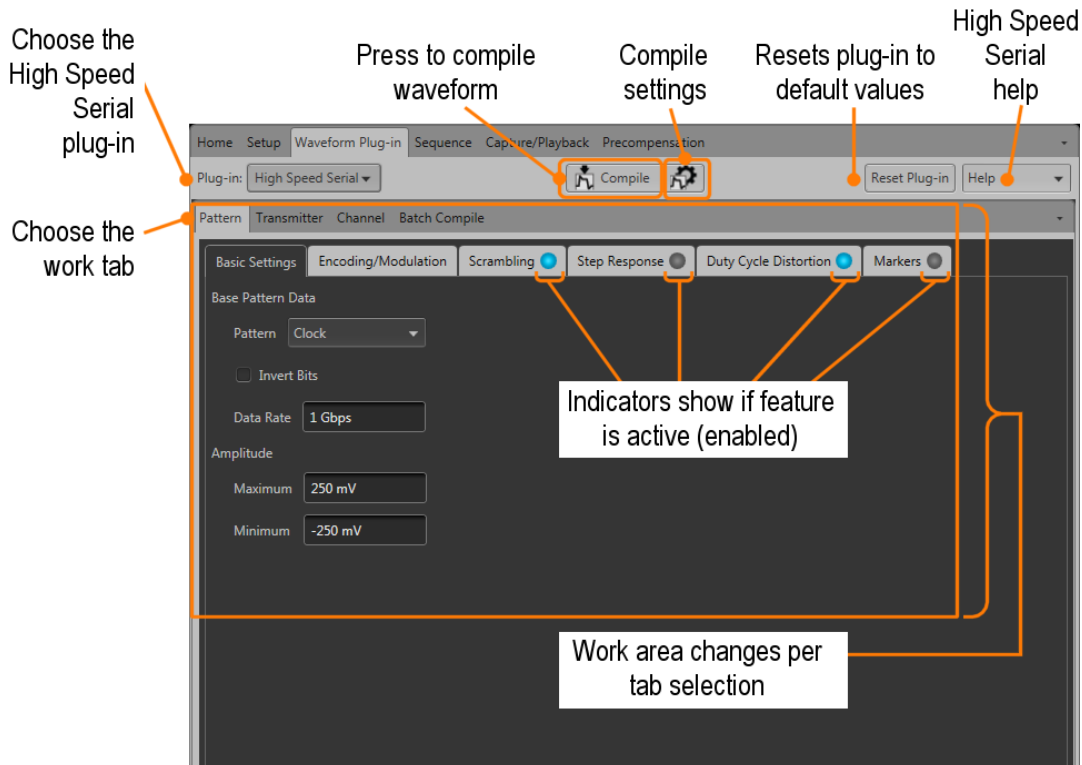
Tektronix offers the following services in support of their products:

- **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.

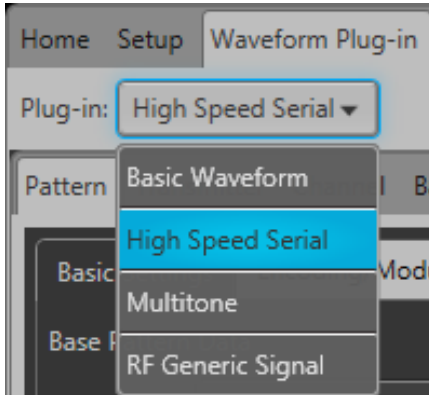


Plug-in selection

Use the Plug-in pull-down menu to select the High Speed Serial plug-in application. The plug-in pull-down menu varies depending the installed applications.

NOTE. *High Speed Serial requires a license to create waveforms.*

Refer to [Licensing \(see page 39\)](#).



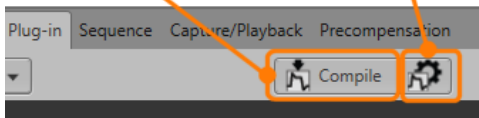
Compile button

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.



Press to compile
waveform

Compile
settings



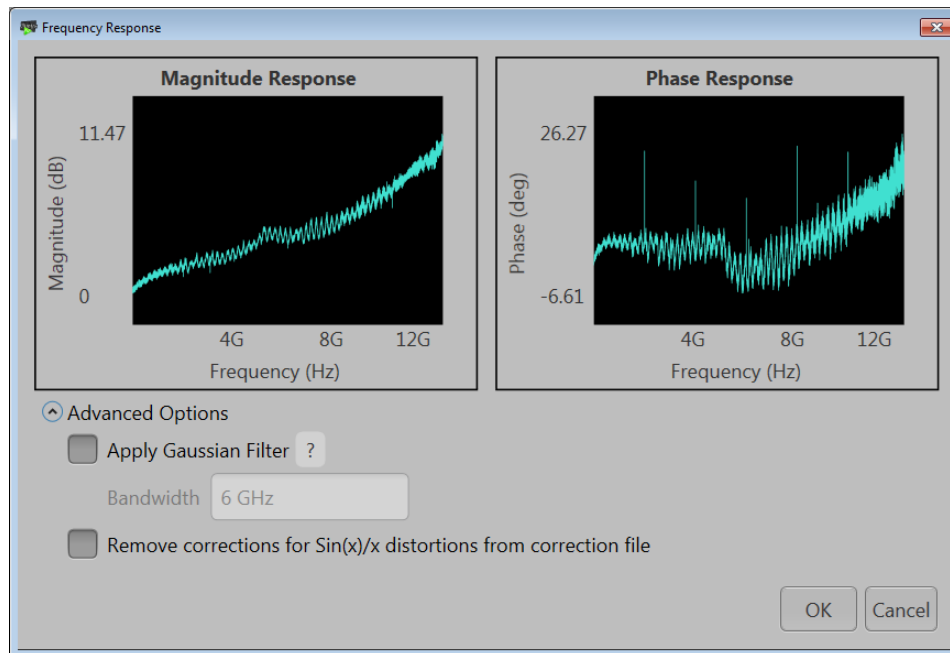
Compile settings

| Item | Description |
|-----------------------------|--|
| Name | <p>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).</p> <p>The Reset Plug-in button resets the Name field to the default name.</p> |
| Overwrite existing waveform | If checked, a waveform with the same name (in the waveforms list) is overwritten with no warnings. |
| Compile for | <p>Choose the channel to associate with the compiled waveform.</p> <p>Single channel instruments default to the single channel.</p> |
| Compile only | The compiled waveforms are simply entered into the Waveforms list. |

