Mil-Dot Ballistics For iPhone

Version 4.5
User Manual

Copyright © 2013 Tom Holsten

Introduction 7

What is a mil-dot reticle? 7

What is a milliradian? 7

The basics of range estimation with a mil-dot scope 8

Using Mil-Dot Ballistics to estimate range *10*

Controls 11

Target Size Manual Adjustment *13*

Target Shapes and Size Presets *13*

Target Anchor Points *14*

POI Lock *15*

Free Floating Anchor Points *15*

Reticle Subtension *15*

Range Estimate *15*

Solution Information *16*

Target Speed *16*

Wind Speed/Direction *17*

LOS Angle *18*

Trajectory Info 19

POI Display 20

BDC Display 20

Azimuth 21

Reticle Scale/Magnification 21

Ballistic Chart 22

Settings 24

Mode 25

Trajectory Info 25

BDC 25

POI 25

POI Lock 25

Training 25

Profile 26

Atmosphere Correction 27

Using GPS to Acquire Current Conditions 27

Use Density Altitude 28

Altitude 29

Temperature 29

Pressure 30

Pressure is Absolute 30

Humidity 31

Latitude 31

Vital Zone Radius 32

Wind Display 32

Target UOM 33

Target Size Precision 33

Trajectory Info/Range UOM 34

Wind Direction Accuracy 34

Azimuth Accuracy 35

Colors 35

Display 36

Control Wheel Sensitivity 36

Display Brightness 37

Angle Calculator 37

Creating/Editing Ballistics Profiles 38

Library **39**

Description **40**

Bullet Diameter **40**

Bullet Mass **41**

Drag Function **41**

BC **42**

Multiple/Variable BCs **42**

Muzzle Velocity **44**

Chronograph Distance **44**

Reticle Type **45**

Focal Plane **45**

Maximum Magnification **46**

Ranging Magnification **46**

Minimum Magnification **47**

Sight Height **47**

Zero Range **48**

Max Range **49**

Lock Time **49**

Calculate Coriolis Effect **50**

Zero Azimuth **50**

Calculate Spin Drift **51**

Barrel Twist Rate **51**

Twist Direction **52**

Bullet Length **52**

Use Density Altitude **53**

Density Altitude **53**

Altitude **54**

Temperature **54**

Pressure **55**

Pressure is Absolute **55**

Humidity **56**

Latitude **56**

Using GPS to Acquire Zero Conditions Data **57**

Trajectory Info - Elevation Units & Windage Units **58**

Support **59**

Disclaimer **60**

Introduction

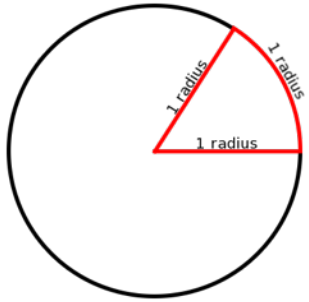
Mil-Dot Ballistics is a combination range estimation and ballistic calculation utility. It is designed to make range estimation with a mil or MOA scale reticle fast and easy while providing a real time ballistic solution. The intuitive graphical interface was designed to replicate what you would actually see through your riflescope.

What is a mil-dot reticle?

The mil-dot reticle is a range estimation reticle that was developed for military applications. The space between the center of one dot on the reticle to the center of the next dot subtends one milliradian (mil). Hence the name mil-dot. One mil subtends 3.6” at 100 yards, or 36” at 1000 yards.

What is a milliradian?

A milliradian is 1/1000 of a radian. A radian is an angular measurement similar to degrees. But unlike degrees, it is not an arbitrary unit selected by man. Instead it is based on the basic components of a circle. A radian is the measure of the central angle subtended by an arc equal in length to the radius of a circle.



There are 2pi (2 x pi) radians in a circle (360°). This equates to about 6.283185 radians or 6283.185 milliradians.

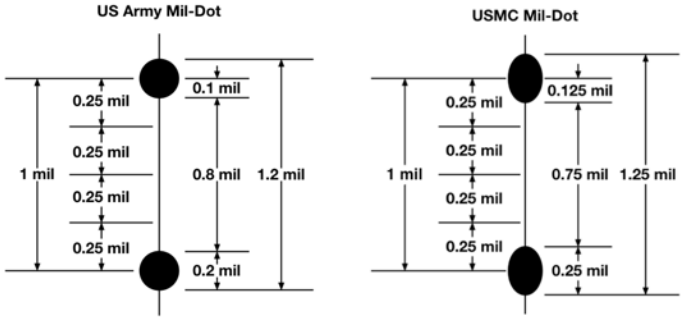
The basics of range estimation with a mil-dot scope

To estimate the range of a target with a mil-dot riflescope, you must know the actual physical size of the target. This can be the height, width, or an identifiable portion thereof.

1. View the target through the scope.

2. Place one of the reference points (horizontal posts, vertical posts, center of crosshair) against one edge (top, bottom, or either side) of the target so that the reticle extends along it's width or height.

3. Using the dots or hash marks, measure along the reticle to the opposite edge of the target. Note, the portion of the target that you are measuring with the reticle, must be the same portion for which you know the actual physical size.



Note: Not all "mil-dot" reticles conform to the above dimensions. Consult your riflescope's manual to verify reticle dimensions.

The more specific you are in your estimation of the size of your target in mils, the more accurate your results will be. This is especially important when estimating the range to a small target or a target at a great distance. Measuring the size of a target with a scope sounds easy in theory, but it takes a lot of practice and a steady hand to get accurate results in the field.

Once the measurement of the target has been determined in mils, the range can be estimated with a simple formula.

The formula for estimating the range in Yards

$$\frac{\text{Size of Target in Yards} * 1000}{\text{Size of Target in mils}} = \text{Range of the target in Yards}$$

The formula for estimating the range in Meters:

$$\frac{\text{Size of Target in Meters} * 1000}{\text{Size of Target in mils}} = \text{Range of the target in Meters}$$

Note: A lot of mil-dot scopes do not have the reticle on the first focal plane. If the reticle is not on the first focal plane, the reticle subtension is only calibrated at a specific magnification level. As you change your magnification level, the reticle does not grow or shrink with the magnification level. Consult your riflescope's manual for the proper magnification to range targets at. With a first focal plane reticle, the reticle subtension does not change with magnification adjustments. In other words, the reticle grows or shrinks with the magnification level. The advantage of a first focal plane riflescope is that you can accurately range a target without regard to the magnification setting.

Using Mil-Dot Ballistics to estimate range

Estimating range with Mil-Dot Ballistics is fast and easy.

1. View the target through the riflescope.

2. Place one of the reference points (horizontal posts, vertical posts, center of crosshair) against one edge (top, bottom, or either side) of the target so that the reticle extends along it's width or height.

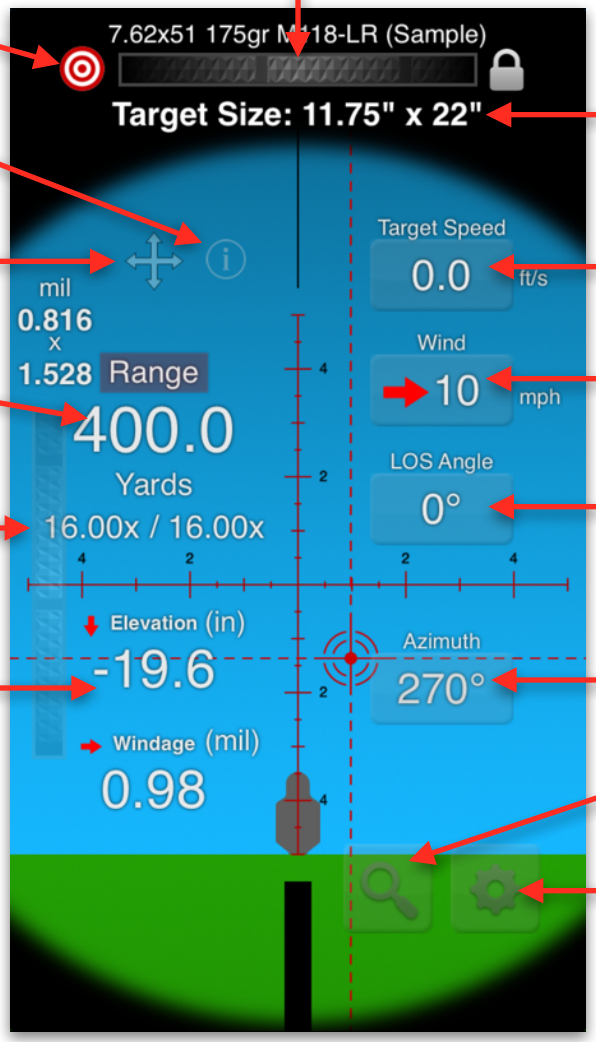
3. Using the dots or hash marks, measure along the reticle to the opposite edge of the target. Note: the portion of the target that you are measuring with the reticle, must be the same portion of the target for which you know the actual physical size.

4. Dial in the physical size of the target by swiping the dial at the top of the reticle display left or right.

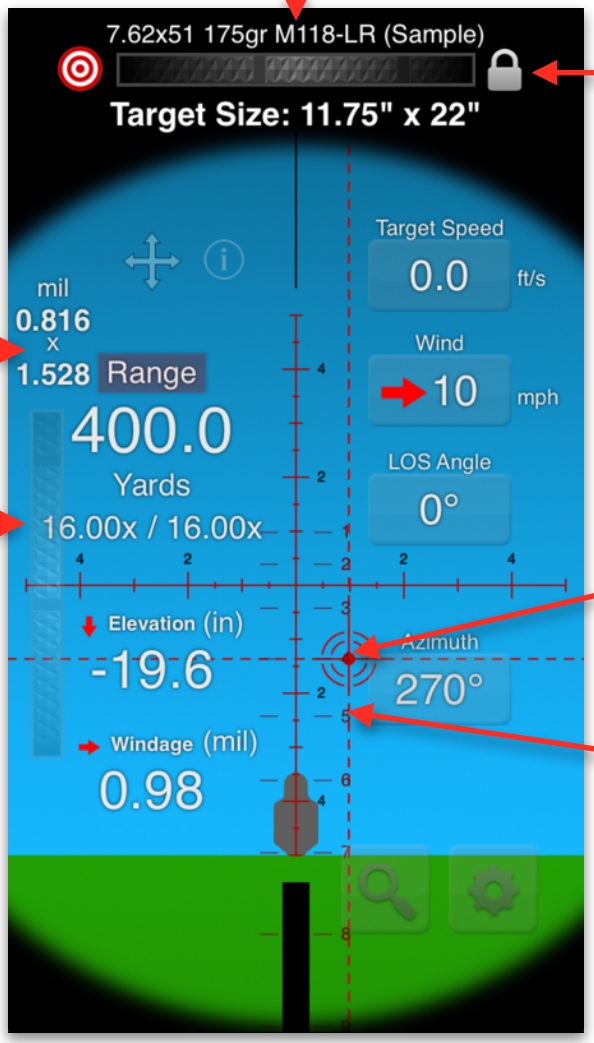
5. Dial in the measurement of the target in mils by swiping up or down on the left side of the reticle display to match what you see in the riflescope.

6. Read the range.

Controls


Swipe left or right to adjust target size.
(locked when “real shapes” target is selected)
Tap to access target size presets and target selector
Tap info button to access solution info display. This display shows the range calculation formula and additional trajectory info.
Tap 4-way arrow to set target anchor point and enable/disable reticle illumination (when available)
Double-tap Range display to toggle between Yards and Meters
Swipe up or down to adjust the subtension of the target or the range to the target. Input mode is selected in the settings display.
Trajectory info is displayed realtime. Double tap elevation or windage to toggle between display units. The available units are defined in the ballistic profile.
7.62x51 175gr M118-LR (Sample)
Target Size: 11.75" x 22"
mil
0.816
x
1.528
Range
400.0
Yards
16.00x / 16.00x
Elevation (in)
-19.6
Windage (mil)
0.98
Target Speed
0.0
ft/s
Wind
10
mph
LOS Angle
0°
Azimuth
270°
Double-Tap the target size label to cycle through the available units of measure.
Tap to adjust the target’s lateral speed for moving target lead calculations
Tap to adjust wind speed and direction
Tap to adjust LOS (line of sight) angle
Tap to adjust Azimuth. (only visible if Coriolis calculation is enabled in ballistic profile)
Tap button to adjust reticle scale and/or magnification.
Tap button to access Settings display

Additional Reticle Features



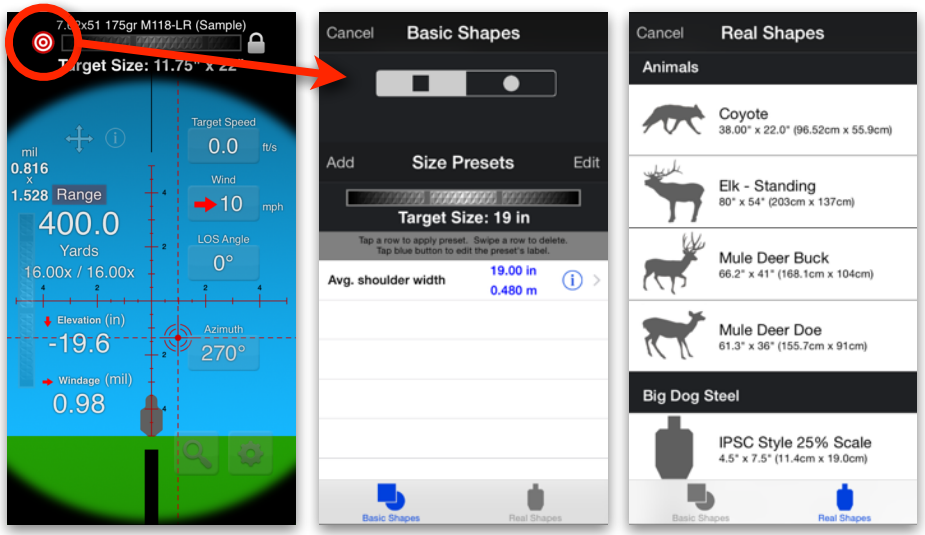
Target Size Manual Adjustment

When the target shape is set to one of the basic shapes (circle or square) you can adjust the target size by sliding the horizontal dial at the top of the reticle display, left or right until the proper measurement is displayed. You can change the target size unit of measure by double-tapping the target size label. This will cycle the target size unit of measure through the available unit types. The target size unit of measure (UOM) can also be set in the settings display.

Target Shapes and Size Presets

To access the target Shapes and Size Presets display, tap the red and white target icon in the upper left hand corner of the reticle display.

Mil-Dot Ballistics now allows you to select two basic shapes, circle or square, and a number of of realistic target shapes. When you choose one of the basic shapes, you can adjust the size of the target to match the height or width of any target or landmark to establish a range estimation of the target. You can save commonly used target sizes in the Size Presets section of the Basic Shapes display..



To add a size preset, first dial in the target size you want to save, then tap the *Add* button.

To rename the size preset, tap the blue arrow icon next to the preset.

To delete a preset, swipe the size preset you wish to delete, then tap the *Delete* button that appears.

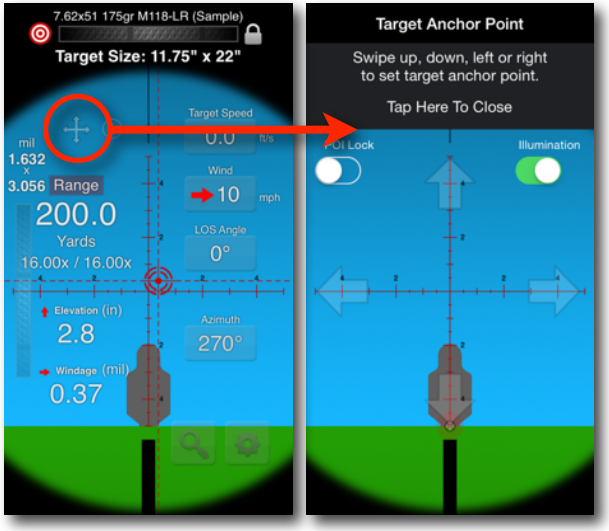
To use a preset value, tap the size preset you wish to use. This will apply the preset value and close the Target Shapes and Size Presets display.

To rearrange the order of the size presets, first tap the *Edit* button, then use the three line control on the right side of the row you wish to move to drag it to the new location.

