

# wePilot4RMAX

## Flight Control System for Yamaha RMAX Helicopters

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### 1 Overview

The wePilot4RMAX is a flight control system for Yamaha's RMAX helicopter family. It is simply plugged in the existing YACS avionics and connects redundantly to the YACS receiver board and the YACS backplane board. A GPS antenna, a magnetometer and a data-link are the only devices to be mounted externally on the helicopter airframe. This minimal weight addition preserves the full payload capacity of the RMAX helicopter. The wePilot4RMAX uses the underlying Yamaha Attitude Control System (YACS) and adds velocity and position control features based on GPS. Pilots can control the RMAX helicopter in traditional Manual/YACS Mode or in Assisted Mode (speed commands from the RC transmitter or the ground control station). Furthermore, a waypoint guidance package allows automatic take-off, pre-programmed flight trajectory tracking and automatic landing with engine shut-down. The flight range of RMAX helicopters is considerably increased, since the pilot no longer depends on visual information for control. The wePilot4RMAX provides excellent assistance to pilots for close and long-range applications, like aerial photography, video, filming and surveillance.

The wePilot4RMAX consists of a flight control processor with a built-in embedded computer system, a GPS receiver, a barometer, and an externally connectable magnetometer. The wePilot4RMAX combines integrated GPS/inertial navigation with robust controller design methodologies and a low-power, high-performance embedded computer. It provides attitude stabilization, velocity control for cruise, and position control for hover. The flight controller has been specifically designed to handle a large range of payload weights without need of retuning. Two serial interfaces allow control of custom

payload equipment. A data-link must be added to monitor and control the aircraft from a ground control station (laptop).

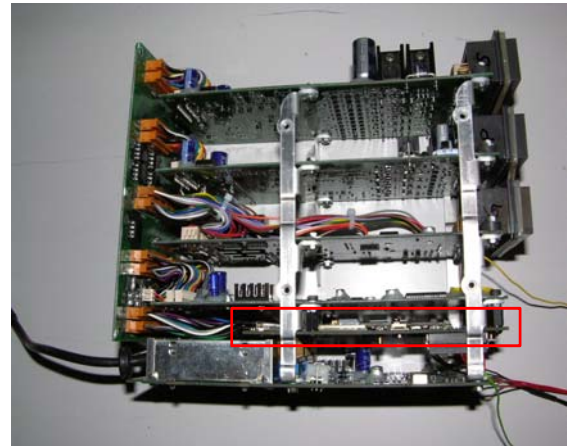
### 2 Features

- Attitude stabilization and velocity control
- Position of RC transmitter sticks interpreted as velocity commands
- Integrated GPS/inertial navigation
- Payload insensitive flight controller
- Built-in data logger and telemetry capability
- Built-in payload interfaces (RS-232)
- Integrated in YACS avionics
- No R&D version necessary

#### Hardware:

- Embedded computer system
  - Intel XScale PXA255 32-bit RISC Processor
  - 32 MB Flash ROM
  - 64 MB SDRAM
  - 16 KB Ferroelectric Nonvolatile RAM
  - 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
- Uses RMAX built-in IMU
- Piezoresistive pressure sensor: 300 – 1100 mbar
- Interfaces
  - MMCX connector for active GPS antenna
  - Connectors for YACS radio receiver board
  - Connectors for YACS backplane board
  - 26 pin Datamate connector:

- RS-232 interface for IMU
- RS-232 interface for external magnetometer
- RS-232 interface for external data-link
- RS-232 interface for external DGPS correction message receiver
- 2 RS-232 interfaces for custom payload equipment
- RS-232 interface for host computer
- Analog input for optical distance sensor
- Uses unregulated 12 V power supply from YACS
- Power consumption: 180 mA @ 12V



#### Algorithms:

- Extended Kalman Filter for data fusion of GPS and inertial sensors
- Robust flight controller design based on  $H_\infty$  methods
- Bumpless transfer between manual and automatic control
- Waypoint guidance package
- Automatic take-off and landing
- Monitoring of GPS solution, IMU, magnetometer, PWM inputs, and power supply

### 3 Dimensions and Environment

- Dimensions : 130 x 84 mm (L x W)
- Weight: 70 g
- Operating temperature: -40 °C ... 85 °C

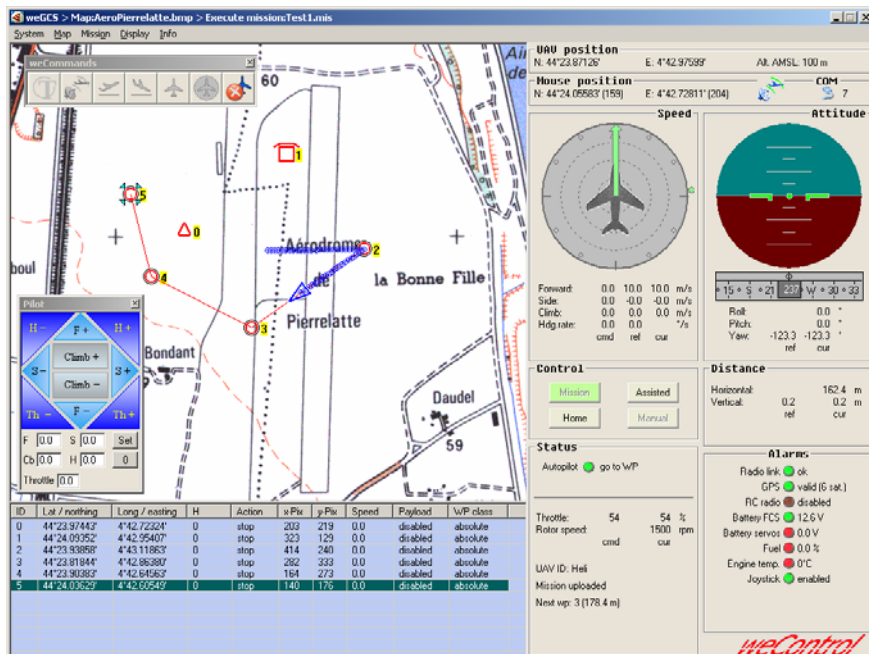
### 5 Ordering information

- wePilot4RMAX: Flight control processor, including
- computer board
  - GPS receiver with antenna
  - magnetometer module
  - weGCS ground control station software

### 4 Design Support

weControl provides consultancy services as well as hardware and software support for

- Custom payload control
- Ground control station
- Sensor integration



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