



# Sound check with INCA

BMW Group relies on ETAS INCA to calibrate audio systems

In-vehicle acoustics are a complex business. To ensure all occupants in a car enjoy the best possible audio experience, auto-makers individually calibrate audio systems in each of their models. Developers have so far relied on a variety of tools and programs to calibrate audio ECUs. The BMW Group, however, is taking a new approach by combining ETAS INCA with the XCP communication protocol to form the core of a standardized workflow.

Regardless of whether it's Bach, Pink Floyd, or an audio book, sound quality in today's premium car models is easily comparable to that of concert halls. Ultimately, the ideal listening experience relies on digital amplifiers, which are custom-fitted according to cabin features, as well as on the number, position, and performance of the speakers built into the coupé, SUV, or station wagon. Of course, safety always takes a front seat when the audio system is in use. When a driver turns up the volume, the clicking sound of the indicators and warning tones from the assistance systems remain audible without startling the vehicle's occupants. This is made possible by the ECUs, which automatically control the audio system's volume based on the urgency of the situation at hand.

## As complex as the powertrain

Engineers have to choose from tens of thousands of parameters to calibrate infotainment ECUs to perfection. However, although audio and powertrain control units share comparable

complexity, no standardized processes or tools previously existed for audio. Heterogenous toolchains with proprietary data formats and communication protocols were the order of the day. The lack of a formal data description also made administration and quick access to measurement and calibration data an arduous process. All these drawbacks made calibrating the sound system an unnecessarily complex, time-consuming task that required expertise in numerous tools.

To tackle this challenge, the BMW Group joined forces with ETAS to develop a new procedure. The goal of the project was to establish a lean, standardized solution to replace the various proprietary measurement and calibration tools from different audio systems and ECU manufacturers. The partners scored a win with an unconventional path; adapting ETAS' INCA solution for powertrains to the infotainment system. This approach had the added benefit of using a software solution that is well established among OEMs and key suppliers.

## Standardization over unchecked growth

In order to cap further uncontrolled development, the project partners redesigned the audio workflow based on INCA. This approach required a powerful architecture because, unlike powertrains, the data flow in audio systems is large, and this most often calls for multi-core processors that use Linux operating systems and Ethernet connections. The answer lay in the Universal Measurement and Calibration Protocol, or XCP – a communication protocol standardized by the Association of Automation and Measuring Systems (ASAM). Thanks to separate command and transport layers, XCP is usable not just for CAN and FlexRay

buses in powertrains, but also for USB or Ethernet data buses. The necessary XCP connection was achieved via Ethernet by integrating an XCP driver into the Linux operating system.

## INCA replaces nearly a dozen tools

ETAS' consistent efforts to standardize its tools paved the way for the use of INCA in audio systems. Implementing XCP in INCA according to specifications was key to helping ensure a smooth flow of data traffic. However, capturing and visually processing the audio measurement data in INCA was somewhat more complex. Measuring instruments for powertrain systems from the

