GNS-MC35IT

Integrator's Manual

CE

Third edition (September 2006)

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Contents

Part 1: Overview

1. Introduction

1.1 Target Users

GNS-MC35IT modems are designed to be integrated into machine-machine or man-to-machine communications applications. They are intended to be used by manufacturers, system integrators, applications developers and developers of wireless communications equipment.

1.2 Prerequisites

It is assumed that the person integrating the GNS-MC35IT into an application has a basic understanding of the following:

- GSM networking;
- Wireless communication and antennas (aerials);
- AT commands;
- ITU-T standard V.24/V.28;
- Micro controllers and programming;
- Electronic hardware design.

1.3 Manual Structure

The manual is composed of four parts:

Part 1- Overview

This section provides a broad overview of the GNS-MC35IT and includes a list of abbreviations used in the manual.

Part 2 - Integrating the Modem

This section describes each of the signals available on the GNS-MC35IT modem, along with mechanical information. The section also provides you with design guidelines and explains what is needed to commercialise an application from a regulatory point of view.

Part 3 - Using AT Commands

This section lists all the AT commands relevant to the GNS-MC35IT, including their associated parameters. The purpose of part 4 is to give you detailed information about the function of each command in the AT command set.

2. GNS-MC35IT
Modem

2.1 Description

The dual band EGSM 900/1800MHz GNS-MC35IT is a GSM/GPRS serial modem. The modem is a powerful and flexible device that can be used in a wide range of telemetry and telematics applications that rely on the remote exchange of data, voice, SMS or faxes via the GSM cellular network.

Small and lightweight, the GNS-MC35IT has standard connectors and an integral SIM card reader making it easy and quick to integrate. As well as providing a standard RS232 serial communication interface the GNS-MC35IT also has an audio interface allowing an analogue handset to be connected. When the GNS-MC35IT is integrated into an external application, a wireless communications system is created.

A typical end-to-end system consists of a micro controller in an external application communicating, via the GNS-MC35IT modem, with a remote terminal or host using the GSM network. The micro controller uses a set of AT commands to control the modem, and to set up the end-to-end communications link, via its 9-way RS232 serial interface.

GNS-MC35IT serial modems are intended to be used by manufacturers, system integrators, application developers and developers of a wide range of equipment and business solutions, typically in the following fields:

- Security and alarms
- Vending
- Monitoring and control
- Utilities
- Fleet Management

2.2 Highlights

- Dual band, EGSM 900/1800MHz, GSM/GPRS serial modem
- Flexible plug-and-play device
- Data: GPRS, HSCSD, CSD, SMS
- Voice: full rate, enhanced full rate, half rate
- SMS: mobile-originated, mobile-terminated, cell broadcast
- Fax: Group 3, Classes 1 & 2
- RS232 9-way serial interface
- 5V - 32V d.c. input
- 4-wire audio connection
- Antenna connection (FME male)
- R&TTE type approved

2.3 GNS-MC35IT in a Communication System

Figure 2.1 illustrates the main blocks of a wireless communication system using the GNS-MC35IT. It also shows the communication principles of the system. The definitions in the figure, as used elsewhere in this manual, are in accordance with the recommendations of GSM 07.07.

- The MS (mobile station) represents the GNS-MC35IT modem plus SIM card. The modem excluding SIM card, is known as the ME (mobile equipment).
- The TE (terminal equipment) is a micro-controller (i.e., a computer) and is a part of the application.

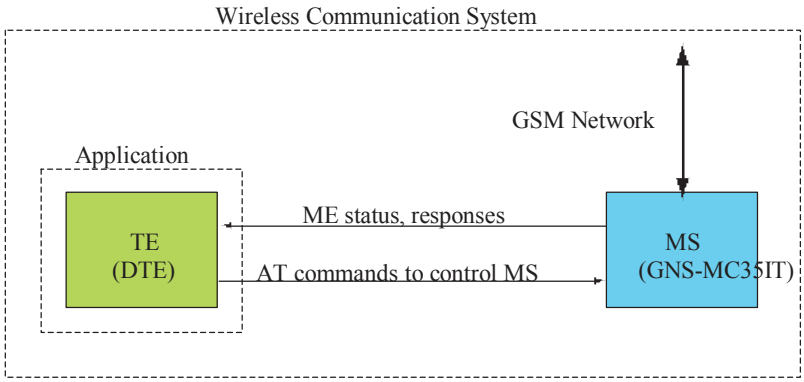


Figure 2.1 Main Blocks in a Wireless System

In accordance with the recommendations of ITU-T (International Telecommunication Union - Telecommunications Standardisation Sector) V.24, the TE communicates with the MS over a serial interface.

The functions of the GNS-MC35IT follow the recommendations provided by ETSI (European Telecommunications Standards Institute) and ITU-T.

ETSI specifies a set of AT commands for controlling the GSM element of the modem; these commands are supplemented by Sony Ericsson specific commands.

To find out how to work with AT commands, see “Part 3: Using AT Commands”, page 51.

Figure 2.2 illustrates the interface between the modem and the application. The entire System Connector Interface is described in detail in "Electrical Description", page 28.

