



## Musashi 3 Upgrade

### Tadao 3.0/4.0/5.0 Matrix Board

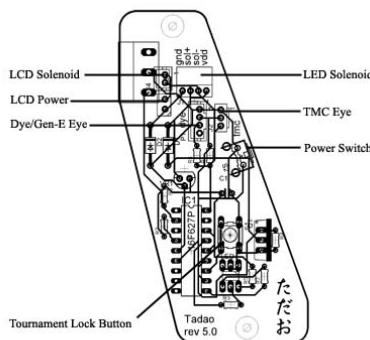
#### Features

- Built on the Musashi code base (hybrid debounce scheme)
- Includes three fire modes: uncapped semi-auto, capped semi-auto, and modified NXL/PSP
- Continuously monitors the trigger switch through the entire firing cycle
- Adjustable ABS programming prevents first shot drop off
- AMB algorithms help to eliminate mechanical bounce
- Power efficient software lengthens battery life
- Programming mode allows changes to debounce, dwell, loader delay, AMB, ABS, fire mode, and fire mode max rate of fire
- All settings are stored in non-volatile memory so they are not lost when power is disconnected
- One-touch startup enables the marker to fire instantly
- Automatic 15-minute idle power down saves batteries
- Force shot allows the marker to be fired when the eyes are enabled but no object is present in the breech

#### Installation

**Upgrade Chip Installation** – Removal and installation of the chip on a Tadao 3.0, 4.0, or 5.0 Matrix board must be carefully done to ensure the chip and the electronics are not damaged. Begin by removing the grips from the left side of the marker. This will expose the entire circuit board. The chip is located in a socket near the bottom of the grip frame. To remove, gently pry under each end with a small flathead screw driver. Alternate sides until it is far enough out to remove with your fingers. Insert the new chip, making sure it is aligned properly. A notch in one end of the chip lines up with a notch in the socket and the white drawing on the surface of the board. If the marker will not turn on and it is not due to a low battery or broken battery harness, you may have installed the chip backwards.

**Board Installation** – Installation of a new board consists of disassembling the marker, removing the original circuit board, mounting the new board, and reassembling the marker. It may be necessary to remove the trigger pin and trigger in order to facilitate removal of the existing circuit board. The following diagram shows which connectors are used for different setups, depending on the type of eyes and solenoid/power connectors in your particular marker.



#### LED Indicator

The multi-color LED that shines out the left side of the grip panels shows which mode of operation the marker is currently in:

Solid Blue	Ball in breech, ready to fire
Slow Blinking Blue	No ball in breech
Slow Blinking Yellow	Eye malfunction; clean eyes or make sure the gun is being fired with paint and air
Slow Blinking Red	Eyes disabled, rate of fire limited to 20 balls per second in mode 1; otherwise capped at fire mode max rate of fire for fire modes 2 and 3

#### Power and Eye Operation

Pressing and releasing the power button turns the marker on. It will show a solid or blinking blue LED in the grip frame to indicate that the marker is ready to be used.

The eyes are enabled when the marker is first turned on. To disable the eyes press and hold the power button for 1 second. The LED will start slowly blinking red to indicate the eyes are turned off.

To turn the marker off, press and hold the power button for 1 second again. The marker will power down.

#### Power Button Sequence

1. Press and release power button.
2. LED lights solid blue or blinking blue depending on if something is in the breech, ready to fire.
3. To disable eye system, press and hold power button for 1 second.
4. Eye system turns off, LED slowly blinks red to indicate eyes off mode.
5. To turn off, press and hold power button for 1 second.
6. Marker turns off.

Note that the eye logic can tell the difference between paint being fired and an object constantly blocking the eyes. The eyes watch for the bolt to return every shot, so if this does not happen, it will start flashing yellow to indicate an eye malfunction. Unblocking the eyes will cause it to revert to a blinking blue LED to show that the eyes are working again and the breech is empty.

To determine if the eyes are working correctly, insert an object into the breech. Check to see if the LED changes from blinking blue to solid blue, and then back to blinking blue once the object is removed.

#### Programming

Programming mode can only be initiated while the tournament lock is disabled. Pressing the push button switch to the right of the chip on the circuit board will toggle the tournament lock. After every press the light will flash green or red to indicate the status of the lock. Green means the lock is off and will allow the user to enter programming mode. Red indicates that the lock is on, so programming mode cannot be initiated.

If the tournament lock is disabled, the user may enter programming mode by pressing and holding the trigger while the marker is off, and then turning on the marker by pushing the power switch.

