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<td>27.09.2012</td>
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1 Product overview

The GPS Plus collar offers the possibility to measure and store

- the position of the animal in WGS84 coordinates
- the temperature profile of the collar
- the activity scheme of the animal

Based on the activity of an animal, the collar can create an mortality event message to immediately inform the user that the collar has not been moved for a certain time. It is also able to switch automatically to hibernation mode to save battery power if the animal’s movement and activity schemes are quite low and will re-enter normal operation if the animal is moving again.

All data is stored in the on-board non-volatile memory and can be downloaded via cable, VHF-/UHF link, GSM or satellite. Activity data can only be downloaded via VHF-/UHF link or cable. VHF, UHF, GSM and Iridium also provide upload possibilities for schedules.

To simplify collar recovery, a timer- or a radio-and-timer-controlled drop-off mechanism is available on demand.
Fast guide to deploy the collar

To get your GPS Plus collar working properly, you need to follow some basic steps:

In the lab/office/field station (magnet needs to be attached to the electronic housing to keep collar in stand-by mode, otherwise the collar will perform GPS fixes and transmissions):

1. Make yourself familiar with the collar and its part
2. Attach the GPS Plus collar to your PC with the Link Manager
3. Check and maybe change the configuration of the collar:
   - GPS schedule
   - VHF beacon schedule, pattern and configuration
   - Argos schedule
   - GSM schedule
   - mortality/hibernation sensor
   - activity sensor
   - Argos, Iridium or Globalstar mode
   - proximity sensor
   - drop-off made and lifetime (please refer to GPS Plus Drop-off Manager Manual)
4. Do a lifetime calculation (optional)
5. Test the collar for performance of sensors and data interfaces/transfer. Do not trigger the drop-off! It can only be used once!

When deploying the collar

6. Make sure the communication connector endcap is in place to protect it from dirt and humidity
7. Adjust the belt to the correct circumference for the animal
8. Make sure the magnet is removed from the electronic housing and from the drop-off, otherwise it stays deactivated and will not perform any GPS fixes or transfer data, and the drop-off will not release the collar

The steps of this list will be explained in more detail in the next chapter.
3 The GPS Plus system

The GPS Plus collar is a modular system based on a standard collar set-up that can be customised and upgraded to your personal needs in size, battery life, data interface and sensors. Handling and software for all collars is identical. This enables you to manage all collars with the same software and database; handling of several collars becomes easy.

3.1 The collar

The basic GPS Plus collar consists of the following components shown in Figure 1:

- the antenna and electronic housing containing the GPS antenna, the temperature sensor, the activity sensor (optional), the GSM antenna (optional), the Iridium antenna (optional) and the Globalstar antenna (optional)
- the magnet, which is attached to the electronic housing when the collar is turned off
- the communication connector for the Link Manager
- the battery pack with integrated battery connector and the drop-off (optional and with own magnet)
- collar belt with harness and integrated VHF/UHF- antenna in the right side of the collar
- the external Argos antenna (optional)

The collar is designed to function at extreme temperatures (-45°C to +70°C) and to be completely water proof (withstands total immersion).
3.2 Beacon

To locate your animal with VHF tracking, collars are equipped with VHF beacons. The beacon battery is independent from the GPS battery, so you might be able to locate the collar even after the GPS has stopped working (depending on your schedules).

The beacon is also able to transmit the status of the animal or the collar. The default pattern is mode 0 with one signal of 12 ms every 1.5 s (Figure 2 top). If no activity has been detected for a user-defined time span, the signal will switch to the mortality mode: one 6 ms signal per 750 ms (Figure 2 centre). If the battery is low, there will be a double signal of 6 ms each during the 1.5 s interval (emergency signal, Figure 2 bottom).

![Beacon patterns](image)

**Figure 2: Beacon patterns for default mode (mode 0), mortality mode and emergency mode**

Each collar beacon transmits on its own frequency, but you can also choose between four different beacon patterns. You can change the standard pattern in GPS Plus → Collar Mode → Commands → Collar Configuration → Beacon Pattern.
3.3 Drop-off

There are two optional drop-offs available:

GPS Plus collars offer several options of communication interfaces between the scientist and the collar. The modular concept of this collar allows you to buy only the components you need.

- **Timer-controlled drop-off**: The collar is released after a pre-defined period of time (relative mode, e.g. 100 weeks) or at a pre-defined date and time (absolute mode, e.g. 01 April 2013). The lifetime of the drop-off is up to four years after production. Release time in relative mode starts after removal of drop-off magnet.

- **Radio-and-timer-controlled drop-off**: The collar is released on demand by UHF radio signal from a maximum distance of 500 m (depending on terrain). Additional timer control (relative or absolute mode) functions as backup. The lifetime of the drop-off is up to three years after production.

Figure 3: Top: Position of drop-off magnet for stand-by mode. Bottom: Position of drop-off release sites, magnet removed.
3.4 Data interface

GPS Plus collars offer several options of communication interfaces between the scientist and the collar. The modular concept of this collar allows you to buy only the components you need.

- **Cable interface – Link Manager:** All GPS Plus collars can be accessed via Link Manager (Figure 4), a small device you can attach by cable to the collar and to a USB port on your computer. Combined with the Windows based GPS Plus management software this is a powerful tool to upload configurations, schedules and to download measurement data or show collar status information. Some collar configurations (e.g. activity sensor settings) can only be changed using the cable interface, not remotely.

- **VHF/UHF radio link:** At any time you can get in contact with the collar via the VHF or UHF radio link. Using the GPS Plus Handheld Terminal (Figure 5), you can download GPS positions, temperature, activity and mortality data. This interface is especially interesting if you want to download activity data remotely. You can also upload new schedules.

- **GSM communication:** If GSM coverage is present in the study area, you will get your data onto your PC almost in real-time. Depending on the schedule you choose, the animal’s position, mortality, and proximity events will be sent automatically via SMS (text message, free choice of provider) to a ground station and from there to a computer. You can also send new GPS or beacon schedules via SMS from the ground station and upload new configurations. In addition, the GPS Plus software is able to forward the received SMS to a specified email address or a community.

- **Satellite communication:** You can choose between the satellite systems Argos, Iridium and Globalstar to transmit data from the collar.
  
  o The Argos satellite communication module gives you worldwide access to the GPS data of the tracked animal. It is a one-way communication system: the collar transmits the same GPS position message several times to the satellites to increase the probability that the message has been received, but no confirmation is sent by the satellites.
satellites. To reduce costs, transmission time can be restricted to a six hour window (defined by Argos) and to certain days (e.g. every second or third day between 06:00 and 12:00). Due to the inclination of the satellite orbits, coverage in the polar region is better than at the equator. Argos needs an external antenna on the collar.

- The Globalstar SIMPLEX service is a one-way only communication like Argos, but it uses a satellite network of 48 satellites with 24 hour coverage. The GPS data are repeatedly sent to the satellites, but no confirmation is sent by the satellites. The Globalstar antenna is integrated into the electronic housing. There are areas not covered by Globalstar yet (Figure 6), so please check the availability in your study area.

- Iridium offers a two-way communication using a satellite network of 66 satellites with global coverage for 24 hours per day (Figure 6). You can download GPS data, and upload GPS and beacon schedules. Due to the two-way communication, the collar knows which data have been received by the satellite and which data need to be resent again. The Iridium antenna is integrated into the electronics housing, but it is relatively heavy. The smallest available size is currently a GPS Plus-2 collar with Iridium, weight around 800 g.

Depending on the communication options of a collar, different information can be exchanged with the collar. Table 1 shows gives a summary of these data.
Table 1: Options for data transfer using different communication options

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* ID number of UHF tags only are downloaded via GSM. Full data sets including time stamp and signal strength can be downloaded via UHF or Link Manager USB interface.

3.5 Data format

All data is stored in binary format and can be exported as ASCII, Spreadsheet, DBase, and BioTelemetry eXchange format. GPS data can also be exported as GPS Exchange and Google Earth files.

- **GPS position information**: Date and time, latitude/longitude/height, DOP, 2D/3D navigation, number of used satellites, satellite PRN code and carrier to noise ratio, main and VHF beacon battery voltage, temperature. Data is saved as GDF file and can be accessed with GPS Plus.

- **Temperature**: Date and time, logging same as GPS fixes or activity sampling interval. Temperature is stored with the GPS and the activity data in the .GDF and .ADF files.

- **Activity (optional)**: Date and time, different activity modes measuring acceleration X, acceleration Y, head angle. Activity is stored as .ADF file and can be accessed and analysed with the GPS Plus and Activity Pattern software.

- **GSM information**: Time and date of GSM communication, RSSI (received signal strength indicator), and bit error rate. This information is stored in every SMS.

- **Mortality information**: Date and time of a mortality event based on the activity of the animal.
3.5.1 List of files and extensions used

Table 2: Download files

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| .GDF      | GPS Data File | Binary coded GPS fix data from collar, handheld terminal, or GSM ground station including main battery voltage, VHF beacon battery voltage, and temperature. The file name consists of the collar number and the time stamp of the file creation coded as “yymmddhhmmss”.
| .ADF      | Activity Data File | Coded activity data from collar or handheld terminal including activity and temperature. The file name consists of the collar number and the time stamp of the file creation coded as “yymmddhhmmss”.
| .SMS      | GSM Message File | Contains one GSM or part of a Globalstar/Iridium message with GPS data. The file name consists of the collar number and the time stamp of the SMS coded as “yymmddhhmmss”.
| .PRX      | Proximity Sensor Data | Contains data from proximity sensor including signal strength and time stamp.

