

## **BMC065. 3 In 4 Out Logic Gates**

If you have any questions, or need help trouble shooting, please e-mail  
[Michael@Bartonmusicalcircuits.com](mailto:Michael@Bartonmusicalcircuits.com)

**I What it does / Truth Tables**

**II Schematics**

**III Construction**

**A.Parts List**

**B.The Board**

## I. What it Does

This is a logic module initially designed to create three 2-input AND gates and a 3-input AND gate using just three inputs. Because a number of logic gate chips in the CD4000 series use the same pin configuration, you can swap the logic chip in the circuit to have it act as an OR, XOR, NAND, NOR or XNOR instead of an AND. The arrangement of gates makes it intuitive for AND and OR gates, and less predictable for other gates.

Truth tables for each type of gate are provided below. A truth table documents what outputs are active depending on what inputs are active. On the tables a “1” indicates a high input or output and a “0” indicates a low output. A high input is any voltage over 0.12V and a high output is +5V, a low input is any voltage below 0.12V and a low output is 0V.

<b>AND</b>		Chip to use: <b>CD4081</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	0	0	0	0
1	0	0	0	0	0	0
0	1	0	0	0	0	0
0	0	1	0	0	0	0
1	1	0	1	0	0	0
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	1	1	1	1

<b>NAND</b>		Chip to use: <b>CD4011</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	1	1	1	1
1	0	0	1	1	1	1
0	1	0	1	1	1	1
0	0	1	1	1	1	0
1	1	0	0	1	1	1
0	1	1	1	0	1	0
1	0	1	1	1	0	0
1	1	1	0	0	0	1

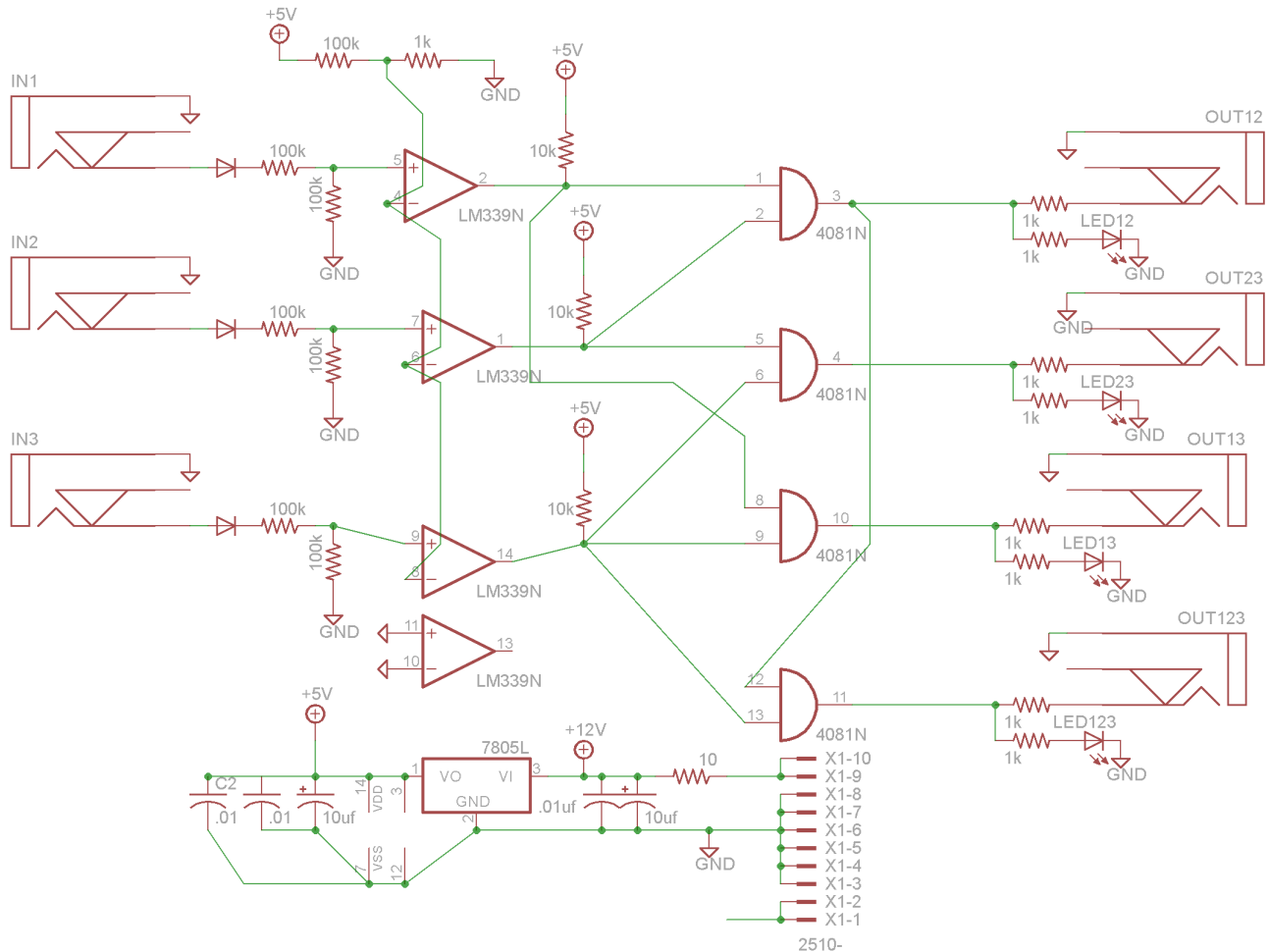
<b>OR</b>		Chip to use: <b>CD4071</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	0	0	0	0
1	0	0	1	0	1	1
0	1	0	1	1	0	1
0	0	1	0	1	1	1
1	1	0	1	1	1	1
0	1	1	1	1	1	1
1	0	1	1	1	1	1
1	1	1	1	1	1	1