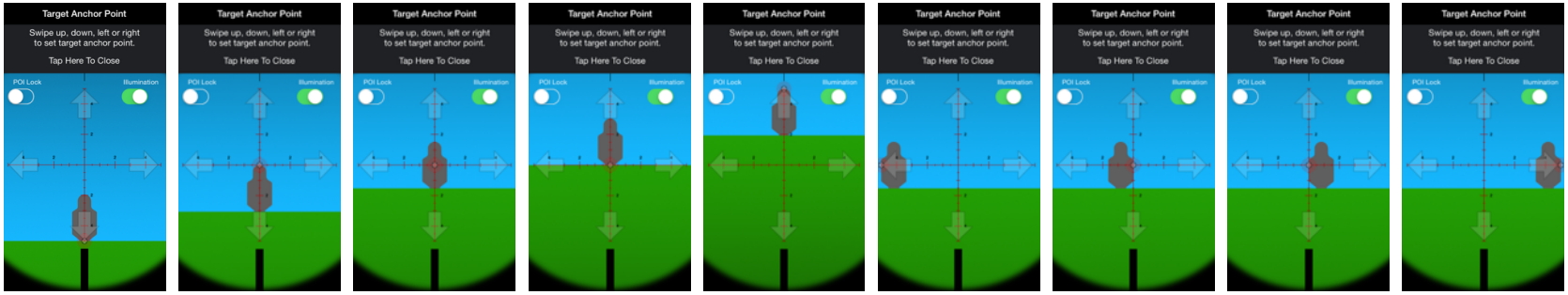
To exit the Target Size Presets display without applying a preset, tap the *Done* button.

Target Anchor Points

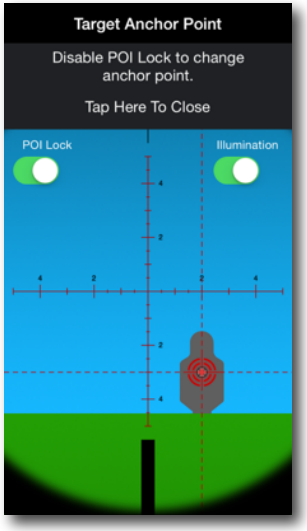
You can anchor the target to nine different points on the reticle. Tap the 4-way arrow icon on the reticle display to open the target anchor point settings. Swipe up, down, left, or right, or tap the arrows to change the target anchor point. When adjusting the subtension measurement of the target, the target will grow or shrink from the anchor point.



The 9 reticle anchor points



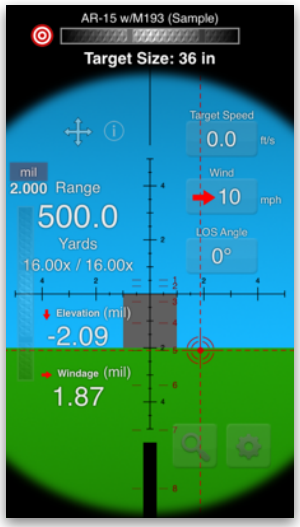
POI Lock
In addition to the 9 reticle anchor points you can also anchor the target to the POI indicator. To enable the POI lock feature, first the POI indicator must be enabled in the settings display, then within the target anchor point display, you can enable the POI Lock.



Free Floating Anchor Points
In addition to the 9 reticle anchor points, you can anchor the target anywhere in the reticle that you like. Tap and hold on the target for one second, the target will dim slightly and you can drag it to any location within the reticle. The last reticle anchor point used, will define the point from which the target will grow/shrink when adjusting the reticle subtension.

Reticle Subtension
Reticle Subtension is the amount of the reticle occupied by the target. Or simply, how big does the target appear in the reticle. To adjust the size of the target as it appears in the reticle slide the vertical dial on the left side of the reticle display up or down. The current subtension measurement of the target appears just above the dial.

In the example to the right, we can see that the square target, which is 36” tall, measures 2 mil in the reticle, which results in a range estimation of 500 yards. Another way to state it is that at 500 yards, 2 mil subtends 36”.

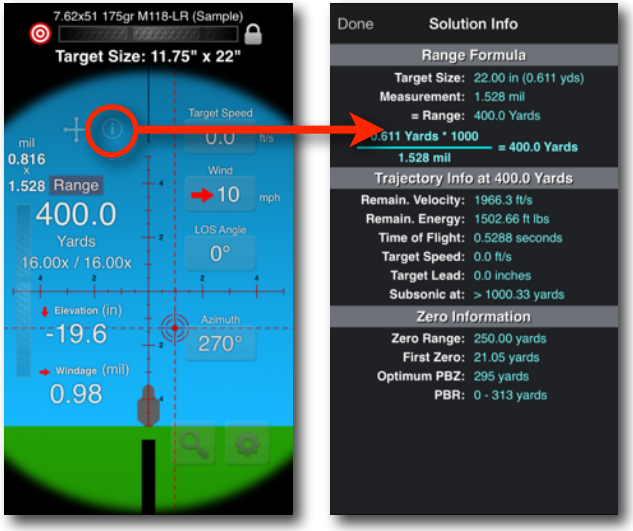


Range Estimate
As you adjust the Target Size and/or Reticle Subtension, the range estimate is automatically calculated and updated. To toggle the range units between Imperial (Yards) and metric (Meters), double tap the range label. The range unit of measure (UOM) can also be set in the settings display. Changing the range UOM also changes the unit of measure for Target Speed and Wind Speed, as well as the trajectory info (windage and elevation) if linear units (inches/centimeters) are currently displayed.

Solution Information

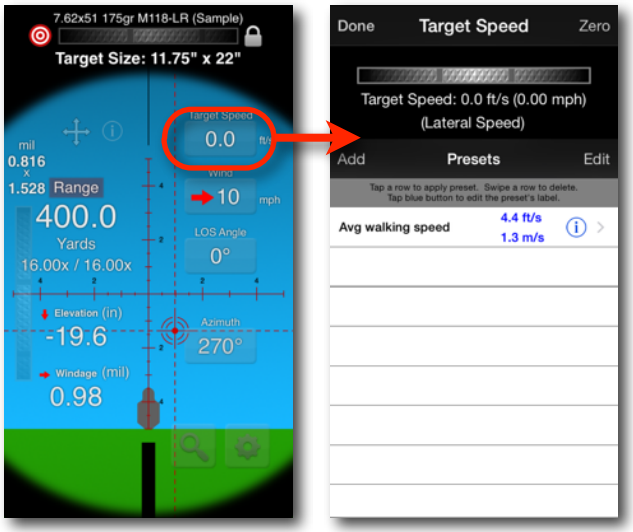
The solution information display illustrates how the range estimate is calculated, as well as the following trajectory information:

- Remaining velocity at current range
- Remaining energy at current range
- Time of flight to current range
- Target Speed
- Target Lead in linear units (inches/meters)
- The range the projectile will go subsonic (when applicable)
- Zero Range
- First (near) Zero



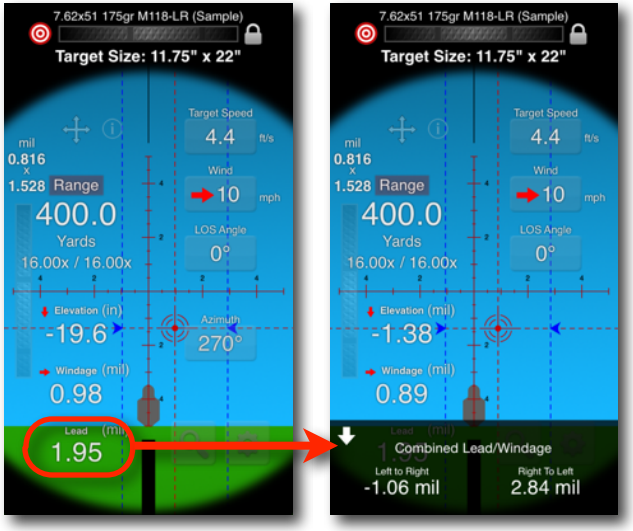
Target Speed

The target speed setting is used to estimate the lead hold for a moving target. The speed represents the lateral speed of the target. To adjust the target speed, tap the *Target Speed* button on the reticle display. This will open the "Target Speed" display. The target speed is displayed in feet per second when the range UOM is yards and meters per second when the range UOM is meters. To adjust the value, slide the horizontal dial at the top of the display left or right. To apply the setting, tap the *Done* button in the upper left hand corner of the display. To save the value as a preset, tap the Add button. To edit the label of a preset, tap the blue icon to the right of the preset you wish to rename. To delete a preset, swipe the preset you wish to delete, then tap the *Delete* button that appears. To apply a preset, tap the preset you wish to apply then tap the *Done* button in the upper left hand corner of the display. To rearrange the order of the presets, tap the Edit button, then drag the rows using the ☰ control on the right of each row. When the target speed is greater than zero, an additional data field (Lead) will appear below the Windage display. The Lead display shows how much to lead your target in addition to the windage adjustment. The calculation is the same for either a left to right, or right to left lead. If the POI feature is activated, two



vertical blue lines will be added to the display that represent the lead value for both L-->R and R-->L leads.

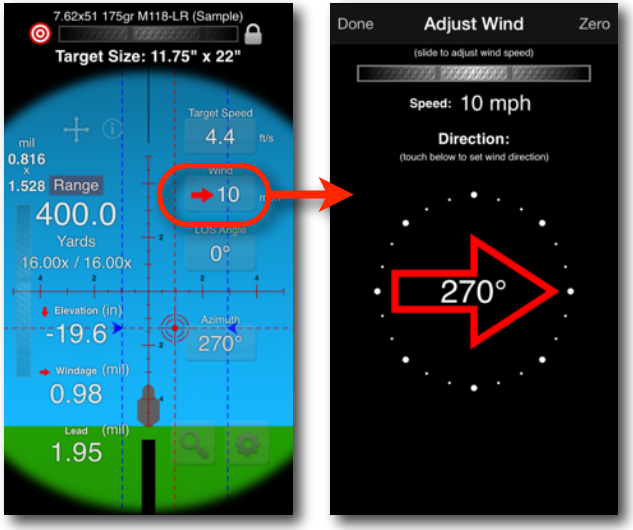
To display the combined values for windage and lead for both L-->R and R-->L leads, double tap the lead display. This will bring up a small display with the combined values. The lead value is always displayed in the same UOM as the windage value.



Wind Speed/Direction

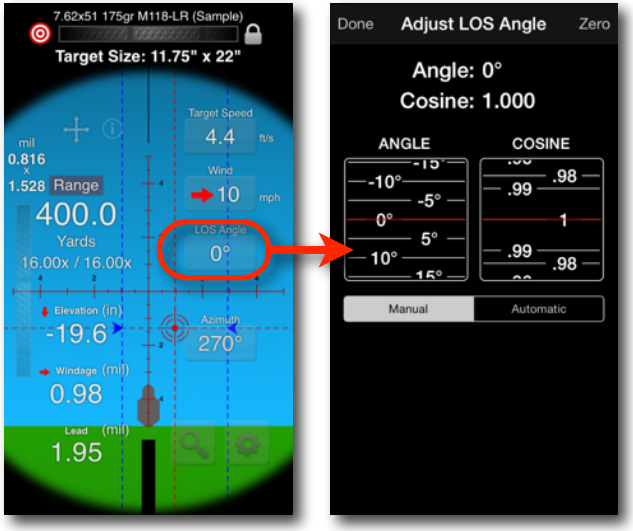
To adjust the wind speed and/or direction, tap the *Wind* button on the main reticle display. This will open the "Adjust Wind" display.

To increase/decrease the wind speed, slide the horizontal dial at the top of the display left or right. To quickly zero the wind speed, tap the *Zero* button in the upper right hand corner of the display. To adjust wind direction, touch anywhere around the arrow, below the direction label. The arrow represents the path of the wind. To save the settings and return to the reticle display, tap the *Done* button. The unit of measure for wind speed is either miles per hour or kilometers per hour, and is tied to the range unit of measure. If the range UOM is Meters, the wind speed will be displayed in kilometers per hour or meters per second, and incremented/decremented by 1 kph. If the range UOM is Yards, the wind speed will be displayed in miles per hour or feet per second, and incremented/decremented by 1 mph. The default direction increment is 5 degrees. This can be changed in the settings display to 1 degree, 5 degrees or 10 degrees.



LOS Angle

The LOS (Line of Sight) angle is defined as the angle between a horizontal line and the line from you to your target. To change the LOS Angle, tap the ***LOS Angle*** button on the main reticle display. This will open the "Adjust LOS Angle" display. This display will allow you to manually set the angle in degrees or by the angle cosine.

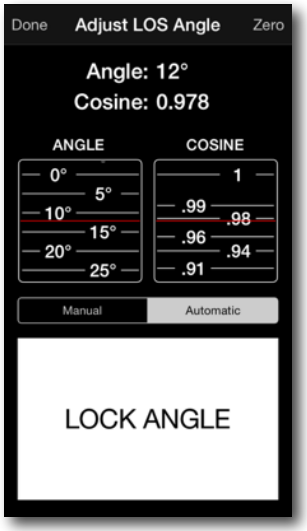


Manual Adjustment

To manually adjust the angle, touch/drag the Angle/Cosine wheel to the desired setting. To quickly zero the Angle, tap the *Zero* button in the upper right hand corner of the display. When the desired angle is set, tap the *Done* button to save the setting and return to the reticle display.

Automatic Adjustment

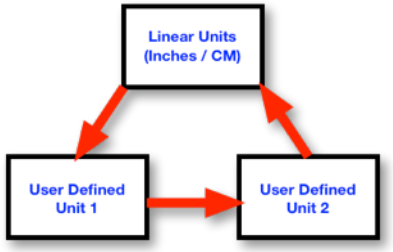
To use the device's built in accelerometer to calculate the LOS Angle, first toggle the mode from Manual to Automatic. Then, sight down the face of the iPhone to your target, or lay the iPhone on top of rifle and then tap the LOCK ANGLE button. Hold the device steady and after 5 seconds, the angle will lock in.



Trajectory Info

The trajectory info displays the elevation, windage, and moving target lead solution for the current range estimate. To change the unit of measure for elevation or windage, double tap the elevation or windage value. The lead units are always the same as the windage units. When you double tap to change the UOM of the elevation or windage values, it will cycle through three possible units:

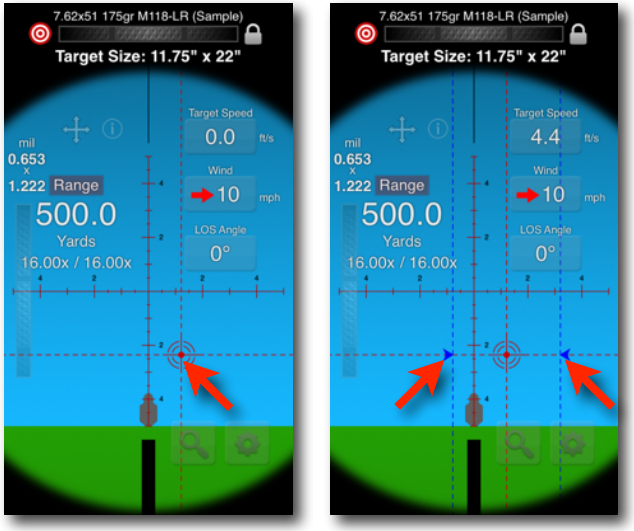
1. Linear Units (Inches or Centimeters depending on the Range UOM)
2. User-defined unit 1
3. User-defined unit 2



The user-defined units are set in the ballistics profile. There is an extensive list of units to select from including mil, MOA, IPHY and a variety of click units. See *Creating/Editing Ballistic Profiles --> Elevation Units & Windage Units* for information on setting the user-defined units.

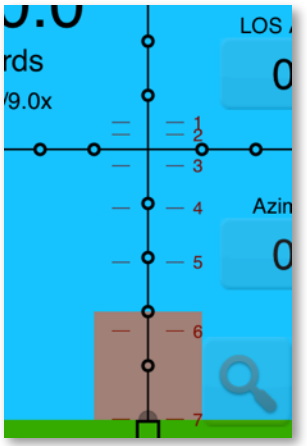
POI Display

The POI (Point of Impact) display is a graphical representation of the estimated elevation and windage corrections on the reticle display. If a target speed is specified, the POI display will also plot the moving target lead holds. The POI display can be enabled or disabled in the Settings display.



