Tadao Mini Board Instructions

**Features**
- Fully functional in the Empire Invert Mini
- Based on the Musashi 7 software
- New microcontroller core – 8 MHz for no hardware lag and the fastest code execution
- Enhanced power switching hardware for the solenoid
- Includes 12 modes: un Kemped semi-auto, capped semi-auto, PSP auto-response, PSP 50% ramping, PSP 100% ramping, PSP burst, full-fault automatic, auto-respons, 59% ramping, 100% ramping, 3 round burst, and 4-auto-ordinate.
- Automatically monitors the trigger switch, using an interrupt based scan at 1 million times per second
- 6 mode setting allows 3 different options for every fire mode, giving 36 different “feature” style modes.
- Adjustable ABS programming prevents first shot drop-off
- The marker is first turned on. The eyes can be toggled by using the
- Power efficient software and hardware lengthens battery life
- Programming mode allows changes to debounce, dwell, loader delay, AMB, ABS dwell, fire mode, mode max rate of fire, eye mode, CPI, ramp start, G mode, mode 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.

**LED Indicator**

- The multi-color LED that shines out the rear of the grip gives you some indication of mode of operation: currently in:
  - **Fast Blinking Red** At startup this indicates a new battery
  - **Fast Blinking Yellow** At startup this indicates a low battery
  - **Fast 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 12 bps; clean eyes or make sure that there is no paint in the rails.
  - **Slow Blinking Red** Eyes disabled, rate of fire limited to 20 bps 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. To turn off, press and hold the power button for 1.5 seconds, until the LED turns off, then release. Ensure that the marker is turned on, the eyes are enabled. The marker can be turned off regardless of the state of the eyes.

**Eyes Operation and Logic**

- When the eyes are enabled, the first time the eyes are turned on, the eyes can be toggled by using the power button. Press and release the power button quickly and the LED will change colors to indicate the mode the eyes are enabled.
- If used, the system cycle with the fastest 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 trigger. If the eyes are not seeing a shot, a warning will beep. If the user changes the bolt, the eyes will see a shot and the warning will stop. After the shot, the eyes will check the bolt position. If the bolt is not in position, the eyes will not see the shot and the warning will beep again.
- The eyes are enabled when the marker is first turned on. The eyes can be disabled by pressing and releasing the power button. When the eyes are disabled, the rate of fire is limited to 20 bps per second, the maximum rate of fire is set to 100 bps, and the LED will show a solid blue.
- The eyes are enabled when the marker is turned on, the eyes are enabled. The marker can be turned off regardless of the state of the eyes.

**Programming Example**

- If you want to set the bolt forward dwell to 10, 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 bolt forward dwell setting.
  5. The LED will show slow.
  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 been completed.

**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**

- **Debounces** – The Empire Tadao Mini board features an interrupt based debounce algorithm that effectively “cancels” the trigger for 2 million times per second. To prevent this, you must set a debounce setting 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 5 and may be set from 1 to 25.

- **ABS** – Anti-mechanical bounce – Allows the user to adjust the anti-mechanical bounce feature. The mechanical bounce occurs due to the kick generated during each shot and can cause the marker to “run away” on the first few shots. ABS 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.

- **Fire modes** – The Empire Tadao Mini board features an interrupt based debounce algorithm that effectively “cancels” the trigger for 2 million times per second. To prevent this, you must set a debounce setting 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 5 and may be set from 1 to 25.

- **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 5 and may be set from 1 to 25.

- **Dwell** – The limit of dwell time is energized each time the marker is fired to make the bolt go forward. The default is 8 the range is from 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.

- **Rate of Fire** – The rate of fire is limited to 20 bps per second, the maximum rate of fire is set to 100 bps, and the LED will show a solid blue. To turn off, press and hold the power button for 1.5 seconds, until the LED turns off, then release. Ensure that the marker is turned on, the eyes are enabled. The marker can be turned off regardless of the state of the eyes.

- **Eye System** – The Empire Invert Mini board features an interrupt based debounce algorithm that effectively “cancels” the trigger for 2 million times per second. To prevent this, you must set a debounce setting 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 5 and may be set from 1 to 25.

- **Automatic 15-minute idle power down** – Automatically switches the marker off after 15 minutes of idling.

