Signal Polarity

The polarity of signals, simple as it seems, turns out to be a potentially confusing issue. With such phrases as positive and negative logic, active HIGH, and active LOW, and with one person saying “asserted,” another saying “active,” and another saying “enabled,” all of which may or may not be well defined, it is very difficult to explain the relationships between signals. This can also make the generation of the design file more difficult.

In an attempt to sidestep the ambiguities in the language, this discussion contains tables instead of vague descriptions. The tables list the various possibilities. If you know what you want, you should be able to find how to specify your equations from the tables. The issues of input signal polarity, output signal polarity, and feedback signal polarity are treated separately.

Input Pin Polarity

Table 1 shows the relationships between the input pin names and the use of the input in a Boolean equation. As an example of how this table can be used, if you have a signal called /A on your schematic, and you wish for the output to go HIGH when both /A and B are HIGH, then from the second row of Table 1, declare the pins as /A and B in the design file, and use the equation:

```
X = /A*B
```

The basic function A*B has been used throughout for the purpose of illustration. The same procedure holds regardless of the waveforms being used or generated.

Output Pin Polarity

The issue of output polarity is slightly more complicated because of the issue of active-HIGH and active-LOW outputs. The possibilities are shown in Table 2. As an example, if a signal X is to go LOW only when inputs A and B are HIGH, and this function is to be implemented in an active-HIGH device, then from the third row of Table 2, declare the output pin as X in the design file, and use the equation:

```
X = /(A*B)
```

Feedback Polarity

Using feedback combines some of the polarity issues of inputs with some of the polarity issues of outputs. It is more difficult to use a simple example for this type of circuit. In Table 3, an output is assumed to be fed back to itself. The basic principles can be extended to any output feeding back to any other output. The waveform shows the output level that is considered to be “TRUE,” or “active.”

As an example, if the equation for a pin /X has to contain the inverse of the output, the output signal is to be active when HIGH, and an active-LOW device is to be used, then from the sixth row of Table 3, declare the output pin as /X in the design file, and specify the Boolean expression as:

```
/X : = f (A, X)
```

meaning that the Boolean equation uses X as an input term.

Table 1. Input Pin Polarity

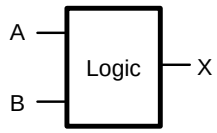
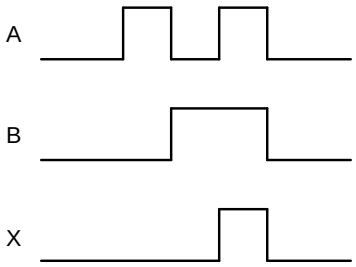
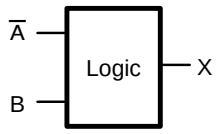
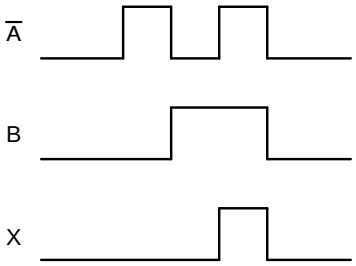
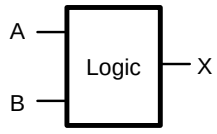
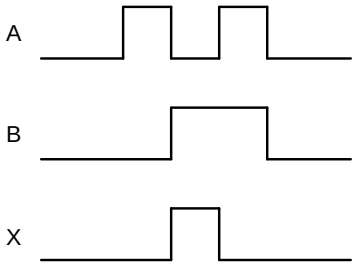
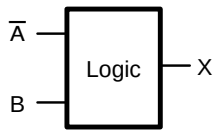
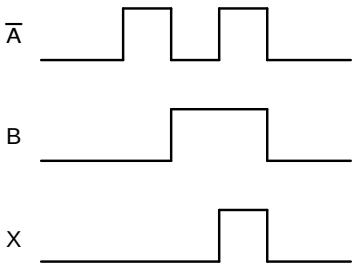
Schematic	Desired Waveform	Input Pin Definition	Boolean Equation
		A, B	X = A*B
		/A, B	X = /A*B
		A, B	X = /A*B
		/A, B	X = A*B

