

# Programming the MicroStar 2000

## Version 2.0



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February 19, 2010  
Version 2.0c

## **Dedication**

I would like to dedicate this project to my Dad, Richard C. Anderson and my brother Dave. My Dad created my interest in RC at a very young age. This interest in RC sparked my interest and career in electronics.

Without his love and support this would not have been possible.

And to Dave, my big brother, who's life was cut short by cancer, at an age of only 37.

## Notes on Encoder Versions

This manual has been updated to define all the functions in the latest version of the MicroStar, version 2.0n. In general this manual can be used for all of the 2.0 series versions and I have listed below versions that have added features found in this manual. If you are using a earlier version you my not find all the menus and selections defined in this manual.

- 2.0a**      Original version with baseline function. **Please upgrade if you are using this version!**
- 2.0c**      Added option to edit and enter frequency band.
- 2.0e**      Updated the way the internal channel normalization was done to improve the mixers. Also added the option to invert the buzzer. **This is the minimum level you should be running.**
- 2.0f**      Added the Advanced menu option and the following programmable functions: CH5 and CH8 slew rate control, RF deck PLL Ref Osc frequency, Framing rate control and framing rate defect and the trim center beep function.
- 2.0g**      Added the CCPM function, digital trim options and the Send Serial option.
- 2.0i**      Added servo reversing functions, trim center beep options for throttle and channels 6 and 7 and the digital trim update rate option. This version also added support for the 12 bit ADC.
- 2.0k**      Added the FMS flight simulator options for UART 1 and 2
- 2.0l**      Fixed a Futaba buddy box problem and a MicroStar buddy box communication error.
- 2.0m**      Fixed a rounding problem in the user interface and improved the switch debounce logic.
- 2.0n**      Added the helicopter modes and restructured code for MicroProStar mode.

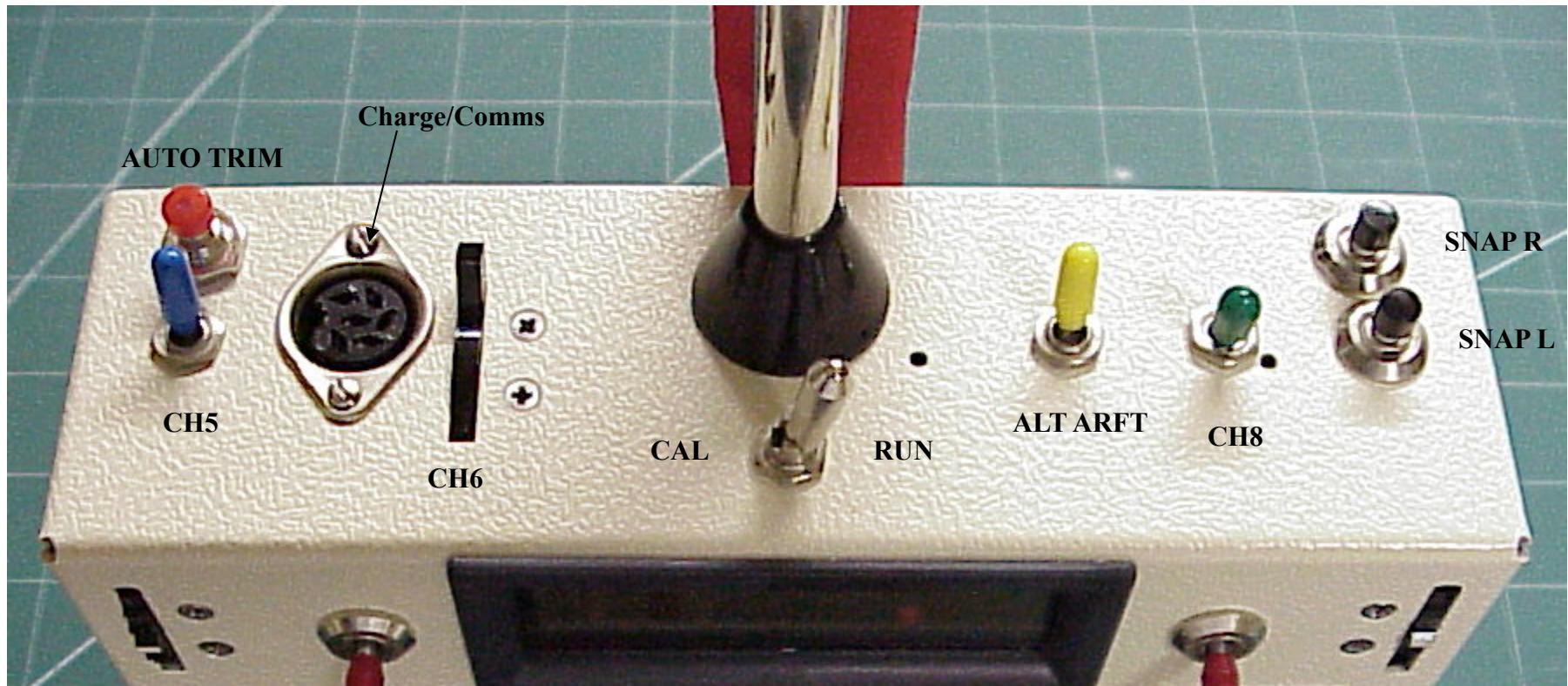
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## Transmitter Front Switches



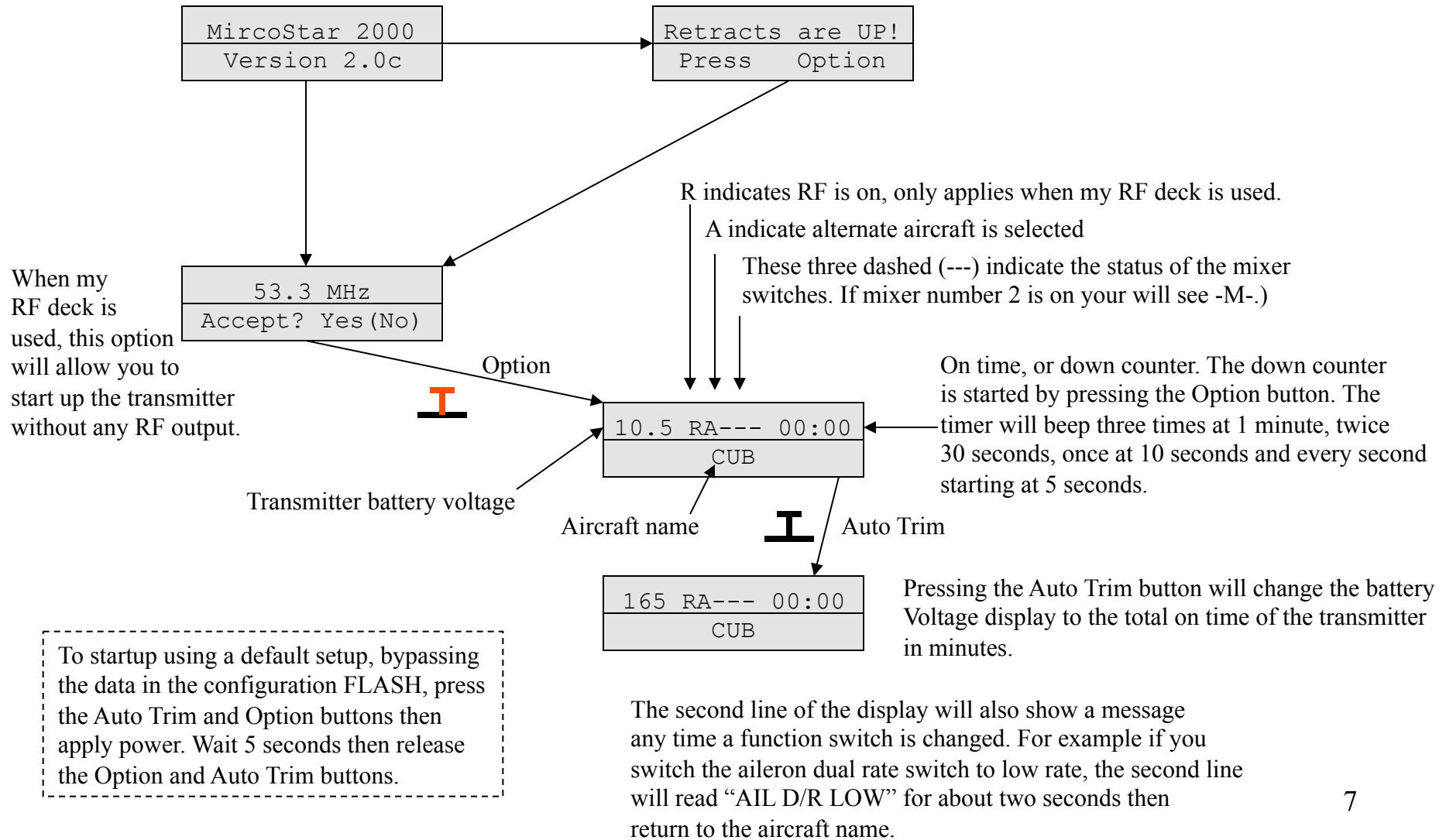
## Transmitter Top Switches



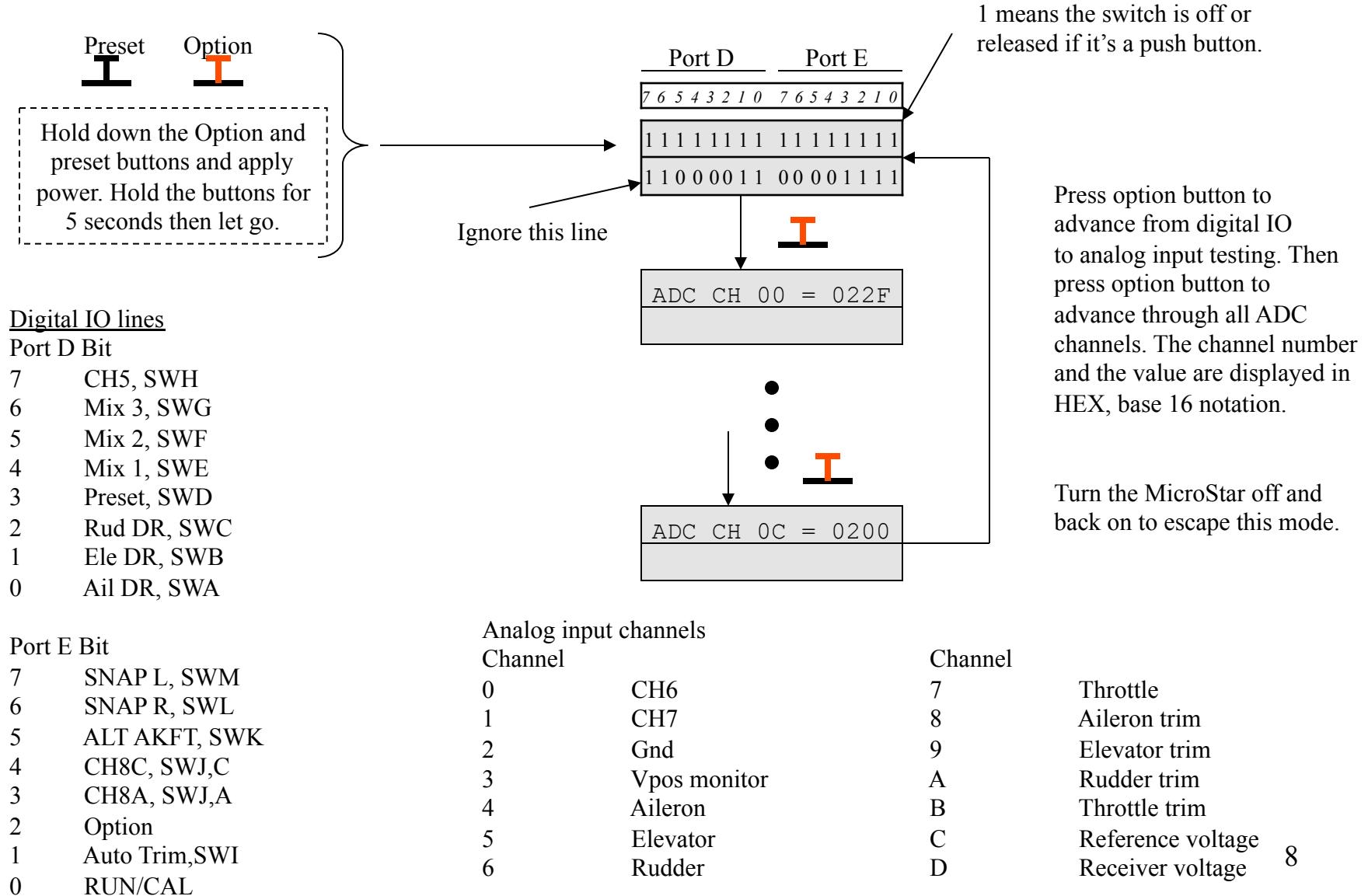
## MicroStar startup

When power is first applied you will see the following signon message for about one second.

After a 1 second delay this retract warning will be displayed if it has been enabled in the Options menu.

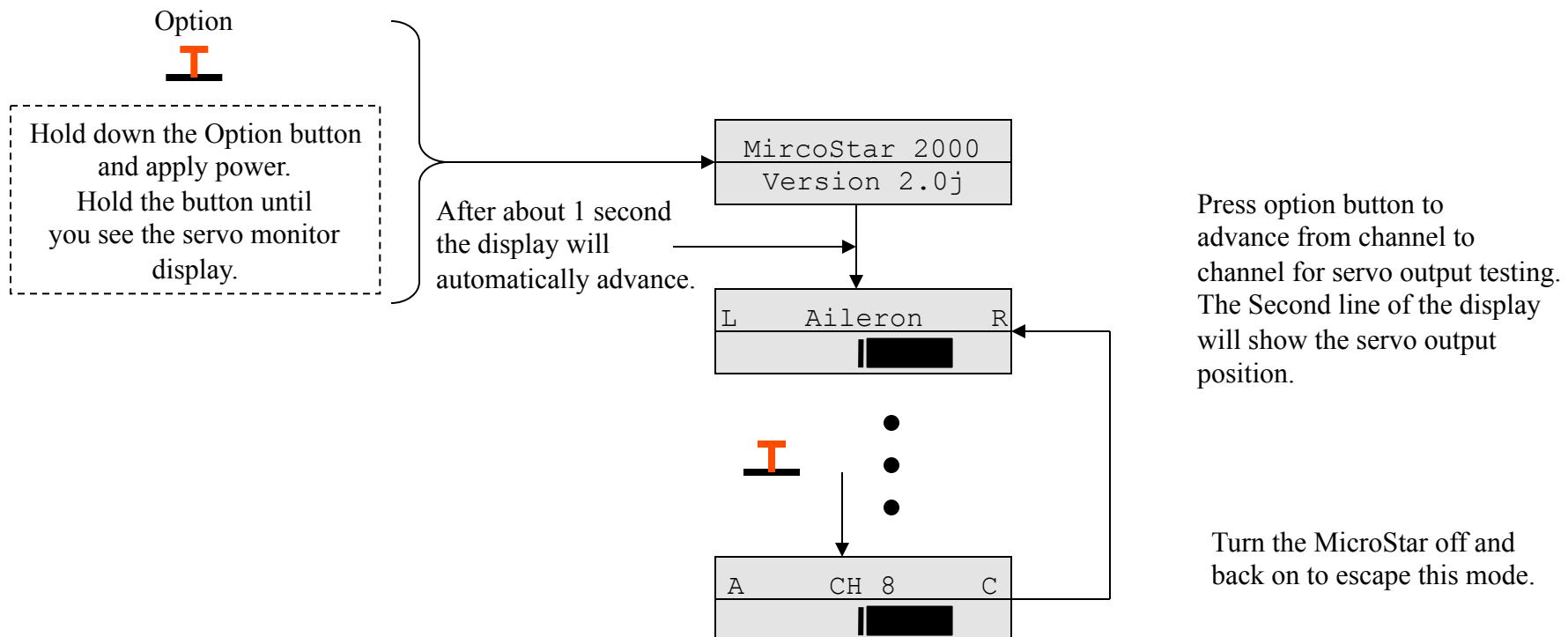


# MicroStar TEST IO startup option



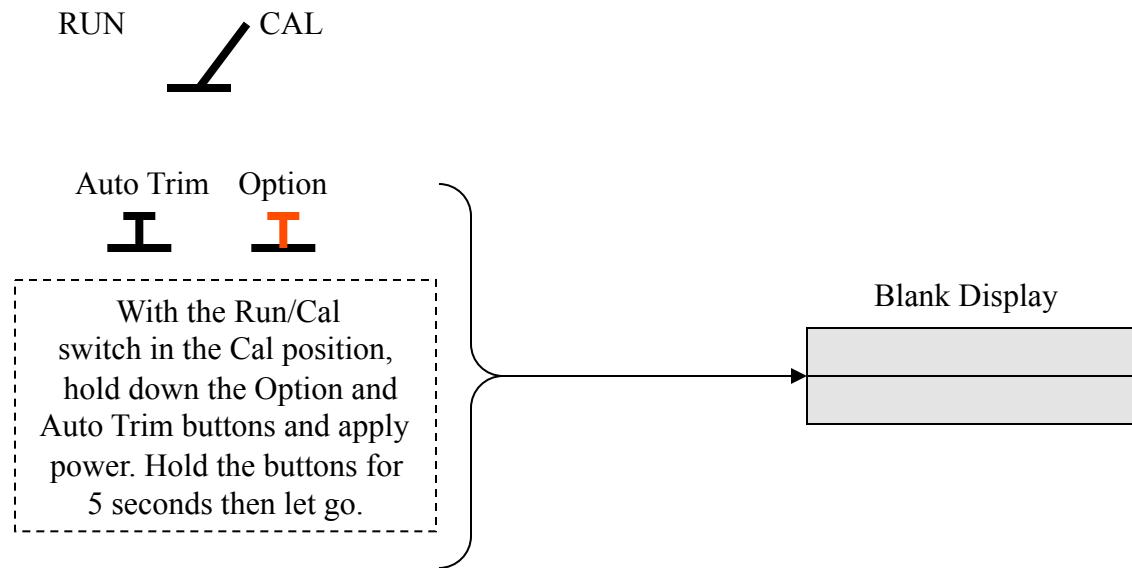
## MicroStar Servo Monitor startup option

The servo output monitor function allows you to see the servo signal that is being transmitted by the MicroStar. The display will show a bar graph representing the position of the selected signal. This will allow you to test your mixing setup to make sure you have properly configured your system. While in this mode your transmitter is fully functional and transmitting a valid signal.



The function requires MicroStar Version 2.0j or later.

## MicroStar Bootloader startup option



The MicroStar 2000 PIC (18F8722 or 18F8723) contains two programs. The bootloader and the encoder application. The bootloader allows you to download new versions of the encoder application as they become available. This can be done using the PC interface application and no special hardware. When power is applied to the MicroStar the bootloader looks for a flag in FLASH memory indicating an application program is present and then starts the application. To reprogram the application you must communicate with the bootloader and stop the automatic startup of the application. This can be done two ways, 1.) Using the PC application to reset the flag or 2.) Use this startup procedure to start the MicroStar in bootloader mode. After the MicroStar is running in bootloader mode you must use the PC application to program a new application.

## Tachometer Module

When the optional Tachometer module is plugged into the accessory jack on the side of the MicroStar the second line of the display will read the detected RPM. The MicroStar detects the presence of the Tach module automatically!



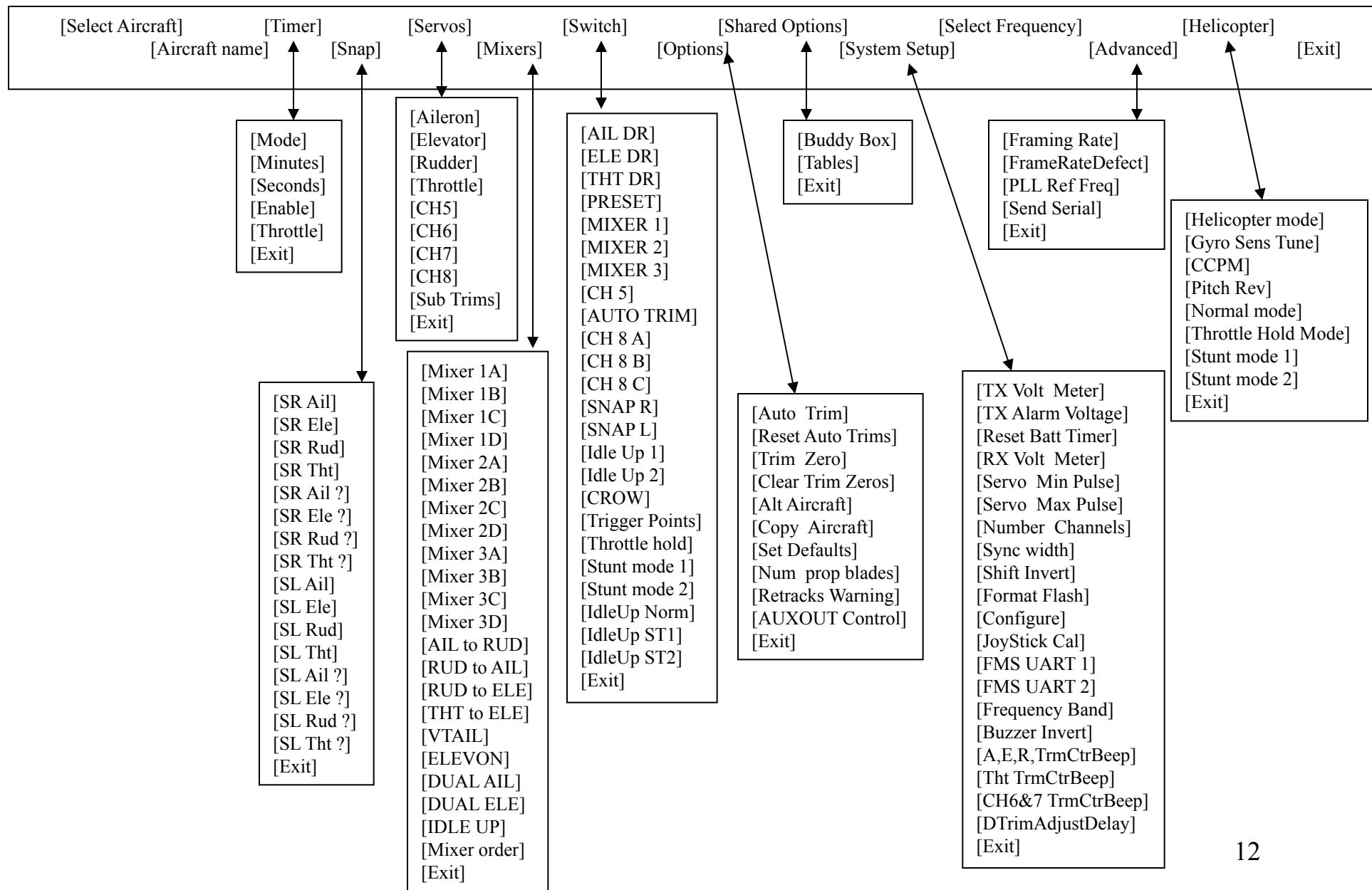
Example display

10.5 RA---	00:00
2Bld RPM =	2430

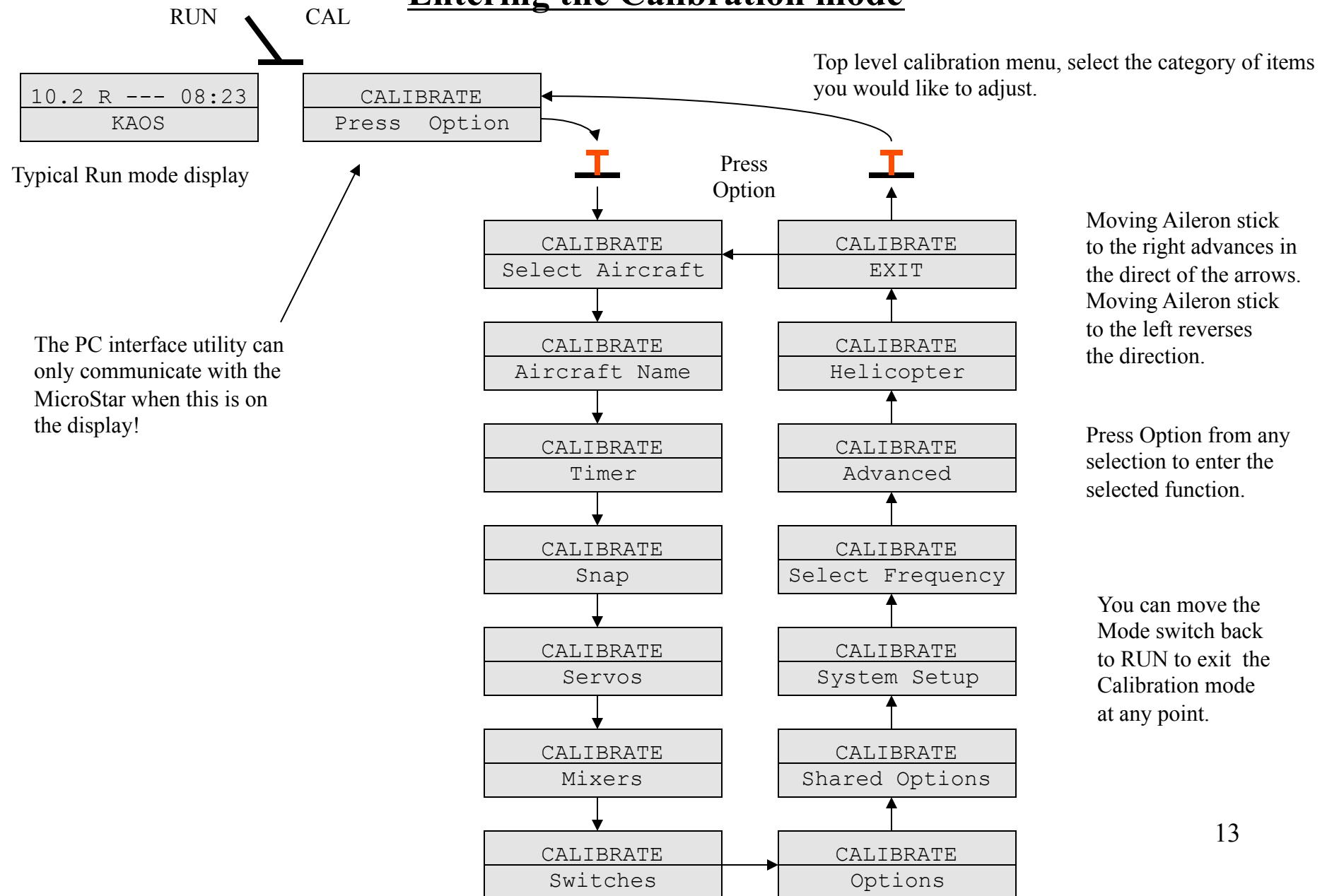
The number of prop blades can be defined in the MISC parameters, different aircraft can have different Tach parameters

Another unique feature of the MicroStar is direct servo drive. Through the same accessory jack any channel can be used to drive a servo. This is helpful during programming and testing.

