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LABCAR Combo Benches at GM Powertrain

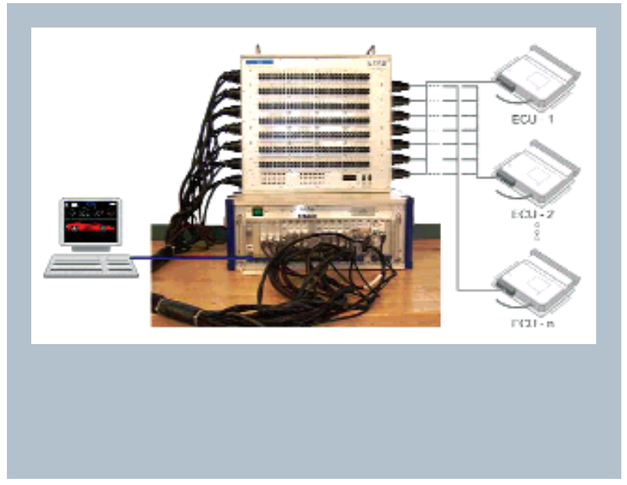
By Walburga Zahn and Pjeter Vuli, ETAS

Innovative systems can be switched in minutes



Developers at General Motors have been relying on ETAS HiL systems for testing their powertrain controllers since 2000. Worldwide, over 60 LABCAR benches are in use by General Motors Powertrain (GMPT). To increase bench usage and controller flexibility, GMPT and ETAS implemented a number of innovative HiL combo systems that can be switched in minutes to support different ECU applications.

The need for HiL bench testing and validation at GMPT has increased dramatically in recent years. This trend can be seen across the automotive industry since embedded controls software and electronic components are becoming more and more complex. The pressure of increased ECU complexity and verification timing forced GMPT to come up with a better testing concept. Instead of designating one bench for one specific ECU project only, GMPT and ETAS created HiL combo systems. These flexible LABCAR benches can support a variety of different controllers and multiple software variations. The ability to use LABCAR benches for different ECU applications gives GMPT great flexibility, increases bench utilization, and saves time. In fact, only about 15 minutes are needed to reconfigure a bench for a different ECU testing project. As a result, maximum bench utilization is ensured at all times and projects can continue without downtime.



Typical LABCAR combo bench at GMPT.

Mike Barrera (Product Development Tools Leader – GMPT) and Pjeter Vuli (Product Support Manager – ETAS Inc.) led the LABCAR combo bench project. When Mike Barrera initiated Phase I of this project in 2003, the main objective was to adapt hardware and software for the support of multiple ECU applications.
With the completion of Phase II in June 2006, the following objectives were reached:

- Increase bench uptime
  - > by making any under-utilized benches available for other ECU projects with high testing needs
- Reduce the need for training and onsite bench support
  - > by reusing the same software versions, projects, and GUIs
  - > by sharing test scripts for automated testing between all combo benches
- Minimize configuration effort
  - > pre-configure all benches with the same loads and signal conditioning
  - > use one bench for several controller testing projects by only changing the ECU harness and software project
- Shift more testing efforts to the lab
  - > reduce in-vehicle testing and thus minimize the need for test and validation fleet vehicles
  - > support GM Road-to-Lab-to-Math (RLM) strategy

To reach these goals, ETAS and GMPT selected a number of specific controllers to be supported by one LABCAR bench. Controller projects were grouped by finding the highest number of common I/O needs. A generic signal adaptation system (SAS) was built that combined signal adaptation, load, and breakout options.
The SAS accommodates all common ECU pins and sufficient additional pins to cover all controller-specific I/O needs. In Phase I, four controllers with multiple applications were supported. These controllers are used in 2002 to 2007 production vehicles, such as Cadillac XLR, Chevy Corvette, GMC Trucks, Pontiacs, and many others.

During Phase II (2005-2006), the benches were adapted once more for the support of an additional set of four controllers (for vehicle model years 2008 to 2013). The adaptation included the latest VME boards developed by ETAS for the support of new functionality. In addition to meeting new ECU specs, these new LABCAR boards offer better resolution, more throughput, and onboard signal adaptation. Upgrading the LABCAR benches with new boards also made more testing options available on the HiL systems.

Adapting the benches for future controller projects will require relatively little effort, thus protecting GMPT's investments in these powerful development test tools. LABCAR hardware is highly scalable and uses non-proprietary standards for communication and computation (VME bus, PCI, off-the-shelf PC for computation power, etc.).

Mike Barrera summarized the efforts and benefits of the combo benches as follows:



PT-LABCAR for powertrain applications.

"By migrating powertrain HiL benches to a "combo bench" strategy, we have significantly improved the flexibility, capability, and utilization of these HiL investments. One bench can be quickly re-configured to test a variety of ECUs (and is now like seven or more benches in one). This is a dramatic capability improvement for those GMPT teams that must test multiple controllers, and for multiple teams sharing the same bench resources. This also has had a dramatic impact on satellite test locations, which need only invest in a bench or two. One bench can now provide the test capabilities of multiple benches.

For the next generation of ECUs, GMPT recently upgraded many existing LABCAR benches to the "combo bench" architecture. The cost of this strategy was significantly lower than purchasing all new equipment. As we continue to add new controllers to the "combo" set, we also extend the lifespan and overall return on investment of these existing benches. Compared to the time it took to deploy a non-combo bench in the past, to add a new controller to the new "combo" upgrade represents only 1/3 of the cost and required down time. This is a tremendous savings in terms of bench development time and cost. In 2007, GMPT plans to further extend the number of supported controller projects."

Based on the GMPT combo LABCAR project and other customer requirements, ETAS released a new product in October 2006, PT-LABCAR (see RealTimes 2/2006, pp. 16-17).
PT-LABCAR is a standardized ETAS HiL system for powertrain applications. While the basic system was designed for typical applications, the open architecture and high scalability of PT-LABCAR enable it to meet the requirements for high-end applications as well.

With this product, ETAS responded to customers such as GMPT who wanted a more generic and more flexible solution to their increasing bench testing needs.

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