With their pioneering Heading Lock, Yaw Rate Demand and Gyro Flight Mode concepts CSM revolutionised the tail rotor gyro. The Micro SL310 is a dual mode heading lock/conventional gyro, particularly suited to those flying their first RC helicopter, whether it is an electric or small conventional model.

Like other CSM gyros, your Micro SL310 gyro incorporates advanced features not found in other makes of gyro. Please read this manual fully before installing and flying.
See Appendix A for the philosophy behind the design of Heading Lock gyros.

We want you to enjoy the full potential of this product. If you are unsure about any aspect ot its installation or use please contact us at: tech@csm-ltd.co.uk or Tel (+44) 1457 854680

Micro SL310 key features:-

- NEW! **Even smaller, ultra lightweight, single box design.**
- **Smart Lock -** Enhanced Heading Lock mode that gives even better lock & stop.
- **Gyro Flight Modes** (as pioneered by CSM)
- **Selectable Digital/Super Servo support -** gives optimum update rate for Super & Digital servos.
- **Quick-setup -** makes it simple to set gyro sense, servo type & servo travel from your transmitter.
- **Quick-trim -** accurately corrects linkage set-up.
- **Yaw Rate Demand -** with rudder rates & throws it gives you total control of stick sensitivity.
- Outstanding customer support & repair service.

How to use this manual
Part 1 covers the instructions for the initial installation and adjustment of the SL310. It assumes that the helicopter is correctly assembled and adjusted ready for the gyro, the servo operating sense is correct, and that the user is familiar with model helicopters and is a competent pilot. If you are a beginner, or unsure about the necessary mechanical setup, you should also look at Part 2, especially sections E and F.

See Part 2, Section A for the philosophy behind the design of Heading Lock gyros.

CONTENTS

System Requirements

Model

The SL310 is recommended for 30 or 50 size IC helicopters and small electric helis such as the T-Rex.

Radio

The wiring of this gyro is compatible with JR, Futaba, Hi-Tec, Graupner, Robbe and the current style (blue plug) Sanwa/Airtronics radio systems. To use this unit with other makes of radio please check with the service centre in your country or e-mail the CSM service centre (tech@csm-ltd.co.uk). Most systems of 7 channels and more have the facilities needed.

Servo

Optimum performance can be obtained from the SL310 by using a high speed Super Servo or Digital Servo (0.1 seconds/60 degrees or less) for the tail. We particularly recommend high speed servos for small electric helicopters. However, the SL310 is designed to be usable with slower and/or non-digital servos. For further information, see Part 2, Section C.

Before installing the gyro

Before installing the gyro, please enter the menus of your transmitter and set up the rudder and gain channels as follows:

- Centre rudder trims and (if fitted) rudder sub trim.
- Ensure that the rudder dual rates are set to 100% (this is the default value)
- Set the gain channel travel adjustment to 60% (both ways)
- Ensure that Automatic Tail Stabilisation (ATS) or 'REVO' mixing is INHIBITED.
- Ensure that pilot authority mixing is INHIBITED.
- Put the throttle hold switch to the OFF position.

Now check that the Tail Servo Operating Sense is set correctly. **Incorrect servo operating sense will cause an uncontrollable pirouette on take-off!** Look at the tail rotor from above, and hold on a left tail rotor command. The leading (fatter) edges of the tail blades should point right. This will swing the tail to the right and turn the nose left. When turning right, the leading edges should point left.
If the tail blades move in the wrong direction, change the servo reversing of the tail rotor channel in your transmitter, then check again. **Please note**: it is vital to have the tail blades fitted the right way around! If you have only just assembled your helicopter, ask a more experienced modeller to check it over.

If you are unsure about any aspect of the helicopter or radio setup, please refer to Part 2, especially sections E and F. Particular care should be taken with the pushrod and servo arm lengths, as these affect the behaviour of the tail.

Installation

Mounting the gyro

The gyro may be mounted lengthways (longitudinally) or across (transversely) within the model. However, it must be mounted flat on its base (as shown) so that its axis of rotation is parallel to the main shaft of the helicopter. You will need to see the LEDs, so mount the gyro where these can readily be seen.
It is important to avoid vibration and shock to any gyro, as vibration can cause precession drift (see Section H). Choose a site which has low levels of vibration from the main rotor. Many plastic radio trays are too flexible and better performance can often be gained by mounting the gyro at the rear of the frames. To protect the gyro from vibration and shock, use one of the double sided adhesive foam squares provided. If used in a high vibration environment better performance will be obtained by using the anti-vibration mounting system available as a CSM spare. Do not use any other type of mounting foam as this will reduce the performance of your gyro. For good adhesion, ensure that the surface is smooth, hard and clean.
Vibration can be transmitted to the gyro along wires. Leave about 50mm of unanchored wire before you attach the wire to the helicopter frame. Where possible bring the wires around in an arc and anchor them to the frame alongside the gyro mount.

