Wireless CPU® Q24 Series
Product Technical Specification

Revision: 005

Date: November 2007

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Wireless CPU® Q24 Series

Product Technical Specification

Reference: **WM_PGM_Q24NG_PTS_001**
Revision: **005**
Date: **November 20, 2007**

Powered by the Open AT® Software Suite

Document History

Revision	Date	List of revisions	
001	May 2006	Creation (Preliminary version)	
002	September 2006	First update	
003	November 2006	Update	
004	January 16, 2007	Modification of the ON/ ~OFF paragraph Modification of the Battery charging paragraph Modification of electrical characteristics BAT-TEMP Integration of ATEX conformance information	
005	November 7, 2007	Update	

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Overview

This Product Specification document defines and specifies the Wireless CPU® Q24 Series is available in four different GSM/GPRS Class 10 quad-band versions:

- **Q24 Classic**: **EGSM 900/1800/850/1900** MHz version with **32** Mb of Flash memory and **16** Mb of PSRAM (**32/16**), T° range **[-20°C / +55°C]**.

- **Q24 Plus**: **EGSM/GPRS 900/1800/850/1900** MHz version with **32** Mb of Flash memory and **16** Mb of PSRAM (**32/16**), T° range **[-20°C / +55°C]**.

- **Q24 Extended**: **EGSM/GPRS 900/1800/850/1900** MHz version with **32** Mb of Flash memory and **4** Mb of SRAM (**32/4**), extended T° range.

- **Q24 Automotive**: **EGSM/GPRS 900/1800/850/1900** MHz version with **32** Mb of Flash memory and **4** Mb of PSRAM (**32/4**), extended T° range.

  This version is dedicated to automotive applications.

This document covers the Wireless CPU® alone and do not include the programmable capabilities provided in Open AT® Software Suites.

For detailed software programming guides, refer to the documents shown in the "Reference Documents" section.

Open AT® Software Suites allow developers to natively execute ANSI C software programs directly on the Wireless CPU®.

Contents

Table of Figures

1 References

1.1 Reference Documents

For more details, several reference documents may be consulted. The Wavecom reference documents are provided in the Wavecom documents package contrary to the general reference documents, which are not Wavecom owned.

<u>Note</u>: All below documents are related to V3.12 Open AT® Software and 6.57 Open AT® Firmware. Wavecom recommends that the developer should check the web site for the latest documentation

1.1.1 Open AT® Software Documentation

[1]   Getting Started with Open AT® (Ref. WM_ASW_OAT_CTI_001)

[2]   Open AT® Basic Development Guide (Ref. WM_ASW_OAT_UGD_002)

[3]   ADL User Guide for Open ATA® V3.12 (Ref. WM_ASW_OAT_UGD_006)

1.1.2 AT Software Documentation

[4]   AT Commands Interface Guide for OS 6.57 (Ref. WM_ASW_OAT_UGD_0044)

[5]   AT Commands Interface Guide (Bluetooth) (Ref. WM_ASW_BLU_UGD_001)

1.1.3 Hardware Documents

[6]   Wireless CPU® Q24 Series Customer Design Guidelines
        (Ref. WM_PRJ_Q24NG_PTS_002)

[7]   Wireless CPU® Q24 Series Process Customer Guidelines
        (Ref. WM_PRJ_Q24NG_PTS_003)

1.1.4 Wavecom Reference Documents

[8]   Automotive Environmental Control Plan for Wireless CPU® Q24 Series
        (Ref. WM_PRJ_Q24NG_DCP_001)

[9]   Environmental Control Plan for Wireless CPU® Q24 Series
        (Ref. WM_PRJ_Q24NG_DCP_002)

1.1.5 General Reference Documents

[10] "I²C Bus Specification", Version 2.0, Philips Semiconductor 1998

[11] ISO 7816-3 Standard

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1.2 List of Abbreviations

Abbreviation	Description
3GPP	Third Generation Partnership Project
ADC	Analog to Digital Converter
A/D	Analog to Digital conversion
AT	ATtention (prefix for modem commands)
AUX	AUXiliary
CBS	Cell Broadcast Service
CLK	CLocK
CMOS	Complementary Metal Oxide Semiconductor
CODEC	COder DECoder
CPU	Central Processing Unit
CTS	Clear To Send
dB	Decibel
DC	Direct Current
DCD	Data Carrier Detect
DCS	Digital Cellular System
DCXO	Digitally Controlled Crystal Oscillator
DR	Dynamic Range
DSR	Data Set Ready
DTR	Data Terminal Ready
EDGE	Enhanced Data rates for GSM Evolution
EGSM	Extended GSM
EN	Enable
ESD	ElectroStatic Discharges
ETSI	European Telecommunications Standards Institute
FEM	Front End Module
FR	Full Rate
GND	GrouND
GPI	General Purpose Input
GPC	General Purpose Connector
GPIO	General Purpose Input Output
GPO	General Purpose Output
GPRS	General Packet Radio Service

Abbreviation	Description
GSM	Global System for Mobile communications
IF	Intermediate Frequency
INTR	INTeRrupt
I/O	Input / Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LSB	Less Significant Bit
MAX	MAXimum
MIC	MICrophone
MIN	MINimum
MMS	Multimedia Message Service
MS	Mobile Station
NOM	NOMinal
NTC	Negative Temperature Coefficient
PA	Power Amplifier
PBB	PolyBrominated Biphenyl
PBDE	PolyBrominated Diphenyl Ethers
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communications Services
PLL	Phase Lock Loop
RAM	Random Access Memory
RF	Radio Frequency
RI	Ring Indicator
RoHS	Restriction of Hazardous Substances
RST	ReSeT
RTC	Real Time Clock
RTS	Request To Send
RX	Receive
SCL	Serial CLock
SDA	Serial DAta
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	Serial Peripheral Interface

Abbreviation	Description
SPK	SPeaKer
SRAM	Static RAM
TDMA	Time Division Multiple Access
TU	Typical Urban fading profile
TUHigh	Typical Urban, High speed fading profile
TDMA	Time Division Multiple Access
TX	Transmit
TYP	TYPical
UART	Universal Asynchronous Receiver-Transmitter
VLSI	Very Large Scale Integration
VSWR	Voltage Standing Wave Ratio

2 General Description

2.1 General Information

The Q24 Series are self-contained EGSM/GPRS 900/1800 and 850/1900 quad-band Wireless CPU®s with the following characteristics:

Note:

The Q24 classic is limited to GSM only (GPRS not supported).

2.1.1 Overall Dimensions

Completely shielded:

- Length: 58.4 mm

- Width: 32.2 mm

- Thickness: 3.9 mm:

  - Excluding Shielding legs

  - 6, 2 mm for Q24 Automotive, which offers either a MMS or UFL connector on the top side

- Weight:<11 g (12g for Q24 Automotive)

2.1.2 Open AT® Software Suite

Every Wavecom Wireless CPU® comes with the "Open AT® Software, which has the following five elements:

→ Open AT® IDEs

→ Open AT® Applications

→ Open AT® Plug-Ins

→ Open AT® Operating Systems

→ Open AT® Firmwares

The Open AT® Software Suite enables a customer to develop within the Open AT® IDE an ANSI C based Open AT® Application, which is natively executed under the Open AT® OS which may utilise one or more Open AT® Plug-Ins and connect to wireless networks, peripheral devices & companion controllers via the Open AT® Firmware.

Among other things (please refer to Open AT® Programming Guides), the Open AT® firmware offers:

- Real Time Clock (RTC) with calendar

- Echo Cancellation and noise reduction (quadri codec)

- Full GSM or GSM/GPRS Operating System stacks

The Wireless CPU® Q24 Series are designed to integrate various types of specific process applications such as vertical applications (telemetry, multimedia, automotive).

The Open AT® firmware offers a set of AT commands to control the Wireless CPU®. With this standard Operating System, some interfaces of the Wireless CPU® are not available since they are dependent on the peripheral devices connected to the Wireless CPU®.

This symbol is used to indicate that the interfaces are not available with AT commands.

The Operating System is Open AT® compliant.

The Open AT® OS offers a set of Open AT® AT API's to control the Wireless CPU®. The limitation mentioned above is not valid in this case.

2.1.3 GSM/GPRS Features

- 2-Watt EGSM 900/GSM 850 radio section running under 3.6 volts

- 1-Watt GSM1800/1900 radio section running under 3.6 volts

- Hardware GSM/GPRS class 10 capable (except the Wireless CPU® Q24 Classic)

2.1.4 Interfaces

- Complete interfacing is through a 60-pin connector:
  - SPI and 2-wire bus interface
  - Keyboard interface
  - Two serial link interfaces (UART1 and UART2)
  - 3V/1.8V SIM interface
  - GPIOs
  - Activity status indication interface
  - Analog to digital converter
  - Analog audio
  - Buzzer interface
  - Battery charging interface
  - External interrupt
  - Power supply interface
  - Back-up battery interface

- Optional SIM holder (offered on Wireless Q24 Classic and Wireless CPU® Q24 Plus)

2.1.5 External RF Connection Interfaces

The Wireless CPU® Q24 Series are available with different external RF connection configurations:

Product reference	UFL	UFL or MMS	Antenna pad	IMP
Position	Bottom side	Top side	Top side	Bottom side
Q24 Classic	X		X	X
Q24 Plus	X		X	X
Q24 Extended	X		X	X
Q24 Automotive		X	X	X

2.1.6 SIM Card Holder

The Wireless CPU® Q24 Series are available with a SIM Card holder at the TOP:

SIM interface location		
Product reference	60-pin connector	Optional SIM holder
Q24 Classic	X	X
Q24 Plus	X	X
Q24 Extended	X	
Q24 Automotive	X	

⚠️Caution:

- **The Wireless CPU® Q24 Series does not allow two SIM Cards to be connected at the same time**
- **If a Wireless CPU® Q24 Classic or Q24 Plus is used with a SIM Card holder at the top, it is mandatory to avoid a SIM interface connection through the 60-pin General Purpose Connector (GPC)**

2.1.7 Green Policy

The Wireless CPU® Q24 Series are compliant with RoHS (Restriction of Hazardous Substances in Electrical and Electronic Equipment). Directive 2002/95/EC which sets limits for the use of certain restricted hazardous substances.

This directive states that "from 1st July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)".

2.2 Functional Architecture

The global architecture of the Wireless CPU® Q24 Series is shown below:
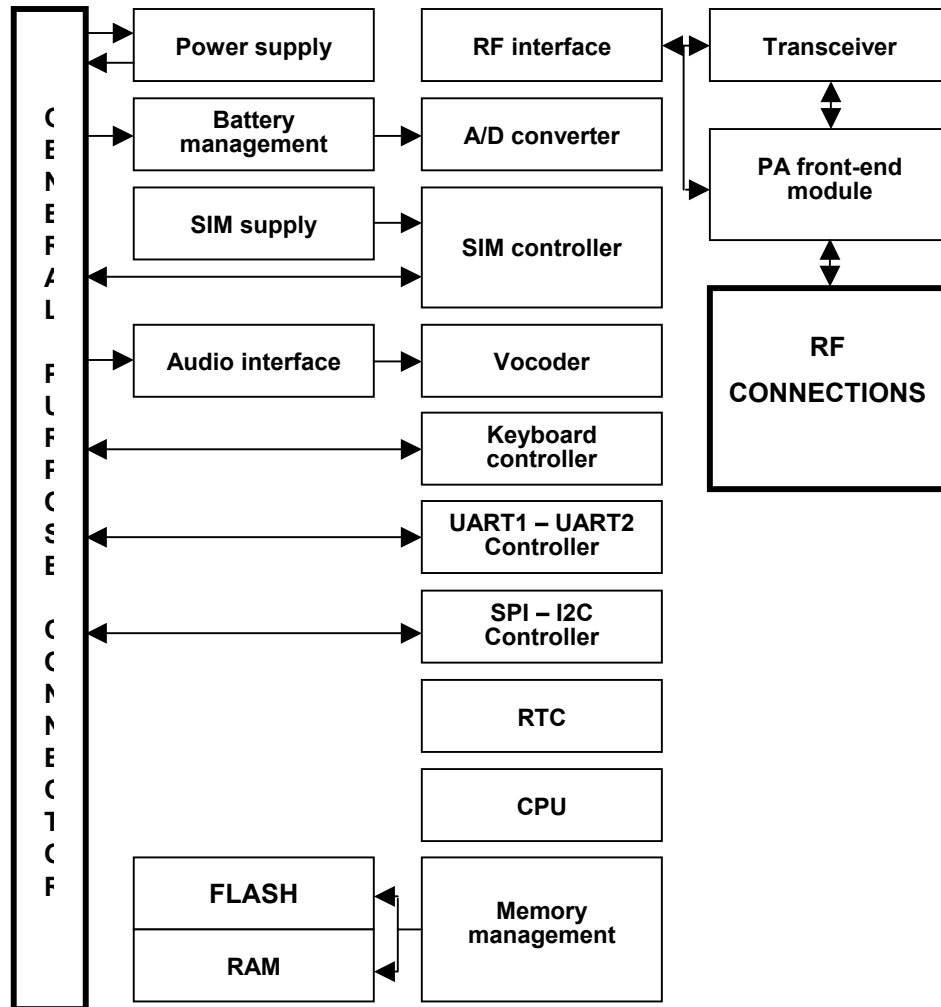
Figure 1: Functional architecture

2.2.1 RF Functionalities

The Radio Frequency (RF) range complies with the Phase II EGSM 900/DCS 1800 and GSM 850/PCS 1900 recommendations. The frequencies are given below:

GSM band	Transmit band (Tx)	Receive band (Rx)
GSM 850	824 to 849 MHz	869 to 894 MHz
EGSM 900	880 to 915 MHz	925 to 960 MHz
DCS 1800	1710 to 1785 MHz	1805 to 1880 MHz
PCS 1900	1850 to 1910 MHz	1930 to 1990 MHz

The Radio Frequency (RF) part is based on a specific quad-band chip. It includes a:

- Digital low-IF receiver,

- Quad-band LNAs (Low Noise Amplifier),

- Offset PLL (Phase Locked Loop) transmitter,

- Frequency synthesizer,

- Digitally controlled crystal oscillator (DCXO),

- Tx/Rx FEM (Front-End module) for quad-band GSM/GPRS.

2.2.2 Baseband Functionalities

The Wireless CPU® Q24 Series digital parts are based on the PHILIPS-VLSI chip (ONE C GSM / GPRS Kernel).

This chipset uses a 0.25 μm CMOS mixed technology, which allows massive integration as well as low current consumption.

3 Interfaces

Note:

Some of the Wireless CPU® Q24 Series interface signals are multiplexed in order to limit the total number of pins. But this architecture imposes some restrictions.

Example:

If the SPI bus and 2-wire bus are multiplexed and if the SPI bus is used, then the 2-wire bus is not available.

⚠️Caution:

To power-ON the Wireless CPU® Q24 Series correctly and to avoid any damage, all external signals must be inactive when the Wireless CPU® Q24 Series is OFF.

3.1 General Purpose Connector (GPC)

A 60-pin connector, with 0.5 mm pitch, is provided to interface the Wireless CPU® Q24 Series with a customer application board containing either an LCD module, or a keyboard, a SIM connector, a battery connection, etc.

The GPC is made by the KYOCERA / AVX group with the following reference:

- 14 5087 060 930 861.

The matting connector has the following reference:

- 24 5087 060 X00 861.

For further details, refer to section 6.1 General Purpose Connector Data Sheet.

The available interfaces on the GPC are shown below:

Section	Name	OS 6.57		Open AT®	
		Supported	Not supported	Supported	Not supported
3.4	Serial interface	X		X	
3.5	Keyboard Interface	X		X	
3.6	Main Serial Link	X		X	
3.7	Auxiliary Serial Link	X		X	
3.8	SIM interface	X		X	
3.9	General Purpose IO	X		X	
3.10	Activity status indication	X		X	
3.11	Analog to digital converter	X		X	
0	Audio Interface	X		X	
3.14	Battery charging interface	X		X	
3.15	ON/~OFF	X		X	
3.16	Boot		X		X
3.17	Reset	X		X	
3.18	External interrupt	X		X	
3.19	VCC output	X		X	
3.20	Real Time Clock	X		X	
3.21	RF interface	X		X	

3.2 Power Supply

3.2.1 Power Supply Description

The power supply is one of the key factors in the design of a GSM terminal.

Due to the burst emission in GSM / GPRS, the power supply must be able to deliver high current peaks in a short time. During these peaks, the ripple (Uripp) on the supply voltage must not exceed the limits specified; see the table "Maximum voltage ripple (Uripp) vs Frequency" given below.

- In communication mode, a GSM/GPRS class 2 terminal emits 577µs radio bursts every 4.615ms. (see the Figure 2: Power supply during burst emission).

