



EVOLUTION

Race Start

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1. Introduction

This short manual describes the “Race Start” functions included in EVOLUTION. At the same time, it offers some recommendations to perform a start with the aid of the system to calculate times and distances.

As a starting point, it is worthwhile to read the chapter “Start Line”, included in the “Racecourses, Marks and Waypoints” manual. As the start is a part of the racecourse, its setup is explained in this context.

The chapter “[Start Functions](#)” details the use of the system in a prestart scenario.

Then the chapter “The Start using EVOLUTION” describes the best practices and strategies to perform an optimal race start using the information provided by the system.

How to use this manual

A careful and ordered reading of this manual will provide a complete and clear picture of the possibilities offered by the system, its capacity, and the functions available to perform a perfect start. It will also allow you to familiarize yourself with all sections and easily find explanations for the different topics.

If a specific answer to a problem is not found in this manual, contact EVOLUTION TACTIC SYSTEMS directly by email at info@evolution-tactic.com

Suggestions

All suggestions and contributions to help improve this manual and the system EVOLUTION will be welcome.

Any error or omission in the system’s documentation could be informed directly to info@evolution-tactic.com

2. Start Functions

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

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

Using sophisticated predictive calculations and a clear display of information, EVOLUTION is of great help for the tactician or navigator to 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 Display](#)”, describes how to operate all functions related to a race start and which information the system gives. Whenever convenient, it points out the purpose and usefulness of the different available data.

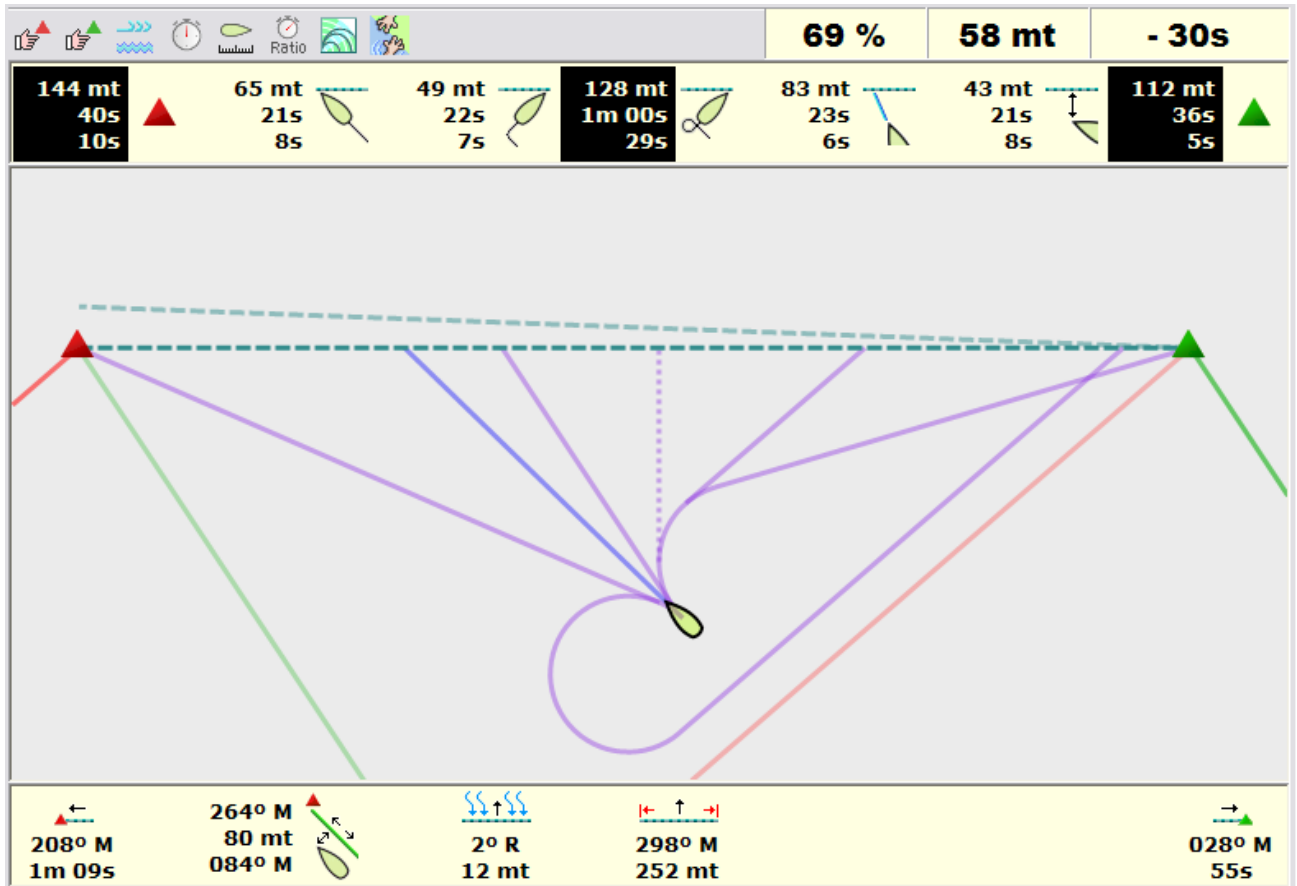
The second section, “[Available Actions](#)”, describes all the operations the user can perform using the system during a start.

