High-Performance RF Solutions for Agile New Markets

Mighty Guides

Sponsored by

qorvo | MOUSER ELECTRONICS

Table of Contents

Meet Our Experts

Today's RF systems—spanning autonomous drones, satellite communications, and industrial IoT—are increasingly defined by the need for speed, flexibility, and rapid scalability. We interviewed leading experts about the shift away from custom, application-specific designs toward agile development strategies that can meet compressed timelines. This eBook explores how engineers are addressing challenges in time-to-market, coexistence, power efficiency, and system complexity through wideband components, modular architectures, and proven, off-the-shelf solutions that enable faster, more adaptable RF development.

David Rogelberg
Publisher,
Mighty Guides Inc.
david@mightyguides.com
(516) 234 2969

Christian Demitri
Senior Lead Space Systems Engineer, Ariane 6 ULPM APFC Technical Leader - Exploitation Phase, ArianeGroup

Shashanka Dontula
Staff RF Engineer, RADAR

Jeff Gengler
Director, Applications Engineering, Qorvo, Inc.

Debbie Gibson
General Manager, Infrastructure, Qorvo, Inc.

Suma Kapilavai
Product Line Manager, Marketing Manager, Qorvo, Inc.

Arash Mousavi
RF Engineer, Relativity Space (Dark Matter Lab)

Saurabh Sanghai
RF Avionics, Zipline

Foreword

By **Debbie Gibson**, General Manager, Infrastructure, Qorvo, Inc.

As wireless technology moves forward faster than ever, RF designers are facing both exciting opportunities and new challenges. Applications like autonomous drones, satellite communications, and industrial IoT are redefining expectations for performance, flexibility, and time to market. At the same time, traditional design approaches are increasingly challenged to keep up with shorter development timelines and rapidly changing requirements.

In this environment, flexibility and availability is key. Designers need to create systems that not only meet demanding performance metrics but also can quickly adapt to different frequencies, conditions, and use cases. This means shifting toward more flexible RF design strategies that use readily available wideband components and proven, scalable technologies.

Qorvo is helping engineers meet these demands. With high-performance, ready-to-use RF solutions, designers can reduce development time while still achieving strong, reliable results. These solutions make it easier to build systems that are both powerful and adaptable.

This eBook explores how RF design is evolving to meet the needs of fast-growing markets. We also look at the tools and strategies that help engineers overcome common challenges and bring products to market faster. Whether you're addressing coexistence challenges, improving efficiency, or designing for new applications across global bands, this guide will help you get started.

Introduction

Today's global markets are driving a growing need to deliver new products and communication solutions faster than ever before.

For the RF designer, the traditional pursuit of bespoke, application-specific designs is often at odds with meeting these aggressive commercial timelines. Standard front-end radio solutions typically take up to two years to reach high-volume production due to complications with designing custom silicon and boards. In contrast, emerging sectors like autonomous drones and commercial space applications require hardware cycles that teams can complete within six months to remain competitive.

To resolve these challenges, developers have begun turning to off-the-shelf, qualified components that speed their time to market while retaining high performance. With access to mass-produced devices, they can implement proven hardware without lengthy custom development phases. For example, a single wideband product can cover multiple frequency ranges, which simplifies part inventories and significantly reduces total SKU count. In a similar vein, modular designs can help teams avoid hidden costs associated with custom hardware iterations, as the parts have already undergone rigorous characterization.

In this eBook, we'll examine the industry-wide move toward agile RF development and how Qorvo is responding to these challenges with high-performance wideband components and flexible architectural strategies.

Chapter 1

MARKET DYNAMICS & HIGH PERFORMANCE

Several dynamic markets now create significant challenges for the RF designer, almost all of which result from the need for massive data throughput in unconventional environments.

