HX900

AVCS GYRO

INSTRUCTION MANUAL

Ⅰ. Prologue

The HX900 is a headlock GYRO with AVCS and Fuzzy PID control systems. The GYRO has advanced features such as integrated construction and easy installation.

Higher speed, faster response and improved GYRO sensitivity and performance, require the use of a high-speed digital servo (over 0.1sec/60°).

1. Features

- Tail lock stiffness and turning speed are regulated independently to achieve uniform stability and flexibility
- The removal of the "set switches" and "potentiometers" of common GYRO's improves water-resistance, and dust protection ensuring improved reliability and service life.
- Seven-color LED indication: GYRO working and Set State indicators are shown with LED's.
- Fuzzy PID control system uses a lag method to reduce drift caused by temperature changes.
- AVCS System controls rudder trim changes caused by wind and other meteorological elements. Attitude changes are automatically controlled. Tail (rudder) operations are easy and make it perfect for 3D flight

2. Functions

- Yaw-axis stability control: included are helicopter yaw axis (head rudder) and attitude stability control (GYRO).
- Dual work mode includes two GYRO operation settings: Lock Mode or Normal (Non-lock mode) by adjusting a sensor on the Transmitter.
- Stability adjustment: the GYRO's stability control value can be adapted to different conditions or different environments by adjusting the sensor on the Transmitter.

3. Parameter class

- Servo selection (S-TYPE): Analog (1520uS/70Hz), digital (1520uS/280Hz), or narrowband (760uS/560Hz)
- Anti-twist compensation
- Direction of anti-twist compensation (DIR): Forward / Reverse

- Turning velocity adjustment (SPEED): can be set from 1 to 10
- Control Delay Setting: Can be set from 1 to 10
- Left Limit Trim （LIMIT_L）: 50%~150%
- Right Limit Trim （LIMIT_R）: 50%~150%
- Parameter Restore：Restore to default settings

4. Specifications

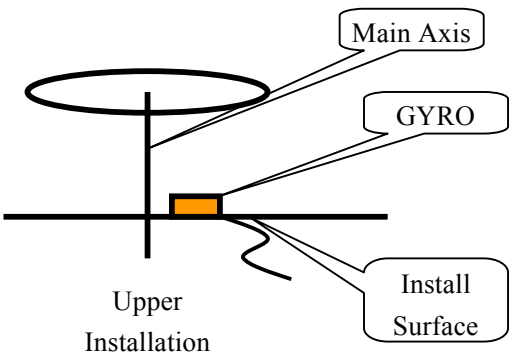
- Operating Voltage：DC 4.0 ~ 6.0V
- Operating Current：5mA @ 5.0V
- Operating Tempreature：-5℃ ~+45℃
- Dimensions：20 × 20 × 11.5 mm
- Weight：4.5g

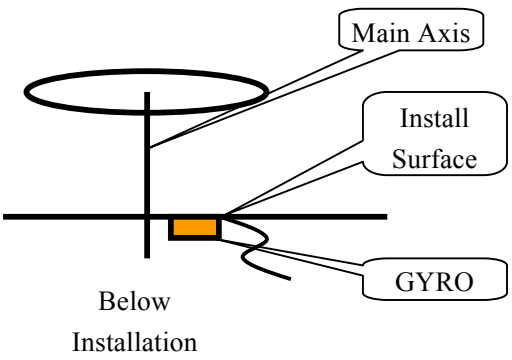
II. Installation

1. Mounting Surface

The Mounting Side（Bottom of the Case）must be perpendicular to the axis (keep 90 degree angle with the main axis of the HELI).

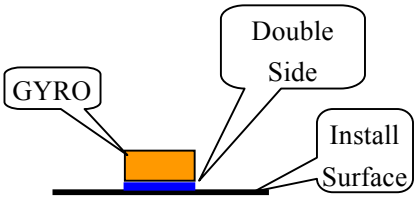
The GYRO can be Mounted either above or below the axis but should be kept 90 degrees with the Axis (as shown).



