unconventional-airsoft.com http://trigger-master.com

Congratulations on your new digital fire control computer! This unit will change the way you use and look at your electric gun. With this short document, you will know all you need to install and use your new **Trigger Master Mark III** (MkIII) unit!

You should have basic soldering skills and feel comfortable with the idea of disassembling and re-wiring your gun before you start this. If you do not, get your local Airsoft gun mechanic to install this for you.

Firing Modes Available

Normal (Safe-Semi-Full)	Fire selector works like a normal gun.
Burst/Full Hybrid Mode (Safe-Semi-Burst/Full)	When on "FULL", a 3-shot burst is fired. If the trigger is held down after the burst, the gun begins firing in full-auto.
Semi-only (*) (Safe-Semi-Semi)	The gun will only fire semi-auto, regardless of selector switch setting.
Burst Mode (Safe-Semi-Burst)	When on "FULL", a 3-shot burst is fired. No full auto follows the burst.
Sniper/DM mode (*)	Like Semi-only, but with a 1-second shot delay between each shot to simulate the delay from recoil and careful aim. (This mode can be useful to allow electric Sniper/DM guns higher FPS limits, when semi-only is not enough of a handicap.)
Bonus Mode (Safe-Burst-Full)	Provided as an extra bonus firing mode for those who like to try out experimental things!

Modes marked with an (*) are the only modes available on semi-locked units.

Technical Details
Size and Weight: 50.8mm x 16.5mm x 13.5mm. 14 grams. Unit can fit in a 19mm diameter tube. **Voltage Range:** Accepts from 7.0V to 18.0V (maximum). Li-Po is OK to use! **Power:** The Trigger Master is rated for 450 Amps peak, 60 Amps continuous. It can deliver 7000 Watts of power. **Low Battery Warning:** Low battery signal happens when the battery drops to 85% of the initial voltage. Shutdown will occur when the battery voltage is either under 7.0V (too low to run the Trigger Master), or drops below 80%. (These values can be changed – see *Advanced Configuration* for details.)

