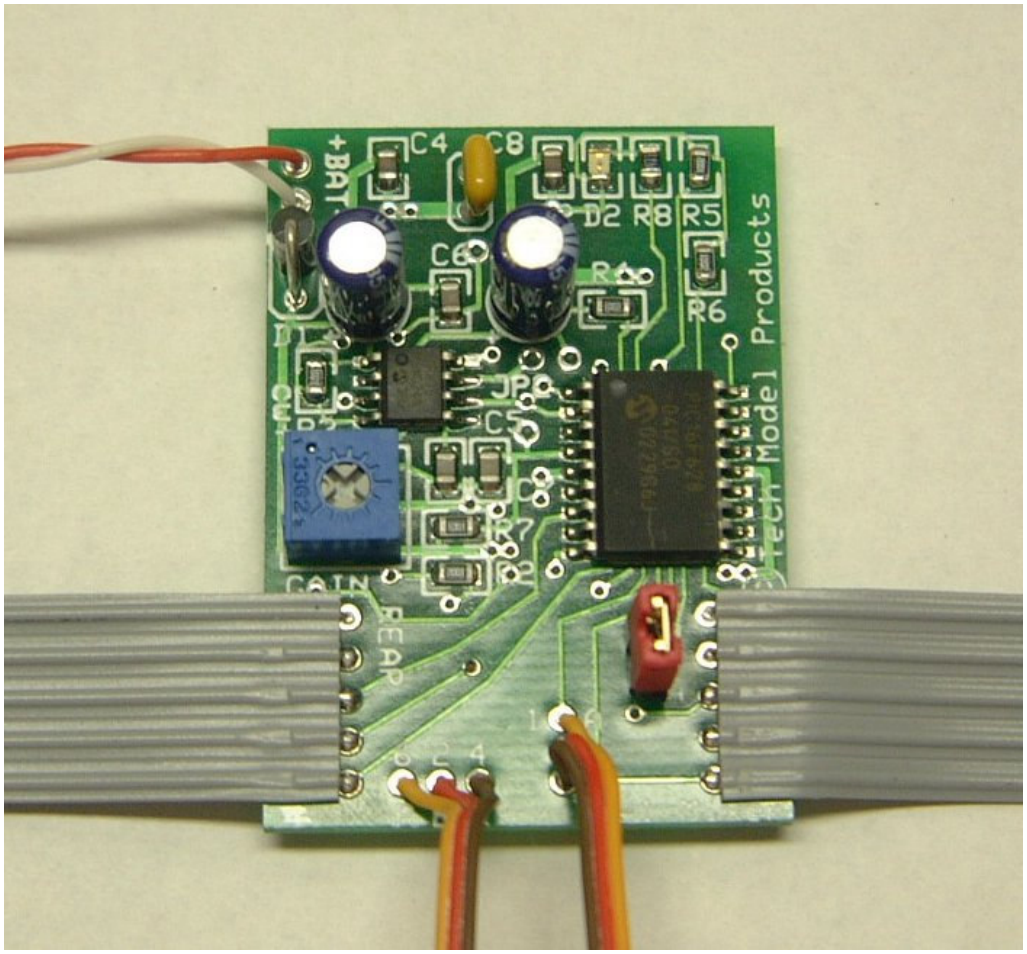
TH-1

Tandem Rotor R/C Helicopter Control System

Operators Manual



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Rev. E

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1.0. Introduction

Thank you for purchasing the Tech Model Products LLC. TH-1 Tandem Rotor R/C Helicopter Control system. It's small size and weight allows it to be used for micro tandem helicopter applications as well as larger machines. It uses a form of Cyclic Collective Pitch Mixing (CCPM) for tandem rotor helicopters. The TH-1 is self contained, and provides all mixing and compensation required to control the model. It only requires a basic radio (heli preferred) with travel volume adjustments (also known as end point adjust) and throttle / pitch mixing.
The TH-1 has a dual Battery Eliminator Circuit (BEC) that can supply up to 1 amp each.

1.1. Specifications

Dimensions	1.25x1.75 inches
Weight	17.4 grams
Temperature	-10°C to +45°C
Input Voltage	5 to 10 cells (1.2 volt) ; See Note1.
BEC1 Current	1 amp @ 8 cells
BEC2 Current	1 amp @ 8 cells
Connectors	JR, Futaba, Hitec
Servos needed	6
Control system	CCPM type TH-1
Swashplate type	SWH1

Note 1. The TH-1 can only be used with more than 8 cells under certain conditions and with limitations. See section 1.5 for more information.

1.2. Receiver Compatibility

The TH-1 requires a low jitter receiver to operate properly. The receiver should have a jitter level of about 1 microsecond or less. TH-1 system measures the pulse width of each receiver output channels (aileron, elevator, rudder, pitch) and then performs 16 bit signed arithmetic calculations on these measurements. The jitter error adds and subtracts which in some cases doubles the error. A typical servo has a deadband of about 8 microseconds, any jitter above the deadband will cause the servo to hunt and twitch.

