# WISMO Quik Q3100 series

## WISMO Quik Q3106
## Customer Design Guidelines

Reference: **WM_PRJ_Q3100_PTS_002**
Revision: **003**
Date: **June 2003**

# Document Information

| Revision | Date | History of the evolution | |
|---|---|---|---|
| 001 | January 2003 | Creation | |
| 002 | March | Addition of paragraph "Reference documents",<br>Deletion of Udrop in § 2.1<br>Modification of the figure in § 3.1.4<br>Modification of the drawing in § 5.1<br>Addition of paragraphs BOOT, RESET and INTR | |
| 003 | June 2003 | Q3106E stopped<br>Update for final release | |

# Contents

# Cautions

Information provided herein by Wavecom is accurate and reliable. However no responsibility is assumed for its use. Please read carefully the safety precautions for a terminal based on WISMO Quik Q3106 module (refer to document [1]).

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# Overview

This document gives recommendations for WISMO Quik Q3106 module integration in a wireless application.

It gives some recommendations for:

- Baseband design rules and typical implementation examples,
- RF design rules and typical implementation examples
- Mechanical constraints for module fitting,
- PCB routing recommendations,
- Test and download recommendations.

It also gives some part references and suppliers.

WISMO QUIK Q3106 module is available under three GSM/GPRS Class 10 versions:

- **Q3106A**: E-GSM/GPRS **900/1800** MHz version with **16** Mbits of Flash memory and **2** Mbits of SRAM (16/2)
- **Q3106B**: E-GSM/GPRS **900/1800** MHz version with **32** Mbits of Flash memory and **4** Mbits of SRAM (32/4)
- **Q3106D**: E-GSM/GPRS **900/1800** MHz version with **64** Mbits of Flash memory and **8** Mbits of SRAM (64/8). This configuration will be available for handset application and vertical application where UART2 is not used.

# Reference Documents

[1] WISMO Quik Q3100 Series Product Technical Specification
Ref. WM_PRJ_Q3100_PTS_001

[2] AT Commands Interface Guide (X41)
Ref. WM_ASW_OAT_UGD_010

# List of abbreviations

| | |
|---|---|
| ADC | Analog to Digital Converter |
| A/D | Analog to Digital convertion |
| AT | ATtention (prefix for modem commands) |
| AUX | AUXiliary |
| CLK | CLocK |
| CMOS | Complementary Metal Oxide Semiconductor |
| CPU | Central Processing Unit |
| CTS | Clear To Send |
| DC | Direct Current |
| DCD | Data Carrier Detect |
| DCE | Data Communication Equipment |
| DCS | Digital Cellular System |
| DSR | Data Set Ready |
| DTE | Data Terminal Equipment |
| DTR | Data Terminal Ready |
| EMC | ElectroMagnetic Compatibility |
| EMI | ElectroMagnetic Interference |
| EN | ENable |
| ESD | ElectroStatic Discharges |
| GND | GrouND |
| GPC | General Purpose Connector |
| GPI | General Purpose Input |
| GPIO | General Purpose Input Output |
| GPO | General Purpose Output |
| GPRS | General Packet Radio Service |
| GPSI | General Purpose Serial Interface |
| GSM | Global System for Mobile communications |
| IC | Integrated Circuit |
| IF | Intermediate Frequency |
| I/O | Input / Output |
| I2C | Inter Integrated Circuit |
| KSPS | Kilo Samples Per Second |

| | |
|---|---|
| LCD | Liquid Crystal Display |
| LDO | Low Drop Out regulator |
| LED | Light Emitting Diode |
| LSB | Less Significant Bit |
| MIC | MICrophone |
| NTC | Negative Temperature Coefficient |
| PA | Power Amplifier |
| PCB | Printed Circuit Board |
| PCL | Power Control Level |
| PCM | Protection Circuit Module |
| PFM | Power Frequency Modulation |
| PLL | Phase Lock Loop |
| PSM | Phase Shift Modulation |
| PWM | Pulse Width Modulation |
| RF | Radio Frequency |
| RI | Ring Indicator |
| RST | ReSeT |
| RTC | Real Time Clock |
| RTS | Request To Send |
| RX | Receive |
| SIM | Subscriber Identification Module |
| SPI | Serial Peripheral Interface |
| SPK | SPeaKer |
| SPL | Sound Pressure Level |
| TDMA | Time Division Multiple Access |
| TVS | Transient Voltage Suppressor |
| TX | Transmit |
| UART | Universal Asynchronous Receiver-Transmitter |
| VLSI | Very Large Scale Integration |
| VSWR | Voltage Stationary Wave Ratio |

# 1 General Information

WISMO Quik Q3106 module is a self-contained E-GSM/GPRS 900/1800 dual band module designed to meet various types of applications. The module is available in several memory sizes (FLASH and RAM) and includes the following main features:

- 32 x 44 x 3 mm,
- 2 Watts E-GSM 900 radio section running under 3.6 Volts,
- 1 Watt DCS 1800 radio section running under 3.6 Volts,
- Digital section running under 2.8 Volts,
- 1.8 V / 3 V SIM card interface,
- Real Time Clock with calendar,
- Battery charge management,
- Echo Cancellation + noise reduction,
- Full GSM or GSM/GPRS software stack,
- Hardware GPRS class 10 capable,
- Complete shielding,
- Complete interfacing through a 100-pin connector:
  - Power supply,
  - Serial links (UART1, UART2, SPI1, SPI2 and 2-wire bus),
  - Audio (main audio interface + auxiliary audio interface),
  - Keyboard,
  - SIM card,
  - Buzzer and vibrator,
  - A 16-bit parallel bus allowing various device selection (an example of application is given in paragraph 2.2.3).
- Several GPIOs are available to drive customer I/O applications:
  - Up to 8 Inputs/Outputs,
  - Up to 3 Outputs,
  - Up to 1 Input.

  Note: due to signal multiplexing, the number of available I/O depends on the functions used on the module.

WISMO Quik Q3106 module has just one external connection: **General Purpose Connector** (GPC) to Digital, Keyboard, Audio, Supply, and 50 Ω adapted RF connection.

WISMO Quik Q3106 module is designed to fit in very small and thin applications and only some custom functions have to be added to make a complete Dual Band solution:

- Keypad and LCD modules,
- Microphone and speaker (main audio interface),
- Headset (auxiliary audio interface),
- Base connector,
- Battery,
- Antenna switch,
- SIM connector,
- Buzzer and vibrator.

Some of the WISMO module interface signals are multiplexed in order to limit the number of pins but this architecture implies some limitations.
For example: in case of using SPI1 bus, 2-wire bus can not be used.

# 2 Baseband Design

Warning:

All external signals must be inactive when the WISMO module is OFF to avoid any damage when starting and allow WISMO module to start correctly.

## 2.1 Power supply and Ground design rules

### 2.1.1 Electrical constraints

The power supply is one of the key issues in the design of a GSM terminal. Due to the bursted emission in GSM / GPRS, the power supply must be able to deliver high current peaks in a short time. During these peaks the ripple ($U_{ripp}$) on the supply voltage must not exceed a certain limit (see table "Power Supply Voltage" below).

In communication mode, a GSM/GPRS Class 2 terminal emits 577 µs radio bursts every 4.615 ms.

In communication mode, a GPRS class 10 terminal emits 1154 µs radio bursts every 4.615 ms.

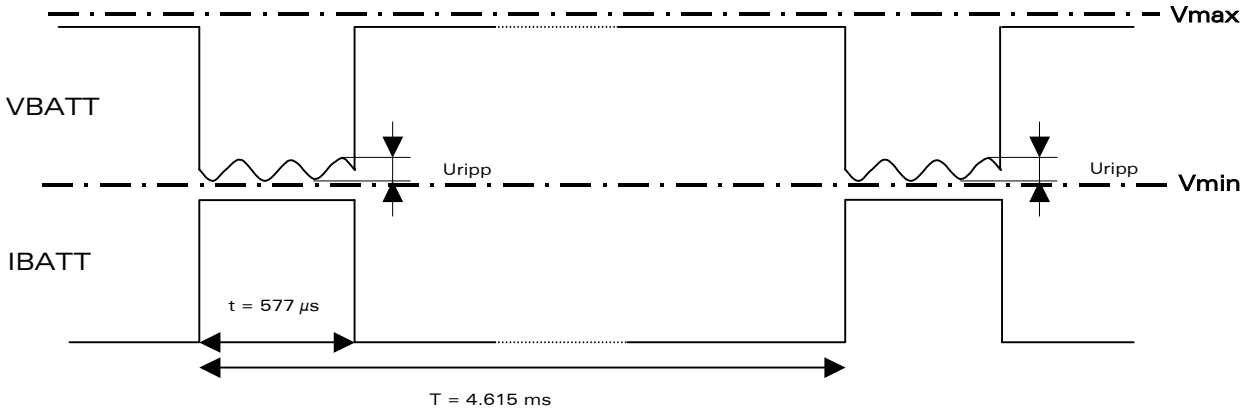



Figure 1: Typical Power supply voltage in GSM/GPRS class 2 mode

VBATT is the only external power supply source. It is used to supply the RF part and the baseband part.

The WISMO Quik Q3106 module shielding case is link to the ground. The ground has to be connected on the mother board through a complete layer on the PCB.

The power supply voltage features given in the table hereunder will guarantee nominal functioning of the module.

Power Supply Voltage

| | $V_{MIN}$ | $V_{NOM}$ | $V_{MAX}$ | $U_{ripp}$ max |
|---|---|---|---|---|
| VBATT | 3.3 V (*) | 3.6 V | 4.5 V (**) | 50 mVpp for freq<200 kHz<br>2 mVpp for freq>200 kHz |

(*): This value has to be guaranteed during the burst (with 2.0 A Peak in GSM or GPRS mode).
(**): max operating Voltage Stationary Wave Ratio (VSWR) 2:1.

### 2.1.2 Design Requirements

#### 2.1.2.1 Risk

VBATT is used to supply both Baseband and RF parts.

VBATT supplies directly the RF components with 3.6 V. It is essential not to exceed the maximum limit of voltage ripple at this connection in order to avoid any phase error. Insufficient power supply voltage could dramatically affect some RF performances: TX power, modulation spectrum, EMC (Electro-Magnetic Compatibility) performances, spurious emission and frequency error.

#### 2.1.2.2 General design rules

A Careful attention should be paid to:

- Quality of the power supply: linear regulation (recommended) or PWM (Pulse Width Modulation) converter (usable) are preferred for low noise. PFM (Power Frequency modulation) or PSM (Phase Shift Modulation) systems must be avoided.
- Capacity to deliver high current peaks in a short time (bursted radio emission).
- The battery charger line must support 800 mA to comply with the voltage level required for the product.
- The VBATT line must support peak currents with a voltage drop below the specified limit.

In order to test the supply tracks, a burst simulation circuit is shown here-after. This circuit simulates burst emissions, equivalent to bursts generated when transmitting at full power.

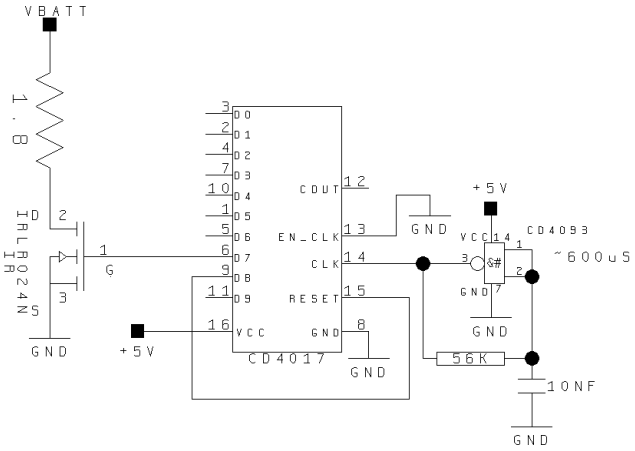



**Figure 2: Burst simulation circuit**

### 2.1.2.3 Battery for handset integration

In a handset application, the WISMO module may be directly connected to a Li-Ion battery (3.7 V typical voltage, with internal PCM – Protection Circuit Module). The internal impedance of the battery must be lower than 150 mΩ to limit voltage drop-out within emission burst (max. drop 0.3 V @ 2 W).

Battery internal impedance must take into account:

- the internal impedance of the battery cell,
- the protection circuit impedance,
- the "packaging" impedance (contacts),
- the PCB track impedance (up to the module pins).

### 2.1.2.4 External DC power supply for vertical application

In a vertical application, the WISMO module may be connected to DC power supply directly or via a DC/DC converter on the mother board. The internal impedance of the power supply must be lower than 150 mΩ to limit voltage drop-out within emission burst (max. drop 0.3 V @ 2W**).**

This impedance must take into account:

- the internal impedance of the power supply,
- the protection circuit impedance,
- the "packaging" impedance (contacts),
- the PCB track impedance up to the WISMO module pin.