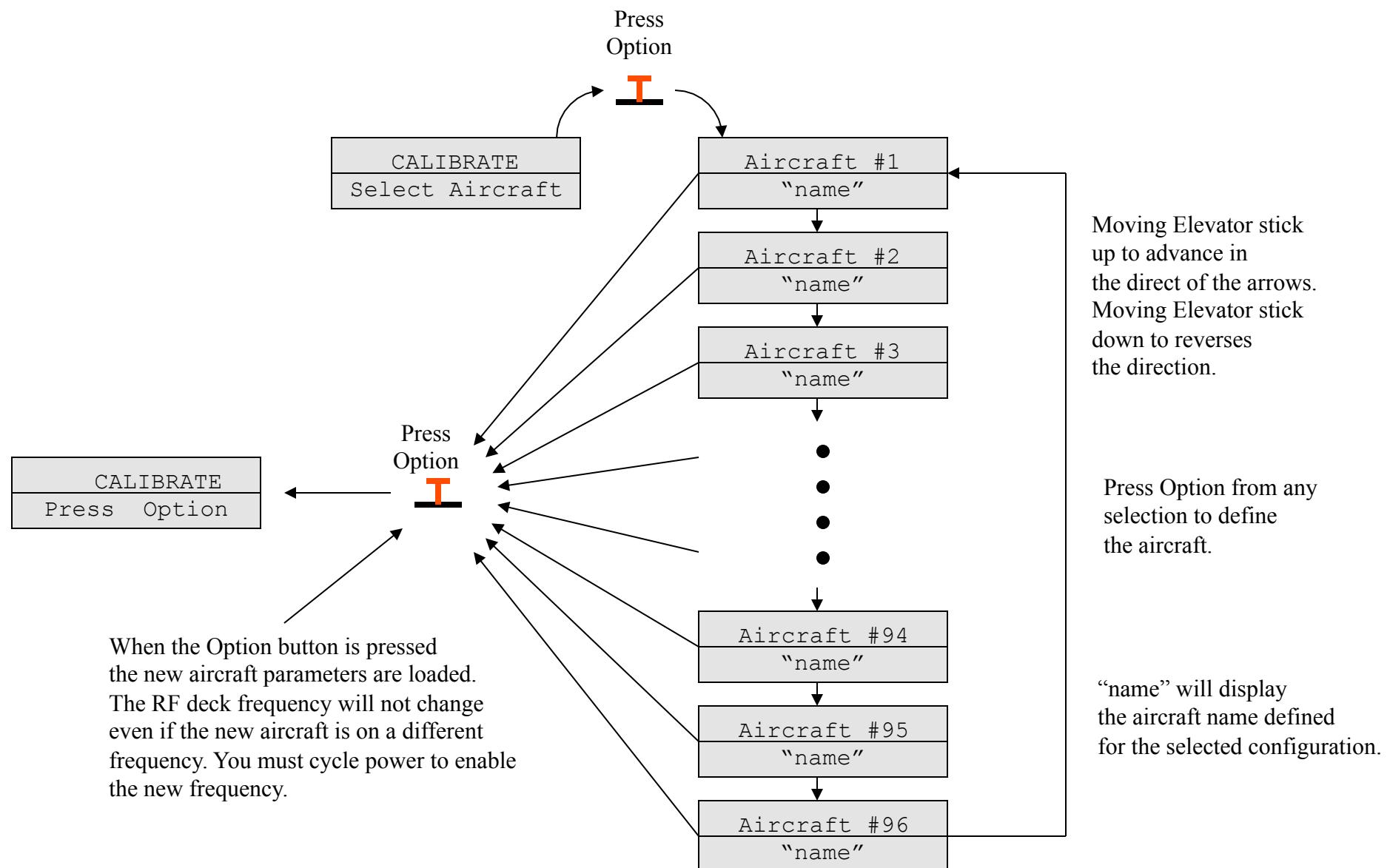
# MicroStar 2000 Menu Options



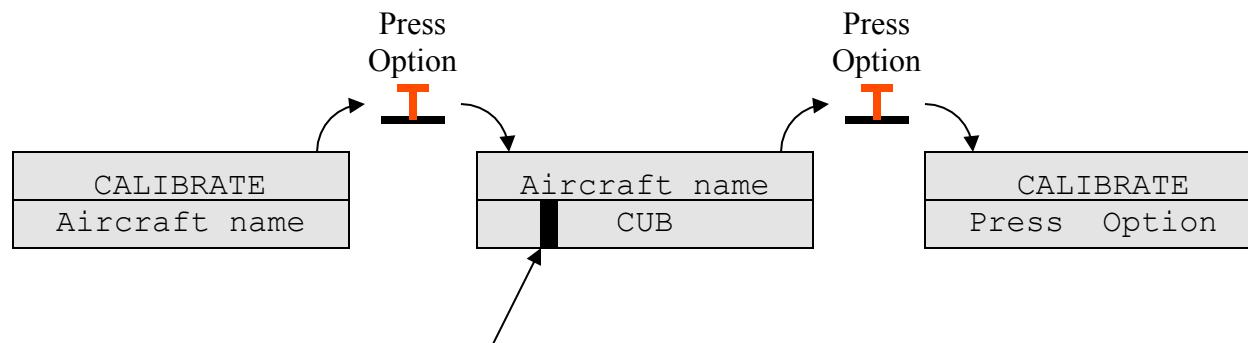
## Entering the Calibration mode



## Select Aircraft



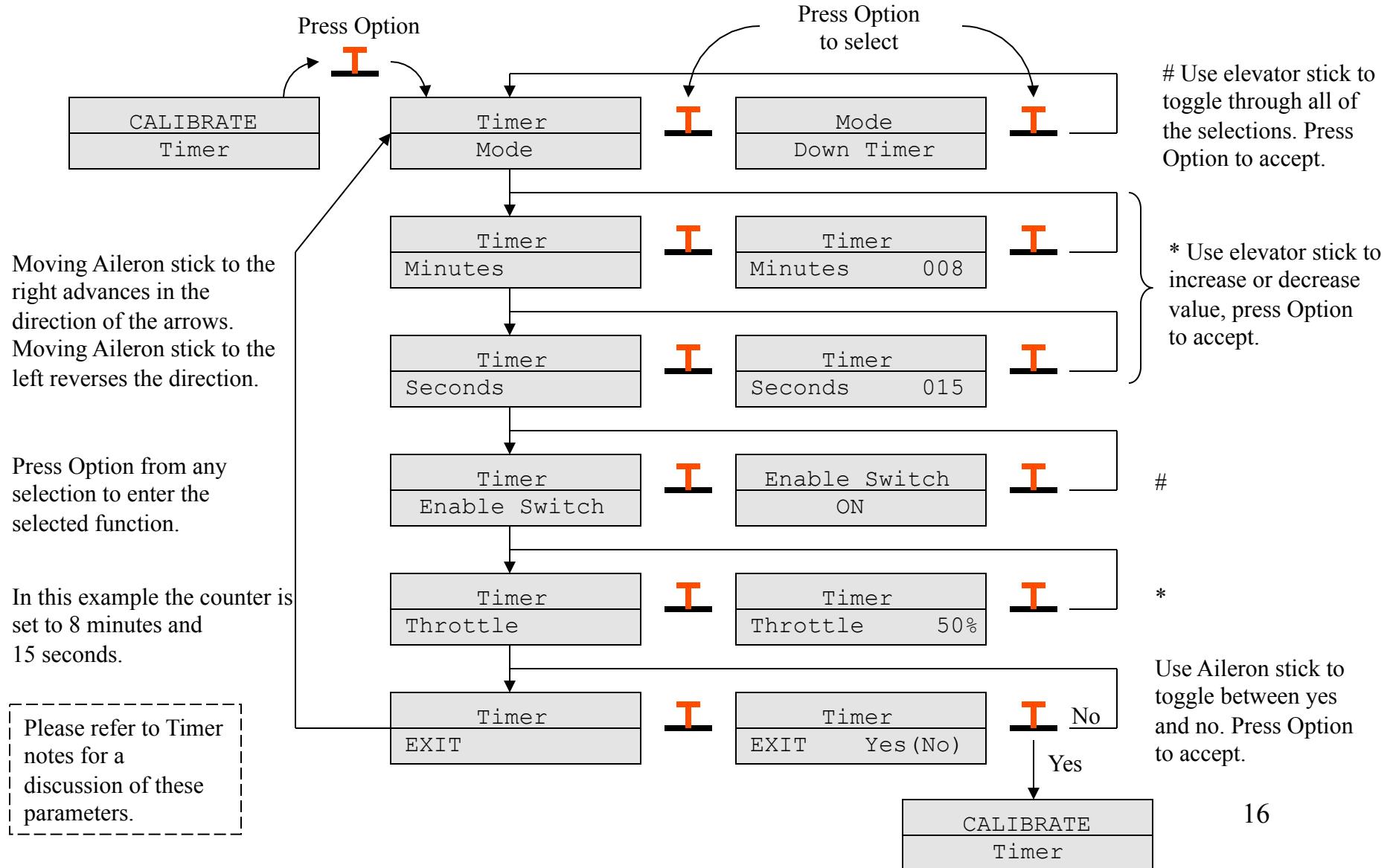
## Aircraft Name



This blinking cursor can be moved to the right or left using the aileron stick. The character defined at the cursor can be changed using the elevator stick. After the model name is defined, press the Option button to accept the changes.

# Timer

This function allows you to define the flight timers parameters. This counter is started by pressing the option button when you are in the run mode. Pressing the option button again will stop the timer. When the timer is started again, it will start counting down from the starting value defined in this function.



## Timer notes

The Flight Timer is started by pressing the Option button. The timer will beep three times at 1 minute, twice 30 seconds, once at 10 seconds and every second starting at 5 seconds. The Timer can be stopped by pressing the Option button while the Timer is counting. Stopping the Timer will reset the count and when the Option button is pressed again the Timer will restart.

The flight timer supports three modes of operation.

### **Up Timer**

In this mode the timer starts at 0 and counts up. When the time limit has expired the buzzer will sound warning the pilot that its time to land. After the alarm has sounded the timer will continue to count up, this allows you to determine the total flight time.

### **Down Timer**

The Down Timer is the default mode. In this mode the counter starts at the programmed time limit and counts down to zero. At zero the alarm will sound and the counter will start counting up. After the alarm has sounded the count value indicates how long after the time limit expired that the flight continued.

### **Down Stop Timer**

The Down Stop Timer works similar to the Down Timer except the counting stops when the limit is reached.

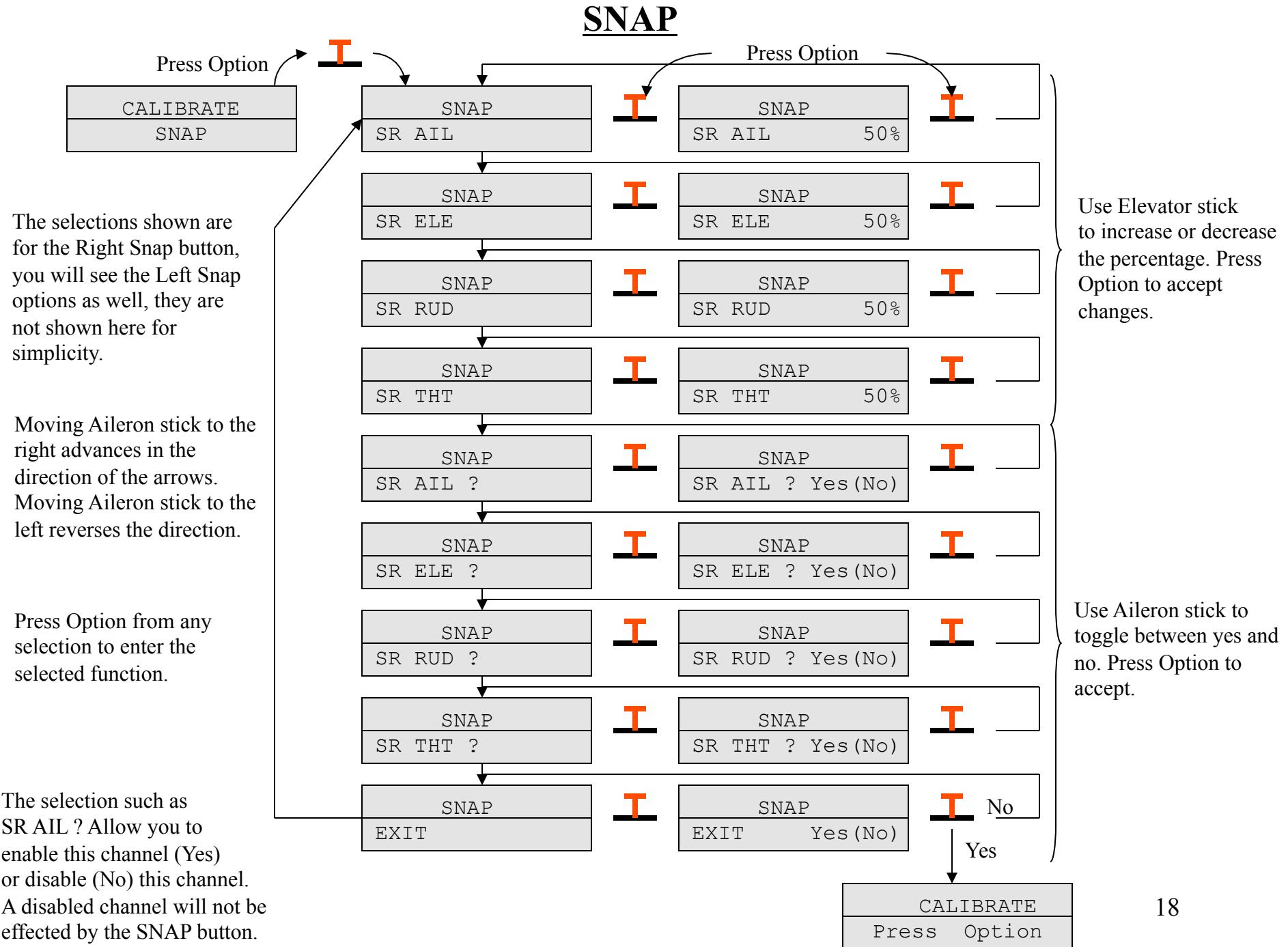
The timer can be enabled and disabled in using both the throttle position and a user programmable switch function. The two methods are described below:

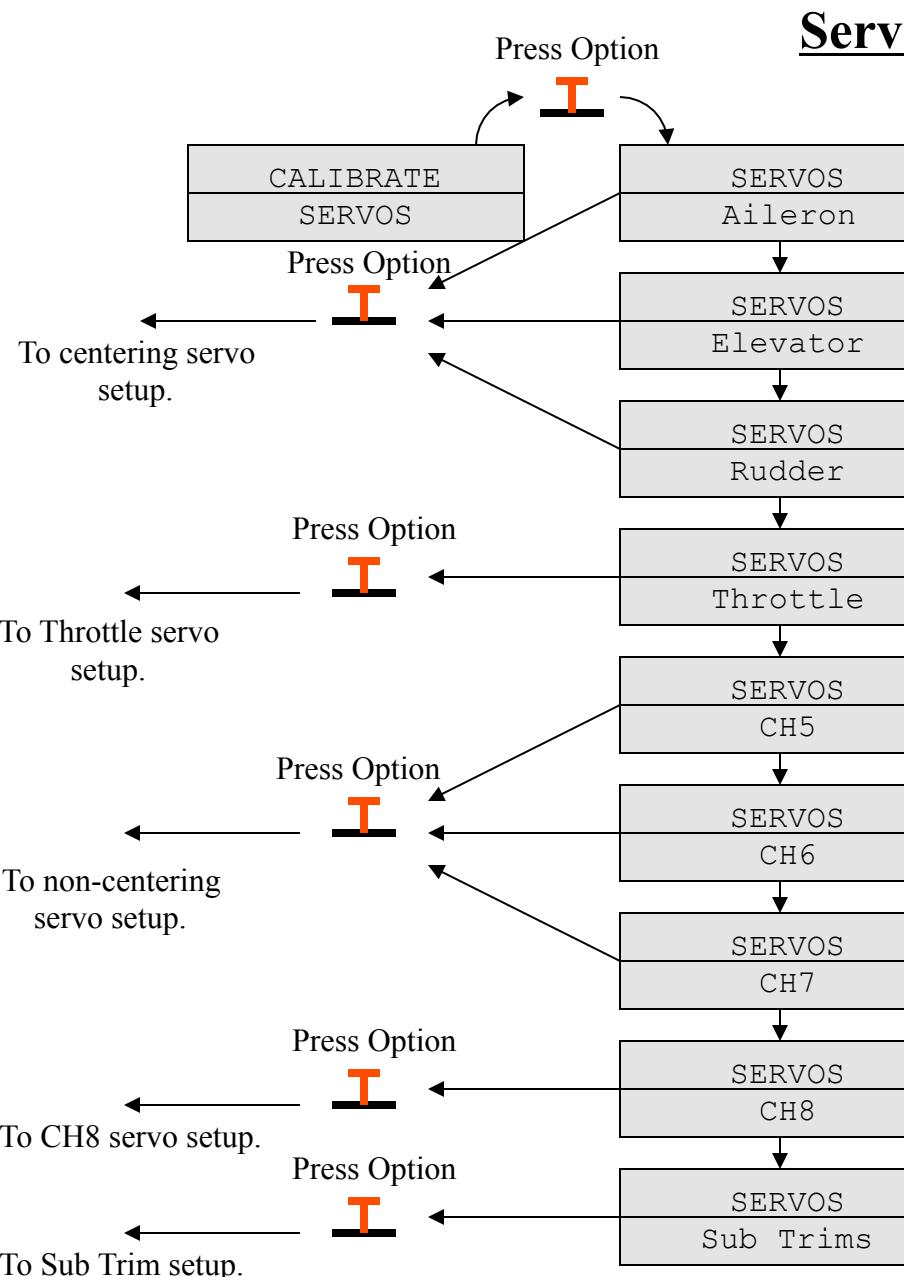
### **Throttle**

Flight time is generally a function of the fuel consumption and this is controlled by the throttle setting. To allow the pilot to factor the throttle setting into the flight time, the throttle stick position can be used to enable and disable the timer. This setting is in percent of full throttle, if the throttle setting is above this value the timer will run. The default value is 0.

### **Enable Switch**

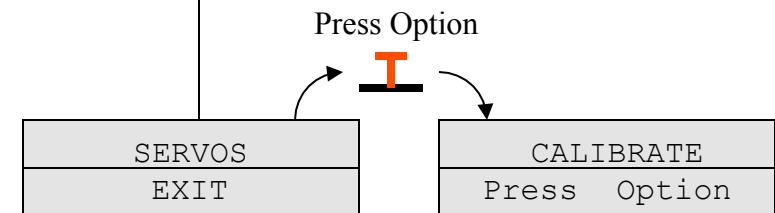
The Enable Switch option allows the pilot to define a switch to be used to enable and disable the timer. The default value for this switch is “ON”.





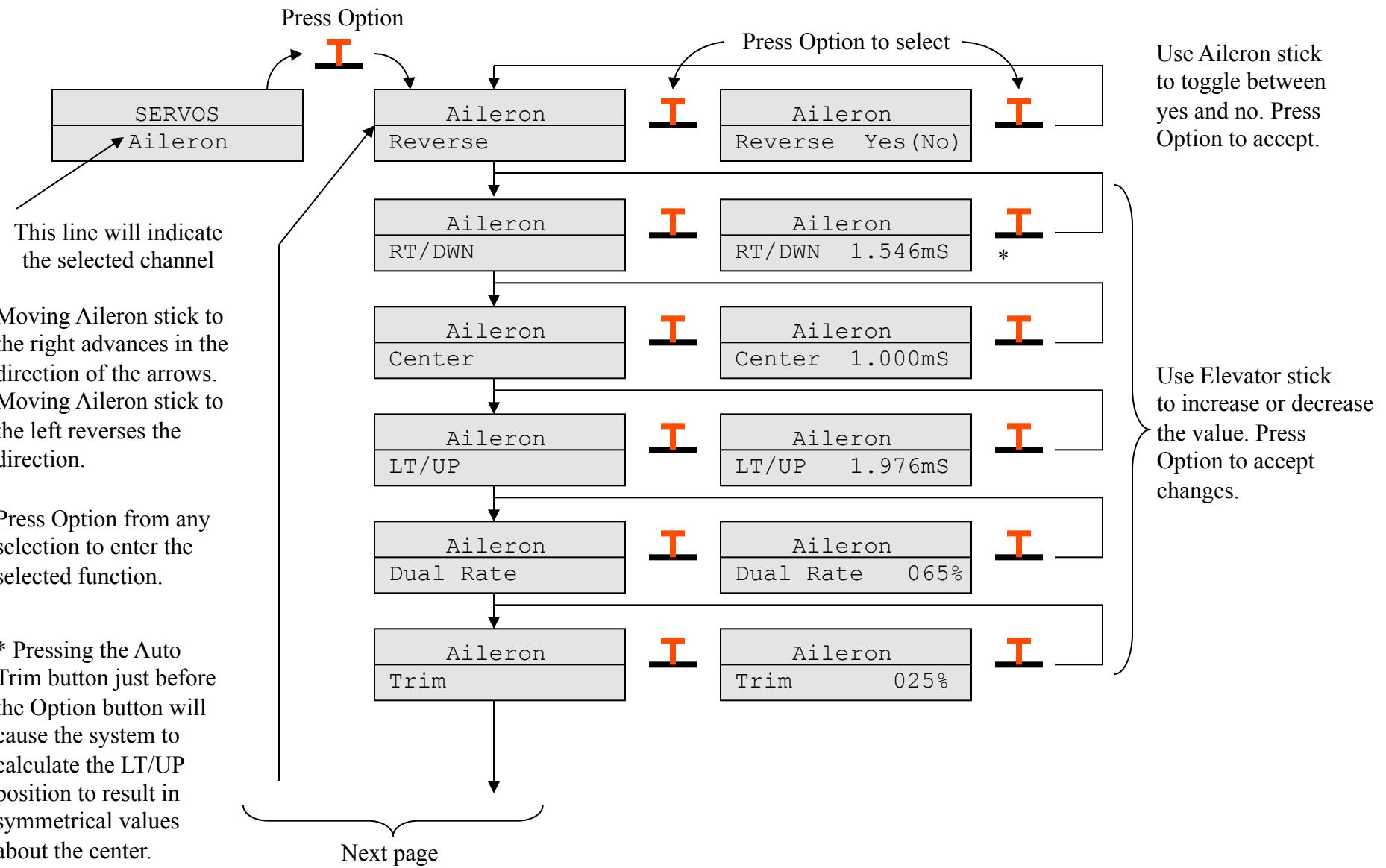
Moving Aileron stick to the right advances in the direct of the arrows. Moving Aileron stick to the left reverses the direction.

Press Option from any selection to enter the selected function.



The servo options that you update are permanently saved only when you exit this function. If you turn off the MicroStar before exiting all edits will be lost!

