



Product Technical Specification & Customer Design Guidelines

AirPrime WISMO218



SIERRA
WIRELESS

WA_DEV_W218_PTS_002

006

April 29, 2010

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6,191,741	6,199,168	6,339,405	6,359,591	6,400,336	6,516,204	6,561,851	6,643,501
6,653,979	6,697,030	6,785,830	6,845,249	6,847,830	6,876,697	6,879,585	6,886,049
6,968,171	6,985,757	7,023,878	7,053,843	7,106,569	7,145,267	7,200,512	7,295,171
7,287,162	D442,170	D459,303	D599,256	D560,911			

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Document History

Version	Date	Updates
001	April 22, 2009	Creation
002	April 28, 2009	Addition of Power Consumption table and software note in section 3.3.2
003	July 17, 2009	Document Cover/Footer: Updated the file name (from WA_DEV_W218_PTS_002-002 to WA_DEV_W218_PTS_002-003), the revision number and the revision date.
		Throughout the document: adjusted figure size to better display components and their corresponding values.
		§ 1.1.1: Updated the 4 th reference document name to Customer Process Guideline for WISMO Series.
		§ 3.5: Changed the section title to “SPI Bus for Debug Trace ONLY”.
		§ 3.5.1: Changed the SPI-CLK Pin number from 16 to 15 Added an additional sentence at the end of the paragraph text
		§ 3.5.1.1: Changed the value of X101 from 3.6884MHz to 3,6864MHz.
		§ 3.11.2: Changed the PWM1 Pin number from 27 to 35.
		§ 3.12.3: Updated the section description.
		§ 5.2.2: Changed the Recommended connection when not used column for Pin 18, TX_CTRL from “2.8V TX Burst Indicator” to “not connected”.
		§ 5.4: Updated the description for Class B condition.
		§ 5.5.2: Updated the section description Deleted Figure 40: Recommended PCB landing pattern for WISMO218
		§ 5.5.3: Added this section.
		Made grammatical and other punctuation corrections throughout the document. Updated links and references.
		§ 3.8: Changed the number of General Purpose I/Os from 11 to 3.
		§ 3.9.2 Added a Caution box after the table.
		§ 3.10.4.1.1 and 3.104.1.2: Removed the GND within the WISMO218 in the figures (figures 15, 16, 17 and 18)
		§ 3.10.5.5: Added additional information in the Caution box regarding the ESD sensitivity of the audio interface.
		§ 5.2.2: Changed the recommended connection when not in use value from “open” to “Ground” for pin #5, AUX-ADC0.
		§ 3.10.5.5: Separated the audio track figure and the differential connection figure Labeled the differential connection figure as Figure 21 Added Figure 22: single-ended audio connection
		§ 5.4: Updated the Class B temperature range from -30 to +75 to -40 to +85.

Version	Date	Updates
		§ 5.5.3: Updated the figure to display it rotated 90 degrees counterclockwise.
		Updated text wording, checked for spelling and grammar, updated links and captions throughout the document.
		§ 3.2.2: Updated the value of VBATT's Ripple max.
		§ 3.10.1.1: Updated table values.
		§ 3.10.2.1.1: Updated table values.
		§ 3.10.4.1.1: Deleted the description for Z2.
		§ 3.13.3.1: Changed "de-assert" to "release" (re: recommendation for the ON/~OFF signal)
		§ 3.14: Updated reference to section 3.13.3.1.
		§ 4.1.4: Updated Caution text.
		§ 3.10.1: Updated the DC equivalent circuit.
		§ 3.10.1.1: Updated the table values and notes section.
		§ 3.10.4.1.1 and 3.10.4.1.2: Updated figures from 2.85V to 2.4V
		§ 3.13.3.1: Updated figure and included the T_{ready} table just beneath the figure.
		§ 3.17.3: Updated figure and updated descriptive text below the figure.
		§ 3.13.3.1: Updated the figure to include ramp up time of VBAT.
	August 12, 2009	Updated the Pin Description table (Table 7) of the Main Serial Link (UART) subsection of section 3: Interfaces.
		Added List of Figures and List of Tables.
	September 10, 2009	Updated Figure 31 .
		Added T_{rampup} values in the Power on sequence table .
		Added Figure 46 .
		Moved Recommended PCB Landing Pattern after Figure 47.
004	October 27, 2009	<ul style="list-style-type: none"> Updated Class A Operating Temperature Range Updated documentation reference
005	November 23, 2009	<p>ON/~OFF Signal:</p> <ul style="list-style-type: none"> Added an extra note about controlling the signal via an open collector switching transistor Updated Figure 30 to include a figure showing the signal connection via an open collector transistor Set the low level pulse length to 5.5sec Updated Figure 32 to include the 5.5s low level pulse length <p>TX_CTRL Signal for TX Burst Indication:</p> <ul style="list-style-type: none"> Added TX_CTRL frequency and duration Updated Figure 36 to include $T_{duration}$ Updated Figure 37 (added the transistor, T601)
006	January 20, 2010	Added additional information regarding the use of AT+PSSLEEP=1 .
	April 29, 2010	<p>Power Consumption:</p> <ul style="list-style-type: none"> Specified that power consumption values are typical Deleted Alarm Mode and updated Off Mode

Version	Date	Updates
		Updated document template.
		Updated section 8 Certification Compliance and Recommended Standards.
		Updated Figure 46 Castellation Pin Dimension and Location.
		Updated section 3.18 Reset.
		Updated section 3.2.4.1 Recommended Components.

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>> 1. References

1.1. Reference Documents

Several documents are referenced throughout this specification. For more details, please consult the listed reference documents. The Sierra Wireless documents referenced herein are provided in the Sierra Wireless documentation package; however, the general reference documents which are not Sierra Wireless owned are not provided in the documentation package.

1.1.1. Sierra Wireless Reference Documentation

- [1] AirPrime WISMO218 Hardware Presentation
Reference: WA_DEV_W218_PTS_001
- [2] AirPrime WISMO218 AT Commands Manual
Reference: WA_DEV_W218_UGD_003
- [3] AirPrime WS Series Development Kit User Guide
Reference: WA_DEV_W218_UGD_004
- [4] Customer Process Guideline for AirPrime WS Series
Reference: WA_DEV_WISMO_PTS_001

1.2. List of Abbreviations

Abbreviation	Definition
AC	Alternative Current
ADC	Analog to Digital Converter
A/D	Analog to Digital conversion
AF	Audio-Frequency
AGC	Automatic Gain Control
AT	ATtention (prefix for modem commands)
AUX	AUXiliary
CAN	Controller Area Network
CB	Cell Broadcast
CBS	Cell Broadcast Service
CE	-
CEP	Circular Error Probable
CLK	CLock
CMOS	Complementary Metal Oxide Semiconductor
CODEC	COder DECoder
CPU	Central Processing Unit
CS	Coding Scheme

Abbreviation	Definition
CSD	Circuit Switched Data
CTS	Clear To Send
DAC	Digital to Analog Converter
DAI	Digital Audio Interface
dB	Decibel
DC	Direct Current
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cellular System
DR	Dynamic Range
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
E-GSM	Extended GSM
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EMS	Enhanced Message Service
EN	ENable
ESD	ElectroStatic Discharges
ETSI	European Telecommunications Standards Institute
FIFO	First In First Out
FR	Full Rate
FTA	Full Type Approval
GND	GrouND
GPI	General Purpose Input
GPC	General Purpose Connector
GPIO	General Purpose Input Output
GPO	General Purpose Output
GPRS	General Packet Radio Service
GPS	Global Positioning System
GPSI	General Purpose Serial Interface
GSM	Global System for Mobile communications
HR	Half Rate
Hi Z	High impedance (Z)
IC	Integrated Circuit
IDE	Integrated Development Environment
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identification
I/O	Input / Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNA	Low Noise Amplifier

Abbreviation	Definition
LSB	Less Significant Bit
MAX	MAXimum
MIC	MICrophone
MIN	MINimum
MMS	Multimedia Message Service
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
na	Not Applicable
NF	Noise Factor
NMEA	National Marine Electronics Association
NOM	NOMinal
NTC	Negative Temperature Coefficient
PA	Power Amplifier
Pa	Pascal (for speaker sound pressure measurements)
PBCCH	Packet Broadcast Control CHannel
PC	Personal Computer
PCB	Printed Circuit Board
PCL	Power Control Level
PCM	Pulse Code Modulation
PDA	Personal Digital Assistant
PFM	Power Frequency Modulation
PLL	Phase Lock Loop
PSM	Phase Shift Modulation
PWM	Pulse Width Modulation
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RHCP	Right Hand Circular Polarization
RI	Ring Indicator
RMS	Root Mean Square
RST	ReSeT
RTC	Real Time Clock
RTCM	Radio Technical Commission for Maritime services
RTS	Request To Send
RX	Receive
SCL	Serial CLock
SDA	Serial DATA
SIM	Subscriber Identification Module
SMD	Surface Mounted Device/Design
SMS	Short Message Service
SPI	Serial Peripheral Interface
SPL	Sound Pressure Level

Abbreviation	Definition
SPK	SPeaKer
SW	SoftWare
PSRAM	Pseudo Static RAM
TBC	To Be Confirmed
TDMA	Time Division Multiple Access
TP	Test Point
TU	Typical Urban fading profile
TUHigh	Typical Urban, High speed fading profile
TVS	Transient Voltage Suppressor
TX	Transmit
TYP	TYPical
UART	Universal Asynchronous Receiver-Transmitter
UBX	μ-blox proprietary protocol (NE DOIT PAS APPARAÎTRE)
USB	Universal Serial Bus
USSD	Unstructured Supplementary Services Data
VSWR	Voltage Standing Wave Ratio
WAP	Wireless Application Protocol



2. General Description

2.1. General Information

The AirPrime WISMO218 Intelligent Embedded Module is a self-contained EGSM/GPRS 900/1800 dual-band embedded module that was specifically designed for M2M systems deployed in Europe and Asia.

2.1.1. Overall Dimensions

- Length: 25.0 mm
- Width: 25.0 mm
- Thickness: 2.8 mm (excluding label thickness)
- Weight: 3.8 g

2.1.2. Environment and Mechanics

- Green policy: Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) compliant
- Complete shielding

The AirPrime WISMO218 is compliant with RoHS 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) or polybrominated diphenyl ethers (PBDE)”.

2.1.3. GSM/GPRS Features

- 2 Watts EGSM 900 radio section running under 3.6 Volts
- 1 Watt GSM1800 radio section running under 3.6 Volts
- Hardware GPRS class 10 capable

2.1.4. Interfaces

- VBAT power supply
- Digital section running under 2.8 Volts
- 3V/1V8 SIM interface
- Power supplies
- Serial link (UART)
- Analog audio
- ADC
- Serial bus SPI for debug trace
- PWM0,1 and PWM2 for buzzer output

- GPIOs
- ON/~OFF
- TX burst indicator
- Embedded Module ready indicator
- Reset

2.1.5. Firmware

- Drives the AirPrime WISMO218 Embedded Intelligent Module via an AT command interface over a serial port
- Full GSM/GPRS Operating System stack
- Real Time Clock with calendar

2.1.6. Connection Interfaces

The AirPrime WISMO218 has a 46-pin castellation form factor which provides:

- One ANT pin for RF in/out
- Other pins for baseband signals

2.2. Functional Description

The global architecture of the AirPrime WISMO218 is shown below:

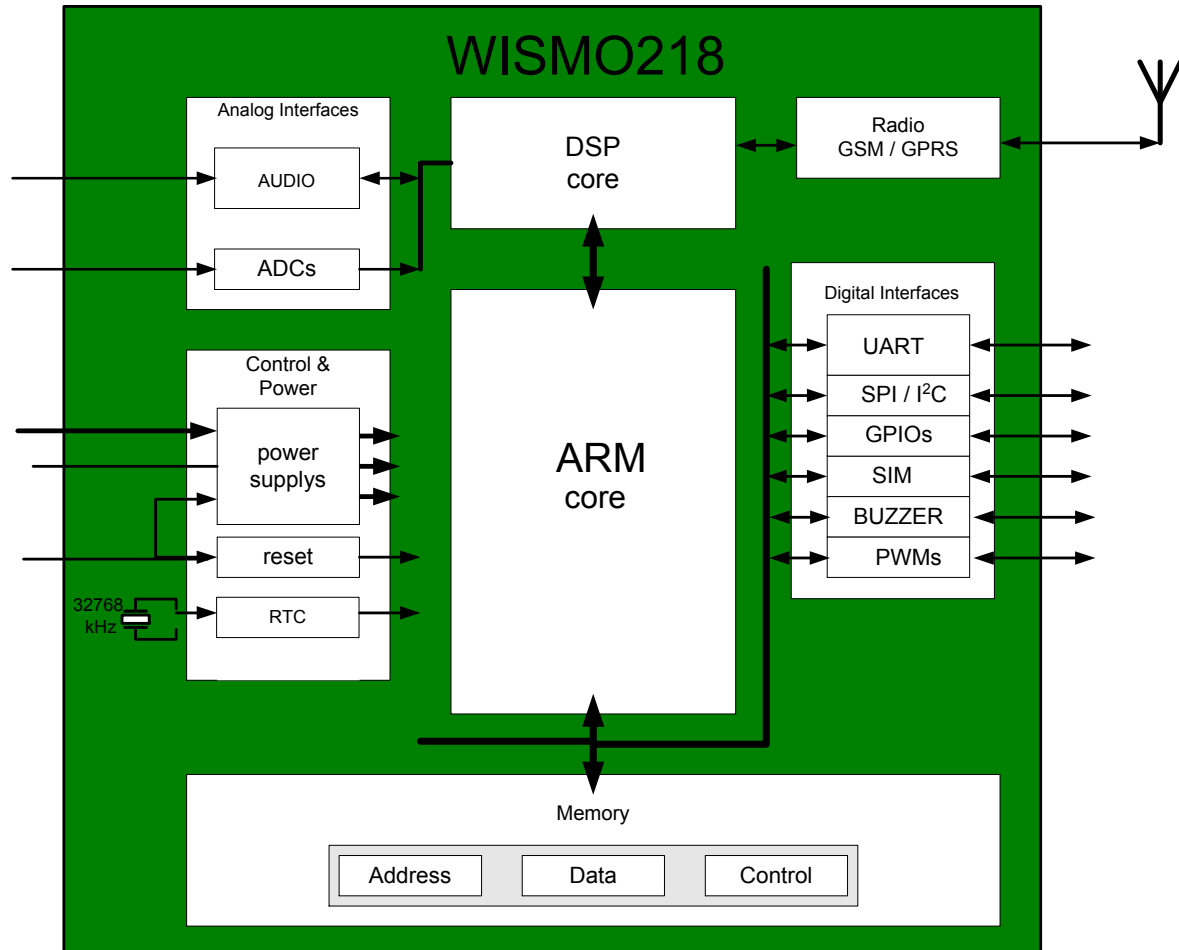


Figure 1. Functional Architecture

2.2.1. RF Functionalities

The Radio Frequency (RF) range complies with the Phase II EGSM 900/DCS 1800 recommendation. The frequency range for the transmit band and receive band are listed in the table below.

	Transmit Band (Tx)	Receive Band (Rx)
E-GSM 900	880 to 915 MHz	925 to 960 MHz
DCS 1800	1710 to 1785 MHz	1805 to 1880 MHz

The RF part of the AirPrime WISMO218 is based on a specific dual band chip which includes:

- a Digital low-IF receiver
- a dual-band LNAs (Low Noise Amplifier)
- an Offset PLL (Phase Locked Loop) transmitter
- a Frequency synthesizer
- a Digitally controlled crystal oscillator (DCXO)
- a Tx/Rx FEM (Front-End Module) for dual-band GSM/GPRS

2.2.2. Baseband Functionalities

The Baseband is composed of an ARM9, a DSP and an analog element (with audio signals, I/Q signals and ADC).

The core power supply is 1.2V and the digital power supply is 2.8V.

>> 3. Interfaces

3.1. General Interfaces

The AirPrime WISMO218 has a 46-pin castellation connection, which provides access to all available interfaces.

The available interfaces are listed in the table below.

Subsection Name	Driven by AT Commands
Serial Interface (SPI)	No
Main Serial Link	Yes
SIM Interface	Yes
General Purpose IO	Yes
Analog to Digital Converter	No (*)
Analog Audio Interface	No (*)
PWMs	Yes
PWM2 for Buzzer Output	Yes
ON/~OFF	No
Embedded Module Ready Indication	No
VBAT_RTC (Backup Battery)	No
TX Burst Indication Signal	No
Reset	No

(*) These interfaces will have AT command support in future versions.

3.2. Power Supply

3.2.1. Power Supply Description

The power supply is one of the key elements 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 the peaks, the ripple (U_{ripple}) on the supply voltage must not exceed a certain limit (see Table 1: Input Power Supply Voltage below).

Listed below are the corresponding radio burst rates for the different GPRS classes in communication mode.

- A GSM/GPRS class 2 terminal emits 577 μ s radio bursts every 4.615ms. (See Figure 2 Power Supply During Burst Emission below.)

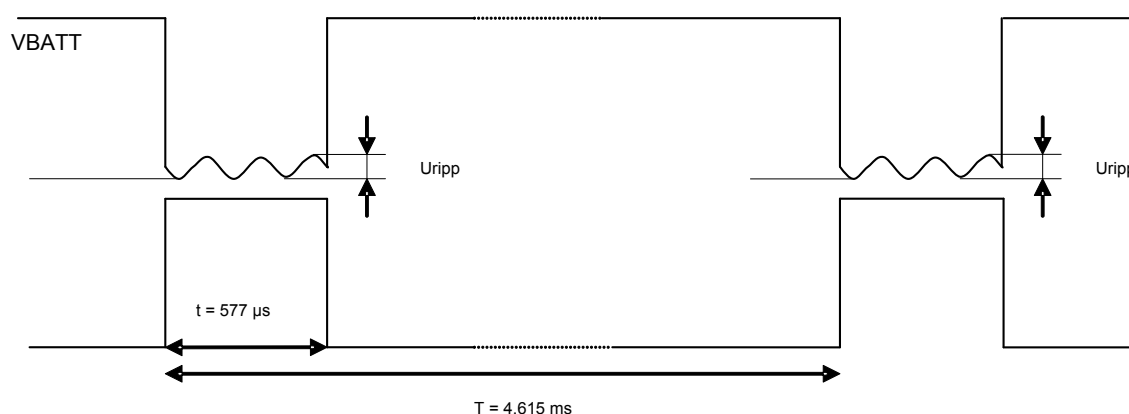


Figure 2. Power Supply During Burst Emission

- A GPRS class 10 terminal emits 1154 μ s radio bursts every 4.615ms.

VBATT provides for the following functions:

- Directly supplies the RF components with 3.6V. It is essential to keep a minimum voltage ripple at this connection in order to avoid any phase error.

The peak current (1.4A peak in GSM /GPRS mode) flows with a ratio of:

- 1/8 of the time (around 577 μ s every 4.615ms for GSM /GPRS cl. 2)
and
- 1/4 of the time (around 1154 μ s every 4.615ms for GSM /GPRS cl. 10)

with the rising time at around 10 μ s.

- Internally used to provide, via several regulators, the supply required for the baseband signals.

3.2.2. Electrical Characteristics

Table 1: Input Power Supply Voltage

	V _{MIN}	V _{NOM}	V _{MAX}	I _{TYP.}	I _{MAX}	Ripple max (U _{ripp})
VBATT	3.2(1)	3.6	4.8	1.35A	1.4A	10kHz to 100kHz: less than 100mVpp greater than 100kHz: less than 10mVpp

(1): This value has to be guaranteed during the burst (with 1.4A Peak in GSM or GPRS mode)

(2): Maximum operating Voltage Stationary Wave Ratio (VSWR) 1.5:1

When powering the AirPrime WISMO218 with a battery, the total impedance (battery + protections + PCB) should be less than 150mΩ.

3.2.3. Pin Description

Table 2: Power Supply Pin Descriptions

Signal	Pin Number(s)
VBATT	29,30
GND	20,22,23,26,28,31

3.2.4. Application

The reject filter can be connected between VBATT and the supply sources if the supply source is noisy.