Linear regulation (recommended) or PWM (Pulse Width Modulation) converter (usable) are preferred for low noise.

PFM (Power Frequency Modulation) or PSM (Phase Shift Modulation) systems must be avoided.

### 2.1.3 PCB routing constraints

#### 2.1.3.1 Power supply routing constraints

- Attention shall be paid to the ground track or the ground plane on the application board for the power supply which supplies the module. The ground track or the ground plane on the application board must support current peaks as for the VBATT track.
- If the ground track between the module and the power supply, is a ground plane, it must not be parceled out.
- Since the maximum peak current can reach 2 A, Wavecom strongly recommends a large width for the layout of the power supply signal (to avoid voltage loss between the external power supply and the module supply). Pins 77, 78, 79 and 80 should be gathered in a same piece of copper, as shown in the figure hereafter. Filtering capacitors, near the module power supply, could also be added.
- The routing must be done in such a way that the total impedance line must be ≤ 10 mΩ @ 217 Hz. This impedance must include the via impedances.
- Same care shall be taken when routing the ground supply.
- If these design rules are not followed, phase error (peak) and power loss could occur.

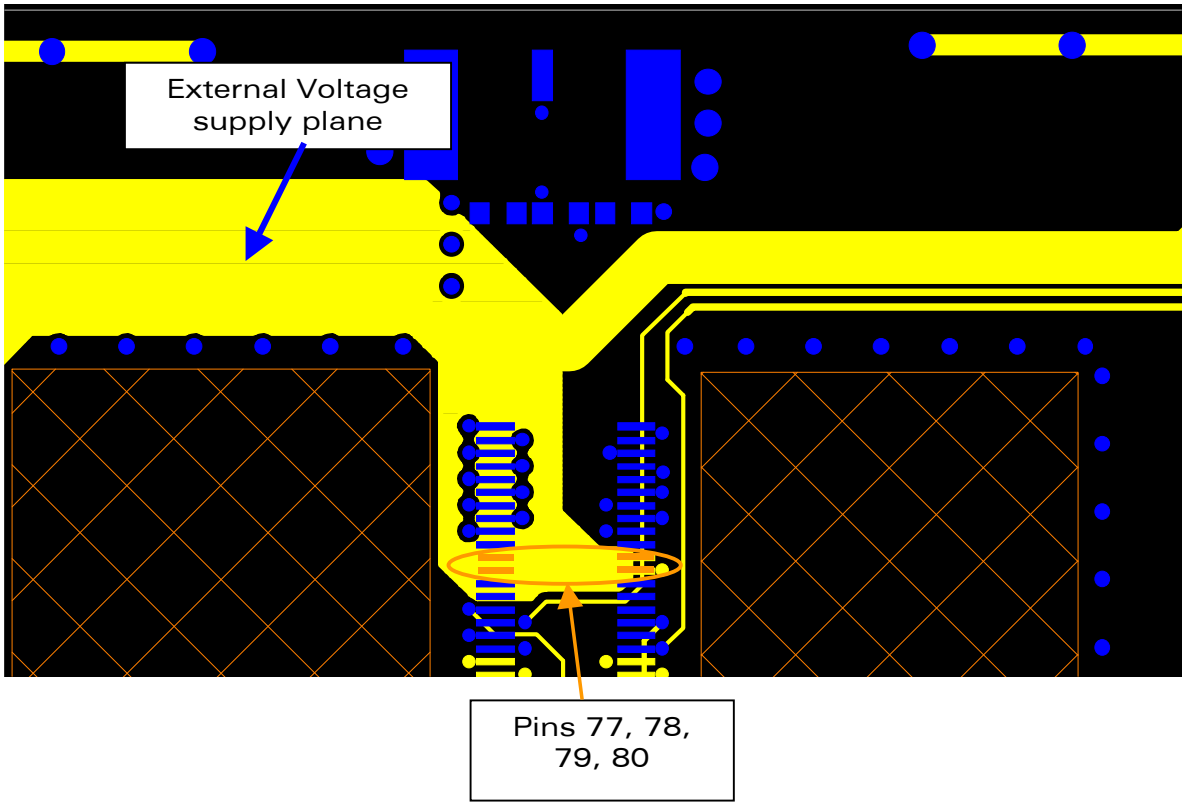



Figure 3: Example of power supply routing

#### 2.1.3.2 Application ground plane and shielding connection

A ground plane must be available on the application board to provide efficient connection to the module shielding:

- The bottom side shielding of the WISMO module is achieved through the top cold rolled steel cover connected to the internal ground plane of the module. This one is connected through the shielding to the application ground plane.

Best shielding performance will be achieved if the application ground plane is a complete layer of the application PCB:

- To ensure a good shielding of the module, a complete ground plane layer on the application board must be available, with no trade-off. Connections between other ground planes shall be done with vias.
- Without this ground plane, external Tx spurious or Rx blockings could appear.

It is strongly recommended to avoid routing any signals under the module.

#### 2.1.3.3 Decoupling of power supply signals

Decoupling capacitors on VBATT and VDD lines are imbedded in the module. So it should not be necessary to add decoupling capacitors close to the module.

However, in case of EMI/RFI problem, some signals like VBATT and charge line (CHG_IN) may require some EMI/RFI decoupling: parallel 33 pF capacitor close to the module or a serial ferrite bead (or both to get better results).

In case a ferrite bead is used, the recommendation given for the power supply connection must be carefully followed (high current capacity and low impedance).

## 2.2 Digital I/O and peripheral implementation

### 2.2.1 Electrical information for digital I/O

All digital I/O are supplied in 2.8 V and comply with 3 V CMOS.

Operating conditions

| Parameter | Input type | Output type | Min | Max | Condition |
|---|---|---|---|---|---|
| $V_{IL}$ | CMOS | | -0.5 V | 0.8 V | |
| $V_{IH}$ | CMOS | | 2.1 V | 3.0 V | |
| $V_{OL}$ | | 1X | | 0.2 V | $I_{OL}$ = -1 mA |
| | | 2X | | 0.2 V | $I_{OL}$ = -2 mA |
| | | 3X | | 0.2 V | $I_{OL}$ = -3 mA |
| $V_{OH}$ | | 1X | 2.6 V | | $I_{OH}$ = 1 mA |
| | | 2X | 2.6 V | | $I_{OH}$ = 2 mA |
| | | 3X | 2.6 V | | $I_{OH}$ = 3 mA |

To interface the WISMO module digital signals with other logics:

- 3 V logic: some serial resistors (between 2.2 kΩ and 4.7 kΩ) can be added on the lines,
- 3.3 V logic: some serial resistors (between 4.7 kΩ and 10 kΩ) can be added on the lines,
- For higher voltage logics, a resistor bridge or a level shifter integrated circuit can be added.

### 2.2.2 GPSI interface

#### 2.2.2.1 SPI Bus

The WISMO Quik Q3106 module offers a dual SPI bus using 6 signals:

- **SPI_1 bus**: SPI_EN_1, SPI_DAT_1 and SPI_CLK_1,
- **SPI_2 bus**: SPI_EN_2, SPI_DAT_2 and SPI_CLK_2.

These 2 buses can typically be used to drive a sub_LCD, a MP3 player, or a polyphonic synthesizer.

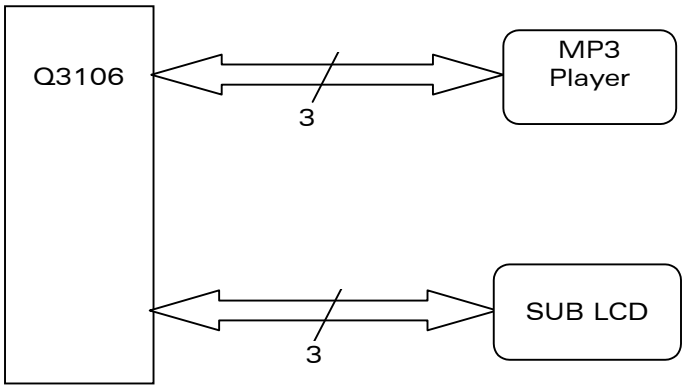



**Figure 4: Example of typical SPI bus use**

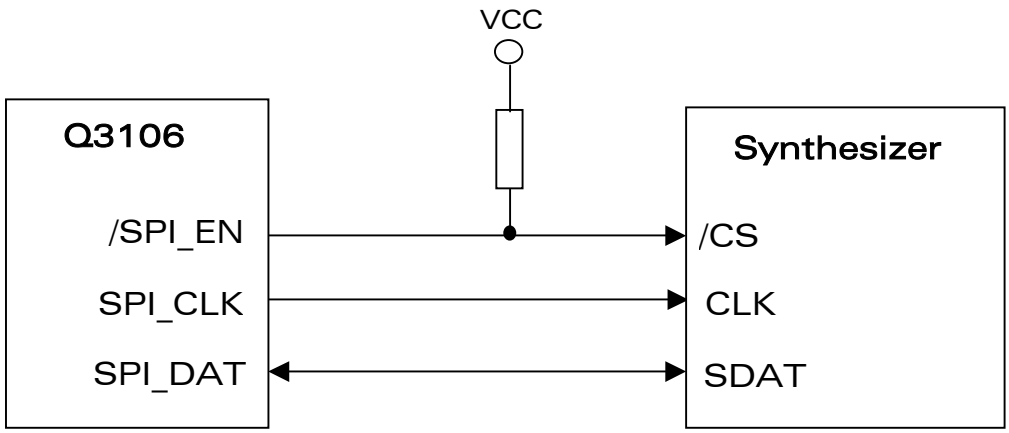



**Figure 5: Example of SPI bus implementation**

#### 2.2.2.2 Two-wire Bus Interface

The 2-wire bus includes a clock signal (SCL) and a data signal (SDA) complying with a standard 96 kHz interface. The maximum speed transfer is 400 kbits/s.

As SPI bus, it can be used to drive a LCD.

For 2-wire bus compliance, two pull-up resistors must be added on the application board on the SDA and SCL signals (between 2.2 kΩ and 4.7 kΩ).

### 2.2.3 Parallel Bus

The WISMO Quik Q3106 modules offer a 16-bit wide parallel bus interface.

In addition to the 16 data lines, the parallel bus includes the control signals (/RD, /WR, A2, A3, A22, A23, GPO1 and CSUSR).

A22 is available on pin 44 of the GPC connector with WISMO Quik Q3106A and Q3106B modules only (16 and 32 Mbits of Flash memory). It is multiplexed with CTS2 and GPIO4 signals.

A23, available on pin 47 of the GPC connector, is multiplexed with RTS2 and GPIO5 signals.

GPO1 signal can be used as a Chip Enable signal to drive a LCD and CSUSR is a Chip Select signal which can be used to drive any standard parallel peripheral device.

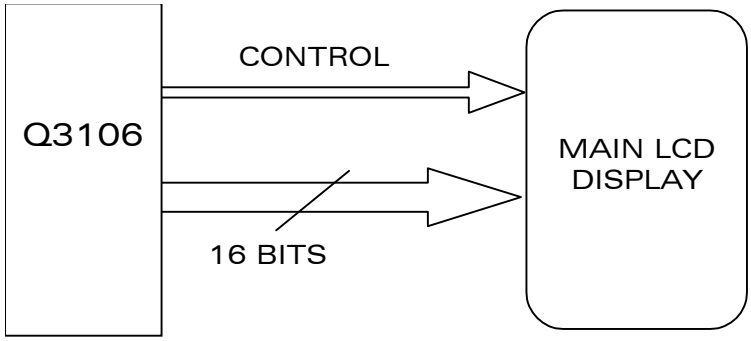



**Figure 6: Example of typical parallel bus use**

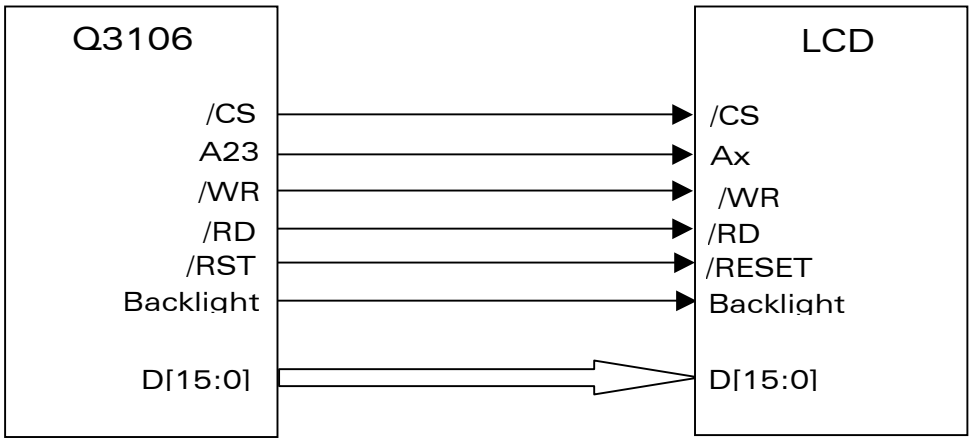



**Figure 7: Example of parallel bus implementation**

☞ WARNING: AT commands only drive data transfers on lines D0 to D7 of the parallel bus (byte format transfer).

