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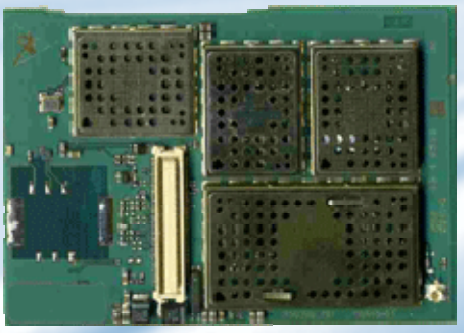

HMS1
Siemens Cellular Engine

Version: 01.62
DocID: HMS1_HD_V01.62

Hardware Interface Description

Document Name:	**HMS1 Hardware Interface Description**
Version:	**01.62**
Date:	**August 21, 2006**
DocId:	**HMS1_HD_V01.62**
Status:	**Confidential / Preliminary**

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0. Document History

New document: "HMS1 Hardware Interface Description" Version **01.62**

Chapter	What is new
All	Initial document setup.

1. Introduction

This document describes the hardware of the Siemens HMS1 module that connects to a 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.

The HMS1 module is a single band WCDMA, quad band GSM/GPRS data modem and features high downlink speeds using HSDPA. It can be connected to a standard PC via USB interface for high speed data communication, such as email, web browsing, data base retrieval, server access, as well as audio and video streaming.

1.1. Related Documents

[1] HMS1 AT Command Set, Version 01.62
[2] DSB75 Support Box - Evaluation Kit for Siemens Cellular Engines

1.2. Terms and Abbreviations

Abbreviation	Description
A/D	Analog-to-Digital Converter
AF	Audio Frequency
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AMR	Adaptive Multi Rate
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
BB	Baseband
CPU	Central Processing Unit
CR	Change Request
CTR	Common Technical Regulation
DAI	Digital Audio Interface
/DCD	Data Carrier Detect
DFC	Digital Frequency Centering
DSB	Development Support Board
DSP	Digital Signal Processor
/DSR	Data Set Ready
/DTR	Data Terminal Ready
DTX	Discontinuous transmission

EFR	Enhanced Full Rate
EMC	Electro Magnetic Compatibility
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ESR	Equivalent Serial Resistance
ETS	European Telecommunication Standard
FE	Front-End
FFC	Flat Flexible Cable
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GSC	(Type of antenna connector)
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSDPA	High Speed Downlink Packet Access
HW	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identity
I/O	Input/Output
ISO	International Standards Organization
ITU	International Telecommunications Union
LDO	Low Drop Out
LFBGA	Low-Profile Fine-Pitch Ball Grid Array
Li-Ion	Lithium-Ion
LNA	Low Noise Amplifier
LO	Local Oscillator
Mbps	Mbit per second
MMI	Man Machine Interface
MTBF	Mean Time Between Failures
NTC	Negative Temperature Coefficient
OC	Offset Compensation
OTP	One Time Programmable
PA(C)	Power Amplifier (Control)
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PD	Power Down
PGC	Programmable Gain-Controlled Amplifier

PLL	Phase Locked Loop
PSU	Power Supply Unit
RAM	Random Access Memory
RF	Radio Frequency
/RING	Ring Indication
ROM	Read-Only Memory
RTC	Real Time Clock
/RXD	Receive direction
Rx	Receive direction
SAW	Surface Acoustical Wave Filter
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMS	Short Message Service
SRAM	Static Random Access Memory
SW	Software
TBR	Technical Based Regulation
TBD	To Be Defined
TBI	To Be Inserted
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
/TXD	Transmit direction
Tx	Transmit direction
UART	Universal Asynchronous Receiver Transmitter
VCO	Voltage Controlled Oscillator
VCXO	Voltage Controlled Quartz Oscillator
VSWR	Voltage Standing Wave Ratio

1.3. Type Approval

HMS1 has been approved 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
89/336/EC	Directive on electromagnetic compatibility
73/23/EC	Directive on electrical equipment designed for use within certain voltage limits (Low Voltage 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 North American type approval

CFR Title 47	Code of Federal Regulations, Part 22 and Part 24 (Telecommunications, PCS); US Equipment Authorization FCC
NAPRD.03 V3.5.1	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS133 (Issue2)	Canadian Standard

Table 3: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Phase 2); 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.xx.0	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 4: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

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 HMS1 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)

1.4. 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 HMS1. 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.

SOS

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	Quad band: GSM 850/900/1800/1900MHz Single band: WCDMA 2100
GSM class	Small MS
Output power (according to Release 99, V5)	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 The values stated above are maximum limits. According to Release 99, Version 5, the maximum output power in a multislot configuration may be lower. The nominal reduction of maximum output power varies with the number of uplink timeslots used and amounts to 3.0dB for 2Tx.
Power supply	3.6V, supplied by limited power source
Ambient operating temperature according to IEC 60068-2	Normal operation 0°C to 55°C
Physical	Dimensions: 70mm x 49.7mm x 5mm Weight: approx. 17g
RoHS	All hardware components fully compliant with EU RoHS Directive
GSM / GPRS / EGPRS / UMTS features	
Data transfer	UMTS • FDD Mode • HSDPA Mode Cat. 11.12 • GPRS • Multislot Class 10 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4

Feature	Implementation
	EGPRS • Multislot Class 10 • Mobile Station Class B • Modulation and Coding Scheme MCS 1 – 9 CSD • V.110, RLP, non-transparent • GSM: 2.4, 4.8, 9.6, 14.4kbps • UMTS: 57.6kbps
SMS	• Point-to-point MT and MO • Cell broadcast • Text and PDU mode
Fax	Group 3; Class 1, Class 2
Software	
AT commands	AT-Hayes GSM 07.05 and 07.07, Qualcomm AT command Set
Firmware update	Generic update from host application over USB.
Interfaces	
USB	Supports a USB 1.1 Full Speed (12Mbit/s) device interface.
SIM	SIM card reader on board
Antenna	External antenna can be connected via antenna pads. For test purposes a 50Ohm antenna can be connected via coaxial switch (Hirose MS-156NB).
Module interface	80 pin board-to-board connector
Power on/off, Reset	
Power on/off	• Switch-on by hardware pin IGT • Switch-off by AT command
Reset	• Orderly shutdown and reset by AT command • Emergency reset by hardware pins EMERG_RST
Evaluation kit	
DSB	DSB Evaluation Board designed to test and type approve Siemens cellular engines and provide a sample configuration for application engineering.

