PROGRAMMING THROTTLE CUT FOR ELECTRIC AIRCRAFT

1/17/2019

PROBLEM

Electric powered model airplanes are more dangerous than glow or gas powered airplanes in at least one respect; if the battery is connected to the electronic speed controller (ESC), inadvertently bumping the throttle may turn them on.

SOLUTION

Safety solutions include arming switches (where a separate action is required after plugging the battery in to actually connect the ESC) and a throttle cut function enabled in the transmitter. When the throttle cut function is activated on the transmitter, the throttle channel output sets the throttle (via the ESC) to off regardless of the position of the throttle stick. The activation function has to be on a two position switch, where two stable positions are available (throttle cut on and throttle cut off), not a momentary or push button switch which applies to glow or gas powered planes to kill the engine.

PROGRAMMING A KILL SWITCH ON A TRANSMITTER

You may find some of the following when programming a kill switch on your transmitter.

1. Many transmitters have a “throttle cut” function. However this function is designed to shut off a gas or glow engine when the throttle is at the low position. At high throttle, the function is disengaged and full throttle is the result. Also, some of these transmitters use a momentary button to active the cut. Not for electrics.
2. Some transmitters have a dual mode “throttle cut”. It can be programmed to shut off a glow or gas engine or programmed to shut off the ESC. In some cases the function is on a switch, which is appropriate. However, in at least one case, the manual says it “disarms the ESC”. Not sure what that means.
3. In some cases, the dual mode “throttle cut” function, when set to ESC, appears to operate properly for electric models. The language used in the manual is: “When Thr.

Cut is active, the throttle position is held regardless of the throttle stick position". This is what we want.

4. If your transmitter does not have a proper throttle cut function but does have at least one channel mix available, you can program it to perform a throttle cut function. See the following slides for how to do that.
5. If you have a Spectrum DX7s, DX-8, DX-9 or higher transmitter, the throttle cut function is available in the Function List for the particular model selected and you don't need to resort to using mixing.

In the following slides, slides 1-6 provide general information about mixing in computer transmitters. It is provided so that you can see what is happening in the transmitter and permit troubleshooting if things don't work the way you expect. Slides 7 and 8 provide specific instructions regarding how to program the throttle cut function. Specific menu navigation, button pushes, scroll wheel actions, etc. are dependent on the brand and model transmitter you have. Refer to the manual.

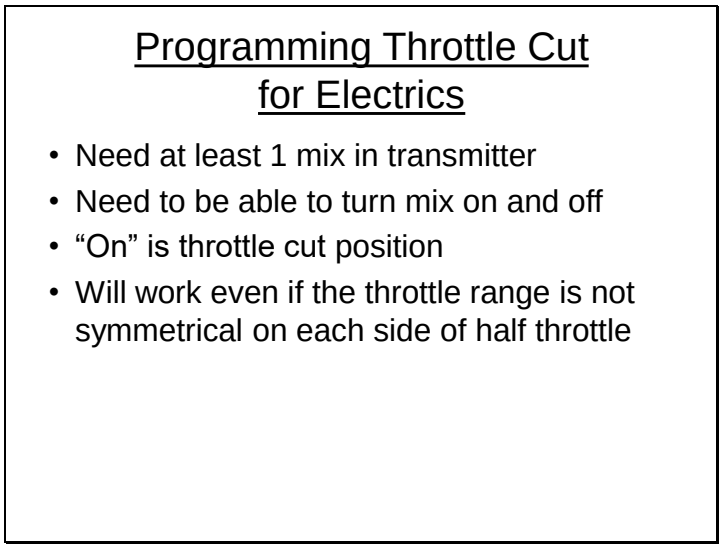
<u>One can go directly to Slides 7 and 8 and program their transmitter without reviewing Slides 1-6.</u>

<u>Bottom Line:</u>

<u>Program a kill switch on your transmitter for safety</u>

<u>Read the manual and test out the function before relying on it for field operation.</u>