Table 3: Export files

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<tr>
<td>.TXT Spreadsheet</td>
<td>Computer readable table, compatible to conventional text editors and spreadsheets</td>
</tr>
<tr>
<td>.DBF DBase Table</td>
<td>Database format, compatible to conventional spreadsheets and most text editors</td>
</tr>
<tr>
<td>.GPX GPS Exchange Format</td>
<td>File for data exchange with GPS devices</td>
</tr>
<tr>
<td>.KML KML</td>
<td>Google Earth file</td>
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<tr>
<td>.KMZ KMZ</td>
<td>Zipped Google Earth file</td>
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<td>.BTX BioTelemetry eXchange</td>
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Table 4: Upload files

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<tr>
<td>.BRF Beacon Rule File</td>
<td>Rules for both UHF and VHF beacon schedule</td>
</tr>
<tr>
<td>.GRF GPS Rule File</td>
<td>Rules for GPS schedule</td>
</tr>
<tr>
<td>.VFC Virtual Fence Collection</td>
<td>Coordinates for Virtual Fences</td>
</tr>
</tbody>
</table>
Table 5: Hardware information files

<table>
<thead>
<tr>
<th>File Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCF</td>
<td>Collar Configuration File contains the configuration (schedules, communication configuration, activity mode) for the collar</td>
</tr>
<tr>
<td>COL</td>
<td>Collar Firmware File contains firmware for collars</td>
</tr>
<tr>
<td>KEY</td>
<td>Collar Key File contains a key for one collar, needed to register the collar in the GPS PLUS Collar Manager and to manage its data</td>
</tr>
<tr>
<td>TCF</td>
<td>Terminal Configuration File contains the configuration of the handheld terminal</td>
</tr>
<tr>
<td>TRM</td>
<td>Terminal Firmware File contains firmware for handheld terminals</td>
</tr>
</tbody>
</table>

3.6 Software

The GPS Plus collar comes with a software package including two programs:

The **GPS Plus Collar Manager** (GPS Plus) is used to configure and manage the GPS Plus/Pro Light collars, handle a GSM base station for SMS reception of collar data, and to configure and manage a VHF/UHF handheld terminal. GPS Plus allows you to generate schedules for GPS fixes, the VHF beacon, and remote communication. It manages all data on GPS positions, activity, mortality, temperature, virtual fence, and proximity sensor.

**Activity Pattern** is used to analyse activity data obtained from the GPS Plus collars. It can plot activity levels, calculate and plot mean and median of activity, analyse activity peaks, day-night relation of activity and perform biological time series analysis. All results can be exported as text or as graph.

Additionally, we offer the **GPS Plus Data Manager**, a program to organise your GPS and activity data in an SQL database and perform and store first analyses on your GPS data. It has interfaces to GIS and R, and thus allows further analysis without the need to export data to text files. A demo version is part of the free software package which comes with the collar. For more than three collars you need to purchase a license.
4 Handling of the collar

The collar is turned on or off with the magnet on the electronic housing (Figure 8). If the magnet is attached correctly, the collar is deactivated, thus no GPS fixes, transmissions, or activity measurements are performed. You need to attach the magnet for collar configuration and upload/download via the Link Manager interface.

The collar can be connected directly to your computer via the Link Manager cable interface (Figure 9) and the communication connector on the electronic housing. Connect the Link Manager’s plug of the long cable to the Link Manager connector on the collar. Connect the Link Manager to an USB port.

The link manager connector is protected by an endcap. Be careful when reattaching the endcap to not damage the thread. The endcap protects the connector from dirt and moisture.

**Note:** To save battery, leave the magnet on the collar during storage and do not leave the collar connected to the Link Manager if you do not use it.

**Note:** You can configure the collar only in the stand-by mode which is achieved by attaching the magnet to the collar.

**Note:** Do not use the collar outside, if the connector has no endcap!

If your collar has a drop-off mechanism, a second magnet is attached to the battery case (Figure 10). In case of a timer scheduled drop-off with a countdown setting (defined time period, e.g. 100 weeks), the countdown for the drop-off starts after removal of the magnet. In case of a radio-controlled drop-off, the mechanism is now receptive for the radio signal.

**Note:** The drop-off can only be used once. After it has been opened, the entire batterypack needs to be replaced.
Note: If you use a countdown drop-off, countdown will be reset whenever the magnet is attached to the collar and release time will begin again after the magnet is removed.

Note: If you use the timer scheduled drop-off with a defined date of release and the magnet is still attached on or after the release date, the drop-off will be triggered five days after the magnet is removed from the collar to allow reconfiguration of the release date.

4.1 Changing of battery pack

For all collars with exception of those with the 1C battery, the battery pack and the integrated drop-off can easily been replaced with caution to some fragile parts. Make sure to follow these instructions to prevent damage or leakage.

Note: Due to current leakage, up to 25% of battery capacity per year (depending on battery size) can get lost in a collar in stand-by mode. We therefore advice to remove the battery pack from a collar that is stored for several months. Currently it is not possible to remove the battery from a 1C collar.

Note: Be careful when un- or replugging the battery connector pins since they can break if bended.

Note: Store the battery package at room temperature.

4.1.1 Oval collar

Figure 11: Battery connector on oval collar

Unscrew the two nuts attaching the battery pack to the adjustable side of the collar with an 8 mm hexagon socket wrench (delivered with the collar, Figure 11, right) and remove the black base plate. The screws are integrated into the battery pack and cannot be removed.
Unscrew the two nuts and remove the washer on the non-adjustable side of the collar with the battery connector. **Carefully** pull the battery connector from the battery pack (Figure 12, left).

The battery pin socket is located between the two screws (Figure 12, centre). To attach a new battery pack, replace the sealing ring on the battery plug and **carefully** push the three threaded pins of the connector plug into the connector socket (Figure 12, right). **Be careful to avoid any damage to the connector!** Place the washer on the threaded pins and reattach the collar with new self-locking nuts to ensure that the sealing ring of the nuts is not damaged.

### 4.1.2 Round collar, standard battery pack

Remove the screws attaching the bracket to the battery pack with an 8 mm hexagon socket wrench (delivered with the collar, Figure 13, centre and right). Start with the screws on the adjustable side and then remove the screws attaching the battery connector.
Figure 14: Removing the battery connector from round collar, standard battery pack

Unscrew the nuts attaching the bracket to the collar to gain more flexibility around the battery pack (Figure 14, left). **Be careful when moving the battery pack.** Unplug the battery connector by **carefully** pulling the bracket away from the battery pack (Figure 14, centre). **Be careful to avoid any damage to the connector!** Remove silicon around the battery connector (be careful not to damage the cables). Replace the sealing ring on the battery plug. **Carefully** push the three threaded pins of the connector plug into the connector socket. Tighten the bracket to the collar with **new** self-locking nuts and screw the battery pack to the bracket with **unused screws** to ensure that the self-locking coating on the screws is not damaged. Apply fresh silicon around the battery connector to protect the contacts from humidity and to prevent sticks and debris from being caught between collar and battery pack.

4.1.3 Round collar, curved battery pack

Figure 15: Battery connector on round collar, curved battery pack

First remove the nuts for closing the collar with an 8 mm hexagon socket wrench (Figure 15, centre), then open the screws attaching the battery pack to the collar with a 3 mm hexagon socket key (“Inbus” or “Allen key”, delivered with the new battery pack) starting with the exterior screws (Figure 15, right).
Figure 16: Removing the battery connector from round collar, curved battery pack

Unplug the battery connector by pulling the collar away from the battery pack (Figure 16, left). You can support this by very carefully wedging a flat screwdriver between the battery connector and the battery pack (Figure 16, right). Be careful to avoid any damage to the connector!

Figure 17: Battery connector and plugs on round collar, curved battery pack

Figure 17 shows the battery socket (left) and pins (right). To attach a new battery pack, exchange the sealing ring on the battery plug and carefully plug the three threaded battery pins into the socket.

Figure 18: Attachment of curved battery pack to round collar with two metal base plates (left) and two Fastlock washers (right).
In older collars, the battery packs are fixed to the belt with six screws and three metal base plates. To avoid the base plates pressing onto the battery cable, new batteries are fixed with only two metal base plates and two Fastlock washers (Figure 18).

Figure 19: Attachment for curved battery pack on round collar. Left: metal base plate; centre: screw and Fastlock washer; right: angle to attach screws.

Put the black washer (Figure 19) with the convex side onto the collar (otherwise you will not be able to countersink the screw head) and carefully attach the collar with unused screws beginning with the central pair and then the pair at the side next which you will open to deploy the collar. Note that the exterior threads run radially to the curved surface of the battery pack. Take care to arrange the screw correctly to avoid damaging the thread.

Screw the last two screws into a Fastlock washer each (Tip: Use a piece of wood as shown in Figure 20 and countersink the screw into a pre-drilled hole until the washer sits next to the screw head). Then countersink the screws into the battery pack.

Figure 20: Tightening the screw into the Fastlock washer (left); countersinking the screws into the battery pack.
5 Configuration of the collar

Prior to deploying the collar to an animal, it has to be configured. This is done according to your requirements by VECTRONIC Aerospace before delivery, but you can change the configuration yourself with the GPS Plus Collar Manager (GPS Plus). It is also advisable to check all configurations before deploying the collar to the animal.

For collar configuration, you need to perform the following steps:

Compulsory

- install the GPS Plus Collar Manager Software (see chapter 3.6)
- register the collars on your computer (see chapter 5.2)
- set the collar time and UTC correction (see chapter 5.30)
- create and upload a GPS schedule (see chapter 5.4.1)

Optional (depending on the components of the collar)

- create and upload a beacon schedule (see chapter 5.4.2)
- create and upload an Argos schedule (see chapter 5.4.3)
- create and upload a GSM schedule (see chapter 5.4.4)
- configure the activity sensor (see chapter 5.5.1)
- configure mortality and hibernation sensor (see chapter 5.5.2)
- configure GSM or Argos/Globalstar/Iridium communication (see chapters 5.5.5 to 5.5.10)
- configure the proximity sensor (see chapter 5.5.11)
- configure the virtual fence (see chapter 5.5.12)

Recommended

- calculate the expected lifetime based on your configuration
- test the collar with all functions/configurations you plan to use prior to deployment!

Note: To configure the collar, make sure the magnet is attached correctly so the collar is in stand-by-mode and attach the Link Manager to the communication connector.

Note: Whenever you communicate with the collar, the message “Waiting for connection for max. 16s.” will appear. This time is needed to establish communication.
5.1 Install the GPS Plus Collar Manager Software

You will find the setup file for the GPS Plus software on your CD “Set-Up your System” → “Install GPS Plus” (filename GPS_Plus_X_X_X_setup.exe) or on our homepage (http://www.vectronic-aerospace.com/wildlife.php?p=wildlife_downloads). Please install the program on your computer (see GPS Plus Manual). GPS Plus can be run in three different modes: Collar mode, GSM base mode and Handheld mode. Some configurations can only be changed in Collar mode, which means the collar has to be attached to the PC with the Link Manager and has to be in stand-by mode.

5.2 Collar Registration

To be able to configure the collars and to process data and messages with the GPS Plus Collar Manager (“GPS Plus”), you need to register the collar. The keys for each collar will be provided on the CD which is sent with the collars.

