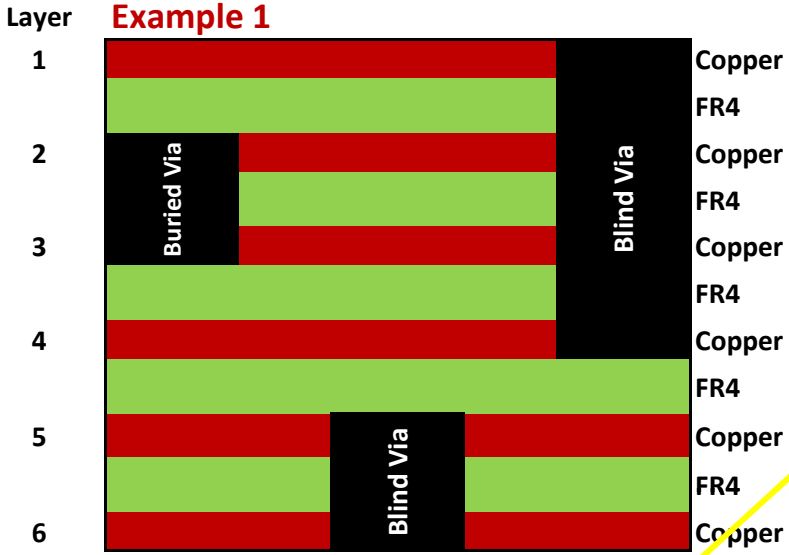
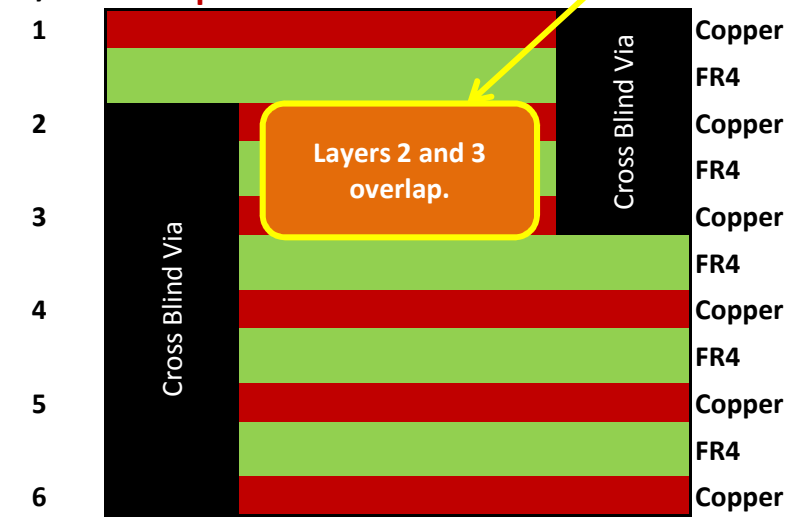
Blind and Buried Via Design Tips

Example 1



Example 2



Blind Via	A via that is visible from an outside layer but is not drilled completely through to the opposite side.
Buried Via	A via that is not visible from the outside of the board and only connects inner layers.
Cross Blind/Buried Vias	Vias that overlap which layers they connect. This is possible to construct but much more expensive and difficult to manufacture. If possible, it's best to design your board so this type of via is not required. This process requires a controlled depth laser drill.

The simplest form of Blind/Buried via processing is **mechanically drilled with sequential lamination**. In **Example 1**, layers 2-3 are connected (buried), layers 1-4 and 5-6 are connected (blind). The rest of the holes on the board are standard thru hole so they are not depicted in the drawing. *While this stack is possible, it is always best to use as few different via combinations as possible to reduce material and manufacturing costs.*

In a standard build with no Blind/Buried vias, all of the layers would be laminated together in a single press cycle, then the thru holes would be drilled. When there are B/B vias required, we must first laminate only the layers that will be connected with these B/B vias. In **Example 1**, the first step would be to drill the holes between layers 2-3. Then we would laminate layers 1-4 together so we could drill the 1-4 vias. Layers 5-6 are laminated together and drilled separately. Once all the drilling is complete, we would laminate all of the layers together and drill the standard thru holes that go all the way through the board. You can see that just adding 1 blind via doubles the amount of drilling and lamination cycles required. Always use as few different via combinations as possible. If they can be eliminated completely that is best!

