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D-0007
BOM (Broadcasting Outer Module) Company Standards

LEVL AVIATION
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BOM (Broadcasting Outer Module) Company Standards					
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AMENDMENT RECORD

This procedure is reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or mission is given below:

Revision No.	Date	Responsable Person	Description of Change
1	12/6/2017		Initial release
2	06/15/2022	Maureen Magner	Battery Specs Update
3	6/23/2023	Maureen Magner	Technical Specs Updated

Warranty

Levil Aviation warrants this product to the original purchaser to be free from defects in material and workmanship for a period of one year from the date of the original purchase. The following are not covered: software, damage resulting from accident, neglect, misuse, fire, or flood, improper voltage supply or failure to follow operational guidelines supplied with this product. Extended warranty is available for purchase on our website.

Please register your product online at: https://shop.levil.com/pages/warranty-registration

IN NO EVENT, SHALL LEVIL AVIATION BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MIUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Table of Contents

1. Compliance and Use

The BOM meets the design and performance requirements of 14 CFR 21.137 and is produced under a quality system that satisfies the requirements of the FAA Policy number PS-AIR-21.8-1602. The BOM is not TSO'd. With the NORSEE Certification, the BOM is approved for design and production for Aircraft Certified under 14 CFR 23 or earlier regulations. The BOM's installation will be approved by a certified mechanic using the installation guidelines provided by Levil Aviation.

2. Technical Specifications

Specification	Description	Industry Standards
Wind Speed Requirements	Low Speed 65 kt. (Min); 120 kt. (Max) High Speed 100 kt. (Min); 210 kt. (Max)	
Temperature Range	-20 °C to 60 °C	
Altitude (Absolute Pressure)	Max: 30,000 ft.; 24-bit resolution; Pressure Transducer range: 260 – 1260 hPa.	Pressure Transducer: ISO 9001
Air Speed (Pressure Differential)	Range: 32-320 kt.; 14-bit resolution	Pressure Transducer: ISO 9001
Angle of Attack	14-bit resolution	Pressure Transducer: ISO 9001; ASTM F3011-13
AHRS	Max. Rotation Rate: 500 °/sec; Roll/Pitch accuracy: ± 3°; Magnetic Heading accuracy: ± 4°	
WI-FI	Qualified 2.4-GHz IEEE 802.11b/g transceiver	FCC, CE, IC, and RoHS

Battery	-3.7V, 2600mAh, 9.62Wh; Over charge and discharge protection with a charging manager; 2 Amp fast blown fuse protected; Battery life ≤ 4 Hours (ADS-B Receiver ON), ≤ 5 Hours (ADS-B Receiver OFF)	UL1642
Turbine	Operation Voltage: 12 – 50 VDC; Output Current: 0.48 (Max. 0.72) A; Output Power: 5.76 (Max. 25) W; Speed: 32,000 R.P.M.; Insulation Type: UL: Class A; Life Expectance: 2,000 Hours continuous operation at 40°C with 15 ~ 65 %RH	
GPS	Uses NAVSTAR GPS L1 C/A signal; WASS Compatible; 48 verification channel GPS receiver; Format Selectable Output Data: NMEA and OSP™	CSR/SiRF™ SiRFStar IV™
GPS Antenna	Passive Antenna; 1575 MHz $\pm 3\ MHz$ center frequency	RoHS
ADS-B Receiver Transmission Frequency	978/1090 MHz (Dual Band)	RTCA 282-B
Weight	370 g	
Length	250 mm	
Outer Diameter	48 mm	
Turbine Diameter	54 mm	
Patent	No. US 9,776,730 B1	

Table 1. Technical Specifications

3. Design Specifications

3.1 Material Requirements

The outer housing of the BOM must use UV resistant and non-permeable materials including:

a. Delrin and Aluminum-Alloy 6061.

b. Assembly screws for the outer housing must be stainless steel.

3.2 Design Requirement

All systems of the BOM must meet all the design parameters as set by the different system's operational requirements and/or drawing specifications. Engineering drawings must include the information necessary to duplicate each product to comply with this standard.

