EVOLUTION

Race Start

1. Introduction

This short manual describes the "Race Start" functions included in EVOLUTION and offers some recommendations for performing a start using the system to calculate times and distances.

It is worthwhile to read the "Start Line" chapter in the "Racecourses, Marks and Waypoints" manual as a starting point. The start is part of the racecourse, and its setup is explained in this context.

The chapter "Start Functions" details the use of the system in a prestart scenario.

The chapter "The Start using EVOLUTION" describes the best practices and strategies for performing an optimal race start using the system's information.

How to Use This Manual

"Take your time to go through this manual step by step carefully."

It provides a comprehensive view of the system's capabilities and available functions for working with electronic nautical charts.

If you can't find the answer to your problem in this manual, email info@evolution-tactic.com.

We're happy to help!

Suggestions

We would love to hear any suggestions that could help make this manual and EVOLUTION even better!

If you encounter any errors in the system documentation, we would greatly appreciate it if you could email us at info@evolution-tactic.com. Your help in improving our system is appreciated.

2. Start Functions

The start is a decisive moment in every race and a real challenge, as the right decisions should be made in seconds.

The system will provide all the necessary information if you face a typical start against the wind, the occasional beam reach, or downwind starts.

Using sophisticated predictive calculations and a clear information display, EVOLUTION helps the tactician or navigator execute a perfect start.

The start functions offered by EVOLUTION are the most complete and are specially designed to assist the navigator and helmsman with precise and timely information.

The first section of this chapter, "The Start Page", describes how to operate all functions related to a race start and what information the system provides. It points out the purpose and usefulness of the different available data whenever convenient.

The second section, "Available Actions", describes all the operations the user can perform using the system during a start.

The third section, "Start Calibration", presents different related adjustments that EVOLUTION performs to refine time and distance calculations.

The Start Page

EVOLUTION includes a specific display for a start. It is selected by clicking on the tab.

Once the start line has been set up, for example, in a windward-leeward race, and the timer has been used to show time to the gun, EVOLUTION will show a start display as follows:
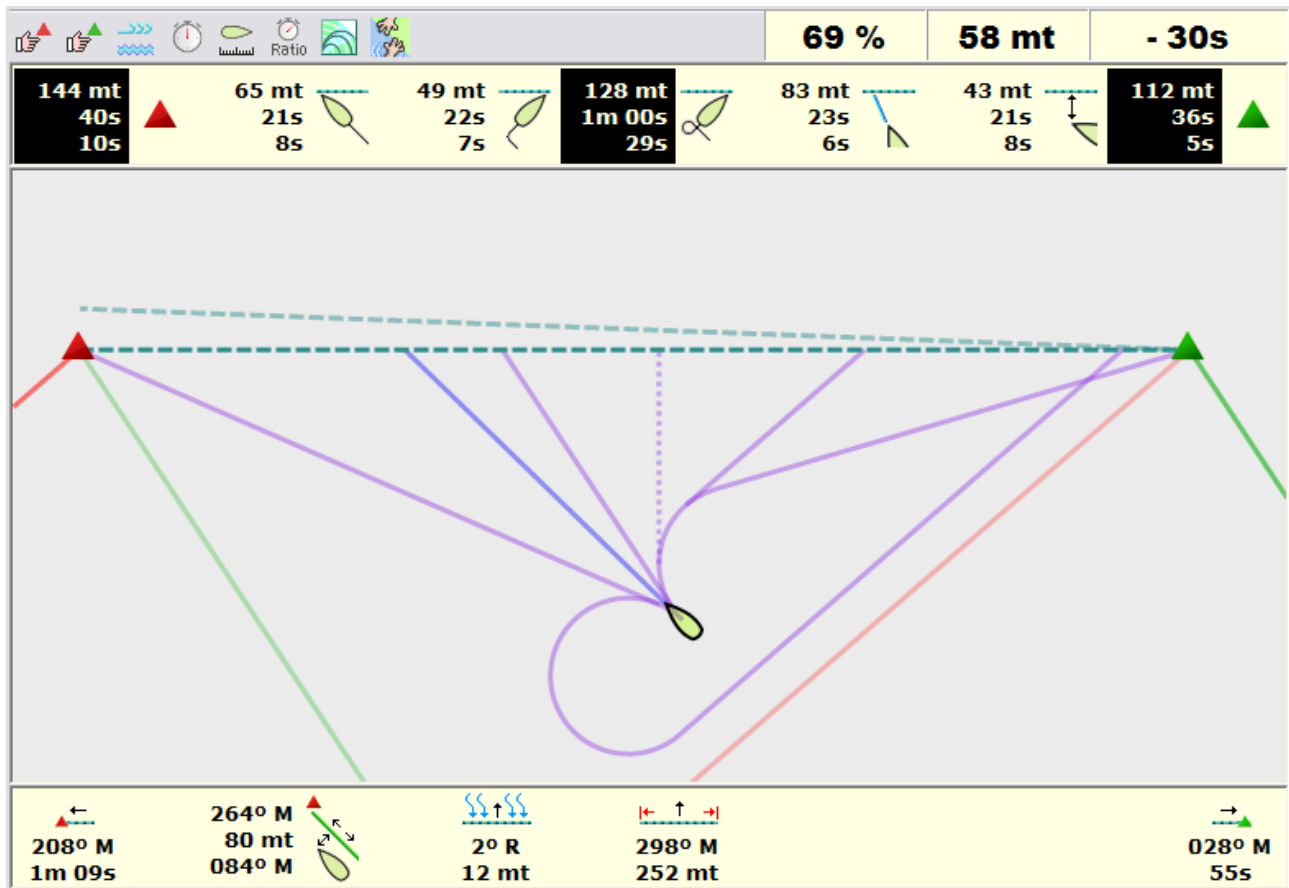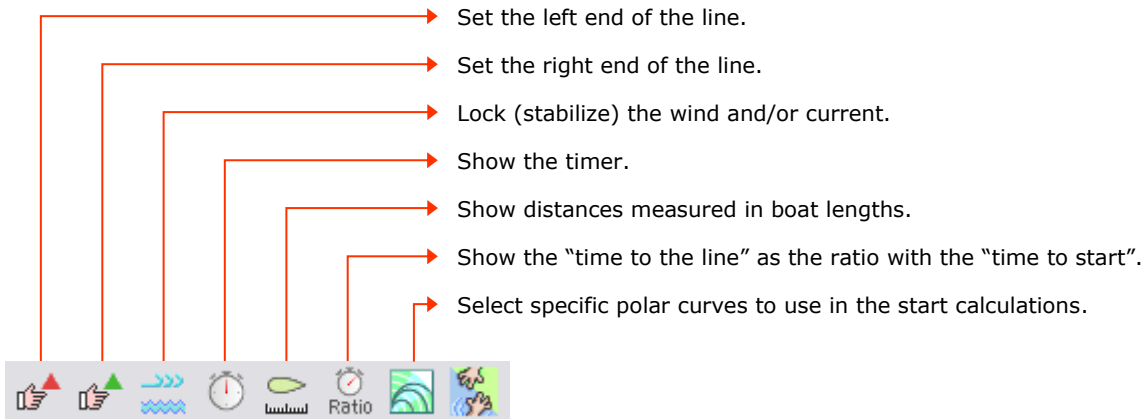

