Project:

GPS Plus Handheld

Title:

Handheld Terminal User Manual

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DOCUMENT CHANGE RECORD

Issue	Date	Item(s) Affected	Description
1	08.05.2002		First Issue
1.1	10.05.2002	Specifications	Add number of datasets per collar
1.2	22.01.2003	Chapter: 5.1.3	Add Update Collar Menu
		Chapter: 5.1.2.2.2	Add 2D and 3D range mode
		Chapter: 7	Update Software Revision List
1.3	04.04.2003	Chapter 5.1.2.1.1	Add upload command “Force GPS Fix”
		Chapter: 5.1.2.2.2	Change selection of 2D and 3D range mode
		Chapter 5.1.2.2.6	Add additional menu
		Chapter 5.2	Change description from selected to used collars
		Chapter: 7	Update Software Revision List

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Introduction

The **GPS Plus Handheld Terminal** provides the wireless radio interface between a PC and the GPS-Plus collar. It is used to

- download GPS datasets from the GPS PLUS collar (standard or differential datasets),
- download high resolution activity and temperature datasets from the GPS PLUS collar,
- download mortality datasets from the GPS PLUS collar,
- download telemetry (status) information from the GPS PLUS collar,
- upload UTC time and date to the GPS PLUS collar,
- upload new GPS scheduler to the GPS PLUS collar,
- upload new UHF beacon scheduler to the GPS PLUS collar,
- upload new VHF beacon scheduler to the GPS PLUS collar,
- activate the powerful UHF beacon,

in the field.

A built in 12 channel GPS receiver gives you important 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. 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 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 kilometre. Under normal conditions, the range is several kilometres with a small handheld yagi antenna.

1 Specifications

Size	204 x 110 x 41 mm³ without UHF antenna connector
Weight	550 g
Keyboard	21 keys membrane keypad
Display	128 x 64 Pixel Matrix display with LED background illumination
Memory capacity	64 MByte standard (data storage of 16 collars), 128 MByte extended (data storage of 32 collars) 315520 Temperature and activity datasets per collar 65536 GPS datasets in non differential mode per collar 24576 GPS datasets in differential mode per collar
Battery	Internal rechargeable Li-Ion battery 3.6 Volt / 6000 Ah
Charging time	less than 8 hours typ.
Operating time with charged battery	Dependent on operation mode (24 hours GPS mode, 75 hour receive mode)
External Power Supply	Only needed for charging the battery 12 Volt, 800 mA max.
Interface	Serial Interface 115200 baud 8N1 (to be connected to LM1 Link Manager) USB 8Mbit/s
Ingress protection	IP65
GPS Receiver	Internal 12 Channel GPS receiver with active antenna
UHF frequency range	420 – 470 MHz (factory settings)
Output power	0 – 500 mW (factory settings)
Modulation	FM
Antenna impedance	50 Ohm
Compass module	Built in electronic Compass
Resolution	1mgauss
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

2 Optional Accessories

- Memory Expansion from 64 MByte to 128 MByte
- 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
- LM1 Link Manager

3 Controls & Connectors

Figure 1: GPS PLUS Handheld terminal

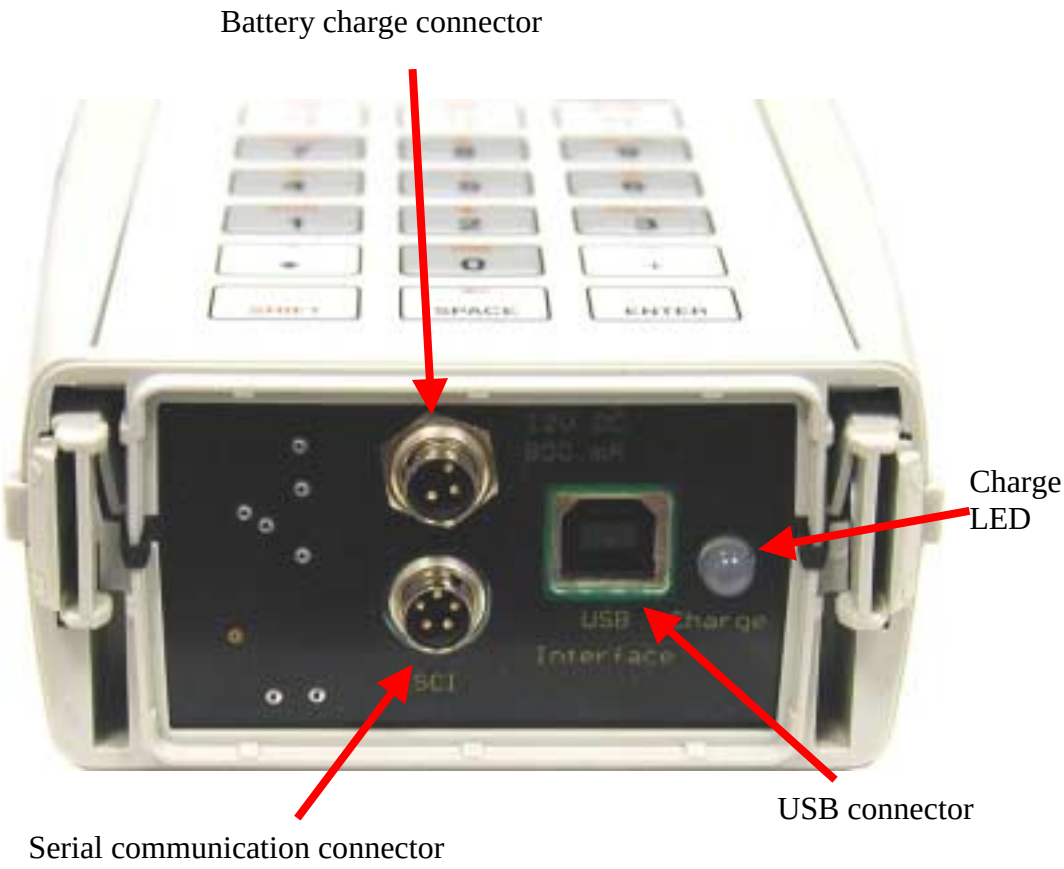

Figure 2: GPS PLUS Handheld terminal with removed base cap

3.1 Removing of the base cap

Press both snap locks at the same time and remove the base cap from the main housing (see Figure 3).

Figure 3: Location of the snap locks to remove the base cap

Behind the base caps you will find connectors to recharge the internal battery, the serial communication and USB connector and a LED, which indicates the charge status.

Warning: ***Do not use the handheld without the base cap in humid areas. Moisture can destroy the electronic components inside the hand-held terminal.***

4 Operations

The Handheld Terminal is switched on when the key ***START*** is pressed briefly. At any time you can interrupt the software by pressing the ***START*** key.
When nothing happens after pressing the key ***START***, the battery is completely discharge. Connect a power supply of 12 Volt DC 800 mA to the Battery Charge Connector until the battery is fully charged. During charging you should avoid to switch on the Handheld Terminal, because the charge current will be reduced or switched off when the Handheld Terminal is switched on.
To save power the LED background illumination will be switched off automatically 30 seconds after a key has been pressed. When a key is pressed the background illumination will be switched on automatically for further 30 seconds. Press the key ***SHIFT*** to switch on the LED again without interrupt 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 menu with a down counter (Figure 4). After five further minutes, the Handheld Terminal will be switched off automatically. The Handheld Terminal can be switched off directly as well via the main menu with the key ***F10*** (***SHIFT*** + ***F5***).
After switched on the Handheld Terminal the non-volatile memory will be checked. The Handheld Terminal is available with 64 Mbyte (Memory Bank 1) and with 128 Mbyte (Memory Bank 1 + 2) on board memory. Up to 16 Collars can be controlled with 64 Mbyte memory. The memory expansion to 128 Mbyte will increase the possibility to control up to 32 collars at the same time. Press the Key ***ENTER*** to reach the main menu. The software will be explained in chapter 5.

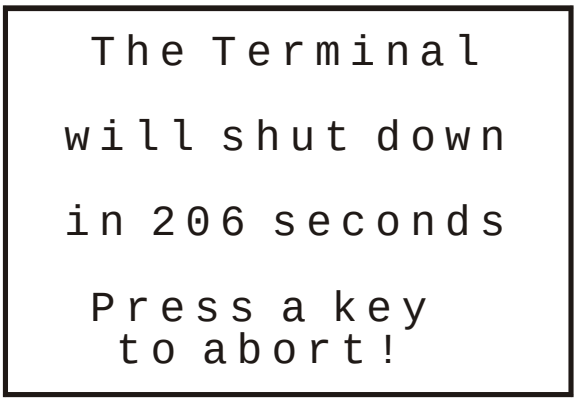

Figure 4: Shut down display

4.1 Extending Battery Lifetime

How long the battery last between charges depends largely on your operation habits. The Handheld Terminal supports several ways to save power automatically and extend the life of

each charge. To switch off the Handheld Terminal before it will shut down automatically will reduced the power consumption in addition.

4.2 Battery charging

Connect a power supply of 12 Volt DC 800 mA to the Battery Charge Connector until the battery is fully charged. During charging you should avoid to switch on the Handheld Terminal, because the charge current will be reduced or switched off when the Handheld Terminal is switched on.
The GPS PLUS Handheld Terminal includes a state machine that controls the charging algorithm for the Li-Ion accumulator. When power is applied the state machine goes into the reset state where the timers are reset to zero to prepare for charging. From the reset state, it enters the prequalification state. In this state, 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 under voltage threshold before the prequalification timer expires (45 minutes), the charging terminates and the *Charge LED* is switched red.
In the fast-charge state, the *Charge LED* is switched 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 (9 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* is switched red. In the full-charge state, the *Charge LED* is switched green and the accumulator charges at a constant voltage. When the charging current drops below 100mA, or if the full-charge timer expires (9 hours), the state machine enters the top-off state. In the top-off state, the accumulator continues to be charged at a constant voltage until the top-off timer expires (4.5 hours) when it enters the done state. In the done state, charging stops and the *Charge LED* is switched off until the battery voltage drops below the recharge voltage threshold when it enters the reset state to start the charging process again.

Warning: ***Do not charge the Li-Ion accumulator below 0°C or above 50°C. Charging the Li-Ion accumulator outside the charging temperature range (0°C to +50°C) will destroy your Handheld Terminal.***

Table 1: Charge LED function of the Handheld Terminal

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

4.3 Connecting the Handheld Terminal to a PC via SCI

To exchange data between the Handheld Terminal and the PC or Laptop via the SCI interface, do the following steps:

1. Switch on the Handheld Terminal by pressing the key ***START***. When nothing is displayed on the LCD screen, recharge first the battery.
2. Connect the Link Manager to the PC with a standard RS-232 cable between the RS-232 connector of the Link manager and one of the PC's COM ports (Figure 5).
3. Connect the Handheld Terminal with the special link cable to the Collar interface connector of the Link Manager (Figure 5).
4. Start the GPS_PLUS.EXE software on the connected PC and chose the correct com port to upload or download data or to reprogram new firmware.

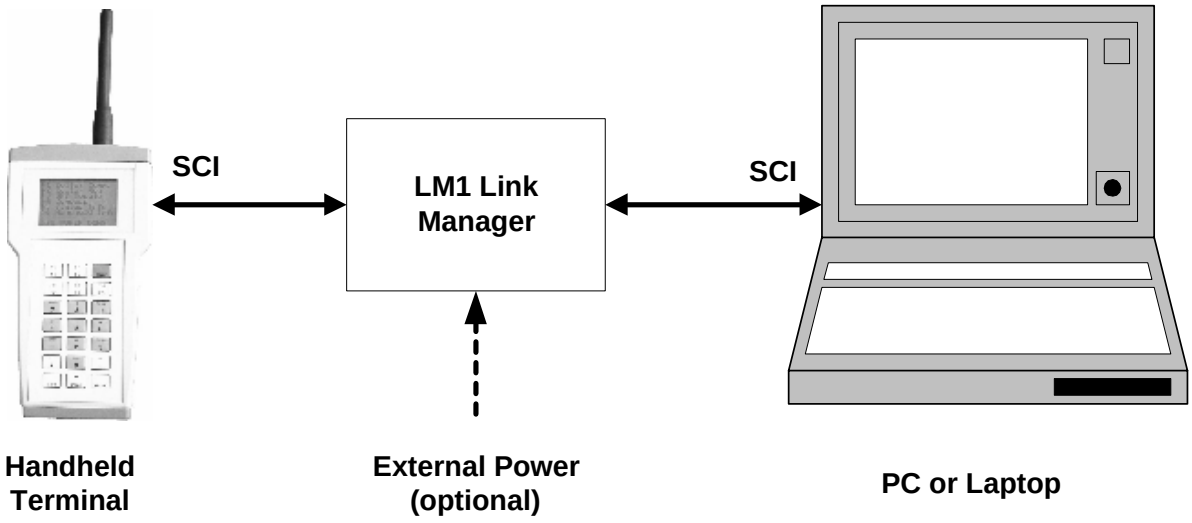

Figure 5: SCI connection between Handheld Terminal and the PC / Laptop

4.4 Connecting to USB

To exchange data between the Handheld Terminal and the PC or Laptop via the USB interface, do the following steps:

1. Switch on the Handheld Terminal by pressing the key ***START***. When nothing is displayed on the LCD screen, recharge first the battery.
2. Connect the Handheld Terminal to the PC with a standard USB cable (Figure 6).
3. Start the GPS_PLUS.EXE software on the connected PC and chose the USB port to upload or download data. Reprogramming of new firmware for the Handheld Terminal is not possible via USB interface. Use the serial interface to update new firmware.

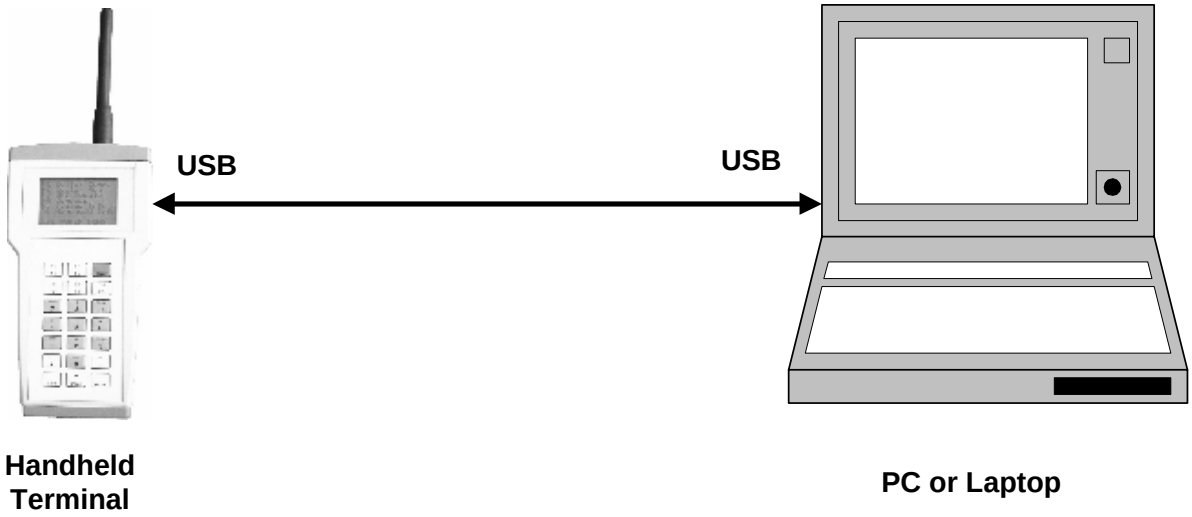

Figure 6: USB connection between Handheld Terminal and the PC / Laptop

4.5 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 compass will only work properly when the Handheld Terminal will be hold vertical. Vertical means antenna to the sky, base cap to the bottom. Any angle out of the vertical axis will induced an error (pitch error).

4.5.1 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“.

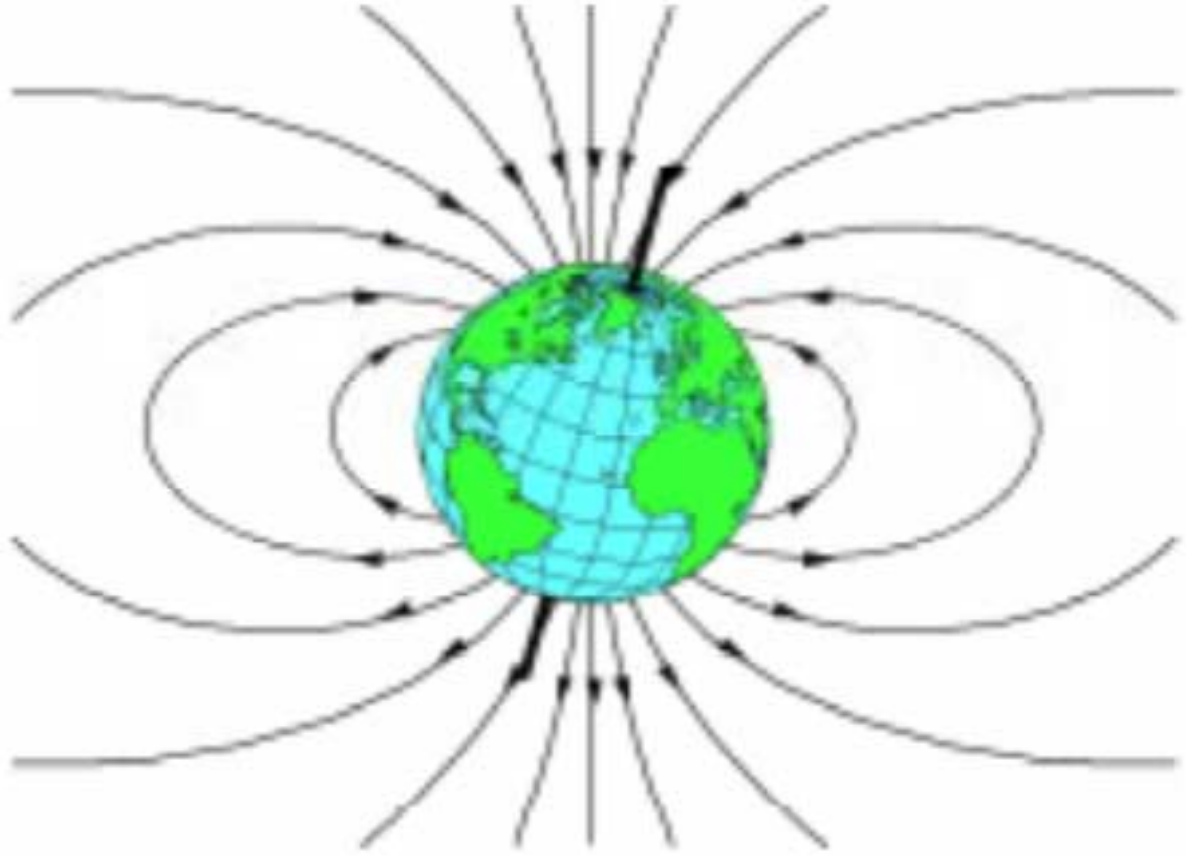

Figure 7: Earth‘s Magnetic Field vs. True North

The earth‘s magnetic field can be approximated with the dipole model shown in Figure 7. This figure illustrates that the earth’s field points down toward north in the northern hemisphere, is horizontal and pointing north at the equator, and point up toward north in the southern hemisphere. In all cases, the direction of the earth‘s field is always pointing to magnetic north. The components, which are parallel to the earth’s surface, are used to determine compass direction. The angle of the magnetic field to the surface of the earth is called the dip, or inclination, angle. 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.
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 8. This difference is called the declination angle and can be determined from a lookup table based on the geographic location.

