## Temperature & depth logger and diving duration logger

The CREX-based trackers as well as all LRD GPS-UHF ones like URIA, STERNA and PICA can be equipped with temperature and hydrostatic pressure sensor and TDR functionality. This sensor can record hydrostatic pressure (diving depth), temperature as well - in lower resolution - the barometric pressure (altimeter).

The separate/In contrast to the TDR, the wet/dry sensor is present always when TDR is installed, as well always in LRD GPS-UHF trackers. The wet/dry sensor can be used to record diving duration, for diving detection as a trigger for TDR and to disable the GPS work under the water.

The wet/dry sensor allows to record each diving duration with the time stamp at the beginning and at the end of each dive. This sensor is calibrated to work in fresh and seawater. To avoid recording of the false dives - when bird just splashes in the water or when water floods the sensor - recording may be started after 4 or 8 seconds after detecting the immersion, and it depends on chosen "sensitivity" settings.
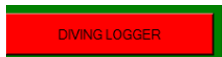
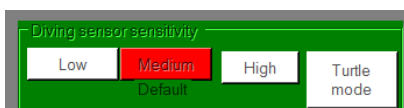**Sensor configuration from Tracker's menu:**
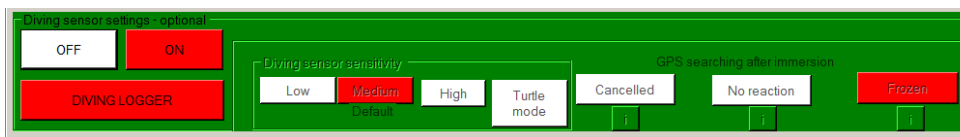
- Sensor activation is necessary to detect diving or use loggers.

- When the "diving logger" function is not activated, diving duration logger as well TDR will not work. Only the wet/dry sensor will be active to prevent GPS positioning under the water.


- Sensitivity/delayed immersion detection:

- Low: 8 seconds delay (for conditions when 4 seconds delay does not eliminate false diving)
- Medium: 4 seconds delay (recommended for most projects)
- High: 0 seconds delay (for not diving species like gulls to detect contact with water or for species that do not float but dive to get the food like osprey, kingfisher, terns etc.)
- Turtle mode – specific settings for animals which stay very long time under water, even for months. In all above mentioned settings the wet/dry sensor will be disabled when diving is longer than 30 minutes to avoid permanent disabling of the GPS in case of shortening the sensor pins by any object like algae, wet feathers or plants etc.

Please test above options to find optimal settings for your species, its behavior and local conditions.

The gold pins are used as a sensor pins, but in case of all SRD loggers they serve to charge the batteries. In CREX, KITE or HARRIER loggers they can not be used to recharge the battery.

- Action after diving detection
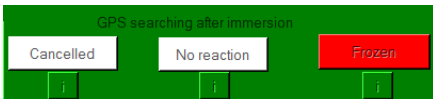
When scheduled GPS search starts just before or during the diving, some different reactions of the logger are possible:

- Cancelled - diving switches off the GPS receiver till the next scheduled position search.
- No reaction - diving sensor is used only by the diving logger and do not affect the GPS work. It is not recommended setting due to much faster battery discharging because of unsuccessful work of the GPS receiver in environment without GPS signal.
- Frozen - the most recommended choice for diving species. Diving pauses the GPS work. GPS continues work after emersion. When time on the water surface is too short to calculate position, this process is repeated till reaching "GPS work time limit" which usually is set to 90 seconds.

The temperature and depth sensor

The hydrostatic pressure [mbar] is recorded every one second when changes of the pressure are >2 mbar. When pressure do not change, the readings are not recorded to save memory. The hydrostatic pressure and temperature are recorded only when diving is detected by the wet/dry sensor.

When logger is programmed to record altitude

The barometric pressure as well altitude & speed calculated by the GPS module will be recorded together which each GPS position.

Sensor parameters:

Operating range: 0 to 30 bar (0-300 meters depth), -20 to +85 °C

Overpressure protection: max 50 bar

Absolute accuracy:

- pressure within range: 0 - 6 bar & temperature 0 - 40°C: +- 50 mbar
- pressure within range: 6 – 30 bar & temperature 0 - 40°C: +- 100 mbar
- pressure resolution: 1 mbar (temperature compensated)
- temperature accuracy: +- 1.5 °C
- temperature resolution: 0.01 °C

Real accuracy:

- pressure: +-10mbar (+-10 cm depth)
- temperature: +- 0.25°C

The hydrostatic pressure is temperature compensated but measurements recorded just after immersion may be slightly less precise due to logger's thermal inertion, especially when bird dives from hot air to cold water or when the device is warmed by the body after a long flight.

