

Futaba



**AVCS RATE GYRO
GYA351**

**INSTRUCTION
MANUAL**

Rate gyro for models

Thank you for buying a GYA351 AVCS gyro. Before using your new gyro, please read this manual thoroughly and use the gyro properly and safely. After reading this manual, store it in a safe place.

- No part of this manual may be reproduced in any form without prior permission.
- The contents of this manual are subject to change without prior notice.
- This manual has been carefully written. Please write to Futaba if you feel that any corrections or clarifications should be made.

1 FOREWORD

The GYA351 is a high performance, compact, and light weight AVCS gyro developed for model aircraft ailerons, especially two servos FLAPRON wing, control. Integrated sensor and control circuit make it easy to mount.

Servos:

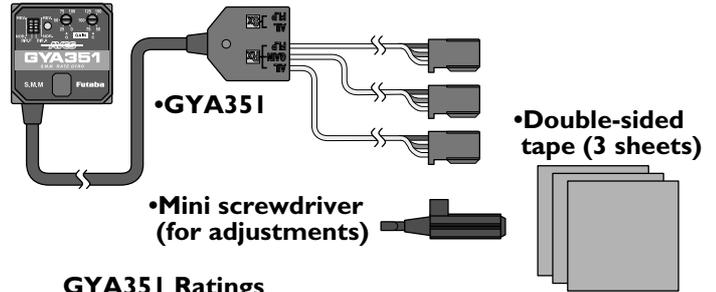
Gyro performance largely depends on the servo used. The faster and more responsive the servo, the higher the speed and the better the sensitivity and performance of the gyro.

Features

- AVCS used
Forward, climb, descent, back, knife edge, and other flying attitudes are maintained even when the wind shifts. Therefore, since meeting rudder is almost completely unnecessary, flying is easy. At the same time, the gyro automatically corrects bad tendencies of the aircraft.
- SMM gyro sensor
Newly developed very low drift SMM (Silicon Micro Machine) gyro sensor practically eliminates trim changes during flight.
- Remote gain and mode switching functions
Remote gain function lets you switch the gyro gain from the transmitter. AVCS mode/Normal mode/Gyro OFF can also be switched from the transmitter.
- Integrated type, compact size, and light weight
Compact size (27x27x20mm) and light weight (32g) have been achieved by the use of high density mounting technology.
- Conductive resin case improves EMC resistance (electrostatic, electromagnetic wave interference).

2 SET CONTENTS

The GYA351 comes with the following accessories:



GYA351 Ratings

- (Integrated sensor type AVCS rate gyro)
- Control system:
Digital advanced PI (Proportional Integration) control
- Gyro sensor:
SMM (Silicon Micro Machine) system vibration gyro
- Operating voltage: +4 to +6VDC
- Dimensions: 27 x 27 x 20mm
- Weight: 32g (including connector)
- Functions:
Gyro operation direction switch, Gyro gain trimmer, Control gain trimmer

3 NAME AND FUNCTION OF EACH PART

•Monitor LED

Monitors the operating status of the GYA351. See the table below for the display contents.

•Gyro direction of operation selector switch (ch1)(DIR.A)

Selects the direction of operation of the gyro. If the servo moved when the fuselage was moved in the aileron axis direction and the servo moved to cancel this movement, the direction of operation is matched.

If the aircraft is flown while the direction of operation is wrong, the gyro may apply reverse rudder and is very dangerous.

•Gyro gain trimmer (G GAIN)

Adjusts the gyro gain. Gain adjustments are made from the transmitter. In this case, the value set with this trimmer becomes the reference and the gain can be adjusted by changing the servo deflection angle setting of the transmitter gain adjustment channel. When the trimmer is turned clockwise, the gain increases. Adjust the gain to the maximum value at which hunting does not occur.

•Control gain trimmer (C GAIN)

Adjusts the steering signal controlled variable. The effect of the rudder when the gyro is turned on can be adjusted. When the trimmer is turned clockwise, the controlled variable increases.

