Tektronix®

Environment Signals Plug-in Application

Printable Help Document

077-1401-00

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077-1401-00

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Supports the Environment Signals Plug-in Version 3.0.x and above.

Help part number: 076–0415–00

PDF of Help system part number: 077–1401–00

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

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

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Welcome

The Environment signal plug-in is a waveform creation application that allows you to emulate realistic signal interference.

The standards that are supported in the Environment plug-in include:

• Bluetooth	• DVB-T	• P25
• CDMA	• GSM	• WiFi
• W-CDMA	• LTE	• WiMAX

Along with the various signal standards, it also allows seamless integration of signals created using other waveform plug-in capabilities such as:

• Radar [1]	• Pulses
• OFDM [1]	• Noise
• Analog modulation [1]	• Tones
• Digital modulation [1]	• User created waveforms

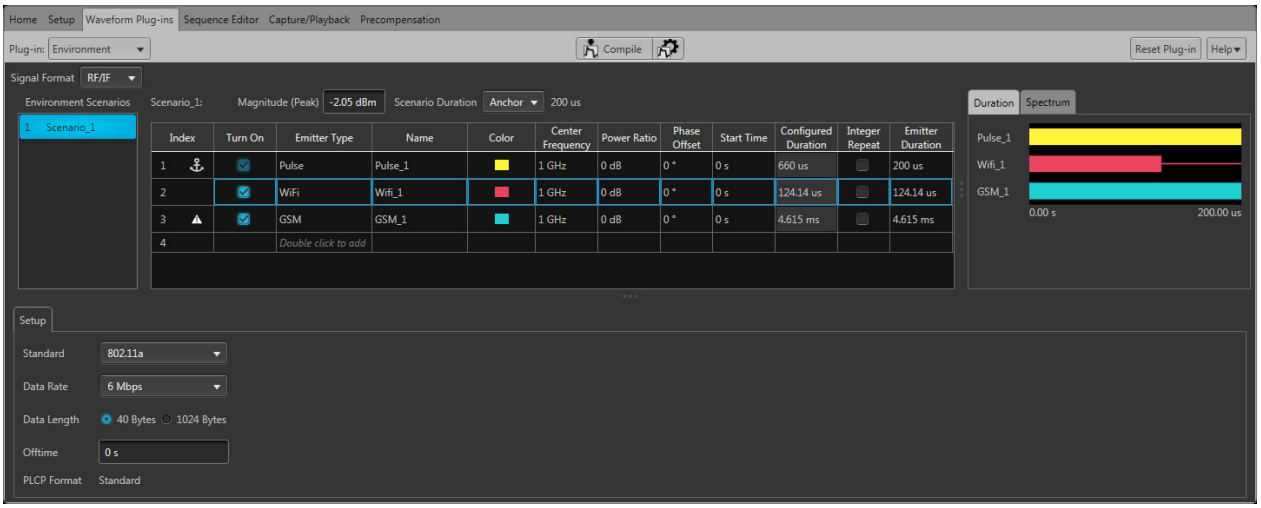
[1] Requires additional licensing.

The Environment signal plug-in is designed to integrate and operate seamlessly as an enhancement to the following products:

- SourceXpress waveform creation software version 5.3 and above
- AWG70000 series arbitrary waveform generators software version 5.3 and above
- AWG5200 series arbitrary waveform generators software version 6.0 and above

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

The illustrations in this document show the Environment signals plug-in viewed from the SourceXpress application. The plug-in interface is identical whether used from SourceXpress or installed on a generator.



Key features

The Environment signal plug-in allows you to build scenarios of varying types of signal interference.

Some of the key features include:

- Build a variety of scenarios
- Ability to build up to 50 scenarios
- A large variety of emitters available
- Ability to add up to 100 emitters to a scenario
- Compile both scenario waveforms and sequences
- Control durations of each emitter
- Set emitter power, start time, center frequency/baseband offset
- Import user created interference signals
- Create RF/IF or IQ signal formats

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
Environment 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 Environment 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.
Environment 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 or AWG5204)	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 or AWG5204)	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

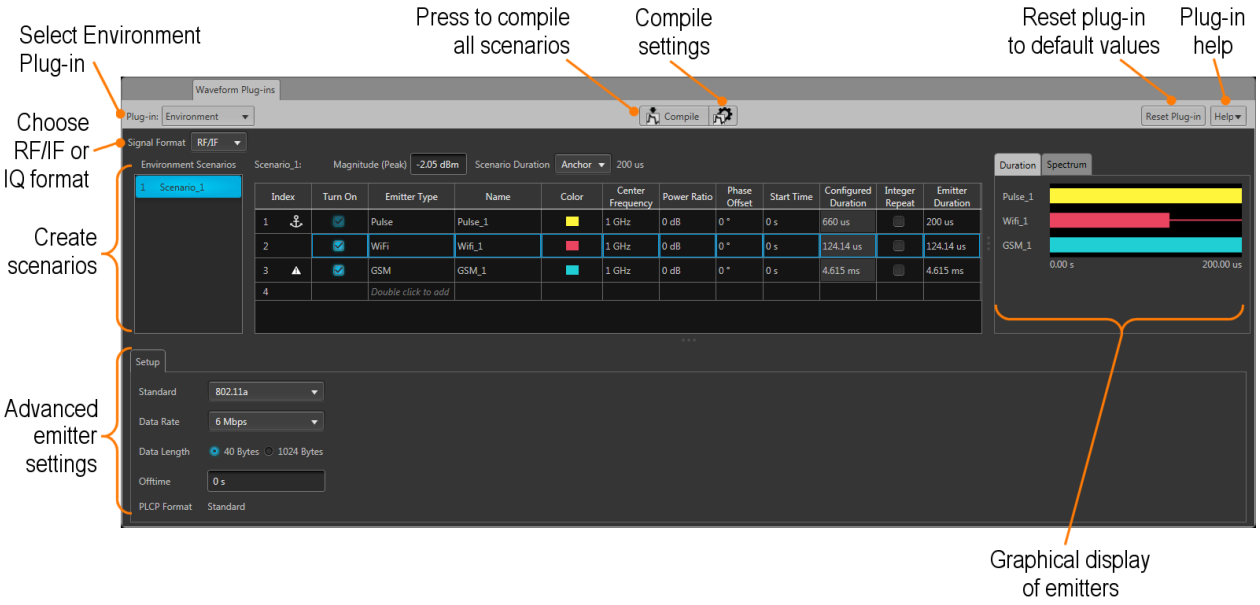
Tektronix offers the following services in support of their products:

- **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 Environment plug-in application. The plug-in pull-down menu varies depending on the installed applications.

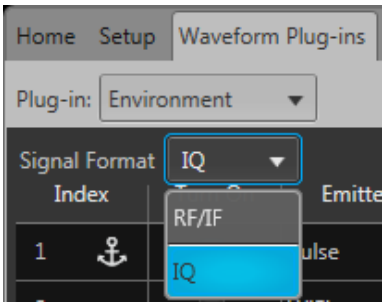
NOTE. *The Environment plug-in requires a license to create waveforms.*

Refer to *Licensing (see page 69)**.*

Signal Format selection

The Environment plug-in supports generation of two signal formats (RF/IF and IQ). This allows you to create baseband waveforms (complex signals with I and Q waveforms) and RF/IF waveforms (real signal waveforms).

- Baseband signals (IQ format): When the IQ signal format is selected, a baseband complex signal is generated for each scenario. If the instrument contains an IQ modulator, a complex signal can be assigned to a single channel which will be upconverted to the user defined center frequency. Refer to the compile settings (see page 6).
- RF signals (RF/IF format): When the RF signal format is selected, one waveform file is generated for each scenario if the setting is to create a single waveform in the compile settings.



Environment Scenarios

The Environment Scenarios area contains both the current list of scenarios and the emitter selections (for the selected scenario). A graphical representation of each emitter is also provided. The emitters can be shows in relation to emitter durations or a spectral graph of each emitter.

Refer to:

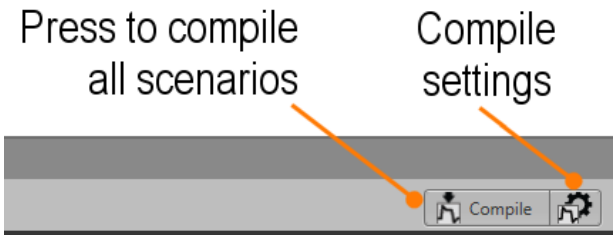
Environment Scenarios list and menu (see page 19)

Emitter menu operations (see page 20)

Compile button

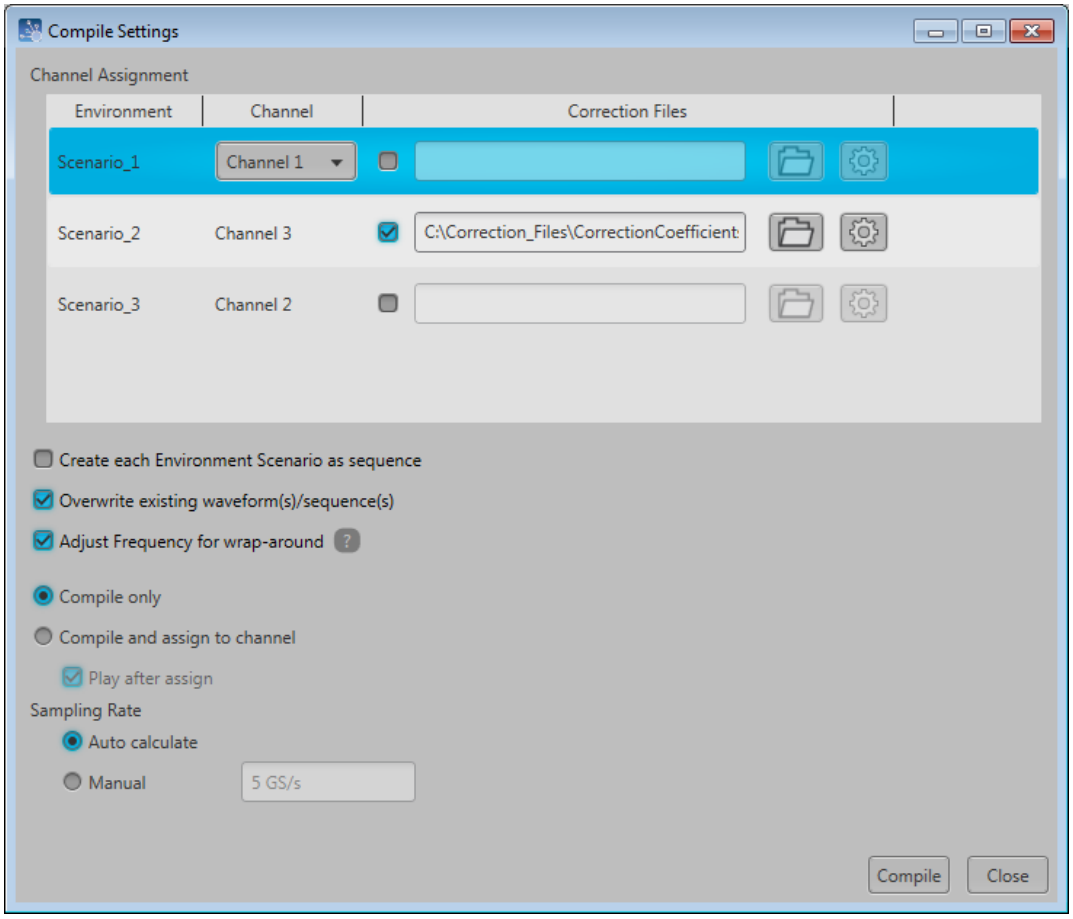
Use the Compile button to compile all Environment Scenarios and place the scenario waveforms into the Waveforms list of the host application. Sequences (if enabled) are placed in the Sequence list.

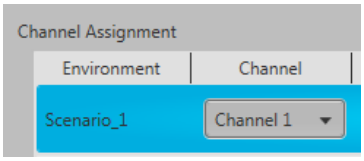
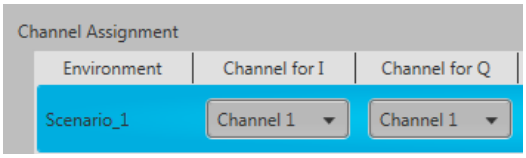
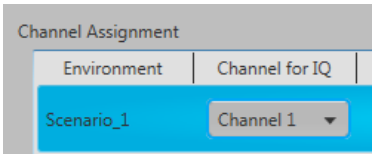
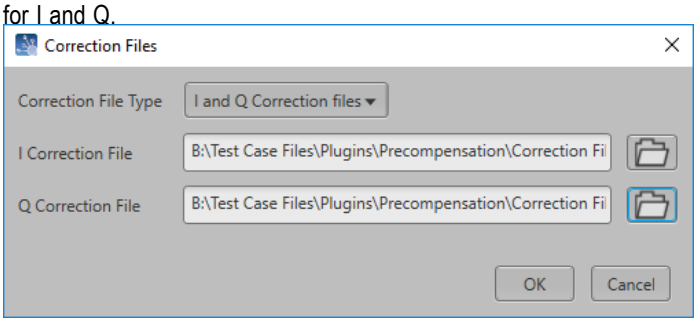
Use the Compile settings button to edit the compilation settings.



NOTE. *When compiling, all scenarios in the Environment Scenarios list are compiled.*

Compile settings

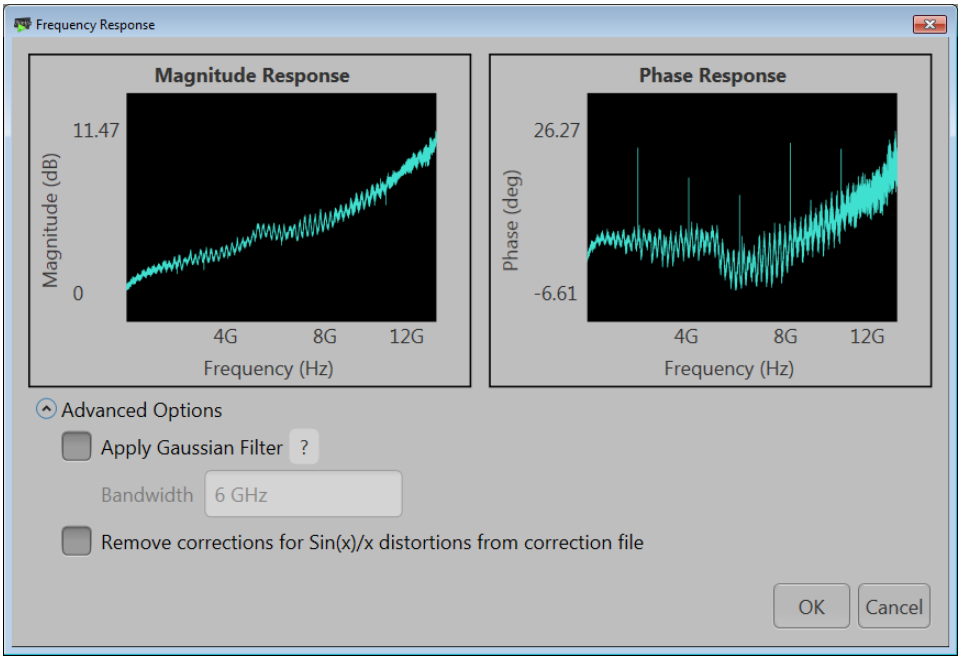


Item	Description
Channel Assignment	The channel assignment area changes based on several factors: Signal Format selection (RF/IF verses IQ). Generator capabilities (IQ modulator to create IQ waveforms).
RF channel assignment	 Choose the channel to associate with the compiled RF waveform. The selected channel is also used to define the amplitude ranges.
I and Q channel assignment	 Choose the channels to associate with the compiled I and Q waveforms. The selected channel is also used to define the amplitude ranges. See the information about the “Use Internal IQ Modulator” selection.
IQ channel assignment	 If the generator has IQ modulator capabilities (digital up converter), you are able to assign the complex IQ waveform to a channel. Choose the channel to associate with the compiled IQ waveform. The selected channel is also used to define the amplitude ranges. See the information about the “Use Internal IQ Modulator” selection.
Correction Files	Check the box to apply a correction file directly to the scenario when compiling. 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. For RF signal formats, you apply a single correction file to the scenario. For IQ signal formats, you can choose either a single IQ correction file or correction files for I and Q. 

