

Track Box Passive

Quick Reference Guide

The **RACE RESULT Track Box** provides a simple solution for split points for events which are timed using the **RACE RESULT passive transponder**. The Track Box is an all-in-one solution with the reader, battery and antenna integrated into a single unit which can be easily transported and setup faster than a conventional decoder and antenna.

The Track Box includes an integrated stand and magnets which allows for a variety of mounting methods and angles. As the Track Box includes a 2.4Ghz module it can also operate as an [Active Track Box](#) simultaneously.

Track Box Management can be done using a [Management Box](#), or the most important configurations can be setup using either a dedicated online setup portal or via SMS sent to the device.

Configuration of Track Boxes

Insert SIM Card

First, ensure the PIN settings are correctly defined for your SIM cards if required. The Track Box will try and connect as soon as it is on, and if the PIN is not properly setup, your SIM card may be locked by your operator.

Open the Track Box by unscrewing the 6 screws on the front using a 2.5mm hex key.

The SIM card slot is located on the right side just above the center screw, marked by a SIM symbol. Insert the SIM card into the SIM holder according to the orientation of the symbol until it clicks in to place.

Replace the lid of the Track Box ensuring correct orientation of the cover with the clamp for the stand position at the bottom, and fasten the screws. Do not fasten too tight.

If you are doing this with several Track Boxes at once, make sure that the serial number on the lid matches the one inside the Track Box.

Once your SIM cards are inserted, you can turn your Track Boxes on, the Track Boxes will attempt to automatically set the APN which may take up to 5 minutes on the first connect. If they do not show as connected within this time you may need to [Configure the SIM APN manually](#)

Basic Settings

There are some basic parameters which need to be set on the Track Box in order to work correctly.

Key Settings

- Customer ID - Your RACE RESULT customer ID which will be used to access the Track Box data.
- Name - A name for the device can be set for easier identification of devices.

SIM Settings (no configuration needed when using RACE RESULT SIM Cards)

- PIN - The PIN code of your SIM card. If you have disabled the PIN protection on your SIM, you can leave the field blank. If you wish to use your own SIM card with a PIN, you need to configure it through TagTool (using a Management Box).
- APN Domain - APN URL which should be connected to.
- APN User - Username for connecting to the APN if applicable.
- APN Password - Password for connecting to the APN if applicable.

Advanced Settings

- Status URL and Tracking URL - The URLs the Track Boxes are reporting their status and transmitting the trackings to. By default, these are set to communicate with the RACE RESULT servers. Do not modify these settings unless you want to report directly to your own server.

These settings can be configured in three different ways. Please note that some settings are not available through all methods. Configuring the Track Box using TagTool with a Management Box is the only way to access all settings.

As settings may be changed remotely, we recommend setting Track Boxes to lock using the [Track Box Configuration Rules](#) and only unlock Boxes at the end of an event or to make changes yourself.

Online Portal Configuration

A dedicated setup portal is available at <https://www.raceresult.com/setup>. You will need to login with your RACE RESULT customer ID and password.

When using the online configuration your Track Box must be turned on, connected to the server and cannot be locked (via the [Track Box Configuration Rules](#)), for this reason it is not possible to set the SIM PIN using the online configuration portal.

In addition, you need to have physical access to the Track Box (either directly or through an assistant) as applying the config requires the Track Box button to be pressed.

To use the online configuration define the device ID of the Track Box you wish to update, select which parameter you want to change and the new value, then click set.

TrackBox ID:	<input type="text" value="T-20012"/>
Setting:	<input type="text" value="Customer ID"/>
Value:	<input type="text" value="20705"/>
<input type="button" value="SET"/>	

You will then need to press the Track Box Button quickly 3 times. This sends a request to the server, the Track Box will give a short beep to acknowledge the request. Wait for a long beep from the Track Box to confirm the parameter has been updated, the online portal will also show a confirmation message, this can take several minutes.

The confirmation message will show in a pop-up window and includes information on the Track Box ID, the parameter that you have changed and its new value.

Note: If the Track Box cannot connect to the server via GSM, for example in the event of incorrect APN settings, then the Track Box will instead send an SMS message to a RACE RESULT server which if successful will also reply with an SMS. If using data only SIM cards then beware that this may cause additional charges for the sending / receiving of SMS.

