

# Cadence® Calculator Functions V 0.71, 050429

## Introduction

All functions - **EyeDiag**, **MomAmp**, **MomFreq**, **MomTime**, **MomPhase**, **Resample**, **XHist**, **YHist** and **Write** - appear as plug-ins in Cadence® Calculator and are listed in the “Special Functions” menu of Cadence® Calculator. They are executed either by typing the commands at the Calculator command line or by using an input mask which is invoked from the “Special Functions” menu of Cadence® Calculator.

All functions will already respond while the simulation is running. This allows an early check of the simulation results which may save much time (in the waveform window, perform a Window|UpdateResults operation to re-read the last simulation results).

**New:** beginning with V0.7 all calculator functions can operate on single waveforms as well as on parametric plots!

## Function Description

### EyeDiag

#### Description:

EyeDiag draws an **eye diagram** of the Signal (e.g. random data), beginning after  $T_{\text{Delay}}$ , with a bit period of  $T_{\text{Per}}$ . It will draw N eyes on the screen. The density of the diagram does not depend on the number of eyes, thus you can select a higher number and still need only a short simulation time.  $T_{\text{delay}}$  is used to remove possible settling processes from the eye diagram.

#### Execution:

Click in Calculator on “Special functions” -> “EyeDiag”

Or: Type in Calculator command line: EyeDiag(Signal,  $T_{\text{Delay}}$ ,  $T_{\text{Per}}$ , N)

#### Example:

```
EyeDiag(VT("/out"),2n,25p,3)
```

This draws a 40Gbit/s eye diagram with 3 eyes on the screen after 2ns simulation settling time.

### **MomAmp**

#### Description:

MomAmp calculates the **instantaneous peak-to-peak amplitude** of the Signal which lies around threshold. Useful e.g. for VCOs or AM-modulated signals.

#### Execution:

Click in Calculator on “Special functions” -> “MomAmp”

Or: Type in Calculator command line: MomAmp(Signal, from, to, threshold)

#### Example:

```
MomAmp(VT("/out"),5n,50n,0)
```

### **MomFreq**

#### Description:

MomFreq calculates the **instantaneous frequency** of the Signal between from and to time values, based on the rising edge of the signal, crossing threshold. Useful e.g. for VCO and PLL simulations.

#### Execution:

Click in Calculator on “Special functions” -> “MomFreq”

Or: Type in Calculator command line: MomFreq(Signal, from, to, threshold)

#### Example:

```
MomFreq(VT("/out"),5n,50n,0.0)
```

### **MomTime**

#### Description:

MomTime calculates the **time difference between rising edges** of Signal1 crossing threshold1 to Signal2 crossing threshold2 in between from and to time values. Useful for delay measurements or phase measurements (e.g. quadrature mixers: *MomTime(Sig\_I,Sig\_Q,...)\*f<sub>ref</sub>\*360.0*)

NOTE: due to a limitation of the calculator, it is necessary to add Signal2 manually to the function string when using the Special Functions menu.

#### Execution:

Click in Calculator on “Special functions” -> “MomTime”

Or: Type in Calculator command line:

```
MomTime(Signal1, Signal2, from, to, threshold1, threshold2)
```

#### Example:

```
MomTime(VT("/ref"),VT("/out"),5n,50n,0.0,-0.1)
```

### MomPhase

#### Description:

MomPhase calculates the **instantaneous phase** of the rising edge of the Signal crossing threshold and the reference signal with frequency f0 and initial phase phi0. Useful e.g. for VCO and PLL simulations.

#### Execution:

Click in Calculator on “Special functions” -> “MomPhase”

Or: Type in Calculator command line: MomPhase(Signal, f0, phi0, from , to, threshold)

#### Example:

```
MomPhase(VT("/out"),10G,180,5n,50n,0.0)
```

### Resample

#### Description:

Resample **resamples the waveform** value at time intervals  $T0+N*T$ , based on linear interpolation. It is used by our statistical functions but may also be useful for data sampling in the calculator.

#### Execution:

Click in Calculator on “Special functions” -> “Resample”

Or: Type in Calculator command line:

```
Resample(Signal, T, T0)
```

#### Example:

```
Resample(VT("/out"),25p,0)
```

### XHist

#### Description:

XHist creates a normalized **histogram of Signal crossings** of Threshold. The simulation data is internally resampled for this operation. The signal period T is used to calculate the spread of the crossing times. Time resolution of the histogram is  $T/Resolution$ . For Edge=0 both rising and falling edges are taken into account, for +1 only rising edges, for -1 only falling edges.

