Sensor of Payload

SHT31 → Humidity & Temperature (capacitance change)

Stress & Noise:

- Place sensor at stable environment → verify humidity/temperature noise is low and stable.
- Log at mission sampling rate (e.g., 1–10 Hz) → confirm no data loss.

Basic Communication:

- **Connectivity:** Confirm I²C address detected on bus.
- **Detection:** Read sensor ID to ensure recognition.

Sensor Outputs:

- **Data Acquisition:** Verify stable values in steady environment; readings change when exposed to humidity/temperature steps.
- **Profiles:** Confirm smooth variation when breathing on sensor or applying warm/cool air.

Calibration Tests

- **Calibrating:** Compare against reference hygrometer/thermometer.
- **Verification:** Check accuracy within ±2%RH and ±0.3 °C.

Fusion Accuracy

- **Consistency:** Place in sealed container → humidity stable.
- **Response:** Move from dry to humid air quickly → confirm expected step.
- **Comparison:** Compare logged data with external reference meter.

BMP390 → Pressure Sensor

Stress & Noise

- Vibrate PCB or apply step altitude (vacuum pump) → ensure no freeze.
- Log at high rate (100–200 Hz) → confirm no sample loss.

Basic Communication

- **Connectivity:** Detect I²C/SPI address.
- **Detection:** Read chip ID register.

Sensor Outputs

- **Data Acquisition:** Stable pressure at rest; altitude drift small and smooth.
- **Altitude Profiles:** Pressure decreases with elevation change; smooth curve.

Calibration Tests

- **Calibrating:** Compare with reference barometer and known altitude steps.
- **Verification:** Check RMS noise only a few Pa; altitude error within 1–2 m.

Fusion Accuracy

- **Axes:** Pressure constant indoors, altitude steady.
- **Response:** Simulate ascent/descent → verify lag <150 ms.
- **Comparison:** Match against GPS altitude or reference station.

VEML6075 → UV Sensor

Stress & Noise

- Shield sensor indoors → confirm baseline near zero.
- Log at 5 Hz → verify no data loss.

Basic Communication

- **Connectivity:** Check I²C bus presence.
- **Detection:** Confirm device ID register.

Sensor Outputs

- **Data Acquisition:** UVI increases in sunlight, decreases in shade.
- **Profiles:** Verify smooth changes when moving between light levels.

Calibration Tests

- **Calibrating:** Compare against weather station UVI.
- **Verification:** UVI error within ±0.3.

Fusion Accuracy

- **Axes:** Orientation shouldn't affect reading significantly.
- **Checking:** Block/Unblock light quickly → confirm sharp step.
- **Comparison:** Cross-check with handheld UV meter.

LIS2MDL → Magnetometer

Stress & Noise

- Shake PCB → confirm heading stable.
- Log at 50 Hz → verify continuity.

Basic Communication

- **Connectivity:** Scan I²C/SPI bus.
- **Detection:** Read sensor ID.

Sensor Outputs

- **Data Acquisition:** Values change when rotated; stable when static.
- **Heading:** Compass direction follows orientation smoothly.

Calibration Tests

- **Calibrating:** Perform figure-8 hard/soft-iron calibration.
- **Verification:** Heading error <3°.

Fusion Accuracy

- **Axes:** Place facing North/East/South/West → verify headings.
- **Checking:** Rotate sensor slowly → heading changes smoothly.
- **Comparison:** Compare with smartphone compass.

BMA400 → Accelerometer (MEMS mass movement)

Stress & Noise

- Vibrate or drop PCB → confirm readings don't freeze.
- Log at 200 Hz → verify no FIFO overrun.

Basic Communication

- **Connectivity:** Detect I²C/SPI link.
- **Detection:** Read WHO_AM_I register.

Sensor Outputs

- **Data Acquisition:** Resting axis shows ~1 g; tilting shows proper shift.
- **Profiles:** Movement/impulses reflect correctly.

Calibration Tests

- **Calibrating:** Compare static readings with gravity vector.
- **Verification:** Error < ±20 mg.

Fusion Accuracy

- **Axes:** Align flat → X,Y ≈ 0 g, Z ≈ 1 g.
- **Checking:** Tilt 90° → verify 1 g shifts axis correctly.
- **Comparison:** Compare dynamic response to reference accelerometer.

MAX-M10S GPS → Position (trilateration)

Stress & Noise

- Test under vibration/shock → verify GPS doesn't lose lock.
- Log at 5–10 Hz → confirm continuous NMEA/PVT stream.

Basic Communication

- **Connectivity:** UART/I²C detection.
- **Detection:** Confirm GNSS fix message available.

Sensor Outputs

- **Data Acquisition:** Position changes when moving; stable when static.
- **Velocity:** Speed outputs follow cart motion.

Calibration Tests

- **Calibrating:** Compare coordinates against surveyed location.
- **Verification:** CEP <2 m in open sky.

Fusion Accuracy

- **Axes:** Lat/lon stable; altitude steady.
- **Checking:** Move known distance → position shift matches reality.
- **Comparison:** Cross-check with mapping app.

Geiger Counter

Stress & Noise

- Vibrate PCB → confirm no false pulses.
- Log at 1 Hz → verify no missed counts.

Basic Communication

- **Connectivity:** Check GPIO/interrupt pin from tube driver.
- **Detection:** Verify counts increment with pulses.

Sensor Outputs

- **Data Acquisition:** Baseline CPM stable at background radiation.
- **Profiles:** Count increases near source (if safe/legal).

Calibration Tests

- **Calibrating:** Compare with calibrated dosimeter or known source.
- **Verification:** Background CPM within expected range (≈10–30 CPM).

Fusion Accuracy

- **Axes:** Orientation has no effect (non-directional).
- **Checking:** Pulse injection test → verify count increments exactly.
- **Comparison:** Compare CPM → µSv/h conversion with tube datasheet.
