

## **Like other CSM gyros, your Micro SL420 gyro incorporates advanced features not found in other makes of gyro. Please read this manual fully before installing and flying.**

With their pioneering Heading Lock, Yaw Rate Demand and Gyro Flight Mode concepts CSM revolutionised the tail rotor gyro. The SL420 range uses **all new sensor and processor technology** to extend gyro performance still further.

### **Micro SL420 key features:-**

- **NEW! Even smaller, ultra lightweight, single box design.**
- **NEW! 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.
- **NEW! Quick-trim** - accurately corrects linkage set-up.
- **Built-in Exponential** - gives a smooth, progressive stick response.
- **Yaw Rate Demand** - with rudder rates & throws it gives you total control of stick sensitivity.
- **Command conditioning** - removes stick bounce & improves performance with PPM (FM) receivers.
- **Acceleration Gain** - gives automatic, dynamically adjusting gain tracking.
- **High Resolution pulse measurement and generation systems.**
- **Two stage power supply regulation.**
- **Outstanding customer support & repair service.**

### **Radio System requirements**

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](mailto:tech@csm-ltd.co.uk)) The gyro requires an auxiliary channel with travel adjustments to control the gyro mode/gain. It cannot be used with basic RC systems that lack such a channel. We recommend that you use an RC system that also provides travel adjustment on the rudder channel. Most current production computer RC transmitters have these facilities.

### **Servo choice**

#### **Servo speed**

Optimum performance from the Micro SL420 is obtained when it is used in conjunction with a high speed Super Servo or Digital Servo (0.1 seconds/60 degrees or less). Use with slower servos will significantly reduce gyro performance.

#### **'DS' Support**

Digital/super servos are capable of running at high data frame rates (250 frames/second or more). Examples of this type of servo are JR 8700G, Futaba FP-S9253, Sanwa ERG-WRX and Airtronics 94758. The use of such servos with the Micro SL420 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 Micro SL420 should be activated. This can be done during the Quick-setup routine (but may also be accessed via the PC interface if desired).

**Warning: Use of the DS 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 support on.

#### **Standard Servos**

With "DS" support off the Micro SL420 will work with any servo in the Futaba, JR, Sanwa and Airtronics ranges (and many other makes) but as with any gyro system a fast servo with a speed of 0.12 sec/60 deg. or better is to be preferred.

### **Batteries, power consumption and wiring**

Although the power consumption of the gyro unit itself is very modest, as with all high performance Solid State gyro systems the speed of the gyro response will work the tail rotor servo harder than slower mechanical gyro systems. Especially where a high performance servo is being used the battery drain from the tail rotor servo can be high. **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.

## The Micro SL420 philosophy

To get the best from this gyro system it is useful to understand how the SL420 range differs from conventional gyros.

### Conventional gyro systems

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 and reduces the servo deflection. The yaw rate achieved in such a system depends on the 'gain' of the gyro. The more gain the gyro has the lower the yaw rate that can be achieved. It is common with such systems to have to reduce the gyro gain to achieve the required yaw rate for some manoeuvres (this being accomplished with the gyro gain switch).

### The Micro SL420 system

The Micro SL420 employs a 'Yaw Rate Demand' philosophy making it a true yaw rate gyro. In this system 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 needed to obtain this yaw rate. This means that the SL420 makes full yaw rate available even at high gain settings. 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.

### Behaviour on the ground

For those used to conventional gyro systems the behaviour of the SL420 on the ground may seem unusual.

Unlike conventional systems, it is quite normal for the SL420 in Standard mode (mode 0) 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 SL420 gives such a crisp response.

With the helicopter on the ground and the SL420 set 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 is caused by the stationary helicopter not responding to the heading corrections requested by the gyro. In the absence of a response from the helicopter 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. In order to minimise these movements the trim of the rudder stick needs to be very accurately set. To do this the SL420, during its Quick-setup routine, samples the mid-stick signal to an accuracy much finer than one click of trim. This feature also accommodates the variations in servo pulse standards adopted by RC manufacturers.

### Flight Modes

The SL420 has two flight modes selectable by the transmitter gyro gain switch (or Auxiliary channel switch). **Note:** A rotary knob or slider is **not** recommended as it is not possible to accurately and repeatedly set the gain with these.

