

# Windows Package

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## Getting Started

Load the windows package by placing the pathname to the Windows package below:

```
<< "Windows.m"
```

Windows are created in two steps: First, a continuous function describing the window is defined over the domain  $[-1,1]$ . This continuous function is the name of the window followed by the letter 'F', for example TriangleF. Next, a discrete window is sampled from this continuous function by a function using the window name and ending in the letter 'W'. A few windows have variable parameters, such as the Kaiser window. You can see if a window has any extra parameters by typing Options>windowName] (without the 'F' or 'W' ending).

```
Options@KaiserD
```

```
8Alpha A 2.<
```

The variable \$Windows contains a list of all possible window types from the windows package.

```
$Windows
```

```
8Blackman, BlackmanHarris, Bohman, Cauchy, Cosine, Gaussian, Hamming,  
Hann, HannPoisson, Kaiser, Poisson, Rectangle, Reisz, Riemann,  
Triangle, Turkey, VallePoussin<
```

To get information on a particular type of Window:

```
? Blackman
```

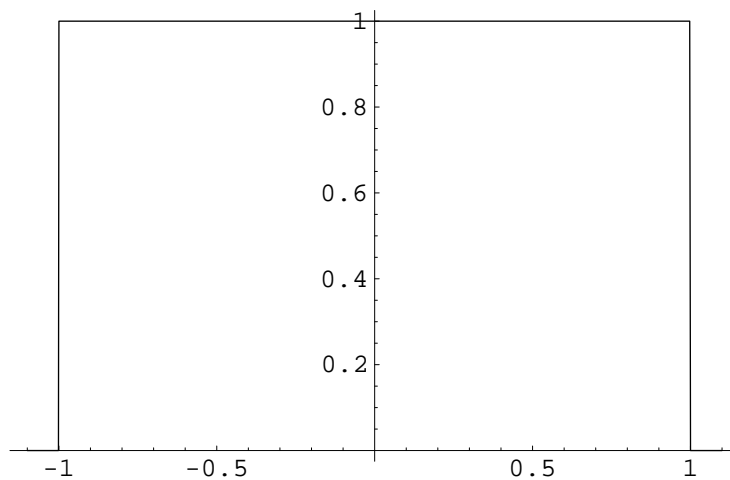
```
BlackmanW@length, optionsD returns the Blackman window.
```

There are two plotting functions designed for plotting continuous windows, and their transforms: `WindowPlot`, and `WindowTransformPlot`.

Double-click to the right of the headings below to open/close sections of this notebook.

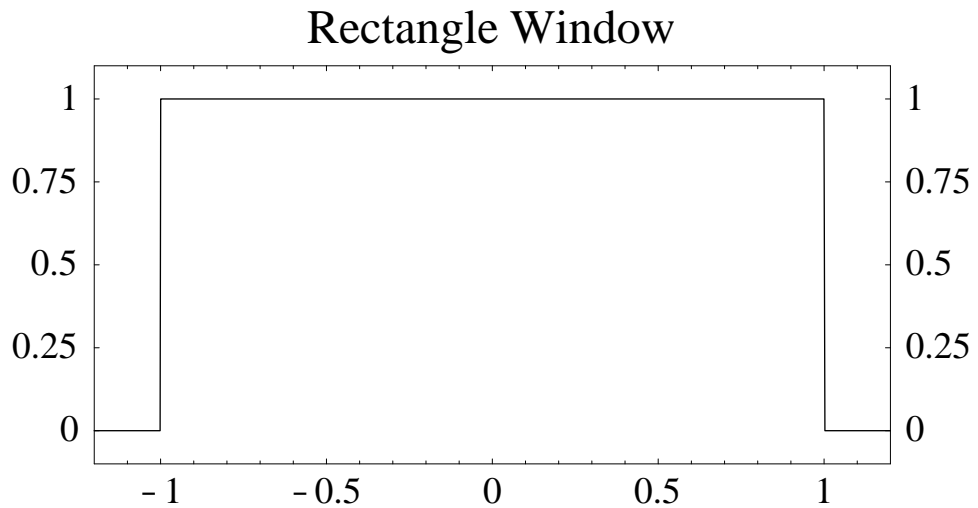
## Rectangle Window

```
Plot@RectangleF@xD, 8x, -1.1, 1.1<D;
```



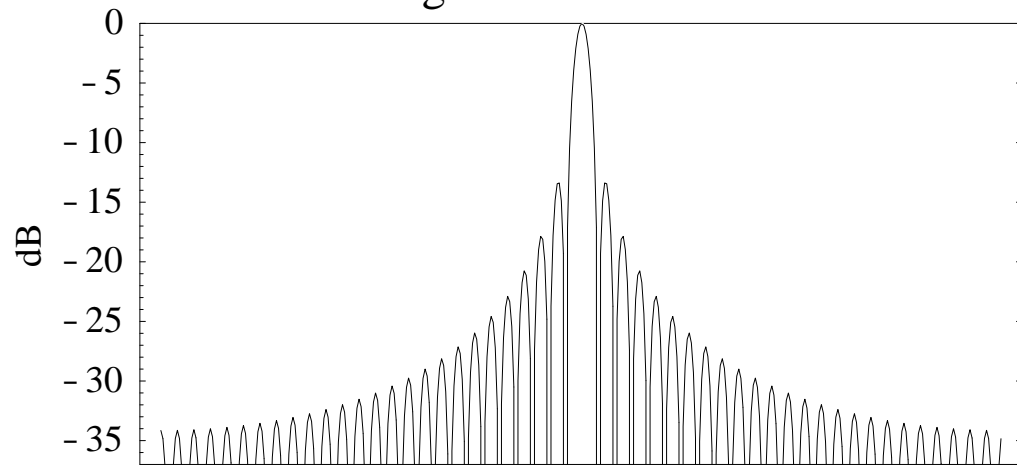
Or use the built-in function to plot a window in a standardized style:

```
WindowPlot@RectangleD;
```

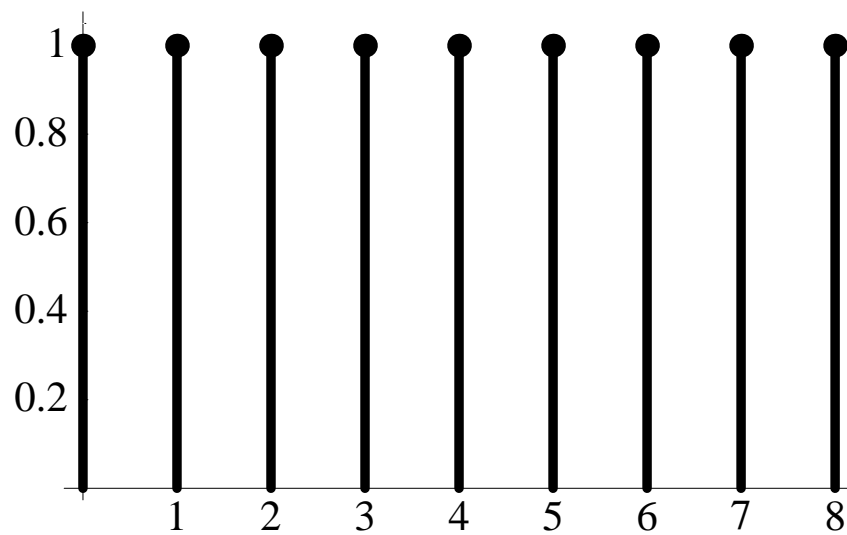


```
WindowTransformPlot@Rectangle, PlotRange -> 8-37, 0<D;
```

### Rectangle Window Transform

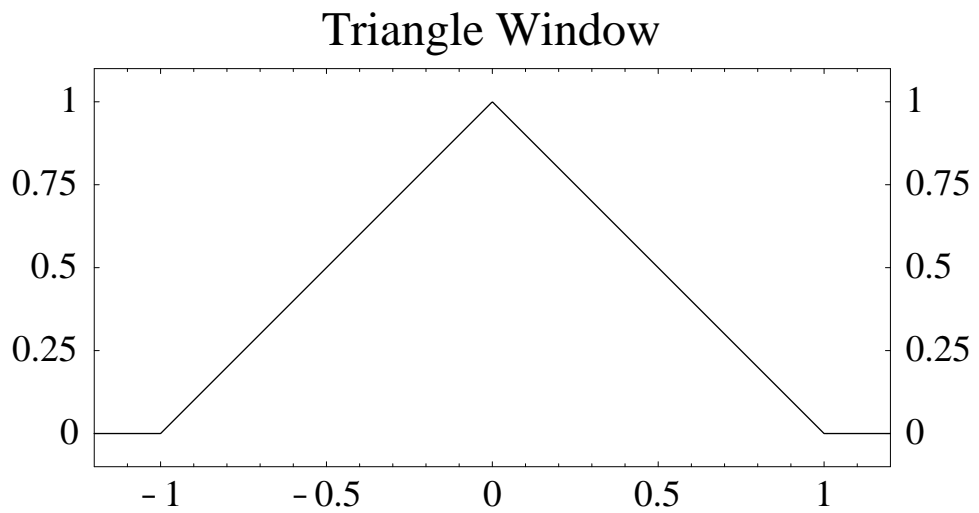


```
SeqPlot@RectangleW@9DD;
```

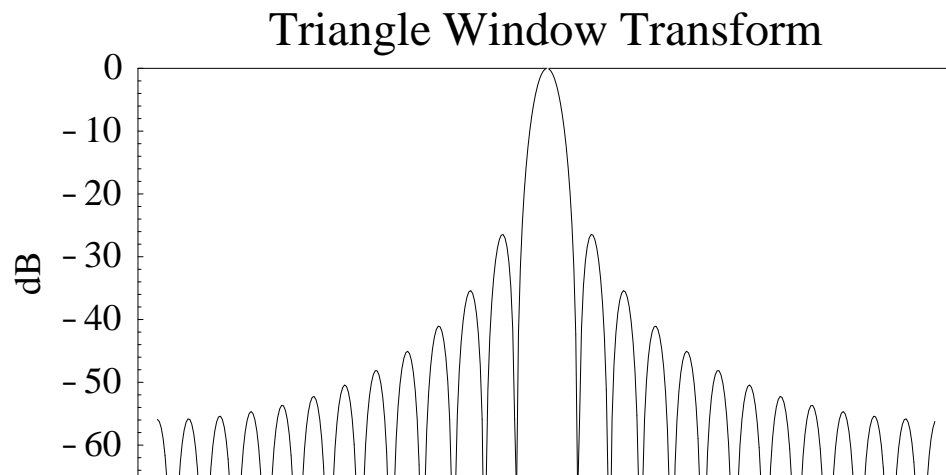


## Triangle Window

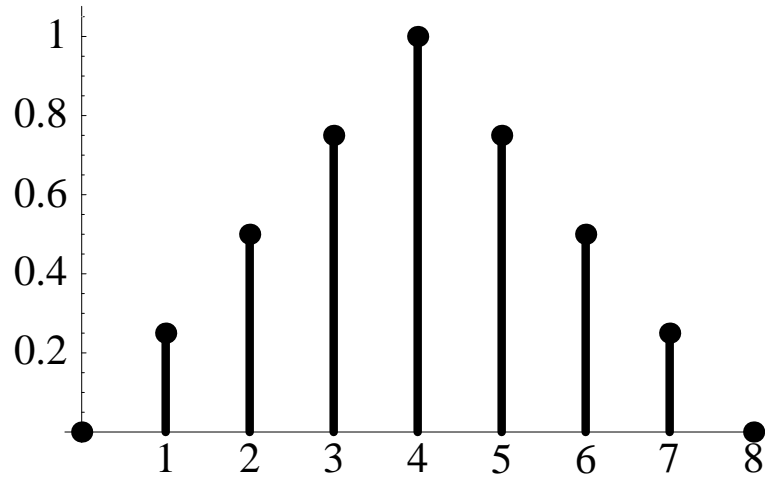
```
WindowPlot@TriangleD;
```



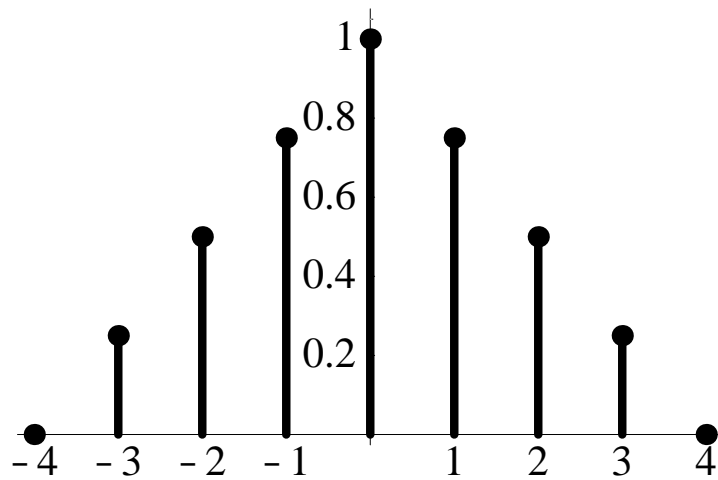
```
WindowTransformPlot@Triangle, PlotRange -> 8-65, 0<D;
```



```
SeqPlot@TriangleW@9DD;
```



```
SeqPlot@TriangleW@9, Causal -> FalseD, Causal -> FalseD;
```

