

BMC072. 4HP 4In-3Out Logic Gates

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I. What it Does

This module provides two separate two-input logic gates and a master logic gate output fed from the output of the other two gates. By swapping what chip in the CD4000 series you use, you can have gates for AND, OR, XOR, NAND, NOR and XNOR logic functions.

Below are truth tables for each type of gate and what chip should be used for them. 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.

AND		Chip to use:			CD4081		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
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	
0	0	0	1	0	0	0	
1	1	0	0	1	0	0	
1	0	1	0	0	0	0	
1	0	0	1	0	0	0	
0	1	1	0	0	0	0	
0	1	0	1	0	0	0	
0	0	1	1	0	1	0	
1	1	1	0	1	0	0	
1	0	1	1	0	1	0	
1	1	0	1	1	0	0	
0	1	1	1	0	1	0	
1	1	1	1	1	1	1	

NAND		Chip to use:			4011		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
0	0	0	0	1	1	0	
1	0	0	0	1	1	0	
0	1	0	0	1	1	0	
0	0	1	0	1	1	0	
0	0	0	1	1	1	0	
1	1	0	0	0	1	1	
1	0	1	0	1	1	0	
1	0	0	1	1	1	0	
0	1	1	0	1	1	0	
0	1	0	1	1	1	0	
0	0	1	1	1	0	1	
1	1	1	0	0	1	1	
1	0	1	1	1	0	1	
1	1	0	1	0	1	1	
0	1	1	1	1	0	1	
1	1	1	1	0	0	1	

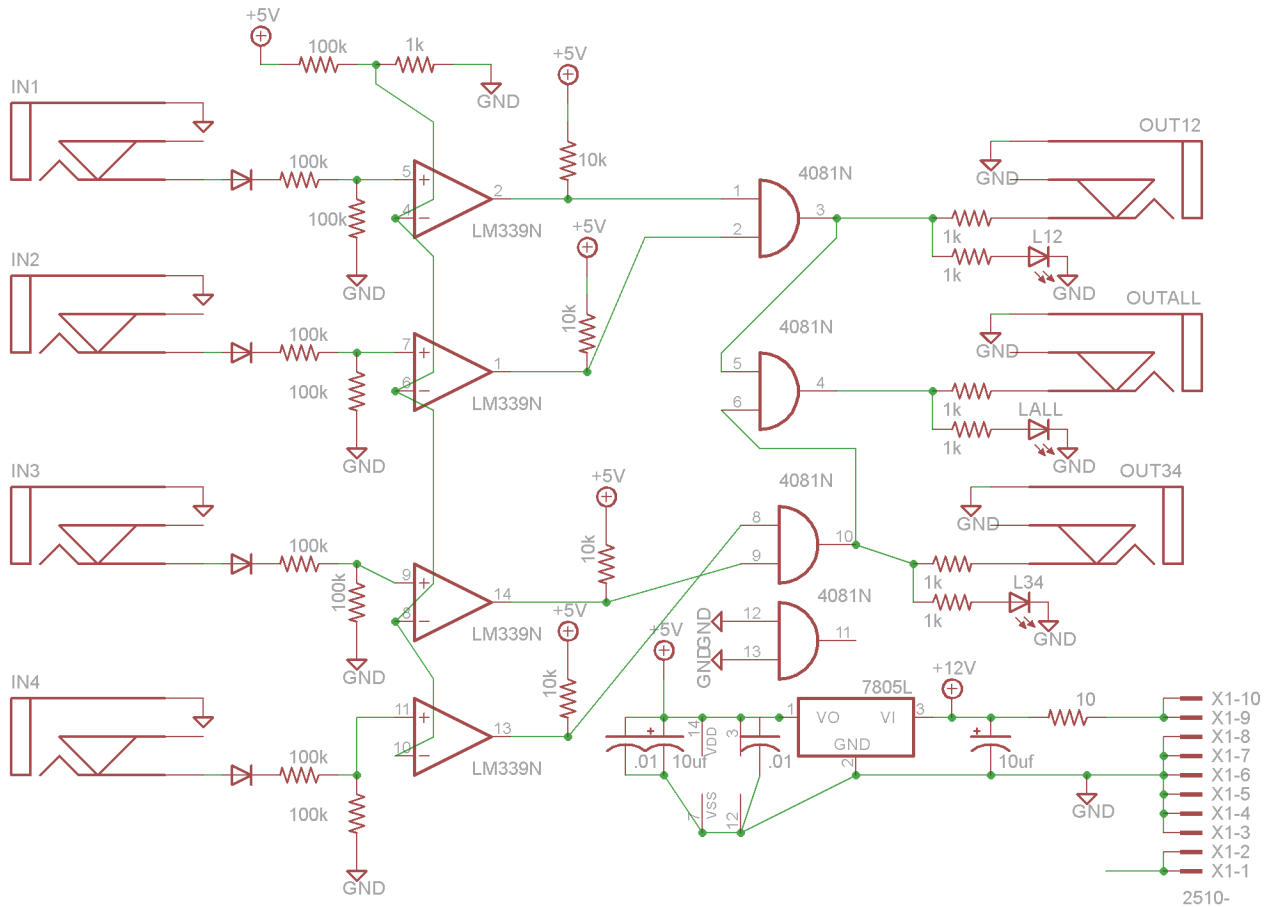
OR		Chip to use:			CD4071		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
0	0	0	0	0	0	0	
1	0	0	0	1	0	1	
0	1	0	0	1	0	1	
0	0	1	0	0	1	1	
0	0	0	1	0	1	1	
1	1	0	0	1	0	1	
1	0	1	0	1	1	1	
1	0	0	1	1	1	1	
0	1	1	0	1	1	1	
0	1	0	1	1	1	1	
0	0	1	1	0	1	1	
1	1	1	0	1	1	1	
1	0	1	1	1	1	1	
1	1	0	1	1	1	1	
0	1	1	1	1	1	1	
1	1	1	1	1	1	1	

