Lemon 7-channel Stabilized Receiver
Instructions

The Lemon DSMX Receiver with Integrated Stabilizer

The Lemon 7-channel stabilized receiver, shown above, is expressly designed as a “simple” integrated, full range, DSMX receiver and rate-gyro stabilizer for electric models.[1]

This receiver is not an autopilot or self-leveling device. It will not fly the plane for you. It is designed simply to smooth out flight and thus make flying in wind and turbulence a pleasure rather than a risk.

The Lemon stabilizer is very small and light. Despite its low cost, it offers both high quality and high performance. A Lemon DSMX satellite receiver can be added to further improve performance.

The unit automatically switches between DSMX and DSM2 and so will work with any Spektrum or compatible transmitter of five channels or more, including the basic DX4e and DX5e units, as well as computer transmitters such as DX6, DX7, DX8 and DX9. It can also work with open source transmitters such as Taranis, and Turnigy 9XR, provided they are using an add-on DSM2 or DSMX module.

This document provides both **basic instructions** for installing and adjusting the Lemon stabilizer, as well as more **detailed information** on various aspects of operation.

[1] The picture shows a v3 or v4 Stabilizer. The v2 Stabilizer (up to May 2014) is physically different and lacks the plastic case. See page 13 for details.

Basic Instructions for Using the Lemon Stabilized Receiver

NOTE: These instructions assume you are using a Spektrum transmitter. If you are using a different transmitter, such as a Taranis or 9XR, see page 12.

They also assume you are using a transmitter with seven channels or less and thus do not have access to Master Gain (channel 8). Stabilization will work normally but without the ability to adjust gain in flight. See page 11.

1. Set up the transmitter

If using a computer transmitter, set up a new model. Disable any V-Tail or Delta mixing on your transmitter – the stabilizer must do all such mixing. Make sure control throws (end points) are set to 100%.

2. Bind the receiver

Bind the receiver to the transmitter in the normal way. If you are using a satellite it must be connected during this process. Completion of the bind is indicated by solid lights on the receiver (and satellite if used). Be sure to turn off both receiver and transmitter and remove the bind plug after binding. For details, see page 8.

3. Test the receiver in non-stabilized mode

Check that all stabilizer switches are in the OFF position.[2] Turn on the transmitter and then the receiver. Check for solid green and red LEDs indicating that the receiver is operating properly in non-stabilized mode.

Temporarily plug a servo into each of the Ail, Ele, and Rud outputs and check that they operate normally in response to the correct sticks. Power off.

4. Test the receiver in stabilized mode

Set switches J4 and J5 to the ON position. Power on the transmitter, and then receiver. Check that the green LED is ON and that the red LED goes off when you move the Gear switch. The stabilizer is operating when **only** the green LED is ON (i.e., red LED ON = stabilizer OFF). Power off.

> ***HINT***: For troubleshooting, plug a servo into the Gear pins (channel 5) on the stabilizer. The servo should move through about 80-90˚ when the Gear switch is toggled.

5. Mount the receiver in the plane

Install the stabilizer flat in the fuselage, aligned with the centerline and with the pins at the either back or front. The bottom of the stabilizer should be mounted firmly to the aircraft using the supplied double-sided tape. If using a satellite, mount it away from the stabilizer, with the antenna wires straight and at right angles to the main receiver antenna (see page 10).

Note that the receiver can be mounted upright or inverted with the servo connectors at front or back. It will not work properly if mounted across the fuselage, on edge, tilted

[2] As shipped, all the switches on the stabilizer are OFF. This means the stabilizer is inactive and the receiver operates as a normal unstabilized 7-channel receiver.

forward or backward, or at an angle to the centerline.[3] Both receiver and satellite (if used) must be firmly attached. See page 9 for more detail.

6. Connect servos and speed control (ESC)

Plug the servos and ESC into the appropriate slots on the receiver. Normally, the Gear slot will be empty, as that channel is used internally to control stabilization.

Important safety warning: Leave the motor unconnected or remove the propeller when testing or programming. Electric models can bite!

