
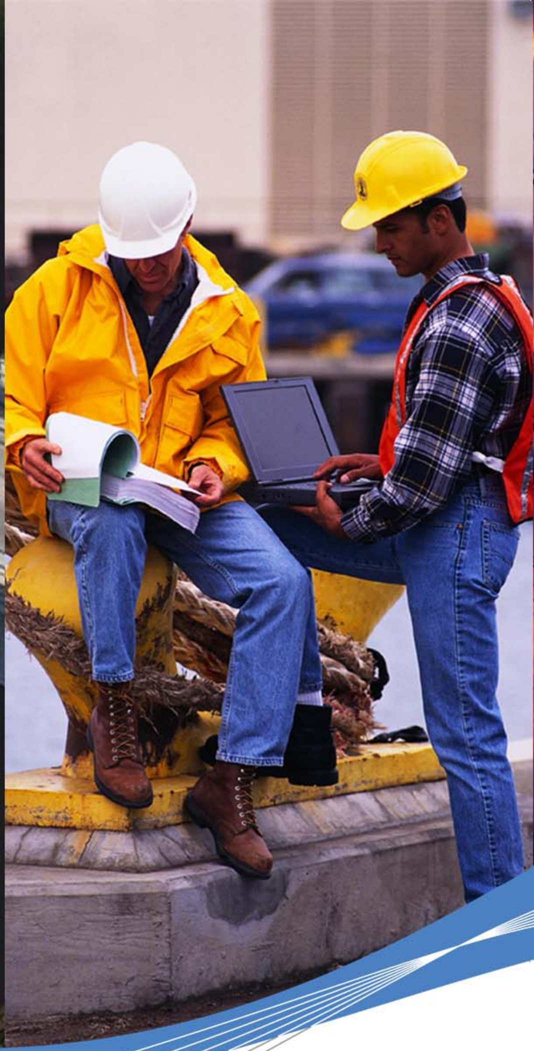


WISMO Quik Q2686 series

Wismo Quik Q2686
Customer Design Guidelines

Revision: 003
Date: February 2006

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WISMO Quik Q2686
Customer Design Guidelines

Reference : **WM_PRJ_Q2686_PTS_003**
Revision : **003**
Date : **February 9th 2006**

Powered by the Wavecom Operating System and Open AT®

Document Information

Revision	Date	History of the evolution	
001	Sep 2005	Preliminary version	
002	13 Oct 2005	Update "Overview" Update "Trademarks, Cautions, Copyright" Update "Audio interface" (see chapter 3.2.10) Update "General purpose I/O » (see chapter 3.2.6)	
003	09 Feb 2006	Update "Functional Architecture" (see chapter 2.2) Update "GSM serial link" (see chapter 3.2.5) Update "General purpose I/O" (see chapter 3.2.6) Update "External Interrupt" (see chapter 3.2.13) Update "Audio interface" (see chapter 3.2.10) Update "Download function BOOT" (see chapter 3.2.3)	

Overview

The WISMO Quik Q2686 Wireless CPU is an E-GSM/DCS/GSM850/PCS - GPRS 900/1800/850/1900 MHz quad-band Wireless CPU driven by AT commands.

The WISMO Quik **Q2686** memory configuration is:

- GSM/GPRS part: **32** Mbits of Flash memory and **8** Mbits of SRAM

This document gives recommendations and general guidelines to design an application using the WISMO Quik Q2686 Wireless CPU.

It gives some recommendations for:

- Base Band design rules and typical implementation examples
- RF design rules and typical implementation examples
- Mechanical constraints for Wireless CPU fitting
- PCB routing recommendations
- Test and download recommendations

It also recommends some manufacturers and suppliers for the peripheral devices which can be used with the WISMO Quik Q2686 Wireless CPUs.

For further information about the WISMO Quik Q2686 wireless CPU, refer to the Product Technical Specification (document [2]).

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Cautions

This platform contains a modular transmitter. This device is used for wireless applications. Note that all electronics parts and elements are ESD sensitive.

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1 References

1.1 Reference Documents

[1] Automotive Environmental Control Plan for WISMO Quik Q2686
WM_PRJ_Q2686_DCP_001

[2] WISMO Quik Q2686 Product Technical Specification
WM_PRJ_Q2686_PTS_001

[3] WISMO Quik Q2686 Process Customer Guidelines
WM_PRJ_Q2686_PTS_004

[4] WISMO Quik Q2686 AT Commands Interface Guide for OS 6.60
WM_DEV_OAT_UGD_003

1.2 Glossary

Term	Definition

1.3 Abbreviations

Abbreviation	Definition
AC	Alternative Current
ADC	Analog to Digital Converter
A/D	Analog to Digital conversion
AF	Audio-Frequency
AT	ATtention (prefix for modem commands)
AUX	AUXiliary
CAN	Controller Area Network
CB	Cell Broadcast
CEP	Circular Error Probable
CLK	CLocK
CMOS	Complementary Metal Oxide Semiconductor
CS	Coding Scheme
CTS	Clear To Send
DAC	Digital to Analogue Converter
dB	Decibel

Abbreviation	Definition
DC	Direct Current
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cellular System
DR	Dynamic Range
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
E-GSM	Extended GSM
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EMS	Enhanced Message Service
EN	ENable
ESD	ElectroStatic Discharges
FIFO	First In First Out
FR	Full Rate
FTA	Full Type Approval
GND	GrouND
GPI	General Purpose Input
GPIO	General Purpose Input Output
GPO	General Purpose Output
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
HR	Half Rate
I/O	Input / Output
LED	Light Emitting Diode
LNA	Low Noise Amplifier
MAX	MAXimum
MIC	MICrophone
MIN	MINimum
MMS	Multimedia Message Service
MO	Mobile Originated

Abbreviation	Definition
MT	Mobile Terminated
NF	Noise Factor
NMEA	National Marine Electronics Association
NOM	NOMinal
PA	Power Amplifier
Pa	Pascal (for speaker sound pressure measurements)
PBCCH	Packet Broadcast Control CHannel
PC	Personal Computer
PCB	Printed Circuit Board
PDA	Personal Digital Assistant
PFM	Power Frequency Modulation
PSM	Phase Shift Modulation
PWM	Pulse Width Modulation
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RHCP	Right Hand Circular Polarization
RI	Ring Indicator
RST	ReSeT
RTC	Real Time Clock
RTCM	Radio Technical Commission for Maritime services
RTS	Request To Send
RX	Receive
SCL	Standard CLock
SDA	Shot Data Analysis
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	Serial Peripheral Interface
SPL	Sound Pressure Level
SPK	SPeaKer
SRAM	Static RAM
TBC	To Be Confirmed
TDMA	Time Division Multiple Access
TP	Test Point

Abbreviation	Definition
TVS	Transient Voltage Suppressor
TX	Transmit
TYP	TYPical
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
USSD	Unstructured Supplementary Services Data
VSWR	Voltage Standing Wave Ratio

2 General Information

2.1 Features

WISMO Quik Q2686 is a self-contained E-GSM/DCS/GSM850/PCS-GPRS 900/1800/850/1900 quad-band Wireless CPU.

Following table reminds the WISMO Quik Q2686 features:

Feature	Information
Physical characteristics	• Overall dimensions: 40 x 32.2 x 4 mm • Weight: <10 g • Complete shielding
Wireless CPU control	• Full set of AT commands for GSM/GPRS including GSM 07.07 and 07.05 AT command sets • Status indication for GSM
GSM/DCS	• Frequency bands: o Rx (GSM 850): 869 to 894 MHz o Rx (E-GSM 900): 925 to 960 MHz o Rx (DCS 1800): 1805 to 1880 MHz o Rx (PCS 1900): 1930 to 1990 MHz o Tx (GSM 850): 824 to 849 MHz o Tx (E-GSM 900): 880 to 915 MHz o Tx (DCS 1800): 1710 to 1785 MHz o Tx (PCS 1900): 1850 to 1910 MHz • Transmit power: o Class 4 (2 W) at GSM 850 and E-GSM o Class 1 (1 W) at DCS and PCS
GPRS	• GPRS multislot class 10 • Multislot class 2 supported • PBCCH support • Coding schemes: CS1 to CS4
Voice Features	• GSM Voice Features with Emergency calls 118 XXX • Full Rate (FR)/ Enhanced Full Rate (EFR) / Half Rate (HR) / Adaptive Multi Rate (AMR) • Echo cancellation and noise reduction • Full duplex Hands free

Feature	Information
SMS	• SMS MT, MO and SMS CB • SMS storage into SIM card
GSM Supplementary Services	• Call Forwarding, Call Barring • Multiparty • Call Waiting, Call Hold • USSD
Data / Fax	• Data circuit asynchronous, transparent, and non-transparent up to 14400 bits/s • Fax Group 3 compatible
SIM interface	• 1.8V/2.9 V SIM interface • 5 V SIM interfaces are available with external adaptation • SIM Tool Kit Release 99
Real Time Clock	Real Time Clock (RTC) with calendar and alarm

2.2 Functional architecture

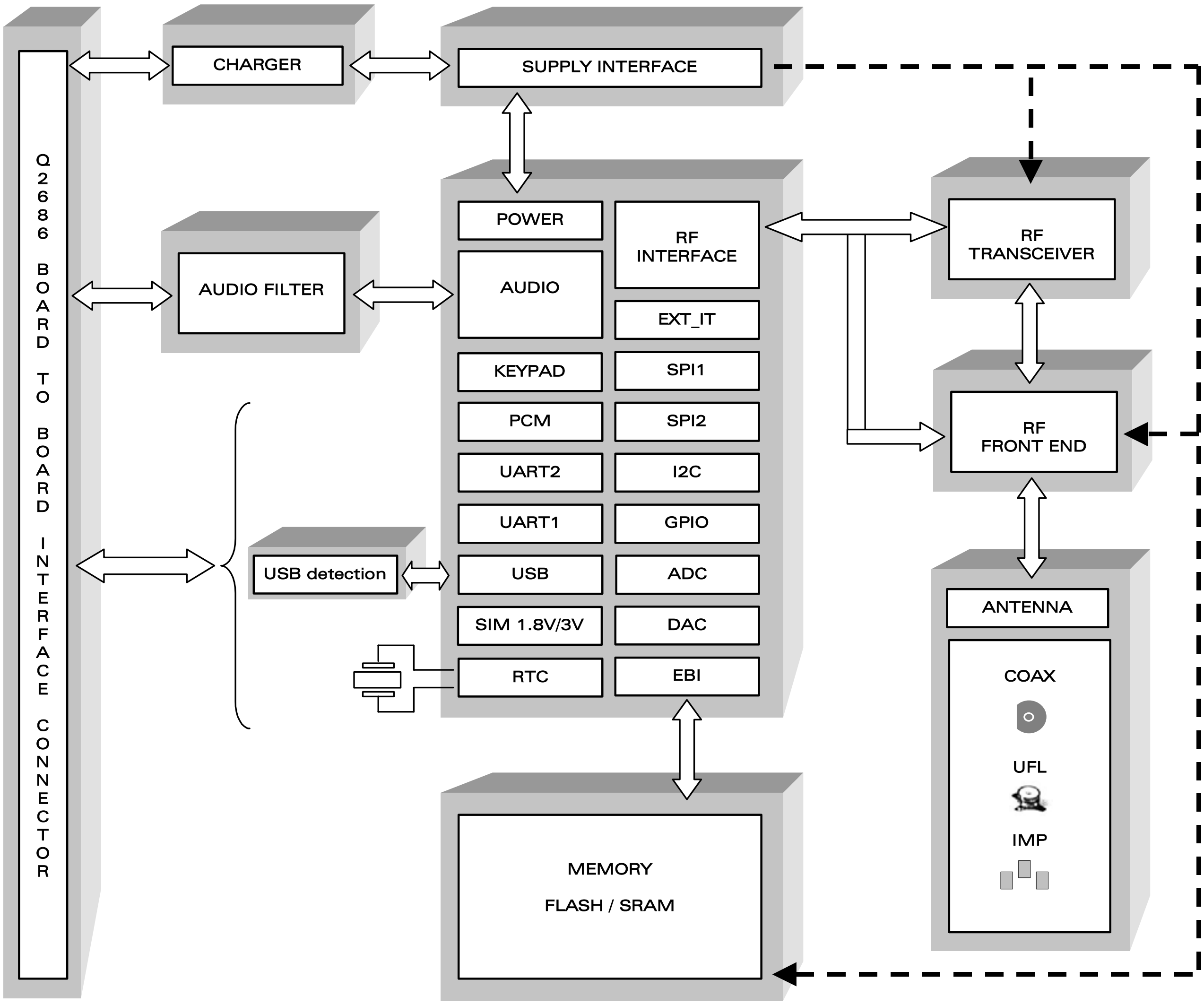


Figure 1: Functional architecture

3 Functional description

CAUTION

Some of the WISMO interface signals are multiplexed in order to limit the number of pins but this architecture implies some restrictions.

WARNING

All external signals must be inactive when the WISMO Wireless CPU is OFF to avoid any damage when starting the Wireless CPU.

3.1 Power supply

3.1.1 Main power supply and ground plane

3.1.1.1 Electrical constraints

The main power supply (VBATT) is the single external power supply source. It is used to supply the GSM/GPRS functions.

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 (rising time is around 10 µs).

In communication mode, the GSM RF power amplifier current flows with a ratio of (Figure 2):

- Max current 1/8 of the time (around 577 µs every 4.615 ms for GSM/GPRS class 2 – 2RX / 1TX),
- Max current 2/8 of the time (around 1154 µs every 4.615 ms for GSM/GPRS class 10 – 3RX / 2TX).

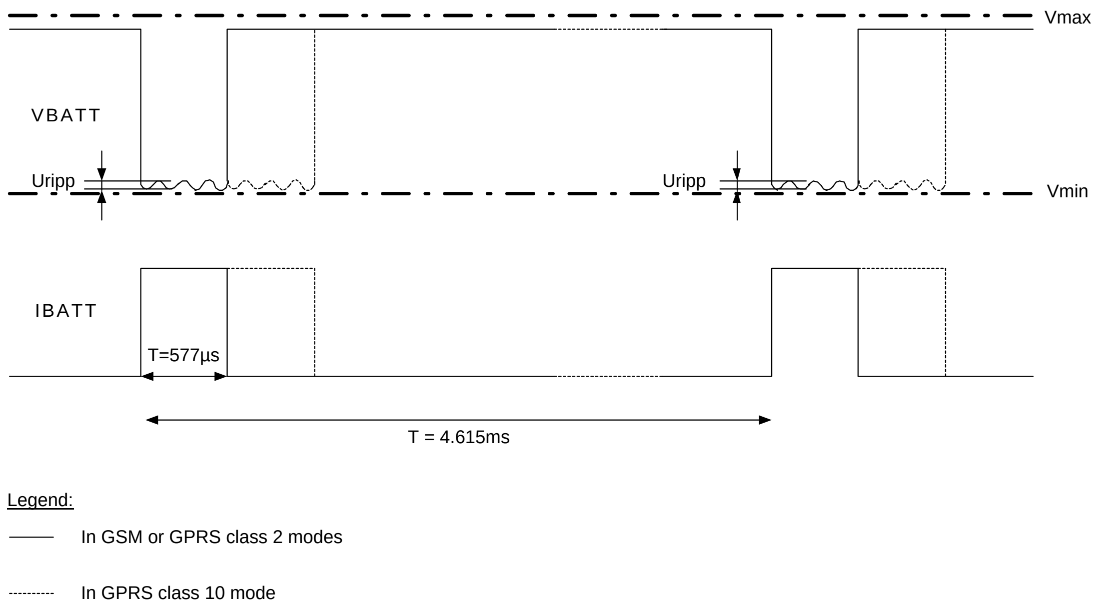


Figure 2: Typical Power supply voltage in GSM/GPRS mode

During the high current peaks the ripple (U_{ripp}) on the supply voltage must not exceed a certain limit (refer to document [2]).

Because **VBATT** supplies directly the GSM RF power amplifier component, it is essential to keep a minimum voltage ripple at this connection in order to avoid any phase error or spectrum modulation degradation.

On the other hand, insufficient power supply voltage could dramatically affect some RF performances: TX power, modulation spectrum, EMC (Electro-Magnetic Compatibility) performances, spurious emission and frequency error.

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

Power Supply Voltage

	V_{MIN}	V_{NOM}	V_{MAX}	U_{ripp} Max	I_{peak} Max
VBATT	3.2V (*)	3.6 V	4.8 V (**)	10 mVpp (TBC)	2.0 A

(*): 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.

