

# *Cadence Virtuoso Layout Connectivity Mark-Net Tutorial*

Digital VLSI Chip Design CAD manual addendum

When you're drawing layout, especially of a complex cell, it's sometimes hard to see exactly what your layout is corresponding to. That is, with all those overlapping rectangles, what's connected to what? You have lots of overlapping colors and layers, and some of them represent a single connected electrical node (perhaps going from a transistor drain, through metal1 to some other transistor's drain, and also connecting through poly to another transistor's gate). This can be a little hard to unwrap when you're staring at all those colors.

In theory, the layout tool can tell how things are connected, but in practice all it really knows is that there are colored rectangles. It's the extracted version that has connectivity information. Notice that you even have to run a separate program to tell if you have violated design rules. While there are actually more smarts hiding under the hood than I'm letting on, in some sense the tool is just a colored rectangle editor.

One of the extra smarts "under the hood" of Virtuoso Layout Editor is the ability to do a mini-extraction and highlight an entire connected net through a bunch of connected layers. That is, there is a mode to select a piece of layout, and have the entire node that is electrically connected to that piece of layout be highlighted. This is known as "mark net" and is under the "connectivity" menu in the layout editor.

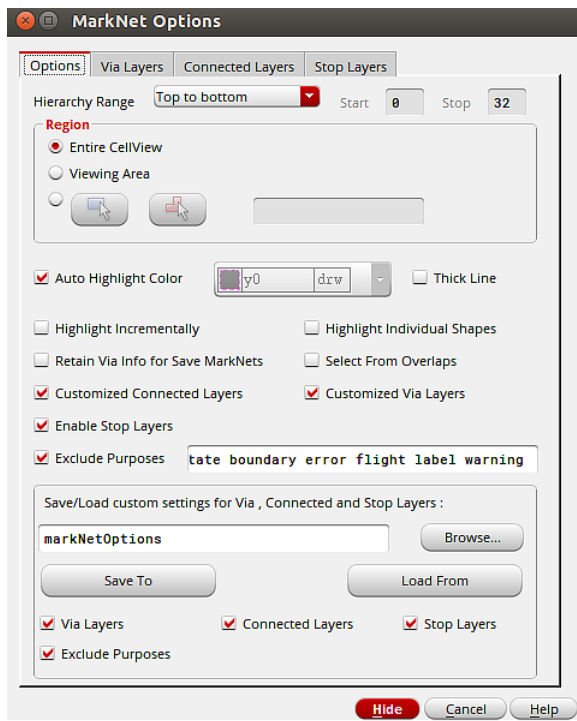
Unfortunately, the default description of how to make that connection has all the layers included. So, when you select a node, it connects through the active, across the channel, and basically every node in the circuit shows up as being connected. So, we need to modify the behavior of Connectivity->MarkNet to show only connections through the metal and poly layers. This is really what you likely want to see anyway. More on that soon...

The other thing that will be helpful is the ability to turn the visibility of various layers on and off in the layout tool. The "Layers" menu on the left of the drawing screen lets you control the visibility and selectability of every layer. You can individually turn layers on and off, or make them selectable or not, with the check boxes, or you can select AV for All Visible, NV for None Visible, AS for All Selectable and NS for None Selectable.

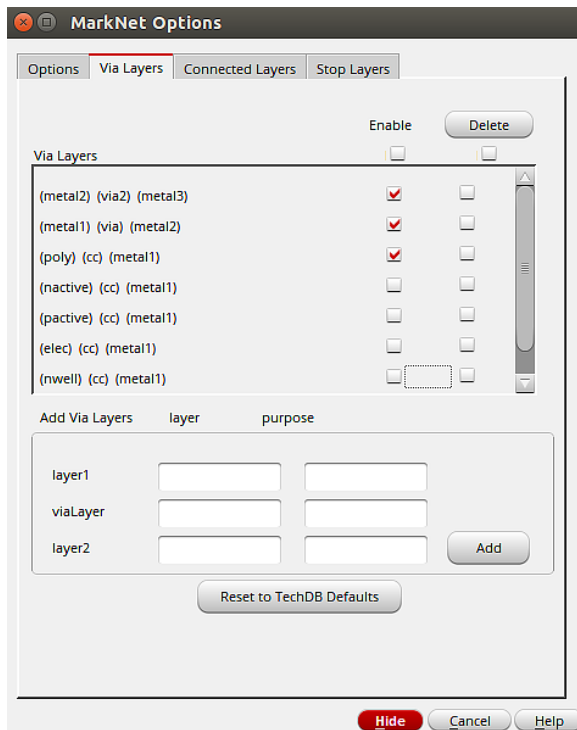
This turns out to be useful when you "mark" a net, because the marking is a dashed line surrounding the entire connected net, and that's sometimes very hard to see in the sea of other colors on the screen. So, once you "mark" a net, it's sometimes handy to turn off most of the layers to see what's going on.

