

# PowerSet Mk2 Programmer Instructions

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## PowerSet Programmer Overview

The PowerSet programmer is compatible with all the Daystate range of electronic guns using Gun Control Units (GCUs) except early A Type units and later Trigger Control Units (TCU).

The programmer allows the user installer to set up gun power levels and monitor performance in real time.

## PowerSet Description

The programmer is supplied in a removable tough rubber boot with hinged stand:

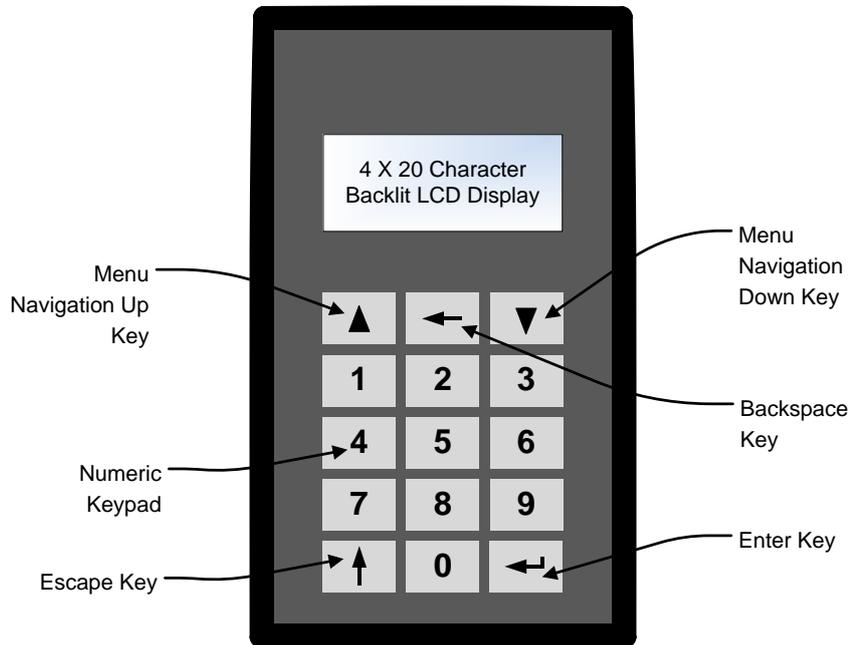


A USB charging socket and RJ45 PSU connection socket are located at the top of the programmer:



## Programmer Keypad

The programmer has a 15-key membrane keypad that is used to navigate all the menus and enter and retrieve information. The up and down keys will scroll through the menus, the enter key is used to select menus and enter commands, the escape key allows the user to quit menus, the backspace key is used for deleting numeric entries and the numeric keypad is used for numeric data entry.



### To Turn the Programmer On

Press any of the left-hand column keys

### To Turn the Programmer Off

Press the escape key repeatedly until "Turn Off?" is shown and press enter. If left continuously on accidentally the programmer will automatically power down after 15 minutes of non-use. The test set will stay on continuously when the charging adapter is plugged in and charging.

## Test Set Specifications

SPECIFICATIONS	
<b>Charging</b>	USB Micro B, 5V, 450mA Maximum (cable supplied)
<b>Charge Time</b>	2 hours to fully charge
<b>Battery</b>	Rechargeable LiPo battery, 3.7V nominal, 800mAH
<b>Battery Life</b>	2 days continuous operation
<b>Test Lead</b>	1 Metre FCC-68 (RJ45) to 5-way 2.5mm Molex KK receptacle
<b>Display</b>	Backlit 4 x 20 character LCS display, readable in direct sunlight
<b>Communication interface</b>	5V logic, asynchronous serial
<b>Accuracy</b>	+/- 2 Least significant digits. Actual measurements are derived from GCU
<b>Dimensions</b>	76.5mm x 127mm x 24mm without boot, 93mm x 155mm x 36mm with boot
<b>Weight</b>	140gm without boot, 310gm with boot

### Warning

**Before using the programmer ensure the gun is unloaded and the muzzle pointing away in a safe direction from any persons or animals.**

# Programmer Menus

## Glossary

The programmer uses various symbols and units, they are described below:

**us:** Microseconds, one millionth of a second

**Bar:** 1 atmosphere of air pressure = 14.5 pounds per square inch

**bit:** Digital measurement of Bar or Voltage, 1bit = 0.244Bar. 1bit = 0.0744 Volts respectively. Note: bits are used in all the GCU internal measurements, using whole bits help to make calculations more accurate rather than using Bar or voltage decimal approximations.

**HS and LS:** High slope and low slope shown in us per Bar. These slopes are used to control power with pressure variation.

**GCU:** Gun Controller Unit.

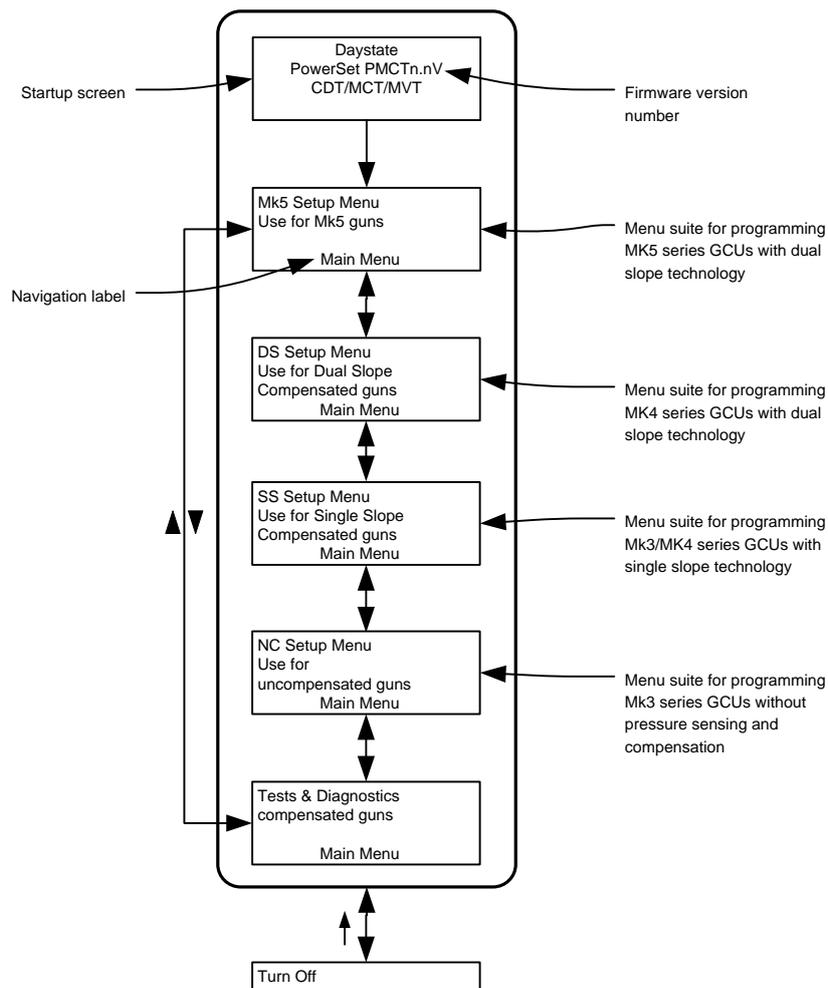
**DS:** Dual Slope

**SS:** Single Slope

**NC:** Non-compensated

## Main Menu

This menu selects the various function suites of the test set. When the test set is first switched on a screen with the software version is shown briefly in the second line, on the right (n.n on the figure below). Pressing the up/down arrows will step through the functions. Pressing enter will select the menu of interest, when in the main menu "Main Menu" will be shown to aid menu navigation.



# Mk 5 Setup Menu

This suite of programming features are used to program all the more recent Mk5 range of guns and use dual slope technology, these include Pulsars and electronic versions of Wolverines.