3.1.1.2 Design requirements

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 VBATT line must support peak currents with an acceptable voltage drop which guarantees a VBATT minimal value of TBD V (lower limit of VBATT).

For PCB design constraints related to power supply tracks, ground planes and shielding, refer to paragraph 4.2.2.

3.1.1.3 Decoupling of power supply signals

Decoupling capacitors on VBATT lines are embedded in the Wireless CPU. So it should not be necessary to add decoupling capacitors close to the Wireless CPU.

However, in case of EMI/RFI problem, VBATT signal may require some EMI/RFI decoupling: parallel 33 pF capacitor close to the Wireless CPU or a serial ferrite bead (or both to get better results). Low frequency decoupling capacitors (22µF to 100µF) can be used to reduce the TDMA noise (217Hz).

CAUTION:
When ferrite beads are used, the recommendation given for the power supply connection must be carefully followed (high current capacity and low impedance).

3.1.2 RTC Back-up supply

3.1.2.1 Design requirements

BAT-RTC pin is used to provide a back-up power supply for the internal Real Time Clock (RTC).

The RTC is supported by the WISMO Quik Q2686 Wireless CPU when powered on but a back-up power supply is needed to save date and time information when the Wireless CPU is switched off.

The WISMO Q2686 includes a regulator witch powers the RTC when the VBATT power supply is available, independently of the Wireless CPU state; ON or OFF.

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

Back-up Power Supply can be provided by:

- A super capacitor
- A non rechargeable battery
- A rechargeable battery cell.

3.1.2.2 Typical application electrical diagram

3.1.2.2.1 Super Capacitor

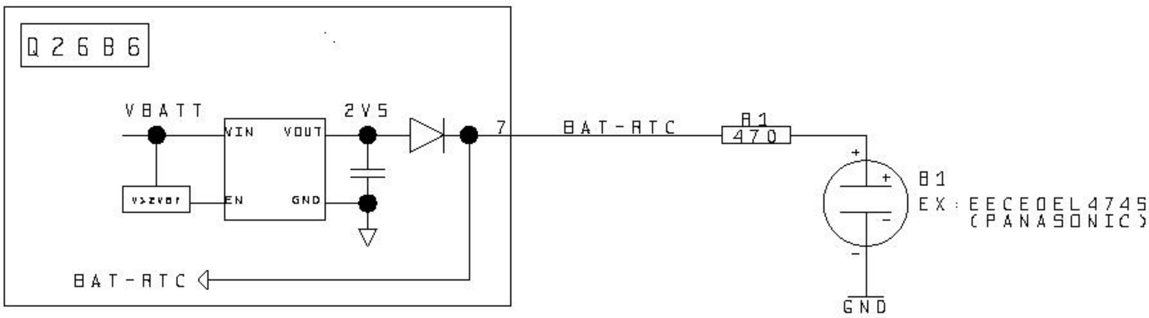


Figure 3: RTC supplied by a gold capacitor

Estimated range with 0.47 Farad Gold Cap: 25 minutes minimum.

<u>Note</u>: the Gold Capacitor maximum voltage is 2.5V.

3.1.2.2.2 Non Rechargeable battery

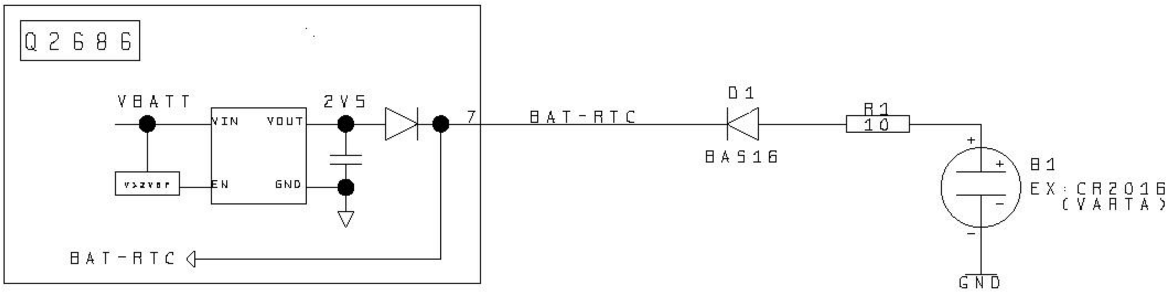


Figure 4: RTC supplied by a non rechargeable battery

The diode D1 is mandatory to not damage the non rechargeable battery.

Estimated range with 85 mAh battery: 800 h minimum.

3.1.2.2.3 Rechargeable battery cell

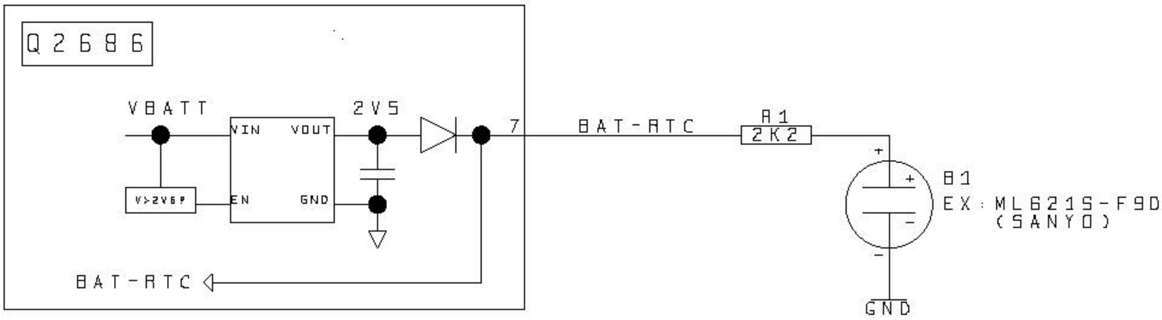


Figure 5: RTC supplied by a rechargeable battery cell

Estimated range with 2 mAh rechargeable battery: ~15 hours.

WARNING:
Before battery cell assembly insure that cell voltage is lower than 2.75 V to avoid any damage to the WISMO Wireless CPU.

3.2 GSM/GPRS Base Band part

3.2.1 Wireless CPU activation function (ON/~OFF)

The ON/~OFF input (pin 19) is used to switch ON (ON/~OFF=1) or OFF (ON/~OFF=0) the WISMO Quik Q2686 Wireless CPU.

A high level signal has to be provided on the pin ON/~OFF to switch ON the Wireless CPU.

The level of the voltage of this signal has to be maintained at 0.8 x VBATT during a minimum of TBD ms.

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

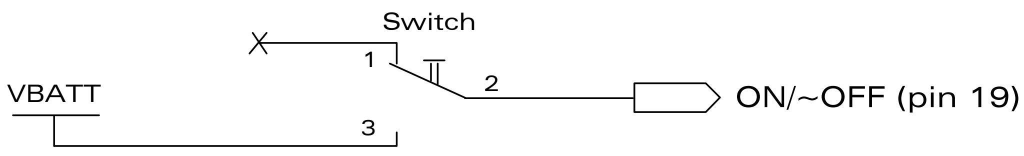


Figure 6: Example of ON/~OFF pin connection

3.2.2 Reset function (~RESET)

The ~RESET input (pin 18) is used to force a reset procedure by providing low level during at least 200 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 (due to the internal pull-up resistor embedded into the Wireless CPU) as shown in the diagram hereunder.

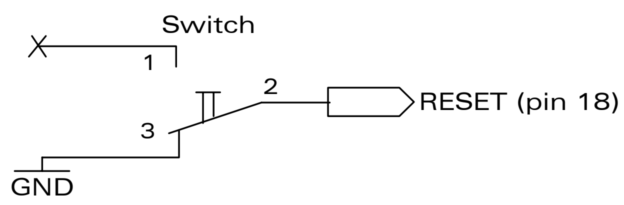


Figure 7: Example of ~RESET pin connection with switch configuration

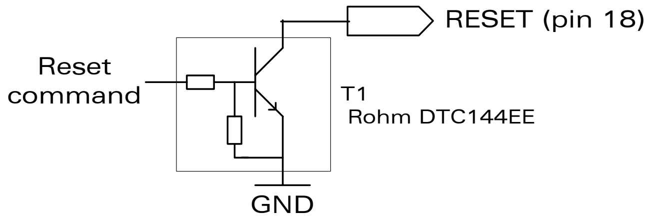


Figure 8: Example of ~RESET pin connection with transistor configuration

Open collector or open drain transistor can be used. If an open collector is chosen, T1 can be a Rohm DTC144EE.

Reset command	~RESET (pin 18)	Operating mode
1	0	Reset activated
0	1	Reset inactive

3.2.3 Download function (BOOT)

A specific control pin BOOT is available to download the WISMO Quik Q2686 Wireless CPU only if the standard XMODEM download, controlled with AT command, is not possible.

A specific PC software, provided by WAVECOM, is needed to performed this specific download.

The BOOT pin must be connected to the VCC_1V8 for this specific download.

BOOT	Operating mode	Comment
Leave open	Normal use	No download
Leave open	Download XMODEM	AT command for Download AT+WDWL
1	Download specific	Need WAVECOM PC software

For more information, see Q2686 / X60 AT Commands Interface Guide for OS 6.60 [4].

This BOOT pin can be left open for normal use or XMODEM download but it is highly recommended to set a test point , a jumper or a switch to VCC_1V8 (pin 5) power supply.

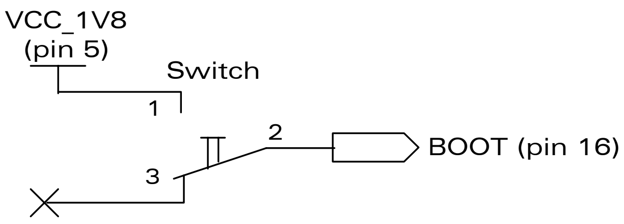


Figure 9: Example of BOOT pin implementation

3.2.4 Activity status indication function (FLASH-LED)

The GSM activity status indication signals FLASH-LED (pin 17) can be used to drive a LED. This signal is an open-drain digital transistor according to the Wireless CPU activity status.

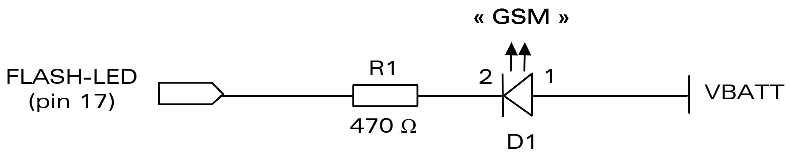


Figure 10: Example of GSM activity status implementation

R1 value can be harmonized depending of the LED (D1) characteristics.

For electrical characteristics of the FLASH-LED, refer to document [2].

3.2.5 GSM serial links

The GSM/GPRS Base Band part of the WISMO Quik Q2686 includes two independent V24/CMOS serial link interfaces which can speed up to 115Kb/s:

- UART1 (main serial link) It is the link used for communication between the WISMO Quik Q2686 Wireless CPU and a PC or a host processor. It consists in a flexible 8-wire serial interface complying with V24 standard (TX, RX, CTS, RTS, DSR, DTR, DCD and RI).
- UART2 (auxiliary serial link) It is the link used for communication with external devices. It consists in a flexible 4-wire serial interface complying with V24 standard (TX, RX, CTS and RTS).

Both serial link interfaces (UART1 and UART2) are compliant with V24 standard but not with V28 (electrical interface) due to a 2.8 Volt interface for UART1 and 1.8 Volt interface for UART2. To get a V24/V28 (i.e. RS-232) interface, the use of an RS-232 level shifter device is required as shown in the following paragraphs.

3.2.5.1 Main Serial Link implementation UART1

The level shifter must be a 2.8V with V28 electrical signal compliant.

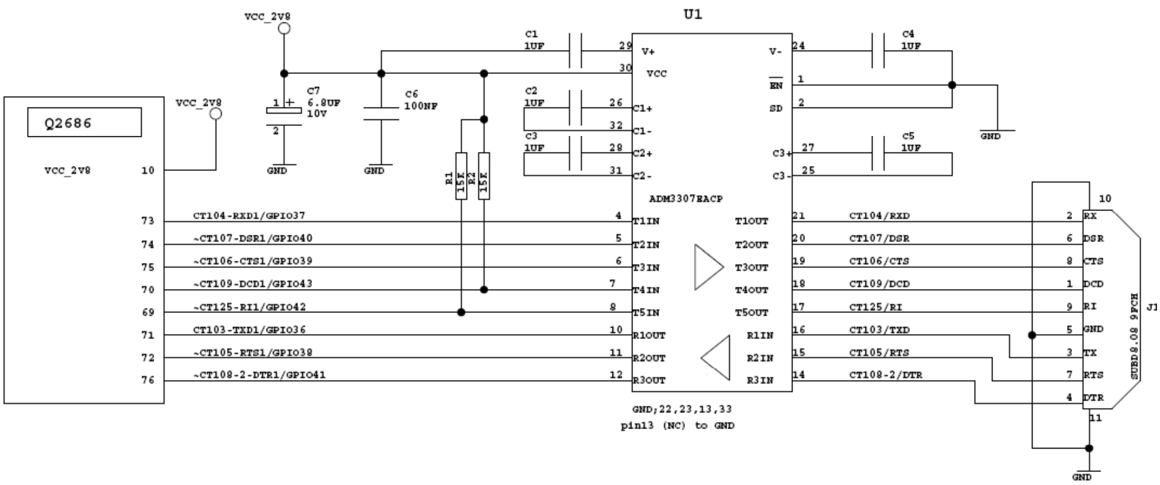


Figure 11: Example of RS-232 level shifter implementation for UART1

U1 chip also protects the Wireless CPU against ESD at 15KV. (Air Discharge)

Recommended components :

- R1, R2 : 15Kohm
- C1, C2, C3, C4, C5 : 1uF
- C6 : 100nF
- C7 : 6.8uF TANTAL 10V CP32136 AVX
- U1 : ADM3307AECP ANALOG DEVICES
- J1 : SUB-D9 female

R1 and R2 are necessary only during Reset state to forced ~CT1125-RI1 and ~CT109-DCD1 signal to high level.

The ADM3307AECP chip is able to speed up to 921Kb/s. If others level shifters are used, ensured that their speed are compliant with the UART1 speed useful.

The ADM3307AECP can be powered by the VCC_2V8 (pin 10) of the WISMO Quik Q2686 Wireless CPU or by an external regulator at 2.8 V.

If the UART1 interface is connected directly to a host processor, it is not necessary to used level shifters. The interface can be connected as bellow :

V24/CMOS possible design:

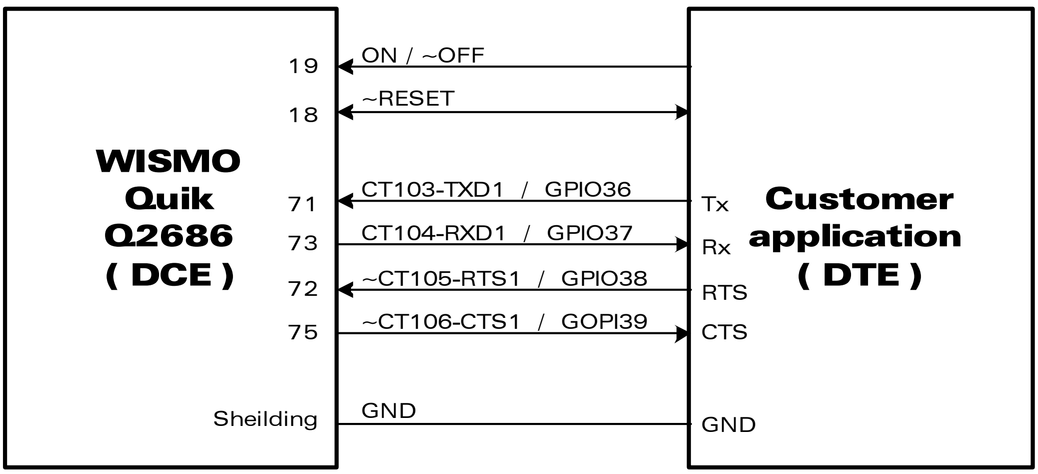


Figure 12: Example of V24/CMOS serial link implementation for UART1

The design given in the Figure above is a basic one.