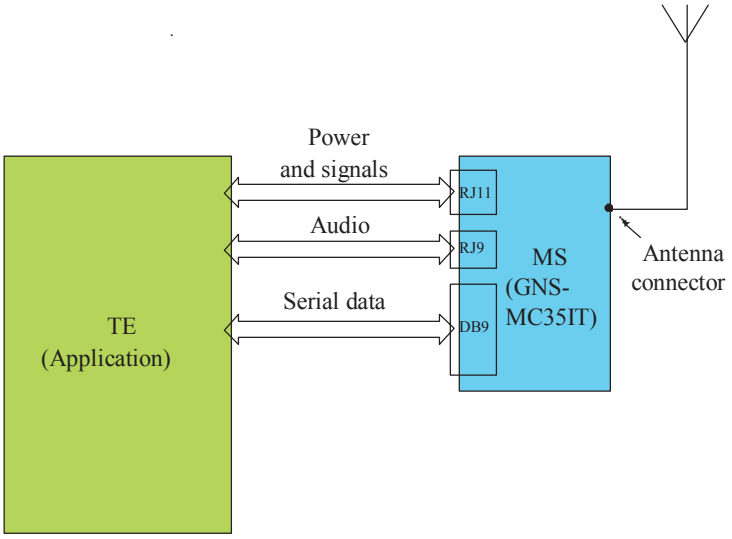


Figure 2.2 The Interface between the modem and the Application

Note! ITU-T standards define TE and TA as DTE (Data Terminal Equipment) and DCE (Data Circuit Terminating Equipment) respectively.

2.4 Main Features and Services

The modem performs a set of telecom services (TS) according to GSM standard phase 2+, ETSI and ITU-T. The services and functions of the modem are implemented by issuing AT commands over the RS232 serial interface.

2.4.1 Types of Mobile Station

The GNS-MC35IT is a dual band serial modem with the GSM radio characteristics shown in the table below.

GNS-MC35IT	*GSM900*	*E-GSM900*	*GSM1800*
Frequency Range (MHz)	TX: 890-915 RX: 935-960	TX: 880-890 RX: 925-935	TX: 1710-1785 RX: 1805-1880
Channel spacing	200kHz		200kHz
Number of channels	173 carriers *8 (TDMA) GSM: channels 1 to 124 E-GSM: channels 975 to 1023		374 carriers *8 (TDMA) DCS: channels 512 to 885
Modulation	GMSK		GMSK
TX phase accuracy	< 5є RMS phase error (burst)		< 5є RMS phase error (burst)
Duplex spacing	45MHz		95MHz
Receiver sensitivity at antenna connector	< –102dBm		< –102dBm
Transmitter output power at antenna connector	Class 4 2W (33dBm)		Class 1 1W (30dBm)
Automatic hand-over between GSM 900 and GSM1800			

2.4.2 Short Message Service

The modem supports the following SMS services:

- Sending; MO (mobile-originated) with both PDU (protocol data unit) and text mode supported.
- Receiving; MT (mobile-terminated) with both PDU and text mode supported.
- CBM (cell broadcast message); a service in which a message is sent to all subscribers located in one or more specific cells in the GSM network (for example, traffic reports). This feature is network dependent.
- SMS STATUS REPORT according to GSM 03.40.
- SMS COMMAND according to GSM 03.40.

The maximum length of an SMS message is 160 characters when using 7-bit encoding. For 8-bit data, the maximum length is 140 characters. The modem supports up to 6 concatenated messages to extend this function.

2.4.3 Voice Calls

The GNS-MC35IT offers the capability of mobile originated and mobile terminated voice calls, as well as supporting emergency calls.
Multi-party, call waiting and call deflection features are available.
Some of these features are network-operator specific.

For the inter-connection of audio, the modem offers a balanced 4-wire analogue interface.

DTMF (Dual Tone Multi Frequency) is supported.

2.4.4 Data

The modem supports the following data protocols:

- GPRS (General Packet Radio Service).
  Modems are Class B terminals, which provide simultaneous activation and attachment of GPRS and GSM services. GNS-MC35IT modems are GPRS class 8 (4+1) enabled devices, which are capable of transmitting in one timeslot per frame (up link), and receiving at a maximum of four timeslots per frame (down link).
- CSD (Circuit Switched Data).
  GNS-MC35IT modems are capable of establishing a CSD communication at 9.6kbps.
- HSCSD (High Speed Circuit Switched Data).
  GNS-MC35IT supports HSCSD class 2 (2+1) communication, with one timeslot per frame capacity in the up link and two timeslots per frame capacity in the down link.

2.4.5 Fax

The GNS-MC35IT allows fax transmissions to be sent and received by commercial software installed on the application computer. Group 3 fax Classes 1 and 2 are supported.

2.4.6 Supplementary Services

- Call forwarding
- Call hold, waiting and multiparty
- Calling/called number identification
- Advice of charge
- USSD
- Alternate line service
- Customer service profile
- Preferred networks
- Operator selection

- Network registration
- Call barring
- Call transfer

2.4.7 Serial Communication

The GNS-MC35IT enables an end-to-end communication path to be established between the external telemetry/telematics application and a remote terminal or host, via the GSM network. Once a path has been set up, voice or data communication can take place. Serial data with flow control according to the RS232 signalling protocol operates between the modem and the external application.

Control of the GNS-MC35IT is by the external application, via the RS232 serial interface, using a set of AT commands. The GNS-MC35IT supports the full set of AT commands according to GSM 07.05 and GSM 07.07. It also supports an extended set of Novacom-Wirelessproprietary AT commands to add extra functionality.

AT commands are used to operate the modem and have a broad range of functions including:

- configuring general parameters of the GNS-MC35IT;
- setting up and controlling communications to and from the GSM network;
- configuring the modem to communicate across the RS232 serial interface;
- and obtaining GSM network status information.

For more detail on the AT commands supported by the GNS-MC35IT see “Alphabetical Listing of AT Commands”, page 259.