#### 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.

#### Mode 1 (Smart Lock Mode)

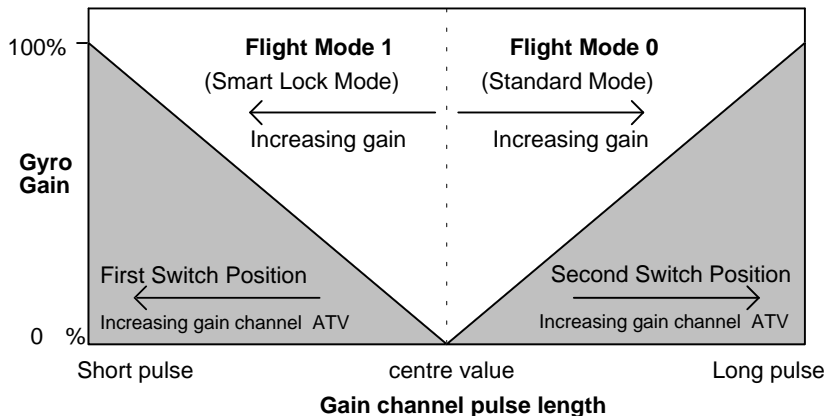
This mode gives both Yaw Rate Demand and Heading Lock. It provides a much higher resistance to unwanted yawing movements than can be obtained with a conventional gyro system. This mode has great advantages in the following situations:

- 1) For the beginner, where this mode makes it possible for him/her to almost ignore the tail rotor control in the initial hovering phase, which is made even easier as this mode allows the tail trim to be set before the helicopter leaves the ground. (see 'Trim Adjustment')
- 2) For cross-wind hovering manoeuvres where the natural tendency of the helicopter to weathercock into wind needs to be resisted.

3) For backwards flight manoeuvres and general "3D" flying.

The Standard mode may be employed for basic forward flight where the natural tendency of the helicopter to weathercock can be helpful, especially to the less experienced pilot.

The graph (Figure 1) 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 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 that it is not possible to use the Micro SL420 with basic radio systems that lack a suitable channel for controlling the gyro gain.



**Figure 1.** The Gyro gain channel acts as both gyro mode switch and gain control

### Gain channel operation

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.

## Installation

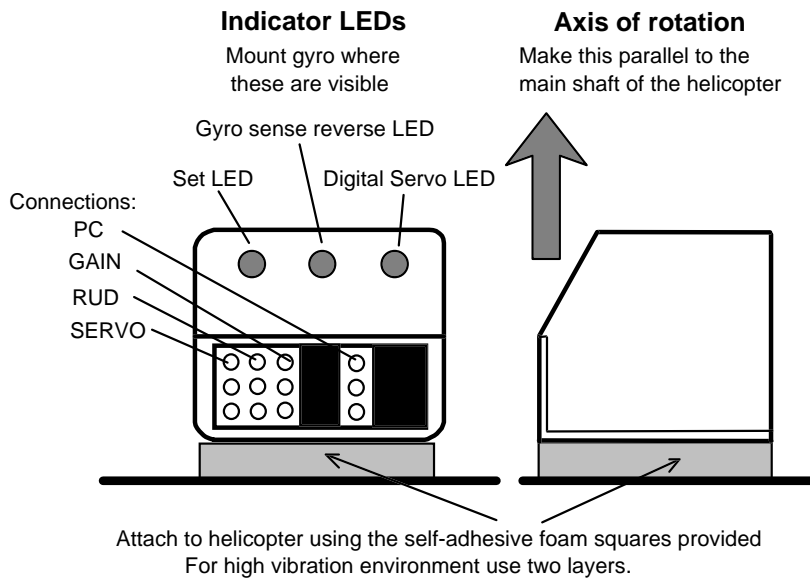
### Preparing the helicopter mechanics

Attention to the tail control linkage is important to get the best from this gyro. 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. You should also fit a long servo arm (between 15 & 20mm) to the tail servo.

Remember that during aerobatic manoeuvres the combination of a high performance gyro and a fast tail servo can place very high loads on the tail rotor drive train. 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.

### Mounting the gyro

The gyro may be mounted lengthways (longitudinally) or across (transversely) within the model however it should have its axis of rotation parallel to the main shaft of the helicopter. For setting up you will need to see the LEDs so mount the gyro where these can easily be seen.



