

Project:

GPS PLUS

UHF/VHF Handheld Terminal

Title:

User's Manual

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3.0	19.04.2011	Complete issue	Complete revision, now includes VHF Handheld, Proximity Sensor, Drop-off release



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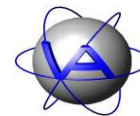
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1 Product overview

The **GPS PLUS Handheld Terminal** provides the wireless radio link between the GPS PLUS VHF/UHF collar and the PC. There are two models:

- the UHF Handheld Terminal (420 – 460 MHz or 800 – 950 MHz)
- the VHF Handheld Terminal (130 – 300 MHz).

While basic handling is identical for both Handheld Terminals, there are certain features only available for the UHF Handheld Terminal. This document describes both Handheld Terminals.

The GPS PLUS Handheld Terminal enables you to

- download GPS, high resolution activity, temperature, and mortality data from the GPS PLUS collar
- download proximity data from the GPS PLUS collar (UHF handheld only)
- download telemetry (status) information from the GPS PLUS collar,
- upload UTC time and date to the GPS PLUS collar,
- upload new GPS and VHF schedules to the GPS PLUS collar,
- upload new Proximity GPS schedules to the GPS PLUS collar (UHF handheld only),
- upload new Virtual Fence Collections to the GPS PLUS collar,
- check for UHF ID-tag signals (UHF handheld only),
- release radio-controlled drop-off by demand (UHF handheld only).

A built-in GPS receiver gives you information about your position in the field. With the assistance of an integrated electronic compass and the internal GPS receiver it is now very easy to find the tracked animal. The “Range Checker Mode” opens unbeatable support in finding the direction and distance to the collar based on its last GPS location transmitted from the collar. The GPS and compass information will be used to calculate and display azimuth and elevation (direction) and the distance with an accuracy of some meters to your collar.

The communication range is dependent on the receiver antenna gain, the humidity, the kind and density of the surrounding vegetation, the height above the ground of both the transmitter and the receiving system, the topography and the configuration between transmitting and receiving antenna. For that reasons, the range can vary from several hundred meters to several kilometres for the UHF handheld. The range of the VHF handheld is limited to several hundred meters.



2 Specifications

Size	204 x 110 x 41 mm ³ without antenna connector
Weight	550 g
Keyboard	21 keys membrane keypad
Display	128 x 64 Pixel Matrix display with LED background illumination
Memory capacity	512 Mbytes <ul style="list-style-type: none">– up to 512 collars with up to 315 520 temperature and activity datasets– up to 131 072 GPS datasets per collar– 2 Mbyte additional sensor memory per collar, e.g. for proximity data
Battery	Internal rechargeable Li-Ion battery 3.6 Volt / 6000 mAh
Charging time	less than 8 hours typ.
Operating time with charged battery	Dependent on operation mode (70 hours GPS mode, 75 hour receive mode)
External Power Supply	Only needed for charging the battery 12 Volt, 800 mA max.
Interface	<ul style="list-style-type: none">– Serial Interface 115200 baud 8N1 (to be connected to Link Manager)– USB 8Mbit/s
Ingress protection	IP65
GPS Receiver	Internal GPS receiver with integrated antenna
UHF frequency range	420 – 460 MHz or 800 – 950 MHz (factory settings)
VHF frequency range	130 – 300 MHz (factory settings)
Output power	0 – 1000 mW (factory settings), default 630 mW
Modulation	DFM
Antenna impedance	50 Ohm
Compass module	Built in electronic compass with tilt compensation
Resolution	1 mgauss
Range	± 1 gauss
Max. Exposed Field	1000 gauss
Operating temperature	0°C...+50°C (charging) -20°C...+60°C (non charging)
Storage temperature	-40°C...+80°C



3 Optional accessories

- International wall plug adapter 90-240 Volt input, 12V 1000 mA output
- Flexible helical antenna (short range)
- HB9CV direction finding antenna, Gain 5 dB, Length 33 cm (middle range)
- 6 Element Yagi antenna, Gain 8 dB, Length 75 cm (long range)
- 10 Element Yagi antenna, Gain 11.5 dB, Length 160 cm (long range)
- Coax cable, length 1 m
- Coax cable, length 1.5 m
- Coax cable, length 2 m
- Antenna mast, length from 3 – 15 m
- USB cable



4 Controls and connectors

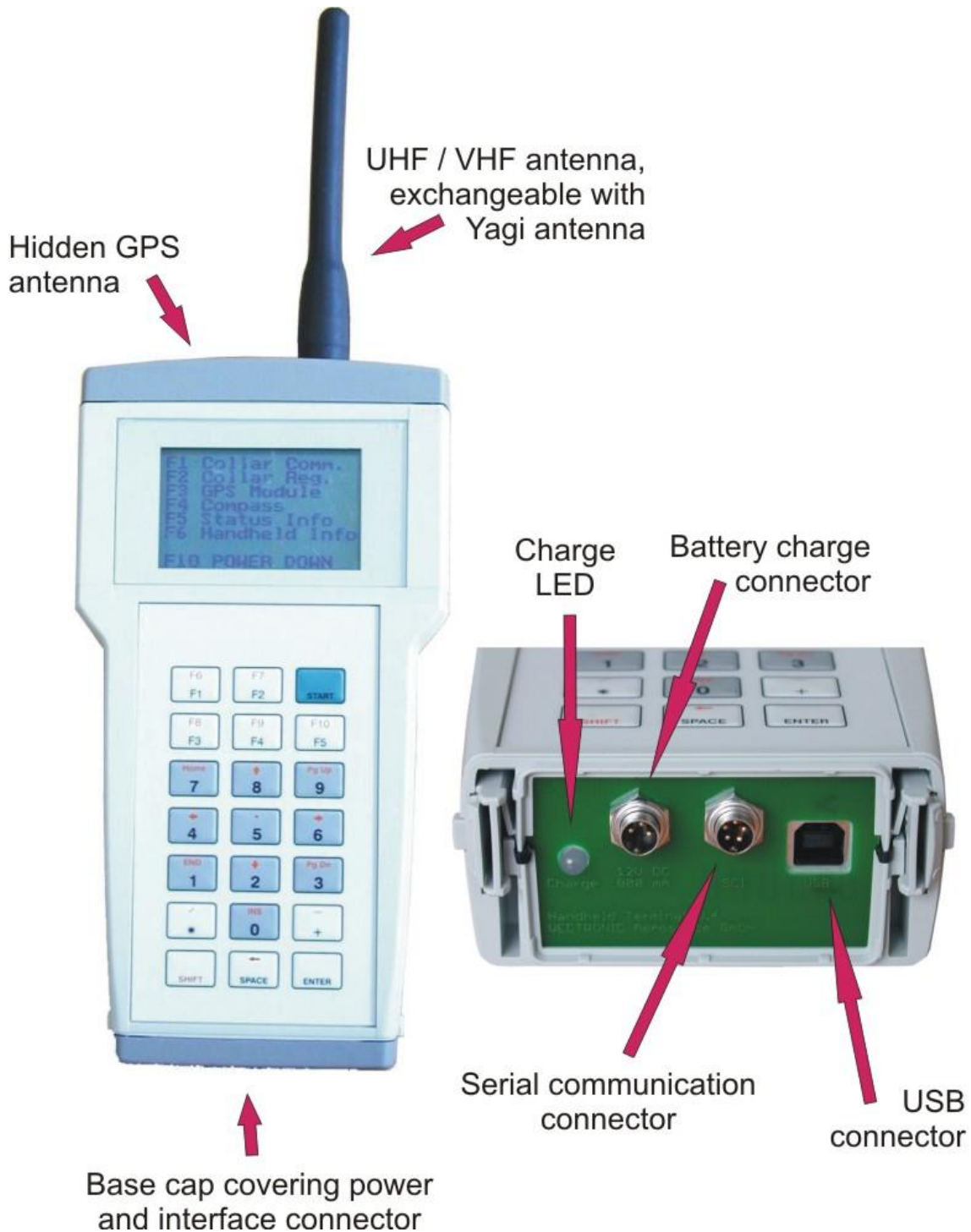


Figure 1: GPS PLUS Handheld Terminal (left); base with removed cover (right)



4.1 Removing the base cap

Press both snap locks at the same time and remove the base cap from the main housing (see Figure 2).



Figure 2: Location of the snap locks to remove the base cap

Underneath the base caps you will find a charge connector for the internal battery, the serial communication, an USB connector and a LED which indicates the charge status (see Figure 1, right).

Note: Do not use the Handheld Terminal without the base cap in humid areas. Moisture can destroy the electronic components inside the handheld terminal.



5 Basic operations

The Handheld Terminal is switched on when the key **START** is pressed briefly. You can interrupt the software at any time and return to the Start-up Display by pressing **START**. The Start-up Display will appear briefly (Display 1, left), followed by the Handheld Terminal Info Screen (Display 1, right, also see section 13.2: Handheld Terminal info).

VECTRONIC Aerospace GmbH Carl-Scheele- Str. 12 D-12489 Berlin Germany www.vectronic- aerospace.com	GPS PLUS UHF Handheld Station Serialno. 00315 Softwareversion: V.2.3.0 30.08.10 Hardwareversion: V. 005 30.03.09 [Enter] → Continue
---	--

Display 1: Start-up Display (left), followed by the Handheld Terminal Info Screen (right)

After switching on the Handheld Terminal, the non-volatile memory will be checked. The Handheld Terminal is equipped with 512 Mbytes internal memory. Up to 512 Collars can be controlled with a single Handheld Terminal. To access the Main Menu (Display 2), press **ENTER**. UHF Handheld Terminals offer the additional functions ID-Tag Receiver and Drop-Off Release. The different features will be explained in section 6 to 14.

F1 Collar Comm. F2 Collar Reg. F3 GPS Module F4 Compass F7 Terminal Info F10 POWER DOWN	F1 Collar Comm. F2 Collar Reg. F3 GPS Module F4 Compass F5 ID-Tag Rcv. F6 Dropoff-Rel. F7 Terminal Info F10 POWER DOWN
--	---

Display 2: Main Menu for the VHF Handheld Terminal (left), and the UHF Handheld Terminal (right)

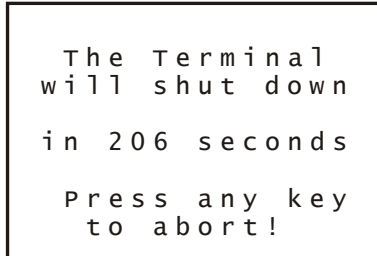
If nothing is displayed after pressing **START**, the battery is completely discharged. Connect a 12 Volt DC 800 mA power supply to the Battery Charge Connector until the battery is fully charged.

To save power, the LED background illumination will be switched off automatically 30 seconds after the last time a key has been pressed. When another key is pressed, the background illumination will be switched on automatically for further 30 seconds. Press the key **SHIFT** to again switch on the LED without interrupting the program.

Ten minutes after the last communication (USB, SCI, wireless) or after the last key has been pressed, the Handheld Terminal displays a shutdown warning with a countdown (Display 3).



After five further minutes, the Handheld Terminal will be switched off automatically. The Handheld Terminal can be switched off manually via the Main Menu with the key **F10** (**SHIFT** + **F5**).



The Terminal
will shut down
in 206 seconds
Press any key
to abort!

Display 3: Shut down warning

5.1 Battery

5.1.1 Extending battery lifetime

The battery lifetime between charging depends highly on your operation habits. The Handheld Terminal supports several ways to save power automatically and thus extend battery lifetime. Switching off the Handheld Terminal manually before automatic shutdown is one way to reduce power consumption.