2.4.8 Interfacing with the GNS-MC35IT

The GNS-MC35IT uses the following industry standard connectors to interface with the external application and the GSM network;

- RJ11 (plug-in power supply connector)
- RJ9 (handset audio connector)
- Integral SIM card reader
- FME male (antenna connector)
- Sub-D socket, 9 pin (RS232 serial port)

2.5 Service and Support

To contact customer support please use the details below:

Customer Support

E-mail: modules.support@novacom-wireless.com
or
modules.info@novacomwireless.com

Information about Novacom-Wireless and its products is available on the following web site:

http://www.novacom-wireless.com

3. Abbreviations

Abbreviation	*Explanations*
CBM	Cell Broadcast Message
CBS	Cell Broadcast Service
CSD	Circuit Switched Data
DCE	Data Circuit Terminating Equipment
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
EFR	Enhanced Full Rate
EMC	Electro-Magnetic Compatibility
ETSI	European Telecommunication Standards Institute
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HR	Half Rate
HSCSD	High Speed Circuit Switched Data
ITU-T	International Telecommunication Union - Telecommunications Standardisation Sector
ME	Mobile Equipment
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
PDU	Protocol Data Unit
RLP	Radio Link Protocol
RF	Radio Frequency
RTC	Real Time Clock
SIM	Subscriber Identity Module
SMS	Short Message Service
TA	Terminal Adapter
TE	Terminal Equipment
TS	Telecom Services

Part 2: Integrating the Modem

1. Mechanical Description

1.1 Overview

The pictures below show the mechanical design of the GNS-MC35IT along with the positions of the different connectors and mounting holes. The GNS-MC35IT case is made of durable PC/ABS plastic.

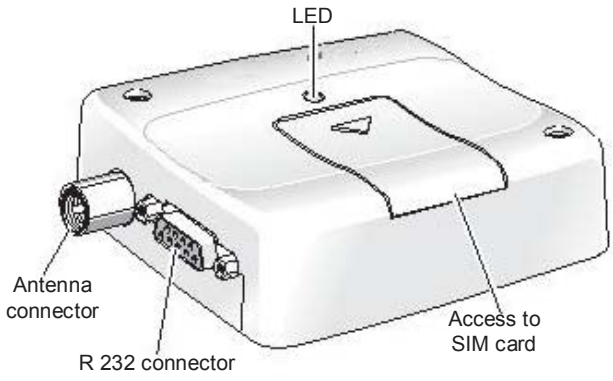


Figure 1.1 GNS-MC35IT viewed from the left side

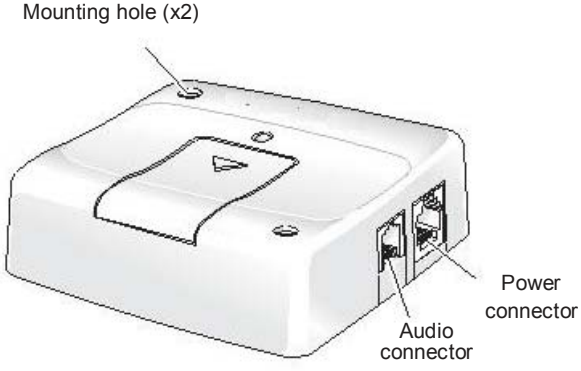
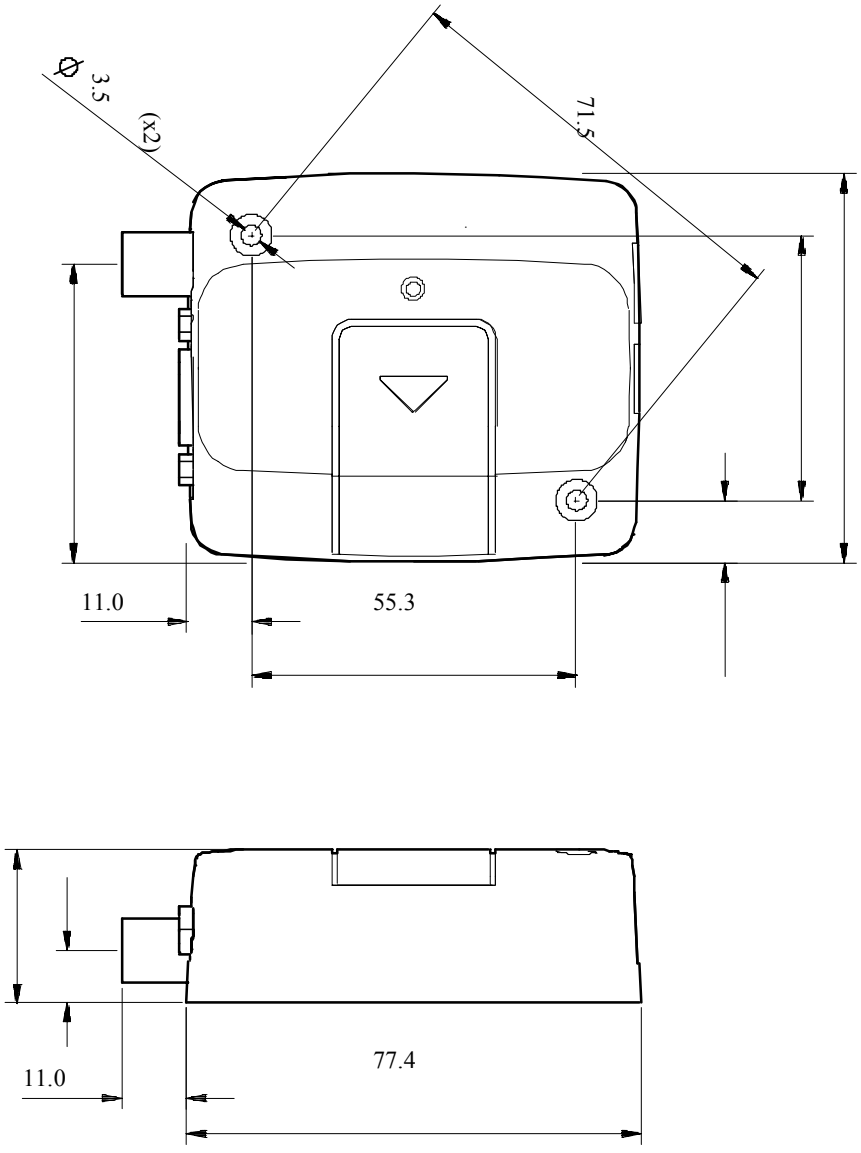