In general, a growing reliance on AI-enabled telemetry and machine-to-machine communication is spiking need for high-speed data sharing among remote systems. Handling the frequent data bursts required by these complex AI models requires expanded instantaneous bandwidth to provide the necessary capacity. Consequently, teams in a variety of application spaces need to design agile radio systems capable of real-time frequency changes to navigate increasingly congested spectrums.

Drones and UAVs

Uncrewed aerial vehicles (UAVs) face the complex issue of maintaining reliable communication links while traversing diverse and unpredictable RF environments. To counter localized interference in unlicensed bands, wideband architectures are a powerful tool. When a single piece of RF hardware supports multiple frequency ranges simultaneously, systems can identify and switch to clear channels in real time. And, with wideband hardware underpinning the system, engineers can implement software-defined radio (SDR) platforms to further boost system agility.

“Building-block architectures allow you to dramatically shorten time to market and capitalize on previous development investments. Because these blocks are minimally interdependent, you can respond to changing requirements by efficiently maintaining core blocks and modifying only those needed for new missions.”

Christian Demitri

Senior Lead Space Systems Engineer,
Ariane 6 ULPM APFC Technical Leader - Exploitation Phase,
ArianeGroup

Many of the markets that Qorvo serves are evolving every day. Some of them are brand new and are changing very, very fast because of their expanding use cases. That makes life extremely difficult for the RF designer who needs to find readily available components. Qorvo offers a wide array of RF front-end solutions to support this demand and drive time to market."

Jeff Gengler

Director, Applications Engineering,
Qorvo, Inc.

Beyond signal integrity, wideband solutions help UAV designers reduce the total number of unique part numbers within their bill of materials. By employing a single wideband component to cover multiple communication interfaces, teams significantly simplify their logistics and supply chain management.

However, engineers must carefully balance these performance gains against the strict Size, Weight, Power, and Cost (SWaP-C) constraints common in UAVs. High-efficiency power amplifiers and front-end modules are essential in this context, as they minimize the overall power draw to preserve mission endurance. Integrating these high-performance RF chains into small-form-factor drones is possible only through compact packaging technologies that optimize board real estate.

NTN and D2D Satellites

Meanwhile, the expansion of 5G, non-terrestrial networks (NTN), and direct-to-device (D2D) satellites is pushing the requirements for link capacity and data throughput to new extremes, which forces a re-evaluation of traditional front-end architectures.

These satellite-to-device communications depend on components that offer high power levels and superior noise figures to deliver clear signals over vast distances. As low Earth orbit satellite (Leosat) NTN markets move toward broadband capabilities to support the high data rates users expect, system architects can address link reliability challenges with high-element massive multiple-input multiple-output (MIMO) configurations. By using hundreds or thousands of antennas to focus signals into narrow, high-gain beams, these configurations offer precise beam steering that lets satellites moving at high velocities effectively target end users.

And because new dedicated NTN bands like n254 and n256 are in close proximity to traditional licensed terrestrial frequencies, designers can repurpose existing high-performance hardware for adjacent satellite applications. Engineers will tune or adjust many of these standard infrastructure components to function optimally at specific satellite frequencies, delivering high linearity and low noise for both signal chains.

RFID and Smart Metering

Industrial IoT applications, such as radio-frequency identification (RFID) and smart metering, present unique constraints concerning the balance between signal range and battery longevity. Here, low-power signals must penetrate dense building materials or traverse expansive industrial sites without exhausting the localized power source. Because these applications frequently operate in sub-1 GHz bands (e.g., 450 MHz or 915 MHz), power amplifier efficiency directly dictates operational service life.

And, since smart meters typically remain in fixed, often inaccessible locations for over a decade, they need front-end components that offer exceptional long-term reliability and thermal stability.