Caution: If the reject filter (C1+L1+C2) is an option, a capacitor (i.e. C2) is mandatory close to VBATT.

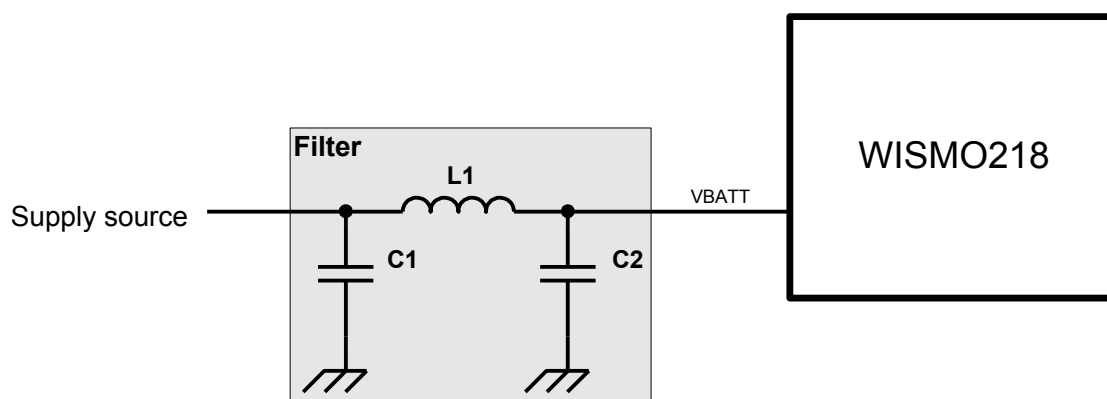


Figure 3. Reject Filter Diagram

3.2.4.1. Recommended Components

C1, C2: 10 μ F +/-20%

Component	Manufacturer
GRM21BR60J106KE19L	MURATA
CM21X5R106M06AT	KYOCERA
JMK212BJ106MG-T	TAYO YUDEN
C2012X5R0J106MT	TDK

L1: 200nH +/-20%

Component	Manufacturer
XPL2010-201ML	COILCRAFT

3.3. Power Consumption

3.3.1. Various Operating Modes

There are various kinds of operating modes for the AirPrime WISMO218 as defined in the table below.

Table 3: AirPrime WISMO218 Operating Modes

Mode	Description
OFF Mode	When VBATT power is supplied to the AirPrime WISMO218 but has not yet been powered ON.
Alarm Mode	When alarm clock is set for the AirPrime WISMO218 with ALL of the following conditions: <ul style="list-style-type: none">• before time is up• with AT + CPOF having been entered from a computer that is connected to the AirPrime WISMO218• with the ON/~OFF signal being left open (remains at HIGH level)
Idle Mode	When the AirPrime WISMO218 has a location update with a live network but with no GSM/GPRS connection, while the UART interface is in sleep mode. Refer to Note 1 .
Connected Mode	The AirPrime WISMO218 has GSM voice codec connection with a live network.
Transfer Mode	The AirPrime WISMO218 has GPRS data transfer connection with a live network.

Note 1. There are two different methods to enter sleep mode through the AT command setting, AT + PSSLEEP, as described below:

- AT + PSSLEEP = 0
 - The entry of sleep mode is controlled by the level of DTR signal and the firmware.
 - When DTR (viewed from the embedded module side) is of LOW voltage level, the AirPrime WISMO218 will never enter sleep mode.
 - When DTR (viewed from the embedded module side) is of HIGH voltage level, the AirPrime WISMO218 will enter sleep mode. To wake the AirPrime WISMO218 up, it is necessary to toggle the DTR (viewed from the embedded module side) from HIGH to LOW voltage level.
 - This method should be applied if the application needs to forbid the entry of sleep mode.
- AT + PSSLEEP = 1
 - For this method, the entry of sleep mode is controlled just by the firmware.
 - When the AirPrime WISMO218 has had no activities for a certain period of time, it will enter sleep mode automatically, regardless of the DTR level.
 - Any ASCII character on the UART can wake the AirPrime WISMO218 up. Note that due to the wake-up mechanism of the AirPrime WISMO218, it is recommended to have at least 10ms latency time after the wake-up character before sending AT commands to the embedded module.

For details of the AT + PSSLEEP command, please refer to document [2] AirPrime WISMO218 AT Commands Manual.

Note that the power consumption level will vary depending on the operating mode used.

3.3.2. Power Consumption

The power consumption level will vary depending on the operating mode, and it is for this reason that the following consumption values are given for each mode and RF band.

The following consumption values were obtained by performing measurements on AirPrime WISMO218 samples at a temperature of 25° C.

Note: All of the following information given assumes a 50Ω RF output.

Power consumption performance is software related. The results listed below (typical values) are based on the software version L02_00gg.WISMO218.

AirPrime WISMO218 Power Consumption							
Operating Mode		Parameters		Average			Unit
				VBATT=4.8V	VBATT=3.6V	VBATT=3.2V	
Off Mode (AirPrime WISMO218 stand alone)				50			μA
Off Mode (using application note: Very Low Power Consumption*)				<1			μA
Idle Mode**	Paging 2 (Rx burst occurrence ~0.5s)			1.9	2.0	2.1	mA
	Paging 9 (Rx burst occurrence ~2s)			1.2	1.3	1.3	mA
Connected Mode	900 MHz	PCL5 (TX power 33dBm)		211	214	217	1400 TX mA
		PCL19 (TX power 5dBm)		79	82	84	220 TX mA
	1800MHz	PCL0 (TX power 30dBm)		160	163	164	950 TX mA
		PCL15 (TX power 0dBm)		77	80	81	200 TX mA
GPRS	Transfer Mode class 8 (4Rx/1Tx)	900 MHz	Gam.3 (TX power 33dBm)	201	203	206	1400 TX mA
			Gam.17 (TX power 5dBm)	73	77	78	220 TX mA
		1800 MHz	Gam.3 (TX power 30dBm)	151	154	155	950 TX mA
			Gam.18 (TX power 0dBm)	71	75	76	200 TX mA
	Transfer Mode class 10 (3Rx/2Tx)	900 MHz	Gam.3 (TX power 33dBm)	366	369	373	1450 TX mA
			Gam.17 (TX power 5dBm)	107	111	113	240 TX mA
		1800 MHz	Gam.3 (TX power 30dBm)	263	267	268	970 TX mA
			Gam.18 (TX power 0dBm)	103	106	108	220 TX mA

* The application note "Very Low Power Consumption" (Reference: WA_DEV_GEN_APN_020-003) can be found on the [Sierra Wireless website](#) (under the Developer section).

** Idle Mode consumption depends on the SIM card used. Some SIM cards respond faster than others, in which case the longer the response time is, the higher the consumption is.

_{TX} means that the current peak is the RF transmission burst (Tx burst).

_{RX} means that the current peak is the RF reception burst (Rx burst), in GSM mode only (worst case).

Three VBATT values are used to measure the power consumption - VBATTmin (3.2V), VBATTmax (4.8V) and VBATTtyp (3.6V).

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

For more information about the consumption measurement procedure, refer to Section 4 Consumption Measurement Procedure.

3.3.3. Consumption Waveform Samples

The consumption waveforms presented below are for an EGSM900 network configuration.

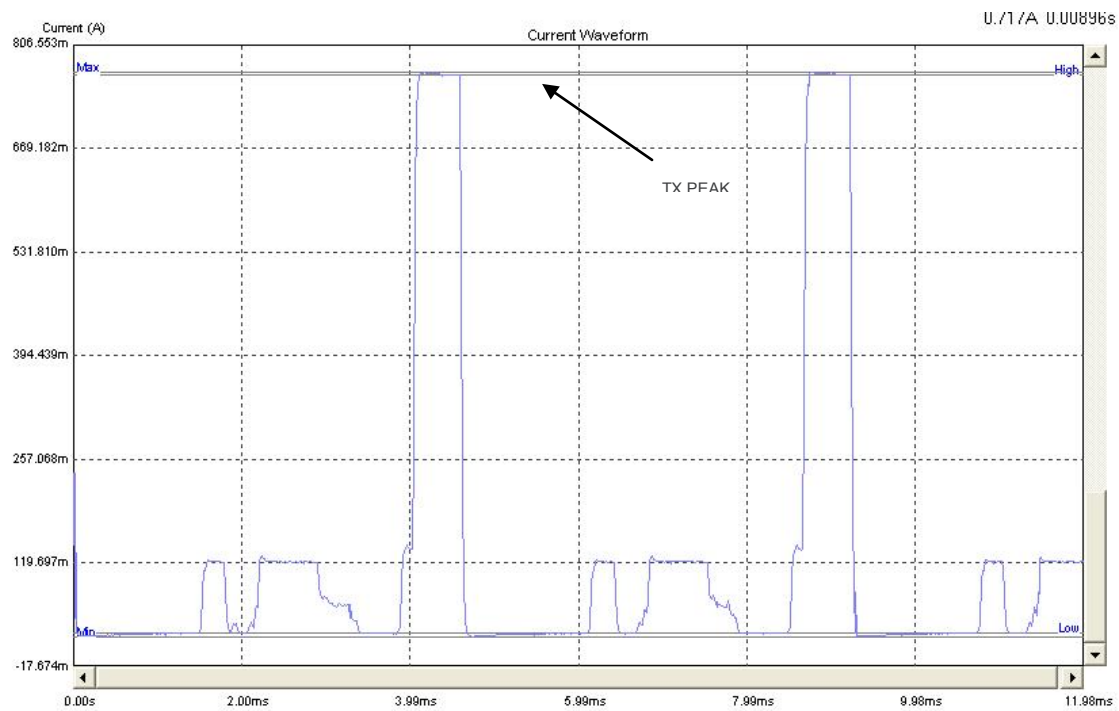
The typical VBATT voltage is 3.6V.

Four significant operating mode consumption waveforms are shown in the following subsections, namely:

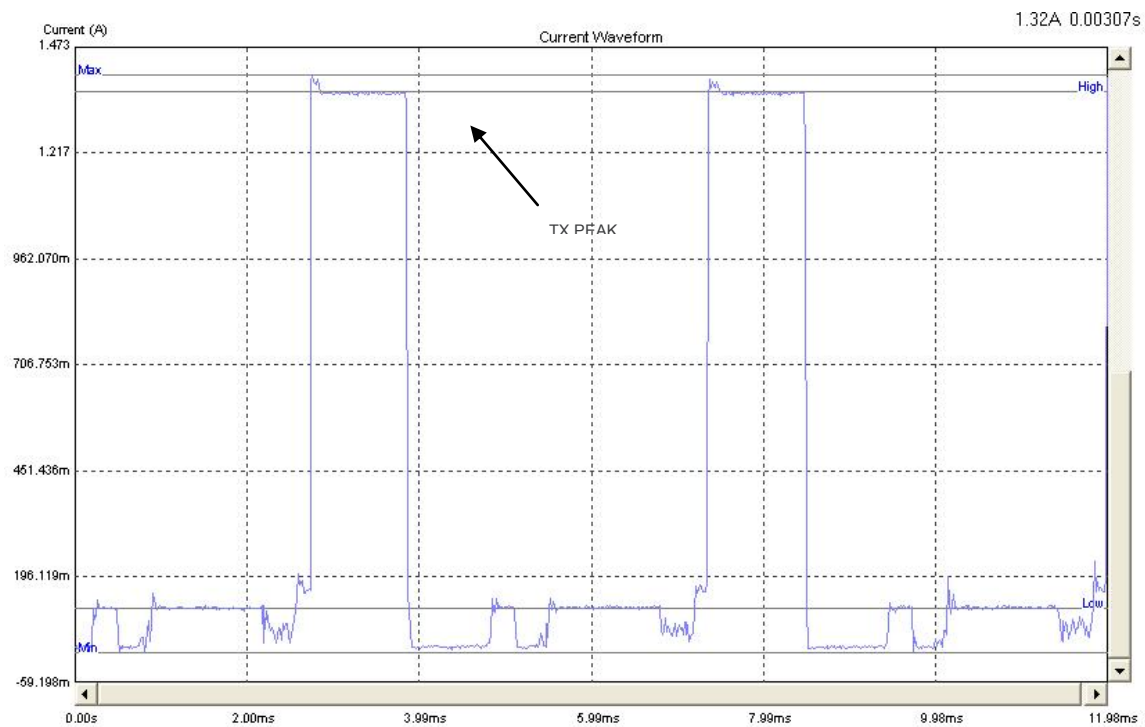
- Connected Mode (PCL5: Tx power 33dBm)
- Transfer mode (GPRS class 10, gam.3: Tx power 33dBm)
- Idle mode (Paging 2)
- Idle mode (Paging 9)

Note that the following diagrams only show the waveform of the current, but not the exact values.

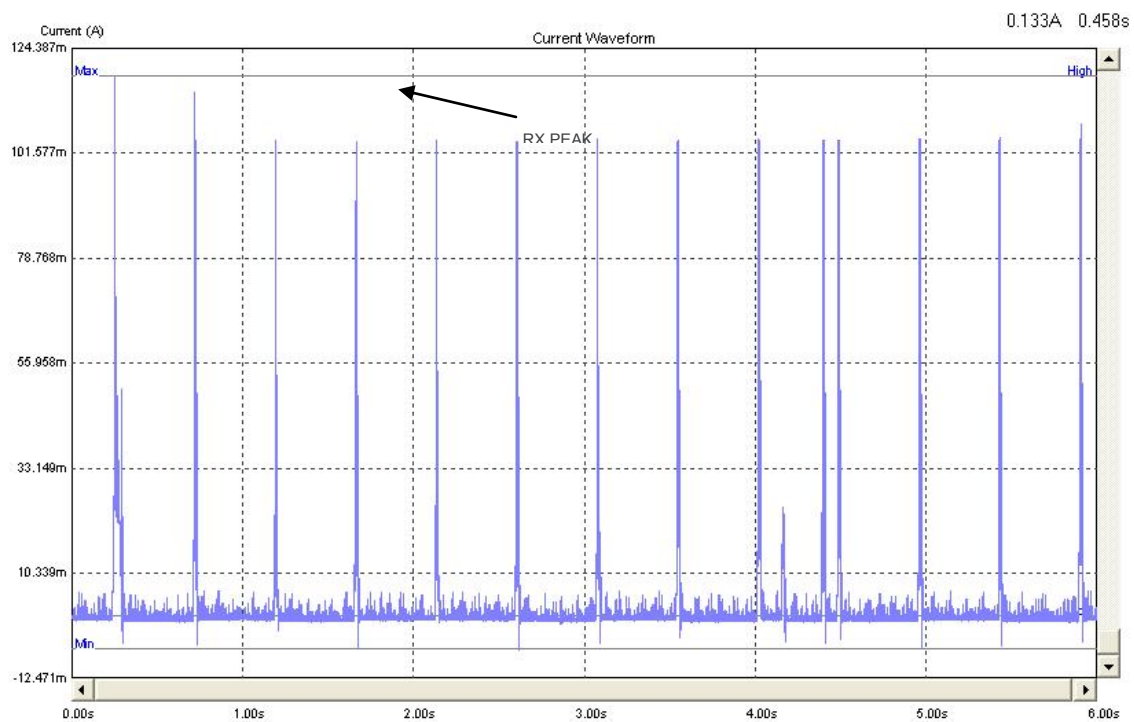
3.3.3.1. Connected Mode Current Waveform



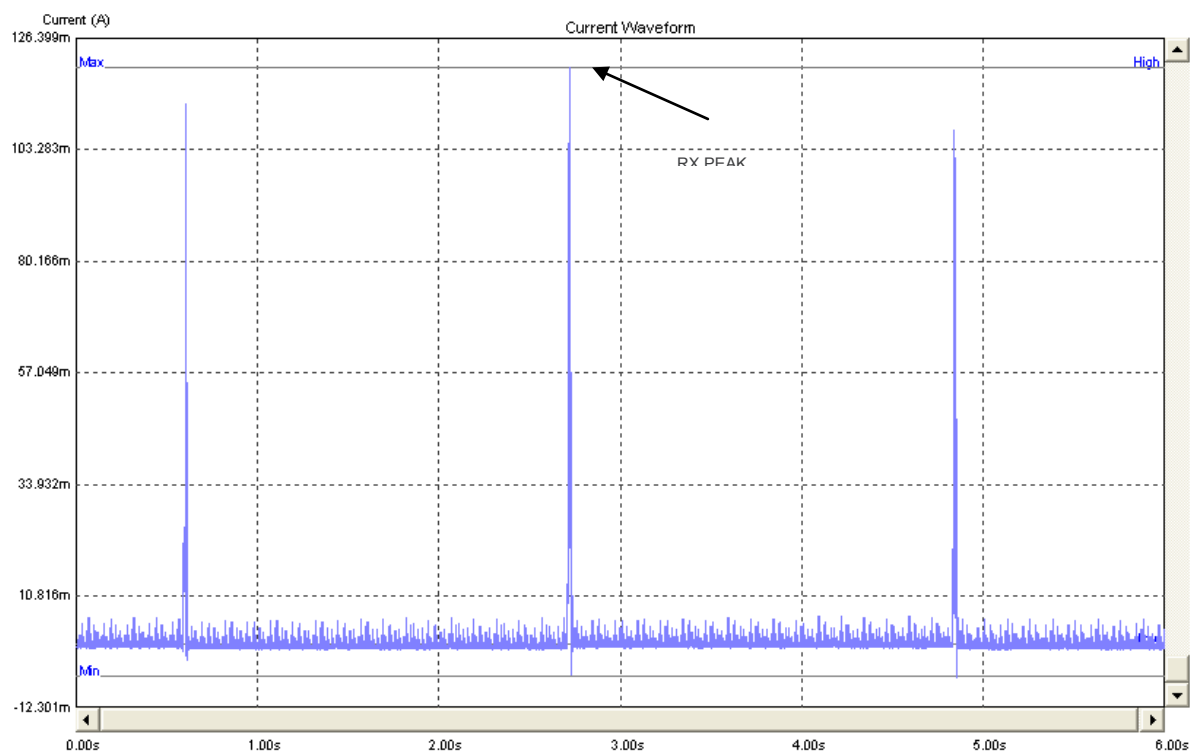
3.3.3.2. Transfer Mode Class 10 Current Waveform



3.3.3.3. Idle Mode Page 2 Current Waveform



3.3.3.4. Idle Mode Page 9 Current Waveform



3.3.4. Recommendations for Less Consumption

For better power consumption, in particular for the quiescent current, it is recommended to drive the GPIOs as shown in the table below.

Table 4: Consumption/Software Driver Recommendations

Signal	Pin Number	I/O	I/O Type	Reset State	SW Driver Recommended (Output State)
GPIO1	24	I/O	2V8	Pull up	1 logic level
GPIO3	16	I/O	2V8	Pull up	1 logic level
GPIO5	19	I/O	2V8	Z**	Input: 0 logic level Output: 1logic level

GPIO2 is dedicated for WISMO_READY and is not open as GPIO purpose for customer use.

GPIO4 is dedicated for TX burst indication and is not open as GPIO purpose for customer use.

** When GPIO5 is used as a general purpose output, it is necessary to have an external pull up resistor connecting to a 2.8V source. Resistance value depends on the current drain required by the application side.

3.4. Electrical Information for Digital I/O

The I/Os concerned are all interfaces such as GPIOs, SPIs, etc.

Table 5: Electrical Characteristics of Digital I/O

2.8 Volts Type (2V8)						
Parameter		I/O type	Minimum	Typ	Maximum	Condition
Internal 2.8V power supply		VCC_2V8	2.7V	2.8V	2.95V	
Input / Output pin	V _{IL}	CMOS	-0.4V*	-	0.4V	
	V _{IH}	CMOS	2.4V	-	VCC_2V8 + 0.4V	
	V _{OL}	CMOS	-	-	0.1V	
	V _{OH}	CMOS	2.7V	-	-	
			2.4V	-	-	I _{OH} = 4mA

* Absolute maximum ratings

3.5. SPI Bus for Debug Trace ONLY

The AirPrime WISMO218 provides one SPI bus through the castellation pin.

