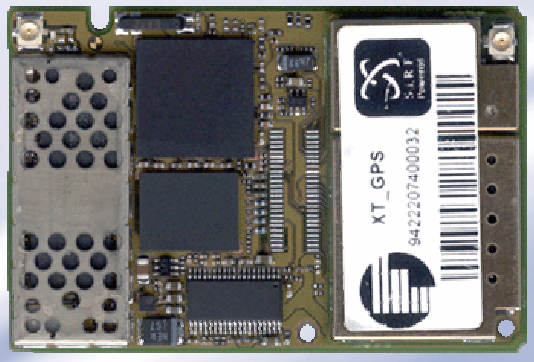
SIEMENS
mobile



XT55 AVL

Siemens Cellular Engine

Version: 03
DocID: XT55_avl_ug_V03

User's Guide

Document Name:	**XT55 AVL User's Guide**
Version:	**03**
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0 Version history

Preceding document: "XT55 AVL Software User's Guide" Version 02
New document: "XT55 AVL Software User's Guide " Version **03**

Chapter	What is new
2nd front page	Added trademark notice regarding SiRF software
5	Revised Figure 13, improved description of example application

Preceding document: "XT55 AVL Software User's Guide" Version 01
New document: "XT55 AVL Software User's Guide " Version 02

Chapter	What is new
2nd front page	New version of General Notes
3.1	Revised Figure 11: History filter
3.1.1	New chapter giving examples how to set filters for GPS history data
3.2.1.1	Added footnote 4 regarding the termination of messages and further information about carriage return and line feed
3.2	New chapter explaining the advantages of the implemented XT55 AVL software
3.2.1.2	Added new commands: • PARF112,1 • PARF112,2 • PARF112,4 • PARF112,5 • PSRF112,31 • PSRF112,32 • PSRF103 • PRSF109
5	Added new chapter: Example application

1 Overview of the document

The XT55 module, supporting GSM, GPRS and GPS features, contains the Automatic Vehicle Location software application (AVL) which can be configured.
The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit. GPS satellites receive data to determine the current position of the tracked vehicle.
The concept of the device is based on a simple implementation for a wide range of applications with low costs and high flexibility. In particular it offers a fast development of system solutions within the fields of:

- **Tracking**
  The vehicle to be tracked is fitted with the module XT55 including a GPS and a GSM antenna. GPS satellites are continuously transmitting a radio message containing information, including when the data was sent, which satellite sent it and the current reliability of the system. The XT55, containing the AVL software, fitted in a vehicle receives this information from at least 4 satellites and carries out the necessary calculations to determine its current position.

- **AVL**
  The GPS receiver embedded into the XT55 module determines its current location, speed and heading. These data can either be stored or directly transmitted to an operating center. The terminal reports its position to the call center over GSM communications network. The current position can be displayed on a PC/PDA in digital maps which must be obtained separately.

Depending on the configuration, the device exchanges data with a server application (e.g. mapping software, etc.). The module XT55 can be configured by the user via local RS-232 interface or via remote GSM (air link).

At the core of the system solutions mentioned above is a classical set-up with client-server architecture. In this scenario, the module XT55 represents the so called mobile client (see Figure 1).

The integration of the module XT55 requires a clear definition:

- The characteristics of the integrated AVL software solution of the module XT55 as a client of the user solution, and the possibilities for configuration.
- The instruction command for communicating with the client as the main part of the server application

This document intends to describe the module XT55 AVL firmware and how it can be configured, including the description, which is based on the Windows™ HyperTerminal configuration (terminal emulator program). For the flashing process of the AVL software into the module please contact Siemens AG for further information.

Furthermore, this document gives a detailed description of the instruction command, providing information for setting up customized server applications for communicating with the mobile client (XT55).

Application example:

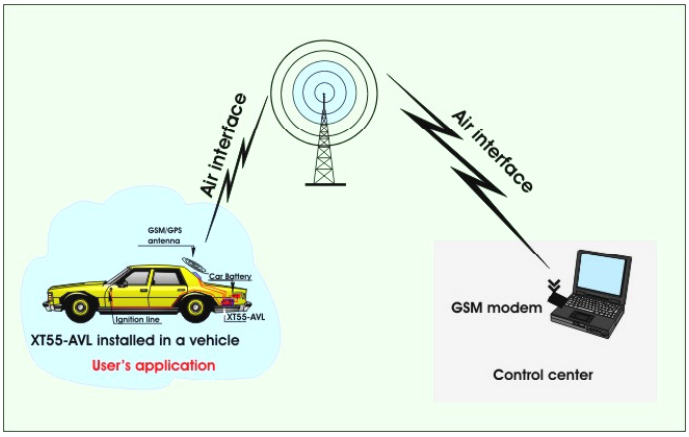

Figure 1: Simplified presentation of the AVL client-server architecture.

The connected GSM modem enables the communication to the XT55 (server side).

1.1 Hardware configuration

Please use the following hardware configuration to ensure the proper operation of the AVL application (see Figure 2).