Set Configuration via SMS

To set parameters via SMS the Track Box must be turned on with the SIM card fitted. You will need to send a text message with the parameter and new value to the phone number associated with your SIM card.

For example, send an SMS in the following format.

```
CUSTOMER=12345  
APN=mobile.net
```

The different parameters should be defined as:

- APN (APN url)
- CUSTOMER (Customer ID)
- NAME (Device Name)
- TRACKPINGURL (Server location to send data)
- STATUSURL (Server location to send status updates)

Passive Track Box Setup

The Passive Track Box can be set up and mounted in a variety of methods thanks to its integrated mount.

Some additional precautions and care should be taken in order to maximise read rates of Track Boxes.

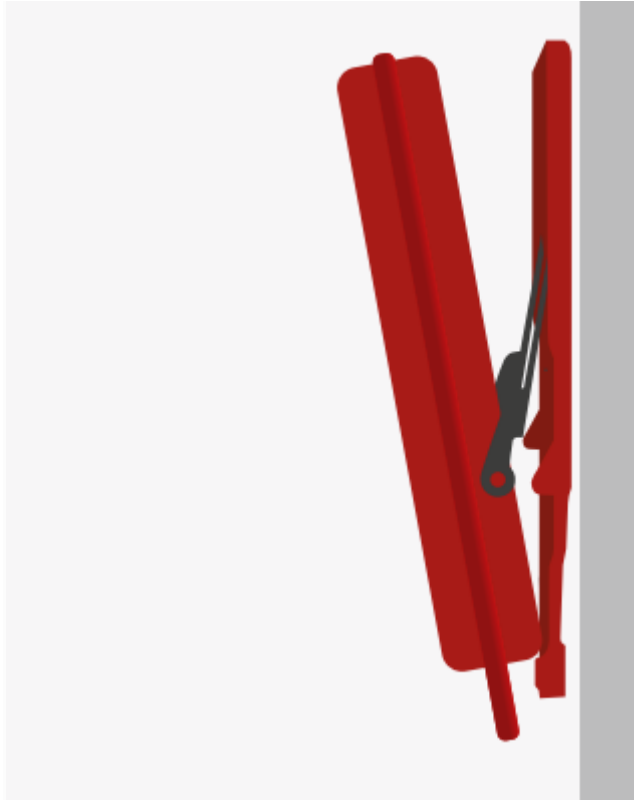
Mounting of Track Boxes

The integrated mount of the Track Box allows for a variety of mounting methods for both temporary and permanent installations. Please note that the Track Box reads all passive transponders in a radius of ~1m (3ft), even behind the Track Box. Make sure to place the Track Box in a good location.

Vertical Mounting

Track Boxes can be mounted vertically using the integrated magnetics or screw mounting / VESA mount holes. It is also possible to secure the Track Box using cable ties and the existing mounting holes when it's not possible to secure in another way.

When mounted vertically the mount offers 4 different hanging angles to ensure maximum coverage of the read area depending on the height of the mounting point.