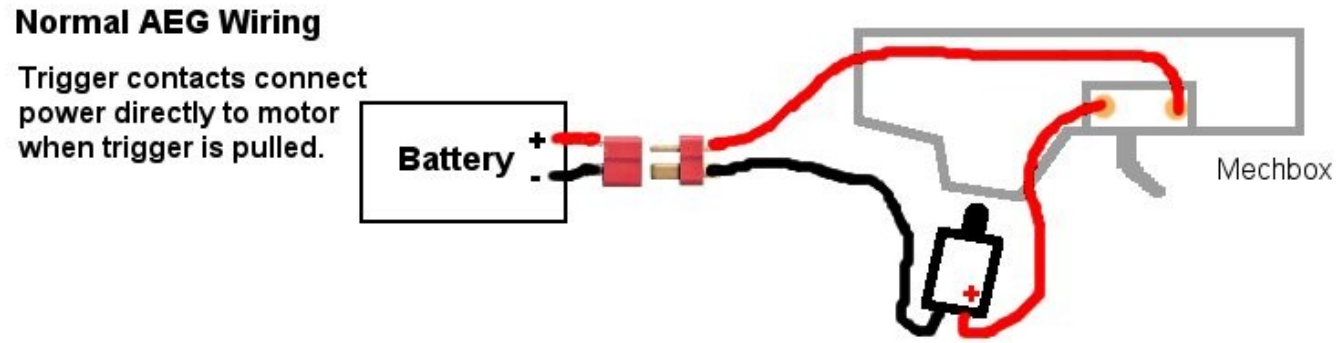
STEP 1: Disassemble your Gun

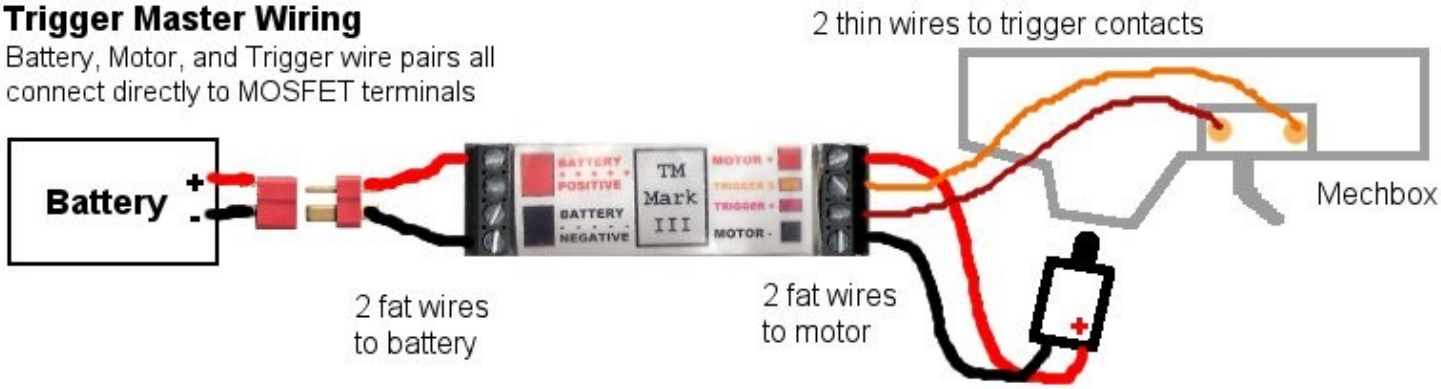
You will need to access and change some wiring in your gun to install and use the Trigger Master. If you are not comfortable with doing that, find a gunsmith who can do the installation for you.

STEP 2: Install the Trigger Master unit and Wiring

The Trigger Master is small enough to be placed in almost any spot inside an AEG. It can even sit in the same space as a normal fuse holder (replacing the stock fuse) if space is tight. (But keeping your fuse is recommended.)

One of pair of wires goes to the battery, one pair goes to the motor, and one pair is for the trigger contacts as shown in the following diagrams. (The gun's fuse is not shown.)





NOTE: There are two “Battery +” and two “Battery -” terminals on the Trigger Master. You need only connect the battery wires to one positive and one negative. (You do not need to use both “+” and both “-” terminals.)

Additional Wiring Details and Notes

- One trigger wire is marked “Trigger +” and the other is marked “Trigger S”. It doesn't matter which wire goes to which trigger contact.
- 16 (or 18) gauge wire is appropriate for the battery and motor wires. These wires carry a lot of current, so the thicker the better. Thinner wire (24 gauge) is OK to use for the trigger wires.
- The **Trigger Master Mk III** has screw terminals (use a 0.1” or 2.5mm flathead) for solder-free wire connections to the unit. Strip about 1/8” of wire, fit it into the screw terminal, and tighten the screw. If you know how to solder, tin the stripped end of wire for a fray-free end to work with.

- The wires to and from the Trigger Master should be twisted in pairs where possible. (Diagrams do not show the wires twisted to make it easier to see what wires go where.)

This picture shows a good twist. Try to twist wire pairs whenever possible when you install. Twisting helps minimize electrical noise and voltage spikes due to the large currents used by the motor.

- Double and Triple-check your battery wires **before** you power up! Be extra sure to connect the "+" and "-" wires appropriately! (Deans connectors have a small + and – marked on the plugs.)

- The trigger wires should connect directly to the trigger switch contacts in the trigger assembly of the mechbox. The most common way to do this is by soldering the trigger wire ends to the contacts. Alternately, snip the existing wires attached to the contacts at a convenient place, and splice into those instead.

- Double and Triple-check that you have the polarity of the wires to the motor right! If you wire the motor backwards, you will be running it in reverse which will probably damage your gun.

- The diagrams do not show the AEG fuse. If at all possible, it is recommended that you leave your AEG fuse in place (between the battery and the Trigger Master unit) for extra protection.

STEP 3: Testing

1. Connect a battery. Touch the grip of the gun (where the motor is). You will feel a **short** vibration, then a **longer** vibration. This means that the power-up self-test is complete and OK. (If you do NOT feel the pulses described, disconnect power and check your wiring. If you feel four pulses, either you are holding the trigger down, or there is a short in the trigger wiring.)