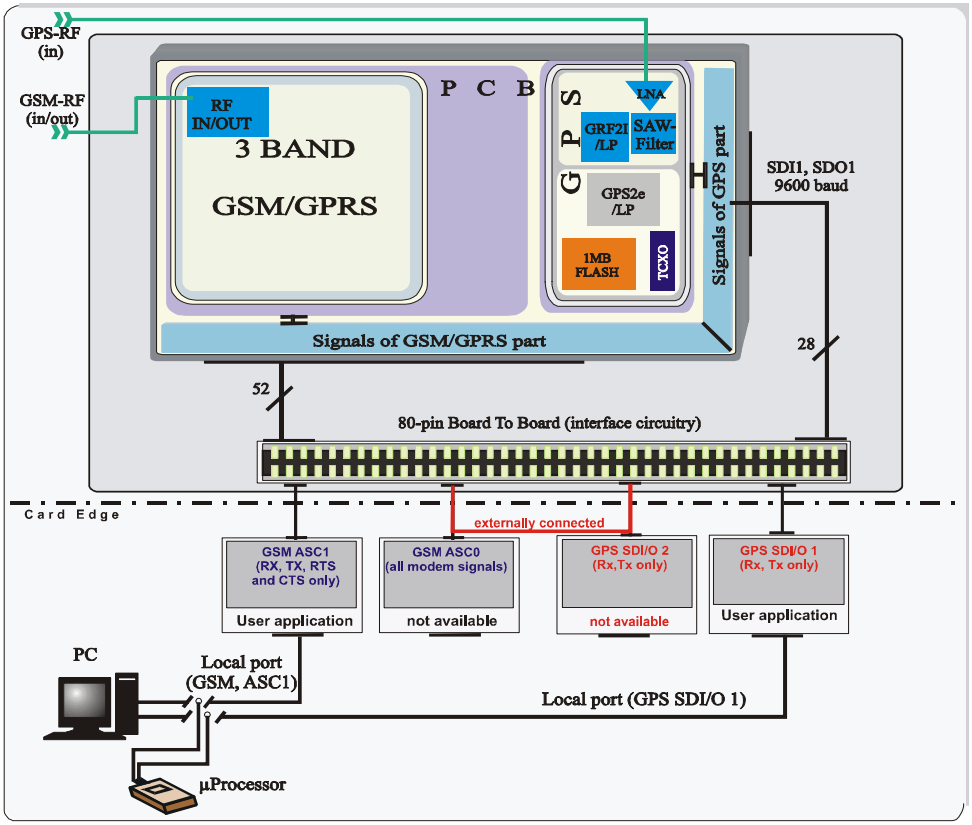

Figure 2: Block diagram of XT55 with AVL application

1.2 Related documents

[1] XT55 AT Command Set
[2] XT55 Hardware Interface Description
[3] XT55 GPS Startup Users Guide
[4] XT55 GPS Command Specification
[5] XT55 TCP/IP Software User's Guide
[6] GPRS Startup User's Guide
[7] Remote-SAT User's Guide
[8] GSM / GPS Evaluation Board Description
[9] Application Note 16: Upgrading XT55 Firmware
[10] Application Note 14: Audio and Battery Parameter Download
[11] Application Note 02: Audio Interface Design
[12] Application Note 24: Application Developer's Guide
[13] Multiplexer User's Guide
[14] Multiplex Driver Developer's Guide for Windows 2000 and Windows XP
[15] Multiplex Driver Installation Guide for Windows 2000 and Windows XP

Prior to using the XT55 engines or upgrading to a new firmware release, be sure to carefully read the latest product information.

To visit the Siemens Website you can use the following link:
http://www.siemens.com/wm

2 How to configure and evaluate the XT55 module

The XT55 device can be easily configured and evaluated by the customer using the local RS-232 interface (directly connected to the serial port) or via remote (e.g. installed in a vehicle) GSM (air link).

With the Windows™ HyperTerminal application (utility that is preinstalled on all versions of Windows 98, 98SE, Windows ME, Windows NT, Windows 2000 and Windows XP) it is possible to receive GPS position data and alarm status reports, as well as to execute a range of remote configurations.

In order to connect the XT55 remotely it is absolutely necessary to establish a connection to a suitable GSM modem.
If the module XT55 is configured remotely, prerequisite is the connection of a suitable GSM modem.

The configuration possibilities mainly cover the following areas:

1. **GPS**
   - History function
   - Activation of predefined time, distance and speed as a condition for storing position data in the internal history memory, as well as the option of remotely retrieving the history.

   - GPS polling (NMEA commands, data calls)
   - NMEA command remote request the current status of alarms, start position request.
   - Start data calls directly to the GPS position surveillance of a module XT55.

2.1 Terminal emulator setup

The example given below is based on the Windows™ HyperTerminal application (terminal emulator program). It describes how to use the module XT55 with a PC running Windows 2000.

On the first time power-up you can use terminal software, which makes the communication with modem through a RS-232 serial port possible. The following example is using the Hyper Terminal in Windows 2000.

On Windows 2000, start the Hyper Terminal program. Assign the name for a new session on the displayed window (e.g. XT55-AVL).

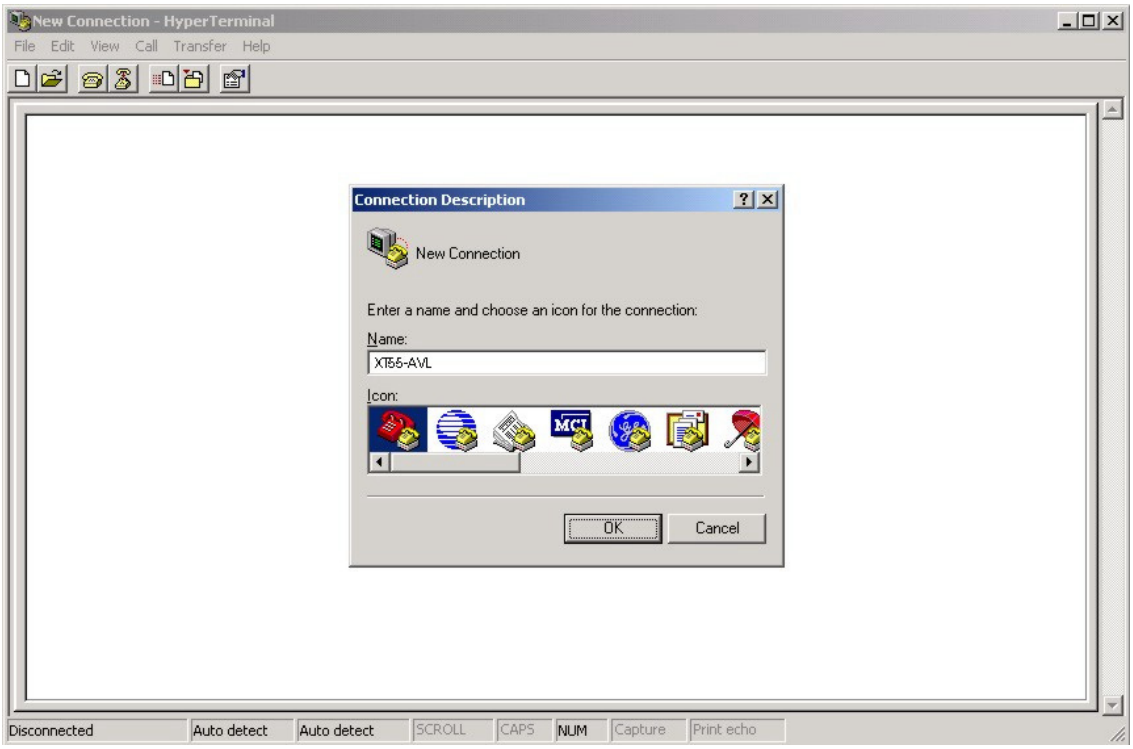

Figure 3: Assign the name for a new session

Choose the correct COM Port and baud rate settings (9600bps, 8 bit, no parity bit, 1 stop bit).

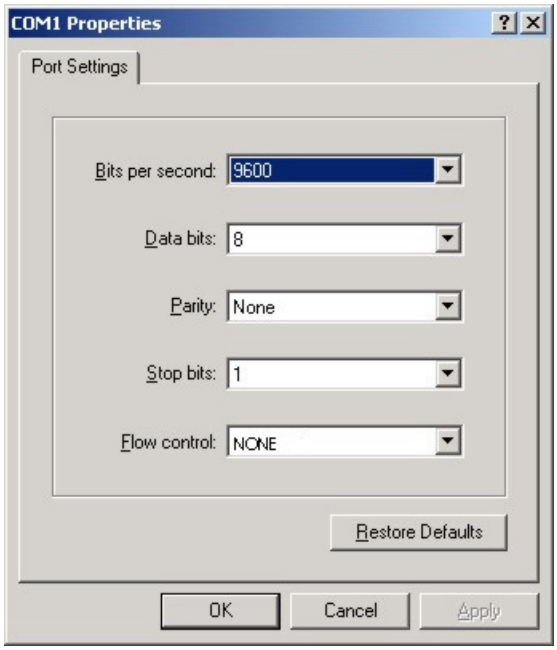

Figure 4: COM Port transmission settings

The connection to the module XT55 is established, the transmitted protocols are already displaying.

