The Design Process, Part 7

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Building the Library: Drawing things in the library - Multi-Gated Parts

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7 January 2022

Single Gated Parts can be used in situations where all of the connecting wires to associated parts are in the immediate vicinity on the schematic. But, this is not always the case. Often the parts associated with the Gated Part are in other areas and on other pages, so it is best in these circumstances to break the part down into its individual Gates.

When I build a part that will often be used broken out into its gates, I always build it first as a single gated part so that it's available when needed.

Here we will compare an IC as a single gated part and as a multi-gated part. This SN74LV86APW contains four 2-Input Exclusive-Or Gates and two Signal Pins. To an engineer, these strange sounding things will make sense. A layout person doesn't need to know what magic goes on inside these gates, but any additional knowledge about their functions doesn't do any harm. Whether the part is kept as one gate or broken out into its individual parts makes no difference when it's on the PC Board as the same footprint is used for both. Here they are side by side. And at this stage they look identical except for their names.
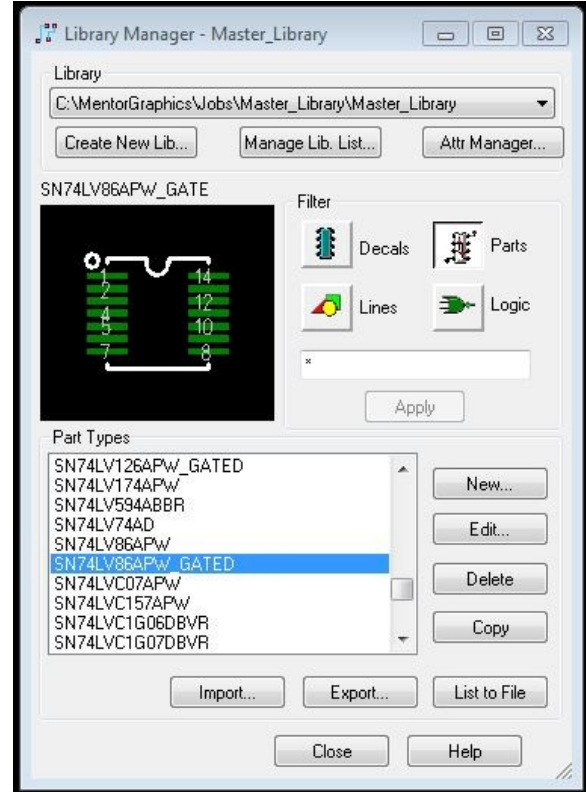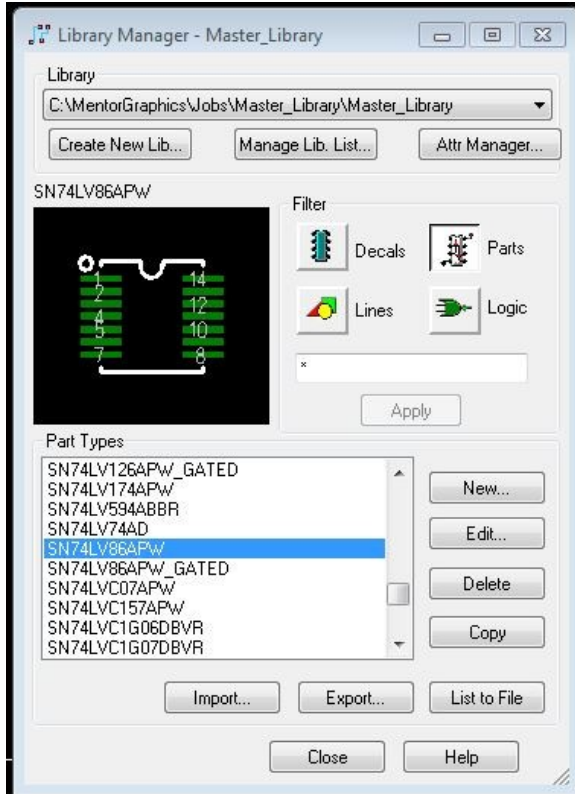
When we look at the General information about the part we see that the single gated part has a Gate Count of 1 and the multi-gated part shows a count of 5. Now, note that the description of the part said that it had four 2-Input Exclusive-Or Gates and two Signal Pins. Here, I have created a gate that incorporates the two signal pins, thus not leaving them off the schematic.
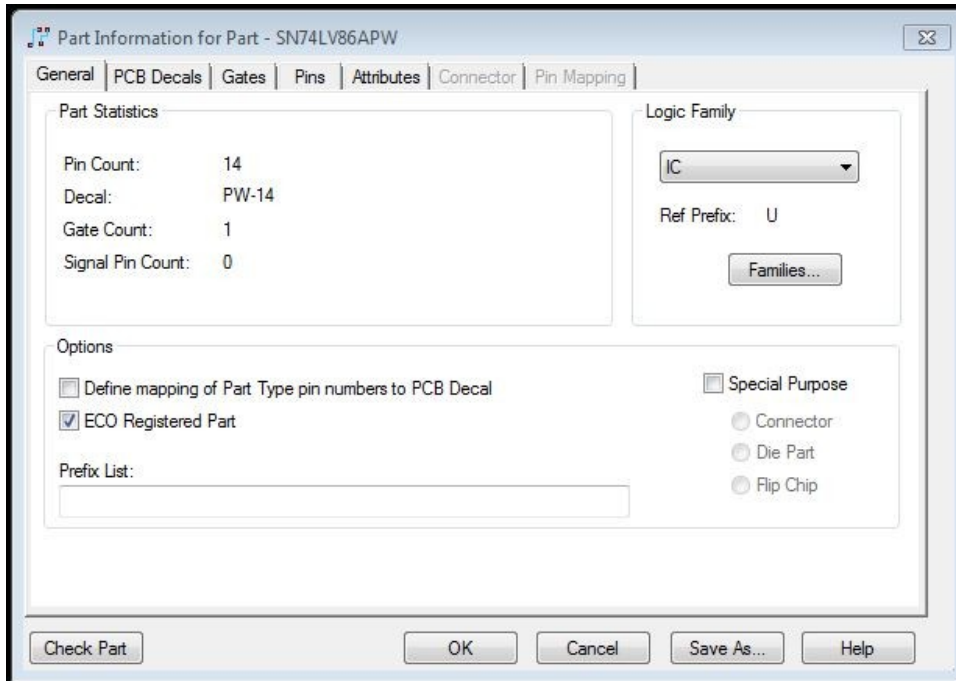
So here, the Signal Pins Count is 0. And their connections to Power and Ground will be visible in the last gate.
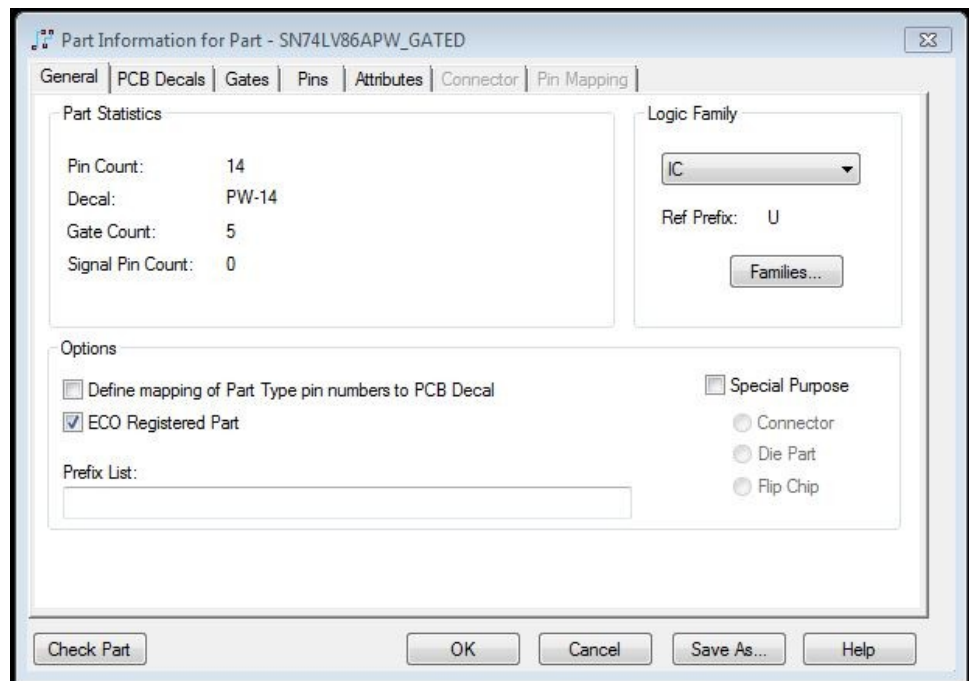
