# ANATOMY OF A RADIO

## AN INSIDE LOOK AT HOW RC TRANSMITTERS WORK

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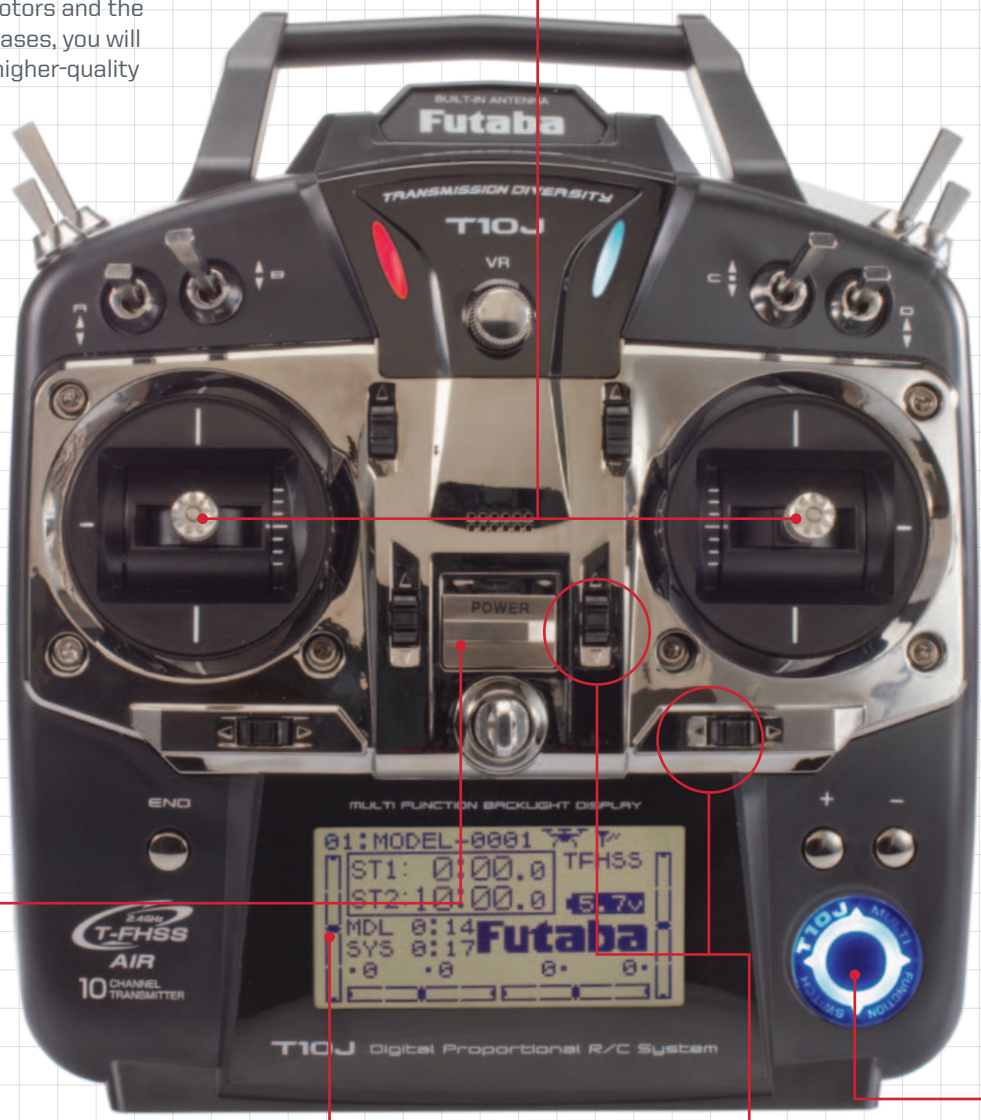
As you become more involved with multirotors and the sophistication of your aerial vehicle increases, you will get to a point where you will start using higher-quality radio systems. Many multirotors come with a dedicated transmitter that's programmed to work with that rotordrone. For aircraft that are built from kits or come in almost ready to fly or bind and fly packages, you'll have to supply your own transmitter. There are several programmable radio systems available and to demonstrate the basics, we've chose the popular 10J radio system from Futaba. All modern radio systems operate on basically the same principles and differ mostly with how their programming menus are navigated. Relatively simple in operation, transmitters (and their internal components) can be a little intimidating for first-time user. This overview explains what the main parts are, where they're found and what the basic functions are.

### Control Sticks

There are two main control sticks. The left stick (mode 2 setup) controls the power of the motors and the yaw response of the quadcopter. If you were inside a cockpit, the left stick takes the place of the throttle control and rudder pedals. The right control stick is like the main control column or joystick that would be between your legs in the cockpit. For an airplane, it controls the ailerons (roll) axis and the elevator (pitch) axis. With a quadcopter, by moving the right stick you control the left/right movement of the multirotor as well as the forward/aft movement.




### Power Switch

All transmitters have a main power switch for turning the radio on and off. Some transmitters have a program menu option to turn on with or without the radio signal being transmitted. This is helpful for setting up your radio's programming.