> ***Reusable building blocks with proven pedigree improve resilience, parallel development, future proofing, and cost efficiency for large UAS fleets or LEO constellations. Modular interfaces let teams upgrade payloads or comms suites without redesigning everything in a market exposed to shifting technology and tight regulations.”***

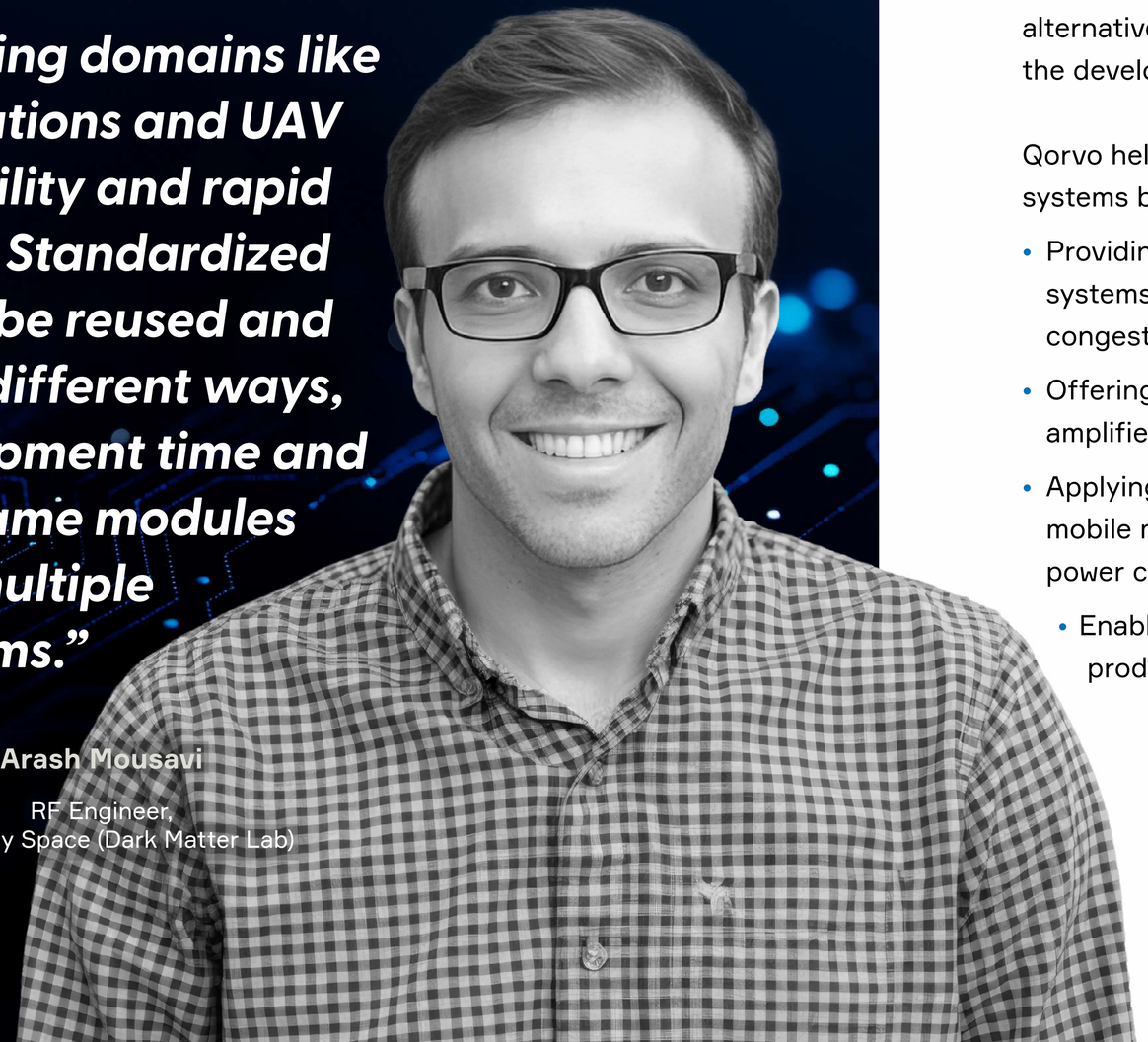
Saurabh Sanghai

RF Avionics, Zipline

“For fast-evolving domains like LEO constellations and UAV operations, scalability and rapid iteration are critical. Standardized components can be reused and combined in different ways, reducing development time and cost since the same modules apply across multiple missions or platforms.”