•Servo output connector

Connects the corresponding servo.

•Gain switching connector (red)

Gyro gain switching signal input connector. Connects to the receiver gain switching channel output connector. The signal from this connector is also used to switch the AVCS and Normal operation modes simultaneously with gain switching.

•Ch6 input connector (black)

Connects to ch6 servo output connector of the receiver.

•Ch1 input connector (black)

Connects to ch1 servo output connector of the receiver.

(Monitor LED display)

LED display	Gyro operation status
Rapid flashing	Displayed while data is being initialized at power ON.
Steady light	Shows that the gyro is operating in the AVCS mode.
Off	Shows that the power is OFF, or the gyro is operating in the Normal mode.
Slow flashing	Displayed when a control signal is input from the transmitter. At this time, the servo does not operate.
Double flash	In the AVCS mode, displayed when the signal from the transmitter deviates from the neutral signal memorized at the gyro. Also displayed when a stick is operated.
Single flash	Displayed when the AVCS function is reset, and a neutral signal is sent to the servo. The LED flashes once when the gain selector switch was quickly switched between the Normal and AVCS positions three or more times and then left in the AVCS position, or when a transmitter stick was quickly moved to the left and right three or more times. After this display is performed, the servo moves to the neutral position. This display also flashes when the operation direction or control selector switch was moved.

GYA351 operation modes

The GYA351 has two operations modes: AVCS mode and Normal mode.

Normal mode

This mode performs general proportional control operation. For instance, it controls the gyro so that changes are countered when the attitude of the aircraft is changed by cross-wind, etc.

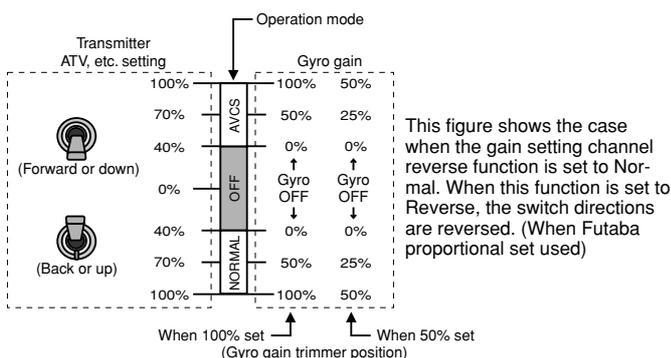
AVCS mode

This mode performs both proportional and integrated control operation. The difference between Normal mode and AVCS mode operation is that whereas the Normal mode only counters changes in attitude, the AVCS mode returns to the original controlled variable simultaneously with countering changes in attitude. For example, during knife edge flying, aileron and elevator meeting rudder is normally necessary, but in the AVCS mode, meeting rudder is performed automatically by the gyro.

Also, in the AVCS mode, high-speed control is possible, but when the usage method is incorrect, unintended operation may be performed. Before use, gain a thorough understanding by reading the Usage Precautions and Operation Instructions.

4 GAIN AND OPERATION MODE SETTING

The relationship between the travel adjustment functions (ATV, AFR) settings and gyro gain when the gyro gain is switched using the transmitter switching channel is shown below.



Gyro OFF setting:

As shown in the figure, when the ATV rate of the gain setting channel switch is 0% or less, the gyro gain becomes zero. When you want to turn off the gyro, set to this range (40% or less).

AVCS mode gain setting:

When the ATVB rate is 40% or more, the gyro operates in the AVCS mode. The actual gyro gain changes based on the gyro gain trimmer setting of the gyro itself. When the gyro gain trimmer is set to 100%, the gyro gain becomes 100% at 100% ATV rate and becomes 50% at 70% ATV rate. When the gyro gain trimmer is set to 50%, when the ATV rate is 100%, the gyro gain becomes 50% and when the ATV rate is 70%, the gyro gain becomes 25%.

Normal mode gain setting:

When the ATVA rate is 40% or more, the gyro operates in the Normal mode. The gyro gain setting can be adjusted the same as in the AVCS mode.

