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**Aerial
Robotics**

FLEXIPILOT

Feature list

The autopilot has been designed for low-cost reliable photography using popular RC model planes and is sold pre-tuned for stable pusher motor glider using rudder, elevator and throttle for control.

Performance specifications:

- 32Hz IMU update loop with analog filtering, 32Hz control loop
- 70Hz servo output with 10bit resolution
- 6DOF IMU
- External 5Hz GPS, 32 Channels, weight 15g
- Tightly-coupled GPS course and IMU (32Hz course update)
- Hardware servo override
- 12 input channels, TTL 5V, 3.3V, and PCM compatible
- 5 output channels (rudder, elevator, throttle, 2 triggers)
- Barometric altitude sensor (13cm resolution, operational up to 9km), self-calibrating to ground level
- Power supply: unregulated 5.35-8V, power consumption typ. 140mA @ 6V, max 200mA, possible regulated (clean) input 5V.
- Operating temperature -20...60C, possible IMU calibration for extreme conditions
- Max measured accelerations 3G, max roll/pitch/yaw rates 300deg/s
- Flat, single-board design: 50x120x10mm, weight 40g
- USB connector
- Typical control range: climb +/-3m/s, turn rate +/-40deg/s, roll +/-50deg
- Typical altitude control precision: +/- 2...5m depending on weather

Navigation capabilities:

- 3D waypoints (position and altitude) with trigger action
- Possible automatic landing based on low-speed loiter with motor off or straight approach based on waypoints
- Absolute or relative waypoints

The position expressed as floating point numbers (6 decimal digits precision), relative to takeoff position, last waypoint or home position – you can define all-relative pattern and fly several times at different locations without connecting to the computer.

The altitude in meters nominally up to 32000m is measured relative to takeoff point and accepts negative values.

- Waypoint iterator logic
Counting up/down given range of waypoints, N times.
- Guaranteed no-loiter waypoint navigator
Allows tight satisfy radius without the risk of infinite loiter around remote waypoint.
- Adjustable Track-Follower
Flying along the line connecting waypoints, eliminating crosswind influence.
- Navigational situation display using OSD
- Adjustable corner-rounding, anti-overshoot waypoint switching
For entertainment and tight pattern flying.
- Preserves direction of turns defined by waypoint pattern
For predictable pattern shape (well defined behavior at visual limits) and loop elimination.
- Loiter after returning home or automatic landing
Based on circling home with fixed turn rate, motor off and constant descent, possible straight-line approach based on multiple waypoints.
- Landing at takeoff position or fixed home location

Data storage:

- Self-tuning IMU, self-calibrating barometric altimeter, stores auto-trimmed control surfaces positions based on manual flight
- All variables editable by name with command-line prompt built-in into the autopilot
- Number of **3D waypoints**: 128
adjustable, min=1, max=2048 at the expense of event log size
- Realtime log (**LOG**): 4MB
up to 32Hz, selectable frequency, 77 variables, 55minutes @8Hz
- Event log (**TRACE**): 960 events
flight time;latitude; longitude;roll angle; pitch angle; AGL altitude;course; eventID
size dependent on the max number of waypoints, periodic logging also possible at 32Hz max, recommended rate 0.5-1Hz
- Fast data transfer at 1Mb/s plus compression via USB port

Support software:

- Self-installing USB drivers
- Possibility to use HyperTerm console installed on every Windows system
- The autopilot exposes a fixed COM port on the PC
- Log download scripts available (automatic export to **kml** data and exporting trigger events to synthetic **NMEA** data, simulating fixed number of GPS position marks)
- Features automatically connecting command+simulation console, includes IMU viewer and Mission Simulation

Unique feature:

- Output connector for On-Screen-Display video overlay for intuitive video telemetry
- OSD output allows connection to one-way telemetry modem using 115200 8N1 5V TTL asynchronous serial port

Trigger support:

- Uses standard servo output, primarily used for aerial photography
- Can work as 5V TTL switch
- Buffered and filtered servo outputs

- 3-state: Disabled/Enabled/Active
- Each state supports different servo position
- Enabling/disabling at specified waypoints or remotely with RC transmitter, any channel, any position
You can just move the slider, the actual activation time and servo positions are programmable.
- Possible 'controls freeze' for shake-free photos
Inhibit elevator moves and throttle change for prescribed time during photoshooting.
- Possible repetitive action
Advanced timing engine includes: activation delay, activity time, inactivity time, max number of activations, activation by time or/and by distance flown and distance along the line between waypoints, possible to 'reload' max trigger counter at waypoints; the actual 'photo' position is written to the log at prescribed time after activation.

Safety:

- Separate override management processor and hardware servo override specified for wide operating temperature range guarantees taking control with RC equipment, compatible with 5V or 3.3V PCM receivers
- Automatic manual override when the main processor is rebooting means that in (extremely unlikely, except in temperatures around -40C) the case of autopilot software crash, the RC receiver is being used (its nonvolatile fail-safe settings are enabled if the transmitter is turned off)
- Programmable return-home based on cone angle, distance and altitude
- Programmable 'RC watchdog channel' that forces return home if is out of specified bounds
- Always use receivers with programmable failsafe (prevent accidental autopilot disable at distance, use mode channel programmed to magnet-home or use non-recovering return home channel)
- You can use mode channel to steer home at any time without interrupting navigation, with possible resuming as soon as the magnet-home is released
- In autopilot mode you can use rudder stick on your RC transmitter for obstacle avoidance (extreme rudder commands will intuitively command turn rate left or right, navigation resumes after release)
- Possible programmable 'RC receiver ignore, autopilot enable' above specified distance to avoid 'UAV hijacking' when using common RC frequencies
- Status LED indicating barometric pressure calibration, IMU and GPS sanity
- The motor WILL NOT RUN in autopilot mode before detecting takeoff what requires simultaneously applied throttle, well-calibrated system and moving.
- @@@THRDISABLE command at console
- Smooth throttle management (no sudden high RPM)
- Mission simulator allows evaluating proper waypoint arrangement, uses the triggers on the ground, minimizes 'wasted flight' probability, allows testing of return-home settings and 'RC transmitter off' situations
- Realtime log without file system corruption possibility, no moving parts or sockets
- Full-IMU autopilot is protecting against spin and allows safer, slower flight
- Clear distinction of operation modes: manual or automatic, without partially assisted modes (unless tuning mode is enabled with ground console)
- Single-board design enhances robustness, no jumpers or adjustment dials