Connecting the gyro

Please note that if the supplied 300mm cables are too short or too long for your gyro location, alternative cables between 100mm and 500mm long are available from your CSM stockist.

- Ensure the radio is off.

• Using one of the supplied cables connect the rudder channel from the receiver to the "RUD" input of the gyro
• Using the other supplied cable connect the gyro gain channel from the receiver to the "GAIN" input of the gyro.
• Connect the tail servo to the "SERVO" output on the gyro.
• Power up, and wait until the "SET" LED comes on (approximately 5 seconds).
• Move the rudder stick and check that the servo swings both ways. If it swings the same way for left and right stick movements you have the rudder and gain inputs of the gyro the wrong way around. Connect rudder and gain inputs correctly and repeat this test .

The rudder channel is Channel 4 on Futaba, and labelled 'Rudd' on JR. For the gyro gain use Channel 5 or 7 on Futaba, and 'Gear', 'Aux2' or Aux3' on JR. If you are using any other make of transmitter, please consult your radio manual. More information on using the SL310 with specific radios can be found in Section G.

Mode Switching
The gyro has two modes: Mode 0 (standard) and Mode 1 (Smart Lock). You can switch between these two modes in flight, using the gain switch. To identify which switch position gives which mode, watch the way the servo reacts in each mode. Hold the rudder stick at full travel for two seconds and release to centre. If the servo returns close to mid position the gyro is in Standard mode (mode 0). If the servo stays at or near full travel, the gyro is in Smart Lock mode (mode 1). Another way of testing it is to pick up the helicopter and slowly turn it around. In Mode 0, the servo should remain in the middle whenever the helicopter is stationary, whereas in Mode 1 it will gradually move over to its limit in less than a quarter turn. **Note which switch position gives which mode.**

The Quick-Setup routine.

The unique Quick-Setup facility in CSM SmartLock gyros allows the important parameters (Rudder stick centre, Gyro sense, Servo type and Travel limits) to be set up quickly and simply from the transmitter. It will also set the rudder trim to an accuracy much finer than one click of trim, and picks up on the servo pulse width used by your transmitter. The set-up should not need to be repeated unless you wish to change any of these parameters. **Please note**: if you repeat Quick-Setup at any time, it will wipe any Quick-Trim settings (see the next section), so you may need to repeat Quick-Trim.

Remember:
- All forms of mixing to the tail rotor channel (i.e. ATS, REVO, Pilot Authority, or throttle to tail rotor mixing) must be inhibited.
- The trim and sub trim of the tail rotor channel must be centred.
- The tail rotor servo operating sense must be correctly set in the transmitter. **Failure to do this will cause an uncontrollable pirouette!**

Entering Quick-Setup

1. Turn on the transmitter, and allow it to settle for a few seconds
2. Turn on the receiver and toggle the gain switch back and forth a couple of times. This must be done during the gyro's boot-up time (the first few seconds after the receiver is switched on). **Do not** touch the rudder stick or move the helicopter! Please note that on the Sanwa RD6000/8000, the Flight Mode 1 switch should act as the gain switch (see Part 2 Section G)
3. The gyro will make the servo zip back and forth a couple of times to confirm that it has entered Quick-Setup.

The gyro may not enter Quick-Setup if low gain values (less than 35%) are set. If this occurs, increase the gain values - they can be lowered again later.

1. Gyro sense reversing

The first item to be set is the gyro sense.
1. Check that the "REV" LED turns on and off as the rudder stick is moved fully left and right. If it does not, then you are not in Quick-Setup.
2. Push the rudder stick to the left and release it back to the middle. This will set the gyro sense to match your system. The servo will travel over to allow the user to check that left tail command is indeed being given.
3. Toggle the gain switch once (i.e. into Mode 1 and back to Mode 0) to save the gyro sense. The gyro will 'zip' the servo back and forth in acknowledgement and then park the servo in the middle.

2. Digital/Super servo support

Now select digital or conventional tail servo.
1. As you push the stick left and right, the "DS" LED turns on and off. Move the stick to select digital/super servo on or off as required: LED **on** for Digital/Super servo, LED **off** for conventional servo.
2. Release the stick to the middle and toggle the gain switch. This will be acknowledged as before by zipping the servo back and forth. **Please note:** DS should never be switched on when using a conventional servo, as the servo may be damaged.

3. Servo travel limits

The servo now travels over to the first travel limit and this can now be adjusted.
1. Hold the stick over in the direction of the servo deflection to increase the limit or hold it over against the deflection to reduce the limit. The servo will move slowly as you change the limit, so it can be set very accurately.
2. When the correct limit has been found, enter this value by toggling the gain switch. Once again an acknowledging 'zip' is given.
3. The servo now travels to the opposite limit. Repeat the same procedure.

The Quick-Setup routine is complete. A double acknowledgement is given to show this, then the servo will centre, and the gyro will halt with no activity. For the set-up changes to

take effect, the gyro must be turned off for about 5 seconds and turned on again. In turn on the gyro takes approximately 5 seconds to re-boot. If you have made any mistakes in the Quick-Setup, toggle the gain switch during this boot-up time. Otherwise, do not touch the sticks, switches or helicopter in this time.