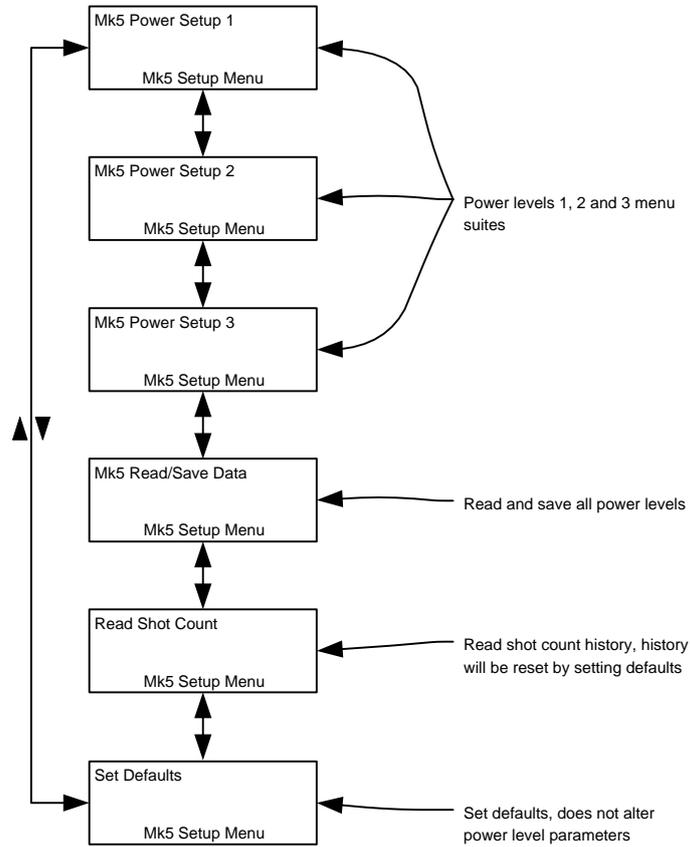
**NOTE:**

The power levels are indicated differently on the gun:

Power Level 1 = Hi Power

Power Level 2 = Mid Power

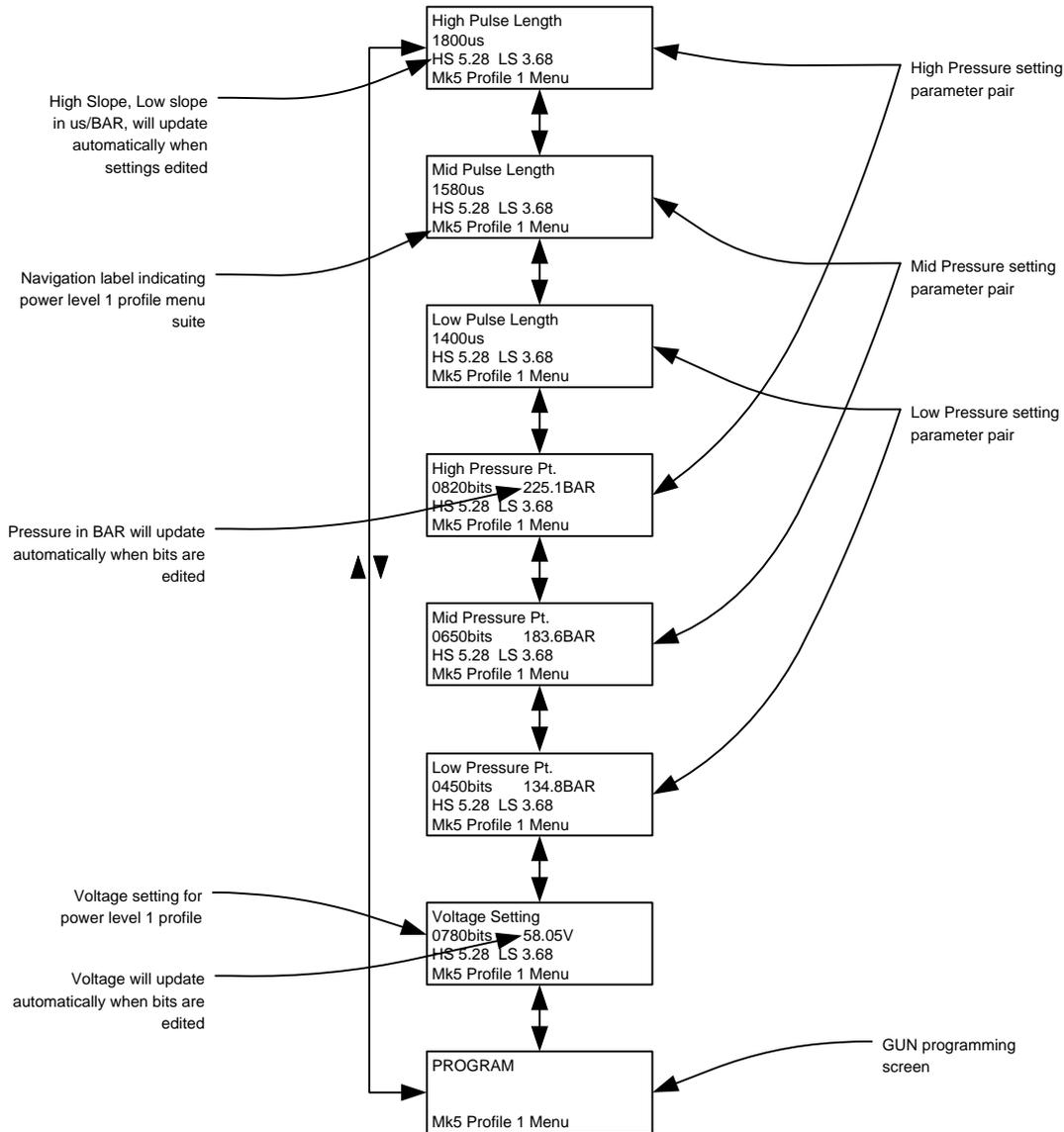
Power Level 3 = Low Power



The menu operation is now described in detail:

## Mk5 Power Setup 1 to Mk5 Power Setup 3

These menus are used to setup the individual power levels and are central to the correct operation of the gun. Pressing enter will show the following menus, for clarity only power profile 1 is shown, the other power level profile settings are identical in operation. Values are shown as an example only:



### Pulse Length Data Entry

The pulse length data can be edited by pressing enter when in the required High, Mid or Low Pulse Length menu, a flashing cursor will appear over the “u” in “us” and the backspace key can be used to delete the old entry and the numeric keys used to update data, enter will save the data.

### Pressure Point Data Entry

The pressure data can be edited by pressing enter when in the required High, Mid or Low Pressure Point menu, a flashing cursor will appear over the “b” in “bit” and the backspace key can be used to delete the old entry and the numeric keys used to update data, enter will save the data. Note that the pressure display to the right will be updated with the new pressure setting in BAR.

### Pulse Length and Pressure Associations

High pressure point – High pulse length, at a pressure of 225.1BAR, the pulse length will be 1800us.

Mid pressure point – Mid pulse length, at a pressure of 183.6BAR, the pulse length will be 1580us.

Low pressure point – Low pulse length, at a pressure of 134.8BAR, the pulse length will be 1400us

## Slope Display

When editing the pressure and pulse length data, the HS (High Slope) and LS (Low Slope) data in microseconds per BAR will automatically be updated. A default of zero will be displayed until all the fields required for slope data calculation are populated.

## Voltage Setting

The voltage setting allows for extreme muzzle energies to be setup with precision, lower energies of typically 12FPE will need a voltage of approximately 60V and higher energies might need up to 70V, this is also dependant on calibre. A gun set to 12FPE need would need a pulse length range of 300us to 400us from High Pressure Point to Low Pressure Point to get precision control of the power, if the voltage setting was to high this range might be reduced to less than 200us, making setup more difficult.

The voltage data can be edited by pressing enter when in the Voltage Setting menu, a flashing cursor will appear over the "b" in "bit" and the backspace key can be used to delete the old entry and the numeric keys used to update data, enter will save the data. Note that the voltage display to the right will be updated with the voltage setting in Volts.