However, a more flexible design to access this serial link with all modem signal is described bellow :

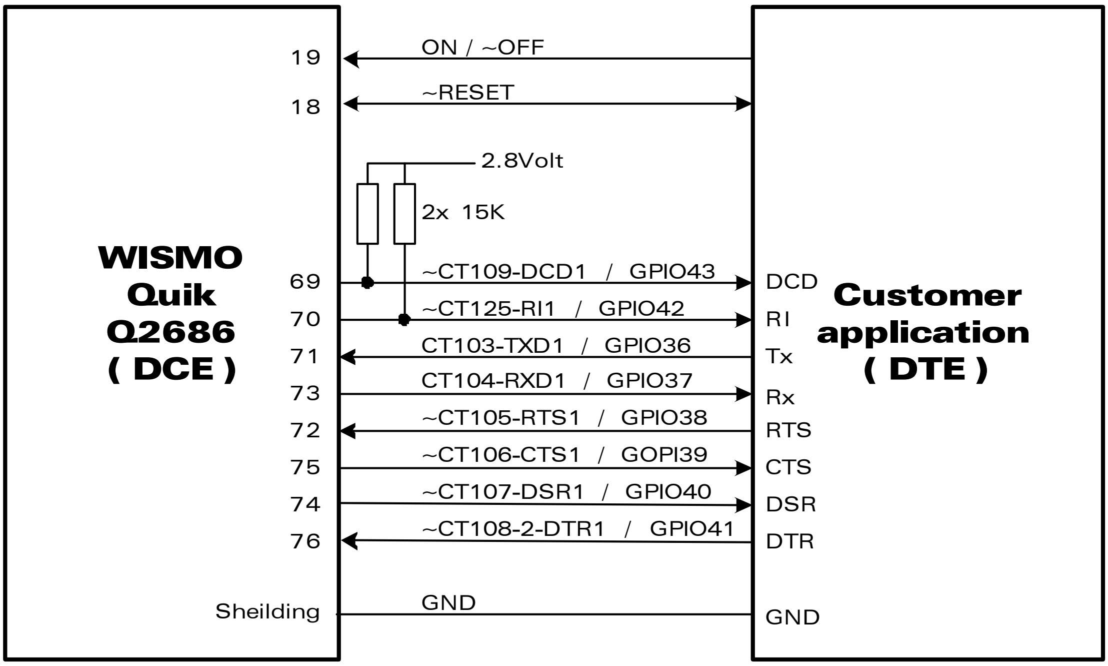


Figure 13: Example of full modem V24/CMOS serial link implementation for UART1

It is recommended to add 15K ohm pull up resistor on ~CT125-RI1 and ~CT109-DCD1 to set high level during reset state.

The UART1 interface is a 2.8Volt type, but it is 3 Volt tolerant.

The Q2686 UART1 is designed to operate using all the serial interface signals. In particular, it is mandatory to use RTS and CTS for hardware flow control in order to avoid data corruption during transmission.

Warning : In case, you want to activate the Power Down mode (Wavecom 32K mode) using Open AT®, you need to wire the DTR pin to a GPIO. Please refer to document [4]. (see chapter “Appendixes”) for more informations on Wavecom 32K mode activation using Open AT®"

3.2.5.2 Auxiliary Serial Link implementation UART2

The voltage level shifter must be a 1.8V with V28 electrical signal compliant.

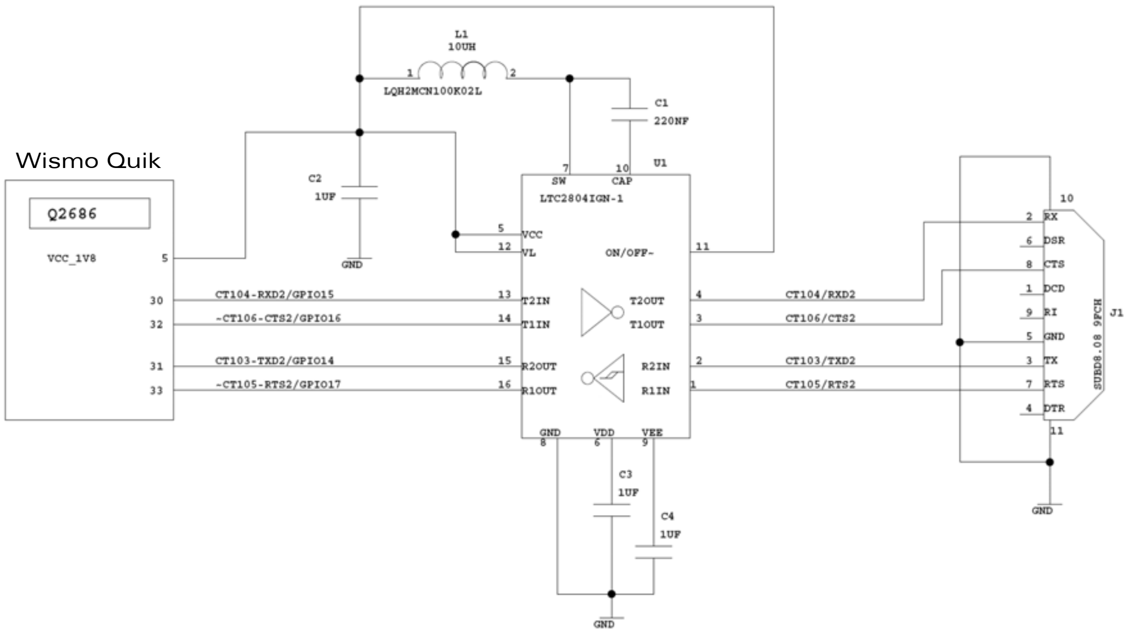


Figure 14: Example of RS-232 level shifter implementation for UART2

<u>Recommended components :</u>

Capacitors

- C1 : 220nF
- C2, C3, C4 : 1µF

Inductor

- L1 : 10µH

RS-232 Tranceiver

- U1 : LINEAR TECHNOLOGY LTC®2804IGN
- J1 : SUB-D9 female

The LTC2804 can be powered by the VCC_1V8 (pin 5) of the WISMO Quik Q2686 Wireless CPU or by an external regulator at 1.8 V.

The UART2 interface can be connected directly to others components if the voltage interface is 1.8 V.

The Q2686 UART2 is designed to operate using all the serial interface signals. In particular, it is mandatory to use RTS and CTS for hardware flow control in order to avoid data corruption during transmission.

3.2.6 General purpose I/O

The WISMO Quik Q2686 provides up to 45 General Purpose I/O.

All grey highlight I/O are 1V8 whereas the others are 2V8.

Pin description of the GPIOs

Signal	Pin number	I/O	I/O type*	Reset state	Multiplexed with
Reserved	42	I/O	Do not used**		
GPIO1	51	I/O	1V8	0	Not mux**
GPIO2	53	I/O	1V8	0	Not mux**
GPIO3	50	I/O	1V8	Z	INT0
GPIO4	59	I/O	1V8	Pull up	COL0
GPIO5	60	I/O	1V8	Pull up	COL1
GPIO6	61	I/O	1V8	Pull up	COL2
GPIO7	62	I/O	1V8	Pull up	COL3
GPIO8	63	I/O	1V8	Pull up	COL4
GPIO9	68	I/O	1V8	0	ROW0
GPIO10	67	I/O	1V8	0	ROW1
GPIO11	66	I/O	1V8	0	ROW2
GPIO12	65	I/O	1V8	0	ROW3
GPIO13	64	I/O	1V8	0	ROW4
GPIO14	31	I/O	1V8	Z	CT103 / TXD2
GPIO15	30	I/O	1V8	Z	CT104 / RXD2
GPIO16	32	I/O	1V8	Z	~CT106 / CTS2
GPIO17	33	I/O	1V8	Z	~CT105 / RTS2
GPIO18	43	I/O	1V8	Z	SIMPRES
GPIO19	45	I/O	2V8	Z	Not mux
GPIO20	48	I/O	2V8	Undefined	Not mux
GPIO21	47	I/O	2V8	Undefined	Not mux
GPIO22	57	I/O	2V8	Z	Not mux
GPIO23	55	I/O	2V8	Z	Not mux
GPIO24	58	I/O	2V8	Z	Not mux

GPIO25	49	I/O	2V8	Z	INT1
GPIO26	44	I/O	Open drain	Z	SCL
GPIO27	46	I/O	Open drain	Z	SDA
GPIO28	23	I/O	2V8	Z	SPI1-CLK
GPIO29	25	I/O	2V8	Z	SPI1-IO
GPIO30	24	I/O	2V8	Z	SP1-I
GPIO31	22	I/O	2V8	Z	~SPI1-CS
GPIO32	26	I/O	2V8	Z	SPI2-CLK
GPIO33	27	I/O	2V8	Z	SPI2-IO
GPIO34	29	I/O	2V8	Z	SP2-I
GPIO35	28	I/O	2V8	Z	~SPI2-CS
GPIO36	71	I/O	2V8	Z	CT103 / TXD1
GPIO37	73	I/O	2V8	1	CT104 / RXD1
GPIO38	72	I/O	2V8	Z	~CT105 / RTS1
GPIO39	75	I/O	2V8	Z	~CT106 / CTS1
GPIO40	74	I/O	2V8	Z	~CT107 / DSR1
GPIO41	76	I/O	2V8	Z	~CT108-2 / DTR1
GPIO42	69	I/O	2V8	Undefined	~CT125 / RI1
GPIO43	70	I/O	2V8	Undefined	~CT109 / DCD1
GPIO44	43	I/O	2V8	Undefined	Not mux

**: For information about the multiplexing of those signals, refer to document [2].

For electrical characteristics of the GPIOs description, refer to document [2].

<u>Reset State :</u>

- 0 : Set to GND
- 1 : Set to supply 1V8 or 2V8 depending of I/O type.
- Pull down : Internal pull down with ~60K resistor.
- Pull up : Internal pull up with ~60K resistor to supply 1V8 or 2V8 depending of I/O type.
- Z : High impedance.
- Undefined : Be careful, undefined musn't be used in your application if a special state at reset is needed. Those pins can be toggling signals.

3.2.7 Peripheral buses

Three peripherals bus are available on the WISMO Quik Q2686 System Connector:

- Two SPI peripherals (3 or 4-wire interface)
- One I²C peripheral (2-wire interface)

For electrical characteristics and connector pin attribution, refer to document [2].

3.2.7.1 SPI Bus

The both SPI bus include clock (SPIx-CLK), I/O (SPIx-IO and SPIx-I) and enable signals (~SPIx-CS) complying with SPI bus standard.

The maximum speed transfer is 13 Mb/s.

Each SPI bus are master and can be configured undependably as 3-wire or 4-wire serial interface.

3.2.7.1.1 4-wire application

The particularity of the 4-wire serial interface (SPI bus) is that the input and the output data lines are dissociated. The SPIx-IO signal is used only for data output and the SPIx-I signal is used only for data input.

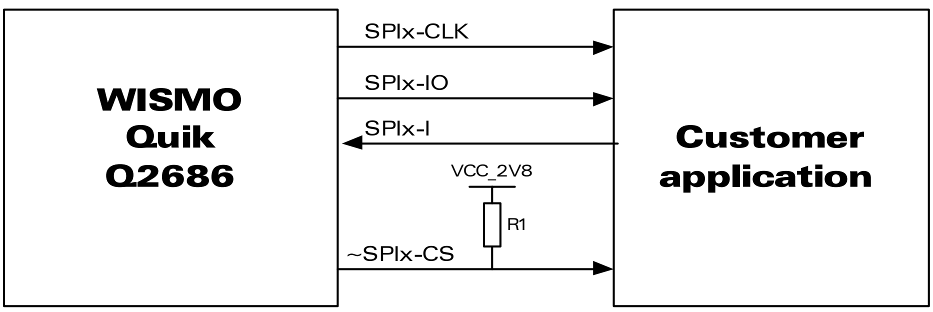


Figure 15: Example of 4-wire SPI bus application

One pull up resistor R1 is needed to set the SPIx-CS level during the reset state.

Exept R1, no external component are needed if the electrical specification of the customer application are complying with the WISMO Quik Q2686 SPIx interface electrical specification.

3.2.7.1.2 3-wire application

When used in 3-wire interface (SPI bus), only the line SPIx-IO is used for output and input data.

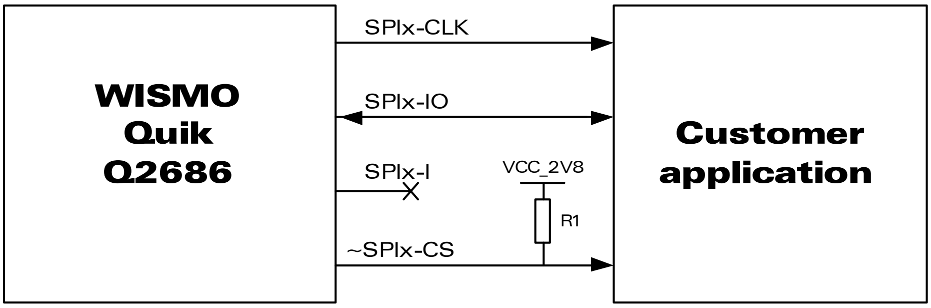


Figure 16: Example of 3-wire SPI bus application

The SPIx-I line is not used in 4-wire configuration. This line can be left opened or used as GPIO for others application functionality. For the multiplexing of SPIx and GPIOs, refer to document [2].

One pull up resistor R1 is needed to set the SPIx-CS level during the reset state.

Exept R1, no external component are needed if the electrical specification of the customer application are complying with the WISMO Quik Q2686 SPIx interface electrical specification.

The SPIx interface voltage range is 2.8V. It can be powered by the VCC_2V8 (pin 10) of the WISMO Quik Q2686 or by an other power supply.

R1 value depends on the peripheral plugged on the SPIx interface.

3.2.7.2 I²C Bus

The WISMO Quik Q2686 provides an I²C bus complying with the Philips specification. For more information, see "I²C Bus Specification", Version 2.0, Philips Semiconductor 1998.

The WISMO Quik Q2686 I²C bus consists of 2 open drain lines:

- the clock (SCL)
- and the data (SDA).

For electrical characteristics of the I²C open drain , refer to document [2].

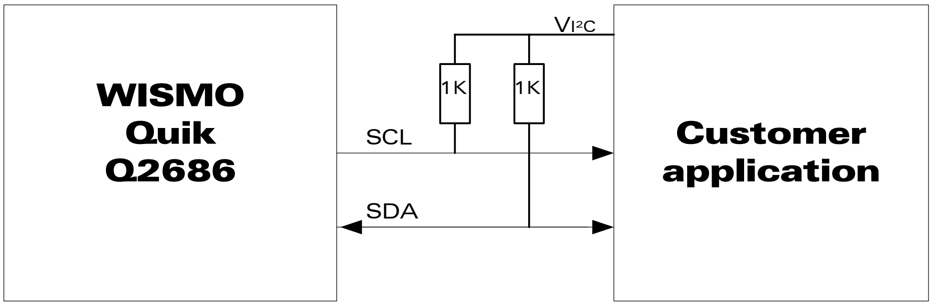


Figure 17: First example of I²C bus application

The two lines need to be pull up to the VI²C voltage. The VI²C voltage is dependent on the customer application component connected on the I²C bus. Nevertheless, the VI²C must complying with the WISMO Quik Q2686 electrical specification. Refer to document **[2]**.

The VCC_2V8 (pin 10) of the WISMO Quik Q2686 can be used to connect the pull up resistors, if the I²C bus voltage is 2.8 V.

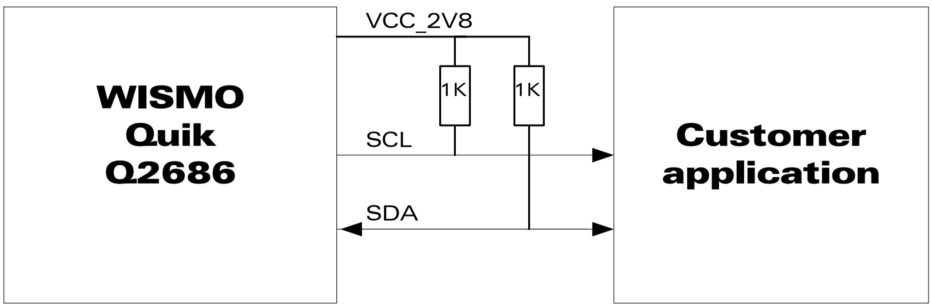


Figure 18: Second example of I²C bus application

The I²C bus is complying with the Standard mode (baud rate 100Kbit/s) and the Fast mode (baud rate 400Kbit/s). The pull up resistor value choice are depending of the mode used. For the Fast mode, it is recommenced to used 1K ohm resistor to ensure the compliance with the I²C specification. For the Standard mode, higher values of resistors can be used to save power consumption.

