

# UEI App Notes:

## Cessna Uses PowerDNA Cube To Build Compact In-flight Data Acquisition System

by Bob Judd  
Director of Marketing  
United Electronic Industries, Inc.



The High-Performance Alternative™

## Cessna™ Uses UEI PowerDNA™ Cube To Build On-board In-flight Data Acquisition System

Taking advantage of the small size and high I/O density of a PowerDNA Cube and associated I/O modules, Cessna engineers have designed, built, and tested their new Micro-Pak in-flight data acquisition system in record time. The system is initially being used to collect in-flight near-real-time data from the new Model 162 SkyCatcher™ single engine piston powered, 2-seater, all metal, high wing monoplane.

Cessna expects to produce up to 700 SkyCatchers a year at full-rate production. The aircraft will cruise at speeds up to 118 knots and will have a maximum range of 470 nautical miles. It will be capable of Visual Flight Rules/Day/Night operation.



**Figure 1. Model 162 Cessna SkyCatcher™**

### Key Design Goals

The new system was designed to achieve several key goals:

- The most critical design driver was small size — the unit had to fit into a very small space and yet accept all the analog and digital inputs (145 total)
- Another important requirement was low power draw — because of other equipment needs, limited power was available for the DAQ system
- Ability to operate within spec in an in-flight environment
- Portability and flexible re-configuration
- Capable of handling ARINC 429 messaging

### Other Benefits

- Transfer all measurement/control data via single Ethernet bus
- Compatibility with Cessna proprietary-design accessory units that perform signal conditioning tasks such as thermocouple cold junction compensation and RTD bridge completion/excitation, and also facilitate re-configuration of inputs to meet changing application needs
- Use short sensor leads for minimum noise pickup and reduced wiring costs

- Permit “off-line” calibration and testing of each DAQ system, simplifying test setup/changeover
- Achieve scan rates of up to 1000 samples/sec
- Use COTS components to reduce equipment/installation cost and to increase reliability
- Improve safety, reliability, maintainability, flexibility, and facilitate expandability

The Cessna Micro-Pak system achieves an efficient, high density, and easily configurable system that can meet the data collection requirements for many aircraft types currently being developed at Cessna.

Since the Micro-Pak unit is separable from the aircraft and portable, it can be configured, calibrated, and tested as an off-line task, independent of the aircraft in which it will be installed. It is then ready for quick setup in a plane whenever the specific type for which it is calibrated is scheduled for a test — without requiring modifications of the aircraft itself.

The requirement for on-board mounting of the data acquisition equipment mandates the use of very compact, rugged, hardware devices with high density input/output capabilities that can operate reliably in the severe environment of in-flight conditions. The on-board mounting design also means very short wire lengths (less than 10 feet) are needed between sensors and DAQ, resulting in much reduced signal noise or loss of signal strength.

In addition, the need for reliable, high speed communication between DAQ and host with minimal cabling logically leads to the use of an industry-standard Ethernet network over a single twisted-pair cable — all of which is immediately available with COTS equipment from UEI.