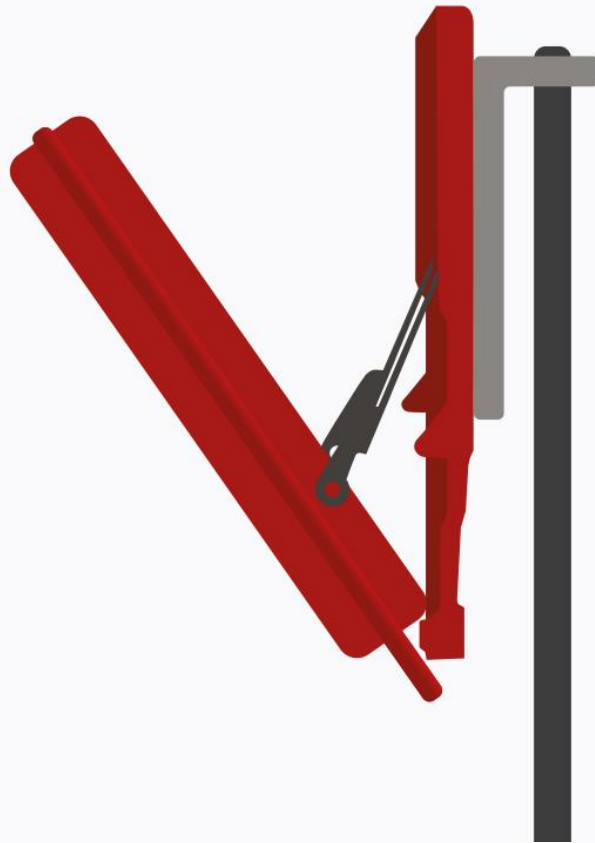


Overhead Mounting

The integrated magnets of the Track Box are strong enough to hold the Track Box even when mounted hanging from an overhead surface. When hanging inverted like this then the hook bar must use the 12, 24, or 36 degree hanging slots, it is not possible to hang overhead at 0 degrees.

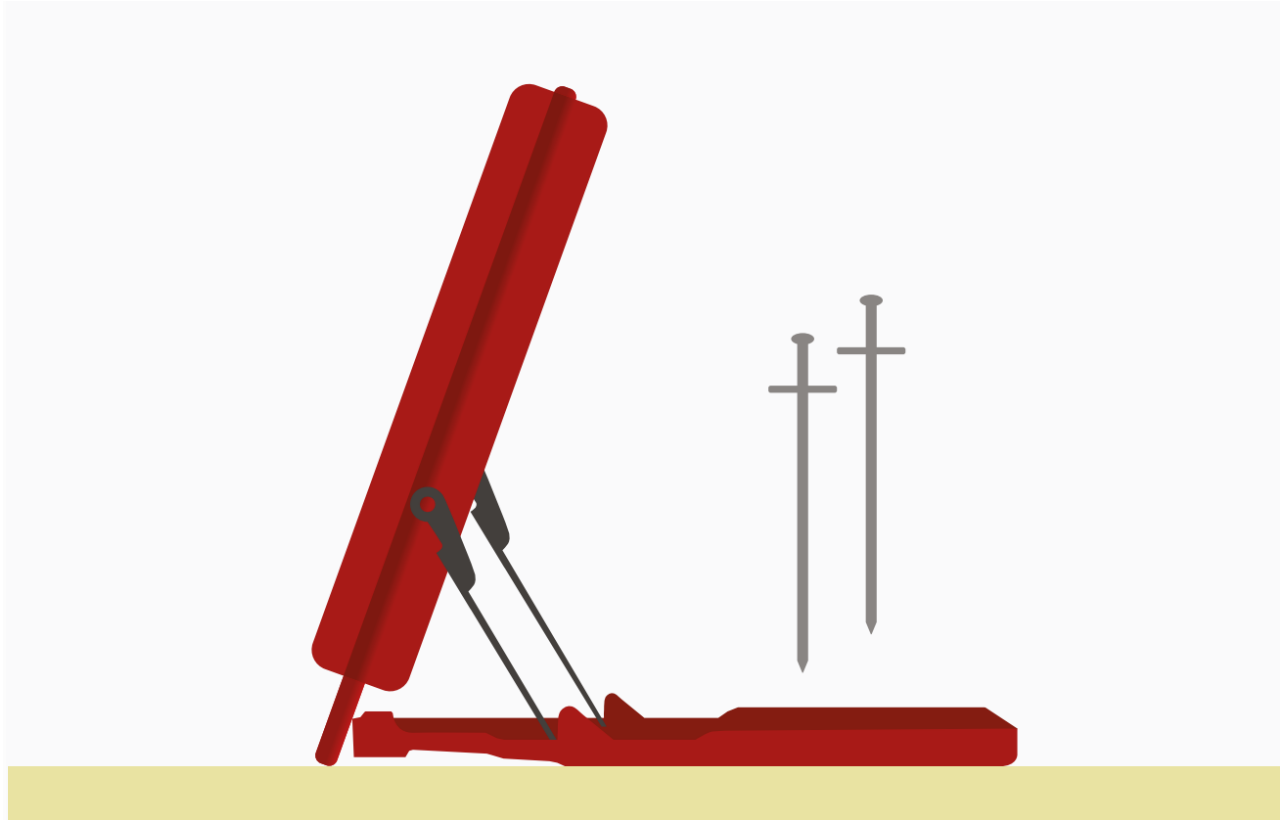
Tripod Mount

The Track Box includes a metal bracket that can be fitted to a standard UNC thread of a tripod. The Track Box can then be mounted to this using the upper 2 magnets, which provide enough hold to secure the Track Box to the tripod mount.



