

ROHDE & SCHWARZ

Make ideas real



Test solutions for safety and security in the new aviation era

URBAN AIR MOBILITY



YOUR CHALLENGE

Urban air mobility (UAM) – mobility in the third dimension – is shaping the future of aerospace. In the race to bring eVTOL concepts to global markets and provide safe, secure and sustainable mobility services, aerospace designers and engineers are looking to many different technologies to address the associated challenges.

From electric powered propulsion to automated/autonomous flight, the realization of the UAM vision depends on the seamless integration of various technologies such as onboard sensors for DAA capability, inflight connectivity, communication links and flight navigation.

Robust system performance, even in congested electromagnetic environments

The seamless integration of sensors, communications, state-of-the-art fly-by-wire avionics systems and powerful electric propulsion systems represents an unprecedented challenge for design engineers when it comes to the safe operation of future eVTOL aircraft. Every sensor and every process is safety-relevant and has to be reliably tested and pass a variety of industry and regulatory certifications.

In line with UAM standardization and backed by our long-standing expertise and dedicated test and measurement solutions, Rohde & Schwarz is committed to ensuring that your test system complies with the latest standards and regulations.

Precise GNSS navigation – unharmed by spoofing and interference

Tomorrow's UAM applications are inconceivable without precise geo-positioning using the Global Navigation Satellite System (GNSS). Realistic modeling of the flight routes of eVTOL aircraft is essential. A complete GNSS scenario must include proper simulation of the satellite orbits, the signal propagation characteristics, the characteristics of the receive antenna and the receiver environment. Generation of jamming and interfering signals is crucial to setting up a simulation environment that is close to reality. Rohde & Schwarz offers a whole range of GNSS simulation solutions for designing, testing and validating high precision onboard devices.

Enhanced radar performance for safety in the lower airspace

Radar is the first choice for onboard sensors, enabling detection and avoidance (DAA) and air space surveillance with extended sensor range, all-weather operability and the ability to detect even small objects such as drones and birds. It offers a small form factor with efficient power for UAM applications. Rohde & Schwarz provides effective T&M solutions for designing, testing and validating radar systems.

OUR SOLUTION

Rohde & Schwarz is the right partner to ensure flawless system performance for safety and security in tomorrow's urban air mobility. As an expert in aerospace test applications, we are leading the way with innovations for testing and validating sensors (radar), communications (4G, 5G, SatCom), flight navigation (GNSS) and the overall electronic system performance. Working with our customers and partners to meet their exact requirements, Rohde & Schwarz offers unique test solutions for

- ▶ EMI and EMC testing
- ▶ OTA performance and coexistence testing
- ▶ Effective radar testing
- ▶ Advanced multi-frequency GNSS navigation testing
- ▶ Customizable and future-ready satellite link testing
- ▶ Comprehensive communication testing
- ▶ Power and data management

