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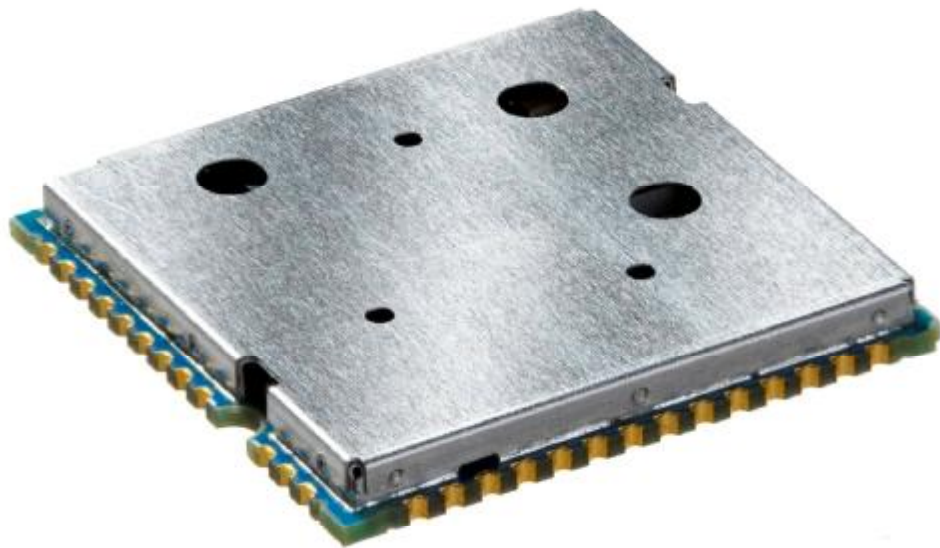
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HiloNC Application Note



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1. OVERVIEW

1.1 OBJECT OF THE DOCUMENT

The aim of this document is to describe some examples of hardware solutions for developing some products around the Sagem Communications HiloNC GPRS Module. Most part of these solutions is not mandatory. Use them as suggestions of what should be done to have a working product and what should be avoided thanks to our experiences.

This document suggests how to integrate the HiloNC GPRS module in machine devices such as automotive, AMM (Automatic Metering Management), tracking system: connection with external devices, layout advises, external components (decoupling capacitors...).

1.1 REFERENCE DOCUMENTS

URD1 OTL 5665.1 001 70883 - HiloNC technical specification

URD1 OTL 5635.1 008 70248 - AT Command Set for SAGEM Hilo Modules

1.2 MODIFICATION OF THIS DOCUMENT

The information presented in this document is supposed to be accurate and reliable. Sagem Communications assumes no responsibility for its use, nor any infringement of patents or other rights of third parties which may result from its use.

This document is subject to change without notice.

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

1.3 CONVENTIONS

SIGNAL NAME : All signal name available on the pads of the HiloNC module is written in *italic*.

F Specific attention must be granted to the information given here.

1.4 DECLARATION

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received; including interference that may cause undesired operation.

2. BLOCK DIAGRAM

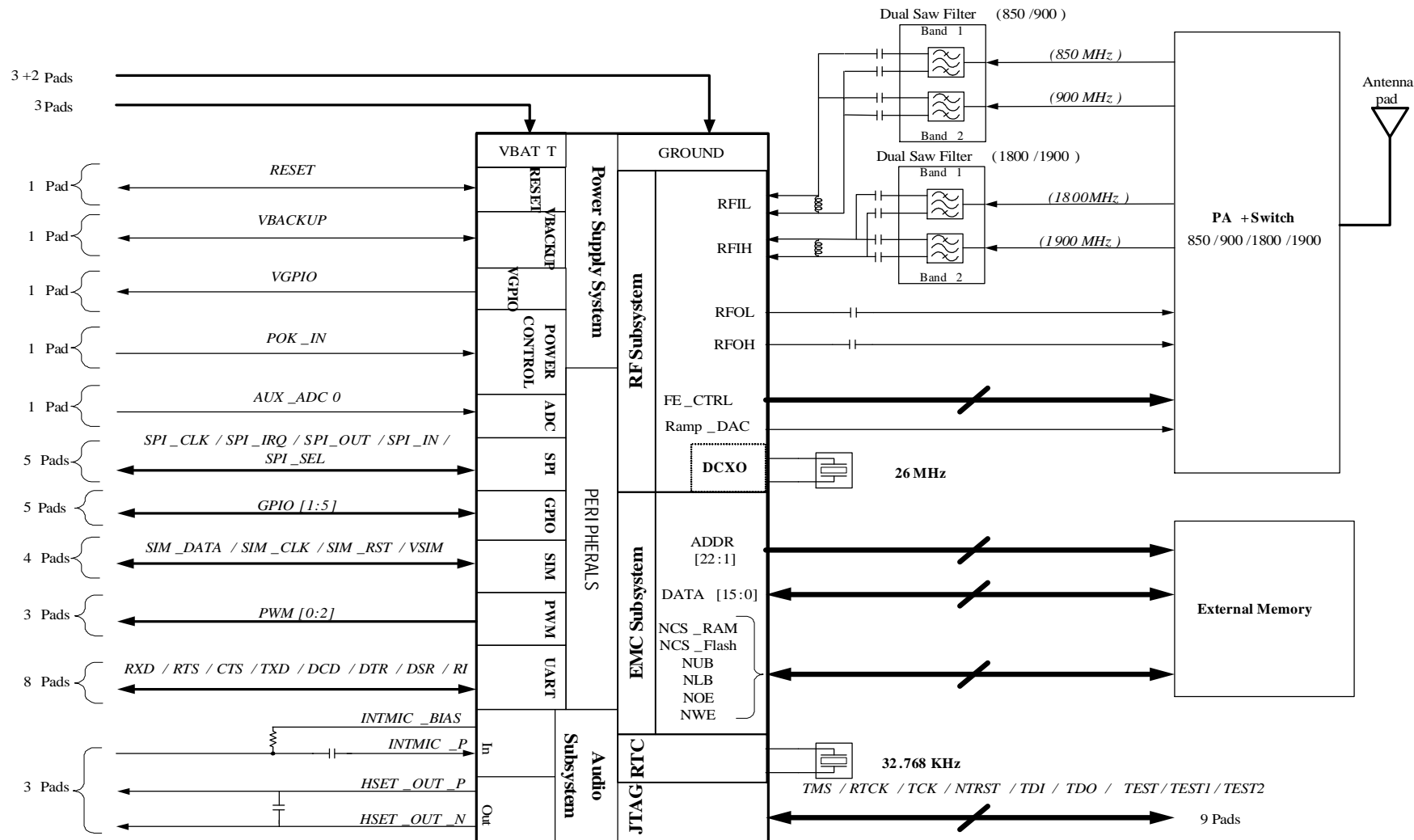


Figure 1: Block diagram of HiloNC module

3. FUNCTIONAL INTEGRATION

The improvement of Silicon technologies heads toward functionality improvement, less power consumption. The HiloNC module meets all these requirements and uses the latest high-end technology.

- F** All digital I/Os among the 51 pads are in 2.8V domain which is suitable for most systems except :
- VSIM (the SIM I/Os at 1.8V or 2.9V)
 - VBAT (from 3.2V to 4.5V).

3.1 HOW TO CONNECT TO A SIM CARD

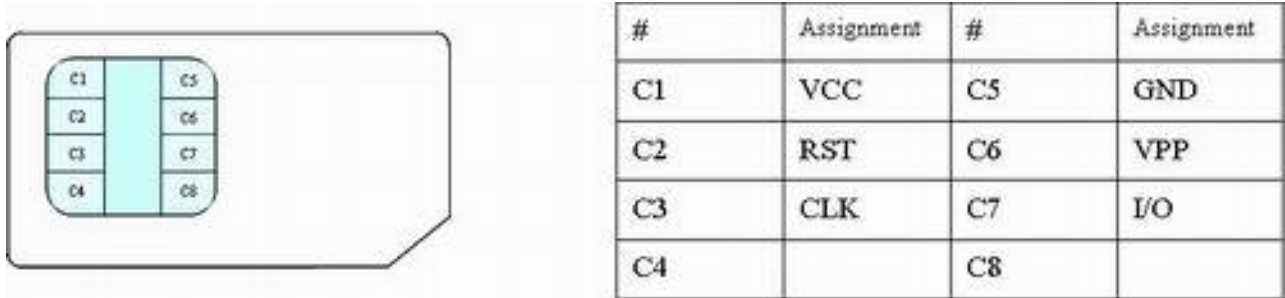


Figure 2: SIM Card signals

HiloNC module provides the SIM signals on the 51 pads. A SIM card holder with 6 pads needs to be adopted to use the SIM function.

F Decoupling capacitors have to be added on *SIM_CLK*, *SIM_RST*, *VSIM* and *SIM_DATA* signals **as close as possible** to the SIM card connector to avoid EMC issues.

F Use ESD protection components to protect SIM card and module I/Os against Electro Static Discharges. The following schematic show how to protect the SIM access for 6 pads connector.

