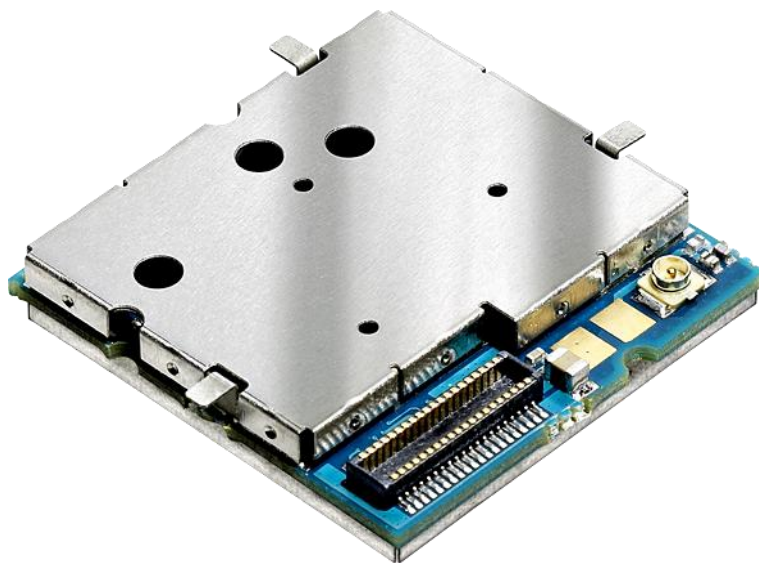


HILO 3G TECHNICAL SPECIFICATION



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SAGEMCOM

FICHE RECAPITULATIVE / SUMMARY SHEET

Ed	Date <i>Date</i>	Référence <i>Reference</i>	Pages modifiées <i>/ Changed pages</i>	Observations <i>Comments</i>
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1. INTRODUCTION

This document describes the hardware interface of the Sagemcom HiLo 3G M2M module used to connect the device application and the air interface.

1.1 PRODUCT CONCEPT

The HiLo 3G module is one of the smallest available UMTS/HSDPA module of the market with an industrial connector. The target application is the Machine to Machine (M2M) market including automotive, AMM (Automatic Metering Management), tracking system, Alarm, etc. Despite its small size and cost, it has comprehensive GPRS/EDGE/HSDPA data services.

In addition to its size it has the following outstanding characteristics:

- Automotive temperature range: -40 °C to +85 °C
- Minimum low power consumption in idle mode: 1.4mA
- High input voltage range: 3.2 V to 4.4 V
- USB High Speed
- Digital Audio PCM
- Form factor compliant with the HiLo module (thickness is higher)
- Pin to pin compliant with HiLo module for the main mandatory signals (Power, Sim, UART)

There are two variants of the HiLo3G module: HiLo3G-900 and HiLo3G-850. Both are quadband for GSM (GSM850, GSM900, DCS1800, PCS1900) and triple band for UMTS respectively (Band I – 2100 MHz, Band II – 1900 MHz, Band VIII – 900 MHz) for HiLo3G-900 and (Band I – 2100 MHz, Band II – 1900 MHz, Band V – 850 MHz) for HiLo3G-850

As other Sagemcom GSM/GPRS/EDGE modules, it has a full set of AT commands as well as analogue and Digital audio interface [1].

In addition to the HiLo 3G module a complete development kit can be provided to customers.

1.2 STANDARDS

This product with its evaluation board has been approved to comply with the directives and standards listed below:

ID		
A-Tick Statement number for HiLo3G-900		CBS11011
FCC ID	HiLo3G-900	VW3HILO3G
	HiLo3G-850	VW3HILO3G850
IC Number	HiLo3G-900	2599H-HILO3G
	HiLo3G-850	2599H-HILO3G850

EU Directive – only for HiLo3G-900 variant

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
2004/108/EC	Directive on electromagnetic compatibility
2006/95/EC	« Directive on electrical equipment designed for use within certain voltage limits » (Low Voltage Directive)
2002/95/EC	RoHS Directive
95/94/EC	Automotive EMC Directive

Standards of type approval

3GPP TS 51.010-1	« Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification »
ETSI EN 301 511	« 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 v3.39.0 Only for HiLo3G-900 variant	Global Certification Forum - Certification Criteria
PTCRB NAPRD.03 v5.4	PCS Type Certification Review Board
ETSI EN 301 489-7	« 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)»
EN 60 950	Safety of information technology equipment

PTCRB/GCF	GCF: GCF-CC V3.39.0 PTCRB: NAPRD03 V5.4
2G RF/Protocol/ SIM/ Acoustic : 3GPP TS51.010-1	3GPP TS51.010-1: Mobile Station (MS) conformance specification; Part 1: Conformance specification
3G RF : TS 34.121-1	TS 34.121-1 : Terminal conformance specification, Radio transmission and reception (FDD)
3G Protocol:TS 34.123-1	TS 34.123-1: User Equipment (UE) conformance specification; Part 1: Protocol conformance specification
Acoustic: 3GPP TS 26.132	TS 26.132 : Speech and video telephony terminal acoustic test specification
USIM digital:3GPP TS 31.121	TS 31.121 UICC-terminal interface; Universal Subscriber Identity Module (USIM) application test specification
USIM analog: ETSI TS 102230	ETSI TS 102230. Technical Specification. Smart cards; UICC-Terminal interface; Physical, electrical and logical test specification
STK: 3GPP TS 51.010-4	3GPP TS 51.010-4 : Mobile Station (MS) conformance specification; Part 4: Subscriber Identity Module (SIM) application toolkit conformance test specification
USAT:3GPP TS 31.124	3GPP TS 31.124 : Mobile Equipment (ME) conformance test specification; Universal Subscriber Interface Module Application Toolkit (USAT) conformance test specification

CE – only for HiLo3G-900 variant	
RF: 2G EN301511 (refer to PTCRB/GCF RF report)	ETSI EN 301 511 Global System for Mobile Communications (GSM); Harmonized EN for Mobile Stations in the GSM 900 and GSM 1800 Bands Covering Essential Requirements Under Article 3.2 of the R&TTE Directive (1999/5/EC)
RF: 3GEN301908-2 (refer to PTCRB/GCF RF report)	ETSI EN 301 908-2 Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS), Repeaters 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
RF: 3G EN301908-1	EN 301908-1 Electromagnetic compatibility and Radio spectrum Matters (ERM) - Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks - Part 1: Harmonized EN for IMT-2000, introduction and common requirements, covering essential requirements of article 3.2 of the R&T
EMC: EN301489-1,-7,-24	ETSI EN 301 489-1 Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements ETSI EN 301 489-7 ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); ElectroMagnetic 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) ETSI EN 301 489-24 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
SAR (MPE) : EN62311	EN 62311:2008 Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
Safety: EN60950-1	EN60950-1: Information technology equipment. Safety. General requirements

FCC	
RF : FCC Part 22H (850 MHz Band) FCC Part 24E (for 1900 MHz Band)	FCC Part 22 Subpart H: Cellular Radiotelephone Service; Subpart I: Offshore Radiotelephone Service; FCC Part 24 E: Personal Communications Service;Subpart E: Broadband PCS.
EMI: FCC Part 15B	Subpart B - Radio frequency devices subpart B – Unintentional Radiators
SAR (MPE) : OET65C	

IC	
RF 2G : RSS-132	RSS-132 - Cellular Telephones Employing New Technologies Operating in the Bands 824-849 MHz and 869-894 MHz
RF 3G: RSS-133	RSS-133 - 2 GHz Personal Communications Services
EMI: ICES-003	ICES-003: Digital Apparatus
SAR: RSS-102	RSS-102 - Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands)

A-Tick – only for HiLo3G-900 variant	
AS/ACIF S042.1	AS/ACIF S042.1: Requirements for connection to an air interface of a telecommunications network – Part 1
AS/ACIF S042.3	AS/ACIF S042.3: Requirements for connection to an air interface of a Telecommunications Network - Part 3: GSM Customer Equipment

Requirements of quality	
IEC 60068-2	Environmental testing
ISO TS 16959	Hilo3G module is manufactured in accordance with ISO TS 16959 in certified factory

1.3 TERMS AND ABBREVIATION

ADC	Analog to Digital Converter
CODEC	Coder-Decoder
CLIP	Calling Line Identification Presentation
COLP	Connected Line Identification Presentation
CLIR	Calling Line Identification Restriction
COLR	Connected Line Identification Restriction
CTS	Clear To Send
CSD	Circuit Switched Data
CS	Codec Scheme
DCS	Digital Communications System
DSR	Data Set Ready
DTR	Data Terminal Ready
EDGE	Enhanced Data Rate for GSM Evolution
EGSM	Enhanced GSM
ENS	Enhanced network selection
EONS	Enhanced operator name string
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
GSM	Global System for Mobile communication
GPRS	General Packet Radio Services
HSCSD	High Speed Circuit Switched Data
HSDPA	High Speed Downlink Packet Access
IC	Integrated Circuit or Industry Canada (depends on the context)
I/O	Input / Output
ISO	International Standards Organization
ITU	International Telecommunication Union
JTAG	Joint Test Action Group
Kbps or kbit/s	kilobit per second
LCD	Liquid Crystal Display
LED	Light Emitting Diode
Mbps or Mbit/s	Megabit per second

PBCCH	Packet Broadcast Channel
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PWM	Pulse Width Modulation
RAM	Random Access Memory
RF	Radio Frequency
RI	Ring Indication
RMS	Root Mean Square
RTS	Ready To Send
RX	Reception
SIM	Subscriber Identification Module
SMS	Short Message Service
TBC	To Be Confirmed
TBD	To Be Defined
TX	Transmission
UART	Universal Asynchronous Receiver and Transmitter
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USSD	Unstructured Supplementary Service Data

1.4 CONVENTIONS

Throughout this document, DTE (Data Terminal equipment) indicates the equipment which masters and controls the module device HiLo 3G by sending AT commands via its serial interface.
DCE (Data Communication Equipment) indicates the module device HiLo 3G.

1.5 PRODUCT FEATURES OVERVIEW

Temperature range	Normal range: -20°C to +85°C (fully compliant) Extended range: -40°C to +85°C (fully functional) Storage: -40°C to +105°C
Weight (in g)	6.6 g (typical)
ESD	ESD protection < 2 kV
Physical dimensions	27x27x4.8 mm (typical)
Connection	40 pins connector + 1 RF UFL connector + 1 pair of antenna pad
Power supply	3.2V to 4.4V range, 3.7V nominal
Power consumption*	Off mode: 50 µA typical Registered idle mode: <ul style="list-style-type: none"> • WCDMA: 1.3 mA (DRX=9) • GSM: 1.4 mA (paging rate=9) Peak Current <ul style="list-style-type: none"> • WCDMA: up to 700 mA • GSM: up to 1.75A EDGE DATA: 4 Down + 1 Up Class 10 <ul style="list-style-type: none"> • GSM 850/900: 450mA • DCS 1800: 350mA WCDMA: HSDPA: up to 700mA
Battery charge management and interface	No battery charge management is included.