### 2.2.4 PWM Outputs

Two PWM interfaces are available on the WISMO Quik Q3106 modules.

The PWM features are the following:

- Frequency range: from 199 Hz to 6.5 Hz,
- Duty cycle: from 0.4 % to 99.6 %.
- Output voltage: 2.8 V.

### 2.2.5 Keyboard interface

This interface provides 10 connections:

- 5 rows (ROW0 to ROW4),
- 5 columns (COL0 to COL4).

Digital scanning and debouncing are done within the module. No discrete components like R, C (Resistor, Capacitor) are needed.

ROW lines are connected to internal pull-down resistors while COL lines are connected to internal pull-up resistors.

Typical Implementation:

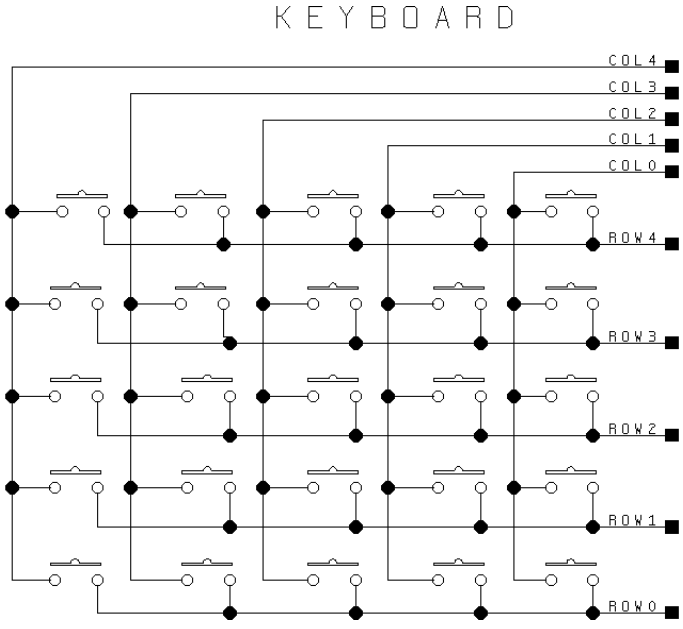



Figure 8: Example of keyboard implementation

### 2.2.6 Serial Links

The WISMO Quik Q3106A and Q3106B modules integer two independent V24/CMOS serial link interfaces:

- UART1: main serial link,
- UART2: auxiliary serial link.

The WISMO Quik Q3106D modules integer only one serial link interface:

- UART1: main serial link,

The main serial link UART1 is a flexible 6-wire serial interface while the auxiliary serial link UART2 is a 4-wire serial interface.

Both serial interfaces comply with V24 protocol signaling but not with V28 (electrical interface) due to a 2.8 Volt interface.

V24/V28 (RS232) typical implementation:

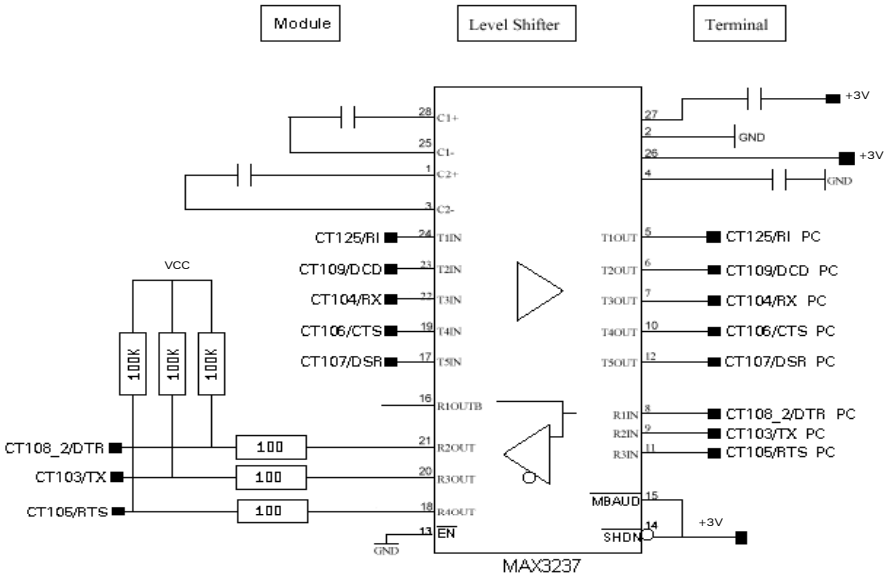



Figure 9: Example of RS232 level shifter implementation for UART1

☞ Warning:

The application must allow the WISMO serial link signals + the BOOT, the RESET and the ON/OFF module signals to be easily accessed thus allowing the module firmware to be upgraded.

V24/CMOS possible design :

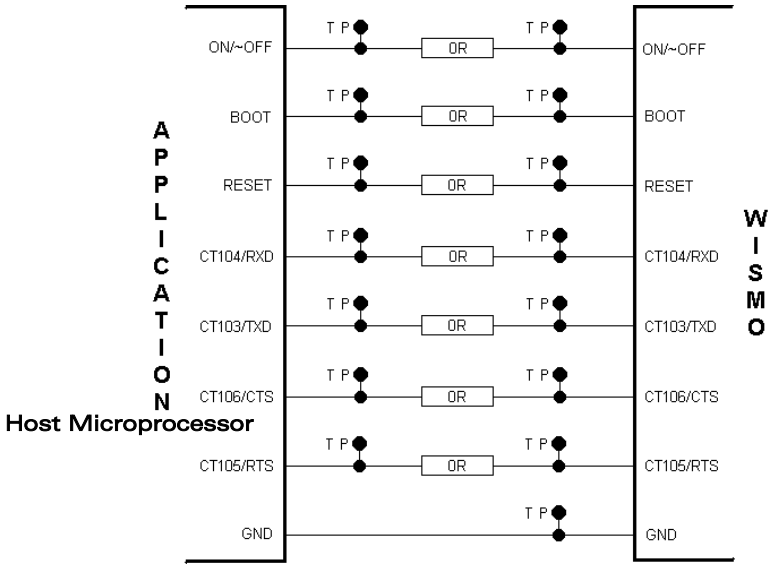



Figure 10: Example of V24/CMOS serial link implementation for UART1

### 2.2.7 SIM interface

#### 2.2.7.1 SIM 1.8 V / 3 V management

It is possible to manage dual voltage (3 V / 1.8 V) or 3 V only SIM cards, using an internal shifter level that allows SIM interface with 3 V or 1.8 V.

It is recommended to add Transient Voltage Suppressor diodes on the signals connected to the SIM socket in order to prevent any ElectroStatic Discharge. TVS diodes with low capacitance (less than 10 pF) have to be connected on SIM_CLK and SIM_IO to avoid any disturbance of the rising and falling edges. These types of diodes are mandatory for the Full Type Approval. They shall be placed as close as possible to the SIM socket.

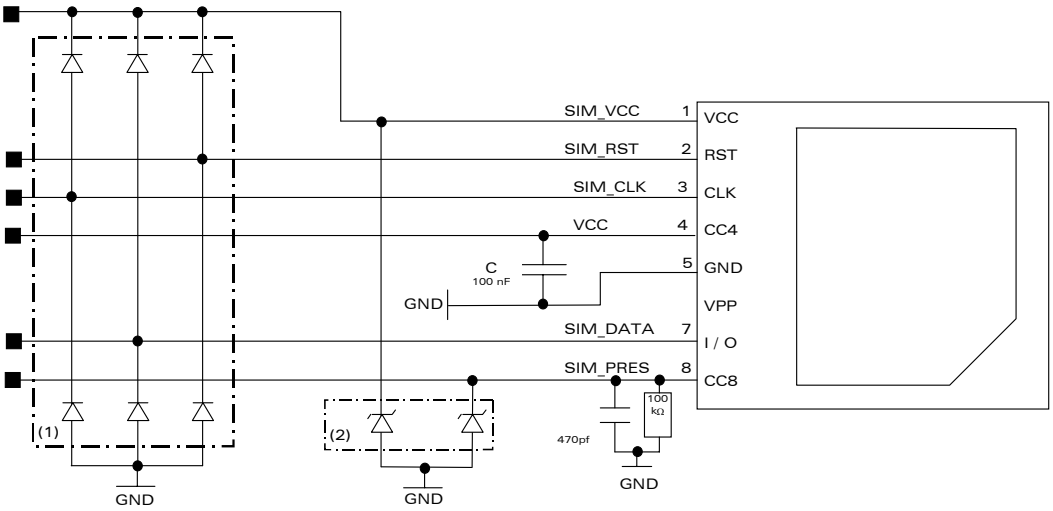
The following reference can be used (see Figure 11: Example of 3V SIM Socket implementation):

- DALC208SC6 from ST Microelectronics.
- ESDA6V1SC6 (ST).

No external implementation will be required.

Note: When not used, SIM_PRES signal has to be tied to VCC.

Typical implementation with SIM detection:




(1) Recommended components: DALC208SC6 (SGS-THOMSON).

(2) Recommended components: ESDA6V1SC6 (ST).

**Figure 11: Example of 3V SIM Socket implementation**

For possible suppliers of SIM card reader, refer to chapter 9:Manufacturers and suppliers.

#### 2.2.7.2 PCB constraints for SIM interface

- For the SIM interface, length of the track between the WISMO module and the SIM connector should be as short as possible. Maximum length recommended is 10 cm.
- ESD protection is mandatory on the SIM lines if access from outside of the SIM connector is possible.

### 2.2.8 Activity status indication

The activity status indication signal (LED_OUT) can be used to drive a LED. LED_OUT output is an open drain output. A LED and a resistor can be directly connected between this output and VBATT.

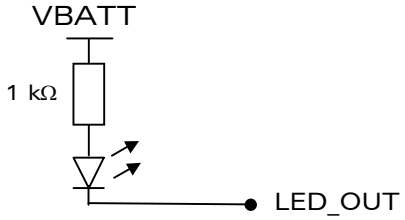



**Figure 12: Example of activity status LED implementation**

## 2.3 Analog I/O and peripheral implementation

### 2.3.1 Analog to Digital Converter (ADC) inputs

Two Analog to Digital converters are available on the WISMO module. These converters have a 10-bit resolution, ranging from 0 to 2.8 V.

To reduce noise perturbations, AUX_ADC input is protected by an internal RC filter (R = 4.7 kΩ, C = 100 nF).

Typical application:

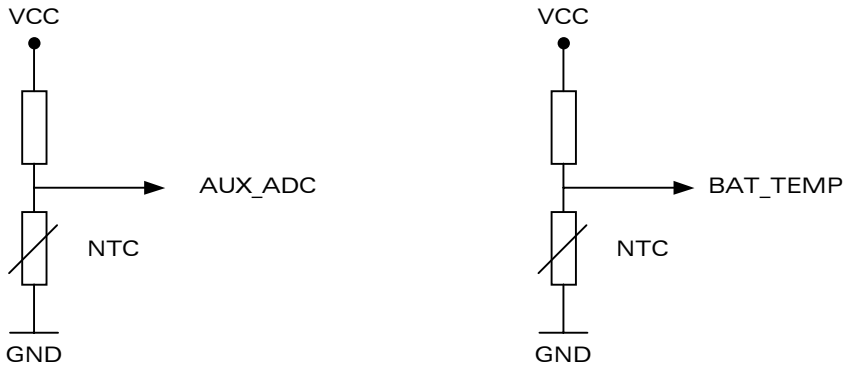



Figure 13: Example of circuitry for ADC inputs

### 2.3.2 Audio interface

Two different microphone inputs and two different speaker outputs are supported.

An echo cancellation feature for hands-free application is also available. In some cases, ESD protection must be added on the audio interface lines.

#### 2.3.2.1 Microphone inputs

##### 2.3.2.1.1 General

The MIC2 inputs already include the biasing for an electret microphone allowing an easy connection to a handset.

The MIC1 inputs do not include an internal bias.

MIC1/SPK1 is then appropriate for a hands-free system or a handset with biasing external to the module.

#### 2.3.2.1.2 Recommended characteristics for the microphone

- 2 V / 0.5 mA.
- Type: Electret.
- Impedance: 2.0 KΩ to 2.2 kΩ.
- Sensitivity: -40 to –50 dB (0 dB = 1V/Pa).
- SNR > 50 dB min.
- Frequency response: compatible with the GSM specifications.

