What lies before you is an attempt to provide a set of written procedures to take you step-by-step through the programming of a typical 30%-40% RC aerobatic aircraft. The programming steps are intended to address the JR PCM 10SX, 10SXII, and 10X radio systems and today's IMAC style of aircraft that utilize 2 channels and servos each for ailerons, elevators and rudder. The Idea was to start at the very beginning with servo installation and linkage set up, and then proceed step-by-step until the basic programming set-up was complete. While in the process of describing some of the basic programming two things became immediately apparent. First was the fact that these radio systems were so rich in useful programming features that it would be difficult to exclude some of them even during basic set up. And second, it is a lot easier to do the actual programming than it is to write about it.

On more than one occasion fellow modelers have been overheard saying things like; "This radio has so many features that I don't know where to start learning about them" and "I can't use the manual because I don't know which part to read first" and "I don't know anything about computers so programming is too difficult." Well don't let the thought of programming intimidate you. Do you remember the first time you encountered Cruise Control in an automobile? It had some buttons that were attached to some form of computer. How long was it before you messed around with it and when you got it going you thought, "this is bad, cool, nifty, slick, or maybe even far-out" – depending on how long ago it was. Each and every feature in the radio was designed for a specific purpose – to help the aircraft fly better, easier, with more precision, faster, and slower… and to make the job easier for the builder, mechanic and pilot. All it takes is some "messing around" and perhaps a little guidance. Try to have some fun with it. Take your time, read and perform the steps below, and if things get terribly messed-up you can just start over and perform the steps as many times as you like.

Disclaimer: Owing to the number of variables that exist in each RC aircraft it cannot be guaranteed that these instructions will work for every installation. Therefore the author assumes no responsibility for any outcome including the proper operation of aircraft controls and functions, safety while testing and adjusting parameters, and any other effect that may be associated with the material contained herein.

You may mount your servos now and plug them into the channels indicated below or wait until one of the steps below instructs you to do so. However DO NOT ATTACH ANY LINKAGES TO THE SERVOS AT THIS TIME.

Plug the servos into the receiver ports as indicated below.

<table>
<thead>
<tr>
<th>SERVO LOCATION</th>
<th>RX CHANNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throttle servo</td>
<td>Channel 1 (Throttle)</td>
</tr>
<tr>
<td>Right Aileron servo</td>
<td>Channel 2 (Aileron)</td>
</tr>
<tr>
<td>Right Elevator servo</td>
<td>Channel 3 (Elevator)</td>
</tr>
<tr>
<td>Right Rudder servo</td>
<td>Channel 4 (Rudder)</td>
</tr>
<tr>
<td>Left Aileron servo</td>
<td>Channel 6 (Flap, Aux1)</td>
</tr>
<tr>
<td>Left Rudder servo</td>
<td>Channel 7 (Aux2)</td>
</tr>
<tr>
<td>Left Elevator servo</td>
<td>Channel 8 (Aux3)</td>
</tr>
</tbody>
</table>

TIP: If we plug a DSC or Trainer cord (or just a pin plug with no wires attached) into the DSC receptacle in the back of the transmitter it will turn on the display without transmitting and will enable us to program without running the battery down so quickly.
1. **Select a Model and Reset all Parameters (settings)**
   It is best to start with a fresh program that has all settings reset to factory defaults. This will ensure that all previous sub trim and trim memory settings are set to zero and that all programmable mixes, dual rates and other special functions are inactive. It will help to ensure the proper set up of all servo linkages/throws and there should be no surprises after set up is complete.

   a. Select a model using code **84**. All programming for this model is going to be erased in the next step. Touch ENTER when you have selected the model memory you want to use.
   b. RESET the programming for the model by accessing code **28** and touching CLEAR to reset all data for the model. Answer Yes to any questions regarding clearing or resetting the model and touch ENTER when you are finished. We now have a “Fresh” set up to work with.
   c. As a final step in this process, move all trim levers to their neutral or center positions.

2. **Name The Model**
   Lets name the model to help get our fingers limbered-up for programming.

   a. Access code **81** to select the appropriate letters/characters for the model name. Touch the SEL key to change the selection of characters across the bottom of the display until we see the character we want. Then touch the character. Touching it will move the character to the next position in the model name. The cursor will automatically move one position to the right ready for us to select the next character (the cursor is a pointer that shows us where the next letter is to be inserted -- it only moves to the right and will wrap around to the beginning when it gets to the end). If we want to leave a space, touch the arrow key to move the cursor one position to the right. If we make a mistake and need to replace a letter or want to reposition the cursor just keep touching the arrow key until the cursor gets to where we want it to be and select the character we want. If we need to replace a character with a space, touch the arrow until the cursor is positioned at the character to be replaced, touch SEL until we see a space character at the bottom of the display and then touch the space character. Keep selecting characters until we have the model name completed. Touch ENTER when finished to exit the Model Name function.

3. **Set the Wing Type to FLAPERON**
   In order to use two channels/servos for the ailerons we will take advantage of the FLAPERON wing type and its ability to control 2 aileron servos on two separate channels.

   a. Access the Wing Type function using code **22**.
   b. Touch SEL under NORMAL until FLAPERON appears. Then touch ENTER to exit the Wing Type function

4. **Inhibit the FLAP, AUX2 and AUX3 Levers and Switches**
   We need to disable the FLAP, AUX2 and AUX3 levers and switches because we are going to use these channels for primary flight controls (ailerons, elevators and rudder) and we no longer want the levers and switches to control them.

   a. Access TRIMMER FUNCTIONS or FUNCTION SELECT using code **17**.
   b. For the **10SX** owner, touch CLEAR under FLAP, AUX2 and AUX3 until INH appears under each indicating that the levers and switches are inhibited. For the **10SXII** and **10X** owner, touch SEL under the 1st column that has FLAP in it until the little arrow is next to FLAP. Touch CLEAR to inhibit the FLAP lever. Touch SEL again and the arrow will be next to AUX2 – touch CLEAR again to inhibit the AUX2 switch. The arrow should already be next to AUX3 in the 2nd column so just touch CLEAR under the 2nd column to inhibit the AUX3 lever.
   c. Make sure that FLAP, AUX2 and AUX3 all have INH next to them before touching ENTER to exit the function.
5. **Set Up A Mixer for Dual Elevator Channels/Servos**

At this point we will set up a mixer for the elevator channels/servos. For PCM 10SXII and 10X owners this involves only 1 setting because these transmitters have a built-in function to handle dual elevator servos. The PCM 10SX requires programming of a programmable mixer to control two elevator servos on separate channels. By the way, using a separate servo and channel for each control surface has the benefits of providing redundancy; ease of setting both servos to neutral; and the ability to remove any differential throw that may be inherent in the linkages.

a. PCM 10SXII and 10X owners, return to the Wing Type function code 22 and touch SEL under TAIL until D/ELEV appears. The radio will now automatically use a built-in mixer to control channels 3 (Elevator) and Aux3 (channel 8) for the elevator servos. We are finished with this step so touch ENTER to exit.

b. For PCM 10SX owners select the first programmable mixer using code 51 and continue with the steps in this topic.

c. Touch number 3 to set the Elevator as the Master channel and then touch 8 to set channel 8 or Aux3 as the Slave channel. Then touch ENTER to get to the next display. If you make a mistake, touch CLEAR and touch 3 and 8 again before touching ENTER.

d. Hold the elevator stick in the up-elevator position and touch and hold the + key until the percentage reads 100%. Now push and hold the elevator stick in the down-elevator position and touch and hold the + key until the percentage reads 100%.

e. Touch the PAGE key to get to the next display.

f. Touch SEL under MASTER until INLC appears indicating that INCLUDE mixing is activated. INCLUDE mixing tells the mixer to move the left elevator anytime the right elevator moves regardless of where the input is coming from (stick, snap button, another program mix etc.)  
*Always activate INCLUDE mixing when mixing two channels for a primary flight control (Aileron, Elevator, Rudder).*

g. Now touch SEL under TRIM until ON appears so that the left elevator will move with the right elevator when the elevator trim lever is moved.  
*Always activate TRIM when using multiple channels for a primary flight control.*

h. Programming of the dual elevator mixer is now complete. Touch ENTER to exit the mixer.

6. **Set Up A Programmable Mixer for Dual Rudder Channels/Servos**

Now we’ll set up a programmable mixer for the Dual Rudder channels/servos.

a. Access the second programmable mixer using code 52.

b. Touch number 4 to set the Rudder as the Master channel and then touch 7 to set channel 7 or Aux2 as the Slave channel. Then touch ENTER to get to the next display. If you make a mistake touch CLEAR and then 4 and 7 again before touching ENTER.

c. Hold the Rudder stick in the right-rudder position and touch and hold the + key until the percentage reads 100%. Now push and hold the rudder stick in the left-rudder position and touch and hold the + key until the other percentage reads 100%.

d. Touch the PAGE key to get to the next display (10SXII & 10X owners touch PAGE twice).

e. Touch SEL under MASTER until INLC appears indicating that INCLUDE mixing is activated. INCLUDE mixing tells the mixer to move the left rudder servo anytime the right rudder servo moves regardless of where the input is coming from (stick, snap button, another program mix etc.)  
*Always activate INCLUDE mixing when mixing two channels for a primary flight control (Aileron, Elevator, Rudder).*

f. Touch SEL under TRIM until ON appears so that the left rudder servo will move with the right rudder servo when the rudder trim lever is moved.  
*Always activate TRIM when using multiple channels for a primary flight control.*

g. Programming of the dual rudder servo mixer is now complete. Touch ENTER to exit the mixer.
7. **Set Servo Directions For All Channels**

It is important that all servos move in the proper direction before proceeding with any other programming. Make sure all servos are mounted in their intended locations and plugged into the channels indicated at the beginning of these instructions.

Temporarily install an output arm on each servo just for a visual reference – there is no need to install the output arm screws yet as they will be moved and repositioned in subsequent steps. The servo arms for both elevators should be pointing in the same direction (both up or down) and the servo arms for the rudder servos should be pointing in the same direction (both up or down). **DO NOT ATTACH ANY LINKAGES TO THE SERVOS AT THIS TIME.**

a. Turn on the transmitter and receiver and access the Reverse Servo function code 11.

b. Move the throttle stick from low to high and note the direction of travel relative to the throttle arm on the carburetor. If moving the throttle stick to high will cause the carb to open once the linkage is attached, then it is ok. Otherwise touch 1 on the bottom of the display to reverse the throttle servo direction.

c. Move the aileron stick to the Right and note the movement of the Right aileron servo. If the servo movement will cause the Right aileron to deflect upward once the linkage is attached then the right aileron servo direction is ok, if not, touch the 2 at the bottom of the display to reverse the direction of the right aileron servo. Now observe the Left aileron servo when the aileron stick is moved to the Right. If its movement will cause the Left aileron to deflect upward it is ok, otherwise touch 6 at the bottom of the display to reverse the direction of the left aileron servo.

d. Move the elevator stick to the Up-elevator position and observe the movement of the Right elevator servo. If its movement will cause the Right elevator half to deflect upward once the linkage is attached it is ok, otherwise touch 3 at the bottom of the display to reverse the direction of the right elevator servo. Move the elevator stick to the Up-elevator position again and observe the Left elevator servo. If its movement will cause the Left elevator to deflect upward then it is ok, otherwise touch 8 at the bottom of the display to reverse the direction of the left elevator servo.

e. Move the rudder stick to the Right and note the movement of the Right rudder servo. If the servo movement will cause the rudder to move Right once the linkage is attached then it is ok, otherwise touch the 4 at the bottom of the display to reverse the direction of the right rudder servo. Now observe the Left rudder servo when the rudder stick is moved to the Right. If its movement will cause the rudder to deflect Right it is ok, otherwise touch 7 at the bottom of the display to reverse the direction of the left rudder servo.

f. Touch ENTER to exit the servo reversing function.
8. Set Up and Adjust the Throttle Linkage

Now we will set up the throttle linkage and adjust the servo travel for full throttle and idle. **Note:** Use a non-conductive linkage such as a Ny-Rod if the engine has an ignition system! Using a non-conductive linkage greatly reduces the possibility of interference should the ignition develop a leak. **Note:** some carbs come equipped with a throttle-stop mechanism (usually an adjustable screw) that can keep the throttle from closing all the way. Either adjust the screw so the carb can be closed tight or remove it altogether as we want the throttle servo to be able to close the carb far enough to stop the engine.

a. Turn on the transmitter and receiver and set the throttle stick at 1/2 throttle.