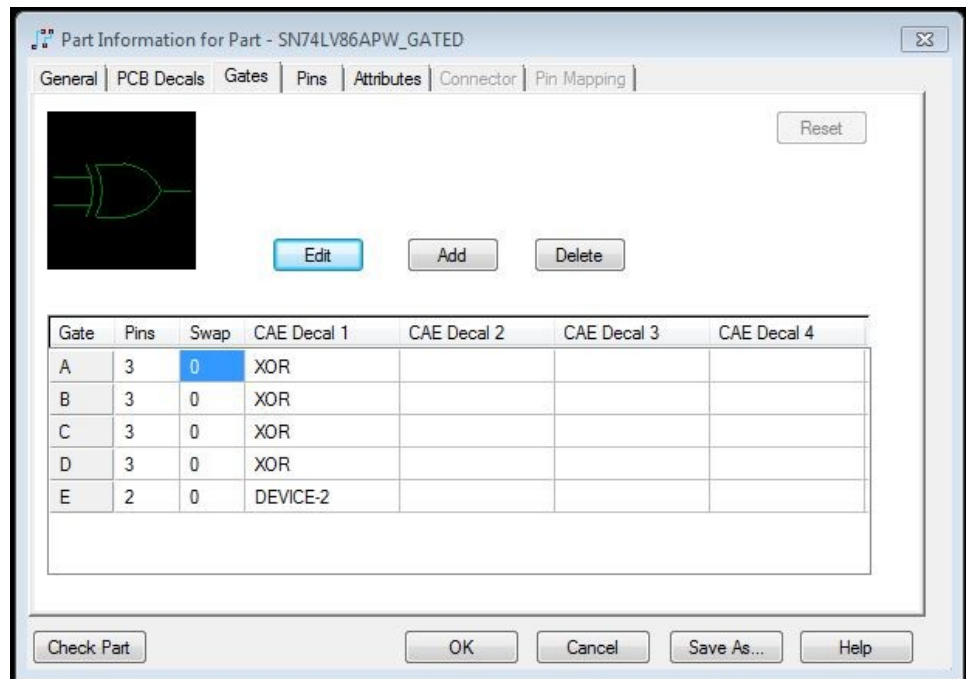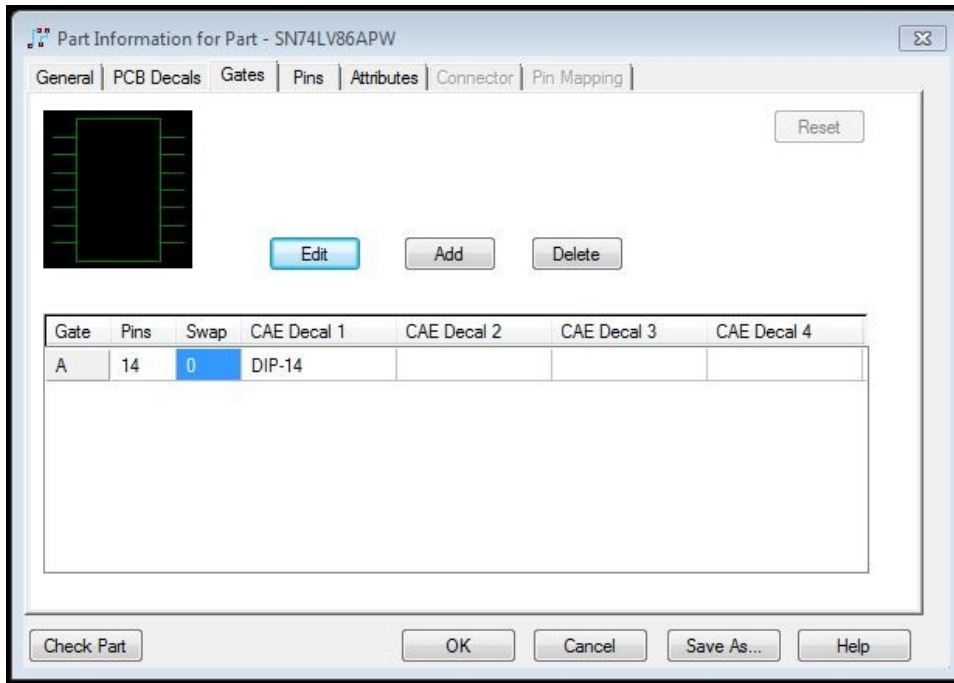Here in PCB Decals, we see that both the single gated part and the multi-gated part are both assigned a PW-14 Decal. So, to emphasize, there is no difference on the PC Board Layout half of the software whether the single gated or the multi-gated part is used.
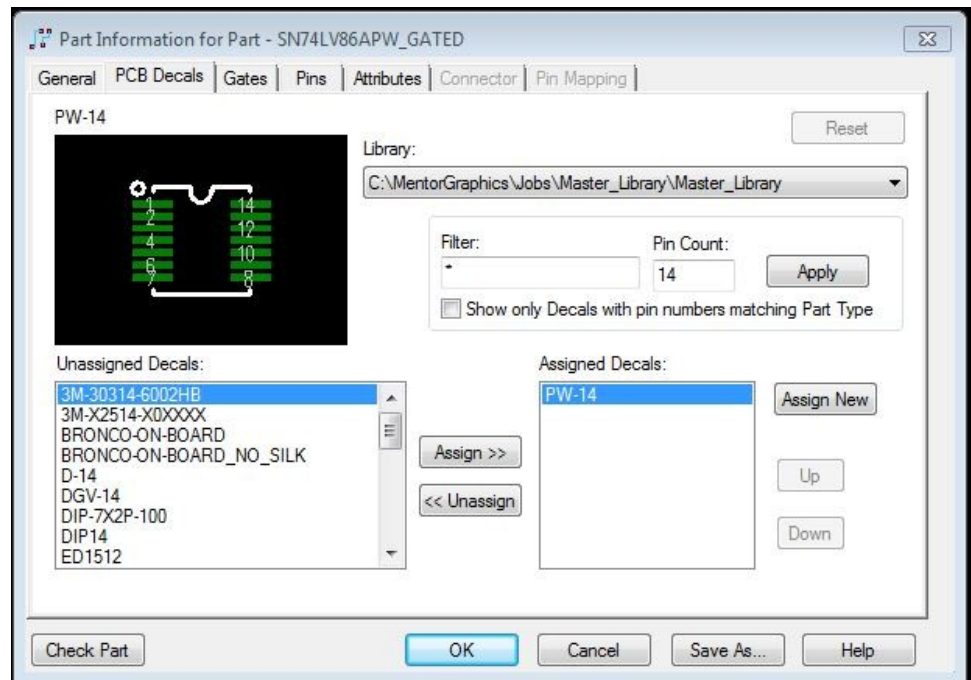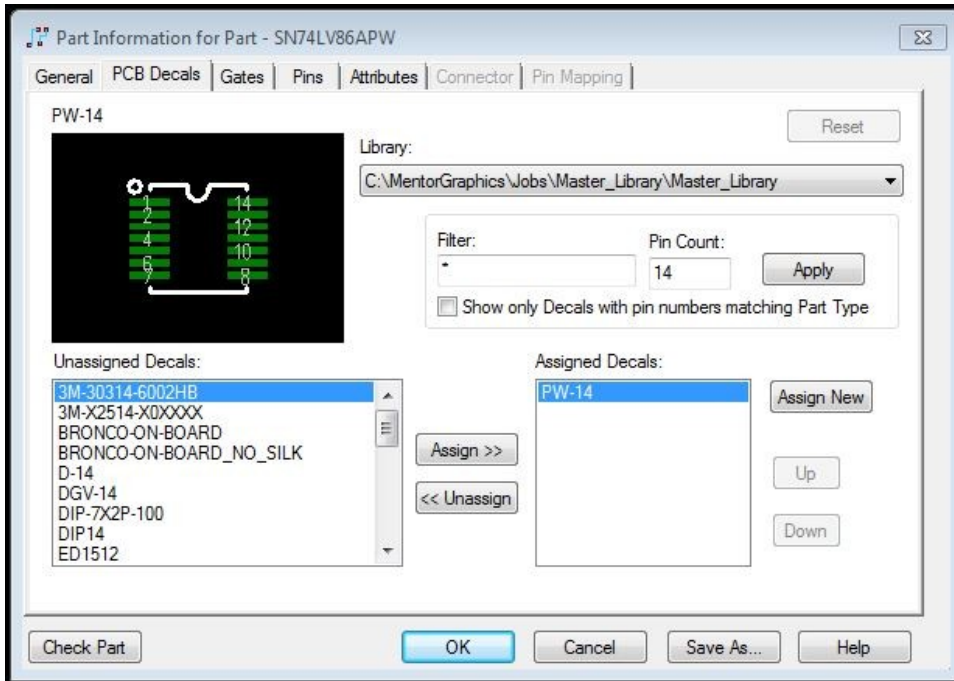
In the Gates window, we see the difference between these parts. And how very different they look. The four 2-Input Exclusive-Or Gates, called XOR, each have 3 Pins from the Part and the two Signal Pins are built into the last Gate.

