

ROHDE & SCHWARZ

Make ideas real



MAKING QUANTUM COMPUTING READY FOR THE REAL WORLD

Testing the world's first quantum error correction stack

AT A GLANCE

- ▶ **Customer:** Riverlane
- ▶ **Task:** Building the quantum error correction stack to make useful quantum computers sooner
- ▶ **Challenge:** Analyzing signals from megahertz to multiple gigahertz in frequency and time domains, to assess spurious signals, unwanted frequency peaks and noise floor
- ▶ **Products:** R&S®RTP high-performance oscilloscope, R&S®FSPN phase noise analyzer and VCO tester, R&S®FSV3030 signal and spectrum analyzer
- ▶ **Benefits:** The R&S®FSV3030 easily handles the whole range of signals from 10 Hz to 30 GHz to cater to the customer's current and future needs. The R&S®RTP high-performance oscilloscope meets Riverlane's requirement for 5 GHz to 10 GHz pulses and checks timing synchronization with picosecond accuracy



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Situation and requirements

Riverlane, founded in Cambridge and with offices in the UK and US, is developing hardware and software for quantum computers to perform useful work in the real world. Incomparably faster and more powerful than conventional computers, quantum computers could drastically accelerate the pace of progress in areas such as materials science, drug discovery, encryption and computational fluid dynamics.

Aiming to advance this new quantum era, the team at Riverlane is building the first quantum error correction stack, a range of technologies to scale and stabilize quantum computers so that software engineers can create powerful applications and quantum hardware companies can unlock the potential of their qubits. This quantum error correction stack controls the computer's qubits and decodes their quantum information using software as well as analog and digital electronics. The circuitry is implemented using scalable semiconductor chips distributed across multiple devices and cards.

Working with Riverlane, world-leading quantum hardware companies, university labs and government agencies are using this quantum error correction stack to scale and stabilize their quantum computers. The work demands high performance from the electronics, which must handle wide-bandwidth signals with close spacing between tones and extremely short pulse durations. Frequencies of interest can range from 20 MHz to 50 GHz.

Building and testing this hardware calls for low noise signal sources and extremely accurate high-speed test equipment capable of measuring spurious signals including harmonics, unwanted frequency peaks and noise.



For more information, visit
www.rohde-schwarz.com

Rohde & Schwarz solution

The Riverlane team has chosen high-performance test equipment including the R&S®RTP, the R&S®FSPN and the R&S®FSV3030. These powerful, user-friendly instruments enable the engineers at Riverlane to make the most of their capabilities.

The R&S®RTP provides accurate time-domain analysis, including checking system timing synchronization between different outputs. It can measure timing alignment with picosecond accuracy and easily handles Riverlane's requirements for pulses in the 5 GHz to 10 GHz range. The team is using the fast Fourier transform (FFT) feature to identify harmonics of interest, later analyzed in detail with the R&S®FSV3030.

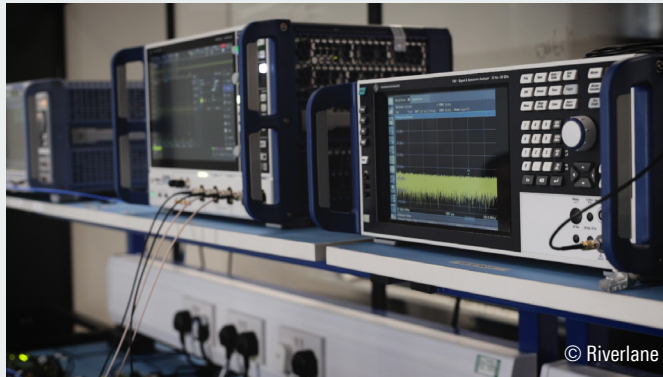
The R&S®FSPN gives insight into signal purity over a wide frequency range and ensures that Riverlane hardware provides the extremely low jitter needed to maintain determinism, which is critical to quantum hardware. The speed of the R&S®FSPN is essential for testing this hardware. It can easily handle the signal frequencies currently in use and will enable the team to build more powerful setups in the future.

Summary

Because Riverlane's quantum error correction stack is mainly used by experimental physicists, its team is often unaware of the parameters, such as phase noise, the system has to satisfy. This means that the hardware must have a certain flexibility engineered in. This flexibility combined with the high performance of the Rohde & Schwarz test equipment offers a range well suited to these challenging test environments. In addition, the instruments provide further valuable features, such as built-in scripting tools, which the team can use to automate test generation and thus accelerate delivery of new product releases.

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Making quantum computing ready for the real world
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R&S®FSV3030

- ▶ Signal and spectrum analyzer with frequency range up to 30 GHz
- ▶ Analysis bandwidth up to 200 MHz
- ▶ Features including GUI with multi-touch, SCPI recorder for simple script programming and event based actions

R&S®FSPN

- ▶ Phase noise analyzer and VCO tester with extremely low-noise internal DC sources
- ▶ High measurement speed with simultaneous measurement of phase noise and amplitude noise
- ▶ Frequency range from 1 MHz to 26.5 GHz

R&S®RTP

- ▶ High-performance oscilloscope with 4 GHz to 16 GHz bandwidth
- ▶ Sample rate up to 40 Gsample/s, memory depth up to 3 Gpoints per channel
- ▶ Up to 16 bit resolution

"We really appreciated the guidance we received from the Rohde & Schwarz team on performance. Their technical team spent time with us in the lab and allowed us to use the equipment to make sure it would meet our requirements before making our decision."

Marco Chibaudi, vice president of engineering, Riverlane