5.1.2 Battery charge

To charge the battery, connect a 12 Volt DC 800 mA power supply to the battery charge connector (Figure 1, right) until the battery is fully charged. While charging, avoid to switch on the Handheld Terminal, because in this case the charge current will be reduced or switched off completely.

The GPS PLUS Handheld Terminal includes a state machine to control the charging algorithm for the Li-Ion accumulator. Whenever power is applied, the state machine switches to the reset state, in which the timers are reset to zero to prepare for charging. From the reset state, it enters the prequalification state. In the prequalification-charge state, the *Charge LED* (Figure 1, right) is lit yellow. In this state, $\frac{1}{10}$ of the fast-charge current charges the accumulator, and the accumulator voltage is measured. If the voltage is above the under voltage threshold, it will enter the fast-charge state. If the accumulator voltage does not rise above the minimum voltage threshold before the prequalification timer expires (15 minutes), charging terminates and the *Charge LED* switches to red.

In the fast-charge state, the *Charge LED* is lit yellow and the accumulator charges with a constant current of about 1A. If the accumulator voltage reaches the voltage limit before the



fast charge timer expires (5 hours) the Handheld Terminal enters the full-charge state. If the fast-charge timer expires before the voltage limit is reached, charging terminates and the *Charge LED* switches to red. In the full-charge state, the *Charge LED* is lit green and the accumulator charges at a constant voltage. If the charging current drops below 100mA, or if the full-charge timer expires (2 hours), charging stops and the *Charge LED* is switched off until the battery voltage drops below the recharge voltage threshold and it enters the reset state to start the charging process again.

The battery charger circuit is equipped with a temperature sensor to prevent the battery from being charged outside the charging temperature range (0 °C to +50 °C), so there will be no charging process outside this temperature range!

Table 1: Charge LED function of the Handheld Terminal

LED CHARGE	Function	State
(Only in use with external power)	Yellow	Prequalification or Fast charge (0...80%)
	Green	Full charge (80...100%)
	Red	Malfunction
	Off	Accumulator fully charged

5.2 Connecting the Handheld Terminal to a PC or laptop

Data exchange between Handheld Terminal and a PC or Laptop is performed via the USB interface:

1. Switch on the Handheld Terminal by pressing **START**. If no display appears on the LCD screen, the battery needs to be recharged to continue.
2. Connect the Handheld Terminal to PC with a standard USB cable (Figure 3).
3. Start the GPS PLUS Collar Manager software on the connected PC and select the USB port to communicate with the collar.

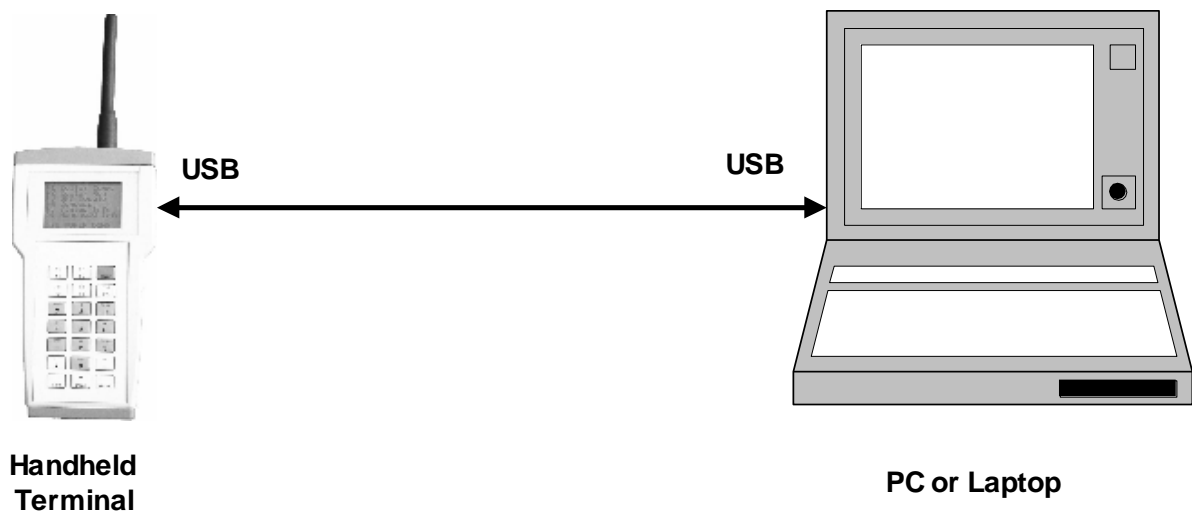


Figure 3: USB connection between Handheld Terminal and the PC / Laptop

5.3 Electronic magnetic compass

An electronic compass module inside the Handheld Terminal is used to determine the magnetic north direction and to find the direction to the collar in „Range Checker Mode“. The Handheld Terminal is designed to be held horizontally with the display facing upwards when using the magnetic compass. The magnetic compass is equipped with a tilt sensor to compensate heading errors that occur if the handheld is not held exactly horizontal. The tilt sensor can compensate tilt errors of $\pm 90^\circ$, so the magnetic compass will still work correctly when the Handheld Terminal is held vertically.

Before the magnetic compass can be used, it has to be calibrated. For instructions and the theoretical background on the compass, please refer to section 15: The built-in magnetic compass.



6 Short instruction

- Register your collars on the Handheld Terminal with the assistance of the GPS PLUS Collar Manager software (section 8: Collar registration)
- Upload GPS schedules and/or VHF schedules to the Handheld Terminal with the GPS PLUS Collar Manager software (only if needed)
- Search and select collars for communication (sections 7.1: Search for collars and 7.2: Select collars)
- Up- or download data (sections 7.2.1: Upload data and 0: Download data)
- Copy data from the Handheld Terminal to the PC using the GPS PLUS Collar Manager software
- Erase data with the GPS PLUS Collar Manager software (only if really necessary, e.g. after you erased the data inside the collar too)
- Select or remove collar IDs (section 8.2: Remove collar ID). **Note:** When you remove your collar ID from the Handheld Terminal all data attached to it will be erased too!



7 Collar Communication (F1 Collar Comm.)

In the Main Menu (Display 2), press **[F1]** to enter the Collar Communication Menu (Display 4). Here, you can search for collars in communication range and select collar IDs to up- and download data.

```
F1 Search for  
Collars  
F2 Select Collar  
F3 Update Collar  
  
[Enter] → Go Back
```

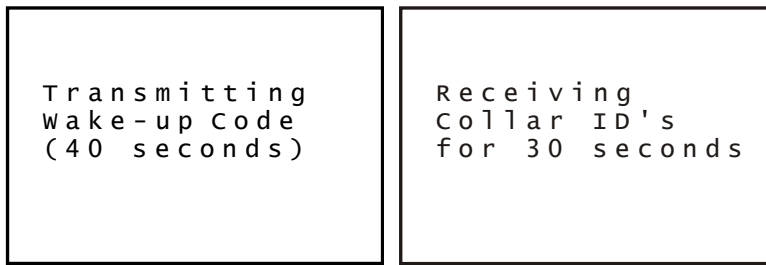
Display 4: Collar Communication Menu

The collar will be switched on every 32 seconds for 200 ms. During this short period, the Handheld Terminal must transmit a wakeup code to the collar. Due to possible time differences between collar and Handheld Terminal, the Terminal must transmit the wakeup code much longer than 200 ms. This results in extended periods, in which the Handheld Terminal transmits and waits for answers from the collars.

Note: Do not press any other key than **[ENTER]** if you are in the Collar Communication Menu or in one of its submenus without a connected 50 Ohm antenna. Transmitting without an antenna may cause permanent damage to the RF power amplifier.

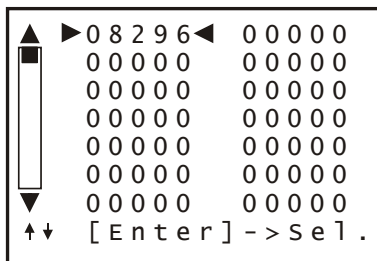
7.1 Search for Collars (F1)

To establish a radio link between Terminal and collar, the UHF Terminal transmits a 40 seconds wakeup code and then receives the collar IDs (serial number of the collar) for a period of 30 seconds (Display 5). The VHF Terminal transmits a 34 seconds wakeup code and receives the collar IDs for a period of 3 seconds. During these 30 resp. 3 seconds, every collar that is currently active and in range transmits its own ID within a predefined time slot back to the Terminal. This search for collars will be started if you press **[F1]** in the Collar Communication Menu (Display 4).



Display 5: Displays during transmission of the Wake-up Code and following reception of collar IDs

After the reception of the collar IDs is completed, the received collar IDs are shown on a list (Display 6). You will only be able to contact collars that are registered on your Handheld Terminal. All other collars, even if in range, will not be displayed.



Display 6: Received Collar IDs after Wake-up Code has been transmitted

7.2 Select Collar (F2)

All received collars which were registered before with the GPS PLUS Collar Manager software (section 8: Collar registration) are now shown on the display. They will stay responsive for two minutes, after that you need to send the wake-up code again. To select the desired collar, you can navigate with the number keys **1** - **4** and **6** - **9**. The Up and Down arrow above and below the bar graph in the left side of the display (Display 6) will appear if there are collar IDs available outside the current viewing section. The black box inside the bar graph indicates the scrolling position of the two markers (left and right arrow) in the collar list. To select a collar for communication, move the two markers with the cursor keys to the desired collar ID and press **ENTER**.

The selected collar is now valid for communication for 2 minutes. After each successful data transfer this time will be reset to 2 minutes again. After 2 minutes without further command from the handheld, the collar will switch off the radio unit automatically. If a new command is sent after these two minutes, the following message will be displayed:



```
Collar: 08296  
Collar is no  
longer active!  
Please select  
another collar  
or re-activate  
this one!  
[Enter] → Continue
```

Display 7: Collar is no longer valid

For new access to the collar, you need to wake up the collar again (see section 7.1: Search for collars). To return to the Collar Communication Menu (Display 4), press **ENTER** several times until the menu appears, then press **F1**. If you have selected collar ID 00000, the following message will be displayed:

```
Collar 00000  
is not a valid  
collar ID!  
  
Please select  
another valid ID  
[Enter] → Continue
```

Display 8: Invalid Collar ID

Once you have selected a valid collar ID the Up- and Download Menu will appear (Display 9).

```
Collar: 08296  
F1 Upload Data  
F2 Download Data  
  
[Enter] → Go Back
```

Display 9: Up- and Download Menu

You can now decide whether you want to up- or download data. Upload data means to transfer data from the Terminal to the collar (e.g. a new GPS schedule), download means to transfer data from the collar to the Terminal (e.g. GPS data).