Slide 1

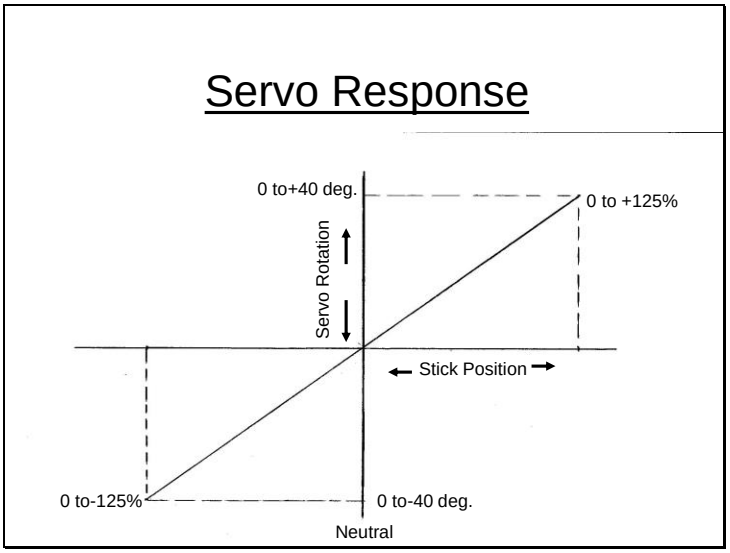


Slide 1 lays out the throttle cut function.

Most computer radios have at least one mixing function. More modern computer radios have a throttle cut function built in, so a separate mix is not required. Follow manufacturer's instructions regarding setting up the throttle cut function if the transmitter has one.

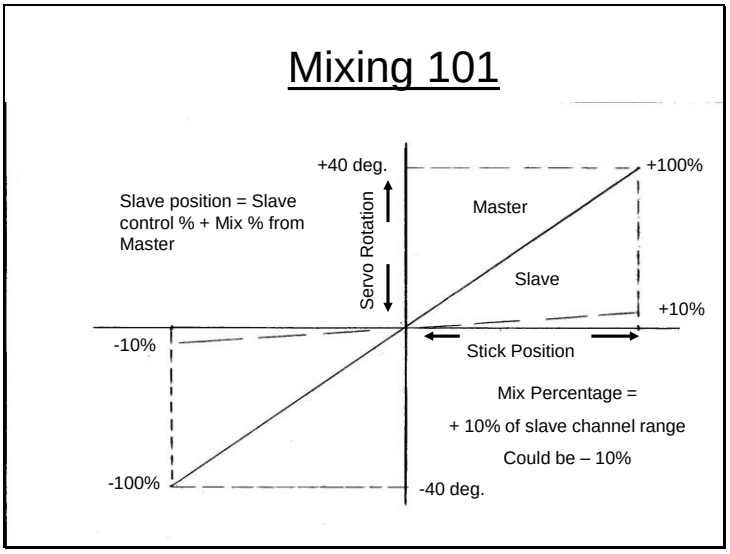
This discussion will focus on Spectrum transmitters that don't have the throttle cut function available (e.g. DX-7) because I am familiar with them. Programming for other brands will be similar, although the terminology might be different.

Slide 2



Slide 2 shows the servo response (typically up to 40 degrees or so) as a function of stick position. I will use servo response as the system output for this discussion even though (for electrics) there is no servo on the throttle channel. That way one can visualize what is happening in the throttle channel. The range of 0 to 40 degrees is shown because the transmitter can be adjusted to provide less servo response at the extremes than 40 degrees.

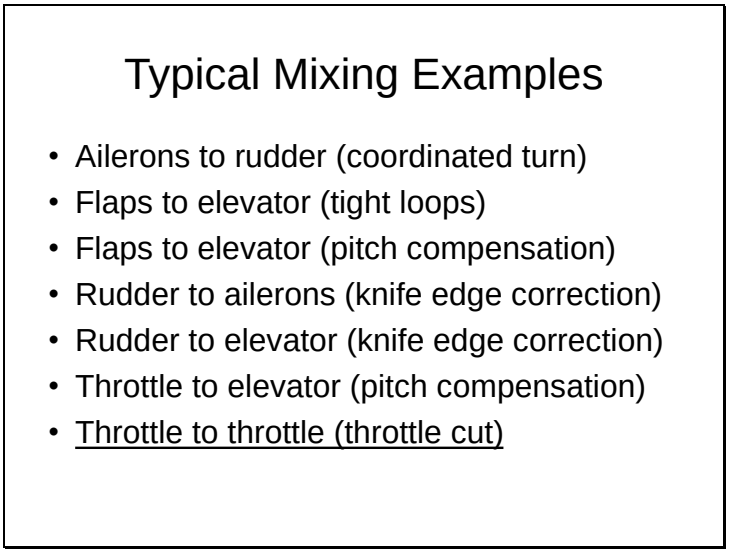
Slide 3



Mixing involves the interaction of two transmitter channels. The master and the slave. The master channel is typically the channel that controls the flying surface (rudder, aileron, elevator, etc.) The slave channel output is controlled by the slave channel controller (stick, switch, etc.) but is also controlled by the master channel when its position is changed. Also, in most cases, the master and slave channels are different, but not in the case we are considering.