Despite the amount of information included, the operation of the start functions is simple and almost automatic. Below is a description of each area of the page and how to interpret it.

The chapter "The Start using EVOLUTION" then shows how to use each data item to execute an ideal start.

Buttons

The top left corner of the page contains several buttons to execute a simple series of actions. These actions are briefly detailed here and are described in depth later in "The Start Available Actions" section of this manual.

Set the left end of the line.

Set the right end of the line.

Lock (stabilize) the wind and/or current.

Show the timer.

Show distances measured in boat lengths.

Show the "time to the line" as the ratio with the "time to start".

Select specific polar curves to use in the start calculations.

Basic Data

On the upper right side of the display, EVOLUTION presents three primary data. However, as described later, they are not the most important when making decisions. They are:

69 % Polar speed of the boat at that moment. Remember that this is a function of the wind speed (TWS) and the boat's angle to the wind (TWA).

58 mt Distance from the bow to the line (or its lateral projection). If the bow is on the side of the racecourse, the text and background colors are reversed.

- 30s Time to start, like a countdown. If the start time has already occurred, the colors of the text and the background are reversed.

Points on the Start Line

The next area of the start display includes a series of icons with three numerical values. Each of these sets is associated with a specific point on the start line and represents:
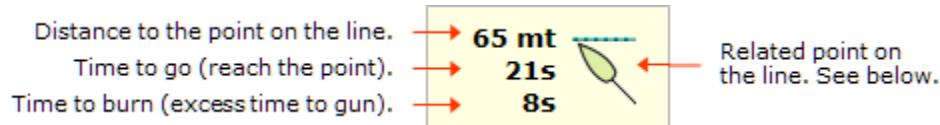
Points over the line presented in this area are (from left to right):

 Direct navigation to the left end of the line, executing the maneuver that represents the smallest turn (be it a simple alignment, a tack, or a jibe)

The following three points correspond to the places of the line to be crossed if sailing optimally upwind. EVOLUTION will show a different icon depending on the sailing tack.

 The point on the line would be reached in optimal upwind sailing without executing a tack or a jibe and continuing in that mode until crossing the start line.

 The point on the line would be reached by tacking immediately, then adjusting the boat to optimal upwind sailing and continuing in that mode until crossing the line.