Figure 1.2 GNS-MC35IT viewed from the right side

Please note the following:

- Mounting holes positioned at two of the corners make it possible to securely bolt the modem into your application.
- Keypad, display, microphone, speaker and battery are not part of the modem.
- The SIM card is mounted in the modem.
- The pins and electrical characteristics or the modem's various connectors are described in
  "2. Electrical Description", page 28.
- Information about the antenna connector is found in
  "2.3 Antenna Connector", page 31.

1.2 Physical Dimensions



Measurements are given in millimetres.

2. Electrical Description

All electrical connections to the GNS-MC35IT are protected in compliance with the standard air (4kV) and contact (8kV) discharge ESD tests, of EN 301 489-1.

The modem uses the following industry standard connectors:

- RJ11 6-way (power connector)
- RJ9 4-way (handset connector)
- SIM card reader
- FME male coaxial jack (antenna connector)
- Sub-D socket, 9 pin (RS232 serial port)

2.1 Power Connector

An RJ11 6-way connector, as shown and described below, serves as a means of supplying and controlling d.c. power to the modem.

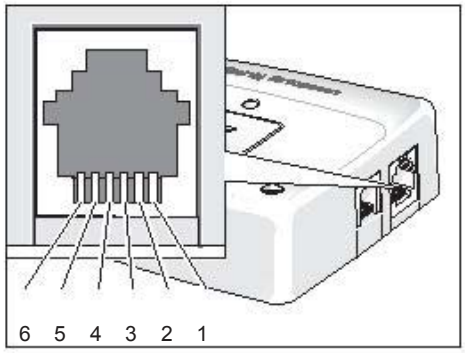
The supply voltage, VCC, required by the modem is in the range 5V - 32V d.c.

An active-high control signal, HR_IN, can be used to switch the modem off when applied for 1 - 2 seconds, or can be used to perform a hardware reset when applied for > 3.5s.

HR_IN are referenced to GND (pin 6 on the connector).

VCC and GND are reverse polarity and overvoltage protected.

Please note to switch the modem "RESET" & "SWITCH-ON" it's necessary to apply GND level to DTR signal on RS232 for at least 0.3 C



1 VCC	3 HR_IN	5 n/c
2 n/c	**4 n/c**	6 GND

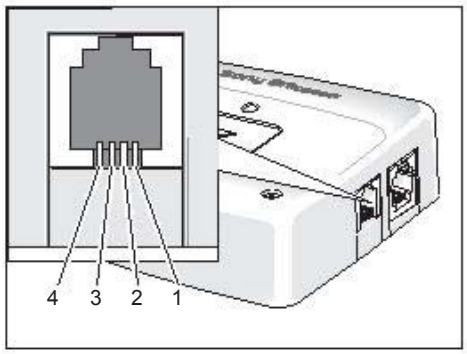
The power connector electrical characteristics are listed below:

Pin	*Signal*	*Dir*	*Limits*	*Description*
1	VCC	I	5 - 32V	Positive power input
2	-	-	-	No connection
3	HR_IN	I	–0.5 - 32V	Active high control line used to switch OFF the Modem and RESET V_{IH} > 5V, V_{IL} < 2V Power on: t > 0.2s
4	TO_IN	I		**No connected** **Will be applied in next version**
5	-	-	-	No connection
6	GND	I	-	Negative power (ground) input and return path for TO_IN and HR_IN

2.2 Audio Connector

A 4-way RJ9 connector, as shown below, allows a telephone handset to be plugged into the modem, giving access to the microphone and earpiece signals. The connector may also be used to drive other analogue audio sub-systems or devices.

Although the GNS-MC35IT is pre-configured to work with a range of handsets, the audio interface is flexible and its performance can be configured, using AT commands, to match a particular handset or audio subsystem.



1 MICN
2 BEARN
3 BEARP
4 MICP

Audio signal descriptions are listed below:

Pin	*Signal*	*Dir*	*Description*
1	MICN	I	Microphone negative input
2	BEARN	O	Earpiece negative output
3	BEARP	O	Earpiece positive output
4	MICP	I	Microphone positive input

MICP and MICN are balanced differential microphone input signals. These inputs are compatible with an electret microphone.

BEARP and BEARN are the speaker output signals. These are differential-mode outputs. The electrical characteristics are given in the table below.

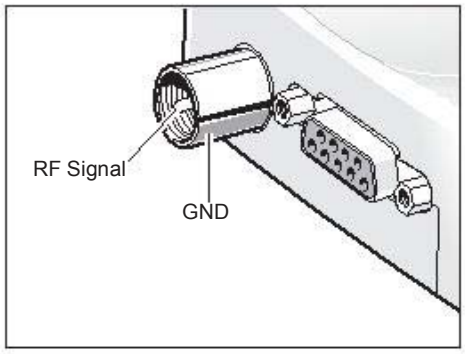
Parameter	*Limit*
Output level (differential)	$\geq 4.0V_{pp}$
Output level (dynamic load = 32Ω)	$\geq 2.8V_{pp}$
Distortion at 1kHz and maximum output level	≤ 5%
Offset, BEARP to BEARN	±30mV
Ear-piece mute-switch attenuation	≥ 40dB

The following table shows the ear piece impedances that can be connected to BEARP and BEARN.