Go to the directory Collar Keys and copy the files to the folder GPS_Plus/Keys on your computer. Then enter GPS Plus and go to File → Collar List. In the new window, press or Register. This will open the folder with your key files (*.key). Choose the appropriate file. Then choose or Edit → Add Collar to add a new collar (Figure 21).

If you add the details before registering the collar, the registration status of the collar will be invalid. After registration, the entry of the corresponding collar will change from invalid to valid. For more information on collar registration go to the GPS Plus Manual.

Figure 21: Edit Collar Info window
5.3 Setting the time

To set the time in the collar, connect the collar to the PC with the Link Manager. Open GPS Plus and make sure that it is running on Collar Mode. Start with setting the collar’s time using Commands → Set Collar time....

Two times are displayed, the Current Collar Time and the PC Time. The form also displays the UTC Correction of your collar. The New Collar Time is by default given as the PC Time in UTC. If there are any aberrations between PC time and the time you want to set on the collar, use the up/down arrows and the calendar function or type in the new time. Press Set Time to send the new time to the collar.

Note: With each GPS fix, the collar time is reset to the correct UTC time, corrected by your UTC correction (if enabled). It is thus not possible to synchronise the collar with another time, e.g. one running in your office, than the GPS satellite system’s time. Also, UTC correction cannot be enabled by sending the local mean time to the collar.

You can enable the collar to calculate schedules in Local Mean Time (LMT) with Collar Configuration → UTC Correction. With this setting, you can program the schedules in LMT (Local Mean Time) and the collar will correct the time according to the user-defined UTC correction. If you do not enable this option, UTC will be used. GPS fixes will also be displayed with UTC and LMT time stamps.
5.4 Schedules

5.4.1 GPS schedule

The next step is to create and upload a GPS schedule. Go to Schedule → Create GPS schedule. Create a schedule by using one of the three rule types (choose them by pressing the corresponding button). Set your rule, press OK to add it or Cancel to discard it. All rules of the schedule will be shown in a list in the main window of the scheduler (Figure 24).

The Cyclic Rule defines a period of time with a start date and an end date between which measurements will be done every day in a selected frequency. Enter the start and end day of the period and start and end time on each day within this period. Then select the frequency of GPS measurements (Cycle Frequency). The first measurement will be taken at the exact start date and time (in our example 06:30 on the 04.05.2010, Figure 25). The second measurement will take place at the start time plus the cycle frequency (here 07:30 on the 04.05.2010). The end time is not necessarily the time of the last measurement of the day. In our example the last measurement would be at 21:30.

The Discrete Rule defines a period of time with a start date and an end date in which several discrete times per day can be defined for measurement. Enter the start and end day of the period (see Figure 26). Then enter the discrete times of measurements and press Add Time to add them to the list. Select a time from the list and press Remove Time to discard it. The measurements will take place at exactly these times on every day.

Figure 24: Window with all rules of one GPS schedule. Binary size of the Virtual Fence is given in the bottom left corner.

Figure 25: Cyclic rule edit form

Figure 26: Discrete rule edit form
The **Rollover Rule** does not work on a day-by-day basis like the other two rules. It defines a start mark with date and time (*First Day*, in our example, Figure 27, 06:00 on the 04.05.2010), an end mark (*Last Day*, here 04.05.2011) and again a *Cycle Frequency*. The measurement starts on the first day at the selected time and is repeated with the cycle frequency until the end mark. This way, the measurements do not necessarily take place every day at the same time and are independent from single days. You can enter any frequency from one minute to 36 hours 24 minutes and 30 seconds in two seconds steps.

You can define as many rules as you like and combine different rule types. If two rules apply at the same time, GPS fixes will take place according to both rules. For more details on creating GPS schedules refer to the GPS Plus Manual. Save the schedule to the folder GPS Plus/Schedule Files. You can always access and edit it at a later time.

The schedule needs to be uploaded to the collar. This is done with **Schedule → Send GPS Schedule**. Select a schedule (.GRF) (Figure 28). The file will be loaded and converted to an internal event list, containing all times when the GPS has to be activated. You can see this on the progress bar at the top of the window. After the file has been loaded and converted the events will be shown in the white **Schedule Overview** area at the bottom. This will give you an overview of the schedules.

After selecting a file you need to decide if a schedule will be rule or list based. Rule based means that the rules are stored in the collar; list based means that the rules are transformed into times and these times will then be stored in the collar. A rule-based schedule is much smaller than the list-based schedule and faster to upload. List based allows only to download the list for verification; the downloaded schedule

Figure 27: Rollover rule edit form

Figure 28: Send Collar GPS Schedule main window
cannot be uploaded as schedule to other collars.

After verifying the schedule press Send to upload it to the collar. This will take up to several minutes for a list based schedule and less than a minute for a rule based schedule. After a successful upload, the message “Finished sending Schedule!” will appear and you can close the window.

For more details and possible error messages refer to the GPS Plus Manual.

**Note:** For safety reasons you should define at least one schedule starting on 01.01.2000. If the collar's time is reset for any reason, the timer will start at this date and will attempt to take one fix per week until another schedule starts or until the clock is set to the correct UTC time by a successful GPS fix.

**Note:** When the last scheduled GPS fix has been performed, the collar will automatically perform a GPS fix every 6 hours, enabling you to locate and recover the collar. To avoid this, define a schedule that extends the calculated operational lifetime. This is especially important if you do not use the VHF/UHF link for communication, since GSM or satellite transmissions are linked to GPS fixes and cease without GPS schedule.

### 5.4.2 VHF Beacon schedule

To activate the VHF beacon, a beacon schedule is necessary. To save battery it might be useful to switch off the beacon during times when you will not track your animal (e.g. during the night). The creation of a VHF schedule is similar to the creation of a GPS schedule, but here only cyclic rules are possible (Figure 29). You need to define the time the beacon is switched on and the time it is switched off. These times apply for every day during the rule.

**Note:** When all End Dates of the VHF schedule are outdated, the VHF beacon is switched off and you cannot locate the collar via VHF telemetry.

To send the VHF schedule to the collar, go to Schedule → Send VHF Beacon Schedule. The next steps are identical to the GPS schedule upload.

You can change the pattern of the beacon transmitter with Commands → Collar Configuration → Beacon Pattern. Here you can choose from four different beacon patterns.
These patterns are independent from the pattern changes done by the beacon to transmit the status of the animal (e.g. mortality event) or collar (e.g. low battery) (see 3.2 Beacon).

5.4.3 Argos schedule (optional)

The Argos schedule (Schedule → Create Argos schedule) defines (a) the periods and a loop duration per period and (b) a transmission time in a loop of a period. The period is the total time span of your observation. For details on the parameters needed for the Argos schedule, please refer to the GPS Plus Collar Manager manual.

![Argos schedule list with rules for periods, rules for loops and graphical display of one rule](image)

You can add a new period with or Period → Add Period. A new window will open (Figure 31). The period will begin at UTC 00:00:00 at the selected Start day and end at UTC 00:00:00 at the selected End day. Then you need to define the Loop Duration. The loop is the time span in which the transmission is repeated. It is given in days, hours, minutes and seconds. If you click OK, you will return to the list of Argos schedules and your schedule will be marked empty.

![Add Period for Argos schedule window](image)
The next step is to define a transmission time within the period. Select the schedule and click on 🎈 or On Times → Add On Time. A new window will open (Figure 32).

Define the time between the start of the loop and the start of the transmission (Start Offset). Then define the Duration of the transmission. If you click OK, you will return to the list of Argos schedules and your schedule will be marked valid (Figure 30). The schedule is displayed graphically in the Argos schedule list.

### 5.4.4 GSM/Iridium schedule (optional)

The creation of a schedule for GSM or Iridium (Schedule → Create GSM/Iridium schedule) is similar to creating a GPS schedule, but there is only one rule similar to the rollover rules (Figure 33). Define a Start Date and Time and an End Date and Time. Then define the period in which GSM or Iridium transmissions are attempted by number of days and hours.

**Note:** The GSM/Iridium schedule is supported from collar firmware 2.7.4 (February 2011).

A new GSM/Iridium schedule can be sent by SMS/email or by using the VHF/UHF handheld terminal (from handheld firmware 2.3.1, February 2011).

**Note:** If all rules in the collar are in the past or invalid, then an SMS will be sent once a week.

**Note:** If all rules in the collar are in the future, an SMS is sent every two weeks.
5.5 Configuration

You can configure several parameters depending on the components of your collar. Therefore only some of the configurations in this section will be applicable for you.

5.5.1 Activity sensor

If your collar contains an activity sensor, you need to select an activity mode. The adequate mode depends on your research question. To get more details on activity data analysis, sample size and activity modes, refer to the Activity Pattern Manual).

**Note:** Activity sensor settings cannot be altered via VHF/UHF interface, so please give some thought to the selection of the right activity configuration beforehand.

To configure the activity sensor, go to **Commands → Collar Configuration → Activity Mode**. Use **Read** to check for the current configuration.

You can choose the activity mode from the drop-down menu (Figure 34). Select the **Activity Interval** using the up and down arrows. Depending on your collar type and the firmware version you can select different activity measurement modes. Modes 1-3 measure acceleration on the X and Y axis and store them as two separate values. The modes differ in the length of one sampling interval. In modes 4-7 you can select the sampling interval, but the modes differ in the axes and parameters used for measurements.

**Mode 1 – 300s Activity Measurement:** The acceleration on the X and Y axis is stored in 296 s intervals, the time series is regularly corrected to 300 s intervals.

**Mode 2 – 152s Activity Measurement:** This mode measures activity over a sampling interval of 152 seconds.

**Mode 3 – 64s Activity Measurement:** This mode measures activity over an interval of 64 seconds; it is the smallest storing interval available.

**Mode 4:** Accumulated activity is measured for a predefined interval; intervals can be chosen in 8 second steps.

**Mode 5 – Head Angle / Acceleration Threshold:** This mode measures two parameters and stores them in two channels:
1. Head Angle / Head up: Gives the ratio of measurements on the X axis within one sampling interval in which the head exceeds a user-defined angle towards the vertical axis.
2. Acceleration: Gives the ratio of combined measurements on all three axes within one sampling interval in which the acceleration exceeds a user-defined threshold.