7.2.1 F1 Upload Data

In the Up- and Download Menu, press **[F1]** to enter the Upload Menu (Display 10). You are now able to:

- Upload a GPS schedule (F1)
- Upload a VHF Beacon schedule (F2)
- Upload a GSM schedule for GSM or Iridium collars (F3)
- Upload a Virtual Fence (F4)
- Force the GPS receiver (collar) to make a fix, independent of the GPS schedule (F8 + F1)
- Upload time and date from the Handheld Terminal to the collar (F8 + F2)
- Upload a Proximity schedule (F8 + F3)
- Upload collar configurations (F8 + F4)

Collar: 08296	Collar: 08296
F1 Tx GPS Sched.	F1 Force GPS Fix
F2 Tx VHF Beacon Schedule	F2 Tx UTC Time
F3 Tx GSM Sched.	F3 Tx ProxSched.
F4 Virtual Fence	F4 Collar Config
F8 → Next Page	F8 → Prev. Page
[Enter] → Go Back	[Enter] → Go Back

Display 10: Upload Menu

The upload menu (Display 10) contains two pages. You can change between pages with **[F8]** (**[SHIFT]** + **[F3]**), or leave the upload menu with **[ENTER]**. To upload a schedule, Virtual Fence, or configuration from the Handheld Terminal to the collar, you first need to upload the schedule from the PC via the serial or the USB interface to the Handheld Terminal (see GPS PLUS Collar Manager Manual). You have to assign a collar ID to each schedule you upload to the Handheld Terminal. Once you have uploaded a schedule to the Handheld Terminal, this schedule is valid until you erase the collar from the Handheld Terminal or overwrite this schedule. The schedule will not be erased from the Handheld Terminal after a successful upload to the collar, but can be uploaded again to the same collar. If no valid schedule or Virtual Fence is available for this collar on the Handheld Terminal, Display 11 will appear.



```
Collar: 08296  
  
No valid  
schedule  
is available.  
  
[Enter] → Continue
```

Display 11: No valid schedule available

It is possible that communication between handheld and collar is interrupted, for example because the collar is out of range or because its communication is inactive again. In this case, Display 12 will appear.

```
Collar: 08296  
  
NO VALID  
COMMUNICATION  
(Out of range)  
  
[Enter] → Continue
```

Display 12: Unsuccessful communication

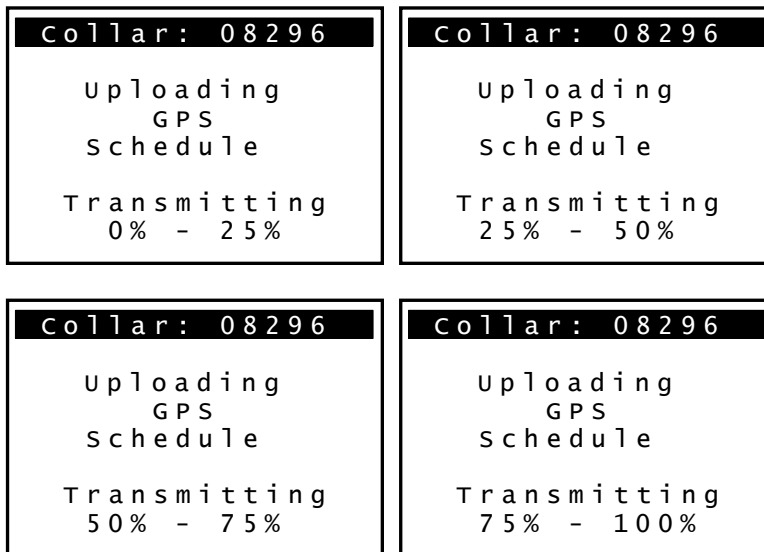
If the collar has not received any communication for more than two minutes, it will switch off again to save energy. In this case, Display 7 will appear and you need to search for collars again (7.1 Search for Collars).

7.2.1.1 Upload GPS schedule from Handheld Terminal to collar (F1 Tx GPS Sched.)

To start the GPS schedule upload, press **F1**. If no valid schedule is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 11).

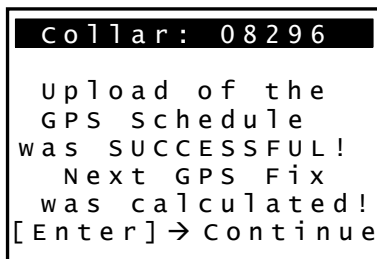
If a valid schedule for this collar ID is stored on the Handheld Terminal, the upload process starts immediately. The GPS schedule will be transmitted in four packets. If bit errors occur during transmission, the data will be resent several times. If no communication has been established, Display 12 will appear.

During upload of the four data packets the screens of Display 13 will appear in succession.



Display 13: GPS schedule upload

After the transmission of all four blocks, Display 14 will appear and the new schedule will be activated. If the transmission is aborted before all blocks are transmitted, the old schedule will remain active.

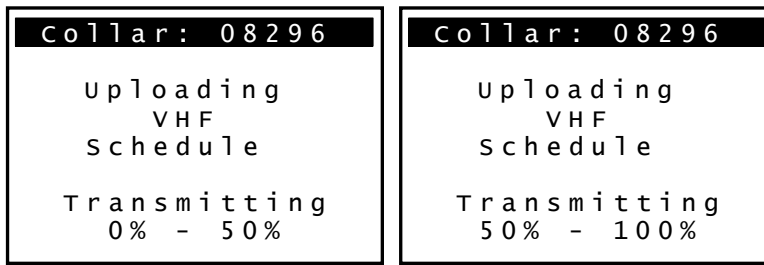


Display 14: Acknowledgement of successful GPS schedule transmission

Press **ENTER** several seconds to return to the Upload Menu.

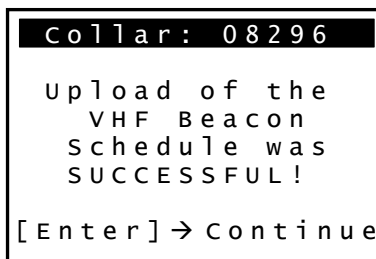
7.2.1.2 Upload VHF beacon schedule from Handheld Terminal to collar (F2 Tx VHF Beacon Schedule)

To start the VHF Beacon schedule upload, press **F2**. If no valid schedule is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 11). If a valid schedule for this collar ID is stored on the Handheld Terminal, the upload process starts immediately. The VHF beacon schedule will be transmitted in two packets. If a bit error occurs during transmission, the data will be resent several times. If no communication has been established, Display 12 will appear. During upload of the two data packets the screens of Display 15 will appear in succession.



Display 15: VHF schedule upload

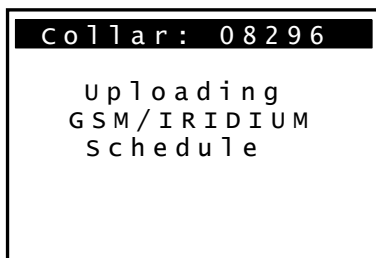
In case of transmission errors, the process will be repeated automatically several times. If no communication has been established, Display 12 will appear. After the transmission was successfully finished, Display 16 will appear and the collar will calculate the next VHF beacon event. Press **ENTER** to return to the Upload Menu.



Display 16: Acknowledgement of successful VHF schedule transmission

7.2.1.3 Upload GSM/Iridium schedule from Handheld Terminal to collar (F3 Tx GSM Sched.)

If you are using a GSM or Iridium collar, you can upload schedules for data transmission (GSM schedule). To start the GSM schedule upload, press **F3**. If no valid schedule is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 11). If a valid schedule for this collar ID is stored on the Handheld Terminal, the upload process starts immediately. During upload of the schedule, Display 17 will appear.



Display 17: GSM schedule upload

In case of transmission errors, the process will be repeated automatically several times. If no communication has been established, Display 12 will appear. After the transmission was



successfully finished, Display 18 will appear and the collar will calculate the next GSM transmission time.

```
Collar: 08296

Upload of the
GSM/IRIDIUM
Schedule was
SUCCESSFUL!

[Enter] → Continue
```

Display 18: Acknowledgement of successful GSM schedule transmission

7.2.1.4 Upload Virtual Fence from Handheld Terminal to collar (F4 Virtual Fence)

To start the Virtual Fence upload, press **[F4]**. A Virtual Fence contains a file with coordinates of the Virtual Fence area and a Virtual Fence schedule. If no Virtual Fence is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 11). If a valid schedule for this collar ID is stored on the Handheld Terminal, the upload process starts immediately (Display 19).

```
Collar: 08296

Uploading
Virtual
Fence

Transmitting
Fence...
```

Display 19: Virtual Fence upload

The Virtual Fence will be transmitted in two packets. In case of transmission errors, the process will be repeated automatically several times. If no communication has been established, Display 12 will appear. After the transmission was successfully finished, Display 20 will appear and the collar will calculate the next GSM transmission time.

```
Collar: 08296

Upload of the
Virtual Fence
was
SUCCESSFUL!

[Enter] → Continue
```

Display 20: Acknowledgement of successful Virtual Fence transmission



7.2.1.5 Transmit command to the collar to switch on the GPS receiver immediately (F8 ⇒ F1 Force GPS Fix)

The Handheld Terminal can send a command to the collar to switch on the collar's GPS receiver immediately. This is very helpful in combination with the Range Checker Mode to find the current position of the collar.

Press **[F1]** on the second page of the Upload Menu (with **[F8]**, Display 10) to send the command. The display in Display 21 will appear while the radio link of the collar will be shut down and the collar GPS receiver will be switched on to make a fix. After a valid fix or a timeout, the collar will go into the standard stand-by mode to save power. To wake up the collar, you need to establish the radio link again (section 7 Collar Communication). To abort a fix, press **[ENTER]**, and return to the Upload Menu (Display 10).

```
Collar: 08296
The GPS receiver
is now switched
on. ATTENTION:
Collar may not
respond for
several minutes
[Enter] → Cancel
```

Display 21: Transmit "Switch GPS On" command

7.2.1.6 Upload UTC Time from Handheld Terminal to collar (F8 ⇒ F2 Tx UTC Time)

The UTC time and date of the Handheld Terminal will be updated by the GPS satellite system every time the on-board GPS receiver can solve a valid fix. To send this time to the collar, go to the second page of the Upload Menu (with **[F8]**) and press **[F2]**. The current time and date of the Handheld Terminal is shown on the display (Display 22); press **[F10]** to start the upload (Display 23).

```
Collar: 08296
Upload the
following time?
Time 12:29:56
Date 27.04.2007

[F10] → Upload
[Enter] → Cancel
```

Display 22: Upload Time and Date Menu



```
Collar: 08296
Uploading
Time and Date

Please wait
```

Display 23: Transmission of Time and Date

If time and date are received without errors, a success message will be displayed (Display 24). After the collar has received the new time and date, it recalculates the GPS, UHF and VHF schedules. In case of transmission errors, the process will be repeated automatically several times. If no successful upload was possible, Display 12 will inform you that no valid communication was possible (either because it is out of range or because the collar's communication is inactive again). Press **ENTER** to return to the Upload Menu (Display 10).

```
Collar: 08296

Upload of
Time and Date
was SUCCESSFUL!
Schedule events
will be updated!
Press [Enter]
```

Display 24: Acknowledgement of successful time and date transmission

7.2.1.7 Upload Proximity schedule from Handheld Terminal to collar (F8 ⇒ F3 Tx ProxSched., UHF collars only)

If you are using an UHF collar in combination with VECTRONIC UHF ID tags, you can upload a proximity schedule. To start the Proximity schedule upload, go to the second page of the Upload Menu (with **F8**) and press **F3**. If no valid schedule is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 11). If a valid schedule for this collar ID is stored on the Handheld Terminal, the upload process starts immediately. During upload of the schedule, Display 25 will appear.

```
Collar: 08296

Uploading
Proximity
Schedule
```

Display 25: Transmission of Proximity schedule



If the Proximity schedule was received without errors, a success message will be displayed (Display 26). In case of transmission errors, the process will be repeated automatically several times. If no successful upload was possible, Display 12 will inform you that no valid communication was possible (either because it is out of range or because the collar's communication is inactive again). Press **ENTER** to return to the Upload Menu (Display 10).

```
Collar: 08296

Upload of the
Proximity
Schedule was
SUCCESSFUL!

[Enter] → Continue
```

Display 26: Acknowledgement of successful Proximity schedule transmission

7.2.1.8 Upload Collar Configuration from Handheld Terminal to collar (F8 ⇒ F4 Collar Config)

Collar configuration files can be created with the GPS Plus software (Commands ⇒ Collar Configuration) or are supplied by VECTRONIC Aerospace. To start the upload of a collar configuration, go to the second page of the Upload Menu (with **F8**) and press **F4**. If no valid collar configuration is stored on the Handheld Terminal for the specified collar, an error message will appear (Display 27).

```
Collar: 08296

No valid
collar
configuration

[Enter] → Continue
```

Display 27: No valid Collar Configuration available.

