Overview

The **Racebox** is a simple and powerful tool created for vehicle performance testing and race practice timekeeping. Device operation is based on data obtained from precise 16Hz GPS/GLONASS/Galileo navigation module. Following vehicle parameters can be tested:

- Acceleration time – from stand to specific speeds and distances or in speed ranges defined by the user
- Engine power calculation – based on forces applied to the vehicle
- Stopping distance – from any speed to full stop with average braking deceleration calculation
- Lap time – up to 20 laps, from standing or rolling wheels with best results tracking and prediction mode
- Checkpoint time – up to 10 checkpoints, with best results tracking
- Intermediate and total distance in rally odometer mode

Device has a separate Info mode for driving parameters indication: speed, accelerations, altitude, road incline, heading, precise time and GNSS signal accuracy.

Racebox Pro devices can store measurement reports in HTML format (with charts plot feature) and full logs in CSV, GPX and VBO formats. It also can be used as external GNSS receivers for particular mobile apps. Also, they can gather and record some vehicle data from supported OBD adapters.

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Installation and Recommendations

Fix the bracket to a suitable place in the center of the vehicle's windscreen and slide the device on the windshield bracket. Racebox has an internal antenna, so mount the unit where it will have largest possible view of the sky. To switch on the device just plug the power cable to the device and to any available USB socket. At first startup Racebox should be kept for 10-20 minutes in the open area, away from obstacles such as tall buildings and trees to fully acquire the latest satellite constellation information. At further startups, at normal environment, it will take 1-2 minutes to find required satellites. If the device was not used for a long period of time or moved for a long distance in disabled condition, it is recommended to perform **GNSS Cold Start** procedure (**GPS COLD** item in **Options Menu**).

Measurements are available only after strong GPS/GLONASS signal establishing. If the signal is weak, the screen will indicate a number of available satellites **SATS** and horizontal dilution of precision **HDOP**. Measurements allowed when **HDOP** value is below 2.5 and prohibited when the value is increased above 4. To achieve maximum accuracy, it is recommended to perform measurements in open area, away from tall buildings, in windless weather and on flat roads. To minimize the influence of external factors, it is recommended to conduct a series of measurements with following averaging and statistical analysis of the obtained results.

Note. There may be significant GNSS signal strength reduction inside the vehicles equipped with athermal film on windshield. In this case it is better to use external GNSS module.

Operation with devices, equipped with battery

To power on the device press and hold **Mode** button about 2 seconds. To power off the device press and hold **Mode** button about 5 seconds. To reboot the device press and hold **Mode** button about 15 seconds.

For charging the device connect it to any USB power supply. You can monitor battery state and charging process in **BAT** menu. In this menu you can see battery level (%), battery voltage and charge current. After end of charging process device will indicate **BAT FULL** message. When battery level drops below 20%, device will show **BAT LO** message.

Cautions:

- Battery should be charged at temperature 0 – 45ºC
- Battery should be used at temperature -20 – 60ºC
- Long device storage without charging can lead to deep battery discharge with following battery degradation
- Do not leave the device under direct sun light. It can lead to battery overheat and following malfunction
- Do not disassemble the battery
- Do not short positive and negative battery outlets

RACEBOX

Device control

Device control performs with **Mode** button located on a front panel. Press the button to swap between working modes:

- o **ACCEL** – acceleration time measurement
- o **STOP** – braking distance measurement
- o **DYNO** – power measurement
- o **LAPS** – lap time measurement
- o **POINTS** – checkpoint time measurement
- o **RALLY** – rally odometer
- o **INFO** – driving parameters indication
- o **ENGINE** – engine parameters indication from OBD-adapter *(if supported)*
- o **LOGGER** – driving parameters logging to memory card *(if supported)*
- o **OPTION** – device and vehicle parameters setting
- o **BAT** – battery monitoring menu *(if supported)*

- Press and hold the **Mode** button (about 1 sec) to swap between screens inside one mode or to access to measurements history.
- You can switch between measured parameters in history mode or change parameters in settings mode by short pressing of **Mode** button.
- To exit from settings or history modes press and hold **Mode** button about 2 sec. Also, in settings mode after 7 seconds with no action device will switch to previously used mode automatically.

Current firmware version indicates at every device startup (**VER X.XX** screen). Actual firmware and how-to-update manual you can find at Racebox web-site.

Note. The information contained in this manual was correct at the time of going to print. In the interest of continuous development, we reserve the right to change specifications, design or equipment at any time without notice or obligation.

Operations with memory cards
(if supported by the device)

Device can work with MicroSD cards formatted in FAT or FAT32 file systems with the capacity up to 32Gb. Files and folders structure will be created (if necessary) and information from configuration files will be loaded every time the unit is powered up, or when the card is re-inserted. If the card is not compatible with the device, **SD FAIL** message will be indicated.