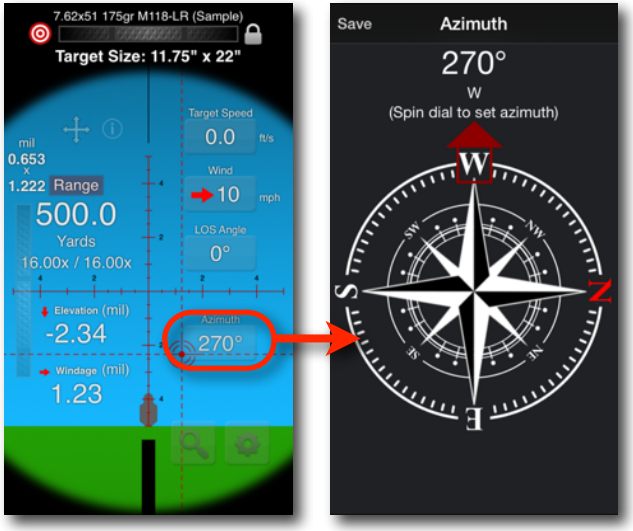
BDC Display

The BDC (Bullet Drop Compensator) display is a graphical display of elevation holds for each 100 yards/meters. If the range value is displaying in yards, the BDC is shown in 100 yard increments. If the range value is displaying in meters, the BDC display is shown in 100 Meter increments.



Azimuth

The Azimuth setting is used to in the Coriolis Effect calculation and is only visible when the current Ballistic Profile has the “Calculate Coriolis Effect” option enabled. Azimuth describes the direction from your current position to the target. Azimuth is measured in degrees where True North is 0°, East is 90°, South is 180° and West is 270°. To adjust the Azimuth, tap the Azimuth button on the reticle display, then spin the compass dial to the desired setting and tap save.

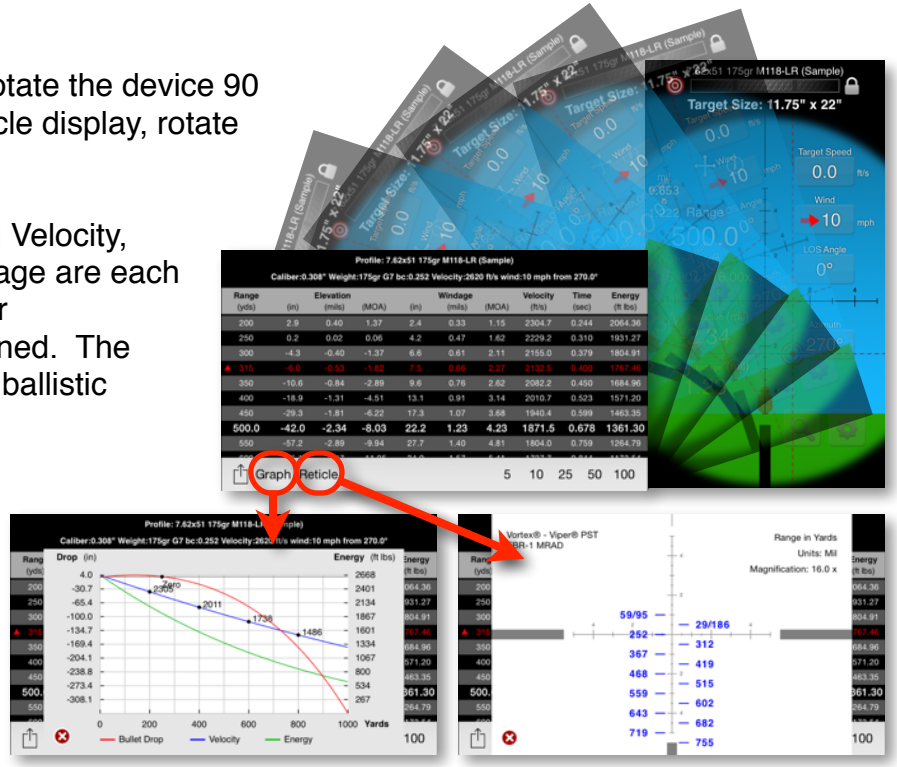


Reticle Scale/Magnification

The reticle scale adjustment adjusts the scale of the reticle. This enlarges or shrinks the view of the reticle and target similar to a FFP (First Focal Plane) scope. To adjust the reticle scale, tap the magnifying glass button in the lower right hand corner of the reticle display. The magnification control is available when the active ballistic profile is configured with the Focal Plane set to Second. The magnification control changes the scale of the target in relation to the magnification without affecting the scale of the reticle. This simulates the magnification setting on a second focal plane scope.

Ballistic Chart

To access the ballistic chart, from the main reticle display, rotate the device 90 degrees to the left (counter-clockwise). To return to the reticle display, rotate the device back to the original portrait orientation.



The ballistics chart displays Elevation, Windage, Remaining Velocity, Time of Flight, and Remaining Energy. Elevation and Windage are each displayed in three different units. The first column is a linear measurement. The second and third columns are user-defined. The elevation and windage user defined units are defined in the ballistic profile.

You can quickly change the range increment for the chart by tapping one of the five numbered buttons at the bottom of the display.

To display the bullet trajectory in a graph, tap the *Graph* button in the lower left hand corner of the display.

To display the reticle with ranges for each of the major increments on the reticle, tap the *Reticle* button.

If your device is set up for email, you can email a copy of the ballistics chart. Or you have the option of printing the ballistics chart, graph and reticle via AirPrint.

To email or print the ballistics chart, tap the action button in the lower left-hand corner of the display.

The ballistic chart will also display the range(s) that the elevation of the trajectory crosses in and out of the vital zone radius defined in the settings display. The ranges where the projectile crosses in and out of the vital zone is the point blank range. In the example below, the vital zone radius is set to 6 inches. At 315 yards, the projectile has dropped below the 6 inch vital zone radius.

Profile: 7.62x51 175gr M118-LR (Sample)

Caliber:0.308" Weight:175gr G7 bc:0.252 Velocity:2620 ft/s wind:10 mph from 270.0°

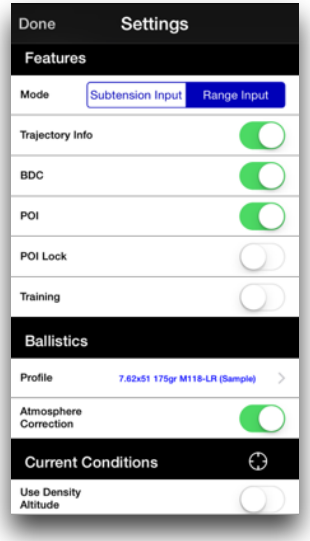
Range (yds)	Elevation (in)	Elevation (mils)	Elevation (MOA)	Windage (in)	Windage (mils)	Windage (MOA)	Velocity (ft/s)	Time (sec)	Energy (ft lbs)
200	2.9	0.40	1.37	2.4	0.33	1.15	2304.7	0.244	2064.36
250	0.2	0.02	0.06	4.2	0.47	1.62	2229.2	0.310	1931.27
300	-4.3	-0.40	-1.37	6.6	0.61	2.11	2155.0	0.379	1804.91
▲ 315	-6.0	-0.53	-1.82	7.5	0.66	2.27	2132.5	0.400	1767.46
350	-10.6	-0.84	-2.89	9.6	0.76	2.62	2082.2	0.450	1684.96
400	-18.9	-1.31	-4.51	13.1	0.91	3.14	2010.7	0.523	1571.20
450	-29.3	-1.81	-6.22	17.3	1.07	3.68	1940.4	0.599	1463.35
500.0	**-42.0**	**-2.34**	**-8.03**	**22.2**	**1.23**	**4.23**	**1871.5**	**0.678**	**1361.30**
550	-57.2	-2.89	-9.94	27.7	1.40	4.81	1804.0	0.759	1264.79

Graph Reticle 5 10 25 50 100

Settings

To access the settings display, tap the gear symbol at the bottom of the reticle display. The following options are available in the settings display:

- Features
  - Mode (Subtension Input/Range Input)
  - Trajectory Info (On/Off)
  - BDC (On/Off)
  - POI (On/Off)
  - POI Lock (On/Off)
  - Training (On/Off)
- Ballistics
  - Profile
  - Atmosphere Correction (On/Off)
- Current Weather
  - Use Density Altitude (On/Off)
  - Density Altitude (visible when atmosphere correction and density altitude enabled)
  - Altitude (visible when atmosphere correction enabled)
  - Temperature (visible when atmosphere correction enabled)
  - Pressure (visible when atmosphere correction enabled)
  - Humidity (visible when atmosphere correction enabled)
  - Latitude (visible when calculate Coriolis effect enabled)
- Preferences
  - Vital Zone Radius
  - Wind Display
  - Target UOM
  - Target Size Precision
  - Trajectory Info/Range UOM
  - Wind Direction Accuracy
  - Azimuth Accuracy
  - Colors
  - Display (Standard\Reverse)
  - Control Wheel Sensitivity
  - Display Brightness
  - Angle Calculator
- About/Help



Mode
The standard mode for the application is “Subtension Input”. This mode allows you to estimate range by dialing in the physical size of the target along with a measurement of the target (subtension) in reticle units (e.g. 2.5 mil).
The “Range Input” mode allows you to dial in a range value directly. Instead of estimating range, the “Range Input” mode will calculate the measurement of the target (subtension) in reticle units (e.g. .2.5 mil). This option is useful if you want to dial in the range to a target at a known distance to obtain a ballistics solution.

Trajectory Info
The Trajectory Info switch enables or disables the trajectory info fields on the reticle display (elevation, windage and lead).

BDC
The BDC switch enables or disables the BDC display on the reticle display.

POI
the POI switch enables or disables the point of impact display on the reticle display.

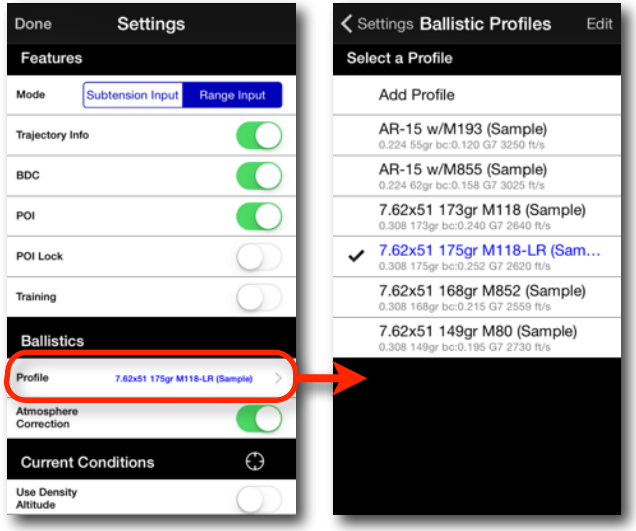
POI Lock
The POI Lock anchors the target to the estimated point of impact on the reticle display. This option helps visualize the hold over for the target. The POI Lock option is only available when the POI switch is set to ON.

Training
The training option is provided so that you can practice your range estimation math skills. When you enable the training option, the output values on the reticle display are hidden and all of the ballistics calculations are disabled. This gives you a chance to practice figuring out the range calculation for yourself. To check your work, tap the solution info button just above the Range label on the reticle display.

When you enable training mode, the ballistics settings are hidden and a Reticle Type field is displayed so that you can practice your range estimation skills with different reticle designs. When you disable training, the Reticle Type field on the settings display is hidden, and the last selected profile and weather settings are reapplied.

Profile
This is the current ballistic profile. The ballistic profile defines all of the parameters for a specific load/weapon combination that are used to estimate the trajectory of the bullet. The ballistic profile also determines what reticle is used on the reticle display as well as the windage/elevation units that are available.

To access the Ballistic Profiles display, from the Settings display, tap on the Profile row. From the Ballistic Profiles display, you can select a specific profile to apply, rearrange the order of the profiles, edit existing profiles, and add, clone or delete profiles. The currently selected profile is marked with a checkmark and a highlighted description.



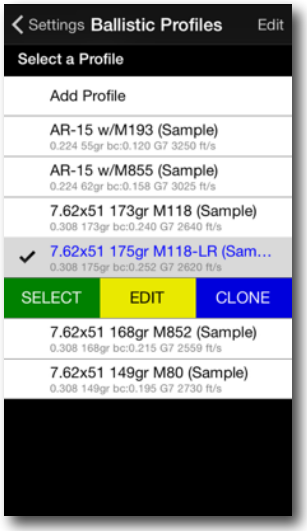
To apply a profile, tap the desired profile and then tap the green *Select* button.

To add a new profile, tap the *Add Profile* row.

To edit a profile, tap the desired profile and then tap the yellow *Edit* button.

To clone a profile, tap the desired profile and then tap the blue *Clone* button.

To delete a profile, swipe your finger across the profile, then tap the *Delete* button.



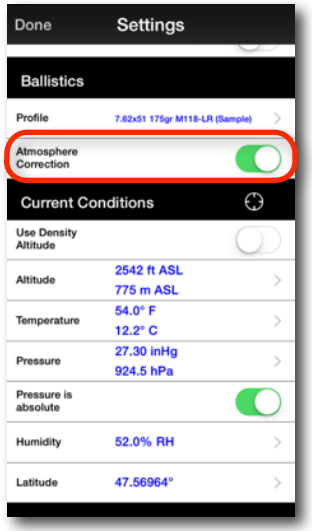
To rearrange the order of the profiles, first tap the Edit button in the upper right-hand corner of the display to enter the list edit mode. Then tap and hold the control on the right side of the row you wish to move and drag the row to the new location in the list.

While in edit list mode, you can also delete profiles by tapping on the red button to the left of the profile you wish to delete then tapping the *Delete* button.

To return to the normal list mode, tap the *Done* button in the upper right hand corner.

To return to the settings display, tap the Settings button in the upper left-hand corner of the display.

For more information see *Creating/Editing Ballistic Profiles*.



Atmosphere Correction

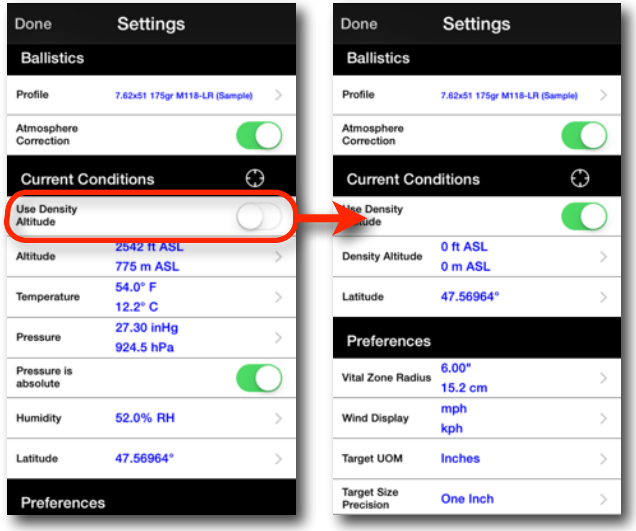
Atmosphere correction allows the ballistic engine to take in account the local weather conditions when calculating a solution. To use atmosphere correction you will need to supply the current weather conditions as well as the weather conditions present when you zeroed the rifle (zero conditions are set in the ballistic profile). If the Atmosphere Correction switch is turned off, the Current Weather fields will not be visible and the ballistic engine will use a standard sea level atmosphere for both the current conditions and zero conditions.

Using GPS to Acquire Current Conditions

If your device has built-in GPS and you have an internet connection, you have the option of acquiring your weather conditions using GPS to calculate your location. To acquire weather conditions by GPS, tap the button next to the current conditions header. The GPS will attempt to acquire a location for up to 30 seconds. The device will then contact the weather service for the weather information from the closest station. If the GPS cannot acquire a reasonably accurate altitude within 30 seconds you will be prompted if you want to use the reported GPS altitude (if available), the weather station altitude, or not update altitude. If on the rare occasion that the weather service doesn't return a value for one of the four values, the missing value will be highlighted in red to bring it to your attention.

Use Density Altitude

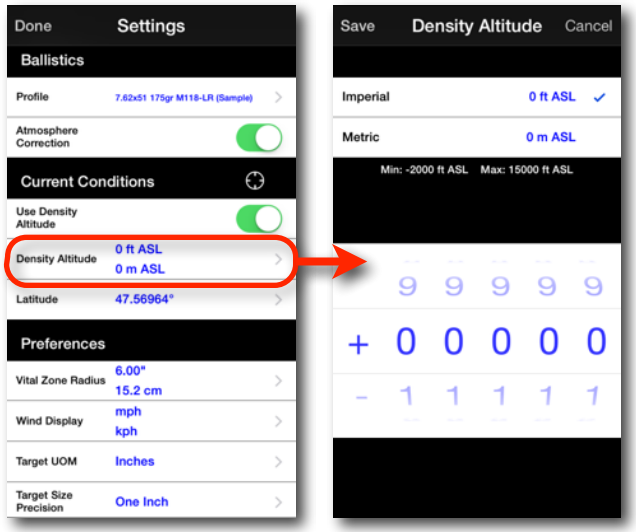
Controls whether you want to input atmospheric conditions in the form of Density Altitude or by Altitude, Temperature, Pressure and Humidity. When the Use Density Altitude switch is turned on, only the Density Altitude field is displayed for atmospheric conditions.



