

# Tadao M7 Ego Board Instructions

## Features

- Based on the Musashi 7 software
- Ultra bright LED array is available in red, white, or blue
- Includes 12 fire modes: uncapped semi-auto, capped semi-auto, PSP auto-response, PSP mild ramping, PSP max ramping, PSP z-burst, NXL full-automatic, auto-response, mild ramping, max ramping, z-burst, and full-automatic
- Asynchronously monitors the trigger switch using an interrupt based scan at 2 million times per second
- Gangster setting allows 3 different options for every fire mode, giving 36 different “breakout” style modes
- Adjustable ABS programming prevents first shot drop-off
- AMB (anti-mechanical bounce) and CPF (cycle percentage filter) algorithms help to eliminate mechanical bounce and switch bounce
- Power efficient software and hardware lengthens battery life
- Programming mode allows changes to debounce, dwell, loader delay, AMB, ABS dwell, fire mode, fire mode max rate of fire, eye mode, CPF, ramp start, and gangster mode
- All settings are stored in non-volatile memory so they are not lost when battery is disconnected
- One-touch startup enables the marker to fire instantly
- Automatic 15-minute idle power down saves batteries
- 4 eye modes: delayed, forced with force shot, test mode with rate of fire indicator, and training mode with rate of fire indicator
- Low battery indicator hardware and software shows battery level each time the marker is turned on and at the touch of a button while in use

## Installation

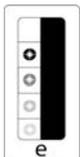
1. Remove the grips from the grip frame.
2. Remove the battery.
3. Remove the 3 mounting screws from the stock board.
4. Gently lift out the stock board, rotating it to get around the trigger pin.
5. Pull the trigger switch board off the Tadao Ego board.
6. Insert the Tadao Ego board into the frame.
7. Replace the mounting screws and tighten, making sure the 3 tactile buttons on the back of the grip frame make a sharp “click” when pressed.
8. Gently slide the trigger switch board onto the mounting pins of the main board.
9. Readjust the trigger.
10. Insert the battery.
11. Put the grips back on the frame.

## Power Operation

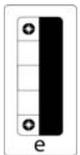
By pressing and releasing the middle button, the marker turns on, shows the battery level, and is instantly ready to be fired, as indicated by the LED array on the back of the grip frame. To turn it off, press and hold the middle button until the LEDs turn off or stop blinking, then release. Every time the marker is turned on, the eyes are enabled. The marker can be turned off regardless of the state of the eyes.

## LED Array Indicator

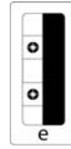
The LED array that shines from the window on the back of the Ego grip frame shows which mode of operation the marker is currently in:



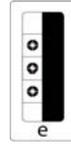
Eye system enabled, ball in breech - LED array scrolls up and down continually



Eye system enabled, empty breech - LED #1 and #5 blink continually



Eye system enabled, eye malfunction - LED #2 and #4 blink continually



Eye system disabled - LED #2, #3, and #4 blink continually

## Battery Indicator

Upon startup the LED array will climb towards the top of the marker, showing the battery level. If it climbs to the top and flashes briefly, the battery is full. Whenever the marker is in the main fire mode (eyes on or off) you may check the battery level by holding down button 3 for 1 second. The LEDs will scroll up and flicker at the current battery level.

## Eye Operation and Logic

The eyes are always enabled when the marker is first turned on. To toggle the eyes on and off, push and hold the top button. The 3 middle LEDs will continually blink in unison to indicate that the eye system is off.

Be aware that when the eye system is enabled, the eyes watch the bolt return after every shot. If this doesn't happen (due to broken paint/debris or to your finger blocking the eyes) the rate of fire will be capped to prevent additional chopping. If the marker is fired with paint and air, the eye system will see the bolt return and maximize the firing rate of the marker. When the eyes are off, the rate of fire is limited to 20 balls per second unless in fire mode 2-12, in which case the rate of fire is selected by the user.

