**Obriy 1.5 OEM Module** is a miniature RF detection module designed primarily for drone evasion maneuvers by detecting radio signals from hostile UAVs attempting to intercept the platform on which the OEM module is installed. It can also be used as a standard drone detection module when integrated into vehicles, unmanned ground systems, electronic warfare solutions, and other platforms. As an OEM component, it does not include its own power supply or user interface and is intended for seamless integration into third-party systems.

**Operating Principle**

The module performs continuous **spectrum scanning in the 300–6000 MHz range (1000-6000 MHz reliable detection)**. During each scan, it measures the relative energy level (RSSI) at each frequency point with 1 MHz resolution. Signals exceeding the calibrated noise floor are identified, tracked over time, and classified.

**Key detection parameters:**

- **Detection threshold:** 6 dB above the calibrated noise floor (configurable). For frequencies below 900 MHz, the detection threshold is automatically increased by +6 dB.
- **Signal tracking:** The system tracks signal behavior over time using linear regression of RSSI values from the last 10 scans.
- **Classification rules:**
  Slope > 0.5 dB/scan → Approaching
  Slope < −0.5 dB/scan → Moving away
  Otherwise → Stable
- **Signal timeout:** Signals that are not detected for 3 seconds are automatically removed from the tracking list.
- **Tracking capacity:** The module can simultaneously track up to 50 signals. If the buffer is full, a newly detected stronger signal replaces the weakest tracked signal.

**Signal Classification**

Signal classification is performed in two stages.

1. **Analog video detection**

The system first attempts to determine whether the detected signal corresponds to an analog video transmission using FM demodulation followed by synchronization pulse detection.

**Key elements of the algorithm:**

- FM demodulation of the detected RF signal.
- Detection of video synchronization structure using the Goertzel algorithm at the horizontal scan frequency 15,625 Hz and its 2nd and 3rd harmonics.
- Five consecutive analysis attempts are performed, with the final decision based on the median SNR value, providing robustness against random false detections.
- A Hann window is applied to reduce spectral artifacts during signal processing.

2. **Digital video detection (work in progress)**

The second stage attempts to determine whether the signal corresponds to digital video transmission.

**Currently implemented method:**

- **Wideband signal test**
  Signal power is measured at ±3 MHz from the center frequency.
  If both sidebands remain within 12 dB of the center frequency level, the signal is classified as wideband, which is characteristic of digital video transmissions.

**Available Signal Classes**

The system classifies detected RF activity into the following signal categories:

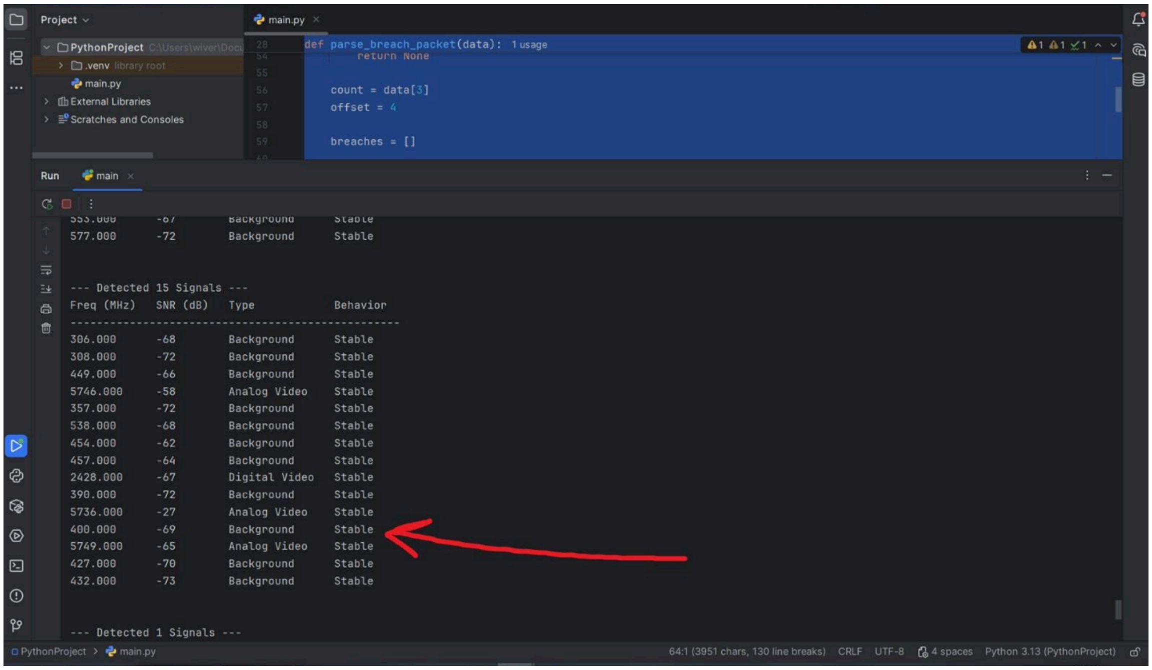
- **Unknown** — Newly detected signal that has not yet been classified.
- **Background** — Background signal identified during the calibration process and recognized as part of the normal RF environment.
- **Analog** — Analog video transmission (PAL/NTSC) confirmed through synchronization detection using the Goertzel algorithm.
- **Digital** — Digital wideband signal with an estimated bandwidth of ≥ 6 MHz, typical for digital video transmission.
- **Narrowband** — Narrowband signal that does not pass the wideband test. This classification is also automatically assigned to signals below 900 MHz.