Preparing to Fly

We suggest that you reduce the rudder travel adjustments (rudder ATV) in your transmitter to 80% for the first few flights until you get used to the response of the gyro system. If you run a very high head speed, or if your tail servo is slower than 0.12sec/60 degrees, you may also wish to reduce the gyro gains (adjusted using the gain channel ATV) to 50% for these initial flights.

Turn-on sequence

1. Turn on your transmitter.
2. With the model stationary on the ground, turn on your receiver.
3. Wait while the gyro goes through its self test/boot up sequence and the Power LED comes on. (Do not move the gain switch until the boot up is complete unless you wish to enter the Quick-Setup routine)
4. Move the rudder stick fully in both directions and ensure that the tail rotor servo responds to stick movements. Your Micro SL310 is now ready for flight.

!! Make sure the model is not moved during the gyro self test period !!

Restart checks

Before flying, check that the tail servo responds properly to rudder inputs and to the helicopter being moved. Do this for both flight modes. It is especially important to check the gyro operating sense. To do this simply set the gyro in mode 1 (Smart Lock mode) and rotate the helicopter 90 degrees to the right (clockwise as viewed from above) then look at the tail blades. These should have their leading edges pointing to the right. If you are in any doubt about this, please ask a more experienced flyer to check it for you.

Before the first flight check that you know which of the gyro mode/gain switch position gives you Heading Lock (Mode 1) and which conventional (Mode 0) operation. Remember never to use ATS/REVO or Pilot Authority Mixing.

Gain and Trim setting

Gain is set using the ATV on the gain channel – see Part 2, Section B for full details. Section G contains advice specific to particular brands of transmitter.

Approximate method (for beginners)

Switch to Mode 1. In Mode 1, the servo should move gradually from centre to full travel if the helicopter is turned slowly. Before starting the helicopter, check the gain as follows: the servo should cover its full range of movement as the helicopter is turned by about 50 degrees. If the servo reaches its full travel in much under 50 degrees, the gyro gain is too high. If it takes much more than 50 degrees, it is too low. Remember, if you have a slower servo, you may wish to have a lower gain (50%). Set the same gain value for Mode 0 as for Mode 1.

Please note: an error in the pushrod length may cause the helicopter to turn its nose out of wind or 'crab' in slow forward flight. See Part 2, Section E on how to adjust the pushrod length.

Gain setting – more confident flyers

Select Flight mode 1 (Smart Lock mode). Start by checking that the servo covers its full range of movement for about 50 degrees change in helicopter heading, as above.

1. Hover the helicopter. Now use short small 'stabs' of rudder control to disturb the helicopter in yaw and observe.
2. If the tail tends to oscillate, slightly reduce the gyro gain.
3. If the tail has no tendency to oscillate, try increasing the gain. You are looking for the highest gain that gives no sign of oscillation when the tail is disturbed by sudden changes in tail command.
4. The same technique can be used to adjust the gain for mode 0, but **please perform Quick-Trim first.** For now, set the Mode 0 gain to the same value as Mode 1.

Quick-Trim (Mode 0)

Quick-Trim is a facility that simplifies the correction of the tail pushrod length. Ideally, the pushrods should be as close as possible to the correct length, so that there is little error for the Quick-Trim to correct (see Part 2, Section E). As the Quick-Trim requires you to use the switches during the hover, beginners may prefer to adjust the pushrod lengths entirely by hand. **For optimum performance do the Quick-Trim even if you do not wish to fly in mode 0.**

1. Start in Mode 1. Hover nose into a moderate wind or fly in slow forward flight. Activate the Quick-Trim by switching the gyro gain/mode switch on your transmitter back and forth five times between the two gyro modes. Hold each mode for about 1 second. The right timing for this is easily obtained by counting the clicks of the switch out aloud to yourself as you do it. (You will now be in Mode 0)
2. If the tail push-rod length adjustment is reasonably correct the Quick-Trim will now compensate for the remaining error and the model should fly straight in Mode 0. If not, repeat the Quick-Trim sequence.
3. If the Mode 0 trim is still wrong, then the push-rod length is outside the range of the Quick-Trim system and must be adjusted by hand before repeating the Quick-Trim.

Do not try to correct errors with the transmitter trim.

If you make changes (e.g. to the hovering head speed) that may affect the tail trim you should repeat the Quick-Trim procedure. You should also repeat it if you have entered Quick-Setup.
You may now adjust the mode 0 gain in the same way as described for mode 1 above. When both gains have been set, check both modes for tail wagging in fast forward flight. Should this be observed, you should lower the gyro gain slightly in that mode.

Your SL310 Micro is now set up and ready to fly!

