OPAL-RT TECHNOLOGIES

Success Story

socomec
Innovative Power Solutions

An innovative HIL Test Bench to Validate Embedded SOCOMEC Inverter Software

SOCOMEC is represented on 5 continents, either through direct affiliates or distributors. Thanks to its commitment to innovation, SOCOMEC is the leader in all its lines of business, all related to electrical equipment for the service and industrial sectors : switching and protection (fuses, isolators, breakers), energy efficiency (power meters, electrical sensors), power converters such as Uninterruptible Power Supply (UPS) and service (product maintenance, training and consultancy services.

"Thanks to NI and OPAL-RT, we now have a hardware and software solution to validate high-performance, real-time HIL, which will allow us to improve product quality and reduce time-to-market."

- Thierry Rohmer, SOCOMEC SA

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1. Challenge

SOCOMEC challenge was to have an HIL simulator for our power electronics converters that would allow them to validate all the operations that have strict real-time constraints and to test product reliability in all types of use.

2. Solution

Use the National Instruments PXI Express chassis and FPGA boards that support the OPAL-RT eHS64 solver, with the NI software suite with LabVIEW and VeriStand for the real-time node and TestStand for test automation.

3. In our client's words

Application Detail

We wanted a turnkey, reliable and scalable solution for our validation needs. After consulting numerous HIL simulation system vendors, we chose the combined NI and OPAL-RT solution because their product best met our specifications, such as:

- Simulate our converters operating with a chopping frequency over 10 kHz (and, therefore with a model running at over 200 kHz).
- Support over 150 simulation variables with more than 50 semiconductors, 36 PWM control inputs and 30 real-time analog signals received from the solver.

Avoid needing to repeat long compilation processes after every change to the converter diagram.

- Have one solution to simulate both convertors and their environment, but preferably with only only go-to person for the solution.
- Use industry standard products or programming languages.

NI recommended a hardware and software solution, including the implementation of OPAL-RT's eHS64 solver on a FlexRIO FPGA board, to meet these needs.

Now, we can change digital power electronics models in runtime, simulate environment models in LabVIEW, and acquire and generate signals – all managed in real-time by VeriStand.

The test bench is comprised of electronic boards under test (UUT), slightly modified to be compatible with electrical signals output from or input to the instrumentation bay.

Each element is dedicated to a specific task: the controller runs models developed in LabVIEW for signals with lower real-time constraints, such as batteries or electric motors (< 5 kHz); the solver is dedicated to simulating power converters and related filters (< 1 MHz) and is run with flexibility thanks to the FPGA.

A project developed in partnership with MESULOG

After the entire team received training from VeriStand and OPAL-RT, the system was up and running in less than a week thanks to the hard work and dedication of system engineers and R&D from both NI and OPAL-RT.

We hired MESULOG, an NI partner company, to work with us throughout the project and, in close collaboration, we were able to update the manual HMI with a total investment of only three man-months.

Tests allowed us to quickly root out areas for improvement and we were reassured by the choice of technology for this ambitious project.

The next goal was test automation, for which the team received TestStand training. While MESULOG was working on the software architecture and creating business-driven TestStand « bricks », we designed specific test sequences that communicate equally well with the real-time controller or the UUT.

During the first few months of our development, NI and OPAL-RT made changes to the solver, to ensure it more accurately met our needs.

Many advantages

SOCOMEC now has a well integrated system, in a single development environment with VeriStand for both the high performance solver part and for the simulation models. This system makes for easier development, greater control and system stability.

Being able to rely on the power of the FPGA calculations, rather than using an average converter model, greatly reduces the effort required to obtain a

simulation model. Being able to change a diagram and see the results of that

change in less than a minute is of inestimable value. If errors occur, they can be seen and corrected quickly.

HIL is the only means of reliability testing that allows us to subject hardware to real environments, such as temperature extremes and supply grid voltage/frequency deterioration. Physical testing means that have been available up to now would never have allowed us to see all the types of network wavesforms that we see in other countries.

With this HIL test bench, developers have a risk free test platform with which to test features and, if necessary, replay sequences that put the embedded software in fault mode in a very short timeframe.

Conclusion

The goals for this investment are being met and the forecast is very good.

We will be able to deliver better quality products thanks to the non-regression and reliability testing that we can now perform, and we will also be able to reduce development and testing times.

4. Next Steps

Since the system is very adaptable and easy to implement, we foresee using it in the future to validate new converter topologies before building prototypes.

Once the majority of ASI tests will be complete, we will be able to implement several units in parallel and the amount of tests run will more than double.