

## This ULU

The *ULU.02 Dual multi gate* can be used to create two 2-input Not, OR, NOR, AND, NAND, XOR or XNOR gates. Also, two 5-input AND, as well as one 3- or 4-input OR, NOR or NAND port can be created. In total, ten different gate types can be constructed with this ULU.

## Used parts

The following standard parts are used:

1x casing 80 x 50 x 20mm;  
14x 1-bit connector;  
14x black O-ring 9 x 5 x 2mm;  
1x power connector;  
2x 3mm LED;  
2x resistor to dim the LEDs;

2x LED holder;  
4x mini (SRD-5VDC-SL-C) relay;  
4x fly back diode (1N4148);  
3x 2mm plug;  
6x 2mm banana plug.

## Construction

The standard ULU specifications are applicable as specified in the datasheet *ULU.00 – Common specifications*.

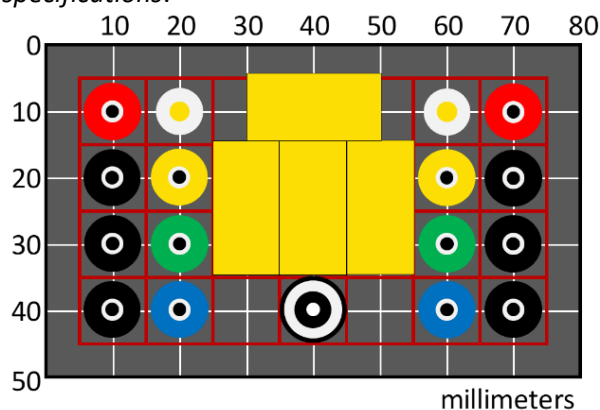


Figure 1 – Drill guide

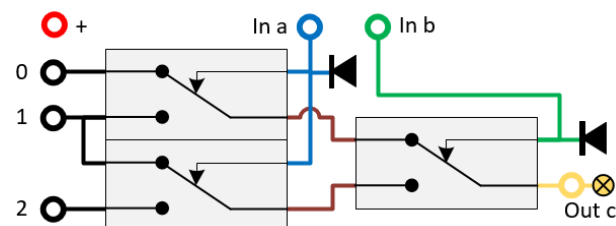


Figure 2 – Schematic (ground is left out)

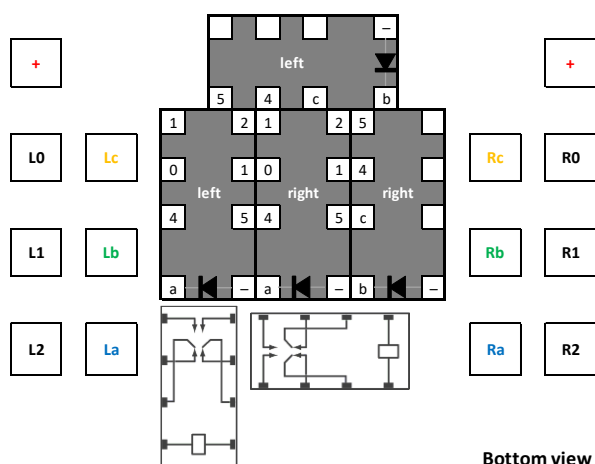


Figure 3 – Soldering schematic

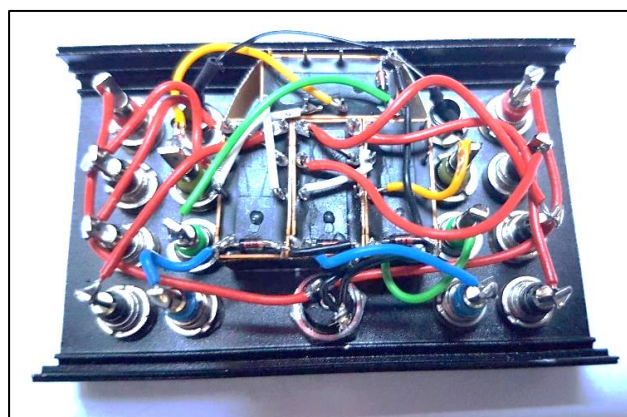


Figure 4 – ULU inside

The relays are hold together by a piece of tape wrapped around them. First, all the wires are soldered on the block of relays. Corresponding numbers from respectively the right and the left part, need to be connected. Then the relay-block is attached with double sided tape to the aluminum casing and the wires are soldered to the connector sockets. For the port selector, two wires are soldered to the banana plug. The long wire is 5cm, the short is 3.5cm.

