NANODIMENSION

CUSTOMER SUCCESS STORY

High-Altitude RF Communication Platform

LoRa 433 MHz RF communication

This customer story highlights how additive manufacturing is reshaping electronics education and enabling rapid, high-performance development for real-world applications.

Nano Dimension

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SWISS AIRFORCE LEARNING CENTER

The Swiss Air Force's learning center, located in Payerne and operational since 1967, serves as a premier training ground for electronics and precision mechanics apprentices.

Over the past decade, it has evolved into a hub for hands-on development with a strong focus on in-house design and prototyping capabilities. The center provides full access to advanced fabrication technologies for students, preparing them to work with modern tools used in RF design and aerospace applications.

High-Altitude RF Communication Platform

The center initiated an in-house development project centered on LoRa 433 MHz RF communication, aimed at a high-altitude balloon mission. The technical goal was to design and validate a low-power (1W) modem for telemetry and tracking, integrating live GPS data over long-range RF links with minimum bandwidth, maximum reach, and fault-tolerant architecture.

This project was part of a broader vision: to prepare future engineers by exposing them to real-world AME (Additively Manufactured Electronics) challenges and solutions. The mission supports both academic training and practical industry alignment for aerospace and RF system design.

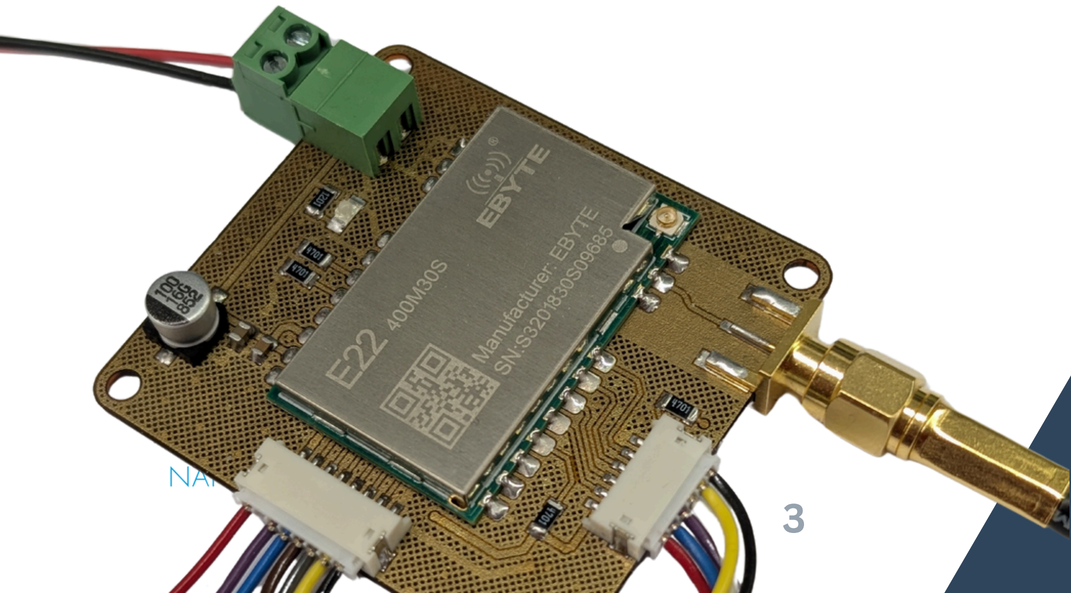
Traditional PCB Manufacturing Constraints

Historically, the Swiss Air Force's learning center relied on outsourcing PCB fabrication to manufacturers in Asia. While this approach is standard across the industry, it introduces a range of technical and operational limitations that impede innovation, particularly for high-frequency and aerospace applications.

One of the most pressing issues was the long turnaround time. With each iteration cycle taking several weeks from design submission to board delivery, the pace of development slowed dramatically. This delay made it impractical to quickly test and refine designs—especially problematic in educational and research settings where rapid experimentation is essential.