b. Move the throttle trim lever to its center detent and install a medium-length servo arm on the throttle servo so that the arm is 90° or perpendicular to the throttle linkage.

c. Install the throttle linkage attaching one end to the servo arm (use the hole furthest from the output shaft) and the other end to the carb lever that opens and closes the carb. Adjust the linkage so that the carb is halfway open to correspond to the throttle stick being midway between high and low throttle. Make sure there is no binding whatsoever in the linkage!

d. Access the TRAVEL function using code 12. PCM 10X owners should touch the “S” at the top of the display to allow independent adjustment of the high- and low-end travel.

e. Move the throttle stick to the full-throttle position and observe the carb and linkage. If the carb is fully open and the servo is buzzing and/or the throttle linkage is bending it is an indication that there is too much travel. If this is the case, touch the “–” key under THRO to decrease the servo travel until the servo stops buzzing and the linkage stops bending. If the carb is not fully open with the stick at high throttle then there is not enough throw. In this case touch the + key Under THRO to increase the travel until the carb is just fully open and no more. If the travel reaches 150% and the carb is still not fully open, then a longer servo arm is required or you must attach the linkage closer to the pivot point at the carb lever.

f. Now move the throttle stick to the full-low position and observe the carb and linkage. If the carb is closed tight and the servo is buzzing there is too much throw in this direction. If this is the case, touch the "–" key under THRO until the servo stops buzzing and the carb just begins to open about 1/32". If the carb is not closed within about 1/32" then more throw is required and you must touch the + key under THRO until the carb is just barely open. If you reach 150% travel and the carb is still not within 1/32" of being closed there is probably differential built into the linkage. Try removing the servo arm and rotating it 1 spline towards the low-end travel and readjust the high-end again. If there just isn't enough travel, a longer servo arm is required or the linkage must be attached closer to the pivot point on the carb lever.

g. Now move the throttle trim lever to the full-low position. It should completely close the throttle. If there is excessive servo buzzing with the throttle trim at full low, then touch the"–" key under THRO a few more times to reduce the throw a few more percentage points.

**Note:** Once you have finished setting the throws look at the percentages for low- and high-end travel. If they are rather small (less than 60%) you may want to move the linkage inward on the servo arm and perform all adjustments again from the beginning to provide better resolution.

h. Final adjustment of the throttle low-end travel should be performed with the engine running and a helper securely holding the aircraft. Start the engine and run it until it gets up to normal operating temperature.

i. Access TRAVEL code 12 (10X owners touch S) and position the throttle trim lever in its center detent. If the engine idle gets too low and the engine quits when the trim lever is positioned in the center, touch the "–" key under THRO to reduce the low-end Travel until the engine does not die with the trim in its center detent.

j. Making sure the engine stays up to temperature, adjust the low-end travel using the + and – keys under THRO until you get the lowest dependable idle with the throttle trim in it’s center detent position. This completes the throttle servo adjustment so touch ENTER to exit.
**SUB TRIM AND MECHANICAL ADVANTAGE**

**Sub Trims** are intended for relatively minor adjustments to servo linkages and not for major trim adjustments to the aircraft. Using excessive sub trim percentages can cause a loss in servo resolution where the servo reaches its travel limit and stops moving before the control stick is fully deflected.

The diagram below illustrates an ideal servo/linkage setup when the servo is at neutral (no sub trim or trim offset and digital trim centered). Notice that the servo arm is positioned at 90° or perpendicular to the servo. Also note that the linkage or rod is attached at 90° to both the servo arm and the control surface horn. This setup will result in the same amount of throw in both directions (0 differential throw). If the servo cannot be mounted parallel to the linkage/rod then just make sure the servo arm is at 90° to the control rod when the servo is at neutral.

**Mechanical Advantage** is a very important concept when dealing with larger aircraft. It refers to the leverage that the servo can exert on the control surface. Since the control surfaces are rather large it is important for the servo to have enough mechanical advantage or leverage to control them, regardless of the servo's rated torque. A large amount of torque is of little value if there is not enough leverage to use it. Insufficient leverage can lead to control surface flutter (usually a catastrophic event) and blow-back where the air flow pushes the control surface backwards resulting in mushy or no control at higher speeds.

There are two ways to increase the mechanical advantage of the servo. One is to make sure that the control horn device, whether it be a horn as shown in the illustration above or a bolt with a Rocket City-type fastener, is long enough. The horn is the lever that the servo uses to control the surface. The longer the horn, the more leverage the servo has. It's like a Lug Wrench – when you can't get a lug nut loose you put a piece of pipe over the end of the lug wrench to extend the handle and that gives you more leverage to break the lug nut free. It's the same thing - the lug nut is the control surface and you are the servo trying to move it. *As a general rule-of-thumb, try to attach the linkage at the control surface so that it is at least 1" away from the surface – longer is better.*

The second way to increase the mechanical advantage for the servo is to attach the linkage at the servo arm as far inward (towards the servo arm retaining screw) as possible while still providing enough throw. It's the "lever thing" again, but in reverse, as we are trying to *take leverage away from the control surface* by providing it with a shorter lever to work against the servo.

Ensure that the attach-point is the same distance from the hinge line for like surfaces (two ailerons, two elevators and two rudder horns). If the attach points are not the same distance from the hinge line there will be unequal throw and it will be more difficult to synchronize the surfaces for equal deflection. *This is especially critical for the rudder where two servos are attached to the same surface – unequal throw will cause the servos to fight one another causing excessive battery drain, and in severe cases may cause servo damage.*

Always try to use the maximum amount of Travel (100%-150%) that the radio provides. If it is too much travel don't reduce the percentage of travel in the radio, instead, move the linkage further away from the hinge line at the control surface and/or move the linkage inward on the servo arm or use a shorter arm. If you use high percentages of travel you maintain resolution (fine movements of the stick result in fine positive movements of the control surface). When we decrease travel percentages we lose resolution.
9. **Set Up and Adjust the Dual Elevator Servos and Linkages**

The two elevator servos and linkages will be set up so they match one another at center (neutral) and at full deflection up and down. The objective is to first get everything aligned as closely as possible from a mechanical perspective by installing the servo arms correctly and mechanically adjusting the linkages. Only then should the radio settings be adjusted to fine-tune everything. Remember, the excessive use of Sub Trims is to be avoided, as it will result in dead band and a loss in resolution.

a. Turn on the transmitter and receiver and make sure the trim levers are centered. It is assumed that all Sub Trims and Trim Offsets are still set to zero as a result of performing the RESET operation at the beginning of these instructions. If you did not perform the RESET operation then set all sub trims to zero using code **15** and reset all Trim Offsets (PCM **10SX** and **10SXII** only) to zero using code **82** and touching CLEAR under AIL, ELEV and RUDD.

b. Install servo arms on the 2 elevator servos so that the arms are at 90˚ or perpendicular to the servo cases (i.e. straight up or straight down). Rotate, swap and reinstall the arms or try different arms if necessary to get them as close to 90˚ as you can. It is not unusual for the arms to be tilted slightly and we will fine-tune them in a minute but get them as close as you can for now.

c. Access the Sub Trim function code **15** and touch the + and – keys under ELEV to adjust the Right elevator servo so its arm is right at 90˚ to the case (straight up or straight down).

d. Touch PAGE to get to the next display of channels and touch the + and – keys under AUX3 to adjust the Left elevator servo until its arm is right at 90˚ to the servo case.

e. We now need to set the Right elevator half to 0˚ incidence in relation to the wing. This can best be accomplished by placing an incidence meter on the wing inboard of the ailerons and blocking-up the tail until the wing incidence is at 0˚. Now install the linkage for the Right elevator half. Put the incidence meter on the Right stab/elevator and adjust the Right elevator linkage to obtain 0˚ incidence (or as close to 0˚ as you can get). Now do the same for the Left stab/elevator and its linkage.

f. If zero degrees incidence could not be obtained using the mechanical adjustments, use the SUB TRIM function (code **15**) and touch the + and – keys under ELEV to adjust the Right elevator servo and touch the + and – keys under AUX3 (on the next PAGE) to adjust the Left elevator servo to get both elevator halves at 0˚. When finished, both stab/elevator halves should be at 0˚ incidence relative to one another and to the wing.

g. Now its time to adjust the overall travel (up and down) of the two elevator servos. The elevator travel should be set to the maximum that you ever intend to use for precision aerobatic flying. As a general guideline, use as high a percentage of travel as you can (100%-150%) in order to maintain maximum resolution. If a high percentage of travel results in too much throw do not decrease the travel of the servo. Instead, move the linkage outward (away from the hinge line) at the elevators or, move the linkage inward on the servo arm or use a shorter servo arm. This will decrease the throw while increasing resolution and the mechanical advantage of the servo!

h. Access the TRAVEL function (code **12**). (PCM **10X** owners touch $. Hold the elevator stick in the up-elevator position and touch the + and – keys under ELEV to set your maximum deflection for the Right elevator half. Do the same while holding the elevator stick in the down-elevator position. Now adjust the travel of the Left elevator by touching PAGE and touching the + and – keys under AUX3 to exactly match the travel of the Right elevator in both directions. A degree gauge works well for matching deflections. Dual elevator set up is now complete!

**NOTE**: Once the elevators have been adjusted as described above, use the TRACE RATE function (code **14**) to make future adjustments to overall elevator travel. Using TRACE RATE eliminates the need to individually measure/adjust the throws of each servo when more than one channel is used for a primary flight control (Elevator, Aileron, Rudder). It is used to make adjustments only after the channels have been setup for equal throws.
10. Set Up and Adjust the Dual Rudder Servos and Linkages

The two rudder servos and linkages will be set up so they match one another at center (neutral) and at full deflection left and right. The objective is to first get everything aligned mechanically and then make fine adjustments with the radio. The excessive use of Sub Trims is to be avoided, as it will result in significant dead band and a loss in resolution. **It is very important that the servos don’t “fight” one another as it may cause excessive battery drain and in severe instances may cause servo damage.**

a. Turn the transmitter and receiver ON and make sure the rudder trim lever is centered.
b. Install servo arms on the 2 rudder servos so that the arms are at 90° or perpendicular to the servo cases (i.e. both straight up or both straight down). Rotate, swap and reinstall the arms or try different arms if necessary to get them as close to this position as you can.
c. Access the Sub Trim function code 15 and touch the + and – keys under RUDD to adjust the Right rudder servo so its arm is right at 90° to the case.
d. Touch PAGE to get to the next display of channels and touch the + and – keys under AUX2 to adjust the Left rudder servo until its arm is 90° to the servo case.
e. We now need to set the Right rudder servo and linkage center point. Install the linkage for the Right rudder servo and adjust the linkage so that the rudder is straight. If you cannot get it dead-on with the linkage, get it as close as you can and then use Sub Trim code 15 and touch + and - under RUDD to get it straight.
f. Now set the rudder throw in each direction by accessing TRAVEL code 12 (PCM 10X owners touch $) and touching the + and – keys under RUDD while holding the rudder stick to the right and then the left to establish the maximum desired throw in each direction. Make sure that the servo is not trying to move the rudder past the physical limitations of hinges and hinge line bevel. Excessive servo buzzing at the end points is an indication of binding and is undesirable.
g. Attach the linkage for the Left rudder servo BUT DO NOT MOVE THE RUDDER STICK! Adjust the linkage so that it does not fight the Right rudder servo when the rudder stick is at neutral. Get it as close as you can by mechanically adjusting the linkage. If the servos are buzzing loudly it is an indication that they are fighting one another at neutral. If this is the case, access Sub Trim code 15 and touch PAGE to get to the 2nd page of channels where you can touch the + and – keys under AUX2 until the servos are no longer fighting each other – it should only take a few percentage points to get them to stop fighting.
h. Disconnect the Left rudder servo linkage from the rudder but leave it attached to the servo. Access TRAVEL code 12 and touch PAGE to get to the 2nd page of channels (PCM 10X owners touch $). Now move the rudder stick all the way to the right and hold it there. Pick up the Left rudder servo linkage and hold it up to the attach point at the rudder to see if it needs more or less throw to properly attach and touch the + or – key under AUX2 until it looks like the linkage will attach properly. Next move the rudder stick to the Left and adjust AUX2 throw in this direction until it looks like the linkage will attach properly. Get these adjustments as close as you can!
i. Attach the Left rudder servo linkage to the rudder. Move the rudder stick all the way to the Right and listen and look for signs of the servos fighting each other. Touch the + and – keys under AUX2 until servo buzzing is at a minimum and the servos are not fighting each other. Now move the rudder stick all the way to the Left and repeat the adjustment. Dual rudder servo set up and adjustment is now complete!