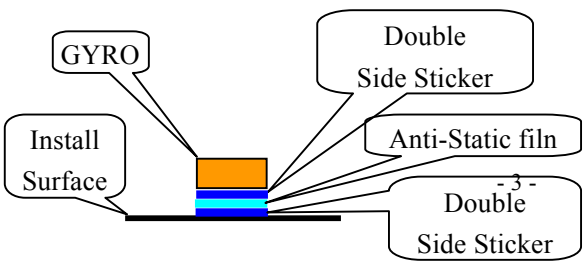


2. Installation

Install the GYRO with Double-Sided Sponge Tape. The Signal Wire should be attached on the Heli with to avoid it swinging and causing the GYRO work incorrectly.



Normal Sticker



Sponge Tape(Anti-Shade,Anti-interference)

3. How to Connect

The GYRO comes with two set cables and three connectors (As shown).

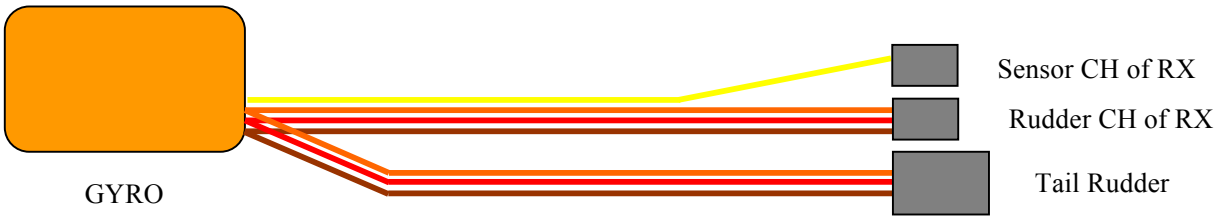
The four-wire cable connects with receiver, The three-wire cable connects with rudder.

A three-wire socket for connecting the tail rudder; a three-wire plug for connecting the rudder channel of receiver ; and a single-wire plug for the sensor channel of receiver are provided.

The four-wire cable uses: Brown as negative, Red as positive, Orange as rudder input, and Yellow as the sensor input

The three-wire cable uses: Brown as negative, Red as Positive, and Orange as the servo signal input

Please check the input polarity carefully before connecting.



III. Transmitter Adjustment

Adjust the following Parameters with the Transmitter to control the Gyro. We have provided a Futaba-6EXHP as example (for certain parameters please refer to the transmitter manual).

EPA-CH4R/L = 100
D/R-CH4 = 100
EXPO-CH4 = 0
TRIM-CH4 = 0
REVR-CH4 = NOR（adjust follow actual direction）
REVO = INH
GYRO = ON
GYRO sensitivity (Lock Mode；SWITH-CH5=UP) to 30，GYRO = 30
GYRO Sensitivity (Non-lock mode SWITH-CH5=DN)35，GYRO = 35

In addition, the throttle curve, pitch curves, power, tail rotor efficiency and flight mode all influence the Gyro's performance, please adjust the throttle curve and pitch curve to the best flight control to make sure Gyro operates at full performance potential when setting the transmitter.

IV. Working Status and LED Indicators

Gyro mode can be divided into normal working status and additionally within a setting status. For the parameter setting status indicator display, please refer to the following "parameter setting".

The Normal working Mode and LED Indicators are described in this section.

There are two working modes under the normal working status: Lock tail mode and non-lock tail mode. Please refer to following table.

Working status	LED Color	Display	Description
Lock mode	RED	Continuously lit	GYRO in lock mode (AVCS) (AVCS)
		Continuous flash	One second after power application the Gyro enters the initialization mode
		Flash one time	For resetting the neutral point of rudder (on Transmitter). To fast switch, toggle the sensitivity button on the transmitter between the non-lock mode and lock mode at least three times, then stop in the lock mode. The light flashes one time to indicate the rudder neutral point has been reset.
		Intermittent flashes twice	In Tail lock mode， receiving this signal indicates tail rudder neutral point and the signal stored in the gyro are different. The following two conditions cause this light: 1. Tail rudder switch set incorrectly. 2. The neutral point of the rudder should be reset
		Continuous slow flash	No rudder signal or sensitivity signal input
Non-Lock Mode	GREEN	Continuously lit	Indicate the GYRO under non-Lock mode (NOR)

V. Parameters Setting

1. Explanation of GYRO Movement

Full Rudder: Full rudder left or right (FUTABA-CH4, the same below) rudder value at 80 ~ 100%;

Half Rudder：Half rudder left or right , rudder value at 20~80%。

Rudder Neutral：Keeps the rudder neutral, rudder value at 0~20%。

2. Indication of the LED Flash time

To get easy observation and counting the flash group indication be adapted in this GYRO. Two times flash is one Group, a middle pause between each flash group. There's only one time flash at the end of the odd time flash flash(such as 1,3,5,7,9 times flash) and also a long pause follow after all 10 flash Group. For Details of flash group please refer to attached table below.

