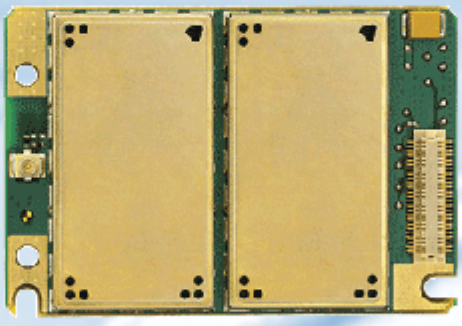
SIEMENS



Hardware Interface Description

HC15
Siemens Cellular Engine

Version: 01.001
DocId: HC15_HD_v01.001

Document Name:	**HC15 Hardware Interface Description**
Version:	**01.001**
Date:	**2007-2-2**
DocId:	**HC15_HD_v01.001**
Status	**Confidential / Released**

General Notes

Product is deemed accepted by recipient and is provided without interface to recipient's products. The documentation and/or product are provided for testing, evaluation, integration and information purposes. The documentation and/or product are provided on an "as is" basis only and may contain deficiencies or inadequacies. The documentation and/or product are provided without warranty of any kind, express or implied. To the maximum extent permitted by applicable law, Siemens further disclaims all warranties, including without limitation any implied warranties of merchantability, completeness, fitness for a particular purpose and non-infringement of third-party rights. The entire risk arising out of the use or performance of the product and documentation remains with recipient. This product is not intended for use in life support appliances, devices or systems where a malfunction of the product can reasonably be expected to result in personal injury. Applications incorporating the described product must be designed to be in accordance with the technical specifications provided in these guidelines. Failure to comply with any of the required procedures can result in malfunctions or serious discrepancies in results. Furthermore, all safety instructions regarding the use of mobile technical systems, including GSM products, which also apply to cellular phones must be followed. Siemens or its suppliers shall, regardless of any legal theory upon which the claim is based, not be liable for any consequential, incidental, direct, indirect, punitive or other damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information or data, or other pecuniary loss) arising out the use of or inability to use the documentation and/or product, even if Siemens has been advised of the possibility of such damages. The foregoing limitations of liability shall not apply in case of mandatory liability, e.g. under the German Product Liability Act, in case of intent, gross negligence, injury of life, body or health, or breach of a condition which goes to the root of the contract. However, claims for damages arising from a breach of a condition, which goes to the root of the contract, shall be limited to the foreseeable damage, which is intrinsic to the contract, unless caused by intent or gross negligence or based on liability for injury of life, body or health. The above provision does not imply a change on the burden of proof to the detriment of the recipient. Subject to change without notice at any time. The interpretation of this general note shall be governed and construed according to German law without reference to any other substantive law.

Copyright

Contents

0 Document History 7

1 Introduction 8
1.1 Related Documents 8
1.2 Terms and Abbreviations 8
1.3 Regulatory and Type Approval Information 11
1.3.1 Directives and Standards 11
1.3.2 SAR requirements specific to portable mobiles 12
1.3.3 SELV Requirements 12
1.3.4 Safety Precautions 13

2 Product Concept 14
2.1 Key Features at a Glance 14
2.2 HC15 System Overview 17
2.3 Circuit Concept 18

3 Application Interface 19
3.1 Operating Modes 20
3.2 Power Supply 21
3.2.1 Minimizing Power Losses 21
3.2.2 Measuring the Supply Voltage (V_{BATT+}) 22
3.3 Power-Up / Power-Down Scenarios 23
3.3.1 Turn On HC15 23
3.3.2 Turn Off HC15 Using AT Command 24
3.3.3 Configuring the IGT Line for Use as ON/OFF Switch 25
3.3.4 Automatic Shutdown 25
3.3.5 Turn Off HC15 in Case of Emergency 26
3.4 Power Saving 27
3.5 USB Interface 27
3.6 UICC/SIM Interface 28
3.7 Analog Audio Interface 30
3.8 PWR_IND Signal 31
3.8.1 Network Connectivity Status Signals 31

4 Antenna Interface 32
4.1 Antenna Installation 32
4.2 Antenna Pad 33
4.3 Antenna Connector 33

5 Electrical, Reliability and Radio Characteristics 38
5.1 Absolute Maximum Ratings 38
5.2 Operating Temperatures 39
5.3 Storage Conditions 40
5.4 Reliability Characteristics 41
5.5 Pin Assignment and Signal Description 42
5.6 Power Supply Ratings 47
5.7 Electrical Characteristics of the Voiceband Part 49
5.7.1 Characteristics of Audio Modes 49
5.8 Air Interface 50

5.9 Electrostatic Discharge 51

6 Mechanics 52
6.1 Mechanical Dimensions of HC15 52
6.2 Mounting HC15 to the Application Platform 54
6.3 Board-to-Board Application Connector 55

7 Sample Application 57

8 Reference Approval 59
8.1 Reference Equipment for Type Approval 59

9 Appendix 60
9.1 List of Parts and Accessories 60
9.2 Fasteners and Fixings for Electronic Equipment 62
9.2.1 Fasteners from German Supplier ETTINGER GmbH 62
9.3 Mounting Advice Sheet 66

Tables

Table 1: Directives 11
Table 2: Standards of European type approval 11
Table 3: Requirements of quality 12
Table 4: Overview of operating modes 20
Table 5: Signals of the UICC/SIM interface (board-to-board connector) 28
Table 6: Return loss in the active band 32
Table 7: Product specifications of U.FL-R-SMT connector 34
Table 8: Material and finish of U.FL-R-SMT connector and recommended plugs 34
Table 9: Ordering information for Hirose U.FL Series 37
Table 10: Absolute maximum ratings 38
Table 11: Board temperature 39
Table 12: Sample operating conditions without forced air circulation (according to IEC 60068-2) 39
Table 13: Sample operating conditions with forced air circulation (air speed 0.9m/s) 39
Table 14: Storage conditions 40
Table 15: Summary of reliability test conditions 41
Table 16: Signal description 43
Table 17: Power supply ratings 47
Table 18: Voiceband characteristics (typical) 49
Table 19: Air interface GSM / UMTS 50
Table 20: Measured electrostatic values 51
Table 21: Electrical and mechanical characteristics of the board-to-board connector 55
Table 22: List of parts and accessories 60
Table 23: Molex sales contacts (subject to change) 61
Table 24: Hirose sales contacts (subject to change) 61

Figures

Figure 1: HC15 system overview 17
Figure 2: HC15 block diagram 18
Figure 3: Power supply limits during transmit burst 21
Figure 4: Position of the reference points BATT+ and GND 22
Figure 5: Power-on with IGT held low before switching on operating voltage at BATT+ 23
Figure 6: Power-on with operating voltage at BATT+ applied before activating IGT 23
Figure 7: Signal states during turn-off procedure 24
Figure 8: Timing of IGT if used as ON/OFF switch 25
Figure 9: Shutdown by EMERG_OFF signal 26
Figure 10: UICC/SIM interface 29
Figure 11: Audio block diagram 30
Figure 12: PWR_IND signal 31
Figure 13: Status LED Circuit (example) 31
Figure 14: Restricted area around antenna pad (side and bottom view) 32
Figure 15: Mechanical dimensions of U.FL-R-SMT connector 33
Figure 16: U.FL-R-SMT connector with U.FL-LP-040 plug 35
Figure 17: U.FL-R-SMT connector with U.FL-LP-066 plug 35
Figure 18: Specifications of U.FL-LP-(V)-040(01) plug 36
Figure 19: Pin assignment HC15 42
Figure 20: HC15 – Top and bottom view 52
Figure 21: Dimensions of HC15 (all dimensions in mm) 53
Figure 22: Mechanical dimensions of the board-to-board connector 56
Figure 23: HC15 sample application 58
Figure 24: Reference equipment for Type Approval 59

0 Document History

Preceding document: "HCx5 Hardware Interface Description" Version 00.050a

New document: "HC15 Hardware Interface Description" Version **01.001**

Chapter	What is new
--	Separate document for HC15.
1.3	Section now comprises Regulatory and Type Approval Information including new sub-section 1.3.3 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.
3.5	Revised parts of the section.
3.6	Added description for CCIN pin and Figure 10.
3.7	Revised complete section.
3.8	Added Figure 12.
3.8.1	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 16: Changed $V_I$max for BATT+ from 4.3. to 4.2. Added note on automatic shutdown.
5.6	Updated power supply ratings (Table 17).
5.7	New section: Electrical Characteristics of the Voiceband Part.
6.1	Updated Figure 20 and Figure 21 (top/bottom view as well as mechanical dimensions)
6.2	New section: Mounting HC15 to the Application Platform.
6.3	Added note regarding inverse polarity protection for board-to-board connector.
7	New chapter: Sample Application
8	Added HC15/HC25-DSB75-Adapter to reference equipment.
9	New Appendix with a List of Parts and Accessories, Fasteners and Fixings for Electronic Equipment and Mounting Advice Sheet.

Preceding document: "HC15 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 HC15 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

[1] HC15 AT Command Set 01.001
[2] HC15 Release Notes 01.001

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
DTMF	Dual Tone Multi Frequency
DTX	Discontinuous Transmission
EDGE	Enhanced Data rates for GSM Evolution
EFR	Enhanced Full Rate

Abbreviation	Description
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
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

Abbreviation	Description
RACH	Random Access Channel
RF	Radio Frequency
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

HC15 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
95/94/EC	Automotive EMC directive
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 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)
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

Table 2: Standards of European type approval

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 3: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

1.3.2 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 HC15 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 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 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)

1.3.3 SELV Requirements

The power supply connected to the HC15 module shall be in compliance with the SELV requirements defined in EN 60950-1.

