FM-9 Instructions

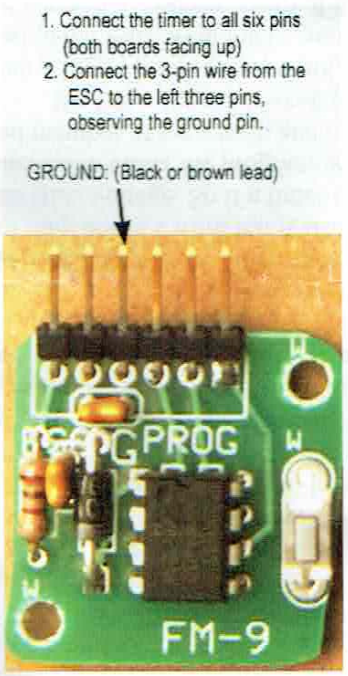
Programming

1. To program the FM-9 timer, first connect it to the programmer with the 6-pin cable. Connect it so that the printing on both boards is **up**.
2. **With the start button on the timer held down,** turn on the programmer. You should get the welcoming message. **Release** the start button. Press the "OK" button. (The programmer's battery is available on the underside of the programmer's circuit board. It should last for many programming sessions but will probably need replacing if left on overnight.)
3. If you are properly connected to the FM-9 timer, you should see the current value for the flight time. Adjust with the "UP" and "DOWN" buttons, as desired (from 1 minute to 9'59"), and then press the "OK" button again.
4. Similarly, adjust the delay time (after the motor blip which confirms that timing has started, after you push the start button). Available delay times are from 2 to 59 seconds. Press "OK" again.
5. Next, you choose the ESC and the operating mode. If you have an ESC that supports the governed/constant-RPM mode (Phoenix/ICE/Edge/Talon, Schulze, Hacker, Jeti Spin, Brodak Hornet), you probably will want to choose the corresponding mode. If you do not, choose either the "throttle" mode or the "compensated throttle" mode, with the preference being the latter. Press "OK".
6. (a) If you are using the governed/constant-RPM mode, you can now select the RPM you desire, directly. (The programmer uses a test-stand calibration, which generally will be within about 50 RPM of what you will measure, assuming the battery/motor/prop combination can provide, but the important thing is that this RPM is very reproducible and precise—and can be varied in very small increments.) (b) If you are using any other ESC or mode, you should be using the "compensated throttle" mode. It allows you to choose the percent of throttle directly. (However, many ESCs do not provide a noticeable increment of power above about 90% of the nominal 100% of throttle, so you had best be able to use a lower throttle setting if you want the power to stay constant during the flight.
7. After another "OK", you are finished if you are using a constant RPM mode or the simple throttle mode, and you should switch off the programmer. (However, you can switch it back on if you have any lingering doubts as to how you programmed the timer…)
8. If you are using the "compensated throttle" mode, you now choose the degree of compensation for the normal decline in battery voltage during the flights, varying from 0 (none) to a maximum of 15. In this mode, the throttle is incremented at 30", 1', 2', 3', 4', and 5'. The closer you are to the maximum available power from your battery/ESC combination, the more compensation you will need. Try an intermediate compensation value to start and adjust based on flight experience.

Using the timer

1. Connect the 3-pin lead from the ESC to the timer, as shown below.
2. When power is applied to the ESC, you should hear the ESC announce it, including probably the number of cells that it recognizes.
3. After a few seconds, you can push the start button; a second later, the timer will blip the motor to confirm that timing has begun; after the programmed delay time, the programmed flight time begins, using the programmed power/RPM setting.
4. As a convenience when testing and as a safety feature, the timer will turn off the motor if the start button is pushed after the beep and during the "flight" time (Serial #4825ff).
5. When the flight time is over, the motor power/RPM is reduced by about 15% as a warning (or *increased* by 15% if that would bring the throttle setting below about 15%), then the former power/RPM is restored for 5 seconds, and then the motor is stopped. (If you have enough battery to make two flights without re-charging the battery, you must disconnect and then reconnect the battery.)

This is the timer board that most will use on a profile model; others with a fuselage model will use the FM-9 with the start button replaced with a remote start button on 6" leads. Other timer boards include the FM-9R which has a BEC circuit for ESCs that don't provide the 5 volts needed by the timer. There are also some timers that add control of retractable landing gear. FM-9V timers uses a pot to vary the RPM around the programmed value, etc.



Trouble-shooting a Premature Motor Shutdown

According to plan, every electric-powered flight should end with a one-second power-drop as a warning at the end of the programmed flight time, followed by five seconds of flight power, followed by motor shutdown. Any earlier motor shutdown is hazardous to the health of the airplane, at minimum, and must be corrected.