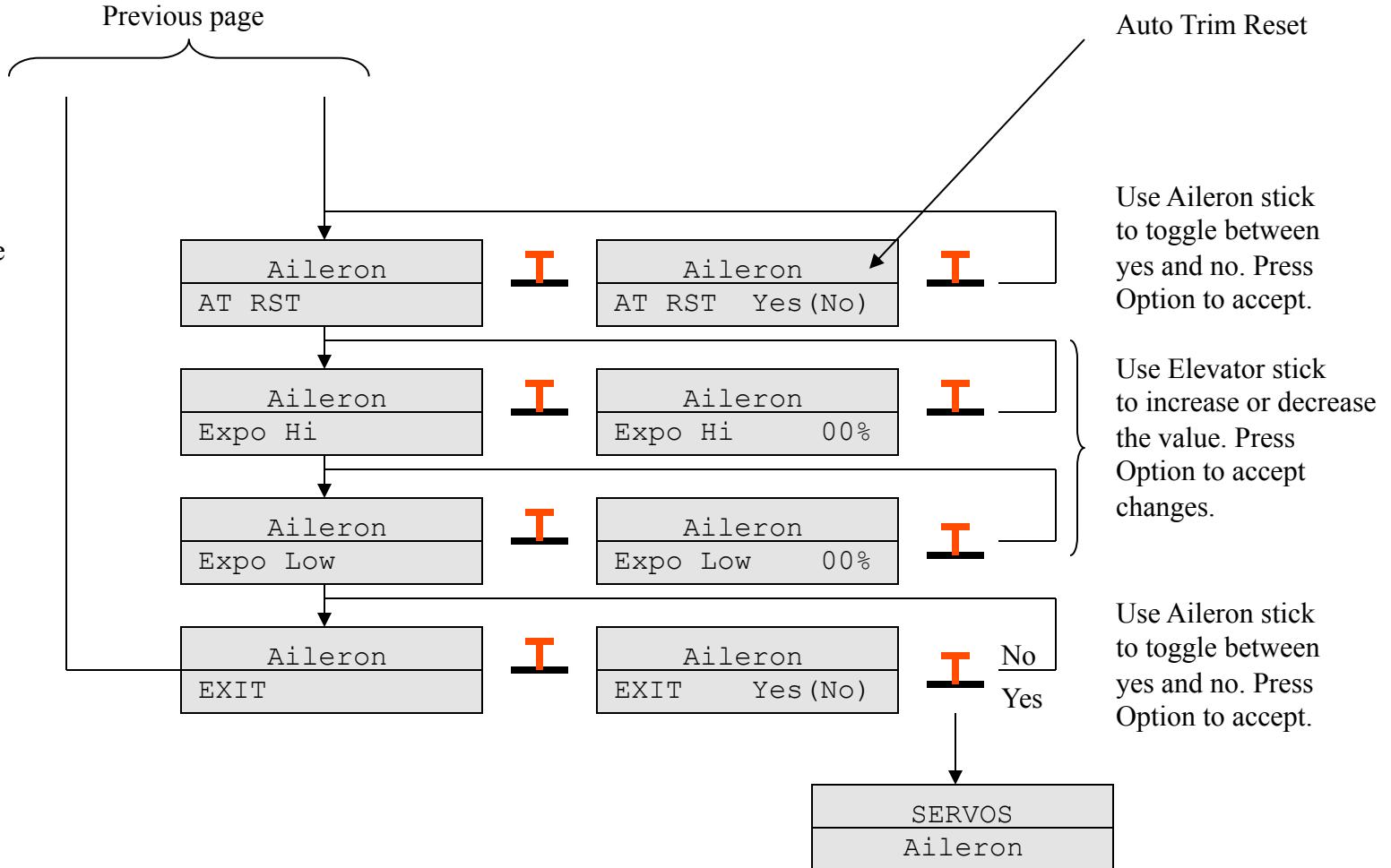
## Centering servo setup



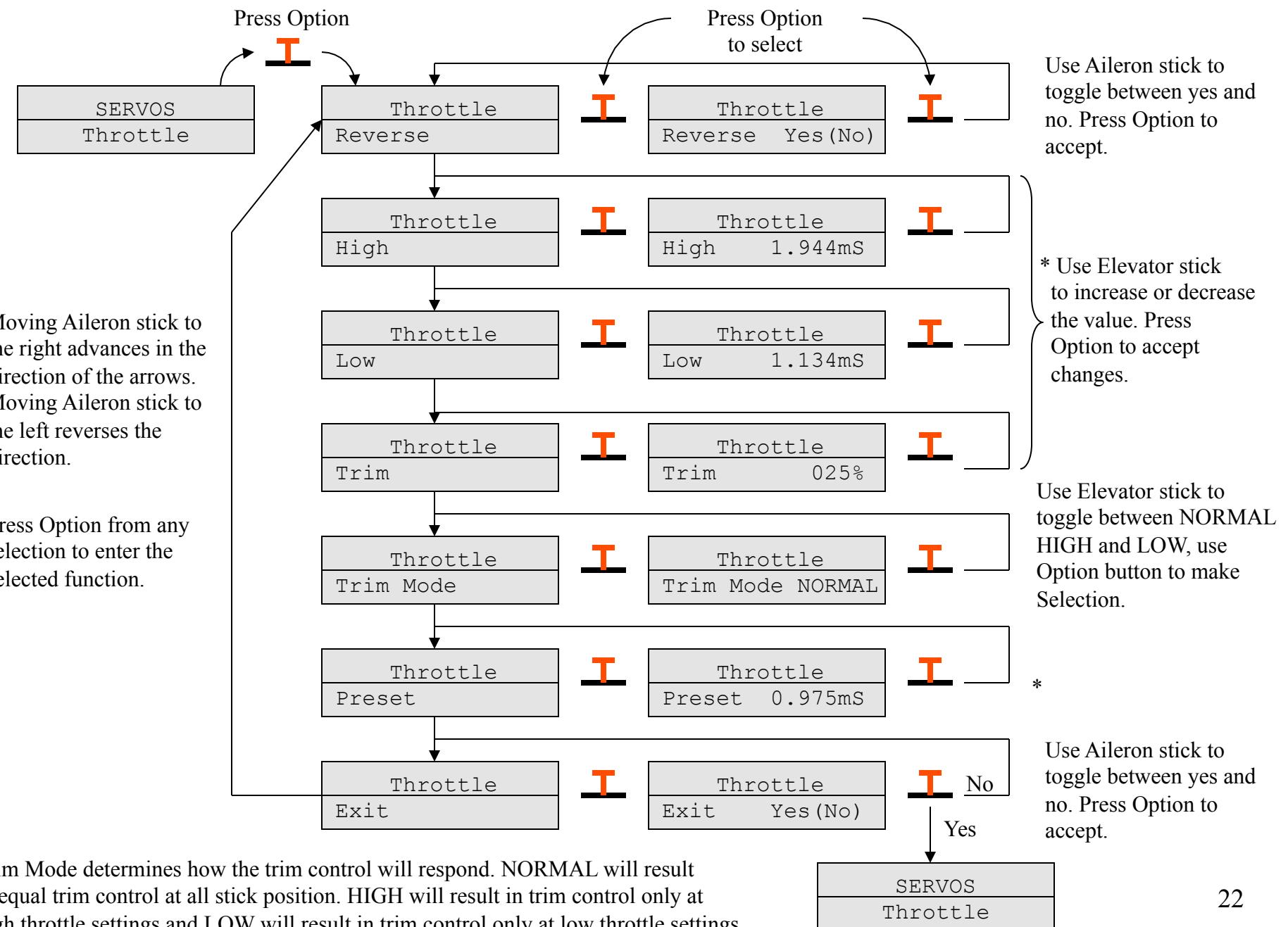
## Centering servo setup, continued

Moving Aileron stick to the right advances in the direction of the arrows.  
Moving Aileron stick to the left reverses the direction.

Press Option from any selection to enter the selected function.



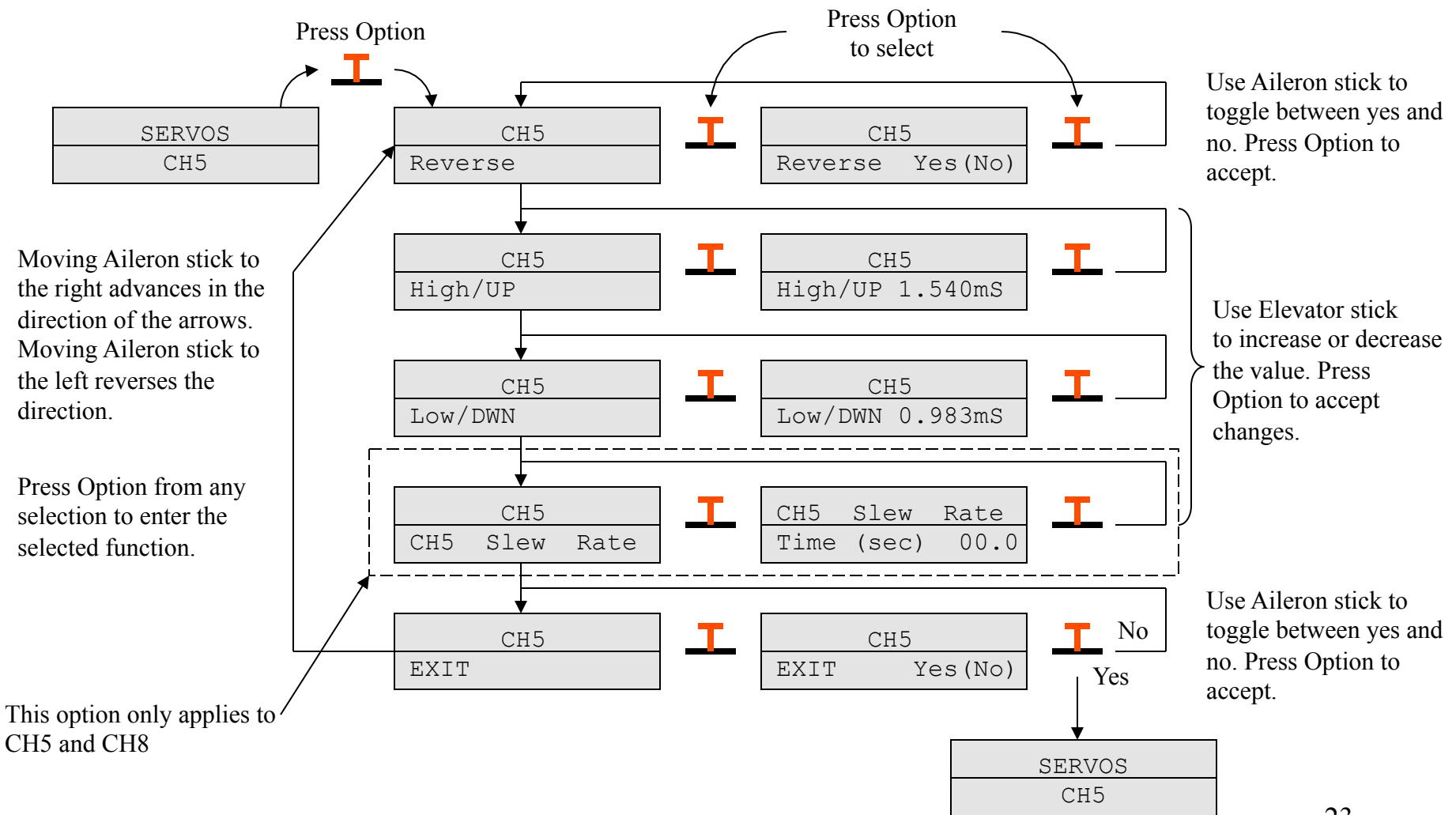
## Throttle servo setup



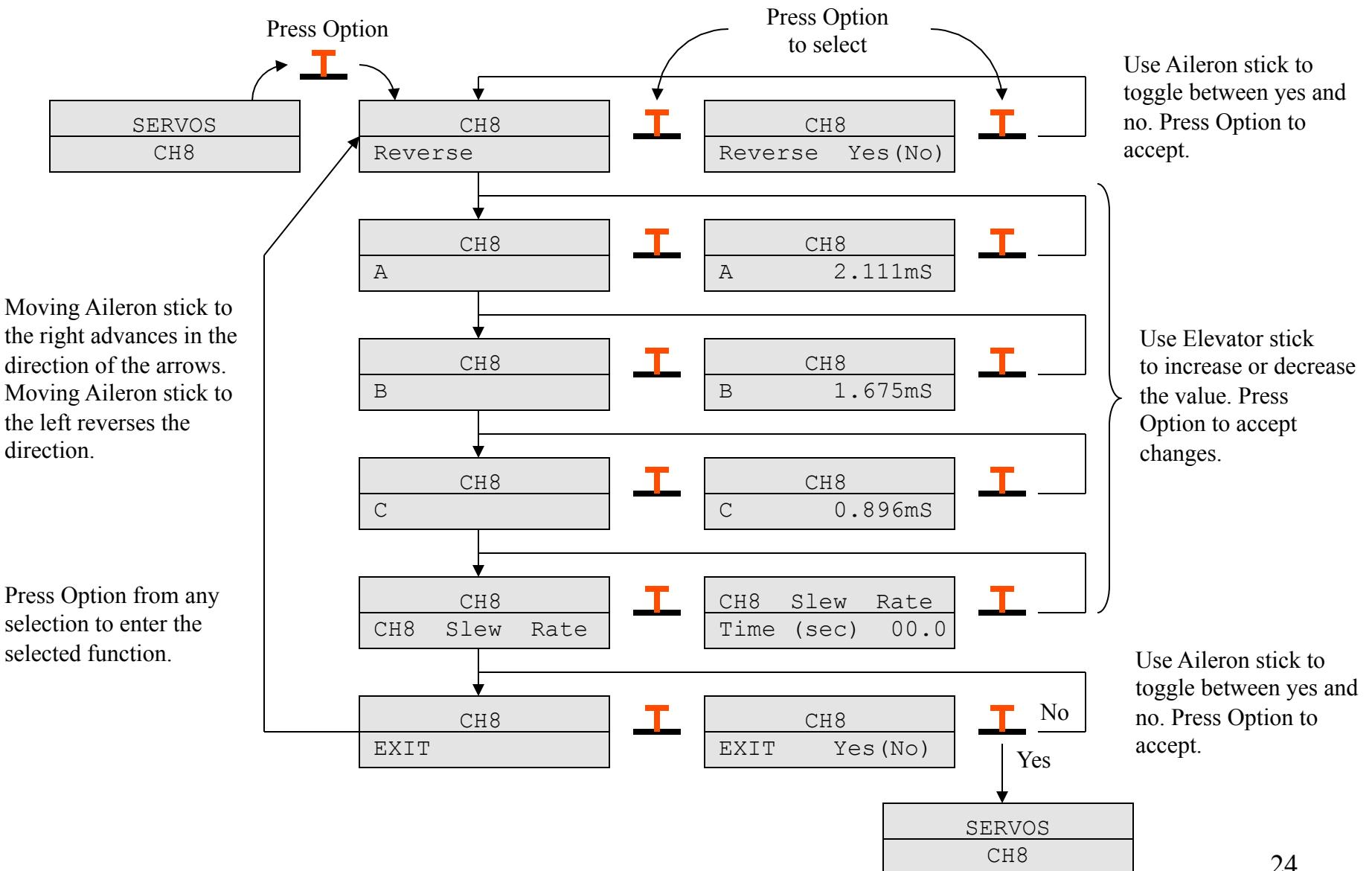
Trim Mode determines how the trim control will respond. NORMAL will result in equal trim control at all stick position. HIGH will result in trim control only at high throttle settings and LOW will result in trim control only at low throttle settings.

## Non-centering servo setup

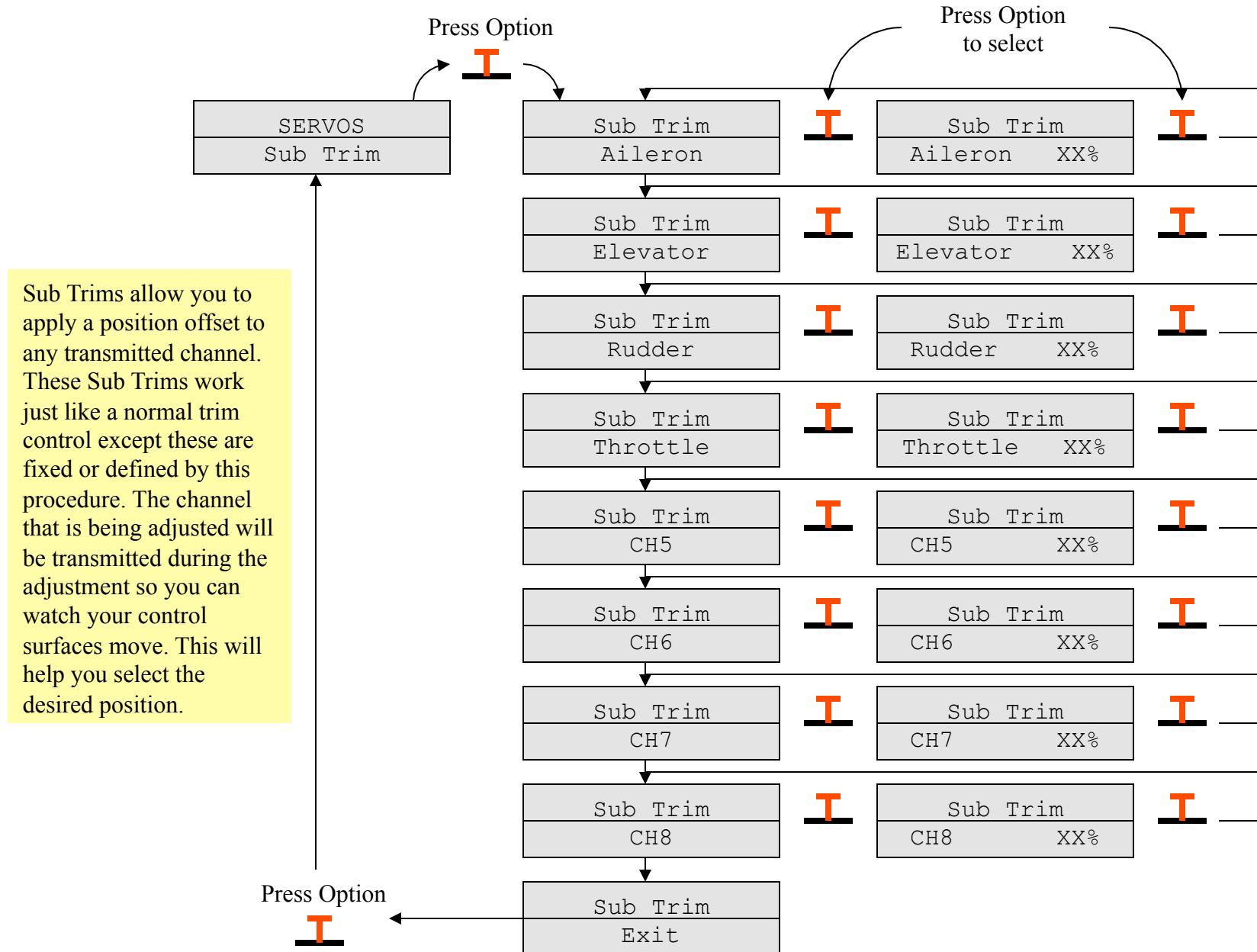
This non-centering servo setup description applies to CH5, CH6, and CH7. The example below is shown for CH5 and the options are the same for CH6 and 7 with the exception of slew rate. Slew rate (the speed the servo moves) can only be defined for CH5 and CH8 (CH8 setup is shown on a different page in this manual).



