Ultimate Guide to Using SAFE with AR637T

This issue of Flight Notes will provide a walkthrough of how to set up a plane to use SAFE with a Spektrum transmitter and a Spektrum AR637T receiver.

The AR637T is configured using a Spektrum feature called “Forward Programming”. You don’t use a computer and a cable to configure this receiver. Instead, you use a Spektrum transmitter with an LCD display. That’s any current DX or iX series model except for the DXe.

Overview

This guide is divided into four sections. If you aren’t familiar with installing a receiver with SAFE features in a plane that did not include SAFE, then you’ll likely find all of the sections to be useful. If you are familiar with at least certain portions of the process, then you can skip over those sections.

Section 1 – What is SAFE?
This section explains the features that are included in SAFE.

Section 2 – Creating a Model on Your Transmitter, Install Receiver
The first step in setting up the AR637T is setting up a model on your transmitter that controls the plane, and then testing to ensure the controls are correct.

Section 3 – Configure the AR637T
Once you can control your plane, you can set up SAFE and AS3X in the receiver.

Section 4 – Testing SAFE/AS3X Controls
You MUST test, test, and test again how the receiver responds to the plane’s movements. If something is configured incorrectly, SAFE could cause a crash very quickly.

Section 5 – Additional Receiver Settings
A little information about some of the other settings and menu options in the receiver.

A Word of Caution

As with any programmable receiver with active stabilization controls, it’s important that ***you*** understand how your airplane works and how the receiver is going to add input to the controls. The receiver must move the controls in the correct direction, and you must test the receiver’s reactions to the plane’s movements.

Additionally, there are settings in the AR637T receiver that will need to be adjusted

by test-flying the airplane without the assistance of the SAFE or AS3X stabilization systems. Such settings are necessary in order to ensure that the SAFE and AS3X systems work properly to help you fly the plane, rather than working against you to make the plane harder to control. If you are not comfortable flying the airplane without SAFE/AS3X, you may need assistance from another pilot to properly complete the setup of the airplane.

What You'll Need to Get Started

Along with your AR637T receiver, you may need a few more things.

Latest Version of AirWare for your Transmitter

The AR637T was announced in late 2019, so you'll need to have AirWare firmware for your transmitter that was released after that date. For the DX models, that's a version of at least 2.03 or higher. Register your transmitter in the MySpektrum portion of Spektrum's Web site and then download upgrades from there.

AR637T Manual

The manual for this receiver has a lot of information in it, as evidenced by how thick it is and how the AR637T's package bulges as a result! You can find it on the product page on Spektrum's Web site:
http://www.spektrumrc.com/Products/Default.aspx?ProdID=SPMAR637T

Videos by Miguel Alvarez from Spektrum

Miguel Alvarez has set up a YouTube channel with videos that help explain the AR637T setup.
https://www.youtube.com/playlist?list=PL-qOUjKDj-ZazEnV0vavFZYuT9nQJRQ2p

Spektrum Programmer Software

Optionally, you'll want a copy of the Spektrum Programmer Software (SPS) for a Windows PC. As of this writing, it's version 3.4 from October 2018. The software can be obtained here:
http://spektrumrc.cachefly.net/apps/spektrum_programmer.html

At the time of release of the AR637T (March 2020), all you can do with Spektrum Programmer Software is check the serial number (for registration) and apply firmware upgrades. At some point the future, SPS will also have the ability to backup your model setup to a file and restore the model setup from a file. Currently, there is no expectation to be able to edit any of the settings in the model setup using SPS.

USB Programming Cable

If you decide to use the PC software, you'll need the SPMA3065 USB Interface cable.
http://www.spektrumrc.com/Products/Default.aspx?ProdID=SPMA3065

Section 1 – What is SAFE?

Sensor-Assisted Flight Envelope, or SAFE, is a flight stabilization system developed by Horizon Hobby. (SAFE is a registered trademark of Horizon Hobby.) Unlike the stabilization systems that came before it, SAFE will take much more active control of your airplane if you want it to in order to make it easier for beginners to fly. Not only is it a great learning tool, but it's also a wonderful safety net for intermediate or experienced pilots.

How is it different from AS3X?

AS3X, another Horizon Hobby stabilization system (and trademark), is designed to react to unexpected acceleration. In other words, if the plane starts moving in a direction the receiver doesn't expect it to go, then the receiver will add control input as long as necessary to get it back on track. That's a really fancy way to say that it will automatically compensate for a gust of wind. If a sudden gust of wind comes along and starts pushing the plane, the receiver will help you correct for that. When the wind stops, the receiver's input stops. AS3X is designed to help you fly the plane, but you're still the one doing 99% of the flying. AS3X is nowhere near as active as SAFE can be. You can use both AS3X and SAFE at the same time, as they do different things.

What are the features of SAFE?

SAFE adds a number of capabilities to your receiver.

SAFE Self-Level / Angle Demand

SAFE has the ability to keep the aircraft level on the pitch and roll axes (nose up/down and tilt left/right). When you allow the elevator or aileron control stick to return to their center position, the receiver will take over and maintain level flight on that axis. This feature alone can be a great help for beginner and intermediate pilots, as it allows you to correct for a minor mistake just by letting off the control stick and allowing it to spring back to the center.

Furthermore, when you give control inputs for elevator (pitch) or aileron (roll), this mode will hold the plane at a specific angle that's based on the amount of stick input you give it. The more stick input you give, the steeper the angle the plane will maintain as long as you're holding the stick in that position.

Flight Envelope (Bank Angle Limits)

This feature tells the receiver to limit how far the plane can pitch or roll in response to your control inputs. Once the limit is reached, the receiver will ignore any more stick input that would direct the plane to pitch or roll past that limit. This is another way to prevent mistakes, as the envelope feature will prevent you from turning the plane over too sharply or even upside down. This mode is different from the Self-Level/Angle Demand mode in that you are directly

controlling the plane as long as the plane stays within the envelope's limits, and the plane will be more reactive to larger stick inputs.

Panic Mode
The Panic Mode is a special flight mode that combines self-level and the envelope to quickly return your plane to a level flight attitude. Panic Mode is typically configured with a very small envelope so that the receiver will ignore any improper stick input. Panic Mode is intended to be used for just a brief period of time to override your current flight mode settings, so it uses its own control channel on your transmitter and it's usually assigned to the button instead of a switch.

Throttle-to-Pitch or Throttle-to-Elevator (THR>ELE) Mix
All SAFE configurations come with a pre-programmed THR>ELE mix inside the receiver. The intent of the mix is to help beginners manage the pitch of the plane through the throttle stick. Older versions of SAFE, such as the specialized receiver in the Apprentice S, had a simple mix that increased up elevator as the throttle increased. This helps beginners point the nose of the plane up just by increasing the throttle, amplifying the effect of applying more power to make the plane gain altitude. In the AR637T, the configuration of the mix is more flexible. For example, it's possible to configure the mix such that the nose will pitch down (elevator down) at low throttle. This may be helpful for beginners who deploy the flaps when landing, using the elevator to help control the initial "bounce" you get from the flaps. Intermediate and experienced pilots often find this mix is more intrusive than helpful, and the AR637T gives you a choice of whether or not to use it.

SAFE Failsafe
When a receiver goes into failsafe mode when it loses the signal from the transmitter, it needs to make a decision about how to react. Most receivers will either leave the control surfaces in the position they're in at the time, or else they'll return to the position they were in when the transmitter was bound to the receiver, which is usually the center position. SAFE creates a third option, where it can actively work to keep the plane level and hopefully it comes down more gracefully!

What is a traditional "three-mode" SAFE setup?

Most Spektrum receivers with flight stabilization are capable of three flight modes, corresponding to a three-position switch. With a two-position switch, you typically get modes 1 and 3, skipping mode 2.

The Apprentice S set a standard for a SAFE receiver with three flight modes. Those modes generally behave as follows.

Self-Level / Beginner Mode – Includes Self-Level/Angle Demand, Envelope, Panic Mode, and the THR>ELE mix. The envelope limits are pretty conservative, preventing beginners from getting in

too much trouble too quickly. Beginner mode also often comes with some amount of dual rate on the control surfaces, making the controls a bit less responsive so it feels like it's easier to fly.

Intermediate Mode – Includes Envelope and Panic Mode. The envelope limits are less restrictive than the settings in Beginner Mode. Intermediate Mode lets you control the plane for the most part, but the envelope limits will prevent the plane from becoming inverted.

AS3X / Experienced Mode – Includes only Panic Mode. In Experienced Mode, there are no limits imposed by the receiver. The plane will do whatever you tell it to do! The Panic Mode function is still available if you need it.