For possible suppliers of microphone, refer to chapter 9:Manufacturers and suppliers.

**Microphone must be decoupled by a capacitor CM. This one must be as close as possible to the microphone. Some microphone manufacturers provide this capacitor directly soldered on the device**

- E-GSM 900 CM = 33 pF to 47 pF.
- GSM 1800 or 1900 CM = 10 pF to 18 pF.
- Dual Band CM = 33 pF to 47 pF in parallel with 10 to 18 pF.

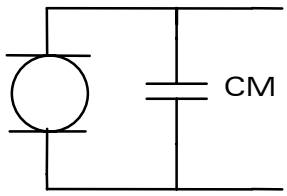



**Figure 14: Microphone decoupling capacitor**

#### 2.3.2.1.3 Main microphone inputs (MIC2)

The MIC2 inputs are differential ones and they include the convenient biasing for an electret microphone (0.5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. AC coupling is embedded within the module.

The impedance of the connected microphone has to be around 2 kΩ. These inputs are the standard ones for a handset design while MIC1 inputs can be connected to an external headset or a hands-free kit.

AC coupling is already embedded in the module.

Typical implementation:

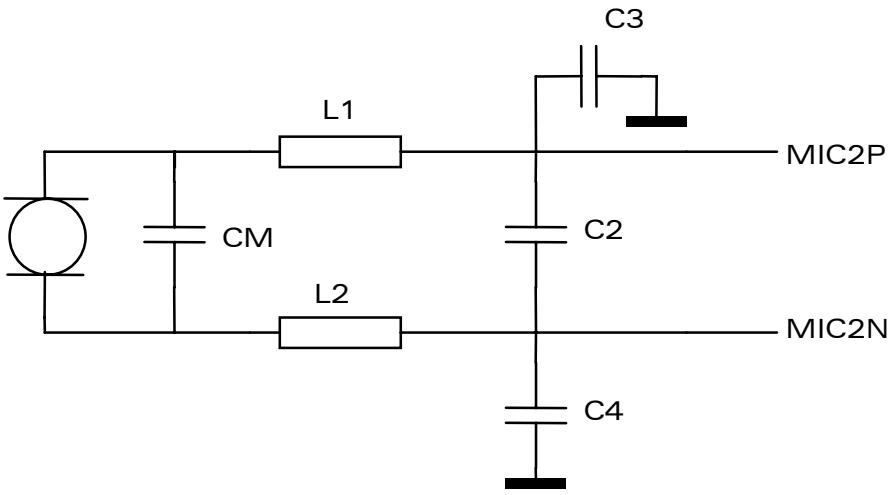



**Figure 15: Example of main microphone (MIC2) implementation**

C2 = C3 = C4 = 22 pF to 100 pF.
L1 = L2 = 100 nH.

C2 has to be as close as possible to the module MIC2 pins.

L1, L2, C3 and C4 should be put close to the module but they can be removed according to their environment (ground plane, shielding, ...).

A good solution could be to place these component footprints on the design and remove those not necessary for good performance with the TDMA noise on the audio path.

#### 2.3.2.1.4 Auxiliary microphone inputs (MIC1)

The MIC1 inputs are differential and do not include internal bias. To use these inputs with an electret microphone, bias has to be generated outside the module according to the characteristics of this electret microphone. These inputs are the standard ones used for an external headset or a hands-free kit.

AC coupling is already embedded in the module.

*A/ Differential connection*

Impedance of the microphone input in differential mode:

- Module ON: Rin = 10 kΩ ± 30 %,
- Module OFF: Rin > 10 MΩ ± 30 %.

Typical Implementation:

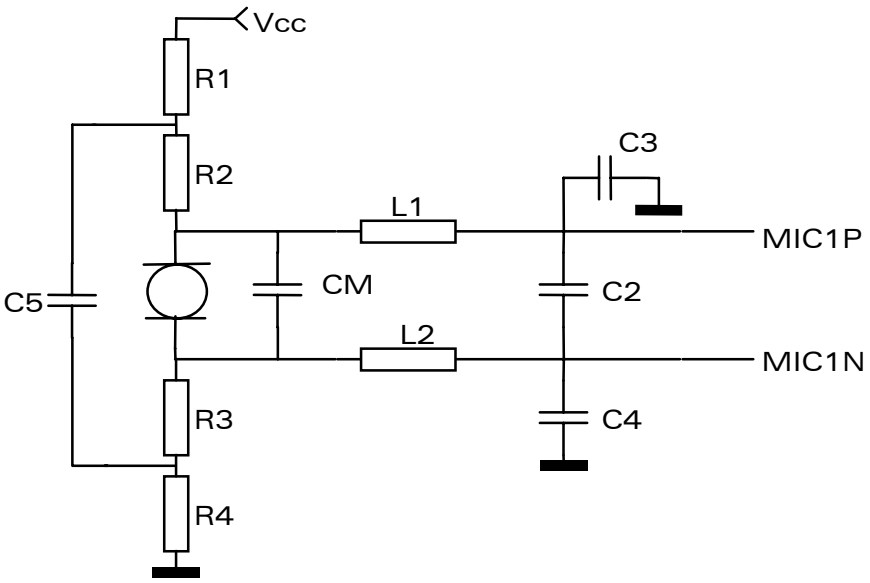



**Figure 16: MIC1 input differential connection**

R1 = R4 = 100 Ω to 330 Ω.
R2 = R3 = usually between 1 kΩ and 3.3 kΩ as per microphone characteristics.
C2 = C3 = C4 = 22 pF to 100 pF.
C5 = 15 µF to 47 µF.
L1 = L2 = 100 nH.

R1 and R4 are used as a supply voltage filter with C5.

C2 has to be as close as possible to the module MIC1 pins.

L1, L2, C3 and C4 should be put close to the module but they can be removed according to their environment (ground plane, shielding, ...). A good solution could be to place these component footprints on the design and remove those not necessary for good performance with the TDMA noise on the audio path.

*B/ Single-ended connection*

Typical Implementation:

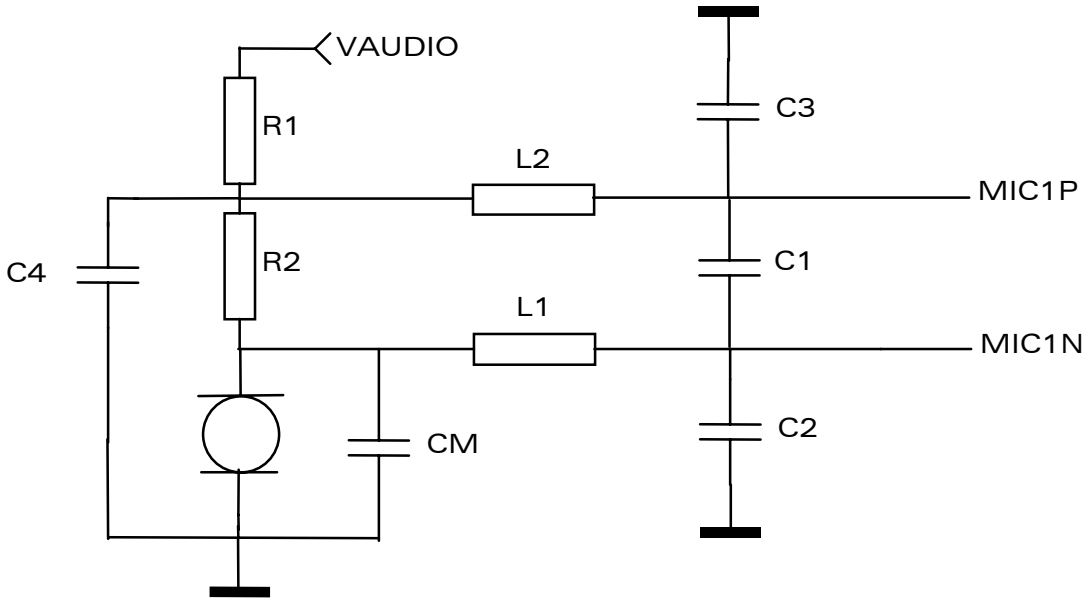



**Figure 17: MIC1 Input single-ended connection**

VAUDIO must be very "clean" to avoid bad performance in case of single-ended implementation. VAUDIO could be Vcc with RC or LC filter cell for example.

R1 = 100 Ω to 330 Ω.
R2 depends on the VAUDIO level and microphone characteristics (usually between 1 kΩ and 3.3 kΩ).
C1 = C2 = C3 = 22 pF to 100 pF.
C4 = 15 µF to 47 µF.
L1 = L2 = 100 nH.

R1 is used as a voltage supply filter with C4.

R1, R2, C4 and C5 have to be as close as possible to the microphone (PCB tracks from the module connector to these components must be as straight and parallel as possible).

C1, C2, C3 have to be very close to the module connector.

L1, and L2 has to be put close to the module connector and they can be removed according to their environment (ground plane, shielding...etc). The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

#### 2.3.2.2 Speaker outputs

##### 2.3.2.2.1 Common speaker output characteristics

The connection can be either differential or single-ended but using a differential connection to reject common mode noise and TDMA noise is strongly recommended. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

##### 2.3.2.2.2 Differential connection

Typical Implementation:

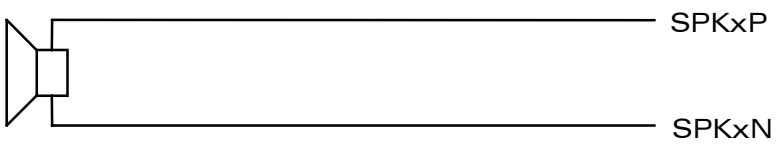



Figure 18: Speaker differential connection

Impedance of the speaker amplifier output in differential mode:

$R \leq 1\Omega$ +/-10 %.

The connection between the module pins and the speaker must be designed to keep the serial impedance lower than 3 Ω in differential mode.

##### 2.3.2.2.3 Single-ended connection

Typical implementation:

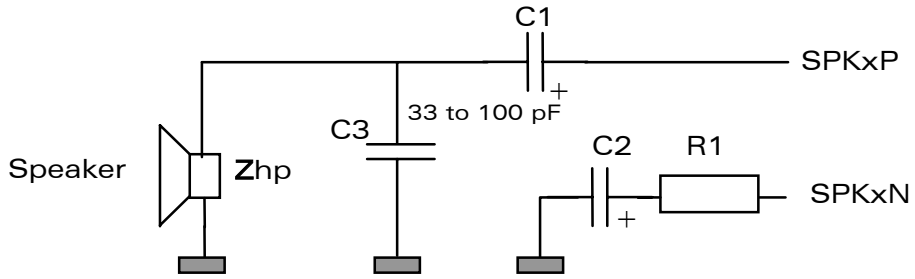



Figure 19: Speaker single-ended connection

4.7 µF < C1 < 47 µF (depending on speaker characteristics and output power).
C1 = C2.
R1 = Zhp.

Using a single-ended connection includes losing of the output power (- 6 dB) compared to a differential connection.

Nevertheless in a 32-Ohm speaker case, you should use a cheaper and smaller solution: R1 = 82 Ohms and C2 = 4.7 µF (ceramic).

The connection between the module pins and the speaker must be designed to keep the serial impedance lower than 1.5 Ω in differential mode.

#### 2.3.2.2.4 Recommended characteristics for the speaker

- Type: 10 mW, electro-magnetic.
- Impedance:
  - Z = 8 Ω for handset,
  - Z = 32 Ω for headset or hands-free kit.
- Sensitivity: 110 dB SPL min. (0 dB = 20 µPa).
- Frequency response compatible with the GSM specifications.

For possible suppliers of speaker, refer to chapter 9:Manufacturers and suppliers.

### 2.3.2.3 Buzzer Output

The buzzer output (BUZ) is a digital one. A buzzer can be directly connected between this output and VBATT. The maximum peak current is 80 mA and the maximum average current is 40 mA. A diode against transient peak voltage must be added as described below.

Typical Implementation:

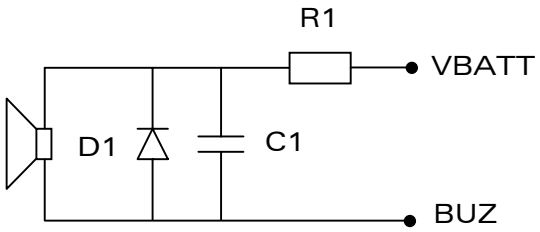



**Figure 20: Example of buzzer implementation**

R1 must be chosen in order to limit the current at $I_{PEAK}$ max.

C1 = 0 to 100 nF (depending on the buzzer type).

