



MagnetoSpeed

V3 Ballistic Chronograph

For barrel diameters: 0.5" – 2.0"

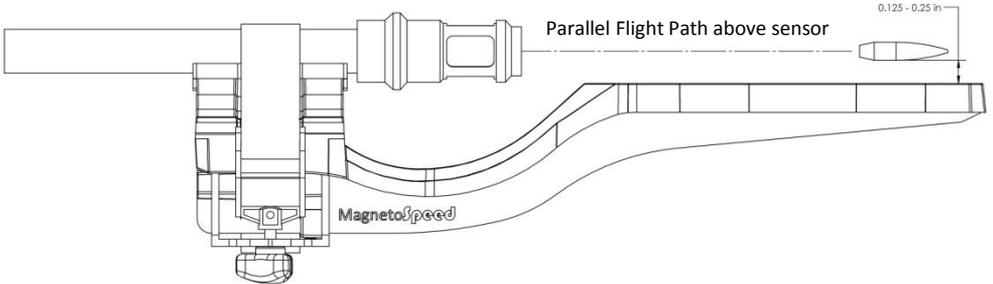
Muzzle brakes up to 2.5" Dia x 3.0" length



- Quick Start Guide
- Parts List
- Spacer/ Alignment Guide
- System overview
- Main Menu
- Troubleshooting Guide

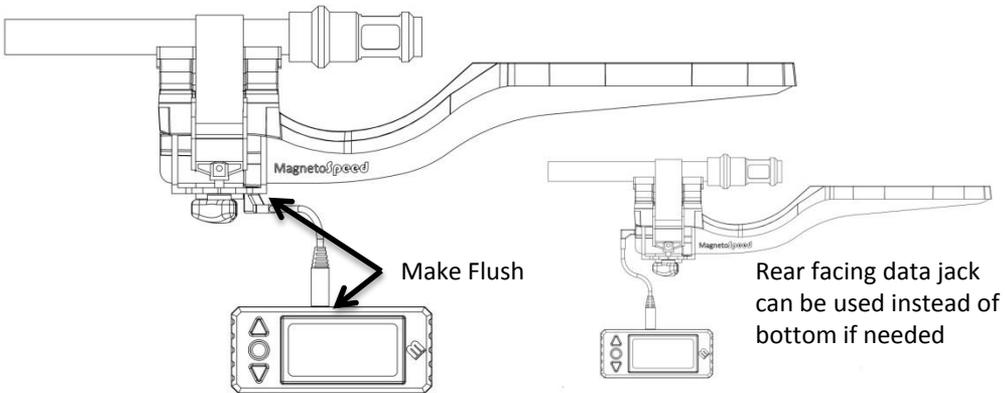
Quick Start Guide

Mount it



- Use alignment tool to pick spacers to create a 0.25" gap between bottom of bullet and sensor deck (spacing can be reduced down to 0.125" if bullet is hard to detect. Example: .177 air rifle)
- With thumb nut loosened to end of threads, pull strap tight through cam buckle then tighten thumb nut
- Double check that spacing is still good and bullet will travel in a parallel path above the sensor (tapered barrels will introduce a slight angle which is OK)