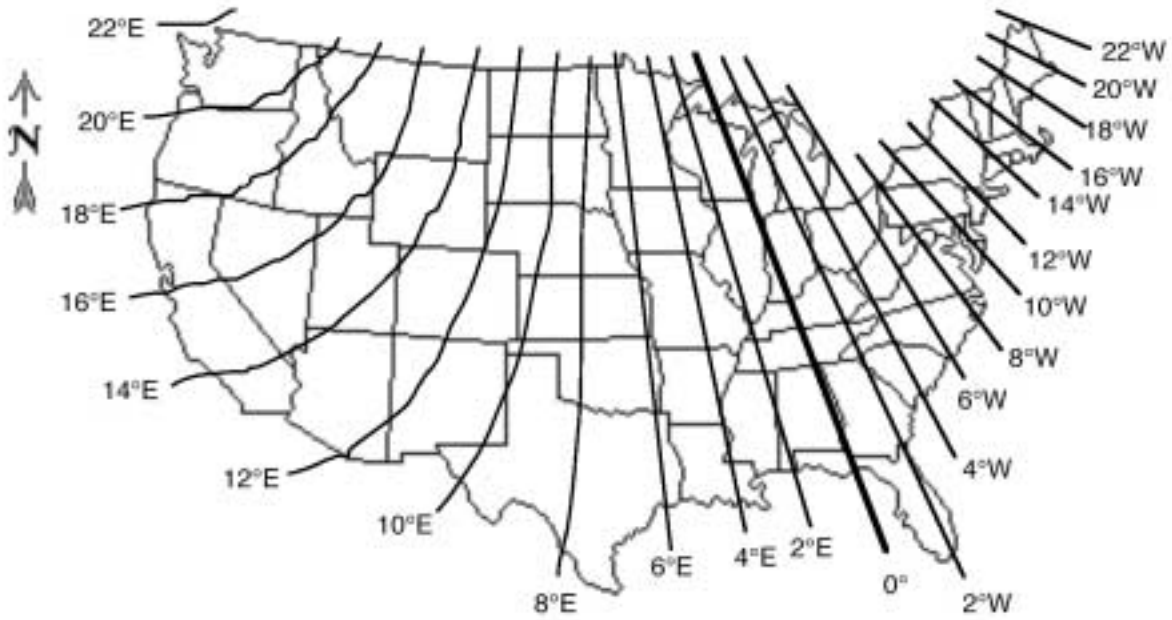

Figure 8: Declination Angle To Correct For True North

The key to find 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 Step 2 is not implemented into the Handheld Terminal to maintain compatibility with a standard compass.

4.5.2 Pitch error

Pitch error (out of vertical axis) will result in the heading calculations as shown in Figure 9.

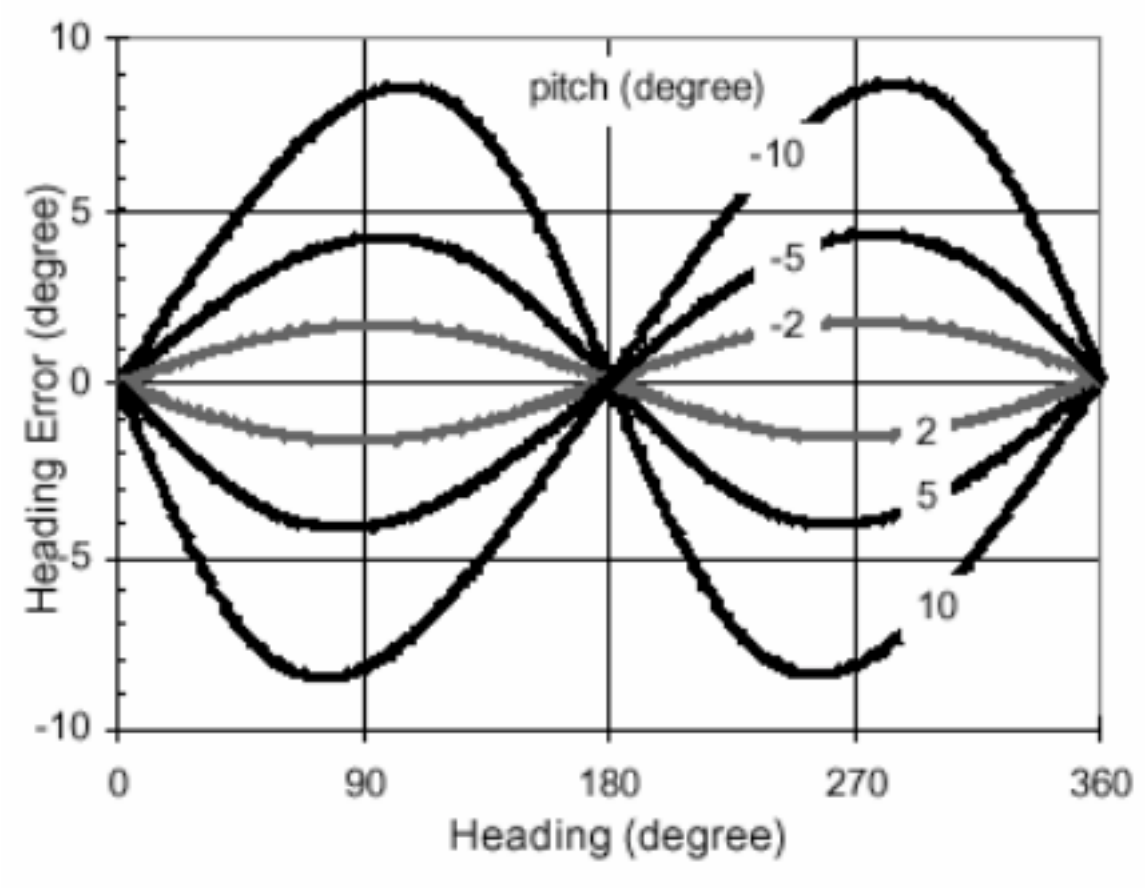

Figure 9: Heading errors due to pitch without tilt compensation (Dip Angle =40°)

4.5.3 Nearby Ferrous Materials

Another consideration for heading accuracy is the effects 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. When 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 10). If a heading is calculated at each point on the circle, the result will be a linear sweep from 0° to 360°.

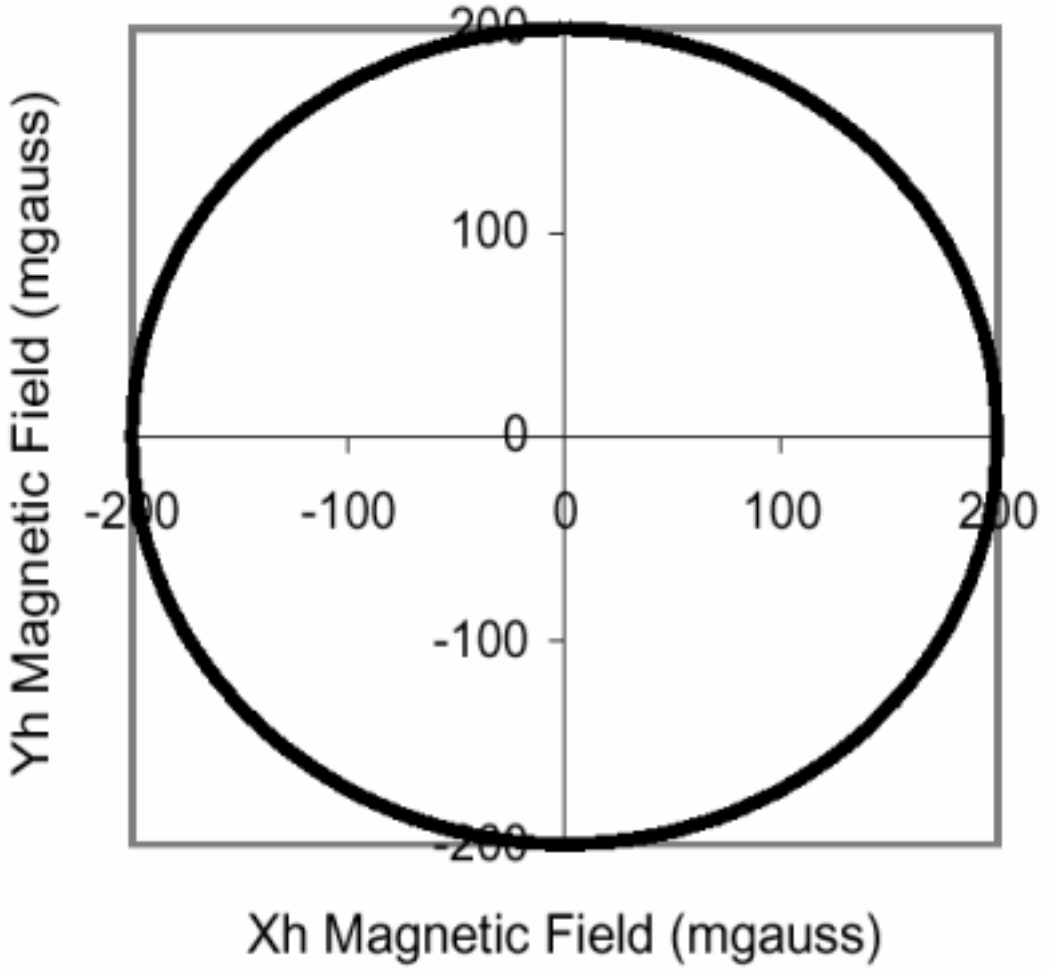

Figure 10: Magnetic sensor outputs (X, Y) rotated horizontally in the earth's field with no disturbances

The effect of a magnetic disturbance on the heading will be a distortion of the circle shown in Figure 10. 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 11). The effect of the hard iron distortion on the heading is a one-cycle error and is shown in Figure 12. 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 13. Figure 14 illustrates the compass heading errors associated with this effect—also known as a two-cycle error.

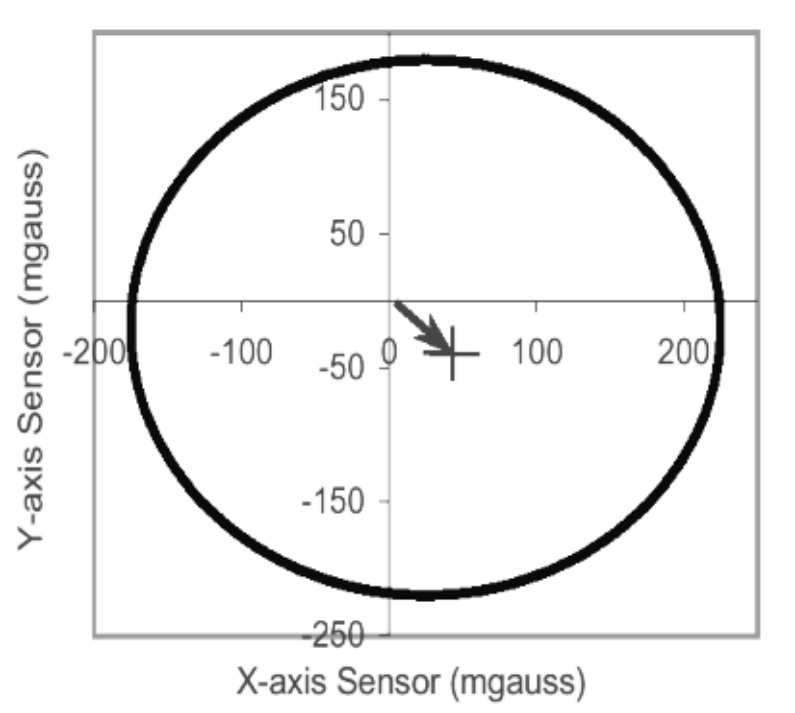

Figure 11: Hard iron offsets when rotated horizontally in the earth's field

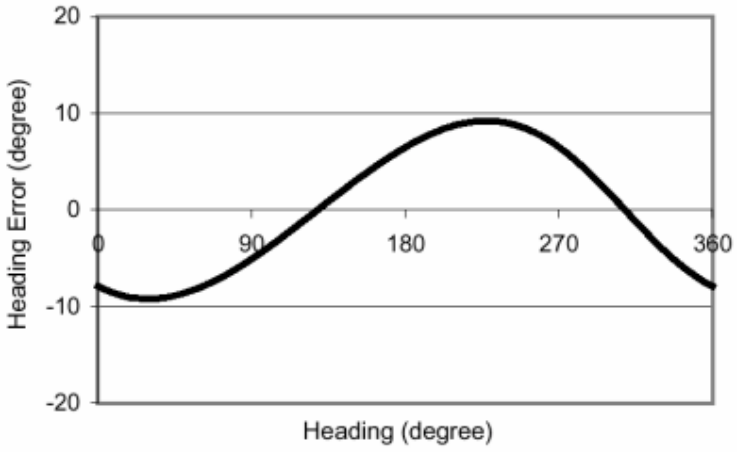

Figure 12: Heading error due to hard iron effects known as single-cycle errors

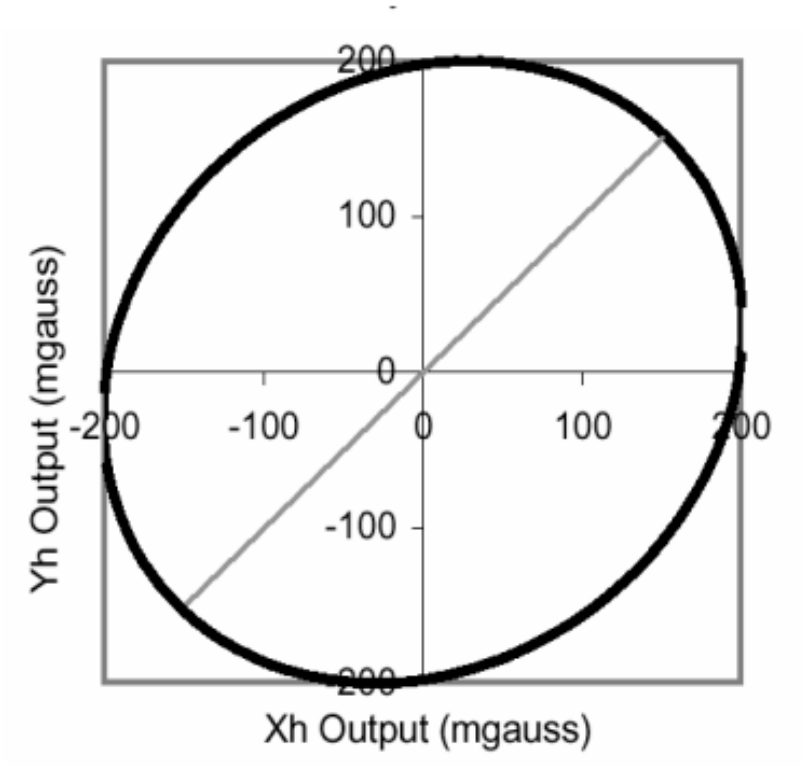

Figure 13: Soft iron distortion when rotated horizontally in the earth's field

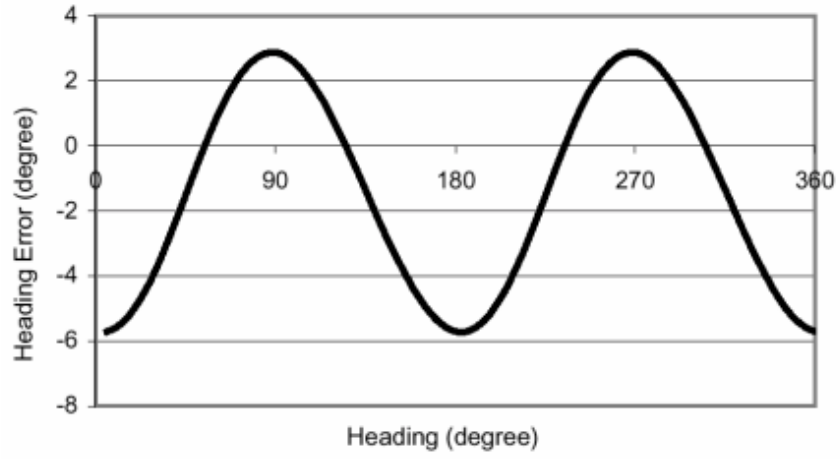

Figure 14: Heading error due to soft iron effects known as two-cycle errors

Compensating for soft iron effects is a bit more difficult than for hard iron effects. This involves a bit 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 10. Most ferrous material in vehicles tends to have hard iron characteristics. The

best approach is to eliminate any soft iron materials near 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.

4.5.4 Compass Calibration

To compensate the previous described errors, the built in compass should be recalibrated from time to time. Switch on the Handheld Terminal and press the Key ***F4*** to go to the Compass Menu. Put the Handheld Terminal vertical on iron **free** subsoil, e.g. table. The UHF antenna should be on the top (Figure 15). Press now the Key ***F10*** without moving the Handheld Terminal. Rotate the Handheld Terminal slowly two times around the vertical axis within 30 seconds and wait until the calibration process is finished (Figure 16). The calibration data are stored in a non-volatile memory and will be available after power up again.
The built in compass is only able to sample the horizontal field components. For that reason there will be an uncompensated heading error with tilt. 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.