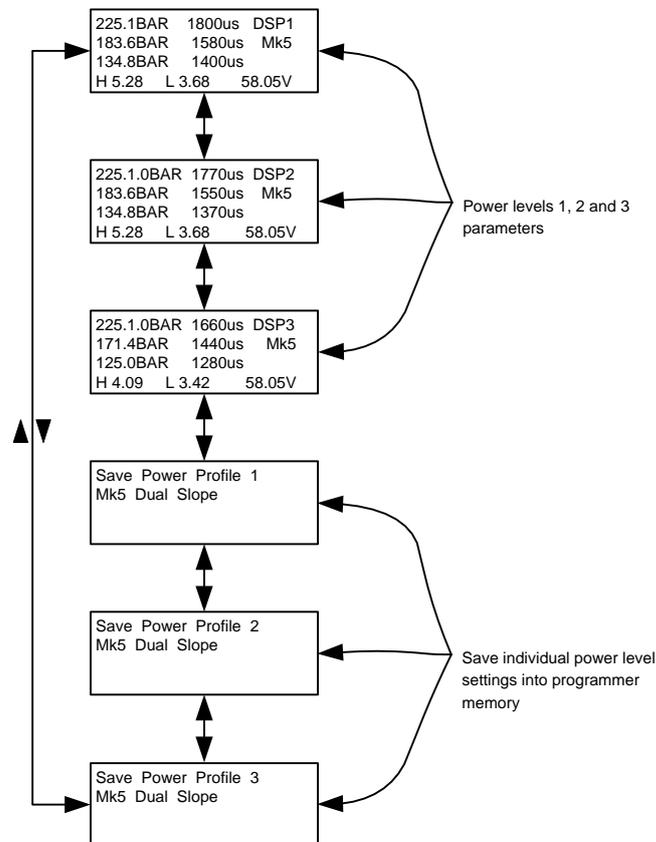
## Program

This menu is used to program the gun with the data entered in the other menus in this suite. If there is a data range error or a missing data error, the programmer will not program the gun with bad data. Data range error would typically be a low pressure point setting higher than the mid pressure point, or a mid-pulse length setting greater than the high pulse length setting.

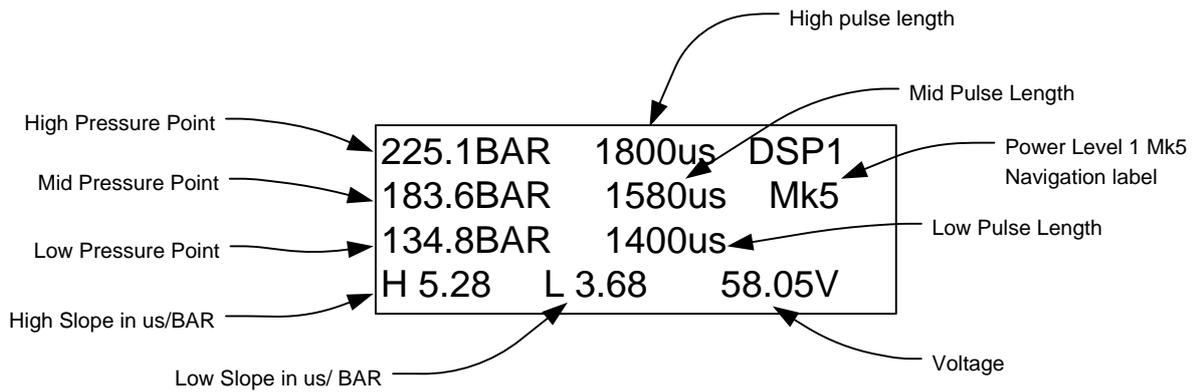
The programmer will have to be plugged into the gun, and the gun switched on before programming can be commenced. Pressing the enter key when in the programming menu will download the data to the gun and a confirmation signal will be given.

## Mk5 Read/Save Data

1. An example of a gun reading is shown below:



The first screen displays the following data:



### Saving Power Profile Settings

Pressing enter when in these screens will save the displayed parameters into the programmer's internal memory. These parameters can be retrieved when going back to the Mk5 Setup Menu suite and used to program guns if required. Individual parameter sets can be saved and retrieved in this way.

### Read Shot Count

This screen allows the shot count history to be displayed. The shot count history will be reset to zero when defaults are loaded.

### Set Default

When enter is pressed when this screen is displayed the gun will be defaulted to the following settings:

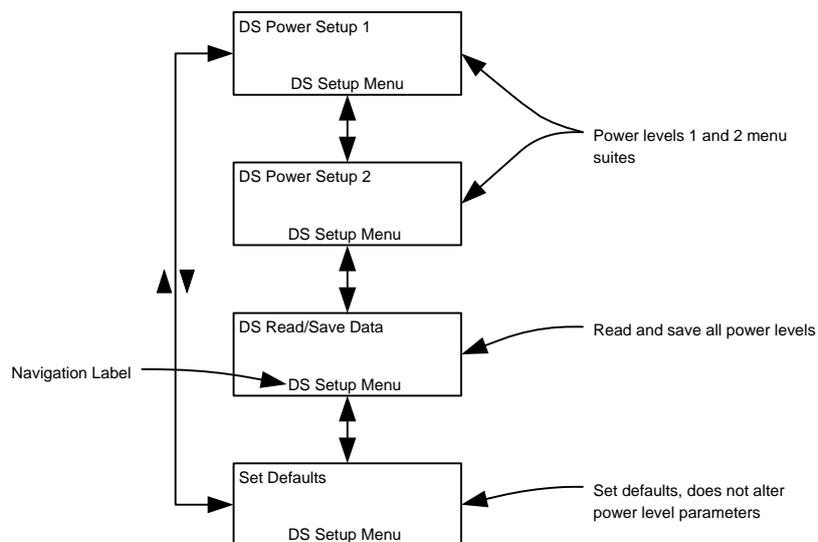
Hi Power (power setup 1)

Magazine Off

Laser On

### DS Setup Menu

This suite of programming features are used to program all the more recent Mk4 type G or H boards programmed with 03MDS0AV.hex dual slope firmware. Dual slope is used to give a flatter and more consistent power characteristic that enables a larger shot capacity to be achieved.



The dual slope (DS) programming is a sub-set of the Mk5 programming suite. A comparison of feature differences are shown below:

Features	Mk5	DS
Power Level Settings	3	2
Voltage Setting	Yes	No
Shot count	Read by programmer	Displayed on gun
Set Defaults	Hi Power Magazine Off Laser On Shot count reset	Hi Power Magazine Off Shot count reset

In all other respects the programming functions are very similar and the Mk5 Setup Menu instructions above should be consulted when programming a DS gun.

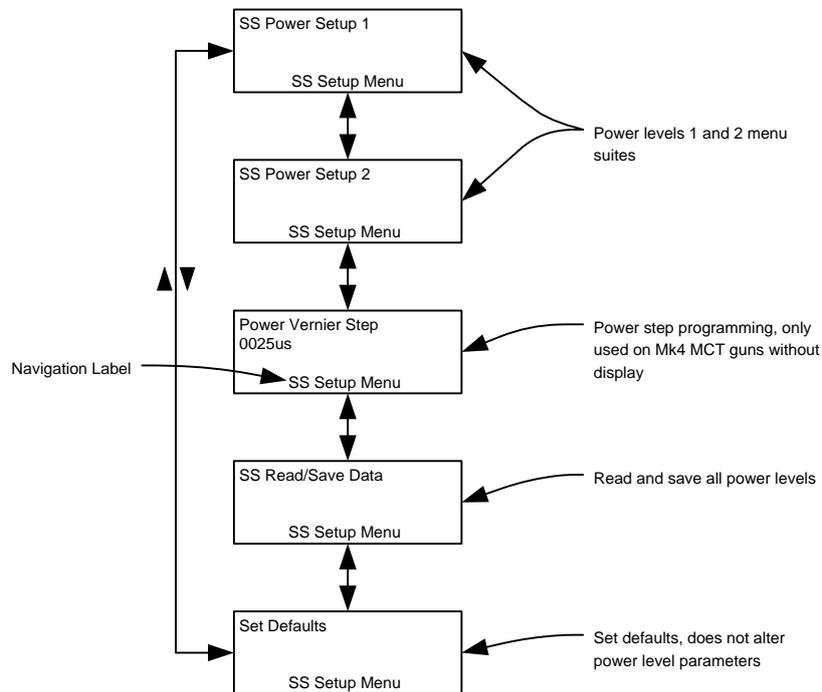
**NOTE:**

The power levels are indicated differently on the gun:  
Power Level 1 = Hi PWR

Power Level 2 = PWR 2

## SS Setup Menu

The Single Slope menu suite is for programming pressure sensing, pressure compensated Mk4 GCUs with single slope technology and MVT, velocity regulated guns.



