

Data Acquisition

The data acquisition system can store up to 130 different channels including analog data from the meteorological sensors and ARINC 429 data from the avionics. Additional user data can also be stored on this system. The standard data acquisition frequency is 10 Hz, data used for turbulence investigations are sampled with 100Hz.

The quicklook onboard offers graphic and alphanumeric displays which are configured according to the users specific needs.

Data processing can be done in the field, the **final** 1 second time series and quicklook plots of meteorological parameters are available 3-4 hours after landing.

Aircraft Position, Velocity and Attitude

The Honeywell Laserref Inertial Reference System (IRS) uses ring laser gyros and servo accelerometers to measure horizontal, vertical and angular acceleration in the Cartesian aircraft reference system. The IRS internal computer determines aircraft position, attitude and velocity from the measured accelerations using advanced Kalman filtering techniques to reduce drift errors from signal integration.

The Flight Management Computer (FMC) uses IRS, GPS and other navigation system to calculate a high precision blended position.

Output from the IRS and FMC is used in calculations of aircraft motion and wind velocities.

Static Pressure

The Rosemount Model 1501 is a digital solid state sensor providing low frequency high precision static pressure measurements. The principal of operation is a mechanical vibrating element controlled by an integral electronic oscillator to output a frequency proportional to the applied pressure. Digitized data are output and recorded via ARINC 429 bus.

The Rosemount Model 1201F2 is an analog capacitive sensor providing high frequency (100 Hz) static pressure measurements. The principal of operation is the capacitive measurement of the deflection of a diaphragm against a reference vacuum.

The static pressure port is part of the deiced Rosemount five hole probe located at the tip of the nose boom.

The measured static pressure has to be corrected for the static pressure error caused by the airflow disturbance of the aircraft . This error was determined by extensive in-flight calibration using a trailing cone reference measurement system.

All pressure sensors are housed in a temperature stabilized box to minimize temperature drift errors of the sensors and electronics.

Dynamic Pressure

The Rosemount Model 1221F2 is an analog capacitive sensor providing high frequency (100 Hz) differential pressure measurements. The principal of operation is the capacitive measurement of the bi-directional deflection of a diaphragm against a reference pressure port.

The dynamic pressure port is part of the deiced Rosemount five hole probe located at the tip of the nose boom. As reference pressure port the static pressure port of the five hole probe is used.

All pressure sensors are housed in a temperature stabilized box to minimize temperature drift errors of the sensors and electronics.

Temperature

Two deiced Rosemount Total Air Temperature sensor housings BW102 are used for temperature measurement. As sensing elements a fast open wire PT100 element and a slow encapsulated PT100 element are placed inside the housings.

The principal of operation is the measurement of the temperature dependent resistance of a platinum wire. To avoid errors by the airflow disturbance of the aircraft the Total Air Temperature is measured. Total Air Temperature is the maximum temperature attainable by air when brought to rest adiabatically. The inability of achieving a 100% adiabatic compression results in a recovery correction which has to be applied to the calculation of the Static Air Temperature of the undisturbed air from the measured temperature.

Since the sensing elements can get wet from hydrometeors it will not give an accurate measurement in cloud or precipitation.

Flow Angle Sensor

A Rosemount 858 flow angle sensor is used to measure the 3-D airflow. The principal of operation is sensing differential pressures across horizontally and vertically aligned ports positioned on a hemispherical head. At zero angle of attack/sideslip all ports sense equal pressures. As the aircraft rotates to a positive angle of attack/sideslip a differential pressure is sensed across the vertical/horizontal pressure port.

The deiced flow angle sensor (five hole probe) is mounted at the tip of the nose boom.

The measurements of the flow angle sensor are used to calculate the 3-D wind vector.

Dew Point and Humidity

For water vapor measurements three different instruments are used: a commercial aircraft dew point hygrometer (GE 1011B, General Eastern), a slightly modified capacitive sensor (Humicap-H[®], Vaisala) and a Lyman-alpha absorption instrument (Buck Research, Boulder).

The General Eastern 1011B is a dew/frost point hygrometer developed for aircraft application. A special reverse flow inlet is used for particle separation. The principal of operation is the detection and control of a thin layer of dew/frost on a mirror surface by optical methods and simultaneous temperature measurement of the mirror surface. The mirror temperature is controlled by a 2 stage peltier element.

Due to its slow time response and limited range the dew/frost point hygrometer is mainly used for consistency check during takeoff and landing.

The Vaisala HMP230 is a capacitive humidity sensor. The principal of operation is the measurement of the humidity dependent capacity of a polymer coated capacitor.

The HMP230 shows excellent long term stability and good time response in the lower troposphere. Time response degrades with decreasing temperatures. The sensor is placed in a pressure tight flow channel together with the Lyman-alpha instrument. A modified Rosemount BW102 Total Air Temperature housing is used as inlet. Since the HMP230 sensor measures relative humidity an adiabatic compression correction has to be applied similar to the Total Air Temperature sensor.

The Lyman-alpha absorption hygrometer is a fast (100 Hz) humidity sensor. The principal of operation is the measurement of absorption of water vapor molecules at 121 nm wavelength.

Due to its fast response time of a few milliseconds and wide sensitivity range the data of the Lyman-alpha instrument are used whenever possible. The absorption signal has to be corrected for O₂ interference and long term lamp intensity fluctuation. Therefore intensive laboratory and in-flight calibration is performed. The sensor is placed in a pressure tight flow channel together with the Vaisala sensor. A modified Rosemount BW102 Total Air Temperature housing is used as inlet.

Altitude

Radar altimeter. The principal of operation is the 'time of flight' measurement of a series of RF pulses emitted by an antenna aboard the aircraft being reflected

off the ground. The radar altimeter is intentionally thought as supporting system during landing and is limited in the height range from 0-xxx m.

Remote Sensing (optional)

The Heitronics Model KT19.85 is used to remotely measure surface or cloud top temperature in the range of -50 to 200 °C. The principal of operation is the pyroelectric detection of infrared radiation emitted by the earth referenced to an internal black body source. The spectral range of the detector is 9.6 to 11.5 μm .

Radiation (optional)

Eppley Model Pyranometer

Measures global radiation (direct solar radiation and diffuse solar radiation) using a wirewound plated thermopile. The PSP has a black sensor protected by two precision ground, polished hemispheres. The wavelength range is 0.285-2.8 μm . The direct solar radiation has to be attitude corrected.

Eppley Model PIR Pyrgeometer

Measures global incoming or outgoing longwave terrestrial radiation using a wirewound plated thermopile. The wavelength range is 3.5-50 μm . The dome temperature and body temperature are recorded and used to correct the measured raw ir radiation.

DLR Model PIR Pyrgeometer

Modified Eppley Pyrgeometer, measures global incoming or outgoing longwave terrestrial radiation using a coated film thermopile. The wavelength range is 3.5-50 μm . The dome temperature and body temperature are recorded and used to correct the measured raw ir radiation.