Part Information for Part - SN74LV86APW

General | PCB Decals | Gates | Pins | Attributes | Connector | Pin Mapping

Reset

Edit   Add   Delete

Gate	Pins	Swap	CAE Decal 1	CAE Decal 2	CAE Decal 3	CAE Decal 4
A	14	0	DIP-14			

Check Part   OK   Cancel   Save As...   Help

Part Information for Part - SN74LV86APW_GATED

General | PCB Decals | Gates | Pins | Attributes | Connector | Pin Mapping

Reset

Edit   Add   Delete

Gate	Pins	Swap	CAE Decal 1	CAE Decal 2	CAE Decal 3	CAE Decal 4
A	3	0	XOR			
B	3	0	XOR			
C	3	0	XOR			
D	3	0	XOR			
E	2	0	DEVICE-2			

Check Part   OK   Cancel   Save As...   Help

Here is a view of the last Gate, called E, DEVICE-2, which has the last 2 Pins of the part.
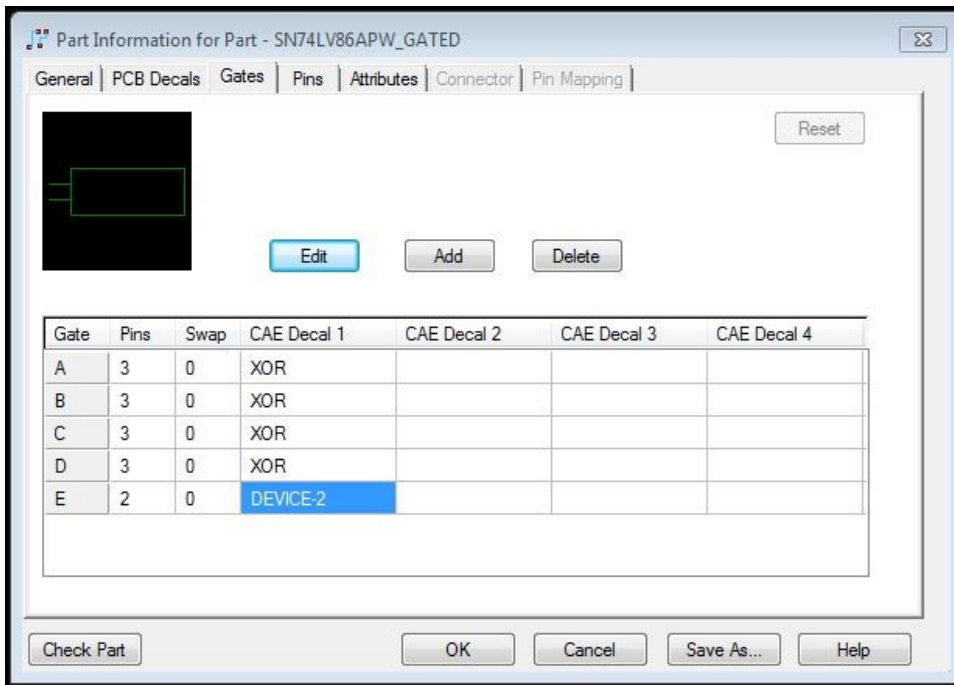
The Pin windows on the following page, show the dramatic difference between these Parts and how their gates are assigned.
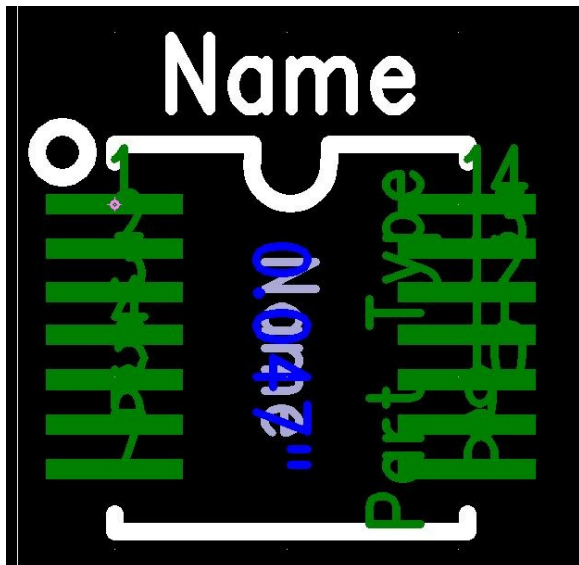
In the single gated part the Pin Numbers correspond to the footprint starting at the top left as viewed in the Gates window of the single gate part and continue counter-clock wise around the part.
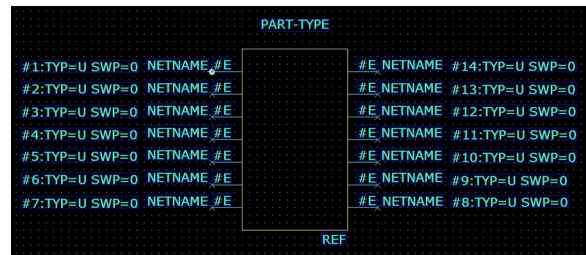

To the left is the PW-14 Decal and to the right is the DIP-14 Logic Symbol.