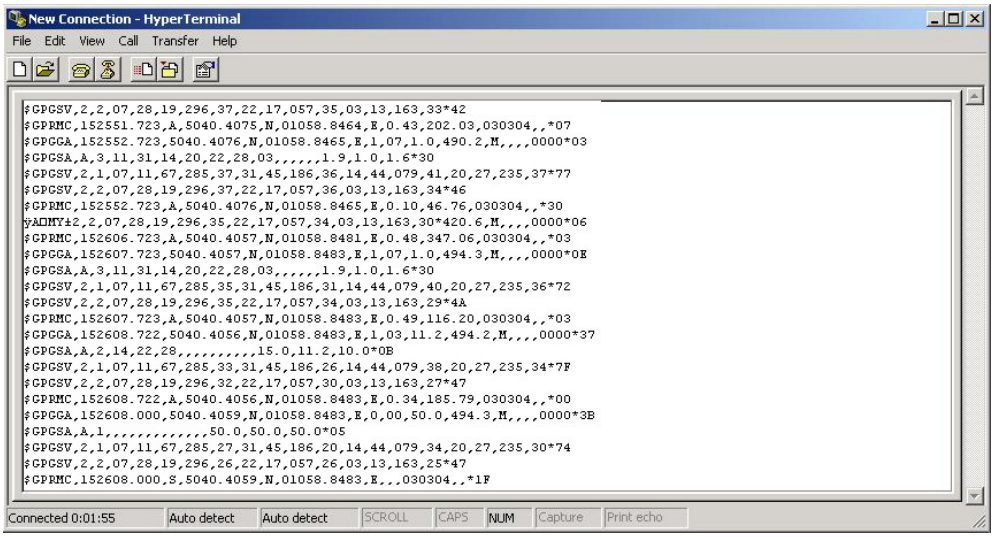

Figure 5: Displaying of the transmitted NMEA protocols

Next, click the **Property** button. Then select the **settings tab** sheet. Click the **ASCI setup...** button.

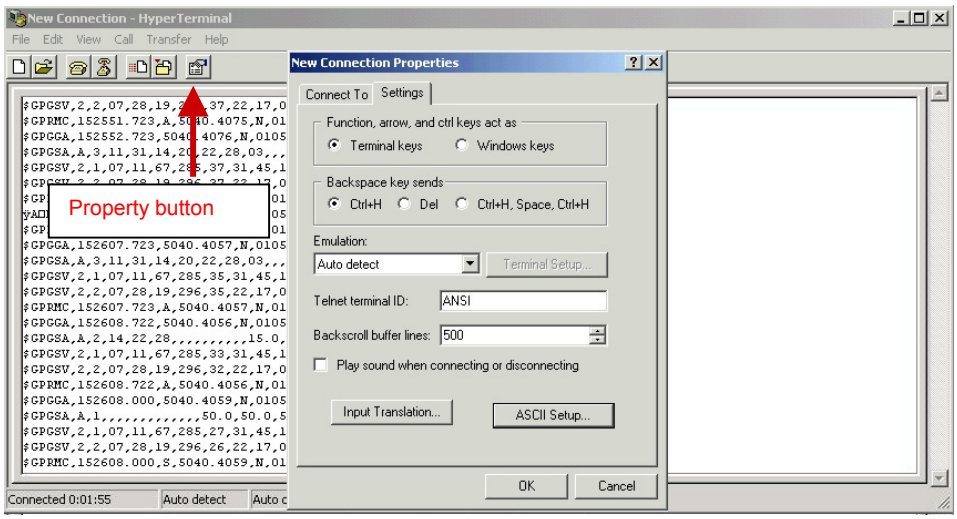

Figure 6: Settings of connection properties

On the appeared window thick the check box with caption **Send line ends with line feeds**.

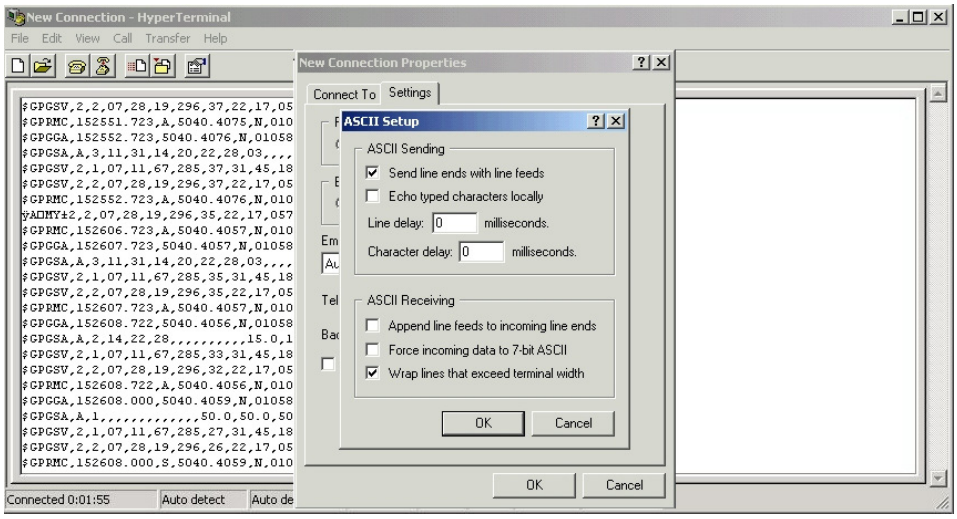

Figure 7: ASCII setup

Next, open a text file and write the desired command (see Figure 8). Please note that after the command is written, the **enter** key needs to be pressed in order to complete the NMEA command (<CR><LF>), else the command will be ignored from the XT55 module. To save the active document to its current name and directory just open **File** menu and click **Save** item. Then close the current file.

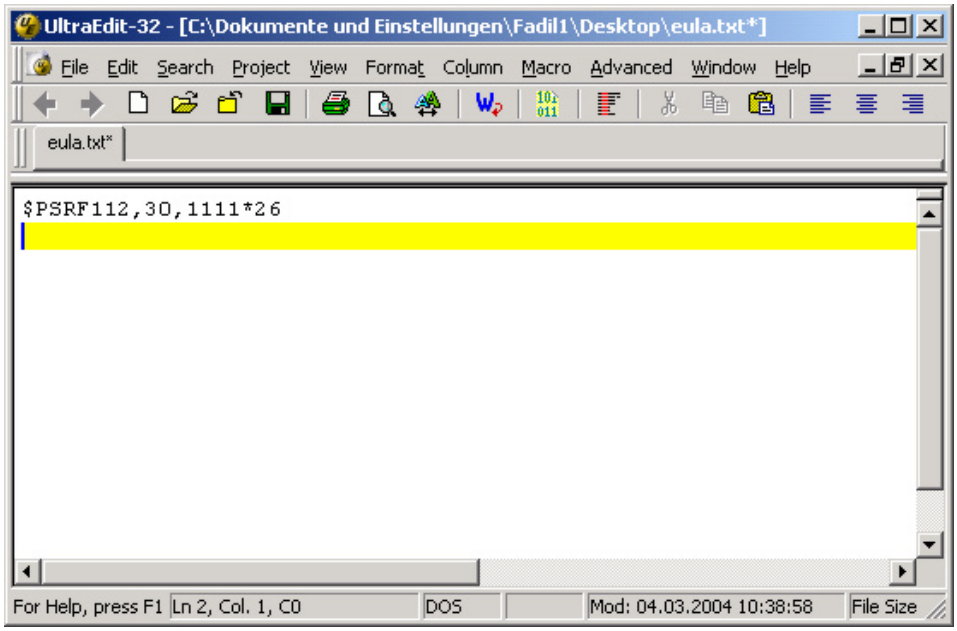

Figure 8: Example of an extended NMEA command

Next, click the **Transfer** on the HyperTerminal menu and select **Send text file...** .