Arash Mousavi

RF Engineer,
Relativity Space (Dark Matter Lab)



Teams can address these longevity requirements by leveraging proven, mature technologies, which provide a pathway to adapt high-performance signal chains for specialized industrial use cases. This access to high-volume commercial hardware offers a cost-effective alternative for segments that lack the scale to justify the development of fully custom silicon.

Qorvo helps engineers design frequency-agile systems by

- Providing broadband RF solutions that allow systems to hop between clear channels in congested unlicensed environments.
- Offering high-power components and low-noise amplifiers for satellite-to-device communication.
- Applying innovative packaging and high-volume mobile market expertise to reduce size and power consumption.
    - Enabling them to retune existing infrastructure products to new frequency bands.

One reason wideband components are becoming important is the large number of applications that need to navigate crowded airwaves. Devices need to find a clear channel where there's no congestion or contention in a specific frequency range."

Debbie Gibson

General Manager, Infrastructure, Qorvo, Inc.

Qorvo QPA9510 General-Purpose Sub-1GHz Power Amplifier

Learn More

Qorvo QPL9098 Ultra Low Noise Gain Block Amplifiers

Learn More

Qorvo QPL9547 0.1GHz to 6.0GHz Ultra Low-Noise LNA

Learn More

Key Points

- New RF markets, such as drones and commercial space communications, require agile, wideband solutions that can reach high-volume production within six months.
- Non-terrestrial networks are adopting massive MIMO and increased instantaneous bandwidth to provide high-capacity, reliable links.
- Comprehensive device telemetry requires efficient hardware to manage frequent data sharing within the power constraints of mobile systems.
- Qorvo offers industry-leading expertise and RF solutions to help designers deal with the complexities of modern RF design.

Chapter 2

OVERCOMING TECHNICAL BARRIERS IN NEXT-GEN RF

Designers working in dense coexistence environments – where multiple frequencies and protocols operate in close proximity – must work to actively prevent receiver desensitization. This phenomenon takes place when a strong, unwanted signal, such as a 5G transmission, couples into an adjacent receiver path and masks the desired low-power signal.

To reduce these interference issues, engineers can implement high-performance, small-form-factor filtering solutions like bulk acoustic wave (BAW) filters.

“Following regulatory standards like FCC Part 15, 20, 22, and 27 is vital for frequency band compliance. Pre-validated RF offerings optimize board space and mitigate the need for product redesigns.”

Shashanka Dontula

Staff RF Engineer,
RADAR

Coexistence is probably one of the biggest concerns for most radio front-end designers. More devices are supporting multiple protocols at the same time, and that can become a nightmare for an RF designer trying to maintain a reliable signal. Qorvo offers solutions to address these challenges."

Debbie Gibson

General Manager, Infrastructure, Qorvo, Inc.

By using acoustic waves in piezoelectric materials to achieve steep rejection curves, BAW filters help teams handle higher power levels while significantly reducing board layout area compared to traditional ceramic alternatives. These steep rejection characteristics isolate signals that are physically adjacent in the spectrum, helping systems effectively manage coexistence.

Beyond filtering, systems need to discern weak signals from the inherent noise of the receiver architecture. High-performance, low-noise amplifiers (LNAs) empower the system to amplify these signals without distortion for more reliable communication within high-noise environments. In particular, high-linearity LNAs enable the system to amplify weak signals without distortion, even in the presence of interferers.

Integrating high-isolation switches further supports signal integrity by effectively managing the transition between transmit and receive paths. Because high isolation prevents the transmitter signal from leaking into the sensitive receive path, it protects the system from internal interference that would otherwise lead to desensitization.