2. Put the gun into SEMI and fire the gun 5 times. Pull the trigger completely for each shot. The MOSFET computer will now be "trained" for your gun, battery, and gear timing. (NOTE: You should do this every time you power up the gun – fire the first 5 shots in SEMI.) Ignore this step for a gun with no semi-auto capability such as the M249.

3. Put the selector on FULL and pull the trigger. You should get a burst. If you keep the trigger held down after the burst, the gun will go full-auto.

4. If all went well, you are done! Leave things alone to "just work", or read on for advanced uses!

TROUBLESHOOTING

- Four pulses at powerup instead of the normal short then long pulse? The trigger is either being held down (don't pull it when powering up) or there is a short or other wiring problem with the trigger.

- Is your gun "stuttering" when it tries to fire in burst or auto? Does it not complete shots in semi-auto? This is probably due to a trigger malfunction. Make sure your trigger wire connections to the trigger contacts are good. Or your trigger contacts might be dirty, corroded, not making proper contact when you pull the trigger, or all of the above! Clean them up (or replace them) to

make sure you are getting good operation. (Arcing on the trigger contacts from stock-wired guns damages them and can cause this problem, and it means your trigger switch would eventually fail completely; the good news is that the Trigger Master MOSFET eliminates this arcing.)

- If the operation of your gun ever seems completely messed up (or you can't remember what you did or didn't change in the configuration), do a FACTORY RESET - see the next section for how.

- 99% of problems can be traced to low batteries! Having strange problems? Charge your batteries with a good quality charger and give it another go!

USING THE TRIGGER MASTER – TIPS, CARE, AND MAINTENANCE

- **Always fire the first 5 shots in SEMI after powering up to train the gun's auto-timing.** (Does not apply to a gun with no semi-auto capability such as the M249.)

- Pull the trigger completely for each shot when in SEMI-AUTO; try not to release the trigger "early" before the firing cycle is complete (especially during those first 5 shots in SEMI.)

- Using a Li-Po battery? No problem, but to avoid overdischarging your battery pack (which is very bad for a Li-Po) change the battery when you get the "Low Battery" warning – which is one pulse from the motor after a shot is fired. "Low Battery" kicks in when the battery drops to 85% voltage.

- If you will always be using the same Li-Po, try the **Li-PO Battery Cutoff Mode** option! (See the Advanced Configuration section on the following pages for details.)

- Is your Li-Po battery running your gun too fast and hard? Use motor speed reduction to slow things down with **no** loss in torque! (See the Advanced Configuration section for details.)

- Disconnect the battery while the gun is in storage. (The Trigger Master uses a small amount of power while connected to a battery, which will slowly drain the battery over a long time if not connected.)

- If you ever pull the trigger and the gun does something strange (or doesn't fire) – **STOP!** Release the trigger and look for the problem.

- Try to use the same battery packs with the same gun. The computer uses a highly accurate method of timing for bursts, but switching to a much higher or much lower voltage/capacity battery can confuse the auto-timing. Always fire the first 5 shots in semi-auto after powering up to keep the timing "topped up".

ADVANCED CONFIGURATION

Many people are perfectly happy with the default settings for the Trigger Master, but if you'd like to explore the additional options and firing modes, this next section is for you!

Remember you can ALWAYS return your Trigger Master to the factory defaults by doing a FACTORY RESET, so don't be afraid to play around!

Advanced Configuration Reference

The following options are available to be programmed into the Trigger Master via a system of trigger pulls and motor grip-pulses for feedback. For advanced users only! Anything you set here will be remembered even if you disconnect the battery.

NOTE: Programming mode has changed in the Trigger Master Mark III - it is not the same as previous versions!