Depending on the tripod design it may be necessary to weight or secure the tripod in some way.

Free Standing



The mount can also be used as a stand with the Track Box standing on the ground angled upwards.

On soft / uneven ground it may be necessary to use the supplied stakes to secure the Track Box in position, these can be pushed slotted through the stake holes and then pushed into the ground.

Optimising Read Rates

Transponders

Track Boxes will only perform according to specification when participants transponders are worn correctly, when using bib transponders this means that the bib is worn on the front of the torso and is not covered.

Higher performance can be expected when transponders are in free air, such as when using MTB number plates or seatpost stickers. Weaker or more restricted transponders, such as HuTags or Disposable Triathlon Transponders, will result in reduced performance and are not recommended to be used.

Please note that old transponder types or models may not work with the Track Box, the device is optimized to work with the RACE RESULT passive transponder.

Angle of Antenna

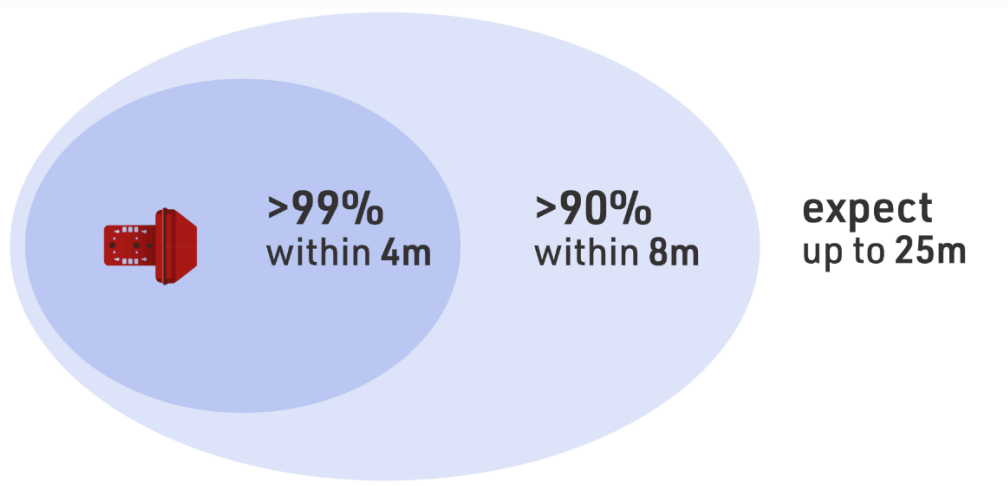
To maximize the opportunity to detect transponders, Track Boxes should be setup perpendicular (90 degrees) to the direction of travel. This increases the opportunity to detect transponders which may be worn incorrectly and also helps to ensure transponders are detected regardless of the direction of travel.

If Track Boxes are angled to face participants then the transponder can only be detected when worn visibly on the front, this also increases the distance between antenna and transponders which may reduce read rates.

Single Box Performance

Although the Track Box may detect passive transponders up to 25m away, long distances will result in reduced read rates.

When using a single Track Box then the maximum width should be restricted to 4m, this can offer read rates >99% when setup correctly.