**NOTE:** Once the rudder servos have been adjusted as described above, use the TRACE RATE function (code 14) to make future adjustments to overall rudder travel. Using TRACE RATE eliminates the need to individually measure/adjust the throws of each servo when more than one channel is used for the Elevator, Aileron, or Rudder. It is used to make adjustments only after the channels have been setup for equal throws.
11. Set Up and Adjust the Aileron Servos and Linkages

The two aileron servos and linkages will be set up so they match one another at center (neutral) and at full deflection up and down. The objective is to first get everything aligned mechanically by installing the servo arms correctly and adjusting the linkages. Only then should the radio settings be adjusted to fine-tune everything. The excessive use of Sub Trims (high Sub Trim percentages) is to be avoided, as it will result in significant dead band and a loss in resolution.

a. Make sure the aileron trim lever is centered.
b. Install servo arms on the 2 aileron servos so that the arms are at 90˚ or perpendicular to the control rods. Rotate, swap and reinstall the arms or try different arms if necessary to get them as close to this position as you can.
c. Access the Sub Trim function code 15 and touch the + and – keys under AILE to adjust the Right aileron servo so its arm is right at 90˚ to the linkage.
d. Touch PAGE to get to the next display of channels and touch the + and – keys under FLAP to adjust the Left aileron servo until its arm is right at 90˚ to the linkage.
e. Set the ailerons at neutral so that they are in line with the wing root trailing edges. Install the linkages for both ailerons. Adjust the linkages so that the aileron trailing edges are in line with the trailing edges at the roots of the wings. Get them as close as you can.
f. If exact alignment could not be obtained with the mechanical adjustments, use the Sub Trim function code 15 and touch the + and – keys under AILE to adjust the Right aileron servo and touch the + and – keys under FLAP (touch PAGE to get to the 2nd display) to adjust the Left aileron servo to get both aileron trailing edges aligned with the wing.
g. Now its time to adjust the overall travel (up and down) of the two aileron servos. The aileron travel should be set to the maximum that you ever intend to use for precision aerobatics. As a general guideline, use as high a percentage of travel as you can (100%-150%) in order to maintain maximum resolution. If a high percentage of travel results in too much throw then move the linkage inward on the servo arm (closer to the servo arm screw) or use a shorter servo arm, and/or move the linkage outward (away from the hinge line) at the ailerons.

Note: Ailerons are large long control surfaces and as such are more prone to flutter than elevators and rudder. It is therefore very important that the linkage set-up provide enough mechanical advantage for the servo to keep the ailerons under control. Mechanical advantage is increased when you attach the linkage closer to the servo screw on the servo arm and when you attach further away from the hinge line at the aileron. As a general rule-of-thumb, try to attach the linkage at the aileron at least 1” from the surface of the aileron and preferably more. If the horns/screws aren't long enough – get longer ones!

h. Access the TRAVEL function (code 12). (PCM 10X owners touch S). Hold the aileron stick in the full Right-aileron position and touch the + and – keys under AILE to set your maximum deflection for the Right aileron. Do the same while holding the aileron stick in the full Left-aileron position. Make sure the deflection is the same in both directions.
i. Now adjust the travel of the Left aileron by touching PAGE and touching the + and – keys under FLAP to exactly match the travel of the right aileron in both directions. A degree gauge works well for matching deflections. Dual aileron set up and adjustment is now complete!

NOTE: Once the ailerons have been adjusted as described above, use the TRACE RATE function (code 14) to make future adjustments to overall aileron travel. Using TRACE RATE eliminates the need to individually measure/adjust the throws of each servo when more than one channel is used for the Elevator, Aileron, or Rudder. It is used to make adjustments only after the channels have been setup for equal throws.

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12. Setting Dual Rates and Exponential Curves.

Dual Rates and Exponential curves can be very effective in setting up an aircraft to "feel" the way you would like it to feel when performing different types of maneuvers. You can essentially change the aircraft's personality just by flipping a switch, causing the aircraft take on traits that make certain maneuvers easier for the pilot. At times you may want the aircraft to feel very crisp such as when performing point rolls and sided-loops and then feel softer for other maneuvers such as rolling circles and consecutive rolls and yet other times when you would like the aircraft to be very crisp but without a the tendency to be over-controlled like in performing snap rolls. Dual Rates and Exponential curves can be combined to produce these traits for most any aircraft. When programming a Dual Rate and Exponential curve always think about what kind of maneuver or flying style you plan to accomplish with it.

**Dual Rates (D/R)** limit how far a control surface travels. Without dual rates your control surfaces deflect to their full travel – the travel that you previously established with the TRAVEL function and linkage set-up. When a D/R is programmed it limits the amount of deflection that occurs when the stick is moved to its extremes. For example if you set an elevator D/R to 75% the elevator will only deflect 75% or 3/4 of its full travel, if set to 50% it will be limited to ½ of its full travel and so forth. A D/R setting of 100% results in full travel again as though there were no D/R programmed at all.

An example of programming a D/R for the ailerons would be to set up an aileron D/R for flying consecutive rolls by setting the aileron D/R to 25% (actual percentage will vary). At this setting moving the aileron stick full left or full right would result in a roll rate of about 1 roll per second. This allows you to deflect the aileron stick all the way and just hold it there while concentrating on elevator and rudder inputs – flying consecutive rolls just became easier.

**EXPONENTIAL (EXP)** does not limit the total deflection of a servo/control surface – the surface still moves 100% of its travel. It does however determine how the surface reaches its full travel, or how the control surface moves relative to the stick. When Exponential is not used, the servo response is said to be linear. That is, every movement of the stick causes the same movement in the servo--if the stick moves 20%, the servo moves 20% and the control surface follows the stick throughout the entire travel range. When plotted on a graph where the X-axis (left and right) = stick movement and the Y-axis (up and down) = servo movement, the result is a straight line that is at 45 degrees.

When using Exponential, a positive (+) exponential percentage causes the servo to move less when the stick is close to the neutral point, and to move more as the stick moves further from the neutral point. For instance, the stick is moved from neutral to 20% and the servo only moves from neutral to 10%. As the stick is moved further from center (from 20% to 40%) the servo moves further and faster (from 10% to 35%) The further the stick is moved away from center, the higher the rate of servo movement. The larger the positive (+) Exponential percentage, the further the stick must be moved from center before the servo rate increases, and the faster the servo rate becomes when it gets close to the end of its travel. When stick travel (left and right) versus servo travel (up and down) is plotted on a graph, the result is a “curve”. The curve stays close to the X-axis at the center (small servo movement) and moves away from the X-axis at a greater rate (more servo movement) as the stick is moved further off center.
Exponential is typically used to reduce sensitivity or otherwise dampen movements around the neutral stick position without sacrificing full servo travel. This provides the pilot with very smooth and precise control of the aircraft while allowing relatively large movements in the control stick. It becomes easier to make very smooth and precise corrections that are difficult to detect.

The PCM 10SX and SXII allow 3 D/R and EXP settings each for Aileron, Elevator and Rudder. The 10X allows 3 D/R & EXP settings when Flight Modes are not activated and up to 5 D/R & EXP settings if all Flight Modes are activated.

In our example we will use the POS0 switch positions (switches in the UP position) for normal flying, POS1 (middle switch positions) for snap rolls and POS2 (switches all the way down) for consecutive rolls, slow rolls and rolling circles. If you are already familiar with Dual Rates and Exponential curves and have your own settings in mind, then please feel free to substitute your own settings. It is recommended however that you set rates and curves for each of the 3 switch positions for each control surface. It is also recommended that you use POS0 (switches in the upper position) for normal flying because of some Flight Mode considerations that will be introduced later.

**NOTE:** The percentages provided below are only starting points and serve mostly to convey the concept of Dual Rate and Exponential curves. You will need to test-fly the aircraft using the various switch settings to determine if percentages need to be increased or decreased.

a. **AILERON D/R & EXP.** Access the DR/EXP function 13. The Aileron D/R EXP display appears. If you move the Aileron D/R switch through its 3 positions you will notice the display changing to POS0, POS1 and POS2.

b. Position the Aileron D/R switch in its upper position (POS0). We will use this position for normal flying. Decrease the D/R percentage to 75% by touching – under D/R. This will limit aileron deflection to ¾ of full travel and set a moderate amount of exponential by touching + under EXP until it is +30%. Touch SEL under TYPE until NORMAL appears to select a normal exponential curve.

c. Now put the Aileron switch in the POS1 or middle position. We'll use this position for snap rolls where we want full Aileron deflection and perhaps less exponential so the Ailerons will be more responsive around neutral. Leave the D/R percentage at 100% and set the EXP percentage to +20 by touching + under EXP. Now touch SEL under TYPE until NORMAL appears.

d. To set the 3rd Aileron D/R EXP combination for consecutive rolls, slow rolls and rolling circles, set the Aileron D/R switch to its lower or POS2 position. Reduce the Aileron D/R percentage to 25% by touching – under D/R to give us a nice slow roll rate. Let's also set the EXP to +30% and set the TYPE to NORMAL.

You now have 3 aileron rates/curves defined – POS0 (upper position) gives ¾ Aileron travel and moderate exponential for normal flying, POS1 (middle position) provides full Aileron travel and has less Exponential for snap rolls, and POS2 (lower position) has significantly reduced aileron deflection for consecutive rolls and slow rolls. After test flying them, you can come back into D/R EXP code 13 and adjust them by PAGING to the Aileron display, moving the aileron D/R switch in the desired position (POS0, POS1, POS2), and adjusting the D/R and EXP percentages.

e. **ELEVATOR D/R & EXP.** Touch PAGE until the Elevator D/R EXP settings are displayed. Position the Elevator D/R switch in its upper position (POS0). We will use this position for normal flying. Lets leave the D/R percentage at 100% to provide full Elevator travel and set a moderate amount of exponential by touching + under EXP until +30% is obtained. Touch SEL under TYPE until NORMAL appears to select a normal exponential curve.
f. Now put the Elevator D/R switch in the POS1 or middle position. We'll use this position for snap rolls where we want to reduce Elevator deflection to help us avoid "burying" the snaps. We also want less exponential so the Elevators will move off center quickly. Decrease the D/R percentage to 50\% by touching – under D/R. This will limit Elevator deflection to ½ of full travel. Lets also set the EXP percentage to +20 by touching + under EXP. Now touch SEL under TYPE until NORMAL appears.

g. To set the 3rd Elevator D/R EXP combination, set the Elevator D/R switch to its lower or POS2 position. Reduce the Elevator D/R percentage to 75\% by touching – under D/R to give us enough Elevator authority, and lets set the EXP to +45\% to give us ultra-smooth control for Elevator input during rolling maneuvers. Touch SEL under TYPE until NORMAL appears to obtain a normal exponential curve.

You now have 3 Elevator rates/curves defined – POS0 gives full Elevator travel and moderate exponential for normal flying, POS1 has the Elevator travel reduced by ½ and has less Exponential for snap rolls, and POS2 has ¾ deflection and increased exponential for smooth inputs during rolling maneuvers such as consecutive rolls, slow rolls and rolling circles. After test flying them, come back into D/R EXP code 13 and adjust them by PAGING to the Elevator display, moving the Elevator D/R switch in the desired position (POS0, POS1, POS2), and adjusting the D/R and EXP percentages.

h. **RUDDER D/R & EXP.** Touch PAGE until the Rudder D/R EXP settings are displayed. Position the Rudder D/R switch in its upper position (POS0). We will use this position for normal flying. Lets leave the D/R percentage at 100\% to provide full Rudder travel and set a moderate amount of exponential by touching + under EXP until +35\% is obtained. Touch SEL under TYPE until NORMAL appears to select a normal exponential curve.

i. Now put the Rudder D/R switch in the POS1 or middle position. We'll use this position for snap rolls where we want to reduce Rudder deflection to help us avoid "burying" the snaps. We also want less exponential so the Rudder will respond quickly around neutral. Decrease the D/R percentage to 45\% by touching – under D/R. This will limit Rudder deflection to less than ½ travel. Lets also set the EXP percentage to +25 by touching + under EXP. Now touch SEL under TYPE until NORMAL appears.

j. To set the 3rd Rudder D/R EXP combination, set the Rudder D/R switch to its lower or POS2 position. Keep the Rudder D/R percentage at 100\% and lets set the EXP to +50\% to give us ultra-smooth control for Rudder input during rolling maneuvers. Touch SEL under TYPE until NORMAL appears to obtain a normal exponential curve.