When gain switching from transmitter function not used:

The gyro gain switching connector is not connected to the receiver. In this case, the gyro operates in the Normal mode. The gyro gain is set using the gyro gain trimmer.

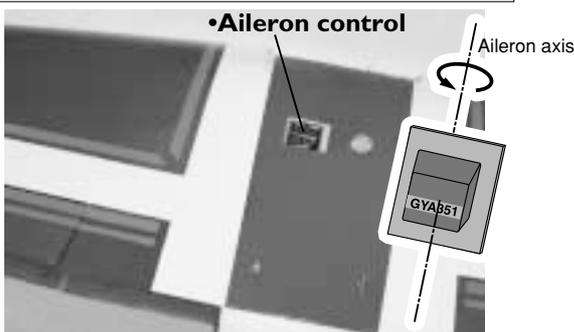
5 OPERATION INSTRUCTIONS

Mount and adjust the GYA351 as described below.

Gyro Mounting Method

Make a gyro bed so that the bottom of the gyro body is perpendicular to the direction of the axis to be controlled and securely install the gyro with the accessory double-sided sponge tape at a position at which vibrations are minimal.

- If this axis changes, the gyro also corresponds to linkage of other axis.



Usage Precautions

- When taking off and landing, always switch to the Normal mode. Taking off and landing in the AVCS mode is dangerous.
- When using an air brake, use the gyro in the Normal mode. If used in the AVCS mode, the aircraft will roll.
- When the gyro is ON, the servo operating angle increases. Increase the travel width of the flight control surfaces so that they will not strike the linkage even when the servo is operated to its maximum deflection angle.



- Always use the miniature screwdriver supplied to operate the GYA350 selector switches and trimmers. Do not apply excessive force.

Beginner setting

(When there is no vacant receiver channel)

Use this setting method when there is no vacant receiver channel. Use the GYA351 in the Normal mode only.

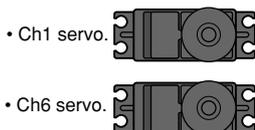
Mounting to fuselage and initial setting

1. Gyro mounting

Mount the gyro to the axis in accordance with "Gyro Mounting Method".

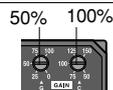
2. Gyro connection

- Connect to the receiver output of ch1.
- Do not connect the gain switching connector.
- Connect to the receiver output of ch6.



3. Trimmer setting (Initial)

Set the gyro gain trimmer to about the 50% position. Set the control gain trimmer to about the 100% position.



4. Power ON procedure

Turn on the transmitter power, then turn on the receiver and gyro power. After the gyro power is turned on, initialization is automatically performed for about three seconds. Never move the aircraft during this period. During initialization, the gyro monitor LED flashes.

5. Gyro direction of operation check

Tilt the aircraft about the aileron axis, and check if the gyro applies rudder in the direction opposite the direction of tilt. If the rudder moves in the opposite direction switch the gyro direction of operation selector switch.

Gyro direction of operation selector switch (ch6)(DIR.F)



Gyro direction of operation selector switch (ch1)(DIR.A)

Flight adjustments

1. Power ON procedure

Turn on the transmitter power, then turn on the receiver and gyro power. After the gyro power is turned on, initialization is automatically performed for about three seconds. Never move the aircraft during this period.

2. Trimming

Fly and trim the aircraft. If there is a large mechanical deviation, correct the linkage. Connect the linkage so that the servo horns are as close to the center position as possible and the transmitter trimmers are also at the center position.

3. Gyro gain adjustment

When the servo hunts, the gyro gain is too high. Lower the gain with the gyro gain trimmer until the hunting stops. The gyro will display best performance at a gain just before hunting occurs. Perform trimming by flying the aircraft repeatedly.



Gyro gain trimmer (G GAIN)

4. Rudder effect adjustment

Use the transmitter steering angle adjustment function to adjust the rudder effect.

However, when the rudder effect is substantially different from that when the gyro was not mounted, adjust it with the control gain trimmer.