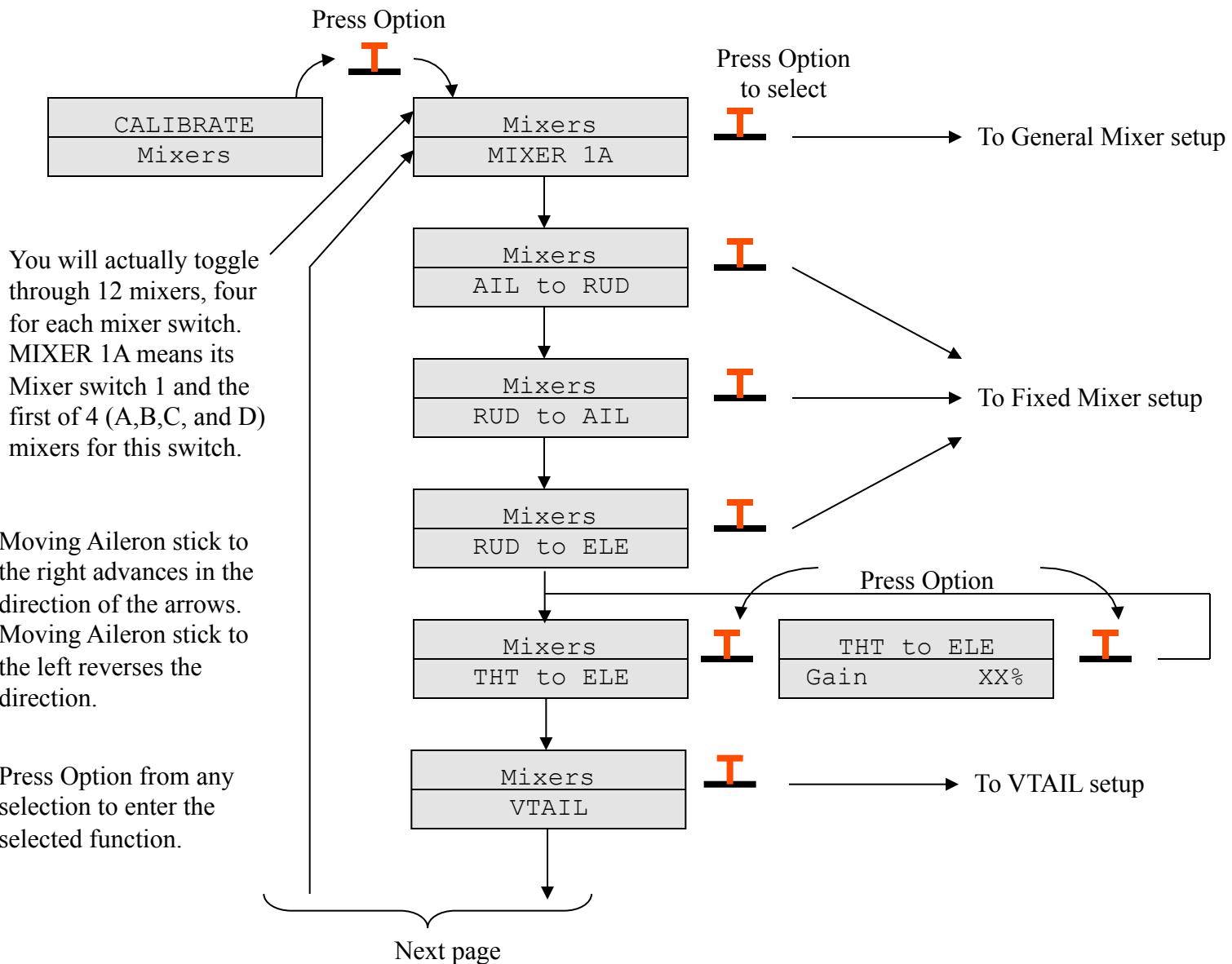
## CH8 servo setup



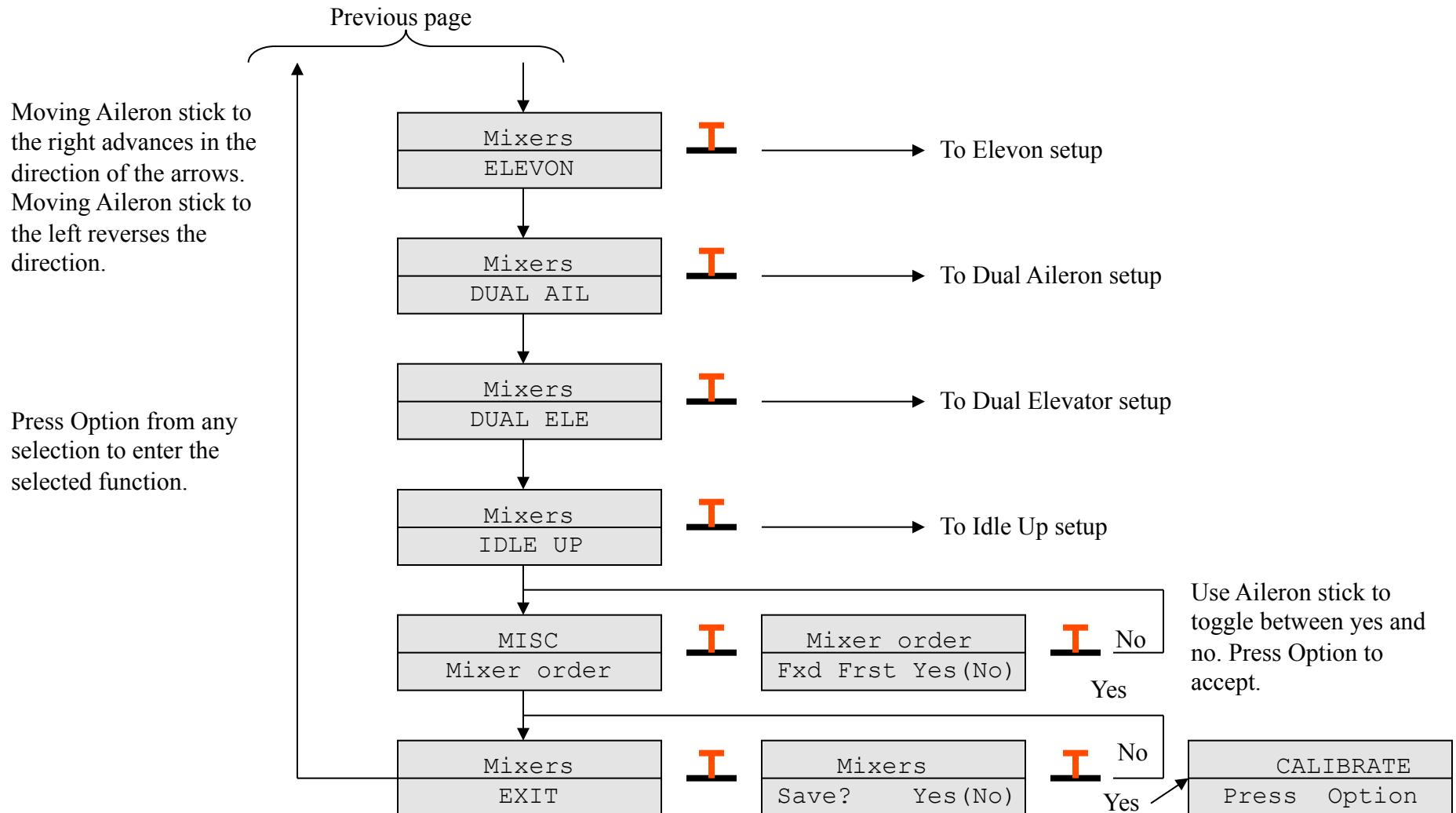
## Sub Trim setup



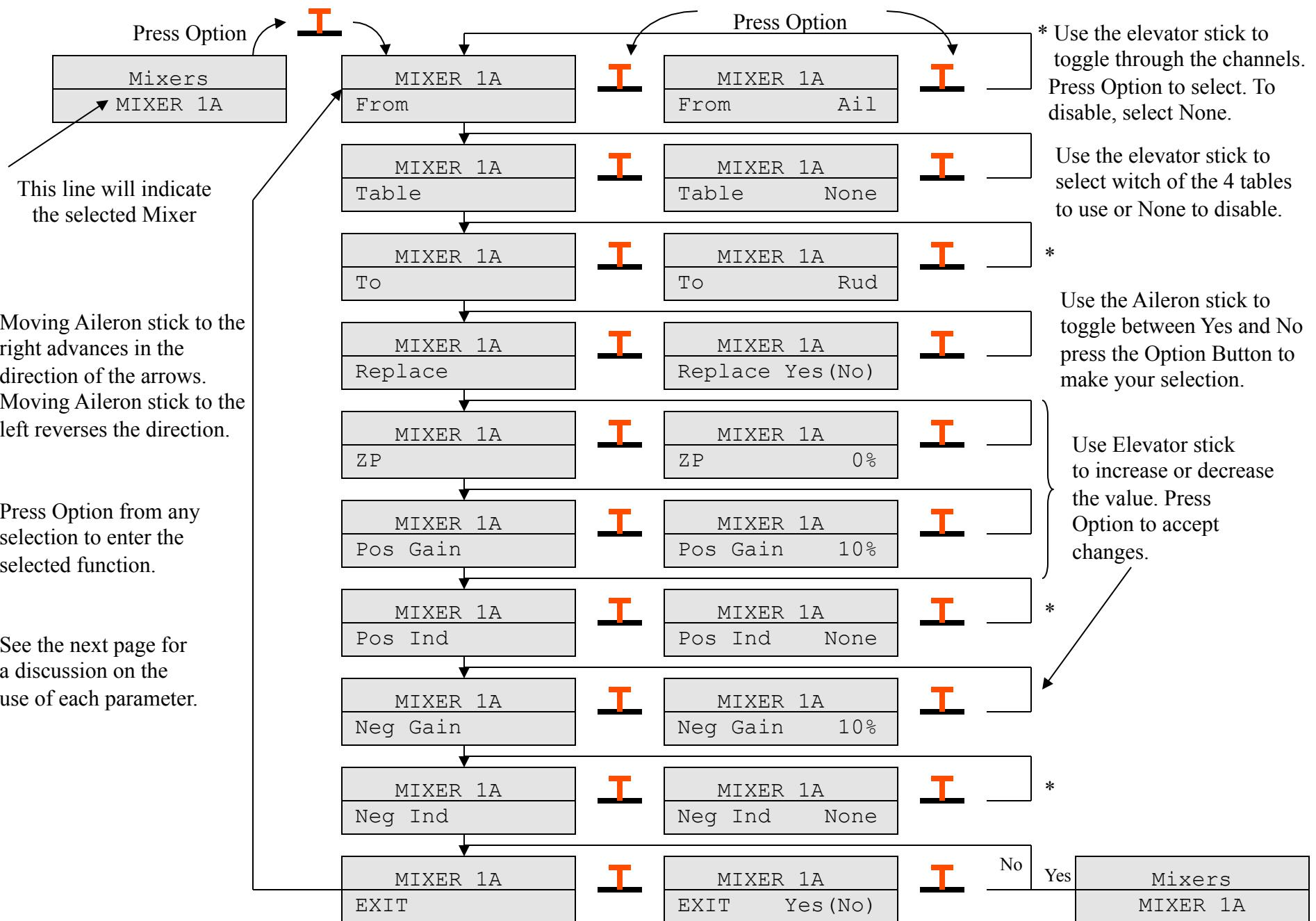
# MIXER



## MIXER, continued



## General Mixers



# General Mixer parameters

## **From:**

The From channel defines the input position data to be used by the mix function. Any of the 8 channels can be used.

To disable a mixer, set the from channel to None.

## **Table:**

The input channel can be translated using any function you like through the use of the look up tables. Eight tables are provided (1 through 8), or select None to disable. Each table contains 11 points that the user can define (please see the details in the Shared Options section).

## **To:**

The output channel for the mixing function, this is the channel effected by the mixing. Any of the 8 channels may be used.

## **Replace:**

This is a Yes No parameter that lets you use the result to add to the To channel or replace the To channel.

## **Zp:**

This is the zero point for the mixing function, in percentage. Mixing is performed by subtracting the zero point from the From channel position. The resulting value can be positive or negative. This result is multiplied by the negative or positive gain and then added to the To channel, or written to the To channel. It's important to remember that these calculations are performed using normalized stick positions. All controls except Throttle are normalized to; -1000 for left or up, 0 for center, and 1000 for right or down. The Throttle channel is normalized 0 to 1000.

## **Pos gain:**

Position gain in percentage.

## **Pos Ind:**

Positive indirection allows you to define a channel to be used as the gain channel. Any of the 8 channels can be used, or select None to disable.

## **Neg gain:**

Position gain in percentage.

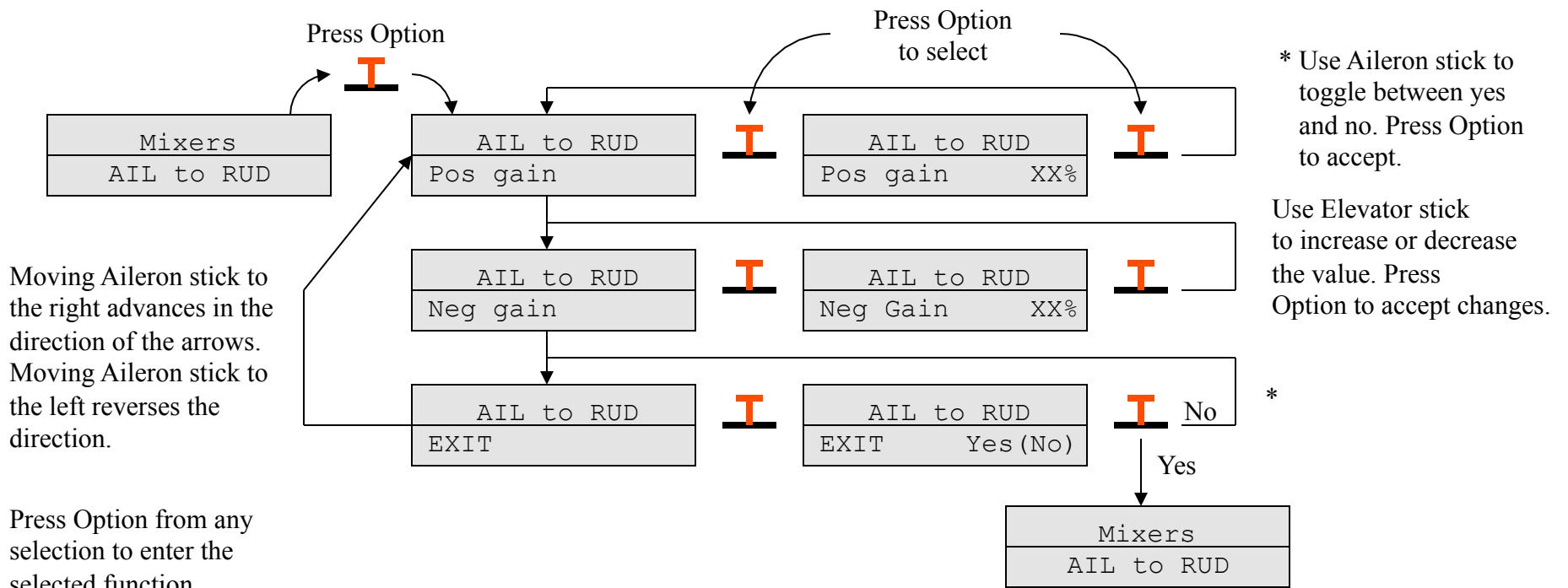
## **Neg Ind:**

Negative indirection allows you to define a channel to be used as the gain channel. Any of the 8 channels can be used, or select None to disable.

## **EXIT:**

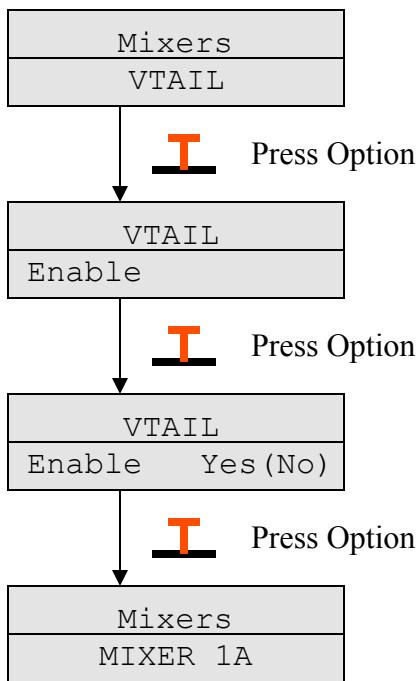
Select this option to exit this mixer function.

## Fixed Mixer Setup



This example shows the Aileron to Rudder mixer but this procedure is applied to the Rudder to Aileron and Rudder mixers as well.

## VTAIL

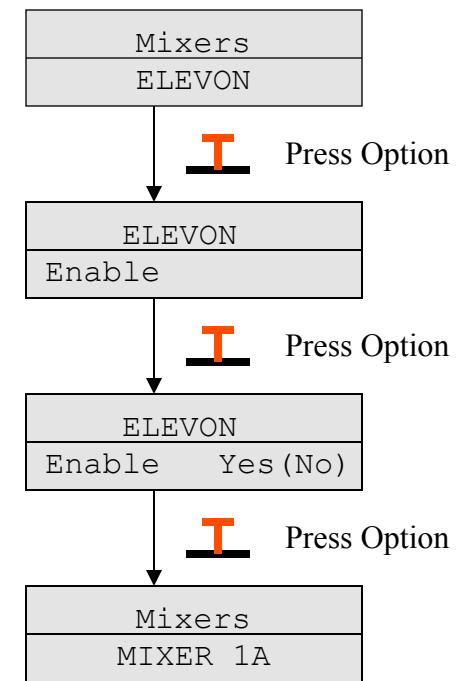


Press Option to enable VTAIL edit.

Use the aileron stick to toggle between Yes and No, press Option to make selection

VTAIL mixing is Rudder and Elevator mixed to support aircraft designs with V shaped tail surfaces.

## ELEVON



Press Option to enable VTAIL edit.

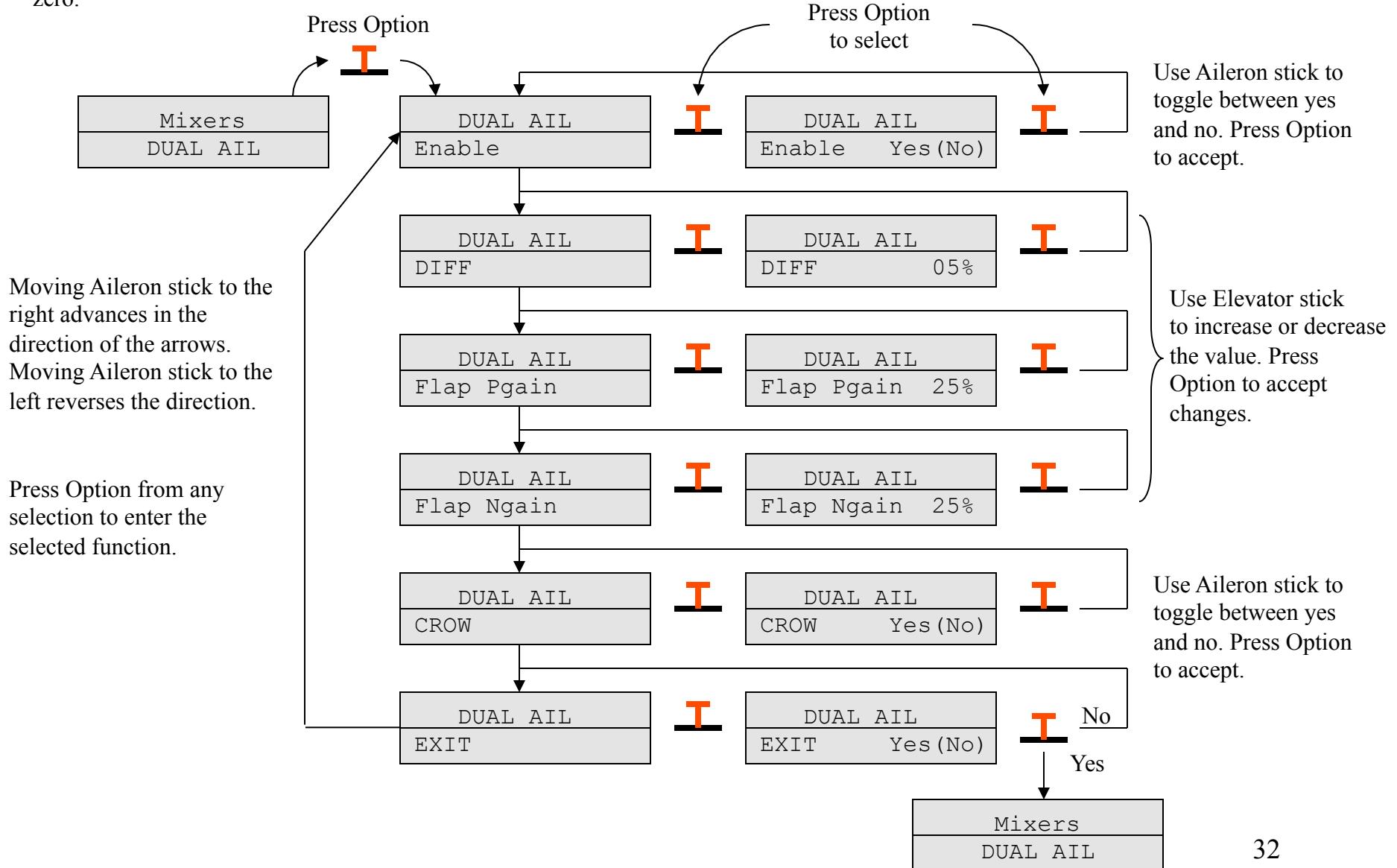
Use the aileron stick to toggle between Yes and No, press Option to make selection

ELEVON is aileron and elevator mixing to support flying wing type of aircraft designs.

Before enabling the Vtail or Elevon mixers first adjust the servo's ranges using the servo setup functions. It is important that the center positions and the ranges are defined and matched between the two servos before you enable the mixer. After enabling the mixer if the directions are incorrect you can use the servo reverse functions to change the servo directions. If you find it necessary to reverse a servo's direction then you should disable the mixer and reestablish the servos center and end points incase there is any slight shift after reversal. Finally after the servo's positions and directions are correct, enable the mixer.

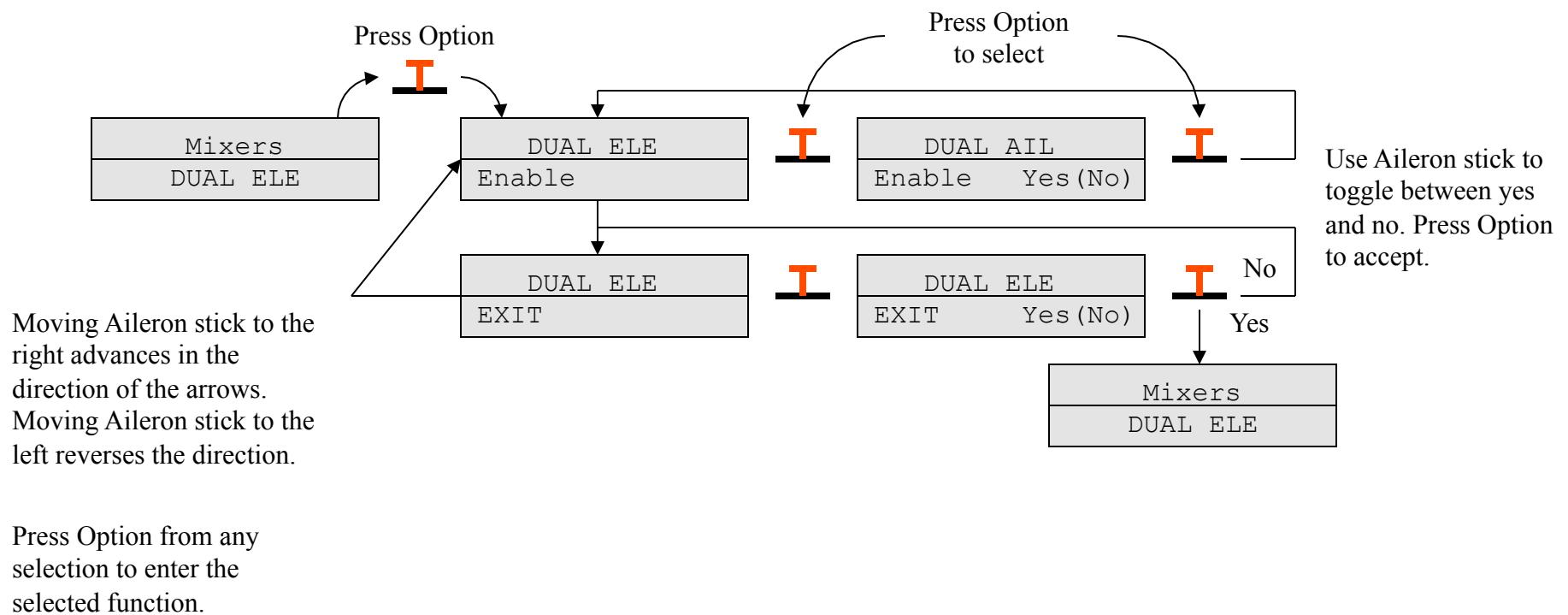
## Dual Aileron

When dual aileron mode is enabled the aileron servos are controlled by the normal aileron channel and CH7. The CH7 control on the transmitter can be used for flap control if enabled by this function. To enable the flaps just set the flap gains to a value other than zero.



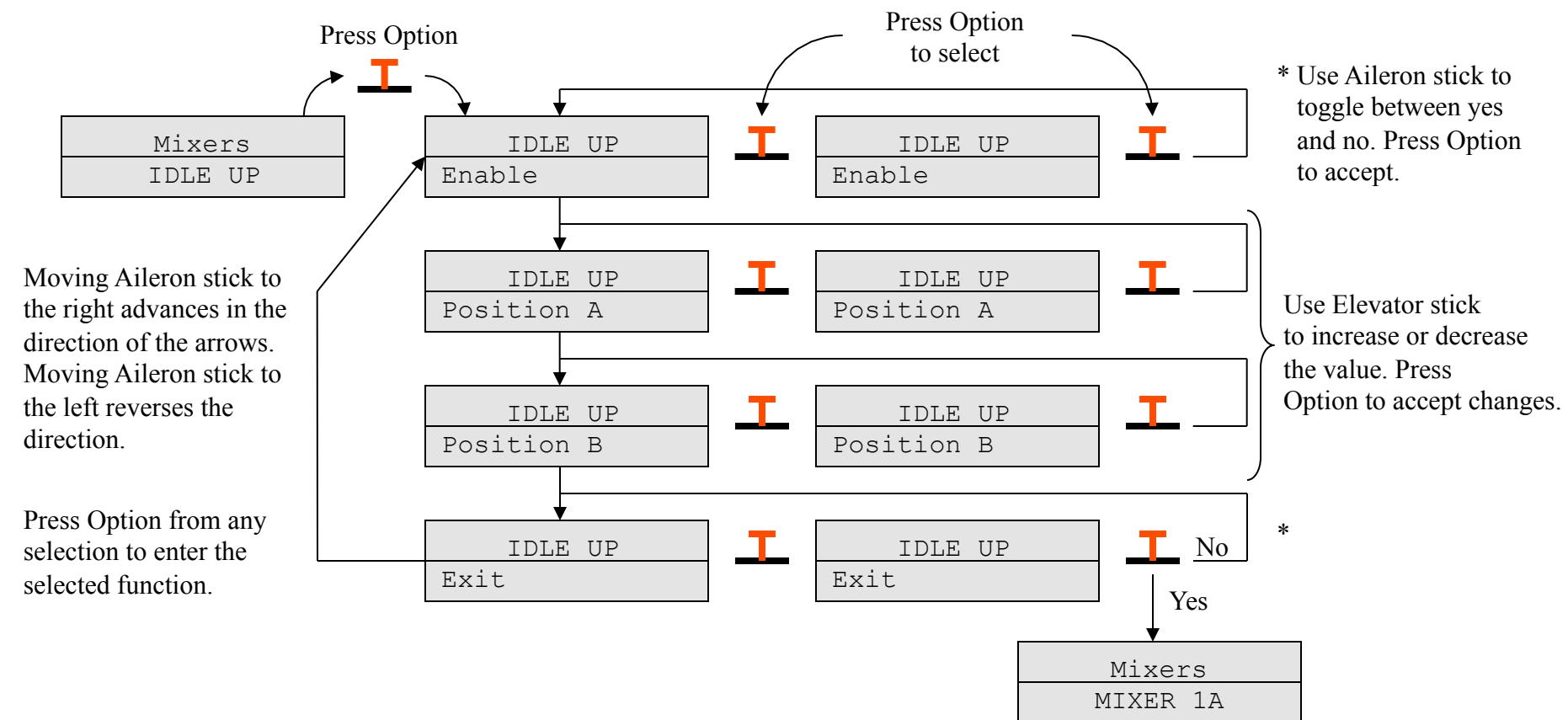
## Dual Elevator

When dual elevator mode is enabled the elevator servos are controlled by the normal elevator channel and CH6. The CH6 control on the transmitter can be programmed for other functions using the general purpose mixers.



## Idle Up

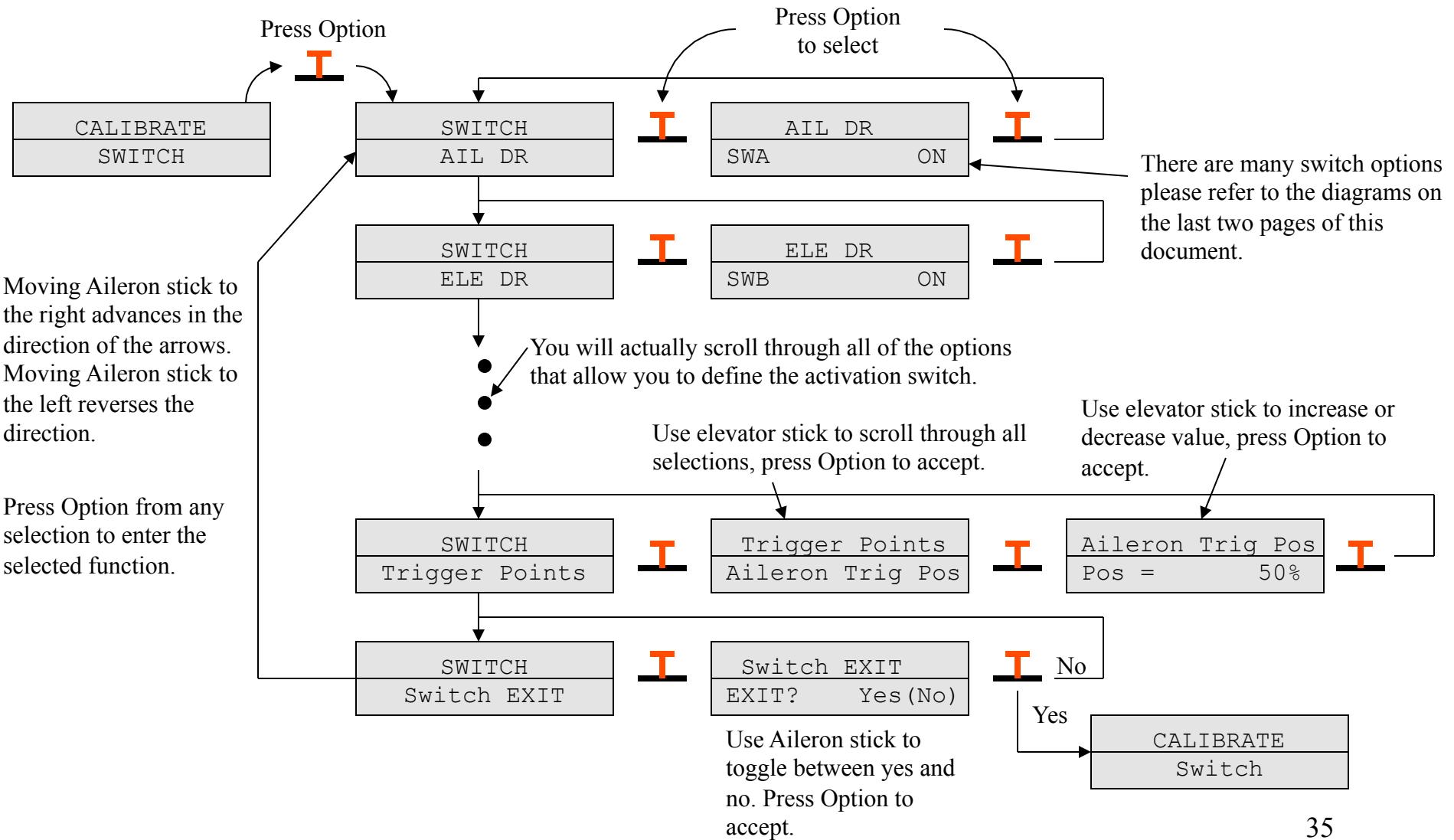
The Idle Up function is used to increase the idle setting after you take your aircraft off. Increasing the idle setting will result in a more reliable idle performance on your engine and potentially avoid a dead stick landing. This is now a helicopter function, you will find separate idle up helicopter functions later in this manual.