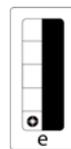
## Programming

To initiate programming mode, make sure the marker is off and the tournament lock is disabled. The tournament lock can be toggled by pressing the small switch next to the battery contacts on the surface of the board while the marker is turned off. After each press the top or bottom LED will light up to indicate the lock status. If the top LED (#5) is lit, the lock is engaged, preventing access to the programming mode. If the bottom LED (#1) is lit, the lock is off, allowing the user to change settings.

Once the lock is turned off, pull and hold the trigger before pushing the power button. The board will boot into programming mode, showing a double running sequence on the LED array before stopping on LED #1 at the bottom.

Pulling and releasing the trigger quickly will toggle between the different programming modes. The first 5 are shown with a solid color LED:

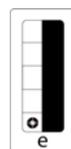
(solid)



- LED #5 ABS dwell
- LED #4 Anti-mechanical bounce
- LED #3 Loader delay
- LED #2 Dwell
- LED #1 Debounce

After reaching solid LED #5 at the top, it will start over at the bottom with flickering color LEDs:

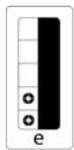
(flickering)



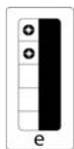
- LED #5 Cycle percentage filter
- LED #4 Bolt delay
- LED #3 Eye mode
- LED #2 Fire mode max rate of fire
- LED #1 Fire mode

After reaching flickering LED #5 at the top, it will start over with the last two settings:

(dual flickering)



LED #1 and #2 Ramp start for PSP ramping fire mode



LED #4 and #5 Gangster mode

While the LED is lit for the desired setting you would like to change, press and hold the trigger until the LED goes out. When you release the trigger, the LED will blink to show the current setting. For example, if the current setting for debounce is 5, the LED will blink 5 times. Once the LED stops blinking, you have 2 seconds to begin entering the new setting. To enter the new setting, pull the trigger the desired number of times. For example, to set the debounce to 2, you must pull the trigger 2 times. After all settings have been changed to the desired amounts, turn the marker off using the power button.

### Programming Example

If you wanted to set the dwell to 12:

1. Make sure the marker is powered off.
2. Make sure the tournament lock is disabled.
3. Pull and hold the trigger, then push the middle button.
4. The programming LED array shows a dual running sequence, then stops on LED #1. This is the debounce mode.
5. Quickly pull and release the trigger 1 time to switch to the dwell mode. LED #2 will now be lit.
6. Pull and HOLD the trigger until the LED turns off.
7. Release the trigger. The LED will blink out the current setting.
8. When the LED stops blinking, enter the new setting by pulling the trigger 12 times.
9. Wait until the LED turns back on, indicating programming has completed.
10. Turn the marker off using the middle button.

### Program Reset

To reset all settings back to factory defaults, hold down the 1<sup>st</sup> button for 10 seconds while in programming mode. The board will rapidly cycle through every LED to indicate that the process has completed.

## Settings

**Debounce** – The Musashi 7 software features an interrupt based debounce algorithm that effectively “scans” the trigger over 2 million times per second. It runs completely independent of code execution on the microcontroller so your trigger pulls are always registered. The debounce setting is in increments of ½ milliseconds. Users should be aware that low debounce settings may cause the marker to read switch bounce as additional pulls, falsely generating shots or near full-automatic fire. The setting ranges from 1 to 50 and is defaulted at 10 (5 ms).

**Dwell** – The amount of time the solenoid is energized each time the marker is fired. The default is 9 ms. The range is 1 to 25 ms. Too low of a dwell may lead to inconsistency or drop-off. Too high of a dwell can cause bad air efficiency.

**Loader delay** – Adds a slight delay after the eye has seen a ball and the bolt is cycled, causing the gun to fire. If not using force fed loaders, it may be necessary to increase this setting to prevent chopping. A setting of 1 means no loader delay, which is the fastest. The default is 2 and may be set from 1 to 25.

**AMB (Anti-mechanical bounce)** – Allows the user to adjust the anti-mechanical bounce feature. Mechanical bounce occurs due to the kick generated during each shot and can cause the marker to “run away” on the first few shots. AMB helps stop markers from going full-auto when the trigger is pulled very slowly. The default is 2 and may be set from 1 to 5 (1 being off). AMB is only used in fire modes 1 and 2 (semi-automatic unlimited and adjustable).