**SignalBehavior**

The system evaluates the temporal behavior of tracked signals based on the RSSI trend across recent scans.

- **Stable** — RSSI slope between −0.5 and +0.5 dB per scan, indicating no significant change in signal strength.
- **Approaching** — RSSI slope > +0.5 dB per scan, indicating the signal is strengthening over time.

- **Receding** — RSSI slope < −0.5 dB per scan, indicating the signal is weakening over time.




**Automatic Calibration**

The module implements an automatic calibration mechanism to suppress persistent background signals such as cellular communications, onboard drone telemetry, and electronic warfare emissions.

**Calibration operates in two modes:**

- Startup calibration. During system initialization, the module performs 10 spectrum scans. The results are averaged to build an initial RF noise floor map for the monitored frequency range.
- Adaptive calibration during operation. During normal operation, the noise floor map is continuously adjusted to account for slow environmental changes.
  - The estimated noise level gradually increases at a rate of 1 dB per scan when long-term drift is detected.
  - The noise level drops rapidly when the background RF level decreases.
  - Signals exceeding the background level by 10 dB or more are excluded from noise floor updates to prevent legitimate transmissions from being incorrectly learned as background noise.

**Implemented Features**

- Spectrum scanning and energy output. The module performs spectrum scanning and provides relative energy measurements. This data can be streamed to a ground station, displayed via OSD, or otherwise presented to the operator, allowing the pilot to visually assess RF activity in the environment.

- Communication protocol. Data exchange is implemented via MAVLink, using TUNNEL-type messages with header “SB” v3, supporting packets containing up to 20 tracked signals.
- Analog video detection. The module can detect the presence of analog video transmissions and classify them accordingly.
- Human-readable UART output. A parallel human-readable output over UART is available alongside MAVLink communication. This is primarily intended for debugging and direct integration testing.

**Experimental Features (Beta)**

The following capabilities are currently under development and provided in beta status:

- **Automatic RF environment calibration** — adaptive background noise learning to suppress persistent signals such as cellular communication, onboard telemetry, and other continuous RF sources.
- **Digital video signal detection** — preliminary identification of wideband digital video transmissions, based on signal bandwidth analysis. This feature is still under development and subject to further validation and refinement.