* The power consumption is highly dependent on customer's product design and environment of the module

Antenna	No antenna is included in the module.
Frequency bands	<p>HiLo3G-900</p> <ul style="list-style-type: none"> • UMTS bands: I (2100 MHz), II (1900 MHz), VIII (900 MHz) • GSM bands: GSM850, EGSM900, DCS1800, PCS 1900 <p>HiLo3G-850</p> <ul style="list-style-type: none"> • UMTS bands: I (2100 MHz), II (1900 MHz), V (850 MHz) • GSM bands: GSM850, EGSM900, DCS1800, PCS 1900
Voice codec	Half Rate, Full Rate, Enhanced Full Rate, Adaptive Multi Rate
GSM class	Small MS
Transmit power	<p>Class 4 (2W) for GSM850 / EGSM900</p> <p>Class 1 (1W) for DCS1800 / PCS1900</p> <p>Class E2 EDGE 900 / 1800</p> <p>Class 3 for UMTS 900/1900/2100</p>
Supported SIM card	3V and 1.8V SIM cards
SIM slot	Signals for the management of the SIM card are provided on 40 pins connector
PWM	Signal for LED, vibrating device and Buzzer management is provided on the PWM pin
Audio up-link	1 differential input is provided for microphone
Audio down-link	1 differential output is provided for non stereo earphone
Digital audio link	Digital audio interface PCM bus is provided. Master mode with 16 bits and 2048 KHz frequency.
UART interface with flow control	<p>Up to 4 Mbit/s for data transmission (no autobauding)</p> <p>Full flow control signals (+2.9V) are provided on 40 pins connector.</p> <p>A reference schematic to build the RS232 interface is provided in the HiLo 3G application note.</p>
USB	Supported USB High speed 480Mbps and full speed 12Mbps, with 3 logical Channels
Data services	HSDPA, GPRS, EDGE, CSD
Supplementary services (supported via AT commands)	Automatic answer, Internal Phonebook, Caller Line Identification: CLIP / CLIR / COLP, Call Waiting, Call Hold, Call Forwarding, Multiparty, Call Barring, Advice of Charge, USSD, CPHS, Fixed Dialing Number, ENS, EONS.
Power on pin	Available
General purpose I/Os pin	3 GPIO + 1 ADC available
GSM release	R99
UMTS/WCDMA release	R5
GPRS	SMG 31bis, Multi slot class 12, class B terminal, PBCCH support, 3 PDP contexts, CS1 to CS4.
EDGE	Multi slot class 12
UMTS/HSDPA	Class E2, Voice and Data in parallel for UMTS/HSDPA, 4 logical channels
HSDPA	<p>DL: 3.6 Mbit/s</p> <p>UL: 0.384 Mbit/s</p>
GSM/DCS certification GCF-CC	GCF-CC v3.39.0
PTCRB	I NAPRD.03 v5.4

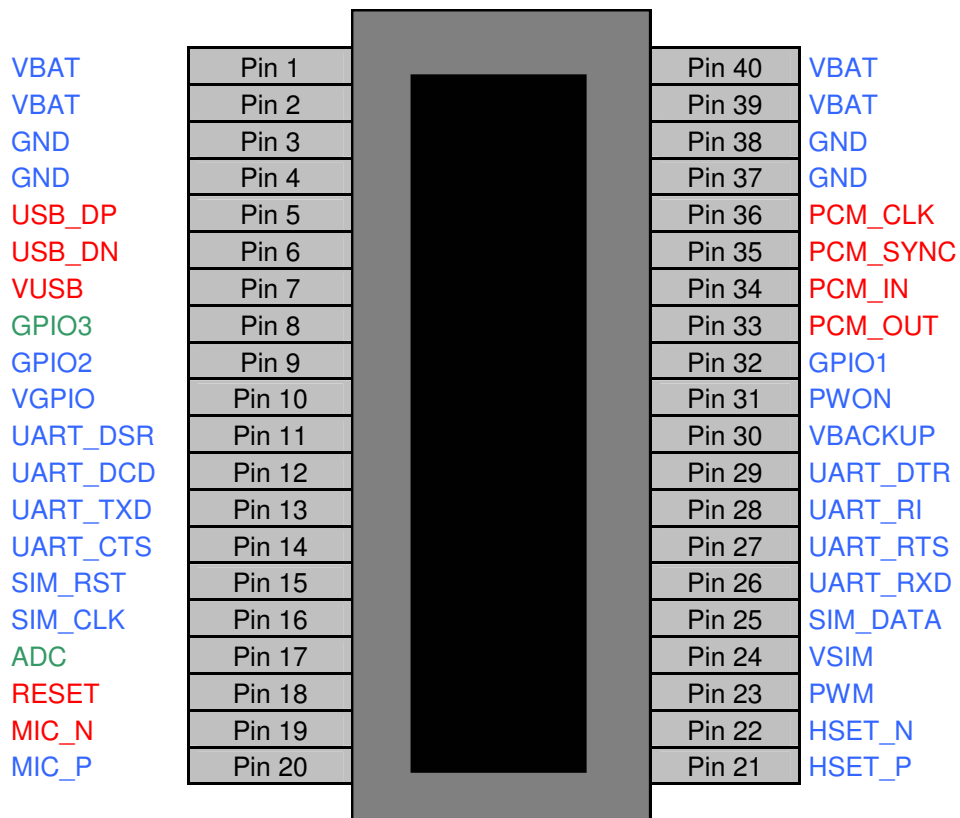


Figure 2: HiLo 3G Pinout*

*In **blue** HiLo 3G pin to pin compliant functions compared to HiLo version.
 In **red** HiLo 3G new feature pins compared to HiLo,
 In **green** HiLo 3G moved functions pins compared to HiLo.

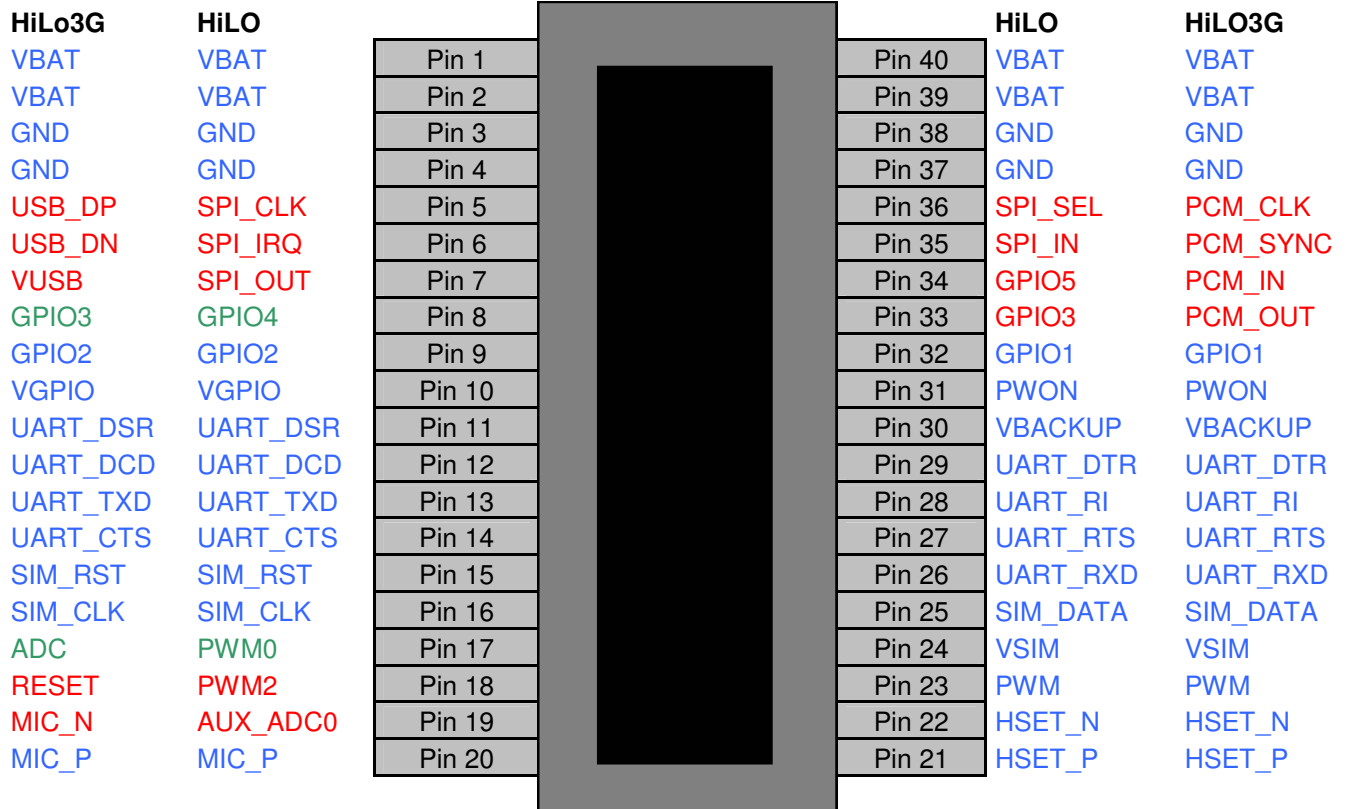


Figure 3: HiLo 3G & HiLo Pinout Definition

3. FUNCTIONAL DESCRIPTION

3.1 SIM

3.1.1 SIM card interface

The SIM card interface is compatible with the ISO 7816-3 IC card standard on the issues required by the GSM 11.11 Phase 2+ standard and adapts to 3V and 1.8V SIM card.

To prevent SIM card's damages, the power supply of the module has to be turned off before any manipulation on SIM card.

