Musashi 5 Matrix Board Instructions

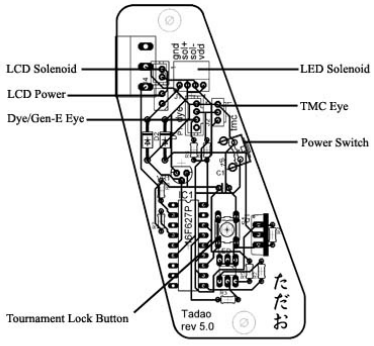
Features

- Based on the Musashi 5 software
- Fully functional in the LCD or LED Matrix, with support for the Dye, Gen-E, and TMC eye sets
- Includes five fire modes: uncapped semi-auto, adjustable semi-auto, PSP ramping, PSP burst, and NXL full-automatic
- Continuously monitors the trigger switch through the entire firing cycle
- Super light 25-gram trigger switch
- Adjustable ABS programming prevents first shot drop-off
- AMB and CPF algorithms help to eliminate mechanical bounce and switch bounce
- Power efficient software 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, cycle percentage filter, and ramp start
- 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
- Two eye modes: delayed and forced with force shot

Installation

There are two types of installation:

1. Board replacement if you have purchased a complete M5 5.0 Matrix board.
2. Chip replacement if you have purchased an M5 3.0/4.0 or M5 5.0 Upgrade Chip and already own a 3.0, 4.0, or 5.0 Matrix board.



1. Board Replacement

1. Remove the grips from the grip frame.
2. Unplug the eye harness (if present), power harness, and solenoid harness.
3. Remove the grip frame from the body, being careful with the unplugged wiring harnesses.
4. Remove the mounting screws from the stock board.
5. Depending on the trigger used, it may be necessary to remove it for board clearance. This is done by punching out the trigger pivot pin.
6. Rotate and remove the stock board from the grip frame.
7. Insert the M5 Matrix board into the grip frame, power switch side first. It will line up with the power switch hole. Be careful with the trigger switch when you insert the board into the frame since it is fragile.
8. Replace the board mounting screws, making sure to test the power button after tightening. The board mounting holes are large so it can be shifted around for optimum power button placement.
9. Replace the trigger, readjusting the pre- and post-travel set screws as necessary.
10. Reattach the grip frame to the Matrix body, threading the wiring harnesses into the frame.
11. Plug in all the wiring harnesses.
12. Reattach the grip panels.

2. Chip Replacement

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. Unplug the battery or battery harness. The stock 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, which should point towards the top of the Matrix. If the marker will not turn on and it is not due to a low battery, broken power switch, or broken battery harness, you may have installed the chip backwards.

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

Press the power button to turn the marker on. It will boot instantly, showing a solid or blinking blue LED in the grip frame. The eye system is enabled when the marker is first turned on. To disable the eyes press and hold the power button for one second. The LED will switch to blinking red to indicate that the eye system is disabled. To turn off the marker, press and hold the power switch for one more second. The LED will turn off when the board powers down.

If used, the eye system cycles the marker as fast as possible. During each shot the eyes watch for the bolt to return, ending the current firing cycle and starting another as quickly as the pneumatics allow. If the eye system is continually blocked (e.g. putting your finger in front of the eyes) and is unable to see the bolt return after every shot, the max rate of fire will be reduced to about 12 balls per second to prevent further chopping. The only way to show the true speed of the M5 Matrix board is to fire the marker with paint and air. When the eyes are off, the rate of fire is limited to 20 balls per second unless in fire mode 2-5, in which case the rate of fire is selected by the user.

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 microcontroller 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 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 (anti-mechanical bounce)
Red	ABS dwell
White	Fire mode
Teal	Fire mode max rate of fire
Flickering Green	Eye mode
Flickering Purple	CPF (cycle percentage filter)
Flickering Yellow	Ramp start

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 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 power button.
4. The programming LED shows a rainbow sequence then stops on solid green. This is the debounce mode.
5. Quickly pull and release the trigger 1 time to switch to the dwell mode. The LED will show purple.
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 power button.

Program Reset
To reset all settings to factory defaults hold down the lock 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 ½ 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 10.

Dwell – Also known as "front pulse," this is the amount of time the solenoid is energized each time the marker is fired. The default is 14 ms. The range is 5 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).

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 5. Setting this to 1 turns ABS off. For a more detailed explanation of ABS see the "Additional Features" section.

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

1. Semi-automatic, unlimited rate of fire
2. Semi-automatic, adjustable rate of fire
3. PSP ramping, adjustable rate of fire
4. PSP burst, adjustable rate of fire
5. NXL full-automatic, adjustable 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 limits the maximum balls per second that can be fired. The cap is set by the Max ROF setting.

Setting 3 is the first PSP fire mode that works as follows:

- The first 3 shots of a string are semi-automatic.
- After the 4th shot the marker will add shots as long as the user fires faster than the ramp start setting. For example, if the ramp start setting is 5, the user must pull 5 times per second or faster for the software to add additional shots.
- If the trigger is released, the marker will stop firing immediately.
- If the trigger is not pulled again within 1 second of release, the 3-shot semi-automatic count starts over.

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

- The first 3 shots of a string are semi-automatic.
- After the 4th shot the marker will fire 2 or more shots per pull as long as the user continually pulls and releases the trigger.
- If the trigger is released, the marker will stop firing immediately.
- If the trigger is not pulled again within 1 second of release, 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 4th shot it will resume a faster fire rate.

PSP ramping and PSP burst differ in that PSP ramping requires the user to maintain the ramp start rate of fire for software assistance, whereas the PSP burst mode will fire at least 2 shots per pull, regardless of rate of fire. Some players prefer multiple shots every time they pull the trigger after the initial 3 semi-automatic shots, while others like to shoot 1 ball at a time until they achieve a certain rate of fire.

Setting 5 is the NXL full-automatic fire mode. It functions similarly to the PSP fire modes except, after the 3rd semi-automatic shot, the user may pull and hold the trigger for the marker to fire in full-automatic.

Fire Mode Max ROF – The maximum rate of fire setting only applies to the 2nd, 3rd, 4th, and 5th fire modes. The max rate of fire is adjustable from 14 to 20 balls per second in ¼ balls per second increments. It also has an unlimited setting. The default is 4, which is roughly 14.75 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
				26	Unlimited w/eyes on

Eye Mode – Two eye modes are available:

1. Delayed – The marker fires ½ second after every trigger pull regardless of a ball in the breech. This is useful for sound activated loaders because it insures 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, thus initiating a force shot.

Cycle Percentage Filter (CPF) – 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 – The ramp start setting is only used for the PSP ramping fire mode (mode 3). 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.

Additional Features

Force Shot – If using the forced eye mode and 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 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, 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, then 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.

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. AMB 2
    d. CPF 2-5
    e. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)

2. PSP X-Ball, CFOA, Millennium
    a. Fire mode 3 or 4 (Millennium requires mode 3)
    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. Ramp start 8 or higher if playing Millennium
    f. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)

3. NXL
    a. Fire mode 5 (NXL full-automatic)
    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. Loader delay set to match your loader (1-4 for Halo, 4-10 for gravity feed)

4. Ludicrous Speed (absolute fastest/bounciest)
    a. Any fire mode
    b. Max rate of fire set to 26 (unlimited)
    c. Debounce 1
    d. AMB 1 if using semi-automatic
    e. CPF 1
    f. Ramp start 4 if using PSP ramping
    g. Loader delay 1

Additional Information

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