**NOTE:**

The power levels are indicated differently on the gun:  
Power Level 1 = Hi PWR

Power Level 2 = PWR 2

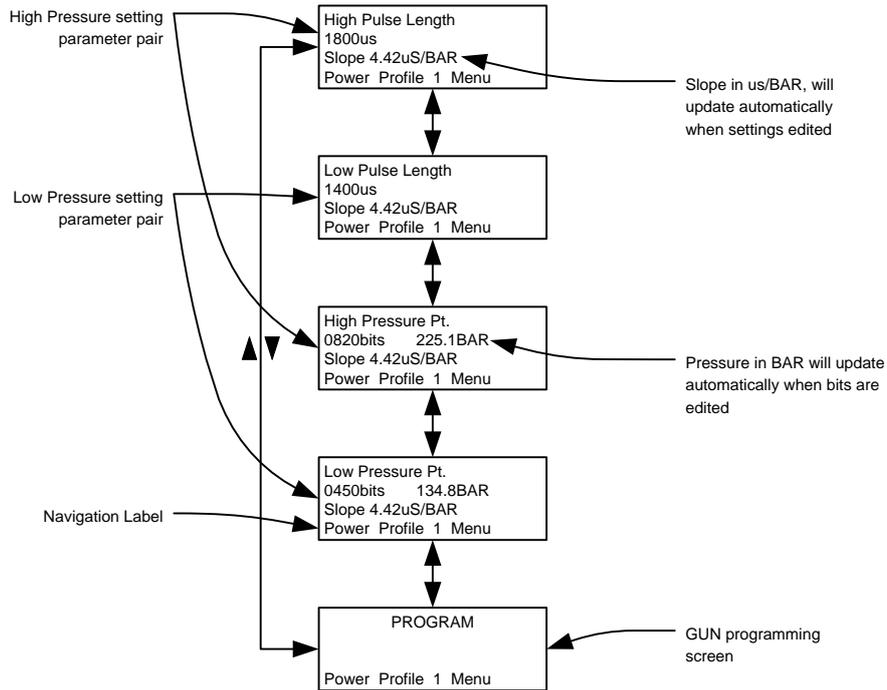
### Power Vernier Step

On earlier Mk4 guns using pressure compensation without a LCD display, only one power level is fully programmable, power level 1 and power level 2 is redundant. The power level can be reduced by the user using the program stage 5 power setting feature on the gun. This is where the power can be reduced when in programming mode by a Power Vernier Step increment. This step is typically about 25us for 12FPE guns and is multiplied every time the power step is incremented i.e. when in stage 5 programming mode and the trigger is pulled twice, the pulse length will be reduced by  $25\mu s \times 2 = 50\mu s$ , if the trigger is pulled 5-times the pulse length will be reduced by  $125\mu s$ , etc.

The Power Vernier Step screen has no associated menus below and the step in microseconds can be edited directly from this screen.

## SS Power Setup 1 and SS Power Setup 2

These menus are used to setup the individual power levels and are central to the correct operation of the gun. Pressing enter will show the following menus, for clarity only power profile 1 is shown, the other power level profile settings are identical in operation. Values are shown as an example only:



### Pulse Length Data Entry

The pulse length data can be edited by pressing enter when in the required High or Low Pulse Length menu, a flashing cursor will appear over the “u” in “us” and the backspace key can be used to delete the old entry and the numeric keys used to update data, enter will save the data.

### Pressure Point Data Entry

The pressure data can be edited by pressing enter when in the required High or Low Pressure Point menu, a flashing cursor will appear over the “b” in “bit” and the backspace key can be used to delete the old entry and the numeric keys used to update data, enter will save the data. Note that the pressure display to the right will be updated with the new pressure setting in BAR.

### Pulse Length and Pressure Associations

High pressure point – High pulse length, at a pressure of 225.1BAR, the pulse length will be 1800us.

Low pressure point – Low pulse length, at a pressure of 134.8BAR, the pulse length will be 1400us

### Slope Display

When editing the pressure and pulse length data, the Slope data in microseconds per BAR will automatically be updated. A default of zero will be displayed until all the fields required for slope data calculation are populated.

### Program

This menu is used to program the gun with the data entered in the other menus in this suite. If there is a data range error or a missing data error, the programmer will not program the gun with bad data. Data range error would typically be a low pressure point setting higher than the high pressure point, or a low pulse length setting greater than the high pulse length setting.

The programmer will have to be plugged into the gun, and the gun switched on before programming can be commenced. Pressing the enter key when in the programming menu will download the data to the gun and a confirmation signal will be given.

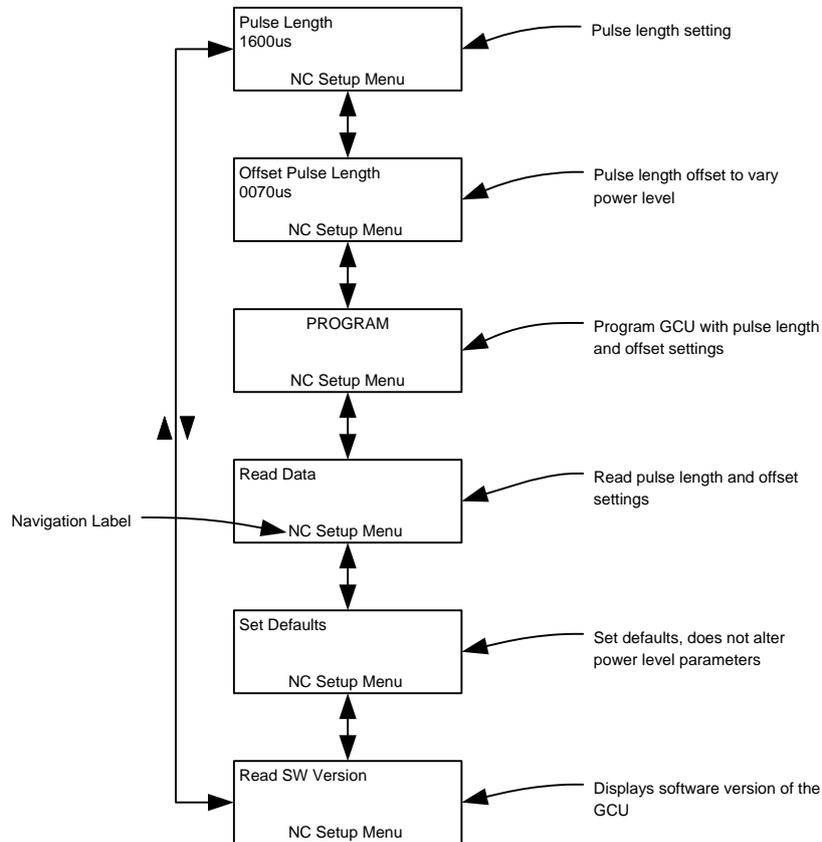
### MVT Setup

SS Power Setup 1 will also setup the “native” velocity of a MVT gun, which is the intended velocity with a specific pellet that the gun will operate at. This is useful as it will compensate for pressure when the gun is

recharged with air, so it will operate and its predetermined velocity after a fill with a minimum number of velocity learning shots. If a gun is programmed correctly the velocity should be accurate from the first shot after a fill of air.

## NC Setup Menu

This suite of menus are used to program early non-compensated Mk3 guns using lean-charge technology. The programming suite is self-contained as it has all test and diagnostic menus within this suite.



### Pulse Length

This screen allows the user to edit the pulse length directly.

#### NOTE:

This setting will not be updated with the read data menu.