Ear piece model	*Impedance*	*Tolerance*
Dynamic ear piece	[32Ω + 800µH] // 100pF	±20%
Dynamic ear piece	[150Ω + 800µH] // 100pF	±20%
Piezo ear piece	1kΩ + 60nF	±20%

2.3 Antenna Connector

The antenna connector allows transmission of radio frequency (RF) signals between the modem and an external customer-supplied antenna. The modem is fitted with a 50 Ω, FME male coaxial jack as shown below.

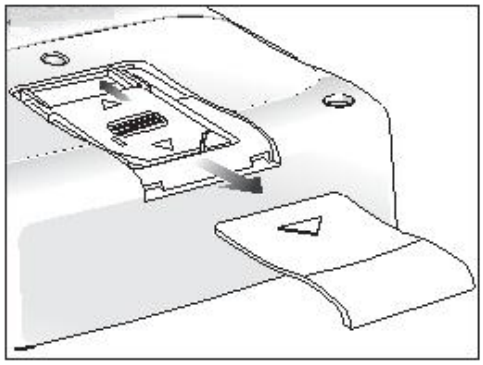


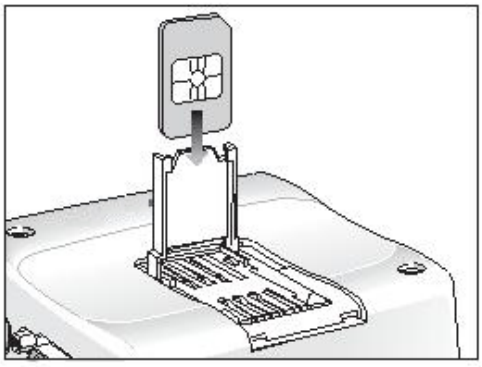
The table below shows the antenna electrical characteristics:

Parameter	*Limit*	*Description*
Nominal impedance	50Ω (SWR better than 2.5:1)	
Output Power	2 Watt peak (Class 4)	Extended GSM900
	1 Watt peak (Class 1)	GSM1800
Static Sensitivity	Better than –102dBm	Extended GSM900
	Better than –102dBm	GSM1800

2.4 SIM Card Reader

The GNS-MC35IT is fitted with a SIM card reader designed for 3V and 5V SIM cards. It is the flip-up type which is lockable in the horizontal position and is accessed through a removable panel as shown below.

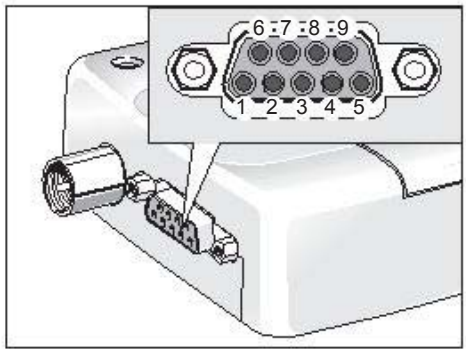




The SIM card reader includes a SIM presence switch. This ensures that when a SIM card is inserted or removed while the GNS-MC35IT is turned ON, it will reset.

2.5 RS232 Serial Port

The modem supports a standard RS232 serial interface (EIA/TIA 574) via its 9 pin Sub-D connector, shown below. In line with serial communication terminology the GNS-MC35IT serial modem should be considered as the *data circuit-terminating equipment* (DCE) and the external application or computer as the *data terminating equipment* (DTE).



1 DCD	4 DTR	7 RTS
2 RD	5 GND	8 CTS
3 TD	6 DSR	9 RI

The electrical characteristics of the serial port signals are shown below:

Pin	*Signal*	*Dir*	*Voltage levels*	*Description*
1	DCD	O	> +4V < –4V	Data carrier detect
2	RD	O	> +4V < –4V	Received data
3	TD	I	> 2V < 0.8V	Transmitted data
4	DTR	I	> 2V < 0.8V	Data terminal ready **("RESET" & "SWITCH ON" the modem)**
5	GND	-	0V	Ground connection
6	DSR	O	> +4V < –4V	Data set ready
7	RTS	I	> 2V < 0.8V	Request to send
8	CTS	O	> +4V < –4V	Clear to send
9	RI	O	> +4V < –4V	Ring indicator

2.5.1 Serial Data

The modem supports the standard data character format of 1 start bit, 8 bit data, no parity plus 1 stop bit, in total 10 bits per character.

2.5.2 Serial Data Signals - RD, TD

The default baud rate is 9.6kbps, however higher bit rates up to 460kbps are supported. At start-up the GNS-MC35IT transmits and receives data at the default rate of 9.6kbps in either standard AT mode or binary mode (the first received data - AT or binary format - determines the operating mode). When reprogramming, the transmission rate is automatically negotiated by the programming application. Speeds up to 460kbps are supported.

Serial Data From Modem (RD)

RD is an output signal that the modem uses to send data to the application.

Serial Data To Modem (TD)

TD is an input signal, used by the application to send data to the modem.

2.5.3 Control Signals - RTS, CTS, DTR, DSR, DCD, RI

RTS and CTS are capable of transmitting at 1/10th of the data transmission speed for data rates up to 460kbps (byte-oriented flow control mechanism).

Request to Send (RTS)

Used to condition the DCE for data transmission. The default level is high by internal pull up.

The exact behaviour of RTS is defined by an AT command. Software or hardware control can be selected. Hardware flow is the default control.

The application must pull RTS low to communicate with the modem. The modem will respond by asserting CTS low, indicating it is ready for communication.

Clear To Send (CTS)

CTS indicates that the DCE is ready to transmit data. The default level is high. You can define the exact behaviour of CTS through an AT command, and can select software or hardware flow control.

