

## Lebanon High School

# Circuit Board Plotter Helps High School Electronics Students Complete Their Projects

## *PCB Plotter for engineering prototypes yields big dividends in the classroom*

### *Introduction*

Students of Steve Robinson's electronics classes at Lebanon High School in Lebanon, Oregon use a ProtoMat<sup>®</sup> 91s circuit board plotter system from LPKF Laser & Electronics to manufacture their class projects. The plotter has yielded valuable educational benefits for the students by teaching them PCB design and production techniques, and it's also yielded significant time-saving and financial benefits for the classes.

Steve teaches four levels of electronics classes: Beginning Electronics, which provides hands-on study of components and soldering; Linear Electronics, where students study diodes, transistors circuits and troubleshooting; Digital Electronics, which is the study of logic chips and microcontrollers; and Robotics and Automation, where students learn simple robotics by building and programming their own robots. All students in the Linear, Digital and Robotics classes use the LPKF milling machine to produce their own boards.

### *The Assignment: Design and produce an amplifier circuit board*

Students in the Linear Electronics class were assigned the task of designing and producing a 100 watt RMS two-channel amplifier board. They used schematic capture and PCB design software to create the circuit board layout, then they produced a gerber data file for the board milling machine and milled the board. Steve remarked, "What we really

like about the milling machine is that the students do a prototype, find their mistakes, then they change the design."

The prototype boards were designed as single-sided PCBs to simplify component placement and soldering, They were milled on half-ounce copper board material to extend the life of the milling machine tools.

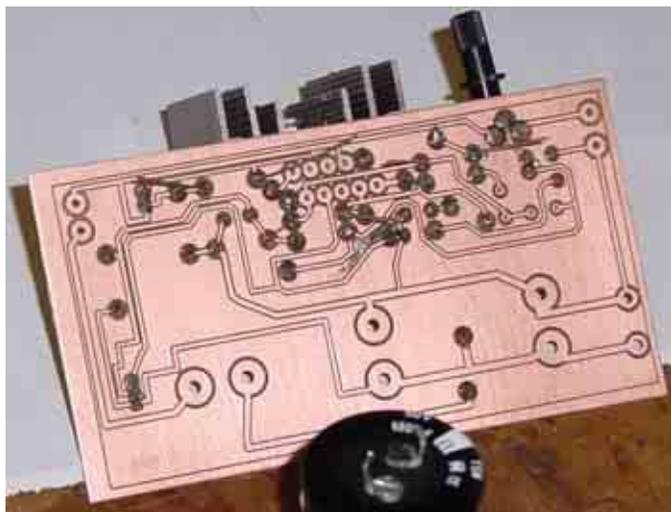


*Steve Robinson*

*The Result: Prototype circuit boards were milled in the classroom, then the amplifiers were assembled and tested*

The LPKF plotter made it easy for the students to rapidly check their milled board designs, make any changes, then produce a new PCB before assembling the actual amplifier circuit. Steve commented, "If we didn't have the milling machine, the students would have to draw the board layout in paint and then dry it and etch it in acid." The ProtoMat 91s provided the students with the ability to quickly produce quality PCB prototypes in the classroom using techniques very similar to actual board production facilities, and without the use of aggressive etching chemicals.

By using PCB layout software along with the ProtoMat milling machine CAM software, the students benefited from gaining knowledge about PCB layout and manufacturing techniques that optimize milling paths and component placement. They also acquired valuable understanding of the importance of proper CAD data preparation, which can prevent circuit board production problems.



*Milled amplifier board partially assembled*

The students assembled their milled boards by hand, inserting and soldering the components in place. If a layout or placement error was detected that couldn't be worked around, the board could be milled again in just a few minutes. After the board

was assembled, the remainder of the amplifier board's external components and circuitry was attached and tested.



*Assembled amplifier circuit*

*The Benefits of the LPKF plotter: Educational, time-saving and financial*

Steve said that in addition to the valuable educational and time-saving benefits of the LPKF plotter, it has also saved his electronics classes hundreds of dollars a year by reducing PCB production costs from nearly five dollars a board to typically only around two dollars a board. With these savings he was able to purchase new test meters, oscilloscopes and power supplies, as well as additional electronics projects for his students.



*Lebanon High School's LPKF 91s plotter*

Four of Steve's Lebanon High School electronics students recently worked with students at Albany High School to participate in the FIRST Robotics Competition. This international competition teams professionals and young people to solve an engineering design problem in an intense and competitive way. Steve's students designed a robotic arm which had to grab an overhead bar placed 10 feet above the floor, then pull the robot off the floor. Steve Robinson knows that his LPKF plotter will help his talented students achieve success with whatever projects they tackle.

### *About LPKF*

LPKF Laser & Electronics has established itself on the international market in the fields of advanced circuit board prototyping, SMD stencils and high-density circuit board designs, eliminating the need for hazardous chemicals. Their revolutionary MicroLine laser circuit structuring processes are transforming the design of smaller, lower-cost, higher-performance products for computing, video, telecommunications, medical and measurement applications.