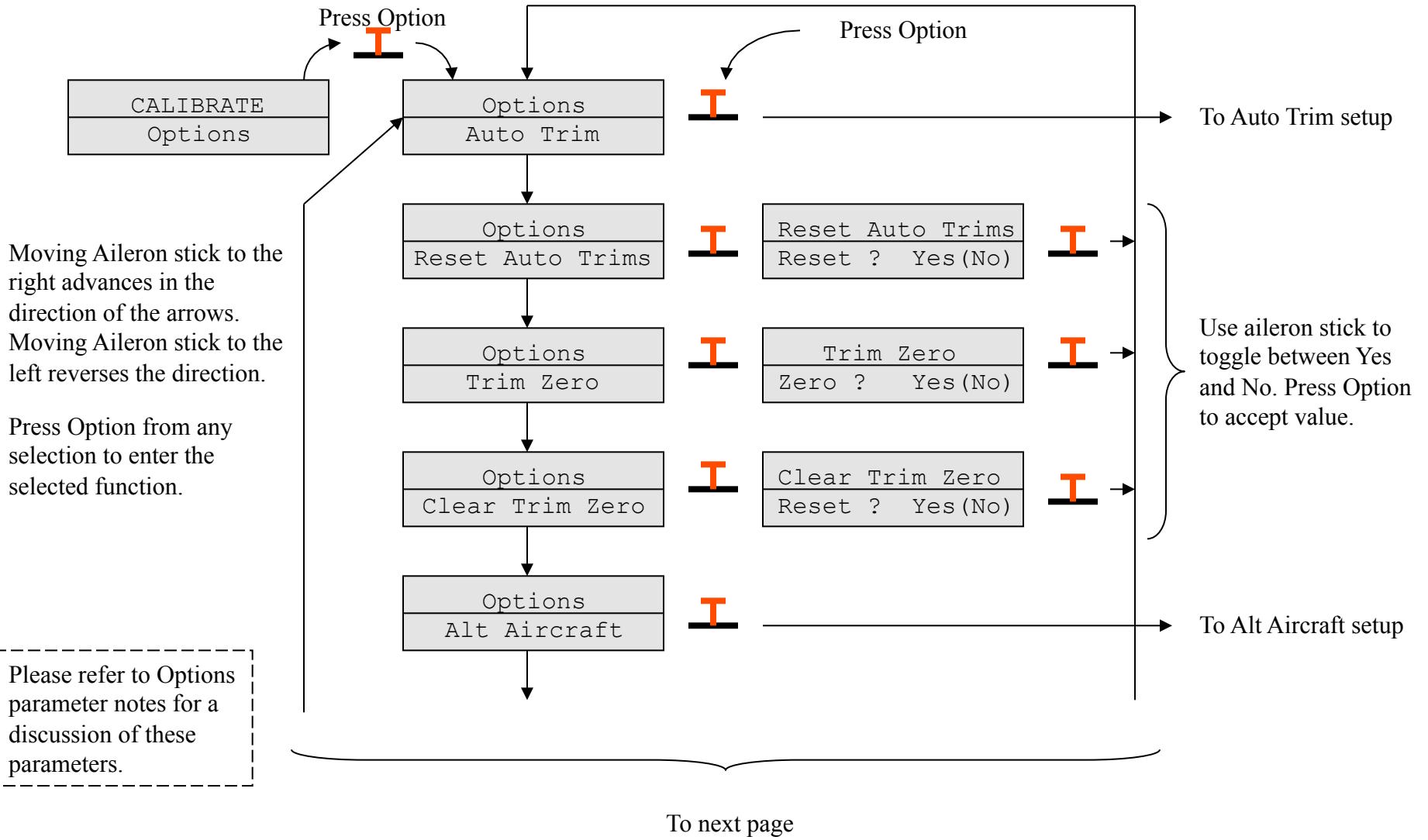
The Idle Up function uses the channel 8 three position switch to enable and disable, this switch can be changed using the SWITCH menu . In position C the function is disabled, in position A and B the percentages defined about are used to define a minimum throttle level.

# SWITCH

The Switch calibration function allows you to define which transmitter switch is used to activate different options on the MicroStar transmitter. The 4 main controls can also be used as switches by defining a trigger position using this option.



# Options



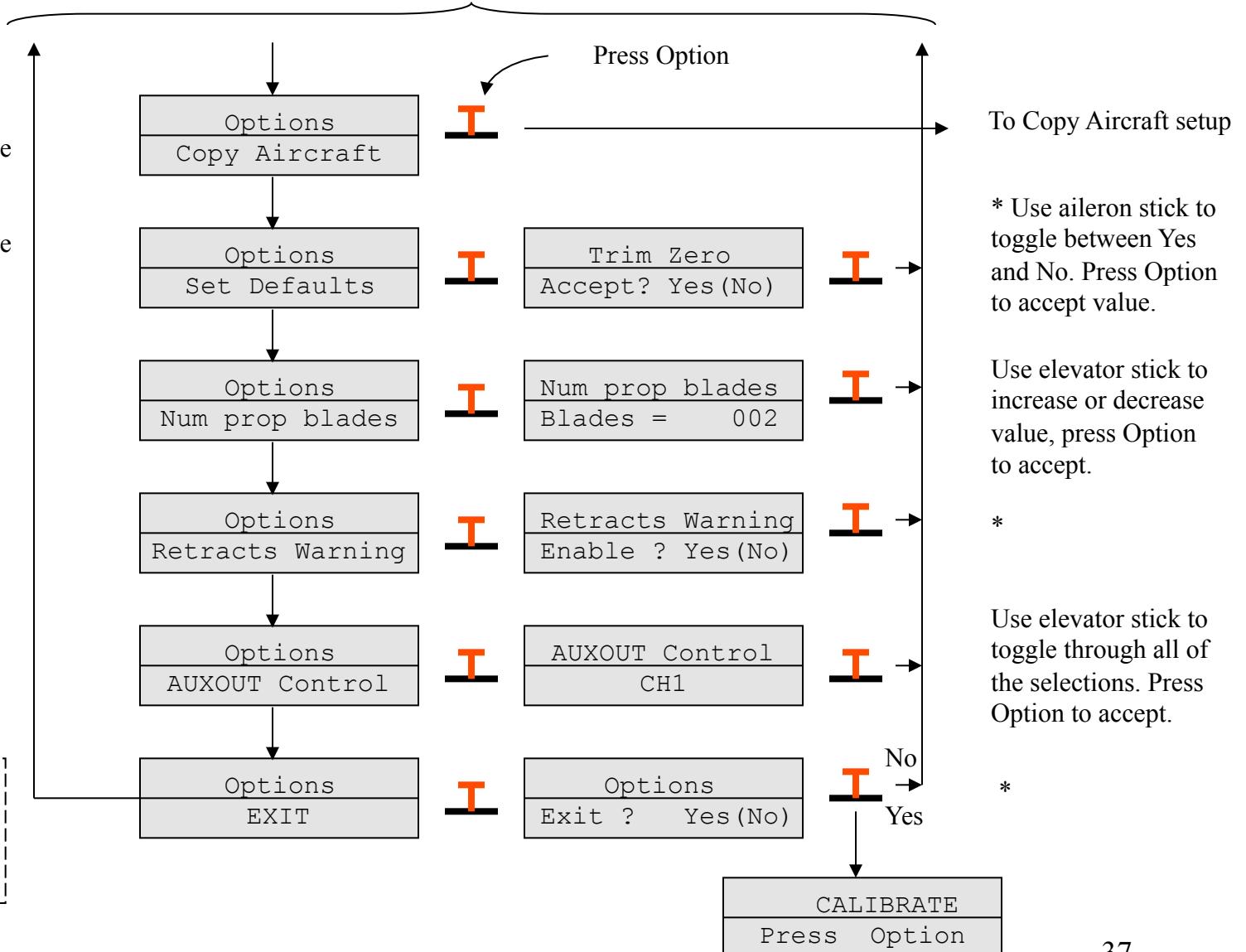
## Options, continued

To previous page

Moving Aileron stick to the right advances in the direction of the arrows.  
Moving Aileron stick to the left reverses the direction.

Press Option from any selection to enter the selected function.

Please refer to Options parameter notes for a discussion of these parameters.



## Options parameters notes

### **Reset Auto Trims**

This function allows you to reset the data stored in the Auto Trim data registers. This data is stored with the aircraft configuration and allows unique settings for each aircraft. The Auto Trim values are defined during flight by the use of the Auto Trim function. This function will reset all three (Aileron, Elevator, Rudder) values.

### **Trim Zero**

The Trim Zero function, when enabled, will read the current trim settings for Aileron, Elevator, and Rudder, this data will then be saved in internal registers along with the aircraft configuration data. This data is used to correct for the current non-zero trim positions. After this function is selected, the trim data will be read and applied to the controls, this will allow you to then return the trim positions to zero.

### **Clear Trim Zero**

This function allows you to clear the Trim Zero registers described above.

### **Set Defaults**

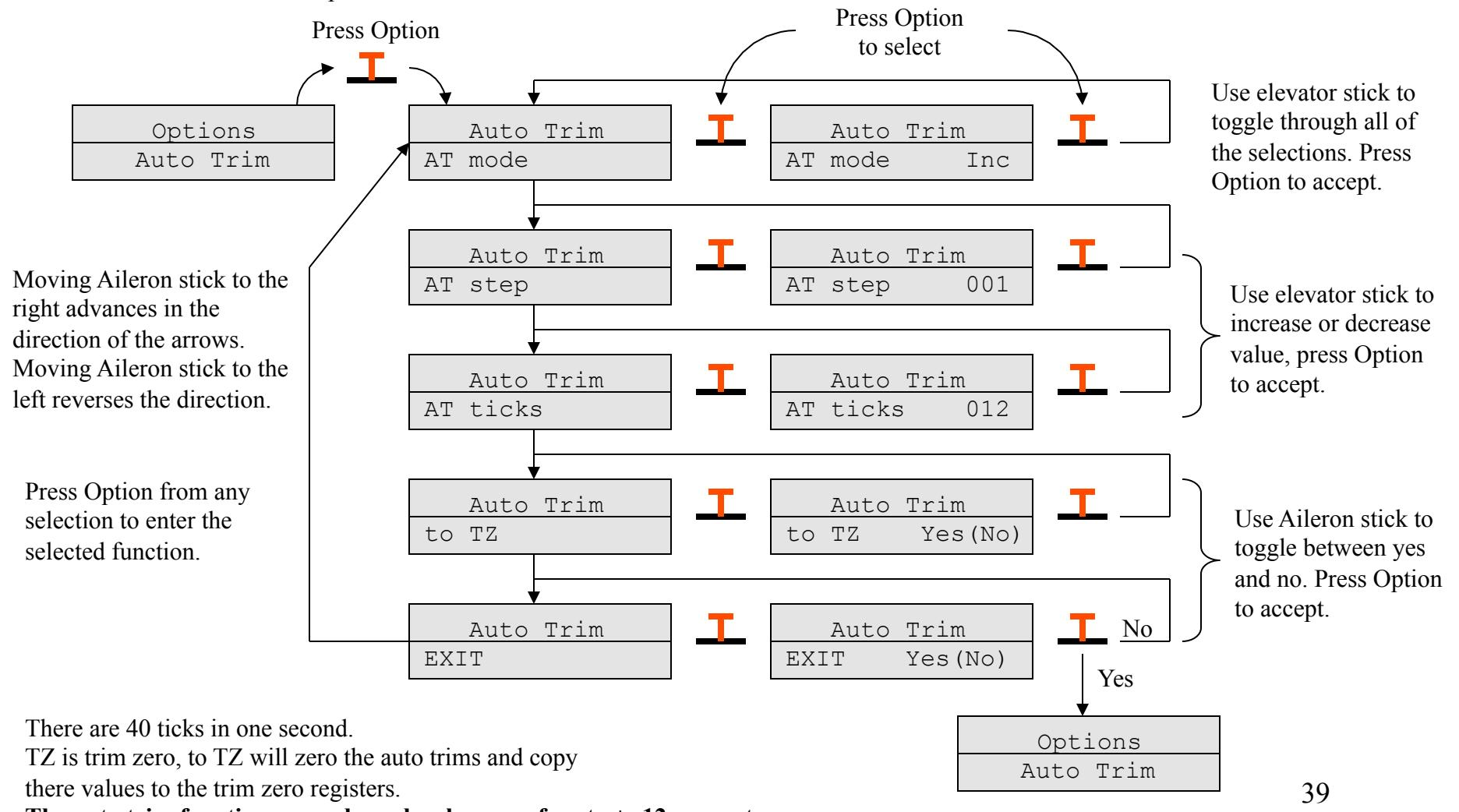
The Set Defaults function will set all Aircraft data to the factory default status. All aircraft configuration data that you have entered will be lost!

### **AUXOUT Control**

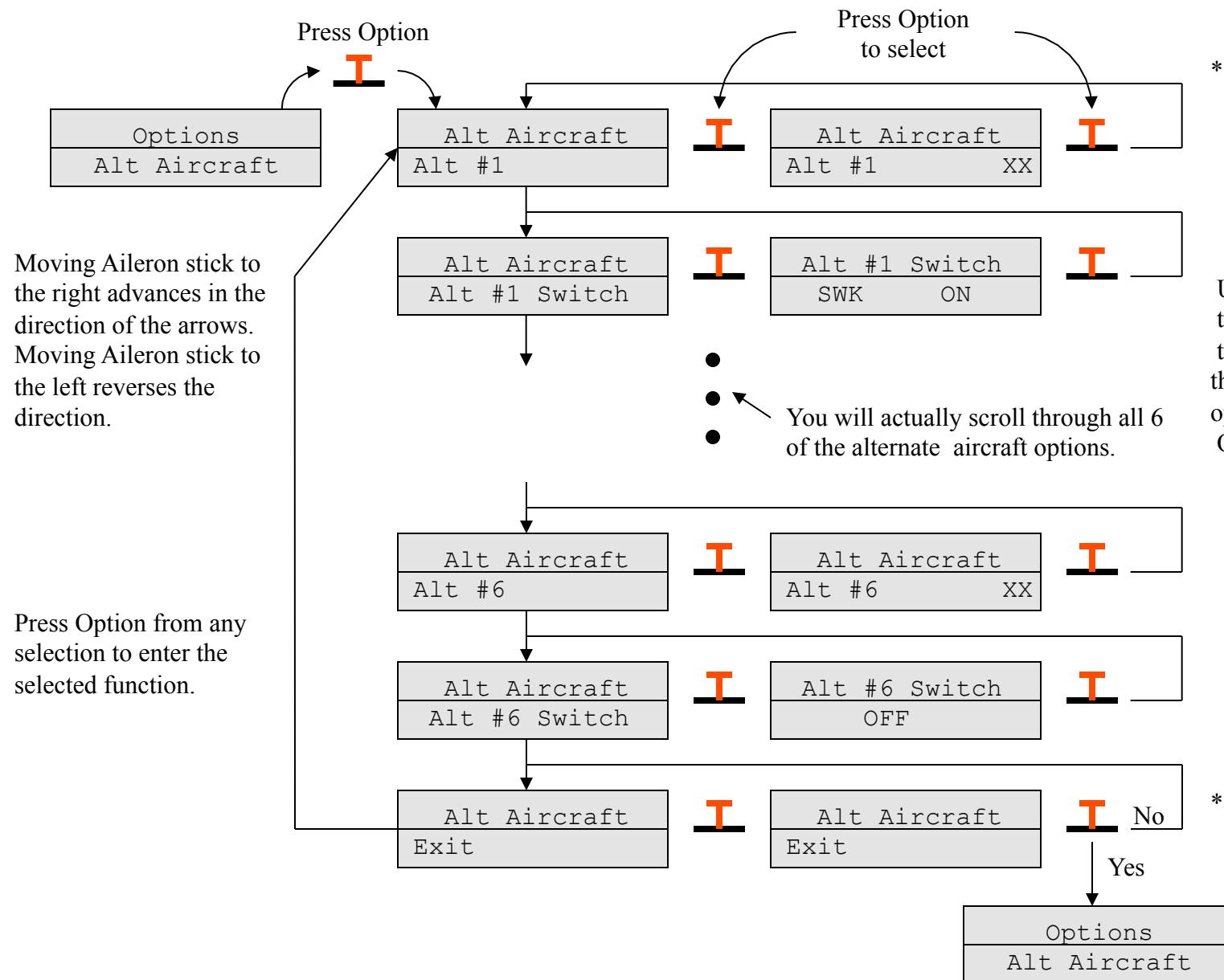
This function allows you to define the signal sent to the AUXOUT pin. This can be any one of the servo position signals or the PPM modulation signal.

## Auto Trim

The Auto Trim function allows the aircraft's trim to be adjusted without touching the trims! This is done by holding the flight controls in a position to make the aircraft fly straight. This function will then adjust the trims in small steps made at regular intervals. The steps and intervals can be defined in this menu. Two Auto Trim modes are supported, the Inc mode described above and a single shot mode. In Single Shot mode the entire trim adjustment is made when the Auto Trim button is pressed.



## Alt Aircraft Setup



- \* Use Aileron stick to toggle between yes and no. Press Option to accept.

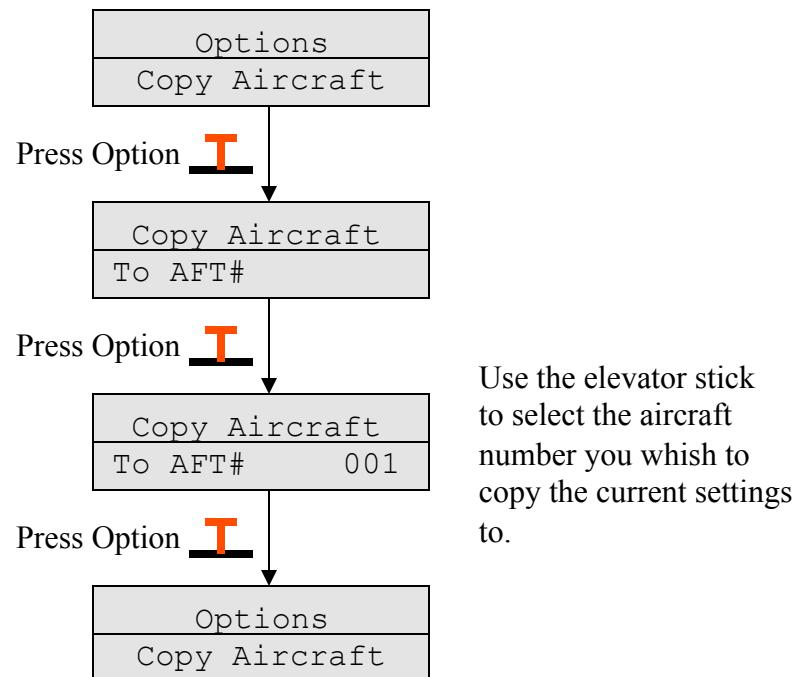
Use Elevator stick  
to increase or decrease  
the value as well as scroll  
through all of the switch  
options. Press  
Option to accept changes.

Moving Aileron stick to the right advances in the direction of the arrows.  
Moving Aileron stick to the left reverses the direction.

Press Option from any selection to enter the selected function.

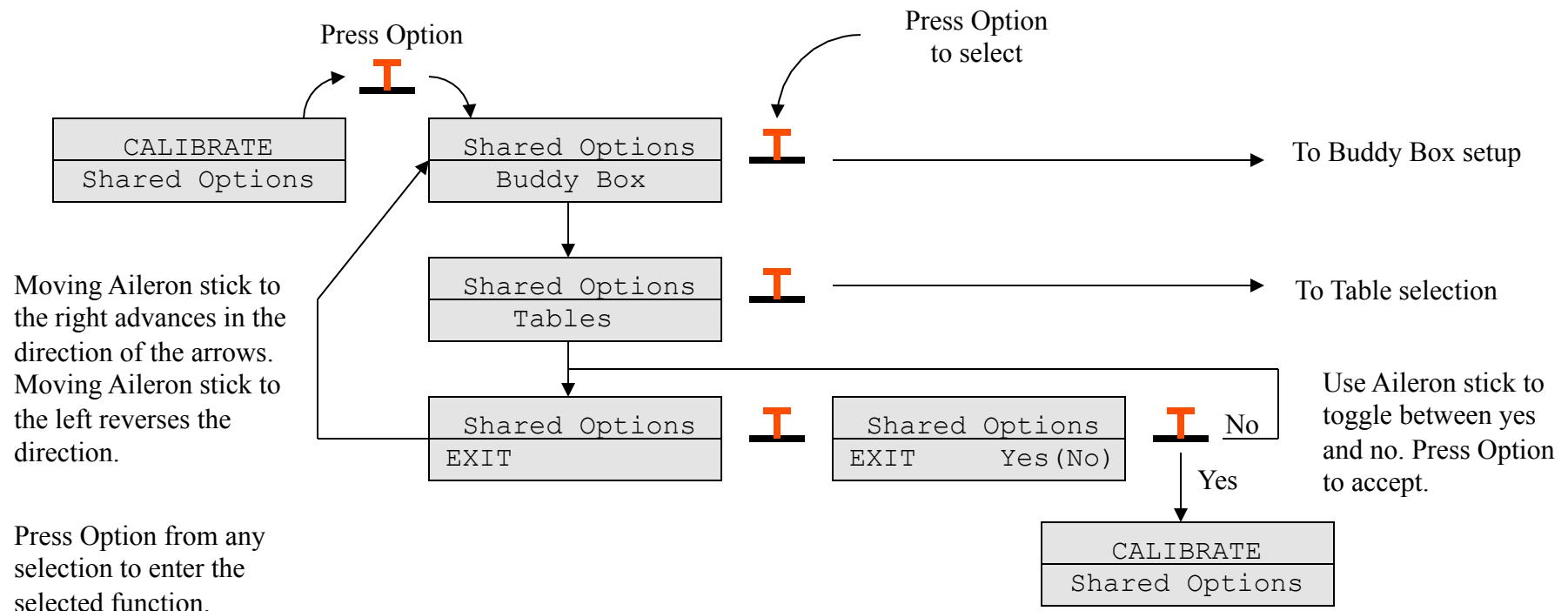
## Copy Aircraft

This function will copy the current aircraft settings to a aircraft number that you define.



Use the elevator stick to select the aircraft number you wish to copy the current settings to.

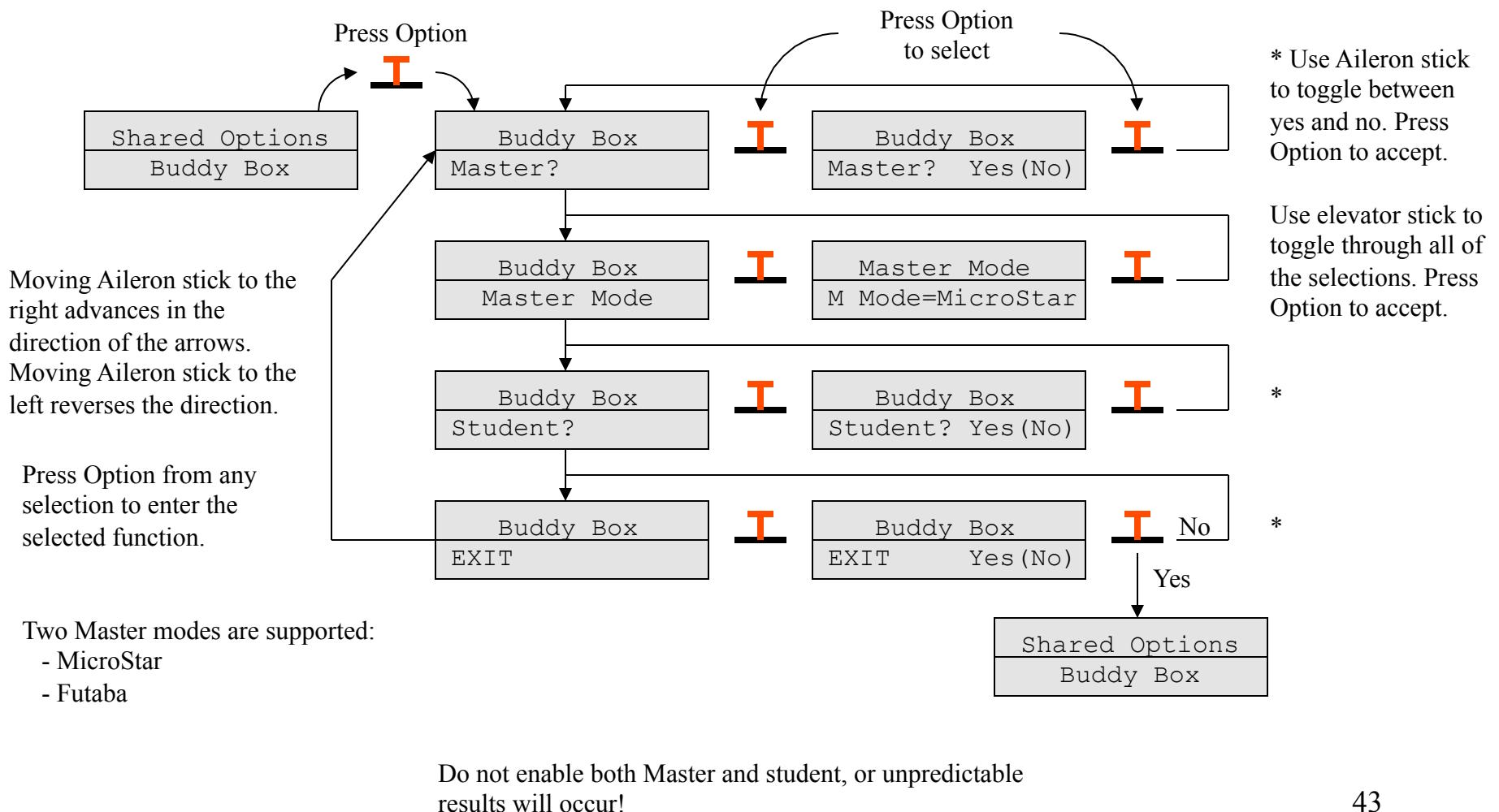
## Shared Options



## Buddy Box

This function allows you to define the type of Buddy Box behavior the MicroStar will have, it acts as a master or a Student. In the Master mode the instructor will push the AutoTrim button to give control to the student.