| Item | Description |
|-----------------------------|---|
| Compile and assign to | The compiled waveforms are entered into the Waveforms list and automatically assigned to the selected channel. |
| Play after assign | If checked, the waveform starts to play out immediately after compiling. |
| Add to an existing sequence | The compiled waveforms are entered into the Waveforms list and added to the specified sequence. There must be at least one sequence available in the Sequences list. |
| Sequences | Use the pull-down list to view the available sequences. |
| Tracks | Use the pull-down list to select the track the of the specified sequence to append the waveform. |
| Sampling Rate | |
| Auto Calculate Sample Rate | 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 Sampling Rate | Select to enter a specific sampling rate. |
| Samples/Unit Interval | Enter the samples per UI of the waveform A unit interval (UI), also referred to as a bit time, is the time taken in a data stream for one bit. For example, in a serial line with a baud rate of 2.5 Gb/s, a unit interval is $1/(2.5 \text{ Gb/s}) = 0.4 \text{ ns}$. This value, either calculated or user defined, determines the number of Coefficients available when adding Pre- or De-Emphasis. |
| 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 (see page 9) screen. |
| Auto Repeat Count | When compiling a waveform, the waveform must meet the minimum waveform length requirement for the instrument (to be a valid waveform). If the current setup would create a waveform of invalid length, the system automatically repeats the waveform until the minimum length is reached. Auto Repeat Count enabled (default mode): If necessary, the waveform is automatically repeated until it meets the minimum waveform length requirement. Auto Repeat Count disabled: When disabled, you are presented with a control to either set a number of times to repeat the waveform, or to enter a waveform length in time. If the manual setting would cause a waveform of insufficient length, the software automatically increases the repeat count so that a valid waveform is generated. If this happens, a warning message is displayed informing you of the event. If the manual setting causes a waveform that exceeds the maximum waveform length allowed, an error message is displayed and no waveform is created. |
| Compile | Compiles the waveform. |

Correction file frequency response

When 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.



Reset Plug-in button

Returns the plug-in features and settings to their default values.

Help button

Help button: Provides links to open the application help.

| 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. |

Enabled/disabled indicators

All distortion types that can be enabled or disabled include a status indicator in their tab. This provides a view of which distortions currently enabled (turned on) for use when compiling a waveform.

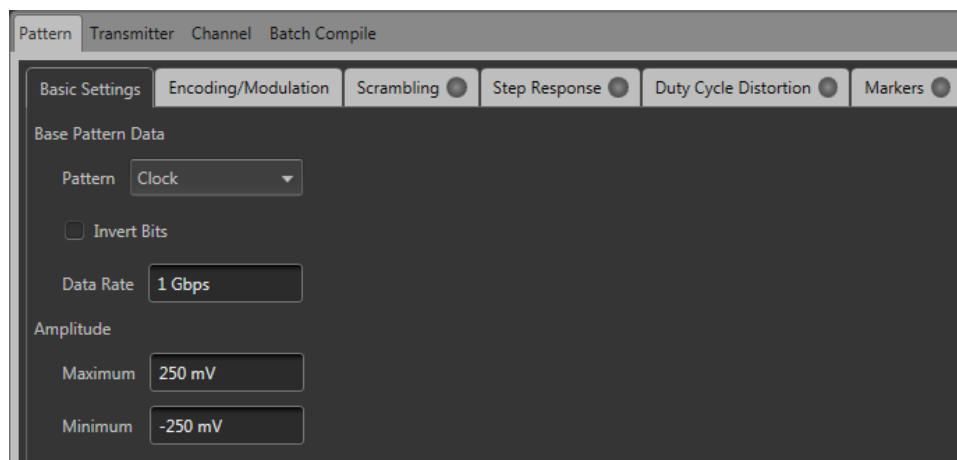
Blue indicates the distortion is turned on.



Turning off a distortion type means it will not be used while compiling. But all settings remain, allowing you to quickly add the distortion.

Pattern tab overview

This tab allows users to set the basic pattern for waveform generation including encoding and modulation schemes along with scrambling. In addition to this, users can enable DCD and step response to include rise/fall time effects on the waveform. You can also include markers with desired settings.




Basic Settings

Table 1:

| Item | Description |
|-------------------|---|
| Base Pattern Data | |
| Pattern | Select the pattern type. |
| Clock | This generates a waveform with clock-like bit pattern of alternate 0s and 1s. |
| All Zero | This generates a waveform with an amplitude corresponding to the maximum negative voltage level. |
| All One | This generates a waveform with an amplitude corresponding to maximum positive voltage level. |
| IdleState | <p>Enter the idle state value (in samples or secs) of the waveform.</p> <p>Idle state is the state used for some standards like SATA. During this state, the value is neither 0 or 1. It is a state during which no valid data is transferred between the transmitter and the receiver. SourceXpress supports Idle state waveforms with idle value and idle offset.</p> <p>Idle state waveforms are individual waveforms that can be sent to the AWG. The waveforms contain the DC values with no base data during this state. You can add the number of samples and noise as required in the idle state waveform.</p> <p>NOTE. All other features of the High Speed Serial plug-in are disabled (except for Noise) when IdleState is selected as the Pattern.</p> |

Table 1: (cont.)

| Item | Description |
|-------------------|--|
| Idle State Offset | Enter the offset value (in Volts) of the waveform. This is available only when Pattern is set to IdleState. |
| Idle State Time | Enter the amount of time the Idle State Offset value is held. |
| PRBS | Select one of the available PRBS patterns. You can also define a custom PRBS pattern with the PRBS Editor. Set the Pattern type to User Defined PRBS and click the Settings icon  to display the editor. |
| Pattern | Select the pattern type. <ul style="list-style-type: none"> • Binary • Hex • Symbol Based on the type, enter the pattern. You can also copy and paste a pattern directly into the pattern field. You can enter up to 512 characters. |
| File | Click the folder icon to navigate to a pattern file. |
| Invert Bits | Use the Invert Bits to create an inverted signal. For example, an input bit stream of 011000 will create a signal of 100111 when the Invert Bits option is enabled. |
| Data Rate | Specify the data rate (in bps) of the waveform. |
| Amplitude | |
| Maximum | Specify the maximum amplitude (in volts) of the waveform. Range: dependent on instrument. |
| Minimum | Specify the minimum amplitude (in volts) of the waveform. Range: dependent on instrument. |