3.5.1. Pin Description

Table 6: SPI Bus Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Reset State	Description
SPI-CLK	15	O	2V8	Pull down	SPI Serial Clock
SPI-IO	13	I/O	2V8	Pull down	SPI Serial input/output
SPI-O	14	O	2V8	Pull down	SPI Serial input
~SPI-CS	17	O	2V8	Pull up	SPI Enable
SPI-IRQ	25	I	2V8	Pull down	SPI Interrupt

By default, the AirPrime WISMO218 SPI interface is only used for monitoring trace for debug purposes. An SPI-to-UART2 conversion circuit is required to convert the SPI trace to UART2. Also, the SPI-IRQ (pin 25) is required for interrupt. Again, note that the SPI interface of the AirPrime WISMO218 is not open for application use other than debug trace.

3.5.1.1. SPI Waveforms

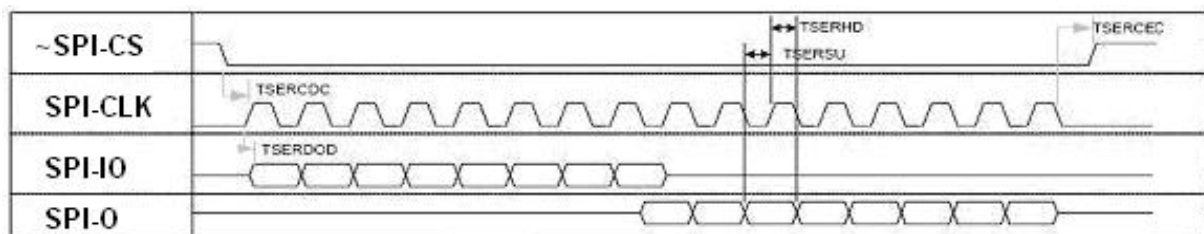


Figure 4. SPI Timing Diagrams

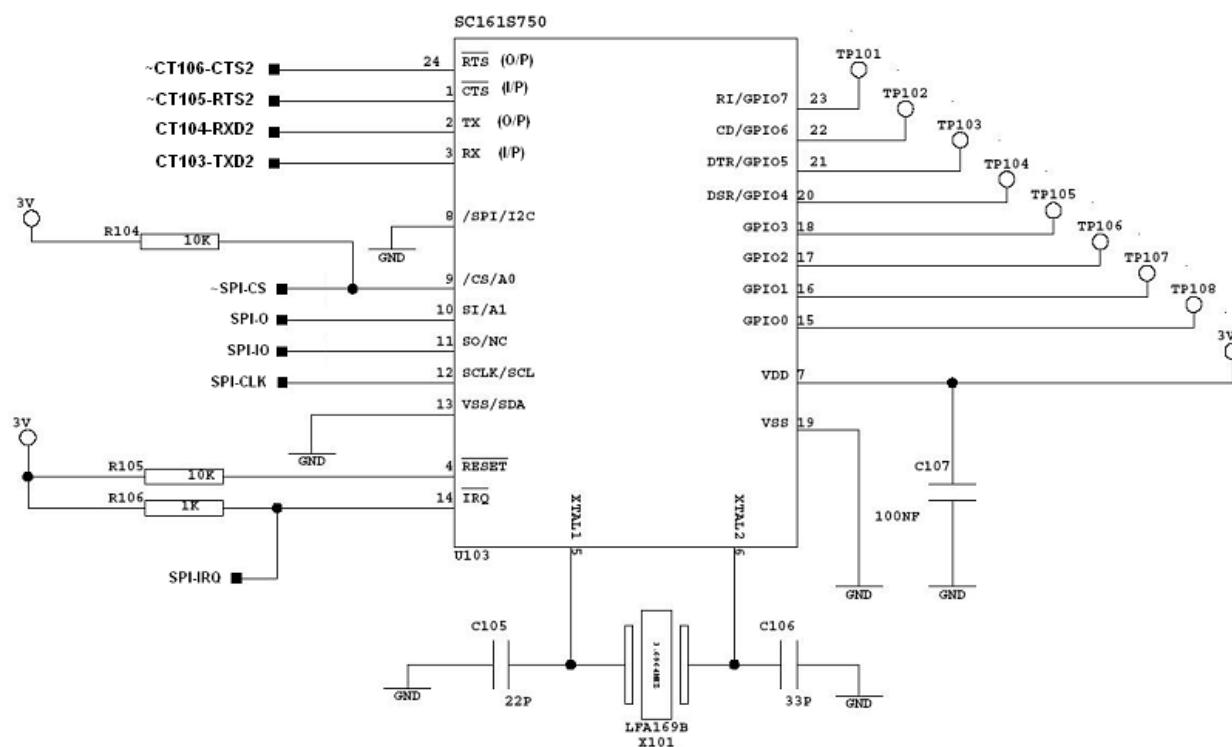


Figure 5. Example of an SPI to UART2 Interface Conversion Implementation

The following table lists the recommended components to use in implementing the SPI to UART2 interface.

Component	Description/Details	Manufacturer
U103	SC16IS750IPW	NXP Semiconductors
X101	3, 6864MHz 86SMX surface mount crystal (971-3131)	Farnell
R104, R105	10K Ω	
R106	1K Ω	
C105	22pF	
C106	33pF	
C107	100nF	

After converting the SPI signal to a UART signal, a UART transceiver circuitry is needed to communicate this UART signal to DTE.

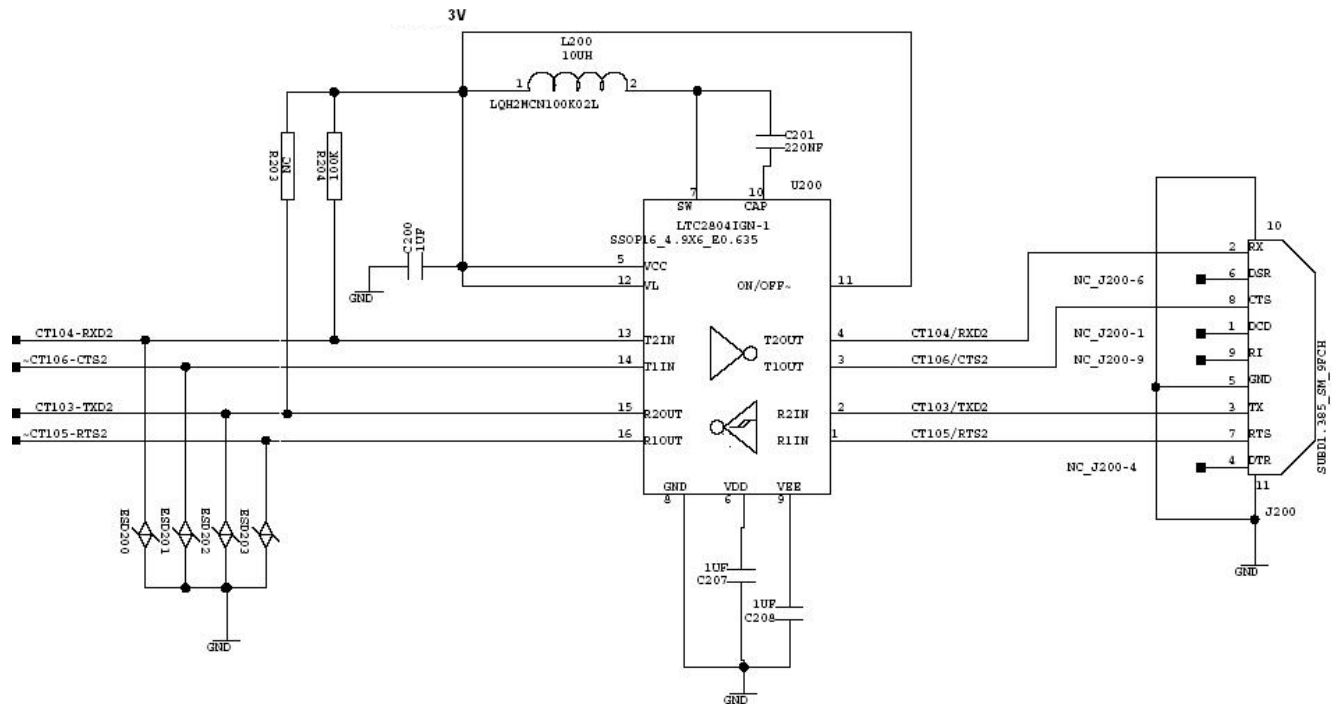


Figure 6. Example of RS-232 Level Shifter Implementation for UART2

The following table lists the recommended components to use in implementing a UART transceiver circuitry.

Component	Description/Details	Manufacturer
U200	LTC2804IGN-1	LINEAR TECHNOLOGY
L200	LQH2M CN100K02L	MURATA
J200	096615276119 SUBD9F	HARTING
R202	NC	
R204	100KΩ	
C200	1µF	
C201	220nF	
C207	1µF	
C208	1µF	

Note: It is recommended to make SPI signals accessible for diagnostics by reserving some test points, for example.

3.6. Main Serial Link (UART)

A flexible 8-wire serial interface is available on the AirPrime WISMO218 that complies with the V24 protocol signaling, but not with the V28 (electrical interface) due to its 2.8-Volt interface.

3.6.1. Features

The supported baud rates of the UART are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 Kbits, with autobauding.

The signals used by the UART are as follows:

- TX data (CT103/TXD)
- RX data (CT104/RXD)
- Request To Send (~CT105/RTS)
- Clear To Send (~CT106/CTS)
- Data Terminal Ready (~CT108/DTR)
- Data Set Ready (~CT107/DSR)
- Data Carrier Detect (~CT109/DCD)
- Ring Indicator (~CT125/RI)

3.6.2. Pin Description

Table 7: Main Serial Link Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Reset State	Description
CT103/TXD*	38	I	2V8	1	Transmit serial data
CT104/RXD*	40	O	2V8	1	Receive serial data
~CT105/RTS*	39	I	2V8	0	Request To Send
~CT106/CTS*	41	O	2V8	0	Clear To Send
~CT107/DSR*	42	O	2V8	1	Data Set Ready
~CT108/DTR*	44	I	2V8	1	Data Terminal Ready
~CT109/DCD*	43	O	2V8	1	Data Carrier Detect
~CT125/RI *	45	O	2V8	1	Ring Indicator
GND*			GND		Ground

* According to PC (DTE) view

The rising time and falling time of the reception signals (mainly CT103/TXD) have to be less than 300ns.

Tip: *The AirPrime WISMO218 is designed to operate using all the serial interface signals. In particular, it is recommended to use ~CT105/RTS and ~CT106/CTS for hardware flow control in order to avoid data corruption during transmissions.*

3.6.2.1. 5-wire Serial Interface Hardware Design

- Signal: CT103/TXD*, CT104/RXD*, ~CT105/RTS*, ~CT106/CTS*
- The signal ~CT108/DTR* must be managed following the V24 protocol signaling if we want to use idle mode.
- For detailed configuration, please refer to Figure 10 Example of V24/CMOS Serial Link Implementation for 5-wire UART.

3.6.2.2. 4-wire Serial Interface Hardware Design

- Signal: CT103/TXD*, CT104/RXD*, ~CT105/RTS*, ~CT106/CTS*
- The signal ~CT108/DTR* can be looped back to ~CT107/DSR from both the AirPrime WISMO218 side and from the DTE side.
- For detailed configuration, please refer to Figure 9 Example of V24/CMOS Serial Link Implementation for 4-wire UART.

3.6.2.3. 2-wire Serial Interface Hardware Design

- This case is possible for a connected external chip, but it is not recommended.
- The flow control mechanism has to be managed from the customer side.
- Signal: CT103/TXD*, CT104/RXD*
- The signal ~CT108/DTR* can be looped back to ~CT107/DSR from both the AirPrime WISMO218 side and from the DTE side.
- The signals ~CT105/RTS*, ~CT106/CTS* are not used, please configure using the AT command, AT + IFC = 0,0 (see document [2] AirPrime WISMO218 AT Commands Manual).
- The signal ~CT105/RTS* can be looped back to ~CT106/CTS* from both the AirPrime WISMO218 side and from the DTE side.
- For detailed configuration, please refer to Figure 8 Example of V24/CMOS Serial Link Implementation for 2-wire UART.

Note: The loop back connection of ~CT108/DTR* to ~CT107/DSR is not allowed when the case AT+PSSLEEP=0 is used, for which sleep mode entry is ~CT108/DTR* level dependent. (Refer to Note 1 of the Power Consumption section. In order to go to sleep mode properly under such configuration, AT+PSSLEEP=1 should be used instead. For details, please refer to document [2] AirPrime WISMO218 AT Commands Manual.

* According to PC (DTE) view

3.6.3. Application

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

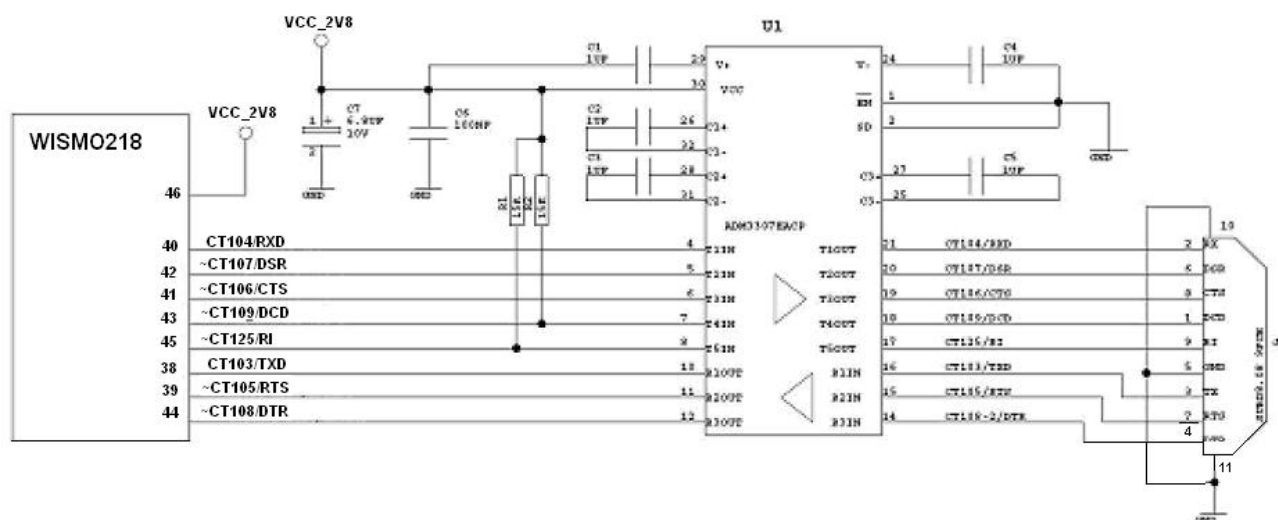


Figure 7. Example of RS-232 Level Shifter Implementation for UART

Note that the U1 chip also protects the AirPrime WISMO218 against ESD (Air Discharge) at 15KV.

Table 8: Recommended Components

Component	Description/Details	Manufacturer
R1, R2	15K Ω	
C1, C2, C3, C4, C5	1 μ F	
C6	100nF	
C7	6.8uF TANTAL 10V CP32136	AVX
U1	ADM3307EACP	ANALOG DEVICES
J1	SUB-D9 female	

R1 and R2 are necessary only during Reset state to force the ~CT125/RI and ~CT109/DCD signals to HIGH level.

The ADM3307EACP can be powered by the VCC_2V8 (pin 46) of the AirPrime WISMO218 or by an external regulator at 2.8V.

If the UART interface is connected directly to a host processor, it is not necessary to use level shifters. The interface can be connected as shown in the figure(s) below:

3.6.3.1. V24/CMOS Possible Design

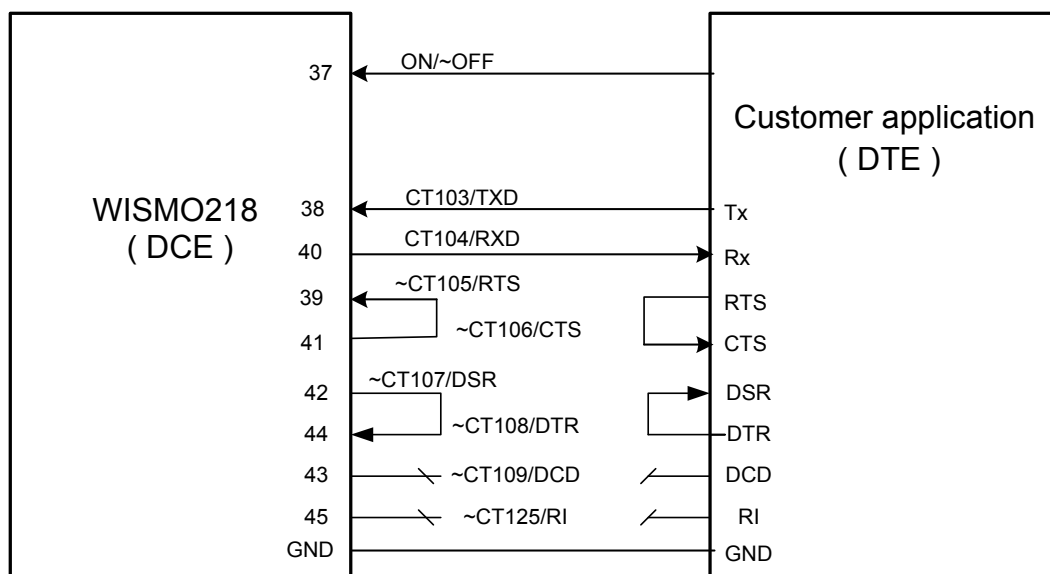


Figure 8. Example of V24/CMOS Serial Link Implementation for 2-wire UART

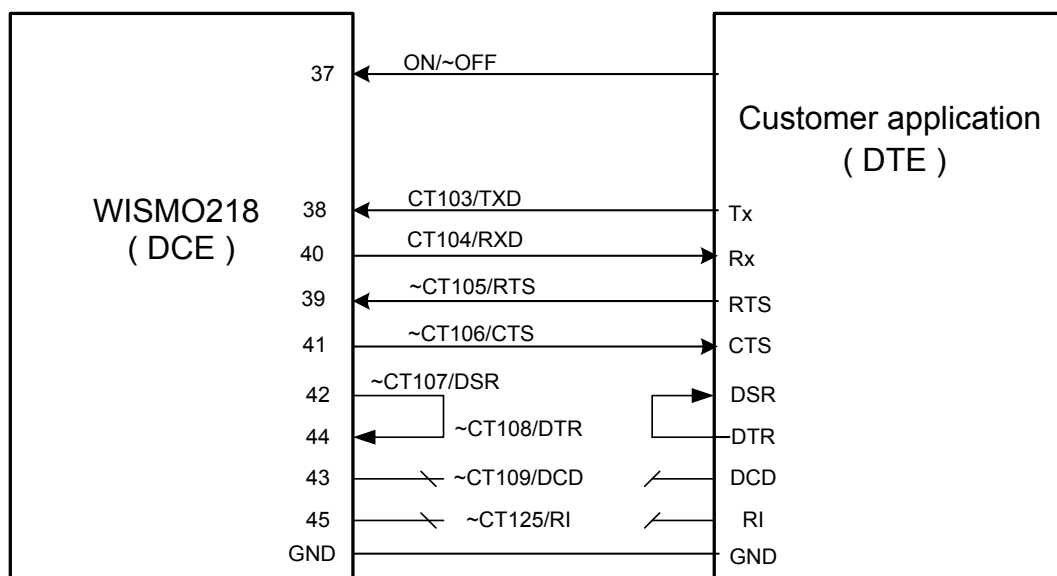


Figure 9. Example of V24/CMOS Serial Link Implementation for 4-wire UART

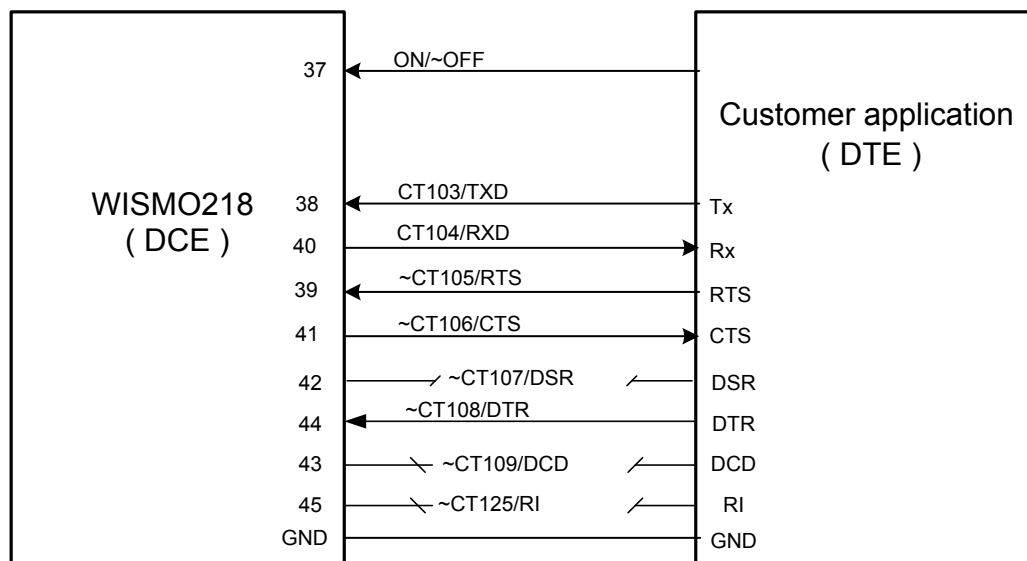


Figure 10. Example of V24/CMOS Serial Link Implementation for 5-wire UART

The designs shown in Figure 8, Figure 9, and Figure 10 are basic designs. Both the DCD and RI can be left open when not used.