If there is at least one valid configurations for the selected collar stored on the Handheld Terminal, a list off all configurations will appear (Display 28). Up to five configurations can be stored on the handheld at one time.

Note: If you upload new configurations to the Terminal, the configurations already stored on the Terminal will be overwritten in the Terminal, but not in the collar.



```
Collar: 08296
▶RF Comm Time◀
VF Events
PRX Mode
N/A
N/A
[F1] -> Transmit
[Enter] -> Go Back
```

Display 28: List of all configurations available for the selected collar. N/A indicates unused memory slots.

Select a configuration with the number keys **2** and **8**. Then press **F1** to transmit the configuration to the collar. Press **ENTER** to abort and return to the Upload Menu (Display 10). During upload of the schedule, Display 29 will appear.

```
Collar: 08296

  Uploading
    Collar
  Configuration
```

Display 29: Transmission of Collar Configuration

If the Collar Configuration was received without errors, a success message will be displayed (Display 30). In case of transmission errors, the process will be repeated automatically several times. If no successful upload was possible, Display 12 will inform you that no valid communication was possible. Press **ENTER** to return to the Upload Menu (Display 10).

```
Collar: 08296

  Upload of the
    Collar
  Configuration
was SUCCESSFUL!

[Enter] → Continue
```

Display 30: Acknowledgement of successful Collar Configuration transmission



7.2.2 F2 Download Data

Press **F2** in the Up- and Download Menu to reach the Download Menu (Display 31). This menu allows you to:

- Download the GPS data (F1)
- Download activity and temperature data (F2)
- Download mortality data (F3)
- Download data from the proximity sensor or external sensors linked to the collar (F4, if sensors are available in collar)
- Download telemetry (status) information of the collar (F5)
- Download the last valid position and then navigate towards the collar with the assistance of the built-in electronic compass (F6)

```
Collar: 08296
F1 Rx GPS Data
F2 Rx Act. Data
F3 Rx Mortality
F4 Rx Sens. Data
F5 Telemetry
F6 Range Checker
[Enter] → Go Back
```

Display 31: Download Menu

If transmissions errors occur during data download, Display 32, left, will appear and data will automatically be requested again. If no answer from collar is received, Display 32, centre, will appear and the collar will automatically try to re-establish radio connection to the collar. If no further data transmission is possible, Display 32, right, will appear.

```
Collar: 08296
BIT ERRORS
WHILE RECEIVING
DATA
Trying to
reconnect
Hold any key to
cancel
```

```
Collar: 08296
NO CONTACT
WITH COLLAR
Trying to
reconnect
Hold any key to
cancel
```

```
Collar: 08296
NO VALID
COMMUNICATION
(Out of range)
[Enter] → Continue
```

Display 32: Possible error messages

To interrupt the transmission, press any key but **SHIFT**, and hold it until Display 33 (“User interrupt”) appears.



```
Collar: 08296  
  
USER INTERRUPT!  
  
[Enter] → Continue
```

Display 33: User interrupt

7.2.2.1 Download GPS data from collar to Handheld Terminal (F1 Rx GPS Data)

Press **F1** to download the GPS information from the collar. The downloaded data cannot be viewed on the Handheld Terminal's display, but need to be downloaded to a PC with the GPS PLUS Collar Manager (see GPS PLUS Collar Manager Manual). Display 34 allows you to choose whether you want to receive the GPS data with or without channel information. Channel information includes:

- Used Satellite ID for each channel,
- Carrier to noise ratio for the used satellites for each channel.

One GPS data set (one GPS position) with channel information has a size of 33 Bytes. The same position information can be transmitted without channel information with a size of 21 Bytes, resulting in a 40% faster download from collar to Handheld Terminal without channel information. It is possible to download a part of the GPS data memory from the collar with channel information and another part without channel information, but it is not possible to download only the channel information later. If you want to get the channel information from a dataset which was downloaded previously, you need to erase the GPS data memory of this collar on the Handheld Terminal and download all GPS data again.

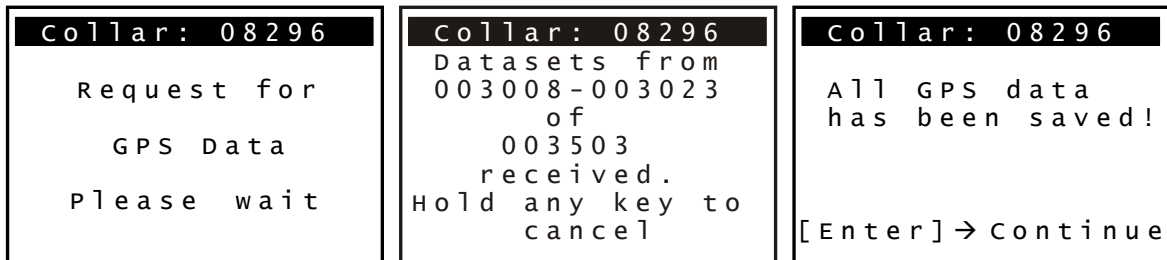
```
Collar: 08296  
F3 Receive GPS  
Data with  
Channel Info  
F5 Receive GPS  
Data without  
Channel Info  
[Enter] → Go Back
```

Display 34: Select GPS data download mode

After pressing **F3** or **F5**, the Handheld Terminal receives telemetry data to calculate how many datasets are ready for download from the collar (Display 35, left). Then the download starts automatically and the running number of the datasets currently being downloaded is shown (Display 35, centre). To interrupt the transmission, press any key but **SHIFT**, and hold



it until Display 33 (“User interrupt”) appears. After all data has been received, Display 35, right, will appear.



Display 35: Request for GPS data (left), download of GPS data (centre), and acknowledgement of successful GPS data download (right)

The error free received data is stored inside the Handheld Terminal. Press **ENTER** to return to the Download Menu (Display 31).

Note: Previously downloaded GPS data from this collar ID will NOT be overwritten. Instead, only data sets which have a running number higher than the last one stored on the Handheld Terminal yet are downloaded from the collar and added to the existing data file. This saves transmission power, since only new data need to be transmitted. If you have ERASED the data on your collar, you must ERASE these data on the Handheld Terminal as well. Otherwise data sets with low running numbers will not be downloaded.

7.2.2.2 Download Activity and Temperature Data from collar to Handheld Terminal (F2 Rx Act. Data)

Press **F2** to download activity and temperature data sets containing Date and Time of measurement, activity value depending on selected activity mode, and temperature. Valid data will only be downloaded from collars with an enabled activity and/or temperature sensor. The downloaded data cannot be viewed on the Handheld Terminal’s display, but need to be downloaded to a PC with the GPS PLUS Collar Manager (see GPS PLUS Collar Manager Manual).

After pressing **F3**, you will immediately see Display 36. The Handheld Terminal now receives telemetry data to calculate how many datasets are ready for download from the collar. Then the download of activity and temperature data starts automatically and the running number of the datasets currently being downloaded is shown (Display 37, left). To interrupt the transmission, press any key but **SHIFT** and hold it until Display 33 appears.



```
Collar: 08296  
  
Request for  
Activity Data  
  
Please wait
```

Display 36: Request for Activity Data

```
Collar: 08296  
Datasets from  
003008-003023  
of  
003503  
received.  
Hold any key to  
cancel
```

```
Collar: 08296  
  
All Activity  
data has been  
saved!  
  
[Enter] → Continue
```

Display 37: Download of Activity and Temperature Data (left) and acknowledgement of successful Activity data download (right)

Possible error messages during transmission are explained in Display 32. The error free received data is stored inside the Handheld Terminal. After all data has been received, Display 37, right, will appear. Press **[ENTER]** to return to the Download Menu (Display 31).

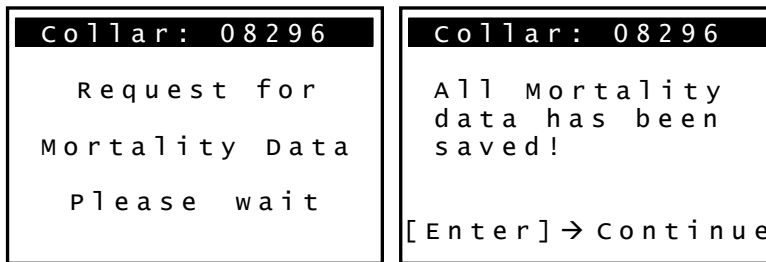
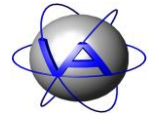
Note: Previously downloaded activity and temperature data from this collar ID will NOT be overwritten. Instead, only data sets which are not stored on the Handheld Terminal yet are downloaded from the collar and added to the existing data file. This saves transmission power, since only new data need to be transmitted. If you have ERASED the data on your collar, you must ERASE these data on the Handheld Terminal as well.

7.2.2.3 Download mortality data from collar to Handheld Terminal (F3 Rx Mortality)

Press **[F3]** to download the mortality data containing Date and Time of the mortality detection. Valid data will only be downloaded from collars with an enabled mortality sensor. The downloaded data cannot be viewed on the handheld display, but need to be downloaded to a PC with the GPS PLUS Collar Manager (see GPS PLUS Collar Manager Manual).

After pressing **[F3]**, you will immediately see Display 38, left. If no errors occur during data transmission, Display 38, right, will be shown. Possible error messages during transmission are explained in Display 32.

Previously downloaded mortality data from this collar will be overwritten in the Handheld Terminal's memory. It is not necessary to delete the data before downloading it from the collar. Finally press **[ENTER]** to return to the Download Menu (Display 31).

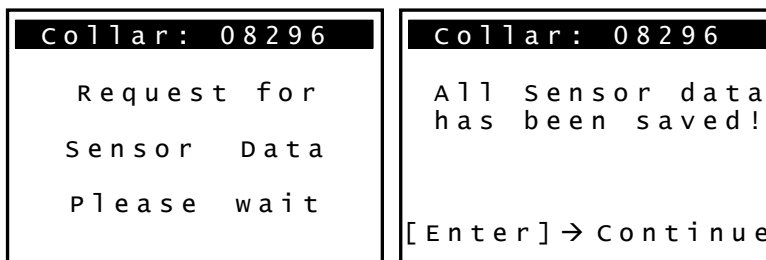


Display 38: Request for Mortality Data (left) and acknowledgement of successful data download (right)

7.2.2.4 Download Proximity or External Sensor data from collar to Handheld Terminal (F4 Rx Sens. Data)

Press **F4** to download data from the proximity sensor or any external sensor linked to the collar¹. Data sets for the Proximity Sensor contain Date and Time of encounter, ID of encountered UHF transmitter and signal strength (RSSI). This option is only available in UHF Handheld Terminals V4 or higher with Firmware 2.2 or higher, and valid data will only be downloaded from UHF collars with a proximity sensor. The downloaded data cannot be viewed on the Handheld Terminal's display, but need to be downloaded to a PC with the GPS PLUS Collar Manager (see GPS PLUS Collar Manager Manual).

After pressing **F4**, you will immediately see Display 39, left. If no errors occur during data transmission, Display 39, right will be shown. Possible error messages during transmission are explained in Display 32. After all data has been saved (Display 39, right) press **ENTER** to return to the Download Menu (Display 31).