1.3.4 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 HC15. 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: Single band, 2100MHz GSM/GPRS/EDGE: Dual band, 900/1800MHz
GSM class	Small MS
Output power (according to Release 99)	Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 2100, WCDMA FDD BdI
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	
Release 99, June 2004, W-CDMA FDD standard	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 One ringing melody supported CEPT supervisory tones supported DTMF supported 2 audio modes: Approval, Router
Software	
AT commands	AT-Hayes GSM 07.05 and 07.07, Siemens
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 HC15 System Overview

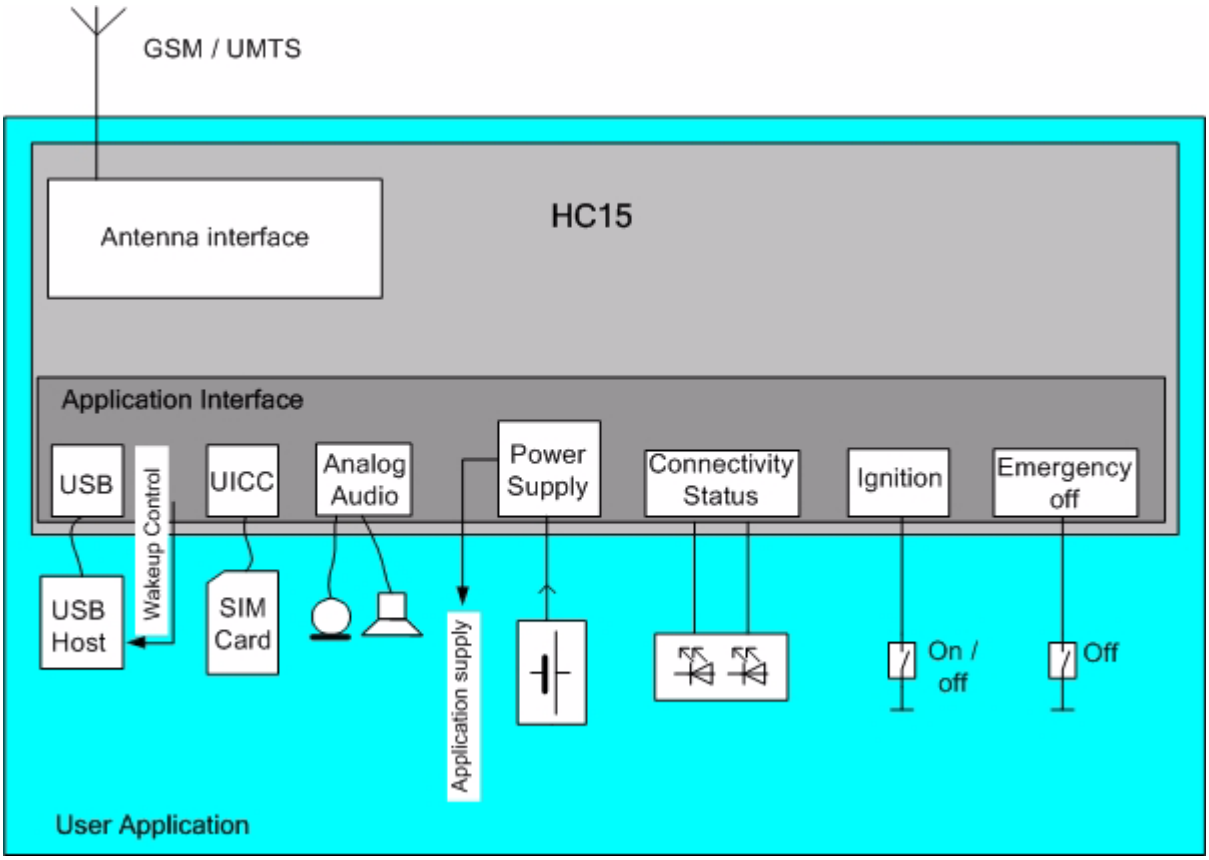


Figure 1: HC15 system overview

2.3 Circuit Concept

Figure 2 shows a block diagram of the HC15 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 GSM/ WCDMA power amplifier
- RF front end
- Antenna connector

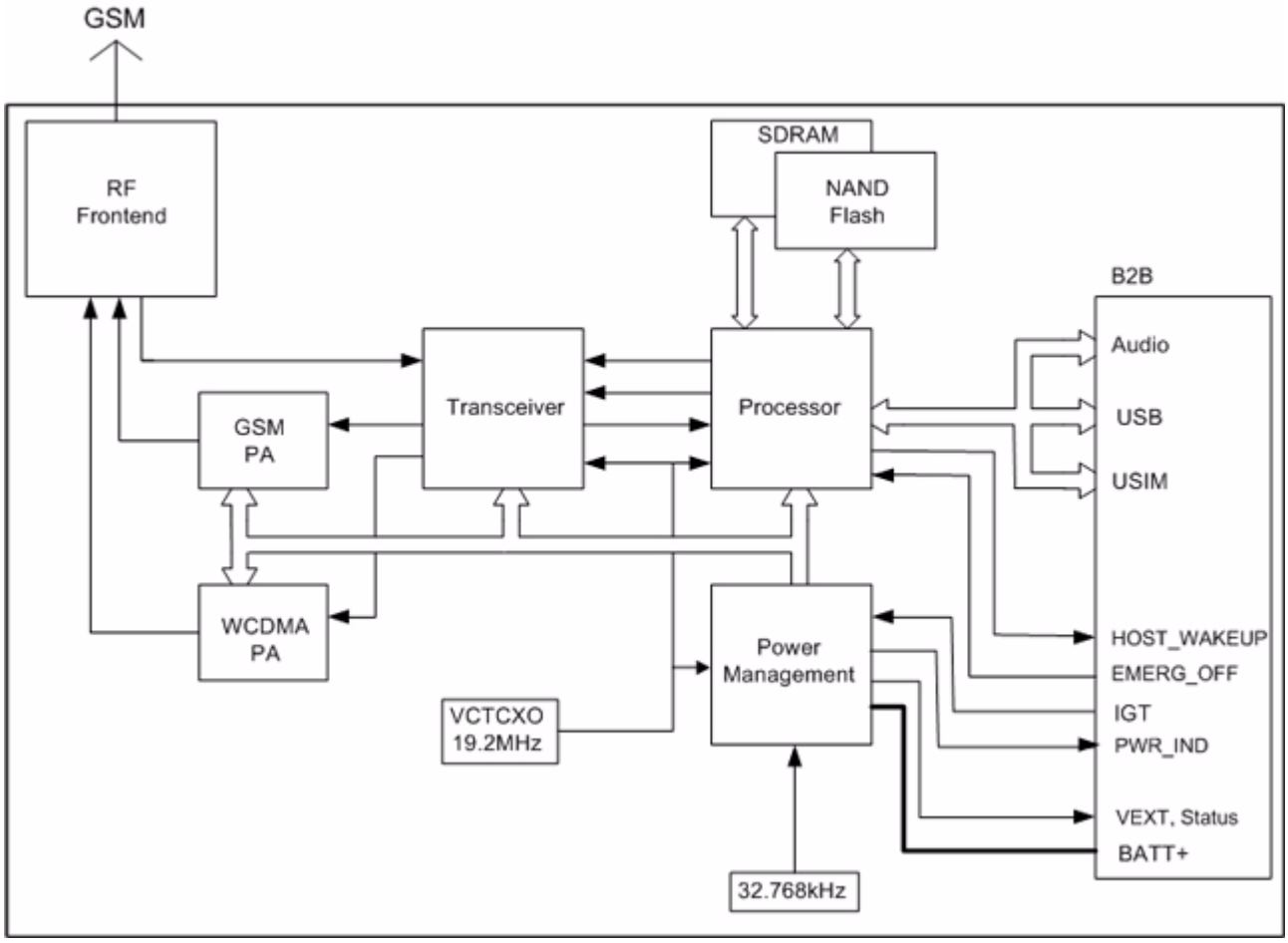


Figure 2: HC15 block diagram

3 Application Interface

HC15 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 3.5
- UICC/SIM interface - see Section 3.6
- Analog audio interface - see Section 3.7
- Status and control lines: IGT, EMERG_OFF, PWR_IND, STATUS1/2, HOST_WAKEUP - see Table 16.

3.1 Operating Modes

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

Table 4: 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

HC15 needs to be connected to a power supply at the board-to-board connector (5 pins each BATT+ and GND).

The power supply of HC15 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 HC15 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 HC15 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.

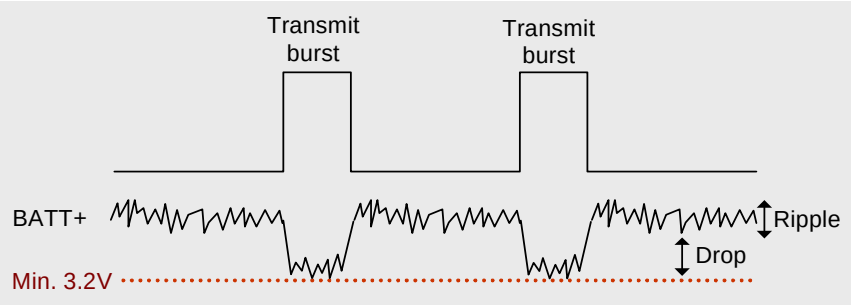


Figure 3: Power supply limits during transmit burst

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.