In addition, the rudder travel can indicate the rudder angle when setting the limit left or right (so check the Rudder travel directly, if get limit Left or right the rudder travel in large angle) and meanwhile, the Flash time does not follow the Flash group but the flash speed to indicate the rudder angel that is the low speed flash indicates smaller rudder angel but the quick flash indicates larger rudder angle.

Table : Attached the Flash Group

Flash time	Indication of flash time
1	●————
2	●—●————
3	●—●——●————
4	●—●——●—●————
5	●—●——●—●——●————
6	●—●——●—●——●—●————
7	●—●——●—●——●—●——●————
8	●—●——●—●——●—●——●—●————
9	●—●——●—●——●—●——●—●——●————
10	●—●——●—●——●—●——●—●——●—●————

Remarks：

●：LED Light 0.5s

—：LED dark 0.5s

——：LED dark 1s

————：LED dark 2s

3. Entering and exiting the Setup mode

Entering the setup mode: set the mode switch to Non-lock mode. The LED changes to Green (FUTABA-CH5), then you will have 5 seconds to set the full rudder before the LED changes to Red and the tail rudder returns to nuetral).

To exit the setup mode: Switch to lock mode to exit, this automatically saves the last setup parameter (if the parameter was changed), at that time the indicator LED flashes rapidly about 1 second.

4. Parameter value setting and monitor LED display

NO	Parameter	LED color	Parameter value range	Flash sequence of the LED	Factory Default
1	Servo selection S-TYPE	Red	Available value ： 1~3		1
			1：Analog Servo(1520uS/70Hz)	One time	
			2：Digital Servo(1520uS/280Hz)	twice	
			3：Narrow Band servo (760uS/560Hz)	Three times	
2	Gyro direction selection DIR	Green	Available value ： 1~2		1
			1：Forward	One Time	
			2：Reverse	Twice	
3	Turn Speed SPEED	Blue	Available value ： 1~10		1
			1：Minimum Speed	1 time	
			…	…	
			10：MAX Speed	10 times	
4	Response Delay DELAY	Cyan-Blue	Available value ： 1~10		1
			1：Minimum Delay	1 time	
			…	…	
			10：Max Delay	10 times	
5	Limit Left Rudder LIMIT-L	Orange	Available value ： 50~150		100
			50：Minimum Rudder	Very slow flash	
			…	…	
			150：Max Rudder	Very fast flash	
6	Limit right rudder LIMIT-R	Pink	Available value ： 50~150		100
			50：Minimum Rudder	Very slow flash	
			…	…	
			150:Max Rudder	Fastest flash	
7	Reset to factory default RESET	White	Available value ： 1~2		1
			1：Readiness	Slow flash	
			2：Implementation of Reset	Fast flash	