### Offset Pulse Length

This setting varies the pulse length with the use of the gun programming settings, to reduce the power output. This step is typically about 70us for 12FPE guns and is multiplied every time the power step is incremented i.e. when in stage 6, set power programming mode and the trigger is pulled twice, the pulse length will be reduced by  $70\text{us} \times 2 = 140\text{us}$ , if the trigger is pulled 3-times the pulse length will be reduced by 210us, etc.

#### NOTE:

This setting will not be updated with the read data menu.

### Program

Pressing enter when this screen is displayed will program the gun with the selected pulse length and offset settings.

### Read Data

This command is read only and will not save settings. The resultant display will show the pulse length and offset in microseconds.

## Set Defaults

This menu will allow the user to set the gun back to its factory set default state.

### NOTE:

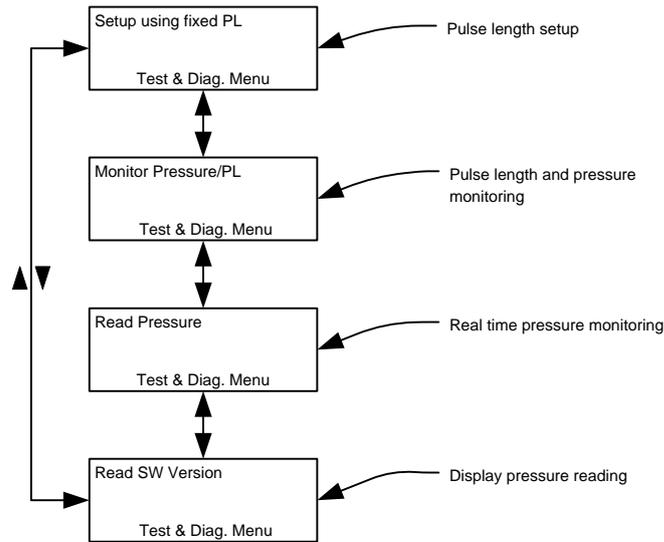
Use the feature before setting up the gun to ensure that it is set to its maximum power and any power reduction offset is disabled.

## Read SW Version

This screen will allow the software revision to be displayed.

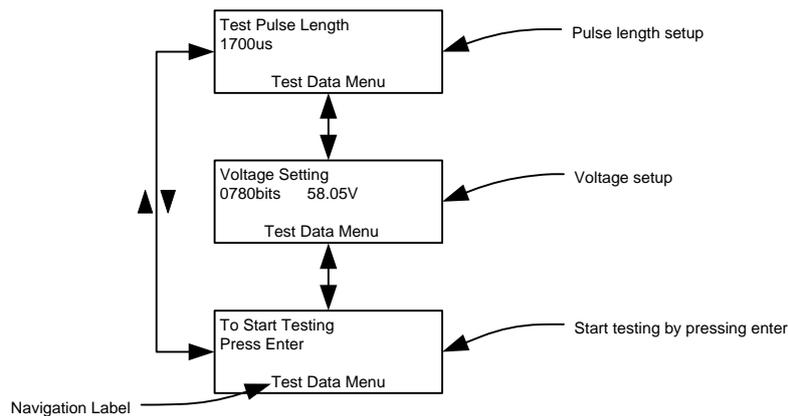
## Tests & Diagnostics

This suite of menus are designed to help in setting up compensated guns where it helpful to monitor pressure and pulse length on one convenient screen. The menus also offer other information including real-time pressure measurement for accurate gun air recharging.

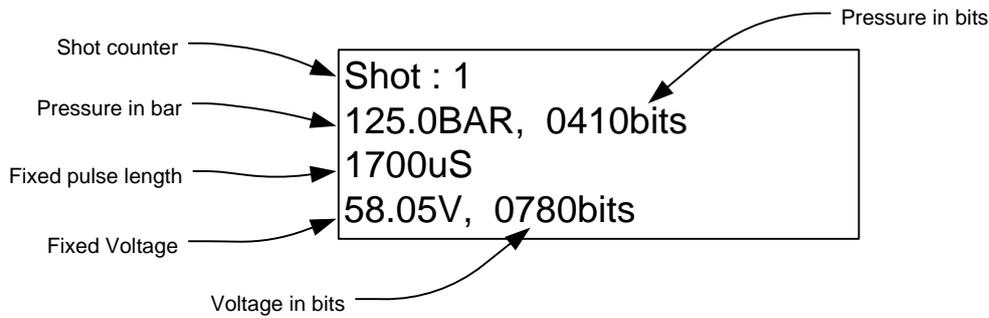


## Setup using fixed PL

This is the main menu used in the gun's setup, before this menu can be used, the pulse length and voltage have to be programmed, using the menus displayed after pressing enter when in this screen:



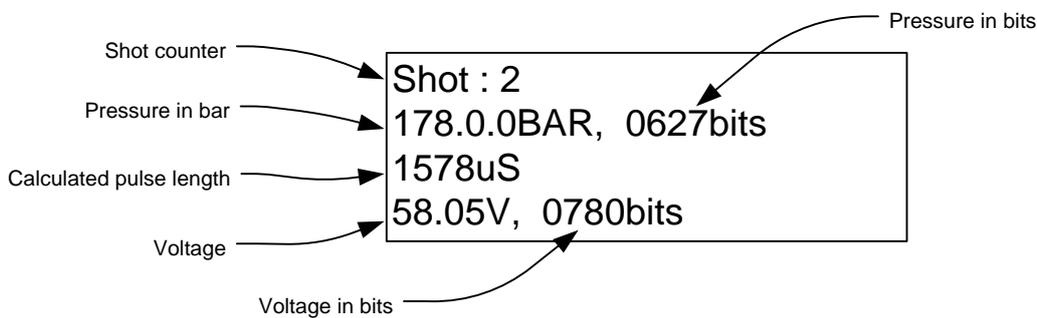
These Test Pulse Length and Voltage Setting screens allow pulse length and voltage to be reviewed and edited before starting the setup procedure. Pressing enter while in the bottom screen will program the edited values shown in the previous screens and put the gun into test mode. When the trigger is pulled the following screen will be displayed:



The shot counter will increment with every shot and the pressure will drop accordingly. Both the pulse length and voltage parameters are fixed and shown in decimal notation and in bits for convenience. If the gun does not support voltage programming (only later Mk5 GCUs and onwards support this feature), then the bottom line is to be ignored.

### Monitor Pressure/PL

When enter is pressed while this screen is displayed, the following information is shown:



This is similar to the previous menu as described above, except there are no associated parameter setup menus.

The display shows the parameters as the gun “sees” them and calculates the pulse length as necessary. All the information shown is live data at the time a shot is taken and is dependent on the data stored in the gun.

### Read Pressure

This menu allows the real time pressure to be read to one decimal point of accuracy and is useful for precise gun filling.

### Read SW Version

The software version can be displayed using this menu.

## Gun Setup Procedures

Before commencing gun setup it is most important to observe safety measures and to follow these basic rules:

1. Ensure that the gun is pointing in a harmless direction away from people and animals.
2. Never leave an unattended gun loaded.
3. Use a sturdy and secure pellet stop that ensures that there are no dangerous ricochets.
4. Remove loaded magazines from unattended guns.
5. Ensure that the gun is securely held in a vice or clamp.
6. Double check the alignment of gun, chronoscope and pellet stop before and after testing.
7. Wear safety glasses and ear defenders, especially when setting up high power FAC guns.
8. If a gun should misfire or jam, always clear the pellet with a cleaning rod or similar as soon as practicable.
9. Inspect the pellet stop regularly for signs of wear to ensure integrity.