Set the correct wing type on the transmitter. If you have a dual aileron or flaperon setup, plug the second aileron servo into the Aux1 (channel 6) output and switch J6 ON.

If you have a V-Tail or Delta wing (elevons), now is the time to switch OFF either J4 or J5 and ensure that the other is ON (the selection is marked on the case).

For a conventional Aileron/Elevator/Rudder model, J4 and J5 should both be ON. If you have two separate aileron servos, J6 should be ON as well. If you have two aileron servos but they are on a Y-cable plugged into channel 2, J6 should be OFF.

7. Verify control directions, centering and servo throws

Power on. Turn the stabilizer OFF with the Gear switch (green ON, red ON).

Reverse the Gear channel in the transmitter if you wish to change the switch direction. Make a note of which way is ON!

Adjust transmitter reversing so that all the servos work in the correct direction in response to the sticks.

With trims in neutral, adjust servo arms and linkages to align your control surfaces and use subtrim on the transmitter for fine tuning. Servo arms should be at right angles to push rods to ensure equal movement in both directions.

Check that control surface throws are as recommended for the model and adjust linkages if necessary. Note that adjusting throws in the transmitter will affect response to the stick inputs but not affect stabilization, so throws need to be set mechanically to give the stabilizer enough control; the exact amount is not critical, as gain will be used to fine tune stabilization.

8. Test stabilization response

Turn the three onboard gain adjustment pots fully clockwise (maximum). Switch the stabilizer ON using the Gear switch (green ON, red OFF). Sharply move the plane in each of the three flight axes and check that the control surfaces move vigorously to oppose the disturbance. See diagram below.

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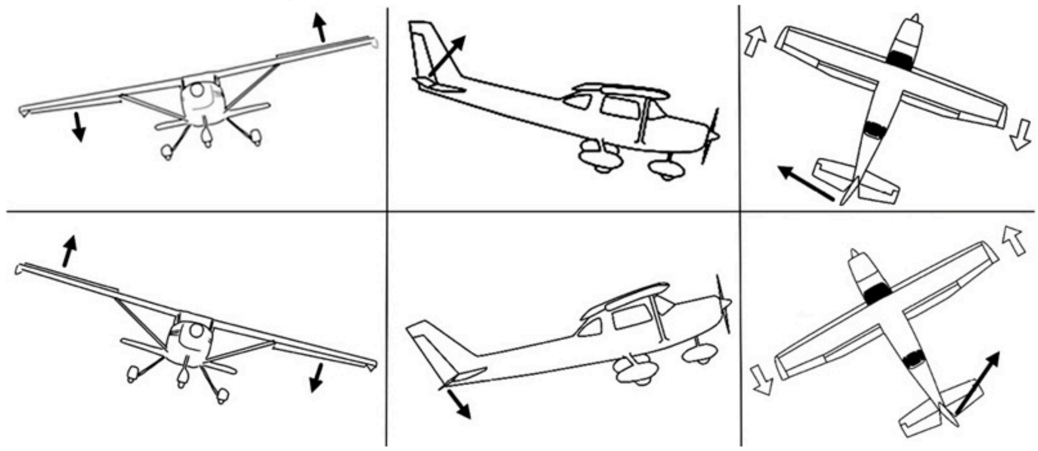
[3] A transmitter that allows reassignment of physical sticks to different channels gives more freedom of orientation. See page 9.

Direction of servo movment with changes in direction when stabilizer is enabled



The diagram shows how the surfaces should respond to movement of the model about each axis. When the model is rolled sharply to the right, the right aileron should go down and the left aileron up to resist the displacement. Likewise, when the model pitches nose-down, the elevator should go up to compensate. And when it yaws nose-right, the rudder should go left.

Note that the control surfaces will **only** be displaced while the model is being disturbed; as soon as it stops moving, they will return to neutral. So look for quick twitches of the control surfaces in the right directions.