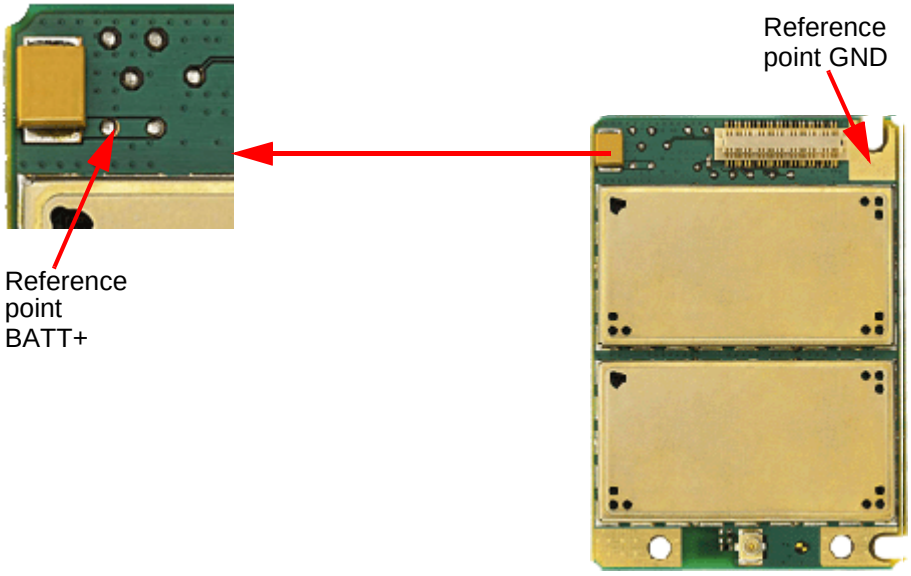


Figure 4: Position of the reference points BATT+ and GND

3.3 Power-Up / Power-Down Scenarios

In general, be sure not to turn on HC15 while it is beyond the safety limits of voltage and temperature. HC15 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 HC15

When the HC15 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 HC15 IGT has to be kept active at least 300ms. After turning on HC15 IGT should be set inactive to prevent the module from turning on again after a shut down by AT command or EMERG_OFF.

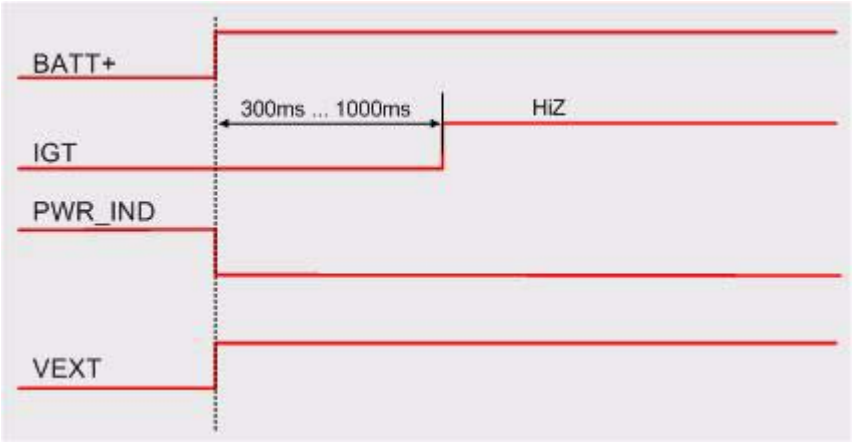


Figure 5: Power-on with IGT held low before switching on operating voltage at BATT+

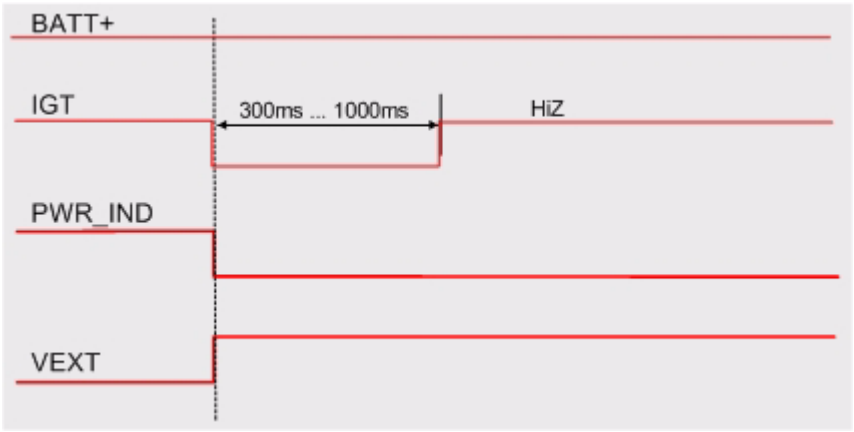


Figure 6: Power-on with operating voltage at BATT+ applied before activating IGT

Note: After power up IGT should remain high

3.3.2 Turn Off HC15 Using AT Command

The best and safest approach to powering down HC15 is to issue the AT^SMSO command. This procedure lets HC15 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.

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 HC15 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.

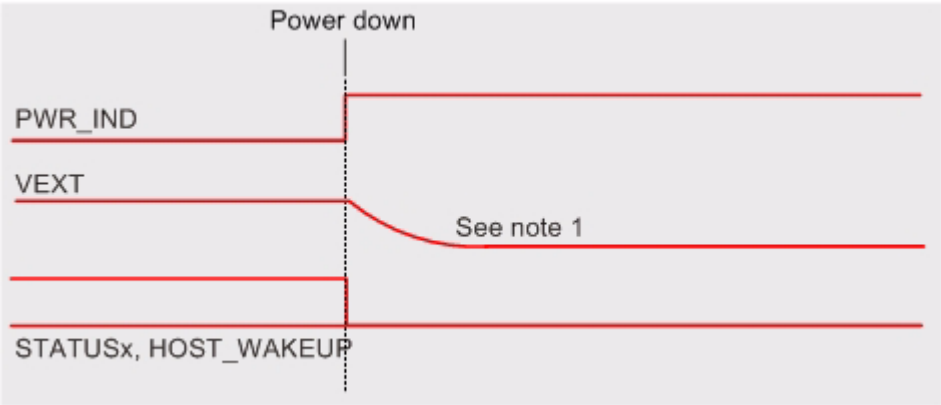


Figure 7: Signal states during turn-off procedure

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 HC15. 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 HC15.

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 HC15 is off, the IGT line must be asserted for at least 300ms before being released.

Switch-off condition: If the HC15 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.

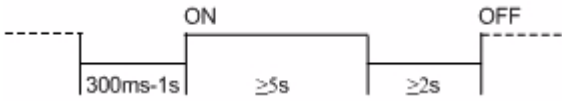


Figure 8: Timing of IGT if used as ON/OFF switch

3.3.4 Automatic Shutdown

Automatic shutdown takes effect if:

- The HC15 board is exceeding the critical limits of over-temperature or under-temperature
- Under-voltage or over-voltage is detected

The automatic shutdown procedure is equivalent to the Power-down initiated with the AT^SMSO command, i.e. HC15 logs off from the network and the software enters a secure state avoiding loss of data.

Alert messages transmitted before the device switches off are implemented as Unsolicited Result Codes (URCs). The URC presentation mode varies with the condition. For further details on AT commands refer to [1].

3.3.5 Turn Off HC15 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 HC15 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.

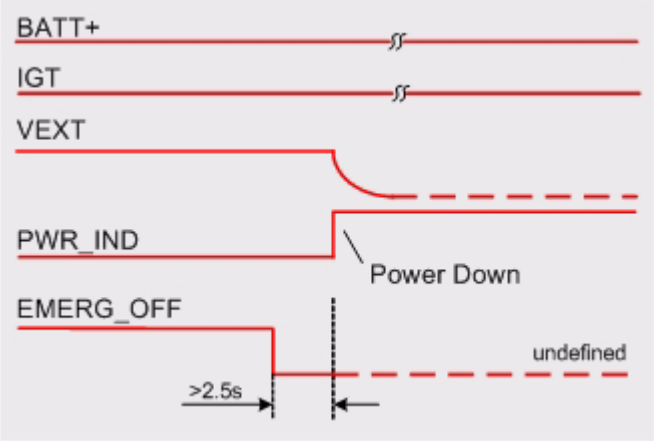


Figure 9: Shutdown by EMERG_OFF signal

3.4 Power Saving

Intended for power saving, SLEEP mode reduces the functionality of the HC15 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 3.5).

3.5 USB Interface

HC15 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“[1] for a definition of the term „Message Pipe“) to work with the HC15 USB interface.

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

To properly connect the module's USB interface to the host a USB 2.0 compatible connector is required. Furthermore, the USB driver package for Windows XP delivered with HC15 must be installed as described in [2].

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“[1] for a description of the Suspend state). On incoming calls HC15 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 16. For more information on how to configure the USB interface by means of AT commands see [1].

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

3.6 UICC/SIM Interface

HC15 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 16 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 HC15 and is part of the Siemens reference equipment submitted for type approval. See Section 9.1 for Molex ordering numbers.

Table 5: 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 HC15.

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 HC15.

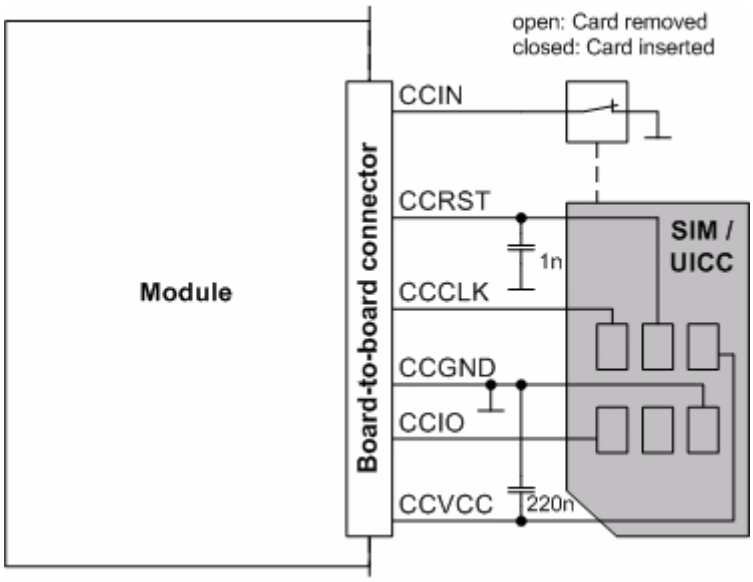


Figure 10: UICC/SIM interface

The total cable length between the board-to-board connector pins on HC15 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.