The AR637T allows you to choose whether or not AS3X is active in each flight mode. Traditionally, AS3X is active in all modes, and Experienced Mode is often referred to as "AS3X Only Mode." As described earlier, AS3X is different from SAFE, so there is no conflict in their functions. While SAFE typically only controls pitch and roll (elevator and aileron), AS3X will provide input for unexpected yaw (rudder) in addition to pitch and roll.

Section 2 – Creating a Model on Your Transmitter

The first thing you'll do is create a model on your transmitter that's capable of controlling the plane. For now, you don't need to worry about configuring SAFE and AS3X – you want to focus on making the transmitter control the plane correctly.

I'm going to walk through this process using screen shots from a Spektrum DX9. Other DX transmitters will look very similar.

Create a New Model

I'm going to create a new model for a high-wing trainer. It's a pretty typical setup with "four channels" – throttle, ailerons connected with a Y-cable, elevator, and rudder. I'm also going to note the subtle differences along the way to include flaps, a pretty common addition.

Even though we don't need to make SAFE and AS3X work at this point, we do need to plan ahead for that. The control switches need to be set up before you begin the process of configuring the receiver. I want to set up the SAFE/AS3X with the traditional three-mode setup I described in Section 1. This is the behavior I want:

- Flight Mode 1 – Self-Level/Angle Demand, Envelope, THR>ELE Mix, AS3X, Panic
- Flight Mode 2 – Envelope, AS3X, Panic
- Flight Mode 3 – AS3X, Panic

To make all this work, here's how I plan to assign channels:

- Channels 1-4 – Normal throttle, aileron, elevator, rudder
- Channel 5 (Gear) – Flight Mode Switch
- Channel 6 (Aux1) – Flaps (if equipped)
- Channel 7 (Aux2) – Panic Button
- Channel 8 (Aux3) – In-Air Adjustment of AS3X Gain Settings

Note that while the AR637T has six connections for servos, it listens for up to twenty radio channels. If you have a transmitter with more than six channels, then you can keep channels 5 and 6 open for anything you like (such as flaps and retractable landing gear), and use channels 7 and 8 for the flight mode switch and the Panic control. You can also use a higher channel to adjust the AS3X gains during flight; more details later on how that works.

Since I don't have retractable gear and I'd like for this transmitter setup to work for a six-channel transmitter, I'm going to leave the flight mode switch on channel 5 (Gear). If you have a six-channel transmitter and you don't have flaps, you could move the Panic control to channel 6 (Aux1) if you want to use Panic.

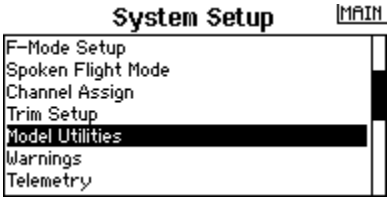
Here's how I will assign switches to the channels:

- Flight Mode Switch: Gear Channel -> Switch B
- Flaps: Aux1/Flap Channel -> Switch E
- Panic Button: Aux2 Channel -> Switch I (button)
- AS3X Gain Settings: Aux3 Channel -> RKnb (knob)

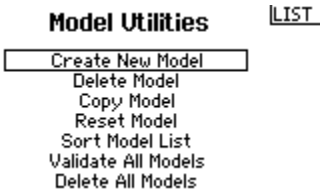
Step-by-Step Instructions

Armed with all of that information, let's go ahead and set up the transmitter.

1. Go to the System Setup menu, and find and select Model Utilities.

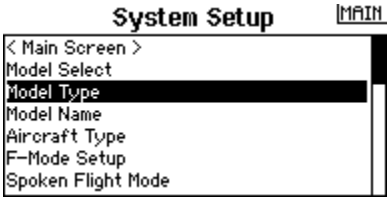


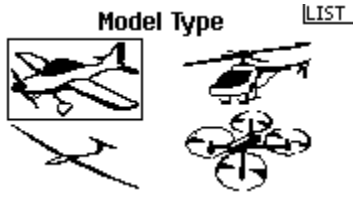
2. Choose "Create New Model". Verify that yes, you want to CREATE a new model.



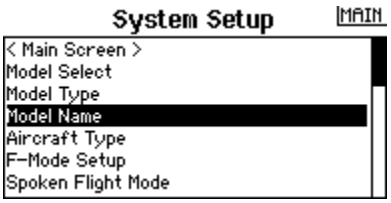
3. You're returned to the System Setup menu with your new model selected as the current model.

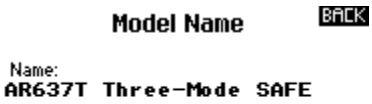
4. Go to Model Type, and select the type "Airplane". Verify that YES, data will be reset. (Although this seems unnecessary since the default for a new model is Airplane, I've read that it's best to make sure the model is reset to default settings. Maybe that's due to an old bug in a Spektrum transmitter a long time ago. Now it's habit.)



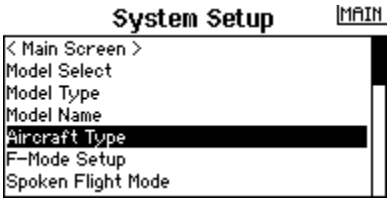


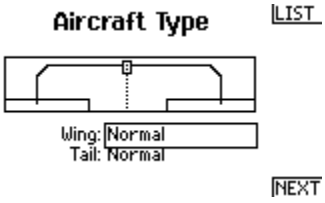
5. Go to Model Name and give the model a name.
   Hint: To erase the default text provided, click to select the first character (probably a number, since the default format is something like “10: Acro”) and then press the CLEAR button TWICE. (Pressing it just one clears just the one character.) Select “BACK” in the upper right corner when you’re done.





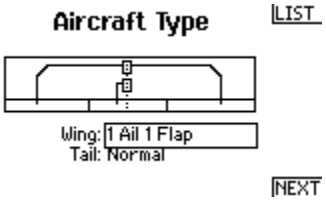
6. Next go to Aircraft Type. The first screen shows the wing type.





   For a plane with simple controls for elevator, aileron, and rudder, leave the Wing and Tail set to Normal.

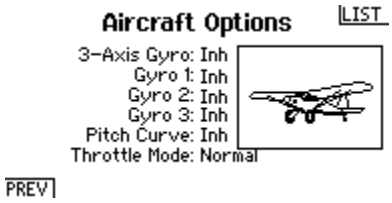
   If your plane has that basic setup plus flaps, change the Wing Type to “1 Ail 1 Flap”. This will enable the Flap System screen and special flap controls.



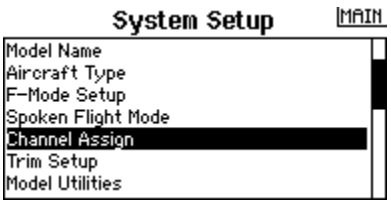
   You must set the Wing Type and Tail Type correctly for your plane. If your plane has more complicated control surfaces (elevons, flaperons, etc.) there cannot be any additional mixes that would be *required* for proper control of the airplane. All controls must function correctly based on selecting the Wing Type and Tail Type alone, as that’s how the receiver will configure itself. It’s OK to add mixes for your own convenience however, such as an AIL>RUD mix for coordinated turns on a four-channel plane.

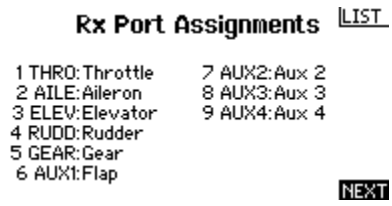
   Then choose “NEXT” in the lower right corner.

On the second screen (Aircraft Options), you can change the picture that the transmitter will display on the screen for this plane. Scroll over until the picture of the plane is highlighted. Select that, and then change the picture as desired. Then choose “LIST” in the upper right corner.

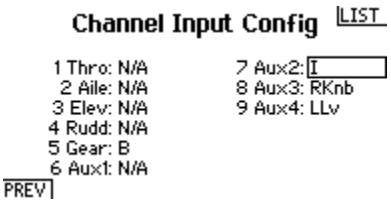


7. Go to Channel Assign. On the first screen (Rx Port Assignments), ignore those settings and go to “NEXT” in the lower right corner.