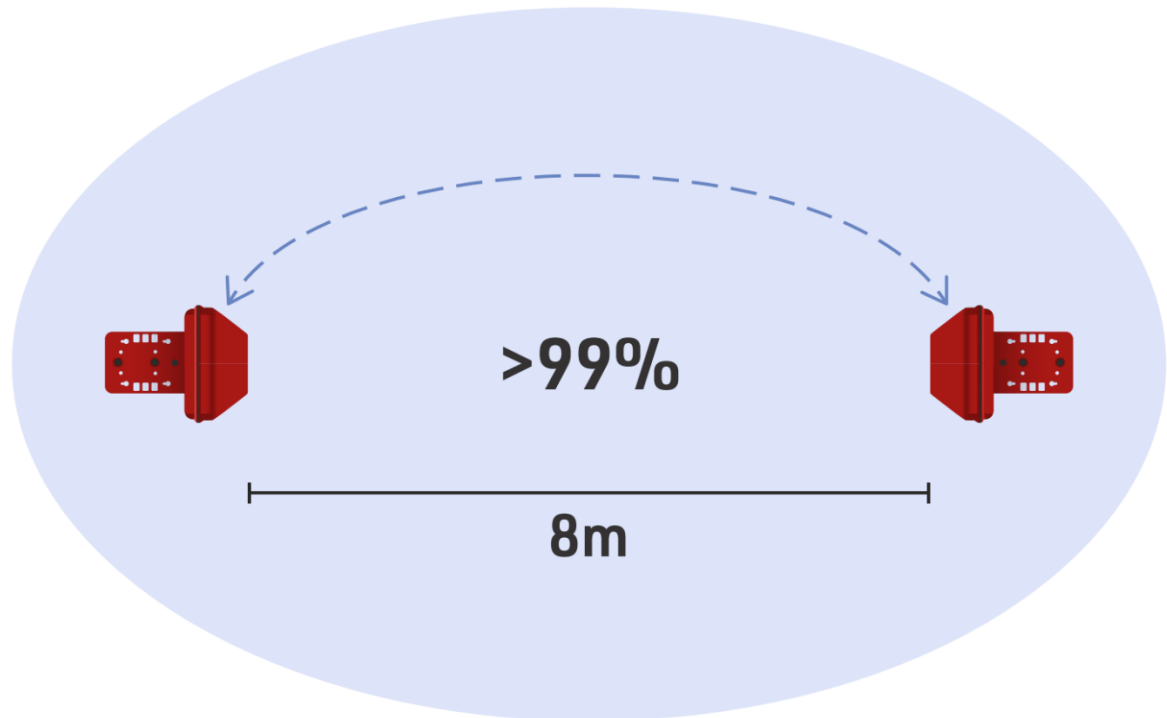


Dual Box Performance

Track Boxes are optimised to be used in pairs with boxes set up on opposing sides of the timing point using [Dual Track Box Synchronisation](#).

Nearby boxes communicate with each other using the built-in 2.4Ghz and automatically synchronise their readers to prevent interference between them.

In this setup then >99% read rate can be achieved at up to 8m wide.



Setup of Multiple Systems

Track Boxes should not be set up in close proximity to other timing systems such as other Track Boxes (which are not paired using [Dual Box Synchronisation](#)) or Decoders with folding ground antenna / high-gain antennas.

When set up with overlapping read zones then you should expect a severe reduction in read rates, for this reason a minimum distance of 20m should be observed between multiple systems.

Setup Precautions

Track Boxes on the Ground

When setting up Track Boxes on the ground, ensure the lower section of the box has an unobstructed view of transponders. Any obstruction such as wet grass, leaves or branches will limit the field of view of the lower internal antenna significantly!

Similarly, the Track Box should not be below the surface of the road, in this setup, the lower antenna has a partially restricted field of vision and creates a zone in which the transponder cannot be read

In this setup, we can see the Track Box is below the surface of the road (as shown by the grey line). The lower antenna can only transmit above the surface of the road thus transponders can only be read in the green shaded area, transponders in the red area cannot be activated by the Track Box and so will not be read.

Other common mistakes include:


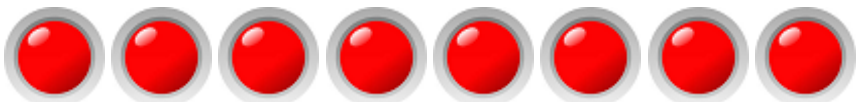
- Not expecting spectators/assistants to stand in front
- Not using stakes or heavy weights to secure the stand








LED Blink Codes, Button & Beeper

LED Blink Codes

The Track Box has 2 LEDs on the front, the left is red/green and the right is blue, each LED indicates a different function

Red/Green LED

	<ul style="list-style-type: none"> - less than 20s (directly after turning on) -> Firmware upgrade in progress - during operation and without beep -> Strong reflection (See Error Code descriptions) - with continuous beep -> Fatal Hardware Error (See Error Code descriptions)
	<p>SIM Card error</p>

	no GPS, Network OK
	no GPS, no network
	GPS OK, no network
	no GPS, network OK Receiving active Track Pings!
	no GPS, no network Receiving active Track Pings!
	GPS and network OK
	GPS and network OK Receiving active Track Pings!