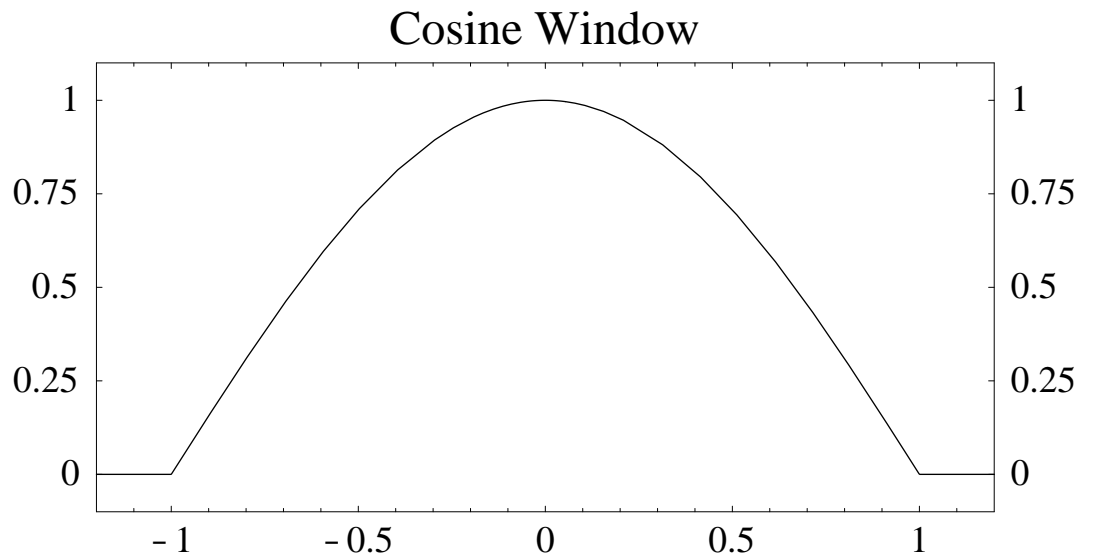


## Cos^n Window

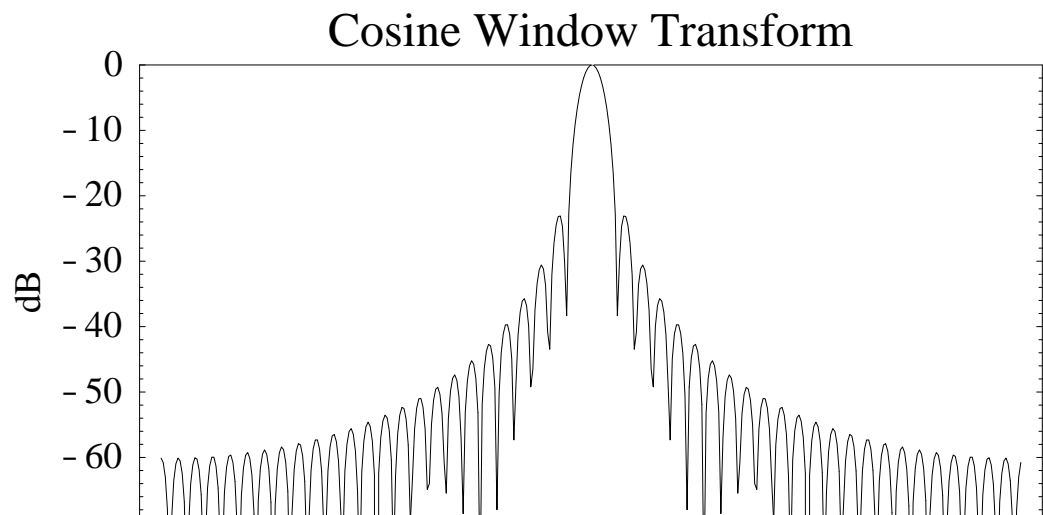
```
Options@CosineD
```

```
8Power  $\notin$  1<
```

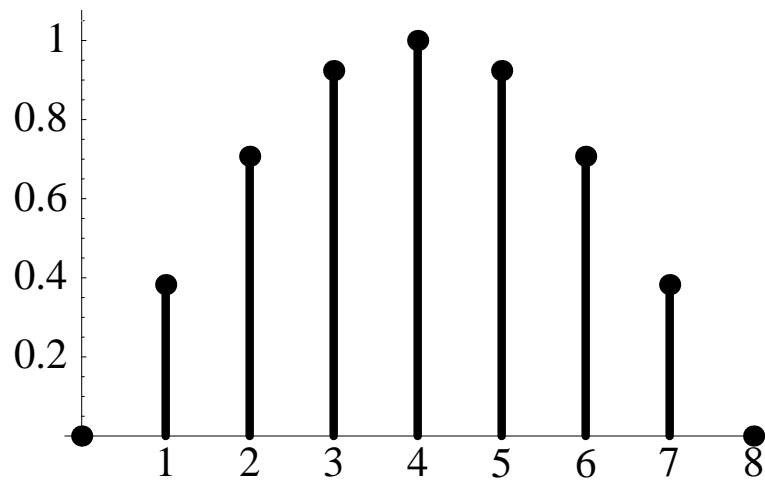
```
WindowPlot@CosineD;
```



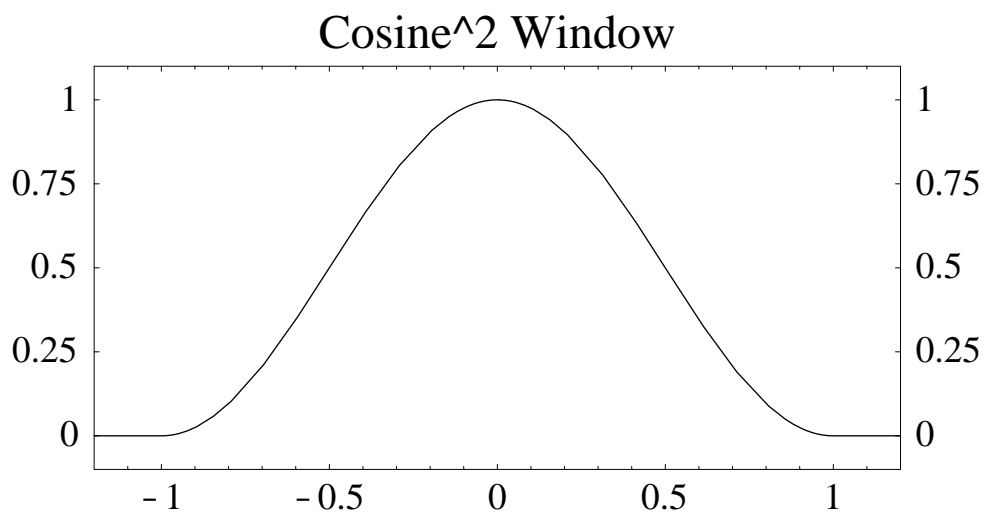
```
WindowTransformPlot@Cosine, PlotRange -> 8-69, 0<D;
```



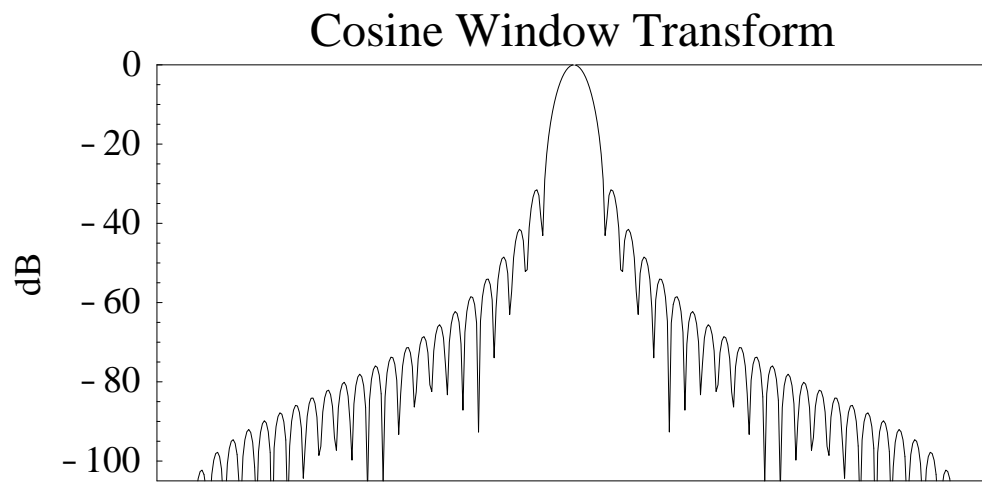
```
SeqPlot@CosineW@9DD;
```



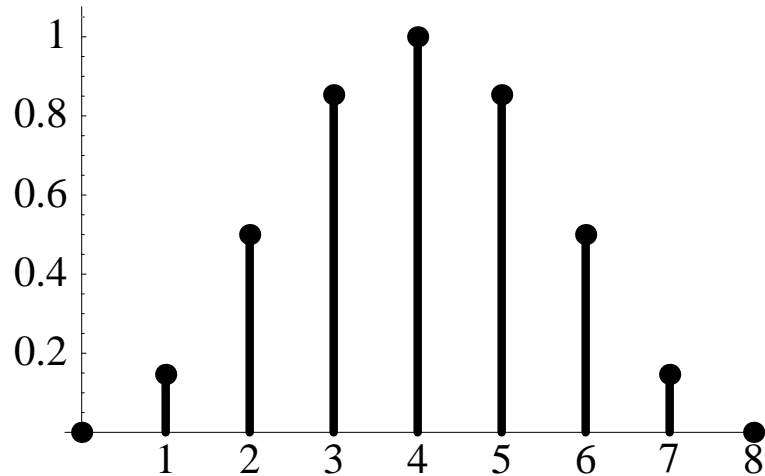
```
WindowPlot@Cosine, Power -> 2, Title -> "Cosine^2 Window"D;
```



```
WindowTransformPlot@Cosine, Power -> 2, PlotRange -> 8-105, 0<D;
```



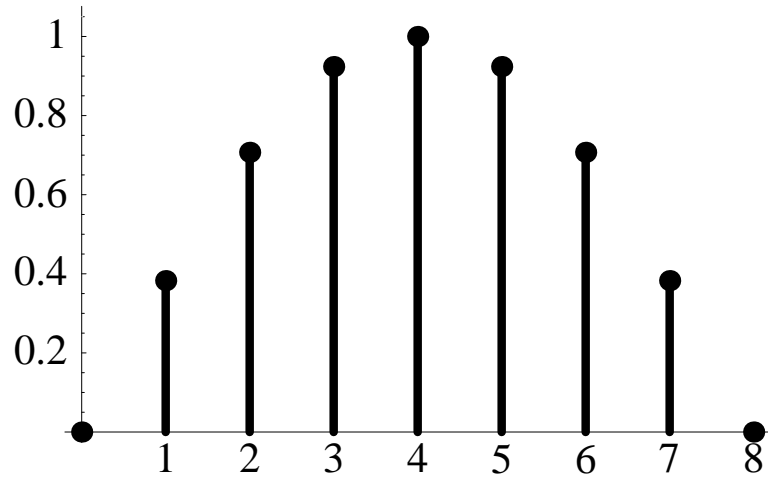
```
SeqPlot@CosineW@9, Power -> 2DD;
```



There are additional window functions called `CosinLobeW` which sets `Power` to 1, and `RaisedCosineW` function which sets `Power` to 2.