1. First modify how Connectivity->MarkNet understands materials and connections. There's a feature in Virtuoso that many of the commands have a secret options screen that modifies how they work. It's not much of a secret once you know. When you're in a new mode (like Connectivity->MarkNet mode), if you press the F3 function key, and if there's a "secret" configuration dialog box, this will open it up. Unfortunately, I haven't found a way

to press F3 when running in NoMachine mode and have that recognized by Virtuoso. So, you'll have to be sitting in front of a Linux machine to do this. When you do you'll see the following configuration dialog box:



The main Options menu doesn't require modification. It's in the Via Layers tab that the action happens:



In this dialog box, you want to make sure that only the buttons shown are selected. This will highlight only the Poly, Metal1, Metal2, and Metal3 nodes. If you select, say, the nactive-cc-metal1 option, you'll show connections through metal1, through active, through the channel, to the other side of the transistor. I don't know why they even have this mode because it's hard to imagine when you'd want to do this.

2. Once you have the options set, you won't need to do this again. Now, you can use Connectivity->Net->MarkNet to go into a mode where you can select a shape in your layout and the tool will highlight every piece of layout that is connected to that shape (through poly, metal1, metl2, and metal3). It does this by drawing a dotted line around the connected shapes. If you select another node, it will highlight that one in a different color.
3. But, you might not be able to see it without changing the visibility of the layers in your current view. You can do this with the Layers menu to the left of the screen.

What follows are some examples of using Connectivity->Mark-Net and the layers menu to choose what layers are visible.

