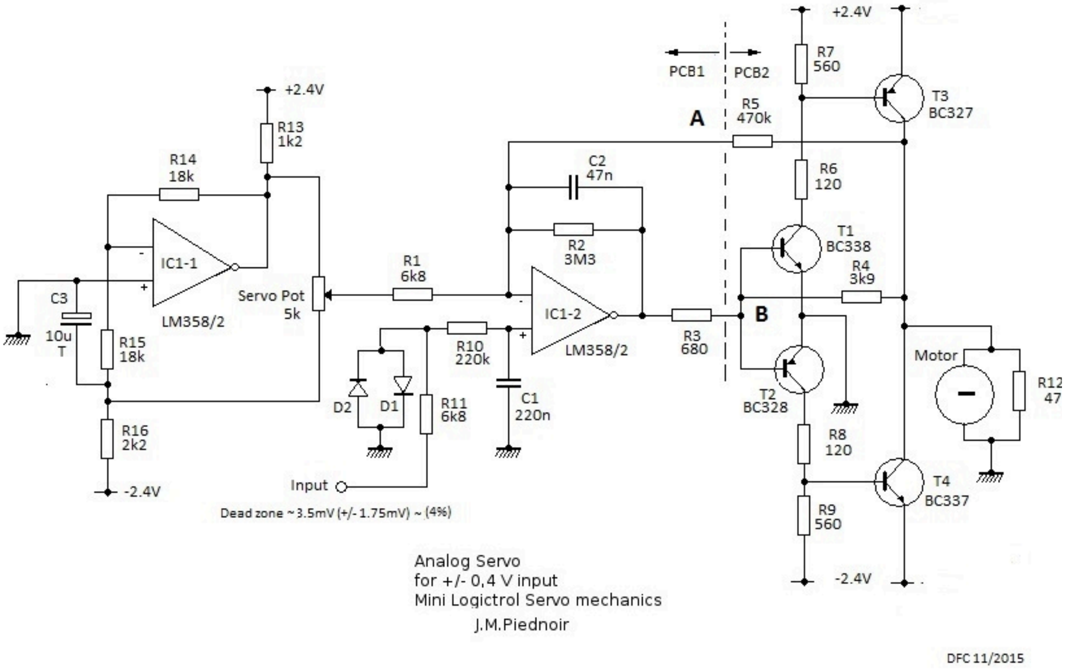
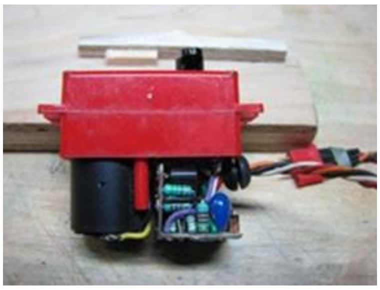
By Jean-Marie Piednoir

An analogue servo design that equals or exceeds the precision of normal ‘digital’ servos used in R/C systems.

Operation principle and schematic:



Op-amp IC1-1 generates symmetrical voltages of +/- 1,2V for the servo feedback potentiometer. This ensures elimination of neutral drift if the +/- 2,4V battery depletes asymmetrically.

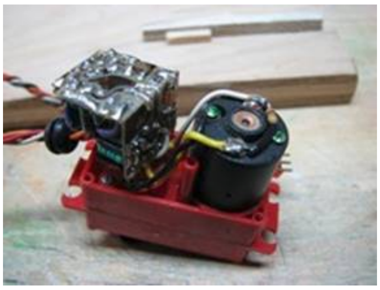


Referring to the schematic, when the voltage at B reaches +0,62V. Transistor T1 begins to drive T3 into conduction. R4 reinforces the conduction of T1 and T3 saturates rapidly.
T3 will be turned off only after the voltage at B has come down to approximately +0,15V (depending on the value of R4).
The same sequence happens with T2 and T4 with thresholds at -0,62V and -0,15V.
Thus, we have a double Smith trigger with a deadband of +/-0,62V.

Let's assume that the servo is in a balanced state. If the input voltage at « A » is raised slowly by 3mV, the voltage at « B » will decrease by 0,62V and T4 will be driven into sturation.

The feedback resistor R5 will cause a positive-going voltage ramp at « B » as C2 is charged. After approximately 3mS (depends on the values of R5 and C2), the voltage at « B » will have risen up to -0,15V and T4 will turn off.
If at this time the servo hasn't moved, C2 will discharged again towards -0,62V with a slope depending on the voltage at « A » and the cycle repeats itself.

