Quick Guide for Nokia 9000/9000i/9110 Communicator GPS – SMS Application Version 1.0

By
Nokia Mobile Phones

Table of Contents

1. ABBREVIATIONS

This section defines some technical terms and abbreviations used in the field of GPS technology.

Almanac	A reduced-precision subset of the ephemeris parameters. Used by the receiver to compute the elevation angle, azimuth angle and estimated Doppler of the satellites. Each satellite broadcasts the almanac for all the satellites in the system
C/A code	The Coarse/Acquisition code. This is the civilian code made available by the Department of Defense (DOD). It is subject to selective availability (SA). Users can reduce the effects of SA using differential GPS.
DGPS	Differential GPS is a procedure for correcting GPS solutions to achieve improved position accuracy. Differential GPS provides 2 to 5 meter position accuracy. Differential accuracy is obtained by applying corrections determined by the stationary Differential GPS Reference Station to the GPS data collected by the RPU unit on board the vehicle.
Differential Relative Positioning	Determination of the relative coordinates of two or more receivers which are simultaneously tracking the same satellites. Static differential GPS involves determining baseline vectors between pairs of receivers.
DOP (Dilution of precision)	A description of the purely geometrical contribution to the uncertainly in a position fix, given by the expression DOP = SQRT TRACE (AA) where AA is the design matrix for the instantaneous position solution (dependent on satellite-receiver geometry). Standard terms for the GPS application are: GDOP: Geometric (three position coordinates plus clock offset in the solution) PDOP: Position (three coordinates) HDOP: Horizontal (two horizontal coordinates) VDOP: Vertical (height only) TDOP: Time (clock offset only)
Epoch	Measurement interval or data frequency, as in making observations every 15 seconds. Loading data using 30-second epochs means loading every other measurement
GDOP	Geometric Dilution of Precision. GDOP describes how much an uncertainly in pseudo-range and time affects the uncertainty in a position solution. GDOP depends on where the satellites are relative to the GPS receiver and on the GPS clock offsets.
Geoidal separation	Geoidal separation is the difference between the WGS-84 earth ellipsoid and mean-sea-level

GPD	GPS with differential corrections applied.
GPS	Global Positioning System. A constellation of 24 radio navigation satellites which transmit signals used (by GPS receivers) to determine precise location (position, velocity and time) solutions. GPS signals are available worldwide, 24 hours a day, in all weather conditions. This system also includes 5 monitor ground stations, 1 master control ground station and 3 upload ground stations. GPS provides 20 to 50 meter position accuracy without differential correction.
GPS Antenna	An antenna designed to receive GPS radio navigation signals.
GPS Receiver	The combination of a GPS antenna and a GPS processor.
GPS Time	The length of the second is fixed and is determined by primary atomic frequency standards. Leap seconds are not used, as they are in UTC. Therefore, GPS time and UTC differ by a variable whole number of seconds.
Maximum PDOP	A measure of the maximum Position Dilution of Precision that is acceptable in order for a GPS processor to determine a location solution.
NAVSTAR	The name given to the GPS satellites, built by Rockwell International, which is an acronym formed from NAVigation System with Time And Ranging.
NMEA	National Marine Electronics Association. An association that defines marine electronics interface standards for the purpose of serving the public interest.
NMEA 0183 message	The NMEA 0183 is a standard for interfacing marine electronics navigational devices. The standard specifies the message format used to communicate with marine devices/components.
PDOP	Position Dilution of Precision. PDOP is a unitless figure of merit that describes how an uncertainty in pseudo-range affects a position solution.
Relative Positioning	The process of determining the vector distance between two points and the coordinates of one spot relative to another. This technique yields a GPS position with greater precision than single point positioning mode can.
RS-232	A communication standard for digital data.
RxD	Received Data. RS-232 Signal Function Connector Pin Designation.
SA	Selective Availability