The SIM card interface includes:

- Power supply output (VSIM)
- Bi-direction data signal (SIM_DATA),
- Clock output (SIM_CLK)
- Reset signal (SIM_RST)

Signal	Pin N°	Description
SIM_RST	15	SIM reset, provided by Base-band processor
SIM_CLK	16	SIM clock, provided by Base-band processor
VSIM	24	SIM supply voltage
SIM_DATA	25	SIM serial data line, input and output

3.1.2 SIM card connection

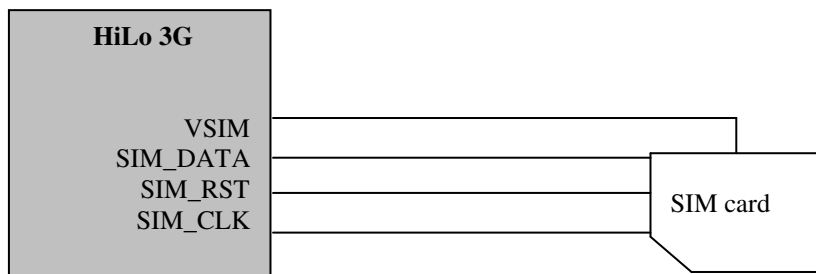


Figure 4: SIM connection

A reference schematic of the SIM card connection is given in the application note.

3.2 AUDIO

3.2.1 ANALOG AUDIO

The module supports the following voice codec:

- Half-Rate
- Full-Rate
- Enhanced Full Rate
- Adaptive Multi Rate

Signal	Pin N°	Description
MIC_N	19	Negative polarized input signal for microphone
MIC_P	20	Positive polarized signal for microphone
HSET_P	21	Positive polarized output signal for external speaker
HSET_N	22	Negative polarized output signal for external speaker

It manages an external microphone (MIC_P / MIC_N) in differential mode and an external earphone (32 Ohms HSET_P/HSET_N) in differential mode.

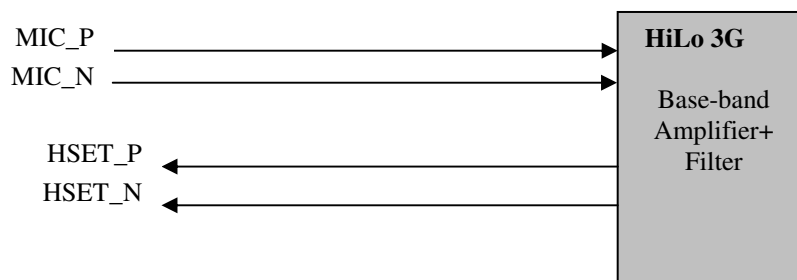


Figure 5: Audio

To ensure proper operation of such sensitive signal, the audio signals should be isolated by ground on DTE layout. Characteristics of microphone, speaker and reference schematic are given in the application notes.

3.2.2 DIGITAL AUDIO

The HiLo 3G M2M module features a PCM interface.

The PCM interface is a High speed full duplex interface that can be used to send and receive digital audio data to external audio ICs.

PCM interface feature includes the following:

- PCM master mode
- Full duplex operation
- 16 bits PCM data word length
- Configurable PCM clock rate up to 2 MHz

Signal	Pin N°	Description
PCM_CLK	36	PCM clock signal
PCM_SYNC	35	PCM sync signal
PCM_IN	34	PCM data input
PCM_OUT	33	PCM data output

3.3 PWM

One PWM pin is available on the module. It's a general purpose PWM which can be used for driving a vibrating device, keypad backlight or LED. PWM pin can be controlled through AT commands, allowing several periods and duty cycles. More details are given in the AT commands specification.

Signal	Pin N°	Description
PWM	23	Pulse Width Modulation

3.4 DATA

3.4.1 Data services

The module supports the following services:

- Data over CSD:
 - 2400, 4800, 7200, 9600 and 14400 bit/s
 - Transparent and non transparent mode
 - V.32 or V.110
- Data over GPRS:
 - 3 PDP contexts at the same time
 - PBCCH
 - Class 12
 - CS1 to CS4
- Data over EDGE
 - Class 12
- Data over 3G:
 - UMTS/HSDPA: Class E2
 - HSDPA: 3.6Mbps
 - Voice and Data in parallel
 - 4 Logical channels

3.4.2 UART: V24

A V24 interface is provided on external pins of the module with the following signals:

- RX/TX
- RTS/CTS
- DSR
- DTR
- DCD
- RI

UART Speed

AT commands and data transfert: up to 4 Mbit/s

Software download: up to 1 Mbit/s

Signal	Pin N°	Description
UART_DSR	11	UART Data Set Ready
UART_DCD	12	UART Data Carrier Detect
UART_TX	13	UART Transmit
UART_RTS	27	UART Request To Send
UART_RX	26	UART Receive
UART_CTS	14	UART Clear To Send
UART_RI	28	UART Ring Indicator
UART_DTR	29	UART Data Terminal Ready

3.4.3 USB

An USB link is available for the AT commands and a trace port.

This interface is compliant with the USB High Speed (480Mbit/s) and USB Full speed (12Mbit/s) specifications.

If the USB feature is not used on the customers design it is however strongly recommended to leave this interface accessible through tests points for debug purpose.

Signal	Pin N°	Description
USB_DP	5	USB Data Positive
USB_DN	6	USB Data Negative
VUSB	7	USB Voltage

3.5 SPARE I/O

There are 3 GPIO that can be customized easily from the customer's application through appropriate AT commands. And they can be configured as input or output.

Signal	Pin N°	Description
GPIO1	32	General Purpose Input/Output 1
GPIO2	9	General Purpose Input/Output 2
GPIO3	8	General Purpose Input/Output 3

3.6 PWON

One power input pin is available to start up the module. This pin is low level active with a de-bouncing delay of 100ms.

Signal	Pin N°	Description
PWON	31	Low level active input signal to power up the module

3.7 RESET

One reset input pin is available to reset the module in case of undesirable behavior.

Signal	Pin N°	Description
RESET	18	Low level active input signal to reset the module

3.8 ADC

One ADC input pin is available to measure an external analog voltage through dedicated AT command.

Signal	Pin N°	Description
ADC	17	Analog to digital converter input

3.9 VBACKUP

One VBackup pin is available to keep supplying the real time clock 32768 Hz in case of main battery loss. It is used to connect a backup battery coin cell or rechargeable backup battery or super cap. This pin is an input / output and can manage the charge function of the backup battery

Signal	Pin N°	Description
VBACKUP	30	Power supply for backup battery

3.10 VGPIO

This Voltage pin is the reference voltage for the internal digital I/O's it can be used as a power supply and also as a module power status (ON/OFF). VGPIO is high when the module starts and remains at this level until the module is OFF.

Signal	Pin N°	Description
VGPIO	10	Digital Power supply and power up status

3.11 POWER SUPPLIES

Power supplies pins : 4 for the VBAT and 4 for the GND. It is recommended to connect them all, in order to lower the power signal path serial resistance.

Signal	Pin N°	Description
VBAT	1,2,39,40	VBAT power input pins
GND	3,4,37,38	Ground pins

3.12 POWER MANAGEMENT

3.12.1 SLEEP MODES

There are two kinds of sleep mode, the “off mode” and “stand-by” mode. They are described below.

3.12.1.1 Off mode

When the module is in off mode it can not receive any call, it can not receive any AT commands but can be awoken either by its internal clock using AT+CALA or using PWON signal [2].
To go to this mode use AT+*PSCPOF.

3.12.1.2 Stand-by mode management

There are three stand-by modes management:

- AT+KSLEEP=0
In this mode the sleep state is controlled by the DTR and by the firmware
 - DTR = 1[†] - The module never goes to sleep mode
 - DTR = 0 - The module goes to sleep mode when it is ready and **can not** be awoken with an AT command. To wake up the module the user must toggle DTR to 1.
 Remark: even in this mode it is possible to use DTR signal to go from data to command mode, however in this case DTR has to be toggled from 1 to 0 then from 0 to 1.
- AT+KSLEEP=1
In this mode the sleep state is only controlled by the firmware.
The module goes to sleep mode when it is ready. The module may be awoken with any character received on the UART. However to be sure to wake up the module the “0x00” character has to be sent.

The main interest of the AT+KSLEEP=0 mode is to be able to forbid the sleep mode using the DTR signal.

- AT+KSLEEP=2
In this mode the sleep state is never authorized what ever the DTR state.

A detailed description of those modes is given in [3].

[†] Here we gives the logical state, '1' means connected to the ground

3.12.2 Power supply and power consumption

The power supply input of VBAT ranges from 3.2V to 4.4V and 3.7V is nominal.

All measurements in communication mode are done at maximum RF power transmission (PCL max).

		-20°C	25°C		+85°C
		Typ.	Typ.	Max	Typ.
Off mode			50 µA	100 µA	
Stand-by mode Paging rate 2 – connected to the network		2.8mA	2.8 mA	3 mA	3.1mA
Stand-by mode Paging rate 5 – connected to the network		1.7mA	1.7 mA	1.9 mA	2.0mA
Stand-by mode Paging rate 9 – connected to the network		1.4mA	1.4mA	1.6 mA	1.8mA
CSD mode – in communication	GSM900 / GSM850(PCL=5)	260mA	260 mA	290 mA	280mA
	DCS / PCS(PCL=0)	180mA	180 mA	200 mA	200mA
GPRS when transmitting data (CS-4 Class 10 4DL, 1UL)	GSM900 / GSM850	600mA	600 mA	750 mA	650mA
	DCS / PCS	520mA	520 mA	610 mA	550mA
EDGE when transmitting data (MCS-9, Class 10, 4DL, 1UL)	GSM900 / GSM850	310mA	310 mA	430 mA	330mA
	DCS / PCS	310mA	310 mA	340 mA	320mA
GPRS stand-by mode – 1 or 2 PDP context are open		The HiLo 3G behavior in GPRS stand-by mode is similar to GSM stand-by mode. The power consumption also depends on DRX and on other network setting (number of adjacent cells, etc.), it is between 1.4 mA and 2.8 mA.			
Current consumption during a burst [‡]	GSM900 / GSM850	1.95A		1.72A	1.32A
	DCS / PCS	0.9A		0.9A	0.9A
UMTS Stand-by mode DRX=6	All band		2.6 mA	3 mA	
UMTS Stand-by mode DRX=9	All band	1.3mA	1.3 mA	1.5 mA	1.4mA
UMTS data mode TX: Maximun power Channel: B1 : 9613, 9750, 9887 B2 : 9263, 9400, 9537 B8 : 2713, 2788, 2862	All band	600	600 mA	690 mA	650

[‡] A burst transmission happens in Standby, communication and GPRS mode. This measurement is performed with a 22 µF capacitor on the power supply path required to remove the overshoot.