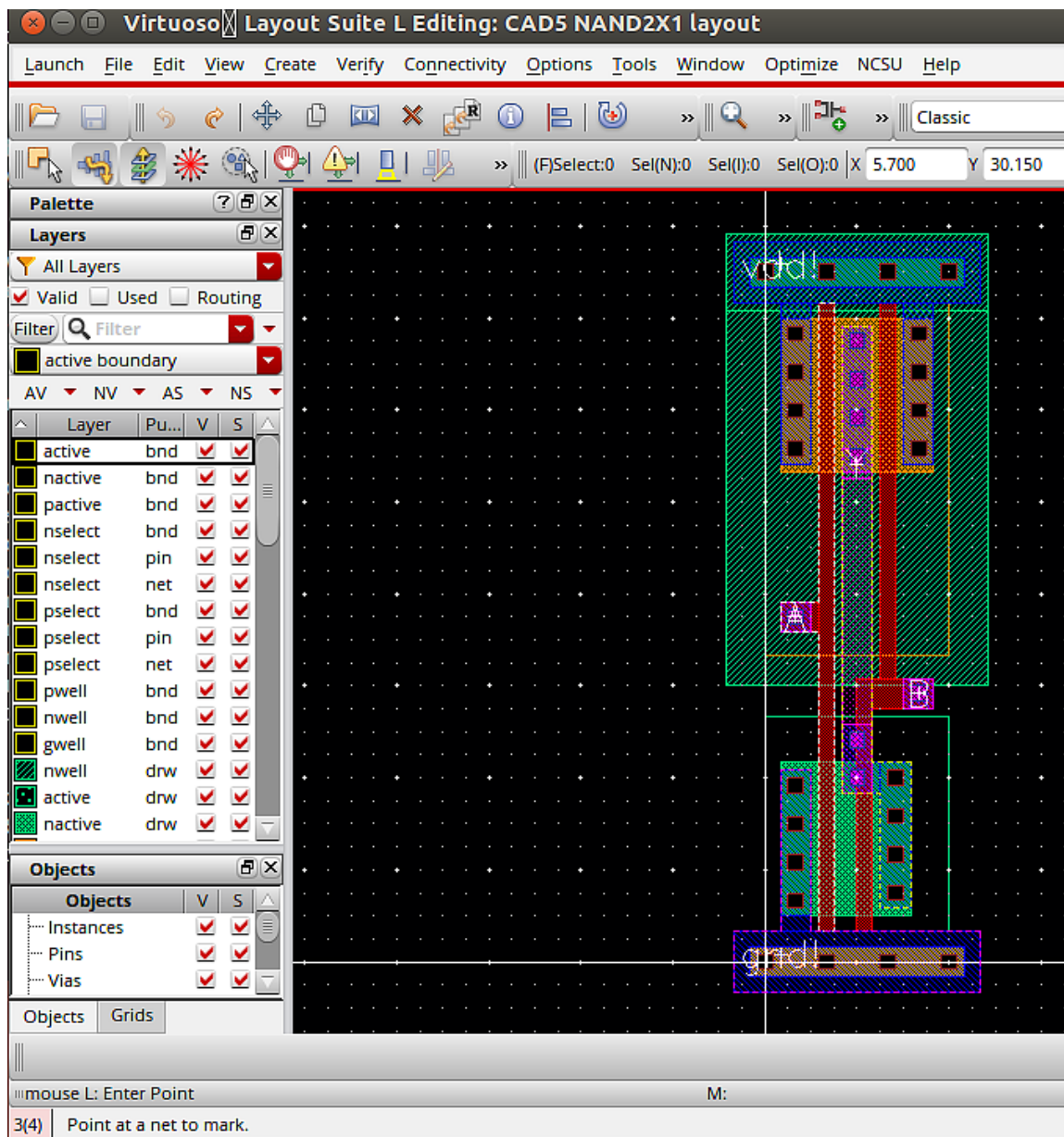
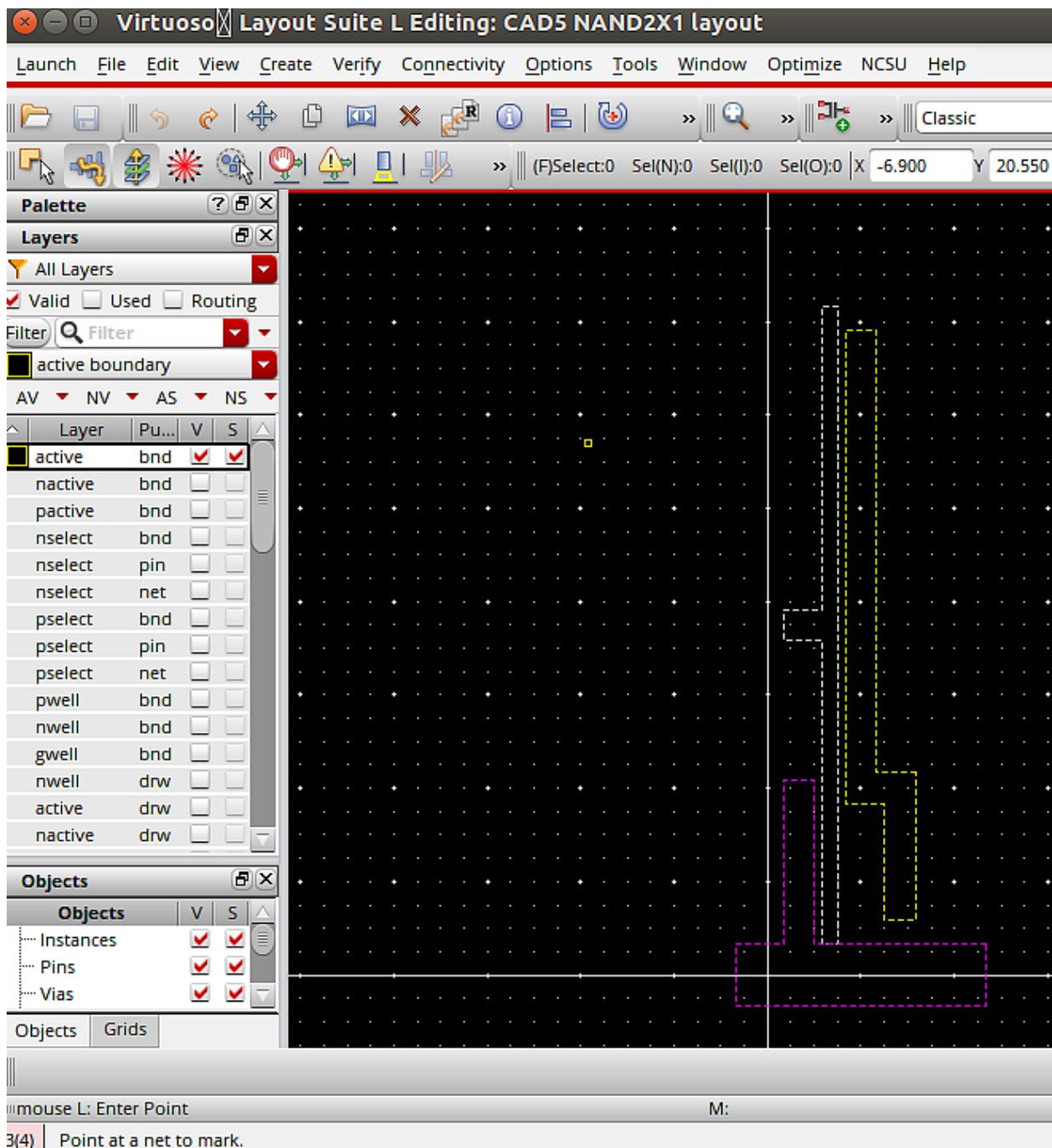


