Tadao Technologies

Tadao Cyborg Board Instructions

Features

- MacDev Cyborg factory recommended circuit board
- Based on the Musashi 5 software
- Includes five fire modes: uncapped semi-auto, capped semi-auto, PSP ramping, PSP burst, and NXL full-automatic
- Continuously monitors the trigger switch through the entire firing cycle
- Super light 25-gram switch
- AMB and CPF algorithms help to eliminate mechanical bounce and switch bounce
- ARS (anti-ram stick) prevents first shot drop-off
- Power efficient software lengthens battery life
- Programming mode allows changes to debounce, dwell, loader delay, AMB, ARS, bolt delay, eye mode, fire mode, fire mode max rate of fire, CPF, 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
- Delayed and forced eye mode with force shot allows the marker to be fired when the eyes are enabled but no object is present in the breech
- Low battery indicator software

Installation

The Tadao Cyborg Board is a drop-in upgrade. Installation consists of removing the old board and putting in the new one:

1. Remove the grip screws and grips from the Cyborg frame.
2. Unplug both eye harnesses, one on the left side of the board, one on the right side of the board.
3. Loosen the eye cover mounting screws with a 5/64” hex wrench.
4. Remove the frame screws with a 1/8” hex wrench.
5. Gently lift the Cyborg body off the frame, making sure not to stress the still connected solenoid wiring.
6. Unplug the solenoid harness from the solenoid.
7. Remove the board mounting screw with a 7/64” hex wrench.
8. Remove the stock board from the frame.
9. Reverse the steps to install the Tadao Cyborg Board.

Note: You may have to readjust the trigger set screws after board installation. Use of a trigger return mechanism, such as a spring or magnet, is recommended to reduce trigger bounce.

LED Indicator

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

Rapid Blinking Red	At startup this indicates a low battery
Solid Red	No ball in breech
Solid Green	Ball in breech, ready to fire
Slow Blinking Green	Eye malfunction; 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, 3, 4, and 5.

Power and Eye Operation

Pressing and releasing the power button turns the marker on. If the battery is low, the LED will flicker red. A solid red or green LED in the grip frame indicates that the marker is ready to be fired.

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.

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

Startup Sequence:

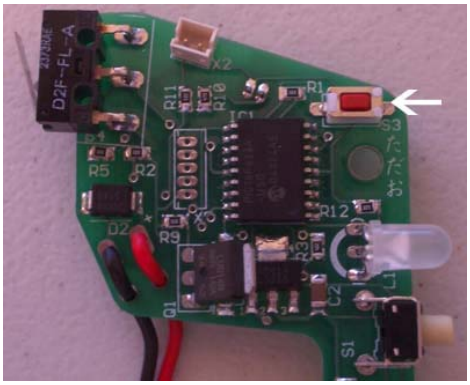
1. Press Power Button
2. If battery is fine, skip this step. If low battery, LED rapidly pulses red.
3. LED lights solid red or green, depending on whether something is in the breech, ready to fire.
4. To turn off the eyes, press and hold the power button for 1 second. The LED will start blinking red.
5. To turn off the marker, press and hold the power button for 1 second. The LED will turn off.

Eye Logic

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 LED will slowly blink green to indicate an eye malfunction. 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 Tadao Cyborg Board is by firing the marker with paint and air.

Programming

The tournament lock must be disabled in order to change settings on the board. The tournament lock is toggled by pushing the red lock button on the surface of the board:



Each time the lock button is pressed while the marker is off, the LED will briefly flash green or red to indicate the status of the programming mode. If it flashes green, programming mode is allowed. By default the tournament lock is disabled, allowing the user to change settings.

While the marker is turned off, press and hold the trigger and turn the marker on. This will initiate the programming mode, cycling through a rainbow of colors, and then show solid green. Pulling and releasing the trigger quickly will toggle between the different programming modes:

Green	Debounce
Red	Dwell
Orange	Loader delay
Flickering Green	AMB
Flickering Red	ARS dwell
Flickering Orange	Bolt delay
Alternating Green/Orange	Eye mode
Alternating Red/Orange	Fire mode
Alternating Green/Red	Fire mode rate of fire
Alt Flicker Green/Orange	Cycle percentage filter
Alt Flicker Red/Orange	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 want to set the dwell to 10, you should:

1. Make sure the marker is powered off and the tournament lock is disabled.
2. Push and hold the trigger and press the power button to turn on the marker.
3. The LED goes through a rainbow, and then shows 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 red.
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 10 times.
8. Wait until the LED turns back on, indicating programming has been completed.
9. Turn the marker off.

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 – The amount of time the solenoid is energized each time the marker is fired. The default is 10 ms. The range is 5 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 – Allows the user to adjust the anti-mechanical bounce feature. Mechanical bounce occurs with the Cyborg 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-automatic 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 the PSP or NXL modes AMB is disabled.

ARS Dwell – Amount of dwell time added for an ARS (anti-ram stick) shot. The range is from 1 to 10 additional milliseconds of dwell. The default is 1, which turns ARS off. This feature may not be necessary with the Cyborg. It is only necessary if the user is experiencing a low first shot. ARS is only used if the Cyborg is left sitting idle for more than 20 seconds. The next shot will then have a slightly higher dwell time to make sure the ram breaks free and there is no low shot. Be aware that a high ARS dwell setting will lead to a much higher velocity first shot.

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 20 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.

Eye Mode – This setting selects the eye mode. Setting 1 is delayed. In delayed mode the eyes will watch for a ball up to ½ second after the trigger is pulled. After ½ second the marker will fire whether or not a ball is in the breech. If set to 2 (the default), the eye mode is forced. In forced mode the marker will not fire unless a ball is present in the breech or a force shot is utilized. The user can fire a force shot by holding down the trigger for ½ second.

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, then 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 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

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 (while in forced eye mode only) – 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 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 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 used, 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 5 or 6 (PSP ramping or PSP burst)
    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)

3. 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)

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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