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File http://www.didel.com/Ir/IraShort.pdf

Didel IR solutions and evolution path

Partial print-out of the 2004 document http://www.didel.com/slow/mip/Ira.doc
Updated November 2007

1. Model control

Nowaday, infrared control (IR) is the lightest solution for controlling a very slow flying plane. It is fully suitable for home flying, and works well even outside when distance is kept short, say below 5-10 meters. Radio components are getting smaller, and adequate radio receivers will be available in a near future, but IR will stay due to its advantages.

IR sensors are light, down to 0.1 gram. It will take some time until radio receivers will be as light, but base radios in the range of 0.3 to 0.5 grams will surely appear in 2005 – not yet in 2007!.

The receiver must be a plug-in module. Now one changes the quartz to work on a different frequency. With Didel concept, one changes the receiver, and uses on the same plane one day IR, another day 40 Mhz in Europe, another day 72 MHz in US, etc.

The key idea is to separate on the plane the receiver, that depends on the transmitter, and the controller, that depends on the model. The receiver, an IR or radio module, maybe Bluetooth some day, plugs on the controller. When everybody will use this concept, you will fly a friend's model with your own radio just by plugging your own base radio module on your friend's plane!
The model (plane, glider, helico, boat) uses several actuators and motors that require a given number of channels to be controlled; this has nothing to do with selecting a radio frequency. The receiver must be a plug.in module that converts the radio or IR signal and does not split the signal for the different channels. The controller do this job, taking care of the motors and actuators that control the plane.

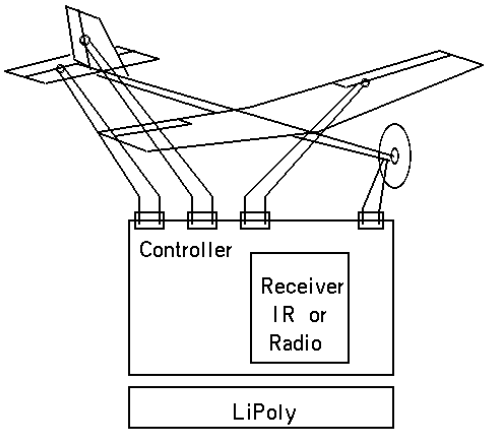


Fig 1 Receiver as a plug-in module

The transmitter encode and mix the joystick position into a PPM stream before converting to an adequate radio signal. The physical link is of no concern to the model. Didel works on the logical link that does not care how the data will be transmitted, and leaves to specialists the delicate technology of recognizing and radio or IR signal among parasistic signals.

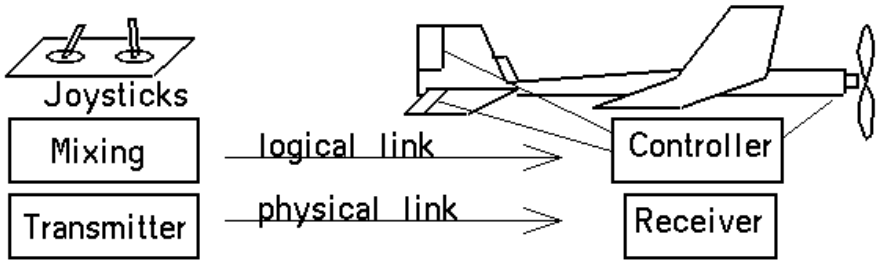


Fig 2 Logical and physical link between the transmitter and the model

Traditionnal radios receivers have one output connector for every channel. Before the channel separation, the receiver gets from the radio high frequency (HF) part a PPM serial stream, explained in section 3. Using the PPM format for the IR stream provides the required compatibility between IR and radio. A three pin connector (ground, power, signal) links the receiver and the controller. The general usage of LiPoly batteries specify 3 to 4.2V for the power supply.