**ABS dwell** – Amount of dwell time added for an ABS (anti-bolt stick) shot. The range is from 1 to 15 additional milliseconds of dwell. The default is 1, or off. ABS programming helps to eliminate first shot drop-off which occurs when the lube and o-rings settle or “stick” inside the marker after it has been sitting. The next shot fired will be lower in velocity because the bolt has to break free. ABS will slightly increase the dwell to compensate if the marker is left sitting for 15 seconds.

**Fire mode** – Included are 12 different fire modes (default is 1):

1. Semi-automatic, unlimited rate of fire
2. Semi-automatic, adjustable rate of fire
3. PSP auto-response
4. PSP mild ramping, adjustable ramp start
5. PSP max ramping, adjustable ramp start
6. PSP z-burst
7. NXL full-automatic
8. Auto-response
9. Mild ramping
10. Max ramping
11. Z-burst
12. Full-automatic

Setting 1 is normal semi-automatic with an unlimited rate of fire while the eyes are enabled. When the eyes are turned off, the max rate of fire is set to 20 balls per second.

Setting 2 is semi-automatic with an adjustable rate of fire. It limits the maximum balls per second that can be fired. The cap is set by the max rate of fire setting.

Setting 3 is the PSP auto-response fire mode that works as follows:

- The first 3 shots of a string are semi-automatic
- After the 4<sup>th</sup> shot the marker will fire on the pull and release in auto-response mode
- If the user stops firing for more than 1 second, the 3-shot semi-automatic count starts over

Setting 4 is the PSP mild ramping fire mode that works as follows:

- The first 3 shots of a string are semi-automatic
- After the 4<sup>th</sup> shot the marker will ramp based on the speed of the trigger pulls as long as the user pulls the trigger faster than the ramp start setting
- If the user stops firing for more than 1 second, the 3-shot semi-automatic count starts over

Setting 5 is the PSP max ramping fire mode that works as follows:

- The first 3 shots of a string are semi-automatic
- After the 4<sup>th</sup> shot the marker will ramp up to the loader’s maximum speed or the maximum rate of fire as long as the user pulls the trigger faster than the ramp start setting
- If the user stops firing for more than 1 second, the 3-shot semi-automatic count starts over

Setting 6 is the PSP z-burst fire mode that works as follows:

- The first 3 shots of a string are semi-automatic
- After the 4<sup>th</sup> shot the marker will burst fire from 2-3 shots per pull, depending on how quickly the trigger is pulled and released
- If the user stops firing for more than 1 second, the 3-shot semi-automatic count starts over

Setting 7 is the NXL full-automatic fire mode. It functions similarly to the PSP fire modes except, after the 3<sup>rd</sup> semi-automatic shot, the user may pull and hold the trigger for the marker to fire in full-automatic.

Setting 8 is the normal auto-response fire mode. The marker will fire on each pull and release of the trigger, generating two shots per full pull cycle.

Setting 9 is the normal mild ramping fire mode. The marker will fire in semi-automatic unless the user pulls the trigger faster than the ramp start setting. Once the ramp start setting has been achieved, the marker will mildly ramp, generating additional shots depending on how fast the user pulls the trigger.

Setting 10 is the normal max ramping fire mode. The marker will fire in semi-automatic unless the user pulls the trigger faster than the ramp start setting. Once the ramp start setting has been achieved, the marker will ramp up to the maximum feed rate of the loader or the maximum rate of fire setting, whichever is lower.

Setting 11 is the normal z-burst fire mode. The marker will burst fire 2 times or more for every pull and release of the trigger, depending on how fast the user pulls the trigger.

Setting 12 is the normal full-automatic fire mode. As long as the trigger is depressed the marker will fire in full-automatic.

**Fire mode max rate of fire** – The max rate of fire setting applies to the 2nd – 12th fire modes. The max rate of fire is adjustable from 10 to 25 balls per second, and has an unlimited setting for maxing out the loader system. The default is 7, which is roughly 13 balls per second. Oscillator inconsistencies from chip to chip make it impossible to time perfectly, so the only true way to check rate of fire is to use a Pact Timer or ballistic chronograph. The red radar chronographs commonly found at fields are NOT reliable.