Density Altitude

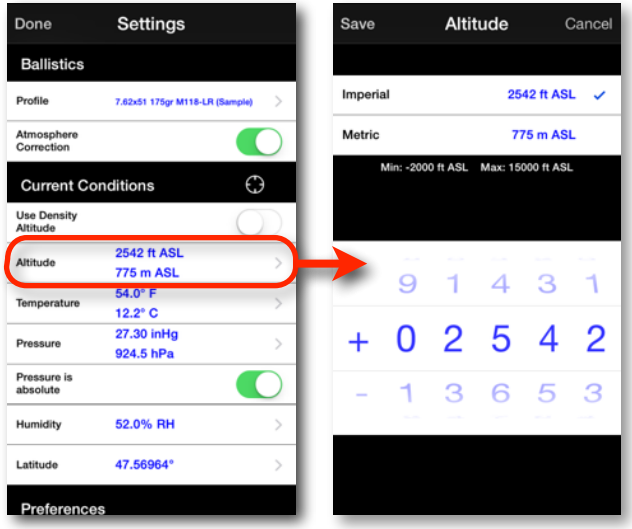
Density altitude is the altitude relative to the ISA (International Standard Atmosphere) standard atmosphere conditions at which the air density would be equal to the indicated air density at the place of observation. In other words, density altitude is air density given as a height above mean sea level. Using density altitude to represent your current atmospheric conditions removes the need to input altitude, temperature, pressure and humidity.

This is most commonly used in conjunction with a portable weather station like a Kestrel Weather Meter.



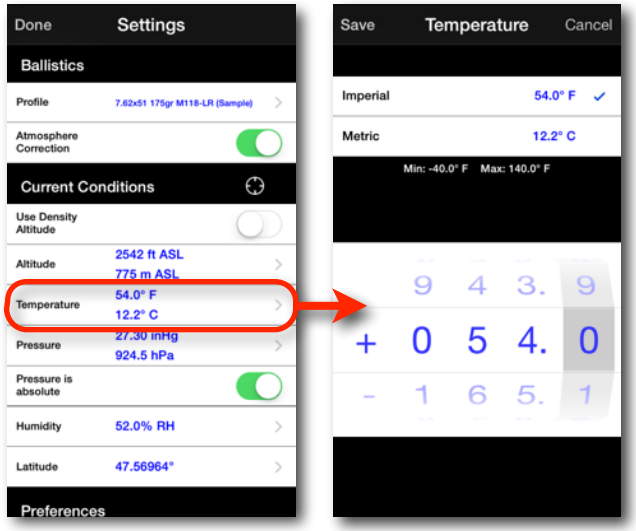
Altitude

The altitude setting is only available when Atmosphere Correction is turned on. To edit the altitude, from the settings display, tap the altitude row. This will open the altitude editor, where you can enter the altitude in Feet above sea level (ft ASL) or Meters above sea level (m ASL). At the top of the display, you will see an entry for both ft ASL and m ASL. The value with the checkmark signifies which value you are currently updating. To adjust the value, spin the dials at the bottom of the page. To switch the value you are updating, simply tap the value you want to update. Tap the *Save* button to commit your changes or the *Cancel* button to cancel the changes.



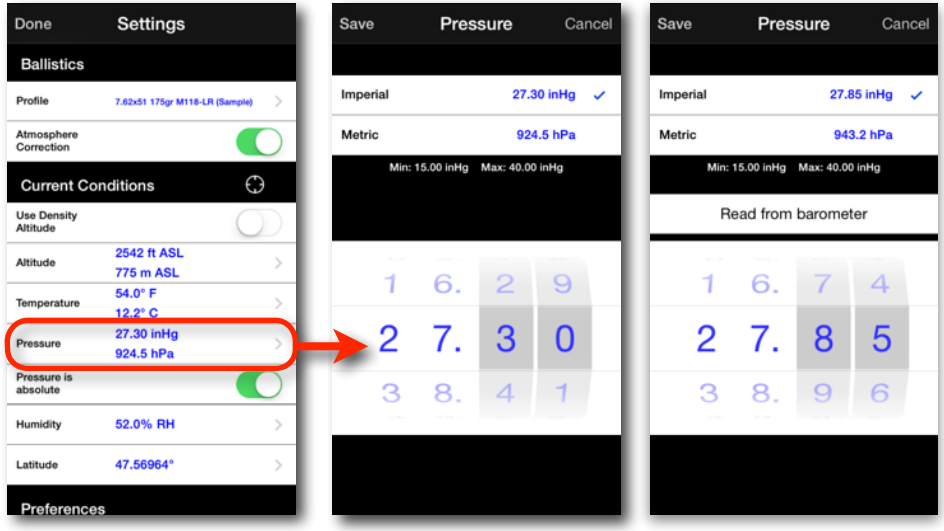
Temperature

The temperature setting is only available when Atmosphere Correction is turned on. To edit the temperature, from the settings display, tap the temperature row. This will open the temperature editor where you can input the temperature in either Fahrenheit or Celsius. At the top of the display, you will see an entry for both Fahrenheit and Celsius. The value with the checkmark signifies which value you are currently updating. To adjust the value, spin the dials at the bottom of the page. To switch the value you are updating, simply tap the value you want to update. Tap the *Save* button to commit your changes, or tap the *Cancel* button to cancel the changes.



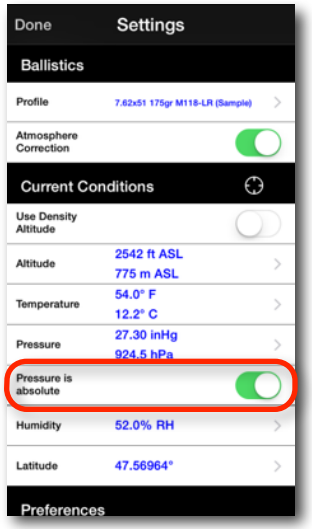
Pressure

The pressure setting is only available when Atmosphere Correction is turned on. To edit the barometric pressure, from the settings display, tap the pressure row. This will open the pressure editor where you can enter the altitude in Inches of Mercury (InHg) or Hectopascal (hPa). At the top of the display you will see an entry for both InHg and hPa. The value with the checkmark signifies which value you are currently updating. To adjust the value, spin the dials at the bottom of the page. To switch the value you are updating, simply tap the value you want to update. If you have an iPhone 6 / 6 Plus, you also have the option to use the built in pressure sensor to retrieve the station pressure by tapping the *Read from barometer* button. Tap the *Save* button to commit your changes or tap the *Cancel* button to cancel the changes.



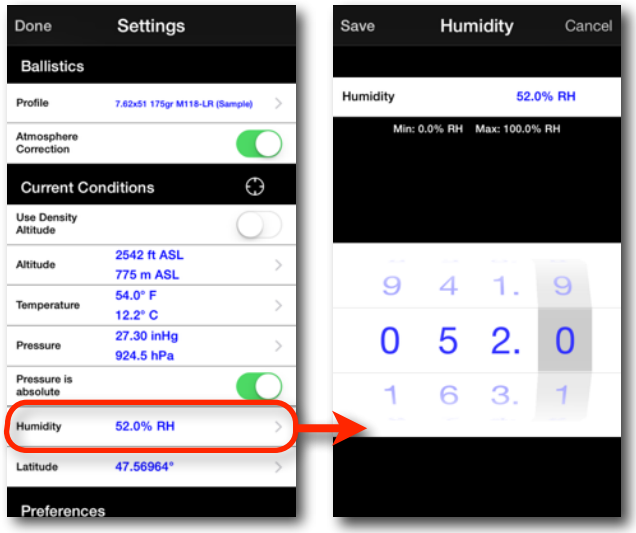
Pressure is Absolute

This switch is used to indicate whether the stated pressure is absolute (station pressure), or if it is adjusted for sea level pressure. Most pressure readings that you get from weather reports are sea level adjusted pressure readings.



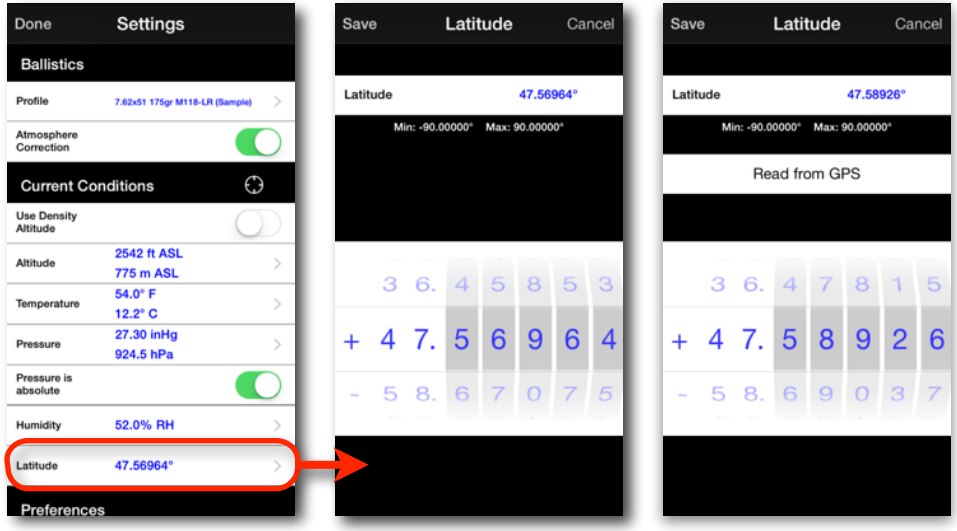
Humidity

The humidity setting is only available when Atmosphere Correction is turned on. To edit the percentage of relative humidity, from the settings display, tap the pressure row. This will open the humidity editor where you can enter the percentage of relative humidity. To adjust the value, spin the dials at the bottom of the page. Tap the *Save* button to commit your changes or tap the *Cancel* button to cancel the changes.



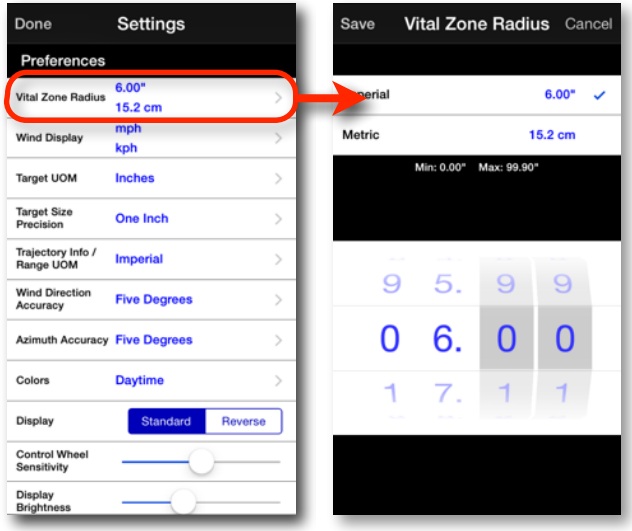
Latitude

The latitude of your shooting location. The Latitude setting is used in the Coriolis Effect calculation and is only visible if the current Ballistic Profile has the Calculate Coriolis Effect option enabled in the selected ballistic profile. Positive values represent latitudes in the northern hemisphere and negative values represent latitudes in the southern hemisphere. To edit the latitude, from the settings display, tap the Latitude row. This will open the latitude editor where you can enter your latitude. To adjust the value, spin the dials at the bottom of the page. If your device has GPS and you allow the application to access location services, you also have the option to retrieve the latitude via GPS by tapping the *Read from GPS* button. Tap the *Save* button to commit your changes or tap the *Cancel* button to cancel the changes.



Vital Zone Radius

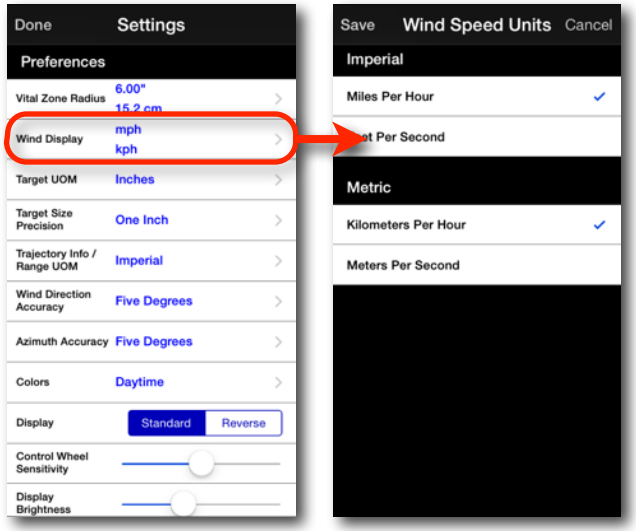
A radius measurement used to calculate the point blank range. To edit the value, tap the Vital Zone Radius row. To edit the Vital Zone Radius, from the settings display, tap the Vital Zone Radius row. This will open the Vital Zone Radius editor where you can enter your Vital Zone Radius. To adjust the value, spin the dials at the bottom of the page. Tap the *Save* button to commit your changes or tap the *Cancel* button to cancel the changes.



Wind Display

The Wind Display setting allows you to choose what units you want the wind speed displayed in for both Imperial and Metric values.

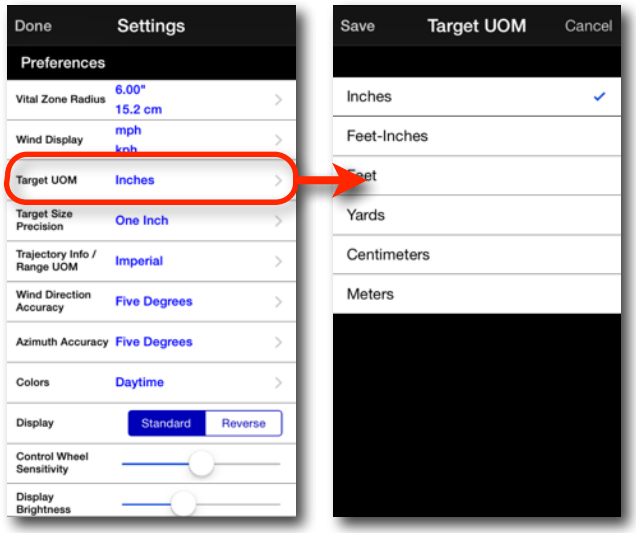
- Imperial
  - Miles Per Hour
  - Feet Per Second
- Metric
  - Kilometers Per Hour
  - Meters Per Second



Target UOM

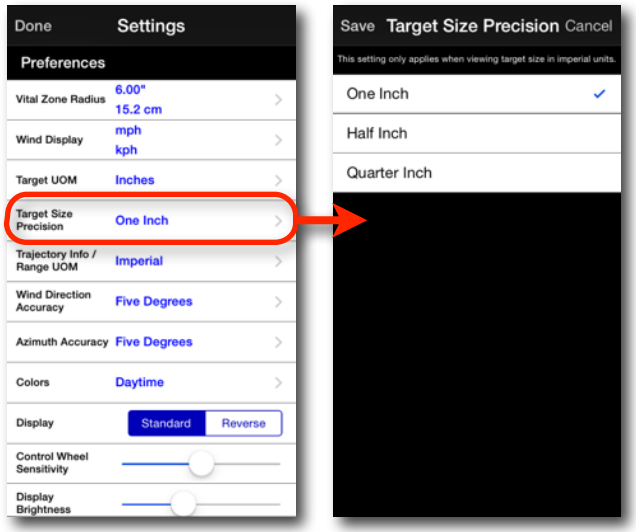
The target unit of measure defines how the target measurement is displayed on the reticle display. To edit the Target UOM, from the settings display, tap the Target UOM row. This will open the Target UOM selector. Select a unit, then tap the *Save* button to commit the changes, or tap the *Cancel* button to cancel any changes.

Note: This setting can also be changed on the main reticle display by double-tapping the Target Size label.