3.7 Analog Audio Interface

HC15 supports an analog audio interface with a balanced microphone input and a balanced loudspeaker output. The following picture shows a simplified block diagram:

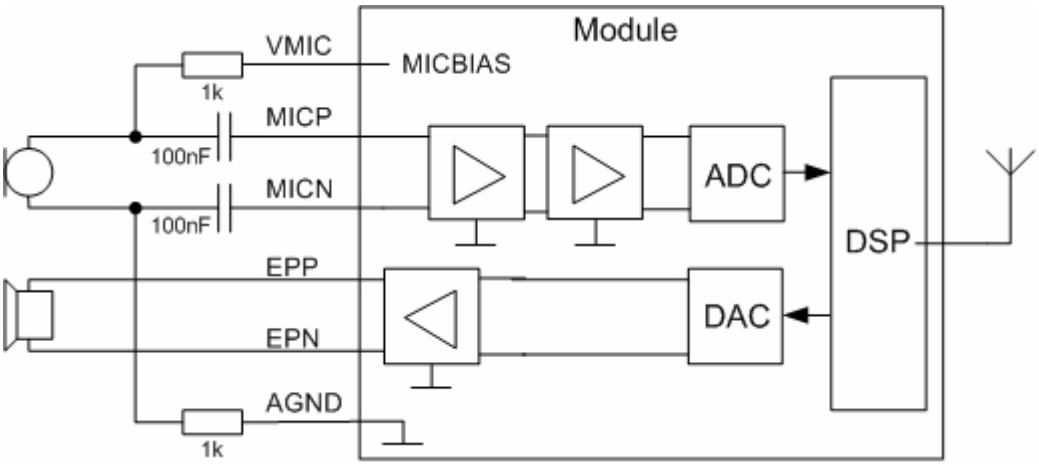


Figure 11: Audio block diagram

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.

The default audio mode (AT^SNFS=1) is optimized for the Votronic HH-SI-30.3/V1.1/0 handset and used for type approving the Siemens reference configuration. The second audio mode (AT^SNFS=2) is intended to be used together with a subscriber line interface circuit (SLIC) providing an analogue telephone interface in a router device. Both audio modes have fixed parameters that cannot be modified. For further details see Section 5.7.

3.8 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.

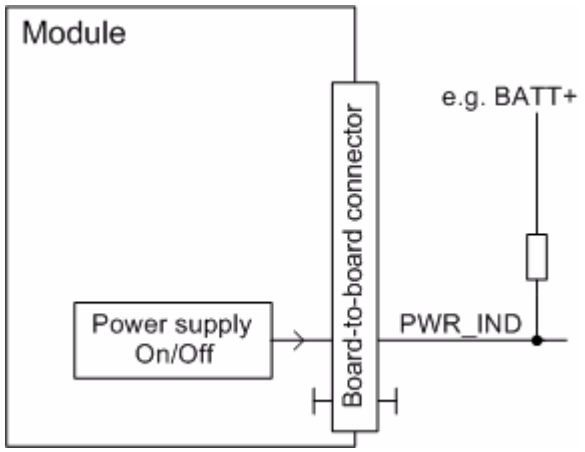


Figure 12: PWR_IND signal

3.8.1 Network Connectivity Status Signals

Two status signals (STATUS0 and STATUS1) are provided for signaling the module's connectivity status. Each signal acts as a current sink and can be used to control externally connected LEDs. For electrical characteristics see Table 16.

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

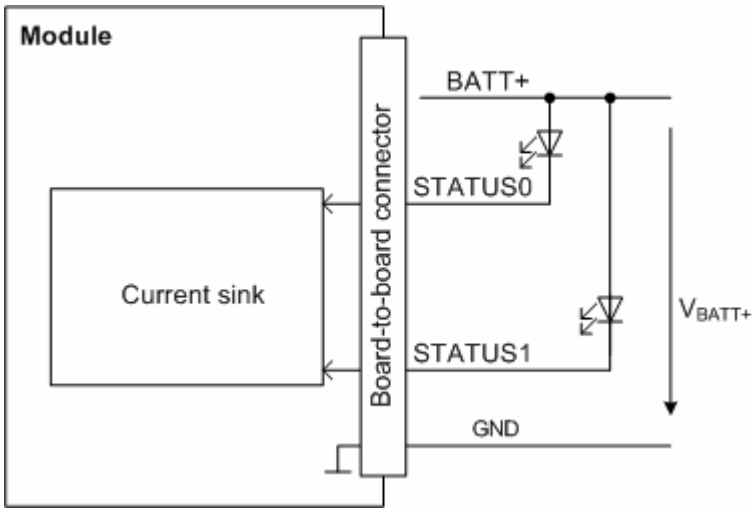


Figure 13: Status LED Circuit (example)

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 see the [1].

4 Antenna Interface

The RF interface has an impedance of 50Ω. HC15 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 HC15 PCB and should be placed in the host application.

Regarding the return loss HC15 provides the following values in the active band:

Table 6: 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 HC15 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 HC15. 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 area filled with air, which must also be reserved 1.4mm in height.

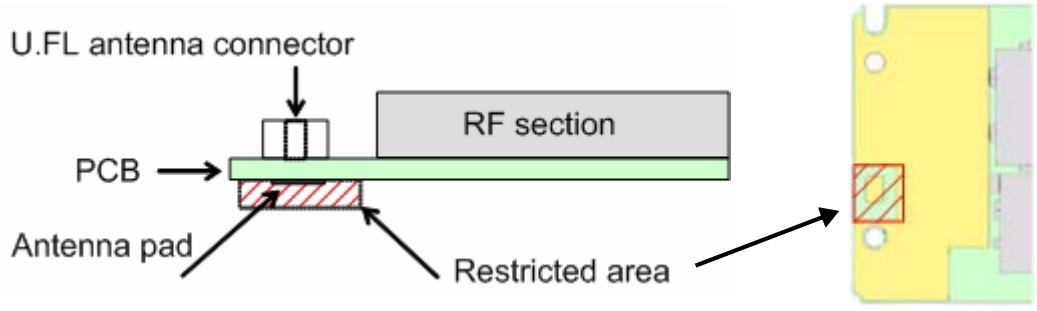


Figure 14: Restricted area around antenna pad (side and bottom view)

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 HC15 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.

HC15 material properties:

HC15 PCB: FR4
Antenna pad: Gold plated pad

4.3 Antenna Connector

HC15 uses an ultra-miniature SMT antenna connector supplied from Hirose Ltd. The product name is:

- U.FL-R-SMT

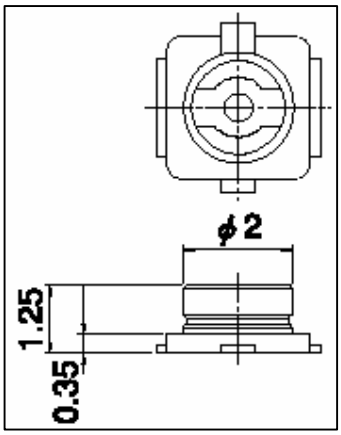


Figure 15: Mechanical dimensions of U.FL-R-SMT connector

Table 7: 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 disengagement
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
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 8: 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 9. For latest product information please contact your Hirose dealer or visit the Hirose home page, for example http://www.hirose.com.

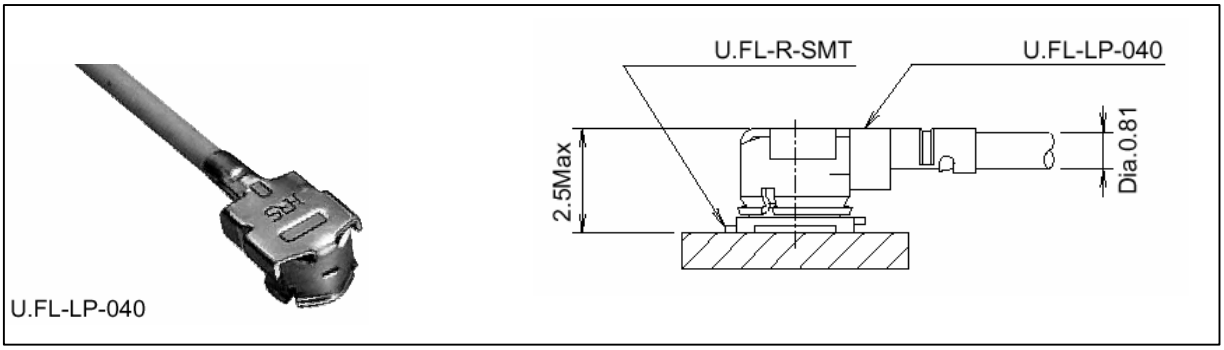


Figure 16: U.FL-R-SMT connector with U.FL-LP-040 plug

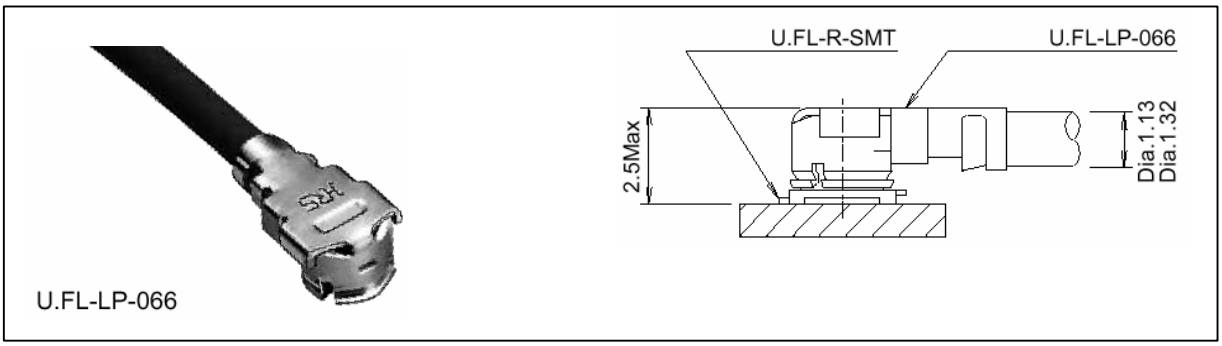


Figure 17: U.FL-R-SMT connector with U.FL-LP-066 plug

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 ∅ 0.81mm) and minimizes the mating height to 2mm. See Figure 18 which shows the Hirose datasheet.