- In communication mode, a GPRS class 10 terminal emits 1154µs radio bursts every 4.615ms.
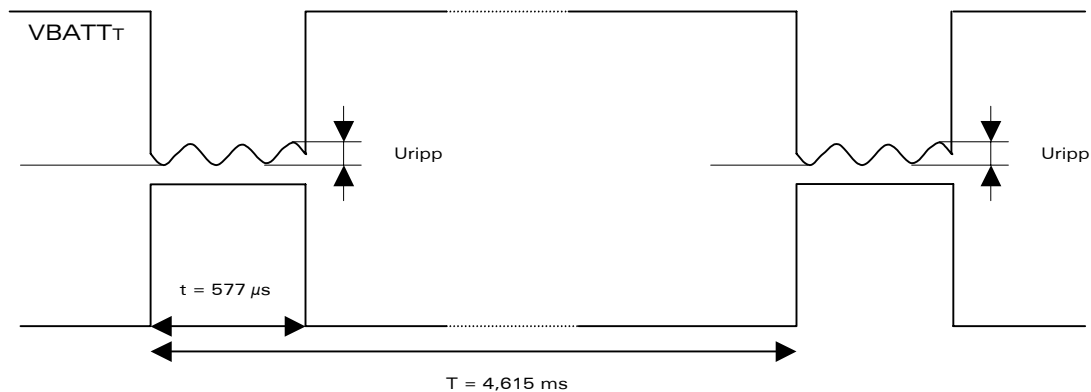
Figure 2: Power supply during burst emission

Two different inputs are provided for the power supply:

- VBATT is used to supply the RF part and

- VDD is used to supply the baseband part.

VBATT: Directly supplies the RF components with 3.6 V. It is essential to keep a minimum voltage ripple at this connection in order to avoid any phase error. In particular, VBATT supplies the RF Power Amplifier.

The current waveform is bursted with the following duty cycles:

- 1/8 of the time (around 577 µs every 4.615 ms for GSM/GPRS class 2),

- 2/8 of the time (around 1154 µs every 4.615 ms for GSM/GPRS class 10).

The rising time is around 10 µs.

VDD: Supplies the +2.8 V ballast regulators of the Wireless CPU® Q24 Series. It is essential to keep the voltage over 3.1 volts at any time.

Notes:

- It is possible to connect VBATT and VDD together.

- In the event of separate power supply, they must be in same state: e.g. either active or inactive at the same time.

GND: The grounding connection of the Wireless CPU® Q24 Series is made through the shielding ⇨ The four "legs" must be soldered to a complete ground plane.

The power supply voltage for VBATT and VDD is given below:

Power supply pin-out

Signal	Pin number
VBATT	55,57,58,59,60
VDD	11
GND	Shielding legs

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Electrical characteristics

Signal	MIN	NOM	MAX
VBATT	3.2 V	3.6 V	4.5 V *
VDD	3.1 V		4.5 V

*Max operating Voltage Standing Wave Ratio (VSWR) 2:1.

3.2.2 Power Supply Recommendation

The VBATT voltage limits must be considered at any time.

The worst condition is during the burst period transmission, when current consumption is at its highest. During this period, the VBATT voltage is minimum:

- The output voltage of the power supply drops.

- Voltage drop is present between the power supply output and the Wireless CPU® supply pins (VBATT).

To ensure a good design, <u>make sure that</u> during a transmit burst period, the total drop in voltage should not set the Wireless CPU® supply voltage (VBATT) below $VBATT_{MIN} = 3.2V$.

<u>Notes:</u>

- During a transmit burst, Wireless CPU® nominal current is 1.4A only.

- To design the Wireless CPU® power supply with a margin, <u>a target of 2A</u> is recommended.

⚠️<u>Caution:</u>

- If VBATT<3.2V, the Wireless CPU® automatically powers OFF.

- When a Wireless CPU® is supplied with a battery, the total impedance (battery + contacts + protections + PCB) should be < 150mΩ to limit voltage drop-out within emission burst.

- As the radio power amplifier is directly connected to the VBATT, the Wireless CPU® Q24 Series are sensitive to any voltage variation. When a DC/DC converter is used, Wavecom recommends to set the converter frequency in such a way that the resulting voltage does not exceed these values, which are given in the following table. "Maximum voltage ripple (Uripp) vs Frequency".

Maximal voltage ripple (Uripp) versus Frequency

Freq. (kHz)	U_{ripp} Max (mVpp)	Freq. (kHz)	U_{ripp} Max (mVpp)	Freq. (kHz)	U_{ripp} Max (mVpp)
<100	100	800	33	1500	70
200	91	900	44	1600	71
300	12	1000	44	1700	75
400	6	1100	45	1800	77
500	10	1200	59	>1900	80
600	15	1300	53		
700	21	1400	62		
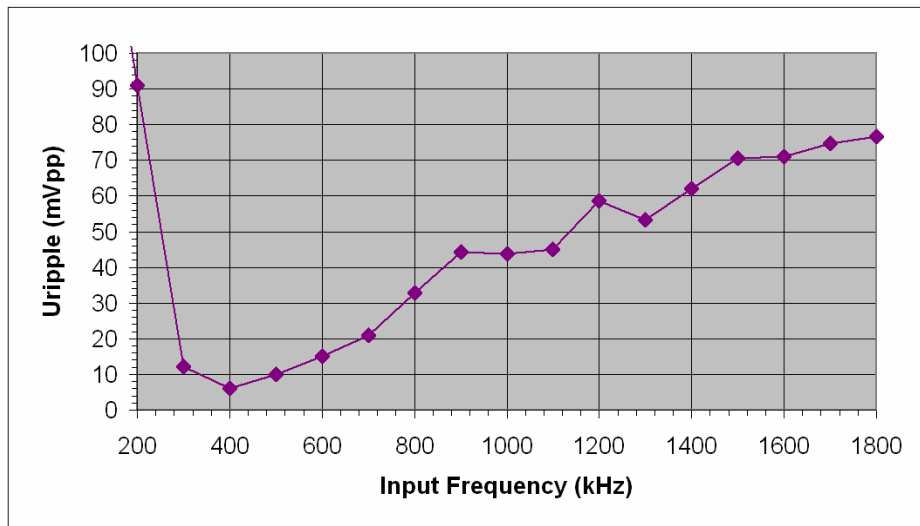
for f<100kHz   Uripp Max = 100mVpp
for f>1800kHz   Uripp Max = 80mVpp

Figure 3: Maximum voltage ripple (Uripp) versus Frequencies in GSM & DCS

Refer to Wireless CPU® Q24 Series Customer Design Guidelines [6], for further information on power supply design.

3.2.3 Power Consumption

The Wireless CPU® Q24 Series support different power consumption modes:

Working modes	Comments
OFF mode	The Wireless CPU® is in OFF mode.
ALARM mode	The Wireless CPU® is in OFF mode with RTC block running, when an ALARM occurs, the Wireless CPU® wakes-up automatically.
FAST idle mode	The Wireless CPU® is synchronized with an RF GSM/GPRS network. The internal 26 MHz of the Wireless CPU® is constantly active.
SLOW idle mode	The Wireless CPU® is synchronized with an RF GSM/GPRS tester. The internal 26 MHz of the Wireless CPU® is not constantly active.
FAST Standby mode	The SIM and Radio interface are deactivated via AT command or Open AT® API: -The embedded application is running -The serial port remains active (AT commands are available). The internal 26 MHz of the Wireless CPU® is constantly active.
SLOW Standby mode	This mode is similar to the FAST Standby mode. All the features are disabled (no GSM, no GPRS, no SIM and no Serial port). The internal 26 MHz of the Wireless CPU® is not constantly active.
Communication mode	A GSM/GPRS communication is established with a RF GSM/GPRS network.

The power consumption depends on the configuration used. It is for this reason that the following power consumption values are given for each modes, **RF bands and software used (AT or Open AT®).**

All the following information is given, by assuming a <u>50 Ω</u> RF output.

Three VBATT values are used to measure the consumption, **VBATT$_{MIN}$ (3.2V), VBATT$_{MAX}$ (4.5V) and VBATT$_{TYP}$ (3.6V).**

The average current is given for three VBATT values and peak current given is the maximum current peak measured with three VBATT voltages.

For more information on power consumption measurement, hardware configuration, SIM used, and software Dhrystone application, see the AT Command Interface Guide or OS 6.57 [4] and Wireless CPU® Q24 Series Customer Design Guidelines [6].

When Wireless CPU® is in Alarm mode, no voltage must be applied to any pin of the 60-pin connector, except on the BAT-RTC (pin 56) for RTC operation or ON/~OFF (pin 6) to power-ON the Wireless CPU®.

3.2.3.1 Power Consumption without Open AT® Processing

The following measurement results are relevant only when:

- There is no Open AT® application,

- The Open AT® application is disabled,

- No processing is required by the Open AT® application.

Operating mode		Parameters		INOM average	IMAX average	IMAX peak	Unit
OFF Mode		VBATT= 3.6V		16.5	18		μA
Alarm Mode		VBATT= 3.6V		18.5	20		μA
Fast Idle Mode		Paging 9		10.5	11	150_{Rx}	mA
		Paging 2		13	13.5	150_{Rx}	mA
Slow Idle Mode		Paging 9		2.8	3	150_{Rx}	mA
		Paging 2		5.5	5.8	150_{Rx}	mA
Fast Standby		VBATT = 3.6V		9.5	11	-	mA
Slow Standby		VBATT = 3.6V		1.5	2	-	mA
Connected Mode		GSM850	PCL5	217	225	1400_{Tx}	mA
		EGSM900	PCL19	90	95	250_{Tx}	mA
		DCS1800	PCL0	165	175	800_{Tx}	mA
		PCS1900	PCL15	90	100	250_{Tx}	mA
GPRS	Transfer Mode Class 8 (4Rx/1Tx)	GSM850	Gamma 3	209	220	1400_{Tx}	mA
		EGSM900	Gamma 17	87	90	250_{Tx}	mA
		DCS1800	Gamma 3	150	170	800_{Tx}	mA
		PCS1900	Gamma 18	84	95	250_{Tx}	mA
	Transfer Mode Class 10 (3Rx/2Tx)	GSM850	Gamma 3	380	410	1400_{Tx}	mA
		EGSM900	Gamma 17	130	160	270_{Tx}	mA
		DCS1800	Gamma 3	258	290	800_{Tx}	mA
		PCS1900	Gamma 18	123	150	240_{Tx}	mA

$_{TX}$ means that the peak current is measured during a TX transmission burst

$_{RX}$ means that the peak current is measured during a RX reception burst

[1] Slow Idle mode power consumption depends on the SIM Card used.

In OFF mode, VDD pin must be disconnected from VBATT in order to reach the indicated value (18μA).

Some SIM Cards respond faster than others, the longer the response time, the higher the consumption. The measurements were performed on a large number of 3V SIM

Cards and the results in brackets shown in the above table are the minimum and maximum currents measured from among all the SIM Cards used.

3.2.3.2 Power Consumption with Open AT® Software

The power consumption with Open AT® software used is the Dhrystone application and the following consumption results were measured while performing on the Dhrystone application.

Operating mode		Parameters	INOM average	IMAX average	IMAX peak	Unit
OFF Mode		VBATT = 3.6V	16.5	18		µA
Alarm Mode		VBATT = 3.6V	18.5	20		µA
Fast Idle Mode		Paging 9	10.5	11	150_{Rx}	mA
		Paging 2	13	13.5	150_{Rx}	mA
Slow Idle Mode		Paging 9	N/A	N/A	N/A	mA
		Paging 2	N/A	N/A	N/A	mA
Fast Standby		VBATT = 3.6V	9.5	11	150_{Rx}	mA
Slow Standby		VBATT = 3.6V	N/A	N/A	N/A	mA
Connected Mode		GSM850	PCL5	232	240	1400_{Tx}	mA
		EGSM900	PCL19	101	110	250_{Tx}	mA
		DCS1800	PCL0	175	185	800_{Tx}	mA
		PCS1900	PCL15	100	110	250_{Tx}	mA
GPRS	Transfer Mode Class 8 (4Rx/1Tx)	GSM850	Gamma 3	209	220	1400_{Tx}	mA
		EGSM900	Gamma 17	87	90	250_{Tx}	mA
		DCS1800	Gamma 3	150	170	800_{Tx}	mA
		PCS1900	Gamma 18	84	95	250_{Tx}	mA
	Transfer Mode Class 10 (3Rx/2Tx)	GSM850	Gamma 3	380	410	1400_{Tx}	mA
		EGSM900	Gamma 17	130	160	270_{Tx}	mA
		DCS1800	Gamma 3	258	290	800_{Tx}	mA
		PCS1900	Gamma 18	123	150	240_{Tx}	mA

In OFF mode, VDD pin must be disconnected from VBATT in order to reach the indicated value (18µA).

3.2.3.3 Consumption Waveform

The consumption waveforms are given for an EGSM900 network configuration with AT software running on a Wireless CPU®.

The VBATT voltage value is 3.6V typical.

Four significant operating mode consumption waveforms are described as:

- **Connected mode** with one TX and one RX burst at PCL5 (33dBm)

- **GPRS class 10 transfer mode** with two TX bursts and three RX burst at Gamma 3 (33dBm)

- **Slow Idle mode** with a paging 9 (every 2 seconds)

- **Fast Idle mode** with a paging 9 (every 2 seconds)

The following waveform shows only the current form versus time:

Current Waveform

Connected mode with One TX burst at PCL5 and one RX burst	**Slow idle mode** paging 9
GPRS Class 10 Transfer mode with two TX bursts at PCL5 and three RX burst	**Fast idle mode** paging 9
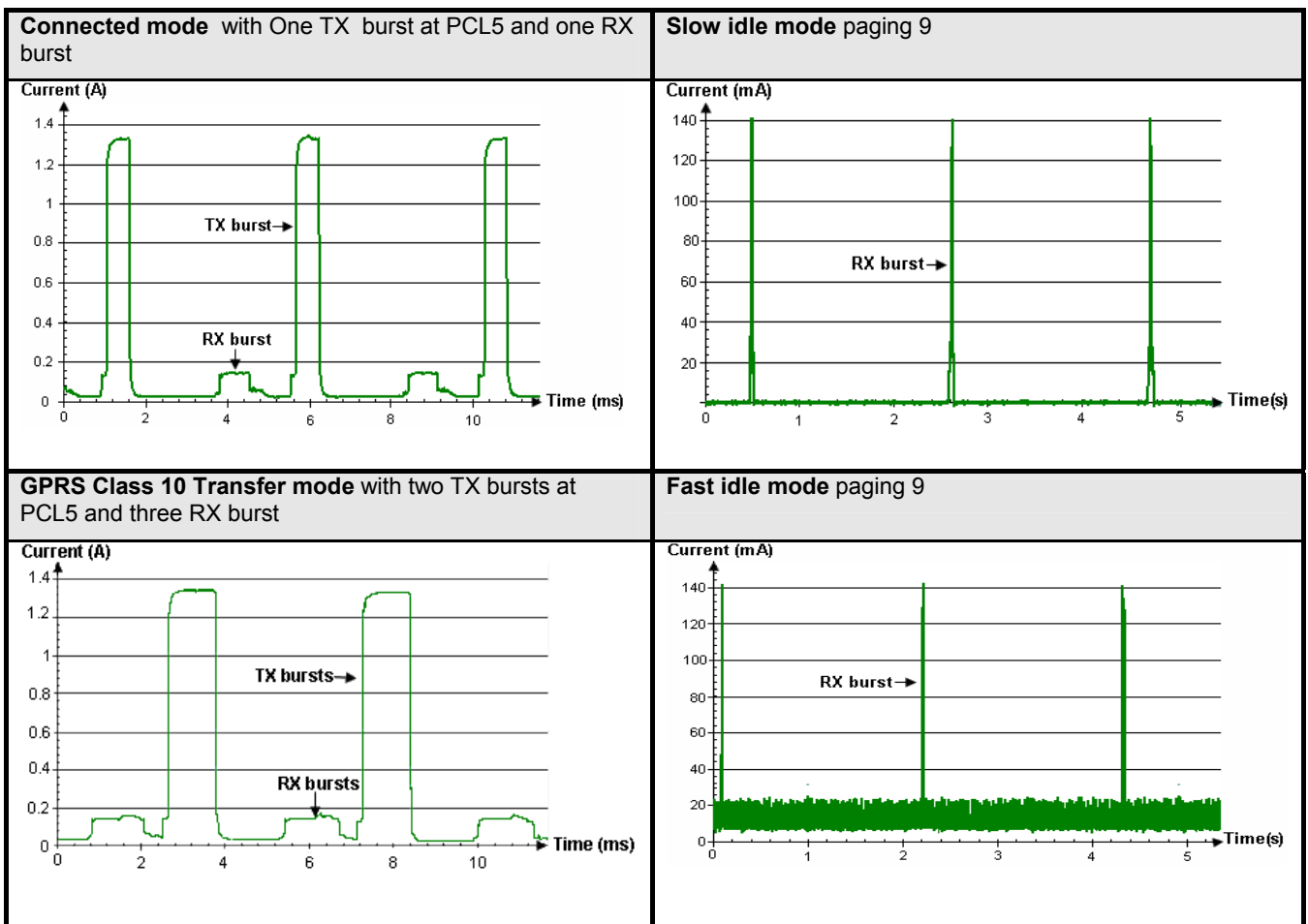
3.3 Electrical Information for Digital I/O

All digital I/O comply with a 3 volt CMOS.

Electrical characteristics

Parameter	I/O type	min	Max	Conditions
VIL	CMOS	-0.5 V	0.8 V	
VIH	CMOS	2.1 V	3.0 V	
VOL	1X	-0.2V	0.2 V	IOL = -1 mA
-	2X	-0.2V	0.2 V	IOL = -2 mA
-	3X	-0.2V	0.2 V	IOL = -3 mA
VOH	1X	2.55 V	2.95V	IOH = 1 mA
-	2X	2.55 V	2.95V	IOH = 2 mA
-	3X	2.55 V	2.95V	IOH = 3 mA

3.4 Serial Interface

3.4.1 SPI Bus

The SPI bus includes a CLK signal (SPI_CLK), an I/O signal (SPI_IO), and an EN signal (SPI_EN) complying with the SPI bus standard.