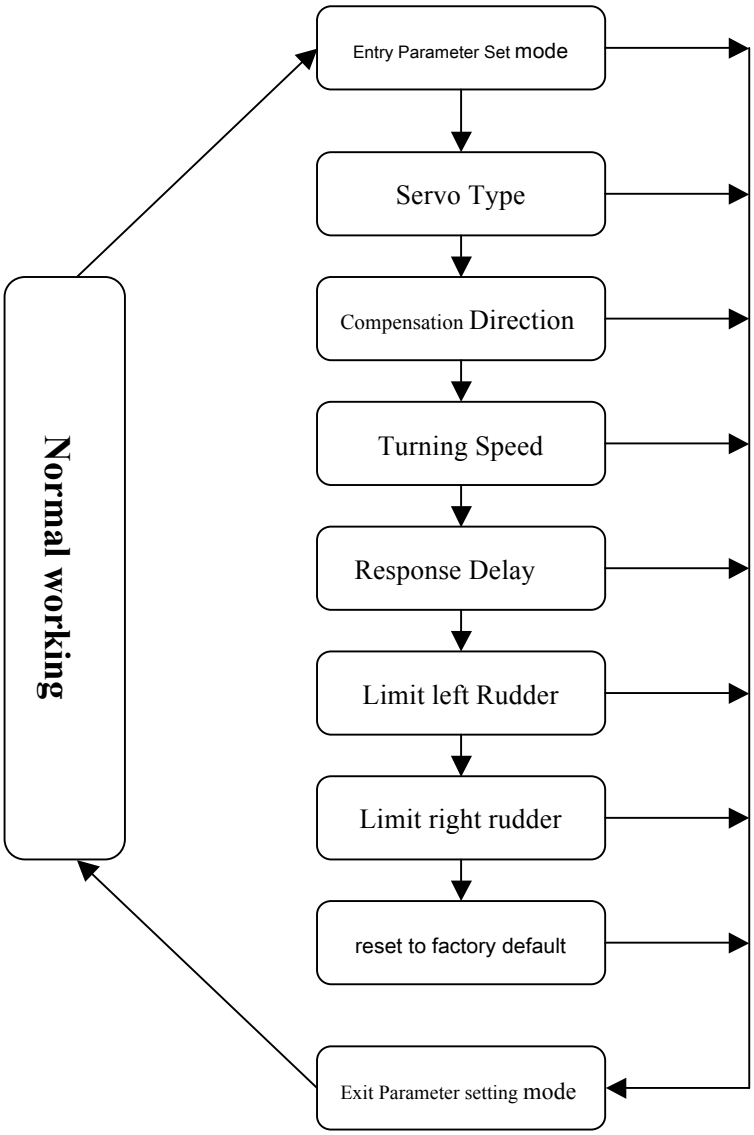
5. The Process of Parameter setting

5.1 Preparation

Before Setting parameters, please be sure that the following conditions are met:

A. Helicopters are completely stationary

B. The throttle lock is turned on to ensure that during the process of parameter setting the helicopter blades will not start rotating by moving throttle stick accidentally.



5.2 Entering parameter setting mode

The gyro is in the normal working status (lock tail mode LED) when the indicator is Red. To enter the setting parameter power off the helicopter and set the sensitivity switch of the transmitter to non-lock tail mode, then the LED indicator will turn green.

Hold full rudder about 5 seconds until the LED will turns to red, when the tail rudder returns back to neutral position this indicates the gyroscope has entered the "set parameter mode" and you can now set the servo type.

5.3 Servo Setting

As mentioned in 4.1, "Servo Setting" is the first step of Setup mode.

If you need to observe or change the parameters, move Rudder to Neutral until the LED turns red

A. At this time, you can observe the LED'S flash time to know the current parameters value.
Flash 1 time indicates servo type is analog servo 1520Us/70Hz (Factory defaults)
Flash 2 times indicates the servo type is digital servo 1520Us/280Hz
Flash 3 times indicates the servo type is a narrow band Servo 760Us/560Hz

B. If you want to change the "Servo Type", just hold "Half-rudder" about 0.3 seconds and the "servo type" parameter will automatically increase or decrease to "1", while the time of light flashes will increase or decrease one time. For example if we hold "left half rudder" then flashes will be increased by 1, then hold the "right half rudder," it will reduce by 1. Specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Go to the next parameter entry "compensation direction" by holding "full rudder" about two seconds until the GYRO indicator light (LED) changes to green, indicating the gyro has entered into the compensation direction mode.

D. To exit the "setting mode" you can move the sensitivity switch to "tail lock mode", until the light (LED) flashes quickly about 1 second then the LED remains RED. This indicates the gyro is back to the tail lock mode or normal working mode.

5.4 Compensation Direction Setting

Follow section 4.3.C to enter into the "Compensation Direction mode" the LED changes to Green, move the rudder to neutral immediately indicating zero rudder.

A. This time you can observe the LED'S flash time to know the current parameters value
Flash 1 time the compensation direction is forward direction (Factory defaults)
Flash 2 times the compensation direction is reverse direction

B. If you want to change the "Compensation Direction", just hold "Half-rudder" one time about 0.3 second. The "Compensation Direction" parameter will automatically increase or decrease by "1", while the light flash will increase or decrease one time. For example we hold "left half rudder" the parameter will increase by 1, or hold the "right half rudder," it will reduce by 1. Specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Enter the next parameter "Turning Speed" by holding "full rudder" about two seconds then the gyro indicator LED changes to Blue, indicating the gyro has entered into the Turning Speed mode.