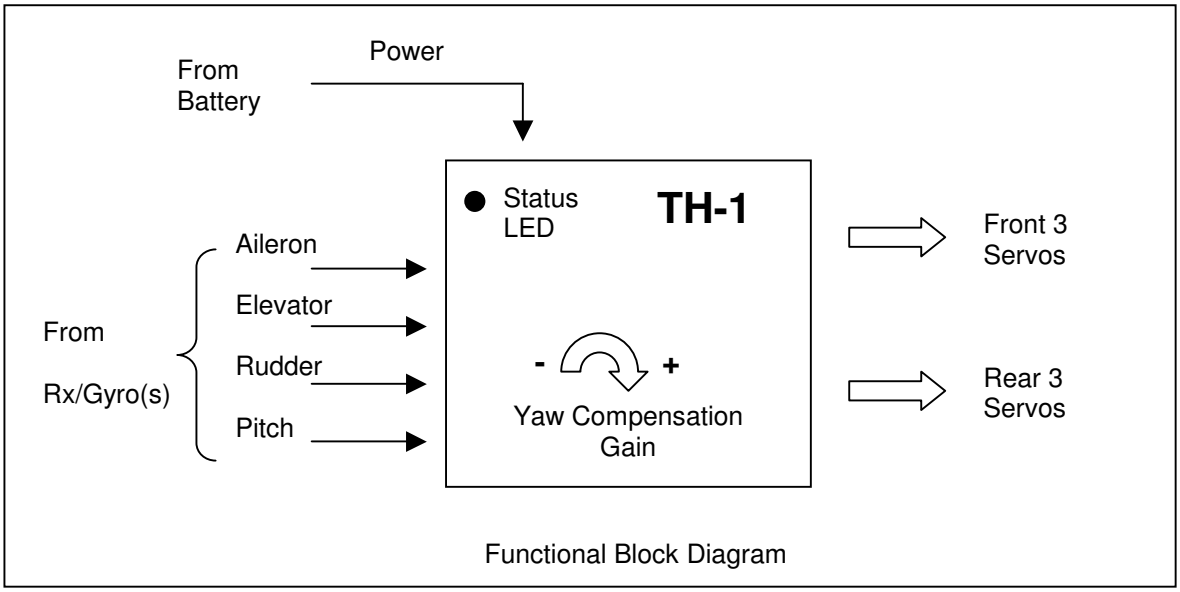
1.3. Gyro Compatibility

The TH-1 will only work with gyros that operate **synchronously** with the receiver. A synchronous gyro will output its corrected signal at about the same time or slightly delayed from when the receiver outputs for that channel.

Our testing has shown that the GWS "PG-03" and Ikarus "Micro-Gyro" work well. **Note: Some Futaba gyros are not of the synchronous type such as the "GY-240" and will not work.**

1.4. Functional Description

The TH-1 Implements a new form of Collective Cyclic Pitch Mixing (CCPM) named TH-1 for tandem rotor helicopters. It connects directly to the battery for powering it's twin Battery Eliminator Circuits (BEC). It has 4 inputs , channels (aileron, elevator, rudder, pitch), that connect to the receiver/gyro(s) and 6 servo outputs which connect to 3 front servos and 3 rear servos. It has a single LED that functions as a status indicator.
The TH-1 provides yaw compensation with gain that is adjustable over a range from 0 to 100 percent and has 32 unique gain values. A jumper is provided to enable/disable the function completely. See Figure 1 for a functional block diagram and photo.



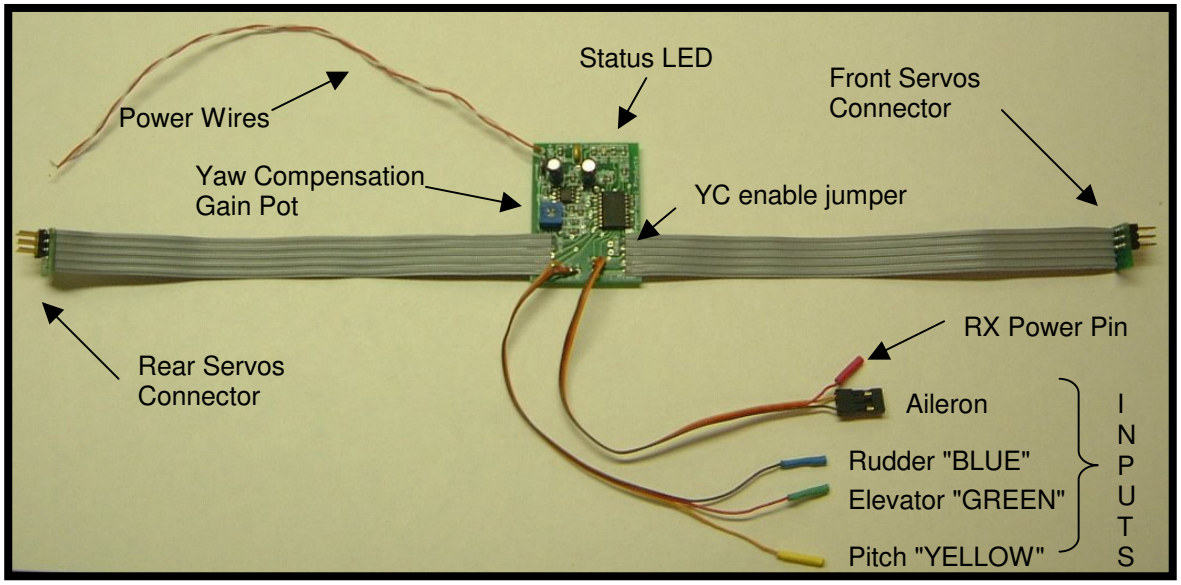


Figure 1

Each BEC is capable of sourcing 1 amp of current. The 3 front servos and the aileron receiver input are powered by BEC 1 and the rear 3 servos are powered by BEC2**.**

Note: The power connection to the aileron receiver input is supplied from the factory disconnected (pin is removed from connector shell and insulated with heat shrink tubing). Normally, the Electronic Speed Control (ESC) BEC is used to power the receiver and gyro(s). The Installation section has more information. See Figure 2.

