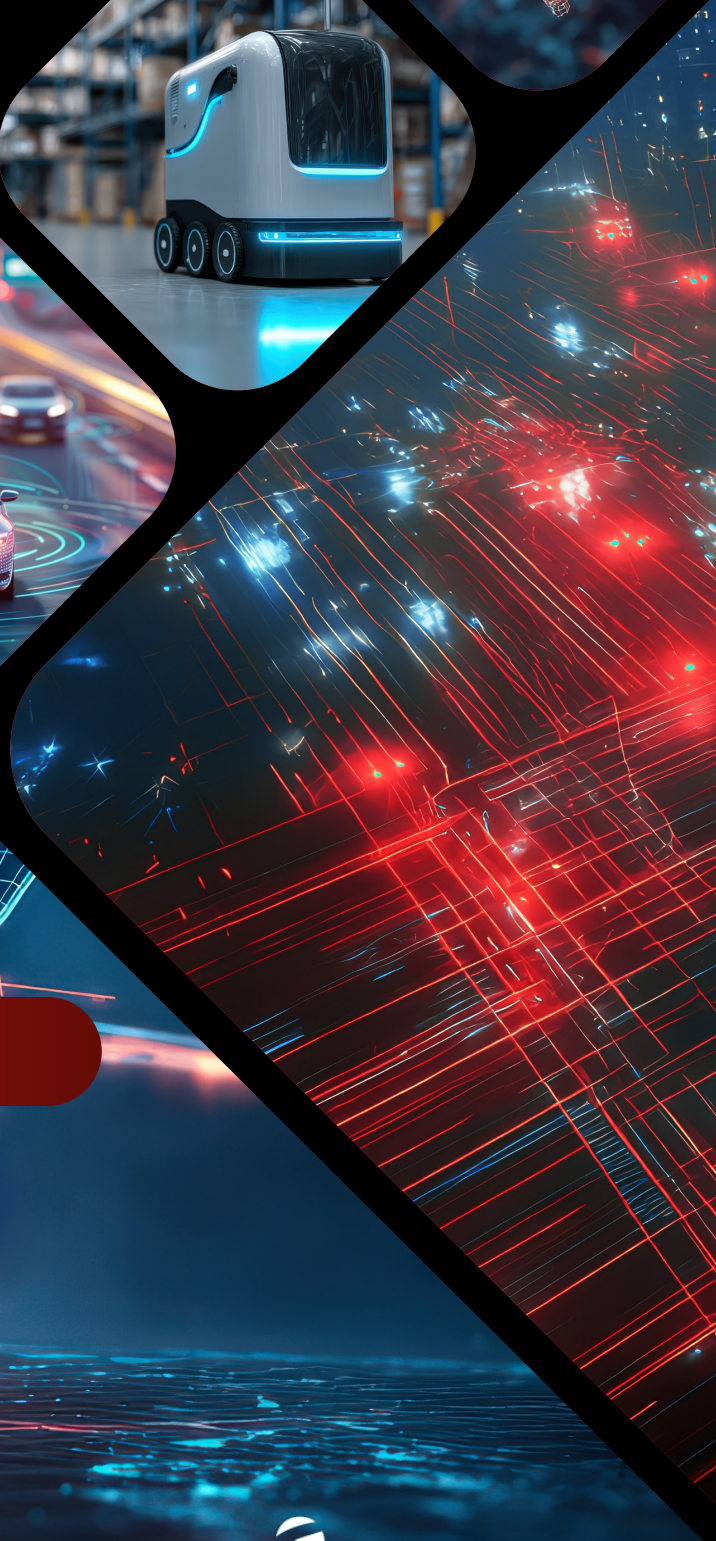




NEXT-GENERATION

AUTONOMOUS DESIGN

RENESAS

altera

septentrio
part of HEXAGON

CALIAN

SKYWORKS



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ABOUT BRAEMAC

Braemac is a global leader in the distribution of semiconductor components and electronic systems as well as value-added services. Empowering engineers and developers for over 40 years—Braemac features expert in-house engineers, extensive design-phase support, state-of-the-art distribution, value-add facilities, comprehensive supply chain solutions, and unparalleled customer service. Braemac offers solutions for diverse markets and applications, helping customers streamline development, reduce costs, accelerate time to market, and support long-term interoperability.

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INTRODUCTION

BEYOND THE BASICS OF ADVANCED AUTONOMOUS DESIGNS

Key Takeaways

- Advanced autonomy depends on specialized hardware architectures that enable real-time AI inference, sensor fusion, and deterministic decision-making at the edge, which requires system-level design approach.
- Next-gen drone capabilities depend on three core systems that collectively define performance:
 - Edge processing & Control
 - Navigation, localization, & perception
 - Communications & networking
- Designing for real-world environments requires resilient architectures that can overcome thermal constraints, GNSS degradation, RF interference, and connectivity disruptions.
- Braemac is a solutions provider for drone innovation, offering a wide portfolio of cutting-edge components purpose-built to support advanced autonomous systems capabilities.