DOs and DON'Ts

DOs:

Do mount the gyro with its axis of rotation parallel to the helicopter main shaft
Do mount the gyro on the foam pad
Do mount the gyro to a hard, smooth, clean surface
Do use the rudder ATV and rates to tailor required stick response
Do check the sense of the gyro operation **before flight**
Do use a battery state monitor and check it before each flight
Do remove slop and stiffness from tail control linkage
Do inspect tail gears etc. for wear
Do explore the performance limits of this gyro with care

DON'Ts:

Don't subject the gyro to mechanical shock
Don't mount the gyro where it will be subjected to high vibration levels
Don't use Pilot Authority Mixing
Don't use Automatic Tail Stabilisation (ATS) or Throttle-Tail mixing
Don't use unnecessarily long servo extension leads with the gyro
Don't move the model during gyro self-test time

Trouble shooting

Gyro will not go into Quick-Setup routine.
Ensure ATS (REVO) mixing is off & rudder trim centred. Increase the gyro gain for both Mode 0 and Mode 1 to 100% and retry. You can return the gains to their desired values after completion.

Model pirouettes violently as soon as it starts to lift off.
The gyro sense has been set incorrectly. Repeat the rudder control sense checks and the Quick-Setup routine

Model tail wags from side to side in the hover.
Reduce the gyro gain (using the gain channel travel adjustment)

Model flies OK in one gyro mode but wags when switched to the other mode.
You have too much gain in just the one mode. Reduce the gain channel travel adjustment for the mode that wags.

Tail response is not crisp.
Too little gyro gain. Gradually increase travel adjustment of the gain channel until tail shows some tendency to wag and then reduce it back until wag just stops.

Model wags even when the gain is very low.
Possible causes are slop or friction in pitch linkage, tail hub bearings locking up under load, a very slow servo, or a short servo arm with excessive servo travel.

Model hovers steadily in Mode 1 but starts to rotate when switched to Mode 0.
Repeat Quick-Trim procedure (see **Quick-Trim** section of this manual for details).

Model slowly rotates in Mode 1.
Carry out the Quick-Setup procedure so that the gyro samples accurate stick value.

Even in calm conditions the model suffers continuous small movements of the tail. It may also appear to drift.
Check the model for vibration. The SL310 micro is not recommended for the larger, gasser models. However, the gyro can be protected from vibration by a double thickness of mounting foam, or CSM's Vibration Isolating Mounting System (available from your model shop)

Model flies OK on first few flights of the day but tail starts to wag on later flights.
Servo consumption with fast gyros is high, and falling battery voltage reduces servo performance making the tail system less stable. Cycle receiver battery and check its capacity. Also consider using a fast Delta-peak charger to top up battery between flights.

Model was OK last season but after the winter in store the tail now wags.
Check the tail control linkage for free movement. Pay special attention to the pitch slider and the tail hub bearings. Receiver battery may have developed a high internal resistance. Cycle the battery and check its capacity. It may show a normal capacity at low discharge rates, but a much reduced capacity when measured at say 3 amps discharge rate indicating a high internal resistance.

The left and right hand stops are not equal. Stops from right hand turns are slow but clean while left hand stops are bouncy, (or vice versa)
The mechanical tail trim needs setting correctly. Carry out the procedure in the **Quick-Trim** section of this manual and re-assess. If the problem exists after the trim has been set

correctly try reducing one servo travel as follows: if bouncy when stopping left turns reduce the right pitch travel limit and vice versa.

The model suffers violent erratic twitches in yaw.
With belt-driven tails static electrical charges can build up on the tail boom, etc. and discharge via the tail servo to the RC system. In severe cases this can damage the RC components. Use an anti-static spray such as Servisol on the belt. You could also use a grounding system – your model shop or helicopter supplier may be able to advise you.

PART 2

Section A: Smart Lock Dual Mode gyros

To get the best from this gyro system it is useful to understand how Heading Lock and Smart Lock gyros differ from Conventional gyros such as the ICG180.

In a conventional gyro, the pilot applies a rudder command which is transmitted through the gyro to the servo. As the helicopter responds to the command the gyro detects the movement and opposes the pilot's command, reducing the servo deflection. The yaw rate achieved in such a system depends on the 'gain' of the gyro. Since the gyro is 'fighting' the pilot, higher gyro gain means a lower maximum yaw rate can be achieved. It is often necessary to reduce the gyro gain to get the required yaw rate for some manoeuvres.

Your CSM Smart Lock gyro employs a 'Yaw Rate Demand' philosophy. The rudder command from the pilot is interpreted as a request to the gyro to establish the desired yaw rate. The gyro drives the tail rotor servo as much as is needed to obtain this yaw rate. This means that the Micro SL310 makes full yaw rate available even at high gain settings.

Mode 0 (Standard Mode)
This mode gives flying characteristics that are similar to conventional gyro systems. However, unlike conventional gyros, this mode operates a Yaw Rate Demand scheme making high yaw rates available at high gain levels. It is best for basic forward flight and circuits, and for those who are used to Conventional gyros.
Mode 1 (Smart Lock Mode)
This mode gives Heading Lock with Yaw Rate Demand. It provides a much higher resistance to unwanted yawing movements than can be obtained with a conventional gyro system. This is ideal for hovering, especially for beginners, since you can almost ignore the tail rotor control, whereas in Standard mode the helicopter tends to turn into the wind. You can also set the tail trim without taking off. You should get used to using Heading Lock, as it is the best mode for 3D.