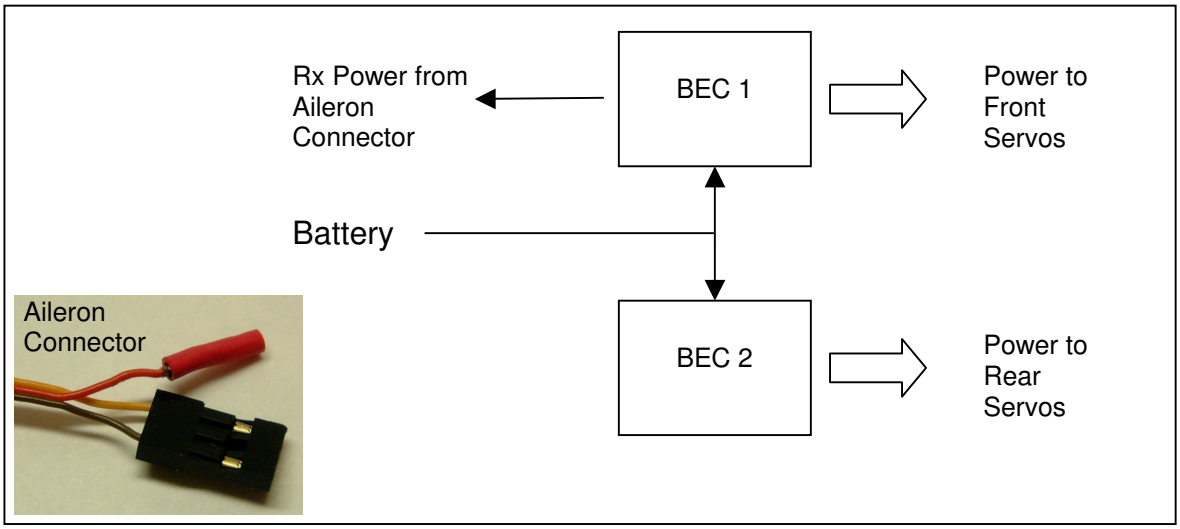


Figure 2

1.5. Special Precautions

Caution: The TH-1 can operate on a battery with up to 10 cells. (1.2 volts) or equivalent . In this case, it is possible to overheat the BEC regulators. When overheated the voltage regulators will auto-shutdown and restart when cooled. The following limitations will apply:

- Use the 10 cell battery only for flying since running the motors lowers the voltage to a tolerable level.
- Use an 8 cell battery for bench setup and when operating the servos for extended periods.
- For the 10 cell battery, the receiver and gyro(s) must be powered by the ESC BEC.

Caution: The TH-1 does not have any failsafe features. It operates as a slave device driven by the receiver. Any glitch or interference passed from the receiver to the TH-1 will cause the servos to operate erratically.

Caution: It is important that the TH-1 is connected properly before the power (battery) is connected. Failure to so do may damage the TH-1 and whatever it is connected to at the time. The TH-1 supports most radios such as Futaba, JR, Hitec and others without modifications.

The TH-1 assumes a center positive power pin for the connectors. Some radio equipment such as Airtronics, uses a center negative power pin. The appropriate connector adapters must be used in this case.

2.0. Installation

This section explains how to mount the TH-1 and connect it to the battery, receiver and servos. Refer to Figure 3, which is an overall system connection diagram.