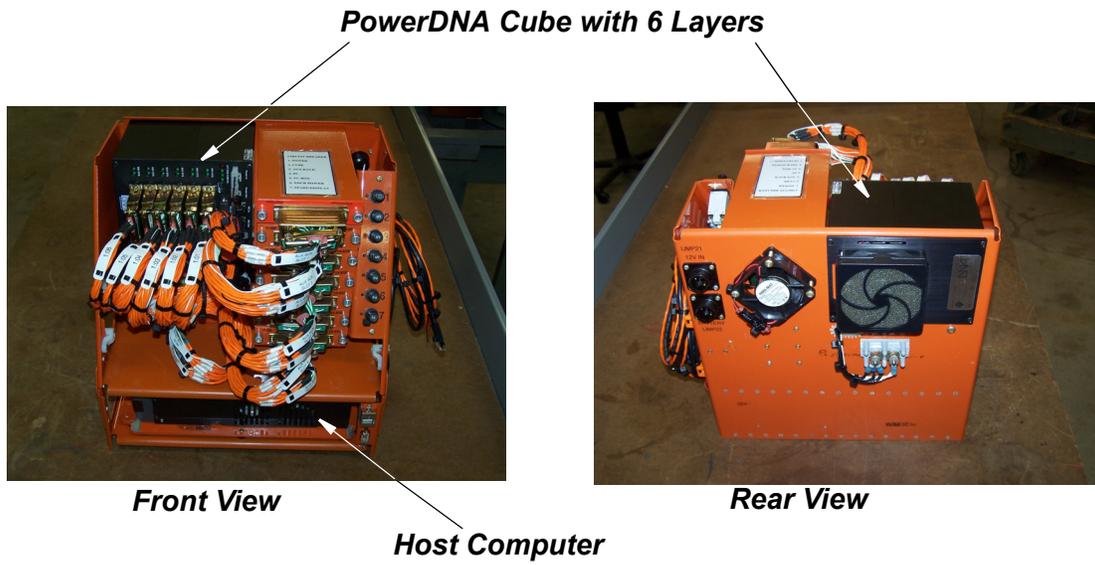
### Major DAQ System Equipment Components

As shown in **Figure 2**, the Micro-PAK data acquisition system package is an independent module that can be removed from the aircraft as a unit. It can then be configured, calibrated, and tested offline and set aside until needed. It can be quickly installed in and re-configured for any of several aircraft types and tasks without further modification and can be disconnected from other on-board equipment by simply removing the single Ethernet cable and power connection.

**Figure 2** shows a photograph of a Cessna Micro-Pak In-flight DAQ system that shows how compact the unit is when assembled and ready for mounting in a 162 SkyCatcher aircraft.



**Figure 2. Cessna Micro-Pak In-Flight DAQ System**



**Figure 3. Front and Back Views of Micro-Pak DAQ System**

### **UEI-supplied Data Acquisition System Equipment**

**Figure 4** illustrates the equipment items used in the Data Acquisition System supplied by UEI. As shown in the diagram, the heart of the DAQ system is a PPC8 PowerDNA Cube. This unit has a PowerPC CPU, SD card slot, DB-9 Serial Port, SD Card slot, several indicating LEDs, and an Ethernet interface plus 6 slots for any of over 30 different types of UEI PowerDNA I/O boards that interface with various types of sensors.

The Cube used in the Micro-Pak on-board DAQ system contains the following UEI I/O boards:

- **4 DNA-AI-207 Analog Input Boards**

Each unit accepts up to 16 differential input analog voltage inputs. It has an input range of  $\pm 10$  VDC, programmable gain selection, one 18-bit A/D per board, and a sampling rate of up to 1000 samples/sec per channel (aggregate maximum of 16 kS/s per board). It also has a dedicated CJC channel for use with thermocouple inputs and automatic offset autozero.

In the In-flight Application, the AI-207 boards accept analog inputs from several thermocouples, RTD temperature sensors, pressure, and other analog transducers. These sensors are used to measure various temperatures in the engine, aircraft, and environment, and pressures such as altitude, manifold pressure, engine oil, etc.

Cessna also uses two proprietary accessory units that provide special signal conditioning functions for thermocouples and RTDs, and that also enable quick re-configuration of sensors and I/O boards.