Reliable, robust and secure communication and data links

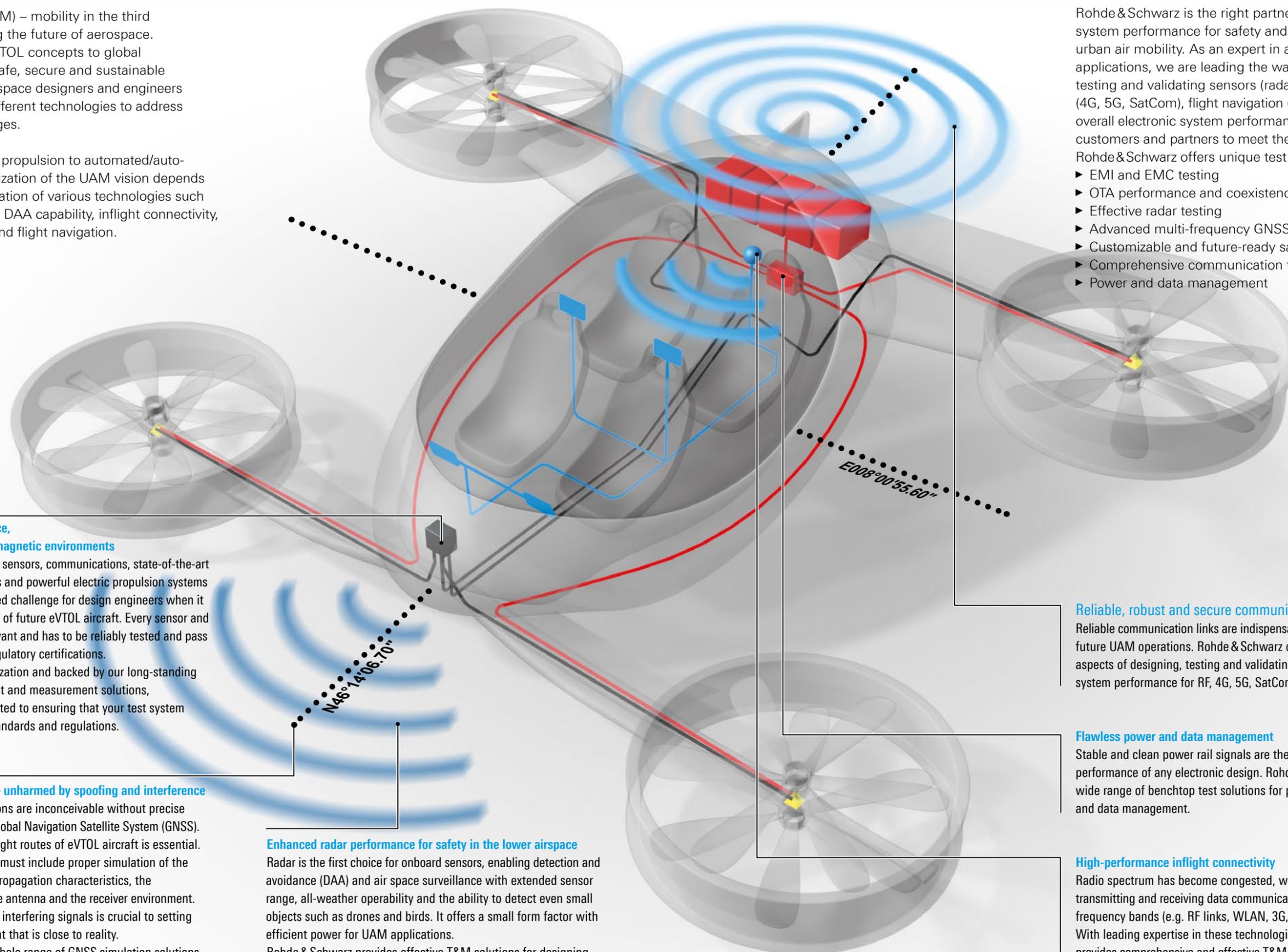
Reliable communication links are indispensable for safe and secure future UAM operations. Rohde & Schwarz offers solutions for all aspects of designing, testing and validating the communication system performance for RF, 4G, 5G, SatCom, and others.

Flawless power and data management

Stable and clean power rail signals are the basis for the proper performance of any electronic design. Rohde & Schwarz provides a wide range of benchtop test solutions for power integrity testing and data management.

High-performance inflight connectivity

Radio spectrum has become congested, with many components transmitting and receiving data communications signals in different frequency bands (e.g. RF links, WLAN, 3G, LTE, 5G). With leading expertise in these technologies, Rohde & Schwarz provides comprehensive and effective T&M solutions for designing, testing and validating wireless communication links.



EMI/ EMC TEST FOR ROBUST SYSTEM PERFORMANCE

Congested electromagnetic environments

eVTOL aircraft will operate in congested electronic environments. Putting safety first, aerospace engineers and designers are looking to test and validate the electromagnetic compatibility of their system design – even beyond standards and regulations. Seamless integration of all electronic modules and reliable operation will be major distinguishing factors and unique selling points in the future UAM market.

Test solutions for EMI/EMC

As the established market leader in EMC test solutions, we provide professional expertise across the aerospace, automotive and mobile communications industries. Partner with us for the widest range of instruments and turnkey solutions

- ▶ From emission (EMI) and immunity testing (EMS)
- ▶ From detection of low-level emissions to test levels of several thousand volts per meter
- ▶ From 10 Hz to 40 GHz
- ▶ From the component and subassembly level to complex system compliance testing
- ▶ For all major national and international EMC standards, and beyond

OTA Compliance test

Ready to address fast-paced development cycles, we provide outstanding test solutions for over-the-air (OTA) performance and compliance testing – from development to certification of components and eVTOL aircraft, fully in line with international regulatory and manufacturer standards.