Satellite masks	As satellites approach the horizon, their signals can become weak and distorted, preventing the receiver from gathering accurate data. Satellite masks enable you to establish criteria for using satellite data in a position solution. There are three types of satellite masks: Elevation, SNR and PDOP.
SMS	Short Message Service
SMS-C	Short Message Service Centre
SPS	Standard positioning service. Refers to the GPS as available to the authorized user.
TAIP	Trimble ASCII Interface Protocol
TANS	Trimble Advanced Navigation Sensor
TSIP	Trimble Standard Interface Protocol
TxD	Transmitted Data. RS-232 Signal Function Connector Pin Designation.
UTC	Universal Time Coordinates. Uniform atomic time system/standard that is maintained by the US Naval Observatory. UTC defines the local solar mean time at the Greenwich Meridian
UTC offset	The difference between local time and UTC time (Example: UTC – EST = 5 hours)

2. APPLICATION

There are three main parts in the application:

- The serial port connection
- The User Interface
- The SMS sending support.

This application has been successfully used with a GPS receiver which has Trimble's ACE II 8-channel GPS receiver board and Aztec's OEM4000 RDS board. It uses Trimble's miniature OEM Antenna. However this application can also be used without the RDS board. This application supports the NMEA 0183 protocol and GGA and VTG frames.

2.1 The Serial Port Connection

The application receives defined location frames from a GPS device using serial cable. The frame structure is explained later on in this document (Section 3). There is no need to edit frames in the communicator. The line feed (\n) between the GGA frame and the VTG frame is erased by the application. Only Ground and RxD pins are needed on the communicator end. The GPS device uses only Ground and TxD pins to send the frames. The easiest way is to use the communicator's normal PC-cable (DLR-1 or DLR-2) and pin-converter, if needed.

One example of a pin-converter is shown in Figure 1.

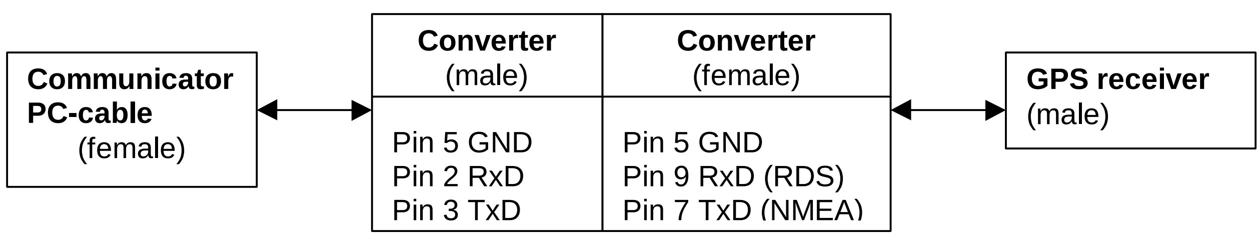

Figure 1. Example of a Pin-Converter.

2.2 The User Interface.

There are four selectable functions on the main UI (Figure 2):

1. The **Start** button starts sending position information according to the settings.
2. The **Reset** button clears the current position information.
3. The **Settings** button opens the settings screen.
4. The **Quit** button exits from the software.

More exact UI Figures are specified later on in this section.

Here are a few captures from the Nokia 9110 Communicator screens. The Nokia 9000/9000i Communicator screens are very similar. Only the grey status bar on the left side differs a bit from the Nokia 9110 Communicator status bar.

Figure 2 shows the main view of the application when it has been started from the Communicator's "Extras" menu.

Figure 2. The Application Main View.

The text “No link to the GPS device yet” means that the cable between the communicator and the GPS receiver is out of order or is not connected properly.

After the both connections from the satellite to the GPS and from the GPS to the communicator are OK, the next menu is shown to the user (Figure 3). First the only information given is the number of satellites that the GPS receiver has made contact with, the time and the GPS quality; later on other information (latitude, longitude, speed…) is displayed as shown in Figures 4 and 5.