However, a more flexible design to access this serial link with all modem signals is shown below.

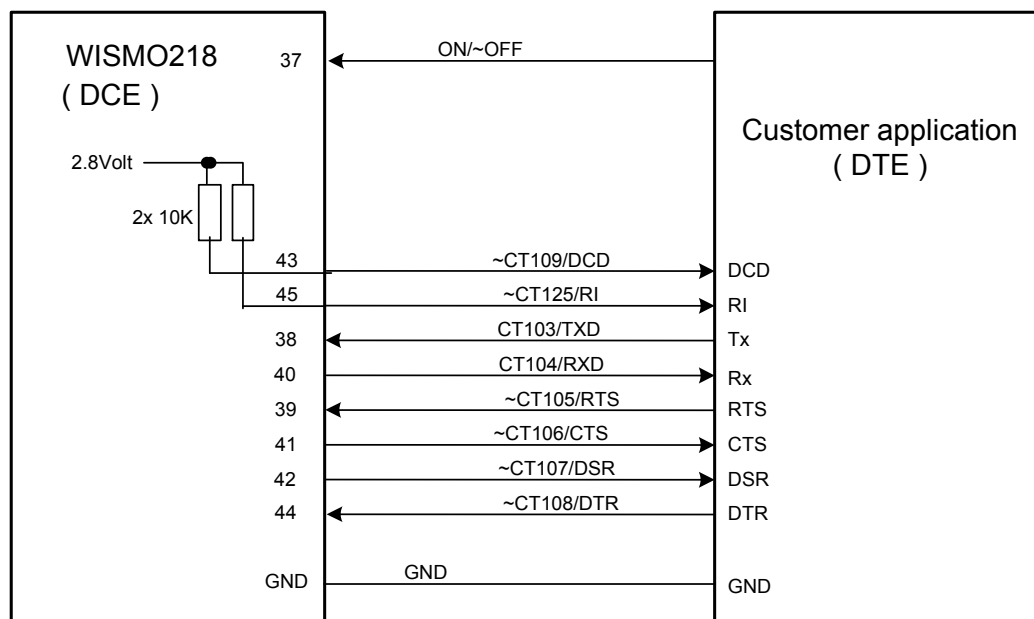


Figure 11. Example of Full Modem V24/CMOS Serial Link Implementation for full-UART

There is an internal 10K Ω pull-up resistor on RI and DCD to set it to HIGH level during the reset state.

The UART interface is a 2.8V type, but is 3V tolerant.

Tip: The AirPrime WISMO218 UART is designed to operate using all the serial interface signals. In particular, it is recommended to use ~CT105/RTS and ~CT106/CTS for hardware flow control in order to avoid data corruption during transmission.

3.7. SIM Interface

The Subscriber Identification Module can be directly connected to the AirPrime WISMO218 through this dedicated interface.

3.7.1. Features

The SIM interface controls both 1.8V and 3V SIM cards.

It is recommended to add Transient Voltage Suppressor diodes (TVS) on the signal connected to the SIM socket in order to prevent any Electrostatic Discharge.

TVS diodes with low capacitance (less than 10pF) have to be connected on SIM-CLK and SIM-IO signals to avoid any disturbance from the rising and falling edge.

These types of diodes are mandatory for the Full Type Approval. They will be placed as close as possible to the SIM socket.

The recommended low capacitance diode array to use is the DALC208SC6 from ST Microelectronics.

The SIM uses four (4) signals, namely:

- SIM-VCC: SIM power supply
- ~SIM-RST: reset
- SIM-CLK: clock
- SIM-IO: I/O port

The SIM interface controls a 3V/1V8 SIM. This interface is fully compliant with the GSM 11.11 recommendations concerning SIM functions.

Table 9: Electrical Characteristics of SIM Interface

Parameter	Conditions	Minim.	Typ	Maxim.	Unit
SIM-IO V_{IH}	$I_{IH} = \pm 20\mu A$	$0.7 \times V_{SIM}$	-	-	V
SIM-IO V_{IL}	$I_{IL} = 1mA$	-	-	0.4	V
\sim SIM-RST, SIM-CLK V_{OH}	Source current = $20\mu A$	$0.9 \times V_{SIM}$	-	-	V
SIM-IO V_{OH}	Source current = $20\mu A$	$0.8 \times V_{SIM}$	-	-	V
\sim SIM-RST, SIM-IO, SIM-CLK V_{OL}	Sink current = $-200\mu A$	-	-	0.4	V
SIM-VCC Output Voltage	SIM-VCC = 2.9V	2.75	2.9	3.0	V
	SIM-VCC = 1.8V	1.65	1.8	1.95	V
SIM-VCC current	full-power mode	-	-	20	mA
	Sleep mode with 32kHz system clock enabled.	-	-	3	mA
SIM-CLK Rise/Fall Time	Loaded with 30pF and ESD protection diode	-	25	50	ns
\sim SIM-RST, Rise/Fall Time	Loaded with 30pF and ESD protection diode	-	45	-	ns
SIM-IO Rise/Fall Time	Loaded with 30pF and ESD protection diode	-	0.2	1	μs
SIM-CLK Frequency	Loaded with 30pF	-	-	3.25	MHz

3.7.2. Pin Description

Table 10: SIM Interface Pin Description

Signal	Pin Number	I/O	I/O Type	Reset State	Description	Multiplexed with
SIM-CLK	9	O	2V9 / 1V8	0	SIM Clock	Not mux
\sim SIM-RST	11	O	2V9 / 1V8	0	SIM Reset	Not mux
SIM-IO	10	I/O	2V9 / 1V8	Pull up	SIM Data	Not mux
SIM-VCC	8	O	2V9 / 1V8		SIM Power Supply	Not mux

3.7.3. Application

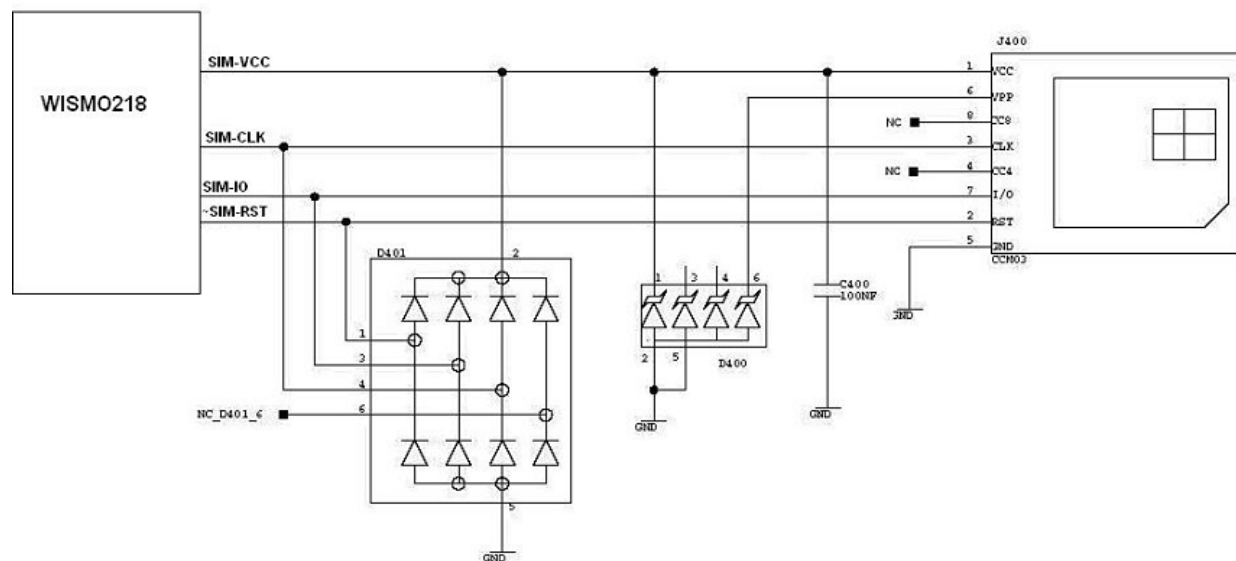


Figure 12. Example of SIM Socket Implementation

Table 11: Recommended Components

Component	Description/Details	Manufacturer
C400	100nF	
D400	ESDA6V1SC6	ST
D401	DALC208SC6	SGS-THOMSON
J400	ITT CANNON CCM03 series (See section 6.2 SIM Card Reader for more information)	CANNON

3.7.3.1. SIM Socket Connection

Table 12: Pin Description of the SIM Socket

Signal	Pin Number	Description
VCC	1	SIM-VCC
RST	2	~SIM-RST
CLK	3	SIM-CLK
CC4	4	Not connected
GND	5	GROUND
VPP	6	Not connected
I/O	7	SIM-IO
CC8	8	Not connected

Note: CC4 and CC8 are not connected as the AirPrime WISMO218 does not support SIM detect feature.

3.8. General Purpose Input/Output

The AirPrime WISMO218 provides up to 3 General Purpose I/Os. They are used to control any external device such as an LCD or a Keyboard backlight.

These GPIOs offer the possibility to read the pin state whatever their direction may be.

3.8.1. Pin Description

Table 13: GPIO Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Reset State
GPIO1	24	I/O	2V8	Pull up
GPIO3	16	I/O	2V8	Pull up
GPIO5	19	I/O	2V8	Pull down

Caution: *GPIO2 is dedicated for WISMO_READY and is not open as GPIO purpose for customer use.*

GPIO4 is dedicated for TX burst indication and is not open as GPIO purpose for customer use.

When GPIO5 is used as a general purpose output, it is necessary to have an external pull up resistor connecting to a 2.8V source. Resistance value depends on the current drain required by the application side.

3.9. Analog to Digital Converter

One Analog to Digital Converter input is provided by the AirPrime WISMO218. It is a 10-bit resolution converter, ranging from either 0 to 1V or 0 to 3V, depending on the general purpose input mode.

3.9.1. Features

The AUX-ADC0 input can be used for customer applications.

Table 14: Electrical Characteristics of ADC

Parameter		Min	Typ	Max	Unit
Resolution		-	10	-	bits
Sampling frequency		-	-	200	kHz
Input signal range	1 general purpose input	0	-	1	V
	1 general purpose input in div-by-3 mode	0	-	3	V
Integral non-linearity (INL)		-2.5	-	+2.5	bit
Differential non-linearity (DNL)		-1	-	+3	bit
Input impedance	input resistance	120	-	-	K Ω
	input capacitance	-	-	10	pF

3.9.2. Pin Description

Table 15: Analog to Digital Converter Pin Description

Signal	Pin Number	I/O	I/O Type	Description
AUX-ADC0	5	I	Analog	A/D converter

Caution: *The AUX-ADC0 pin is ESD sensitive. It is a must to add ESD protection to this pin once it is externally accessible.*

Recommended ESD protection: AVL5M02200 from Amotech.

3.10. Analog Audio Interface

The AirPrime WISMO218 supports one microphone input and one speaker output. It also includes an echo cancellation feature which allows hands free function.

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

3.10.1. Microphone Features

The microphone, MIC, can either have a single-ended or a differential connection. However, it is strongly recommended to use a differential connection in order to reject common mode noise and TDMA noise.

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

The gain of MIC inputs is internally adjusted and can be tuned using AT commands.

The MIC already includes suitable biasing for an electret microphone. The electret microphone can then be connected directly on the inputs for easy connection.

AC coupling is also already embedded in the AirPrime WISMO218.

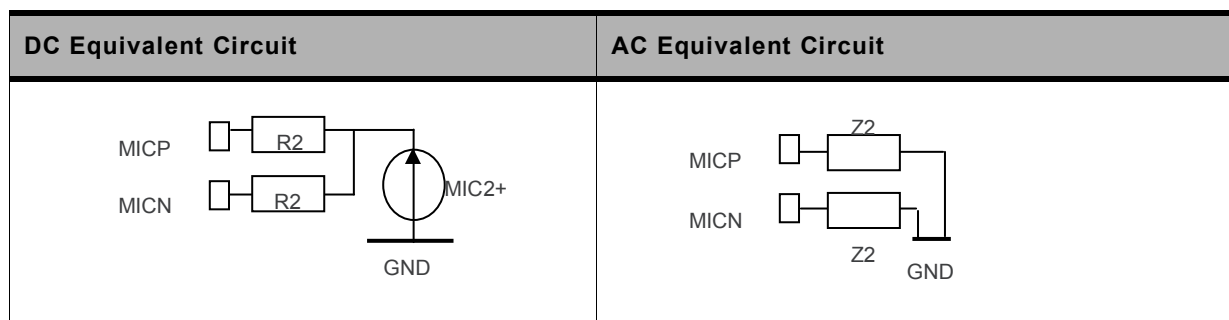


Figure 13. DC and AC Equivalent Circuits of MIC

3.10.1.1. Electrical Characteristics

Table 16: Electrical Characteristics of MIC

Parameters		Min	Typ	Max	Unit
Internal biasing DC Characteristics	MICP	-	2.4	-	V
	MICN without 2.2K Ω to GND	-	2.4	-	V
	MICN with 2.2K Ω to GND	-	1.2	-	V
	Output current				mA
	R2	-	2.2	-	K Ω
AC Characteristics 200 Hz<F<4 kHz	Z2 MICP (MICN=Open)		2.2		K Ω
	Z2 MICN (MICP=Open)				

Parameters		Min	Typ	Max	Unit
	Z2 MICP (MICN=GND)		2.2		
	Z2 MICN (MICP=GND)				
	Impedance between MICP and MICN without 2.2K Ω to GND		4.5		
	Impedance between MICP and MICN with 2.2K Ω to GND		3.2		
Maximum working voltage (MICP-MICN) (THD 10%)	AT+VGT*=1	-	-	210	mVpp
Maximum rating voltage (MICP or MICN)		-0.5	-	4.4	V

* The input voltage depends on the input micro gain set by the AT command. Please refer to document [2], AirPrime WISMO218 AT Commands Manual.

** Because both MICP and MICN are internally biased, it is necessary to use a coupling capacitor to connect an audio signal provided by an active generator. Only a passive microphone can be directly connected to the MICP input.

3.10.2. Speaker Features

The speaker, SPK, can either have a single-ended or a differential connection. However, it is strongly recommended to use a differential connection in order to reject common mode noise and TDMA noise. Moreover, in single-ended mode, half (1/2) of the power is lost.

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

Table 17: Speaker Details

Parameter	Typ	Unit	Connection
Z (SPKP, SPKN)	16 or 32	Ω	Differential mode
Z (SPKP, SPKN)	8	Ω	Single-ended mode

3.10.2.1. Speakers Outputs Power

The maximal specifications given below are available with the maximum power output configuration values set by an AT command. The typical values are recommended.

3.10.2.1.1. SPK Outputs

The SPK interface allows for both differential and single ended speaker connections.

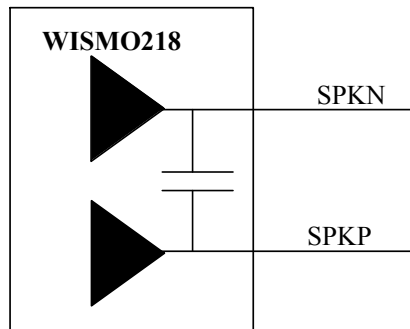


Figure 14. Equivalent Circuit for SPK

Table 18: Electrical Characteristics of SPK

Parameters		Min	Typ	Max	Unit
Biasing voltage	SPKP and SPKN	-	1.4	-	V
Output swing voltage	RL=8Ω: AT+VGR=6*; single ended	-	-	1	Vpp
	RL=8Ω: AT+VGR=6*; differential	-	-	2	Vpp
	RL=16Ω or 32Ω: AT+VGR=6*; single ended	-	-	1.1	Vpp
	RL=16Ω or 32Ω: AT+VGR=6*; differential	-	-	2.2	Vpp
RL	Load resistance	6	8	-	Ω
IOUT	Output current; peak value; RL=8Ω	-	-	90	mA
POUT	RL=8Ω; AT+VGR=10*;	-	-	65	mW

* The output voltage depends on the output speaker gain set by the AT command. Please refer to document [2] AirPrime WISMO218 AT Commands Manual.

If a single-ended connection is used, only SPKP has to be connected. The result is a maximal output power divided by 2.

3.10.3. Pin Description

Table 19: Analog Audio Interface Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
MICP	3	I	Analog	Microphone positive input
MICN	4	I	Analog	Microphone negative input
SPKP	1	O	Analog	Speaker positive output
SPKN	2	O	Analog	Speaker negative output

3.10.4. Application

3.10.4.1. Microphone

The following subsections define different microphone configuration examples.

3.10.4.1.1. Microphone Differential Connection Example

When a differential connection of MIC is used, it is necessary to add a 2.2K Ω resistor from MICN to GND in order to have proper bias of the microphone.

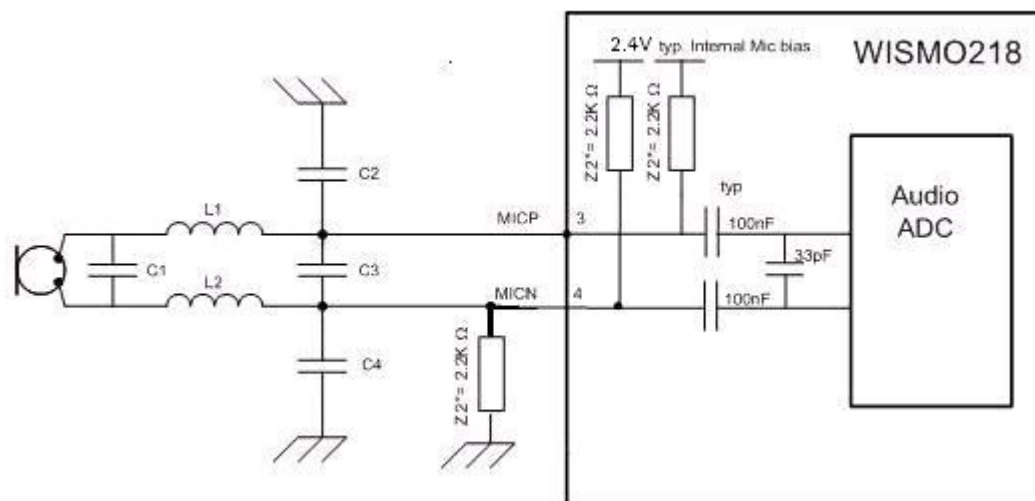


Figure 15. Example of MIC Input Differential Connection with LC Filter

Audio quality can be very good without L1, L2, C2, C3 and C4 depending on the design. But if there is EMI perturbation, this filter can reduce the TDMA noise. This filter (L1, L2, C2, C3 and C4) is not mandatory. If not used, the capacitor must be removed and the coil replaced by a 0 Ω resistor as the shown in the following schematic.