You now have 3 Rudder rates/curves defined – POS0 (upper position) gives full Rudder travel and moderate exponential for normal flying; POS1 (middle position) has the Rudder travel reduced by more than ½ and has less Exponential for snap rolls; and POS2 (lower position) has full deflection and increased Exponential for smooth inputs during rolling maneuvers such as consecutive rolls, slow rolls and rolling circles. After test flying them, come back into D/R EXP code 13 and adjust them by PAGING to the Rudder display, putting the Rudder D/R switch in the desired position (POS0, POS1, POS2), and adjusting the D/R and EXP percentages.

k. **D/R EXP Notes.** As you touch SEL under TYPE you will notice that there are a number of Exponential types available—NORMAL, EXP/LIN, LIN/EXP, and VTR\%. Repeatedly touching SEL under TYPE will cycle through all of the available types.

**EXP/LIN** results in the servo following the stick in an exponential fashion for the first ½ of stick movement and then it switches to a linear progression (straight line) from ½ stick to full stick deflection.
LIN/EXP results in the servo following the stick in a linear fashion for the first ½ of stick movement and then it switches to an exponential progression (curved line) from ½ stick to full stick deflection.

**VTR (Variable Trace Rate)** is used in conjunction with Dual Rate and acts like a Double Dual Rate. When VTR is active, servo response follows the Dual Rate response line (smaller percentage gives a flatter line and less movement like a high EXP percentage) until the VTR point is reached (VTR point can be set at 50%, 60%, 70%, 80%, 90%). When the VTR point is reached, the servo rate increases, and the servo follows a higher linear rate. VTR is selected by touching SEL under TYPE until the desired VTR percentage appears. VTR can be used to produce a very versatile response curve. If for instance, an aileron Dual Rate is set relatively low (30%-60%) and the VTR point is set at 70%-90% the resulting response is moderately flat for the majority of travel and then increases dramatically toward the end of the travel. With this type of curve the response is docile around center for slow rolling; crisp in the middle for point rolls; and full at the ends for vertical rolls or crisp rolls at low speed.

**PCM 10SXII** owners have the ability to program 1 customized response curve for each control (Aileron, Elevator, Rudder). The curve is established by setting and moving points just like in programming a multi-point mixer. This feature allows you to tailor the response for both sides of neutral (i.e. one response for up-elevator and a different response for down-elevator). If you need a customized response curve and you are not familiar with programming multi-point mixers then wait until you cover multi-point mixing and then return to this section to program a custom response curve.

**PCM 10X** owners have the ability to set different D/R and EXP values in both directions for all 3 switch positions of each control (5 positions if 5 Flight Modes are activated). I.e. different D/R and EXP settings for up-elevator and down-elevator, right- and left-aileron, and right-and left-rudder. Just hold the stick in the desired direction while setting D/R and EXP values for POS0, POS1 and POS2 (and optionally POS3 & POS4)
13. Set Up Exponential for the Throttle

The larger engines typically employ a carburetor such as Walbro, Tillitson and Delorto. In many instances these carbs do not produce a linear throttle response where ¼ throttle stick movement results in ¼ engine RPM. Instead, they will cause engine RPM to increase very rapidly from low throttle up to about ½ throttle and then very slowly from ½ throttle to full throttle. When the carb is open ½ way the engine may be running at 75%-90% of its maximum RPM. Obviously this is not an ideal situation.

What we would like to have is a linear throttle response where the engine RPM follows our throttle stick so that at ¼ throttle the engine is running at ¼ RPM and at ½ throttle the engine is running at ½ RPM etc. This can be accomplished by causing the throttle servo to move in an EXPONENTIAL fashion which means that the servo will move very little for the first ¼ - ½ of stick movement and then move more rapidly as the stick is advanced further. Ideally, there should be a noticeable RPM change with each click of throttle stick movement.

a. PCM 10SX and 10SXII owners access the D/R EXP function 13. Touch PAGE 3 times to get to the Throttle Exponential display

b. Touch SEL under TYPE NORMAL until LO BASE appears. Now touch the + key until you obtain a percentage of approximately 30% - 40%. This is a good place to start. Some engines may require up to 70% exponential to achieve a linear throttle response while others may require less than 30%. Once your aircraft is all set up, run your engine and adjust the percentage until the engine RPM follows the throttle stick. If the engine RPM is still ahead of the stick position increase the percentage – if it lags behind the stick position then decrease the percentage. PCM 10SX and 10SXII owners are now finished with this step.

c. PCM 10X owners have the ability to program 2 separate throttle curves in order to finely tune the Exponential that is applied to the throttle and to set up specialty curves. We will program only one basic curve here.

d. Access the Throttle Curve function code 18. Touch YES at the Throttle Servo Hold question (it's a good habit to get into in the event you make adjustments with the engine running). Now touch SEL under EXP until ON appears.

e. Move the throttle stick to the full-low position. Now advance the throttle stick slowly while watching the bottom of the center of the display. When the word STORE appears, touch STORE and it will store a point on the 45-degree line. Advance the stick slowly again and each time you see STORE touch it to store a point on the line. When you finish you will have 5 or 6 points along the 45-degree line.

f. At this time, the 45-degree line represents a linear servo response (move the stick ½ way, the servo moves ½ way). Each of the points on the line PLUS each end of the 45-degree line can be adjusted by positioning the cursor (the vertical line that moves across the graph as you move the throttle stick) over a point and touching the + and – keys.

g. Position the cursor (vertical line) over point# 1 by moving the throttle stick. Touch the “-” key to drag the point down some. Do the same to points 2-4 until your curve looks something like the one to the right. This is a good place to start. Final adjustments need to be made while running the engine with a helper securely holding the aircraft. If the engine still accelerates to quickly (relative to the Throttle stick position) pull points 1, 2, 3 and maybe 4 down further making the line more curved at the bottom and middle. If the engine accelerates too slowly move points 1, 2, 3 and 4 up a little at a time making the line straighter at the bottom and or middle until a linear throttle response is achieved.

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14. Set Up and Adjust the Idle-Up Mixer

Idle-Up is a very useful function for larger aircraft because it allows you to set up a very slow idle to produce a breaking effect for landing and at the flip of a switch provide a higher idle that is very dependable for flying. It is especially useful in the thinner air of higher altitudes.

Our Idle-Up function will use the **AUX5** knob/channel to set how much the engine idle increases. PCM 10SXII and 10X owners will use the Retract switch to turn Idle-Up on and off whereas PCM 10SX owners will use the Brake switch. Actually, any of the available switches can be used.

**NOTE:** It is very important that the throttle linkage be **Completely Free** of binding and contain no slop for the Idle-Up to work properly.

a. Access the next Program Mix, code 53.
b. Touch **10** to select **Aux5** as the Master and touch **1** to select channel 1 (throttle) as the Slave. Now touch ENTER to get to the next display.
c. Touch PAGE to get to the switch selection display. PCM 10SXII and 10X owners touch SEL under GER or GR to select the Retract Gear switch. PCM 10SX owners touch SEL under SW until BRK appears under SW, and also touch SEL under MASTER until ORIG appears.
d. Now touch PAGE to get back to the first display (SXII and 10X owners touch PAGE twice).
e. Rotate the **Aux5** knob all the way **Counter Clockwise** and touch STORE under OFFSET. This should result in an OFFSET percentage of approximately -86%. This offset will limit the **Aux5** knob so that it can only increase the idle and not decrease it. It will safeguard against accidentally killing the engine by switching on Idle-Up.
f. Flip your new Idle-Up switch back and forth and notice the display changing from POS-0 to POS-1 just above the percentages.
g. Position your Idle-Up switch in the position (forward or back) where you would like the Idle-Up to be turned "ON". Touch the + key until the percentage is 10%. This represents the total percentage that will be mixed into the throttle when the Idle-Up switch is turned on and the **Aux5** knob is rotated fully clockwise.
h. Turn the transmitter and receiver ON. Rotate the **Aux5** knob fully **clockwise**. Flip the Idle-Up switch on and off and check to make sure the throttle is moving in the correct direction. It should move towards the high throttle direction when turned "ON". If it is moving in the wrong direction, touch TURN under the percentages to change direction. Check the direction again with the knob still fully clockwise.
i. **Make these final adjustments with the engine running.** Rotate the **Aux5** knob fully **Counter Clockwise** and set the Idle-Up switch to OFF. Start the engine and get it up to normal operating temperature – this is important.
j. Access TRAVEL code **12** (10X owners touch S) and position the throttle trim lever in its center detent. If the engine idle gets too low and the engine quits when the trim lever is positioned in the center, touch the "−" key under THRO to reduce the throw on the low-end until the engine does not die with the trim in its center detent.
k. Making sure the engine stays up to temperature, adjust the low end travel using the + and − keys under THRO until you get the **lowest dependable** idle with the throttle trim in it’s center detent position.
l. Now turn on the Idle-Up using your Idle-Up switch and slowly turn the **Aux5** knob **Clockwise** to get the desired RPM increase (if the Aux5 Knob is too sensitive or insensitive, go back into mix 53 and adjust the mix percentage down or up respectively). Don't set the Idle-Up too high, or you may not be able to enter a spin but make sure it is set high enough so that the engine does not quit during a spin or tail slide.
m. Once you have the correct amount of Idle-Up, kill the engine and inspect the throttle linkage to ensure that the addition of throttle for Idle-Up does not stall the throttle servo at the high-throttle position. Advance the throttle stick to full high and turn on the Idle-Up. If the throttle servo is trying to drive the carb past full open and/or the throttle servo is buzzing, access TRAVEL code 12, (PCM 10X owners touch C) and touch the “−” key until the throttle servo is not trying to drive the carb past full open when the throttle stick is in the full high position.

n. **Using the Idle-Up.** Prior to your take-off roll or just after take-off, turn the Idle-Up on. Turn the Idle-Up off when you are ready to enter the landing pattern.

Sometimes the engine will be hotter/leaner at the end of the flight and the idle will be too high or too low with Idle-Up turned off. If this happens, keep the throttle trim lever in its center detent position and readjust the low-end travel (code 12) for the **lowest dependable idle** right after landing when the engine is still hot. The low-idle should be adjusted to provide the **lowest dependable idle** for **landing** at the end of the flight rather than for taxi and take-off at the beginning of the flight. You should be able to turn the Idle-Up off at the end of a flight and have confidence that the engine is running slow enough to provide good braking effect without quitting.

You may find that on some days the idle is too fast or too slow with the trim lever in its center detent (air changes & pushrods sometimes expand/contract). You can adjust the low-end travel in function 12, or, you can simply move the throttle trim lever off center a few clicks and leave it there after the engine is warmed-up to operating temperature. The Idle-Up will increase RPMs from whatever point the throttle trim lever is set. Normally, once you have the **Aux5** knob set for the desired increase in RPM, it does not require further adjustment provided that the low-idle is set properly. Remember to turn Idle-Up OFF before attempting to land or you may sail right on by!

15. **Set Up Fail Safe**

Now that the throttle is all set up it's a good time to set your Fail Safe. We will set Fail Safe such that all controls hold their last good inputs except for the throttle – it will go to high idle.

a. Access Fail Safe code 77.
b. Touch 1. This puts the Throttle in Fail Safe mode while all other channels remain in HOLD mode.
c. Lower the Throttle Stick to full-low, put the Throttle Trim Lever in its center detent, and turn on your Idle-Up switch. If you have not programmed an Idle-Up switch, set the Throttle Trim Lever just a bit above low idle so that going into Fail Safe does not kill the engine completely.
d. Now touch STORE to store the throttle position. The system is now set so that only the throttle will be affected if the RX encounters interference. It will go to idle while all other servos hold their last position.
e. In the event that you do encounter interference there is a chance that you will fly right through it without knowing it except for hearing the engine hesitate for a split second as it is lowered to idle and then back to the present throttle setting.
16. Set the Count Down Timer (PCM 10SX, SXII & 10X)

It's always a good idea to use a timer to help avoid running out of fuel. It is typical to fly 10-15 minutes on 32 ounces of fuel when running a gas engine in the 100 CC range. Set the timer so that it will give you an adequate safety margin before running out of fuel.

a. Access the Timer function code 87.
b. Touch ACT to activate the Count-Down Timer.
c. Touch the + and – keys to the left to set the number of minutes in 1 minute increments.
d. Touch the + key to the right to set the number of seconds in 10 second increments.
e. Look at the integrated Timer. It is showing you how long the TX has been turned on since the RESET function was performed way back at the beginning of this document. Touching CLEAR under the Integrated Timer will reset it to zero.
f. Activating the Count-Down Timer causes ST/SP and CLEAR to appear on the power-up display (the screen that is displayed when the system is powered-up). To use the Count-Down Timer, Touch ST when you are about to take off. When the timer counts down close to zero, it will beep several times indicating that it is time to land.