When the gyro is turned on, the rudder will feel sluggish. Adjust the control gain so that the rudder effect matches the rudder effect when the stick is set to its maximum position. When the control gain is increased, the rudder effect increases.



Control gain trimmer (C GAIN)

Standard Setting

(Setting using all GYA351 functions)

This standard setting controls gain switching and AVCS/Normal gyro operation mode switching from the transmitter.

However, when using the GYA351 with its GYA350 sister product, and mounting gyros in three axis, three vacant channels are necessary for gain and operation mode switching. When there are not enough vacant channels, do not connect the gain switching connector and operate the gyro in the Normal mode only. The gain of the gyros of two axes can also be switched simultaneously by using a branch cord.

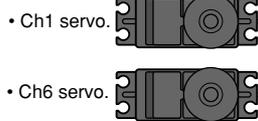
Mounting to fuselage and initial setting

1. Gyro mounting

Install the gyros to the axes in accordance with "Gyro Mounting Method".

2. Gyro connection

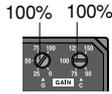
- Connect to the receiver output of ch1.
- Connect to the gain switching channel.
- Connect to the receiver output of ch6.



When there is no vacant channel that can be used for gain switching, "Standard setting" cannot be performed. See "Beginner setting". When gyros are installed in two or three axis, and there are not enough vacant channels, use a branch cord to simultaneously switch the gain of two axis.

3. Trimmer setting (Initial)

Set the gyro gain trimmer to the 100% position.
Set the control gain trimmer to about the 100% position.



4. Gain setting

Set the gain as described below.

(Gain setting with T8UAPS example 1)

The following describes how to use the channel 5 switch to switch the aileron axis gain. (When GYA351 used independently.)

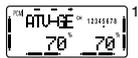


1. Call the transmitter 5ch ATV screen and make the following setting:
Set the rate of both directions of the CH5 switch to 70%. This sets the gyro gain to 50%.

•In the switch forward position, the gyro operates in the AVCS mode and in the switch backward position, the gyro operates in the Normal mode.

(Gain setting with T8UAPS example 2)

The following describes how to use channels 5, 7, and 8 to switch the gain of the rudder, aileron, and elevator axis. (When GYA350 being used in the rudder and elevator.)



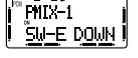
1. Call the transmitter 5ch ATV screen and make the following setting:
Set the CH5 switch rate for both directions to 70%. This sets the gyro gain to 50%.



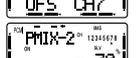
- In the switch forward position, the gyro operates in the AVCS mode and in the switch backward position, the gyro operates in the Normal mode.
2. Call the transmitter PMIX-1 screen, and make the following settings:



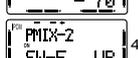
- Activate PMIX-1.
- Set master channel to OFS.
- Set slave channel to CH7.
- Set mixing rate to +70%.
- Select switch SW-E.
- Select switch direction DOWN.



3. Call the transmitter PMIX-2 screen, and make the following settings:



- Activate PMIX-2.
- Set master channel to OFS.
- Set slave channel to CH7.
- Set the mixing rate to -70%.
- Select switch SW-E.
- Select switch direction UP.



4. Lock the transmitter CH7 knob in the 0% position. This sets the aileron axis gyro gain to 50%.
•When switch SW-E is in the forward position, center position, and backward position, the GYA350 gyro operates in the AVCS, OFF, and Normal modes, respectively.



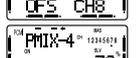
5. Call the transmitter PMIX-3 screen, and make the following settings:



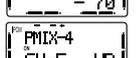
- Activate PMIX-3.
- Set master channel to OFS.
- Set slave channel to CH8.
- Set mixing rate to +70%.
- Select switch SW-E.
- Select switch direction DOWN.



6. Call the transmitter PMIX-4 screen, and make the following settings:



- Activate PMIX-4.
- Set master channel to OFS.
- Set slave channel to CH8.
- Set mixing rate to -70%.
- Select switch SW-E.
- Select switch direction UP.