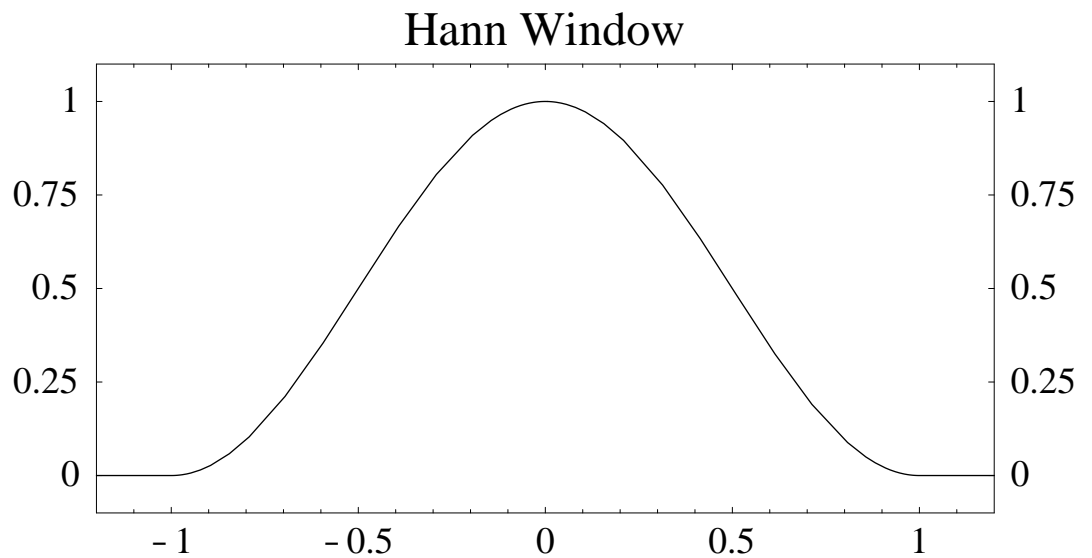


```
SeqPlot@CosineLobeW@9DD;
```

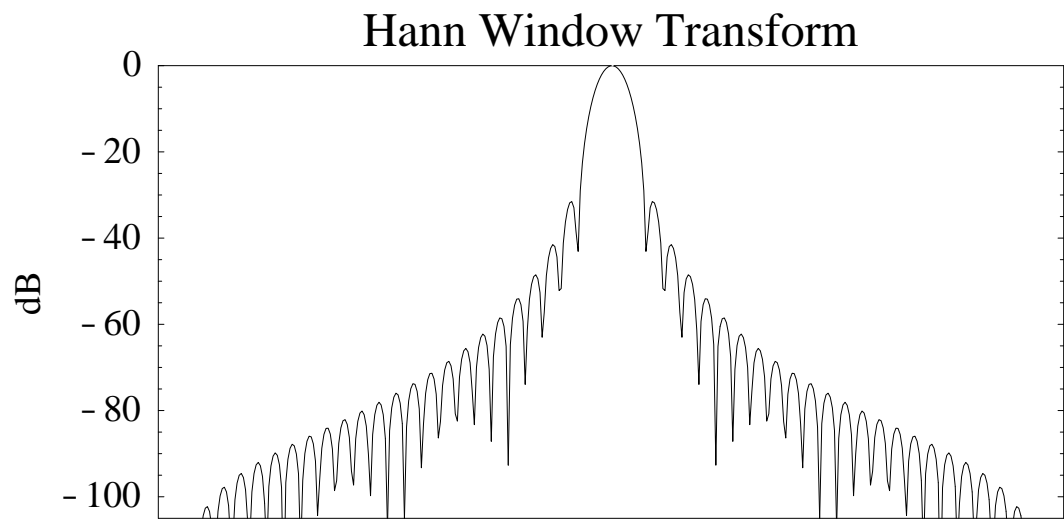


## Hann Window

```
WindowPlot@Hann D;
```



```
WindowTransformPlot@Hann, PlotRange -> 8-105, 0<D;
```

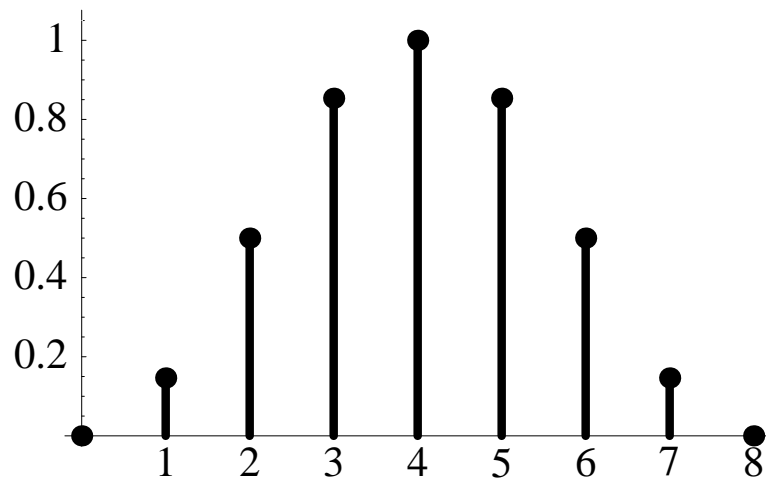


The Hann window is the same as a Cos<sup>2</sup> window:

```
Chop@CosineW@21, Power -> 2D - HannW@21DD
```

```
80, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0<
```

```
SeqPlot@HannW@9DD;
```

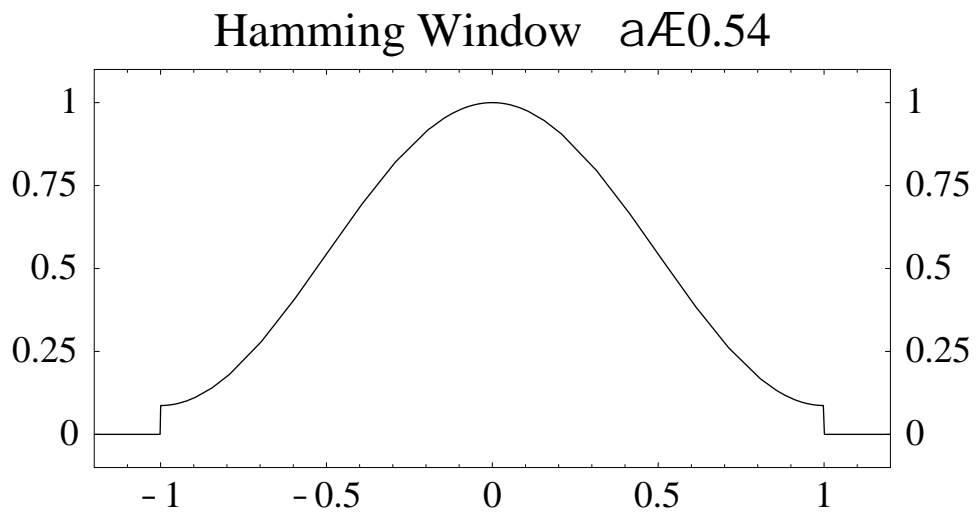


## Hamming Window

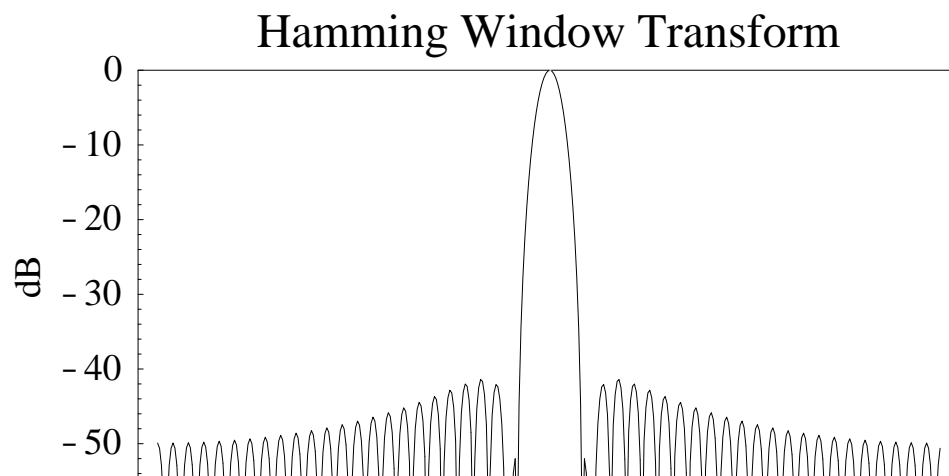
```
Options@HammingD
```

```
Options@HammingD = {Alpha -> 0.54}
```

```
WindowPlot@Hamming, Alpha -> 0.54, Title -> "Hamming Window  $\alpha=0.54$ ";
```



```
WindowTransformPlot@Hamming, PlotRange -> {8, -55, 0, 0};
```

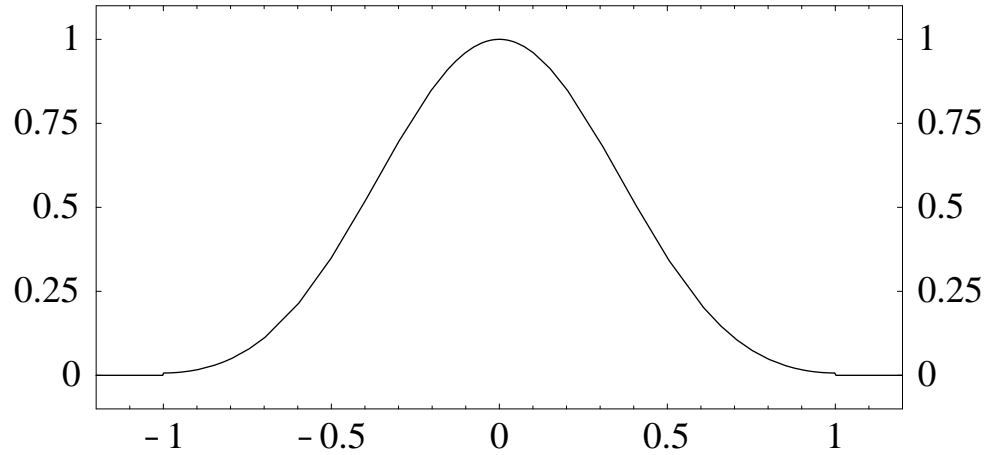


The Hann window is the same as a Hamming window with  $\alpha=0.5$ :



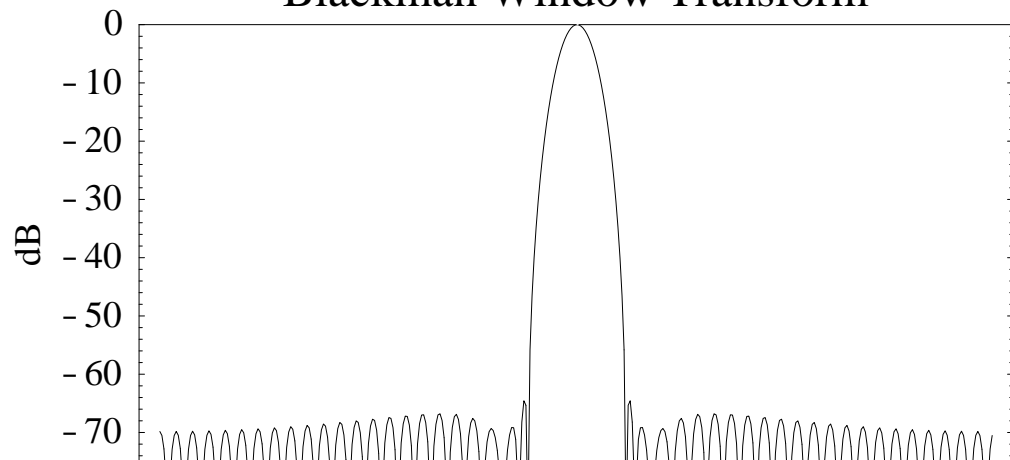
```
WindowPlot@Blackman,  
Title -> "Blackman Window a0→.427 a1→.497 a2→.077"D;
```