The third section, “[Start Calibration](#)”, presents different related adjustments that EVOLUTION performs to refine time and distance calculations.

The Start Display

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:

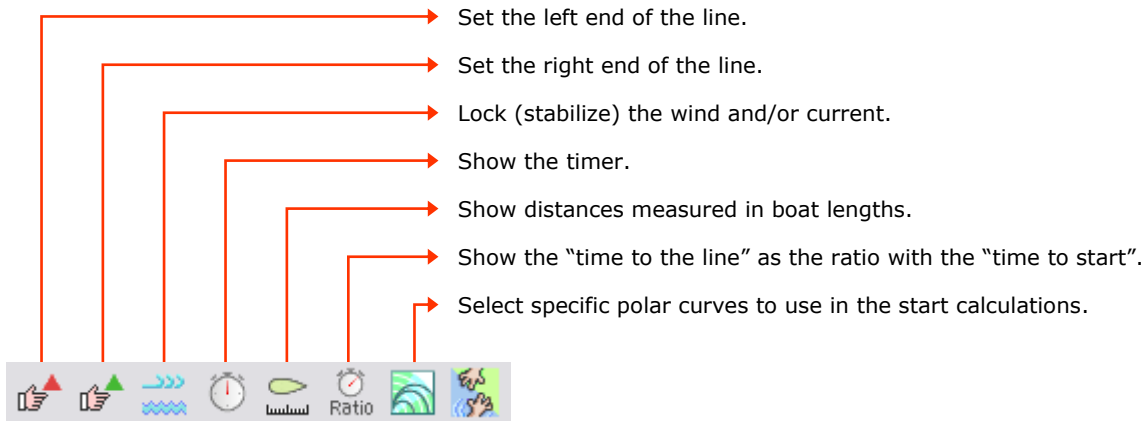


Despite the amount of information included, the operation of the start functions is simple and almost automatic. Below is a description of each area of the page and how to interpret it.

Then, the chapter “The Start using EVOLUTION” shows how to use each data 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.



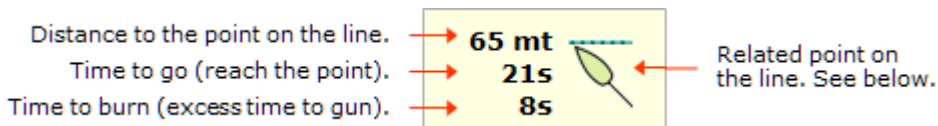
Basic Data

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 both 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 colors of the text and the background 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 places of the line to be crossed if sailing in optimal 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 neither a tack nor a jibe, and continuing in that mode until crossing the start line.

-   The point on the line would be reached by tacking immediately, then taking the boat to an 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. This is an excellent tool in fleet starts, but 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 in starts with beam or stern winds. If beating is required, EVOLUTION will compute the times of the two tacks necessary to reach this point.