All folders and files are stored in **Racebox** folder. Report and log files are located in subfolders with the names corresponded to device working mode names. Acceleration and braking distance reports also allow to plot charts using recorded logs. Charts are plotted at Racebox server side and require Internet connection.

You can also create branded reports with your own logo. Just put your logo into the folder with measurement reports and rename it to **logo.jpg**. Now all new reports will have your logo in the header instead of Racebox. For correct operation logo file should be located in one folder with the reports. Recommended logo height – 100 px.

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Configuration files stored in **Racebox** folder:

- **Racebox.cfg** – text file containing device and user preferences (see **Options Menu** chapter for details).

Card-reader mode

Racebox Pro can be used as a card-reader for MicroSD cards. To switch on this feature: insert MicroSD card into the device, hold the **Mode** button and connect the device to PC via USB-cable. Device should be recognized by PC as external storage.

Embedded firmware update

New firmware releases are available on official web-site www.racebox.cc at **Support – Firmware update** section. There are several ways for firmware update.

For all device versions you can use **Racebox Loader** utility downloaded from the web-site.

For **Pro** and **Pro+** versions you can update firmware from MicroSD card by following actions:

1. Copy new firmware file in HEX format to the root folder of the memory card
2. Insert the card to the device
3. Hold **Mode** button and connect the device to power supply via USB-cable
4. Wait for card initialization and message **HOLD TO UPDATE X.XX** (where X.XX is the version of the new firmware), then hold **Mode** button for a while to start update process
5. Wait until update ends and confirm that new firmware version is displayed during device startup

Bootloader update, if necessary, available via DFU-protocol:

1. Decouple the device and disconnect GNSS-module cable from the main board
2. Extract the memory card and connect the device to PC USB port, holding **Mode** button and wait for **DFU ON** message
3. Load bootloader image in BIN format with **Dfuse**, **dfu-util** or **STM32CubeProgrammer** utils by the address 0x08000000

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Pairing with mobile phones and OBD-adapters

Racebox Pro device can be paired with mobile devices to operate as external GNSS receiver. Connection to the device should be done in the app, not in the phone settings. Data stream is performed only in **INFO** or **RALLY** modes. After app connect to the device, it will be automatically switched to **INFO** mode. Following mobile apps are already integrated with Racebox (you can find actual list on our web-site):

- **Harry's LapTimer**
- **RaceChrono Pro**
- **TrackAddict Pro**
- **RaceBuddy Pro**
- **Speed Logic Pro** (only for Android)

Racebox Pro can be paired with BLE OBD adapters, in order to receive and record vehicle parameters. Actual list of supported adapters can be found at Racebox web-site.

Initial connection to OBD adapter should be done in **Options** menu (**BLE** parameter to be set to **OBD** status). Further connections will be done automatically after device startup (see **Option** chapter and **Operation with OBD-adapters manual** for more details).

Note. Pairing with mobile devices and OBD-adapter are mutually exclusive functions because Racebox device has only one BLE module inside.

Acceleration Time Measurement Mode (—ACCEL—)

In **free run mode (FREE RUN)** in order to begin the test, stop the vehicle and wait for **—GO—** message on the display, then start acceleration run. Current speed will be indicated at the left part of the display and current acceleration time with 0.1 sec precision at the right part. As your vehicle goes over threshold speed or distance, the measured time result will blink on the display during 2 seconds. In order to do not overload the display with result messages, you can choose distance threshold in **Options Menu** (**DST** parameter).

| `0 --GO--` | `100    8.1` | `402    15.2` |

The list of predefined threshold speeds in km/h: 60, 100, 150, 200, 300
The list of predefined threshold speeds in mph: 30, 60, 100, 150, 200
The list of predefined threshold distances: 60 ft; 201, 402, 1000, 1609 meters.

You have also possibility to measure acceleration time between various speeds (**SP1** and **SP2** parameters). This measurement can be done either from stand or on rolling wheels. To measure on rolling wheels, start acceleration run from the speed slightly below **SP1** speed up to **SP2** speed.

On **Racebox Pro** devices you can set up to 3 user speed ranges and up to 5 user speed and distances in **Racebox.cfg** file. Open it with any test editor and change parameters in sections **[RANGES]**, **[EXTRA_SPEEDS]** and **[EXTRA_DISTS]**.

Measurement will be finished after your vehicle decelerated or 65 seconds left after acceleration start. **FAIL** message will be indicated.

```
30-90 4.3      78 FAIL
```

If acceleration run was done successfully, you will also see maximum acceleration value achieved during the run in "G" units.

```
ACC 0.36G
```

If the vehicle speed will exceed threshold level of 60 km/h (or 30 mph), then results will be saved in the device internal memory and to the memory card (if supported) and **–SAVE–** message will be indicated. Device can store 10 last measurements.

