CASE STUDY

Robust and Reliable Flight Test Instrumentation System Deployed on Hypersonic Test Bed

CURTISS-WRIGHT

DEFENSE SOLUTIONS

Challenge

- Particularly expensive test flights with high risk of data loss
- Extreme environmental conditions
- Small team with limited resources

Solution

- Implement layers of redundancy
- Use rugged hardware designed for the environment
- Partner with industry experts

Results

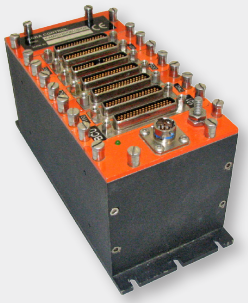
- Highly reliable acquisition, recording, and telemetering system implemented
- Low risk of data loss due to hardware failure
- Small team able to define required system

Challenge

A company that was developing their own hypersonic vehicle for use as a technology test bed wanted a flight test instrumentation (FTI), recording, and transmission system. A key criterion of the system was reliable telemetering and recording of all data. There was a higher than normal risk of data loss due to telemetry dropouts that can occur at the extreme speeds at which hypersonic aircraft fly. Additionally, although less likely, recorded data could be lost if the test article was damaged or lost. Given the high cost of hypersonic test flights, a very low-risk solution was sought, as any unanticipated additional flights could greatly impact a flight test budget.

The company had already invested in a data acquisition system for another project; however, they were concerned about its ability to perform reliably in harsher environments. This included the need to withstand more severe shock, vibration, and temperatures that equipment onboard a hypersonic vehicle would encounter compared to that experienced on a large aircraft. There was also a need to cope with the conditions found at altitudes above 100,000 ft.

A further challenge was the small size of the team. There was a lot of work required to define system requirements, setup, and validation, and receiving as much guidance and expert assistance as possible would be important to meeting challenging deadlines within budget.



KAM-500 Data Acquisition Unit

Solution

The solution chosen to improve the reliability of data delivery was two-fold. First, a system was chosen that had a proven track record of reliable data gathering and recording. The second step was to add redundancy. The data was effectively telemetered twice, once in real-time, and then again a short time later. This created two copies of the data in the one telemetry steam, where one was offset from the other by a short time. This approach has the advantage of providing a copy of the data if issues such as a telemetry dropout or data corruption occur, as one can almost immediately recover this from the offset stream. This was implemented by using a Curtiss-Wright processing module (MAT/101) in one of the data acquisition units (DAU). The module hosted custom authored software that gathers a copy of the telemetry stream and then pushes it to the encoder after a set.

For the recording system, a two-fold approach was also taken. While all the data was stored on a dedicated recording device, each DAU also stored the data it gathered to its own local device. In this case, this was trivial to implement, as the data acquisition system was modular and an integrated data recording module was readily available. This meant all the data was backed up to increase the chances of its recovery.

To meet the aircraft's challenging environmental needs, the company chose hardware that was already trusted and proven in other similar applications – in this case, Curtiss-Wright DAUs. These have been used extensively in flight test programs for decades, including onboard space launchers and hypersonic craft. Due to the anticipated need for these to operate at extreme altitudes, variants that were optimized for such conditions (by removing certain types of capacitors, for example) were selected.

Another advantage of the Curtiss-Wright solution was the wealth of experience and willingness of the sales and support network to work closely with the customer and help them with a smooth system definition and selection. There was extensive communication, advice, and training supplied to help ensure the system would perform as needed.

Results

The resulting system met the high reliability requirement by providing a redundant recording and telemetry solution. This helps to ensure that the flight test team could monitor the subset of the data being telemetered to ground in real-time while conducting more detailed analysis at a later date on the more complete data set that was recorded onboard in two locations.

The use of widely proven hardware gave confidence that mission failure, e.g., the loss of data during a flight, would not be a result of hardware malfunctioning or not performing to specifications due to the harsh environmental conditions. Thanks to the close working relationship between Curtiss-Wright and the company, the small team was able to successfully define the required FTI system needed to gather all the necessary data and work out how to best get the reliability and ruggedness needed. The partnership approach that Curtiss-Wright adopts was invaluable to helping the team move as quickly as possible with a reliable and robust system.

nREC-4000S Airborne Network Flight Recorder