**Technical Specifications**

- Scan speed: ~2 seconds per full spectrum scan
- Startup calibration time: ~20 seconds (10 scans + system initialization)
- Weight: 100 g ±10 g
- Dimensions: compact form factor: 60 × 60 × 25 mm (excluding SMA connectors); extended form factor: 120 × 60 × 15 mm (excluding SMA connectors)
- Operating frequency range: 1000–6000 MHz — reliable detection; 300–6000 MHz — limited reliability due to high-power interference commonly present in lower frequency bands
- Software-expandable range up to 7500 MHz (sensitivity not yet validated)
- Frequency step (scan resolution): 1 MHz
- Measurement resolution: ~5000 measurement points per scan
- Sensitivity: approximately −80 to −100 dBm, depending on frequency (sensitivity decreases at higher frequencies)
- Power consumption: 3.5–4 W, depending on board temperature
- Supply voltage: 6–60 V DC
- Communication interface: MAVLink TUNNEL messages with a proprietary data structure
- Command interface: No command input supported (output-only telemetry)

**MavLink Data Format**

Each packet contains:

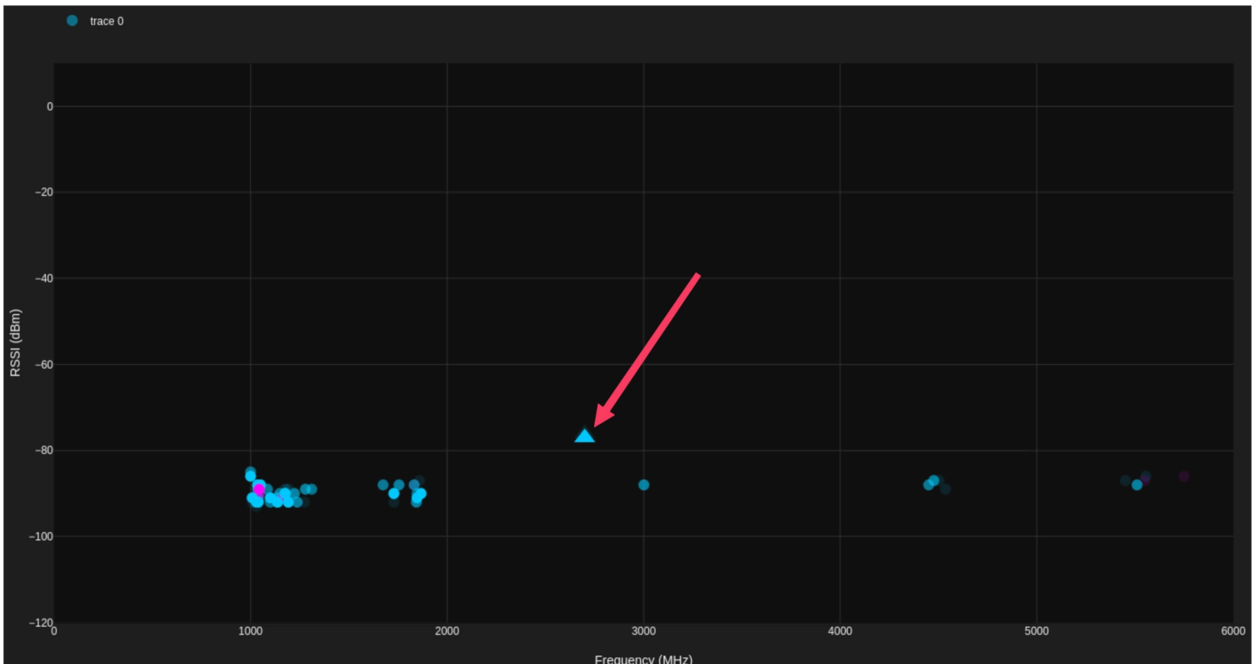
- Header: 'S', 'B', version (3), number of signals in the packet (up to 20)

For each signal: frequency (kHz, uint32), SNR (dBm, int16), type (uint8: 0 = Unknown, 1 = Background, 2 = Analog, 3 = Digital, 4 = Narrowband), behavior (uint8: 0 = Stable, 1 = Approaching, 2 = Receding)

**Visualization Tool for Debugging**

There is code available that allows you to connect the device via MavlinkReader and observe its behavior. To run the Python code, Python and the required packages must be installed on your computer (requirements.txt; installation via venv is recommended). Claude.ai can easily explain how to install everything.

**Archive: MavlinkReader**




Data from the device in test mode is received via an RS232-to-USB converter.

Test modules are supplied with the USB converter.

**Firmware Update**

A programmer is required to update the firmware.

Test modules are supplied with the programmer.

**Software Features Pipeline**

(As a client, you have the main influence — features and their priority/order can be adjusted.)