OTSL Plug-and-Play Testing & Validation Protocol

Objective: verify that the OTSL unit (Raspberry Pi 5 + Waveshare GNSS Timing HAT + BME280 + MPU9250) is truly plug-and-play. With Ethernet and power connected, the logger must auto-start, log one CSV row every 90 s, and self-recover from common faults.

NOTE: The H x W x D of the assembled logger will dictate the size of the weatherproof enclosure. Once dimensions are known, enclosure will be purchased. Ideally will fit inside a 10" x 8" x 6" enclosure, but that can be changed.
https://altelix.com/altelix-10x8x6-fiberglass-vented-weatherproof-nema-enclosure/

A. Bill of Materials (Lab Bench)

• Raspberry Pi 5 (16 GB) with active cooler
• Waveshare GNSS Timing HAT (with SMA GNSS antenna)
• BME280 barometer (I^2C)
• MPU9250 IMU (AK8963 magnetometer) (I^2C)
• Weatherproof enclosure (with small vent near BME280)
• 5V/USB-C Pi power supply; Ethernet cable

B. Wiring Cross-Check (I^2C + HAT)

BME280 → Pi: VCC→3.3V (Pin 1), GND→GND (Pin 6), SDA→GPIO2/SDA (Pin 3), SCL→GPIO3/SCL (Pin 5)
MPU9250 → Pi: VCC→3.3V (Pin 1), GND→GND (Pin 9), SDA→GPIO2/SDA (Pin 3), SCL→GPIO3/SCL (Pin 5)
Waveshare GNSS Timing HAT: plugs directly on 40-pin header (UART + PPS wired on-board)
Notes: 3.3 V ONLY for I^2C sensors; place the magnetometer away from Pi power/metal surfaces.

C. Service Auto-Start Verification

1) Confirm service status:
   sudo systemctl status otls.service
2) Reboot to prove auto-start:
   sudo reboot
   (after boot) systemctl status otls.service → Active (running)
3) Confirm CSV is growing (one row / 90 s):
   tail -f /opt/otls/logs/otls_unified_log.csv

D. GNSS Timing & PPS Checks

• GNSS Fix transitions to FIX within several minutes in open sky
• Sat_Count increases (> 4 typical); PPS_Seen toggles YES periodically
• Drift_System_vs_GNSS_s becomes numeric (not NULL) after GNSS time is present

E. Environmental Sensor Checks

• BME280 values (pressure/temperature/humidity) non-NULL and reasonable for lab conditions
• Magnetometer (Bx, By, Bz) changes with gentle rotation during test, then stabilize at rest
• |B| total magnitude remains within a stable envelope after baseline

F. Baseline Capture (Final Orientation)

• Place enclosure in final orientation; mark orientation arrows on case
• Record 30–60 minutes of baseline data without moving the unit
• Verify steady drift, stable |B|, and continuous logging cadence

G. Self-Healing & Alerts (If configured)

• Healthcheck job (every 15 min) restarts service if CSV is stale; emails a warning
• Daily self-check (07:00 UTC) emails a 24-hour status summary
• Optional hourly rsync to DigitalOcean for archival and remote comparison

H. Acceptance Criteria (Pass/Fail)

PASS if ALL are true:
• Service auto-starts after reboot and remains active
• GNSS Fix achieved; PPS_Seen observed; drift values present
• BME280 + magnetometer values present and sensible; |B| stable at rest
• CSV rows appear every ~90 s for ≥ 30 minutes uninterrupted
• (If configured) healthcheck can detect a stopped service and auto-restart

I. Troubleshooting Quick Guide

• No rows in CSV → check service status; inspect /var/log/otls/otls_stderr.log
• No GNSS Fix → move antenna to open sky; reseat HAT; check SMA connector
• NULL sensors → verify I^2C wiring/addresses (BME280 0x76/0x77); ensure 3.3 V
• Magnetic spikes → keep IMU away from metal; minimize cable loops; do not move after baseline
• Email issues → review /etc/msmtprc and /var/log/otls/msmtp.log; use app password for Gmail

J. Sign-Off

Technician: _____   Date: _____

Supervisor: _____   Date: _____