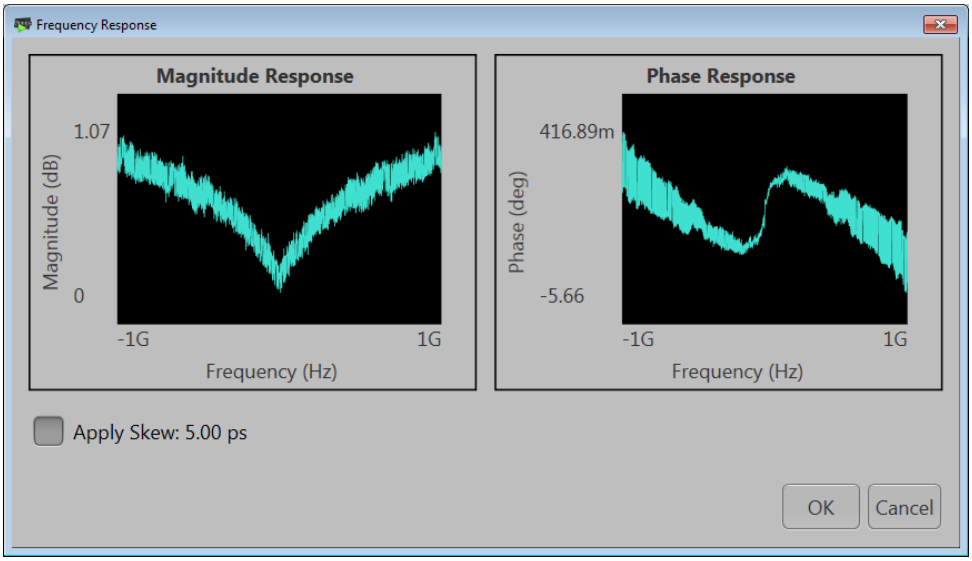
Item	Description
Create each Environment Scenario as sequence	If checked, each scenario will be compiled as a sequence. If unchecked, each scenario is created as one single waveform, which may take more memory to compile, depending on the settings. This check box is not shown if the instrument does not have the sequence option.
Adjust Frequency 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.
Use Internal IQ Modulator	If checked, a complex IQ waveform is created during compile. This check box is not shown if the instrument does not have an internal IQ modulator.
Overwrite existing waveform(s)/sequence(s)	If checked, a scenario with the same name (in the scenario list) is overwritten with no warnings.
Compile only	The compiled scenarios are simply entered into the Waveforms and Sequences lists.
Compile and assign to channel	The compiled scenarios are automatically assigned to the selected channel. The scenarios are compiled and listed in the waveform and sequence lists depending on the state of the "Create each Environment Scenario as sequence" setting.
Play after assign	If checked, the scenarios 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.
Manual	Select to enter a specific sampling rate.
Compile	Compiles the scenarios. When compiling, all scenarios in the Environment Scenarios list are compiled.

Correction file frequency response

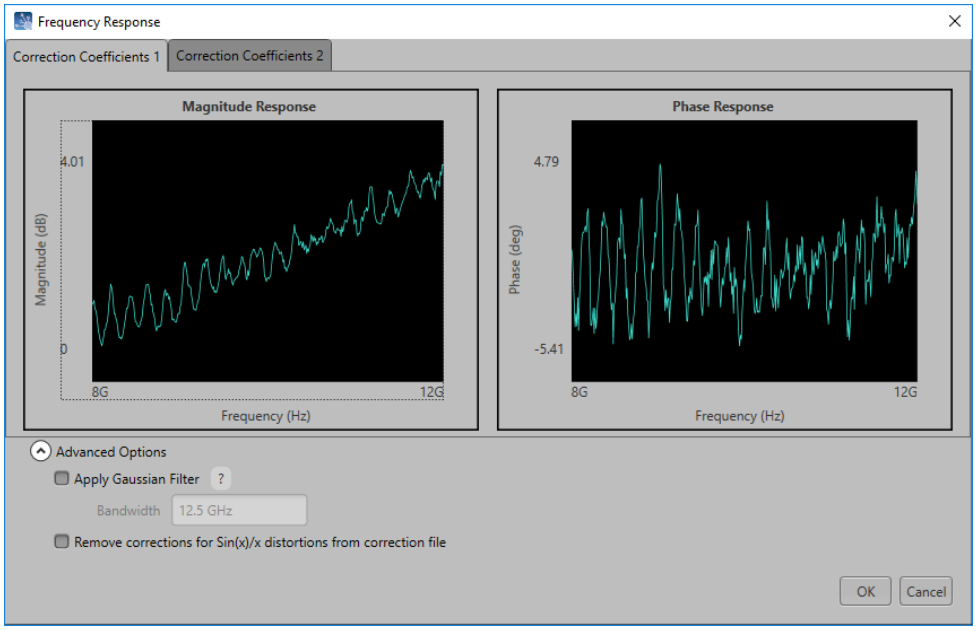
If applying an RF correction file, the Frequency Response screen shows plot information and provides Advanced options to apply a Gaussian filter or remove Sin(x)/x distortions.



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.



When applying an I/Q correction file you can choose either a single IQ correction file or correction files for I and Q. The Frequency Response screen shows plot information and provides Advanced Options to apply a Gaussian filter or remove Sin(x)/x distortions. When selecting I and Q correction files, separate files for I and Q are shown in the Frequency Response window.



Reset Plug-in button

Returns all plug-in settings to their default values.

Help button

Click User Manual to display the plug-in Help file which provides information about the selected plug-in application. Click About to display the selected plug-in's version information.

Emitter graphical displays

The emitter definition area provides two types of graphical displays of the emitters selected to be included in the scenario when compiled.

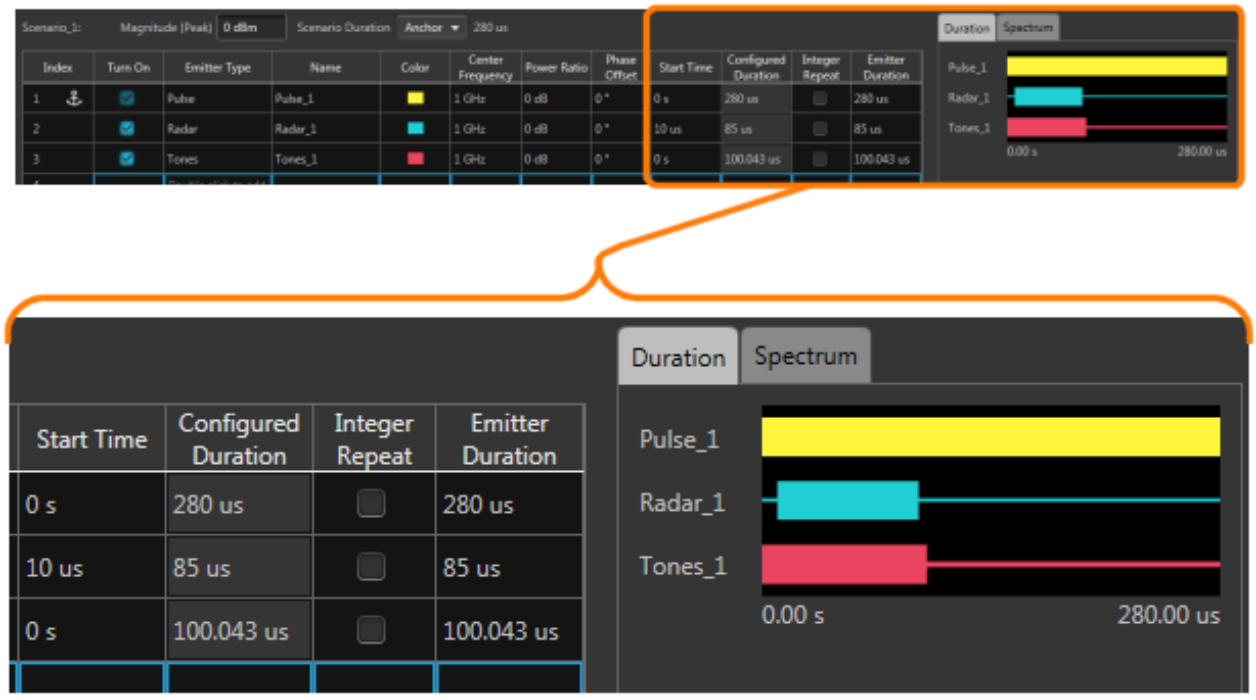
- Duration: provides a graphical representation of the emitter's durations in relation to each other.
- Spectrum provides a plot of the emitters represented as amplitude verses frequency in relation to each other.

Duration display

The duration displays a time-bar for each emitter's duration. The emitter must be turned on.

As seen in the illustration here, there are three emitters. As shown, the duration display represents the following aspects:

- The Pulse is the anchor emitter.
- Each emitter has a color assignment.
- The Scenario Duration is set to Anchor. So the Pulse duration is the total scenario duration, at 280 µs.
- The Radar emitter has a duration of 85 µs but has a Start Time (delay) of 10 µs from the anchor emitter.
- The Tones emitter has a duration of 100.043 µs.
- All durations are within (less than) the Anchor emitter.

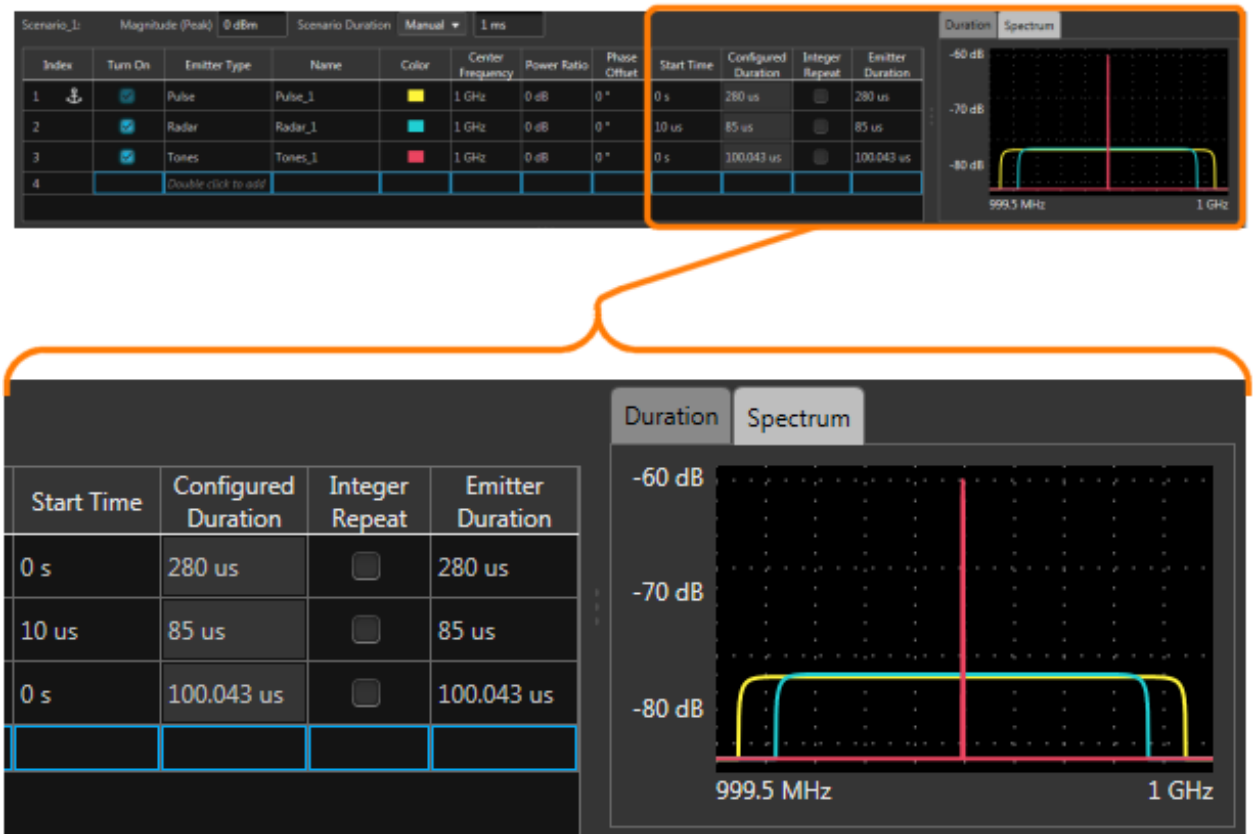


Spectrum display

The spectrum displays a spectrum plot for each emitter. The emitter must be turned on.

As seen in the illustration here, there are three emitters. As shown, the spectrum display represents the following aspects:

- Each emitter has a color assignment.
- The center frequency of each emitter.
- The amplitude relationship between emitters.

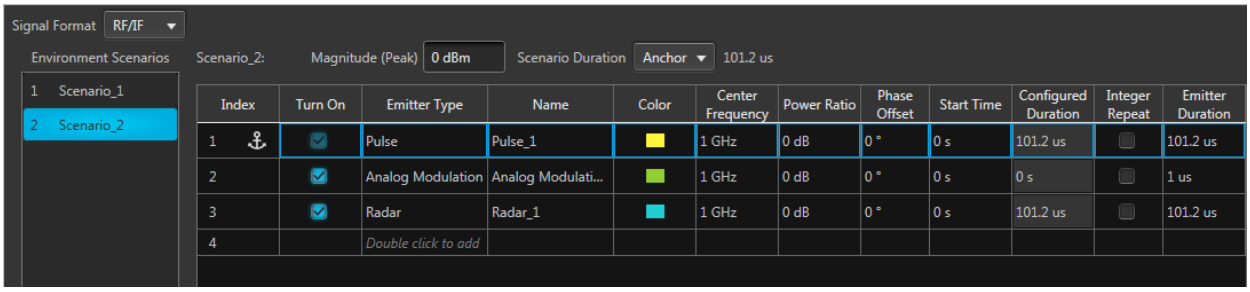

Start Time
Configured Duration
Integer Repeat
Emitter Duration
0 s
280 us
280 us
10 us
85 us
85 us
0 s
100.043 us
100.043 us
Duration
Spectrum
-60 dB
-70 dB
-80 dB
999.5 MHz
1 GHz

Working with scenarios

The Environment plug-in displays all existing scenarios. As you select scenarios, the emitters table display the emitters for the selected scenario. You can only display the emitters table for one scenario at a time.

NOTE. *New scenarios are created with a single Pulse emitter with all default settings.*

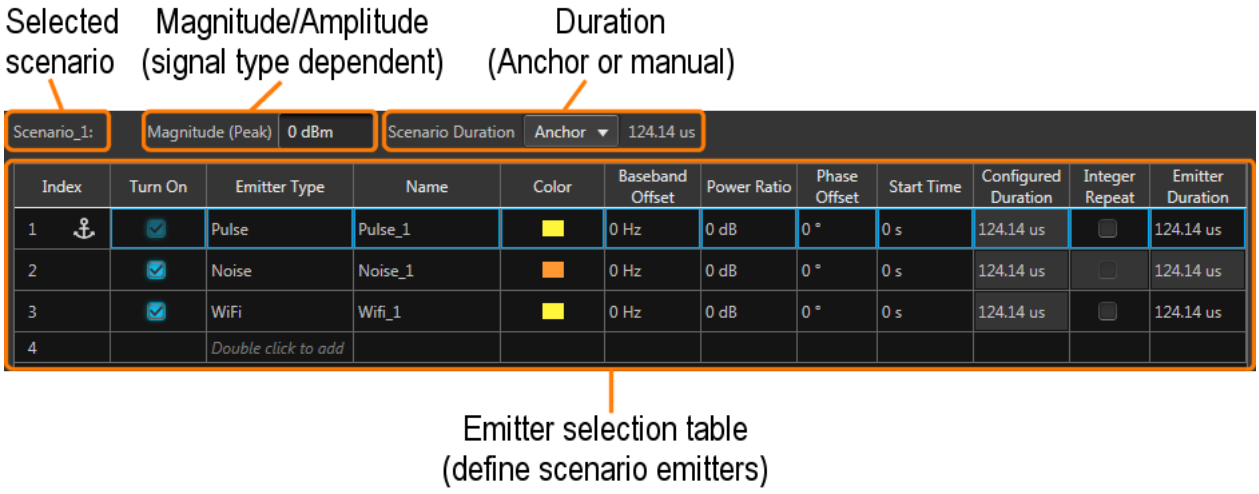
See the Scenarios list operations (see page 19) for details about managing the scenario list.



Scenario definition area

The Scenario definition area contains two areas to add and define emitter parameters:

- Common scenario parameters (see page 16)
- Basic emitter parameters (see page 17)

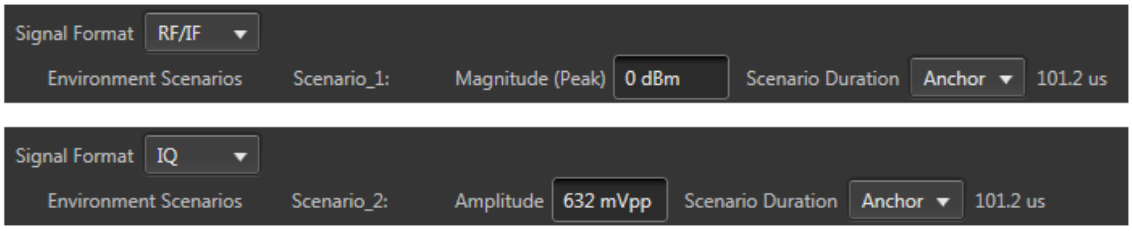


Once an emitter is added to the Scenario definition area, selecting the emitter displays its Advanced settings in tabs at the bottom of the screen.

See the section Advanced emitter settings (see page 23) to configure emitters.

Common scenario parameters

Each scenario has three basic parameters that are applicable to the selected scenario:

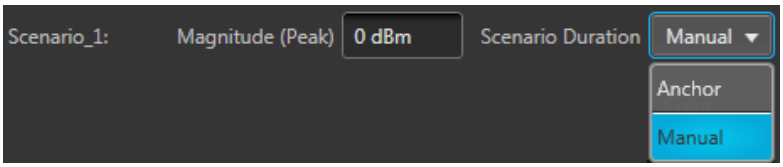


- Magnitude (Peak): If the Signal Format is RF/IF, set the signal amplitude in units of dBm.
- Amplitude: If the Signal Format is IQ, set the signal amplitude in units of peak-to-peak volts.
- Scenario Duration: Choose to set the scenario's duration to either match the Anchor emitter's duration or to set the duration manually. See Defining scenario durations (see page 16) for more information.

Defining scenario durations

The total scenario duration is determined by the Scenario Duration setting.

- Anchor sets the scenario duration to the duration of the emitter (plus start time) chosen to be the anchor.
- Manual lets you enter a scenario duration independent of the emitters.