THIS IS VITALLY IMPORTANT:

If stabilization moves the surfaces the wrong way (i.e., to **increase** *the disturbance) your model will be uncontrollable!* To correct, change the appropriate switch J1, J2 or J3.

Just as experienced RC pilots check stick directions before the first flight of the day, so any pilot using a stabilizer should always check that the surfaces move correctly in response to a disturbance.

9. Set dual rates and expo in the transmitter

You should already have the control surfaces set up to move in the correct directions and with the full throws recommended for your model. Now you should adjust the response to transmitter inputs by setting dual rates and expo.

A good starting point for D/R is to set High Rate at 100% and Low Rate at 65-75% for each axis.[4] Expo settings of 20-40% soften response around neutral and can make smooth flying easier.

Stabilization settings also affect the response of the model to the transmitter sticks, typically reducing sensitivity. You may want to adjust your rates and expo once you find out how the model reacts with stabilization on.

Note that the dual rate and expo settings don't affect how the stabilization works. That is entirely done within the receiver.

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[4] If using a DX4e or DX5e, the built-in D/R switch gives 100% and 75% rates.

10. Adjust the stabilizer gain pots

Set the three gain pots at about the 10 o'clock position. This is a good conservative starting point that will produce noticeable stabilization. For most models, at least one or two gain settings will need to be increased or decreased during flight testing to achieve optimum stabilization.

11. Prepare for flying

Plug in the motor and/or install the propeller. Check the control directions and stabilization functions one more time. Do a reduced power range test (should give at least 25m range with full control). Check that the Gear switch is operating correctly to turn stabilization ON (green light only) and OFF (green and red lights). Make sure you know which way is ON!

Test failsafe by running the model (well secured) at about half throttle and turning off the transmitter. The motor should stop within a few seconds and the control surfaces should hold their current positions.

Toggle the Gear switch back and forth quickly (within 1 second) to store the neutral positions of the controls.

12. Perform a test flight

Take off with stabilizer turned OFF. Fly around and adjust trim as necessary.

At a safe height use the Gear switch to turn the stabilizer ON. If the model rolls dives or turns suddenly, at least one of the gyro direction switches (J1, J2, J3) is incorrectly set. Switch OFF the stabilizer immediately! Land and fix.

Assuming the model does nothing scary, continue flying to explore the action of the stabilizer. Do a shallow dive to pick up speed and watch for oscillation on one or more axes. If it happens, just throttle back and slow down (oscillation is different from control surface flutter and is generally not destructive).

Notice how the model handles with the stabilizer turned on. It may well be less responsive on one or more axes. Experiment with dual rate settings. Turn stabilization off and back on. Get familiar.

13. Fine tune stabilizer gain

Now make a series of flights to optimize the individual gain settings. This will involve repeated landings to adjust each pot on the receiver, followed by retesting in flight, but the basic job can be done relatively quickly.[5]

A good way to adjust stabilization is as follows:

- Turn Aileron and Elevator pots fully anticlockwise (minimum gain) and set the Rudder pot to 2 o'clock.

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[5] If you have an eight or more channel transmitter you can use Master Gain to help speed up the process of adjusting the individual gains. See page 10.

- Take off with stabilization OFF. Turn ON at a safe height with the model in level flight. Watch for oscillation on the yaw axis ("tail wag"). Do a shallow dive to pick up speed and again watch for oscillation.
- Land and adjust the rudder pot. If there was no oscillation, even when diving, turn the pot up close to full (about 4 o'clock). If there was oscillation, turn the pot down a bit (12 o'clock).
- Take off and retest. You're aiming to set the pot to the maximum gain that doesn't produce oscillation in any normal flying.
- Now turn up the elevator gain pot and repeat the process.
- Finally follow the same procedure to set the aileron gain pot.

Many people find that on typical models the rudder gain can be quite high (or even full) while roll and elevator end up somewhere in the range of 9 o'clock to 2 o'clock, but the settings vary with factors such as model design, flight speed and control setup.