### Blackman Window a0→.427 a1→.497 a2→.077

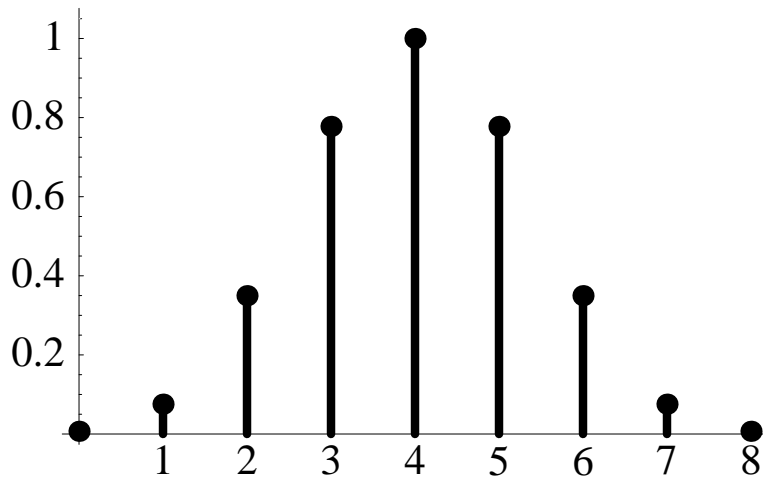


```
WindowTransformPlot@Blackman, PlotRange -> {8-75, 0}<D;
```

### Blackman Window Transform



```
SeqPlot@BlackmanW@9DD;
```



Note that the Blackman window does not get to 0 at its edges:

```
BlackmanF@1D
```

```
0.00687876
```

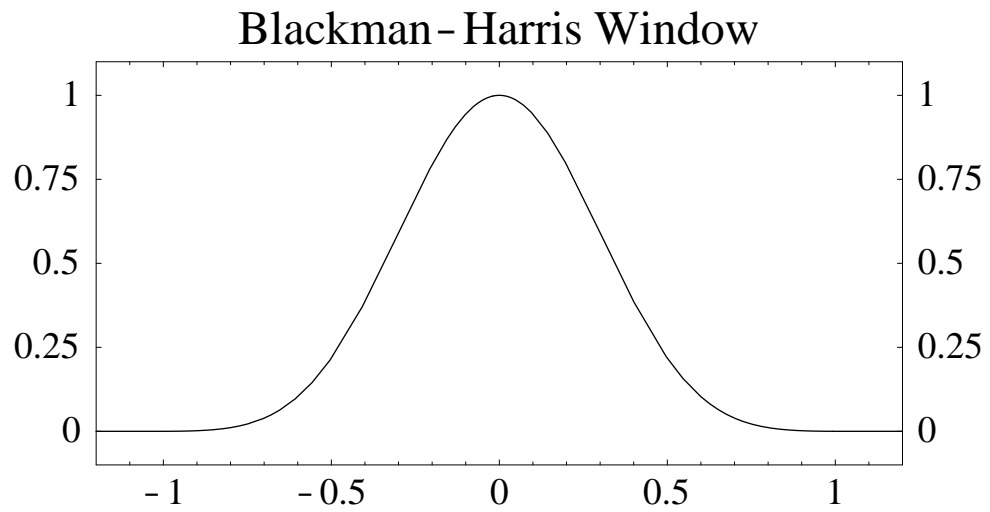
## Blackman-Harris Window

Default parameters are for the 4-Term -96dB Blackman-Harris window:

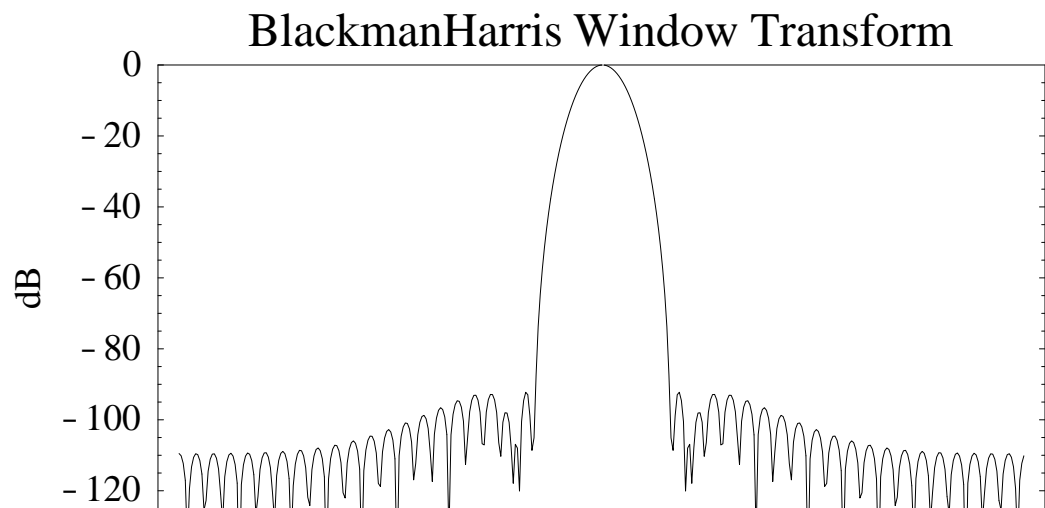
```
Options@BlackmanHarrisD
```

```
8A0 Æ 0.35875, A1 Æ 0.48829, A2 Æ 0.14128, A3 Æ 0.01168<
```

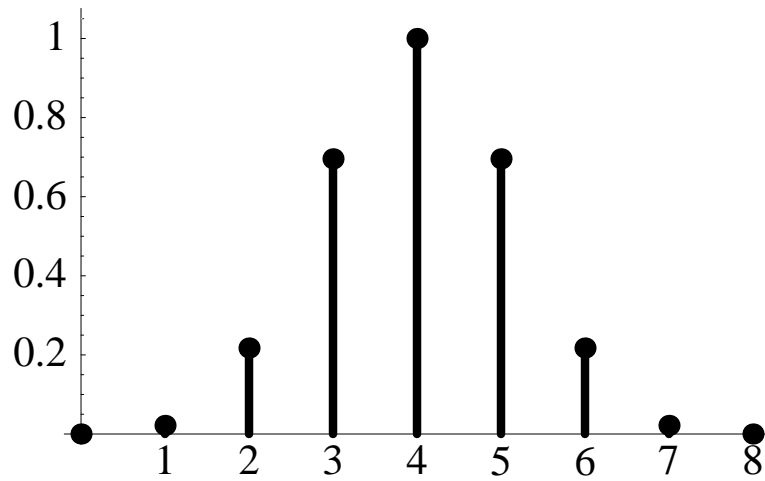
```
WindowPlot@BlackmanHarris, Title -> "Blackman-Harris Window"D;
```



```
WindowTransformPlot@BlackmanHarris, PlotRange -> 8-125, 0<D;
```



```
SeqPlot@BlackmanHarrisW@9DD;
```

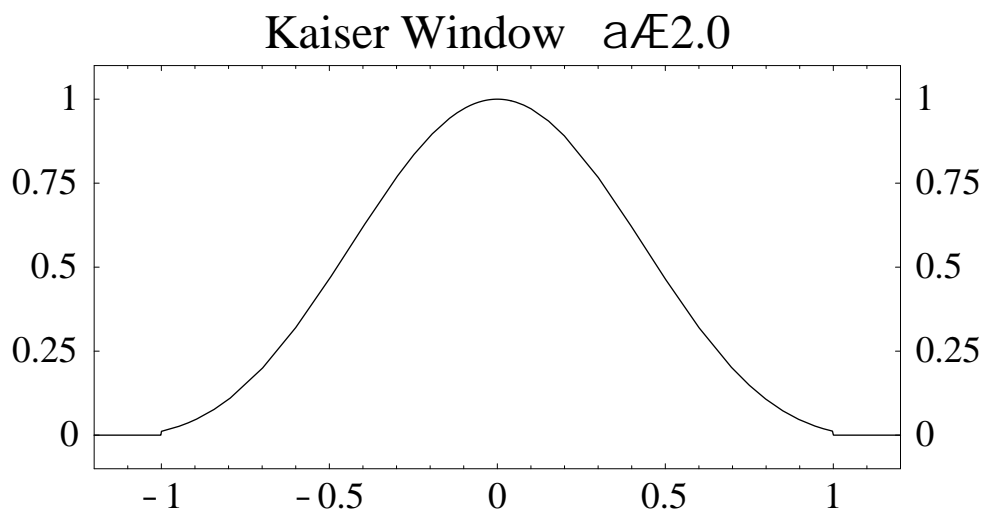


## Kaiser Window

```
Options@KaiserD
```

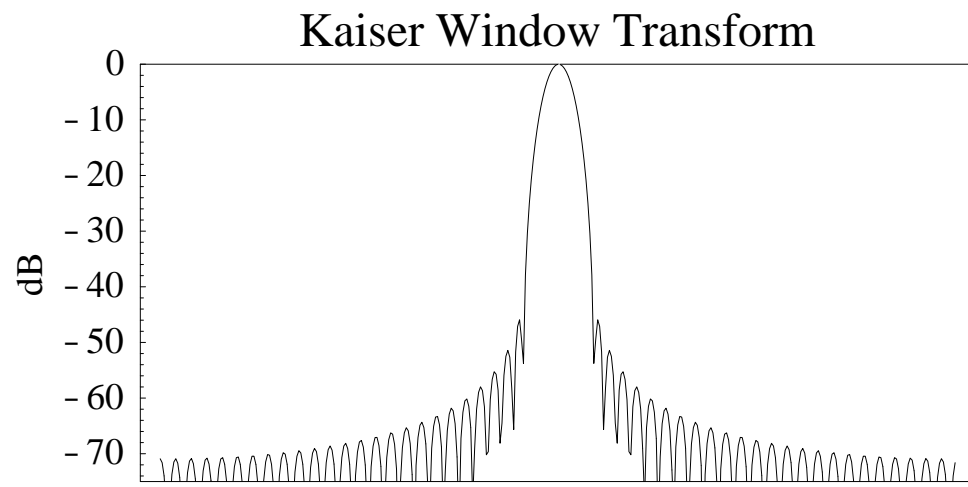
```
8Alpha  $\in$  2.<
```

```
WindowPlot@Kaiser, Title -> "Kaiser Window  $\alpha \rightarrow 2.0$ "D;
```

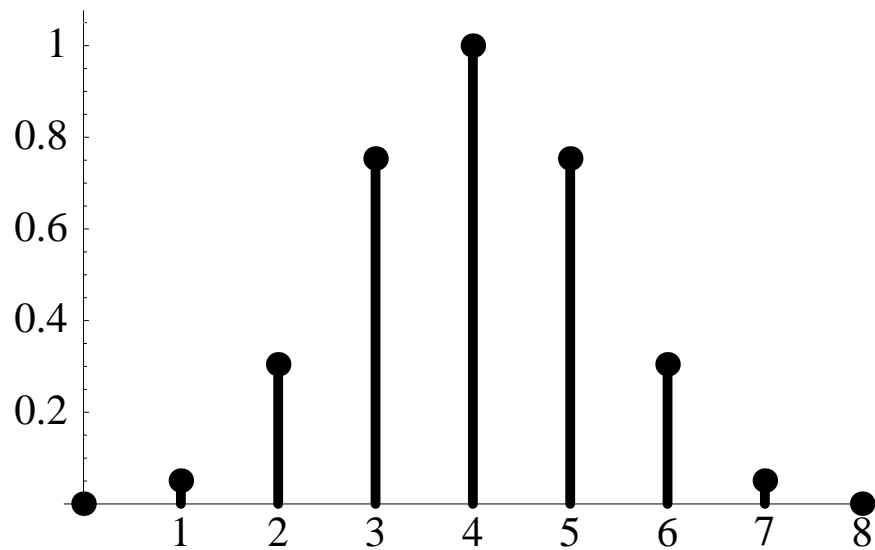




```
WindowTransformPlot@Kaiser, PlotRange -> 8-75, 0<D;
```