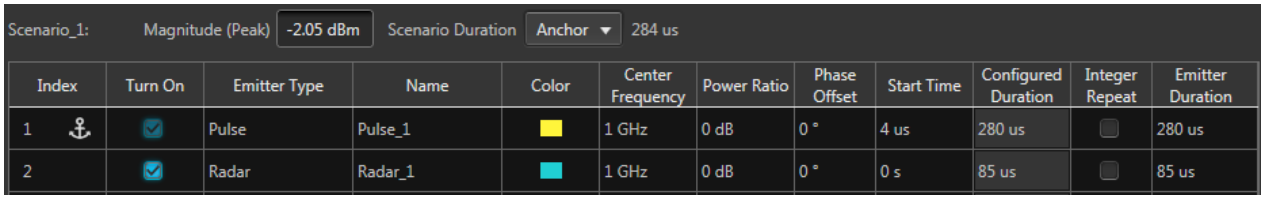


Using the Anchor as duration

When the Scenario Duration is set to use the Anchor, the scenario duration equals the duration of the emitter chosen to be the Anchor. If the emitter has a Start Time, this is added to the scenario duration.

In the example below, the Scenario Duration is set to Anchor. The Anchor emitter is chosen to be the Pulse emitter, which has an Emitter Duration of 280 µs. The Pulse emitter also has a Start Time of 4 µs. So the total Scenario Duration is set to 284 µs.

The Radar emitter duration is less than the Anchor emitter duration, which allows the Radar emitter signal to complete its entire cycle.



Index	Turn On	Emitter Type	Name	Color	Center Frequency	Power Ratio	Phase Offset	Start Time	Configured Duration	Integer Repeat	Emitter Duration
1	☑	Pulse	Pulse_1		1 GHz	0 dB	0 °	4 us	280 us	☐	280 us
2	☑	Radar	Radar_1		1 GHz	0 dB	0 °	0 s	85 us	☐	85 us

Note that the emitters have both a Configured Duration and an Emitter Duration field.

The Configured Duration is the duration of the emitter as configured in the emitter's Advanced settings. The Configured Duration is not adjustable from the emitter table, only from the emitter's advanced settings.

The Emitter Duration field is initially set to match the Configured Duration, but you can adjust the emitter's duration in this field.

NOTE. *Changing the emitter duration to a value different than its configured duration will impact the emitter signal.*

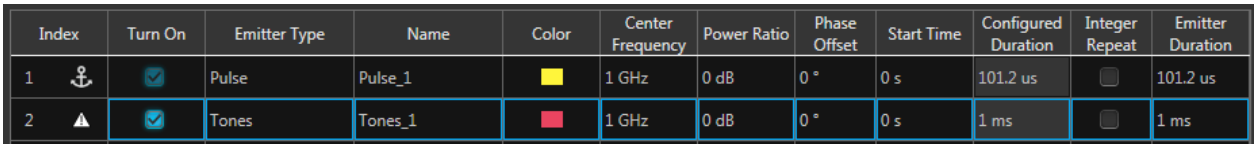
Shortening the Emitter Duration will truncate the signal. Lengthening the Emitter Duration causes the emitter signal to repeat (as many times necessary) to match the modified Emitter Duration time. But the final repeated cycle of the signal might be truncated. If an emitter's configured duration is such that there is dead time when compared to the Anchor emitter's duration, consider using the Integer Repeat function. This causes the emitter signal to repeat as many times as possible, within the Anchor duration time frame, without truncating the signal.

Using Manual duration

Setting the Scenario Duration to Manual allows you to directly specify the scenario duration. No emitters impact the duration.

Emitter basic parameters

Each emitter contained within a scenario has basic parameters that are displayed next to the selected scenario. These settings are independent between the scenario emitters, although the chosen anchor may impact other emitters, based on duration settings.



Index	Turn On	Emitter Type	Name	Color	Center Frequency	Power Ratio	Phase Offset	Start Time	Configured Duration	Integer Repeat	Emitter Duration
1	☑	Pulse	Pulse_1		1 GHz	0 dB	0 °	0 s	101.2 us	☐	101.2 us
2 ⚠	☑	Tones	Tones_1		1 GHz	0 dB	0 °	0 s	1 ms	☐	1 ms

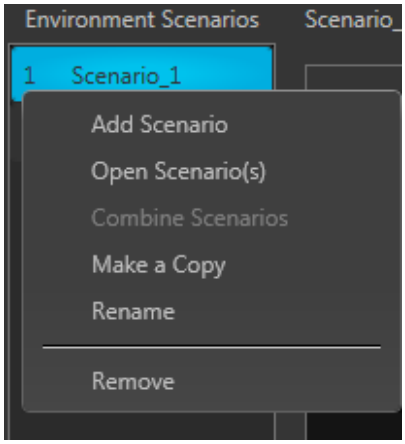
NOTE. *Detailed emitter settings are displayed at the bottom of the screen. Refer to the specific emitter in the Advanced emitter settings (see page 23) section.*

Item	Description
Index	Lists the index number of the emitter. Up to 100 emitters can be defined per scenario. This field also includes two possible icons: Anchor and warning icons.  indicates the emitter the anchor emitter. The overall duration of the compiled waveform is limited by the anchor signal duration.  indicates that the emitter's duration is longer than the scenario duration (anchor or manual). This will cause the emitter signal to be truncated to the length of the scenario duration.
Turn On	When selected, the emitter signal will be included when the scenario is compiled.
Emitter Type	Use the pull-down list to select an emitter.
Name	Use this field to rename the emitter. The emitter name is used in the Duration graph. By default, the emitter name uses the Emitter Type name appended with a numerical value.
Color	Select the color to use to represent the emitter in both the Duration and Spectrum graphs.
Center Frequency	Available for RF/IF signal format. Adjust the center frequency for each emitter. ***NOTE.*** *For User Defined emitters (user supplied RF waveforms), the center frequency and phase offset is obtained from the waveform file.*
Baseband Offset	Available for IQ signal format. Adjust the Baseband Offset for each emitter.
Power Ratio	Enter a relative power level (of the emitter) with respect to other emitters within the scenario.
Phase Offset	Enter a phase offset (of the emitter) with respect to other emitters within the scenario. ***NOTE.*** *For User Defined emitters (user supplied RF waveforms), the center frequency and phase offset is obtained from the waveform file.*
Start Time	Select a start time for the emitter to start in relation to the other emitters in the scenario, effectively adding a delay to the emitter signal. If the emitter is the anchor, the overall scenario duration is increased by the additional start time.
Configured Duration	Displays the current configured duration for the emitter. This is not adjustable from the emitter table. The duration is defined in the advanced emitter setup tabs.

Item	Description
Integer Repeat	Selecting Integer Repeat causes the emitter signal to repeat (as many times as possible) complete full cycles of the emitter's Configured Duration within the time defined by the Scenario Duration.
Emitter Duration	Defines the signal duration for the specific emitter in the final compiled scenario. If the value is less than the configured duration, the signal will be incomplete. If the value is more than the configured duration, the configured duration repeats until the emitter duration is reached. This can lead to incomplete cycles and truncated signals. Use the Integer Repeat function for the emitter to avoid incomplete and truncated signals.

Scenarios list menu

Initially, the Environment plug-in contains one default Scenario with a single Pulse emitter. Right-clicking in the Environment Scenario list opens a menu that allows you to manage the scenario list. The list can contain up to 50 scenarios.



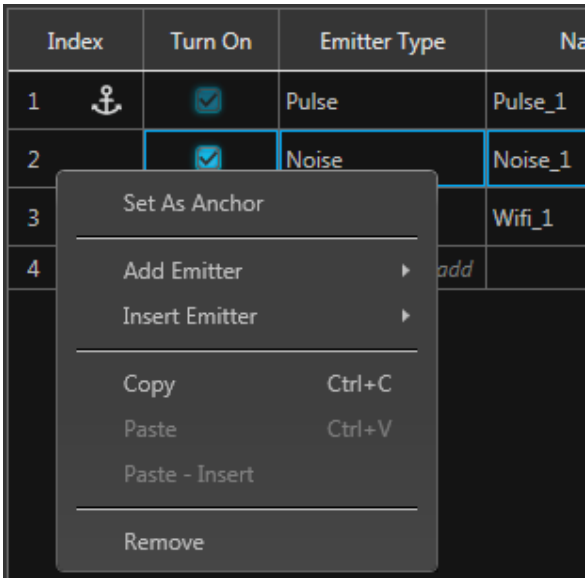
The Environment Scenario menu contains the following options:

Item	Description
Add Scenario	Creates an new Scenario containing one Pulse emitter. The Scenario is placed at the bottom of the Environment Scenarios list. All parameters of the new Scenario are set to their default values.
Open Scenario(s)	Allows you to select and open an existing setup file containing scenarios. The scenarios are added to the Environment Scenarios list. If the setup file contains multiple scenarios, you are presented with an Available Environment Scenarios screen to select which scenarios to import. If a scenario name already exists, you'll be presented with a screen to decide how to handle the scenario. Waveforms and Sequences, that may have been saved with the setup file, are not imported. If you want the saved waveforms and sequences, use the File menu of the host application.

Item	Description
Combine Scenarios	Allows you to create a new scenario that includes all emitters contained in the scenarios selected to combine. The order in which you select the scenarios to combine dictate the order of the emitters in the new combined scenario. The anchor emitter for the new combined scenario is the anchor emitter from the scenario selected first. ***NOTE.*** *The order in which the emitters are displayed has no impact on the compiled scenario.*
Make a Copy	Creates a duplicate copy of the selected scenario.
Rename	Allows you to rename the selected scenario.
Remove	Deletes the selected Scenario. This menu item is not selectable if there is only one scenario in the list. At least one scenario must always exist.

Emitter menu operations

With any emitter selected, a right-mouse click in the table displays a menu of operations.



Item	Description
Set As Anchor	Chooses which emitter to use as the anchor. The overall duration of the final waveform is limited by the anchor signal duration. The anchor icon  is placed in the index column of the anchor emitter.
Add Emitter	Select to add a new emitter type to the selected scenario. Use the drop-down list to select the emitter type to add. The new emitter is appended to the end of the existing emitters.

Item	Description
Insert Emitter	Select to insert a new emitter type into the selected scenario. Use the drop-down list to select the emitter type to add. The new emitter is inserted above the currently selected emitter.
Copy	Copies the selected emitter definition (or definitions) in preparation to paste into a scenario.
Paste	Pastes the copied emitter definition(s) over the selected emitter definition(s). ***NOTE.*** *The anchor emitter can not be pasted over.* Emitter definitions can be copied and pasted between scenarios.
Paste-Insert	Pastes the copied emitter definition(s) into the scenario above the selected emitter definition.
Remove	Deletes the selected emitters. You can also press Delete on the keyboard. There are several ways to select multiple emitters: Left-mouse click on an emitter, continue to hold the left-mouse button and slide the selection either up or down to highlight the emitters. Select an emitter, then hold the Shift key to select continuous emitters. Hold the Ctrl key and select emitters. ***NOTE.*** *The anchor emitter can not be removed.*

Advanced emitter settings

This section contains the information for about advanced parameters available for each emitter. The advanced parameters appear as tabbed sections at the bottom of the screen.

The links below provide quick access to each emitter's advanced settings.

Pulse emitter parameters (see page 23)	Noise emitter parameters (see page 33)
Bluetooth emitter parameters (see page 23)	OFDM emitter parameters (see page 33)
CDMA emitter parameters (see page 23)	P25 emitter parameters (see page 43)
W-CDMA emitter parameters (see page 24)	Radar emitter parameters (see page 43)
Digital Modulation emitter parameters (see page 24)	Tones emitter parameters (see page 66)
Analog Modulation emitter parameters1 (see page 30)	User Defined emitter parameters (see page 66)
DVBT emitter parameters (see page 31)	WiFi emitter parameters (see page 67)
GSM emitter parameters (see page 31)	WiMAX emitter parameters (see page 68)
LTE emitter parameters (see page 32)	

Pulse emitter parameters

Item	Description
Pulse Width	Enter the pulse width.
PRI	The Pulse Repetition Interval (PRI) value sets the configured emitter duration and is displayed as seconds. The PRI value can be affected by the Pulse Width setting.
Repeat Count	Select the number of times to repeat the pulse emitter signal. The emitter duration (PRI) increases to match the repeat count.

Bluetooth emitter parameters

Item	Description
Standard	Choose the Bluetooth standard to create. LE 1M, LE 2M, LE Coded, BR, EDR
Modulation	Fixed to GFSK.
DataRate	Fixed to 1 Mbps.

CDMA emitter parameters

Item	Description
Link	Set the CDMA channel type to Forward or Reverse.
Number of channels	Set the number of traffic channels to 9, 12, or 15.

Item	Description
Radio configuration	Set the radio configuration to RC1, RC2, RC3, RC4, or RC5.
Data rate	The available data rates is dependent on the Radio configuration setting. RC1: 1200 bps, 2400 bps, 4800 bps, 9600 bps. RC2: 1800 bps, 3600 bps, 7200 bps, 14400 bps. RC3: 1500 bps, 2700 bps, 4800 bps, 9600 bps. RC4: 1500 bps, 2700 bps, 4800 bps, 9600 bps. RC5: 1800 bps, 3600 bps, 7200 bps, 14400 bps.

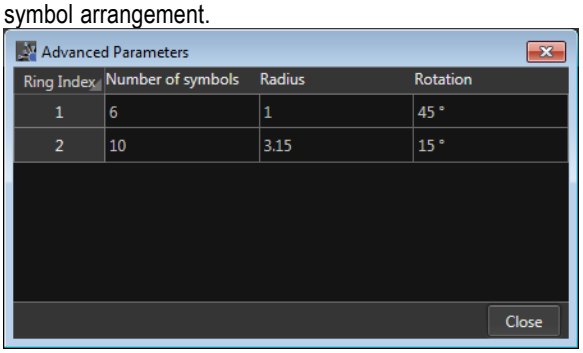
W-CDMA emitter parameters

Item	Description
Link	Set the link type to Down or Up.
Down link mode	Set the mode to DPCH or TestMode 1–6. This option is available when the Link type is set to Down.
With CPICH channel	Select this to include a CPICH channel. This option is available when you select Down in the Link list and TestMode4 in the Down Link Mode list.
Number of Channels	Set the number of channels. When the Link is set to Up, the number of channels is from 1 to 6. When the Link type is set to Down, the number of channels varies based on the Down Link mode.
Number of HS-PDSCH channels	Set the number of channels to 4 or 8. This option is available when you select Down in the Link list and TestMode6 in the Down Link Mode list.
Number of DPCH channels	Select the number of channels, 1–6. This option is available when you select Down in the Link list and DPCH in the Down Link Mode list, or when you select Up in the Link list.
Data rate	When the Link type is Up, the data rates can be set to 15 kbps 30 kbps, 60 kbps, 120 kbps, 240 kbps, 480 kbps, or 960 kbps. When the Link type is Down, the data rate is fixed at 15 kbps.

Digital Modulation emitter parameters

Setup tab

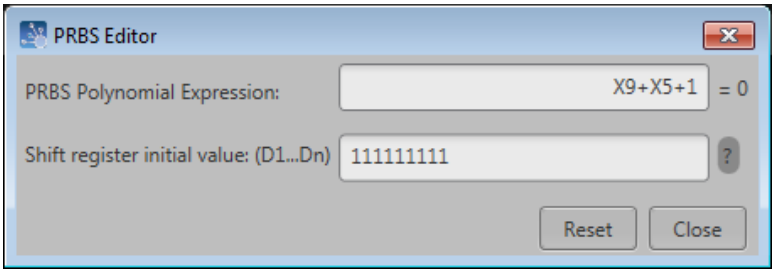
Item	Description
Digital Modulation setup parameters	
Data	
Pattern	Select the data source:
All Zero	Sends a sequence of binary 0 symbols.
All One	Sends a sequence of binary 1 symbols.

Data	
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 26) dialog screen.
Pattern	Enter a pattern of 0s and 1s up to a maximum of 256 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.
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.

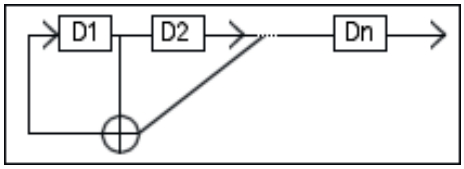
Filter	
Filter	The filter selection is dependent on the Modulation selection. Select the filter from the following options: Rectangular, Raised Cosine, Root Raised Cosine, Gaussian, Triangular, Edge, Half-Sine, and User Defined. **User Defined** Selecting User Defined provides a filename dialog box to 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.

PRBS Editor

This dialog box is displayed when clicking PRBS Editor icon when PRBS is set to User Defined for the Data and Pilot pattern type. (Symbols tab).