On the second screen (Channel Input Config), you map switches to radio channels. Make these changes:
Set GEAR to B
Set AUX2 to I
Set Aux3 to RKnb (the knob)



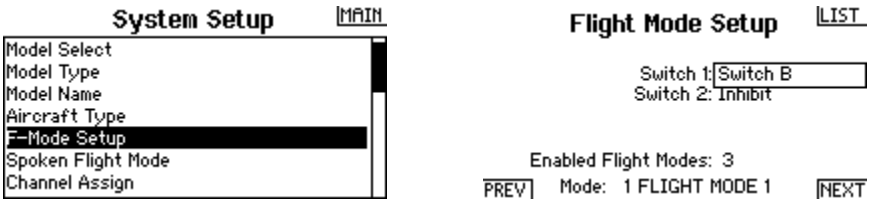
Note that if you have flaps, you do not change the switch for the flaps here. (That’s why it shows “N/A” in the picture.) You’ll do that later in the flap setup.

When you’re done, choose “LIST” in the upper right corner.

8. We’re going to take advantage of the fact that the transmitter supports “flight modes”. However, understand that what the transmitter calls a flight mode is not exactly the same as what the SAFE receiver calls a flight mode. On the SAFE receiver, you get totally different behavior from the aircraft when you change flight modes. In contrast, a flight mode on a transmitter means that you have more options for defining advanced

features like throttle curves. This became popular with helicopter pilots who need may need very different transmitter settings based on whether or not they're flying upside down. Nonetheless, we can apply the transmitter's flight modes to the SAFE receiver. Among other things, it will also display the name of the flight mode on the screen.

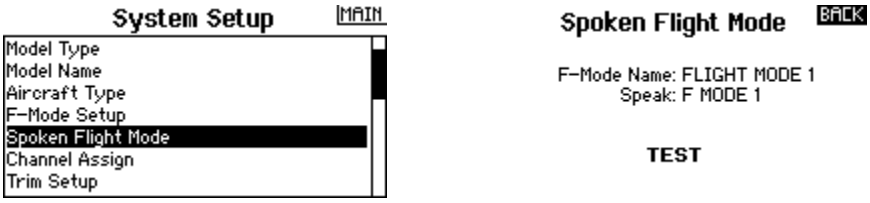
Choose F-Mode Setup from the menu. Set Switch 1 to the main switch for the flight mode control (the GEAR channel), which is switch B.



At the bottom of the screen, you should see that there are three enabled flight modes. You can even test it. If you flip Switch B through its positions, you should see the text change at the bottom of the screen.

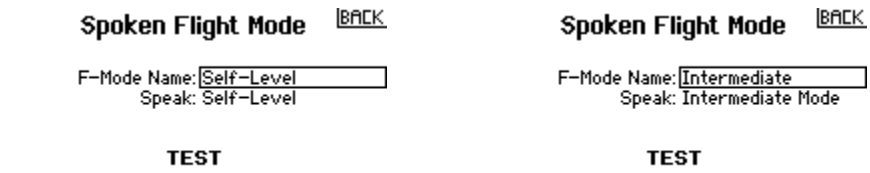
Choose "LIST" in the upper right corner to go back to the menu. It's not necessary to change any of the other flight mode settings.

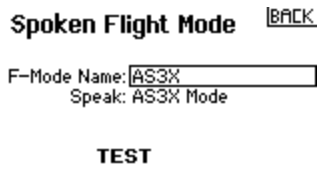
9. Go to Spoken Flight Mode. This screen lets you change the flight mode names as well as the voice alert assigned to each mode.



Set the names and choose voice alerts for each mode that make the most sense to you.

To change the mode you're editing, physically flip the switch to that mode.
Switch B position 0 = Self-Level
Switch B position 1 = Intermediate
Switch B position 2 = AS3X and Panic Only

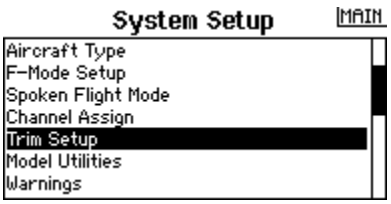


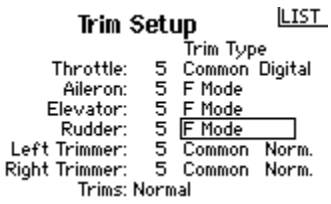


Choose “BACK” in the upper right corner when you’re done with all three modes.

10. There’s a feature in the transmitter that lets you have different trim settings for each of the different flight modes. That’s important, as trim will have different effects when self-level is active as opposed to when it is not active. If you prefer to trim out your plane for level flight using the trim sliders or subtrim, then you’ll want the ability to set it differently in the different flight modes.

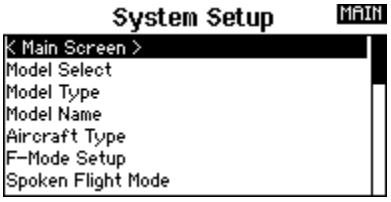
    Go to Trim Setup on the menu. Change aileron, elevator, and rudder from “Common” (same settings all the time) to “F Mode” (different setting for each transmitter flight mode).



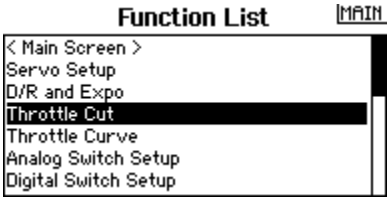


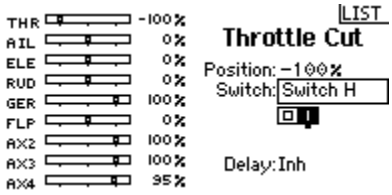
Choose “LIST” in the upper right corner when you’re done.

11. Back on the System Setup menu, choose “< Main Screen >“. Then, click the scroll wheel again to get into the Function menu.

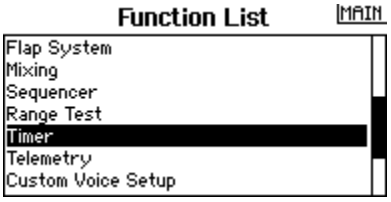


12. I like to set up a throttle cut switch so you can turn on the switch to effectively disable the motor. To do that, select Throttle Cut from the menu. Change it from “Inhibit” to a switch of your choice – I prefer switch H because that’s the traditional location for it with helicopter setups. Ensure that the value is -100%. Then, select “LIST” in the upper right corner to go back to the menu.





13. Select Timer from the menu. This is where you adjust the countdown timer so you know how long your battery will last.

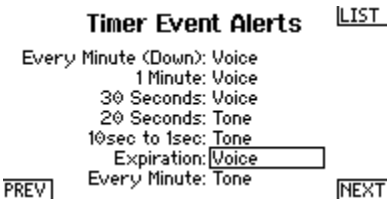


Change the time to a value that’s appropriate for your model and flying habits. If you’re not sure which value to use, consult the manual for your model. Note that it is not good for the batteries to keep flying until the motor reaches the Low Voltage Cutoff warning. You want to land before that happens! Over time you’ll find the optimum setting for the timer based on your flying habits.

Then choose “NEXT” in the lower right corner.

The next screen shows you which switch will reset the timer, defaulting to the CLEAR button to the left of the display. Unless you want to change that, simply choose “NEXT” in the lower right corner.

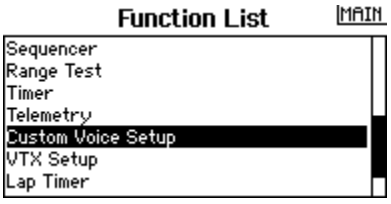
This brings you to the Timer Event Alerts screen. Change the Alert settings to your liking.



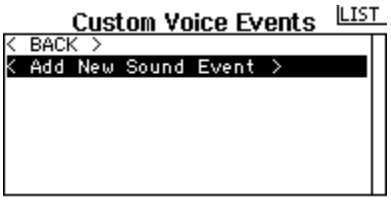
I prefer to have the voice call out each minute, so I set Every Minute, 1 Minute, 30 Seconds, and Expiration to Voice. Having the tone from 10sec to 1sec makes it start beeping at 10 seconds.

Choose “LIST” when you’re done making changes to go back to the Function menu.

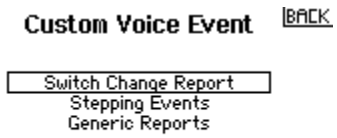
14. Choose Custom Voice Setup.



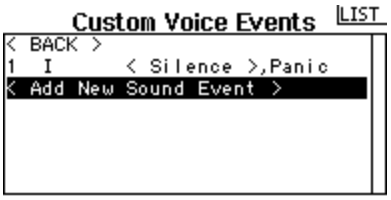
First, let’s add a voice callout to the button so it talks when we press the button for Panic Mode. Choose “< Add New Sound Event >” to add a new event.