Figure 15: Place the Handheld Terminal on an iron free table during compass calibration

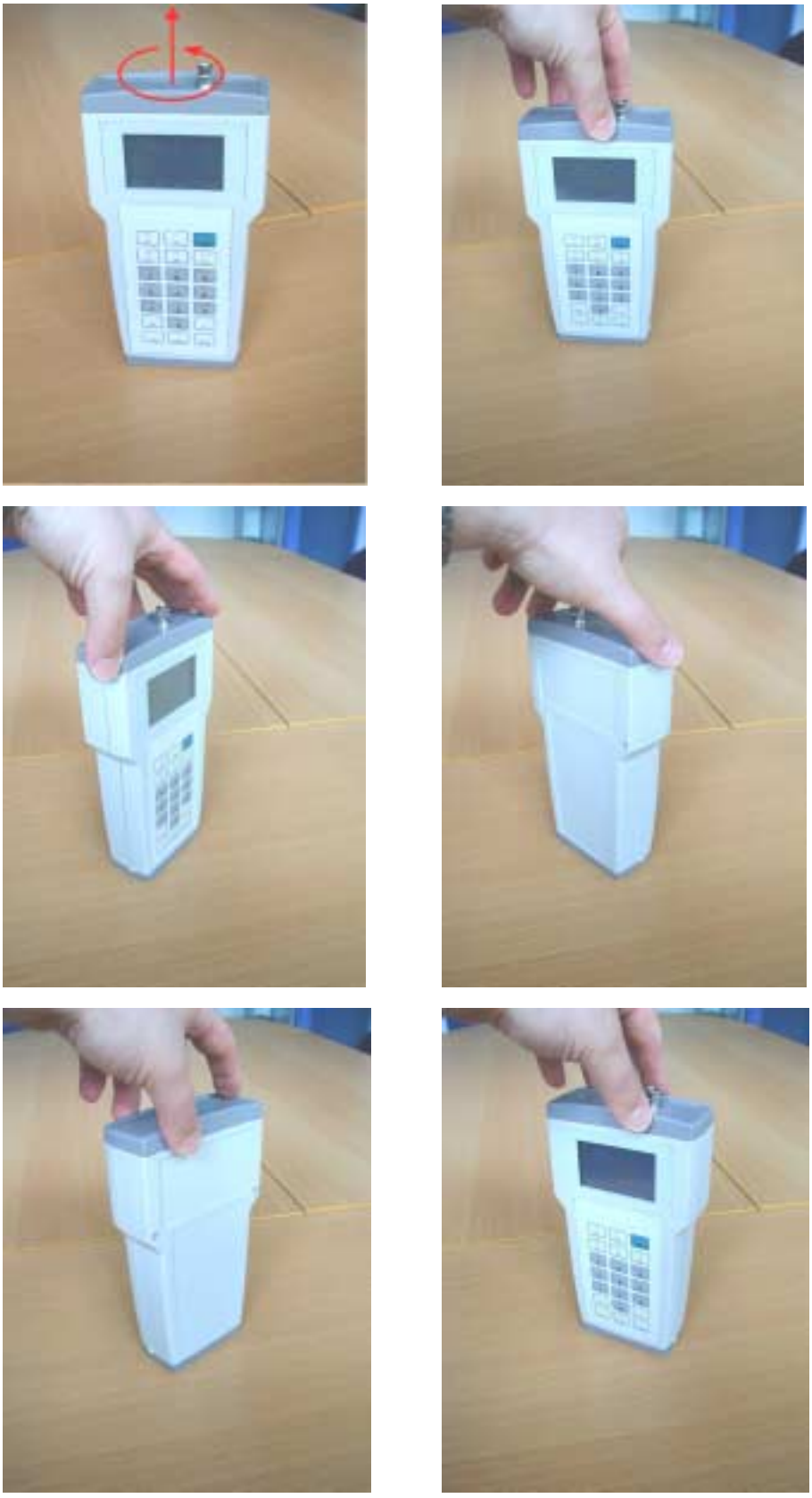

Figure 16: Rotate the Handheld Terminal slowly to calibrate the compass

4.6 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 12 channel GPS receiver. In contrast to the magnetic compass the GPS compass can calculate the "True North" direction. Switch on the Handheld Terminal and press the Key ***F4*** to go to the Compass Menu and ***F2*** to start the GPS compass. Conditional on the technology the compass will only work outside 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.

5 Software Description

After Power Up (press Key ***START***) the company information is shown for some seconds (Figure 17). After that the internal non-volatile memory will be checked. Dependent on the memory option the Handheld Terminal is equipped with one or two memory banks. During memory test the screen of Figure 18 is shown on the display, the result of the memory test is shown Figure 19.

Figure 17: Start Up Display

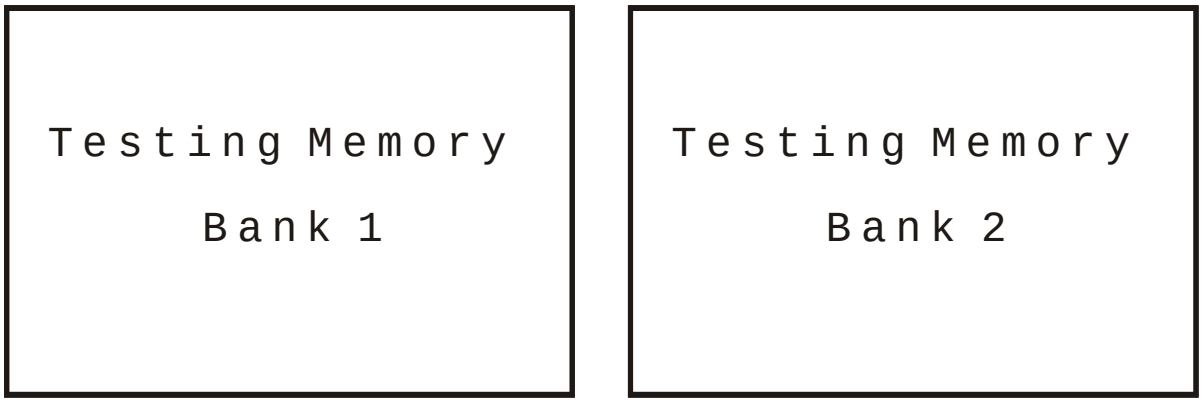

Figure 18: Testing Memory Display Bank1 (left) and Bank2 (right)

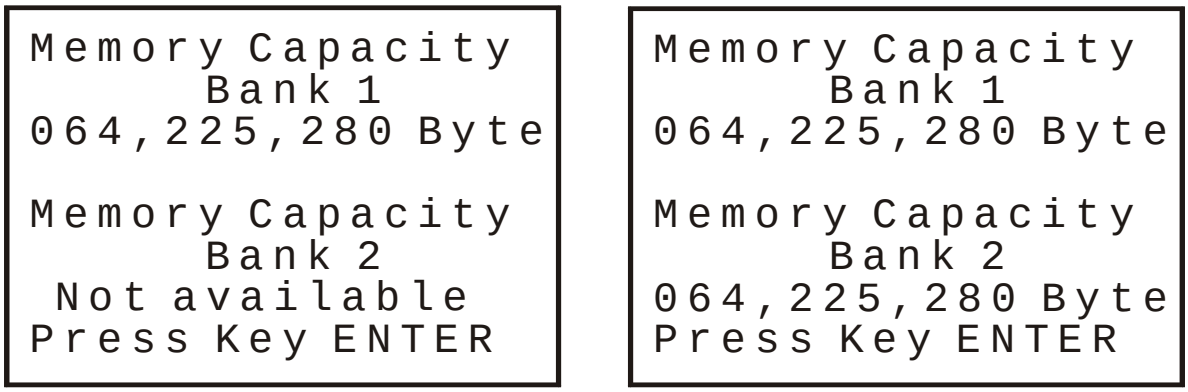

Figure 19: Result of Testing Memory Display Bank1 (left) and Bank1 and Bank2 (right)

After finishing the memory test press the key ***ENTER*** to go to the main menu (Figure 20). The following menu structure is straightforward and divided into several independent sub tasks.

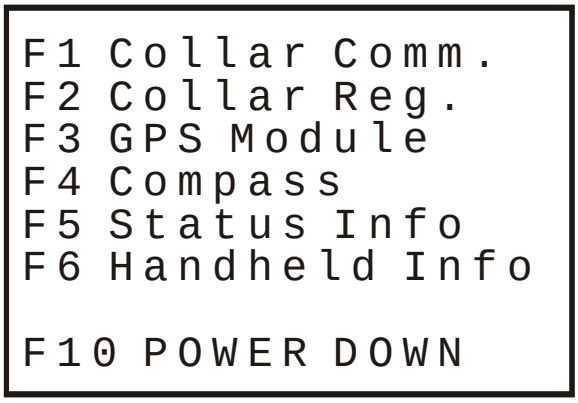

Figure 20: Main Menu Display

5.1 Collar Communication (F1 Collar Comm.)

Press key ***F1*** to go to the collar communication menu from main menu (Figure 21). This is the Collar Communication Menu. You can select Collar ID's up- and download data, switch on the UHF beacon transmitter on demand and upload schedules and/or the collar time.

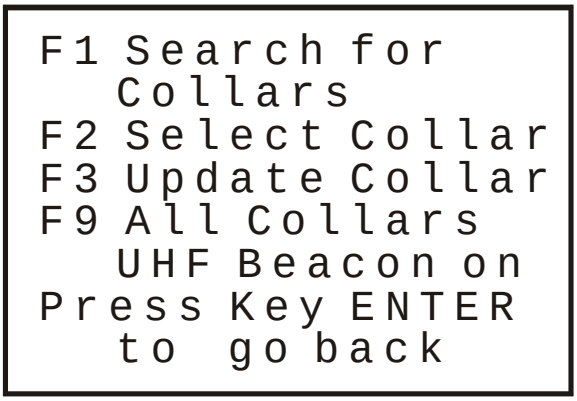

Figure 21: Collar Communication Menu

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. Conditional on possible time differences between collar and Handheld Terminal, the Terminal must transmit a wakeup code much longer than 200 ms.

5.1.1 Search for Collar (F1)

To establish a radio link between Terminal and Collar the Terminal transmits 40 seconds wakeup code and receives than the collar ID's (serial number of the collar) for a period of 24 seconds (Figure 22). During these 24 seconds each collar, which is online, transmits its own ID in a predefined timeslot back to the Terminal. This will happen when you press ***F1*** in the collar communication menu.

Note: ***Do not press any other key than ENTER when you are in the collar communication menu or submenus without a connected 50 Ohm antenna. Transmitting without a 50 Ohm antenna can destroy the power amplifier.***

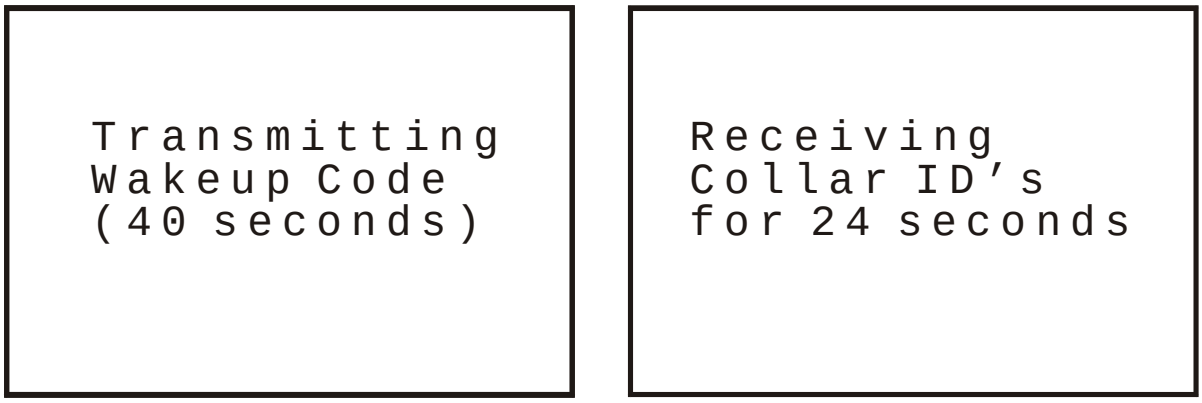

Figure 22: Display during transmitting Wakeup Code and following reception of collar ID's

After the reception of the collar ID's is complete the received collar ID's are shown in the next "Select Collar" display (Figure 23).

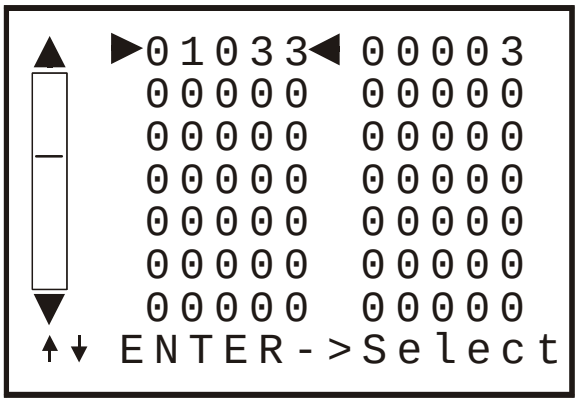

Figure 23: Received Collar ID's after transmitting wakeup command

5.1.2 Select Collar (F2)

All received collars which were registered before with the GPS PLUS software (see section 5.2) are now shown on the display. To select the desired collar you can navigate with the keys ***SHIFT*+*8*** or ***8***, ***SHIFT*+*2*** or ***2***, ***SHIFT*+*6*** or ***6*** and ***SHIFT*+*4*** or ***4***. The Up and Down arrow above and below the bar graph will appear when previous or following collar ID's are available. The small marker 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 2 minutes. After every successful data transfer the time will be reset to 2 minutes again. The collar will switch off the radio automatically when no further command is received within a period of 2 minutes. When the interval between two wireless commands was longer than 2 minutes the Terminal shows a message like in Figure 24 after trying to have access to the collar. To get new access to the collar you need to

wake up the collar again, see section 5.1.1 Search for Collar (F1). You will then go back by pressing the key ***ENTER*** several times until you are in the Collar Communication Menu. When you have selected the collar ID 00000, the display shown in Figure 25 will appear.

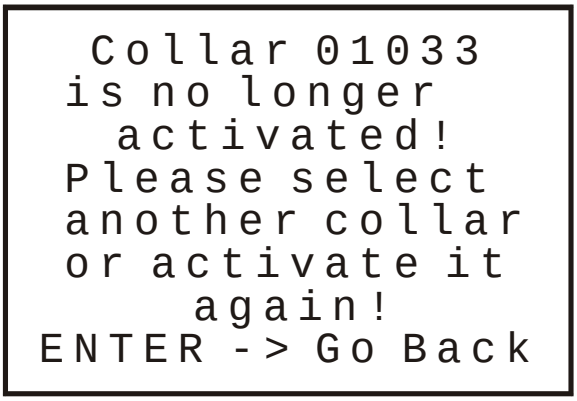

Figure 24: Collar is no longer valid

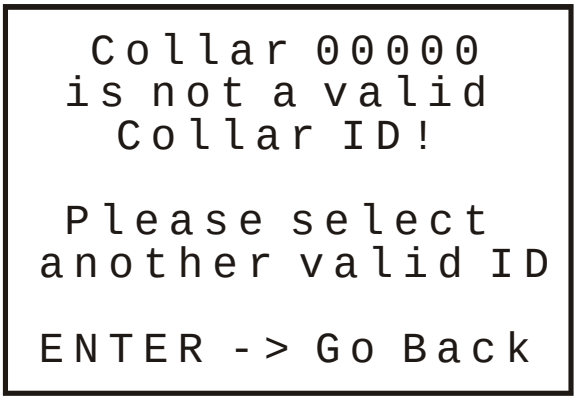

Figure 25: Invalid Collar ID

Once you have selected a collar ID the Up- and Download Menu will appear (Figure 26).

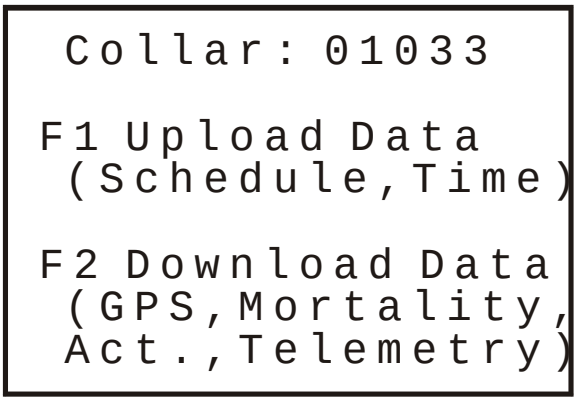

Figure 26: Up- and Download Menu

You can now decide if you want to upload or download data. Upload data means transfer data from the Terminal to the collar, download means transfer data from the collar to the Terminal.

5.1.2.1 F1 Upload Data

When you are in the Up- and Download Menu and you press the key ***F1*** you will go to the Upload Menu, shown in Figure 27. You are now able to:

- Force the GPS receiver (collar) to make a fix, independent on the GPS schedule
- Upload time and date from the Handheld Terminal to the collar
- Upload a rule based GPS scheduler
- Upload a UHF Beacon scheduler
- Upload a VHF Beacon scheduler

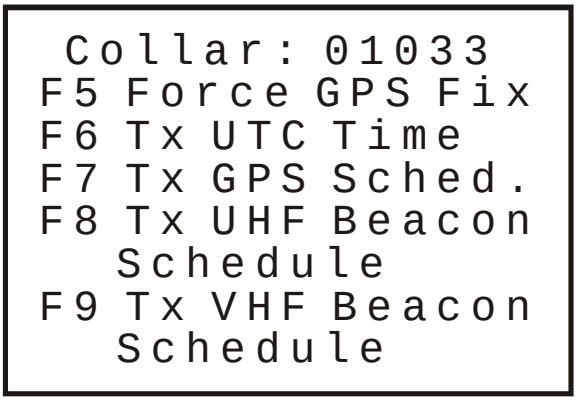

Figure 27: Upload Menu

5.1.2.1.1 Transmit Command to the collar to switch on the GPS receiver immediately

The Handheld Terminal can send a command to the collar to switch on the collar GPS receiver immediately (collar firmware Version 1.3.0 or higher). This is very helpful together with the range checker mode to find the current position of the collar.
This command will be sent when you press the key **F5** in the upload menu and the screen of Figure 28 will appear for a short time. After the collar has received the command without errors (Figure 29), 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 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 (5.1.1 Search for Collar (F1)).