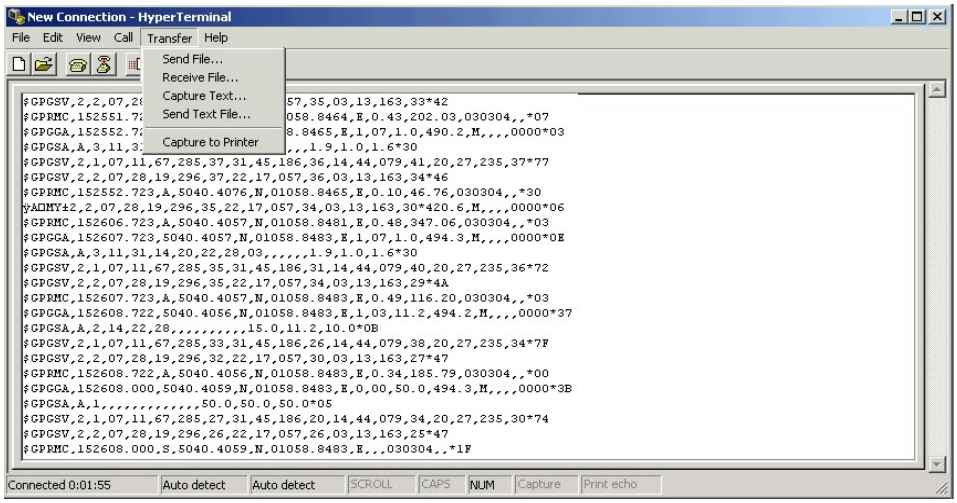

Figure 9: Import saved text file

Select the saved text file "eula.txt" and click the **open** button.
The text file including command(s) is sent directly to the connected module XT55.

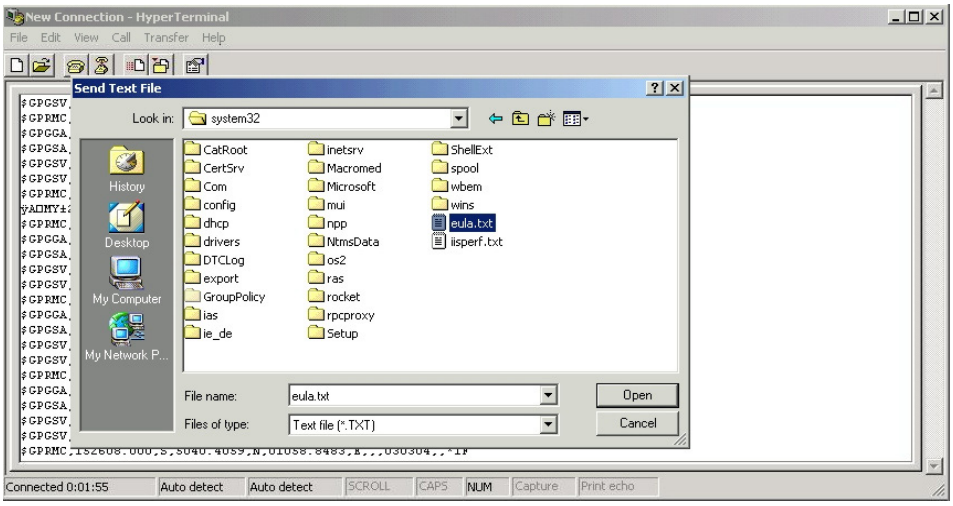

Figure 10: Select text file with included command(s)

In order to configure and evaluate, remote the XT55 unit, prerequisite is the connection of a suitable GSM modem, then establish a data connection to the XT55 module via AT commands (see below), then follow the steps described above.

How to establish a data connection to the XT55 AVL:

AT	*//send command*
OK	*//respond*
AT+CPIN=<pin>	*//enter the pin number and send command*
OK	*//respond*
ATD0123213346	*//enter the XT55 AVL phone number and send command*
+CRING: ASYNC	*//respond*
Connect 9600	*//respond*
.....	*//receiving protocols*

3 Tracking

The GPS satellites in orbit are continuously transmitting radio signals. Each satellite transmits a unique code, allowing the GPS receiver to identify its position, time and speed. The main purpose of these received signals is to carry out the necessary calculation to determine the current position of the vehicle.

3.1 History function

The embedded GPS receiver continuously calculates the current position data. In order to save these data to the XT55 Flash memory the required NMEA command has to be sent, see [4] for details.
When receiving valid GPS messages, the module XT55 is capable of saving up to 100000 GPS protocols in its history memory.
The XT55 is capable of saving up to 100.000 GPS messages (GGA, GSV, VTG, GLL, RMC, depend on the user configuration) in its history memory.
When the memory space has been used up, the oldest message will be overwritten automatically.
Figure 11 shows a logical flow chart, for a better understanding how the module XT55 saves history data.