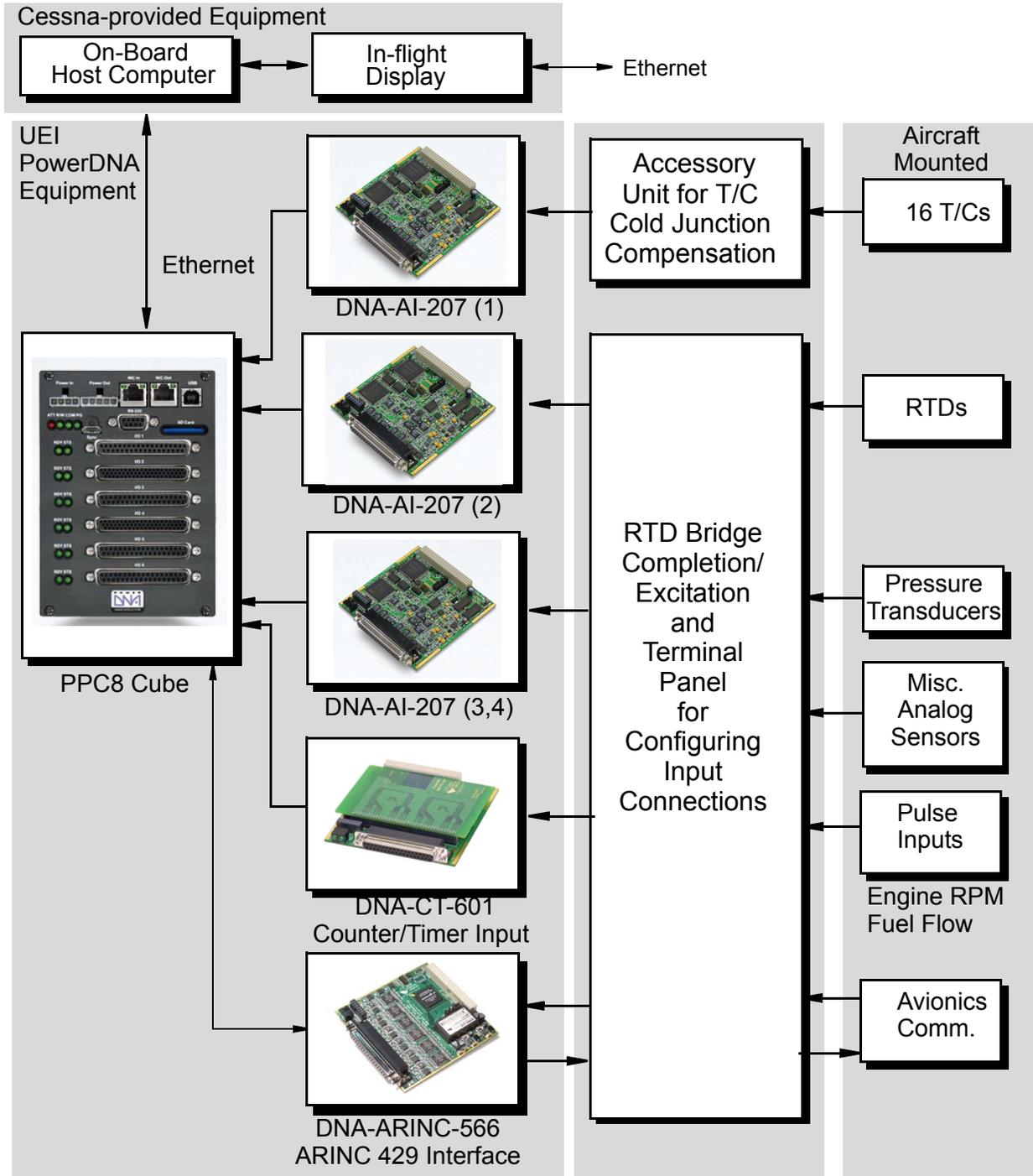
- **1 - DNA-CT-601 Counter/Timer Input Board**

This unit has 8 independent counter/timer channels that can accept pulse inputs and perform counter tasks such as event counting, width/period measurement, or quadrature encoder measurements.

In the In-flight DAQ system application, this board is used to detect pulse rates that indicate current engine RPM and fuel flow.

- **1 - DNA-ARINC-429-566 ARINC Communications Interface Board**

This board provides fully-compliant ARINC 429 messaging capability for 6 transmitter and 6 receiver channels. When the Micro-Pak system is fully implemented, this module will enable the Micro-Pak system to send and receive messages to/from remote systems and devices using standard ARINC 429 communication protocols.



**Figure 4. UEI DAQ System Equipment (All Mounted Directly in Cessna Micro-Pak DAQ)**

## **Summary**

By completing an initial in-flight test in March, 2008, Cessna successfully demonstrated proof-of-concept of the Micro-Pak DAQ system design and has made a significant advance in small aircraft on-board data collection and communication. UEI appreciates the opportunity to have contributed to its success.