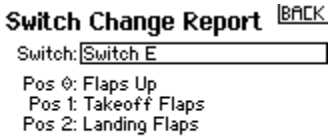
Next, select “Switch Change Report”. Then choose Switch I, and for position 1 choose the phrase “Panic”.



Then choose “BACK” in the upper right corner. Now add another new sound event for the throttle cut switch. It’s another Switch Change Report for Switch H. You can choose voice callouts for each position.

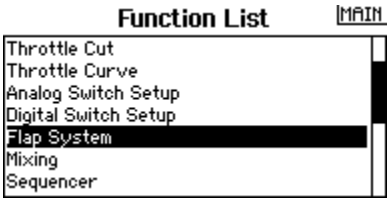


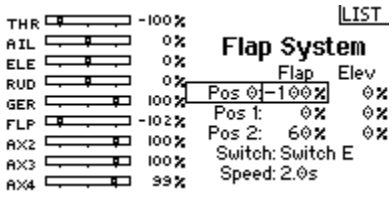
If you have flaps, you'll want to add one more sound event for the flap switch.



To get back to the menu, choose "BACK" in the upper right corner, and then choose "< BACK >" from the list of events.

15. If your plane has flaps, go to the Flap System screen. Change the setting from "Inhibit" to the switch you want to use for the flaps. This is where you set the flap control for each switch position, along with any additional elevator input, and the speed at which the flaps move. The Flap System will automatically associate the switch with the Aux1 channel.





You may notice that I haven't set up any Dual Rates or Expo along the way. There's an explanation of how those two features work in another entry in my blog here:

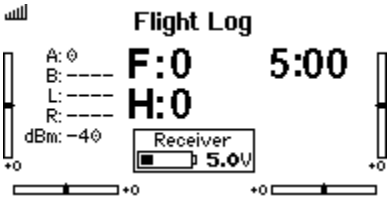
https://www.rcgroups.com/forums/showthread.php?2481671-Flight-Notes-Basics-of-Dual-Rate-and-Expo

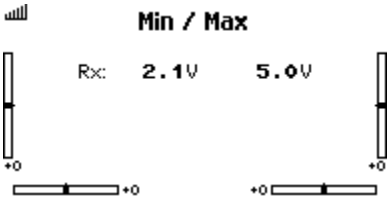
Enable Telemetry

The AR637T features the capability for full-range telemetry, including an integrated barometer to provide altitude and vario telemetry data without additional sensors. A voltage sensor can be connected to the "Volt" port, and Spektrum XBus telemetry sensors can be connected through the XBus connector.

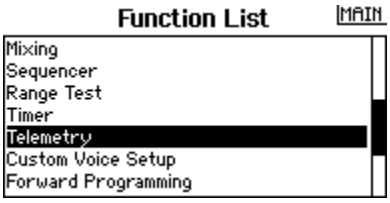
Without doing anything, the transmitter will collect data about the quality of the radio signal from the receiver's end, and also the voltage being supplied to the receiver.

To view telemetry data in real time, turn the scroll wheel while you're looking at the main model screen. The transmitter will scroll through several screens of information.

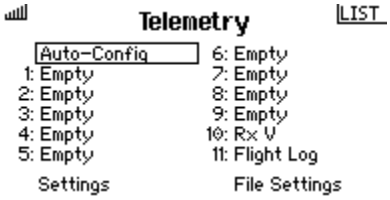


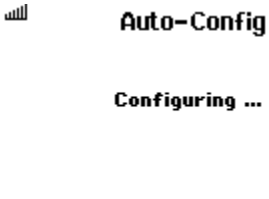


You can turn on the collection and display of additional telemetry information from the built-in sensors on the receiver. To do this, go to the Function menu, and then Telemetry.

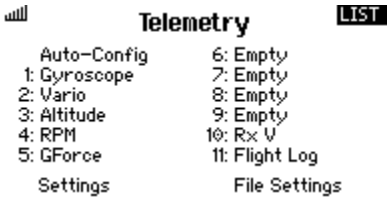


Next, select "Auto-Config" to have the transmitter learn from the data that's being sent back from the receiver.

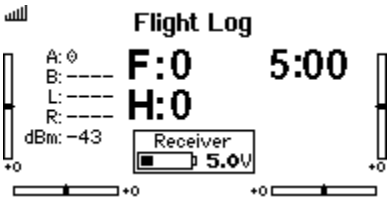


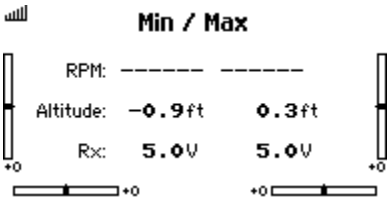


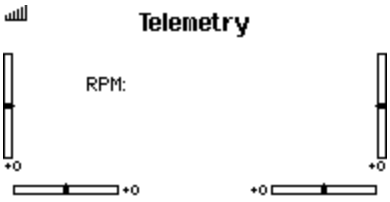
When that process is complete, you'll see a lot more sensors listed.

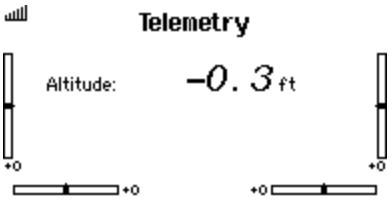


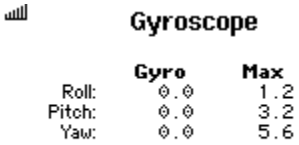
Now if you scroll through the screens of data, there's a lot more information there!

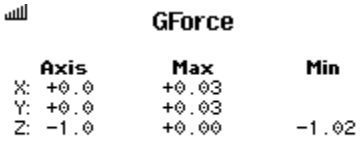


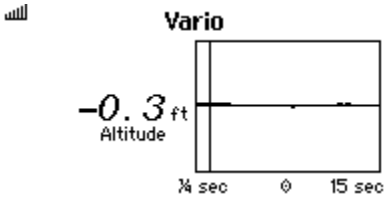








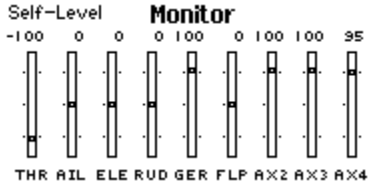




Checking Your Setup

You can check some of your work without the airplane running! For that, we're going to use the Monitor screen. If you're still in a menu, exit back out to the main model screen.

From there, roll the scroll wheel once to the right. That will show you the Monitor screen. (If that didn't work, choose "Montior" from the Function menu.) It has a number of vertical graphs – one for each channel – that visually show the current value on that channel as well as reporting an actual number above each graph.



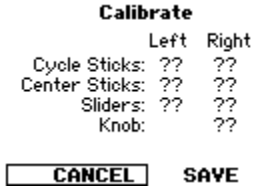
The AIL, ELE, and RUD channels will move with the sticks. Go ahead and play with it.
BE CAREFUL WITH THE THROTTLE IF THE PROPELLER IS MOUNTED ON THE PLANE!

The flight mode switch should cause movement on the GER channel. Switch position 0 (Self-Level) should read +100%, position 1 (Intermediate) should read 0%, and position 2 (AS3X) should read -100%. Similarly, the panic button should move AX2 to -100% when you press the button. If you have flaps, your flap switch should change the value on FLP.

You can also test the throttle cut switch. When throttle cut is on, the transmitter should ignore any movement of the throttle stick (no change on THR). **AGAIN, BE CAREFUL WITH THE THROTTLE IF THE PROPELLER IS MOUNTED ON THE PLANE!**

Stick Calibration

If your sticks are not showing exactly 0 on AIL, ELE, or RUD when they're self-centered, then you may wish to calibrate the sticks. If the receiver sees a value other than 0 when the stick is centered, it would consider that as input, so the plane may flight slightly off-center as a result. To calibrate the sticks, go into the System Setup menu, then System Settings. Click "NEXT" in the lower right corner until you get all the way to the Calbrate screen.



On this screen, move the sticks in the shape of PLUS SIGNS, not circles. Move each stick up and down, back to center, and then left to right. Repeat the movement a couple of times until the screen shows "OK" instead of "??". For knob and slider inputs, move the input all the way from one end of its range of movement to the other. When all items are "OK" select "SAVE" to save the calibration.

Installing the Receiver

We're ready for the receiver to be installed in the airplane.

In order to help the receiver maintain an accurate measure of the movement of the plane, you must mount it with something a little more secure than Velcro. Double-stick tape is a common way to mount it. For planes with gas engines, it's important that the receiver is secure but also somewhat isolated from the vibration of the engine.