Here are some things to keep in mind when designing your Blind/Buried Via board.

1. Connect as few combinations of layers together as possible. For example connecting layers 1-2 together is a simple setup that is relatively easy to manufacture. The more complex you make the B/B connections, the more difficult and expensive it becomes.

2. Try to connect layers that will already be made from a single core to reduce lamination cycles. **Example 3** shows a 6 layer built with a FOIL construction. Almost all PCB shops use FOIL construction as their standard process because the materials required are cheaper than a CAP construction. FOIL is cheaper because the number of pre-fabbed cores that must be purchased from the laminate supplier is minimized. FOIL construction always uses pre-preg to "glue" the outer layer copper foil to the inner cores. So no matter how many layers your multi-layer board is, you'll always know that the layers 1-2 will be pre-preg and layers 2-3 will be your first inner layer core. (The sequence alternates after that). If you have a 6 layer design, layers 5-6 would be created with pre-preg/foil. Of course, if layers 1-2 are the layers you are tying together with a Blind Via, we would use a CAP construction reversing the sequence from pre-preg/core/pre-preg to core/pre-preg/core etc. ***If you are going deeper than layers 1-2, a CAP construction may not be necessary depending on what layers are connected.***

In this 6 layer FOIL example, the ideal layers to connect would be 2-3 or 4-5. In the CAP construction example, you would want to connect 1-2, 3-4 or 5-6. Most designs will need to go to the CAP construction simply because the surface layers are the layers that will usually need to use a blind via to transfer the signal to the inner layers.

3. Try to keep the depth of the B/B via as shallow as possible. The easiest construction is where layers that are closest together are connected. 1-2 or 4-5 for example. Deeper drills are certainly possible. Just be careful you don't get into a position where you need to cross connect layers between multiple sets of vias.

4. Your min drill size should be at least 8 mils (.2mm) or larger. Using micro vias smaller than 8 mils requires the use of a laser drill adding cost.

Example 3 — FOIL Construction

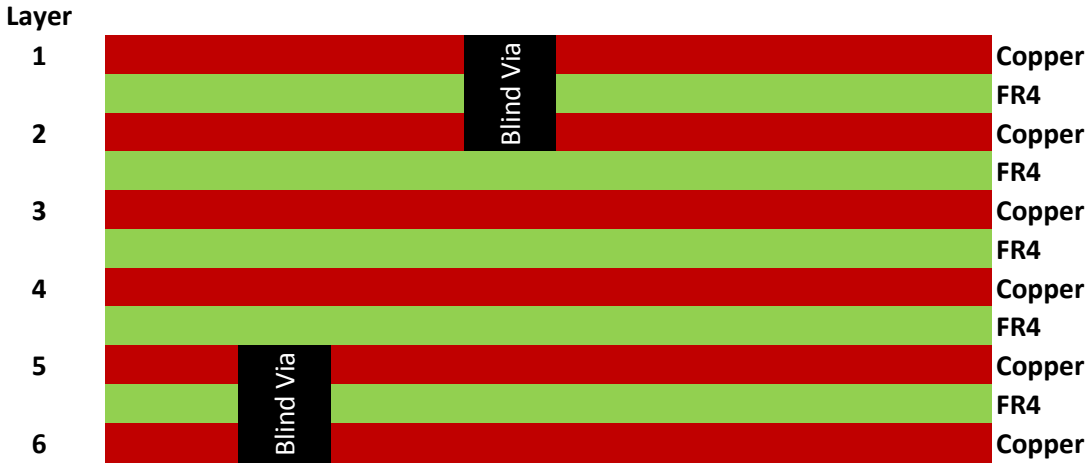
Layer	
1	Copper Foil
	Pre-Preg
2	Copper is pre-pressed onto the core
	Core
3	Copper is pre-pressed onto the core
	Pre-Preg
4	Copper is pre-pressed onto the core
	Core
5	Copper is pre-pressed onto the core
	Pre-Preg
6	Copper Foil

