

# FORD MOTOR

When Ford audio engineers needed to shorten their design and documentation cycle, they turned to SaberDesigner™ — and reduced the time involved from 4–6 weeks down to 2–3 days.

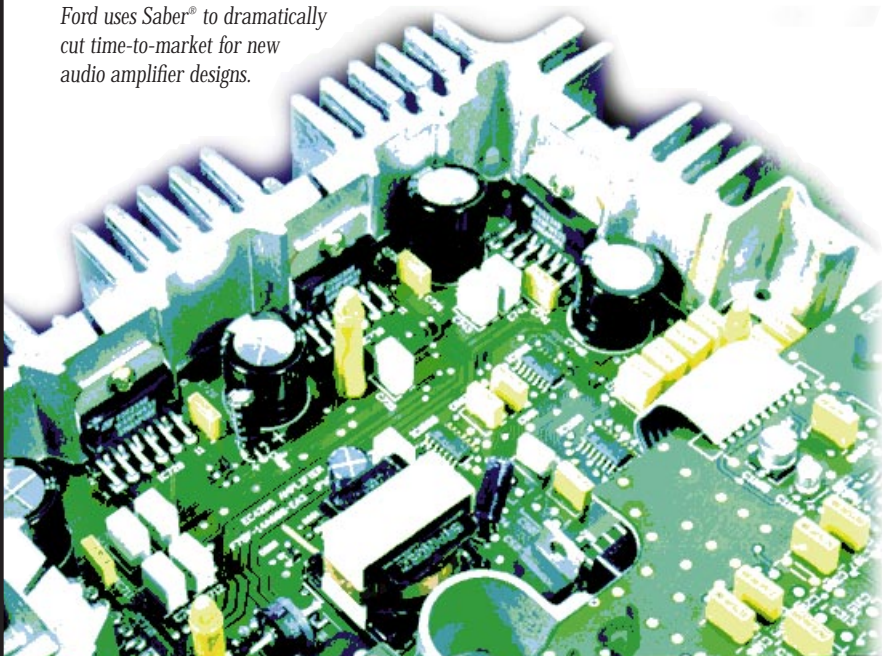
# COMPANY

You ease yourself into the plush seat and turn on the stereo. Instantly, you're surrounded by sound so vibrant and pure that you feel you're almost part of the performance. But you're not in a sound studio or even a stereo showroom. You're in your car.

Buyers of today's top-of-the-line automobiles are no longer satisfied with standard car stereo systems. These buyers want top-quality sound to match the prestige — and price — of their vehicle. But delivering this high quality sound is no easy task. To achieve it, the automotive audio designer has to consider much more than simple exterior noise and weather factors. For the kind of quality demanded in these high-end systems, the design must also address such factors as the shape of the car's interior.

Dr. Joe Tillo knows all about these design challenges. As a design engineer in the CAD/CAE department of Ford's Electronics Division (now part of Visteon Automotive Systems), Joe's team is responsible for audio circuit design, testing, and a trouble-free integration into the manufacturing process.

Ford uses Saber® to dramatically cut time-to-market for new audio amplifier designs.



**// SaberDesigner allows us to perform our engineering tests in a much faster and more precise fashion... When we make changes, we can repeat the calculations and simulations and have the new design ready in a short time... This is where we really saw some big improvements over our old methods. Saber was the only product that did the whole job. It's the preferred simulator here at Ford. //**

Joe Tillo, design engineer

Ford has three levels of audio systems for their vehicles. The mid-line systems have minimal features. The premium system has more power and features than the mid-line. The top-of-the-line audiophile system is the most complex, with components specifically tuned to the individual car model. The audio designer builds appropriate compensation into the audio amplifier, specific to the vehicle. "The trick," said Tillo, "is to come up with a good basic amplifier design that lets you change the values of the parts so it sounds equally good in vehicles with different acoustic characteristics. You use a basic schematic, but the component values change to fit the vehicle."

Tillo's challenge was to reduce the time it takes to customize an audio system for a new vehicle model.

 **Analogy**®

Cut the Risk. Get it Right. Make it Real.™

## SABER SUCCESSES

**// The audio guys were absolutely ecstatic about it. It's a big benefit to them. It's really satisfying to work on projects that generate so much positive feedback! //**

The prevailing method required nearly four weeks of lab time to modify the component values and measure the results, plus an additional two weeks to generate the required documentation. The best way to shorten this cycle, Tillo reasoned, would be to use a pow-

erful mixed-technology simulator like Analog's Saber to replace the time-consuming, manual lab process.

Tillo's team entered their audio schematics and equations into Saber. "This doesn't guarantee that everything will work out perfectly the first time through, but it does allow us to perform our engineering tests in a much faster and more precise fashion... When we make changes, we can repeat the calculations and simulations and have the new design ready in a short time."

To automate the calculations, Tillo created a script using Analog's AIM scripting language. This allowed him to create a framework that matched the schematic of the audio amplifier. The filter characteristics were mapped to automatically change the values in the simulator. SaberScope™ was used to display the results and get useful information quickly. The output files were then compared with lab results. Tillo used AIM scripts to read in and compare the measured and simulated data on the same graph. "This is where we really saw some big improvements over our old methods," he commented.

Using Saber quickly became the obvious choice for the project team. "Saber was the only product that did the whole job," he said. "It's the preferred simulator here at Ford." He went on to explain that when designers simulate first and then take the results to the lab, they have much more confidence that the design will work as intended. Also, without simulation, designers need to make a lot of assumptions and approximations and then verify their calculations in the lab. "With hand design, there's a lot of back-and-forth and it can be very discouraging," said Tillo. "Plus, it

uses parts and lab space that are at a premium. This [simulation] lets us stay out of the lab."

Every member of his project team found Saber a valuable tool for their different responsibilities: Tillo, for example, was responsible for circuit theory — analysis, design, and equations. Rajeev Joshi was responsible for man/machine and machine/machine interfacing. Anne Marie Graham was responsible for product engineering — actually getting the amplifier into the car. Each of them used Saber to improve their part of the process.

With Saber now the "fourth member" of their team, Tillo and his co-workers were able to shrink the design and documentation process from 4–6 weeks down to 2–3 days. And Saber's ability to simulate amplifier response and automate the component specification process made fans of others, too.



The Ford CAD/CAE team on this project included: Dr. Joe Tillo (left), a Michigan native with a BSE(EE), MSE(EE) and Ph.D. from the University of Michigan. Joe currently works as a design engineer in Ford's security and electronic controls department. Rajeev Joshi (center), born in Bombay, India, holds a BS and MS in Computer Engineering and is a software engineer in the multimedia department of Visteon, a Ford subsidiary. Anne Graham, (right) holds a BS in Electrical Engineering and is currently working as an application engineer for audio systems in Ford's light truck division.



Their technical presentation was chosen as the Best Technical Paper at the 1997 North American ASSURE Saber Users Group Meeting.

Analog®