For a typical four-channel installation, the radio channels are assigned to the receiver ports as follows:

Port 1 = Throttle	Port 4 = Rudder
Port 2 = Aileron	Port 5 = Gear
Port 3 = Elevator	Port 6 = Aux1 (if flaps are present, they go here)

The markings on the edge of the receiver for the correct orientation of the servo wires aren't easy to read. The servo leads are plugged into the receiver such that the signal wire goes up (toward the side of the receiver with the AR637T label) and the (-) wire goes down (toward the bottom of the receiver.)

The AR637T has a button on it for putting it into bind mode. If you need to mount the receiver in a location where the bind button will not be accessible, you may go with a more traditional setup with a servo extension on the Bind/Prog port and use a bind plug instead.

Bind Transmitter to the Receiver

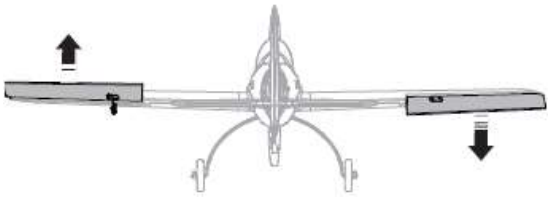
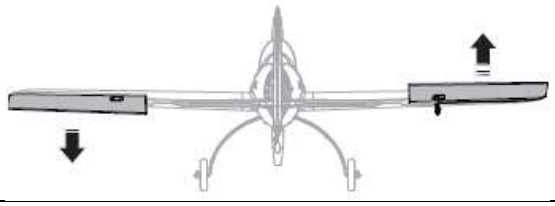
To get the receiver into bind mode, either power it up and then press and hold the bind button until the orange light starts flashing rapidly, or power it up with a bind plug connected to the Bind/Prog port.

Put your transmitter into bind mode either by tuning it on while holding the button down, or by going to the Bind screen on the System Setup menu.

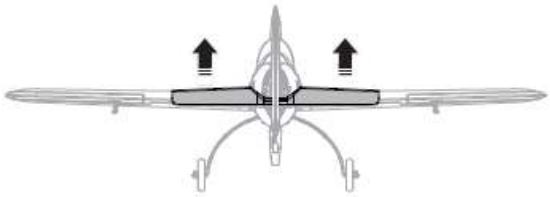
Testing the Transmitter Control

Now you can test the controls for the airplane. At this point, you're looking for the sticks to move the controls in the correct directions, and if you have flaps, that the flaps respond to the flap switch. For a typical four-channel plane, these diagrams show how the plane should respond to the sticks (looking from behind the airplane).

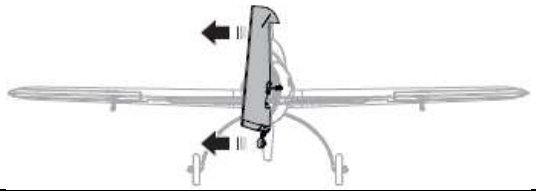
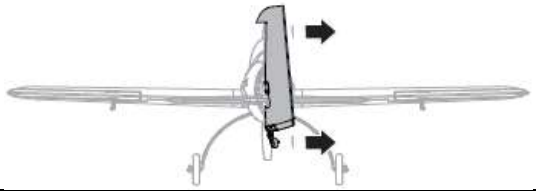
Transmitter Control Test – Ailerons

Aileron Stick Left	Left aileron moves up, right aileron moves down 
Aileron Stick Right	Right aileron moves up, left aileron moves down 

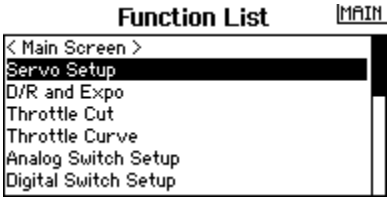
Transmitter Control Test – Elevator

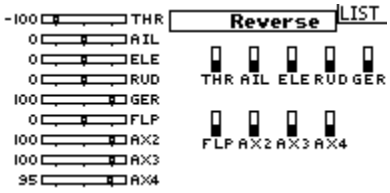
Pull Elevator Stick Down	Elevator surface moves up 
Push Elevator Stick Up	Elevator surface moves down 

Transmitter Control Test – Rudder

Rudder Stick Left	Rudder moves left 
Rudder Stick Right	Rudder moves right 

If a control is backwards, go to the Servo Setup screen in the Function menu to correct it. The Servo Setup screen initially shows “Travel”, so select that word and change it to say “Reverse”. Select the channel you need to change and click the wheel to flip that one to the reverse direction.





When you're done, choose "LIST" in the upper right corner to go back to the menu.

If the flaps need adjustment, go to the Flap System screen in the Function menu.

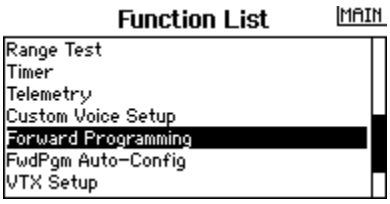
Section 3 – Configure the AR637T

In Section 2, the transmitter model was set up and the receiver was installed in the plane.

Now that your transmitter is controlling the plane correctly, you can begin the setup of the AR637T receiver.

Going forward from here, the receiver will learn settings from your transmitter about wing type, tail type, channel assignments, subtrim, and servo direction and travel. If you find you need to go back to the transmitter setup and make any changes to wing type, tail type, channel assignments, you'll have to redo the configuration of the receiver. If you change subtrim or servo settings, you'll need to get the receiver to update its servo settings (available in a menu option).

On your transmitter, go to Forward Programming on the Function menu.



You must have the throttle stick down to 0 in order to enter Forward Programming. If your model has Throttle Cut configured (which the sample from Section 2 does), then Throttle Cut must be ON to proceed.

With Throttle Cut turned on, the Main Menu appears. Then go to Gyro Settings.

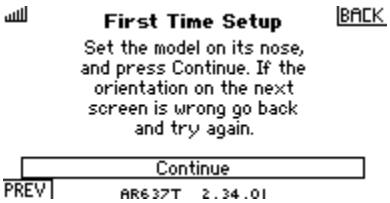
First Time Setup

Assuming the receiver has not been configured before, the only option in Gyro Settings is to go through the First Time Setup.

The transmitter will walk you through the setup process, starting with a reminder that all of your controls should be configured correctly before proceeding.

The first step is to set the mounting orientation of the receiver. There are two ways to do this. One way is to let the receiver figure out how it's mounted, or the other way is to choose the orientation manually.

If you'd like to let the receiver figure it out, then you will start by setting the plane in a level flying attitude. If the plane is a tail-dragger, prop up the tail so that the plane is in the correct position. Then choose "Continue". Next, you'll be prompted to position the model so it's facing nose down, and then choose "Continue" again.



After that, the receiver will display what it believes is the detected orientation.

If you choose to set the orientation manually, you get to this screen directly.

There are 24 possible settings for the orientation.

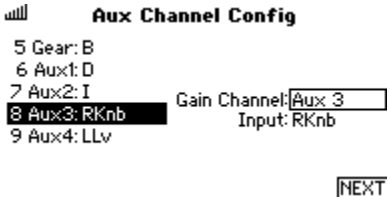
After setting the orientation, you can choose to select a Gain Channel.

What is a Gain Channel?

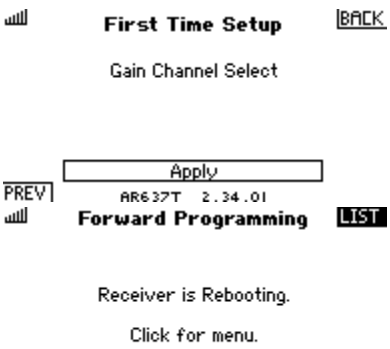
The AR637T has configurable gain settings; think of "gain" as "sensitivity" and how fast the receiver will detect and make corrections. You can set the gain values manually, but you can also adjust and experiment with them during flight, just like the AR636/7350/9350 series of receivers. Assigning a Gain Channel here enables this dynamic adjustment feature.

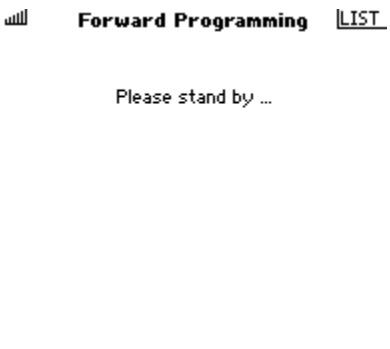
Going into that screen displays which switches are currently assigned to each channel, and then ask you for a Gain Channel input. If you'd like to take advantage of this feature, you would assign a channel for that purpose here (as shown). There will be more on how to use this feature later, but for now I'm going to go ahead and assign Aux3 (the knob) to this function.