For these reasons, such switches are particularly useful in integrated systems to coordinate high-power transmission and low-power reception on the same hardware.

Finally, leveraging wide-bandwidth standard products offers the flexibility to optimize the design, while also increasing the speed of development. While custom parts may offer specific narrowband advantages, modular designs help engineers adjust performance criteria such as output power and noise contribution as requirements change across multiple systems. In terms of flexibility, teams may adjust the DC power consumption of LNAs to scale the power draw based on the actual noise levels detected in the environment. This adjustable power consumption means teams can optimize for right-sized performance, ensuring the system does not waste energy when interference is low.

Qorvo helps RF designers by

- Providing high-Q BAW filters with superior power handling and rejection for coexistence environments.
- Offering wideband LNAs and amplifiers that can be externally matched to service multiple frequency bands with a single component.
- Delivering high-isolation switches that prevent coupling from other paths.
- Offering components with adjustable DC power consumption so teams can balance performance against power draw in real time.

“As more systems operate simultaneously, effective filtering is essential to prevent signal degradation. Integrated front ends improve efficiency and compactness, enabling better coexistence of multiple communication standards within the limited hardware space of modern RF systems.”

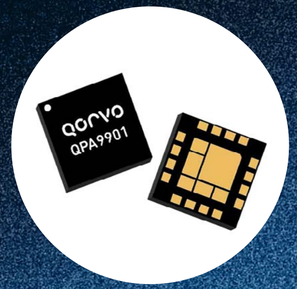
Arash Mousavi

RF Engineer, Relativity Space (Dark Matter Lab)

By offering customers very small, high-Q BAW filters that can handle the necessary power levels, we're helping designers notably reduce their overall board size as well as cost."

Suma Kapilavai

Product Line Manager, Marketing Manager,
Qorvo, Inc.



Qorvo QPA9901 High-Efficiency Amplifier

Learn More

Qorvo QPL9058 Ultra Low-Noise LNA

Learn More

Qorvo QPQ3550 High-Performance BAW Bandpass Filter

Learn More

Key Points

- Engineers manage dense coexistence environments by using BAW filters and high-linearity LNAs to prevent desensitization.
- Wideband components allow teams to consolidate their BOM and reduce costs by using a single part that they can externally tune for specific frequency ranges.
- High-isolation switches help transmit and receive modules prevent internal signal leakage.
- Qorvo provides a portfolio of modular RF solutions that help designers adjust power consumption and performance criteria.

Chapter 3

ARCHITECTURAL AND TECHNOLOGY STRATEGIES FOR MODERN USE CASES

Autonomous drone systems gain significant advantages with SDR architectures. This technology allows software to control the carrier frequency and radio signal processing, enabling the system to hop across a very wide frequency range. As such, SDR architectures provide inherent resistance to jamming and general interference in urban or conflict zones.

To support these agile architectures, the entire signal link must be broadband capable. Implementing these broadband solutions in the sub-6 GHz range leads to better signal penetration and more reliable communication links over longer distances for the drone.

In satellite applications, where energy is at a premium, engineers face a different set of constraints that value power efficiency over pure link distance. Designers might address these limitations with dynamic voltage adjustments to optimize real-time power consumption in phased array antennas. With this feature, systems can scale power amplifier capability based on the actual traffic load or data rate required at any given moment.

> ***A major benefit of modularity is team efficiency. Different teams can work in parallel on well-defined components instead of stepping on each other's work. This reduces long-term technical risk, as proven modules are reused with confidence rather than being reinvented."***

Arash Mousavi

RF Engineer, Relativity Space (Dark Matter Lab)

Modular building blocks provide proven components for predictable performance and on-time project execution. For critical verticals like aviation and satellites, they enable an easier platform strategy where one core design can drive multiple product SKUs for global markets.”