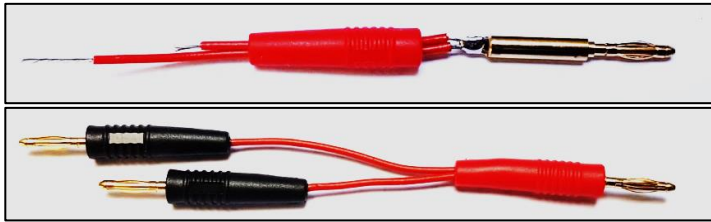


Figure 5 – The soldering of the port selector wires

### Usage

The required gate is selected by plugging a connection cable, as shown in Figure 6. Depending on the required gate, a logical 1 (red connector) is fed into one or two black connectors. If required, the gate selection can also be done by three cabled signals and therewith be fully reconfigurable/programmable.

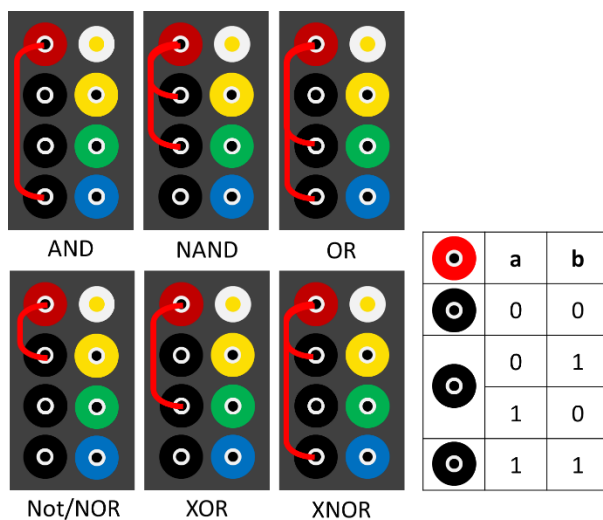


Figure 6 – Gate selection

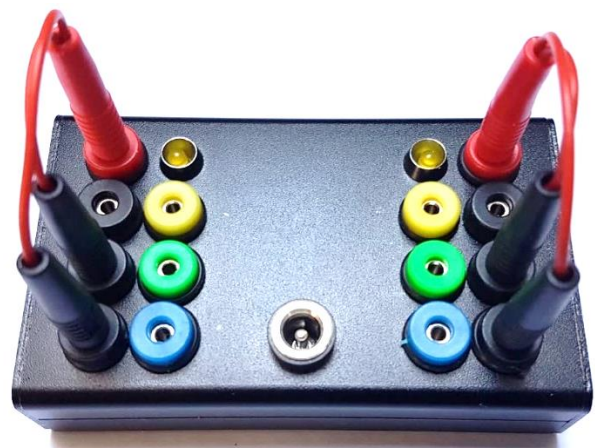


Figure 7 – The finished ULU

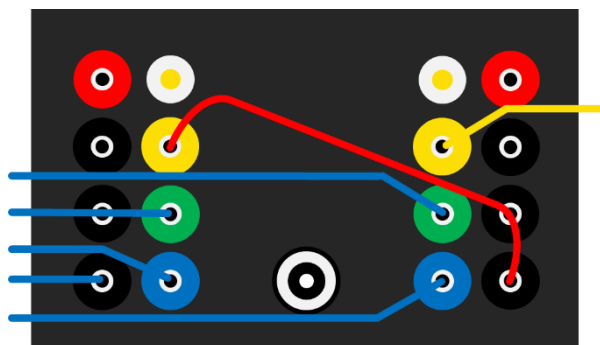


Figure 8 – 5-input AND gate

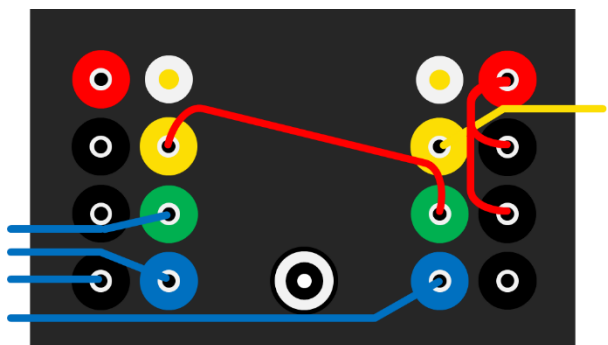


Figure 9 – 4-input NAND gate

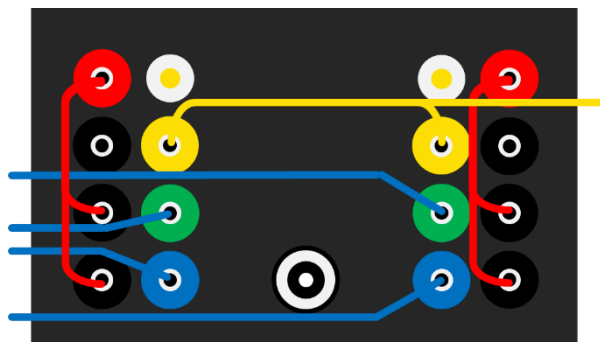


Figure 10 – 4-input OR gate

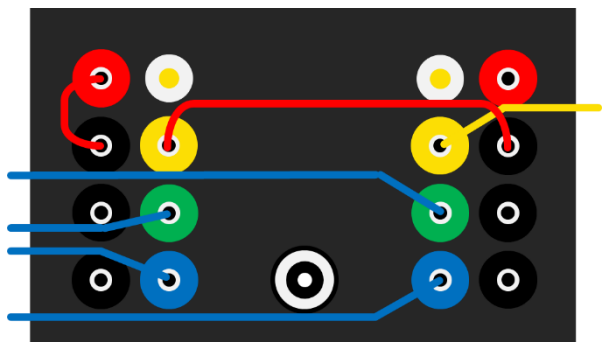


Figure 11 – 4-input NOR gate

The construction of gates with more than two inputs are shown in Figure 8 up to Figure 11.

### 5-input AND

The AND gate will only provide an output 1, when all inputs are 1. The left gate is a two input AND gate, and will only work when the port is configured as an AND gate. For this purpose, the third input is used. With this technique the ULU can be also used as two 3-input AND gates. The right gate adds two more inputs, since one of the inputs is used to incorporate the result of the left gate. When only three or four inputs are needed, connect the unused inputs to the 1 (+) connector. See Figure 8.