### MAIN DISPLAY SCREEN

**This LCD screen is the window into your radio's programming. It is where you navigate to the various programming functions and options and it also provides important information while you are operating your multirotor. Basic information that is shown on the main screen includes the model type, name and number, the transmitter battery voltage, the type of signal modulation selected, user countdown or count-up timers, and graphic bars to show the various trim lever positions. There are several submenus also available for specific control functions and programming parameters. There may also be a graphic for telemetry receiving accuracy if your transmitter has that capability.**

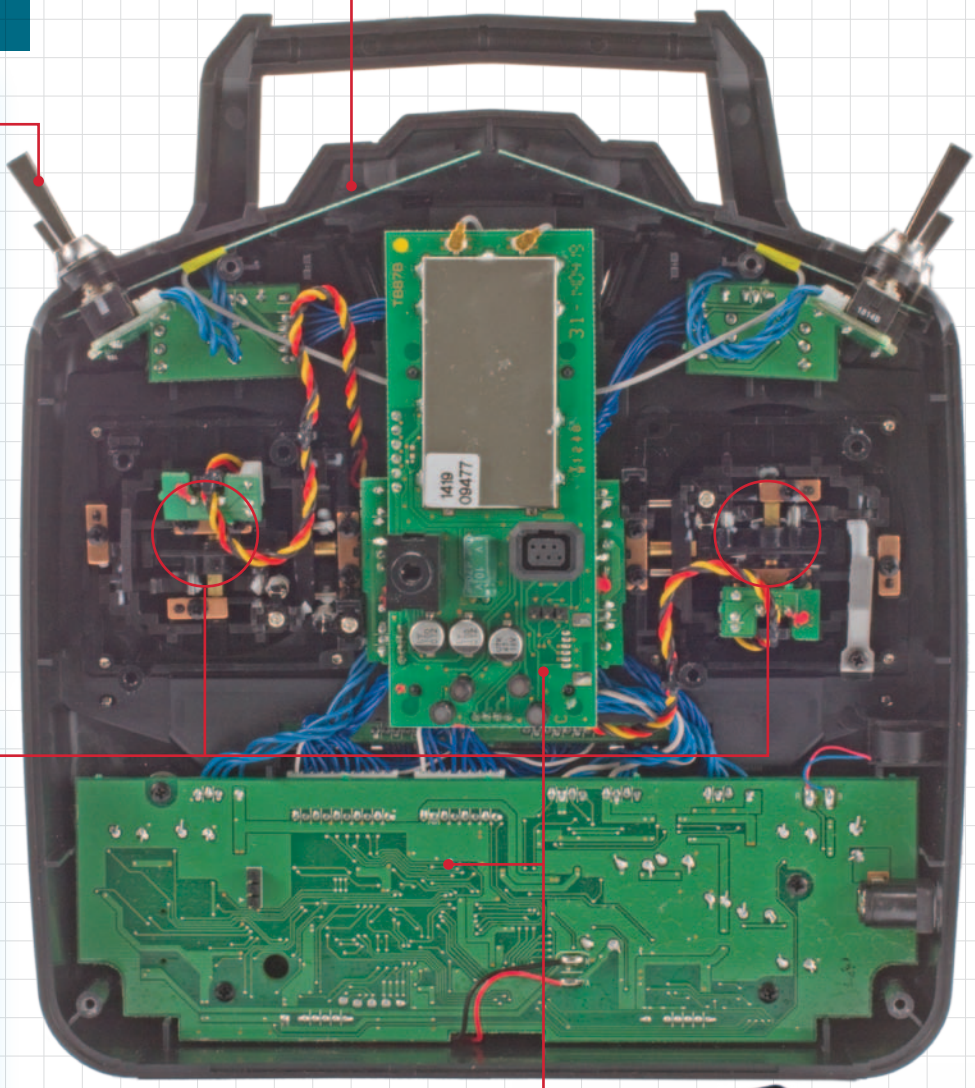
### Control Trim Levers

Close to the control sticks, are small switches that may be used to "trim," or offset, the neutral position of each of the control functions. These trims adjust the center neutral position of each control function (or the idle position in the case of the throttle control) and allow you to fine– tune your multirotor's response. When the control stick is centered but the model wants to drift to the left or right or forward of backward, the trim levers are used to bring the model back to a solid and consistent hover.

## ON THE INSIDE

**Inside the transmitter case are the various circuit boards, wiring and electronic items that transmit the radio frequency, vary the signal modulation that in turn controls the multirotor, and if so equipped, receive telemetry data from the multirotor.**

**Antenna** The antenna that transmits the radio signal to the multirotor can be internally or externally mounted. Some newer transmitters have the antenna incorporated into the transmitter's handle. Depending on the radio's systems, single or dual transmitter antennas may be used.



### Switches

Transmitters are equipped with various two- and three-position switches located at the two upper corners of the case. These switches allow you to change from various settings, including dual rates and exponential control as well as auxiliary functions. You can also activate various flight modes and programmed mixes between various controls. Basic radios have fixed switch functions with the switches labeled to identify their functions. More advanced radios provide the flexibility to allow you to assign various functions, flight modes and mixes to the switches you want.