2.2. HMS1 System Overview

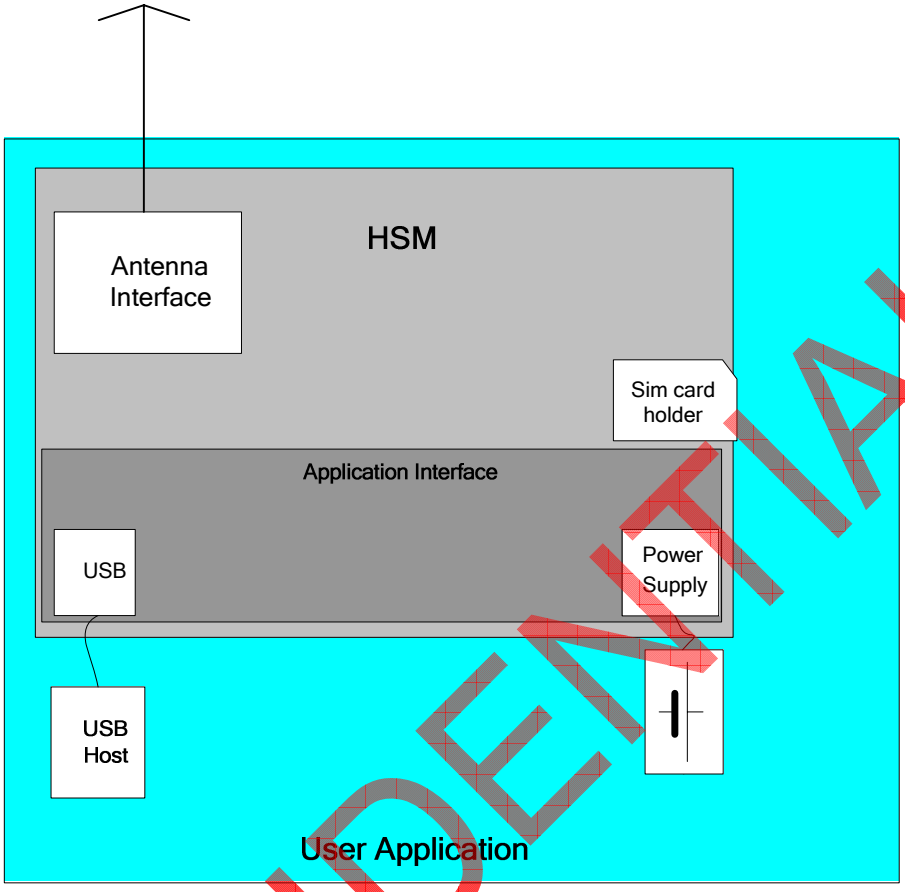


Figure 1: HSM system overview

2.3. Circuit Concept

Figure 2 shows a block diagram of the HMS module and illustrates the major functional components:

Base band block:

- WCDMA/GSM Baseband Controller
- Power supply unit
- Flash/SDRAM memory
- External Interface, 80 pin board-to-board connector

RF section:

- RF WCDMA Receiver
- RF WCDMA Transmitter
- RF Power Amplifiers
- EPCOS receive SAWs (according to variant – see below)
- Antenna Connector

