

Exploring the MICROSTAR 2000

An expanded description of some of its features

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FEB, 2005

Edited by GA Anderson

Oct 2009

DEDICATION

To my mother, Gertrude ("Gee") B. Sander
1921 - 2005

While not always appreciating the noises and smells of my life long involvement in Model Aircraft, she strongly encouraged and supported the intellectual inquiry, development of technical skills, and social development it required

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INTRODUCTION

This started because of what initially appeared to be some unexplained relationships, and misunderstood behaviors, when setting up mixing on a Hanger 9 Ultra-Stick. While I was able to achieve what I wanted to do, it involved a lot of try and retry in setting up the MicroStar. I have since found that some of my assumptions about “how it worked” were wrong. I decided to take a more systematic approach to divining the “rules” of using the mixing, and therefore some of the other functions available. With Gordon Anderson’s release of version 2.0, the need was expressed by some to have something that augmented Gordon’s documentation in greater depth. Hence this expanded work.

While covering many of the features of the radio, it is not meant to be comprehensive. There may be some unstated assumptions made about the reader’s knowledge of the system, and its predecessor, the Ace MicroPro 8000. I may slip into “jargon” native to each, with no explanation of terms, or I may just assume that you know how to get to a particular parameter setting. That’s what Gordon’s official documentation can help with!

Errors in understanding or expression are all mine! Users of this guide should verify on their own, to ensure they have not been inadvertently led astray. Correction or additions to this paper will always be gratefully received!

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Feb. 2005

Updated to support version 2.0 of the Encoder by Gordon Anderson in October of 2009. I have edited Ted’s original content to reflect the new version. I have added my comments in places and this text will be in italics.

THE “STANDARD” SYSTEM

There is none! The MicroStar is a custom system configured by the original builder to meet a wide variety of desires. Different RF decks are possible. Different numbers, kinds, and the placement of switches is at the discretion of the builder. Different control sticks can be utilized. Different cases. Each one, therefore, is unique.

For the purposes of this manual, the following will be the basis for discussion. Please make allowances for variations in the system you own.

- This manual is intended for version 2.0 of the software. Earlier versions will have different menu layouts, and may not have some of the options noted.
- It will be assumed that Gordon Anderson’s RF deck, using HAM bands, has been installed.
- Instructions will be geared toward a conventional, dual stick configuration. Mode 2 (Throttle and Rudder on the left stick) will be assumed.
- All switches possible have been installed, and follow the conventions of the Ace Micropro.
- References to aircraft controls will be for a conventional R/C airplane. Helicopter pilots, and others, should “translate” accordingly.
- You have Gordon’s documentation (this is the programming manual V2.0) at hand, to refer to as discussions dictate!
- For this paper, it is assumed you have freshly formatted your flash – and are starting with all system and aircraft parameters at their defaults.
- And, that you’ve played with it enough that you know how to move around the menu options, increment numbers with the right stick, and know about when to click the “Option” button – all basic navigation, which will allow the elimination of tiresome “click this” descriptions.
- **Always get back to the opening “CALIBRATE Press Option” screen before flipping the switch from “CAL” to “RUN”. In some instances, if you don’t, your setting may not save.**

SYSTEM SETUP

The first time you configure your MicroStar, perform the following, in the order listed.

FLASH Formatting

Found under “System Setup”.

Formatting the FLASH should be the first thing to do when setting up a new system.

Formatting the FLASH will clear all saved aircraft (models 1 through 96) and system settings!

It is also very appropriate to try when you encounter a variety of unexplained behaviors in the programming or output of the system. If you have the PC Interface installed on your computer, you can first save all settings and models to a computer file, for later reloading.

Get to know “Right/Down”

In many places in the manual and the radio “Right/Down” or “Up/Left” stick motion will be asked for. Right and Left should be no problem. “Down” means like for down elevator – push the stick to the top of the case. “Up”, of course, then means pull up elevator, toward the bottom of the case. Yes, even for throttle! Confusing this will give you some very odd stick behaviors after calibration!!

Joystick Calibration

Found under “System Setup”.

ALWAYS calibrate your joysticks after reformatting, or any time you feel that there is some lack of precision with your system! It is the first thing to try if control inputs seem to be working incorrectly!

This is also very likely the cure if you are having issues moving between menu selections.

Re-Calibration will not reset any other parameters, but it may produce changes in servo centering and output, if you have set up aircraft with very miscalibrated joysticks, and then correct by calibrating. If it was that far off, you would have noticed other issues, too!

The calibration process reads the actual voltage of the pots, and sets up a standard translation into digital values. Gordon’s technical notes describe this in more detail, and documents how you can view directly what the radio sees coming from the pots. A very useful process if your controls seem to have “dead” spots, and you want to diagnose the problem.

Find your switches

Page 7 of Gordon's manual has the guide on to how to read the switches on the MicroStar display. He notes both the default settings ("Mix 1", "Ch 5", etc) as well as the switch names (SWA, SWB, etc.). Review your radio, and verify where SWA, SWB and the rest are located. This will come in very handy, both in knowing what switch currently does what, but also when reprogramming switches to different functions. Of course, this function is useful to also verify if the switch is working!

Set Frequency and Shift

Move to "Select Aircraft", and select the memory location for your first aircraft. Usually this will be the default, "MODEL 01". Name it if you care to, by moving to "Aircraft Name".

Navigate to the "Select Frequency" menu. Initially this will be set to "OFF". Scroll up or down to pick the channel or frequency you will be using. The frequency is stored with the aircraft information, so you may use different frequencies within a band for different aircraft. You can change bands (50MHz, 53MHz or 72MHz) using the "Frequency Band" option in the "System Setup" menu. The RF deck must be built and tuned for the band selected, simply changing this band selection will not change bands!

Note: If you are not using Gordon's RF deck then the frequency selection should not be used (it will have no affect) and the Frequency Band option should be set to None.

