Parseval for D.T. F.T.

$$\sum_{n=-\infty}^{\infty} |x[n]|^2 = \frac{1}{2\pi}\int_{-\pi}^{\pi} |X(e^{j\omega})|^2 d\omega$$

Parseval's relation for D.F.T.

$$\sum_{n=0}^{N-1} |x[n]|^2 = \frac{1}{N}\sum_{k=0}^{N-1} |X[k]|^2$$

<u>Proof:</u>

$$x[n] \overset{N}{\longleftrightarrow} X[k], \quad k=0,1,\dots,N-1$$

$$x^*[-n] \overset{N}{\longleftrightarrow} X^*[+k], \quad k=0,1,\dots,N-1$$

$$x^*[n] \overset{N}{\longleftrightarrow} X^*[-k]$$

$$v[n] = x[n] \circledast_N x^*[-n] \overset{N}{\longleftrightarrow} V[k]=X[k]\,X^*[k]$$

$$k=0,1,\dots,N-1$$

$$V[k] = |X[k]|^2$$

$$v[n] = \sum_{l=0}^{N-1} x[l]\,x^*[l-n]$$

$$v[0] = \sum_{l=0}^{N-1} x[l]\,x^*[l] = \sum_{l=0}^{N-1} |x[l]|^2$$

$$v[n] = \frac{1}{N}\sum_{k=0}^{N-1} V[k]\,e^{+j\frac{2\pi kn}{N}}$$

$$v[0] = \frac{1}{N}\sum_{k=0}^{N-1} |X[k]|^2 \cdot 1 = \sum_{l=0}^{N-1} |x[l]|^2$$

Q.E.D.