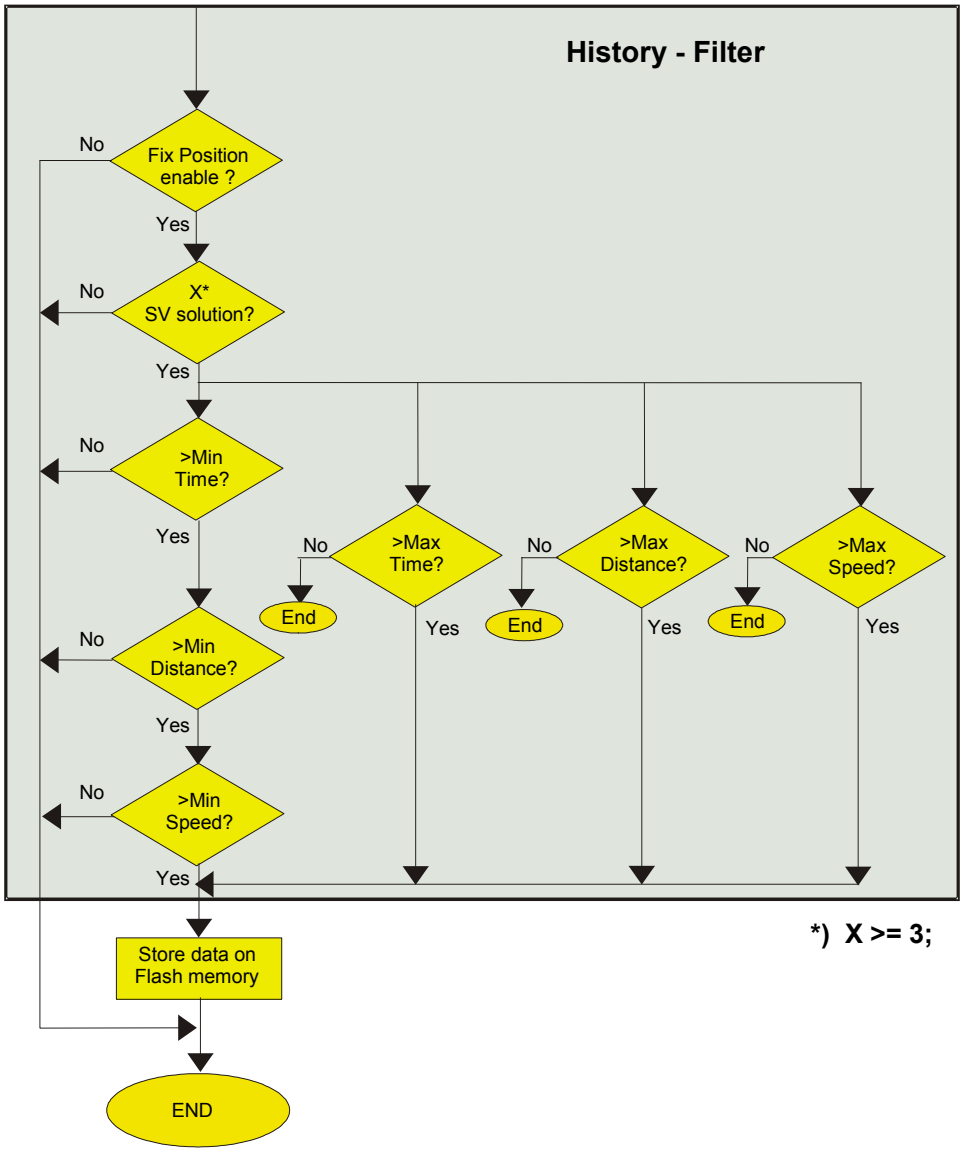

Figure 11: History filter

3.1.1 Configuration examples

The following example explains how to use filters for time, distance and speed. The respective minimum values for time, speed and distance have an AND-operation. This means that if only one value does not apply, all three values are ignored and not saved in the history.
The maximum values have an OR-operation. If one of the maximum parameters has been met, the GPS protocols will be saved in the GPS history.
According to the flow chart given in Figure 11 either all minimum parameter or at least one maximum parameter must be exceeded in order to store the NMEA messages in the GPS history.
If all values are set to 0, no data will be saved in the history.

Table 1: Conditions for saving data in the GPS history

	Minimum (lowest value)	**Maximum (highest value)**
Time filter	FixMinTime (sec)	FixMaxTime (sec)
Distance filter	AND	OR
	Dist.Min(m)	Dist.Max(m)
Speed filter	AND	OR
	SpeedMin(km/h)	SpeedMax(km/h)
Combination of both	OR	
	Storing of protocol	

Table 2: Programming example

	minTime [s]	**maxTime [s]**	**minDist [m]**	**maxDist [m]**	**minSpeed [km/h]**	**maxSpeed [km/h]**
Logs every 10 sec.	0	10	0	0	0	0
Logs every 100 m	0	0	0	100	0	0
Logs at speed ≥ 40 km/h	0	0	0	0	0	40

3.2 XT55 AVL software main features at a glance

This chapter provides a short summary of the XT55 AVL software:

- Enters/deletes phone numbers authorized for remote access of the XT55 module
- Enables/disables the remote tracking of pre-defined phone numbers
- Enters the PIN number of SIM card to deactivate the PIN request of SIM card
- Updates the SMSC address, through which mobile originated SMS are transmitted
- Downloads the stored GPS history to a connected PC or to a remotely connected GSM module in either NMEA or SiRF binary format
- Enables/disable the history function
- Deletes the stored history data
- Controls the output of the standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG
- Enables the key configuration with pre-defined RMC messages
- Enables the device to send a SMS periodically to the authorized number in the case of an alarm on the configured keys
- Disables the periodically sending of SMS

Furthermore the current status of the device can be requested using the XT55 AVL software. The displayed settings are:

- Overview of all implemented history, alarm and remote tracking commands
- Displaying all authorized phone numbers
- Show the current address of service center
- Read current history settings
- Disable the key configuration
- Display the settings of defined key

3.2.1 Extended NMEA commands

3.2.1.1 Command Syntax

The XT55 module accepts NMEA commands in the following formats:

$PSRF<command>,<parameter>, .. ,<parameter><* Checksum><CR> <LF>.

Command[1]	Parameter[2]	Checksum[3]	End Sequence[4]
$PSRF11	Data	*CKSUM	<CR> <LF>

[1] NMEA command
[2] Valid parameters
[3] The checksum consists of a "*" followed by 2-digit hex value of checksum. In order to calculate the Checksum, use your own application, which calculates the Checksum. Below a small source code is written in Java:

```
private static void calcCS(String strCommand) {
     int iCS = 0;
     int iTemp = 0;
     String strCS = "0";
     for(int i=0; i<strCommand.length(); i++) {
      iTemp = (int)strCommand.charAt(i);
      iCS= iCS^iTemp;
     }
     if(Integer.toHexString(iCS).length()==1) {
      strCS+=Integer.toHexString(iCS);
     }
     else {
      strCS = Integer.toHexString(iCS);
     }
     System.out.println("CheckSum: "+strCS);
}
```

Therefore, the string over which the checksum has to be calculated is (see example below):
field = PSRF112,21 *//without the character "$"*

[4] <CR> <LF>Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Example:
$PSRF112,21*0A

Command	Parameter	Checksum	End Sequence
$PSRF112,	21	*0A	<CR> <LF>

3.2.1.2 Extended NMEA command description

Please note that all extended NMEA commands beginning with **$PSRF111** are for internal test purposes only. Whereas all extended NMEA commands beginning with **$PSRF112** and **$PSRF109** are implemented for configuration of history, alarm and remote tracking function. Please note that all NMEA commands, which have to be sent to the XT55 module, are accepted when the **End Sequence** <CR><LF> is also included. The **End Sequence** <CR><LF> tells the GPS receiver that the received command is terminated and incoming next string is new command.

- The CR – Carriage Return (ASCII code 13), which positions the cursor to the left side of the current line of characters
- The LF - Line Feed (ASCII code 10), which moves the cursor down one line on the input commands.

All commands listed below are available for direct connected XT55 as well as for remote configuration (except the **$PSRF111** command**)**.