Mode 6 – Acceleration Peak / Acceleration Threshold: This mode measures two parameters and stores them in two channels:

1. The maximum acceleration measurements on all three axes within one sampling interval.
2. The ratio of acceleration measurements on all three axes within one sampling interval below and above a user-defined activity threshold.

Mode 7: Acceleration is measured with two channels: channel 1 measures forward-backward motion, channel 2 measures head up/down motion.

Note: Channel 1 in modes 1-4 and mode 7 measure the same movement, which is forward-backward. However, the raw data are scaled differently, so the values for mode 7 are five times as high as those for modes 1-4.

For more details on the activity modes and their application in analysis, refer to the Activity Pattern Manual.

Now select an interval from 64 to 896 seconds in eight second steps. After making your selections, press Write to upload the configuration to the collar.

If you already had configured the activity sensor, the window in Figure 35 will appear.

Figure 35: First warning before erasing activity data

If you press Cancel, the configuration will not be uploaded to the collar. If you press OK, the window in Figure 36, left will appear. If you press No, the configuration will not be uploaded to the collar. If you press Yes, the window in Figure 36, right will appear and you have 5 seconds to cancel the overwrite. After this, all data will be erased and cannot be restored.
If you select mode 5 or 6, you need to set thresholds. You can do this with Commands → Collar Configuration → Activity Threshold (Figure 37). You can set the Angle Threshold (head angle, mode 5 only) and the Acceleration Threshold (activity) using the up/down arrows. To enable you to choose values, press Display Test Measurement. The angle and acceleration of the collar is now shown in real time on screen (Figure 38). After testing different angles, close the window. Select the thresholds and press Write to upload them to the collar.

**Note:** The head angle and the acceleration depend on various factors, e.g. neck circumference or fur thickness. If possible, perform trials on an animal with parallel observations to find an angle and acceleration threshold.

### 5.5.2 Mortality and hibernation

For this configuration go to Commands → Collar Configuration → Mortality and Hibernation. Select the Mortality Period in hours with the up/down arrows. This is the period without movement after which the VHF beacon switches to the mortality signal and the collar takes 14 positions which will be transmitted as mortality message via GMS or Iridium.
You can also enable the *Hibernation Sensor* by checking the box. Select a *Wakeup Activity Level* and a *Hibernation Delay Time*. Now the mortality counter will be used for hibernation mode. In hibernation mode, collars with the firmware 2.8.4 or higher will attempt to take a GPS fix every 24 hours and send them according to the collars communication mode. In collars with older firmware, no attempts will be made to perform a GPS fix or a transmission. *Wakeup Activity Level* is the level of activity which stops the hibernation mode and returns the collar into normal operation. *Hibernation delay time* is the time after which the collar enters hibernation mode if no activity is detected within this time.

**Note:** Make sure to choose an adequate *Wakeup Activity Level*. If it is too low, the animal might never trigger the hibernation mode and battery is used by the collar trying to perform a GPS fix within a cave.

**Note:** If the *Wakeup Activity Level* is too high in collars with firmware lower than 2.8.4, hibernation mode will be entered too often and you will lose data. In worst case, you can lose your collar since no GSM or satellite transmission takes place during hibernation mode and you cannot relocate your collar! To avoid this, ask VECTRONIC Aerospace for the latest collar firmware.

### 5.5.3 Beacon pattern

You can change the normal beacon pattern with *Commands → Collar Configuration → Beacon Pattern* (Figure 40). This is independent from the mortality or emergency signal automatically send by the collar. For more details see 3.2 Beacon.

### 5.5.4 VHF/UHF communication time

Figure 39: Mortality and hibernation window

Figure 40: Beacon Pattern window
To save battery you can turn off the VHF/UHF communication for certain times of the day with Commands → Collar Configuration → RF Communication Time. In our example (Figure 41), UHF communication would be switched off from 19:00 to 07:00, which means the collar will not respond to the handheld during these times.

**Note:** The collar communication time cannot be changed after the collar is deployed on the animal. Make sure that the VHF/UHF communication is not switched off during your field working hours.

**Note:** The RF Communication Time is given in UTC. Make sure to consider the difference between UTC and LMT.

### 5.5.5 GSM configuration

With Commands → Collar Configuration → GSM Mode, you can configure the destination address to which the collar will send the data (Figure 42). This is either the address of the VECTRONIC Aerospace GSM Ground Station in Berlin or of your own GSM ground station. Depending on the factory initialisation, an external GSM communication mode will be activated. This mode defines the number of GPS fixes after which a SMS is sent (select from one to seven fixes). You can also select whether the transmission will be repeated in case the first SMS attempt was sent without GSM coverage, and if the message will contain 7 or 6 bit. SMS transmission after each fix will give you real-time information on your animal, but will also cost more energy.
**Note:** Not all GSM providers support the complete character set. Be careful when choosing between 7 bit and 6 bit GSM mode! You may need to test the settings or confirm them with your GSM service provider.

With *Commands → Configuration → GSM Destination Address*, you can change the destination address of the collar (Figure 43), but the number must belong to a GSM ground station.

### 5.5.6 SMS Reception Delay

SMS can be used to download data and also to upload new schedules or Virtual Fence collections to the collar. SMS can only been received if the GSM modem is switched on, which is only the case when fixes are transmitted. By default, the GSM modem is turned on and logs itself into the GSM net. After two minutes, data transfer starts, the collar sends an SMS and at the same time receives SMS from the ground station. Then it is turned off again.

It is possible to set up a system which automatically decides to send a new schedule depending on the location of the animal. Without SMS reception delay, this schedule will be received by the collar when the next SMS is sent (in worst case 7 fixes later). At *Commands → Collar Configuration → SMS Reception Delay*, you can configure a delay from up to 320 s in which the GSM modem stays on and awaits further SMS to allow your system to analyse the SMS and respond (Figure 44).

**Note:** The GSM modem needs a considerably amount of energy, so a long SMS reception delay will shorten the operational lifetime of the collar battery. You should test the effect of different delay times before deploying the collar.

![Figure 44: SMS Reception Delay window](image-url)
5.5.7 Argos

To configure the Argos system, go to Commands → Collar Configuration → Argos (Figure 45).

For Argos communication you need two IDs, one decimal and one hexadecimal, both provided by Argos. In this section, the hexadecimal ID code must be entered, everywhere else in the program the decimal code is used.

The Channel is the frequency of your collar's Argos transmitter; it will be used for location and transmission services by Argos. Argos will recommend a frequency you should use.

Repetition Rate defines the interval, in which Argos messages are retransmitted. You can make suggestion to Argos but they set the value according to an internal optimisation. When using Argos transmissions for GPS, a copy of the GPS fix data will be stored in a ring buffer to await transmission, organised in blocks of three fixes (triplets). The buffer has a maximum capacity of 30 triplets (GPS Triplet Buffer Size). Number of blocks defines the number of 32-bit blocks per message. This value has to be eight, if you are transmitting GPS positions via Argos. If you are using the location service of Argos, adjust to the value provided by Argos.

Note: The oldest GPS fix data will be removed from the buffer when new GPS fixes are stored (“first in first out principle”). In this case, they will not be transmitted anymore, so the shorter the transmission rate the higher the possibility that a GPS fix is received by an Argos satellite. However, a high repetition rate needs more energy. All GPS fixes are stored in the collar, so even if the fix is not received by Argos, it is still available from the collar (e.g. by VHF/UHF download).

5.5.8 Globalstar

To configure the Globalstar system, go to Commands → Collar Configuration → Globalstar (Figure 46). The Transmission Mode defines after how many fixes a transmission is done. Mode 0 means that every fix is transmitted immediately.

Figure 45: Argos configuration window

Figure 46: Globalstar configuration window
Mode 3 means a transmission is done after every fourth fix.

You can define if you want to send one or two fixes per transmission. In case of two the collar will send the last two GPS fixes. By combining both settings, you can affect the number of positions transferred by Globalstar, i.e. the configuration Mode 3, 2 fixes per message result in the transfer of two GPS fixes being sent, and two GPS fixes being stored in the non-volatile collar memory only.

**Note:** The satellite reception success rate increases with reduced length of the message. Hence the “1 fix per message” mode has a higher satellite reception rate than the “2 fix per message” mode. **All GPS fixes are stored in the collar, so even if the fix is not received by Globalstar, it is still available from the collar** (e.g. by VHF download).

### 5.5.9 Iridium

*Commands → Collar Configuration → Iridium* (Figure 47) defines the number of positions per transmitted message. With high numbers of positions less energy is used, but the higher the transmission frequency, the higher is the chance for the transmission to reach a satellite. Messages are only sent after a connection to the satellites is established and reception of the message is confirmed.

**Note:** All GPS fixes are stored in the collar, so even if the fix is not received by Iridium, it is still available from the collar (e.g. by VHF/UHF download).

### 5.5.10 Position Transmission

With GSM and Iridium collars, you do not need to transmit every position, but instead only every second, third, fourth etc. The highest value is every 16th position. All positions are stored in the collars memory and can be downloaded via VHF/UHF radio link or Link Manager. By not sending all positions, you can save energy and money for transmissions, especially if you have short GPS intervals.
5.5.11 Proximity sensor

The proximity sensor enables you to receive ID signals from UHF tags in the collar’s surroundings (see 7.2.5 Proximity Sensor). It can be configured with Commands → Collar Configuration → Proximity Sensor. Proximity Mode and Receiver Frequency are provided by VECTRONIC Aerospace. You can download the proximity data as .PRX file using GSM or Iridium if your collar has the appropriate interface and if you are using VECTRONIC UHF ID tags.

You can configure an interval in which the proximity sensor is switched on and listening to the UHF tags (Listen Interval) for a given Listen Duration. In our example (Figure 49), the sensor is switched on every 600 s for 1 s. Additionally, you can define a time period during the day in which the Listen Interval is applied (Sensor Active Time). With diurnal birds for example, it might not be necessary to use the proximity sensor at night, so in our example it is only switched on from 05:00 to 19:00.