Either set up a model with the receiver you will be using, or assemble a simple test system with receiver, switch, battery, and servo.

Turn off the MicroStar, and then back on. You will see the prompt "XX.XX MHz Accept?". If you say "Yes", you're broadcasting. If "No" then the radio is functional, but not emitting anything! *Actually the RF deck is on and locked but the final RF driver is off. A very low level of RF is emitted and most receivers will work with very limited range.*

Receivers use one of two ways to detect the transmitted waveform – starting at a "high" level and looking for the drops, or starting "low" and looking for peaks. This may vary by manufacturer, and even between the band or age of the receiver from the same manufacturer. Adjusting for this is pretty easy – just find the way that works with your receiver!

Turn on your receiver, and check for operation of the servo. It should work! If not, access the "Shift Invert" selection under "System Setup" and try the other setting.

Save and go back to “CALIBRATE Press Option”, flip to “Run”, turn the radio off, then back on to reinitialize the RF deck. Now you should be working!

The SHIFT value can be defined for each model, so changing it on one model will only affect the selected model and you need to make sure and set it as needed for each model. Earlier versions of the MicroStar only allowed one SHIFT value to be set and it was shared for all model settings. All the 2.0 version and SHIFT setting definable for each model.

Number of Channels

Found under “System Setup”.

Most modern receivers have no problem deciphering the 8 channel output of the MicroStar, even if they have fewer output connectors for servos. But, if your system seems to be having trouble – no response, jitters, unpredictable motion when moving your sticks, then access this parameter, and reduce it to match your receiver. This, of course, means that the higher channels won’t directly work with your receiver – but you can still use them to provide input for mixing!

Synch Width

Found under “System Setup”.

Experts only! Some systems may require a variation in the last pulse transmitted, which tells the receiver to reset and be ready to receive another set of instructions. You may change the width of that pulse here. This requires knowing the technical specifications of your receiver. In almost all cases, it is recommended to NOT change the default of .20ms!

Min/Max - a critical safety feature.

Found under “System Setup”.

As you will see under “Servos”, you directly control the length, measured in milliseconds (ms), of the pulse for any given channel. The variation in the length is what tells the servo to move in one direction or another. It is possible to transmit a pulse that is either too short, or too long. The servo will then move to an extreme amount of throw. In particular, at least one model of digital servo behaves very badly when its inherent maximum throw is exceeded – wildly excessive current, chattering or pulsing, and erratic swinging of the output shaft. A sure crash if it happens in flight. It is also possible to inadvertently exceed normal servo settings,

for example, when using mixing. Setting the Min/Max values will prevent these issues.

Under “System Setup” are two menu items, “Servo Min Pulse”, and “Servo Max Pulse”. By default (after formatting) the min is at .75ms and the max is at 2.250ms. This is the master limit for any servo range.

Rule #1: Test your servos by setting up throw to be the same as the system Min and Max (Servo setup covered in the next section). Many analog servos can utilize a range of .500ms to 2.500ms or a little more. Adjust your Min/Max to accommodate the most restrictive servo in your system, to prevent servos from stalling at their range of motion lock point, or to move to the maximum limit that you are comfortable using. Use the default settings as a conservative starting point.

Configure

Found under “System Setup”

Different receivers may “translate” the signals coming from the transmitter slightly differently. Elevator may be Channel 1 on some brands, while it is Channel 2 on others. While this has no impact on use of the system, you may find you have a “mismatch” between what it says on the receiver and what you program in the radio. For example, the Elevator servo may have to plug into the channel marked “Ail” on the receiver. You may, instead, define what output channel is controlled by what stick, and change the sequence so your receiver label will be correct! **CONFIGURE is defined for each model so remember that you need to set it for each model.** The same caution as above applies – be aware of the change if mixing several brands and models of receivers, although in this instance the change should be obvious as soon as you plug things in!

The Configure option also allows you to define what physical trim is applied to what channel. You can even assign an elevator trim to the aileron channel if you want, this does not make sense but you can do it! The main intent of this feature is to support cross trims if you chose.

BASIC AIRCRAFT SETUP

End-points

Found under “Servos”

When setting end points, you are directly setting the length of the pulse sent to the receiver. This is in terms of milliseconds, and consists of the difference between your lowest setting and your highest. If your low was 1.250 and your high was 2.250, then the pulse will be 1.000ms long. Your “neutral” or mid point of the servo travel will be whatever “middle” point you designate it to be. Thinking in terms of the numbers may take a little adjustment, especially if you previously used a radio system that used percentages, or some arbitrary scale of motion.

Example: Setting the ailerons.

Turn on your airplane or bench receiver/servo system.

The first menu option under “Servos”, “Aileron”, prompts for “RT/DN”. Use the Aileron stick to move the number higher or lower, until your servo/control surface moves to the position you want for maximum deflection when the stick gets moved to the right.

Click the option button once, and scroll right to the next setting, “Center” and click the option button again. Adjust the timing so that your servo/control surface is at its neutral or centered position.

Click the option button once, and scroll right to the next setting, “LT/UP”, and click the option button again. Again adjust the surface/servo so that it moves to the position you want for opposite maximum deflection – in this case, when you will be moving the aileron stick fully to the left.

You’re done! Click the option button, scroll to “Exit” (skipping the other menu choices for now), confirm, and scroll to “Exit” again from the “Servos” menu.

Flip to “Run”, and wiggle the aileron stick to admire the perfect up and down motions of the control surface – set to whatever “up” and “down” motion you thought was the appropriate amount!

Setting the other channels functions similarly. When setting the servo limits for the Throttle channel you will see instruction for setting the High and Low settings. In this case High is full throttle as you would expect.

At the field, after a test flight, if you need a little more or less control authority, it’s simple to go to that appropriate control in the menus, and move the timing higher or lower to dial in the exact throws you want.