Data Terminal Ready (DTR)

DTR indicates that the DTE is ready to transmit and receive data. It also acts as a hardware 'hang-up', terminating calls when switched high. The signal is active low. You can define the exact behaviour of DTR with an AT command. The DTR line can also be used to switch "ON" or "RESET" the modem when activated for 0.3 seconds. The DTR line must be deactivated prior to switching off the modem to ensure it switches off (powers down) correctly.

Data Set Ready (DSR)

An active DSR signal is sent from the modem to the application (DTE) to confirm that a communications path has been established. DSR has two modes of operation, settable using the AT command AT&S.

Data Carrier Detect (DCD)

DCD indicates that the DCE is receiving a valid carrier (data signal) when low. You can define the exact behaviour of DCD with an AT command.

Ring Indicator (RI)

RI indicates that a ringing signal is being received by the DCE when low. You can define the exact behaviour or RI with an AT command.

2.6 Real Time Clock

The GNS-MC35IT contains a real time clock (RTC) to maintain accurate timekeeping and to enable "timestamping" of messages.

The RTC is powered when d.c. power is connected to the modem AND the modem is switched on. If the d.c. supply fails, a stored energy device within the GNS-MC35IT provides back-up power to maintain the RTC for at least 12 hours.

2.7 Software Updates

It is possible and sometimes necessary to update the GNS-MC35IT software. Updates must be carried out by a Novacom-Wirelessapproved technician. Please contact your supplier for details (see "Service and Support", page 9).

3. Operation

3.1 Switching Off the Modem

There are three ways to switch off (power down) the modem as described below:

- either use the AT+CFUN command;
- or assert HR_IN high for 1 - 2 seconds. A delay of up to 10s is experienced as the modem logs off the network
- or assert TO_IN low to high for 1 - 2 seconds.

Note! The DTR line must be deactivated prior to switching off the modem to ensure the unit switches off correctly.

3.2 Resetting the Modem

A full system reset, independent of the status of the software, may be applied to the modem as follows:

- assert HR_IN high for > 3.5s.

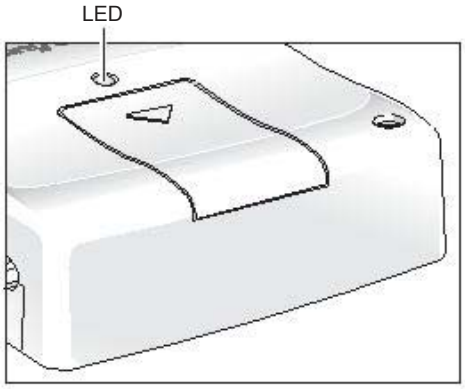
Or

The DTR line can also be used to "RESET" the modem when activated for 0.3 seconds.

The DTR line must be deactivated prior to switching off the modem to ensure it switches off (power down) correctly

3.4 Operating States/LED

The modem has a green LED, as depicted below, which is used to indicate various operating states. These states are described in following table.



Operating State	*LED Status*
After switching on the modem	On after 4s
Switch off (Power down) or power removed	Off
Standby or talk	Flashing
No network, network search, no SIM card, no PIN entered	On

Notes!

Switch off (Power Down): DC power is applied but the modem is switched OFF.

Standby: The GNS-MC35IT is switched ON and camped on to the network. No call in progress.

Talk: The GNS-MC35IT is switched ON and a voice/data call is in progress.

4. Safety and Product Care

Please read the information in this section and the information in "Installation of the Modem", page 40 before starting your integration work.

4.1 Safety Instructions

PLEASE READ THESE SAFETY INSTRUCTIONS AND KEEP A COPY OF THEM.

- Always ensure that use of the modem is permitted. The modem may present a hazard if used in proximity to personal medical electronic devices. As a rule, the modem must not be used in hospitals, airports or planes.
- Never use the modem at a gas station, refuelling point, blasting area or in any other environment where explosives may be present.
- Operating the modem close to other electronic devices, such as antennas, television sets, and radios may cause electromagnetic interference.
- This product is intended to be used with the antenna or other radiating element at least 20cm away from any part of the human body. In applications where this rule cannot be applied, the application designer is responsible for providing the SAR measurement test report and declaration.
- You are responsible for observing your country's safety standards, and where applicable, the relevant wiring rules.

4.2 General Precautions

- The GNS-MC35IT as a stand alone item is designed for indoor use only. To use outside it must be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in "Technical Data", page 45.
- Avoid exposing the modem to lighted cigarettes, naked flames or to extreme hot or cold temperature.
- Never try to dismantle the modem yourself. There are no components inside the modem that can be serviced by the user. If you attempt to dismantle the modem, you may invalidate the warranty.
- The GNS-MC35IT must not be installed or located where the surface temperature of the plastic case may exceed 85°C.
- All cables connected to the GNS-MC35IT must be secured or clamped, immediately adjacent to the modem's connectors, to provide strain relief and to avoid transmitting excessive vibration to the modem in the installation.

- Ensure the d.c. cable, supplying power to the GNS-MC35IT, does not exceed 3 metres. For longer distances please contact Sony Ericsson Service and Support.
- To protect power supply cables and meet the fire safety requirements when the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply.
- Do not connect any incompatible component or product to the GNS-MC35IT.

Note! Novacom-Wirelessmay refuse warranty claims where evidence of product misuse is found.

4.3 SIM Card Precautions

- Before handling the SIM card in your application, ensure that you are not charged with static electricity. Use proper precautions to avoid electrostatic discharges.
- When the SIM card hatch is opened, the SIM card connectors lie exposed under the SIM card holder.

Caution! Do not touch these connectors! If you do, you may release an electrical discharge that could damage the modem or the SIM card.

- When designing your application, the SIM card's accessibility should be taken into account. We always recommend that you have the SIM card protected by a PIN code. This will ensure that the SIM card cannot be used by an unauthorized person.