**Figure 49: Proximity Sensor configuration window**

*Note: The Sensor Active Time is always given in UTC, so please make sure that you do not enter local time.*

It is possible to change the GPS schedule if an UHF tag has been detected by the sensor. To do this you need to upload an additional GPS schedule with Schedule → Send Proximity GPS Schedule. If an UHF tag has been detected the collar will automatically change from the standard GPS schedule to the proximity GPS schedule. To disable this change, select Disable proximity schedule, if one is present. If you want to use a proximity schedule again, simply upload a new proximity schedule to the collar (via USB, VHF, GSM or Iridium interface). You cannot enable this function by unselecting the option in this menu.
5.5.12 Virtual Fence

The virtual fence allows you to use a different GPS schedule in a certain area (7.2.6 Virtual Fence). To do this, you need to define a virtual fence around this area and assign a GPS schedule (“Virtual Fence schedule”) to it. This is done with Commands → Edit Virtual Fence (Figure 50). You can create a new fence by defining up to 62 posts (max. binary size 385 byte, see below for details).

Figure 50: Edit Virtual Fence window. Binary size of the Virtual Fence is given in the bottom left corner.

There are two ways to create a polygon. You can use the Virtual Fence editor in the GPS Plus software and define fence posts by their coordinates. Alternatively, you can create a polygon in Google Earth and import the .KML file into GPS Plus. A Virtual Fence Collection can contain several single fenced areas (“polygons”). Each fence will be created and edited on its own tab, but all opened fences are shown in all tabs. The fence that belongs to the opened tab is marked with bright red posts. All fences that are opened at one time can be saved as Virtual Fence Collections (.VFC) and can be uploaded to the collar via Link Manager, VHF/UHF Handheld Terminal, GSM, and Iridium. For detailed information on shapes, combinations of several polygons of a Virtual Fence refer to 7.2.6 Functionality of sensors: Virtual Fence.

5.5.12.1 Creating a Virtual Fence with the GPS PLUS Collar Manager

Add a Fence: You can add a fence to the fence collection by clicking on the icon or calling Add Fence... in the Fences menu.
**Edit Fence name:** The currently selected fence can be renamed with this option. Click on the icon or use *Edit Fence...* in the *Fences* menu.

**Remove Fence:** The currently selected fence will be removed from the Fence Collection. You will be asked for a confirmation before this command is executed. Click on the icon or use *Remove Fence...* in the *Fences* menu.

**Append Post:**Appending a post will add a post to the end of the list of the current fence. A dialogue will open where you have to enter a name for the post (by default “Post x”) and the coordinates. Click on the icon or use *Remove Fence...* in the *Posts* menu.

**Insert Post:** Inserting a post will only work if another post from the list is selected. A new post will be inserted before the currently selected post just like appending a post if you click in the icon or select *Insert Post...* in the *Posts* menu.

**Edit Post:** You can edit each fence post by double clicking on it, by clicking on the icon, or by clicking on *Edit Post...* in the *Posts* menu.

**Remove Post:** The currently selected post will be removed without further confirmation if you click on the icon or by selecting *Remove Post...* in the *Posts* menu.

To rearrange posts, you can drag & drop them in the list of the current fence.

### 5.5.12.2 Importing and Exporting Virtual Fences from Google Earth

You can create a polygon in Google Earth, save it as .KML file, and import it into GPS Plus. Please make sure that you use the command *Add Polygon* in Google Earth.

**Import KML polygon as Fence:** Imports a polygon created in Google Earth from a .KML file into GPS Plus. You can do this by clicking on the item or *Import Fence...* from the *Files* menu. The name of the file will be the name of the fence. If you have multiple polygons in the .KML file, only the first will be imported.

**Export Fence as KML polygon:** Exports a polygon as .KML file to view it in Google Earth. Click on the icon or select *Export Fence...* from the *Files* menu. Polygons are saved as Virtual Fence Collection (.VFC), which can contain more than one polygon.

The area of the polygon is not necessarily identical with the Virtual Fence area. With the Inside Point you can define whether the Virtual Fence area is inside or outside the polygon. Figure 51 shows two examples for Virtual Fence definitions:

a) Inside Point is inside of the polygon, i.e. the Virtual Fence area and the polygon are identical.
b) Inside Point is outside of the polygon, i.e. the Virtual Fence area surrounds the polygon.

**Note:** In some cases, the Inside Point might be set automatically not inside the polygon, but outside (Figure 52). Please make sure that the Inside Point is on the correct position before sending the Virtual Fence to the collar.

Though you can combine several polygons, you can upload only one Virtual Fence schedule which will be applied to all Virtual Fences on the collar. The collar can only decide between “inside” and “outside”, so it is “inside polygon 1 and inside polygon 2”, but “inside polygon 1 but not inside polygon 2” is not possible. If the collar is inside at least one of these polygons it uses the Virtual Fence schedule, otherwise it uses the standard GPS schedule.

The size of the Virtual Fence Collection is limited and depends on how you transfer the data to the collar. If you use the Link Manager, the maximum size of the VFC is 385 bytes, the maximum size of the associated GPS schedule is 490 bytes. The actual size of the VFC is given in the bottom left corner. If you transfer the VFC via Iridium or GSM, Virtual Fence collection and GPS schedule must be transferred in one message, so both files must be smaller. For Iridium or GSM 7-bit coding, the maximum size of the two files is 129 byte, for GSM 6-bit coding, the maximum size of the two files is 109 byte. The size of the GPS schedule is shown in the bottom left corner of the GPS schedule editor (Figure 24).

To upload a Virtual Fence to the collar, go to **Commands → Send Virtual Fence...** (Figure 53). Select a Virtual Fence Collection and one GPS schedule which will be applied to all virtual fences in the collection. Press **Send** to upload it to your collar.

![Figure 52: Virtual Fence with Inside Point automatically set outside of the polygon](image)

![Figure 53: Upload Virtual Fence window](image)
It is possible to program the collar to send a message via GSM or Iridium whenever the animal enters and/or leaves the Virtual Fence (for details see 7.2.6). This can be set up at 

**Commands** → **Collar Configuration** → **Virtual Fence Events**... (Figure 54).

You can define whether you want a message after the collar has been located inside the Virtual Fence and/or after it has been located outside the Virtual Fence.

### 5.6 Lifetime calculation

After creating all schedules, you have the possibility to estimate the operational lifetime of the main and the VHF beacon battery. The calculation is done at an average temperature of 0°C for full battery capacity with the command **Schedule** → **Calculate Operational Lifetime** (Figure 55). This calculation is based on the collar type and battery size, the VHF/UHF communication time, the proximity sensor, the GSM/Iridium/Globalstar mode, the Argos communication, the GPS schedule and the VHF beacon schedule. Lifetime is calculated for the assumption that the battery is fully loaded and the collar will be activated today. If you want to deploy the collar at a later stage, change the **Collar Activation Date**.

The battery lifetime is presented with the total amount of expected days and the end date of the expected collar lifetime. Three scenarios will be calculated:

- **worst case**: the GPS receiver needs the maximum time of 180 seconds for each fix
- **average case**: the GPS receiver needs on average 90 seconds for a fix
- **best case**: the GPS receiver needs 45 seconds for each fix

**Note**: The calculation is only an estimate of the operational lifetime. Ambient temperature and many other factors can influence the lifetime of your battery.

**Note**: Lifetime calculation is based on full battery capacity. If you want to calculate the lifetime for an already used collar you need to change the Collar Activation Date according to the time the battery has been used yet and add the past GPS schedules.
Figure 55: Lifetime Calculation window for a collar with VHF and GSM interface. Satellite interfaces are switched off.

**Note:** Lifetime calculation does not include the GPS schedule for the proximity sensor or the virtual fence, but only the GPS schedule you load for the calculation. For a proper worst case result you should use the schedule with the highest frequency of GPS fixes.

**Note:** Make sure to select a VHF schedule that enables the VHF beacon battery to work longer than the GPS battery. This will enable you to retrieve the collar after the main battery has run out.

**Note:** Depending on your activity sampling interval the activity memory capacity of the collar might run out prior to the battery lifetime.
6 Getting the collar into action

6.1 Testing the collar

Before the collars are shipped to you, they are configured according to your requirements and tested thoroughly at VECTRONIC Aerospace. Nevertheless we strongly recommend to test the collar and the battery before the collar is deployed to the animal. This is especially important after you have changed the configuration or stored the collar for several months, even if it has been tested before. Also make sure that data is received correctly and is accessible to you.

6.2 Attaching the collar

The adjustable side of the collar is at the left side of the animal. You should shorten the surplus belt material to avoid irritation and abrasions. Before you release the animal make sure that the endcap is tightly placed on the communication connector to protect it from dirt and humidity, that the magnet is removed from the electronic housing (collar is activated) and that the second magnet is removed from the drop-off (if existing) as well!

6.3 Collar circumference

To achieve the best possible GPS signal, the GPS antenna should be on top of the animal’s neck. The GPS antenna is inside the electronic case facing upwards. The battery pack acts as counterweight to keep the electronic case in that position; if the collar is adjusted to the circumference given on the order information sheet, the electronic case is located exactly on top of the animal (Figure 56).

![Figure 56: Variations in collar circumference and antenna position. (a) Predefined circumference: Electronic case is exactly on top of animal’s neck, best possible GPS reception. (b) Up to ±10% variation from predefined circumference: Electronic case is slightly on side of animal’s neck, still good GPS reception. (c) Circumference variation bigger than ±10%: bad or no GPS reception, also collar might rotate because battery pack and electronic case are out of balance.](image)
Collar circumference can be adjusted by ± 10% without degrading satellite reception. If the collar is shortened to a higher degree, the electronic case will be located on the side of the animal’s neck and satellite reception can decrease. It is also possible that the battery pack cannot act as counterweight anymore and the collar rotates, leaving the electronic case underneath the animal’s neck and blocking satellite reception. To avoid this, define a realistic neck circumference when ordering the collar.
7 Collar specifications

7.1 Communication

7.1.1 GSM

GSM communication is related to the GPS schedule and configuration. You can decide the number of GPS fixes after which the positions are transmitted (see 295.4.1 GPS schedule). In our example (Figure 57), the original GSM mode is 4 fixes per message. After the fourth fix, the GSM modem tries to establish communication with the GSM network. If successful (Figure 57 top), all four fixes will be sent to your GSM ground station. The collar checks if any new schedule or Virtual Fence collections have been sent by you. After transmitting GPS data and optionally receiving schedules, the GSM device inside the collar is turned off until the next four GPS fixes are performed. If a new schedule has been received, it is applied immediately. If no communication is established between collar and network, no GPS positions are transmitted and no new schedules are received by the collar until the next successful GSM connection is achieved (Figure 40 bottom).