 The point on the line would be reached by jibing immediately, then taking the boat to an optimal upwind sailing, and continuing in that mode until crossing the line.

The following points are not subject to the concept of optimal upwind sailing (Optimal VMG).

 The point on the line intersected by the boat's current heading is an excellent tool in fleet starts. However, using this information requires special coordination between the helmsman and the navigator.

 The point on the line closest to the bow. This information is generally used when starting with beam or stern winds. If beating is required, EVOLUTION will compute the times of the two tacks necessary to reach this point.

 Direct navigation to the right end of the line, executing the maneuver representing the smallest turn (be it a simple alignment, a tack, or a jibe).

If, due to the position of the boat and the direction of the wind, it is impossible or inappropriate to execute the start at any of these points, EVOLUTION will not show the corresponding information.

The Start Line Graphic Display

The next area of the Start Display is a graphic representation of the start line. Using the boat's position and this line, it is possible to identify the seven points on the start line for which the system indicates distance, time to arrive, and time to burn.

EVOLUTION shows the expected course to arrive at each point if the maneuver begins immediately (lavender lines).
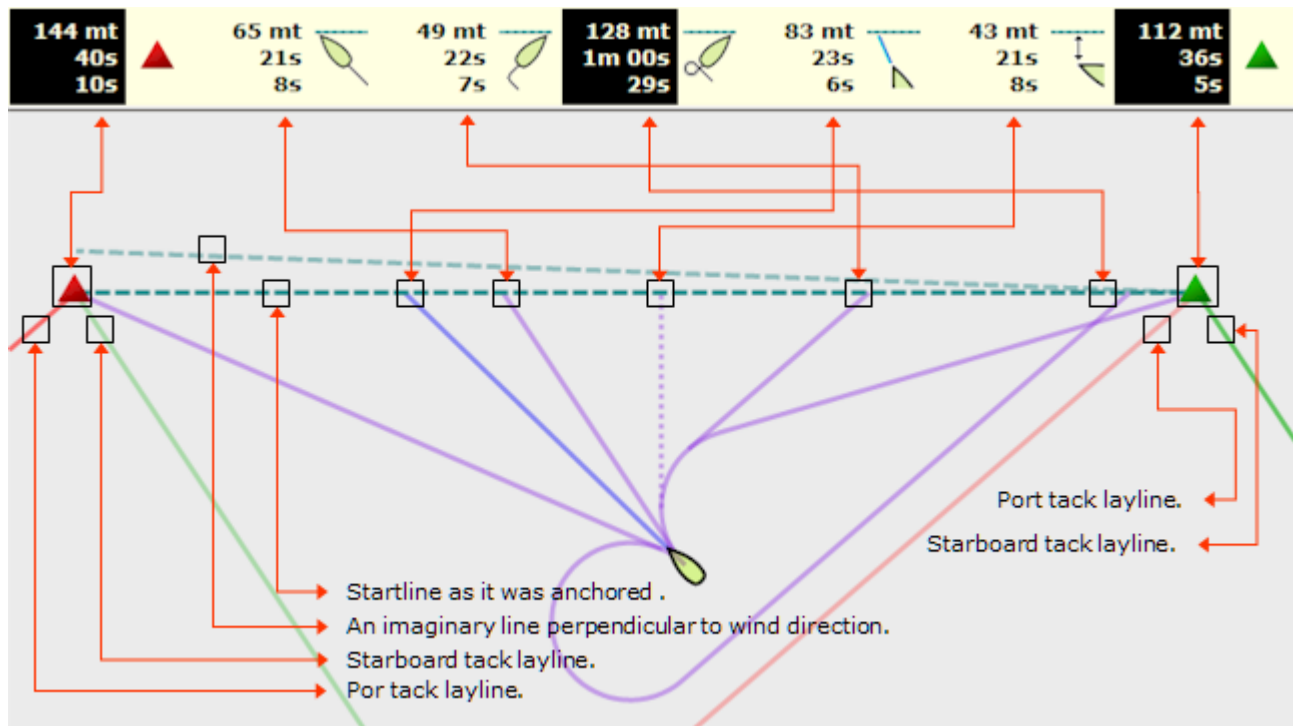
Also visible is an imaginary broken line (dim green) perpendicular to the wind direction and the starboard tack laylines (green) and port tack laylines (red) for both ends of the line. The boat is presented in actual size to the length of the line.

Unlike the Chart Page, the start scenario's representation (centering, scale, orientation, etc.) is resolved automatically. In other words, the user cannot modify how the system presents this graphic.

EVOLUTION follows the next set of simple rules to show this information:

The start line always appears horizontally oriented.

Once the position of the left and right ends of the line is entered, the direction of the start is defined. It will always be displayed from the bottom of the graphic to the top.

The boat and the line are always visible, and the boat is less than one mile from either end.