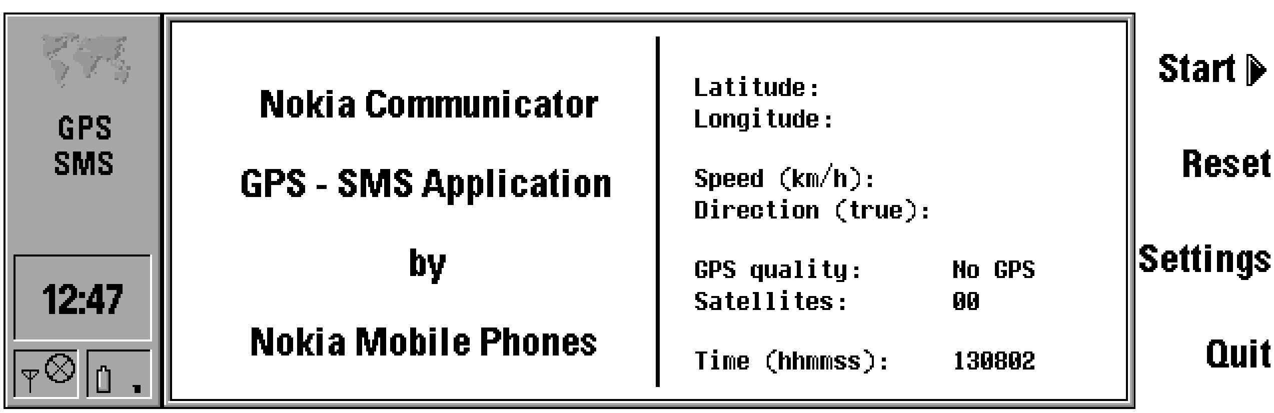

Figure 3. The Menu after a valid connection has been established.

In Figure 4 the DGPS is OFF (No FM antenna contacted). The coordinates are only given correct to 3 decimal places and the GPS quality is GPS. In this Figure the Speed is 0.0 km/h and the Direction is 0.0 because the GPS receiver with antenna is not moving.

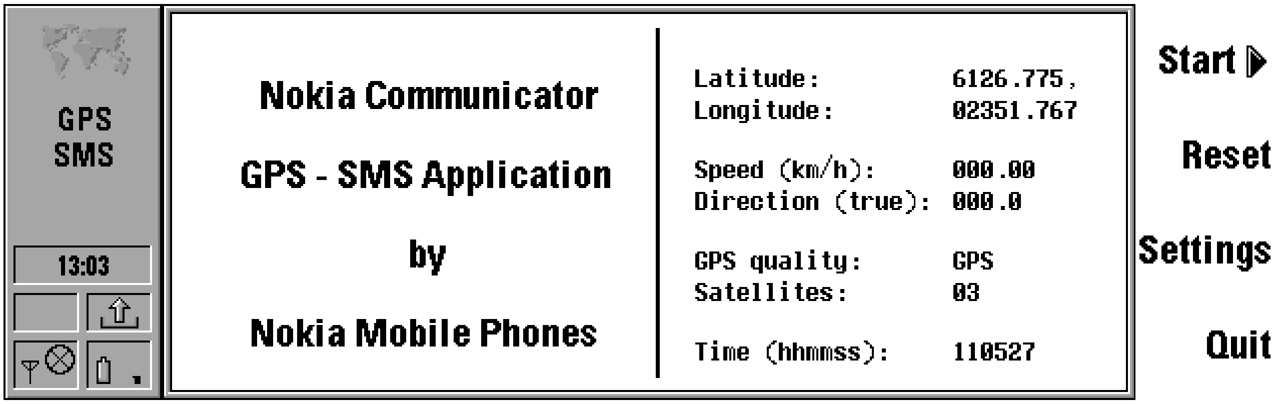

Figure 4. The Menu when the GPS quality is GPS.

In Figure 5 the DGPS in ON (FM antenna contacted). The coordinates are given correct to 4 decimal places and the GPS quality is DGPS. In this Figure the Speed is 0.0 km/h and the Direction is 0.0 because the GPS receiver with antenna is not moving.