Behaviour on the ground
For those used to conventional gyro systems, the behaviour of the Micro SL310 on the ground may seem unusual. In Standard Mode (Mode 0), it is quite normal for the gyro to provide full tail rotor servo movement for rudder commands that are as little as 30% of the full stick movement. This is a consequence of the Yaw Rate Demand feature, and is

why the Micro SL310 gives such a crisp response. In Smart Lock Mode (Mode 1) you will find that even very small movements of the rudder stick will set the servo moving slowly and may, over the course of a few seconds, reach full travel. This apparently strange behaviour only happens because the helicopter is on the ground. Since the helicopter is not responding, the gyro continues to increase the servo command in an attempt to get the helicopter to obey. In flight the helicopter will, of course, respond to the tail servo movements and the system will act normally.

Section B: Mode switching, Gain and Response

The Micro SL310 has two flight modes (Standard and SmartLock) which can be selected in flight using the transmitter gyro gain switch (or Auxiliary channel switch). The gain in each mode is set from your transmitter, using the travel adjustment ('Travel Volume' or ATV) settings for the two switch positions of the gain channel. Increasing the ATV of the gyro gain channel increases the gain for that mode. **Please note**: A rotary knob or slider is not recommended as it is not possible to accurately and repeatedly set the gain with these. It is not possible to use the Micro SL310 with basic radio systems that lack a suitable channel for controlling the gyro gain.

How it works

The graph shows the way in which the gyro gain channel provides both mode switching and independent gain adjustment of the two modes. If the gyro gain channel pulse is longer than the centre value the gyro is in Mode 0 while with the gain channel pulse shorter than the centre value the gyro is in Mode 1. The centre pulse value is set at the factory at 1.51ms. However the Quick-Setup routine will adjust the gyro centre value to accurately match that of your particular radio system. This accommodates the different pulse length standards adopted by different radio system manufacturers.
The travel adjustment (or ATV) settings for the two switch positions of the gain channel provide a convenient way of adjusting (from the transmitter) the gain for the two modes. Increasing the ATV of the gyro gain channel increases the gain for that mode. **Please note**: if you are using a JR PCM10S/SX radio with Code 44 enabled, the gain values will be displayed differently - please see section G.

The Gyro gain channel acts as both gyro mode switch and gain control

With this system you can use the rudder travel adjustments ('Travel Volume', 'ATV') and rudder rates facilities to set up the desired full-stick yaw rate and the gyro gain switch now becomes a 'Flight Mode Switch' for the gyro. There is no need for so called Pilot Authority Mixing - indeed you should not use pilot authority mixing with this gyro
It is important to realise that with this system the limits to the servo travel are set by the gyro and not by the transmitter's travel adjustment of the rudder channel. The servo travel limits imposed by the gyro are set during the Quick-Setup sequence as described later in this manual.

Adjusting the stick response

After initial setting, use the rudder ATV, Rates, and Exponential facilities of the transmitter to tailor the control response as required. Be aware that the Micro SL310 makes high rates of yaw available (at all gain settings). If an increase in available yaw rate is required, this is done using the Rudder travel adjustment. (Increasing the rudder travel adjustment will not increase the overall tail servo throw – please adjust servo limits using Quick-Setup)
The Micro SL310 has built-in exponential. This reduces control sensitivity around the mid-stick position. Remember that the ATV and rates facilities work together so that setting the rudder ATV to 80% in both directions and also setting a rudder rate of 60% will give a total rudder throw of 0.8 x 0.6 = 0.48 = 48%

Section C: Servos

Standard servos

With "DS" support turned off, the Micro SL310 will work with any servo in the Futaba, JR and Sanwa ranges (and many other makes) but, as with any gyro system, a fast tail servo with a speed of 0.12 sec/60 deg. or better is to be preferred.

Digital/Super servos

Digital/Super servos are capable of running at high data frame rates (250 frames/second or more). Examples of this type of servo are Sanwa ERG-WRX, Airtronics 94758, JR 8700G and Futaba S9254. The use of such servos with the SL310 is highly recommended as they allow the gyro to fully exploit its fast response. When used with this type of servo the "DS" support of the SL310 should be activated. This is done during the Quick-Setup routine.

Warning: Use of the Digital/Super servo facility with servos not designed to accept the high frame rate will result in damage to the servo and may cause malfunction in flight.

The Quick-Setup routine runs the servo in standard mode so it is always possible to access this routine with a standard servo even when the gyro has DS Servo support on.

