3

PRIORITY ENCODER

3.1 PURPOSE

Often a circuit will receive data from several sources at one time and there must be a way to prioritize those inputs. This circuit creates a simple priority encoder for nine different inputs. This is a fairly simple circuit but is best explained by building and "playing around" with it rather than attempting to understand a printed text; thus, the explanation for this lab is somewhat limited.

3.2 PROCEDURE

Start *Logisim-Evolution* and create a subcircuit named `Encoder`. Open that subcircuit and place 12 `AND` gates as illustrated in Figure 3.1.

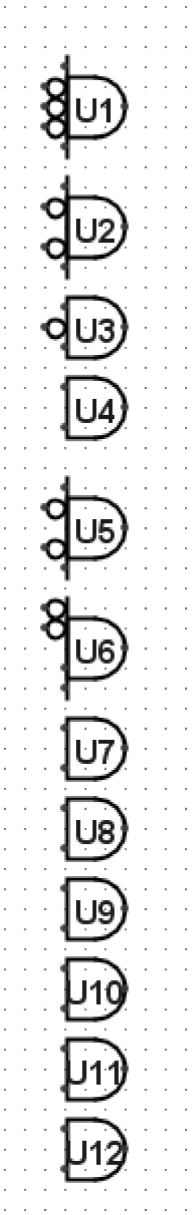

Figure 3.1: AND Gates

The gates have one data bit and these properties:

- **U1**: Five inputs, numbers two, three, and four negated.
- **U2**: Four inputs, numbers two and three negated.
- **U3**: Three inputs, number two negated.
- **U4**: Two inputs, none negated.
- **U5**: Four inputs, numbers two and three negated.
- **U6**: Four inputs, numbers one and two negated.
- **U7-U12**: Two inputs, none negated.

Many of the output signals need to be combined with OR gates and those should be added next, as in Figure 3.2. Note: U16 is a NOR (*Gates* library) gate.

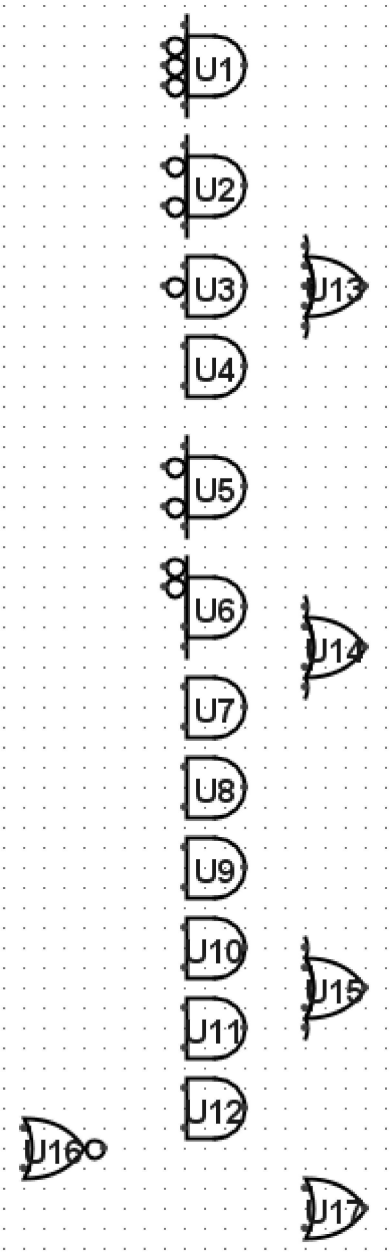

Figure 3.2: OR Gates Added

This encoder is designed to prioritize nine input lines so nine inputs must be added, as illustrated in Figure 3.3.