The frequency clock is programmable from 812 kHz to 13 MHz.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
SPI_CLK	10	O	CMOS 1X (C5)	Pull-up to 2V8	SPI Serial Clock	SCL
SPI_IO	8	I/O	CMOS / CMOS 1X (C2)	Pull-up to 2V8	SPI Data	SDA
SPI_EN	28	O	CMOS 1X (C3)	2V8	SPI Enable	GPO3

(C2), (C3) and (C5): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.4.2 SPI Auxiliary Bus

A second SPI Chip Enable (called SPI_AUX) must be used to add a second SPI peripheral to the Wireless CPU® Q24 Series.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
SPI_CLK	10	O	CMOS 1X (C5)	Pull-up to 2V8	SPI Serial Clock	SCL
SPI_IO	8	I/O	CMOS / CMOS 1X (C2)	Pull-up to 2V8	SPI Data	SDA
SPI_AUX	26	O	CMOS 1X (C3)	2V8	SPI Aux. Enable	GPO0

(C2), (C3) and (C5): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.4.3 Two-wire Bus Interface (I²C)

The two-wire bus interface includes a CLK signal (SCL) and a DATA signal (SDA) complying with a standard two-wire bus interface.

The frequency clock is programmable either to a 96 kHz or a 400 kHz.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description
SCL	10	O	CMOS 1X (C5)	Pull-up to 2V8	Serial Clock
SDA	8	I/O	CMOS / CMOS1X (C2)	Pull-up to 2V8	Serial Data

(C2) and (C5): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.5 Keyboard Interface

Equivalent circuit
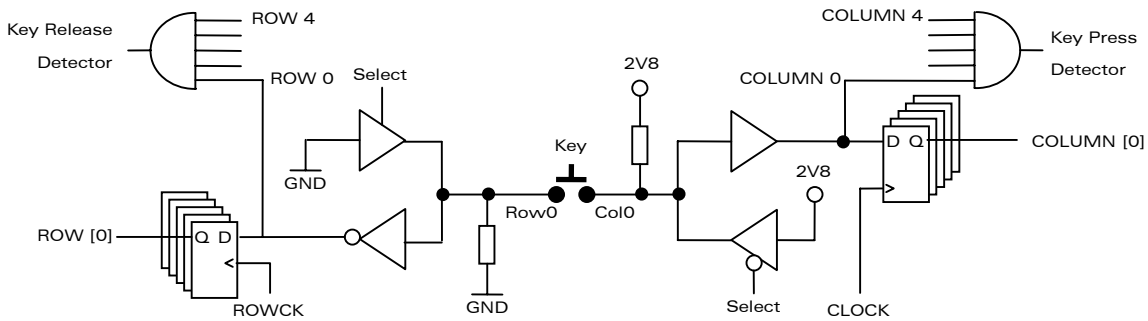
An AT command or Open AT® API allows the input key code to be obtained (see the AT+CMER command description). This code must then be processed by the application.

For a total of 25 keys (5 rows x 5 columns), the keyboard interface provides 10 connections:

- 5 rows (ROW0 to ROW4) and
- 5 columns (COL0 to COL4)

The scanning is digital, and the debouncing is performed in the Wireless CPU®. No discrete components such as R, C (Resistor, Capacitor) are needed.

Pin description

Signal	Pin number	I/O	I/O type	Reset state	Description
ROW0	13	I/O	CMOS / CMOS 1X	Pull-down to 0V	Row scan
ROW1	15	I/O	CMOS / CMOS 1X	Pull-down to 0V	Row scan
ROW2	17	I/O	CMOS / CMOS 1X	Pull-down to 0V	Row scan
ROW3	19	I/O	CMOS / CMOS 1X	Pull-down to 0V	Row scan
ROW4	21	I/O	CMOS / CMOS 1X	Pull-down to 0V	Row scan
COL0	23	I/O	CMOS / CMOS 1X	Pull-up to 2V8	Column scan
COL1	25	I/O	CMOS / CMOS 1X	Pull-up to 2V8	Column scan
COL2	27	I/O	CMOS / CMOS 1X	Pull-up to 2V8	Column scan
COL3	29	I/O	CMOS / CMOS 1X	Pull-up to 2V8	Column scan
COL4	31	I/O	CMOS / CMOS 1X	Pull-up to 2V8	Column scan

3.6 Main Serial Link (UART1)

A flexible 6-wire serial interface is available, complying with V24 protocol signaling, but not with V28 (electrical interface) due to a 2.8 volt interface.

The signals are:

- TX data (CT103/TX)
- RX data (CT104/RX)
- Request To Send (CT105/RTS)
- Clear To Send (CT106/CTS)
- Data Terminal Ready (CT108-2/DTR)
- Data Set Ready (CT107/DSR)

The two additional signals are:

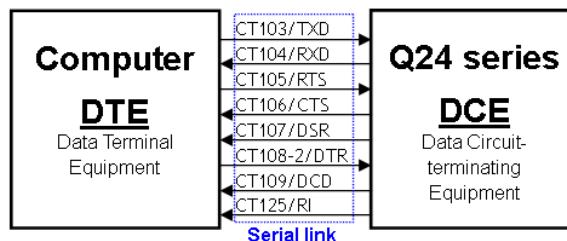- Data Carrier Detect (CT109/DCD).
- Ring Indicator (CT125/RI).

Figure 4: UART1 Serial Link signals

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
CT103/TXD1	39	I	CMOS	High impedance	Transmit serial data	
CT104/RXD1	32	O	CMOS 1X (C3)	2V8	Receive serial data	
CT105/RTS1	30	I	CMOS	High impedance	Request To Send	
CT106/CTS1	37	O	CMOS 1X (C1)	2V8	Clear To Send	
CT107/DSR1	36	O	CMOS 1X (C3)	2V8	Data Set Ready	
CT108-2/DTR1	34	I	CMOS	High impedance	Data Terminal Ready	
CT109/DCD1	51	O	CMOS 2X (C1)	High impedance	Data Carrier Detect	GPIO3
CT125/RI1	54	O	CMOS 2X (C1)	High impedance	Ring Indicator	GPIO2
CT102/GND	Shielding legs				Ground	

(C1) and (C3): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

⚠️**Caution:**

- The rise and fall time of the reception signals (mainly CT103) must be less than 200 ns

- The Wireless CPU® Q24 Series are designed to operate using all the serial interface signals. In particular, it is necessary to use RTS and CTS signals for hardware flow control in order to avoid data corruption during transmission

3.7 Auxiliary Serial Link (UART2)

For specific applications, an auxiliary serial interface (UART2) is available on the Wireless CPU® Q24 Series.

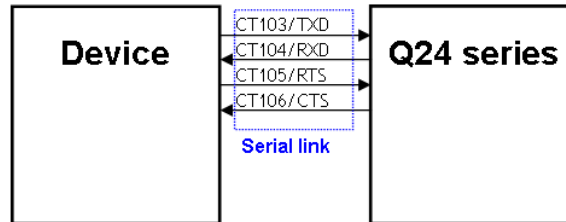E.g. Bluetooth connectivity: See AT commands interface guide (Bluetooth) [5].

Figure 5: UART2 Serial Link signals

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
CT103 / TXD2	18	I	CMOS (C4)	Pull down to 0V	Transmit serial data	GPI
CT104 / RXD2	20	O	CMOS 1X (C3)	2V8	Receive serial data	GPO2
CT106 / CTS2	24	O	CMOS 2X (C1)	High impedance	Clear To Send	GPIO0
CT105 / RTS2	35	I	CMOS	High impedance	Request To Send	GPIO5

(C1), (C3) and (C4): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.8 SIM Interface

3.8.1 General Description

The following five signals are available:

- **SIM_VCC**: SIM power supply.
- **SIM_RST**: Reset.
- **SIM_CLK**: Clock.
- **SIM_DATA**: I/O port.
- **SIM_PRES**: SIM Card detection.

The SIM interface controls a 3V / 1V8 SIM (and a 5V SIM through an external SIM driver). This interface is fully compliant with the GSM 11.12 recommendations concerning SIM functions.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description
SIM_CLK	3	O	2V9/1V8	0V	SIM Clock
SIM_RST	5	O	2V9/1V8	0V	SIM Reset
SIM_DATA	7	I/O	2V9/1V8	0V	SIM Data
SIM_VCC	9	O	2V9/1V8	0V	SIM Power Supply
SIM_PRES	50	I	2V8	High impedance	SIM Card Detect

⚠️Caution:

Disturbances (digital noise, ESD) in the SIM signals may interrupt the Wireless CPU® functionality, a good layout of these signals are recommended:

- Ground separation between SIM signals and others signals

- ESD protections

    (Refer to Wireless CPU® Q24 Series Customer Design Guidelines [6])

Electrical characteristics

Parameters	Conditions	Min	Type	Max	Unit
SIM_DATA VIH	IIH = ± 20 µA	0.7xSIMVCC			V
SIM_DATA VIL	IIL = 1 mA			0.3xSIMVCC	V
SIM_RST, SIM_CLK VOH	Source current = 20 µA	0.9xSIMVCC			V
SIM_DATA	Source current = 20 µA	0.8xSIMVCC			V
SIM_RST, SIM_DATA, SIM_CLK VOL	Sink current = -200 µA			0.4	V
SIM_VCC Output Voltage	SIMVCC = 2.9V	2.84	2.90	2.96	V
	SIMVCC = 1.8V	1.77	1.8	1.86	V
SIM_CLK Rise/Fall Time	Loaded with 30 pF		20		ns
SIM_RST, Rise/Fall Time	Loaded with 30 pF		20		ns
SIM_DATA, Rise/Fall Time	Loaded with 30 pF		0.7		µs
SIM_CLK Frequency				3.25	MHz

Note for SIM_PRES connection:

- When not used, SIM_PRES must be tied to 2V8

- When used, a **low to high** transition means that the SIM Card is inserted and a

---

high to low transition means that the SIM Card is removed.

3.8.2 SIM Card Holder

An optional SIM Card holder may be placed on top of Wireless CPU®. This SIM Card holder does not use the SIM_PRES signal.

⚠️Caution:

Customers are advised to verify that the SIM Card environmental specification used is compliant with the Wireless CPU® Q24NG environmental specifications [3] (see the Wireless CPU® Q24NG Product Technical Specification WM_PRJ_Q24NG_PTS_001). Any application must be qualified by the customer with the SIM Card in storage, transportation and operation.

Some ESD protections were placed to protect SIM form ESD stress; ESD protection position is described in Figure 6 and should be taken into account during a mechanical design.

Figure 6: SIM Card holder constraints

(see next page)

SCALE 1,000
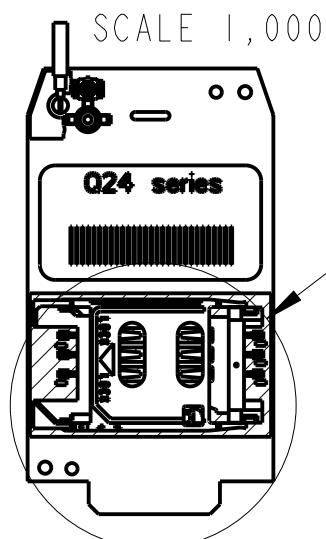
Q24 series

SEE DETAIL A

Area without components

ESD protectors

18,8

10,1

LOCK LOCK

DETAIL A
SCALE 4,000

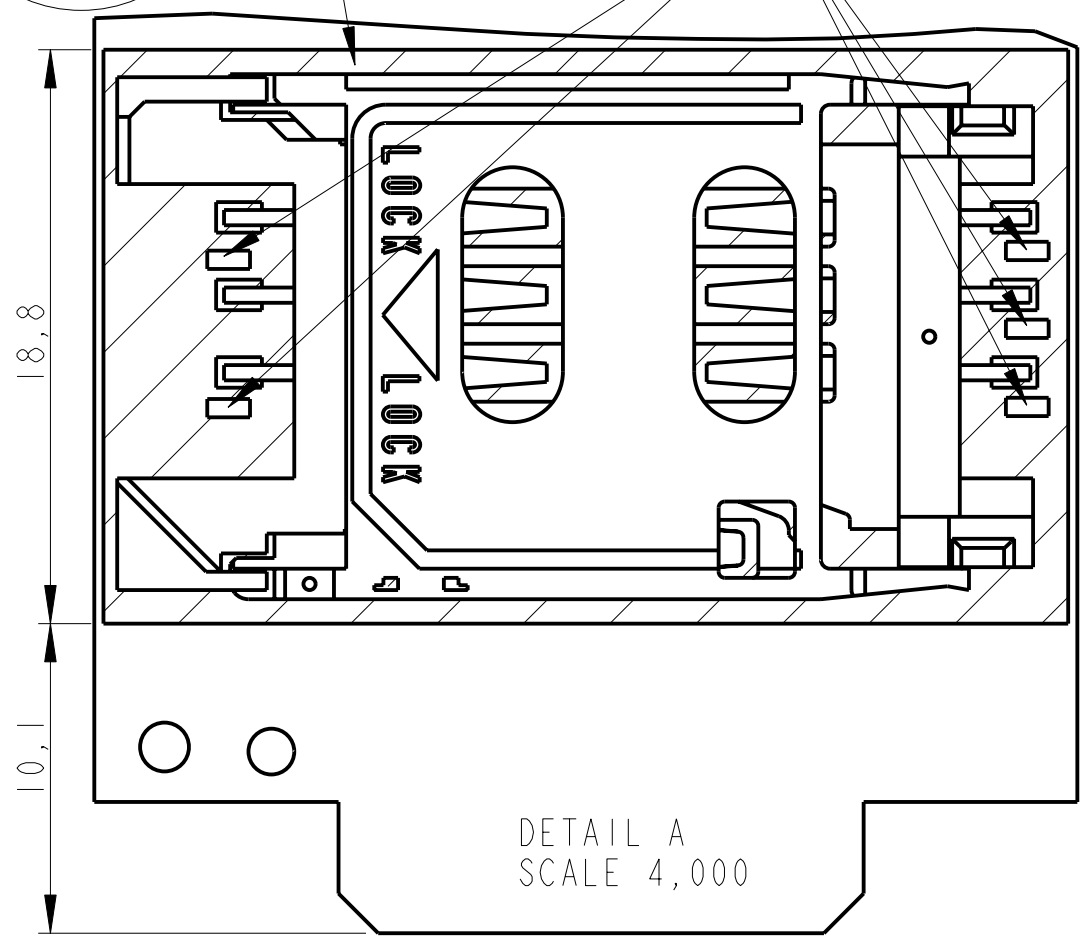ESD PROTECTORS

Q24_SERIES

TOL.GEN.:±0,3
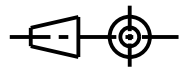
SCALE:1,000

FOLIO : 1/1

WM-4-600101-X-017-A

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A

IND.

3.9 General Purpose Input/Output

The Wireless CPU® Q24 Series provide:

- 3 General Purpose I/O,

- 4 General Purpose Output,

- 1 General Purpose Input.

They are used to control any external devices such as an LCD or a Keyboard backlight.

Note:

GPIO0 has a 100K pull-down resistor, which would allow users to set a high logic state to the pin during reset state.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
GPIO0	24	I/O	CMOS / CMOS 2X (C1)	100K pull-down to 0V	General Purpose I/O	CT106/CTS2
GPIO1	52	I/O	CMOS / CMOS 2X (C1)	High impedance	General Purpose O	FLASH LED
GPIO4	53	I/O	CMOS / CMOS 2X (C1)	High impedance	General Purpose I/O	
GPIO5	35	I/O	CMOS / CMOS 2X (C1)	High impedance	General Purpose I/O	CT105/RTS2
GPO0	26	O	CMOS 3X (C3)	2V8	General Purpose O	SPI_AUX
GPO1	22	O	CMOS 3X (C3)	0V	General Purpose O	
GPO2	20	O	CMOS 3X (C3)	2V8	General Purpose O	CT104/RXD2
GPO3	28	O	CMOS 3X (C3)	2V8	General Purpose O	SPI_EN
GPI	18	I	CMOS (C4)	Pull-down to 0V	General Purpose I	CT103/TXD2

(C1), (C3) and (C4): To obtain more details on I/O type, refer to section 4.2 "I/O Circuit diagram"

AT The following GPIOs are not available (reserved) with a Wireless CPU® running with an AT commands firmware:

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
GPIO2	54	I/O	CMOS / 2X (C1)	High impedance	General Purpose I/O	CT125/RI1
GPIO3	51	I/O	CMOS / 2X (C1)	High impedance	General Purpose I/O	CT109/DCD1

(C1): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.10   Activity Status Indication

The activity status indication signal may be used to drive a FLASH LED through an <u>open collector transistor</u>.