Ditto for changing the center point of a control surface, just change the value for the center position, if you feel you need a bit of change to trim the plane out correctly (but see the trimming section below).

Servo Reversing

Just swap high number end point for low, and vice versa. For example, if you have the “UP” elevator at 1.150, and the “DN” at 1.900, but things move backwards in RUN, just change the “DN” setting to 1.15 and the “UP” to 1.900. Easy!

Well, there is a wrinkle. To get the exact duplication of reversed servo control, do the math. If your center was at 1.57, and the original UP was at 1.15, that means a difference of .42 ($1.57 - 1.15 = .42$). Add .42 to the 1.57 to give 1.99, and that is your new UP needed that exactly duplicates the movement when it was reversed. Do the same for the other direction.

You will find a new function in each servo selection that will allow reversing the servo direction with a single command. This performs the calculations define above in one simple step.

Centering and resolution

All modern servos are designed for a center point of 1.500ms, which just happens to be the default of the MicroStar! Normal variation of the components may call for some tweaking of that number, as will the positioning of the servo, its arm, and the angles of the control linkages. 1.500 is a great starting point, but don't concern yourself if you have to tweak it some to get your surface in the correct position.

It generally is desirable to set the linkages so that you have to use as much servo throw as possible to move them the desired amount. Why? Resolution! If your center is at 1.500 and your full “UP” is at 1.510, then you only have 10 “steps” of Up control. That would be very “choppy” in flight, and make smooth flying very difficult! Take advantage of the precision of the system, and use as much servo motion as you can. Ditto for the centering – if your installation requires really far off centering, then you will only have a limited number of “steps” available to you in one direction before your servo is unable to move any further. *This is a very good point!*

Auto calculation of the opposite end point

Gordon notes: “Pressing the Auto Trim button just before the Option button will cause the system to calculate the LT/UP position to result in symmetrical values about the center.”

A handy feature! Set the RT/DN position, set the center, and at the LT/UP screen hit the Auto trim button, then the Option button, and the system will calculate the correct opposite setting for you! Saves trying to do that addition/subtraction in your head for exactly equal numbers above/below neutral! Note, though, that the screen won't update until you exit out of the

control surface (Get back to the “Aileron” screen, for example), and then go back in to the LT/UP selection – then you will see the new number!

Additional Servo Settings

After setting the basic end points as described above, there are a few more settings under each Servo menu.

Dual Rates

The dual rate control is set as a percentage of throw. If your servo moves 30° from neutral to full throw, then setting the Dual Rate to 50% will result in it only moving 15° at full throw. Useful for aerobatics, when at times you may want more or less control authority, but be able to change back for other phases of flying. Example: Reduced so that low rate on rudder is 25%, only giving 10° motion for smooth take-offs. Flip the dual rate to “High” just before the top of a stall turn, to give 40° of rudder for a nice pivot, and flip back to “Low” afterward to keep the rest of the flying smooth.

Normally the Dual Rate setting means that you will be getting LESS throw when the switch is turned on, but you can set the percentage to as high as 127%, meaning that you can get set it to give more throw when the switch is flipped. Also, you can drive the per cent negative! This effectively reverses the servo! So, if you really, really want your controls to operate the same when flying inverted.....(but that's NOT a recommended option!).

You can temporarily disable a channel in flight by setting the dual rate to 0%. Flip the switch, and it works, flip it again, and it doesn't! Why you might want to do something like that is left as an exercise for the reader....

Trim

A percentage setting that applies to the sensitivity of the trim levers. 10% means that moving the trim lever the full amount will move the servo 10% of whatever throw it has been programmed to move. If the servo moves 30° in one direction, then full trim at 10% will move it 3°. This setting applies to the full throw of the servo, and is unaffected by dual rates – you always get 10% of total throw as determined by the end points.

Trim levers may be disabled by setting this parameter to zero! (See the section on trimming for more details).

AT RST

“Auto Trim Reset”. See the trimming section below for details. This selection clears out the saved “Auto Trim” settings that had been previously stored for this channel.

Expo Hi/Expo Low

Exponential allows you to vary the proportion of surface movement as the stick is moved. The result is reduced servo movement when moving the stick a little, but progressively more and more servo motion as the stick is moved a greater amount. Very useful, for example, in 3D flying, where control surfaces are very large, and move a great deal. When flying conservatively, it would be too easy to over control, and the aircraft would bounce all over the sky. Expo “deadens” the stick movements close to neutral, allowing smoother flight, yet gives full throw when moving the stick the full amount. Some flyers prefer this instead of using dual rates. In the MicroStar, you can have two different settings for each channel, one that takes effect when on “low” rate, and the other when on “high” rate.

For those that want just Expo, set the Dual Rates to 100%, and both Expo Hi and Expo Low to the same value. But, you can have both dual rates AND expo at the same time. The dual rate controls the total throw of the surface (High or Low), while the Expo controls the “softness” of the control around neutral.

Setting is a percentage. High per cents mean less sensitivity to stick movement close to neutral. 0% means there is no Expo, and the servo movement corresponds directly to the stick movement. Proper adjustment is per your personal liking. It is recommended that the larger the amount of control surface and/or the amount of throw, the higher the per cent should be!

Channel Specific Servo Settings

Throttle

Trim Mode

This option lets you define where in the motion of the throttle stick the trim is effective. Set at “Normal”, and it behaves like any other trim – moves the servo a reduced amount no matter what position the main stick is in. Set to “Low”, and the trim is only effective when the stick is in the “bottom” half of it’s range. “High” is the reverse, trim is only effective during the top half of the stick motion.

This allows you to set a specific high (or low) end for the servo, that will not be effected by the trim lever. No more fiddling with the linkages to get that last 50 RPM, because the trim has caused the end point of the servo to shift a little from fully open!