> ***HINT***: It is best to do the initial setup in fairly calm conditions to avoid confusing oscillation with buffeting caused by turbulence. Then test the effectiveness of stabilization by flying in windier weather, turning stabilization on and off. You should see a noticeable improvement in smoothness with stabilization turned on.

A More Detailed Look at the Stabilized Receiver and its Use

What a Rate Stabilizer Does.

A rate-gyro stabilizer compensates for external disturbances on all three flight axes: pitch, roll and yaw. If your plane is disturbed by an external force (such as a thermal or wind gust) then the gyro sends out a "shot" of opposite control on the appropriate axis (using ailerons, elevator or rudder). This will "even out" the flight path and make flying in turbulent conditions much easier.

The 7-channel stabilizer is designed to function with minimum interference to normal control. To achieve this, the amount of correction is automatically reduced for large stick excursions. However, the balance between on-board stabilization and transmitter control is a compromise. There is always some stabilizing effect whenever the stabilizer is active. If you need maximum airborne response to large stick excursions, the stabilizer should be turned off using the Gear switch.

It's important to understand that the current 7-channel Lemon stabilizer, unlike some more costly units, does not contain any accelerometers or other sensors to establish an absolute level or direction. The plane will still only go where you point it! The Lemon stabilizer does not, for example, provide heading hold or the equivalent of the SAFE technology of Spektrum.

If you want a more sophisticated stabilizer with auto leveling and a GPS sensor that enables the plane to return to the launch site automatically, Lemon will have such technology available in future receivers.

Number of Transmitter Channels

The minimum number of transmitted channels required to use the stabilizer with a conventionally configured, electric-powered, three-axis plane is five.

That covers the four flight channels: Throttle (channel 1), Aileron (channel 2), Elevator (channel 3) and Rudder (channel 4); plus Gear (channel 5) to switch the stabilizer on and off in flight.

All full range Spektrum transmitters have at least five controllable channels and thus can be used with the Lemon stabilizer.[6]

With a DX6i or DX6[7], Aux1 (channel 6) can be used to control <u>one</u> of three main possibilities: retracts **OR** flaps **OR** a second aileron servo (as in a flaperon setup).

A DX7 or DX7s enables the use of Aux2 (channel 7), but only when using a v4 receiver (introduced in September 2014, see page 13). This enables any <u>two</u> of the above three possibilities.

A DX8 or higher transmitter enables internal use of Aux3 (channel 8), giving Master Gain control. It does not provide an additional free channel.

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[6] Gear (channel 5) is operated by the ACT/Aux switch on a DX4e and the Ch 5 switch on a DX5e.

[7] Not the old DX6 from 2006 but the new one introduced in 2014.

Note that no amount of transmitter mixing can change the Gear (channel 5) and Aux3 (channel 8) usage by the receiver. These are permanently committed to stabilizer ON/OFF and Master Gain respectively. You can on some transmitters adjust which switches, knobs or sliders actually direct those channels, or you may be able to use mixes from other channels for this purpose, but the channel assignments cannot be altered at the receiver.

It follows from all this that you cannot have all three of dual ailerons **and** independent flaps **and** independent gear on a conventional powered model. There are simply not enough channels available in the receiver.

Lemon do provide Gear (channel 5) output pins on the receiver. But to use that option for flaps or retracts you would have to accept stabilization being turned on and off as the flaps or gear are deployed or retracted. This is generally not very practical.

Practical arrangements for a powered plane, using a seven channel transmitter and v4 receiver, include:

- A single Aileron servo (or two servos on a Y-cable) on Ail (channel 2), with Flaps on Aux1 (channel 6) and Retracts on Aux 2 (channel 7);
- Separate Aileron servos on Ail (channel 2) and Aux1 (channel 6), with Retracts **OR** flaps on Aux 2 (channel 7); this arrangement would allow use of flaperons with retracts.

Binding

The stabilizer is bound just like any other Lemon or DSMX/DSM2 receiver.