Q24 Series LED status

LED status	Comments	
OFF	Wireless CPU® in download mode or Wireless CPU® is in OFF mode.	
ON	Permanent	Wireless CPU® switched ON, not registered on the network.
Slow flash	LED ON for 200 ms, OFF for 2 s	Wireless CPU® switched ON, registered on the network.
Quick flash	LED ON for 200 ms, OFF for 600 ms	Wireless CPU® switched ON, registered on the network and communication is in progress.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description	Multiplexed with
FLASH LED	52	O	CMOS 2X (C1)	High impedance	LED driving	GPIO1

(C1): To obtain more details on I/O type, refer to section 4.2 "**I/O Circuit diagram**"

3.11 Analog to Digital Converter (ADC)

Equivalent circuit
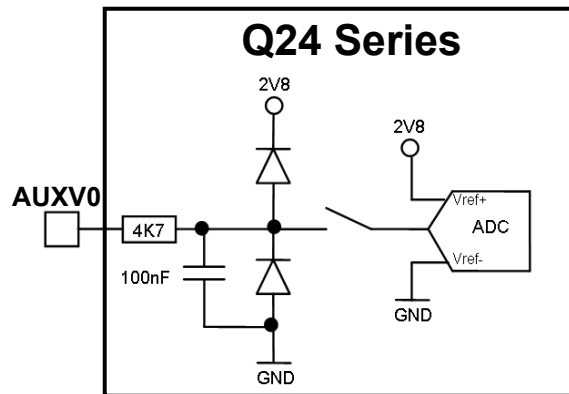
An Analog to Digital Converter is provided by the Wireless CPU® Q24 Series. This converter is a 10-bit resolution, ranging from **0.9 to 2.775 V**.

Note:

- The Q24NG ADC accuracy cannot be guaranteed for an ADC input level less than 0.9 V or greater than 2.775 V.

- Q24NG ADC accuracy is guaranteed to +/- 10 mV for Q24NG input level between 0.9 V and 2.775 V at ambient temperature, and is guaranteed to +/- 20 mV for Q24NG input level between 0.9 V and 2.775 V at extreme temperature.

Pin description

Signal	Pin number	I/O	I/O type	Description
AUXV0	33	I	Analog	A/D converter

Electrical characteristics

Parameter	Min	Max	Unit
Resolution	10		Bits
Hardware sampling rate	17		Ksps/s
Input signal range	0.9	2.775	V
ADC reference accuracy	0.75	2	%
Integral accuracy	+/- 1		LSB
Differential accuracy	+/- 1		LSB
Input impedance (R)	10		MΩ
Input impedance (C)		100	nF

3.12   Audio Interface

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

The Wireless CPU® Q24 Series also include an echo cancellation feature, which allows hands-free operation.

⚠️Caution:

When speakers and microphones are exposed to the external environment, it is recommended to add ESD protection on the audio interface lines.

3.12.1   Microphone Inputs

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

The MIC1 inputs do not include an internal bias. MIC1/SPK1 may be used for a hands-free system or a handset, including biasing circuit for the microphone.

The microphone connections may be either differential or single-ended, but using a differential connection in order to reject common mode noise and TDMA noise is strongly recommended.

⚠️Caution:

While using a single-ended connection, ensure to have a good ground plane, a good filtering as well as shielding, in order to avoid any disturbance on the audio path.

3.12.1.1 Common Microphone Input Characteristics

Both microphone inputs are designed with the following audio transmit characteristics:

Internal audio filter characteristics

Frequency	Gain
0-150 Hz	< -22 dB
150-180 Hz	< -11 dB
180-200 Hz	< -3 dB
200-3700 Hz	0 dB
>4000 Hz	< -60 dB

The gain in the MIC inputs are internally adjusted and may be tuned from -6.5 dB to 51.3 dB by using AT commands (refer to AT commands documentation [4]).

Microphone gain versus Max input voltage

| Using Controller 1		Using Controller 2	
Transmit Gain (dB)	Max Vin (mVrms)	Transmit Gain (dB)	Max Vin (mVrms)
+30	43.80	-6.5	3031
+33	31.01	-6	2861
+36	21.95	0	1434
+39	15.54	+9.5	480
+42	11	+10	454
+45	7.79	+30.3	43.80
+48	5.51	+30.8	41.36
+51	3.9	+50.8	4.14
-	-	+51.3	3.90

*   For more details, refer to the AT commands documentation [4]

3.12.1.2 MIC1 Microphone Inputs

The MIC1 inputs are differential and **do not include internal bias**. To use these inputs with an electret microphone, bias must be generated outside the Wireless CPU® Q24 Series in accordance with the characteristic of this electret microphone. These inputs are the standard inputs used either for an external headset or a hands-free kit.

The impedance of microphone 1 must be around 2 kΩ. AC coupling is already embedded in the Wireless CPU®.

Equivalent circuits

DC equivalent circuit	AC equivalent circuit
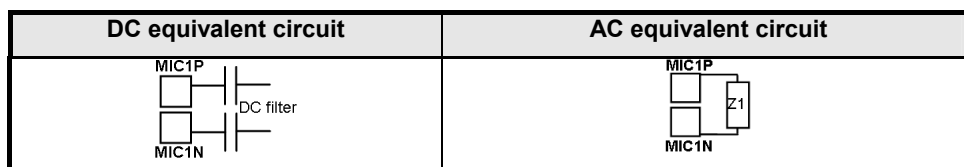
Pin description

Signal	Pin	I/O	I/O type	Description
MIC1P	42	I	Analog	Microphone 1 positive input
MIC1N	44	I	Analog	Microphone 1 negative input

Electrical characteristics

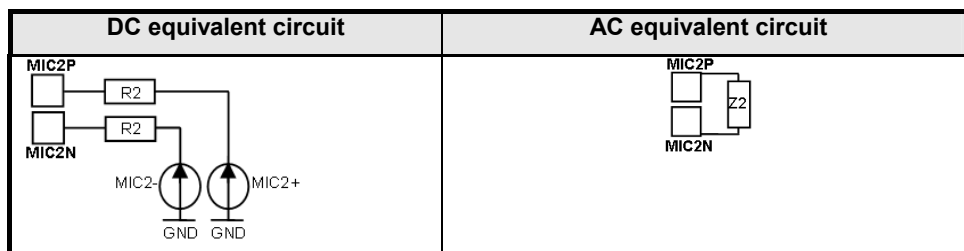| MIC1 Electrical characteristics					
Parameters		Min	Typ	Max	Unit
DC characteristics	-	-	-	-	V
AC characteristics 100 Hz<F<5 kHz	Z1	80	120	160	KΩ

3.12.1.3 MIC2 Microphone Inputs

The MIC2 inputs are differential inputs. **They already include convenient biasing for an electret microphone (0.5 mA and 2 volts)**. This electret microphone may be directly connected to these inputs.

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

AC coupling is already embedded in the Wireless CPU®.

Equivalent circuit

DC equivalent circuit	AC equivalent circuit
MIC2P R2 R2 MIC2N MIC2- MIC2+ GND GND	MIC2P Z2 MIC2N

Pin description

Signal	Pin	I/O	I/O type	Description
MIC2P	46	I	Analog	Microphone 2 positive input
MIC2N	48	I	Analog	Microphone 2 negative input

Electrical characteristics

MIC2 Electrical characteristics					
Parameters		Min	Typ	Max	Unit
Internal biasing DC characteristics	MIC2-	0.225	0.35	0.475	V
	MIC2+	2.025	2.15	2.275	V
	Output current		0.5	1	mA
	R2	900	1150	1400	Ω
AC characteristics 100 Hz<F<5 kHz	Z2	1.2	1.5	1.8	KΩ

3.12.2 Speaker Outputs

Two speaker outputs are available: SPK1 and SPK2.

Both speaker outputs may be represented as follows:

Equivalent circuit
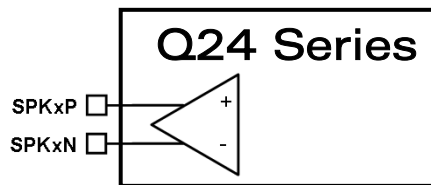
3.12.2.1 Common Speaker Output Characteristics

The connection may be differential or single-ended, but using a differential connection to reject common mode noise and TDMA noise is strongly recommended. Moreover, in single-ended mode, the power is reduced by two, compare to the differential mode

⚠️Caution:

When using a single-ended connection, ensure to have a good ground plane, a good filtering as well as a good shielding in order to avoid any disturbance on the audio path.

Speaker outputs SPK1 and SPK2 are push-pull amplifiers and may be loaded down to 150Ω and up to 1 nF

The impedance of the speaker amplifier outputs in differential mode is:

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

When speaker output is not used, the speaker interface is in three states and a 20K +/-30% impedance is kept between SPK1N and SPK1P as well as SPK2N and SPK2P.

These outputs are differential and the output power may be adjusted by step of 2 dB. The output may be directly connected to a speaker.

The gain in the speaker outputs are internally adjusted and may be tuned by using AT commands (refer to the AT commands documentation [4]).

Speaker gain versus Max output voltage

Receive Gain (dB)*	Max output level (Vrms)	Max.speaker load (Ω)
+2	1.74	150
0	1.38	50
-2	1.099	32
-4	0.873	32
-6	0.693	32
-8	0.551	32
-10	0.437	32
-12	0.347	32
-14	0.276	32
-16	0.219	32
-18	0.174	32
-20	0.138	32
-22	0.110	32
-24	0.087	32
-26	0.069	32

**Analog gain: may not be significant

3.12.2.2 Speaker 1 Output

Pin description

Signal	Pin	I/O	I/O type	Description
SPK1P	41	O	Analog	Speaker 1 positive output
SPK1N	43	O	Analog	Speaker 1 negative output

3.12.2.3 Speaker 2 Output

Pin description

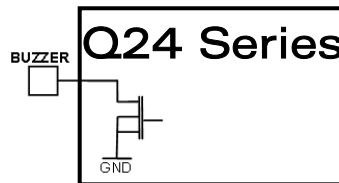| Signal	Pin	I/O	I/O type	Description
SPK2P	45	O	Analog	Speaker 2 positive output
SPK2N	47	O	Analog	Speaker 2 negative output

3.13   Buzzer Output

3.13.1   Hardware Description

The buzzer interface is accessible through an open drain embedded on the Wireless CPU® Q24 Series.

A buzzer may be directly connected between this output and VBATT.

Equivalent circuit

Pin description

Signal	Pin	I/O	I/O type	Description
BUZZER	49	O	Analog	Buzzer output

Operating conditions

Parameter	Condition	Min	Max	Unit
VOL	Iol = 100mA		0.4	V
IPEAK	VBATT = VBATT Max		100	mA

Caution:

A diode against transient peak voltage must be connected as described below.
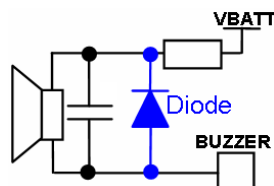

Figure 7: Buzzer connection

For the implementation of the buzzer interface, refer to the Customer Design Guidelines [6].

3.14   Battery Charging Interface

### 3.14.1   Hardware Description

⚠️Caution:

The battery charging interface <u>does not allow</u> the Wireless CPU® to be supplied and is only used to charge a battery connected to VBATT.

Battery charging is performed through a switching transistor connecting the VBATT signal to the Charger (**CHG_IN** signal).

The switching transistor is controlled by the operating system with two kinds of algorithms.

Equivalent circuit
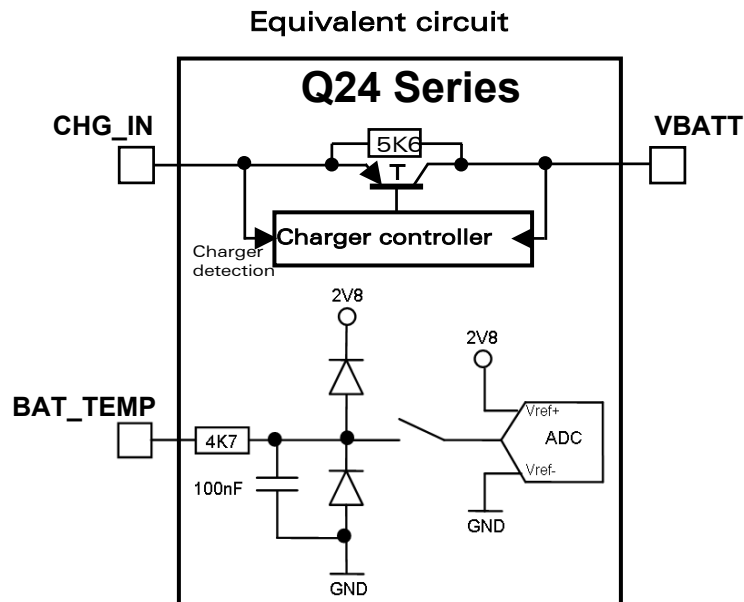
The Wireless CPU® Q24 Series supports three types of battery technologies:

- **Ni-Cd** (Nickel-Cadmium), which is charged with the **algorithm 0**

- **Ni-Mh** (Nickel-Métal Hydrure), which is charged with the **algorithm 0**

- **Li-Ion** (Lithium-Ion), which is charged with the **algorithm 1**

The algorithm controls the frequency and the connected time of switching transistor (T).

To select the algorithm:

- AT+WBCM=4,0→ Ni-Cd/Ni-Mh (by default)
- AT+WBCM=4,1→Li-Ion
- AT+WBCM=4,2→To know which algorithm is used

During the charging procedure, battery charging level is controlled.

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WM_PGM_Q24NG_PTS_001-005   November 20, 2007

When the operating system is not activated (**VBATT< 3V2**), the battery charging procedure remains possible by hardware control as long as the charger is plugged:

- **VBATT<2V8**: the battery is charged through a trickle current

- **2V8<VBATT<3V2**: pre-charging current (min=40mA, typ=50mA, max=60mA)

The purpose of the trickle and pre-charging current is to:

- Allow the battery charging, even if VBATT is too low to power-ON the Wireless CPU®.

- Avoid battery damage, by preventing the battery from being discharged below the minimum battery level.

Pin description

Signal	Pin number	I/O	I/O type	Description
CHG_IN	1, 2, 4	I	Analog	Current source input
BAT_TEMP	38	I	Analog	A/D converter

Electrical characteristics

Parameter		Min	Typ	Max	Unit
BAT_TEMP	Resolution	10			bits
	Sampling rate	17			Ksps/s
	Input Impedance (R)		1M		kΩ
	Input Impedance (C)			100	nF
	Input signal range	0		2V8	V
CHG_IN		<BattLevelMax +0.5*	-	6	V
CHG_IN	Current	400		800	mA

* *The min CHG_IN voltage depends on the battery characteristics. (see the following chapter).*

3.14.2 Temperature Monitoring

Temperature monitoring is available only for the Li-Ion battery with **algorithm 1**. The BAT-TEMP ADC input must be used to sample the temperature analog signal provided by an NTC temperature sensor. The minimum and maximum temperature range may be set by an AT command (see the section 3.14.4 Li-Ion charging algorithm).

3.14.3　Ni-Cd / Ni-Mh Charging Algorithm

During the charging process of a Ni-Cd and Ni-Mh battery, it is required to tune software parameters in the Wireless CPU® operating system:

AT+WBCM=<Mode>, <ChargeInd>, <BattLevelMax>, <BattLevelMin>, <TPulseInCharge>, <TPulseOutCharge>, <BattIntRes>, <BattChangeLevel > (See the AT command Interface Guide [4]).

⚠️Caution:

The parameters need to be tuned according to the battery specifications.

The main parameters to be tuned are:

Parameters related to time:

- **TPulseInCharge**: Monitoring time of the VBATT voltage during a charging process **(T2)**
- **TPulseOutCharge**: Monitoring time of the VBATT voltage when charging process is not activated**(T3)**

Parameters related to voltage:

- **BattLevelMin**: Minimum VBATT voltage allowed by the battery (>3.2V)
- **BattLevelMax**: Maximum VBATT voltage allowed by the battery (<4.5V)

Ni-Cd / Ni-Mh battery and tunable parameter

Parameter	Default value	Min	Max	Unit
T1	1000 (Not tunable)			ms
T2	100	100	10000	ms
T3	5000	100	10000	ms
BattLevelMin	3400	3400	3800	mV
BattLevelMax	4200	4000	5000	mV

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Ni-Cd / Ni-Mh charging process

Charger connected: CHG_IN =VBATT+0.5V			
VBATT	Operating system	Charging status	Switching transistor (T)
VBATT<2V8	Not activated	Trickle charge	Open
2V8<VBATT<3V2	Not activated	Pre-charging	50mA typ cross the switching transistor
3V2<VBATT VBATT<BattLevelMin	Activated	Charging process is automatically started	Open (T2)/Close (T1) periodically
BattLevelMin<VBATT VBATT<BattLevelMax	Activated	Charging process running	Open (T2)/Close (T1) periodically
		Charging process not activated	VBATT is monitored periodically (T3)
	Deactivated	Trickle charge	Open
>=BattLevelMax	Activated	Charging process is ended	Open

The graph below summarizes the charging process (charge and discharge).