#### Execution:

Click in Calculator on “Special functions” -> “XHist”

Or: Type in Calculator command line:

```
XHist(Signal, Threshold, T, Resolution, Edge)
```

#### Example:

```
Xhist(VT("/out"),0.0, 25p,100, 0)
```

### YHist

Description:

YHist creates an **amplitude histogram** of the Signal. The Signal is internally resampled with a period T for this operation. Amplitude resolution is  $(y_{\max}-y_{\min})/\text{Resolution}$ , based on the measured extrema of the Signal. For Flip=nil the x-axis contains the amplitude and y contains the normalized amplitude distribution, for Flip=t the axis are swapped.

Execution:

Click in Calculator on "Special functions" -> "YHist"

Or: Type in Calculator command line:

YHist(Signal, Resolution, T, Flip)

Example:

Xhist(VT("/out"), 200, t)

**Write**Description:

Write writes an **ASCII data file** (gnuplot style) with x/y-pairs. For parametric plots the individual parameter values are listed as a comment. Comment is an ASCII string that may hold information about the meaning of the x/y values. This command is better executed in the CIW instead of the calculator.

Execution:

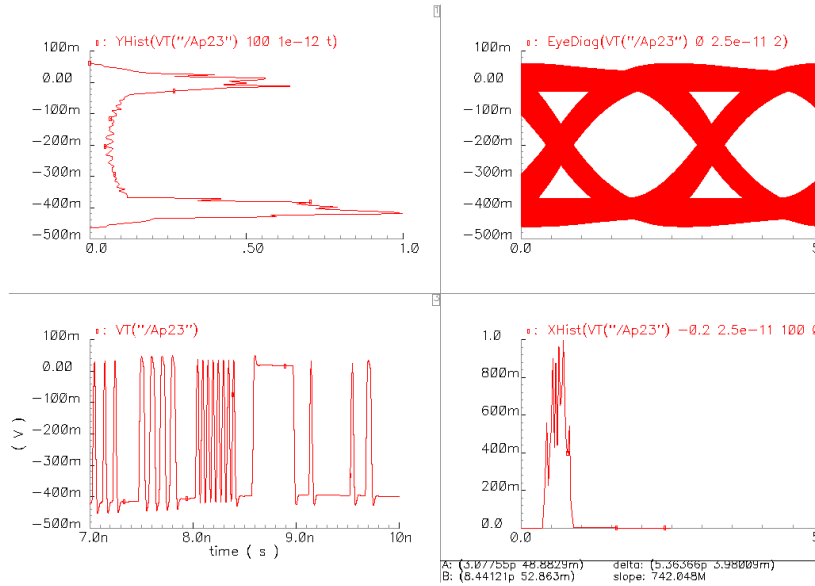
Click in Calculator on "Special functions" -> "Write"

Or: Type in Calculator or CIW command line: Write(Signal Filename, Comment)

Example:

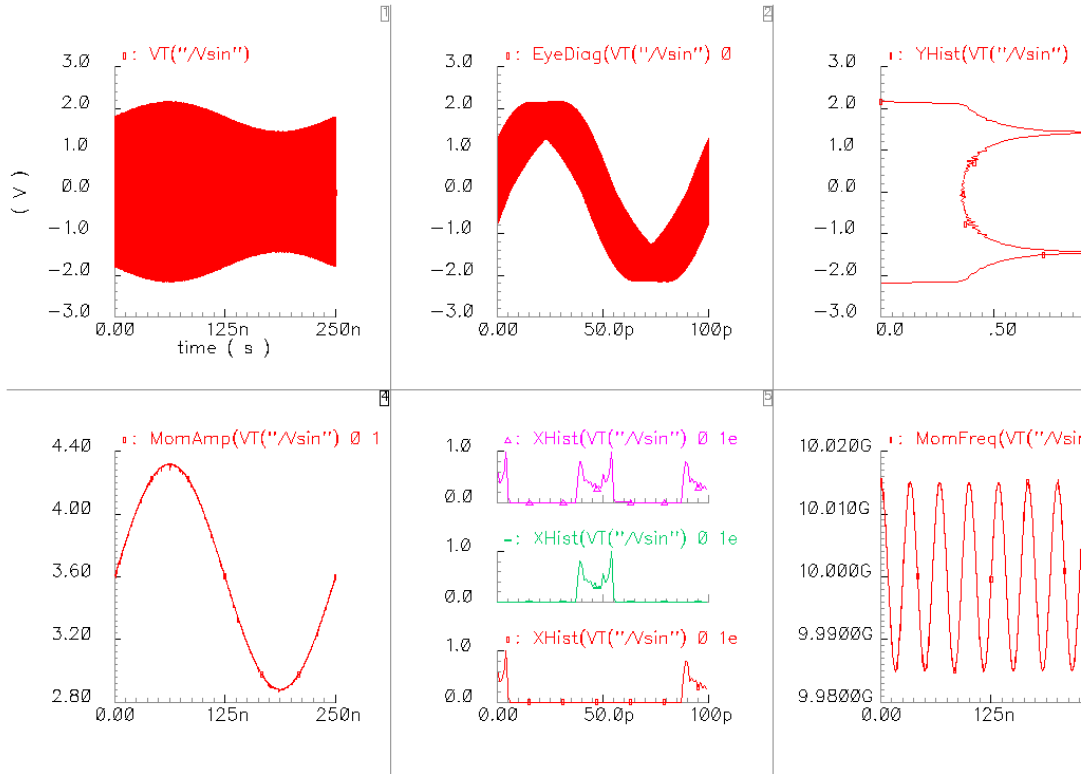
Write(VT("/out"), "//tmp/result.dat", "x=time, y=V(out), param=VDD")

