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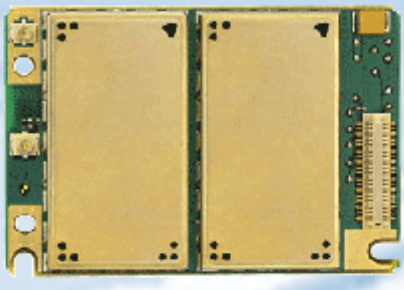

Hardware Interface Description

HC25
Siemens Cellular Engine

Version: 01.000
DocId: HC25_HD_v01.000

Document Name:	**HC25 Hardware Interface Description**
Version:	**01.000**
Date:	**2007-03-31**
DocId:	**HC25_HD_v01.000**
Status:	**Confidential / Released**
Supported Products:	**HC25**

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0 Document History

Preceding document: "HC25 Hardware Interface Description", Version 00.142
New document: "HC25 Hardware Interface Description", Version **01.000**

Chapter	What is new
1.3.1	Added MII standards to list of directives and standards (Table 5 and Table 6).
3.3.4	Revised section on Automatic Shutdown.
3.10	Modified description for network connectivity status signals.
5.2	Added module's thermal resistance values to Table 17 and Table 18.
5.5	Revised Figure 19 showing pin assignment. Updated electrical specification for VDDLP pin in Table 21.
5.6	Updated power supply ratings (Table 22).
5.7	New section: Electrical Characteristics of the Voiceband Part.
6.2	New section: Mounting HC25 to the Application Platform.
8	Added HC15/HC25-DSB75-Adapter to reference equipment.
9	Added Fasteners and Fixings for Electronic Equipment and Mounting Advice Sheet to Appendix.

Preceding document: "HCx5 Hardware Interface Description", Version 00.050a
New document: "HC25 Hardware Interface Description", Version 00.142

Chapter	What is new
--	Separate document for HC25.
1.3	Section now comprises Regulatory and Type Approval Information including new sub-section 1.4.1 with note on SELV requirements.
2	Updated key features, system overview and block diagram.
3.2.2	New subsection: Measuring the Supply Voltage (V_{BATT+}).
3.3.2	Added Figure 7 showing signal states during turn-off procedure
3.3	Revised order of subsections.
3.3.3	New subsection: Configuring the IGT Line for Use as ON/OFF Switch.
3.6	Revised parts of the section.
3.7	Added description for CCIN pin and Figure 10.
3.8	Revised complete section.
3.9	Added Figure 12.
3.10	Revised complete section.
5.2	Updated section on operating temperatures.
5.3	New section: Storage Conditions.
5.4	New section: Reliability Characteristics.
5.5	Revised Figure 19 showing pin assignment. Table 21: Changed $V_I$max for BATT+ from 4.3. to 4.2. Added note on automatic shutdown.
5.6	Updated power supply ratings (Table 22).

Chapter	What is new
6.1	Updated Figure 21 and Figure 22 (top/bottom view as well as mechanical dimensions)
6.3	Added note regarding inverse polarity protection for board-to-board connector.
7	New chapter: Sample Application
9	New Appendix with a List of Parts and Accessories.

Preceding document: "HC25 Hardware Interface Description", Version 00.005
New document: "HCx5 Hardware Interface Description", Version 00.050a

Chapter	What is new
	Initial document setup.

1 Introduction

This document describes the hardware of the Siemens HC25 module that connects to the cellular device application and the air interface. It helps you quickly retrieve interface specifications, electrical and mechanical details and information on the requirements to be considered for integrating further components.

1.1 Related Documents

Documents supplied with HC25

[1] HC25 AT Command Set 01.000
[2] HC25 Release Notes 01.000
[3] User's Guide: Getting Started with HC25
[4] Application Note 02: Audio Interface Design for HC25
[5] Application Note 16: Updating HC25 Firmware
[6] Application Note 22: Using TTY / CTM equipment with HC25
[7] Application Note 39: USB Interface Description for HC25
[8] Remote-SAT User's Guide

1.2 Terms and Abbreviations

Abbreviation	Description
ANSI	American National Standards Institute
AMR	Adaptive Multirate
ARP	Antenna Reference Point
B2B	Board-to-board connector
BB	Baseband
BEP	Bit Error Probability
BTS	Base Transceiver Station
CB or CBM	Cell Broadcast Message
CE	Conformité Européene (European Conformity)
CS	Coding Scheme
CS	Circuit Switched
CSD	Circuit Switched Data
DAC	Digital-to-Analog Converter
dBm0	Digital level, 3.14dBm0 corresponds to full scale, see ITU G.711, A-law
DCS	Digital Cellular System
DL	Download
DRX	Discontinuous Reception
DSB	Development Support Board
DSP	Digital Signal Processor

Abbreviation	Description
DTMF	Dual Tone Multi Frequency
DTX	Discontinuous Transmission
EDGE	Enhanced Data rates for GSM Evolution
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (U.S.)
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HSDPA	High Speed Downlink Packed Access
HR	Half Rate
I/O	Input/Output
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
Mbps	Mbits per second
MCS	Modulation and Coding Scheme
MO	Mobile Originated
MS	Mobile Station, also referred to as TE
MT	Mobile Terminated
NTC	Negative Temperature Coefficient
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCM	Pulse Code Modulation

Abbreviation	Description
PCS	Personal Communication System, also referred to as GSM 1900
PS	Packet Switched
PDU	Protocol Data Unit
PSK	Phase Shift Keying
R&TTE	Radio and Telecommunication Terminal Equipment
RACH	Random Access Channel
RF	Radio Frequency
RTC	Real Time Clock
Rx	Receive Direction
SAR	Specific Absorption Rate
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SLIC	Subscriber Line Interface Circuit
SMS	Short Message Service
SRAM	Static Random Access Memory
SRB	Signalling Radio Bearer
TA	Terminal adapter (e.g. GSM engine)
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TS	Technical Specification
Tx	Transmit Direction
UL	Upload
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
UICC	USIM Integrated Circuit Card
USIM	UMTS Subscriber Identification Module
WCDMA	Wideband Code Division Multiple Access

1.3 Regulatory and Type Approval Information

1.3.1 Directives and Standards

HC25 has been designed to comply with the directives and standards listed below.

Table 1: Directives

99/05/EC	Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC). The product is labeled with the CE conformity mark CE 0682
2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Table 2: Standards of North American type approval

CFR Title 47	Code of Federal Regulations, Part 22 and Part 24 (Telecommunications, PCS); US Equipment Authorization FCC
UL 60 950	Product Safety Certification (Safety requirements)
NAPRD.03 V3.9.1	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132, RSS133	Canadian Standard

Table 3: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
ETSI EN 301 511 V9.0.2	Candidate Harmonized European Standard (Telecommunications series) Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998)
GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
ETSI EN 301 489-1 V1.4.1	Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements
ETSI EN 301 489-7 V1.2.1 (2000-09)	Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
IEC/EN 60950-1 (2001)	Safety of information technology equipment (2000)

Table 3: Standards of European type approval

EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
EN 301 908-01 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements of article 3.2 of the R&TTE Directive
EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
3GPP TS 34.121	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
3GPP TS 34.123-1	User Equipment (UE) conformance specification; Part 1: Protocol conformance specification.
3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.

Table 4: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 5: Standards of the Ministry of Information Industry of the People's Republic of China

SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06).  According to the "Chinese Administration on the Control of Pollution caused by Electronic Information Products" (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Siemens Hardware Interface Description. Please see Table 6 for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.

Table 6: Toxic or hazardous substances or elements with defined concentration limits

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O

O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

1.4 SAR requirements specific to portable mobiles

Mobile phones, PDAs or other portable transmitters and receivers incorporating a GSM module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable HC25 based applications to be evaluated and approved for compliance with national and/or international regulations.

Since the SAR value varies significantly with the individual product design manufacturers are advised to submit their product for approval if designed for portable use. For European and US markets the relevant directives are mentioned below. It is the responsibility of the manufacturer of the final product to verify whether or not further standards, recommendations or directives are in force outside these areas.

Products intended for sale on US markets

ES 59005/ANSI C95.1 Considerations for evaluation of human exposure to Electromagnetic Fields (EMFs) from Mobile Telecommunication Equipment (MTE) in the frequency range 30MHz - 6GHz

Products intended for sale on European markets

EN 50360 Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz - 3GHz)

IMPORTANT:
Manufacturers of portable applications based on HC25 modules are required to have their final product certified and apply for their own FCC Grant and Industry Canada Certificate related to the specific portable mobile. See also Section 8.2.

1.4.1 SELV Requirements

The power supply connected to the HC25 module shall be in compliance with the SELV requirements defined in EN 60950-1.

1.5 Safety Precautions

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating HC25. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Siemens AG assumes no liability for customer's failure to comply with these precautions.

	When in a hospital or other health care facility, observe the restrictions on the use of mobiles. Switch the cellular terminal or mobile off, if instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy. The operation of cardiac pacemakers, other implanted medical equipment and hearing aids can be affected by interference from cellular terminals or mobiles placed close to the device. If in doubt about potential danger, contact the physician or the manufacturer of the device to verify that the equipment is properly shielded. Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker, while it is on.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it cannot be switched on inadvertently. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communications systems. Failure to observe these instructions may lead to the suspension or denial of cellular services to the offender, legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. Remember that interference can occur if it is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the cellular terminal or mobile wherever forbidden, or when you suspect that it may cause interference or danger.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for speakerphone operation. Before making a call with a hand-held terminal or mobile, park the vehicle. Speakerphones must be installed by qualified personnel. Faulty installation or operation can constitute a safety hazard.
	IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. Because of this, connection cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls. Remember, in order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

2 Product Concept

2.1 Key Features at a Glance

Feature	Implementation
General	
Frequency bands	UMTS/HSDPA: Triple band, 850//1900/2100MHz GSM/GPRS/EDGE: Quad band, 850/900/1800/1900MHz
GSM class	Small MS
Output power (according to Release 99)	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1900 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 2100, WCDMA FDD BdI Class 3 (+24dBm +1/-3dB) for UMTS 1900,WCDMA FDD BdII Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV
Power supply	$3.2V \leq V_{BATT+} \leq 4.2V$
Physical	Dimensions: 50mm x 34mm x 4.5mm Weight: approx. 10g
RoHS	All hardware components fully compliant with EU RoHS Directive
HSDPA features	
3GPP Release 5	3.6 Mbps, UL 384 kbps UE CAT. [1-6], 11, 12 supported Compressed mode (CM) supported according to 3GPP TS25.212
UMTS features	
3GPP Release 4	PS data rate – 384 kbps DL / 384 kbps UL CS data rate – 64 kbps DL / 64 kbps UL

Feature	Implementation
GSM / GPRS / EGPRS features	
Data transfer	GPRS • Multislot Class 10 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS • Multislot Class 10 • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • BEP reporting • SRB loopback and test mode B • 8-bit, 11-bit RACH • PBCCH support • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B CSD • V.110, RLP, non-transparent • 9.6 kbps
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode
Audio	Audio speech codecs GSM: AMR, EFR, FR, HR 3GPP: AMR CEPT supervisory tones supported DTMF supported 6 audio modes: Approval, Router, Handset, Headset, Speakerphone and Transparent mode TTY support selecting a dedicated audio mode Download of audio parameters Gains and volumes can be controlled by AT commands 9 ringing melodies supported CEPT and ANSI supervisory tones supported
Software	
AT commands	AT-Hayes GSM 07.05 and 07.07, Siemens AT commands for RIL compatibility (NDIS/RIL)
Microsoft™ compatibility	RIL / NDIS for Windows Mobile™
SIM Application Toolkit	SAT Class C
Firmware update	Firmware update from host application over USB.
Interfaces	
USB	Supports a USB 2.0 Full Speed (12Mbit/s) device interface.
Wakeup Control	Signal pin to wake up an inactive USB Host into an active state.

Feature	Implementation
Status	Signal pins to indicate network connectivity status.
Audio	1 analog interface
UICC interface	Supported chip cards: SIM / UICC 3V, 1.8V
Antenna	50Ohms. External antenna can be connected via antenna connector or antenna pad (spring contact).
Module interface	50-pin board-to-board connector
Power on/off, Reset	
Power on/off	Switch-on by hardware pin IGT Switch-off by hardware pin IGT Switch-off by AT command
Reset	Orderly shutdown and reset by AT command Emergency off by hardware pin EMERG_OFF and restart with hardware pin IGT
Emergency off	Emergency off by hardware pin EMERG_OFF
Evaluation kit	
DSB	DSB75 Evaluation Board designed to test and type approve Siemens cellular engines and provide a sample configuration for application engineering. A special adapter is required to connect the module to the DSB75.

2.2 HC25 System Overview

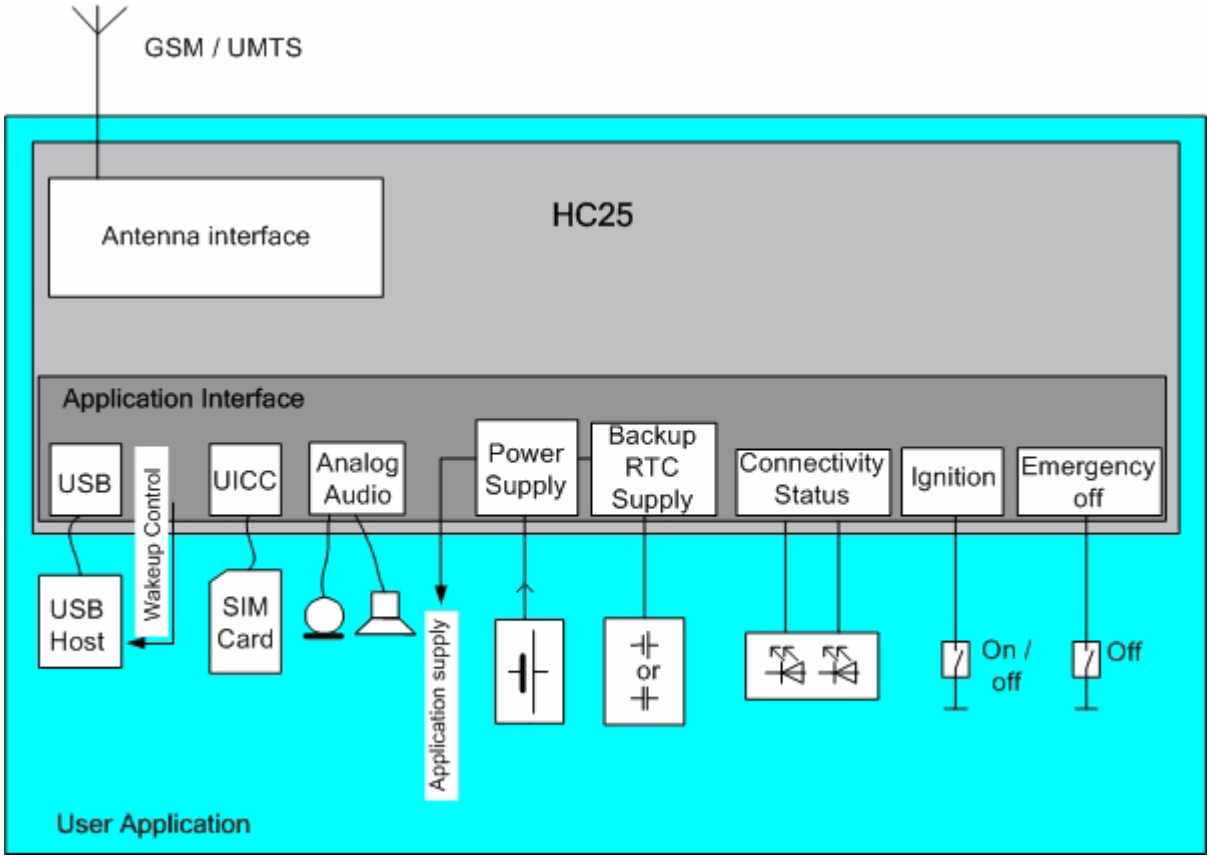


Figure 1: HC25 system overview

2.3 Circuit Concept

Figure 2 shows a block diagram of the HC25 module and illustrates the major functional components:
Base band block:

