
Atrenne®
A Celestica Company
Unique Chassis Designs for UAV Programs
DESIGN › DEVELOP › DEPLOY
50 Years
1972-2022

Unique Chassis Designs for UAV Programs

Atrenne is an industry leader in designing and delivering rugged embedded computing enclosures deployed on Unmanned Aerial Vehicles (UAVs). Customers rely on us to meet the most rigorous SWaP and cooling requirements; we value their trust and welcome the challenges they bring.

UAVs Are Today's Essential Data Acquisition Platforms

It is no secret that today's defense and intelligence operations are deploying a wide range of UAVs of various sizes and characteristics. While their missions vary, these UAVs share a common task, providing a platform for sensors and embedded computing systems that capture, process, store, and transmit images and electromagnetic spectrum data.

Atrenne Houses the Critical UAV Electronics

Atrenne's role is to design and deliver the rugged chassis that house, power, monitor, and cool those sophisticated embedded systems. For more than 50 years, we have been focused on providing innovatively designed and customized chassis systems for defense electronics. Many of our biggest challenges now come from UAV programs, with requirements ranging from strict restrictions on SWaP to extremely rigorous environmental and performance specifications.

> Our design team has embraced each of these challenges, harnessing the power of engineering innovation to meet our customers' needs. Three successful systems, each one distinctly different, demonstrate Atrenne's unique capabilities.

Combining Legacy and New Technology in a Large UAV

One of our most complex designs involved combining a legacy 20-slot 3U CompactPCI system with a new, 14-slot 6U VPX system. Our customer needed both systems housed together in a single chassis within a very large UAV. Among the long list of requirements, two were notable for their difficulty:

1) We needed to optimize the temperature of a massive, two-system array of electronics during operation at high altitudes.

2) The power supply had to support the most complex set of voltages we encountered to date, each with its own unique start-up sequence.

The final design consisted of two card cages, each with its own backplane, in a single enclosure. This very large chassis included five heat exchangers; two for the CompactPCI card cage, two for the VPX card cage, and one for the customized, high-capacity power supply.

Thermal energy moves by conduction from the various electronic components into the heat exchangers, where it is transferred to jet fuel moving through the exchangers on its way to the UAV's engine. This approach is extremely effective at any altitude, while preheating the jet fuel creates a small increase in engine efficiency.

While the cooling concept is fairly straightforward, making it work at an engineering level, especially in this massive system, required extensive thermal analysis and seemingly endless software simulations.

Despite the complexity, we met our customer's development schedule. The system is currently operationally deployed in multiple areas across the globe.

A Small Form Factor System at 70,000 Feet

At the other end of the system size spectrum is a Min-ITX enclosure we recently designed, manufactured, and delivered. The biggest challenge with the system was that it had to operate in an unpressurized UAV at altitudes up to 70,000 feet. Under those conditions, it is very difficult to optimize temperatures with such densely packaged, high-performance computer processors. At such high altitudes, temperatures can drop down to -65C, therefore heaters were installed in the unit as well.

Atrenne was brought onto the program after another enclosure vendor was unable to create a viable solution. Some members of the customer's engineering team were doubting if any current technology could meet the specifications.

Our team took on the challenge and developed a modified heat pipe design. The small card with the hot processors is enclosed within a sealed container holding an inert material that exists in two phases, gas and liquid. In its liquid phase, the material moves over the processors; heat leaves the processors, turning the material into gas. At the container sidewalls, cooled by conduction contact with a metal plate attached to the UAV platform, the gas gives up its heat and returns to liquid.

The thermodynamics of the two-phase material allows this design to remove significant levels of heat from a very small surface area, regardless of operating altitude. It works so well that we've delivered over two hundred deployable units to our customer.

Multiple Systems in a Rotary Wing UAV

While SWaP is always a factor in our designs, sometimes it is the most important factor. That was the case for a program requiring three conduction-cooled, 3U VPX ATR systems in a single rotary wing UAV. The system application is coastal imaging, with a maximum operating altitude of just 10,000 feet.

For an application like this, it is not difficult to design a conduction-cooled chassis that moves heat to a platform-attached metal plate. At 10,000 feet, ambient air is fairly efficient at removing heat from the plate.

The challenge was to make a conduction-cooled chassis as light as possible because system weight had a direct effect on sustainable mission duration. Our design team used simulations to iteratively work through design versions, removing any metal mass that wasn't being used efficiently to conduct heat. Eventually, they settled on a physical configuration with the minimal amount of mass necessary to transfer heat generated during system operation.

Our final design allowed the customer to meet mission duration requirements and we've since delivered over 100 systems to this on-going program.

Engage with Atrenne

These three successful UAV programs demonstrate Atrenne's experience and expertise in meeting a wide range of real-world challenges. We are proud to deliver creatively designed, fully tested, and extremely reliable electromechanical solutions on schedule and with world-class quality.

All our innovations are complemented and enhanced by collaborating with our customers to solve problems. We see close cooperation with technology visionaries, program managers, and other engineers as key to getting the maximum value from our hardware platforms.

Engage with our team to explore how we can meet your most demanding embedded requirements and help move your programs forward.

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