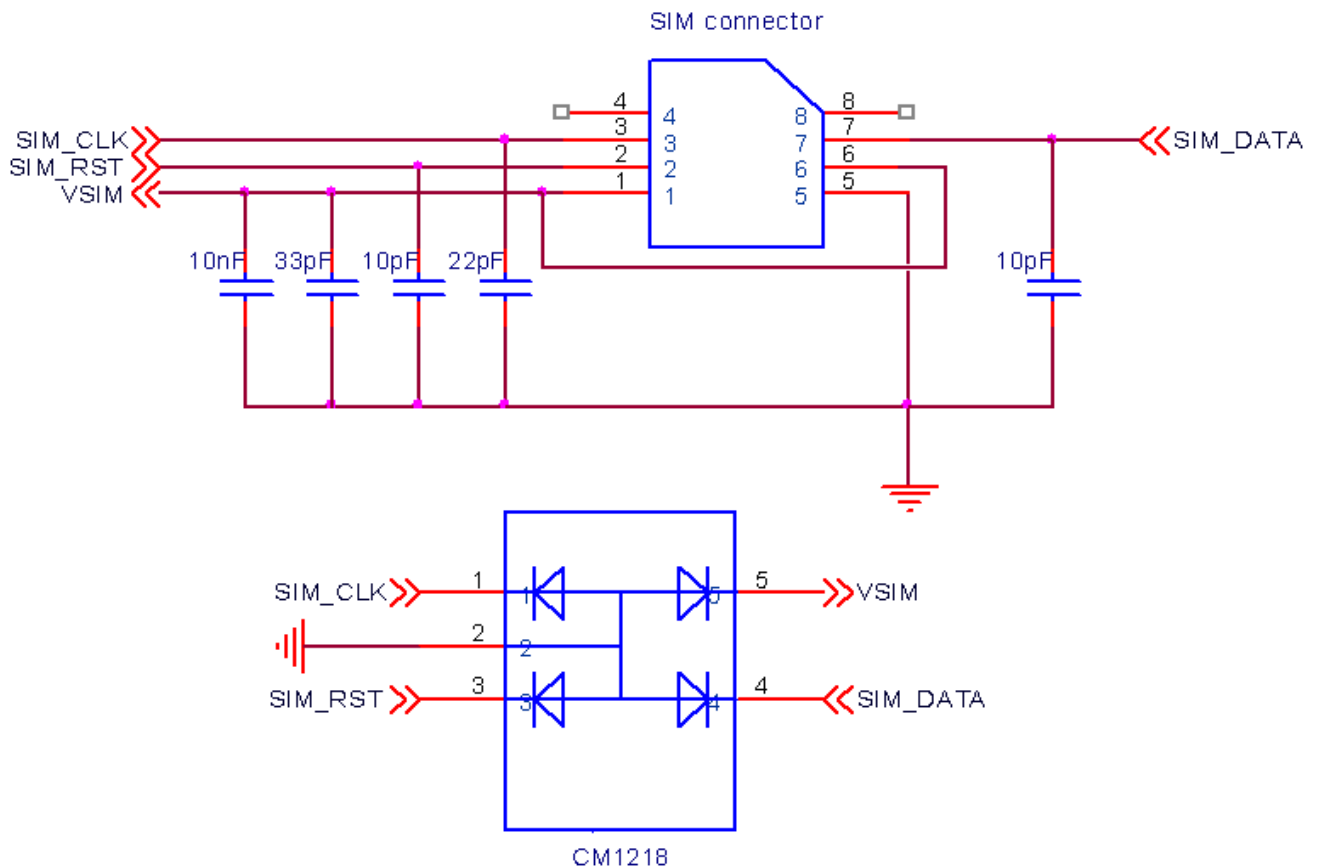


Figure 3: Protections: EMC and ESD components close to the SIM

3.2 HOW TO CONNECT THE AUDIOS?

The HiloNC module features one input audio path and one output audio path. The input path is single-end while the output path is differential. In this following chapter examples of design will be given including protections against EMC and ESD and some notes about the routing rules to follow to avoid the TDMA noise usually present in this sensitive area of design.

F Please note that acoustic competences are mandatory to get accurate audio performance on customer's product.

3.2.1 Connecting microphone and speaker

The HiloNC module can manage an external microphone (*INTMIC_P*) in single-end mode and an external speaker (*HSET_OUT_P* / *HSET_OUT_N*) in differential mode. Thus, one speaker and one microphone can be connected to the module. The bias supply to microphone is implemented in the module.

F The speaker connected to the module should be 32 ohms.

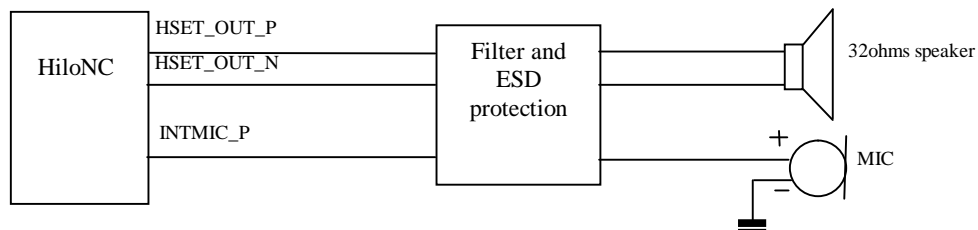


Figure 4: Audio connection

If the design is ESD or EMC sensitive we strongly recommend to read the notes below.

The weakness can either come from the PCB routing and placement or from the chosen components (or both).

3.2.1.1 Notes for microphone

F Pay attention to the microphone device, it must not be sensitive to RF disturbances.

F Some microphones include two spatial microphones inside the same shell and allow to make an electrical difference between the environment noise (received by one of the two mic.) and the active signal (received by the other mic. + noise) resulting in a very high SNR.

F If you need to have deported microphone out of the board with long wires, you should pay attention to the EMC and ESD effect. It is also the case when your design is ESD sensitive. In those cases, add the following protections to improve your design.

F To ensure proper operation of such sensitive signals, they have to be isolated from the others by analogue ground on customer's board layout. (Refer to Layout design chapter)

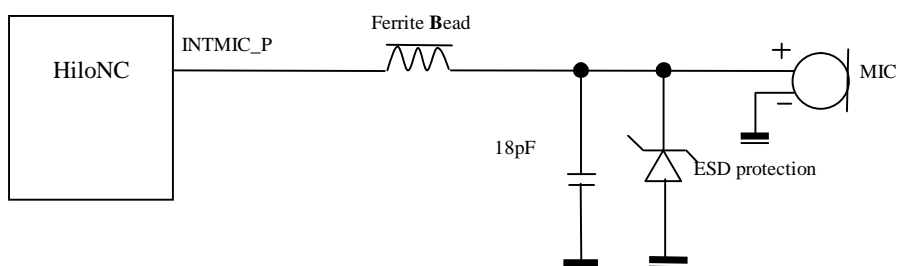


Figure 5 : Filter and ESD protection of microphone

3.2.1.2 Notes for speaker

As explained for the microphone, if the speaker is deported out of the board or is sensitive to ESD, use the schematic here after to improve the audio.

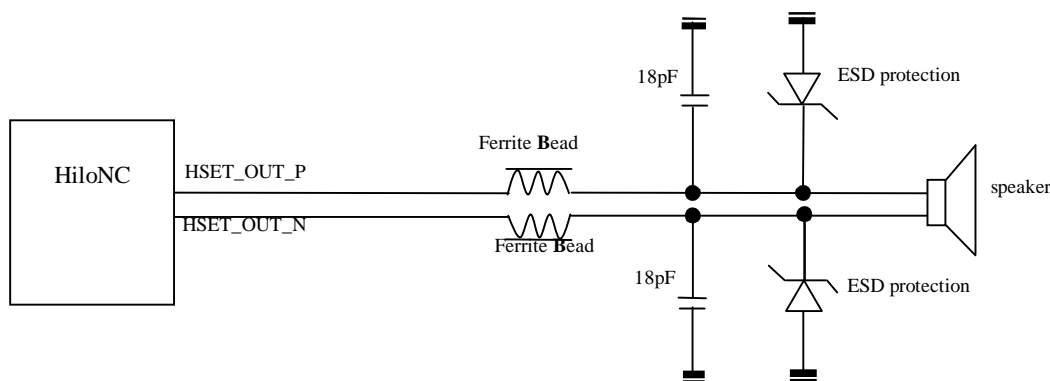


Figure 6: Filter and ESD protection of 32 ohms speaker

- F** *HSET_OUT_P, HSET_OUT_N* tracks must be larger than other tracks: 0.1 mm.
- F** As described in the layout chapter, differential signals have to be routed in parallel (*HSET_OUT_P* and *HSET_OUT_N* signals)
- F** The impedance of audio chain (filter + speaker) must be lower than 32 Ohm.

3.2.2 Recommended characteristics for the microphone and speaker

3.2.2.1 Recommended characteristics for the microphone

Item to be inspected	Acceptance criterion																											
Sensitivity	- 40 dB SPL +/-3 dB (0 dB = 1 V/Pa @ 1kHz)																											
Frequency response	Limits (relative values) <table border="1"> <thead> <tr> <th>Freq. (Hz)</th> <th>Lower limit</th> <th>Upper limit</th> </tr> </thead> <tbody> <tr> <td>100</td> <td>-1</td> <td>1</td> </tr> <tr> <td>200</td> <td>-1</td> <td>1</td> </tr> <tr> <td>300</td> <td>-1</td> <td>1</td> </tr> <tr> <td>1000</td> <td>0</td> <td>0</td> </tr> <tr> <td>2000</td> <td>-1</td> <td>1</td> </tr> <tr> <td>3000</td> <td>-1.5</td> <td>1.5</td> </tr> <tr> <td>3400</td> <td>-2</td> <td>2</td> </tr> <tr> <td>4000</td> <td>-2</td> <td>2</td> </tr> </tbody> </table>	Freq. (Hz)	Lower limit	Upper limit	100	-1	1	200	-1	1	300	-1	1	1000	0	0	2000	-1	1	3000	-1.5	1.5	3400	-2	2	4000	-2	2
Freq. (Hz)	Lower limit	Upper limit																										
100	-1	1																										
200	-1	1																										
300	-1	1																										
1000	0	0																										
2000	-1	1																										
3000	-1.5	1.5																										
3400	-2	2																										
4000	-2	2																										
Current consumption	1 mA (maximum)																											
Operating voltage	DC 1 to 3 V (minimum)																											
S / N ratio	55 dB minimum (A-Curve at 1 kHz, 1 Pa)																											
Directivity	Omni-directional																											
Maximum input sound pressure level	100 dB SPL (1 kHz) Maximum distortion 1%																											
Radio frequency protection	Over 800 -1200 MHz and 1700 -2000 MHz, S/N ratio 50 dB minimum (signal 1 kHz, 1 Pa)																											

3.2.2.2 Recommended characteristics for the speaker

Item to be inspected	Acceptance criterion
Input power: rated / max	0.1W (Rate)
Audio chain impedance	32 ohm +/- 10% at 1V 1KHz
Frequency Range	300 Hz ~ 4.0 KHz
Sensitivity (S.P.L)	>105 dB at 1KHz with IEC318 coupler,
Distortion	5% max at 1K Hz, nominal input power

3.3 PWM

3.3.1 PWM outputs

The HiloNC module can manage two PWM outputs. They can be configured with appropriate AT command (for more details refer to AT command set for Sagem HiloNC module specification).

User application can set for each output:

- Frequency between : 25.6KHz and 1083.3KHz
- Duty range from: 0 to 100%

F Please note available PWM frequencies are too high to be used to make LEDs blinking. If purpose is to make LEDs blinking (for network states indication for example), GPIO usage is more accurate.

3.3.2 PWM for Buzzer connection

The HiloNC module can manage a dedicate PWM output to drive a buzzer. The buzzer can be used to alarm for abnormal state.

F Resistors should be added to protect the buzzer. The value of these resistors depends on the buzzer and the transistor. Normally, they can be set as 1K ohm.