If you don't want to use it, leave it set to "Inhibit". Then select "NEXT" to proceed.

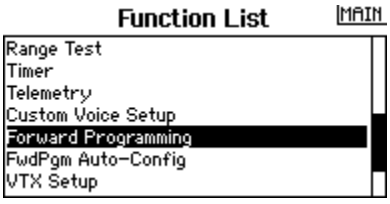


At this point it has enough information for the basic configuration of the receiver. You can choose “Apply” to apply the settings, and then it will update the receiver.





Sometimes this screen that says “Receiver is Rebooting” will go away on its own, and sometimes it waits for you to click the scroll wheel. If you click the scroll wheel, it takes you all the way back out to the Function menu. Just select “Forward Programming” again and then “Gyro Settings” to get back to the programming screens.



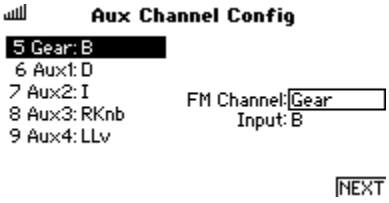
After the receiver reboots, you’ll see a new version of the Gyro Settings screen.

SAFE Setup

To get SAFE going, select the First Time SAFE Setup.

The first thing you'll need to do is set the channel that is used to change flight modes. "Select FM Channel", and then choose the flight mode channel.

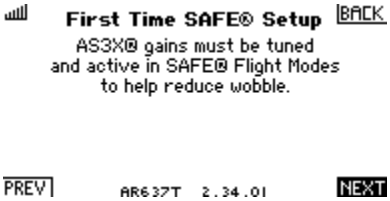
Following along with the settings from Section 2, the flight mode channel is on Gear.



After choosing the channel, you're back to the First Time SAFE Setup screen, which now has a "Continue" option. Select that.

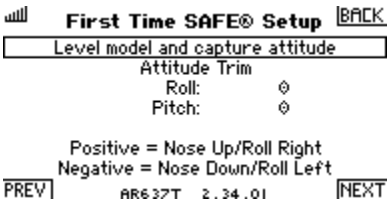
Now you're going to be prompted to choose SAFE features for each of the three flight modes.

You'll get a notice that AS3X gains should be tuned correctly in order to get the best results with SAFE. We'll get into that later, but for now, acknowledge the message and select "NEXT".



The first screen that comes up is for the Attitude Trim setting. Attitude Trim will compensate for a situation where the receiver may not be mounted perfectly level when the plane is in the level flying position.

You may choose to let the receiver detect how much Attitude Trim is necessary based on how it's installed and how the airplane is sitting. If you'd like to do that, set the model in a level flying attitude. If it's a tail-dragger, prop up the tail so that the plane is in the correct position to fly level. Then select "Level model and capture attitude."



The receiver will then fill in suggestions for the trim values.

Whether or not you let the receiver detect the settings, you can also edit the settings yourself.

When you're satisfied with the Attitude Trim settings, choose "NEXT".

It will then step through the SAFE self-level and envelope feature settings for each of the three flight modes.

For "SAFE Mode", you have three choices:

- Self-Level/Angle Demand – turns on both self-level and envelope limits
- Envelope – turns on only envelope limits
- Inh (Inhibit) – neither feature is active

If you choose either of the first two SAFE Modes, then you use the Angle Limits to configure the envelope limits for this flight mode.

These pictures show values that are equivalent to the Apprentice S settings that I'm comfortable with. In Flight Mode 1, the SAFE Mode is Self-Leve/Angle Demand, and the limits

are set at 50 for roll and 40 for pitch. Flight Mode 2 (flip your flight mode switch to get to that mode) is Envelope with roll at 65, pitch up at 45, and pitch down still at 40. Flight Mode 3 is set to “Inh” (Inhibit) for the SAFE Mode.

To change the screen from Flight Mode 1 to 2 to 3, flip your flight mode switch. Don’t choose “NEXT” until you have configured all three flight modes.

After going through all three modes, choose “Apply” to save the settings on the receiver.

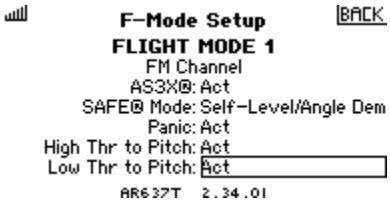
Other SAFE Features for Each Flight Mode

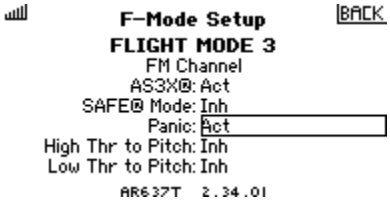
The Gyro Settings screen gets another new look, and there are more SAFE settings to configure! Next go into “F-Mode Setup”.

This is where you set additional features that will be active in each flight mode.

Use your flight mode switch to change the screen from Flight Mode 1 to Flight Mode 3.

In keeping with the Apprentice S setup, I configured Flight Mode 1 to have the Thr-to-Pitch mix enabled. I also enabled AS3X and Panic in all three modes. (As with similar flight mode screens, flip the flight mode switch to change which mode is being adjusted.)



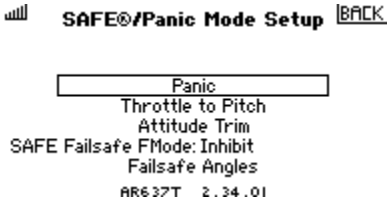


Choose “BACK” when you’re finished to return to the Gyro Settings screen.

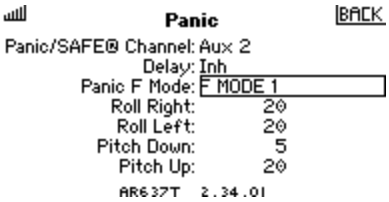
SAFE Panic Setup

Next go into “System Setup”, and then “SAFE/Panic Mode Setup”.

Choose “Panic” to configure the Panic feature.

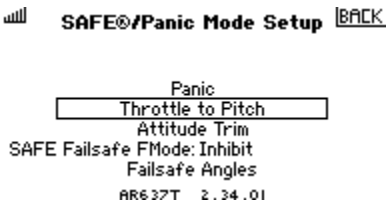


The settings in Section 2 assigned the panic control channel to be Aux 2. I also adjusted the envelope limits to be a lot tighter, especially for pitch (nose) down. You also need to select a flight mode that Panic should use for gain settings. Select the flight mode that has self-level enabled.

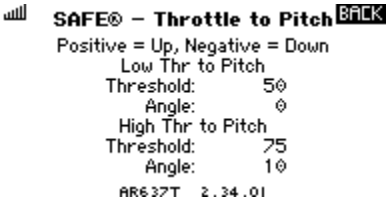


SAFE Throttle-to-Pitch (THR>ELE) Mix

Going "BACK" to the SAFE/Panic Mode Setup menu, choose "Throttle to Pitch" to adjust the THR>ELE mix.



This mix has two parts – a low end and a high end. On the low end, if the throttle is below the threshold percentage, then the angle will be applied to the pitch. Similarly, on the high end, the angle is applied when the throttle is above the threshold percentage.

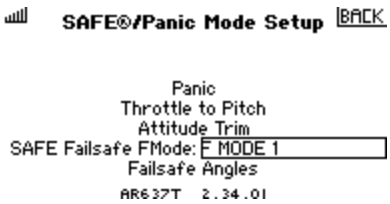


If you're used to working with this setting on the AR636, you'll notice two things. One, the AR637T only supports a constant/fixed angle – if the throttle is in a position to enable the angle input, then the entire input will be applied. Two, the threshold for "low" must be between 0% and 50%, and the threshold for "high" must be between 51% and 100%. The AR636 doesn't have that limitation.

Select "BACK" when you're finished with that screen.

SAFE Failsafe Setup

You can set up the receiver to use SAFE as a failsafe. Should the receiver lose contact with the transmitter, it can do something a little smarter than simply holding the controls in the last position. On this screen, select a flight mode that the receiver should switch to – ideally, one with self-level active.



The Failsafe Angles screen lets you adjust how the plane should fly in the failsafe mode with SAFE active.

If you leave the angle set at 0/0, it would fly straight. If you change these angles a little bit, you can have the plane circle in the air and slowly come down to the ground.

Select “BACK” when you’re finished with the Failsafe Angles.