INTEGRITY TEST FOR FLAWLESS POWER AND DATA MANAGEMENT

Validation of advanced aircraft data networks (ADN)

To address the complexity and requirements of future eVTOL aircraft, engineers are turning to aviation buses such as ARINC 429, MIL-STD-1553 and even proprietary solutions for their aircraft data network (ADN) designs. Rohde & Schwarz oscilloscopes provide powerful tools for debugging low speed serial buses by turning the scope into a protocol analyzer with the ability to see time-correlated analog waveforms at the same time. Even proprietary buses based on Manchester or NRZ coded protocols are supported with a generic trigger and decode solution.

Electric drive test

Analyzing modern electric drive systems means measuring motor voltages and currents and evaluating the associated digital control signals. Since voltages and currents are safety critical and require special measurement setup considerations, the R&S®Scope Rider offers up to four isolated input channels with CAT IV 600 V rating that allow measurements on high-voltage electronics without compromising user safety. Digital control signals can be analyzed with the 8-bit logic interface that is isolated from the analog input channels. The R&S®Scope Rider can be controlled and monitored via a wireless LAN interface, ensuring operator safety, for example during test runs.

Validating ASIC performance

The R&S®RTP high-performance oscilloscope combines high-class signal integrity with a fast acquisition rate for efficient analysis of power and signal integrity. Customized frontend ASICs and realtime processing hardware enable highly accurate measurements with an unprecedented speed of 1 million waveforms/s, sample rate of 20 Gsample/s and memory depth of 2 Gsample – all in a compact form factor.



R&S®RTP high-performance oscilloscope for advanced signal integrity analysis

COM TEST FOR RELIABLE COMMUNICATION AND DATA LINKS

Seamless communication links in urban environments

Deployment in the crowded electromagnetic environments of highly populated urban environments and numerous communications standards in one eVTOL aircraft impose demanding requirements on system robustness e.g. to WLAN, LTE, 5G interference. The R&S®CMW wideband radio communication tester and extensions offers universal, efficient test solutions for all modern cellular and non-cellular standards. It meets all requirements for a state-of-the-art wireless communication tester.

Ensuring proper IP application and service

IP traffic and data packet communication environments are complex. Thanks to the deep packet inspection (DPI) capability of the R&S®CMW, IP streams and IP connections can be analyzed for conformity and security. The R&S®CMW platform offers an efficient test environment for executing complex IP application tests for various technologies, including complete traffic flow analysis, throughput analysis, file transfer as well as an integrated IMS Server (IP Multimedia Subsystem) for testing services like Voice or Video over LTE and WLAN.

Guaranteed communication for automated emergency calls

Passenger safety will be the key factor to social acceptance of UAM technologies. In an emergency, clear communication with first responders is paramount. Covering the latest developments in this field such as eCall, ERA-GLONASS and also LTE based Next Generation eCall, Rohde & Schwarz offers test solutions to ensure guaranteed performance of automated emergency call functionality integrated in the eVTOL aircraft. The R&S®CMW500 in combination with the R&S®SMBV100A is a powerful solution for functional testing, standard-compliant conformance testing and performance testing of emergency call modules. The test solution from Rohde & Schwarz is a future-ready investment, not just for legacy eCall but also for LTE and IMS based next generation eCall system testing.

Satellite test solutions

For extended range operations of eVTOL aircraft, engineers are looking to utilize the latest satellite technology to ensure global coverage. Due to requirements like very large data volumes and lowest latency, the services offered by small satellites constellations deployed in low earth orbit (LEO) are of special interest. The Rohde & Schwarz OneWeb-compliant solution for signal generation and analysis for the uplink and downlink was qualified by Qualcomm, a test solution provider for OneWeb, one of the leading small satellite constellation operators. In cooperation with solution partners and system integrators, we also offer customization of reference signals and test scenarios at all levels.



Leading in technologies, R&S®CMW500 wideband radio communication tester



OneWeb Test Systems with Rohde & Schwarz test solution

GNSS TEST COUNTERING THE THREAT OF SPOOFING AND INTERFERENCE

GNSS navigation test solutions

Rohde & Schwarz provides the most realistic GNSS scenario simulations for satellite orbit, signal propagation and electromagnetic environment characteristics. All GNSS simulations can be performed under well-defined and controlled conditions, giving design engineers the benefit of repeatable, fully customizable and scalability test and validation scenarios.