Charging:



Battery full



Battery not yet full

Note: the Track Boxes are always on when charging.

Blue LED



On (Solid) - Passive reader active

On (Flashing Rapidly) - Passive reader active and detecting transponders

Off - Passive reader switched off

Note: See [Orientation of Track Boxes](#) to understand the conditions in which the passive reader will be switched off

Button

Press button to switch on.

Keep the button pressed for 1 second to turn off. If the Track Boxes are stacked, or very close to each other, they will send a shutdown command via 2.4GHz to shut down all boxes in the stack.

You can reset the Track Box by pressing the button for 10 seconds.

If the Track Box is locked via [Tracking Box Configuration Rules](#), the LED will not blink at all and the button won't turn off the box. You can still reset the box by pressing the button for 10 seconds.

Beeper

The internal beeper will signal a passing similar to the decoder beep. While the decoder beeps as soon as a transponder is in range, the Track Box Passive beeps when the actual passing has been created.

When you hear a continuous beep and see the box blinking red/green, it signals a fatal error (see above).

Error Codes

An error code (indicated by a continuously flashing red/green LED) can indicate one of two possibilities.

Strong reflection in front of the antenna - no beep

In most cases, an alternating red/green LED indicates a strong reflection in front of the antenna and you should check the surroundings of the box.

This can be anything in front of or around the Track Box, Most commonly (too much) metal, but it could be simply a person standing in front of the Track Box. You can easily test this by

placing your hand in front of the antenna. The box will immediately start blinking red/green and should stop shortly after the antenna has no objects obstructing its view.

Remove everything in a minimum radius of 50cm (2ft) around the Track Box, particularly on the front side.

Fatal Hardware Error - continuous beep

If the box has no obstructions which could be causing reflections and the error code is always present then this may indicate a fatal hardware error

How Passive Track Boxes Work

Below is some key information about how the Track Box (Passive) works to help maximise the performance of the device.

Battery & Charging

Battery Life

The Track Box (Passive) contains 4000mAh 3,7V Li-Po batteries with a total capacity of 45Wh, this offers expected battery life between 12-18 hours.

Battery life will be reduced if transponders are continuously in range, since the reader must process these chip reads and transmit them to the server. For example if a test transponder is left in the antenna field for the whole day then you should expect shortened battery life.

Battery life can be extended by using [Standby Mode](#) which is further explained in the article below.

Charging

The Track Box (Passive) uses the same connector type as Loop Boxes and supplied with the Track Box (Active), an additional splitter is provided allowing 2 Track Boxes to be charged simultaneously.

Charging time depends on the status of the reader.

Reader OFF (Standby Mode) - 6 hours

Reader ON (Reading Transponders) - 10 hours

The Track Box can only charge when the temperature is between 0°C and 40°C.

External Power Input

It is possible to connect the Track Box (Passive) to an external power supply such as 12v battery or solar panel.

When connected to an external power source the Track Box will completely use the power input before switching back to the internal battery. If using an external battery then the Track Box will stop drawing power when the input drops to 10.8V in order to protect the life of the external battery.

It is also possible to connect the Track Box to a solar panel, particularly useful for permanent installations. The Track Box has a dedicated [Solar Mode](#) which is further explained in the article below.

Standby Mode

Track Boxes feature a standby mode which when enabled switches off the passive UHF reader (Transponders are NOT detected).

With the reader switched off, battery life is vastly increased offering a total standby time of up to 7 days, this also helps to reduce charging time.

Reader status is indicated by the [Blue LED](#), when OFF the reader is switched off, when ON the reader is switched on and active.

Standby mode can be enabled in 2 ways.

Lay-Flat Standby

When a Track Box is laid flat with the antenna pointing upwards, then the reader will automatically enter standby mode. The reader will be automatically enabled when the angle is raised and will begin detecting transponders.

This mode is most useful when charging, since Track Boxes can be stacked on top of one another and charged simultaneously using the dual charger adapter, and also prevents unnecessary reading of transponders which would otherwise result in increased mobile data consumption.

This is not activated when the Track Box is laid flat with the antenna pointing down, this is to allow for applications where the Track Box is mounted overhead and angled downwards to detect transponders.