Connect it

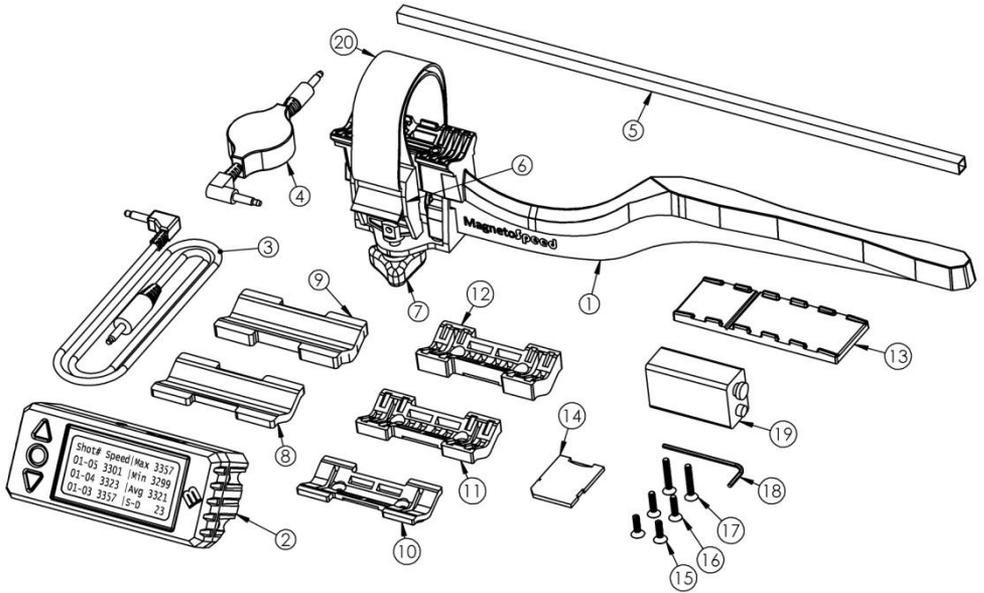


- Plug data cable end into bayonet sensor (make sure it is fully inserted)
- Plug other end into display unit (Unit will turn on and show home screen)

Ready to take data... Under most circumstances your chronograph should be ready to shoot over and record data

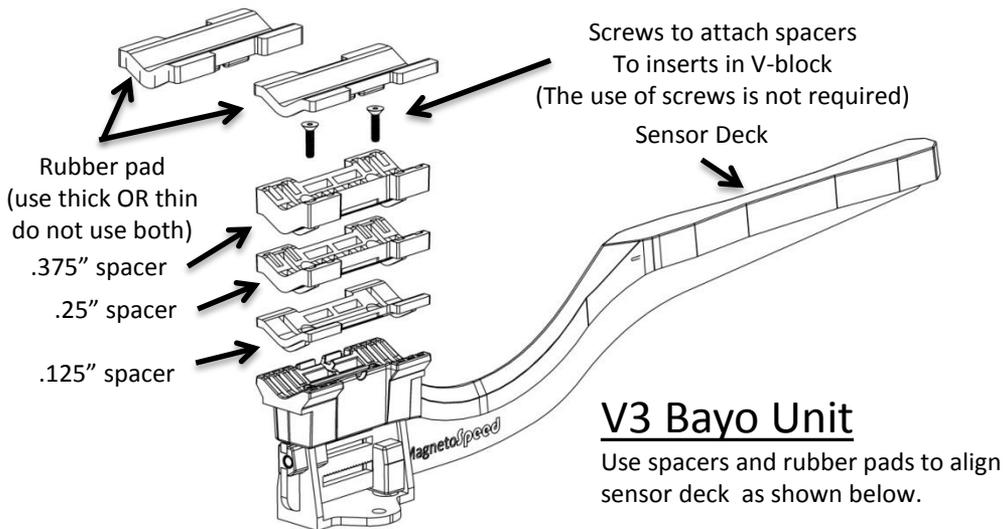
Note: Read full instructions before operating 2

Parts List



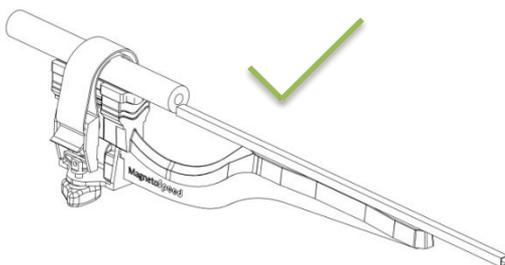
ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
1	V3 Bayonet Sensor	1	11	1/4 Inch Plastic Spacer	1
2	V3 Display Unit	1	12	3/8 Inch Plastic Spacer	1
3	6ft Standard Data Cable	1	13	Rubber Heat/Strap Guard	1
4	4ft Retractable Data Cable	1	14	Micro to SD adapter	1
5	1/4 Inch Alignment Rod	1	15	Cap Screw, 4-40 x 7/16"L	2
6	Strap Cam Buckle	1	16	Cap Screw, 4-40 x 1/2"L	2
7	Strap Tightening Thumb Nut	1	17	Cap Screw, 4-40 x 3/4"L	2
8	Thin Rubber V-block Pad	1	18	1/16 Hex Drive	1
9	Thick Rubber V-block Pad	1	19	9V Battery	1
10	1/8 Inch Plastic Spacer	1	20	1 Inch Black Strap	1

Spacer Guide



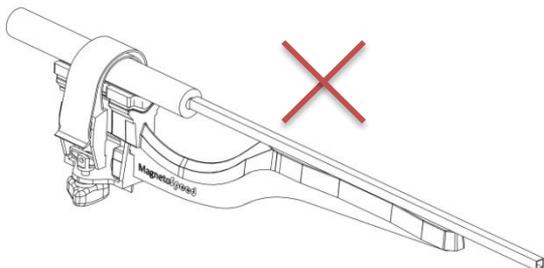
Alignment Guide

Use alignment tool (square aluminum rod) to help determine number of spacers to use. Place alignment tool on sensor deck, check to see that top of alignment tool sits just below bore.



