

The many modes of the FM-9 Programmer

Gas and glow-powered models controlled the throttle by sending a standard servo signal that physically moved a rod that throttled the engine. (The standard servo signal is a signal that pulses from 0 to 5 volts for only a short amount of time, from 0.001 seconds for the "throttle-off signal" and to 0.002 seconds for a full throttle signal, repeating about 50 times a second.)

When electric power was introduced, it was necessary (or at least easiest) to use this same servo signal to control the current (and power) to the electric motor. Therefore our ESCs (electric speed controls) also respond (only) to this 1 to 2 millisecond (ms) pulse width.

Modelers who fly helicopters wanted their rotors to be able to maintain a set RPM independent of the power requirement and so many ESC manufacturers provided what is called governed, or constant-RPM, modes. Usually it requires a separate programmer to utilize these modes because they usually default to standard R/C throttle control. Control-line fliers take advantage of these governed modes to maintain our propeller RPMs at a constant RPM throughout the stunt pattern.

A governed mode means that every throttle signal corresponds to a certain RPM, as long as the chosen RPM is within the governed range. Generally we aim for an RPM around 75% of the maximum RPM for our combination of battery and motor so that there is plenty of "headroom" available. (The theoretical maximum RPM is the number of cells times 3.7 volts/cell times the kV of the motor.)

On a test stand I have measured these RPM vs. throttle values for a number of ESCs that promise a governed mode. It involves measuring at increments of 0.05 ms over the expected RPM range. The programmer incorporates these values, and interpolates between them for intermediate RPMs, so you can directly dial in an RPM and expect the tach RPM to be very close, especially at the lower RPMs. This provides very reproducible RPMs that are separated by only ½ of 1% within the throttle range. The FM-9 timers store **only** the mode and the throttle value they send to the ESC.

Here are the modes currently (in 2019) supported by the FM-9 Programmer: They assume you have an up-to-date downloaded program from Castle.

1. Throttle mode. The user selects the throttle value from 0 to 100% and the timer sends a throttle signal from 1 to 2 milliseconds to the ESC.
2. Compensated throttle mode. The user selects the throttle value and also indicates how much (on a scale from 0 to 15) the throttle should be increased gradually during the flight time to compensate for the normal decline in battery voltage with time. This can provide a very flyable pattern with inexpensive ESCs.
3. Brodak Hornet mode. Brodak supplies this ESC already programmed for the governed mode for CL models.
4. Phoenix Set RPM mode. This is a mode specific to Castle Creations ESCs, as programmed with their Castle link and downloaded software. It allows you to choose three RPMs and, if you tell it the battery and kV of your motor, it will also tell you if the chosen RPMs are within the governable range. Then you must also use the Set RPM mode when you program your FM-9 timer, where you choose one of three RPMs (perhaps one for a calm wind and others for two wind conditions) and the timer uses one of the other RPMs as the warning RPM.
5. Phoenix High RPM. For the original Castle Phoenix series of ESCs.
6. Jeti Spin. This is a very old calibration for a popular European ESC.
7. Talon High RPM. For the new Talon series from Castle. No data stored.
8. Phoenix ICE/Edge. The Edge is the current and most popular Castle ESC. Data stored.