Explore all the real-world engineering decisions driving next-gen UAV design in the full blog.

Addressing the Growing Demand for Autonomy

The rapid adoption of autonomous systems is driving unprecedented growth across unmanned aerial vehicle (UAV), drone, and autonomous mobile robot (AMR) markets. As organizations deploy these platforms for surveillance, logistics, agriculture, infrastructure monitoring, and defense applications, onboard systems are being tasked with processing larger volumes of sensor data, supporting multiple wireless links, enabling advanced navigation, and making real-time decisions at the edge.

To meet evolving mission requirements, developers are increasingly adopting modular architectures that allow sensors, radios, GNSS receivers, AI accelerators, and compute resources to be added or reconfigured without redesigning the entire platform. While this approach improves flexibility, scalability, and platform longevity, it also introduces new challenges in RF system design. Engineers must balance competing requirements including size, weight, power, and cost (SWaP-C), low-latency communications, reliable connectivity, spectrum awareness, and resilience against interference, spoofing, and jamming.

QUESTIONS?

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EDGE PROCESSING

HOW TO NAVIGATE AI CAPABILITIES AMIDST HARDWARE LIMITATIONS

Embedded processing architectures have evolved beyond traditional MCU-based designs toward advanced heterogeneous computing platforms that synergize the benefits of MCUs, DSPs, NPUs, GPUs, and dedicated AI accelerators. Supporting advanced workloads such as vision transformers, real-time object classification, sensor fusion, and safety-critical decision-making requires significantly greater computational performance than legacy architectures can provide.

However, system developers face a fundamental design challenge known as the "memory wall," where transferring data between the processor and external memory becomes a major source of latency, power

consumption, and heat generation. Engineers are trapped between needing high-end AI capabilities and operating within strict, fanless SWaP-C constraints.

To overcome these limitations, modern drones and autonomous vehicles are increasingly relying on edge computing as a solution. Cameras, LiDAR, radar, infrared sensors, GNSS receivers, and inertial measurement units continuously generate large volumes of data that must be analyzed in real-time. By integrating Ai and decision-making at the edge, autonomous systems can reduce latency, improve reliability, and maintain operation even in environments with limited connectivity.



Design Techniques for Next-Gen Computing

FAULT-TOLERANT CONTROL ARCHITECTURES	LEVERAGING PURPOSE-BUILT COMPUTE PLATFORMS
To operate safely even when components degrade, sensors fail, or environmental conditions change unexpectedly, fault-tolerant control architectures improve system resilience by detecting issues early and adapting vehicle behavior to maintain stability and mission continuity. As the decision-making layer of the vehicle, onboard compute enables adaptive control systems, health monitoring and predictive maintenance, and failover logic that helps ensure mission continuity and safe operation.	Ensuring optimal processing architecture is one of the most important design decisions for autonomous systems. As a global distributor with a unique value-added approach, Braemac deeply understands the requirements of specialized compute platforms that combine high-performance processing with hardware acceleration to overcome memory, thermal, and power limitations.



QUESTIONS?

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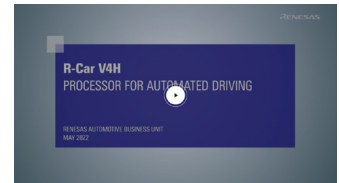
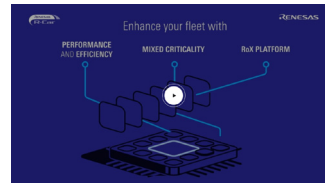
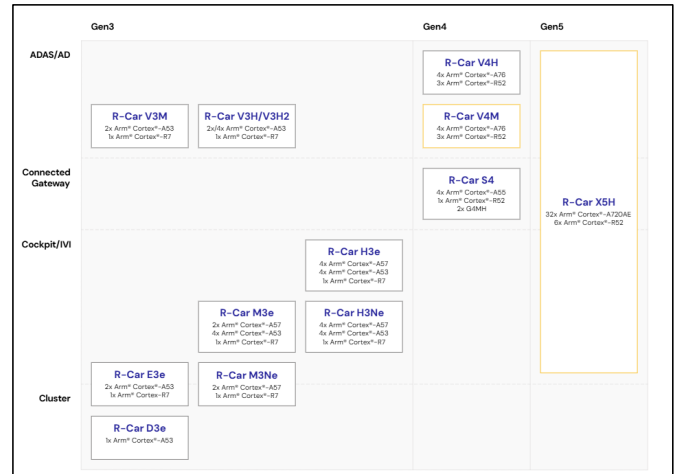
EDGE PROCESSING FEATURED SOLUTIONS

RENESAS R-CAR & RZ/V SERIES

The R-Car SoC family and RZ/V Series MPUs feature proprietary DRP-AI acceleration that provides a powerful option for thermally constrained autonomous platforms. These devices support advanced vision AI, machine learning inference, and real-time control without requiring active cooling, enabling compact drones, AMRs, and other edge AI systems to maintain high performance while minimizing power consumption.