Preset

This is primarily used as an engine kill parameter. Set the timing to result in a fully closed carburetor, to stop the engine. Activated only when the “Preset” button on the transmitter is pushed. Of course, button can be preset here to define throttle servo movement to any position when pushed. Combine this with changing of switches, output channels, and/or mixing, and you can use it for a wide variety of functions, beyond just throttle.

AutoTrimming Engine Idle

Finding the perfect idle setting for a throttle trim has always been a challenge, involving setting servo end points, testing the engine, fiddling with the linkage, and lots of trial and error. Most flyers just tweak the idle speed with their throttle trim, and hope the lever doesn't get bumped!

With the MicroPro and the MicroStar, you have the option to fine tune your idle trim ((UP/LFT timing) while the engine is running, in normal flight mode! Here's the process:

With your plane safely restrained, start the engine, and rough in the idle using the conventional trim.

If your trim lever is already at minimum, then press and hold both the “AutoTrim” and “Preset” buttons at the same time. Use the Elevator stick to dial in more or less RPM as desired, until you reach that perfect idle. Release the buttons, and your idle is set, with the trim in full down!

If your trim lever isn't quite full down yet, do as above, going back and forth between the trim lever and the “AutoTrim”+“Preset” function, sneaking up on the final setting – increase RPM with the Auto method, cut down on your trim lever, increase RPM again using “Auto”, cut back your trim lever, until you get to the full minimum position for the trim lever.

If you combine this with the “Idle Up” function of the radio (primarily aimed at helicopter pilots), you can have two idle settings! One for those periods when the engine is a bit cold, and needs a slightly higher idle RPM, and one for after it's fully warmed up and can be dialed down a little more. Helps in those situations where the landing approach is a bit too fast, because the engine increased it's RPM after warming up!

Use the “Preset” (described above) to kill the engine!

Channels 5, 6, 7, 8

RT/DN and LT/UP positions for each of these channels as described above. But except for Ch 8, there is no Center position. And, because these have no associated trim levers, the Trim option is not available.

The SNAP Button

Found under the “Snap” menu selection

As per its predecessor, the MicroStar has a self centering, three position switch for automating right and left Snap rolls. The “Snap” menu selection has a series of selections for SR (Snap Right) and SL (Snap Left). You may program the percent of throw for each channel (Aileron, Rudder, Elevator AND Throttle) you want to use for controlling the snap roll.

A second set of selections for each channel, ending in a question mark (“SL Tht ?”) allows you enable or disable that control from being affected by the setting programmed for it when using the Snap button. For example, if you did not want the Throttle to be changed when doing a left snap roll, you should not set the per cent to zero – that would just kick the engine to idle when the button was pushed! Instead, you have to disable it by setting “SL Tht ?” to “No”.

Trimming

Four ways to trim your aircraft using the MicroStar!

Conventional Trim Levers

The trim levers can be used like, ummm...trim levers. Moving the trim lever will adjust the center and end points of your servo proportionally. As noted before, you program the percent of trim authority that you would like. Your choice as to whether to keep the lever positions as they are after flight testing, tweak the center position of the servo so that you can bring the trim back to neutral, or to adjust linkages for the same effect.

See the section under “Channel Specific Servo Settings” about the special settings programmable for the Throttle trim.

Trim Zero

Found under “Options”

Only works for Aileron, Elevator, and Rudder – not throttle.

Trim Zero is the MicroStar version of digital trims! Test fly your plane, adjusting the trims to suit for straight and level. On the ground, access the “Trim Zero” selection under “Options”, save, and move your trim levers back to the middle! The radio remembers the amount of trim you dialed in, and applies it to that aircraft consistently. The saved trim does not reset until you specifically pick the “Clear Trim Zero” selection.

Note that saving a new Trim Zero replaces the old – they do not add together.

This can be a fooler – if you already have Trim Zero set, with your trims in the middle, then move them, the amount of surface movement will be less, and only that amount will be captured if you resave. The result, an out of trim aircraft the next time you take off! Best practice is to “Clear Trim Zero” BEFORE the test flight, to get an accurate trim lever position.

Auto Trim

Found under “Options”

Only works for Aileron, Elevator, and Rudder – not throttle.

Auto Trim was the great contribution introduced in the ACE MicroPro, and replicated and improved on with the MicroStar.

Limitation – Auto Trim is limited to changes of no more than 20% of the surface throw (20% either direction). It is not a “cure-all” for a wildly out of trim aircraft, but is VERY useful for normal trimming, and can be used in conjunction with the other trims as needed.

All changes made using either method of Auto Trim are saved in their own areas of memory for each aircraft. Unlike the Ace MicroPro, changing servo settings does not automatically clear the Auto Trim settings. You may do so for all channels at once, using the “Reset” menu under “Options” or individually using the “AT RST” selection under each individual servo selection.

Incremental Auto Trim

The “classic” version, first introduced with the Ace MicroPro.

How it works: As you fly, you might find you need to hold some “up” elevator, and some “right” aileron to maintain straight and level. When you push and hold the Auto Trim button, the control surfaces will move in the direction of the stick control you are holding, feeding in “up” and “right”. To maintain straight and level, you then naturally release pressure on the stick. Once back to neutral, release the Auto Trim button, and you’re trimmed!

After setting “AT Mode” to “Inc” (for “incremental”), holding a stick position causes the control surface to move in a series of small jumps, or “steps”. By defining the number under “ATStep”, you can define how coarse or fine each “jump” of the control surface is. The higher the number, the more movement for each “step” used. In addition, you can control how fast the surface will move in response to the stick, by defining the “ticks” that are counted off before the next “step”. There are 40 “ticks” in one second, so setting the parameter to 40 would mean that there will be a rate of one second between each step. In practice, lower numbers (1-10) provide a better “feel” to the process.

If you define lots of steps and/or an excessive amount of “ticks”, or vice versa the Auto Trim may either move too quickly or too slowly (giving either very rapid changes in trim in flight, or frustratingly slow changes). Start with the defaults, and test variations of both “ticks” and “steps” until you get comfortable with your custom setting. Bench testing of changes in these parameters is in order, so that you can judge the impact before trying it in the air!