Example 4 — CAP Construction

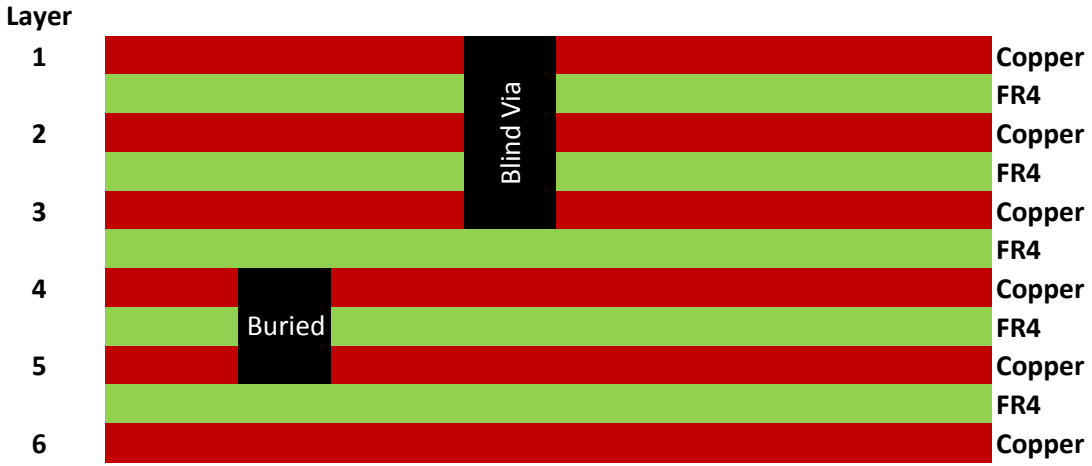
Layer	
1	Copper is pre-pressed onto the core
	Core
2	Copper is pre-pressed onto the core
	Pre-Preg
3	Copper is pre-pressed onto the core
	Core
4	Copper is pre-pressed onto the core
	Pre-Preg
5	Copper is pre-pressed onto the core
	Core
6	Copper is pre-pressed onto the core

Copper Foil	It is what it sounds like. Simply a sheet of copper foil that is laid on top of pre-preg that becomes your outer layers.
Pre-Preg	Pre-Preg has the consistency of heavy wax paper and comes in various thicknesses so they can be stacked to create the desired thickness after heating in the laminate press. It is generally made from the same material the cores are made from, the only difference is they have not been heated, pressed and allowed to harden (cure). This is why it is more cost effective to use as much pre-preg as possible in a multi-layer construction rather than relying on pre-fabricated cores from the supplier.
Core	Cores come from the laminate supplier already pressed and ready for processing. They are completely covered on both sides with copper foil at the desired weight. (.5oz, 1oz, etc). It is for this reason a 5 layer board costs as much to manufacture as a 6 layer. A 3 layer as much as a 4 layer. The inner cores already have copper on both sides so if your design does not use one of these inner layers we still have to etch away this copper. Plus, using a balanced construction helps reduce the chance of warping during processing. If you find yourself needing to add 1 more layer to your design, go ahead and add 2. Your copper layers should always be even numbers...2,4,6,8 and so on.

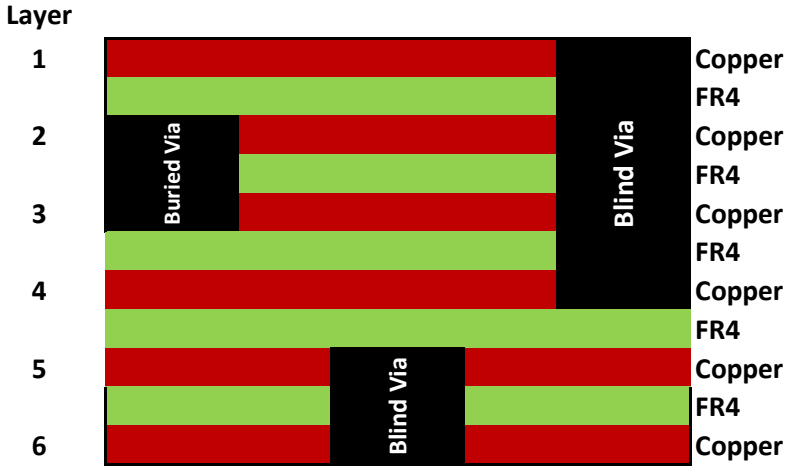
Here are some examples of different Blind and Buried Via setups