17. Setting Trim Offsets (PCM 10SX & 10SXII)

After test flying your aircraft and using the trim levers for trimming you should store the trims so that you can move the Trim Levers back to their center detents for future flying.

Note: Do not activate this function while flying!!

a. PCM 10SX and SXII owners Access Trim Offset code 82.
b. Touch STORE at the lower left of the display.
c. The display will now tell you to SET TRIM & ENTER. At this point move all trim levers to their center detents and touch the ENTER key to store trims for Aileron, Elevator and Rudder. The throttle trim is not stored in this function.
d. Touch ENTER to exit Trim Offset.

18. Adjusting the Trim Rates (PCM 10SX, SXII & 10X)

After test flying our aircraft and storing our trims (10SX & 10SXII) it is a good idea to reduce the trim rates so that we can make very fine adjustments to trim. Reducing the trim rates will also eliminate the condition where one click (beep) of trim is either too much or not enough. Reducing the Trim Rate on the PCM 10SX and SXII reduces the travel that can be obtained with a trim lever (0-30 degrees). With the PCM 10X the travel of the analog throttle trim is reduced but the travel of the digital trims on aileron, elevator and rudder is not. Instead the travel on these digital trims is divided-up into smaller (finer) increments so that each beep of the trim results in a smaller movement of the servo.

a. Access Trim Rate code 83.
b. PCM 10SX and SXII owners touch – under AILE, ELEV and RUDD until the trim rate is 30%. If the next time you need to trim the aircraft you find that the trims are still too sensitive where a click in one direction is too much and a click in the other direction is not enough, return to this function and reduce the rates further.
c. PCM 10X owners touch – under AILE, ELEV and RUDD to obtain a setting of 1. This will provide us with maximum trim resolution for keeping our aircraft in trim. If we find that our throttle trim is to sensitive (one click down is too low and one click up is too fast) then touch – under throttle to reduce the throttle trim rate until the throttle trim is no longer too sensitive.
d. Touch ENTER to exit Trim Rate.

By Len Alessi

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Mixing Out or Eliminating Pitch- and Roll-Coupling

Most aerobatic aircraft exhibit both pitch and roll coupling with the application of rudder. It is most noticeable when flying the aircraft in a knife-edge attitude. Normally, when we put the aircraft in a knife-edge and apply rudder to hold it there two things happen. First, the plane usually tries to roll out of the knife-edge. When it rolls in the same direction as the rudder input it is called Proverse roll (most common) and when it rolls in the opposite direction of the rudder input it is called Adverse roll. The second thing that happens is that the aircraft "pitches" as though elevator input were being applied. It pitches either towards the landing gear (most common) or towards the canopy with application of rudder.

Ideally we would like to be able to roll the aircraft to the knife-edge position and only apply rudder to have the aircraft maintain a straight line. The next few pages explain how to set up mixers in your PCM 10SX, 10SXII and 10X to eliminate Pitch- and Roll-Coupling so that the aircraft will do just that.

19. Mixing Out Roll-Coupling with the PCM 10SX
We are going to set up a programmable mixer that will automatically provide aileron input when we move the rudder stick. The aileron movement will counteract any roll coupling that is induced by the rudder. If we have Proverse roll coupling then we want the ailerons to move in the opposite direction of the rudder and if we have Adverse roll coupling we want the ailerons to move in the same direction as the rudder.

a. Test fly your aircraft in both the right and left knife-edge attitude to determine if it has Proverse roll coupling (aircraft rolls in the same direction as the rudder input) or Adverse roll coupling (aircraft rolls in opposite direction as the rudder input). You will need to know this before programming the mixer.

b. Access the next programmable mixer 54.

c. Touch 4 to select the rudder as the master and touch 2 to select the ailerons as the slave. Then touch ENTER to get to the next display. If you make an error touch CLEAR and touch 4 and 2 again before touching ENTER.

d. Mixing is typically so slight that it can be left on all of the time. However, if you would like to be able to turn the roll-coupling mixer on and off proceed with "e" below. If you do not want to turn the mixer on and off skip to "f" below.

e. If you would like to be able to turn the roll-coupling mixer on and off then touch PAGE to get to the next display. Touch SEL under SW until the desired switch is displayed under SW. If you have already used the BRK switch for the Idle-Up mixer, then do not select BRK – use a different switch instead. Set the switch to the position where you want the mixer to be turned ON. (If after test flying and adjustment you would like to have the roll-coupling mixer on all of the time, write down the percentages you have programmed for each direction; come back to this display and touch SEL under SW until FIX appears.)

f. Move the rudder stick to the Right and hold it there. Touch the + key to set the percentage to 3%. Now move the rudder stick to the Left and while holding it there touch the + key to set the percentage to 3%. Since roll coupling is typically very slight we are starting with small percentages.

g. Turn on the transmitter and receiver. Move your rudder stick to the Right and note the movement of the Right aileron. If your aircraft exhibits Proverse roll-coupling then we want the right aileron to deflect downward with right rudder, just like applying a small amount of left aileron input. If your aircraft has Adverse roll coupling then we want the right aileron to deflect upward when right rudder is applied. If the aileron is not deflecting in the proper direction touch the TURN key to reverse its direction while still holding the stick to the right.
h. Now hold the rudder stick to the Left and note the movement of the Right aileron. If your aircraft exhibits Proverse roll coupling then we want the right aileron to deflect upward just like applying a small amount of right aileron input. If your aircraft has Adverse roll coupling then we want the right aileron to deflect downward. If the aileron is not deflecting in the proper direction then touch the TURN key to reverse its direction while holding the rudder stick to the Left.

i. The ailerons should now be deflecting a small amount with the application of full Right and Left Rudder. They typically only need to deflect about the ½ the thickness of the trailing edge to mix-out roll-coupling. If your ailerons are deflecting a lot more or a lot less than this, then change the percentages from 3% to something greater or less by touching the + and – keys while holding the rudder to the right and to the left.

j. If your aircraft has Proverse roll-coupling then your ailerons should be deflecting in the opposite direction of the rudder input i.e. left aileron when right rudder is applied and right aileron when left rudder is applied. If your aircraft has Adverse roll coupling the ailerons should be deflecting in the same direction as the rudder input. If the ailerons are moving in the wrong direction touch TURN while holding the rudder stick to the right and/or left.

k. Now it is time to test and adjust our roll-coupling mixer. With the mix turned on roll the plane to the Right knife-edge and apply Left rudder. Note if the aircraft tries to roll out of the knife-edge to the Left. If it does and the aircraft has Proverse roll then you need to increase the percentage in the mixer for Left rudder input so that it results in more Right aileron. If it tries to roll out to the Right and you have Proverse roll then you need to decrease the percentage of mix for Right rudder input to decrease the amount of Right aileron coming out of the mixer.

Now roll the plane to the Left knife-edge and apply Right rudder. Note if the aircraft tries to roll out of the knife-edge to the Right. If it does and you have Proverse roll then you need to increase the percentage in the mixer for Right rudder input so that it results in more Left aileron. If it tries to roll out to the Left and you have Proverse roll then you need to decrease the percentage of mix for Right rudder input to decrease the amount of Left aileron coming out of the mixer.

The same tests apply for Adverse-roll coupled aircraft and the adjustments are just the opposite of those described above for Proverse roll.

l. Keep testing and adjusting the 2 mix percentages until the aircraft does not try to roll out of knife edge with either right or left rudder input and your roll-coupling mixer programming is complete.
20. Mixing Out Roll-Coupling with the PCM 10SXII and 10X

We are going to use a built-in mixer that was specifically designed to eliminate roll coupling by generating aileron input with the application of rudder. The aileron movement will counteract any roll coupling that is induced by the rudder. The built-in mixer provides for both pitch and roll coupling however, we will be using only the roll coupling portion at this time so be sure that mixing is set while in the Aileron portion of the display.

a. Test fly your aircraft in both the right and left knife-edge attitude to determine if it has Proverse roll coupling (aircraft rolls in the same direction as the rudder input) or Adverse roll coupling (aircraft rolls in opposite direction as the rudder input). You will need to know this before programming the mixer.

b. Access the built-in Rudder-to-Aileron/Elevator mixer code 64. The Aileron display will appear.

c. Roll coupling is typically so slight that it is usually not a problem to leave it on all the time. However, if you would like to turn the mixing on and off, touch PAGE twice and select a switch that you would like to use to do so. Then touch PAGE again to return to the Aileron mixing display.

d. In this step you will need to enter percentages either under POS0 if you did not select a switch to turn the mix on and off, or under POS1 if you did select a switch. Hold the rudder stick to the Right and touch + under POS0 if you did not select a switch, or touch + under POS1 if you did select a switch until you obtain 3%. Hold the rudder stick to the Left and do the same. Since roll coupling is typically very slight we are starting with small percentages.

e. Turn on the transmitter and receiver. Turn on the mix if you selected a switch. Move your rudder stick to the Right and note the movement of the Right aileron. If your aircraft exhibits Proverse roll coupling then we want the right aileron to deflect downward with Right rudder, just like applying a small amount of left aileron. If your aircraft has Adverse roll coupling then we want the right aileron to deflect upward when Right rudder is applied. If the aileron is not deflecting in the proper direction touch TURN to reverse its direction while still holding the stick to the Right.

f. Now hold the rudder stick to the Left and note the movement of the Right aileron. If your aircraft exhibits Proverse roll coupling then we want the right aileron to deflect upward just like applying a small amount of right aileron. If your aircraft has Adverse roll coupling then we want the right aileron to deflect downward when Left rudder is applied. If the aileron is not deflecting in the proper direction then touch TURN to reverse its direction while holding the rudder stick to the left.

g. The ailerons should now be deflecting a small amount with the application of full Right and Left Rudder. They typically only need to deflect about the ½-¾ the thickness of the trailing edge to mix-out roll-coupling. If your ailerons are deflecting a lot more or a lot less than this, then change the percentages from 3% to something greater or less by touching the + and – keys while holding the rudder to the right and to the left.

h. Now it is time to test and adjust your roll-coupling mixer. With the mix turned on roll the plane to the Right knife-edge and apply Left rudder. Note if the aircraft tries to roll out of the knife-edge to the Left. If it does and the aircraft has Proverse roll coupling then you need to increase the percentage in the mixer for Left rudder input so that it results in more Right aileron. If it tries to roll out to the Right and you have Proverse roll then you need to decrease the percentage of mix for Left rudder input to decrease the amount of Right aileron coming out of the mixer.
Now roll the plane to the Left knife-edge and apply Right rudder. Note if the aircraft tries to roll out of the knife-edge to the Right. If it does and you have Proverse roll then you need to increase the percentage in the mixer for Right rudder input so that it results in more Left aileron. If it tries to roll out to the Left and you have Proverse roll then you need to decrease the percentage of mix for Right rudder input to decrease the amount of Left aileron coming out of the mixer.

The same tests apply for Adverse-roll coupled aircraft and the adjustments are just the opposite of those described above for Proverse roll.

i. Keep testing and adjusting the 2 mix percentages until the aircraft does not try to roll out of knife edge with either right or left rudder input and your roll-coupling mixer programming is complete.
21. Mixing Out Pitch-Coupling With the PCM 10SX, SXII and 10X using a Multi-Point Mixer.

Pitch coupling is usually more severe than roll coupling and is typically non-linear in nature so we will use a Multi-Point mixer to mix-out pitch coupling. It will allow you to fine-tune the mixing to provide the right amount of elevator output for all amounts of rudder input.

a. Access the first multi-Point programmable mixer code 56.
b. Touch 4 to select the Rudder as the Master and touch 3 to select the elevator as the Slave. If you make a mistake touch CLEAR and the touch 4 and 3 again.
c. Touch SEL under TYPE NORMAL until CURV appears. Now touch ENTER to get to the mixing display. Yikes!
d. An Explanation of the display. Don't panic! While the display looks complicated it is actually pretty simple if we know what we are looking at. Slowly move the rudder stick left and then right while observing the graph. A vertical line moves across the graph as you move the rudder stick. This is called the Cursor and it shows us the position of the rudder stick.