Section D: Batteries, power consumption and wiring

Although the power consumption of the gyro unit itself is very modest, a Solid State gyro system will be faster than a slower, mechanical gyro system, and will therefore work the tail rotor servo harder. The battery drain from the tail rotor servo can be high, especially when a high performance servo is being used. We recommend that you use a good quality battery state monitor and check it carefully before each flight.
Your receiver battery is a vital part of your tail rotor system. Remember that a battery in a low state of charge or an old battery that has developed a high internal resistance will adversely affect servo performance, especially its acceleration, and may even cause the tail to wag on an otherwise well set up helicopter. You may wish to consider maintaining the charge in your receiver battery between flights by the use of a quality Delta Peak type field charger. In installing the gyro also bear in mind that voltage losses down long servo extension leads will also detract from servo performance. Where the installation requires

extensions to be used (either between the receiver and gyro or between the gyro and the servo) avoid using ones that are unnecessarily long. Gyro input leads in a range of lengths from 100mm to 500mm are available from CSM stockists.
If you are using LiPo batteries, remember that these can catch fire or explode if overcharged or over-discharged. JG LiPo guards and LiPo balancers are available from CSM - see our website or ask your local shop for details.

Humidity
Under conditions of extremely high humidity it is possible for condensation to form on the sensor. This can adversely affect gyro performance. If you cannot avoid flying in high humidity conditions, it is best to leave the model standing for a few minutes with the radio switched on so that the internal heating of the gyro helps disperse the condensation. Always protect the gyro from ingress of water (e.g. rain).

Section E: Preparing the helicopter mechanics

While you have the helicopter on the bench to install the gyro is a good time to check the condition of tail drive gears, belts, pulleys etc. Inspect them regularly to ensure that they are in good condition. To get the best from your SL310 Micro, pay particular attention to the tail control linkage. You should aim for an easy-moving but slop-free linkage between the tail servo and the tail blades. Inspect the bearings/thrust races in the tail hub for smoothness of operation. Check the pitch slider and ball links for slop and replace if needed. Some helicopters that have noticeable 'give' in the tail linkage may benefit from the addition of a rear-mounted tail servo and rigid pushrod.

It is a common misconception that the higher the electronic gyro gain is, the better the system will work. Whilst this is generally true, the electronic gain is only one part of the tail rotor system. Of equal importance is the amount of tail pitch range available, and the tail rotor disk size. The disk size is also related to the tail rotor speed. Of course there are other influences on the tail system but these are the most important and can be grouped together as **mechanical gain**.

Because the detailed mechanics differ from machine to machine, this is a general guide to obtaining an acceptable initial mechanical setup of the tail linkage. This should be done with the **tail servo connected directly to the rudder channel** of the receiver (i.e. before the gyro is installed, or bypassing the gyro) so that the amount of servo travel in each direction can be assessed quickly from stick deflections and ATV settings. Optimising the linkage can be an iterative process with several adjustments to servo arm length and pushrod length needed to home in on the optimum adjustment.

Servo Arm Length
You should fit a long servo arm to the tail servo. The gyro performs best when it is able to make very quick changes of the tail rotor pitch in response to pilot commands, turbulence, engine power changes etc. In general, the longer the servo arm used the smaller the servo movements need to be to achieve a given pitch change. On 30 or 50 size IC powered

models arms of between 17 and 22mm will provide good results. With small electric helicopters much smaller arms are of course appropriate.

1. Connect the receiver directly to the rudder servo, and set rudder travel adjustment (ATV) to 90%. Most transmitters have separate adjustments for left and right movements and you should make sure you have set the travel adjustment for both directions. At this stage (i.e. before the gyro has been installed) we are using this value to help establish the right servo arm length. Once the gyro has been installed the rudder ATV is used to set the yaw rate demand.
2. Watch the tail rotor linkage while moving the rudder stick slowly fully left and fully right. If the linkage does not approach either extreme of the pitch linkage travel then increase the servo arm length. Conversely, if the linkage binds at one extreme or the other then slightly reduce the servo arm length.
3. Re-check the mid-stick pitch set-up and repeat this test. You are looking to achieve a servo arm length that gives full pitch linkage movement but avoids the linkage binding or the servo stalling. The rule of thumb is to ensure that about 90 degrees of servo travel (+-45 degrees) covers the full available pitch range of the tail.

Many helicopters have pitch systems that do not give equal throw about the hover pitch value. The Micro SL310 has independent servo throw adjustments for left and right which will accommodate this - fine tuning of the servo throw is done in the Quick-Setup routine.

Note: As the servo travel limits are programmed in the Quick-Setup routine, increasing the rudder travel adjustment will **not** increase the servo throw. The rudder travel adjustment is used instead to adjust the rotation rate. To adjust the servo travel limits, please use Quick-Setup.

Servo arm position

Ensure that with the servo centred the arm is at right angles to the pushrod.

Pushrod length

The SL310 Micro's Quick-Trim facility should compensate for any errors in pushrod length. However, if you have repeated the Quick-Trim several times without the Mode 0 trim being corrected you will need to adjust the pushrod length to reduce the trim error to within the range of the Quick-Trim. Beginners who are not yet confident enough to perform the Quick-Trim should also follow these instructions.