Setting	BPS	Setting	BPS
1	10.0	12	15.5
2	10.5	13	16.0
3	11.0	14	17.0
4	11.5	15	18.0
5	12.0	16	19.0
6	12.5	17	20.0
7 (default)	13.0	18	21.0
8	13.5	19	22.0
9	14.0	20	23.0
10	14.5	21	24.0
11	15.0	22	Unlimited eyes on, 25.0 bps eyes off

**Eye mode** – four eye modes are available:

1. Delayed – If the eye system does not detect a ball in the breech for ½ second, the marker automatically fires. This is useful for sound activated loaders because it ensures that a shot is fired, even without paint, so the loader will continue to feed.
2. Forced with force shot – The marker only fires if paint is seen in the breech or the user pulls and holds the trigger for ½ second, thereby initiating a force shot.
3. Test – This mode shows how fast the user can fire the marker and how fast the pneumatics can actually cycle. The eyes work to prevent firing if they are blocked. This mode is only for dry firing. The LED is used to show the fastest achieved rate of fire:

LED #5	25 bps or higher
LED #4	20 bps to 25 bps
LED #3	15 bps to 20 bps
LED #2	10 bps to 15 bps
LED #1	Less than 10 bps

As long as the user continues to fire, the fastest achieved rate of fire will continue to be displayed on the LED. If the user stops firing for 1 second, the LED will fall back down.

4. Training – This mode functions exactly the same as eye mode 3 (Test), except it runs the marker at ½ dwell to conserve air and reduce the sound signature of the Ego while testing.

Note: The test and training eye modes work with any fire mode selected. The fire mode max rate of fire is set to unlimited while in test or training eye mode.

**Bolt delay** – This setting determines how long the eyes are ignored after the dwell time ends. Some delay is necessary to allow the bolt to get far enough forward so the eye system does not mistake a small gap between a paintball and the bolt face for a bolt return. The default is 10 ms and may be set from 5 to 25 ms. Higher settings will reduce the maximum capable rate of fire, while lower settings may lead to skipped or blank shots because the bolt does not have enough time to block the eyes on its forward stroke.

**CPF (Cycle percentage filter)** – The cycle percentage filter allows adjustment of the point within the current firing cycle that a new buffered shot is allowed. Almost all electronic paintball markers allow a single shot to be buffered in the event the user is fast enough to release the trigger and pull again during the current firing cycle. The CPF setting is adjustable from 1 to 10. Setting 1 turns the CPF off, allowing buffered shots at any point in the firing cycle. Setting 2 through 10 sets the percentage of the firing cycle that must pass before shots may be buffered:

1. CPF turned off
2. 10% of the firing cycle must pass before a buffered shot is allowed
3. 20%
4. 30%
5. 40%

6. 50%
7. 60%
8. 70%
9. 80%
10. 90%

A higher CPF setting results in less unintentional bounce. For instance, it is possible that if your debounce setting is border line, you can fire the marker a few times, then hold it loosely and allow it to brush against your finger, going full-automatic. Since most switch bounce from either a low debounce setting or mechanical bounce occurs almost immediately after the trigger is released, CPF can be very effective in eliminating falsely generated trigger activity.

**Ramp start** – This setting is only used for the 4 ramping fire modes (PSP mild and max ramping, and normal mild and max ramping). It sets the minimum pulls per second that must be maintained for the software to add shots or ramp up to the maximum rate of fire setting. The default is 5 and is adjustable from 4 to 12 pulls per second.

**Gangster mode** – The Musashi 7 software includes a special mode that can be applied 3 different ways to each of the 12 fire modes, giving 36 “breakout” style combinations. Gangster mode gives the user full-automatic with an unlimited rate of fire for a single pull, for use at the start of the game. The setting is defaulted at 4, which turns gangster mode off. A setting of 1-3 dictates at which pull that gangster mode will become active. If set to 1, the first shot after you turn on the marker will be full-automatic and have an unlimited rate of fire for as long as you hold down the trigger. As soon as you release the trigger, the marker will stop shooting and default back to your selected fire mode. If set to 3, the gangster mode will be active on the 3<sup>rd</sup> shot after the marker is turned on. Regardless of the fire mode selected, the shots before the gangster mode will be semi-automatic. Gangster mode can only be used once for each time the marker is turned on.