The **most likely** cause of a premature shutdown is by the ESC as it is protecting the battery when it senses an average battery voltage less than 3.1 volts per cell (or for whatever voltage for which it has been programmed). [Some ESCs do give you the option of choosing a power reduction rather than a motor cut-off at that point, and R/C fliers often use this.] Once the ESC shuts down the motor, it ignores the throttle instructions from the timer. And because the timer receives no feedback from the ESC, it will just continue its programmed throttle pulses, to the end of the "flight" – or until stopped by a push on the "start" button. Do push the start button!

An ESC may also be programmed to shut down the motor when it senses a too-large motor current (as in a nose-over) and, similarly, the timer will continue to provide throttle pulses until the start button is pushed or time is up or power is removed.

To test whether the ESC did shut down the motor, try disconnecting the battery for a few minutes and then seeing if the timer will restart the motor when the battery is reconnected. Stop it with the "start" button and determine why the battery got low. The cell voltages decrease throughout a flight and very rapidly under high currents, so it is no use to try to measure the voltages after the flight is over or to use the voltages provided by the charger. Instead, check to make sure a battery cell isn't failing or that you have an adequate battery for the prop load. (It is easy to monitor the battery voltage on the a test stand if you use one of the available power monitors. However, the current draw is always higher if the plane isn't moving because the prop has a high drag then.)

The **second most likely** cause of a premature motor shutdown is an intermittent electrical connection between the battery and the ESC or between the ESC's BEC and the timer. This is especially likely when a battery-ESC-motor-timer system has been working properly over many flights and suddenly begins to malfunction. Life inside a Stunter is a violent life, after all, and connections to the battery and to the motor are already stressed because of the high currents; the 5-volt BEC connection to the timer provides extremely low currents but sometimes the mechanical strength holding the parts together may decrease with time. All the connectors are gold-coated to minimize contact resistance, but a contact cleaner (e.g., Radio Shack) might be a good idea.

The **least likely** cause of a premature motor shutdown is the timer because its embedded program is not stressed electrically or thermally – and most of all, every failed timer I have checked is incapable of being programmed or starting the motor. (If you have an ESC which allows its BEC to be programmed for a voltage above 5 volts, that can damage the timer because it is rated for only up to 5.5 volts.)

For a failed timer (and I've delivered many thousands of un-failed timers), the embedded processor can't tell me what hurt it but the usual suspects are incorrect connections to the programmer (for the FM-9 system) or to the ESC (an offset connection, in particular, can reverse the positive and ground leads). I have seen at least one case of a timer that died from static electricity, but that is quite rare – but, again, it did **not** fail during the flight. And if the processor is going to fail from manufacturing defects, it is most likely to do so early in its life ("infant mortality") but almost certainly this will stop it from working at all.

In a few cases a timer has failed internally such that it not only doesn't work but it also provides a low resistance to the BEC voltage. So if a timer ever gets hot when connected to either the programmer or the ESC, consider it a failed member of your team and have it repaired or replaced.

If a timer loses its 5-volt power even momentarily during a flight, it will re-boot and provide only a throttle-off signal to the ESC, as at the beginning of the flight. If this is what happened, you can verify it by holding the model after it lands and push the start button!

As a safety feature, all of my timers will shut down the motor (and will absolutely not re-start until the battery is removed and re-connected) if the "start" button is pushed during the programmed "flight" time. This means that anything that electrically connects the same two pins (the two upper right-hand pins) during the flight will also shut it down. This has happened at least once when a flier mounted the timer on a carbon fiber (electrically-conducting) fuselage and flight loads made the connection. It is one more thing to check, though.

I don't know of **any** timer that has failed in flight. If a timer can start a motor run you can be confident that it will provide the programmed throttle pulses throughout the programmed flight time (unless reset with the start button). It is most important to realize that the ESC doesn't start or run the motor based on simple voltages. Instead, the ESC responds only to a signal that pulses to the supply voltage and lasts between about 0.001 second and 0.002 seconds (off to full throttle), at about 50 times a second. Anything else and the ESC won't run the motor! That is why a "timer" needs a computer chip and why the timer causing a motor shutdown (or sudden start-up!) is so unlikely.

Protecting the timer

The timer can be damaged by connecting it incorrectly to either the programmer or the ESC. In particular, if the connection to the ESC is offset by a pin, the +5 volts will be connected to the wrong pin.

A damaged timer is indicated by its inability to be programmed and, usually, a failure to even blip the motor. I.e., a failed timer won't even produce the "throttle off" signal required to initialize an ESC, let alone blip it or run it. The timer requires negligible current so if it ever gets even warm to the touch, it **must** be repaired or replaced.