Lab Work 1 (Part 2)

Introductory Module

We are going to look at common logic gates IC module:

- Inverter @{NOT gate} (7404: Hex)
- AND gate (7408: Quad 2-input) & OR gate (7432: Quad 2-input)
- NAND gate (7400: Quad 2-input) & NOR gate (7402: Quad 2-input)
- XOR gate (7486: Quad 2-input)

Datasheets

Datasheets are documentations for electronic components. They can be sometimes hard to understand, simply because they are prepared by engineers... for engineers (thinking only those who already understands will read them). But, most basic (and important) information will always be available somewhere in them.

The first thing what we usually look for is the **pin diagram** (or pinout or connection diagram etc.) - this will help designers how to connect that particular component to another component. Sometimes, a **functional block digram** is also needed here.

When working with new components, it is also good to look at electrical specifications. Here, things like **absolute maximum ratings** and **recommended operating conditions** should be observed in detail. In addition to that, we usually look at **electrical characteristics** and **switching characteristics** in order to decide whether the component will fit into our current design specifications. For components that require timing information, timing diagrams are available.

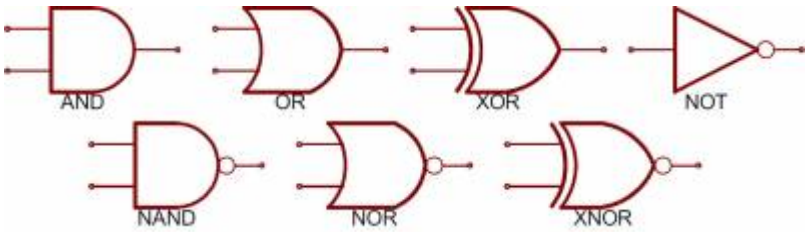
Datasheets for some components that are not common will usually include detailed schematics to show how they can be connected and what other components should be used along with them.

For board designs, **physical dimensions** of the component is also included so that designers can prepare a proper footprint for it. Sometimes there will also be a section on **layout considerations**, which provides suggestions on how the board should be prepared in order to allow the component to perform as designed.

Do try to identify the various sections mentioned above.

From Schematic to Breadboard

Schematic symbols of common logic gates:



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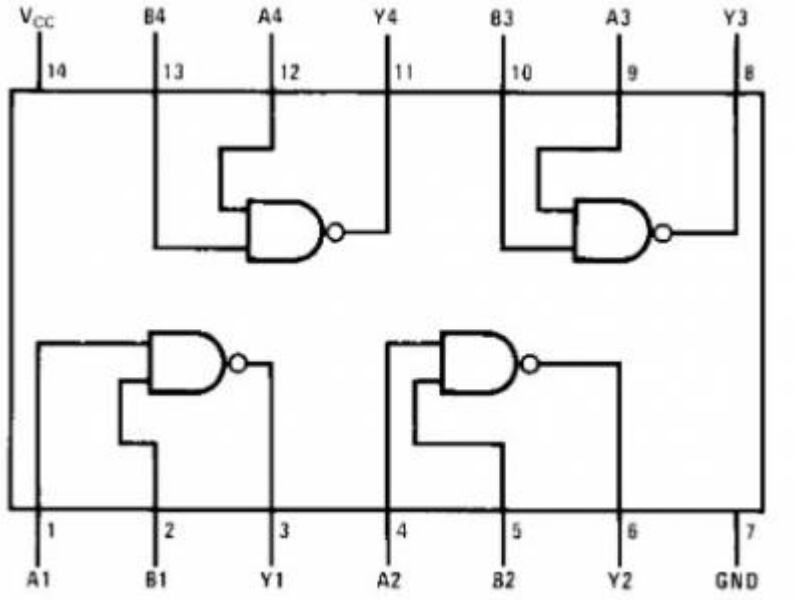
Example of a connection diagram for an IC (integrated circuit):



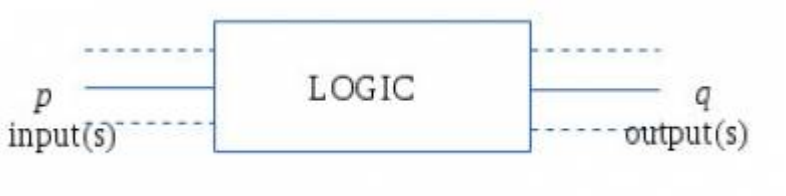
***Disclaimer**: The image above is copied from datasheet provided the manufacturer (link available above)*

Notice for every pin there is a *label* and a *pin number*. Try to find out how to identify pin 1 on an IC.

Logic Verification

To verify if a logic gate is working (in other words, this is how we 'test' a gate), we simple have to check if the output driven by a gate is as expected (when a known set of input is asserted). This mapping of input signal to output signal is usually specified in the form of a truth table (in the datasheet, it may be called function table).

To verify a *p*-input and *q*-output logic gate:



- create a truth table with $p+q$ columns, and $1+2^p$ rows (including first row header)

- populate the input columns with *p*-bit binary values from 0 to 2^p-1
- connect the hardware logic accordingly
- for every input row, assert Vdd/GND accordingly at the hardware input
- monitor the output and fill in the output column(s) accordingly
- compare the complete truth table with the one given in the datasheet

Things To Do

THING 1 Verify all logic gates listed above.

THING 2 Create an XOR gate using inverter(s), AND gate(s) and OR gate(s). Verify the circuit.

THING 3 Create 3-input NAND logic. Verify the circuit.

ask your instructor for more...