



BT-90Q QuadCopter Controller

Flight Stabilization System

Installation & Operation Manual

Dear Pilot,

Thank you for purchasing the BT-90Q QuadCopter stabilizer from Bay-Tec. In order to achieve full potential and safe operation of this product, please carefully read this manual prior to installation.

Warning:

- The installation and use of this device require some skill and knowledge in flying Quadcopters (or Quad).
- If you are a new to the hobby and have never flown a Quad before, we do not recommend you install this device on your own.
- Please find assistance from an experienced person who may provide you with the basic knowledge required to use this device successfully.
- If you are already an experienced Quad pilot, you will find the installation to be easy and logical. Just follow this manual and you won't go wrong.
- You may e-mail us directly for assistance; info@bay-tec.de

OVERVIEW

The BT-90Q controller is specially designed for QuadCopter use. The Attitude Flight Stabilization System (AFSS), which is the heart of the BT-90Q, is an integrated 3-axis gyroscope and 3-axis accelerometer. AFSS forms a comprehensive inertial based navigation platform that calculates 3D flight attitude using proprietary algorithm.

When in Full Balanced-Mode (Mode 1), the AFSS detects any changes to the model's horizontal attitude. If attitude change is detected, the unit will send out controlling signals to change the Quad's four motor speed to maintain stability and balance.

BT-90Q Package:

In each box of BT-90Q, you will receive the following:

- 1 x BT-90Q circuit board.
- 1 x Receiver connecting wires
- 2 x double-sided tape or Velcro fasteners
- 1 x shock absorbing platform with 4 damper bands already installed
- 1 x instruction manual for BT-90Q



Technical Specification and working requirements:

Input voltage	: 4.0 to 6.0 Volts	Weight (excluding wires)	: 20g (71oz)
Current draw	: 52mA (5V)	Temperature range	: -25°C~+70°C
Size	: 55 x 33 x 20 mm (2.17 x 1.3 x .79 in)	Maximum rate of rotation	: ≤ 500 ° / s

The BT-90Q supports two flight formats, "Cross" and "X" (see section on Flight Format). The pulse signal output to control ESCs is between 900-2100µs PPM pulses.

ELECTRONIC SPEED CONTROL (ESC) REQUIREMENTS:

- ESC's with Fast response rates are recommended, as too slow response will result in failure to maintain Quad flight stabilization and control.
- Do not use ESC's that do not have manually settable throttle endpoints. All endpoints MUST be manually matched.
- Do not use ESC's that lose their throttle endpoint settings at each power off (e.g. Castle Thunderbird series).
- Do not use ESC's that must be "armed" before you can set the throttle endpoints (e.g. Castle Thunderbirds). With this ESC type, you must power up all motors and go to full throttle to set the endpoints.
- From our tests, we highly recommend ESC's such as those from ALIGN; throttle endpoints can be set manually before arming, fast throttle response capability and 200 step throttle resolution. Please source for ESC's of such ability.

Any other configuration, please e-mail us for enquiry: info@bay-tec.de

Remote Control system requirement:

The BT-90Q has been tested to work with the following RC systems:

- Robbe-Futaba PPM / PCM 1024 / PCM G3 mode, 2.4 GHz systems ;
- Graupner/JR PPM 8, PPM 12, SPCM mode ;
- MPX PPM8, PPM 12 with UNI mode
- Any remote control system using the standard of 1.5 ms neutral position.

BT-90Q Flight Modes

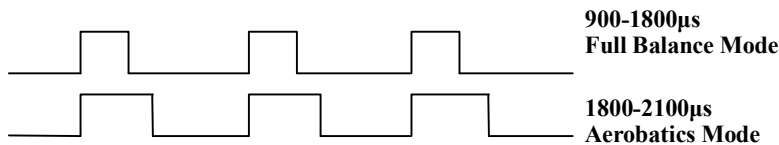
The BT-90Q supports two Flight Modes. Selection of Flight Modes is via a free channel on your Receiver:

- Mode 1:** Full Balance Mode: in this mode, the Quad flight is fully stabilized on all 3 axis, resulting in extremely leveled flight. Suitable for aerial photography, videography, FPV and beginner quad pilots.
- Mode 2:** Aerobatics Mode: In this flight mode, the controls to the Quad motors are very responsive. Specifically for skilled Quad pilots for sports flying, fast forward flights (FFF), stunts, etc.