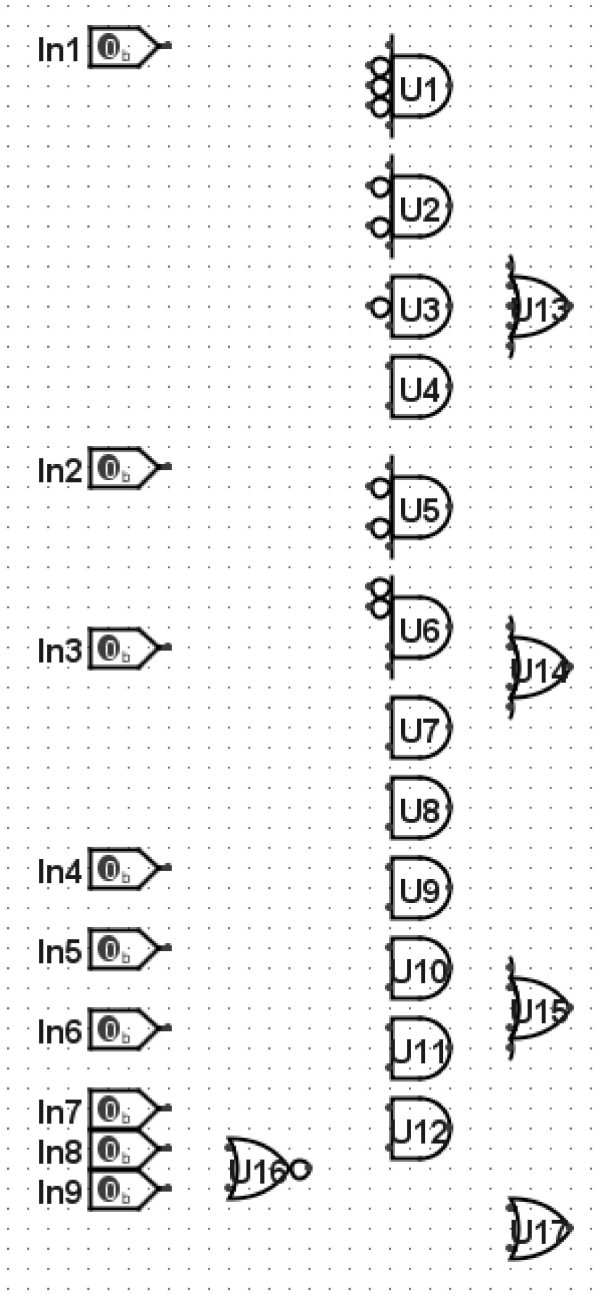

Figure 3.3: Inputs Added

Wiring this circuit is the most challenging part of the build. As illustrated in Figure 3.4, the inputs are wired to several different `AND` gates.

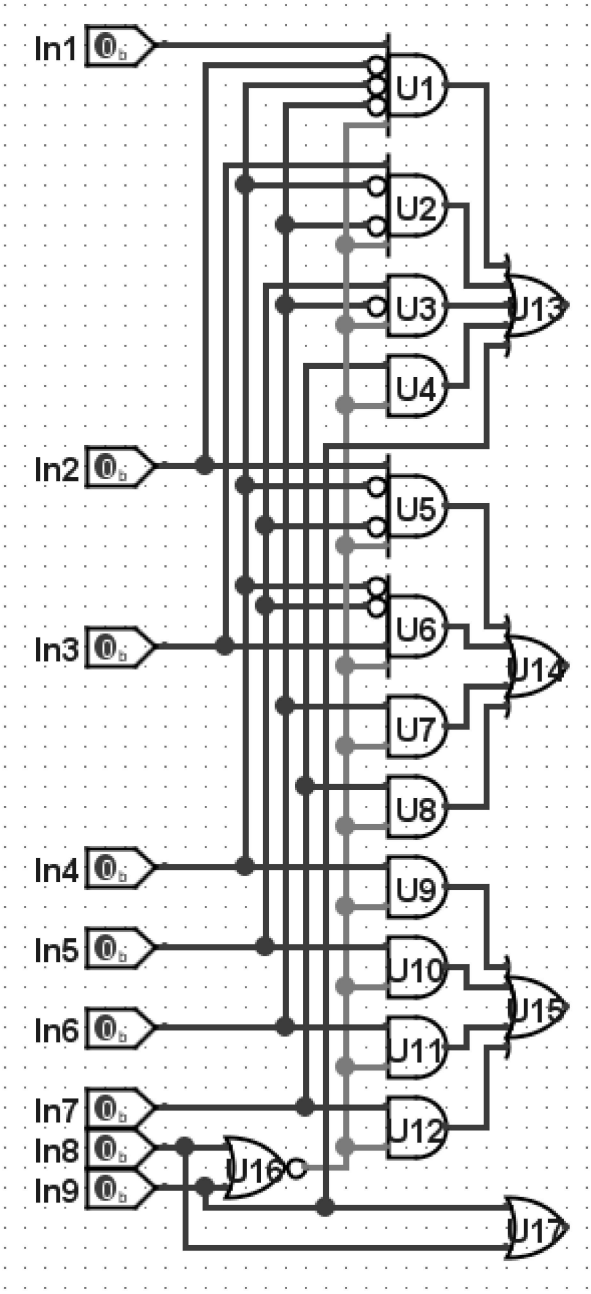

Figure 3.4: Wiring the Encoder

Finally, four output ports are added, as illustrated in Figure 3.5.