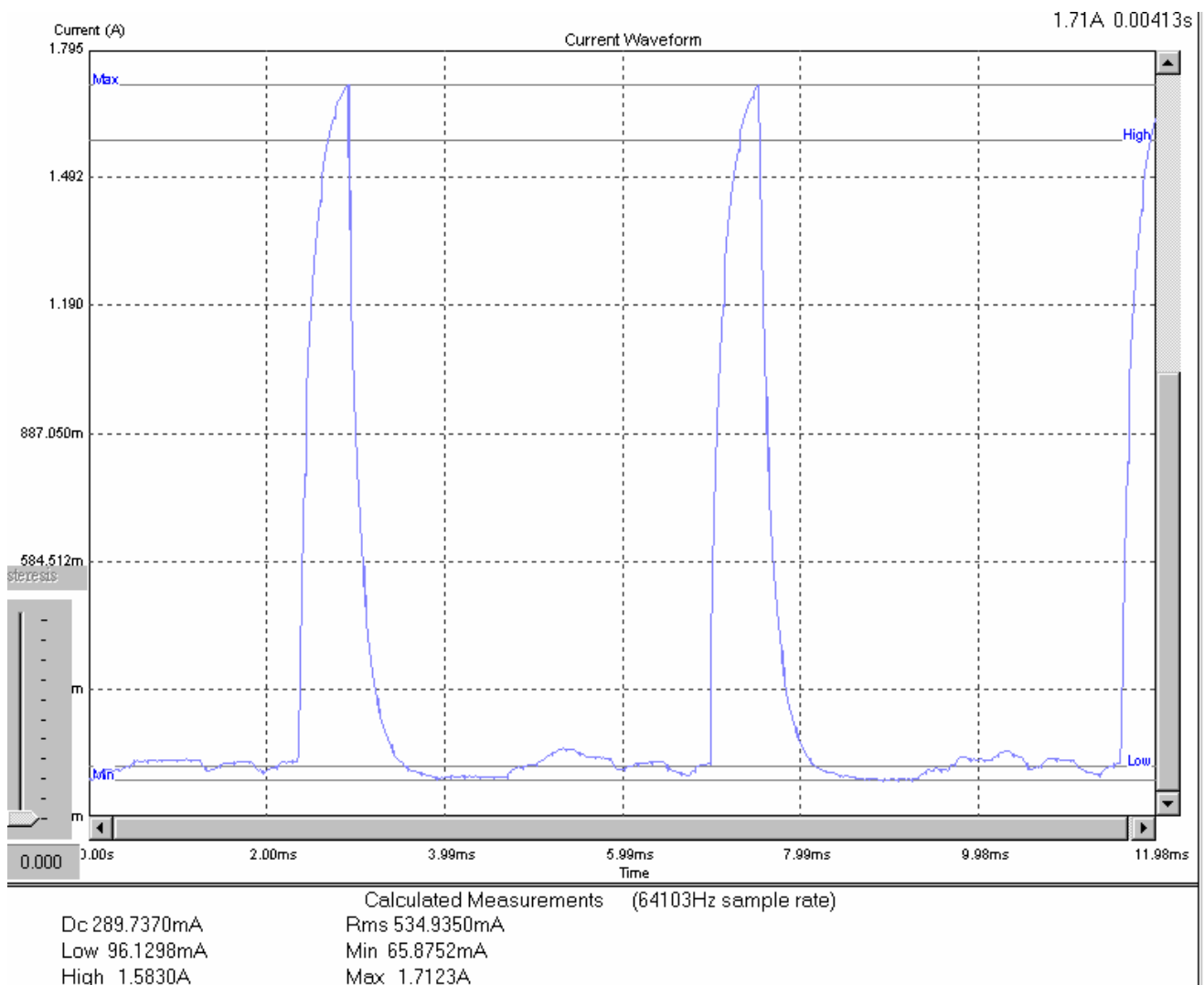


Figure 6: typical GPRS burst in the GSM900 frequency band

3.12.3 VGPIO

This +2.8V supply output is available on external pin of the module and can supply +2.9V external components. The current capability for 2.9V output is:

- 290mA in active mode

3.12.4 VBACKUP

In order to keep the internal Real Time Clock available, a VBACKUP input is present on the module interface. Depending on the main battery voltage, the internal RTC is supplied by the VBACKUP or by the main power supply voltage:

RTC supply with external BACKUP present:

- If VBAT < VBACKUP, internal RTC is supplied by VBACKUP.
- If VBAT ≥ VBACKUP, internal RTC is supplied by VBAT.

An internal mechanism of the HiLo 3G module is able to manage the charge of the backup battery. More details about the battery choice and the charge schematics are given in the application notes.

4. PINOUT

4.1 I/O CONNECTOR PIN ASSIGNMENTS

Pin N°	Pin name	IO Type	Description
1	VBAT	Power supply input	+3.7 V power supply (nominal)
2	VBAT	Power supply input	+3.7 V power supply (nominal)
3	GND	Ground	GND
4	GND	Ground	GND
5	USB_DP	Digital bi-directional buffer	USB DATA
6	USB_DN	Digital bi-directional buffer	USB DATA
7	VUSB	Digital output buffer	USB Voltage
8	GPIO3	Digital bi-directional buffer	General purpose input/output 3
9	GPIO2	Digital bi-directional buffer	General purpose input/output 2
10	VGPIO	Power supply output	+2.9V power supply output
11	UART_DSR	Digital output buffer	UART data set ready
12	UART_DCD	Digital output buffer	UART data carrier detect
13	UART_TX	Digital output buffer	UART transmit
14	UART_CTS	Digital output buffer	UART clear to send
15	SIM_RST	Digital output buffer	SIM reset
16	SIM_CLK	Digital output buffer	SIM clock
17	ADC	Analog input	Analog input to digital converter
18	RESET	Digital input buffer	General Reset input
19	MIC_N	Analog input	Differential input from microphone
20	MIC_P	Analog input	Differential input from microphone
21	HSET_P	Analog output	Differential output to earphone
22	HSET_N	Analog output	Differential output to earphone
23	PWM	Digital output buffer	PWM output
24	VSIM	Power supply output	SIM power supply
25	SIM_DATA	Digital bi-directional buffer	SIM data
26	UART_RX	Digital input buffer	UART receive
27	UART_RTS	Digital input buffer	UART request to send

28	UART_RI	Digital output buffer	UART ring indicator
29	UART_DTR	Digital input buffer	UART data terminal ready
30	VBACKUP	Power supply input/output	power supply for RTC backup
31	PWON	Digital input	Module power on signal
32	GPIO1	Digital bi-directional buffer	General purpose input/output 1
33	PCM_OUT	Digital output buffer	Digital audio in
34	PCM_IN	Digital input buffer	Digital audio out
35	PCM_SYNC	Digital bi-directional buffer	Digital audio sync
36	PCM_CLK	Digital bi-directional buffer	Digital audio clock
37	GND	Ground	GND
38	GND	Ground	GND
39	VBAT	Power supply input	+3.7V battery power supply (nominal)
40	VBAT	Power supply input	+3.7V battery power supply (nominal)

The signals which are unused must be left unconnected. If flow control is not used on UART, the signal RTS must be connected to the signal CTS and the signal DTR must be connected to the signal DSR. For detailed information please refer to the HiLo 3G module Application Notes document.

4.2 POWER DOMAINS AND UNUSED PINS POLICY

HiLo 3G Pins	Signal Name	Function	Power domain	Connection when not used / Mandatory connected
1	VBATT	POWER	3.7V	VBATT
2	VBATT	POWER	3.7V	VBATT
3	GND	POWER	0V	0V
4	GND	POWER	0V	0V
5	USB_DP	USB	2.9V	Left Open
6	USB_DN	USB	2.9V	Left Open
7	VUSB	USB	2.9V	Left Open
8	GPIO3	GPIO	2.9V	Left Open
9	GPIO2	GPIO	2.9V	Left Open
10	VGPIO	EXT_VDD	2.9V	Left Open
11	UART1_DSR	UART	2.9V	Loop to DTR
12	UART1_DCD	UART	2.9V	Left Open
13	UART1_TX	UART	2.9V	TXD
14	UART1_CTS	UART	2.9V	Loop to RTS
15	SIM_RST	SIM	1.8V or 3 V	SIM RESET
16	SIM_CLK	SIM	1.8V or 3 V	SIM CLOCK
17	ADC	ADC	2.1V	Left Open
18	RESET	RESET	2.9V	Left Open
19	MIC_N	A-AUDIO	1.8V	Left Open
20	MIC_P	A-AUDIO	1.8V	Left Open
21	HSET_P	A-AUDIO	3.7V	Left Open
22	HSET_N	A-AUDIO	3.7V	Left Open
23	PWM	PWM	2.9V	Left Open
24	VSIM	SIM	1.8V or 3V	VSIM
25	SIM_DATA	SIM	1.8V or 3V	SIM DATA
26	UART1_RX	UART	2.9V	RXD
27	UART1_RTS	UART	2.9V	Loop to CTS
28	UART1_RI	UART	2.9V	Left Open
29	UART1_DTR	UART	2.9V	Loop to DSR
30	VBACKUP	EXT_VDD	3V	Left Open
31	PWON	POWER ON	2.9V	POWER ON
32	GPIO1	GPIO	2.9V	Left Open
33	PCM_OUT	D-AUDIO	2.9V	Left Open
34	PCM_IN	D-AUDIO	2.9V	Left Open
35	PCM_SYNC	D-AUDIO	2.9V	Left Open
36	PCM_CLK	D-AUDIO	2.9V	Left Open
37	GND	POWER	0V	0V
38	GND	POWER	0V	0V
39	VBATT	POWER	3.7V	VBATT
40	VBATT	POWER	3.7V	VBATT

5. ELECTRICAL SPECIFICATION

Five system operating states are defined:

- NO SUPPLY: No power voltage is present.
- BACKUP: Only backup battery is present.
- OFF: Main power voltage is present, backup voltage present or not.
- ACTIVE: Main power voltage is present, backup battery present or not. Internal power supplies are on.
- SLEEP: Main power voltage is present, backup battery present or not. Internal power supplies are in low power mode.

If not specified, all electrical values are given for the active state at VBAT=3.7V and an operating temperature of 25°C.