Display 39: Request for Sensor Data (left) and acknowledgement of successful data download (right)

¹ Please contact VECTRONIC Aerospace for further details on external sensor options.



7.2.2.5 Download telemetry from collar to Handheld Terminal (F5 Telemetry)

Press **F5** to request telemetry data from the collar. A process display will appear (Display 40).

```
Collar: 08296  
  
Request for  
Telemetry  
  
Please wait
```

Display 40: Request for Telemetry

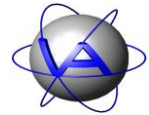
Possible error messages during transmission are explained in Display 32. If no communication can be established, Display 12 will appear. After a valid telemetry set was received, the Handheld Terminal shows the information on several consecutive display pages. You can continue to the next page by pressing **ENTER**.

The first screen of the Collar Telemetry Set (Display 41, left) shows the UTC time and date of the collar, the voltage of the main and the backup battery and the current temperature of the collar. The second screen (Display 41, centre) contains information about the UHF beacon frequency and the time and date of the next GPS fix. The third screen (Display 41, right) shows the number of GPS, activity, and temperature datasets stored on the collar.

<pre>Collar: 08296 Time 12:29:56 Date 27.04.2007 Main Voltage 3.4 Backup Volt. 3.3 Temperature 21°C [Enter] → Continue</pre>	<pre>Collar: 08296 UHF Beacon Frq. 447.000 MHz Next GPS Fix Time 18:00:00 Date 01.05.2010 [Enter] → Continue</pre>	<pre>Collar: 08296 GPS Fixes: 039812 Activity values: 102589 [Enter] → Continue</pre>
--	---	--

Display 41: Display pages of the Collar Telemetry Set

The last screen (Display 42) contains information about the last valid GPS fix. It includes the time and date and the position in the form of latitude, longitude and altitude coordinates. If no last valid fix is available, the two letters N/A (not available) will be shown on the screen. The last valid position is not available after a battery replacement, because the information about the last valid position is kept in a volatile memory area, whereas all GPS, mortality, activity and temperature information are stored in a non-volatile memory area and therefore are available after battery replacement.



Collar: 08296 Last Valid Fix Time 18:00:00 Date 30.04.2007 Lat: 052.43048° Lon: 013.52530° Altitude 0148.5m [Enter] → Continue	Collar: 08296 Last Valid Fix Time N/A Date N/A Lat: N/A Lon: N/A Altitude N/A [Enter] → Continue
--	--

Display 42: Last display page with (left) or without (right) valid GPS information

7.2.2.6 Activate Range Checker Mode (F6 Range Checker)

Press **F6** (**SHIFT** + **F1**) in the Download Menu to go to the Range Checker Mode. In this mode, the Handheld Terminal first receives telemetry from the collar (see section 0 F5 Telemetry). If no valid GPS fix is available, you will receive an error message (Display 43).

Collar: 08296 No Information about last valid GPS Fix! [Enter] → Continue
--

Display 43: No valid GPS available information

After receiving a valid telemetry set, the Handheld Terminal switches on the built-in GPS receiver and the display changes to Display 44 (left). You can now select if the Handheld Terminal will calculate the distance (range) as 2D (**F2**) or 3D (**F3**) value.

Collar: 08296 F2 Use 2D Range F3 Use 3D Range [Enter] → Go Back	GPS Receiver is switched on waiting for satellite signal Please wait or [Enter] → Cancel
---	---

Display 44: Selection of 2D or 3D range calculation (left) and screen “GPS receiver is switched on” (right)

After the selection, display Display 44, right, will appear. If the GPS receiver receives enough satellite signals, the display will switch automatically to the range checker screen (Display 45). The Handheld will now calculate the current distance and direction to the last valid collar position. Δ Time is the difference between the time of the last valid position of the collar and the current time of the Handheld Terminal. The format is hhh:mm:ss. The distance to the collar will be calculated according the earth centre earth fix coordinates and is labelled



Range on the display. The resolution is one meter. Depending on your previous selection, the display shows the two-dimensional calculation of the range (2D) or the three dimensional calculation of the range (3D). The direction is calculated in two axes according the horizon system. The horizontal direction is calculated as azimuth and the vertical direction is calculated as elevation. The resolution of both values is one degree.

Collar: 08296	Collar: 08296
ΔTime 001:07:28	ΔTime 001:07:28
Range 00447m2D	Range 00447m3D
Az:040° El: 035°	Az:040° El: 035°
Magnetic Direct.	Magnetic Direct.
GPS Direction	GPS Direction

Display 45: Range Checker Display with 2D (left) and 3D (right) range information

The azimuth is running from 0° to 359°, like a compass rose. Direction north is referred to as 0°, direction east is referred to as 90°, direction south is referred to as 180° and direction west is referred to as 270° (Figure 4). The elevation is running from 0° to 90°. An elevation of 0° indicates directly above the horizon, an elevation of 90° indicates vertically into the sky (Figure 5).

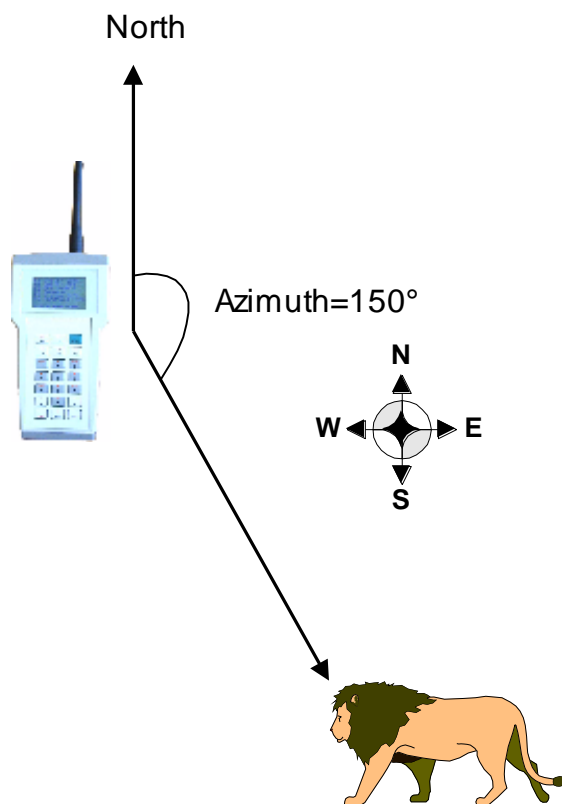


Figure 4: Azimuth angle between Handheld Terminal and Collar

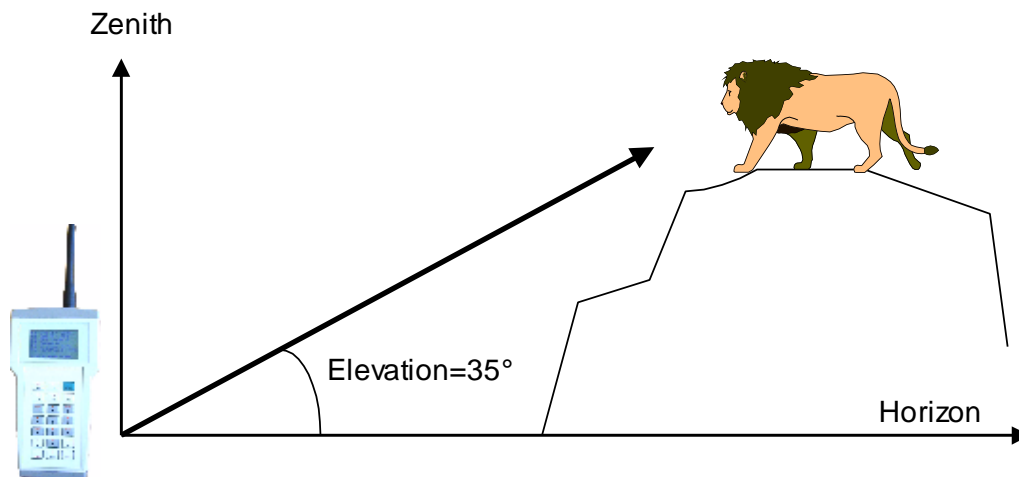


Figure 5: Elevation angle between Handheld Terminal and Collar

Below azimuth and elevation information there are two bar graphs (Display 45). The first bar graph shows the direction to the collar with the assistance of the magnetic compass. This system is referenced to the magnetic north. The second bar graph shows the direction to the collar with the assistance of the GPS receiver. This system is referenced to true north. The magnetic compass works well if the compass errors are not so relevant (declination error, etc. see section 5.3 Electronic Magnetic Compass). If you turn the Handheld Terminal along its vertical axis, the direction finder (marker) will change the position too. This is not the case when you work with the GPS based compass. The GPS based compass uses the velocity of the Handheld Terminal (velocity of the person or car). The overall velocity must be at least 0.3 m/s. The higher your velocity, the higher the precision of the GPS based compass. If you do not move, the direction finder will go to the centre of the bar graph, because the velocity is too low and it is not possible to calculate a direction based on its velocity. The GPS compass works well if you are able to walk fast and if you receive satellite signals.

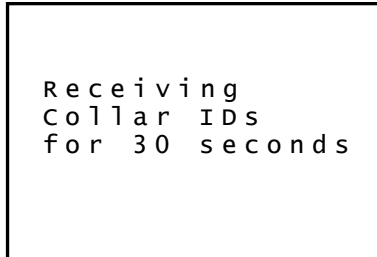
To find the way to your collar, try to move the direction finder (marker) to the centre of the bar graph. The bar graph has a resolution of $\pm 180^\circ$. If the marker is in the centre, go straight ahead. If the marker is left of the centre, turn to the left, if the marker is right of the centre, turn to the right. If the marker is at the edge of the bar graph (left or right) make a 180° turn.

7.3 Update Collar (F3)

If the collars are still in receptive mode and the terminal has been switched off or the user has cancelled collar communication, it is possible to establish the radio link between Handheld Terminal and collar again without transmitting the wake-up code by pressing **F3**. The Handheld Terminal will send a short command to all collars and listen to collar IDs for a



period of 30 seconds (UHF) respectively 3 seconds (VHF) (Display 46). During this time, each collar that is in receptive mode, and in range will transmit its own ID in a predefined time slot back to the Terminal.



Display 46: Displays during reception of collar IDs

Note: Do not press any other key than **ENTER** if you are in the Collar Communication Menu or in one of its submenus without a connected 50 Ohm antenna. Transmission without an antenna may cause permanent damage to the RF power amplifier.

After the reception of the collar IDs is completed, the received collar IDs are shown as list and you can select collars for communication (Display 6).



8 Collar Registration (F2 Collar Reg.)

To block people other than the owner of the collar from wireless access to the collars, the collar IDs must be registered in the Handheld Terminal. Each collar is delivered with a unique key file for registering. This file is needed to register the collar in the GPS PLUS Collar Manager (see Manual) and on the Handheld Terminal. Up to 512 Collars can be registered on the Handheld Terminal using the GPS PLUS Collar Manager.