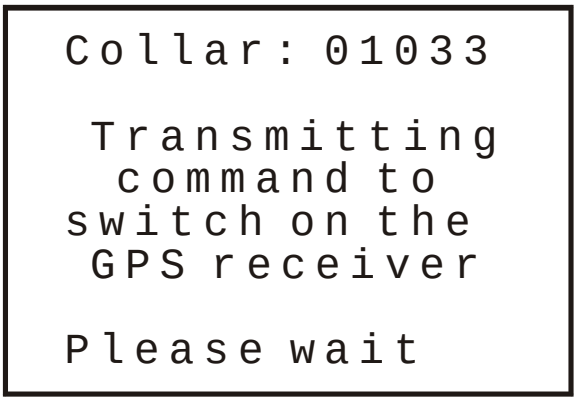

Figure 28: Transmit "Switch GPS On" command

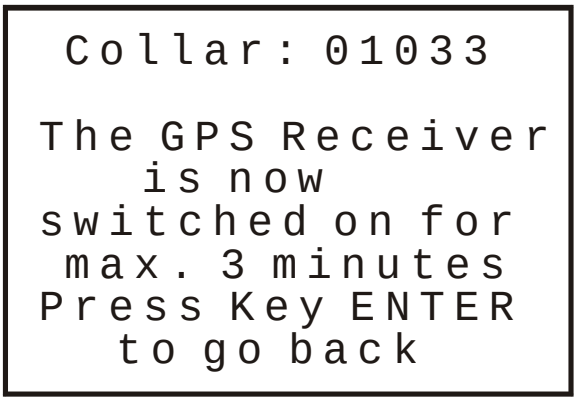

Figure 29: Confirmation of the successful transmission of the command "Force GPS Fix"

5.1.2.1.2 Upload UTC Time from Handheld Terminal to Collar (F6 Tx UTC Time)

The UTC time and date of the Handheld Terminal will be updated each time the on Board GPS receiver can solve a valid fix. This Time will be sent to the collar when you press the key ***F6*** (***SHIFT***+***F1***). The Current time and date of the Handheld Terminal is shown on the screen (Figure 30). When you press the key ***ENTER*** the uploading of time and date will be interrupted before the transmission starts and the display jumps back to the Upload Menu. When you press the key ***F10*** (***SHIFT+F5***) the upload process of time and date will start immediately (Figure 31).

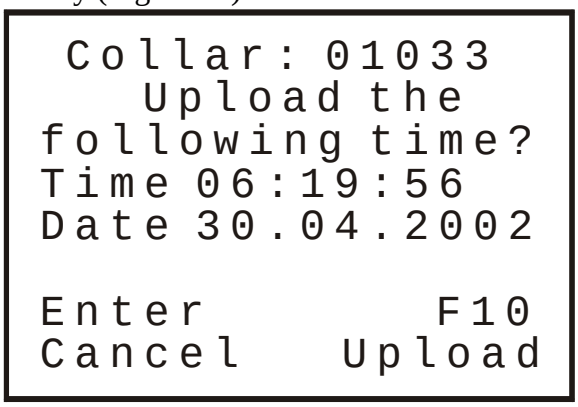

Figure 30: Upload Time and Date Menu

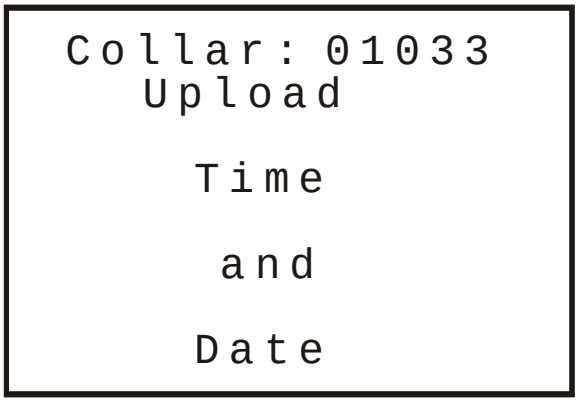

Figure 31: Transmission of Time and Date

When the time and date were received without errors, the screen of Figure 32 will appear. After the collar has received new time and date, it calculates the GPS, UHF and VHF schedules. In case of transmission errors the process will be repeated automatically several times. When no successful upload was possible, the screen of Figure 33 will inform you that no valid communication was possible. Press the key ***ENTER*** to go back.

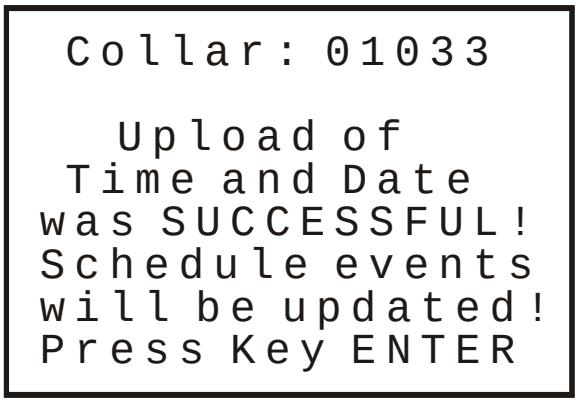

Figure 32: Acknowledgement of successful Time and Date transmission

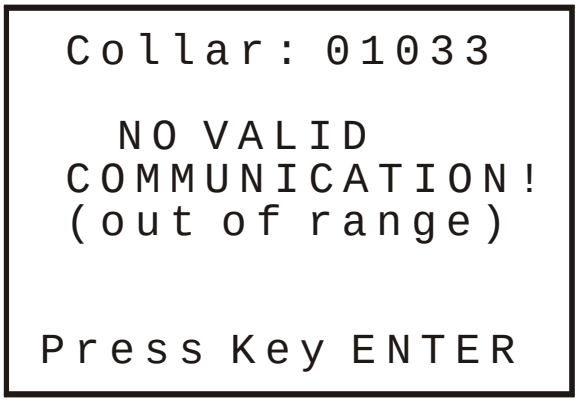

Figure 33:Unsuccessful communication

5.1.2.1.3 Upload GPS Schedule from Handheld Terminal to Collar (F7 Tx GPS Sched.)

To upload a GPS schedule from the Handheld Terminal to the Collar, you need first to upload the schedule from the PC via the serial or the USB interface into the Handheld Terminal (see GPS PLUS software manual). Once you have uploaded a schedule into the terminal for a collar ID, this schedule is valid until you erased the collar data in the Handheld Terminal or until you overwrite this schedule. The schedule will not be erased after a successful upload to the collar.
To start the GPS schedule upload process, press the key ***F7*** (***SHIFT***+***F2***). When no valid schedule is stored inside the Handheld Terminal for the specified collar the screen of Figure 34 will appear.

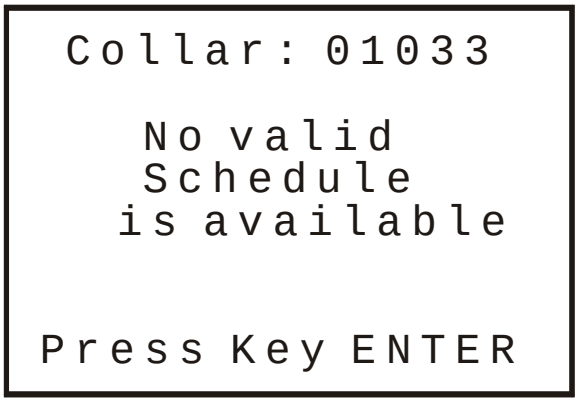

Figure 34: No valid GPS schedule available

When a valid schedule for this collar ID is stored inside the Handheld Terminal, the upload process starts automatically. The GPS schedule will be transmitted in four packets. When a bit error during transmission will occur the data will be sent again several times. When no successful communication was possible, the screen like in Figure 33 will appear. During upload of the four data packets the screens of Figure 35 will appear in succession. After the transmission was successfully finished the screen of Figure 36 will be shown and the collar will calculate the next GPS fix time.
When you press the key ***ENTER***, the Handheld Terminal will go back to the Upload Menu.

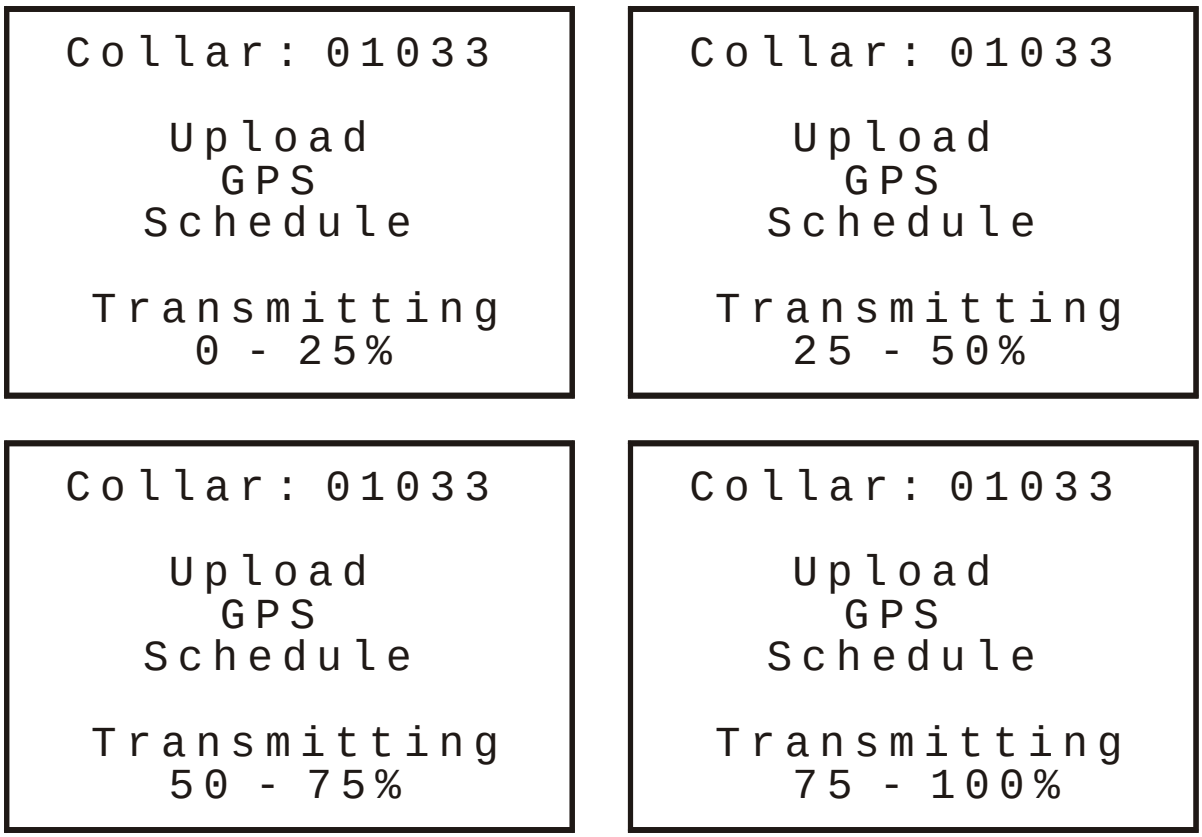

Figure 35: Upload GPS schedule

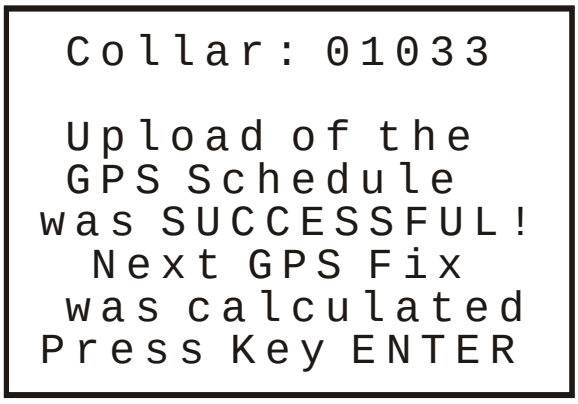

Figure 36: Acknowledgement of successful GPS schedule transmission

5.1.2.1.4 Upload UHF Beacon Schedule from Handheld Terminal to Collar (F8 Tx UHF Beacon Schedule)

To upload a UHF beacon schedule from the Handheld Terminal to the Collar, you need first to upload the schedule from the PC via the serial or the USB interface into the Handheld Terminal (see GPS PLUS software manual). Once you have uploaded a schedule into the terminal for a collar ID, this schedule is valid until you erased the collar data in the Handheld Terminal or until you overwrite this schedule. The schedule will not be erased after a successful upload to the collar.
To start the UHF beacon schedule upload process, press the key ***F8*** (***SHIFT***+***F3***). When no valid schedule is stored inside the Handheld Terminal for the specified collar the screen of Figure 34 will appear.
When a valid schedule for this collar ID is stored inside the Handheld Terminal, the upload process starts automatically. The UHF beacon schedule will be transmitted in two packets. When a bit error during transmission will occur the data will be sent again several times. When no successful communication was possible, the screen like in Figure 33 will appear. During upload of the two data packets the screens of Figure 37 will appear in succession. After the transmission was successfully finished the screen of Figure 38 will be shown and the collar will calculate the next UHF beacon event.
When you press the key ***ENTER***, the Handheld Terminal will go back to the Upload Menu.

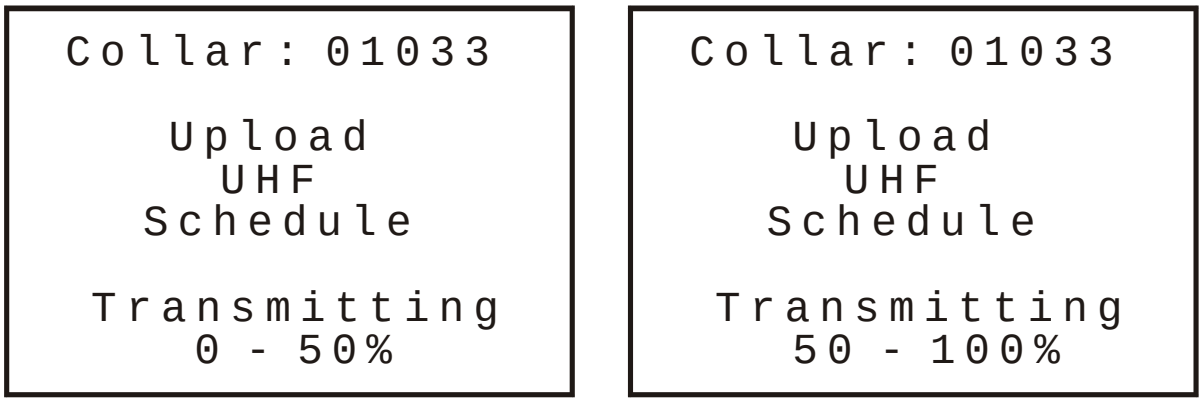

Figure 37: Upload UHF schedule

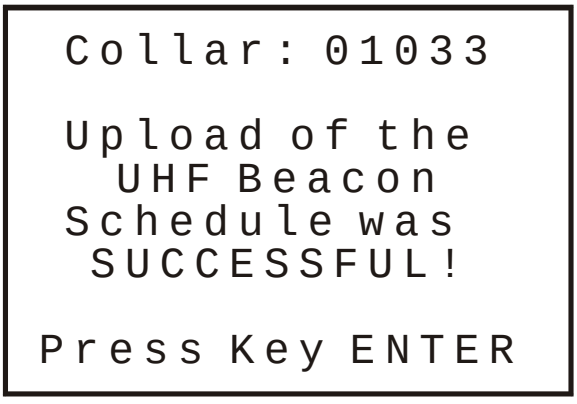

Figure 38: Acknowledgement of successful UHF schedule transmission

5.1.2.1.5 Upload VHF Beacon Schedule from Handheld Terminal to Collar (F9 Tx VHF Beacon Schedule)

To upload a VHF beacon schedule from the Handheld Terminal to the Collar, you need first to upload the schedule from the PC via the serial or the USB interface into the Handheld Terminal (see GPS PLUS software manual). Once you have uploaded a schedule in the terminal for a collar ID, this schedule is valid until you erased the collar data into the Handheld Terminal or until you overwrite this schedule. The schedule will not be erased after a successful upload to the collar.
To start the VHF beacon schedule upload process, press the key ***F9*** (***SHIFT***+***F4***). When no valid schedule is stored inside the Handheld Terminal for the specified collar the screen of Figure 34 will appear.
When a valid schedule for this collar ID is stored inside the Handheld Terminal, the upload process starts automatically. The VHF beacon schedule will be transmitted in two packets. When a bit error during transmission will occur the data will be sent again several times. When no successful communication was possible, the screen like in Figure 33 will appear. During upload of the two data packets the screens of Figure 39 will appear in succession. After the transmission was successfully finished the screen of Figure 40 will be shown and the collar will calculate the next VHF beacon event.
When you press the key ***ENTER***, the Handheld Terminal will go back to the Upload Menu.