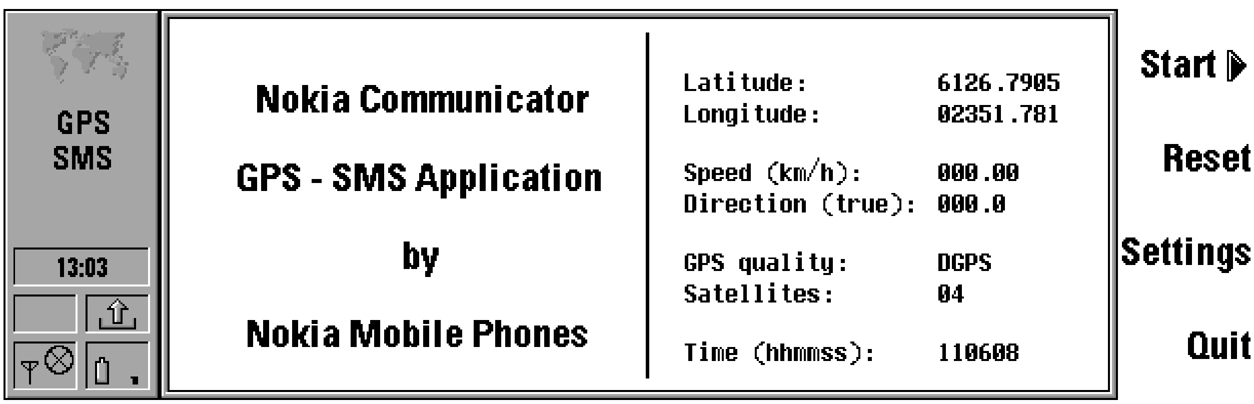

Figure 5. The Menu when the GPS quality is DGPS.

The **Settings** button opens the settings screen. There are three settings:

1. SMS centre number
2. Receiver's (Destination) number
3. Sending frequency in seconds.

The user can simply type the required "SMS-c number", "Destination number" and "Sending frequency in sec's" to the settings screen as shown in Figure 6. The sending frequency is limited to between 1 and 999 seconds. Settings can be saved by pressing the **Save** button. Pressing the **Cancel** button cancels the latest setting changes.

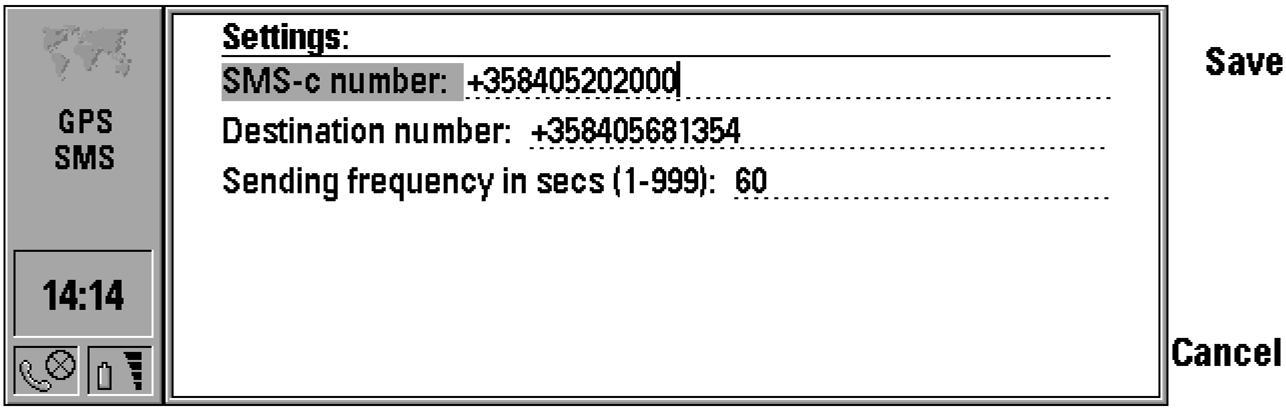

Figure 6. The Settings View.