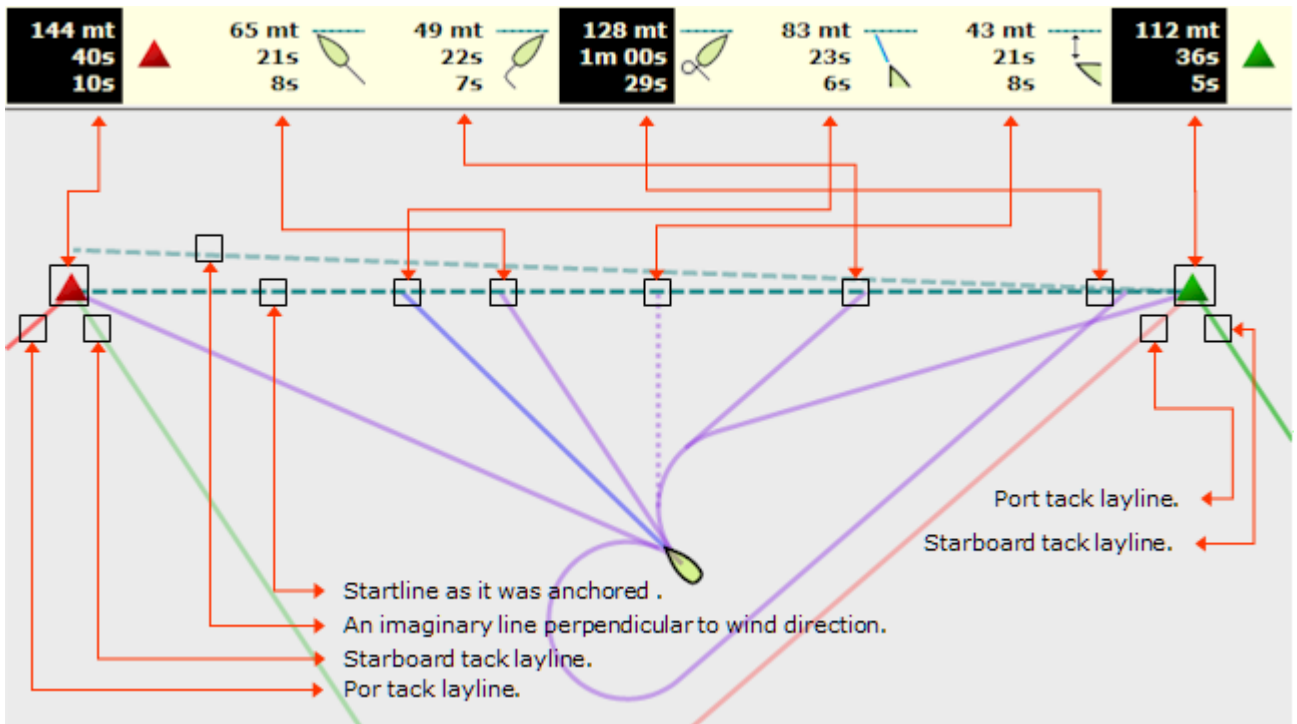
Direct navigation to the right end of the line, executing the maneuver representing the smallest turn (be it a simple alignment, a tack, or a jibe).

If by the position of the boat and the direction of the wind, it is impossible or inappropriate to execute the start by 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. On this line and having the boat's position, 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 are 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 what happens with the Chart Display, 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:

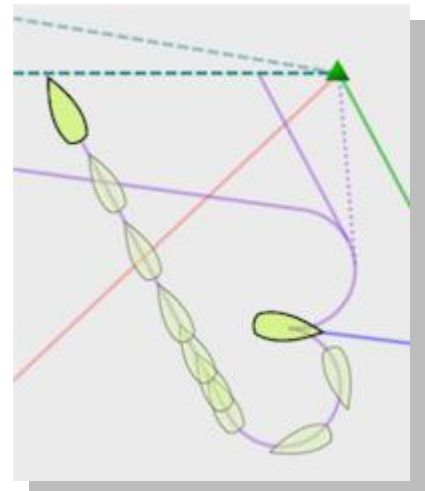
- The start line always appears horizontally oriented.
- Once the position of the left and right ends of the line is entered, the direction of the start is defined. It will always be displayed from the bottom of the graphic to the top.
- The boat and the line are always visible while the boat is less than one mile from either end.
- The scale is continuously selected always to show all the relevant information.
- If a 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 much time it will take to reach the different points on the start line, EVOLUTION considers the current (initial) boat speed together with 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.