3.2.8 SIM interface

3.2.8.1 SIM 1.8V and 3V management

The SIM interface controls 1.8V and 3V SIM card.

It is recommended to add Transient Voltage Suppressor diodes (TVS) on the signal 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 signals to avoid any disturbance of the rising and falling edge.

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 references can be used: DALC208SC6 from ST Microelectronics.

<u>Typical implementation with SIM detection:</u>

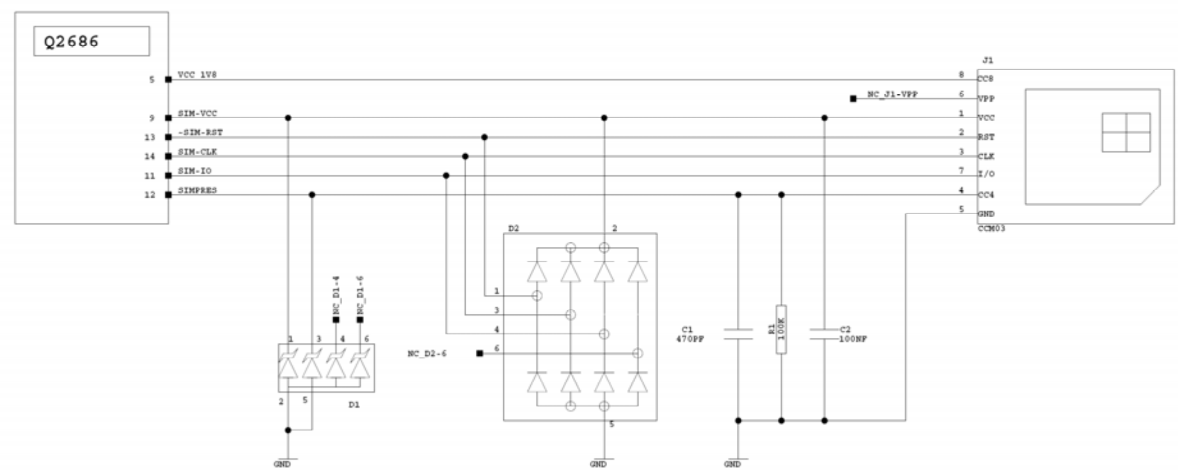


Figure 19: Example of SIM Socket implementation

Recommended components :

- R1 : 100K ohm
- C1 : 470pF
- C2 : 100nF
- D1 : ESDA6V1SC6 from ST
- D2 : DALC208SC6 from SGS-THOMSON
- J1 : ITT CANNON CCM03 series (See chapter 9.2 for more information)

The capacitor (C2) placed on the SIM-VCC line must not exceed 330 nF.

SIM socket connection:

Pin description of the SIM socket

Signal	Pin number	Description
VCC	1	SIM-VCC
RST	2	~SIM-RST
CLK	3	SIM-CLK
CC4	4	SIMPRES with 100 kΩ pull down resistor
GND	5	GROUND
VPP	6	Not connected
I/O	7	SIM-IO
CC8	8	VCC_1V8 of Wireless CPU (pin 5)

3.2.9 Keyboard interface

This interface provides 10 connections:

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

The scanning is a digital one, and the debouncing is done in the WISMO Wireless CPU. No discrete components like resistors or capacitors are needed.

The keyboard scanner is equipped with:

- internal pull-down resistors for the rows
- pull-up resistors for the columns.

Current only flows from the column pins to the row pins. This allows a transistor to be used in place of the switch for power-on functions.

Pin description of the Keyboard interface

Signal	Pin number	I/O	I/O type	Description
ROW0	68	I/O	1V8	Row scan
ROW1	67	I/O	1V8	Row scan
ROW2	66	I/O	1V8	Row scan
ROW3	65	I/O	1V8	Row scan
ROW4	64	I/O	1V8	Row scan
COL0	59	I/O	1V8	Column scan
COL1	60	I/O	1V8	Column scan
COL2	61	I/O	1V8	Column scan
COL3	62	I/O	1V8	Column scan
COL4	63	I/O	1V8	Column scan

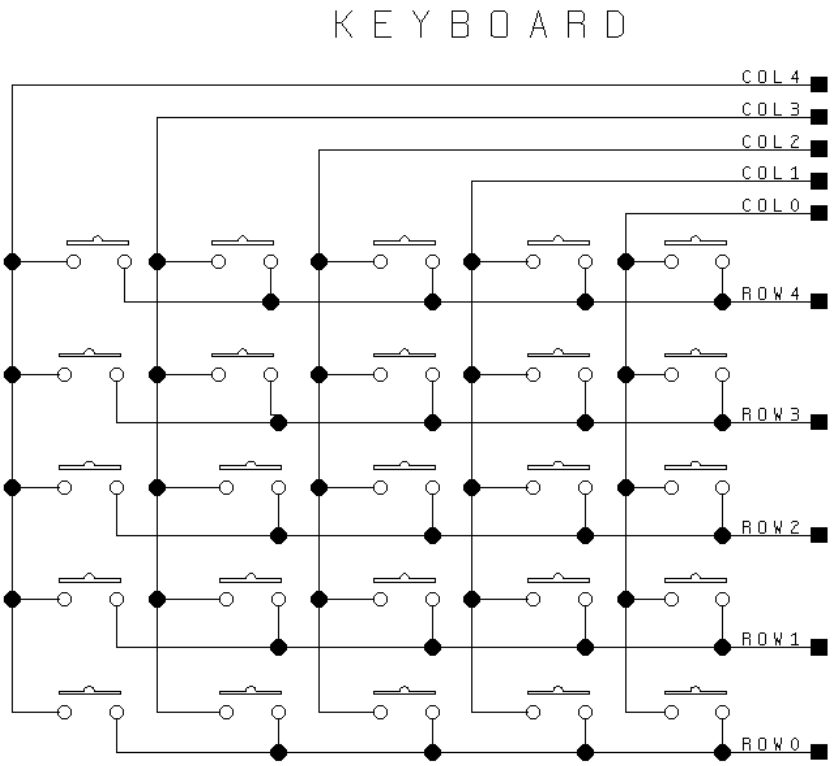


Figure 20: Example of keyboard implementation

3.2.10 Audio interface

3.2.10.1 General

WISMO Quik Q2686 supports:

- two different microphone inputs
- two different speaker outputs.

The WISMO Quik Q2686 also includes echo cancellation and noise reduction features improving quality of hands-free function.

In some cases, ESD protection must be added on the audio interface lines.

3.2.10.2 Microphone inputs

3.2.10.2.1 General description

The difference between main microphone inputs (MIC2) and auxiliary microphone inputs (MIC1) consists in the availability of an internal biasing for an electret microphone.

For both microphone paths the connection can be either differential or single-ended but using a differential connection in order 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.

When using single ended configuration , audio input signal decreases of 6dB comparing to a differential audio input signal.

3.2.10.2.2 Main Microphone Inputs (MIC2)

MIC2 inputs include an internal convenient biasing for an electret microphone. This electret microphone can be directly connected on these inputs, either in differential or single-ended mode.

AC coupling is already embedded in the Wireless CPU.

For electrical characteristics of MIC2 biasing , refer to document [2].

Pin description of the main microphone inputs

Signal	Pin number	I/O	I/O type	Description
MIC2P	36	I	Analog	Microphone 2 positive input
MIC2N	34	I	Analog	Microphone 2 negative input

3.2.10.2.3 MIC2 Differential connection example

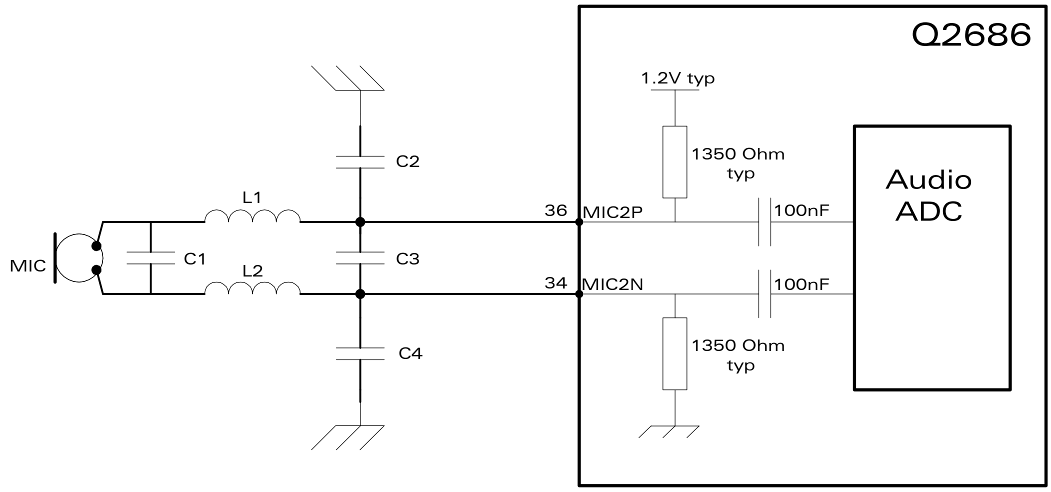


Figure 21: Example of MIC2 input differential connection with LC filter

Note : Audio quality can be very good without L1, L2, C2, C3, C4 depending of the design. But if there is EMI perturbation this filter can reduce the TDMA noise. This filter (L1, L2, C2, C3, C4) is not mandatory. If not used, capacitor must be removed and coil replace by 0 Ohm resistors as the following schematic.

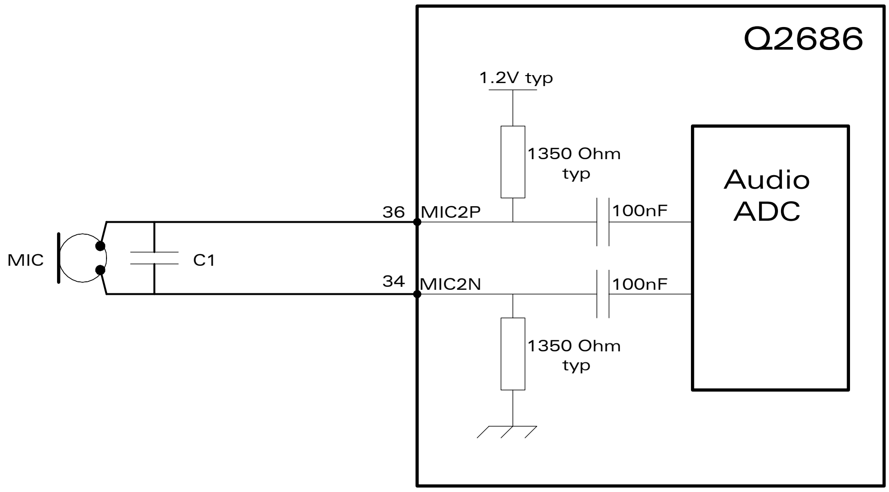


Figure 22: Example of MIC2 input differential connection without LC filter

The capacitor C1 is highly recommended to eliminate the TDMA noise. C1 must be close to the microphone.

Recommended components :

- C1 : 12pF to 33pF (depending of the design ,need to be tunned)
- C2, C3, C4 : 47pF (need to be tuned on the design)
- L1, L2 : 100nH (need to be tuned on the design)

3.2.10.2.4 MIC2 single-ended connection example

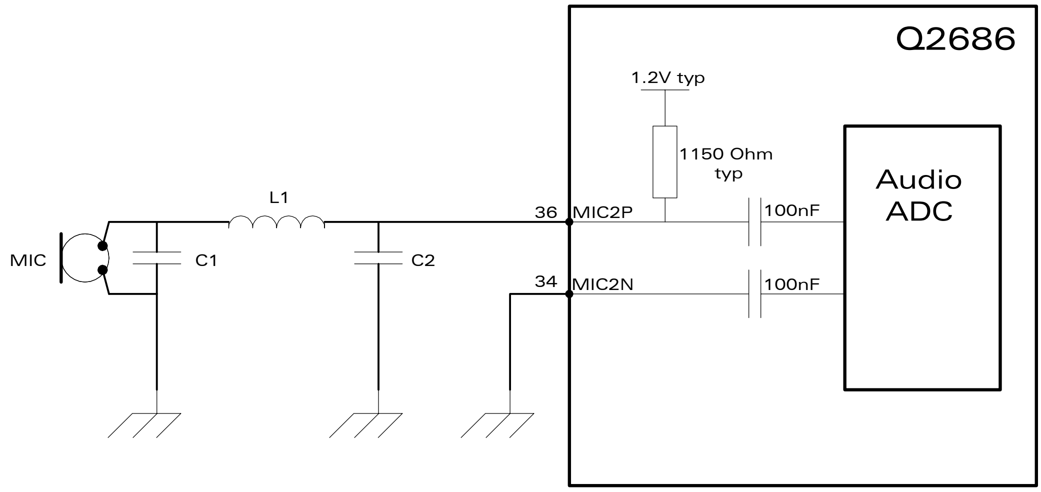


Figure 23: Example of MIC2 input single-ended connection with LC filter

The internal input resistor value becomes 1150 ohm, due to the connection of MIC2N to the ground.

The single ended design is not recommended for improve TDMA rejection noise. Usually, it's difficult to eliminate TDMA noise from a single ended design.

It is recommended to add L1 and C2 footprint to add a LC filter to try to eliminate the TDMA noise.

When not used , the filter can be removed by replacing L1 by a 0 Ohm resistor and by disconnecting C2, as the following schematic.

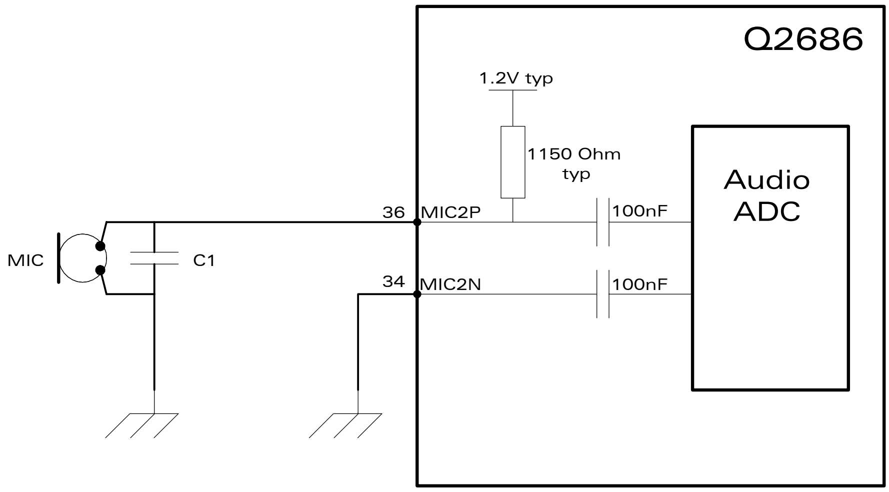


Figure 24: Example of MIC2 input single-ended connection without LC filter

The capacitor C1 is highly recommended to eliminate the TDMA noise. C1 must be close to the microphone.

Recommended components :

- C1 : 12pF to 33pF (depending of the design ,need to be tunned)
- C2 : Must be tuned. Depending of the design.
- L1 : Must be tuned. Depending of the design.

3.2.10.2.5 Auxiliary Microphone Inputs (MIC1)

MIC1 inputs do not includes internal biasing, making these inputs the standard ones for an external headset or a hands-free kit, connected either in differential or single-ended mode.

To use these inputs with an electret microphone, bias has to be generated outside the WISMO Quik Q2686 Wireless CPU according to the characteristics of this electret microphone.

AC coupling is already embedded in the Wireless CPU.