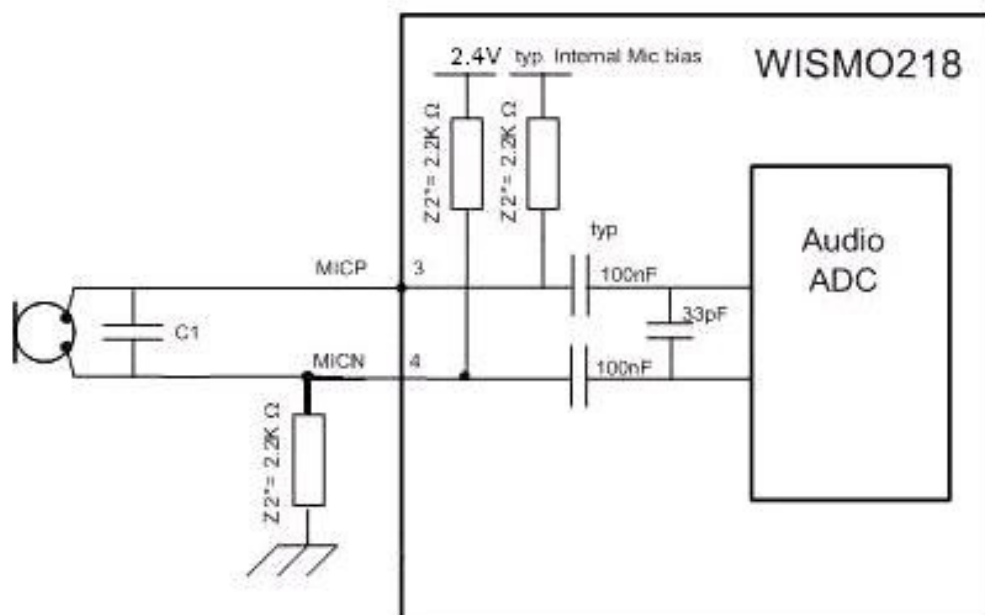


Figure 16. Example of MIC Input Differential Connection without LC Filter

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

3.10.4.1.1. Recommended Components

Component	Description/Details	Notes
C1	12pF to 33pF	needs to be tuned depending on the design
C2, C3, C4	47pF	needs to be tuned depending on the design
L1, L2	100nH	needs to be tuned depending on the design

3.10.4.1.2. Microphone Single-Ended Connection Example

When single-ended connection is used for MIC, MICN is just left open.

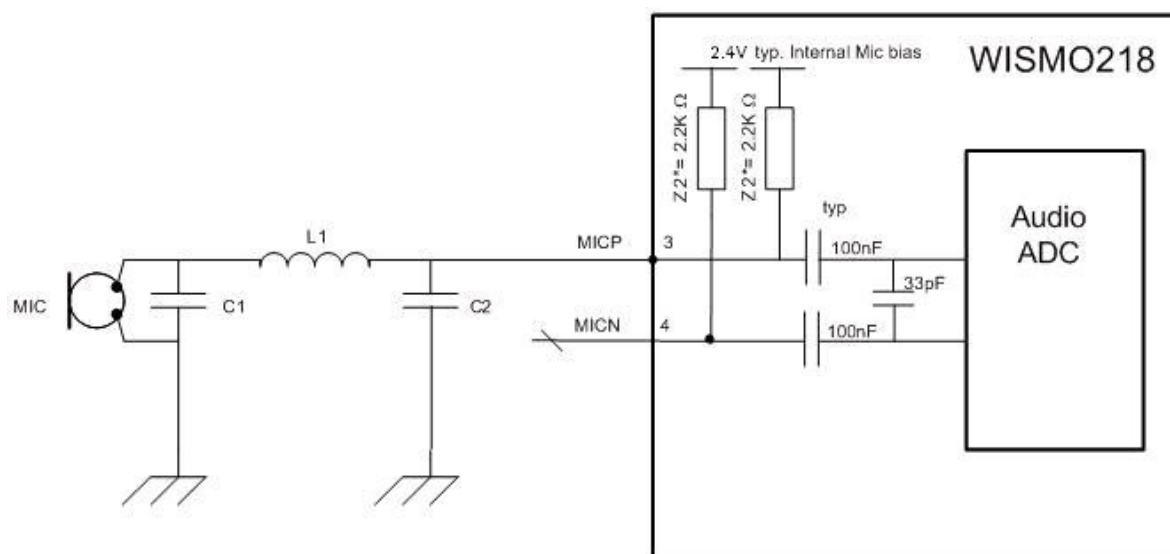


Figure 17. Example of MIC Input Single-Ended connection with LC Filter

*Z2 is from 200Hz to 4kHz. For more characteristics refer to section 3.2.2 Electrical Characteristics.

Note that:

- Internal input impedance value becomes 1100Ω, due to the connection of the other end to ground.
- The single ended design is very sensitive to TDMA noise.
- It is recommended to add L1 and C2 footprint as an LC filter to try to eliminate TDMA noise.
- A very good grounding on the MIC is a must in order to ensure good audio performance against TDMA. Also, special care on the PCB layout must be taken.
- When not used, the filter can be removed by replacing L1 with a 0Ω resistor and by disconnecting C2, as shown in the following schematic.

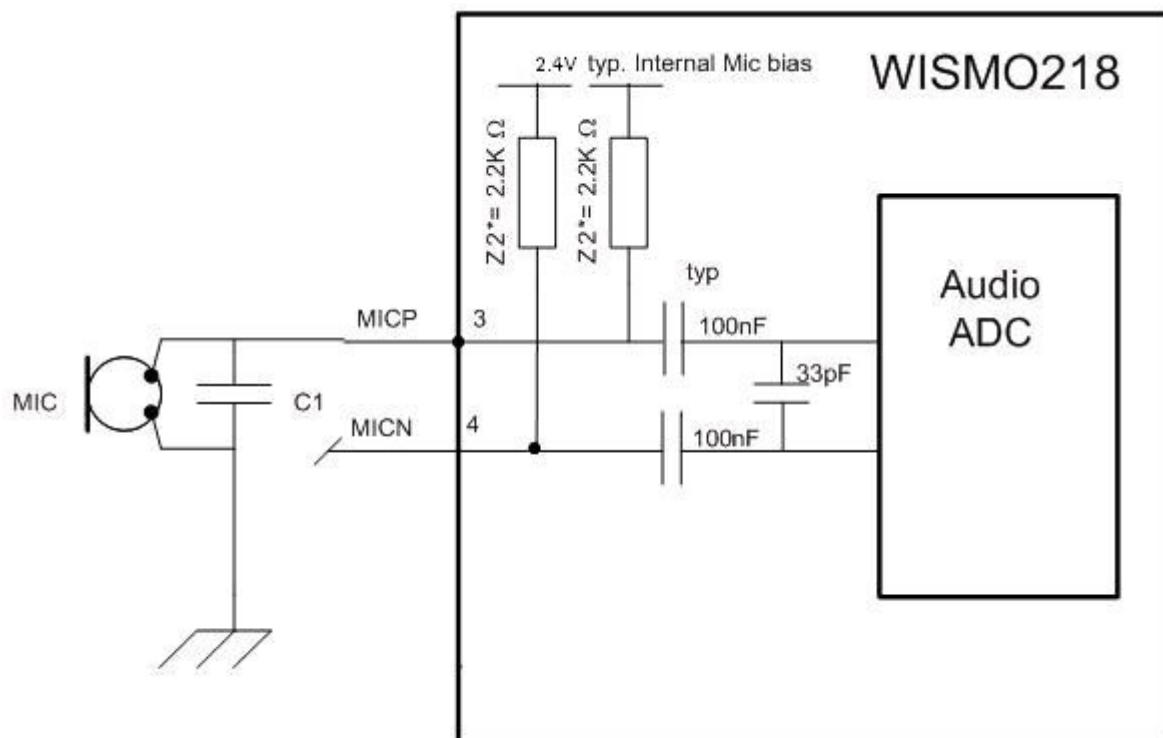


Figure 18. Example of MIC Input Single-Ended Connection without LC Filter

*Z2 is from 200Hz to 4kHz. For more characteristics refer to section 3.2.2 Electrical Characteristics.

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

3.10.4.1.2.1. Recommended Components

Component	Description/Details	Notes
C1	12pF to 33pF	needs to be tuned depending on the design
C2		needs to be tuned depending on the design
L1		needs to be tuned depending on the design

3.10.4.2. Speaker SPKP and SPKN

3.10.4.2.1. SPK Differential Connection

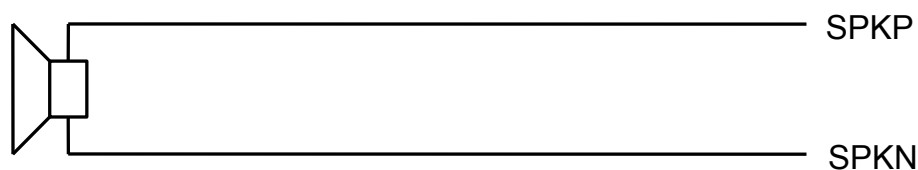


Figure 19. Example of Speaker Differential Connection

3.10.4.2.2. SPK Single-Ended Connection

Typical implementation:

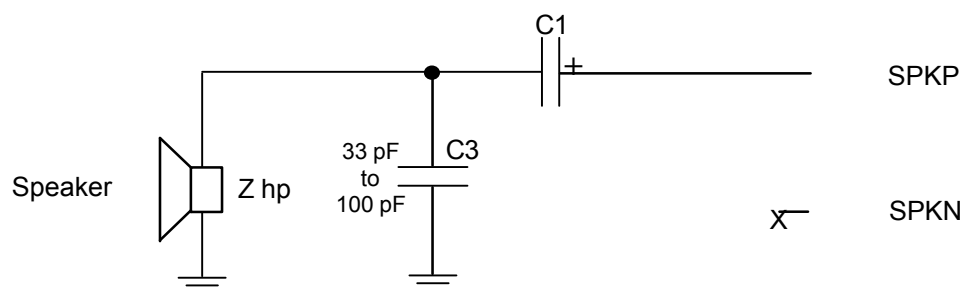


Figure 20. Example of Speaker Single-Ended Connection

$4.7\mu\text{F} < C1 < 47\mu\text{F}$ (Depending on speaker characteristics and output power.)

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

The connection between the AirPrime WISMO218 pins and the speaker must be designed to keep the serial impedance lower than 1.5Ω in a single-ended connection.

SPKN can be left open in a single-ended connection.

3.10.5. Design Recommendation

3.10.5.1. General

When both speaker and microphone are exposed to the external environment, it is recommended to add ESD protection as close as possible to the speaker or microphone, connected between the audio lines and a good ground.

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

It is important to select an appropriate microphone, speaker and filtering components to avoid TDMA noise.

3.10.5.2. Recommended Microphone Characteristics

The impedance of the microphone has to be around $2\text{K}\Omega$.

Sensitivity is from -40dB to -50 dB.

SNR > 50 dB.

Frequency response is compatible with the GSM specifications.

To suppress TDMA noise, it is highly recommended to use microphones with two internal decoupling capacitors:

- CM1=56pF (0402 package) for the TDMA noise coming from the demodulation of the GSM900 frequency signal
- CM2=15pF (0402 package) for the TDMA noise coming from the demodulation of the DCS frequency signal

The capacitors have to be soldered in parallel to the microphone:

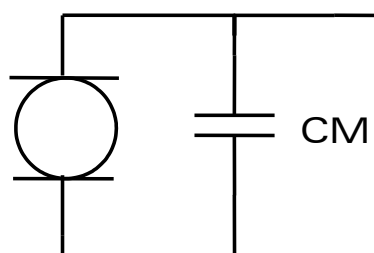


Figure 21. Microphone

3.10.5.3. Recommended Speaker Characteristics

Type of speakers: Electro-magnetic /10mW

Impedance: 8Ω for hands-free

Impedance: 32Ω for heads kit

Sensitivity: 110dB SPL min

Receiver frequency response is compatible with the GSM specifications.

3.10.5.4. Recommended Filtering Components

When designing a GSM application, it is important to select the right audio filtering components.

The strongest noise, called TDMA, is mainly due to the demodulation of the GSM900 and DCS1800 signal: A burst is produced every 4.615ms; where the frequency of the TDMA signal is equal to 216.7Hz plus harmonics.

The TDMA noise can be suppressed by filtering the RF signal using the right decoupling components.

The types of filtering components are:

- RF decoupling inductors
- RF decoupling capacitors

A good "Chip S-Parameter" simulator is proposed by Murata. Refer to http://www.murata.com/products/design_support/mcsil/index.html for more details.

Using different Murata components, we could see that the value, the package and the current rating can have different decoupling effects.

The table below shows some examples with different Murata components:

Table 20: Murata Examples

Package	0402		
Filtered band	GSM900	GSM 850/900	DCS/PCS
Value	100nH	56pF	15pF
Types	Inductor	Capacitor	Capacitor
Position	Serial	Shunt	Shunt
Manufacturer	Murata	Murata	Murata
Rated	150mA	50V	50V
Reference	LQG15HSR10J02 or LQG15HNR10J02	GRM1555C1H560JZ01	GRM1555C1H150JZ01 or GRM1555C1H150JB01
Package	0603		
Filtered band	GSM900	GSM 850/900	DCS/PCS
Value	100nH	47pF	10pF
Types	Inductor	Capacitor	Capacitor
Position	Serial	Shunt	Shunt
Manufacturer	Murata	Murata	Murata
Rated	300mA	50V	50V
Reference	LQG18HNR10J00	GRM1885C1H470JA01 or GRM1885C1H470JB01	GRM1885C1H150JA01 or GQM1885C1H150JB01

3.10.5.5. Audio Track and PCB Layout Recommendation

To avoid TDMA noise, it is recommended to surround the audio tracks with ground as shown in the following figure:

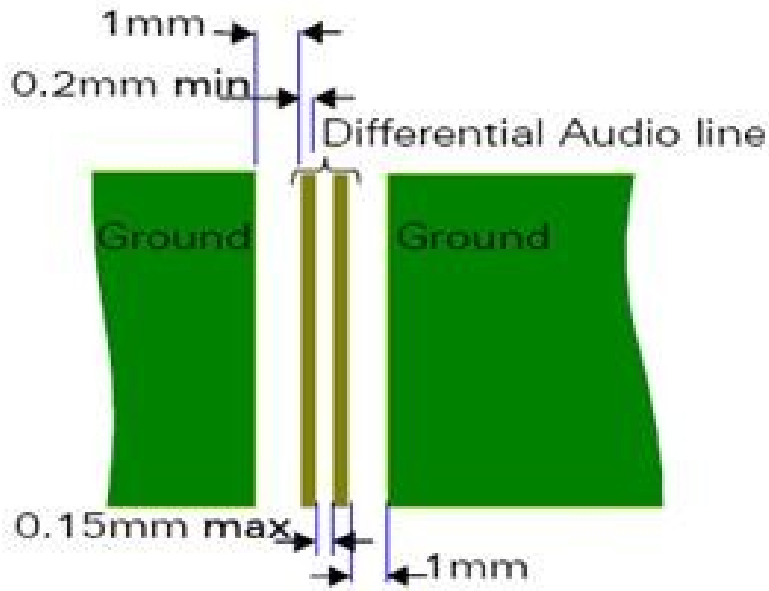


Figure 22. Audio Track Design

For differential connections, it is necessary to add a 2.2K Ω resistor from MICN to GND to have a proper bias of the microphone. Refer to the following figure.

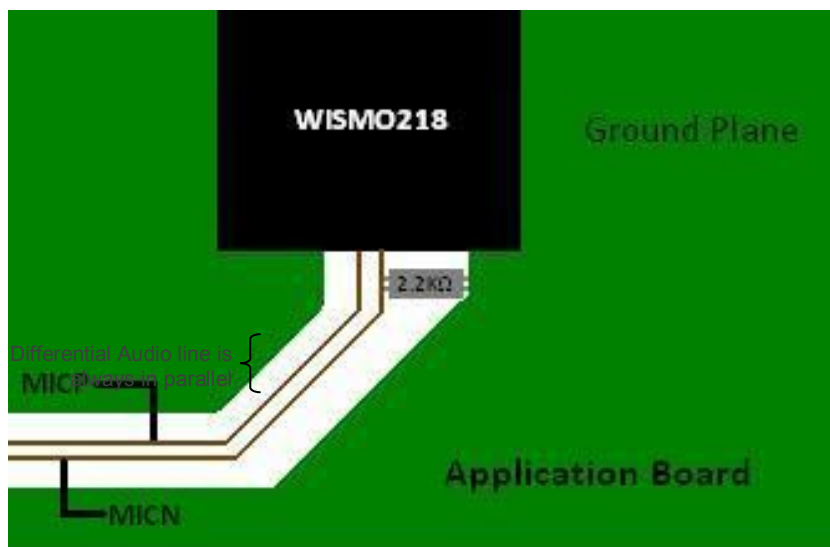


Figure 23. Differential Audio Connection

For single-ended connections, the negative pole of the microphone, MICN, should be connected to GND. Refer to the following figure.



Figure 24. Single-Ended Audio Connection

Caution: *It is a must to avoid digital tracks crossing under and over the audio tracks.*

Even when MICP is singled-ended, it is highly recommended to have the MIC ground and the LC filter ground to act as an audio analog ground during the PCB layout. This audio ground, together with the MICP signal, should act as the differential line pair. And this audio ground should only be connected to the AirPrime WISMO218 embedded module ground as close as possible to the castellation GND pin of AirPrime WISMO218. It is the same case for SPKP and SPKN.

Also, the audio interface is ESD sensitive. It is a must to add ESD protection to the interface once it is externally accessible.

Recommended ESD protection: ESDA6VIL from ST.

3.11. Pulse-Width Modulators (PWMs)

The AirPrime WISMO218 contains two Pulse-Width Modulators (PWMs). They can be used in conjunction with an external transistor for driving a vibrator, or a backlight LED.

3.11.1. Features

Each PWM uses two 7-bit unsigned binary numbers: one for the output period and one for the pulse width or the duty cycle.

The relative timing for the PWM output is shown in the figure below.

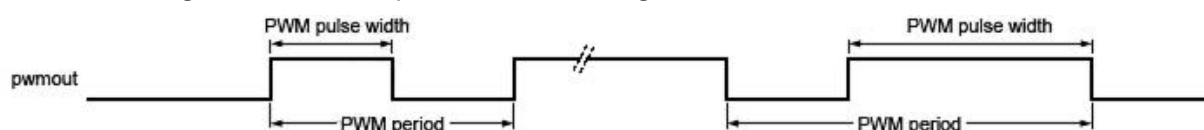


Figure 25. Relative Timing for the PWM Output

Table 21: PWM Electrical Characteristics

Parameter	Condition	Minimum	Typical	Maximum	Unit
V_{OH}	High impedance load	2.7	2.85	-	V
	Load with $I_{OH} = 4\text{mA}$	-	2.4	-	V
V_{OL}	-	-	-	0.1	V
I_{PEAK}	-	-	-	4	mA
Frequency	-	25.6	-	1083.3	kHz
Duty cycle	-	0*	-	100*	%

3.11.2. Pin Description

Table 22: PWM Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
PWM0	36	O	2V8	PWM output
PWM1	35	O	2V8	PWM output

3.11.3. Application

Both the PWM0 and PWM1 signals can be used in conjunction with an external transistor for driving a vibrator, or a backlight LED.

