

## **Board Features:**

- **Drop-in replacement to the factory board**
  - Perfect fit, professional quality red PCB
  - No modifications required
  - Built in battery charger circuit
- **12 user defined power levels!**
  - The power of each level can be changed by adjusting the calibration
  - 20 calibration points for each power level
  - Adjustable “number of shots remaining” function for each level
  - Adjustable capacitor voltage
- **Hand made assembly with complete quality control**
  - Each board is individually tested prior to shipment
- **Live pressure reading on main screen**
- **Maximum number of shots feature**
- **Atmel 328 Microprocessor**
- **Hi ripple, low ESR capacitor**
- **Low power consumption**
  - ~16mAh with the LCD light off
  - Up to 53 hours of power-on time with the 850mAh battery

### **Additional Information**

- There is no waterproof coating. Water contact must be strictly avoided
- There is no auto shutdown function. The battery will fully drain if the power switch is not shut off
- There is no buzzer or other audible warnings. You should check the battery voltage on the LCD and recharge when it reaches 7.5V
- Velocity consistency is not a given and depends on several factors not related to the electronic board
- Power can reach 43+ ftlbs at high pressure levels (230-200bar) with capacitor overcharge
- Low power settings such as 6 ftlbs and below may be used for fun shooting. Do not expect good consistency

## **CAUTION!**

This circuit board generates a voltage of about 70v across the capacitor's terminals.

This voltage remains for a long time period after disconnecting the battery.

Keep your hands away from the back of the board while it is powered on, or has powered on recently.

Avoid touching with wet hands!

Do not install or uninstall if the circuit board has been powered on recently.

The capacitor's voltage needs about 2 hours after battery disconnect, to drop to about 20v. Removing the battery 8 hours prior to working with the board is advisable.

This warning is also applicable to the factory board.

When installing and uninstalling the board, there may be some residual voltage. Be careful not to create a short circuit with a tool or loose screw!

Board version:

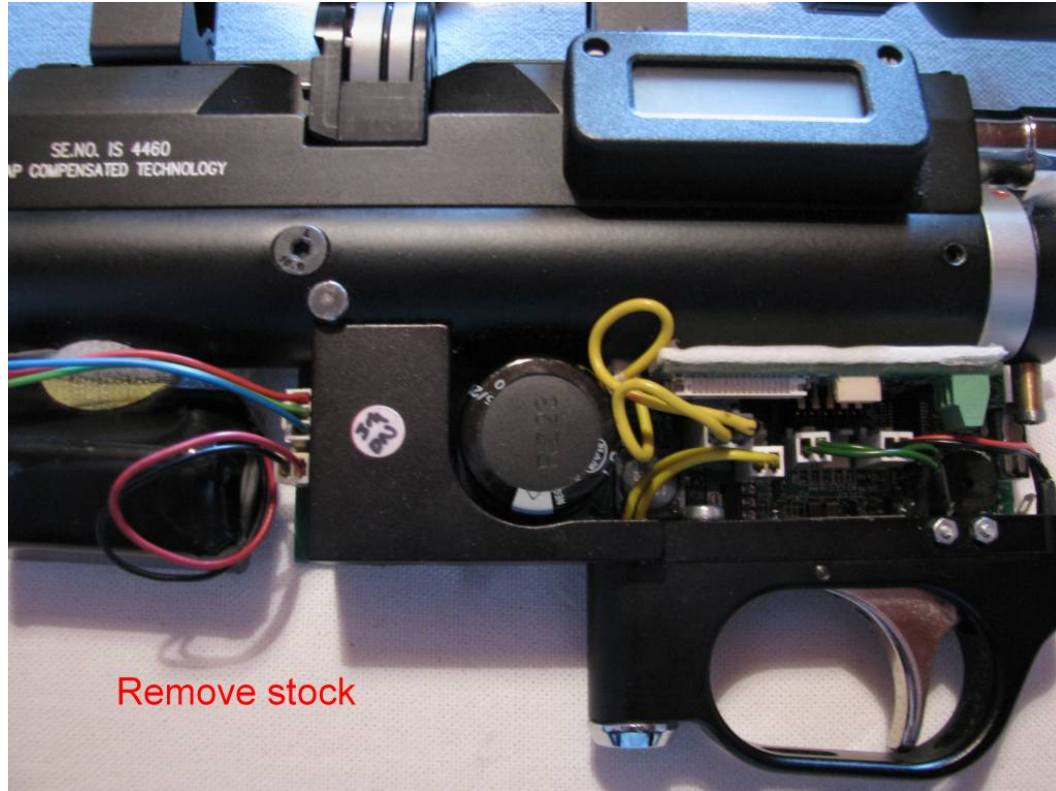
Firmware version:

Menu updated: October 19, 2014

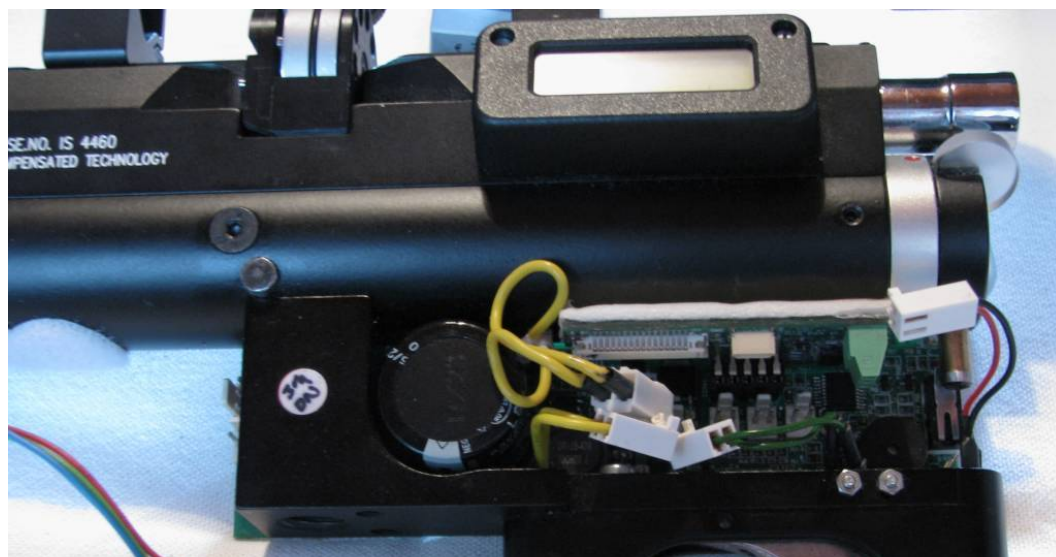
# Installation Instructions

Note: These pictures on these instructions are from a Daystate Mk4, however, the same steps apply for the Airwolf.

1) Remove the stock



2) Remove the battery, then wait at least 2 hours before removing the other connectors.

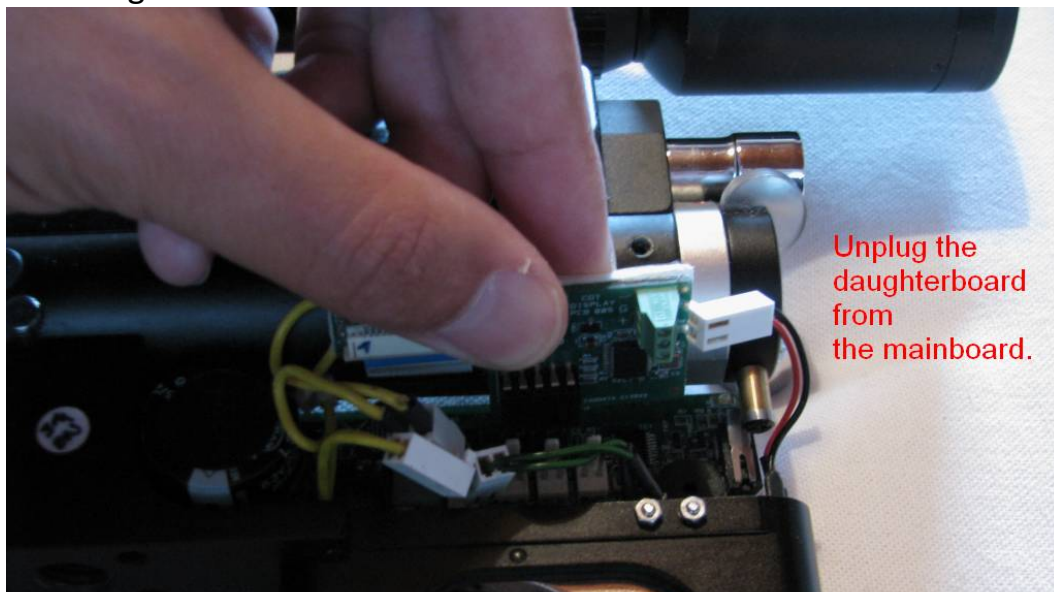




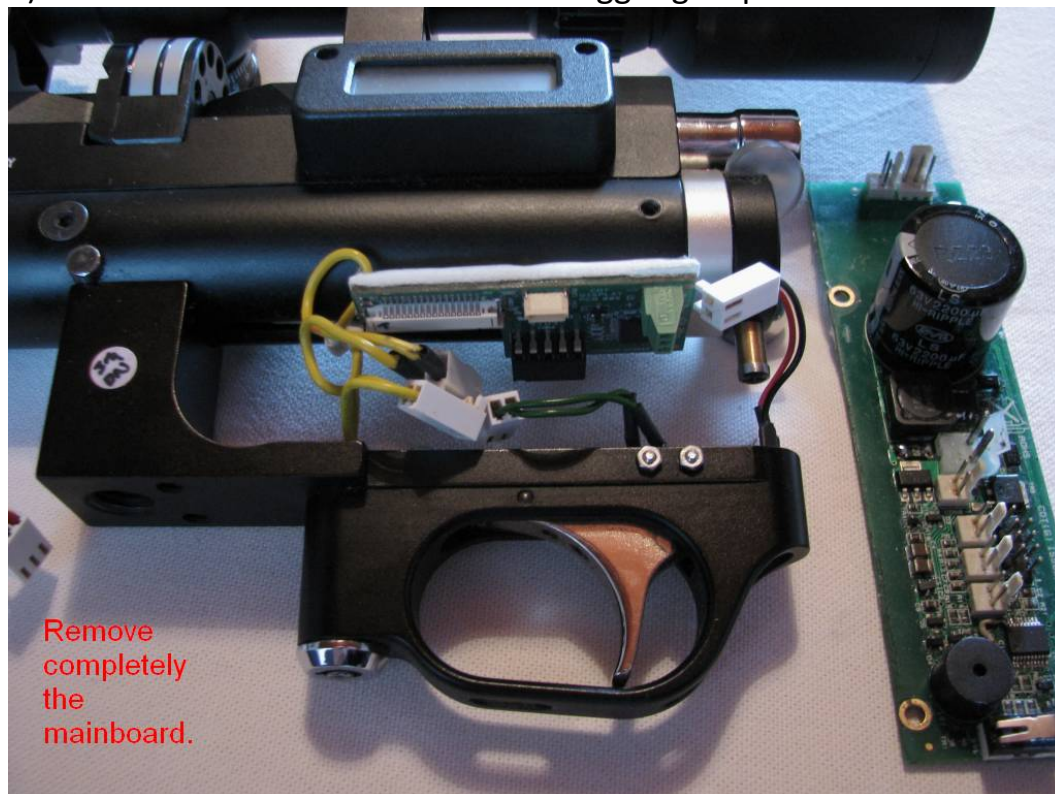
3) Peel the foam covering from the back of the original board. You may also peel just enough material to access the 3 holding screws. Remove the 3 screws.