**Figure 2.** Gyro orientation

To provide vibration and shock resistance it is important that the gyro be mounted to the airframe using one of the double sided adhesive foam squares provided. Do not use any other type of mounting foam as this will reduce the performance of your gyro. Replacement squares are available as a CSM spare. For good adhesion, ensure that the surface to which the gyro is attached is smooth, hard and clean. As with all high performance solid state gyro systems, the SL420 performs best if sited at a point of low vibration in the helicopter airframe. Where possible avoid siting the gyro at the extreme front of the radio tray for example as this area is often subject to high levels of main rotor generated vibration. Also many plastic radio trays are too flexible and better performance can often be gained by mounting the gyro at the rear of the frames. Do not use cable ties to hold the wiring together for at least 75mm from the gyro case to reduce vibration being transmitted to the gyro along the wires.

## Radio and tail linkage adjustment

In our experience most problems with gyro systems arise from incorrect radio set-up, incorrect servo arm length, or poor adjustment of the tail control linkage. The following sequence is designed to avoid these snags and ensure a fault-free installation first time. You may need to consult your radio control system manual in order to identify the receiver channels for the rudder and gain inputs to the gyro, however we have included information for some commonly used systems later in this manual.

### Radio Set-up

First 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.
- 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.
- Ensure that the rudder rates are set to the default value of 100%.
- 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.

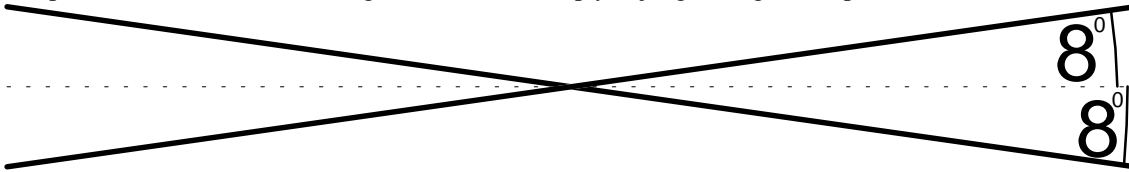
### Rudder channel checks

- At this point you should plug rudder servo directly into rudder output of receiver.

- Turn on the radio and open and close the throttle. The rudder servo should not move as the throttle is operated. If it does, then ATS or REVO mixing is still active. **You will need to inhibit it before proceeding** further. Make sure it is inhibited in all your transmitters idle-up states.

### Mid stick trim

- With the rudder stick and trim centred make sure that servo arm is at right angles to tail push rod.
- Now adjust push rod length until the pitch of the tail blades is about 8 degrees with the rudder stick centred. This will correspond approximately to the pitch of the tail in the hover and ensures that the servo will be close to its mid position in the hover. The diagram below will help you judge 8 degrees of pitch.



### Servo arm length

- 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. 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. Many helicopters have pitch systems that do not give equal throw about the hover pitch value. The SL420 has independent servo throw adjustments for left and right which will accommodate this and fine tuning of the servo throw is done later (in the Quick-setup routine).

### Rudder control sense

- Now we must establish that the sense of the transmitter rudder control is correct (i.e. that the application of a right rudder command causes a change in tail pitch that will rotate the model to the right). **Failure to do this will cause an uncontrollable pirouette on take-off. Beginners who are in any doubt on this aspect of the set-up should seek advice.** To work out which way the tail rotor will go just remember the leading edge (front) of the tail blades will point in the direction that the tail rotor will go, so for a left stick command you want the tail blades to point to the right (tail swings to the right and the nose goes left). It is vital for this test that you have the tail blades fitted the right way around!

### Gain channel checks

- 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).
- 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 its switch.
- Now move the rudder stick over its full range and observe the servo. If it moves then pilot authority mixing is still active. Disable it and repeat this test.

### Connecting the gyro

- It is now time to connect the gyro into the system. Power down the radio and connect the servo to the gyro's output and connect the gyro's rudder and gain inputs to the correct receiver channels.
- Power up, and wait until the 'Set' LED comes on (approximately 5 seconds).
- Move the rudder stick and check that 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 transposed. Connect rudder and gain inputs correctly and repeat this test .
- We must now identify which gain switch position gives mode 0 and which gives mode 1. The flight modes can be identified by the different way the servo reacts in the two modes. For both gain switch positions 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), while if the servo stays at or near full travel the gyro is in Smart Lock mode (mode 1). For future reference note which switch position corresponds to which mode.

You should now have your gyro installed and have your radio and tail linkage set up correctly and may now proceed with the Quick-setup routine as described below.

## The Quick-setup routine.

The unique Quick-setup facility of the SL420 allows the important parameters Rudder stick centre, Gyro sense, Servo type and Travel limits to be quickly and simply set up from the transmitter. The set-up is stored in the gyro's non-volatile memory so the routine will only need repeating if one of these parameters needs to be changed.