Switch Settings for Mode Selection:

To select the modes, set your End Point Adjustment (EPA) for the 2-Position Switch as follows:

Switch channel signal input	900-1800µs	1800-2100µs
Functional Mode	Full balance mode	Aerobatics Mode



Gyroscope initialization (re-setting):

Out of the box, the BT-90Q has been fully initialized. However, if the following conditions occur, re-setting and initialization is recommended:

- The device has not been used for a long time.
- There is a change in environmental temperature of over 30 degrees.
- During initialization, do not move the BT-90Q module for at least 20 seconds. If during the initialization, the blue LED flashes, that means movement occurred and you will need to initialize the gyro again.

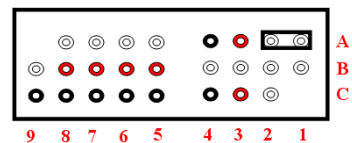
NOTE:

- Carry out this re-setting procedure only if any of the three conditions (above) occur. **We do not recommend regular scheduled re-setting.** It is NOT necessary and NOT recommended.
- The stabilizer unit does not need to be in a horizontal position during initialization. However, you must ensure there is no vibration during this process. If you suspect shaking had occurred, just restart the initialization process.

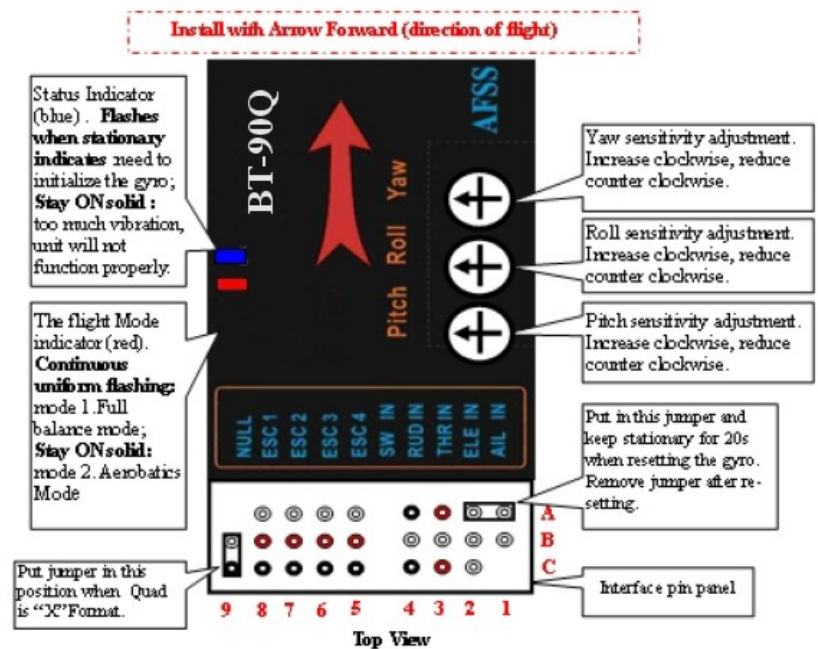
Initialization / Reset Procedure

- Install the jumper as shown in this picture:

- Power-ON the BT-90Q and keep it stationary for at least 20 seconds. You will notice the red light blink with two different rates.
- After 20 seconds the re-setting / initialization is complete.
- Disconnect the power, unplug the jumper and remove (keep it in a safe place for future use).



BT-90Q Connection Interface



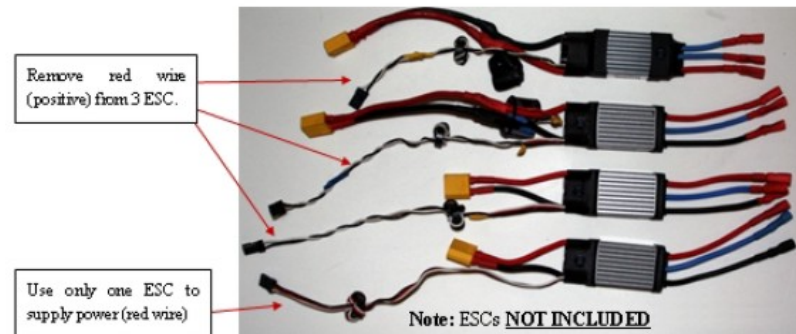
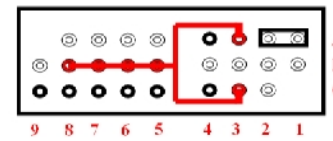
The list of the pin Interface:

9	8	7	6	5	4	3	2	1	No.
Not used	ESC1 Output	ESC2 Output	ESC3 Output	ESC4 Output	GND	Power	Reset the gyro2	Reset the gyro1	A
X-mode	Power	Power	Power	Power	SW IN	RUD IN	THR IN	ELE IN	B
GND	GND	GND	GND	GND	GND	Power (to Receiver)	AIL IN	Not used	C