1. Start by looking at the tail from above. With the servo centred, the tail rotor blades should be at about 8 degrees of right pitch (or 8 degrees of left pitch for a machine with an anticlockwise rotor head). The following diagram will help you to judge 8 degrees of pitch. The angle between the two blades is twice the pitch - 16 degrees - and this may be easier to judge.
2. If the angle is greater or smaller than 8 degrees, adjust the pushrod length until it is right. This will almost invariably get the linkage very close to the correct trim in Mode 0. Any residual trim error should be small enough to be accommodated by the gyro's Quick-Trim facility.
3. For the greatest accuracy, test-fly the machine. In Mode 0, observe the direction of the yaw. If the yaw is to the left then you will need to adjust the pushrod length to increase

the right tail pitch. Whether you need to increase or reduce the length of the pushrod to achieve this depends on your particular model. Conversely, if the yaw is to the right adjust the pushrod for more left pitch. As a rule of thumb lengthen or shorten the pushrod by about 1/6th of the servo arm length (e.g. with an 18mm servo arm lengthen or shorten the pushrod by about 3mm). This should nearly always bring the pushrod length within the range of the Quick-Trim. Note that the amount of yaw may change slightly in flight, due to the changing weight of the helicopter as the fuel is burned, so it is not possible to get a perfect pushrod length in all circumstances.
4. When the pushrod length is correct, **repeat Quick-Setup** to establish the new travel limits, then fly the model to carry out the Quick-Trim.

Tail pitch range
In our experience it is almost impossible to have too great a pitch range. It is usually limited by the range of movement available at the tail pitch slider. It is recommended that you have about 40 to 45 degrees of right pitch and 30 to 35 degrees of left pitch available (reverse these figures for anticlockwise rotor head models). Substantially lower ranges will limit stop performance and holding power.

Section F: Checking your radio set-up

If you are unsure as to whether you have your transmitter correctly set up for the gyro, please carry out these checks.

Rudder channel check
1. Plug the rudder servo directly into the rudder output of the receiver, bypassing the gyro
2. Turn on the radio. Open and close the throttle - if the rudder servo moves, then the ATS/REVO is still active. **You will need to inhibit it before continuing.** Make sure it is inhibited in all your transmitter's idle-up states.

Mid-stick trim
You should not use stick trim to correct yawing in the hover. Centre the rudder stick and trim: the servo arm should be at right-angles to the pushrod and the pitch of the tail blades should be about 8 degrees. See Section E to correct any errors.

Gain channel checks
1. Plug the rudder servo directly into the channel on the receiver you are going to use for the gyro gain/mode control. This allows us to check for correct gain channel operation.
2. Operate the gyro gain switch and observe the servo movement. If there is no movement, check that you have correctly identified the gain channel and the gain switch.
3. Now move the rudder stick over its full range and observe the servo. The servo should not move. If it moves then Pilot Authority Mixing is still active. **Disable it** and repeat this test.

Section G: Information on popular radio types.

CSM gyros are designed to accept a wide range of radio system parameters (frame rate, servo pulse timings etc.) however it is not possible to provide information as to channel usage and radio set-up details for all manufacturers' equipment. The information below

covers some popular systems. If you wish to use this gyro with other types of radio system please consult your radio manual. In case of difficulty please contact your radio manufacturer or the CSM technical department (Email: tech@csm-ltd.co.uk) for advice.

Connecting the gyro

Connect the gyro to your receiver as indicated in the following table:
For other brands of radio, please consult your transmitter manual.
Connect the "SERVO" output to the tail rotor servo.

JR PCM10S/SX

Set-up with 'code 44' disabled:

On these radios it is easier to disable the JR 'code 44' (gyro sense adjust) and control the gyro gain by a switch. In this case the gain for the two gyro modes is adjusted by the two travel adjustment values for the gyro channel. Initial values of 60% should be used.

Set-up with 'code 44' enabled:

If you wish the gyro to switch automatically between mode 0 and mode 1 as the Flight Mode (Idle Up) switch is operated you will need to enable the JR 'code 44' gyro sensing facility.

When using 'code 44' you should remember that the SL310 gain control works from the centre of the channel outwards. As a consequence, an LCD value of 50% (the channel centre) is in reality zero gain (the switchover point between the two gyro modes). Increasing the value above 50% will increase the gain in one flight mode while the other mode is adjusted by decreasing the value below 50%. Be aware that the value for this mode will be reversed, so that an LCD value of 25% will actually be a higher gain value than a LCD value of 30%. Note: if the gyro is adjusted through the JR gyro software, the gyro channel travel adjustments should be set to equal values each way. Initially set them to 100% and only increase them if you run out of gain adjustment with the code 44 parameters. The starting point should be with the code 44 parameters set to 10% and 90%.

JR X388S/X3810/X8103

On these radios it is easier to control the gyro gain through the gear channel as it is not always possible to have control over other channels on a 2 position switch. **Note**: if so desired it is possible to set the gyro up using the JR gyro software on the 3810/8103, see the PCM10 instructions above.

