

Formal verification

Verification of a linear display

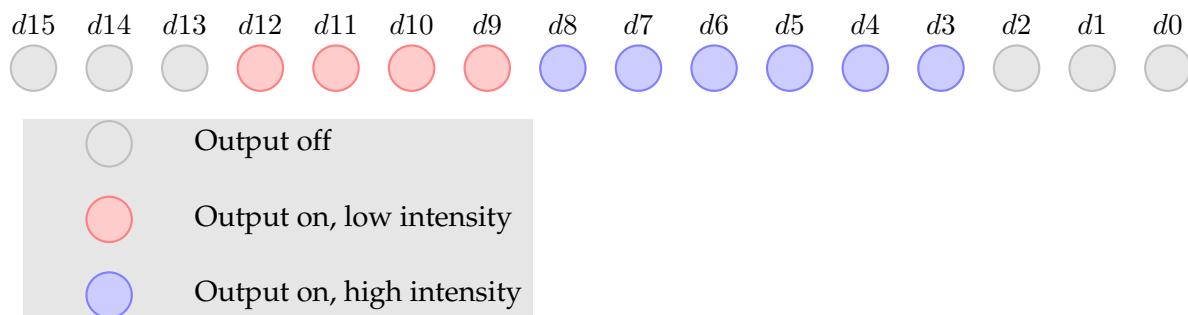
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Module to verify

We want to test a system that allows the linear display of a value. The display will be controlled to indicate where this value is in relation to two limits, Min and Max.

The example below shows the output for the following values :

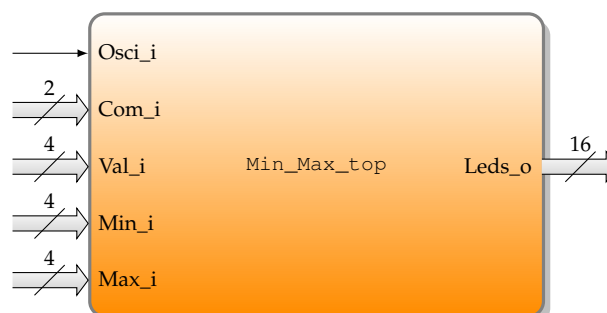
- Max_i = 12
- Min_i = 3
- Val_i = 8



Input/output

The input/outputs are :

Name	Size	Dir.	Description
Com_i	2	in	Mode of operation, on 2 bits
Val_i	4	in	Input value to be displayed on the linear display
Min_i	4	in	Lower bound
Max_i	4	in	Higher bound
Osc_i	1	in	Oscillatory signal for obtaining a low intensity
Leds_o	16	out	Linear display to be connected to 16 leds




Behavior

A LED at high intensity corresponds to constant activation of its corresponding output. A LED at low intensity is achieved by alternating 1-0 activation of the LED with the `Osci_i` signal.

Thus, the emitted power is lower. Therefore, in the case of low intensity, the activation is combined with the `Osci_i` signal thanks to an `and` gate.

The following table presents the mode of operation :

Command	Function	Description
00	Normal mode	If <code>Val_i</code> is in the interval $[Min_i, Max_i]$ <ul style="list-style-type: none"> — LEDs from <code>Min_i</code> to <code>Val_i</code> are on at high intensity — LEDs from (Val_i+1) to <code>Max_i</code> are on at low intensity — All other LEDs are off If <code>Val_i</code> is out of $[Min_i, Max_i]$, then all LEDs are off
01	Linear mode	Display of <code>Val_i</code> as a linear value, LEDs from 0 to <code>Val_i</code> are on with high intensity.
10	All off mode	All LEDs are off ('0')
11	All on mode	All LEDs are on at high intensity ('1')

 When in normal mode, `Max` shall be greater than `Min`. If this is not the case, the output is undefined!

A generic parameter `ERRNO` allows to inject errors in the design. Its behavior is the following :

1. When in the $[0, 15]$ interval the result is valid;
2. When in the $[16, 21]$ interval, the result is invalid.

This generic parameter allows to test your assertions by trying various `ERRNO` values thanks to modifications to the `.sby` file.