## Setup Equipment

Here follows a list of equipment to be used for testing:

1. PowerSet programmer.
2. Pellet stop.
3. Chronoscope.
4. Vice or clamp for gun.
5. Safety glasses.
6. Ear defenders.
7. Flat continuous surface or bench for equipment layout.
8. Writing materials for taking notes.
9. Tin of pellets.
10. Air bottle to refill gun

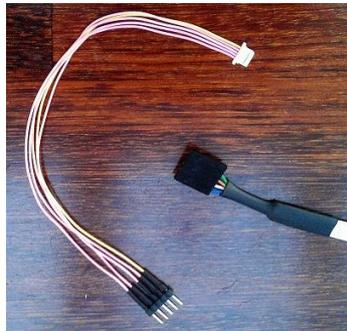
## Setup Preparation

Remove the stock from the gun and ensure that the programming connector can be accessed. Ensure that the gun has either been recently charged or fresh batteries have been fitted and the gun has been filled with air.

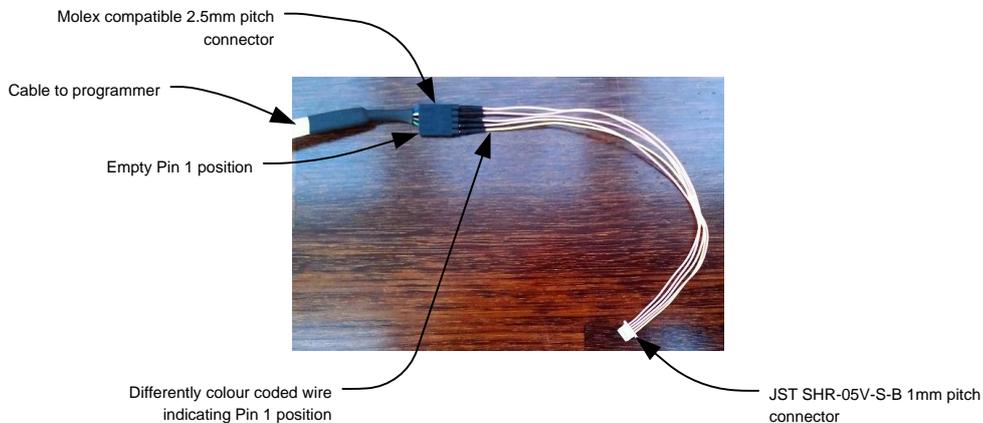
Arrange the equipment on a flat surface making sure that the gun, chronoscope and pellet stop are aligned correctly, when the tester is satisfied that the test bed is safe and secure, the PowerSet programmer can be plugged in and the gun data parameters recorded for reference. It is strongly recommended that a written data record is kept of the data settings before any setup is commenced.

## Programming Lead

The programming lead consists of two parts:



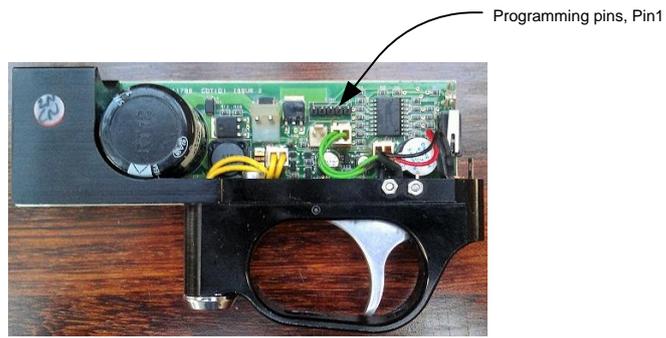
The five wire adaptor is used to connect the more recent guns, the single colour coded wire indicates Pin1 and must be plugged into the empty position on the larger connector to give the correct polarity. See below for a labelled description of the cable assemblies:



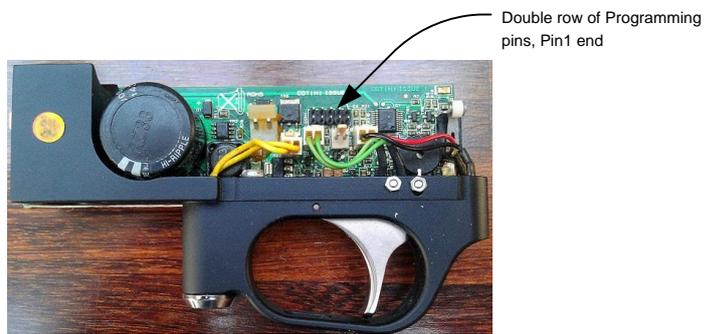
## Gun Programming Connectors

There are four types of gun connectors to plug into:

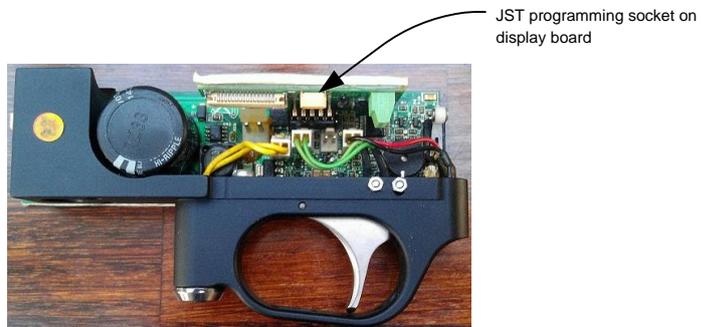
Early Mk3 GCU



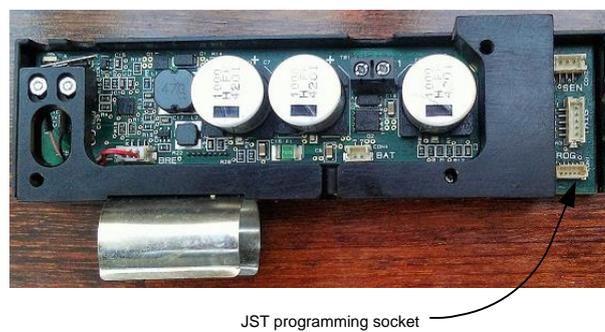
Later Mk3/4 GCU



Mk4 GCU with Display



Mk5 GCU



## Early Regulated Mk3 Gun Setup

This is the easiest of all the electronic guns to setup as the gun uses a mechanical Joe Koric pressure regulator. The very first "A" series used a small pre-set voltage control on a board located in the stock to allow power adjustment and does not require the use of a programmer.

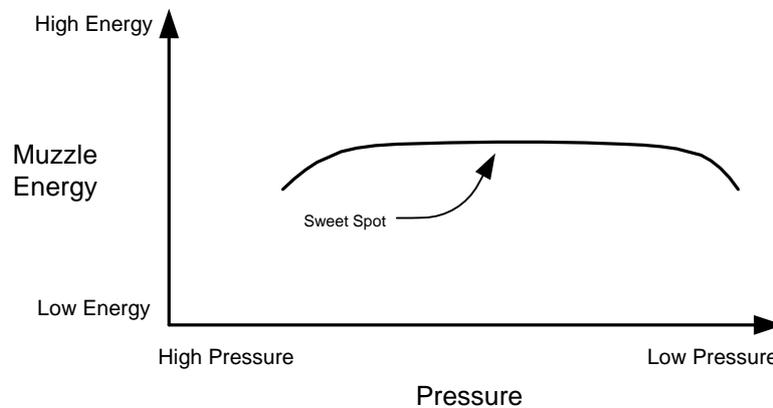
Later Mk3 and upgraded Mk3 guns uses a pulse length controlled GCU to alter power levels, see above early Mk3 GCU photograph for connector position and polarity. The setup procedure is listed below:

1. Setup equipment as described above, connect programmer to the programmer pins, with the empty position connected to Pin1 and switch on the programmer.
2. Select the NC Setup Menu and go the Read Data Menu and press enter. Record the settings for later reference and program them into the PowerSet programmer.
3. Select the Set Default menu and press enter to ensure that the high power default setting is used.
4. Dry fire the gun a few times without any pellets loaded to allow the regulator to "settle".
5. Load the gun and fire a test shot, if the velocity is lower than required, increase the pulse length using the Pulse Length and Programming menus. If the velocity is higher, then reduce the pulse length. Pulse lengths of 10us to 20us are recommended, fine tuning with smaller pulse lengths can be done by trial and error over a series of shots.
6. Record the new pulse length setting for future reference, setup is complete.

Normally the offset pulse length will not need to be altered. However, if the power step difference needs to be changed then the offset pulse length needs to be made either larger for a greater power step difference, or lower for a smaller incremental step. Offsets of over 100us can be used, but are not recommended.