Binding is the process of "locking" the receiver to the transmitter so that it ignores any others. Binding is the first step in setting up any receiver and is most easily done on the bench, rather than in the model. Ensure the transmitter and receiver are separated by at least 6ft/2m or the transmitter may "swamp" the receiver. In some cases it may be necessary to have 10ft/3m or more separation to achieve binding.

Generally you should only need to bind once, unless you change transmitters, and, after binding, normal link-up should not require more than a couple of feet of separation.

Step 1. Power up the receiver in bind mode

Put the bind plug on to the Bind/Aux2 pins (see picture on page 1). Connect a suitable power source to any of the receiver servo pins. This can be:

- A receiver pack battery; or
- A stand-alone BEC; or
- The throttle connection from your speed controller (ESC) with built-in BEC.

If using a speed controller as the power source, and it is installed in a model, make sure the motor is unplugged or the propeller is removed for safety.

If you are using a satellite with the stabilizer, then binding must be done with the satellite connected. Binding can be done with or without servos. Servos plugged in the wrong way round may prevent binding, so check this if you have difficulty.

The LEDs on the receiver (and satellite, if used) will flash rapidly to indicate bind mode. If they don't, you have a problem (such as a reversed power connector). Don't go any further until you get rapid flashing.

Step 2. Turn on transmitter in bind mode

On some transmitters entering bind mode requires holding the Bind or Trainer button/switch while powering up. Others require opening a menu to enable bind mode.

If appropriate, continue to hold the switch/button until the receiver LED stops flashing. Release it at that point and the bind process will complete. A solid green or green and red light indicates a successful bind.

Some transmitters will display on-screen (and/or announce) the type of bind (DSMX/DSM2) and the frame rate (22mS for the Lemon)

Step 3. Power down and test

Remove power from the receiver, **remove bind plug**, and switch the transmitter off.

If you didn't use servos while binding, plug one in now to channel 2, 3 or 4. Turn the transmitter back on, and then apply power to the receiver. Check that the receiver is operating properly and that servos respond to the transmitter controls. Check that the Gear switch turns stabilization on (green light only) and off (green and red lights).

Failsafe.

It's important to note that the Lemon stabilizer, unlike other Lemon receivers, does not use preset failsafe. Instead, on loss of signal the servo pulses stop completely. This causes the speed control (ESC) to shut down the motor and leaves all servos where they were when signal was lost. Control is quickly restored when the signal returns.

This is a perfectly satisfactory arrangement for electric powered models such as those for which the Lemon stabilizer is intended. One advantage is that it doesn't rely on the operator to ensure that the throttle is set correctly at bind time.

It does, however, make the unit unsuitable for use in fuel-powered models where the throttle servo must be driven to a safe position (low) on loss of signal.

Note that a few very old ESCs may not shut down when pulses are removed. This unsafe behavior makes them unsuitable for use with the Lemon stabilizer (and most other systems). Be sure to test failsafe for any new setup.

Orientation

The most common arrangement is to mount the stabilizer level and upright, aligned with the centerline of the fuselage, with the connector pins toward the tail. The stabilizer can, however, be flipped 180˚ on any of the 3 axes. A common case is mounting the stabilizer upside down for access from the bottom of the model.

The stabilizer will not work properly if rotated 90˚ on an axis with most transmitters. This means you cannot fasten it to the flat side of a profile aircraft. Nor can you mount it across the fuselage. It has to align with the matching aircraft axes. However if your transmitter has the ability to assign any physical stick to any receiver channel (like the DX9 and Taranis for example), then you can mount the stabilizer with any of its 3 axes aligned with any model axis. Just ensure the internal stabilizer axis, servo connection and control stick all agree.

What the LEDs mean – in more detail

The 7-channel stabilizer has three LEDs: red and green ones near the connectors, and a red one on the back of the PC board inside the case. This single internal LED can normally be ignored as it just mirrors some of the actions of the green LED. There is one exception: when using a transmitter on DSM2 this LED can flash a "brownout warning" to indicate momentary power loss.

