Musashi 7 Series LED
Proto SLG Board

FEATURES

- Fully functional in the Proto SLG
- Musashi Series LED display system shows eye status, battery life, and menu system
- Advanced microcontroller running at 8 Mhz
- Fully legal in the NPPL, PSP, and Millennium tournament series (12 bps and 13.3 bps compatible)
- RF socket and wiring harness included to support Magna, Pulse, and other RF transmitters
- Multiple modes of fire: unlimited semi-automatic, adjustable semi-automatic, PSP & Millennium ramping, PSP 3-round burst, NXL full-automatic, auto-response, 3-round burst, and full-automatic
- Tadao trigger logic asynchronously monitors the trigger switch, using an interrupt based scan at 4 million times per second for the quickest response time and fastest semi-automatic
- Tadao dynamic eye logic watches for the bolt to return every shot, cycling the marker as fast as possible
- Rate of fire adjustable from 10 to 25 bps, plus unlimited rate of fire
- AMB (anti-mechanical bounce) and CPF (cycle percentage filter) algorithms help to prevent mechanical and switch bounce without missing real trigger pulls
- G-mode setting allows 3 different breakout options for every fire mode
- More than 1 billion unique ways to adjust settings
- Extremely easy to use LED menu system, which allows changes to a multitude of settings, including debounce, dwell, loader delay, AMB, anti-bolt stick, fire mode, max rate of fire, eye mode, CPF, g-mode breakout, ramp start, and more
- All settings are stored in non-volatile memory so they are not lost when the battery is disconnected
- Power-efficient software and hardware lengthen battery life
- Automatic 20-minute idle power down saves batteries
- One-touch startup enables the marker to fire almost instantly
- Includes super light high quality microswitch with wiring harness
- Lifetime warranty against manufacturing defects
- Free software updates

INSTALLATION

Installation of the SLG board must be carefully done to avoid damaging the electronics or wiring harnesses.
1. Remove the grip panel from the left side of the grip frame, exposing the battery and circuit board.
2. Remove the battery and unplug the eye, solenoid, trigger switch, and power harnesses.
3. Remove the 2 mounting screws.
4. Gently pull the stock board out of the frame.
5. Make sure to keep track of the 2 switch contacts.
6. Insert the new board into the grip frame.
7. Replace the 2 mounting screws, making sure the power switch and eye switch sit snugly against the switch contacts.
8. Unscrew the mounting screws for the stock trigger switch and remove it from the frame.
9. Thread the new trigger switch wiring harness through the frame, following the eye and solenoid wiring as a guide.
10. Secure the new trigger switch using the mounting screws.
11. Plug the eye, solenoid, trigger switch, and power harness back into the appropriate color-coded sockets.
12. Replace the battery.
13. Replace the grip panels.

BOARD OPERATION

Turn on the board by pushing the power (top) switch. The LED will flicker briefly to show the current battery level and then display the breech status by showing solid or blinking blue.

Turn off the board by pressing and holding the power switch for at least 1 second. The LED will turn off to indicate the board has shut down.

The eye system is toggled on and off by pressing and holding the eye (bottom) switch. The LED will reflect the eye status by blinking red when they are turned off.

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 8 balls per second to prevent further chopping, and the LED will display an eye malfunction by blinking yellow. Firing the marker with paint and air will utilize the eye system correctly, maximizing the rate of fire.

LED INDICATORS

The multi-color LED shows the user battery status, eye status, and is used for the programming menu.

Rapid Blinking Red	At startup this indicates an exhausted battery
Rapid Blinking Yellow	At startup this indicates a low battery
Rapid Blinking Green	At startup this indicates a good battery
Solid Blue	Ball in breech, ready to fire
Slow Blinking Blue	No ball in breech
Slow Blinking Yellow	Eye malfunction, max rate of fire reduced to ~8 bps; clean eyes or make sure the gun is fired with paint and air
Slow Blinking Red	Eyes disabled, rate of fire limited

MENU SYSTEM

The tournament lock must be disabled in order to change settings on the board. Pushing the small switch beside the color-coded sockets 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 indicates the lock is on, while green indicates 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)
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	G mode
Flickering Red	Bolt delay
Flickering White	PWM 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 5, 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 5 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 (default 10 ms, range 1-25)
The amount of time the trigger must be released for the microcontroller to allow the next trigger pull. The Musashi series uses an asynchronous interrupt-based scan at 2 million times per second that is run independently from code execution. This ensures that every trigger pull is registered. Higher values reduce bounce. Lower values cause more bounce.

Main dwell (default 4 ms, range 2-10)
The amount of time the solenoid is energized during each firing cycle. On the SLG there are actually 2 dwell times, since it is sear based. The total dwell time is the Main Dwell + PWM Dwell. The Main Dwell drives the coil at 100% power to move it initially, then the PWM dwell time makes sure the sear stays down without wasting additional power. **It is VERY important to note that excessively long dwell times can cause the marker to fire twice, since the bolt will return but the sear will not be up to catch it. The second shot will not be restricted by any rate of fire settings or utilize the eye system because it is a mechanical side effect of the SLG's design.**

Loader delay (default 2, range 1-10)
A slight delay that allows each paintball to settle in the breech before firing. Lower settings potentially lead to higher achievable rates of fire.

Anti-mechanical bounce (default 1, range 1-4)
Helps eliminate mechanical bounce which can cause a loosely held paintball marker to go full-auto when the trigger is pulled slowly.