R-Car System-on-Chip

R-Car System-on-Chip (SoC) solutions deliver exceptional TOPS-per-watt efficiency, enabling high-throughput AI processing with optimized power consumption across a scalable portfolio that supports applications from advanced driver assistance (ADAS) and Navigate on Autopilot (NOA) to Level 5 autonomous driving. These solutions also power next-generation in-vehicle experiences using large and visual language models, including AI-driven driving assistance, immersive multi-display infotainment, and unified cross-domain architectures that integrate ADAS and IVI functions, while meeting ISO 26262 standards and supporting functional safety up to ASIL-D for mission-critical automotive environments.



Key Applications

ADAS	INFOTAINMENT	VEHICLE CONTROL
 • ADAS Front Camera System • Comprehensive ADAS & Autonomous Driving Hard-ware-Software System • Intelligent Camera System • Parking Assistance System with AHL Camera • Video Output Expansion for Surround View & AR HUD	 • Automotive Cockpit System with Haptics • Connected Android-Based Vehicle Instrument Cluster • Cost-Effective Digital Cluster with 4-Channel AHL & Surround View • Full Graphics Cluster & Cockpit System • High-End Cockpit & Infotainment Solution • Infotainment & Automated Driving Systems with Fewer Components	 • Automotive Communication Gateway Platform • Communication Gateway & Integrated DVR/DMS System • Connected Gateway for Future E/E Architecture • Tire Pressure Monitoring System • Vehicle Computer for Future E/E Architecture

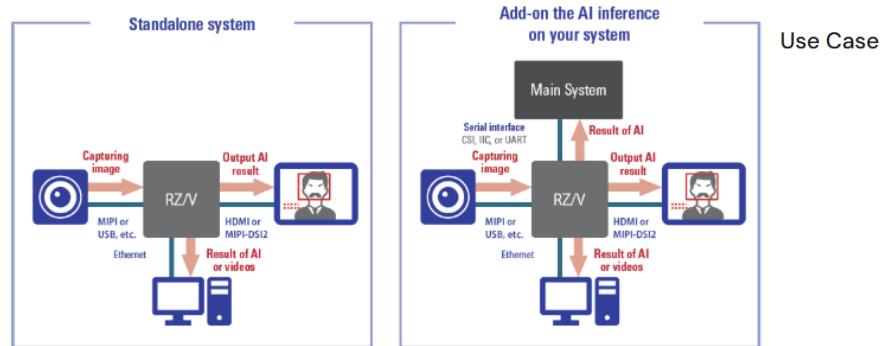
EDGE PROCESSING FEATURED SOLUTIONS

RZ/V EMBEDDED AI MPUS

The RZ/V series of microprocessors integrates Renesas' proprietary DRP-AI (Dynamically Reconfigurable Processor) accelerator to deliver a strong balance of AI performance and energy efficiency.

Target Applications:

- IP camera
- Surveillance camera
- Retail
- Logistics
- Image inspection
- Vision AI Gateway

