Mini-Accelerometer Makes a Mighty HUM

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MINI-ACCELEROMETER MAKES A MIGHTY HUM

Miniature accelerometers and the lightweight expandable rotorcraft diagnostic system combine to make a leading health and usage monitoring system

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Health and usage monitoring systems (HUMS) enable effective predictive maintenance strategies in helicopters and fixed-wing aircraft. Early HUMS were a pioneering effort that proved the benefits of the technology. But these early systems came at a high cost in dollars and weight added to the aircraft. These disadvantages limited the implementation of front-line strategies to reduce maintenance costs.

Next-generation HUMS provide more capabilities at a lower cost and weight. Modern HUMS improve safety by alerting maintenance personnel to drivetrain health issues and reduce costs by helping to eliminate precautionary landings and minimizing unscheduled downtime. Additionally, combining these features with flight data to support Safety Management Systems leads to reduced insurance costs.

HUMS enable the recording of flight conditions in excess of approved flight parameters, and they give the ability to check aircraft health status during and after each flight. Typical helicopter HUMS applications include rotor track and balance, shaft balance, monitoring of transmission and engine vibration, and bearing diagnostics.

Modern HUMS comprise a data acquisition device with an onboard processor and high-quality measurement sensors. One leading example is HUMS-supplier RMCI's expandable rotorcraft diagnostic system (XRDS), which measures data using piezoelectric ICP accelerometers, such as PCB Piezotronics' (PCB) Model 355A44 case isolated high-frequency design.

ICP piezoelectric accelerometer technology is a widely accepted standard used in HUMS. These accelerometers are not only easy to adapt to qualification requirements such as MIL-STD-810 and DO-160, they are also optimized for the performance and reliability requirements and packaging particulars of the aircraft platform. PCB developed ICP technology in the mid-1960s, and it has grown into an industry standard. The more generic description of this technology is 'integrated electronic piezoelectric' (IEPE).

1 // PCB's HUMS accelerometer model 355A44 and RMCI's easy-mount method

2 // RMCI's state-of-the-art expandable rotorcraft diagnostic system (XRDS) mounted in the cockpit of a Sikorsky helicopter

The Model 355A44 accelerometer incorporates a microelectronic amplifier that converts the high-impedance charge output from the piezoelectric sensing element into a low-impedance voltage signal. Using hermetic packaging, the high-impedance circuitry is sealed and electrically case-isolated inside the accelerometer. This approach provides excellent performance in the high electromagnetic interference environment common to helicopters. These sensors also have the ability to pass the various environmental and lightning category tests of DO-160.

HUMS accelerometer specifications differ depending upon the particular airframe and desired mounting location. Typical considerations for accelerometer selection include a high resonant frequency for rotating part diagnostics, as well as accurate low-frequency phase data for rotor track and balance. PCB's Model 355A44 features an internal shear mode element that limits strain from irregular mounting surfaces, uses reliable hermetic

"PIEZOELECTRIC ACCELEROMETER TECHNOLOGY IS A WIDELY ACCEPTED STANDARD USED IN HUMS"

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connectors, and includes a cable that is oil-resistant. The accelerometer also features a single-bolt mount that enables easy installation and cable alignment. This mount is ideal for difficult installation locations, such as on a helicopter transmission. RMCI's through-hole easy-mount solution provides for a safety wire attachment that secures the accelerometer for flight operations (Figure 1). The PCB accelerometer is powered directly by RMCI's XRDS product.

HIGH QUALITY DATA CAPTURE

RMCI's latest HUMS (Figure 2) exceeds the capabilities of legacy on-aircraft monitoring systems. Leveraging PCB's new, advanced sensor and RMCI's patent-pending sensor mounting approach, the XRDS hardware is capable of capturing high-quality vibration data from critical aircraft components.

The XRDS HUMS includes powerful ground station software. The software provides superior analysis functionality to extract actionable information from a wide variety of data. The total XRDS system provides mechanical diagnostics, flight data monitoring (FDM) with regime recognition, and advanced rotor track and balance capabilities. The software architecture supports the integration of performance data and custom, platform-specific algorithms and methods for advanced FDM and flight operations quality assurance. The XRDS solution is certified, commercially available, and currently flying on nine different aircraft models, including both helicopter and fixed-wing platforms.