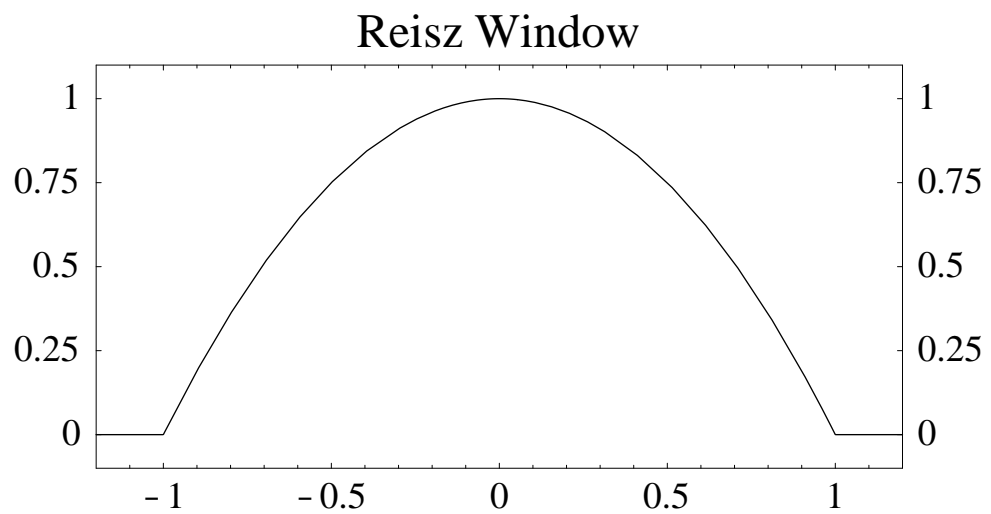
```
SeqPlot@KaiserW@9, Alpha -> 3.0DD;
```



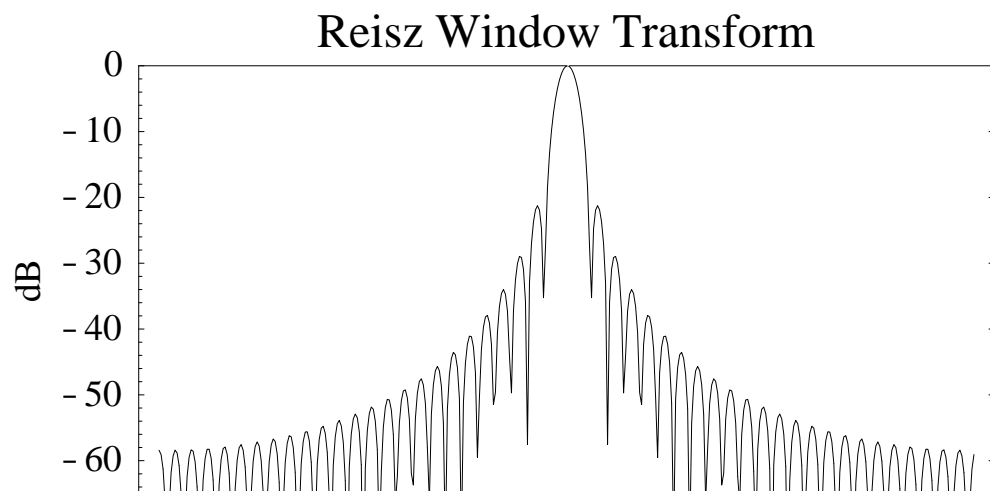
## Less Common Windows

### Riesz Window

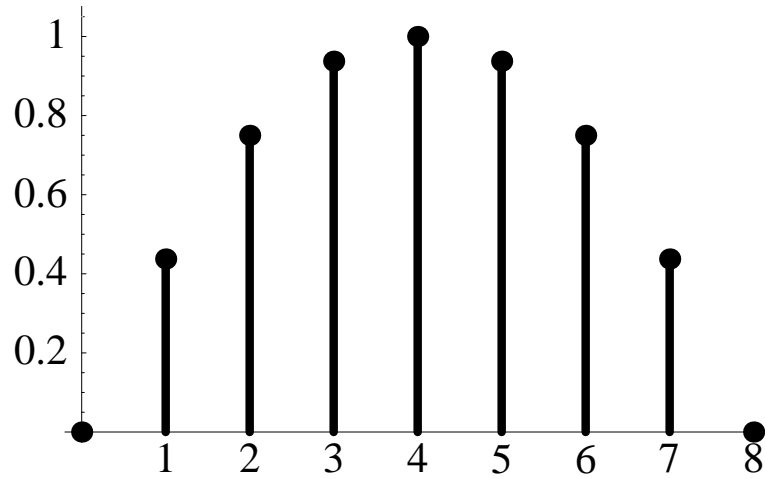
```
WindowPlot@ReiszD;
```



```
WindowTransformPlot@Reisz, PlotRange -> {8-65, 0<D};
```

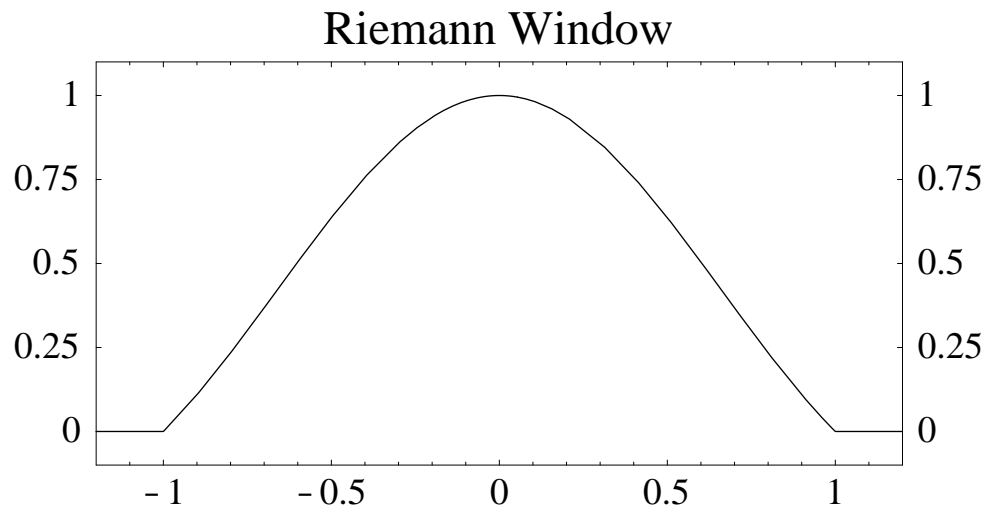


```
SeqPlot@ReiszW@9DD;
```

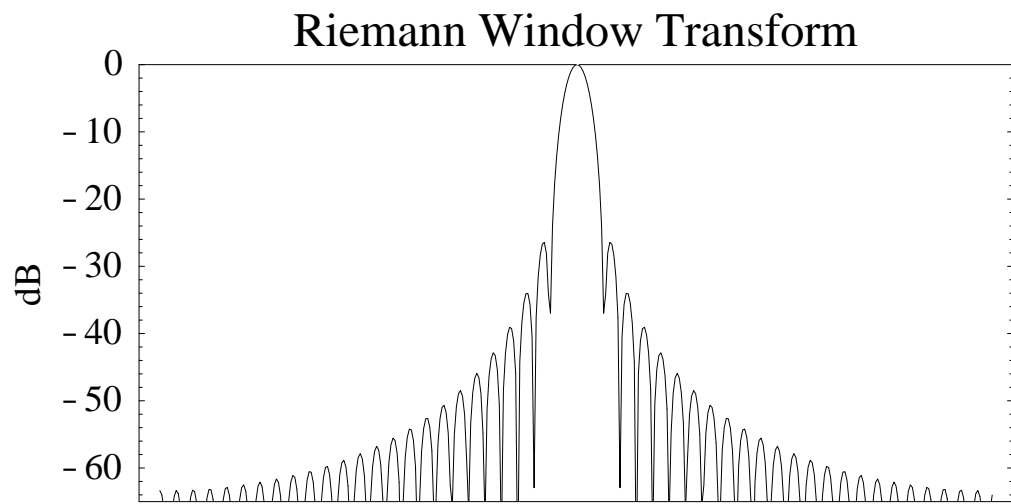


## Riemann Window

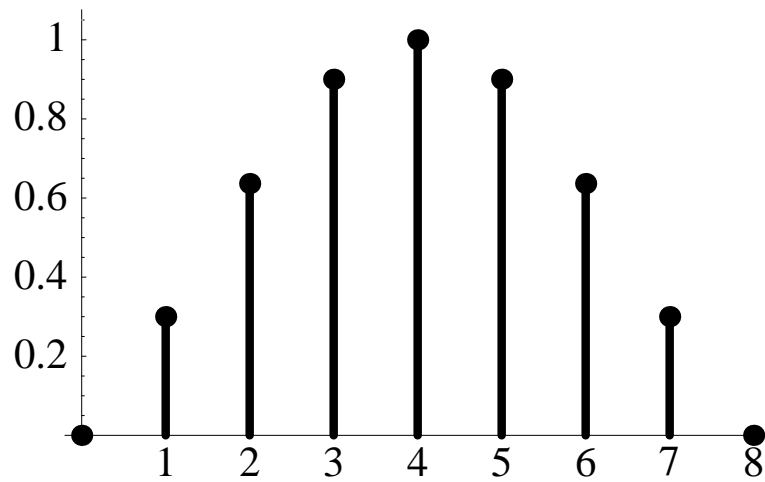
```
WindowPlot@RiemannD;
```



```
WindowTransformPlot@Riemann, PlotRange -> 8-65, 0<D;
```

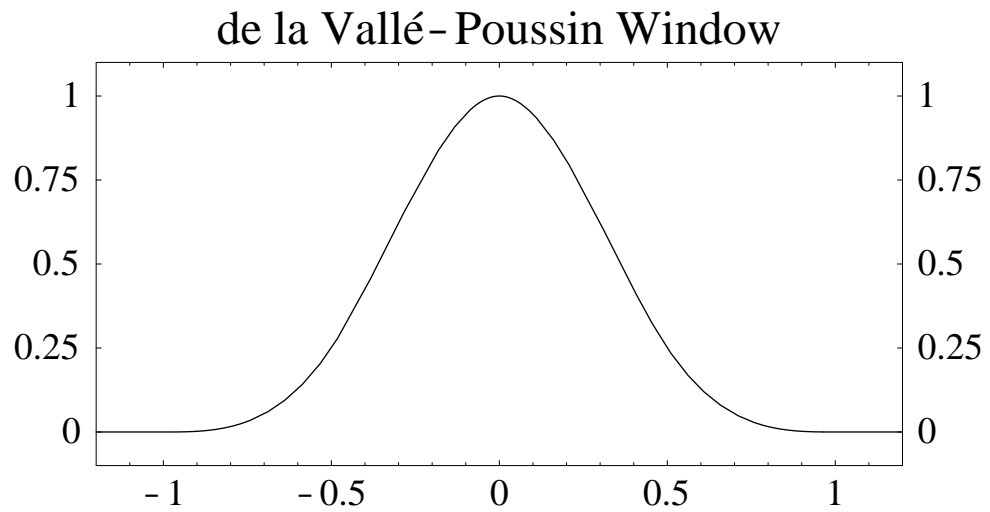


```
SeqPlot@RiemannW@9DD;
```

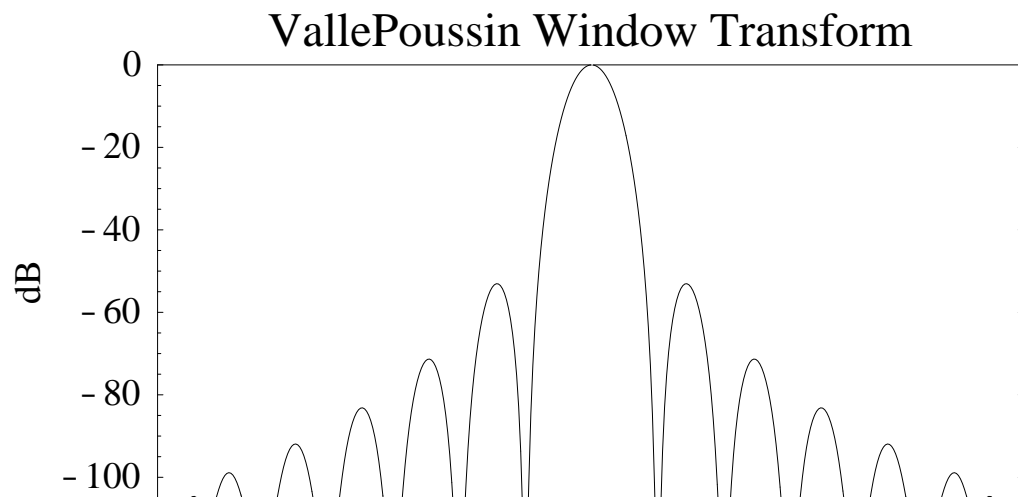


## de la Vallé-Poussin Window

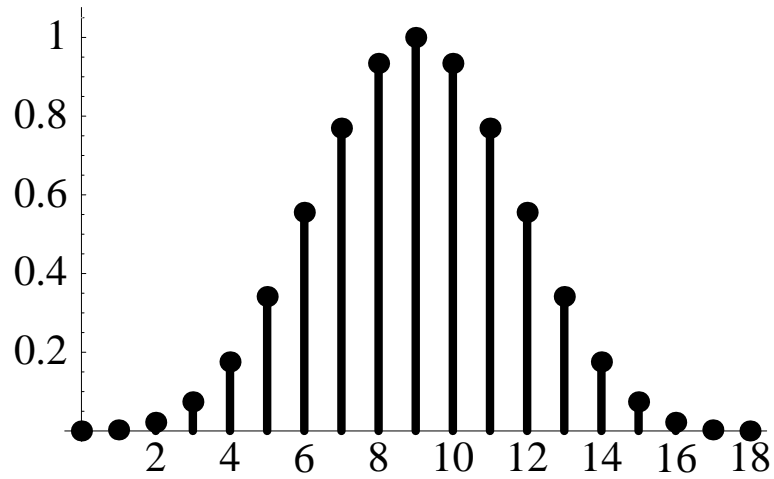
```
WindowPlot@VallePoussin, Title -> "de la Vallé-Poussin Window" D;
```



```
WindowTransformPlot@VallePoussin, PlotRange -> 8-105, 0<D;
```

