R&S®SCOPE RIDER RTH HELPS DEVELOP AN ELECTRIC SUPERBIKE

UoN Racing – University of Nottingham E-Racing Team develops their most successful ever electric superbike with the help of the R&S®Scope Rider RTH

At a glance

The user-friendly functionality and features of the R&S®Scope Rider RTH provided to the University of Nottingham team helped them develop their most successful ever electric superbike. On the 60.73 km Isle of Man TT circuit, with a lap time of 18:58:294 minutes and an average speed of 191 km/h, rider Daley Mathison finished just 24 seconds behind Michael Rutter from Team Mugen Honda.

Summary

- **Customer**: UoN Racing – University of Nottingham E-Racing Team
- **Task**: Characterization of electric superbike during development and race preparation
- **Challenge**: Support, analyze and debug to overcome complex problems at the cutting edge of innovation
- **Solution/product**: R&S®Scope Rider RTH
- **Key features**: Comprehensive test and measurement functions of the R&S®Scope Rider RTH to characterize the batteries, electronics and control in the workshop, dynamometer and on the track

Case Study | Version 02.00

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About the bike

- Designed for speeds over 180 mph
- > 20 kWh of stored energy in a 290 kg package, peak power of > 175 kW [1] (approx. 235 hp)
- Weight: 208 kg [2]
- Acceleration: 0 km/h to 100 km/h in < 3 s
- Top speed: 280 km/h

About the R&S®Scope Rider RTH

Eight instruments in one handheld package, 33 automatic measurement functions

- Protocol analyzer (I^2C/SPI, UART, CAN/LIN, CAN-FD…)
- Lab performance oscilloscope: 0 Hz to 500 MHz with 5 Gsample/s sampling rate
- Logic analyzer
- Data logger
- Digital multimeter
- Spectrum and harmonics analyzers
- 10-bit A/D converter
- 50 000 waveforms/s
- 2 mV/div to 100 V/div
- Up to 200 V offset range

[1] Depending on motor/drive combination.
[2] When configured for short-track racing.

The R&S®Scope Rider RTH offers eight instruments in one handheld package.

Daley Mathison on the UoN bike during TT Zero race on the Isle of Man

The situation

Research is paving the way for the development of commercial electric superbikes

Environmental and economic factors are driving many governments and international organizations to put a deadline on the lifetime of the internal combustion engine. In 2016, Germany voted to ban the internal combustion engine by 2030, and the UK government announced plans to ban sales of new petrol and diesel cars and vans by 2040 (source: www.motorcyclenews.com/news/2017/december/top-electric-motorcycle).

While there has been much progress on electric cars, scooters and small bikes, commercial progress is not so advanced when it comes to electric alternatives for the motorcycle. As with many automotive innovations, the racetrack has acted as a proving ground for technologies that could drive commercial success. Competitions like the MotoE European Race Series and Isle of Man TT Zero represent a major challenge for research teams working on electric superbikes.

The task

Providing the tools to characterize new electric powertrain, converter and motor

The UoN team set itself the target of improving on its previous performance in key e-racing fixtures. Following the University of Nottingham's success in 2015 and 2016, becoming MotoE Champions in both years, the team entered the 2018 season with its third generation electric superbike, which incorporates a new powertrain with different converter and modified motor. A specific objective was to improve the team's performance in the Isle of Man TT Zero race – an electric motorsport event that was introduced in 2010 and involves one lap (37.733 miles) of the Snaefell Mountain Course. Here, the motorcycles have to be powered without the use of carbon-based fuels or toxic/noxious emissions.

The technical solution

R&S®Scope Rider RTH – a portable, rugged, lab performance oscilloscope

Rohde&Schwarz provided their R&S®Scope Rider RTH handheld oscilloscope to the University of Nottingham team to help them develop their 2018 electric bike. The R&S®Scope Rider RTH was used in the lab, on the rolling road dynamometer, on the test track and on the track at the Isle of Man TT during practice and race weeks. The R&S®Scope Rider RTH is the first handheld oscilloscope with the functionality and touch and feel of a state-of-the-art lab oscilloscope. It is equally impressive in the lab as in the field. It has been designed with an easy-to-use interface, combining a tablet-like touchscreen, large buttons and a practical multifunction wheel for convenient parameter adjustment, making every function and setting easily accessible, even when wearing gloves.

In the lab, the R&S®Scope Rider RTH proved to be the ideal instrument for characterizing the bike's advanced power electronics and controls. With an acquisition rate of 50 000 waveforms per second, a 10-bit A/D converter developed by Rohde&Schwarz, isolated floating channels and a maximum bandwidth of 500 MHz for the analog input channels, it copes admirably with fast-switching semiconductors in the drivetrain. Built-in spectrum and harmonics analysis is key to characterizing the power electronics, and its protocol analyzer with trigger and decoding capability proved highly useful for analyzing the CAN bus based control.

UoN team with its third generation electric superbike

> "We found the R&S®Scope Rider RTH invaluable for our testing. Because it is battery driven and easily portable, it's unlike any other scope we've used in the past. It also has a wide range of user-friendly functionality."
>
> **Dr. Miquel Gimeno-Fabra, Assistant Professor in Mechanical and Electrical Engineering and University of Nottingham Racing General Manager**

The outcome

Helping the bike to success

On the track, the mobile R&S®Scope Rider RTH could be used as a portable high-speed data logger, with the additional ability to operate it over a Wi-Fi connection.

With rider Daley Mathison on board, the team put the bike through its paces at the TT Zero, achieving a podium finish and reaching second place. The team managed to improve on their previous position of third in 2017 and shaved 1.45 minutes off last year's lap time, improving their average lap speed from 109 mph to 119 mph.

The brilliant start to the MotoE season continued with Daley riding the bike to victory at Donington Park, becoming the first rider of an electric bike to win a race on a mixed short circuit grid.

The University of Nottingham superbike has also recently won its class and category at the Pikes Peak International Challenge and made appearances at MotoE European Championships at Donington Park and Assen TT in the Netherlands in August 2018.

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