D. To exit the "setting mode" you can move the sensitivity switch to "tail lock model" until the LED flashes quickly about 1 second then the LED remains RED. This means the gyro is back to the tail lock mode or Normal working.

5.5 Turning Speed Setting

Enter this setup using the instructions in 4.4.C. The Turning Speed Setting mode is entered when the LED turns to Blue. Move the rudder to neutral immediately to indicate zero rudder.

A. This time you can observe the LED'S flash sequence to know the current parameters value
Flash one time means the turning speed is slowest (factory defaults)
Flash 10 times the turning speed is Fastest

B. If you want to change the "Turning Speed", hold "Half-rudder" one time about 0.3 second. Quickly you will notice the "Turning Speed" parameter will automatically increase or decrease by "1", while the time of light flashes will increased or decreased. For example we hold "left half rudder" and the LED will increase by 1, then hold the "right half rudder," it will reduce by 1. The specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Enter the next parameter "Response Delay" by holding "full rudder" about two seconds then the gyro LED changes to Cyan, indicating the gyro has entered into the Response delay mode.

D. To exit the "setting mode" you can move the sensitivity switch to "tail lock model" until the LED flashes quickly about 1 second then the LED remains RED. This indicates the gyro is back to the tail lock mode or Normal working mode.

5.6 Response Delay Setting

Enter this setup using the instructions in 4.5.C. In the Response Delay Setting mode the light turns to Cyan. Move the rudder to neutral immediately indicating zero rudder.

A. At this time you can observe the LED'S flash time to know the current parameters value
Flash One time the response delay is fastest (Factory defaults)
Flash two times the response delay is slowest

B. If you want to change the "Response Delay", hold "Half-rudder" about 0.3 second. . Quickly the "Response Delay" parameter will automatically increase or decrease by "1", while the LED will increase or decrease by one. For example hold "left half rudder" until the LED increases by 1, then hold the "right half rudder," to reduce by 1. The specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Enter the next parameter "Limit left rudder" by holding "full rudder" about two seconds then the GYRO led turns to Yellow, indicating gyro has entered into the Limit left rudder mode.

D. To exit the "setting mode" move sensitivity switch to "tail lock model" until the LED flashes quickly about 1 second then the LED remains RED. This indicates the gyro is back to the tail lock mode or Normal working mode.

5.7 Limit Left Rudder

Follow the instructions in 4.6.C to enter the Limit Left Rudder Setup mode. The light turns to Yellow to indicate you are in the setup mode, then move the rudder to neutral immediately indicating zero rudder.

A. At this time you can observe the LED'S flash speed to know the current parameters value

Flash slowest the limit left rudder is 50%

Flash in middle speed the limit left rudder is 100% (Factory defaults)

Flash fastest the limit left rudder is 150%

B. If you want to change the "Limit Left Rudder", hold "Half-rudder" one time about 0.3 second. Quickly the "Limit Left Rudder" parameter will automatically increase or decrease and the movement of rudder will increase or decrease simultaneously, while the LED will go faster or slower. For example hold "left half rudder" the LED will increase then hold the "right half rudder," it will reduce. The specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Enter the next parameter "Limit Right rudder" by holding "full rudder" about two seconds until the gyro indicator LED changes to Pink, indicating gyro has entered into the Limit right rudder mode.

D. Exit the "setting mode" by moving the sensitivity switch to "tail lock model", until the LED flashes quickly about 1 second then the LED remains RED. This indicates the gyro has returned to the tail lock mode or normal working mode.

5.8 Right Limit Rudder Setting

Follow the instructions in 4.7.C to enter into the Limit Left Rudder Setting mode. The LED turns to Pink. Then move the rudder to neutral immediately indicating zero rudder.

A. This time you can observe LED flash sequence to know the current parameters value.

Flash slowest the Limit Right rudder is 50%

Flash in middle speed the limit Right rudder is 100% (Factory defaults)

Flash fastest the limit Right rudder is 150%

B. If you want to change the "Limit Right Rudder", hold "Half-rudder" one time about 0.3 second. Quickly the "Limit Right Rudder" parameter will automatically increase or decrease and the LED will increase or decrease simultaneously, while the LED flashes will go faster or slower. For example hold "left half rudder" and the LED will increase, then hold the "right half rudder," it will reduce. The specific direction of motion can be adjusted by Direction Setting of Rudder.