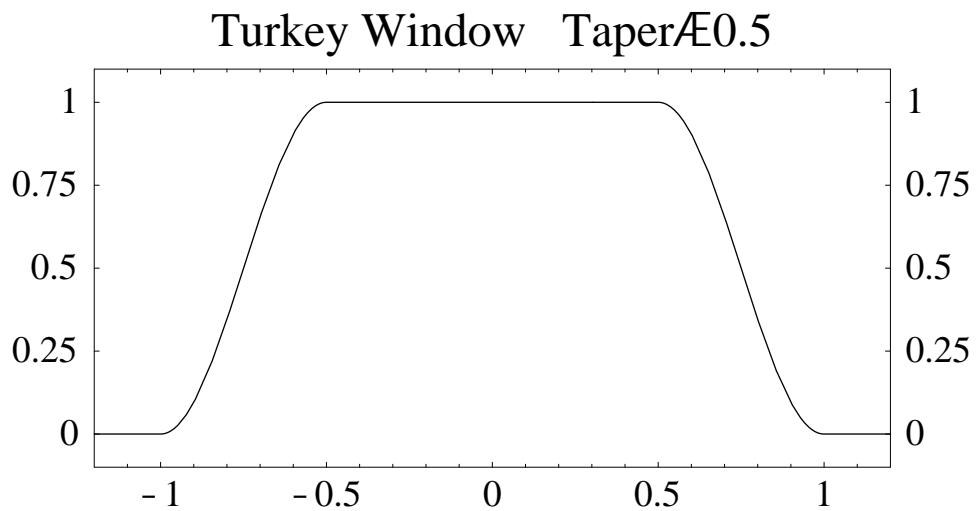


```
SeqPlot@VallePoussinW@19DD;
```

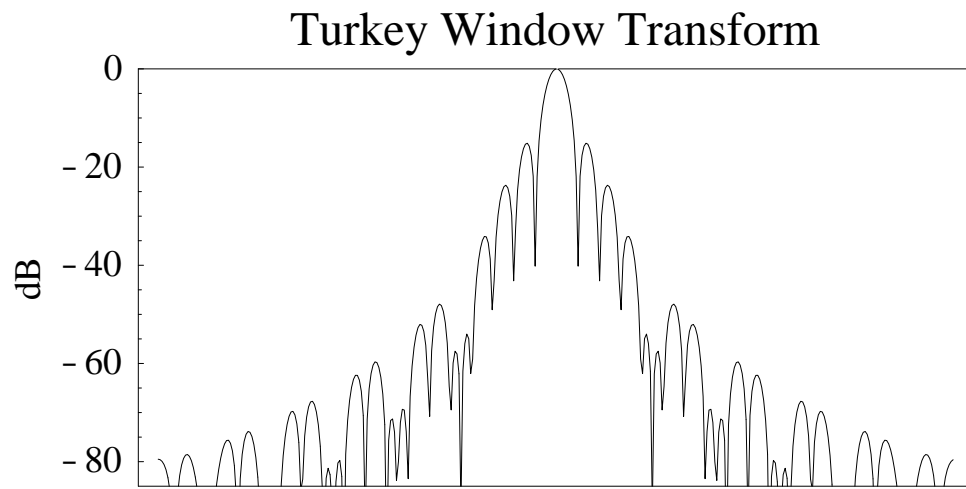


### Turkey Window

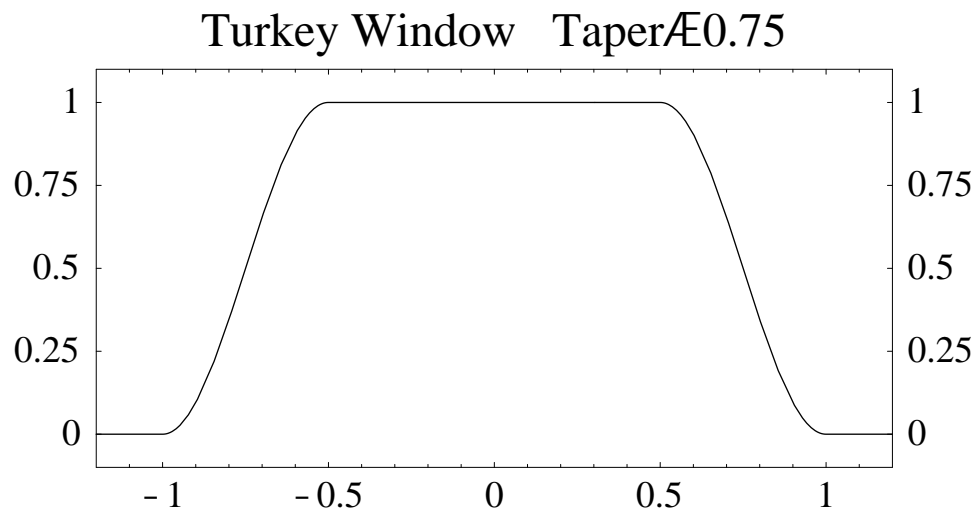
```
WindowPlot@Turkey, Taper -> 0.5, Title -> "Turkey Window Taper=0.5"D;
```



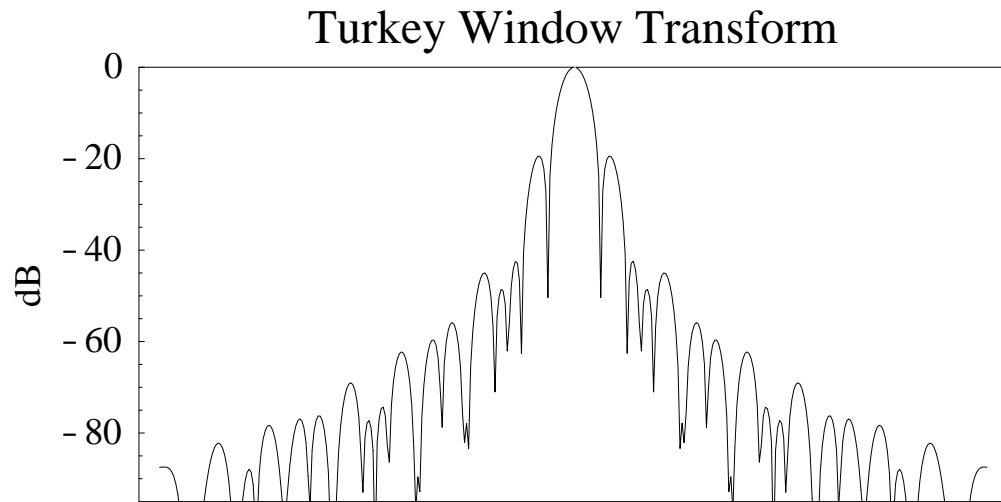
```
WindowTransformPlot@Turkey, Taper -> 0.5, PlotRange -> {8, -85}, 0 < D;
```



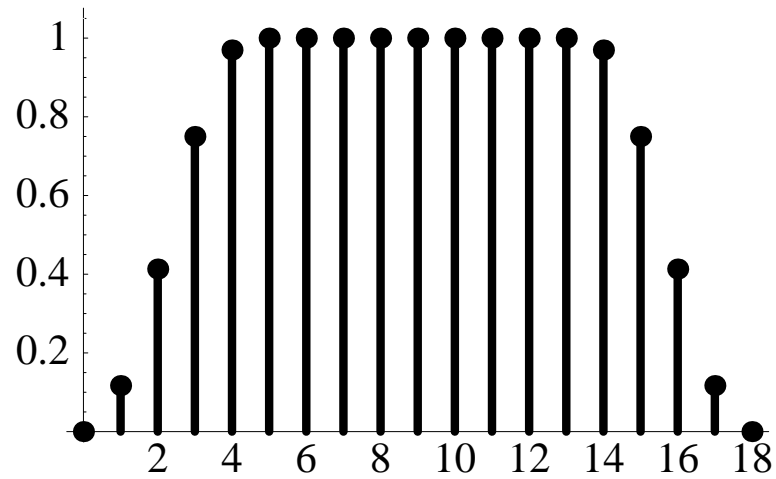
```
WindowPlot@Turkey, Taper -> 0.75, Title -> "Turkey Window Taper=0.75", D;
```



```
WindowTransformPlot@Turkey, Taper -> 0.75, PlotRange -> 8-95, 0<D;
```