- Digital base band processor with DSPs
- Power Management
- NAND Flash and SDRAM
- Application interface (board-to-board connector)

RF section:

- RF Transceiver
- RF Receiver
- RF GSM/ WCDMA power amplifier
- RF front end
- Antenna connector

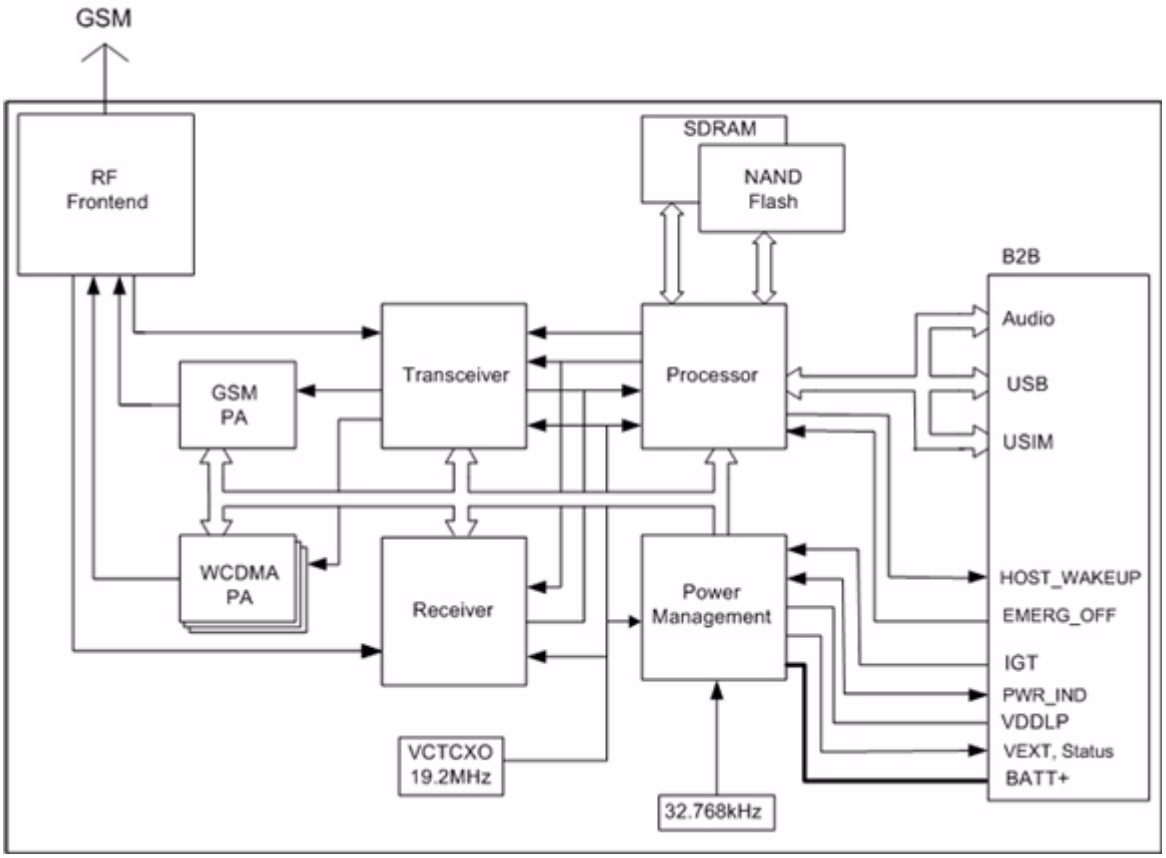


Figure 2: HC25 block diagram

3 Application Interface

HC25 is equipped with a 50-pin board-to-board connector that connects to the external application. The host interface incorporates several sub-interfaces described in the following chapters:

- Operation Modes - see Section 3.1
- Power supply - see Section 3.2
- USB interface - see Section 3.6
- UICC/SIM interface - see Section 3.7
- Analog audio interface - see Section 3.8
- Status and control lines: IGT, EMERG_OFF, PWR_IND, STATUS1/2, HOST_WAKEUP - see Table 21.

3.1 Operating Modes

The table below briefly summarizes the various operating modes referred to in the following chapters.

Table 7: Overview of operating modes

Mode	Function	
Normal operation	GSM / GPRS / UMTS / HSDPA SLEEP	Power saving mode set automatically when no call is in progress and the USB connection is suspended by host or not present.
	GSM IDLE	Software is active. Once registered to the GSM network, paging with BTS is carried out in order to achieve synchrony with the GSM network. The repetition rate depends on the parameter BSPA_Multiframe. The module is ready to send and receive.
	GSM TALK/ GSM DATA	Connection between two subscribers is in progress. Power consumption depends on the GSM network coverage and several connection settings (e.g. DTX off/on, FR/EFR/HR, hopping sequences and antenna connection). The following applies when power is to be measured in TALK_GSM mode: DTX off, FR and no frequency hopping, otherwise same as for IDLE measurements.
	GPRS IDLE	Module is attached and ready for GPRS data transfer, but no data is currently sent or received.
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multislot settings).
	EGPRS DATA	EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and EGPRS configuration (e.g. used multislot settings).
	UMTS / HSDPA IDLE	Module is attached and ready for UMTS / HSDPA data transfer, but no data is currently sent or received.
	UMTS TALK/ UMTS DATA	UMTS data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
	HSDPA DATA	HSDPA data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
Power Down	The internal power section is shut down. The SW on the module is not active. The interfaces are not accessible.	

3.2 Power Supply

HC25 needs to be connected to a power supply at the board-to-board connector (5 pins each BATT+ and GND).

The power supply of HC25 has to be a single voltage source at BATT+. It must be able to provide the peak current during the GSM uplink transmission. For an overview of power supply ratings see Section 5.6.

All the key functions for supplying power to the device are handled by the power management section of the analog controller. This IC provides the following features:
- Stabilizes the supply voltages for the GSM / UMTS baseband using voltage regulators.
- Switches the module's power voltages for the power-up and -down procedures.
- Delivers, across the VEXT pin, a regulated voltage for an external application. This voltage is not available in Power-down mode.
- Regulator to provide SIM power supply.

3.2.1 Minimizing Power Losses

When designing the power supply for your application please pay specific attention to power losses. Ensure that the input voltage VBATT+ never drops below 3.2V on the HC25 board, not even in a GSM transmit burst where current consumption can rise (for peak values see the power supply ratings listed in Section 5.6). It should be noted that HC25 switches off when exceeding these limits. Any voltage drops that may occur in a transmit burst should not exceed 400mV.

The module switches off if the minimum battery voltage (Vbattmin) is reached.
Example:
VImin = 3.2V
Dmax = 0.4V

Vbattmin = VImin + Dmax
Vbattmin = 3.2V + 0.4V = 3.6V

The best approach to reducing voltage drops is to use a board-to-board connection as recommended, and a low impedance power source. The resistance of the power supply lines on the host board and of a battery pack should also be considered.

Note: If the application design requires an adapter cable between both board-to-board connectors, use a flex cable as short as possible in order to minimize power losses.

Example:
If the length of the flex cable reaches the maximum length of 100mm, this connection may cause, for example, a resistance of 30mΩ in the BATT+ line and 30mΩ in the GND line. As a result, a 2A transmit burst would add up to a total voltage drop of 120mV. Plus, if a battery pack is involved, further losses may occur due to the resistance across the battery lines and the internal resistance of the battery including its protection circuit.

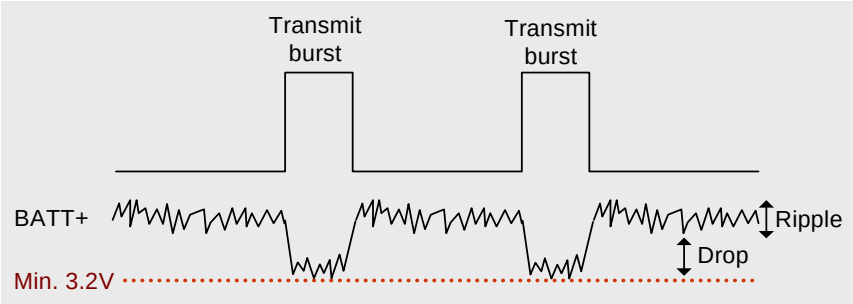


Figure 3: Power supply limits during transmit burst

3.2.2 Measuring the Supply Voltage (V_{BATT+})

The reference points for measuring the supply voltage V_{BATT+} on the module are BATT+ and GND, both accessible at a capacitor located close to the board-to-board connector of the module.

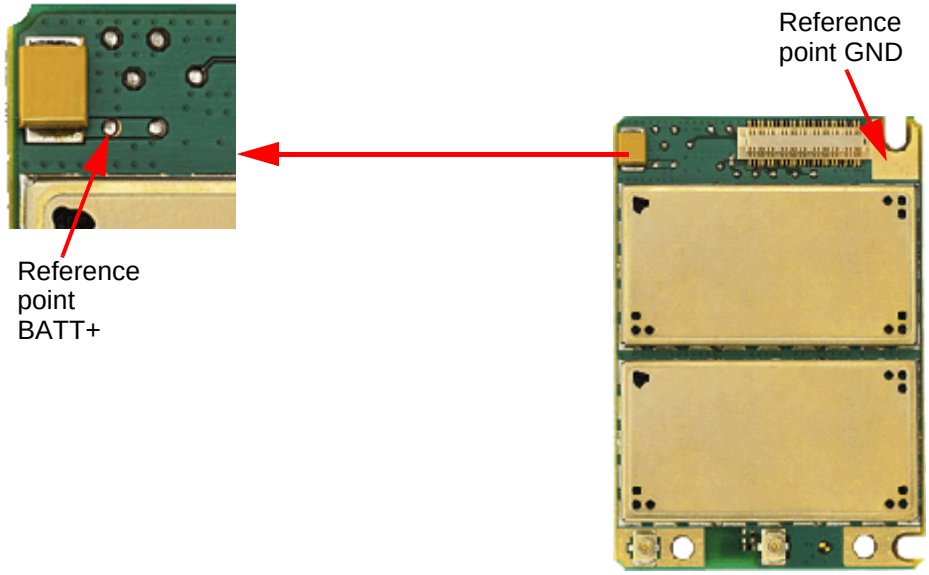


Figure 4: Position of the reference points BATT+ and GND

3.3 Power-Up / Power-Down Scenarios

In general, be sure not to turn on HC25 while it is beyond the safety limits of voltage and temperature. HC25 would immediately switch off after having started and detected these inappropriate conditions. In extreme cases this can cause permanent damage to the module.

3.3.1 Turn On HC25

When the HC25 module is in Power-down mode, it can be started to Normal mode by driving the IGT (ignition) line to ground. This must be accomplished with an open drain/collector driver to avoid current flowing into this pin. Pulling this pin low triggers a power-on sequence. To turn on HC25 IGT has to be kept active at least 300ms. After turning on HC25 IGT should be set inactive to prevent the module from turning on again after a shut down by AT command or EMERG_OFF.

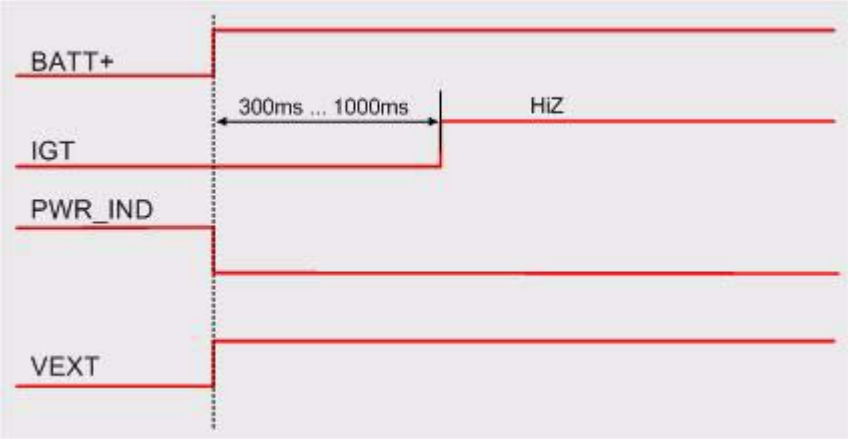


Figure 5: Power-on with IGT held low before switching on operating voltage at BATT+

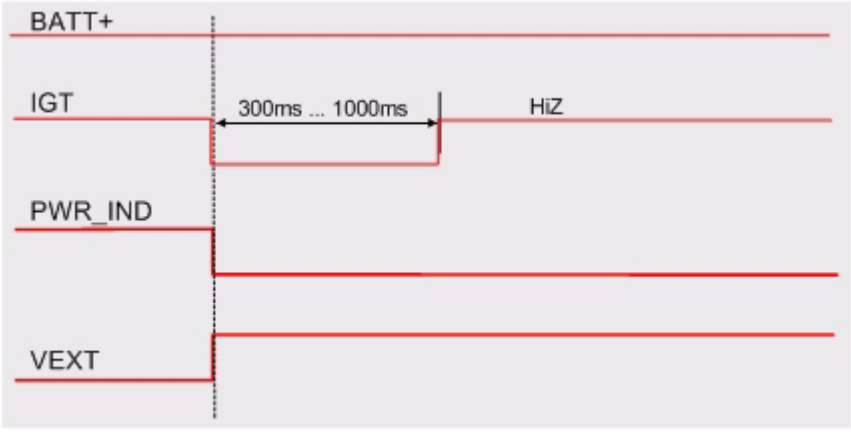


Figure 6: Power-on with operating voltage at BATT+ applied before activating IGT

Note: After power up IGT should remain high

3.3.2 Turn Off HC25 Using AT Command

The best and safest approach to powering down HC25 is to issue the AT^SMSO command. This procedure lets HC25 log off from the network and allows the software to enter into a secure state and safe data before disconnecting the power supply. The mode is referred to as Power-down mode.In this mode, only the RTC stays active.After sending AT^SMSO do not enter any other AT commands. There are two ways to verify that the module turns off:

- Wait for the ”OK” – response. It indicates that data has been stored non-volatile and that the module turns off after about 1 second.
- Also, you can monitor the PWR_IND pin. A high state of the PWR_IND pin definitely indicates that the module is switched off.

Be sure not to disconnect the supply voltage V_{BATT+} before the module has been switched off and the PWR_IND signal has gone high. Otherwise you run the risk of losing data.

While HC25 is in Power-down mode the application interface is switched off and must not be fed from any other source. Therefore, your application must be designed to avoid any current flow into any digital pins of the application interface, especially of the serial interfaces. No special care is required for the USB interface which is protected from reverse current.

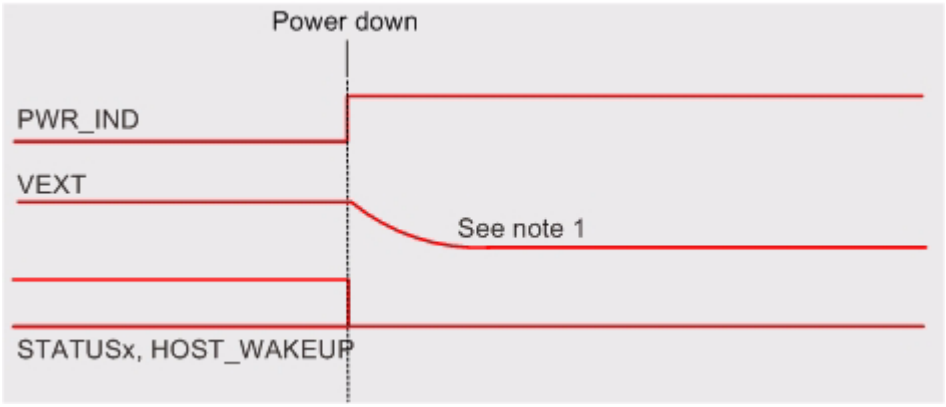


Figure 7: Signal states during turn-off procedure

Note 1: Depending on capacitance load from host application

Note 2: After module shutdown by means of AT command, please allow for a time period of at least 1s before restarting the module.