5.1 VBAT

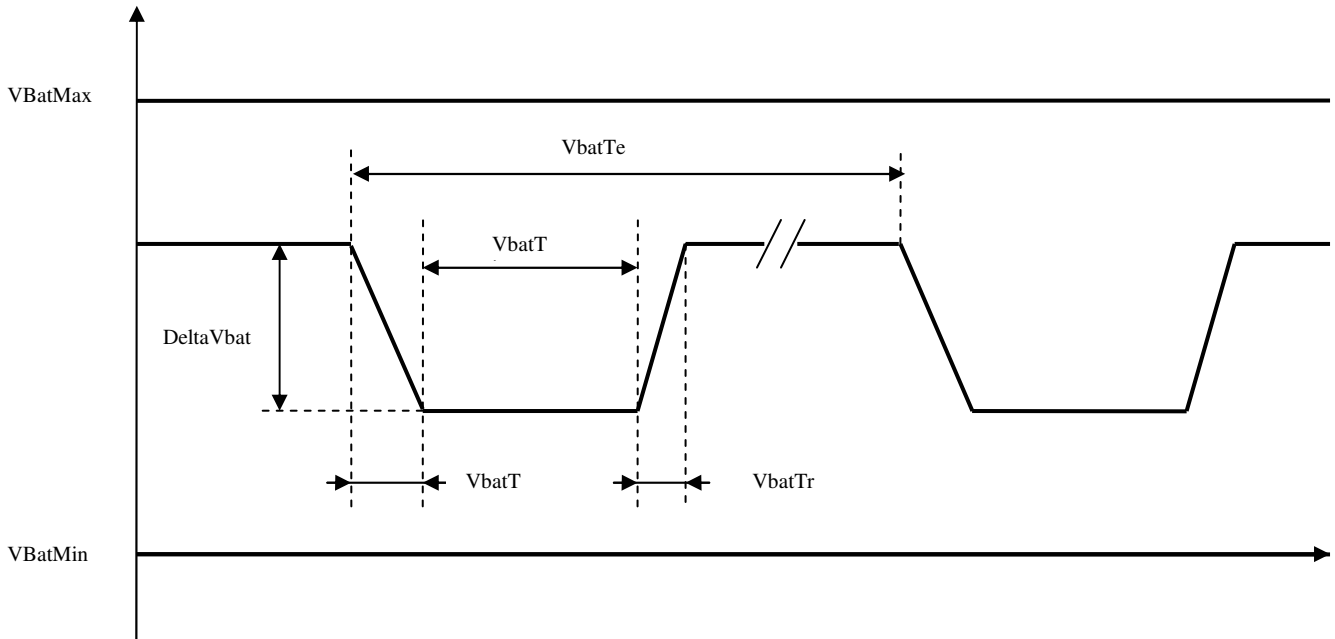
The module is supplied through the VBAT signal with the following characteristics:

Parameter	Name	Min	Typ	Max
VBAT period (ms)	VbatTe (*)	4.614	4.615	DC
VBAT low duration (us)	VbatTi (*)	550	-	VBAT period
VBAT rise time (us)	VbatTr (*)	0	-	-
VBAT fall time (us)	VbatTf (*)	0	-	-
VBAT maximum voltage (V)	VbatMax (*)	-	-	4.4
VBAT minimum voltage (V)	VbatMin (*)	3.2	-	-
VBAT drop voltage (mV)	DeltaVbat (*)	-	-	300 (**)
Transient voltage (V)		2.9	-	-
Noise level (Vrms)@100KHz-1MHz		-	-	50mV

(*): cf. Application Notes for more details.

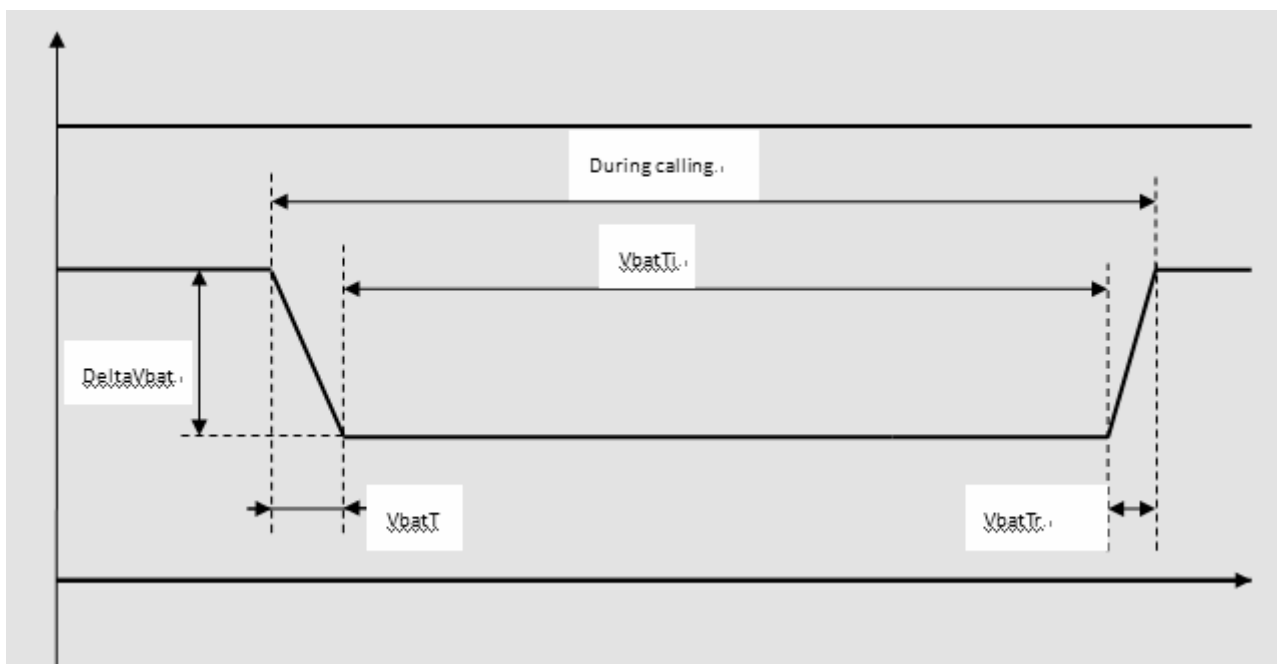
(**): This value depends on the power supply serial resistor (plus contact and tracks serial resistors)

5.2 VBAT WAVEFORM



This signal shape is due to the drops on Vbat when the radio power amplifier drains the current at the GSM rate of 217Hz

Figure 7: VBAT voltage waveform



This signal shape is due to the drops on Vbat when the radio power amplifier drains the current at the WCDMA.

Figure 8: VBAT voltage waveform

5.3 VGPIO

Signal	Min	Typ	Max	Remarks
Voltage level(V)	2.75	2.90	3.05	Both active mode and sleep mode
Current capability active mode(mA)	-	-	290 mA	
Current capability sleep mode(mA)	-	-	290mA	32KHz system clock enable
Line regulation(mV/V)	-	-	50	Iout = MAX
Rise Time(us)	-	-	102us	Test load capacitor = 2.2uF

5.4 VBACKUP

Parameter	Min	Typ	Max	Remarks
Voltage level(V)	1.5	3	3.25	

5.5 VSIM

Parameter	Min	Typ	Max	Remarks
Output Voltage(V)	2.7	3	3.15	The appropriate output voltage is auto detected and selected by software
	1.65	1.80	1.95	
Output Current(mA)	-	-	150	
Line Regulation(mV/V)	-	-	50	IOUT = MAX
Powerup Setting Time(us) from Power down	-	10	-	

5.6 DIGITAL INTERFACE

The digital interface has the following characteristics, which includes UART, PCM, PWM and GPIOs.

Parameter	Min	Typ	Max	Remarks
Input Current-High(μ A)	-10	-	10	
Input Current-Low(μ A)	-10	-	10	
DC Output Current-High(mA) ⁽¹⁾	-	-	10	Pin driving a "1" with output set at "0"
DC Output Current-Low(mA) ⁽¹⁾	-10	-	-	Pin driving a "0" with output set at "1"
Input Voltage-High(V)	2.4			
Input Voltage-Low(V)	-	-	0.4	
Output Voltage-High(V)	2.7	-	-	
Output Voltage-Low(V)	-	-	0.1	

⁽¹⁾ The maximum current for one GPIO is 10mA

5.7 PWON

The PWON signal has the following characteristics:

Parameter	Min	Typ	Max
Input Voltage-Low(V)	-0.3	0	0.3
Input Voltage-High(V)	1.2	1.8	3.3V
Power up Period (ms) from PWON falling edge (debouncing)	100	-	-

5.8 RESET

The RESET signal has the following characteristics:

Parameter	Min	Type	Max
Input Voltage-Low(V)	-0.3	0	0.3
Input Voltage-High(V)	1.2	1.8	3.3
Power up Period (ms) from RESET falling edge	20	-	-

5.9 SIM

Signal	VL (V)		VH (V)	
	Min	Max	Min	Max
SIM_RST	Fully compliant to the GSM11.11 and ISO/IEC 7816-3 standards			
SIM_CLK				
SIM_DATA				

5.10 PWM

PWM has the following characteristics

Signal	Frequency		Duty (%)		Remarks
	Min	Max	Min	Max	
PWM	100Hz	400 KHz	0	100	

5.11 USB

USB signals have the following characteristics

Signal	VL (V)		VH (V)	
	Min	Max	Min	Max
USB_DP	0	0.3	2.8	3.3
USB_DN	0	0.3	2.8	3.3
VUSB	0	0.3	4.9	5.1

5.12 ADC

The ADC has the following characteristics. A detailed description of the AT command is given in [1].

Parameter	Min	Typ	Max	Remarks
ADC Resolution(bits)	-	12	-	
Number of Inputs	-	-	1	
Input Voltage Range(V)	0	-	2.1	
Update rate per channel	-	-	2.44MHz	
Differential Nonlinearity(bits)		-	2	
Integral Nonlinearity(bits)		-	2	
Offset Error(mV)	-	30	-	
Gain Error(mV/LSB)	-	2.53	-	
Input Resistance (k Ω)	-	2	-	
Input Capacitance (pF)	-	-	53	

5.13 UART

TXD, RXD, CTS, RTS, DCD, DSR, DTR and RI have the following characteristics:

Signal	VL (V)		VH (V)	
	Min	Max	Min	Max
UART_TX	-0.3	0.4	2.5	3.3
UART_RX	-0.3	0.4	2.5	3.3
UART_RTS	-0.3	0.4	2.5	3.3
UART_CTS	-0.3	0.4	2.5	3.3
UART_DCD	-0.3	0.4	2.5	3.3
UART_DTR	-0.3	0.4	2.5	3.3
UART_DSR	-0.3	0.4	2.5	3.3
UART_RI	-0.3	0.4	2.5	3.3

5.14 AUDIO SIGNALS

5.14.1 Audio Inputs

The audio inputs contain the following characteristics:

Parameter	Min	Typ	Max	Test Conditions
Maximum input range		1.8V		With Gain = - 6dB
Nominal reference level		16mV		Typical value Gain = + 34dB
Input Micro amplifier gain (dB)	-6		+ 50	