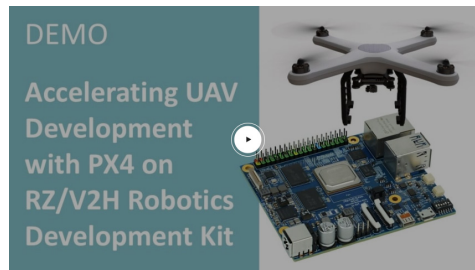


RZ/V2H Robotic Development Kit

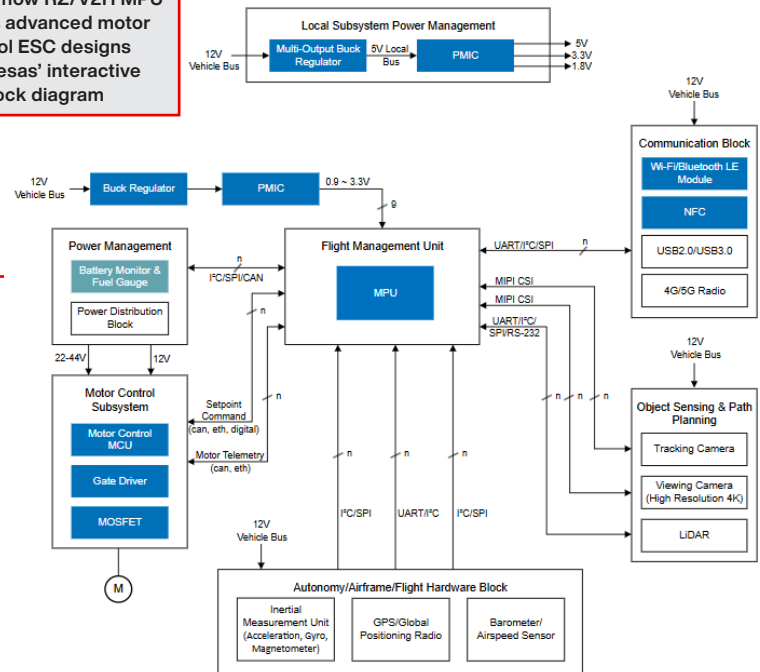
The RZ/V2H Robotic Development Kit (RDK) is specifically engineered to accelerate high-end AI vision & robotics application development. Powered by the Arm®-based RZ/V2H MPU, it handles intensive image-processing tasks with up to 80 TOPS (sparse) of AI performance while supporting multi-OS operation across its multi-core architecture.

Key Features:

- Arm® architecture supporting simultaneous multi-OS operation
- RZ/V2H MPU delivering up to 80 TOPS (sparse) AI inference for real-time vision and robotics workloads
- MIPI CSI-2 and multiple high-bandwidth interfaces for camera and sensor integration
- Onboard JTAG, DIP switches, and flexible power architecture for efficient debug and bring-up
- Yocto 5.1 (Styhead) and Ubuntu 24.04 support for Linux-based AI development
- Software enablement for ROS 2 Jazzy-based robotics development, with customized packages and development support



Discover how RZ/V2H MPU enables advanced motor control ESC designs in Renesas' interactive block diagram



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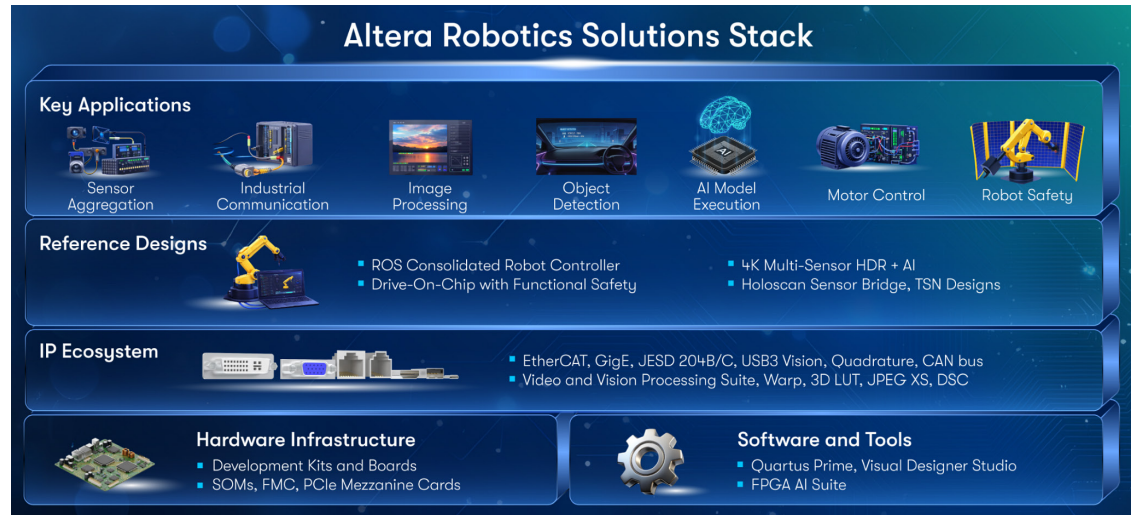
EDGE PROCESSING FEATURED SOLUTIONS

AGILEX™ 5 FPGA AND SOC FPGAS

Altera's high-performance FPGAs and SoC platforms help address growing compute density requirements by enabling hardware-accelerated AI pipelines, sensor processing, and custom workloads at the edge. Programmable logic allows developers to optimize data movement and parallel processing, reducing memory bottlenecks while delivering exceptional throughput-per-watt performance.

Agilex 5 solutions

address a wide range of autonomous applications that demand strong performance, reduced power consumption, compact designs, and moderate logic requirements.



