

OptiSystem

Global Parameters Reference Guide

Optical Communication System Design Software

Version 14



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Optical Communication System Design Software

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Global Parameters

This quick reference guide describes the simulation parameters available within the *Layout Parameters* dialog box (also called global parameters). It also provides guidance on how to adjust these settings to optimize the effectiveness of your simulations.

About Global/Layout Parameters

When you create a new design, you must first define your global simulation parameters. These parameters are critical to the simulation as they will affect the speed, accuracy, and memory requirements for a particular simulation. Global parameters also have an impact on all the components that use these parameters.

Note: The global/layout parameters for a design apply only to the current layout. A project, which may have several layouts, may thus have different global/layout settings per layout

The Layout parameters are grouped into five categories:

- [Simulation parameters](#)
- [Signals parameters](#)
- [Spatial effects parameters](#)
- [Noise parameters](#)
- [Signal tracing parameters](#)

Simulation parameters

The simulation parameters (see Figure 1) define the primary settings for your simulation.

The three most critical parameters are **Bit rate**, **Sequence length**, and **Samples per bit**. They are used to calculate the **Time window**, **Sample rate**, and **Number of samples** as follows: ().

- **Time window** = Sequence length * 1/Bit rate
- **Number of samples** = Sequence length * Samples per bit
- **Sample rate** = Number of samples / Time window

OptiSystem works primarily as a sequential “block” simulator, meaning that the entire sampled data contained in the simulation time window is processed independently by each component. This allows for the efficient conversion of sampled data, using the Fast Fourier Transform (FFT), between the time and frequency domains at any point during the simulation. For this reason both the **Sequence length** and **Samples per bit** parameters must be set to an integer value that is a power of two (2).



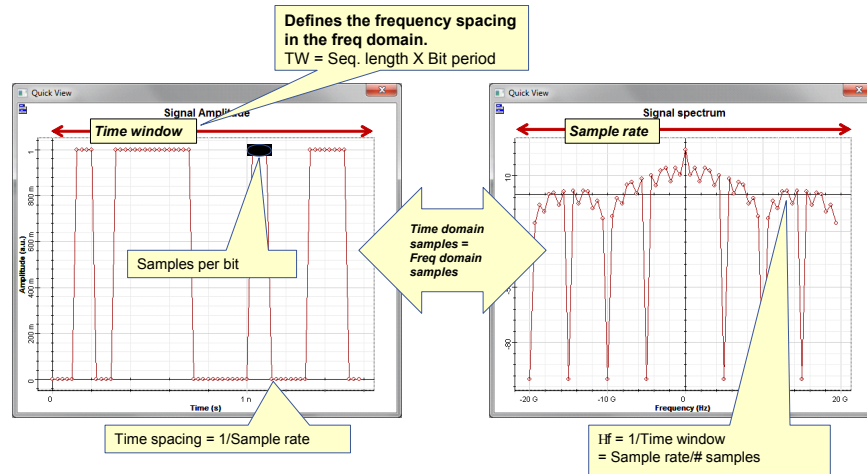
Figure 1 Simulation parameters

Simulation			
Signals Spatial effects Noise Signal tracing			
Name	Value	Units	Mode
Simulation window	Set bit rate		Normal
Reference bit rate	<input checked="" type="checkbox"/>		Normal
Bit rate		10e+009 bit/s	Normal
Time window		1.6e-009 s	Normal
Sample rate		40e+009 Hz	Normal
Sequence length		16 bits	Normal
Samples per bit		4	Normal
Guard Bits		0	Normal
Symbol rate		10e+009 symbols/s	Normal
Number of samples		64	Normal
Cuda GPU	<input type="checkbox"/>		Normal

Please use the following tips to assist in setting up the simulation parameters:

- Set the **Bit rate** to the fundamental binary data rate of your simulation. For example if designing a WDM system with channels operating at 10 Gbps (on and off keying) set the global parameter Bit rate to 10 Gbits/s. If different data rates are going to be used in a simulation, the associated Bit sequence generators can be used to locally adjust the binary data rate (as a ratio of **Bit rate** or directly defined)
- The **Sequence length** should be set based on the simulation objectives. Use long sequences if you need to gather statistical metrics such as eye diagrams or bit error rates. Use short sequences to study optical effects (such as pulse dispersion).
- The **Samples per bit** parameter, along with the **Bit rate** and the **Sequence length**, directly affect the sampling rate of the simulation. Once the **Sequence length** and **Bit rate** are set, use the **Samples per bit** parameter to fine tune the resolution of your simulation (see Fig 2 for more information on the relationship between the simulation parameters settings). For example if the highest known or expected frequency component (non-negligible) of the signal stream is F_{sample} , then the sampling rate should be set to at least $2 \times F_{sample}$ (Nyquist rate) to ensure the fidelity of the reconstructed signal (and the avoidance of aliasing)
- Set the **Symbol rate** to the fundamental symbol data rate of your simulation (if designing a higher order modulation system). The bandwidth or cutoff frequency of most electrical filters are linked by default to the Symbol rate. For example if designing a PAM4 modulation system with a fundamental bit rate of 10 Gbps, set **Symbol rate** to 5 Gbps.

Figure 2 Global parameters relationships



Simulation window

Specifies the setup mode for entering the parameters that define the main simulation parameters:

- **Set bit rate:** Allows you to enter the **Bit rate**. This is the default mode — you can easily set up the simulation using typical parameters such as **Bit rate**, **Sequence length**, and **Samples per bit**.
- **Set time window:** Allows you to enter the **Time window** value
- **Set sample rate:** Allows you to enter the **Sample rate**

The parameter **Bit rate** recalculates based on these parameters.

Reference bit rate

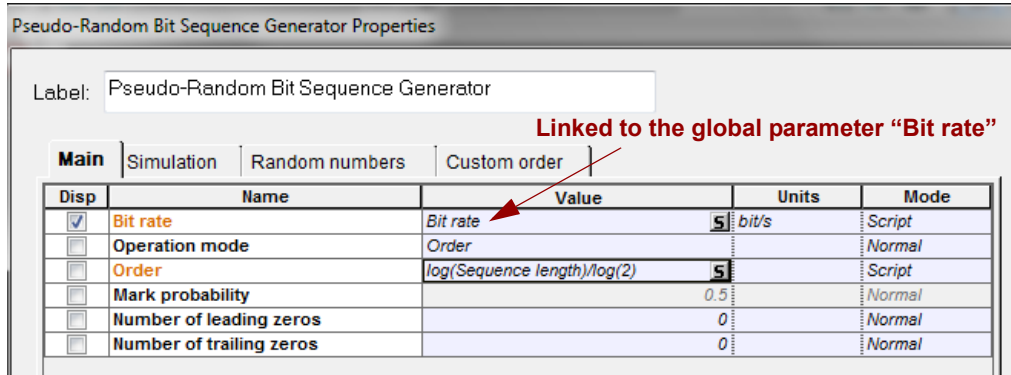
If this parameter is enabled, when you select **Set time window** or **Set sample rate** in the **Simulation** window, it will find the closest **Time window** or **Sample rate** without changing the **Bit rate**.

Bit rate

The value of the global bit rate is in bits per second. All components can access this parameter (see Fig 3). The global bit rate can affect components such as **Bit sequence** generators because components that require this parameter use it as a default value.

An expression relative to this bit rate value is used to define the default value for the bandwidth or cutoff frequency with several component. When you change this global parameter, you can change the bit rate setting of all modules in the design simultaneously.

Figure 3 Global parameter Bit rate



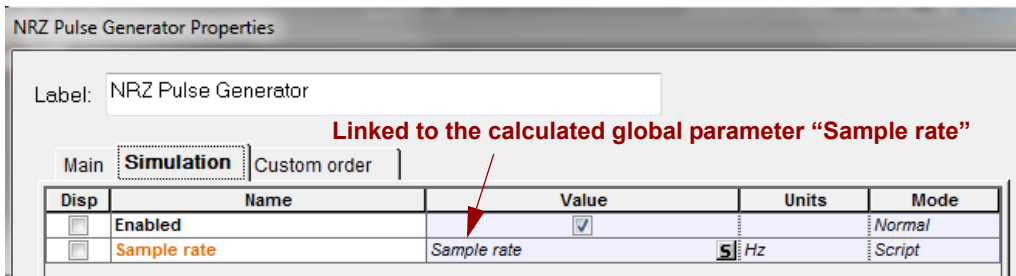
Time window

Specifies in seconds the **Time window** of the simulation. OptiSystem shares the parameter **Time window** with all components. This means that each component works with the same **Time window**. Since the **Time window** defines the frequency spacing in the frequency domain, the sampled signal will always have the same frequency spacing. This parameter is best expressed in terms of the sequence length and the bit rate used during the simulation. It affects all components.