Recommended characteristics for the buzzer:

- Type: electro-magnetic.
- Impedance: 7 to 30 Ω.
- Sensitivity: 90 dB SPL min @ 10 cm.
- Current: 60 to 90 mA.

For possible suppliers of buzzer, refer to chapter 9:Manufacturers and suppliers.

#### 2.3.2.4 Routing constraints

To get better acoustic performances, basic recommendations are the followings:

- The speaker lines (SPKxx) must be routed in parallel, without any wire in between.
- The microphone lines (MICxx) must be routed in parallel, without any wire in between.
- All the filtering components (RLC) must be placed as close as possible to the associated MICxx and SPKxx pins.

### 2.3.3 Vibrator Output

The WISMO module provides a LDO regulated voltage output (VIBRATOR) dedicated to drive a vibrator. The vibrator can be directly connected between this output and GND. The maximum peak current is 100 mA on 2.8 V.

Recommended characteristics for the vibrator:

Operating conditions

| Parameter | Condition | Min | Max | Unit |
|---|---|---|---|---|
| $V_{OH}$ | | | 2.8 | V |
| $I_{MAX}$ | VBATT = VBATT max | | 100 | mA |

For possible suppliers of vibrator, refer to chapter 9:Manufacturers and suppliers.

Typical implementation:

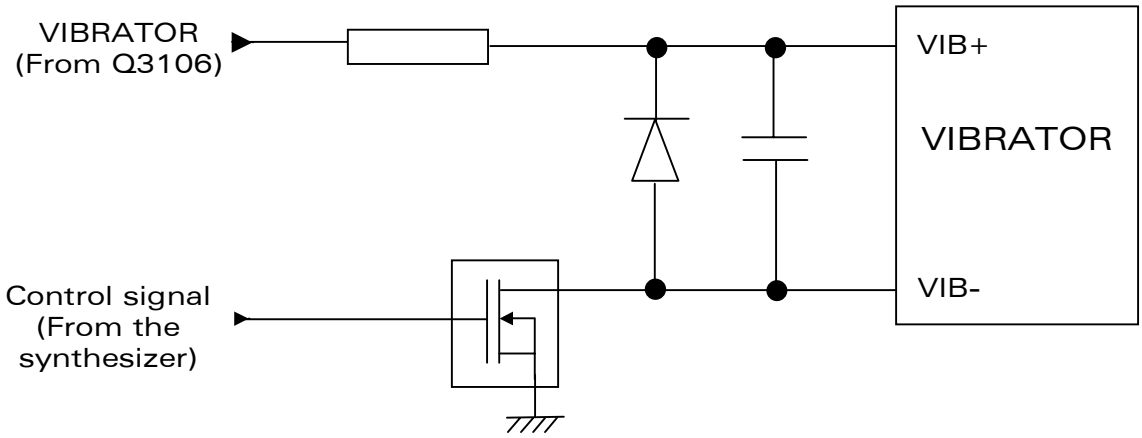



Figure 21: Example of vibrator implementation

## 2.4 Battery charging interface

The WISMO Quik Q3106 module supports one battery charging circuit for Li-Ion batteries.

For this, a current generator must be connected on the CHG_IN pins. The generator current intensity depends on the battery capacity.

It is recommended to provide a current equal to the value of the capacity plus 50 mA. For a 550 mA battery the current will be 600 mA. The maximum accepted current is 800 mA.

The module monitors the battery voltage to detect the end of the charge.

The WISMO module also monitors the temperature of the battery (for security matters) through the BAT_TEMP pin which has to be connected to a temperature sensor inside the battery pack (a NTC resistor for instance).

Typical Implementation:

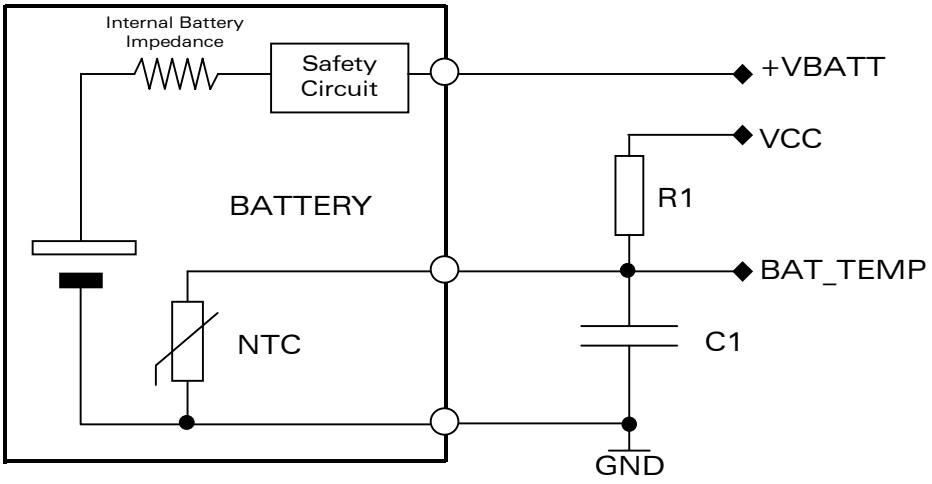



Figure 22: Example of battery implementation

How to choose R1 and C1:

How to choose R1:

R1 has to be chosen to have a full range of BAT_TEMP (from 0 V to 2.8 V) when the NTC value changes from the minimum to the maximum temperature.

How to choose C1

C1 has to be chosen to have a RC filter with a time constant lower than 2 ms.

Examples of calculation: at VCC=2.8 V

$NTC_{25°C}$ = 47 kΩ
$NTC_{55°C}$ = 10 kΩ
$NTC_{-10°C}$ = 300 kΩ
$NTC_{-10°C}$ x VCC = ($NTC_{-10°C}$ + R1) x $BAT\_TEMP_{full\ range}$

R1= 47 kΩ ⇨ $BAT\_TEMP_{-10°C}$ = 2.42 V; $BAT\_TEMP_{55°C}$ = 0.49 V

$R_{-10°C}$ = R1//$NTC_{-10°C}$ = 40 kΩ  $R_{+55°C}$ = 8 kΩ

With C1 = 10 nF:
$RC_{-10°C}$ = 400 µs
$RC_{+55°C}$ = 80 µs

## 2.5 ON / ~OFF

This input is used to switch ON or OFF the WISMO Quik Q3106 module.

A high level signal has to be provided on the pin ON/~OFF to swith ON the module.

The level of the voltage of this signal has to be maintained between 2.4 V and VCC during a minimum of 500 ms.

This signal can be left at high level until switch OFF.

## 2.6 BOOT signal

This input must be used to download the software in the Flash memory of the module.

The internal boot procedure is started when this pin is low during the reset of the module.

In Internal boot mode low level has to be set through a 1 kΩ resistor.

If used, this input has to be driven by an open collector or an open drain output as shown in the diagram hereunder:

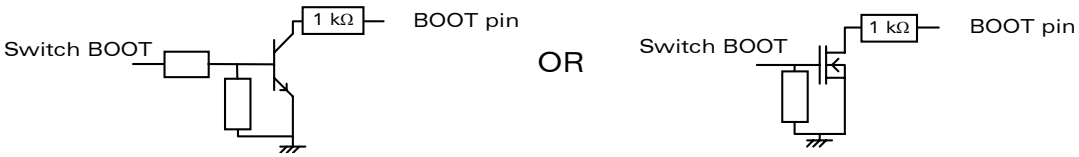



Figure 23: Example of BOOT pin connection

- If Switch BOOT = 1, BOOT pin = 0 ⇨ Internal boot mode for downloading.
- If Switch BOOT = 0, BOOT pin = 1 ⇨ Normal mode.

## 2.7 Reset signal (~RST)

The ~RST signal is used to force a reset procedure by providing low level during at least 500 µs. This signal has to be considered as an emergency reset only: a reset procedure is automatically driven by an internal hardware during the power-up sequence.

This signal can also be used to provide a reset to an external device (it then behaves as an output).

If no external reset is necessary this input can be left open.

If used (emergency reset), it has to be driven by an open collector or an open drain output as shown in the diagram hereunder.

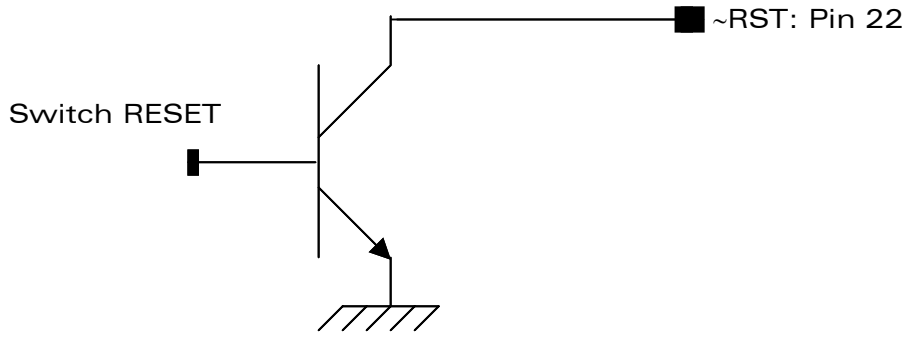



**Figure 24: Example of ~RST pin connection**

- If Switch RESET = 1, ~RST pin = 0 ⇨ Reset activated.
- If Switch RESET = 0, ~RST pin = 1 ⇨ Reset inactive.

## 2.8 External Interrupt (~INTR)

The WISMO modules provide an external interrupt input (~INTR).

An interrupt is activated on high to low edge and detection of a transition is very sensitive.

If this signal is not used it can be left open.

If used this input has to be driven by an open collector or an open drain output as shown in the diagram hereunder.

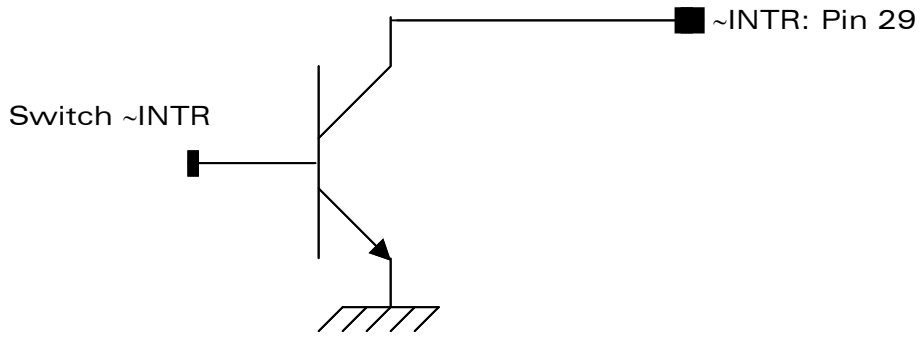



Figure 25: Example of ~INTR pin connection

## 2.9 Real Time Clock Supply

### 2.9.1 General description

BAT_RTC is used to provide a back-up power supply for the internal Real Time Clock.

The RTC is supported by the WISMO Quik Q3106 module when powered on but a back-up power supply is needed to save date and time information when the module is switched off.

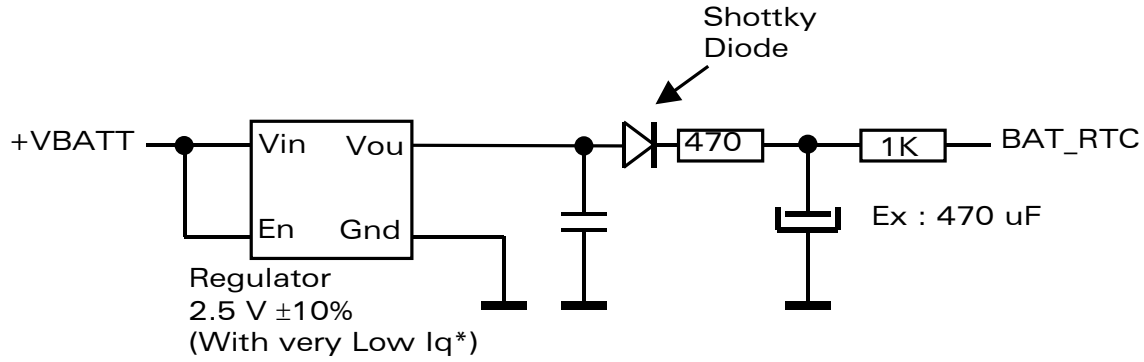
If the RTC is not used this pin can be left open.

Back-up Power Supply can be provided by:

- A capacitor,
- A super capacitor,
- A non rechargeable battery,
- A battery cell with regulator.