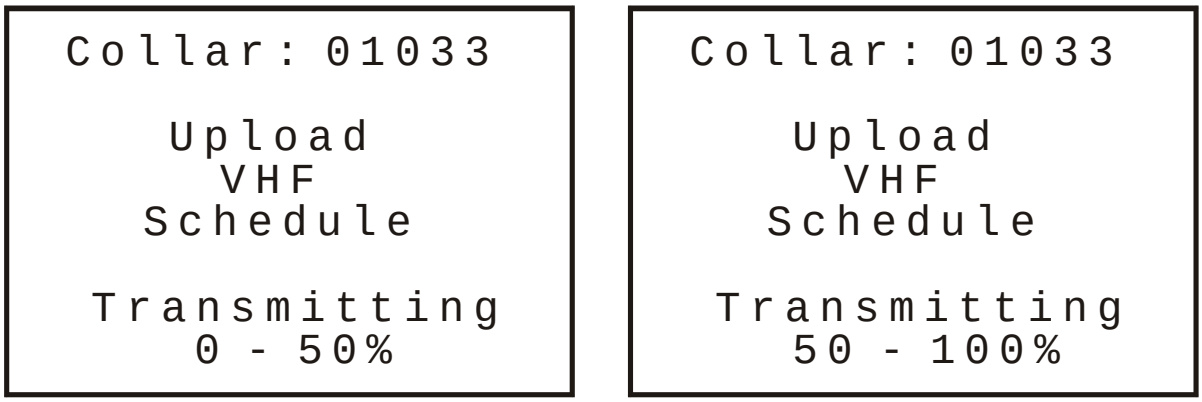

Figure 39: Upload VHF schedule

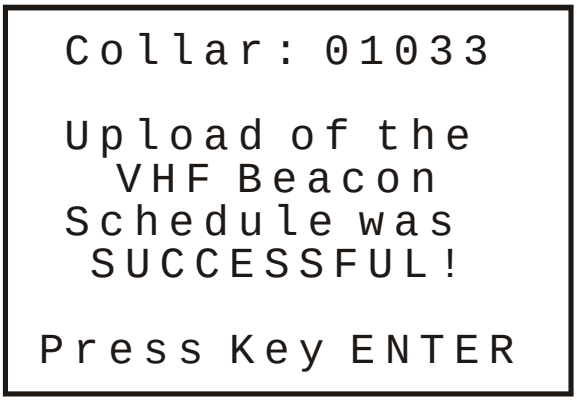

Figure 40: Acknowledgement of successful VHF schedule transmission

5.1.2.2 F2 Download Data

When you are in the Up- and Download Menu and you press the key ***F2*** you will reach the Download Menu, shown in Figure 41. You are now able to:

- Download Telemetry of the collar (status information)
- Download last valid position and navigate with the assistance of the Handheld Terminal to the Collar
- Activation of the UHF Beacon transmitter
- Download of the Mortality Data (if option is available)
- Download of the Activity and Temperature Data (if option is available)
- Download of the GPS Data

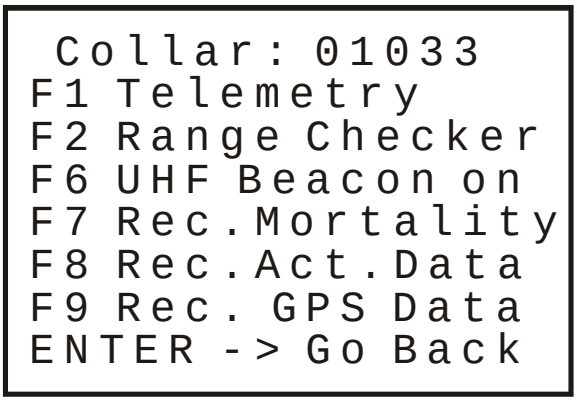

Figure 41: Download Menu

5.1.2.2.1 Download Telemetry from Collar to Handheld Terminal (F1 Telemetry)

You can receive telemetry data from the collar when you press the key ***F1*** in the Download Menu. Immediately after you have pressed the key F1 the telemetry request process starts automatically (Figure 42). When a transmission error occur (Figure 43) or when the Handheld Terminal doesn't receive any data (Figure 44), the telemetry will be requested automatically again for several times. When no successful communication was possible, a screen like in Figure 33 will appear.

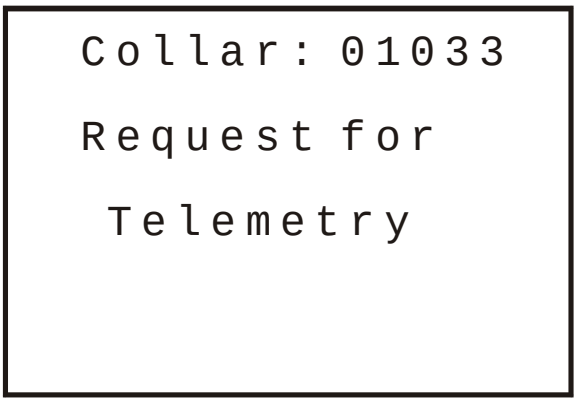

Figure 42: Request for Telemetry

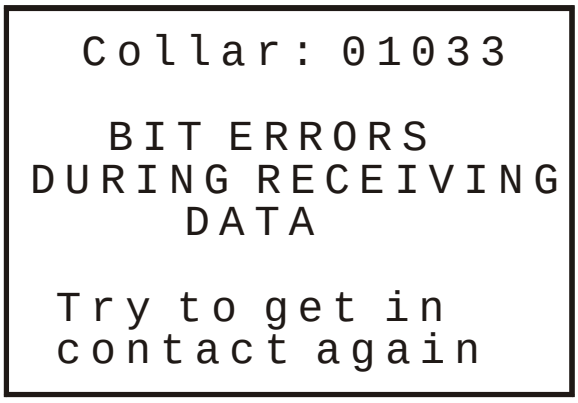

Figure 43: Bit errors during transmission

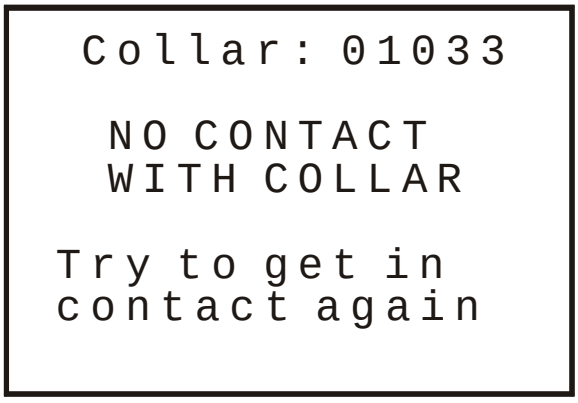

Figure 44: No contact with collar

After a valid telemetry set was received, the Handheld Terminal shows the information in several display pages. You can continue from one page to another by pressing the key ***ENTER***. The First screen contains the UTC time and date of the collar, the voltage of the main and backup battery and the current temperature of the collar (Figure 45).

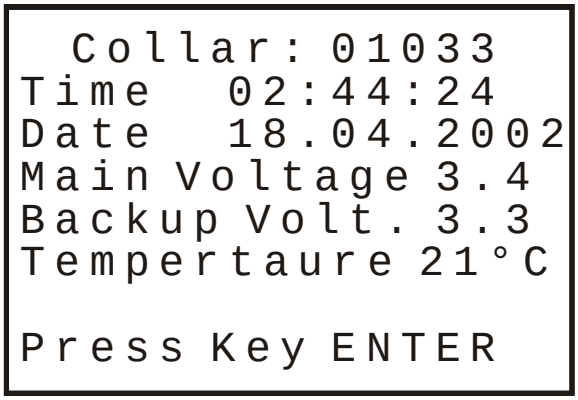

Figure 45: First Display Page of the Collar Telemetry Set

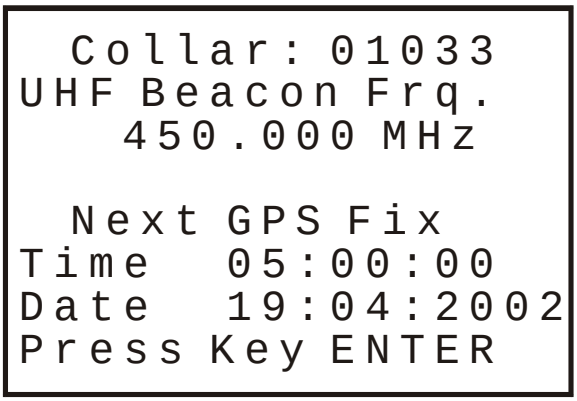

Figure 46: Second Display Page of the Collar Telemetry Set

The second screen contains information about the UHF beacon frequency and the time and date of the next GPS fix (Figure 46). The third screen shows the number of stored GPS data-sets and the number of stored Activity and Temperature datasets (Figure 47). The last screen contains the 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. When no last valid fix is available, the two letters N/A (not available) will be shown on the screen (Figure 48). 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 be available after battery replacement.
When you press the key ***ENTER***, you will go back to the download menu.

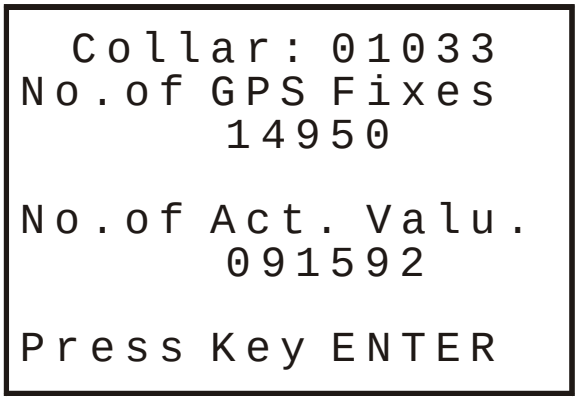

Figure 47: Third Display Page of the Collar Telemetry Set

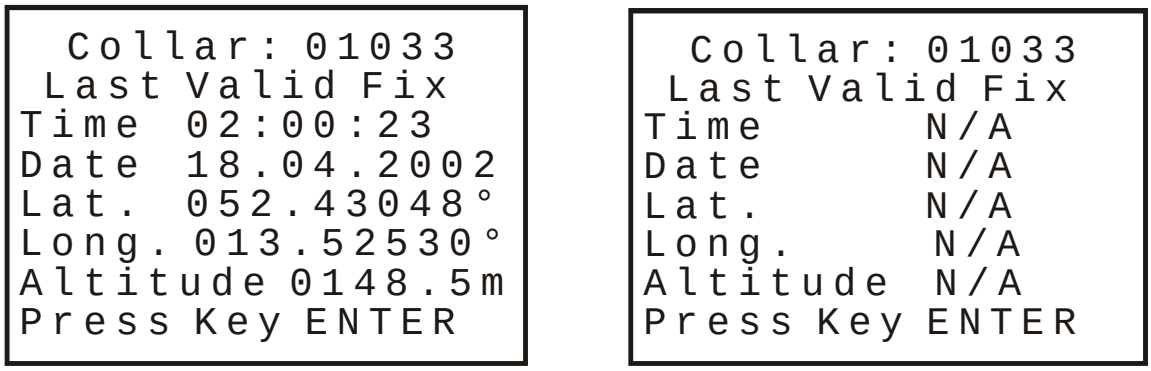

Figure 48: Last Display Page with or without valid GPS information

5.1.2.2.2 Activate Range Checker Mode (F2 Range Checker)

Press key ***F2*** in the download menu to go to the Range Checker Mode. In Range Checker Mode the Handheld Terminal receives first telemetry from the collar (see section 5.1.2.2.1 Download Telemetry from Collar to Handheld Terminal (F1 Telemetry)). After the reception of a valid telemetry set the Handheld Terminal switch on the built in GPS receiver and the screen shown in Figure 49 (left) will appear. You can now select if the Handheld Terminal shall calculate the distance (range) as 2D or 3D value. After the selection, press F2 or F3, the screen shown in Figure 49 (right) will appear. When the GPS receiver receives enough satellites the display will switch automatically to the range checker screen (Figure 50). The Handheld will now calculate the current distance and direction to the last valid collar position. The ΔTime means the time difference between 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 called 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.

Note: ***Range Checker Mode and GPS Mode will only work outside buildings and with a clear view to the sky. The GPS receiver will not work until it receives enough satellites.***

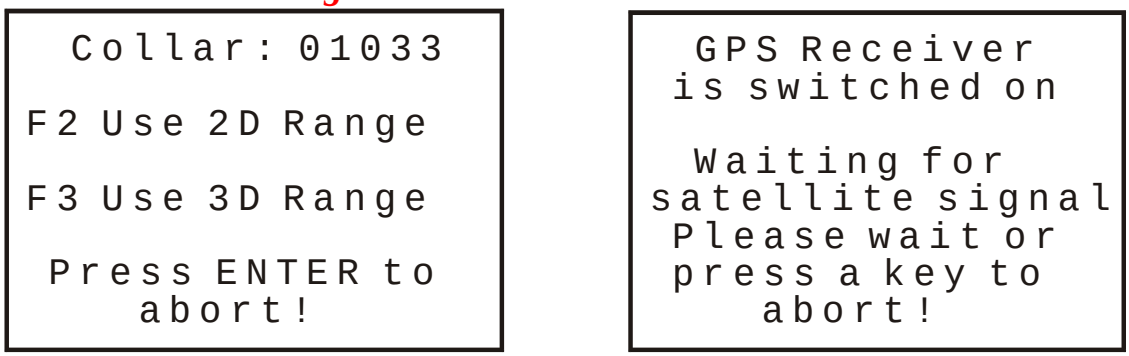

Figure 49: Selection of 2D or 3D range calculation (left) and screen "GPS receiver is switched on" (right)

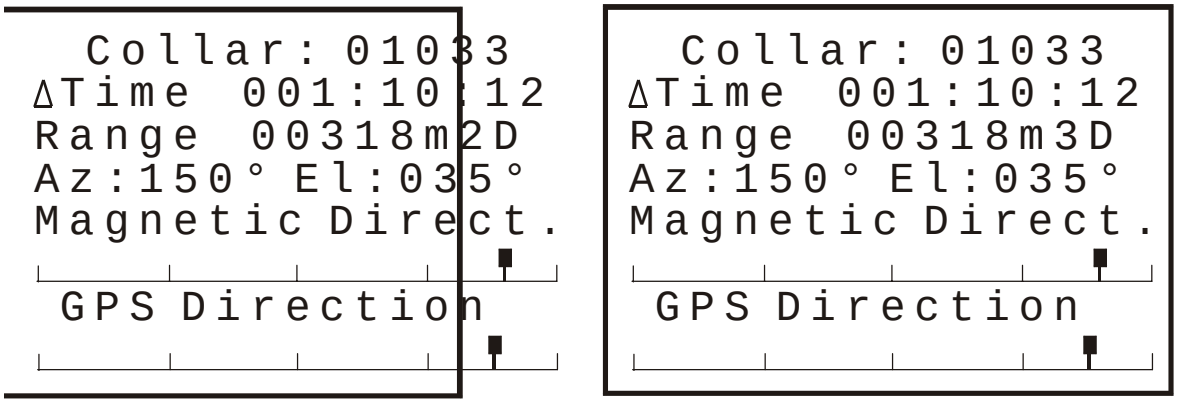

Figure 50: Range Checker Display with 2D (left) and 3D (right) range information

The azimuth is running from 0° to 359°, like a compass rose. Direction north is refers to 0°, direction east is refers to 90°, direction south is refers to 180° and direction west is refers to 270° (Figure 51). The elevation is running from 0° to 90°. An elevation of 0° means directly above the horizon, an elevation of 90° means vertical into the sky (Figure 52).

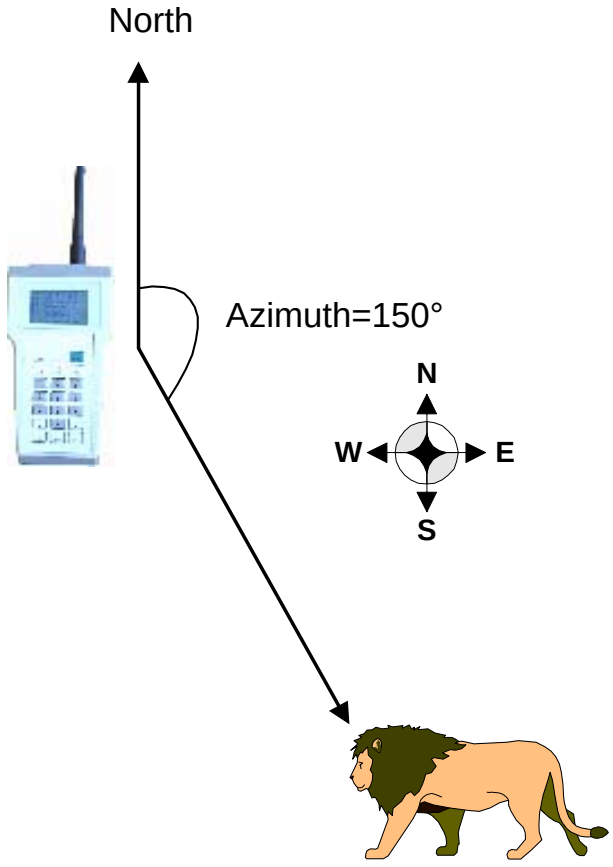

Figure 51: Azimuth angle between Handheld Terminal and Collar

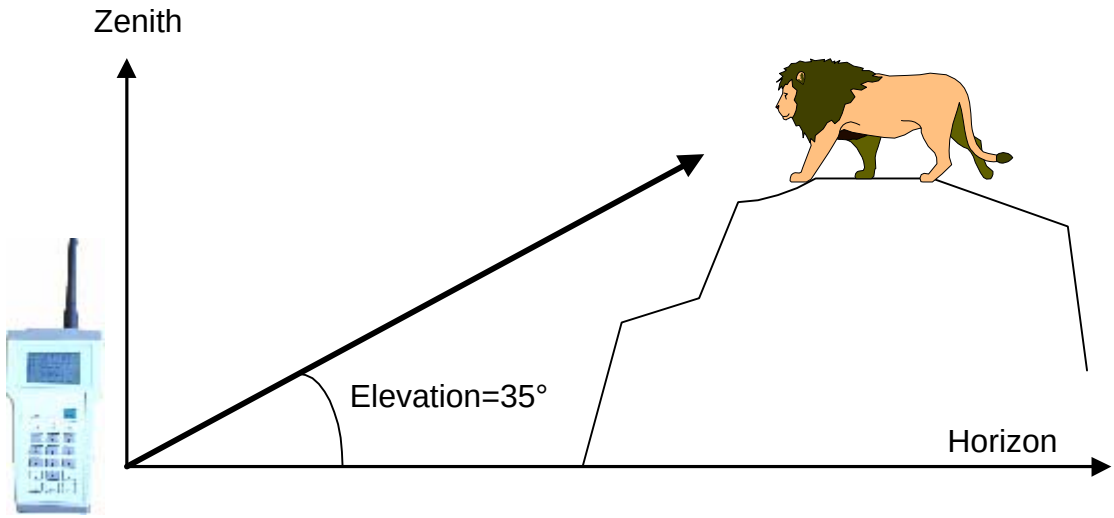

Figure 52: Elevation angle between Handheld Terminal and Collar

Below the azimuth and elevation information are two bar graphs. The first bar graph shows the direction to the collar with the assistance of the magnetic compass. This system is referenced to 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 when the compass errors are not so relevant (declination error, etc. see section 4.5 Electronic Magnetic Compass). When you turn the Handheld around the 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. As higher your velocity as higher the precision of the GPS based compass. When you don't move the direction finder will go to the middle of the bar graph, because the velocity is to low and it is not possible to calculate a direction, based on the velocity. The GPS compass works well when you are able to walk fast and when you receive satellite signals.
To find the way to your collar try to move the direction finder (marker) in the middle of the bar graph. The bar graph has a resolution of ± 180°. When the marker is in the middle go straight ahead. When the marker is left to the middle turn to the left, if the marker is right to the middle, turn to the right. When the marker is at the edge of the bar graph (left or right) make a 180° turn.