Pin description of the auxiliary microphone inputs

Signal	Pin number	I/O	I/O type	Description
MIC1P	40	I	Analog	Microphone 1 positive input
MIC1N	38	I	Analog	Microphone 1 negative input

3.2.10.2.6 MIC1 Differential connection example

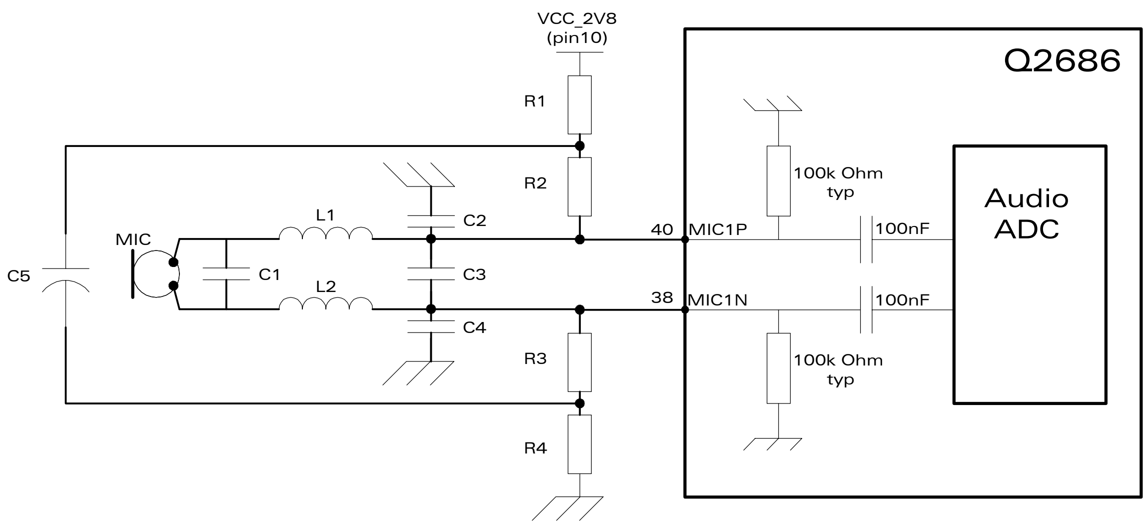


Figure 25: Example of MIC1 input differential connection with LC filter

Note : Audio quality can be very good without L1, L2, C2, C3, C4 depending of the design. But if there is EMI perturbation this filter can reduce the TDMA noise. This filter (L1, L2, C2, C3, C4) is not mandatory. When not used, capacitor must be removed and coil replace by 0 Ohm resistors as the following schematic.

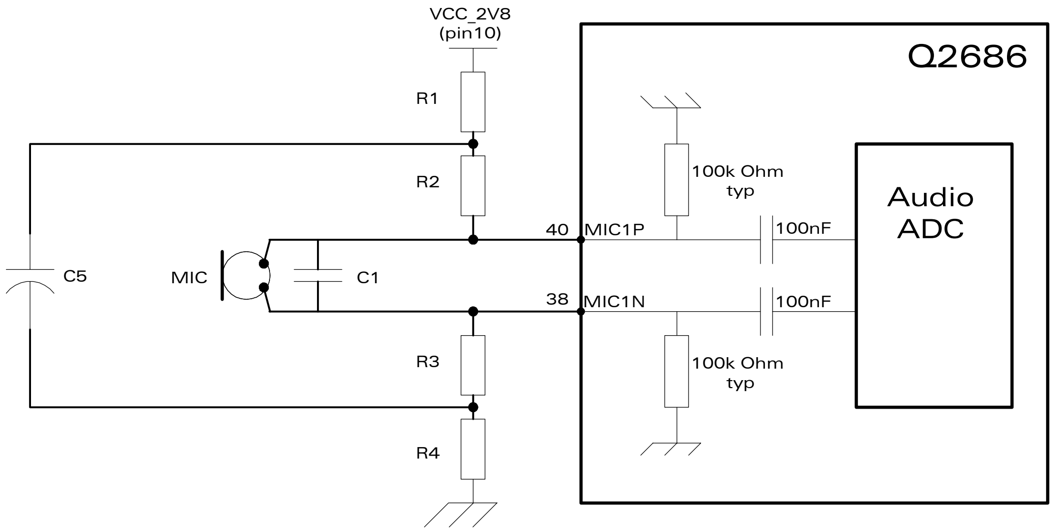


Figure 26: Example of MIC1 input differential connection without LC filter

The capacitor C1 is highly recommended to eliminate the TDMA noise. C1 must be close to the microphone.

Vbias can be VCC_2V8 (pin 10) of WISMO Quik Q2686 but it is possible to use another 2V to 3V supply voltage depending of the micro characteristics.

Be careful, if VCC_2V8 is used TDMA noise can degrade quality.

Recommended components :

- R1 : 4.7K ohm (for Vbias equal to 2.8V)
- R2, R3 : 820 ohm
- R4 : 1K ohm
- C1 : 12pF to 33pF (depending of the design ,need to be tunned)
- C2, C3, C4 : 47pF (need to be tuned on the design)
- C5 : 2.2uF +/- 10%
- L1, L2 : 100nH (need to be tuned on the design)

3.2.10.2.7 MIC1 Single-ended connection example

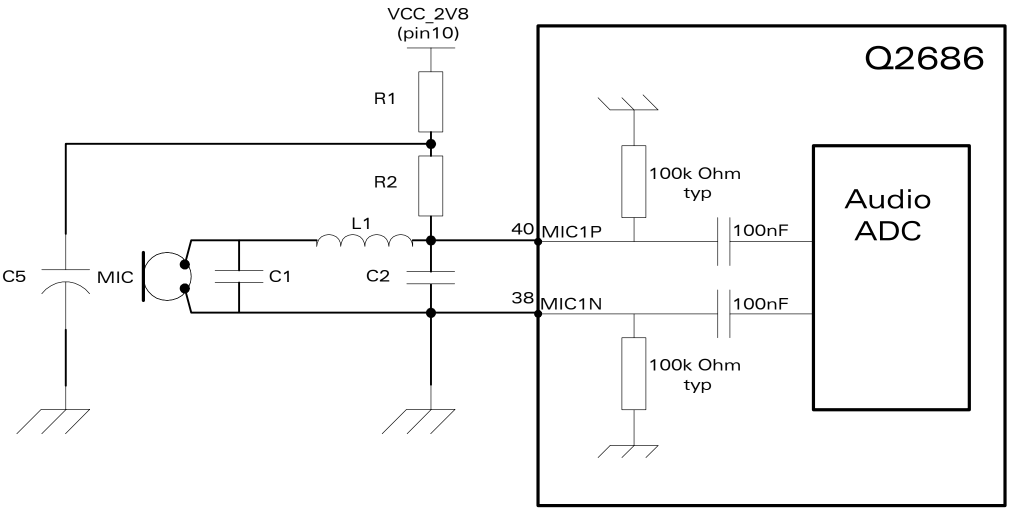


Figure 27: Example of MIC1 input single-ended connection with LC filter

The single ended design is not recommended for improve TDMA rejection noise. Usually, it's difficult to eliminate TDMA noise from a single ended design.

It is recommended to add L1 and C2 footprint to add a LC EMI filter to try to eliminate the TDMA noise.

When not used , the filter can be removed by replacing L1 by a 0 Ohm resistor and by disconnecting C2, as the following schematic.

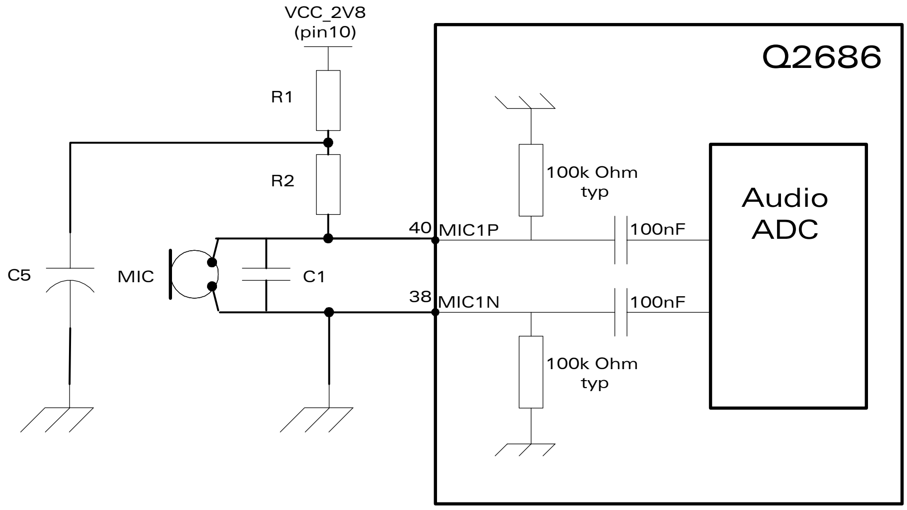


Figure 28: Example of MIC1 input single-ended connection without LC filter

Recommended components :

- R1 : 4K7 ohm (for Vbias equal to 2.8V)
- R2 : 820 ohm
- C1 : 12pF to 33pF (depending of the design ,need to be tunned)
- C2 : Must be tuned. Depending of the design.
- L1 : Must be tuned. Depending of the design.

Vbias must be very “clean” to avoid bad performance in case of single-ended implementation. That is the reason why Vbias could be an other 2 V to 3V power supply instead of VCC_2V8 which is available on system connector (pin 10).

Be careful, if VCC_2V8 is used TDMA noise can degrade quality.

The capacitor C1 is highly recommended to eliminate the TDMA noise. C1 must be close to the microphone.

3.2.10.3 Speaker outputs

Two different speaker channel are available on the WISMO Quik Q2686 Wireless CPU :

- SPK2 : Speaker 2 can be used as well in differential as single ended.
- SPK1 : Speaker 1 can be used only in single ended (SPK1P pin 35 only).

One of these outputs is single ended (SPK1) and the other one is differential output (SPK2), nevertheless it can also be used as single ended .

Speaker outputs can be directly connected to a speaker.

The gain of each speaker outputs channel is internally adjusted and can be tuned using an AT command (refer to AT Commands Interface Guide for OS 6.60[4]).

Warning : The maximal speakers output power of Q2686 is defined in the Q2686 specification (refer to document [2]). It 's mandatory to not exceed this maximal output power. The speaker load must be according to the gain selection (gain is controlled by AT command). If the maximal output power exceed the specification value, the module can be damaged.

Pin description of the Speaker 2 outputs

Signal	Pin number	I/O	I/O type	Description
SPK2P	39	O	Analog	Main Speaker 2 positive output
SPK2N	41	O	Analog	Main Speaker 2 negative output

Pin description of the Speaker 1 outputs

Signal	Pin number	I/O	I/O type	Description
SPK1P	35	O	Analog	Aux Speaker 1 positive output
SPK1N	37	O	Analog	Aux Speaker 1 negative output

For electrical characteristics of SPK1 and SPK2 , refer to document [2].

3.2.10.3.1 Common speaker output characteristics

The connection can be either differential (SPK2 only) or single-ended (SPK2 and SPK1) 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.

3.2.10.3.2 Differential connection

Figure 29: Example of Speaker differential connection

Impedance of the speaker amplifier output in differential mode is:

R ≤ 1Ω +/-10 %.

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

3.2.10.3.3 Single-ended connection

Typical implementation:

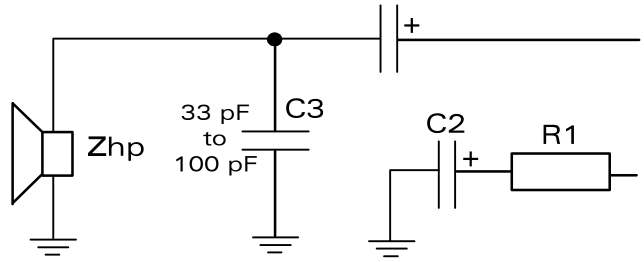


Figure 30: Example of Speaker single-ended connection

6.8 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 = 6.8 µF (ceramic).

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

When SPK1 channel is used, only SPK1P is useful, SPK1N can be left opened.

3.2.10.3.4 Recommended characteristics for the speaker

- Type: 10 mW, electro-magnetic.
- Impedance:
  - Z = 8 Ω for hands-free (SPK2).
  - Z = 32 Ω for headset kit (SPK1).
- Sensitivity: 110 dB SPL minimum (0 dB = 20 μPa).
- Frequency response compatible with the GSM specifications.

3.2.11 Buzzer / PWM interface

The buzzer output (BUZZ-OUT) is a digital one. A buzzer can be directly connected between this output and VBATT. This output is PWM controlled and can be used for others applications.

Pin description of the Buzzer / PWM interface

Signal	Pin number	I/O	I/O type	Description
BUZZ-OUT	15	O	Open Drain	Buzzer output

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.

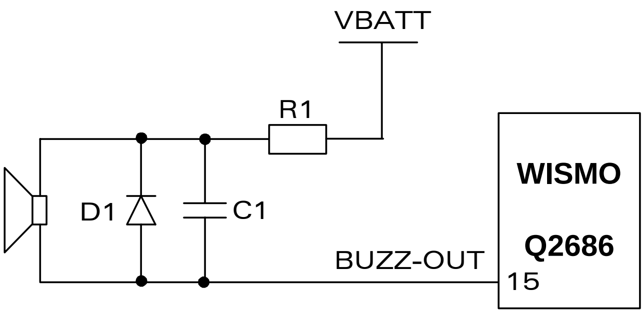


Figure 31: Example of buzzer implementation

Where:

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

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

D1 = BAS16 (for example)

<u>Recommended characteristics for the buzzer:</u>

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

The BUZZ-OUT output can also be used to drive a LED as shown in the Figure below:

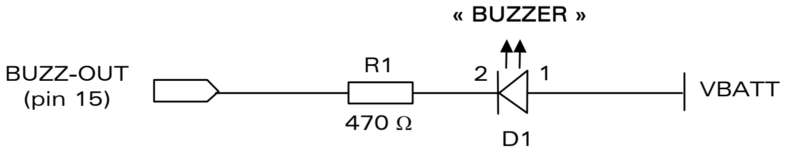


Figure 32: Example of LED driven by the BUZZ-OUT output

R1 value can be accorded depending of the LED (D1) characteristics.

For electrical characteristics of the BUZZ-OUT, refer to document [2].

3.2.12 Digital Power Supply for External Devices VCC_1V8 and VCC_2V8

Those output can be used to power some external functions. Those power supply is available when the Wireless CPU is on.

Pin description

Signal	Pin number	I/O	I/O type	Description
VCC_1V8	5	O	Supply	1.8 V Power supply for external digital devices
VCC_2V8	10	O	Supply	2.8 V Power supply for external digital devices

Those digital power supply is mainly used to:

- pull-up signals such as I/O
- supply the digital transistors driving LEDs
- supply the SIMPRES signal
- act as a voltage reference for ADC interface AUX-ADC (only for VCC_2V8)

The maximal current being able to be provided by each output is 15 mA.

For more electrical characteristics of the VCC_1V8 and VCC_2V8, refer to document [2].

3.2.13 External Interrupt

The WISMO Quik Q2686 Wireless CPU provides two external interrupt input with two different voltage.

Pin description of the External Interrupt input

Signal	Pin number	I/O	I/O type	Description
INT0	50	I	1V8	External Interrupt
INT1	49	I	2V8	External Interrupt

An interrupt can be activated with five type of transition :

- Low to High transition
- High to Low transition
- Low to High and High to Low transition
- Low level
- High level

INT0 and INT1 are high impedance input type, so it is important to set the interrupt input signal with pull up or pull down resistor if they are driven by an open drain, open collector or by a switch. If they are driven by a push-pull transistor, no pull up or pull down resistor are necessary.

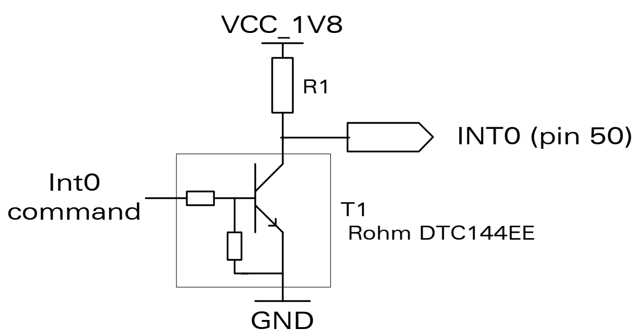


Figure 33: Example of INT0 driving example with open collector

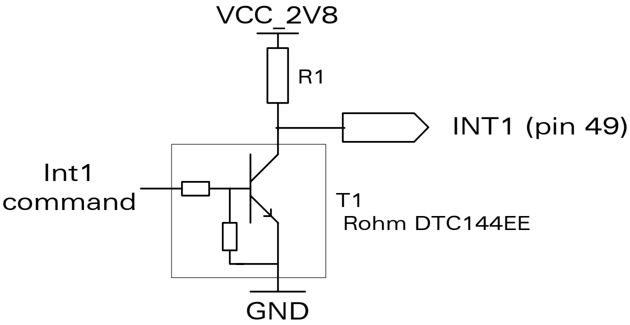


Figure 34: Example of INT1 driving example with open collector

Where:

R1 value can be 47K Ohm.

T1 can be a Rohm DTC144EE open collector transistor.

For electrical characteristics of the INT0 and INT1 signals , refer to document [2].