The advanced configuration (programming mode) works by putting the gun into a state where you can select an option (for example, firing mode) then change the setting of that option. Here is the basic process:

1. Power up the gun.

2. You will feel a short vibration.

3. Pull the trigger once (**after** the short vibration but **before** the second, longer vibration.)

4. The gun will give **3 quick vibrations**. You are now in programming mode and the gun is waiting for you to tell it which option you want to change. If you do nothing for 2 seconds, it will go to step 5.

    a) Pull the trigger "X" times where X is the number of the option you want to change.
    b) The gun will vibrate "X" times to confirm the option number selected.
    c) Pull the trigger the desired number of times to set the option, or do nothing to leave the option unchanged. The gun will vibrate slightly with each trigger pull to signal that it "heard" each trigger pull.
    d) After a short pause, the gun will give **3 quick vibrations** to signal that it accepted the new setting, and is ready for new input.
    e) Go to step **a)** to select another option, or do nothing if you are done.

5. The gun will give a long vibration, signaling that programming mode is done and the gun is ready to use the new settings.

Option 1 – MODE selection

This option sets the gun's function. Specifically, how the gun fire selector behaves.

1. Normal mode (SAFE-SEMI-FULL)
2. Burst/Full Hybrid Mode (SAFE-SEMI-BURST/FULL) *
3. Semi Only (SAFE-SEMI-SEMI)
4. Burst Mode (SAFE-SEMI-BURST with no full-auto after the burst)
5. Sniper/DM Mode (Semi-only with a forced 1 second delay between shots) **
6. BONUS Mode (SAFE-BURST-FULL) ***

* In mode 2 (Burst/Full Hybrid) with selector on AUTO the gun fires a burst, then goes full-auto if the trigger is held down.

** The first 5 "timing training" shots in Sniper/DM mode will not have the shot delay.

*** The burst timing on this experimental mode is not guaranteed to always be 3 shots – it is possible that after sustained use the burst timing may result in the occasional burst that is not exactly 3 shots. This is because the auto-timing adjustment relies on semi-auto and "semi-auto" has been turned into "BURST". The good news is that none of this can damage your gun or MOSFET settings, so feel free to try it out! **The first 5 "training" shots are always semi-only, they will not be bursts.**

Option 2 – BURST TIME REDUCTION

Pulling the trigger one or more times in this option will shorten the length of time of a burst. This is useful to manually correct the timing if the gun happens to be shooting more than 3 shots for a burst, or if you want to manually tweak it to get 2-shot bursts.

Each trigger pull = 4% shorter burst time

Note: On semi-locked units installed on full-auto only guns (meaning gearboxes that have NO semi-auto, e.g. M249) this option will manually *decrease* the length of a single firing cycle. (A semi-locked full-auto gun is technically firing "bursts" that are only one shot long.)

Option 3 – BURST TIME INCREASE

Pulling the trigger one or more times in this option will lengthen the length of time of a burst. This is useful to manually correct the timing if the gun happens to be shooting less than 3 shots for a burst for some reason, or if you want to manually tweak it to get longer bursts.

Each trigger pull = 2% longer burst time

Note: On semi-locked units installed on full-auto only guns (meaning gearboxes that have NO semi-auto, e.g. M249) this option will manually increase the length of a single firing cycle. (A semi-locked full-auto gun is technically firing "bursts" that are only one shot long.)

Option 4 – MOTOR SPEED REDUCTION

Pulling the trigger one or more times in this option will slow down the motor, which effectively reduces the rate of fire. This can be useful for guns that have very powerful batteries and/or high-speed gears which are simply firing too fast (which can lead to double-feeds, etc.)

Each trigger pull = 10% slower motor speed

*(See also **Option 11 – Smart Rate-of-Fire** if you are interested in reducing rate-of-fire.)*

Option 5 – MOTOR SPEED INCREASE

Pulling the trigger one or more times will speed up the motor if it has been previously slowed down. It is not possible to increase motor speed past 100%. Motor speed is always 100% unless specifically changed.

Each trigger pull = 10% faster motor speed (Factory default is 100%)

Option 6 – SHOT DELAY END VIBE ON/OFF (For Sniper/DM Mode only)

This mode applies only when the gun is in Sniper/DM mode (which has a 1 second forced delay between shots.)

To make the motor give a short vibration to signal to you *exactly* when the shot delay is over and you can fire again, enable this option. (The vibration should not be confused with the low-battery warning, which is a longer vibration.)