## Unregulated Mk3 Setup Procedure

The Mk3 uses modified Harper valve and matched porting in conjunction with lean charge CDT technology to achieve a very broad sweet spot where muzzle velocity is relatively constant with change of pressure. A representative diagram of this method of muzzle energy compensation is shown below:



The principal goal of the setup procedure is to set the pulse length for the required power level at the middle of the power band at the "sweet spot" as shown above. This is most important for sub-12FPE guns where gun shall not be capable of producing more than 12FPE. The procedure to do this is listed below:

1. Setup equipment as described above, connect programmer to the programmer pins, with the empty position connected to Pin1 and switch on the programmer.
2. Select the NC Setup Menu and go the Read Data Menu and press enter. Record the settings for later reference and program them into the PowerSet programmer.
3. Select the Set Default menu and press enter to ensure that the high power default setting is used.
4. Dry fire the gun a few times without any pellets loaded to allow the gun to "settle".
5. Load the gun and fire a test shot, if the velocity is lower than required, increase the pulse length using the Pulse Length and Programming menus. If the velocity is higher, then reduce the pulse length. Pulse lengths of 10us to 20us are recommended, fine tuning with lower pulse lengths can be done by trial and error over a series of shots.

6. Check the power of the gun by refilling, then firing a test shot and noting the velocity, dry firing the gun 9-times to reduce pressure, fire a test shot again and note the velocity. Repeat this pattern until the gun is getting low on pressure. In this way the velocity can be tested for not exceeding the desired limit by checking one shot in ten over a fill of air.

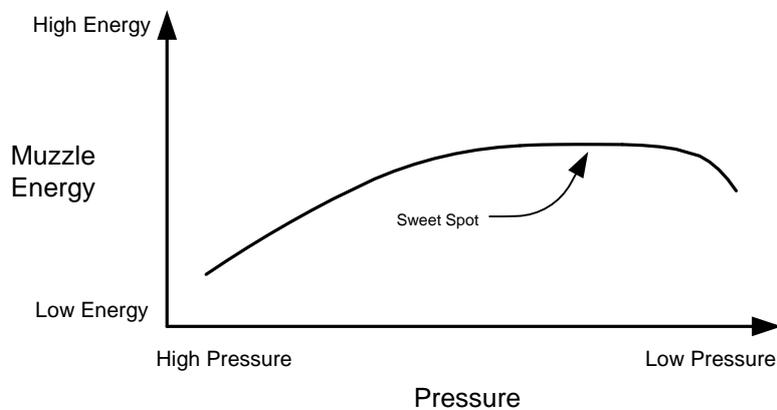
**TIP:** The process of reducing power by dry firing is called “shooting down” the pressure and is a useful technique to arrive at a desired pressure setting without wasting pellets.

7. Record the new pulse length setting for future reference, setup is complete.

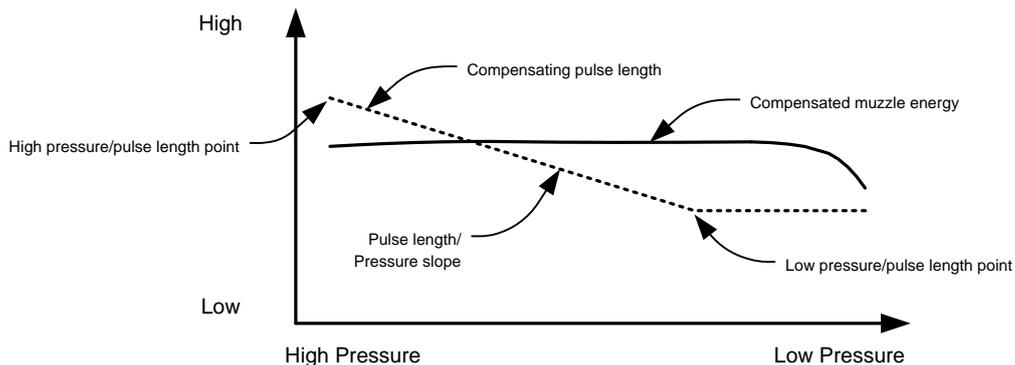
Normally the offset pulse length will not need to be altered. However, if the power step difference needs to be changed then the offset pulse length needs to be made either larger for a greater power step difference, or lower for a smaller incremental step. Because the gun does not use a pressure regulator the lower power characteristics are not as linear as a mechanically regulated gun and pulse length offsets of over 70us should not be used.

## Single Slope Mk4 Regulated Gun Setup Procedure, without Display

The MK4 series of guns are fitted with pressure sensors to allow for a higher shot capacity with a more constant muzzle energy characteristic over a large range of fill pressures. This development was done to allow more efficient valves and larger porting to extend shot capacity, unfortunately this distorts the flat “sweet spot” at the expense of efficiency, this is represented below:



Because muzzle energy is largely proportional to valve hammer energy which is also largely proportional to pulse length, the power curve can be straightened out if the pulse length is increased in proportion to pressure as shown below:



Please note the concepts of:

High Pressure Point

High pulse length

Low pressure point

Low pulse length

Pulse length/pressure slope

Gun without displays only have one compensation set of parameters stored, and variable energy is achieved by simply subtracting of an offset from the pulse length to reduce power.

The setup procedure is listed below:

1. Setup equipment as described above, connect programmer to the programmer pins, with the empty position connected to Pin1 and switch on the programmer.
2. Select the SS Setup Menu and go the SS Read/Save Data Menu and press enter. Record and Save the Power Profile 1 settings for the programmer and later reference. SS Power Setup 2 is to be ignored.
3. Select the Set Default menu and press enter to ensure that the high power default setting is used.
4. Using the Tests & Diagnostics Menu, select the Setup using fixed PL screen and enter the test pulse length as recorded previously as the High Pulse Length value and fill the gun to the pressure recorded previously as the High Pressure Point. Fire a test shot and adjust the pulse length accordingly to get the desired velocity reading. Refill and repeat as necessary to get the desired velocity at the High Pressure Point pressure recorded by the PowerSet programmer.

**TIP:** It is not essential to get the exact velocity and pressure at the high pressure point and an accuracy of +0FPS/-10FPS at a pressure of +/-3BAR will suffice. The pulse lengths and pressure points can be recalled by entering the SS Power Setup 1 menu and scrolling through the parameters to get the desired information.

5. Dry fire the gun until the low pressure point as recorded by the programmer is reached. Adjust the pulse length in the Setup using fixed PL menu until the desired velocity is reached. Top-up the gun with air if necessary to get the correct velocity +/-5FPS at the correct pressure +/-1BAR. This setting is most important as the gun will produce most of its shots near and within the sweet spot zone.
6. Check the power of the gun by refilling, then firing a test shot and noting the velocity, dry firing the gun 9-times to reduce pressure, fire a test shot again and note the velocity again. Repeat this pattern until the gun is getting low on pressure. In this way the velocity can be tested for not exceeding the desired limit by checking one shot in ten over a fill of air. If the maximum velocity is exceeded, reduce the high pulse length to suit. This compromise will mean that the gun will not quite produce the required velocity at the high pressure extreme end of the fill, but will produce accurate, consistent velocities at lower pressures.

**TIP:** The technique of using one shot in ten is very useful for checking the power consistency of a gun quickly and efficiently. It is recommended that pressure, velocity and pulse length for each 1 in10 shot are recorded against the gun's description and serial number for future reference.

7. Record the new settings for future reference, setup is complete.

Normally the offset pulse length will not need to be altered and will have been saved and programmed into the gun unchanged unless it edited. However, if the power step difference needs to be changed then the offset pulse length needs to be made either larger for a greater power step difference, or lower for a smaller incremental step. A step difference more than 50us is not recommended.

## Single Slope Mk4 Regulated Gun Setup Procedure, with Display

This is very similar to the single slope Mk4 setup without display procedure above. The main difference (apart from the display) is that the user now has the opportunity to setup two power profiles accurately, rather than using an offset that is a compromise. The same SS Setup Menu is to be used for setup and the Single Slope Mk4 Regulated Gun Setup Procedure, without Display section is to be used as a guide.