One Shot Auto Trim

Setting the “AT Mode” to “One Shot” changes the operation of the button to be similar to Trim Zero, except in this case the stick positions are read rather than the trim levers. Hold the model to be straight and level, hit the button, and you’re trimmed! The limitation does apply, so the maximum amount of trim in one direction is 20% of the surface movement, even if you hold your stick in a greater position.

Combined trimming

You may mix and match trimming methods as desired. Set your trim levers to a broad percent (15% to 20%) for coarse adjustment on an initial flight, and after getting close, use Auto Trim to dial it in. Save trim settings to the TZ and you will have both types of trim active. Move your trim levers back to the middle.

Or, just use Auto Trim, and then under “Options”, “Auto Trim”, you may copy the current Auto Trim settings to the Trim Zero memory, thereby freeing up the Auto Trim (after then resetting it, of course) for another 20% of adjustment, as needed. Some flyers then prefer to then reset their trims to 0% (or a small percent, such as 5%), to avoid problems of accidentally moved trim levers. They still have the Auto Trim available, to use as conditions warrant.

Sub Trims

The Sub Trims option can be found under the “Servo” menu selection. Sub Trims allow you to apply a position offset to any transmitted channel. These Sub Trims work just like a normal trim control except these are fixed or defined using the Sub Trim adjustment procedure in the Cal mode. The channel that is being adjusted will be transmitted during the adjustment so you can watch you control surfaces move. This will help you selected the desired position.

The Sub Trim values are unique to each aircraft setting in the MicroStar. This function is very useful when you are mixing channels and you do not have a center adjustment on a channel you are mixing to. Sub Trims will allow you to reposition the center of any channel and this offset is independent of all mixers and is always applied after all the mixing functions are performed.

Digital Trims

Starting with version 2.0g of the MicroStar firmware Digital Trims are supported. You can combine conventional analog trims and digital trims in one transmitter design. For example you may chose to use digital trim on

Aileron, Elevator, and Rudder and conventional trim for the Throttle like is done on JR systems or you could use all digital trims. Any combination is allowed and configurable. The type of trims are used are selected in the “System Setup” menu selection under the “Configure” option. When you select a trim to configure you will see digital trims as one of the options. You will find details on Gordon’s web site that tell you how to connect digital trim switched to the encoder.

SWITCHES

Found under “SWITCH”

The options here allow you to program which function of the radio is control by which switch. One example: A normal configuration is to have a single position switch control the “Alt Aircraft” function (switch to another aircraft while in flight!). by reassigning the function to the three position switch (normally used for Ch 8), you can then have three aircraft configurations to choose from while flying – Normal, Alt Aircraft #1, and alt Aircraft #2. What function you want what switch to control, with what aircraft is up to you – to the limits that you can remember different configurations!

You did make a “map” of where your switches were at the default settings, right? (See the section under “Find your switches”).

ALTERNATE AIRCRAFT

Found under “Options”

The MicroStar can hold 96 models in memory. You may designate one or two of these to be “alternatives” for flying. This is the same, or better, than “flight conditions” in other radios. For example:

You’ve perfected all the settings for normal flying of your “Super WhizBang”. Now’s the time for trying out 3D throws.

Use the “Copy Aircraft” function to duplicate all of your current settings in a new memory location.

Change to that model using the top level “Select Aircraft” menu option.

Adjust control throws, dual rates, expo, mixing, etc. as needed for your new flying style.

Flip back to the original model, and designate the new version under “Alt Aircraft 1” (under “Options”).

Take her up! While flying, flip your “Alt Aircraft” switch to have the new settings take effect. When you’re done with the wild and crazy, flip the switch back to bring all the settings back to the original.

ALL aircraft parameters are modifiable in the copy, so you are only limited by your imagination as to what alternative configuration you want to set up.

The MicroStar is capable of designating SIX such Alternative Aircraft, but to use all, you will also need to designate multiple switches using the Switch function.

PRESET MIXING

Gordon’s documentation for VTAIL, ELEVON, DUAL AILERON, THROTTLE HOLD, and IDLE UP are very simple, direct, and clear, so will not be repeated here. Suffice it to say that between the preset mixers, and the programmable ones discussed below, there is a HUGE number of ways you can configure an aircraft!

PROGRAMMABLE MIXING

The MicroStar has a variety of combinations that can be programmed, to change the motion of a surface, based on multiple changes of the sticks and switches. A simple example would be the need to automatically add some right or left rudder every time aileron is used – to assist in the turning of a scale Piper Cub. You can build very complex interactions, to achieve an unprecedented amount of control of your aircraft.

The MicroStar has 12 mixers available, grouped into three sets of four each. Each set is turned on or off by its own switch. Some versions may not have the third switch – this was an option in the Ace MicroPro – in which case, the mixing for set 3 is always “on”.

The Basics

A given “stick” (or slider, or switched channel control) is defined as the “FROM” control. Move this control, and its position determines what happens.

An output channel is then designated as the “TO” function – this is what ends up moving when the “FROM” control is moved!

There are several parameters that can be changed, to influence what happens during the above. Please see Gordon’s documentation for the descriptions, and review how each is accessed and set. The following is based on specific testing, to demonstrate the effect of each of those parameters, and to note possible uses. It is suggested that you set up a bench system, and try the settings as described, to more fully understand the interactions.

Mixing one “stick” channel to another

As tested, FROM = Ail, TO = Rud, using Mix number “1A”.

Positive and Negative Gain settings reflect their respective “FROM” stick motion away from neutral.

Giving right Ail used the Pos Gain setting. Giving left Ail used the Neg Gain setting. Neither gain setting had any effect when the stick was moved in the “other” direction. Setting one of the gains to 0% prevented any output when moving the stick in that gains direction, while the other direction still functions.