Start by timer mode (TREE RUN). In this mode run should done after 10 seconds timer or random timer (3 to 10 seconds) expiration. After finish the run you will see your start reaction time (**RT**). Reaction time less than 0.1 seconds considers as invalid (false start). This mode can be enabled by long button press from normal mode (**TREE RUN** message on display). Then timer can be activated by short button press (**-PUSH-** message). After timer expiration you will see **-RUN-** message on the display together with sound signal – then you should start your run. Timer mode (random or fixed 10 seconds) can be chosen in **OPTIONS** menu with **RAND** parameter (**ON/OFF**).
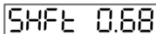
-PUSH-   -REAdY-   -GO-

Racebox has **road incline monitoring** function. This function works only if good GPS signal level has been achieved. With this function device continuously tracks road incline during acceleration run and if incline value exceeds the threshold value of 2% (2 meters of altitude by 100 meters of road length), then measurement result will be marked as invalid and **NOTVALID** message will be indicated. If the maximum road incline is less than threshold value, then measurement result will be marked as valid and **–VALID–** message will be indicated. Maximum incline value and measurement status will be saved together with measurement results.

INCL   0.4   -VAL Id-

Roll-out function. When this function is enabled, distance measurement starts after 1 foot from vehicle start point, as customary at drag strips. It leads to distance time results decrease by 0.3-0.6 sec. For correct comparison of results, roll-out status saves together with measurement results. If roll-out is enabled **ROLL ON** message will be indicated each time when you switch device to acceleration time measurement mode. Roll-out function has no any influence on acceleration to threshold speeds time results.

Gear shift time monitoring. This function works only when device is paired with OBD-adapter and OBD refresh rate is higher than 4 Hz. Shift events are detected by engine RPM change. When acceleration run is finished you will see an average shift time on the device. If memory card is

RACEBOX

inside, in the measurement report you will find the data about maximum engine RPM, speed and shift time for each gear.

$$\boxed{\text{SHFt } 0.68}$$

This function can be disabled in **Option** menu (**SHFT** parameter).

To access history mode and browse measurements press and hold **Mode** button. To browse measured parameters shortly press **Mode** button. Parameters will be listed in following order:

- Record number
- Date and time in **DD.MM HH.MM** format
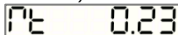- Acceleration time to threshold speeds and between user speeds

$$\boxed{\text{100 } \quad 8.1} \qquad \boxed{30\text{-}90 \ 4.3}$$

- Acceleration time to distances and maximum speed on distance

$$\boxed{402 \quad 15.2} \qquad \boxed{402 \quad 153}$$

- Start Reaction time (in **TREE RUN** mode)

$$\boxed{\text{rt } \quad 0.23}$$

- Maximum acceleration during the run

$$\boxed{\text{ACC } 0.36G}$$

- Average gear shift time *(if connected to BLE OBD-adapter)*

$$\boxed{\text{SHFt } 0.68}$$

- Maximum road incline during acceleration in % (if road incline monitoring is enabled)

$$\boxed{\text{INCL } 0.4}$$

- Measurement status depend on road maximum incline: **VALID** or **NOTVALID** (if road incline monitoring is enabled) or **INCL OFF** if road incline monitoring is disabled

$$\boxed{-\text{UAL Id}-}$$

- Roll-out status: **ON** or **OFF**

$$\boxed{\text{ROLL OFF}}$$

- Maximum speed achieved during acceleration

$$\boxed{\text{TOP } 254}$$

RACEBOX

- Selected measurement system: **EU** (metric) or **US** (imperial)

To exit history mode press and hold **Mode** button more than 2 seconds.

Racebox Pro devices will also save measurement reports (in HTML format) and full logs (in CSV, GPX or VBO formats) at **Accel** folder. If device is paired with OBD-adapter, logs will contain engine data from OBD. Report contains a table with measured acceleration characteristics and map with marked test track. Best results additionally saved to **Accel/Best** folder. If OBD adapter is paired, the log file will also consist vehicle engine data. Acceleration reports allow to plot charts with detailed acceleration information using recorded log. To get the charts, open the report, push "Choose file" button and select log file in CSV or VBO format with corresponding file name. To see the map or the charts, you should have Internet connection.

Stopping Distance Measurement Mode (–STOP–)

Accelerate your vehicle slightly above required speed and start braking. After deceleration to the speed aliquot of 10 km/h (or 10 mph) device will start to measure stopping distance.