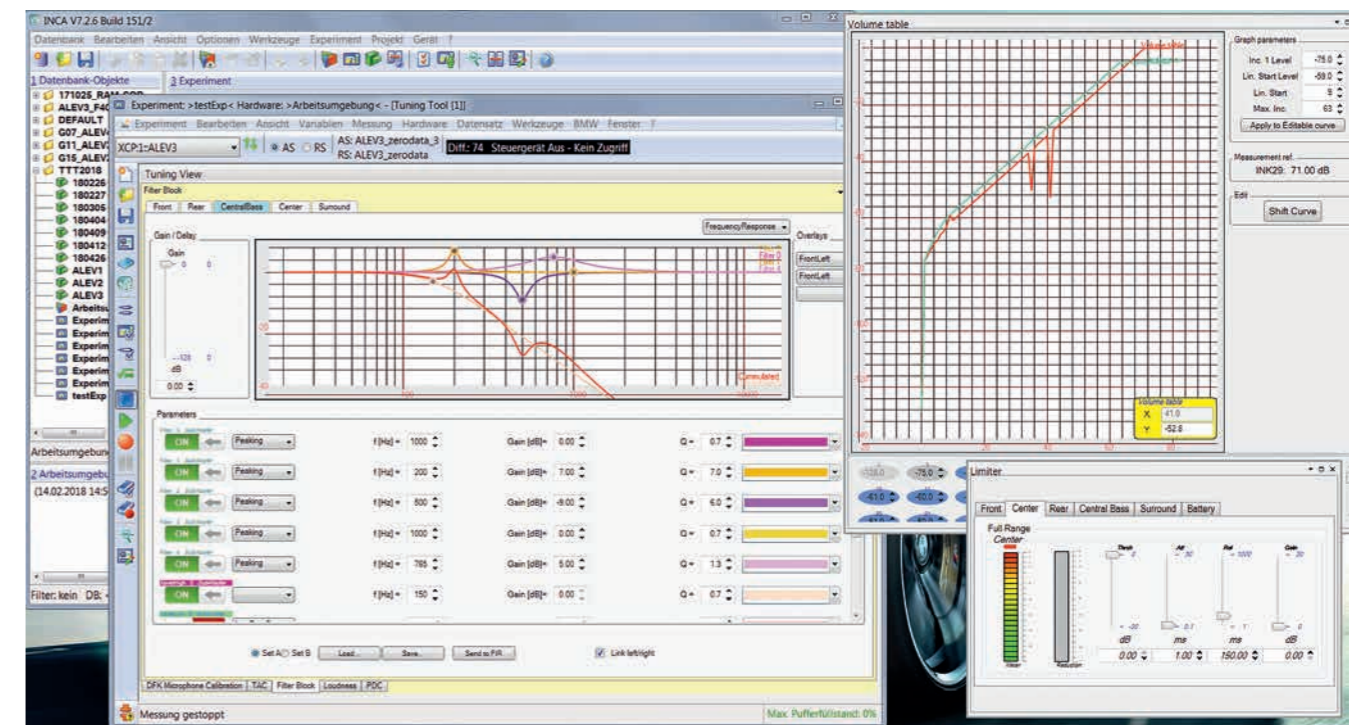


Figure 1: Plug-in for setting acoustic filter curves

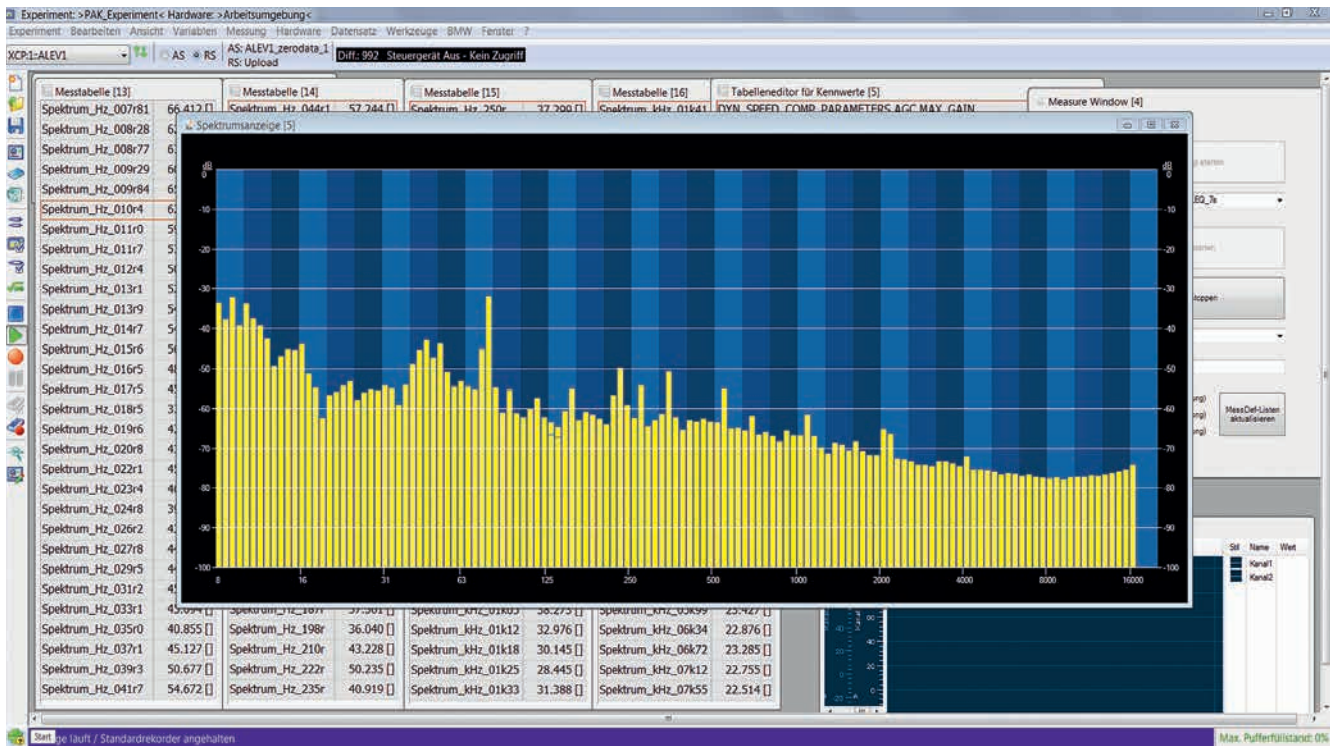


Figure 2: Display of the acoustic spectrum. The measurement data were recorded with a third-party acoustic measurement system

ETAS ES series and the oscilloscopes used for drive applications proved unsuitable for the task. Instead, measuring and visualization solutions for acoustic design were needed – for example, to set frequencies and to manipulate filters (see Figure 1). Both partners set to work to develop corresponding plug-ins for measurements and adjustments using ETAS' instrumentation kit for INCA. Measuring instruments from third-party vendors were then integrated through the development of INCA and XCP-compatible drivers. Calibration engineers can thus continue to display and process data directly in INCA using trusted third-party acoustic measuring technology (see Figure 2).

Once the prerequisites were established, a typical INCA workflow could be introduced. INCA-FLOW helps expedite the process of scripting recurring measurement and adjustment tasks. In addition, BMW is already experimenting with virtualization – for example, to bypass audio signals and quickly test new sound algorithms on the PC. It is precisely such virtualization that could raise development of sound systems to a new level of efficiency, making it an important tool for tackling increasing complexity in the years ahead.

### Summary and outlook

Before making the switch to a standardized toolchain with INCA and XCP, the desktops of BMW's sound engineers were typically crowded with almost a dozen icons from different tool manu-

facturers. Developers needed to know how to handle numerous proprietary stand-alone solutions in order to calibrate infotainment ECUs. This situation has given way to a completely new, standardized workflow with INCA at its core. With only minor adjustments, this widely used platform in the automotive industry offers calibration engineers a development method to more quickly achieve optimum sound in every new vehicle model. Its use noticeably simplifies and expedites the development process in the infotainment sector. In order to exploit the toolchain's full potential, it is now being enhanced with additional functions. After all, it's only a matter of time before sound design for electric and hybrid vehicles will throw up a whole new set of challenges for audio specialists. This will require the creation of entirely new sound scenarios, and the INCA sound check is geared up to make a difference here, too.

### Author

**Robert Siwy** is Project Manager for digital audio amplifiers and sound production at the BMW Group in Munich, Germany.

Contact at ETAS GmbH: **Peter Elsenhans** (Sales Director at ETAS GmbH), peter.elsenhans@etas.com