Encoding/Modulation

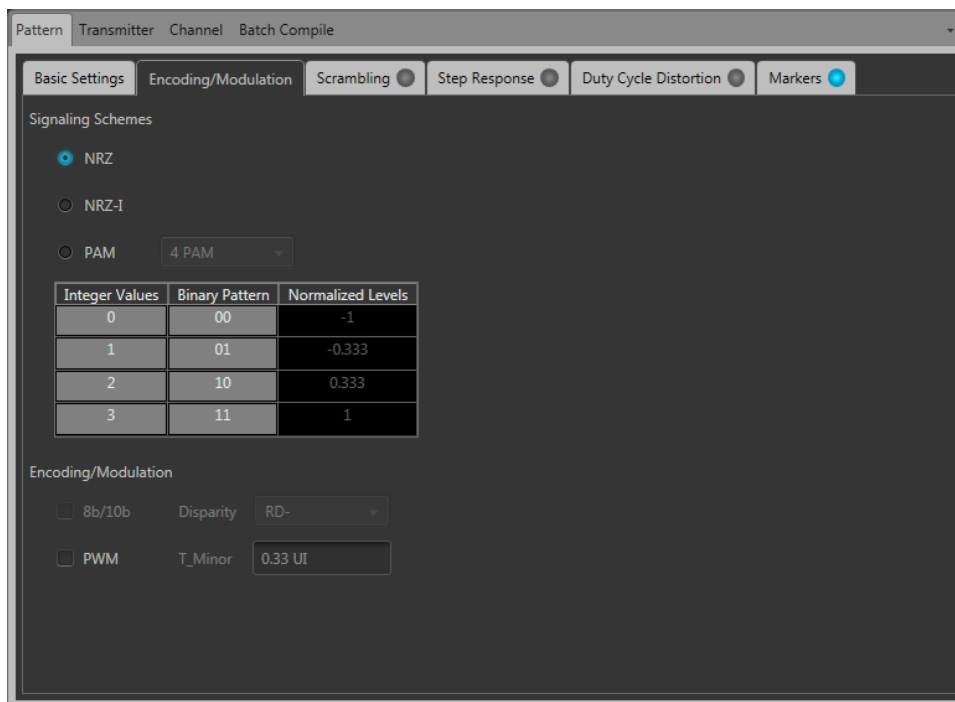


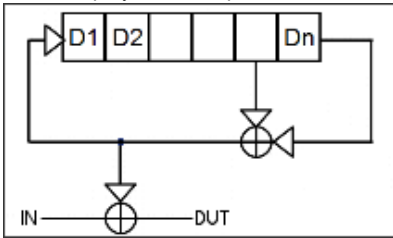
Table 2:

| Item | Description |
|---------------------|--|
| Signaling Schemes | SourceXpress supports these common encoding techniques: |
| NRZ | In an NRZ (no-return to zero) signal, level-0 and level-1 represents the states of bit 0 and bit 1. |
| NRZ-I | In an NRZ-I (NRZ inverted) signal, transitions occur only if the bit being transmitted is a logical 1. |
| PAM | Select PAM to create a Pulse Amplitude Modulated signal. The High Speed Serial plug-in supports 4-, 8-, and 16-PAM encoding. |
| Encoding/Modulation | |
| 8b/10b | 8B10B is used to encode 8-bit data to 10-bit data. This is the most common encoding mechanism used for Serial data standards. This is only available for Symbol Patterns. The Base Pattern Data (in Basic Settings) must have the Pattern type set to Pattern>Symbol. |

Table 2: (cont.)

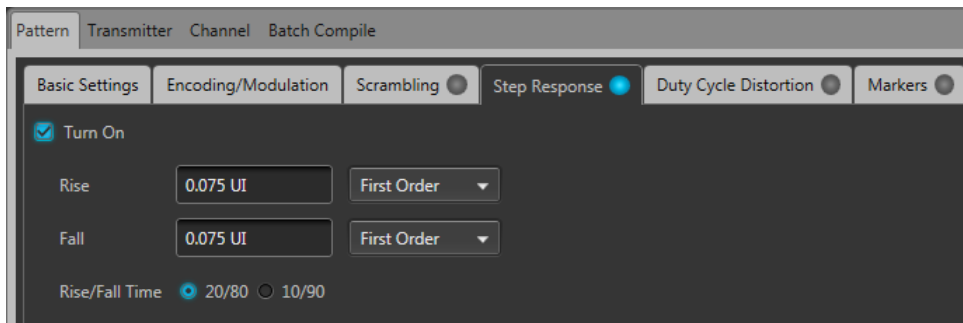
| Item | Description |
|-------------------|---|
| Running Disparity | 8B/10B encoding scheme uses the difference between the total number of ones and zeros transmitted to encode the present symbol. This difference is referred to as the running disparity. Its value is limited to +1 (RD+) or -1 (RD-). |
| PWM | <p>Select PWM to generate a Pulse Width Modulated signal.</p> <ul style="list-style-type: none"> T_Minor: Enter a value for T_Minor as a fraction of the UI (unit interval). <p>In the PWM scheme, each bit is represented in terms of a 0 followed by 1. In order to distinguish between the original bits, the T_Minor parameter is used to specify the duration of the encoded bit 0 (or 1) with respect to the original unit interval (UI). In case the original bit was a 0, then T_Minor specifies the width of the encoded bit 0. If the original bit was 1, then T_Minor specifies the width of the encoded bit 1.</p> |

Scrambling

| Item | Description |
|------------------------|--|
| Scrambling Type | <p>Scrambles the input data pattern with a Polynomial</p> <ul style="list-style-type: none"> Additive Multiplicative |
| Polynomial | <p>Specify the scrambling polynomial expression. Define a polynomial expression such as $X^{16}+X^{14}+1$.</p>  |
| Register Initial Value | <p>Specify the register initial values and select the format (Hex or Binary). The length of the register is equal to the degree of the polynomial.</p> <ul style="list-style-type: none"> Binary Hex |

Step Response

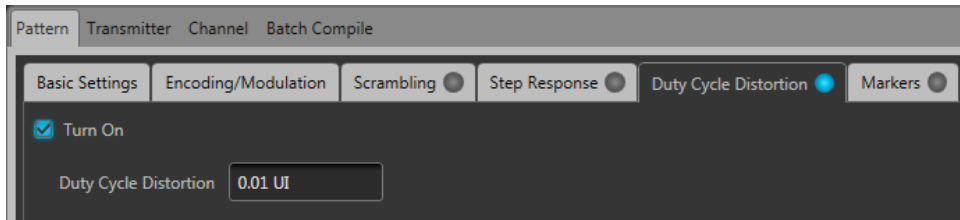
Step Response defines the rise and fall time edges of the waveform. Rise and fall times can be defined in UI or seconds.



| Item | Description |
|----------------|---|
| Rise | <p>Elapsed time between the low reference level crossing and the high reference level crossing on the rising edge of the waveform. It is measured in time units between the 10% and 90% levels or between the 20% and 80% levels.</p> <p>Set the rise time in UI or seconds from 0.05 UI to 0,5 UI (50 ps to 500 ps)</p> <ul style="list-style-type: none"> • First Order conveys an exponential transition between the low and high level. • Linear conveys a linear transition between the low and high level. |
| Fall | <p>Elapsed time between the high reference level crossing and the low reference level crossing on the falling edge of the waveform. It is measured in time units between the 10% and 90% levels or between the 20% and 80% levels.</p> <p>Set the rise time in UI or seconds from 0.05 UI to 0,5 UI (50 ps to 500 ps)</p> <ul style="list-style-type: none"> • First Order conveys an exponential transition between the low and high level. • Linear conveys a linear transition between the low and high level. |
| Rise/Fall Time | <p>Define how the rise time and fall time are measured.</p> <ul style="list-style-type: none"> • 20/80: Measured between 20% and 80% of the signal amplitude. • 10/90: Measured between 10% and 90% of the signal amplitude. |