4. Flammability Testing Requirements

The material of the BOM, produced under this design standard, must comply with the requirements of Civil Aeronautics Regulation 3, definition of flame resistance, when tested as a complete assembly.

5. Structural Strength Requirement

The structure must be able to sustain 6G pull test in the vertical axis when installed in test fixture representative of an aircraft panel. The 6G requirement is based on the mass of the unit for which the part is intended to accommodate.

6. Software Validation

Software/Hardware integration shall be designed and tested using ASTM F3153-15 practices and reports.

7. Electronic Emissions

Wi-Fi equipment has been tested and found to comply with the limits for a Class digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to the radio communications. However, there are no guarantees that interference will not occur in a particular installation. The Wi-Fi transceiver must have a MAX of 10 mW output power.

8. ADS-B IN

Unit meets the performance requirements for the FAA TSO-C154C for sections appropriate for ADS-B In operation. This will include:

- RTCA DO-282B (Section 2.2.8, 2.2.9 and 2.2.10) for 978 MHz receiver.

9. Company Specifications

The BOM combines different avionic systems into one module and sends the information via Wi-Fi to a tablet. All systems of the BOM are individually tested to meet certain performance criteria and are then combined and tested as a whole system. The following diagram shows the different systems that make up the BOM and how they all integrate with one another.