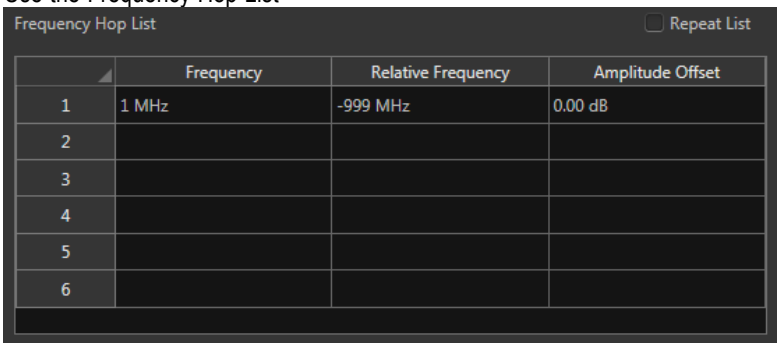


PRBS sequences are generated by a feedback shift register. The number (#) following PRBS indicates the length of the generating shift register. For instance, a shift register with 16 memory cells is required to generate a PRBS 16 sequence. The pseudo-random sequence of a PRBS generator is determined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



Hopping tab

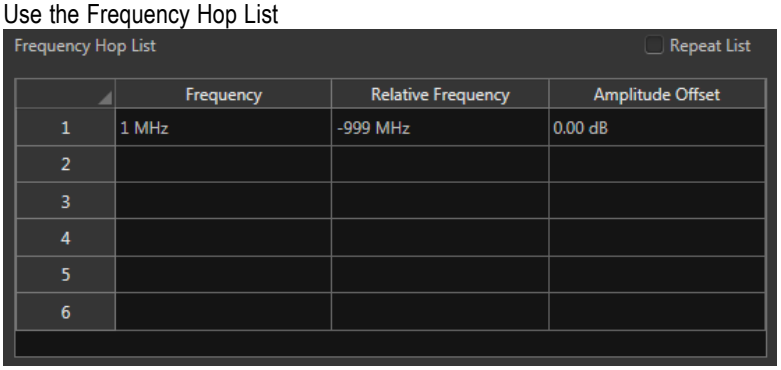
Item	Description
Hopping Pattern	Three hopping patterns are available. Custom: Hops are based on the Frequency Hop List. Pseudo Random List: Hops are chosen randomly (based on PRBS selection) from the Frequency Hop List. Pseudo Random Range: Hops are chosen randomly (based on PRBS selection) from frequencies 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.
	Use the Frequency Hop List



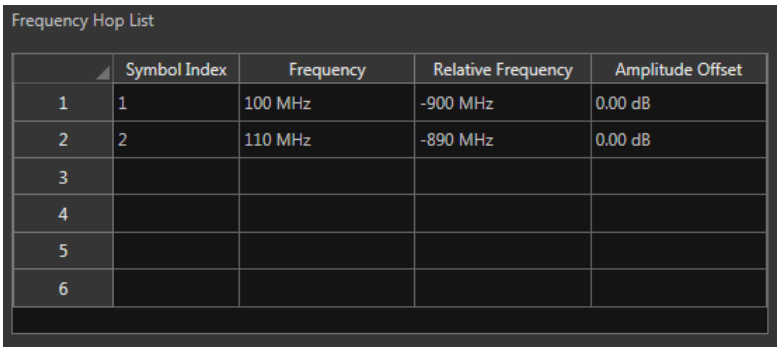
Hops Per Second	Hops Per Second determines how many hops occur for each second. Range: 1 to 1000000000.

Custom Hopping Pattern

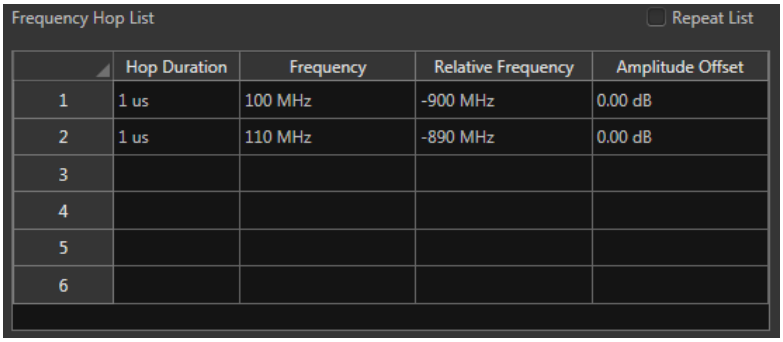
Use the Frequency Hop List



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

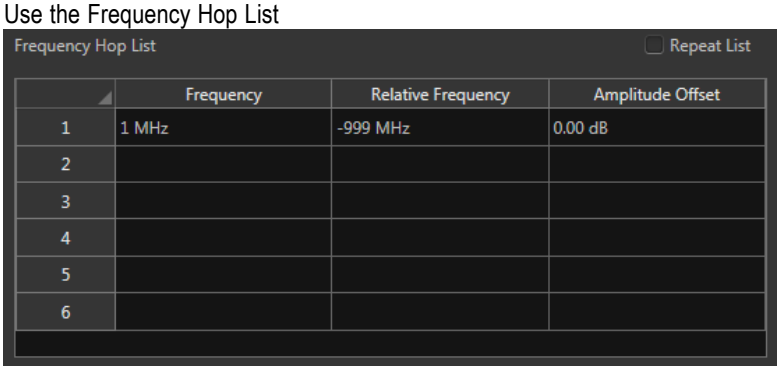
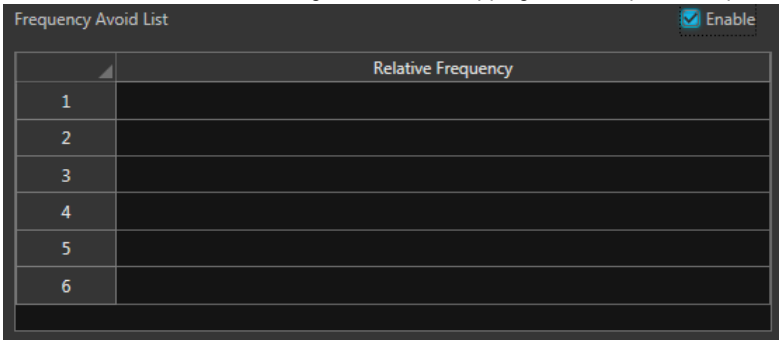


Hop Duration	Defines the amount of hop time the pattern will play each hop. Each hop must have its own duration.



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.

Pseudo Random List Hopping Pattern	
	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.
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. 

Power Ramp tab

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.

Item	Description
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.

Analog Modulation emitter parameters

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.
Phase Offset	Available for Sinusoidal, Triangular, and Square modulation signals. Define the phase offset of the modulating signal from 180° to –180°.
Filename	Available for User Defined modulation signals. 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.

Modulating Signal	
Sampling Rate	Available for User Defined modulation signals. Define the Sampling Rate at which the signal is created.
Interpolation Sinc Nearest Neighbor	Available for User Defined modulation signals. The User defined signals will have to be interpolated to the 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.

DVB-T emitter parameters

Item	Description
Transmission	Set transmission type to Hierarchical or Non-Hierarchical. In hierarchical modulation, two separate data streams are modulated onto a single DVB-T stream. A high-priority stream (HP) is embedded in a low-priority stream (LP). In non-hierarchical modulation, all the programs multiplexed onto the transport stream effectively undergo the same channel coding and mapping in the physical layer.
Mode	Set the mode to 2 K or 8 K.
Interleaver	Set the interleaver to Native or In-Depth.
Bandwidth	Set the bandwidth to 5 MHz, 6 MHz, 7 MHz, or 8 MHz.
Modulation	Set the modulation from the following: Hierarchical transmission: 16 QAM or 64 QAM. Non-hierarchical transmission: QPSK, 16 QAM, or 64 QAM.
Alpha	This value is fixed at 1 and is only displayed when the transmission type is set to hierarchical modulation.

GSM emitter parameters

Item	Description
ARFCN	This display-only field shows a value based on what you choose in the Frequency Band field: either 100, 512, or 600. ARFCN specifies a pair of physical ratio carriers and channels used for transmission and reception.
Frequency band	Specifies the cellular frequencies designated by the ITU. Set the frequency band to P-GSM_900, DCS_1800, or PCS_1900.
Transmit device	GSM networks consist of a Mobile Station (MS) and a BaseStation Subsystem (BSS). Set the transmit device to Base or Mobile.
Radio format	Set the radio format to GSM, EDGE, EGPRS2A, or EGPRS2B.

Item	Description
Timeslot burst type	The options in this list depend on what you chose for Radio format: GSM: Normal, Frequency correction, Synchronization, Access, Dummy EDGE: Normal, Frequency correction, Synchronization, Access, Dummy EGPRS2A: Normal EGPRS2B: Normal
Modulation	The options in this list depend on what you chose for Radio format: GSM: GMSK EDGE: GMSK EGPRS2A: π/4 16QAM, π/4 32QAM EGPRS2B: π/4 HSR 16QAM, π/4 HSR HSR 32QAM, π/4 HSR QPSK
Timeslot configuration	Specifies the number of timeslots that are occupied. Set the Timeslot timing to All timeslots, 1 timeslots, or 047 timeslots.
Timeslot timing mode	The options in this list depend on what you chose for Radio format. GSM: 157 symbols*2 TS, 156 symbols*6 TS or 156.25 symbols*8 timeslots EDGE: 157 symbols*2 TS, 156 symbols*6 TS or 156.25 symbols*8 timeslots EGPRS2A: 157 symbols*2 TS, 156 symbols*6 TS or 156.25 symbols*8 TS EGPRS2B:188.4 symbols*2 TS, 187.2 symbols*6 TS or 187.5 symbols*8 TS

LTE emitter parameters

Item	Description
Bandwidth	Set the carrier bandwidth value to 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, or 20 MHz.
Duplexing Type	Set the Duplexing Type to TDD (time-division-duplexing) or FDD (frequency division duplexing).
Configuration	Configuration is available when the Duplexing Type is set to TDD. Choose a Configuration type from 0 to 6. See the following chart for specifics about the various types.
Transmission	Transmission is available when the Duplexing Type is set to FDD. Set the Transmission to UpLink or DownLink.
Carrier Aggregation	
Additional Carriers	Set the number of addition carriers to 1, 2 or 3.

Configuration Type	Down Link	Up Link	Special Sub frames
0	0,5	2,3,4,7,8,9	1,6
1	0,4,5,9	2,3,7,8	1,6
2	0,3,4,5,8,9	2,7	1,6
3	0,5,6,7,8,9	2,3,4	1
4	0,4,5,6,7,8,9	2,3	1
5	0,3,4,5,6,7,8,9	2	1
6	0,5,9	2,3,4,7,8	1,6

Item	Description
Carrier BandWidth	Set a Carrier BandWidth for each addition carrier. Set the Carrier BandWidth to 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, or 20 MHz.
Carrier Offset	Set a Carrier Offset for each addition carrier. The carrier offset frequency range is determined by the selected Bandwidth.

Noise emitter parameters

Item	Description
Noise	
White	Adds white noise.
Band Limited	Adds Band Limited noise. If you select this option, the Bandwidth field becomes active.
Bandwidth	Available only if you choose Band Limited as the Noise type. Enter a value to specify the bandwidth of the noise signal.
Duration	
Full Scenario Duration	Choose this option to match the noise signal duration to the final waveform duration.
User Defined Duration	If you select this option, the Duration field becomes active. Enter a value to specify the duration, in seconds, of the noise signal.

OFDM emitter parameters

The OFDM emitter advanced parameters are divided into six tabs:

Frame Settings tab (see page 33)

Preamble tab (see page 34)

Header tab (see page 35)

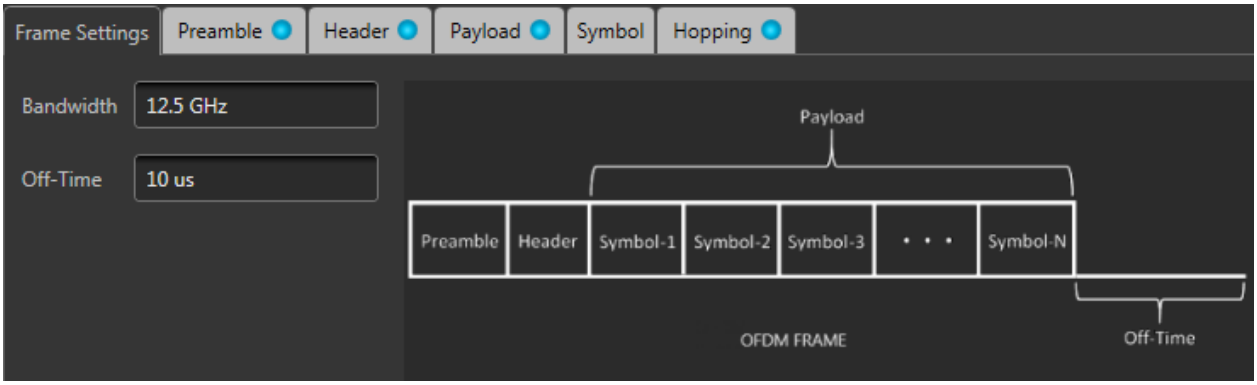
Payload tab (see page 35)

Symbol tab (see page 36)

Hopping tab (see page 42)

Frame Settings tab

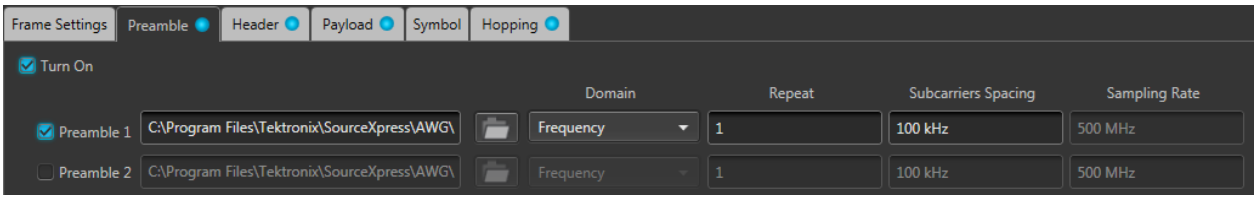
The Frames tab sets the bandwidth and off-time of the OFDM frame.



Item	Description
Bandwidth	Enter the bandwidth of the carrier in Hz. The bandwidth is dependent on the instrument type.
Off-Time	Enter the amount of off-time to add to the end of the OFDM frame.

Preamble tab

Click Turn On to enable the frame preamble.



Enable one (or both) of the Preamble selections to define the path to a saved preamble file. You can enter the path directly or use the folder icon to navigate to your saved file.

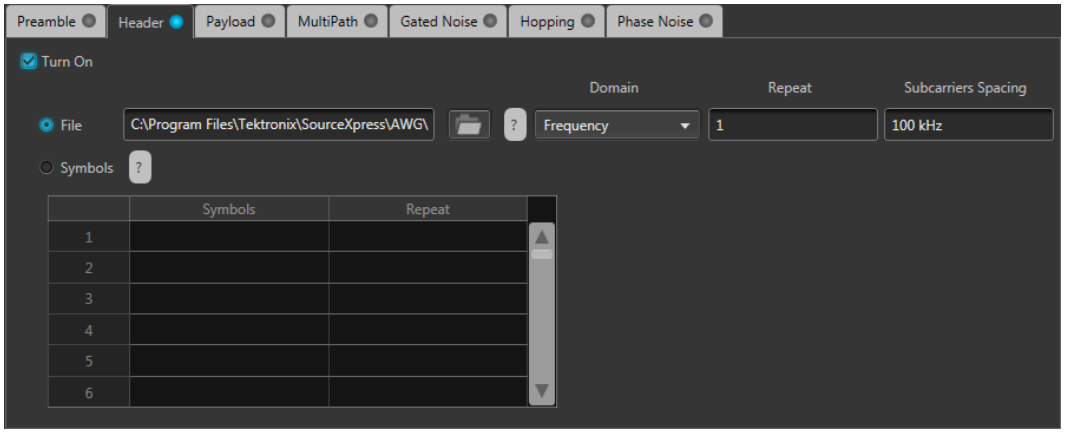
For each frame, you can use either or both preamble files. Based on the different standard needs, there can be multiple preamble requirements. Two preambles are supported.

Item	Description
Domain	Specify data in Frequency domain or Time domain.
Frequency	Preamble data can be specified in the Frequency domain.
Time	Preamble data can be specified in the Time domain.
Repeat	Specify the repeat value, which defines the number of times Preamble is repeated.

Item	Description
Subcarriers Spacing	Subcarrier spacing defines the separation of each carrier in the frequency domain description of the Preamble data.
Sampling Rate	Specify the sampling rate for the data in the Preamble file.

Header tab

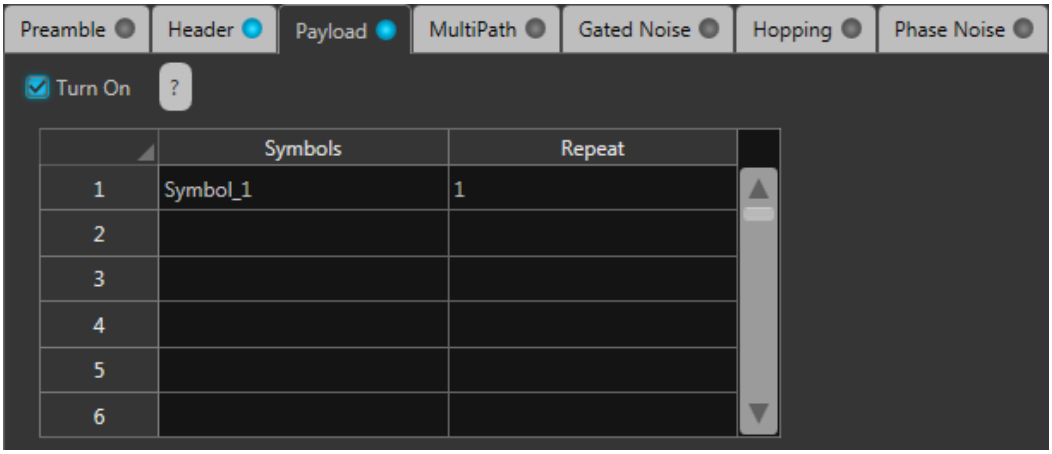
Click Turn On to enable the header.