Press **[F2]** in the Main Menu to enter the Collar Registration Menu (Display 47). Here you have the possibility to view a list of currently registered collars or to remove collar IDs from the list. **(This will remove the collar data from the Handheld Terminal as well!)**

```
F1 Show
  Collar IDs

F2 Remove
  Collar IDs

[Enter] → Go Back
```

Display 47: Collar Registration Menu

8.1 Show list of the registered collar IDs (F1 Show Collar IDs)

Press **[F1]** in the Collar Registration Menu to view a list of all collars currently registered on the Handheld Terminal (Display 48).

```
▲ 03814 07793
■ 08270 08296
▼ 00000 00000
  00000 00000
  00000 00000
  00000 00000
  00000 00000
  00000 00000
↑↓ [Enter] → Ret.
```

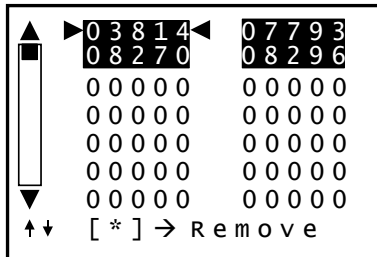
Display 48: List of collar IDs registered on the Handheld Terminal

All registered collars are now shown on the display. To navigate within the list, use the number keys **[1] - [4]** and **[6] - [9]**. The Up and Down arrow above and below the bar graph in the left side of the display will appear if there are collar IDs available outside the current viewing section. The black box inside the bar graph indicates the scrolling position of the two markers (Left and Right arrow) in the collar list.



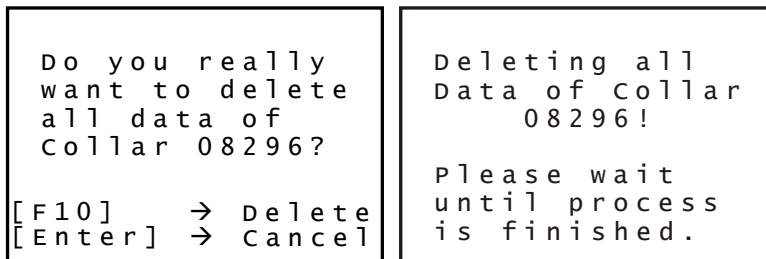
8.2 Remove Collar ID from Handheld Terminal (F2 Remove Collar IDs)

To remove a collar from the ID list, press **[F2]** in the Collar Registration Menu. Display 49 will appear. All registered collars are highlighted (white numbers on black background). To navigate within the list, use the number keys **[1]** - **[4]** and **[6]** - **[9]**.



Display 49: List of collar IDs registered on the Handheld Terminal, highlighted for removal

To remove a collar from the Handheld Terminal, select the desired ID and press **[*]**. Display 50, left, will appear immediately. To cancel this operation and return to Display 49, press **[ENTER]**, to delete the collar ID and all data belonging to this collar, press **[F10]** (**[SHIFT]** + **[F5]**). Display 50, right, will now be shown until the deletion is completed and you have returned to the collar list. After deleting all desired collars, press **[ENTER]** to return to the Collar Registration Menu.



Display 50: Erasing confirmation (left) and deletion process is currently performed (right)

Note: If you remove a collar ID, all data associated with this ID will be removed from the Handheld Terminal as well!



9 GPS On Board Module (F3 GPS Module)

The Handheld Terminal is equipped with a GPS receiver. You can use the information of this receiver to determine your position in the field or to navigate. Press **F3** in the Main Menu to reach the GPS Menu (Display 51).

```
F1 GPS Power off
F2 GPS On ECEF
F3 GPS On LLA
F4 GPS Cold.ECEF
F5 GPS Cold. LLA

[Enter] → Go Back
```

Display 51: GPS Menu

9.1 Switch off GPS Receiver (F1 GPS Power off)

Press **F1** in the GPS Menu to switch off the GPS receiver in the Handheld Terminal. Display 52 will appear to inform you that the GPS receiver is switched off. Press **ENTER** to return to the GPS Menu (Display 52).

```
GPS Receiver
is switched off

[Enter] → Continue
```

Display 52: Switch off GPS Receiver

Note: The GPS receiver will only be in off-state if you switch it off manually or if the Handheld Terminal is switched off. The receiver will not be switched off when you leave the GPS Menu.

9.2 Start GPS Receiver in ECEF Mode (F2 GPS On ECEF)

To start the GPS receiver in Earth Centre Earth Fixed mode press **F2** in the GPS Menu. Display 53 will appear while the receiver is searching for GPS satellite signals. Once the GPS receiver gets data from at least one satellite, the display will change to Display 54.



To abort and return to the GPS Menu, press **ENTER** until the screen changes. This can take several seconds, depending on the receiving conditions. If you start the receiver indoors and it is not able to receive GPS satellite signals, you need to press **ENTER** for several seconds until the screen changes, if you have open access to the sky it should take a maximum of one second.

```
GPS Receiver
is switched on

Waiting for
satellite signal
Please wait or

[Enter] → Cancel
```

Display 53: GPS Receiver waits for satellite signal

```
Time 12:29:56
Date 27.04.2007
X: 3789069 m
Y: 0911458 m
Z: 5032231 m
3D Nav. Validated
DOP:02.0 Usat:06
```

Display 54: GPS Receiver in ECEF Mode

The first and second line of Display 54 show UTC time and date. The next three lines show the position of the Handheld Terminal in Earth Centre Earth Fixed coordinates with a resolution of one meter. The next line gives information about the navigation status. Possible values are:

- No Navigation
- 2D Navigation
- 3D Navigation
- 3D Nav. Validated

For 3D Nav. Validated, the GPS receiver uses 5 or more satellites to calculate the position fix and the DOP value must be lower than 10. Since the navigation solution needs only 4 satellites, the equations are over determined by one or more. This can be used to calculate some validation on the range measurements. If this has been succeeded, the fix is considered validated. 3D Nav. validated is the best fix quality you can get.

The last displayed line describes the DOP value (Dilution Of Precision) and the number of used (tracked) satellites. Below this line, there are two horizontal bar graphs. These bar graphs show the received signal strength for every tracking channel. The left bar graph covers



channel 1 to 6, the right bar graph covers channel 7 to 12. If a line is shown within these bar graphs the GPS receiver receives satellite signals. The left edge indicates 25 dBHz (very poor signal), the right edge indicates 50 dBHz (strong signal).

Note: The GPS receiver will only be in off-state if you switch it off manually or if the Handheld Terminal is switched off. The receiver will not be switched off when you leave the GPS Menu.

9.3 Start GPS Receiver in LLA Mode (F3 GPS On LLA)

To start the GPS receiver in Latitude, Longitude and Altitude Mode Press **F3** in the GPS Menu. Display 55 will appear while the receiver is searching for GPS satellite signals. Once the GPS receiver gets data from at least one satellite, the display will change to Display 56.

```
GPS Receiver
is switched on

Waiting for
satellite signal
Please wait or

[Enter] → Cancel
```

Display 55: GPS Receiver waits for satellite signal

To abort and return to the GPS Menu press **ENTER** until the screen changes. This can take several seconds, depending on the receiving conditions. If you start the receiver indoors and it is not able to receive GPS satellite signals, you need to press **ENTER** for several seconds until the screen changes, if you have open access to the sky it should take a maximum of one second.

```
Time 12:29:56
Date 27.04.2007
Lat: 052.43056°
Lon: 013.52553°
Altitude 0113.0m
3D Nav. Validated
DOP:02.0 Usat:06
```

Display 56: GPS Receiver in LLA Mode


The displayed information are the same as in ECEF mode (see Display 54, section 9.2 Start GPS Receiver in ECEF Mode), with exception of the position data. These are given as latitude, longitude and altitude.



Note: The GPS receiver will only be in off-state if you switch it off manually or if the Handheld Terminal is switched off. The receiver will not be switched off when you leave the GPS Menu.

9.4 Start GPS Receiver in Coldstart ECEF Mode (F4 GPS Cold. ECEF)

If the GPS receiver has not been able to track any satellite for several minutes, it is sometimes useful to perform a reset or coldstart. For this, press **[F4]** in the GPS Menu. Display 57, left, will appear and the real time clock, the position and the ephemeris of the satellites will be erased. The receiver is now in coldstart mode for some seconds and starts searching GPS satellite signals. Once the GPS receiver receives at least one satellite, Display 57, right, will appear.

GPS Receiver is switched on	Time 12:29:56
waiting for satellite signal	Date 27.04.2007
Please wait or	X: 3789069 m
[Enter] → Cancel	Y: 0911458 m
	Z: 5032231 m
	3D Nav. validated
	DOP: 02.0 USat: 06
	

Display 57: GPS Receiver waits for satellite signal (left), GPS Receiver in ECEF Mode (right)



To abort and return to the GPS Menu, press **[ENTER]** until the screen changes. This can take several seconds, depending on the receiving conditions. If you start the receiver indoors and it is not able to receive GPS satellite signals, you need to press **[ENTER]** for several seconds until the screen changes, if you have open access to the sky it should take a maximum of one second.

Note: The GPS receiver will only be in off-state if you switch it off manually or if the Handheld Terminal is switched off. The receiver will not be switched off when you leave the GPS Menu.

9.5 Start GPS Receiver in Coldstart LLA Mode (F5 GPS Cold. LLA)

If the GPS receiver has not been able to track any satellite for several minutes, it is sometimes useful to perform a reset or coldstart. For this, press **[F5]** in the GPS Menu. Display 58, left, will appear and the real time clock, the position and the ephemeris of the satellites will be erased. The receiver is now in coldstart mode for some seconds and starts searching GPS satellite signals. Once the GPS receiver receives at least one satellite, Display 58, right, will appear.



GPS Receiver is switched on	Time 12:29:56
Waiting for satellite signal	Date 27.04.2007
Please wait or	Lat: 052.43056°
[Enter] → cancel	Lon: 013.52553°
	Altitude 0113.0m
	3D Nav. Validated
	DOP:02.0 USat:06
	 

Display 58: GPS Receiver waits for satellite signal (left), GPS Receiver in LLA (right)

To abort or to return to the GPS Menu, press **ENTER** until the screen changes. This can take several seconds, depending on the receiving conditions. If you start the receiver indoors and it is not able to receive GPS satellite signals, you need press **ENTER** for several seconds until the screen changes, if you have open access to the sky it should take a maximum of one second.

Note: The GPS receiver will only be in off-state if you switch it off manually or if the Handheld Terminal is switched off. The receiver will not be switched off when you leave the GPS Menu.



10 Compass Module (F4 Compass)

The Handheld Terminal is equipped with an electronic compass and with a GPS compass. You can use the information of this compass to work with it in the field or to navigate. Press **[F4]** to go to the Compass Menu from Main Menu (Display 59).

```
F1 Mag.Compass  
  Information  
F2 GPS Compass  
  Information  
F9 Calibrate  
  Compass  
  
[Enter] → Go Back
```

Display 59: Compass Menu

10.1 Magnetic Compass (F1 Mag. Compass Information)

To read out the direction to “Magnetic North”, press **[F1]** in the Compass Menu. The display will change to Display 59. The Handheld Terminal is designed to be held horizontally (i.e. display facing upwards) when using the magnetic compass. The magnetic compass is equipped with a tilt sensor to compensate heading errors that occur if the Handheld Terminal is not held exactly horizontal. The tilt sensor can compensate tilt errors of $\pm 90^\circ$, so the magnetic compass will still work correctly when the Handheld Terminal is held vertically.

```
Magnetic North  
Azimuth: 040°  
180      0      180  
  
[Enter] → Continue
```

Display 60: Magnetic Compass information

The azimuth is running from 0° to 359° , like a compass rose, in which north equals 0° , east equals 90° , south equals 180° and west equals 270° (see Figure 4). The azimuth information is given as number in line 2 and underneath as bar graph. The left edge of the graphic equals 180° South, the next vertical line equals 270° West, the middle line equals 0° North (360°), the next vertical line to the right equals 90° East and the right edge equals 180° South again. If you turn the Handheld Terminal around the vertical axis you will see how the marker is moving from one edge to the other. Press **[ENTER]** to return to the Compass Menu (Display 59).