`16 --UP--`	`74 PUSH`	`70 20.4`

After full stop, the measured distance (in meters or ft) and average deceleration (in G's) will be indicated. Results will be saved to the internal memory and to the memory card (if supported).

To access history and browse measurements press and hold **Mode** button. To browse measured parameters shortly press **Mode** button. Parameters will be listed in following order:

- Record number
- Date and time in DD.MM HH.MM format
- Braking initial speed and measured stopping distance
- Average deceleration
- Selected measurement system: **EU** (metric) or **US** (imperial)

`70 28.3`
`AUG 0.53G`

To exit history mode press and hold **Mode** button more than 2 seconds.

Racebox Pro devices will also save measurement reports (in HTML format) and full logs (in CSV, GPX or VBO formats) at **Stop** folder. Report contains a table with measured distances from different speeds, average deceleration value and map with marked test track. Repot also allow to plot charts with detailed braking information using recorded log. To get charts open the report, push "Choose file" button and select log with corresponding name. To see the map or the charts, you should have Internet connection.

RACEBOX

Engine Power Estimation Mode (–DYNO–)

Device can estimate engine power on flywheel by calculating the main forces applied to the vehicle. For correct power estimation, you should initially set your vehicle characteristics in the Options Menu:

- Your vehicle weight in kg (**Ld** parameter)
- Transmission type: manual, automatic or robotized (**Gb** parameter)
- Drag coefficient C_x or C_d (**Cd** parameter)
- Body frontal area in square meters (**Fa** parameter)

For devices with memory cards support these parameters can be defined in **Racebox.cfg** configuration file. Open this file in any text editor and change required fields: Weight, Cd and Fa.

There are two screens available in this mode:

- **CUR HP** for current power indication. Negative value shows that the vehicle is braking.

```
CUR HP          HP    45
```

- **TOP HP** for maximum achieved power indication.

```
TOP HP          --HP-- 206
```

You can switch between these screens by holding **Mode** button.

If estimated engine power exceeds the threshold level of 20 hp, then maximum achieved power value will be saved in the device memory and to the memory car (if supported).

To access history mode and browse measurements press and hold **Mode** button 2 times. To browse measured parameters shortly press **Mode** button. Parameters will be listed in following order:

- Record number
- Date and time in DD.MM HH.MM format
- Maximum estimated engine power on flywheel and corresponding vehicle speed

--HP-- 206	SPD 195

- Selected measurement system: **EU** (metric) or **US** (imperial)

To exit history mode press and hold **Mode** button more than 2 seconds.

micro SD **Racebox Pro** devices will also save measurement reports (in HTML format) and full logs (in CSV, GPX or VBO formats) at **Dyno** folder. Report contains estimated engine power values calculated on flywheel and on wheels, corresponding vehicle speed and initial vehicle characteristics. If OBD adapter is paired, log file will also consist vehicle engine data.

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Lap Timer Mode (–LAPS–)

Two lap timer scenarios have been implemented in this device:

- **STANDING** – lap timing begins after first vehicle movement
- **ROLLING** – lap timing begins after first crossing of the predefined Start/Finish gate

You can switch from Standing to Rolling modes by holding and back by pressing the **Mode** button.

In STANDING mode. To start the race put your vehicle on the S/F line and wait for recording of the S/F gate position. You will notice that by changing of the flashing **STAY** message by the **–GO–** message. Now, lap time count will start immediately after the first vehicle movement.

$$\boxed{L\ 1\quad STAY}\qquad \boxed{L\ 1\quad --GO--}$$

In ROLLING mode. Before the race you should set the S/F gate. Enter the **SET GATE** screen by holding the **Mode** button from the **ROLLING** mode.

$$\boxed{SEt\ GAtE}\qquad \boxed{-GAtE-}$$

Place the device at the S/F gate and press **Mode** button once. During next 3 seconds device will record its location and then return to the **ROLLING** mode. You can cancel S/F gate position recording by pressing **Mode** button within these 3 seconds.

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On devices with memory cards support, you can also set S/F gate coordinates manually in **Racebox.cfg** configuration file. Open this file in any text editor and

set coordinates for **gate** parameter in degrees with decimal fraction. For example, the coordinates of The Red Square in Moscow will look like that:

gate: 55.754113, 37.620330

To start the race, drive the vehicle away from the S/F gate (more than 10 meters). As soon as the S/F gate is crossed, lap time count will begin.

In both modes. During the race at the left part of display you will see current lap number and at the right part – current lap time with 0.1 sec precision. Race will be finished if the vehicle stops and stay immobilized within 10 seconds, or if the **Mode** button pressed.