3.2.14 Analog to Digital Converters

WISMO Quik Q2686 provides two analog to digital converters, AUX-ADC and BAT-TEMP.

They are 10 bit resolution ADC ranging from 0V to 2V.

BAT-TEMP input can be used, typically, to monitor external temperature, useful for safety power off in case of application over heating.

AUX-ADC input can be used for customer application.

Pin description of the Analog to Digital Converters

Signal	Pin number	I/O	I/O type	Description
BAT-TEMP	20	I	Analog	A/D converter
AUX-ADC	21	I	Analog	A/D converter

3.2.14.1 BAT-TEMP Input for temperature monitoring

The BAT-TEMP input is used for battery monitoring during charging of battery. All informations are provided in the “Battery Charging” (see chapter 3.2.16).

3.2.15 USB interface

The USB interface of the WISMO Quik Q2686 Wireless CPU is a 2.0 slave compliant to the USB standard. The interface is a 3.3V typ one. To adapt the interface, one EMI/RFI filter which integer ESD diode is necessary. A power supply is also needed to supply the USB block of the Wireless CPU.

Typical schematic is described below :

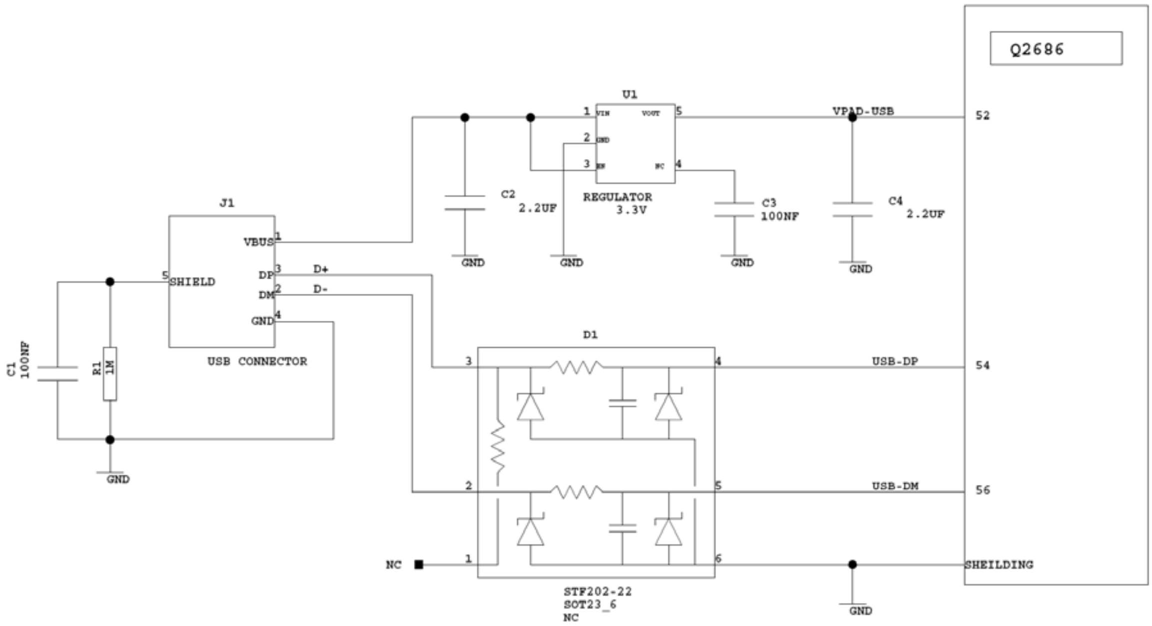


Figure 35: Example of USB implementation

Recommended components :

- R1 : 1MOhm
- C1, C3 : 100nF
- C2, C4 : 2.2µF
- D1 : STF2002-22 from SEMTECH
- U1 : LP2985AIM   3.3V from NATIONAL SEMICONDUCTOR

The regulator used is a 3.3V one. It is supply through J1 when the USB wire is plugged.

The EMI/RFI filter with ESD protection is D1. The D1 internal pull up resistor, used to detection of full speed, is not connected because it's embedded in the Wireless CPU.

R1 and C1 have to be close J1.

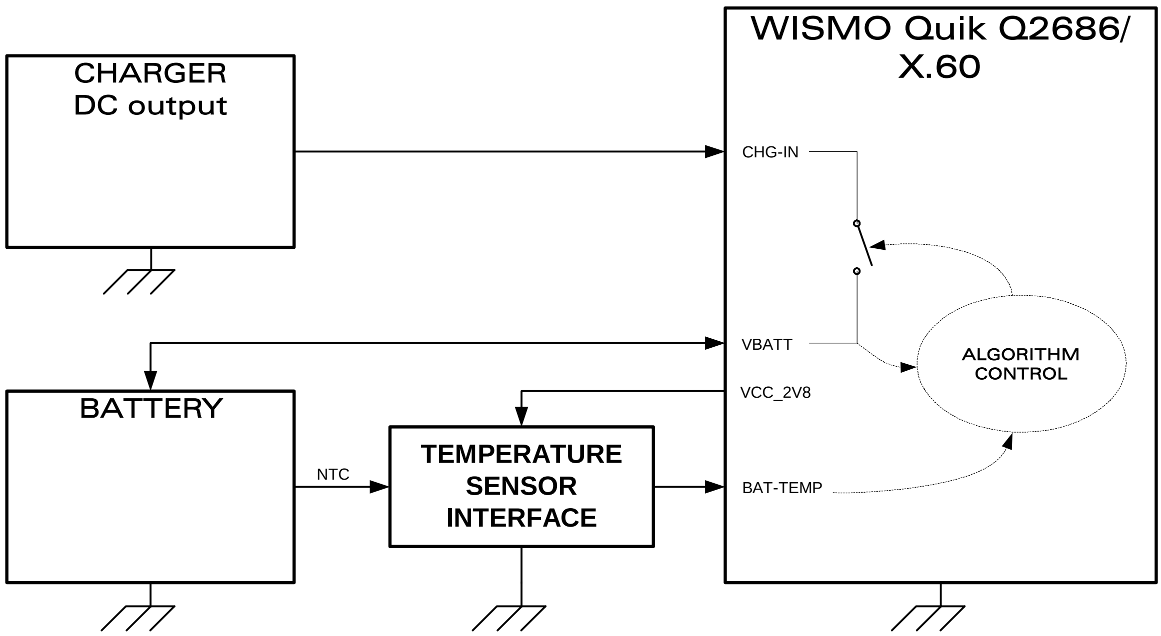
3.2.16 Battery Charging

The WISMO Quik Q2686 Wireless CPU supports one battery charging circuit, 2 algorithms and one hardware charging mode (Pré-charging) for 3 batteries technologies:

- Ni-Cd (Nickel-Cadmium) with algorithm 0
- Ni-Mh (Nickel-Métal Hydrure) with algorithm 0
- Li-Ion (Lithium-Ion) with algorithm 1

This chapter describes the typical charging application implementation.

3.2.16.1 Synoptic



The Q2686 charging circuit is composed of a transistor switch (between CHG-IN pin6,8 and VBATT pin 1,2,3,4).And the charging is controlled by 2 software's algorithms.

An dedicated ADC input BAT-TEMP pin 20 for temperature monitoring (only for Li-Ion battery technologies).

To use, the charging functionality, 3 hardware parts are necessary :

- A charger power supply

It provides an DC current power supply limited to 800mA and with voltage range according to the battery choice and to the WISMO Quik Q2686 specification.

- A battery

The charging functionality must be used with rechargeable battery only. Three battery types are supported : Li-Ion, Ni-Mh and Ni-Cd.

If the WISMO Quik Q2686 Wireless CPU is not powered (VBATT pin 1,2,3,4) by a rechargeable battery, it's mandatory to left opened the CHG-IN input (pin 6,8).

- A analog temperature sensor

Analog temperature sensor is only used for Li-Ion batteries for the monitoring of the batteries temperatures. This sensor is composed of NTC sensor and several resistors.

For all the electrical specification concerning the Charging interface, refer to document [2]

3.2.16.2 Charger Recommendations

This paragraph defines and specifies the AC/DC adapter for a battery cell.

Parameter	Min	Typ	Max	Unit	Remark
Input voltage	90		265	Vrms	
Input frequency	45		65	Hz	
Output voltage limit			6	V	No load
Output voltage limit	4.6			V	Io max
Output current	(1)	1C (2)	(3)	MA	
Output Voltage Ripple			150	MVpp	Io max Vout=5.3V

Notes:

(1) see the cell battery specifications for conditions current charging.

(2) 1C = Nominal capacity (of the battery cell).

(3) see the cell battery specifications for conditions current charging.T1 and D1 must be chosen according to the nominal capacity battery cell.

We recommend, the output voltage (Vo) falls under 1.18V in less 1 second, when the adapter AC/DC is unplugged.

3.2.16.3 CHARGING ALGORITHM

The X60 version, provides charging algorithms for the Li-ion, Ni-Mh and Ni-Cd batteries.

One algorithm is dedicated to the Ni-Mh and Ni-Cd batteies and the second one to the Li-Ion batteries. The second one provides temperature monitoring.

The charging algorithms is controlled by two AT commands :

- AT+WBCI
- AT+WBCM

Please refer to the AT Commands Interface Guide for OS 6.60[4], for more information about AT+WBCM command and +WBCI indication. The AT command sets the charging battery parameters, selects the type of battery and starts/stops the charging battery.

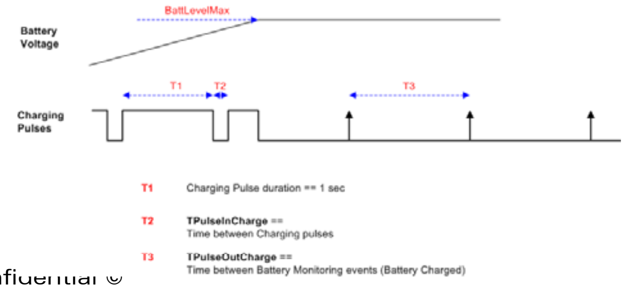
Note : In this chapter, the parameters in bold and italic type can be modified with AT+WBCM command.

3.2.16.3.1 Ni-Cd/Ni-MH Charging Algorithm

The algorithm measures the Battery Voltage (DC switch open).

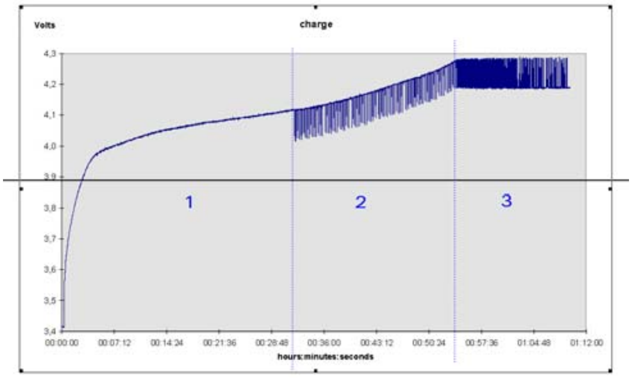
If the Voltage is below ***BattLevelMax***, the switch is closed for 1 sec and open for a time specified by ***TPulseInCharge*** (typically 100 ms), then the switch is closed again.

When the Battery Voltage has reached ***BattLevelMax***, the S/W monitors the battery voltage (typically every 5 secs; specified by ***TPulseOutCharge)***



3.2.16.3.2 Li-ion Charging Algorithm

FULL CHARGE



The charge was done with an empty battery, in order to know the maximum duration of a full charge.

In this case, the test underlines a 1 hr long charge.

We can see the three parts of a charge:

1- Constant current charge, until the battery voltage reaches

< *DedicatedVoltStart* > (4.1V on the graph above but 4.0V as default value).

2 -The beginning of the pulse charge alternating 1 second charge pulse and 100 ms rest.

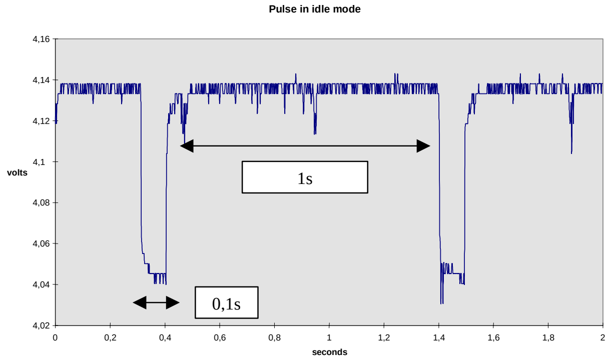
3 -The end of the pulse charge, when the rest period lasts longer, because the voltage exceeds *BattLevelMax* (4.2 V default value) during the rest period.

The charge stops when the battery voltage exceeds 4.2 V (by default) and when not charging during at least 10 s (see § 5.2.3 Rest between two pulses).

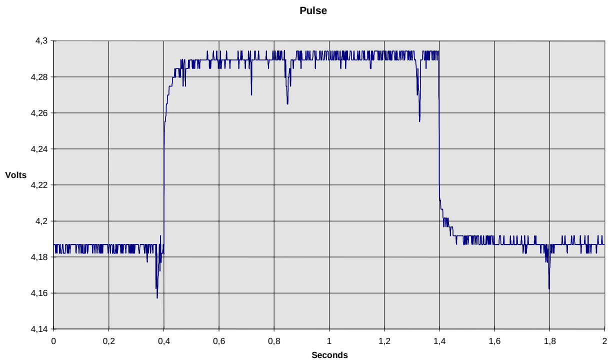
PULSE APPEARANCE IN STEP 2

The pulse is always 1 s long, and it does not depend on the battery voltage. The pulse charge starts when, while charging, the battery voltage reaches *DedicatedVoltStart*.

At the beginning of the pulse charge, the battery voltage looks like a square signal, with a 91% duty cycle.



This lasts until the voltage does not exceed *BattLevelMax* while resting.

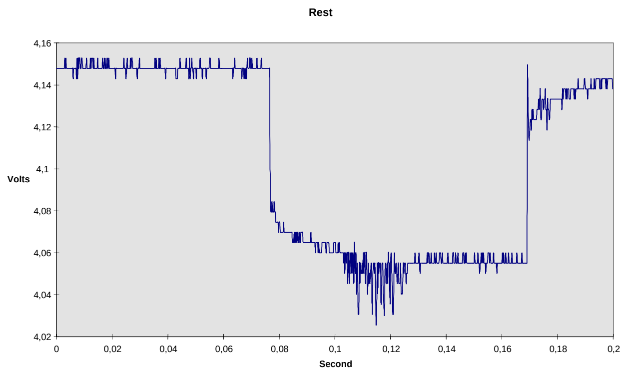


REST BETWEEN TWO PULSES IN STEP 3

The rest period between two pulses lasts as long as the voltage stays beyond 4.2 V (phase 3 only). This can happen at the end of the charge, when the battery is almost full.

In this case, the pulse length is still the same, but the rest time between 2 pulses increases, regularly, until it reaches 10 s.

If this period lasts more than 10 s, then the charge stops (the battery is full charged). The minimum is 100 ms.



3.2.16.3.3 Recharge

When the charge stops because the maximum battery level reached, if the charger is left plugged the charging algorithm wait that the delta voltage reaches 103mV and five minutes before authorizing a new charge.

3.2.16.3.4 Temperature management (analogue temperature sensor)

The Li-ion charging algorithm manages the battery temperature (NTC). The values, minimum and maximum temperatures, are configurable by AT command.

Schematic

The VCC_2V8 (pin 10) voltage provided by the WISMO Quik Q2686 Wireless CPU can be used to polarized the CTN. But additional resistors, R1 and R2, must be used to adjust the maximal voltage at the ADC input to 2Volt.

If an other polarized voltage is used, the resistors must be adapted.

It is not recommended to used the VCC_1V8 (pin 5) voltage.

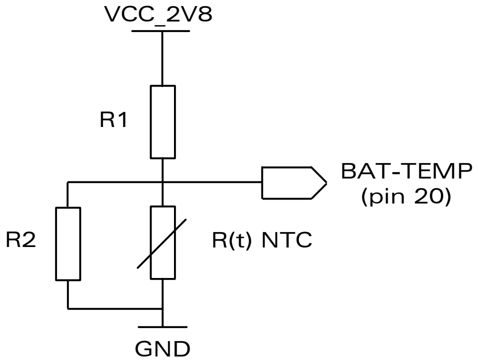


Figure 36: Example of ADC application

The R(t) resistor is the NTC which must be close to the battery. Usually it's integrated into the battery.