4.4 Antenna Precautions

- If the antenna is to be mounted outside, consider the risk of lightning. Follow the instructions provided by the antenna manufacturer.
- Never connect more than one modem to a single antenna. The modem can be damaged by radio frequency energy from the transmitter of another modem.
- Like any mobile station, the antenna of the modem emits radio frequency energy. To avoid EMI (electromagnetic interference), you must determine whether the application itself, or equipment in the application's proximity, needs further protection against radio emission and the disturbances it might cause. Protection is secured either by shielding the surrounding electronics or by moving the antenna away from the electronics and the external signals cable.
- The modem and antenna may be damaged if either come into contact with ground potentials other than the one in your application. Beware, ground potential are not always what they appear to be.

5. Installation of the Modem

This chapter gives you advice and helpful hints on how to integrate the GNS-MC35IT into your application from a hardware perspective.

Please read the information given in "Safety and Product Care", page 38 and then the read the information in this section before starting your integration work.

5.1 Where to Install the Modem

There are several conditions which need to be taken into consideration when designing your application as they might affect the modem and its function. They are:

5.1.1 Environmental Conditions

The modem must be installed so that the environmental conditions stated in the Technical Data chapter, such as temperature, humidity and vibration are satisfied. Additionally, the electrical specifications in the Technical Data section must not be exceeded.

5.1.2 Signal Strength

The modem has to be placed in a way that ensures sufficient signal strength. To improve signal strength, the antenna can be moved to another position. Signal strength may depend on how close the modem is to a radio base station. You must ensure that the location at which you intend to use the modem, is within the network coverage area.

Degradation in signal strength can be the result of a disturbance from another source, for example an electronic device in the immediate vicinity. More information about possible communication disturbances can be found in section 5.3.5, page 43.

When an application is completed, you can verify signal strength by issuing the AT command AT+CSQ. See "AT+CSQ Signal Strength", page 88.

Tip! Before installing the modem, use an ordinary mobile telephone to check a possible location for it. In determining the location for the modem and antenna, you should consider signal strength as well as cable length

5.1.3 Connection of Components to GNS-MC35IT

The integrator is responsible for the final integrated system. Incorrectly designed or installed, external components may cause radiation limits to be exceeded. For instance, improperly made connections or improperly installed antennas can disturb the network and lead to malfunctions in the modem or equipment.

5.1.4 Network and Subscription

- Before your application is used, you must ensure that your chosen network provides the necessary telecommunication services. Contact your service provider to obtain the necessary information.
- If you intend to use SMS in the application, ensure this is included in your (voice) subscription.
- Consider the choice of the supplementary services described in section “2.4.2 Short Message Service”, page 17.

5.2 How to Install the Modem

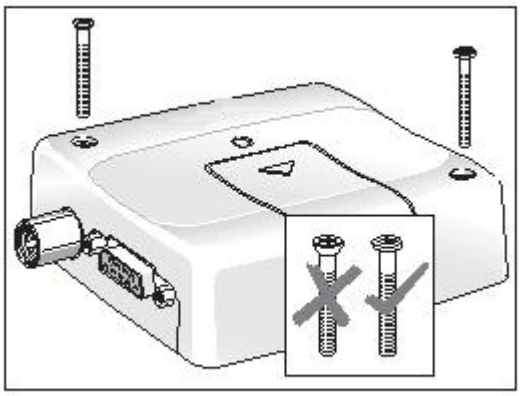
5.2.1 Power Supply

- Use a high-quality power supply cable with low resistance. This ensures that the voltages at the connector pins are within the allowed range, even during the maximum peak current.
- When the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply. This protects the power cabling and modem.

5.2.2 Securing the modem

- Before securing the modem take into account the amount of additional space required for the mating connectors and cables that will be used in the application.
- Where access is restricted, it may be easier to connect all the cables to the modem prior to securing it in the application.
- Securely attach the GNS-MC35IT modem to the host application using two 3mm diameter pan-head screws of appropriate length as shown below.

Caution! Do not exceed a torque of 25Ncm when tightening the fixings screws. Excessive torque applied to the screws can crack the plastic case.



5.3 Antenna

5.3.1 General

The antenna is the component in your system that maintains the radio link between the network and the modem. Since the antenna transmits and receives electromagnetic energy, its efficient function will depend on:

- the type of antenna (for example, circular or directional);
- the placement of the antenna;
- communication disturbances in the vicinity in which the antenna operates.

In the sections below, issues concerning antenna type, antenna placement, antenna cable, and possible communication disturbances are addressed.

In any event, you should contact your local antenna manufacturer for additional information concerning antenna type, cables, connectors, antenna placement, and the surrounding area. You should also determine whether the antenna needs to be grounded or not. Your local antenna manufacturer might be able to design a special antenna suitable for your the application.

5.3.2 Antenna Type

Make sure that you choose the right type of antenna for the modem.

Consider the following requirements:

- the antenna must be designed for the dual frequency bands in use: EGSM/GSM900/1800;
- the impedance of the antenna and antenna cable must be 50Ω;
- the antenna output-power handling must be a minimum of 2W;

• the VSWR value should be less than 3:1 to avoid damage to the modem.

5.3.3 Antenna Placement

The antenna should be placed away from electronic devices or other antennas. The recommended minimum distance between adjacent antennas, operating in a similar radio frequency band, is at least 50cm.

If signal strength is weak, it is useful to face a directional antenna at the closest radio base station. This can increase the strength of the signal received by the modem.

The modem's peak output power can reach 2W. RF field strength varies with antenna type and distance. At 10cm from the antenna the field strength may be up to 70V/m and at 1m it will have reduced to 7V/m.

In general, CE-marked products for residential and commercial areas, and light industry can withstand a minimum of 3V/m.