Commands	Description
$PSRF112, value, *XX	Parameter description: value: *//commands overview* **Defined value** 0 *//overview of all implemented history, alarm and remote tracking commands* *XX *//CheckSum has to be calculated.* **Example 1** $PSRF112,0*01

Commands build in remote tracking function	
$PSRF112, value, position, phone_number *XX	Parameter description: value: *// configure the remote tracking* **Defined values** 20 *//enables remote tracking for authorized phone number* position: *// enter the position of authorized telephone number into the list (0..9 available). Overwrites the phone number at the selected position* phone_number: *// enter the authorized phone number for remote access* *Note: At least one phone number has to be entered to the list. Only numbers included in the list are authorized to interact with the XT55. All other accesses will be ignored.* *XX *// CheckSum has to be calculated.* **Example 1:** $PSRF112,20,2,012345678*01 This command writes a phone number in the list which is authorized to access the XT55 remotely. It overwrites the previously entered phone number at the selected position.
$PSRF112, value, *XX	Parameter description: value: *// configure the remote tracking* **Defined values** 21 *// enables remote tracking for any mobile phone* *XX *// CheckSum has to be calculated.* **Example 1:** $PSRF112,21*0A This command deletes all existing entries (phone numbers) in the list. In this case it is possible to have remote access from any GSM modem or mobile phone to the XT55 module.

$PSRF112, value, position, *XX	Parameter description: value: *// configure the remote tracking* **Defined values** *22 // deletes and disables remote tracking for specified phone number(s) in the list* position: *// enter the position of authorized telephone numbers into the list (0..9 available).* *XX *// CheckSum has to be calculated.* **Example 1**: $PSRF112,22,2*17 This command deletes the existing phone number listed in the given position (in our example position 2) and disables the remote tracking for this number.
$PSRF112, value, *XX	Parameter description: value: *// configure the remote tracking* **Defined values** *23 // disable remote tracking and delete all phone numbers in the list* *XX *// CheckSum has to be calculated.* **Example 2**: $PSRF112,23*08 This command deletes all existing entries (phone numbers) in the list and disables the remote tracking function.
$PSRF112, value, *XX	Parameter description: value: *// configure the remote tracking* **Defined values** *24 //displays the authorized phone numbers for remote access.* *XX *// CheckSum has to be calculated.* **Example 3:** $PSRF112,24*0F This command displays all telephone numbers entered in the list. Response: phone number 1: 012345678 phone number 2: 012355689 …… phone number 9: 012449677

Enable the GSM functionality	
$PSRF112, 30, PIN *XX	Parameter description: 30: *//enable the GSM functionality (i.e. deactivate PIN request)* PIN: *//enter the PIN number of SIM card* *XX *//CheckSum has to be calculated.* **Example 1:** $PSRF112,30,1111*26 This command enters the PIN number of SIM card also deactivates the PIN request of SIM card.
$PSRF112, 31, ServiceCentre, Format, *XX	The write command updates the SMSC address, through which mobile originated SMs are transmitted. In text mode, the setting is used by send and write commands. In PDU mode, the setting is used by the same commands, but only when the length of the SMSC address coded into <pdu> parameter equals zero. Note: This command writes the service centre address to non-volatile memory For further information refer to [1] 31: *// Configure the SMSC address.* ServiceCentre: *//GSM 04.11 RP SC address (address value field in string format); BCD numbers (or GSM default alphabet characters) are converted into characters; type of address given by <format>. Maximum length of address: 20 characters* Format: *//Service centre address format GSM 04.11 RP SC address Type-of- Address octet in integer format* *XX *// CheckSum has to be calculated.* **Example 1:** Enter: $PSRF112,31,+492710760000,145*18 Responds: OK +CSCA: "[ServiceCenter]",[Format] (error) +CME ERROR: [CME_error] (error) communication failure Note: - See [1] for further explanation of the displayed Address Format or CME error code. - If the modem returns "communication failure", it did not respond to the entered command and ended in timeout (which is currently set to 5 seconds). - The SMS service center address should be entered as specified by the service provider

$PSRF112, 32 *XX	This read command returns the current address of service centre. Parameter description: 32: *// read command* *XX *// CheckSum has to be calculated.* Enter: $PSRF112,32*08 Response: OK +CSCA: "[ServiceCenter]",[Format] (error) +CME ERROR: [CME_error] (error) communication failure Note: - See [1] for further explanation of the displayed Address Format or CME error code. - If the modem responds "communication failure", it did not respond to the entered command and ended in timeout (which is currently set to 5 seconds).

Commands build in the history function	
$PSRF112, 1, LOG=[parameters], *XX	Parameter description: 1: *// enable history function* Parameters: *// configure history function* **Defined values** numSat *// Minimum number of satellites required for storage in the GPS history.* MinTime *// Minimum time interval for saving GPS protocols in the GPS history* MaxTime*// Maximum time interval for saving GPS protocols in the GPS history* MinDist*// Minimum covered distance for saving GPS protocols in the GPS history* MaxDist*// Maximum covered distance for saving GPS protocols in the GPS history* MinSpeed*// Minimum driving speed for saving GPS protocols in the GPS history* MaxSpeed*// Maximum driving speed for saving GPS protocols in the GPS history* *XX *// CheckSum has to be calculated.* **Example 1:** $PSRF112,1,LOG=3,5,0,0,40,20,50*68 This command enables the GPS history function with entered values. Please refer to the Chapter 3.1.1for detailed examples. The XT55 AVL stores location data in the history memory as follows: • every 40 m if the vehicle has a speed less then 20km/h • every 5 seconds if the vehicle is driving at a speed of between 20 and 50 km/h • every second if the vehicle is driving faster than 50 km/h All included settings are user-configurable parameters.
$PSRF112, 2, *XX	Parameter description: 2: *//disables history* *XX *// CheckSum has to be calculated.* **Example 1:** $PSRF112,2*3B This command disables the history function. No data will be saved in the GPS history.

$PSRF112, 3, rawData, *XX	Parameter description: 3: *// pre-defined value which performs the history download procedure* rawData: *// configure the data format* **Defined values** 0 *// request history in the SiRF binary format* *XX *// CheckSum has to be calculated.* **Example**: $PSRF112,3,0*26 This command configures the XT55 to send (upload) stored GPS history either from a directly connected PC or from communicating via a remote connection in the binary format.
$PSRF112, 3, rawData, *XX	Parameter description: 3: *// pre-defined value which performs the history download procedure* rawData: *// configure the data format* **Defined values** 1 *// request history in the NMEA format* *XX *// CheckSum has to be calculated.* **Example:** $PSRF112,3,1*27 This command configures the XT55 to send (upload) stored GPS history either from a directly connected PC or from communicating via a remote connection in the NMEA format.