Flexibility was another major concern. Complex multilayer PCBs, particularly those with four to six layers, often required design adjustments based on initial test results. However, the lengthy outsourcing process meant that any change—no matter how minor—would restart the entire cycle, severely limiting the ability to respond to evolving design requirements in real time.

In addition, the technical demands of RF systems posed unique challenges that traditional PCB fabrication methods struggled to meet. Designing for 433 MHz transmission required precisely impedance-matched traces and tightly controlled dielectric properties, which are difficult to achieve without direct control over the fabrication process. Subtle mismatches in trace geometry or substrate characteristics could lead to performance degradation, signal loss, or interference. Boards needed to be mechanically robust, lightweight, and thermally stable to survive the extreme conditions encountered at 30–40 kilometers above sea level.



In-House Prototyping of High-Altitude RF Communication Platform

To overcome the limitations of traditional PCB outsourcing and gain full control over the design and fabrication process, the Swiss Air Force's learning center implemented the Nano Dimension DragonFly AME platform. This advanced, multi-material 3D printing system enabled in-house production of complex, multi-layered high-performance RF boards, all within a compact 10x10 cm footprint. With the system, the center could rapidly iterate on designs, precisely control impedance characteristics, and tailor dielectric properties to meet the exacting demands of high-frequency RF applications.

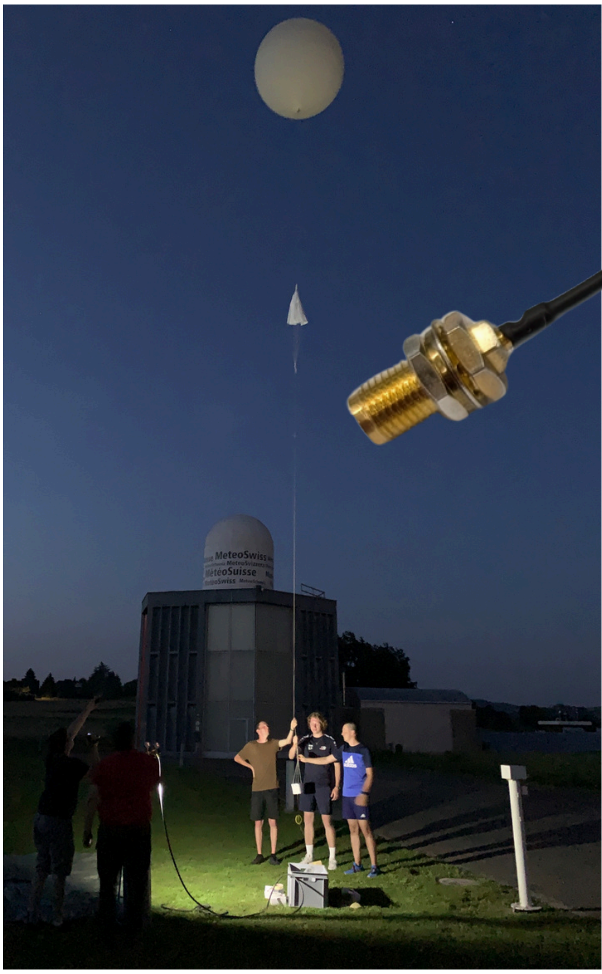
The adoption of the DragonFly IV system marked a major shift in the center's prototyping capabilities. Boards that once took weeks to arrive from external vendors could now be designed, printed, and tested within 24 hours. This rapid prototyping workflow allowed for continuous iteration, enabling students and engineers to adopt a "fail-fast" mentality—experimenting freely without the bottleneck of external production delays.