5.14.2 Analog Audio Outputs

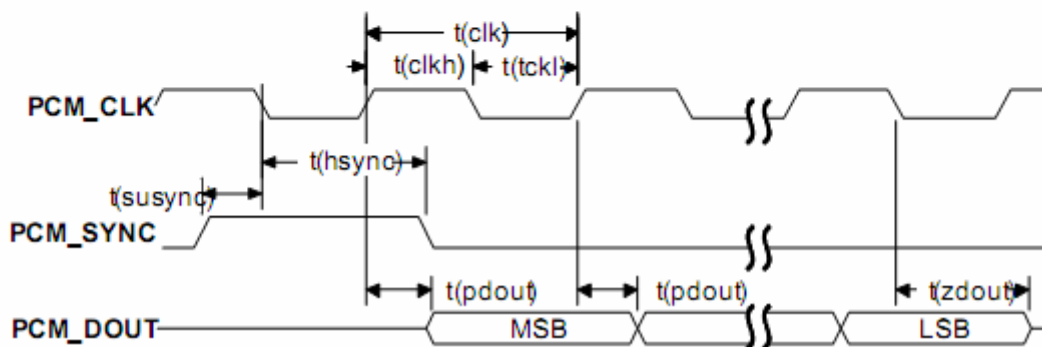
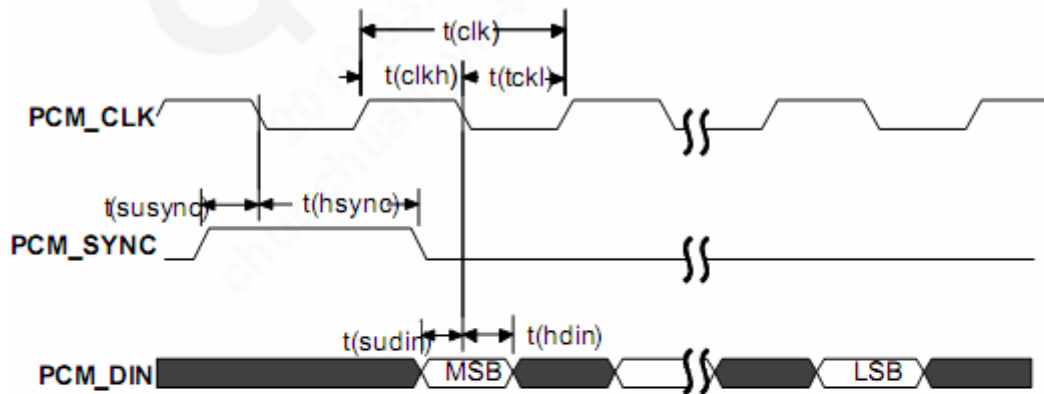
The audio outputs contain the following characteristics:

Parameter	Min	Typ	Max	Test Conditions
Maximum output range		1.65 V _{eff}		Load=32Ω, THD=1%, Output gain = 8 dB
Load resistance (Ω)	25.6	32		
Output amplifier gain (dB)	-28	-	8	

5.14.3 Digital Audio

The audio outputs contain the following characteristics

Primary PCM mode (2048 kHz PCM clock)



Parameter	Description	Min	Typ	Max	Unit
T(sync)	PCM_SYNC cycle time	-	125	-	μs
T(synch)	PCM_SYNC high time	400	500	-	ns
T(sync _l)	PCM_SYNC low time	-	124.5	-	μs
T(clk)	PCM_CLK cycle time	-	488	-	ns
T(clkh)	PCM_CLK high time	-	244	-	ns
T(clkl)	PCM_CLK low time	-	244	-	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	60	-	-	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	60	-	-	ns
T(sudin)	PCM_DIN setup time before falling edge of PCM_CLK	50	-	-	ns
T(hdin)	PCM_DIN hold time after falling edge of PCM_CLK	10	-	-	ns
T(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	-	-	350	ns
T(zdout)	Delay from PCM_CLK falling to PCM_DOUT HIGH-Z	-	160	-	ns

5.15 RF SIGNALS

5.15.1 Load mismatch

The module accept a VSWR < 20:1 (all phase angles) without damage or permanent degradation
The module accept a VSWR < 12:1 (all phase angles) without any spurious emission > - 30 dBm

5.15.2 Input VSWR

The typical input VSWR is 1.5:1 (max = 1.5:1)

5.15.3 Antenna matching network

A matching network in HiLo 3G is optimized for 50 ohm work load.

To get good performance in application, an additional matching circuit and adjustment for actual antenna is required. A π -type matching network is recommended in HiLo 3G application note.

6. ENVIRONMENTAL SPECIFICATION

Parameter	Min	Max
Ambient temperature Normal range	-20 °C	+85 °C
Ambient temperature Extended range	-40 °C	+85 °C
Storage temperature	-40 °C	+105 °C
Long damp heat Operating conditions	Tested at +60 °C, 95% RH during 504 hours	
Short damp heat Storage and transportation conditions	Tested at +40 °C, 95% RH during 96 hours	

6.1 NORMAL TEMPERATURE RANGE

ETSI performances are guaranteed by Sagemcom in the range of -20 °C to +85 °C.

Enhanced sensitivity performance at 25 °C is guaranteed as follow:

Frequency band	GSM850	EGSM	ETSI value
Min sensitivity (dBm) for BER = 2.4%	-106	-106	< -102

Frequency band	DCS	PCS	ETSI value
Min sensitivity (dBm) for BER = 2.4%	-106	-106	< -100

Frequency band	Typical-	ETSI value
EDGE (GMSK modulation)	-106	<-104

Frequency band	Typical	ETSI value
UMTS B1	-109	<-106.7
UMTS B2	-108	< -104.7
UMTS B8	-108	< -104.7

6.2 EXTENDED TEMPERATURE RANGE

6.2.1 Sensitivity

Frequency band	GSM850		EGSM		ETSI value	
Temperature (°C)	-40	+85	-40	+85		
Typical sensitivity (dBm)	-107	-105	-107	-105	< -102	

Frequency band	DCS		PCS		ETSI value	
Temperature (°C)	-40	+85	-40	+85		
Typical sensitivity (dBm)	-107	-104	-107	-104	< -100	

Frequency band	EDGE				ETSI value	
Temperature (°C)	-40	+85				
Typical sensitivity (dBm)	-107	-105			< -102	

Frequency band	UMTS B1 (2100 MHz)				ETSI value	
Temperature (°C)	-40	+85				
Typical sensitivity (dBm)	-110	-107			< -106.7	

Frequency band	UMTS B2 (1900 MHz)				ETSI value	
Temperature (°C)	-40	+85				
Typical sensitivity (dBm)	-109	-106			< -104.7	

Frequency band	UMTS B5 (HiLo3G-850)				ETSI value	
Temperature (°C)	-40	+85				
Typical sensitivity (dBm)	TBD	TBD			< -104.7	

Frequency band	UMTS B8 (HiLo3G-900)				ETSI value	
Temperature (°C)	-40	+85				
Typical sensitivity (dBm)	-109	-107			< -104.7	

6.2.2 Transmission characteristics

6.2.3 Typical transmission values obtained at extreme temperature

Frequency band	GSM850		EGSM		ETSI value	
Temperature (°C)	-40	+85	-40	+85	min	max
Output power - max. PCL (dBm)	32	31.7	32	31.7	31.5	35.5
Frequency error (Hz)	50	50	50	50	- 90	+ 90
Phase error RMS (degree)	3	3	3	3	-	5°

Frequency band	DCS		PCS		ETSI value	
Temperature (°C)	-40	+85	-40	+85	min	max
Output power - max. PCL (dBm)	29.1	28.1	28.7	27.7	26.5	30.5
Frequency error (Hz)	70	70	70	70	-180	180
Phase error RMS (degree)	3	3	3	3	-	5°

6.3 OUT OF OPERATIONAL RANGE (To be updated)

No operation is guaranteed by Sagemcom out of the extended range. However, it has been observed on several modules:

Temperature range	Comments
-50 °C to -40 °C and +85 °C to 125 °C	TBD
125 °C to 150 °C	TBD
T = 150 °C	TBD
T < -50 °C and T > 150 °C	TBD

7. ESD

Using human body model from JEDEC JESD 22-A114 standard, the HiLo 3G can stand for +/-2kV ESD on all pins of the 40 points connector and on the RF connector.