Note:
A charger is connected to the CHG_IN pin of the Wireless CPU®.
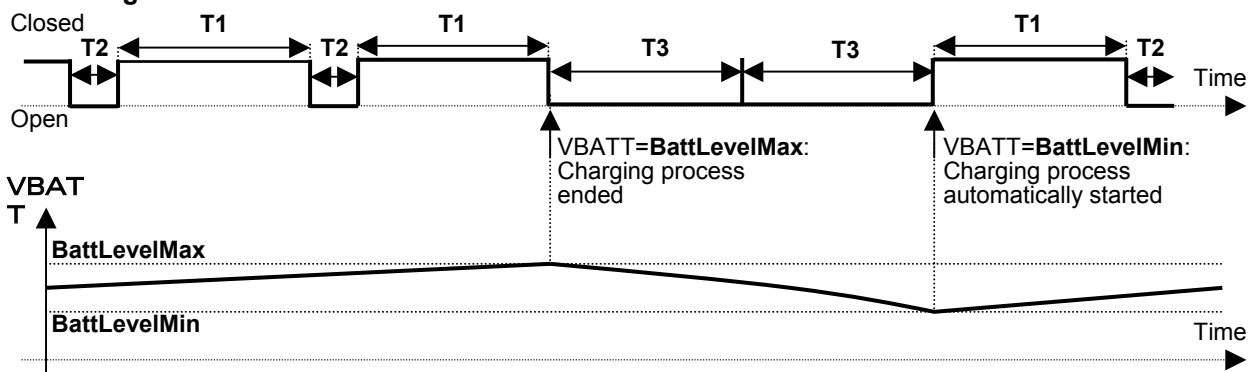
Switching transistor:

Figure 8: Ni-Cd / Ni-Mh charging waveform

3.14.4 Li-Ion Charging Algorithm

During the charging process of a Li-Ion battery, it is required to tune parameters embedded in the Wireless CPU® operating system:

AT+WBCM=<Mode>,<ChargeInd>,<TdeltaTemp>,<BattLevelMax>, <BattLevelMin>, <MaxVoltPulse>, <MaxBatteryTemp>,<MinBatteryTemp>,<Charging_Current>, <DedicatedVoltStart>, <Battery_Pulse_Charging_Timeout>, <Battery_Fast_Charging_Timeout>, <TPulseOutCharge>, <BattIntRes>, <BattChangeLevel> (See the AT command Interface Guide [4]).

⚠️Caution:

The parameters need to be tuned according to the battery specifications.

The main parameters to be tuned are:

Parameters related to time:

- **BatteryFastChargingTimeout**: Maximum duration of the fast charging period. **(T1)**
- **BatteryPulseChargingTimeout**: Maximum duration of the charging pulse period.**(T2)**
- **TPulseOutCharge**: Monitoring time of the VBATT voltage when charging process is not activated**(T3)**

Parameters related to voltage:

- **BattLevelMin**: Minimum VBATT voltage allowed by the battery (>3.2V)
- **BattLevelMax**: Maximum VBATT voltage allowed by the battery (<4.5V)
- **DedicatedVoltStart**: Pulse charging is started above this threshold voltage

Parameter related to charging current:

- **ChargingCurrent**: Charging current delivered by the charger

Parameters related to safety:

These parameters are important; as they ensure that the battery will not be damaged.

- **MaxVoltPulse**: Maximum VBATT over-voltage supported by the PCM of the battery (Protection Circuit Module)
- **TdeltaTemp**: Delta time interval to measure the variation of the battery temperature
- **Min_Battery_Temp_Volt**: Lowest value for battery temperature sensor voltage in mV (highest temperature with a NTC
- **Max_Battery_Temp_Volt**: Highest value for battery temperature sensor voltage in mV (lowest temperature with a NTC)

Li-Ion battery and tunable parameters

Parameters	Default value	Min	Max	Unit
T1	90	70	90	min
T2	90	60	90	min
T3	5000	100	10000	ms
BattLevelMin	3400	3400	3800	mV
BattLevelMax	4200	4000	5000	mV
DedicatedVoltStart	4000	4000	4199	mV
ChargingCurrent	500	500	800	mA
MaxVoltPulse	4608	4200	4608	mV
TdeltaTemp	3	1	5	mm
Max_Battery_Temp_Volt	2171 ($\approx$3°C)	1816 ($\approx$14°C)	2256 ($\approx$ 0°C)	mV
Max_Battery_Temp_Volt	908 ($\approx$42°)	831 ($\approx$45°C)	1233 ($\approx$31°C)	mV

Li-Ion charging process

Charger connected: CHG_IN =VBATT+0.5V			
VBATT	Operating system	Charging status	Switching transistor (T)
VBATT<2V8	Not activated	Trickle charge	Open
2V8<VBATT<3V2	Not activated	Pre-charging	50mA typ cross the switching transistor
3V2<VBATT<BattLevelMin	Activated	Fast charging process is automatically started	Close
BattLevelMin<VBATT VBATT< BattLevelMax	Activated	Fast charging process running	Close (<T1)
		Charging process not activated	VBATT is monitored periodically (T3)
	Deactivated	Trickle charge	Open
>=BattLevelMax	Activated	If after "n" periods (1<n<100) of charge (nx0.1s), the VBATT voltage is measured higher than "BattLevelMax", the battery charge is stopped.	Open: Timing increases regularly from 0.1s to 10s Close: 1s Open and close being periodical

The graph below summarizes the charging process (charge and discharge).

<u>Note:</u>
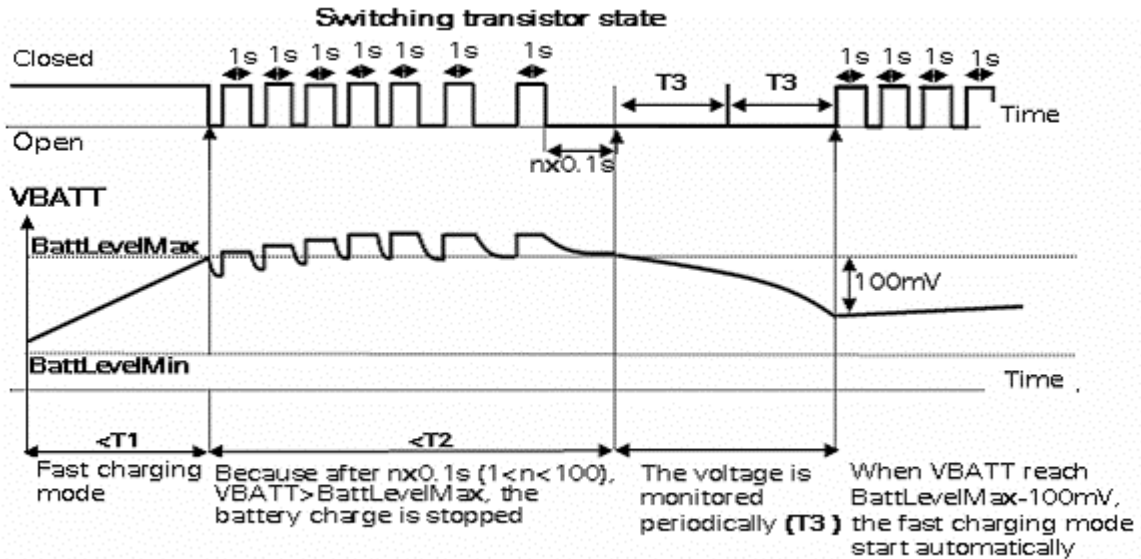A charger is connected to the CHG_IN pin of Wireless CPU®.


Figure 9: Li-Ion full-charging waveform

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3.15   ON / ~OFF

3.15.1   General Description

This input is used to power ON or OFF the Wireless CPU®.

To power-ON, a high level signal must be provided on the ON/~OFF pin of the Wireless CPU®.

To power-OFF, the ON/~OFF signal must be set to low and the AT command "AT+CPOF" must be sent to the Wireless CPU®.

.

Equivalent circuit
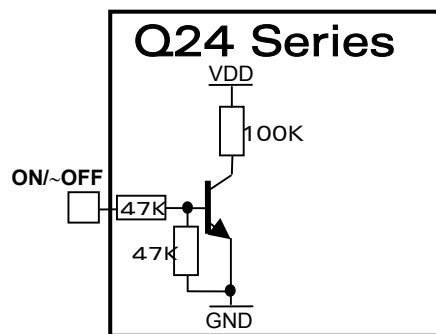
Pin description

Signal	Pin	I/O	I/O type	Description
ON/~OFF	6	I	CMOS	Power ON/OFF

Electrical characteristics

Parameters	Min	Max	Unit
VIL	0	0.6	V
VIH	2.4	5	V

Warning:

All external signals must be inactive when the Wireless CPU® is OFF to avoid any damage when starting and allow the Wireless CPU® to start and stop correctly.

3.15.2 Operating Sequences

3.15.2.1 Power-ON

Once the Wireless CPU® is supplied, the ON/~OFF signal must be asserted high during a delay of $T_{on-hold}$ (Hold delay on the ON/~OFF signal) to power-ON.

After this delay, once the firmware has completed its power-up sequence, an internal logic maintains the Wireless CPU® in power-ON condition.

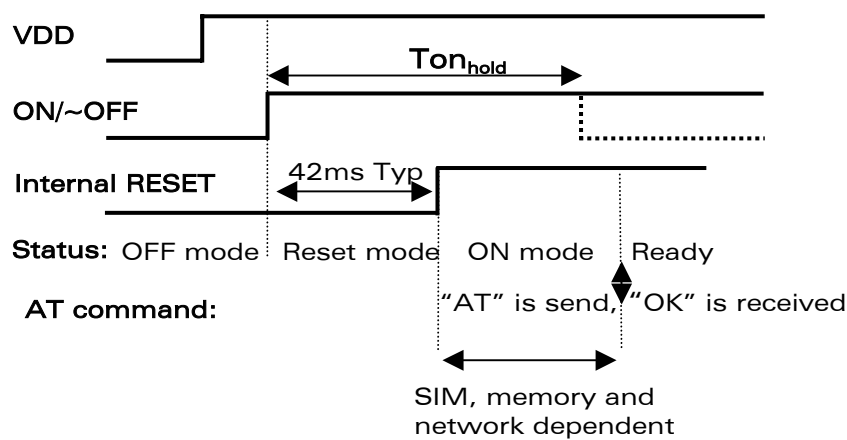You must not de-assert this ON/~OFF signal before this internal logic is internally asserted by the firmware; the Wireless CPU® would not start-up otherwise.

Figure 10: Power-ON sequence diagram

The duration of the firmware power-up sequence depends on several factors:

- firmware version used by the Wireless CPU®
- need to perform a recovery sequence if the power has been lost during a flash memory modification

Other factors have a minor influence

- number of parameters stored in EEPROM by the AT commands received so far
- ageing of the hardware components, especially the flash memory
- temperature conditions

The *recommended* way to de-assert the ON/~OFF signal is to use either an AT command or WIND indicators: the application must detect the end of the power-up initialization and de-assert ON/~OFF afterwards.

- Send an "AT" command and wait for the "OK" answer: once the initialization is complete the AT interface answers « OK » to "AT" message[1].

- Wait for the "+WIND: 3" message: after initialization, the Wireless CPU®, if configured to do so, will return an unsolicited "+WIND: 3" message. The generation of this message is enabled or disabled via an AT command.

Note:
   See also "AT Commands Interface Guide" [4] for more information on these commands.

Proceeding thus – by software detection - will always prevent the application from de-asserting the ON/~OFF signal too early.

If WIND indicators are disabled or AT commands unavailable or not used, it is still possible to de-assert ON/~OFF after a delay long enough ($T_{on-hold}$) to ensure that the firmware has already completed its power-up initialization.

The table below gives the minimum values of $T_{on-hold}$ for all firmware versions:

$T_{on-hold}$ minimum values

Open AT® Firmware	$T_{on-hold}$ Safe evaluations of the firmware power-up time
6.57 & above	8 s

The above figures take the worst cases into account: power-loss recovery operations, slow flash memory operations in high temperature conditions). But they are safe because they are large enough to ensure that ON/~OFF is not de-asserted too early.

Remarks:

1. Typical power-up initialization time figures for best cases conditions (no power-loss recovery, fast and new flash memory...) approximate 3.5 seconds in every firmware version. But releasing ON/~OFF after this delay does not guarantee that the application will actually start-up if for example the power plug has been pulled off during a flash memory operation, like a phone book entry update or an AT&W command.

2. The ON/~OFF signal can be left at a high level until switch OFF. But this is not recommended as it will prevent the AT+CPOF command from performing a clean power-off. (see also Note in section 3.15.2.2 Power-OFF for an alternate usage)

[1] If the application manages hardware flow control, the AT command can be sent during the initialisation phase.

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3. When using a battery as power source, it is not recommended to let this signal high:

   If the battery voltage is too low and the ON/~OFF signal at low level, an internal mechanism switches OFF the Wireless CPU®. This automatic process prevents the battery to be over discharged and optimize its life span.

4. During the power-ON sequence, an internal reset is automatically performed by the Wireless CPU® for 42 ms (typical). Any external reset should be avoided during this phase.

5. Connecting a charger on the Wireless CPU® as exactly the same effect than setting the ON/~OFF signal. In particular the Wireless CPU® will not POWER-OFF after the AT+CPOF command, unless the Charger is disconnected.

3.15.2.2 Power-OFF

To properly power-OFF the Wireless CPU®, the application must reset the ON/~OFF signal to low and then send the AT+CPOF command to de-register from the network and switch off the Wireless CPU®.

Once the « OK » response is issued, the Wireless CPU® is set to OFF mode. The external power supply can be switched off.
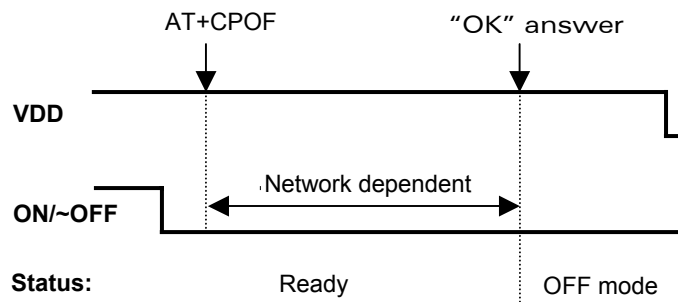

Figure 11: Power-OFF sequence diagram

⚠️Caution:

It is not allowed to power-OFF the Wireless CPU® by disconnecting the supply pins VBATT and VDD.

Notes:

- If the ON/~OFF pin is maintained to ON (High Level), then the Wireless CPU® can't be switched OFF.

- Instead of sending AT+CPOF, use the Wireless CPU® external interrupt pin (see the External interrupt)

- If the AT command AT+CFUN=1 is sent to the application, the Wireless CPU® re-starts whatever the level (high or low) of the ON/~OFF signal

3.16 BOOT (optional)

This input may be used to download software to the Flash memory of the Wireless CPU®.

For applications based on AT commands, this is a backup download procedure (refer to document [6] Customer Design Guidelines).

The internal BOOT procedure starts when this pin is low during Wireless CPU® reset.

⚠️Caution:

- **This BOOT pin must be left open for normal use or X-modem download.**

- **The nominal firmware download procedure uses the X-modem.**

In Internal BOOT mode, low level must be set through a 1KΩ resistor.

- BOOT = logical state 0, for download mode and

- BOOT = logical state 1, for normal mode.

Pin description

Signal	Pin	I/O	I/O type	Reset state	Description
BOOT	12	I	CMOS (C5)	Pull-up to 2V8	Flash Downloading

(C5): To obtain more details on I/O type, refer to the section 4.2 "**I/O Circuit diagram**"

3.17 Reset Signal (~RST)

3.17.1 General Description

The reset signal is used to force a reset procedure by providing low level, for at least **500 µs**.

The Wireless CPU® remains in reset mode as long as the ~RST signal is held low.

The reset process is activated either by the external ~RST signal or automatically by an internal signal (coming from a reset generator).

- ~RST = logical state 0, for Wireless CPU® Reset and

- ~RST = logical state 1, for normal mode.

Note:

A software reset is always preferred to a hardware reset.

The automatic reset is activated during a power-ON sequence.

During a power-ON sequence, the ~RST pin of the Wireless CPU® is set to the logical state 0.

⚠️Caution:

- **During a power-ON sequence of the Wireless CPU®, avoid to apply any voltage in the ~RST pin**

- o Otherwise:
  - - Wireless CPU® reset procedure may not perform correctly
  - - Wireless CPU® may be damaged
- If an external hardware reset happens with the ON/~OFF signal set to low, the Wireless CPU® powers OFF
- If an external hardware reset happens with ON/~OFF signal set to high, the Wireless CPU® re-starts

Equivalent circuit
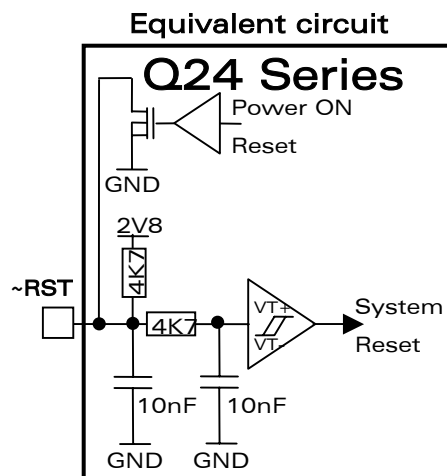
Pin description

Signal	Pin number	I/O	I/O type	Description
~RST	14	I/O	Schmitt	Reset

Electrical characteristics

Parameters		Min	Max	Condition
Hysteresis thresholds	VT-	0.9	1	
	VT+	1.7	1.8	
~RST	Reset state	0	0.4	IOL = -50 μA
	Normal mode	2.74	2.86	IOH = 50 μA

This signal may also be used to provide a reset to an external device. It then behaves as an output. If no external reset is necessary, then this input may be left open.