The scale is continuously selected always to show all the relevant information.
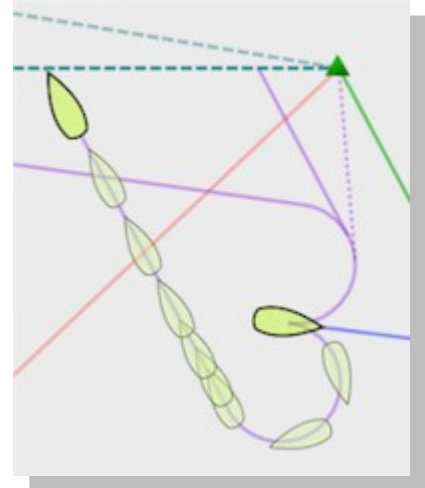
If the start point in optimal upwind sailing (Optimal VMG), or the point to which the bow is heading or the closest (perpendicular) point, are not contained between the ends of the line, the system does not show them. Also, it does not show the corresponding numerical data.

Times

To accurately predict how long it will take to reach the different points on the start line, EVOLUTION considers the current (initial) boat speed and the time and turning radius necessary to complete the alignment maneuver to the selected start point.

The system also calculates the speed loss or gain when executing this maneuver.

The time to burn is just the difference between the remaining time to start and the time needed to reach the selected point on the line. Spare time means time to burn to avoid an early start. Insufficient time represents time late if starting by that point on the line.

The following example shows that if an optimal upwind sailing mode is established immediately, the boat will be 2.5 L (boat lengths) away from the line, and it will take 8 seconds to cross the line, starting 31 seconds early.

If the remaining time to the start gun is insufficient to reach a specific point on the line, the system shows the information corresponding to that point with reversed background and letter colors, as shown in this figure.

In this example, the system indicates that jibing and sailing upwind on port tack, the boat will be at 6.5 L (boat lengths) from the line once the maneuver is completed. Crossing the line will take 42 seconds, starting 2 seconds after the gun.

Distances

Distances are measured from the boat´s bow for all start functions. The "Start Special Calibrations" section includes more related information.

Distances are calculated between the bow and the point on the start line only after the alignment turn maneuver to this point has been completed. In other words, the trajectory of the turn is NOT part of the distance displayed by the system, although it is computed in time calculations.

For example, in the figure on the right, the 6.5 L (boat lengths) distance to the right end of the line is taken from point A.
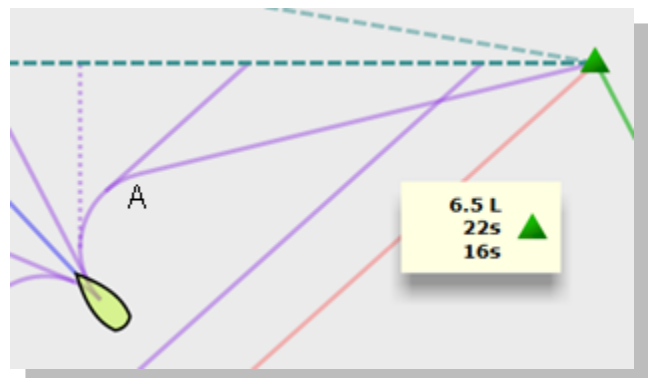
The Start Line and the Laylines

In the bottom section of the start display, EVOLUTION shows specific information related to the start line and the boat's position relative to the laylines. Data is also associated with icons for easy identification.

Indicates the course to sail between both ends of the line. In other words, the paths parallel to the line in one direction and the other. Also, the time it will take the boat to sail from one end to the other.

Above, the wind direction for which the line is anchored. This is an essential data item when starting against the wind. Below is the length of the line from end to end.

