

SPECTRUM ANALYSIS WITH THE R&S® FPH FOR EMI AND SIGNAL STRENGTH TESTING OF HORYZN eVTOL



At a glance

HORYZN is a diverse project group of the Technical University of Munich that develops eVTOL drones for everyday use cases. In its most recent Mission Pulse project, the group is developing the Frankenstein drone which will carry a defibrillator to cardiac arrest patients in immediate need. Due to relatively few obstacles combined with a linear aerial trajectory, the drone significantly reduces the response time to four minutes vs. nine minutes for an ambulance. This can triple survival rates from 11% to 34%.

Summary

- ▶ **Customer:** NEXT Prototype e.V., HORYZN, Mission Pulse
- ▶ **Task:** eVTOL spectrum analysis for EMI and signal strength testing
- ▶ **Challenge:** Analyzing potential real-world interference and signal performance
- ▶ **Product:** R&S® Spectrum Rider FPH handheld spectrum analyzer
- ▶ **Key benefits:** Reliable and robust flight field measurements

Case Study | Version 01.00

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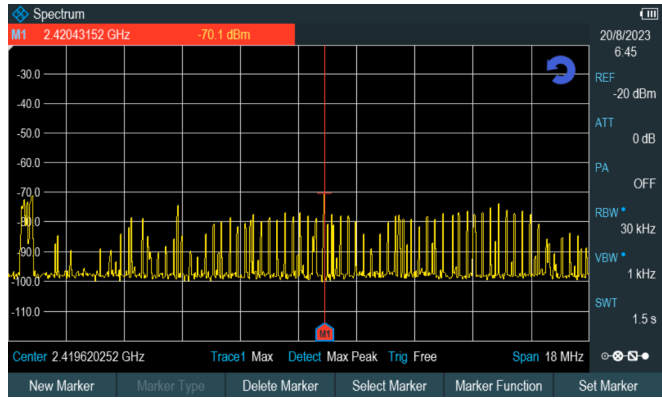
Make ideas real



The task

HORYZN uses and compares off-the-shelf antennas and transceivers to minimize costs. However, total reliance on data sheets can lead to disaster. Looking at today's test and measurement challenges, there has been a major shift in industry due to the proliferation of 5G, the internet of things and consumer electronics, resulting in a world filled with billions of electrical and electronic devices. These devices increase the ambient noise in the radio spectrum around us. RF emissions from non-EMC compliant products cause radio frequency interference when placed near one another. Moreover, switch-mode power supplies are becoming more prevalent in electronics. As power supplies become smaller in size while needing to maintain their efficiency, the tradeoff requires operation at high frequencies. All these frequencies can couple up and interfere with analog circuitry or other critical wireless signals.

The drone must ensure a steady communications channel and create the least possible interference to medical personnel and ambulatory devices. HORYZN does not rely solely on data sheets and lab findings, but uses test equipment in the field. The robustness and consistency of the channel link must be maintained throughout the space and time of the emergency operation. Comparing fading and link budget losses of different transmitters and receivers on the flight field helped select the most durable antennas and transceivers from various vendors and sponsors.



Flight field spectrum analysis results.

The drone not only has flight communications but also provides a video and audio link which is critical for operation monitoring. Any distortion or loss of communications can result in mission failure and even possible harm to bystanders, which is why the drone needs to be rigorously tested.

Solution

The R&S®Spectrum Rider FPH handheld spectrum analyzer is the best instrument on the market for observing the entire frequency spectrum of the various communications links and highlighting interfering noise from the surrounding environment. Unlike conventional spectrum analyzers which are bulky and designed for lab use, the R&S®Spectrum Rider FPH can be easily used on the airfield since it weighs only about 3 kg. The rugged, high-quality non-reflective backlighting screen provides additional flexibility under different weather conditions and allows measurements even in intense sunlight.

Flight tests can be long in many cases, but the R&S®Spectrum Rider FPH has seven hours of battery life, which is entirely sufficient. The touchscreen makes it easy to zoom in and traverse through the spectrum, while



The R&S®Spectrum Rider FPH

R&S®SPECTRUM RIDER FPH

- ▶ 5 kHz up to 44 GHz
- ▶ Performance: excellent displayed average noise level (DANL)
- ▶ Portability: lightweight (from 2.5 kg) with sufficient battery power for a day's work
- ▶ Price: affordable
- ▶ User experience redefined based on multitouch interface

knobs can often be less intuitive in the field. This ease of use enabled multiple members of the HORYZN team to participate in flight testing experiments.

The frequency mode of operation is easy to use. The analyzer accurately displays waveforms and all operation frequency bands from 800 kHz up to 3 GHz and 5 GHz. The R&S®Spectrum Rider FPH marker funktion is remarkable. Whenever markers are placed, they automatically assign peak search markers. This makes it easy to measure and track signal peaks instantaneously. Double-tapping the screen creates a double marker that displays the relative measurement, making it simple to calculate the bandwidths of fast-changing signals.

Tests showed that various tones and intermodulation products of the drone's communications spectrum were well under the acceptable limits as defined in the system specifications. Built-in RF measurement functions help find the carrier frequency and provide important signal information such as the carrier power, modulation frequency, signal-to-noise and distortion ratio, and total harmonic distortion. These parameters are essential for determining the signal quality. A separate power measurement mode provides a quick view of the total transmit power and channel power density. The latter is constantly changing, especially due to movement of the drone in different orientations.

The R&S®Spectrum Rider FPH has a built-in GPS and compass for future triangulation experiments to determine interference and signal strengths. These features can be easily configured in the field. The spectrogram function helps visualize the measurement bandwidth and interpret the overall channel stability. Its clear, warm tones depict the power densities to allow intuitive analysis of different signals.



The HORYZN team after successful rollout of the "Frankenstein I" prototype in December 2021.

Benefit

The R&S®Spectrum Rider FPH gives HORYZN the confidence to carry out tests on even the smallest hardware parts, ensuring failsafe critical applications. In the future, HORYZN wants to develop most of its dedicated hardware in-house. Information about the various communications channels can be very helpful in the process of designing the communications modules and ensuring the necessary reliability.



HORYZN's Mission Pulse "Frankenstein I" eVTOL test bench includes the R&S®Spectrum Rider FPH handheld spectrum analyzer to test EMI and signal strength.

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