7. Lock the transmitter CH8 knob in the 0% position.



This sets the elevator axis gyro gain to 50%.
•When SW-E is in the forward, center, and backward positions, the GYA350 operates in the AVCS, OFF, and Normal mode, respectively.

(Gain setting with T8UAPS example 3)

The following describes how to use CH7 to switch the aileron and elevator gain and CH8 to switch the rudder axis gain. (When GYA350 being used in the rudder and elevator.)

The aileron and elevator gyros gain switching connector is connected to receiver CH7 by branch cord. When air brake is ON, the aileron and elevator axis gyros must be set to the Normal mode.



1. Call the transmitter PMIX-1 screen, and make the following settings:

- Activate PMIX-1.
- Set master channel to OFS.
- Set slave channel to CH7.
- Set mixing rate to +70%.
- Select switch SW-C.
- Select switch direction UP.



2. Call the transmitter PMIX-2 screen, and make the following settings:

- Activate PMIX-2.
- Set master channel to OFS.
- Set slave channel to CH7.
- Set the mixing rate to -70%.
- Select switch SW-C.
- Select switch direction C/DN.



3. Lock the transmitter CH7 knob in the 0% position. This sets the aileron and elevator gyro gain to 50%.

•When switch SW-C is in the up, center, and down positions, the GYA350 operates in the AVCS, Normal, and air brake ON modes, respectively.



When you want to set the gain of the aileron and elevator gyros independently, adjust the gyro gain trimmer on the gyros individually.



4. Call the transmitter PMIX-3 screen, and make the following settings:

- Activate PMIX-3.
- Set master channel to OFS.
- Set slave channel to CH8.
- Set mixing rate to +70%.
- Select switch SW-E.
- Select switch direction DOWN.



5. Call the transmitter PMIX-4 screen, and make the following settings:

- Activate PMIX-4.
- Set master channel to OFS.
- Set slave channel to CH8.
- Set mixing rate to -70%.
- Select switch SW-E.
- Select switch direction UP.



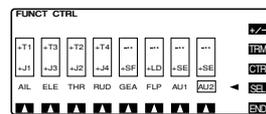
6. Lock the transmitter CH8 knob in the 0% position.

This sets the rudder axis gyro gain to 50%.
•When SW-E is set to the forward, center, and backward positions, the GYA350 operates in the AVCS, OFF, and Normal modes, respectively.



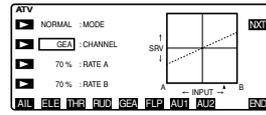
(Example of gain setting using T9ZAP)

The following describes how to use vacant channels 5, 7, and 8 to switch the gain of the rudder, aileron, and elevator axis. (When GYA350 being used in the rudder and elevator.)



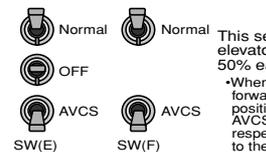
1. Call the transmitter function control functions screen, and make the following settings:

- Set switch SF to GEA(5CH) and switch SE to AU1(7CH) and AU2(8CH), respectively.



2. Call the transmitter ATV function screen, and make the following settings:

- Select GEA(5CH) and set both RATEA and RATEB to 70%.
- Set AU1(7CH) and AU2(8CH) to 70% rate similarly.



This sets the gain of the aileron, elevator and rudder axis gyros to 50% each.

•When switch SW(E) is set to the forward, center, and backward positions, the GYA350 operates in the AVCS, OFF and Normal modes, respectively. When switch SW(F) is set to the forward and backward positions, the rudder axis gyro operates in the AVCS and Normal modes, respectively.

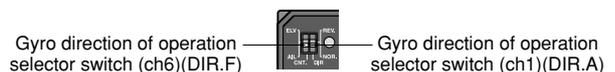
5. Power ON procedure

Turn on the transmitter power, then turn on the receiver and gyro power. Initialization is performed automatically for about three seconds after the gyro power comes on. Do not move the aircraft during this period. During initialization, the gyro monitor LED flashes. When the gain selector switch is set to the AVCS position, the monitor LED changes to a steady light. When the gain selector switch is set to the Normal position, the LED goes off.

