



FLEXIPILOT 1.35

Telemetry options

The document describes uplink and downlink options.

FLEXIPILOT offers both uplink and downlink telemetry and possibility to change mission in flight. Uplink is using a classic RC transmitter.

Downlink consists of second-party OSD and analog/digital video feed accepting 115200 GPS data or any baudrate long range modem at 115200bps (typically working in broadcasting, simplex mode).

This specific choice offers shortest uplink delay (with typically 35ms but hard-realtime on the uplink) and maximizes range of transmitter-only modem (since its antenna doesn't have to receive anything and can be set to max power).

FLEXIPILOT has been designed with civilian applications in mind. The practice of civilian clients is performing flights close to the takeoff point, sometimes because of the laws (visual range) or for practical reason (during photomapping one tends to maximize time over target). Since brand RC controllers have range of about 1.5-4km at the altitudes 100-300m where the UAV is expected to operate, they offer the smallest transmission delay and minimize time jitter. FLEXIPILOT has extended RC input logic that allows executing the commands you would normally enter on the GCS. This limits the number of equipment on the field.

Operation without RC is possible but very dangerous as it leaves no room for mistakes.

In practice, it is common to operate without the groundstation since the single operator has all the options at hand and can spot to longer distance without sharing the attention between airplane and monitor. This concept allows for safe single-operator flying at the edge of visual range.

The following logic changes are possible using RC transmitter in flight:

- enable/disable autopilot
- UAV handover: select a specific plane to command, ignore the others
- auto-disable RC beyond specific range
- select navigation mode: Mission/Loiter/GoHome
- change loiter radius and direction
- switch between pre-defined loiter conditions (duration, radius, direction)
- change mission, reevaluate waypoints (typically a few per RC slider or knob)
- restart a mission
- mark Target Position to be optionally used for waypoint evaluation
- open parachute manually
- reception watchdog (return home if channel ill after predefined time)
- rotate stabilized head axis
- temporary direction and altitude override
- enable/disable one of 2 trigger logic (self-repetitive action possible)
- enable assisted drive in autopilot mode (flying by turnrates and climb rates)
- initiate automatic takeoff procedure

Also, due to advanced waypoint logic, most of manual interaction is avoided at all since the waypoints can be predefined as relative to takeoff point, home position, target position, use realtime estimate of wind heading, use takeoff course, enter loiter for/until predefined time etc. Fully automatic set of emergency return conditions is also the most extensive on the market of small autopilots.

FLEXIPILOT uplink consists of 11 input channels (SCAP0-SCAP9, SCAP11) which are used both as servo commands (when RC is used in manual mode, as backup controller) or as autopilot control logic. While some of them are always used (SCAP0 is typically RUDD or AILL), their value in automatic mode can still be used but treated differently. In this case, SCAP0 is often defined as Direction (Turnrate) Override in automatic mode.

Technically, for downlink, several options are possible:

1. Using OSD video telemetry, at this point the autopilot can emit either NMEA or RVOSD serial data that is accepted by practically all OSD solutions on the market. The decoded and video-overlaid text is then sent to the ground receiver. This solution offers less lag but variable readability.
2. Using modem. The modem can use or even share the same output line as OSD. FLEXIPILOT offers aid in selecting specific baudrate, which may be limited per modem. The autopilot supports many protocols of the other open-source groundstations, and a few commercial ones. To mention MAVLINK, HK GCS compatibility.
3. There is a custom, encoded and optimized BEACON protocol specific for FLEXIPILOT, which offers best correctness checking, selectable baudrate and others. There is PC-based cygwin code with example groundstation in text mode. The decoding application is also generating self-refreshing kml file that can be viewed in GroundStation.