INTERNAL ELECTRICAL CONNECTIONS

a) BT-90Q Power Supply

- Note the pin diagram of the BT-90Q:
- The red line indicates the internal common connection for VCC (positive). Black circles indicate the internal common Ground (GND).
- The BT-90Q can safely operate between 4 to 6 volts input.
- If your ESC has an internal BEC, you can supply power to the BT-90Q and Receiver via any of the ESC connection (ESC 1 to ESC 4).
- VERY IMPORTANT:** Only one BEC power source should be used. If all four ESCs have internal BEC, choose only one to supply power. Disconnect the red wire (positive) of the other 3 ESCs:



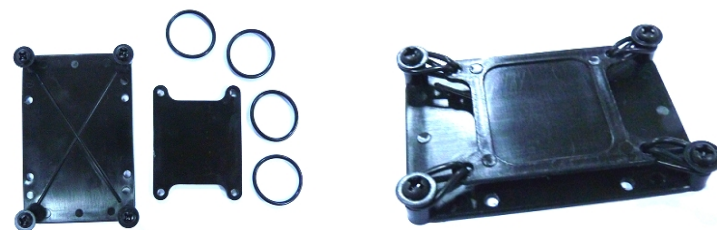
b) Connection between the BT-90Q and RC Receiver output is via this supplied wire. Note the wires are colour coded:



- BT-90Q requires a minimum of 5-channel RC receiver..
- 4 Receiver channels are used; Aileron (Channel 1), Elevator (Channel 2), Throttle (Channel 3) and Rudder (Channel 4). Connect this 4 receiver outputs to the BT-90Q with the supplied wires (**Note each channel is colour coded**).
- 1 Receiver channel (e.g. Channel 5) is required to control the BT-90Q working modes via a 2-position switch.

VIBRATION CONTROL

- Like all accelerometer devices, the BT-90Q is vibration-sensitive. To optimize its stabilization capability, vibrations reaching the unit must be kept at minimum.
- Therefore we highly recommend that you install it with the supplied vibration damper mount.
- The algorithm in the BT-90Q compensates for normal levels of flight vibration. However, if the vibration experienced by the unit exceeds the acceptable level, it will NOT work normally or may even stop working altogether.
- To keep vibration at a minimum, install the BT-90Q away from the engine or any other vibration sources.



- Use the supplied Velcro strips to mount the BT-90Q onto the suspended platform (below).
- Mount the entire unit to the plane using double sided tape (recommended), Velcro, screws or glue.



Only the vibration damping pad is enough when the vibration is not so big.

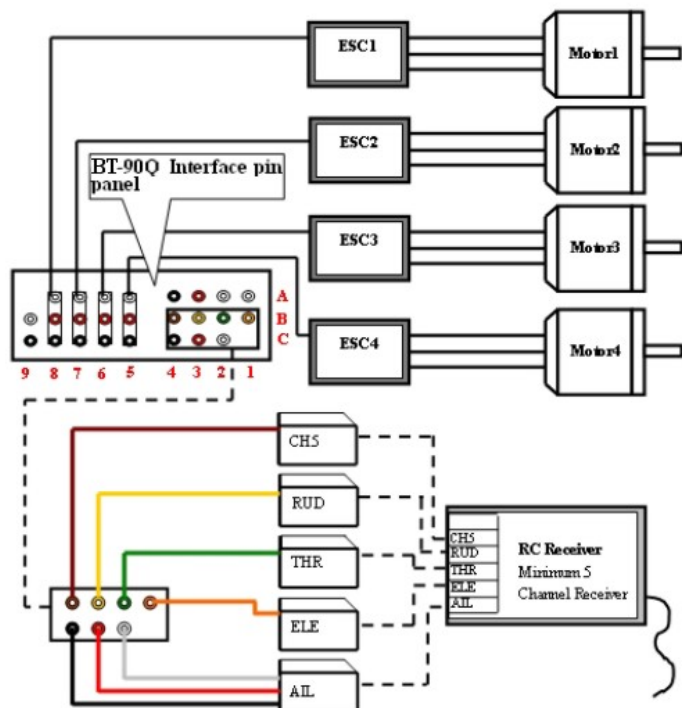
The supplied Damper Mount will take care of most aircraft vibrations, unless it is (the vibration) too severe.