8. MECHANICAL SPECIFICATION

8.1 PHYSICAL DIMENSIONS

Whole size: 27 x 27 x 4.8 mm

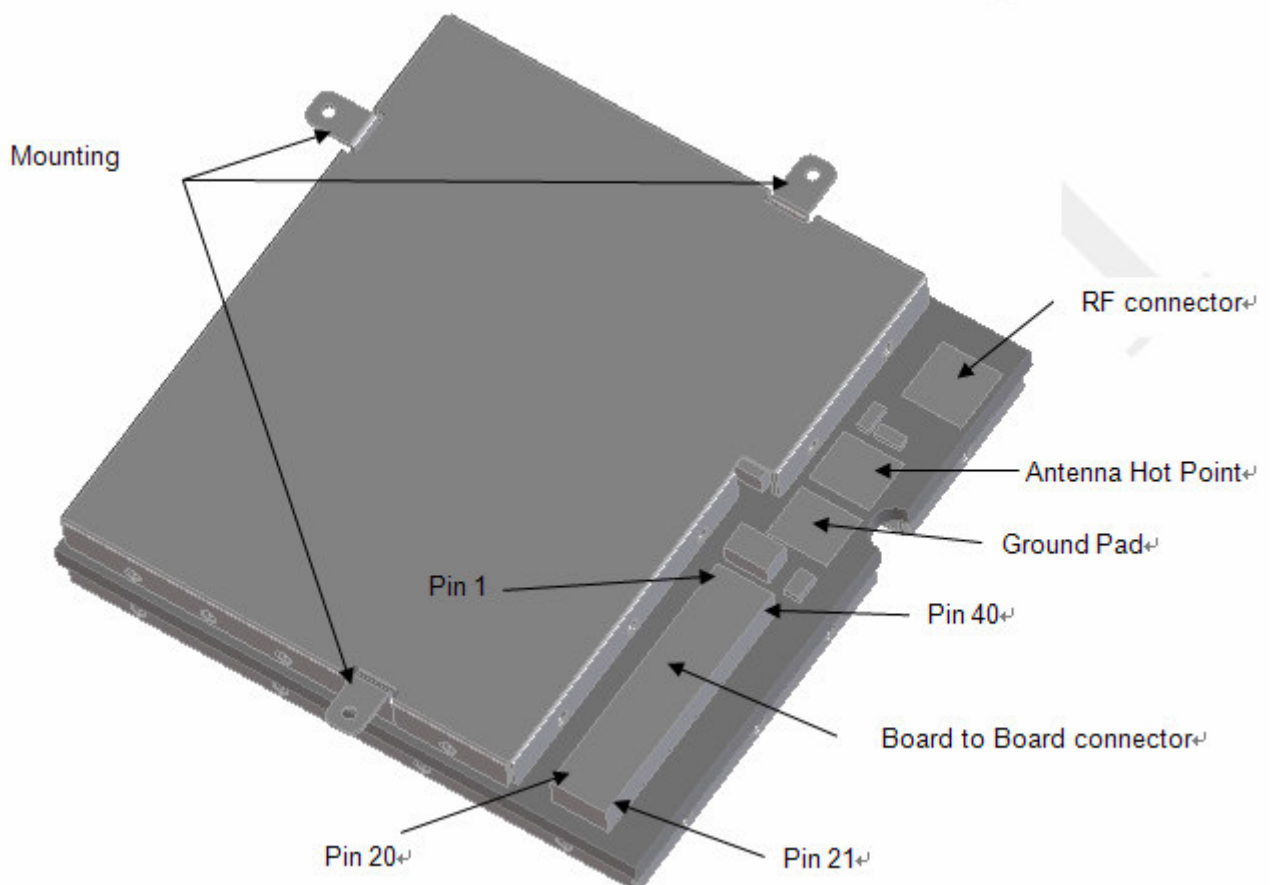


Figure 9: HiLo 3G interface

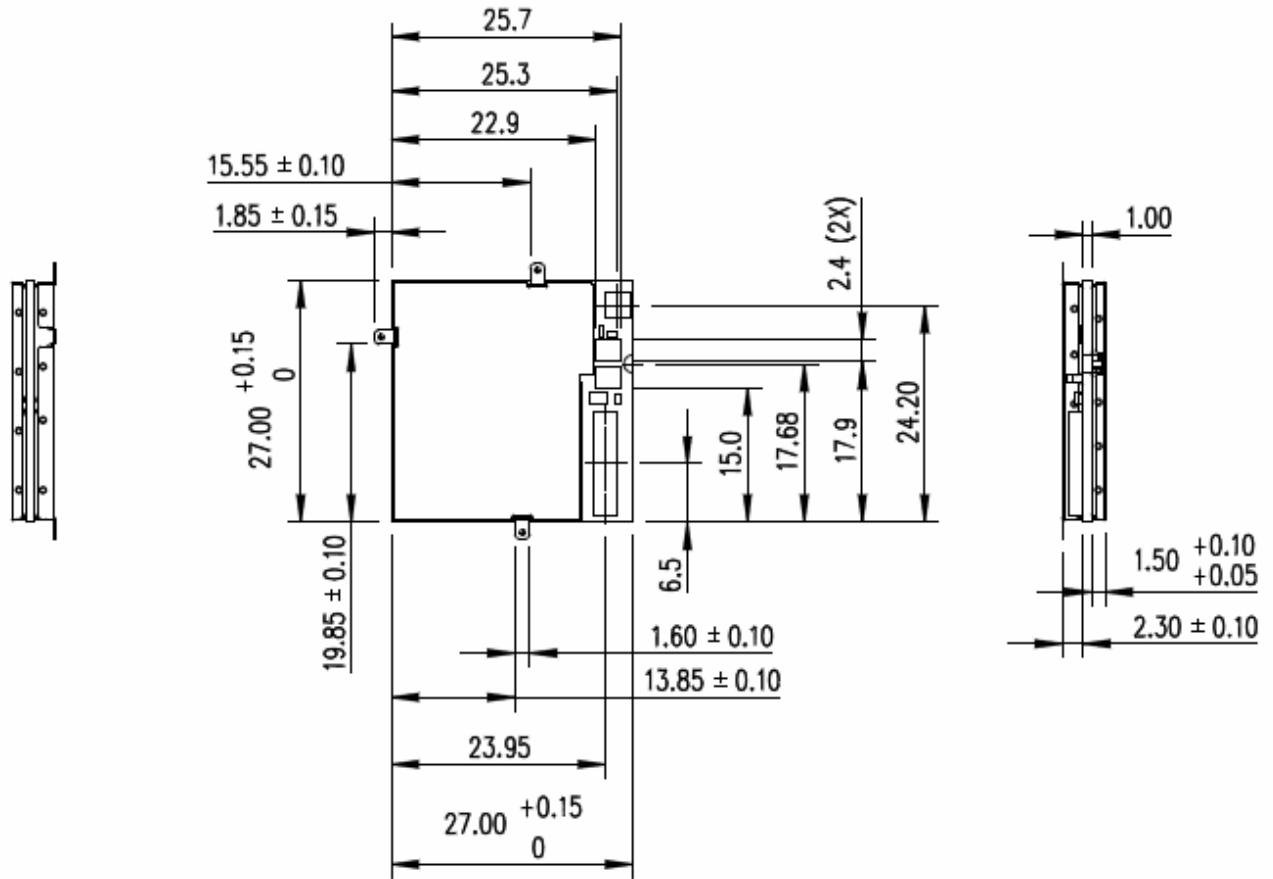


Figure 10: HiLo 3G dimensions

8.2 ASSEMBLY

Shield frame is soldered on HiLo 3G PCB; Shield cover is assembled with shield frame and removable.

The recommended solution to fix the HiLo 3G module is to manually solder the three mounting pins on the motherboard.

The solder pad geometries for the mounting pins are given in Figure 14.

The assembly description of the module under the mother board is described in Figure 13.