Item	Description
File	Select file to use a predefined header file.
Domain	Chose how the header file is structured in the Frequency domain or Time domain. Two-sided spectrum is assumed for Frequency domain.
Repeat	Specify the repeat value, which defines the number of times Header is repeated.
Subcarriers Spacing	Subcarrier spacing defines the separation of each carrier in the frequency domain description of the Header data.
Sampling Rate	Specify the sampling rate for the data in the Header file.
Symbols	Select Symbols to insert defined symbols into the table.
Symbols	Select a row to insert a user defined symbol. A dialog box is presented to allow you the select the symbol to insert. The symbols must first be defined in the Symbol tab (see page 36).
Repeat	Specify the repeat value, which defines the number of times the symbol is repeated.

Payload tab

Click Turn On to enable the payload.



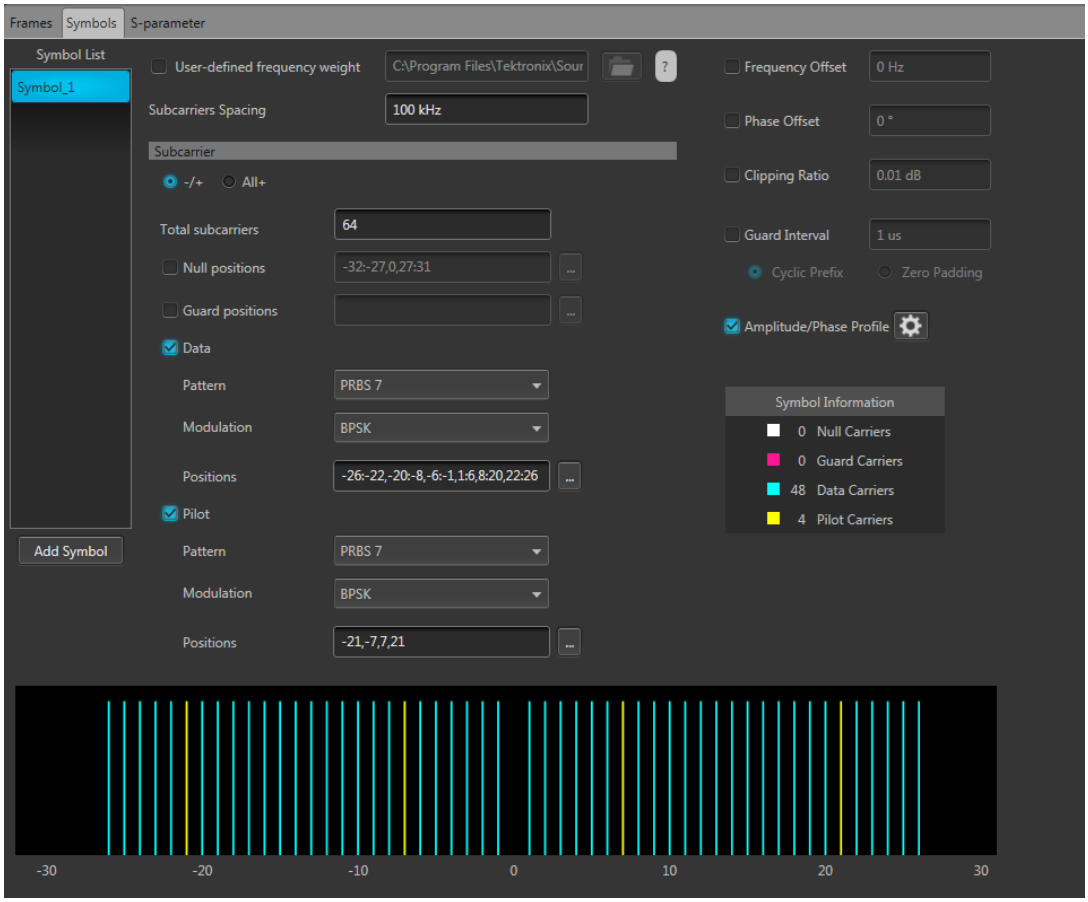
Item	Description
Symbols	Select a row to insert a user defined symbol. A dialog box is presented to allow you the select the symbol to insert. The symbols must first be defined in the Symbol tab (see page 36).
Repeat	Specify the repeat value, which defines the number of times the symbol is repeated.

Symbol tab

Use the Symbol tab to create and define symbols. Each symbol is unique with different settings.

At least one symbol is present in the symbol tab. Click Add to add a symbol to the table. To rename a symbol, select the symbol, double-click it and type a name.

The symbols defined here are then available for selection in the Frames Payload tab (see page 35).

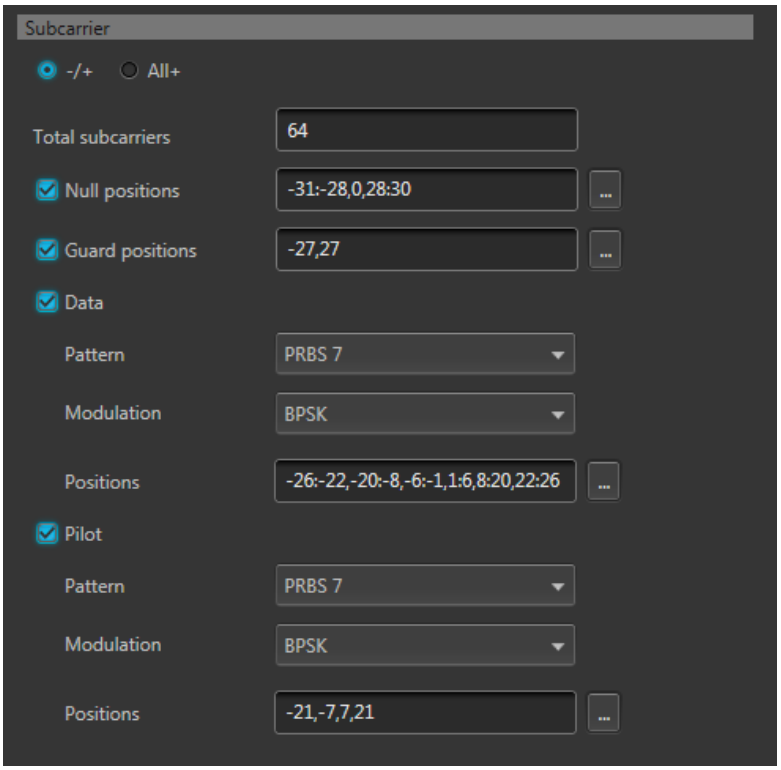


Item	Description
User-defined frequency weight	Specify the file from which to load symbol data. You still have to specify the Subcarrier spacing. Additionally, you can add Frequency Offset, Phase Offset, Clipping Ratio, Guard Interval, and an Amplitude/Phase Profile to the symbol. The Subcarrier parameter selections are disabled when using a user defined file. A two-sided spectrum is assumed for a frequency domain symbol description.
Subcarriers Spacing	Enter the frequency interval between carriers. The maximum value is dependent on carrier bandwidth (BW). Range is from 1 Hz to carrier bandwidth. Min: 1 Hz Max: Carrier BW value
Frequency Offset	If enabled, then specify the frequency offset value for the selected symbol.
Phase Offset	If enabled, then specify the phase offset value for the selected symbol.
Clipping Ratio	If enabled, then specify the Clipping Ratio value for the selected symbol. Clipping Ratio is the Clip power level divided by Average Power.

Item	Description
Guard Interval	This is used to reduce inter-symbol interference and reducing fading due to the frequency selective nature of the channels. Cyclic Prefix Zero Padding
Amplitude Phase Profile	Select to turn on the profile. Use the settings icon to display the profile configuration display. See the topic Amplitude Phase Profile (see page 41).
Subcarrier	The subcarrier section is not available when using a user-defined frequency weight. See the Subcarriers (see page 38) for an explanation of the settings.

Subcarriers for symbols

The subcarrier section is not available when using a user-defined frequency weight.



Item	Description
–/+	Select –/+ to show both the negative and positive subcarriers in the display graph.
All+	Select All+ to only show the positive subcarriers in the display graph.
Total subcarriers	Enter the number of carriers for each symbol. A minimum of two carriers is required. A maximum of 4096 carries is allowed but the number must be a multiple of two.
Null positions	Enable the Null positions if you want to specify certain subcarriers as null carriers, then specify the positions. Double click inside the positions box to enter values directly. Click the  icon to display a text entry screen for easier entry. Null carriers are colored white in the display graph. See Defining subcarrier positions (see page 41) for information on how to properly format the positions.
Guard positions	Enable Guard positions if you want to specify certain subcarriers as guard carriers, then specify the positions. Double click inside the positions box to enter values directly. Click the  icon to display a text entry screen for easier entry. Guard carriers are colored fuchsia in the display graph. See Defining subcarrier positions (see page 41) for information on how to properly format the positions.
Data and Pilot subcarriers	Enable Data and Pilot subcarriers to specify these subcarriers. Data carriers are colored blue in the display graph. Pilot carriers are colored yellow in the display graph. Once enabled, you can specify the Pattern, Modulation, and Positions.
Pattern	Data and Pilot subcarriers require a pattern selection. See Defining the Pattern (see page 39).
Modulation	Data and Pilot subcarriers require a modulation selection. See Modulation types (see page 40).
Positions	Data and Pilot subcarriers require that you specify the positions of these carriers. See Defining subcarrier positions (see page 41) for information on how to properly format the positions.

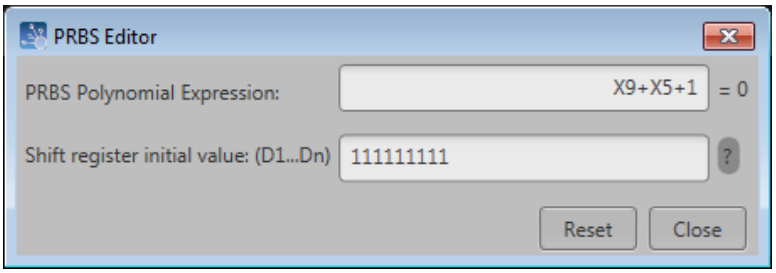
Defining the Pattern

Item	Description
All One	Sends a sequence of binary 1 symbols.
All Zero	Sends a sequence of binary 0 symbols.
File	Select the base data file to be used by entering the path or browsing to the file. The supported format is .txt.

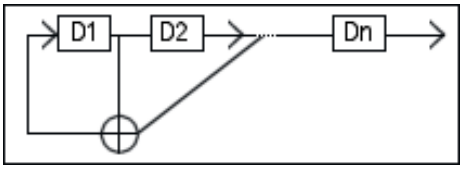
Item	Description
PRBS	Select the PRBS type from the following: 7, 9, 15, 16, 20, 21, 23, 29, 31, and User Defined. To edit the bit sequence, select User Defined. This displays the PRBS Editor icon  . Select to display the PRBS Editor (see page 40) dialog screen.
Pattern	Enter a pattern of 0s and 1s up to a maximum of 256 digits in the text field that appears.

PRBS Editor

This dialog box is displayed when clicking PRBS Editor icon when PRBS is set to User Defined for the Data and Pilot pattern type. (Symbols 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 available

Item	Description
PSK	BPSK, QPSK, 8PSK
QAM	8 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM, 512 QAM, 1024 QAM

Defining subcarrier positions

Null, Guard, Data, and Pilot positions all need to be specified when enabled.

Proper format of the positions must be followed to avoid errors.

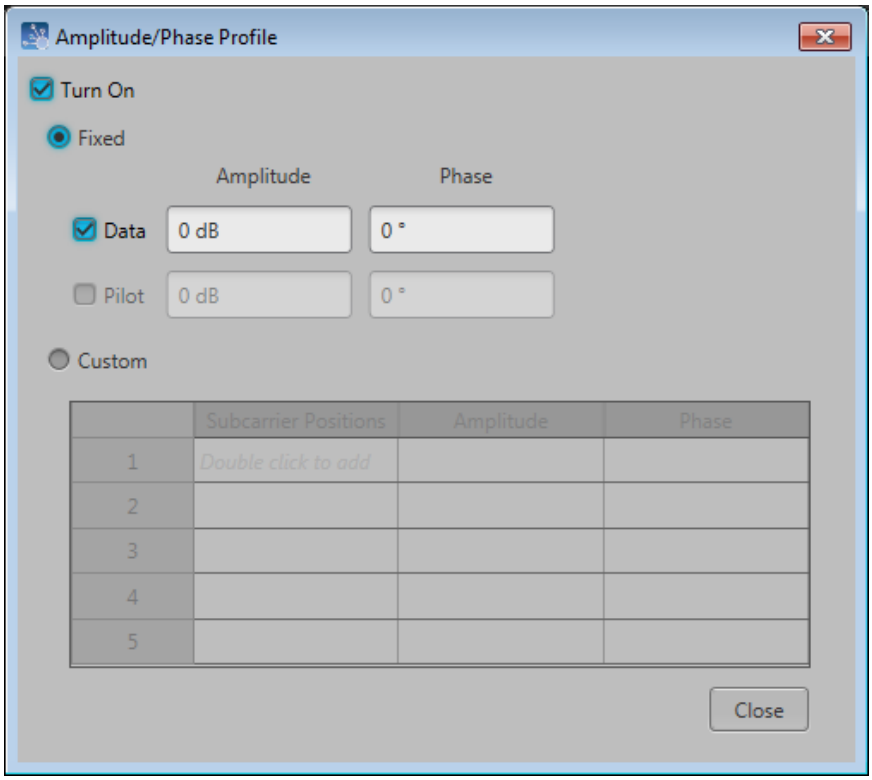
- Double click inside a positions box to enter values directly. Or, click the  icon to display a text entry screen for easier entry.
- Separate all positions (or ranges) with a single comma.
- Define a range of positions with the use of colon.

Example:

–22:–19,12,20 selects the four positions from –22 through –19, then positions 12 and 20.

Amplitude Phase Profile

This feature enables the you to selectively apply attenuation and phase rotation on each subcarrier or each type of subcarrier, such as pilot and data subcarriers.



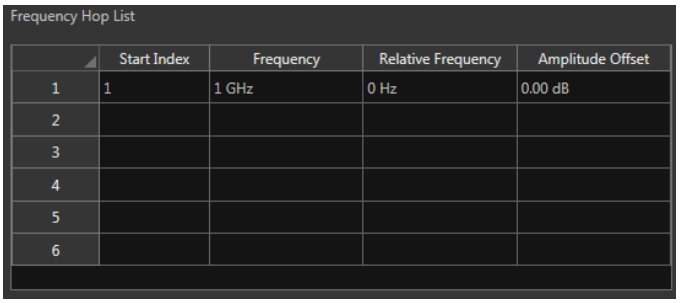
Item	Description
Fixed	Selecting Fixed allows you to enter the amplitude and phase for all data and pilot positions.
Data	The data subcarrier (in the Symbols tab) must be enabled before you can choose to set the data phase profile.
Pilot	The pilot subcarrier (in the Symbols tab) must be enabled before you can choose to set the Pilot phase profile.
Custom	Selecting Custom enables the table editor. With the custom table editor, you can specify the amplitude and phase for any carrier position. See Defining subcarrier positions (see page 41) for information on how to properly format the positions.

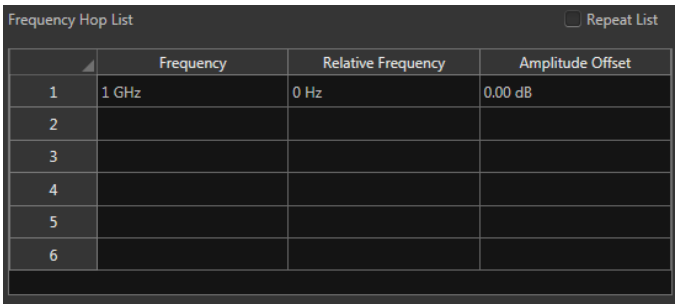
Hopping tab

Click Turn On to enable hopping.

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

Frequency hopping can be 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
Hop Time	Hopping times are based on the Frequency Hop List. Select the method to define the Hop Time: Symbol Start Index Symbols Per Hop
Symbol Start Index	Defines the index the specific hop starts. Each hop must contain a unique start index.
	

Symbols Per Hop	
Symbols per Hop field	Symbols per Hop determines how many Symbols occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.
	 Frequency (not available for IQ signal format) Relative Frequency Amplitude
Repeat List	When the Repeat List is enabled, the relative frequency and amplitude offset values are repeated.

P25 emitter parameters

Item	Description
Standard	Choose the P25 standard to create. Phase 1 or Phase 2.
Modulation	For Phase 1, Modulation is fixed to C4FM. For Phase 2, Modulation can be set to either HCPM or HDQPSK.

