

## clock\_1.xce

### Attributes

```
main_vars: y
rparms:
+   t0=0
+   x_high=1
+   dt1=0.01
+   dt2=0.01
+   frequency=10
+   duty_cycle=0.5
```

### Description

clock\_1.xce is a square wave source with `y` as the output. The parameters have the following meaning:

**frequency:** Frequency.

**duty\_cycle:** The ratio  $T_1/(T_1 + T_2)$  where  $T_1$  is the “high” interval and  $T_2$  is the “low” interval. The output is equal to `x_high` during the  $T_1$  phase and 0 during the  $T_2$  phase.

**t0:** An “offset” time interval. Its meaning will become clear in the following example.

**dt1:** Width of the transition at the beginning of the  $T_1$  phase.

**dt2:** Width of the transition at the beginning of the  $T_2$  phase.

Note that the transition width is included in  $T_1$  or  $T_2$ . For example, consider `frequency=100` and `duty_cycle=0.3`. For these parameters,  $T=1/\text{frequency}=10$  ms, and  $T_1$  and  $T_2$  will be computed to be  $T_1 = 0.3 \times T = 3$  ms,  $T_2 = 0.7 \times T = 7$  ms. If `dt1` has been specified as 0.2 ms, then, at the beginning of the  $T_1$  phase, there would be a rising edge of 0.2 ms durations, followed by a “high” (constant) level for 2.8 ms.

AC behaviour is not implemented.

The effect of the various parameters of `clock_1.xce` on the waveforms is shown in Fig. 1. The corresponding circuit file is given below.

```

begin_circuit
    xelement type=clock_1 y=y1
+   x_high=1
+   frequency=5
+   dt1=0.02
+   dt2=0.02
+   t0=0
+   duty_cycle=0.5

    xelement type=clock_1 y=y2
+   x_high=1
+   frequency=5
+   dt1=0.02
+   dt2=0.02
+   t0=0
+   duty_cycle=0.3

    xelement type=clock_1 y=y3
+   x_high=1
+   frequency=5
+   dt1=0.005
+   dt2=0.005
+   t0=0.18
+   duty_cycle=0.5

    outvar:
+   y1=xvar_of_y1
+   y2=xvar_of_y2
+   y3=xvar_of_y3
end_circuit

begin_solve
    solve_type=trns
    begin_output
        filename=clock_1_xce.dat
        variables: y1 y2 y3
    end_output
    method: forward_euler=yes
+   t_start=0 t_end=0.6 delt_const_x=0.05
end_solve

```

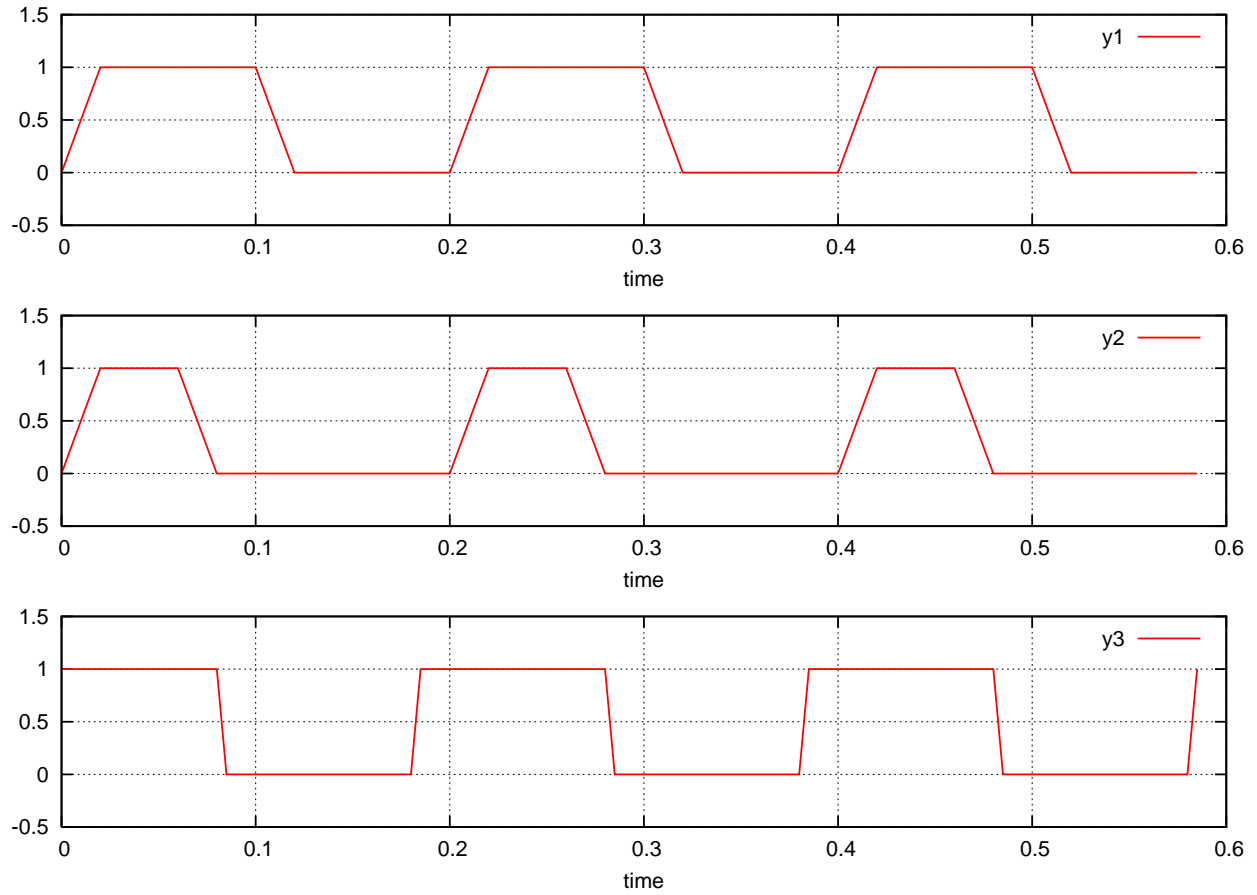


Figure 1: Waveforms obtained with `clock_1.xce`: (a) `x_high=1`, `frequency=5`, `dt1=0.02`, `dt2=0.02`, `t0=0`, `duty_cycle=0.5`, (b) `x_high=1`, `frequency=5`, `dt1=0.02`, `dt2=0.02`, `t0=0`, `duty_cycle=0.3`, (c) `x_high=1`, `frequency=5`, `dt1=0.005`, `dt2=0.005`, `t0=0.18`, `duty_cycle=0.5`.