Two Buddy Box modes are supported; The MicroStar mode is designed to work between MicroStar transmitters only, The Futaba mode is designed to work with a Futaba student transmitter.

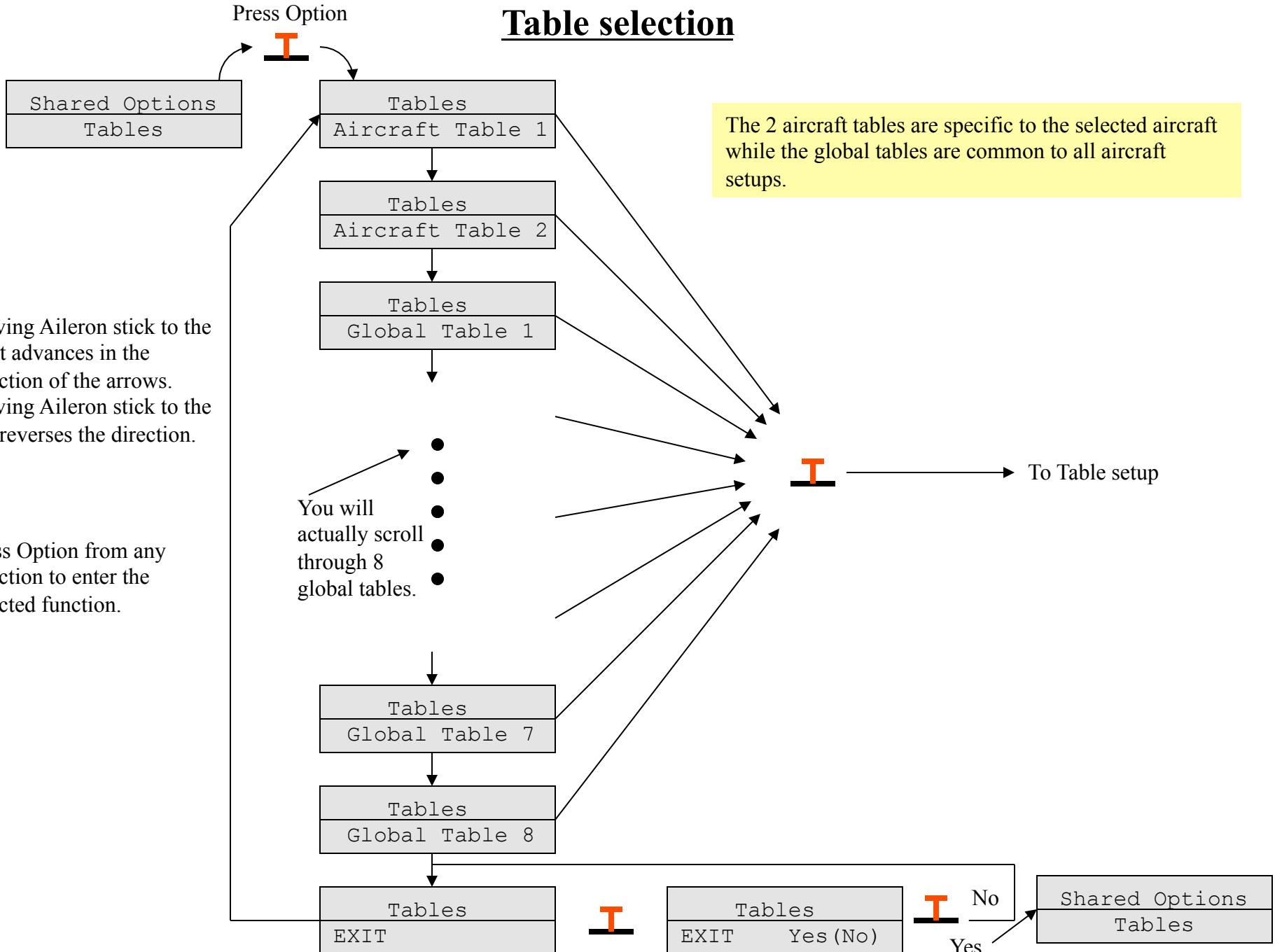


## **Table selection**

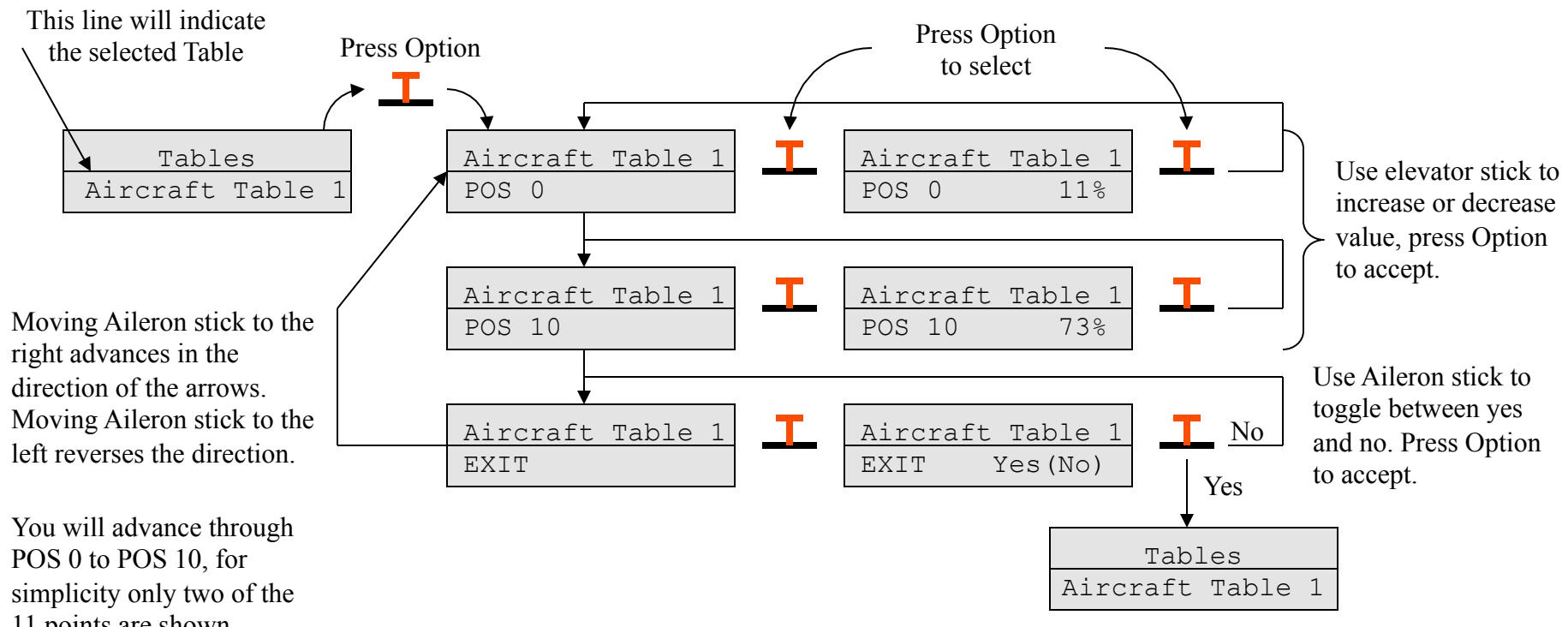
The 2 aircraft tables are specific to the selected aircraft while the global tables are common to all aircraft setups.

Moving Aileron stick to the right advances in the direction of the arrows.  
Moving Aileron stick to the left reverses the direction.

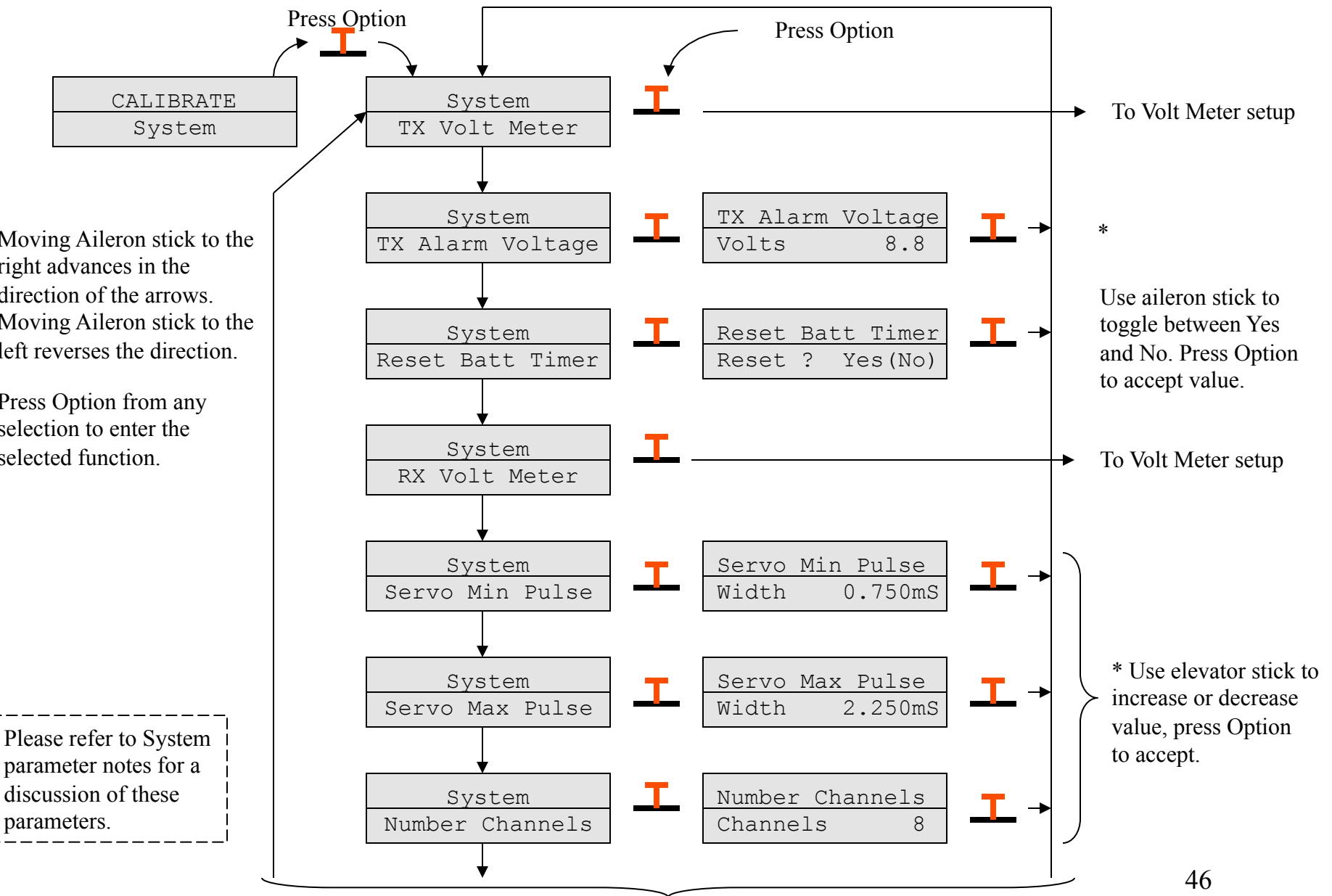
Press Option from any selection to enter the selected function.



## Table setup



# System Setup

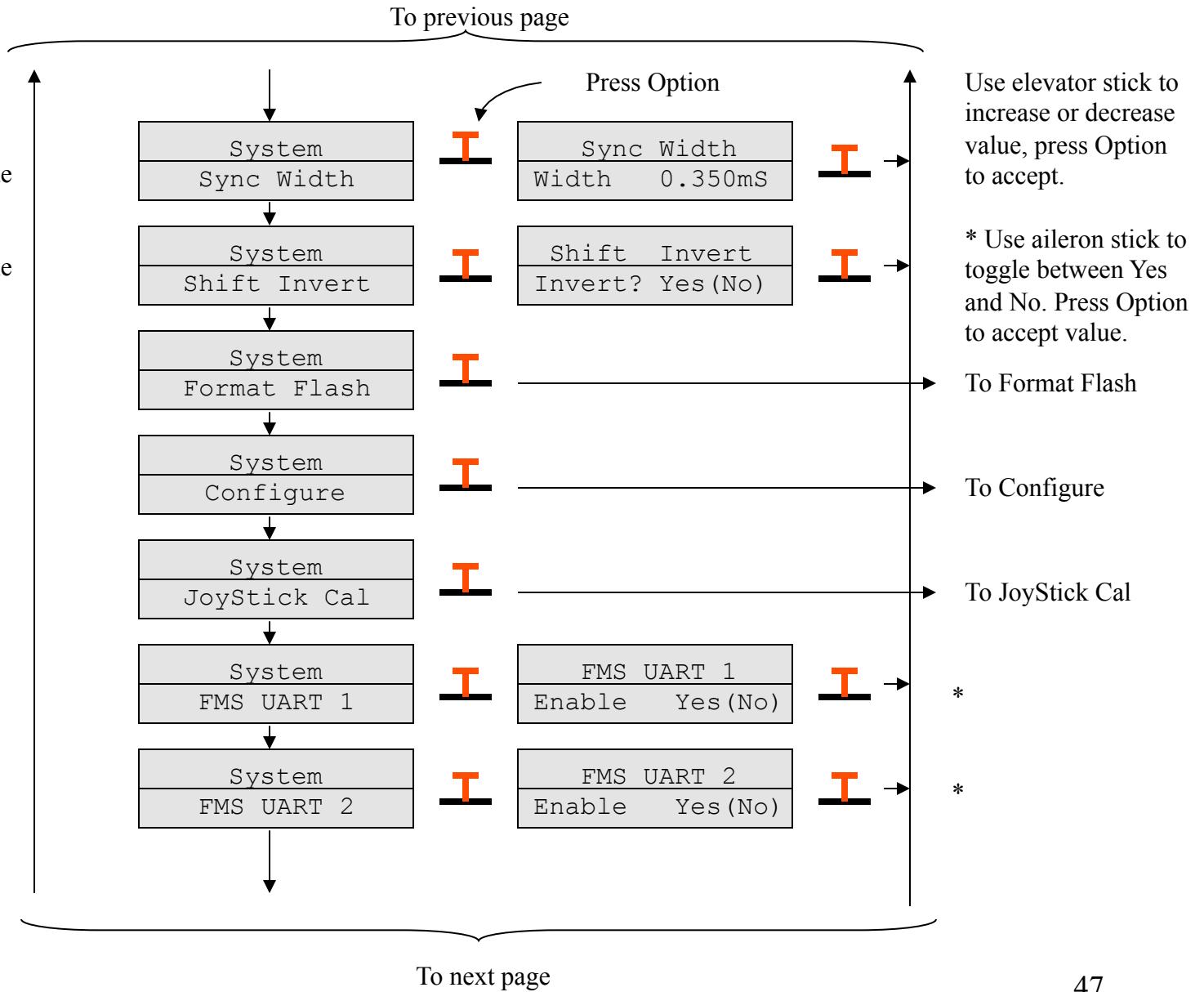


## System Setup, continued

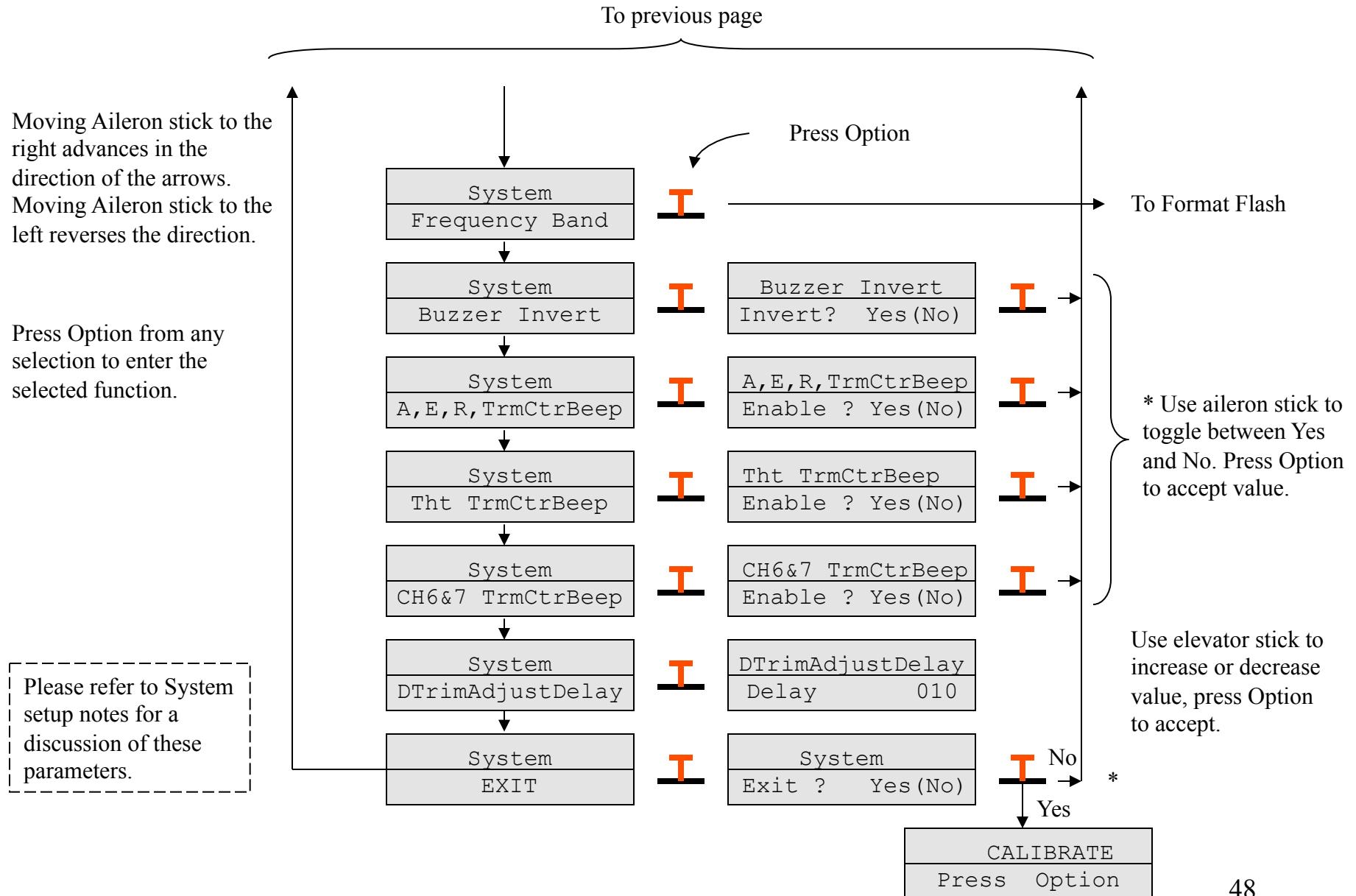
Moving Aileron stick to the right advances in the direction of the arrows.  
Moving Aileron stick to the left reverses the direction.

Press Option from any selection to enter the selected function.

Please refer to System setup notes for a discussion of these parameters.



## System Setup, continued



# System Setup notes

## **Reset Batt Timer**

The battery timer function is used to measure total transmitter on time. This is helpful in determining the transmitters battery status. To read the battery timer data, press the Auto Trim button. To reset this value to zero select this function. This timer is updated every minute when the transmitter is in run or cal mode.

## **Number Channels**

This parameter allows you to define the number of channels you wish the MicroStar to transmit.

## **Sync Width**

This parameter should be set to 0.350 mS. This defines the width of the PPM sync pulse that is sent to the RF deck.

## **Shift Invert**

Shift invert determines the polarity of the FM RF frequency deviation. This value is specific to the type of receiver you are using.

## **Servo Min Pulse and Servo Max Pulse**

This is the minimum and maximum amounts any servo can move. Used to prevent overrunning due to extreme values on the individual channels, or caused by some combinations of mixing. [May need cross reference to here from the sections on servos and mixing].

## **FMS**

This option enables the Flight Model Simulator (FMS) serial interface. FMS is a free flight simulator and selecting this option will cause the MicroStar to generate and send RS232 data at 9600 baud to UART1 or UART2. UART1 is the serial channel used to communicate with the PC and UART2 is the serial channel used for the MicroStar buddy box. Selecting the desired UART and connecting this serial port to the proper COMM port on our PC will allow you to use the MicroStar as the FMS controller. This setup information will be lost when you remove power from the MicroStar so you will need to enable the function each time you intend to use the simulator.

Information on the simulator can be found at this link; [http://n.ethz.ch/student/mmoeller/fms/index\\_e.html](http://n.ethz.ch/student/mmoeller/fms/index_e.html)

## **System Setup notes, continued**

### **Trim Center Beep**

The MicroStar will announce when the Trims have been positioned to the center of there range. This is useful for wheel trims where you can't really feel the center. With this function enabled the buzzer will beep when a trim is positioned near its center. This capability can be enabled for various channels as defined by the following selection options:

A,E,R,TrmCtrBeep: Trim center beep selection for Aileron, Elevator, and Rudder.

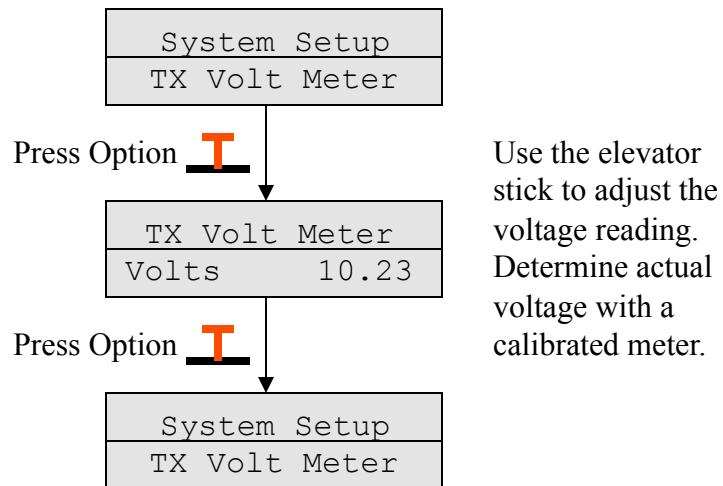
Tht TrmCtrBeep: Trim center beep selection for Throttle.

CH6&7 TrmCtrBeep: Trim center beep selection for Channels 6 and 7.

### **DTrimAdjustDelay**

The digital trims move in a continuous mode when the digital trim switch is held down. The speed that the trims will advance is determined by this parameter. The smaller the number the faster the trims will move. The units are in system clock ticks and there are 40 tics per second. The default for this value is 10.

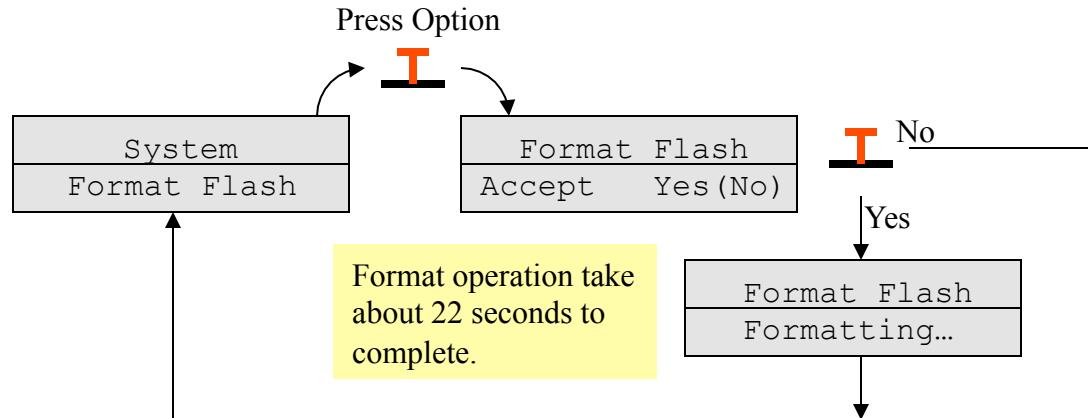
## Voltmeter Calibration



This procedure is shown for the Transmitter Voltage calibration but this same procedure applies for the receiver calibration as well. Make sure you have a receiver battery connected to the proper input when performing the receiver calibration procedure.

In order to perform the calibration of the voltage reading you must first determine the battery voltage with a calibrated voltmeter. This voltage reading is then used to as the target value when you perform the voltage adjustment show above.