2.5 L
8s
31s

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.

In case the remaining time to the start gun is not enough 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. The time to cross the line will be 42 seconds, starting 2 seconds after the gun.

6.5 L
42s
2s

Distances

For all start functions, distances are measured from the boat's bow. More related information is included in the "Start Special Calibrations" section.


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

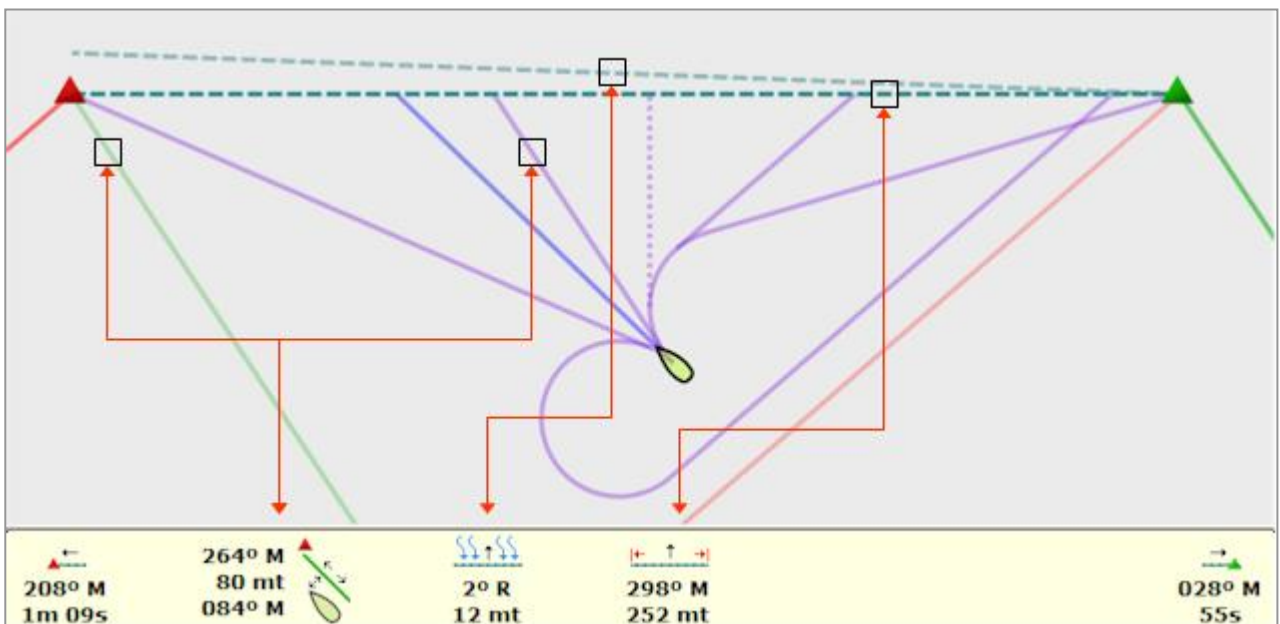
In the bottom section of the start display, EVOLUTION shows specific information related to the start line and the boat position relative to the laylines. Here too, data is associated with icons for easy identification.

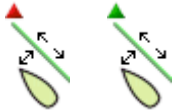
- 

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 essential data when starting against the wind. Below, is the length of the line from end to end.
- 

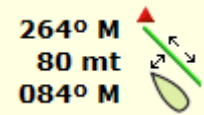
Above, the difference between the wind direction for which the line is anchored and the actual wind direction (TWD) is given in degrees and followed by the favored side, R (right) or L (left). Below, is the gain of starting on the favored side.