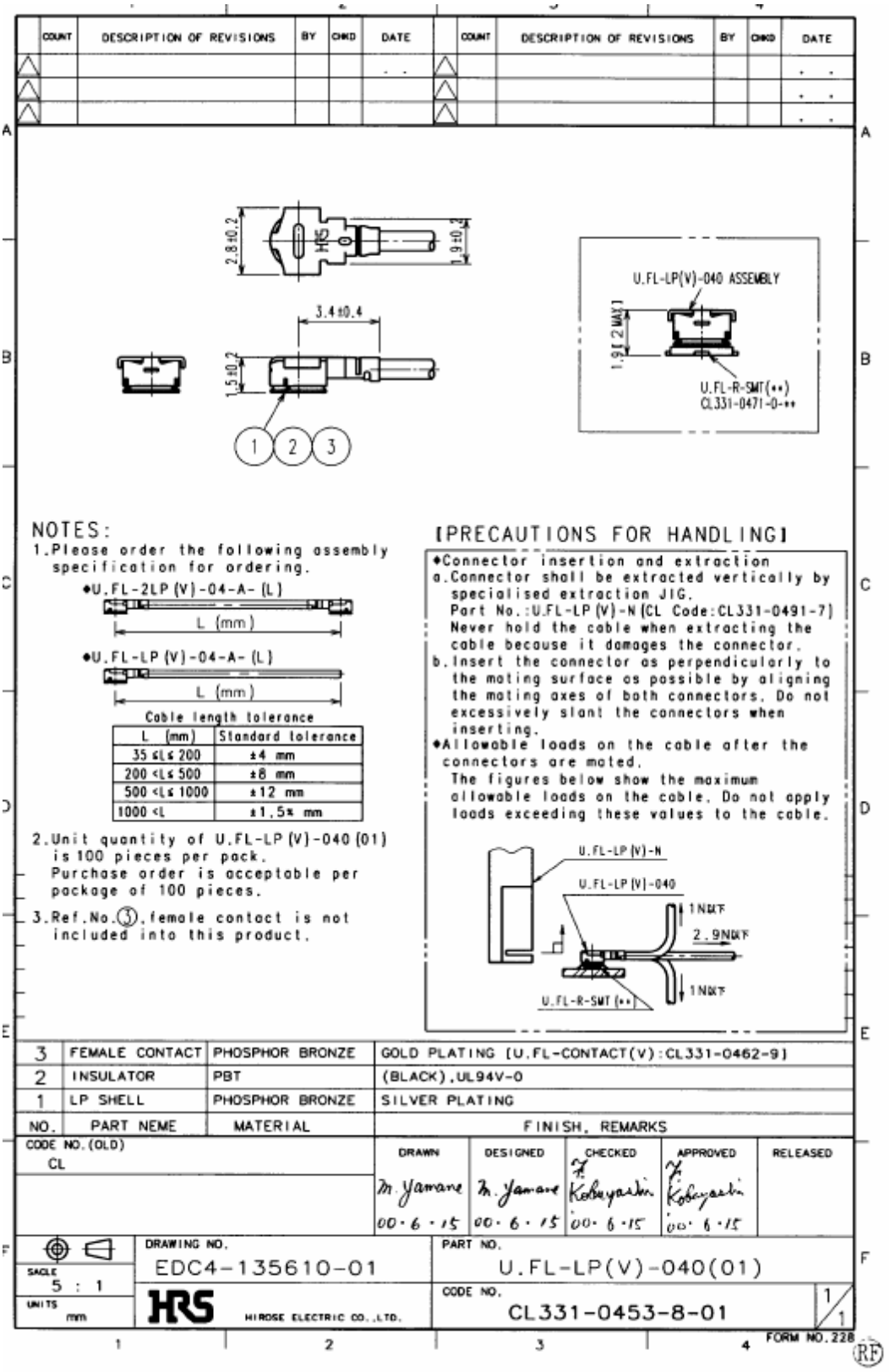


Figure 18: Specifications of U.FL-LP-(V)-040(01) plug

Table 9: Ordering information for Hirose U.FL Series

Item	Part number	HRS number
Connector on HC15	U.FL-R-SMT	CL331-0471-0-10
Right-angle plug shell for ∅ 0.81mm cable	U.FL-LP-040	CL331-0451-2
Right-angle plug for ∅ 0.81mm cable	U.FL-LP(V)-040 (01)	CL331-053-8-01
Right-angle plug for ∅ 1.13mm cable	U.FL-LP-068	CL331-0452-5
Right-angle plug for ∅ 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 10 are stress ratings under any conditions. Stresses beyond any of these limits will cause permanent damage to HC15.

Table 10: 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 STATSUSx 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

5.2 Operating Temperatures

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

Table 11: Board temperature

Parameter	Min	Typ	Max	Unit
Operating temperature range	-20	+25	+85	°C
Automatic shutdown[1] Temperature measured on HC15 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 11 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 12 and Table 13 show sample lab environment conditions. Please be aware that the operating duration and the maximum ambient temperature will vary significantly for your application.

Table 12: Sample operating conditions without forced air circulation (according to IEC 60068-2)

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

Table 13: Sample operating conditions with forced air circulation (air speed 0.9m/s)

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.	∞

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 (24dBm), 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 14: Storage conditions

Type	Condition	Unit	Reference
Air temperature: Low	-40	°C	ETS 300 019-2-1: T1.2, IEC 68-2-1 Ab
High	+85		ETS 300 019-2-1: T1.2, IEC 68-2-2 Bb
Humidity relative: Low	10	%	---
High	90 at 30°C		ETS 300 019-2-1: T1.2, IEC 68-2-56 Cb
Condens.	90-100 at 30°C		ETS 300 019-2-1: T1.2, IEC 68-2-30 Db
Air pressure: Low	70	kPa	IEC TR 60271-3-1: 1K4
High	106		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	1120	W/m^2	ETS 300 019-2-1: T1.2, IEC 68-2-2 Bb
Heat	600		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:			IEC TR 60271-3-1: 1M2
Displacement	1.5	mm	
Acceleration	5	m/s^2	
Frequency range	2-9 9-200	Hz	
Shocks:			IEC 68-2-27 Ea
Shock spectrum	semi-sinusoidal		
Duration	1	ms	
Acceleration	50	m/s^2	

5.4 Reliability Characteristics

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

Table 15: 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 HC15 is a 50-pin double-row receptacle (see also Chapter 6). The pin assignment for HC15 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	Do not use	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 HC15

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

Table 16: Signal description

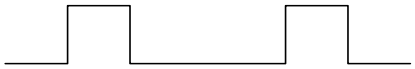
Function	Signal name	IO	Signal form and level	Comment
Power supply	BATT+	I	$V_I$max = 4.2V $V_I$norm = 3.8V $V_I$min = 3.2V during Tx burst (GSM) on board I ≈ 2A, during Tx burst (GSM)  n Tx = n x 577µs peak current every 4.616ms	Pins of BATT+ and GND must be connected in parallel for supply purposes 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 16: 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		
3V SIM/ UICC Inter-face	CCIN	I	$R_I \approx 110k\Omega$ V_{IL}max = 0.5V at I = -25µA V_{IH}min = 2.2V at I = -5µA, $V_O$max= 2.95V	CCIN = Low, SIM card holder closed 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.
	CCRST	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 2.6V at I = -1mA V_{OH}max = 3.10V	
	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 16: Signal description

Function	Signal name	IO	Signal form and level	Comment
1.8V SIM/ UICC Inter-face	CCIN	I	$R_I \approx 100k\Omega$ V_{IL}max = 0.5V at I = -25µA V_{IH}min = 2.2V at I = -5µA, $V_O$max= 2.95V	CCIN = Low, SIM card holder closed 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 man-datory.
	CCRST	O	V_{OL}max = 0.25V at I = 1mA V_{OH}min = 1.50V at I = -1mA V_{OH}max = 1.85V	
	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 16: 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 earphone 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 17: Power supply ratings

Parameter	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<200kHz @ f>200kHz			 50 2	 mV mV
I_{BATT+}	OFF State supply current	POWER DOWN		50		µA
	Average GSM / GPRS supply current[1]	SLEEP (USB Suspend) @DRX=9		2.9		mA
		SLEEP (USB Suspend) @DRX=5		3.4		mA
		SLEEP (USB Suspend) @DRX=2		5.6		mA
		IDLE (USB active) @DRX=2		55		mA
		Voice Call GSM900; PCL=5		350		mA
		GPRS Data transfer GSM900; PCL=5; 1Tx/4Rx		375		mA
		GPRS Data transfer GSM900; PCL=5; 2Tx/3Rx		540		mA
		EDGE Data transfer GSM900; PCL=5; 1Tx/4Rx		315		mA
		EDGE Data transfer GSM900; PCL=5; 2Tx/3Rx		410		mA
		Voice Call GSM1800/1900; PCL=0		315		mA
		GPRS Data transfer GSM1800; PCL=0; 1Tx/4Rx		325		mA
		GPRS Data transfer GSM1800; PCL=0; 2Tx/3Rx		430		mA
		EDGE Data transfer GSM1800; PCL=0; 1Tx/4Rx		290		mA
		EDGE Data transfer GSM1800; PCL=0; 2Tx/3Rx		355		mA

Table 17: Power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
I_{BATT+}	Peak current during GSM transmit burst	VOICE Call GSM900; PCL=5		1.8[1]	2.9[2]	A
		VOICE Call GSM1800; PCL=0		1.5[1]	2.1[2]	A
	Average WCDMA supply current	Idle (USB active) @ DRX=6		45		mA
		SLEEP (USB Suspend) @DRX=9		2.6		mA
		SLEEP (USB Suspend) @DRX=8		3.0		mA
		SLEEP (USB Suspend) @DRX=6		5.3		mA
		UMTS Data transfer Band I @+10dBm		390		mA
		HSDPA Data transfer Band I @+10dBm		450		mA
		UMTS Data transfer Band I @+24dBm		760	820[2]	mA
		HSDPA Data transfer Band I @+24dBm		795		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. Under total mismatch conditions at antenna connector

5.7 Electrical Characteristics of the Voiceband Part

5.7.1 Characteristics of Audio Modes

The electrical characteristics of the voiceband part depend on the current audio mode set with the AT^SNFS command.