### Before entering the Quick-setup routine it is important that:-

- All forms of mixing to the tail rotor channel (i.e. Automatic Tail Stabilisation, or throttle to tail rotor mixing) are inhibited.
- The trim and sub trim of the tail rotor channel are centred.
- The tail rotor servo operating sense has been correctly set in the transmitter. **Failure to do this will cause an uncontrollable pirouette on take-off. Beginners who are in any doubt on this aspect of the set-up should seek advice.** The correct operating sense can be established by looking at the tail rotor blades. With a left tail rotor command held on, the leading edge of the tail blades are pointing to the right (see Figure 3)

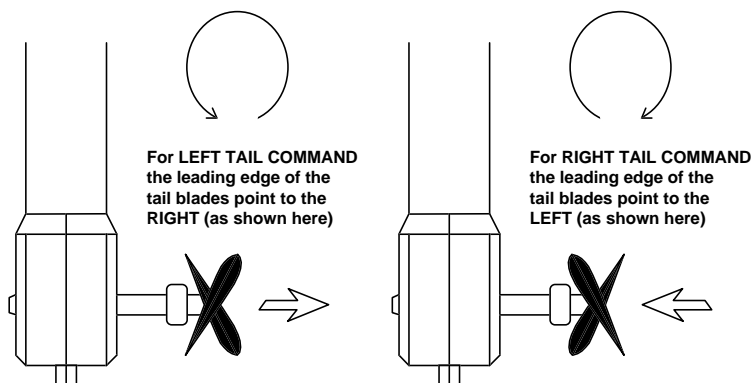


Figure 3 Getting tail servo operating sense right.

If the tail blades move in the wrong direction the condition of the servo reversing of the tail rotor channel should be changed and the movement of the tail blades re-checked.

## Performing the Quick-setup

To access the Quick-setup you toggle the gain switch a couple of times during the gyro boot-up time (this is the first few seconds after the radio system is switched on). The gyro acknowledges this by zipping the servo back and forth a couple of times before parking it in the mid position. The gyro also samples the mid-stick pulse width at this time so you need to have the rudder trim set to centre before entering the Quick-setup. **Make sure you do not touch the rudder stick at this time.** For maximum accuracy, turn on the transmitter and allow a few seconds for it to settle before turning on the receiver and starting the Quick-setup. If low gain values (less than 35%) are set the gyro may not enter the Quick-setup.

### Gyro sense reversing

The first item to be set is the gyro sense reversing. Check that the "REV" LED turns on and off as the rudder stick is moved fully left and right. Now, **if the servo operating sense has been set correctly** as described previously, **simply 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 and once this has been checked **the gyro sense is 'entered' by toggling the gain switch once** (i.e. into mode 0 and back to mode 1) The gyro will 'zip' the servo back and forth in acknowledgement and again park the servo in the middle.

### Digital/Super servo support

Now set the DS support. By pushing the stick left and right you will observe the "DS" LED turns on and off. Just select digital/super servo on or off as required (LED ON = DIGITAL/SUPER SERVO ACTIVE). Having done so, release the stick to the middle and enter the DS condition by toggling the gain switch. This will be acknowledged as before by zipping the servo back and forth.

### Servo travel limits

Following the acknowledgement the servo travels over to the first travel limit and this can now be adjusted. 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 as you change the limit and with its slow movement it is possible to set the limit very accurately. When the correct limit has been found enter this value by toggling the gain switch. Once again an acknowledging 'zip' is given.

Now the servo travels over to the opposite travel limit. Adjustment and entering is the same as the first limit. Once this limit has been entered the Quick-setup routine is complete. A double acknowledgement is given to show this and the servo will centre, and the gyro will halt with no activity until the power is cycled.

### Restart checks

For the set-up changes to take effect the gyro must be turned off for about 5 seconds and turned on again. At turn on the gyro takes approximately 5 seconds to re-boot. Having re-started the system check the operation of the tail servo for rudder inputs and helicopter movements. Do this for both flight modes. It is 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.

### Quick-trim reset

The Quick-trim value is zeroed when the gyro enters the Quick-setup routine. This allows you to assess the error in the tail linkage adjustment during the Quick-trim procedure.