Above, the difference between the wind direction for which the line is anchored and the actual wind direction (TWD) is given in degrees and followed by the favored side, R (right) or L (left). Below is the gain of starting on the favored side.
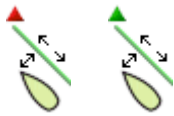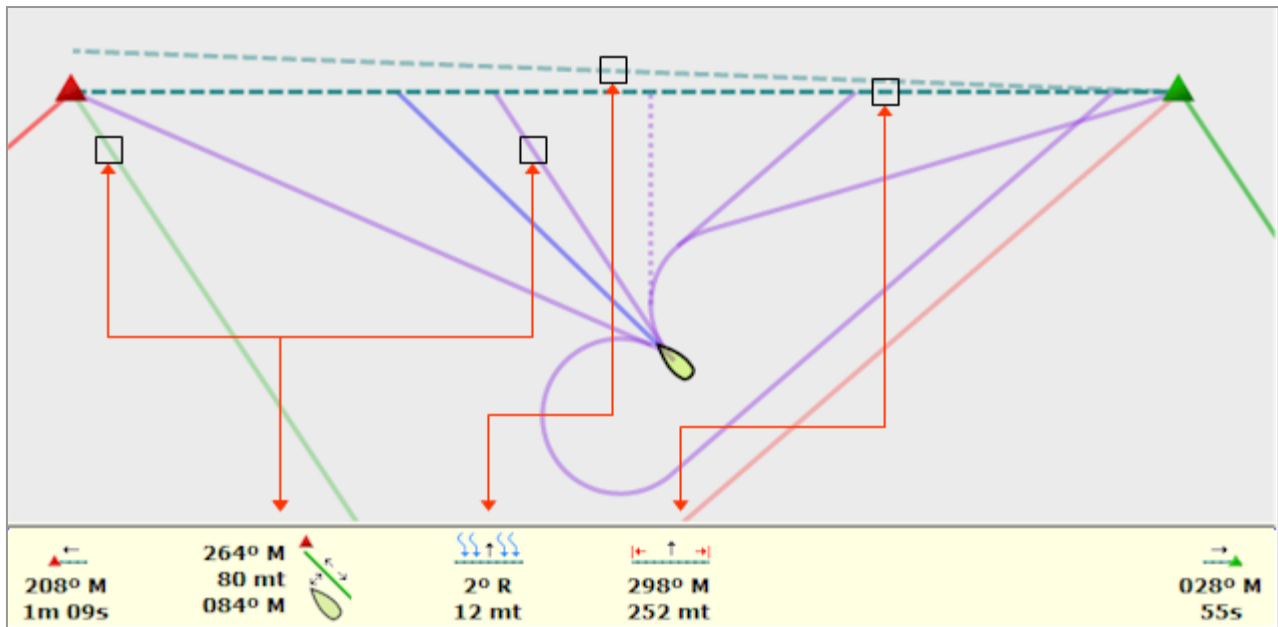
The data associated with these icons give an idea of the distance from the boat to the laylines sailing in starboard tacks at both ends of the line. If the boat is on the "external" side of the line, the information is presented in text and reversed background colors. Above and below, EVOLUTION also shows the directions to sail up and down these laylines.

In this example, the distance from the boat to the left end layline is 80 meters on the inner side. In upwind sailing to optimal VMG, the course up and down the layline is 264° M and 84°, respectively.
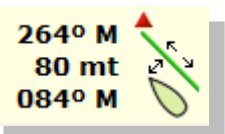
Knowing the distance to the laylines is essential to execute a precise start. The "The Start using EVOLUTION" section includes more about this topic. For now, it is only necessary to make the following remarks:

The system will NOT display this information if the boat does not overlap the layline perpendicularly. See the example above, where the boat does not overlap the right-end layline.

To calculate the distance to the layline, the system considers the necessary turn to align the boat parallel to it.

EVOLUTION will show the distance between the boat and the layline once the alignment maneuver has been completed, either by luffing or tacking.

As shown in the figure on the right (in red), if the alignment maneuver is executed immediately, the boat will be 82 meters away from the layline.

Another essential data point when making the final approach to the start line is the boat's position relative to the "laylines," or optimal upwind sailing lines.

Due to the right-of-way rules in force during the start, being poorly positioned with respect to the layline can put the boat at a risky tactical disadvantage.
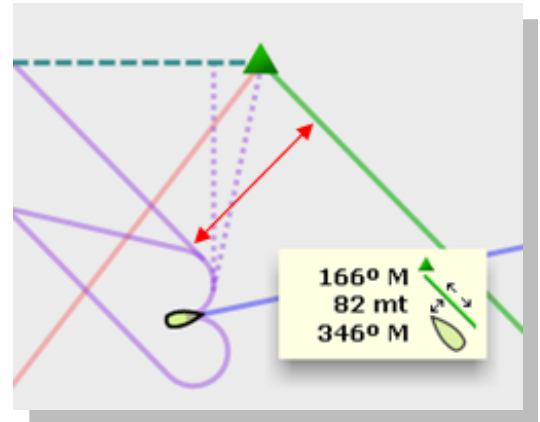
Available Action

This section presents a series of operations or actions that are available at the start. The buttons on the upper left side of the "Start" display allow access to all of them.

Setting the Ends of the Start Line

EVOLUTION considers the ends of the start line two special marks of the currently active racecourse. The manual "Courses, Marks and Waypoints" details this subject in depth. Here, it is only necessary to remember that the following buttons activate the form to set each end of the line.

At this point, a careful reading of the section "The Start Line" of the said manual is recommended.

The startline will only be shown on the "Start" page if both ends are set and the distance between them is less than 1000 meters.

The Race Timer

The race timer is an internal data set for EVOLUTION. Its purpose is not only to define the exact start time; it can also be used to record the finish time.

This button activates a specific form to control the race timer. It will remain visible on any page until it is closed.