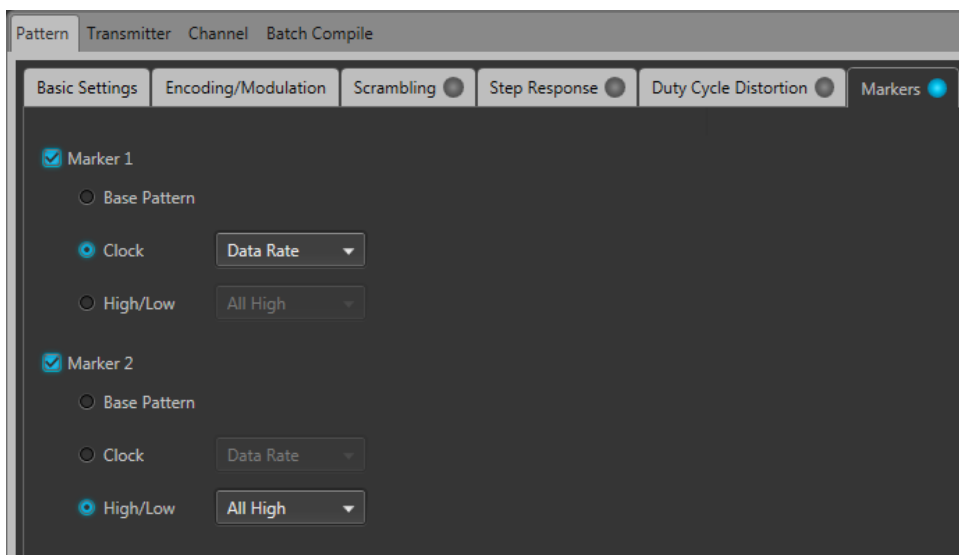
Duty Cycle Distortion

Duty Cycle Distortion (DCD) is the portion of the deterministic jitter directly correlated with waveform polarity (the difference in the positive edges and negative edges). The duty cycle can be defined in UI or seconds.



Markers

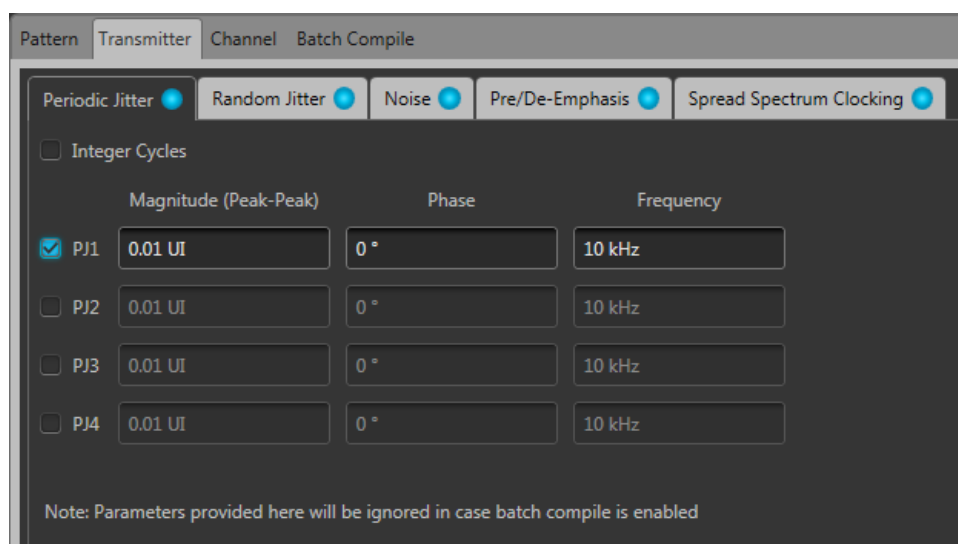
Markers are used to help synchronize equipment. Use the Markers tab to enable markers and define the marker parameters.



| Item | Description |
|-----------------------------|--|
| Marker 1 and Marker 2 | Enable markers. The markers can be independently defined. |
| Base Pattern | Marker matches the base pattern. |
| Clock | Define the clock frequency based on the selected data rate. <ul style="list-style-type: none"> • Data Rate • Data Rate/2 • Data Rate/4 • Data Rate/8 • User-Defined, Range: 1 Hz to Data Rate |
| High/Low | <ul style="list-style-type: none"> • All High • All Low • Trigger: Define the marker to transition (High To Low or Low To High) at the set number of samples. |

Transmitter tab overview

The transmitter tab allows user to include timing impairments like Periodic Jitter, Random Jitter, and Spread Spectrum Clocking during waveform compilation. In addition to this, users can also include amplitude impairments like Noise, and specify the Pre-Emphasis scheme and set the appropriate values on the waveform.



Periodic Jitter

Use the Periodic Jitter tab to introduce one or more sine waves as periodic jitter.

Periodic Jitter is the portion of the deterministic jitter that is periodic, but for which the period is not correlated with any data in the waveform. It is measured by peak-to-peak variation and frequency.

NOTE. *If Batch Compile is enabled, the Periodic Jitter tab is disabled.*

Enable Periodic Jitter by selecting at least one of the Periodic Jitter (PJ) check boxes and enter the parameters.

| Item | Description |
|----------------|---|
| PJ1 — PJ4 | |
| Magnitude | Set the magnitude of the sine wave (jitter) (in UI) to introduce. Range: 0 UI to 50 UI |
| Phase | Set the phase of the sine wave (jitter) (in degrees) to introduce. |
| Frequency | Set the frequency of the sine wave (jitter) (in Hz) to introduce. Range: 10 kHz to ½ Data rate. |
| Integer Cycles | Select to ensure that there is an integer number of sinusoidal jitter cycles over the entire bit pattern under consideration. In some cases, the bit pattern might be repeated to meet this requirement. |
| Deviation | Users can indicate the choice of either allowing the software to automatically decide the final sinusoidal frequency by using 'Auto' or provide the maximum allowable variation as a percentage of the dialed sinusoidal frequency by using the 'Manual' mode. <ul style="list-style-type: none"> • Auto: The software to automatically decides the final sinusoidal frequency. • Manual: Enter the maximum allowable variation as a percentage of the dialed sinusoidal frequency. |

Random Jitter

Random Jitter is jitter that does not exhibit deterministic behavior and is not bounded. It can be described by a Gaussian probability distribution. It is characterized by standard deviation value (RMS).

NOTE. If Batch Compile is enabled, the Random Jitter tab is disabled.

