Musashi 8 Board Instructions

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Features

- Fully functional in the Bob Long Onyx/Marq series of markers
- Based on the Musashi 8 software, with full support for the 4C™ eye system
- Both a plug-and-play wiring harness socket and board mounting point for the Draxxus Pulse RF transmitter are standard
- New model microcontroller runs at 8 Mhz for no hardware lag and the fastest code execution
- Enhanced power switching hardware for the solenoid
- Includes 12 fire modes: uncapped semi-auto, capped semi-auto, PSP auto-response, PSP 50% ramping, PSP 100% ramping, PSP burst, NXL full-automatic, auto-response, 50% ramping, 100% ramping, 3 round 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, gangster mode, bolt delay, and training mode dwell
- 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 reduced dwell training mode with rate of fire indicator
- Low battery indicator hardware and software shows battery level each time the marker is turned on

Installation

Removal and installation of the board in a Marq must be carefully done to ensure the electronics are not damaged. Begin by removing the grips from the marker. This will expose the entire circuit board. Remove the main wiring harness, the three mounting screws from the board, and then the board itself. Be aware of the trigger switch return spring mounting bracket which sits over the trigger switch. Place the return spring mounting bracket over the M8 Marq board's trigger switch, then insert the board into the grip frame top first, making sure the wiring does not get pinched. Replace the 3 mounting screws. Plug in all the connections. It may be easier to completely remove the grip frame from the marker to replace the trigger return spring so you can insert it from the top. If the marker does not turn on, it may be due to a low or incorrectly inserted battery.

LED Indicator

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

Rapid Blinking Red	At startup this indicates an exhausted battery
Rapid Blinking Yellow	At startup this indicates a low battery
Rapid Blinking Green	At start this indicates a good battery
Solid Teal	Both eyes are blocked
Solid Blue	Top eye is blocked
Solid Purple	Bottom eye is blocked
Slow Blinking Blue	No ball in breech
Slow Blinking Yellow	Eye malfunction, max rate of fire reduced to 12 bps; clean eyes or make sure the gun is 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 through 12.

Power Operation

Pressing and releasing the power button turns the marker on. The battery indicator will show the current power level of your battery with a flickering red, yellow, or green LED. After, it will show a solid or blinking blue LED (unless changed from the default). To turn off, press and hold the power button for 1.5 seconds, until the LED turns off, 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.

Eye Operation and Logic

The eyes are enabled when the marker is first turned on. The eyes can be toggled by quickly pressing and releasing the power button. The LED will change colors to indicate the mode change.

The Musashi 8 Marq board supports the 4C™ system, and will automatically detect whether a single eye set or dual eye set is installed at start up.

If using a **single** eye set the LED indicator works as follows:

Slow Blinking Blue	Empty breech
Solid Purple	Ball in breech, ready to fire

With a **dual** eye set the LED indicator works as follows:

Slow Blinking Blue	Empty breech, both top and bottom eyes unblocked
Solid Blue	Top eye set is blocked
Solid Purple	Bottom eye set is blocked
Solid Teal	Both top and bottom eye sets blocked

The use of the 4C™ eye system allows for much faster rates of fire because it can anticipate the next paintball being loaded into the breech and start the firing cycle early, which negates the delay time found in the pneumatics of the paintball marker. The Musashi 8 software was written specifically to take advantage of this arrangement, and automatically uses the top eye set when the loader is feeding fast enough. It can also determine when the top eye set is blocked by paint or debris, and will default to using only the bottom eye until the top is clear again. Once the top eye is clear, it will resume use of both eye sets.

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, and the LEDs will blink yellow to indicate the eye malfunction. Firing the marker with paint and air will utilize the eye system correctly, maximizing the rate of fire. When the eyes are off, the rate of fire is limited to 20 balls per second unless in fire modes 2 through 12, 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 and then back to blinking blue once the object is removed.

Battery Indicator

Battery indicator software and hardware are standard on the M8 Marq board. When the marker is turned on, the LED will briefly flicker red, yellow, or green to indicate the status of your battery. If it flickers red, the battery is exhausted and should be changed as soon as possible. If it flickers yellow, the battery may last for another case of paint, but it is close to failing.

Programming

The tournament lock must be disabled in order to change settings on the board. Pushing the small switch beside the Pulse socket toggles the tournament lock. While the marker is turned off, push and hold the lock button. The LED will flash red or green to indicate the status of the lock. Red means the lock is on, while green means the lock is off. When the lock and the marker are off, pull and hold the trigger, then push the power button. The marker will boot into programming mode, showing a rainbow sequence before stopping at solid green.