SAFE Gain Settings

The SAFE Gain adjustment is found under SAFE Settings. This gain only applies to flight modes where the Self-Level feature is active. Increasing the gain will increase the speed at which the receiver reacts to changes in your stick inputs and moves to the desired angle.

The SAFE Gain must be tuned correctly for your aircraft. If the gain is set too high, SAFE self-level may over-correct and cause handling problems when flying the aircraft with self-level active. The default setting of 35 may be too high for some kinds of aircraft.

The SAFE Gain should be set after the AS3X Gains have been set (on the next page), as the AS3X Gains will also affect SAFE self-level. Properly tuned AS3X Rate Gain will help keep SAFE from over-correcting if the SAFE Gain is too high.

If you have more than one flight mode with self-level active, you can set each flight mode by flipping the flight mode switch while looking at the Gain screen.

AS3X Setup

Even though we're really focused on SAFE, we can't ignore the AS3X settings.

On the Gyro Settings screen, select "AS3X Settings".

Do not use numerical gain settings you may have used on an AR636 or other receivers, even for the same airplane. The AR637T uses a different formula for how the rate and heading gain settings are applied.

AS3X Gains are settings that need to be tuned specifically for your aircraft for the best performance. AS3X Gains also affects how SAFE self-level performs.

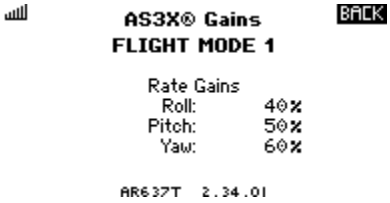
You cannot judge whether the gains are set correctly if SAFE is active. Therefore, you must fly the plane in a flight mode where SAFE self-level and envelope are not active in order to go through the process of tuning the gains.

If the gains are not set correctly, either SAFE or AS3X may work incorrectly and possibly cause the aircraft to be difficult to control when SAFE or AS3X is active. If you are not comfortable flying the plane under those conditions, you may need help from another pilot to complete the gain adjustment.

The default settings are 40% for roll, 50% for pitch, and 60% for yaw. If the gains are set too low, then you may not even notice the effect of AS3X. If they're too high, they'll cause the plane to wobble or oscillate in mid-air, as the receiver will be correcting for its own movement. Ideally, you want to adjust the gains to be high enough so that they're just below the point of causing the oscillation problem.

If you assigned a Gain Channel, then you can use that channel to adjust the gain settings during flight to experiment with how different values for gain will affect how AS3X reacts.

Select "AS3X Gains" on the AS3X Settings screen, and then you'll be able to set the baseline rate gains for each flight mode. (As with similar flight mode screens, flip the flight mode switch to change which mode is being adjusted.)



Similarly, select "Priority" to set the priority. This setting controls the balance between stick input and automatic reaction from AS3X. The default setting is 160% for all axes, and that seems to be a good starting point for most models.

If you have configured the Gain Channel, then you can select which axes would be affected by making adjustment during flight on the "Fixed/Adjustable Gain" screen.

When set to "Fixed", the Gain Channel adjustment would be ignored by that axis. The default setting for all AS3X Gains is "Adjustable".

How does adjustable gain work?

When you use adjustable gain, the Gain Channel will modify the effect of the gain settings shown in the configuration screen. For example, let's say the AS3X Rate Gains are at the defaults of 40%, 50%, and 60%. The Gain Channel is used to select a value between 0% and the number you have programmed in the screen. When the Gain Channel is at -100% (the knob turned all the way counterclockwise, for example), the net gain will be 0%, effectively disabling the gain complete. When the Gain Channel is at 0% (knob centered), the net gain will be half of what you have on the screen (20%, 25%, and 30%). Finally, when the Gain Channel is at +100% (knob all the way clockwise), the net gain will equal the settings you have on the screen.

Process for Adjusting the Gains

For the AS3X Rate Gain, the goal is to set the gain as high as possible without causing the plane to wobble or oscillate in the air due to over-correction from AS3X.

For a much more comprehensive explanation of the gain settings and how to tune them, I'll direct you to the YouTube channel Miguel Alvarez from Spektrum has created for the AR637T. There are multiple kinds of gain settings – AS3X Rate, Priority, Heading, and also a SAFE Gain to adjust how aggressively the self-level feature will move the plane to the desired angle.

https://www.youtube.com/playlist?list=PL-qOUjKDj-ZazEnV0vavFZYuT9nQJRQ2p

This guide takes a different approach to setting up the receiver by configuring all of the SAFE flight mode features *before* tuning the AS3X gains. Therefore, when you get the AS3X gains set to your liking in the flight mode without SAFE features, you'll need to set the AS3X gains manually for the other flight modes instead of using the menu feature for copying the settings from one flight mode to another.

Before flying the airplane to adjust gains, complete Section 4 on the ground (or "bench testing") to ensure that the controls are operating correctly.

Section 4 – Testing SAFE/AS3X Controls

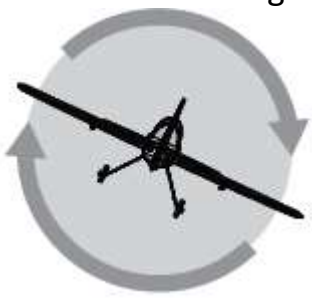
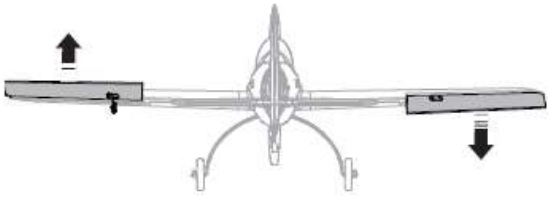
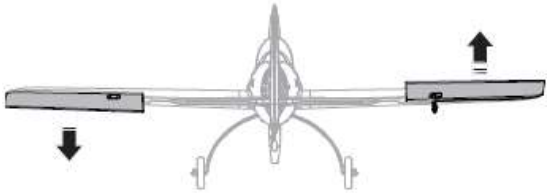
The SAFE functions are active at all times if enabled for the current flight mode. To activate the AS3X functions in the receiver, you'll need power up the plane and then throttle up past 25% for just a brief moment. If the propeller is on the plane, do this very carefully!!! You don't need to keep the throttle running – just move the throttle stick up and then right back down. If the SAFE/AS3X is activated, you'll probably start hearing the servos "sing" and things will move around if you move the airplane.

If you still don't have any reaction from AS3X, make sure that your Throttle Cut is not active! You might have moved the throttle stick but nothing happened because Throttle Cut was on (as required by the Forward Programming menu).

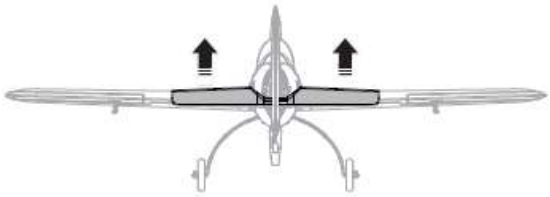
It's easier to see the movements of the flight surfaces if you conduct these tests in a flight mode with SAFE self-level turned on. That's because SAFE self-level will hold the aileron and elevator flight surfaces steady whenever the plane is not level. AS3X still controls the rudder, which will result in movement only while the plane is moving.

For each of these tests, you will pick up the plane and move it in the direction indicated. The directions "left" and "right" are based on the perspective of sitting in the pilot's seat in the plane. The diagrams below show what *should* happen as you move the plane around.

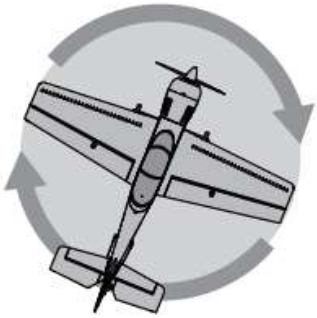
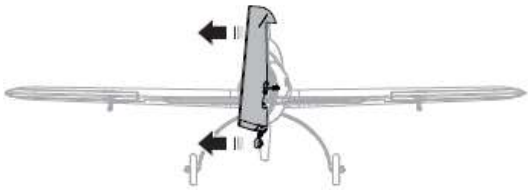
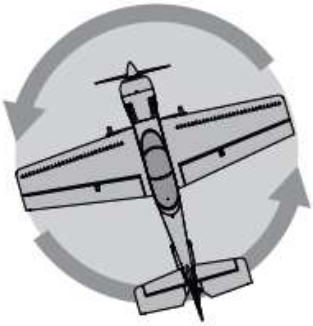
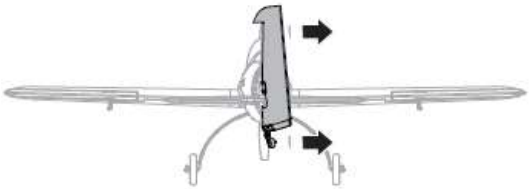
Receiver Control Test – Ailerons

Roll Plane to its Right 	Left aileron moves up, right aileron moves down 
Roll Plane to its Left 	Right aileron moves up, left aileron moves down 

Receiver Control Test – Elevator

Point Nose Down 	Elevator surface moves up 
Point Nose Up 	Elevator surface moves down 

Receiver Control Test – Rudder

Turn to Plane's Right 	Rudder moves left 
Turn to Plane's Left 	Rudder moves right 

What if a test failed??