Please note that this form is not the timer itself. The system preserves and uses the start time even though the form, or EVOLUTION, is voluntarily or accidentally closed.

The first important feature of the form is its proof cap that prevents unwanted clicks on the buttons. To lift the lid, click on the open padlock icon.
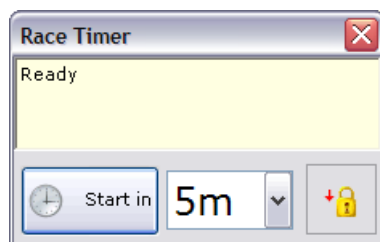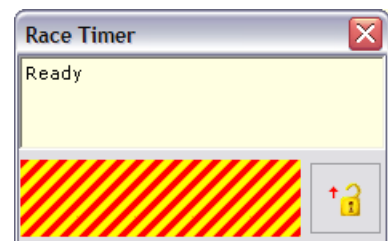
The lid will remain open until an action is executed or the icon on the right (now with a closed padlock) is used again.

Keeping the cap closed until adjusting the timer and closing the form once the start time is correctly set will prevent triggering timer functions accidentally.

As the figures show, all the buttons are large to facilitate the operation of the timer in adverse situations.

Starting the Timer

Initially, the timer has a "Ready" status, showing the button that activates the countdown. Next, a selection list shows "5m," indicating a 5-minute countdown before the gun.

A value can be chosen from this selection list according to the time matching the next race committee signal.
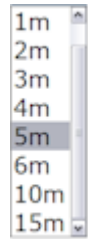
To activate the timer:

Select from the list the number of minutes to the gun of the following signal from the committee.

Then, the "Start in" button starts the countdown when receiving the signal.

The system then establishes the exact start time and closes the safety lid.

If you are confident that the time was set correctly, close the form. Otherwise, if you started the timer late or in advance, use the action described below to synchronize the timer more accurately.

Synchronizing the Timer

Re-synchronizing the timer allows adjusting the time to start if it was not done correctly in a previous step.
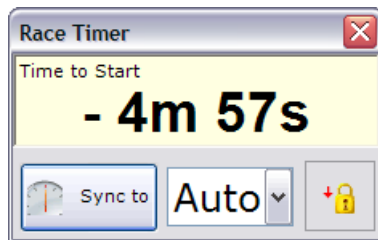
Once the timer has been started, the form will have the following configuration: The status caption changes to "Time to Start", and the countdown is displayed in minutes and seconds.

On the other hand, now the button text is "Sync to", and the selection list shows the additional option "Auto".

This action can be used in two different ways depending on whether the error in taking the time (delay or advance) was of a few seconds (less than 30), or if otherwise, the difference is substantial

Case 1: If you are sure that the error is of a few seconds (less than 30):

Select the AUTO option from the list.

Use the "Sync to" button to synchronize the timer when receiving the signal from the committee (TOP).

The system will adjust the countdown to the nearest minute (zero seconds). If the start time was taken in advance, this action would delay it. If, on the contrary, time was taken initially with delay, it will advance it.

For example, if the 5-minute TOP was taken 8 seconds in advance, the TOP of the 4 minutes would occur with the timer showing -3m 52s. Doing Sync to Auto at that moment will return the timer to -4m 00s. On the contrary, if the original TOP was marked with a 16-second delay, the TOP of the 4 minutes will find the timer showing -4m 16s; selecting Sync to Auto just then will advance it to -4m 00s.

Case 2: If the error is more than or equal to 30 seconds when taking the original TOP, DO NOT use the option "Auto" since it will need a more significant correction than the one this option offers. In this case, use the list to select the correct time to synchronize the timer.
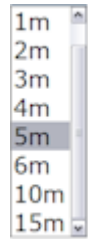
Select the number of minutes corresponding to the following race committee signal from the list of times.

Use the "Sync to" button to synchronize the timer when receiving the signal.

The timer will adjust the remaining minutes and continue with the countdown.

Doing "Sync to" in number-of-minutes mode is equivalent to a "Start in" action. It can be used instead of a timer reset if the countdown has not reached 0s.

When synchronizing in Auto mode or with a specific time, the safety lid closes, and the countdown continues. At this point, if no further action is required, you can close the form.

Set the Finish Time

Once the countdown has reached zero and the race has started, the timer automatically begins measuring the race time.
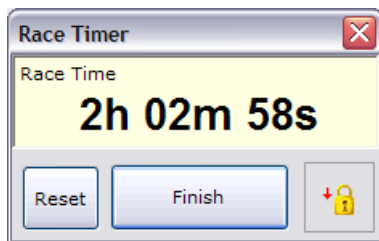
The timer control form is reconfigured to show the race duration in this situation. It now shows the status caption "Race Time" and the time in seconds, minutes, or hours.

It also provides two buttons: one to set the finish time and the other to reset the timer to its initial state; the latter action will be detailed in the next point.

