

Like other CSM gyros, your ICG400 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 Flight Mode concepts CSM revolutionised the tail rotor gyro with their ICG360.

This new ICG400 builds on those ideas and extends gyro technology still further with its Heading Lock System+.

ICG400 key features:-

- **Heading Lock** (as pioneered by CSM)
- **Gyro Flight Modes** (as pioneered by CSM)
- **NEW Auto-setup system** allows rudder trim, gyro reversing, and servo travel limits to be set FROM YOUR TRANSMITTER.
- Preset '**Look Ahead**' gain.
- Preset '**Exponential gain**'.
- Preset '**Glitch Limiter**'.
- **Yaw Rate Demand** with preset linear + exponential Demand Curve.
- **NEW Fuzzy logic Drift Compensation.**
- **NEW High Resolution** pulse measurement and generation systems.
- Two stage power supply regulation - ensures gyro is fully functional down to 2.5 volt supply (even if your radio isn't!)

Radio System requirements

The wiring of this gyro is compatible with JR, Futaba, Hi-Tec, Graupner, Robbe and the new style only (Blue Plug) Sanwa/Airtronics radio systems. If you are considering using this unit with other makes of radio please check the feasibility with the service centre in your country, look at our website (<http://www.rcmodels.org/csm>) or e-mail the CSM service centre (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 ICG400 is obtained when it is used in conjunction with a high speed servo (0.12 seconds/60 degrees or better).

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 drops 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.

The ICG400 philosophy

To get the best from this gyro system it is useful to understand how the ICG400 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 ICG400 system

The ICG400 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 ICG400 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 auto-setup sequence as described later in this manual.

Behaviour on the ground

For those used to conventional gyro systems the behaviour of the ICG400 on the ground may seem unusual.

Unlike conventional systems, it is quite normal for the ICG400 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 ICG400 gives such a crisp response.

With the helicopter on the ground and the ICG400 set in Heading Lock mode (mode 1) you will find that even very small movements of the rudder stick or trim will set the servo moving slowly and may, over the course of a few seconds, reach full travel. Your transmitter rudder trim will affect the direction and speed of this movement. 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 ICG400, during its auto-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 ICG400 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, but it also incorporates an auto trim that compensates for small inaccuracies in the mechanical adjustment of the tail linkage, variations in engine performance, etc.

Mode 1 (Heading Lock Mode)

This mode 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 ICG400 with basic radio systems that lack a suitable channel for controlling the gyro gain.

Gain channel operation

The centre pulse value is set at the factory at 1.51ms however the Auto-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.

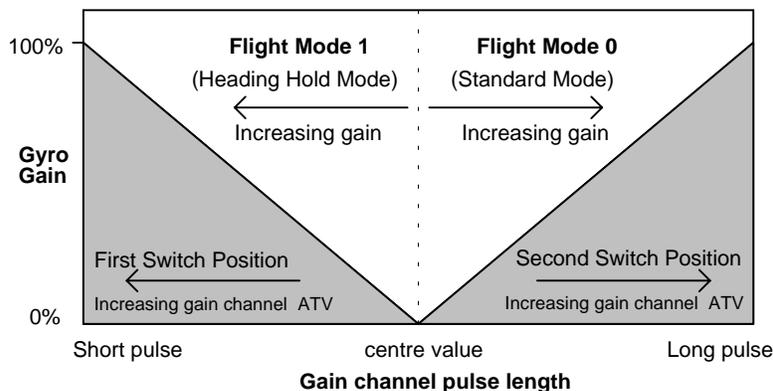


Figure 1. The Gyro gain channel acts as both gyro mode switch and gain control

Installation.

Preparing the helicopter mechanics

Attention to the tail control linkage is important to getting the best from this gyro. You should aim for a 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 rotor gears etc. Inspect them regularly to ensure that they are in good condition.

Mounting the gyro

The gyro may be mounted lengthways, or across, or indeed at any angle within the model so long as its axis of rotation (as marked on the back of the gyro case) is parallel to the main shaft of the helicopter. For setting up you will need to see the LEDs so mount the gyro so that these can readily be seen.