Figure 1: A NAND layout with three nodes "marked:" B, Y, and gnd!.



3(4) | Point at a net to mark.

Figure 2: The same NAND layout with all the layers turned off so that all you can see is the marked nets.

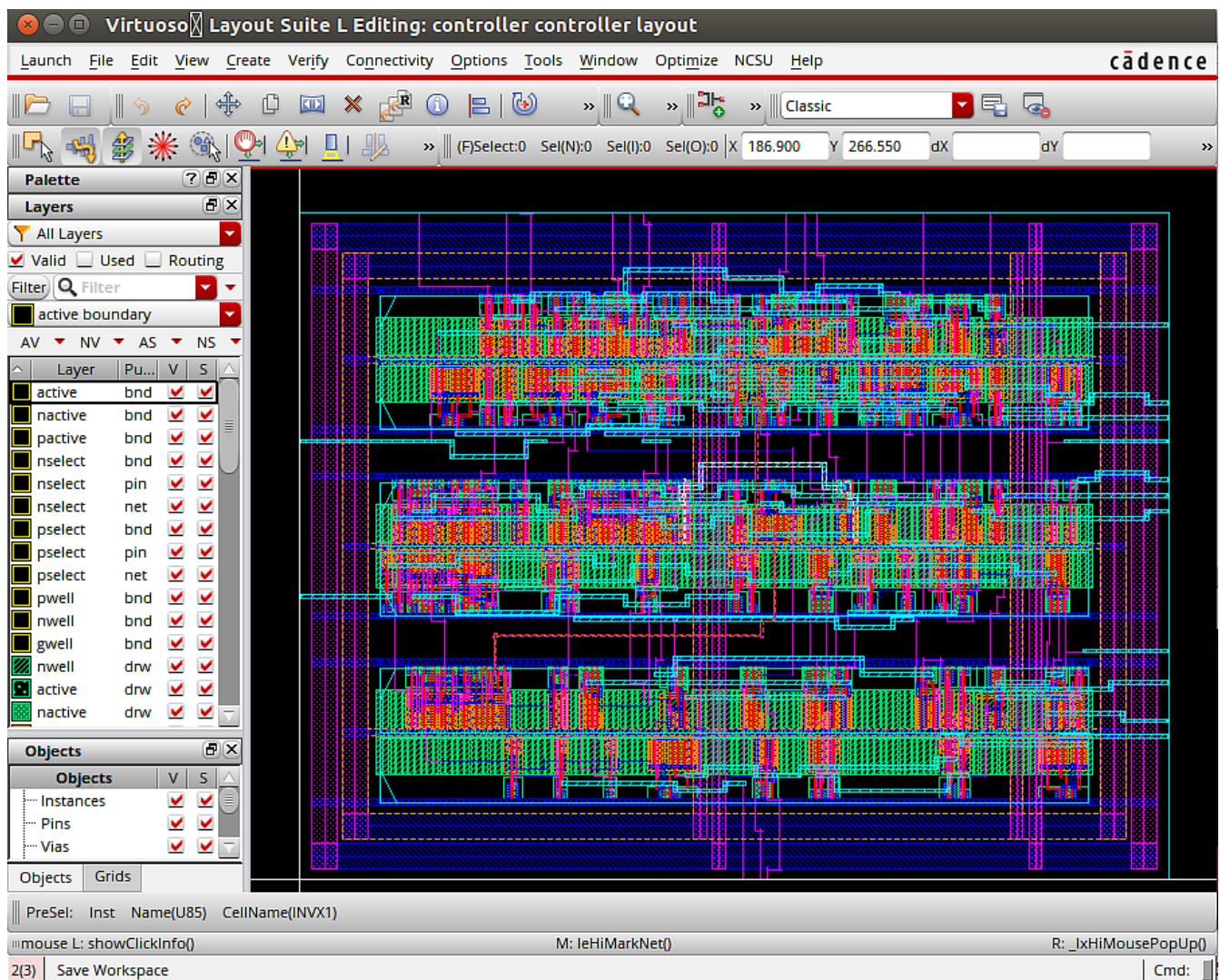


Figure 3: A larger layout produced by Innovus place and route (preview - this is from CAD6). There are three nets marked in this layout, but they're a little hard to see. One of the marked nets is gnd!.

