Accelerating Parallel Test of Multiple Infotainment Systems at a Tier 1 Supplier

Abstract

New product introduction timelines for infotainment systems are tight. As soon as a leading Tier 1 supplier knew the preliminary specifications of its next-generation infotainment system for a German OEM, it turned to NOFFZ to discuss validation testers. Within four months, the supplier needed NOFFZ to design, build, and install 12 parameter and monitoring test systems. NOFFZ was confident that its Universal Tester Platform (UTP) and the team's expertise could solve this challenge.

Background

A global Tier 1 supplier turned to NOFFZ with a test request for premium infotainment systems. NOFFZ designed the tester based on the available preliminary device under test (DUT) specifications to meet the timeline. Less than 3.5 months were left from ordering to final prototype tester delivery. The tester needed to be prepared for the product validation phase as a parameter and monitoring test system. The tester had to cover the various I/Os (22 different types including audio, camera, display, CAN-FD, and Automotive Ethernet signals) as well as the integrated wireless and connectivity standards. The setup needed to be modular to incorporate possible future upgrades or reuses. On top, the configuration for testing six DUTs in parallel had to fit in one standard 19 in. rack.

Challenges

01. Number of Connections to Be Tested

The infotainment system for a German premium OEM is the main unit in the vehicle, which combines the instrument cluster and infotainment functionality. It is a so-called convergence or one-box product and controls the cluster, head-up, and in-vehicle infotainment (IVI) display.

On the compact housing, the system contains 16 ports only on the rear side. In total, each DUT has 22 different hardware types on the I/O list. They sum up to 50 I/Os in total per DUT. To no surprise, the infotainment systems support multiple audio sources and sinks like Bluetooth, microphones, and internal and external amplifiers. The number of displays inside a vehicle depends on the end-user configuration. Besides the central display and the instrument cluster head-up display, co-driver displays are becoming more popular. While a rear-view camera is more or less standard in premium vehicles, cameras inside the vehicle are optional. The system needs to support up to four additional camera inputs for selfie cams and driver or occupant monitoring systems. In total, the video test requirement includes four display outputs and five camera inputs (GMSL1/2). Rounding out the I/O list are Automotive Ethernet, Ethernet, CAN-FD, GNSS, and microphone inputs and output.

NOFFZ designed the test systems based on commercial off-the-shelf (COTS) components. Through extensive research on available instruments for the best technical solution, NOFFZ's standard guideline of about 80% standard instrumentation and 20% customer-specific equipment was applied.

The final instrument list included NOFFZ PDU, UPS, NOFFZ SCU with six DUT-specific modules (signal conditioning unit), and RF distribution. An IPC was connected to two NI PXI chassis using one cabled PCI Express (MXI) bridge. The first chassis contains two PXI Multifunction I/O Modules (PXIe-6345) that offer analog I/O, digital I/O, and four timers as well as a special measurement card for DUT power consumption in all stages. Placed on top of the rack, the second chassis hosted NI Automotive Camera interface modules for GMSL. Depending on the DUT variant, the chassis was equipped with up to four Automotive Camera interfaces (PXIe-1487) with eight output channels each. Power supply units from TDK-Lambda and Ethernet/CAN interface modules completed the solution. Most instruments were installed in a 40 in. rack including accessories like single-board computers, Ethernet switches, and a monitor. The thermal design turned out to be another challenge since the rack was really packed.

02. Exchangeable Interface Box Individually Configured for up to Six DUTs

The optimum number for testing multiple DUTs in parallel is dictated by the number of DUTs the temperature chamber can support. Therefore, the requirement for each test rack to account for testing six DUTs in parallel was defined.

Engineers from the Tier 1 supplier demanded the installation of a custom specific interface (CSI) box that needed to be individually configured for up to six DUTs with loads, BIAS-Ts, and so on. This box needed to be exchangeable and able to provide standard connections for LF-signals and RF standard connections like SMA, Mini-FAKRA, and more for the other signals.

At the same time, all radio inputs to a single tester needed to enter through a single coaxial input and be split inside the test stand to be routed to individual connectors for each DUT.

To account for all the requirements, NOFFZ configured the rack using a VPC interconnection (receiver). The CSI box was placed in front of the VPC receiver on a sliding table. A hand gear for locking and releasing the CSI box was mounted on the operator side of the rack. Of course, the CSI connections needed to match the connections of the VPC receiver. Still, both components were easy to change if the tester was repurposed or modified.

In summary, the CSI box is a smart solution that covered three main tasks. First and foremost, it connected all the non-critical (non-high-speed) signals of the DUT to the test system. In addition, it covered the level adjustments of the measurement signals. Finally, it accommodated smaller equipment for speakers and USB tests.

03. Compact Test System with Upgrade Options for Reuse (Future-Proof)

The test system had to be built in an off-the-shelf 19 inch rack no bigger than 42U. Two main use and upgrade ideas were considered while writing the specifications. If additional hardware was required for parametric testing, continuous monitoring testers needed to be upgradable to support that functionality. The cabling between the DUT and the test system needed to be a length of 3 m to be used with a climate chamber. Cabling needed to be selected in accordance with the temperature range of the climate chamber.

Another future-proof design aspect was the use of the CSI box. The VPC components could be easily exchanged. The software framework also was scalable and extendable to meet upcoming test needs.

Summary and Outlook

Close collaboration and early involvement were crucial to the success of this project. In the meantime, 16 testers were deployed.

Companion test systems have already been ordered for other departments. For example, the video inputs of the premium infotainment system were to be tested in an EMC laboratory. For this, only manual contacting was an option. In addition, all instruments had to be powered by a battery that covered 10 hours of operation. The solution provided by NOFFZ included an NI PXI DC chassis and two more NI Automotive Camera Interface modules (PXIe-1487).

In addition to the competent consulting, compact design, and quick setup of the test systems, the service and flexibility of NOFFZ were key. During the product introduction of the infotainment system, changing requirements had to be accommodated. Further testers and upgrades for different products and variants—in total 20 systems—were installed with the leading Tier 1 supplier. Up until now four of these EMC testers were deployed successfully.

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