Prediction display mode. When this function is switched on (**PREDICT** in option menu), starting from the second lap, device will show current deviation from best lap time. Negative value means advance of the best lap time, and a positive value – retard from the best lap time.

$$\boxed{L3 \quad -12.6} \qquad \boxed{L4 \qquad 0.7}$$

When crossing the S/F gate, current lap time will be saved in device memory and to the memory card (if supported) and the next lap time count will be started. Maximum number of laps – 20. After driving two or more laps, the time gap from the best lap time or the message about best lap time will be indicated.

$$\boxed{L1 \quad 2.34.5} \qquad \boxed{GAP \quad 15.3} \qquad \boxed{--BEST--}$$

To stop the race press **Mode** button or wait 10 seconds when vehicle is stopped.

RACEBOX

To access history mode and browse measurements press and hold **Mode** button 3 times. To browse measured parameters shortly press **Mode** button. Parameters will be listed in following order:

- Record number
- Date and time in DD.MM HH.MM format
- Lap time for each lap

$$\boxed{\text{L6} \quad \text{12.34.5}}$$

- Time gap from the best lap in the race or message about the best lap

$$\boxed{\text{GAP} \quad 15.3} \quad \text{or} \quad \boxed{\text{--BEST--}}$$

- Maximum anв average speed for each lap

$$\boxed{\text{AVG} \quad 123} \quad \boxed{\text{TOP} \quad 256}$$

- Selected measurement system: **EU** (metric) or **US** (imperial)

To exit history mode press and hold **Mode** button more than 2 seconds.

micro SD **Racebox Pro** devices can store reports (in HTML format) and full logs (in CSV, GPX or VBO formats) in **Laps** folder. Report contains a table with all laps' times,

average and maximum lap speeds and race track map with designation of the S/F line. Map is available only with Internet connection. Log files in VBO format can be used for detail race analysis with **VBOX Circuit Tools** or **Track Attack** software. If OBD adapter is paired, log file will also consist vehicle engine data.
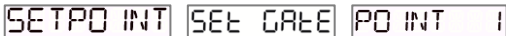
RACEBOX

Checkpoint Timer Mode (–POINTS–)

Two timer scenarios have been implemented in this device:

- **STANDING** – timing begins after first vehicle movement
- **ROLLING** – timing begins after first crossing of the predefined start gate

There are four screens available: **STANDING** race screen, **ROLLING** race screen, checkpoints adding, checkpoints reset. To swap between the screens press and hold **Mode** button.

Before the race you should setup start gate, where time count starts in ROLLING mode, and checkpoints for race time cut-off. To do this follow to points adding screen.

SETPO INT	SET GATE	PO INT 1

Place the device in the checkpoint and press **Mode** button once. During next 3 seconds device will record its location and then it will propose you to add the next point. If the **Mode** button is pressed within these 3 seconds, then point record will be cancelled and device will switch back to the Main race screen.

On **Racebox Pro** devices you can also define checkpoints coordinates manually in **Racebox.cfg** configuration file. Open this file in any text editor and set coordinates for the gate and each checkpoint in degrees with decimal fraction.

For example:

gate: 55.723323, 37.543325

point_1: 55.723453, 37.543256

point_2: 55.754113, 37.620330

To reset checkpoints, follow to **RESET** menu and press the **Mode** button once. After 3 seconds all checkpoints will be erased. If the **Mode** button is pressed within these 3 seconds, then the resetting will be cancelled.

In STANDING mode. To begin the race, put your vehicle at Start point and switch the device to the **STANDING** race screen. Wait for **–GO–** message indicated on the display. As soon as the vehicle is moved race timing will begin.

```
P 1   STOP        P 1   --GO--
```

In ROLLING mode. Switch the device to ROLLING mode and drive to the predefined start gate. Race time count will begin after crossing the start gate.

```
P 1   GAtE
```

At the left part of the display you will see the next checkpoint number and at the right part – current race time with 0.1 sec precision. After crossing the checkpoint, checkpoint time will blink on the display and then it will be saved in the device memory and to the memory card (if supported). Maximum number of checkpoints – 10. Also, device can track best checkpoint time and during the next driving by the same route, time gap from the best result will be indicated and saved. After checkpoints reset or change, the best track results will be erased.

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`P1  3.27.5`   `GAP  15.3`   `--BEST--`

To access history mode and browse measurements press and hold **Mode** button 3 times (from Main mode). To browse measured parameters shortly press **Mode** button. Parameters will be listed in following order:

- Race number
- Date and time in DD.MM HH.MM format
- Race time on each checkpoint   `P2  5.34.1`
- Gap from the best checkpoint time or the message about best time achieving

  `LAG  15.3`   `--BEST--`

- Average speed on track section from previous checkpoint

  `AUG  123`

- Maximum speed on track section from previous checkpoint

  `TOP  256`

- Selected measurement system: **EU** (metric) or **US** (imperial)

To exit history mode press and hold **Mode** button more than 2 seconds.