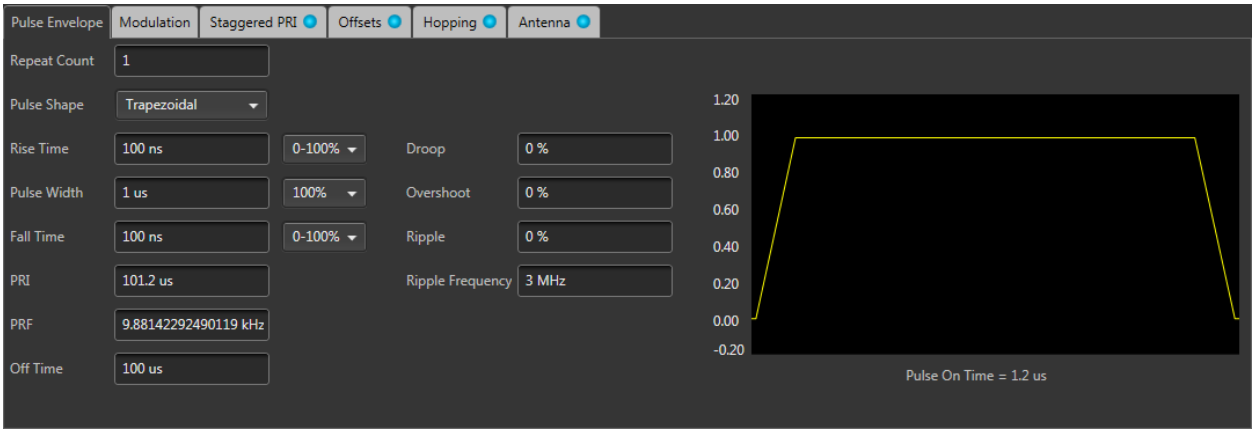
Radar emitter parameters

Radar emitter advanced parameters are divided into six tabs:

- Pulse Envelope (see page 43)
- Modulation (see page 45)
- Staggered PRI (see page 55)
- Offsets (see page 59)
- Hopping (see page 60)
- Antenna (see page 63)

Pulse Envelope tab

Pulse Envelope parameters define the Pulse Shape, Rise Time, Pulse Width, Fall Time, and Off Time.



NOTE. *The available Pulse Envelope parameters depend on the selected pulse shape. Not all parameters are available for all pulse shapes.*

Item	Description	Range, Default value
Repeat Count	Enter the number of times to repeat the pulse. The PRI of the pulse does not increase, but the Configured Duration for the radar emitter increases to match the PRI × Repeat Count.	
Pulse Shape	Select the pulse shape from the following: Rectangular, Trapezoidal, Raised Cosine, Exponential, Saw tooth, Gaussian, and Custom.	Trapezoidal
Rise Time	Enter the rise time for the pulse. Define the rise time between 0–100%, 10–90% or 20–80% of the voltage level. Available only for Trapezoidal, Raised Cosine, Exponential, and Saw Tooth pulse shapes.	The range depends on the instrument and options installed. The default values change based on the pulse shape.
Fall Time	Enter the fall time for the pulse. Define the fall time between 0–100%, 10–90% or 20–80% of the voltage level. Available for all pulse shapes except Saw Tooth, Gaussian, and Custom.	
Pulse Width	Enter the pulse width. Define the width at 50% or 100% voltage. Available for all pulse shapes except Saw Tooth and Custom.	
Off Time (dead time)	Enter the off time after the fall time.	
Sampling Rate	Available only when the pulse shape is Custom. Enter the sampling rate at which the custom pulse has been generated in kHz, MHz, GHz, or Hz.	
PRI	The Pulse Repetition Interval (PRI) value is automatically generated based on the pulse envelope parameters and is displayed as seconds. The PRI value is updated whenever the values of any of the pulse envelope parameters are changed. Changing the PRI updates the off time without changing the other parameters of the pulse.	

Item	Description	Range, Default value
PRF	The Pulse Repetition Frequency (PRF) is 1/PRI and the value is automatically generated based on the pulse envelope parameters. The PRF value is updated whenever the values of any of the pulse envelope parameters are changed.	NA
Droop	Enter the droop in percentage of voltage. Available for all pulse shapes except Saw Tooth, Gaussian, and Custom.	0 to 50%, 0
Overshoot	Enter the overshoot in percentage of voltage. Available for all pulse shapes except Saw Tooth, Gaussian, and Custom.	0 to 50%, 0
Ripple	Enter the ripple in percentage of voltage. Available for all pulse shapes except Saw Tooth, Gaussian, and Custom.	0 to 50%, 0
Ripple Frequency	Enter the ripple frequency in Hz, kHz, MHz, or GHz. Available for all pulse shapes except Saw Tooth, Gaussian, and Custom.	Based on the instrument and the options installed, 3 MHz

Create a custom pulse

Selecting Custom from the pulse Shape menu allows you to define a custom pulse shape. The custom file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB files (.mat).
- Only positive numbers are allowed. All other characters are invalid (including tab and space). The application stops reading data when it encounters invalid data.
- The maximum length of the file is 1M samples.
- In case of an ASCII file, the data should be in floating point and the values should be arranged in a single column and several rows with one value in each row.
- The variable name in the .mat file should be "SamplePoints". The .mat file should be saved with the v7.3 option.
- Here is an example of MATLAB command for saving a file: save('SamplePulseEnvelope.mat','SamplePoints', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ sample points or values of the format 1 x n or n x 1. For example,

  SamplePoints = [0.5 0.3 0.2 0.7 ….]

Modulation tab

The Modulation tab allows you to provide different modulation schemes that can be applied to the pulse width for a selected pulse.

The available modulation schemes are shown in the following table. See the links in the following table to view detailed information about these modulation types. You can also view the Modulation Settings (see page 46) topic.

NOTE. *The No Modulation setting is the same as continuous modulation. No Modulation is the default setting.*

Modulation category	Modulation type
No modulation	
Frequency	Linear frequency modulation (LFM)
	Chirp Sequence
	Up-Down Chirp
	Piece-wise LFM
	Step Frequency
	User Defined Step FM AM
	Non Linear FM
Phase	Barker Code
	Frank Code
	Polyphase Codes
	P1 Polyphase Codes
	P2 Polyphase Codes
	P3 Polyphase Codes
	P4 Polyphase Codes
	User Defined Step PM AM
Digital Modulation	BPSK
	QPSK
Custom Modulation	You can select a custom pulse shape file from a directory.

Modulation settings

Linear Frequency Modulation (LFM)

In LFM or Chirp Modulation, the frequency is swept linearly across the pulse width. The sweep can be Low to High (upward) or High to Low (downward). LFM is used to achieve higher bandwidths in pulse compression RADARS.

Table 1: Linear frequency modulation parameters

Selection	Description	Range, default value
Sweep Range	Enter the sweep range in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Frequency Sweep	Enter the frequency sweep: High to Low, or Low to High.	Low to High

Chirp Sequence Modulation

Chirp Sequence modulation allows you to define multiple LFMs. This modulation is mainly used in automobile RADAR.

Table 2: Chirp Sequence parameters

Selection	Description	Range, default value
Sweep Range	Enter the sweep range in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Frequency Sweep	Enter the frequency sweep: High to Low, or Low to High.	Low to High
Number of chirps	Enter the number of chirps in the modulation.	1 to 100, 4

Up-Down Chirp Modulation

Up-Down Chirp modulation varies the frequency of the carrier from –Sweep Range/2 to +SweepRange/2 and then again from +Sweep Range/2 to –Sweep Range/2.

Table 3: Up-down chirp modulation parameters

Selection	Description	Range, default value
Sweep Range	Enter the sweep range in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Number of Up-Downs	Enter the number of peaks (ups) and troughs (downs) in the modulation. If the number of Up-downs = 1, then the pulse width is divided into two. The first half of the pulse will have linear chirp from –Sweep/2 to +Sweep/2 and the second half of the pulse will have linear chirp from +Sweep/2 to –Sweep/2. If the number of Up-downs is greater than 1 (n>1), then the modulation shall create multiple (n) number of 'V's or Inverted 'V's. The subpulse width of each V is equal to PulseWidth/n.	1 to 12, 1
Invert	Check the box to create Down-Up chirp, which creates a 'V' shaped frequency profile. When unchecked, an inverted 'V' shaped frequency profile is created.	Unchecked

Piecewise LFM Modulation

Piecewise LFM modulation allows you to define LFM for each subpulse.

Table 4: Piecewise LFM parameters

Selection	Description	Range, default value
Initial Offset	Enter the initial offset in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Add steps button	Enter the number of steps to add and then click the Add button. The added step(s) will appear in the table. If there are no entries in the table and the Add button is clicked, then the duration of each sub pulse = pulse width / number of steps.	1 to 10, 1
Table settings:		
Duration (s)	Enter the duration of the subpulse width in s.	Cannot be greater than the pulse On Time
Duration (%)	Automatically calculated based on the pulse width and the duration of the subpulse.	N/A
Sweep Range	Enter the sweep range in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Frequency Sweep	Enter the frequency sweep: High to Low, or Low to High.	Low to High

Step Frequency Modulation

Step Frequency modulation allows you to divide the pulse width to equal subpulses and to assign different frequencies to each subpulse.

Table 5: Step Frequency parameters

Selection	Description	Range, default value
Step Count	Enter the number of steps.	1 to 200, 4
Initial Offset	Enter the initial offset in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Frequency Offset	Enter the frequency offset in Hz, kHz, MHz, or GHz.	Range is dependent on the instrument, 10 MHz
Ramp Function	Select Linear or Cosine to set how the transition from one subpulse to another occurs.	Linear
Ramp Duration (%)	Enter the desired ramp duration.	Up to 100%, 0%

User-defined Step FM AM Modulation

User Defined Step FM AM modulation allows you to define the number of subpulses and to set frequency offset and amplitude values for each subpulse.

Table 6: User-defined Step FM AM parameters

Selection	Description	Range, default value
Ramp Function	Select Linear or Cosine to set how the transition from one subpulse to another occurs.	Linear
Ramp Duration	Enter the desired ramp duration (%).	Up to 100%, 0%

Selection	Description	Range, default value
Add steps button	Enter the number of steps to add and then click the Add button. The added step(s) will appear in the table. If there are no entries in the table and the Add button is clicked, then the duration of each sub pulse = pulse width / number of steps.	1 to 10, 1
Table settings:		
Duration (s)	Enter the duration of the subpulse width in s.	Cannot be greater than the pulse On Time
Duration (%)	Automatically calculated based on the pulse On Time and the duration of the subpulse.	N/A
Frequency Offset	Enter the frequency offset in Hz for the subpulse.	Range is dependent on the instrument, 10 MHz
Amplitude (dB)	Enter the amplitude in dB for the subpulse.	-100 dB to 0 dB, 0 dB

NOTE. *Duration in percentage is calculated automatically up to three decimal places. This can cause rounding of the actual duration entered.*

Nonlinear Frequency Modulation

Nonlinear FM can be used to define a frequency modulation that can have a nonlinear profile, unlike with Linear FM.

Nonlinear FM uses the coefficients to create the instantaneous frequencies for modulation. F(t) = 2*pi*C(t)*t, where C(t) is the instantaneous frequency

Instantaneous frequency C(t) can be defined by the following polynomial:

C(t) = c0+c1*t+c2*t*t +c3*t*t*t..., where c0, c1, and c2 and others are the coefficients with order 0, 1, 2, and others.

Curves can be defined/drawn (curve fitting) with polynomials. In the following, a_n and a_0 are the coefficients.

$$Y(t) = a_n * x^n + a_{n-1} * x^{n-1} + a_{n-2} * x^{n-2} + ...+ a_0$$

The equation is based on what the you want to fit. Examples are available in Radar books for different types of nonlinear profiles.

Nonlinear FM profiles. When Nonlinear FM is the chosen Modulation, you can select from the following three profiles. When one of the Taylor Weighted profiles is selected, a control for Bandwidth is also available. When User Defined Coefficients is selected, click on the folder icon that appears to provide a file path.

- Taylor Weighted Non symmetrical (default)
- Taylor Weighted Symmetrical
- User Defined Coefficients

Taylor Weighted Nonlinear FM signals are created using the following equation:

$$f(t) = BW\left(\frac{t}{PW} + \sum_{n=1}^{7} K_n \sin\frac{2\pi nt}{PW}\right)$$

Where

BW = bandwidth

PW = pulse on time

K_1 = –0.1145

K_2 = 0.0396

K_3 = –0.0202

K_4 = 0.0118

K_5 = 0.0082

K_6 = 0.0055

K_7 = –0.0040

User defined coefficients file requirements. A User defined coefficients file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB (.mat).
- The maximum length of the file is 100 coefficients.
- When ASCII file is chosen, the data should be in floating point format and the values should be arranged in a single column and several rows with one value in each row.
- The variable name in the .mat file should be "NLFMCoefficients". The .mat file should be saved with the v7.3 option.
- Here is an example of MATLAB command for saving a file: save('Coefficients.mat','NLFMCoefficients', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ coefficients or values of the format 1 x n or n x 1. For example,

  NLFMCoefficients = [0.5 0.3 0.2 0.7 ….]

Barker Code

With the Barker Code (a bi-phase coded pulse), the phase is switched between 0 and 180 degrees. The number of subpulses is defined by the Barker Code number. For example, Barker 11 has eleven subpulses. The Barker codes are predefined.

Table 7: Barker code parameters

Selection	Description	Range, default value
Code Length	Enter the length of the Barker code. The options are: 2, 3, 4, 5, 7, 11, and 13.	2

Frank Code

Frank Code is a type of Polyphase code where the pulse width is divided into subpulses and the phase of the subpulse is changed.

The phase value for each subpulse changes based on the following formula, where subpulse = Code Length * Code Length and p=0, 1, 2,…..code length–1 and q=0, 1, 2…code length–1.

Phase(p,q) = 2*pi*p*q/Code length

Table 8: Frank code parameter

Selection	Description	Range, default value
Code Length	Enter the length of the code.	1 to 10, 1

Polyphase Codes

Polyphase codes are a type of phase-coded pulse waveform.

Table 9: Polyphase codes parameters

Selection	Description	Range, default value
Number of Steps	Enter the number of phase entries.	1 to 200, 4
Initial Offset	Enter the initial offset in degrees.	–180° to +180°, 45°
Phase Offset	Enter the phase offset in degrees.	–180° to +180°, 90°
Ramp Function	Select Linear or Cosine to set how the transition from one subpulse to another occurs.	Linear
Ramp Duration	Enter the desired ramp duration (%).	Up to 100%, 0%

P1 Polyphase Code

P1 Polyphase code is a type of Polyphase code.

Table 10: P1 polyphase code parameter

Selection	Description	Range, default value
Code Length	Enter the length of the code.	1 to 10, 1

The phase for each of the subpulses is derived as follows:

Phase(p,q) = –180/Codelength*(Codelength–(2*p–1))*[(p–1)*Codelength)+(q–1))]; where p=1, 2…code length and q=1, 2, …code length

Where:

Number of subpulses = Codelength * Codelength

P2 Polyphase Code

P2 Polyphase code is a type of Polyphase code.

Table 11: P2 polyphase code parameter

Selection	Description	Range, default value
Code Length	Enter the length of the code.	1 to 10, 1

The phase for each of the subpulses is derived as follows:

Phase(p,q)=[((90/Codelength)*((Codelength –1)/ Codelength))–((180/ Codelength)*(p–1))]*[Codelength+1–(2*q)] ; where p=1, 2, … code length and q=1, 2, .. code length

Where:

Number of subpulses = Codelength * Codelength

P3 Polyphase Code

P3 Polyphase code is a type of Polyphase code.

Table 12: P3 polyphase code parameter

Selection	Description	Range, default value
Code Length	Enter the length of the code.	1 to 100, 1

The phase for each of the subpulses is derived as follows:

Phase(p)=(180*(p–1)*(p-1))/ code length; where p=1, 2, …..Codelength

Where:

Number of subpulses = Codelength

P4 Polyphase Code

P4 Polyphase code is a type of Polyphase code.

Table 13: P4 polyphase code parameter

Selection	Description	Range, default value
Code Length	Enter the length of the code.	1 to 100, 1

The phase for each of the subpulses is derived as follows:

Phase(p)=[180*(p–1)2/ code length]–[180*(p–1)]

Where:

Number of subpulses = Codelength

User Defined Step PM AM

User Defined Step PM AM allows you to define the number of subpulses and phase and amplitude values for each subpulse.

Table 14: User-defined step PM AM parameters

Selection	Description	Range, default value
Ramp Function	Select Linear or Cosine to set how the transition from one subpulse to another occurs.	Linear
Ramp Duration	Enter the desired ramp duration (%).	Up to 100%, 0%
Add step button	Enter the number of steps to add and then click the Add button. The added step(s) will appear in the table. If there are no entries in the table and the Add button is clicked, then the duration of each sub pulse = pulse width / number of steps.	1 to 10, 1
Duration (s)	Enter the duration of the subpulse width.	Cannot be greater than the pulse On Time
Duration (%)	Automatically calculated based on the pulse On Time and the duration of the subpulse.	N/A
Phase Offset (deg)	Enter the phase offset in degrees for the subpulse.	–180° to +180°, 90°
Amplitude (dB)	Enter the amplitude in dB for the subpulse.	-60 dB to 0 dB, 0 dB

NOTE. *Duration in percentage is calculated automatically up to three decimal places. This can cause rounding of the actual duration entered.*

BPSK and QPSK Modulation

Enter the number of symbols for the pulse. Check the option “Use same symbols for all pulses” to have the same number of symbols for all the pulses in the pulse group.

Item	Description
Modulation	Select BPSK or QPSK.
Number of Symbols	Enter the number of symbols in the pulse. Range: 1 to 200 Default: 4
Use same symbols for all pulses	Check (enable) to use the same number of symbols for all the pulses in the modulation. This option is available only when the Repeat parameter (in the Pulse Train table for the selected Pulse Group) is greater than 1. Default: Unchecked
Data	
Pattern	Select the data source:
All Zero	Sends a sequence of binary 0 symbols.
All One	Sends a sequence of binary 1 symbols.