Target Size Precision

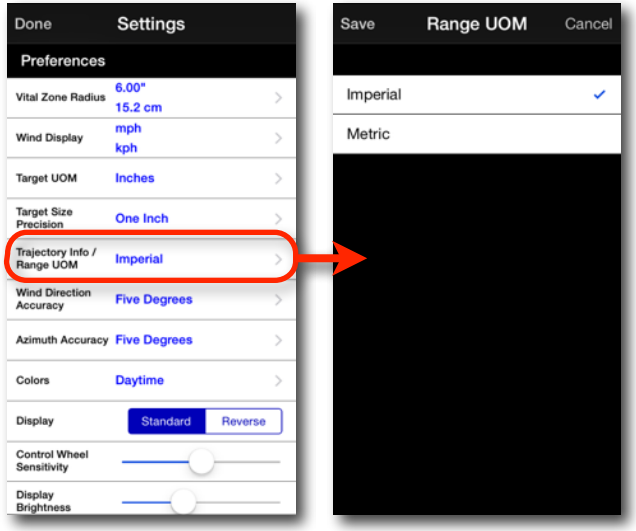
The Target Size Precision setting determines how precise the target size measurement is when viewing target size in imperial units.



Trajectory Info/Range UOM

The Trajectory Info/Range UOM setting defines how the following fields are displayed:

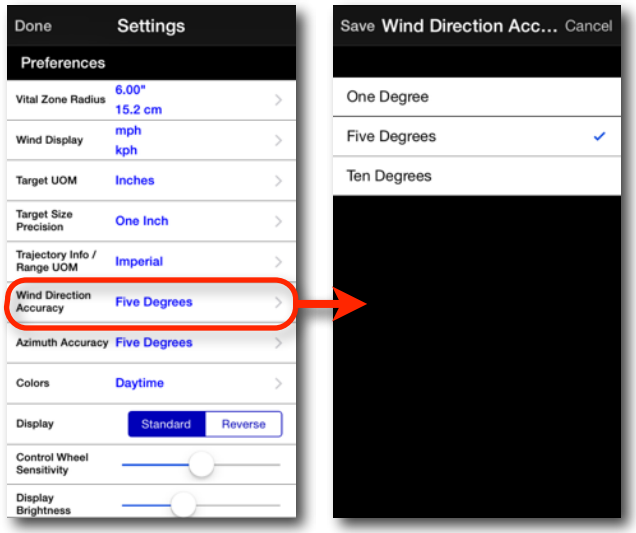
- Range
- Target Speed
- Wind Speed
- Windage (when displaying linear units)
- Elevation (when displaying linear units)
- Lead (when displaying linear units)
- Range divisions on ballistics chart
- First elevation column on the ballistics chart
- First windage column on the ballistics chart
- Remaining velocity



To edit the Trajectory Info/Range UOM setting, from the settings display, tap the Trajectory Info/Range UOM row. This will take you to a selection list where you can select either Imperial or Metric.

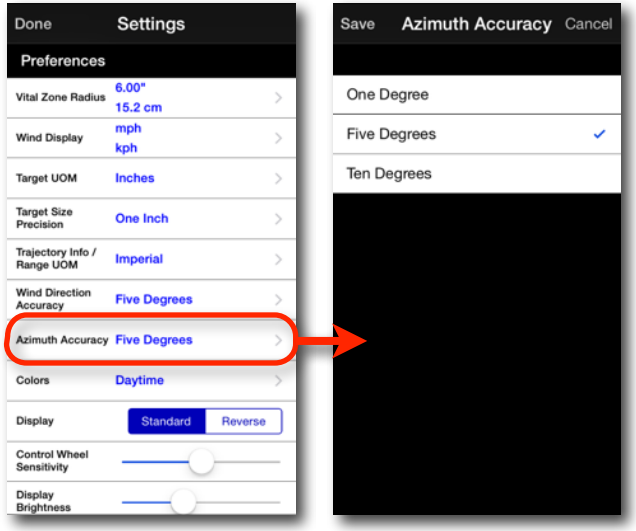
Wind Direction Accuracy

Allows you to set the accuracy of the wind direction selector to one, five or ten degrees. Five degrees is the default setting.



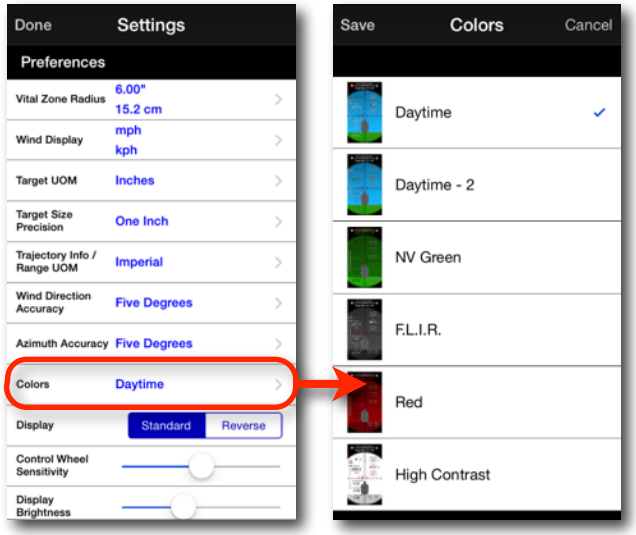
Azimuth Accuracy

Allows you to set the accuracy of the azimuth selector to one, five or ten degrees. Five degrees is the default setting.



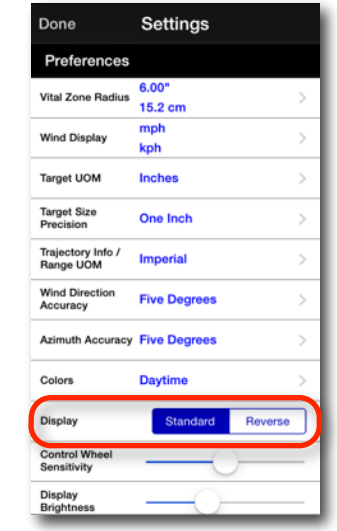
Colors

There are 4 color schemes available. Daytime, Night Vision, F.L.I.R. and Red. To change the color scheme, from the settings display, tap the Colors row. This will take you to a selection list where you can choose the color scheme you like.



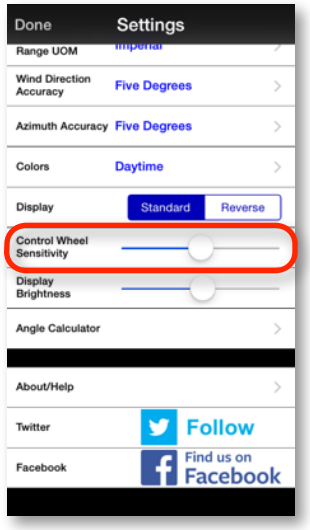
Display

Use the Display selector to reverse the controls and labels on the main reticle display.



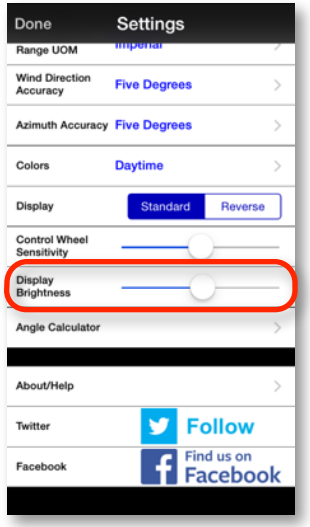
Control Wheel Sensitivity

The Control Wheel Sensitivity setting adjusts how responsive the control wheel inputs are. This setting affects the target size, reticle subtension, target speed and wind speed control wheels.



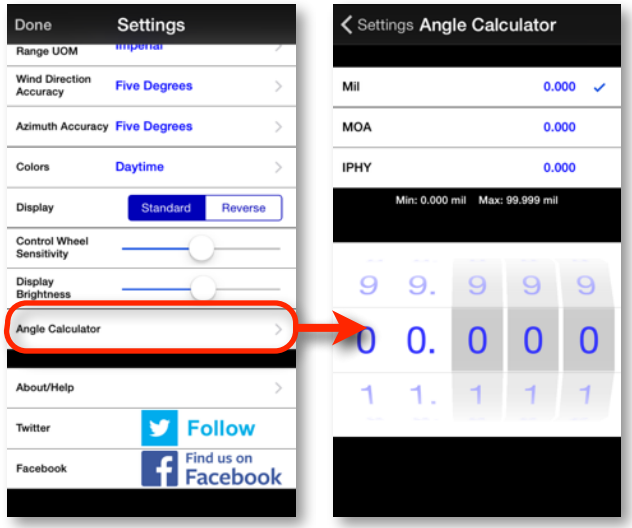
Display Brightness

The display brightness setting allows you to dim the display to make the application easier to use in low light settings. To adjust the display brightness, from the settings display, slide the Display Brightness slider left or right until the desired effect is reached.



Angle Calculator

The angle calculator is a simple utility that can quickly convert Mils to MOA to IPHY. Tap the Angle Calculator row to access the angle calculator. Select the input unit (denoted with the check mark), dial in the value and the other units will automatically display the equivalent value.



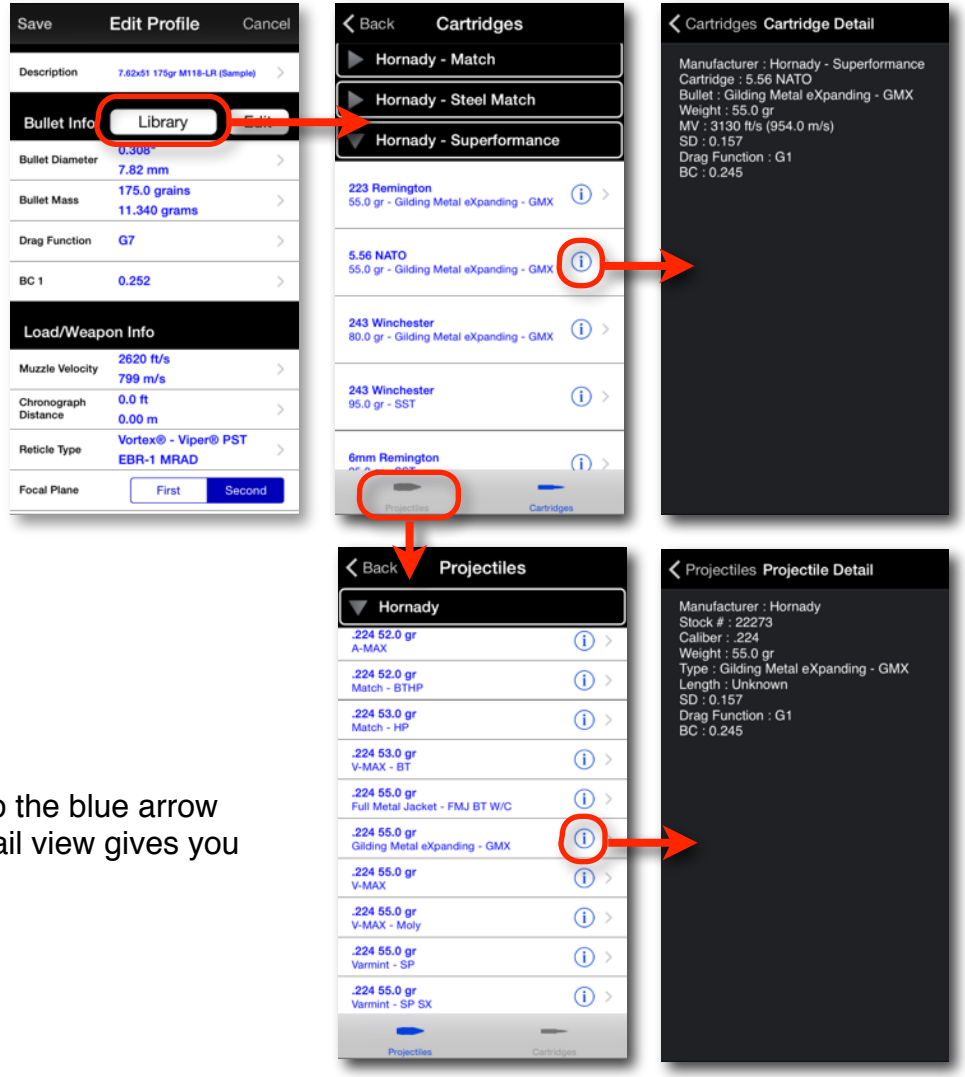
Creating/Editing Ballistics Profiles

The ballistic profile stores all the data for a specific firearm. This includes caliber and load information, zero range, zero conditions, sight height, reticle type and a few other settings that are specific to the firearm.
The following settings are available:

- Description
- Bullet Info
  - Bullet Diameter
  - Bullet Mass
  - Drag Function
  - BC (Ballistic Coefficient)
- Load/Weapon Info
  - Muzzle Velocity
  - Chronograph Distance
  - Reticle Type
  - Focal Plane (First/Second)
  - Maximum Magnification (only visible when Focal Plane set to Second)
  - Ranging Magnification (only visible when Focal Plane set to Second)
  - Minimum Magnification (only visible when Focal Plane set to Second)
  - Sight Height
  - Zero Range
  - Y Intercept
  - Max Range
  - Lock Time
  - Calculate Coriolis Effect (On/Off)
  - Azimuth (only visible when Calculate Coriolis Effect enabled)
  - Calculate Spin Drift (On/Off)
  - Barrel Twist Rate (only visible when Calculate Spin Drift is enabled)
  - Twist Direction Left/Right. (only visible when Calculate Spin Drift is enabled)
  - Bullet Length (only visible when Calculate Spin Drift is enabled)
- Zero Conditions
  - Use Density Altitude (On/Off)
  - Altitude
  - Temperature
  - Pressure
  - Pressure is Absolute (On/Off)
  - Humidity
  - Latitude
- Trajectory Info
  - Elevation Units 1
  - Elevation Units 2
  - Windage Units 1
  - Windage Units 2

Library

The library allows you to quickly look up projectiles and cartridges. To access the library, tap the ***Library*** button. Use the tab bar at the bottom of the display to switch between projectiles and cartridges.



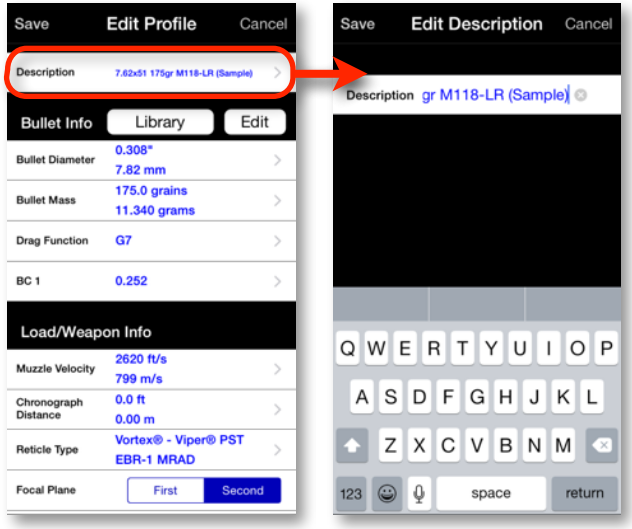
Tap the manufacturer name to expand or Collapse the list of all the projectiles/cartridges for that manufacturer. To use one of the projectiles / cartridges, simply tap the item that you want, and a confirmation dialog will appear asking if you want to apply it to your ballistic profile.
If you confirm that you want to apply, it will set the following values in the Ballistic Profile:

- Bullet Diameter,
- Bullet Mass,
- Drag Function,
- BC(s),
- Bullet Length (if available)
- Muzzle Velocity (Cartridges only)

To view the details of a bullet/cartridge in the library, tap the blue arrow button next to the bullet/cartridge description. The Detail view gives you more specific information about the projectile/cartridge.

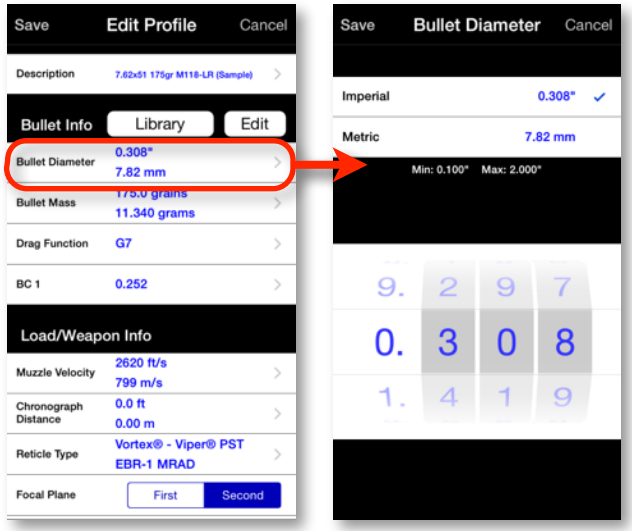
Description

The description is used to describe the ballistic profile. Generally you will want to note the weapon and the ammo load in the description.