Pull trigger ONCE to enable shot delay end vibe in Sniper/DM mode.
Pull trigger TWICE to disable shot delay end vibe in Sniper/DM mode. (Factory default)

Option 7 – FACTORY USE ONLY (Do not use)

This option is reserved for factory testing and should not be used.

Option 8 – FACTORY RESET

This "option" is a way to return the Trigger Master to factory settings.

Enter programming mode as normal. The gun will vibrate 3 times and wait for you to select an option.
Pull the trigger 8 times to select "FACTORY RESET".
The gun will answer/confirm with 8 vibrations.
Immediately **PULL AND HOLD THE TRIGGER** until you feel a long vibration. The gun will now no longer respond.
Disconnect power, then re-connect power. The gun is now back to factory settings.

Option 9 – FACTORY USE ONLY (Do not use)

This option is reserved for factory testing and should not be used.

Option 10 – FACTORY USE ONLY (Do not use)

This option is reserved for factory testing and should not be used.

Option 11 – SMART RATE-OF-FIRE ON/OFF

This option allows you to reduce rate-of-fire in fullauto without losing first-shot trigger response!

When "Smart RoF" is enabled, semi-auto shots, burstfire, and the first shot of a full auto burst are always at motor speed of 100% for fastest rate-of-fire and best trigger response. **After the first shot in fullauto, the RoF is dropped down smoothly for the rest of the fullauto burst.**

This option is intended to work along with a reduction in motor speed (option 4) so that fullauto rate-of-fire can be reduced to something more realistic/less wasteful while trigger response is still kept as high as possible.

Pull the trigger once to enable Smart RoF Drop-Down
Pull the trigger twice to disable Smart RoF Drop-Down. (Factory default)

This option only does anything if the motor speed has been reduced (see option 4).

TECHNICAL DETAIL NOTE: The Smart RoF feature works by disabling motor speed reduction for burst-fire and semi-auto. Bursts and semi-auto are always at full motor speed. Only full-auto is affected by Smart RoF (motor speed only drops down in fullauto).

Option 12 – Lithium-Ion (e.g. Li-PO) Battery Cutoff Mode

It is safe to use a Li-PO battery with your Trigger Master without changing this option. One more time, to be absolutely clear, you can use a Li-PO without ever touching this option. If you are not 100% sure of what you are doing, you can safely leave this mode alone and your gun will work just fine.

Use this feature if you plan to exclusively use Li-PO batteries with the same number of cells in your gun.

This option sets specific Low Battery and Cutoff voltage levels best suited for use with Li-PO batteries. This feature will warn you of a low battery condition **and** will prevent overdischarge of your Li-PO cells by cutting off the firing when the battery gets too low (just a little over 3.0V per cell to be on the safe side). Those features will only work if you use a Li-PO battery that actually matches the settings you provide here! If you don't understand what I'm talking about, you can ignore this setting safely.

If you use this option and ever switch to a Li-PO with a different number of cells, you should update this option to match the new battery. If you switch to non Li-PO batteries, you should disable this option.

Pull the trigger once to disable "Li-PO Battery Mode".
*Pull the trigger twice to enable voltage levels for a 2-cell Li-PO (e.g. 7.4V). Low 7.1V Dead: 7.0V**
Pull the trigger three times to enable voltage levels for a 3-cell Li-PO (e.g. 11.1V). Low: 9.6V Dead:9.2V
Pull the trigger four times to enable voltage levels for a 4-cell Li-PO (e.g. 14.8V). Low:12.8V Dead:12.3V

When the Trigger Master detects that your battery is low, the motor will vibrate after each shot. When the battery is dead the gun will vibrate *instead of* firing when the trigger is pulled (to prevent overdischage.)

* NOTE: The Trigger Master requires a minimum voltage of 7.0V to operate. The low-voltage and cutoff levels for a 2-cell Li-PO (e.g. 7.4V) are therefore set around this requirement. So you may use a 2-cell Li-PO and it will work normally, but realize that the Trigger Master will cut it off at 7V (which is before it is technically "empty").

Advanced Configuration Examples:

Advanced configuration mode can be tricky until you get the hang of it, so here are some examples. Remember you can always reset your gun to factory defaults if you want to start all over (See Option 8).