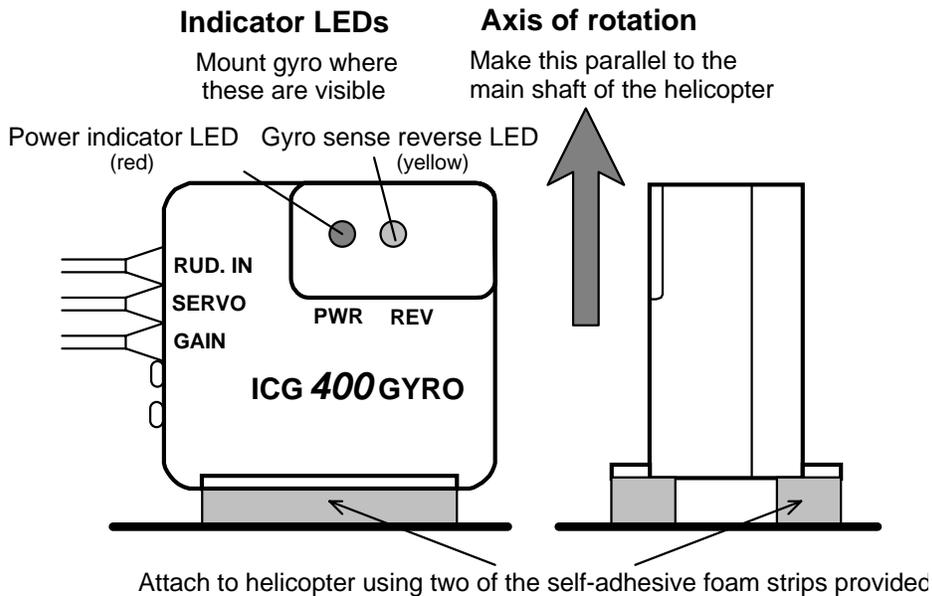


Figure 2. Gyro orientation

The gyro sensor (together with the electronics of the gyro) is anti-vibration mounted inside the gyro case. However, to provide further vibration and shock resistance it is important that the gyro be mounted to the airframe using two of the double sided adhesive foam strips provided. Do not use any other type of mounting foam as this will reduce the performance of your gyro. Replacement strips 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 ICG400 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.

Radio and tail linkage adjustment.

In our experience most problems with gyro systems arise from incorrect radio setup, 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 Setup

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.

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.

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 setup 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 ICG400 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 auto-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 and 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 rudder 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 output and connect the gyro to rudder and gain inputs to the correct receiver channels.
- Power up, observing that the red gyro power LED comes on and wait 5 seconds while the gyro initialises.
- 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 Heading 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 auto-setup routine as described below.

The Auto-setup routine.

The unique auto-setup facility of the ICG400 allows the important parameters Rudder trim, Gyro sense, Servo type and Travel limits to be quickly and simply set up from the transmitter. The setup 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 auto 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 and 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)

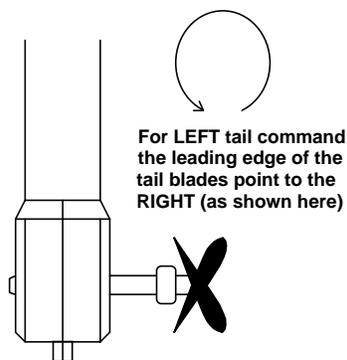


Figure 3 Getting tail servo operating sense right.

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 auto setup

To access the auto 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 powering up). 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 and rudder sub-trim set to centre before entering the auto-setup. **Make sure you do not touch the rudder stick at this time.**

Gyro sense reversing

The first item to be set is the gyro sense reversing. Check that the yellow "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.

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 remaining travel limit. Adjustment and entering is the same as the first limit. Once this limit has been entered the auto 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 setup changes to take effect the gyro must be powered down and powered back up again. On 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 (Heading 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.

Information on popular radio types.

The ICG400 is 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 setup details for all manufacturers' equipment. The information below covers the popular JR, Futaba and Sanwa systems. If you are considering using this gyro with other types of radio system please consult your radio manual. In case of difficulty please contact your radio manufacturer, look at our website (<http://www.rcmodels.org/csm>) or contact 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
JR	"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

Setup 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.

Setup 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 ICG400 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 this value 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

With this transmitter it is important that, initially, all the flight conditions 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. After the auto setup has been done you may wish to return to the ATV menu to set the rudder ATVs to 60% until you are familiar with the gyro's handling characteristics.

Sanwa RD6000

This particular radio demands a slightly different set-up than normal although it may be used with the CSM ICG400. 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 pages 91 and 65.

This leaves the flight mode 1 switch available for gyro mode switching, the gyro channel will also be used. The ICG400 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 Heading Hold 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 (End Point Adjustment, see page 21 of the RD6000 instructions for details), 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 ICG400 Auto set-up routine can still be utilised by toggling the Flight Mode 1 switch a couple of times to enter this mode.

Flying the gyro

Turn-on sequence

1. Turn on your transmitter
2. With the model stationary on the ground turn on your receiver.
3. Wait for about **5 seconds keeping the model still** while the gyro goes through its self test/boot up sequence.
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 auto setup routine.)
5. Your ICG400 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 60% for the first few flights until you get used to the response of the gyro system.**

First select flight mode 1 (Heading 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. Observe any trim offset in the tail and correct this with the transmitter rudder trim.

