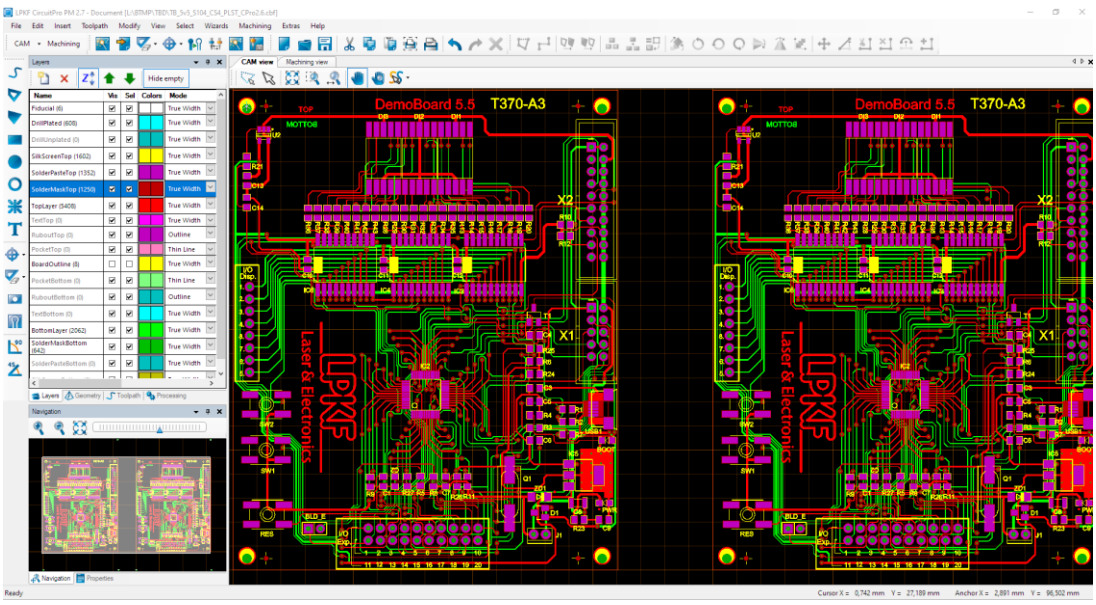
Shrink dimensions, boost processing speed and reduce sample costs

Double-sided PCB production with ProtoLaser ST



LPKF
Laser & Electronics

Best performance with ProtoLaser ST

Contactless PCB production with laser is attractive for many LPKF ProtoMat users as it reduces tool handling and associated costs. On the other side, the investment in a new laser-based system used to be a difficult challenge for many of our valuable customers. What's changed?

Last year, the first tabletop laser system, with the dimensions of a ProtoMat and an affordable price was introduced to the market. The Plug & Play system, with intuitive software, rich material libraries and built-in evolutions based on feedback from many of existing ProtoLaser customers will make you an expert in a day. Besides eliminating the need for carbide surface milling tools by using a laser, your insulation channels can now shrink bellow 100 µm and processing times will drastically shorten, regardless of whether or not you choose to have a full rubout, or just simple isolation of your circuit traces. Now that you have a laser, what do you do with your existing ProtoMat? Let's take a deeper look at double-sided sample production using the new LPKF ProtoLaser ST.

The Sample

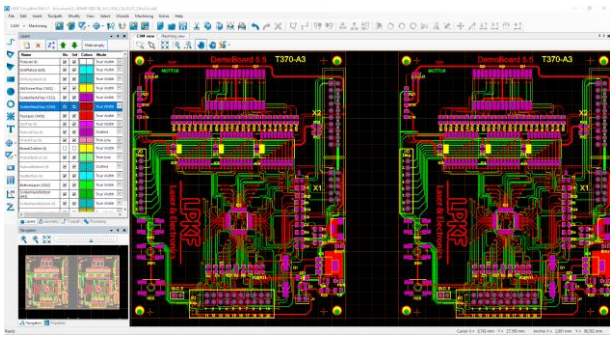
For this sample, an already known, previously used demo board was selected. It's a 32-bit ARM Cortex microcontroller environment, double-sided board with the dimensions 80 x 100mm (approx. 3" x 4") with 304 holes and vias. The ARM controller is housed in a LQFP48 with 0.5mm pitch. With exception of extension pins, all components are SMD. This board also calls for a solder mask.