To change the gun to "Sniper/DM Mode" (and no other changes), do the following:

1. Disconnect and re-connect battery. After the first vibration, pull the trigger once.
2. Feel 3 quick pulses (gun is in programming mode, and waiting for input.)
3. Pull trigger once (Option 1 – Mode) and wait a moment. Gun "answers" with 1 pulse (Option 1 confirmed.)
4. Pull trigger 5 times (to select Sniper/DM Mode) – notice that gun vibes each trigger pull for feedback. Wait a moment.
5. Feel 3 quick pulses (new setting accepted, and waiting for input.)
6. Do nothing. After a moment gun gives a long vibration (New settings accepted, programming mode exited.)

To change the gun to "Semi-only" and reduce motor speed by 20%, do the following:

1. Disconnect and re-connect battery. After the first vibration, pull the trigger once.
2. Feel 3 quick pulses (gun is in programming mode, and waiting for input.)
3. Pull trigger once (Option 1 – Mode) and wait a moment. Gun "answers" with 1 pulse (Option 1 confirmed.)
4. Pull trigger 3 times (for semi-only) – notice that gun vibes each trigger pull for feedback. Wait a moment.
5. Feel 3 quick pulses (new setting accepted, now waiting for input.)
6. Pull trigger 4 times (Option 4 – Motor Speed Reduction) and wait a moment. Gun "answers" with 4 pulses.
7. Pull trigger 2 times for 20% speed reduction (10% per trigger pull) – notice gun vibes each trigger pull for feedback. Wait a moment.
8. Feel 3 quick pulses (new setting accepted, and waiting for input.)
9. Do nothing. After a moment gun gives a long vibration (New settings accepted, programming mode exited.)

To reduce motor speed by about 30% and enable "Smart RoF" feature:

1. Disconnect and re-connect battery. After the first vibration, pull the trigger once.
2. Feel 3 quick pulses (gun is in programming mode, and waiting for input.)
3. Pull trigger 11 times (Option 11 – Smart RoF on/off) and wait a moment. Gun "answers" with 11 pulses (Option 11 confirmed.)
4. Pull trigger 1 time (enable Smart RoF) – notice that gun vibes each trigger pull for feedback. Wait a moment.
5. Feel 3 quick pulses (new setting accepted, now waiting for input.)
6. Pull trigger 4 times (Option 4 – Motor Speed Reduction) and wait a moment. Gun "answers" with 4 pulses.
7. Pull trigger 3 times for 30% speed reduction (10% per trigger pull) – notice gun vibes each trigger pull for feedback. Wait a moment.
8. Feel 3 quick pulses (new setting accepted, and waiting for input.)
9. Do nothing. After a moment gun gives a long vibration (New settings accepted, programming mode exited.)

To enable Li-Po battery cutoff mode (for a 3-cell 11.1V battery):

1. Disconnect and re-connect battery. After the first vibration, pull the trigger once.
2. Feel 3 quick pulses (gun is in programming mode, and waiting for input.)
3. Pull trigger 12 times (Option 12 – Li-Po cutoff mode) and wait a moment. Gun "answers" with 12 pulses (Option 12 confirmed.)
4. Pull trigger 3 times (3-cell Li-Po) – notice that gun vibes each trigger pull for feedback. Wait a moment.
5. Feel 3 quick pulses (new setting accepted, waiting for input.)
6. Do nothing. After a moment gun gives a long vibration (New settings accepted, programming mode exited.)

Startup Codes Reference	
After connecting power, the Trigger Master does a power-up self-check which lasts a few seconds. After the check, the results are communicated by vibrating the motor.	
One Pulse	All systems go (normal). This pulse is about half a second long.
Two Pulses	Battery voltage is less than 7.0 volts. (Battery is really dead!)
Three Pulses	Battery voltage is more than 18.0 volts (too high!)
Four Pulses	Trigger is down during startup. Keep your finger off the trigger, disconnect and re-connect battery. If your finger is *not* on the trigger, check the trigger wiring for a short.
If the gun did not shut down as a result of an error, a **long** pulse will now signal the user that the gun is ready to fire. (So if all is normal, the gun gives one short pulse then one long pulse after powerup.)	