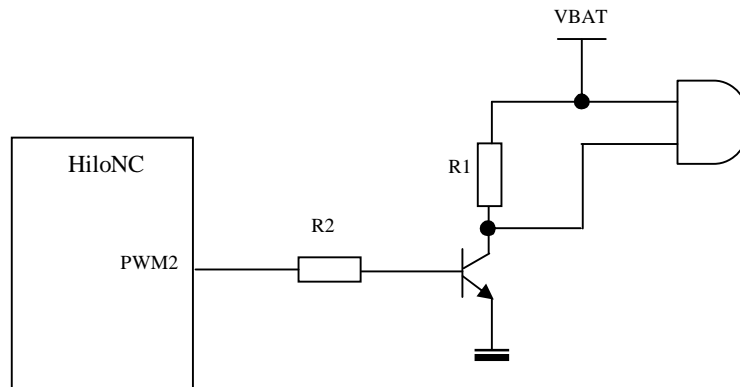


Figure 7: Buzzer connection

3.4 POWER SUPPLY

The HiloNC module can be supplied by a battery or any DC/DC converter compliant with the module supply range 3.2V to 4.5V 2.2 A.

F The PCB tracks must be well dimensioned to support 2.2 A maximum current. The voltage ripple caused by resistance of power supply path (Battery internal resistance, tracks and contact resistance) could result in the low voltage to the module.

F The HiloNC module does not manage the battery charging.

3.4.1.1 Burst conditions

- Communication mode (worst case: 2 continuous GSM time-slot pulse):

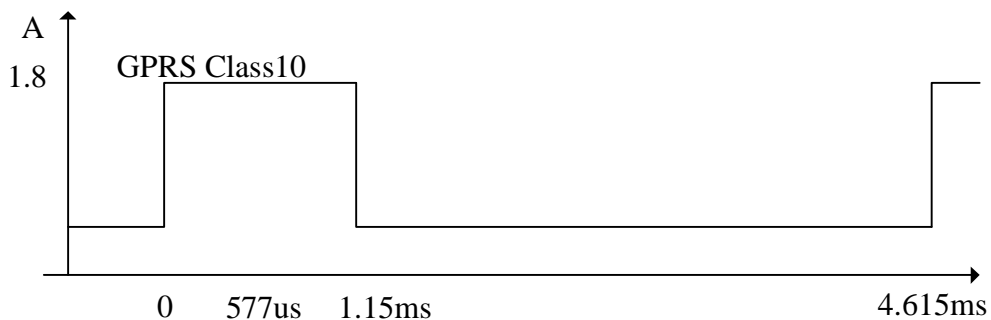


Figure 8: GSM/GPRS Burst

F A 47μF capacitor is highly recommended for VBAT and close to the module.

3.5 EXAMPLE OF POWER SUPPLY

3.5.1 Example 1

It the following application note from Linear Technology LTC3440, this schematic is an example of a DC/DC power supply able to power 3.6V under 2.1A. This can be use with a AC/DC 5V unit or an USB or PCMCIA bus as input power source.

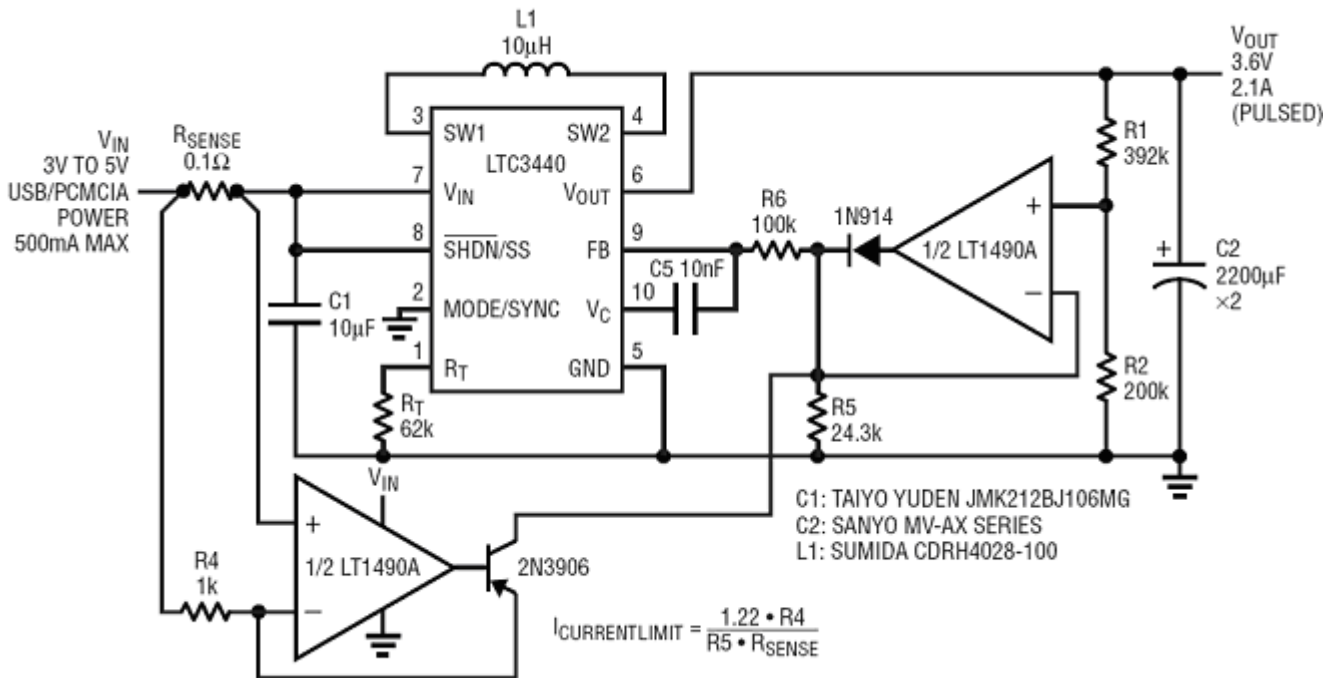


Figure 9: Example of power supply based on a DC/DC step down converter

3.5.2 Example 2

If the whole power consumption is not an issue, this example of a voltage regulator used with an AC/DC 5V converter, can be used as a DC power supply.

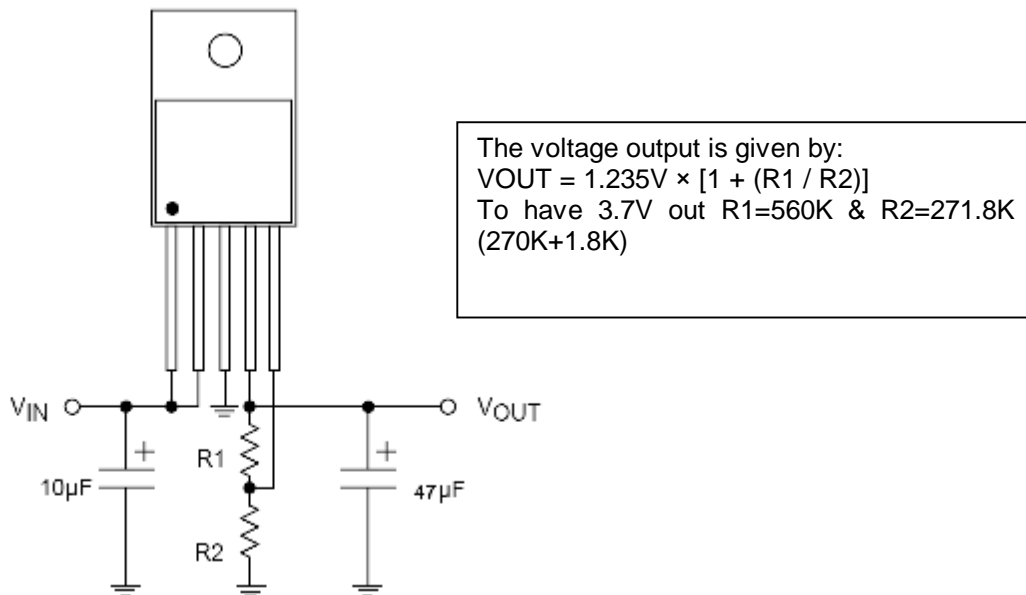


Figure 10: Example of power supply based on regulator

3.5.3 Example 3

Simple boost converter with Linear LT1913 (see LT1316 evaluation kit document).

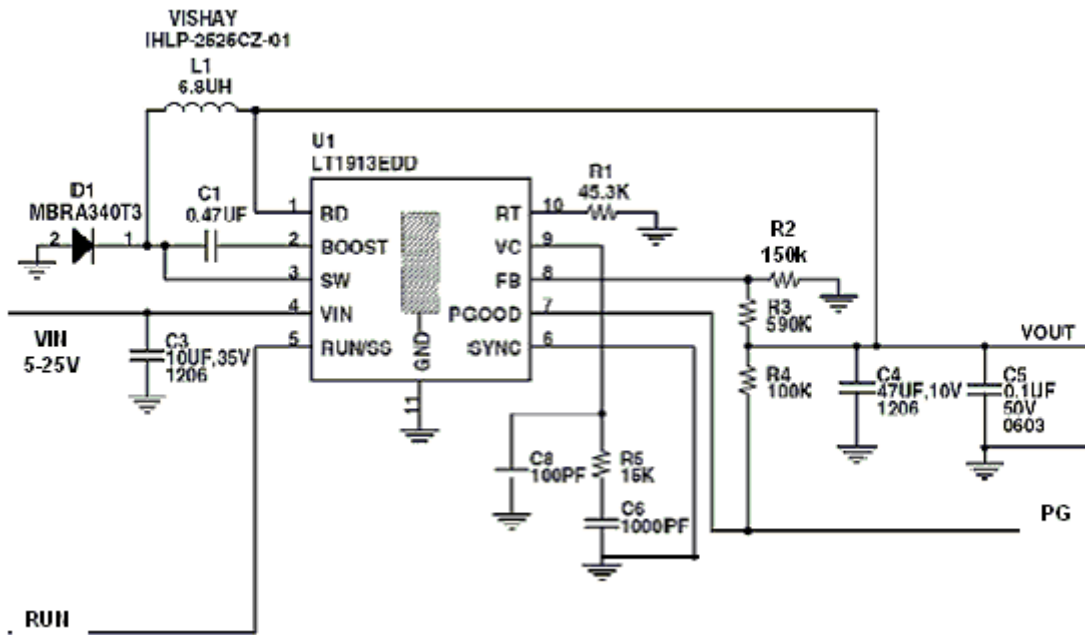


Figure 11: Example with Linear LT1913

3.6 V24

The HiloNC module features a V24 interface to communicate with the Host through AT commands or for easy firmware upgrading purpose.

F It is recommended to manage an external access to the V24 interface, in order to allow easy software upgrade (baud rate up to 460.8kbps, validated with ATEN USB/Serial converter).

F Pull-up resistors must be connected to *DCD*, *DSR* and *RI* signals if these signals are used.

3.6.1 Complete V24 – connection HiloNC - host

A V24 interface is provided on the 51 pads of the HiloNC module with the following signals: *RTS/CTS*, *RXD/TXD*, *DSR*, *DTR*, *DCD*, *RI*.