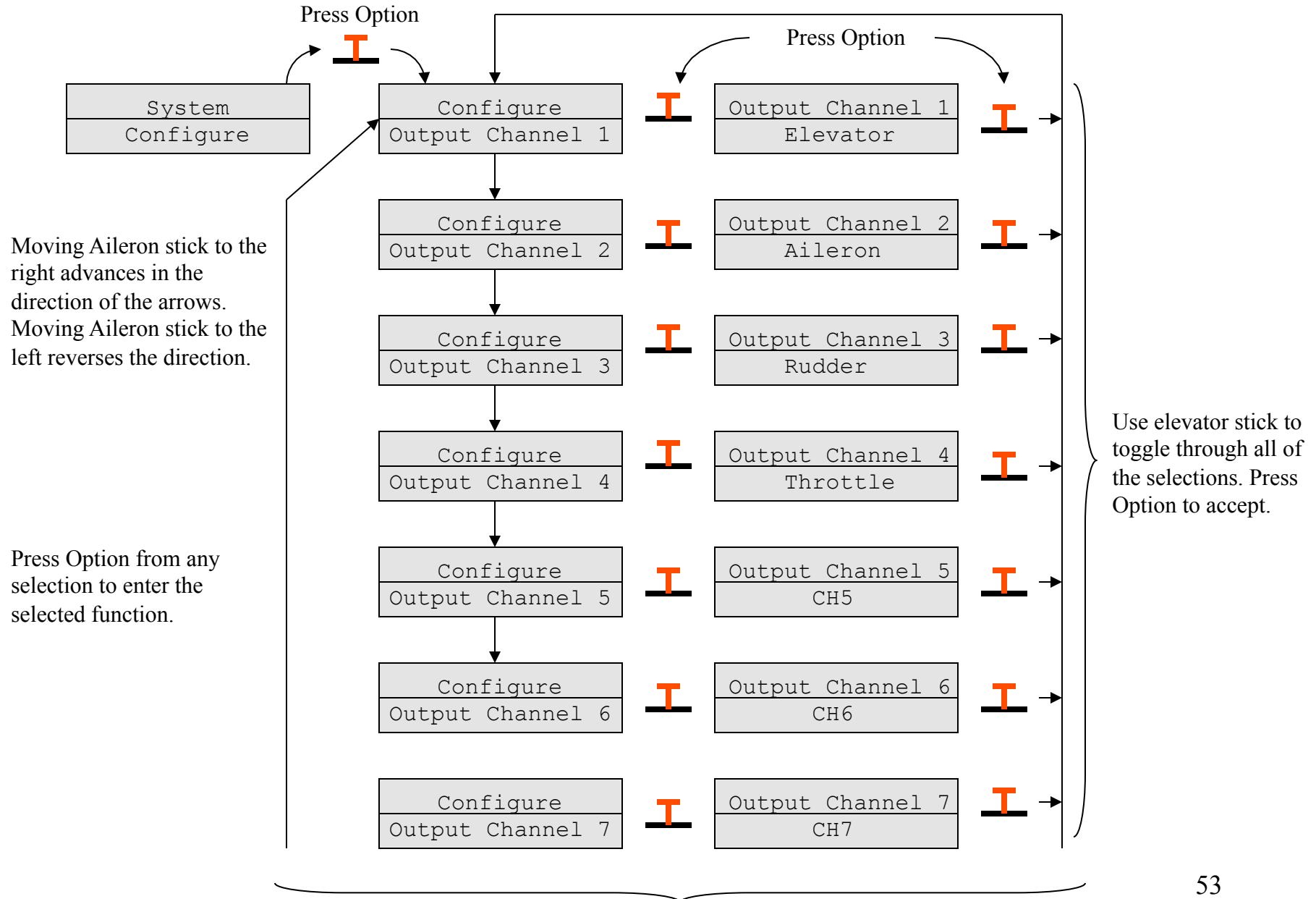
## Format Flash



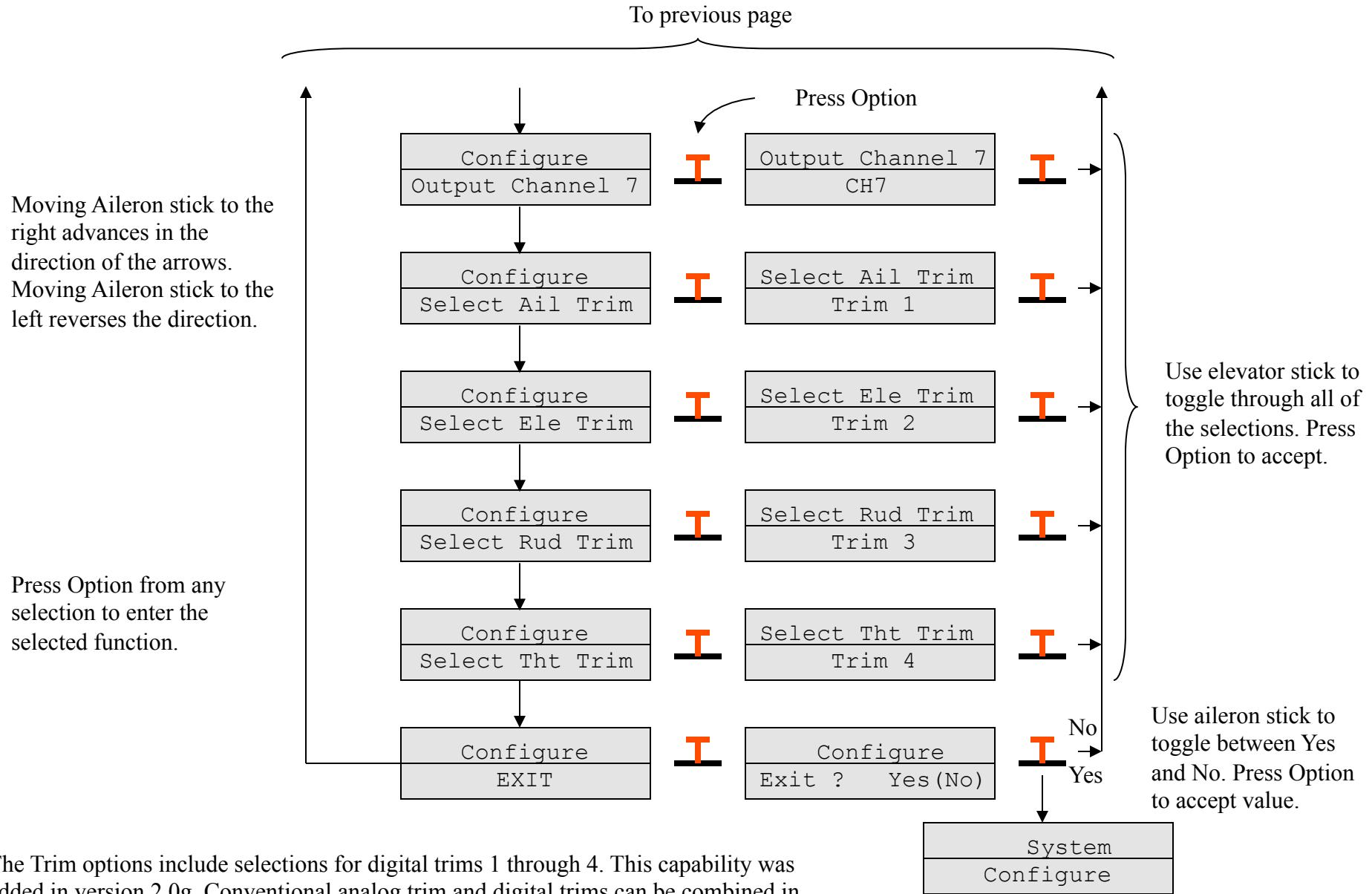
Use aileron stick to toggle between Yes and No. Press Option to accept value.

**Note:** Formatting the Flash will erase all aircraft setup data for all 96 aircraft. You will also lose the joystick calibration data and it will be necessary to repeat the joystick calibration procedure. Formatting the Flash memory is something that should rarely be required.

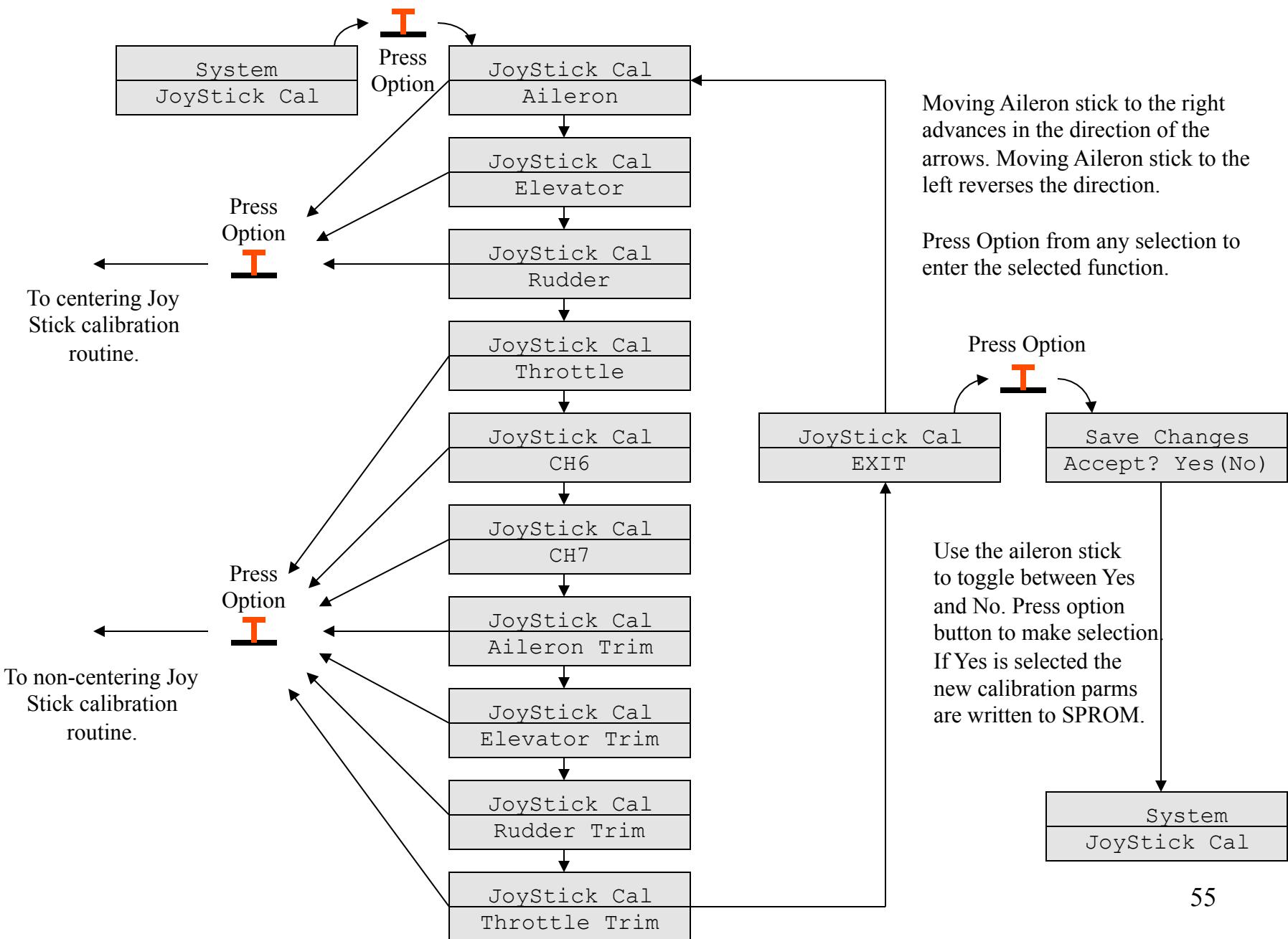
# Configure



## Configure, continued



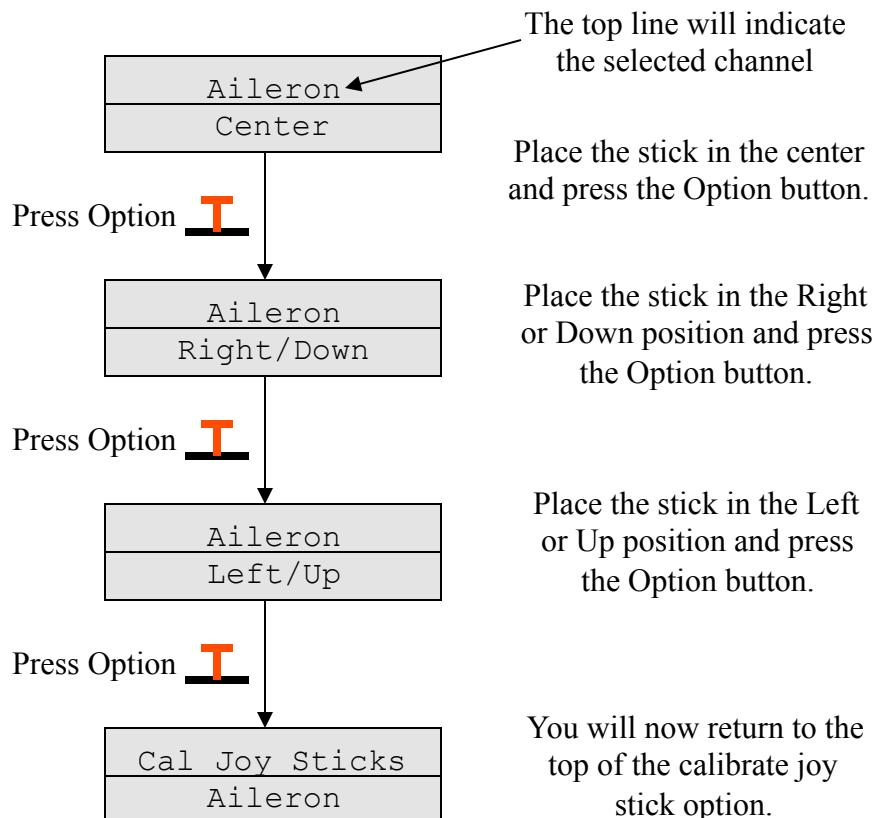
# JoyStick Cal



## JoyStick Cal, continued

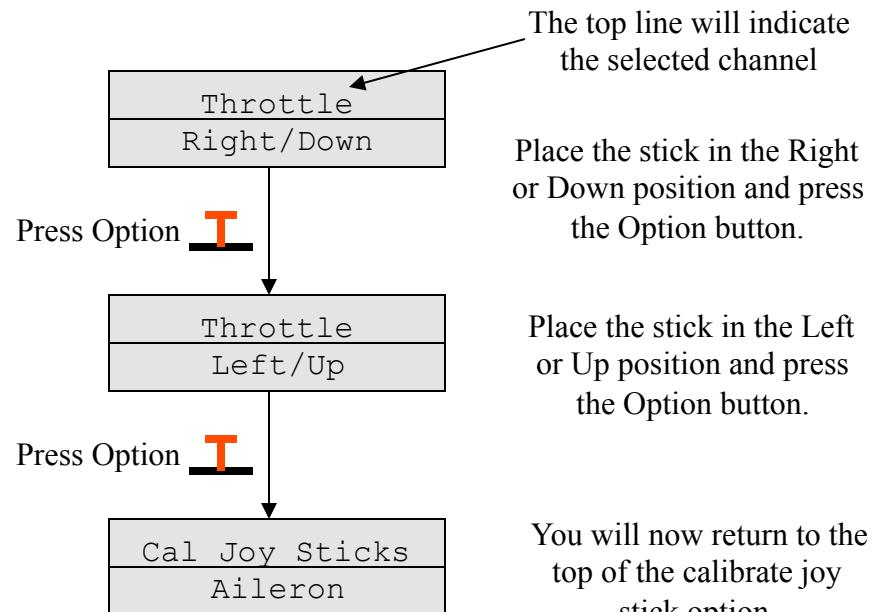
### Centering Joy Stick calibration routine.

*"Down" below means as in "Down Elevator" – push the Elevator or Throttle stick toward the top of the case!  
"Up" is the opposite!*

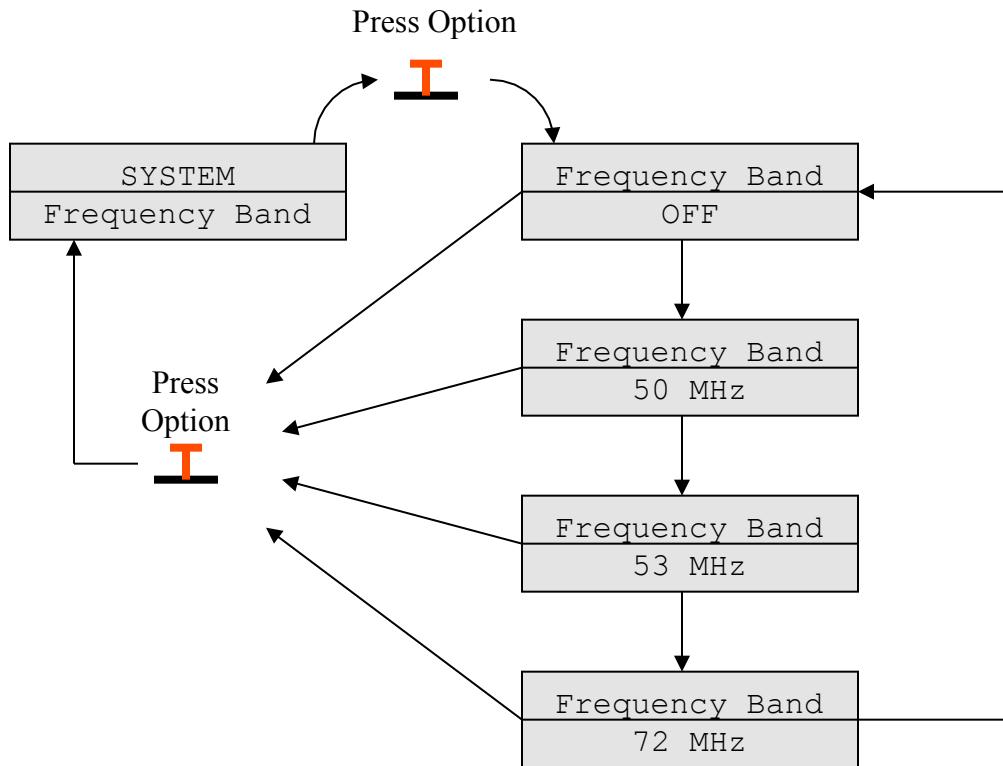


### Non-centering Joy Stick calibration routine.

*"Down" below means as in "Down Elevator" – push the Elevator or Throttle stick toward the top of the case!  
"Up" is the opposite!*



## Frequency Band

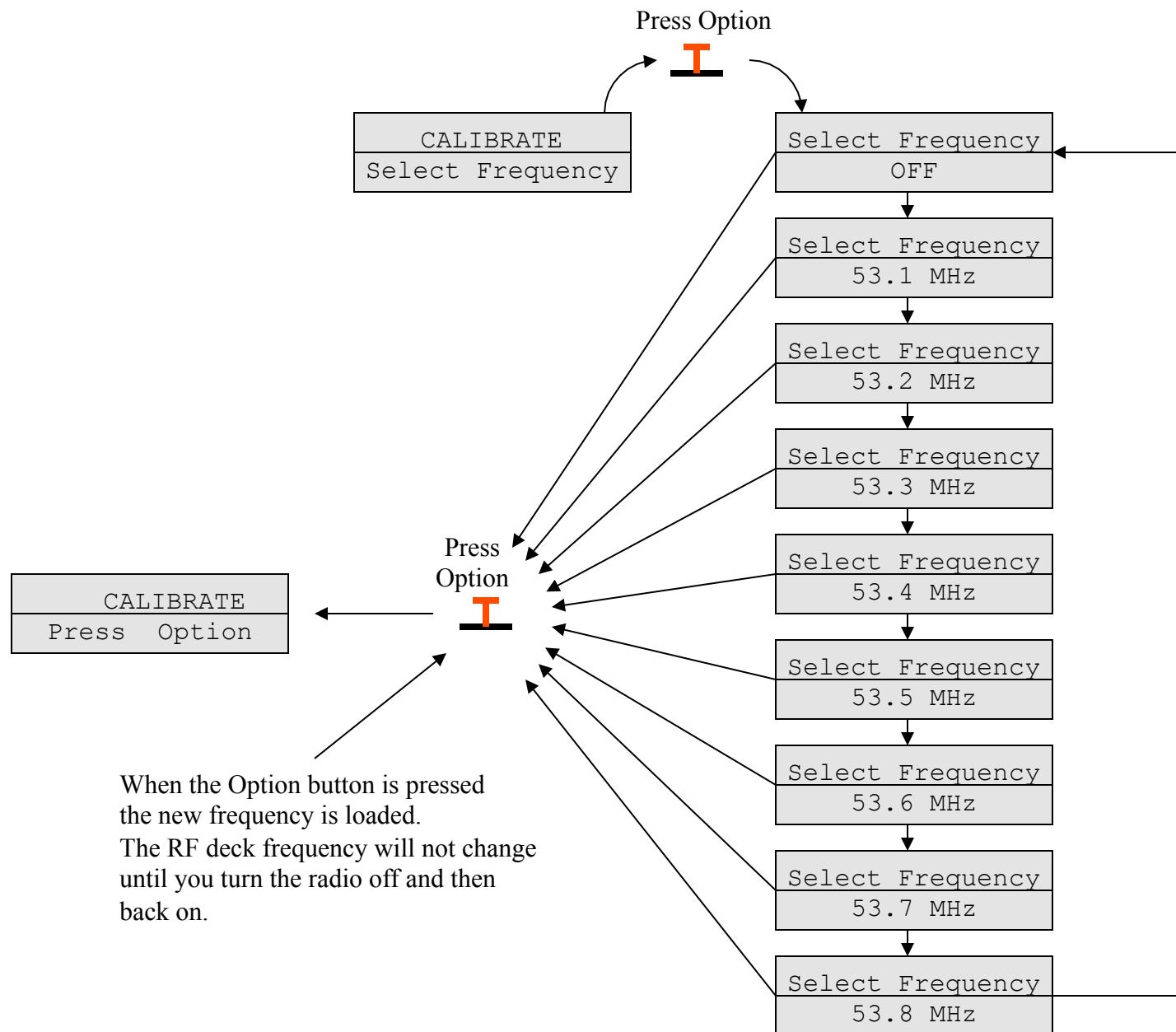


Moving Elevator stick up advances in the direction of the arrows.  
Moving Elevator stick down reverses the direction.

Press Option from any selection to define the band.

When the Option button is pressed the new frequency band is selected.  
The RF deck frequency will not change until you turn the radio off and then back on.

## Select Frequency



Moving Elevator stick up to advances in the direction of the arrows.  
Moving Elevator stick down to reverses the direction.

Press Option from any selection to define the aircraft.

Use the Frequency Band option to select the desired band. The example shown here is for the 53 MHz band.

## Using My Synthesized RF Deck

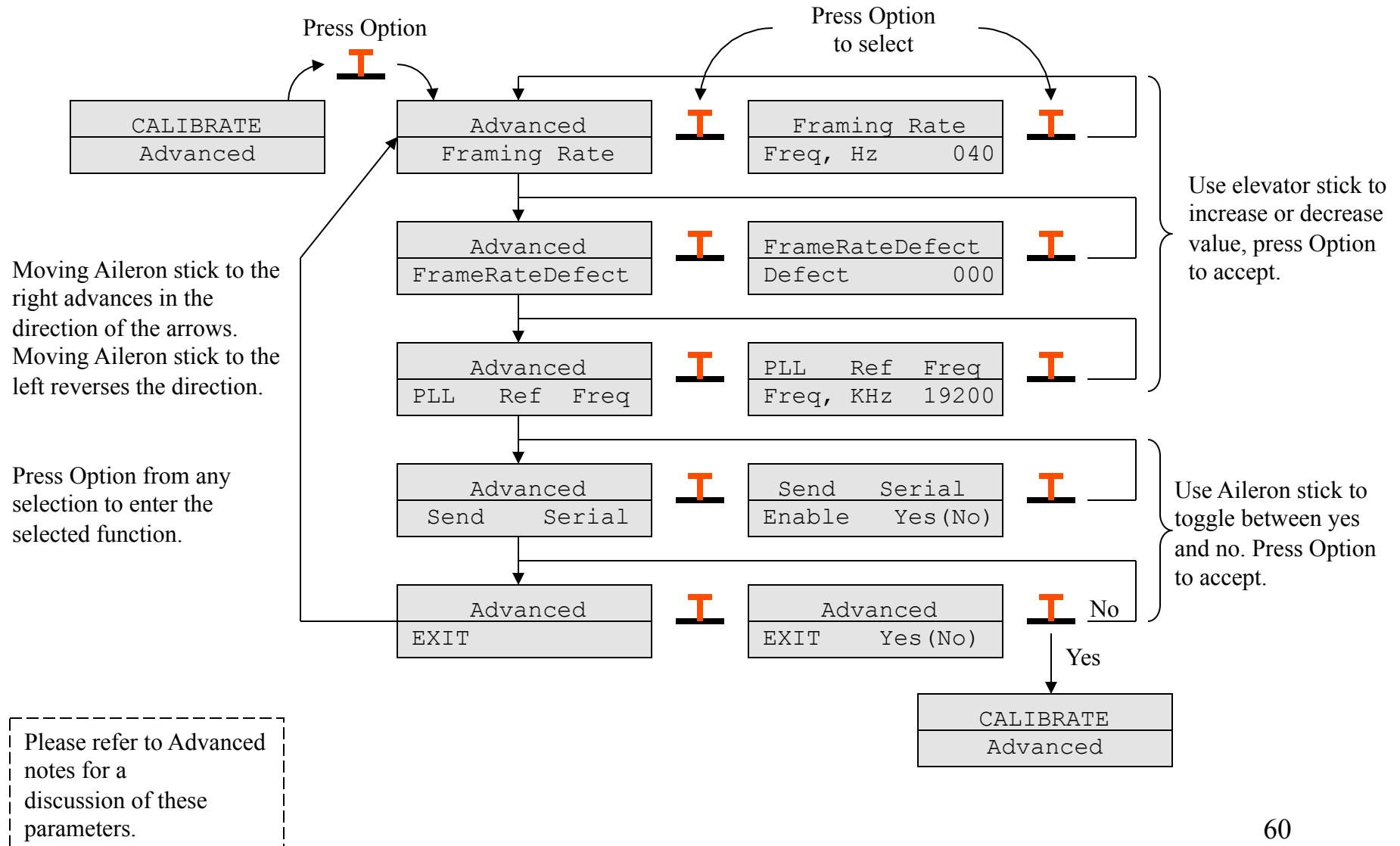
This page will review a few details regarding the use of my synthesized RF deck. This RF deck is designed to be used with the MicroStar but its not required. Virtually any RF deck will work and most have been used by one builder or another. This narrative is intended to point out parameters that need to be defined and how to define them for proper use of my RF deck as well as other options.