## 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.

Connect the gyro to your receiver as indicated in the following table:-

Radio Type	Gyro "RUD IN" connect to	Gyro "GAIN" connect to
J . R	"Rudd"	"Gear", "Aux2" or "Aux3"
Futaba	Channel 4	Channel 5 or Channel 7

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 SL420 gain control works from the centre of the channel outwards. As a consequence a Tx display 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 this value will be reversed so that a Tx display value of 25% will actually be a higher gain value than a Tx display 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). 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. Now check under the "PMX" entry that no throttle to rudder or rudder to gyro mixing is active in any of the flight conditions. Then check in the "P->R" entry that pitch to rudder mixing is inhibited. 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.

Now press "MDL" to enter the "model menu". Use the "FNC" entry to allocate the gyro control to a switch of your choice. Finally use the "SRV" menu to check that the gyro gain behaves as required in all flight modes and both gyro modes.

### **Sanwa RD6000**

This particular radio demands a slightly different set-up than normal although it may be used with the Micro SL420.

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. There is no switch either for throttle hold and this function is usually achieved by using Flight Mode 2 (see the transmitter instruction manual). This leaves the flight mode 1 switch available for gyro mode switching, the gyro channel will also be used. The SL420 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 way in which it will operate will be as follows: the gyro can be set for example to operate in conventional mode when in Normal Flight Mode with a gain of +70%, and then in Smart Lock Mode with a gain of -70% when in Flight mode 1. 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. The SL420 Quick-setup routine can still be utilised by toggling the Flight Mode 1 switch a couple of times to enter this mode.

\*\* EPA =End Point Adjustment. See the RD6000 instructions for details.

### **Flying the gyro**

When competition levels of heading stability are needed we recommend that the receiver of the model is turned on for about 3 minutes immediately before use.

#### **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 Set LED comes on.
4. Move the rudder stick fully in both directions and ensure that the tail rotor servo responds to stick movements. (Do not move the gain switch until the boot up is complete unless you wish to enter the Quick-setup routine)
5. Your Micro SL420 is now ready for flight.

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

#### **Initial flight trials**

We suggest that you **reduce the rudder travel adjustments 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 your tail servo is slower than 0.12sec/60 degrees you may wish to reduce the gyro gains to 50% for these initial tests.

#### **Mode 1 Gain setting**

First select Flight mode 1 (Smart Lock mode) and hover the helicopter. Use short small 'stabs' of rudder control to disturb the helicopter in yaw and observe. If some tendency to oscillate is seen, slightly reduce the gyro gain. Conversely if no tendency to oscillate is seen try increasing the gain. You are looking at this stage for the highest gain that gives no sign of oscillation when the tail is disturbed by sudden changes in tail command.

Once this has been done you may wish to check for tail wagging in fast forward flight. Should this be observed, you should lower the gyro gain slightly.

Once you have adjusted the mode 1 gain to your liking set your transmitter to give the same gain value for Flight mode 0. This value may be refined later but first we need to adjust the mode 0 trim with the Quick-trim procedure.

#### **Quick-trim**

**Note:- Even if you do not wish to fly in mode 0 it is important for optimum performance that you go through the Quick-trim procedure.**

The Quick -trim facility allows the gyro to correct for imperfections in the mechanical adjustment of the tail pitch linkage and does so to a far greater accuracy than can be achieved by push-rod length adjustment. While hovering in calm conditions, switch to Flight mode 0 (Standard mode) and you will probably find that the helicopter will start to

rotate because of slight imperfections in the servo linkage adjustment. **Do not try to correct this with the transmitter trim.** While hovering or in slow forward flight simply switch the gyro mode/gain switch on your transmitter back and forth five times between the two 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. If the adjustment of the tail linkage is within a reasonable range of the correct setting the Quick-trim will now compensate for the residual trim error and the trim state of mode 0 should match that of mode 1. Repeat the Quick-trim sequence several times to allow the gyro to home in on the perfect trim. If, having repeated the Quick-trim several times, you still observe a trim difference between the modes this means that the adjustment of the tail linkage is outside the limits of the Quick-trim system. **Do not move the trim on the transmitter** but observe the direction of the trim error in mode 0 and adjust the tail pushrod length to correct it. If the trim error in mode 0 causes the helicopter to rotate anticlockwise (a leftward trim error) adjust the linkage length to put more right tail pitch on and vice versa. Once the pushrod length has been changed you will need to repeat the Quick-trim routine for the gyro to adjust to the new mechanical set-up.

If you make changes (e.g. to the hovering head speed) that may affect the tail trim you should repeat the Quick-trim procedure. The Quick-trim is zeroed by the Quick-setup routine.