To indicate the finish time:

Use the "Finish" button at the committee signal.

The race time count stops, the safety lid closes, and the system shows the status caption "Race Duration" along with the time consumed in the race.

Reset the Timer

Whether in a new start due to a race committee general call or simply preparing for a new race start, it will be necessary to reset the timer to its initial state.

To reset the timer:

Use the "Reset" button.

The status caption of the timer changes to "Ready", the safety lid closes, and the control form shows this status, as described at the beginning of this section.

Fix (Hold) the Start Wind and Current

In EVOLUTION, wind and current are vital for calculating times, laylines, and distances.

During the rapid maneuvers before the start, and depending on the instrument's characteristics, calibration, and configuration, the wind and current speed or direction may not be consistently calculated.

On the other hand, sudden and short wind shifts can influence the stability of the start functions calculations.

To counteract these effects, EVOLUTION calculates the wind direction (TWD) and speed (TWS) as the average of the last 20 seconds. Generally, this is sufficient to suppress unwanted variations in this data.

However, in some cases, it may be helpful for the starting functions to operate with a consistent wind, such as the average wind of the last 5 or 10 minutes.

This button activates a specific form where you can enter fixed values for wind and current.

The boxes indicated as "Hold" allow, when marked, to hold the value of wind direction, wind speed, and course (Set) and speed (Drift) of the current. On the left, the form shows the present values. On the right, it is possible to enter the desired values.

For any of these three possibilities, the procedure is as follows:

Enter the corresponding value or use the buttons (arrows) to change it at your convenience.

To release data that has been fixed, uncheck the corresponding "Hold" box.

When giving predetermined values to the wind and current at the start, it is essential to consider the following conventions and rules that the system applies:

The fixed values only apply to the start functions and do not affect the rest of the system´s functions.

The wind direction is where it comes from. The current direction is where it is going.

When closing the form, the entered values remain valid.

When closing EVOLUTION and opening it again, these settings are discarded.

Show Distances in Boat Lengths or Meters

In several start functions, EVOLUTION shows distances. For some crews, the natural measure unit is the boat-lengths, while others prefer meters.

 Using this button, you can change the units in which the system presents all distances on the "Start" display.

When the distances are shown in meters, figures are followed by "mt"; the letter "L" is used for boat-lengths. The following images show the length of the start line in both modalities.
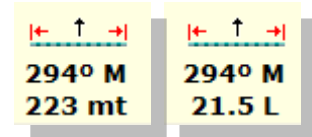
Figures in meters are presented without decimals. Figures in lengths are shown with a .0 or .5 decimal; in other words, distance resolution in lengths is half the boat's length.

 The "Boat Length" value in the "Yacht Setup" form must be correctly entered to display distances in boat lengths accurately. This form is accessed using the main menu option. Evolution→ Yacht→Setup Active.
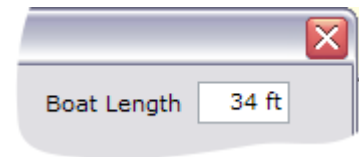
Showing Times to the Line as Ratio of the Time to Start

For the typical start points on the start line, EVOLUTION shows distance, time to line, or "Time to Go (TTG)," and "Time to Burn (TTB)."

For crews with well-practiced and methodical start strategies, it is helpful to know the "Time to Go" based on the "Time to Start (TTS)," specifically the TTS/TTG quotient, commonly called the "Ratio."

As each start point on the line considered by the system has its TTG, there will be a "Ratio" for each.

 Using this button, the time to reach the different points on the line (TTG) is presented in a different mode, switching between "Time" and "Ratio."

When times appear as TTG, they take the format of minutes and seconds, as shown in the figure on the right. When they appear as "Ratio", they are presented as numbers with a decimal preceded by the letter "r", as shown in the figure on the left.
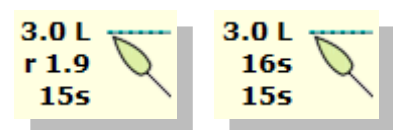
The example in the previous paragraph shows data corresponding to an upwind sailing start with 31 seconds to the gun. The "Ratio" in this case will be 31s/16s = 1.9

On the other hand, with "Ratio" selected and without the Timer being activated to show the countdown to start, the system will show "rNA" (Ratio Not Available).

Using Specific Start Polar Curves

Although the Performance Polar, used by all other EVOLUTION functions, is suitable for most start situations, specific polar curves for the starts may be helpful in certain circumstances.

A couple of examples where this refinement makes sense are:

In starts against an aggressive fleet, it is possible to use polar curves with slightly more closed laylines to avoid remaining in a disadvantaged position.

While starting in beam or broad reach or running, the spinnaker will be raised on the line to maintain maneuverability until the last moment. Here, it is necessary to use polar curves that do not consider the spinnaker available as a pre-start sail. Using the performance polar curves, you would obtain times to reach the line with these hoisted and working sails.