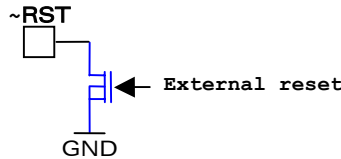If used (as an emergency reset), it must be driven either by an open collector or an open drain output:

Figure 12: RST pin connection

For the implementation of the reset interface, refer to Customer Design Guidelines [6].

3.17.2   Reset Sequence

To activate the "**emergency** "reset sequence, the ~RST signal must be set to low for **500 µs** minimum.

As soon as the reset is completed, the AT interface answers "**OK**" to the application.

In this case, the application must send AT↵. If the application manages hardware flow control, the AT command may be sent during the initialization phase.

Another solution is to use the AT+WIND command to obtain an unsolicited status from the Wireless CPU®.

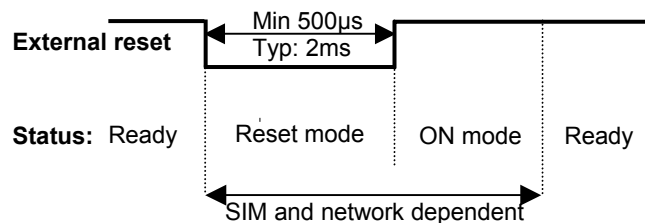For further details, refer to the AT commands documentation [4].

Figure 13: Reset sequence diagram

3.18   External Interrupt (~INTR)

The Wireless CPU® Q24 Series provide an external interrupt input ~INTR. This input is highly sensitive.

An interrupt is activated on a falling edge.

If this signal is not used, it may be left open.

If used, this input must be driven either by an open collector or an open drain output.

Pin description

Signal	Pin number	I/O	I/O type	Reset state	Description
~INTR	16	I	CMOS (C5)	Pull-up to 2V8	External Interrupt

(C5): To obtain more details on I/O type, refer to the section 4.2 "I/O Circuit diagram"

Electrical characteristics

Parameter	Min	Max	Unit
VIL	-0.5	0.7	V
VIH	2.2	3.0	V

The external interrupt may be used to switch OFF the Wireless CPU®. To enable this feature, AT+WFM=1, 83 must be entered:

The ON/OFF signal exists earlier in open or in low level, if an interrupt is received on the external interrupt pin, the Wireless CPU® changes automatically to OFF mode, similar to an AT+CPOF command.

Notes:

- By default, this feature is not activated
- Use AT+WFM=1,84 to return to default mode

3.19 VCC Output

This output may be used to power some external functions. This power supply is available when the Wireless CPU® is ON.

Pin description

Signal	Pin number	I/O	I/O type	Description
VCC	40	O	Supply	Digital supply

Operating conditions

Parameter	Condition	Min	Max	Unit
Output voltage	I = 0		2.86	V
	I = 100 mA	2.74		V
Output Current			100	mA

3.20 Real Time Clock Supply (VCC_RTC)

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

The RTC is supported by the Wireless CPU® when power-ON, but a back-up power supply is necessary to save date and time information, when VDD is removed or the Wireless CPU® is switched off.

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

Equivalent circuit
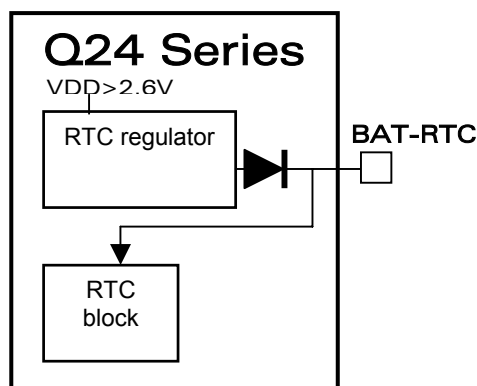
If VDD<2.6V, the RTC regulator is disabled, a back-up battery is then necessary to save date and time information.

Pin description

Signal	Pin number	I/O	I/O type	Description
VCC_RTC	56	I/O	Supply	RTC Back-up supply

Operating conditions

Parameter	Condition	Min	Typ	Max	Unit
Input voltage		2		2.75	V
Input current	VCC_RTC=2.5 V VDD=3.6V		3	10	μA
Output voltage	VDD=3.6V, Iout=0.5mA	2.65	2.7	2.75	V
Output current	VDD=3.6, Vout=2.25V	0.4	1	2	mA

3.21 RF Interface

The impedance is 50Ω nominal and the DC impedance is 0Ω.

3.21.1 RF Connections

The RF interface supports 4 types of connections:

- **U.FL Connector (on both sides)**

  A wide variety of cables fitted with U.FL connectors are proposed by different suppliers.

- **MMS Connector**

  The MMS connector stands on three pliable legs. The design guarantees the receptacle stability after placement. The MMS snap on mating system ensures a correct positive connection on each time.

  A wide variety of cables fitted with MMS connectors are proposed by different suppliers.

- **Soldered solution**

  A soldered solution is preferably based on an RG178 coaxial cable.

- **IMP connector**

  This connector is dedicated to different board applications and must be soldered to the customer board. The supplier is Radiall with the following reference:

  `R107 064 900` or `R107 064 920`.

Notes:

- The Wireless CPU® Q24 Series does not support an antenna switch for a car kit, but this function may be implemented externally and it may be driven using a GPIO.

- The antenna cable and connector should be selected in order to minimize losses

in the frequency bands used for GSM 850/900MHz and 1800/1900MHz.

- 0.5dB may be considered as a maximum value for loss between the Wireless CPU® and an external connector.

- In order to maintain the RoHS status of the Wireless CPU®, Wavecom recommends that *lead-free solder-wire and flux* be used for Wireless CPU® assembly on the motherboard and RF cable, assembly on the Wireless CPU®.

Example:

- Solder-Wire: Kester 245 Cored 58 (Sn96.5Ag3Cu0.5)
- Flux: Kester 952-D6

3.21.2　RF Performance

RF performance is compliant with the ETSI recommendation ETSI TS 151 010-1.

The main parameters for a GSM receiver are:

- GSM850 Reference Sensitivity = -104 dBm Static & TUHigh

- EGSM900 Reference Sensitivity = -104 dBm Static & TUHigh

- DCS1800 Reference Sensitivity = -102 dBm Static & TUHigh

- PCS1900 Reference Sensitivity = -102 dBm Static & TUHigh

- Selectivity @ 200 kHz: > +9 dBc

- Selectivity @ 400 kHz: > +41 dBc

- Linear dynamic range: 63 dB

- Co-channel rejection: >= 9 dBc

And for Transmitters:

- Maximum output power (EGSM & GSM850): 33 dBm +/- 2 dB at ambient temperature

- Maximum output power (GSM1800 & PCS1900): 30 dBm +/- 2 dB at ambient temperature

- Minimum output power (EGSM & GSM850): 5 dBm +/- 5 dB at ambient temperature

- Minimum output power (GSM1800 & PCS1900): 0 dBm +/- 5 dB at ambient temperature

3.21.3   Antenna Specifications

The antenna must fulfill the following requirements, as specified in the table below:

- The optimum operating frequency depends on the application. A dual-band or a quad-band antenna must operate in these frequency bands and have the following characteristics:

Characteristic	Q24			
	EGSM 900	DCS 1800	GSM 850	PCS 1900
TX Frequency	880 to 915 MHz	1710 to 1785 MHz	824 to 849 MHz	1850 to 1910 MHz
RX Frequency	925 to 960 MHz	1805 to 1880 MHz	869 to 894 MHz	1930 to 1990 MHz
Impedance	50Ω			
VSWR Rx max	1.5 :1			
VSWR Tx max	1.5 :1			
Typical radiated gain	0dBi in one direction at least			

4 Technical Specifications

4.1 General Purpose Connector Pin-out Description

Pin	Name	I/O	I/O type	Reset state	Description	Dealing with unused pins
1	CHG_IN	I	Supply	-	Supply for battery charging	Not connected
2	CHG_IN	I	Supply	-	Supply for battery charging	Not connected
3	SIM_CLK	O	-	0V	Clock for SIM interface	Not connected if Q24 SIM Card holder is used
4	CHG_IN	I	Supply	-	Supply for battery charging	Not connected
5	SIM_RST	O	-	0V	Reset for SIM interface	Not connected if Q24 SIM Card holder is used
6	ON/~OFF	I	CMOS	-	Power ON/OFF control	Must be used
7	SIM_DATA	I/O	-	0V	I/O for SIM interface	Not connected if Q24 SIM Card holder is used
8	SDA/SPI_IO	I/O	CMOS/CMOS 1X (C2)	Pull-up to 2V8	Two-wire interface or SPI Serial Data	Not connected
9	SIM_VCC	O	Supply	0V	SIM Card supply	Not connected if Q24 SIM Card holder is used
10	SCL/SPI_CLK	O	CMOS 1X (C5)	Pull-up to 2V8	Two-wire interface or SPI Serial clock	Not connected
11	VDD	I	Supply	-	Low power supply	Must be used
12	BOOT	I	CMOS (C5)	Pull-up to 2V8	BOOT	Test point (Download purposes)
13	ROW0	I/O	CMOS/ CMOS 1X	Pull-down to 0V	Keyboard Row	Not connected
14	~RST	I/O	Schmitt	0V	Reset	Test point (Debug purposes)
15	ROW1	I/O	CMOS/ CMOS 1X	Pull-down to 0V	Keyboard Row	Not connected
16	~INTR	I	CMOS (C5)	Pull-up to 2V8	External interrupt	Not connected
17	ROW2	I/O	CMOS/ CMOS 1X	Pull-down to 0V	Keyboard Row	Not connected

Pin	Name	I/O	I/O type	Reset state	Description	Dealing with unused pins
18	GPI or CT103/TXD2	I	CMOS (C4)	Pull-down to 0V	General Purpose Input or Transmit serial data (UART2)	Not connected
19	ROW3	I/O	CMOS/ CMOS 1X	Pull-down to 0V	Keyboard Row	Not connected
20	GPO2 or CT104/RXD2	O	CMOS 3X (C1) or CMOS 1X (C1)	2V8	General Purpose Output or Receive serial data (UART2)	Not connected
21	ROW4	I/O	CMOS/ CMOS 1X	Pull-down to 0V	Keyboard Row	Not connected
22	GPO1	O	CMOS 3X (C3)	0V	General Purpose Output	Not connected
23	COL0	I/O	CMOS/ CMOS 1X	Pull-up to 2V8	Keyboard Column	Not connected
24	GPIO0 or CT106/CTS2	I/O O	CMOS/CMOS 2X (C1) or CMOS 2X (C1)	High impedance	General Purpose I/O or Clear To Send (UART2)	Not connected
25	COL1	I/O	CMOS/ CMOS 1X	Pull-up to 2V8	Keyboard Column	Not connected
26	GPO0 or SPI_AUX	O O	CMOS 3X (C3) or CMOS 1X (C3)	2V8	General Purpose Output or SPI_AUX	Not connected
27	COL2	I/O	CMOS/ CMOS 1X	Pull-up to 2V8	Keyboard Column	Not connected
28	GPO3 or SPI_EN or	O O	CMOS 3X (C3) or CMOS 1X (C3)	2V8	SPI enable or General Purpose Output	Not connected
29	COL3	I/O	CMOS/ CMOS 1X	Pull-up to 2V8	Keyboard Column	Not connected
30	CT105/RTS1	I	COS	High impedance	Request To Send (UART1)	Please refer to the Customer Design Guidelines [6] for proper implementation.
31	COL4	I/O	CMOS/ CMOS 1X	Pull-up to 2V8	Keyboard Column	Not connected
32	CT104/RXD1	O	CMOS 1X (C3)	2V8	Receive serial data (UART1)	Test point (Download purposes)
33	AUXV0	I	Analog	High impedance	Auxiliary ADC input 0	Tied to GND
34	CT108-2/DTR1	I	CMOS	High impedance	Data Terminal Ready (UART1)	Please refer to the Customer Design Guidelines [6] for proper implementation.

Pin	Name	I/O	I/O type	Reset state	Description	Dealing with unused pins
35	GPIO5 or CT105/RTS2	I/O I	CMOS/CMOS 2X (C1) or CMOS	High impedance	General Purpose I/O or Clear To Send (UART2)	Not connected
36	CT107/DSR1	O	CMOS 1X (C3)	2V8	Data Set Ready (UART1)	Not connected
37	CT106/CTS1	O	CMOS 1X (C1)	High impedance	Clear To Send (UART1)	Test point (Download purposes)
38	BAT_TEMP	I	Analog	High impedance	ADC input for battery temperature measurement	Tied to GND
39	CT103/TXD1	I	CMOS	High impedance	Transmit serial data (UART1)	100kΩ pull-up to 2V8 with test point (download and debug purposes)
40	VCC	O	Supply	2V8	2.8 V digital supply output	Not connected
41	SPK1P	O	Analog	-	Speaker 1 positive output	Not connected
42	MIC1P	I	Analog	-	Microphone 1 positive input	Not connected
43	SPK1N	O	Analog	-	Speaker 1 negative output	Not connected
44	MIC1N	I	Analog	-	Microphone 1 negative input	Not connected
45	SPK2P	O	Analog	-	Speaker 2 positive output	Not connected
46	MIC2P	I	Analog	-	Microphone 2 positive input	Not connected
47	SPK2N	O	Analog	-	Speaker 2 negative output	Not connected
48	MIC2N	I	Analog	-	Microphone 2 negative input	Not connected
49	BUZZER	O	Analog	-	Buzzer output	Not connected
50	SIM_PRES	I	CMOS	High impedance	SIM Card Detect	Tied to 2V8
51	GPIO3 or CT109/DCD1	I/O O	CMOS/CMOS 2X (C1) or CMOS2X (C1)	High impedance	General Purpose I/O or Data Carrier Detect (UART1)	Not connected
52	GPIO1 FLASH LED	I/O O	CMOS/CMOS 2X (C1) or CMOS2X (C1)	High impedance	General Purpose I/O or Flash LED	Not connected
53	GPIO4	I/O	CMOS/CMOS 2X (C1)	High impedance	General Purpose I/O	Not connected

Pin	Name	I/O	I/O type	Reset state	Description	Dealing with unused pins
54	GPIO2 or CT125 / RI1	I/O O	CMOS/CMOS 2X (C1) or CMOS 2X (C1)	High impedance	General Purpose I/O or Ring Indicator (UART1)	Not connected
55	+VBATT	I	Supply	-	Battery Input	Must be used
56	VCC_RTC	I/O	Supply	2V8	RTC back-up supply	Not connected
57	+VBATT	I	Supply	-	Battery Input	Must be used
58	+VBATT	I	Supply	-	Battery Input	Must be used
59	+VBATT	I	Supply	-	Battery Input	Must be used
60	+VBATT	I	Supply	-	Battery Input	Must be used
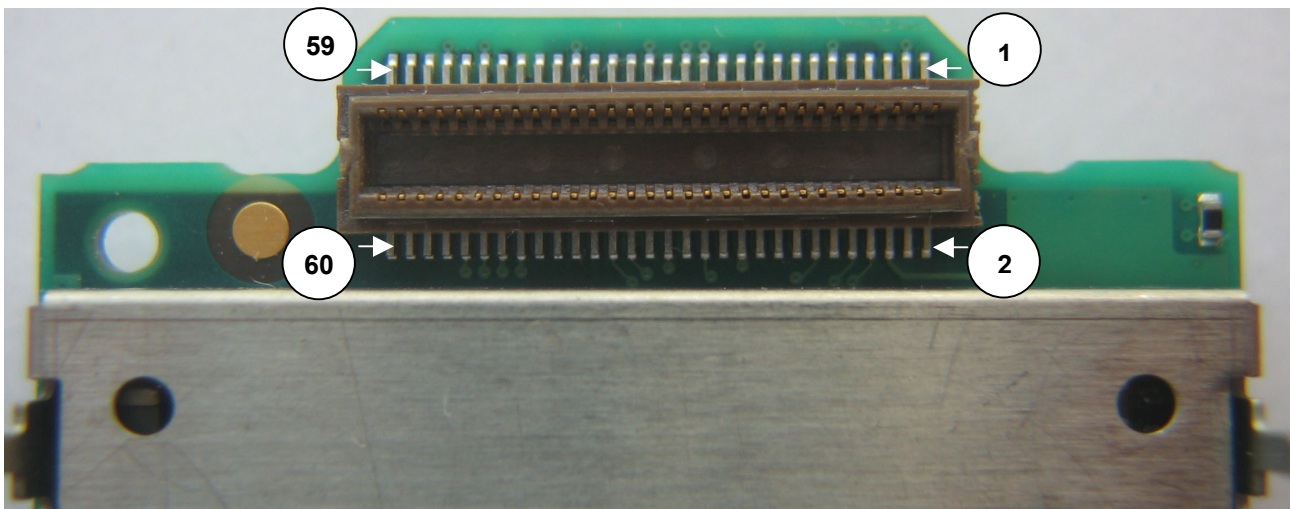
Figure 14: Wireless CPU® pin position (bottom view)