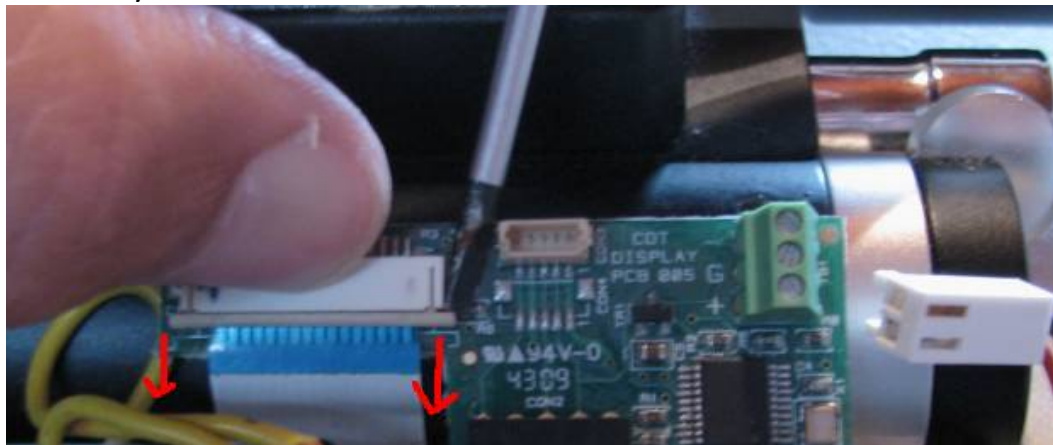
4) Carefully unplug the daughterboard from the mainboard only. Note: The daughterboard will still be connected to the LCD ribbon cable.



5) Remove the main board from the trigger group.



6) With a jewelers screwdriver or similar instrument, carefully push down on the ribbon cable locking mechanism. You will need to do this on both sides. It may be easier to do a little bit at a time on each side until fully unlocked.



7) When the connector is unlocked, gently remove the daughterboard.

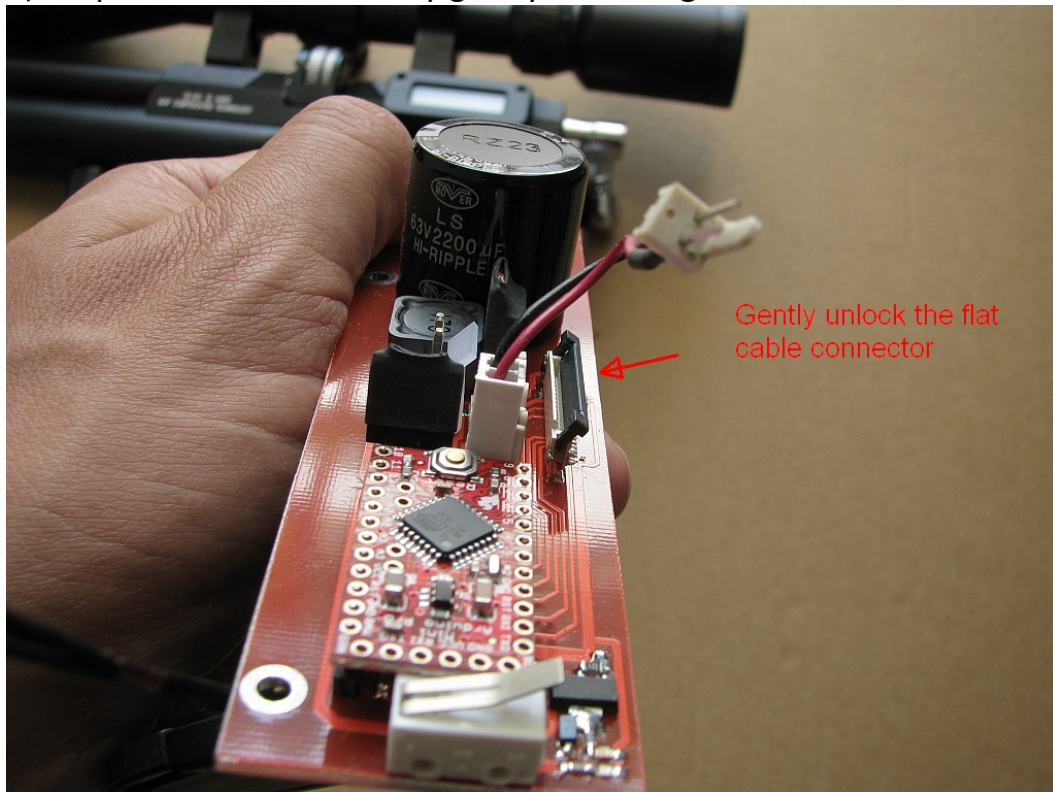


8) Carefully bend the ribbon cable towards the back.