Futaba 9ZHP/ZAP

This transmitter gives independent gyro gain values for each of the idle up states (& throttle hold) and for both gyro modes (i.e. eight gain values in all). If you use different head speeds in each idle up state you should optimise the gyro gain separately in each idle up state. However initially all the flight conditions should have the same gyro configuration. To check all the flight conditions you will need to go into the various menus mentioned below and turn throttle hold on and off and then try each of the idle up positions in order to see the status for all the conditions (see your ZAP/ZHP manual for more detail).

1. First ensure that in all flight modes the gyro sense mode is set to INHIBIT. To do this go to the "GYR" entry of the "helicopter condition" menu and for each flight condition press the INH key to select the INHIBIT state. Then press END to exit the gyro sense menu.
2. Now check under the "PMX" entry that no throttle to rudder or rudder to gyro mixing is active in any of the flight conditions.
3. Then check in the "P->R" entry that pitch to rudder mixing is inhibited.
4. Now enter the "ATV" menu. Press "RUD" to select the Rudder channel and for all flight modes make RATE A and RATE B equal to 90%. Then press "GYR" to select the Gyro menu and set RATE A and RATE B to 60% for all flight modes. Press END to exit the ATV menu.
5. Now press "MDL" to enter the "model menu". Use the "FNC" entry to allocate the gyro control to a switch of your choice.
6. Finally use the "SRV" menu to check that the gyro gain behaves as required in all flight modes and both gyro modes.

Sanwa RD6000/8000
This particular radio demands a slightly different set-up than normal, although you can use it with the CSM SL310. There are no spare switchable channels on the RD6000, so to change gyro mode you will have to use one of the flight mode switches. There are three flight modes: Normal, Flight Mode 1 and Flight Mode 2.
Flight Mode 2 is usually used for Throttle Hold (see the transmitter instruction manual), so this leaves the Flight Mode 1 switch available for gyro mode switching, the gyro channel will also be used. The SL310 gyro is plugged into the rudder channel and the auxiliary lead from the gyro is plugged into the gyro channel in the receiver (Channel 5). The gyro can be set (for example) to operate in Standard Mode (Mode 0) with a gain of +70% when in Normal Flight Mode, and then in Smart Lock Mode (Mode 1) with a gain of -70% when in Flight mode 1. The SL310 Quick-Setup routine can be entered by toggling the Flight Mode 1 switch a couple of times to enter this mode.
Depending on whether or not you have a driven tail during autos will determine what value you will need to use in Flight Mode 2 which will be Throttle Hold Mode.
You should experiment with settings until you are satisfied. The rotation or pirouette rate will still be controlled by the use of EPA** on the rudder channel, and should be set to about 60% initially for both left and right throws. This can be increased after flight testing if you require a quicker rotation rate.
** EPA =End Point Adjustment. See the RD6000 instructions for details.

Section H: Curing neutral errors
If when hovering in Mode 1 (Smart Lock) the helicopter yaws by more than a few degrees/minute with the stick in the middle the following possible causes should be investigated.

1. A slight movement of the helicopter during boot up (the time between turn on and the SET LED coming on). Turn the system off again and reboot without moving the model.

2. Quick-Setup has not been performed, or the rudder stick and trim were not centralised at the entry to Quick-Setup. Perform Quick-Setup again, with the stick and trim centred.
3. Vibration induced precession - an effect that occurs with gyro sensors when vibrated about all three axes.

To see how this comes about imagine a helicopter that does the following movements:

pitch 90 degrees nose down (not seen by gyro)
roll 90 degrees right (not seen by gyro)
pitch 90 degrees nose up (not seen by gyro)
yaw 90 degrees left (seen by gyro)

So - the helicopter is pointing in the direction it started from but the gyro sensor has only seen the 90 degrees left rotation, and responds to this. This extreme case makes the effect obvious, but vibration motions in pitch roll and yaw will cause the sensor to see a rotation that we outside the helicopter don't see. The gyro Heading Lock will yaw the helicopter in response causing the apparent drift. Vibration at engine or main rotor frequencies can cause this effect. The levels present in model helicopters generally cause no problems. If you are experiencing this and have investigated possible sources of excessive vibration you should consider re-siting the gyro. (See the installation section of this manual).

Spares available:

CSM0029	Mounting foams (6)
CSM0032	Pair 100mm leads
CSM0033	Pair 200mm leads
CSM0034	Pair 300mm leads
CSM0035	Pair 400mm leads
CSM0036	Pair 500mm leads
CSM0070	Anti-vibration mounting system

Remember, CSM has a range of gyros to take you from beginner to championship level. For more information on our gyros, engine governors and other products, see www.rcmodels.org/csm

Ratings
Weight: 12g

Dimensions : 24mm square x 20mm high

Supply voltage range: 4.1v to 7.2v**

** Warning: Check your RC system voltage limits as these may be more restrictive.

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