6. Gyro operation direction check

Tilt the aircraft about the control axis, and check if the gyro moves in the direction opposite the tilt direction.

If the gyro moves in the opposite direction, switch the gyro direction of operation selector switch.



Flight adjustment

1. Power ON procedure

Turn on the transmitter power, then turn on the receiver and gyro power. Initialization is performed automatically for about three seconds after the gyro power comes on. Do not move the aircraft during this period.

2. Trim adjustment

Set the gyro gain switch to the Normal or OFF position. The monitor LED goes off. Fly and trim the aircraft in this state.

When the mechanical deviation is large, correct the linkage. Connect the linkage so that the servo horn and transmitter trimmers are in the center position.

3. Gyro gain adjustment

When the servo hunts, the gyro gain is too high. Lower the gyro gain until the hunting stops. The gyro displays top performance at a gain just before hunting begins. Perform trimming by flying the aircraft repeatedly. Adjust the gain by raising and lowering the transmitter ATV or mixing rate.

4. Rudder effect adjustment

Use the transmitter deflection angle adjustment function to adjust the rudder effect.

However, when the rudder effect is substantially different from that when the gyro is installed, adjust it using the control gain trimmer.

When the gyro is turned on, the rudder will feel sluggish. Adjust the control gain to match the rudder effect when the stick is set to its maximum position. When the control gain adjustment amount increases, the rudder effect increases. Adjust the linkage so that use is possible at a transmitter deflection angle setting of 70% or more.

Control gain trimmer (C GAIN)



5. AVCS side neutral data memorization

After landing the aircraft, set the gain switch to the AVCS position and turn on the gyro power again and memorize the AVCS mode neutral data at the gyro. When using flight conditions, verify that the gyro monitor LED lights under all the flight conditions used. If the LED flashes twice, trim of that flight condition has changed. Repeat transmitter trim adjustment. This ends AVCS side setting.

6. Switch to the AVCS or Normal mode, as desired.

In the AVCS mode, meeting rudder is seldom necessary because trim changes during knife edge and upside-down flight are compensated for by the gyro. Conversely, when the aircraft enters a stall condition in the low speed state, the gyro continues to apply correction rudder and the aircraft may enter an unintended attitude. To avoid stalling in such a state, return to normal attitude as soon as possible by increasing engine power and applying reverse rudder, or switch the gyro to the Normal mode.

Using AVCS correctly

The AVCS type gyro controls the attitude of the aircraft by constantly comparing the transmitter operation signals and the gyro internal reference signal (transmitter neutral signal). Therefore, for the AVCS function to operate normally, the rudder neutral signal must be memorized at the gyro before flight.

Neutral signal memorization

There are two methods of memorizing the neutral signal.

[Method 1] When the gyro power is turned on, the signal received from the transmitter at that time is assumed to be the neutral signal and is memorized at the gyro. The gyro is normally used in this state.

[Method 2] The neutral position can also be memorized by rapidly switching the transmitter gain switch between the AVCS and Normal positions at least three times at an interval of within one second. In this case, the monitor LED flashes once to show that memorization is complete.

When the trim was changed during flight, the memorized neutral position can be updated to the current neutral position by repeating this operation. When this performing this operation, kept the stick in the neutral position.

Neutral check method

In the AVCS mode, the servo does not return to the neutral position even though the stick is returned to neutral. When you want to check the servo neutral position during linkage neutral check, etc., set the gain switch to the Normal position, or quickly move the transmitter stick to the left and right at least three times and immediately return the stick to the neutral position. A dead zone is produced in servo operation relative to stick operation. However, this is because the stick control gain rises and is not an abnormality.

⚠ Caution

Mounting Precautions

- ① Always use the accessory sensor tape to install the gyro to the fuselage.

This is necessary to securely fasten the gyro to the fuselage so that operation of the gyro does not transmit unwanted fuselage vibrations directly to the sensor.