Racebox Pro devices can store reports (in HTML format) and full logs (in CSV, GPX or VBO formats) in **Points** folder. Report contains a table with all checkpoints' times, gaps from the best times, average and maximum section speeds and race track map with checkpoints designation. Map is available only with Internet connection. Log files in VBO format can be used for detail race analysis with **VBOX Circuit Tools** or **Track Attack** software. If OBD adapter is paired, log will also consist vehicle engine data.

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Rally Odometer Mode (−RALLY−)

This mode provides a simple rally odometer for measuring intermediate and total distance. There are following screens available in this mode:

- **SPD ODO** – current speed in km/h or mph and intermediate distance in km or miles (0.01 accuracy)
- **CRS ODO** – current course (azimuth) and intermediate distance in km or miles (0.01 accuracy)
- **TOT CUR** – total and intermediate distance in km or miles (0.01 accuracy)
- **CUR ODO** – intermediate distance in km or miles (0.001 accuracy)
- **TOT ODO** – total distance in km or miles (0.001 accuracy)

Press and hold **Menu** button to switch the screens. Push **Mode** button shortly to reset the distance (separately for intermediate and total distance). To switch device to other mode, press **Mode** button again, within 1 sec after odometer reset.

Racebox Pro devices can record all the parameters to memory card in CSV, GPX or VBO formats.

RALLY mode is also used for navigation data stream via BLE to mobile apps.

Information Mode (–INFO–)

In this mode you can observe the following parameters:

- **SATS HDOP** – Number of available GPS/GLONASS satellites and Horizontal dilution of precision value

  ```
  5At HdOP    5.09   H 1.6
  ```

- **SPD ACC** – Current speed in km/h or mph and Longitude acceleration in G's

  ```
  SPd  ACC    78   0.47
  ```

- **SPD LAT** – Current speed in km/h or mph and Lateral acceleration in G's. Letters "L" and "R" means Left and Right turn

  ```
  SPd  LAt    78 L 1.09
  ```

- **SPD ALT** – Current speed in km/h or mph and Altitude above sea level in meters or feet

  ```
  SPd  ALt    78   194
  ```

- **SPD CRS** – Current speed in km/h or mph and Heading in degrees from the north

  ```
  SPd  CRS    78   359
  ```
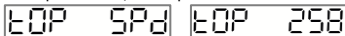
- **SPD INCL** – Current speed in km/h or mph and Road incline in %

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$$\boxed{\text{SPD INCL}} \quad \boxed{\text{78 -1.5}}$$
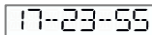
- **SPD ONLY** – Current speed in km/h or mph with 0.1 accuracy

$$\boxed{\text{SPD ONLY}} \quad \boxed{\text{SPD 78.5}}$$

- **TOP SPD** – Maximum speed in km/h or mph achieved after device startup

$$\boxed{\text{tOP SPd}} \quad \boxed{\text{tOP 258}}$$

- Current time

$$\boxed{\text{17-23-55}}$$

Press and hold **Menu** button to switch the parameter. Push **Mode** button shortly to return to the first screen.

Racebox Pro devices can record all the parameters described above to memory card in CSV, GPX or VBO formats. See **Logger Mode** chapter for more details.

Racebox Pro also use this mode for navigation data stream via BLE to mobile apps.

OBD Data Mode (-ENGINE-)

This mode is available only when BLE OBD-adapter is paired. Currently only those parameters are available:

- **THR REV** – throttle position in % and engine speed in RPM

$$45 \quad 3445$$

- **AIR COOL** – intake air and engine coolant temperature in °C

$$16° \quad 45°$$

- **LD PRES** – engine load (in %) and manifold absolute pressure (in kPa)

In this mode, if OBD data exchange log is enabled (**OBD.L** parameter) and memory card is inside, device will record all OBD data exchange in OBD_X.log file. This file can be useful for Racebox developers in order to add new supported OBD-adapters and new vehicle parameters.

Actual list of supported OBD-adapters and vehicle parameters you can find on our web-site.

RACEBOX

Logger Mode (-LOGGER-)

In this mode device records all available parameters to memory card. Following log file formats are supported: CSV (universal tabular data text format), GPX (XML-based navigation data text format), VBO (telemetry data text format, used in VBOX devices). If OBD-adapter is paired, log file will also consist vehicle data from OBD: engine RPM, throttle position, coolant temperature, etc.

After switching to this mode current logger settings will be indicated: log file format and log recording period. To start logging press and hold the **Mode** button.

| CSV 0.1 | -HOLd- | REC ON |

Data recording will be started and device will be switched to Information Mode (**–INFO–**) and you will notice blinking point at the right digit. To stop recording press the **Mode** button. Device will return to **LOGGER** mode.

| 78 0.24 | REC OFF |

Log files store in **Log** folder. File name contains date and time when logging was started. In case of power off during log record – most of the data will be recovered during next device startup and new log file record will be continued.