3.3.3 Configuring the IGT Line for Use as ON/OFF Switch

The IGT line can be configured for use in two different switching modes: You can set the IGT line to switch on the module only, or to switch it on and off. The switching mode is determined by the parameter "MEShutdown/OnIgnition" of the AT^SCFG command. This approach is useful for application manufacturers who wish to have an ON/OFF switch installed on the host device.

By factory default, the ON/OFF switch mode of IGT is disabled:

at^scfg=meshutdown/onignition ^SCFG: "MEShutdown/OnIgnition","off" OK	# Query the current status of IGT. # IGT can be used only to switch on HC25. IGT works as described in Section 3.3.1.

To configure IGT for use as ON/OFF switch:

at^scfg=meshutdown/onignition,on ^SCFG: "MEShutdown/OnIgnition","on" OK	# Enable the ON/OFF switch mode of IGT. # IGT can be used to switch on and off HC25.

We strongly recommend taking great care before changing the switching mode of the IGT line. To ensure that the IGT line works properly as ON/OFF switch it is of vital importance that the following conditions are met.

Switch-on condition: If the HC25 is off, the IGT line must be asserted for at least 300ms before being released.

Switch-off condition: If the HC25 is on, the IGT line must be asserted for at least 2s before being released.
The module switches off after the line is released.
The switch-off routine is identical with the procedure initiated by AT^SMSO, i.e. the software performs an orderly shutdown as described in Section 3.3.2.
Before switching off the module wait at least 5 seconds after startup.

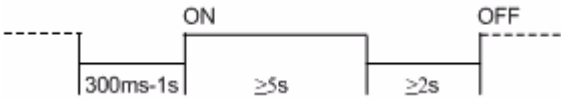


Figure 8: Timing of IGT if used as ON/OFF switch

3.3.4 Automatic Shutdown

Automatic shutdown takes effect if:

- HC25 exceeds the critical limits of *overtemperature* or *undertemperature*.
  The board temperature is constantly monitored by an internal NTC resistor. The values detected by the NTC resistor are measured directly on the board and are therefore not fully identical with the ambient temperature.

  Each time the board temperature goes out of range or back to normal, HC25 instantly displays an alert (if enabled).
  - URCs indicating the level "1" or "-1" allow the user to take appropriate precautions, such as protecting the module from exposure to extreme conditions. The presentation of the URCs depends on the settings selected with the AT^SCTM write command:
    AT^SCTM=1: Presentation of URCs is always enabled.
    AT^SCTM=0 (default): Presentation of URCs is enabled for 15 seconds time after start-up of HC25. After 15 seconds operation, the presentation will be disabled, i.e. no alert messages can be generated.
  - URCs indicating the level "2" or "-2" are instantly followed by an orderly shutdown, except in cases described in Section 3.3.4.1. The presentation of these URCs is always enabled, i.e. they will be output even though the factory setting AT^SCTM=0 was never changed. The maximum temperature ratings are stated in Section 5.2. Refer to the following table for the associated URCs.

Table 8: Temperature dependent alerts

Sending temperature alert (15s after HC25 start-up, otherwise only if URC presentation enabled)	
^SCTM_B: 1	Caution: Module close to overtemperature limit.
^SCTM_B: -1	Caution: Module close to undertemperature limit.
^SCTM_B: 0	Module back to uncritical temperature range.
Automatic shutdown (URC appears no matter whether or not presentation was enabled)	
^SCTM_B: 2	Alert: Module is above overtemperature limit and switches off.
^SCTM_B: -2	Alert: Module is below undertemperature limit and switches off.

- *Undervoltage* or *overvoltage* is detected.
  The following table lists the automatically generated URCs related to under- or overvoltage:

Table 9: Supply voltage dependent alerts

Alert	Description
^SBC: Undervoltage	Generated if the module is close to the undervoltage threshold specified in Table 21. If the undervoltage persists the module keeps sending the URC up to three times within 60 seconds before switching off automatically. When the undervoltage threshold is exceeded before the 60-second period expires the module switches off instantly.
^SBC: Overvoltage warning	Generated once if the module is close to overvoltage.
^SBC: Overvoltage shutdown	Generated if the overvoltage threshold specified in Table 21 is exceeded. The module switches off within 5 seconds after sending the URC. Normally the automatic shutdown procedure is equivalent to the power down initiated with the AT^SMSO command.

The automatic shutdown procedure is equivalent to the Power-down initiated with the AT^SMSO command, i.e. HC25 logs off from the network and the software enters a secure state avoiding loss of data.

3.3.4.1 Temperature Control during Emergency call

If the temperature limit is exceeded while an emergency call is in progress the engine continues to measure the temperature, but deactivates the shutdown functionality. If the temperature is still out of range when the call ends, the module switches off immediately (without another alert message).

3.3.5 Turn Off HC25 in Case of Emergency

The EMERG_OFF line can be used to switch off the module in case of emergency. To switch the module off the EMERG_OFF line must be pulled to ground and held low for at least 2.5s. Afterwards EMERG_OFF can be released and the module shuts down.

Caution: EMERG_OFF does not cause deregistration of cellular network. Use the EMERG_OFF pin only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the EMERG_OFF pin causes the loss of all information stored in the volatile memory. Therefore, this procedure is intended only for use in case of emergency, e.g., if HC25 does not respond, if reset or shutdown via AT command fails.

To control the EMERG_OFF line it is recommended to use an open drain / collector driver.
To register to the network SIM PIN authentication is necessary after restart.

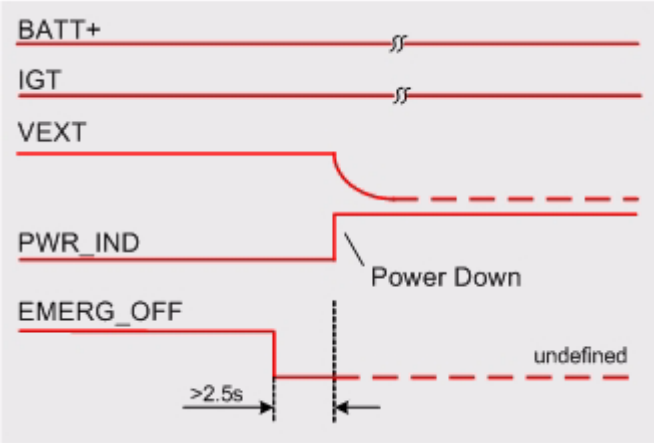


Figure 9: Shutdown by EMERG_OFF signal

3.4 Power Saving

Intended for power saving, SLEEP mode reduces the functionality of the HC25 to a minimum and thus minimizes the current consumption.

The implementation of the USB host interface influences the module's power saving modes and therefore its current consumption (see Section 3.6).

3.5 RTC Backup

The internal Real Time Clock of HC25 is supplied from a separate voltage regulator in the analog controller which is also active when HC25 is in POWER DOWN status. In addition, the RTC clock is used during SLEEP mode as the processor clock.

In addition, it is possible to use the VDDLP pin on the board-to-board connector to backup the RTC from an external capacitor or a battery (rechargeable or non-chargeable). The capacitor is charged from the BATT+ line of HC25. If the voltage supply at BATT+ is disconnected, the RTC can be powered by the capacitor. The size of the capacitor determines the duration of buffering when no voltage is applied to HC25, i.e. the greater the capacitor the longer HC25 will save the date and time.

3.6 USB Interface

HC25 supports a USB 2.0 Full Speed (12Mbit/s) device interface. A USB host has to support at least 6 „Message Pipes“ (see “Universal Serial Bus Specification Revision 2.0“[1] for a definition of the term „Message Pipe“) to work with the HC25 USB interface.

The USB I/O-pins are capable of driving the signal at min 3.0V. They are 5V I/O compliant.

The module's USB interface is powered by VUSB. VUSB must be supplied by the USB host in the range 4.5V to 5.25V The maximum load on VUSB is 10mA.

While the USB connection is active, the module will not change into SLEEP Mode. To enable switching into SLEEP mode the USB host must bring its USB interface into Suspend state (see “Universal Serial Bus Specification Revision 2.0“[1] for a description of the Suspend state). On incoming calls HC25 will then generate a remote wake up request to resume the USB connection.

This can be realized by means of the HOST_WAKEUP line in addition to the normal USB remote wakeup mechanism. If no call, data or message transfer is in progress, the HOST_WAKEUP line is inactive. To save power, the host could then shut down its own USB interface. If a call or other request (URC's, messages) arrives, the host can be woken up again by activation of HOST_WAKEUP (inactive to active low transition).

For more information on the USB related pins see Table 21. For more information on how to configure the USB interface by means of AT commands see [1]. For a detailed description of the USB interface see [7].

1. The specification is ready for download on http://www.usb.org/developers/docs/

3.7 UICC/SIM Interface

HC25 has an integrated UICC/SIM interface compatible with the 34.121 USIM Testing IC Card standard. This is wired to the host interface (board-to-board connector) in order to be connected to an external SIM card holder. Six pins on the board-to-board connector are reserved for the UICC/SIM interface.

The UICC/SIM interface supports 3V and 1.8V UICC cards. Please refer to Table 21 for electrical specifications of the UICC/SIM interface lines depending on whether a 3V or 1.8V SIM card is used.

The CCIN pin serves to detect whether a tray (with SIM card) is present in the card holder. Using the CCIN pin is mandatory for compliance with the GSM 11.11 recommendation, if the mechanical design of the host application allows the user to remove the SIM card during operation. To take advantage of this feature, an appropriate SIM card detect switch is required on the card holder. For example, this is true for the model supplied by Molex, which has been tested to operate with HC25 and is part of the Siemens reference equipment submitted for type approval. See Section 9.1 for Molex ordering numbers.

Table 10: Signals of the UICC/SIM interface (board-to-board connector)

Signal	Description
CCGND	Separate ground connection for SIM card to improve EMC. Be sure to use this ground line for the SIM interface rather than any other ground pin or plane on the module.
CCCLK	Chip card clock.
CCVCC	SIM supply voltage.
CCIO	Serial data line, input and output.
CCRST	Chip card reset.
CCIN	Input on the baseband processor for detecting a SIM card tray in the holder. If the SIM is removed during operation the SIM interface is shut down immediately to prevent destruction of the SIM. The CCIN pin is active low. The CCIN pin is mandatory for applications that allow the user to remove the SIM card during operation. The CCIN pin is solely intended for use with a SIM card. It must not be used for any other purposes. Failure to comply with this requirement may invalidate the type approval of HC25.

Note: No guarantee can be given, nor any liability accepted, if loss of data is encountered after removing the SIM card during operation. Also, no guarantee can be given for properly initializing any SIM card that the user inserts after having removed a SIM card during operation. In this case, the application must restart HC25.

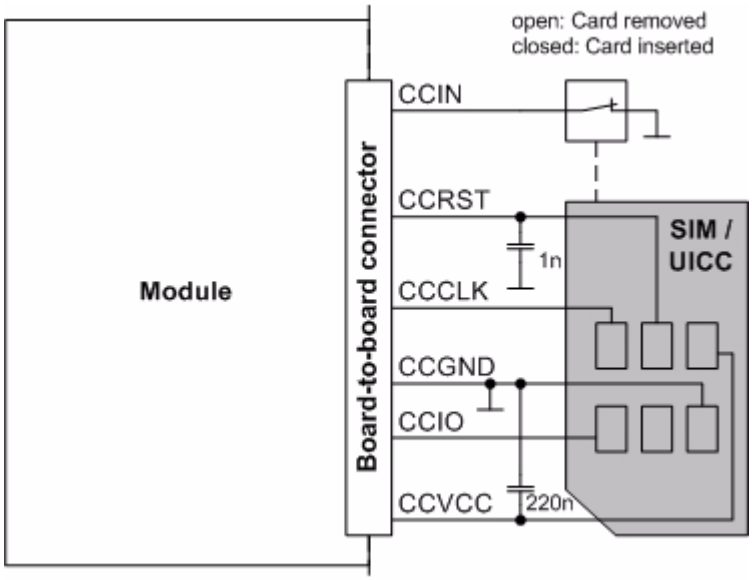


Figure 10: UICC/SIM interface

The total cable length between the board-to-board connector pins on HC25 and the pins of the external SIM card holder must not exceed 100mm in order to meet the specifications of 3GPP TS 51.010-1 and to satisfy the requirements of EMC compliance.

To avoid possible cross-talk from the CCCLK signal to the CCIO signal be careful that both lines are not placed closely next to each other. A useful approach is using the CCGND line to shield the CCIO line from the CCCLK line.

3.8 Analog Audio Interface

HC25 supports an analog audio interface with a balanced microphone input and a balanced loudspeaker output. The following picture shows a simplified block diagram:

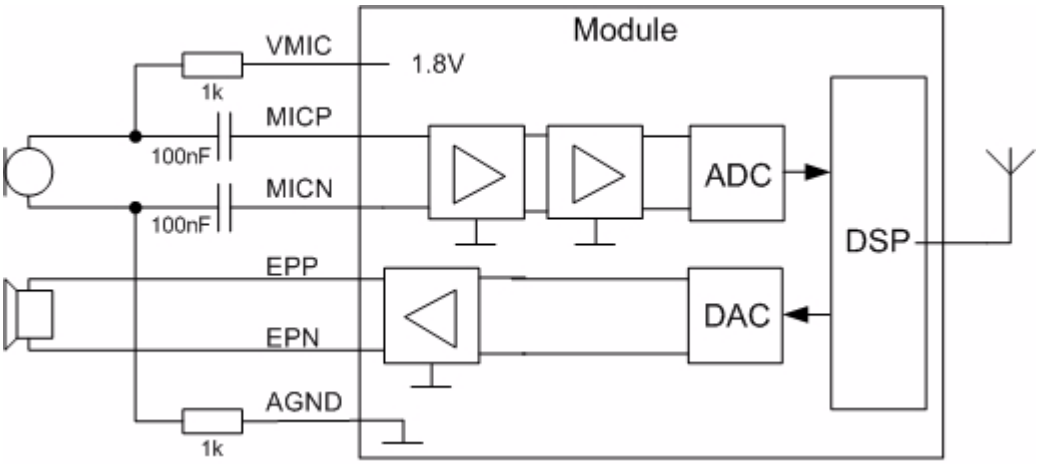


Figure 11: Audio block diagram

A power supply for electret microphones is available via VMIC at the board-to-board connector. VMIC is capable to drive a current of 1mA at a voltage of typically 1.8V. The microphone should be fed symmetrically between VMIC and AGND. AGND provides for an extra connection to the modules ground potential to avoid disturbing the microphone by high power supply current ripple. Coupling capacitors have to be used before the pins MICP and MICN.

Microphone signals are fed via the MICP and MICN pins to an analog-to-digital converter (ADC) and the DSP. The DSP application core calculates e.g. digital gains, sidetone, echo cancellation or noise suppression depending on the current configuration of the audio path. The processed speech samples are passed to the speech encoder.

Received samples from the speech decoder are passed to the digital-to-analog converter (DAC) after post processing (frequency response correction, adding sidetone etc.). The loudspeaker signal is routed via EPP and EPN pins. No gain setting is available in the earphone amplifier. The volume is controlled in the digital data stream by the DSP only.

In order to support different types of equipment, the audio interface can be configured with different audio modes via the AT^SNFS command. The electrical characteristics of the voiceband part vary with the audio mode. For example, sending and receiving amplification, sidetone paths, noise suppression etc. depend on the selected mode and can be set with AT commands. The default audio mode (AT^SNFS=1) is intended to be used with the audio interface. This default configuration is optimized for the Votronic HH-SI-30.3/V1.1/0 handset and used for type approving the Siemens reference configuration. Audio mode 1 has fixed parameters that cannot be modified (see also Section 5.7).

Detailed instructions on using AT commands to configure audio modes are to be found in Section 5.7 and [1].

3.9 PWR_IND Signal

PWR_IND notifies the on/off state of the module. High state of PWR_IND indicates that the module is switched off. The state of PWR_IND immediately changes to low when IGT is pulled low. For state detection an external pull-up resistor is required.