WARNING: VIBRATION CHECK

Even with the shock absorbing mount, your Quad may not meet the damping requirements of the AFSS. To confirm correct vibration damping, please follow this procedure:

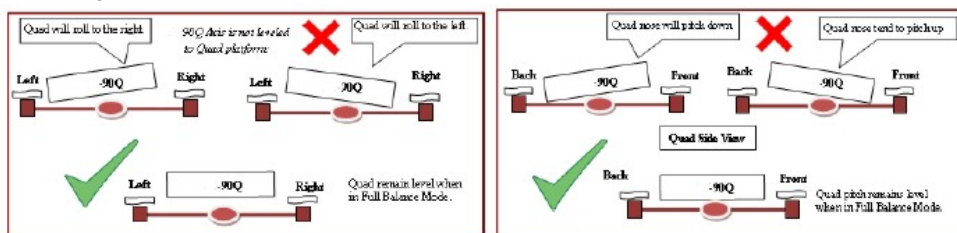
- After connecting all wires between the Receiver, BT-90Q and ESC, install the unit as recommended (ensure correct orientation – arrow pointing forward).
- Activate the 4 Quad motors. **DO NOT TAKE OFF.**
- Observe the state of the blue LED light on the BT-90Q.
- If the blue light remains OFF, this indicates the vibration dampening requirements have been met.
- If the blue LED lights up **ON solid**, then the vibration dampening is not enough. You will need to add additional dampening support or change the installation location.

CONNECTION TO RECEIVER AND ESCs



BT-90Q INSTALLATION: ORIENTATION, POSITION & LEVEL

- The BT-90Q has an arrow printed on the top of it. Orient the arrow towards the front of the Quad (i.e. direction of flight).
- When installing, please keep the BT-90Q horizontal and as close as possible to the "Centre of gravity" (CG) of the aircraft.
- The control benchmark of the BT-90Q is its horizontal position. Therefore, ensure the BT-90Q is in the horizontal position when installed on your Quad.
- If there is deviation between the BT-90Q horizontal position and the Quad's level flight, the off balanced axis will cause the quad to drift as shown below. You may use your transmitter trims for fine-tuning and restore balance.



FLIGHT LAYOUT

- The BT-90Q allows you to choose two types of Flight Layout:

- Cross Type Quad Layout**
- X-Type Quad Layout**

- Note rotor direction of motors.

A. CROSS-TYPE QUAD LAYOUT

- Orientate the BT-90Q so that the arrow points directly at Motor NO. 1.
- The characteristic of 'Cross-Type' layout is easier flight controls and faster response to your flight commands.

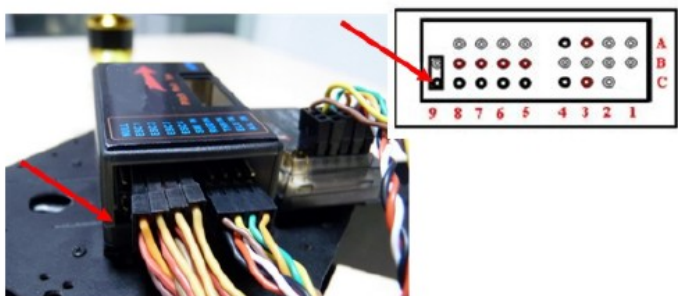
Cross-Type Quad Layout:

- 1 = ESC 1
- 2 = ESC 2
- 3 = ESC 3
- 4 = ESC 4
- cw = clock wise
- ccw = counter clockwise



B. X-TYPE QUAD LAYOUT

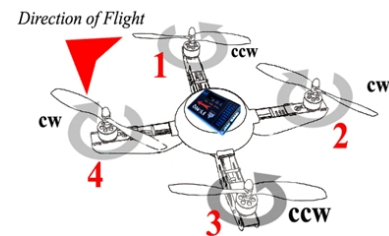
- For X-Type Quad Layout, **install the mixing jumper as shown here:**



- Orientate the BT-90Q so that the arrow points **between** Motor No. 1 and No 4.

X-Type Quad Layout:

- 1 = ESC 1
- 2 = ESC 2
- 3 = ESC 3
- 4 = ESC 4
- cw = clock wise
- ccw = counter clockwise