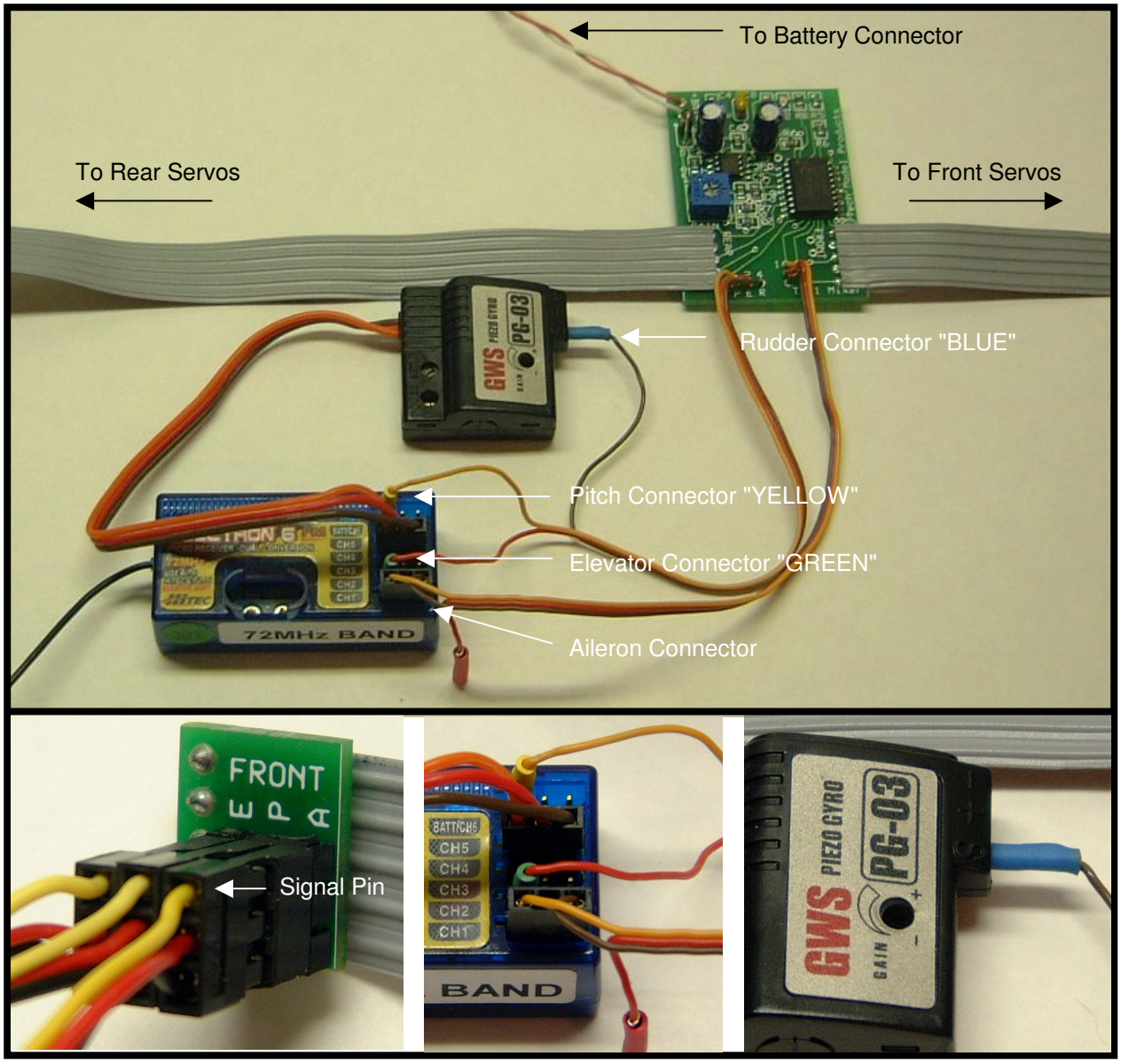


Figure 3

2.1. Mounting the TH-1

Generally the TH-1 main board should be mounted near the center of the model and oriented such that it allows easy access to the gain pot and view of the status LED. The main board and servo cables should be located as far away as possible from the receiver and antenna. Use double sided tape, Velcro etc. attached to the bottom side of the TH-1 to mount it to the model's structure. Avoid covering the two voltage regulator IC's mounted on the bottom of the circuit board. Care must be

used not to let any contaminates touch the top side of the TH-1 circuit board as it is unprotected. **NOTE: Be careful to prevent the TH-1 circuit board from contacting conductive materials such as metals and carbon fiber products.**

2.2. Battery Connection

The TH-1 power leads (red and white wires) need a connector soldered to them that will mate with the connector on the battery. At this point a decision must be made whether to have the ESC and TH-1 tied to a single connector or to have them separate. We recommend using a single connector for simplicity.

We recommend using Deans 2R connectors (Deans PN-1222). Follow the soldering instructions provided with the connectors. The red wire connects to the battery's positive (+) terminal and the white wire connects to the battery's negative (-) terminal.

2.3. Receiver Power Connection

Power to the receiver and gyro(s) can be supplied from either the TH-1 or the ESC. The TH-1 by default is shipped from the factory with the power pin disconnected. **If using a battery with more than 8 cells, the TH-1 can only supply power to the servos.** The pin is removed from the CH1 connector shell and insulated with heat shrink tubing (See Figure 2). This will allow the ESC to power the receiver and gyro(s). **To make the TH-1 supply the power instead, carefully follow the instructions listed below:**

- Remove the power pin (center pin) from the ESC (throttle) connector shell that connects to the receiver and insulate with electrical tape or heat shrink tubing.
- Remove the heat shrink tubing from the TH-1 aileron connector and insert it back into the connector shell.
- Be sure the battery is an 8 cell (1.2 volts) or equivalent maximum.

2.4. Receiver/Gyro(s) Input Connections

The TH-1 has 4 inputs that connect to the receiver/gyro(s) channels (aileron, elevator, rudder, pitch). The connection for each input is described below:

- Aileron input is a 3 pin connector shell the plugs directly into the receiver's Aileron output.

- Elevator input is a single pin connector, color coded **GREEN**, that plugs into the receiver or optional pitch-axis gyro. The gyro if used, plugs directly into the receiver's Elevator output.

- Rudder input is a single pin connector, color coded **BLUE**, that plugs into the yaw-axis gyro. The gyro plugs directly into the receiver's Rudder output.

- Pitch input is a single pin connector, color coded **YELLOW**, that plugs directly into the receiver's Pitch output.

NOTE: High quality electrical tape should be used to secure all of the connections to ensure that they will not separate unintentionally.

Caution: Loss of an input connection while the model is flying will likely result in a crash.

2.5. Servo Connections

The TH-1 implements a form of CCPM mixing suitable for tandem rotor helicopters. The layout for mounting both the front and rear servos is the same. The TH-1 front and rear servo connectors each have 3 headers on them labeled "A", "E", "P". The servo mounted in the "A" position must be connected to the header pins labeled "A". This same labeling convention applies to the other two servos "E" and "P". Be sure to orient the servo connector such that the signal wire points towards the header labels . See Figure 3 bottom left photo. Below is Figure 4, which illustrates the front and rear servo layout required.