C. Enter the next parameter "Reset to factory defaults" by holding "full rudder" about two seconds then the gyro indicator LED will change to White. This indicates the gyro has entered into the

Reset the Factory Defaults mode.

D. To exit the “setting mode" you can move the sensitivity switch to "tail lock model", LED flashes quickly about 1 second then the LED remains RED. This indicates the gyro has returned to the tail lock mode or normal working mode.

5.9 Reset to Factory Defaults

Follow instructions in 4.8.C to enter Reset to factory defaults setting mode. The LED turns to White then move the rudder to neutral immediately indicating Zero Rudder.

A. At this time the light flashes slowly indicating the gyro is ready to reset to factory defaults.

B. If you want to reset the factory defaults hold "Half-rudder" one time about 0.3 second. The direction of half rudder is based on the Rudder’s Direction Setting. Hold half rudder to make the Parameter value increase then the gyro will Reset to the Factory defaults. In this process the LED flashes quickly. This process places the gyro back to “Ready” condition and the Light flashes slower. Half-Rudder is used to make the parameter value of the gyro decrease. This will continue in the “Ready” condition and will not operate the Reset to factory defaults.

C. To enter the next parameter "Servo Type mode" and return to the back to the First Parameter and back to next cycle hold "full rudder" about 2 seconds then the gyro indicator LED changes to Red indicating the gyro has entered into the Servo Type mode.

D. To exit the “setting mode" you can move the sensitivity switch to "tail lock model” until the LED flashes quickly about 1 second then the LED remains RED. This indicates the gyro has returned to the tail lock mode or normal working mode.

VI. Operation and Debugging

The main function of the tail lock Gyro is to lock the helicopters course. When the rudder is in neutral the helicopter’s movement direction remains unchanged. Another name for the GYRO is the helicopter’s “yaw axis attitude stabilization controller”

The gyro’s performance is closely related to the head lock servo and the quality and efficiency of mechanical transmission to the tail rotor by the main power system. Therefore, please make sure all devices are in good condition when you adjust the GYRO

1. Servo selection and adjustment

Generally speaking, the best head lock servo for the gyro must feature sufficient torque and high speed, such as digital servos（760uS/560Hz) with speeds of 0.08S/60 ° or above are recommend. The higher speed digital servo exceeds the narrow band digital servo (760uS/560Hz). There are three kinds of servos recommended, you can choose the best servo to fit your device and set the servo parameters properly.

Tail rudder installations must follow three points: First, the adjustment amount must be zero rudder to rudder arm and keep the tail vertical; Second, adjust the zero-rudder tail length position, so that the formation of about 5 ° angle at the tail rotor the anti-twist pitch angle; third rudder arm should ensure that the minimum radius of the largest left and right rudder volume (LIMIT-L / R) in either case has the maximum tail rotor pitch, the other steering arm radius should not be too large, otherwise it will easily lead to control issues if the step size is too large.

The following three pointes should be noted when you install the Head lock servo. First, the head lock servo arm should be vertical to the tail push bar, Second, adjust the length of tail push bar to zero rudder and adjust the tail rotor to a 5 °anti-twist pitch angle; Third, make sure the minimum value of the servo arm movement causes max tail rotor pitch in the condition of Limit Left/Right rudder. As well, the servo arm radius should be the correct size and not too large, otherwise a large control length will cause in-stability during flight.

1.1 Servo Arm and tail push bar adjustment precision

First please make sure the gyro is in "non-lock tail mode", and the transmitter rudder stick is in the neutral position with a fixed servo arm and tail push bar at about 90 degrees. Adjust the servo vertically to the tail push bar using trimming functions.

Rudder neutral setting can be changed by trimming so the gyro should be reset to fit the transmitters rudder neutral. There are two methods to reset the gyro: first, cut the power of gyro then give power, second, fast switching (within 1 second to switch at least 3 times) the transmitters sensitivity switch, and stop in the tail lock mode.

1.2 Adjustment of Servo Limit Trimmer

The gyro supports the left and right limit rudder movements that be adjusted respectively. Adjust the left/right limit rudder each time you install a head lock servo to make sure the tail rotor slider is adjustable to the largest travel in both directions, while avoiding any contact. Please refer to Chapter 4.7and 4.8.