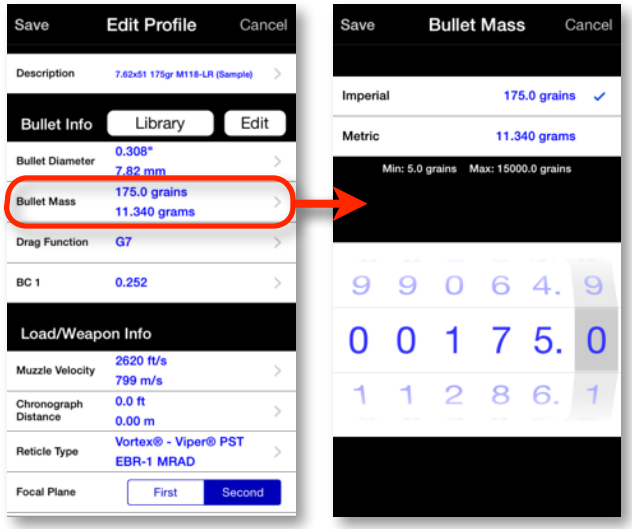
Bullet Diameter

This is the bullet diameter in inches/millimeters. This setting is primarily for your reference, but it is also a required component of the spin drift calculation. To edit the Bullet Diameter, tap the Bullet Diameter row.



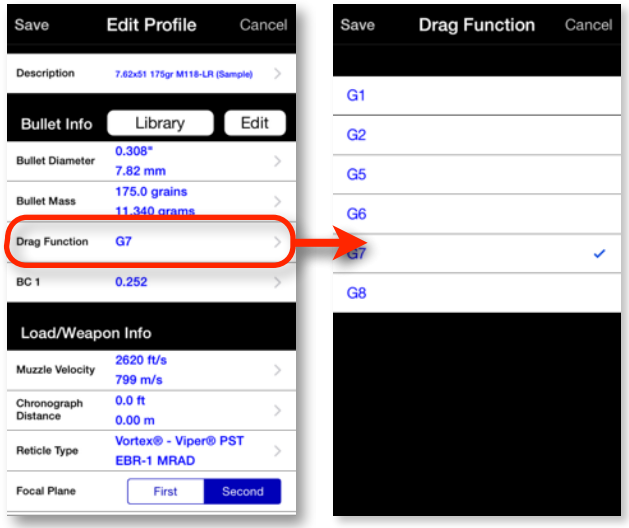
Bullet Mass

This is the mass of the bullet in grains/grams. The Bullet Mass is used to calculate the remaining energy at a specific range. To edit the Bullet Mass, tap the Bullet Mass row.



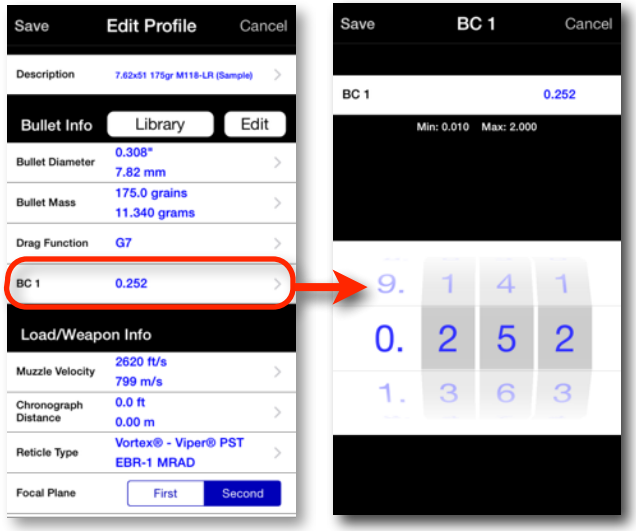
Drag Function

The drag function determines how the ballistic engine interprets the ballistic coefficient (BC). Most manufacturers publish BC's for the G1 drag function. Make sure you check with the bullet manufacturer for the proper setting.



BC

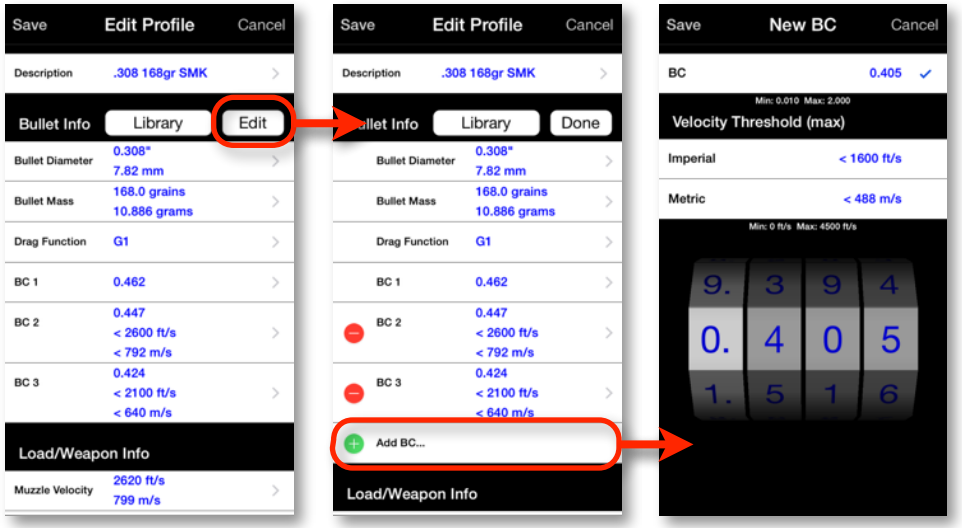
The ballistic engine uses the ballistic coefficient (BC) to calculate the trajectory of the bullet. The ballistic coefficient is the measure of the projectiles ability to overcome air resistance in flight. BC is a function of mass, diameter, and drag coefficient. To edit the BC, tap the BC row.



Multiple/Variable BCs

Some manufacturers provide multiple BC values that correspond to specific velocity ranges. The example below walks thru the process of entering multiple ballistic coefficients.

For the Sierra .224 dia. 55 gr. FMJ BT bullet, Sierra publishes the following G1 BC Values.
.272 @ 3000 fps and above
.245 between 2400 and 3000 fps
.235 @ 2400 fps and below



The steps to enter this bullet data:

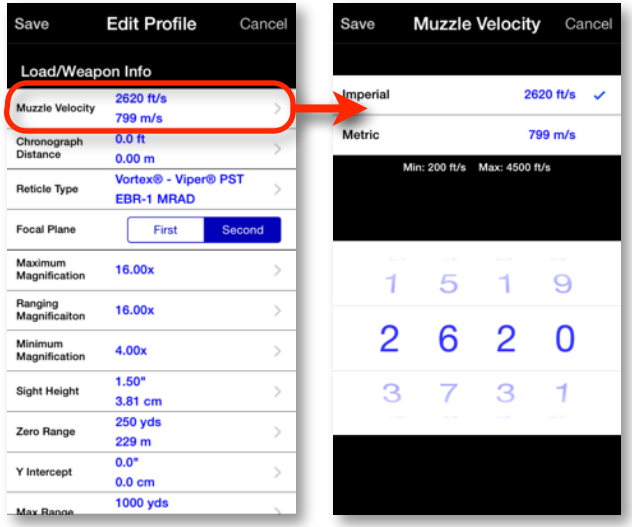
1. Input the Bullet Diameter (.224 in)
2. Input the Bullet Mass (55 gr)
3. Select the proper Drag Function (G1)
4. Enter the BC 1 value (272). For BC 1 always use the BC value that is published for use above the highest velocity value.
5. Tap the *Edit* button (next to the *Bullet Library* button). This puts the BC list in edit mode and will allow you to add or remove additional BC values.
6. Tap the *Add BC...* row. This will open the New BC display.
7. Input the next BC value (.245) in the BC row.
8. Tap Either the imperial row in the Velocity Threshold group and input the maximum velocity threshold for the BC (3000 fps).
9. Tap the *Save* button in the upper right hand corner of the New BC display. This will take you back to the Edit Profile Display.
10. Tap the *Add BC...* row again. This will open the New BC display again.
11. Input the next BC value (0.235) in the BC row.
12. Tap either the imperial row in the Velocity Threshold group and input the maximum velocity threshold for the BC (2400 fps).
13. Tap the *Save* button in the upper right hand corner of the New BC display. This will take you back to the edit profile display.

You can add as many BC values as needed and with the exception of BC 1, the order that they are entered does not matter. The BC values are automatically sorted by the velocity threshold.

To delete a BC, you must be in edit mode. Once in edit mode, tap the red icon next to the BC that you wish to delete. Then tap the *Delete* button that appears to confirm. To exit edit mode, tap the *Done* button next to the *Bullet Library* button.

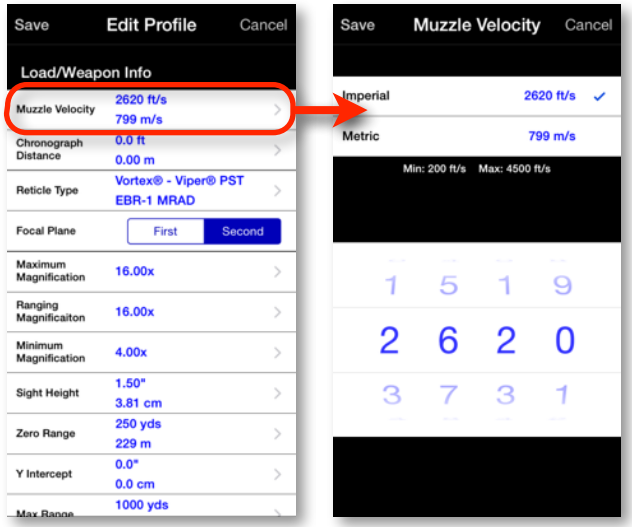
Muzzle Velocity

The velocity of the bullet as it leaves the muzzle of the rifle. To edit the muzzle velocity, tap the muzzle velocity row. If the muzzle velocity was measured by a chronograph, enter the measured velocity here, and then enter the distance to the chronograph in the Chronograph Distance field.



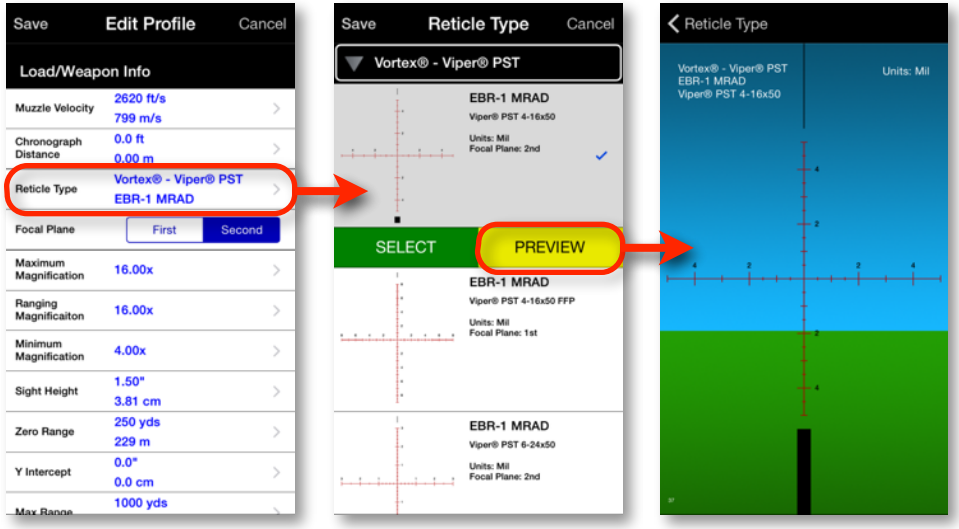
Chronograph Distance

The distance from the muzzle that the Muzzle Velocity was measured. When a Chronograph distance is provided the ballistic engine will automatically adjust the muzzle velocity to take into account the lost velocity between the muzzle and the chronograph.



Reticle Type

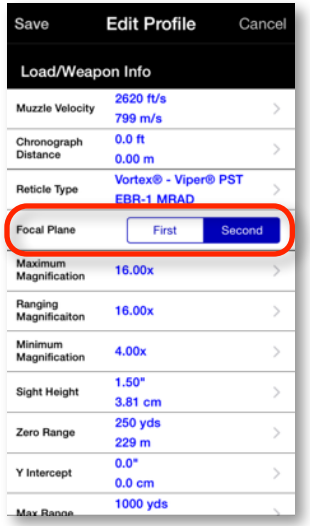
Defines what reticle is drawn on the reticle display when this profile is selected. To change the Reticle Type, tap the Reticle you want to use then tap the *Select* button. To preview a reticle tap the Reticle row then tap the *Preview* button.



Focal Plane

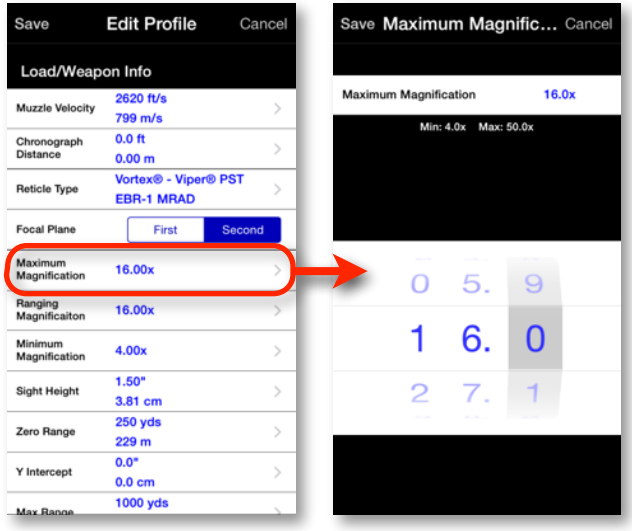
Defines whether the reticle is treated as a first focal plane or second focal plane scope. When you adjust the magnification on a first focal plane scope, the reticle and target increase/decrease in size according to the magnification setting. On a first focal plane scope, the reticle subtension is always the same regardless of the magnification.

With a second focal plane scope, the target increases/decreases in size according to the magnification setting, but the reticle does not. On a second focal plane, the reticle subtension is calibrated at a specific magnification (usually the highest magnification, but can vary from one scope to the next). For example, lets take standard second focal plane 2.5-10x44 mil-dot scope that calibrated at 10x magnification. At the 10x magnification the center of one dot to the center of the next dot subtends 1 mil. However if you were to change the magnification to 2.5x, the center of one dot to the center of the next dot would subtend 4 mil. You must take in account the magnification setting when ranging a target, or setting up your hold over values for a shot when using a second focal plane scope.



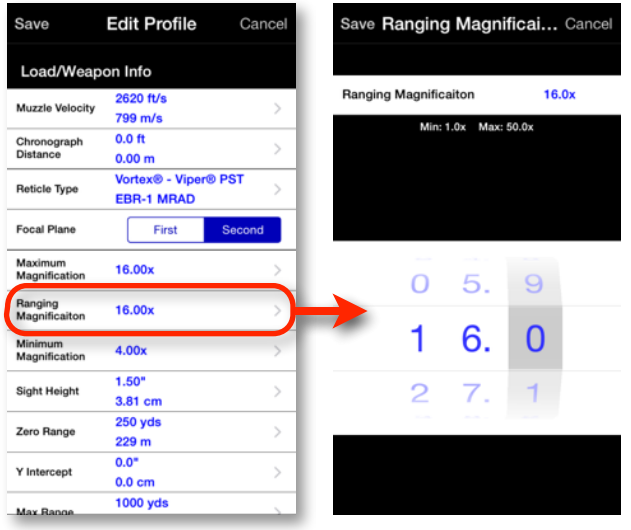
Maximum Magnification

The maximum magnification that your second focal plane scope is rated for. This value sets the upper limit of the magnification. To edit the Maximum Magnification, tap the Maximum Magnification row. This setting is only available when the Focal Plane setting is set to Second.