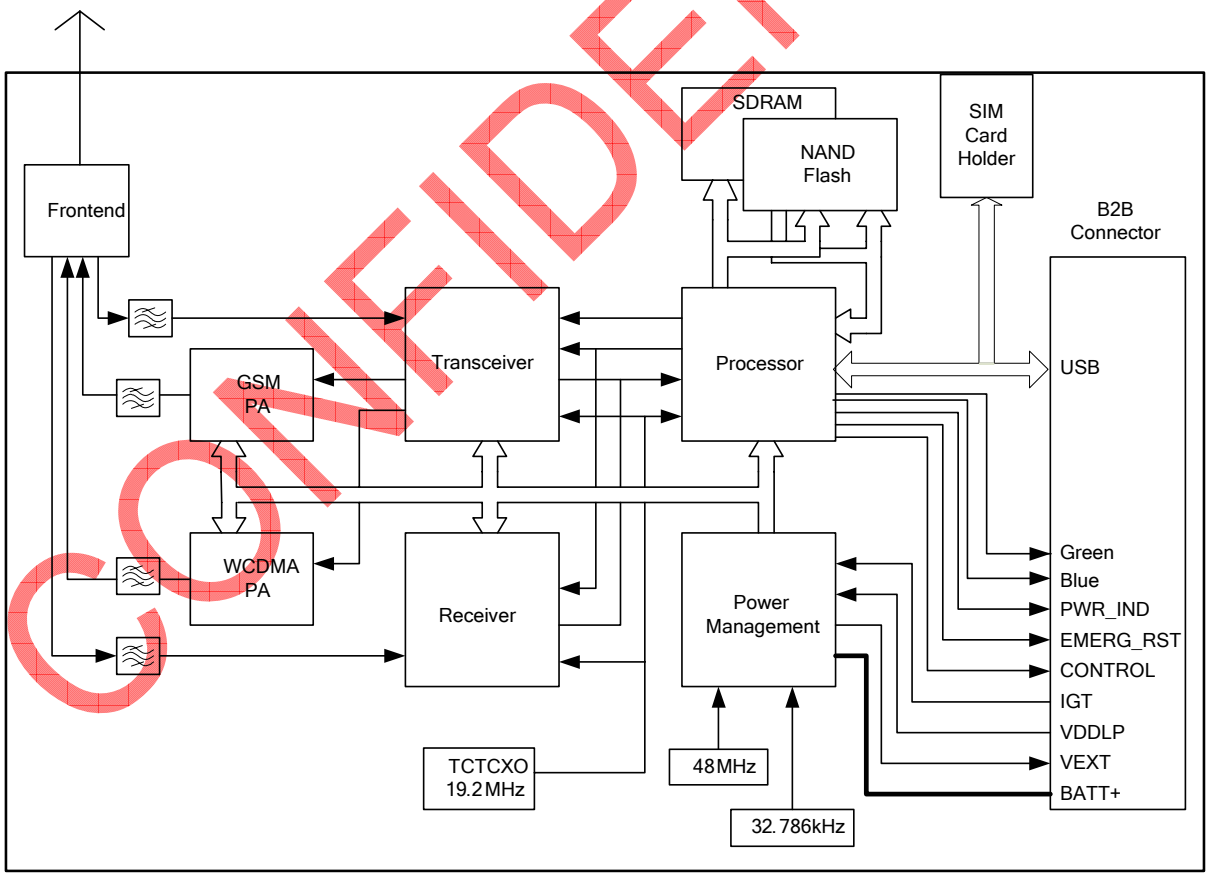


Figure 2: HMS1 schematic overview

3. Application Interface

HMS1 is equipped with an 80 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
- SIM interface - see Section 3.6
- Serial interface USB - see Section 3.7.
- Status and control lines: IGT, EMERG_RST, PWR_IND, STATUS1/2 – see Table 10

3.1. Operating Modes

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

Table 5: Overview of operating modes

Normal operation	GSM / GPRS SLEEP	Tbd.
	GSM IDLE	Software is active. Once registered to the GSM network, paging with BTS is carried out. The module is ready to send and receive.
	GSM DATA	Connection between two subscribers is in progress. Power consumption depends on network coverage individual settings.
	GPRS IDLE EGPRS IDLE	Module is ready for GPRS/EGPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS/EGPRS configuration (e.g. multislot settings).
	GPRS DATA EGPRS DATA	GPRS/EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates, GPRS/EGPRS configuration (e.g. used multislot settings) and reduction of maximum output power.
	UMTS IDLE	Software is active. Once registered to the UMTS network, paging with BTS is carried out. The module is ready to send and receive.
	UMTS DATA	UMTS Data Transfer in progress.
	HSDPA	HSDPA High Speed Data connection in Downlink Direction.
POWER DOWN	Normal shutdown after sending the AT command. Operating voltage (connected to BATT+) remains applied.	

3.2. Power Supply

HMS1 needs to be connected to a power supply at the B2B connector (5 pins each BATT+ and GND).

The power supply of HMS1 has to be a single voltage source at BATT+. It must be able to provide the peak current during the GSM uplink transmission.

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 low drop linear 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.
- SIM switch 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 V_{BATT+} never drops below 3.3V on the HMS1 board, not even in a GSM transmit burst where current consumption can rise to typical peaks of 2A. It should be noted that HMS1 switches off when exceeding these limits. Any voltage drops that may occur in a transmit burst should not exceed 400mV.

In IDLE and SLEEP mode, the module switches off if the minimum battery voltage (V_{batt}min) is reached.

Example:
$V_I$min = 3.3V
Dmax = 0.4V

V_{batt}min = $V_I$min + Dmax
V_{batt}min = 3.3V + 0.4V = 3.7V

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.

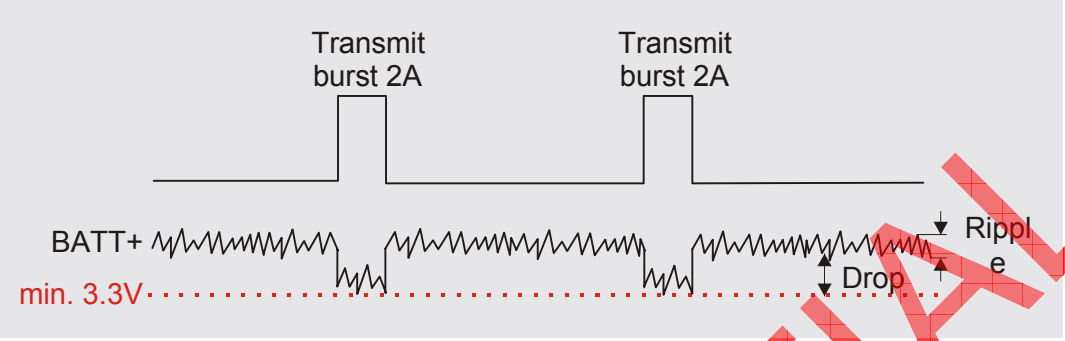


Figure 3: Power supply limits during transmit burst

3.3. Power-Up / Power-Down Scenarios

In general, be sure not to turn on HMS1 while it is beyond the safety limits of voltage and temperature. HMS1 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 HMS1

When the HMS1 module is in Power-down mode, it can be started to Normal mode or Airplane 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.

3.3.1.1. Reset or Turn off HMS1 in Case of Emergency

Caution: Use the EMERG_RST pin only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the EMERG_RST 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 HMS1 does not respond, if reset or shutdown via AT command fails.

The EMERG_RST signal is available on the application interface.

3.3.2. Turn off HMS1

HMS1 can be turned off by Normal shutdown: Software controlled by AT command.
Be sure not to disconnect the supply voltage V_{BATT+}. Otherwise you run the risk of losing data.

3.4. Power Saving

Intended for power saving, SLEEP mode reduces the functionality of the HMS1 to a minimum and thus minimizes the current consumption.

The different sleep modes will be specified later.

3.5. RTC Backup

The internal Real Time Clock of HMS1 is supplied from a separate voltage regulator in the analog controller which is also active when HMS1 is in POWER DOWN status.

In addition, you can 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 or battery is charged by the power management controller of HMS1. If the voltage supply at BATT+ is disconnected, the RTC can be powered by the capacitor or battery. The size of the capacitor determines the duration of buffering when no voltage is applied to HMS1, i.e. the larger the capacitor the longer HMS1 will save the date and time.