<b>NOR</b>		Chip to use: <b>CD4001</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	1	1	1	0
1	0	0	0	1	0	1
0	1	0	0	0	1	1
0	0	1	1	0	0	0
1	1	0	0	0	0	1
0	1	1	0	0	0	0
1	0	1	0	0	0	0
1	1	1	0	0	0	0

<b>XOR</b>		Chip to use: <b>CD4030</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	0	0	0	0
1	0	0	1	0	1	1
0	1	0	1	1	0	1
0	0	1	0	1	1	1
1	1	0	0	1	1	0
0	1	1	1	0	1	0
1	0	1	1	1	0	0
1	1	1	0	0	0	1

<b>XNOR</b>		Chip to use: <b>CD4077</b>				
IN1	In2	In3	Out 12	Out 23	Out 31	Out 123
0	0	0	1	1	1	1
1	0	0	0	1	0	1
0	1	0	0	0	1	1
0	0	1	1	0	0	1
1	1	0	1	0	0	0
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	1	1	1	1

## II. Schematic



Above is the schematic for this module. On the left we see three input jacks. The tip of each jack is connected to a switching diode in series with a 100K resistor connected to another 100k resistor to ground and the positive input of an LM339 comparator. The comparator has an input voltage range of just 0 to +5V, so the diode prevents negative voltages from reaching the comparator and the 100K in series with the diode will create a voltage divider with the 2<sup>nd</sup> 100K to halve input voltage to prevent signals over +5V from reaching the comparator.

Each comparator's threshold is set by a 100K/1K voltage divider creating a voltage of 0.12V. The outputs are connected to 10K pull up resistors that will bring the output to +5V when the input voltage goes above the threshold. The outputs of the comparators are connected to the gates of the CD4081. An unused comparator's inputs are grounded.

Each gate's output connects to an LED through an LED and output jack through 1K current limiting resistors. The top gate's output is also sent to an input for the bottom gate in order to create a three input AND gate.

At the bottom of the schematic are the power connections. This module uses only the positive voltage rail. The incoming +12V signal is filtered by a passive RC filter formed by a 10 ohm resistor and 10uF capacitor. This voltage is then regulated to +5V by a 7805 and further filtered by 10uF capacitors and 01 uF capacitors. The LM339 and CD4081 are both powered by the +5V supply.

### III Construction

#### A.PARTS LIST

##### SEMICONDUCTORS

Name/Value	QTY	Notes
LM339	1	14 pin DIP package.
CD4081 or other quad gate chip	1	14 pin DIP package
7805	1	TO-92 package
1N4148	3	Or any small switching diode
LED	4	3mm. Resistor values assume normal red LED, for high efficiency LEDs or brighter colors you may want to increase some resistor values

##### RESISTORS

Name/Value	QTY	Notes
10 ohms	1	All resistors 1/4W metal film except potentiometers
1K	9	
10K	3	
100K	7	

##### CAPACITORS

Name/Value	QTY	Notes
.1uf	3	cheap ceramic disc. Value not critical.
10uf	2	Electrolytic, 16V or higher rating.

##### OTHER

Name/Value	QTY	Notes
14 pin DIP socket	2	
Power connecter	1	Right angle 2x5 2.54mm, <a href="#">like this</a> .
Jacks	7	PCB is designed around these jacks: <a href="#">PJ-323M</a>

## B. THE BOARD

The PCB is 98mm x 36mm. The jacks are spaced 13.97mm apart (.55 inch). Below are images of the PCB with and without traces present. The image of the PCB with traces does not show connections to ground.