Table 18: Voiceband characteristics (typical)

Audio mode no. AT^SNFS=	**1**	**2**
Name	Default Handset	Router
Purpose	DSB with Votronic handset	Analog phone interface
TX-Filters	Adjusted	Flat
RX-Filters	Adjusted to fit artificial ear type 3.2 low leakage	Flat
Gain setting	Fix	Fix
Power supply VMIC	ON during call	ON during call
Sidetone	Fix	No
Volume control	Fix	Fix
Echo canceller	ON	ON
Non Linear Processor	ON	ON
Comfort Noise Generator	ON	ON
Noise Reduction	-15dB	OFF
MIC input signal for 0dBm0, f = 1024Hz	16mV	582mV
EP output signal in mV rms. @ 0dBm0, 1024Hz, no load (default gain) / @ 3.14 dBm0	516mV 2.1Vpp	516mV 2.1Vpp
Sidetone gain at default settings	25.7dB	-∞ dB

5.8 Air Interface

Table 19: Air interface GSM / UMTS

Parameter	Conditions	Min.	Typical	Max.	Unit
Humidity range		10		90	% relative
HSDPA / UMTS connectivity	Band I				
UMTS Frequency range Uplink (UE to Node B)	UMTS 2100 Band I	1920		1980	MHz
UMTS Frequency range Downlink (Node B to UE)	UMTS 2100 Band I	2110		2170	MHz
Receiver Input Sensitivity @ ARP	UMTS 2100 Band I		-108		dBm
RF Power@ ARP with 50Ohm Load	UMTS 2100 Band I	+21	+24	+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)	E-GSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
GSM Frequency range Downlink (BTS to MS)	E-GSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
Receiver input Sensitivity @ ARP	E-GSM 900	-102	-108		dBm
	GSM 1800	-102	-107		dBm
RF Power@ ARP with 50Ohm Load	E-GSM 900	31	32	35	dBm
	GSM 1800	28	29	32	dBm

5.9 Electrostatic Discharge

The HC15 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 HC15 module.

Special ESD protection provided on HC15:

- Antenna interface: one discharge circuit
- SIM interface: clamp diodes for protection against over voltage.
- USB interface: clamp diodes for protection against over voltage.
- The remaining ports of HC15 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.

HC15 has been tested according to the EN 61000-4-2 standard (as referenced in group standard ETSI EN 300 342-1 (11/2004)). The measured values can be gathered from the following table.

Table 20: Measured electrostatic values

Specification / Requirements	Contact discharge	Air discharge
ETSI EN 300 342-1 (11/2004)		
ESD at SIM port	± 4kV	± 8kV
ESD at USB interface	± 4kV	± 8kV
Human Body Model (Test conditions: 1.5kΩ, 100pF)		
ESD at antenna port	± 1kV	± 1kV
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 HC15