### 4-input NAND gate

The NAND gate will only provide an output 1, when at least one input is 0. The left gate is configured as an AND gate and only will provide an output 1 when all inputs are 1. The right gate is configured as a NAND gate and will only provide an output 0 when all inputs are 1. One of the right gate its inputs, is used to enter the result of the left gate. When only three inputs are needed, connect the unused input to the 1 (+) connector. See Figure 9.

### 4-input OR gate

The OR gate will provide an output 1, when one or more of the inputs are 1. Both gates are configured as OR gates and their signals are taken together to provide the overall output. When only three inputs are needed, just disconnect the unused input and leave the connector empty. See Figure 10.

### 4-input NOR gate

The NOR gate will only provide an output 1, when all the inputs are 0. Both gates are configured as NOR gates. The output of the left gate is used for the gate configuration. When the inputs of the left gate are both 0, the right gate is activated and configured as a NOR gate. When both inputs of the right gate are 0, this 1 of the left gate is propagated to the overall output. When only three inputs are needed, just disconnect the unused input and leave the connector empty. See Figure 11.

So the following 11 gate types can be constructed with this ULU: dual 2-input (N)AND/(N)OR/X(N)OR or dual 3-input AND or 4-input (N)AND/NOR or 5-input AND.

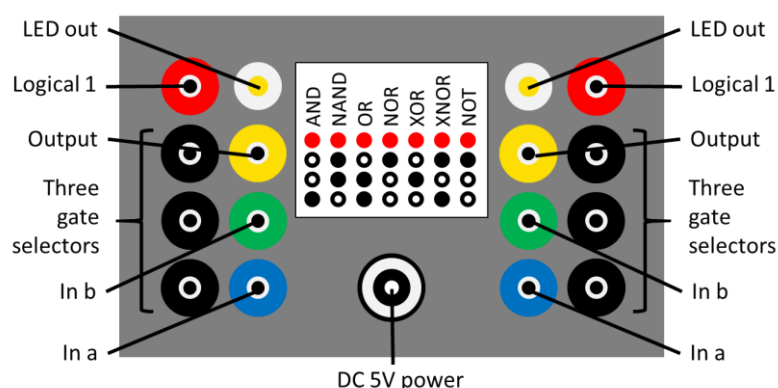


Figure 12 – Controls and connectors