10.2 GPS Based True North Compass (F2 GPS Compass Information)

In addition to the magnetic compass module, the Handheld Terminal has the possibility to calculate direction with the built in GPS receiver. In contrast to the magnetic compass, the GPS compass is able to calculate the “True North” direction. Press **[F5]** in the Compass Menu to start the GPS compass. After some seconds, Display 53 will appear. For technical reasons, the compass will only work outdoors with an open access to the sky. After the GPS receiver has calculated a navigation solution, Display 61 will appear. The GPS compass calculates the direction under consideration of the velocity. If velocity is lower than 0.3m/s, Display 62 will appear. Press **[ENTER]** to return to the Compass Menu (Display 59).

```
True North (GPS)
Azimuth:      040°
|-----|-----|
180          0          180
[Enter] → Continue
```

Display 61: Magnetic Compass information

```
True North (GPS)
Azimuth:      °
Velocity to low!
180          0          180
[Enter] → Continue
```

Display 62: GPS Compass, velocity to low warning



10.3 Calibrate Magnetic Compass (F10 Calibrate Compass)

The calibration method is described in section 15.3: Compass Calibration. Press **F9** (**SHIFT** + **F4**) in the Compass Menu to access Display 63.

```
COMPASS  
CALIBRATION  
X 0746-0482 0789  
Y 0308-0092 0954  
Z-0095-0652 0506  
act. min. max.  
  
01568
```

Display 63: Compass calibration information

Once calibration is finished, the Handheld Terminal will display the calculated calibration parameters (Display 64) that have been stored in non-volatile memory and will be available upon power up. Press **ENTER** to return to the Compass Menu (Display 59).

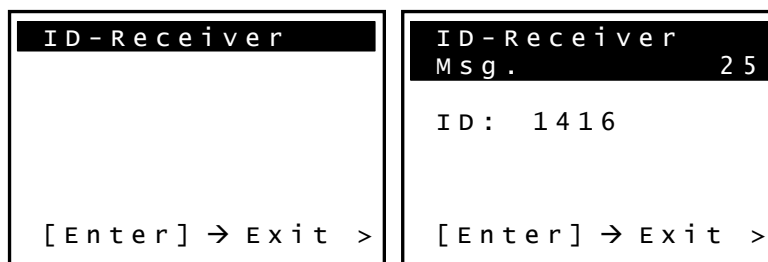
```
CALIBRATION  
FINISHED  
X -0153.5 1.0000  
Y -0523.7 1.2151  
Z 0080.1 1.0975  
offset scale  
[Enter] → Continue
```

Display 64: Compass Calibration finished



11 UHF ID-tag receiver (F5 ID-Tag Rcv.)

Press **F5** to receive the IDs of UHF ID-tags in range of the Handheld Terminal (UHF Handheld Terminals only). Display 65, left, will appear as long as no UHF ID-tag signals have been received. If ID-tag signals have been received, the display changes into Display 65, right. Line 2 gives the number of messages received since the session was started. These messages can be sent from one UHF ID-tag or from several tags. Line 3 gives the ID of the last ID-tag that has been received. If more than one ID-tags are in range, the ID number will change frequently. The message counter will be reset when you exit this session and the received IDs will not be stored in the Handheld Terminal.



Display 65: UHF ID-tag search mode: no tags received (left), after receiving signals from one or more tags (right)



12 Radio-controlled drop-off release (F6 Drop-Off Rel., UHF only)

This menu allows you to release a radio-and-timer-controlled VECTRONIC drop-off on demand. You can only trigger drop-offs that are registered on your Handheld Terminal. Each drop-off is delivered with a unique key file for registering. This file is needed to register the collar in the GPS PLUS Drop Off Manager (see Manual) and on the Handheld Terminal. You can register and delete drop-offs on the Handheld Terminal only with the GPS PLUS Drop Off Manager.

Up to 256 drop-offs can be registered on the Handheld Terminal using the GPS PLUS Drop Off Manager. The maximum transmission range of the release signal is 500 m. Ideally, you should have eye-contact with the collared animal before you send the release command.

Press **F6** (**SHIFT** + **F1**) in the Main Menu. A list of all registered drop-offs will appear (Display 66). Select the desired collar by moving the two black arrows with the number keys **1** - **4** and **6** - **9** and press **ENTER**. Press **SPACE** to return to the Main Menu.

▲	► 0 0 0 2 5 ◀	0 0 0 2 6
■	0 0 0 2 7	0 0 0 4 2
	0 0 0 4 3	0 0 0 0 0
	0 0 0 0 0	0 0 0 0 0
	0 0 0 0 0	0 0 0 0 0
	0 0 0 0 0	0 0 0 0 0
▼	0 0 0 0 0	0 0 0 0 0
	[Enter] → select	
	[Space] → Go Back	

Display 66: List of registered drop-offs

Display 67 will appear. If you are sure that you want to release the selected drop-off, press **F5**. The Handheld Terminal will now send the release signal to the drop-off. The drop-off wakes up every 32 seconds to listen to commands. As soon as the drop-off receives the signal, the release process will be started. The process takes several seconds. Display 68 will be shown as long as the release command is sent. During this time, the transmission can be stopped by pressing **START**. However, if the drop-off has already received the signal, the drop-off will be released. After 36 seconds, the display will return to Display 67.

Note: There will be no confirmation from the drop-off if the signal was received and the drop-off triggered. If you are not sure whether the collar has been released, you can resend the release command.



```
Dropoff Release
ID: 1

[F5] → Fire
[Enter] → Go Back
```

Display 67: Drop-off release stand-by

```
Dropoff Release
ID: 1

Transmitting...
(36 seconds)
```

Display 68: Drop-off release command transmission



13 Accessing terminal info (F7 Terminal Info)

Press **F7** (**SHIFT** + **F2**) to access status information on the Handheld Terminal (Display 69).

```
F1 Status Info
F2 Handheld Info
F3 Memory Info

[Enter] → Go Back
```

Display 69: Terminal Info Menu

13.1 View Status Information (F1 Status Info)

Press **F1** in the Terminal Info Menu to access the status information (Display 70). In the top part, you will receive the UTC time and date programmed into the Handheld Terminal. UTC time and date information will be updated automatically whenever the GPS receiver solves a valid navigation solution.

On this display, you can also check the battery voltage and capacity. The internal Li-Ion battery has a valid voltage range of 3 – 4.1 Volt. In case of under voltage, the battery will be disconnected automatically. Below the battery voltage is a bar graph with the capacity information. This is only a raw guideline, because capacity depends on current, voltage and temperature. Below the capacity bar, you can see the temperature inside the Handheld Terminal. This temperature can increase during data communication, when the GPS receiver is switched on or when the battery is being charged. Press **ENTER** to return to the Terminal Info Menu (Display 69).

```
Time    12:34:56
Date    08.10.2010
Battery Voltage
        3.812 Volt
Battery Capacity
        ██████████
Temperat.: 024 °C
[Enter] → Continue
```

Display 70: Handheld Terminal status information



13.2 View Handheld Terminal Information (F2 Handheld Info)

Press **F2** to view information on serial number of the Handheld Terminal, software and hardware version (Display 71). The same information is displayed each time you switch on the Handheld Terminal. If you encounter problems with your Handheld Terminal, please report software version, hardware version whether it is a UHF or VHF Handheld to help our support team. Press **ENTER** to return to the Terminal Info Menu (Display 69).

```
GPS PLUS UHF
Handheld Station
Serialno. 00315
Softwareversion:
V. 2.3.0 30.08.10
Hardwareversion:
V. 005 30.03.09
[Enter] → Continue
```

Display 71: Handheld Terminal Info Screen

13.3 View Memory Information (F3 Memory Info)

Press **F2** to view information on the total memory capacity of the Handheld Terminal and the free memory available (Display 72). There are two ways to erase data to increase the free memory:

1. Unregister a collar ID (section 8.2: Remove collar ID): This will remove the collar and all data attached to it. You will not be able to communicate with this collar unless you register it again on the Handheld Terminal with the GPS PLUS Collar Manager software.
2. Connect the Handheld Terminal to your PC and delete data with the GPS PLUS Collar Manager software. The collar will stay registered on the Handheld Terminal and you can still communicate with it.

Note: If you download data from a collar, all data sets not currently stored on the Handheld Terminal will be downloaded. Therefore, it is only useful to remove data of collars which will either not be accessed with the Handheld Terminal or from which all data has been downloaded and erased.



```
Memory Capacity
      982,792 kB
Free Memory
      500,379 kB
[Enter] → Continue
```

Display 72: Handheld Terminal memory information

14 Shut Down Handheld Terminal (F10 Power Down)

To switch off the Handheld Terminal, go to the Main Menu and press **F10** (**SHIFT** + **F5**). The Terminal will shut down instantly. To save battery, the Handheld Terminal will begin to shut down automatically when no key has been pressed for more than ten minutes. You have five minutes to abort the automatic shutdown by pressing any key (Display 73).

```
The Terminal
will shut down
in 206 seconds
Press any key
to cancel
```

Display 73: Shut down warning



15 The built-in magnetic compass: theory and calibration

15.1 Introduction: Earth's magnetic field

The earth's magnetic field intensity is about 0.5 to 0.6 gauss and has a component parallel to the earth's surface that always point toward magnetic north. This is the basis for all magnetic compasses. The key words here are „parallel to the earth's surface“ and „magnetic north“.

The earth's magnetic field can be approximated with the dipole model shown in Figure 6. The field lines point from the South Pole up towards the magnetic north, run horizontally at the equator and point down at the magnetic north. The angle of the magnetic field to the surface of the earth is called the dip, inclination, or angle. This component is used to determine compass direction. In the northern hemisphere, the dip angle is roughly 70° down towards north. Only the X and Y components of the earth's field are used when determining the azimuth, or compass direction. The vertical portion of the earth's magnetic field is ignored.

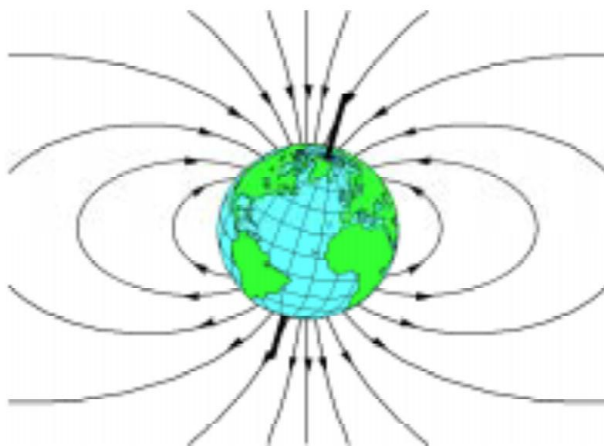


Figure 6: Earth's Magnetic Field vs. True North

The term magnetic north refers to the earth's magnetic pole position and differs from true, or geographic, north by about 11.5 degrees. True north is at the earth's rotational axis and is referenced by the meridian lines found on maps. At different locations around the globe, magnetic north and true north can differ by ± 25 degrees, or more as shown in Figure 7. This difference is called the declination angle and can be determined from reference tables based on the geographic location.