Length: 50.00mm

Width: 34.00mm

Height: 4.5mm

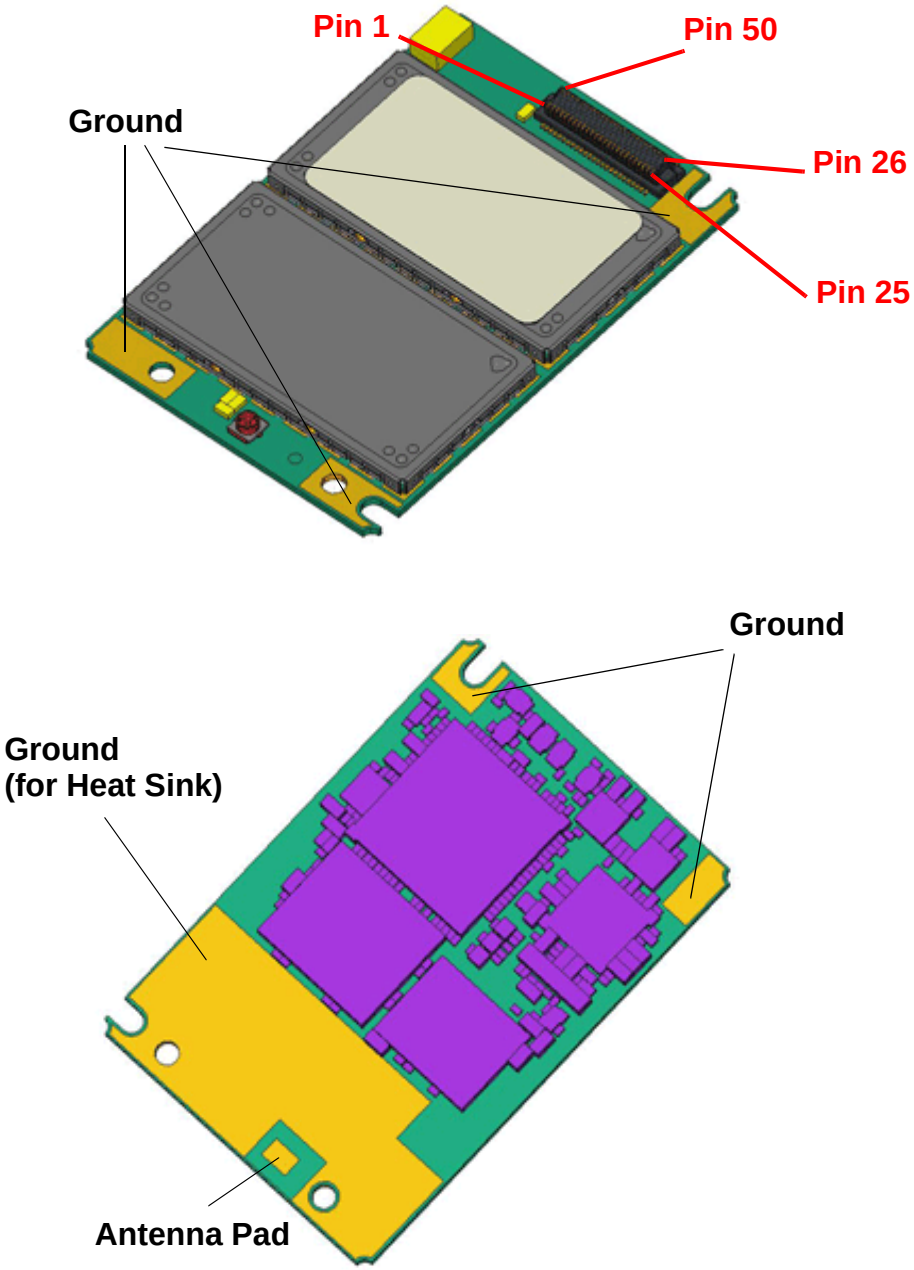


Figure 20: HC15 – Top and bottom view

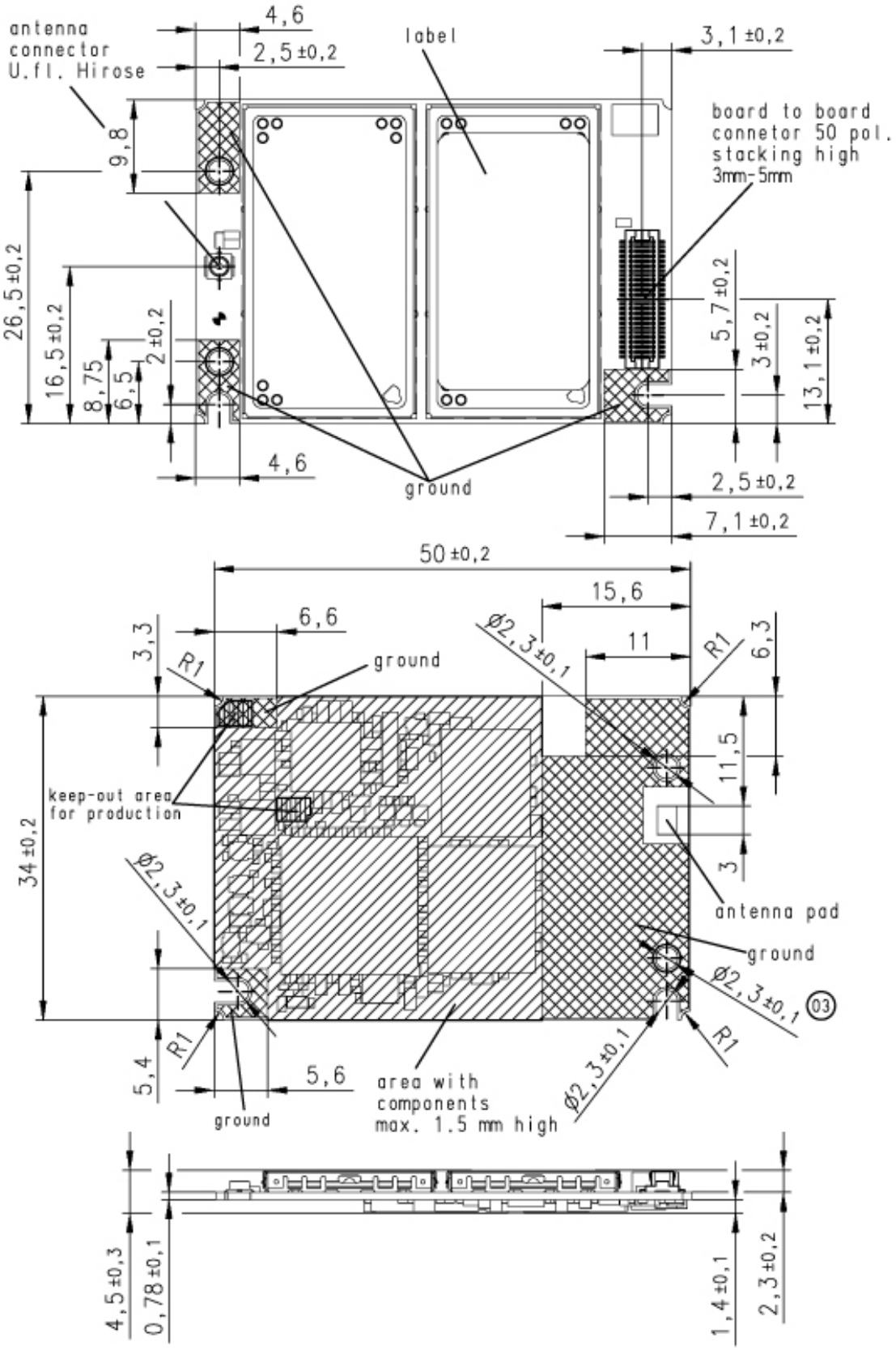


Figure 21: Dimensions of HC15 (all dimensions in mm)

6.2 Mounting HC15 to the Application Platform

There are many ways to properly install HC15 in the host device. An efficient approach is to mount the HC15 PCB 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 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 HC15 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 21: 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 20.

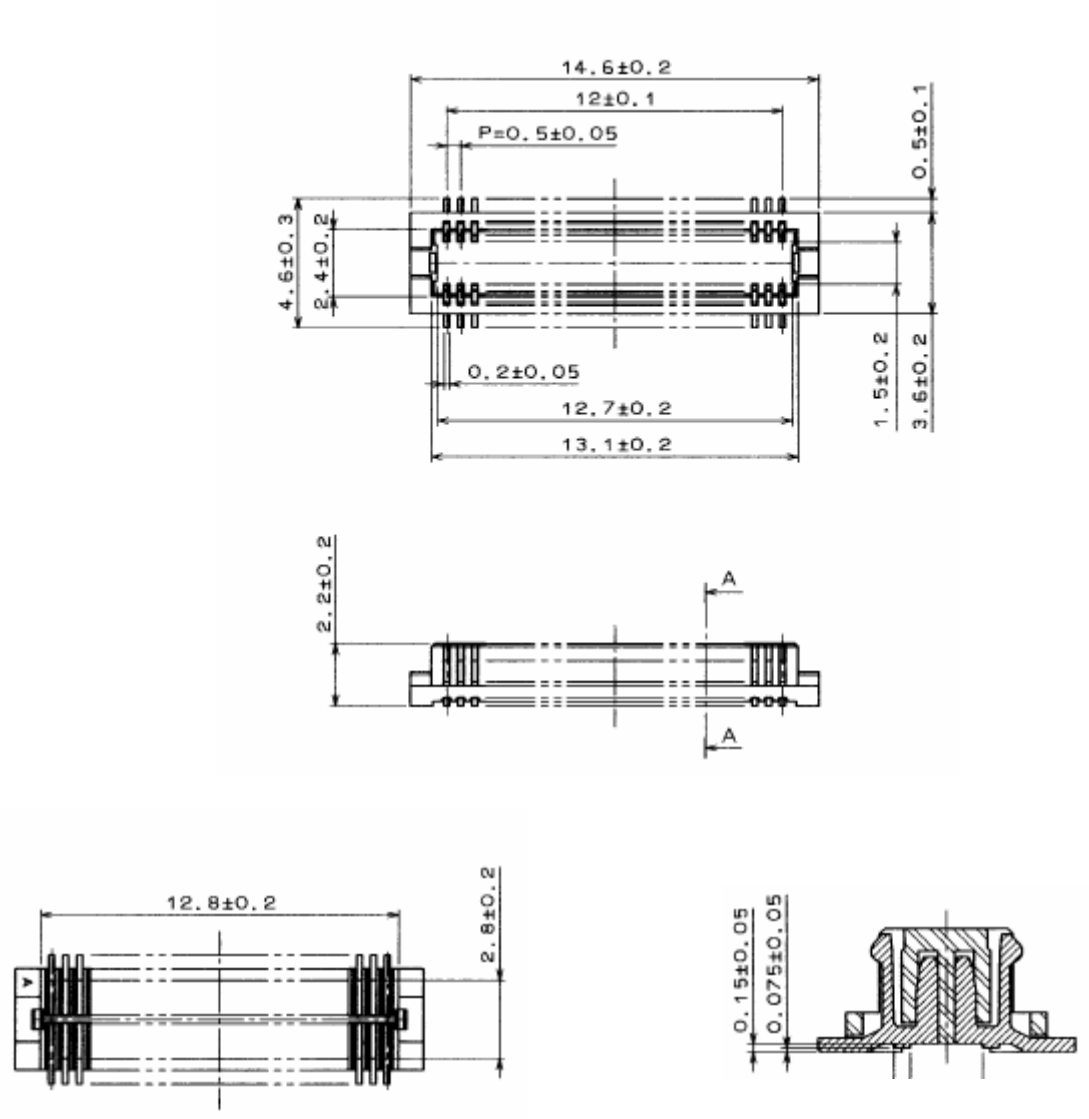


Figure 22: Mechanical dimensions of the board-to-board connector

7 Sample Application

Figure 23 shows a typical example of how to integrate a HC15 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 HC15 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 23 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 HC15 modules.

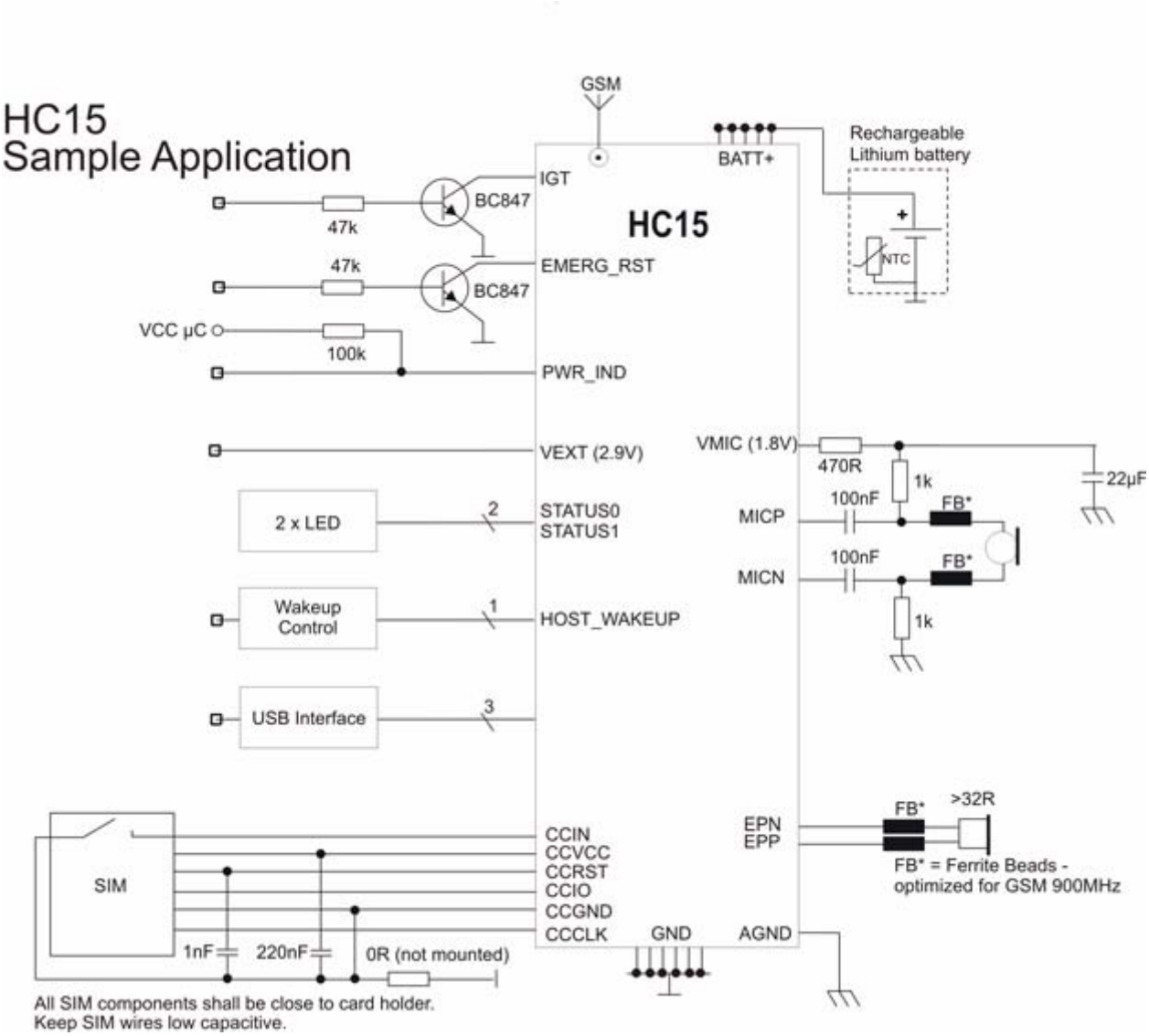


Figure 23: HC15 sample application

8 Reference Approval

8.1 Reference Equipment for Type Approval

The Siemens reference setup submitted to type approve HC15 consists of the following components:

- Siemens HC15 cellular engine
- Development Support Box DSB75 and HC15/HC25-DSB75-Adapter for mounting the HC15 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

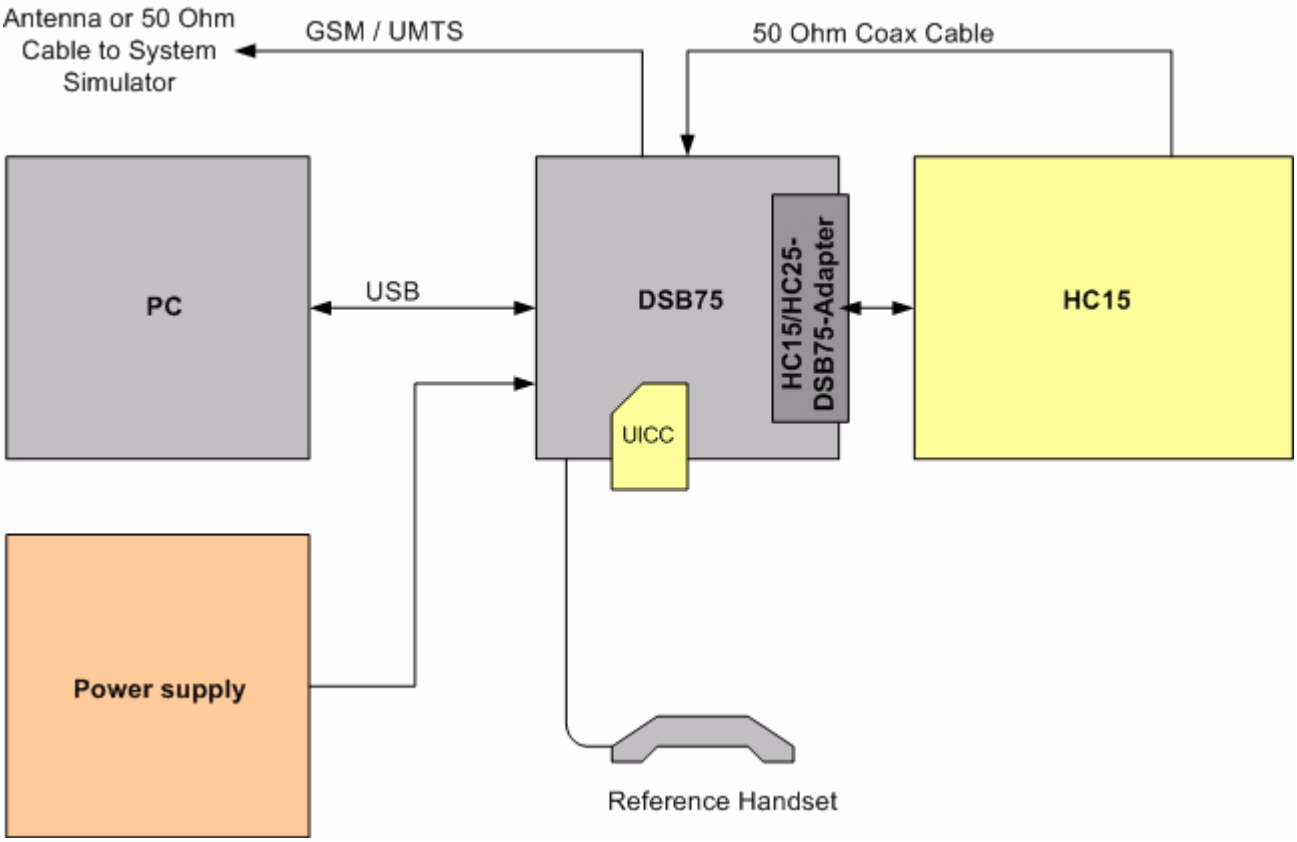


Figure 24: Reference equipment for Type Approval

9 Appendix

9.1 List of Parts and Accessories

Table 22: List of parts and accessories

Description	Supplier	Ordering information
HC15	Siemens	Standard module (Siemens IMEI) Siemens ordering number: L30960-N1000-A100 Customer IMEI mode: Siemens Ordering number: L30960-N1010-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 23.
Board-to-board connector	Molex	Sales contacts are listed in Table 23.
Antenna connector	Hirose	Sales contacts are listed in Table 24.

Table 23: 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 Email: 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 24: 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

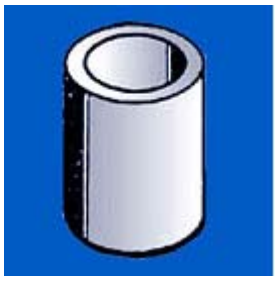
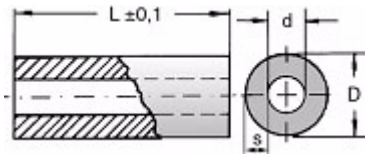
http://www.ettinger.de/main.cfm

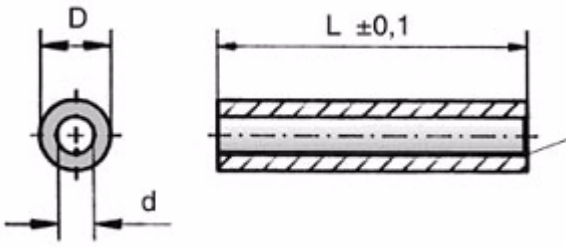
Phone: +49-81-046623-0

Fax: +49-81-046623-99

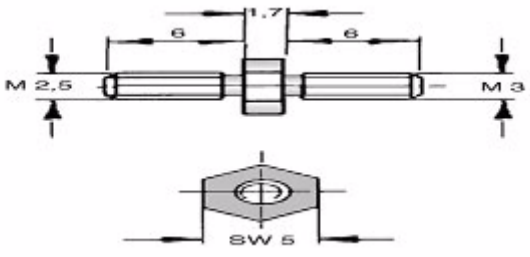
The following tables contain only article numbers and basic parameters of the listed components. For further detail and ordering information please contact Ettinger GmbH.

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
	

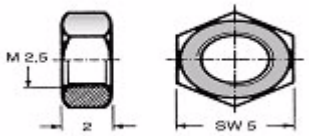
1. 2 spacers are delivered with DSB75 Support Board

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
	

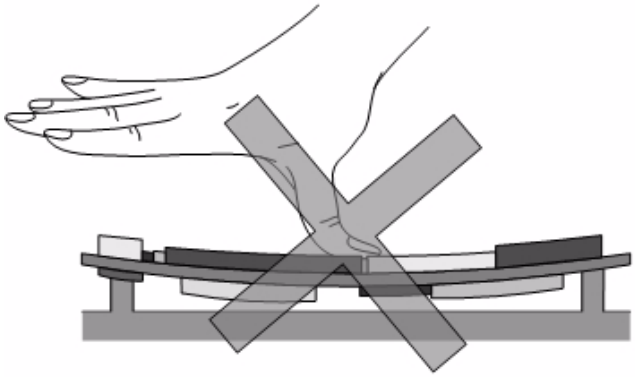
1. 2 nuts are delivered with DSB75 Support Board

9.3 Mounting Advice Sheet

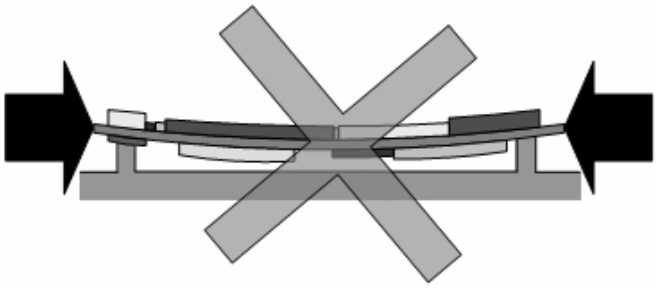
To prevent mechanical damage, be careful not to force, bend or twist the module. Be sure it is positioned flat against the host device. The advice sheet on the next page shows a number of examples for the kind of bending that may lead to mechanical damage of the module.

Mounting Advice

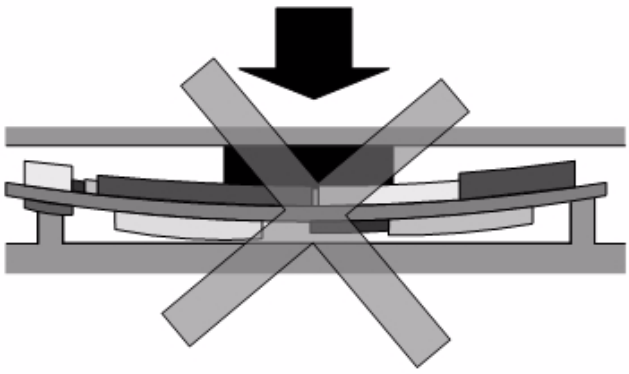
Do NOT BEND the Module



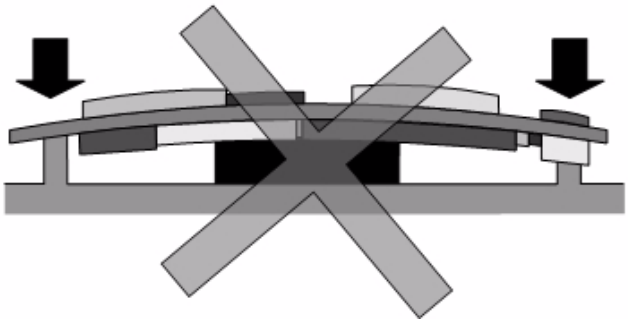
- By pressing from above



- By mounting under pressure



- By putting objects on top



- By putting objects below