These Pin Names are derived from the Data Sheet on this part and will show up internally on the drawing of the Logic symbol. Within the Name, the preceding numbers 1 through 4 identify the four physical function gates that are within the part. The letters A and B represent the inputs to those gates and the letter Y represents the output. VCC is the nomenclature for Power and GND indicates Ground. Here, since there is only one Logic Symbol, the Pin Numbers and Pin Sequences are the same.
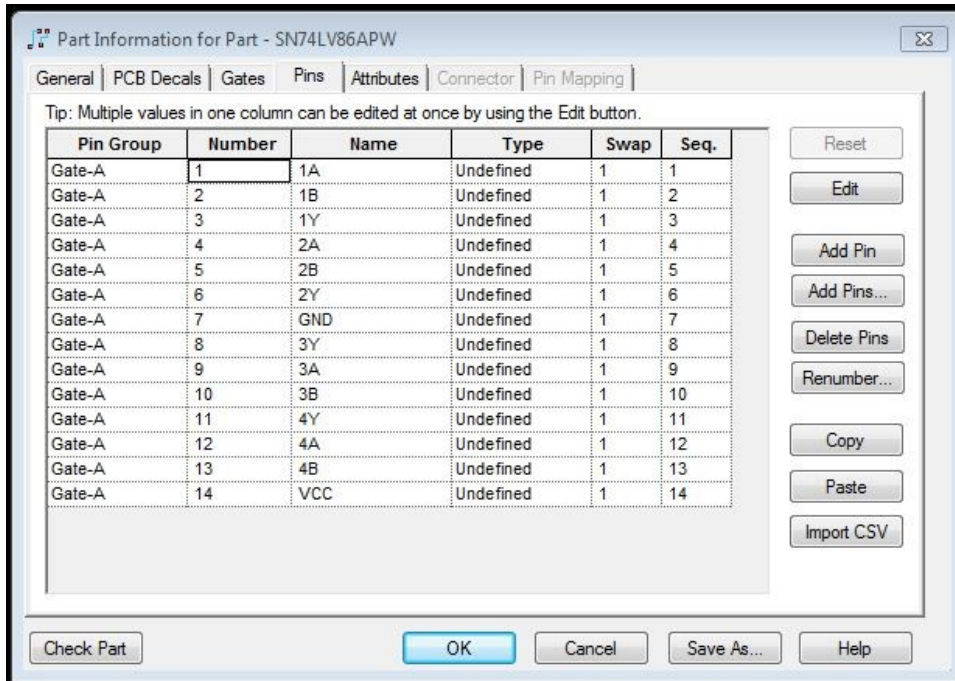
Here is the Logic Symbol for the Exclusive-Or Gate. The numbering on these pins do not correlate to the pin numbers of the part. In these situations, they are the sequential pin numbers within the gate. The same is true for the DEVICE-2 Gate.
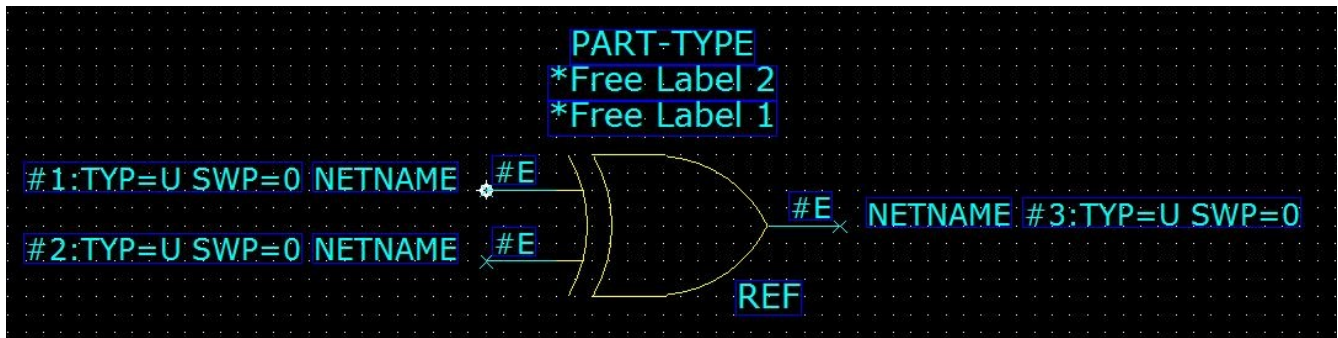