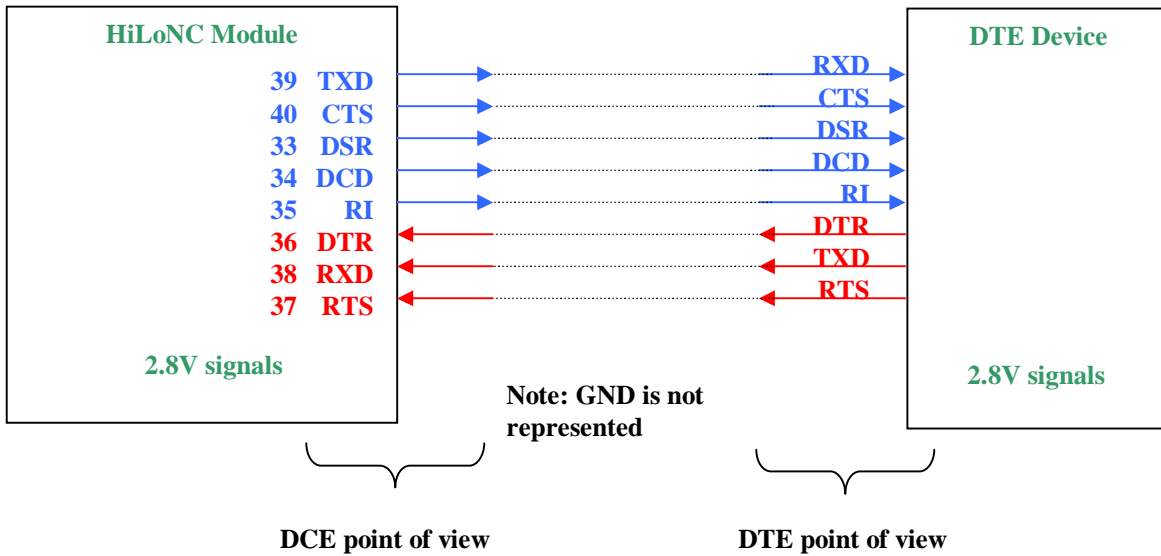


Figure 12: Complete V24 connection between HiLoNC and host

3.6.2 Complete V24 interface with PC

It supports speeds up to 115.2 Kbps and may be used in auto bauding mode. To use the V24 interface, some adaptation components are necessary to convert the +2.8V signals from the HiLoNC to +/- 5V signals compatible with a PC.

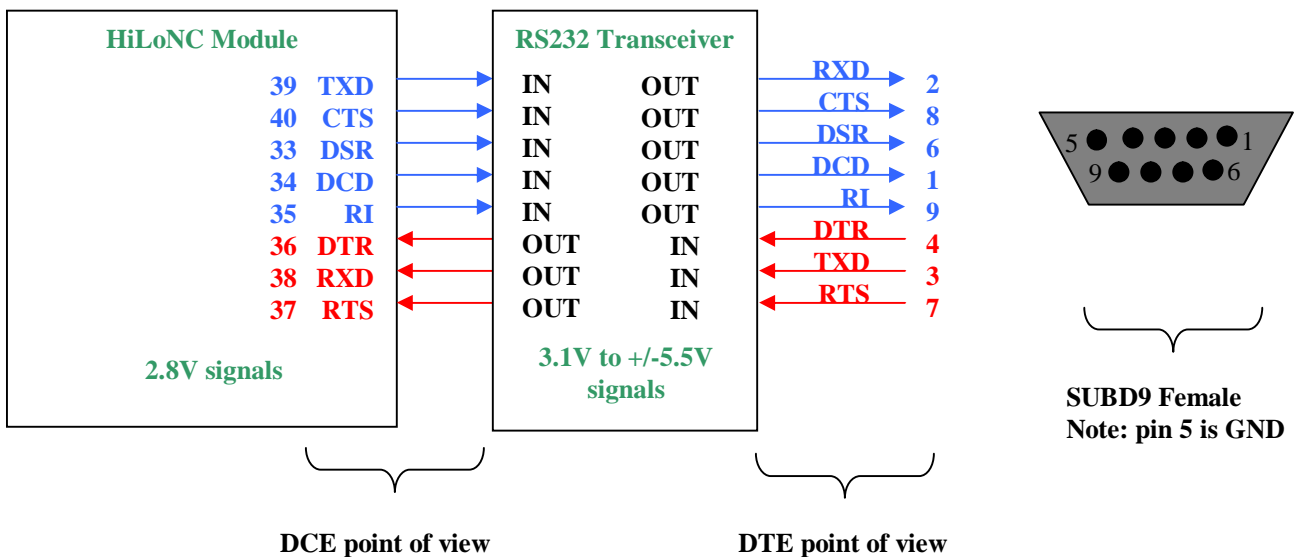


Figure 13: connection t

To create your own data cable (for software download purpose...etc...) please refer to the following schematic as an example:

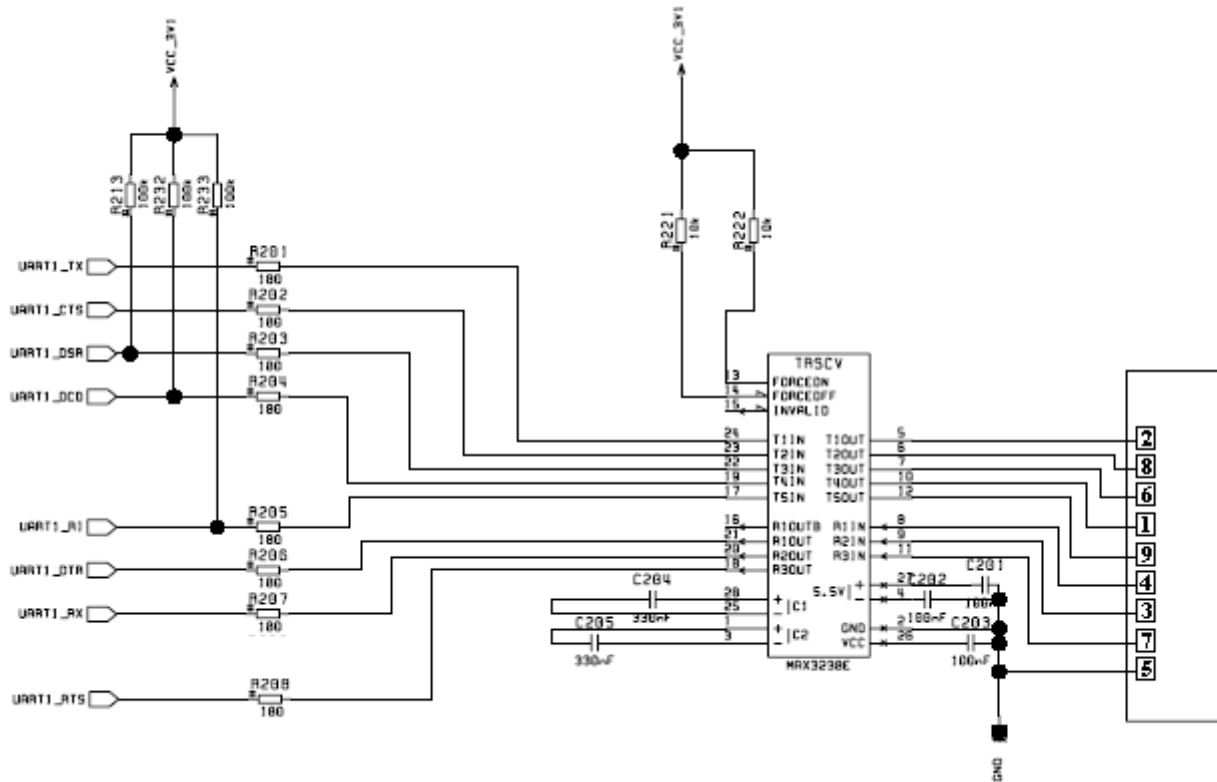


Figure 14: Example of a connection to a data cable

3.6.3 Partial V24 (RX-TX-RTS-CTS) – connection HiLoNC - host

When using only RX/TX/RTS/CTS instead of the complete V24 link, we recommend following schematic.

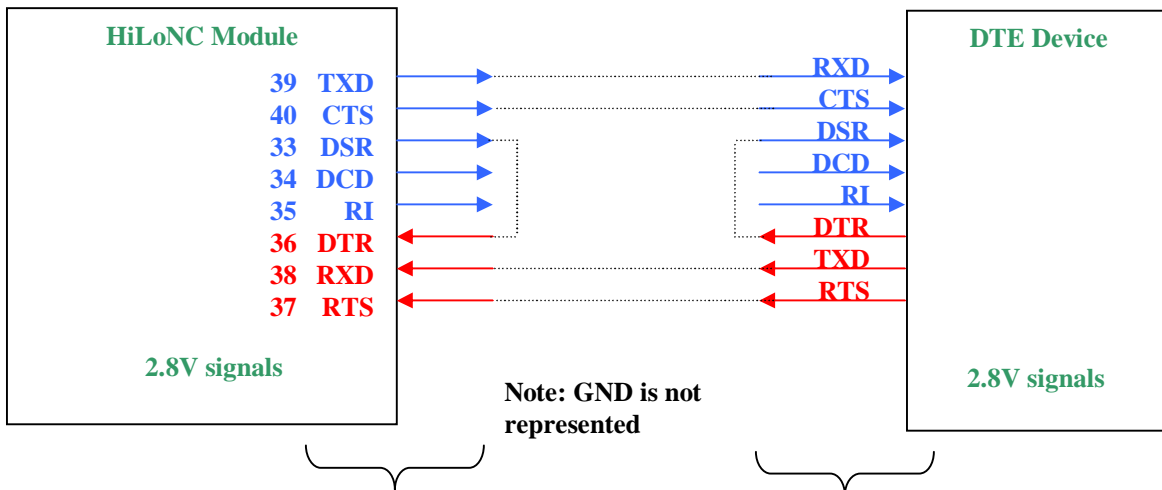


Figure 15: Partial V24 connection (4 wires) between HiLoNC and host

F As we need *DTR* active (low electrical level), a loop *DSR* on *DTR* is sufficient because *DSR* is active (low electrical level) once the HiLoNC is switched on.

F *DCD* and *RI* can stay not connected and floating.

3.6.4 Partial V24 (RX-TX) – connection HiloNC - host

When using only *RX/TX* instead of the complete V24 link, we recommend following schematic.