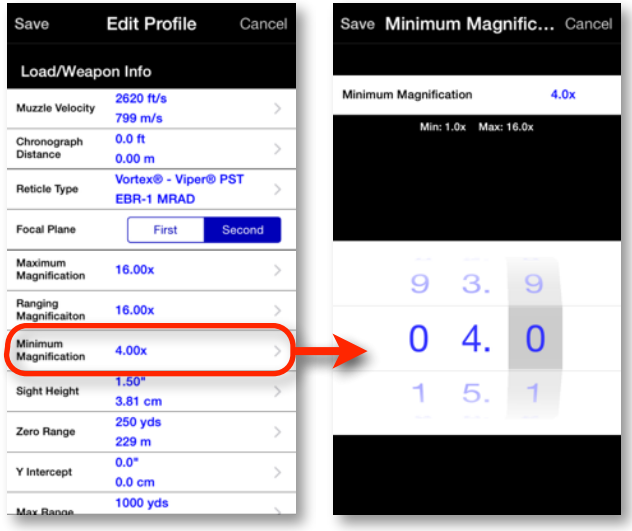
Ranging Magnification

The magnification setting that your second focal plane reticle is calibrated for. To edit the Ranging Magnification, tap the Ranging Magnification row. This setting is only available when the Focal Plane setting is set to Second.



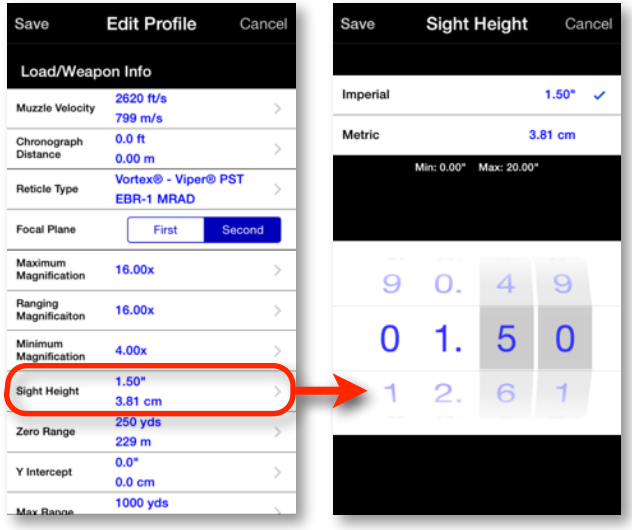
Minimum Magnification

The minimum magnification that your second focal plane scope is rated for. This value sets the lower limit of the magnification. To edit the minimum magnification, tap the Minimum Magnification row. This setting is only available when the Focal Plane setting is set to Second.



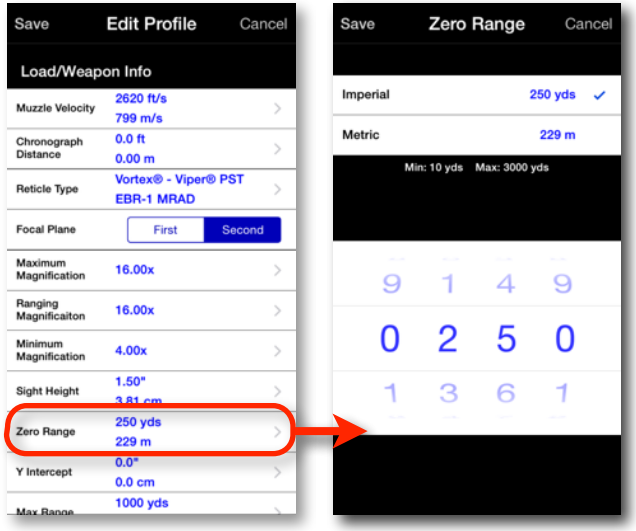
Sight Height

The height of your scope above the bore of the rifle. The measurement is taken from the center axis of the bore, to the center axis of the scope. To edit the Sight Height value, tap the sight height row.



Zero Range

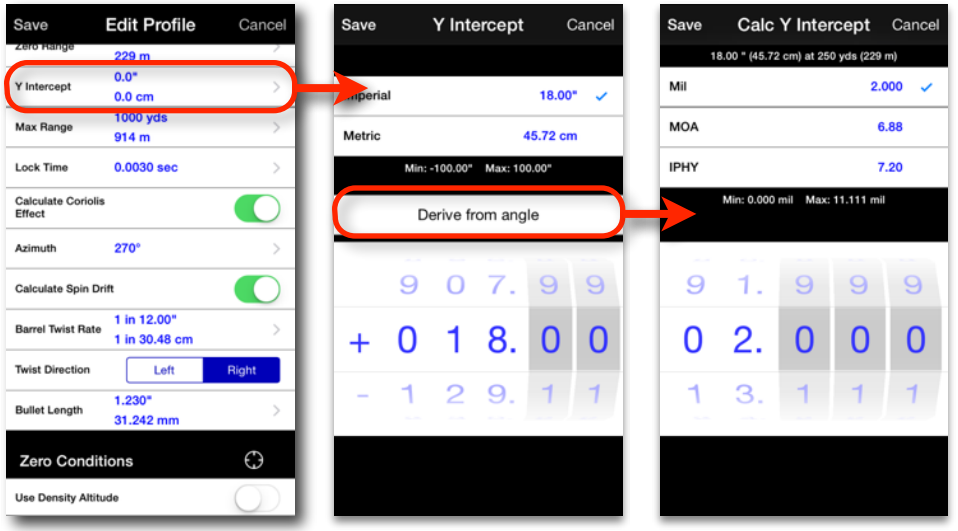
The range your rifle is zeroed at. To edit the zero range value, tap the Zero Range row.



Y Intercept

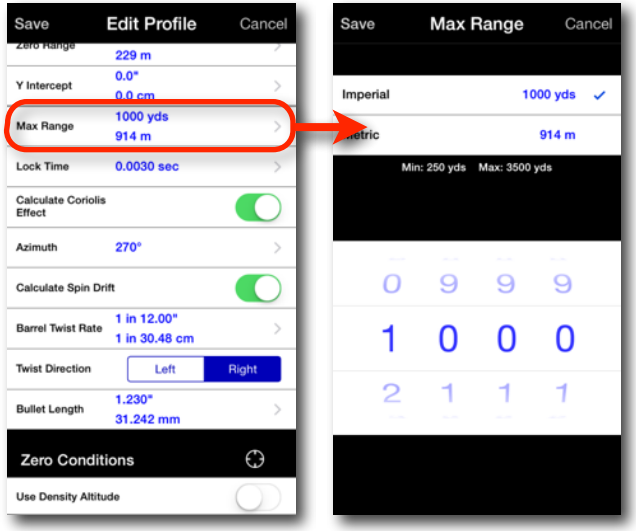
The Y Intercept defines how far above or below the point of aim you want to bullet to impact. For example, if you set the zero range to 250 yards, and the y intercept to 6”, that means that you want the bullet to impact 6” above your point of aim at 250 yards.

The *Derive from angle* button allows you to calculate the Y Intercept from an angle for the given Zero Range. For instance, if your Zero Range is set to 250 yards, and you want the bullet to impact 2 mil above the point of aim, tap the “Derive from angle” button, and input 2 mil. This will result in a calculated Y Intercept of 18” (45.72 cm).



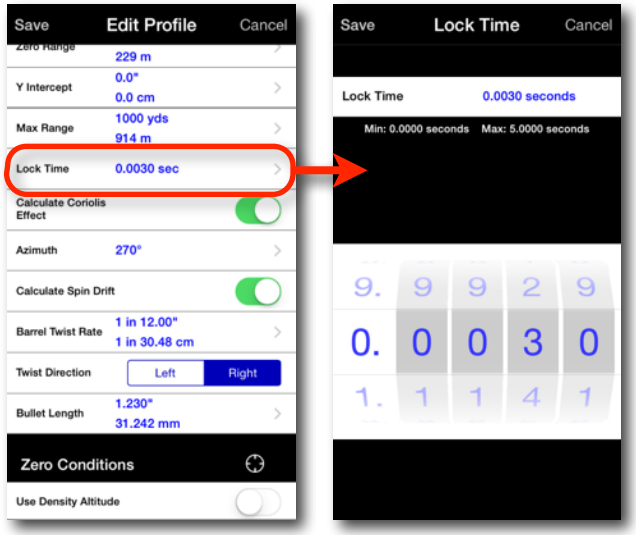
Max Range

The maximum range that will be calculated by the ballistic engine. To edit the Max Range value, tap the Max Range row.



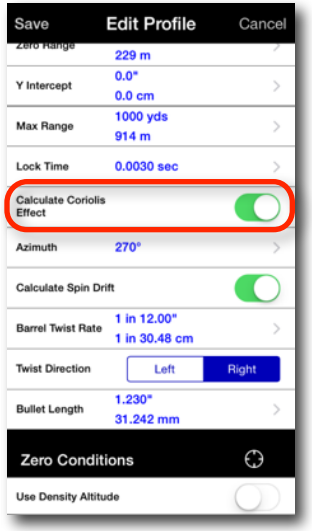
Lock Time

Lock time is the amount of time from when you pull the trigger to when the cartridge fires. This is only used for the moving target lead calculation. To edit the lock time value, tap the Lock Time row.



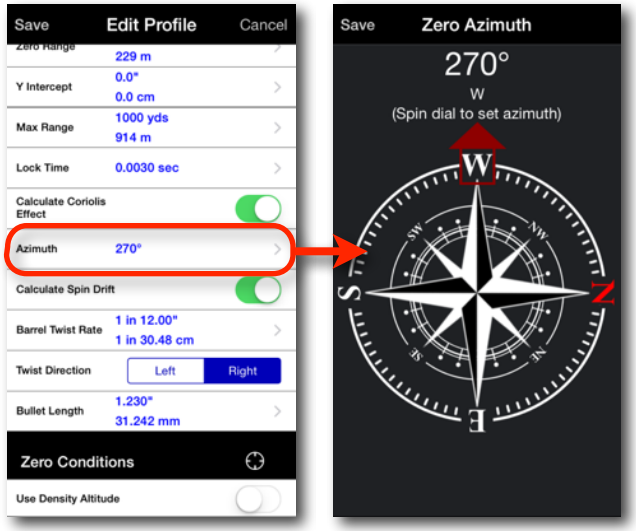
Calculate Coriolis Effect

The Coriolis effect describes the deflection of the bullet as it travels in a rotating reference plane (the Earth). The Coriolis effect is very subtle and can be ignored for most practical shooting situations. The effect is so small at practical ranges that the error factors resulting from improper wind calls, the inherent accuracy of the rifle, and the shooters own ability generally make the Coriolis effect statistically insignificant. At longer ranges, if you eliminate all the other error factors, it can mean the difference between a hit or a miss on a man size target. There are two components to the Coriolis effect. Horizontal deflection and vertical deflection. The only variable that affects the horizontal deflection component is the latitude (degrees above or below the equator) of the shooter. A northern latitude will always result in a deflection to the right, where a southern latitude will always result in a deflection to the left. The vertical deflection component of the effect is dependent on the latitude of the shooter, the azimuth and the muzzle velocity. The vertical deflection is at it's greatest for azimuths that are parallel to and near the equator. A shot to the east (90° azimuth) will result in less drop (shot hits high) where a shot to the west (270° azimuth) will result in more drop (shot hits low).

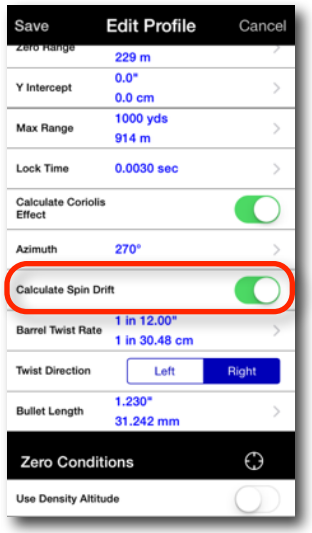


Zero Azimuth

The Azimuth setting is used in the Coriolis Effect calculation, and is only visible when the Calculate Coriolis Effect option is enabled. Azimuth describes the direction from your current position to the target. Azimuth is measured in degrees where True North is 0°, East is 90°, South is 180° and West is 270°. To adjust the Azimuth, tap the Azimuth row, then spin the compass dial to the desired setting and tap save.



Calculate Spin Drift



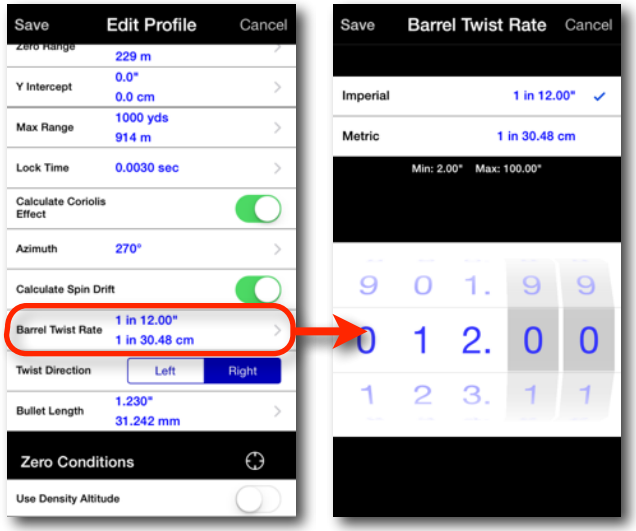
To include the Spin Drift (Gyroscopic Drift) calculation in the solution, enable the ***Calculate Spin Drift*** switch. The following factors are considered when calculating spin drift:

- Bullet Mass
- Barrel Twist Rate
- Twist Direction
- Bullet Diameter
- Length of Bullet
- Velocity
- Temperature*
- Air Pressure*

The spin drift calculation uses the formula published in “Applied Ballistics For Long Range Shooting” by Brian Litz. The formula is an approximation of the spin drift effect that incorporates the Miller stability formula corrected for velocity, and atmosphere.
*If the *Atmosphere Correction* feature is not turned on in the Settings display, the ballistic engine ignores the zero temperature and pressure settings and uses a standard sea level atmosphere for both zero and current conditions.

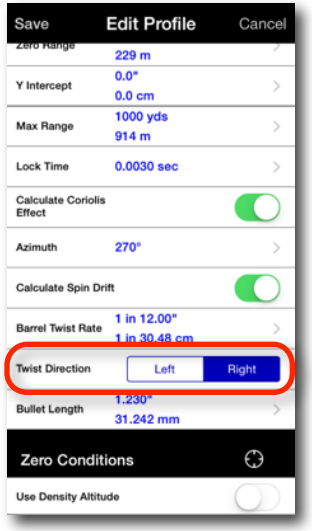
Barrel Twist Rate

The barrel twist rate describes the twist rate of the rifling in the barrel. The measurement is expressed as the distance it would take the bullet to make one full revolution as it’s traveling down the barrel. For instance, a 1 in 9” twist means that the bullet must travel down the barrel 9 inches to complete one full revolution. The barrel twist rate is only used in the spin drift calculation and is only visible when the *Calculate Spin Drift* setting is enabled.



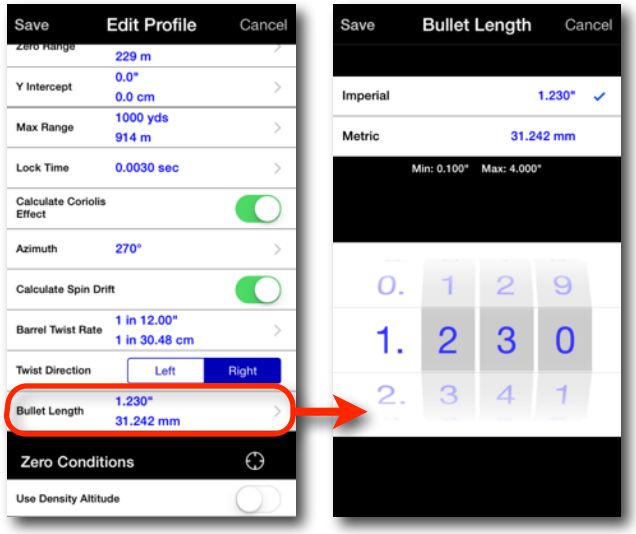
Twist Direction

The twist direction describes which direction the rifling twists, or which way the bullet will spin as it travels down the barrel. A right hand twist will spin the bullet in a clockwise direction from the perspective of the shooter, where a left hand twist will spin the bullet in a counter-clockwise direction. A right hand twist will always result in a drift to the right in relation to the bore axis, a left hand twist will always result in a drift to the left in relation to the bore axis. Most firearms use a right hand twist. The twist direction is only used in the spin drift calculation and is only visible when the *Calculate Spin Drift* setting is enabled.