### 2.9.2 Typical implementation

#### 2.9.2.1 Capacitor

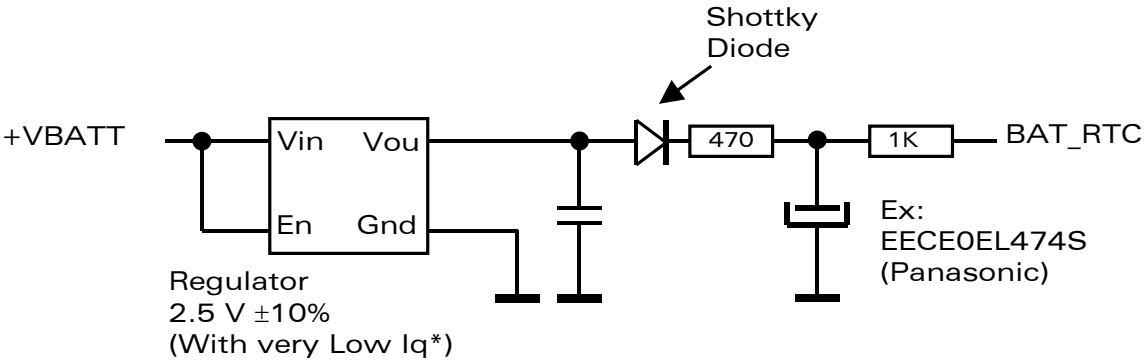



*Iq = Quiescent Current

**Figure 26: RTC supplied by a capacitor**

Estimated range with 470 µF Capacitor: ~30 seconds.

#### 2.9.2.2 Super Capacitor




*Iq = Quiescent Current

**Figure 27: RTC supplied by a super capacitor**

Estimated range with 0.47 Farad Gold Cap:: 2 hours min.

Note: the Gold Capacitor maximum voltage is 2.5 V.

#### 2.9.2.3 Non Rechargeable battery

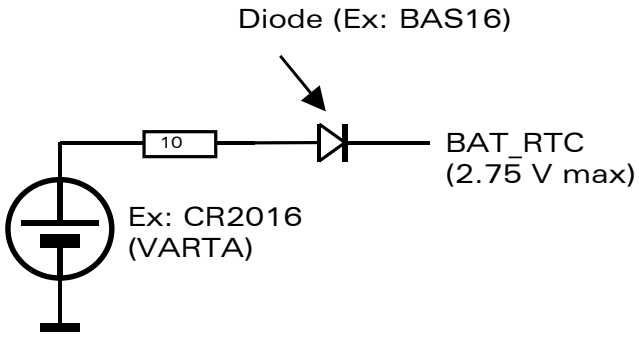
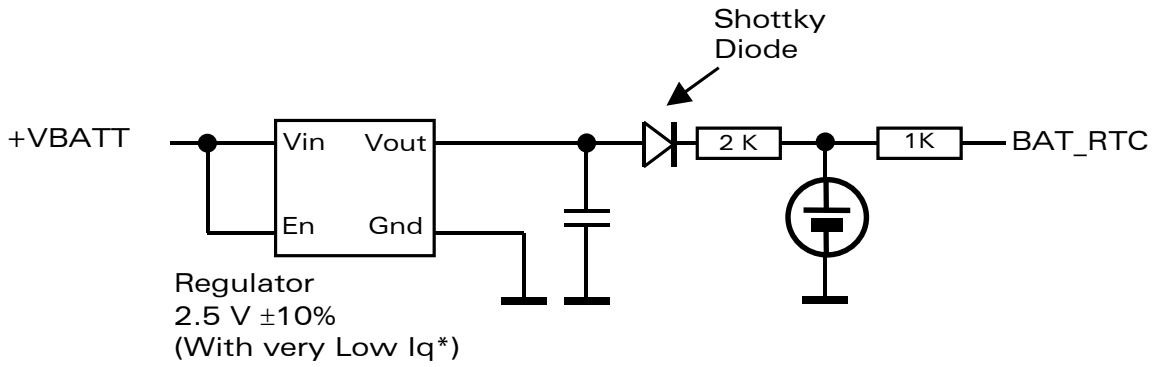



**Figure 28: RTC supplied by a non rechargeable battery**

Estimated range with 85 mAh battery: 4000 h minimum.

Note: The "non rechargeable battery" is always active, except when the module is ON.

#### 2.9.2.4 Battery cell with regulator




*Iq = Quiescent Current

**Figure 29: RTC supplied by a battery cell**

Estimated range with 2 mAh battery rechargeable battery: ~3 days.

**Warning:**
**Before battery cell assembly insure that cell voltage is lower than 2.75 V to avoid any damage to the WISMO module.**

# 3 Radio Design

## 3.1 Antenna specifications

The antenna must support the following conditions:

- Frequency bands: dual band E-GSM 900 MHz – DCS 1800 MHz.

| | Min | Typ | Max |
|---|---|---|---|
| 900–RX<br>1800–Rx | 925 MHz<br>1805 MHz | | 960 MHz<br>1880 MHz |
| 900–Tx<br>1800-Tx | 880 MHz<br>1710 MHz | | 915 MHz<br>1785 MHz |
| Impedance | | 50 Ohms | |
| VSWR Tx<br>VSWR Rx | | | 1.5<br>1.5 |
| Gain | | 0 dBi in one direction at least | |

For possible suppliers of antenna, refer to chapter 9:Manufacturers and suppliers.

## 3.2 Antenna implementation

### 3.2.1 Recommendations

Antenna sub-system and integration in the application is a major issue.

Attention should be paid to:

- The design of the antenna line on the application PCB,
- The antenna connector (type + losses),
- The antenna choice.

These elements could affect GSM performances such as sensitivity and emitted power.

The antenna should be isolated as much as possible from the digital circuitry (including the interface signals) ⇨ it is strongly recommended to shield the terminal.

On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal. Moreover, the power emitted through the antenna could affect the application.

**Warning:**

**Wavecom strongly recommends to work with an antenna manufacturer either to develop an antenna adapted to the application or to adapt an existing solution to the application. The antenna adaptation (mechanical and electrical adaptation) is one of the key issues in the design of a GSM terminal.**

### 3.2.2 RF connection

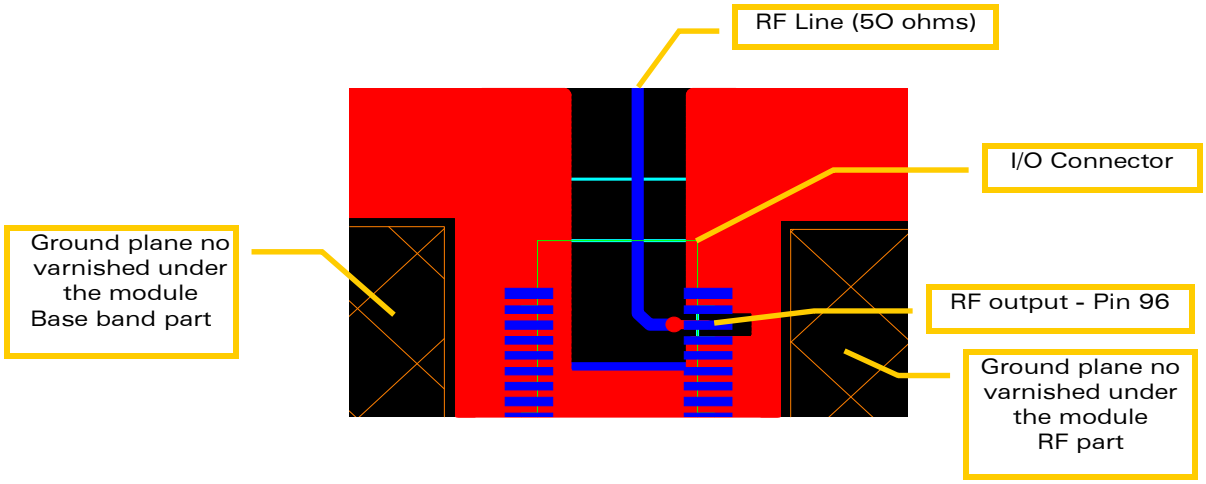



**Figure 30:RF output - pin 96 on the connector I/O**

Wavecom strongly recommends additional matching components between the antenna and the RF output of the module (pin 96 on the connector I/O). Typically, four components can be required to ensure a proper transmission of the maximum output power and to reduce the output power ripple. The topology is a PI structure plus a serial element; the components to be used are capacitors or inductors depending on the antenna matching.

In addition pins 81 to 95 and 97 to 100 must be connected to the ground.

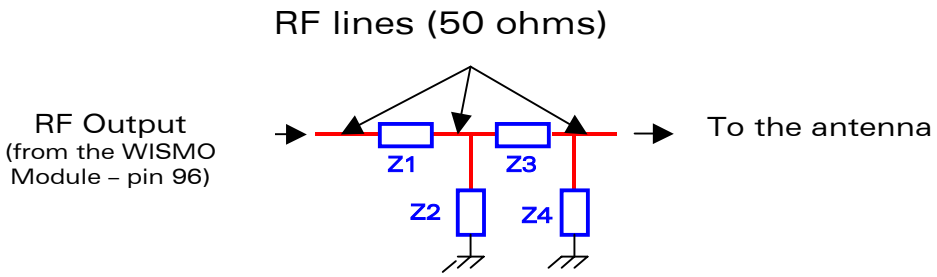



**Figure 31: Matching circuit electrical diagram**

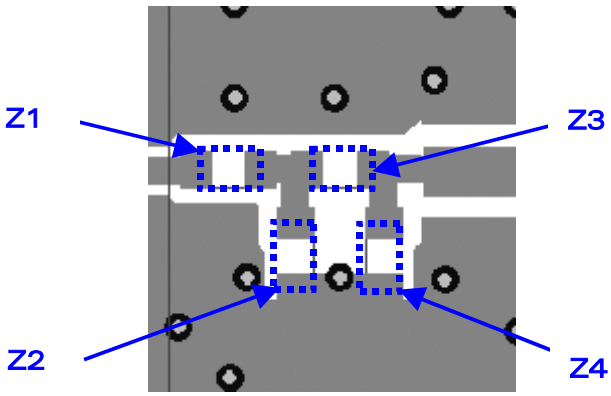



**Figure 32: Example of Matching circuit implementation on PCB**

- The RF connection should be short enough to minimize losses and must have a balancing impedance of 50 Ohms up to F = 2 GHz.
- 0.5 dB can be considered as a maximum value for loss between the module RF output and the antenna.
- The RF line does not have to be covered, in order to keep a correct immunity.
- The lines linking the RF output and the antenna matching, can be designed with a microstrip (on surface or embedded), or with a stripline, according to the way.

**General recommendations:**

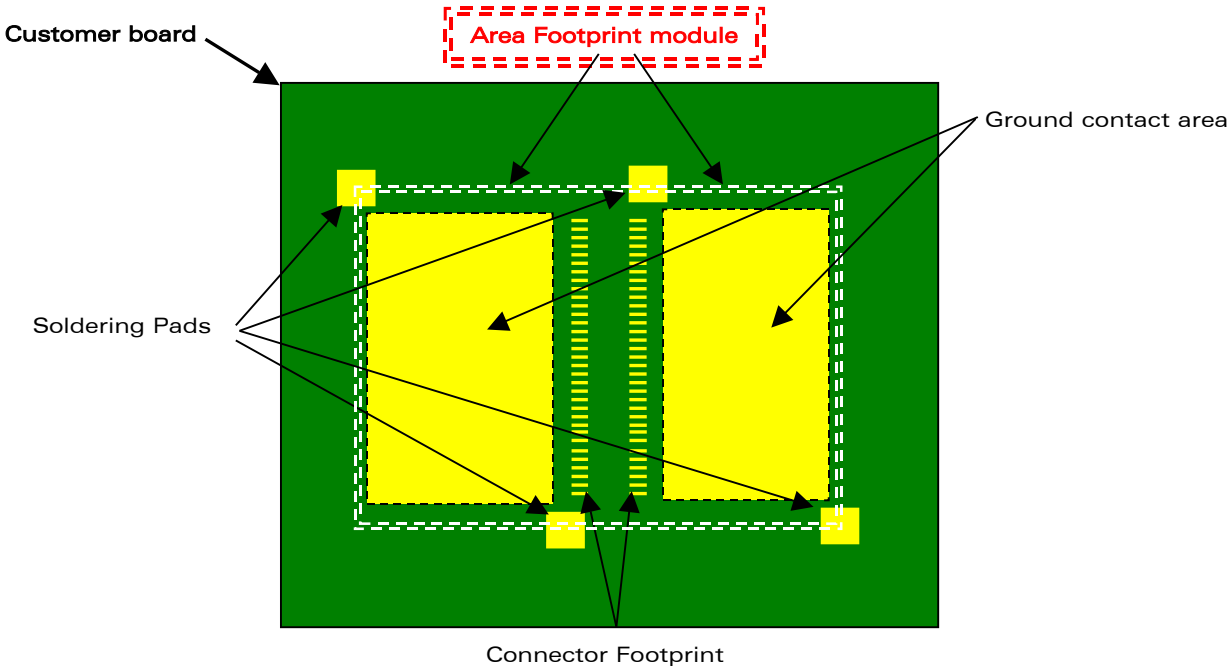
- All components or chips operated at high frequencies (microprocessors, memories, DC/DC converter), or other active RF parts shall not be placed too close to the module. In such a case, correct supply and ground decoupling areas shall be designed and validated.
- One shall avoid placing components around the RF connection and close to the RF line (between the module and the antenna).
- RF lines shall be as short as possible.
- Some signals like VBATT and charger line may require some EMI/RFI decoupling: parallel 33 pF capacitor close to the module, or a serial ferrite bead (or both to get better results). In case a ferrite bead is used, the recommendations given for the power supply connection must be carefully followed (high current capacity and low impedance).