Status			Lights		
Transmitter	**Receiver**	**Stabilizer**	**Green LED**	**Red LED**	**Internal LED**
Normal Operation					
OFF	ON	-	✖	✖	✖
ON	ON	ON	✔	✖	✔
ON	ON	OFF	✔	✔	✔
DSM2 only	"Brownout"[8]				Flashing
Binding					
ON or OFF	BIND MODE	-	Rapid Flash	Rapid Flash	Rapid Flash
BIND MODE	BINDING	-	Flashing	Flashing	Slow Flash
BIND MODE	BOUND	ON	✔	✖	✔

Bottom line: A properly bound, active stabilizer will show only a solid green LED.

The red LED will come on when you turn the stabilizer off using the gear channel.

Aerials, Satellites and Range Checking

All Lemon receivers, including the stabilizer, are "full range". This means that they have ample range for all normal visual flying (as opposed to long range FPV flying). In practice, Lemon receivers match, or better, the range of other comparable DSM2/DSMX receivers under the same conditions.

Modern 2.4 GHz receivers work very well indeed but under some conditions the radio link can be interrupted by factors such as nearby metal fencing or conductive objects, like Carbon fiber, within the model. The reliability of the link for a given range is affected by the number of aerials (antennas) and their orientation, as well as by the installation of the receiver in the model.

The base Lemon stabilizer has one aerial wire. For the strongest and most reliable reception, the wire should stick straight out from the stabilizer; an aerial bent along the stabilizer case may significantly reduce reliable range. Likewise, locating the aerial wire very close to motor wiring, the battery or other conductive objects may reduce reliable range.

A satellite enhances reliability by adding signal diversity. It provides a second independent receiver that can be well separated from the main receiver, thus sampling

[8] The brownout warning will be triggered if you turn the receiver off and back on again without also power cycling the transmitter.

a different part of the radio transmission field. The main receiver selects the stronger of its own signal or that of the satellite.

If a satellite is connected, most reliable reception is obtained when its aerial and that of the stabilizer are at right angles. The two satellite aerial wires should be in a straight line. The satellite should be mounted so that it cannot move around in the model.

To verify a new installation or to check radio operation before the first flight of the day, use the range check function on your transmitter. This temporarily attenuates transmitter power so that range is reduced by a factor of about 30. With Spektrum and similar transmitters, full control at “30 paces” (roughly 27yds/25m) with the transmitter in range check mode indicates ample range for normal visual flying.

Master Gain

If the transmitter has 8 channels or more, then Aux3 (channel 8) is used to control the overall Master Gain of the stabilizer system. The Master Gain function multiplies the setting of the individual gain pots by a factor that can range from 0 to 2. In other words, with Master Gain turned full up the gain setting of each individual axis with be roughly doubled. If turned full down, there will be little or no stabilization on any axis, regardless of the setting of the pots.

For Master Gain to be useful it must be controlled by a knob or slider on the transmitter.

To check Master Gain:

1) Turn Aux3 fully clockwise.

   The control surfaces should move vigorously when the model is disturbed.

2) Turn Aux3 fully anti-clockwise (i.e., to minimum setting).

   The surfaces should show little or no movement when the model is disturbed.

If nothing much happens either way, check that the individual pots on the receiver are somewhere around middle setting or higher.

If the operation of the knob is reversed, the Aux 3 channel can be changed in the transmitter. Most people intuitively think of clockwise as an increase.

Understanding Master Gain

Think of the three stabilized channels as the three inputs of an audio mixer. The on-board rotary controls or pots (potentiometers) are like the three individual volume controls. The Master Gain is the overall volume control. It modifies the levels of all three channels and turns them up or down together. The individual gain values are all **multiplied** by the value of the Master Gain, controlled by Aux3 (channel 8).

- With the knob in the center (Aux3 = 0%) the gain value is 1 and the individual gain values are unaffected.
- If Aux3 is at -100% (full anticlockwise) then the Master Gain is very low and the individual gains become very small.
- If Aux3 is at +100% (full clockwise) the Master Gain is nearly 2x and the individual gains have almost twice their usual effect.