### Control Gimbals

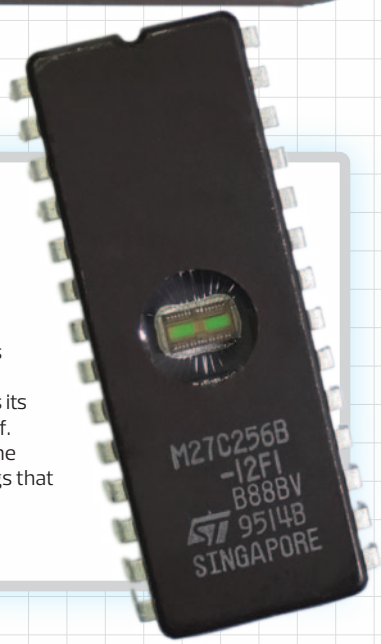
The base of each control stick is connected to a movable gimbal assembly. These spring-loaded (except for throttle), self-centering components read the position of the control stick and send that information to the control board that, in turn, determines the appropriate control commands and sends them out via the signal modulation circuitry. Moving the sticks changes the signals transmitted to the airborne receiver in the multirotor.

## MULTI-FUNCTION SWITCH AND KEY BUTTONS

**These are used to select and adjust the various program menu items. By pressing or by pressing and holding these buttons and switches, you bring up the submenus for the radios, function and system items. Each radio system comes with a detailed instruction manual describing each function and program option in great detail. In the most basic form, this is how you select the type of model function you want, how you name the model and how to set up your controls specifically for the safe and precise control of your multirotor.**

### Circuit Boards

Divided in several main and sub boards, the green PC boards are the brains of the transmitter. All of the integrated circuits, switches and wires are connected to the PC boards. The boards manage the power delivered to the radio's programmable EPROM, which is a type of memory chip (shown at right) that retains its data when its power supply is switched off. In other words, it is non-volatile and it is the integrated circuit that contains the settings that the main display is used to program.



## Airborne System

The little electronic box that "hears" the signal sent to it by the transmitter is called the receiver. Its job is to receive the radio signal, translate it into the desired flight commands, and then convert it back into the proper signals to move the various servos and provide the rotors' speed information to the flight motors. Most of today's RC radio systems operate on the 2.4GHz frequency band and for the transmitter and receiver to work together, you have to "bind" or link the receiver to your particular transmitter. Once this is done, the receiver will only accept the specific coded signals sent to it by the linked transmitter. This type of signal modulation completely eliminates any change of radio interference from other RC transmitters operating in the same area.

The receiver can be powered by a separate battery pack or by an electronic speed control that is equipped with electronic circuitry that provides power to the receiver and servos from the main battery.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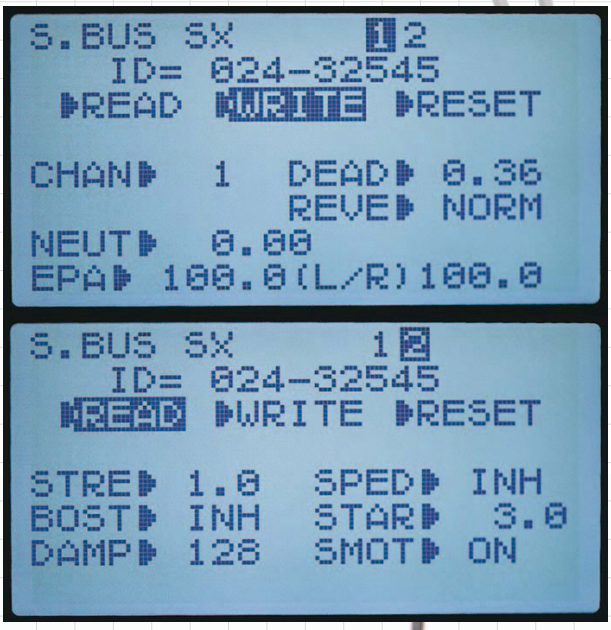
### TRANSMITTER CASE

On the back side of the case there is the battery compartment cover, the Trainer "Buddy Box" connection jack, a 3.5mm earphone plug for listening to telemetry data and an S.Bus connector for advanced servo and telemetry module setup.

## Sub-Menu Screens

Once you enter the radio's programming menus, you can call out and select several sub-menus, where you can enter your changes and selections. Some of the basic sub-menus include those for setting up the various servos for control throw and direction as well as sub-trims for fine-tuning the center point of the servo.

You can also adjust control rates and the sensitivity around the center of the control stick movements. There are sub-menus for selecting the model type, which gives you the choice of airplane, glider/sailplane, helicopter, and with the Futaba 10J, multirotor programming. Like any other type of advanced electronic device, programming your RC transmitter becomes easier with continued use -- and watching multiple YouTube videos! With increased experience comes a better understanding of what's possible.




**Right: The main display shows you all the sub-menus so you can make the required adjustments. Here you see two of the specialty S.Bus receiver setting screens. Below: There are many brands of transmitter and radio systems available with various options and with different numbers of channels.**