Post-Firing Codes Reference	
After firing and releasing the trigger, if any of the following conditions were met the user will be signaled by vibrations from the motor:	
One pulse	Battery is Low. This is a single pulse felt immediately after shooting. If the battery drops much further, the gun will stop firing. Now is a good time to change your battery.
Two pulses	Overcurrent detected. Peak current was over 500 Amps. Motor is stopped immediately and the gun will not fire. (Motor may “click” when trigger is pulled, due to motor startup then immediate shutdown.) Check for shorts or other wiring or motor problem.
Three pulses	Overheating detected (>75 degrees celsius at CPU). Release the trigger, disconnect the power, and inspect your gun for faults.

Technical Support

Your Trigger Master is covered by a full warranty against manufacturing defects! This warranty does not extend to damage caused by improper installations (but we'll do what we can to help you out.)

If you need technical support or have a warranty concern, please go to http://trigger-master.com or email store@unconventional-airsoft.com .

About the Trigger Master

The **Trigger Master** is based on the excellent PANTHER and CHEETAH hardware platforms by Terry Fritz and available from http://extreme-fire.com.

All hardware and software used is **open source**. You can obtain copies of the hardware design and source code at http://unconventional-airsoft.com. You are absolutely free to make and modify your own as long as you keep the hardware and software design free!

For additional help and the latest documentation, you can always go to http://trigger-master.com or email store@unconventional-airsoft.com.

Advanced Configuration Quick Reference

1. Disconnect and re-connect battery. Pull trigger once after the first pulse (but before the second long one.)

2. The gun will give 3 quick vibrations. You are now in programming mode and the gun is waiting for you to tell it which option you want to change. If you do nothing for 2 seconds, it will go to step 3.

    a) Pull the trigger "X" times where X is the number of the option you want to change.
    b) The gun will vibrate "X" times to confirm the option number selected.
    c) Pull the trigger the desired number of times to set the option. The gun will vibrate slightly with each trigger pull to signal that it "heard" each one.
    d) After a short pause, the gun will give 3 quick vibrations to signal that it accepted the new setting.
    e) Go to step a) to select another option, or do nothing if done.

3. The gun will give a long vibration, signaling that programming mode is done and the gun is ready to use the new settings. Remember to fire your first 5 shots in semi-auto to train the timing. Pull the trigger completely and fully for each shot.

Firing Modes Quick Reference

Name	Selector Switch Function	Description / Notes
Normal	SAFE - SEMI - FULL	Selector works like on a normal gun.
Burst/Full Hybrid	SAFE - SEMI - BURST/FULL	When selector is on FULL, a 3-round burst is fired. If the trigger remains held down after the burst, full-auto begins.
Semi-Only	SAFE - SEMI - SEMI	Only one shot per trigger pull regardless of selector setting.
Burst Mode	SAFE - SEMI - BURST	When selector is on FULL, the gun fires a 3-round burst. The burst does <u>not</u> become full-auto if the trigger is held down.
Sniper/DM	SAFE - SEMI - SEMI	Only one shot per trigger pull. 1 second of "dead time" is forced between each shot. *(Note: The first 5 training shots after powering up the gun do not have a shot delay)*
Bonus Mode	SAFE – BURST – FULL	After the first 5 timing shots after powerup, SEMI becomes BURST. Use at your own risk. This mode's results are experimental and harmless but not guaranteed.... it is for the curious only!

Tips and Reminders

1. After connecting a battery, there is a short pulse then a long one. The gun is now ready.

2. **Always shoot the first 5 shots with the selector in "SEMI" after powering up the gun.** This is to train the Trigger Master on your gun's timing to make sure it is up-to-date. (Does not apply to a gun with no semi-auto capability such as the M249.)

3. The Trigger Master uses a small amount of power when plugged in. To prevent a dead battery, unplug battery when not in use.

4. One short vibration felt immediately after a shot is fired is the Low Battery Warning. This is a good time to change your battery.