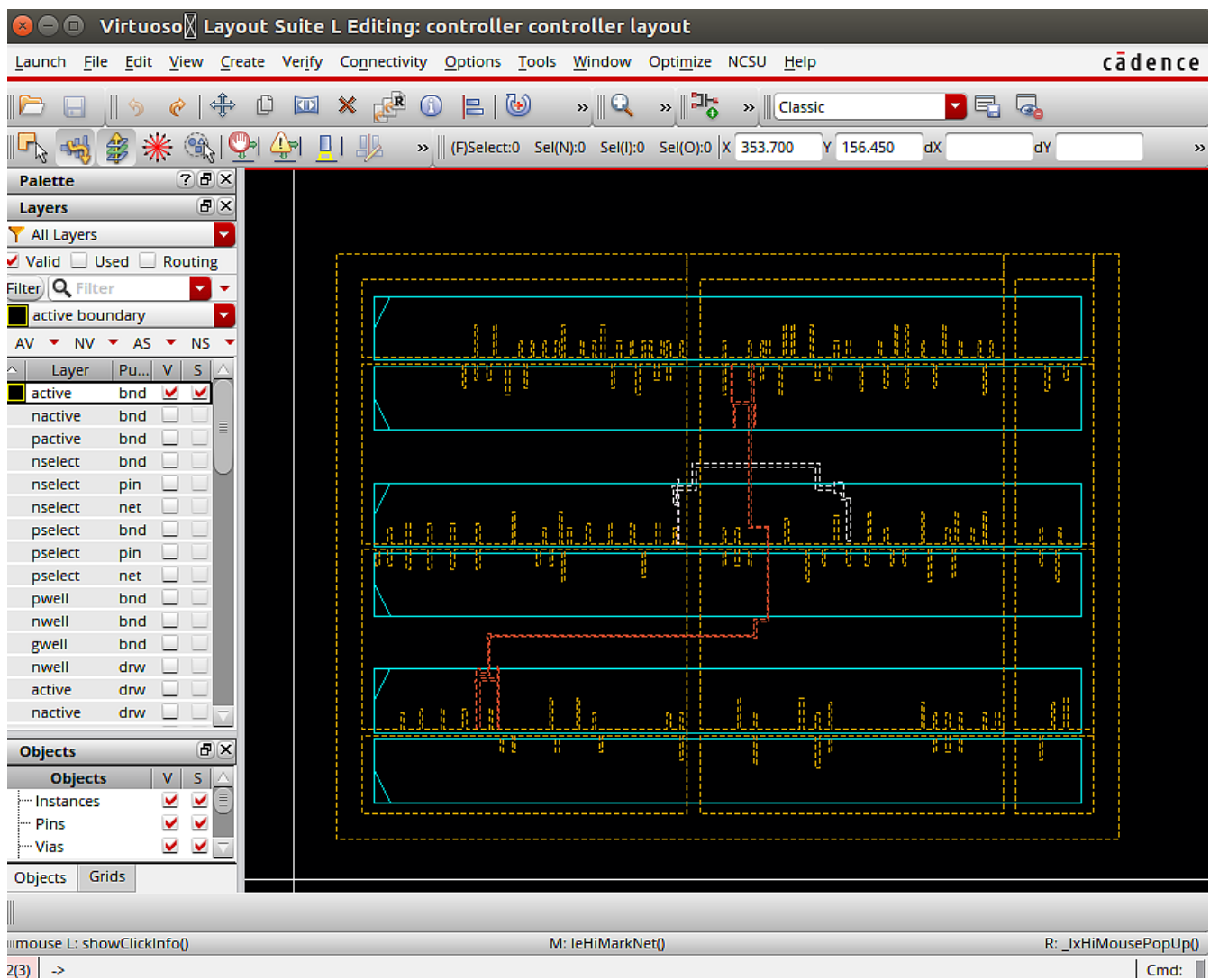


Figure 4: The same as Figure3, but with all the layers invisible so that you can see the marked nets. The gold colored net is gnd!. The other two are random signal nets.