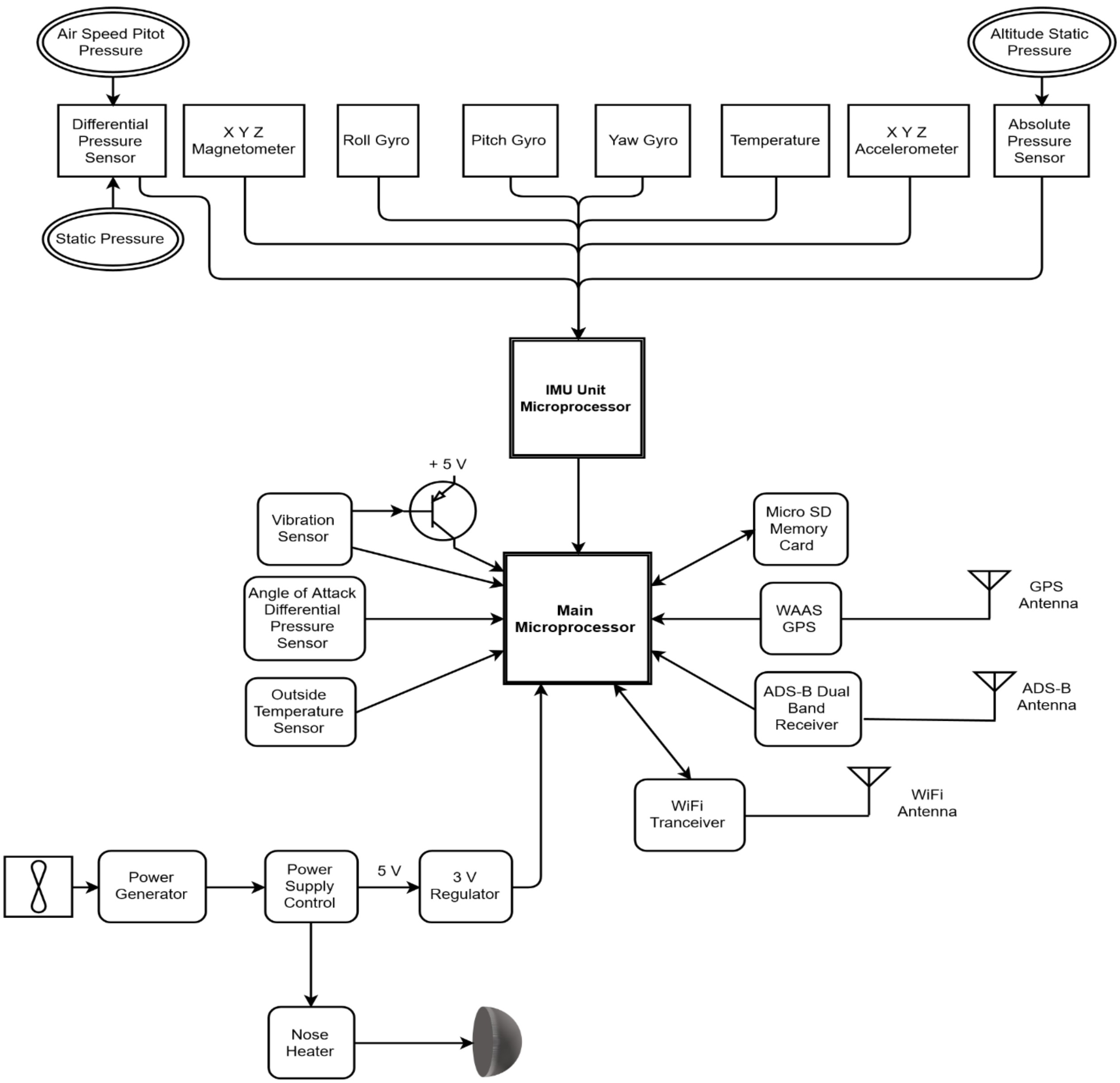

Figure 1. BOM System Integration Diagram

9.1 AD-AHRS

The AHRS Micro is an electronic device developed by Levil Aviation which consists of sensors on three axes that provide attitude and heading information and air data for an aircraft. It is designed and manufactured by Levil Aviation, guaranteeing each individual board is calibrated to withstand extreme environmental conditions (turbulence, humidity, high temperatures, etc.) The AHRS information is sent by the IMU Microprocessor to the BOM's main Microprocessor which is then transmitted to a tablet via Wi-Fi and displayed accordingly. Because of the AHRS component, the BOM must be aligned during installation to display accurate Attitude with respect to the aircraft's straight and level flight. The following listed performance requirements must be met by the AHRS system:

9.1.1 Temperature Calibration

AHRS are individually calibrated in a wide range of temperatures so that their performance is not affected by extreme temperatures during flight. The calibration process ranges from -10°C to 80°C. Temperature matrixes are computed, and a plot of the temperature behavior of the gyros and accelerometers is analyzed for linearity. Figure xxx. Shows an example of a temperature calibration plot; each color represents a gyro or accelerometer.

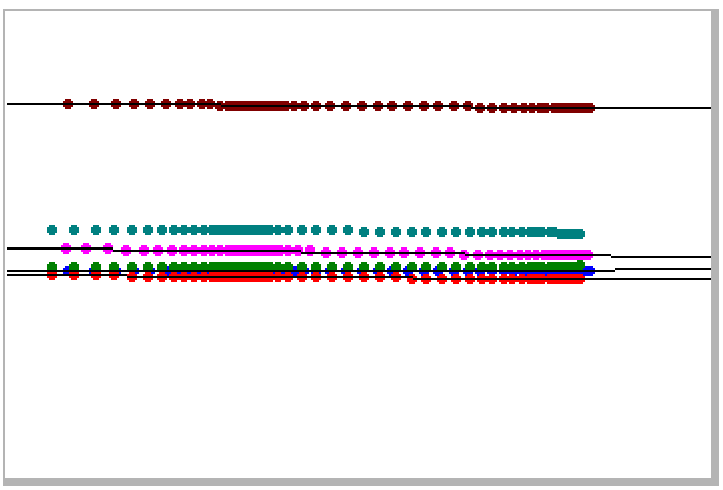

Figure 2. Temperature Calibration plot example

9.1.2 Magnetic Heading

The AHRS uses a 3-axis magnetometer to calculate magnetic heading (even when airplane is up-side-down). The magnetometer is calibrated individually using a Helmholtz Coil. Magnetic readings are taken, values analyzed for accuracy and matrixes computed and sent to the IMU microprocessor. The Magnetic heading is tested for accuracy after calibration. An AHRS compass is considered to Fail if the compass is off by ±10° from the true value.

