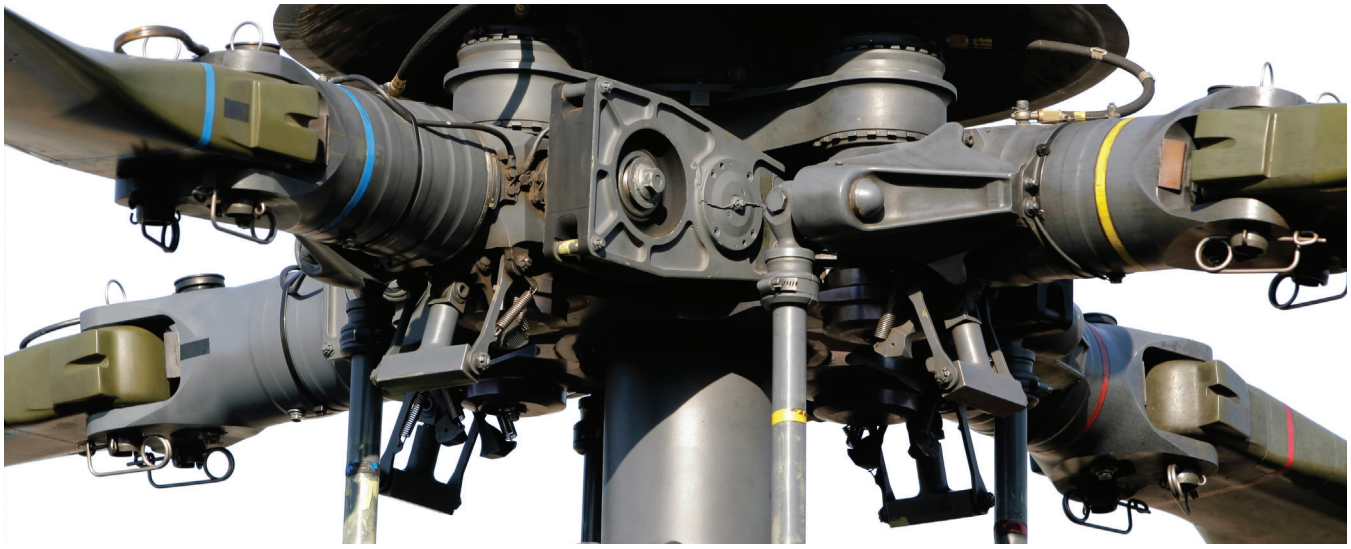
ACCUMETRICS
AN AMPHENOL COMPANY



NASA/AMES HELICOPTER ROTOR BLADE TELEMETRY SYSTEM

256 CHANNELS, HIGH BANDWIDTH, HIGH RESOLUTION

accumetrix.com | 1 518 393 2200

NASA/Ames helicopter rotor blade telemetry system (256 channels, high bandwidth, high resolution)

Industry: Aerospace, Power

Product: AT-7400 (see AT-7600 for new designs)

Parameters measured: Dynamic Pressure (Bridge-based sensors)

This application note discusses the Accumetrics AT-7400 digital telemetry system used for aerodynamic research at NASA Ames Research Center in California. The system was developed to measure dynamic rotor blade surface pressures using silicon diaphragm transducers on a full-scale UH-60 Black Hawk helicopter model.

Overview:

The AT-7400 system was developed for a Rotor Mounted Data Acquisition and Transmission System (RMDATS) to collect wind tunnel measurements at the NASA's National Full-Scale Aerodynamics Complex (NFAC). This data will lead to improved rotorcraft control techniques. The system is based on the proven technology of Accumetrics' AT-7000 Series Multi-channel Digital Telemetry System, but extends its wireless measurement capabilities with new AT-7400 architecture to meet NASA's present day needs, including:

- Dependable retrieval of high bandwidth, high resolution, and high accuracy dynamic rotor pressure sensor data from piezoresistive or other bridge type sensors.
- Selectable rotor azimuth (angle)-based or time-based sampling.
- Continuous simultaneous sampling of either 2048 samples per revolution on all 256 channels (if azimuth-based), or 10000 samples per second on each channel (if time-based).
- Flexible gain and filter frequency settings.
- Auto-balancing of transducer bridge
- PC monitoring and control of the system configuration, with post-process analysis.

Details:

The AT-7400 system consists of three subsystems:

1. The Rotating Subsystem (signal conditioning and digitizing)
2. The Transmission Subsystem (data and power coupling), and
3. The Ground Subsystem (data recovery, monitoring and analysis)

The Rotating Subsystem mounts on the top of the helicopter rotor hub and continuously conditions and digitizes the output from 256 piezoresistive pressure sensors. Signal

conditioning includes shunt calibration and auto-balancing, tenth order linear-phase anti-alias filters, and simultaneously sampled 16 bit digitizing. Data is combined into sixteen digital data streams each representing sixteen of the sensors along with associated status information. These streams are transmitted off the rotor by the Transmission Subsystem.

