

**ROHDE & SCHWARZ**

Make ideas real



# MAJOR SPORT IN SMALL SCALE

From pole position to high precision: the R&S®RTB2004 oscilloscope and the Miniatur Wunderland Formula 1 project

## AT A GLANCE

- ▶ **Customer:** Miniatur Wunderland Hamburg GmbH.
- ▶ **Challenge:** The development team needed a high-performance oscilloscope to help them develop the positioning system for their miniature Formula 1 race cars. It had to be able to acquire four analog channels synchronously and analyze numerous digital channels to check the real-time capability of the system.
- ▶ **Task/project:** Synchronous acquisition of analog sensor signals from a sensor cluster consisting of four Hall sensors, combined with analysis and clear presentation of digital status signals provided by the software.
- ▶ **Solution/product:** The R&S®RTB2004 oscilloscope with the R&S®RTB-B1 mixed signal extension from Rohde & Schwarz.



### At a glance

Miniatur Wunderland in Hamburg is the world's largest model railroad and a popular destination for tourists from all over the world. Fascinating landscapes from around the globe, including Switzerland, Italy, Austria, parts of South America, the USA, Scandinavia, and of course, Hamburg, have been painstakingly recreated at 1 : 87 scale over an area of 1500 square meters. However, it's more than just a model railroad – it's a masterpiece of model engineering, complete with plenty of interesting details and technical innovations.

### The innovative Formula 1 project in Monaco

The breathtaking Formula 1 racetrack around the Principality of Monaco is being recreated in the current Monaco section. Against this magnificent backdrop, 20 miniature race cars compete against each other, and each race is unique. Putting electronics inside the vehicles is impossible due to their small size, so an innovative solution has been developed: Halbach arrays of magnets in the cars and magnetic fields in the streets allow the vehicles to race around the course as if by magic. However, the cars need to follow the magnetic fields at all times to ensure a smooth race. Otherwise, they will stop moving and risk colliding with other cars. That's why a high-precision positioning system was developed to measure the position of

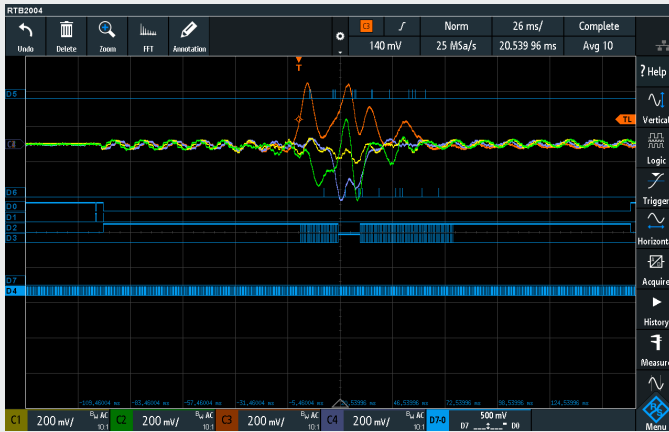
each car in real time and, if necessary, send corrections to the drive electronics.

### Leading the way: the R&S®RTB2004 oscilloscope from Rohde & Schwarz

To develop the positioning system, the development team needed a high-performance oscilloscope that could analyze enormous amounts of data, monitor the real-time capability of the system, and evaluate the four associated analog sensor signals. This is where the R&S®RTB2004 oscilloscope came into play, offering a wide range of features ideal for this task.

### User friendly and clear

The R&S®RTB2004 oscilloscope has an intuitive user interface, and you can change any setting with just a few buttons. The simple menu layout with a limited number of submenus makes it easy to use. Fewer buttons also means there is more room for a large high-resolution touch display to present lots of data clearly. Users can also hide the menu and use the entire display for signals, providing a great overview of all the information. This is a big advantage when you need to display many correlated analog and digital signals at the same time.



A clear view of all analog and digital signals on a 10.1" display.

### Performance and precision

The R&S®RTB2004 oscilloscope has a memory depth of 20 Mpts. What's more, a zoom function makes it easy to analyze this enormous amount of data in detail. You can also trigger on defined bit patterns, which is a huge advantage when searching for specific data packets. Signals are displayed on the screen incredibly clearly.

### Comprehensive connection options

Thanks to the mixed signal extension with 16 digital inputs, the oscilloscope can be used to evaluate software states via corresponding hardware test points. This allows users to check and optimize how the system is processing the sensor signals in real time.



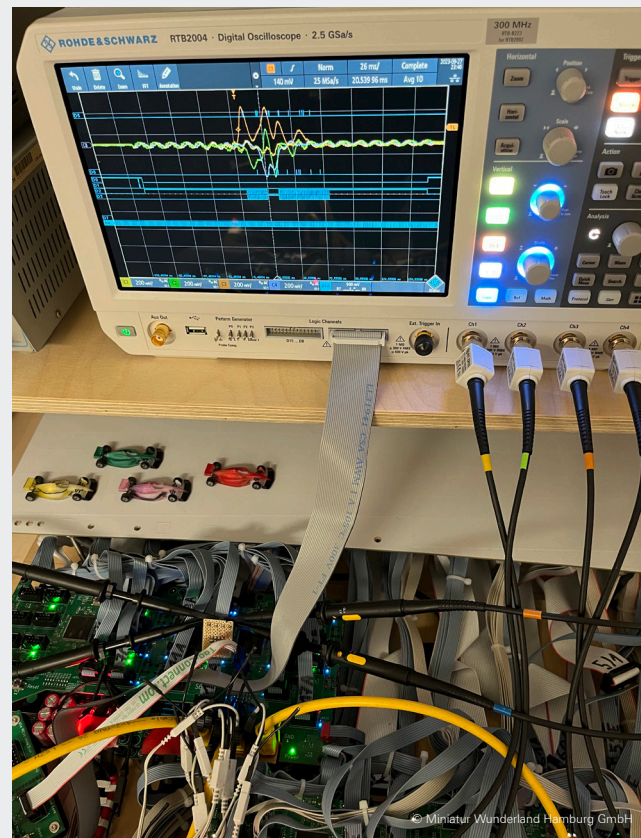
For more information, visit  
[www.rohde-schwarz.com/product/rtb2000](http://www.rohde-schwarz.com/product/rtb2000)

Four analog inputs with 10-bit resolution enable sensor values to be displayed simultaneously, together with digital channels that reflect the software states. This provides an excellent overview of the status of the positioning system.

### Summary

The comprehensive package of features provided by the R&S®RTB2004 from Rohde&Schwarz makes it the perfect tool for developing a reliable positioning system.

The R&S®RTB2004 in action.



"I can't see electrons but Rohde & Schwarz makes them visible."



Stefan Meinel, Miniatur Wunderland

## R&S®RTB2004

The R&S®RTB2004 oscilloscope helped the specialists at Miniatur Wunderland:

- ▶ Acquire software states via digital channels to verify the real-time capability of the positioning system
- ▶ Understand the timing behavior and optimize the response time of the positioning system
- ▶ Identify and correct issues such as clipping, glitches and other anomalies in the analog and digital circuitry
- ▶ Debug the system thanks to easy differentiation of hardware and software errors

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