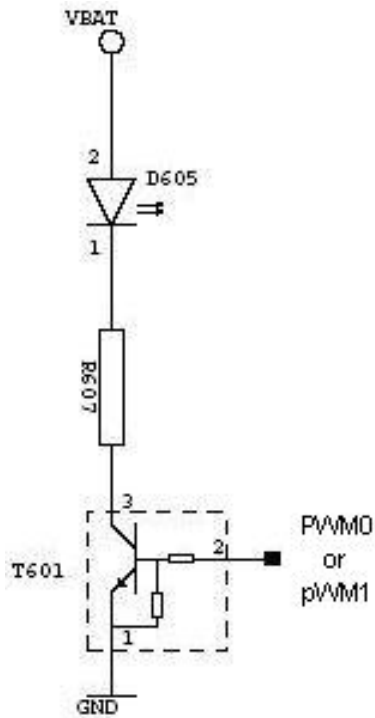


Figure 26. Example of a LED Driven by the PWM0 or PWM1 Output

The value of R607 can be harmonized depending on the LED (D605) characteristics.

The recommended digital transistor to use for T601 is the DTC144EE from ROHM.

3.12. BUZZER Output

The signal BUZZER outputs a square wave at the desired tone frequency. The tone frequencies are programmable and can be re-programmed on-the-fly to generate monophonic audio ringtones or alert tones. The tone level can also be adjusted in 4dB steps, or it can be muted.

3.12.1. Features

The signal BUZZER can be used in conjunction with an external transistor/MOSFET for driving a buzzer in order to give a maximum current of 100mA (PEAK) and an average of 40mA, depending on application requirement.

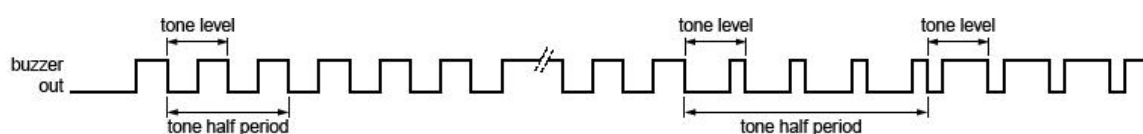


Figure 27. BUZZER Output

Table 23: BUZZER Electrical Characteristics

Parameter	Condition	Minimum	Typical	Maximum	Unit
V_{OH}	High impedance load	2.7	2.85	-	V
	Load with $I_{OH} = 4\text{mA}$	-	2.4	-	V
I_{PEAK}	-	-	-	4	mA
V_{OL}	-	-	-	0.1	V
Frequency	-	200	-	2500	Hz
Duty cycle	-	0*	-	100*	%
Tone level	4 dB step	-24	-	0	dB

* Be mindful of the maximum frequency and the minimum/maximum duty cycle. There is a limitation due to the RC environment. **The amplitude modulation becomes less fine when the set limits are reached.**

3.12.2. Pin Description

Table 24: BUZZER Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
BUZZER	34	O	2.8V	Buzzer output

3.12.3. Application

The maximum peak current of the transistor/MOSFET is 100mA and the maximum average current is 40mA, while the peak current of the BUZZER pin should be less than 4mA. A diode against transient peak voltage must be added as shown below.

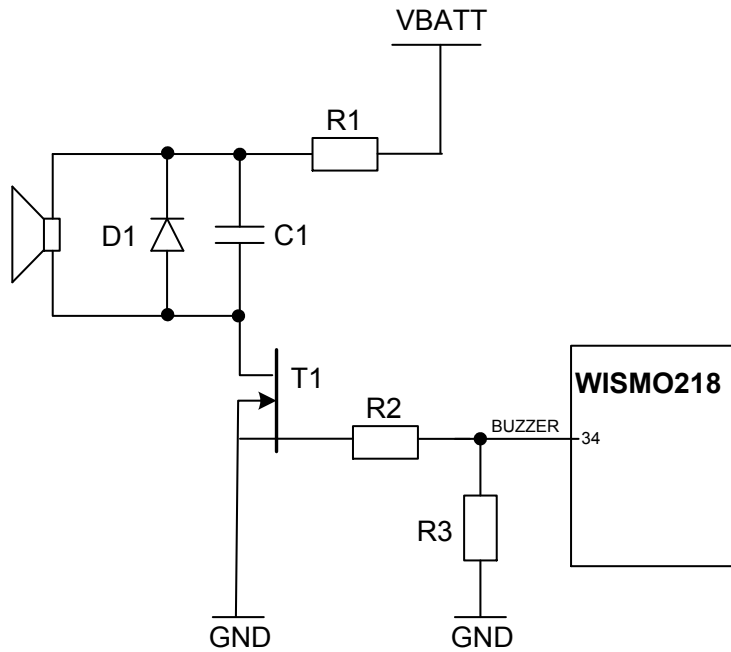


Figure 28. Example of Buzzer Implementation

Where:

- R1 must be chosen in order to limit the current at I_{PEAK} max of 100mA and must be adjusted in function of the frequency and the duty cycle used.
- D1 = BAV70T-7 or BAS16 (for example)
- T1 = FDN335N (for example)
- R2 = 0Ω
- R3 = $1M\Omega$
- A low filter is recommended at low frequencies.

3.12.3.1. Calculations of the Low Filter

Req is the total resistor in line.

C is the capacitive charge on T1 and the ground.

The cut-off frequency (Fc) must be higher than FBUZZ-OUT.

Due to the conception of this signal, the frequency modulation of the BUZZER signal is 64* FBUZZ-OUT.

Fc must be at least 64 * FBUZZ-OUT.

$$F_c = 1 / (2 \cdot \pi \cdot R_{eq} \cdot C)$$

3.12.3.2. Recommended Characteristics for the Buzzer

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

The BUZZER output can also be used to drive a LED as shown in the figure below:

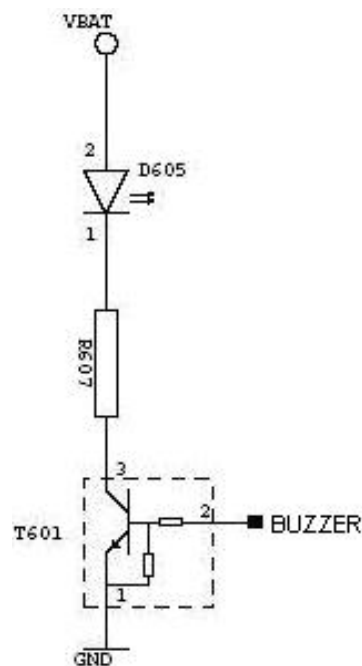


Figure 29. Example of LED Driven by the BUZZER Output

The value of R607 can be harmonized depending on the LED (D605) characteristics.

The recommended digital transistor to use for T601 is the DTC144EE from ROHM.

3.13. ON/~OFF Signal

The ON/~OFF pin is used to switch ON or switch OFF the AirPrime WISMO218.

ON/~OFF signal is internally connected to the permanent 3.0V supply regulator inside the AirPrime WISMO218 via a pull-up resistor. Once there is VBATT supply to the AirPrime WISMO218, this 3.0V supply regulator will be enabled and so the ON/~OFF signal is by default at HIGH level.

A LOW level signal has to be provided on the ON/~OFF pin to switch ON the AirPrime WISMO218.

Caution: *All external signals must be inactive when the AirPrime WISMO218 is OFF to avoid any damage when starting and to allow the AirPrime WISMO218 to start and stop correctly.*

Avoid using application MCU GPIO to directly control the ON/~OFF signal of the AirPrime WISMO218; instead, control this signal via an open collector switching transistor.

3.13.1. Features

Table 25: Electrical Characteristics of the ON/~OFF Signal

Parameter	I/O Type	Minimum	Typ.	Maximum	Unit
V _{IH}	2V8	2.4	-	3.0	V
V _{IL}	2V8	-	-	0.4	V

3.13.2. Pin Description

Table 26: ON/~OFF Signal Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
ON/~OFF	37	I	2V8	AirPrime WISMO218 Power ON/OFF

3.13.3. Application

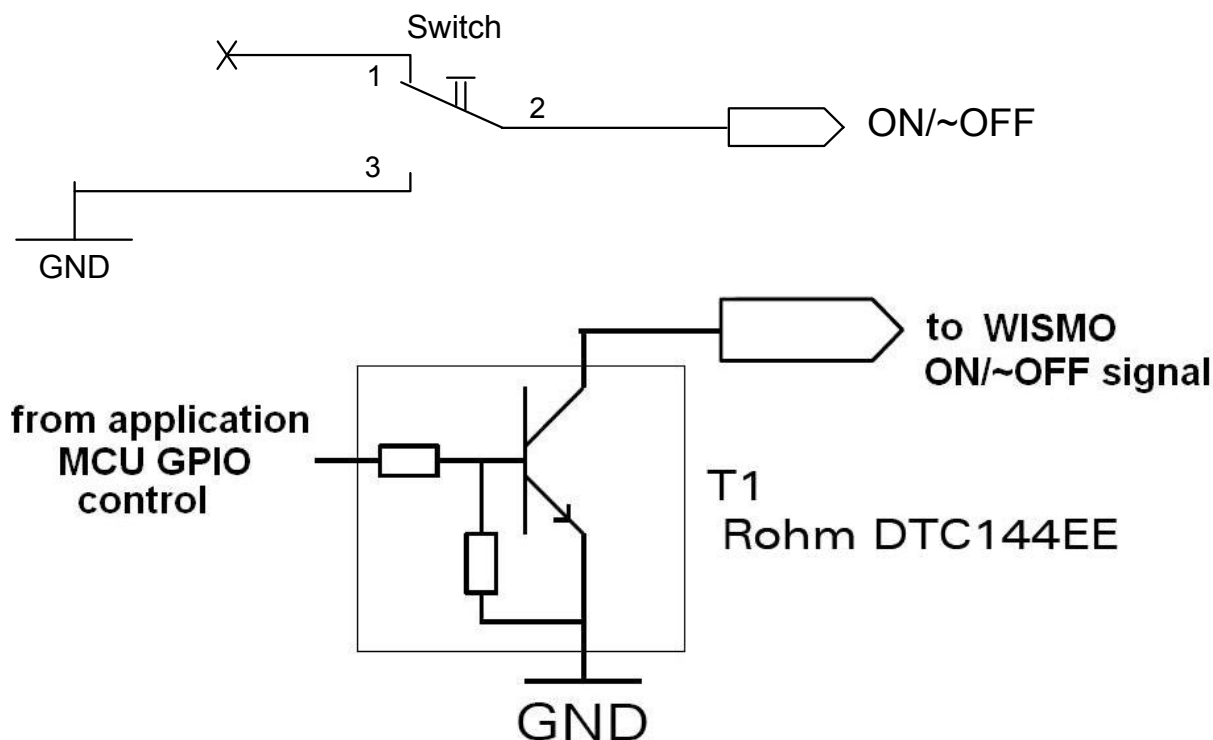


Figure 30. Example of the ON/~OFF Pin Connection Either By a Switch or Via an Open Collector Transistor

3.13.3.1. Power ON

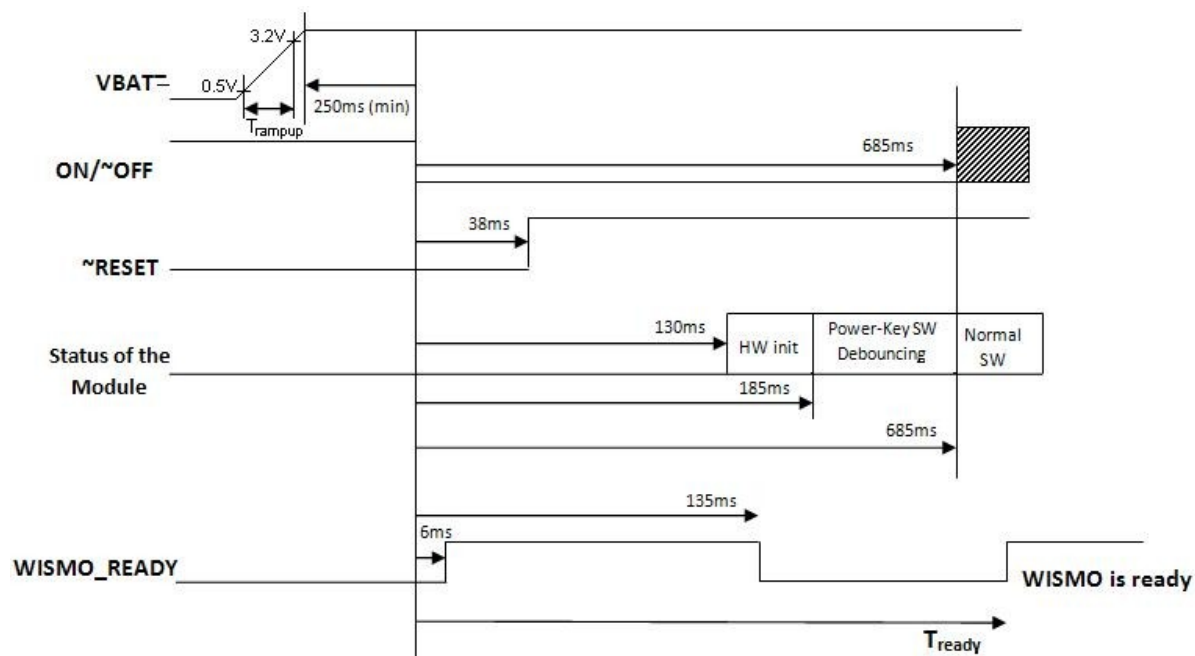


Figure 31. Power-ON Sequence (no PIN code activated)

	Min	Typ.	Max	Unit
T _{ready}	4	5	7	s
T _{rampup}	-	-	120	ms

The ON/~OFF signal level is detected about 250ms after VBATT is available. Note that this timing might be temperature dependant.

The voltage of this signal has to be pulled LOW for at least 685ms for powering ON. Within this 685ms, the WISMO_READY signal will initially reset to HIGH for about 135ms and then resume to LOW.

During the power ON sequence, an internal reset is automatically performed for 38ms (typically). During this phase, any external reset should be avoided.

Once the AirPrime WISMO218 is properly powered ON, the WISMO_READY pin will set to HIGH level to acknowledge the successful powering ON of the AirPrime WISMO218 before it is ready to operate. The ON/~OFF signal can be left at LOW level until power off.

Please note that temperature conditions may affect the timing for powering up.

The recommended way to release the ON/~OFF signal is to detect the WISMO_READY signal within 685ms of powering ON while the level pulse of the ON/~OFF signal is set to LOW, and wait until the WISMO_READY signal goes HIGH again.

3.13.3.2. Power OFF

The AirPrime WISMO218 can be powered off by either software or hardware.

3.13.3.2.1. Software Power OFF

AT command: AT+CPOF is used to power off the AirPrime WISMO218.

Caution: If the ON/~OFF pin is maintained at LOW level when AT+CPOF is used, the embedded module can't be switched OFF.

3.13.3.2.2. Hardware Power OFF

A LOW level pulse is applied on the ON/~OFF pin for 5.5sec. AT+CPOF will then be automatically sent to the AirPrime WISMO218.

Once the AirPrime WISMO218 receives the AT+CPOF command, the AirPrime WISMO218 will be deregistered from the network. The WISMO_READY pin will become LOW to indicate that AT commands are no longer available for the AirPrime WISMO218. If the ON/~OFF signal is HIGH, then the AirPrime WISMO218 will also be switched off.

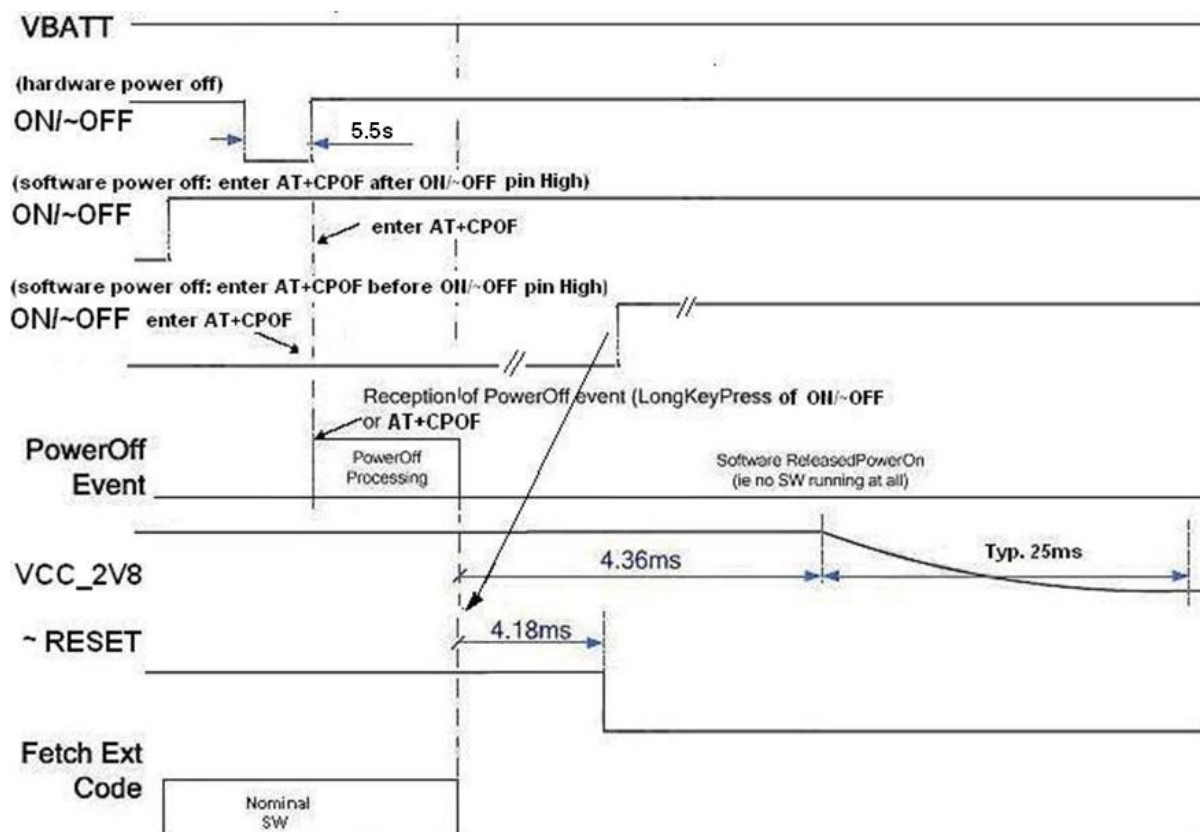


Figure 32. Power-OFF Sequence

3.14. WISMO_READY Indication

This signal indicates the ready status of the AirPrime WISMO218 after powering on. Please note that there is an initial positive pulse of less than 200ms during power ON. For details, please refer to Figure 31 Power-ON Sequence (no PIN code activated). Once the AirPrime WISMO218 is properly powered ON, the WISMO_READY pin will set to HIGH level to acknowledge the successful powering ON of the AirPrime WISMO218 before it is ready to operate.

On the other hand, the level will go LOW before powering off.

3.14.1. Features

Table 27: Electrical Characteristics of the Signal

Parameter	I/O Type	Minimum	Typ.	Maximum	Unit
V _{OH}	2V8	2.7	2.8	2.95	V
V _{OL}	2V8	-	-	0.4	V

3.14.2. Pin Description

Table 28: WISMO_READY Indication Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
WISMO_READY	7	O	2V8	AirPrime WISMO218 ready indication

3.15. VCC_2V8 Output

The **VCC_2V8** output can only be used for pull-up resistor(s) and as a reference supply.

This voltage supply is available when the AirPrime WISMO218 is switched on.

3.15.1. Features

Table 29: Electrical Characteristics of the Signals

Parameter			Minimum	Typ	Maximum	Unit
VCC_2V8	Output voltage		2.70	2.80	2.95	V
	Output Current	Full-power mode	-	-	50	mA
		Sleep mode	-	-	3	mA

3.15.2. Pin Description

Table 30: VCC_2V8 Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
VCC_2V8	46	O	Supply	Digital supply

3.15.3. Application

This digital power supplies are mainly used to:

- Pull-up signals such as I/O
- Supply the digital transistors driving LEDs
- Act as a voltage reference for ADC interface AUX-ADC0

3.16. BAT-RTC (Backup Battery)

The AirPrime WISMO218 provides an input/output to connect a Real Time Clock power supply.