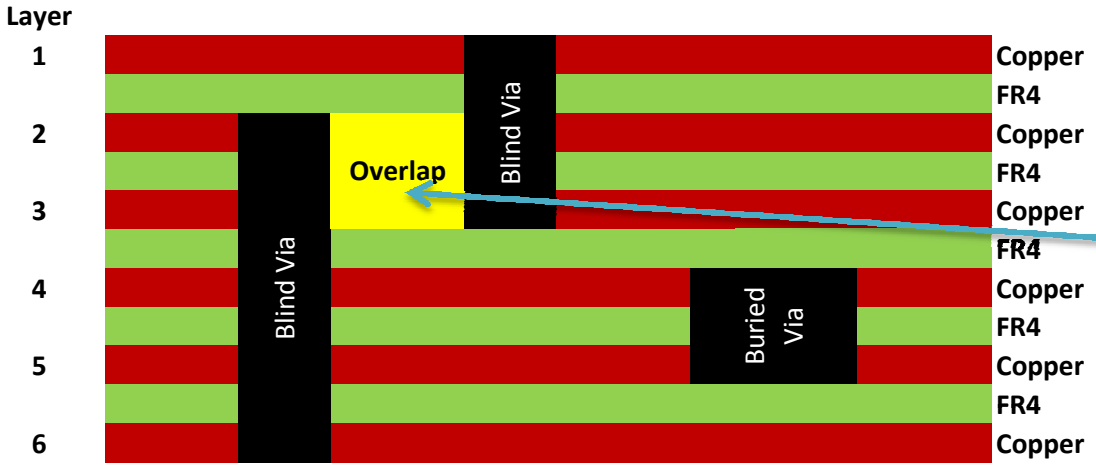
This is a good stack. Connections are not crossed and they are shallow, only connecting 2 adjacent layers.



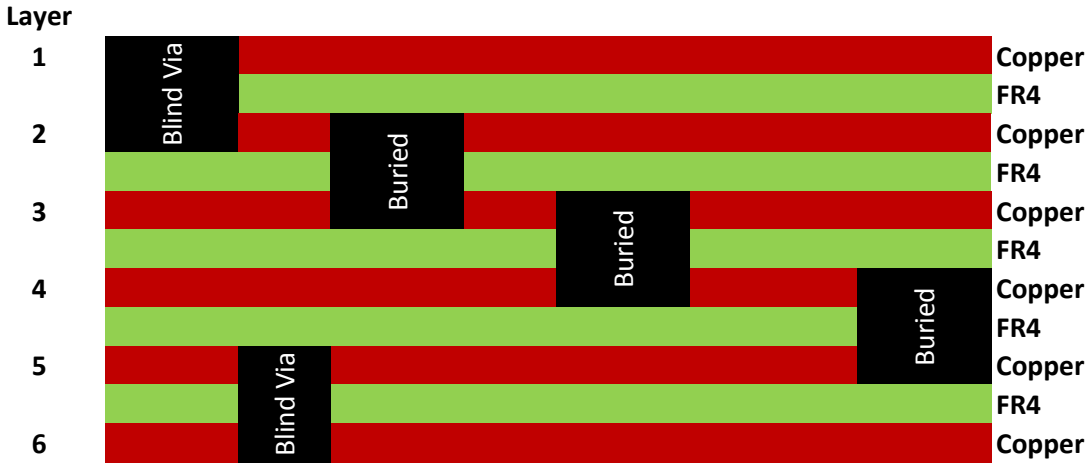
Another good stack.



Another good stack.



While this stack is possible to manufacture it should be avoided due to the cross-connected Blind Vias.



This is not good.