After the settings are OK and saved/cancelled the application returns to the menu shown in Figures 4 or 5 depending on the GPS quality.

When the user presses the **Start** button (Figure 4 or Figure 5) the application starts to send SMS messages according to the Settings. The next menu (Figure 7) is shown to the user. In Figure 7 there is a GPS information screen. The information included in the last received frame is seen. As soon as new frames are again received from the GPS device to the communicator the information is rewritten on the screen.

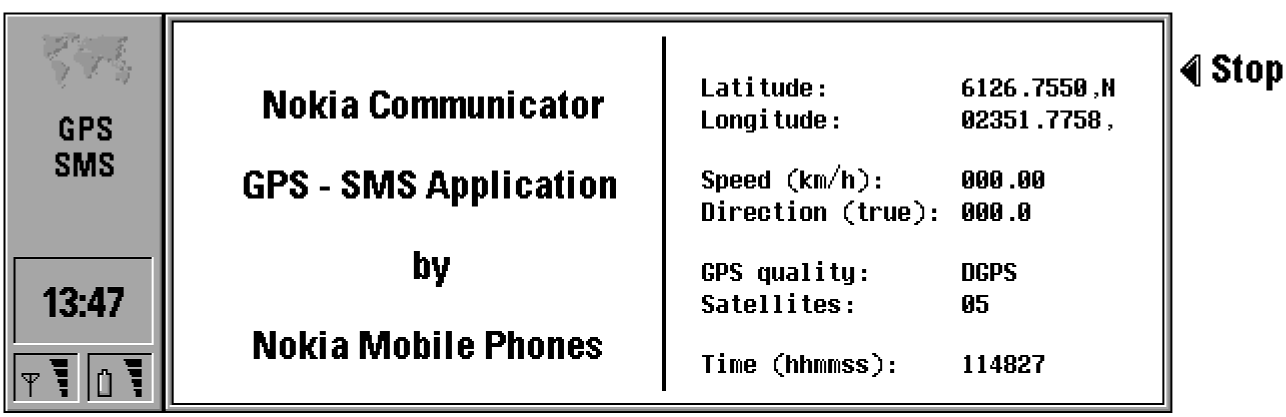

Figure 7. The GPS information view.

Please note that the Stop button is the only indication that the software is sending position information. Pressing the **Stop** button stops the SMS sending and the menu in Figure 4/5 is shown. Received information can be reset by pressing the **Reset** button (Figures 4 and 5).

2.3 The SMS Sending Support.

The unedited frames (edited line exchange) coming from the GPS device are forwarded to the receiving phone number via the selected SMS-C using SMS messages. The SMS messages are always shorter than 160 characters.

When the SMS is sent from the "Document outbox", the message “SMS sending” can be seen in the menu when the “clock” changes to the sending “logo”. The actual SMS sending from the SMS-C to the receiver can be checked from the “delivery report” (Figure 8) if it is set to ON. You can see the delivery report by pressing the **SMS** main menu button and by choosing **Delivery Reports** from the menu. This delivery report is service-provider dependent.