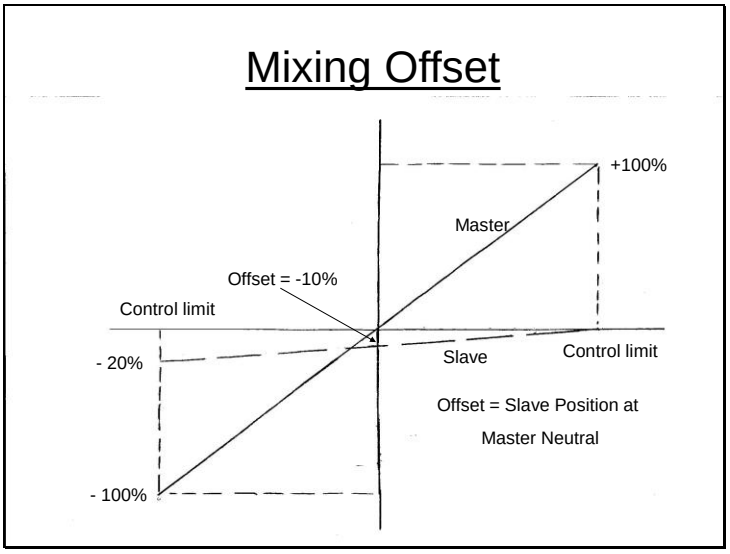
In slide 3, an example of a + 10% mix is shown. Therefore, when the master control (stick position in the slide) is moved over its range, the slave channel will move 10% of its range. This is in addition to whatever movement the slave channel controller dictates, if any. Often, the master channel controls the slave channel and no additional slave channel input is provided by the flyer. The mix can also be negative, in which case, the master effect on the slave is reversed.

Slide 4



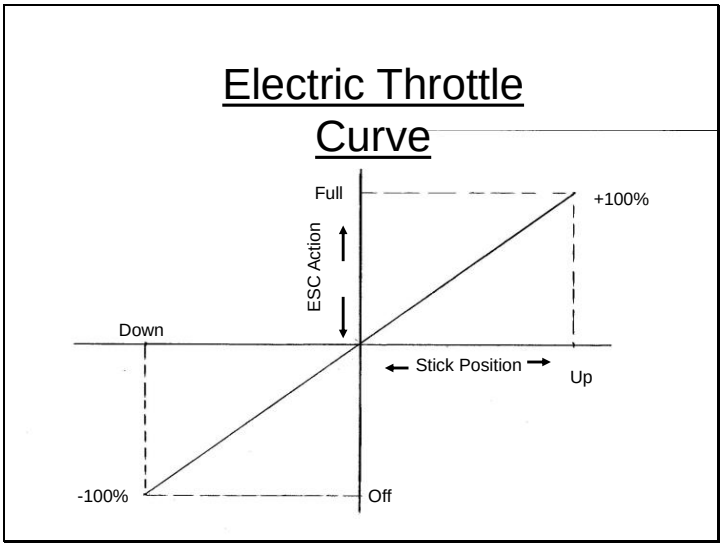
Slide 4 provides typical mixing examples used in RC flying and the reason for incorporating them in the transmitter setup. Note that a channel can be mixed to itself. That is how a throttle cut function is programmed.

Slide 5



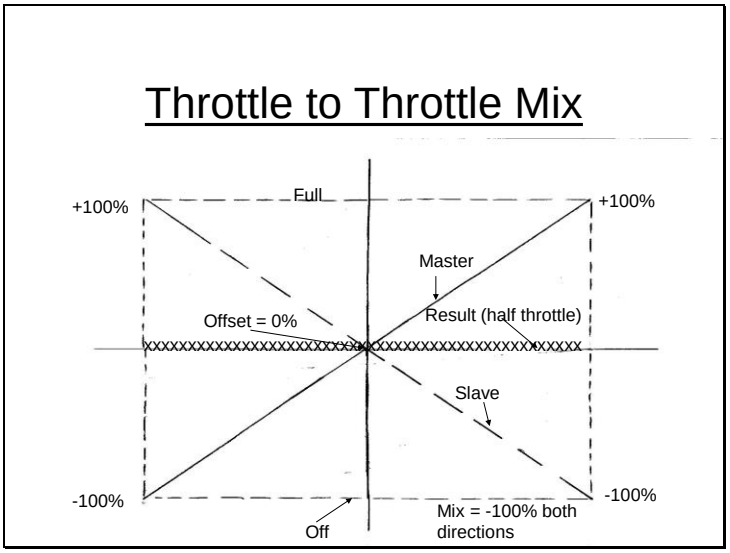
An additional mixing function is offset. Offset determines the slave channel position when the master channel output is at neutral (control stick center in most cases). This shifts the effect of the master on the slave. This feature is used in throttle cut programming.