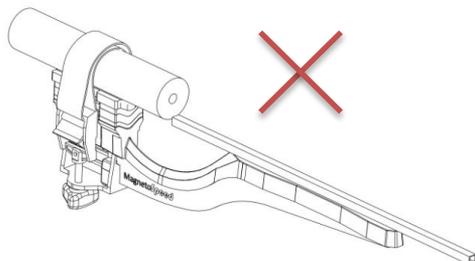
Proper alignment

- TOP of alignment tool tangent to BOTTOM of bore
- If not picking up shots, remove .125" of space
- Always sight down-bore to verify bullet will clear sensor deck



Improper alignment

- Sensor Deck too high
- Bullet will hit Bayo
- Add spacers or use thick rubber pad

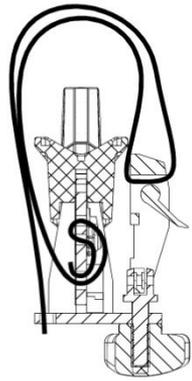
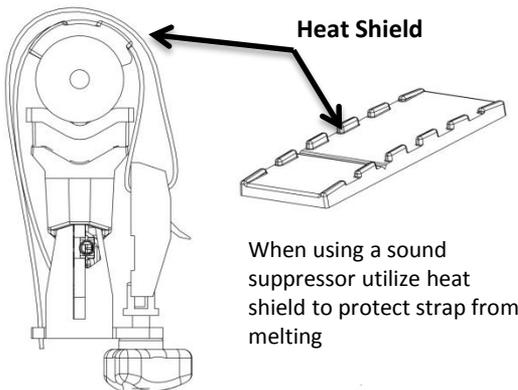
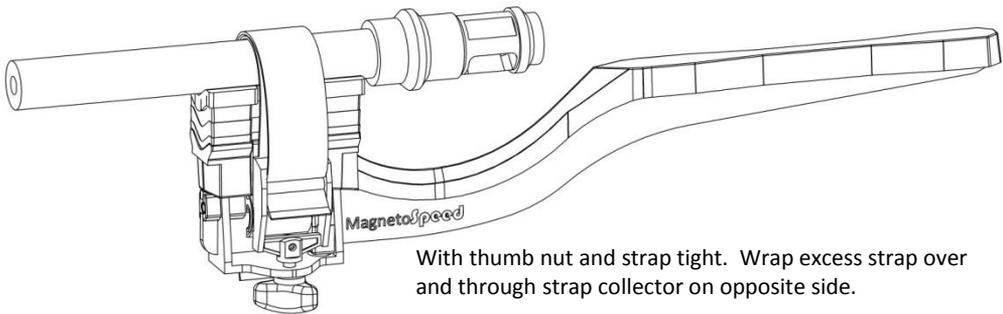
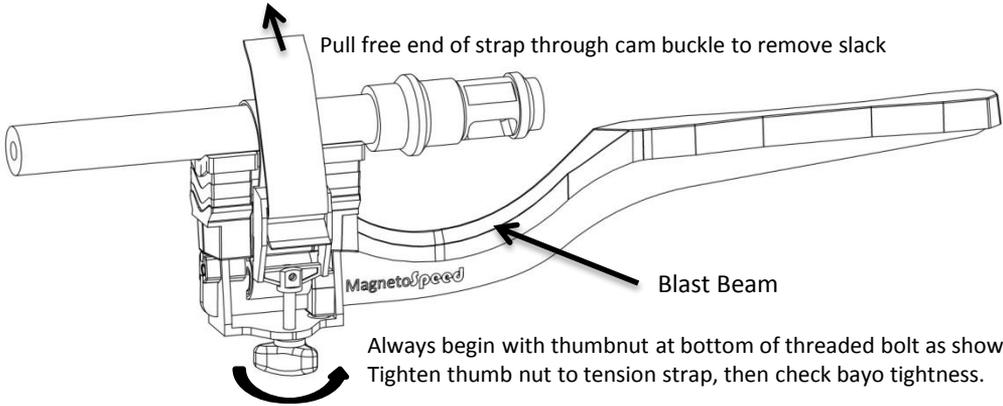