Sample raw data from temperature & diving pressure sensor combined with wet/dry sensor:

The raw data presented below are used only for explanation and better understanding of the logger's work. The diving data will be calibrated automatically and extracted to csv format by the firmware coming together with the Tracker's package.

…

DIV DOWN 24-01-18 12:14:16 HAR30   *(immersion detected)*

PH=1101 T=492 12:14:16   HAR30   *(hydrostatic pressure & temperature recorded)*

TLGW24-01-18 12:14:16   HAR30   *(GPS positioning disabled – "FROZEN" function)*

PH=1119 T=488 12:14:18   HAR30   *(hydrostatic pressure & temperature recorded)*

…

PH=1189 T=479 12:14:23   HAR30   *(hydrostatic pressure & temperature recorded)*

PH=1207 T=479 12:14:24   HAR30   *(hydrostatic pressure & temperature recorded)*

                                         (not recording ->hydrostatic pressure not changed > 2mbar)

PH=1189 T=452 12:14:48   HAR30   *(hydrostatic pressure & temperature recorded)*

…

PH=1017 T=424 12:14:56   HAR30   *(hydrostatic pressure & temperature recorded)*

PH=1016 T=435 12:15:03   HAR30   *(hydrostatic=barometric pressure recorded just after emersion)*

DIV UP   24-01-18 12:15:03 HAR30   *(emersion detected)*

24011812195428789N01833944E2.630   *(after emersion GPS calculation defrosted, position recorded)*

INFO t=8S=10U=4.14T=4.0   HAR30   *(operational parameters to the GPS position recorded)*

H=0021 24-01-18 12:19:23 HAR30   *(altitude calculated by the GPS recorded)*

PA=1015 T=514 12:19:24   HAR30   *(barometric pressure recorded)*

Sample raw data from only wet/dry sensor:
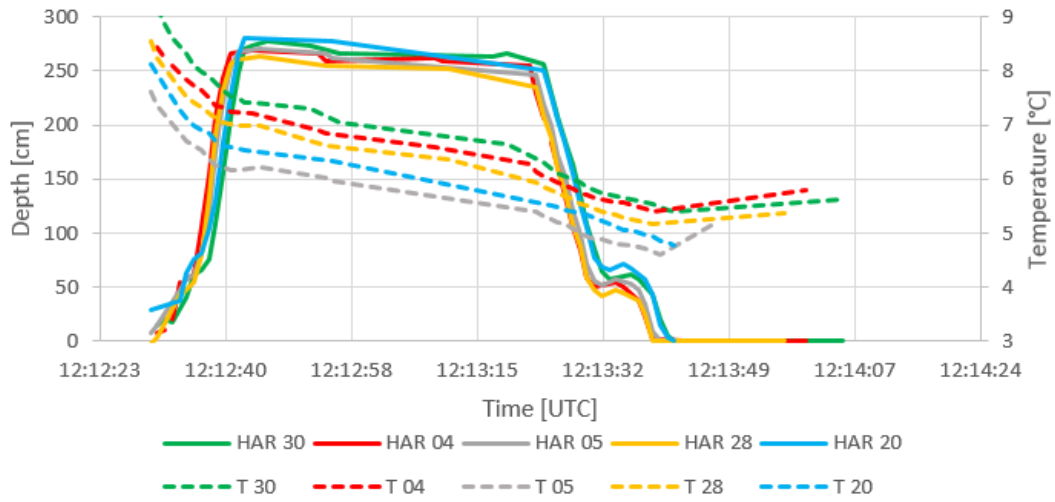
…

DIV DOWN 24-01-18 12:14:16 HAR30   *(immersion detected)*

TLGW24-01-18 12:14:16   HAR30   *(GPS positioning disabled – "FROZEN" function)*

DIV UP   24-01-18 12:15:03 HAR30   *(emersion detected)*

24011812195428789N01833944E2.630   *(after emersion GPS calculation defrosted, position recorded)*

INFO t=8S=10U=4.14T=4.0   HAR30   *(operational parameters to the GPS position recorded)*

H=0021 24-01-18 12:19:23 HAR30   *(altitude calculated by the GPS recorded)*

The last record "PH=1016 T=435 12:15:03   HAR30" has been recorded at the water surface (level 0) and should be used for precise calculation of the diving depth. From the value 1016 all pressure values recorded in this particular dive have to be subtracted to calculate real and well calibrated diving depths.

Please note that the beginning of the each dive usually will be recorded from some depth below the water surface and it depends on the delayed detection of the immersion (see settings of the sensitivity).

Dive test - five loggers in one bunch

Legend: HAR 30, HAR 04, HAR 05, HAR 28, HAR 20, T 30, T 04, T 05, T 28, T 20

Sensor test to >60 m depth

Legend: mBar