3.16.1. Features

This pin is used as a back-up power supply for the internal **Real Time Clock**. The RTC is supported by the AirPrime WISMO218 when VBATT is available but a back-up power supply is needed to save date and hour when VBATT is switched off.

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

If VBATT is available, the back-up battery can be charged by the internal 3.0V power supply regulator via a 2K Ω resistor implemented inside the AirPrime WISMO218.

Table 31: Electrical Characteristics of the Signal

Parameter	Minimum	Typ	Maximum	Unit
Input voltage	-	3.0	-	V
Input current consumption*	-	2.5	-	μ A
Output voltage	2.82	3.0	3.18	V
Max charging current (@VBATT=3.6V)	-	0.6	-	mA

* Provided by an RTC back-up battery when the AirPrime WISMO218 is off and VBATT = 0V.

3.16.2. Pin Description

Table 32: BAT-RTC Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
BAT-RTC	6	I/O	Supply	RTC Back-up supply

3.16.3. Application

The Back-up Power Supply can be provided by any of the following:

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

3.16.3.1. Super Capacitor

Super Capacitor

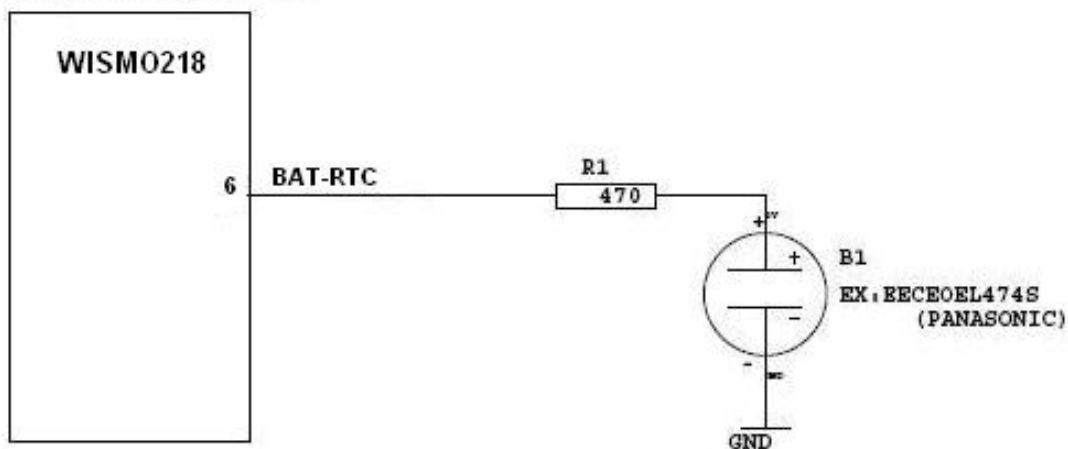


Figure 33. RTC Supplied by a Gold Capacitor

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

Note: The Gold Capacitor maximum voltage is 3.9V.

3.16.3.2. Non-Rechargeable Battery

Non rechargeable battery cell

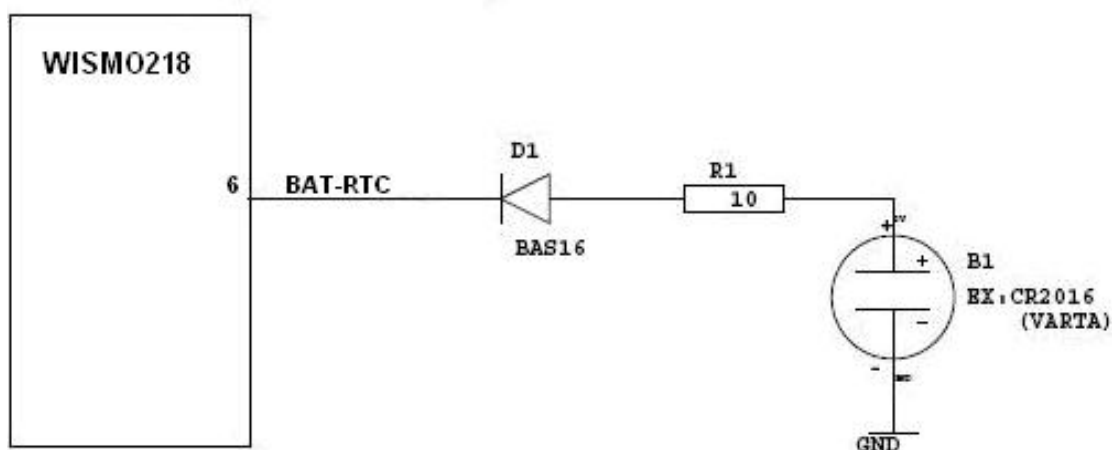


Figure 34. RTC Supplied by a Non Rechargeable Battery

The diode D1 is mandatory to prevent the non rechargeable battery from being damaged.

Estimated range with 85 mAh battery: 800 hours minimum.

3.16.3.3. Rechargeable Battery Cell

Rechargeable battery cell

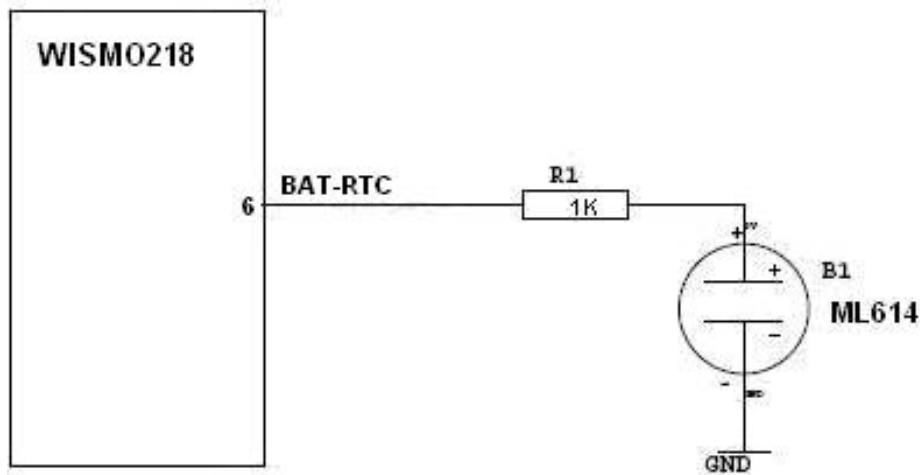


Figure 35. RTC Supplied by a Rechargeable Battery Cell

Rechargeable battery cell: Sanyo ML614

Estimated range with fully charged 3.4mAh rechargeable battery: at least 7 days.

Caution: Before battery cell assembly, ensure that cell voltage is lower than 3.0V to avoid damaging the AirPrime WISMO218.

3.17. TX_CTRL Signal for TX Burst Indication

3.17.1. Features

The TX_CTRL signal is a 2.8V indication signal for TX Burst with a 100KΩ pull-up resistor implemented inside the AirPrime WISMO218 embedded module.

Table 33: TX_CTRL Status

AirPrime WISMO218 State	TX_CTRL Status
During TX burst	Low
No TX	High

During TX burst, there will be higher current drain from the VBATT power supply which causes a voltage drop. This voltage drop from VBATT is a good indication of a high current drain situation during TX burst.

The blinking frequency is about 216Hz.

The output logic low duration, T_{duration} , depends on the number of TX slots and is computed as follows:

$$T_{\text{duration}} = T_{\text{advance}} + (0.577\text{ms} \times \text{number of TX slots}) + T_{\text{delay}}$$

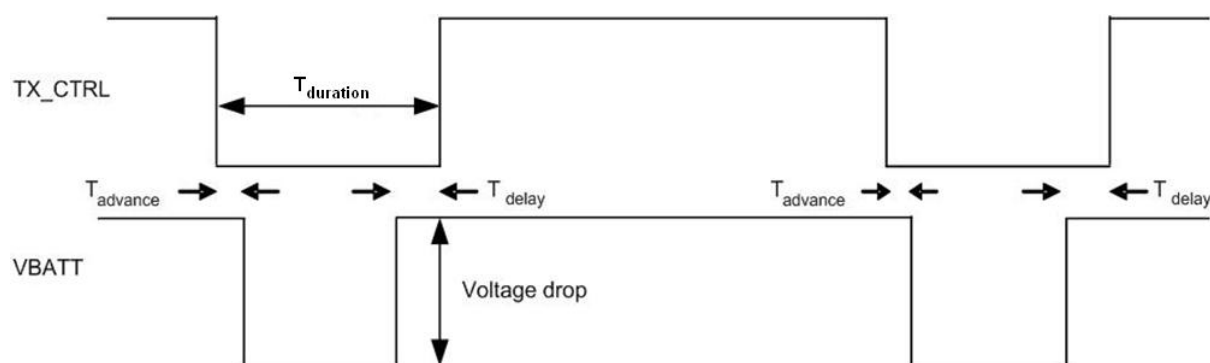


Figure 36. TX_CTRL State During TX Burst

Table 34: Electrical Characteristics of the Signal

Parameter	Condition	Minimum	Typ.	Maximum	Unit
V_{OH}		2.6	-	2.95	V
V_{OL}		-	-	0.4	V
T_{advance}	@500mA	-	18	-	μs
	@1A	-	27	-	μs
T_{delay}		-	11	-	μs

3.17.2. Pin Description

Table 35: TX_CTRL Signal Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Reset State	Description
TX_CTRL	18	O	2V8	1	TX Burst indication

3.17.3. Application

The TX burst indication signal, TX_CTRL, can be used to drive a LED through a transistor. It will then be a good visual indicator for any TX activities.

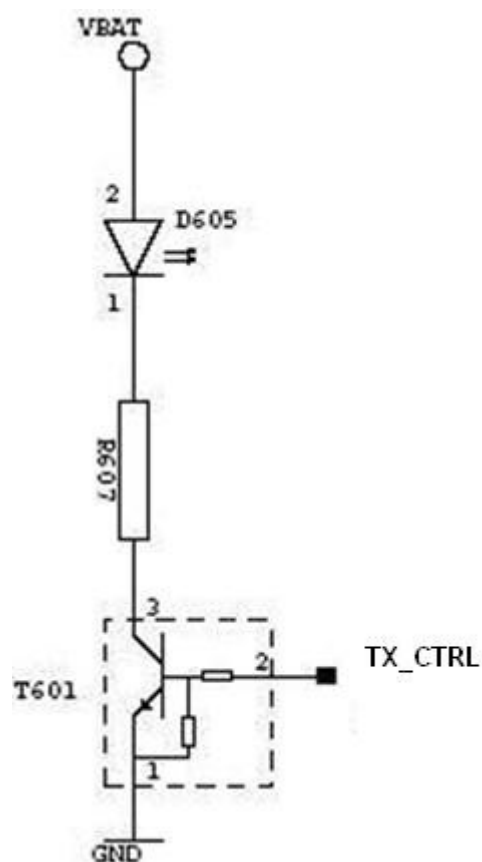


Figure 37. Example of TX Status Implementation

The value of R607 can be harmonized depending on the LED (D605) characteristics.

3.18. Reset

The AirPrime WISMO218 has an input \sim RESET pin. This is a hardware reset and should only be used for emergency reset. The \sim RESET pin should be kept at low level for at least 500 μ s to guarantee a proper reset to take place.

3.18.1. Feature

The \sim RESET signal has a 100K Ω internal pull up resistor to VCC_2V8.

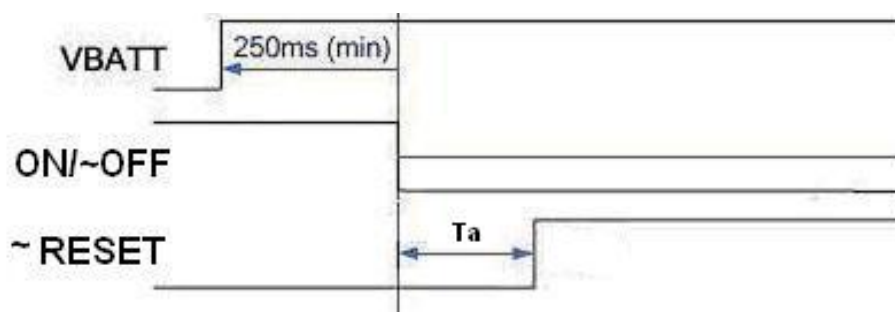


Figure 38. Reset Timing

Table 36: Electrical Characteristics of the Signals

Parameter		Minimum	Typ	Maximum	Unit
\sim RESET	Input Impedance (R)*	-	100K	-	Ω
	Input Impedance (C)	-	10nF	-	F
	Cancellation time (T_a) at power up only	-	38	-	ms
	V_H^{**}	1.57	-	-	V
	V_{IL}	-	0	1.2	V
	V_{IH}	1.96	2.8	--	V

* Internal pull up resistance

** V_H : Hysterisis Voltage

3.18.1.1. Sequence After an External Reset Event (\sim RESET)

To activate the « emergency » reset sequence, the \sim RESET signal has to be set to LOW level manually, for example, by a push button.

3.18.2. Pin Description

Table 37: Reset Pin Descriptions

Signal	Pin Number	I/O	I/O Type	Description
\sim RESET	12	100K Pull-up	2V8	AirPrime WISMO218 Reset

3.18.3. Application

If the « emergency » reset is used, it has to be driven by an open collector or an open drain output (due to the internal pull-up resistor embedded into the AirPrime WISMO218) as shown in the figure below.

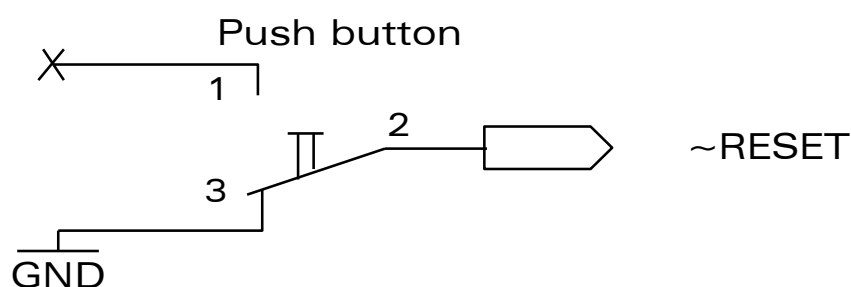


Figure 39. Example of ~RESET Pin Connection with Push Button Configuration

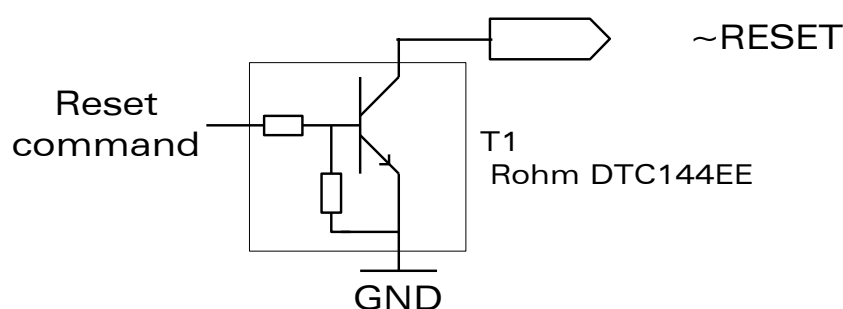


Figure 40. Example of ~RESET Pin Connection with Transistor Configuration

An open collector or open drain transistor can be used to drive the ~RESET pin. If an open collector is chosen, the recommended digital transistor to use for T1 is the DTC144EE from ROHM.

Table 38: Reset Commands

Reset Command	~RESET	Operating Mode
1	0	Reset activated
0	1	Reset inactive

Note: It is recommended to add a varistor (AVL5M02200) on the ~RESET pin in order to enhance the ESD immunity.

3.19. RF Interface

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

3.19.1. RF Connection

The RF input/output of the AirPrime WISMO218 is through one of the castellation pins (Pin 21). A 50Ω stripline can be used to connect to standard RF connectors such as SMA, UFL, etc. for antenna connection.

Note: The antenna cable and connector should be chosen in order to minimize loss in the frequency bands used for GSM900MHz and 1800MHz.

0.5dB can be considered as a maximum value for loss between the AirPrime WISMO218 and an external connector.

3.19.2. RF Performances

RF performances are compliant with the ETSI recommendation GSM 05.05.

The main parameters for the Receiver are:

- E-GSM900 Reference Sensitivity = -109 dBm (typ.)
- DCS1800 Reference Sensitivity = -109 dBm (typ.)
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Linear dynamic range: 63 dB
- Co-channel rejection: >= 9 dBc

The main parameters for the Transmitter are:

- Maximum output power (EGSM): 33 dBm +/- 2 dB at ambient temperature
- Maximum output power (GSM1800): 30 dBm +/- 2 dB at ambient temperature
- Minimum output power (EGSM): 5 dBm +/- 5 dB at ambient temperature
- Minimum output power (GSM1800): 0 dBm +/- 5 dB at ambient temperature

3.19.3. Antenna Specifications

The antenna must fulfill the requirements listed in the table below.

The optimum operating frequency depends on the application. A dual Band antenna will work in these frequency bands and should have the following characteristics:

Table 39: Antenna Specifications

Characteristic	AirPrime WISMO218	
	E-GSM 900	DCS 1800
TX Frequency	880 to 915 MHz	1710 to 1785 MHz
RX Frequency	925 to 960 MHz	1805 to 1880 MHz

Characteristic		AirPrime WISMO218
Impedance		50 Ω
VSWR	Rx max	1.5 :1
	Tx max	1.5 :1
Typical radiated gain		0dBi in one direction at least

Caution: *Sierra Wireless strongly recommends working with an antenna manufacturer either to develop an antenna adapted to the application or to adapt an existing solution to the application. Both the mechanical and electrical antenna adaptations are one of the key issues in the design of the GSM terminal.*

The RF antenna connection uses one of the castellation pins of the AirPrime WISMO218, with grounded castellation pins at both sides.

This castellation pin must be connected to an RF 50 Ω line, in order to protect the antenna line from the noise coming from base-band signals.

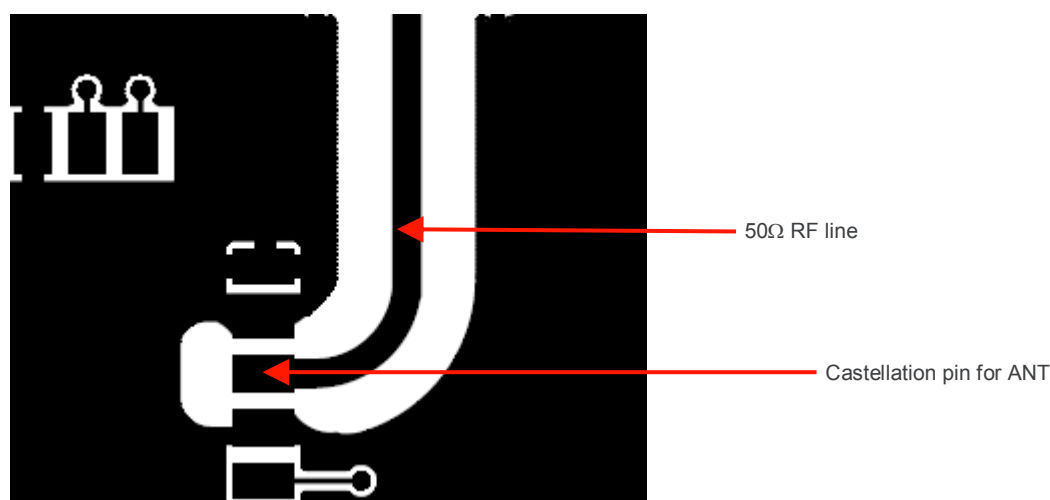


Figure 41. Example of an RF 50 Ω line

This 50 Ω line is surrounded by **two ground planes** in order to protect this antenna line from noise. The length of the line shouldn't be too long (more than a few centimeters) because of RF insertion loss. The **width of the line must be calculated** in order to ensure a 50 Ω characteristic impedance.

For this same reason, the RF embedded line should likewise be kept about 1cm away from any (noisy) baseband signal in order to ensure a good RX sensitivity level.

The other end of the RF 50 Ω line can be connected to an RF connector or a soldering pad in order to connect an antenna.