Computing method : (t represents ambient temperature, in °C):

The resistor value depends on the temperature :

$$R(t) = R(t_0)\ e^{B\left(\frac{1}{t+273} - \frac{1}{t_0+273}\right)}$$

- t_0 represents the ambient temperature (+25), in °C associated to R(to) (nominal resistor)
- « B » is the thermal sensibility (4250K).
- « t » represents the temperature, in °C.

$$R(t) = R(t_0)\ e^{B\left(\frac{25-t}{298*(t+273)}\right)}$$

$$V_{BAT-TEMP} = \frac{(R(t)//R2)}{(R(t)//R2)+R1} * VCC\_2V8$$

$$BatteryTemperature(mV) = V_{BAT-TEMP} * 1000$$

Recommended components :

- R1 : 100K ohm **TBC**
- R2 : 270K ohm **TBC**
- R(t) at 25°C : 100K ohm **TBC**

3.3 RF circuit

3.3.1 GSM/GPRS antenna connection

3.3.1.1 Antenna specifications

The GSM/GPRS antenna must fulfill the requirements given in the table hereafter.

A dual-band, tri-band or quad-band antenna can be used, depending on customers applications. Antenna must have the following characteristics:

<table>
<tr><th colspan="2">Characteristics</th><th>GSM 850</th><th>E-GSM900</th><th>DCS 1800</th><th>PCS 1900</th></tr>
<tr><td colspan="2">Frequency TX (MHz)</td><td>824-849</td><td>880-915</td><td>1710-1785</td><td>1850-1910</td></tr>
<tr><td colspan="2">Frequency RX (MHz)</td><td>869-894</td><td>925-960</td><td>1805-1880</td><td>1930-1990</td></tr>
<tr><td colspan="2">Impedance</td><td colspan="4">50 Ohm</td></tr>
<tr><td rowspan="2">VSWR</td><td>Rx max</td><td colspan="4">1.5 : 1</td></tr>
<tr><td>Tx max</td><td colspan="4">1.5 : 1</td></tr>
<tr><td colspan="2">Polarization</td><td colspan="4">Linear, vertical</td></tr>
<tr><td colspan="2">Typical radiated gain</td><td colspan="4">0 dBi in one direction at least</td></tr>
</table>

Note:

- WAVECOM recommends a VSWR max of 1.5:1 for Rx and Tx bands. Nevertheless, all aspects of this specification will be fulfilled even with a VSWR max. of 2:1.

GSM antenna providers:

Refer to paragraph 9.7.

3.3.1.2 Antenna implementation

The antenna should be isolated as much as possible from analog & digital circuitry (including interface signals).

On applications with an embedded antenna, a poor shielding could dramatically affect the receiving sensitivity. Moreover, the power radiated by the antenna could affect the application (TDMA noise for instance).

As a general recommendation, 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 Wireless CPU. In such a case, correct power supply layout and shielding shall be designed and validated.

Components near RF connections or unshielded feed line must be prohibited.

RF lines must be kept as short as possible to minimize losses.

4 PCB Design

4.1 General Rules and Constraints

On the application board, it is strongly recommended to avoid routing any signals under the Wireless CPU.

Clock and other high frequency digital signals (e.g. 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.

4.2 Specific Routing Constraints

4.2.1 System Connector

- Refer to the reference of the 100-pin receptacle (from NAIS) given in paragraph "9. Manufacturers and suppliers".
- More detailed information is also available at the following internet address: http://www.naisweb.com/e/connecte/con_eng/.

4.2.2 Power Supply

4.2.2.1 Routing constraints

- 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 Wireless CPU supply).
- Pins 1, 2, 3 and 4 should be gathered in a same piece of copper, as shown in the figure hereafter.

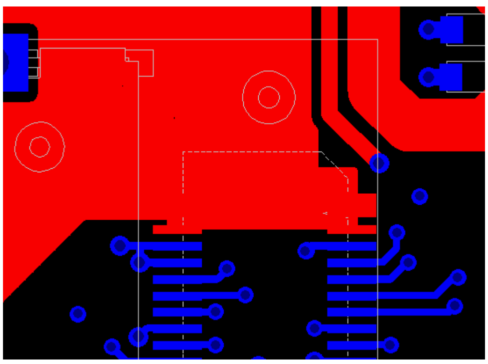


Figure 37 :Example of power supply routing

- Filtering capacitors, near the Wireless CPU power supply, are recommended (22μF to 100μf).

- Attention shall be paid to the ground track or the ground plane on the application board for the power supply which supplies the Wireless CPU.
  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 Wireless CPU and the power supply, is a ground plane, it must not be parceled out.
- The routing must be done in such a way that the total line impedance could 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.

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

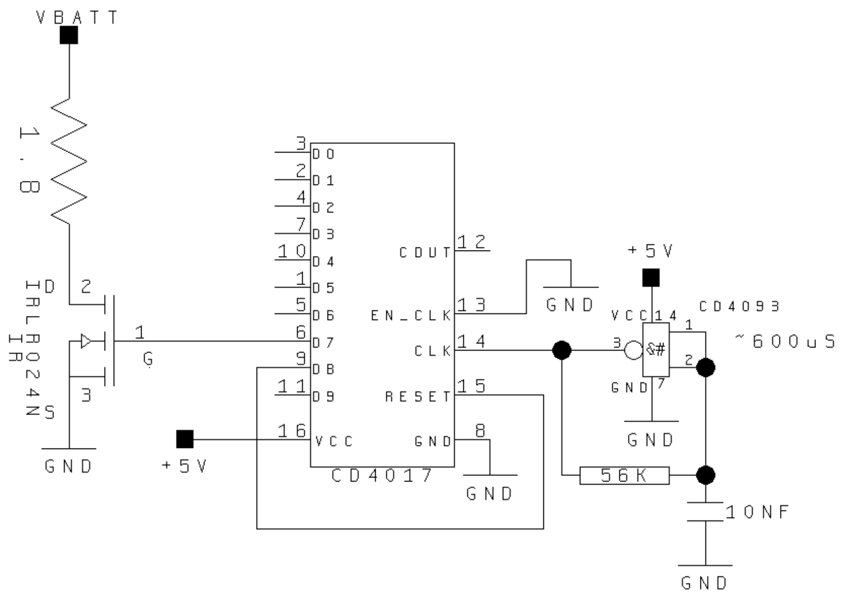


Figure 38: Burst simulation circuit

4.2.2.2 Application Ground Plane and Shielding connection

The WISMO Quik Q2686 Wireless CPU shielding case is linked to the ground. The ground has to be connected on the mother board through a complete layer on the PCB.

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

- The bottom side shielding of the WISMO Wireless CPU is achieved through the top folded tin cover connected to the internal ground plane of the Wireless CPU. 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 Wireless CPU, 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.

4.2.3 SIM interface routing constraints

- For the SIM interface, length of the tracks between the WISMO Wireless CPU and the SIM socket 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 socket is possible.
- The capacitor on SIM_VCC signal (100 nF) must be placed as close as possible to the DALC208SC6 component on the PCB (refer to paragraph 3.2.8).

4.2.4 Audio circuit 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.

4.2.5 RF circuit routing constraints

4.2.5.1 General recommendations

If RF signals need to be routed on the application board, the following recommendations must be observed for the PCB layout:

1. The RF signals must be routed using tracks with 50 Ω characteristic impedance.

   Basically, the characteristic impedance depends on: the dielectric, the track width and the ground plane spacing.

   In order to respect this constraint, WAVECOM recommends to use MicroStrip or StripLine structure and compute the Tracks width with a simulation tool (like AppCad shown in the Figure below and that is available free of charge at the following internet address: http://www.agilent.com).

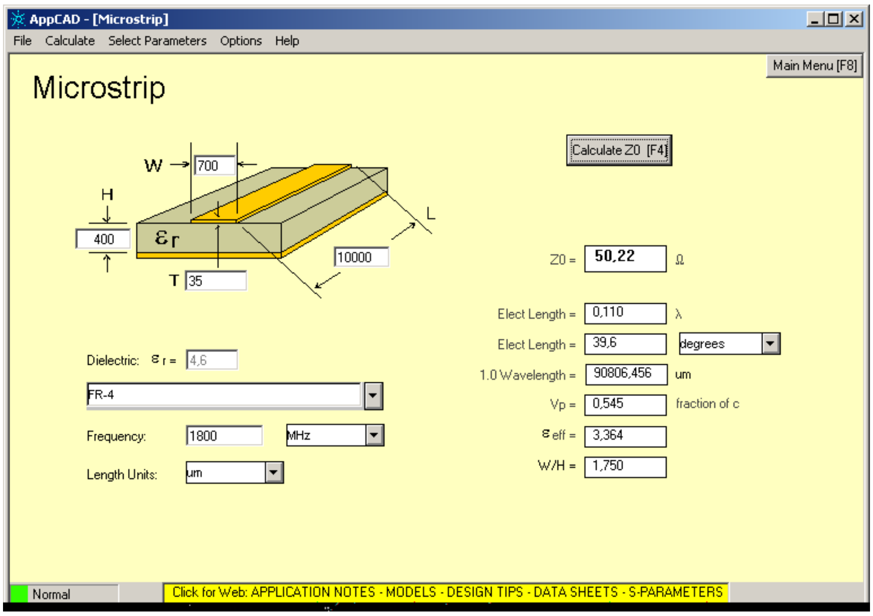
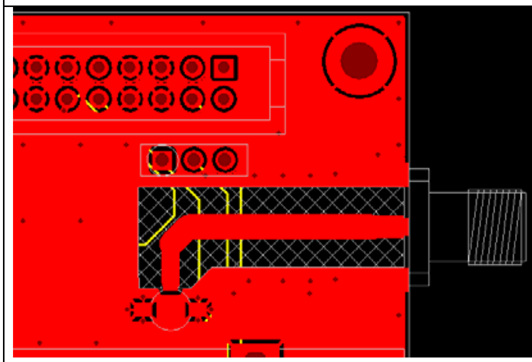
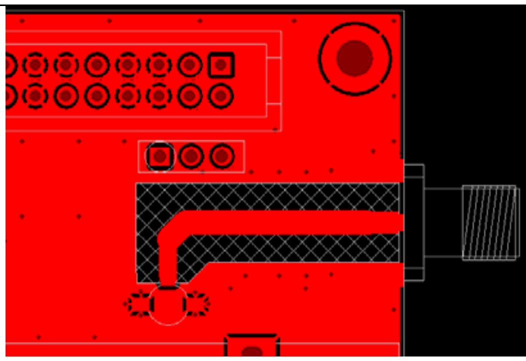


Figure 39: AppCad Screenshot for MicroStrip design

- If multi-layer PCB is used, the RF path on the board **must not cross** any signals (digital, analog or supply).

  If necessary, use StripLine structure and route the digital line(s) "outside" the RF structure as shown in the figure below:

Bad routing	Correct Routing
	
The yellow traces cross the RF trace.	There is no signal around the RF path.

- Stripline and Coplanar design require to have a correct ground plane at both sides. Consequently, it is necessary to add some vias along the RF path.
- It is recommended to use **Stripline design** if the RF path is fairly long (**more than 3 cm**), since MicroStrip design is not shielded.

  Consequently, the RF signal (when transmitting) may interfere with neighboring electronics (AF amplifier…). In the same way, the neighboring electronics (micro-controller) may degrade the reception performances.

4.2.5.2 Connection possibilities

If the GSM/GPRS RF connections need to be implemented on the application board (for mechanical purposes for instance), there are three main connection possibilities:

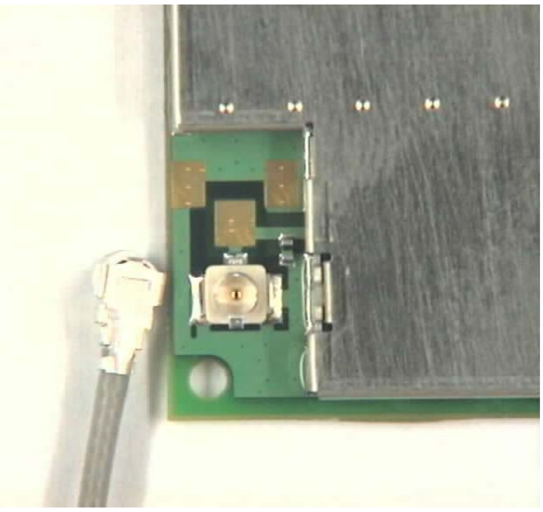
- via UFL/SMA cable
- via coaxial cable
- Via IMP connector

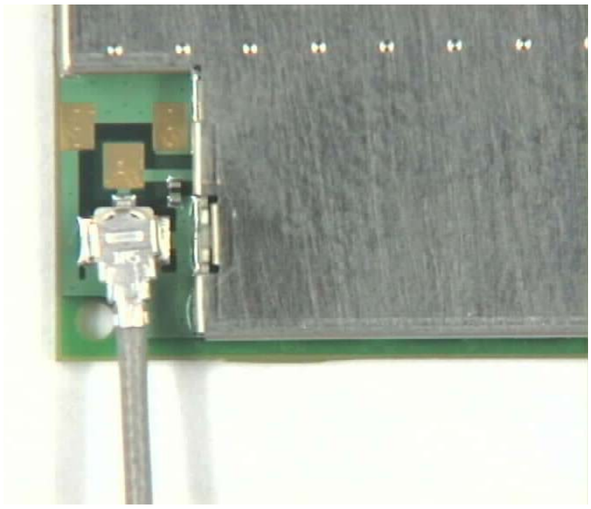
4.2.5.2.1 UFL/SMA connector

The antenna can be connected to the Wireless CPU through the UFL connector present on the Wavecom Wireless CPU.

- Insert the plug in the receptacle

This step is done prior to the Wireless CPU mounting.





4.2.5.2.2 Coaxial cable on the back side of the Wireless CPU

The antenna can be connected to the Wireless CPU through a coaxial cable. The coaxial cable is connected to both the "RF pad" (or Round pad) and the "Ground pad".

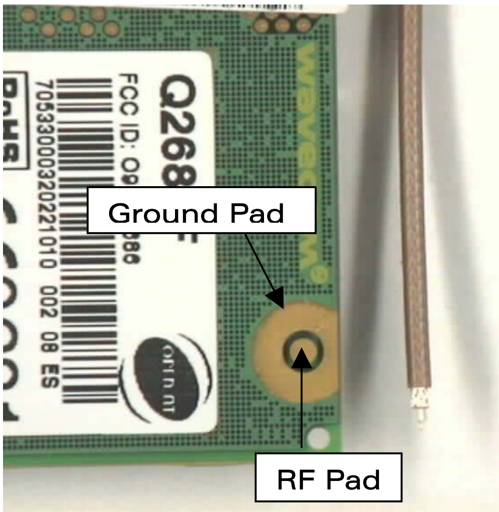
It is recommended to use a RG178 coaxial cable:

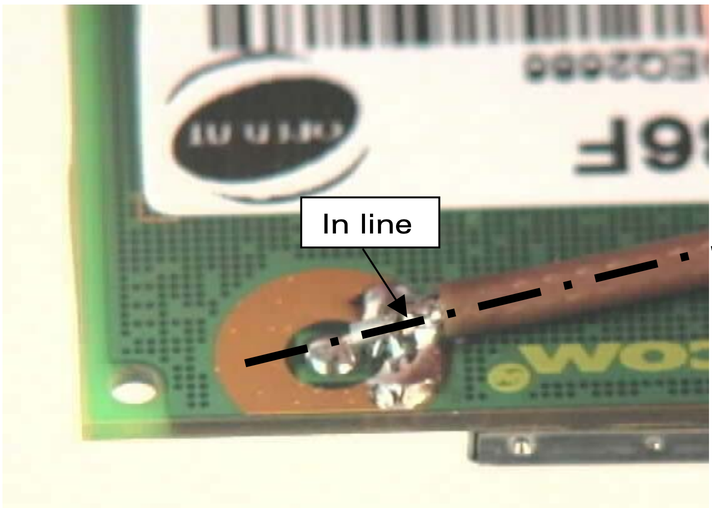
- o Static curvature radius: 10mm
- o Dynamic curvature radius: 20mm

The cable must be soldered as described on the mechanical drawing in the following page:

- The shielding of the antenna cable must be soldered on the “Ground pad”.
- The antenna cable core must be soldered only once positioned in line with the “RF pad” and “Ground Pad”.
- It is highly recommended to use a template to adjust the antenna cable to the “RF pad” and “Ground Pad” before soldering

This step is done after the Wireless CPU mounting.