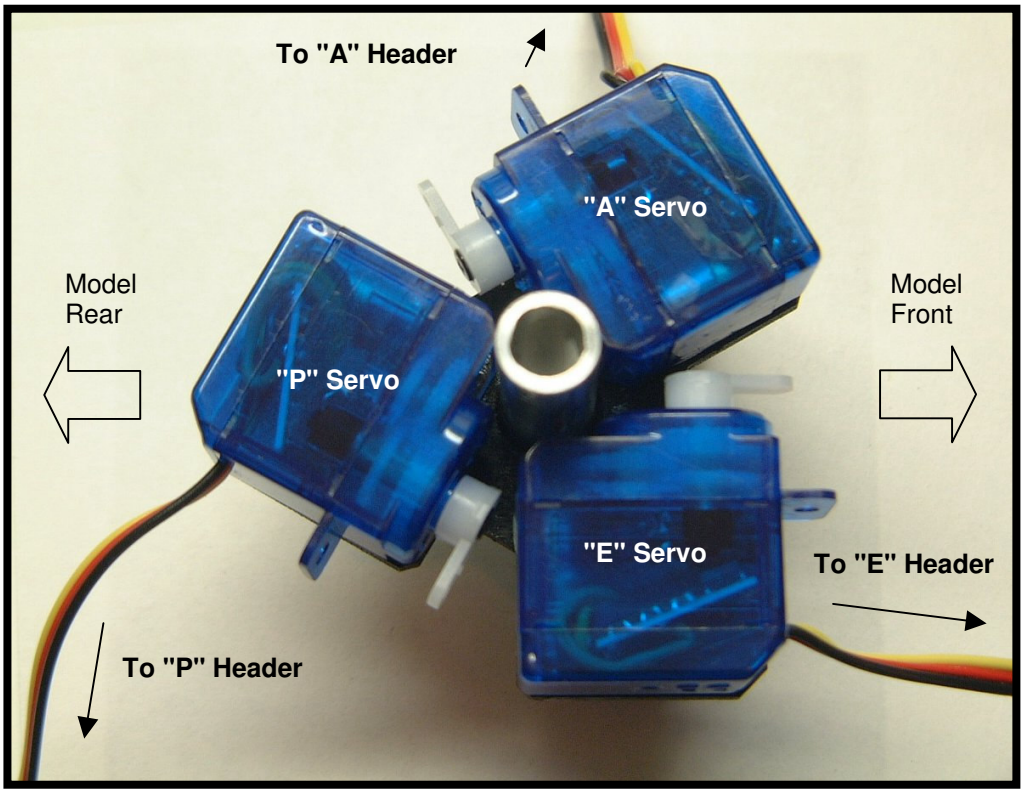


Figure 4

3.0. Setup

This section explains the radio settings required and how the TH-1 controls the model.

3.1. Flight Controls

The TH-1 provides 4 basic flight controls Yaw, Pitch, Roll, and Vertical ascent/decent. These controls map to the familiar transmitter joysticks layout. See Figure 5.

- Yaw - Left transmitter joystick LEFT/RIGHT.
- Vertical ascent/decent - Left transmitter joystick UP/DOWN.
- Roll - Right transmitter joystick LEFT/RIGHT.
- Pitch - Right transmitter joystick UP/DOWN.

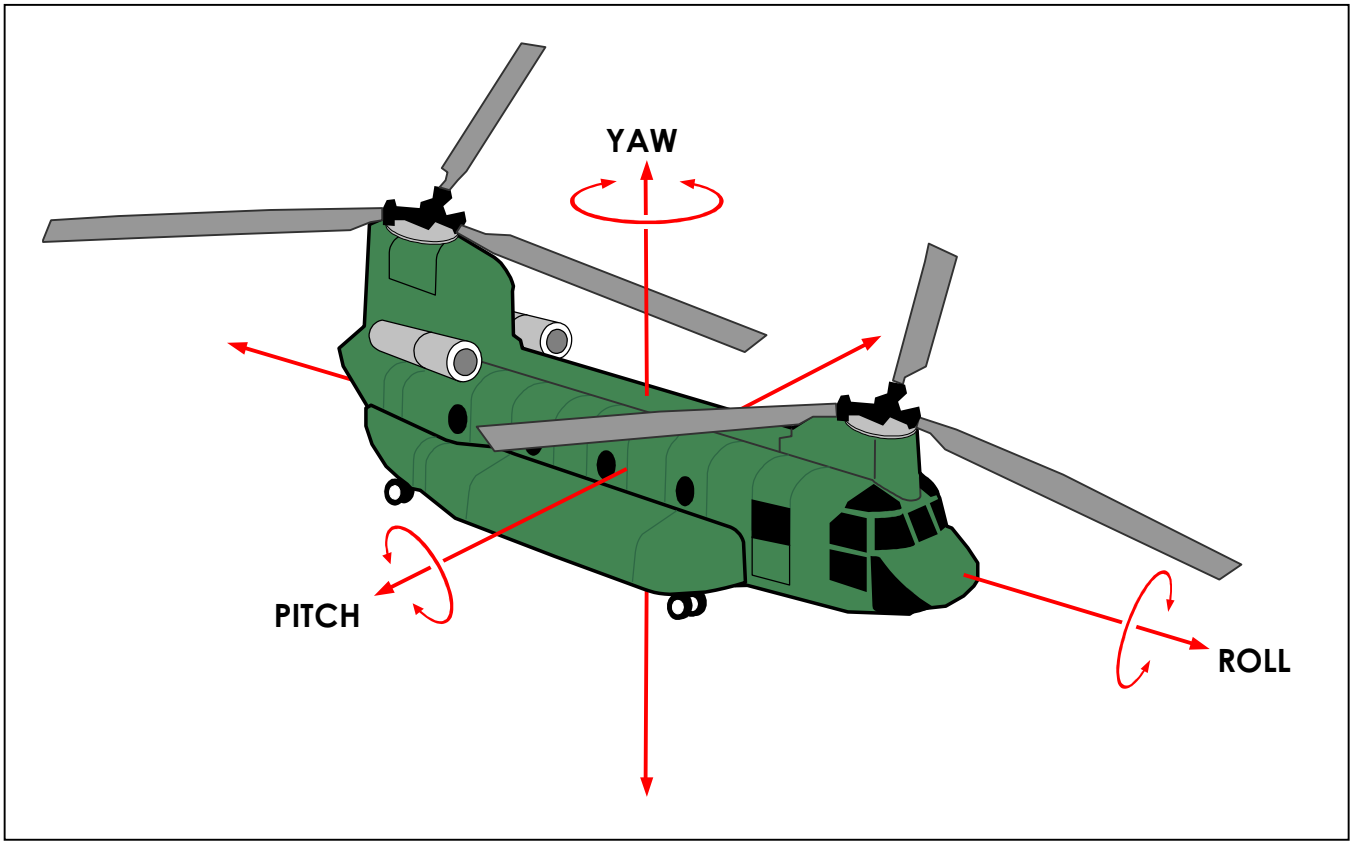


Figure 5

The TH-1 performs yaw control by tilting the front and rear swashplates differentially along the roll axis. See Figure 6.