Data	
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 55) 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.
Filter	
Filter	Select the filter from the following options: Rectangular, Raised Cosine, and Root Raised Cosine.
Alpha	Specify a value for the alpha factor. Range: 0 to 1 Default: 0.35
Pre/Post Pattern	Set the bit pattern for the initial (pre) and final (post) values of the filter. Select Wrap Around, Zeros, or Pattern.

Custom Modulation

Custom modulation allows you to specify a custom pulse modulation using an external file of the MATLAB format or .txt format. This file should contain Time versus Phase values in the specified format. Phase values should be in degrees.

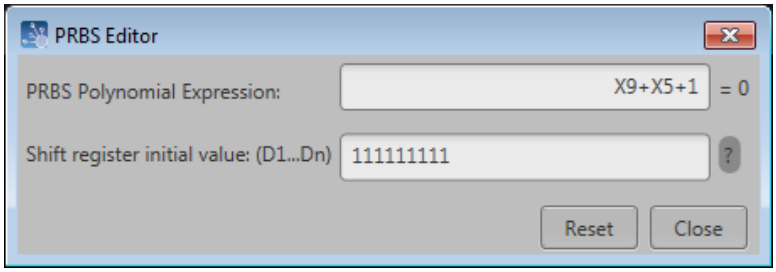
A custom modulation file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB (.mat).
- Both positive and negative numbers are allowed. All other characters are invalid (including tab and space). The application stops reading data when it encounters invalid data.
- The maximum length of the file is 1M samples.
- When ASCII file is chosen, the data should be in floating point format and the values should be arranged in a single column and several rows with one value in each row.
- The variable name in the .mat file should be "CustomPhaseProfile". The .mat file should be saved with the v7.3 option.
- Here is an example of MATLAB command for saving a file: save('SamplePhaseProfile.mat','Custom-PhaseProfile', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ phase points or values of the format 1 x n or n x 1. For example,

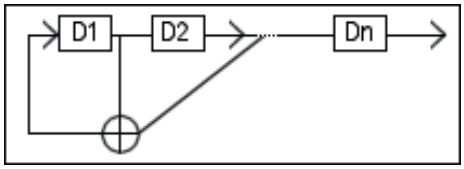
CustomPhaseProfile = [0.5 0.3 0.2 0.7 ….]

PRBS Editor

The Hopping tab and the Modulation tab both provide access to this dialog box when User Defined is selected as the PRBS Pattern. Clicking on the icon that appears next to the PRBS Pattern setting opens this dialog box.

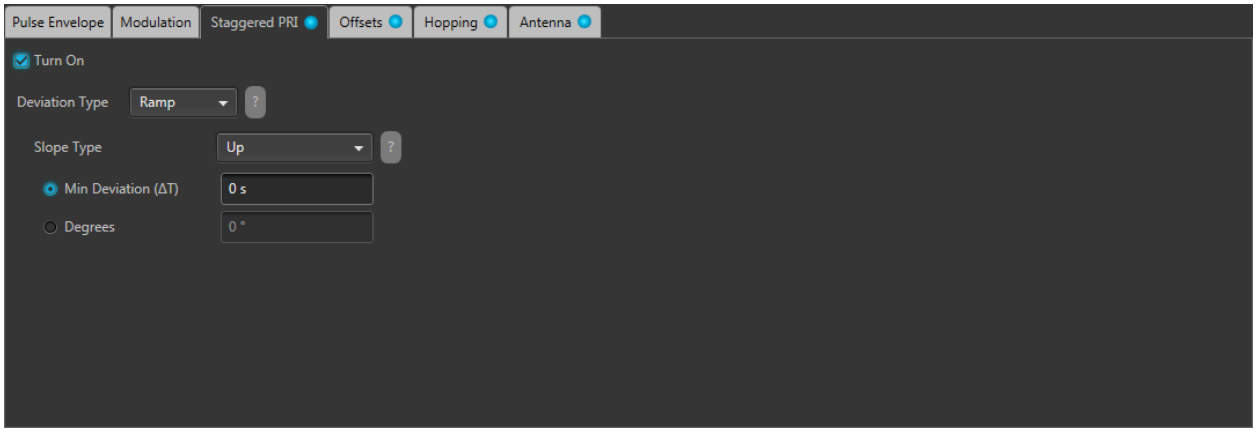


PRBS sequences are generated by a feedback shift register. The number (#) following PRBS indicates the length of the generating shift register. For instance, a shift register with 16 memory cells is required to generate a PRBS 16 sequence. The pseudo-random sequence of a PRBS generator is determined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



Staggered PRI tab

Use the Staggered PRI tab to create multiple pulse repetition intervals and define pulse-to-pulse staggering.



Follow these steps to specify multiple PRIs for a pulse group:

1. Check the Turn On box to enable and access parameter settings. Default setting is off (unchecked).
2. Set the following parameters for the selected pulse.

Table 15: PRI/PRF parameters

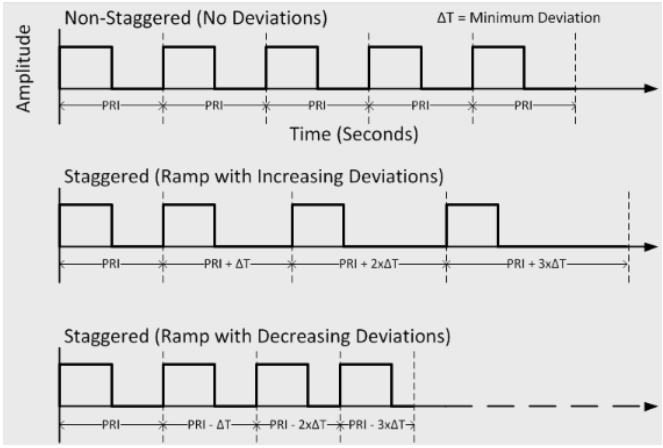
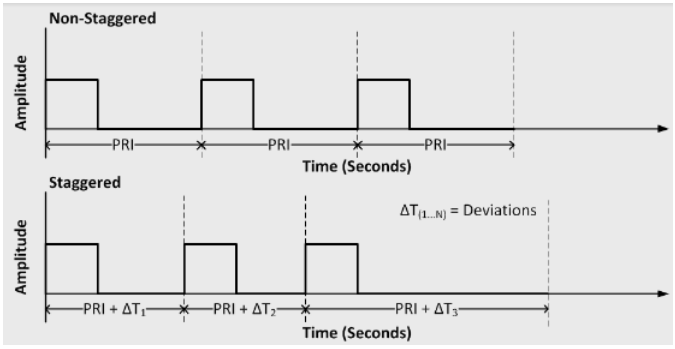
Item	Description	Range, default value
Deviation Type	Select from Ramp, File, and Table.	Ramp
Ramp	Select the Slope type (Up, Down, Up Down, Down Up). Default is Up. The Ramp deviation type is: 	
File	Click the folder icon to select a file path to an ASCII file (.txt) or MATLAB (.mat) file format. Files must meet the conditions described in the File format conditions (see page 58) topic below. The File deviation type is: 	

Table 15: PRI/PRF parameters (cont.)

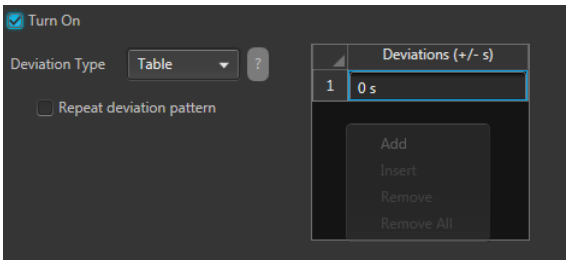
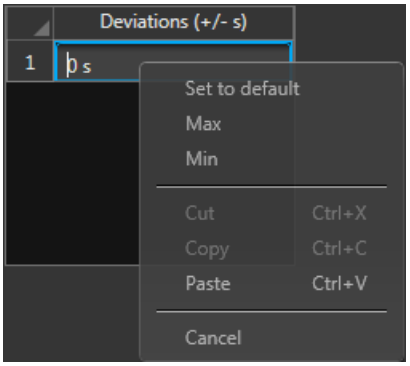
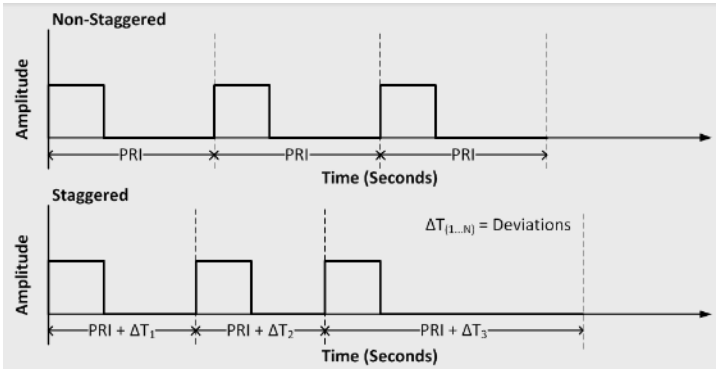
Item	Description	Range, default value
Table	Enter the PRI deviation for each pulse group in the table. Right-click on the blank area in the table to access the menu to add and remove items in the table.  Right-click on the deviation value cell access the menu to set deviation.  The table deviation type is: 	
Slope Type (degrees) (Available only when the Ramp is the selected deviation type.)	Enter the deviation slope in degrees or as the minimum deviation. Slope = ΔT/PRI = tan(angle) = Peak Deviation/ (Repeat*PRI) Peak Deviation = Repeat * ΔT	
Min Deviation (ΔT)	Deviation slope as the minimum deviation.	0 to PRI, 0 s

Table 15: PRI/PRF parameters (cont.)

Item	Description	Range, default value
Degrees	Deviation slope in degrees.	–180° to +180°, 0°
Repeat deviation pattern (Available only when File or Table is the selected deviation type.)	When checked, the application repeats the PRI deviation values for all the pulses. When unchecked, PRI deviation values are used for only those pulses and 0 is used for the number of deviations listed in the file.	Unchecked

NOTE. *If the Deviation Type is Ramp, the deviation ΔT is calculated as follows:*

*ΔT=(y*PRI*(i-1)), where y=tan(slope) in radians and i=1 to Repeat value*

3. If you have selected Table, right-click and select Add to add a row to the table. Edit the deviation values directly in the table. The number of rows in the table is limited to the value in the Repeat pulse envelope parameter

File format conditions

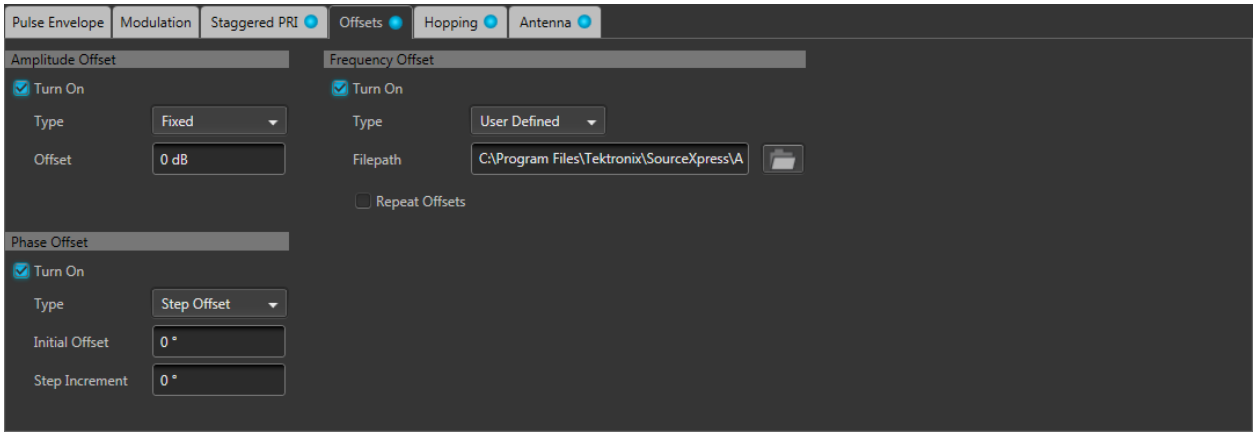
A staggered PRI deviation file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB (.mat).
- Both positive and negative numbers are allowed. All other characters are invalid (including tab and space). The application stops reading data when it encounters invalid data.
- The maximum length of the file is 1M samples.
- When ASCII file is chosen, the data should be in floating point format and the values should be arranged in a single column and several rows with one value in each row.
- The variable name in the .mat file should be "StaggeredPRIDeviations". The .mat file should be saved with the v7.3 option.
- Here is an example of MATLAB command for saving a file: save('SamplePRIDeviations.mat','StaggeredPRIDeviations', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ deviations or values of the format 1 x n or n x 1. For example,

StaggeredPRIDeviations = [0.5 0.3 0.2 0.7 ….]

Offsets tab

This tab allows you to set Amplitude, Frequency, and Phase offset from pulse to pulse. Amplitude hopping can be used to create different swirling models. Frequency and Phase offsets can be used to create Frequency and Phase agile signals used in EW countermeasures.



Item	Description
Turn On	Check a box to activate the associated offset. You can select Amplitude Offset, Phase Offset, and Frequency Offset.
Type	Choose Fixed, Step Offset, or User Defined as the offset type.
Offset	This setting is available when Fixed is the selected offset type. Set the offset in Hz (for Frequency), dB (for Amplitude), or degrees (for Phase). Default setting is 0.
Initial Offset	This setting is available when Step Offset is the selected offset type. Set the initial offset in Hz (for Frequency), dB (for Amplitude), or degrees (for phase). Default setting is 0.
Step Increment	This setting is available when Step Offset is the selected offset type. The step increments sets the offset to the pulses in the pulse group if the repeat is more than 1. Set the step increment in Hz (for Frequency), dB (for Amplitude), or degrees (for phase). Default setting is 0.
File Path	This setting is available when User Defined is the selected offset type. Select a file to apply as frequency, phase, or amplitude offset.
Repeat Offsets	Check the box to repeat offsets. Default setting is unchecked (off). If the Pulse Group has a greater repeat count than the offsets listed in the file, then checking this option repeats the offsets in the file for the rest of the pulses. This selection only applies when User Defined is the selected offset type.

File format conditions

A deviation file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB (.mat).
- Both positive and negative numbers are allowed. All other characters are invalid (including tab and space). The application stops reading data when it encounters invalid data.
- The maximum length of the file is 1M samples.
- When ASCII file is chosen, the data should be in floating point format and the values should be arranged in a single column and several rows with one value in each row. The values are frequency values in Hz for Frequency Offset, in dB for Amplitude Offset, and in degrees for Phase Offset.
- The .mat file should be saved with the v7.3 option. The variable name in the .mat file should be:
  - "AmplitudeOffsets" for Amplitude Offset file.
  - "FrequencyOffsets" for Frequency Offset file.
  - "PhaseOffsets" for Phase Offset file.
- Here is an example of MATLAB command for saving a file: save('SampleOffsets.mat','Amplitude-Offsets', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ sample points or values of the format 1 x n or n x 1. For example,

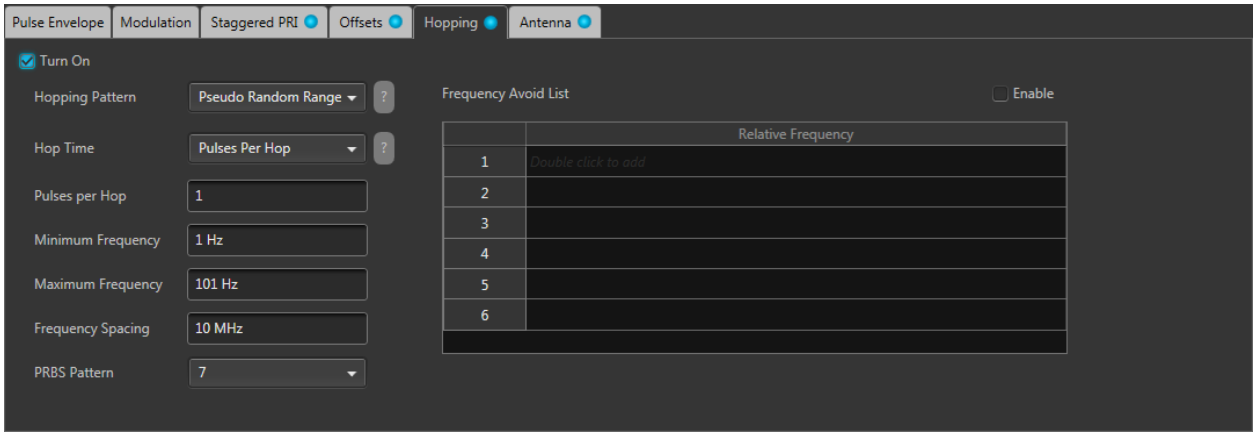
  PhaseOffsets = [0.5 0.3 0.2 0.7 ….]

Hopping tab

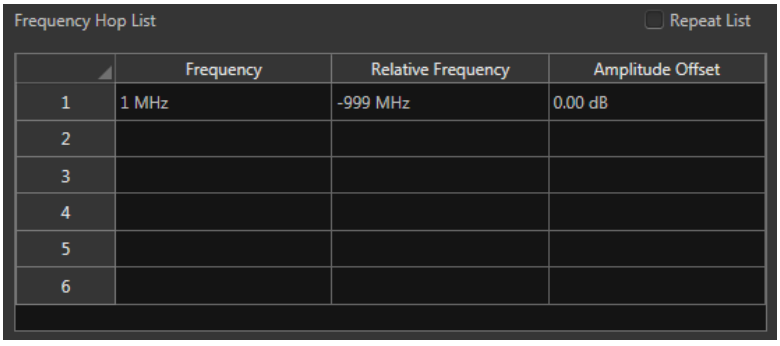
This tab allows you to define the hopping pattern from pulse-to-pulse. You can provide frequency offset and amplitude deviation.