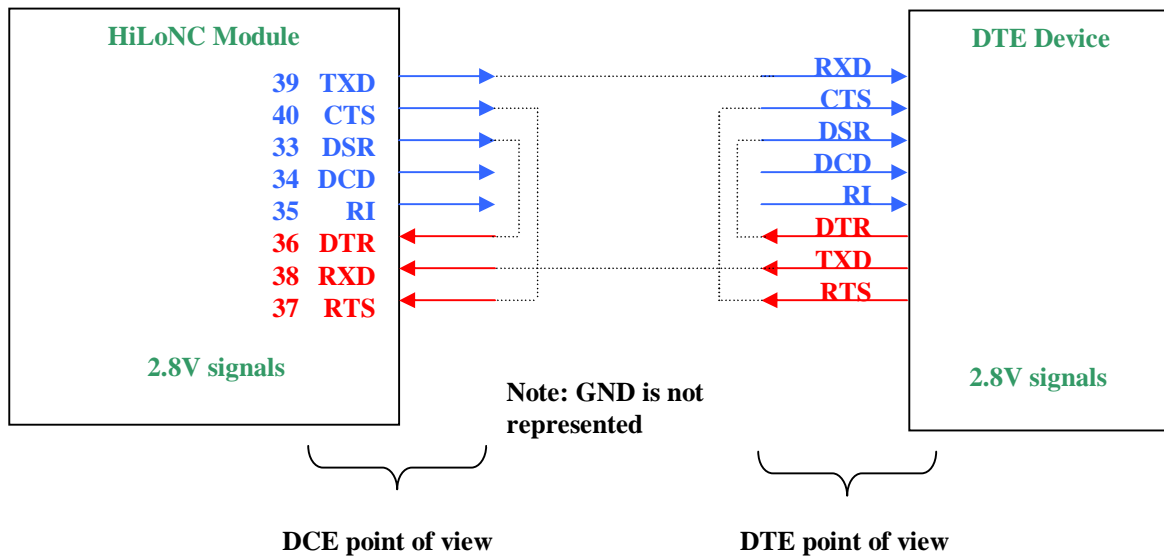


Figure 16: Partial V24 connection (2 wires) between HiloNC and host

- F** We need *DTR* active (low electrical level), a loop *DSR* on *DTR* is sufficient because *DSR* is active (low electrical level) once the HiloNC is switched on.
- F** We need *RTS* active (low electrical level), a loop *RTS* on *CTS* is sufficient because *CTS* is active (low electrical level) once the HiloNC is switched on.
- F** *DCD* and *RI* can stay not connected and floating.

3.6.5 Design impact on DTR usage

The designer must consider when choosing V24 design that *DTR* can be used for several purposes :

- flow control of V24 interface (see chapter 3.6.2)
- enter/exit sleep mode of HiloNC module if *AT+KSLEEP=0* has been configured (see chapter 3.14)
- switch between command/data modes

- F** Depending of the HiloNC/Host V24 connexion, the *DTR* can be usable by customer or not (if always connected to *DSR*) and then has impact on sleep mode management and AT command/data modes management.

3.7 SPI

HiloNC module manages a host SPI interface. This SPI interface is dedicated for trace.

- F** Sagem Communications strongly recommends leaving this interface externally accessible for trace (e.g. access by test point pads).

3.8 GPIO

There are five GPIOs available on HiloNC. The *GPIO1*, *GPIO2* and *GPIO3* have internal pull-up resistors while *GPIO4* and *GPIO5* are open collector.

F If *GPIO4* and *GPIO5* are used as output, they must be pulled up to *VGPIO*. The typical value of the pull-up resistors is 100K ohms.

3.9 BACKUP BATTERY

3.9.1 Backup battery function feature

3.9.1.1 With backup battery

A backup battery can be connected to the module in order to supply internal RTC (Real Time Clock) when the main power supply is removed. Thus, when the main power supply is removed, the RTC is still supplied and the module keeps the time running.

With external backup battery:

- If *VBAT* < 3V, internal RTC is supplied by *VBACKUP*.
- If *VBAT* > =3V, internal RTC is supplied by *VBAT*.

3.9.1.2 Without backup battery

Without backup battery

- If *VBAT* > 1.5V, internal RTC is supplied by *VBAT*.
- If *VBAT* < 1.5V, internal RTC is not supplied.

F *VBACKUP* input of the module has to be connected to a 10µF capacitor (between *VBACKUP* and GND).

F SAGEM does not recommend to connect *VBACKUP* signal to *VBAT*. However, if *VBACKUP* has been connected to *VBAT*, this has no influence if *VBAT* is between 3.2V and 4.2V. For *VBAT* above 4.2V the module can take a longer time to start at low temperature.

3.9.2 Current consumption on the backup battery

When the power supply is removed, the internal RTC will be supplied by backup battery.

F To calculate the backup battery capacity, consider that Current consumption for RTC on the backup battery is below 2,6µA depending on the temperature.

Pin Name	Min	Max
<i>VBACKUP</i>		2.6µA

3.9.3 Charge by internal HiloNC charging function

The charging function is available on the HiloNC without any additional external power supply (the charging power supply is provided by the HiloNC).

F Charge of the back-up battery occurs only when main power supply *VBAT* is provided.

The recommended schematic is given hereafter:

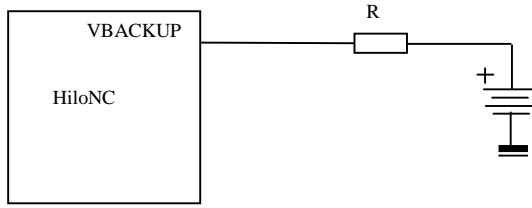


Figure 17: Backup battery internally charged

The resistor R depends on the charging current value provided by the battery manufacturer. The charging curve which is done by the HiLoNC is given hereafter:

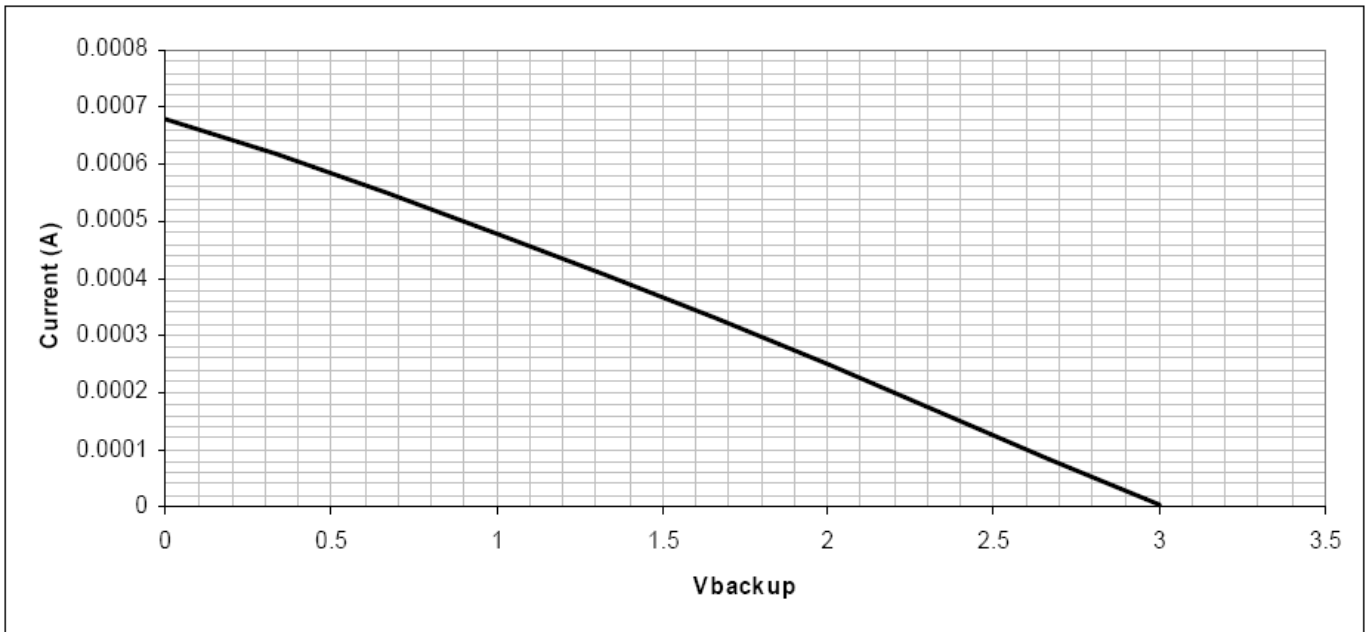


Figure 18: Charging curve of backup battery

3.9.4 Backup Battery technology recommended

3.9.4.1 Manganese Silicon Lithium-Ion rechargeable Battery

Sagem Communications does not recommend using this kind of technology because of the following drawbacks:

- The maximum discharge current is limited (Shall be compliant with the module characteristics).
- The over-discharge problem: most of the Lithium Ion rechargeable batteries are not able to recover their charge when their voltage reaches a low-level voltage. To avoid this, it is necessary to add a safety component to disconnect the backup .battery in case of over-discharge condition. In such a case, this implementation is too complicated (too much components for that function).
- The charging current has to be regulated.

F Sagem Communications does not recommend using this kind of backup battery technology.

3.9.4.2 Capacitor battery

These kinds of backup battery have not the drawbacks of the Lithium Ion rechargeable battery. As there are only capacitors:

- The maximum discharge current is generally bigger,
- There is no problem of over-discharge: the capacitor is able to recover its full charge even if its voltage has previously fallen to 0V.
- There is no need to regulate the charging current.

Moreover, this kind of battery is available in the same kind of package than the Lithium Ion cell and fully compatible on a mechanical point of view. The only disadvantage is that the capacity of this kind of battery is significantly smaller than Manganese Silicon Lithium Ion battery. But for this kind of use (supply internal RTC when the main battery is removed), the capacity is generally enough.

F Sagem Communications strongly recommends using this kind of backup battery technology.

3.10 HARDWARE POWER MANAGEMENT AND MULTIPLEXING INTERFACES

In case hardware power management and multiplexing are used, it is necessary to isolate host and HiloNC module in order not to generate current re-injection when HiloNC is switched-off.

Typical schematic (only useful signals are represented):

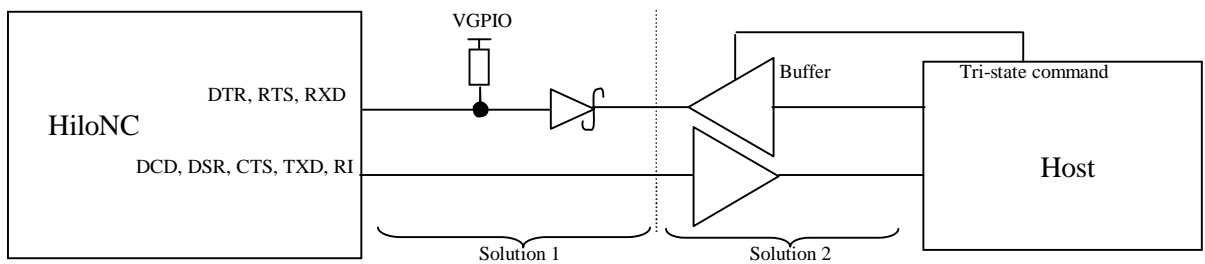


Figure 19: Hardware interface between HiloNC and host

In general, solution1 is enough to protect HiloNC module.