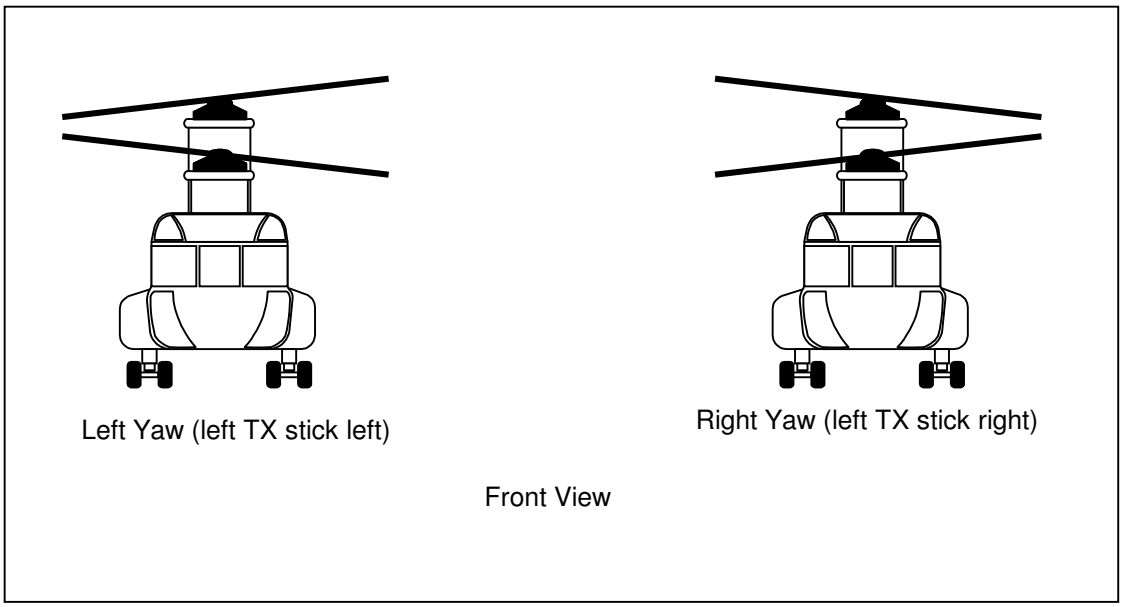


Figure 6

The TH-1 performs roll control by tilting the front and rear swashplates along the roll axis. See Figure 7.

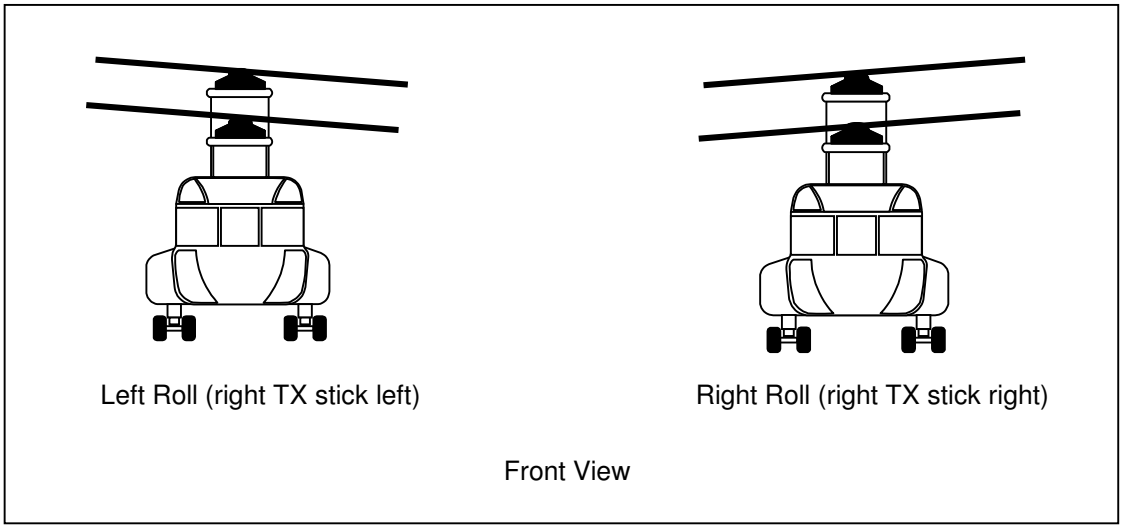
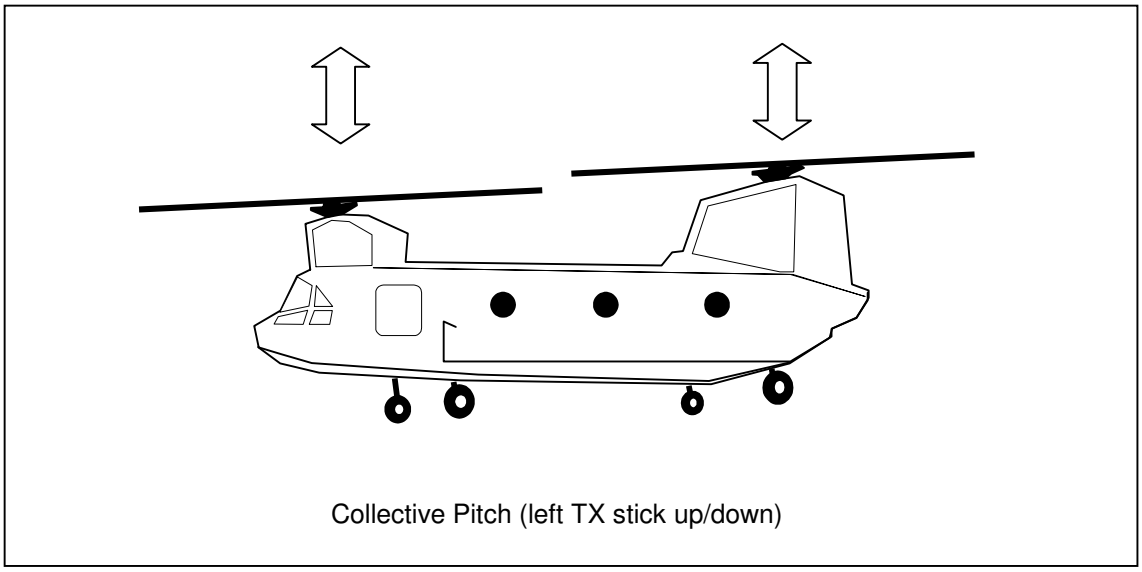