4.2 I/O Circuit Diagram

The following drawings show the internal interface of the Wireless CPU® Q24 Series. The type indication per interface can be found in the previous chapters.
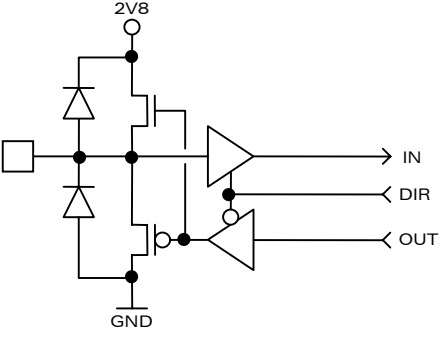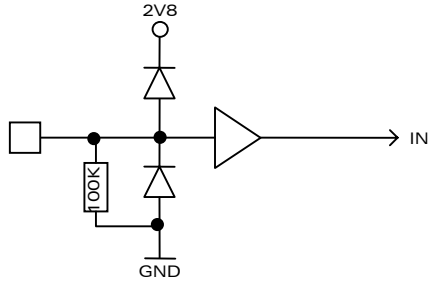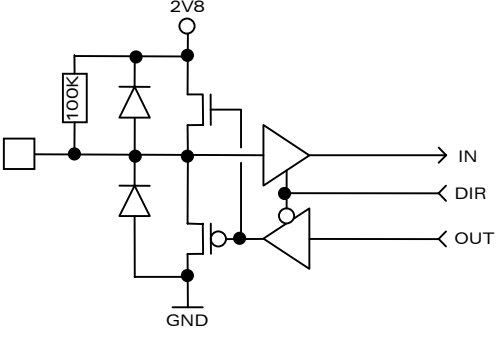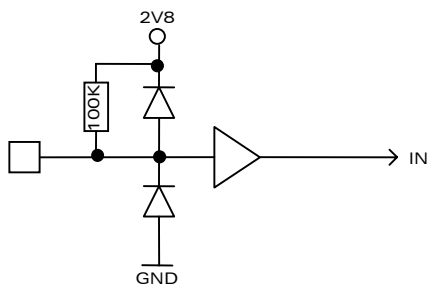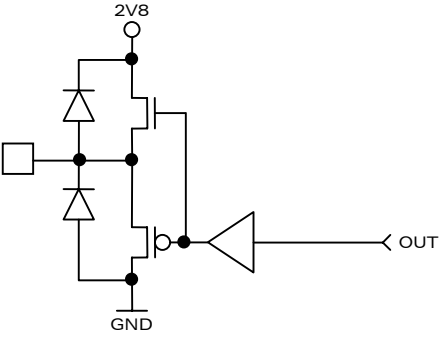
Type	Circuit	Type	Circuit
(C1)		(C4)	
(C2)		(C5)	
(C3)			

Figure 15: I/O Circuit Diagram

5 Environmental Specifications

The Wireless CPU® Q24 Classic and Q24 Plus are compliant with the following operating classes:

Condition	Temperature range
Operating / Class A	-20°C to +55°C for GSM 850 / 900
	-10°C to +55°C for GSM 1800/1900
Storage	-40°C to +85°C

The Wireless CPU® Q24 Automotive and Q24 Extended are compliant with the following operating classes:

Conditions	Temperature range
Operating / Class A	-20°C to +55°Cfor GSM 850 / 900
	-10°C to +55°C for GSM 1800/1900
Operating / Class B	-30°C to +75°C
Operating / Class C	-40°C to + 85°C
Storage	-40°C to + 85°C

Classification and Wireless CPU® Q24 Series:

- **Class A:**

The Wireless CPU® remains fully functional, meeting GSM performance criteria in accordance with ETSI requirements, across the specified temperature range.

- **Class B:**

The Wireless CPU® remains fully functional, across the specified temperature range. Some GSM parameters may occasionally deviate from the ETSI specified requirements and this deviation may not affect the ability of the Wireless CPU® to connect to the cellular network and fully functional, as it does within the Class A range.

- **Class C:**

The functional requirements will not be fulfilled during external influence, but will return to fully functional automatically, after the external influence has been removed.

5.1 Environmental Qualifications

For the Wireless CPU® Q24 Classic, Q24 Plus, and Q24 Extended, applied environmental qualifications are defined in the table below:

TYPE OF TEST	STANDARDS	ENVIRONMENTAL CLASSES		
		STORAGE Class 1.2	TRANSPORTATION Class 2.3	OPERATING (PORT USE) Class 7.3
Cold	IEC 68-2.1 Ab test	-25° C 72 h	-40° C 72 h	-20° C (GSM900) 16 h -10° C (GSM1800/1900) 16h
Dry heat	IEC 68-2.2 Bb test	+70° C 72 h	+70° C 72 h	+55° C 16 h
Change of temperature	IEC 68-2.14 Na/Nb test		-40° / +30° C 5 cycles t1 = 3 h	-20° / +30° C (GSM900) 3 cycles -10° / +30° C (GSM1800/1900): 3 cycles t1 = 3 h
Damp heat cyclic	IEC 68-2.30 Db test	+30° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1
Damp heat	IEC 68-2.56 Cb test	+30° C 4 days	+40° C 4 days	+40° C 4 days
Sinusoidal vibration	IEC 68-2.6 Fc test	5 - 62 Hz : 5 mm / s 62 - 200Hz : 2 m / s2 3 x 5 sweep cycles		
Random vibration wide band	IEC 68-3.36 Fdb test		5 - 20 Hz : 0.96 m2 / s3 20 - 500Hz : - 3 dB / oct 3 x 10 min	10 -12 Hz : 0.96 m2 / s3 12 - 150Hz : - 3 dB / oct 3 x 30 min

Figure 16: Q24 Classic, Q24 Plus and Q24 Extended Environmental classes

For more details, refer to the document "Environmental Control Plan" for Wireless CPU® Q24 Series [9].

Electro-Static Discharge (ESD):

According to the **EN 61000-4-2** standard, the maximum ESD level supported by the Wireless CPU® series on contact discharges is ±1 kV on the 60-pin connector, ±2 kV on the antenna connector, and ±4 kV on the SIM Card holder.

For the Wireless CPU® Q24 Automotive, environmental qualification applied is defined in table below:

Test Designation	Standards	Definition / Severities
Resistance to Heat	IEC 60068-2-2	Temperature: +85°C Duration: 504 h
Resistance to cold test	IEC 60068-2-30 Db	Storage temperature: -40±2°C Storage time: 72 h
Cooking Test	-	Temperature: +70 ±2°C Duration: 100 days
Damp heat test	IEC 60068-2-3	Storage temperature: +40±2°C Storage humidity: 95±3% Storage time: 21 days
Damp heat cycle test	IEC 60068-2-30 Db	Upper temperature: +55±2°C Number of cycles: 10
Temperature change	IEC 60068-2-14 Nb	Low temperature: -40°±2°C High temperature: +85±2°C Total duration: 11 days
Thermal Shock	IEC 60068-2-14	Low temperature: -40°±2°C High temperature: +85±2°C Total duration: 200 hours
Resistance to sinusoidal vibration	IEC 60068-2-6 Fc	[10 Hz to 16 Hz]: ±5 mm (peak) [16 Hz to 62 Hz]: 5 g (peak) [62 Hz to 200Hz]: 3g (peak) [200 Hz to 1000 Hz] 1g (peak) Test duration: 20 cycles Sweep directions: X / Y / Z

Resistance to random vibration	IEC 60068-2-64	Frequency range: 10 Hz - 2000 Hz
		Spectrum level:
		    0.1 g2/Hz at 10 Hz
		    0.01 g2/Hz at 250 Hz
		    0.0005 g2/Hz at 1000 Hz
		    0.0005 g2/Hz at 2000 Hz
		    Duration: 16 h
		Vibration axis: X / Y / Z

Resistance to mechanical shock	IEC 68-2-27	Peak acceleration: 30g / 100g / 200g Direction: ±X, ±Y, ±Z
ESD Test	IEC 1000-4-2	1 kV contact discharge on 60-pin connector 2 kV contact discharge on RF connector 4kV contact discharge on SIM interface

Figure 17: Q24 Automotive environmental classes

For more details, refer to the document:

"Automotive Environmental Control Plan" for Wireless CPU® Q24 Series [8].

5.2 Reflow Soldering

The Wireless CPU® Q24 Series do not support any reflow soldering.

5.3 Conformance with ATEX 94/9/CE Directive

To evaluate the conformity of the final product with ATEX 94/9/CE directive the following datas must be taken into account:

- Sum of all capacitors : $93\mu F$
- Sum of all inductances : $11\mu H$

5.4 Mechanical Specifications

5.4.1 Physical Characteristics

The Wireless CPU® Q24NG sub-series have a complete self-contained shield.

• Dimensions : 58.4 x 32.2 x 3.9 mm external dimensions (excluding shielding pins) • Weight : <11 g (12g for Q24 Automotive)

5.4.2 Mechanical Drawings

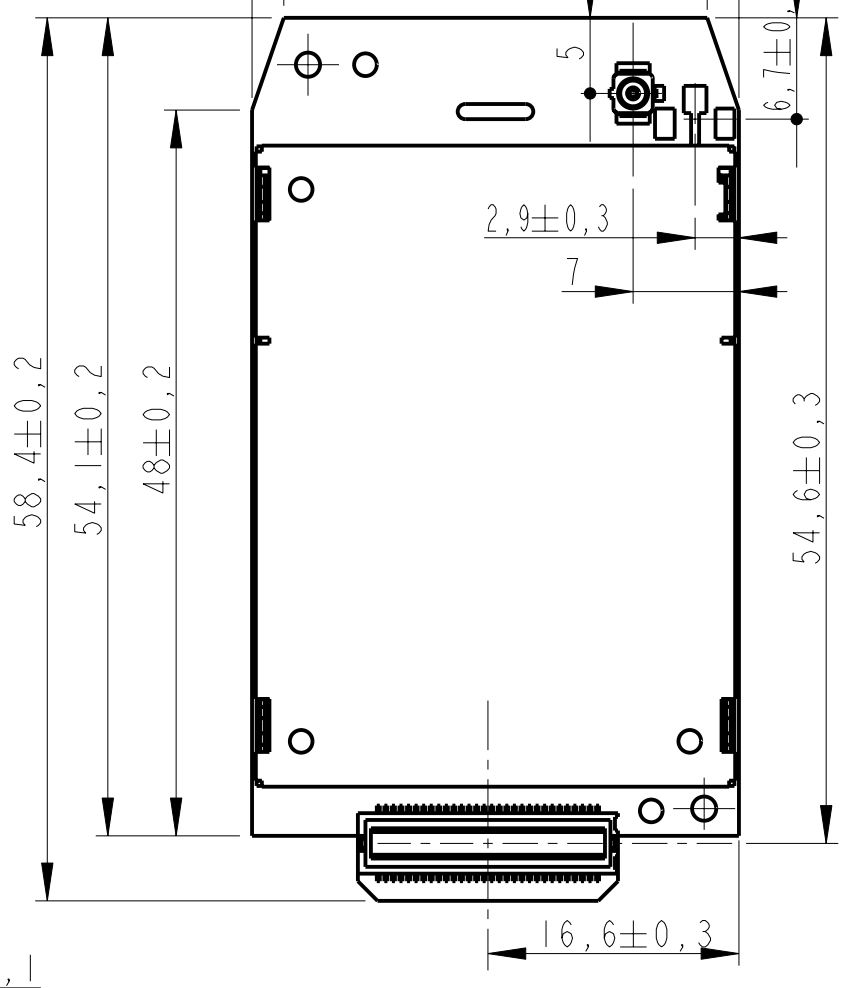The following page gives the mechanical specifications of the Wireless CPU® Q24 Series.

Figure 18: Mechanical drawing.

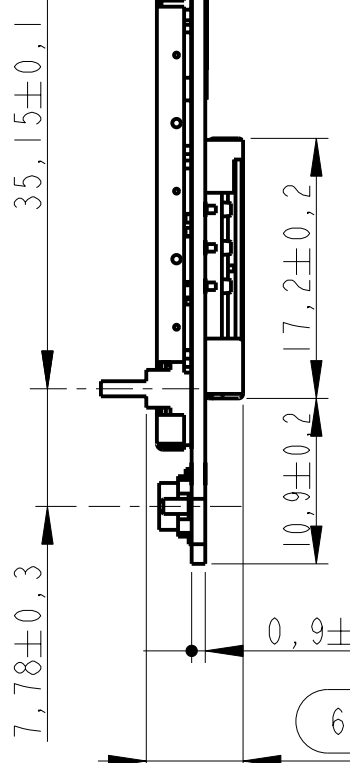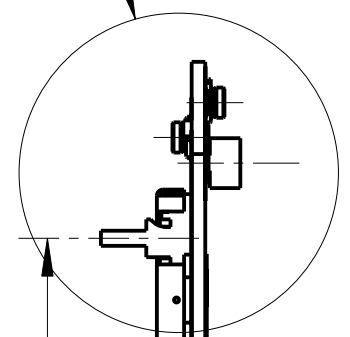(see following page)

SCALE 1,000

SIM card
connector
(optional)