Just like a compass, the magnetometer inside the AHRS is sensitive to ferrous metals, or magnetic fields produced by Landing Lights Wiring etc. Placing the AHRS close to a magnetic compass is not a good idea, as this would affect the readout on both the magnetic compass and the AHRS inside the BOM. As a rule of thumb, one foot is recommended. However, this is not always possible, thus, the AHRS has internal algorithms that "learn" your aircraft configuration as you fly. The heading might be off during initialization, but as soon as the airplane starts turning, the AHRS starts compensating for any errors.

Be aware that this is magnetic heading and there will always be a magnetic deviation (declination) to true north that varies according to your latitude and longitude. If you are comparing the heading output on the AHRS to a GPS source, take into consideration that GPS may be reporting "True Track". You can add/subtract the corresponding magnetic deviation at your current location to obtain True Heading.

9.1.3 Roll, Pitch and Yaw

The AHRS has three MEMs gyros and a 3-axis accelerometer that measures your airplane's attitude. When the AHRS is turned on, it requires a two-minute interval to calibrate itself. You might see the horizon shifting ± 5 °during this self-calibration process and a flashing behavior of the horizon. To achieve better performance, it is recommended that the aircraft stays in a steady position (or taxing) during this two-minute period. During flight, the instrument will calculate the aircraft's attitude based on accelerations and rotation rates and you can expect the horizon to have an accuracy of ± 3 ° degrees. Fast airplanes such as Jets and airlines with high acceleration rates at take-off and landings, may experience a pitch up error right after take-off until the airplane stabilizes. In this situation, it is recommended to perform a + 15 ° bank turn to the left for 10 seconds, then a + 15 ° bank turn to the right at the beginning of the flight. The instrument will operate in a full 360 degrees of turn and may be used in light aerobatic type maneuvers. The gyros are rated for 500 °/sec max turn rates. When the maximum turn rate is exceeded, the AHRS is temporarily disabled. This is indicated by a flashing behavior (pitch goes from 0 to 90 degrees, and roll from 0 to 180 degrees). The instrument automatically resets itself within 4 seconds if kept steady during that time, otherwise the instrument will recover within 15-40 seconds depending on the amount of error induced during recovery. This will not cause any harm to the instrument. Note: Moving the instrument with your hand will most likely trigger the excess rotation alarm unless simulating smooth aircraft behavior.

9.1.4 Indicated Airspeed and Altitude

The BOM has pressure transducers installed, one for static pressure and another one for the dynamic pressure. Having access to pitot-static information the AHRS can transmit Indicated Airspeed and Pressure altitude at 29.92 inHg. To adjust the altitude due to barometric pressure changes, your navigation software of choice will allow you to input the altimeter setting at your current location.

Both the differential and absolute pressure sensors are calibrated using a previously calibrated and tested pressure sensor as a reference. The altitude is calibrated from sea level to 18,000 ft. and the deviation after calibration cannot be more than ±40 ft. The Air Speed is calibrated from 0 to 320 kt. and the deviation after calibration cannot be more than ±3 kt.

9.2 Vibration Sensor

The sensor is designed to aid the BOM determine when to wake up. The BOM is designed to turn ON with power input from the turbine, but since this process requires a minimum speed of 60Kts, the BOM will not start until after takeoff. For this reason, the Vibration sensor is meant to recognize an “Engine ON” versus “Engine OFF” state based on vibrations caused by propeller’s RPM. When “Engine ON”, the BOM will initialize all its systems using power from an internal battery. If an “Engine OFF” state is measured, and there is no power provided by the turbine, the BOM will shut off after 15 seconds. If the battery is not charged, the vibration sensor will not work, thus The Vibration sensor is not a guaranteed method for power ON and is meant only for enhancing the BOM, and NOT as a primary switch ON feature.