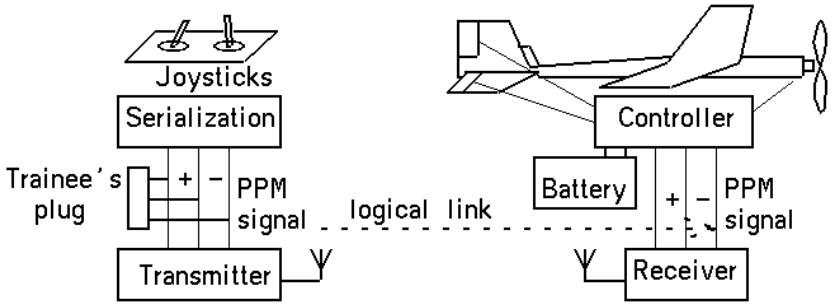


Fig3 PPM logical link

At the radio transmitter level, the PPM signal exists between the controller that mixes the joystick information and the HF part. The PPM signal is frequently available on a connector that allows the connection of a second transmitter, used by a trainee, the radio part of which is not used.

2. Traditional radio solution

Radio receivers have different frequencies and are either narrow band, with a removable quartz, or wide band, responding to all frequencies of the band.
3-pin connectors (power and signal) are usually provided for the servos, but the pinout and connectors may vary from one manufacturer to another.
These connectors contribute significantly to the receiver weight.

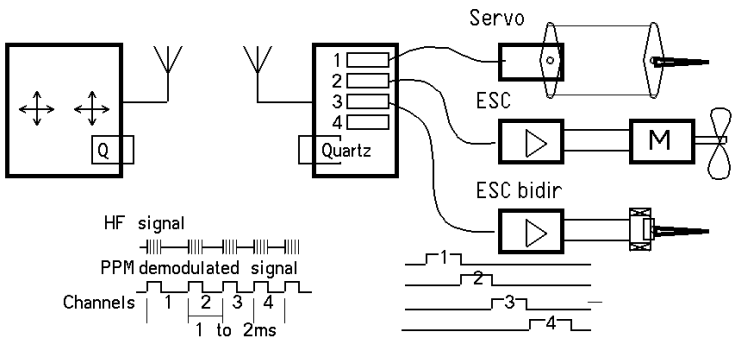
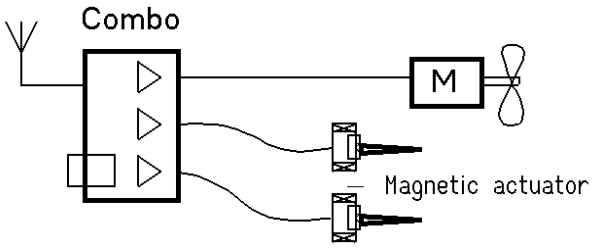


Fig 3 Typical RC system



Combo receivers include weak or strong amplifiers for the propeller motor and the magnetic actuators.

Fig 4 Typical Combo (JMP, Coural, RFFS)

Radio receivers includes the channel separation, and combo receivers include amplifiers for the propeller motor and magnetic actuators. They weight 1.5 grams and more. The receiver part, named the base receiver, converts the radio signal of a given frequency into a PPM signal. The PPM signal is then separated by a microcontroller.

What we propose is to separate the high frequency radio part from the control part. The base radio could generate different formats easy to decode by the control processor: I2C, SPI, CAN. We selected the PPM format, very easy to generate by the processor on the radio board. A significant advantage is it is a 1-line signal, that is only 3 wires connect the radio base module and the controller, usually linked to the power supply. Having two boards with their own processor simpify the design: the radio board has no power transistor, and no timing constraint due to PWM and multi channel handling, the control board has only to handle the I/O form an easy to decode signal.

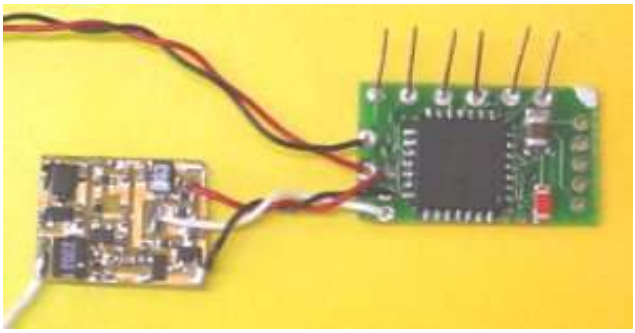
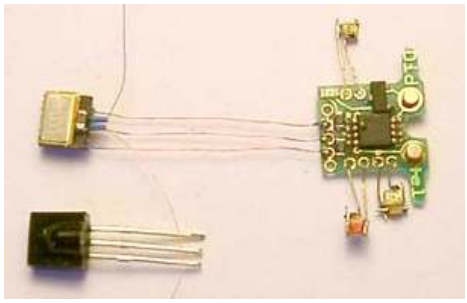


Fig 6 Nick Leichty 27 MHz base receiver and MIP3 in 2004 (0.65g total).