Options Menu (–OPTION–)

This mode is used to setup device and vehicle parameters. Hold the **Mode** button to swap between parameters and press the **Menu** button to change the parameter. To exit from **Options** menu press and hold **Menu** button more than 2 seconds. Also, if no any actions were done with device within 7 seconds, then it will return to the previous mode.

Following parameters are available for setup:

- **Display Brightness (LED)**. Device has 3 levels of brightness.
- **Buzzer on/off (TONE)**. Buzzer is used to notify about the following events: threshold speed or distance achieving (in **ACCEL** mode), checkpoints or S/F line crossing and adding (in **LAPS** or **POINTS** mode), start of stopping distance measuring (in **STOP** mode), device startup.
- **BLE-module mode (BLE):**
  - **OFF** – BLE module is OFF
  - **APP** – device is available for pairing from mobile app. During BLE devices search in mobile app device will be appeared as Racebox#XXXX, where XXXX – last 4 digits of BLE-module MAC address. This is state used by default.
  - **OBD** – device is connected to BLE OBD-adapter. During connection device searching supported adapter **(OBD SCAN)** and trying to connect **(OBD CONN)**. If connection is failed **(OBD NA/NF/ERR)** – device will return to **OFF** state. If the connection is established, device will try retrieve vehicle VIN (it will be used

in reports and logs) and last 4 digits of VIN will be indicated. For details see **Operation with OBD-adapters** manual.

- **First user defined speed (SP1).** Initial speed in km/h or mph for acceleration run in user defined speed range. Minimal value 10, maximum – 300. For **Racebox Pro** devices this parameter can be defined in **[RANGES]** section in **Racebox.cfg**.
- **Second user defined speed (SP2).** Final speed in km/h or mph for acceleration run in user defined speed range. Minimal value 10, maximum – 300. For **Racebox Pro** devices this parameter can be defined in **[RANGES]** section in **Racebox.cfg**.
- **Logging Period (LOG.R).** Values in seconds: 0.1, 1, 10 and 60. For example, if 0.1 sec selected – data will be recorded 10 (16 – for 16Hz version) times per second, at 60 sec – 1 time per minute.
- **Log File Format (LOG.F). CSV, GPX, VBO** formats are available. **OFF** – to disable all logs except in **Logger** mode.
- **Lap timer Prediction Mode (PRED).** This mode allows to see the gap with best lap time in real time when racing in **LAPS** mode.
- **Gear Shift Timing (SHFT).** Available only if BLE OBD-adapter is paired.
- **Timer mode for TREE RUN mode (RAND).** If random timer is switched on, command to run will be done randomly in 3 to 10 seconds after timer activation. Otherwise – there will be fixed 10 seconds countdown before start.
- **One Foot Roll-out on/off (ROLL).** When this function is enabled, distance cut-off will be performed after ~1 foot (30 cm) from vehicle start point, as it customary at drag-

racing competitions. This leads to reduction of distance time results by 0.3-0.6 sec. Acceleration time to threshold speeds is not affected by this setting.

- **Distance Threshold for Result Indication (DST).** Minimal distance from start point where distance time result will be indicated (in **ACCEL** mode). It is made to do not overload the display with too many messages. This parameter will not affect to messages about threshold speeds achieving or to distance results saving. Following values are available: 60 feet; 201, 402, 1000 and 1609 meters.

- **Vehicle Weight in kg (LD).** Minimal value 200 kg, maximal – 5000 kg, step – 50 kg. This parameter is used for engine power estimation. On devices with memory cards support this parameter can be defined in **Weight** field in **Racebox.cfg** file.

- **Transmission Type (GB). AUTO** – for vehicles equipped with usual hydro-mechanical torque converters or with variators, **HAND** – for vehicles with manual transmissions, **ROBOT** – for vehicles with robotized transmissions (DSG, PowerShift, etc.) This parameter is used for engine power estimation.

- **Drag Coefficient (CD).** Minimal value 0.15, maximum value – 0.60, step – 0.01. This parameter is used for engine power estimation. You may find this parameter for your vehicle model in Internet. On devices with memory cards support this parameter can be defined in **Cd** field in **Racebox.cfg** file.

- **Frontal Area (FA).** Minimal value 1.0 m^2, maximum value – 5.0 m^2, step – 0.1 m^2. This parameter is used for engine power estimation. Equation for approximate calculation: $F_a = 0.85 * W * H$, where W – vehicle width (w/o mirrors, in meters), H – vehicle height

RACEBOX

(w/o railings, in meters). On devices with memory cards support this parameter can be defined in **Fa** field in **Racebox.cfg** file.