And below is the Logic Symbol for the DEVICE-2 Gate.
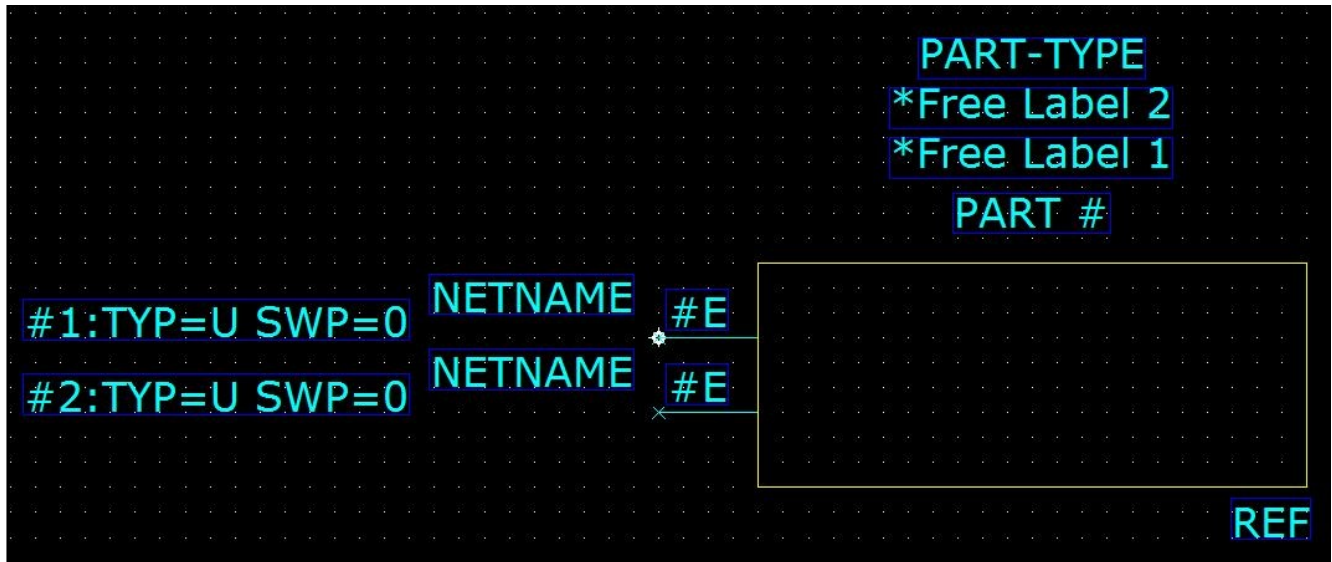
Here is the Pin Information for the Gated Part. Gate-A is the first physical function gate within the part. Its inputs A and B are on Pins 1 and 2 of the part and correspond to the Sequences 1 and 2 on the Logic Symbol shown above. The output Y is on pin 3 of the part and it is on Sequence 3 of the Logic Symbol. Gate B shows the same sequential order and correlates to Pins 4, 5 and 6 of the part. Gates C and D have a slightly different sequential order because of how the functions are distributed within the physical part. And, lastly Gate-E picks up the two Signal Pins of Power and Ground. Arbitrarily, I have assigned VCC to Pin 1 as the power symbol is normally shown pointing up for positive power and GND is normally shown pointing down.