Improper alignment

- Sensor Deck too low
- Poor sensor signal
- Remove spacers or use thin rubber pad

Strapping the Bayonet (Bayo)

Strap the bayo V-block to a smooth section of barrel behind the muzzle or any ported muzzle brake as shown below. Muzzle breaks should be positioned over the blast beam. Sound suppressors can be strapped to directly but should use the heat shield, as noted below. Make sure the sensor deck is parallel to bullet path and properly aligned as described in the alignment section of this guide.



Strap Route
Standard black webbing is used for the strap and can be replaced if needed. The diagram to the left shows how to route the strap

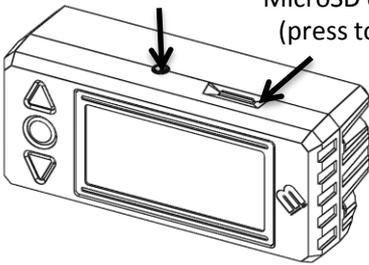
Display System Overview

The MagnetoSpeed display unit was designed to be as intuitive as possible. It should be easy to get it working for normal setups right out of the box. It is still a good idea to look over these instructions before using the device so that you can get a sense for its functionality as there are some modes and options that are not in the normal menu.

Home Screen:

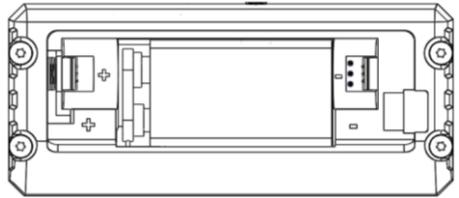
The Home Screen consists of two halves, the shot data on the left and the statistics on the right. Pushing <UP> or <DOWN> will scroll the shot data, but the statistics will stay put. Pushing <ENTER> brings up the Main Menu.

3.5 mm jack (plug in to turn on)

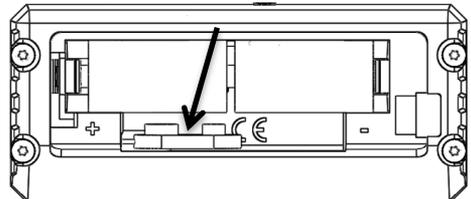
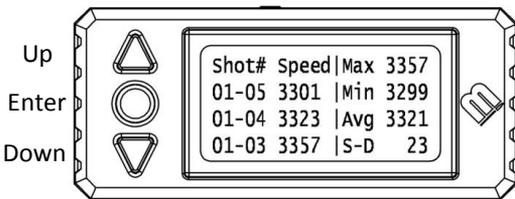


MicroSD card slot (press to eject)

Unit can run on CR123A (2x) or 9V/6LR61 (1x)



9V connector (can be tucked away when using CR123A's)



When you are in the Home Screen and have a bayo plugged in, the device is ready to detect shots. The backlight quickly flashes when a shot is detected, the new shot's velocity is added to the shot data and the statistics are recalculated.

Main Menu

The menu options are listed below and provide a brief description of each. The menu options that require more explanation are listed in subsequent sections.

Go Back: Takes you back to the home screen.

Archive Series: Writes your shot data from local memory to a spreadsheet file called log.csv that is stored on the memory card. When the file gets written to the memory card the shots are removed from local memory and the series number is incremented. We call this “Archiving” rather than “Saving” because once archived, the data is in a different format and cannot be reopened by the device; the archived data can only be viewed by the display unit, not manipulated.

Delete a shot: Allows you to pick a single shot from the shot string to delete.

Set Sensitivity: Lets you set the device to one of 2 preset sensitivity levels, or you can choose a custom level from 1 to 11, with 1 being the least sensitive and 11 being the most sensitive.

Reset Series to 1: Deletes all shots and sets the series number back to 1.

Clear Series shots: Deletes all the shots on the current series, but does not change the series number.