The Transmission Subsystem, located near the bottom of the helicopter model, includes a capacitive data coupler and mechanical sliprings (later system developments have replaced the need for sliprings; see AT-7600 for new designs). The data coupler provides a proven means of transmitting multiple streams of high speed digital sensor data off the rotor as well as the transmission to the rotor of azimuth information from an optical encoder. The sliprings are used to transmit power to the rotor and to handle low speed digital communications for control and monitoring functions.

The Ground Subsystem recovers the data transmitted from the rotor and provides monitoring and analysis capabilities. This subsystem includes sixteen receivers that recover each of the sixteen data streams. All of this data is communicated from the receivers via Ethernet to a quad-core-processor-based PC that can display system status and continuously process the data with a composite throughput of almost 60 Mbps. The PC can acquire and archive all of this data, provide real time monitoring and calibration, as well as provide FFT analysis and other post processing functions.

Summary:

The AT-7400 has an advanced set of capabilities for wireless acquisition of rotary sensor data. It provides an extensive amount of data collection capacity in a compact robust package that is capable of high centrifugal loads and severe environments. This all-digital system can collect and concentrate all data in real time in a single PC, providing impressive monitoring capabilities.

Accumetrics Associates supplies advanced digital rotor telemetry equipment to manufacturers and users of rotating machinery throughout the world. By adapting advanced aerospace technology to rotating machines, Accumetrics has become a worldwide technological leader and has established alliances with leading manufacturers of motors, generators, and turbomachinery. Accumetrics' product offerings range from highly sophisticated digital telemetry systems with hundreds of channels to simple, low-cost devices that monitor and protect rotor components.

4 channel Dynamic Acquisition Module

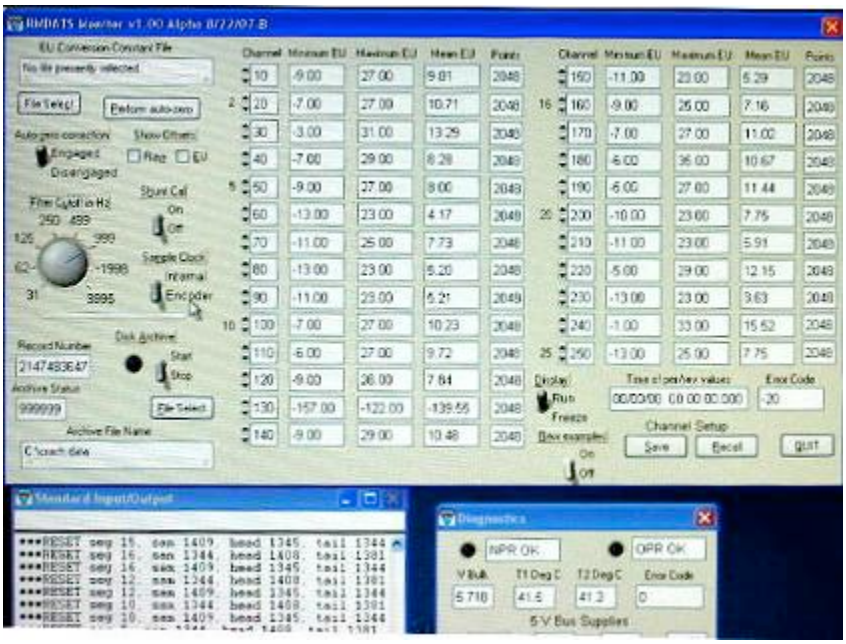
16 channels of Dynamic Acquisition Modules

16 channel Data Acquisition Segment (DAS)

RMDATS assembly (16 DAS segments; 256 dynamic channels)

Receiver module: data stream input/ output

Receiver Chassis (one of two eight channel units)



PC software—controls and
data display

Helicopter model; RMDATS telemetry
installs on top of rotor hub

ACCUMETRICS
AN AMPHENOL COMPANY

6 British American Boulevard, Suite 103-F, Latham, NY 12110 USA

accumetrix.com | telemetry@pcb.com | 888 684 0012 | +1 518 393 2200

© 2021 PCB Piezotronics - all rights reserved. PCB Piezotronics is a wholly-owned subsidiary of Amphenol Corporation. Endevco is an assumed name of PCB Piezotronics of North Carolina, Inc., which is a wholly-owned subsidiary of PCB Piezotronics, Inc. Accumetrics, Inc. and The Modal Shop, Inc. are wholly-owned subsidiaries of PCB Piezotronics, Inc. IMI Sensors and Larson Davis are Divisions of PCB Piezotronics, Inc. Except for any third party marks for which attribution is provided herein, the company names and product names used in this document may be the registered trademarks or unregistered trademarks of PCB Piezotronics, Inc., PCB Piezotronics of North Carolina, Inc. (d/b/a Endevco), The Modal Shop, Inc. or Accumetrics, Inc. Detailed trademark ownership information is available at www.pcb.com/trademarkownership.

MD-0406 revNR 0719