



# Optical signal data format (1)

Signal type	Data elements	Comments
Sampled	<i>InputPort1.Sampled.Signal</i>	Represents the complex envelope of the optical signal (real/imag) – $1 \times n$ complex double If there are two polarization states, two rows will be created ( $2 \times n$ complex double)
	<i>InputPort1.Sampled.Time</i> <i>InputPort1.Sampled.Frequency</i>	The time/frequency sampling points for the sampled optical signal (s or Hz) <ul style="list-style-type: none"> <li>• If the parameter <b>Sampled signal domain</b> = “Time”, use <i>InputPort1.Sampled.Time</i></li> <li>• If the parameter <b>Sampled signal domain</b> = “Frequency”, use <i>InputPort1.Sampled.Frequency</i></li> </ul>
	<i>InputPort1.Sampled.CentralFrequency</i>	The center frequency (Hz) of the optical signal
Sampled (Channels)	<i>InputPort1.Channels</i>	List of wavelength channels entering specified port <ul style="list-style-type: none"> <li>• To access data for a sampled signal (Channel A), use <i>InputPort1.Sampled(A).Signal</i>, etc.</li> <li>• To access data for a parameterized signal (Channel A), use <i>InputPort1.Parameterized.Power(A)</i>, etc.</li> </ul>
Sampled (Spatial)	<i>InputPort1.Sampled.Spatial.ModeX.Amplitude</i>	Real or complex amplitude of spatial mode(s) – $n \times n$ array Note 1: To access Y polarization data, use <b>ModeY</b> in lieu of <b>ModeX</b> Note 2: If more than one mode is present, separate sampled signals will be created for each mode and can be accessed as follows (for Mode A): <i>InputPort1.Sampled(A).Spatial.ModeX.Amplitude</i>
	<i>InputPort1.Sampled.Spatial.ModeX.Properties</i>	String value (describes mode type and index)
	<i>InputPort1.Sampled.Spatial.ModeX.DeltaSpaceX</i> <i>InputPort1.Sampled.Spatial.ModeX.DeltaFrequencyX</i>	X-polarization: Discretization in space (m) or discretization in frequency (1/m)
	<i>InputPort1.Sampled.Spatial.ModeX.DeltaSpaceY</i> <i>InputPort1.Sampled.Spatial.ModeX.DeltaFrequencyY</i>	Y-polarization: Discretization in space (m) or discretization in frequency (1/m)
Parameterized	<i>InputPort1.Parameterized.Power</i>	Average power of parameterized optical signal (W)
	<i>InputPort1.Parameterized.Frequency</i>	Central frequency of parameterized optical signal
	<i>InputPort1.Parameterized.SplittingRatio</i>	Polarization splitting ratio of parameterized optical signal
	<i>InputPort1.Parameterized.Phase</i>	Phase of parameterized optical signal

# Optical signal data format (2)

Signal type	Data elements	Comments
Noise	<i>InputPort1.Noise.Power</i>	Average power of each noise bin (W)
	<i>InputPort1.Noise.LowerFrequency;</i>	Lower frequency range of each noise bin (Hz)
	<i>InputPort1.Noise.UpperFrequency;</i>	Upper frequency range of each noise bin (Hz)
	<i>InputPort1.Noise.Phase</i>	Phase of each noise bin (Hz)
Individual sample	<i>InputPort1.IndividualSample</i>	Represents the complex amplitude of the optical signal for a single sampling point