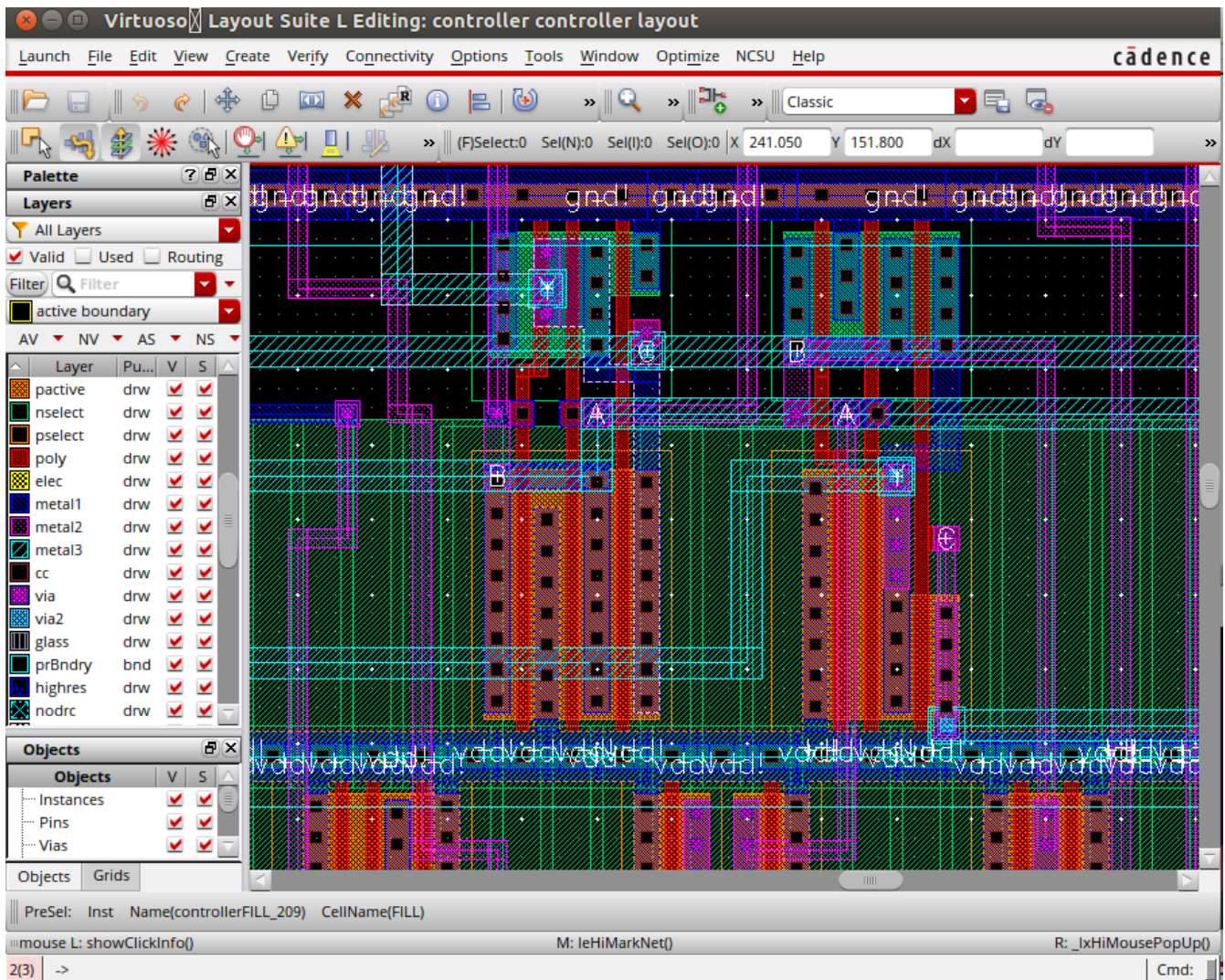


Figure 5: A zoomed version of the marked layout. It's a little hard to see what's marked.