Frequency hopping can used to create frequency agile waveforms. Frequency is changed from one pulse to another pulse. 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.

Amplitude hopping can be used to create different amplitudes from one pulse to another. Amplitude hopping can be used to create different swirling models.

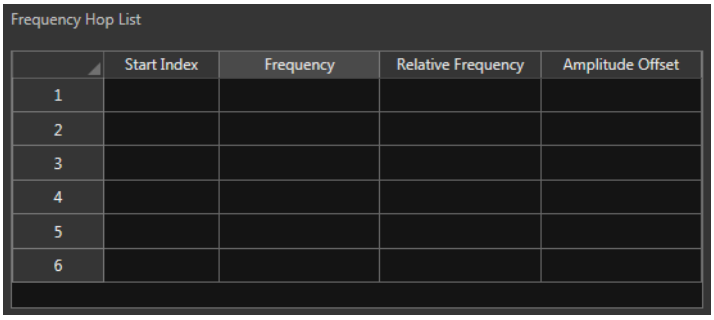


Item	Description
Hopping Pattern	Three hopping patterns are available. Custom: Hops are based on the Frequency Hop List. Pseudo Random List: Hops are chosen randomly (based on PRBS selection) from the Frequency Hop List. Pseudo Random Range: Hops are chosen randomly (based on PRBS selection) from frequencies 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 Pulses Per Hop Pulse Start Index
Pulses Per Hop	Pulses per Hop determines how many Pulses occur between each Hop. The value applies to the entire hop list. Range: 1 to 5000000.
	Use the Frequency Hop List.



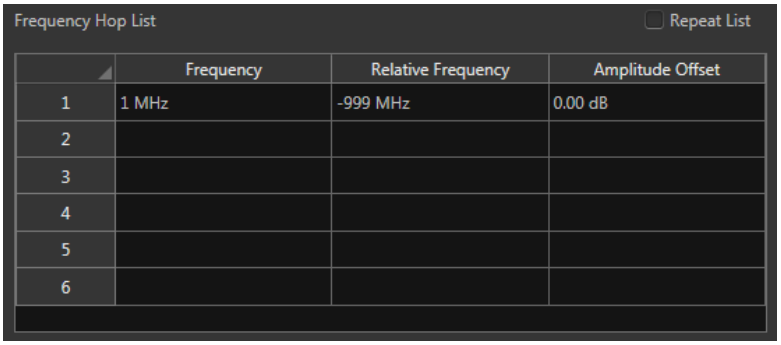
Custom Hopping Pattern

Pulse Start Index	Defines the index the specific hop starts. Each hop must contain a unique start index.
	Use the Frequency Hop List. Each index indicates the pulse that needs to hop to the specified frequency.

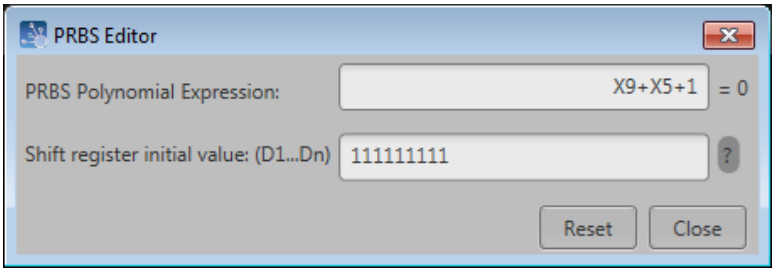


Pseudo Random List Hopping Pattern

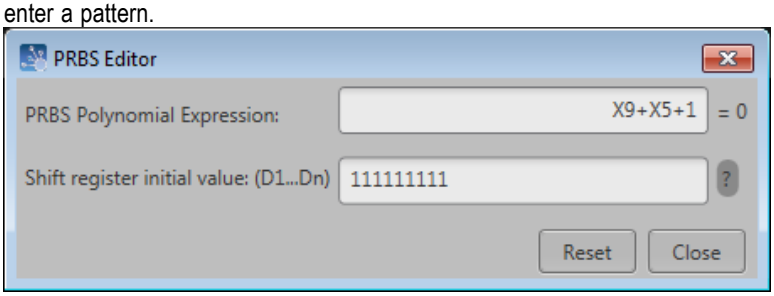
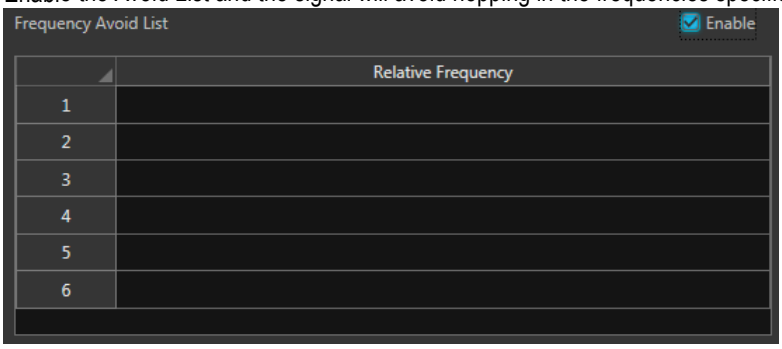
Hop Time	Select the method to define the Hop Time Pulses Per Hop
Pulses Per Hop	Pulses per Hop determines how many Pulses occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.
	Use the Frequency Hop List.



PRBS Pattern	Select the PRBS pattern for hopping. When User Defined is selected, a settings icon appears that allows you to open the PRBS Editor to enter a pattern.



You can read more about the PRBS Editor in the PRBS Editor topic (see page 55).

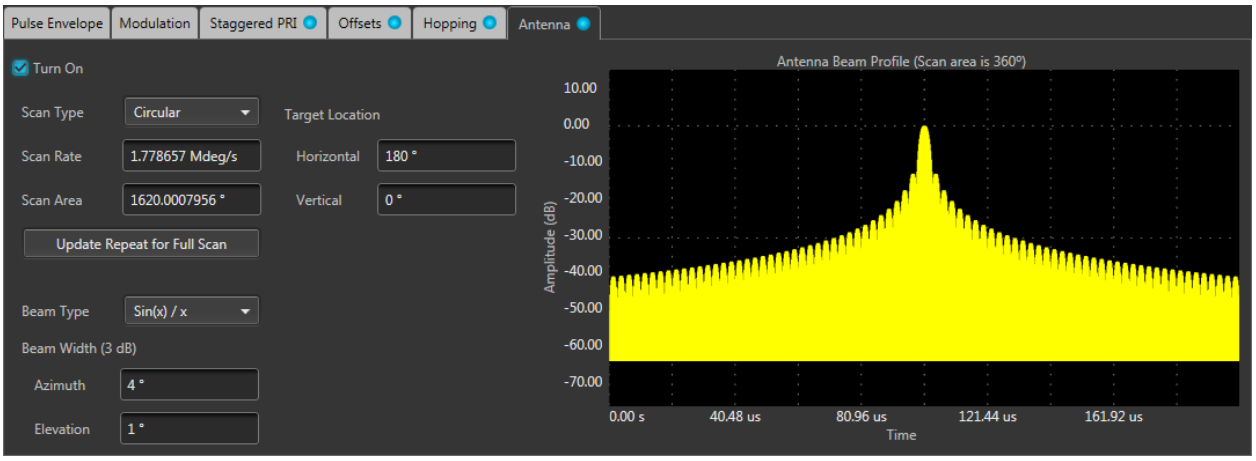
Pseudo Random Range Hopping Pattern	
Hop Time	Select the method to define the Hop Time Pulses Per Hop
Pulses Per Hop	Pulses per Hop determines how many Pulses occur between each Hop. The value applies to the entire hop pattern. Range: 1 to 5000000.
Minimum Frequency	Enter the frequency range within which 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.
PRBS Pattern	Select the PRBS pattern for hopping. When User Defined is selected, a settings icon appears that allows you to open the PRBS Editor to enter a pattern.  You can read more about the PRBS Editor in the PRBS Editor topic (see page 55).
Frequency Avoid List	Enable the Avoid List and the signal will avoid hopping in the frequencies specified in the table. 

Antenna tab

This tab allows you to apply Circular and Custom antenna scan types to the selected Pulse Group. The settings associated with each scan type are described below.

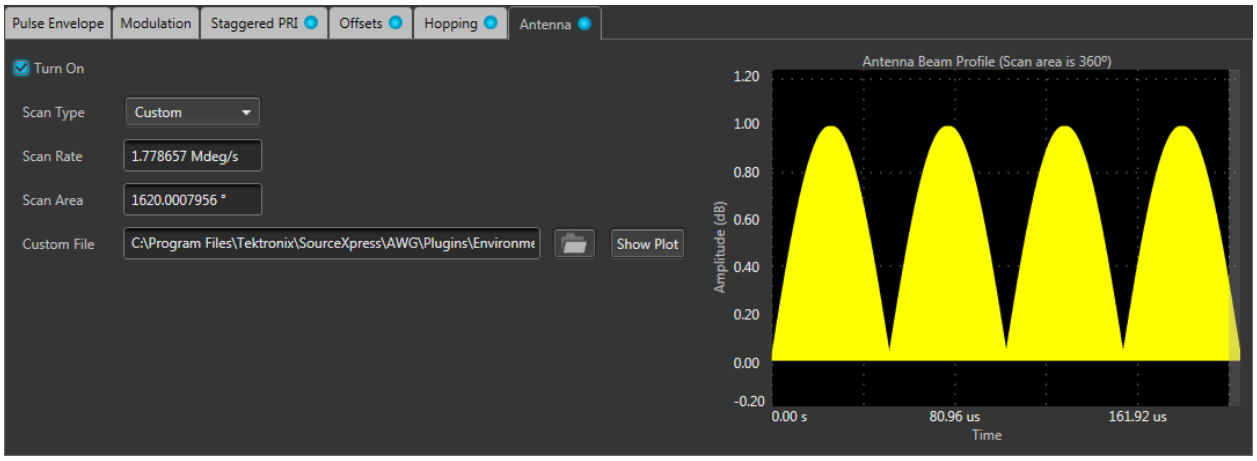
Quick links:

- Antenna settings when Circular is the selected Scan Type (see page 64)
- Antenna settings when Custom is the selected Scan Type (see page 65)



Antenna settings when Circular is the selected Scan Type

Item	Description
Turn On	Check box to apply antenna settings to the pulse train.
Scan Type	Choose Circular or Custom scan to apply.
Scan Rate	Enter the rate at which the scan takes place (degrees/second).
Scan Area	Enter the scanned area (degrees).
Target Location	Shows the following coordinates of the target.
Horizontal	Enter the horizontal location of the target (degrees).
Vertical	Enter the vertical location of the target (degrees).
Update Repeat for Full Scan	Click to update the pulse repeat count for one full scan.
Beam Type	Select from the following beam types: Sin(x)/x Gaussian
Beam Width (3 dB)	
Azimuth	Shows the compass direction of the antenna (azimuth). You can force the azimuth by entering a value. Range: 0° to 360°
Elevation	Shows the elevation of the antenna in degrees. You can force the elevation by entering a value.
Show Plot	Displays the antenna beam profile on an Amplitude vs Time graph.



Antenna settings when Custom is the selected Scan Type

Item	Description
Turn On	Check box to apply antenna settings to the pulse train.
Scan Type	Choose Gaussian or Circular scan to apply to the pulse train.
Scan Rate	Enter the rate at which the scan takes place (degrees/second).
Scan Area	Enter the scanned area (degrees).
Custom File	Allows you to apply settings using a custom antenna scan file. See the File format conditions (see page 65) topic for details.
Show Plot	Displays the antenna beam profile on an Amplitude vs Time graph.

File format conditions

A custom antenna scan file must meet the following conditions:

- Input files are ASCII files (.txt) or MATLAB (.mat).
- Both positive and negative numbers are allowed. All other characters are invalid (including tab and space). The application stops reading data when it encounters invalid data.
- The maximum length of the file is 1M samples.
- When ASCII file is chosen, the data should be in floating point format and the values should be arranged in a single column and several rows with one value in each row.
- The variable name in the .mat file should be "Profile". The .mat file should be saved with the v7.3 option.
- Here is an example of MATLAB command for saving a file: save('Antenna.mat','Profile', '-v7.3');
- A MATLAB file should contain a variable with ‘n’ values of the format 1 x n or n x 1. For example,

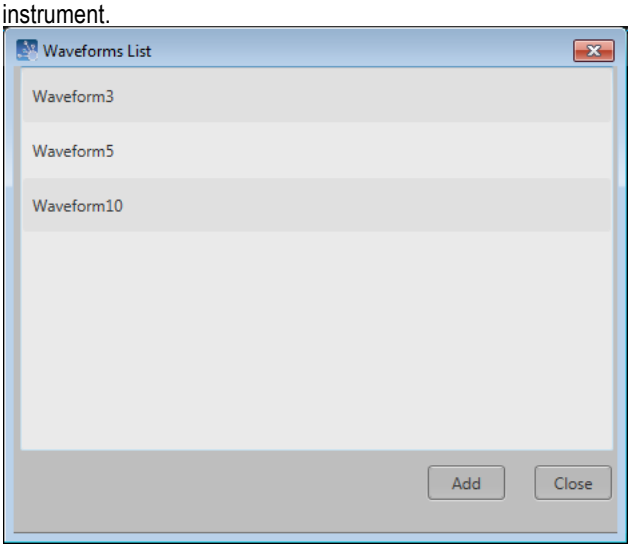
Profile = [0.5 0.3 0.2 0.7 ….]

Tones emitter parameters

Item	Description
Single-Tone Multi-tone	Select to add a single-tone or multi-tone emitter signal.
Number of Cycles	Set the number of cycles of the frequency/resolution for the emitter signal.
When Multi-tone is selected, the following parameters are available.	
Bandwidth	Enter the bandwidth of the carrier in Hz. The bandwidth is dependent on the instrument type.
Phase	Selects the method of applying the phase shift. The selections include: Random: The application applies a random phase shift to each of the tones. Newman: The phase shift is based on the Newman phase calculations. User Defined: Select a specific phase shift in degrees to apply to each of the tones.
Tone Spacing	Sets the number of tones by defining the spacing between tones. Entering a spacing value automatically creates the number of tones (Tone Count) within the set frequency range.
Tone Count	Selects the number of tones by defining the number of tones within the frequency range. Entering a tone count automatically sets the Spacing between tones.

User Defined emitter parameters

The user defined emitter allows you to add an existing waveform (interference signal) to the scenario.

Item	Description
Signal Format	Sets the type of interference signal you are adding to the scenario, RF/IF or IQ. If the Scenario's signal format is set to RF/IF, you can choose to add either an RF/IF interference signal or an IQ interference signal. If you choose to add an IQ waveform, it will be up-converted to an RF waveform during the scenario compile. If the Scenario's signal format is set to IQ, you can only add an IQ interference signal. ***NOTE.*** *For RF/IF waveforms, the center frequency and phase offset is obtained from the waveform file and can not be adjusted in the emitter definition table.* The Signal Format controls the type of waveforms you can add to the scenario.
Interference Signal	Select the Waveform List button to display the list of available waveforms to add to the scenario. The waveforms must have been previously loaded into the Waveform List of the instrument.  The listed waveforms displayed are dependent on the selected Signal Format.

WiFi emitter parameters

Item	Description
Standard	Set the WiFi Standard to 802.11a, 802.11b, or 802.11g.
Data Rate	Data Rate is dependant on the selected standard. 802.11a: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps. 802.11b: 1 Mbps-Barker_DPSK, 2 Mbps-Barker_DPSK, 5.5 Mbps-CCK_DQPSK, 5.5 Mbps-PBCC_BPSK, 11 Mbps-CCK_QPSK, 11 Mbps-PBCC_QPSK. 802.11g: 1 Mbps-Barker, 2 Mbps, 5.5 Mbps-CCK, 5.5 Mbps-PBCC, 11 Mbps-CCK, 11 Mbps-PBCC, 22 Mbps-PBCC, 33 Mbps-PBCC, 6 Mbps-OFDM, 9 Mbps-OFDM, 12 Mbps-OFDM, 18 Mbps-OFDM, 24 Mbps-OFDM, 36 Mbps-OFDM, 48 Mbps-OFDM, 54 Mbps-OFDM.
Data Length	Select between 40 Bytes and 102 4 Bytes.

Item	Description
Offtime	Set the amount of off time to add to the end of the signal.
PLCP Format	PLCP Format is dependant on the selected Standard and Data Rate. For many combinat ions, the Format is fixed to Standard. Other combinations allow 802.11b: Fixed to Standard.for DPSK. For DQPSK, BPSK, and QPSK type data rates, set to Long or Short. For OFDM type Data Rates, set to OFDM, LDSS, or SDSS.

WiMAX emitter parameters

Item	Description
Bandwidth	Select a bandwidth of 1.25 MHz, 2.5 MHz, 5 MHz, 7 MHz, 10 MHz, 15 MHz, 20 MHz, or 28 MHz.
Modulation	Select a modulation type of BPSK, QPSK, QAM 16, or QAM 64.
Payload	Select a payload length of 4 symbols, 10 symbols, or 40 symbols.
Guard Interval	Displays the guard/cyclic prefix interval. The value is fixed at 1/4 (25%) of the symbol duration.
Off Time	Defines the spacing between the packets.

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 SourceXpress, AWG70000 series instruments, or AWG5200 series instruments) for complete information about obtaining and installing license files.

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