

Common DTFT Pairs

$x[n]$	$X(e^{j\omega})$
$\delta[n]$	1
1	$2\pi \sum_{k=-\infty}^{\infty} \delta(\omega + 2\pi k)$
$u[n]$	$\frac{1}{1 - e^{-j\omega}} + \pi \sum_{k=-\infty}^{\infty} \delta(\omega + 2\pi k)$
e^{j3n}	$2\pi \sum_{k=-\infty}^{\infty} \delta(\omega - 3 + 2\pi k)$
$a^n u[n]$	$\frac{1}{1 - a e^{-j\omega}}$

DTFT Properties

Property name	$x[n], h[n]$	$X(e^{j\omega}), H(e^{j\omega})$
Linearity	$a x[n] + b h[n]$	$a X(e^{j\omega}) + b H(e^{j\omega})$
Time-shifting	$x[n-3]$	$e^{-j\omega 3} X(e^{j\omega})$
Frequency-shift	$e^{j3n} x[n]$	$X(e^{j(\omega-3)})$
$\frac{d}{d\omega} ()$	$-j n x[n]$	$\frac{d}{d\omega} X(e^{j\omega})$
convolution	$x[n] * h[n]$	$X(e^{j\omega}) H(e^{j\omega})$
multiplication	$x[n] h[n]$	$\frac{1}{2\pi} \int_{-\pi}^{\pi} X(e^{j\theta}) H(e^{j(\omega-\theta)}) d\theta$

DTFT Symmetries for real $x[n]$

$x[n] = x_{\text{even}}[n] + x_{\text{odd}}[n]$	$X(e^{j\omega}) = X_{\text{re}}(e^{j\omega}) + j X_{\text{im}}(e^{j\omega})$
$x_{\text{even}}[n]$	$X_{\text{re}}(e^{j\omega})$
$x_{\text{odd}}[n]$	$j X_{\text{im}}(e^{j\omega})$
	$ X(e^{j\omega}) $ and $X_{\text{re}}(e^{j\omega})$ are even from $-\pi$ to π $\angle X(e^{j\omega})$ and $X_{\text{im}}(e^{j\omega})$ are odd from $-\pi$ to π

DFT Properties

Property name	$x[n], h[n]$	$X[k], H[k]$
Linearity	$a x[n] + b h[n]$	$a X[k] + b Y[k]$
Time-shifting	$x[\langle n-3 \rangle_N]$	$e^{-j2\pi 3k/N} X[k]$
Frequency-shift	$e^{j2\pi 3n/N} x[n]$	$X[\langle k-3 \rangle_N]$
convolution	$x[n] * h[n]$ $\sum_{m=0}^{N-1} x[m] h[\langle n-m \rangle_N]$	$X[k] H[k]$
multiplication	$x[n] h[n]$	$\frac{1}{N} \sum_{m=0}^{N-1} G[m] H[\langle k-m \rangle_N]$

DFT Symmetries for real $x[n]$

$x[n] = x_{\text{even}}[n] + x_{\text{odd}}[n]$	$X[k] = X_{\text{pcs}}[k] + j X_{\text{pca}}[k]$
$x_{\text{pcs}}[n]$	$X_{\text{re}}[k]$
$x_{\text{pca}}[n]$	$j X_{\text{im}}[k]$
	$ X[k] $ and $X_{\text{re}}[k]$ pcs from 0 to N-1 $\angle X[k]$ and $X_{\text{im}}[k]$ pca from 0 to N-1