View Archived Data: Lets you scroll through the data stored on the memory card

Battery State/Menu: This sub-menu lets you see the battery’s voltage as well as set the type of battery that you are using. It is important to set the proper battery type so that the device can warn you once the voltage is getting low. The current setting is marked with a “*” character.

Data Checker Menu: Ability to switch off one of the data acquisition systems.

Operating Modes: Lets you set the device for use with a shotgun, or rapid fire weapon.

Set ft/s or m/s: This sets the units to feet per second or meters per second. The current setting is marked with a “*” character.

Switch SD/ES: This lets you choose to display standard deviation or extreme spread on the home screen. The current setting is marked with a “*” character. Both SD and ES are written to the memory card when you archive a series.

Mem Card Functions: This sub-menu lets you: 1) test the memory card operation (without needing shot data), 2) clear the log.csv file, and 3) do a “quick format” of the memory card. These options are expanded in the memory card section of this document.

Set Backlight Mode: Lets you turn the backlight on and off. The backlight will reduce runtime roughly 25%-30% in most cases, though with 9Vs the decrease may be more severe, especially at low temperatures.

Reset System: Puts the system back in its default settings.

Sensitivity Settings

There are 11 different levels for sensitivity; level 1 is the least sensitive and level 11 is the most sensitive. The most important thing is to check that the sensor deck is 0.25" to 0.125" from the edge of the bullet as that is BY FAR the most common problem that occurs when customers are having difficulty getting the unit to register velocities. If the sensor spacing is good, following these two guidelines will solve the majority of any other issues.

1. If the spacing is good, the bayo is plugged in, and you are not getting any readings, make the device more sensitive. Make these adjustments in single digit increments, firing one shot after making an adjustment to see if the problem is solved.

2. If you are getting strange readings, it could be that device is too sensitive and you are picking up random "noise". In rare cases when the sensitivity is too high, on very large muzzle blast weapons this may cause erroneous readings. The bayo must be plugged in to set the sensitivity as the device can set the input stages properly. The three following sensitivity presets cover most situations:

Normal: This corresponds to level 2 out of the 11 levels. This is the correct sensitivity level for most centerfire rifle ammunition, assuming the bayo spacing is correct. Works well on:

- Copper-jacketed lead bullets moving over 1000 fps
- Solid copper bullets moving over 1000 fps
- Steel-core
- Steel shot

Custom: Each sensitivity level is about 60% more sensitive than the previous one, with level 11 being over 100 fold more sensitive than level 1. Levels 10 and 11 are really only for extreme cases as they are very easy to trigger accidentally. If you are using those modes, be sure to not touch the metal frame of the screen or the cable connecting the bayo as charge in your fingers can easily trigger the device. Levels 1-3 use the signal directly from the bayo while, levels 4-11 add an additional gain stage that amplifies the signals 20 fold. This additional gain stage will decrease run time somewhat. Review the battery life section for more information.

- Airgun pellets , use a sensitivity of about 7-9
- Shotgun lead shot, use a sensitivity of about 5-9

Error Messages

The error messages are briefly explained below for completeness purposes. However, because each code could be caused by a verity of reasons, we cannot make specific recommendations about how to address the individual error. The most important aspect of the error message is to make note of what error message you received when contacting customer support.

Peak Not Detected: One of the peaks could not be found by the digitizer

Sensor1 (or 2) Crossing Bad: The zero crossing of sensor 1 or 2 is not between the peaks.

Sensor1 (or 2) Misread : There is no zero crossing for sensor 1 or sensor 2.

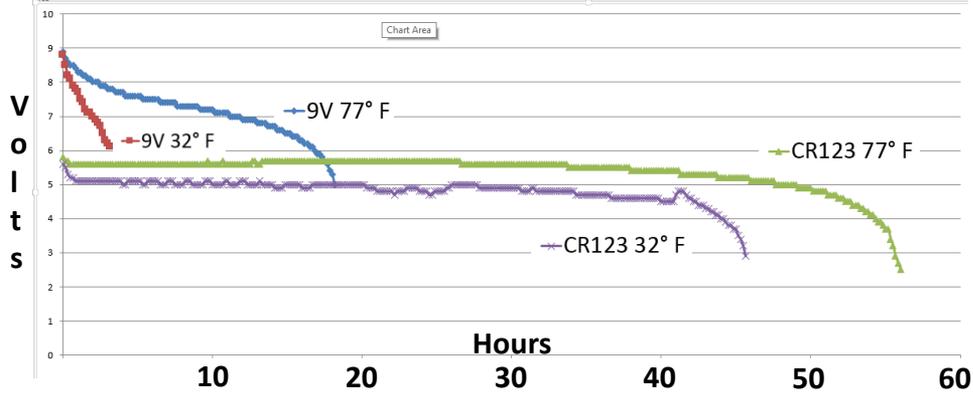
Shotgun Velocity Bad: The special process for determining the shotgun velocity didn't return a valid response.