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 background reversed colors. Above and below, EVOLUTION also shows the directions to sail up and down these laylines, respectively.

In this example, the distance from the boat to the left end layline is 80 meters on the inner side. The course to go up and down the layline, in upwind sailing to optimal VMG is 264° M and 84° , respectively.



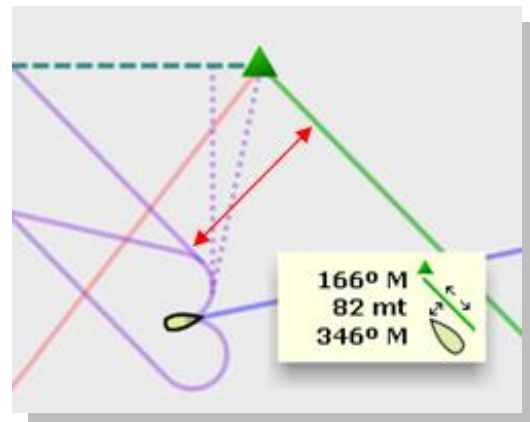
Knowing the distance to the laylines is essential to execute a start with precision. More about this topic is included in the "The Start using EVOLUTION" section. For now, it is only necessary to make the following remarks:

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), the boat will be 82 meters away from the layline if the alignment maneuver is executed immediately.



Another essential data when making the final approach to the start line is the boat's position 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 leave the boat at a risky tactical disadvantage.

Available Action

This section presents a series of operations or actions available during the start. All of them can be accessed by the buttons on the upper left side of the “**Start**” display.

Setting the Ends of the Start Line

The ends of the start line are considered by EVOLUTION as 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

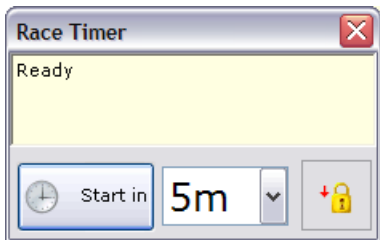
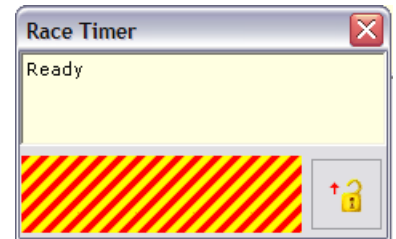
The race timer is an internal data of EVOLUTION. Its purpose is not only to define the exact start time; it can also be used to record the exact finish time.



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, simply 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 the moment of adjusting the timer and closing the form once the start time is correctly set will prevent from accidentally triggering the timer functions.

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

Race Start

Starting the Timer

Initially, the timer has a “Ready” status, showing the button that activates the countdown. Next to it, a selection list shows “5m”, indicating a 5 minutes countdown before the gun.



From this selection list, it is possible to choose a value according to the time matching the next race committee signal.

To activate the timer:

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

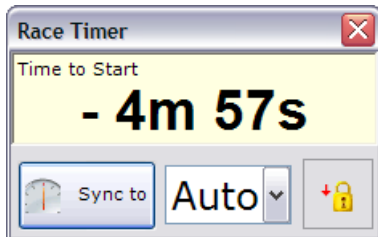
Then use the “**Start in**” button to start the countdown when receiving the signal.

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

If you are confident that the time was set correctly, simply 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 has 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 minutes 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, the timer will return to -4m 00s. On the contrary, if the original TOP was marked with a 16 seconds 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, when taking the original TOP, the error is more than or equal to 30 seconds, 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 which the timer will be synchronized.



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.

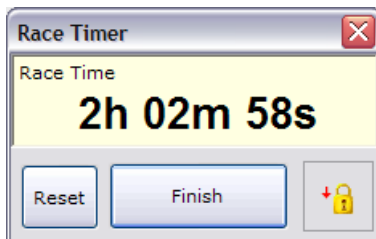
The timer will adjust the remaining minutes and continue with the countdown.