100% gain gives you 100% throw of the “TO” servo.

When Ail is mixed to Rud, and both gains are at 100%, you will get the full range of motion programmed for the Rudder servo, using the Ail stick.

Reduced or increased percentages in the Gain uses the “TO” channels range of motion.

50% gain will gave 50% of the max rudder throw, for the example.

Asymmetrical motion.

If you want right Ail stick to give you 75% right rudder, and left Ail stick to give you 25% left Rudder, just set one Gain to 75%, one Gain to 25%.

Effect of Dual Rates/Expo

The settings for the “From” channel transfer to the “To” channel.

Aileron D/R of 50%, cuts the established rudder motion by 50%.

This is governed by the percent setting in the “From” (Ail) channel for D/R. Varying the “To” channel (rudder) D/R had no effect when mix was turned on.

You will see the D/R percent of the “From” channel (Ail) applied to the “To” (Rud) output. Example: Aileron servo moves +/- 40°, Rudder servo moves +/- 60°. Aileron D/R is 30%. The end result is 30% of 60°, or 18° Rudder output.

Exponential functions similarly, with it being applied to the “To” channel.

Trim effect

“From” trim is also proportional to the “TO” channel.

Both trims were set at 10%. Gains at 100%. Ail and Rudder had differing end points. Result was 10% of Rudder throw, when moving Ail trim. Varying the “From” trim percent, changed the amount of trim applied to the “To” channel.

Reversing

You can “reverse” the output motion by making the corresponding Gain negative.

If Right Ail normally gives you Right Rudder, controlled by the Pos Gain %, you can make Right Ail give you LEFT Rudder, by changing the Pos Gain to a negative value.

This allows you to have surfaces that always move in the same direction, no matter which way the FROM stick is moved (One Gain is a positive percent, the other is a negative percent), or surfaces that move opposite the stick motions (both gains are a negative value). Note that the “TO” stick would then produce normal movement, while the “FROM” stick would reverse it!

Moving both sticks

If moving the Ail stick gives you 100% of Rudder, and then you also move the rudder stick 50%, you get the servo moving 150%.

This can get you in trouble by exceeding maximum servo capacity, unless you have set your Min/Max as noted above.

Example: Rudder moves to 60° at 2.000ms. MAX is set to 2.200, which if we had setup the rudder servo to move to that endpoint, would have given 75° of motion. Mix gain is 100%. Aileron stick at full therefore moves the rudder 60°. Moving the rudder stick full would then move the servo another 60°, or a total of 120° of rotation! Bad things could happen, if that were allowed! The MAX setting limits it, and the rotation of the servo ends at 75°. This can also confuse you, if you forget that there is a limit imposed by the max/min settings!

REPLACE

Selecting “Replace” does just that. No input from the “TO” stick is accepted. In the Ail to Rud example, only the Aileron stick would control the rudder. The Rudder stick would have no effect.

Mixing otherwise acts as described above.

Using ZP or “Zero Point”

Zero Point slews the endpoints and center of the output channel. This is useful for dialing out any minor shift when flipping mixing on or off. Test setup had the rudder servo move off center, and changed the endpoints, by 3° when the Mix 1 switch was flipped. Setting ZP to 6% cured that.

Interesting possibilities for shifting the center a large amount, zeroing out one gain, and putting in large % for the other.

Mixing one “stick” (A,E,R,T) channel to an Auxiliary (Ch 5 – 8)

Before we discuss the details of mixing to the auxiliary channels and the throttle channel it is worth spending a little time explaining how the MicroStar works to better understand the mixers.

The process of Joystick calibration is used to convert the signals from the Joysticks into a standard range. This is done because the ranges differ from system to system and we need a consistent range to use for our mixer calculations as well as other functions such as trims and dual rates. The Joystick calibration converts the signal into a range of -1000 for full left or up, 0 for center, and 1000 for full right or down. This is true for all channels except Throttle, in the case of Throttle 0 is low Throttle and 1000 is full Throttle. For the channels that do not center the Joystick calibration procedure assumes that the center is half way between these two points.

Its worth noting that early versions of the MicroStar used 0 to 1000 ranges for the auxiliary channels and channels 5 and 8. This made mixing to these channels a lot more confusing.

With the Joysticks providing calibrated ranges all the manipulations are pretty simple. For example if a dual rate is set and 60% all that needs to be done is to multiply the calibrated range data by 0.60. All calculations are performed using this calibrated range information and the very last thing that's done is conversion to servo pulse width data. Mixing is also very easy and just requires adding the channels together after applying the gains. A great example of mixing is the trims, the trims function much like a mixer. The trim channel is multiplied by its trim authority setting; default is 25% or .25. Next it is simply added to the control channel.

With this background the mixer settings should make a bit more sense. Positive gain is used when the calibrated Joystick signal from the From channel is positive, this signal is multiplied by the gain percentage then added to the To channel. In a similar fashion this happen for the negative gain. The ZP value, Zero Point, is an offset value in percentage that is subtracted from the From channel before the gain calculations are applied.

We will now go through a couple of mixing examples that illustrate how the mixing functions can be applied to some actual cases. First lets look at a dual elevator setup where we what to use channel 6 for a second elevator channel. This is a very simple case and all that is needed it to set the gains at 100 percent, the ZP value to 0, and make sure and use the replace option. The channel 6 servo end point options will apply and allow you to set the channel 6 servo range. The elevator channel will set only the elevator channel range of motion. If the channel 6 elevator half moves in the wrong direction you can fix this a couple of ways, the best way is to just reverse channel 6 in the servo options but you could also change the sign of the positive and negative gain values in the mixer function. The last point is the center position of channel 6, what if the center is offset? If the center point needs to be adjusted use the channel 6 subtrim settings described in the trim section above.