Velocity Too High: The calculated velocity is above 7,000 ft/s (2,134 m/s).

Velocity Too Low: The calculated velocity is below 300 ft/s (91 m/s).

Battery Life, Voltage Levels, and Temperature Effects

The display unit can use 2x CR123 batteries or a single 9V-alkaline battery. The CR123s provide much longer run time and at low temperature offer substantially better performance. The graph below show the runtime of CR123s and 9Vs running with the “normal” sensitivity setting and no backlight.



The graph above was made by an operating system that logged the measured battery voltage every 10 minutes. The system will operate normally as long as the battery voltage is over about 3.4V. You can check the battery voltage by going to the “Main Menu” and selecting “Battery Menu/State”.

Additional drains

The backlight usually decreases operating time by about 25% or 30%. Setting the sensitivity mode to level 5 or higher adds in an extra amplification stage, which will decrease the operating time by an additional 10%.

CR123

A CR123 operating at room temperature should provide over 50 hours of runtime assuming the sensitivity is set to normal and the backlight is turned off. The CR123 operating voltage is extremely flat and much more dependent on temperature than battery state of charge (SoC), so you can only expect a few hours of warning before CR123s give out. You can check the battery voltage by going to the Main Menu and selecting Battery Menu/State 9V-alkaline

Note: There are other types of 9V batteries other than alkaline, such as Zinc-Carbon and Lithium. These can be used, but running time for them is unknown. Zinc-Carbon batteries are not recommended. At room temperature, a 9V battery should provide about 18 hours of runtime for standard operating mode (no backlight and sensitivity of 4 or less). At low temperatures, a typical 9V performs very badly because they cannot support the current draw due to the reduced speed of electrochemical reactions at low temperatures; MagnetoSpeed recommends CR123s for low-temperature operation. The state of charge for 9V batteries are much easier to determine from their terminal voltage. You can check the battery voltage by going to the **Main Menu** and selecting **Battery Menu/State**.

Data Checker Menu

The V3 display unit has two acquisition systems:

- 1) A high-speed comparator system that determines the actual bullet velocity.
- 2) A digitizer that runs at a slower rate. In full data checking mode output of the two systems are compared to filter out misreads. However, this may cause problems in some rare cases, so we add a "reduced data checker" mode that only uses the high-speed comparator system. In rapid-fire mode the device uses the "reduced data checker" mode because the data process in the normal mode takes too long to allow for over 1000 round per minute fire rates.

In general only switch the data checker mode to reduced after speaking to customer service and having this suggested as an option.

Operating Modes

Shotgun Mode: This mode is used to account for the relatively slow velocity and unique signature of shot. Sensitivity must still be adjusted to high when used with certain types of ammunition. It is also a good idea to mount the MagnetoSpeed so the end of the barrel is only 1 inch rearward of the blast shield. This helps to prevent the wadding from opening up and striking the bayonet by reducing the distance traveled while over the MagnetoSpeed.

Rapid Fire Mode: In rapid fire mode, the V3 display unit is capable of detecting shots fired at a rate of up to 1100 round per minute as well as acquiring the times between each shot. There are several differences between the normal operating mode and the rapid-fire mode that the user should be aware of.

-The display is not updated until 2-seconds after the last shot is acquired. This is to reduce the processing time between shots.

-The device uses the "reduced error checker" mode to reduce the processing time between shots.

-After a shot series, an additional screen appears which shows the Avg, Min, and Max rounds per minute (RPM). This information is cleared after a button press and the device again displays the home screen. The RPM data is no longer displayed, but when you archive the data, there is another column that has the effective RPM between each shot fired, with 0 designating the first shot. No RPM statistics are written to the SD card; multiple sets of rapid-fire shots could be archived at one time, so the user must separate them later and add any statistics of interest.