3.6. USIM Interface

The base band processor has an integrated SIM interface compatible with the 34.121 USIM Testing IC Card standard. This is wired to an integrated SIM card holder. The USIM interface supports 3V and 1.8V USIM cards.

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.

3.7. USB Interface

HMS1 supports a USB 1.1 Full Speed (12Mbit/s) device interface. The USB interface is the recommended communication interface for high speed data transmission.

To properly connect the module's USB interface to the host a USB 2.0 full speed compatible connector is required. The HMS1 distribution contains the suitable USB driver to operate HMS1 over USB. It is recommended to use this drive.

The USB host is responsible for supplying, across the VUSB_IN line, power to the module's USB interface, but not to other HMS1 interfaces. This is because HMS1 is designed as a self-powered device compliant with the "Universal Serial Bus Specification Revision 1.1" (The specification is ready for download on http://www.usb.org/developers/docs/).

3.8. Control Signals

Several control lines are signaling the states of the HMS1 module or control the module. These states are power down, stand by, paging, GSM voice call, GSM data call, UMTS voice call, UMTS data call or HSDPA connection.

3.8.1.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.

3.8.2.Status Signals

Two status signals (GREEN, BLUE) are provided for signaling the module's connectivity status:

- When searching for a network the signal 1 (GREEN) alternates at 2Hz
- When registered with a GSM network signal 1 is active
- When registered with a WCDMA network signal 2 (BLUE) goes active, signal 1 inactive

4. Antenna Interface

The RF interface has an impedance of 50Ω. HMS1 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 HMS1 PCB and should be placed in the host application.

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.

4.1. Antenna Installation

To suit application requirements the HMS1 module adapts an internal antenna from Skycross that is connected to the two antenna pads:

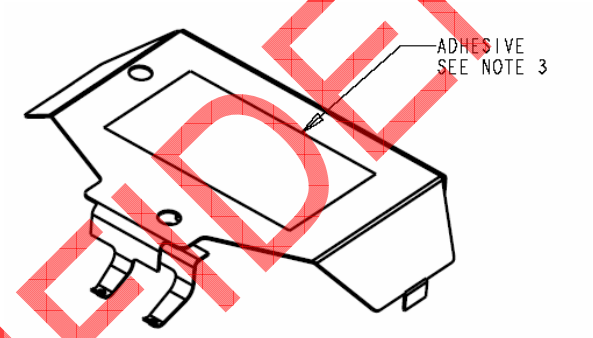


Figure 4: Internal antenna for HMS

4.1.1. Test Antenna

For production and type approval test the HMS1 module also provides a subminiature coaxial switch from Hirose Ltd. The product name is:

MS-156NB

For detailed specifications and latest product information please contact your Hirose dealer or visit the Hirose home page, for example http://www.hirose.com.

5. Electrical, Reliability and Radio Characteristics

5.1. Absolute Maximum Ratings

The absolute maximum ratings stated in Table 6 are stress ratings under any conditions. Stresses beyond any of these limits will cause permanent damage to HMS1. The power supply shall be compliant with the SELV safety standard defined in EN60950. The supply current must be limited according to Table 6.

Table 6: Absolute maximum ratings

Parameter	Min	Max	Unit
Supply voltage BATT+	-0.3	+3.7	V
Voltage at digital pins in POWER DOWN mode	-0.3	+0.3	V
Voltage at digital pins in normal operation	-0.3	+3.0	V
Voltage at analog pins in POWER DOWN mode	-0.3	+0.3	V
Voltage at analog pins in normal operation	-0.3	+3.0	V
VUSB_IN	-0.3	+3.5	V
USB_DP, USB_DN	-0.3	+5.5	V
VDDLP	-0.3	+3.25	V

5.2. Operating Temperatures

Table 7: Ambient temperature according to IEC 60068-2 (without forced air circulation)

Parameter	Min	Typ	Max	Unit
Normal operation	0	+25	+55	°C

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 8: 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 recommended		IEC TR 60271-3-1: 1C1L
Mechanically active substances		Not recommended		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

Table 9: 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

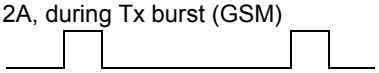
5.5. Pin Assignment and Signal Description

The board-to-board connector on HMS1 is an 80-pin double-row receptacle.

1	GND	GND	80
2	*n.c.*	*n.c.*	79
3	*n.c.*	PWR_IND	78
4	GND	*n.c.*	77
5	*n.c.*	*n.c.*	76
6	*n.c.*	*n.c.*	75
7	*n.c.*	GREEN	74
8	*n.c.*	BLUE	73
9	*n.c.*	*n.c.*	72
10	*n.c.*	*n.c.*	71
11	*n.c.*	*n.c.*	70
12	VUSB_IN	USB_DP	69
13	*n.c.*	USB_DN	68
14	*n.c.*	*n.c.*	67
15	*n.c.*	*do not use*	66
16	*n.c.*	*n.c.*	65
17	*n.c.*	*n.c.*	64
18	*n.c.*	*n.c.*	63
19	*n.c.*	*n.c.*	62
20	*n.c.*	*n.c.*	61
21	GND	*n.c.*	60
22	*n.c.*	*n.c.*	59
23	*n.c.*	*n.c.*	58
24	*n.c.*	*do not use*	57
25	*n.c.*	IGT	56
26	*n.c.*	EMERG_RST	55
27	*n.c.*	*n.c.*	54
28	*n.c.*	*n.c.*	53
29	*n.c.*	*n.c.*	52
30	*n.c.*	*n.c.*	51
31	*n.c.*	*n.c.*	50
32	*n.c.*	*n.c.*	49
33	VDDLP	*n.c.*	48
34	*n.c.*	*n.c.*	47
35	*n.c.*	VEXT	46
36	GND	BATT+	45
37	GND	BATT+	44
38	GND	BATT+	43
39	GND	BATT+	42
40	GND	BATT+	41