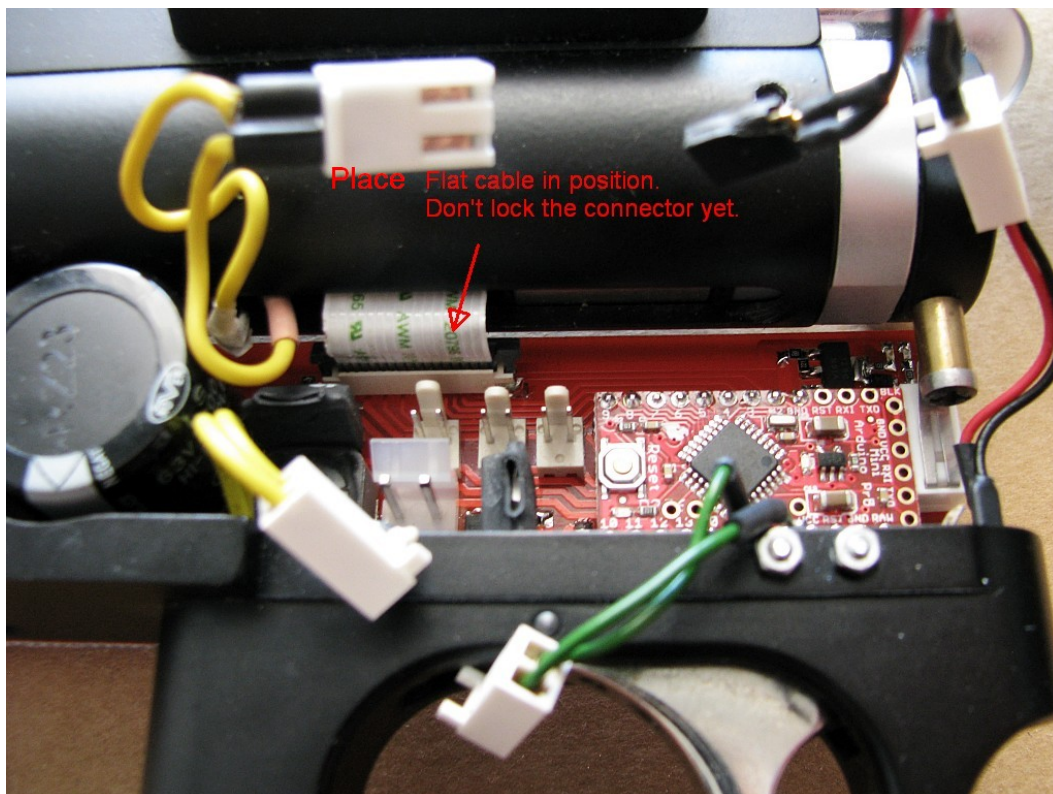




9) Prepare the new board by gently unlocking the flat cable connector.



10) Insert the flat ribbon cable into the connector. Make sure it is fully seated in the connector.



11) Install and tighten the 3 screws on the back. CAUTION! Unlike the factory board, these connections are exposed. You may cover these connections with a suitable insulating material such as electrical tape.

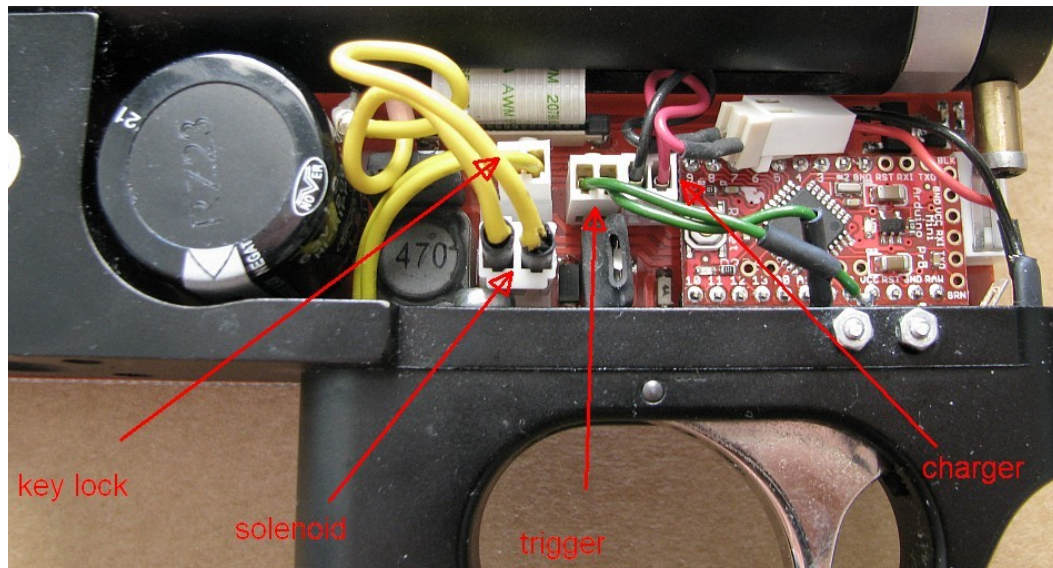


12) Ensure the ribbon cable is fully seated in the connector. Gently push the locking mechanism with a jeweler flat screwdriver or similar instrument on side at a time. You may need to repeat this a few times until the locking mechanism is fully seated. NOTE: Sometimes, one side will pop out while pressing on the other. In this case, use a second screwdriver to prevent the other side from popping out.

