

# wePilot2000

## Flight Control System for Mini Fixed Wing UAV

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### 1 Overview

wePilot2000 is a flight control system for fixed wing aircraft integrated on a single PCB board. It consists of an embedded computer system, a GPS receiver, an integrated full six-degree of freedom inertial measurement unit, a barometer, and an externally connectable magnetometer. wePilot2000 combines integrated GPS/inertial navigation with robust controller design methodologies and a low-power, high-performance embedded computer. It provides attitude stabilization, velocity control and waypoint guidance. A general purpose I/O interface allows control of custom payload equipment. A data-link may be added to interface with the weGCS ground control station. wePilot2000 was specifically designed for mini fixed wing aircraft where small size, light weight, and low power consumption are essential requirements.

The adaptation of wePilot2000 for a specific fixed wing aircraft requires recorded data from a manually piloted flight. Parameter identification techniques are used to extract mathematical models from the data and to synthesize a robust controller.

### 2 Features

- Attitude stabilization and velocity control
- Full integrated GPS/inertial navigation solution

- Flight modes: Manual, assisted, mission, and home
- Payload insensitive flight controller
- Built-in data logger and telemetry capability
- Programmable hardware for rapid customization
- Built-in payload interfaces
- Plug-in between remote control receiver and servos
- Includes power supply for servos

#### Hardware:

- Embedded computer system
  - Intel XScale PXA255 32-bit RISC Processor
  - 32 MB Flash ROM
  - 64 MB SDRAM
  - Xilinx SpartanXL FPGA
- GPS receiver module
  - Receiver type: L1 frequency, C/A code, 16-channel
  - Provides differential GPS (RTCM-SC104) input
  - Position accuracy (SA off): 3m CEP
  - Acquisition time (cold start): 41s
- Inertial measurement unit with
  - 3 gyroscopes:  $\pm 100$  deg/s
  - 3 accelerometers:  $\pm 10$  g
- Piezoresistive pressure sensor: 10 – 1100 mbar
- Interfaces
  - SMA connector for active GPS antenna
  - 8 PWM input channels
  - 6 PWM output channels
  - Interface for 2 motor rpm sensors
  - General purpose I/O interface

- 6 analog input channels with 12-bit resolution
- 4 digital I/O channels
- RS-232 interface for external magnetometer
- RS-232 interface for external data-link
- RS-232 interface for external DGPS correction message receiver
- 4 RS-232 interfaces for custom payload equipment
- RS-232 interface for host computer
- 12 V unregulated power supply
- Power consumption: 300 mA @ 12V (without servos)
- Servos: max. 5000mA @ 5V

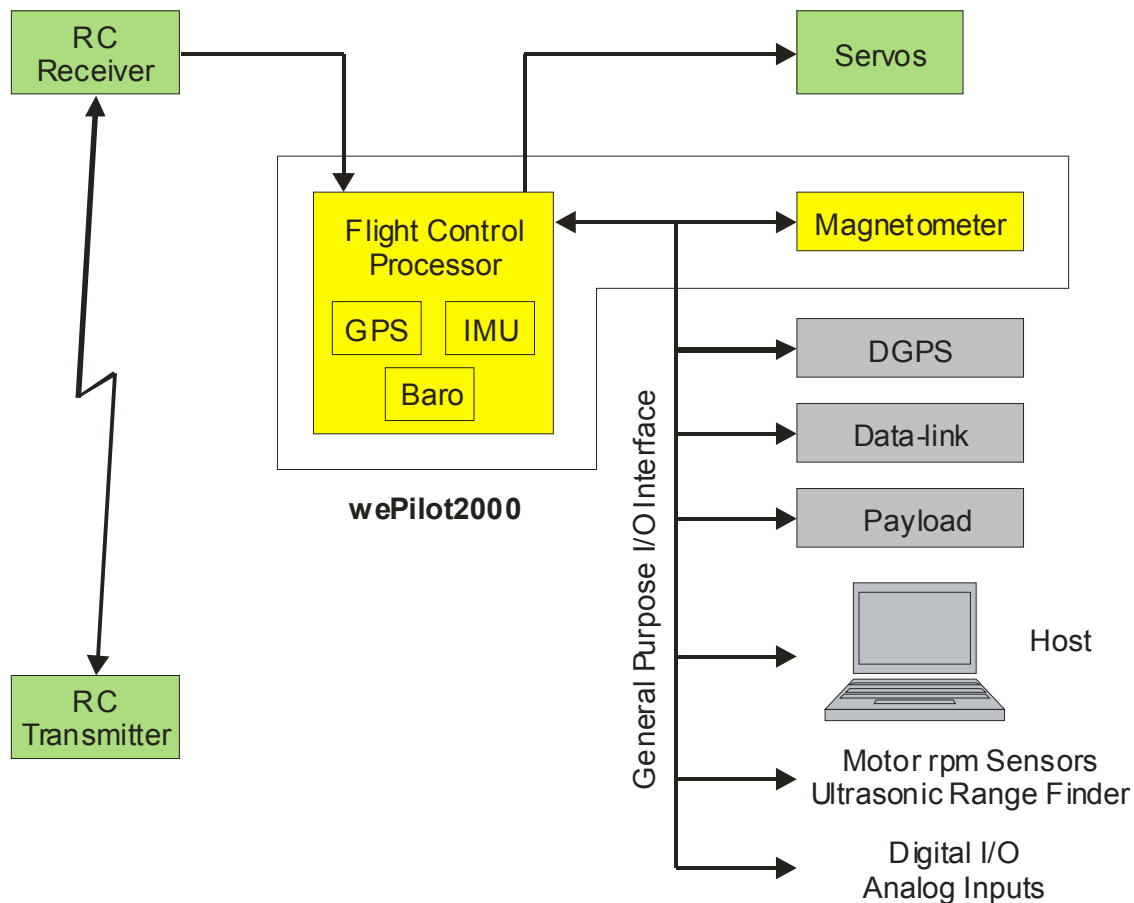
#### Algorithms:

- Extended Kalman Filter for integrated GPS/inertial navigation
- Wind speed estimator
- Turn rate control
- Climb rate control
- Altitude hold control
- Tracking of circles and line trajectories in 3-D

- Automatic take-off with elastic rope
- Semi-automatic landing procedure by tracking a controllable gliding path in space
- Monitoring of GPS solution, IMU, magnetometer, PWM inputs, and power supply
- 4 flight modes: manual, assisted, mission, and home

### 3 Dimensions and Environment

- Dimensions (flight control processor): 185x100x45 mm (L x W x H)
- Weight: 260 g
- Operating temperature: -40 °C ... +85 °C



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