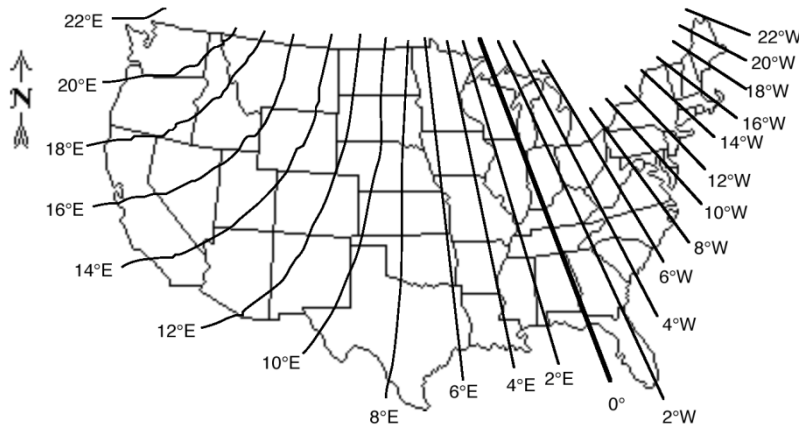


Figure 7: Declination angle for the USA to correct for true north

Finding an accurate compass heading, or azimuth, is a two-step process: (1) determine the horizontal components of the earth's magnetic field and (2) add or subtract the proper declination angle to correct for true north. The correction (2) is not implemented into the Handheld Terminal to maintain compatibility with a standard compass.

15.2 Nearby ferrous materials

Another consideration for heading accuracy is the effect of nearby ferrous materials on the earth's magnetic field. Since heading is based on the direction of the earth's horizontal field, the magnetic sensor must be able to measure this field without influence from other nearby magnetic sources or disturbances. The amount of disturbance depends on the material content of the platform and connectors as well as ferrous objects moving near the compass. If a ferrous object is placed in a uniform magnetic field it will create disturbances. This object could be a steel bolt or bracket near the compass or an iron door latch close to the compass. The net result is a characteristic distortion, or anomaly, to the earth's magnetic field that is unique to the shape of the object. Before looking at the effects of nearby magnetic disturbances, it is beneficial to observe an ideal output curve with no disturbances. When a two-axis magnetic sensor is rotated in the horizontal plane, the output plot will form a circle centred at the (0,0) origin (see Figure 8). If a heading is calculated at each point on the circle, the result will be a linear sweep from 0° to 360°.

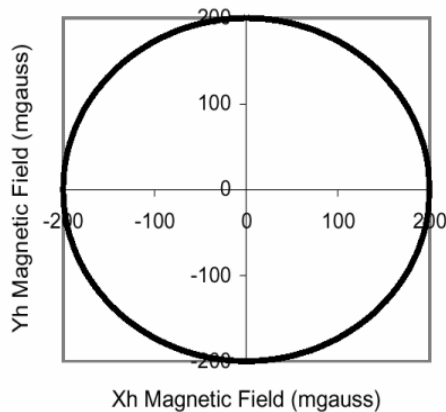


Figure 8: Magnetic sensor outputs (X, Y) rotated horizontally in the earth's field with no disturbances

The effect of a magnetic disturbance on the heading will be a distortion of the circle shown in Figure 8. Magnetic distortions can be categorised as two types - hard iron and soft iron effects. Hard iron distortions arise from permanent magnets and magnetised iron or steel on the compass platform. These distortions will remain constant and in a fixed location relative to the compass for all heading orientations. Hard iron effects add a constant magnitude field component along each axes of the sensor output. This appears as a shift in the origin of the circle equal to the hard iron disturbance in the Xh and Yh axis (see Figure 9, left).

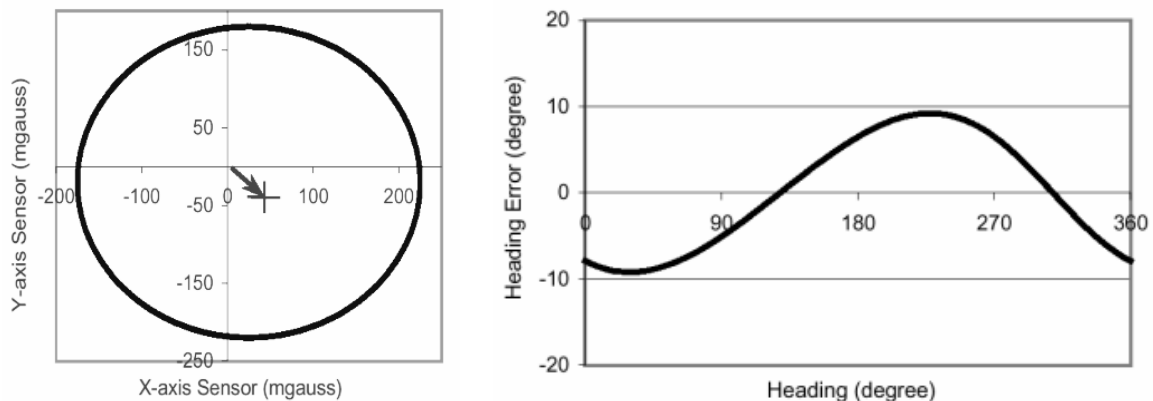


Figure 9: Hard iron offsets when rotated horizontally in the earth's field (left); heading error due to hard iron effects known as single-cycle errors (right).

The effect of the hard iron distortion on the heading is a one-cycle error and is shown in Figure 9, right. To compensate for hard iron distortion, the offset in the centre of the circle must be determined. This is done by rotating the compass and Handheld Terminal in a circle and measures enough points on the circle to determine this offset. Once found, the (X, Y) offset will be stored in memory and subtracted from every reading. The net result will be to eliminate the hard iron disturbance from the heading calculation, as if it were not present.



The soft iron distortion arises from the interaction of the earth's magnetic field and any magnetically soft material surrounding the compass. Like the hard iron materials, the soft metals also distort the earth's magnetic field lines. The difference is the amount of distortion from the soft iron depends on the compass orientation. Soft iron influence on the field values measured by X and Y sensors are depicted in Figure 10, left. Figure 10, right, illustrates the compass heading errors associated with this effect—also known as a two-cycle error.

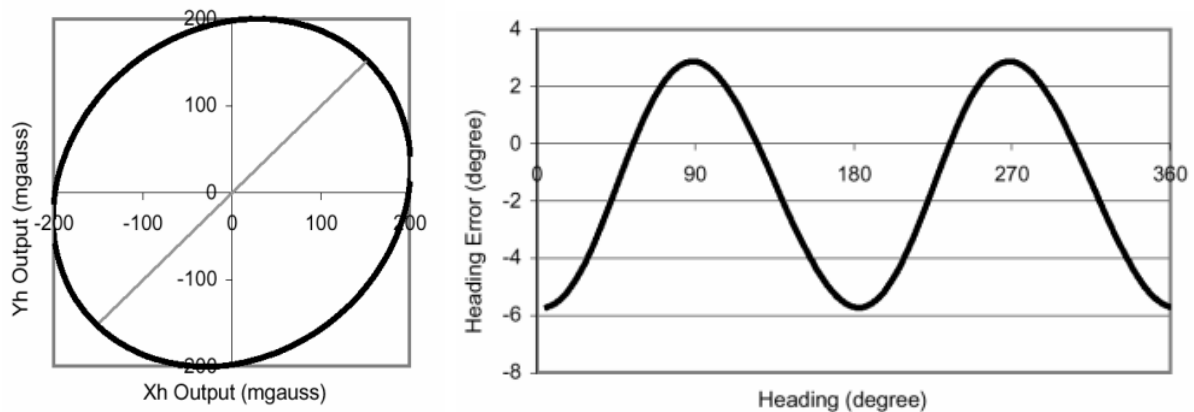


Figure 10: Soft iron distortion when rotated horizontally in the earth's field (left); heading error due to soft iron effects known as two-cycle errors (right).

Compensating for soft iron effects is more difficult than for hard iron effects, since it involves more calculation than a simple subtraction. One way to remove the soft iron effect is to rotate the reading by 45° , scale the major axis to change the ellipse to a circle, and then rotate the reading back by 45° . This will result in the desired circular output response shown in Figure 8. Most ferrous materials in vehicles tend to have hard iron characteristics. The best approach is to eliminate any soft iron materials close to the compass and deal with the hard iron effects directly. It is also recommended to degauss the platform near the compass prior to any hard/soft iron compensation.

15.3 Compass calibration

During compass calibration you first need to determine the direction of the magnetic field lines at your location. Then make sure that each of the three axes of the magnetic field sensor is parallel to the magnetic field lines in positive and negative direction at least once during the calibration procedure. After a short step-by-step instruction you will find a detailed description of what to do below.



Short step-by-step instructions:

1. Switch on the handheld, enter the Compass Menu (F4) and press F9 to start calibration
2. Hold the handheld horizontal and rotate to find the maximum X-axis value
3. Tilt handheld up- and downwards to find maximum X-axis value.
4. Remember direction of the antenna and rotate handheld, in a way that the bottom cap is now pointing in the former direction of the antenna
5. Swing handheld slightly in all directions
6. Repeat steps 4 and 5 with the remaining four surfaces of the handheld
7. Press **Enter** to return to the Compass Menu

To calibrate the compass, switch on the Handheld Terminal and press **F4** to enter the Compass Menu. Keep the Handheld Terminal away from any iron containing or magnetic objects (e.g. desks, tools, computer equipment, magnets to put the GPS-PLUS collars in stand-by mode) and press **F9** to start the calibration. Display 74 will be shown on the Handheld Terminal.

C O M P A S S		
C A L I B R A T I O N		
X	0 7 4 6 - 0 4 8 2	0 7 8 9
Y	0 3 0 8 - 0 0 9 2	0 9 5 4
Z	- 0 0 9 5 - 0 6 5 2	0 5 0 6
	a c t .	m i n . m a x .
		0 1 5 6 8

Display 74: Compass Calibration



The display will show three columns containing the current (act.), minimum (min.), and maximum (max.) value of the magnetic field sensor for X-, Y- and Z-axis of the Handheld Terminal. In the lower right corner of the screen a countdown indicates the number of measurements still left until calibration is finished.



Figure 11: Handheld aligned to magnetic field lines

Hold the handheld horizontally with the display facing upwards. Rotate the handheld to the direction in which the X-axis value reaches its maximum. The antenna is now pointing southwards. Tilt the handheld up- and downwards until the X-axis value reaches its absolute maximum. Now the handheld is aligned to the magnetic field lines (as shown in Figure 11). Remember the direction in which the antenna points to and rotate the handheld in a way that the bottom cap now points to the direction in which the antenna pointed before. Swing the handheld slightly in all direction (as indicated by the red arrows in Figure 12). You do not need to watch the values on the display during this and the following steps.



Figure 12: Calibrating the negative X-axis



Repeat the last two steps with the four remaining surfaces (display side, back side, left side and right side). Now the values for X-, Y- and Z-axis should have reached their absolute maximum and minimum values. Wait until the countdown reaches zero. Now the handheld will calculate the offset and scale values for each axis and store them in a non-volatile memory area. These values will be read upon each start-up. After the calculation of these values the handheld will show them on the display (Display 75). The calibration is now finished. Press **ENTER** to return to the Compass Menu.

```
CALIBRATION
FINISHED
X -0153.5 1.0000
Y -0523.7 1.2151
Z 0080.1 1.0975
offset scale

Press [Enter]
```

Display 75: Compass Calibration finished

The hard and soft iron distortions can vary from location to location within the same Handheld Terminal. It is possible to use a compass without any calibration if the need is only for repeatability and not accuracy.

15.4 True North GPS compass

In addition to the magnetic compass module, the Handheld Terminal has the possibility to calculate the direction with the built-in GPS receiver. In contrast to the magnetic compass the GPS compass can calculate the “True North” direction. Switch on the Handheld Terminal and press **F4** to go to the Compass Menu and **F2** to start the GPS compass. As a condition to the technology, the compass will only work outdoors with an open access to the sky. The GPS compass calculates the direction with the assistance of the velocity. For this reason, it is necessary to move the Handheld Terminal faster than 0.3 m/s or 1 km/h.