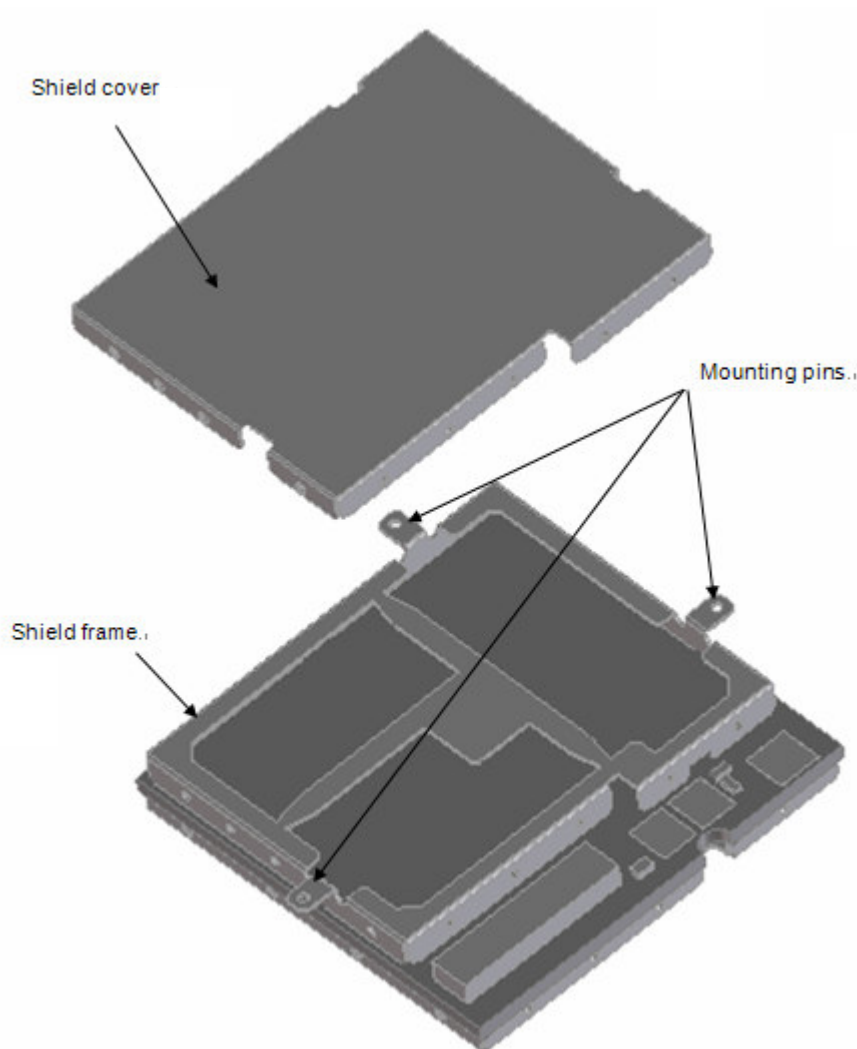


Figure 11: HiLo 3G decomposition

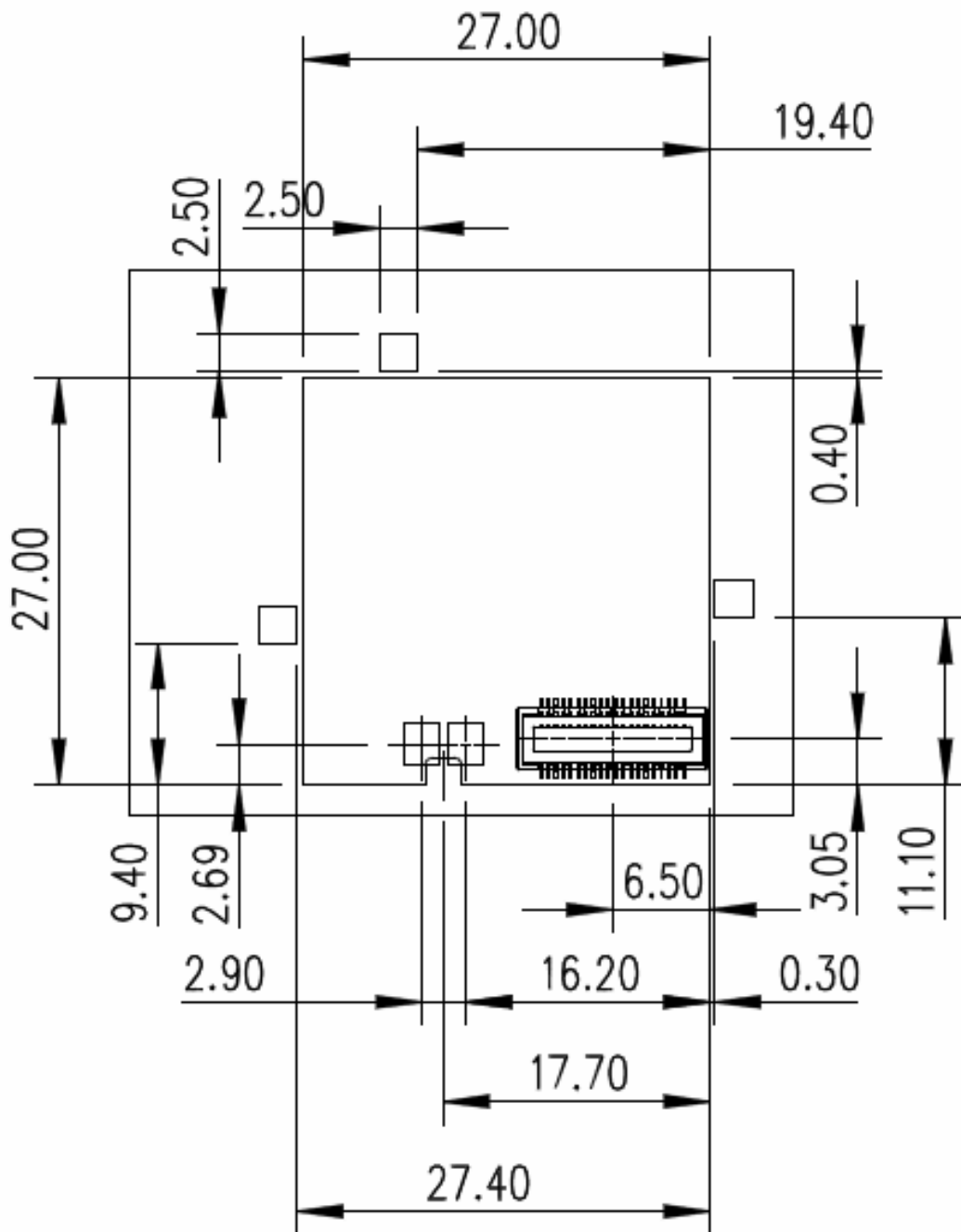


Figure 12: HiLo 3G Assembly Geometry on mother board

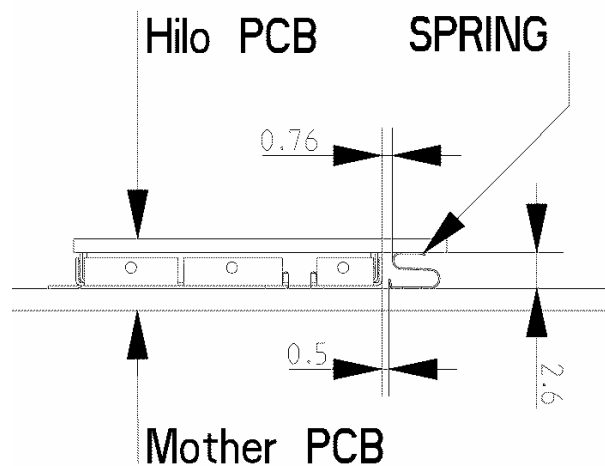


Figure 13: Spring contact assembly

8.3 TERMINAL ASSIGNMENTS

8.3.1 Board to Board connection

A pair of 40-pin-connector connects HiLo 3G and DTE.

8.3.1.1 HiLo 3G connector

Dimensions and references:

Pins Number	Reference
40	MOLEX 53885-0401

Dimension	A	B	C
mm	11.45	9.5	10.55

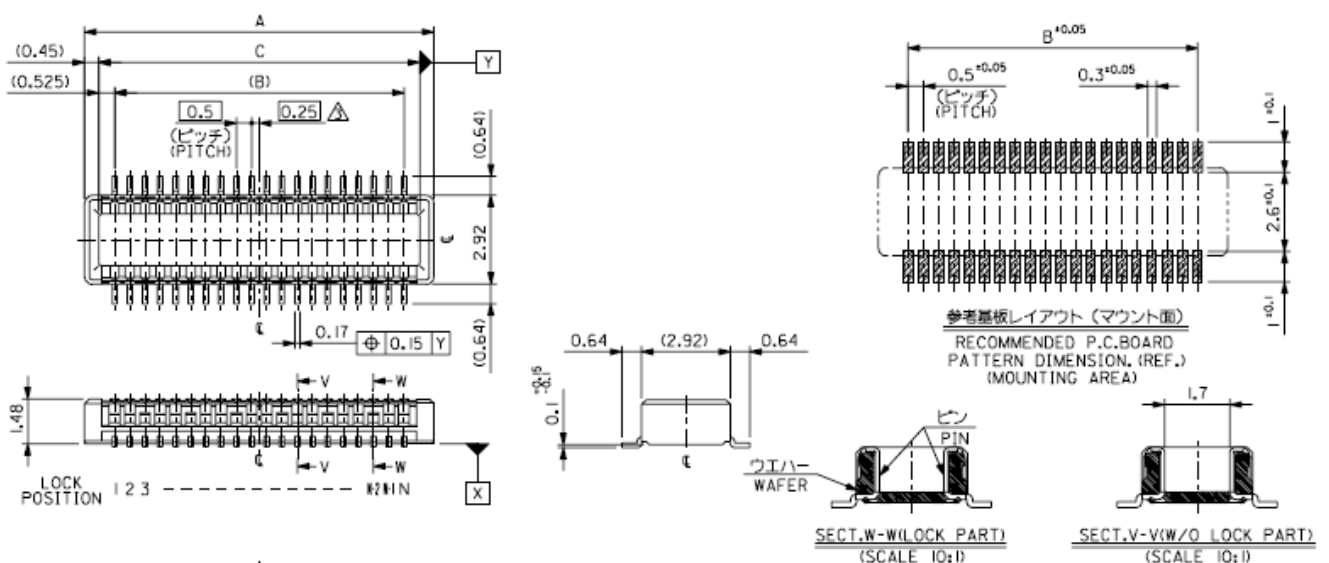


Figure 14: HiLo 3G connector drawing

8.3.1.2 Mother board connector

Dimensions and reference of one connector :

Pin Number	References
40	MOLEX 54102-0403

The reference of a reel of connectors is MOLEX 54102-0404.

Dimension	A	B	C
mm	12.6	9.5	10.5

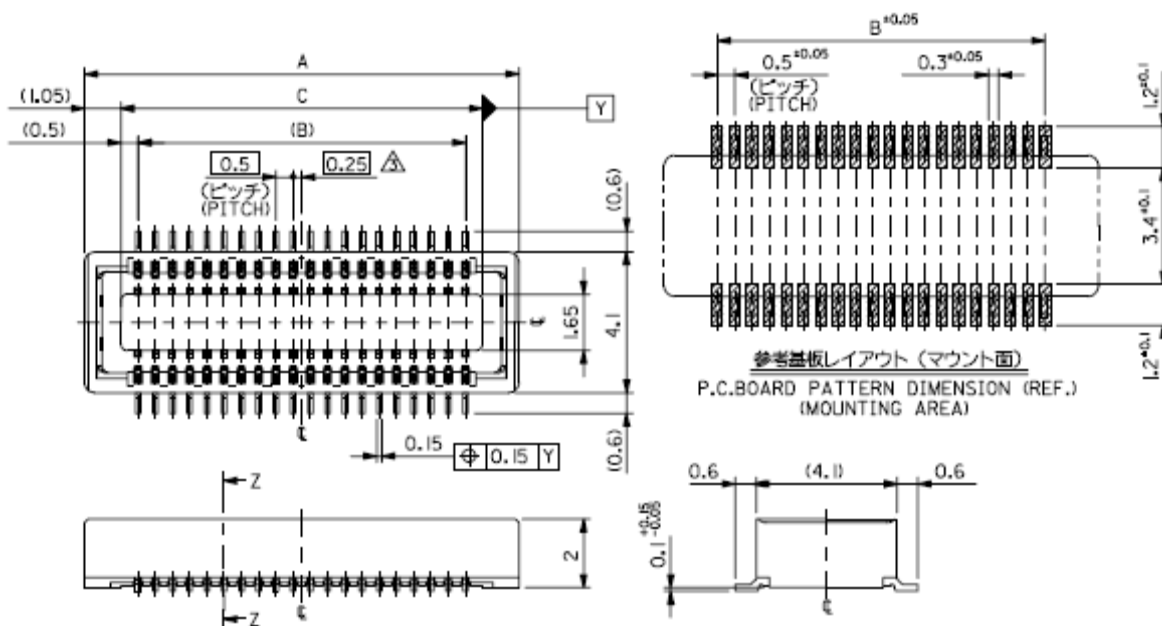


Figure 15: Mother board connector drawing

8.3.2 Antenna connection

Two kinds of antenna connection are for client's selection.

8.3.2.1 Antenna pad

A pair of copper pad on the HiLo 3G PCB could be used for antenna connection with RF spring

8.3.2.2 Antenna connector

A 50-Ohm RF UFL connector on the HiLo 3G PCB is available for antenna (RF cable) connection.

Reference
HIROSE U.FL-R-SMT-1 (10)

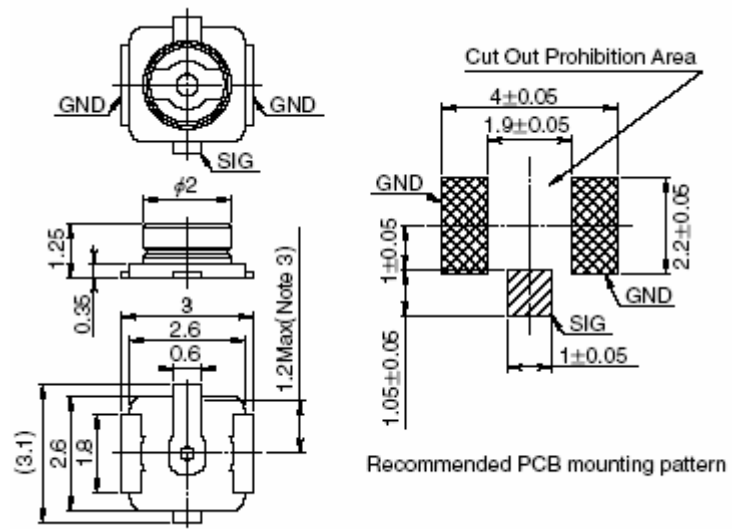


Figure 16: Antenna connector drawing

9. ORDERING AND CONTACT INFORMATION

9.1 PART NUMBERS

Modules:

253370547 MODULE HILO3G-900 GENERIC
253412283 MODULE HILO3G-850 GENERIC

Development kits:

253412291 HILO3G-850 DEVELOPMENT KIT
253370550 HILO3G-900 DEVELOPMENT KIT

Connector:

189880290 CONN.40C.F.DRT.CMS P=0,5 HCC=2,5(HILO)SP

9.2 CONTACT

Email : wireless-modules@sagem.com

Web : <http://www.sagemcom.com/>

SAGEMCOM,
Wireless M2M Modules
250, route de l'empereur
92848 Rueil-Malmaison Cedex
FRANCE

10. REFERENCE DOCUMENTS

-
- [1] URD1 OTL 5696.1 006 72370 - AT Command Set for SAGEMCOM HiLo3G Modules
 - [2] URD1 OTL 5696.1 003 72361 – HiLo3G application note
 - [3] Getting started – How to manage DTR

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