5.1.2.2.3 Activation of the UHF Beacon transmitter (F6 UHF Beacon on)

When you are in the download menu press key ***F6*** (***SHIFT+F1***) to activate the UHF beacon on your selected collar. After you have pressed the key the screen shown in Figure 53 will appear. The Handheld transmits now the command to activate the UHF beacon to the collar. The UHF beacon is then activated according the settings of the collar (UHF beacon on time and UHF beacon period (Figure 54)). During beacon mode, it is not possible to have wireless access to the collar. After the beacon mode is finished you have further two minutes wireless access to the collar. Remember, these two minutes will be reset again to two minutes every time you send a command to the collar.

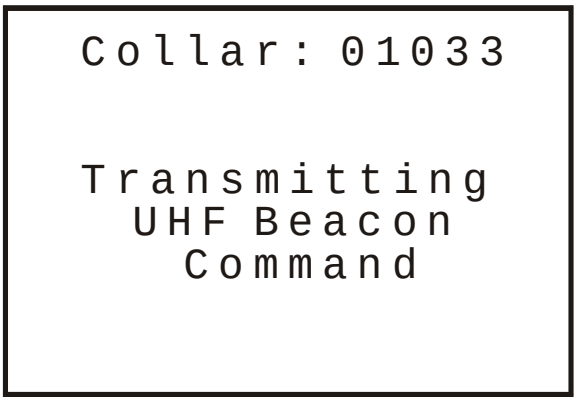

Figure 53: Transmitting beacon command

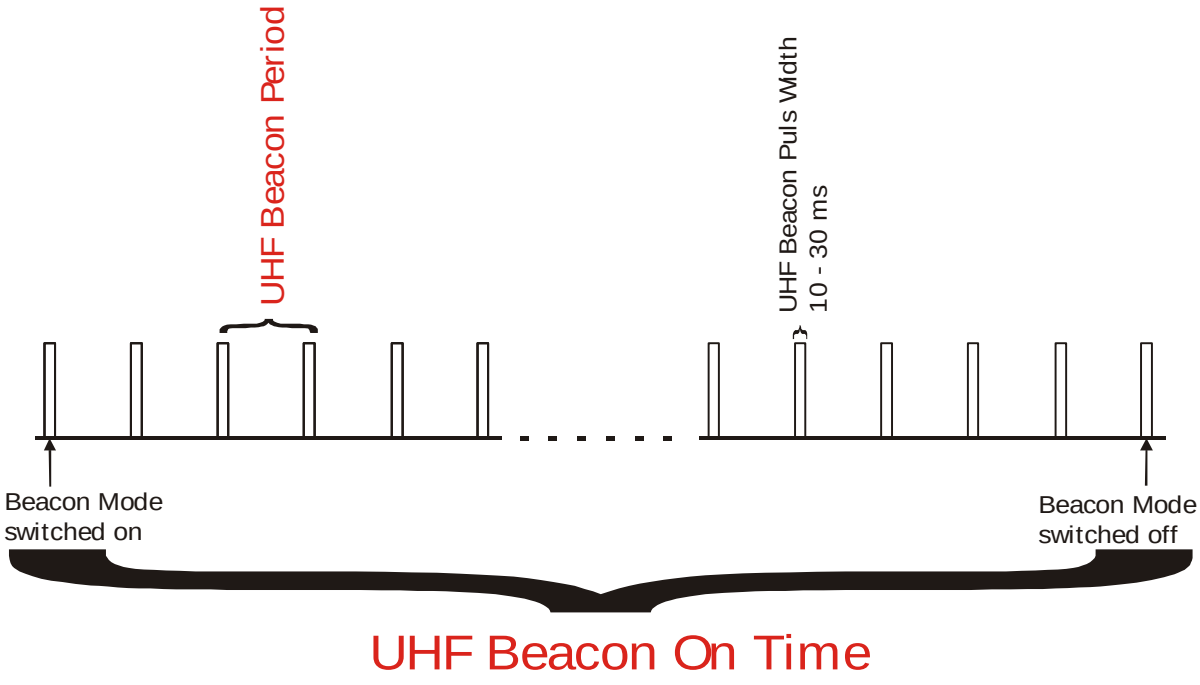

Figure 54: UHF Beacon settings

5.1.2.2.4 Download Mortality Data from Collar to Handheld Terminal (F7 Rec.Mortality)

When you are in the download menu press key ***F7*** (***SHIFT***+***F2***) to download the mortality information from the collar. Downloading of mortality is always possible, even when this option is not enabled. When the data is downloaded from the Handheld Terminal to the PC, the PC software GPS PLUS will check if you have access to this data.
After you have pressed the key ***F7*** (***SHIFT***+***F2***) the screen of Figure 55 will appear. When no errors occur during data transmission, the screen of Figure 56 will then shown. When transmission errors were detected the message of Figure 43 will appear and when the Handheld Terminal receives no data the message of Figure 44 will appear. In both cases the Handheld Terminal will automatically request new data from the collar. When several attempts to get data were failed the message of Figure 33 will appear. Previous downloaded mortality data of this collar will be overwritten inside the Handheld Terminal. It is not necessary to delete the data before downloading it from the collar. Finally press the key ***ENTER*** to go back to the download menu.

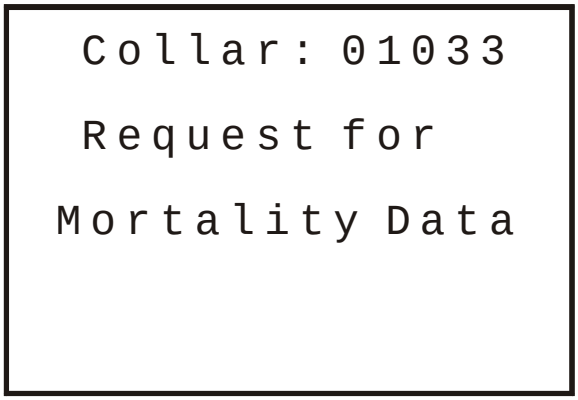

Figure 55: Request for Mortality Data

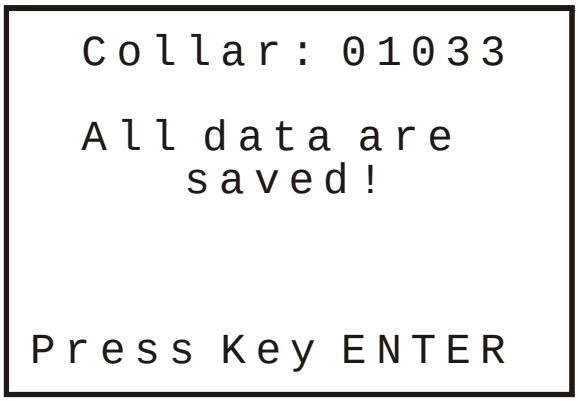

Figure 56: All mortality data are stored

5.1.2.2.5 Download Activity and Temperature Data from Collar to Handheld Terminal (F8 Rec.Act.Data)

When you are in the download menu press key ***F8*** (***SHIFT***+***F3***) to download the activity and temperature information from the collar. Downloading of activity and temperature is always possible, even when this option is not enabled. When the data is downloaded from the Handheld Terminal to the PC, the PC software GPS PLUS will check if you have access to this data.

After you have pressed the key ***F8*** (***SHIFT***+***F3***) the screen of Figure 57 will appear. The Handheld Terminal receives first telemetry data to calculate how much datasets will be received. After that the download process of activity and temperature data starts automatically (Figure 58). You can interrupt this process when you press a key (not the SHIFT key) until the message of Figure 59 will appear. When a transmission error during data download will occur, the message of Figure 60 will appear and the data will be automatically requested again automatically. When no answer from collar will be received the message of Figure 61 will appear. When no further data transmission is possible the message of Figure 62 will appear. Press the key ***ENTER*** to go back to the download menu. The error free received data are stored inside the Handheld Terminal. After the reception of all data the message of Figure 56 will appear. Press the key ***ENTER*** to go back to the download menu.

Note: ***Previous downloaded activity and temperature data of this collar ID will NOT be overwritten. Only new received data will be added to the stored data. This saves transmission power, because only not stored data must be transmitted. When you have ERASED the data inside your collar you must also ERASE the data inside the Handheld Terminal.***

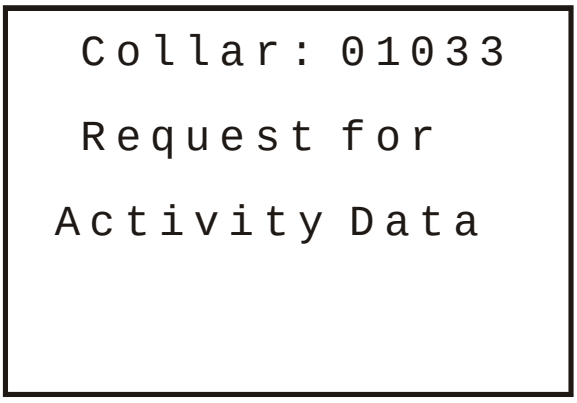

Figure 57: Request for Activity and Temperature Data

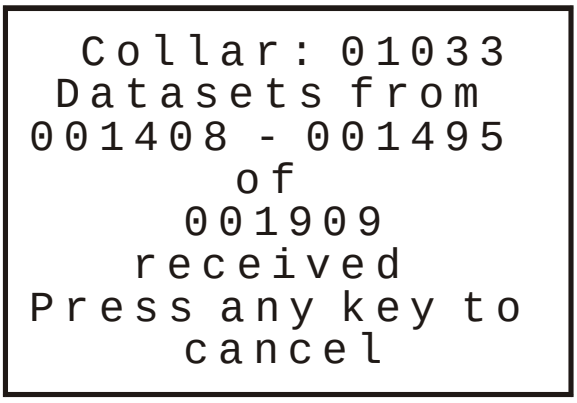

Figure 58: Download of Activity and Temperature Data

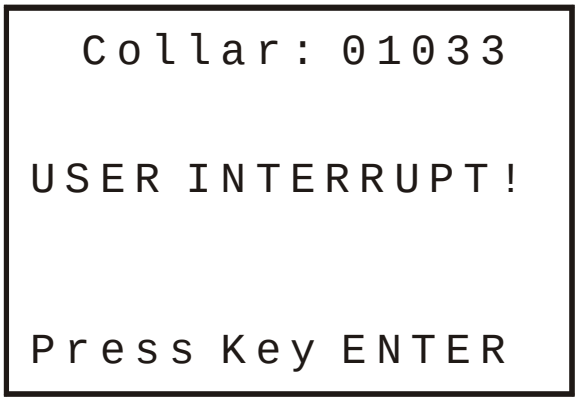

Figure 59: User interrupt

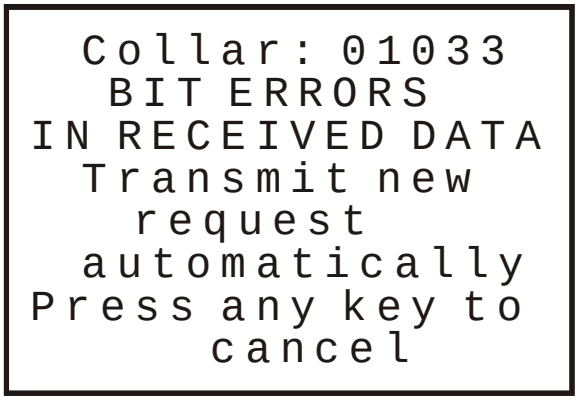

Figure 60: Bit errors in received data

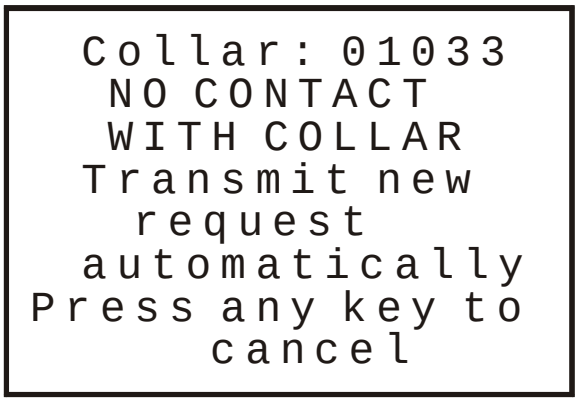

Figure 61: No contact with collar during data transmission

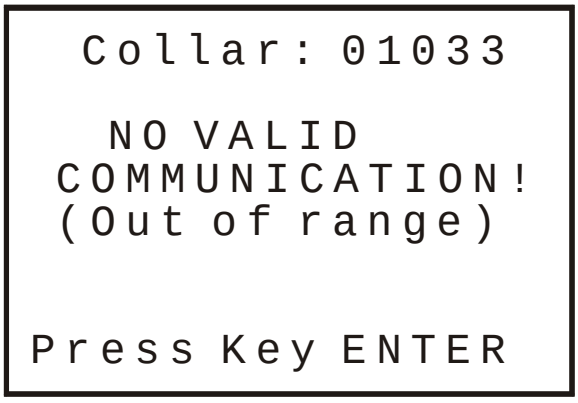

Figure 62: No valid communication

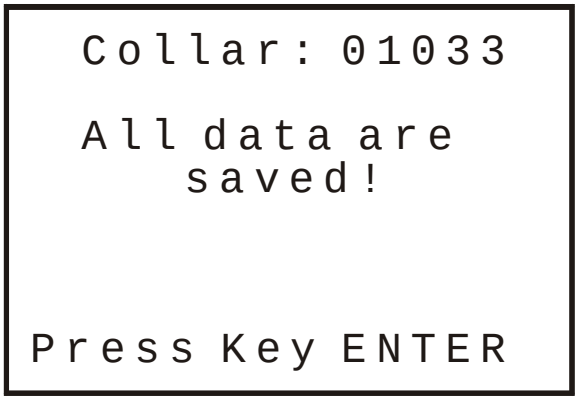

Figure 63: All activity and temperature data are stored

5.1.2.2.6 Download GPS Data from Collar to Handheld Terminal (F9 Rec. GPS Data)

When you are in the download menu press key ***F9*** (***SHIFT***+***F4***) to download the GPS information from the collar. After you have pressed the key ***F9*** (***SHIFT***+***F4***) the screen of Figure 64 will appear. You have now the choice to download data with or without channel information of the GPS receiver. Channel Info means information about:

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

A GPS data set (one GPS position) has a size of 33 Bytes with channel information in solved mode. The same position information can be transmitted without channel information and has then a size of 21 Bytes. In other words the data download from the collar to the Handheld Terminal will be 40% faster without channel information. It is possible to download a part of 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 previously downloaded, you need to erase the GPS data memory for this collar inside the Handheld Terminal. After that the Handheld Terminal must download all GPS data again.
When the collar is configured as DGPS collar (additional data for post processing will be stored) this option has no influence on the transmitted data. The DGPS data will be transmitted as a complete dataset with all information, independent if you have pressed ***F3*** (receive GPS data with channel info) or ***F5*** (receive GPS data without channel info). The transmission of shorter GPS data without channel information is only possible when the collar is configured to store only the solved GPS data set.

After you have pressed ***F3*** or ***F5*** the Handheld Terminal receives first telemetry data to calculate how much datasets can be received. After that the download process of GPS data starts automatically (Figure 66). Dependent on the configuration of your collar (solved/differential GPS information) the number of GPS fixes per data set can be different. You can interrupt this process when you press a key (not the SHIFT key) until the message of Figure 59 will appear. When a transmission error during data download will occur, the message of Figure 60 will appear and the data will be automatically requested again automatically. When no answer from collar will be received the message of Figure 61 will appear. When no further data transmission is possible the message of Figure 62 will appear. Press the key ***ENTER*** to go back to the download menu. The error free received data are stored inside the Handheld Terminal. After the reception of all data the message of Figure 56 will appear. Press the key ***ENTER*** to go back to the download menu.