![Figure 57: Timing of GPS fixes and data transfer via GSM modem](image)

Note: If no communication can be established between the GSM network and the collar or the GSM ground station, the GSM provider will retry to send the data. Data in the provider's memory are subject to a Validity Period. If no contact has been established within this period (usually 2-3 days, but depending on the provider's conditions), the data stored by the provider will be deleted without delivery. For this reason make sure that your ground station is switched on at all times to allow the data to reach you within the Validity Period. If a newly send GPS schedule is not implemented within the Validity Period, resend the schedule to make sure that the collar has received the new schedule from the GSM network. For details see next page.
For better understanding of the communication process, we will explain the steps of the GSM communication in the following instructions. GPS positions are transmitted from the collar to the GSM provider, to the GSM ground station and from there as .SMS data file to your computer (Figure 58). All obtained positions are stored in the collar's non-volatile memory, where it is accessible even after the collar's battery has run out of power. Positions are also sent to the GSM network after the defined number of positions (i.e. 4 positions) have been taken. If the collar is not within GSM coverage, the GPS positions are stored in a buffer until the next contact with the provider is established, and send then. With your GSM settings you can define if the collar will retry to send a SMS message (“Repetition”).

The GSM ground station will be read out by the GPS Plus Collar Manager and data will be stored on a computer. If you are using the ground station at VECTRONIC Aerospace, Berlin, the data will be send as an email to any given email address. If you are using your own ground station, you can access the files with the GPS Plus Collar Manager directly from the ground station.

![Diagram of communication process](download)

**Figure 58: Transmission of GPS positions from the collar to the computer via the GSM provider and GSM ground station (download)**

Whenever you upload data (e.g. schedules, Virtual Fence collections) to the collar, the same transmission route is used (Figure 59). The new schedules must be uploaded to the GSM ground station and send to the provider. If the provider is not able to contact the collar, it will try again. If no communication can be established within the Validity Period, the schedules will be erased from the provider's memory and must be sent again from the ground station.
7.1.2 Iridium

Communication via Iridium satellite network is similar to the GSM communication (7.1.1 GSM). There are two major differences with Iridium:

1. The Validity Period, during which an Iridium message is kept stored if no connection can be established to the collar, is five days. After this period, the message for the collar like new schedules etc., will be automatically removed from the queue by the IRIDIUM system.
2. Data is not received via SMS by a GSM ground station but is transmitted directly from the Iridium network by email.

7.1.3 Argos and Globalstar

These systems provide one-way communication only. This means that data is sent by the collar for a pre-defined time span. If a satellite is in range, data is transmitted to the researcher. If no satellite is in range, data is not transmitted and can only be received from the collar's non-volatile on-board-storage. With Argos and Globalstar, no new schedules can be uploaded to the collar.
7.2 Functionality of sensors

7.2.1 GPS receiver

All positionings are performed with the GPS receiver, even if the collar uses the Argos system for communication. Locations are stored with UTC date and time, LMT date and time, three coordinates (Latitude, Longitude and Height), Dilution of Precision (DOP) and Navigation status as quality information and number of satellites used for positioning.

GPS data can be exported to ASCII, Spreadsheet, DBase, GPS Exchange, Google Earth and BioTelemetry eXchange format (see Table 3 for details). You can easily import them into Google Earth to check the area your animal is using.

7.2.2 Temperature sensor

The temperature sensor is located in the electronic housing. Though the measured temperature is related to the ambient temperature, several factors affect these measurements. These are the animal's body temperature, the heating up of the black housing case by sun energy, cooling effects of wind, etc. Due to the thermic characteristics of the housing material, variations in ambient temperature will not have an immediate effect on the temperature sensor, but will be measured with delay.

7.2.3 Activity sensor

The activity sensor measures activity in three axes based on the true acceleration experienced by the collar (Figure 60). Axis X measures acceleration in forward/backward motion, axis Y measures sideways as well as rotary motion and axis Z measures up/down movements using gravitational acceleration.

Activity is measured four times per second simultaneously on each axis as the difference in acceleration between two consecutive measurements, and is given within a relative range between 0 and 255, characterising the

Figure 60: The direction of the three activity axes
mean activity/acceleration. Measurements are averaged over the user-selected sampling interval and stored with the associated date, time and temperature. Depending on your research topic you can choose from several measurement modes and sampling interval lengths (for details see 5.5.1 Activity sensor and the Activity Pattern Manual).

7.2.4 Mortality & Hibernation Sensor

The mortality sensor measures true acceleration similar to the activity sensor, but without the data storage and the different activity modes. If no acceleration is detected for a user-defined period (e.g. 24 hours), a mortality event is triggered and stored in the collar memory, the beacon changes to the mortality signal (Figure 2), and, if GSM or Iridium communication is enabled in the collar, a mortality SMS or satellite message is sent. If the animal resumes activity, the beacon switches back to the normal pattern. The collar is also able to store up to 132 mortality events with date and start time (UTC and LMT). If more than 132 mortality events are recorded, the first stored event will be overwritten. You can erase mortality events, for procedures please refer to the GPS Plus Manual.

Additionally, the mortality sensor can function as hibernation sensor. For this feature, you define an activity threshold. If the animal’s activity is below this threshold for a given time, the collar changes into hibernation mode and no GPS fixes are attempted or transmitted. The collar returns to normal mode if the activity level exceeds the hibernation threshold again. The hibernation mode will save battery and is expedient for two reasons, (1) the animal does not change its position, and (2) there is little chance of GPS and GSM/satellite contact from a cave or den. The only message that will be sent during hibernation mode is the mortality message if the collar has not been moved at all for the full mortality period. Though mortality and hibernation sensor are based on the same electronic components, the functions are performed independently from each other.

*Note:* If you use the activity sensor modes 5-7, the mortality sensor is not functioning and you will neither get a mortality event nor will the collar enter the hibernation mode.

7.2.5 Proximity Sensor

The proximity sensor is part of a system that enables you to monitor interactions between individuals or species. A group of animals is equipped with UHF tags which send their ID code every 1.25 s ± 0.1 s\(^1\). The proximity sensor in the GPS Plus collar with UHF communication is able to receive these ID codes within a range between 50 and 130 m\(^2\).

\(^1\)This irregularity will prevent two UHF tags sending on the same frequency to constantly overlap with each other.

\(^2\)Please contact VECTRONIC Aerospace if you require short or long range applications.
(Figure 61). If an ID code is received, it will be stored in the memory with the signal strength and the time stamp. If GSM or Iridium transmission is enabled, a list of ID codes encountered between two transmissions is sent with each SMS or Iridium message. Signal strength and time stamp are not transmitted via GSM or Iridium. These are only available via cable or UHF link. The file extension is .PRX.

The signal strength allows an approximation of the distance between ID tag and proximity sensor, but it will not give the absolute distance. Since vegetation, landscape, animal position, etc. have noticeable influence on signal strength, there is no reliable relationship with distance, but relative changes in distance can be estimated from the data.

If an ID code has been received by the proximity sensor, an alternative GPS schedule can be activated. This way the frequency of GPS fixes can be intensified. The proximity GPS schedule will stay active until one hour after the last ID code has been received, then the GPS receiver will return to the standard schedule. The proximity sensor will be switched off during GPS fixes, so data gaps of up to 180 s might occur.

![Proximity sensor diagram](image)

Figure 61: Proximity sensor. UHF tags (blue collars) send an ID code which is received by the proximity sensor on a GPS Plus collar (red) if the UHF tag is within the radius of the sensor (app. 100 m). The IDs of the tags in range (ID1, ID2, ID3) are stored in the collars memory. ID4 is out of range. As soon as an ID is received, the GPS schedule is changed to the proximity GPS schedule.
7.2.6 Virtual Fence

The Virtual Fence option is designed to use a different schedule in areas of interest, for example a national park, a township or a special vegetation area, or to inform the researcher if an animal enters or leaves this area. The Virtual Fence is created with one or more polygons, and an “Inside Point“ for each polygon. This Inside Point defines whether the Virtual Fence area is located inside the polygon (Figure 62a), or if the Virtual Fence area surrounds the polygon (Figure 62b). Through a combination of polygons and Inside Points, a complex Virtual Fence can be created and stored as Virtual Fence Collection (VCF).

The Virtual fence option allows two actions:

- If the animal is located inside the Virtual Fence area, the GPS schedule changes to the Virtual Fence GPS schedule until the animal has been located outside the Virtual Fence area.
- If the animal is located inside the Virtual Fence area, a message stating “Entered fence area” will be sent via GSM or Iridium. If the animal is located outside the fence area again, a message stating “Left fence area” will be sent.

**Note:** The switch to the Virtual Fence schedule takes place after the collar has been located by a GPS fix inside the Virtual Fence area. It is therefore possible that an animal enters and leaves a Virtual Fence area without being located “inside”.

An animal is located inside the Virtual Fence area only after a scheduled fix has positioned it there. This has to be considered when designing the standard schedule. Figure 63 shows what happens when the animal enters the Virtual Fence area. The Virtual Fence event (“Entered fence area” message and/or switch to Virtual Fence schedule) does not take place immediately after the animal crosses the fence, but only after a fix is obtained inside the Virtual Fence area according to the standard schedule. If the standard schedule obtains fixes in long intervals, and the Virtual Fence area is rather small or the animal does spend only a short period of time inside the Fence area, the collar might not detect this. Due to this, the standard GPS schedule either needs intervals short enough to ensure that a Virtual Fence event is triggered or you have to accept that not each presence inside the Virtual Fence area will be detected.
12:00
Standard schedule is active
⇒ next fix 13:00

12:30
bear is inside Virtual Fence, but no
fix is scheduled, so bear is not
located as “inside”
⇒ next fix 13:00

13:00
fix scheduled by standard
schedule locates bear as “inside”
⇒ “Entered fence area” message
⇒ switch to Virtual Fence
schedule, next fix at 13:15

14:15
bear is located outside of the
Virtual Fence
⇒ “Left fence area” message
⇒ switch back to standard schedule,
next fix at 15:00

Figure 63: GPS schedules in relation to Virtual Fence area. 12:00: The bear is outside of the Virtual Fence and the standard GPS schedule is active, taking one position per hour. 12:30: The bear is inside the Virtual Fence, but the collar does not detect this until it obtains the first fix according to the standard schedule. 13:00: The collar has obtained a position according to the standard schedule and locates the bear inside the Virtual Fence ⇒ the collar switches to the Virtual Fence schedule and takes a position every 15 minutes. 14:15: The bear is positioned outside of the Virtual Fence ⇒ The collar switches back to the standard schedule and takes a position every hour.