-You can get back to previously described screen after you return to the home screen by holding down and then pressing up.

-We advise you to make sure that your setup is working properly in normal operating mode before trying rapid-fire mode. We also recommend that you archive the data between each set of rapid fire shots so that it is easier to identify them later.

Memory Cards

General Operation

Your device comes with a micro SD card that has been tested with your display unit and shown to be operating correctly. This card is provided because there are many different types of memory cards that can fit into the memory card slot on the display unit, but can't be guaranteed that they will all work with our specific device.

When you "Archive Series" a file is created on your SD card named "Log.csv". This file will continue to grow everytime you "Archive series".

To start a new log file; rename or delete the LOG.CSV file on the micro SD. The unit will generate a new LOG.CSV file on start-up. Example: change LOG.CSV to 2013-11-18.CSV and re-insert into the display unit. The next time the unit is commanded to archive a series, a new LOG.CSV file will be written with the new shot data.

Mem Card Menu:

- **Test Archive:** This saves the text "test" to the log.csv so that you can make sure your memory card is working properly before going out to the range.
- **Clear LOG.CSV:** This deletes the data in the log.csv file.
- **Format (ADVANCED):** This writes a new allocation table to the memory card and can fix some cards that were not working. If your card works, do not use this option.

In general, reformatting the SD card with a computer is not necessary and can cause problems if done incorrectly. The device should be able to format in FAT, FAT16, and FAT32 file systems.

CSV File:

CSV stands for **Comma-Separated Values** and is a standard file format for scientific computing. Almost all spreadsheet programs can read or import these files. CSV is based on standard ASCII text, so at a minimum, you can open the log.csv file with a text editor.

Advanced Modes

Shot signals report

What it does: Gives additional information about the raw signals the device is getting to help with trouble shooting and to verify correct setup.

How to access: After a shot, push and hold <UP> and then push <DOWN>

MagnetoSpeed Comments:

This is still a beta feature. It is useful to detect bayo lean issues. In the future we would like to extend the functionality to diagnose common problems.

Self- test

What it does: Runs a series of tests to make sure the device is functioning properly

How to access: hold <UP> while you turn on the display

Bootloader

What it does: Updates the firmware from file downloaded on SD card.

How to access: Download appropriate firmware update from MagnetoSpeed. The file must be named "fw.hex" and be copied to the SD card.

-Insert SD card into MagnetoSpeed display with unit unplugged

-Hold <ENTER> while you turn on the display

-Follow prompts on screen to update firmware.

-Do not unplug device during update!

-This process may take several minutes to complete.

Sensor Signal Logging

What it does: Saves the sensor signals to the memory card for troubleshooting.

How to access: An SD card must be in the device for this function to operate.

-Navigate to "Mem Card Functions" in the main menu.

-Select "Test Archive".

-Immediately press "Up, Enter, Down" in quick succession of each other.

-If successful you will see a message displayed that says "Data Save Mode Enabled".

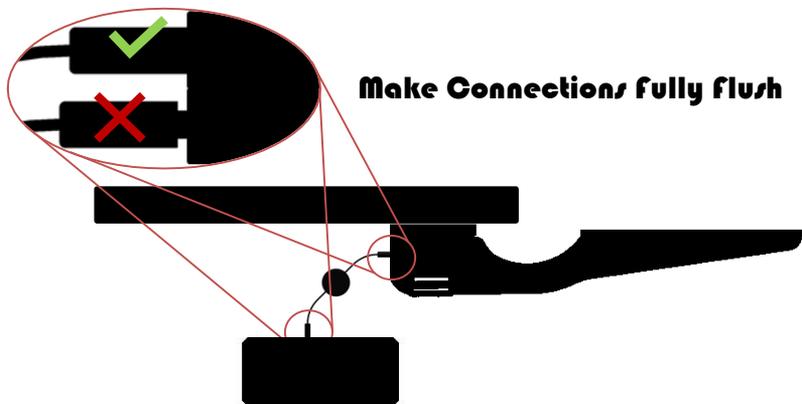
-To stop logging sensor data, just repeat these steps.