Figure 5: Pin assignments on board-to-board connector

Table 10: Signal description

Function	Signal name	IO	Signal form and level	Comment
Power supply	BATT+	I	V_{BATT} = 3.6V±5% I ≈ 2A, during Tx burst (GSM)  n Tx = n x 577µs peak current every 4.616ms	Five 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 3.3V including drop, ripple, spikes.
Power supply	GND		Ground	Application Ground
External supply voltage	VEXT	O	Normal mode: $V_O$min = 2.70V $V_O$typ = 2.85V $V_O$max = 3.00V $I_O$max = Tbd.	VEXT may be used for application circuits, for example to supply power for an SD card. If unused keep pin open. The external digital logic must not cause any spikes or glitches on voltage VEXT.
Power indicator	PWR_IND	O	V_{IH}max = Tbd. V_{OL}max = Tbd. at Imax = Tbd.	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.
Ignition	IGT	I	Internal pull-up: R_I ≈ 200kΩ V_{IL}max = Tbd. at Imax = Tbd. V_{OH}max = Tbd. ON ~~~|____|~~~ Active Low ≥ 400ms (to be verified)	This signal switches on the module. This line must be driven low by an open drain or open collector driver.
Emergency reset	EMERG_RST	I	Internal pull-up. V_{IL}max = 0.2V at Imax = -0.2mA Signal ~~~|_____|~~~ Pull down ≥ Tbd.	Reset in case of emergency. This line must be driven low by open drain or open collector. If unused keep pin open.

Function	Signal name	IO	Signal form and level	Comment
RTC backup	VDDLP	I	$R_I \approx 1k\Omega$ V_{BATT+} = 0V: V_I = 1.5V…3.25V at I_{max}= Tbd.	If unused keep pin open.
USB	VUSB_IN	I	V_{IN}min = 3.2V V_{IN}max = 3.5V	All electrical characteristics according to USB Implementers' Forum, USB 1.1 Full Speed Specification.
	USB_DP USB_DN	I/O	Differential Output Crossover voltage Range V_{CRS}min = 1.3V, V_{CRS}max = 2.0V Pullup at USB_DP R_{typ}=1.5kOhm	

Function	Signal name	IO	Signal form and level	Comment
Status Indication	BLUE GREEN	O O	V_{OH}min = BATT+ - 0.2V V_{OL}max = Tbd. I_{Omax} = Tbd.	Signals can be used to control LEDs via driving transistors. BLUE: “0” = module has been registered to an UMTS cell. GREEN: “0” = module has been registered to a GSM cell. Constantly changing between “0” and “1” = module is in “network search” state.
SIM interface specified for use with 3V SIM card	CCRST	O	R_O ≈ 50Ω V_{OL}max = 0.2V at I = 1mA V_{OH}min = 2.7V at I = -1mA V_{OH}max = 3.1V	All signals of SIM interface are protected against ESD with a special diode array.
	CCIO	I/O	R_I ≈ 10kΩ V_{IL}max = 1V V_{IL}min = -0.3V V_{IH}min = 1.9V V_{IH}max = 3.2V V_{OL}max = 0.2V at I = 1mA V_{OH}min = 2.7V at I = -1mA V_{OH}max = 3.1V	
	CCCLK	O	R_O ≈ 100Ω V_{OL}max = 0.25V at I = 1mA V_{OH}min = 2.65V at I = -1mA V_{OH}max = 3.1V	
	CCVCC	O	$V_O$min = 2.9V $V_O$typ = 3V $V_O$max = 3.1V $I_O$max = -50mA	
SIM interface specified for use with 1.8V SIM card	CCRST	O	R_O ≈ 50Ω V_{OL}max = 0.2V at I = 1mA V_{OH}min = 1.55V at I = -1mA V_{OH}max = 1.85V	All signals of SIM interface are protected against ESD with a special diode array.
	CCIO	I/O	R_I ≈ 10kΩ V_{IL}max = 0.6V V_{IL}min = -0.3V V_{IH}min = 1.15V V_{IH}max = 1.85V V_{OL}max = 0.2V at I = 1mA V_{OH}min = 1.5V at I = -1mA V_{OH}max = 1.85V	
	CCCLK	O	R_O ≈ 100Ω V_{OL}max = 0.25V at I = 1mA V_{OH}min = 1.5V at I = -1mA V_{OH}max = 1.85V	
	CCVCC	O	$V_O$min = 1.74V $V_O$typ = 1.8V $V_O$max = 1.86V $I_O$max = -50mA	

5.6. Power Supply Ratings

Table 11: Power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
BATT+	Supply voltage	Directly measured at reference points Tbd. BATT+ and GND. Voltage must stay within the min/max values, including voltage drop, ripple, spikes.	-5%	3.6	+5%	V
	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_{VDDLP}	OFF State supply current	RTC Backup @ BATT+ = 0V		Tbd.		µA
I_{BATT+}		POWER DOWN mode		Tbd.	Tbd.	µA
	Average standby supply current[2)]	SLEEP mode @ DRX = 9		Tbd.		mA
		SLEEP mode @ DRX = 5		Tbd.		mA
		SLEEP mode @ DRX = 2		Tbd.		mA
		IDLE mode @ DRX = 2		Tbd.		mA

5.7. Air Interface

Test conditions: All measurements have been performed at T_{amb}= 25°C, $V_{BATT+\ nom}$ = . The reference points used on HMS1 are the BATT+ and GND contacts.