The main differences between procedures are listed below:

1. The programmer is plugged in to the display board JST socket using the 5-wire adaptor cable as shown in the Mk4 GCU with Display photograph above.
2. The Power Vernier Step parameter is ignored.
3. If required two power profiles can be setup using the additional SS Power Setup 2 menu.

**TIP:** Remember to save and record **both** Power Profile 1 and Power Profile 2 parameters.

4. The pressure reading on the PowerSet test set should be used, this is because the pressure BEFORE the test shot is displayed on the test set, where the pressure AFTER the test shot is displayed on the gun and is out of step.

## DS Setup Procedure

Dual slope software is available for later Mk4 guns with displays and introduced to simplify gun setup. Dual Slope Mk4 guns can be identified by the software version number 03MDS0AV and subsequent versions starting with 03MDSnnV. This software is a subset of the Mk5 software and only has two power profiles and no voltage control. The gun is setup using the DS Setup Menu on the PowerSet programmer and the Mk5 Setup Procedure is to be used as a guide.

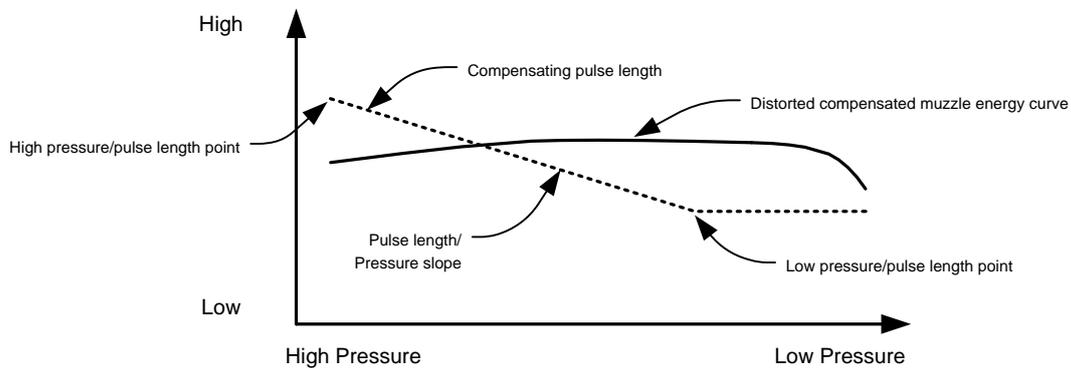
## Mk5 Setup Procedure

Dual Slope technology was requested by the Daystate Engineering department to simplify power profile setup and voltage control was added to accommodate accurate setup of extremes of power outputs found across the range of Daystate guns. This software combined with the MK5 series hardware makes this the most powerful, efficient and versatile of GCUs manufactured to date.

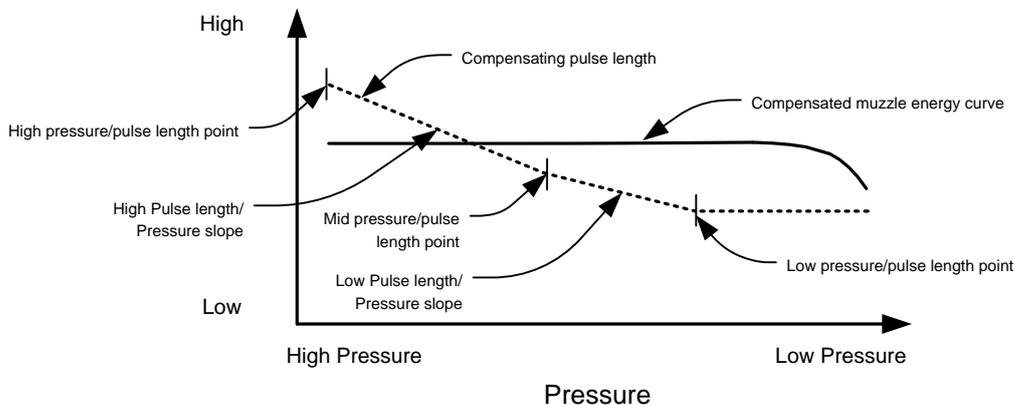
Early boards were fitted with 3 x 1000uF capacitors and in a move to standardise on the same board, a newer board using larger, higher voltage 3 x 820uF capacitors is now a standard part. The older board using the smaller capacitors is not recommended for higher power FAC guns. All of the Mk5 GCUs are protected with an over-voltage safety interlock that prevents potentially damaging voltage overloads, irrespective of the voltage a user might attempt to program using the PowerSet programmer.

## Single Slope Verses Dual Slope

When more efficient valve and porting technology is used, compensation becomes more difficult and single slope compensation produces a compromise, see below:



Ideally the compensating pulse length needs to be non-linear, unlike the straight line slope used in in SS compensation. This is done by introducing a dual slope that approximates the required non-linear pulse length/pressure curve, this is shown below:



Please note the concepts of:

High Pressure Point

High pulse length

Mid pressure point

Mid pulse length

Low pressure point

Low pulse length

High Pulse length/pressure slope

Low Pulse length/pressure slope

The setup procedure is listed below:

1. Setup equipment as described above, connect programmer to the programmer JST socket, see the Mk5 GCU photograph for position and switch on the programmer.
2. Select the Mk5 Setup Menu and go the MK5 Read/Save Data Menu and press enter. Record and Save the Power Profile 1 to 3 settings for the programmer and later reference.
3. Using the Tests & Diagnostics Menu, select the Setup using fixed PL screen and enter the test pulse length as recorded previously as the High Pulse Length value and fill the gun to the pressure recorded previously as the High Pressure Point. Fire a test shot and adjust the pulse length accordingly to get the desired velocity reading +/-5FPS at the High Pressure point +/-1BAR. Refill and repeat as necessary to get the desired velocity at the High Pressure Point pressure recorded by the PowerSet programmer.

**TIP:** The pulse lengths and pressure points can be recalled by entering the MK5 Power Setup 1 menu and scrolling through the parameters to get the desired information. The High, Mid and Low pressure points and voltage setting previously recorded are generally a good reference to start from.

4. Dry fire the gun until the mid-pressure point as recorded by the programmer is reached. Adjust the pulse length in the Setup using fixed PL menu until the desired velocity is reached. Refill the gun if necessary to get the correct velocity +/-5FPS at the Mid Pressure Point +/-1BAR.
5. Dry fire the gun again until the low pressure point as recorded by the programmer is reached. Adjust the pulse length in the Setup using fixed PL menu until the desired velocity is reached. Refill the gun if necessary to get the correct velocity +/-5FPS at the Low Pressure Point +/-1BAR.
6. Check the power of the gun by refilling, then firing a test shot and noting the velocity, dry firing the gun 9-times to reduce pressure, fire a test shot again and note the velocity again. Repeat this pattern until the gun is getting low on pressure. In this way the velocity can be tested for not exceeding the desired limit by checking one shot in ten over a fill of air. If the maximum velocity is exceeded, reduce pulse lengths to suit.

**TIP:** The technique of using one shot in ten is very useful for checking the power consistency of a gun quickly and efficiently. It is recommended that pressure, velocity and pulse length for each 1 in10 shot are recorded against the gun's description and serial number for future reference.

7. Record the new settings for future reference, setup is complete.

If the remaining power settings are needed to be changed, repeat the above procedure for each power level as necessary.

The High, Mid and Low pressure points normally do not need to change, however if the muzzle energy has been changed dramatically, then the voltage and pressure settings will have to be modified.

As a general guide, high power settings will obviously need higher pulse lengths and will need to start at a higher pressure mid and low pressure points and use a higher voltage (70V maximum). Lower power will use correspondingly lower mid and low pressure points and voltage.

Using a lower voltage will mean that a longer pulse length will be required to get a certain level of power. This is important because to get accurate control of a velocity a relatively high slope of microseconds per BAR is required, especially at low power levels, typically 2us to 4us per BAR. If the slope is about 1us per BAR it is wise to lower the voltage so greater pulse lengths and higher slope rates can be used.