Note: ***Previous downloaded GPS data of this collar ID will NOT be overwritten. Only new received data will be added to the stored data. This saves transmission power, because only not stored data must be transmitted. When you have ERASED the data inside your collar you must also ERASE the data inside the Handheld Terminal.***

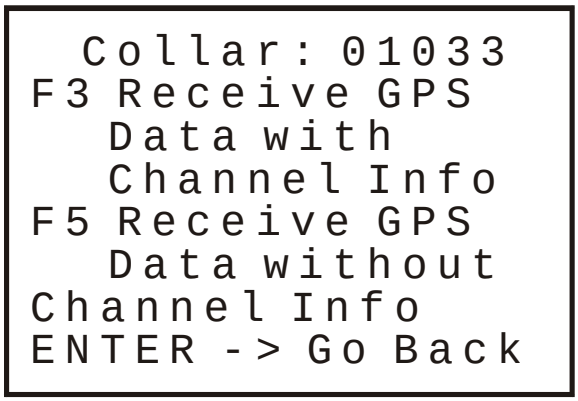

Figure 64: Select GPS data download mode

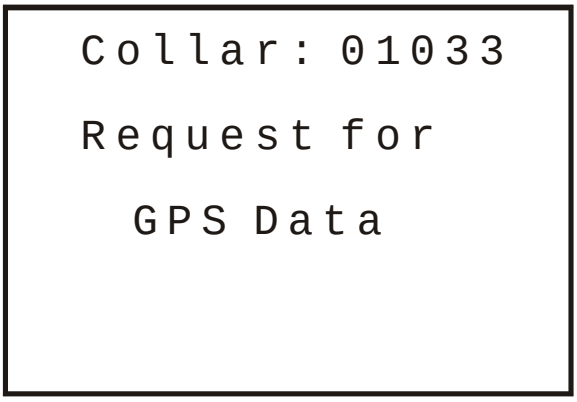

Figure 65: Request for GPS Data

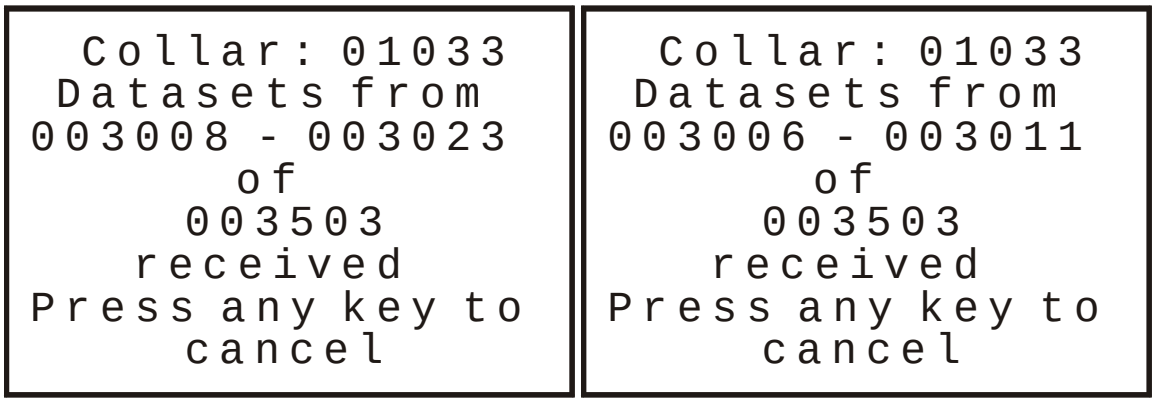

Figure 66: Download of GPS Data (left solved GPS data, right differential GPS data)

5.1.3 Update Collar (F3)

When the collars are still in receive mode and the terminal was switched off or the user has pressed the RESET key, it is possible to establish the radio link between Terminal and Collar again without the transmission of the wakeup code. After transmitting a command to all collars the Handheld Terminal receives the collar ID's (serial number of the collar) for a period of 24 seconds (Figure 67). During these 24 seconds each collar, which is online, transmits its own ID in a predefined timeslot back to the Terminal. This will happen when you press ***F3*** in the collar communication menu.

Note: ***Do not press any other key than ENTER when you are in the collar communication menu or submenus without a connected 50 Ohm antenna. Transmitting without a 50 Ohm antenna can destroy the power amplifier.***

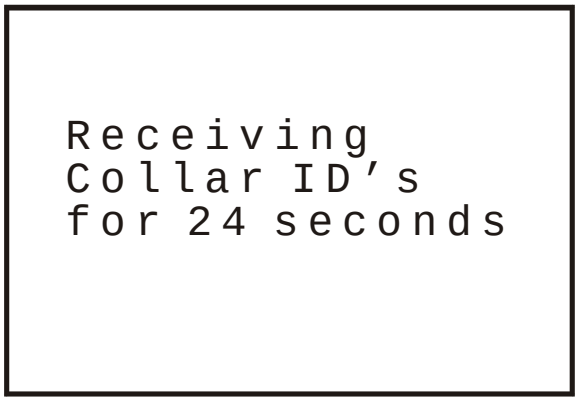

Figure 67: Display during the reception of collar ID's

After the reception of the collar ID's is complete the received collar ID's are shown in the "Select Collar" display (Figure 23).

5.1.4 All Collars UHF Beacon On

If you want to activate only the UHF beacon transmitter for all collars in communication range press the key ***F9*** (***SHIFT***+***F4***) in collar communication menu. The Terminal transmits now 40 seconds wakeup code (Figure 68) and then the beacon activation code. After that the message of Figure 69 will appear. Press the key ***ENTER*** to go back to the collar communication menu.
The UHF beacon transmitter of all collars in communication range is then activated according the settings of the collars (UHF beacon on time and UHF beacon period (Figure 54)). During beacon mode, it is not possible to have wireless access to the collar. After the beacon mode is finished you have further two minutes wireless access to the collar. Remember, these two minutes will be reset again to two minutes every time you send a command to the collar.

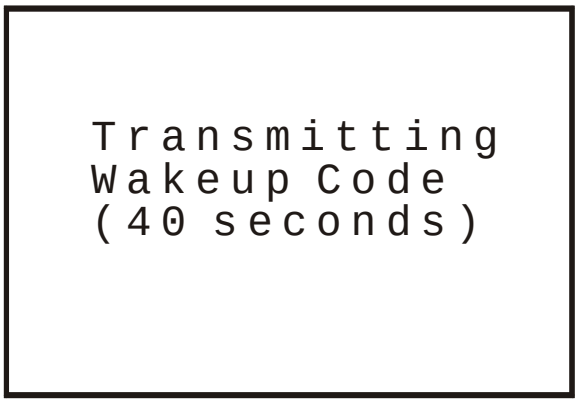

Figure 68: Display during transmitting Wakeup Code

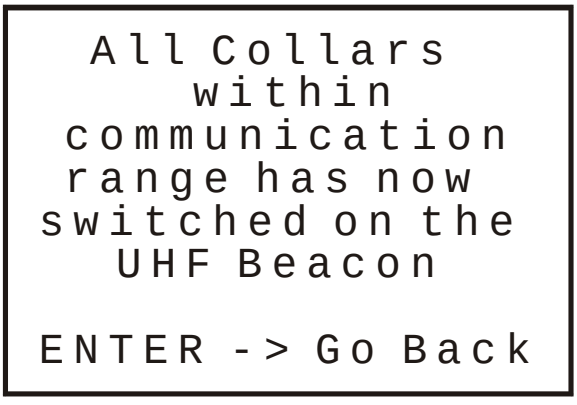

Figure 69: All Collars Beacon On

5.2 Collar Registration (F2 Collar Reg.)

To avoid that other people except the owner of the collar have wireless access to the collars, the collar ID's must be registered in the Handheld Terminal. Each collar is delivered with a unique key file for registering. In the same way you need to register your collar for your PC software GPS PLUS.EXE register your collars for the Handheld Terminal (see GPS PLUS software manual). Up to 64 Collars can be registered with the assistance of GPS PLUS.EXE in the Handheld Terminal (Selected Collar Table). From these maximum 64 collars the user can use maximum 16 or 32 collar ID's for data up- and download, dependent on the memory capacity of the Handheld Terminal (64/128 Mbyte), see Figure 70.

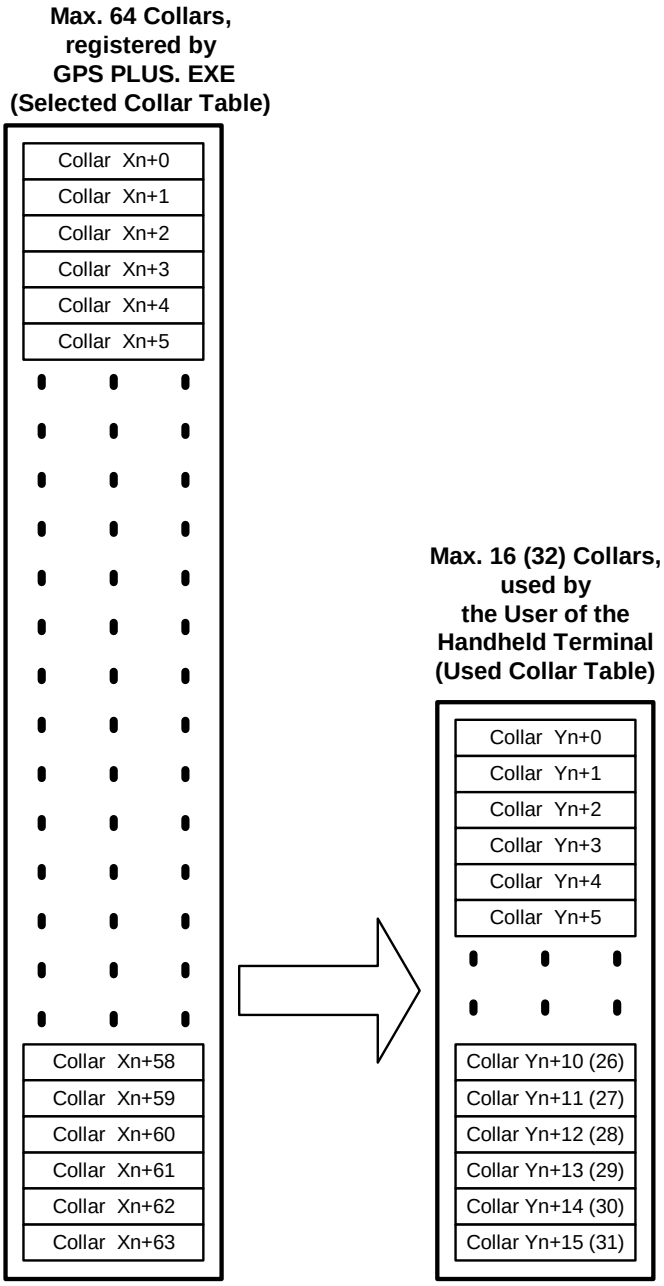

Figure 70: Collar management of the Handheld Terminal

Press key ***F2*** from the main menu to go to the collar registration menu (Figure 71). In the collar registration menu you have the possibility to take a look to the selected collar ID's and you have the possibility to select or remove the collar ID (remove the data belong to it also).

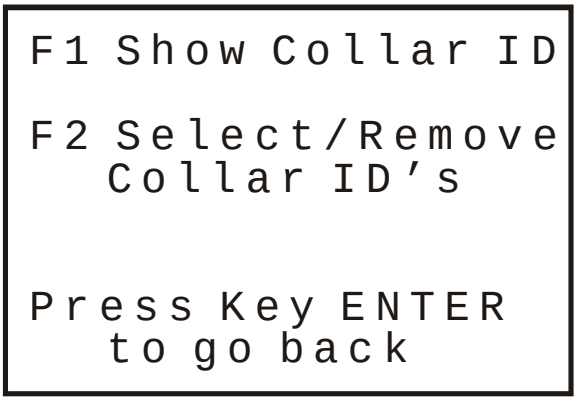

Figure 71: Collar registration menu

5.2.1 Show the List of the Used Collar ID's (F1 Show Collar ID)

When you press the key ***F1*** in the collar registration menu you can take a look to your used collars (Figure 72). The maximum number of usable collars is 16 for a memory capacity of 64 MByte and 32 for a memory capacity of 128 MByte. These collars can be selected via the Select / Remove Collar ID Menu.

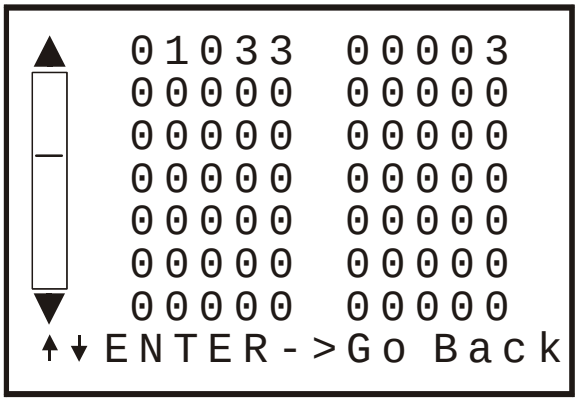

Figure 72: Show Collar ID's

All selected collars (max. 16 or 32 collars) which were registered before with the GPS PLUS software (max. 64 collars) are now shown on the display. You can scroll down and up with the keys ***SHIFT***+***8*** or ***8*** (Up) or ***SHIFT***+***2*** or ***2*** (Down). The Up and Down arrow above and below the bar graph will appear when previous or following collar ID's are available. The small marker inside the bar graph indicates the scrolling position of the screen. Press the key ***ENTER*** to go back to the Collar registration menu.

5.2.2 Select / Remove Collars ID

To select a collar out of the 64-entry list (Figure 70) or to remove it press key ***F2*** in the collar registration menu. The screen of Figure 73 will appear. All previous selected collars (max. 16 or 32 collars) which were registered before with the GPS PLUS software (max. 64 collars) are now shown inverted on the display (white numbers on black background). Not selected collars, which were registered before with the GPS PLUS software, are shown non inverted (black numbers on white background). You can scroll down, up, left and right in this 64-entry list. To scroll down press the keys ***SHIFT+2*** or ***2,*** to scroll up press the keys ***SHIFT+8*** or ***8,*** to scroll left press the keys ***SHIFT+4*** or ***4*** and to scroll right press the keys ***SHIFT+6*** or ***6.*** The Up and Down arrow above and below the bar graph will appear when previous or following collar ID's are available. The small marker inside the bar graph indicates the scrolling position of the list.
Already selected collars are shown inverted, not selected collars are shown non-inverted. To select a new collar from this max. 64 collar list go to your desired non-inverted collar ID with the two markers (left and right arrow) and press the key *****. Immediately after you have pressed the key ***** the collar ID will be shown inverted. This means that you have now add this collar to your 16/32 collar list and the Handheld Terminal has now the authority to communicate with this collar.
If you want to remove a selected collar from the 16/32 collar list go to your desired inverted collar ID with the two markers (left and right arrow) and press the key *****. Immediately after you have pressed the key ***** the screen of Figure 74 will appear. To cancel this operation press the key ***ENTER***, to continue with erasing the collar ID and all data belong to it press the key ***F10***. When you have pressed the key ***ENTER*** you will go back, if you have pressed the key ***F10*** the message of Figure 75 will appear. This message will be shown on the screen as long it takes time to erase all data of this collar (usually from one to several seconds). After that the collar ID is removed from the 16/32 authority list and will be shown as a non-inverted collar ID. After you have selected or removed all desired collar ID's press the key ***ENTER*** to go back to the Collar registration menu.

Note: ***When you remove a collar ID, all data belong to it will be removed also!***

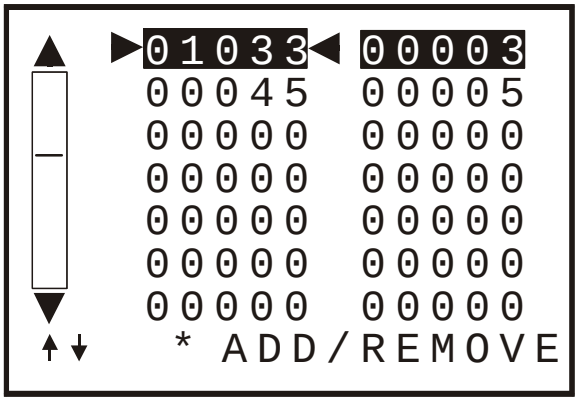

Figure 73: Select / Remove Collar ID's

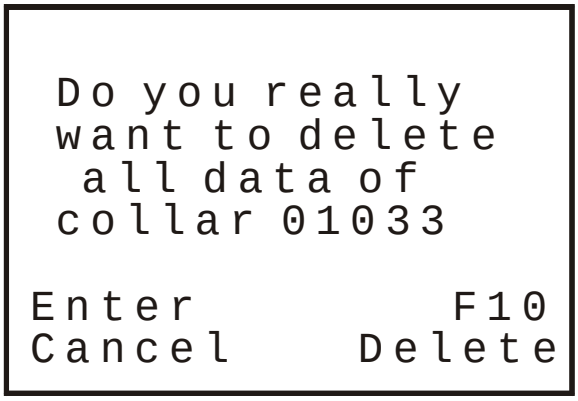

Figure 74: Erasing Confirmation

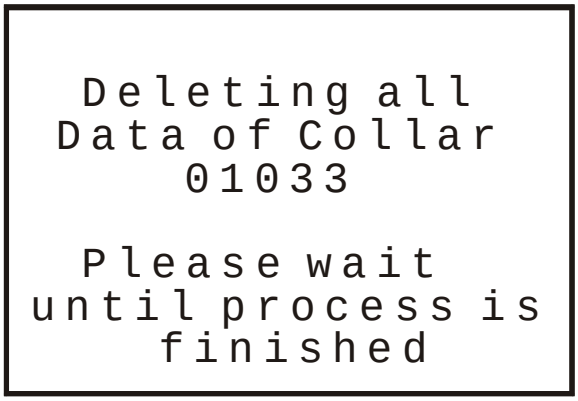

Figure 75: Erasing Message

5.3 GPS On Board Module (F3 GPS Module)

The Handheld Terminal is equipped with a 12 Channel GPS receiver. You can use the information of this receiver to find out your position in the field or to navigate. Press key ***F3*** to go to the GPS menu from main menu (Figure 76).

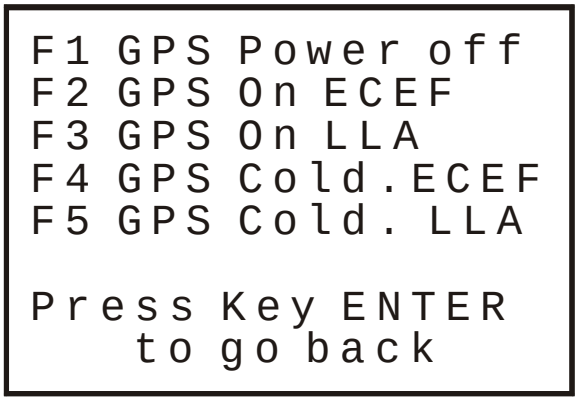

Figure 76: GPS Menu

5.3.1 Switch Off GPS Receiver (F1 GPS Power off)

You can switch off the receiver by pressing the key ***F1*** in the GPS Menu. The message of Figure 77 will appear for one second.

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

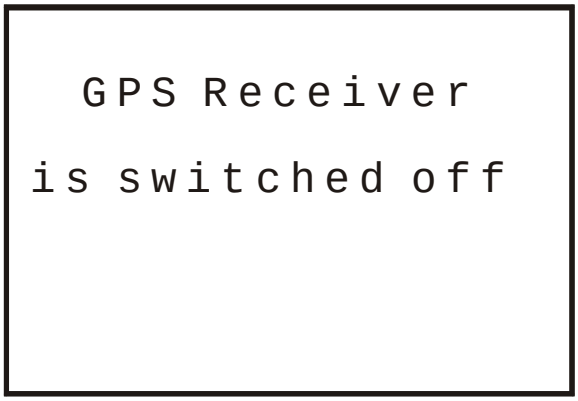

Figure 77: Switch off GPS Receiver

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

To start the receiver with Earth Centre Earth Fixed coordinates press the key ***F2*** in the GPS menu. Immediately after you pressed the key ***F2*** the message of Figure 78 will appear. The receiver is now searching GPS satellite signals. When the GPS receiver gets data from at least one satellite, the display will change like in Figure 79. To abort or to go back to the GPS menu press the key ***ENTER*** until the screen will change. This can take up to some seconds, dependent on the receiving conditions. When you start the receiver indoor and it is not possible to receive GPS satellite signals you need to press the key ***ENTER*** several seconds until the screen will change, if you have open access to the sky it should take max. 1 second.