Sample rate

Specifies the frequency simulation window or simulation bandwidth in Hz (see Fig 4). It can affect components such as pulse generators and optical sources that generate signals at different sample rates. It is often convenient to operate all modules in the design at the same sample rate. This can be done easily by using this global parameter. The default parameter for all components requiring sample rate is referred to as the global sample rate. When you change this global parameter, you can change the sample rate setting of all modules in the design simultaneously.

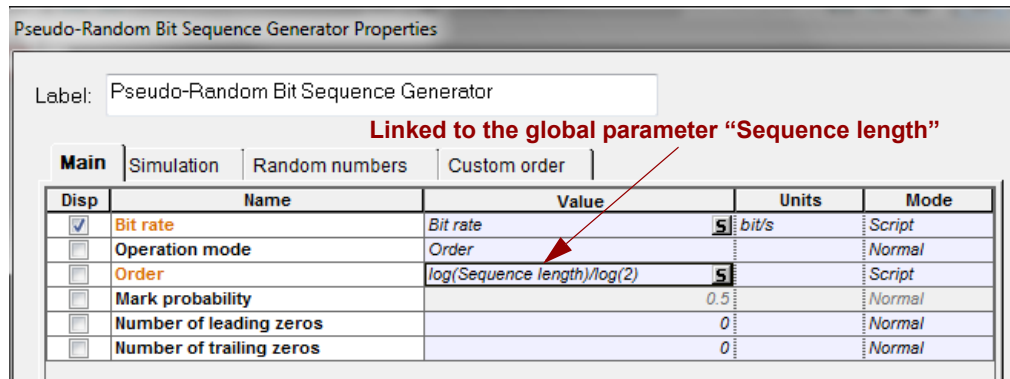
Figure 4 Global parameter Sample rate



Sequence length

The length of the bit sequence in number of bits. It must be a power of two.

Figure 5 Global parameter Sequence length



Samples per bit

Number of samples per bit used to discretize the sampled signals. It must be a power of two.

Guard bits

Linked to the BER Test Set component, **Guard bits** defines the number of bits to ignore before and after a sequence of bits is analyzed (these bits are not included in the calculation of the bit error rate). This parameter is primarily used for designs which include digital signal processing (since certain algorithms require an initial stream of data samples to reach optimized performance)

Symbol rate

Used to define the fundamental symbol data rate of a simulation (when higher order modulation schemes are used). The Symbol rate is linked to some electrical filters (frequency cut-off) and the DSP component.

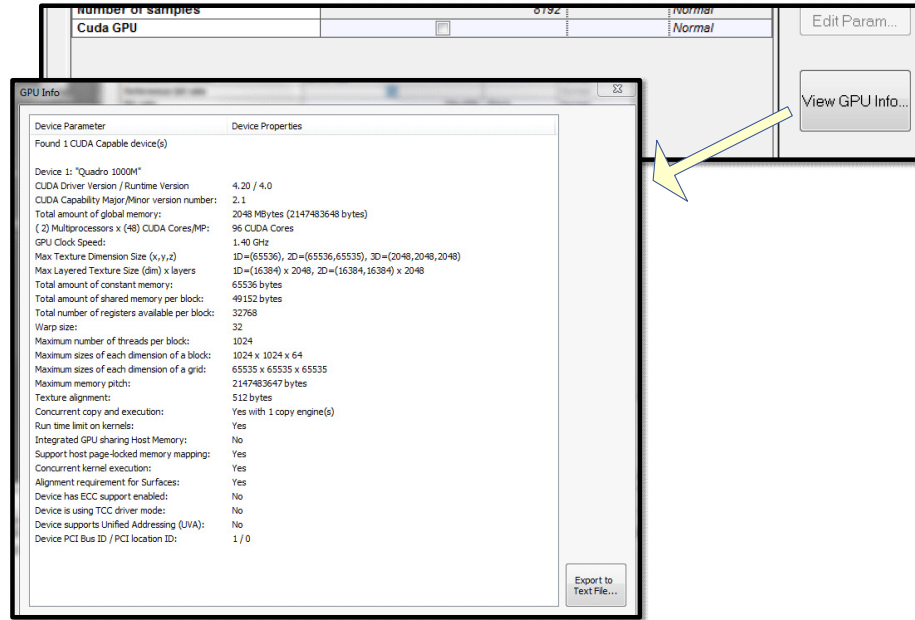
Number of samples

This read-only parameter shows the number of samples calculated by the product of **Sequence length** and **Samples per bit**.