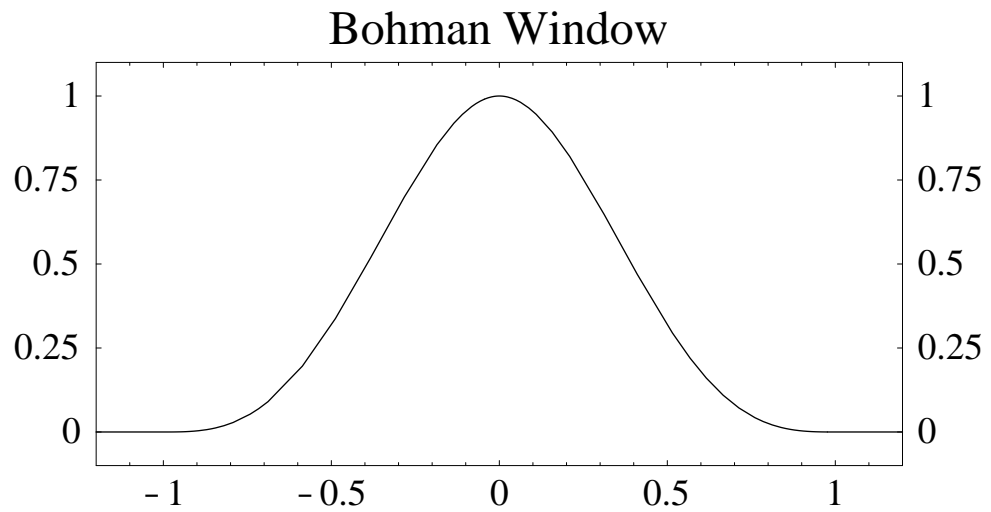
```
SeqPlot@TurkeyW@19DD;
```



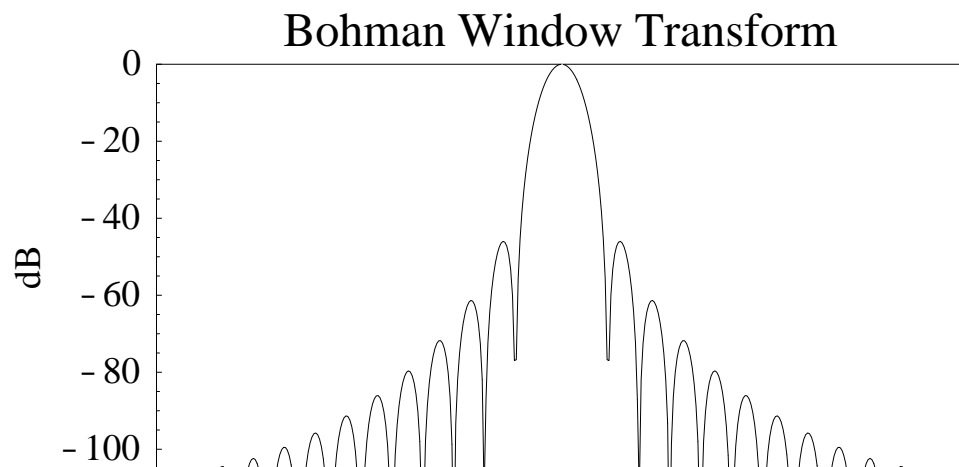


## Bohman Window

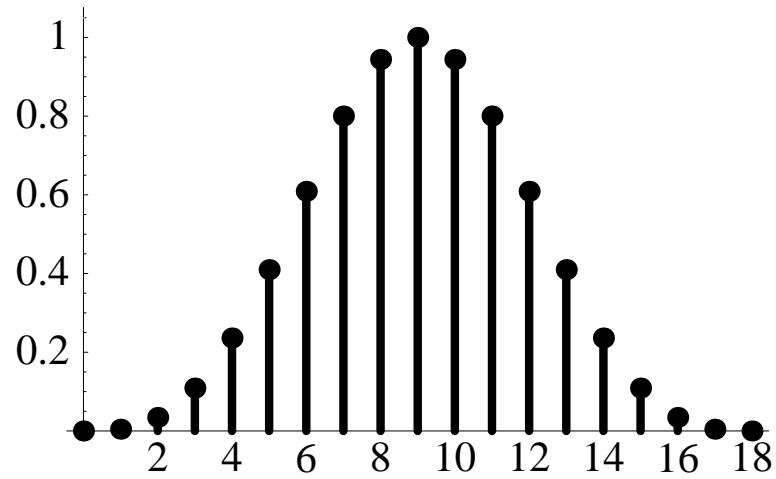
```
WindowPlot@BohmanD;
```



```
WindowTransformPlot@Bohman, PlotRange -> 8-105, 0<D;
```



```
SeqPlot@BohmanW@19DD;
```

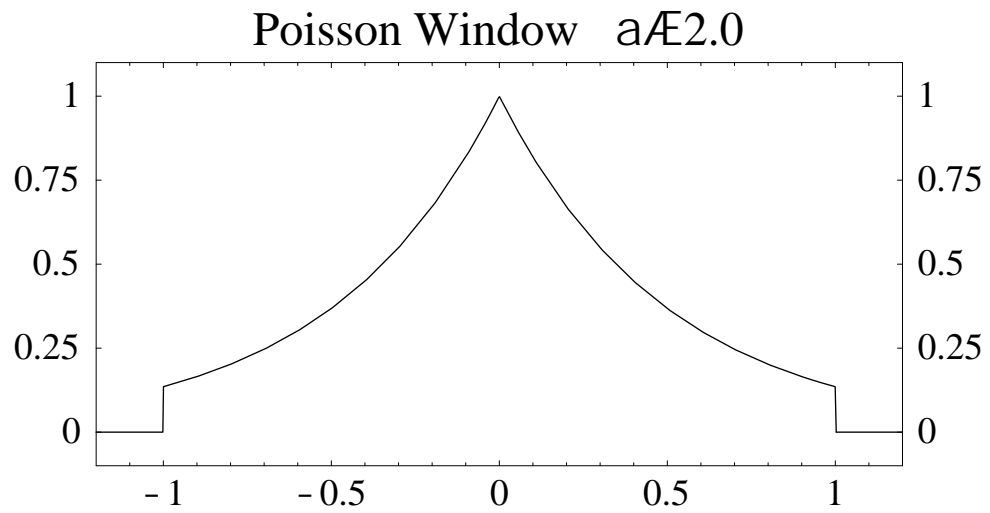


## Poisson Window

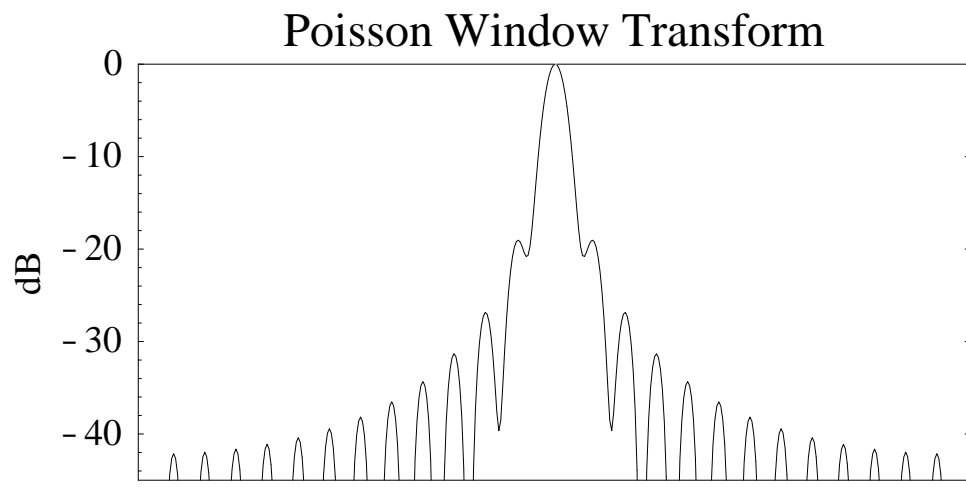
```
Options@PoissonD
```

```
8Alpha  $\in$  2.<
```

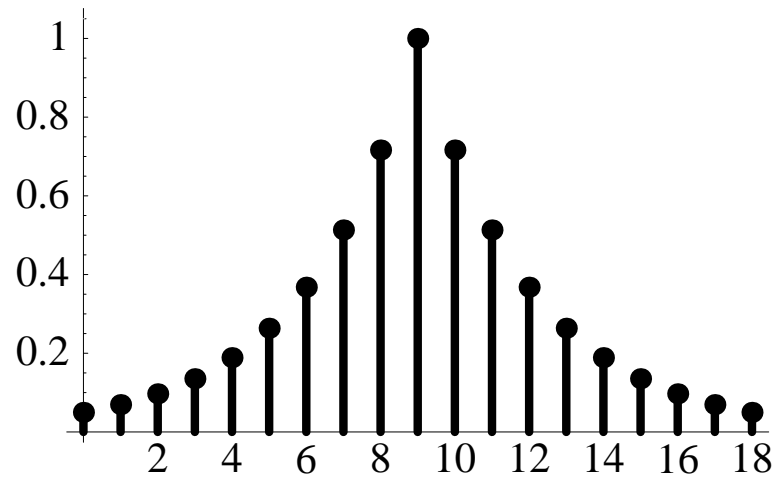
```
WindowPlot@Poisson, Title -> "Poisson Window  $\alpha \in 2.0$ "D;
```



```
WindowTransformPlot@Poisson, PlotRange -> 8-45, 0<D;
```



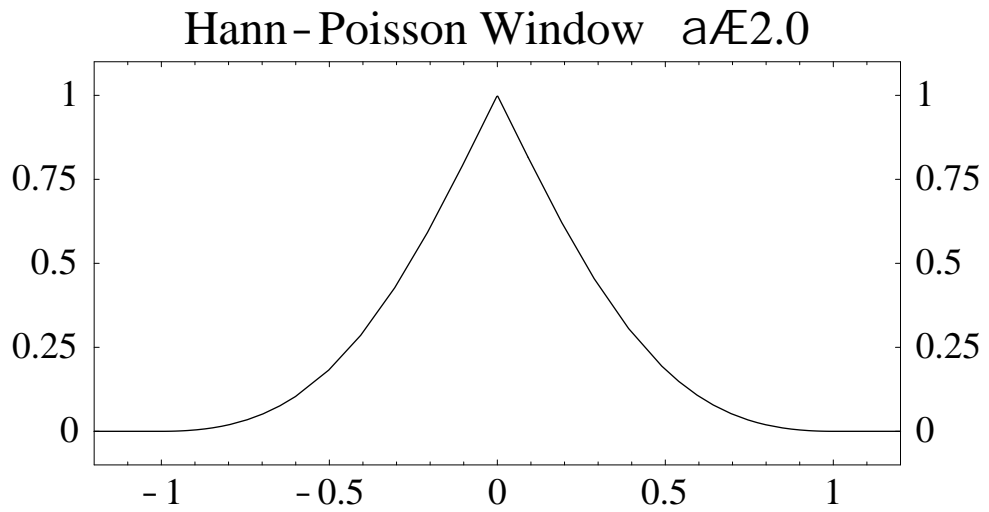
```
SeqPlot@PoissonW@19, Alpha -> 3.0DD;
```



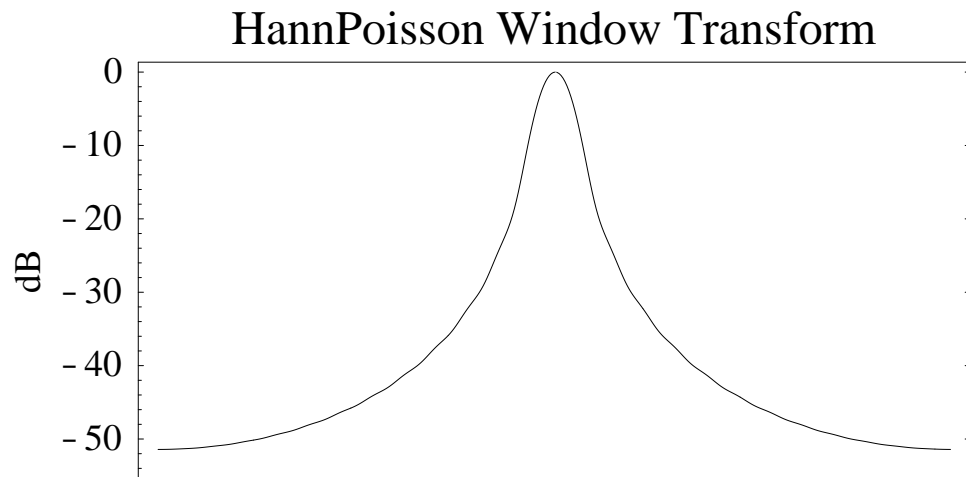
## Hann–Poisson Window

This window is a multiplication of the Hann window with the Poisson window.

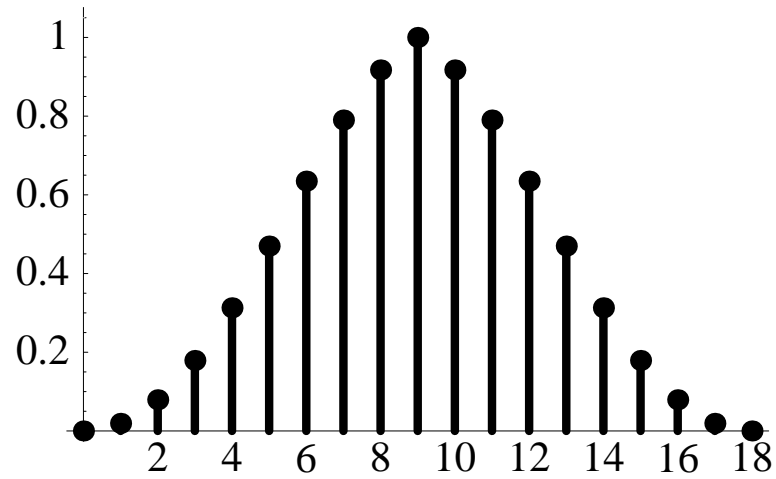
```
WindowPlot@HannPoisson, Title -> "Hann-Poisson Window  $\alpha=2.0$ "D;
```



```
WindowTransformPlot@HannPoissonD;
```



```
SeqPlot@HannPoissonW@19, Alpha -> 0.5DD;
```

