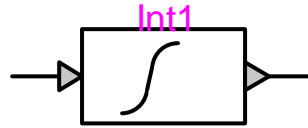


# Control device : integral

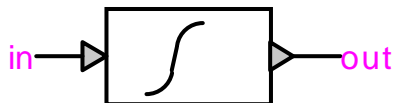


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## 1 Description

This device calculates the time integral of the input signal.

### 1.1 Pins



This device has two signal pins:

<i>pin</i>	<i>description</i>	<i>value when unconnected</i>
in	input	0
out	output	as calculated

### 1.2 Parameters

No user-defined parameters are required.

### 1.3 History

Selection options for the history value of the output signal:

<i>option</i>	<i>value</i>	<i>rules</i>
zero	history(t) = zero	
constant value	history(t) = user-defined value	any value
function value	history(t) = user-defined function	constant or f(t)

## 1.4 Scopes

Setting the scope flag enables monitoring of the output signal during the simulation.

## 1.5 Output signal interpolation

During the simulation, the output value of the element is calculated at successive instants  $t$  at intervals  $\Delta t$ . Between these simulation instants, the output value can be set to vary in one of two modes, ramped or stepped:

<i>mode</i>	<i>output value between <math>t - \Delta t</math> and <math>t^-</math></i>	<i>value at <math>t^-</math></i>	<i>value at <math>t</math></i>
ramped	interpolated linearly between values $out(t - \Delta t)$ and $out(t^-)$	calculated at $t^-$	calculated at $t$
stepped	remains at $out(t - \Delta t)$	remains at $out(t - \Delta t)$	calculated at $t$

## 2 Time-domain representation

In the time-domain calculation at  $t > 0$ , this element approximates the incremental value of the time integral of the input over the interval  $\Delta t$  by linearizing and averaging the value of the input over the interval (applying the trapezoidal rule of integration). The element responds correctly to discontinuities encountered in the value of the input between  $t^-$  and  $t$ .

The output value is calculated as follows:

$$out(t) = out(t - \Delta t) + \frac{in(t^-) + in(t - \Delta t)}{2} \cdot \Delta t \quad (1)$$

## 3 Steady-state representation

In the steady-state calculation at  $t=0$ , the output value is calculated as follows:

$$\begin{array}{ll} \text{if history is defined,} & out(0) = history(0) \\ \text{else} & out(0) = 0 \end{array} \quad (2)$$

## 4 Netlist

### 4.1 Format

Netlist format:

```
_c_i;name;2;2;out,in,  
history,step/ramp,scope,  
history function expression
```

<i>field</i>	<i>description</i>	<i>value</i>
c_i name 2 2	part name instance name pin count pin count	
out in	signal name of the output signal name of the input	
history	history	constant value or "H" for function
step/ramp	calculation mode	"S1" for stepped "S0" for ramped
scope	monitoring, optional	"?s" for enabled
history function expression	optional, required when history field is "H"	