Also note that there is a single point in the middle of the graph labeled 1. The 1 is positioned at 0% or midway (up and down) on the graph which indicates that there is 0 movement of the slave (elevator) at this point. It is also midway 50% (right and left) on the graph and since the rudder stick centers itself when released, it is right under the cursor when the rudder stick is at center. For our purposes we can keep this point right where it is, at 0%.

The X-axis (left and right direction) on the graph represents the position of the master channel stick and that is why we see the cursor moving right and left as we move the rudder stick Rudder input is represented as Left and Right on the graph. The Y-axis (up and down direction) on the graph represents the movement of the slave channel – in this case our elevators. Elevator Servo position is represented as Up and Down on the graph. When a point on the line has a positive (+) percentage it indicates travel of the slave channel (elevator) in one direction like down-elevator and a negative (-) percentage represents movement in the other direction like up-elevator. The greater the percentage, the greater the movement of the slave servo (in our case elevator). A percentage of 0 indicates no movement. When we let go of the rudder stick it returns to the center over point #1 which is set to 0% so there is no movement of the slave (elevator) servo when the stick is centered. The point at which the cursor intersects the mixing line shows us the deflection of the master stick and the movement of the slave servo (both direction and % of deflection).

IN represents the position of the rudder stick (in percentages) in relation to the graph. At the extreme left of the graph the rudder stick is 0%, at the extreme right it is 100% and in the middle is 50%. The IN percentage is displayed to the right of IN.

OUT represents the position of the slave channel, in our case the elevators, also represented in percentages. Only this time it is represented by + and – percentages. A positive (+) percentage indicates movement in one direction (i.e. Down elevator) while a negative (–) percentage indicates movement in the other direction (i.e. Up- elevator). 0% indicates no elevator movement. The top of the graph represents +100% of servo movement (in one direction) while the bottom of the graph represents a –100% (in the other direction). We will be watching the OUT percentage closely while programming.

P-1 is the point number and it appears under PAGE when the cursor is positioned over point #1 and the percentage to the right shows you where point #1 is located relative to the rudder stick position. If you move the rudder stick all the way right and left, P-1 will change to P-L and P-H representing the Low and High points at the ends of the mixing line (the points are invisible at the ends of the mixing line – but they are there, and they can be moved). The point number will appear under PAGE any time the cursor gets close to, or is positioned over a point.
+ and - are located at the bottom of the display. They are used to move a point up and down on the graph. Touching + moves a point upward while touching – moves a point downward. To move a point, we move the rudder stick until the cursor is positioned over the point and hold the stick there while touching the + or – keys.

**CL** located between the + and – keys is used to delete a point on the line. This is not to be confused with CLEAR below. **Note**, the + and – keys and CL are replaced by STORE any time the cursor is moved to a position where a new point can be added to the line. Touching STORE when it appears adds a point to the line where the cursor is positioned.

The shaded 0 to the right of the + and – keys is used to quickly reset a point to 0%. It is a form of shortcut. To use it, position the cursor over a point using the rudder stick and while holding the cursor over the point touch the 0. The point will be immediately moved to 0% or midway up and down on the graph which represents 0 movement of the slave channel.

**EXP** smooths the line between points resulting in curves or one large curve. If EXP is left off the points are connected by straight lines. EXP can be turned on and off to fine-tune mixing response.

**POS0** indicates which position the Mixer is in. Each Multi-point mixer can be programmed to have 2 mixing curves which are switch selectable (the PCM 10SX and the 10X can also switch between the 2 curves using the throttle stick). If one of these curves is programmed such that no mixing occurs then we can effectively turn the mix on and off.

**CLEAR** is in the lower left of the display. It is used to cancel the entire program mixer. If you touch CLEAR you must start programming of the mixer from the beginning (well almost, some of the old settings will remain in effect but the master and slave channels will be gone and the mixer will no longer function).

**OKAY, LETS GET ON WITH IT!**

e. If you have any Dual Rates programmed, set your D/R or Flight Mode switch to the position that gives you full Rudder throw.

f. Touch SEL under EXP until ON appears so that we will have smoothed lines connecting our points.

g. Touch PAGE to get to the next display for a moment. We should select a switch to turn the mixer on and off. If the aircraft exhibits severe pitch coupling with full rudder input then it will probably be a good idea to turn the mixer off when performing some low-speed maneuvers that require large rudder deflections such as Hammerheads. If the mixing is left on when doing a Hammerhead the resulting elevator mixing may cause the aircraft to pitch during the pivot, spoiling the maneuver.

**PCM 10SX** owners can select a switch to turn the mixer on and off by touching SEL under SW until the desired switch is displayed, or the throttle stick can be used to turn the mixer on and off when the throttle stick is moved below say ¼ throttle. If you would like to use the throttle touch SEL until STK appears. Then position the throttle stick at about ¼ throttle and touch STORE. Touch PAGE to get back to the mixing display.

**PCM 10SXII** owners touch SEL under the switch that you would like to use to turn the mixer ON. Touch PAGE twice to return to the mixing display.
PCM 10X owners touch SEL under the switch that you would like to use to turn the mixer ON, or, if you would like to use the throttle to turn the mix on and off then touch SEL under STK; position the throttle stick at \( \frac{1}{4} \) throttle and touch STORE. Touch PAGE twice to return to the mixing display.

h. If you have decided not to use a switch or the throttle to turn the mixer on and off and have not selected any switches or the throttle stick, then proceed with step k below. If you have selected a switch to turn the mix on and off, set the switch to what you want to be the OFF position. If you have selected the throttle to turn the mix on and off, then position the throttle stick at the full-low position. We are going to set the OFF position of the mixer so that no mixing occurs when it is turned off.

i. Make sure there is no mixing with the mixer turned to the OFF position. Move the rudder stick all of the way to the Right and hold it there. Touch the \( 0 \) (shaded 0 key) just to the right of the + and - keys to reset (if not already at 0) the end of the mixing line to 0%. Now move the rudder stick all of the way to the Left and hold it there. Touch the \( 0 \) to reset this end of the line to 0%. There should now be a straight horizontal line across the graph. The straight line indicates that there is 0% mixing (no mixing – no elevator input) when the rudder stick is moved right and left. You can turn on the TX and RX to verify this.

j. If you have selected a switch to turn the mix on, set the switch to the ON position. If you have selected the throttle to turn the mix on and off then position the throttle stick at \( \frac{1}{2} \) throttle or above. Be sure to leave this setting in tact while programming. We are going to set the ON position of the mixer to 0% before we program it further.

k. Move the rudder stick all of the way to the Right and hold it there. Touch the \( 0 \) key just to the right of the + and - keys to reset (if not already at 0) the end of the mixing line to 0%. Now move the rudder stick all of the way to the Left and hold it there. Touch the \( 0 \) key again to reset this end of the line to 0%. There should now be a straight horizontal line across the graph. The straight line indicates that there is 0% mixing (no mixing – no elevator input) when the rudder stick is moved right and left.

l. Slowly move the rudder stick to the Right until the cursor is about \( \frac{1}{2} \) way between point 1 and the left side of the graph and hold it there. STORE appears at the bottom of the display. Touch STORE to add a new point to the mixing line while holding the rudder stick in position. Release the rudder stick and then slowly move it to the Left until the cursor is about \( \frac{1}{2} \) way between point 2 and the right side of the graph and hold it there while you touch STORE again. Another point is added to the line and the points are re-numbered left to right 1, 2 and 3.

m. Now lets program some percentages and check to make sure we are going in the right direction. Move the rudder stick all the way to the Right and hold it there. The cursor will move all the way to the end. Touch the – key until the OUT percentage is –10%. Move the rudder stick all the way Left and hold it there and touch the – key until the OUT percentage is –10% again.

Turn on the Receiver and watch the elevators. Move the rudder stick all the way to the right and the elevators should deflect upward some. Move the rudder stick all the way to the left and the elevators should again deflect upward some. If your aircraft pitched toward the gear in knife-edge flight and the elevators are moving upward when the rudder stick is moved full right and full left then we have programmed the percentages in the proper direction.

If the elevators are moving downwards instead of upwards and the aircraft pitches towards the gear in Knife-edge, we need to reverse the percentages. Move the rudder stick to full Left and touch the + key until +10% is achieved. Now move the rudder stick full Right and touch the + key until +10% is achieved for this end of the mixing line.
The elevators must move in the opposite direction of the pitching that occurs when the aircraft is in knife-edge. If the aircraft pitches towards the gear then we need Up-elevator, if it pitches towards the canopy we need Down-elevator. (+) Percentages move the elevator in one direction and (–) percentages move the elevator in the other direction. If the elevators are moving in the wrong direction change the percentages from + to – or – to + buy touching the + or – keys to move the points above or below the 0% line.

n. Now we can program the two intermediate points. Position the cursor over point #1 by moving the rudder stick. While holding the cursor over point #1 touch the + or – key until the OUT percentage is 4%. Use the same percentage sign (+ or -) as was used for the end points. I.e. if the end points are a (–) percentage then touch the – key until −4% is achieved, if the end points are a (+) percentage touch the + key until +4% is achieved.

o. Set the other intermediate point. Position the cursor over point #3 by moving the rudder stick. While holding the cursor over point #3, touch the + or – key to get the same + or – 4% as was set for point #1. The graph should now look like one of the following:

```
1 2 3
```

p. Move the rudder stick side-to-side and check the elevator movement again to confirm that the elevators are moving in the proper direction to mix-out the pitch coupling of your aircraft. Elevator direction can be changed by moving the points up or down until their signs change from + to – and vise versa.

**Note:** Air-foiled tail surfaces are very efficient and require only a small amount of movement to effect a change. For this reason we start with small percentages for points #1 and #3. These two intermediate points control the amount of mix required for relatively small rudder deflections such as those used during point rolls. However pitch-coupling can become quite severe with full rudder deflections such as those required for knife-edge loops. The percentages at each end of the line control mixing when full deflection is used. Keep this in mind when testing and making adjustments.

q. **Test fly and adjust the multi-point mixer.** Have a helper standing by to take notes. Turn on the mixer and roll the aircraft to each knife-edge and apply just enough rudder to maintain altitude. Note how much pitching occurs in each direction. If the aircraft is still pitching in the direction it was before mixing was applied then the percentages at points #1 and #3 should be increased (more + or more -, in other words, moved further from the 0% center line) to provide more elevator mixing. If the aircraft is now pitching in the opposite direction, then the mix percentages are too great and they should be reduced (moved closer to the 0% center line). It is not unusual to have different percentages for right and left rudder and the multi-point mixers were designed for just this purpose.

Now test the full rudder mix by rolling the aircraft to each knife-edge position and applying full rudder. Again note the pitching that occurs. Adjust the percentages at each end of the line by moving the rudder stick full right and full left and touching the + and – keys. The further positive and the further negative you go the more elevator mix you get.

Keep performing these tests and adjusting the percentages until there are no pitch changes with the application of rudder in Knife-edge.
Additional Notes Regarding Multi-Point Mixers. We have only used 5 of the possible 8 points that can be set/programmed for mixing. It is possible to establish 6 points along the mixing line. Each of these 6 points PLUS each end of the line can be moved up and down for a mixing percentage. A new point can be set on the line any time STORE appears at the bottom of the display. Typically 5 points (2 to the left of center and 2 to the right of center) are sufficient to provide a very fine-tuned mixing curve that will supply the proper mixing for all inputs.

If you really need to get all 6 points onto the curve, start by deleting all points, even point #1 that appears when the mixer is first initiated. To delete a point, position the cursor over the point and touch the CL between the + and – keys. After all points have been removed, move the stick to the full Left position. Slowly let the stick come back towards center until STORE first appears and touch STORE to add the point. Gradually let the stick move towards center again until STORE appears again and then touch STORE. Do this one more time and you should have 3 points defined. Now move the stick all the way to the Right and repeat this procedure.

There is almost no limit to what can be done with the points by positioning the cursor over a point and touching the + and – keys to move it up and down. Here are few examples of multi-point curves:

At times you may notice that the cursor does not go all the way to the ends of the mixing line. This usually happens when you have a dual rate or Flight Mode selected that is using less than 100% of the rudder throw. Always set your dual rate switches or Flight Modes so that you have your maximum rudder (or whatever the Master channel happens to be) rate selected when programming a Multi-Point mixer.
**What is a Flight Mode?** For our discussion a Flight Mode represents an aircraft configuration (Rates/Curves, mixes, Differential, etc.) that is designed and optimized to assist the pilot and the aircraft in performing a specific type of maneuver.