Summary of dual elevator mixer settings.

| | |
|----------|------|
| From | Ele |
| Table | None |
| To | CH6 |
| Replace | Yes |
| ZP | 0% |
| Pos Gain | 100% |
| Pos Ind | 0 |
| Neg Gain | 100% |
| Neg Ind | 0 |

Throttle mixing can be a little tricky because it is not a centering channel and as such its calibrated range goes from 0 to 1000. Lets go through an example with the Throttle channel. Lets assume you want to mix in a little right rudder with throttle, as you increase throttle you want to add more right rudder. In this case you would set the ZP value to 0, the negative gain setting is not used so set it to 0, and the positive gain is set to the amount of gain or mix desired. In this kind of mixing I would set it pretty low, maybe 10%. Using positive values for this gain value will mix in right rudder and negative gain values will mix in left rudder.

Summary of throttle to rudder mixer settings (right rudder mix only).

| | |
|----------|------|
| From | Tht |
| Table | None |
| To | Rud |
| Replace | No |
| ZP | 0% |
| Pos Gain | 10% |
| Pos Ind | 0 |
| Neg Gain | 0% |
| Neg Ind | 0 |

Now lets go through an example that will show the use of the ZP value. Lets assume you want to mix Throttle to Rudder again but in this case you want no mixing when the throttle is in the center and left Rudder mix at Throttle settings below center and right above. This may not be a mixer setting that would ever be used but it will serve to illustrate some of the details. The first thing to do is set the ZP value to 50% this will transform the Throttle into a range of -500 to 500 for use by the mixer gain functions. This ZP percentage is multiplied my 10 and subtracted from the From channel, so 50% becomes 500 that is subtracted from a 0 to 1000 range resulting in a new range of -500 to 500. Next set the positive and negative gains to 10%. This will result in 5% left rudder at low throttle and 5% right rudder at high throttle. Why only 5%? This is because the range after applying ZP is -500 to 500 and not the normal -1000 to 1000 that the centering channels have.

Summary of throttle to rudder mixer settings (right and left rudder mix).

| | |
|----------|------|
| From | Tht |
| Table | None |
| To | Rud |
| Replace | No |
| ZP | 50% |
| Pos Gain | 10% |
| Pos Ind | 0 |
| Neg Gain | 10% |
| Neg Ind | 0 |

Mixing can be very confusing because there is a great deal of flexibility in the MicroStar. There are generally a number of ways to perform a mixing function and the best way to learn is to do a little experimenting.

Tables

Found under "Shared Options"

You will find two sets of Tables. There are 8 general Tables and these apply to all aircraft. Additionally there are two Tables that are unique to each aircraft. The general shared Tables can be used in common between all aircraft.

Tables are pretty easy. Just remember that there are 11 stick positions, from neutral to full throw. You directly enter the per cent of throw that you would like at each stick position (this is a change for earlier versions!) A linear output would be:

POS 0 = 0
POS 1 = 10%
POS 2 = 20%
POS 3 = 30%
Etc.

An exponential type would be:

POS 0 = 0
POS 1 = 1%
POS 2 = 4%
POS 3 = 9%
POS 4 = 16%
Etc.

Tables can be useful for things like throttle, where your RPM may not be linear – use the curve to match your power output to the stick, so that at ½ throttle, you actually get ½ of your max RPM's.

Tables can also be one solution for those odd mixings done with fun fly type airplanes. Looping touch and goes (take off, loop, touch, loop, touch, etc.) are popular. Yes, very frequently the ground moves up two feet between touches, but that's a geology problem, not radio or flying skills! A big plus in this stunt is to reflex the ailerons up (making them spoilers) as the throttle is cut to idle at the top of the loop.

Setup would be: Setup ailerons to act as spoilers at low throttle, program a table so that percents are 0 at most of the positions, with the last (or last few) being high percents, up to 100% at POS 10. As throttle is cut, ailerons stay normal for most of the movement, but then rapidly deploy as spoilers for the final movement of the stick. Actual setup is a little more than that, and there are other ways to do this, but you get the idea.....

Indirection

Gordon's notes pretty well sum up this feature. By assigning a channel to Indirection, under a mixer, you then are able to vary the Pos/Neg gain, up to the maximum specified in the gain settings.

In a simple example, if you mixed Aileron to Rudder, but weren't sure what your final gain should be, set the gains to be relatively high (50%??), and use indirection to have the Ch 6 slider adjust it in flight. When you land, if the optimum setting had the slider at its' mid-point, you would assume that you were using a gain of 25% ((50% of the slider position times the 50% Pos/Neg gain). Readjust the gains to 25%, and then take off indirection.

Helicopter pilots and others with more complicated mixing scenarios can think of multiple uses for this feature.

Mixer Order – “Fixed First”

Here's Gordon's note about the purpose of having a “Mixer Order” parameter:

Mixer order has to do with the problem of combining fixed mixers and programmable mixers. For example; you are using elevons and you are mixing to the elevators from some other channel with the programmable mixers. If you do “fixed first” then the elevon mixing is done first, then the programmable mixers. If you do not do fixed first then the programmable mixer would affect only one of the servos.

Mixing to the same channel

This is where you can apply tables to a single channel! For example, if you want to set a curve for the throttle, to get true linear output of RPM .

When you have figured out the appropriate Table percent settings to apply to get equal increases in RPM at each stick position (an exercise for the reader!), mix Throttle to Throttle using your defined table.

A note of interest – If you do not choose “Replace”, your gains are additive to the original throws! May not be what you want for the throttle. You’d get the normal throw of the servo at 40% stick position PLUS the calculated throw from the table! Easier to turn on Replace, and let the table totally control the amount of throw without complicating it. But there may be other scenarios where you might want to use this feature...

Mixer Groups

When doing more complicated setups, where you create a mix, and then use that result to feed into another one, a problem akin to the “fixed first” option arises – which calculation is the radio supposed to do first? The solution is to define the mixers into groups, and have slightly different “rules” for how the groups do the math.