To select a specific polar curve for the starts (which should be already present in the yacht's folder):

Use this button to open a polar curves file selection form.

At this point, the system may display a warning message that the Performance Polar is in use and ask if you want to select another polar.

Select the polar curves from the system's list and, using the "Open" button, load (activate) this file.

These polar curves will remain active until a new file is selected, even when the system is closed.

Using specific Start Polar Curves will not affect the functions that rely on the Performance Curves for all the other system's functions.

Start Calibrations

This section describes different settings that EVOLUTION contemplates to obtain accurate data to be used as a basis for start calculations.

Knowing more about this topic allows you to understand better how the system calculates times, distances, turning radius, etc., and to have a clear idea of the limitations an instrument's system imposes on these calculations.

EVOLUTION works with specific principles that are detailed below. These are:

The Position of the Bow

When determining the position of the start line ends or calculating any distance, you should consider the most forward point of the boat, including the outrigger, if there is one.

This implies that the system must always define the bow's geographical position as accurately as possible.

At each moment, EVOLUTION obtains the position (latitude and longitude) of the bow based on the course and the position of the GPS antenna to the bow. In other words, it adjusts the position of the GPS by applying its displacement from the bow and the course of the boat at that moment. Therefore, it is essential that:

The GPS is as accurate as possible, with a position error that does not exceed one meter.

The GPS sends the position with an appropriate frequency, at least once per second and preferably five times per second.

The compass responds quickly to course changes and delivers data with a frequency similar to the GPS, between once and five times per second. The compass damping must be the smallest possible, zero being the most suitable figure for most of these sensors.

The calibration of the position of the GPS antenna has been correctly entered, indicating its displacement to the bow and the boat's centerline. To access this calibration, use the menu option Evolution→Yacht→Setup Active and select the Yacht Data tab. From the list in this form, select "Fix" and then click on the "Settings & Calibrations" button.
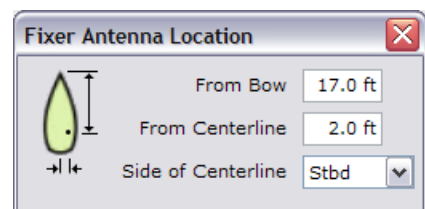
When equipping a boat that will use the start functions included in EVOLUTION, the combination of a GPS with high precision and update frequency and a compass with quick response and stability must be carefully considered.

At the same time, it is recommended that both sensors be directly connected to the computer to ensure that the instrument system does not delay the availability of these data for start function calculations.

The Radius and Rates of Turns

In almost all calculations of the start functions, EVOLUTION includes the turns that must be made to align the proper course for the associated action. The turn speed, measured in degrees of course per second, will depend on the boat's speed.

Generally, at low speeds, the boat turns slowly; at higher speeds, the heading change is more pronounced. EVOLUTION has generic values preset. However, these can be adjusted because each yacht may differ from the standard values.

With the turn rate and boat speed, EVOLUTION automatically calculates the turning radius. The system determines distances and times based on the expected path of each maneuver.

Although the pre-established values are suitable for most cases, changing them to others that better represent the boat's behavior in the pre-start maneuvers is possible. The recommended procedure is:

From recordings of several starts, determine the typical turn speed at different boat speeds.

These values can be entered in the left column of the form "Start Turns and Acceleration".

To access this form, use the menu option **Evolution→Yacht→Setup Active**, select the [Yacht Data] tab, and then the data item "Start Data". Finally, press the "Edit Settings & Calibrations" button.

Obtaining new values representative of turn rates for the entire range of boat speeds is essential before modifying the predefined values.

Start Turns and Acceleration

	Rate of turn at different boat speed (º/sec).		Time to speed-up to target speed at different TWA.	
SOW	ROT		TWA	TTS
2 kt	4º		0º	20
4 kt	6º		40º	40
6 kt	10º		80º	35
8 kt	15º		120º	30
10 kt	20º		160º	30
12 kt	20º		180º	35

Restore Defaults

To obtain the best possible information, it is advisable to schedule start practices with the crew and the boat configuration used while racing.

Time to Accelerate to Target

To calculate the time to the different marks of the line, EVOLUTION considers both the boat speed and the time it takes to reach the polar target speed.

The system assumes that after the alignment turn, the boat will accelerate (or decelerate) until reaching 100% of the target, following a pattern that depends on the wind angle (TWA) but not the wind speed.

The table in the previous figure shows the time it takes for the boat to navigate from "almost static" to target speed. Following the same steps as for the rate of turn (ROT), the time to target speed (TTS) can be analyzed and adjusted according to each boat's characteristics.

⚠️ The rates of turn and times to target predefined by EVOLUTION are perfect for most boats. Do not change them unless you are very sure what you are doing.