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
Flickering Blue	Gangster mode
Flickering Red	Bolt delay

Flickering White   Training mode dwell

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 9, you should:

1. Make sure the marker is powered off and the tournament lock is disabled.
2. Pull the trigger and push the power button to turn on the marker.
3. The LED shows a rainbow sequence then stops on solid green. This is the debounce mode.
4. Quickly pull and release the trigger 1 time to switch to the dwell mode. The LED will show purple.
5. Pull and HOLD the trigger until the LED turns off.
6. Release the trigger. The LED will blink out the current setting.
7. When the LED stops blinking, enter the new setting by pulling the trigger 9 times.
8. Wait until the LED turns back on, indicating programming has been completed.
9. Turn the marker off.

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 M8 Marq board features an interrupt based debounce algorithm that effectively "scans" the trigger over 2 million times per second. It runs this completely independent of code execution on the microcontroller so your trigger pulls are always registered. The debounce setting is in increments of 1/2 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 6 ms. The range is 2 to 20 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 10 additional milliseconds of dwell. The default is 1, which is disabled. ABS 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.

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 50% ramping, adjustable ramp start
5. PSP 100% ramping, adjustable ramp start
6. PSP burst
7. NXL full-automatic
8. Auto-response
9. 50% ramping
10. 100% ramping (Millennium ramping)
11. 3 round 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 4th 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 50% ramping fire mode that works as follows:
• The first 3 shots of a string are semi-automatic
• After the 4th shot the marker will ramp, adding 1 additional shot for every 2 pulled by the user, 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 100% ramping fire mode that works as follows:
• The first 3 shots of a string are semi-automatic
• After the 4th 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 burst fire mode that works as follows:
• The first 3 shots of a string are semi-automatic
• After the 4th shot the marker will burst fire 3 shots per pull
• 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 3rd 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 2 shots per full pull cycle.

Setting 9 is the normal 50% 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 50% ramp, adding 1 additional shot for every 2 trigger pulls.

Setting 10 is the normal 100% 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. This fire mode should be used for Millennium rules, with the ramp start setting at 8.

Setting 11 is the normal 3 round burst fire mode. The marker will burst fire 3 times for every pull and release of 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 1/2 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 1/2 second, thereby initiating a force shot.

3. Test – This mode is specifically for seeing how fast the user can fire the marker, or 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:

Red	less than 10 bps
Yellow	between 10 and 15 bps
Green	between 15 and 20 bps
Blue	between 20 and 25 bps
White	25 bps or greater

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 cycle back through the rate of fire colors.

4. Training – This mode works just like the test eye mode, but features an adjustable dwell setting independent of the normal dwell, which makes it easy for users to adjust their trigger settings and try them out with much less noise and air consumption. The training mode dwell setting corresponds with this eye mode.

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

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. Settings 2 through 10 set 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 four ramping fire modes (PSP 50% and 100% ramping, and normal 50% and 100% 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 14 pulls per second. For Millennium rules a ramp start setting of 8 or higher is required. It will also specifically limit how fast the marker stops shooting once the trigger is released, to ensure compliance with the Millennium rules.

Gangster mode – The M8 Marq board 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. Settings 1, 2, and 3 dictate 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 with 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 third 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 the user's choice in using the gangster 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 1 to 15 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.

Training mode dwell – This setting selects the markers dwell time if using the training eye mode (eye mode set to 4). The dwell time is reduced so that the marker barely cycles, consuming less air and emitting less noise so users can train their finger speed. This setting is adjustable from 1 to 10 ms, and is defaulted at 2 ms. If this setting is too high, the marker may actually fire. If that is your intention, you should switch to the test eye mode, which uses the normal dwell setting.

Additional Features

Draxxus Pulse loader RF transmitter harness – Included with your board is a wiring harness that allows plug and play installation of the Draxxus Pulse loader RF transmitter. The wiring harness plugs into the Pulse socket and Pulse transmitter. When installed, the transmitter will automatically be powered during every shot once it is synchronized with the Pulse loader. Alternatively, the Pulse transmitter can be mounted directly on the board. Pinching the leads on the transmitter should give sufficient contact to hold it on the board, but if you choose to use this method for long term use, soldering the transmitter is much more stable and reliable.

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 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.

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 paint and air:

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.

Additional Information

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