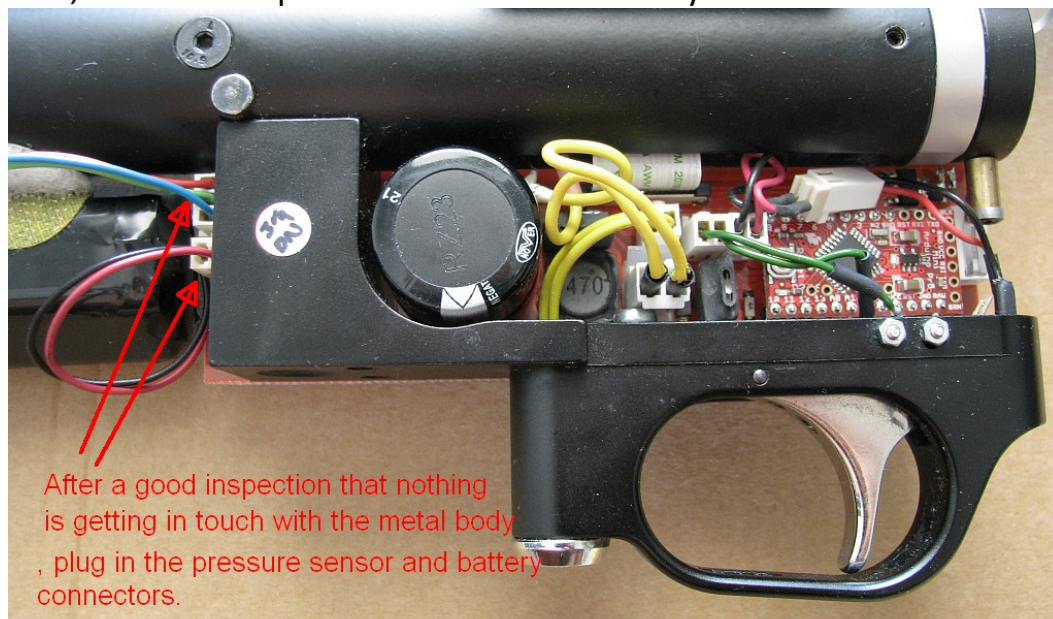




13) Plug the key lock, solenoid, trigger and charger connectors as shown below:



14) Thoroughly inspect your work area for any loose screws, metal, tools, etc... anything that could come into contact with your new board and cause a short circuit. Re-inspect the installation of the board. If all is well, connect the pressure sensor and battery connectors.



**CONGRATULATIONS!** You have successfully installed your new board!  
The following section will explain how your new board works.

## Usage Instructions:

This board has a Main Screen and the following 10 menu options:

- 1) Set Power Level
- 2) Set Capacitor Voltage
- 3) Power Shift
- 4) LCD Light
- 5) LCD Extra Info
- 6) Reduce Shots
- 7) Px Calibration\*
- 8) Px Shots remaining calculator\*
- 9) Welcome Screen
- 10) Text

\* x corresponds to the selected power level.

## Main Screen

The Main Screen displays the following information:



**Pressure:** Reservoir pressure in bars. Unlike the factory board, this value is updated several times per second. As you fill the reservoir, you will see this value change without having to enter a different menu.

**Remaining shots:** This is an estimate based on the Power Level selection and reservoir pressure. This value can be adjusted in the Px Shots Remaining Menu.

**Power Level:** There are 12 Power Levels available to select from. The levels are pre-programmed from 6fpe to 37-40fpe. NOTE: The pre-programmed levels may not perfectly match your rifle. The actual performance will vary depending on caliber, reservoir volume, pellet selection, individual gun condition, etc. However, individual adjustment of the power level is possible through the Px Calibration menu.

**Capacitor Voltage:** Pretty cool to be able to see how your gun is doing! The capacitor voltage may be adjusted through the Set Capacitor Voltage menu.

**Extra Info:** This is optional information that can be turned off through the LCD Extra Info menu. In most applications, you will use this option to help you adjust the calibration of the power levels.

**Battery Voltage:** This is the actual voltage of the battery. It is highly recommended that the battery be charged when the voltage reaches 7.5V or sooner. Discharging below 7.0V may cause damage to the battery pack. NiMH batteries do not suffer from “memory effect” so recharging a partially discharged pack is acceptable.

For reference, a freshly charged battery pack should read about 9.2-9.6v and a pack at about 50% capacity should read 8.4v.



## **Menu Options**

To access the menu options, turn the power on (safety) switch while holding the trigger. Keep holding the trigger until the desired menu is displayed. Once you are in the desired menu, there are two types of trigger presses:

- 1) **Press** - The trigger is quickly pressed and released
- 2) **Hold** - The Trigger is pressed and held for about 3 seconds until the input is accepted, then release it.

### **1) Set Power Level**



**Press** the trigger until the desired power level shows on screen.

**Hold** to save power level. The board will return to the Main Screen.

## 2) Set Capacitor Voltage



**Press** the trigger until desired voltage shows. The voltage will increment in 0.1v steps. Once the maximum setting is reached, the screen will return to the minimum voltage.

Minimum voltage = 61v. Maximum voltage = 76v.

**Hold** to save Voltage level. The board will return to the Main Screen.

NOTE: This setting affects all power levels simultaneously. If you calibrate a power curve and then change this setting, your calibration may be off depending on how big the change was. Approximately 69v has been found to deliver good results at a wide range of power levels. If absolute maximum power is desired, it may be necessary to increase the capacitor voltage. Likewise, if lower power levels are desired, it may be possible to reduce the capacitor level. The pre-programmed curves are based on a capacitor voltage of 69v.

In a nutshell, this option is provided for tuning flexibility but unless you have a good reason to change this, don't.

It is not recommended to increase voltage over 72-73v as it can shorten capacitor's life.

### 3) Power Shift Px



This setting affects the selected power level only. (The power level is selected in menu option #1. The example above shows power level “P 2” being adjusted.)

**Press** the trigger until desired value shows.

**Hold** to save value. The board will return to the Main Screen.

This setting adjusts the pressure dependent pulse width by up to +/-5%.