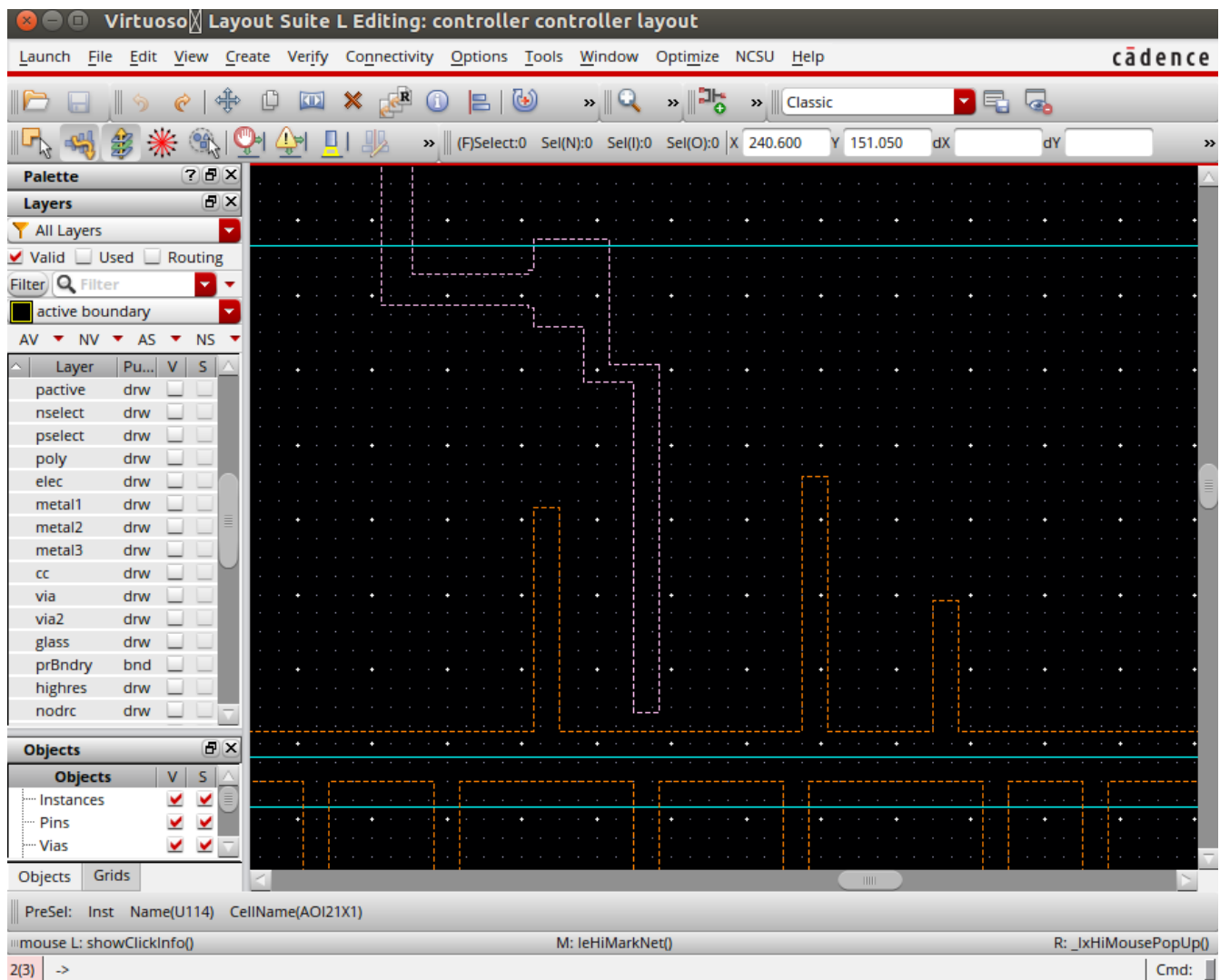


Figure 6: The same figure with all layers invisible so you can see the marks.