If you had all the controls working properly before starting the receiver setup, then all the tests should have passed.

Check Orientation
The first thing to check would be the mounting orientation of the receiver. Be sure that the receiver has that set correctly to match how it's physically mounted in the airplane. The Orientation setting is found in Gyro Settings > System Setup >Orientation.

Adjust Control Directions
If you find that a control surface needs to be reversed in Servo Setup, then you'll need to get the receiver to learn about that change. That's done under Gyro Settings > System Setup > Relearn Servo Settings.

If you have a complex wing type (a jet, or a flying wing, for example), then make sure that the transmitter controls it correctly just by setting the Wing and Tail Type. If you *must* create your own additional mix to make the transmitter control the plane correctly, then the receiver will not work. The receiver won't understand any mixes on your transmitter, and it will attempt to fly the plane based on the Wing and Tail Type alone.

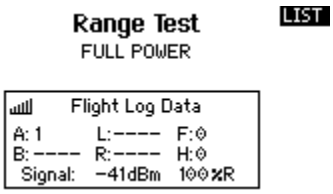
Range Testing

Before you fly the plane for the first time, you should conduct a range test with the transmitter and the receiver. The range test reduces the power from your transmitter to ensure that the plane can receiver a weaker signal as it flies farther away. Follow the range test procedures for your transmitter.

For most Spektrum programmable transmitters, this is the process:

1. From the main model screen, press the scroll wheel to enter the Function Menu.
2. Scroll down to select Range Test.
3. The Range Test screen should display “FULL POWER”. Verify that you have correct control over the aircraft.
4. Walk about 90 feet (about 30 paces) away from the aircraft, and then turn back to face the aircraft like you would as if you were flying it.
5. Again, verify that you have correct control while “FULL POWER” is displayed.
6. Press and hold the Bind/Trainer button. The screen should now display “REDUCED POWER”.
7. Again, verify that you have correct control while “REDUCED POWER” is displayed. If you do have control, then the range test is successful.

The Range Test screen shows you some information about how well the receiver got the signal from the transmitter.



You’ll see the signal strength level at the bottom in both dBm (the technical measurement) and a percentage. The dBm reading should be somewhere between -40 dBm (about as good as it gets) and -85 dBm. Anything worse than -85 dBm would be considered poor reception.

The other numbers quantify different kinds of errors:

A: Fades on the main receiver
B: Fades on the satellite receiver (if one is attached to the AR637T)
F: Frame losses
H: Holds
L and R are not used on the AR637T

A fade is the loss of one bit of information, which is the smallest error that is measured.

A frame loss is the loss of an entire packet of information. That’s not as bad as it sounds, as the transmitter sends a packet every 22 milliseconds, or 45 times per second. When flying, it’s normal to lose as many as 100 frames for every minute of flight time.

A hold is a little more serious, as that’s the loss of 45 consecutive packets, or an entire second with no signal from the transmitter. If you ever see even one hold, you need to check the way you have the antennas positioned within the airplane. Note that the one time a hold is to be expected is if you turn off the transmitter while the receiver is still powered on. (And hopefully you do that with the plane on the ground!)

Checking SAFE Level Flight in the Air

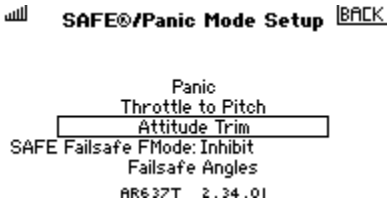
Once your plane is airborne and you have the gains adjusted correctly, a common question is how to adjust "level" flight with SAFE Self-Level/Angle Demand active. Before you can truly judge whether or not SAFE is flying the plane level when your transmitter sticks are self-centered (elevator/aileron), you need to take some other things out of the equation.

First, you'll need to disable the Throttle-to-Pitch mix if you have turned that on. The mix is the most likely reason that the plane doesn't seem to be flying level. The mix will apply either up or down elevator based on how you have set it up, and so the pitch of the plane will not be level but instead will have either some nose up or nose down.

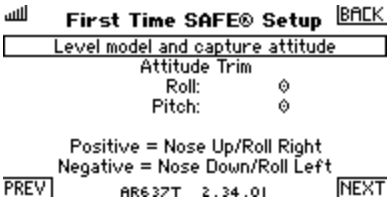
Additionally, you'll need to make sure your transmitter is not applying trim in the flight mode with SAFE Self-Level/Angle Demand active. Without SAFE active, trim may help the plane fly straight, but with SAFE active, SAFE will interpret trim as stick input and therefore deviate from what it thinks is level flight.

A third thing to check is your stick calibration on your transmitter. While the calibration probably isn't very far off, ideally you want the aileron and elevator sticks to send a value as close to 0 as possible in the self-center position. Stick calibration is covered at the end of the transmitter model setup in Section 2.

If you check all of those things and the plane still isn't flying level, then you can adjust the Attitude Trim setting in the receiver. You can get to the screen in Gyro Settings > System Setup > SAFE/Panic Mode Setup > and Attitude Trim.



As with the First Time SAFE Setup, you can either set the plane in a level flying attitude (prop up the tail on a tail-dragger) and let it suggest settings for the trim, or you can adjust the trim manually.



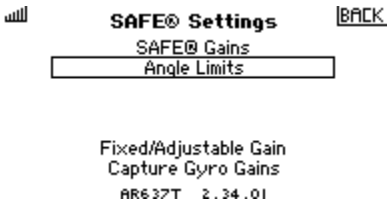
Section 5 – Additional Receiver Settings

There are several other screens available in the menus for the receiver.

All of the screens and settings are described in the AR637T manual. Below are some you find particularly useful.

Adjusting SAFE Envelope Limits

To adjust the SAFE Envelope Limits after the First Time SAFE Setup, go to Gyro Settings, then SAFE Settings, then Angle Limits.



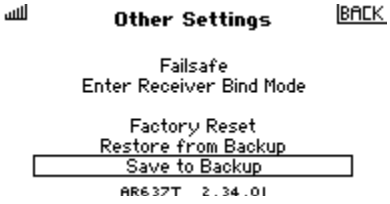
That will take you a screen where you can adjust the angle limits for each flight mode by flipping the flight mode switch.

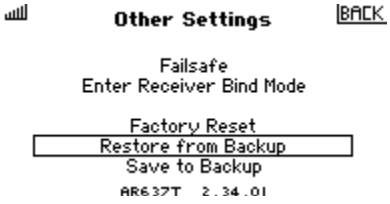
Backup Settings

The receiver has one internal memory slot for saving a backup of your current settings. Use the "Save to Backup" function to save a backup, and "Restore from Backup" to bring back the settings in the backup copy.

From the Main Menu for Forward Programming, go to "Other Settings" and then choose to either save or restore.

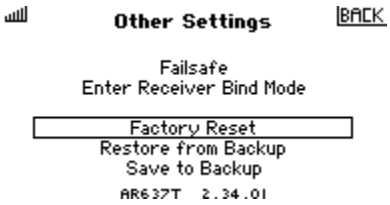
Select "Apply" to perform the task.





Reset the Receiver to Factory Defaults

If you find that you want to start over with the setup, then you can reset the receiver's settings to the factory default state. That's found at Other Settings > Factory Reset. If you do the reset, it will start over all the way back at the First Time Setup process.



Select "Apply" to perform the reset.

Flight Mode Channel Values for Selecting Flight Modes

This receiver is capable of supporting up to 10 flight modes! Traditionally, three is the most that have been used for an airplane, corresponding to one three-position switch on the transmitter.

If you set up the flight mode channel on your transmitter to use multiple switches, here are the values the transmitter would send to select each flight mode.

Flight Mode	Value Sent from Transmitter on Flight Mode Switch
1	+100%
2	0%
3	-100%
4	+125%
5	+75%
6	+50%
7	+25%
8	-25%
9	-50%
10	-75%

Revision 5 – April 2020