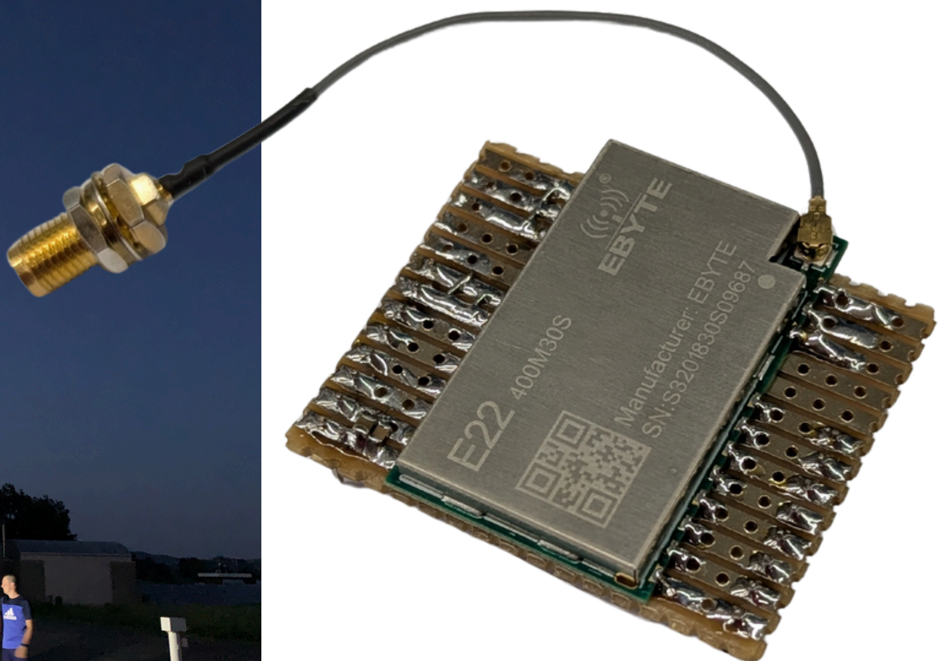
The system was particularly well-suited to RF-specific challenges. It supported the fabrication of impedance-controlled transmission lines, complex matching and balancing networks, and trace geometries optimized for 433 MHz communication. These features made it ideal for developing LoRa-based modem modules, where signal integrity and controlled electrical characteristics were critical to success.

Another core advantage of the DragonFly IV platform was its accessibility. The learning center made the system available to apprentices and university-level students, giving them direct, hands-on experience with AME technology. This exposure provided valuable training in both advanced RF engineering and next-generation fabrication techniques—skills highly relevant to careers in aerospace, defense, and high-frequency electronics. The system encourages innovation beyond conventional design tools. By moving away from standard EDA software like Altium, students are able to explore unconventional board architectures, custom RF layouts, and non-traditional form factors that leveraged the unique strengths of additive manufacturing.

The results were immediate and impactful. Iteration times dropped dramatically, with revised boards fabricated and tested the same day. RF performance was validated in real-world tests, including LoRa transmissions that achieved coverage of up to 700 kilometers using only 100 milliwatts of power—and even more with the final 1W configuration. During balloon flights, the PCBs performed flawlessly, providing live GPS tracking and telemetry data from altitudes approaching the edge of space.

The integration of the DragonFly IV system transformed the Swiss Air Force's learning center into a benchmark for modern electronics education and agile hardware development. By fostering hands-on experience with cutting-edge AME technology, the center has equipped over 450 apprentices with industry-relevant skills, while simultaneously enabling the launch of innovative RF and aerospace projects. This strategic shift from outsourced manufacturing to localized, high-speed prototyping has not only accelerated technical progress but also solidified the center's role as a forward-thinking institution committed to training the next generation of RF engineers and driving sustainable innovation.





Effortless In-house Prototyping

DragonFly IV

The DragonFly IV is a cutting-edge 3D printer redefining how electronics are designed and manufactured. As a multi-material, multi-layer additive manufacturing system, it enables the creation of entire circuits in a single print—integrating substrates, conductive traces, and passive components seamlessly. With the DragonFly IV, engineers and designers can move beyond the constraints of traditional electronics fabrication, unlocking unprecedented design flexibility and enabling a completely new way to build complex, customized electronic devices.

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