Lay-flat standby may also be useful when setting up and testing connectivity at timing points without enabling the reader yet thus preserving battery life.

Track Box Configuration Rules

Track Box configuration rules can be applied through RACE RESULT 12, these allow the mode of Track Boxes to be set and defined for specific time windows. When standby mode is enabled in this way then the rate at which the Track Box communicates with servers is reduced, only sending periodic status updates, further reducing power consumption.

This mode allows for devices to be setup in place in advance with the reader off to preserve battery which will then automatically enable at the configured time.

Solar Mode

Solar Mode allows a Track Box to be permanently operated in remote locations without any additional electronics. The Track Box can automatically detect when it is connected to a solar panel and will optimize the solar power output by adjusting its power consumption.

Enabling Solar Mode

Solar Mode is enabled when the input voltage rises above 17V, this remains enabled until the next reboot of the Track Box. If the panel voltage drops below 10.5V, the Track Box switches to a lower power mode which will reduce the rate of battery charging but is always sufficient to cover the power consumption of the box itself. It automatically retries to step up to a higher power mode once every 20 seconds.

Solar Mode Power Consumption / Charging

In Solar Mode, the Track Box tries to maximize the solar cell power by adjusting its input power between 10W/8W/6W/4W depending on the power received from the solar panel.

At 4W, the internal batteries will not be charged, but the power consumption of the box itself is covered. At 10W, it takes about 10h to charge the Track Box from 0% to 90% when the reader is turned on.

When in solar mode a solar panel will be indicated in the Timing Tab of RACE RESULT 12. A cloud or a sun indicates whether the panel is currently providing power, or not.

In normal solar applications with partly cloudy days, expect the battery to hover around 75%. This is due to the slower charging speed at a higher charge, once the battery is above 80% you would need several hours of perfect sun, to reach 100% battery.

Charging a Track Box that has been connected to a solar panel from mains power will take longer than usual, as the Solar Mode prevents the Track Box from exploiting the voltage. Reboot the Track Box first and then connect to a Mains Power supply to charge the Track Box.

Additional Considerations

- You can connect a Solar Panel directly to a Track Box, provided your panel meets the solar cell requirements below, No additional electronics are required.
- Make sure the solar panel is oriented for optimal performance. Be aware that output power suffers greatly if the panel is not fully exposed to direct sunlight (even the shade of a small branch could be enough to ruin your solar output power).
- On a warm sunny day with >12h of sun, the internal batteries may allow for 24/7 operation.
- For most installations, it is recommended to use AUTOSTANDBY during the night when no solar power is generated. This way you should have sufficient battery in reserve, even on overcast days.
- If the battery reaches empty, the Track Box will automatically restart as soon as the Solar Cell delivers sufficient power for operation again.
- When placed in direct sun on hot days the Track Box may get too hot to charge (see datasheet). In this case, it may make sense to use the Solar Panel to provide shade for the Track Box.
- In Solar Mode the read rate (how often the reader looks for transponders) will be reduced by 50% if the solar power input is low AND the battery is less than 75%. If either condition is not met, the Track Box will operate with the full read rate. This feature will save battery allowing for longer battery life. This may have an impact on races with high speed or high density but will have no noticeable difference for general application.

Solar Cell Requirements:

- 17V nominal "12V" Panel class - see attached datasheet for more details
- 25V DC MAX Voltage at no load (WARNING, never apply more than 25V!)
- min 10W (30W or 50W recommended)

We recommend the following

<https://www.newpowa.com/products/newpowa-30w-12v-monocrystalline-solar-panel>

<https://www.offgridtec.com/generatoren/solarmodule/12v-24v-solarmodule/offgridtec-30w-mono-12v-solarpanel.html> - sufficient for mostly good weather

<https://www.offgridtec.com/generatoren/solarmodule/offgridtec-50w-mono-12v-solarpanel.html> - provides better reserves for bad weather

Time Synchronisation

The Track Box (Passive) has 2 methods for synchronisation of the internal clock, Track Boxes are always synchronised to UTC time and the time recorded in your event file will be based on the event time zone. The Track Box will continuously micro-adjust the time using either method to ensure the time is always as accurate as possible.