# Electrical & Binary/M-ary data formats

## Electrical

Signal type	Data elements	Comments
Sampled	<i>InputPort1.Sampled.Signal</i>	Represents the electrical signal sampled waveform (real/imag) – <i>1xn complex double</i>
	<i>InputPort1.Sampled.Time</i> <i>Inputport1.Sampled.Frequency</i>	The time/frequency sampling points for the sampled electrical signal (s or Hz) <ul style="list-style-type: none"> <li>• If the parameter <b>Sampled signal domain</b> = “Time”, use <i>InputPort1.Sampled.Time</i></li> <li>• If the parameter <b>Sampled signal domain</b> = “Frequency”, use <i>InputPort1.Sampled.Frequency</i></li> </ul>
Noise	<i>InputPort1.Noise.Signal</i>	Represents the electrical noise sampled waveform (real/imag) – <i>1xn complex double</i> Note: If the noise is combined with the sampled signal (before the MATLAB Component) these arrays will be empty (zero values)
	<i>InputPort1.Noise.Time</i> <i>Inputport1.Noise.Frequency</i>	The time/frequency sampling points for the sampled electrical noise (s or Hz) <ul style="list-style-type: none"> <li>• If the parameter <b>Sampled signal domain</b> = “Time”, use <i>InputPort1.Noise.Time</i></li> <li>• If the parameter <b>Sampled signal domain</b> = “Frequency”, use <i>InputPort1.Noise.Frequency</i></li> </ul>
Individual sample	<i>InputPort1.IndividualSample</i>	Represents the amplitude of the electrical and noise signal for a single sampling point

## Binary & M-ary

Signal type	Data elements	Comments
Binary	<i>InputPort1.Sequence</i>	Represents the sequence of binary bits (0’s and 1’s)
	<i>InputPort1.BitRate</i>	Bit rate of binary sequence (1/s)
M-ary	<i>InputPort1.Sequence</i>	Represents the sequence of M-ary symbols – <i>1xn double</i>
	<i>InputPort1.BitRate</i>	Sample rate of M-ary sequence (1/s)

# Accessing the MATLAB workspace

1. The data structure for all input and output ports and all variables declared within the MATLAB m-file can be viewed from the MATLAB workspace
2. To access the workspace, first select **Load MATLAB** from the **MATLAB Component** and select OK. This action pre-loads MATLAB (it will stay open unless it is manually closed)
3. After running a simulation, open the MATLAB Command Window and type “workspace”.

**Optical data (Sampled/Parameterized/Noise Bins)**

The diagram shows a simulation setup with four CW Laser components and an EDFA component. The lasers are configured as follows:

- CW Laser Sampled X:** Frequency = 850 nm, Power = 0 dBm, Azimuth = 0 deg, Parameterized = NO.
- CW Laser Sampled XY:** Frequency = 850 nm, Power = 0 dBm, Azimuth = 45 deg, Parameterized = NO.
- CW Laser Parameterized:** Frequency = 850 nm, Power = 0 dBm, Initial phase = 30 deg, Azimuth = 45 deg, Parameterized = YES.
- CW Laser:** Frequency = 1550 nm, Power = 0 dBm, Initial phase = 30 deg.

The EDFA component is configured with: Length = 5 m, Noise center frequency = 193.4 THz, Noise bandwidth = 13 THz, Noise bins spacing = 125 GHz.

The MATLAB Optical (Time) Properties dialog is shown with the following settings:

Disp	Name	Value	Units	Mode
<input type="checkbox"/>	Load Matlab	<input checked="" type="checkbox"/>		Normal
<input type="checkbox"/>	Run Matlab as shared	<input checked="" type="checkbox"/>		Normal
<input type="checkbox"/>	Run command	OpticalData;		Normal
<input type="checkbox"/>	Matlab search path			Normal
<input type="checkbox"/>	Sampled signal domain	Time		Normal
<input type="checkbox"/>	Spatial mode domain	Space		Normal
<input type="checkbox"/>	Resize	<input checked="" type="checkbox"/>		Normal
<input type="checkbox"/>	User defined image	<input type="checkbox"/>		Normal
<input type="checkbox"/>	Image Filename	Icon.bmp		Normal

**MATLAB Command Window**

After completion of the simulation, type `workspace + Enter` to access the data structure for all signals and variables

```
To get started, type one of these: helpwin, helpdesk, or demo.  
For product information, visit www.mathworks.com.  
  
>> workspace  
>> |
```

# MATLAB m-file associated with *Optical\_Data.osd*

The data structure of any input port can be equated to any output port as long as they are the same type (optical, electrical, m-ary, binary)

Ports are accessed using the nomenclature InputPort1, InputPort2, etc.

