AB139 HUMS Kit

HUMS Kit main functions:

- Transmission Vibration Monitoring (TVM);
- Usage Monitoring (UM) encompassing:
  - Logbook data
  - Transmission Usage Monitoring (TUM);
  - Structural Usage Monitoring (SUM);
- Rotor Track and Balance (RTB).
AB139 HUMS Layout

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quant.</th>
<th>Function</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DAU</td>
<td>1</td>
<td>HUMS</td>
<td>Avionic Bay</td>
</tr>
<tr>
<td>2</td>
<td>CDU/DTD</td>
<td>1</td>
<td>HUMS</td>
<td>Cockpit</td>
</tr>
<tr>
<td>3</td>
<td>Accelerometer</td>
<td>11</td>
<td>TVM</td>
<td>Drive System</td>
</tr>
<tr>
<td>4</td>
<td>Speed sensor</td>
<td>1</td>
<td>TVM</td>
<td>Drive System</td>
</tr>
<tr>
<td>5</td>
<td>Accelerometer</td>
<td>2</td>
<td>RTB MR</td>
<td>Cockpit floor</td>
</tr>
<tr>
<td>6</td>
<td>Accelerometer</td>
<td>2</td>
<td>RTB TR</td>
<td>Tail Gearbox</td>
</tr>
<tr>
<td>7</td>
<td>OBT</td>
<td>1</td>
<td>RTB MR</td>
<td>Cabin roof</td>
</tr>
<tr>
<td>8</td>
<td>Magnetic sensor</td>
<td>1</td>
<td>RTB MR</td>
<td>Swashplate</td>
</tr>
<tr>
<td>9</td>
<td>Magnetic sensor</td>
<td>1</td>
<td>RTB TR</td>
<td>Tail Gearbox</td>
</tr>
<tr>
<td>10</td>
<td>G factor Accelerometer</td>
<td>1</td>
<td>Usage</td>
<td>Cabin floor</td>
</tr>
</tbody>
</table>
HUMS Kit Main LRUs

Cockpit Display Unit/
Data Transfer Unit

Data Acquisition Unit
HUMS Kit Sensors

- 11 TVM Accelerometers
- 4 RTB Accelerometers
- 1 Tail Rotor Magnetic sensor
- 1 Load Factor Accelerometer
- 2 DTD (PCMCIA card)
Main Rotor Tracker
HGS overview

HGS provides functions to:

- Initialise usage values for the OBS via the DTD
- Download measurement data from the DTD
- Store results into database
- Display of individual aircraft and fleet data
- Calculate effective usage of components
- Calculate rotor adjustments
- Maintain aircraft build information
- Manage the database
Transmission Vibration Monitoring

- Engine to main gearbox input drive shafts
- Main gearbox shafts and gears
- Main gearbox bearings
- Accessory gears shafts and bearings
- Tail rotor drive shaft and hangar bearings
- Intermediate and tail gearbox
- Oil fan monitoring
A10 and A11 are on 2nd stage of Engine Inputs (not in scheme)
TVM Processing on HGS

- Download TVM Exceedances from the DTD
- Download TVM Component results from the DTD
- Download raw vibration data
- Individual Aircraft Summary
- TVM Trend at Component level
- Spectral Vibration Display
- Harmonic Vibration Display
Usage Monitoring – Logbook Data

- Engines
  - Engine starts
  - One engine ground idle
  - Both engines stopped
  - Engine running time

- Rotors
  - Rotor turning time
  - Operation Time
  - Rotor start/stop

- Ground/Air transition
  - Flight Time
  - Landing count
  - GAG cycle
Transmission Usage Monitoring

- Monitoring occurs from Operation Start to Operation End
- Two type of data collected and recorded are:
  - TUM histogram record which is updated throughout the operation and recorded at the end of the operation
  - TUM event records which are recorded out to the DTD each time a TUM event has been detected
- Data recorded in TUM histogram record consists of:
  - Time (over the entire operation) spent in each defined band for the following histograms:
    - Rotor Speed (9 bands)
    - Engine 1 Torque (50 bands)
    - Engine 2 Torque (50 bands)
    - Main Rotor Torque (50 bands)
    - Tail Rotor Torque (50 bands)
Structural Usage Monitoring

- SUM is based on Flight Condition Recognition (FCR) algorithm.
- Monitoring occurs from Operation Start to Operation End
- Data collected and recorded are:
  - Time History of 12 flight parameters at 8 Hz
  - SUM histogram based on 46 Flight Condition Types
  - Flight Condition History where each Flight Condition record consists of:
    - Time of day and Date the condition started
    - Flight Condition duration
    - Average value over the regime for the following parameters:
      - Pitch Rate
      - Roll Rate
      - Vertical Speed
      - Radar Altitude
      - Engine 1 Torque
      - Engine 2 Torque
      - Normal Acceleration
      - Normal Jerk
      - Normal Airspeed
      - True Airspeed
      - Density Altitude
      - Roll Rate
      - Pitch Attitude
      - Longitudinal Acceleration
TUM & SUM HGS Processing

- Data download from the DTD
- TUM Events and SUM Parameters Time History Display
- Calculation of Usage Rate & estimated Available Life for each monitored component
- Display of Flight Spectrum and Torque Spectrum
- SUM Regime Summary
- Component Usage Display
- Component Usage Trend
- Usage Threshold Alert
Rotor Track & Balance

- Manual Data Acquisition
  - Initiated by crew via the CDU/DTU
  - Tracker Fitted
  - Rotor Track and Balance
  - 5 Demands (Idle, FPOG, Hover, Cruise & VNE)
  - 1R & 1T Target Measurements
  - Plus 2 Event Logs

- Automatic Data Acquisition
  - Initiated Flight Regime Detection via the EDPU
  - No Tracker
  - Rotor Tuning Only
  - 5 Regimes (FPOG, Hover, Cruise, VNE & Unrecognised)
  - 1R & 1T Target Measurements
RTB – HGS Processing

- Individual Aircraft Summary
- RTB Display
- Spectral Vibration Display
- Harmonic Vibration Display
- Track & Lag Display
- Vibration Trend
- Track & Lag Trend
DTD Storage Approach

- DTD consists of a 384 Mbyte flash card
- Basic format is DOS
  - DTD can be formatted with a standard PC running Windows
  - Files can be viewed, deleted, moved, etc. with a standard PC running Windows
- HGS normally used to initialize the card for HUMS use
- Initialization consists of writing a number of standard files to the DTD.
- User files can be managed individually as to whether or not they wrap when full of data
- Files will be oversized to handle more than 25 hours of data