- 1.) The frequency band must be set to the band the RF deck was built and tuned for, simply changing the band option is not enough. The RF deck must match the band setting. This setting only applies to my RF deck and should be set to *No RF* if you are not using my RF deck. While a 72MHz band option is present in the options, my RF deck is not available on that band.
- 2.) My RF deck uses a phase lock loop (PLL) to generate the output RF frequency. PLLs need a reference oscillator to generate the desired frequency. The reference oscillator frequency used on the RF deck must be entered into the *PLL Ref Freq* selection in the *Advanced* section. If these values do not match, you will very likely be transmitting out of band!
- 3.) After you have everything setup and you power up your MicroStar, you will be asked if you want your RF on and be given a yes/no option with “No” as the default. **Make sure you turn on the RF!** If you select “No” the RF deck will function and generate only the drive signal to the final amplifier. This is enough RF for most receivers to “see” and it may appear that your system is working. Be careful this is not enough signal to fly even a park flier!
- 4.) When using my RF deck always check the RF Lock LED and make sure its on before you fly. This lock light will be off if you do not enable the RF or if any problem is detected.

The communications between the MicroStar and my RF deck is one way and these options will all function even without my RF deck in the system but they only apply and affect the RF if you use my synthesized RF deck.

## Advanced

This function allows you to define several advanced system parameters. Generally you will not need to change these values. These parameters affect all aircraft in the MicroStar. Please read the notes on the following page before make any changes.



## Advanced, notes

### **Framing Rate:**

The framing rate (in Hz) is the rate that servo position data frames are send from the MicroStar transmitter. The default is set at 40 Hz and will not need to be changed in almost all cases. However, there is at least one RF deck (the JR Spectrum 2.4 GHz version) that will not function at a 40 Hz framing rate. This option will allow you to change the rate between 32 to 50 Hz.

### **FrameRateDefect:**

Many modern digital receivers will “imprint” on the transmitters data frames by characterizing them when the receiver is turned on. This is the way my receiver works as well. One parameter they look at is the framing rate. This parameter allows you to make fine changes in the framing rate to allow a unique setting and thus a unique transmitted signal for the receiver to learn. The default value is 0.

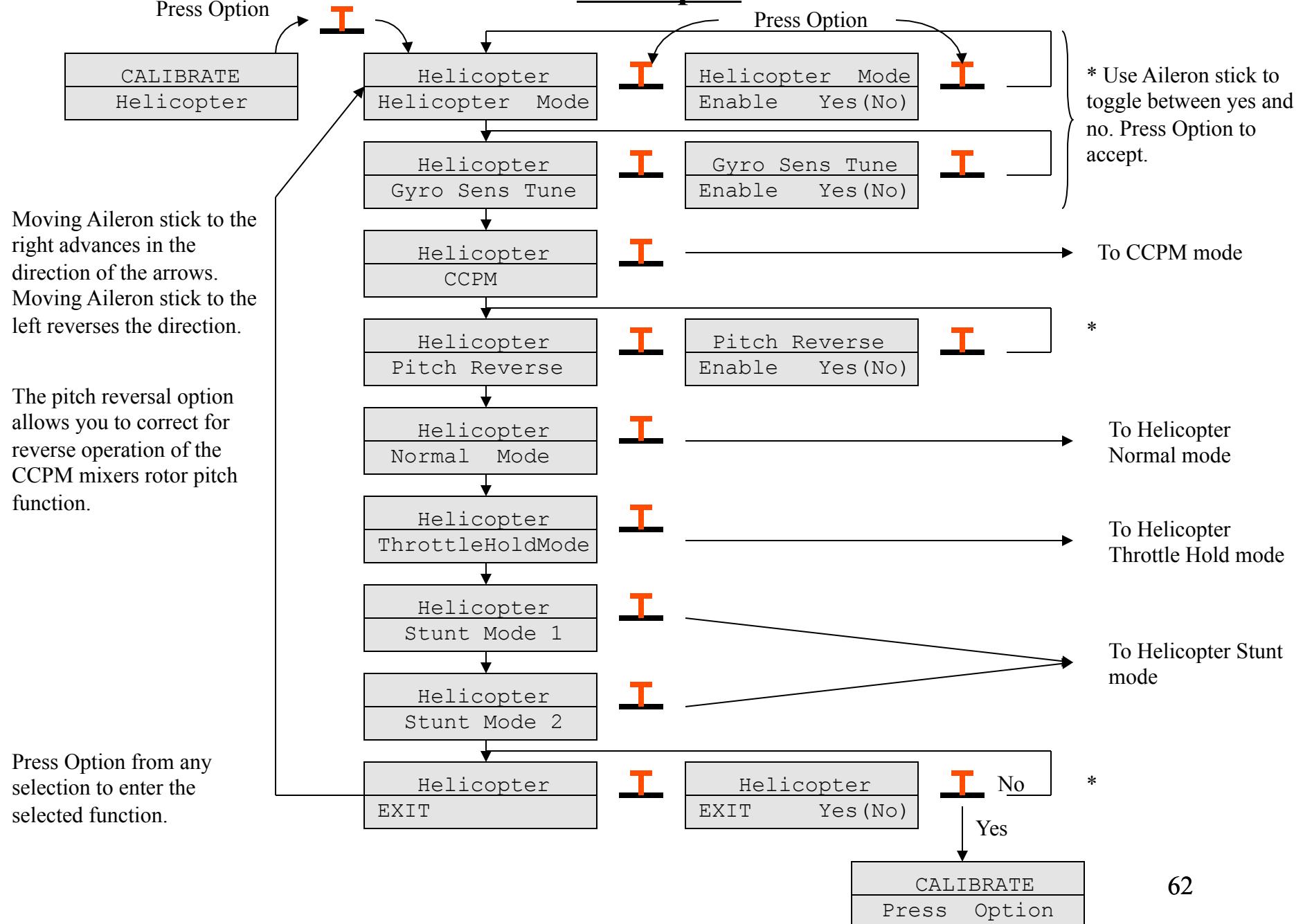
### **PLL Ref Freq:**

The Phase Lock Loop (PLL) Reference Oscillator is used on my RF deck to define the RF deck’s transmitted frequency. This value is entered in KHz, with a default of 19200. This value must match the actual frequency of the reference oscillator used in the RF deck. The setting only applies if you are using my RF deck.

### **Send Serial:**

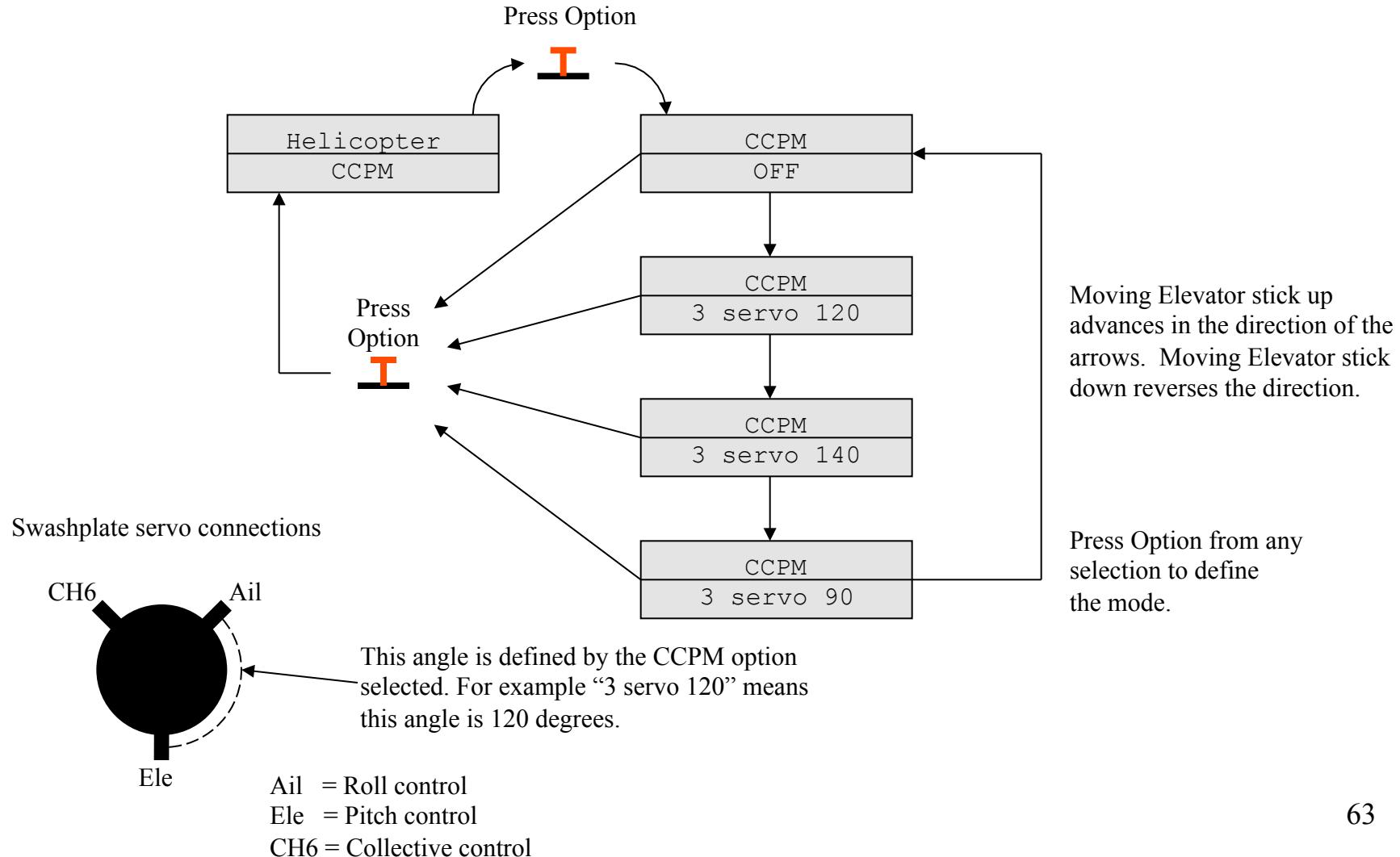
If the send serial option is enabled the Microstar will send the position information using UART2 at 38,400 baud. The full resolution data is sent at the defined framing rate. This feature is intended for direct connection to a receiving decoder and for experimenting. Normally this should be disabled.

# Helicopter



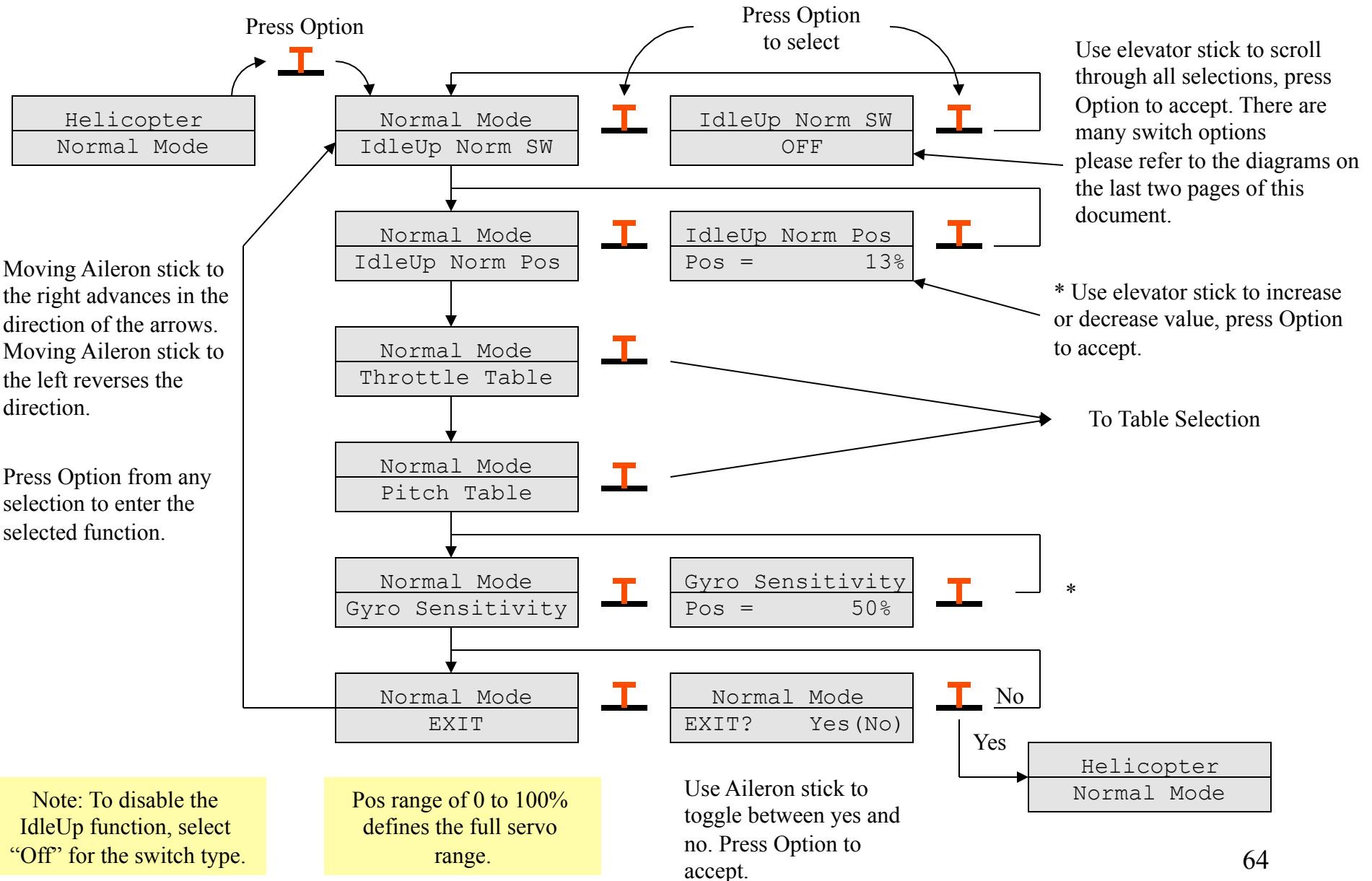
## CCPM

Cyclic/Collective Pitch Mixing (CCPM) controls three servos that connect directly to the swashplate of a model helicopter. Using the CCPM mode allows the transmitter to do the work of coordinating the servo movements to control pitch, roll, and collective. This greatly reduces the mechanical complexity on the helicopter.



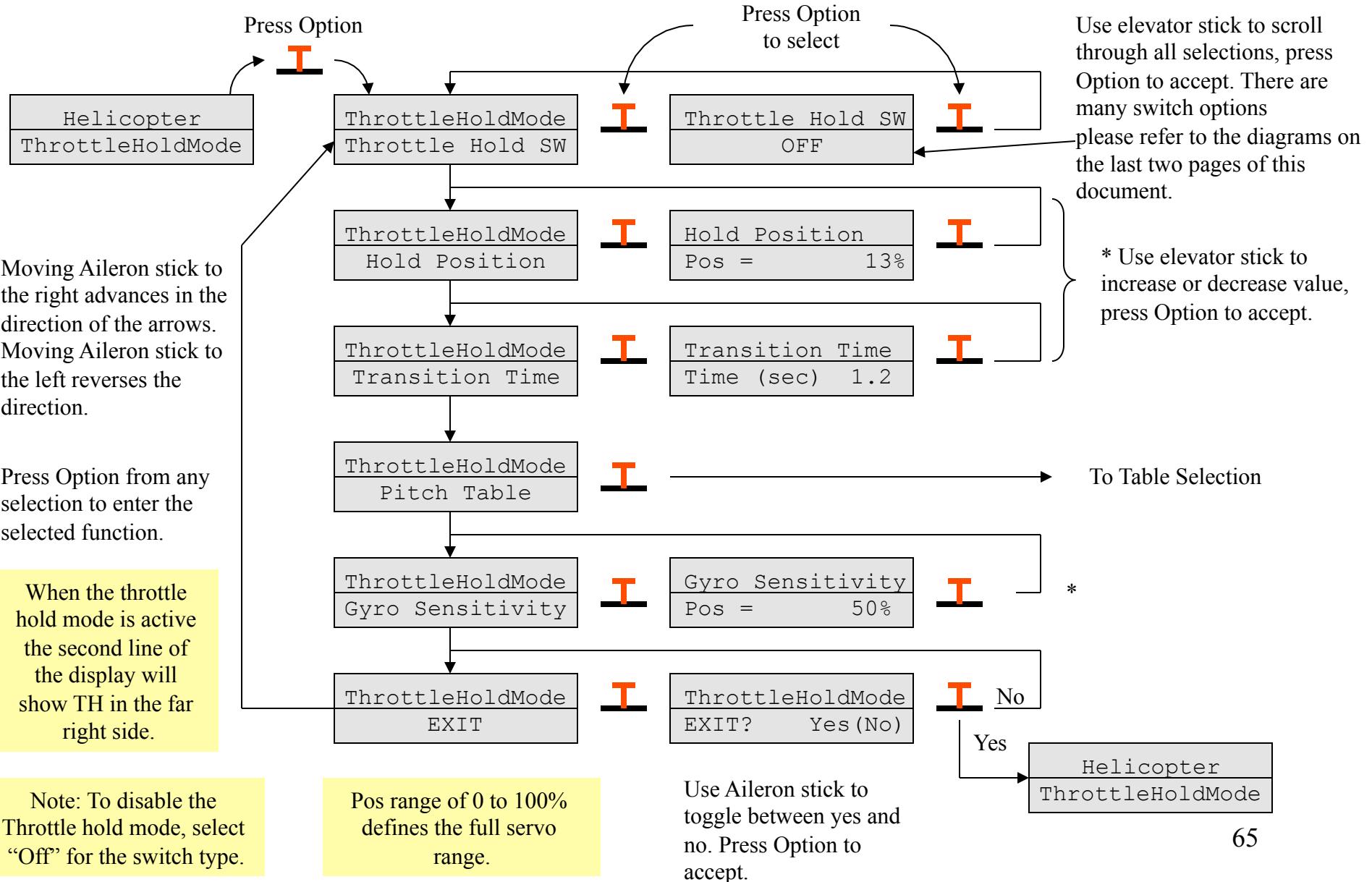
# Helicopter Normal Mode

The Helicopter mode provides 4 flight conditions. The Normal mode is the default condition, this menu selection allows you to define all of the normal mode parameters.



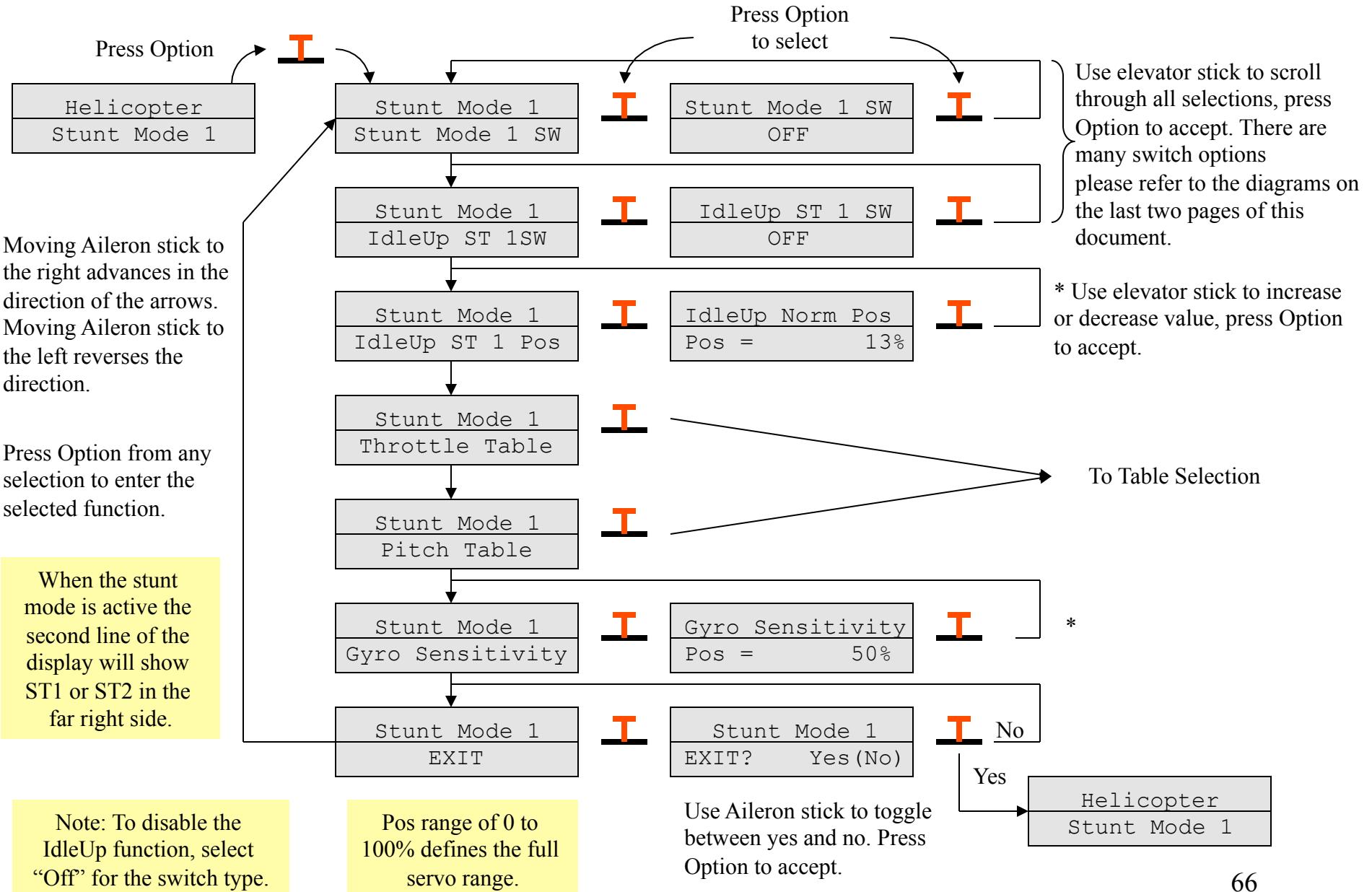
# Helicopter Throttle Hold Mode

The Helicopter mode provides 4 flight conditions. The throttle hold mode is useful for practicing autorotation, this menu selection allow you to define all of this flight conditions parameters.



# Helicopter Stunt Mode

The Helicopter mode provides 4 flight modes. Two user programmable stunt modes are provided, stunt mode 1 and stunt mode 2. This page shows the options for stunt mode 1, a similar set of options are available for stunt mode 2.



## Helicopter, Notes

The throttle stick on a helicopter plays two roles: 1) control of the engine throttle and 2) control of the pitch of the main rotor blades. To allow maximum flexibility for the pilot, the MicroStar allows you to define translation tables to convert the throttle stick motion into the needed control for the engine throttle and a separate table to control the rotor pitch. Unique tables can be defined for both throttle and pitch in all modes with the exception of *Throttle Hold* where only a pitch table is available.

### **Helicopter control summary:**

Aileron	Controls the helicopter roll axis.
Elevator	Controls the helicopter pitch axis.
Throttle	Controls both the engine throttle on the receivers throttle channel and the rotor pitch using CH6 of the receiver.
CH5	Controls the gyro sensitivity.
CH6	Controls the rotor pitch, collective. The CH6 control on the transmitter is the rotor pitch trim.
CH7	Control the gyro sensitivity when in the tune mode. When in the tune mode this transmitter control is routed to CH5 that is use for gyro sensitivity.

Each flight mode also provides a gyro sensitivity control. This setting is a fixed servo output that is used to define the sensitivity of the gyro. Each mode has its own setting that the user can define. The MicroStar also has a Gyro Sensitivity Tune mode that allows the pilot to adjust the gyro sensitivity while in flight. When this mode is enabled the CH7 control is used to define the gyro sensitivity and when you press the option button the servo position is stored in the gyro sensitivity storage location for the selected mode. This tune mode can be selected in the general helicopter settings menu on the transmitter and is reset when power is cycled on the transmitter. The gyro sensitivity is controlled with receiver CH5.

The normal flight mode and the two stunt modes contain an *Idle Up* function. *Idle up* can be enabled using the switch of your choice or disabled by selecting “Off” for the switch. When the *Idle Up* switch is enabled the throttle is set at the position defined for *Idle Up* throttle position. This will hold the throttle in this position until the mode is disabled using the defined switch. This is especially useful when using a speed governor or governor mode ESC.

### **Acknowledgement**

The development of the helicopter mode was made possible by Jack Dice who defined the requirements and performed all the testing both on simulators and using a Eflight Blade 400 electric helicopter.

## Transmitter Switch Definitions, Front



## Transmitter Switch Definitions, Top