Note: the following does get pretty “deep”, and it can be a stretch to understand how it works. Feel free to not worry much about it! For the day-to-day “one channel to a different channel” mixing, groups do not come into play! They are important, though, when trying to have something mixed, and then use the result to mix in something else!

Gordon notes that with Mixer Groups 1 and 3, each of the individual mixers within the group are calculated, and only after all 4 are done will the end result be used. But in Mixer 2, there is no waiting, each result from 2A,B,C or D is used right away.

Here’s his description:

Each mixer calculation results in a new output channel result. The mixer results are saved in a temporary set of internal registers and then applied at various times during the mixer calculations. The 12 mixers are calculated in order, 1 through 12. The results are applied at the beginning of each mixer set and before each of the 4 mixers in group 2 (mixer 2). This changes the way you will use different mixers depending on the desired result. If you want a mix function to use the result of a previous mix function you need to properly select the mixer group and number in that group.

A good example of needing the versatility designed in to the MicroStar mixers can be experienced when you implement VTAIL mixing using the general mixer functions. The mixing needs to perform the following:

$$\text{Elevator} = \text{Elevator} * 0.50 + \text{Rudder} * 0.50$$

$$\text{Rudder} = \text{Rudder} * 0.50 - \text{Elevator} * 0.50$$

The first step is to multiply the Elevator and Rudder channels by 50% (0.50). This is done to insure the servos remain within their range for all combination of the elevator and rudder inputs. Mixer1A and Mixer1B can be used to perform this first step. These results will be applied after all Mixer 1 calculations are complete. Mixer1A and Mixer1B programming is shown below

MIXER1A (Multiply elevator by 0.50)

| | |
|----------|------|
| From | Ele |
| Table | None |
| To | Ele |
| Replace | Yes |
| ZP | 0% |
| Pos Gain | 50% |
| Pos Ind | 0 |
| Neg Gain | 50% |
| Neg Ind | 0 |

MIXER1B (Multiply rudder by 0.50)

| | |
|----------|------|
| From | Rud |
| Table | None |
| To | Rud |
| Replace | Yes |
| ZP | 0% |
| Pos Gain | 50% |
| Pos Ind | 0 |
| Neg Gain | 50% |
| Neg Ind | 0 |

The next step must be performed in Mixer 3 because the results must not be applied until both mixer calculations are performed. This step does the Elevator and Rudder additions and subtractions. The Mixer3A and Mixer3B programming is shown below:

MIXER3A

| | |
|----------|------|
| From | Ele |
| Table | None |
| To | Rud |
| Replace | No |
| ZP | 0% |
| Pos Gain | 100% |
| Pos Ind | 0 |
| Neg Gain | 100% |

| | |
|----------|-------|
| Neg Ind | 0 |
| MIXER3B | |
| From | Rud |
| Table | None |
| To | Ele |
| Replace | No |
| ZP | 0% |
| Pos Gain | -100% |
| Pos Ind | 0 |
| Neg Gain | -100% |
| Neg Ind | 0 |

If Mixer 2 were used for the two operations shown above the results would be very different. This is because in Mixer 2 the results are applied after each individual mixer in the group. This would result in the Elevator to Rudder mix operation changing the Rudder value and not allowing the next mixer operation to calculate the proper result.

Let's assume for a moment that channel 6 is used as a flap channel and you wish to mix some down elevator with as you add flaps and assume you are using the above VTAIL mixing setup. This can be accomplished adding one more mix function using one of mixers in group 2. For example:

| | |
|----------|------|
| MIXER2A | |
| From | CH6 |
| Table | None |
| To | Ele |
| Replace | No |
| ZP | 0% |
| Pos Gain | 10% |
| Pos Ind | 0 |
| Neg Gain | 10% |
| Neg Ind | 0 |

This example illustrates the power and versatility of the MicroStar mixers. The VTAIL function illustrated in this example is one of the fixed mixer functions implemented in the MicroStar so it is unlikely you would ever implement this example. This serves only to show what is possible in a more complex situation.

To summarize, in the above, we started with:

1A = E to E (with 50% gains)

1B = R to R (with 50% gains)

The above is done to limit the total throws to a reasonable number

Then, the critical part:

3A=E to R

3B=R to E

If the system had just stepped through each mixer, doing the math individually, by the time it got to 3B, it wouldn't know what the correct Rudder value was, because 3A had already calculated a new value and sent it on to the servo. Defining it as part of a group resolves this, the value from 3A is held until the rest of the group is calculated. The results of 3A and 3B get combined to form the final output.

There will be times when you explicitly don't want this group calculation to happen, hence the mixers under 2 have been left to send their output directly. In the final step added above, 2A = 6 to E works on just the elevator, which by itself would result in only one surface moving. Because that gets calculated before the mixers in 3, they can now use that result in their calculations, and because they are part of a group, both surfaces end up moving!

OPTIONS NOT COVERED IN THIS DOCUMENT

Either because of the obvious nature of the option, or the documentation by Gordon, many other features of the MicroStar have not been covered. How to program, and how to use, should be obvious, even without a written description. These include:

All the various options for timers, under the "Timer" menu option. Note that this is "by airplane", so you can have different timers for different planes.

"Set Defaults" under "Options", used to reset all settings for a given model, so you can start over!

"Buddy Box" modes, under "Shared Options"

Setting the volt meters, resetting the battery timer, voltage alarm. and output to the FMS flight simulator – under "System Setup"

And finally, the "Prop blades" (for the optional tach), Retrack switch warning, and the AUXOUT control under "Options".

OTHER RESOURCES

Gordon's Web Site: <http://www.mstar2k.com>

Everything – fabrication information, upgrading, manuals, software

MicroPro/MicroStar Yahoo user group: MP8K@yahoogroups.com

E-mail list frequented by Gordon, and users of both kinds of radios. Invaluable help with any question.