Table 12: Air Interface GSM

Parameter		Min	Typ	Max	Unit
Frequency range Uplink (MS → BTS)	GSM 850	824		849	MHz
	E-GSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
	GSM 1900	1850		1910	MHz
Frequency range Downlink (BTS → MS)	GSM 850	869		894	MHz
	E-GSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
	GSM 1900	1930		1990	MHz
RF power @ ARP with 50Ω load	GSM 850	31	33	35	dBm
	E-GSM 900[1]	31	33	35	dBm
	GSM 1800[2]	28	30	32	dBm
	GSM 1900	28	30	32	dBm
Number of channels	GSM 850		124		
	E-GSM 900		174		
	GSM 1800		374		
	GSM 1900		299		
Duplex spacing	GSM 850		45		MHz
	E-GSM 900		45		MHz
	GSM 1800		95		MHz
	GSM 1900		80		MHz
Carrier spacing			200		kHz
Multiplex, Duplex		TDMA / FDMA, FDD			
Time slots per TDMA frame			8		
Frame duration			4.615		ms
Time slot duration			577		µs
Modulation		GMSK			
Receiver input sensitivity @ ARP BER Class II < 2.4% (static input level)	GSM 850	-102	-105.5		dBm
	E-GSM 900	-102	-105.5		dBm
	GSM 1800	-102	-105.5		dBm
	GSM 1900	-102	-105.5		dBm

[1] Power control level PCL 5
[2] Power control level PCL 0

Table 13: Air Interface UMTS

Parameter		Min	Typ	Max	Unit
Frequency range Uplink (MS → BTS)	UMTS Band I	1920		1980	MHz
Frequency range Downlink (BTS → MS)	UMTS Band I	2110		2170	MHz
Max RF power @ ARP with 50Ω load Power Class 3	UMTS Band I	21	24	25	dBm
Duplex spacing	UMTS Band I		190		MHz
Channel raster			200		kHz
Duplex		FDD			
Receiver input sensitivity @ ARP BER < 0,001 (static input level) DPCH_Ec with 12,2 kbps reference channel	UMTS Band I	-117			dBm/3,84 Mhz

5.8. Electrostatic Discharge

The HSDPA 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 HMS1 module.

Special ESD protection provided on HMS1:

- Antenna interface: one discharge circuit
- SIM interface: serial resistor, clamp diodes for protection against over voltage.
- The remaining parts of HMS1 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.

HMS1 has been tested according to the EN 61000-4-2 standard. The measured values can be gathered from the following table.

Table 14: Measured electrostatic values

Specification / Requirements	Contact discharge	Air discharge
CE ETS 300342-1 (June 1997)		
ESD at SIM port	± 4kV	± 8kV
ESD at antenna port	± 4kV	± 8kV
ESD at 3.6V in, GND	± 4kV	± 8kV
Human Body Model (Test conditions: 1.5kΩ, 100pF)		
ESD at SIM port	± 8kV	± 15kV
ESD at antenna port	± 8kV	± 15kV
ESD at 3.6V in, GND	± 8kV	± 15kV

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 Chapter 7.

6. Mechanics

6.1. Mechanical Dimensions HMS1

The below figure shows the top view of HMS1 and provides an overview of the board's mechanical dimensions.

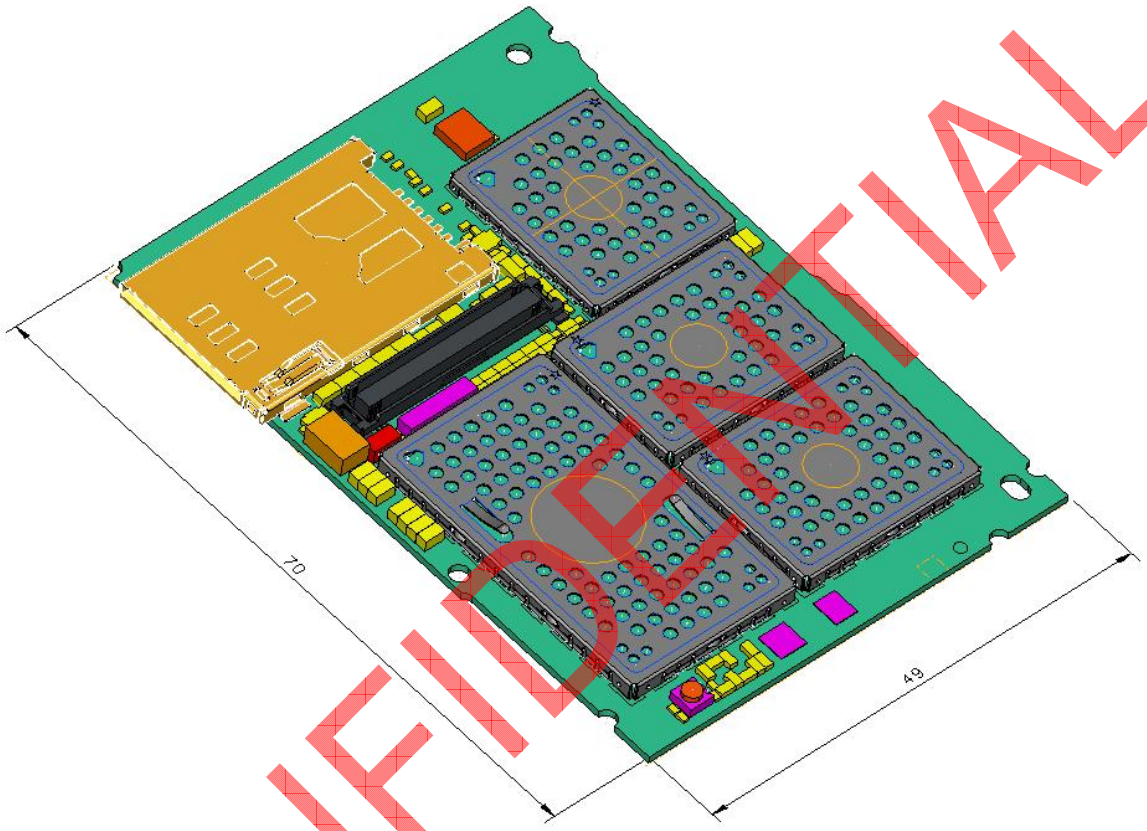


Figure 6: HMS1 Top View (prelim.)