3.11 STARTING THE MODULE

First power up *V_{BAT}*, which must be in the range 3.2V – 4.5V, and able to provide 2.2A during the TX bursts (Refer to the module specification for more details).

To start the module, a low level pulse must be sent on *POK_{IN}* during 1 s minimum (at 25°C).

After a few seconds, the module puts in active state *CTS* when it is ready to receive AT commands.

3.12 MODULE RESET

To reset the module, a low level pulse must be sent on *RESET* pad during 10 ms.

3.13 MODULE SWITCH OFF

AT command “AT*PSCPOF” allows to switch off the module.

3.14 SLEEP MODE MANAGEMENT

AT command "AT+KSLEEP" allows to configure the sleep mode.

When AT+KSLEEP=1 is configured :

- the HiloNC module decides by itself when it enters in sleep mode (no more task running).
- "0x00" character on serial link wakes up the HiloNC module.

When AT+KSLEEP=0 is configured :

- the HiloNC module is active when *DTR* signal is active (low electrical level).
- when *DTR* is deactivated (high electrical level), the HiloNC module enters in sleep mode after a while.
- on *DTR* activation (low electrical level), the HiloNC module wakes up.

4. MANDATORY POINTS FOR THE FINAL TESTS AND TUNING

The design of the customer's board (on which the module is soldered) must provide an access to following signals when the final product will be completely integrated.

F To upgrade the module software, Sagem Communications recommends providing a direct access to the module serial link through an external connector or any mechanism allowing the upgrade of the module without opening the whole product.

Serial link:

TXD	Output	UART transmit
RXD	Input	UART receive

F To debug the module software, Sagem Communications recommends providing a direct access to the module debug port SPI (5 I/Os) through internal test points (TP) located on the customer's main board.

5. ESD & EMC RECOMMENDATIONS

5.1 HILONC ALONE

The HiloNC module alone can hold 2KV on each of the 51 pads including the RF pad.

5.2 CUSTOMER'S PRODUCT WITH HILONC

If customer's design must stand more than 2kV on electrostatic discharge, following recommendation must be taken into account.

5.2.1 Analysis

ESD current can penetrate inside the device via the typical following components:

- SIM connector
- Microphone
- Speaker
- Battery / data connector
- All pieces with conductive paint (plastron, special keys, etc...)

F In order to avoid ESD issues, efforts shall be done to decrease the level of ESD current on electronic components located inside the device (customer's board, input of the HiloNC module, etc...)

5.2.2 Recommendations to avoid ESD issues

F Insure good ground connections of the HiloNC module to the customer's board.

F Flex (if any) shall be shielded and FPC connectors shall be correctly grounded at each extremity.

F Put capacitor 100nF on battery (not on charger), or better put varistor or ESD diode in parallel on battery and charger wires and on all wires on bottom connector.

F Uncouple microphone and speaker by putting capacitor or varistor in parallel of each wire of these devices.

6. RADIO INTEGRATION

6.1 ANTENNA

- Antenna contact
- 50Ω line matching (between module and customer's board, and with RF test point)

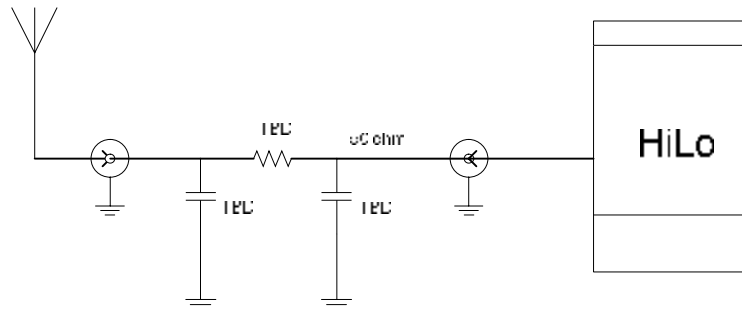


Figure 20: Antenna connection

F Keep matching circuit on customer's board but with direct connection in the first step – it could be necessary to make some adjustment later, during RF qualification stage.

F The selected antenna must comply with FCC RF exposure limits in GSM850 and PCS1900 band :

- GSM850 : MPE < 0.55mW/cm² (Distance is 20 cm)
- PCS1900 : ERP < 3W

6.2 GROUND LINK AREA

Sagem Communications emphasizes the fact that a good ground contact is needed between the module and the customer's board to have the best radio performances (spurious, sensitivity...).

F All HiloNC GND pads must be connected to the GND of the customer's board.

6.3 LAYOUT

Warning : Isolate RF line and antenna from others bus or signals

F No signals on 50 ohms area and if that is not possible, add ground shielding using different layers.

F Do not add any ground layer under the antenna contact area.

F Be careful on the position of the network LED (sometimes situated in front of the antenna pad ...)

F Do not put any via and lines on all the forbidden area under the module, shown as the grey area on the figure below.

F Varnish must be present on all the grey area (except solder pads) to isolate HiloNC module from the customer's board.

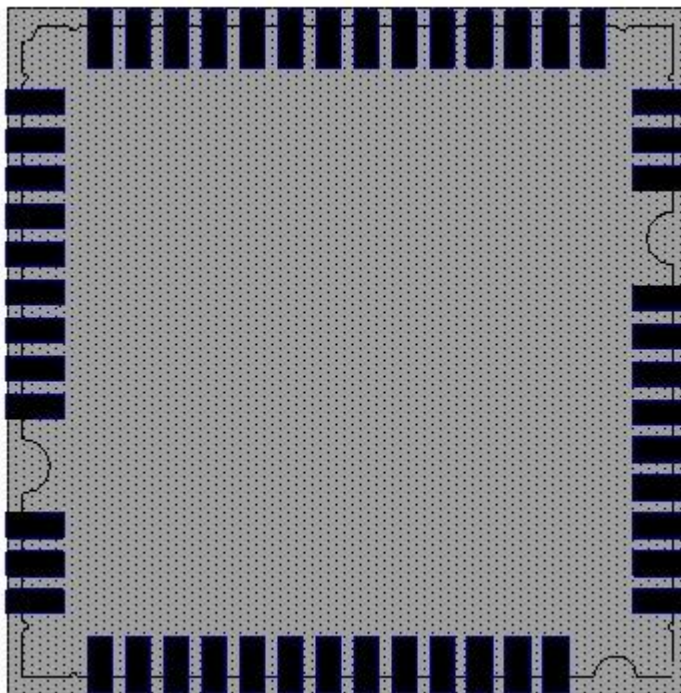


Figure 21: Forbidden area for via and lines

6.4 MECHANICAL SURROUNDING

- F** Avoid any metallic part around the antenna area
- F** Keep jacks, FPCs and battery contact far from antenna area (FLEX)
- F** FPC has to be a shielded one

6.5 OTHER RECOMMENDATIONS – TESTS FOR PRODUCTION/DESIGN

Sagem Communications guarantees the RF performances in conductive mode but strongly recommends making RF measurements in an anechoic chamber in radiated mode (tests conditions for FTA): the radiated performances strongly depend on radio integration (layout, antenna, matching circuit, ground area.....)

7. AUDIO INTEGRATION

Audio mandatory tests for FTA are in handset mode only so a particular care must be brought to the design of audio (mechanical integration, gasket, electronic) in this mode.

The audio norms which describe the audio tests are 3GPP TS 26.131 & 3GPP TS 26.132.

- F** Please note that acoustic competences are mandatory to get accurate audio performance on customer's product.

7.1 MECHANICAL INTEGRATION AND ACOUSTICS

Particular care to Handset Mode: FTA

To get a better audio output design (speaker part) :

- F** The speaker must be completely sealed on front side.
- F** The front aperture must be compliant with speaker supplier's specifications
- F** The back volume must be completely sealed.
- F** The sealed back volume must be compliant with speaker supplier's specifications
- F** Take care of the design of the speaker gasket (elastomer).
- F** Foresee a stable and large enough area for the gasket of the artificial ear.

To get a better audio input design (microphone part) :

- F** Take care of the design of the microphone (elastomer).
- F** All receivers must be completely sealed on front side.
- F** Microphone sensitivity depends on the shape of the device eg. about -40 ± 3 dBV/Pa for clamshell.
- F** Promote the use of pre-amplified microphone. If needed, use a pre-amplification stage.

As audio input and output are strongly linked :

- F** Place the microphone and the speaker as far as possible from one another.

7.2 ELECTRONICS AND LAYOUT

Avoid Distortion & Burst noise

- F** Audio signals must be symmetric (same components on each path).
- F** Differential signals must be routed parallel.
- F** Audio layer must be surrounded by 2 ground layers.
- F** The link from one component to the ground must be as short as possible.
- F** If possible separate the PCB of the microphone and the one of the speaker.
- F** Reduce as much as possible the number of electronics components (loss of quality, more dispersion).
- F** Audio tracks must be larger than 0.5 mm.

8. RECOMMENDATIONS ON LAYOUT OF CUSTOMER'S BOARD

8.1 GENERAL RECOMMENDATIONS ON LAYOUT

There are many different types of signals in the module which are disturbing each other. Particularly, Audio signals are very sensitive to external signals as VBAT⁽¹⁾... Therefore it is very important to respect some rules to avoid disruptions or abnormal behaviour.

8.1.1 Ground

- F** A ground plane as complete as possible
- F** Ground of components has to be connected to the ground layer through many vias not regularly distributed.
- F** Top and bottom layer shall have as much as possible of ground planes.

8.1.2 Power supplies

- F** Plan for power supply signals (*VBAT*, *VGPIO*), no loop.
- F** Suitable power supply (*VBAT*, *VGPIO*) track width, thickness.

8.1.3 Clocks

- F** Clock signals must be shielded between two grounds plans and bordered with ground vias.

8.1.4 Data bus and other signals

- F** Data bus and commands have to be routed on the same plane, none of the lines of the bus shall be parallel to other lines
- F** Lines crossing shall be perpendicular
- F** Suitable other signals track width, thickness.
- F** Data bus must be protected by upper and lower ground plans

8.1.5 Radio

- F** Provide a 50 Ohm microstrip line for antenna connection

8.1.6 Audio (see also § 10.2)

- F** Differential signals have to be routed together, parallel (for example *HSET_OUT_P/HSET_OUT_N*).
- F** Audio signals have to be isolated, by pair, from all the other signals (ground all around each pair).
- F** Cancel any loops between *VBAT* and *GND* next to the speaker to avoid the TDMA burst noise in the speaker during a communication.

F The single-end audio signal should be adopted the same rules as differential signals.