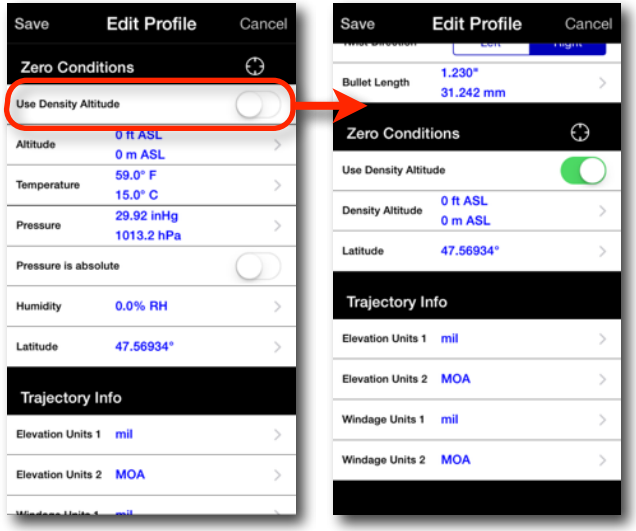
Bullet Length

The length of the bullet (not the whole cartridge). The bullet length is only used in the spin drift calculation and is only visible when the *Calculate Spin Drift* setting is enabled.



Use Density Altitude

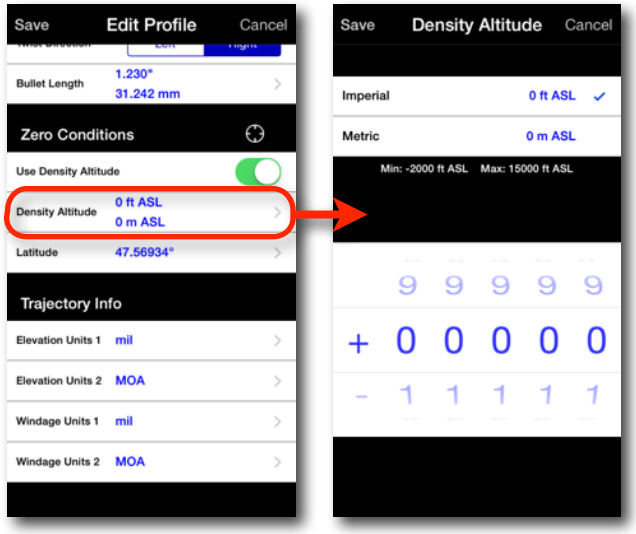
Controls whether you want to input atmospheric conditions in the form of Density Altitude or by Altitude, Temperature, Pressure and Humidity. When the Use Density Altitude switch is turned on, only the Density Altitude field is displayed for atmospheric conditions.



Density Altitude

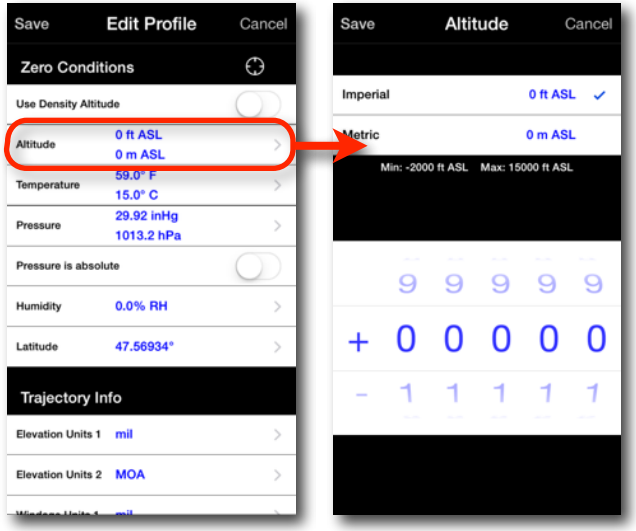
Density altitude is the altitude relative to the ISA (International Standard Atmosphere) standard atmosphere conditions at which the air density would be equal to the indicated air density at the place of observation. In other words, density altitude is air density given as a height above mean sea level. Using density altitude to represent your current atmospheric conditions removes the need to input altitude, temperature, pressure and humidity.

This is most commonly used in conjunction with a portable weather station like a Kestrel Weather Meter.



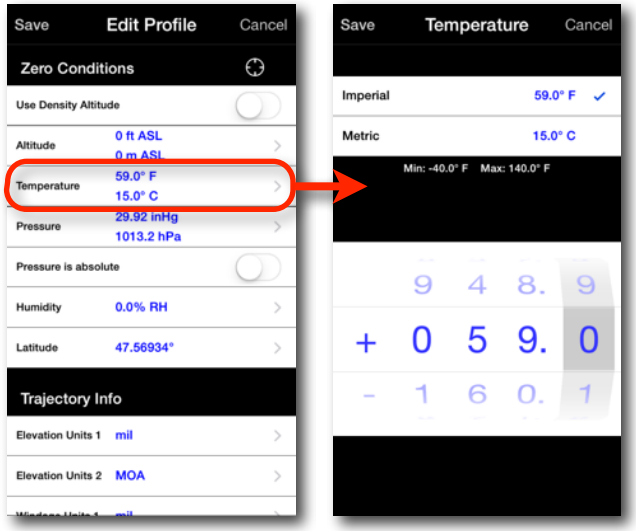
Altitude

The altitude, above sea level, of the location where you zeroed your rifle. To edit the altitude, tap the Altitude row.



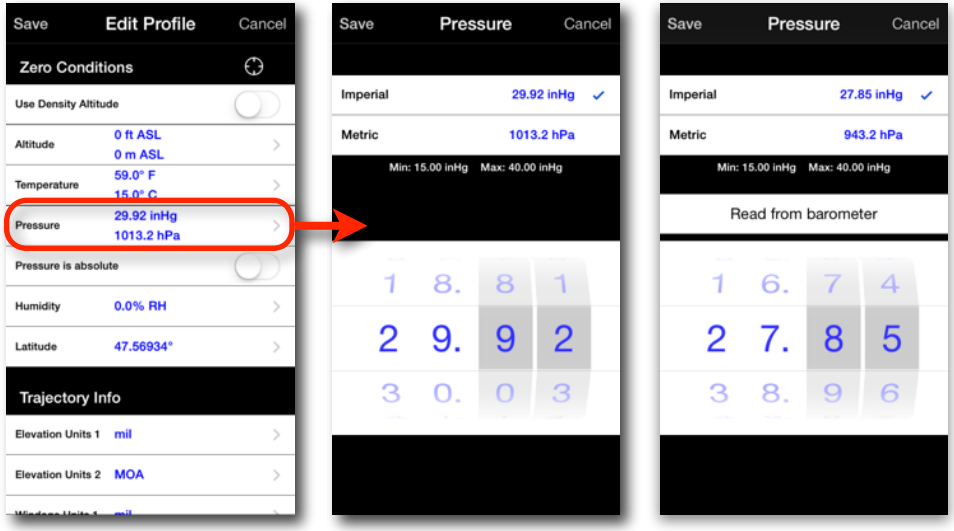
Temperature

The air temperature when your rifle was zeroed. To edit the temperature, tap the Temperature row.



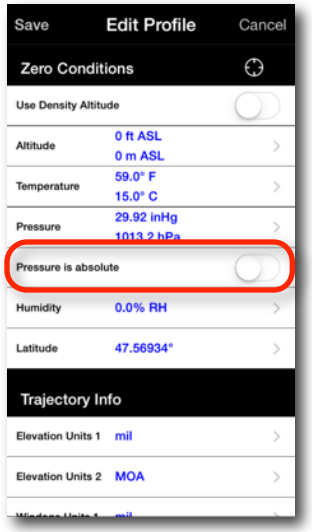
Pressure

The barometric pressure that existed when you zeroed your rifle. To edit the barometric pressure, tap the Pressure row. If you have an iPhone 6 / 6 Plus, you also have the option to use the built in pressure sensor to retrieve the station pressure by tapping the “Read from barometer” button.



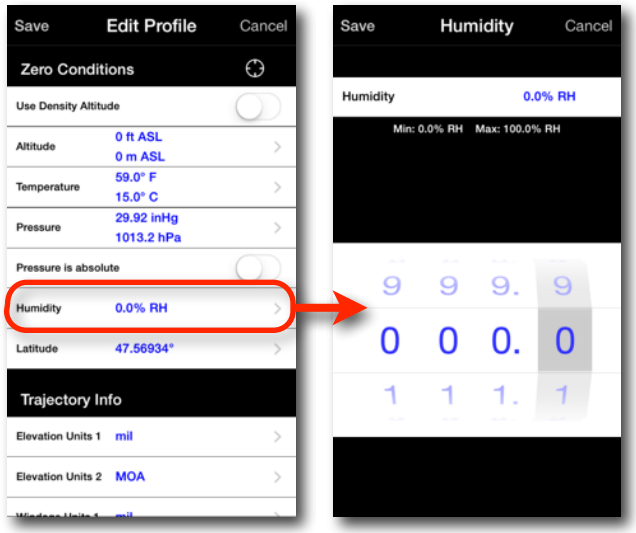
Pressure is Absolute

This switch is used to indicate whether the stated pressure is absolute (station pressure), or if it is adjusted for sea level pressure. Most pressure readings that you get from weather reports are sea level adjusted pressure readings.



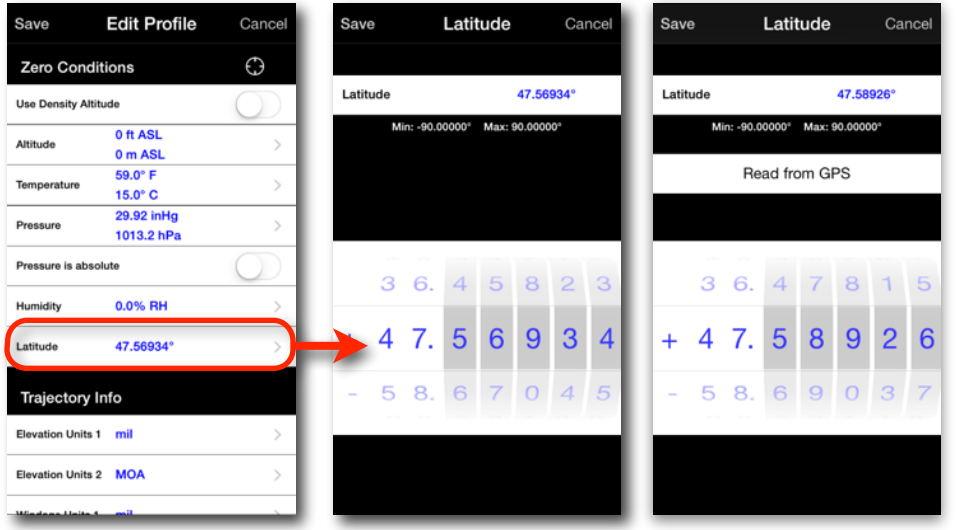
Humidity

The percentage of relative humidity that existed when you zeroed your rifle. To edit the humidity, tap the Humidity row.



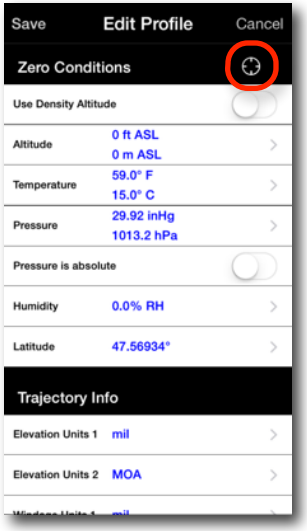
Latitude

The latitude of your shooting location. The Latitude setting is used in the Coriolis Effect calculation. Positive values represent latitudes in the northern hemisphere and negative values represent latitudes in the southern hemisphere. If your device has GPS and you allow the application to access location services, you also have the option to retrieve the latitude via GPS by tapping the *Read from GPS* button.



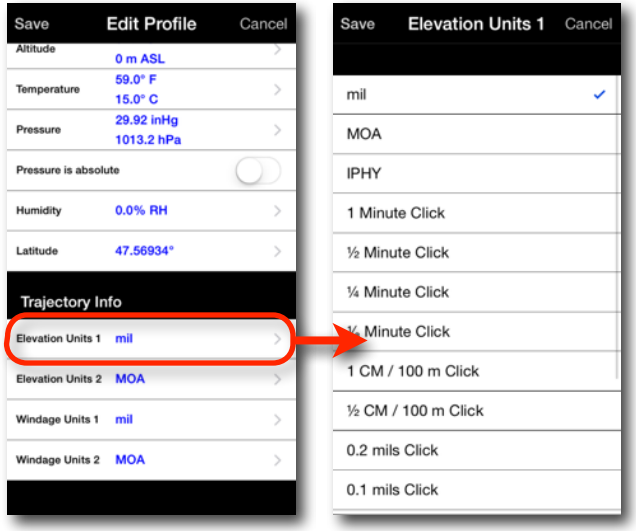
Using GPS to Acquire Zero Conditions Data

If your device has built in GPS and you have an Internet connection, you have the option of acquiring your zero conditions by your location. To acquire zero conditions by GPS tap the button next to the Zero Conditions header. The GPS will attempt to acquire a location for up to 30 seconds. The device will then contact the weather service for the weather information of the closest station. If the GPS cannot acquire a reasonably accurate altitude within 30 seconds you will be prompted if you want to use the reported GPS altitude (if available), the weather station altitude, or not update altitude. If on the rare occasion that the weather service doesn't return a value for one of the four values, the missing value will be highlighted in red to bring it to your attention.



Trajectory Info - Elevation Units & Windage Units

The settings in the Trajectory Info group are used to define the units of measure that are available for the Trajectory info on the reticle display. These settings are also used to determine what units the columns of the ballistics chart use. You can set two different units for Elevation and two different units for Windage.



Support

Please email any questions, issues or suggestions to support@rangetimesoftware.com.

The highest form of compliments I can receive for my hard work are reviews in the App Store, and the referral of my apps to your friends and family. Honest reviews and ratings in the App Store help build buyer confidence, and are often a major factor in a buyer's decision to purchase. If you are having problems with Mil-Dot Ballistics, please email me and give me a chance to make it right before you post a negative review or rating. If you find that I have not been helpful, then feel free to express your disappointment in the form of a negative review. If however you are pleased with my apps, please pass the word.

Thanks,
Tom Holsten
www.rangetimesoftware.com

Disclaimer

Weather services provided through GeoNames. Author is not responsible for the reliability of any acquired weather data or global positioning data. While every effort has been taken to gather accurate projectile information for the Bullet Library, the accuracy of that data is not guaranteed. Bullet data should be considered estimates until verified by the end user. Mil-Dot Ballistics is intended as a training aide only, and should be combined with experience in good marksmanship practices. Always follow all rules of firearms safety. All calculations should be considered estimates until validated by the shooter. Not recommended for use under duress or field combat situations. Author disclaims any liability from damage, injury, or death caused through the use of this software. Use entirely at your own risk.

Nightforce reticle designs used with the permission of Nightforce Optics, Inc. Vortex reticles used with the permission of Vortex Optics. SWFA reticles used with the permission of SWFA Inc. U.S.Optics reticles used with the permission of U.S. Optics Inc. GEN 2 MIL-DOT is a trademark of Premier Reticles. The GEN 2 MIL-DOT reticle is protected under US Patent No. 6,729,062. All rights reserved. Nightforce, NXS, MOAR, NP-R1, NP-R2, MIL-R, MLR, CH-2, NP-2DD, CTR-1, DDR, Velocity, NP-1RR, FC-2, FC-3G, NP-1, IHR, NP-RF1, MLR2.0, MD2.0, LV.5 ATACR, B.E.A.S.T. are registered trademarks of Nightforce Optics, Inc. Nosler, AccuBond, Partition, and E-Tip are registered trademarks of Nosler, Inc. Sierra is a registered trademark of Sierra Bullets. Hornady, GMX, DGX, DGS, FTX, SST, V-MAX, A-MAX, Evolution, Flex-Tip, Interlock, Interbond are registered trademarks of Hornady Manufacturing. Trophy Bonded, Trophy Bonded Bear Claw, Trophy Bonded Soft Point, TSX, XLC, X, and X-Bullet are registered trademarks of Barnes Bullets. Berger is a registered trademark of Berger Bullets. Winchester is a registered trademark of Olin Mathieson Chemical Corporation.

Mil-Dot Ballistics is not affiliated with, endorsed by, or sponsored by any manufacturer.