**Example 1: PRBS sequence**

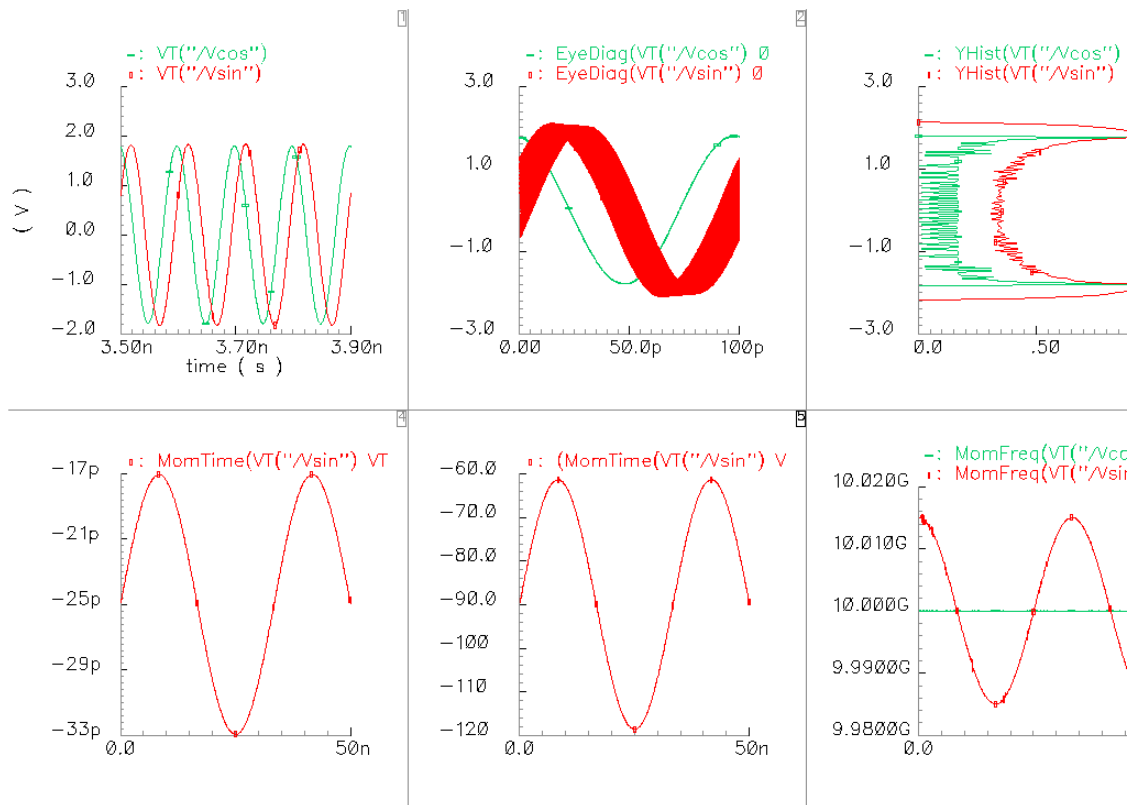


- 1) amplitude histogram,
- 2) eye diagram,
- 3) original y(t) data plot
- 4) jitter measurement, all edges

**Example 2: AM and FM modulated sine wave**



- 1) original y(t) data plot    2) eye diagram    3) amplitude histogram  
 4) instantaneous amplitude    5) jitter of all/falling/rising edges    6) instantaneous frequency

**Example 3: IQ signals, one AM and FM modulated**

- |                            |                            |                            |
|----------------------------|----------------------------|----------------------------|
| 1) original y(t) data plot | 2) eye diagram             | 3) amplitude histogram     |
| 4) rising edge time delta  | 5) rising edge phase shift | 6) instantaneous frequency |

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