A value of 1.050 = +5%; a value of 0.950 = -5%

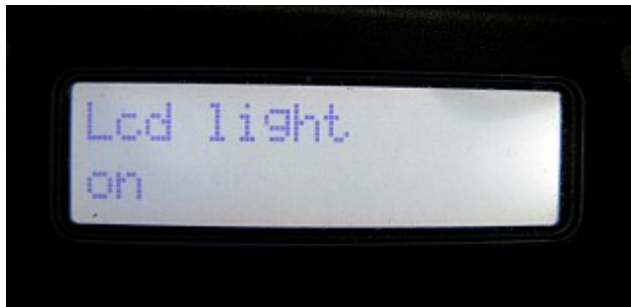
Default: 1.000

This option may be useful for doing a quick adjustment to a power level and is provided for additional flexibility. Do keep in mind that the relationship between the pulse width and pressure is not linear so doing this adjustment on top of a previously calibrated power curve may introduce new curvature. If you need to do a more than a quick adjustment, it may be advisable to use the curve calibration menu.

If you have changed this value to something other than the default, you may want to change it back to 1 before re-calibrating the curve.

NOTE: The lower power levels are affected more than the higher power levels.

#### 4) LCD Light



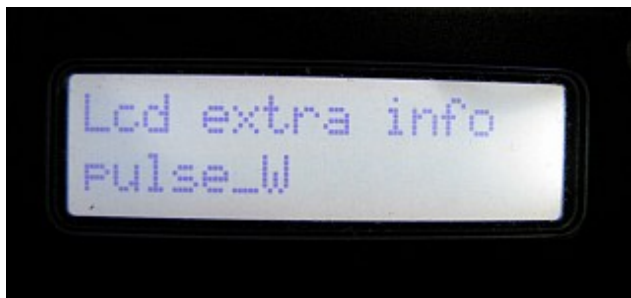
***Press*** the trigger until desired mode shows.

***Hold*** to save mode. The board will return to the Main Screen.

The available modes are

- 1) Continuously on
- 2) On for 5 seconds on after powering on
- 3) Continuously off

## 5) LCD Extra Info



**Press** the trigger until desired mode shows.

**Hold** to save mode. The board will return to the Main Screen.

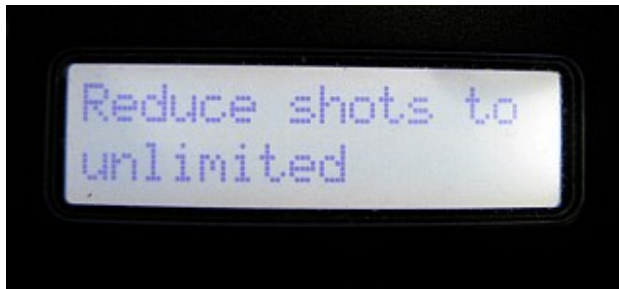
The available modes are:

- 1) Off
- 2) pulse\_W - The pulse width value shows in the second line of the main screen.
- 3) pulse\_W+Rp - The pulse width value shows in the second line of the main screen and the pressure reading changes from bar to the raw data from the pressure sensor.
- 4) velocity fps\* - Display pellet velocity in feet per second
- 5) velocity mps\*- Display pellet velocity in meters per second

\*These options are only available to the MVT version of this board that utilizes the optical sensors on the MVT.



## 6) Reduce Shots



**Press** the trigger until desired number shows.

**Hold** to save number. The board will return to the Main Screen.

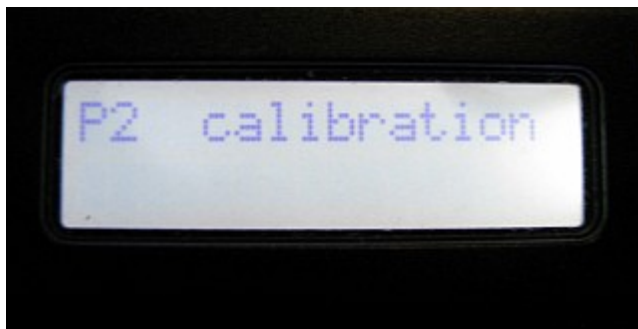
This option affects all power levels. It is intended to set the maximum number of shots that can be taken before the power/safety switch needs to be cycled to reset.

The options are:

- 1) Unlimited
- 2) 1 - 50: One could select "1" for single shot, "10" for a full magazine, "5" so you don't over do it when doing groupings, etc.

When the selected number is reached you need to turn off the main switch and on again to keep shooting.

## 7) Px Calibration



Before discussing the settings in this menu, we will cover some theory on how the board works. This will help you understand what the settings do and how to use them to customize each of the 12 power levels to your specific gun, pellet and power preference.

As you probably know, the MCT system works by reading the pressure in the air reservoir and then sending a pulse of current through a solenoid for a predetermined amount of time. That amount of time is the “pulse width”. The pulse width will affect how hard the hammer strikes the air reservoir valve. By “mapping” the reservoir pressure to a pulse width, it is possible to strike the reservoir valve with just the right amount of force to maintain a constant pellet velocity.

The relationship between the pressure and the pulse width is not linear and can vary depending on the desired power, the pellet weight, caliber, etc. This board uses 20 pairs of pressure and pulse width (for each power level) to define the relationship. The pressure for the 20 pairs of data range from 54 to 240 bar in even increments. The pulse width for each pair is user adjustable. The ability to perform this adjustment is what enables this board to tailor each power level to the needs of the user giving an enormous amount of flexibility not present in the factory board.