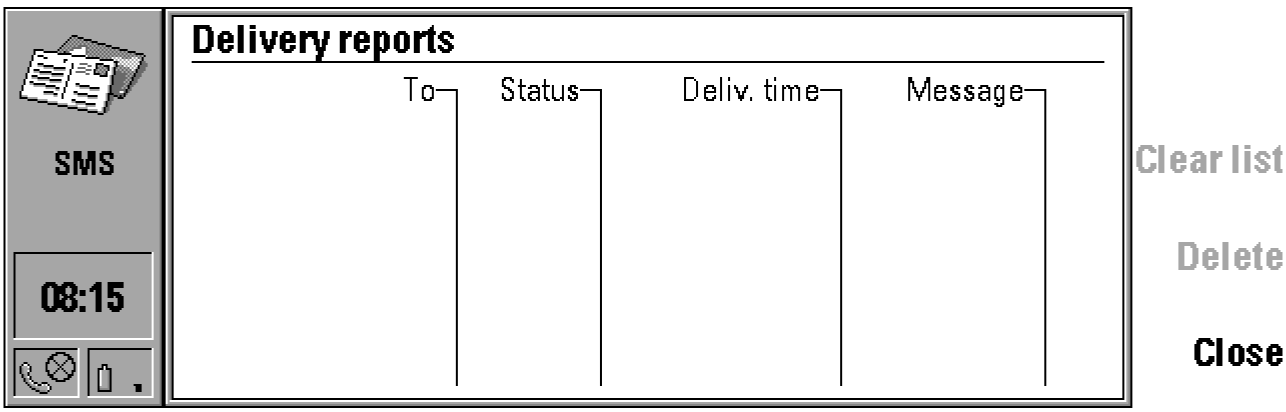

Figure 8. Delivery Reports.

3. GPS FRAME STRUCTURE

The "GPS information" is needed to check whether the frames from the GPS device are received by the communicator. From your GPS device manual you can see how the receiver indicates if there are connections to satellites. The two GPS frames have a different amount of characters depending on the GPS quality (see Section 3.1) and both are sent automatically from the GPS device once a second.

Please note that the application needs both NMEA 0183 protocol frames (GGA and VTG) to function. These frames are described in the next two sections.

3.1 GGA frame

The GGA message includes time, position and fix related data for the GPS receiver. The GGA message provides 3 decimal points of precision in non-differential (GPS) mode and 4 decimal points of accuracy differential (DGPS) mode.

The $GPGGA frame:

$GPGGA,085042.0,6126.7939,N,02351.7650,E,2,7,1.02,00174,M,020,M,01,0000*67

Description	The example frame
Time (hhmmss.0), UTC of Position	085042.0
Latitude (abcd.efgh), N (North) or S (South)	6126.7939,N
Longitude (abcde.fghi), E (East) or W (West)	02351.7650,E
GPS Quality: 0 = no GPS, 1 = GPS, 2 = DGPS	2
Number of satellites in use	7
Horizontal Dilution of Precision (HDOP) (a.bc)	1.02
Antenna altitude in meters, M = meters	00174,M
Geoidal separation in Meters, M=Meters	020,M
Age of Differential GPS Data. Time in seconds since the last Type 1 or 9 Update	01
Differential Reference Station ID (0000 to 1023)	0000
Checksum delimiter (asterisk)	*
The checksum field, two ASCII characters	67

3.2 VTG Frame

The VTG message conveys the actual track made good (COG) and the speed relative to the ground (SOG).

The $GPVTG frame:

$GPVTG,000.0,T,354.8,M,000.00,N,000.00,K*44

Description	The example frame
Track made good in degrees true, T = true	000.0,T
Track made good in degrees magnetic, M = magnetic	354.8,M
Speed over the ground (SOG) in knots	000.00,N
Speed over the ground (SOG) in km/h, K = km/h	000.00,K
Checksum delimiter (asterisk)	*
The checksum field, two ASCII characters	44

NOTE

GPS receiver related questions:

- See the GPS receiver manual or contact the device reseller or the manufacturer.

Map Server Software questions:

- See the Map Server Software manual or contact the software reseller or the manufacturer

4. SMS STRUCTURE

An SMS format is the same as the GPS frame structure. The only difference is that there is no line feed (\n) between GGA and VTG frames. The same bytes coming from the GPS device are forwarded to the selected destination GSM number via the selected SMS-C. The SIM card used specifies the user. No additional individual numbering is needed.

Below is one example of SMS frame structure. The content of this SMS message is described in Section 3.

$GPGGA,085042.0,6126.7939,N,02351.7650,E,2,7,1.02,00174,M,020,M,01,0000*67$GPVTG,000.
0,T,354.8,M,000.00,N,000.00,K*44

5. LEGAL NOTICE