Variables on left are local to the MATLAB workspace.

OpticalData.m

```
OutputPort1 = InputPort1;
SAMPLED SIGNAL (InputPort1.Sampled; InputPort2.Sampled)
-----
%Signal with 1 polarization state (Default) - InputPort1
OpticalSignal_Envelope = InputPort1.Sampled.Signal; %Complex envelope of the optical signal (real/imag amplitudes)
OpticalSignal_Time = InputPort1.Sampled.Time; %Sampled time array (s)
OpticalSignal_CtrFreq_S = InputPort1.Sampled.CentralFrequency; %Central frequency of the optical signal (Hz)

%Signal with 2 polarization states - InputPort2
OpticalSignal_Envelope_XY = InputPort2.Sampled.Signal; %Complex envelope of the optical signal (X data in 1st row ;
OpticalSignal_Time_XY = InputPort2.Sampled.Time; %Sampled time array
OpticalSignal_CtrFreq_XY = InputPort2.Sampled.CentralFrequency; %Central frequency of the optical signal

%OPTICAL PARAMETERIZED SIGNAL (InputPort3.Parameterized)
%-----
%Parameterized signal
OpticalSignal_Pwr = InputPort3.Parameterized.Power; %Average power of parameterized optical signal (W)
OpticalSignal_CtrFreq_P = InputPort3.Parameterized.Frequency; %Central frequency of parameterized optical signal
OpticalSignal_SR = InputPort3.Parameterized.SplittingRatio; %Polarization splitting ratio of parameterized optical signal
OpticalSignal_Ph = InputPort3.Parameterized.Phase; %Absolute phase of parameterized optical signal

%NOISE BINS (InputPort4.Noise)
%-----
NoiseArray_Pwr = InputPort4.Noise.Power; %Average power of each noise bin (W)
NoiseArrayLowFreq = InputPort4.Noise.LowerFrequency; %Lower frequency range of each noise bin (Hz)
NoiseArrayHighFreq = InputPort4.Noise.UpperFrequency; %Upper frequency range of each noise bin (Hz)
NoiseArrayPhase = InputPort4.Noise.Phase; %Phase of each noise bin (rad)
```

# Example of workspace for *Optical\_Data.osd*

To view further details on a data structure, double left click on any variable to open up the Variables window

**Data structure for input ports**

Name	Value
InputPort1	1x1 struct
InputPort2	1x1 struct
InputPort3	1x1 struct
InputPort4	1x1 struct
NoiseArray_Pwr	2x105 double
NoiseArrayHighFreq	1x105 double
NoiseArrayLowFreq	1x105 double
NoiseArrayPhase	1x105 double
OpticalSignal_CtrFreq_P	3.5270e+14
OpticalSignal_CtrFreq_S	3.5270e+14
OpticalSignal_CtrFreq_XY	3.5270e+14
OpticalSignal_Envelope	1x128 complex double
OpticalSignal_Envelope_XY	2x128 complex double
OpticalSignal_Ph	0
OpticalSignal_Pwr	1.0000e-03
OpticalSignal_SR	0.5000
OpticalSignal_Time	1x128 double
OpticalSignal_Time_XY	2x128 double
OutputPort1	1x1 struct

**Size and type of data**

**Data structure for output ports**

**Locally declared MATLAB variables**

Variables - OpticalSignal\_Envelope\_XY

OpticalSignal\_Envelope\_XY

2x128 complex double

	1	2	3	4	5	6	7	8	9
1	0.0224 - 0.0...	0.0224 + 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 + 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 + 0.0...
2	0.0224 - 0.0...	0.0224 + 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 + 0.0...	0.0224 - 0.0...	0.0224 - 0.0...	0.0224 + 0.0...
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**The detailed data structure and contents for the variable *OpticalSignal\_Envelope\_XY*. This example shows the sampled complex amplitude of an optical signal envelope with X (first row) and Y (2<sup>nd</sup> row) polarization data**