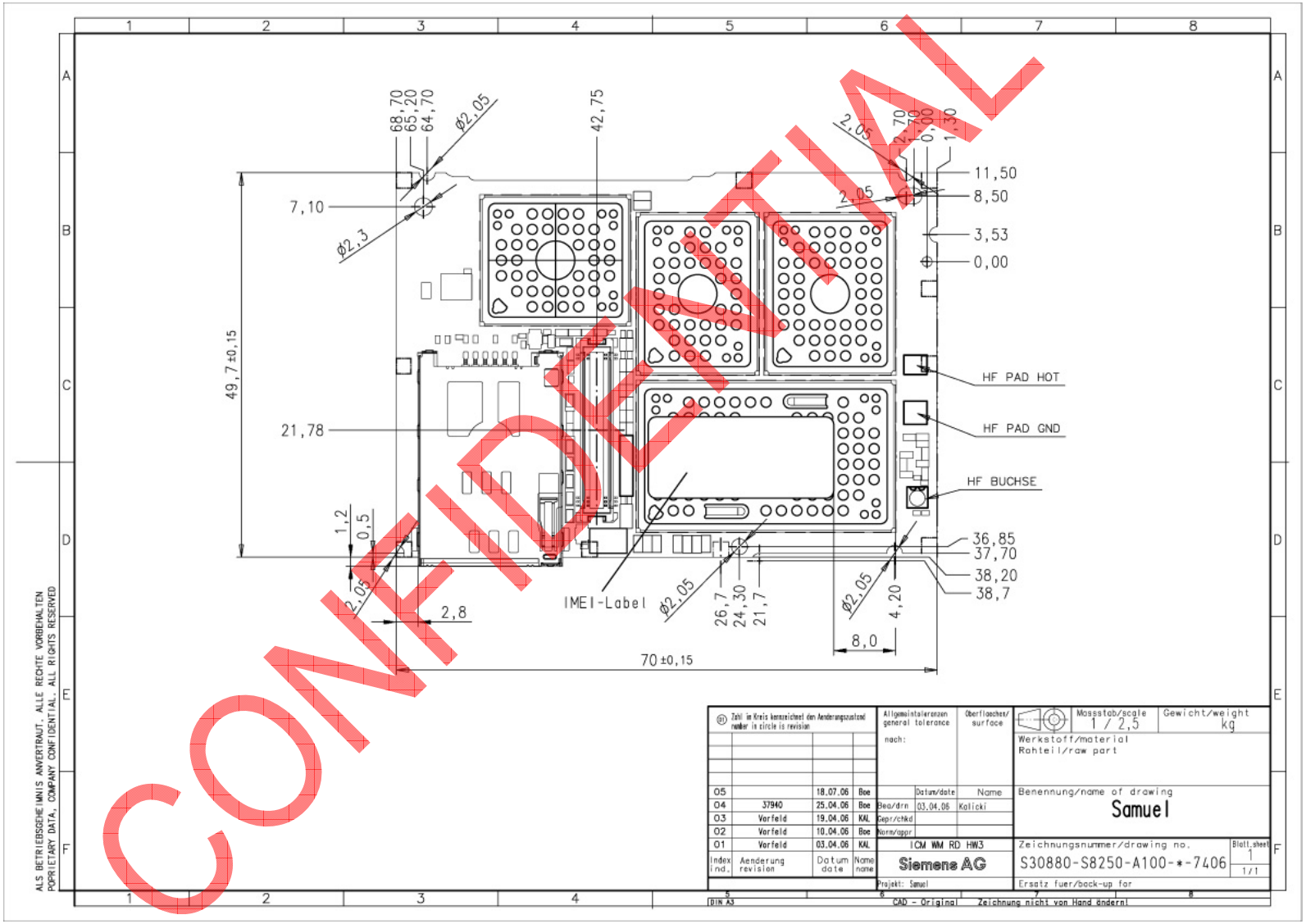


Figure 7: HMS1 Dimensions (prelim.)

7. Board-to-Board Application Connector

This chapter provides specifications and handling instructions for the 80 pin board-to-board application interface connector used to connect the HMS1 module to the host device.

Table 15: Electrical and mechanical characteristics of the 80 pin board-to-board connector

Parameter	Specification (80-way connector)
Number of Contacts	80
Voltage	50V
Current Rating	0.5A max per contact
Resistance	0.05 Ohm per contact
Dielectric Withstanding Voltage	150V RMS AC for 1min
Operating Temperature	-40°C...+125°C
Contact Material	brass (CuZn)
Insulator Material	LCP (= Liquid Crystal Polymer), glass-filled, white
Maximum connection cycles	20 (@ 50mOhm max)

The mechanical dimensions of the 80 pin board-to-board connector are shown below (as an extract from the datasheet):