Figure 7

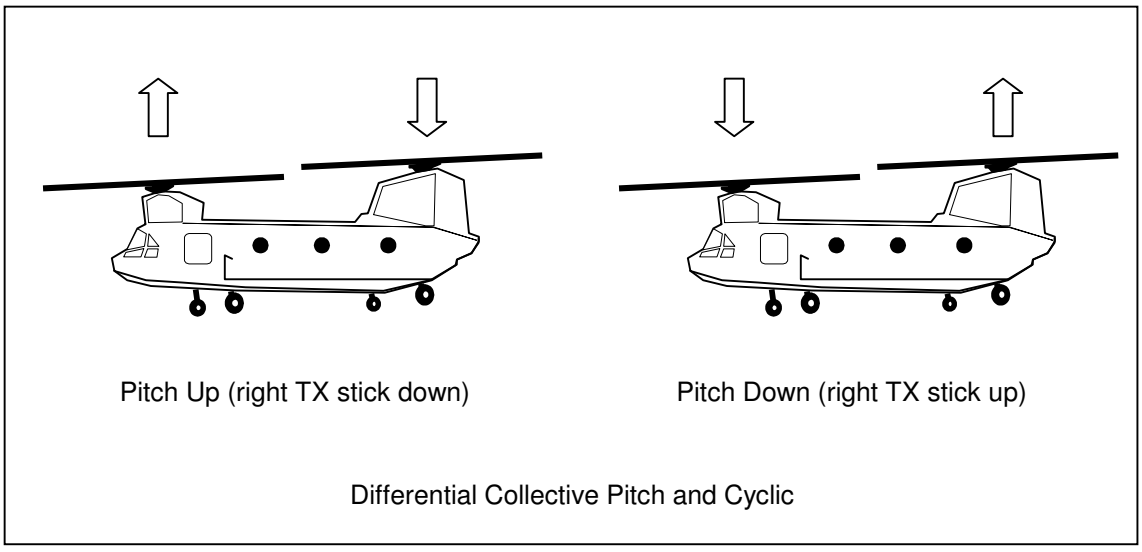
The TH-1 performs Vertical ascent/decent control by increasing/decreasing the front and rear rotor pitch collectively (each the same). This is known as collective pitch. See Figure 8.



Collective Pitch (left TX stick up/down)

Figure 8

The TH-1 performs Pitch control by increasing/decreasing the front and rear rotor pitch differentially. This is known a Differential Collective Pitch (DCP). It also blends in cyclic with the proper ratio. See Figure 9.



Pitch Up (right TX stick down)

Pitch Down (right TX stick up)

Differential Collective Pitch and Cyclic

Figure 9

3.2. Yaw Compensation

The TH-1 provides automatic Yaw compensation that is adjustable by a gain potentiometer. Yaw compensation is needed when using the "Pitch" control since it imbalances the load on the front and rear rotors. The imbalance generates a torque moment that is easily corrected by feeding in the proper amount of Yaw. The gain pot is adjustable over a range from 0 to 100 percent and has 32 unique gain values. The gain should be set such that when a pitch command is given there is no movement by the model along the yaw axis. See Figure 10.

The yaw compensation function can be completely disabled by placing the jumper in the position as shown in Figure 11. With the jumper in place the yaw compensation is disabled and is enabled when the jumper is removed. The jumper is checked only upon power-up. Changing the jumper setting after power-up will have no effect. **Note: JR radios will need to disable the yaw compensation to operate properly with the TH-1 since the channel sequence is incompatible. It will cause frame skipping to occur. Just setting the gain pot to zero will not work, the jumper must be used.**

Yaw compensation can also be done by your transmitter, if it has a programmable mixer. Setup the mixing such that rudder is a slave to elevator. Be sure to disable the yaw compensation on the TH-1 by adding the jumper.