3,4±0,2

0,3   30,8±0,2

1,3±0,2   1,3±0,2

13,6   5

7,9

4,3

3,55

5,1

6,7

2,7

1

9,2

4,85

SEE DETAIL A

3,1

32,2±0,2

28±0,2
SCALE 2,000

(2,1)   2,1

Optional
connectors

3   3±0,1

2,3±0,2

4,7

Q24 series

Label

6,7±0,3

5

2,9±0,3

7

35,15±0,1

49,2

58,4±0,2

54,1±0,2

48±0,2

54,6±0,3

26,1±0,5

17,2±0,2

.003

DETAIL A
SCALE 8,000

Locating
2x Ø1,5

10,9±0,2

2,3   26,2

7,78±0,3

0,9±0,1

6,4 +0,3 -0,2

16,6±0,3
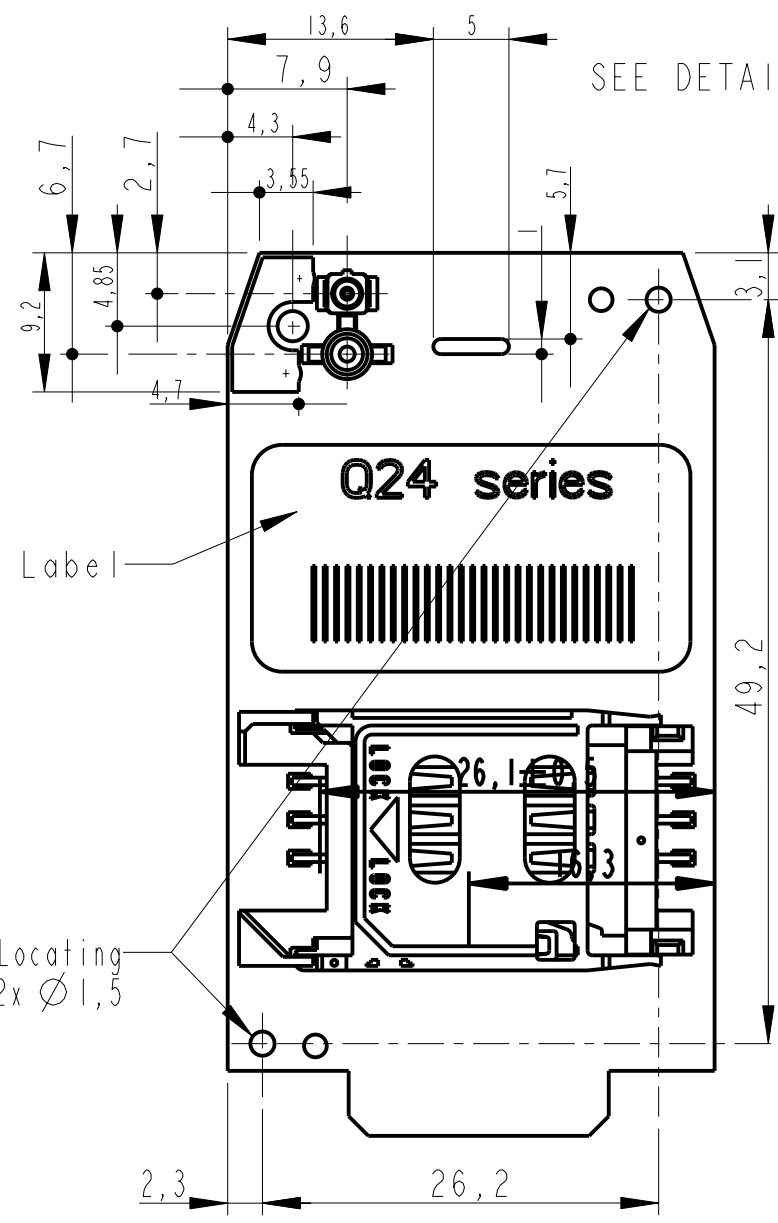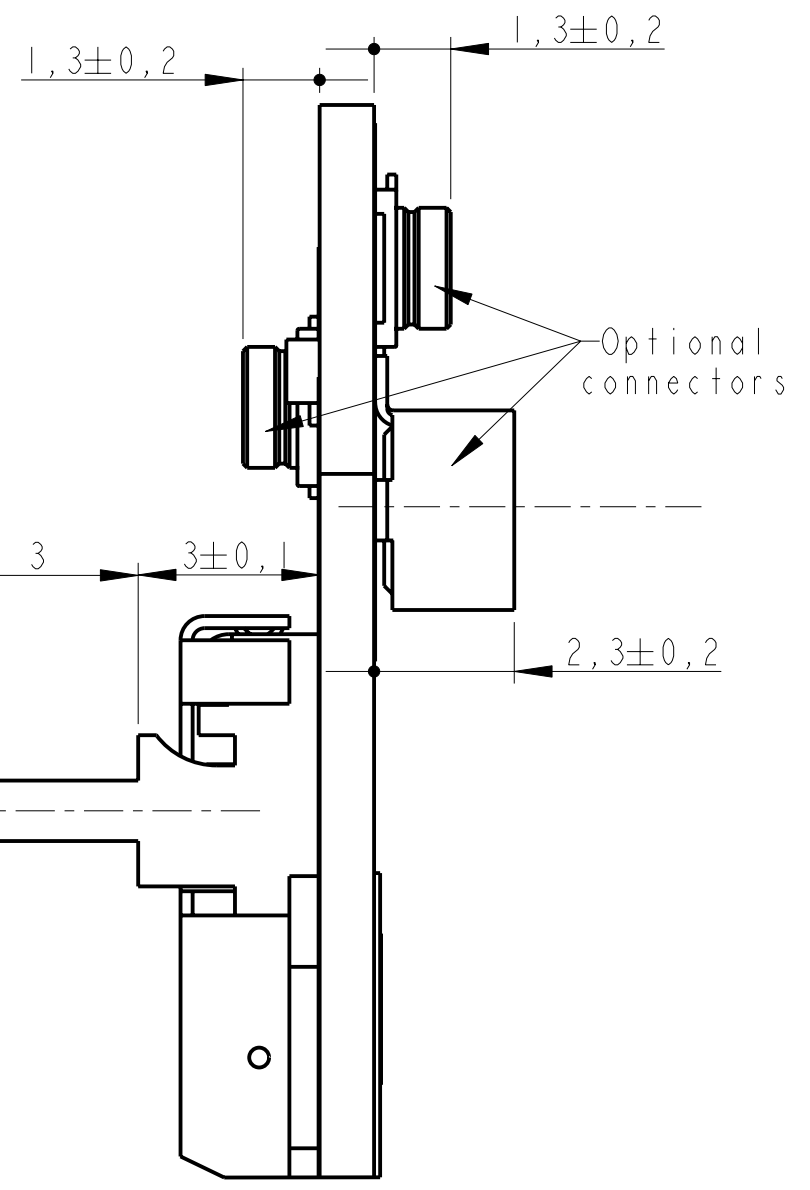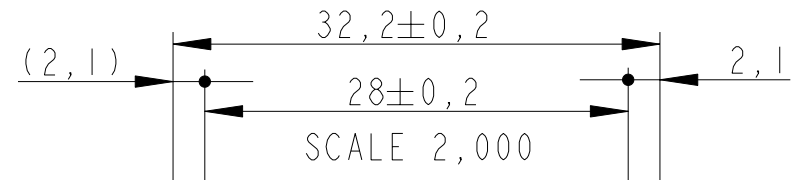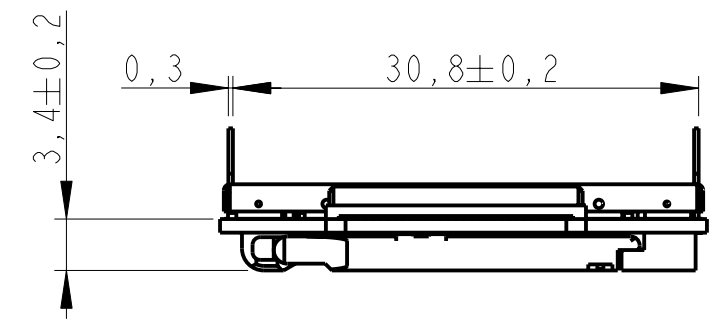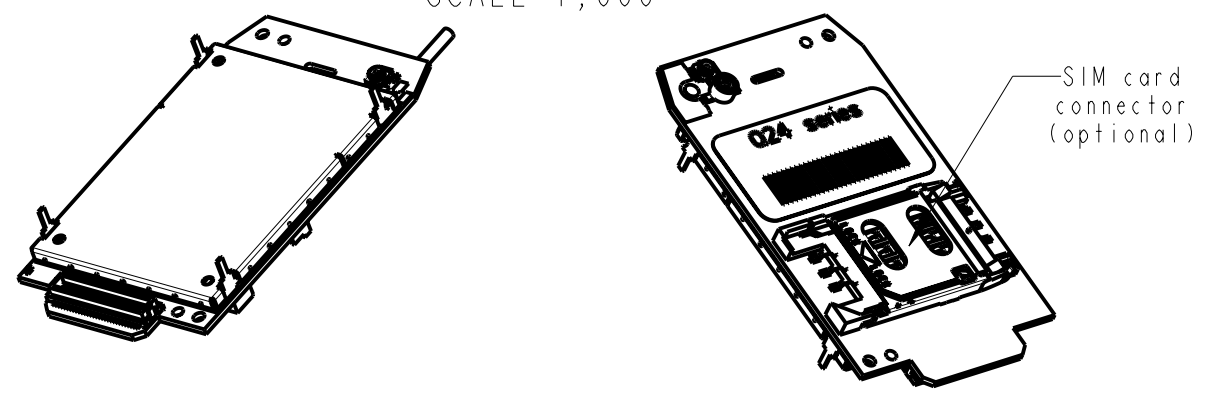
Q24 Series   GEN.TOL. : ±0,3   SCALE : 1,000

DOC.   FOLIO: 1/1   FORMAT : A3

MODULE DIMENSIONS

WM-3-600101-V-003-A

AUTHOR : JPM

RESPONS : ASC   B

wavecom

PRO/ENGINEER   MODULE

MODIFICATION	DATE	AUTHOR	RESP.	STATUS	IND
Sim holder update	28/09/06	JPM	ASC	Production	B
Creation	03/08/06	JPM	ASC	Production	A

6 Connector and Peripheral Device References

6.1 General Purpose Connector Data Sheet

The GPC is a 60-pin connector with 0.5mm pitch from the KYOCERA / AVX group, with the following reference:

- 14 5087 060 930 861 or 19 5087 060 930 861.

The matting connector has the following reference:

- 24 5087 060 X00 861.

The stacking height is 3.0 mm.

More information is available from http://www.avxcorp.com.

6.2 SIM Card Reader

These SIM Card holder references may be used in customer application with Wireless CPU® Q24 version, not already equipped with a SIM Card holder.

- 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 99228-0002 (connector) / MOLEX 91236-0002 (holder) (see http://www.molex.com)

6.3 Microphone

Potential suppliers:

- HOSIDEN
- PANASONIC
- PEIKER

6.4 Speaker

Potential suppliers:

- SANYO
- HOSIDEN
- PRIMO
- PHILIPS

6.5 Antenna Cable

The following cable reference has been certified for mounting on the Wireless CPU® Q24 Series:

- RG178

6.6 RF board-to-board Connector

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

- R107 064 900.
- R107 064 920.

The supplier for the MMS connector is Radiall (http://www.radiall.com)

6.7 GSM Antenna

GSM antenna and support for antenna adaptation may be obtained from the manufacturers such as:

- ALLGON (http://www.allgon.com)
- HIRSCHMANN (http://www.hirschmann.com)

7 Appendix

7.1 Standards and Recommendations

GSM ETSI, 3GPP, GCF, and NAPRD.03 recommendations for Phase II.

Specification Reference	Title
3GPP TS 45.005 v5.5.0 (2002-08) Release 5	Technical Specification Group GSM/EDGE. Radio Access Network; Radio transmission and reception
GSM 02.07 V8.0.0 (1999-07)	Digital cellular telecommunications system (Phase 2+); Mobile Stations (MS) features (GSM 02.07 version 8.0.0 Release 1999)
GSM 02.60 V8.1.0 (1999-07)	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description, Stage 1 (GSM 02.60 version 8.1.0 Release 1999)
GSM 03.60 V7.9.0 (2002-09)	Technical Specification Group Services and System Aspects; Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description; Stage 2 (Release 1998)
3GPP TS 43.064 V5.0.0 (2002-04)	Technical Specification Group GERAN; Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS radio interface; Stage 2 (Release 5)
3GPP TS 03.22 V8.7.0 (2002-08)	Technical Specification Group GSM/EDGE. Radio Access Network; Functions related to Mobile Station (MS) in idle mode and group receive mode; (Release 1999)
3GPP TS 03.40 V7.5.0 (2001-12)	Technical Specification Group Terminals; Technical realization of the Short Message Service (SMS) (Release 1998)
3GPP TS 03.41 V7.4.0 (2000-09)	Technical Specification Group Terminals; Technical realization of Cell Broadcast Service (CBS) (Release 1998)
ETSI EN 300 903 V8.1.1 (2000-11)	Digital cellular telecommunications system (Phase 2+); Transmission planning aspects of the speech service in the GSM Public Land Mobile Network (PLMN) system (GSM 03.50 version 8.1.1 Release 1999)
3GPP TS 04.06 V8.2.1 (2002-05)	Technical Specification Group GSM/EDGE Radio Access Network; Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification (Release 1999)

Specification Reference	Title
3GPP TS 04.08 V7.18.0 (2002-09)	Technical Specification Group Core Network; Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification (Release 1998)
3GPP TS 04.10 V7.1.0 (2001-12)	Technical Specification Group Core Networks; Mobile radio interface layer 3 Supplementary services specification; General aspects (Release 1998)
3GPP TS 04.11 V7.1.0 (2000-09)	Technical Specification Group Core Network; Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface (Release 1998)
3GPP TS 45.005 v5.5.0 (2002-08)	Technical Specification Group GSM/EDGE. Radio Access Network; Radio transmission and reception (Release 5)
3GPP TS 45.008 V5.8.0 (2002-08)	Technical Specification Group GSM/EDGE Radio Access Network; Radio subsystem link control (Release 5)
3GPP TS 45.010 V5.1.0 (2002-08)	Technical Specification Group GSM/EDGE Radio Access Network; Radio subsystem synchronization (Release 5)
3GPP TS 46.010 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Transcoding (Release 5)
3GPP TS 46.011 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Substitution and muting of lost frames for full rate speech channels (Release 5)
3GPP TS 46.012 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Comfort noise aspect for full rate speech traffic channels (Release 5)
3GPP TS 46.031 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Discontinuous Transmission (DTX) for full rate speech traffic channels (Release 5)
3GPP TS 46.032 V5.0.0 (2002-06)	Technical Specification Group Services and System Aspects; Full rate speech; Voice Activity Detector (VAD) for full rate speech traffic channels (Release 5)
TS 100 913V8.0.0 (1999-08)	Digital cellular telecommunications system (Phase 2+); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS) (GSM 07.01 version 8.0.0 Release 1999)

Specification Reference	Title
GSM 09.07 V8.0.0 (1999-08)	Digital cellular telecommunications system (Phase 2+); General requirements on inter-working between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN) (GSM 09.07 version 8.0.0 Release 1999)
3GPP TS 51.010-1 v7.3.1 (2006-10)	Technical Specification Group GSM/EDGE ; Radio Access Network ;Digital cellular telecommunications system (Phase 2+);Mobile Station (MS) conformance specification; Part 1: Conformance specification (Release 7)
3GPP TS 51.011 V5.0.0 (2001-12)	Technical Specification Group Terminals; Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface (Release 5)
ETS 300 641 (1998-03)	Digital cellular telecommunications system (Phase 2); Specification of the 3 Volt Subscriber Identity Module - Mobile Equipment (SIM-ME) interface (GSM 11.12 version 4.3.1)
GCF-CC V3.23.1 (2006-07)	Global Certification Forum – Certification criteria
NAPRD03 v3.8.1 (2006-08)	North America Permanent Reference Document for PTCRB tests

The Wireless CPU® Quik Q24 series connected to a development kit board application is certified to be in accordance with the following Rules and Regulations of the Federal Communications Commission (FCC).

Power listed on the Gant is conducted for Part 22 and conducted for Part 24.

This device contains EGSM/GPRS Class 10 functions in the 900 and 1800MHz Band, which are not operational in U.S. Territories.

This device can be used only for mobile and fixed applications. The antenna(s) used for this transmitter must be installed at a distance of minimum 20 cm from all persons and must not be co-located or operated with any other antenna or transmitter.

Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Antennas used for this OEM module must not exceed 1.4 dBi gain for GSM 850 MHz and 7 dBi for GSM 1900 MHz for fixed operating configurations. For mobile operations the gain must not exceed 1.4 dBi for GSM 850 MHz and 3dBi for GSM 1900 MHz. This device is approved as a module to be installed in other devices.

Installed in portable devices, the RF exposure condition requires a separate mandatory equipment authorization for the final device.

The license module will have a FCC ID label on the module itself. The FCC ID label must be visible through a window or it must be visible when an access panel, door or cover is easily removed.

If not, a second label must be placed on the outside of the device that contains one of the following texts:

FCC ID: O9EQ24CL001

FCC ID: O9EQ24CL003

FCC ID: O9EQ24PL001

FCC ID: O9EQ24PL003

FCC ID: O9EQ24PL005

FCC ID: O9EQ24PL006

FCC ID: O9EQ24AU001

FCC ID: O9EQ24AU002

FCC ID: O9EQ24EX001

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

- This device may not cause harmful interference.

- This device must accept any interference received, including interference that may cause undesired operation.

7.2 Safety Recommendations (for Information only)

> **IMPORTANT**
>
> **FOR THE EFFICIENT AND SAFE OPERATION OF**
>
> **YOUR GSM APPLICATION BASED ON Wireless CPU® Q24 Series**
>
> **PLEASE READ THIS INFORMATION CAREFULLY**

7.2.1 RF safety

7.2.1.1   General

Your GSM terminal is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM terminal is actually a low power radio transmitter and receiver. It sends out as well as receives radio frequency energy. When you use your GSM application, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

7.2.1.2   Exposure to RF Energy

There has been some public concern on possible health effects of using GSM terminals. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was safe to use.

If you are concerned about exposure to RF energy, there are things you can do to minimize the exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular terminal efficiently by following the guidelines given in the sections below.

7.2.1.3   Efficient Terminal Operation

For your GSM terminal to operate at the lowest power level, consistent with satisfactory call quality:

- If your terminal has an extendable antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your GSM terminal operates more efficiently with the antenna when it is fully extended.

- Do not hold the antenna when the terminal is « IN USE ». Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

7.2.1.4 Antenna Care and Replacement

- Do not use the GSM terminal with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace the damaged antenna immediately. You may repair antenna to yourself by following the instruction manual provided to you. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

- Buy or replace the antenna only from the approved suppliers list. Using of unauthorized antennas, modifications or attachments could damage the terminal and may violate local RF emission regulations or invalidate type approval.

7.2.2 General safety

7.2.2.1 Driving

Check with the laws and regulations regarding the use of cellular devices in the area where you have to drive, as you always have to comply with them. When using your GSM terminal while driving, please:

- give full attention to driving,

- pull-off the road and park before making or answering a call, if driving conditions so require.

7.2.2.2 Electronic Devices

Most electronic equipments, for example in hospitals and motor vehicles are shielded from RF energy. However, RF energy may affect some improperly shielded electronic equipment.

7.2.2.3 Vehicle Electronic Equipment

Check with your vehicle manufacturer/representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

7.2.2.4 Medical Electronic Equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc) to determine if they are adequately shielded from external RF energy.

Turn your terminal **OFF** in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

7.2.2.5 Aircraft

Turn your terminal OFF before boarding any aircraft.

- Use it on the ground only with crew permission.

- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you should have prior permission from crew members, to use your terminal while the aircraft is on the ground. In order to prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

7.2.2.6   Children

Do not allow children to play with your GSM terminal. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem, or make calls that increase your modem bills.

7.2.2.7   Blasting Areas

To avoid interfering with blasting operations, turn your unit **OFF** when you are in a « blasting area » or in areas posted: « turn off two-way radio ». Construction crew often uses remote control RF devices to set off explosives.
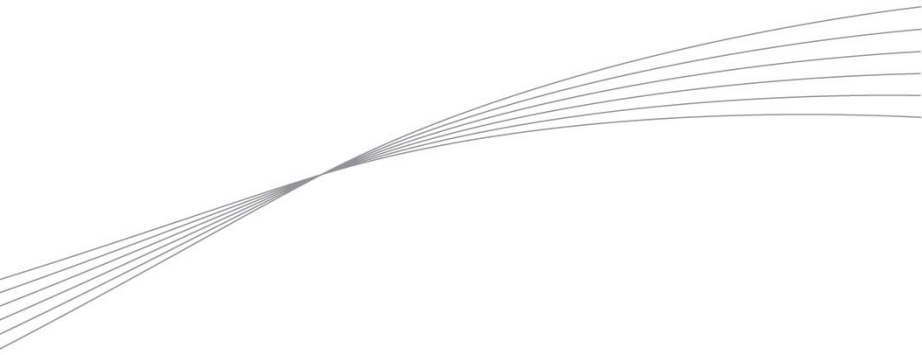
7.2.2.8   Potentially Explosive Atmospheres

Turn your terminal **OFF** in any area with a potentially explosive atmosphere. Though it is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle, which contains your terminal or accessories.

Before using your terminal in a vehicle powered by liquefied petroleum gas (such as propane or butane), ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is used.

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