MagnetoSpeed Comments:

This feature is sometimes useful for trouble shooting. It saves the sensor data, zero-crossing data, and shot-analysis data into a file named data.csv. Note: the zero crossing data that is used to compute the actual velocities is gathered at 32 MHz, but the data in this file is only saved at a rate of 2 MHz. The intent of this feature is for troubleshooting assistance with MagnetoSpeed customer service. This feature is not intended for everyday usage by the end customer.

Troubleshooting Guide

1: Check Cable Connections



Make Connections Fully Flush

-Check both the bayo and display cable connections. It is possible to get the display to turn on without the 3.5mm plug being inserted far enough for both sensors to be connected. Even 1/16" of a gap can cause problems. This is the #1 problem we have seen! Please check those connections

2: Check Sensor Spacing



Use a cleaning rod to check the spacing of sensor 1 and sensor 2 from bottom bullet edge. Distances should be between 1/8" and 1/4" and they should be within 1/16" of each other.

Thick muzzle/barrel

- Low signal
- Reduced velocity accuracy
- Shot pickup error



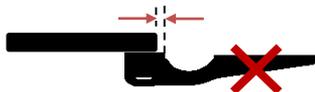
Muzzle too close to Sensor 1

- Signal gets noisy
- Reduced velocity accuracy
- Shot pickup error



V-block overlaps muzzle

- Bayo/strapping damage



3: Check For Loose Strap or Bayo Lean

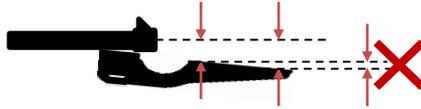
Lean in

- Bayo damage
- Reduced velocity accuracy



Lean out

- Shot pickup error
- Reduced velocity accuracy



-Check for bayo lean. Is there any obstruction at the muzzle that is causing the bayo to lean away from the shot-line? Straps for iron sights, steps in the barrel diameter, and muzzle breaks are a few examples. You can use a cleaning rod to check alignment.

Make sure to rotate the cleaning rod to check its straightness.

-Check strap after every few shots. Ensure that the strap is still very tight, a loose strap can result in false or no readings. It can also result in the bullet impacting the bayo.

It is ultimately the responsibility of the user to ensure that the MagnetoSpeed bayonet is not in the path of the bullet before shooting!!

Always check the bayonet after every few shots to ensure that it is still tight on the barrel. Failure to follow these instructions could result in damage to the MagnetoSpeed or serious bodily injury.

Technical Specifications

Bayo Mounting

Barrel Diameter Range: 0.5 "-2.0"

Strapping: 1" wide x 20" length x 0.06" thick (nylon)

Cable clearance: 0.6" (90 degree plug)

Muzzle Brake Accommodation

Muzzle Brake Length: 4.0" (max possible, but not recommended)

Muzzle Brake Diameter: varies

For ~1.0" Diameter barrels (shown below)

Max Brake Diameter = 2.5"

Max Brake Length for max diameter = 3.0"

Display

Screen: 20x4 Character LCD (backlight)

Battery type: (2) CR123s or (1) 9-Volt Alkaline

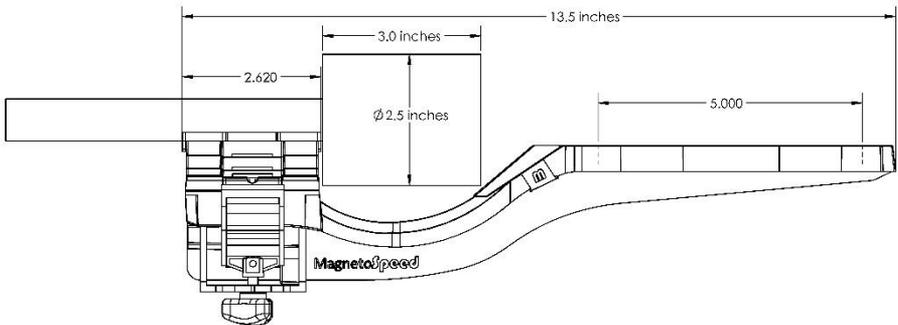
Screws: T10 Torx (4x)

Bayo Dimensions (shown below)

Overall Length: 13.5"

Sensor Spacing: 5.0"

V-block Length: 2.62"



Magnetspeed, LLC

9206 Rod Rd, Suite C
Austin, Texas 78736

(512) 284-8161
info@magnetspeed.com
www.MagnetoSpeed.com



Designed and Assembled in the USA
Patent Pending

