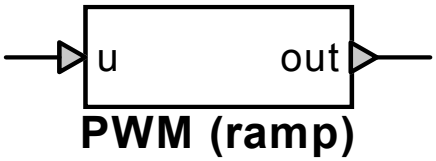
Control function: PWM controller, ramp reference



1 Description

This device is an implementation of a PWM (pulse-width modulation) controller with a rising-ramp reference. For a version with a triangular reference (ramp up and ramp down), use the device "PWM, triangular reference".

1.1 Pins

This device has two pins:

pin	*type*	*description*
u	input	controller input
out	output	controller output

1.2 Parameters

The following parameters must be defined:

parameter	*description*	*units*
fc	carrier frequency	Hz
umax	maximum input value (at duty ratio =1)	units of u
stepped	=1 to indicate stepped transitions =0 to indicate ramped transitions	

The value of the parameter *stepped* determines whether the device operates with *stepped* or *ramped* transitions. In *stepped* mode (the default for ideal logical signals), the output is represented as a stepped signal, where changes in value are observed as vertical steps at the time they occur. In *ramped* mode, the value transitions of the output are seen as ramps between $t-\Delta t$ and t.

1.3 Input

The input pin may be connected to any control signal.

1.4 Output

The output is a pulse-width modulated signal of value 0 or 1. It consists of a sequence of variable-width pulses generated at frequency *fc*. The witdh of each pulse corresponds to the scaled amplitude of the input signal. When the input value is *umax*, the pulse is *on* for a full period, that is, pulse width = period = 1/*fc* .
When the input value is *0*, the pulse is *off* for a full period, that is, pulse width = 0 .

The representation of the output as having *stepped* or *ramped* transitions is determined by the value given to the parameter *stepped*.

1.5 Representation

The implementation of the model can be inspected by opening the device's subcircuit.

The model applies the following equation:

$$\begin{aligned} &\text{when input} > \text{reference} \quad \text{output} = 1 \\ &\text{when input} \le \text{reference} \quad \text{output} = 0 \end{aligned} \tag{1}$$

where *reference* is the instantaneous value of the generated ramp train calculated as

$$\text{reference} = \text{umax} \cdot \frac{t}{T} \qquad \text{for } 0 \le t < T\text{, repeated every period} \tag{2}$$

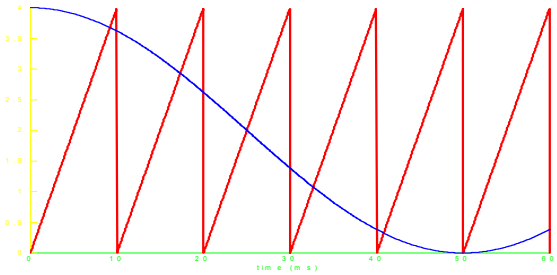


Figure 1 input and rising-ramp reference

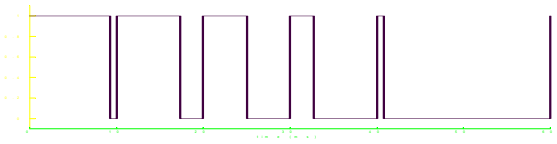


Figure 2 PWM output