- ① When mounting the gyro, provide a little surplus so that the gyro connection cables are not too taut.

If the gyro cables are too taut, the gyro will not display its full performance. If the gyro peels, control will be lost and result in a dangerous situation.

- ① When using the gyro with a airplane, install the GYA351 at least 10cm from the drive motor and at least 2 cm from the servo.

The drive motor etc. generates strong electromagnetic noise. This noise may interfere with the gyro sensor and cause erroneous operation.

- ① Mount the GYA351 so that metals or other conductive objects do not touch the gyro case.

The GYA351 uses a conductive resin case to reduce electromagnetic interference. Because the surface of the case is conductive, metal objects may cause a short circuit.

- ① Insert the connectors fully.

If a connector works loose due to vibration during flight, control may be lost and result in a dangerous situation.

- ① Always check the direction of operation of the servos.

If you attempt to fly the model when a servo operates in the wrong direction, the fuselage will spin in a fixed direction and enter an extremely dangerous state.

Operation Precautions

- ⊘ Never move the fuselage for about 3 seconds after turning on the gyro power. (when using in the AVCS mode)

Since the data inside the gyro is automatically initialized as soon as the power is turned on, if the fuselage is moved, the neutral position will change. If this occurs, turn the power off and on again. When turning on the power, set the transmitter switch to the AVCS position

and turn on the transmitter power switch, then turn on the gyro power.

- ⊘ Do not operate the trim while flying in the AVCS mode.

When the power is turned on, the GYA351 assumes that the stick is in the neutral position. If the trim is moved during flight, the neutral position will change.

- ⊘ Avoid sudden temperature changes.

Sudden temperature changes will cause the neutral position to change. For instance, do not fly the model immediately after removing it from inside a heated vehicle in the winter and an air conditioned vehicle in the summer. Let the model stand for about 10 minutes to allow the temperature inside the gyro to stabilize before turning on the power. Also, consider sudden temperature changes when the gyro is exposed to direct sunlight or is installed near the engine. Take measures so that the gyro is not exposed to direct sunlight.

- ⊘ Do not stall the aircraft.

When the aircraft enters the stall condition, and the gyro tries to maintain its original attitude by applying full rudder. This results in assisting the stall. If the nose remains up and the aircraft stalls when landing, etc., the gyro will try to maintain that attitude by applying more up elevator. To avoid this danger, when taking off and landing, use the gyro in the Normal mode.

- ⊘ Do not use the AVCS mode when taking off and landing.

From the standpoint of the operation characteristics, taking off and landing in the AVCS mode is dangerous. When taking off and landing, use the gyro in the normal mode.

- ① When using the gyro in the AVCS mode, turn off mixing.

For example, if elevator down mixing is used by the air brake, the gyro will judge that an elevator down signal was received and will cause the aircraft to dive. In the AVCS mode, the gyro automatically changes the trim and, therefore, these mixings are unnecessary. When mixing is necessary, set so that the gyro enters the Normal mode when mixing is ON.

- ① Check the operating time of the receiver, gyro, and servo batteries at the adjustment stage and decide the number of remaining flights while allowing a margin.

Fuselage Maintenance Precautions

- ⊘ Do not turn the sensitivity trimmer with too much force.

The trimmer may break. Always use the miniature screwdriver supplied to make adjustments.

- ① Service the fuselage with a little vibration as possible.

Fuselage vibration has a very adverse effect on gyro performance.

Special Markings

Pay special attention to the safety at the parts of this manual that are indicated by the following marks.

Mark	Meaning
⚠ Danger	Procedures which may lead to a dangerous condition and cause death or serious injury to the user if not carried out properly.
⚠ Warning	Procedures which may lead to a dangerous condition or cause death or serious injury to the user if not carried out properly, or procedures where the probability of superficial injury or physical damage is high.
⚠ Caution	Procedures where the possibility of serious injury to the user is small, but there is a danger of injury, or physical damage, if not carried out properly.

Symbol: ⊘ ; Prohibited ① ; Mandatory