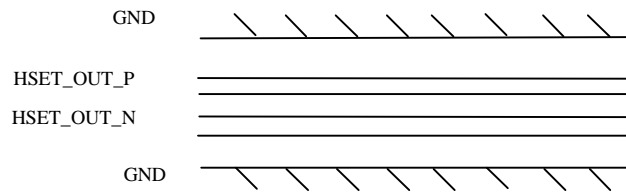


Figure 22: Layout of audio differential signals on a layer n

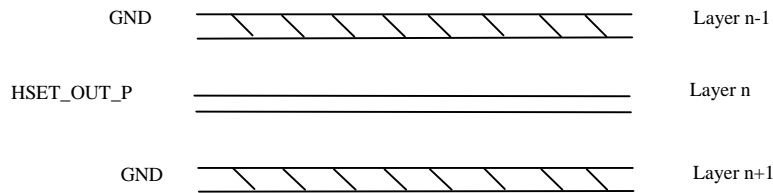


Figure 23: Adjacent layers of audio differential signals

⁽¹⁾. **Warning:** Magnetic field generated by *VBAT* tracks may disturb the speaker, causing audio burst noise. In this case, one shall modify routing of the *VBAT* tracks to reduce the phenomena.

8.2 EXAMPLE OF LAYOUT FOR CUSTOMER’S BOARD

The figure Figure 24 shows an example of layer allocation for a 6 layers circuit (for reference only):

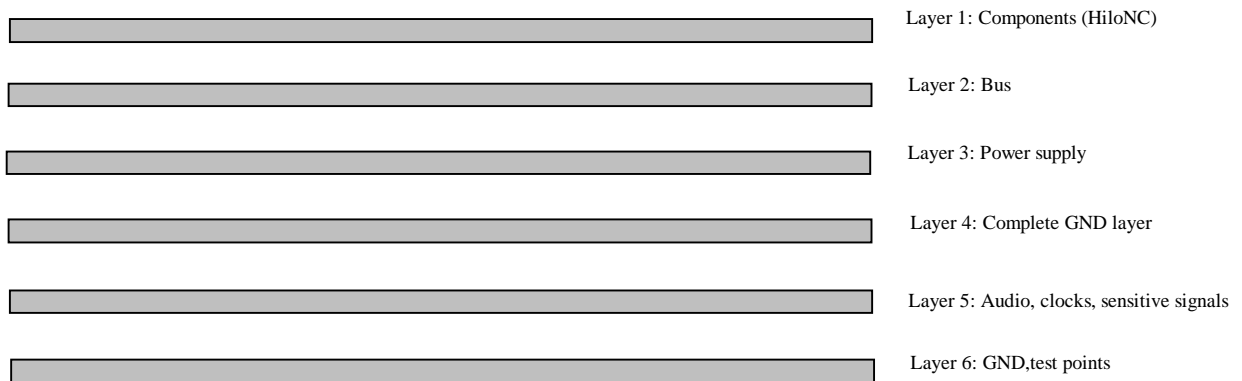


Figure 24: layer allocation for a 6 layers circuit

9. RECOMMANDATIONS FOR CUSTOMER INDUSTRIALIZATION

Please note for following chapters that except where standards are indicated, the given characteristics should be considered as validated conditions used on Sagem Communication product.

F Other conditions depending of the customer’s factory process are not validated but can be submitted to Sagem Communication for proficiency.

9.1 MOISTURE LEVEL

According to IPC/JEDEC J-STD 20, the HiloNC has the following MSL level : 3 (Targeted).

Level	Floor Life		Soak requirements			
			Standard		Accelerated Equivalent	
	Time	Conditions	Time (hours)	Conditions	Time (hours)	Conditions
3	168 hours	<= 30°C/60% RH	192 +5/-0	30°C / 60% RH	40 +1/-0	60°C / 60%RH

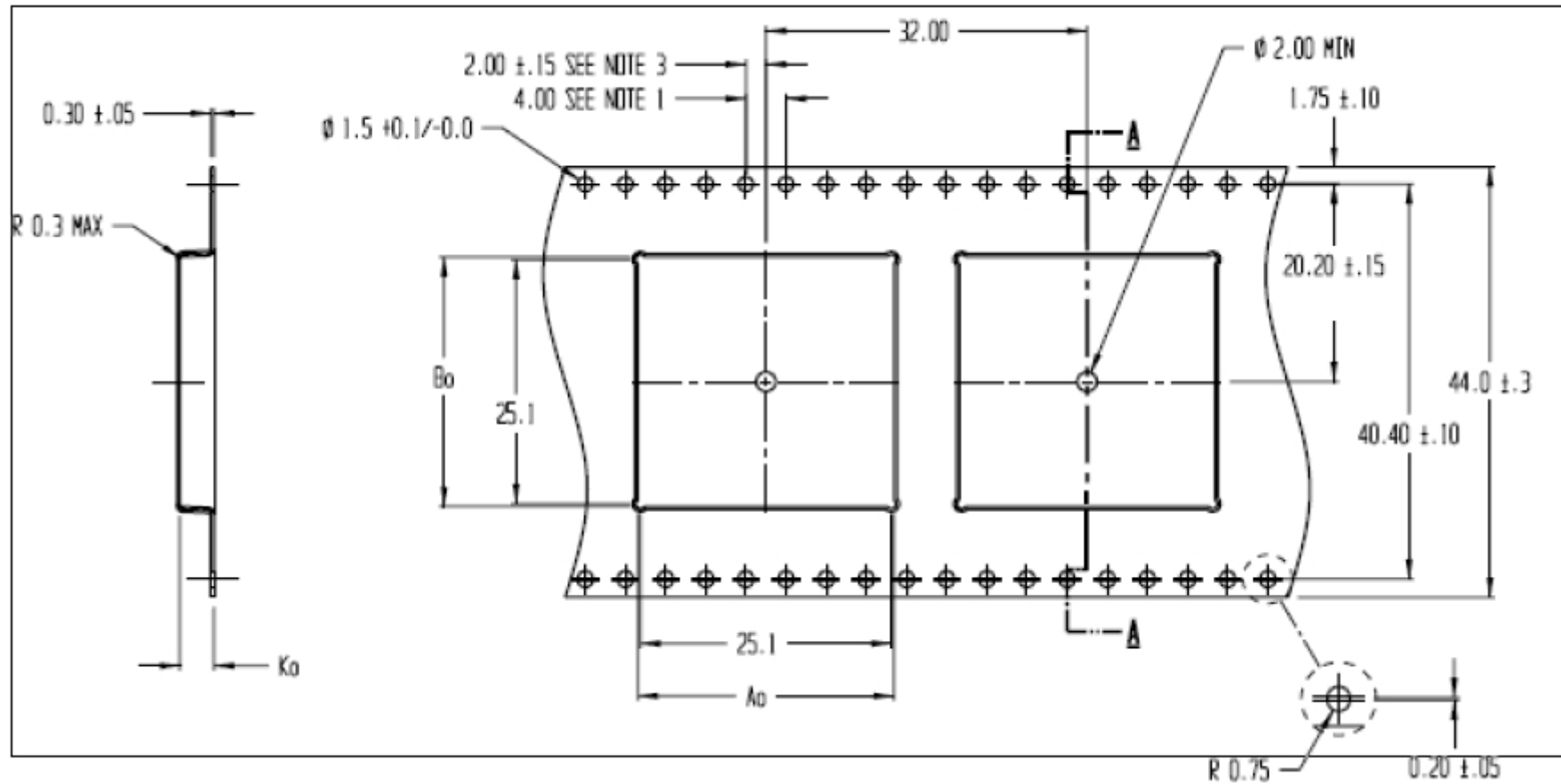
It means that the customer's factory must process and solder the HiloNC on the customer's board at least 168 hours (7 days) after the HiloNC sealed package have been opened. This duration is given for factory floor conditions of T°<30°C, HR 60%.

F If this duration can not be fulfilled, the HiloNC part must be baked again.

9.2 PACKAGE

The HiloNC module is delivered in Tape and Reel package which is hermetically sealed to prevent from moisture and ESD.

The characteristics of the T&R are given in the drawing below.



9.3 SOLDER MASK

Below are given soldering characteristics to report the HiloNC on the customer's board.
Copper footprint is shown in yellow on the figure below. Solder mask footprint is shown in pink.

F Please note that copper mask and solder mask do not strictly recover themselves.

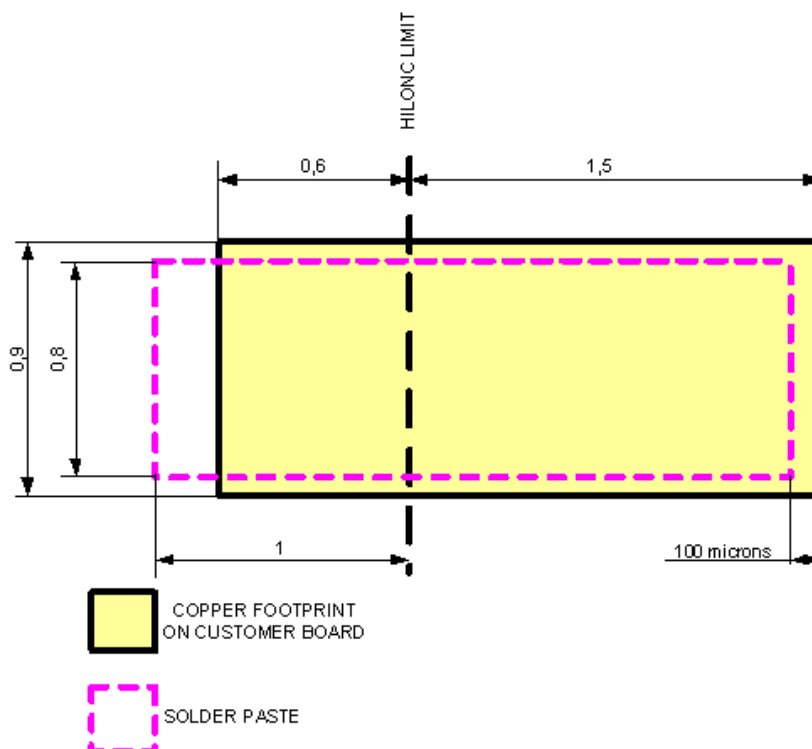


Figure 25 : Solder mask design

9.4 SOLDER PASTE

Solder paste : M705-GRN360-K-V (Senju Metal Industry Co., Ltd.)
Alloy composition : Sn96.5-Ag3.0-Cu0.5
Melting temperature : solidus 216°C / Peak 217°C / liquidus 220°C

F Sagem Communication recommends a stencil thickness of 135 µm.

9.5 PROFILE FOR REFLOW SOLDERING

A convection type soldering oven is recommended.
Typical usable profile is shown on the next figure. The final profile has to be tuned depending on other elements like solder paste, customer's board, other components,...