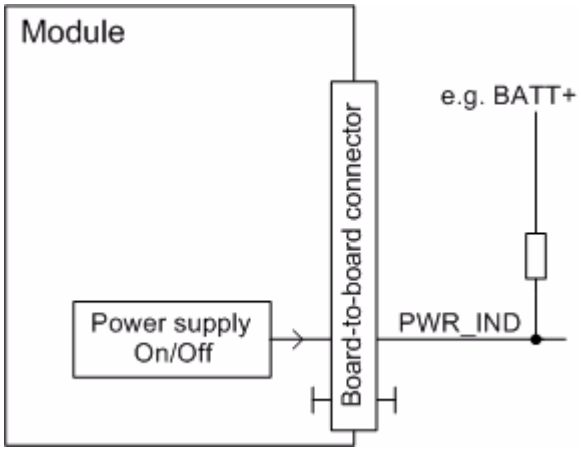


Figure 12: PWR_IND signal

3.10 Network Connectivity Status Signals

Two status signals are provided for signalling the module's network connectivity status - STATUS0 to signal the GSM connectivity and STATUS1 to signal the UMTS connectivity. Each signal acts as a current sink and can be used to control externally connected LEDs. For electrical characteristics see Table 21.

Additional pull up resistors or LED's are required as shown in the below sample circuit for a status LED:

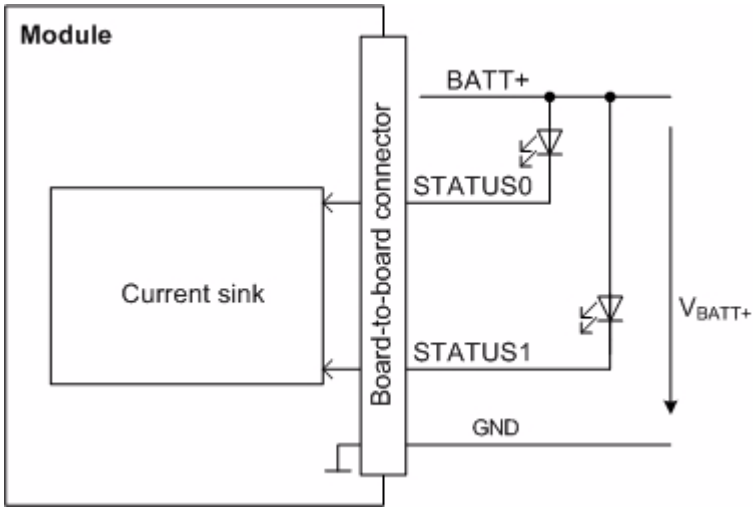


Figure 13: Status LED Circuit (example)

Please ensure that the voltage applied at the status pins does not exceed BATT+.
This status function has to be activated with AT^SLED. For details on the command and the indicated states see [1].

4 Antenna Interface

The RF interface has an impedance of 50Ω. HC25 is capable of sustaining a total mismatch at the antenna connector or pad without any damage, even when transmitting at maximum RF power.

The external antenna must be matched properly to achieve best performance regarding radiated power, DC-power consumption, modulation accuracy and harmonic suppression. Antenna matching networks are not included on the HC25 PCB and should be placed in the host application.

Regarding the return loss HC25 provides the following values in the active band:

Table 11: Return loss in the active band

State of module	Return loss of module	Recommended return loss of application
Receive	≥ 8dB	≥ 12dB
Transmit	not applicable	≥ 12dB
Idle	≤ 5dB	not applicable

The connection of the antenna or other equipment must be decoupled from DC voltage. This is necessary because the antenna connector is DC coupled to ground via an inductor for ESD protection.

Note: The antenna must be isolated for ESD protection (to withstand a voltage resistance up to 8kV air discharge).

4.1 Antenna Installation

To suit the physical design of individual applications HC25 offers two alternative approaches to connecting the antenna:

- Recommended approach: U.FL-R-SMT antenna connector from Hirose assembled on the top side of the PCB. See Section 4.3 for connector details.
- Antenna pad and grounding plane placed on the bottom side. See Section 4.2.

The U.FL-R-SMT connector has been chosen as antenna reference point (ARP) for the Siemens reference equipment submitted to type approve HC25. All RF data specified throughout this manual are related to the ARP.

IMPORTANT: Both solutions can only be applied alternatively. This means, whenever an antenna is plugged to the Hirose connector, the pad must not be used. Vice versa, if the antenna is connected to the pad, then the Hirose connector must be left empty.

No matter which option you choose, ensure that the antenna pad does not come into contact with the holding device or any other components of the host application. It needs to be surrounded by a restricted empty area. The free space must also be reserved 1.4mm in height.

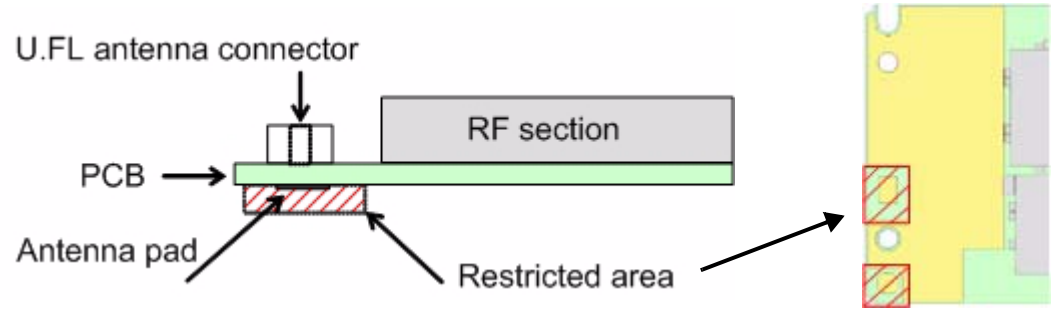


Figure 14: Restricted area around antenna pad (side and bottom view)

4.2 Antenna Pad

The antenna can be attached via contact springs.

If you decide to use the antenna pad take into account that the pad has not been intended as antenna reference point (ARP) for the Siemens HC25 type approval. The antenna pad is provided only as an alternative option which can be used, for example, if the recommended Hirose connection does not fit into your antenna design.

Also, consider that according to the GSM recommendations TS 45.005 and TS 51.010-01 a 50Ω connector is mandatory for type approval measurements. This requires GSM devices with an integral antenna to be temporarily equipped with a suitable connector or a low loss RF cable with adapter.

HC25 material properties:
HC25 PCB: FR4
Antenna pad: Gold plated pad

4.3 Antenna Connector

HC25 uses an ultra-miniature SMT antenna connector supplied from Hirose Ltd. The product name is:

- U.FL-R-SMT

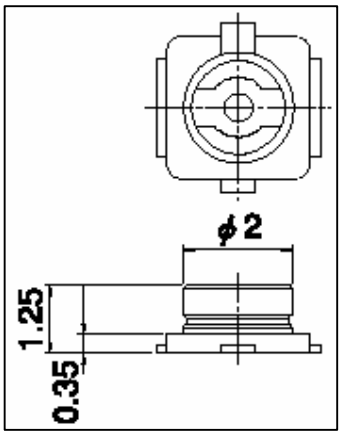


Figure 15: Mechanical dimensions of U.FL-R-SMT connector

Table 12: Product specifications of U.FL-R-SMT connector

Item	Specification	Conditions
Ratings		
Nominal impedance	50Ω	Operating temp:-40°C to + 90°C Operating humidity: max. 90%
Rated frequency	DC to 3GHz	
Mechanical characteristics		
Female contact holding force	0.15N min	Measured with a Ø 0.475 pin gauge
Repetitive operation	Contact resistance: Center 25mΩ Outside 15mΩ	30 cycles of insertion and disengage-ment
Vibration	No momentary disconnections of 1µs; No damage, cracks and looseness of parts	Frequency of 10 to 100Hz, single amplitude of 1.5mm, acceleration of 59m/s^2, for 5 cycles in the direction of each of the 3 axes
Shock	No momentary disconnections of 1µs. No damage, cracks and looseness of parts.	Acceleration of 735m/s^2, 11ms duration for 6 cycles in the direction of each of the 3 axes
Environmental characteristics		
Humidity resistance	No damage, cracks and looseness of parts. Insulation resistance: 100MΩ min. at high humidity 500MΩ min. when dry	Exposure to 40°C, humidity of 95% for a total of 96 hours

Table 12: Product specifications of U.FL-R-SMT connector

Item	Specification	Conditions
Temperature cycle	No damage, cracks and looseness of parts. Contact resistance: Center 25mΩ Outside 15mΩ	Temperature: +40°C → 5 to 35°C → +90°C → 5 to 35°C Time: 30min → within 5min → 30min within 5min
Salt spray test	No excessive corrosion	48 hours continuous exposure to 5% salt water

Table 13: Material and finish of U.FL-R-SMT connector and recommended plugs

Part	Material	Finish
Shell	Phosphor bronze	Silver plating
Male center contact	Brass	Gold plating
Female center contact	Phosphor bronze	Gold plating
Insulator	Plug: PBT Receptacle: LCP	Black Beige

Mating plugs and cables can be chosen from the Hirose U.FL Series. Examples are shown below and listed in Table 14. For latest product information please contact your Hirose dealer or visit the Hirose home page, for example http://www.hirose.com.

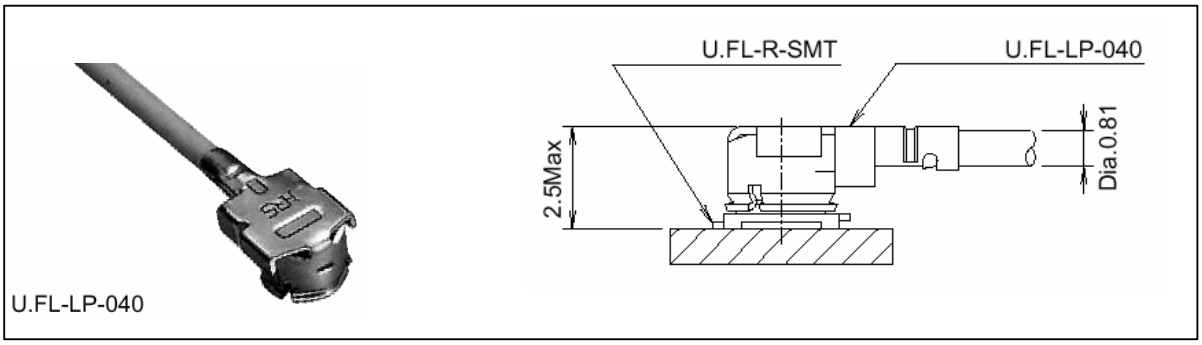


Figure 16: U.FL-R-SMT connector with U.FL-LP-040 plug

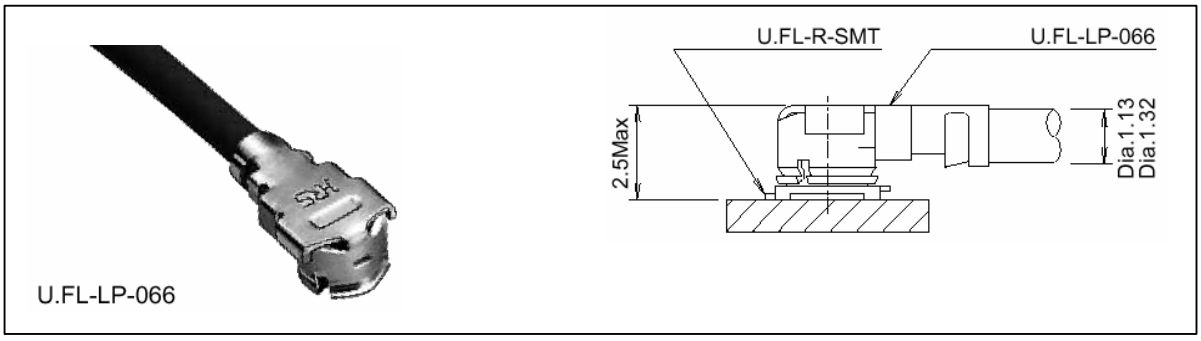


Figure 17: U.FL-R-SMT connector with U.FL-LP-066 plug

In addition to the connectors illustrated above, the U.FL-LP-(V)-040(01) version is offered as an extremely space saving solution. This plug is intended for use with extra fine cable (up to Ø 0.81mm) and minimizes the mating height to 2mm. See Figure 18 which shows the Hirose datasheet.

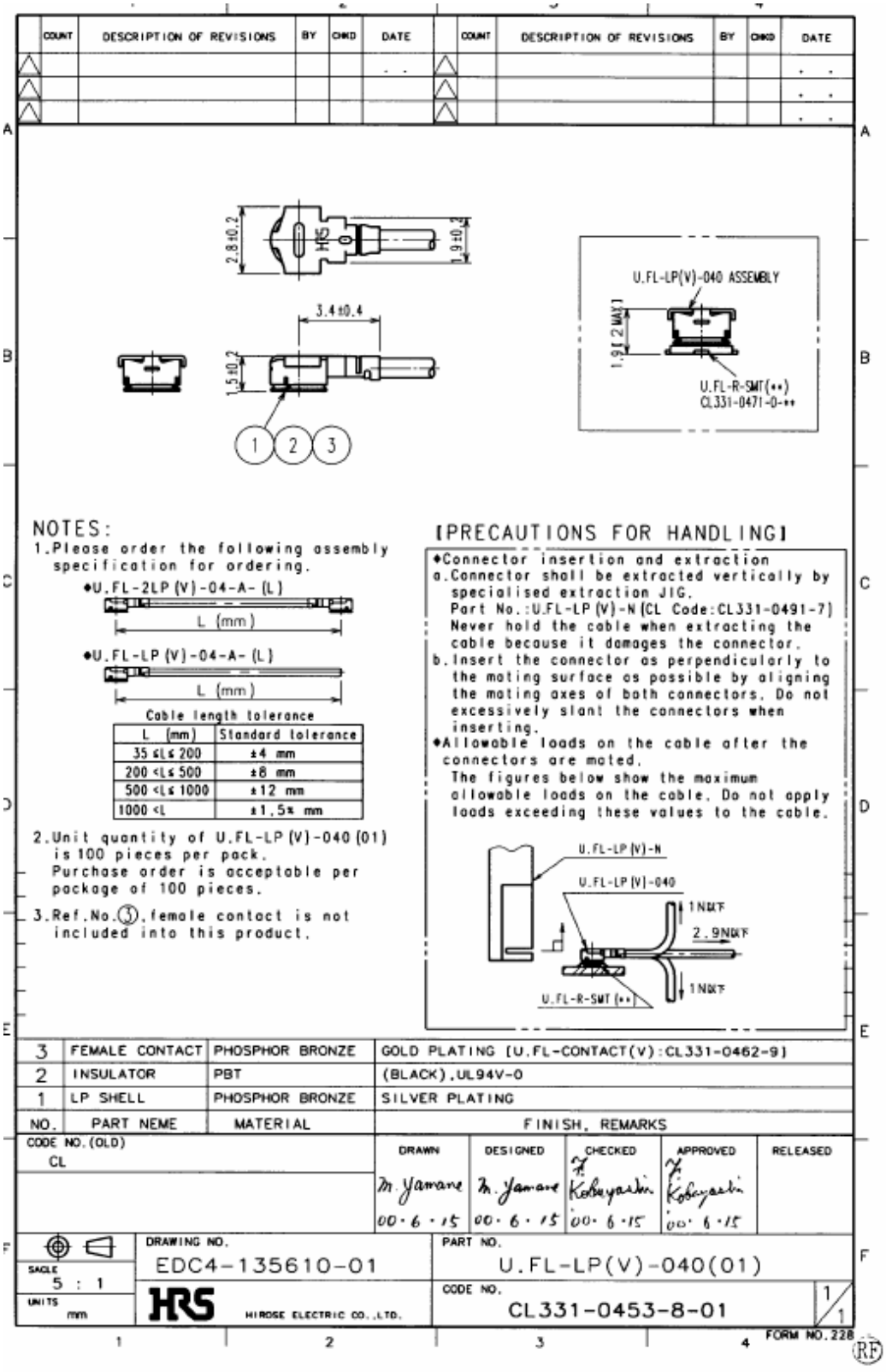


Figure 18: Specifications of U.FL-LP-(V)-040(01) plug

Table 14: Ordering information for Hirose U.FL Series

Item	Part number	HRS number
Connector on HC25	U.FL-R-SMT	CL331-0471-0-10
Right-angle plug shell for Ø 0.81mm cable	U.FL-LP-040	CL331-0451-2
Right-angle plug for Ø 0.81mm cable	U.FL-LP(V)-040 (01)	CL331-053-8-01
Right-angle plug for Ø 1.13mm cable	U.FL-LP-068	CL331-0452-5
Right-angle plug for Ø 1.32mm cable	U.FL-LP-066	CL331-0452-5
Extraction jig	E.FL-LP-N	CL331-04441-9

5 Electrical, Reliability and Radio Characteristics

5.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 15 are stress ratings under any conditions. Stresses beyond any of these limits will cause permanent damage to HC25.