1.3 Response Delay Trimmer

Stability is directly related to the head-lock servos response speed. When servo speed is lower than the gyro control speed, the helicopter tail will enter a serious "step shock." These shocks will be occur obviously when the helicopter is in a turning movement. When you debug the helicopter, these shocks can be eliminated by increasing the "response delay" value. For details please refer to chapter 4.6.

2. Mechanical Parts Clearance and Lubrication

After many flights, due to excessive friction there will be abrasion and thus increased clearance will occur. Generally, a pilot can feel decreased performance because of this change in

clearance. Head lock can be affected by clearance sometimes also called it orientation drift. A check is recommended before each flight of the control components for rotor clearance. If clearance is an issue replace the corresponding parts. Pilots need to pay attention to normal maintenance, lubrication, excess oil, in order to maintain smooth movement and flexible components.

3. The Efficiency of Tail Blades

Adjustment of the tail rotor pitch angle is required to achieve a stable course. The tail rotor must have sufficient speed and blade area, or even a large pitch can't produce enough anti-torque to balance the spin force that is produced by main rotor. As well if the pitch is too steep efficiency is not increased but rather reduced.

In order to improve the efficiency, usually increased throttle is required, or increase the main rotor pitch curve under proper throttle curve. Another method recommended uses a large surface tail blade such as the "Knife shape" tail blade.

4. Stiffness of the head-lock and turning flexibility

Generally speaking, higher sensitivity improves head lock and the course stability. However, the higher sensitivity the lower turning flexibility and turning speed be slowed down.
The difference between this Tiny gyro and other gyros is the stiffness and turning speed can be adjusted independently to get proper head lock stiffness and turning flexibility.

5. Sensor Setting

Sensitivity settings are related to the brand and model of the transmitter; for instance Futaba transmitters use bilateral sensitivity but JR transmitter use unilateral sensitivity. Please refer to the manual to set the sensitivity.

With bilateral sensitivity the "0" is neutral positive and negative full value is 100 the sensitivity range is -100~+100.

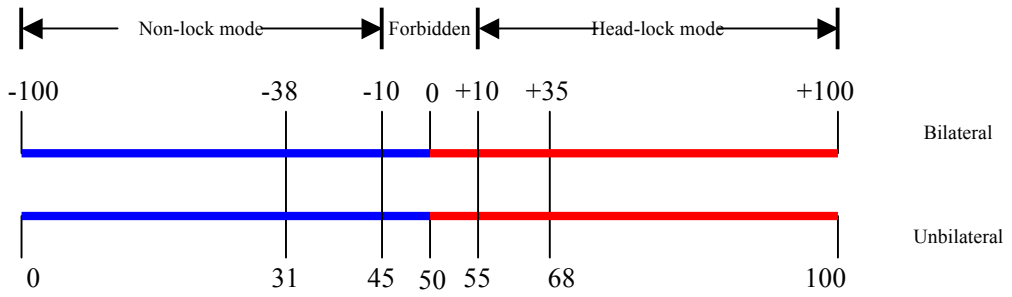
With unilateral sensitivity the "50" is neutral, the positive and negative full value is 50 the sensitivity range is 0~+100.

The gyro under head lock mode is in positive sensitivity but under non-lock mode is in negative sensitivity.

If you use a bilateral sensitivity transmitter the gryo enters the head-lock mode the with a sensitivity value around +35 but the non-lock mode will have a sensitivity around –38.

If you use a unilateral sensitivity transmitter the gyro enters the head-lock mode the a sensitivity value around 68, but the non-lock mode will have a sensitivity around 31.

The following diagram shows sensitivity settings under different conditions (for reference only).



Generally speaking we set the sensitivity value as high as possible so there is no rear-end movement. At this moment, if the turning speed slows down please set the "SPEED" parameter to improve the turning speed. Different Servo response speeds with different sensitivity values, creates a higher response speed a higher degree of sensitivity is needed. The sensitivity value for digital servos is higher than analog servos. Tail rotor speed with different sensitivity values are not the same, the more tail rotor speed the more the high-sensitivity values can be set lower. Therefore, in 3D flight mode, set the value of sensitivity than the normal flight mode, set the value of the sensitivity lower.

Different Tail rotor speeds with different sensitivity values, require higher tail rotor turning speed and a lower sensitivity value, so 3D flight mode needs much more lower sensitivity value than normal flying modes.