Fire mode (default semi-automatic unlimited)
1. Semi-automatic unlimited
2. Semi-automatic adjustable
3. PSP auto-response – 123 shots semi, on 4th shot fires once on each pull/release, resets after 1 second
4. PSP50% ramping – 123 shots semi, on 4th shot slowly ramps at 5 pulls per second, resets after 1 second
5. PSP & Millennium 100% ramping – 123 shots semi, on 4th shot max ramps at 5 pulls per second, resets after 1 second
6. PSP burst – 123 shots semi, on 4th shot fires 3-round burst, resets after 1 second
7. NXL full-automatic – 123 shots semi, on 4th shot fires full-automatic, resets after 1 second
8. Auto response
9. 50% ramping
10. 100% ramping
11. 3 round burst
12. Full-automatic

Maximum rate of fire (default 13 bps, range 10-25 and infinity)
The semi-automatic unlimited fire mode ignores this value, making it easy to switch back and forth between NPPL and PSP gun rules without modifying more than 1 setting. Adjustable from 10 to 25, with an unlimited option.

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 (default forced)
1. Forced with force shot – marker only fires when a paintball is present, unless a force shot is initiated by holding down the trigger for ½ second.
2. Delayed – the eyes will watch for a paintball for up to 500 ms after each pull, then fire. This is useful for sound activated loaders and was the stock setting on original Intimidators.

Cycle percentage filter (default 2, range 1-10)
Secondary debounce filter which adjusts how far into the firing cycle additional buffered shots are allowed. A setting of 1 turns this filter off, while settings 2 through 10 set the percentage of the cycle that must pass before shots may be buffered. Higher settings will reduce bounce.

Ramping start (default 5, range 4-14)
Adjusts how fast a user must pull for the ramping fire modes to start adding additional shots. Use with the PSP ramping and normal ramping fire modes.

G-mode or "breakout mode" (default off)
This breakout setting provides unlimited full-auto, which then falls back to the user-selected fire mode on the 1st, 2nd, or 3rd shot after turning the board on. Breakout modes are illegal for use in all tournament series and most recreational paintball fields. A setting of 1 indicates that breakout mode will start on the 1st pull. A setting of 4 turns breakout mode off. **Tadao Technologies LLC takes no responsibility if a player chooses to use breakout modes**.

Bolt delay (default 5, range 1-15)
A delay time that gives the bolt enough time to block the eyes on the forward stroke. Too low of a bolt delay will cause blank or skipped shots. Too high of a setting can limit the maximum rate of fire.

PWM dwell (default 3, range 1-10)
On the SLG there are actually 2 dwell times, since it is sear based. The total dwell time is the Main dwell + PWM dwell. The Main dwell drives the coil at 100% power to move it initially, then the PWM dwell time makes sure the sear stays down without wasting additional power. **It is VERY important to note that excessively long dwell times can cause the marker to fire twice, since the bolt will return but the sear will not be up to catch it. The second shot will not be restricted by any rate of fire settings or utilize the eye system because it is a mechanical side effect of the SLG's design.**

RECOMMENDATIONS

Settings

The Musashi series ship with default settings which are tuned for a wide range of trigger adjustments and general usage. Certain tournament series allow alternate fire modes with specific characteristics, so the following is a list of settings that will give you a baseline. Ultimately, every marker is unique and may require different settings for optimal performance.

NPPL: Use the default settings, possibly only changing debounce, AMB, and CPF to suit your personal trigger adjustments.

PSP: Use the PSP ramping or PSP burst fire modes, with maximum rate of fire set to the required cap for the league. Make sure debounce is near default values.

NXL: Use the NXL full-automatic or PSP fire modes. See PSP for maximum rate of fire recommendations.

Millennium: For 2008 the Millennium series modified their rules slightly. It is now a 12 bps cap with a 6 pulls per second activation, and requires the 1-2-3 semi-auto shots like PSP mode before ramping can begin.

Use the PSP 100% ramping mode. The ramp start will need to be set to 6 pulls per second as required by the Millennium series. Maximum rate of fire must be manually set to 12 bps.

Many European tournaments besides the Millennium series utilize semi-automatic, but capped at 15 bps. Select the capped semi-automatic fire mode for these events.

Care and cleaning

Your Musashi series board includes a conformal coating to help protect against damage caused by moisture such as broken paint or rain. Under normal conditions the board should continue to operate, even with small amounts of moisture present. However, paint is slightly corrosive and can destroy the conformal coating over time. In the event that you get broken paint or water on the electronics, unplug the battery and use rubbing alcohol and a blast of compressed air to clean the board off. The compressed air will ensure that everything is cleaned out from beneath the components and connectors.

Batteries

Tadao Technologies recommends the use of quality alkaline batteries such as those made by Duracell and Energizer. Photo lithium 9 volt batteries are also adequate. Batteries labeled as "heavy duty" or "super heavy duty" are not true alkaline and will cause inconsistent operation, or may not properly power the electronics. Rechargeable batteries are also not recommended because they typically do not provide enough current.

Trigger adjustment and switch life

The trigger switch included with your SLG board is a high quality tactile lever switch made by Omron. It has a life expectancy of several million actuations. The life of a trigger switch on a paintball marker can be substantially shortened by using too short of a trigger pull. It is imperative to have at least a tiny amount of travel before and after the actuation point. It is also extremely important to use some kind of trigger return force, such as a spring or magnet. Excessive bounce may occur if a spring or magnet is not used, or if the actuation point is too close to the beginning or end of the trigger pull.

Additional information at www.tadaotechnologies.com