Pattern Transmitter Channel Batch Compile

Periodic Jitter ☒ Random Jitter ☒ Noise ☐ Pre/De-Emphasis ☐ Spread Spectrum Clocking ☐

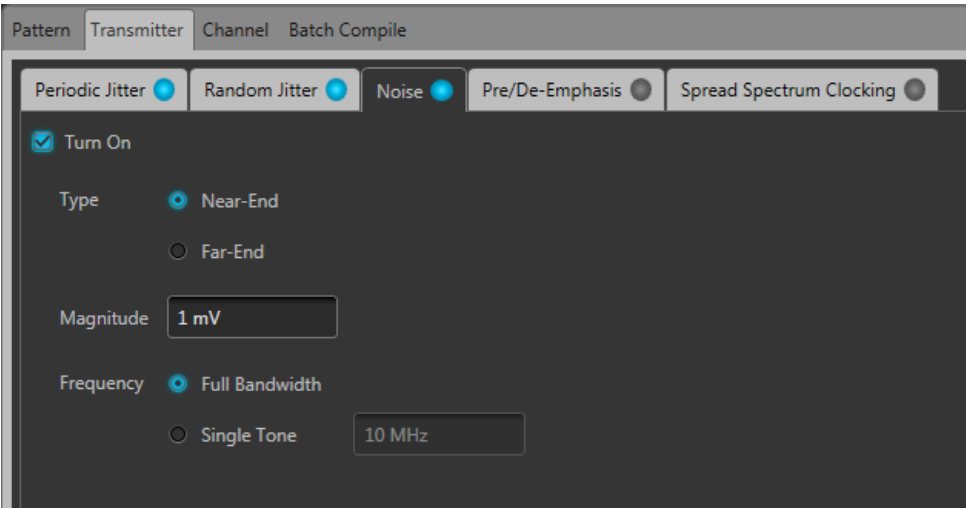
| | Magnitude (RMS) | Low-Frequency | High-Frequency |
|--|-----------------|---------------|----------------|
| <input checked="" type="checkbox"/> RJ1 | 0.01 UI | 100 kHz | 500 MHz |
| <input checked="" type="checkbox"/> Seed | | 12345 | |
| <input checked="" type="checkbox"/> Crest Factor | | 12 | |
| <input type="checkbox"/> RJ2 | 0.01 UI | 100 kHz | 500 MHz |
| <input type="checkbox"/> RJ3 | 0.01 UI | 100 kHz | 500 MHz |

Note: Parameters provided here will be ignored in case batch compile is enabled

| Item | Description |
|----------------------------|---|
| RJ1 — RJ3 | |
| Magnitude (RMS) | Set the magnitude of the jitter (in UI or seconds) to introduce. Range: 0.001 UI to 0.5 UI (1 ps to 500 ps). |
| Low-Frequency | Set the low frequency of the random jitter (in Hz) to introduce. Range: 1 kHz to (High-Frequency – 10 kHz). |
| High-Frequency | Set the high frequency of the random jitter (in degree) to introduce. Range: 1 kHz to ½ Data rate. |
| Seed (RJ1 only) | Select to use the same random jitter sequence during each compilation. The required random jitter sequence is generated through a 5-digit seed. By keeping the 5-digit seed constant, the same random jitter sequence is generated during each compilation. When not selected, the uncorrelated random jitter sequence is generated during each compilation. Range: 1 to 99999 |
| Crest Factor (RJ1 only) | Select to apply the required crest factor value of Rj1 to the serial data. When you enable Rj1 with a specified RMS value within a short signal duration, it will not reach the peak value. By enabling this, a required crest factor value of Rj1 is applied to the serial data during data transmission. For example, if the Rj1 crest factor is set to 12 and magnitude (RMS) for Rj1 is 0.05 UI, then the Rj1 peak value is 12 x 0.05 = 0.6 UI. Range: 1 to 20 |

Noise

This is a type of additive noise that modifies the vertical amplitude of the serial data and contributes to the jitter.



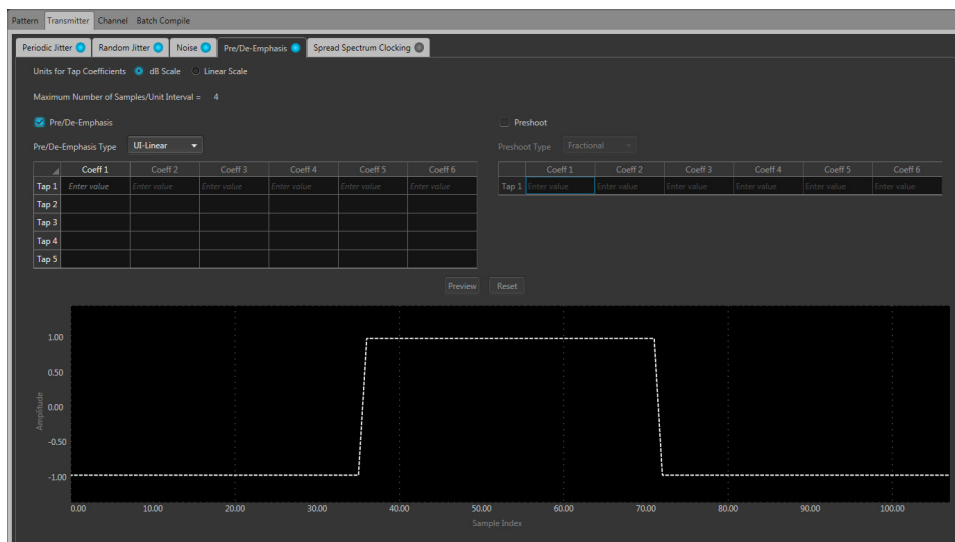
| Item | Description |
|-----------|--|
| Type | <ul style="list-style-type: none">• Near-End: This type of noise corresponds to random amplitude variations on the waveform before it enters the channel.• Far-End: This type of noise corresponds to the random amplitude variations of the waveform at the far-end of the channel. |
| Magnitude | Enter the amplitude of the noise (in volts) to generate. |
| Frequency | <ul style="list-style-type: none">• Full Bandwidth: Generates white noise between 0 Hz to $F_s/2$ Hz. The noise generated is independent for each compilation.• Single Tone: Generates sine noise at the specified frequency. The frequency can be a maximum of half of the data rate. |

NOTE. When noise is added to a differential waveform, its amplitude appears doubled. This is because the noise is generated in the application and appears as a waveform output for AWG.

Limitation of pattern length on randomness

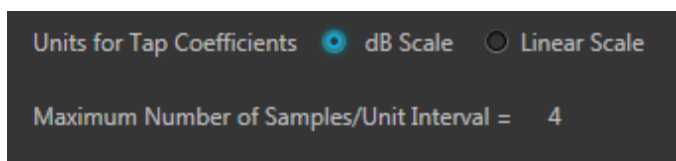
The noise is created as part of the waveform data. Due to AWG memory limitations, the waveform data has finite length. This limits randomness of the noise. The larger the waveform length, the greater is the randomness of the noise. The AWG70000A series supports waveforms up to 16 G samples on a single channel model (8G on a two channel model). Randomness of the noise pattern is limited by waveform length. In the AWG continuous mode, the waveform repeats, thus the noise pattern repeats. This limitation of the AWG pattern length applies to random jitter.