1.05 V to 3.3 V. This combination of features makes them well-suited for midrange deployments across edge and core environments, including communications, video and broadcast, industrial systems, test and measurement, medical technology, data centers, and defense applications.

Introducing an advanced DSP architecture with integrated AI Tensor Blocks, Agilex 5 enables efficient artificial intelligence and digital signal processing capabilities, along with a first-of-its-kind asymmetric processor subsystem featuring dual Arm Cortex-A76 and dual Cortex-A55 cores for optimized workload balance and energy efficiency.

Built on Intel 7 process technology, Agilex 5 FPGAs incorporate next-generation Hyperflex™ architecture, high-speed transceivers supporting up to 28.1 Gbps, PCIe 4.0 x8, DDR5 memory interfaces reaching 5,600 Mbps, and flexible general-purpose I/O ranging from

**Key Features:**

- Up to 2x better fabric performance/watt
- D-Series FPGAs vs Competing 7nm FPGAs
- 2.5x Higher Performance
- 50% Lower Power
- 152x Peak INT8 TOPS

NAVIGATION & LOCALIZATION

ENSURING RESILIENT POSITIONING IN REAL-WORLD ENVIRONMENTS

Autonomous systems are only as effective as their ability to understand where they are and how they move through an environment. Relying solely on consumer-grade GPS or pre-programmed maps is a recipe for disaster in modern UAVs and drones operating in dynamic, unstructured surroundings.

GNSS signals can be obstructed by urban canyons, degraded by warehouse infrastructure, or intentionally disrupted through jamming and spoofing. As autonomy levels increase, achieving reliable positioning requires resilient navigation architectures capable of maintaining accuracy even when primary positioning sources are unavailable.



Design Techniques for Comprehensive Navigation Architecture

MAKE MULTI-SENSOR FUNCTIONALITY THE NEW BASELINE

Autonomous platforms overcome the limits of standalone GNSS by using multi-sensor fusion, integrating data from GNSS, IMUs, cameras, LiDAR, radar, and barometric sensors, and applying RTK corrections when higher precision is required to achieve centimeter-level accuracy that enables advanced capabilities like autonomous landing, coordination, and reliable operation in complex environments.

DESIGN FOR ENVIRONMENTAL AWARENESS AT THE EDGE

Environmental awareness architectures integrate localization and perception systems to model the operating environment, enabling capabilities such as dense mapping, real-time terrain classification, object tracking and threat detection, low-latency obstacle avoidance, and semantic scene understanding, while robust positioning technologies ensure reliable performance even in challenging conditions like heavy foliage, multipath interference, and GNSS-denied environments.



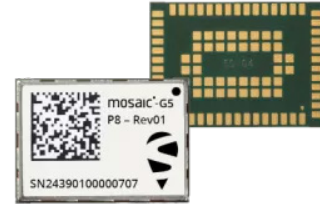
QUESTIONS?

**CONTACT
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NAVIGATION & LOCALIZATION FEATURED SOLUTIONS

SEPTENTRIO MOSAIC-G5 & MOSAIC-X5

Septentrio tackles signal vulnerability head-on with their ultra-compact mosaic-G5 and mosaic-X5 GNSS receiver modules. Packing premium AIM+ anti-jamming and anti-spoofing technology into a tiny, low-SWaP footprint, Septentrio ensures that UAVs and robotic platforms maintain resilient centimeter-level RTK positioning even in highly contested or jammed environments.



Septentrio mosaic-G5

Designed for high-precision autonomous applications, Septentrio's mosaic-G5 family combines RTK positioning with advanced anti-jamming and anti-spoofing capabilities, helping drones and autonomous vehicles maintain accurate navigation in contested or signal-challenged environments.



Key Features:

- Ultra-small 22.8 x 16.4 x 2.4 mm form factor
- Multi-constellation, all-in-view satellite tracking, up to 4-frequencies (and L-band)
- Low latency performance with up to 100 Hz output rate
- Configurable RTK accuracy optimised for availability or accuracy
- Dual-antenna mode supported by command
- Different AIM+ protection levels against jamming and spoofing, tailored to application needs
- Ultra-low power consumption
- SMT-ready LGA package, optimised for automated assembly