5.3.4 The Antenna Cable

Use 50Ω impedance low-loss cable and high-quality 50Ω impedance connectors (frequency range up to 2GHz) to avoid RF losses. Ensure that the antenna cable is as short as possible.

The Voltage Standing-Wave Ratio (VSWR) may depend on the effectiveness of the antenna, cable and connectors. In addition, if you use an adapter between the antenna cable and the antenna connector, it is crucial that the antenna cable is a high-quality, low-loss cable.

Minimize the use of extension cables, connectors and adapters. Each additional cable, connector or adapter causes a loss of signal power.

5.3.5 Possible Communication Disturbances

Possible communication disturbances include the following:

- **Noise** can be caused by electronic devices and radio transmitters.
- **Path-loss** occurs as the strength of the received signal steadily decreases in proportion to the distance from the transmitter.
- **Shadowing** is a form of environmental attenuation of radio signals caused by hills, buildings, trees or even vehicles. This can be a particular problem inside buildings, especially if the walls are thick and reinforced.
- **Multi-path fading** is a sudden decrease or increase in the signal strength. This is the result of interference caused when direct and reflected signals reach the antenna simultaneously. Surfaces such as buildings, streets, vehicles, etc., can reflect signals.

- **Hand-over** occurs as you move from one cell to another in the GSM network. Your mobile application call is transferred from one cell to the next. Hand-over can briefly interfere with communication and may cause a delay, or at worst, a disruption.

5.4 Accessories

The GNS-MC35IT has been type approved together with a range of accessories including:

1. AC-DC Power Adaptor with customised d.c. lead
   (Model # AD-0901000BS)
   Input: 230Va.c., 50Hz, 2m mains lead (UK and Euro plug options)
   Output: 9Vd.c., 1A. 2m d.c. lead with RJ11 connector. CE marked.

2. Dual Band Minimag Antenna (900/1800MHz)
   (Model # 1140.26-FME/F)
   Magnetic-mount antenna, 0dB radiator, 2.6m RG174 cable with FME female connector.

3. Dual Band Antenna (900/1800MHz)
   (Model # EHD1890-FME/F)
   Bulkhead-mount antenna, 0dB radiator, 0.8m low loss cable with FME female connector.

4. RS232 9-way Serial Cable
   (Model # C-E-RS232-2M)
   2m, 9-way cable, DB9 (female) to DB9 (male) connectors.

Please contact Novacom-Wirelessdistribution channels for availability.

6. Technical Data

Data Features

CSD	Up to 9.6kbps
HSCSD (2+1)	Up to 19.2kbps
GPRS Class B (4+1) - P channels - Coding schemes CS1 - CS4	85.6kbps (subject to network support and terminal location)
GSM	07.10 multiplexing protocol

Short Message Service Features

SMS	Text and PDU
	Point to point (MT/MO)
	Cell broadcast
	concatenation of up to 6 SMS

Voice Features

	Full Rate, Enhanced Full Rate and Half Rate (FR/ EFR/HR)
	Dual Tone Multi Frequency (DTMF

Fax Features

	Group 3
	Class 1 and 2

Data Storage

SMS storage capacity	40 in ME In addition, the unit can handle as many SMS as the SIM can store
Phone book capacity	100

Power Supply

Supply voltage range	5 - 32V d.c.

Power Consumption

Supply voltage		*5V*		*12V*		*32V*		*Vdc*
Power Down Mode								
		Av	*Max*	*Av*	*Max*	*Av*	*Max*	
		5	15	5	15	20	50	µA
Standby Mode (typical)								
Frequency	*Paging rate*	*Av*	*Peak*	*Av*	*Peak*	*Av*	*Peak*	
900MHz	2	26	110	9	43	6	20	mA
1800MHz	2	26	120	9	45	6	19	mA
Talk Mode (typical)								
Frequency	*Power Level*	*Av*	*Peak*	*Av*	*Peak*	*Av*	*Peak*	
900MHz	5	220	1230	90	520	40	200	mA
1800MHz	0	170	960	70	350	30	140	mA

Notes! Power Down Mode: DC power is applied but the modem is switched OFF.

Standby Mode: The GNS-MC35IT is switched ON and camped on to the network. No call in progress.

Talk Mode: The GNS-MC35IT is switched ON and a voice/data call is in progress.

The power consumption during transmission in Talk Mode is measured at maximum transmitted power.

The power consumption in Standby Mode is measured at the maximum paging rate.

Radio Specifications

Frequency range	GNS-MC35IT: EGSM 900MHz and 1800MHz (dual band)
Maximum RF output power	2W (900MHz) and 1W (1800MHz)
Antenna impedance	50Ω
Static sensitivity	Better than –102dBm

Audio Specifications

Parameter	*Limit*
Output level (differential)	$\geq 4.0V_{pp}$
Output level (dynamic load = 32Ω)	$\geq 2.8V_{pp}$
Distortion at 1kHz and maximum output level	≤5%
Offset, BEARP to BEARN	±30mV
Ear-piece mute-switch attenuation	≥40dB

Ear piece model	*Impedance*	*Tolerance*
Dynamic ear piece	[32Ω + 800µH] // 100pF	±20%
Dynamic ear piece	[150Ω + 800µH] // 100pF	±20%
Piezo ear piece	1kΩ + 60nF	±20%

SIM Card Reader

Voltage type	Support for 3 V and 5 V SIM cards

Electrical Connectors and LED

Plug-in power supply connector	RJ11 6-way
Handset audio connector	RJ9 4-way
Antenna connector	FME male
RS232 port	Sub-D socket, 9 pin
LED	Green

Mechanical Specification

Length	77.4mm
Width	66.4mm
Height	26.2mm
Weight	<130g