For possible suppliers of antenna cable and antenna connector, refer to chapter 9:Manufacturers and suppliers.

## 3.3 Ground plane on PCB

In order to obtain a correct immunity between the module and the different elements of the customer board, Wavecom recommends (see Figure below):

- to use a ground plane under the module, with two ground contact areas between customer board and the two module's shields.
- to solder the four pads of maintain.




Note: Soldering Pads and ground plane are not covered with protective varnish but should have nickel gold covering.

**Figure 33: Representation of module "footprint" on the customer board**

**Warning:**

**Wavecom strongly recommends to pass no line on the first layer of the customer board in the WISMO module footprint area. Moreover, the footprint area should be drawn on the customer board to ease module insertion.**

**Informations:** For the conception of printed RF lines, a software such as the one mentioned below can be used:

- RF Agilent AppCAD : www.agilent.com

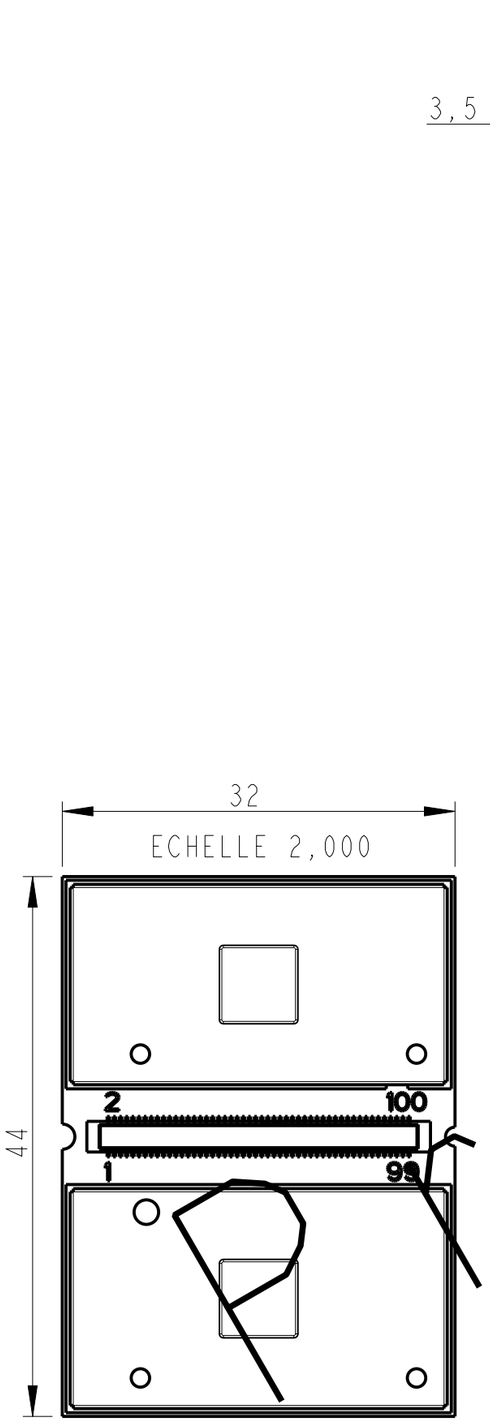
# 4 Mechanical specifications

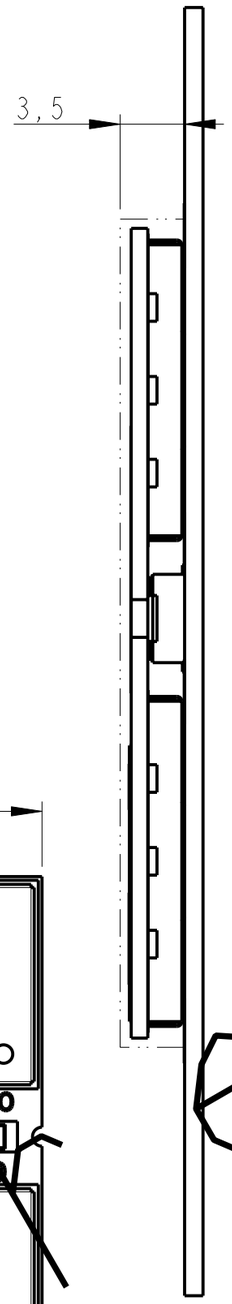
## 4.1 Assembly mechanical constraints

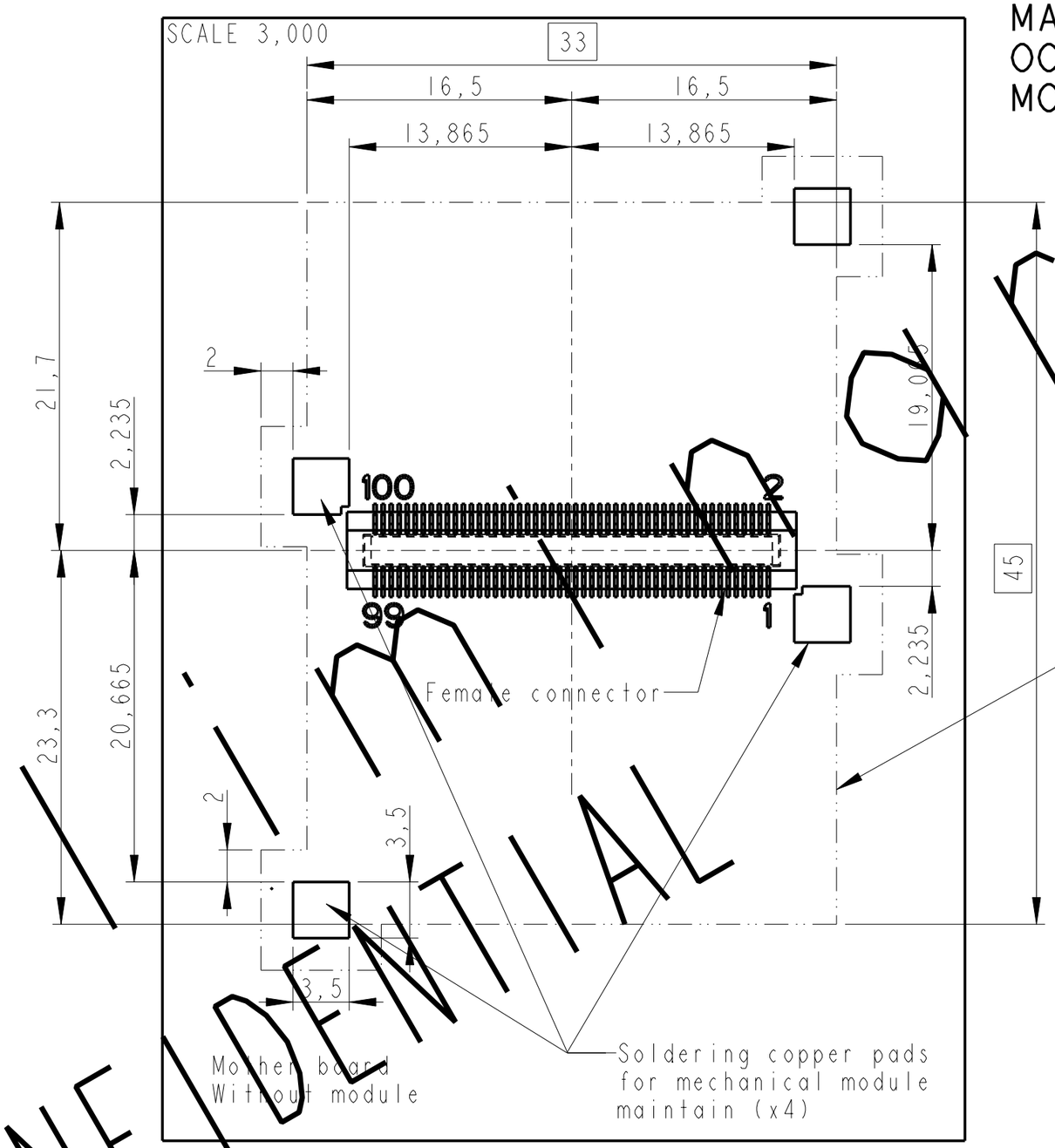
It is important to assure that no components or mechanical elements will enter in contact with the module even in case of vibration or manipulation of the final product.

These contacts may produce bad electrical connections.

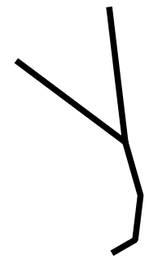
The next page shows a mechanical drawing which specifies the area needed for module fitting in an application.




MAXIMUM BULK OCCUPIED ON THE MOTHER BOARD (*)



(*) Leave space for the manual soldering of the WISMO module pads :
+ 2mm around pads.
+0,5mm around module.



| | | | | | |
|---|---|---|---|---|---|
| Creation | 23/04/03 | JPM | HER | Preliminary | 01 |
| MODIFICATION | DATE | AUTHOR | RESP. | STATUS | IND |

| | | | |
|---|---|---|---|
| Wismo Quik - Q3106 | TOL.GEN.: ±0,1 | | ECHELLE 1,000 |
| CUSTOMER GUIDE | DOC. | FOLIO: 1/1 | FORMAT : A3 |
| | WM-3-2153-V-015-A | | |
| wavecom | AUTEUR : JPM | | |
| | RESPONS : JJO | | 01 |
| PRO/ENGINEER | | | IND. |

# 5 PCB design

## 5.1 Design rules for application manufacturing

For component placement close to the module, leave space for the manual soldering of the WISMO module pads (refer to paragraph 3.3 and mechanical drawing in paragraph 4.1).

The WISMO Quik Q31x6 sub-series does not support any reflow soldering.

## 5.2 General design rules

Clock and other high frequency digital signals (e.g. parallel and serial buses) should be routed as far as possible from the WISMO analog signals.

If the application design makes it possible, all analog signals should be separated from digital signals by a Ground line on the PCB.

# 6 EMC recommendations

The EMC tests have to be performed as soon as possible on the application board to detect any possible problem.

When designing, special attention should be paid to:

- Possible spurious emission radiated by the application to the RF receiver in the receiver band,
- ESD protection on SIM, serial link, ...
- EMC protection on audio input/output,
- Bias of the Microphone inputs,
- Length of the SIM interface lines,
- Ground plane on the application board must be designed with care,
- Use a common ground plane for all signals (analog / digital / RF),
- Metallic case or plastic casing with conductive paint are recommended.

Note: the WISMO module does not include any protection against overvoltage.

# 7 Firmware upgrade

## 7.1 Recommendations

The firmware of the module is stored in flash memory and it can therefore be easily upgraded.

In order to follow the regular evolutions of the GPRS standard and to offer state-of-the-art software, Wavecom recommends that the application designed around a WISMO (or WISMO based product) allows easy firmware upgrades on the module. Therefore, the application shall either allow a direct access to the WISMO serial link through an external connector or implement any mechanism allowing the WISMO firmware to be downloaded using the Wavecom downloader.

The application must allow the WISMO serial link signals + the BOOT, the RESET and the ON/OFF module signals to be easily accessed thus allowing the module firmware to be upgraded.

### 7.2 Nominal upgrade procedure

The firmware upgrade procedure requires a Wavecom specific software to download the new binary file into the module.

This tool has to run on a PC connected to the serial bus of the module (UART1).

The necessary signals to proceed with the downloading are: RX, TX, RTS, CTS and GND.

Prior to running the Wavecom downloader, the module has to be set in download mode. For this, the BOOT signal has to be set to low while powering ON (or resetting) the module.

Another option is to download the firmware using the Xmodem protocol (refer to document [2] AT commands interface guide).

# 8 Embedded Testability

### 8.1 Downloading a test software on the application

As for the upgrade procedure, the first thing to be checked is the possibility to download easily a new software version or a test software in the module. The necessary signals to proceed with the downloading are: RX, TX, RTS, CTS, BOOT, ON/OFF and GND.

Prior to running the Wavecom downloader, the module has to be set in download mode. For this, the BOOT signal has to be set to low while powering ON (or resetting) the module.