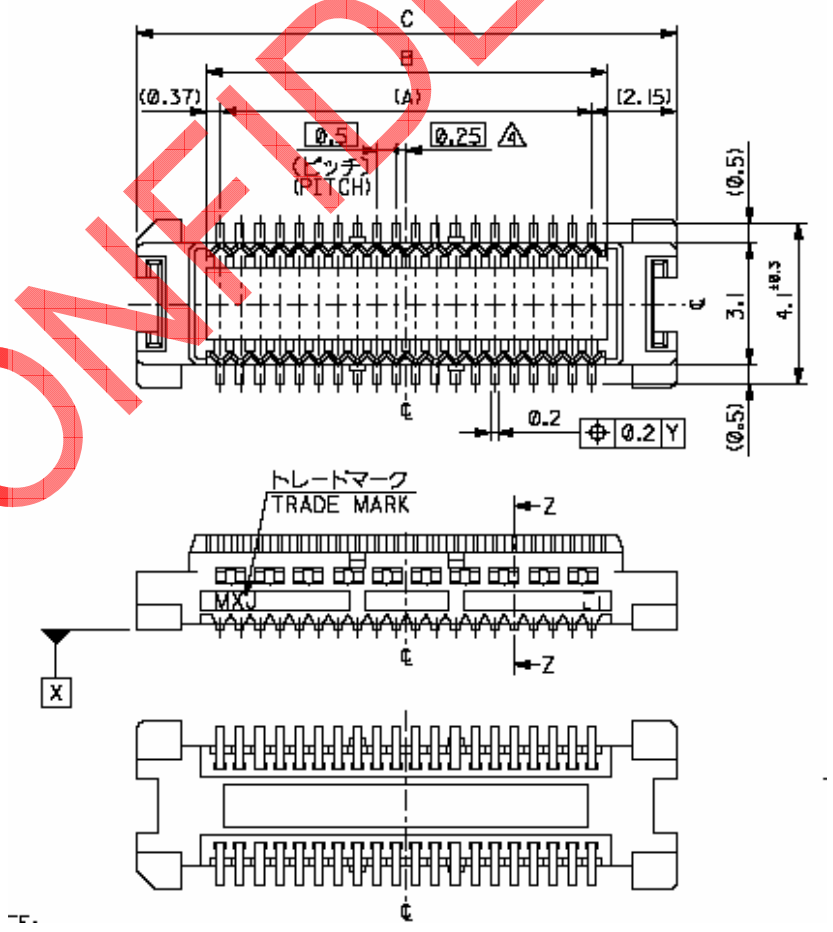


Figure 8: Mechanical dimensions of 80 pin board-to-board connector

8. Reference Approval

8.1. Reference Equipment for Type Approval

The Siemens reference setup submitted to type approve HMS1 consists of the following components:

- Siemens HMS1 cellular engine
- Development Support Box DSB
- SIM card reader integrated on the module
- U.FL-R-SMT antenna connector and U.FL-LP antenna cable
- PC as MMI

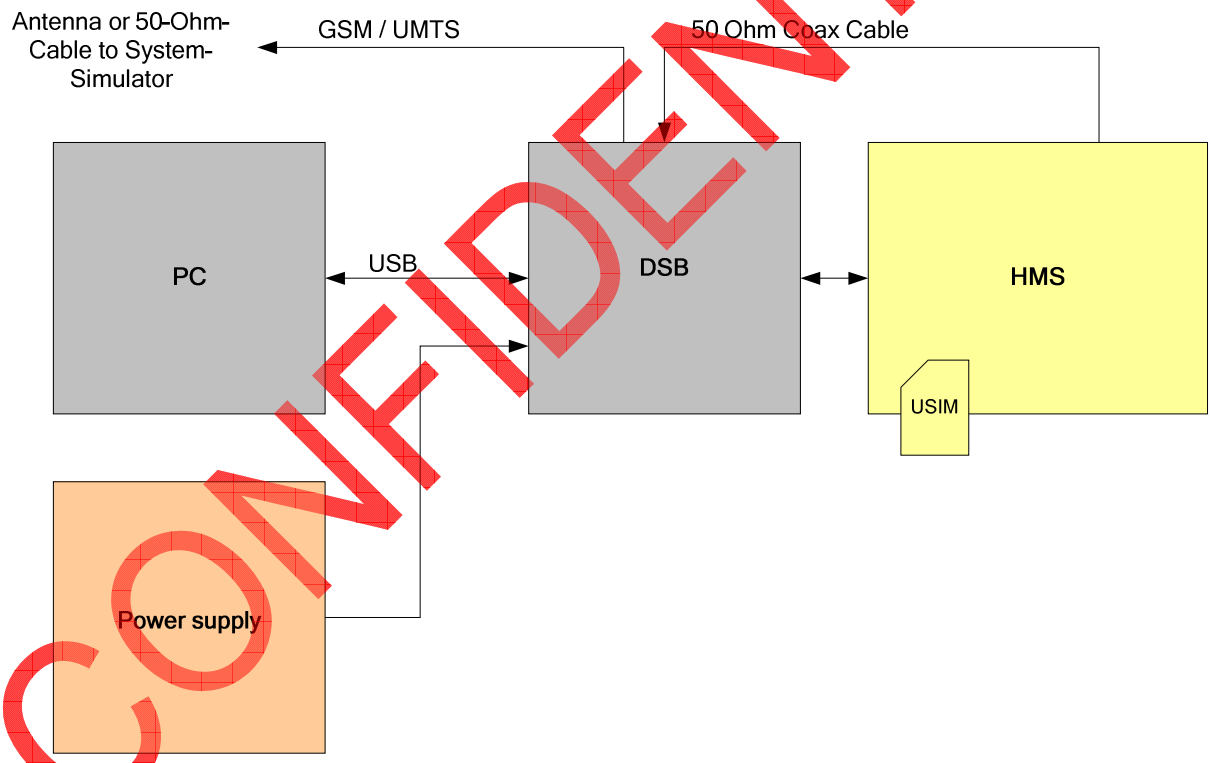


Figure 9: Reference equipment for Type Approval

8.2. Compliance with FCC Rules and Regulations

The FCC Equipment Authorization Certification for the HMS1 reference application described in Section 8.1 is listed under the

FCC identifier QIPHMS1
IC: 267W-HMS1
granted to Siemens AG.

The HMS1 reference application registered under the above identifier is certified to be in accordance with the following Rules and Regulations of the Federal Communications Commission (FCC).

Power listed is ERP for Part 22 and EIRP for Part 24

"This device contains GSM, GPRS Class10 and EGPRS Class 10 functions in the 900 and 1800MHz Band and the WCDMA function in the FDD1 Band (2100MHz) which are not operational in U.S. Territories.

This device is to be used only for mobile and fixed applications. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. Antennas used for this OEM module must not exceed 8.4dBi gain (GSM 1900) and 2.9dBi (GSM 850) for mobile and fixed operating configurations. This device is approved as a module to be installed in other devices."

The FCC label of the module must be visible from the outside. If not, the host device is required to bear a second label stating, "Contains FCC ID QIPHMS1".

Manufacturers of mobile or fixed devices incorporating HMS1 modules are advised to include instructions according to above mentioned RF exposure statements in their end product user manual.

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

If the final product is not approved for use in U.S. territories the application manufacturer shall take care that the 850 MHz and 1900 MHz frequency bands be deactivated and that band settings be inaccessible to end users. If these demands are not met (e.g. if the AT interface is accessible to end users), it is the responsibility of the application manufacturer to always ensure that the application be FCC approved regardless of the country it is marketed in.