Corners of the polygons are defined by their longitude and latitude. You can set the corners as “posts” in GPS Plus, but you can also import a polygon from Google Earth as .KML file. The lines between two corners are not straight lines, but segments of great or Riemannian circles which follow the curvature of Earth. This way they cover the shortest distance between two corners. For small polygons, the difference between the fence line on a flat map and the actual fence line will be marginal, but if you cover greater distances you should keep this in mind to avoid accidental exclusion of places close to the fence line. The polygon’s borderline itself is always defined as inside the Virtual Fence.

To each fence, an Inside Point is defined. Through a combination of polygons and Inside Points, you can create a complex Virtual Fence Collection to cover your study area. Each combination of fence and the associated inside point is checked separately. The animal is
considered “inside” once the current position is located in at least one of these fences, otherwise it is considered to be ‘outside’. Figure 64 shows examples for Virtual Fences created with two polygons.

![Figure 64: Examples for combined polygons. Coloured areas are part of the Virtual Fence, white areas are outside the Virtual Fence. For details see text below.](image)

a) The Inside Point of each Virtual Fence area is inside the polygon. This way, the Virtual Fence areas are identical with the polygons, the animal is inside the fence whenever it is inside one of the polygons.

b) The yellow Inside Point is outside of both polygons, while the green Inside Point is in the green polygon, which is partly inside the yellow polygon. The Virtual Fence area covers all terrain outside the yellow polygon plus the terrain inside the green polygon; this also includes the areas in which the green and yellow polygons overlap.

c) The yellow Inside Point is outside the yellow polygon, while the green Inside Point is inside the green polygon, which is inside the yellow polygon. This way there is a gap between the yellow and the green Virtual Fence areas in which the standard schedule is applied.

d) Fault: The Inside Point of each Virtual Fence area is outside of its polygon, hence the green polygon is inside the yellow Virtual Fence area, and the yellow polygon is inside the green Virtual Fence area. This way, the polygons annul each other because the animal will always be inside the Virtual Fence area.

**Note:** If you combine polygons to a Virtual Fence Collection make sure that the Inside Point of one polygon is in the correct position to all other polygons.

Figure 65 shows an example how to reduce the binary size of a Virtual Fence by combining two polygons. In Figure 65A, a star shaped polygon is created by defining 12 posts and one Inside Point (total 13 points). To reduce the numbers of corners, the polygon can be split in two polygons (Figure 65B) with three corners each, resulting in 6 posts and 2 Inside Points (total 8 points). Whenever the animal is in one of the two polygons, the Virtual Fence GPS schedule will be active.
Figure 65: Example on how to reduce the binary size of a Virtual Fence: A: Star-shaped polygon with 12 corners (“posts”) and one Inside Point, resulting in 13 points in total. B: The same fence area created by combining two triangles with three corners each and 2 Inside Points, resulting in 8 points in total.

7.2.7 Combining different GPS schedules

If a collar is equipped with Virtual Fence and a Proximity Sensor, three different GPS schedules can be programmed into the collar, one standard schedule, one Virtual Fence schedule and one Proximity schedule. The priority of these schedules is as such:
Figure 66: Priority of GPS schedules: the Proximity GPS schedule has the highest priority and overrules the Virtual Fence GPS schedule. The standard GPS schedule has the lowest priority and is overruled by both Proximity and Virtual Fence GPS schedule.

The standard schedule is applied as long as the animal is not positioned inside a Virtual Fence or an UHF ID signal has been received by the Proximity Sensor. In both events, the collar will switch either to the Virtual Fence GPS schedule or to the Proximity schedule.

It is possible that a collared animal encounters an UHF-ID signal within the Virtual Fence area. In this case, the Virtual Fence schedule is overruled by the proximity schedule until one hour after the last UHF-ID signal has been received. If the collared animal is still inside the Virtual Fence then, the collar switches back to the Virtual Fence GPS schedule. If the animal has left the Virtual Fence by then, the collar returns to the standard GPS schedule. Even if the Proximity schedules GPS is applied, the collar will send Virtual Fence messages if the Virtual Fence is entered or left.
8 Specification

8.1 Storage capacity

The collar is able to store

- 131 072 GPS positions in solved mode
- 132 mortality events (time and date)
- 315 128 temperature data sets (3 years)
- 315 128 activity data sets (e.g. 1094 days [3 years] in five-minute intervals or 437 days [14 months] in two-minute intervals)

8.2 Environmental specification for the collar:

Operational temperature range: \(-40^\circ C \leq +70^\circ C\)

Operating humidity range: \(\leq 100\% \text{ RH}\)

Storage temperature range: \(-45^\circ C \leq +80^\circ C\)

Storage humidity range: \(\leq 100\% \text{ RH}\)

8.3 Battery

Do not short-circuit, recharge, puncture, incinerate, crush, immerse or expose battery to temperatures above the declared operating temperature range of the product. **Risk of fire or explosion!**

Storage:
Store in a cool (preferably below 30°C) and ventilated area, away from moisture, sources of heat, open flames, food and drink. Keep adequate clearance between walls and batteries. Temperature above 100°C may result in battery leakage and rupture.

Other:
Lithium batteries are **not rechargeable** and should not be tentatively charged.

Disposal Considerations:

**Do not incinerate**, or subject cells to temperatures in excess of 100°C. Such abuse can result in loss of seal, leakage, and/or cell explosion.

**Do not dispose of the battery with the regular garbage**, but in accordance with appropriate local regulations.
8.4 Declarations of Conformity

<table>
<thead>
<tr>
<th>GPS Plus Collar</th>
<th>Globalstar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains FCC ID: L2V-STX2-1</td>
<td></td>
</tr>
<tr>
<td>Contains IC: 3989A-STX2-1</td>
<td></td>
</tr>
<tr>
<td>Canada 310</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

**Declaration of Conformity for USA**

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.

Usually this is followed by the following FCC caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**Declaration of Conformity for CANADA**

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.

Usually this is followed by the following RSS caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
**Declaration of Conformity**

acc. to 1999/5/EC (R&TTE), 2004/108/EC (EMC directive), 2006/95/EC (Low voltage directive)

We declare that the following product,

<table>
<thead>
<tr>
<th>Type designation:</th>
<th>GPS Plus Globalstar Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type or model:</td>
<td>---</td>
</tr>
<tr>
<td>Serial no.:</td>
<td>---</td>
</tr>
</tbody>
</table>

complies with the technical regulations and their valid changes at the time of issuing this declaration.

**Applied standards / directives**

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<td>EN 300 440-1,-2 V1.5.1/</td>
<td>Short Range Devices 1-40 GHz</td>
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<td>V1.3.1</td>
<td></td>
</tr>
<tr>
<td>EN 301 441 V1.1.1</td>
<td>Satellite Earth Stations and Systems (SES)</td>
</tr>
<tr>
<td>EN 301 489-1,-3 V1.8.1 / V1.4.1</td>
<td>EMC for SRD 9 kHz – 40 GHz</td>
</tr>
<tr>
<td>EN 301 489-20 V1.2.1</td>
<td>EMC for Mobile Earth Stations (MES) used in the Mobile Satellite Services (MES)</td>
</tr>
<tr>
<td>EN 60950-1:2006</td>
<td>Safety of information technology equipment</td>
</tr>
</tbody>
</table>

**Address of the manufacturer or his authorized representative:**

- **Company:** VECTRONIC Aerospace GmbH
- **Name:** Mr. Robert Schulte
- **Street:** Carl-Scheele-Str. 12
- **Location:** 12489 Berlin
- **Country:** Germany
- **Telephone:** +49 (0) 30 6789 4990
- **Fax:** +49 (0) 030 6789 5230
- **Email:** mail@vectronic-aerospace.com

This declaration was issued under the sole responsibility of the manufacturer and if required of his authorized representative:

- **Contact person:**
  - **Name:** Mr. Robert Schulte
  - **Telephone:** +49 (0) 30 6789 4990
  - **Fax:** +49 (0) 30 6789 5230

The product carries the CE mark

```

```

Berlin, 2010-08-23

Robert Schulte
Certificate of Conformity

N° 10006100

Product definition: GPS transmitter
Trademark: VECTRONIC
Product name (Type): GPS Plus Globalstar Halsband
Hardware version: GPS Plus Globalstar Halsband
Serial number: 7247, 7278
Software release number: ---

Operating frequency (TX): 1616.25 MHz
Alignment range: 1610.00 - 1626.50 MHz
Channel spacing: ---
Rated RF output power: 70.2 mW c.i.r.p
Class of emission: 1M95 G1D

This Certificate of Conformity has been granted based on the results of various measurements and tests, performed by m. dudde hochfrequenz-technik on a representative sample of the above mentioned product. The tests have been carried out against the following specifications:

EN 301 441 V1.1.1 (2000-05)
EN 300 440-1 V1.4.1 (2008-05)
EN 300 440-2 V1.2.1 (2008-05)
EN 301 489-1 V1.8.1 (2008-04)
EN 301 489-20 V1.2.1 (2002-11)
EN 60950-1: 2006

The tested sample fulfils the requirements of the above mentioned specifications. The associated m. dudde hochfrequenz-technik test reports numbers are: 10006099, 100066077, 10005993 and 10005994

This Certificate of Conformity has been granted to:

VECTRONIC Aerospace GmbH
Carl-Scheele-Str. 12
12489 Berlin

Bergisch Gladbach, 2010-05-18

Manfried Dudde
Experteise

Expert Opinion of the Notified Body on the Conformity Assessment
according to Article 16.5 of R&TTE Directive 1999/5/EC

PHOENIX TESTLAB
EU Identification Number 0700
Recognized by

Expertise No. 10-111760
Certificate Holder VECTRONIC Aerospace GmbH
Address Carl-Scheele-Str. 12, 12489 Berlin, Germany
Product Description GPS Receiver/ Globalstar Transmitter
Brand Name / Model Name Globalstar / GPS Plus Collar
Frequency Range 1611.25 – 1616.25 MHz
Transmitted Power -38.7 dB (W/4kHz) (mean power)

Opinion on the Essential Requirements
Article 3.1a): Health and Safety Remarks see annex
Article 3.1b): Electromagnetic Compatibility No remarks
Article 3.2: Effective Use of the Radio Spectrum No remarks

CE-marking
Marking Example (Class 1) CE 0700

This certificate is issued in accordance with the Directive 1999/5/EC of the European Parliament and the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity dated 9th March 1999 and is only valid in conjunction with the following annex (2 pages).