- **AMF (anti-mechanical bounce)** – Allows the user to adjust the anti-mechanical bounce feature. The 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 5 and may be set from 1 to 25.

- **Rate of Fire** – The limit of dwell time is energized each time the marker is fired to make the bolt go forward. The default is 8 the range is from 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.

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Setting 6 is the PSP burst rate mode that works as follows:

- The first 3 shots of a string are semi-automatic.
- After the 4th shot, the marker will burst for 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 ramp 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.

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 -nd - 12th fire modes. The max rate of fire is adjustable from 14 to 30 balls per second or 14-30 balls per second increments, and has an unlimited setting for moving out the loader system. The default is 5, which is roughly 15 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.

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 markers 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 shots
   - Yellow: between 10 and 15 shots
   - Green: between 15 and 20 shots
   - Blue: between 20 and 25 shots
   - White: 25 shots 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 mode.

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

CPP (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 CPP setting is adjustable from 1 to 10. Setting 1 turns the CPP 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. CPP 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%
11. 100%

A higher CPP 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, giving full automatic. Since most switch bounce from either a low debounce setting or mechanical bounce occurs almost immediately after the trigger is released, CPP 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 pull per second that must be maintained for the software to ads or ramp up to the maximum rate of fire setting. The default is 5 and is adjustable from 4-14 pulls per second.

Note: G mode is illegal for use in all tournament series. Tadao Technologies LLC takes no responsibility for the user's choice in using G mode.

Bolt delay  - This setting determines how long the eyes are ignored after the bolt forward 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 1 ms and may be set from 1 to 15 ms. 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 dwell mode delay 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 5 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 default dwell setting.

Wireless loader port - This setting allows the user to adjust the duration of the time that the wireless loader port is powered during every cycle of the marker. The range is 1-10 ms with a default of 10. The port is powered with 9 volts, and requires the use of a loader with wireless capability and a transmitter, which can be mounted just above the battery in the fore grip of the Tadao Invert. The default is 0 ms. The range is 2 to 10 ms. Too low a dwell may lead to inconsistency or feed problems.

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 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. After firing, the next ball will load, and operation will continue as normal.

A tip for setting the debounce, AMP, and CPP - This only applies to semi-automatic fire modes (modes 1 and 2) since AMP is disabled in the PSP fire modes or NXL mode.

Debounce, AMP, CPP setup steps, while using paint and air:

1. Turn AMP and CPP (off both last to 1).  2. Starting at debounce 1-5, 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 pump tool 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 pump for solid trigger pulls, try the slow pump test. Holding the marker in your hand, you should be able to feel the trigger and see if multiple shots can be generated from the single pull.
   - 4. Increase the CPP setting a notch at a time until slow pump 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. Eyes reach maximum - turn CPP and the marker may still be pulled to full automatic, but your debouncing setup is probably too low. Go back to step 2.
   - 6. AMP should not be set above 5, if possible, since it is not as transparent to the user as CPP. Even a CPP setting of 10 will not be noticed by the user.

Example Setting Proﬁles:

1. Tournament legal semi-automatic (NPLP)
   - a. Fire mode 1 or 2 (semi-auto unlimited or capped)
   - b. Debounce 5-10
   - c. AMP 2
   - d. CPP 2-5
   - e. Loader delay set to match your loader (1-4 for Hals, 4-10 for gravity feed)
   - f. PSP X-Ball, CFOA
   - g. Fire mode 3, 4, 5, or 6
   - h. Max rate of fire set to 6-8, depending on Pact Timer readings
   - i. Debounce 5-10
   - j. Ramp start up or higher
   - k. Loader delay set to match your loader (1-4 for Hals, 4-10 for gravity feed)
   - l. NXL
   - m. Fire mode 7 (NXL full-automatic)
   - n. Max rate of fire set to 6-8, depending on Pact Timer readings
   - o. Debounce 5-10
   - p. Loader delay set to match your loader (1-4 for Hals, 4-10 for gravity feed)
   - q. Luftwaffe Speed (absolutely fastest/bouncing)
   - r. Any fire mode
   - s. Max rate of fire set to 22 (unlimited)
   - t. Debounce 1
   - u. AMP using semi-automatic
   - v. CPP 1
   - w. Ramp start up using any ramping modes
   - x. Loader delay

Additional Information:

www.tadaotechnologies.com