Slide 6



Slide 6 shows a typical throttle curve for an electric model. ESC action is substituted for servo rotation, but the operation is otherwise identical. Shown here is +- 100% throttle range. My experience has shown that this programming procedure will work even though the range is not +- 100%. But, check it out before depending on it.

Slide 7

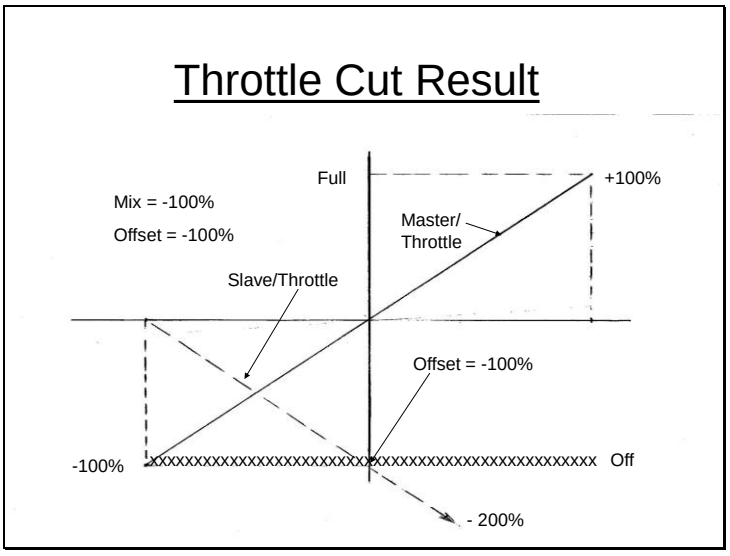


To begin the programming, a throttle to throttle mix needs to be set up, using a transmitter programmable mix, with -100% as the mixing value for both directions of the mix. Slide 7 depicts the result graphically. At full throttle, the throttle channel (master) is at 100%, or full throttle and the slave channel (also the throttle channel) is at -100 %. The net effect of the mixing is to add the two values at each position of the throttle stick. If we left the mix at this point, the effect would be normal throttle operation when the mix was shut off and half throttle when it is activated by a switch. This is obviously not what we want.

See slide 8 for the solution.

The mixing function needs to be assigned to a transmitter switch that has 2 positions. Then the mix can be turned on when the pilot desires to effectively disable the throttle stick and turn it off when getting ready to fly. The gear channel is typically used. See your transmitter manual for how to do that. However, be aware that in some modern on board flight stabilization systems, the gear channel is used to control flight modes and is not suitable for use as a throttle cut switch.

Slide 8



The offset function is used to modify the throttle channel response when the throttle cut function is activated (throttle to throttle mix is on).

The offset is set for -100 % for both directions of the mix. This moves the slave channel (throttle channel) response so that the mix effect is -100% at half throttle. If the two responses (master and slave) are added together, the net result for the throttle channel is – 100%, or off for all throttle stick positions.

This is what we want to happen. Be aware that not all transmitter brands may call this function an “offset”, but the function is likely there under another name.

Two More Bottom Lines

1. **When done with the programming check it out using the channel monitor function (or whatever it’s called for your brand of radio) to make sure that when the throttle cut is engaged, the**

transmitter channel output does not move from "off". Do this before arming your airplane or installing its battery.

2. **If your transmitter does not have a channel monitor function, remove the propeller from the aircraft and check out the operation of the throttle cut function.**
3. **If you do program a throttle cut, be sure to get in the habit of putting the transmitter switch in the position to activate it:**
    a. **Before turning on the transmitter (of course you do that before plugging in the battery and turning on the receiver, don't you?)**
    b. **Or, before plugging in the aircraft battery**
    c. **And immediately after landing and taxiing the aircraft to the pilot station (before picking it up for transport back to the pits) and/or before picking up the aircraft from the runway if it doesn't have a landing gear.**