Necessary process steps

A through-hole plated PCB requires the following basic process steps: drilling the holes to be plated, plating the holes, laser-etching the top and bottom layers, surface finishing with soldermask and finally, cutting it out. Everything starts with importing CAD data.

Data preparation

This step starts exactly as you are used to. Import of CAD data to your existing LPKF CircuitPro for ProtoMat. Yes, that is correct - you will need your ProtoMat for drilling and routing as the IR-based ProtoLaser ST, isn't ideal for drilling FR4. Don't forget to add fiducials. For our report purpose, the sample is being duplicated; after plating, one will be processed using laser and second, using ProtoMat. What we really need at this step, is a board outline and drilling holes, including fiducials, so you can skip the circuit insulation step which has the longest calculation time. Don't forget to save your job.



Picture 1: CAM window of CircuitPro 2.7 for ProtoMat

Drilling

For this application report, we used the ProtoMat S104. It's a hi-end milling system from the current generation, but also an E34 or E44 will do the job. Even an older ProtoMat S62 model with a fiducial alignment camera/vision system can be upgraded with the latest CircuitPro and brought nearly to the level of today's state of the art systems. A vision system is necessary to reposition the PCB for cutting out of the panel mechanically later.

Drilling of a single sample required 13 minutes including fiducial holes, several different diameter drills for vias and TH-based holes including 3.2 mm mounting holes produced with a combination of 2mm drill and routing tool. Usually, both samples would be drilled in a single process, and the average processing time will be remarkably reduced.

Plating

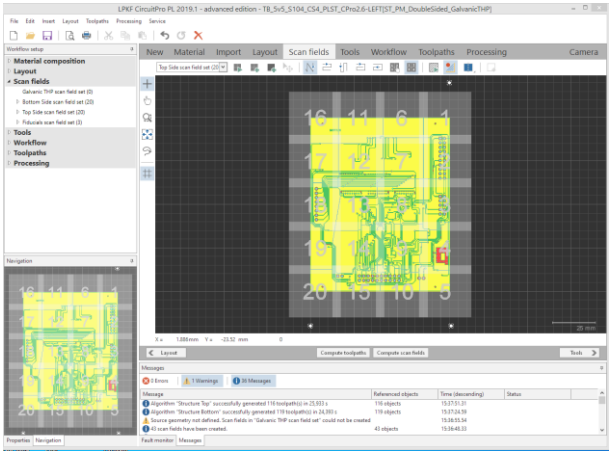
Since we have the extremely reliable LPKF Contac S4, plating is the most boring step. After setup of the process on the integrated display with a target of 17 µm added copper, the initial short cleaning steps and treatments run by themselves without user intervention. I usually copy timer settings from the Contac S4 display to my mobile phone to remind me when the plating process will be completed. Earlier versions of LPKF through-hole plating systems like the MiniContac RS can also complete the plating requirement but the newer Contac S4 provides more uniform copper growth.

Picture 2: LPKF Contac S4 in operation

Back to work – laser processing

Our shiny copper plated panel, with a bunch of plated through-holes, is now ready. The ProtoLaser ST is ready to go with its built-in computer. In the new, contemporary CircuitPro 2019 interface, the software guides a user through the necessary steps. With just a few clicks, you can run through these settings for any standard material. For transparency, a short explanation: The first, very important step is selecting the right template for a job. It will pave your path to a finished PCB. In our case, we opened an existing project we had saved earlier as a *.cbf file. The CircuitPro software will recognize file specifications and preset filters for double-sided boards when connected to the ProtoLaser ST system. Selection will be narrowed to a few choices related to the plating process – in our case, the right solution is the template with the galvanic THP process included in the workflow.