- **Time Zone (UTC).** UTC offset for the local time zone. Minimal value -12 hours, maximum value +12 hours.
- **Measurement units (UNITS). EU** for metric system (km/h, kilometers and meters) or **US** for imperial system (mph, miles and feet). If **US** system selected, it will notify user about it at every device startup.
- **Maps provider used for reports (MAPS).** You can switch between Google Maps **(GOOG)** and Yandex Maps **(YAND)** for the maps, which will be built-in the reports.
- **OBD Debug Log (O.LOG).** This mode is used for debugging of BLE connection with different OBD-adapters. Logs are stored in *OBD_N.log* file. These files can be useful for Racebox developers for adding new supported OBD devices and vehicles parameters.
- **Request of available OBD parameters on connection (O.GET).** Switched on by default. For details see **Operation with OBD-adapters** manual.
- **OBD parameters choose (O.PID). ALL** – request of all available parameters. **REV** – request only engine speed, **2–62** – choose parameters. For details see **Operation with OBD-adapters** manual.
- **OBD protocol choose (O.PRT). AUTO** – automatic protocol detection. **1–9** – choose protocol. For details see **Operation with OBD-adapters** manual.
- **GNSS Data Frequency (GPS 10HZ / GPS 16HZ).** Depends on installed GPS module, device can receive and process navigation data with the rate of 10 or 16 Hz. For devices

based on uBlox-M7020 units only 10Hz is available, for uBlox-M8030 – both 10Hz and 16Hz are available.

- **Navigation data transmission (E.GPS).** After activation of this point, device in **INFO** mode will transmit navigation data in NMEA format through virtual USB COM-port.
- **GNSS second system switch (GNSS).** You can switch between GLONASS **(GLO)** and Galileo **(GAL)** navigation systems, which will be used in addition to GPS.
- **GNSS Cold Start (GPS COLD).** After activation of this point, all GNSS satellites almanac records will be discarded. This can be useful if the device was not used for a long period of time (more than a month) or if the device was moved for a long distance in switched-off condition. Usual time for Cold Start – 10-20 minutes. During this time device should be fixed in one place. User have 3 seconds timeout to cancel this action by pressing **Mode** button.
- **GNSS Module Reconfiguration (GPS CONF).** After activation of this point, GPS module settings will be discarded and reconfigured. This can be useful after broken GPS module replacement. User have 3 seconds timeout to cancel this action by pressing **Mode** button.
- **Default Reset (DEFAULT).** After activation of this point, all settings and results stored in device memory will be discarded. User have 3 seconds timeout to cancel this action by pressing **Mode** button.

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Mode Lock feature

In **Pro** version of Racebox you can lock desired mode in order to avoid its accidental switching or to simplify operation with the device. In locked mode the device will not react on mode switching with **Mode** button, but you can still navigate between the screen in chosen mode. Mode lock can be enabled in **Racebox.cfg** configuration file. There you should enter the name of desired mode in **mode_lock** parameter. List of available options for this parameter: **NONE** (by default, mode lock disabled)**, ACCEL, STOP, DYNO, LAPS, POINTS, INFO, LOGGER, RALLY**. Mode lock enables after configuration file load from the memory card. Mode lock disables after ejecting memory card or by changing **mode_lock** parameter to **NONE**.

RACEBOX

Device Technical Specifications

Parameter	Value
Size	97 x 59 x 25 mm
Weight	150 g
Nominal Voltage	5 V
Nominal Current	Less 0.3 A
USB Input Protection	Yes
GNSS Unit Type	U-Blox UBX-M8030-KT
Navigation Data Refresh Rate	16 Hz
Navigation Accuracy in Horizontal Plane	Less 2.0 m
Horizontal Speed Accuracy	Less 0.1 m/s (0.36 km/h)
Memory Card Type	Micro SD, SDHC, SDXC
BLE Chipset	CC2541
Battery Type	Robiton LP803048 (Li-Po, 1200mAh) or similar

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Warranty Certificate

Customer	
Dealer	
Model	Racebox
Serial	
Date of Purchase	
Warranty Period	1 year

Thank you for purchasing our products!

In case of occurrence of a malfunction, caused the manufacturer's fault, during the warranty period, free repair or replacement of the device with a new one will be provided. The manufacturer reserves the right to refuse free warranty repair or replacement of the product in cases of violation of the rules of transportation or operation of the device (mechanical damage), or the presence of repair marks.

In most cases, issues and questions can be solved remotely. We will be happy to help you! We are waiting for your feedback and questions to e-mail: info@racebox.cc, as well as on social networks VK, Instagram and Drive2.