CUSTOMER SUCCESS STORY

ROJ and Mares

Creating a Function-Rich, Wrist-Based Diving Computer with Maxim Analog and Power Management ICs

Mares's flagship product, the Genius wrist dive computer, provides an array of rich functions in a compact, low-power wearable.

Challenge

- Create compact, wrist-worn diving computer with rich functions, long battery life, and high performance
- Meet aggressive time-to-market schedule

Solution

- **MAX4257**
- **MAX17112**
- **MAX4983E**
- **MAX77801**
- **MAX6778**
- Charger and fuel-gauge IC

Benefits

- Met stringent power, performance, noise immunity, and size requirements
- Saved a year in design cycle
- Lowered BOM as highly integrated ICs reduced need for discrete components

ROJ, based in Biella, Italy, is an electronics designer, developer, and manufacturer that produces solutions for a wide range of applications, including textile manufacturing, electronic production, bank automation, sports equipment, construction, logistics, and farming. One of its clients is Mares, the Rapallo, Italy, developer of innovative dive technologies, founded in 1949 by Ludovico Mares. Together, they've produced Mares's flagship product, the Genius wrist dive computer.

The Genius computer is unique for its ability to deliver an array of functions in a compact, low-power format. Equipped with a full-color, high-resolution display, the computer provides predictive, multi-gas functions; depth display up to 150m; a logbook with multiple graphs; map viewing; timekeeping; a decompression dive planner; a full-tilt digital compass with bearing memory and stopwatch for underwater navigation procedures; and much more. Its "brain" is powered by the ZH-L16C algorithm (the classic Bühlmann decompression algorithm) and features an editable gradient factor that can be selected based on the user's physical and physiological condition on a given day.

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"The MAX4257 is the best component I know on the market, with a very small package, very low noise, high gain, and very low power consumption."

- Vittorio Loggia, Electronic Designer and Product Manager, ROJ

Challenges

Vittorio Loggia, an electronics designer and product manager, worked on the ROJ team's Digitronic area to develop the Genius computer. According to Loggia, there aren't any dive computers like the Genius on the market in terms of its many functions and battery life—its rechargeable battery lasts for 40 hours of dive time on a full charge. Designing such a unique device came with many challenges, he noted. To provide a value-added experience for end users, the computer had to be small enough to be wrist-worn while also highly integrated with a large memory, low power consumption, long battery life, and long-range underwater communications. Delivering underwater communication proved to be a tough task due to noise sensitivity. As a result, the engineering team knew it was important to reduce noise on the power supply and the analog signal. The underlying ICs in the Genius computer had to meet strict size, power, and performance requirements.

Solution and Benefits

The ROJ team has a long history of collaboration with Maxim, so Maxim components were their first choice. Team ROJ recognized that, given their aggressive time-to-market targets, they needed to be able to rely on the ICs to perform as specified. Loggia recalled losing one year's time on a past project because the part (from another vendor) had some problems. However, before making their final decision, Loggia and Mares performed a comparison of Maxim's ICs against other ICs on the market. In each comparison, the Maxim part met the team's stringent specifications—or, in some cases, there was not an equivalent part available from other vendors.

The Genius computer includes these Maxim ICs:

- **MAX4257** low-noise, low-distortion operational amplifier with rail-to-rail outputs and single-supply operation down to 2.4V
- **MAX17112** high-performance step-up DC-DC converter
- **MAX4983E** high-speed USB 2.0 switch with ±15kV electrostatic discharge (ESD) protection
- **MAX77801** high-efficiency buck-boost regulator
- **MAX6778** low-power, 1% accurate battery monitor
- Charger and fuel-gauge IC

The MAX4257 op amp was essential in producing a small, low-power radio capable of high-performing, long-range underwater communication. "The MAX4257 is the best component I know on the market, with a very small package, very low noise, high gain, and very low power consumption," said Loggia. Also used in the radio, the MAX17112 boost converter increases voltage on the antenna from the 8V starting point to enable 300V peak-to-peak transmission.

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Solution and Benefits (Continued)

The Genius computer connects to PCs and chargers via USB. The MAX4983E USB 2.0 switch provides a high level of ESD protection, Loggia noted. The MAX77801 buck-boost regulator addresses the noise challenge in underwater communications. During transmission, noise from the battery initially blocked the antenna, causing a loss of data transmission. However, by utilizing I^2C communication between the microcontroller and the MAX77801, the engineers were able to switch the operating mode to pulse-width modulation and the noise completely disappeared, Loggia explained. When on standby, the operating mode can be switched back to skip mode. Thanks to this capability, the team did not have to make any drastic design changes to mitigate the noise, which would have caused a delay in mass production.

The MAX6778 monitors the voltage of the rechargeable battery in the Genius computer. The charger and fuel-gauge IC provides accurate battery age and state-of-charge (SOC) information, along with efficiency, size, and cost advantages. For obvious safety reasons, the battery SOC accuracy is very important. Competitive solutions, Loggia noted, would have required an additional three to four discrete components to accomplish the same functions. "My customer (Mares) is very happy," Loggia said.

Overall, with the Maxim analog, power management, and battery management ICs, the ROJ team met Mares's technical and time-to-market challenges in creating the Genius dive computer. In fact, the hardware side of the computer was ready before the software and mechanical parts, with the overall design cycle shortened by a year.

With sophisticated products like the Genius, Mares is continuing its founder's vision to share his passion for the sea and diving with the rest of the world.

Learn more at www.maximintegrated.com

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