NOR		Chip to use:			4001		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
0	0	0	0	1	1	0	
1	0	0	0	0	1	0	
0	1	0	0	0	1	0	
0	0	1	0	1	0	0	
0	0	0	1	1	0	0	
1	1	0	0	0	1	0	
1	0	1	0	0	0	1	
1	0	0	1	0	0	1	
0	1	1	0	0	0	1	
0	1	0	1	0	0	1	
0	0	1	1	1	0	0	
1	1	1	0	0	0	1	
1	0	1	1	0	0	1	
1	1	0	1	0	0	1	
0	1	1	1	0	0	1	
1	1	1	1	0	0	1	

XOR		Chip to use:			4030		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
0	0	0	0	0	0	0	
1	0	0	0	1	0	1	
0	1	0	0	1	0	1	
0	0	1	0	0	1	1	
0	0	0	1	0	1	1	
1	1	0	0	0	0	0	
1	0	1	0	1	1	0	
1	0	0	1	1	1	0	
0	1	1	0	1	1	0	
0	1	0	1	1	1	0	
0	0	1	1	0	0	0	
1	1	1	0	0	1	1	
1	0	1	1	1	0	1	
1	1	0	1	0	1	1	
0	1	1	1	1	0	1	
1	1	1	1	0	0	0	

XNOR		Chip to use:			4077		
IN1	In2	In3	In4	Out 12	Out34	OutALL	
0	0	0	0	1	1	1	
1	0	0	0	0	1	0	
0	1	0	0	0	1	0	
0	0	1	0	1	0	0	
0	0	0	1	1	0	0	
1	1	0	0	1	1	1	
1	0	1	0	0	0	1	
1	0	0	1	0	0	1	
0	1	1	0	0	0	1	
0	1	0	1	0	0	1	
0	0	1	1	1	1	1	
1	1	1	0	1	0	0	
1	0	1	1	0	1	0	
1	1	0	1	1	0	0	
0	1	1	1	0	1	0	
1	1	1	1	1	1	1	

II. Schematic



Above is the schematic for this module. On the left we see four 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 2nd 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 inputs of the center gate (ALL) are connected to the outputs of the other two gates.

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 0.1 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	1	14 pin DIP package. Or other CD4000 chip, see page 2
1N4148	4	Or other small signal diode
LED	3	3mm
7805 Regulator	1	TO-92 package

RESISTORS

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

CAPACITORS

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

OTHER

Name/Value	QTY	Notes
14 pin DIP socket	2	
Power connector	1	Right angle 2x5 2.54mm, like this .
Jacks	7	PCB is designed around these jacks: PJ-323M

B. THE BOARD

The PCB is 98mm x 36mm. The jacks are spaced 14mm 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.