Blumberg, 26 July 2010
Place, Date of Issue

Signed by Holger Briese
Notified Body
Technical Construction File (TCF):

Description
Operational Description: STX2 Data Sheet, UM-9100-0151-01 r3, Part Number 9100-0151-01, Rev.1.2, 38 pages, 16 October 2005

Manufacturing Documents
Block Diagram: Block Diagram, Vers.no.1.10, 2 pages, 2010-03-01
Circuit Diagram: Schematics, Vers.no.1.10, 3 pages, 2010-03-01
Parts Placement: TOP GPS PLUS Globalstar, 1 page, --
Bottom GPS PLUS Globalstar, 1 page, --
PCB-Layout: Layer-1-5 GPS PLUS Globalstar, 6 pages, --
Parts List: Parts List, Vers.no.1.10, 3 pages, 2010-03-01
Hardware Version: --
Software Version: --

Applied Standards and Test Reports

<table>
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<tr>
<th>Specification</th>
<th>Laboratory</th>
<th>Test Report Number</th>
</tr>
</thead>
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<tr>
<td>EN 80 950-1: 2006</td>
<td>m. dudde</td>
<td>10006186</td>
</tr>
<tr>
<td>EN 301 489-1 V1.8.1: 2008-04</td>
<td>m. dudde</td>
<td>10006149</td>
</tr>
<tr>
<td>EN 301 489-3 V1.4.1: 2002-08</td>
<td></td>
<td>10006116</td>
</tr>
<tr>
<td>EN 301 489-20 V1.2.1: 2002-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 300 440-2 V1.3.1: 2009</td>
<td>m. dudde</td>
<td>10006148</td>
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<tr>
<td>EN 300 440-1 V1.5.1: 2009-03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 301 441 V1.1.1 : 2000-05</td>
<td>m. dudde</td>
<td>10006238</td>
</tr>
</tbody>
</table>

Further Documents
Antenna Characteristics, Vers.no.1.10, 9 pages, 2010-03-01
Opinion on the Essential Requirements:

The basis of this Expertise is the Technical Construction File (TCF). If the TCF includes test reports issued by laboratories accredited to the standard ISO/IEC 17025, the test results of these reports are considered as a basis for the conformity assessment of the Notified Body.

Article 3.1a): Health and Safety:

- Safety: Conform
- Health: Not assessed

Article 3.1b): Electromagnetic Compatibility:

- Conform

Article 3.2: Effective Use of the Radio Spectrum:

- Conform

General Remarks:

- Before putting a product on the market which uses non harmonised frequencies (Class 2) the national authorities of the member states have to be notified.
- This conformity assessment is limited to the essential requirements of the R&TTE Directive. Only products fulfilling all essential requirements of all applicable new approach directives may be placed on the market and put into service.
  Products in compliance with all provisions of the applicable directives providing for the CE marking must bear this marking.
Agence Nationale des Fréquences

DIRECTION TECHNIQUE DU CONTROLE DU SPECTRE  
Département R&TTE

Affaire suivie par : M LOUIS Laurent  
Mel : rtec@amfr.fr / Fax : 33 (0)3 29 42 20 30  
Ref : ANFR/DTC/RTTE/10340-10/LL

Madame/Monsieur,

J’accuse réception de la notification adressée par Anja HITTIG-RADEMACHER, dûment habilité(e) par la société VECTRONIC Aerospace GmbH, en vue de la mise sur le marché français du type d’équipements suivant :

Désignation commerciale : VECTRONIC  
 Référence : GPS Plus Globalstar Halsband


En conséquence, il est inutile de notifier à l’autorité responsable de la gestion des fréquences votre intention de commercialiser ces appareils sur son marché national.

Sous réserve du respect des dispositions de la directive 99/05/CE du 9 mars 1999 transposée dans le code des postes et des communications électroniques, vous pouvez donc commercialiser votre équipement en France sans délai.

Je vous prie de croire, Madame/Monsieur, en l’expression de ma considération distinguée.

Fait à Saint Dié des Vosges, le 18/08/2010

Pour le Directeur Technique du Contrôle du Spectre  
(DTCS)

Hakim LATRACHE

4 RUE ALPHONSE MATTER – BP 8314 – 88008 SAINT-DIE DES VOSGES CEDEX – FRANCE  
Tél. : 33 (0)3 29 42 20 00 – Télécopie : 33 (0)3 29 42 20 10 – N° SIREN : 180 053 027  
http://www.amfr.fr  
mel : rtec@amfr.fr
Dear Ms. Rademacher,

We confirm that the short range device for animal position identification, model: GPS Plus Globalstar Halshand, manufactured by Vectronic Aerospace GmbH, can be placed on the Lithuanian market.

An individual authorisation to use frequency/channel is not required for the operation of the equipment mentioned above under the conditions set in the line 79 (which refers to European Communications Committee Decision ERC/DEC (00)06) of the List of radio frequencies/channels, which may be used without an individual authorisation, approved by Order No. IV-27 of the Director of the Communications Regulatory Authority of 15 of March 2003 (Official Gazette Valsties Zinios, 2003, No. 30-1277).

Sincerely yours,

Romualdas Leonavičius
Deputy Director
m. dudde hochfrequenz-technik

c/o Mrs Anja HITTIG -
RottaDEMACHER
D - 51429 Bergisch Gladbach
Germany

Luxembourg, the 06/09/2010
Our reference : RT/CK D 45682
File treated by : Kaiser Claude   Tel: +352  45 88 45 - 44

Subject : Notification according to the directive (99/05/CE) R&TTE

Dear Madam, Dear Sir,

Refering to your notification request, received on the 10 August 2010 via the OSN system we inform you about the results of our technical analysis. (see overleaf)

Please note, that no legal claim to frequency assignment can be derived from this notification according to article 3 of the law of 30 May 2005, concerning radio frequency management, the frequency use in Luxembourg may be subject to licence. Further information is given in our analysis.

Please be informed that the "Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services" (ILNAS) is acting as market surveillance authority in Luxembourg concerning R&TTE products.

Pour le Ministre des Communications et des Médias,

Roland Thurmes
Premier Conseiller de direction
# Results of our technical analysis:

<table>
<thead>
<tr>
<th>Date of notification</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/08/2010</td>
<td></td>
</tr>
<tr>
<td>100810/16025</td>
<td></td>
</tr>
</tbody>
</table>

**Notification body:**
0700 - Phoenix Testlab GmbH, Germany

**Manufacturer:**
VECTRONIC Aerospace GmbH

**Type / Number of model:**
VECTRONIC: GPS Plus Globalstar Halsband

**Operating frequency:**
1610-1626.2 MHz

The equipment you notified, according to article 6.3 of the decree of 4th February 2000 concerning radio equipments and telecommunications terminal equipments and the mutual recognition of their conformity (equivalent to article 6.4 of the R&TTE directive), does operate in accordance with the planned frequency use in Luxembourg, which is regulated by the decree of 29th July 2008 containing the frequency plan and the national interfaces LUX/RI MSS 06, LUX/RI MSS 06.1 under following conditions:

**Maximum radiated power:**
-3 dB (W/4 kHz) (mean limit)
In this context, the mean is the mean over time whilst the MES is in the carrier-on mode
-15 dB (W/4 kHz) (peak limit)
SOLICITANTE: VECTRONIC AEROSPACE GMBH

Ref: 000341/2010

Estudiada la Notificación recibida el 31-08-2010, en relación con el artículo 21 del Reglamento que establece el procedimiento para la evaluación de la conformidad de los aparatos de telecomunicaciones, aprobado por Real Decreto 1890/2000, de 20 de noviembre, modificado por la disposición final tercera del Real Decreto 424/2005 de 15 de abril (BOE 29 de abril de 2005), para los equipos:

Equipo: ................... Transceptor por satélite
Fabricado por: ............. VECTRONIC Aerospace GmbH
en: ....................... ALEMANIA
Identificación del equipo:

<table>
<thead>
<tr>
<th>MARCA</th>
<th>MODELO</th>
<th>DENOMINACIÓN COMERCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VECTRONIC</td>
<td>GPS Plus Globalstar Halsband</td>
<td>VECTRONIC</td>
</tr>
</tbody>
</table>

Le comunico que dichos equipos pueden ser puestos en el mercado español, siempre y cuando se cumplan todos los requisitos adicionales para su comercialización recogidos en el Real Decreto 1890/2000, de 20 de noviembre y otras disposiciones que le sean de aplicación.

Además, para la puesta en el mercado y puesta en servicio de estos equipos es necesario:

1. Incorporar la marca correspondiente de acuerdo con los artículos 16 y 17 del citado Reglamento.
2. Incluir en el manual del usuario toda la información requerida según los artículos 12, 13, y 14 de dicho Reglamento, incluyendo las restricciones o requisitos potenciales para la utilización del equipo en algunos o todos los Estados miembros de la Unión Europea.

Estos equipos son conformes con el Cuadro Nacional de Atribución de Frecuencias vigente en la actualidad. Debido a que éste se modifica con cierta periodicidad, se aconseja su consulta por si los cambios que se produzcan puedan afectar a estos equipos.

Madrid, a 2 de septiembre de 2010
EL JEFE DEL ÁREA DE CERTIFICACIÓN Y REGLAMENTACIÓN TÉCNICA,

Juan Antonio Mayayo Leiva.
Nemzeti Média- és Hírközlési Hatóság Hivatala

Frekvencia engedélyezési osztály
E-mail cím: feo@mhhs.hu
Ügyintéző: Bucsás István
Telefonja: 4680661

m. dudde hochfrequenz-technik
Anja Hittig-Rademacher
Rottland S.u.,
51429, Bergisch Gladbach, Germany

Tisztelt Anja Hittig-Rademacher Őrhölgy!

Hivatkozással a 2010. augusztus 10-én kelt levelére, amelyben a(z) VECTRONIC Aerospace GmbH.
gyártmányú GPS Plus Globstar Halsband típusú, Brand: VECTRONIC rádióberendezés forgalomba hozatalával kapcsolatban az alábbiakról tájékoztatam:


Üdvözlettel:

Czuczny Áfrdás
Úrhatóvezető
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