

Snelflight Hoverfly

Why does my Hoverfly have such poor Climbout?

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When operating properly, the Hoverfly hovers at about 65-70% throttle and has rapid climbout. Its performance matches or even exceeds that of outdoor model helicopters in relation to its size. If your Hoverfly barely seems to get off the ground then please read on. There are a number of possible causes for poor climbout, but the problem is almost always quite straightforward to fix.

An important difference between the Hoverfly and outdoor model helicopters is that the Hoverfly has no mechanical throttle linkages to adjust. While this does simplify things, it also means that climbout performance is totally dependent upon the transmitter's throttle signal range, because it is not possible for example, to compensate for limited servo travel by using a longer crank lever. In order to perform at its best the Hoverfly needs to receive a throttle signal with full 100% travel, and unfortunately there are lots of possible reasons why a transmitter might not provide this. Almost all Hoverfly climbout problems are caused by insufficient transmitter throttle travel; quite simply this means that when the throttle stick is at maximum, the transmitter is sending a signal to the Hoverfly which is below maximum, resulting in less-than-maximum performance!

Helicopter radios generally have several controls and adjustments which affect throttle travel, and it obviously makes sense to check these first. The main ones are described below in some detail, since a general understanding of what the controls do will help in finding optimum settings.

Transmitter Throttle Adjustments.

1: Travel Adjusts (ATVs, Endpoint Adjustments): These controls set the full-stick output signal levels, and there are usually two settings per channel, so that the signal level at each end of the stick's travel can be set independently. Setting the ATVs asymmetrically does not change the signal at mid-stick. How the throttle ATVs should best be set depends on a number of factors as we shall see. However, they should certainly not be set below +/-100%, and an increase at the top end will generally improve climbout performance.

2: Throttle Curve: This adjustment allows you to control the relationship between stick position and channel output, to a degree of precision which varies from radio to radio. This relationship is best expressed as a graph or 'curve', with channel output plotted vertically against stick position on the horizontal axis. Some radios let you see this graph on a liquid crystal display, and all let you set a number of points on the curve, which the computer then connects with (usually) straight lines. As a minimum, you can set the two stick endpoint levels (this is like setting the ATVs), plus one point in between. Modern radios usually let you set more points than this, and also allow you to set several complete curves, which can be selected with a switch during a flight session. For instance you might have a curve suited to hovering practice, another for flying about, and another for aerobatics involving inverted flight. The latter would probably be a 'V' shaped curve with minimum throttle at centre-stick. The throttle curve is one of a number of settings used by model helicopter pilots in order to optimise climbout performance on their machines. To make a helicopter climb it is necessary to combine an increase in collective rotor blade pitch with an increase in engine throttle. Ideally the two are balanced so that the rotor speed remains constant at all times, i.e. engine throttle is increased to exactly compensate for the extra loading when the collective pitch is increased, etc. The Hoverfly has no collective pitch control, and climbout depends wholly on throttle. This simplifies things greatly, but the throttle curve nevertheless needs to be set appropriately. It should be adjusted to provide a proportional (straight line) relationship between joystick and output signal, travelling from -100% to +100% with the zero point at mid-stick. The relationship between the throttle curve endpoints and the ATVs depends on the transmitter. Sometimes the ATVs over-ride the throttle curve settings (never the other way around, as far as I know), sometimes the lowest of the two settings prevails, and sometimes one setting is scaled by the other. Setting both to +/-100% is a good way to start since it covers all these eventualities.

3: Trims (and electronic sub-trims): Trims are the small adjuster levers next to the joysticks; they allow the mid-stick signal levels to be adjusted so that the aircraft's control surfaces are at their neutral positions when the joysticks are centred. There is a trim for the throttle, and it should generally be centred with the Hoverfly. On many transmitters, particularly cheap ones, the trim simply shifts the whole stick range up and down; changing the trim therefore alters both endpoints as well as the signal at mid-stick. On other types the trim adjusts the mid-stick signal without changing the endpoints. Transmitter manuals seldom give this sort of subtle detail, but it can be useful to know, and it's well worth experimenting. If the trim alters the endpoints then pushing it forwards will improve Hoverfly climbout! Many transmitters also have electronic sub-trims which can be adjusted along with all the other computerised settings. The throttle sub-trim should generally be centred, since zero output at mid-stick is desirable and sub-trims never alter the endpoints.

Cheap radios often do not have any of these controls, except for external trims. However there are other causes (and solutions!) for Hoverfly climbout problems; please read on.

Mechanical Throttle Limiters.

Many transmitters have mechanical stops on the throttle stick which limit physical movement to less than the full range. It is easy to tell whether your transmitter has these stops, by comparing the physical positions of the left and right joysticks when pushed fully forwards (or backwards). The stops typically reduce throttle range by about 20%, with a disastrous effect on Hoverfly climbout! I have a theory as to why these stops are fitted (see below), but in practice they seem to be nothing but a nuisance. The good news is that they can almost always be removed easily.

The stops usually take the form of one or more plastic components screwed to part of the throttle joystick gimbal. By carefully comparing the two joystick mechanisms they can be spotted easily enough. They generally comprise either a pair of wedge shaped pieces of plastic (one for each end of the stick travel), or a single 'widget' which limits stick range at both ends. Because they are screwed into place they can be restored later (if you want them back for some bizarre reason). Transmitter manuals typically sanction (and describe) opening up the unit to make various adjustments, so no warranty problems arise from delving inside.