Martin Newell 2007 Rabbit 915 MHz receiver (0.15g) with an Ir31

3. PPM standard

PPM (Pulse Position Modulation) is a simple way of sending up to 7 analog values on a single line. A stream of 8 pulses separated by a 1-2 ms duration (max total of 14 ms) is repeated every 20 ms.

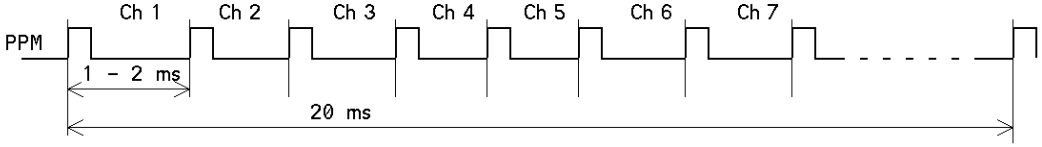


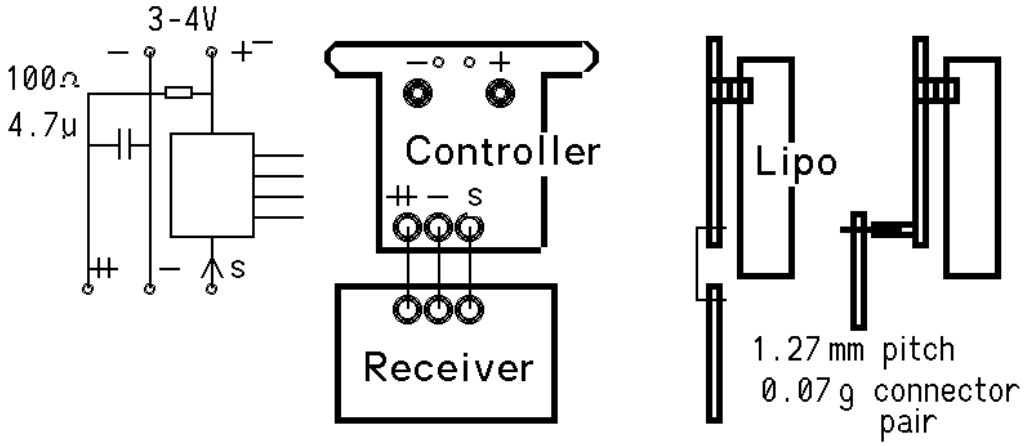
Fig 7 PPM signal (negative pulses are frequently used)

The channel order and the poarity may change depending ont the transmitter mode and base receiver implementation.

4. Compatibility with Didel products

Didel has developed for years controllers modules with a PPM input from an IR sensors.

The most recent models have characteristic winglets for easy attachement to a rod or flat surface. Power supply is from 2 wires or Bahoma magnets.
Power is available on a PPM connector, compatible with IR modules. A 100 Ohm resistor and 4.7 Ohm capacitor filter the provided supply, supposed to be less than 5 mA. 100 Ohm resistor will be reduced if required.



5. Specifications

Radio and controller manufacturers should agree about the following points :

- Connector - proposal 1.27mm pitch, 0.6mm holes
- Connector position – bottom for controller, top for receiver
- Board size – any
- Controller power supply – single cell 3 to 4.2V, any current
- Controller output voltage – Filtered by 100Ohm/4.7 uF
- Receiver power supply – 2.5 to 4V, < 5 mA

6. Didel ultralight controllers

Ir21 Iz3 2-channels controller for < 2g planes 1 transistor for propeller motor, 2 outputs from the controller for a >100 Ohm coil		Kit with 10F200 and transistor, no PC board. For a >120 Ohm BIRD, add 0.03 for you fine soldering Weight 0.07g with strip-down IR sensor
Ur31 Iz2 Iz3 3-channels controllers for < 10g planes		PCB with 12F508, 1 transistor and one dual A3901 bridge Weight 0.22g without IR sensor
Ur62 4 to 6 channels controllers for < 10g planes/helicos		PCB with 16F630, 1 dual transistor and 2 dual A3901 bridge. Weight 038.g without IR sensor