Pre/De-Emphasis



Scale and Unit Intervals

Select the units scale for the Tap Coefficients (dB or Linear). The setting defines the units for both Pre/De-Emphasis and Preshoot. Also note the Samples/Unit Interval setting.



| Item | Description |
|---|---|
| Units for Tap Coefficients | The tap coefficients defines the incremental voltage on the pre-emphasized bit. <ul style="list-style-type: none"> • dB Scale: Range -20 dB to +20 dB. • Linear Scale: Range 0.1 to 10. |
| Maximum Number of Samples/Unit Interval = | The Maximum Number of Samples/Unit Interval displayed is defined by the Samples/Unit Interval set in the Compile Settings. See Compile button (see page 6) . The value is set to the nearest whole number. The maximum number of coefficients is six, although the Samples/Unit Interval can exceed six. The value is set to the nearest whole integer based on the Samples/Unit Interval listed in the Compile Settings. |

Pre/De-Emphasis

☒ Pre/De-Emphasis

Pre/De-Emphasis Type: UI-Linear ▼

| | Coeff 1 | Coeff 2 | Coeff 3 | Coeff 4 | Coeff 5 | Coeff 6 |
|-------|-------------|-------------|-------------|-------------|-------------|-------------|
| Tap 1 | Enter value | Enter value | Enter value | Enter value | Enter value | Enter value |
| Tap 2 | | | | | | |
| Tap 3 | | | | | | |
| Tap 4 | | | | | | |
| Tap 5 | | | | | | |

| Item | Description |
|----------------------------|---|
| Number of Taps | Up to five taps are available for Pre/De-Emphasis. NOTE. This is reduced to one tap if enabling Preshoot. |
| Pre/De-Emphasis Type | Select the type to use. <ul style="list-style-type: none"> • UI-Constant: Pre/De-emphasis is applied to all the samples in the UI. • UI-Linear: Pre/De-emphasis is applied to all the samples in the UI linearly • Fractional: Pre/De-emphasis is applied to a fraction of the UI. |
| Units for Tap Coefficients | The tap coefficients defines the incremental voltage on the pre-emphasized bit. <ul style="list-style-type: none"> • dB Scale: Range –20 dB to +20 dB. • Linear Scale: Range 0.1 to 10. |

Preshoot

☒ Preshoot

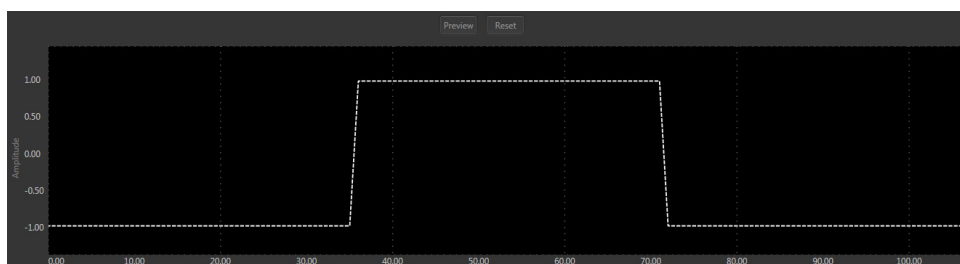
Preshoot Type: Fractional ▼

| | Coeff 1 | Coeff 2 | Coeff 3 | Coeff 4 | Coeff 5 | Coeff 6 |
|-------|-------------|-------------|-------------|-------------|-------------|-------------|
| Tap 1 | Enter value | Enter value | Enter value | Enter value | Enter value | Enter value |

| Item | Description |
|----------------------------|---|
| Number of Taps | Only one tap is available for Preshoot. |
| Preshoot Type | Select the type to use. <ul style="list-style-type: none"> • UI-Constant: Preshoot is applied to all the samples in the UI. • UI-Linear: Preshoot is applied to all the samples in the UI linearly • Fractional: Preshoot is applied to a fraction of the UI. |
| Units for Tap coefficients | The tap-coefficients defines the incremental voltage on the pre-emphasized bit. For dB, the value ranges from -20 dB to +20 dB. For Volt, the value ranges from 0.1 V to +10 V. The units in which the tap-coefficients are specified is defined with the Units For Tap Coefficients (dB or Linear). |

Plot view

The plot view helps you quickly arrive at the most optimized Pre/De-Emphasis and/or Preshoot for a particular channel.

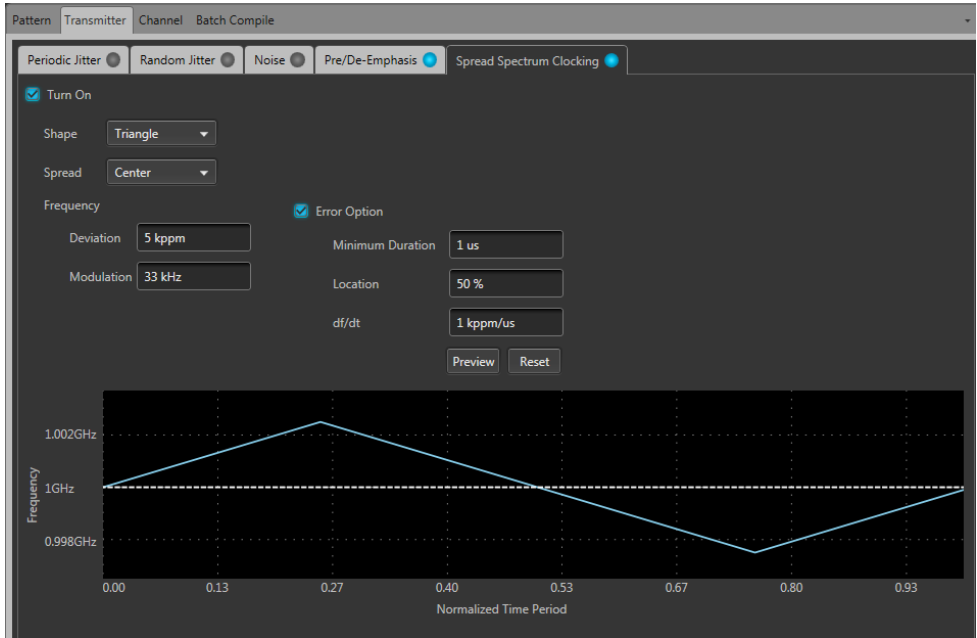


| Item | Description |
|---------|--|
| Preview | Displays the affects of the Pre/De-Emphasis and Preshoot coefficients. |
| Reset | Sets all coefficients to their default values. |

Spread Spectrum Clocking

Spread Spectrum Clocking (SSC) is the technique of modulating the clock frequency to minimize electro magnetic induction (EMI) effects. SSC is generated with a profile having a frequency and frequency deviation.