Computer radios frequently have throttle limiters fitted, and on these units the ATVs can be set to +/- 120% or so to compensate for the reduced stick throw, as an alternative to removing the mechanical stops. However it is better to remove them, since throttle precision is impaired by compressing the full range into diminished physical stick movement.

Certain transmitters, specifically the Futaba Skysport 6YG, do not have mechanical throttle limiters, but instead have their electronics rigged up to generate a throttle signal range *just as if* limiters were fitted. Thus the throttle has about 20% less signal range than the other channels, but there are no plastic 'widgets' to remove! An electrical modification is required to solve this one (a single resistor value needs changed in the Skysport 6); I can supply details of this on request. However if a transmitter is to be purchased especially for the Hoverfly, I would strongly recommend avoiding the above type. The Skysport 4 is a good choice for the Hoverfly (and cheaper than the Skysport 6). It does have mechanical stops, but these are of the 'single widget' type and are easily removed.

Why Fit Throttle Limiters?

On the face of it, throttle limiters seem crazy. Even after much consideration, they still seem crazy. They make the transmitter awkward to use with the Hoverfly (and other electric models), and reduce throttle resolution on all models by squeezing the throttle range into less than full joystick movement. The only semi-explanation I have been able to come up with is that the limiters force the modeller to rig up the model's throttle mechanics (cranks and pushrods) to use only the central part of the servo's angular range. The linear displacement of a pushrod is roughly proportional to the sine of the crank's angular motion; pushrod movement is therefore a fairly linear function of servo rotation in the centre region, say between $\pm 45^\circ$. Outside this range pushrod motion falls off rapidly, dropping to zero at the crank dead centre positions. A precise relationship between joystick position and engine throttle setting is crucial on many models, especially helicopters, so proportional actuation mechanics are helpful. However a typical engine throttle lever is itself a crank, so the non-linearities at opposite ends of the pushrod will cancel one another out to some degree. Also, it seems odd to single out the throttle in this way since linearity issues apply to the other aircraft controls as well, especially helicopter collective pitch which has to track throttle according to a precise relationship. It is perhaps surprising that linear output servos with rack-and-pinion mechanisms are not more popular, since they would eliminate the linearity issue. They used to be made, but I haven't seen them recently. I find it frustrating that transmitter manufacturers force their views on us, instead of supplying the flexibility we need in order to find solutions which suits us.

Signalling Standards.

This is where I really get down to business; the foreplay's over! Radio control transmitters send information about the positions of all the channels by means of a series of timed electrical pulses. One pulse is transmitted for each channel in turn; the setting of a channel is denoted by the time elapsed between its pulse and the previous one. The whole sequence repeats about 50 times per second, thereby updating the channel positions continuously (strictly speaking, only PPM transmitters work this way. However, even PCM signals get converted to timed pulses inside the receiver before reaching the servos).

Although all transmitters work this way, there is unfortunately no universal agreement over the scaling of this scheme. On a JR transmitter, a centred channel is represented by a time period of 1.50 ms. On a Futaba transmitter, the time is 1.52 ms. This difference is minor, amounting to about 5%, so it doesn't prevent JR servos being used with a Futaba radio, for instance. However, owners of JR radios will notice that the Hoverfly comes out of the box slightly out of trim, because it is factory preset for Futaba.

A far more important issue is that of channel range, since this affects Hoverfly climbout. In the past, 100% stick deflection either side of centre was denoted by a timing change of 0.5ms; the time period representing a channel could therefore vary between about 1.0ms and 2.0ms. The Hoverfly controls (including the throttle) were designed to match this. However, during the last few years the R/C industry has been gradually adopting a new standard of ± 0.4 ms to represent 100% deflection. Channel range has effectively been reduced by 20%, without any acknowledgement being made anywhere, as far as I know. The reduction has gone even further on some transmitters. I mentioned the Futaba Skysort 6YG earlier in relation to throttle limiters; the 'electronic limiters' built into it actually reduce throttle throw to ± 0.3 ms (not much over half of ± 0.5 ms throw), so it's hardly surprising that it doesn't work very well with the Hoverfly. Futaba's FF9 transmitter has ± 0.3 ms signalling on the first four channels (the joysticks). However, it does have ATVs, so the throttle can be set above 100% to compensate. I suggest $\pm 150\%$, or whatever the maximum is!

I'm not sure which manufacturer led the way with these changes, but most seem to have followed suit now. Hitec haven't as yet, and their Focus 4 transmitter is a superb (and inexpensive) radio that works brilliantly with the Hoverfly.

In March 2002 we modified the Hoverfly electronics to match the new +/-0.4 ms standard. We have been in a dilemma over this, because changing too soon would result in a lot of Hoverflies being over-driven by the older +/-0.5 ms radios, with possible complications. We didn't want to change over too soon. The result of the change is that the Hoverfly now works properly on most current radios, although it is still well worth removing the throttle limiters.

If you are experiencing climbout problems with a Hoverfly dating from before the changeover (or even if you are not sure about it), please get in touch with us. We will happily modify an older control unit (ECP) to the new standard free of charge.

An Afterword

The Hoverfly is supposed to fly really well! When it is working properly, very few pilots are unimpressed by its performance. Please get in touch with us if you are unhappy with it in any way; we are always happy to help.