GPS Time

The Track Box will primarily use the on-board GPS module to synchronise to GPS time, this will provide the most accurate time in all scenarios. Leap Seconds will be automatically accounted for by the firmware to the current default.

NTP Time

In the event that GPS time cannot be retrieved then the box will next attempt to synchronise using NTP through GSM. In this case the Track Box will attempt to communicate with 3 different NTP servers to maximise the precision. If the variation between different NTP servers is too great, which may be caused by weak GSM signal and communication delays, the box will continue to communicate with the NTP servers until an accurate time can be achieved.

Detection Algorithms

Passive Transponders

Reaction Time & Dead Time

Similar to the [RACE RESULT Decoder](#) the Track Box (Passive) uses a detection algorithm to maximise the accuracy of recorded times.

The 2 key settings are the [Reaction Time](#) and [Dead Time](#), which by default are set differently on Track Boxes due to their design.

The default Reaction Time is 10 seconds, the reason for this is that with antennas mounted to the side there is much greater chance of early detections, particularly if the Track Box is facing participants. A low reaction time may result in a less accurate time being recorded, by increasing this to 10 seconds it provides greater chance to record an accurate time. This

does result in data being sent to the servers after a minimum of 10 seconds, so if speed of data is more critical than accuracy then this could be reduced.

Dead Time is set by default to 20 seconds, meaning that after a time is recorded then another passing will not be captured for 20 seconds, beware if using this on short laps or turnarounds. If multiple passings are expected within a shorter time then this can be reduced as necessary.

Both reaction time and dead time can be configured using [Track Box Configuration Rules](#).

Hits & RSSI

When using the Track Box (Passive) you should also expect less hits compared to a RACE RESULT Decoder with standard antenna, this is due to the communication protocol used between Track Box and Transponder.

The reader will only communicate with each transponder in one of every 5 cycles, this maximises the opportunity for other transponders to communicate with the reader and thus maximising overall read rates.

Guidelines for RSSI values remain the same as [Decoder detection data](#).

Active Trackpings

The Track Box (Passive) can also receive Trackpings from active transponders which have tracking mode enabled. For this the channel must be set in the same way as a Track Box (Active).

For more information see [How Active Track Boxes Work](#).

Dual Track Box Synchronisation

As with all UHF timing systems a transponder should only be in the field of one reader at any one time, furthermore, the strong output of one reader may inhibit the receive antenna of another box when directly facing each other.

To avoid interference between devices, Track Boxes feature dual box synchronisation which prevents the collision of the UHF readers, two boxes will automatically synchronise their UHF Readers to optimize read performance when:

- The 2 boxes are within close range to each other (approx. 20m)
- Both boxes are set to the same 2.4GHz channel
- Both boxes have their reader turned on (not in standby or laying flat)

When dual box synchronisation is active the green LED (to indicate GPS & Network OK) will switch to a quick double blink.

Dual box synchronisation is always enabled automatically regardless of the orientation of antennas, as even 2 boxes with their back to each other may experience some interference. Synchronisation is automatically disabled if the above criteria are no longer met, for example if the boxes are moved apart.

Synchronisation of boxes is only possible between 2 boxes, you cannot synchronise more than 2 boxes within 20m range.

If you have multiple boxes in close range, then you can create pairs of devices by setting the channel accordingly for each device. In this case, you should take care that any 2 boxes which are not synchronised do not have overlapping fields which may cause interference. It is possible to disable dual box synchronisation using [Custom Track Box Configuration Rules](#).

When synchronised, each box will reduce its read rate to 30x per second from 50x per second (when in normal single box operation), this will result in reduced hits per box, however, the sum of hits from both boxes will be roughly equal to that of a single box.

Regulatory Information

Human RF Exposure

To comply with exposure requirements of the EU, US and Canada, this device must be operated at a minimum distance from all persons of at least 30cm/1ft.

Radio Transmitter (FCC Part 15)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Radio Frequency Interference Requirements - FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna. Increase the separation between the equipment and receiver. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. Consult the dealer or an experienced radio/TV technician for help

Radio Frequency Interference Requirements - Canada

CAN ICES-3 (B)/NMB-3(B)

This device complies with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Statement of Compliance - EU/ETSI

race result AG hereby declares that this radio equipment is in compliance with Directives, 2014/53/EU and 2011/65/EU.