In this menu, you will also see the “raw” pressure data from the electronics on the board. As you may remember, one of the prior options was to display this raw data on the main screen instead of bar. Due to processor and memory constraints, calculations are done with the raw data. Also for this reason, the main screen only displays units

and no decimals (when working with microprocessors, resources are limited and one must make choices). The ability to display the raw pressure data on the main screen was done with the intent to provide the maximum amount of accuracy available (one “raw” pressure unit is equivalent to about 1/3 of a bar).

Paired Data Screen (see flow chart at the end of this section for reference)

After selecting the Px Calibration menu, the following screen is displayed:



**Press** the trigger repeatedly to cycle through the 20 pressure & pulse width calibration points.

On the left side of the screen you can see the actual reservoir pressure in raw and bar format. This is a live reading of the pressure in your gun's reservoir. If you were to fill or drain air, you'll see this number change.

On the right side of the screen you can see the selected raw pressure value and below it, the corresponding user adjustable pulse width.

To make changes:

**Hold** the trigger to edit the pulse width of the selected point. A single number will be shown in the middle of the second line and **Press** the trigger to modify the first digit of the 4 digit number. **Hold** the trigger to temporarily save this digit and do the same for the next 3 digits. When you save the last digit a “press & hold to save” screen will appear. If you know that this is the right value **Hold** the trigger to save number.

At this point, the board has a feature to allow “real time” adjustment of the values. If you want to use this feature, fill the reservoir to the pressure setting you are about to adjust. Have your pellets ready and be in an area where it is safe to shoot.

**Caution!! Always keep the muzzle pointing in a safe direction.**

To enter this feature, rather than doing a trigger **Hold**, do a trigger **Press**. A “Press & hold for test shot” screen will appear.

If you now **Hold** the trigger a “Ready to shoot!” warning screen will appear. You may start taking test shots.

**Caution!! Always keep the muzzle pointing in a safe direction.**

To return to editing the pulse duration, **Hold** the trigger.

If you **Press** the trigger you will get back in the calibration menu and not save the value you entered.

For the power calibration procedure you will need a chronograph and good quality pellets. It is recommended the use of weighted pellets.

In the case that you are trying test shots to find the right pulse width value for a specific pressure point you must fill the gun with air at the right pressure first. See the example screen below.



Note how the left hand side live pressure reading (raw units) matches the right hand side pressure point for the curve.

Example : You want to build a curve that shoots the 18.1gn jsb's @ 260m/s.

You have selected the power level of your choice and you are in the screen show above.

Fill the gun to the maximum pressure of about 230 bars. This is equivalent to "840" in raw units. Select the pressure point "840". Set a pulse width and make a test shot. If the velocity is not close enough to 260m/s refill air to 840 and repeat the procedure. When you find the right pulse width that produces the desired speed save it. Make some blank shots to drop the pressure to 800 raw units and go to the next lower pressure point, 800. Repeat until you get to the pressure that is not capable of producing the selected velocity. Fill all the lower points with the same last pulse width value.

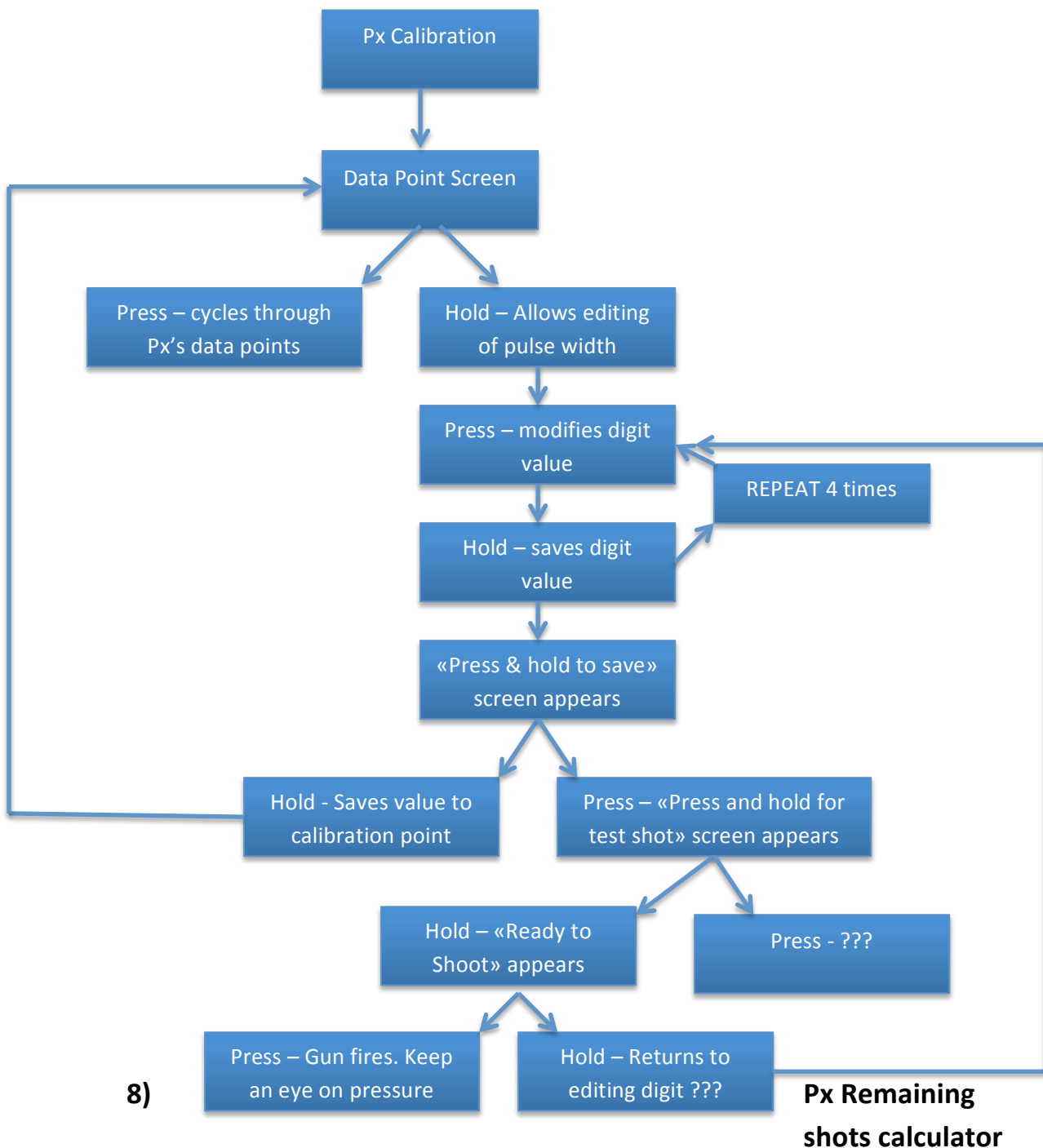
You can also start from a low pressure point and go upwards.