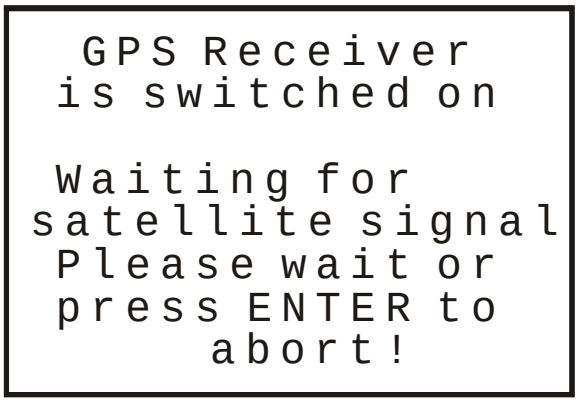

Figure 78: GPS Receiver waits for satellite signal

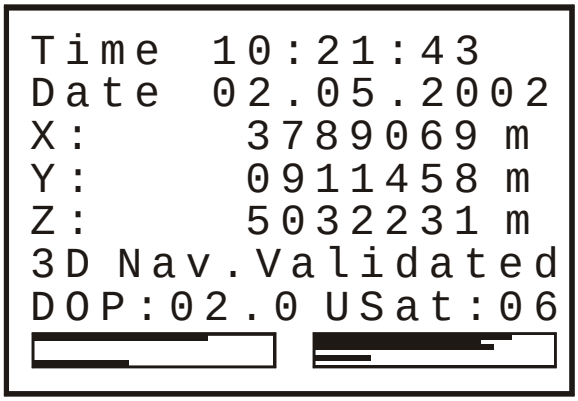

Figure 79: GPS Receiver in ECEF Mode

The first and second line shows the 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

A 3D Nav. Validated means that the GPS receiver uses 5 or more satellites to calculate the position fix. 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. Consider validated is the best fix quality you can get.
The last text line describes the value of the DOP value (Dilution Of Precision) and the number of used (tracked) satellites. Below this line are two horizontal bar graphs. One on the left and one on the right side. These bar graphs show the received signal strength for every tracking channel. The left bar graph covers channel 1 to 6 and the right bar graph covers channel 7 to 12. When a line is shown within these bar graphs the GPS receiver receives satellite signals. The left edge means 25 dBHz (very poor signal), the right edge means 50 dBHz (strong signal).

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

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

To start the receiver with Latitude, Longitude and Altitude coordinates press the key ***F3*** in the GPS menu. Immediately after you pressed the key ***F3*** the message of Figure 78 will appear. The receiver is now searching GPS satellite signals. When the GPS receiver gets data from at least one satellite, the display will change like in Figure 80. To abort or to go back to the GPS menu press the key ***ENTER*** until the screen will change. This can take up to some seconds, dependent on the receiving conditions. When you start the receiver indoor and it is not possible to receive GPS satellite signals you need to press the key ***ENTER*** several seconds until the screen will change, if you have open access to the sky it should take max. 1 second.

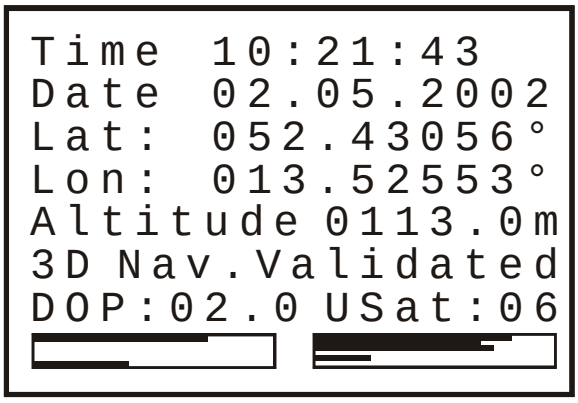

Figure 80: GPS Receiver in LLA Mode

The screen is the same like in section 5.3.2 Start GPS Receiver in ECEF Mode (F2 GPS On ECEF) explained, except the position will be shown as latitude, longitude and altitude information.

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

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

When the GPS receiver is not able to track any satellite after several minutes it is sometimes useful to perform a reset or coldstart. To do this press the key ***F4*** (ECEF mode) in the GPS menu and the Real time Clock, the Position and the ephemeris of the satellites will be erased. Immediately after you pressed the key ***F4*** the message of Figure 78 will appear. The receiver is now in coldstart mode for some seconds and starts searching GPS satellite signals. When the GPS receiver receives at least one satellite, the display will change like in Figure 79. To abort or to go back to the GPS menu press the key ***ENTER*** until the screen will change. This can take up to some seconds, dependent on the receiving conditions. When you start the receiver indoor and it is not possible to receive GPS satellite signals you need to press the key ***ENTER*** several seconds until the screen will change, if you have open access to the sky it should take max. 1 second.

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

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

When the GPS receiver is not able to track any satellite after several minutes it is sometimes useful to perform a reset or coldstart. To do this press the key ***F4*** (LLA mode) in the GPS menu and the Real time Clock, the Position and the ephemeris of the satellites will be erased. Immediately after you pressed the key ***F4*** the message of Figure 78 will appear. The receiver is now in coldstart mode for some seconds and starts searching GPS satellite signals. When the GPS receiver receives at least one satellite, the display will change like in Figure 80. To abort or to go back to the GPS menu press the key ***ENTER*** until the screen will change. This can take up to some seconds, dependent on the receiving situations. When you start the receiver indoor and it is not possible to receive GPS satellite signals you need to press the key ***ENTER*** several seconds until the screen will change, if you have open access to the sky it should take max. 1 second.

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

5.4 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 key ***F4*** to go to the Compass Menu from main menu (Figure 81).

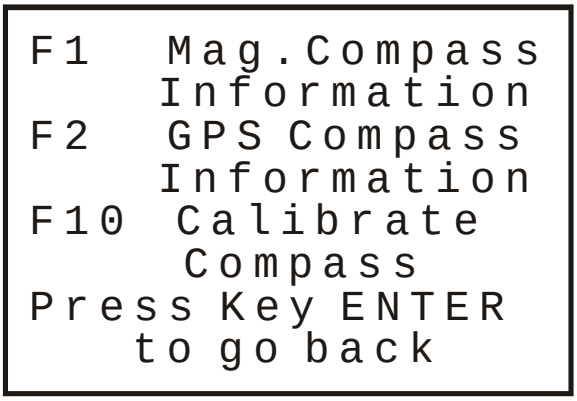

Figure 81: Compass Menu

5.4.1 Magnetic Compass (F1 Mag. Compass Information)

To read out the direction to "Magnetic North" press the key ***F1*** from the compass menu. The compass information (Figure 82) is only valid when the Handheld Terminal will be held vertical. Each angle (Pitch), which is out of the vertical axis, will induce a heading error (seen section 4.5 Electronic Magnetic Compass).

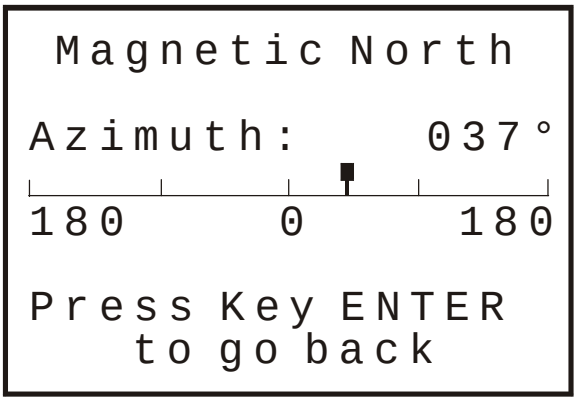

Figure 82: Magnetic Compass information

The azimuth is running from 0° to 359°, like a compass rose. Direction north is 0°, direction east is 90°, direction south is 180° and direction west is 270° (like in Figure 51). Below the text line with the azimuth information an additional bar graph shows the azimuth information

as a graphic. The left edge of the graphic is 180° South, the next vertical line is 270° West, the middle line is 0° North (360°), the next vertical line to the right is 90° East and the right edge is 180° South again. When you turn the Handheld Terminal around the vertical axis you will see how the marker is running from one edge to the other.

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

In addition to the magnetic compass module the Handheld Terminal has the possibility to calculate the direction with the built in 12 channel GPS receiver. In contrast to the magnetic compass the GPS compass can calculate the "True North" direction. Press the key ***F2*** from the compass menu to start the GPS compass. After some seconds the screen of Figure 78 will appear. Conditional on the technology the compass will only work outside with an open access to the sky. After the GPS receiver has a navigation solution, the screen of Figure 83 will appear. The GPS compass calculates the direction with the assistance of the velocity. When the velocity is to slow, lower than 0.3m/s, the screen of Figure 84 instead of Figure 83 will appear.

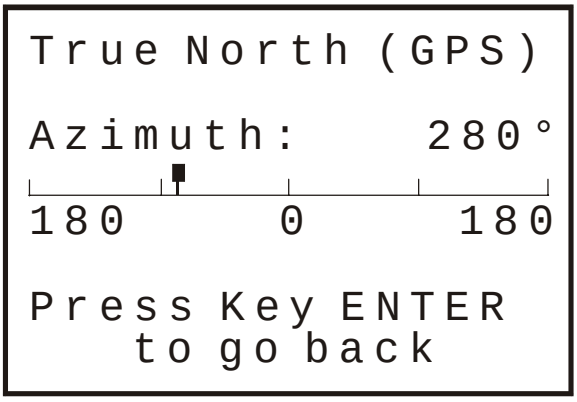

Figure 83: GPS Compass information

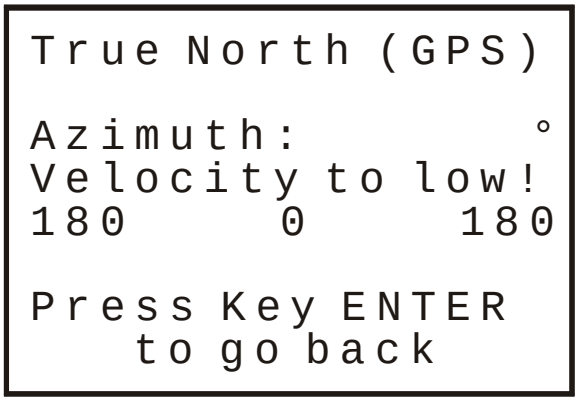

Figure 84: GPS Compass, velocity to low

Press the key ***ENTER*** to go back to the compass menu.

5.4.3 Calibrate Magnetic Compass (F10 Calibrate Compass)

The calibration method is described in section 4.5.4 Compass Calibration. After you have pressed the key ***F10*** (***SHIFT***+***F5***) from the compass menu the screen of Figure 85 will appear.

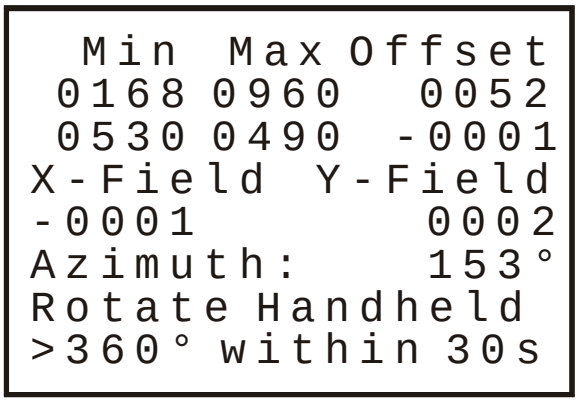

Figure 85: GPS Compass calibration information

5.5 Status Information (F5 Status Info)

To get the status information from the Handheld Terminal you need to press the key ***F5*** from the main menu. The screen like in Figure 86 will appear. The first two lines are the UTC time and date of the Handheld Terminal. The UTC time and date information will be updated automatically whenever the GPS receiver solves a valid navigation solution. The fourth line contains information about the battery voltage. 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 is dependent on current, voltage and temperature. Finally you can read out the temperature inside the Handheld Terminal. This temperature can increase during data communication or when the GPS receiver is switched on. To go back to the main menu press the key ***ENTER***.

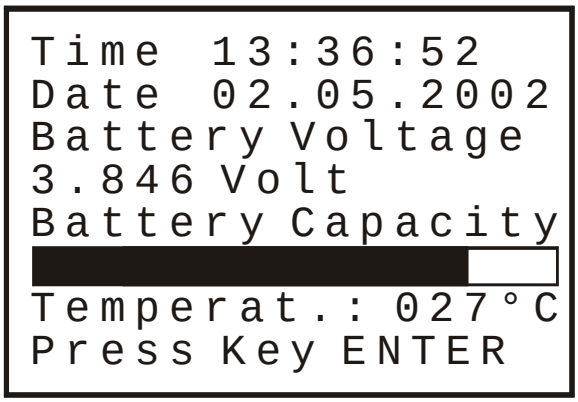

Figure 86: Handheld Terminal status information

5.6 Handheld Terminal Information (F6 Handheld Info)

To get information from the Handheld Terminal about soft- and hardware version you need to press the key ***F6*** (***SHIFT***+***F1***) from the main menu. The screen like in Figure 87 will appear. You will get information about the serial number, software version and the software built date. In addition you can read information about the hardware version and the production date. To go back to the main menu press the key ***ENTER***.

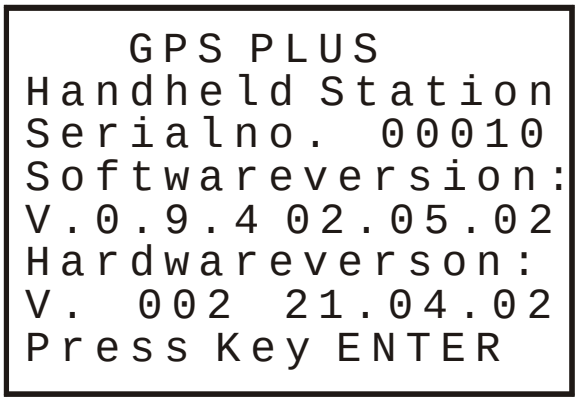

Figure 87: Handheld Terminal Information

5.7 Shut Down Handheld Terminal (F10 Power Down)

To switch off the power of your Handheld Terminal you need to press the key ***F10*** (***SHIFT***+***F5***) from the main menu. The Terminal will shut down instantly.

6 Short instruction

- Register your collars with the assistance of GPS PLUS.EXE (section 5.2)
- Select or remove your collar ID's (section 5.2.2), remember when you remove your collar ID all data belong to it will be also erased!
- Upload GPS schedule and/or UHF schedule and/or VHF schedule to the Terminal with GPS PLUS (only if needed)
- Search for selected collars (section 5.1.1)
- UP / Download data (section 5.1.2)
- Read out data from the Handheld Terminal to the PC with GPS PLUS.EXE
- Erase data with GPS PLUS.EXE (only if really necessary, e.g. after you erased the data inside the collar too)

7 Software Revision List

7.1 V.0.8.0 March 2002

First working version

7.2 V.0.9.0 April 13, 2002, require collar firmware 1.0.6 or higher

- Seconds of real time clock are now incr. every second (previous versions incr. of 8 every 8s)
- LED of LCD display will be switched off after 30 seconds after key was pressed
- Automatic power down mode after 900 seconds implemented
- Additional information on the LCD display about maximum number of datasets during receiving activity or GPS datasets
- Optimise the RF sensitive
- Time and date of collar can now be adjusted via wireless link
- All changes for additional GPS mode 2, 8 and 9 implemented
- Support an optimised mode for the collars for a wireless wakeup
- Support now 1200, 2400, 3600 and 4800 Bit/s (downlink) and autobauding on the wireless link.
- For 4800 baud and above, the internal 60 kHz IF filter will be used (not the external 455 kHz filter)
- Add additional general beacon command for all collars
- Add upload of small GPS scheduler
- Add upload of UHF beacon scheduler
- Add upload of VHF beacon scheduler
- Implement Range Checker
- Implement GPS compass (true north)

7.3 V.0.9.1 April 16, 2002

- Disable all interrupts during EEPROM write to avoid time outs

7.4 V.0.9.2 April 24, 2002

- Replace Tilt -> Activity
- Replace UTC-GMT (special customer version)
- Replace telemetry-diagnostics (special customer version)

7.5 V.0.9.3 April 24, 2002

- Replace Scheduler -> Schedule

7.6 V.0.9.4 May 02, 2002

- Replace Beacon -> UHF Beacon
- Replace Register Collar ID's -> Select Collar ID's

7.7 V.1.0.0 August 14, 2002

- Add GPS Mode 16,17 and 18 and final release
- Add Update collar routine to the communication menu
- Add routines for remote control

7.8 V.1.0.1 October 01, 2002

- Small changes? Not exactly known

7.9 V.1.0.2 October 22, 2002

- Remove the subroutine void TX_100PAGES_MMC2USB(....)
- Add subroutine unsigned char READ_CHECKED_SINGLE_BLOCK_MMC(unsigned long int sector,unsigned char card) to verify the CRC before continue

7.10 V.1.1.0 November 02, 2002

- Double check of erased area on MMC
- changes in subroutine interrupt [UART_RX_vect] void RX_Interrupt(void)
- changes in subroutine void ERASE_FLASHCARD(unsigned char card)
- changes in subroutine void DELETE_COLLAR(unsigned int actioncollar)
- changes in subroutine void USB_INTERPRETER(void)
- Add subroutines unsigned char TEST_GPS_SOLVED_MODE(unsigned char gpsmode) and unsigned char TEST_GPS_DIFFERENTIAL_MODE(unsigned char gpsmode)
- Future implementation of further GPS receiver is now much more easier!
- ADD two new GPS collar receiver, Mode 3, 10, 11 and 32

7.11 V.1.1.1 January 03, 2003

- In range checker mode: add 2D range ->2D and 3D range is alternating every three seconds

7.12 V.1.2.0 April 04, 2003

- Add an additional Collar GPS receiver to database
- Add implementation to switch on the collar GPS receiver via radio link
- Add implementation of the transmission of short GPS datasets (without channel informations) to reduce the overhead
- add new menu in range checker mode to select 2D or 3D range information