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

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 simply 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 in this situation to show the race duration. It now shows the status caption “**Race Time**” and the time in seconds, minutes, 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

For 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 takes the wind direction (TWD) and a speed (TWS) as the average of the last 20 seconds to calculate. Generally, this is sufficient to suppress unwanted variations in this data.

However, in some cases, it may be necessary that the start functions are based on a fixed wind preset by the tactician. For example, this wind may be the "average" of the last 5 or 10 minutes.



For these situations, this button activates a specific form where you can enter a 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, simply uncheck the corresponding "Hold" box.



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

- The values that have been fixed 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 to where it is going.
- When closing the form, the entered values remain valid.
- When closing EVOLUTION and opening it again, these settings are discarded.

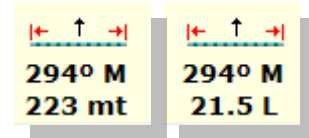
Show Distances in Boat Lengths or Meters

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



Using this button, it is possible to change the units in which the system presents all distances on the “Start” display.

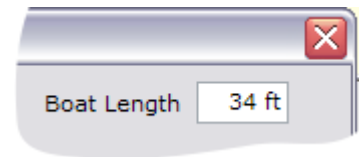
When the distances are shown in meters, figures are followed by “mt”; the letter “L” is used in the case of lengths. The following figures show the length of the start line in both modalities.



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.



For the system to accurately display distances in lengths, the “**Boat Length**” value in the “**Yacht Setup**” form must have been correctly entered. This form is accessed using the 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)”.

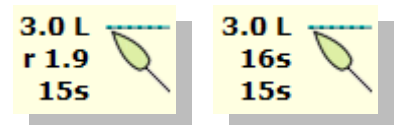
For those crews with well-practiced and methodical start strategies, it is helpful to know the “Time to Go” based on the “Time to Start (TTS)”, specifically the TTS/TTG quotient commonly called “Ratio”.

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



Using this button, it is possible to change the mode in which the time to reach the different points on the line (TTG) is presented, 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 start. 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, in certain circumstances, it may be helpful to have specific polar curves for the starts.

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 as a possible 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.

From the list presented by the system, select the polar curves and, using the "Open" button, load (activate) this file.

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

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 better understand how the system gets times, distances, turning radius, etc.; and to have a clear idea of the limitations that an instrument's system imposes on these calculations.





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

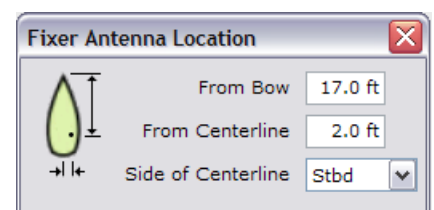
The Position of the Bow

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

For the system, this implies that the geographical position of the bow must be defined as accurately as possible all the time.

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.



The combination of a GPS of high precision and update frequency and a compass of quick response and stability must be carefully considered when equipping a boat that will use start functions included in EVOLUTION.

At the same time, it is recommended that both sensors are directly connected to the computer to ensure that the instruments system does not delay the availability of these data for the start functions 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 speed.

Generally, at low speeds, the boat turns slowly; at higher speeds, the course change is more pronounced. Although each yacht and their crews are different, EVOLUTION assumes certain generic values that can be adjusted if necessary.

With the turn speed and boat speed, EVOLUTION automatically calculates the turning radius; and depending on the expected course of each maneuver, the system determines distances and times.

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

Before modifying predefined values, it is important to obtain new values that are representative of turn rates for the entire range of the boat speeds.

SOW	ROT	TWA	TTS
2 kt	4°	0°	20
4 kt	6°	40°	40
6 kt	10°	80°	35
8 kt	15°	120°	30
10 kt	20°	160°	30
12 kt	20°	180°	35

Restore Defaults

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

Time to Accelerate to Target

To calculate the time to the different marks of the line, EVOLUTION takes into account 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 on 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 the characteristics of each boat.



The rates of turn and times to target predefined by EVOLUTION are a perfect approach for most boats. It is suggested not to change them unless you are very sure of what you are doing.