Addressing the special challenge of urban environments with the presence of multipath, interference, coexistence and even spoofing, differential GNSS capability becomes even more important in order to deliver precise positioning performance. The R&S®SMW200A can simultaneously generate signals from all important GNSS constellations and frequency bands in a single instrument.

Key facts and benefits

- ▶ Multi-constellation, multi-frequency GNSS scenarios (e.g. GPS, GLONASS, Galileo, BeiDou, SBAS and QZSS)
- ▶ Multiple RF outputs for multi-antenna and multi-vehicle simulations
- ▶ GNSS signals plus up to 7 interferers for complex coexistence scenarios
- ▶ Up to 144 GNSS channels
- ▶ Static and dynamic GNSS scenarios
- ▶ Resilience against spoofing with simulation of spoofing attacks and scenarios



High-End multifrequency GNSS signal simulation with the R&S®SMW200A vector signal generator



RADAR TEST FOR SAFETY IN THE LOWER AIRSPACE

Enhancing radar performance for the challenges of UAM traffic

For safe operation in the lower airspace and in urban environments, design engineers of eVTOL aircraft are looking for onboard radar sensor solutions with reliable detect and avoid (DAA) capability that enable surveillance of the surrounding airspace. Given the compact size of eVTOL aircraft, radar sensors have to comply with challenging design limitations in terms of size, weight, output power and power consumption.

Addressing the need to detect even small objects in the flight path, like drones and birds, Rohde&Schwarz solutions characterize radar signals and components to improve general system design considerations and performance. Rohde&Schwarz offers a range of signal generator and spectrum analyzer solutions such as the R&S®FSW signal and spectrum analyzer and R&S®SMW200A vector signal generator. With unparalleled low phase noise and sensitivity, these solutions cover all relevant frequency bands, the latest radar technology functions and provide enhanced analysis of e.g. pulse form, bandwidth, spectrum, linearity and complex waveforms.



Signal generator and analyzer up to 81 GHz covering the latest radar technologies.

For determination of the needed performance level at the component, module or subsystem level, Rohde&Schwarz offers a unique choice of instruments ranging from sophisticated network analyzers (the R&S®ZNA network analyzer) to power meters to full-featured oscilloscopes. These solutions cover all relevant measurements for e.g. power output, antenna pattern, spectral emission mask and interface performance. In addition, Rohde&Schwarz offers market-leading phase noise analyzer solutions (the R&S®FSWP phase noise tester) to determine the phase noise performance level of phased locked loop (PLL) based microwave signal generator assemblies.

Real-time scenario simulation for enhanced radar testing

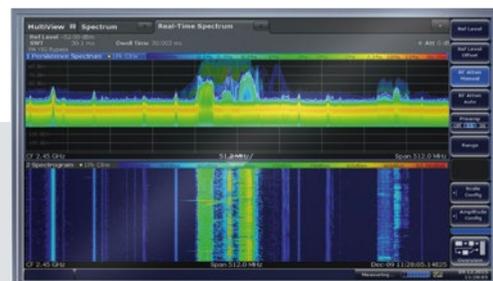
To ensure the flawless performance of the radar sensor in congested urban airspace scenarios, design engineers need to conduct tests in real time and with the most realistic radar simulation. Able to generate arbitrary virtual radar echo signals in real time in the lab, the R&S®SMW-K78 radar echo generation option of the R&S®SMW200A signal generator uniquely addresses these needs.

At the price point of commercially available T&M equipment, the R&S®SMW200A signal generator and the R&S®FSW spectrum analyzer deliver fully reproducible results, provide automated test processes and significantly reduce measurement effort, time and cost.

In combination with its powerful test executive software and shielded chamber with integrated positioner, Rohde&Schwarz provides a fully integrated solution for fast development of new test procedures, test automation and report generation.

Ensuring seamless radar scan coverage

Aircraft body parts can impose a certain amount of attenuation and influence the quality and performance of an integrated radar sensor. In order to ensure that the radar performs adequately after installation, Rohde&Schwarz offers a highly innovative radome tester delivering a high-resolution mmWave image and spectral transmission data to evaluate the impact of any body parts on the radar performance.



Real-time spectrum analysis

Service that adds value

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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Urban Air Mobility, Test solutions for safety and security in the new aviation era

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