Table 2. Output Pin Polarity

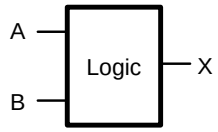
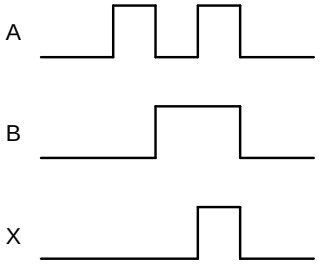
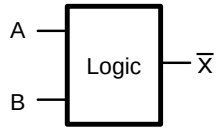
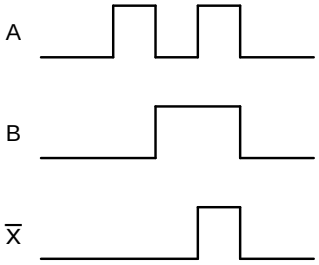
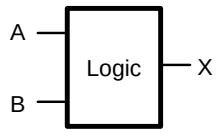
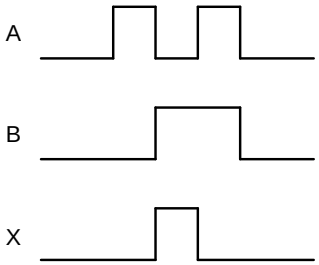
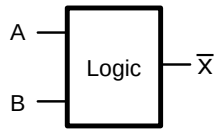
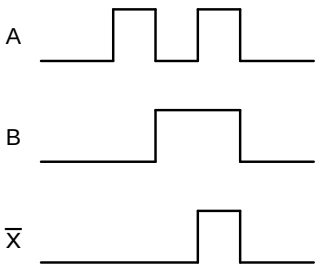
Schematic	Desired Waveform	Output Pin Definition	Boolean Equation	Device Restriction
		X X	X = A*B /X = /(A*B)	Active-HIGH Devices Active-LOW Devices
		/X /X	/X = A*B X = /(A*B)	Active-HIGH Devices Active-LOW Devices
		X X	X = /(A*B) /X = A*B	Active-HIGH Devices Active-LOW Devices
		/X /X	/X = /(A*B) X = A*B	Active-HIGH Devices Active-LOW Devices

Table 3. Feedback Signal Polarity

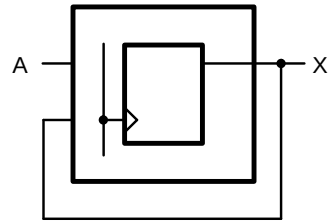
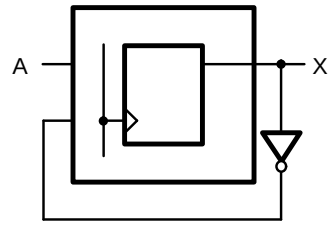
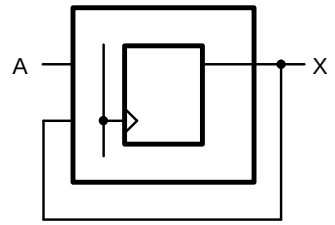
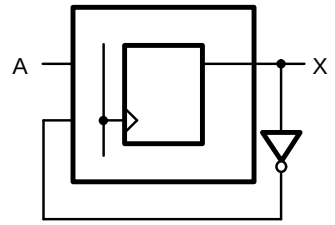
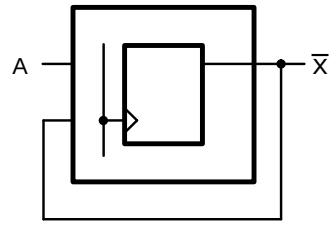
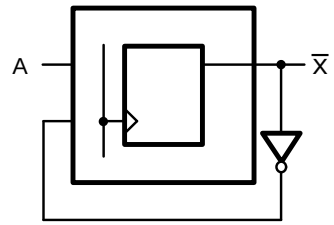
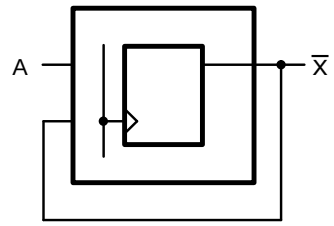
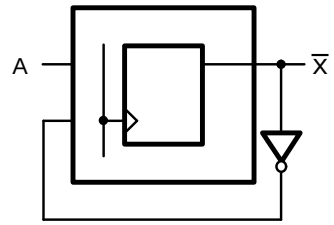
Schematic	Desired Waveform	Output Pin Definition	Boolean Equation	Device Restriction
		X X	X = f(A,X) /X = /f(A,X)	Active-HIGH Devices Active-LOW Devices
		X X	X = f(A,/X) /X = /f(A,/X)	Active-HIGH Devices Active-LOW Devices
		X X	X = /f(A,X) /X = f(A,X)	Active-HIGH Devices Active-LOW Devices
		X X	X = /f(A,/X) /X = f(A,/X)	Active-HIGH Devices Active-LOW Devices

Table 3. Feedback Signal Polarity (continued)

Schematic	Desired Waveform	Output Pin Definition	Boolean Equation	Device Restriction
		/X /X	/X = f(A,/X) X = /f(A,/X)	Active-HIGH Devices Active-LOW Devices
		/X /X	/X = f(A,X) X = /f(A,/X)	Active-HIGH Devices Active-LOW Devices
		/X /X	/X = /f(A,/X) X = f(A,/X)	Active-HIGH Devices Active-LOW Devices
		/X /X	/X = /f(A,X) X = f(A,/X)	Active-HIGH Devices Active-LOW Devices