

Load Characteristic PQWave

The load will be treated as the following function of voltage

$$P_{MW} = MW_{init}(KQ_{scale}) \left(\frac{V}{V_{init}} \right)^{nP}$$

$$Q_{Mvar} = Mvar_{init}(KP_{scale}) \left(\frac{V}{V_{init}} \right)^{nQ}$$

Blue entries are input parameters.

Green entries are values from the initial condition

Until the time of the simulation reaches **StartTime**,

KPscale = **KQscale** = 1.00.

After **StartTime**, an oscillation is followed.

If **OscType** = 0 or 3: Square Wave or Ramp Wave (see image to upper right)

KPscale is (1+**DPup**) for a fraction of **DutyCycleUp** of the Period (**OscType**=3 ramps)

KPscale is (1+**DPdown**) for a fraction of **DutyCycleDown** of the Period (**OscType**=3 ramps)

If **OscType** = 1: Triangle Wave (see image to right)

If **OscType** = 2: Sinusoidal Wave (see image to right)

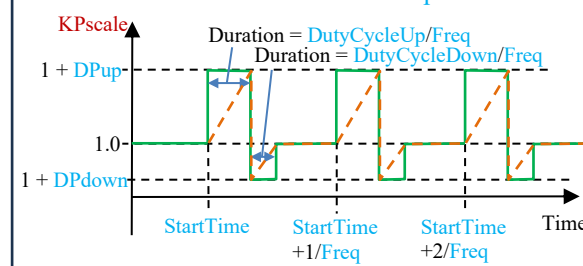
$$KP_{scale} = 1 + \frac{DP_{up} + DP_{down}}{2} + \frac{DP_{up} - DP_{down}}{2} \sin \left[2\pi Freq(t - StartTime) - \sin^{-1} \left(\frac{DP_{up} + DP_{down}}{DP_{up} - DP_{down}} \right) \right]$$

$$KQ_{scale} = 1 + \frac{DQ_{up} + DQ_{down}}{2} + \frac{DQ_{up} - DQ_{down}}{2} \sin \left[2\pi Freq(t - StartTime) - \sin^{-1} \left(\frac{DQ_{up} + DQ_{down}}{DQ_{up} - DQ_{down}} \right) \right]$$

Note: For complete control, use the PlayInLoad model instead where any user-specified playin signal can be used to control **KPscale** and **KQscale**.

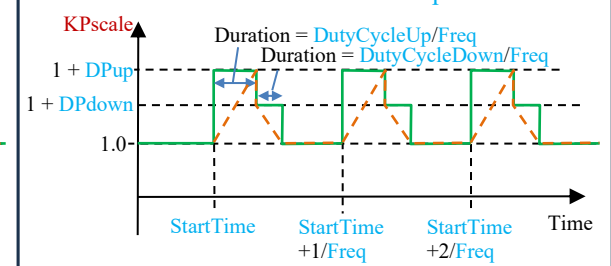
OscType = 0 or 3

Allow any sign for
DPup and DPdown



OscType = 0 or 3

Allow any sign for
DPup and DPdown

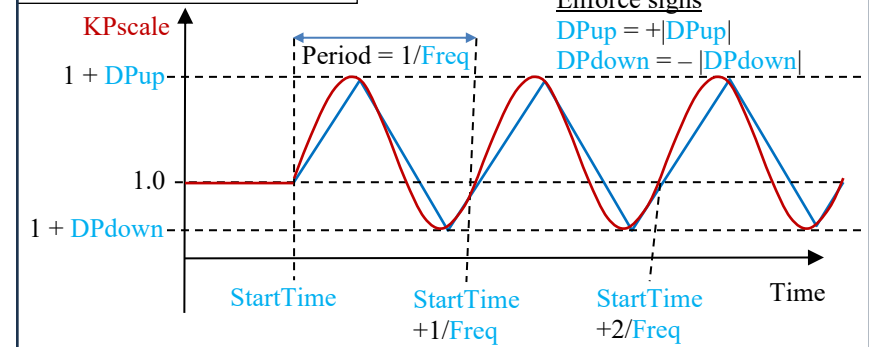


OscType = 1 or 2

Enforce signs

DPup = +|DPup|

DPdown = -|DPdown|



Parameters	Description	Default
OscType	Integer indicating which type of oscillation to use; 0 means a square wave; 1 means a triangle wave; 2 means a sinusoidal wave; All other values will be a square wave	0
StartTime	Start time of oscillation [seconds]	1.0
Freq	Frequency of Oscillation [Hz] (Period of oscillation will be 1/Freq)	1.0
DPup	Delta up value for real power as a fraction of the initial power (For OscType 1 and 2, force >=0)	0.0
DPdown	Delta down value for real power as a fraction of the initial power (For OscType 1 and 2, force <=0)	-0.5
DQup	Delta up value for reactive power as a fraction of the initial power (For OscType 1 and 2, force >=0)	0.0
DQdown	Delta down value for reactive power as a fraction of the initial power (For OscType 1 and 2, force <=0)	-0.5
DutyCycleUp	For the square wave, this is the fraction (0.001 – 0.999) of the oscillation period where scale is Up	0.5
DutyCycleDown	For the square wave, this is the fraction (0.001 – 0.999) of the oscillation period where scale is Down	0.5
nP	Exponent of voltage used for the real power load. Any number can be used, but 0 represents constant power, 1 represents constant current, and 2 represents constant impedance.	1.0
nQ	Exponent of voltage used for the reactive power load. Any number can be used, but 0 represents constant power, 1 represents constant current, and 2 represents constant impedance.	2.0
PF	Power factor of load. ; PF=0 indicates to use the Q value from the load record directly ; PF>0 indicates positive Mvars ; PF<0 indicates negative Mvars	0.0