Success Stories | At a Glance

Fire fighting, cleaning walls, growing crops: one drone at a time

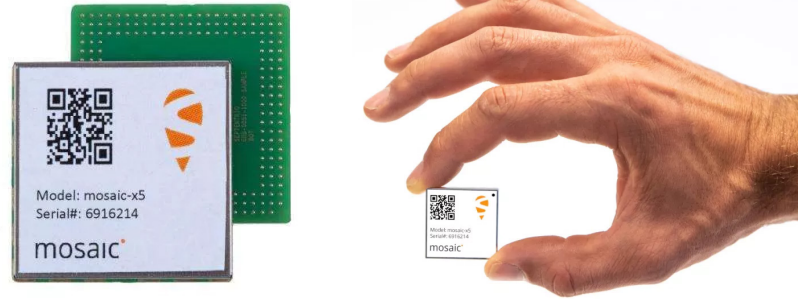
OBJECTIVE	SOLUTION	OUTCOME
AGR aimed to develop industrial drones capable of operating reliably across highly challenging environments—such as dense urban areas, mountainous terrain, and interference-prone airspace—while maintaining precise navigation and safety for applications including firefighting, agriculture, logistics, and building cleaning.	AGR integrated Septentrio's mosaic-G5 P3 GNSS module into its UAV platform, combining multi-frequency, multi-constellation positioning with advanced anti-jamming and spoofing detection (AIM+). This was enhanced by AGR's proprietary flight control system, creating a tightly integrated hardware-software solution capable of delivering accurate and stable navigation even in signal-obstructed or interference-heavy environments.	High-precision, robust, and reliable operation across diverse and demanding use cases, including high-altitude transport, precision agriculture, firefighting missions, and urban façade cleaning. The system minimizes signal loss risks, improves operational efficiency, and enables safe navigation in complex conditions, allowing AGR to expand UAV deployment into more advanced and mission-critical scenarios.

[CLICK HERE TO LEARN MORE](#)

NAVIGATION & LOCALIZATION FEATURED SOLUTIONS

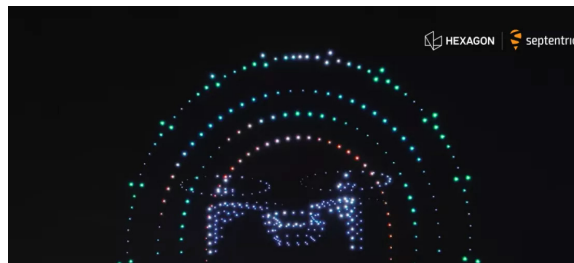
MOSAIC-X5

Septentrio's mosaic-X5 is a compact, low-power GNSS receiver module that supports multi-band and multi-constellation tracking, offering broad connectivity options and targeting high-volume applications such as robotics and autonomous systems. It is designed to receive signals from all major GNSS constellations, including emerging ones, ensuring long-term compatibility and reliability. Featuring integrated AIM+ interference mitigation technology, the mosaic-X5 sets a high standard for performance in scalable, mass-market GNSS positioning solutions.



Key Benefits:

- Small in size, big in performance
- All-in-view satellite tracking: multi-constellation, multi-frequency
- Best-in-class reliable and scalable position accuracy
- Future proof: supporting current and future satellite signals
- AIM+ unique interference mitigation and monitoring system as part of the advanced GNSS+ algorithms
- Update rate of 100 Hz
- Industry-leading ultra-low power consumption
- Easy-to-integrate, optimized for automated assembly



Success Stories | At a Glance

A sky lit up by light-show drones

OBJECTIVE	Enable large-scale drone light shows that require precise synchronization, dependable positioning, and consistent performance in environments with potential signal interference.
SOLUTION	Deploy mosaic-X5 and mosaic-G5 GNSS modules with multi-band, multi-constellation positioning, combined with anti-jamming and anti-spoofing technology, and integrated with base stations to ensure continuous and accurate positioning across the drone fleet.
OUTCOME	Achieved highly synchronized, interference-resilient coordinated performances that deliver safe, scalable, and visually accurate aerial light shows, enabling reliable execution of complex entertainment displays at scale.

[CLICK HERE TO LEARN MORE](#)

NAVIGATION & LOCALIZATION FEATURED SOLUTIONS

CALIAN HELICAL® TECHNOLOGY

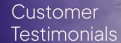
Calian Provides the crucial physical anchor to the navigation stack with their high-precision, multi-band GNSS antennas. Engineered to mitigate multi-path errors and pick up weak signals in challenging environments, Calian's antenna solutions complement advanced receivers to provide an unshakeable, high-fidelity data foundation for sensor fusion algorithms.

Calian's quadrifilar helical® antenna design uses a precisely engineered helix element to deliver strong gain and consistent axial ratio across all angles, reducing multipath interference. Integrated low-noise amplifiers with minimal power draw and built-in low-loss filtering protect against high-level signal interference, resulting in a strong signal-to-noise ratio. Lightweight and capable of high performance without a ground plane, these antennas are well suited for high-accuracy positioning applications such as PPP and RTK.