Peak temperature : 245°C
Average ramp up rate : 3°C/second max
Average ramp down rate : TBC

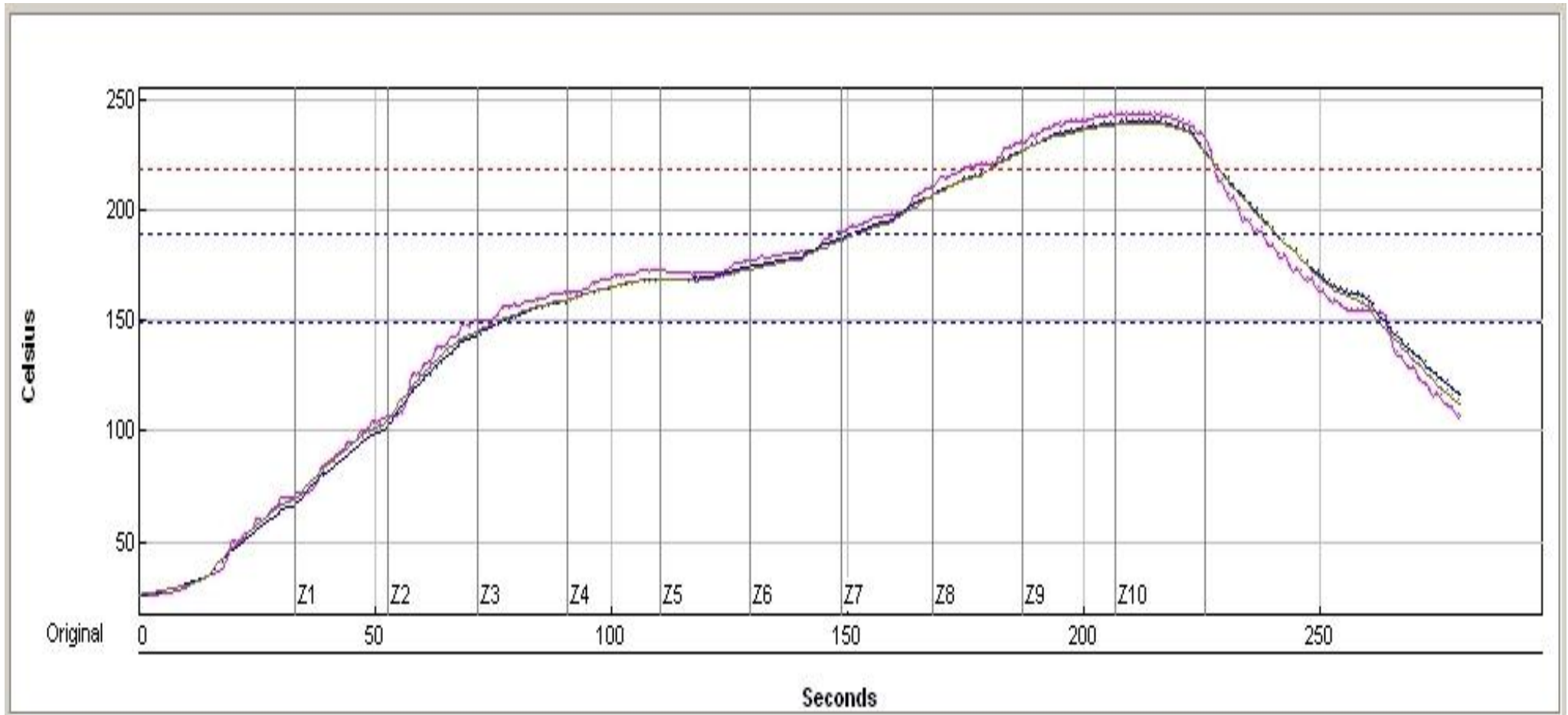


Figure 26 : Typical thermal profile

The HiloNC module is a Lead-free product which has been validated integrated in a lead-free product, using a lead-free factory process.

F No test has been performed using a leaded process. Sagem Communication does not recommend to use a factory leaded process and does not guarantee any reliable result on the final product.

9.6 SMT MACHINE

HiloNC is optimized for use with pick-and-place machines. Optical inspection for placement is possible with SMD fiducials placed on the bottom side of the HiloNC. SMD fiducials are not symmetrical in order to help optical inspection to define the right orientation.

Notes: All dimensions are in millimeter.

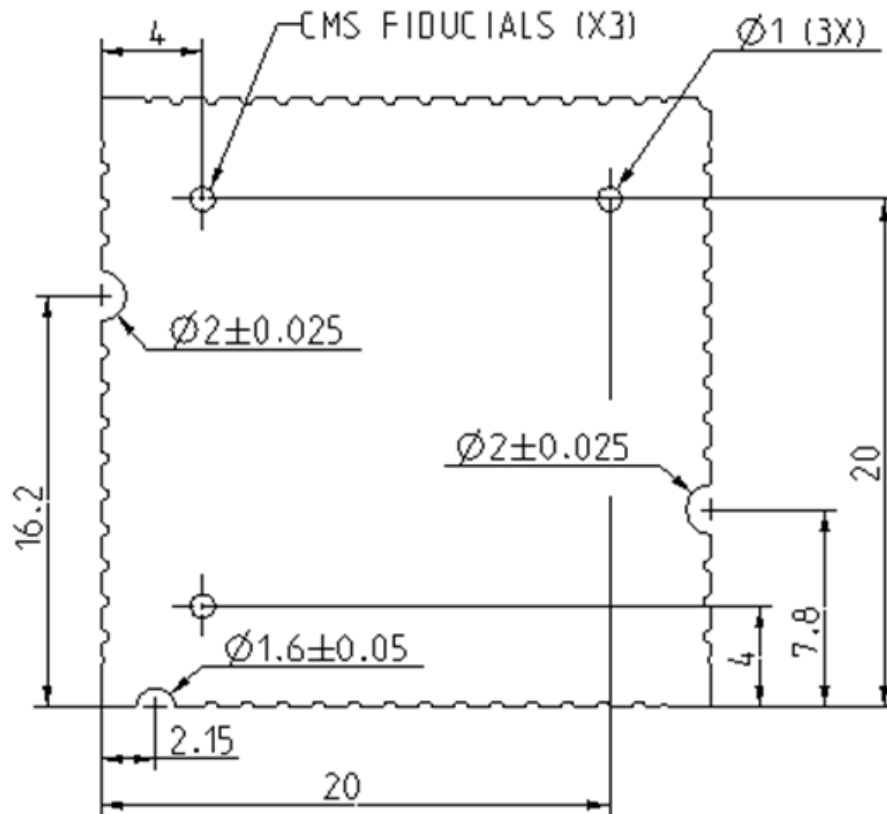


Figure 27 : CMS fiducials positions

9.7 UNDERFILL

Despite its important reliability, some customer could request for some specific and extreme applications the underfill of onboard components.

The HiloNC's shield has been designed accordingly to allow this process, as shown in the figure below. More details will be given in a specific application note.

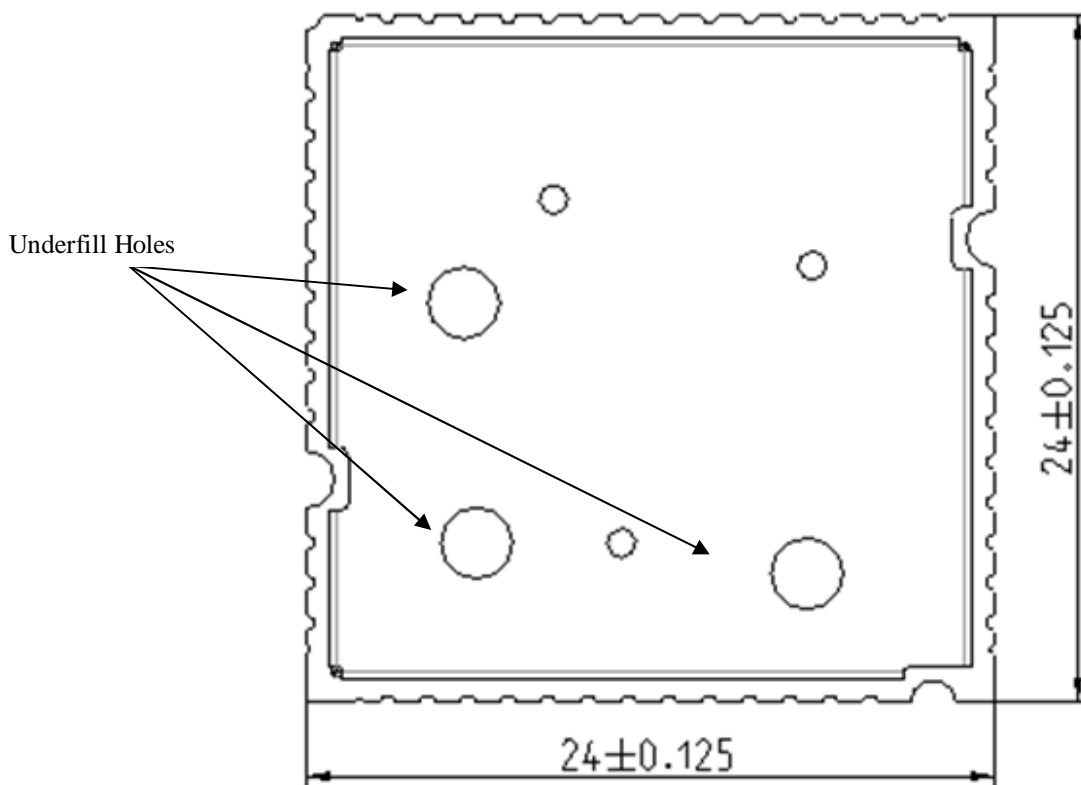


Figure 28 : Underfill holes

9.8 SECOND REFLOW SOLDERING

Even if Sagem Communications recommends a single reflow soldering, a second reflow soldering can be conceivable (only if underfill has not been already performed). Positive tests have been performed with HiloNC on the bottom side.

F Second reflow soldering is not possible if HiloNC module has been already underfilled.

9.9 HAND SOLDERING

Hand soldering is possible.

F An especial care must be considered to properly position the HiloNC on its copper footprint during hand soldering. Begin with pads diagonally opposite to help in proper positioning.

9.10 REWORK

Rework is possible, for repair purpose for example.

F An especial care must be considered in order not to overheat the HiloNC.

10. LABEL

The HiloNC module is labelled with its own FCC ID(VW3HILONC) on its bottom side. When the module is installed in customer's product, the FCC ID label on the module will not be visible. To avoid this case, an exterior label must be stuck on the surface of customer's product signally to indicate the FCC ID of the enclosed module. This label can use wording such as the following: "Contains Transmitter module FCC ID: VW3HILONC" or "Contains FCC ID: VW3HILONC".