Part Information for Part - SN74LV86APW_GATED

General | PCB Decals | Gates | Pins | Attributes | Connector | Pin Mapping

Tip: Multiple values in one column can be edited at once by using the Edit button.

Pin Group	Number	Name	Type	Swap	Seq.
Gate-A	1	1A	Undefined	1	1
Gate-A	2	1B	Undefined	1	2
Gate-A	3	1Y	Undefined	1	3
Gate-B	4	2A	Undefined	1	1
Gate-B	5	2B	Undefined	1	2
Gate-B	6	2Y	Undefined	1	3
Gate-C	9	3A	Undefined	1	1
Gate-C	10	3B	Undefined	1	2
Gate-C	8	3Y	Undefined	1	3
Gate-D	12	4A	Undefined	1	1
Gate-D	13	4B	Undefined	1	2
Gate-D	11	4Y	Undefined	1	3
Gate-E	14	VCC	Undefined	1	1
Gate-E	7	GND	Undefined	1	2

Reset
Edit
Add Pin
Add Pins...
Delete Pins
Renumber...
Copy
Paste
Import CSV

Check Part   OK   Cancel   Save As...   Help

Here is an example of the single gated part and the multiple gated part placed on the schematic. I have placed typical power and ground attachments to Gate-E. Here, because of better viewing, the visibility of the Pin Names has been turned off in Gates A through D (top picture). It is often difficult to have control of where the software places the pin names in the gates and their placement can conflict with the drawn lines as shown in the bottom picture. Here also, I have added Net Names to the Wires.