Now switch to Flight mode 0 (Standard mode) and repeat the exercise above. If the mechanical trim adjustment of the tail linkage is within a reasonable range of the correct setting the auto-trim built into this mode should compensate for the residual trim error and the trim state of mode 0 should match that of mode 1. If however you observe a trim difference between the modes this means that the mechanical trim of the tail is outside the limits of the auto trim system. **Do not move the trim on the transmitter** but observe the direction of the trim error in mode 0 and adjust the mechanical trim of the tail linkage to correct it. If the trim error in mode 0 causes the helicopter to rotate anticlockwise (a leftward trim error) adjust the length of the pitch linkage to put more right tail pitch on and vice versa.

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. Caution should be exercised over the use of the Heading Lock mode in flying circuits or other general flying until you are familiar with the very special handling characteristics that Heading Lock gives.

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 ICG400 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 ICG400 has built-in exponential. You may find the following graph of yaw rate against rudder command useful in deciding on the setting of rudder rates and rudder ATV. 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 $0.8 \times 0.6 = 0.48 = 48\%$

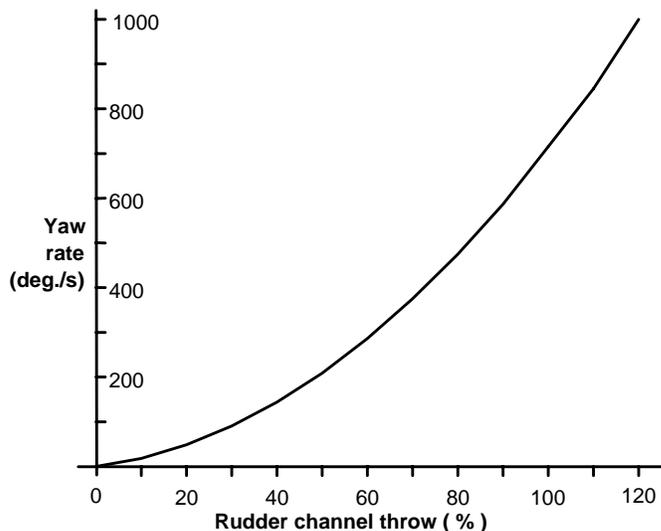


Figure 3. Yaw Rate Demand curve built in to the ICG400.

Automatic Tail Stabilisation (ATS)

This should not be used with the ICG400 gyro

Pilot Authority Mixing

This should **not** be used with the ICG400 gyro.

Tail rotor dynamics

To realise the full benefit of the ICG400 it is important to have a basic understanding of the dynamics of the tail rotor system. It is a common misbelief 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 auto 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 Heading 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 setup.

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.

Maximising Performance for Advanced 3D/Aerobatic Flight - by Bob Johnston

To get the maximum performance from this or any piezo gyro it is essential to minimise the vibration reaching the gyro sensor. Apart from the obvious balance checks, make sure that the canopy, fins, tuned pipe or muffler are not too loosely mounted, especially if the gyro is being used with a fast servo, as it is possible for a resonance to build up which shows as a very fast shake, visible in the canopy and tail.

If you feel confident to do so, try slowly tumbling the model while checking for any visible vibration, a small amount is almost inevitable, but try to dampen any large vibrations present. Alternatively tumble or roll the model at a safe height and if the gyro can be made to wag through the manoeuvre this is a good indication that a component is resonating.

To set the maximum gain permissible for aerobatic flight, either a) fly the model as fast as possible in a straight line and twitch the rudder stick a small amount: if this causes the gyro to wag, lower the gain and repeat the test until the tail cannot be made to wag anymore. Obviously if the model cannot be made to wag initially, keep increasing the gain until it does, and then reduce the gain a few percent. Setting the gyro this way should prove sufficient for all flying except in very windy turbulent conditions where the gain may have to be lowered by a few percent. b) Alternatively, if you feel confident enough in your ability and your models reliability, put the model in a vertical dive for 3 or 4 hundred feet (90 to 120 metres) with the main rotor pitch at zero. Once terminal velocity has been reached, pull the model out in a smooth arc, and if the model does not wag under these conditions it is unlikely to do so under any conditions.

WARNING: Only attempt to carry out these flight tests if you are 100% confident in your own flying ability, and the structural integrity of your equipment.

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 piezo 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 two 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

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 auto 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 one of the gyro flight modes. 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 hovers steadily in mode 1 but starts to rotate when switched to mode 0.

The mechanical tail pitch trim is outside the auto trim range. Adjust the length of the tail push rod to correct this.

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.

Model rotates OK one way but is slow and/or inconsistent the other way.

Too little tail pitch available in the affected direction. Re-set servo travel limits using auto-setup routine.

Ratings

Weight: 40g

Dimensions : 42.5mm High x 26.5mm Wide x 46.5mm Long
(excluding cables and mounting ears)

Supply voltage range: 2.5v to 7.2v**

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

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