Key Features:

- Extreme lightweight, ranging from 4 g to 42 g
- Robust, military-grade, IP67-compliant plastic enclosure
- A certified Iridium model
- A novel helical antenna element delivering excellent axial ratio and multipath rejection
- An extremely low noise amplifier (LNA) combined with a pre-filter
- Selection of housed and embedded models
- Broad GNSS band coverage, including single, dual, triple, and L-band corrections services
- Ideal design and performance for real-time kinematic (RTK) and precise point positioning (PPP) applications





Customer Testimonials

ABRIS Design Group

Obtaining High Precision and Accuracy with Tallysman's Helical Antenna Solutions



ABRIS DG

The high efficiency accuracy and reliability of the above-mentioned GNSS systems under our test method, which is to use a two-antenna GNSS system to determine the angle position of the aircraft, and operate with these values for aircraft navigation, as well as control the camera angle relative to the vertical axis to compensate for the tilt angle. It is expected that the values determined in this way will be much more accurate than with the flight controller magnetometers, since these sensors have low stability and are susceptible to interference.

A Standard Design Solution for Our Aircraft

To obtain accurate and complete orthophotos of the terrain, it is crucial to navigate the aircraft along the designated flight route and to accurately determine the positions of the center of photographs in flight or after a session. To do this, we use the GPS/L1 dual-frequency GNSS system. The imaging sensor is a 1/3" MP full-frame GNSS SoM camera. Ultra-light and compact HC871 helical antennas, from Calian Wireless Inc., are introduced with the optical axis of the camera and operate as part of the GNSS system. This allows reliable and accurate real-time level position accuracy of the image projection center, at a flight speed of up to 30 miles.

The resulting series of images have good orientation and accurate geo-referencing, which allows generation of high-resolution ortho-mosaic without additional ground survey work. In addition, the obtained photographic data are also suitable for processing by the common GIS methods, which is a key requirement for aerial photography from an aircraft type UAV.

Case Study | At a Glance

Obtaining High Precision and Accuracy with Tallysman's Helical Antenna Solutions

OBJECTIVE	SOLUTION	OUTCOME
Achieve highly accurate positioning and orientation for UAV-based aerial imaging to produce precise orthophotos and mapping data without relying on extensive ground survey work.	Deploy a dual-frequency GNSS system paired with Calian helical antennas mounted in alignment with the imaging sensor, enabling precise tracking of image positions. A dual-antenna configuration was also implemented to improve heading and angular accuracy, supported by low-noise amplification to maintain signal stability even during dynamic flight conditions.	Delivered consistent centimeter-level positioning accuracy and highly reliable geo-referenced imagery, allowing generation of high-quality ortho-mosaics and enabling advanced aerial survey methods. This approach improved data accuracy, reduced operational costs by minimizing ground work, and enhanced overall UAV survey efficiency and performance.

[CLICK HERE TO LEARN MORE](#)

COMMUNICATION & NETWORKING

WHY A CUTTING-EDGE COMMUNICATION STACK MATTERS

From coordinated groups to fleets of AMRs, maintaining resilient communications and networking is crucial to autonomous system functionality. Communication failures can have immediate operational and safety consequences. For collaborative autonomous systems, a dropped packet is more than a network issue. It can result in mission disruption, navigation errors, or unsafe vehicle behavior.

As autonomy scales, communication architectures must deliver deterministic, low-latency performance while maintaining reliability in increasingly congested RF environments. Engineers face the challenge of designing communication systems that can withstand electromagnetic interference (EMI) from industrial equipment, cross-talk from neighboring vehicles, and dynamic spectrum conditions without sacrificing performance, power efficiency, or range.



Design Techniques for Securing Autonomous Communications

MULTI-BAND AND MULTI-RADIO FUNCTIONALITY	INTERFERENCE MITIGATION
Modern autonomous systems depend on multiple communication technologies working in parallel to support control, telemetry, sensor data exchange, vehicle coordination, and cloud connectivity. Instead of relying on a single protocol, next-generation designs use multi-radio architectures to adapt performance across varying environments. Sub-GHz enables long-range, low-power links, while L-, S-, and C-band support higher bandwidth and mission-critical data, complemented by cellular, Wi-Fi, satellite, and mesh networks for added flexibility. Integrating multiple radios on one platform creates redundant communication paths, improving reliability and maintaining connectivity if individual links fail.	Reliable communication depends on more than transmission power alone. Autonomous platforms must be capable of identifying interference sources and adapting accordingly. Advanced communication systems increasingly incorporate channel-hopping techniques, adaptive modulation, beamforming, and intelligent spectrum management to maintain link quality in crowded RF environments. Connected communication security is a paramount design consideration. Communication links represent one of the most common attack surfaces for autonomous systems and must be designed to withstand both cyber and RF-based threats.