CUDA GPU

Defines whether to enable or disable the CUDA GPU feature. Information on the GPU CUDA compatible card (if configured on your computer - see Fig 6) can be displayed by selecting the "View GPU Info" button.

Figure 6 GPU Processing



Signals parameters

Figure 7 Global parameters Signals

Simulation Signals Spatial effects Noise Signal tracing				
Name	Value	Units	Mode	
Iterations	1		Normal	
Initial delay	<input type="checkbox"/>		Normal	
Parameterized	<input type="checkbox"/>		Normal	
Synchronize	<input type="checkbox"/>		Normal	

Iterations

Number of signal blocks generated by each simulation. It mainly affects transmitters and components used in bidirectional simulations and in network ring design.

By increasing the parameter iterations a component will repeat the previous calculation until the number of calculations is equal to the iterations. Refer to the tutorial lesson: *Working with multiple iterations*.

Initial Delay

This parameter forces a component to generate a null signal at each output port. It affects all components and it is mainly used in bidirectional simulations. The user does not have to add delays at the component input ports if using this parameter. Refer to the tutorial lesson: *Working with multiple iterations*.



Parameterized

Defines whether the signal output will be sampled signals (disabled) or parameterized signals (enabled). It can affect components such as optical sources and optical pulse generators.

Synchronize

Defines whether bit rates will be recalculated in order to make sure that the number of samples and the number of bits are both power of two numbers. It can affect components such as pulse generators, decoders and BER analyzers. It forces compatibility mode with previous versions of OptiSystem 7.

Noise parameters

Convert noise bins

Selects whether noise within a sampled band's frequency range is added to the sampled signal or represented separately as noise bins. The default value is disabled, which means the noise propagate is separated from the signals. It can affect the Erbium doped fiber amplifiers and the photo detectors.

Figure 8 Global parameters Noise

Simulation Signals Spatial effects Noise Signal tracing			
Name	Value	Units	Mode
Convert noise bins	<input checked="" type="checkbox"/>		Normal

Spatial effects parameters

The spatial effects parameters affect the components that generate spatial modes, where the discretization space and the level of the discretization should be defined. The number of points per spatial mode is defined as the product of the number of points in the X and Y coordinates.

Figure 9 Global spatial effects parameters

Simulation Signals Spatial effects Noise Signal tracing			
Name	Value	Units	Mode
Space width X	50	um	Normal
Space width Y	50	um	Normal
Grid spacing X	0.5	um	Normal
Grid spacing Y	0.5	um	Normal

Space Width X

This is the space for the X coordinate.



Space Width Y

This is the space for the Y coordinate.

Grid Spacing Width X

The grid spacing for the X coordinate. The space width divided by the grid spacing gives the number of points in the X coordinate.

Grid Spacing Width Y

The grid spacing for the Y coordinate. The space width divided by the grid spacing gives the number of points in the Y coordinate

Signal tracing parameters

OptiSystem allows for fast estimation of power and noise at each output port. This estimation is calculated every time a signal is sent to the component output port. The signal tracing parameters allow the user to control the calculation and presentation of the results.

Figure 10 Global signal tracing parameters

Simulation Signals Spatial effects Noise Signal tracing			
Name	Value	Units	Mode
Calculate signal tracing	<input checked="" type="checkbox"/>		Normal
Power unit	<i>dBm</i>		Normal
Frequency unit	<i>THz</i>		Normal
Decimal places	4		Normal
Sensitivity	-100	<i>dBm</i>	Normal
Resolution	0.1	<i>nm</i>	Normal
Calculate noise floor	<input type="checkbox"/>		Normal
Interpolation offset	0.5	<i>nm</i>	Normal

Calculate Signal Tracing

Defines if the signal will be traced.

Power Unit

The units used to display the results (dBm, W or mW).

Frequency Unit

The units used to display the results (Hz, m, THZ or nm).

Decimal Places

The number of decimal places to use when displaying the results.



Sensitivity

The minimum output power that the calculation can detect.

Resolution

The spectral resolution bandwidth of the calculation.

Calculate Noise Floor

Defines if the noise floor will be calculated using interpolation. This is an important parameter when the noise is added to the signal.

Interpolation Offset

The interpolation offset from the signal channel center frequency used to estimate the noise floor.



GLOBAL PARAMETERS





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