**Note: The gangster mode is illegal for use in all tournament series. Tadao Technologies LLC takes no responsibility for a player’s decision to use the gangster mode.**

## Additional Information

**Force shot feature** – In the event the eyes are enabled, the breech is empty, and the user wants to fire a clearing shot, a force shot can be initiated by pulling and holding the trigger for ½ second. This is useful with force fed loaders that sometimes push a ball slightly into the detents where the eyes are unable to see it. After force firing, the next ball will load and operation can continue as normal.

**A tip for setting the debounce, AMB, and CPF** – This only applies to semi-automatic fire modes (modes 1 and 2), since AMB is disabled in the PSP fire modes or NXL mode.

Debounce, AMB, CPF setup steps, while using air (no paint):

1. Turn AMB and CPF off (set both to 1).
2. Starting at debounce 1-3, raise the debounce setting a notch at a time until excessive trigger bounce goes away. The goal is to have one pull, one shot, regardless of rate of fire. Do NOT slow pull test for bounce during this phase. Instead, pull the trigger rapidly or walk it, listening for double or triple fires.
3. When it appears that it is only one shot, one pull for solid trigger pulls, try the slow pull test. Holding the marker steady, slowly pull the trigger and see if multiple shots can be generated from the single pull.
4. Increase the CPF setting a notch at a time until the slow pull bounce starts to disappear. An additional test is to fire a few rounds quickly, then hold the trigger right on the activation point to see if the marker will run away.
5. If you reach setting 10 with CPF and the marker can still be slow pulled to fire full-automatic, your debounce setting is probably too low. Go back to step 2.
6. AMB should not be set above 3, if possible, since it is not as transparent to the user as CPF. Even a CPF setting of 10 will not be noticed by the user.

**A tip for setting the dwell and ABS dwell** – Your ABS dwell time is the additional dwell time added when an ABS shot occurs. If you leave your marker on and don’t fire for 15 seconds, ABS will kick in for the next shot, adding the ABS dwell time to the existing dwell setting. For example, if the dwell is set to 8 ms and the ABS dwell is set to 5 ms, an ABS shot will fire with a 13 ms dwell time. Additional shots will use the 8 ms dwell time until the marker has not been fired for another continuous 15 seconds. This setting is adjustable, so you can tune it to fit your particular marker.

### Example Setting Profiles:

1. Tournament legal semi-automatic (NPPL)
  - a. Fire mode 1 or 2 (semi-auto unlimited or capped)
  - b. Debounce 5-20
  - c. CPF 2-5
  - d. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)
2. Millennium
  - a. Fire mode 4 or 5 (PSP mild or max ramping)
  - b. Max rate of fire set to 3-5, depending on Pact Timer readings. To be safe, use setting 3 (14.5 balls per second)
  - c. Debounce 5-20
  - d. Ramp start 8 or higher to comply with Millennium rules
  - e. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)
3. PSP X-Ball, CFOA
  - a. Fire mode 3-6
  - b. Max rate of fire set to 3-5, depending on Pact Timer readings. To be safe, use setting 3 (14.5 balls per second)
  - c. Debounce 5-20
  - d. Ramp start 5 or higher if using PSP ramping.
  - e. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)
4. NXL
  - a. Fire mode 7 (NXL full-automatic).
  - b. Max rate of fire set to 3-4, depending on Pact Timer readings. To be safe, use setting 3 (14.5 balls per second).
  - c. Debounce 5-20
  - d. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)
5. Ludicrous Speed (absolute fastest/bounciest)
  - a. Any fire mode
  - b. Max rate of fire set to 26 (unlimited)
  - c. Debounce 1
  - d. CPF 1
  - e. Ramp start 4 if using PSP mild or max ramping
  - f. Loader delay 1

### Additional Information

[www.tadaotechnologies.com](http://www.tadaotechnologies.com)