**The Objective** of programming Flight Modes is to provide us with the ability to flip a switch to select a collection of settings that make it easy to perform a maneuver. For example; positioning our Flight Mode switch in its 1st position sets the aircraft up for normal precision flying; positioning the switch in it's 2nd position sets the aircraft up for snap rolls; positioning the switch in its 3rd position sets the aircraft up for consecutive rolls, slow rolls, and rolling circles; while the 4th position gives us a set up for 3D, and the 5th position gives us a setup for performing Torque Rolls.

If you have been following along from the beginning you are probably thinking that we have already done a significant amount of programming to help the aircraft in performing specific types of maneuvers (remember setting up the Dual Rates and Exponential curves?). Now what we need to do is **group them together into Flight Modes** so that we can select them with a single switch (well almost, we can select between 3 Flight Modes with a single switch but selecting between 5 Flight Modes involves 2 switches).

**At this point** we want to adjust our thinking with regard to programming. Instead of worrying about individual features provided by the radio and how to program them, we need to think about what we want to accomplish with the aircraft and what the radio can do to help us. If we approach programming in this fashion we not only have a better chance of using the radio to its full potential, but it will be easier for us to fly maneuvers because the radio will be helping us. Obviously this will require "stick time" because only by flying the aircraft will we be able to determine where we and the aircraft need help. For instance, if in performing snap rolls we discover that we have a problem with the aircraft over-rotating because we are using too much rudder input, then we need to make sure that we don't use too much rudder. How do we get the radio to help us do that? We reduce the amount of rudder travel that is available while we are in the Snap Roll Flight Mode -- problem solved!

The **PCM 10SXII and 10X** contain a number of functions that are easily incorporated into Flight Modes. They include:

- Dual Rates and Exponential curves for aileron, elevator, and rudder
- Flap positions with Elevator Trim correction
- Trim settings for primary flight controls (aileron, elevator, and rudder)
- Servo Speed for all 10 channels
- Gyro Gain
- Aileron Differential
- Snap Roll settings for primary flight controls (rate/direction)
- Aileron to Rudder mixing
- Rudder to Aileron and Rudder to Elevator mixing
- Up to 8 Programmable Mixers (includes 3 multi-point mixers)

As a general rule, any function in the radio that provides a switch selection option can usually be assigned to 1 or more Flight Modes. While the majority of the items listed above pertain to specific functions, the fact that 8 program mixers are included provides us with an unlimited number of other possibilities in determining the aircraft’s behavior when a Flight Mode is selected.
FLIGHT MODE PROGRAMMING (10SXII & 10X)

It is not practical to program all Flight Mode settings at one time, especially for a new aircraft. This approach would be difficult, time-consuming, risky, and would probably result in less-than-optimum Flight Mode configurations. Therefore, the recommended procedure is based upon a phased approach that involves programming and adding functions to Flight Modes one at a time. This allows us to program a function, test-fly the function with minimal risk, and fine-tune the settings for optimal performance before adding the function to Flight Modes.

Note: The PCM 10SXII and 10X provide the option of having 3 Flight Modes (FM-0, FM-1, FM-2) or 5 Flight Modes (FM-0, FM-1, FM-2, FM-3, FM-4).

Note: When Flight Modes are activated only one function is automatically associated with Flight Modes. It is the Dual Rate (D/R & EXP) function (code 13), which effects the movements of the three primary flight controls (aileron, elevator, and rudder). All other functions and features are optional and can be assigned to Flight Modes at the pilot’s discretion. The PCM 10SXII requires a preliminary step to get the D/R EXP settings to function properly with Flight Modes whereas the 10X takes care of this automatically.

22. Activate Flight Modes PCM 10SXII & 10X.

We are going to activate Flight Modes and choose the switch that we are going to use as our Flight Mode switch. We have 3 choices for the Flight Mode switch: the Aileron D/R switch, the Elevator D/R switch or the Rudder D/R switch. Once we select one of the switches the other 2 D/R switches become inoperative and can no longer be used -- not even for selecting Dual Rates because all D/R activity is transferred to the Flight Mode switch.

a. To activate Flight Modes access Function Select (code 17).

b. Touch PAGE to get to the 2nd display.

c. Touch SEL under D/R SW to select one of the switches to use as your Flight Mode switch (Aileron, Elevator, or Rudder). Touching SEL repeatedly cycles through the 3 switches. Selecting a switch is what activates Flight Modes. To turn Flight Modes off, touch SEL under SW until INH appears indicating that Flight Modes are inhibited.

d. PCM 10X owners -- Unless you think that you will need to re-trim the aircraft for each Flight Mode (should only occur if you are going to use flaps or something else that will result in sustained control deflection) then leave the FM TRIM inhibited. Otherwise touch ACT under TRIM INH to activate Flight Mode Trims where you will need to re-trim the aircraft for each Flight Mode.

e. Now decide if you would like to have 3 Flight Modes or 5 Flight Modes (it might be best to start out with just 3). If you would like to have 5 Flight Modes then touch ACT under EXTRA INH to turn on the other 2 Flight Modes.

f. Flight Modes are now activated. If 3 Flight Modes have been activated they are FM-0, FM-1 and FM-2. If 5 have been activated they are FM-0, FM-1, FM-2, FM-3, and FM-4. The switch you selected is now the Flight Mode Switch. The upper switch position is always Flight Mode 0 or FM-0 and can be thought of as HOME BASE because it never changes. Since it never changes it is the ideal Flight Mode to use for normal flying, as you will be able to instantly switch to it in case of an in-flight emergency.

g. Touch ENTER to exit Function Select.
23. Selecting Flight Modes with the Flight Mode Switch.

Selecting Flight Modes can be different depending on whether 3 Flight Modes have been activated or 5 Flight Modes have been activated. The manuals contain good explanations and diagrams of Flight Mode switch operation. See page 32 of the PCM 10SXII manual and page 20 of the 10X manual.

If 3 Flight Modes have been activated then only the Flight Mode switch is used to select between Flight Modes where the Upper position of the switch is FM-0, the Middle position is FM-1 and the Lower position is FM-2.

If 5 Flight Modes have been activated then we must use 2 switches to select Flight Modes. The second switch that is used is the MIX switch, which is located on the top of the transmitter at the right rear corner. When the MIX switch is in its upper position (away from you) then the Flight Mode switch behaves normally where the Upper position is FM-0, the Middle position is FM-1 and the Lower position is FM-2. When the MIX switch is in the lower position (towards you) the Flight Mode switch behaves a little differently. The Upper position is still FM-0 (remember HOME BASE), but the Middle position selects FM-3 and the Lower position selects FM-4.


*PCM 10SXII owners must perform this preliminary step to assign our D/R EXP settings to Flight Modes.* Remember that we have already programmed 3 D/R EXP settings for each control (aileron, elevator and rudder). Now we are going to assign them to the Flight Mode switch.

- **a.** Access the FM Rate Function (code 23). FM-0 appears to the left of the display. This indicates that the 1st Flight Mode, FM-0 is selected. At the bottom of the display is AILE, ELEV and RUDD. Below each of these is a 0 followed by a colon "":" and then a percentage. The zeros indicate that position POS0 of our D/R EXP settings are assigned to each control -- remember we programmed POS0, POS1 and POS2 for each control surface earlier. The percentages indicate the D/R percentage that is associated with POS0.
- **b.** We are going to leave the POS0 D/R EXP settings assigned to FM-0 so just Touch MODE to get to the next Flight Mode -- (FM-1) should now be displayed to the left of the screen.
- **c.** Touch SEL under AILE until 1 appears next to the percentage under AILE. Touch SEL under ELEV until 1 appears next to the percentage under ELEV. Touch SEL under RUDD until 1 appears next to the percentage under RUDD. We have just assigned the POS1 D/R EXP settings for each control (AILE, ELEV, RUDD) to the 2nd Flight Mode (FM-1).
- **d.** Touch MODE to get to the FM-2 settings -- FM-2 will appear to the left of the display.
- **e.** Touch SEL under AILE, ELEV and RUDD until 2 appears next to each percentage. We have just assigned the POS2 D/R EXP settings to the 3rd Flight Mode (FM-2).
- **f.** For our example we are going to leave the 4th and 5th Flight Modes set to use the POS0 rates for each control so just touch ENTER to exit this function.

**Note:** the 4th and 5th Flight Modes automatically default to the POS0 settings even if only 3 Flight Modes have been activated.

We now have all of our D/R EXP settings (POS0, POS1, POS2) for each control (AILE, ELEV, RUDD) assigned to Flight Modes. The D/R EXP settings are still accessible and still adjustable by using the Flight Mode switch to select them while in the D/R EXP function (code 13).

The PCM 10SXII has 3 D/R EXP settings for Ailerons, 3 D/R EXP settings for Elevator, and 3 D/R EXP settings for Rudder that can be distributed among 3 or 5 Flight Modes. If you wish to assign a different D/R EXP setting to a Flight Mode, come back into this function (23), select the desired Flight Mode, and then select the desired D/R EXP setting (0, 1, 2) under the desired control(s) (AILE, ELEV, RUDD).
25. Test the Flight Mode Switch Operation (PCM 10SXII and 10X)

Let's test our Flight Mode switch to see how it selects between the various D/R EXP settings. While PCM 10SXII owners had to assign the D/R settings to Flight Modes, 10X owners will see that the POS0, POS1, and POS2 D/R settings for each control were automatically assigned to FM-0, FM-1, and FM-2 respectively when Flight Modes were activated.

a. Put the Flight Mode switch in the Upper position (FM-0, or HOME BASE). If you have activated 5 Flight Modes, put the MIX switch in its upper position (away from you).


c. The display begins with the Aileron D/R settings. You are now looking at the Aileron POS0 settings. Put the Flight Mode switch in its Middle position (FM-1) and you will see the Aileron POS1 settings. Put the Flight Mode switch in its Lower position (FM-2) and you will see the Aileron POS2 settings. You can adjust any of the settings that are displayed and from now on, this is how you select an Aileron D/R EXP setting in order to make adjustments.

d. Put the Flight Mode switch back to its Upper position (FM-0). Touch PAGE and the display switches to the Elevator settings. Cycle the Flight Mode switch through its positions and you will see the POS0, POS1, and POS2 elevator settings just like you did with the ailerons.

e. Touch PAGE again and you can see the Rudder settings by cycling the Flight Mode switch through its positions. Touching PAGE again on the PCM 10SXII brings up the Throttle Exponential settings whereas the 10X will loop back to the Aileron Settings. PCM 10SXII owners must touch PAGE 1 more time to get back to the Aileron settings.

If you have been following along from the beginning you will keep the Flight Mode switch in its Upper position (FM-0 – HOME BASE) for normal precision flying; when you want to perform snap rolls you will put it in the Middle position (FM-1); and when you want to perform consecutive rolls, slow rolls and rolling circles you will put it in its Lower position (FM-2).

f. If 5 Flight Modes have been activated on the PCM 10SXII put the Flight Mode switch in its center position (FM-1) -- POS1 appears. Now put the MIX switch in its lower position (towards you) and notice that POS1 changes to POS0 -- You have just selected the 4th Flight Mode (remember we left the 4th and 5th Flight Mode set to the 0 positions for each control while we were in Function 23). Now put the MIX switch back to its upper position and put the Flight Mode switch in its lower position to select the 3rd Flight Mode (FM-2) and POS2 appears. Now put the MIX switch in its lower position and it changes from POS2 back to POS0 again because you have selected the 5th Flight Mode. Remember when 5 Flight Modes are activated the MIX switch causes the 2nd and 3rd Flight Modes (FM-1 & FM-2) to become the 4th and 5th Flight Modes (FM-3 & FM-4). The Upper position (POS0) is HOME BASE and it never changes!