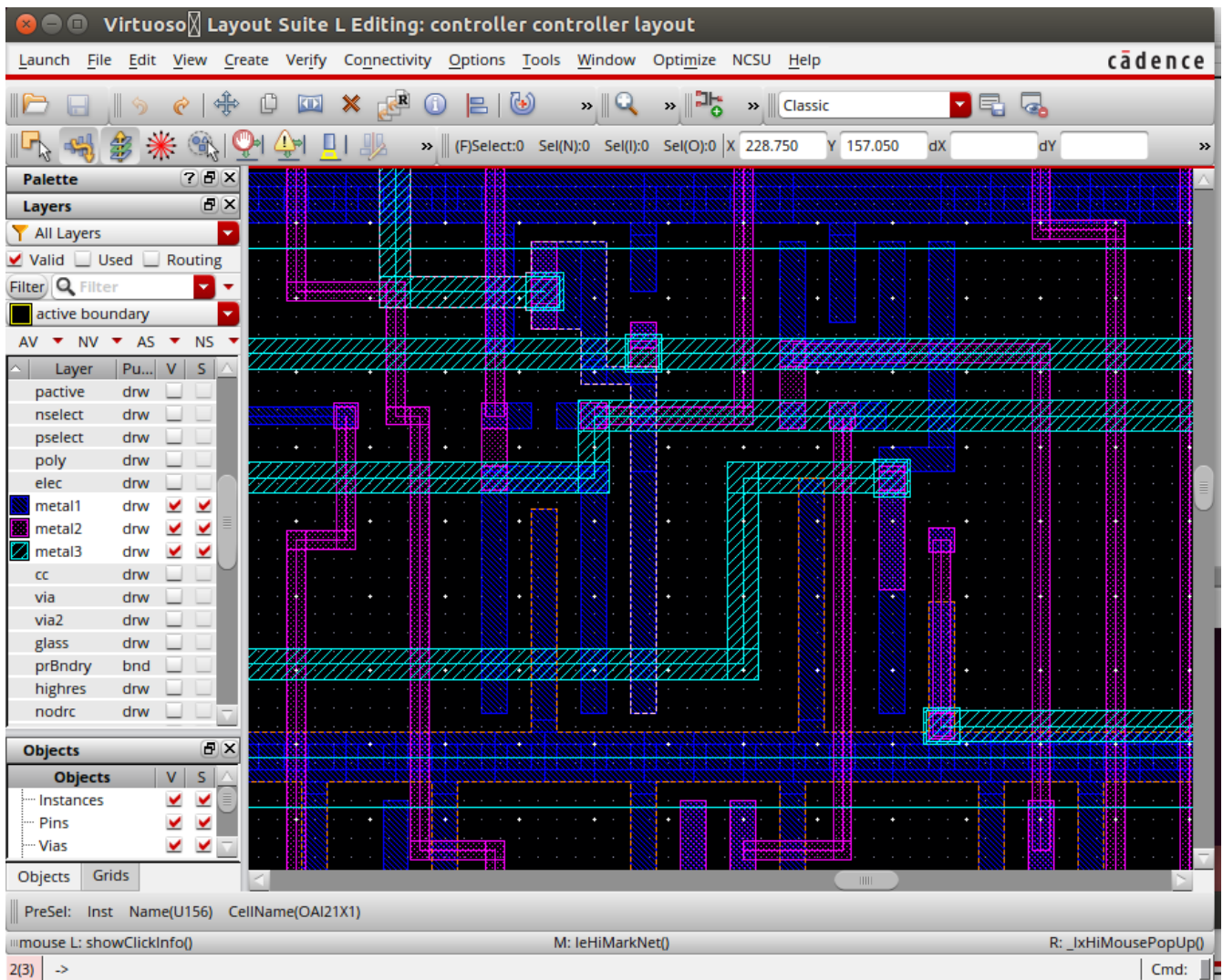


Figure 7: Another view with only metal1, metal2, and metal3 visible (along with the marked net).