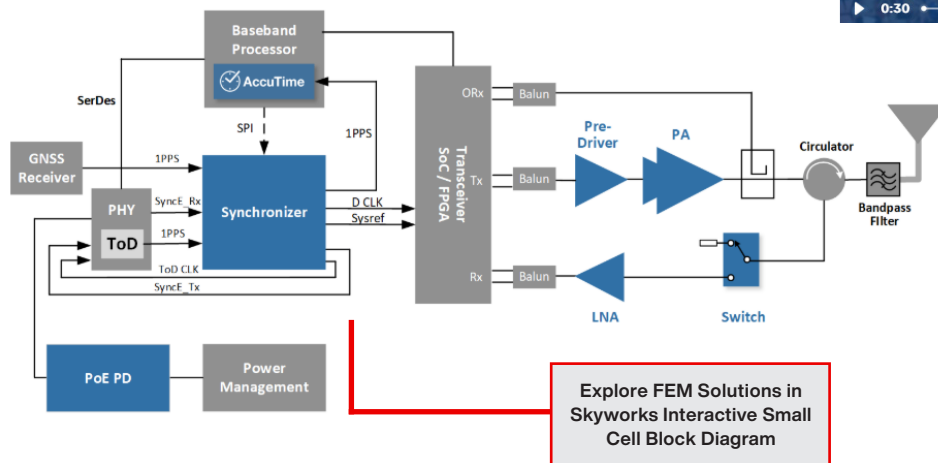


QUESTIONS?

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SKYWORKS HIGH-POWER FRONT-END MODULES

Skyworks eliminates the risk of wireless dropouts with their highly integrated RF Front-End Modules (FEMs), power amplifiers, and low-noise amplifiers. By optimizing the physical RF paths for high efficiency and robust signal isolation, Skyworks solutions ensure that peer-to-peer mesh networks and high-bandwidth wireless links maintain a clean, ultra-reliable connection, keeping autonomous fleets perfectly synchronized without saturating the power budget.



- Reliable performance over wide temperature range (-40 to +105C)
- TX: High efficiency, high power, wide BW
- RX: Low insertion loss, exceptional linearity
- Integrated Single 5V supply compatible packaging
- Reduce TTM multiband single board design
- Minimal external BOM reduce size, weight
- Proven with partner PDP systems
- In development for higher frequencies up to 8 GHz
- An extremely low noise amplifier (LNA) combined with a pre-filter
- Selection of housed and embedded models
- Broad GNSS band coverage, including single, dual, triple, and L-band corrections services
- deal design and performance for real-time kinematic (RTK) and precise point positioning (PPP) applications

Power Amplifiers (PA)

Part Number	Frequency (MHz)	Gain (dB)	PSAT (dBm)	IBW (MHz)	PAE (%)
SKY662xx	700 - 2200	>34	+36	Up to 100	>35
SKY663xx	2200 - 5000	>35	+36	Up to 200	>30
SKY665xx	2200 - 4200	>35	+39	Up to 400	>25

 5x5 mm Family

**High Efficiency
Multi-band Radio**

Part Number	Frequency (MHz)	Gain (dB)	Noise Figure (dB)	Special Features
SKY6718x	400 - 6000	18-21	0.45 - 0.7	Tunable NF, BW, & Gain
SKY67177	2300 - 5000	35	0.65	Bypass Mode
SKY67208	3100 - 4400	36/30	1.1	Dual Ch.; Int. Gain Step; Calibra. System

Interference
Robust Linearity

Part Number	Frequency (MHz)	Power (dBm)	Insertion Loss (dB)	Special Features
SKYA21003	100 – 8500	+35	0.5	SPDT
SKY13335	100 – 6000	+32	0.4	SPDT
SKY13418	100 – 6000	+35	0.8	SP8T

Signal Protection, Mode Switching



CONCLUSION

HOW BRAEMAC SUPPORTS AUTONOMOUS SYSTEMS INTEGRATIONS

At Braemac, we help engineering teams accelerate autonomous system development through access to industry-leading solutions. Our technical experts work closely with customers to identify the optimal architecture for their application, helping balance performance, power efficiency, thermal constraints, reliability, and scalability throughout the design cycle.

Our comprehensive portfolio leverages the building blocks required to transform autonomous concepts into deployable systems. Solutions from suppliers such as Altera, Renesas, Septentrio, Calian, and

Skyworks enable designers to address some of the most difficult challenges in autonomy, including real-time AI processing, resilient localization, anti-jamming navigation, and ultra-reliable wireless connectivity.

**Make Braemac your
trusted design partner.**



QUESTIONS?

**CONTACT
BRAEMAC TODAY!**