Typical implementation:

The first of the following diagrams specifies the way to route the specified signals from the module to a connector on which will be connected the data cable. This diagram has to be implemented on the application board.

The second diagram gives a typical data cable electrical scheme.

On the application Board:

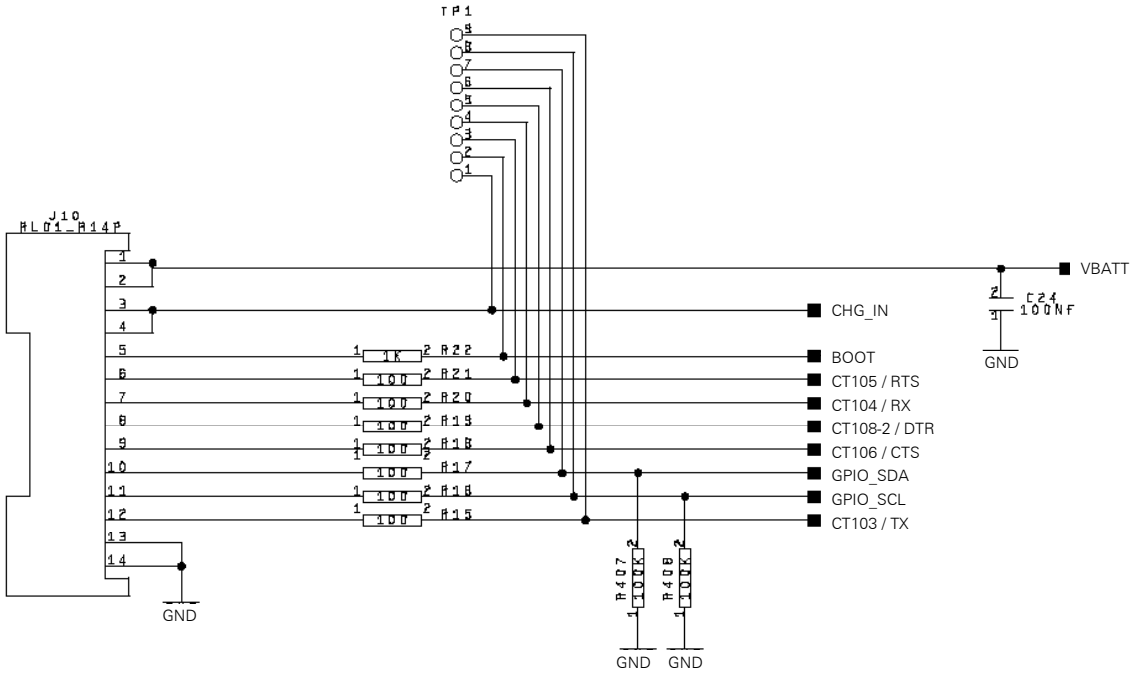



Figure 34: Example of serial link routing for downloading

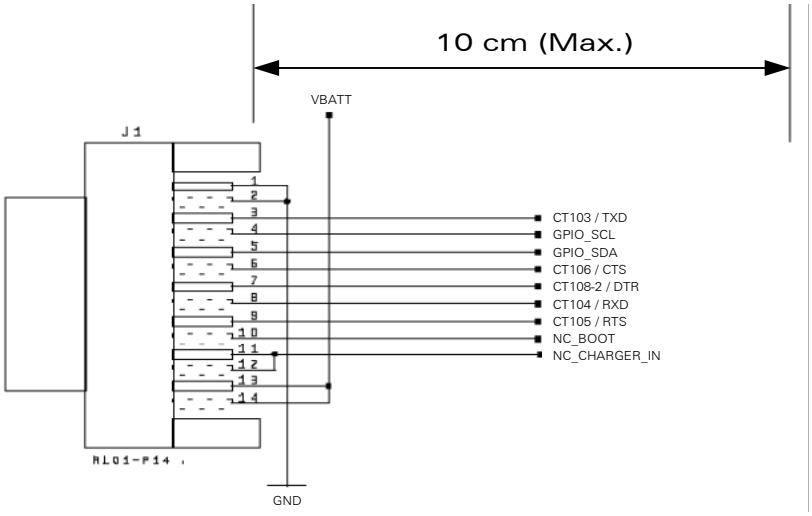



Figure 35: Download cable scheme (1/2)

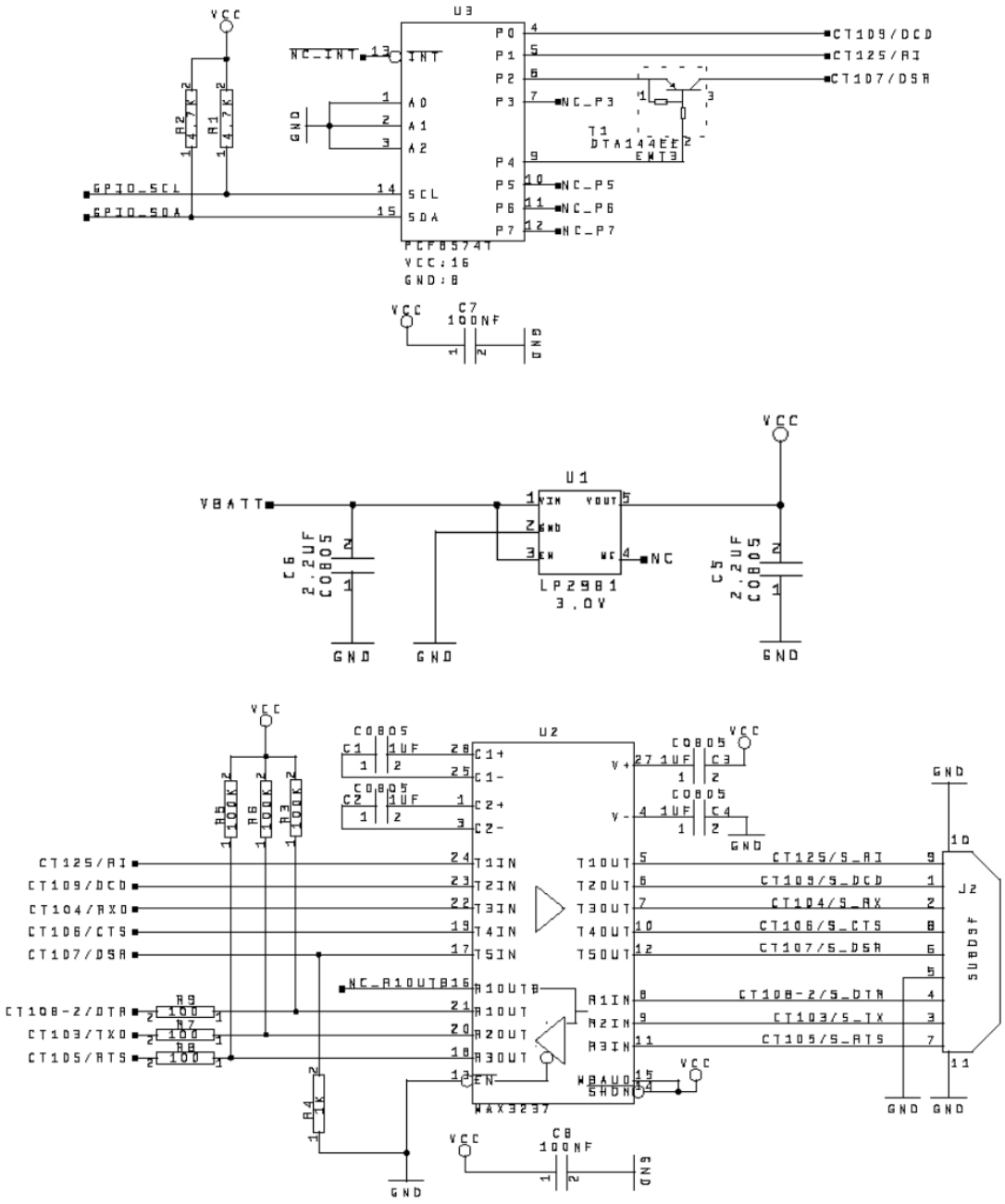



Figure 36: Download cable scheme (2/2)

## 8.2 RF output accessibility for diagnostic

RF output of the module is usually routed to the antenna of the application. All the diagnostic equipments used for RF measurements need an RF connection through connector. The design of the application should permit to mount an RF connector on the application board or to include a RF switch to facilitate RF diagnostic of the module reported on an application.

Typical implementation:

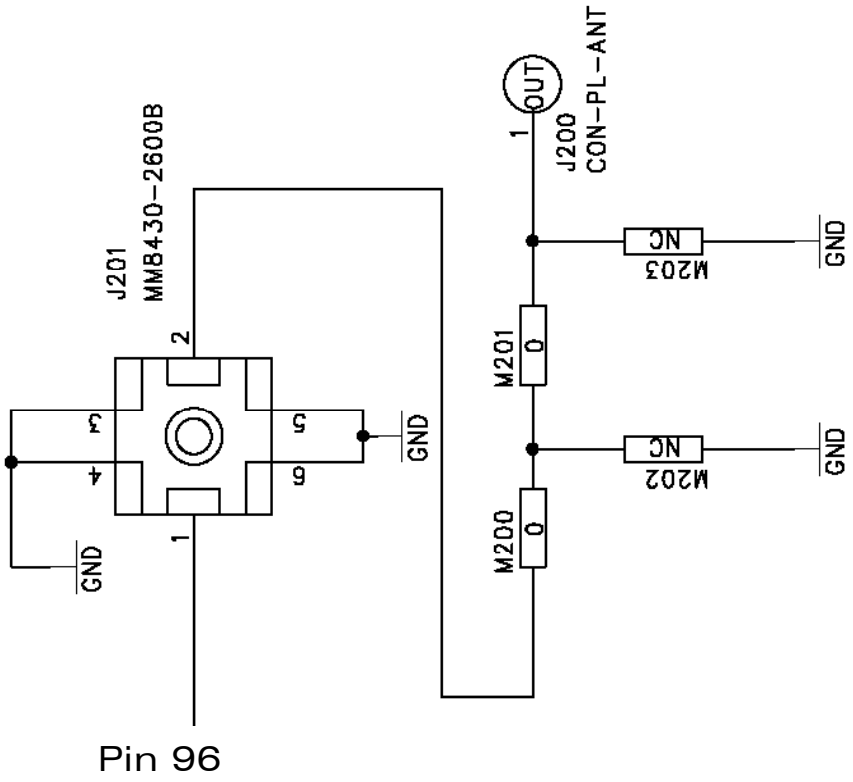



Figure 37: Example of RF output connection implementation

# 9 Manufacturers and suppliers

This section contains a list of recommended manufacturers or suppliers for the peripheral devices to be used with the WISMO Quik Q3106 module.

## 9.1 General Purpose Connector

The General Purpose Connector (GPC) is a 100-pin connector with 0.5 mm pitch from NAIS with the following reference:

AXK6F00345J

The matting connector has the following reference:

AXK5F00545J

For further details about this connector, see GPC data sheets in document [1]. More information is also available from http://www.nais-e.com/

## 9.2 SIM Card Reader

- ITT CANNON CCM03 series (see http://www.ittcannon.com)
- AMPHENOL C707 series (see http://www.amphenol.com)
- JAE (see http://www.jae.com)

Drawer type:

- MOLEX: (see http://www.molex.com)
  - Connector: MOLEX 99228-0002,
  - Holder: MOLEX 91236-0002.

## 9.3 Microphone

The microphone selected must comply with the GSM recommendations in terms of frequency response.

Possible suppliers:

- HOSIDEN (see http://www.hosiden.co.jp/)
- PANASONIC (see http://www.panasonic.com/industrial/components/)

## 9.4 Speaker

The speaker selected must comply with the GSM recommendations in terms of frequency response.

Possible suppliers:

- SANYO (see http://www.sanyo.com/industrial/components/)
- HOSIDEN (see http://www.hosiden.co.jp/)
- PRIMO (see http://www.primo.com.sg/)
- PHILIPS (see http://www.semiconductors.philips.com/)

## 9.5 Antenna Cable

The following cable reference has been qualified for being mounted on WISMO Quik Q3106 modules:

- RG178

## 9.6 GSM antenna

GSM antennas and support for antenna adaptation can be obtained from manufacturers such as:

- ALLGON (see http://www.allgon.com )
- MOTECO (see http://www.moteco.com )
- GALTRONICS (see http://www.galtronics.com )

## 9.7 RF connector

RF connector and accessories can be obtained from:

- Nais (see http://www.nais-e.com/)

## 9.8 Buzzer

- SAMBU (see http://www.sambuco.co.kr/)

## 9.9 Vibrator

- NIDEC COPAL (see http://www.copal-electronics.com/)