Saurabh Sanghai

RF Avionics,
Zipline

By scaling back the power draw during periods of lower activity, the system will improve overall system efficiency and extend the orbital platform’s mission life.

Using gallium arsenide (GaAs) heterojunction bipolar transistors (HBTs) provides the necessary performance across these wide dynamic voltage ranges. GaAs HBTs are highly adaptive and offer consistent performance and signal integrity with voltage control. With inherent adaptability, they let the system scale power up or down without losing the high linearity required for complex, high-speed modulation.

Similar optimization strategies apply to industrial RFID and smart metering applications. Because the effective range of these handheld or remote meters is directly tied to the power amplifier’s collector voltage, designers can use GaAs HBTs to tune performance to the specific deployment environment. For instance, teams might set higher voltages to maximize range in challenging industrial settings, or choose lower voltages to prioritize the battery life.

Adjusting the quiescent current (i.e., the current flowing through the device when no signal is present) further helps teams balance power consumption against signal linearity for specific use cases.

By using wideband components and adjusting external surface-mount parts, a single hardware platform can service different unlicensed global bands, such as 915 MHz or 450 MHz. This hardware flexibility means that a single design can serve multiple international markets with minor component swaps. Teams can further compress these timelines through standard multi-chip modules (MCMs) that combine multiple RF functions into a single, pre-qualified package. These integrated solutions reduce the risk of design iterations while providing greater functionality and a smaller footprint.

Qorvo helps designers implement robust architectures by

- Providing broadband portfolio solutions that enable software-defined radios.
- Offering GaAs HBT & pHEMT devices that maintain high performance during dynamic voltage variation.
- Delivering flexible sub-1 GHz components that engineers can tune for maximum range or extended battery life for RFID and meter-reading applications.
- Providing detailed reference designs, applications engineering support, and standard MCMs to reduce design iterations and reach the market faster.

> ***If you perform dynamic voltage adjustment, you're able to scale back the power capability of the power amplifier, which improves the efficiency of the overall system."***

Suma Kapilavai

Product Line Manager, Marketing Manager, Qorvo, Inc.

“Building-block architectures allow you to eliminate some internal developments entirely by relying on qualified third-party components. This is a strong risk-mitigation advantage, as it provides a detailed understanding of failure propagation while maintaining overall reliability with minimal effort.”

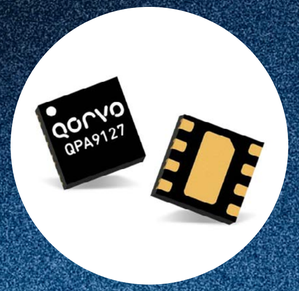
Christian Demitri

Senior Lead Space Systems Engineer,
Ariane 6 ULPM APFC Technical Leader - Exploitation Phase,
ArianeGroup

A large catalog of RF building blocks and expert application support helps our customers get to market faster, ramp up quicker, and manage their development expense.”

Jeff Gengler

Director, Applications Engineering,
Qorvo, Inc.



Qorvo QPA9127 Gain Block Amplifiers

Learn More

Qorvo QPC1022 SPDT Switch

Learn More

Key Points

- Software-defined radio architectures unlock frequency hopping and maintain reliable links in congested or jammed environments.
- Implementing dynamic voltage adjustment in satellite phased arrays helps scale power consumption based on real-time traffic.
- Designers of smart meters and RFID systems can adjust collector voltage and quiescent current to optimize between range and battery life.
- Qorvo provides wideband flexible components, standard MCMs and expert application support to simplify complex RF designs and shorten development timelines.

Conclusion

Agile RF development is a necessity for teams entering high-growth markets. New sectors, such as autonomous drones and commercial space communications, require wideband solutions capable of reaching high-volume production within compressed timelines. Teams can leverage wideband components to consolidate their BOM and reduce costs. Using a single part that is externally tunable to specific frequency ranges allows for a more streamlined supply chain and faster design pivots.