$PSRF109, rawData, startdate, startTime, stopDate, stopTime *XX	Download history from XT55 AVL using specified parameters Parameter description: rawData: *// configure the data format* **Defined value** 0 *// request history in the NMEA format* startdate *// start date in DDMMYY format* startTime *// the start time in HHMMSS format* stopDate *// the stop date in DDMMYY format* stopTime *// the stop time in HHMMSS format* *XX *// CheckSum has to be calculated.* **Example:** $PSRF109,0,280104,155811,300104,150000*37 This command enables you to retrieve stored GPS history data either from a directly connected XT55 AVL or via remote connection. In this example the GPS history is requested for the period starting on 28th January 2004 at 15:58:11 and ends on 30th January 2004 at 15:00:00. Please note that all data in the on board memory are stored according to the UTC time (Universal Time Coordinated). The parameters of this command are also based on the UTC time. Note: To download the GPS history data, please consider the UTC Time, otherwise you will download the stored data in the incorrect time.
$PSRF109, rawData, startdate, startTime, stopDate, stopTime *XX	Download history from XT55 AVL using specified parameters Parameter description: rawData: *// configure the data format* **Defined value** 1 *// request history in the SiRF binary format*
$PSRF112, 4 *XX	Clear history data **Example:** $PSRF112,4*3D This command deletes all previously stored history data
$PSRF112, 5 *XX	Display history settings. **Example:** $PSRF112,5*3D *This command reads the current history settings. (See also write command $PSRF112,1,LOG=[parameters]).* *The XT55 AVL returns the following string:* $current history settings: 3 sat, min 5 s, max 0 s, min 0 m, max 40 m, min 20 kmh, max 50 kmh

$PSRF103, Msg,Mode,Rate, CecksumEnable, *XX	This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC and VTG. Using this command message, the standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. The NMEA message settings are saved in backup memory (as long as the module is supplied with power) each entry when the message is accepted. (Detailed information are available in [3]) Parameters description: Msg: *// Configure the required message.* Defined values 00 *// GGS message* 01 *// GLL message* 02 *// GSA message* 03 *// GSV message* 04 *// RMC message* 05 *// VTG message* Mode *// input values for required configuration* Defined values 00 *// enables the rate parameter settings* 01 *// query the given message* Rate *// Setup the required update rate (unit is second)* Defined values 00…255 *// Set the periodic rate in second on which a given message has to be output* CecksumEnable *// Enable/disable the checksum* Defined values 00 *// Disable Checksum* 01 *// Enable checksum* *XX *// CheckSum has to be calculated.* *This command can be sent either from a directly connected XT55 or from one communicating via a data line.* **Example 1:** $PSRF103,00,01,00,01*25 *Query the GGA message with checksum enabled* **Example 2:** $PSRF103,05,00,01,01*20 *Enable VTG message for a 1 Hz constant output with checksum enabled* **Example 3:** $PSRF103,05,00,00,01*21 *Disable VTG message*

Commands build in the alarm function	
$PSRF112, Value, key_number, msg_mode, phone_number *XX	Parameter description: value: *// configure the alarm keys* **Defined value** 10 *// enables key configuration* key_number *// determine the alarm key (1,2 possible)* **Defined values** 1 *//General propose input (Pin 20)* 2 *//General propose input (Pin 30)* msg_mode *// Defines the call type for each respective telephone number.* **Defined values** D *// A data call is established to the target telephone number in case of alarm the pre-defined RMC message is transmitted.* *alarm* S *// An SMS is sent to the target telephone number in case of containing the alarm text with attached $GPRMC protocol* V *// A voice call is created for the target telephone number in case of alarm* phone_number *//set the authorized telephone number* *XX *// CheckSum has to be calculated.* **Example:** $PSRF112,10,2,S,012345678*7D This command enables the key configuration. The pre-defined RMC protocol is send to the authorized telephone number (012345678) in case of an alarm on the key 2. An alarm is triggered by falling edge on the configured input. Please refer also to Chapter 4.3 for a connection example.
$PSRF112, Value, key_number, *XX	Parameter description: value: *// configure the alarm keys* **Defined value** 11 *// disables key configuration* key_number *// determine the alarm key (1,2 possible)* **Defined values** 1 *//General propose input (Pin 20)* 2 *//General propose input (Pin 30)* *XX *// CheckSum has to be calculated.* **Example:** : $PSRF112,11,2*17 This command disables the key (2) configuration.

$PSRF112, Value, key_number, *XX	Parameter description: value: *// configure the alarm keys* **Defined value** 12 *// displays key number* **Example** : $PSRF112,12,2*14 This command displays the settings of given key number (2). The received format is: $alarm key (2): phone: 012345678, protocol: RMC
$PSRF112, value, interval, phone_number *XX	Parameter description: value: *// configure the sending of SMS* **Defined value** 40 // *enable sending of SMS on interval of time (periodically)* interval *// determine the interval of time on which an SMS has to be delivered (unit is minute)* phone_number *//set the authorized telephone number* *XX *// CheckSum has to be calculated.* **Example:** $PSRF112,40,2,012345678*07 This command enables the device to periodically send an SMS to the target number in the case of an alarm. In the given example the SMS will be send every 2 minutes to the example target number (012345678).
$PSRF112, value, *XX	Parameter description: value: *// configure the sending of SMS* **Defined value** 41 // *disable periodically sending of SMS* *XX *// CheckSum has to be calculated.* **Example 2:** $PSRF112,41*0C This command disables the periodical sending of SMS

Command for internal test purposes	
$PSRF111, value, *XX	Parameter description: value: *//commands overview* **Defined value** 0 *//overview of all implemented test commands* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,0*3A
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined values** 1 *//returns the current version number of software and hardware* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,1*3B Response: current version: SW:XT_GPS_xx HW:XT_GPS_yy (xx refers to the XT55 software version while yy refers to the hardware version of the module)
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 3 *//performs the test of Flash* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,3*39 Response: ERROR or SUCCESS
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 30 *//performs the test of debugging* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,30*09 Response: Information about the performed flash test

$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 4 *//performs the test of serial port* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,4*3E Response: ERR: malfunction detected OK: serial port 2 successfully tested
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 5 *//performs automatic test* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,5*3F Response: ERROR GPIO or SUCCESS ERROR COM2 ERROR GPIO COM2
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 50 *//performs automatic test* *XX *//CheckSum has to be calculated.* **Example:** $PSRF111,50*0F Response: ERROR GPIO or SUCCESS ERROR COM2 ERROR GPIO COM2
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** *7//performs the test of GSM board continuity* XX *//CheckSum has to be calculated.* **Example:** $PSRF111,7*3D Response: ERROR or SUCCESS

$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 70 *//information about the malfunctional tracks* XX *//CheckSum has to be calculated.* **Example:** $PSRF111,7*3D Response: ERROR or SUCCESS
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 8 // performs the test of all GPIO's *XX // CheckSum has to be calculated. **Example:** $PSRF111,8*32 Response: ERR: malfunction detected or OK: all GPIOs successfully tested
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 80 // information about the malfunction of GPIO's *XX // CheckSum has to be calculated. **Example:** $PSRF111,80*02 Response: Verbose information about malfunctional GPIOs
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 81 // reports the current state of each read GPIO's (endless loop) *XX // CheckSum has to be calculated **Example:** $PSRF111,81*03 Response: Current state of each read GPIO (endless loop)
$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 9 // information about the current and voltage of antenna. *XX // CheckSum has to be calculated **Example:** $PSRF111,9*33 Response: Vrf:0x85A Is:0x86C //Hex value of antenna voltage and current of the XT55 GPS part

$PSRF111, value, *XX	Parameter description: value: *//configure the download procedure* **Defined value** 90 // calibration points, calculated voltage and current. *XX // CheckSum has to be calculated. **Example:** $PSRF111,90*03 Response: Calibration points, calculated voltage and current

Received alarm SMS from XT55	
Protocol<CRLF>	
Protocol	The following protocol type can be received: RMC
Example: $GPRMC,103530.000,A,5040.3986,N,01058.8636,E,0.06,171.45,290903,,*04<CRLF>	

4 Software interface

The module XT55 is capable of outputting data in the NMEA-0183 format as defined by the National Marine Electronics Association (NMEA), Standard for Interfacing Marine Electronic Devices, Version 2.20, January 1st, 1997.