PRE-FLIGHT CHECK AND SENSITIVITY ADJUSTMENTS

STEP 1 - Radio Transmitter Settings

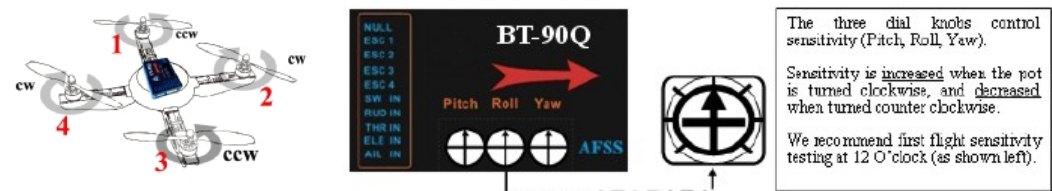
- Select the Model for Traditional Airplane or Glider, where there is **not mixing** for the throttle, elevator, aileron or rudder.
- For transmitters with helicopter settings only, choose mCCPM model setup where throttle, pitch, elevator, aileron and rudder **are not mixed**.
- For a start, we recommend you use your Transmitter EXPO to **reduce** control responsiveness by 50 percent for Aileron and Elevator.
- If the throttle responsiveness is too high, use EXPO to reduce this too.
- For rudder, we recommend no EXPO setting (keep at normal).

STEP 2 – Matching ESC End Points

- Only use ESCs that you can manually set the throttle endpoints. **All endpoints MUST be manually matched.**
- To manually match your ESC endpoints, refer to your ESC Manual.
- As a general guild to ESC end point matching, carry out the following:
 - Install the BT-90Q, 4 x ESCs and 4 x motors as directed in this manual.
 - For added safety, remove all four propellers.
 - Ensure you have set your radio as STEP 1 (above).
 - Activated your radio and push the throttle stick to maximum (ensure your Throttle endpoints is $\pm 100\%$ or more).
 - Power up the quad, therefore activating your RC Receiver, BT-90Q and ESCs.
 - All four** ESCs should give out the signal of detecting the maximum throttle level.
 - Push down your throttle.
 - All four** ESCs should give out the signal of detecting the minimum throttle level.
 - If your ESC do not show detection of the Maximum and Minimum throttle levels, please check with your ESC manual on the correct procedure.
 - If this procedure is successful, proceed with the next steps.

STEP 3 – Rotor rotation.

Please check and confirm the rotation of the motors is correct for ESC 1, ESC 2, ESC 3 and ESC 4. If the rotation is incorrect, just swap two of out the 3 ESC wires to the motor.



STEP 4 - Check Sensitivity Dials

- Check the three BT-90Q sensitivity dials. Never adjust the sensitivity to zero as you will not have any stabilization for your Quad and flight will be impossible.
- As a general rule of thumb, a good stabilization sensitivity is having the three dials on the BT-90Q placed in the middle, as shown below.

STEP 5 – Confirm control movements not reversed

For your first flight, do not fly high. Increase throttle to the point your quad just begins to float. Check your rudder control, elevator (pitch) and aileron (Roll) controls are accurate. If the controls are reversed, adjust (reverse) the settings on your RC Transmitter.

STEP 6 – First Hover

- After checking Step 1 to 5, you may try to hover. Observe the flight character. If the stability is too low (too much drifting or unpredictable flight) you may increase the 3 sensitivity dials.
- If there is wobbling, the sensitivity is too high. **Decrease** the sensitivity accordingly.

STEP 7 – Fine Tuning

Adjust the 3 dials sensitivity as you fly your Quad to the point you are happy with its flying characteristics.

WARNING: SAFETY PRECAUTION – MUST READ

- The purpose of the BT-90Q (AFSS) is to stabilize the Quad aircraft.
- The BT-90Q is for your enjoyment. **Do not** fly the Quad into a crowded area, where your aircraft can cause serious injury if crashed. Please be responsible when using this product.
- Besides the regular pre-flight checks (we recommend a checklist).
- Any electronic hardware on an RC aircraft can fail over time. Please assess your aircraft and electronics condition before use. We are not responsible for any losses as a consequence of using this product.
- Please ask an experienced RC Quad pilot for assistance if you are a beginner. It is absolutely critical that you get flight basics before proceeding. You also need directions to correctly assemble, take off and control your Quad Model.
- Never fly close to people, buildings, wires, vehicles, trees or closed spaces. You could seriously injure someone.
- Minimum flying distance should be 20 feet from yourself or others. Learn about emergency procedures should you lose control of your aircraft.
- Keep the Quad Model and the related equipment away from children. **Quadcopters are not toys.** Children must be supervised at all times if they are allowed to fly.
- Please operate your Quad within the permitted area of your local government. For more details, please check with your local council or government.
- If you are **not using** 2.4 GHz spread spectrum radio, never turn on your radio before checking and re-checking that you're the only one using the frequency. You could cause a crash of another aircraft if the frequency is the same. For security, please obey to the local frequency regulation.
- Never use the remote control within three miles of your local airport. You could endanger full scale aircraft instruments.
- Keep all electrical equipment away from rain water, moisture and extreme high temperature.