



Case Study

The Race Within the Race

Hardware design for Formula One racecars at a leading German Formula One engine supplier

Arguably, the only thing more awe-inspiring than the 200-plus mile per hour speeds of Formula One racecars is their cost to operate. With season budgets topping \$20 million for engines alone, racing teams are under enormous pressure from sponsors and fans to succeed at this highest level of high-performance racing. As such, Formula One teams constantly look for competitive advantages in all facets of their racing operations. This is especially true for racecar electronics, where fractional deviations in quality can be the difference between a victory lap and a last-place finish.

One Formula One team that takes its electronics very seriously is a leading Formula One engine supplier located in Germany. With a second place finish in last year's season, most industry observers expect them to vie for the 2003 championship. One secret to the group's success is their reliance on LPKF Laser & Electronics equipment to give them that extra competitive edge. The group uses the LPKF circuit prototyping system to meet the ever-increasing electronic demands of their racecar engines. This facet of the racing industry truly represents a 'game within a game' - where teams must win the battle of circuitry in order to win the battle on the track.

The German engine supplier is responsible for the engine of a major Formula One racecar. All of their projects are directly related to the engine control units, fuel injection (including sensors), and data acquisition, as well as signal conditioning, preparation and processing. The German supplier uses the LPKF ProtoMat[®] 95s system - one of a series of LPKF circuit board prototyping systems that mechanically etch circuit layouts onto a wide range of substrates. Founded in 1976, LPKF has grown to become the worldwide leader in the fields of advanced circuit board prototyping, laser cut SMT stencils, and HDI technology.

In-House Design Verification Results in High Quality and Efficiency

Since the circuit boards that end up in the Formula One racecar are high-density etched multilayer boards, the German engine supplier uses the LPKF system primarily for breadboards that test sensors and sub-circuits. As a typical engine control system contains over 20 such sub-circuits, the LPKF system is used extensively for design verification of the sub-systems and for experimental sensor design. Although hardware is typically designed once a year before the race season (or when Formula One regulation changes require it), engineers work during the season on firmware and logic programming. While hardware design projects often take several months, sub-designs take from a few hours to a few days since designers can produce boards very quickly with the LPKF system. On average, the supplier creates up to 10 boards per week – allowing for excellent verification efficiency. The system also creates PCBs that are used for component qualification, thus enabling the supplier to check and clear components quickly. The German Formula One engine supplier believes that the LPKF system provides them with significant advantages over having to rely on a lengthy outsourcing option.

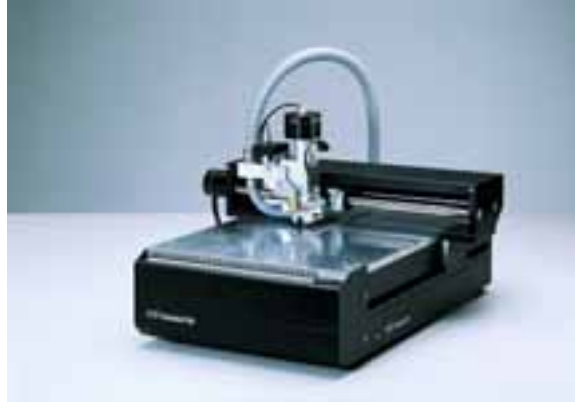
The Engineering Manager of the supplier says, “Being able to test, verify and modify sub-designs quickly while they are still in the design process gives our group the chance to focus on quality without worrying about the significant risk of error that comes from prematurely pushing boards through production. No doubt, the LPKF system provides us with the leading edge on quality, as well as stability and performance.”

With quality as the top priority, the LPKF system allows the group to focus on it versus time spent in an external board production phase. In fact, the group never uses quick-turn board services for either their prototyping or production boards. This is true despite the fact that they don’t have budgetary concerns and never use large quantities of components. In the end, the LPKF system contributes substantially to a 100 percent first yield of the final circuits because the sub-designs have already been verified.

Creating Experimental Circuits Efficiently

Formula One racecars utilize a large amount of leading-edge technology that is not commercially available and therefore require experimental circuitry. Further adding to the German Formula One engine supplier group’s challenges is the fact that electronics must constantly be fit into smaller spaces within the racecar. This is another reason that the LPKF system is beneficial to the German group. Without the option to constantly experiment in a safe in-house environment that facilitates rapid prototype creation, analysis, and redesign, the group’s design engineers would be unable to justify much circuitry experimentation – resulting in a certain competitive disadvantage. This was never more evident as when active suspension and traction control features on the racecars were recently eliminated by Formula One. Changes like these in Formula One’s regulations instantly trigger a wave of redesigns.

In another case, the German group developed a completely new lambda system to precisely measure changes in their engines. The project - from inception to successful car usage - was completed in just four months and involved the creation of custom hardware and software. Within this development, the group used the LPKF system to design several iterations of the input signal conditioning circuitry.



“The ProtoMat[®] 95s is extremely flexible and allows us to approach new ideas and experimental designs quickly. Moreover, space is a critical issue in racecars, so we try to use every cubic inch that is available. The LPKF system is instrumental in helping us accomplish all these things,” says the German group’s Engineering Manager.

Shared Use of Equipment by Design Teams Maximizes Effectiveness

Another major advantage the LPKF equipment provides to the group is that it can be shared across company departments. In this case, the LPKF ProtoMat 95s system is used 30 percent of the time by the German Formula One engine supplier group, while the engineering group that develops drive trains for regular production cars uses it the remainder of the time. This was a contributing factor in the original purchase of the equipment because these two groups can share the equipment and take advantage of instant turnaround breadboards and circuit board prototypes.

With the 2003 Formula One racing season getting underway, the German engine supplier expects to continue to utilize their LPKF system. What’s more, if bi-directional telemetry is eliminated by Formula One this season as expected, they will be even busier with circuit redesigns. As the German Formula One engine group looks to capture the title this season, the group will no doubt continue to rely on the LPKF prototyping system to give them that extra competitive edge for their electronics - the game within the game.