Qorvo offers industry-leading expertise and RF solutions to help designers overcome these complexities. From high-Q BAW filters that manage coexistence to GaAs HBTs that support dynamic voltage scaling, Qorvo built its portfolio for flexibility. By making high-performance requirements more attainable through standard, wideband products, Qorvo is helping unlock the next generation of frequency-agile systems.

Learn More About Our Experts

Christian Demitri

Senior Lead Space Systems Engineer, Ariane 6 ULPM APFC Technical Leader - Exploitation Phase, ArianeGroup

Christian Demitri is a Senior Lead Space Systems Engineer with more than a decade of experience delivering complex spacecraft, orbital vehicles, and launch systems across Europe. He serves as APFC Technical Leader for Ariane 6 upper stages at ArianeGroup, overseeing avionics integration, testing, and qualification across multiple flight models while supporting major ESA and DLR initiatives. With an MBA and strong technical management expertise, he combines engineering leadership with strategic focus on cost, risk, schedule, and mission readiness.

Shashanka Dontula

Staff RF Engineer, RADAR

Shashanka Dontula is a Staff RF Engineer at RADAR, where he works on next-generation sensor architecture for RFID tags. He brings 20+ years of hands-on experience across RF, mixed-signal, and hardware engineering, with deep expertise in transmitter/receiver design, multiband repeaters, and wireless systems spanning LTE, GSM, Wi-Fi, Bluetooth, Zigbee, and more. Prior to RADAR, he spent over 13 years at Nextivity in senior engineering roles, leading RF system design from concept through production. He is especially strong in end-to-end product development, RF validation, and practical design implementation using tools such as ADS, MWO, OrCAD, and PADS.

Jeff Gengler

Director, Applications Engineering, Qorvo, Inc.

Jeff Gengler is the Director of Applications Engineering for Infrastructure products at Qorvo, Inc., leading technical teams and customer applications support. With over 25 years of experience in RF engineering, he specializes in high-efficiency power amplifiers and advanced RF solutions for wireless communications.

Debbie Gibson

General Manager, Infrastructure, Qorvo, Inc.

Debbie Gibson is General Manager at Qorvo, Inc., where she leads business development, strategic planning, design, marketing, and applications engineering for the Infrastructure Business Unit. With decades of experience in product line leadership and technical management, Debbie has driven growth and innovation across complex analog and sensor systems, balancing technical rigor with business and operational strategy.

Learn More About Our Experts

Suma Kapilavai

Product Line Manager, Marketing Manager, Qorvo, Inc.

Suma Kapilavai is a Product Line Manager and Marketing Manager at Qorvo, Inc., where she drives growth, strategy, and product development for the company's commercial infrastructure RF product line. With a background in RF and microwave engineering, Suma brings deep technical expertise to her work in product development, marketing, and portfolio management, helping translate advanced technologies into market-ready solutions.

Arash Mousavi

RF Engineer, Relativity Space (Dark Matter Lab)

Arash Mousavi is a Senior RF Engineer specializing in antenna design, satellite payloads, and microwave systems, with industry experience at Relativity Space, SpaceX, Vast Space, and NASA's Jet Propulsion Laboratory. He holds a Ph.D. in Electrical Engineering from the University of Michigan, where his research focused on wideband radiometric sensing of ice and snowpack. He is a patent holder and a peer reviewer for multiple IEEE journals and conferences.

Saurabh Sanghai

RF Avionics, Zipline

Dr. Saurabh Sanghai is an inventor and wireless technology expert specializing in logistics, IoT, and mission-critical systems. He is currently scaling autonomous instant logistics at Zipline, using wireless technology for high-speed, zero-emission drone delivery. Previously, he held key leadership roles driving hardware programs, IoT innovation, and technology commercialization. His expertise includes super miniaturization and global large scale deployments of wireless systems across aviation, maritime, security, energy, automotive, and defense sectors.