Pulling and releasing the trigger quickly will toggle between the different programming modes:

Green	Debounce
Purple	Dwell
Yellow	Loader Delay
Blue	AMB
Red	ABS Dwell
White	Fire Mode
Teal	Fire Mode Max Rate of Fire

When the LED is lit for the desired setting, 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 green 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. Every time you pull the

trigger the LED will light. After all settings have been changed, turn the marker off, using the power button.

### Programming Example

If you want to set the dwell to 20, you should:

Make sure the marker is powered off and the tournament lock is disabled.  
Pull the trigger and push the power button to turn on the marker.  
The LED shows green. This is the debounce mode.  
Quickly pull and release the trigger one time to switch to the dwell mode.  
The LED will show purple.  
Pull and HOLD the trigger until the LED turns off.  
Release the trigger. The LED will blink out the current setting.  
When the LED stops blinking, enter the new setting by pulling the trigger 20 times.  
Wait until the LED turns back on, indicating programming has been completed.  
Turn the marker off.

### Program Reset

To reset all settings to factory defaults hold down the program button for 10 seconds while in programming mode. The LED will rapidly cycle through every setting color to indicate that the process has completed.

## Settings

**Debounce** – The Musashi software features a hybrid debounce scheme that uses microcontroller cycles to debounce the pull of the trigger and  $\frac{1}{2}$  ms time increments to debounce the release. This results in a very effective debounce algorithm that does not hinder the user at any setting. At low debounce settings, however, it 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 5. Debounce is only used in fire modes 1 and 2 (semi-automatic unlimited and capped). In modified NXL/PSP mode the debounce is locked at a high setting.

**Dwell** – The amount of time the solenoid is energized each time the marker is fired. The default is 14 ms. The range is 10 to 30 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 50.

**AMB** – Allows the user to adjust the anti-mechanical bounce feature. Mechanical bounce occurs with the Matrix due to the kick generated during each shot and can cause the marker to “run away,” firing even after the trigger has been released. 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 capped). In modified NXL/PSP mode AMB is disabled.

**ABS Dwell** – Amount of dwell time added for an ABS shot. The range is from 1 to 15 additional milliseconds of dwell. The default is 10. For a more detailed explanation of ABS see the “Additional Features” section.

**Fire Mode** – Included are three different fire modes (default is 1):

1. Semi-automatic, unlimited rate of fire
2. Semi-automatic, capped rate of fire
3. Modified NXL/PSP, capped rate of fire

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 a capped rate of fire. It simply limits the maximum balls per second that can be fired. The cap is set by the Max ROF setting.

Setting 3 is a modified NXL/PSP 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 add shots as long as the user continues to pull the trigger
- If the trigger is released, the marker will stop firing immediately
- If the trigger is not pulled after releasing within 1 second, the 3-shot semi-automatic count starts over

In normal operation, continually pulling the trigger faster than 5 to 6 pulls per second will effectively give the user full automatic at the max rate of fire. If the user stops shooting then resumes within 1 second, the marker will return to the max rate of fire. If the user stops shooting for more than 1 second, the next 3 shots will be semi-automatic. On the 4<sup>th</sup> shot it will resume a faster fire rate.

**Fire Mode Max ROF** – The maximum rate of fire setting only applies to the 2<sup>nd</sup> and 3<sup>rd</sup> fire modes. The max rate of fire is adjustable from 14 to 20 balls per second in  $\frac{1}{4}$  balls per second increments. The default is 3, which is roughly 14.5 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	Setting	BPS
1	14.0	9	16.0	17	18.0
2	14.25	10	16.25	18	18.25
3	14.5	11	16.5	19	18.5
4	14.75	12	16.75	20	18.75
5	15.0	13	17.0	21	19.0
6	15.25	14	17.25	22	19.25
7	15.5	15	17.5	23	19.5
8	15.75	16	17.75	24	19.75
				25	20.0

## Additional Features

**Force Shot** – 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  $\frac{1}{2}$  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 will continue as normal.

**ABS** – ABS (anti-bolt stick) programming helps to eliminate first shot drop off. First shot drop off 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. Due to the design of the Matrix, this should not increase velocity if the low pressure regulator is set correctly and all o-rings are intact.

**A tip for setting the debounce and AMB** – Although AMB is meant as a safety feature to stop run-away markers, it also has the unfortunate side effect of hiding bounce. To test your marker for bounce, shoot it as fast as possible with a single finger. If you have bounce, you’ll see and hear double shots for individual pulls. This means you need to turn up your debounce. The slow pull test in use by some judges is not realistic for finding guns that have the debounce set too low.

## Additional Information

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