The motor is fed current pulses of a minimum width controlled by the values of C2 and R5 as soon as the edge of the deadband is reached either side. The deadband depends on the ratio R2/R1.
The on/off ratio of the pulses increases as the difference between the actual and desired servo positions up to continuous conduction when the error is large enough (around 40 mV in the actual example).
R5 also sets the damping of the system. This why R5 and C2 must be altered together to maintain sufficiently wide minimum pulses (3mS or more).



The attached schematic is for a supply of + / – 2,4V with an ordinary servo mechanics.

Operation is particularly neat and the signal across the motor terminals is amazingly clean.

This circuit brings the operation of an analogue servo on par with digital servos by:

- Feeding the motor with pulses of a minimum width which can be adjusted by component values, as soon as a position change is called for.
- Operating the output transistors in full saturated mode at all times.
- A very low drain when the servo is not moving, of the order of less than 5 mA.
- Eliminating the « soft » centring of the typical analogue servo amplifier.

Deadband for the example: 3,5 mV for an input range of +/-0,40V, i.e. 3,5/800 = 0,43% or equivalent to 232 steps.

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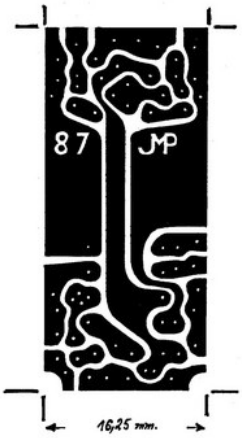
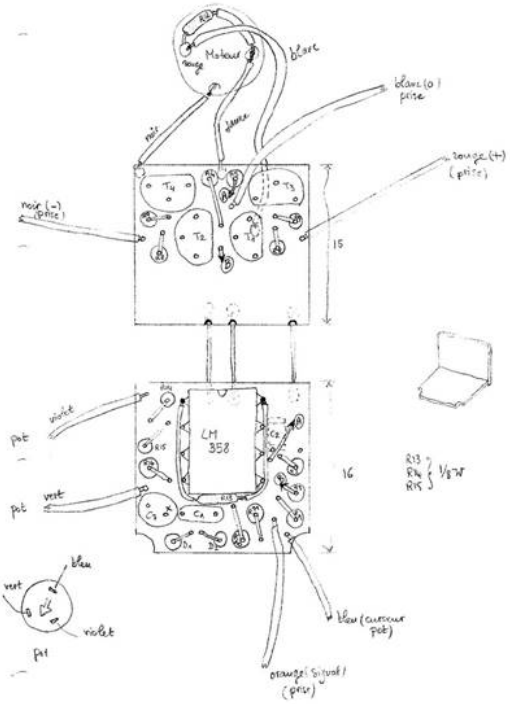
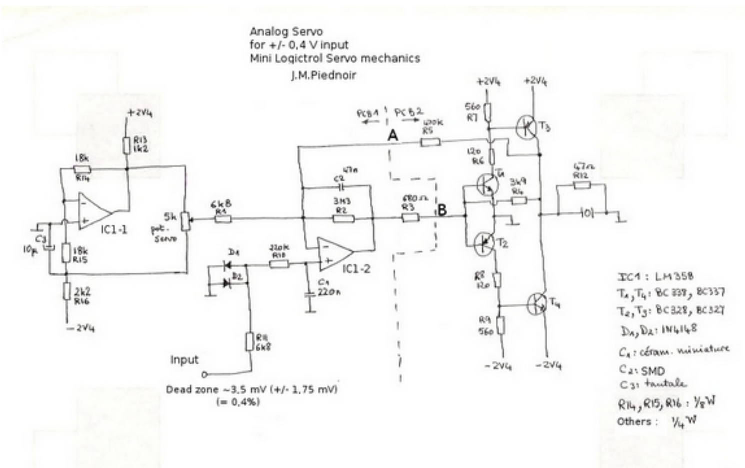
Some further constructional information follows…….







Jean-Marie Piednoir continues with his superb Retro Galloping Ghost model using
60 year old model radio control technology……

After the early days of R/C using valves and sequential left right ruder control, came the first simple proportional system using a small spring centred electric motor to wobble backwards and forwards (around 10cps) via an on/off pulser built into the transmitter. The mark space of the pulser causing the motor and rudder to proportionately 'shiver' proportionally, to the left or right. A pot on the transmitter with an external knob controlled the pulser and hence the direction of the plane. Proportional control was born! It offered the first really smooth control of the direction of the model plane.

It didn't take long before some bright spark (Don Brown US. in 1954) to realize that the same piano wire crank that was shivering the rudder left and right via the on/off mark space of the Tx....could also be used to 'kick' the elevator upwards if the pulsing was slowed down! Looking at the picture and the