Table 15: Absolute maximum ratings

Parameter	Min	Max	Unit
Supply voltage BATT+	-0.3	4.5	V
Voltage at digital pins in POWER DOWN mode	-0.3	0.3	V
Voltage at digital pins in normal operation	-0.3	2.8	V
Voltage at analog pins in POWER DOWN mode	-0.3	0.3	V
Voltage at analog pins in normal operation	-0.3	2.5	V
Voltage at STATUSx pins	-0.5	7.5	V
VUSB	-0.3	7.5	V
USB_DP, USB_DN	-0.3	7.5	V
PWR_IND	-0.3	10	V
VDDLP	-0.3	3.25	V

5.2 Operating Temperatures

The values stated below are in compliance with GSM recommendation TS 51.010-01.

Table 16: Board temperature

Parameter	Min	Typ	Max	Unit
Operating temperature range	-20	+25	+85	°C
Automatic shutdown[1] Temperature measured on HC25 board	< -30	---	>+85	°C

1. Due to temperature measurement uncertainty, a tolerance on the stated shutdown thresholds may occur. The possible deviation is in the range of ± 3°C at the overtemperature limit and ± 5°C at the undertemperature limit.

Table 16 shows the temperatures for automatic shutdown as measured by the on-board measuring element NTC. The maximum allowable ambient temperature that causes the module to shut down depends on various conditions. The following tables Table 17 and Table 18 show sample lab environment conditions. Please be aware that the operating duration and the maximum ambient temperature will vary significantly for your application.

Table 17: Sample operating conditions without forced air circulation (according to IEC 60068-2)[1]

Mode	Ambient Temperature	Voltage	RF Power	Operating Duration
GSM, GPRS/EDGE Class 8	+65°C	$V_{BATT+} \leq 3.8V$	Max.	∞
WCDMA	+55°C	$V_{BATT+} \leq 3.4V$	≤ 10dBm	∞
WCDMA	+65°C	$V_{BATT+} \leq 3.4V$	≤ 0dBm	∞
GRPS/EDGE Class10	+65°C	$V_{BATT+} \leq 3.8V$	Max.	≤ 2min
WCDMA	+65°C	$V_{BATT+} \leq 3.8V$	Max.	≤ 2min

1. The thermal resistance of the module (board-to-ambient) was measured to be R_{th}=20K/W

Table 18: Sample operating conditions with forced air circulation (air speed 0.9m/s)[1]

Mode	Ambient Temperature	Voltage	RF Power	Operating Duration
GSM, GPRS/EDGE Class 8	+75°C	$V_{BATT+} \leq 3.8V$	Max.	∞
WCDMA	+60°C	$V_{BATT+} \leq 3.4V$	≤ 10dBm	∞
WCDMA	+70°C	$V_{BATT+} \leq 3.4V$	≤ 0dBm	∞
GRPS/EDGE Class 10	+65°C	$V_{BATT+} \leq 3.8V$	Max.	∞
WCDMA	+60°C	$V_{BATT+} \leq 3.4V$	Max.	∞

1. The thermal resistance of the module (board-to-ambient) was measured to be R_{th}=7K/W

Note: Generally it is strongly recommended to implement additional measures to lead the heat out of the application, especially at maximum transmission power levels of WCDMA, e.g. use of ground area for a heat sink or convection (see Section 6.1 for the ground area that may be used for a heat sink).

5.3 Storage Conditions

The conditions stated below are only valid for modules in their original packed state in weather protected, non-temperature-controlled storage locations. Normal storage time under these conditions is 12 months maximum.

Table 19: Storage conditions

Type	Condition	Unit	Reference
Air temperature: Low High	-40 +85	°C	ETS 300 019-2-1: T1.2, IEC 68-2-1 Ab ETS 300 019-2-1: T1.2, IEC 68-2-2 Bb
Humidity relative: Low High Condens.	10 90 at 30°C 90-100 at 30°C	%	--- ETS 300 019-2-1: T1.2, IEC 68-2-56 Cb ETS 300 019-2-1: T1.2, IEC 68-2-30 Db
Air pressure: Low High	70 106	kPa	IEC TR 60271-3-1: 1K4 IEC TR 60271-3-1: 1K4
Movement of surrounding air	1.0	m/s	IEC TR 60271-3-1: 1K4
Water: rain, dripping, icing and frosting	Not allowed	---	---
Radiation: Solar Heat	1120 600	W/m^2	ETS 300 019-2-1: T1.2, IEC 68-2-2 Bb ETS 300 019-2-1: T1.2, IEC 68-2-2 Bb
Chemically active substances	Not recom-mended		IEC TR 60271-3-1: 1C1L
Mechanically active substances	Not recom-mended		IEC TR 60271-3-1: 1S1
Vibration sinusoidal: Displacement Acceleration Frequency range	 1.5 5 2-9 9-200	 mm m/s^2 Hz	IEC TR 60271-3-1: 1M2
Shocks: Shock spectrum Duration Acceleration	 semi-sinusoidal 1 50	 ms m/s^2	IEC 68-2-27 Ea

5.4 Reliability Characteristics

The test conditions stated below are an extract of the complete test specifications.

Table 20: Summary of reliability test conditions

Type of test	Conditions	Standard
Vibration	Frequency range: 10-20Hz; acceleration: 3.1mm amplitude Frequency range: 20-500Hz; acceleration: 5g Duration: 2h per axis = 10 cycles; 3 axes	DIN IEC 68-2-6
Shock half-sinus	Acceleration: 500g Shock duration: 1msec 1 shock per axis 6 positions (± x, y and z)	DIN IEC 68-2-27
Dry heat	Temperature: +70 ±2×C Test duration: 16h Humidity in the test chamber: < 50%	EN 60068-2-2 Bb ETS 300 019-2-7
Temperature change (shock)	Low temperature: -40×C ±2×C High temperature: +85×C ±2×C Changeover time: < 30s (dual chamber system) Test duration: 1h Number of repetitions: 100	DIN IEC 68-2-14 Na ETS 300 019-2-7
Damp heat cyclic	High temperature: +55×C ±2×C Low temperature: +25×C ±2×C Humidity: 93% ±3% Number of repetitions: 6 Test duration: 12h + 12h	DIN IEC 68-2-30 Db ETS 300 019-2-5
Cold (constant exposure)	Temperature: -40 ±2×C Test duration: 16h	DIN IEC 68-2-1

5.5 Pin Assignment and Signal Description

The board-to-board connector on HC25 is a 50-pin double-row receptacle (see also Chapter 6). The pin assignment for HC25 is shown below:

1	CCCLK	VMIC	50
2	CCVCC	MICP	49
3	CCIO	MICN	48
4	CCRST	EPP	47
5	CCIN	EPN	46
6	CCGND	AGND	45
7	Do not use	Do not use	44
8	Do not use	Do not use	43
9	Do not use	Do not use	42
10	GND	IGT	41
11	PWR_IND	EMERG_OFF	40
12	STATUS0	Do not use	39
13	STATUS1	Do not use	38
14	VUSB	Do not use	37
15	USB_DP	Do not use	36
16	USB_DN	Do not use	35
17	Do not use	Do not use	34
18	VDDLP	Do not use	33
19	Do not use	HOST_WAKEUP	32
20	Do not use	VEXT	31
21	GND	BATT+	30
22	GND	BATT+	29
23	GND	BATT+	28
24	GND	BATT+	27
25	GND	BATT+	26

Figure 19: Pin assignment HC25

The following table describes the signal pins available over the application interface via the board-to-board interface.

Table 21: Signal description

Function	Signal name	IO	Signal form and level	Comment
Power supply	BATT+	I	$V_I$max = 4.2V $V_I$norm = 3.8V $V_I$min = 3.2V during Tx burst (GSM) on board I ≈ 2A, during Tx burst (GSM)  n Tx = n x 577µs peak current every 4.616ms	Pins of BATT+ and GND must be connected in parallel for supply purposes because higher peak currents may occur. Minimum voltage must not fall below 3.2V including drop, ripple, spikes. Overvoltage shutdown takes effect if BATT+ = 4.3V ± 2%.
Power supply	GND		Ground	Application Ground
External supply voltage	VEXT	O	$V_O$typ = 2.6V ± 3% $I_O$max = 50mA	VEXT may be used for application circuits. If unused keep pin open. Not available in Power-down mode. The external digital logic must not cause any spikes or glitches on voltage VEXT.
Power indicator	PWR_IND	O	V_{IH}max = 10V V_{OL}max = 0.4V at Imax = 2mA	PWR_IND (Power Indicator) notifies the module's on/off state. PWR_IND is an open collector that needs to be connected to an external pull-up resistor. Low state of the open collector indicates that the module is on. Vice versa, high level notifies the power-down mode. Therefore, the pin may be used to enable external voltage regulators which supply an external logic for communication with the module, e.g. level converters.

Table 21: Signal description

Function	Signal name	IO	Signal form and level	Comment
Ignition	IGT	I	Internal pull-up: $R_I \approx 200k\Omega$, $C_I \approx 1nF$ V_{IL}max = 0.8V at Imax = -25µA V_{OH}max = 4.2V (V_{BATT+}) IGT as ON switch: ~~~|____|~~~Active Low 300ms < t < 1s IGT as ON/OFF switch: ON OFF ~~~~|_____|~~~~~~~~~~~~|_____|~~~ | 300ms-1s | >5s | ≥ 2s |	This signal switches the module ON and OFF. This line must be driven low by an open drain or open collector driver.
Emergency off	EMERG_OFF	I	Internal pull-up: $R_I \approx 6.6k\Omega$ V_{IL}max = 0.6V at Imax = -0.4mA V_{OH}min = 2.0V V_{OH}max = 2.7V For emergency off (power down): Signal ~~~|_____|~~~ Pull down ≥ 2.5s	This line must be driven low. This line must be driven low by an open drain or open collector driver. If unused keep pin open.
Status	STATUS0	O	current sink Isink= 20mA ±20% V_{OH}max=V_{BATT+} VOLmax=0.5V	Connectivity Status e.g. for ext. LED circuits
	STATUS1	O		
RTC backup	VDDLP	I/O	VOmax = 3.20V while BATT+ > 3.5V VI = 1.5V…3.25V at Imax = 3 µA while BATT+ = 0V	If unused keep pin open.
SIM Detected	CCIN	I	$R_I \approx 110k\Omega$ V_{IL}max = 0.5V at I = -25µA V_{IH}min = 2.2V at I = -5µA, V_{OH}max = V_{IH}max = 2.95V	CCIN = Low, SIM card holder closed
3V SIM/ UICC Interface	CCRST	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 2.6V at I = -1mA V_{OH}max = 3.10V	Maximum cable length or copper track 100mm to SIM card holder. All signals of SIM interface are protected against ESD with a special diode array. Usage of CCGND is mandatory.
	CCIO	I/O	$R_I \approx 5k\Omega$ V_{IL}max = 0.8V V_{IL}min = -0.3V V_{IH}min = 2.05V V_{IH}max = 3.10V V_{OL}max = 0.25V at I = 1mA V_{OH}min = 2.4V at I = -0.1mA V_{OH}max = 3.10V	
	CCCLK	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 2.60V at I = -1mA V_{OH}max = 3.10V	
	CCVCC	O	$V_O$min = 2.90V $V_O$typ = 3.00V $V_O$max = 3.10V $I_O$max = -50mA	
	CCGND		Ground	

Table 21: Signal description

Function	Signal name	IO	Signal form and level	Comment
1.8V SIM/ UICC Interface	CCRST	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 1.50V at I = -1mA V_{OH}max = 1.85V	Maximum cable length or copper track 100mm to SIM card holder. All signals of SIM interface are protected against ESD with a special diode array. Usage of CCGND is mandatory.
	CCIO	I/O	$R_I \approx 5k\Omega$ V_{IL}max = 0.50V V_{IL}min = -0.3V V_{IH}min = 1.20V V_{IH}max = 1.85V V_{OL}max = 0.25V at I = 1mA V_{OH}min = 1.25V at I = -0.1mA V_{OH}max = 1.85V	
	CCCLK	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 1.50V at I = -1mA V_{OH}max = 1.85V	
	CCVCC	O	$V_O$min = 1.75V $V_O$typ = 1.80V $V_O$max = 1.85V $I_O$max = -50mA	
	CCGND		Ground	
USB	VUSB	I	V_{IN}min = 4.5V V_{IN}max = 5.25V Active current: $I_I$typ = 2.5mA $I_I$max = 10mA Suspend current: $I_I$typ = 450µA	If lines are unused keep pins open
	USB_DP USB_DN	I/O I/O	Input sensitivity (Diff), |D+ - D-|, V_{IN} = 0.8V to 2.5V: 0.2V min Common mode range (Diff), V_{IN} = 0.8V to 2.5V Receiver threshold (single-end), $V_{threshold}$min = 0.8V $V_{threshold}$max = 2.0V Receiver hysteresis, V_{hys}typ = 200mV	
Wakeup control	HOST_WAKEUP	O	V_{OL}max = 0.45V at I = 2mA V_{OH}min = 2.05V at I = -2mA V_{OH}max = 2.7V	With a signal transition from inactive to active low the module expects the host to wake up into an active state. If unused keep pin open.

Table 21: Signal description

Function	Signal name	IO	Signal form and level	Comment
Analog Audio Interface	VMIC	O	$V_O$min = 1.69V $V_O$typ = 1.80V $V_O$max = 1.91V I_{min} = 1.0 mA, I_{typ} = 1.07mA at 1.69k resistive load	Microphone supply for customer feeding circuits If unused keep pin open.
	EPP	O	Differential, typ. 70mW at 32Ω load and PCM level = +3dBm0, 1.02 kHz sine wave Output common mode voltage 1.25V ±0.125V	Balanced output for ear-phone or balance output for line out. If unused keep pins open.
	EPN	O		
	MICP	I	$R_I$min = 16kΩ $R_I$typ = 20kΩ $R_I$max = 24kΩ Input DC common mode V_{IDC}min = 1.13V V_{IDC}typ = 1.25V V_{IDC}max = 1.38V	Balanced differential microphone with external feeding circuit (using VMIC and AGND) or balanced differential line input. Coupling capacitors required. If unused keep pins open.
	MICN	I		
	AGND		Analog Ground	GND level for external audio circuits.