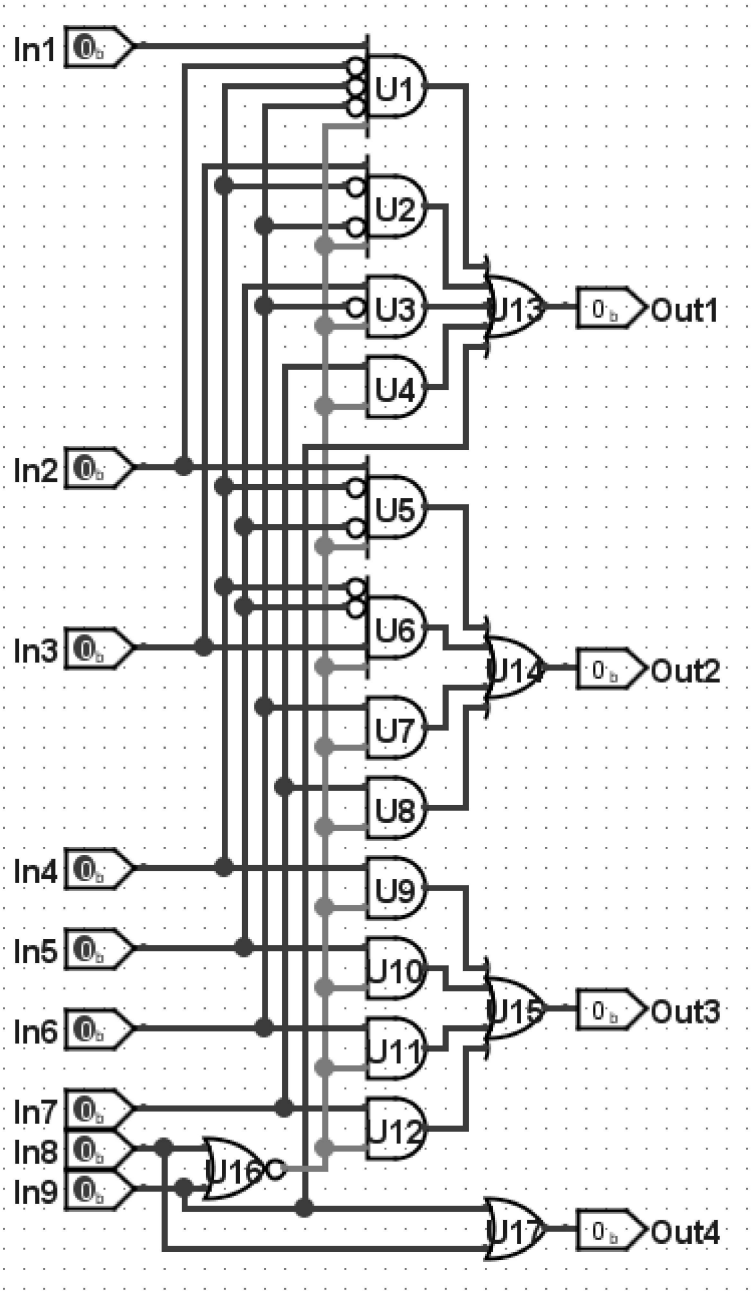

Figure 3.5: Nine-line Priority Encoder

This circuit is designed to output a Binary Coded Decimal (BCD) number, so no further conversion is needed to be able to read the highest priority input line. At this point, the circuit is complete and the *poke* tool can be used to change the inputs and observe how that high input bit drives the outputs.

To finish the project, open the `main` circuit and drop the `Encoder` on the drawing canvas. Add nine inputs and label them *In1* through *In9*. Place a four-bit output labeled *PriOut* and wire the four outputs through a splitter to that output port. To make it easier to read the BCD number, connect a Hex Digit Display (*Input/Output* library) to

the four-bit bus between the splitter and output port. The completed `main` circuit is illustrated in Figure 3.6.

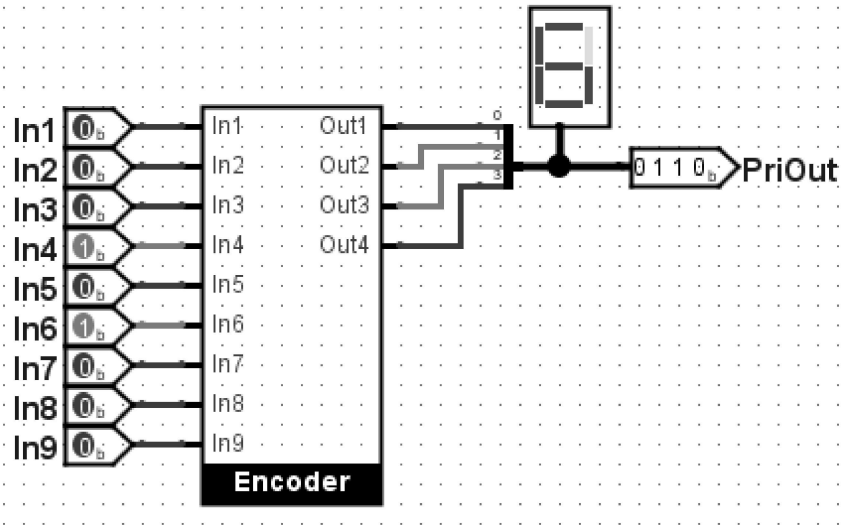

Figure 3.6: Main Circuit

In Figure 3.6, notice that two inputs are selected, *In4* and *In6*. Since *In6* is a higher priority (it is a larger number), the output is set for six and *In4* is ignored.

3.2.1 *Testing the Circuit*

The circuit is now complete. It should be tested by entering various combinations of inputs and observing that the output always displays the highest numbered input.

3.3 DELIVERABLE

To receive a grade for this lab, create the Nine-line Priority Encoder circuit as defined in this lab. Be sure the standard identifying information is at the top left of the circuit, similar to this:

```
George Self
Lab 03: Nine-line Priority Encoder
February 18, 2018
```

Save the file with this name: *`Lab03_Encoder`* and submit that file for grading.