With this set up if you inadvertently turn on the 4th and 5th Flight Modes the aircraft will fly as though you have your Normal rates (POS0 rates) selected. While it may seem useless for the 4th and 5th Flight Modes to use the same D/R settings as the 1st Flight Mode, it is not. There are many more things that we can make happen when the 4th and 5th Flight Mode are selected that do not happen when the 1st Flight Mode is selected. For instance, we could set up program mixers that mix elevator to elevator, rudder to rudder and aileron to aileron in order to increase control throws to maximum for 3D maneuvers and assign them to the 4th and 5th Flight Modes (FM-3 & FM-4). We could also set up a multi-point mixer that mixes the throttle to the throttle to provide a very steep curve to quickly get the throttle up to the point to provide enough power to hover and then have it progress very slowly upward to provide precise throttle control for the torque rolls. If we assigned this mixer to the 5th Flight Mode then we could use the 4th Flight Mode for 3D and the 5th Flight Mode for Torque Rolls! While we're at it we could program a gyro and assign it to the Torque Roll Flight Mode as well.
g. **If 5 Flight Modes have been activated on the PCM 10X** put the Flight Mode switch in its center position (FM-1). Now put the MIX switch in its lower position (towards you) and notice that FM-1 changed to FM-3. You have just selected the 4th Flight Mode. Put the Flight Mode switch in its Lower position and you have selected the 5th Flight Mode (FM-4). **Remember when 5 Flight Modes are activated the MIX switch causes the 2nd and 3rd Flight Modes (FM-1 & FM-2) to become the 4th and 5th Flight Modes (FM-3 & FM-4). The Upper position (POS0) is HOME BASE and it never changes!**

Also notice that when the 4th and 5th Flight Mode are selected that fresh displays are presented ready to be programmed with new D/R and EXP percentages. Set up your rates and curves for these 2 additional Flight Modes to help you perform specific types of maneuvers. If you really have no use for these 2 additional Flight Modes at this time, it might be best to inactivate them by returning to function 17, touching PAGE, and Inhibiting EXTRA to turn them off in order to avoid selecting them by mistake. You can always re-activate them later when you have thought of a specific use for them.

h. Put some additional flights on the aircraft to become familiar with your Flight Mode switch(s), and the rates/curves that are active in each Flight Mode. If you need to make adjustments to the rates and curves for any Flight Modes come back into the D/R EXP function 13, select the appropriate Flight Mode using the Flight Mode Switch, select the appropriate control surface by touching PAGE, and then make your adjustments.

Preliminary Flight Mode programming is now complete. When you are comfortable with flying the aircraft in this basic Flight Mode configuration, proceed with programming, test flying, and adjusting the settings for the next function (if any) that you would like to be incorporated into Flight Modes.
26. Aileron Differential

When ailerons are deflected the aileron that deflects downward creates more drag than the aileron that deflects upward. If the amount of drag is great enough it will cause the aircraft to yaw in the direction of the down aileron, i.e. a roll to the right will case the aircraft to yaw to the left because the left aileron deflects downward. This, of course, is an undesirable tendency that will result in non-axial rolls and a loss of heading when rolls are performed on vertical and 45 degree lines. But there is good news! The PCM 10SX, SXII and 10X radio systems provide a Differential function that allows you to decrease how far each aileron deflects downward (or upward) without affecting the aileron that travels upward (or downward) and therefore enables you to eliminate yaw tendencies in rolling maneuvers. The Differential function allows us to have 2 differential settings that are switch or Flight Mode selectable. We can have one setting that is on all of the time or we can have one setting that is on and one that is off (0 differential) or we can have 2 different amounts of differential -- maybe one for normal flying and another for flat spins.

NOTE: There is another factor that can cause the aircraft to roll in a non-axial fashion. If the mass of the aircraft is mostly above or below the thrust or datum line it can cause a pendulum effect and the aircraft will appear to wobble as it rolls. Aileron differential may help to straighten out the rolls, however it will not be able to eliminate it. If the aircraft still wobbles after trying differential adjustments in both directions there is a chance that the aircraft is out of balance vertically. Try raising and lowering batteries and other radio gear to eliminate the wobble and then proceed with differential adjustment again.

a. Access the Wing Type function (code 22).

b. If you would like a single aileron differential setting to be in effect all of the time (recommended for now), touch + to set a small percentage of differential and touch TURN if necessary to obtain the proper direction (less Down deflection than Up deflection or less Up deflection than Down deflection). Programming is complete -- touch ENTER to exit the Wing Type function. Test fly the aircraft and return to this function (22) to make adjustments until the yaw tendency has been reduced or eliminated.

c. At this point it is assumed that you would like to switch between two aileron differential values. If one of these values is set to zero, you will be able to turn aileron differential OFF by selecting the position that has the 0 value.

PCM 10SX owners touch SEL under SW to select the switch that will be used to toggle between the 2 differential values. Put the switch in one position and touch + to set the amount of differential and touch TURN if necessary to obtain the proper direction. Now put the switch in the other position and touch + to set the amount of differential for this position (if one of the positions is left at zero (0) then selecting this position turns the differential OFF). Touch ENTER to exit the Wing Type function and test fly the aircraft. Return to this function (22) to make adjustments until the yaw tendency has been eliminated.

PCM 10SXII and 10X owners touch PAGE to obtain the switch selection display. Touch SEL under each Flight Mode or switch where you would like aileron differential turned ON. Leave all other FMs and switches set to P-0. Put the switch in the ON position and touch + to set the amount of differential for this position and touch TURN if necessary to obtain the proper direction. Now put the switch in the other position and touch + to set the amount of differential for this position (if this position is left at zero (0%) then selecting this position turns the differential OFF). Touch ENTER to exit the Wing Type function and test fly the aircraft. Return to this function (22) to make adjustments until the yaw tendency has been eliminated.
27. Servo Speed

If less-than-normal servo speed is desired for one or more channels then the Servo Speed function is for you. The Servo Speed function allows the pilot to decrease the speed of any servo. A practical application of this function is to reduce the speed of the throttle servo so that “jamming” the throttle stick (high or low) will not cause the engine to flood and die. Another application may be when two servos/channels are used for a common control (like dual elevators) and for some reason one servo seems to move a little faster than the other servo. We could slow the faster servo down until it matches the speed of the slower servo.

Servo speed is displayed in degrees per second and may actually show a value that is greater than the rated speed of the servo. Therefore, decrease the value until you can start to see a noticeable difference in speed.

Note: Use extreme caution if you decrease the speed of primary flight control servos (Aileron, Elevator, Rudder)!! You may not be able to control the aircraft properly if the servos move too slowly.

a. Access the Servo Speed function (code 24).

b. PCM 10SX owners touch – under the desired channel to decrease the speed of the servo(s) plugged into that channel (touch PAGE to see all channels). Touch – until you can see a noticeable decrease in the servos speed. Touch ENTER to exit the Servo Speed function.

Ground test the servo speed settings and then test fly the aircraft. Make adjustments until the desired results are obtained.

c. PCM 10SXII and 10X owners. If Flight Modes are Not activated adjust the speed as described in "b" above.

If Flight Modes are activated we must set the speed for each Flight Mode where we want the servo(s) speed decreased. Touch – under the desired channel to decrease the speed of the servo(s) plugged into that channel (touch PAGE to see all channels). Touch – until you can see a noticeable decrease in the servos speed (take note of the speed you end up with). To set the speed of the servo for the next Flight Mode touch MODE and set the servo(s) speed to the same value as noted previously. Keep touching MODE and setting the servo speed until the speed is reduced for all intended Flight Modes. Touch ENTER when finished to exit the Servo Speed function.

Ground-test the servo speed settings to ensure that the proper settings are activated with the intended Flight Modes. Make adjustments as appropriate.

Fly the aircraft to become familiar with this additional Flight Mode feature.
28. Programmable Mixing and Flight Modes – General Concept (PCM 10SXII & 10X)

This section presents a general guide to the steps involved in setting-up a programmable mixer and assigning it to one or more Flight Modes. It is not intended to accomplish any specific function or flight task, but rather to provide a form of checklist for setting up a mixer and getting it assigned.

There are 8 programmable mixers (51-58) that can be assigned to Flight Modes. Each programmable mixer can be programmed to have 2 sets of mix percentages and we can assign one of two sets to each Flight Mode. If one set of mix percentages is set to zero, we will be able to turn the mixing on and off using the Flight Mode switch (ON for one or more Flight Modes and OFF for the remaining Flight Modes).

It is assumed that Flight Modes are already active and the D/R&EXP settings have been established. It is recommended that you initially leave 1 set of percentages (POS0) set to zero and only program mix percentages into the 2nd set (POS1). This will allow us to turn the mix on (POS1) and off (POS0) with the Flight Mode switch for initial test flying and adjustment.

a. Access a programmable mix function (code 51-58).

b. After selecting the master and slave channels touch ENTER. Note: select NORM or CURV before touching ENTER if a multi-point mixer is being used (56-58).

c. Touch PAGE until the switch/position display appears. Identify a non-critical Flight Mode (FM-0 – FM-4) that will be used to test the program mix. Touch SEL under this Flight Mode to indicate that it will use POS1 settings. Leave all other Flight Modes set to POS0. Now mixing will be activated only when this Flight Mode is selected.

d. Touch PAGE and select the type of mix (Normal, Include, Origin) and whether or not the Trim feature is to be enabled.

e. Touch PAGE until the mixing percentage screen is displayed. Move the Flight Mode switch to the ON position (POS1 appears over the percentages indicating that the mixer is in the ON position).

f. Set the mix OFFSET (if any) and set the mixing percentages as may be appropriate for the desired mixing activity. Thoroughly ground-test the mixer.

g. Fly the aircraft and test the mixer by selecting the Flight Mode that was selected as using POS1. Adjust the mixing parameters in the Function Code that was used in step 1 to obtain the desired results.

h. You may now return to the programmable mix (51-58) to program the POS0 settings and/or to assign the mixing values to other Flight Modes. Remember, in order to be able to turn mixing off, either POS0 or POS1 values must be set to zero.
29. Programming Down Elevator for Vertical Down Lines (PCM 10SX, 10SXII & 10X)

Some aircraft exhibit the tendency to "pull out" towards the canopy on vertical down lines. This trait can easily be eliminated with a program mix that applies just a little down-elevator when the throttle stick is brought all the way back to the full-low stick position.

a. Access an unused programmable mixer (code 51-58).
b. Touch 1 to select the throttle as the master and touch 3 to select the elevator as the slave. If you make a mistake, touch CLEAR and then touch 1 and 3 again.
c. If you are using a Multi-point mixer (56-58) make sure that the type of mix is NORM and not CURV and then touch ENTER to get to the mixing display.
d. It may be desirable to turn the mixer ON and OFF so that there is no mixing when landing. If you do NOT want to turn down-elevator mixing on and off then proceed with "e" below.

At this point we're assuming that we want to turn the mix ON and OFF. Touch PAGE to get to the switch selection display. If you have programmed an Idle-UP function then the ideal switch to use for turning the mix on and off is the Idle-Up switch. When we turn Idle-Up off we can also have the switch turn the down-elevator mixing off.

PCM 10SX owners touch SEL under SW until the Idle-Up switch is selected (we used the BRK switch in our example). If Idle-Up has not been programmed then select the switch of your choice, but do not use STK. Put the switch in the ON position and proceed with "f" below.

PCM 10SXII and 10X owners touch SEL under the Idle-Up switch (we used GER or GR in our example). If Idle-Up has not been programmed, touch SEL under the switch of choice, but do not use STK. Put the switch in the ON position and touch PAGE to get to the type of mix display and then proceed with "f" below.

e. PCM 10SX owners touch PAGE once while 10SXII and 10X owners touch PAGE twice to get to the type of mix display.
f. Touch SEL under MASTER until ORIG appears so that mixing will be based only on the physical position of the throttle stick and will ignore any exponential that may be associated with the throttle channel. Touch PAGE to return to the mixing display.
g. Move the throttle stick to the full-low position. Now move it 1 click upward. Touch STORE under OFFSET with the throttle stick in this position. This sets the mixer's center point or offset.
h. Move the throttle stick back to the full-low position. Touch + until the percentage is about 3%. We are setting the mixing percentage that occurs when the throttle stick is moved below the offset or the full-low position.
i. Now test the mix direction by turning on the RX and watching the elevators. If you are using a switch to turn the mix on and off, make sure the switch is in the ON position. Moving the stick to the full-low position should cause the elevators to deflect downward slightly. If you see no movement, touch + to increase the percentage while holding the throttle stick in the full-low position until you see the elevators move a little.

If the elevators move in the wrong direction (up elevator) touch TURN while the stick is in the full-low position and the elevators should now deflect downward when the throttle stick is moved to the full-low position.

If you are using a switch, turn the switch off and the elevators should no longer move when the throttle stick is brought to the full-low position.

Test fly the aircraft and return to this mixer to adjust the amount of down elevator required to eliminate the "pulling-out" tendency. Increase down-elevator by touching + and decrease it by touching – while holding the throttle stick in the full-low position with the switch (if used) in the ON position.