5.6 Power Supply Ratings

Table 22: Power supply ratings

	Description	Conditions	Min	Typ	Max	Unit
BATT+	Supply voltage	Directly measured at Module Voltage must stay within the min/max values, including voltage drop, ripple, spikes.	3.2	3.8	4.2	V
	Maximum allowed voltage drop during transmit burst	Normal condition, power control level for $P_{out\ max}$			400	mV
	Voltage ripple	Normal condition, power control level for $P_{out\ max}$ @ f<400kHz @ f>400kHz			 50 10	 mV mV
I_{VDDLP} @3V	OFF State supply current	RTC Backup @BATT+ = 0V		3		µA
I_{BATT+}	OFF State supply current	POWER DOWN		50		µA
	Average GSM / GPRS supply current[1]	SLEEP (USB Suspend) @DRX=9		2.4[2]		mA
		SLEEP (USB Suspend) @DRX=5		3.0[2]		mA
		SLEEP (USB Suspend) @DRX=2		4.8[2]		mA
		IDLE (USB active) @DRX=2		45[2]		mA
		Voice Call GSM850/900; PCL=5		350		mA
		GPRS Data transfer GSM850/900; PCL=5; 1Tx/4Rx		375		mA
		GPRS Data transfer GSM850/900; PCL=5; 2Tx/3Rx		540		mA
		EDGE Data transfer GSM850/900; PCL=5; 1Tx/4Rx		315		mA
		EDGE Data transfer GSM850/900; PCL=5; 2Tx/3Rx		410		mA
		Voice Call GSM1800/1900; PCL=0		315		mA
		GPRS Data transfer GSM1800/1900; PCL=0; 1Tx/4Rx		325		mA
		GPRS Data transfer GSM1800/1900; PCL=0; 2Tx/3Rx		430		mA
		EDGE Data transfer GSM1800/1900; PCL=0; 1Tx/4Rx		290		mA
		EDGE Data transfer GSM1800/1900; PCL=0; 2Tx/3Rx		355		mA

Table 22: Power supply ratings

	Description	Conditions	Min	Typ	Max	Unit
I_{BATT+}	Peak current during GSM transmit burst	VOICE Call GSM850/900; PCL=5		1.8[1]	2.9[3]	A
		VOICE Call GSM1800/1900; PCL=0		1.5[1]	2.1[3]	A
	Average WCDMA supply current	SLEEP (USB Suspend) @DRX=9		2.0[2]		mA
		SLEEP (USB Suspend) @DRX=8		2.5[2]		mA
		SLEEP (USB Suspend) @DRX=6		4.7[2]		mA
		Idle (USB active) @ DRX=6		35[2]		mA
		UMTS Data transfer Band I @+10dBm		390		mA
		HSDPA Data transfer Band I @+10dBm		450		mA
		UMTS Data transfer Band I @+23dBm		750	820[3]	mA
		HSDPA Data transfer Band I @+23dBm		775		mA
		UMTS Data transfer Band II @+10dBm		455		mA
		HSDPA Data transfer Band II @+10dBm		500		mA
		UMTS Data transfer Band II @+23dBm		810	930	mA
		HSDPA Data transfer Band II @+23dBm		850		mA
		UMTS Data transfer Band V @+10dBm		390		mA
		HSDPA Data transfer Band V @+10dBm		420		mA
		UMTS Data transfer Band V @+23dBm		620	790	mA
		HSDPA Data transfer Band V @+23dBm		640		mA
I_{VUSB}	USB transceiver supply current (average)	USB suspend		0.5		mA
		USB active		3		mA

1. With an impedance of Z_{LOAD}=50Ohm at the antenna connector
2. Without neighbouring cells; without t3212 timer occurance
3. Under total mismatch conditions at antenna connector

5.7 Electrical Characteristics of the Voiceband Part

5.7.1 Setting Audio Parameters by AT Commands

The audio modes 2 to 6 can be temporarily adjusted according to the AT command parameters listed in the table below. The audio parameters are set with the AT commands AT^SNFI as well as AT^SNFO and they are reset to their default values when the audio mode is changed by AT^SNFS (see [1]). For an model of how the parameters influence the audio signal path see Section 5.7.2.

Table 23: Audio parameters adjustable by AT command

Parameter	Influence to	Range	Gain range	Calculation
micAmp1	MICP/MICN first analogue amplifier gain of before ADC	0,1	0 or 24dB	1 step
micAmp2	MICP/MICN second analogue amplifier gain of before ADC	0…22	-6…25.5dB	1.5 dB steps
micTxVol	Digital gain of input signal after ADC	0, 1...65535	Mute, -84...+12dB	20 * log (micTXVol/ 16384)
cdcRXGain	Digital gain of output signal after summation of sidetone	0, 1...65535	Mute, -84...+12dB	20 * log (cdcRxGain/ 16384)
rxVol	Digital Volume of output signal after speech decoder, before summation of sidetone and DAC	0, 1…41	Mute, -48...+12dB	1.5 dB steps
stGain	Digital attenuation of sidetone	0, 1...65535	Mute, -96...0dB	20 * log (stGain/ 16384) -12

5.7.2 Audio Programming Model

The audio programming model shows how the signal path can be influenced by varying AT command parameters: AT^SNFI allows to set the parameters <micAmp1>, <micAmp2> and <micTxVol>, whereas the parameters <cdcRxGain>, <stGain> and <rxVol> can be adjusted with AT^SNFO. For more information on the AT commands and parameters see Section 5.7.1 and [1].

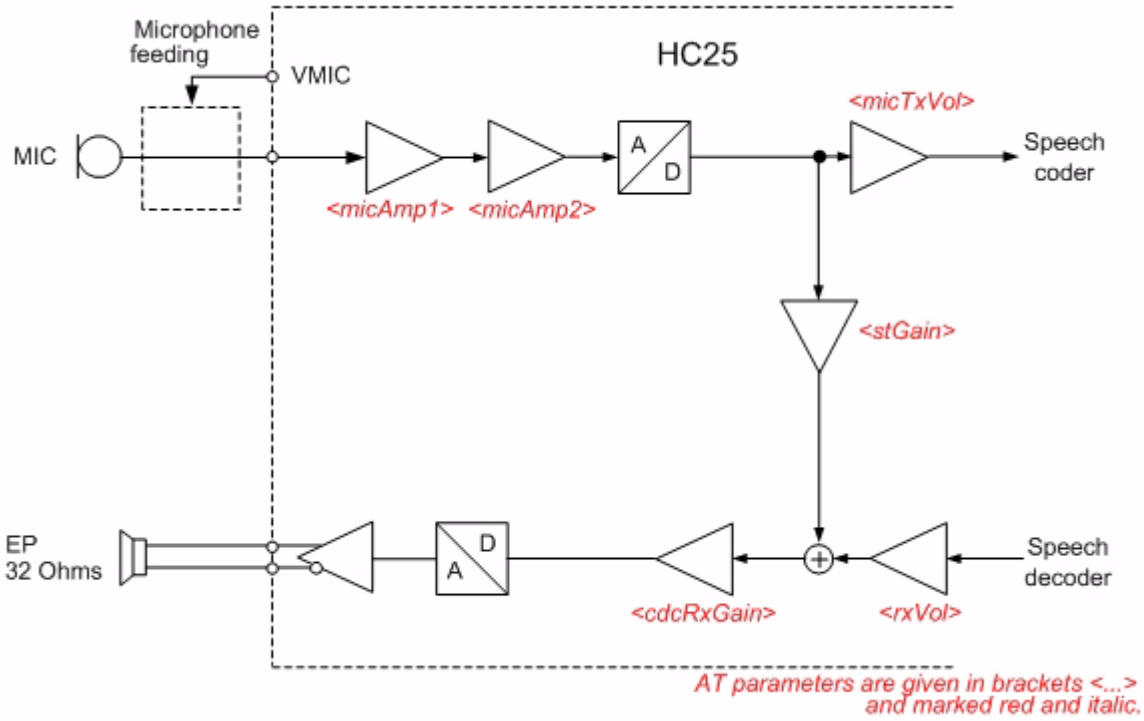


Figure 20: Audio programming model

5.7.3 Characteristics of Audio Modes

The electrical characteristics of the voiceband part depend on the current audio mode set with the AT^SNFS command. All values are noted for default gains e.g. all parameters of AT^SNFI and AT^SNFO are left unchanged.

Table 24: Voiceband characteristics (typical)

Audio mode no. AT^SNFS=	**1**	**2**	**3**	**4**	**5**	**6**
Name	Default Handset	Router	User Handset	Headset	Speaker phone	Transpar-ent
Purpose	DSB with Votronic handset	Analogue phone inter-face		Mono Headset	handheld speaker-phone	Direct access to speech coder
TX-Filters	Adjusted	Flat	Flat	Flat	Flat	Flat
RX-Filters	Adjusted to fit artificial ear type 3.2 low leakage	Flat	Adjusted to fit artificial ear type 3.2 low leakage	Flat	500 Hz HP	Flat
Gain setting:	Fix	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable
Default SNFI Parameters	1,11,16384	0,6,16384	1,11,16384	1,11,16384	1,11,16384	0,4,16384
Default SNFO Parameters	30862,33, 9025	7978,33,0	30862,33, 9025	7732,33, 12288	23198,33,0	16384,33, 0
Power supply VMIC	ON during call	ON during call	ON during call	ON during call	ON during call	ON during call
Sidetone	Fix	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable
Volume control	Fix	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable
Echo canceller Filter length Behaviour opti-mized for	ON 16ms low echo	ON 16ms low echo	ON 16ms low echo	ON 16ms moderate echo	ON 64ms high echo	OFF
Non Linear Proces-sor with Comfort Noise Generator	ON	ON	ON	ON	ON	OFF
Noise Reduction	-12dB	OFF	-12dB	-12dB	-12dB	OFF
MIC input signal for 0dBm0, [1] f = 1024 Hz	17.5mV	665mV	17.5mV	5mV	5mV	1036mV
EP output signal in mV rms. @ 0dBm0, 1024 Hz, no load (default gain) / @ 3.14 dBm0	508mV / 2.1Vpp	516mV / 2.1Vpp	508mV / 2.1Vpp	407mV / 1.68Vpp	1220mV / 4.5Vpp	1060mV / 4.3Vpp

Table 24: Voiceband characteristics (typical)

Audio mode no. AT^SNFS=	1	2	3	4	5	6
Sidetone gain at default settings	25.0dB	-∞ dB	25.0dB	25.3 dB	-∞ dB	-∞ dB

1. All values measured before the noise reduction attenuates the sine wave after a few seconds.

Note: With regard to acoustic shock, the cellular application must be designed to avoid sending false AT commands that might increase amplification, e.g. for a highly sensitive earpiece. A protection circuit should be implemented in the cellular application.

5.8 Voiceband Receive Path

Test conditions:

- The values specified below were tested to 1024Hz with default settings in audio mode 6 during a GSM EFR voice call unless otherwise stated.

Table 25: Voiceband receive path

Parameter	Min	Typ	Max	Unit	Test condition / remark
Maximum differential output voltage (peak to peak) EPP to EPN		4.0 4.3		V V	32Ω, no load, @ 3.14 dBm0 (Full Scale)
Nominal differential output voltage (peak to peak) EPP to EPN		2.8 3.0		V V	32Ω, no load, @ 0 dBm0 (Nominal level)
Output bias voltage		1.24		V	From EPP or EPN to AGND
Fine scaling by DSP (cdcRxGain)	-84		+12	dB	Set with AT^SNFO
Differential output load resistance	25.6	32		Ω	From EPP to EPN
Differential output load capacitance			300	pF	From EPP to EPN

5.9 Voiceband Transmit Path

Test conditions:

- The values specified below were tested to 1024 Hz and default settings in audio mode 6 during a GSM EFR unless otherwise stated.

Table 26: Voiceband transmit path

Parameter	Min	Typ	Max	Unit	Test condition / Remark
Full scale input voltage (peak to peak) for 3.14dBm0 MICP to MICN		4.2		V	balanced
Nominal input voltage (rms) for 0dBm0 MICP to MICN		1.036		V	balanced
Input amplifier 1 gain (micAmp1)	0		24	dB	Set with AT^SNFI
Input amplifier 2 gain in 1.5dB steps (micAmp2)	-6		25.5	dB	Set with AT^SNFI
Fine scaling by DSP (micTxVol)	-84		+12	dB	Set with AT^SNFI
Microphone supply voltage VMIC	1.69	1.8	1.91	V	
VMIC current		1	1.07	mA	At 1.69kOhm resistive load
Input DC common mode voltage	1.13	1.25	1.38	V	

5.10 Air Interface

Table 27: Air interface GSM / UMTS

Parameter	Conditions	Min.	Typical	Max.	Unit
HSDPA / UMTS connectivity	Band I, II, V				
UMTS Frequency range Uplink (UE to Node B)	UMTS 850 Band V	824		849	MHz
	UMTS 1900 Band II	1850		1910	MHz
	UMTS 2100 Band I	1920		1980	MHz
UMTS Frequency range Downlink (Node B to UE)	UMTS 850 Band V	869		894	MHz
	UMTS 1900 Band II	1930		1990	MHz
	UMTS 2100 Band I	2110		2170	MHz
Receiver Input Sensitivity @ ARP	UMTS 850 Band V		-109		dBm
	UMTS 1900 Band II		-107		dBm
	UMTS 2100 Band I		-108		dBm
RF Power@ ARP with 50Ohm Load	UMTS 850 Band V	+21	+23	+25	dBm
	UMTS 1900 Band II	+21	+23	+25	dBm
	UMTS 2100 Band I	+21	+23	+25	dBm
GPRS coding schemes	Class 10, CS1 to CS4				
EGPRS	Class 10, MCS1 to MCS9				
GSM Class	Small MS				
GSM Frequency range Uplink (MS to BTS)	GSM 850	824		849	MHz
	E-GSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
	GSM 1900	1850		1910	MHz
GSM Frequency range Downlink (BTS to MS)	GSM 850	869		894	MHz
	E-GSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
	GSM 1900	1930		1990	MHz
Static Receiver input Sensitivity @ ARP	GSM 850	-102	-108		dBm
	E-GSM 900	-102	-108		dBm
	GSM 1800	-102	-107		dBm
	GSM 1900	-102	-107		dBm
RF Power@ ARP with 50Ohm Load	GSM 850	31	32	35	dBm
	E-GSM 900	31	32	35	dBm
	GSM 1800	28	29.25	32	dBm
	GSM 1900	28	29.25	32	dBm

5.11 Electrostatic Discharge

The HC25 engine is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates a HC25 module.

Special ESD protection provided on HC25:
- SIM interface: clamp diodes for protection against over voltage.
- USB interface: clamp diodes for protection against over voltage.
- The remaining ports of HC25 are not accessible to the user of the final product (since they are installed within the device) and therefore, are only protected according to the “Human Body Model” requirements.

HC25 has been tested according to group standard ETSI EN 301 489-1 (see Table 3). The measured values can be gathered from the following table.

Table 28: Measured electrostatic values

Specification / Requirements	Contact discharge	Air discharge
ESD at SIM port	± 4kV	± 8kV
ESD at USB interface	± 4kV	± 8kV
Human Body Model (Test conditions: 1.5kΩ, 100pF)		
ESD at all other interfaces	± 1kV	± 1kV

Note: Please note that the values may vary with the individual application design. For example, it matters whether or not the application platform is grounded over external devices like a computer or other equipment, such as the Siemens reference application described in Section 8.1.