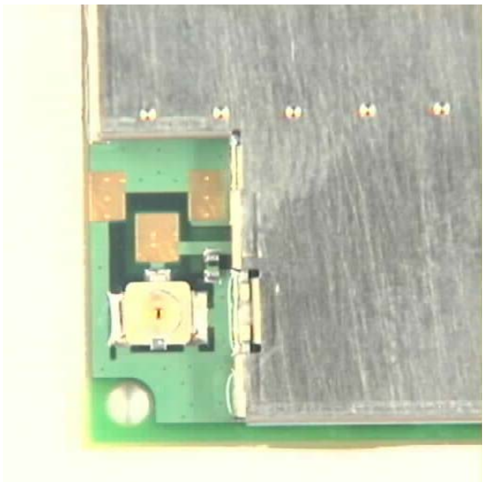
When soldering the antenna cable, the temperature of the iron must not exceed 350°C during 3s.

Note: the coaxial cable can be soldering in every direction. It can also be soldering on “the opposite direction”. In that case it is necessary to make a curve (as describe on the figure bellow).

4.2.5.3 Via IMP connector

The antenna can be connected to the Wireless CPU through an IMP connector that must be assembled on the customer board.

The description of the contact pad on Q2686 CPU is described in section 4.3.



IMP connector is fragile. Special attention should be taken when handling the customer board in order to prevent any damage on it.

- No additional process step

Concerning mounting, assembly and handling of this component, please contact directly the supplier Radiall. Wavecom can not support the customer regarding the use of this connector.

4.2.5.4 RF circuit for GSM/GPRS function

The GSM/GPRS connector is intended to be directly connected to 50Ω antenna. No matching need.

4.3 Pads design

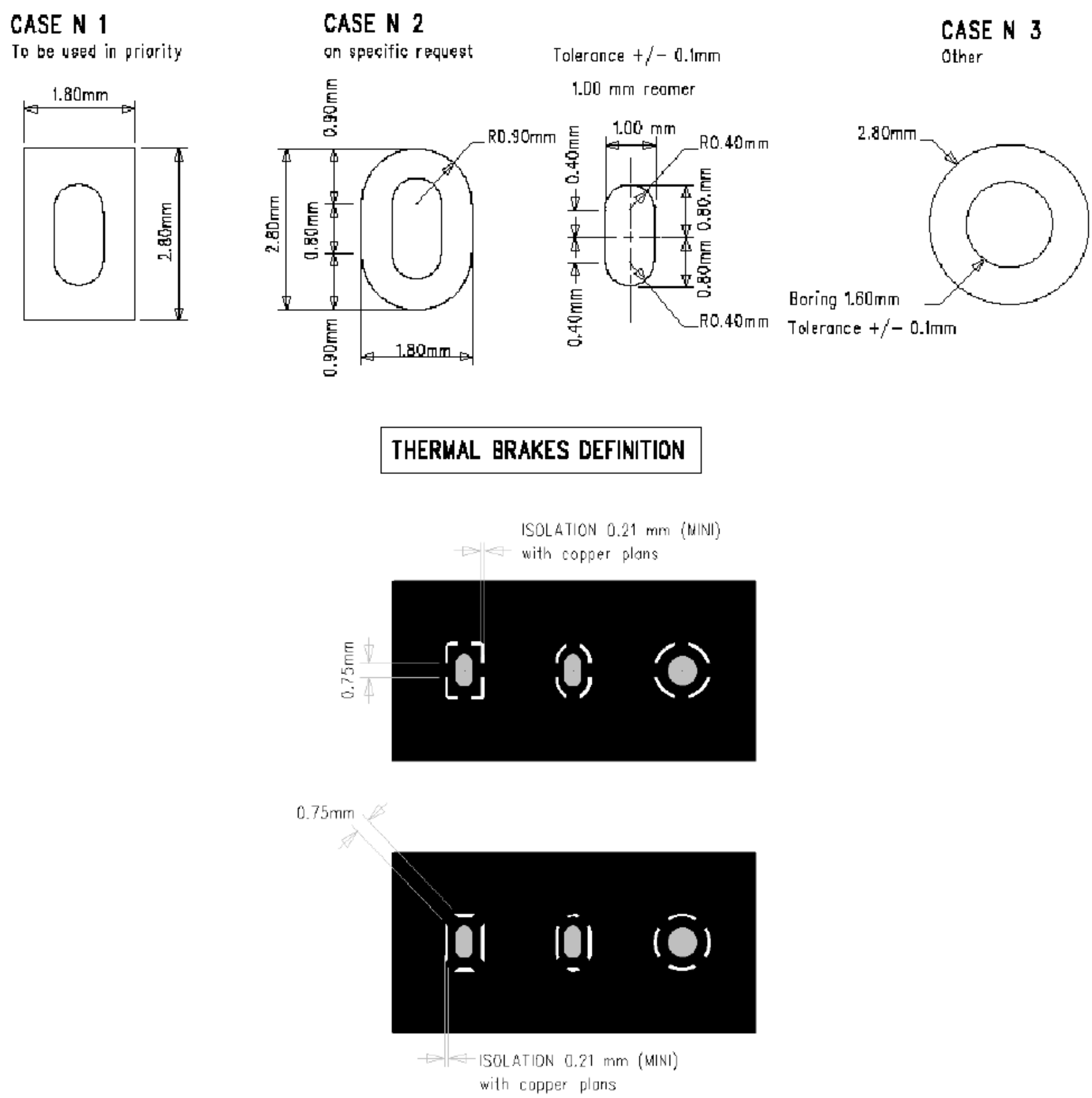
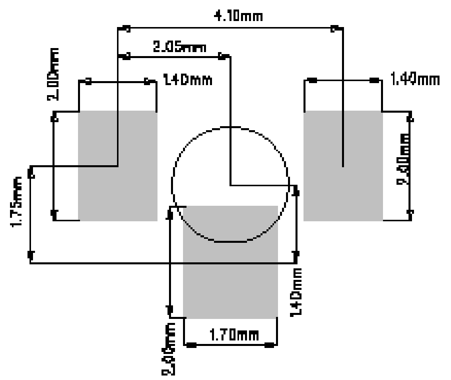


Figure 40: Pads design

It is strongly recommended to use through hole pads for the 4 legs of the Q2686. If the hole are connected internally to ground plane, please use thermal brakes.

IMP CONTACT PAD _ WAVECOM SIDE



INDUSTRIAL NORMALIZATION	WRITTEN BY : HER	DATE : 07/02/06
	APPROUVED BY : ASC	SECTION : 01P102
	IMP CONNECTOR PAD DESIGN	

5 Mechanical Specifications

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

That drawing gives, among other things:

- the drill template for the four pads to be soldered on the application board,
- the dimensions and tolerance for correctly placing the 100-pin female connector on the application board.

In addition, it is strongly recommended to plan a free area (no components) around the Wireless CPU in order to facilitate the removal/reassembly of the Wireless CPU on the application board.

- Thermal behavior
  - Be aware that when transmitting, the Q2686 will heat itself (because of the internal Power Amplifier). This self heating will generate a temperature increase may warm the application board on which the Q2686 is soldered. This is especially true for GPRS Class 10 use in low band.

6 EMC and ESD recommendations

The EMC tests have to be performed as soon as possible on the application 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 (if accessible from outside), serial link, etc. Refer to paragraph 3.2.8 SIM interface
- Length of the SIM interface lines (preferably <10cm)
- EMC protection on audio input/output (filters against 900 MHz emissions), refer to paragraph 3.2.10 audio interface
- Bias of the Microphone inputs, refer to paragraph 3.2.10.2 audio interface
- Ground plane : WAVECOM recommends to have a common ground plane for analog / digital / RF grounds
- Metallic case or plastic casing with conductive paint are recommended

Note:

The Wireless CPU does not include any protection against overvoltage.

7 Firmware upgrade requirements

The firmware upgrade process consists in downloading a GSM/GPRS software into the corresponding flash memories internal to the WISMO Quik Q2686 Wireless CPU.

For GSM/GPRS software, the downloading is done through the GSM Main Serial link port (UART1) connected to a PC.

The way for downloading a software into the WISMO Q2686 Wireless CPU is using the XMODEM protocol.

A specific AT command is used to start the download : AT + WDWL (refer to AT Commands Interface Guide for OS 6.60[4]).

Access to the following signals is required to carry out a downloading:

- UART1 Main serial link signals:
    - CT103-TXD1,
    - CT104-RXD1,
    - ~CT106-CTS1,
    - ~CT105-RTS1,
    - GND,

Consequently, it is very important to plan an easy access to these signals during the hardware design of the application board.

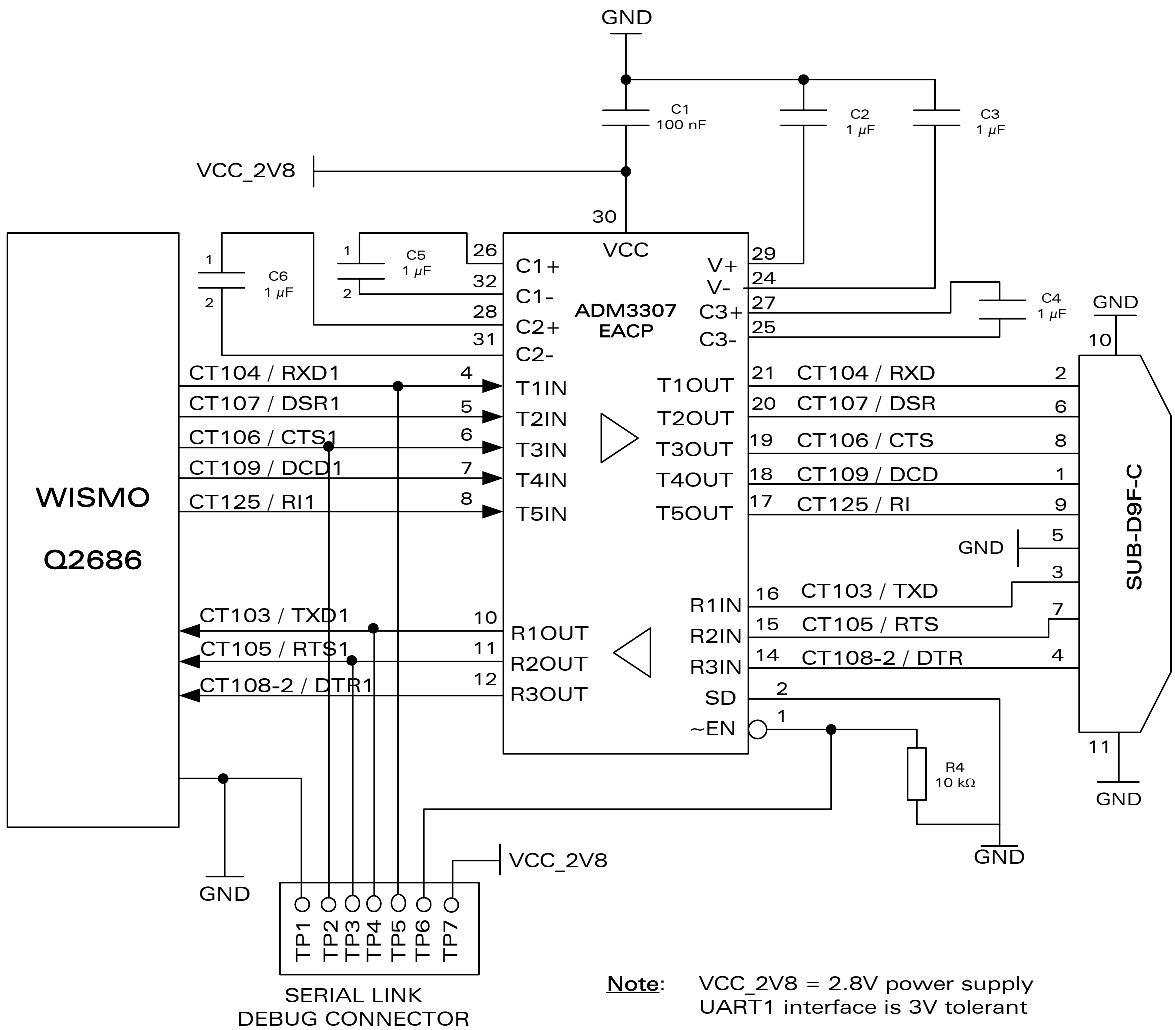
8 Embedded Testability

8.1 Access to the serial link

Direct access to UART1 serial link is very useful for:

- Testability operations,
- Firmware download.

To allow that access, the following design is recommended:



Note: VCC_2V8 = 2.8V power supply
UART1 interface is 3V tolerant

Figure 41: Main UART1 serial link debug access

When it is necessary to download a firmware into the WISMO Wireless CPU without going through the RS232 interface, access to the Wireless CPU is forced via the debug connector. In such a case, input signals coming from this connector mask the input signals coming from the ADM3307 device.

VCC_2V8 and GND are available on the debug connector to allow the powering of an external RS232 transceiver in order to, for example, communicate with a PC via a COM port (COM1 or COM2).

Through the debug connector, it is also possible to spy the signals on the serial link.

Note: R1 is used to have the possibility to disable the R1OUT, R2OUT and R2OUT of the ADM3307 by the enable signal (~EN) when the debug connector is used. For used the debug connector, the TP6 must be connected to VCC_2V8. For normal used, the TP6 must be left opened.

An economical solution consists in making the debug connection using 7 Test points (TP) and placing these points to the edge of the application board.

8.2 RF output accessibility for diagnostic

During the integration phase of the Wireless CPU, it can be helpful to connect the Q2686 Wireless CPU to a GSM/GPRS simulator in order to check some critical RF Tx parameters and the power behavior.

Even though the Wireless CPU has been certified, some parameters can be degraded because some basic precautions have not been taken (poor power supply for example).

Most of the time, this will not affect the functionality of the product, but the product will not comply with the GSM specifications.

The following TX parameters can be checked with a GSM/GPRS simulator:

- phase & frequency error,
- output power & GSM burst time template,
- output spectrum (modulation & switching).

Typical GSM/GPRS simulators available are:

- CMU200 from Rhode & Schwarz,
- 8960 from Agilent.

Because of the high price associated with the GSM/GPRS simulator and the necessary required GSM know-how, the customer can check its application in WAVECOM laboratory.

Please feel free to contact WAVECOM support team.

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 Q2686 Wireless CPU.

9.1 System connector

The GPC is a 100-pin connector with 0.5mm pitch of P5K series from PANASONIC group with the following reference :

AXK69510002

The matting connector has the following reference :

AXK59510001

The stacking height is 3.0 mm.

WAVECOM recommends to you to used the **AXK59510001** connector for your application to profit of WAVECOM's prices. For more information, contact WAVECOM by specifying the WAVECOM connector reference : **WM17077**.

For further details see GPC data sheets in appendix. More information is also available from http://www.panasonic.com/host/industrl.html

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.

A list of possible suppliers is given hereafter:

- 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.

A list of possible suppliers is given hereafter:

- 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 RF cable

A wide variety of cables fitted with UF-L connectors is proposed by HIROSE (refer to the UF-L datasheet in document [2]):

- UF-L pigtails,
- UF-L cable assemblies,
- Between series cable assemblies.

More information is also available from http://www.radiall.com/).

9.6 RF board to board connector

The supplier for the IMP connector is Radiall (http://www.radiall.com) with the following reference :

- R107 064 900.

9.7 GSM antenna

Provider	Reference	Adress	Contact
Mat Equipement	MA112VX00	Z.I. La Boitardière Chemin du Roy 37400 Amboise FRANCE	Laurent.LeClainche@matequipement.com Tel: +33 2 47 30 69 70 Fax: +33 2 47 57 35 06
ProComm	MU 901/1801/UMTS -MMS + 2M FME	Europarc 121, Chemin des Bassins F-94035 CRETEIL CEDEX	Tel: +33 1 49 80 32 00 Fax: +33 1 49 80 12 54 procom@procom.fr

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

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

9.8 Buzzer

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

WAVECOM S.A. - 3 esplanade du Foncet - 92442 Issy-les-Moulineaux Cedex - France - Tel: +33(0)1 46 29 08 00 - Fax: +33(0)1 46 29 08 08
Wavecom, Inc. - 4810 Eastgate Mall - Second Floor - San Diego, CA 92121 - USA - Tel: +1 858 362 0101 - Fax: +1 858 558 5485
WAVECOM Asia Pacific Ltd. - 4/F, Shui On Centre - 6/8 Harbour Road - Hong Kong - Tel: +852 2824 0254 - Fax: +852 2824 025