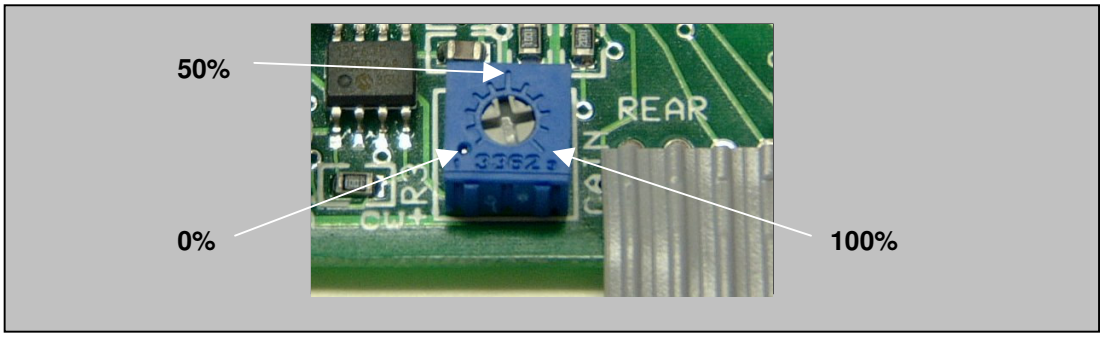


Figure 10

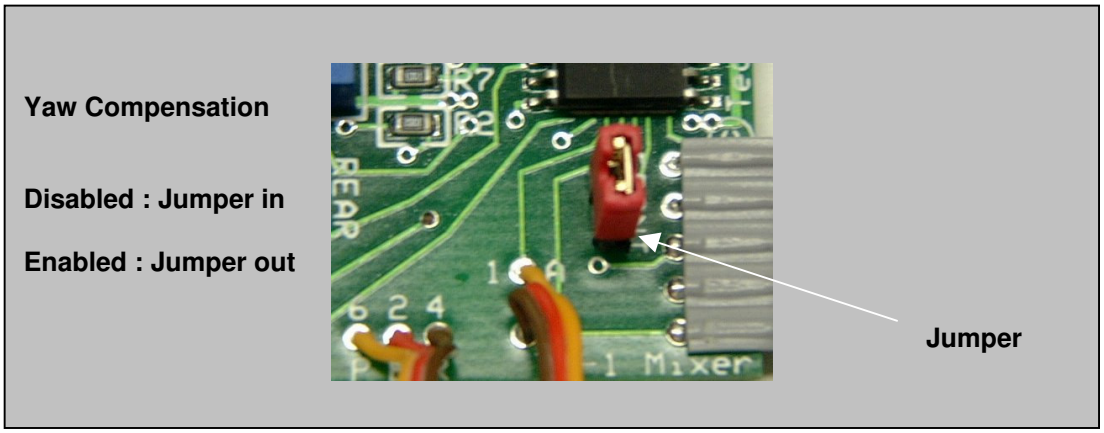


Figure 11

3.3. Radio settings

The TH-1 requires the radio settings for servo reversing and travel volume (also known as end-point-adjust) to be set correctly and within the proper ranges**.**

For Futaba: The servo reverse settings for channels (1, 2, 4, 6) should be set to NORMAL and the travel volume should be set to 80% for each direction.

- CH1 = aileron
- CH2 = elevator
- CH4 = rudder
- CH6 = pitch

For JR: The servo reverse settings for channels (2, 3, 4, 6) should be set to REVERSE and the travel volume should be set to 80% for each direction.

- CH2 = aileron
- CH3 = elevator
- CH4 = rudder
- CH6 = pitch

The actual travel volume values may vary with your installation due to different servo arm lengths etc. Use 80% as a starting point. **Use swashplate type SWH1 (no CCPM mixing by TX). Turn off all other TX mixing functions and set channel 5 for minimum pulse width (1 ms).**

NOTE: Because of the multi-channel mixing it is possible to drive a servo beyond the limits of the mechanical linkages. The servo travel volume of each channel should be adjusted to prevent this situation.

NOTE: With some setups, an unwanted mix between CH4 and CH6 can occur when CH5 is not set to the minimum pulse width of 1 ms. If you need CH5, then try adjusting the travel volume below the point at which the unwanted mixing occurs.

3.4. Gyro settings

The TH-1 requires the gyro(s) used, be properly adjusted for signal offset. Ideally, the offset should be zero (0). This should be checked regularly since the offset adjustment on most gyros is done with a pot . **Be aware that vibration can cause unwanted changes to the pot setting.** Follow the instructions that came with the gyro(s).

3.5. Power-up Initialization

Always power- up your transmitter first and then the TH-1.
On power-up the TH-1 checks the yaw compensation jumper. With the jumper in place the yaw compensation is disabled and is enabled when the jumper is removed.
Note: JR radios will need to disable the yaw compensation to operate properly with the TH-1 since the channel sequence is incompatible. It will cause frame skipping to occur. See section 3.2.

3.6. Run Mode - Troubleshooting

Following the auto-calibration procedure the TH-1 enters Run mode and is ready to fly. The Status LED will blink at about every second to indicate that the TH-1 is operational. If the Status LED fails to blink, this indicates a problem exists. Below is a list of areas to check that may be the source of the problem:

- Check that the power is connected and the battery is charged.
- Check that transmitter is operating properly.
- Check that receiver is operating properly.
- Check that the receiver/gyro inputs are connected properly.

3.7. Preflight Checklist

- Inspect the model for flightworthiness.
- Always perform a radio range check before attempting to fly the model.
- Check that the TH-1 is operational (Status LED blinking).
- Check the controls.
- Happy Flying.

4.0. Warranty

The Tech Model Products LLC. Service Center warrants this TH-1 Tandem Rotor R/C Helicopter Control System against any defects in material or workmanship for a period of one (1) year from the date of original consumer purchase. If the product becomes defective during this warranty period, Tech Model Products LLC. will repair it or replace it at Tech Model Products LLC. discretion without charge for parts or labor, in accordance with the warranty service procedure described below. This warranty extends only to the original consumer buyer and is not assignable or transferable to any other person.

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Warranty returns should be sent to the following address:

TECH MODEL PRODUCTS LLC.
PO Box 154
Guilford, CT. 06437
support@tech-mp.com