### **Mode 0 Gain setting**

You may now adjust the mode 0 gain in the same way as described for mode 1 above.

### **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. **Beware that the SL420 makes high rates of yaw available (at all gain settings).** If an increase in available yaw rate is required increase the rudder travel on your transmitter **gradually** until the desired response is obtained. Remember that increasing the rudder travel adjustment will not increase the overall tail servo throw as this is set by the gyro's own travel limiters.

The SL420 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  $0.8 \times 0.6 = 0.48 = 48\%$

### **Automatic Tail Stabilisation (ATS)**

This should **not** be used with the SL420 gyro

### **Pilot Authority Mixing**

This should **not** be used with the SL420 gyro.

### **Tail rotor dynamics**

To realise the full benefit of the SL420 it is important to have a basic understanding of the dynamics of the tail rotor system. 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 and 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. If the mechanical gain is not correct, then the gyro will not be able to function to its best ability. For this reason it is important to select the correct size servo arm that will give maximum tail pitch movement without stalling the servo. In most helicopters this will be an arm of between 15 and 20 mm radius. Note: As the servo travel limits are set during the Quick-setup routine, increasing the rudder travel adjustment will not increase the servo throw as this is limited electronically in the gyro. The rudder travel adjustment is used instead to adjust the rotation rate.

### **Tail blade size**

The correct length of tail blade can only be selected by flight testing. There are 2 types of test to ascertain the correct size:

- 1) With the model in the hover at its normal flight rpm, making sure the gyro is in Smart Lock mode, make a rapid vertical climb for 50 to 60 feet: there should be no discernible rotation of the model. If the tail does not maintain its position this is a good indication that the diameter is too small. Note: if the model is over pitched and there is a noticeable drop in rotor rpm during the climbout, then this will invalidate the test as the tail would probably not be able to cope with this situation regardless of the set-up.
- 2) This test is only really necessary for those who wish to do advanced aerobatics/3D flying and should only be carried out those who are confident to do so. With the model at a safe height fly the model sideways, starting slowly and building up speed until it reaches its maximum possible speed:
  - a) If the tail manages to hold its position then the blade length is OK.
  - b) If the tail starts to lag behind, then either more pitch is needed (if the mechanical limits haven't already been reached) or longer tail blades.

c) If the tail swings round suddenly and cannot return to the correct position then the tail rotor is stalling and longer tail blades are needed.

### **Boom supports**

Tests have shown that the use of boom supports significantly increase the rigidity of the tail boom and so allow a higher gyro gain to be used. Generally the longer the boom supports the better they will work. Note: A loose/cracked boom support or a loose/cracked boom support clamp can have a significant effect on the gyro gain. Even a slightly loose boom clamp or support will have a dramatic effect on the amount of gain that can be used. Stand on the skids of the model and try to flex the end of the boom from side to side while holding a finger against the joint to feel any movement.

### **Humidity**

Under conditions of extremely high humidity it is possible for condensation to form on the sensor. This can adversely affect gyro performance. Where it is not possible to avoid subjecting the gyro to such humidity levels it is advisable 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).

### **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 one of the supplied self-adhesive foam strips.
- 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. Return the gains to their desired values after completion.

#### **Model pirouettes violently as soon as it starts to lift off.**

Gyro sense has been set incorrectly. Repeat the rudder control sense checks and the Quick-setup routine to rectify

#### **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: Slop in pitch linkage. Friction in pitch linkage. Tail hub bearings locking up under load. Servo is very slow. Short servo arm with excessive servo travel.

#### **Model slowly rotates in mode 1.**

Carry out the Quick-setup procedure so that the gyro samples an accurate stick centre value.

**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).

**Even in calm conditions model suffers continuous small movements of the tail. May also appear to drift.**

Check model for vibration. Where vibration cannot be reduced (e.g. large gas powered helicopters) try resiting the gyro on double thickness of mounting foam.

**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.**

The mechanical tail trim needs setting correctly. Carry out the procedure in the **Quick-trim** section of this manual and reassess. If the problem exists after the trim has been set correctly use the PC interface to adjust the left and right stop gains to get the stop quality you want. If you still have problems, 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 very high voltage static electrical charges can build up on the tail boom, etc and discharge via the tail servo to the RC system. In severe cases damage to RC components can result. Your helicopter supplier will be able to advise on a suitable grounding scheme to eliminate this problem.

**Ratings**

Weight: 11g

Dimensions : 24mm square x 20mm high  
(excluding cables)

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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