Spread Spectrum Clocking license. An SSC license is required to use the Spread Spectrum Clocking features. With the license installed on the host PC where SourceXpress is installed, SSC is available regardless of connecting to a virtual generator or a real instrument. Refer to [Licensing \(see page 39\)](#) for information about obtaining a license file.



| Item | Description |
|------------------|--|
| Shape | Select the shape of the SSC profile to use. <ul style="list-style-type: none"> • Sine • Triangle |
| Spread | Select the SSC spread to use <ul style="list-style-type: none"> • Up (100% spread) • Down (0% spread) • Center (50% spread) • Unequal: Enter the unequal spread, 0% to 100%. |
| Frequency | |
| Deviation | Enter the frequency deviation. This defines the maximum deviation of the data rate from mean data. 0 ppm to 200000 ppm |
| Modulation | Enter the frequency modulation. This defines the frequency of the modulating SSC profile. 10 kHz to 500 kHz |
| Error Option | |
| Minimum Duration | Enter the minimum duration of df/dt. The duration is the same for both the rising and falling edges. 1 μ s to 5 μ s |

| Item | Description |
|----------|---|
| Location | Enter the location of df/dt. This specifies the location (in % of height) of the df/dt spike on both the edges. The spikes are located symmetrically on both the rising and falling edges. 1 ppm/ μ s to 5000 ppm/ μ s |
| df/dt | Enter the df/dt of the waveform. This defines the sudden deviation (spikes) of the SSC profile from the predefined pattern. |

S-Parameter license

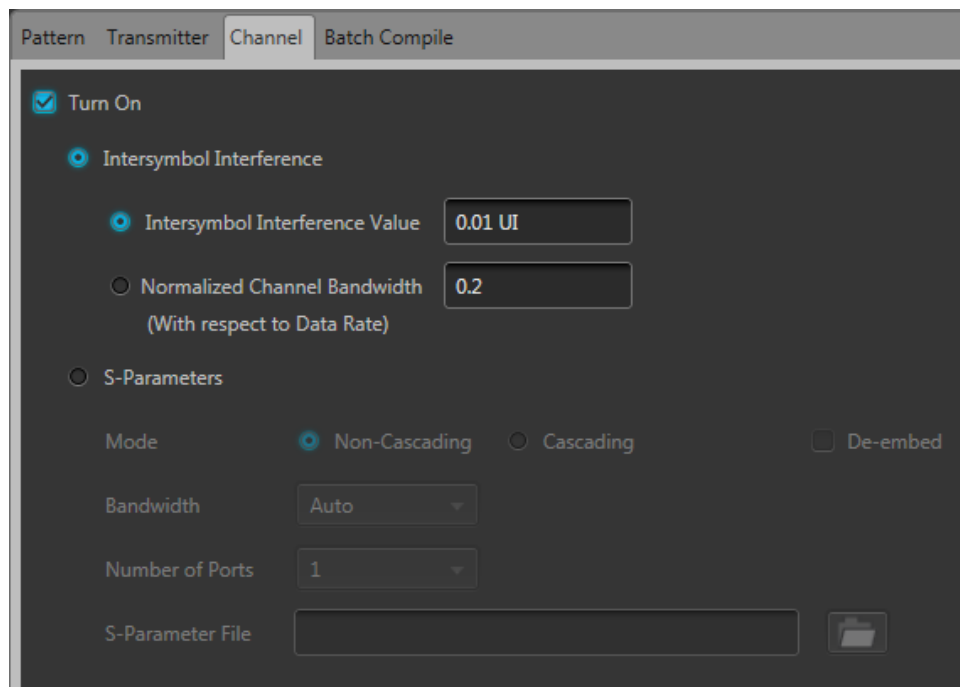
An S-Parameter license is required to use the Channel features (Intersymbol Interference or S-Parameters).

The Channel features are 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 \(see page 39\)](#) for information about obtaining a license file.

Channel tab overview

Channel tab allows users to choose the appropriate channel emulation model using either a known Intersymbol Interference (ISI) value or through Scattering Parameters (S-Parameters) data.



The screenshot shows the 'Channel' tab in a software interface. The tab is selected, and the 'Turn On' checkbox is checked. Under 'Intersymbol Interference', the 'Intersymbol Interference Value' is set to '0.01 UI' and the 'Normalized Channel Bandwidth (With respect to Data Rate)' is set to '0.2'. The 'S-Parameters' option is also visible. Under 'S-Parameters', the 'Mode' is set to 'Non-Cascading', and there are options for 'Cascading' and 'De-embed'. The 'Bandwidth' is set to 'Auto', and the 'Number of Ports' is set to '1'. The 'S-Parameter File' field is empty, with a file selection icon to its right.

Intersymbol Interference

Inter Symbol Interference (ISI) is generated due to the limited bandwidth of the channel.

Enable Intersymbol Interference to simulate the effect of ISI by directly entering the ISI value.

When ISI is 0, no ISI is introduced through the filter. However, the signal will contain some ISI depending on various parameters like bit pattern, rise/fall time, data rate, connecting cables, and so on.

| Item | Description |
|---|--|
| Intersymbol Interference Value | Enter the ISI value in UI or seconds. Range: 0.01 UI to 0.5 UI (10 ps to 500 ps). When ISI is 0, no ISI is introduced through the filter. However, the signal will contain some ISI depending on various parameters like bit pattern, rise/fall time, data rate, connecting cables, and so on. |
| Normalized Channel Bandwidth (With respect to Data Rate) | ISI can also be represented in terms of the channel bandwidth normalized to the Data Rate. Since ISI arises due to band-limited nature of the channel, specifying the channel bandwidth normalized to the data rate is another way of specifying the ISI. |

S-Parameters

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


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

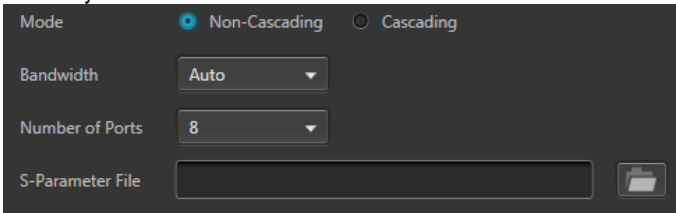
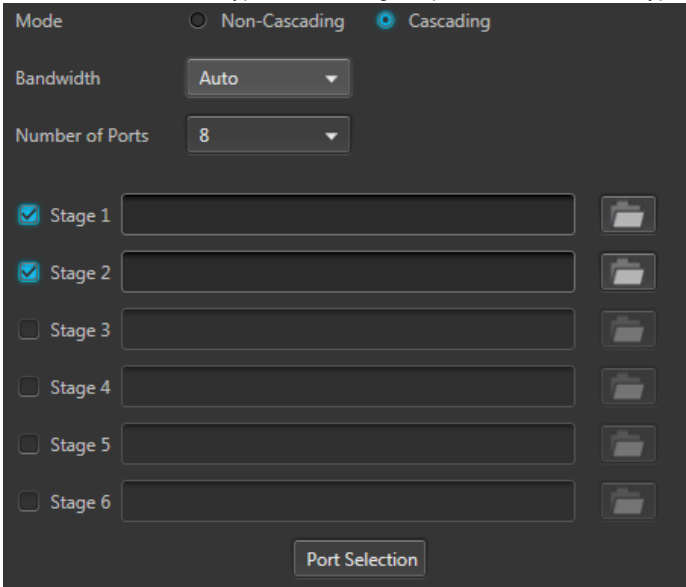
Number of Ports