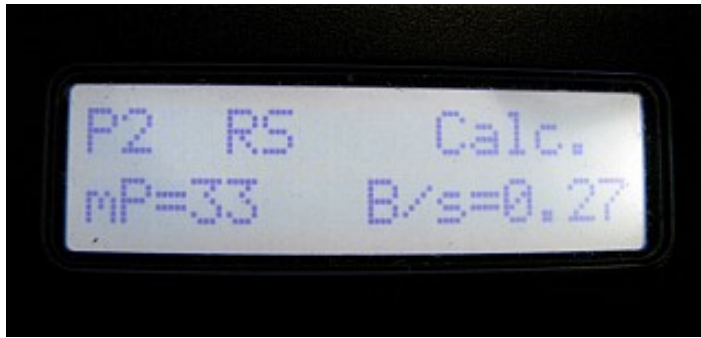
Note: Calibration points are provided for raw values above 840 for unique circumstances and it is not advised to try to exceed the manufacturer's pressure recommendation. For best results, you should fill these values with the same pulse width as you found worked for 840. However, as with other things in this board, those values are provided for maximum flexibility should you want to calibrate at higher pressures.

Alternatively, you may also collect data on the behavior of your gun, analyze it on the software of your choice and then just input the calibrated numbers back in. By selecting the "pulse\_W+Rp" option in the LCD Extra Info menu, you can record data points consisting of pressure, pulse width and velocity (from your chronograph). It is outside of the scope of this manual to show you how to analyze this data, however, with the right statistical tools, you can optimize the settings in a multidimensional space and then enter those settings directly in the menu.



In summary, the 12 power levels are pre-filled with values that should get you close to a decent calibration. Experiment with your own gun first and see if this meets your needs. You can then modify merely a single value or create whole new curves if you so desire!





This menu allows for you to make adjustments to the remaining shots calculator for each Power Level.

You need to provide 2 values:

- 1) Minimum Pressure (mP) – This is the lowest pressure in bar that delivers the desired power for a particular power level (Ex. After calibration you find out that 140bar is the lowest pressure you can shoot at 35fpe).
- 2) Bars/shot (B/s) – This is the average air consumption for you power level.

You can measure the air consumption by shooting 10 shots and applying (initial pressure – final pressure) / 10. It is better doing that in the middle of the working pressure spectrum for the specific level, as air consumption is lower at high pressures and higher at low pressures.

You can also choose to shoot from your highest to lowest calibrated value, count the number of shots and determine the average consumption for your power level. This may use more air and time but would be more accurate.

NOTE: This setting provides an estimate and may not be 100% accurate. Ultimately, your minimum calibrated pressure will dictate how many consistent shots you can get.

In order to change this setting:

Instructions on how to change this setting

## 9) Welcome screen



**Press** the trigger until desired mode shows.

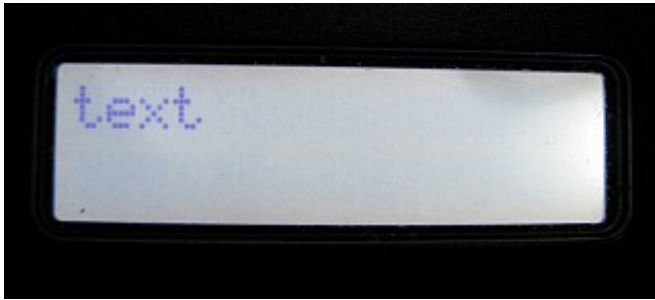
**Hold** the trigger to save the selection.

The available modes are:

- 1) Disable
- 2) Enable 0.5 seconds
- 3) Enable 1 second
- 4) Enable 2 seconds.

NOTE: Welcome Screen text is set in menu 10 "Text".

## 10) Text\*



\* This is the text that appears in the welcome screen so this menu item will change depending on what you enter here.

**Press** the trigger until the desired character shows on screen.

**Hold** the trigger to save the selected character and go to the next.

The first 2 trigger **presses** are spaces. You can save them too in order to have separate words.

## **Battery charging.**

The circuit board charges the battery with constant current at 1/10c mode. This means that to fully charge a battery of 850mah capacity 11 – 14 hours are needed when it is completely discharged. Charging starts when you plug in the charger and turn the main switch off.

Do not leave the charger connected for extended periods of time. After fully charging the battery, disconnect the charger.