9.3 Angle of Attack

The AOA is based on differential pressure sensor and indicated airspeed. The angle of attack requires user calibration to set the “near stall” point and the “max L/D” point of the aircraft. The AOA data will be disabled until these two values are calibrated. This calibration is performed using Levil’s dedicated Levil Aviation App on a iPad. To measure near stall point, the pilot must fly at a minimum controllable airspeed and “SET NEAR STALL” using the App interface. To measure the “max L/D” point, the pilot must fly at the Speed that will allow for the best rate of climb (Vy), and “SET MAX L/D” using the App interface. Once the two calibration points have been determined, the AOA gauge will be enabled.

9.4 Micro SD Memory Card

There is an internal memory designed to record telemetry data during flight, thus the BOM can be used as a “Black Box”. The internal memory is not meant to be removable. The stored data is instead broadcasted via Wi-Fi upon commands. The user can request a list of stored files and/or the contents of a specific file. The Filename must contain the unique serial number, date and time for the flight. Data can be stored at a rate of 1Hz or 5Hz (user selectable). Data inside the file includes but is not limited to Identification (Call sign), GPS telemetry (track, speed altitude etc.) AHRS telemetry, pressure data, error messages, etc.

9.5 Position Source (GPS or GLONASS)

A WAAS capable position source is standard in the BOM. The antenna is located in the front, right behind the Heated Nose cone. Thus, the BOM's nose requires view to the satellites to obtain a position fix. Installations that require the BOM to be located under the wing, must be aware of degraded GPS reception due to Aluminum structures for example. It is recommended to follow installation procedures as suggested for the type of aircraft. If a valid fix is obtained, information from GPS/GLONASS source is broadcasted over Wi-Fi and stored in memory, including Latitude, Longitude, Geometric Altitude, Ground Speed, Track, Climb Rate UTC time. If the GPS/GLONASS source is not able to get a position fix, the BOM will continue to stream primary flight data (i.e. AHRS) since other systems are independent from GPS.

9.6 ADS-B Dual Band Receiver

The BOM is equipped with a dual band ADS-B Receiver. The ADS-B received can capture the following data:

- Flight Information Services–Broadcast (FIS-B): Is the ground-to-air broadcast of meteorological and aeronautical information. FIS-B allows the pilot to passively collect and display real-time weather and other operational data such as METAR, TAF, NOTAMs etc.
- Traffic Information Services-Broadcast (TIS-B): Is the broadcast of traffic information to ADS-B-equipped aircraft from ADS-B ground based transceivers. For an aircraft to receive TIS-B services, the following conditions must exist:
    - Your aircraft (or an aircraft within range) must be equipped with an ADS-B OUT
    - The aircraft must fly within the coverage volume of a compatible ground station that is configured for TIS-B uplinks.
    - The target aircraft must be within the coverage of, and detected by, at least one of the ATC radars serving the ground station in use.
- Air-To-Air Traffic: Is the traffic broadcasted by other ADS-B Out equipped aircraft on 978 MHz

If you or somebody close to you is equipped with ADS-B out, your chances of seeing the traffic is greatly improved. The second band (1090 MHz) can detect Mode-S transponders with the extended squitter.

9.7 Wireless Transmission

The BOM has an internal Wi-Fi transceiver that acts as an access point. You may connect as many as 5 devices simultaneously regardless of the operating system (iOS or Android). Note: You do NOT need an Internet or Cellular connection in the air for your BOM to work.

Communications have been tested to up to 100ft in an open field. Wi-Fi usually provides significantly more range than Bluetooth.

You can have two Wi-Fi devices turned ON without interfering with each other. However, the tablets can only connect to one Wi-Fi network at a time. Thus, if you have two devices using Wi-Fi communications, you will have to switch networks back and forth to be able to access each device temporarily.

9.8 Power System

The BOM is self-powered and completely independent from the power of the aircraft or any of its systems. The BOM turns On and Off using a vibration sensor and it has an internal battery which is recharged using a turbine. The excess power of the turbine is dissipated to the nose and the heat keeps the nose free of ice.

9.8.1 Turbine

- DC Brushless Axial Flow Fan
- The fan motor is with single phases and four poles

9.8.2 Nose Heater

The turbine AC power is rectified and converted to 5 V via switching power supply. The excess power is dissipated to the nose with a 12 V Zener Diode to keep the nose free of ice.