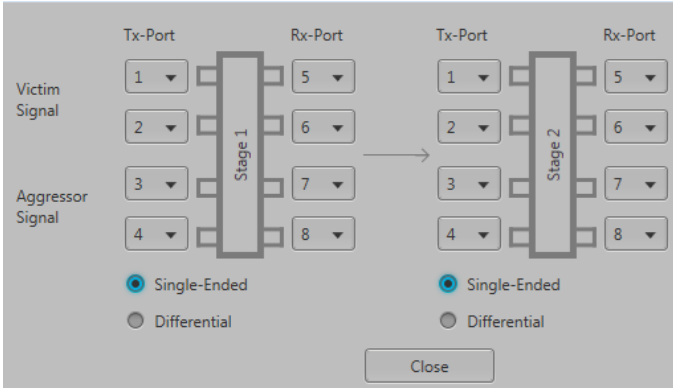
S-Parameter File 

Signalling Scheme ☒ Single-Ended ☐ Differential

Selection of the port

| Tx-Port | | | Rx-Port | |
|--------------------------------|---|--|--------------------------------|---|
| <input type="text" value="1"/> |  | | <input type="text" value="3"/> |  |
| <input type="text" value="2"/> | | | <input type="text" value="4"/> | |

| Item | Description |
|--|---|
| Mode | <p>Select Non-Cascading or Cascading S-Parameter mode.</p> <p>In the Non-Cascading mode, you apply S-Parameter characteristics on the signal from only one S-Parameter file.</p>  <p>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.</p>  <p>The files supported are s1p, s2p, s4p, s6p, s8p, and s12p.</p> |
| De-embed (Non-Cascading mode) Cascading De-embed (Cascading mode) | <p>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.</p> |
| Bandwidth | <p>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).</p> <p>Full Bandwidth – The bandwidth is set to ½ of the waveform's sample rate (i.e. Nyquist Frequency).</p> <p>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.</p> |

| Item | Description |
|--|--|
| Number of Ports | <p>Choose the number of ports. The port matrixes supported are 1, 2, 4, 6, 8, and 12.</p> <p>The number of ports selected determines:</p> <ul style="list-style-type: none"> • The type of S-Parameter file to apply • The Signalling Scheme choice • The port matrixes available |
| S-Parameter File | <p>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.</p> <p>The files supported are s1p, s2p, s4p, s6p, s8p, and s12p.</p> |
| Signalling Scheme (Only for 4, 8, and 12 ports) | <p>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.</p> <p>Differential: If the data is differential, you must select the data layout in the file.</p> |
| Selection of the port (No port selection for 1 Port environments) | <p>Use the diagrams to map the ports for the transmitter ports (Tx-Port) and the receiver ports (Rx-Port).</p> <p>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).</p> |
| Victim Aggressor and Both (Only for 8 and 12 ports) | <p>Victim: The default setting with no cross-talk effects.</p> <p>Aggressor: Select this to activate aggressor signal parameters, adding the effect of cross-talk.</p> |
| Port Selection | <p>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.</p>  |

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 | <p>Choose the type of aggressor signal with the dropdown list:</p> <ul style="list-style-type: none"> • 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 | <p>Specify the data rate (in bps) of the signal.</p> <p>This is not available when the Aggressor signal is set to be the same as the victim.</p> |
| Aggressor Amplitude | <p>Enter the signal amplitude.</p> <p>This is not available when the Aggressor signal is set to be the same as the victim.</p> |
| Crosstalk Type | <p>Choose the type of crosstalk of the aggressor signal.</p> <ul style="list-style-type: none"> • Near-End Crosstalk • Far-End Crosstalk • Both |

Batch compile tab overview

Batch Compile creates multiple waveforms with random jitter, periodic jitter, or a combination of both.

NOTE. *Batch Compile is disabled if Periodic Jitter or Random Jitter is enabled in the Transmitter tab.*

| Item | Description |
|------------------------|--|
| Periodic Jitter | |
| Integer Cycles | Select to ensure that there is an integer number of sinusoidal jitter cycles over the entire bit pattern under consideration. In some cases, the bit pattern might be repeated to meet this requirement. |
| Deviation | <p>Users can indicate the choice of either allowing the software to automatically decide the final sinusoidal frequency by using 'Auto' or provide the maximum allowable variation as a percentage of the dialed sinusoidal frequency by using the 'Manual' mode.</p> <ul style="list-style-type: none"> • Auto: The software to automatically decides the final sinusoidal frequency. • Manual: Enter the maximum allowable variation as a percentage of the dialed sinusoidal frequency. |
| Magnitude (Peak-Peak) | Set the start and end periodic jitter magnitudes. A waveform for each UI increment will be created for each frequency increment (as defined in the Frequency Range). |
| Start | Set the periodic jitter start value (in UI). |
| End | Set the periodic jitter end value (in UI). |
| Increment | Set the periodic jitter increment value (in UI). |
| Frequency Range | Set the periodic jitter frequencies. A waveform for each UI increment is created for each frequency increment. |
| Low | Set the Low (first) periodic jitter frequency (in Hz). Range: 10 kHz to Frequency High. |

| Item | Description |
|----------------------------|--|
| High | Set the High (last) periodic jitter frequency (in Hz). Range: 10 kHz to Data rate/2. |
| Increment | Set the frequency increment value (in Hz). |
| Random Jitter | |
| Magnitude (Peak-Peak) | Set the start and end periodic jitter magnitudes. A waveform for each UI increment will be created for each frequency increment (as defined in the Frequency Range). |
| Start | Set the random jitter start value (in UI). |
| End | Set the random jitter end value (in UI). |
| Increment | Set the random jitter increment value (in UI). |
| Frequency Bandwidth | |
| Low | Set the low frequency of the random jitter (in Hz) to introduce. Range: 1 Hz to (Frequency-High – 1 MHz). |
| High | Set the high frequency of the random jitter (in degree) to introduce. Range: 1.1 MHz to Data rate/2. |

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

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