6 Mechanics

6.1 Mechanical Dimensions of HC25

Length:50.00mm
Width: 34.00mm
Height:4.5mm

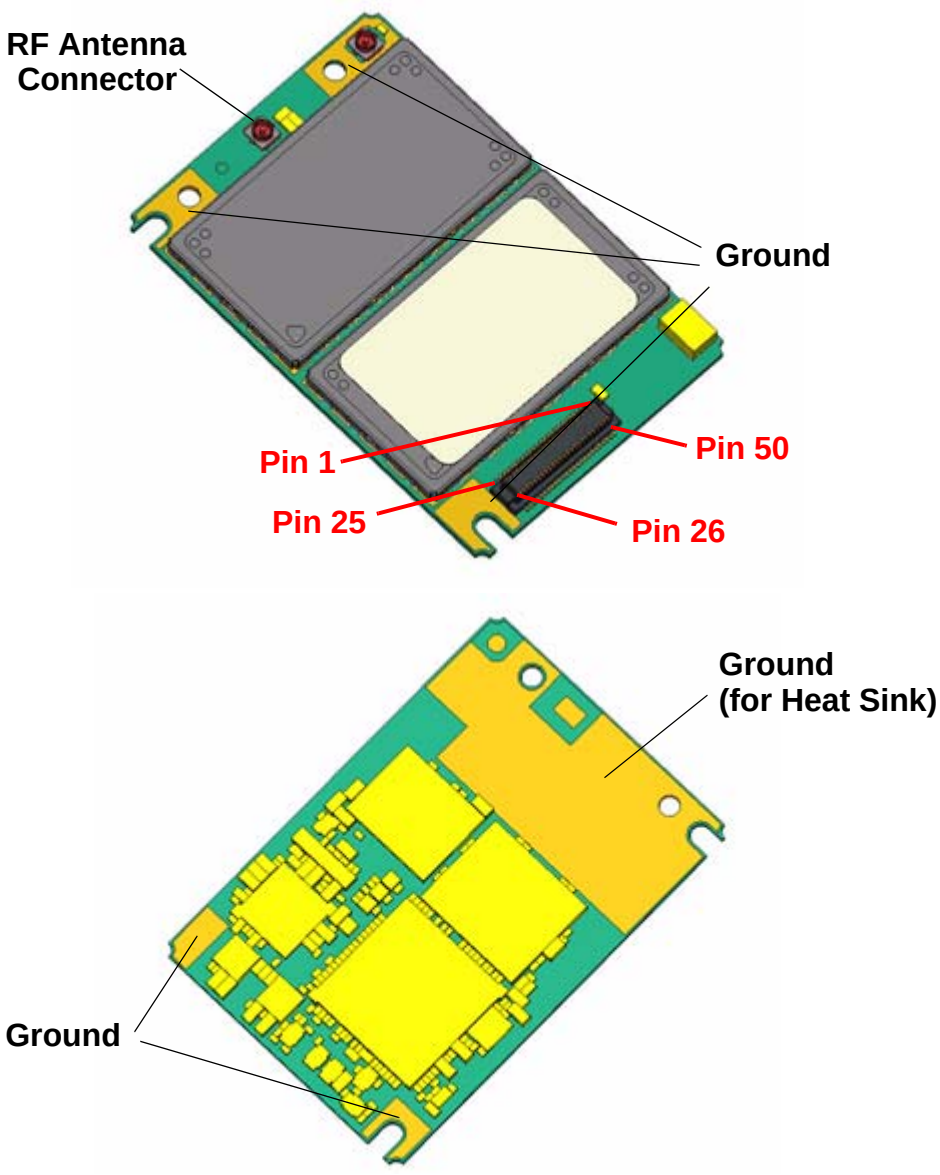


Figure 21: HC25 – Top and bottom view

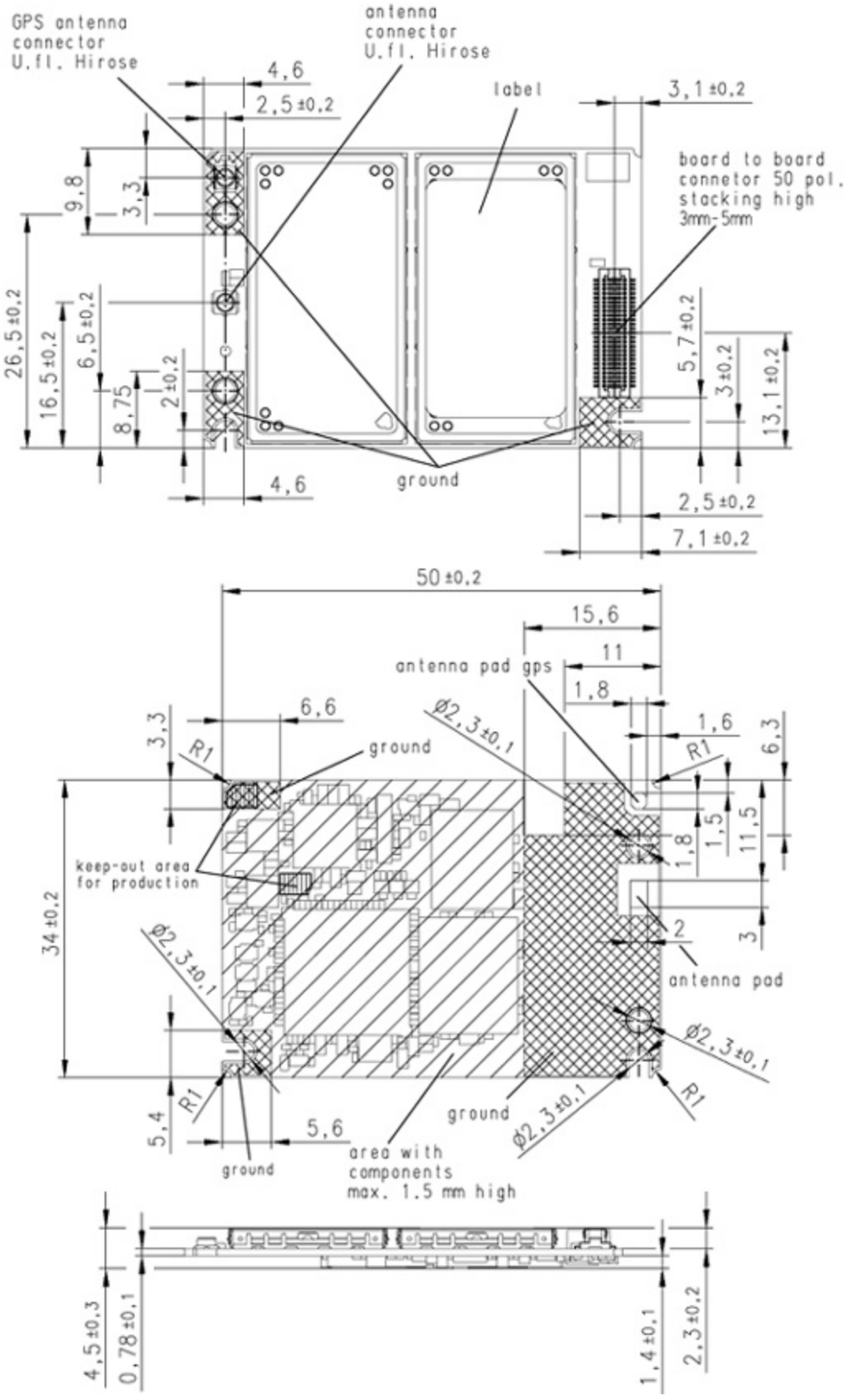


Figure 22: Dimensions of HC25 (all dimensions in mm)

6.2 Mounting HC25 to the Application Platform

There are many ways to properly install HC25 in the host device. An efficient approach is to mount the HC25 to a frame, plate, rack or chassis.

Fasteners can be M2 screws plus suitable washers, circuit board spacers, or customized screws, clamps, or brackets. In addition, the board-to-board connection can also be utilized to achieve better support. To help you find appropriate spacers a list of selected screws and distance sleeves for 3mm stacking height can be found in Section 9.2.

When using the holes the screws can be inserted from top or bottom.

For proper grounding it is strongly recommended to use the large ground plane on the bottom of board in addition to the five GND pins of the board-to-board connector. The ground plane may also be used to attach cooling elements, e.g. a heat sink or thermally conductive tape. Please take care that attached cooling elements do not touch the antenna pads on the module's bottom side, as this may lead to a short-circuit.

To prevent mechanical damage, be careful not to force, bend or twist the module. Be sure it is positioned flat against the host device (see also Section 9.3 with mounting advice sheet).

6.3 Board-to-Board Application Connector

This section provides specifications for the 50-pin board-to-board (B2B) connector used to connect HC25 to the host application.

For the module's external interface the following connector series has been chosen:
Supplier: Hirose (www.hirose.com)
Type: DF12C (3.0)-50DS-0.5V (SlimStack Receptacle)
Height: 3.0 mm

Table 29: Electrical and mechanical characteristics of the board-to-board connector

Parameter	Specification (50-way connector)
Number of Contacts	50
Quantity delivered	2000 Connectors per Tape & Reel
Voltage	50V
Current Rating	0.4A max per contact
Resistance	0.05 Ohm per contact
Dielectric Withstanding Voltage	150V RMS AC for 1min
Operating Temperature	-40°C...+85°C
Contact Material	phosphor bronze finish: solder plating
Insulator Material	PPS, deep brown / Polyamide, beige
FFC/FPC Thickness	0.3mm ±0.05mm (0.012" ±0.002")
Maximum connection cycles	20 (@ 50mOhm max)
Cable	FFC (Flat Flexible Cable), max. length 150mm from SIM interface

A recommended corresponding board-to-board connector series for external applications is:
Supplier: Hirose (www.hirose.com)
Type: DF12x-50DP-0.5V (SlimStack Header)
Height: 3.0 – 5.0 mm

For Hirose sales contacts see Chapter 9.

Note: There is no inverse polarity protection for the board-to-board connector. It is therefore very important that the board-to-board connector is connected correctly to the host application, i.e., pin1 must be connected to pin1, pin2 to pin 2, etc. Pin assignments are listed in Section 5.5, pin locations are shown in Figure 21.

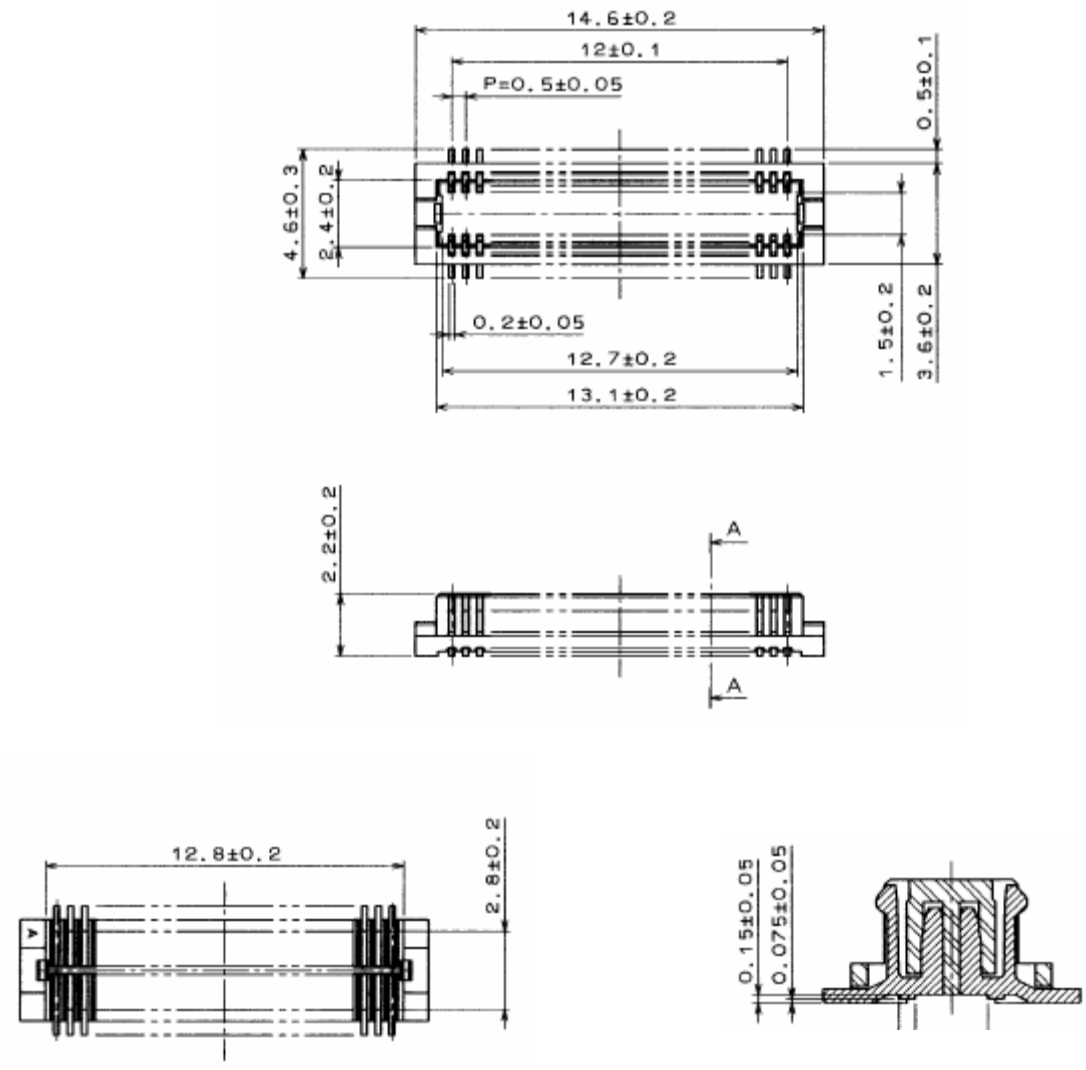


Figure 23: Mechanical dimensions of the board-to-board connector

7 Sample Application

Figure 24 shows a typical example of how to integrate a HC25 module with an application.

The audio interface demonstrates the balanced connection of microphone and earpiece. This solution is particularly well suited for internal transducers.

The PWR_IND line is an open collector that needs an external pull-up resistor which connects to the voltage supply VCC µC of the microcontroller. Low state of the open collector pulls the PWR_IND signal low and indicates that the HC25 module is active, high level notifies the Power-down mode.

If the module is in Power-down mode avoid current flowing from any other source into the module circuit, for example reverse current from high state external control lines. Therefore, the controlling application must be designed to prevent reverse flow.

The EMC measures are best practice recommendations. In fact, an adequate EMC strategy for an individual application is very much determined by the overall layout and, especially, the position of components. For example, when connecting cables to the module's interfaces it is strongly recommended to add appropriate ferrite beads for reducing RF radiation.

Disclaimer:
No warranty, either stated or implied, is provided on the sample schematic diagram shown in Figure 24 and the information detailed in this section. As functionality and compliance with national regulations depend to a great amount on the used electronic components and the individual application layout manufacturers are required to ensure adequate design and operating safeguards for their products using HC25 modules.

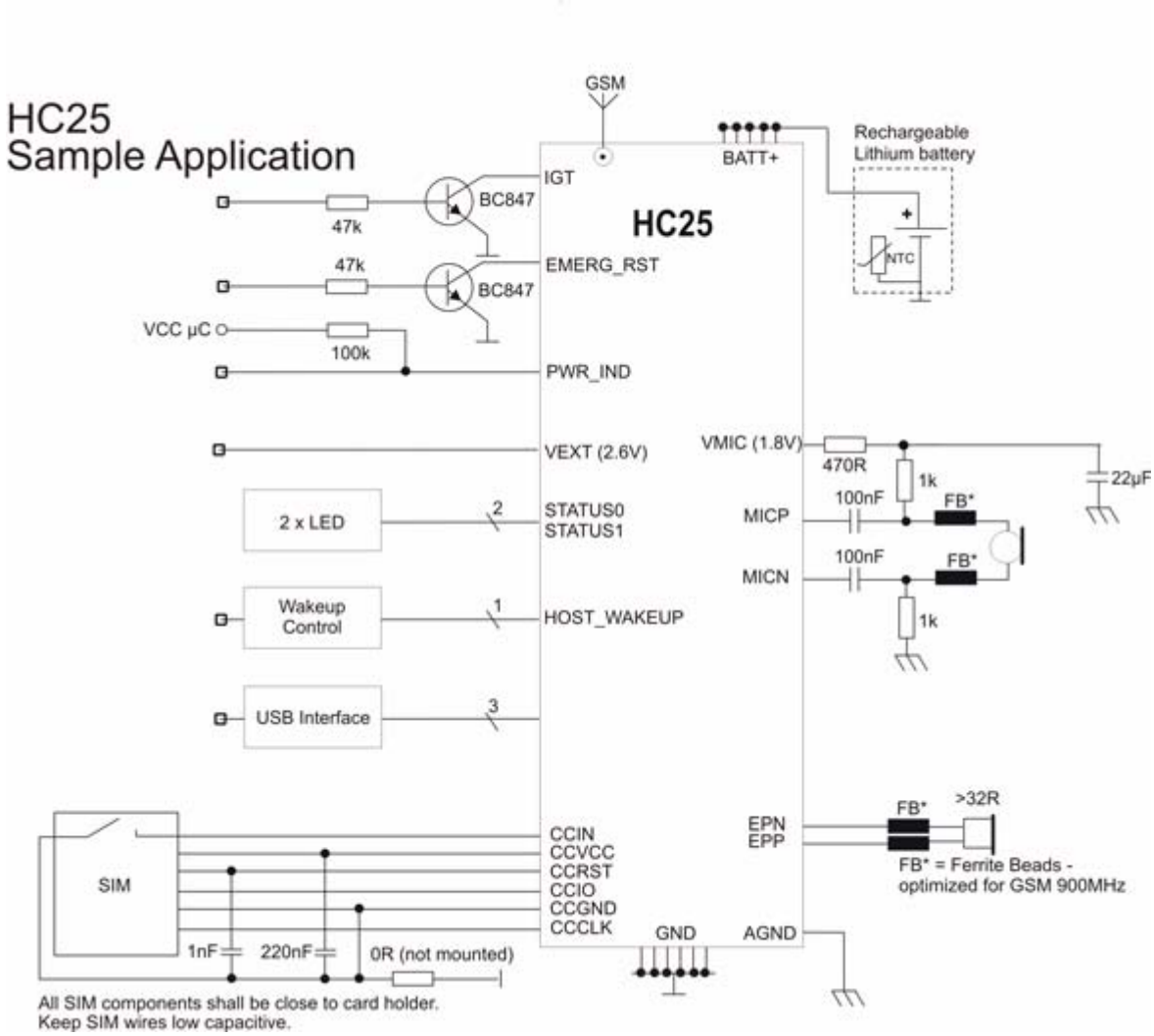


Figure 24: HC25 sample application

8 Reference Approval

8.1 Reference Equipment for Type Approval

The Siemens reference setup submitted to type approve HC25 consists of the following components:

- Siemens HC25 cellular engine
- Development Support Box DSB75 and HC15/HC25-DSB75-Adapter for mounting the HC25 module
- SIM card reader integrated on DSB75
- U.FL-LP antenna cable
- Handset type Votronic HH-SI-30.3/V1.1/0
- PC as MMI

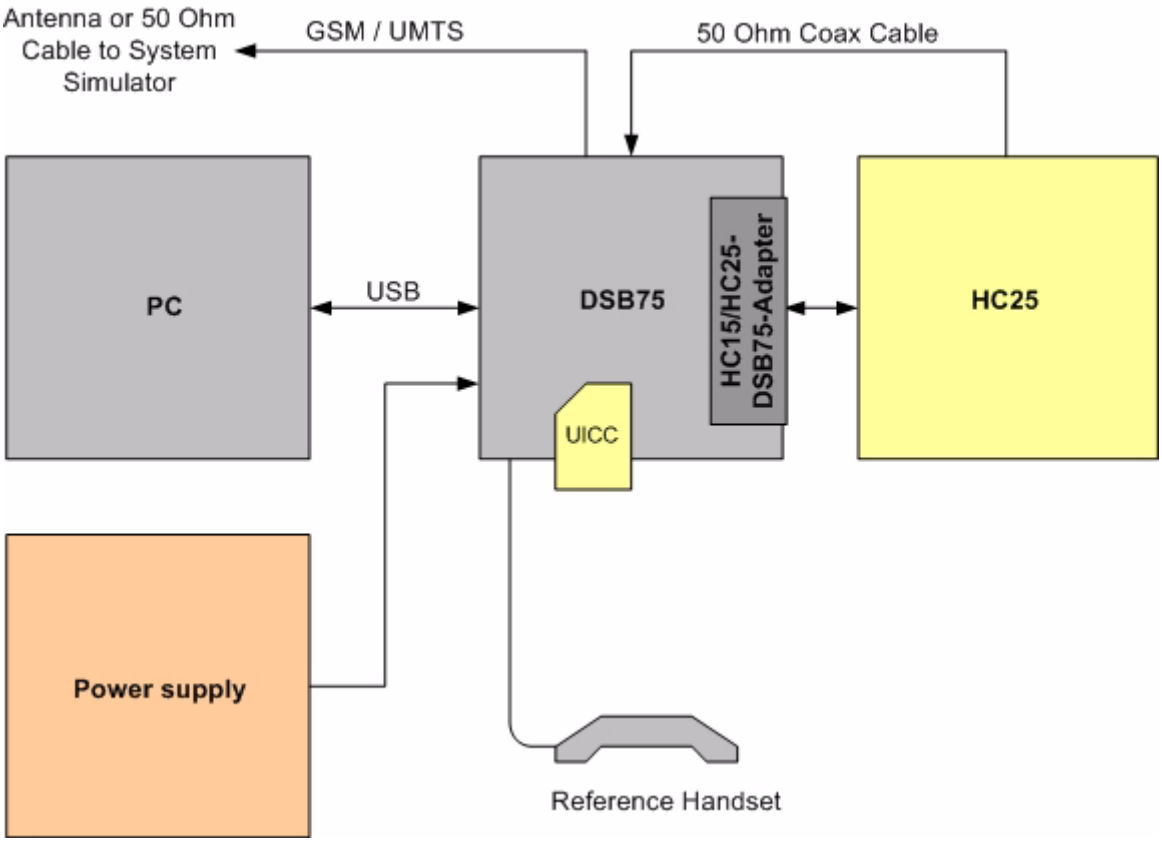


Figure 25: Reference equipment for Type Approval

8.2 Compliance with FCC Rules and Regulations

The Equipment Authorization Certification for the Siemens reference application described in Section 8.1 will be registered under the following identifiers:

FCC Identifier: QIPHC25
Industry Canada Certification Number: 267W-HC25
Granted to Siemens AG

Manufacturers of mobile or fixed devices incorporating HC25 modules are authorized to use the FCC Grants and Industry Canada Certificates of the HC25 modules for their own final products according to the conditions referenced in these documents. In this case, the FCC label of the module shall be visible from the outside, or the host device shall bear a second label stating "Contains FCC ID QIPHC25".

IMPORTANT:
Manufacturers of portable applications incorporating HC25 modules are required to have their final product certified and apply for their own FCC Grant and Industry Canada Certificate related to the specific portable mobile. This is mandatory to meet the SAR requirements for portable mobiles (see Section 1.4 for detail).

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

9 Appendix

9.1 List of Parts and Accessories

Table 30: List of parts and accessories

Description	Supplier	Ordering information
HC25	Siemens	Standard module (Siemens IMEI) Siemens ordering number: L30960-N1050-A100 Customer IMEI module: Siemens Ordering number: L30960-N1060-A100
DSB75 Support Box	Siemens	Siemens ordering number: L36880-N8811-A100
HC15/HC25-DSB75-Adapter	Siemens	Siemens ordering number: L30960-N1001-A100
Votronic Handset	VOTRONIC	Votronic HH-SI-30.3/V1.1/0 VOTRONIC Entwicklungs- und Produktionsgesellschaft für elektronische Geräte mbH Saarbrücker Str. 8 66386 St. Ingbert Germany Phone: +49-(0)6 89 4 / 92 55-0 Fax: +49-(0)6 89 4 / 92 55-88 e-mail: contact@votronic.com
SIM card holder incl. push button ejector and slide-in tray	Molex	Ordering numbers: 91228 91236 Sales contacts are listed in Table 31.
Board-to-board connector	Molex	Sales contacts are listed in Table 31.
Antenna connector	Hirose	Sales contacts are listed in Table 32.

Table 31: Molex sales contacts (subject to change)

Molex For further information please click: http://www.molex.com	Molex Deutschland GmbH Felix-Wankel-Str. 11 4078 Heilbronn-Biberach Germany Phone: +49-7066-9555 0 Fax: +49-7066-9555 29 Mail: mxgermany@molex.com	American Headquarters Lisle, Illinois 60532 U.S.A. Phone: +1-800-78MOLEX Fax: +1-630-969-1352
Molex China Distributors Beijing, Room 1319, Tower B, COFCO Plaza No. 8, Jian Guo Men Nei Street, 100005 Beijing P.R. China Phone: +86-10-6526-9628 Phone: +86-10-6526-972 Phone: +86-10-6526-9731 Fax: +86-10-6526-9730	Molex Singapore Pte. Ltd. Jurong, Singapore Phone: +65-268-6868 Fax: +65-265-6044	Molex Japan Co. Ltd. Yamato, Kanagawa, Japan Phone: +81-462-65-2324 Fax: +81-462-65-2366

Table 32: Hirose sales contacts (subject to change)

Hirose Ltd. For further information please click: http://www.hirose.com	Hirose Electric (U.S.A.) Inc 2688 Westhills Court Simi Valley, CA 93065 U.S.A. Phone: +1-805-522-7958 Fax: +1-805-522-3217	Hirose Electric GmbH Herzog-Carl-Strasse 4 73760 Ostfildern Germany Phone: +49-711-456002-1 Fax: +49-711-456002-299 Email info@hirose.de
Hirose Electric UK, Ltd Crownhill Business Centre 22 Vincent Avenue, Crownhill Milton Keynes, MK8 OAB Great Britain Phone: +44-1908-305400 Fax: +44-1908-305401	Hirose Electric Co., Ltd. 5-23, Osaki 5 Chome, Shinagawa-Ku Tokyo 141 Japan Phone: +81-03-3491-9741 Fax: +81-03-3493-2933	Hirose Electric Co., Ltd. European Branch First class Building 4F Beechavenue 46 1119PV Schiphol-Rijk Netherlands Phone: +31-20-6557-460 Fax: +31-20-6557-469

9.2 Fasteners and Fixings for Electronic Equipment

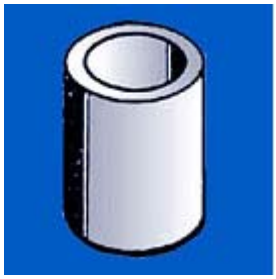
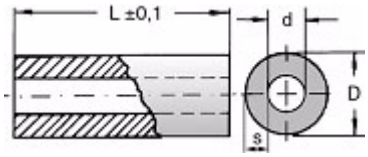
This section provides a list of suppliers and manufacturers offering fasteners and fixings for electronic equipment and PCB mounting. The content of this section is designed to offer basic guidance to various mounting solutions with no warranty on the accuracy and sufficiency of the information supplied. Please note that the list remains preliminary although it is going to be updated in later versions of this document.

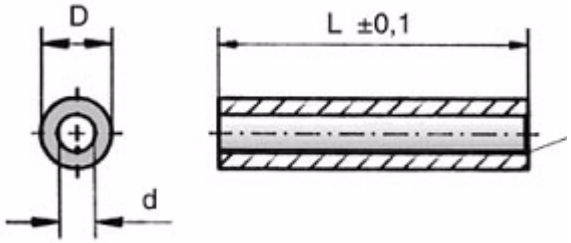
9.2.1 Fasteners from German Supplier ETTINGER GmbH

Sales contact:
ETTINGER GmbH
http://www.ettinger.de/main.cfm
Phone: +49-81-046623-0
Fax: +49-81-046623-99

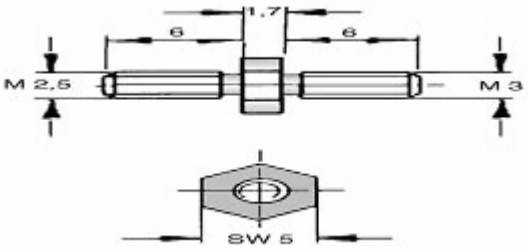
The following tables contain only article numbers and basic parameters of the listed components. For further detail and ordering information please contact Ettinger GmbH.

Please note that some of the listed screws, spacers and nuts are delivered with the DSB75 Support Board. See comments below.

Article number: 05.71.038	Spacer - Aluminum / **Wall thickness = 0.8mm**
Length	3.0mm
Material	AlMgSi-0,5
For internal diameter	M2=2.0-2.3
Internal diameter	d = 2.4mm
External diameter	4.0mm
Vogt AG No.	x40030080.10
	

Article number: 07.51.403	Insulating Spacer for M2 Self-gripping[1]
Length	3.0mm
Material	Polyamide 6.6
Surface	Black
Internal diameter	2.2mm
External diameter	4.0mm
Flammability rating	UL94-HB
	

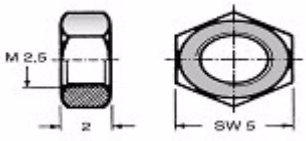
1. 2 spacers are delivered with DSB75 Support Board

Article number: 05.11.209	Threaded Stud M2.5 - M2 Type E / External thread at both ends
Length	3.0mm
Material	Stainless steel X12CrMoS17
Thread 1 / Length	M2.5 / 6.0mm
Thread 2 / Length	M2 / 8.0mm
Width across flats	5
Recess	yes
Type	External / External
	

Article number: 01.14.131	Screw M2[1] DIN 84 - ISO 1207
Length	8.0mm
Material	Steel 4.8
Surface	Zinced A2K
Thread	M2
Head diameter	D = 3.8mm
Head height	1.30mm
Type	Slotted cheese head screw
	

1. 2 screws are delivered with DSB75 Support Board

Article number: 01.14.141	Screw M2 DIN 84 - ISO 1207
Length	10.0mm
Material	Steel 4.8
Surface	Zinced A2K
Thread	M2
Head diameter	D = 3.8mm
Head height	1.30mm
Type	Slotted cheese head screw
	

Article number: 02.10.011	Hexagon Nut[1] DIN 934 - ISO 4032
Material	Steel 4.8
Surface	Zinced A2K
Thread	M2
Wrench size / Ø	4
Thickness / L	1.6mm
Type	Nut DIN/UNC, DIN934
	

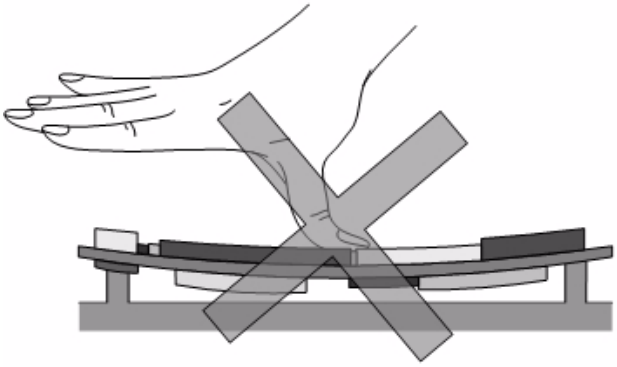
1. 2 nuts are delivered with DSB75 Support Board

9.3 Mounting Advice Sheet

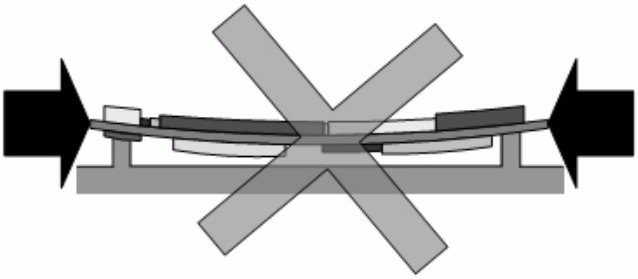
To prevent mechanical damage, be careful not to force, bend or twist the module. Be sure it is positioned flat against the host device (see also Section 6.2). The advice sheet on the next page shows a number of examples for the kind of bending that may lead to mechanical damage of the module.

Mounting Advice

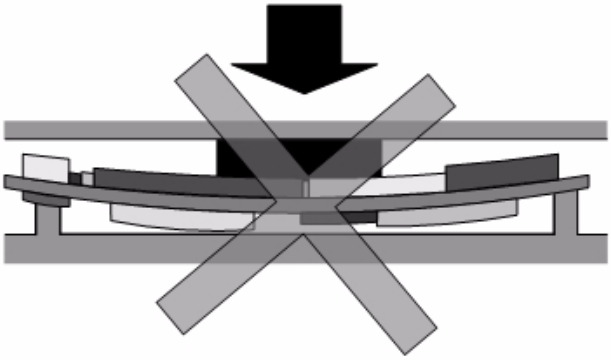
Do NOT BEND the Module



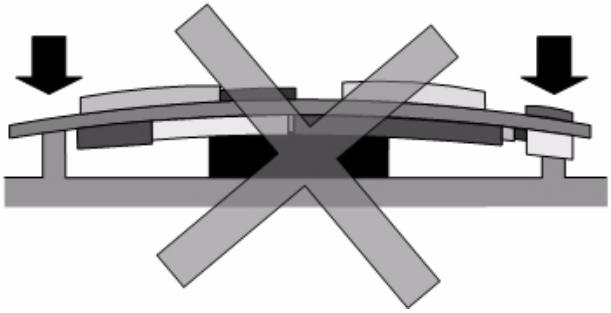
- By pressing from above



- By mounting under pressure



- By putting objects on top



- By putting objects below