4.1 NMEA output messages

The table below shows all NMEA output messages supported by the module XT55 as well as a brief description of each output message.

Option	Description
GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.
RMC	Time, date, position, course and speed data.
VTG	Course and speed information relative to the ground.

4.2 How to switch the XT55 AVL in the command mode and vice versa

While running XT55 AVL software the module can be easily switched back and forth from GPS mode to command mode.
To set the XT55 module to command mode enter the AT#1<enter> command. It should be mentioned that while entering the AT command the module still receives GPS data and the typed characters will not de displayed on the screen.
In order to switch the echo mode on the command ATE1<enter> has to be sent.
The XT55 module can be switched back to GPS mode by issuing the AT#0<enter> command.

NOTE: Hardware handshake on the terminal software should be deactivated, otherwise the commands are ignored from the terminal software.

4.3 Digital Inputs

The input pins (pin 20 – GPIO 15, pin 30 – GPIO 3) of the 80-pin board-to-board connector are pre-defined as digital inputs.
These input pins can be connected to the CMOS +3.3V DC. The figure below illustrates how to connect these inputs.

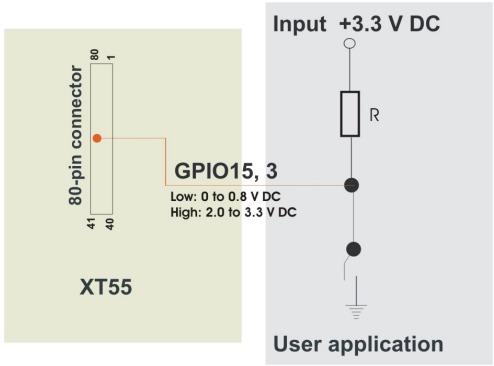

Figure 12: Connection example for GPIO 15 and GPIO 3

5 Example application

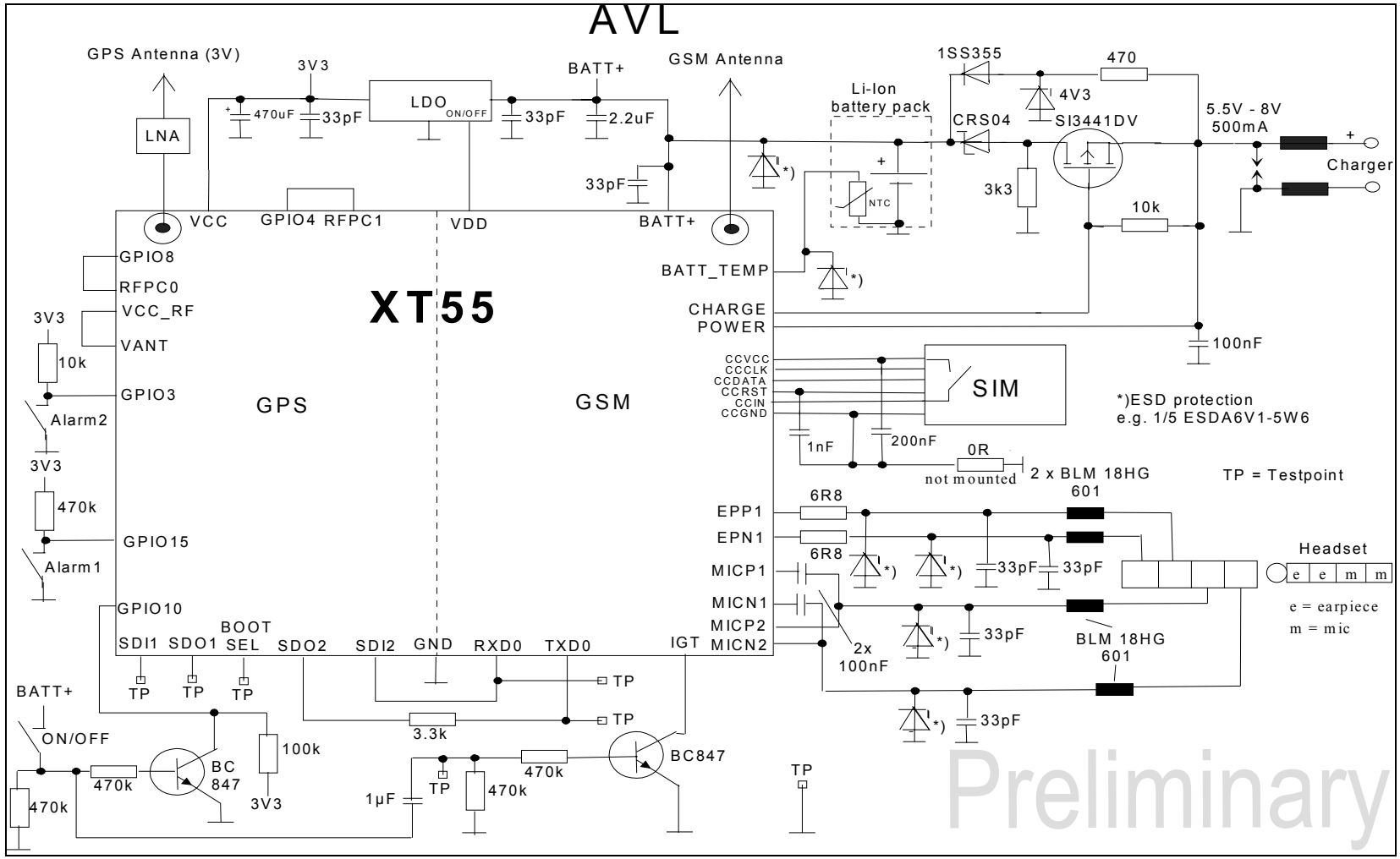

Figure 13: Example application of XT55 module with integrated AVL software

Figure 13 shows a typical example of a portable AVL application set.
Power will be supplied from an integrated Li-Ion battery pack. The charging control is integrated in the GSM part of the XT55 module and can be used for the entire module, see [2] for details. The headset jack is assigned to audio interface 1 of the XT55 module. The MICP2 and MICN2 lines are intended for feeding a microphone.

Switch on /off procedure
The GSM part of the XT55 module can be powered on by pressing the ON/OFF key. The ignition line (IGT) goes low level via the pnp transistor. During the start-up procedure the VDD line output goes active high and the low drop regulator will be switched on. This causes the GPS part of the XT55 module to start-up.
When pressing the ON/OFF key during operation the XT55 module will be switched off safely using the internally activated AT^SMSO command.

NOTE: No warranty can be given for the example above because the functionality and the compliance with regional regulations are depending in a great amount on the used electronic components and the application layout.

Power supply ratings can be found in Table 3. For further details refer to [2]

Table 3: Average supply current without antenna

Parameter	Description	Conditions	Typ	Unit
I_{GPS_VCC}	Average supply current	Continuous mode (without antenna feeding on GPS_VCC_RF)	80	mA

Please note that the stated current values are depending on the used mode of the module