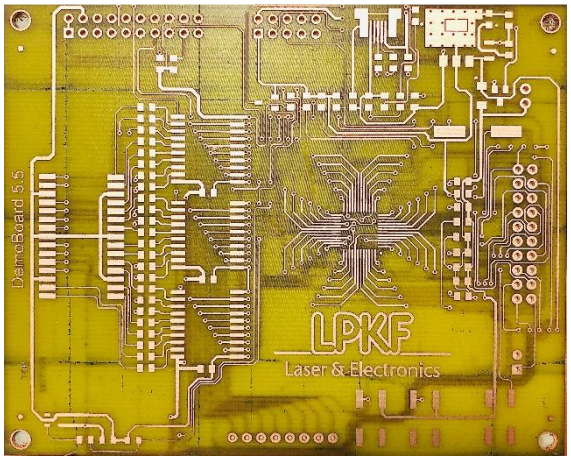
In the next step, select the material from a library list of various double-sided materials starting with FR4 variations with different core and copper thicknesses. You will also find many popular RF materials to choose from. The selection at this point defines the core material, an FR4, with 18/18 µm Cu on each side. The material library is nicely supported by graphics which makes the process very easy to follow. The next arrow in the workflow leads you to the next window, scan fields. Clearly labeled buttons will run the calculations of the scan fields and toolpaths with one move. Moving to the Tools dialog, there is a small task for the operator. In the line with the selected material is also a button labeled THP. This action will make the difference between 18 and 35 µm of copper on your plated board top coincide with the proper tool parameters for that copper thickness. Moving on, we step into the Workflow dialog. This is like phases within the previous ProtoMat CircuitCAM software but is far more transparent with the new graphic interface. It allows advanced users to experiment and adjust their process to new materials and specific jobs. For this demo board, however, we do not need to change anything. Next window: The software displays the calculated laser tool paths with the 27 µm diameter laser tool. It is quite a dense design with the patented rubout algorithm and the laser beam moves very fast to ensure rapid metallization removal during processing.



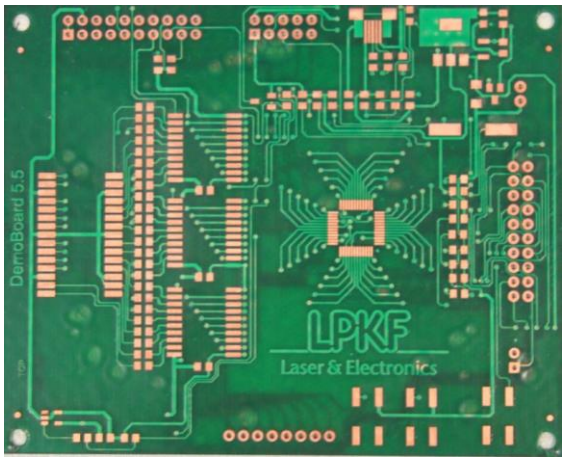
Picture3: LPKF CircuitPro 2019 for ProtoLaser

When starting the process, the software will guide the operator through material set up and then take over from there. The feature I personally like most, is a small sample production feature to test parameters for your mounted material. It's like milling tool depth test on a

ProtoMat. With earlier versions of CircuitPro, an operator needed several steps to perform such test – now you can just uncheck or skip it, if you don't like it. After the data prep steps mentioned above are completed, which maybe requires 5 minutes, the bottom side of the board is processed with direct laser etching in just 21 minutes. After manually flipping board, the top side requires 19 minutes to complete.



Picture 4: Processed double-sided demo board



Picture 5: Solder resist on sample

PCB finishing - solder resist

When utilizing a ProtoLaser, the solder resist process becomes more attractive immediately. When using the LPKF ProMask kit in conjunction with a ProtoLaser, some of the usual process steps can be omitted, thus simplifying the process while increasing the precision. The polymer should be still applied to board and cured by UV light, but, we do not need any film or wet process steps because the solder resist can be removed from the pads by the laser, adding the precision needed for the demands of fine-pitch SMT components.

Cutting out

For routing, the PCB should be transferred back to the ProtoMat. The same fiducials will be used for aligning the board and performing a perimeter cut-out. This follows the same routine job you know from your ProtoMat experience.

Summary

The ProtoLaser ST provides existing LPKF prototyping customers an excellent opportunity to reduce pitch below 100/100 µm, while increasing process speed. The sample with 35 µm (1oz) Cu was produced in a less than half of the time of the flagship milling system, the ProtoMat S104. In case of 18 µm Cu (rather than 35 µm on this job), the processing time would be less than a quarter of the time comparing to same ProtoMat.

Milling tool wear is no longer a concern with an always sharp laser beam which brings the LPKF ProtoLaser ST user a considerable savings, especially when running small production batches, full size samples or larger quantity of sample runs. Last, but not least, a wider range of materials can be processed, from various soft RF materials to fired and unfired ceramics.

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