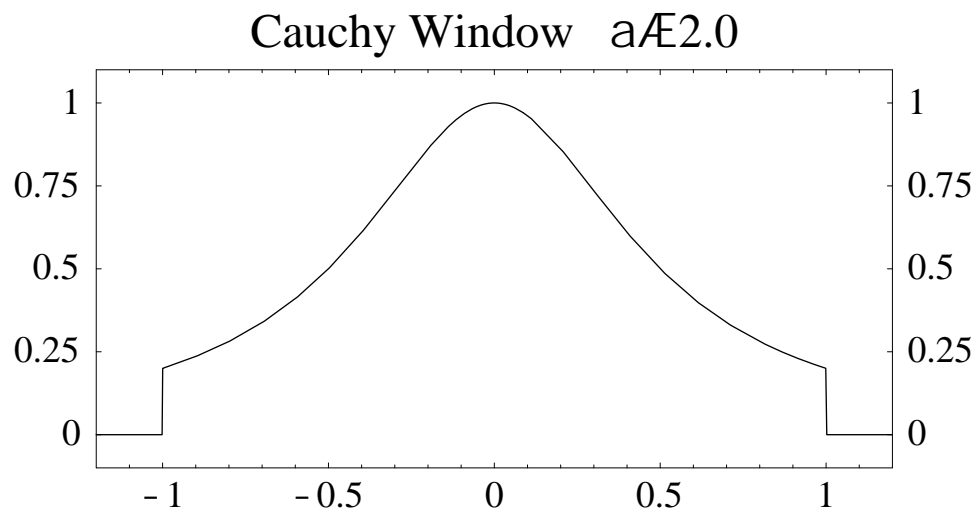


## Cauchy Window

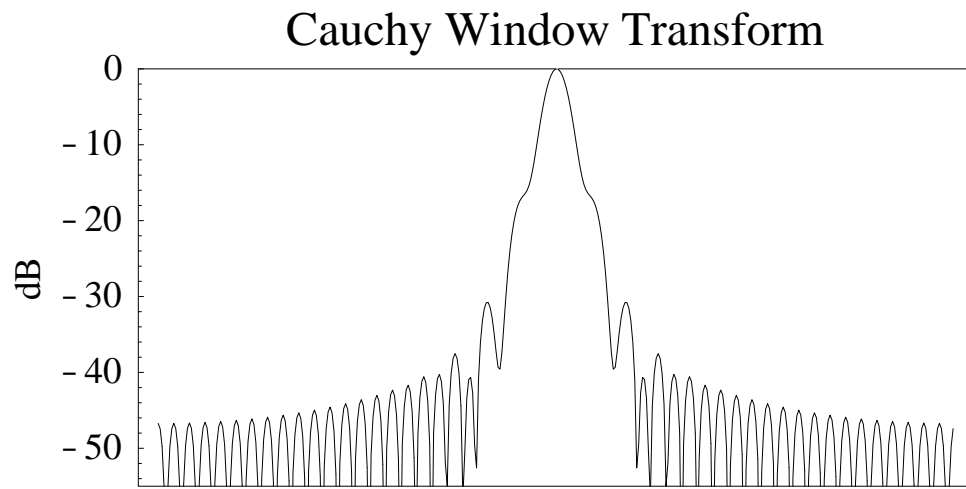
```
Options@CauchyD
```

```
8Alpha  $\in$  2.<
```

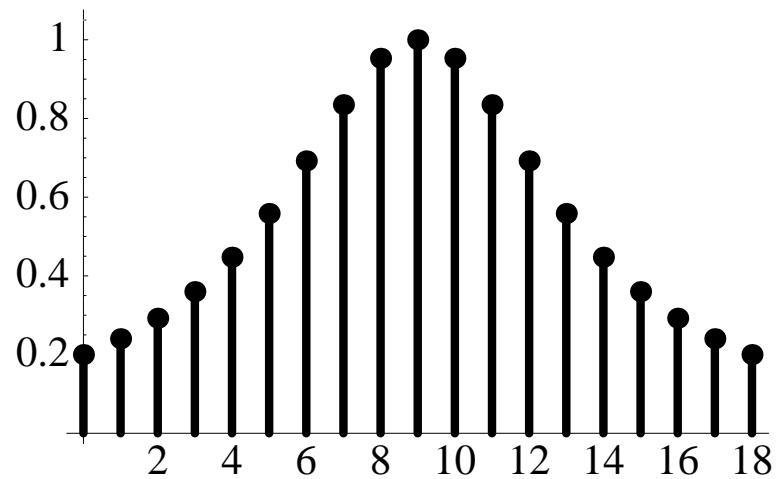
```
WindowPlot@Cauchy, Alpha -> 2.0, Title -> "Cauchy Window  $\alpha \rightarrow 2.0$ "D;
```



```
WindowTransformPlot@Cauchy, Alpha -> 3.0, PlotRange -> 8-55, 0<D;
```



```
SeqPlot@CauchyW@19DD;
```

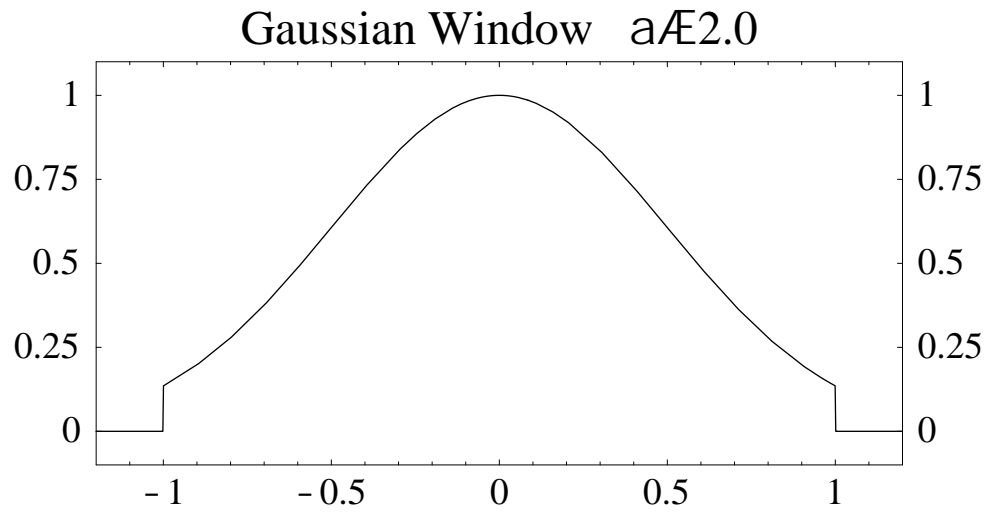


## Gaussian Window

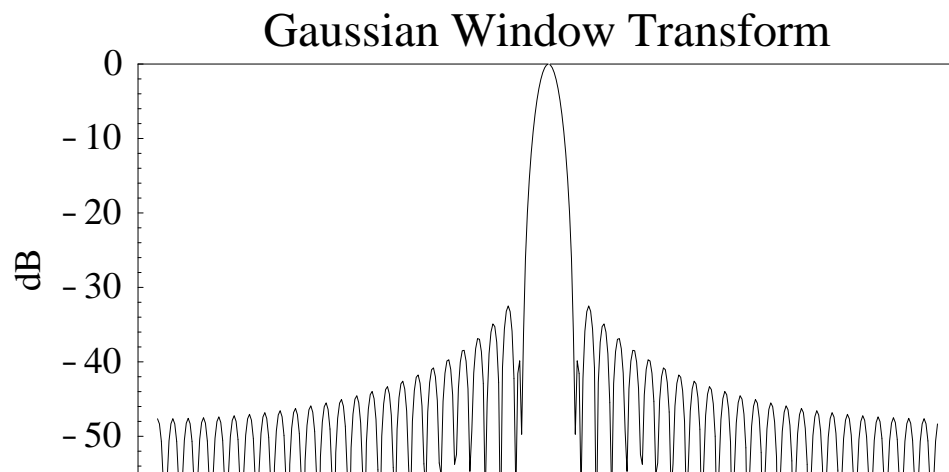
```
Options@GaussianD
```

```
8Alpha  $\in$  2.<
```

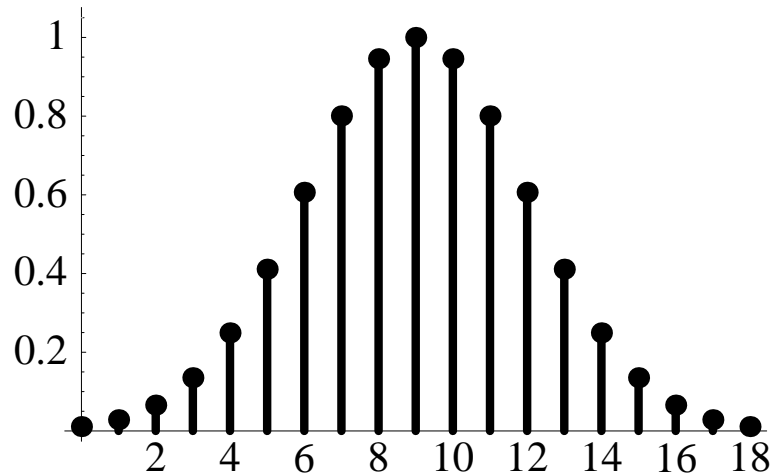
```
WindowPlot@Gaussian, Title -> "Gaussian Window  $\alpha=2.0$ "D;
```



```
WindowTransformPlot@Gaussian, PlotRange -> {8-55, 0}<D;
```



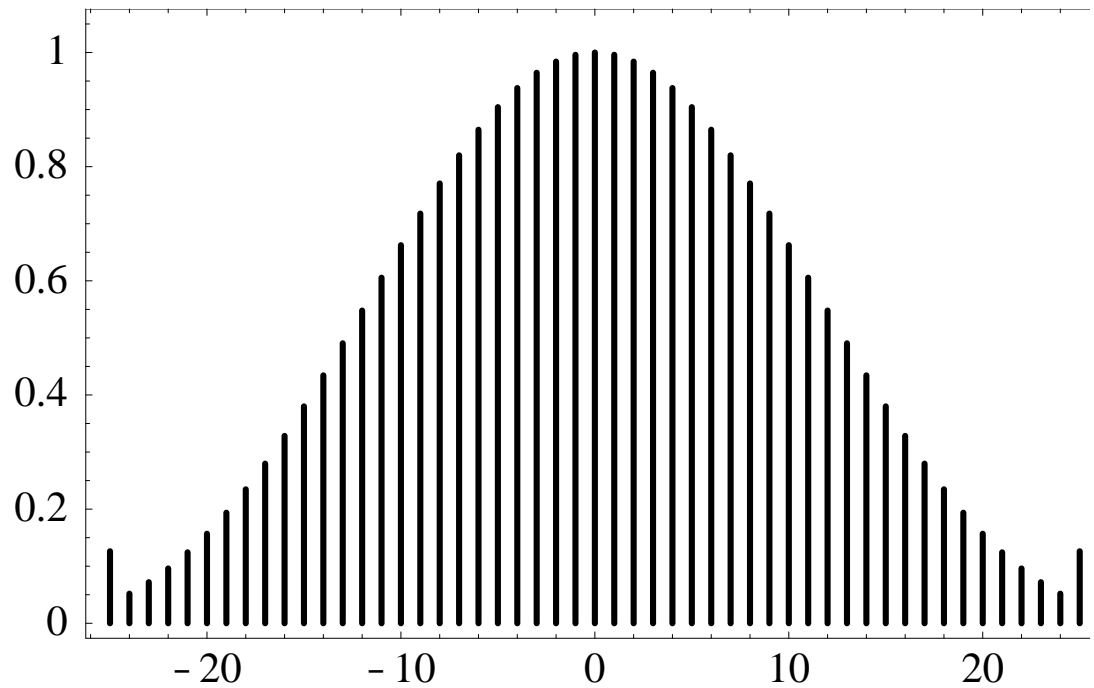
```
SeqPlot@GaussianW@19, Alpha -> 3.0DD;
```



## Dolph-Chebyshev Window

Note: there is no DolphChebyshevF continuous function due to the window generation algorithm.

```
SeqPlot@DolphChebyshevW@51, Causal -> False, Alpha -> 2.5D,  
Points -> False, LineStyle -> Thickness@0.006D, Causal -> False,  
Frame -> True, Axes -> False, FrameTicks -> AutomaticD;
```





## Barcilon–Temes Window

Not implemented

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## References

Harris, Frederic J. "On the Use of Windows for Harmonic Analysis with the Discrete Fourier Transform,"  
Proceedings of the IEEE, Vol.66, No.1 (January 1978) pp. 51–84.