The RMCI hardware and software system acquires various types of flight, performance and health data. The system then processes the data to produce metrics and maintenance actions to provide the user with timely and accurate feedback via a single interface.

The XRDS solution provides operators with the maximum benefit from aircraft data – at a fraction of the weight and cost of legacy systems. \\

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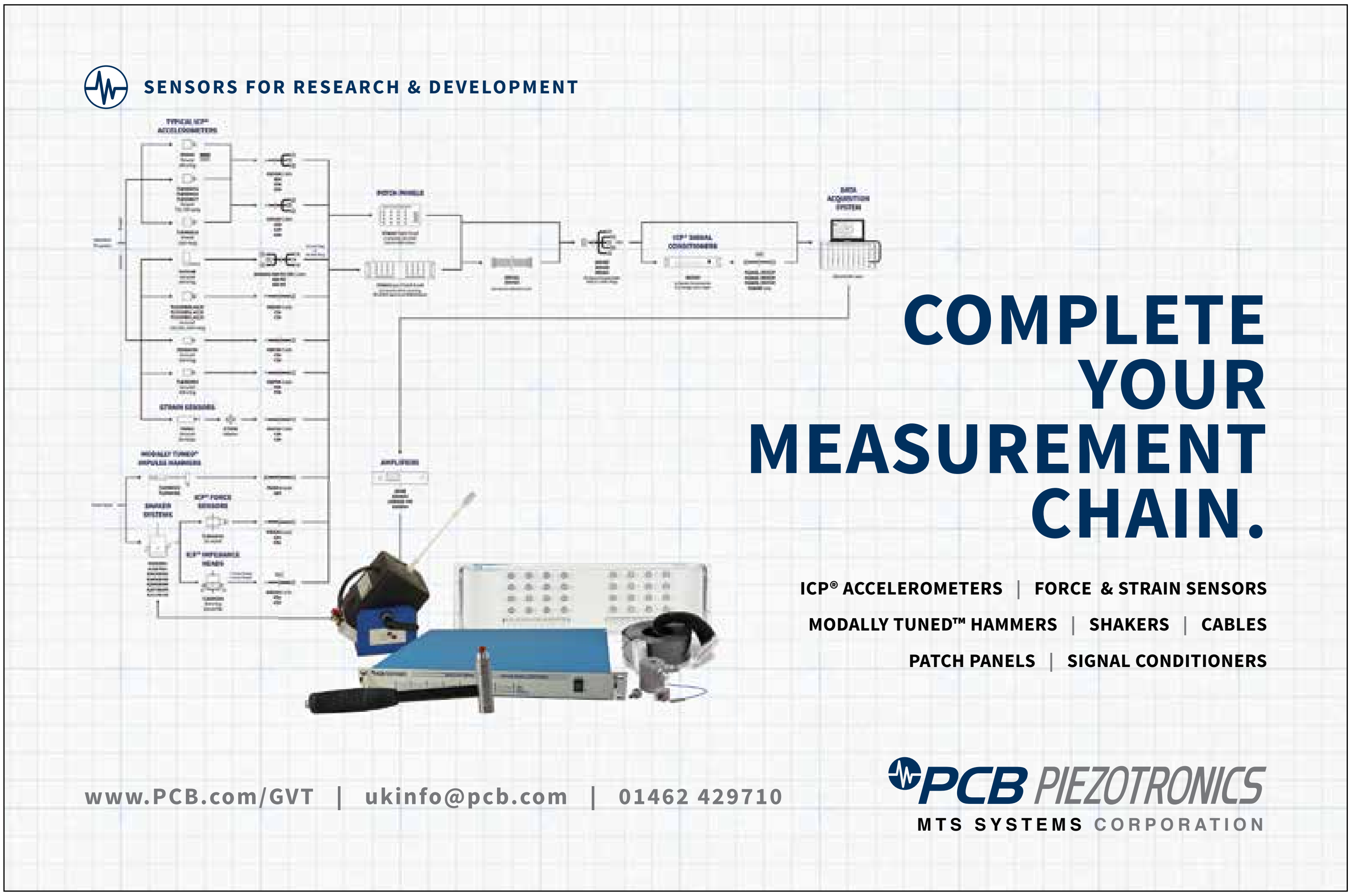

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