To turn the stabilizer completely off, the low end of Aux 3 must be set to -150%.

In practice many people initially set Aux3 at 0% so that the Master Gain multiplier is 1x, then, as explained in Basic Instructions, they adjust the individual gains to give good stabilization without any oscillation. Master Gain can greatly help in this process and can subsequently be used to turn the overall gain up or down to suit changing flight conditions.[9]

If your transmitter has 7 channels or less Master gain will default to a value of 0.8. This is a practical compromise erring on the side of safety so that the individual pots have a good range of control but are less likely to induce oscillation if set too high.

Using an Open Source Transmitter (Taranis, 9XR, etc.)

The Lemon stabilized receiver can be used with other transmitters provided they have a DSMX or DSM2 module installed.

Transmitters such as the FrSky Taranis and the Turnigy 9XR and 9XR Pro all use open source firmware that can be easily programmed to emulate the output of a Spektrum transmitter. While the programming steps are slightly different for the various transmitters, the following suggested setup can be applied to any of them:

- Channels 1-4 as a simple four channel model with channel order TAER
- Channel 5 to give +/- 100% in response to a suitable two-position switch.
- Channel 6 for dual aileron, flap or gear, as required.
- Channel 7 for flap or gear, as required.
- Channel 8 to provide +/- 100% on a knob or slider

Set limits of 80% on all channels to match Spektrum pulse width standards.

Reverse channel 2 (aileron) and channel 4 (rudder) to match Spektrum.

This will give you a transmitter that works very much like a DX8 and that will provide a good basis for setting up the stabilizer according to the Basic Instructions earlier.

[9] For many planes it's not all that critical. With an 8 channel or higher transmitter some people just set the pots to about 2 o'clock (60%) on all 3 axes (sometimes even 100% on rudder) and don't bother with much tuning. With Master Gain, they can turn it up for slow flight and maximum correction and down for fast flight to avoid oscillation. More effective stabilization can be achieved, however, if the channels are tuned individually.

Versions of the Lemon Stabilized Receiver

Four variants of the stabilizer have been produced to date:

V1 was only briefly available, had a different circuit board, and was withdrawn.

V2 lacks a plastic case. On/Off is controlled by Aux1 (channel 6). J6 can disable Master Gain.

V3 has a plastic case, as shown in the picture on page 1. On/off is controlled by the Gear switch (channel 5) and Master Gain is available on Aux3 (channel 8). Access to Aux2 (channel 7) is available on the bind pins, but only when the receiver is in non-stabilized mode. J6 (labeled "Flaperon") enables stabilization on a second aileron servo plugged into Aux1.

V4 is identical to V3 in appearance and function, except that it provides access to Aux2 (channel 7) on the bind pins in stabilized and non-stabilized modes. It can be recognized by a double flash of the red and green LEDs at power up.

Notes on servos

The Lemon stab does not have any specialized requirements for which servos you can use with it. However experience from users confirms the following:

1. Some servos may exhibit slight "chatter" when driven by a stabilizer, even when the stabilizer is absolutely at rest. This is true also of many digital servos when driven by normal receiver outputs and is not regarded as a problem.
2. If a servo shows drift or significant intermittent movements with no stick input, then it is likely the sensing resistor and wiper in the servo are worn. Stabilizers put much heavier demands on servos than normal receivers as they are constantly issuing small corrective movements. The servo resistor tracks will tend to wear out around the neutral point.
3. High-speed and digital servos will perform better than standard servos or analog servos in demanding applications as the corrections are applied more quickly. Gains can thus be set higher.
4. Ball bearing servos are likely to cope better with the constant movement. Metal gear servos will wear more quickly. The only advantage they have is greater strength.

Batteries and BECs

A stabilized system puts heavier demands on your power source than a standard receiver because the servos tend to be in constant motion correcting flight deviations. Accordingly a receiver battery pack that is just adequate for a non-stabilized system may drop voltage significantly, or in the case of a BEC shut down completely, when a stabilizer is added. Brown outs are more likely with a stabilized receiver.

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