It is also possible to use an antenna chip or to design a PCB antenna directly on the application board.

The ANT pin of the AirPrime WISMO218 is ESD protected, for both ± 4 KV contact and ± 8 KV air discharge.



4. Consumption Measurement Procedure

This chapter describes the consumption measurement procedure used to obtain the AirPrime WISMO218 consumption specification.

The AirPrime WISMO218 consumption specification values are measured for all operating modes available on the product.

Consumption results are highly dependent on the hardware configuration used during measurement. This chapter also describes the hardware configuration settings that must be used to obtain optimum consumption measurements.

4.1. Hardware Configuration

The following hardware configuration includes both the measurement equipment and the AirPrime WISMO218 with its socket-up board on the AirPrime WS Series Development Kit.

4.1.1. Equipment

Four devices are used to perform consumption measurement:

- A communication tester
- A current measuring power supply
- A standalone power supply
- A computer, to control the AirPrime WISMO218 and save measurement data

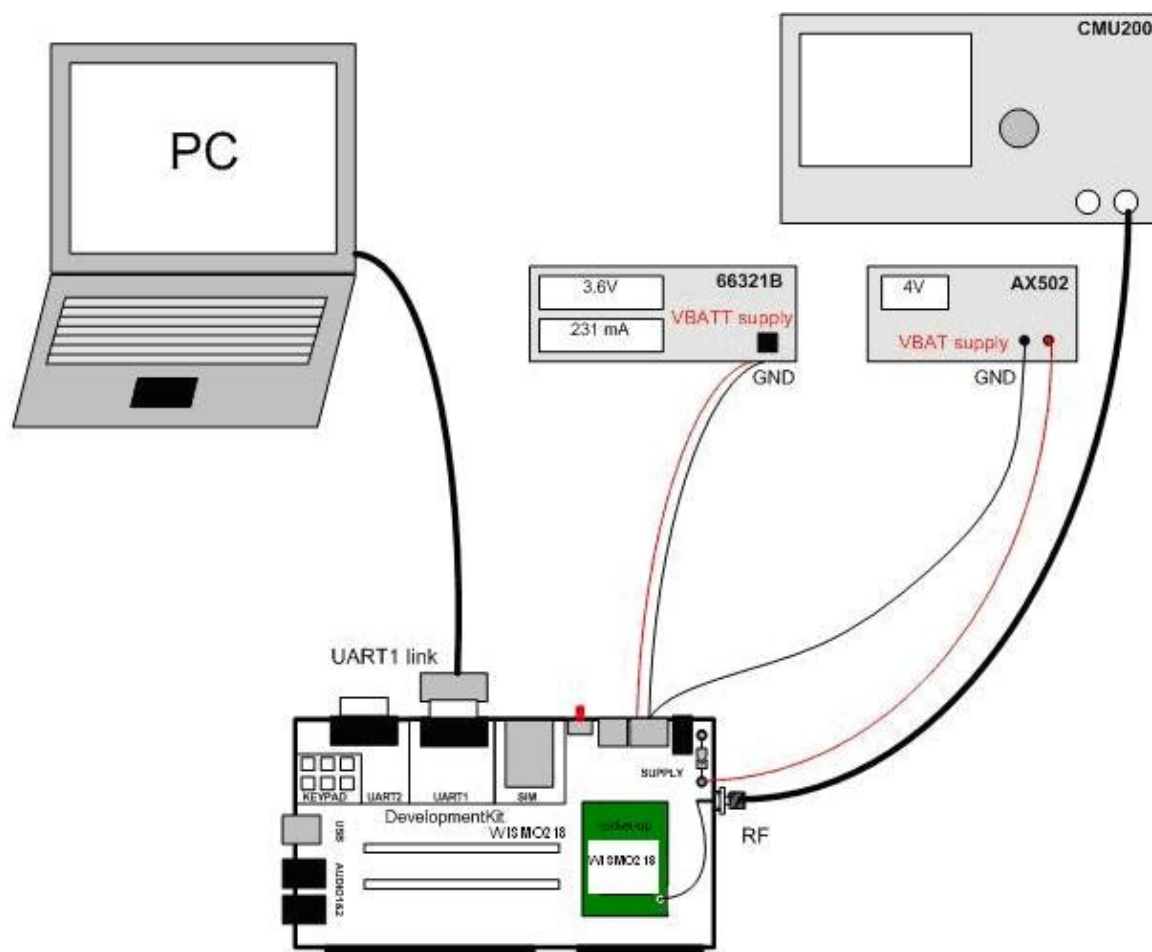


Figure 42. Typical hardware configuration

The communication tester is a **CMU 200** from **Rhode & Schwartz**. This tester offers all GSM/GPRS network configurations required and allows a wide range of network configurations to be set.

The **AX502** standalone power supply is used to supply all motherboard components except the AirPrime WISMO218. The goal is to separate the AirPrime WS Series Development Kit board consumption from the AirPrime WISMO218 consumption - which is measured by the other power supply, the **66321B** “current measuring power supply”.

The “current measuring power supply” is also connected and controlled by the computer (GPIO control not shown in the previous figure).

A SIM must be inserted in the AirPrime WS Series Development Kit during all consumption measurements.

Table 40: Equipment Reference List

Device	Manufacturer	Reference	Notes
Communication Tester	Rhode & Schwartz	CMU 200	Quad Band GSM/DCS/GPRS
Current measuring power supply	Agilent	66321B	Used for VBAT (for AirPrime WISMO218 alone)

Device	Manufacturer	Reference	Notes
Stand alone power supply	Metrix	AX502	Used for VBAT (for boards peripherals)

4.1.2. AirPrime WS Series Development Kit

The AirPrime WS Series Development Kit is used as a basis for the AirPrime WISMO218 measurement via an adaptor board. The AirPrime WS Series Development Kit can be used to perform consumption measurement using several settings. For the list and corresponding description of the settings, see document [3] AirPrime WS Series Development Kit User Guide and document [1] AirPrime WISMO218 Hardware Presentation.

The AirPrime WS Series Development Kit can be replaced by AirPrime Development Kit WMP100 once a suitable socket-up board is available.

The AirPrime WISMO218 is only powered by VBATT. The AirPrime WS Series Development Kit board is powered by the standalone power supply at VBAT. It is for this reason that the link between VBATT and VBAT (J605) must be opened (by removing the solder at the top of the board in the SUPPLY area). Note the following information regarding both power supplies.

- VBATT is powered by the current measuring power supply (66321B)
- VBAT is powered by the standalone power supply (AX502) through TP602

Also take note of the following additional configuration/settings:

- The R600 resistor and the D603 and D604 diodes (around the BAT-TEMP connector) must be removed.
- The UART2 link is not used; therefore, J201, J202, J203, J204 must be opened (by removing the solder).
- The “FLASH-LED” must be not used, so J602 must be opened (by removing the solder).
- The USB link is not used, therefore J301, J302, J303, J304, J305 must be opened (by removing the solder).
- The audio is not used, therefore J702, J703, J704, J705, J605 must be opened (by removing the solder).
- There is no SIM detect feature on the AirPrime WISMO218; therefore, J403 must be opened (by removing the solder).
- Charging is not used; therefore, R602 must be removed.
- C600 and R607 must be removed to avoid unexpected current consumption.
- The switch, BOOT (around the “CONFIG” area), must be set to the OFF position.

The goal of the settings listed above is to eliminate all bias current from VBATT and to supply the entire board (except the AirPrime WISMO218) using VBAT only.

4.1.3. Socket-Up Board Used

There is an adaptor board which is used to adapt the AirPrime WISMO218 to work on the AirPrime WS Series Development Kit. It is called the socket-up board (WM0801706-020-20).

On this socket up board, the soldering point of J203, J204, JP101, JP102, JP103, JP104, JP105, JP106 and JP107 must be opened.

4.1.4. SIM Cards Used

Consumption measurement may be performed with either 3-Volt or 1.8-Volt SIM cards. However, all specified consumption values are for a 3-Volt SIM card.

Caution: *The SIM card's voltage is supplied by the AirPrime WISMO218's power supply. Consumption measurement results may vary depending on the SIM card used.*

4.2. Software Configurations

This section discusses the software configuration for the equipment(s) used and the AirPrime WISMO218 settings.

4.2.1. AirPrime WISMO218 Configuration

The AirPrime WISMO218 software configuration is simply performed by selecting the operating mode to be used to perform the measurement.

A description of the operating modes and the procedure used to change the operating mode are given in the appendix of document [2] AirPrime WISMO218 AT Commands Manual.

An overview of the AirPrime WISMO218 operating modes is given below:

- OFF Mode
- Alarm Mode
- Idle Mode
- Connected Mode
- Transfer Mode class 8 (4Rx/1Tx) (in GPRS mode)
- Transfer Mode class 10 (3Rx/2Tx) (in GPRS mode)

4.2.2. Equipment Configuration

The communication tester is set according to the AirPrime WISMO218 operating mode.

Paging during idle modes, TX burst power, RF band and GSM/DCS/GPRS may be selected on the communication tester.

Listed in the table below is the network analyzer configuration according to operating mode:

Table 41: Operating Mode Information

Operating Mode		Communication Tester Configuration	
OFF Mode		N/A	
Alarm Mode		N/A	
Idle Mode		Paging 9 (Rx burst occurrence ~2s)	
		Paging 2 (Rx burst occurrence ~0,5s)	
Connected Mode		900 MHz	PCL5 (TX power 33dBm)
			PCL19 (TX power 5dBm)
		1800MHz	PCL0 (TX power 30dBm)
			PCL15 (TX power 0dBm)
GPRS	Transfer Mode class 8 (4Rx/1Tx)	900 MHz	Gam.3 (TX power 33dBm)
			Gam.17 (TX power 5dBm)
		1800MHz	Gam.3 (TX power 30dBm)
			Gam.18 (TX power 0dBm)
	Transfer Mode class 10 (3Rx/2Tx)	900 MHz	Gam.3 (TX power 33dBm)
			Gam.17 (TX power 5dBm)
		1800MHz	Gam.3 (TX power 30dBm)
			Gam.18 (TX power 0dBm)

The standalone power supply may be set from 3.2V to 4.8V.

The power supply (VBATT) used for measurement may be set from 3.2V to 4.8V according to the AirPrime WISMO218 VBATT specifications.

4.3. Template

This template may be used for consumption measurement for all modes and configurations available.

Three VBATT voltages are measured: 3.2V, 3.6V and 4.8V; and the minimum/maximum RF transmission power configurations are also set and measured.

Table 42: AirPrime WISMO218 Power Consumption

AirPrime WISMO218 Power Consumption								
Operating Mode		Parameters		Average			I _{peak}	Unit
				VBATT=4.8V	VBATT=3.6V	VBATT=3.2V		
Off Mode (AirPrime WISMO218 stand alone)							NA	μA
Off Mode (using application note : Very Low Power Consumption*)							NA	μA
Idle Mode**		Paging 2 (Rx burst occurrence ~0.5s)					570	mA
		Paging 9 (Rx burst occurrence ~2s)					570	mA
Connected Mode		900 MHz	PCL5 (TX power 33dBm)				1400 _{TX}	mA
			PCL19 (TX power 5dBm)				220 _{TX}	mA
		1800MHz	PCL0 (TX power 30dBm)				950 _{TX}	mA
			PCL15 (TX power 0dBm)				200 _{TX}	mA
GPRS	Transfer Mode class 8 (4Rx/1Tx)	900 MHz	Gam.3 (TX power 33dBm)				1400 _{TX}	mA
			Gam.17 (TX power 5dBm)				220 _{TX}	mA
		1800 MHz	Gam.3 (TX power 30dBm)				950 _{TX}	mA
			Gam.18 (TX power 0dBm)				200 _{TX}	mA
	Transfer Mode class 10 (3Rx/2Tx)	900 MHz	Gam.3 (TX power 33dBm)				1450 _{TX}	mA
			Gam.17 (TX power 5dBm)				240 _{TX}	mA
		1800 MHz	Gam.3 (TX power 30dBm)				970 _{TX}	mA
			Gam.18 (TX power 0dBm)				220 _{TX}	mA

* The application note "Very Low Power Consumption" (Reference: WA_DEV_GEN_APN_020-003) can be found on the [Sierra Wireless website](#) (under the Developer section).

** Idle Mode consumption depends on the SIM card used. Some SIM cards respond faster than others, in which case the longer the response time is, the higher the consumption is.



5. Technical Specifications

5.1. Castellated Connector Pin Configuration

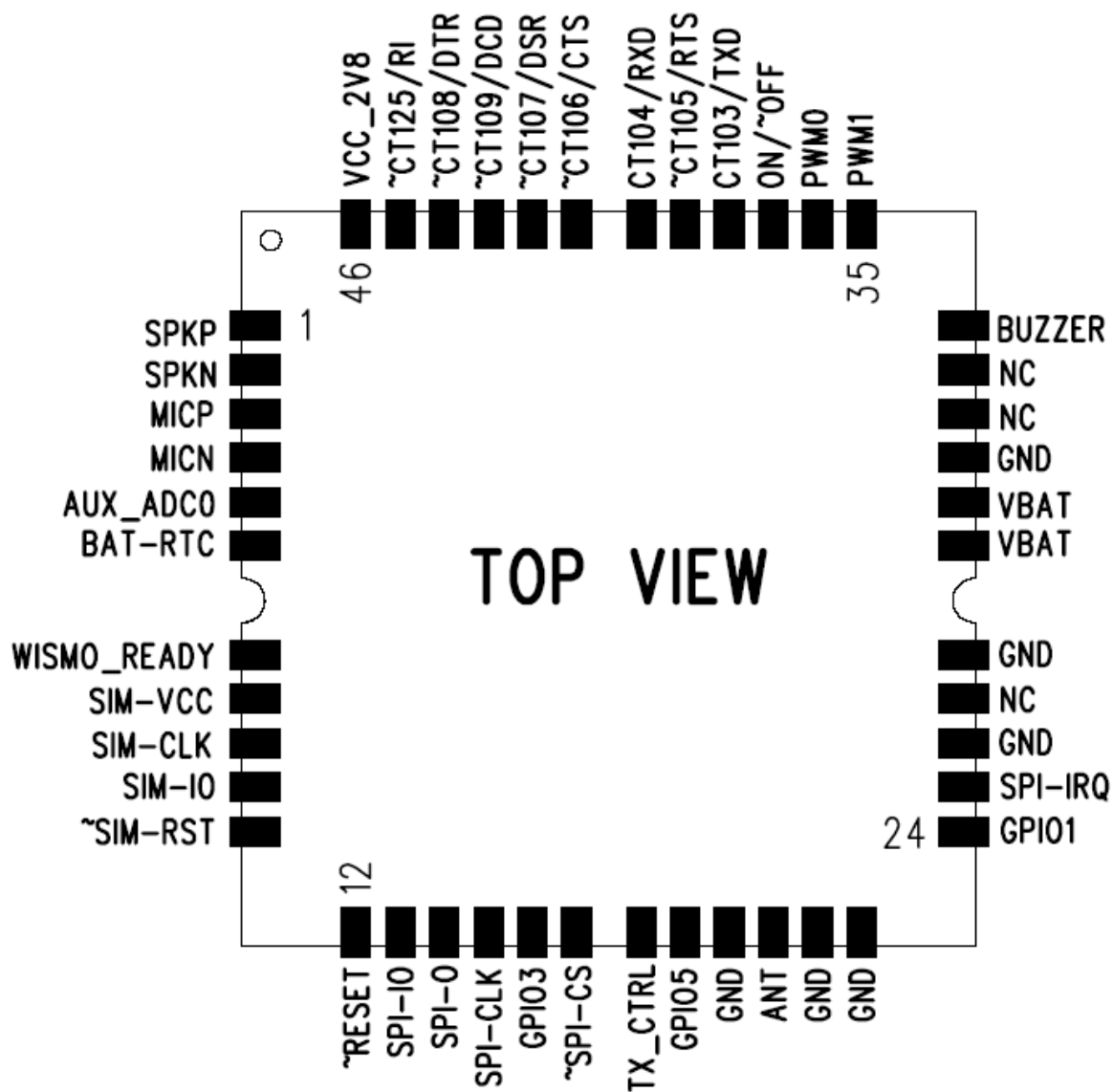


Figure 43. AirPrime WISMO218 Pin Configuration

5.2. Castellation Pin

5.2.1. Pin-Out Description

Pin #	Signal	Description	I/O	Pin #	Signal	Description	I/O
1	SPKP	Speaker output positive 32 ohms	Analog	24	GPIO1	2.8V GPIO	I/O
2	SPKN	Speaker output negative 32 ohms	Analog	25	SPI-IRQ	2.8V SPI interrupt request input	I
3	MICP	Microphone input positive	Analog	26	GND	Ground	Ground
4	MICN	Microphone input negative	Analog	27	NC	Not connected	-
5	AUX_ADC0	Analog to digital converter	I	28	GND	Ground	Ground
6	BAT-RTC	Power supply for RTC backup	I	29	VBATT	Power supply	I
7	WISMO_READY	2.8V WISMO Ready	O	30	VBATT	Power supply	I
8	SIM-VCC	SIM power supply	O	31	GND	Ground	Ground
9	SIM-CLK	SIM clock	O	32	NC	Not connected	-
10	SIM-IO	SIM data	I/O	33	NC	Not connected	-
11	~SIM-RST	SIM reset	O	34	BUZZER	2.8V Buzzer PWM2	O
12	~RESET	input reset signal	I	35	PWM1	2.8V DC PWM 1	O
13	SPI-IO	2.8V SPI data input	I/O	36	PWM0	2.8V DC PWM 0	O
14	SPI-O	2.8V SPI data output	O	37	On/~OFF	Power On control signal	I
15	SPI-CLK	2.8V SPI clock output	O	38	CT103/TXD*	2.8V UART1: Transmit data	I
16	GPIO3	2.8V GPIO	I/O	39	~CT105/RTS*	2.8V UART1: Request to send	I
17	~SPI-CS	2.8V SPI chip select output	O	40	CT104/RXD*	2.8V UART1: Receive data	O
18	TX_CTRL	2.8V TX Burst Indicator	O	41	~CT106/CTS*	2.8V UART1: Clear to send	O
19	GPIO5	2.8V GPIO	I/O	42	~CT107/DSR	2.8V UART1: Data set ready	O
20	GND	Ground	Ground	43	~CT109/DCD	2.8V UART1: Data carrier detect	O
21	ANT	Radio antenna connection	I/O	44	~CT108/DTR	2.8V UART1: Data terminal ready	I
22	GND	Ground	Ground	45	~CT125/RI	2.8V UART1: Ring indicator	O
23	GND	Ground	Ground	46	VCC_2V8	2.8V power supply from the embedded module	O

* UART signal names are according to PC view.

* The I/O direction information only concerns the nominal signal. When the signal is configured in GPIO, it can either be an Input or an Output.

5.2.2. Recommended Connection When Not Used

The table below gives the recommended connection for any unused pins.

Pin #	Signal	Recommended Connection when not Used	Pin #	Signal	Recommended Connection when not Used
1	SPKP	open	24	GPIO1	open
2	SPKN	open	25	SPI-IRQ	PCB test point
3	MICP	open	26	GND	Ground
4	MICN	open	27	NC	Not connected
5	AUX_ADC0	Ground	28	GND	Ground
6	BAT-RTC	open	29	VBATT	Power supply
7	WISMO_READY	open	30	VBATT	Power supply
8	SIM-VCC	SIM power supply	31	GND	Ground
9	SIM-CLK	SIM clock	32	NC	Not connected
10	SIM-IO	SIM data	33	NC	Not connected
11	~SIM-RST	SIM reset	34	BUZZER	open
12	~RESET	open	35	PWM1	open
13	SPI-IO	PCB test point	36	PWM0	open
14	SPI-O	PCB test point	37	On/~OFF	Power On control signal
15	SPI-CLK	PCB test point	38	CT103/TXD*	2.8V UART1: Transmit data
16	GPIO3	open	39	~CT105/RTS*	Connect to ~CT106/CTS
17	~SPI-CS	PCB test point	40	CT104/RXD*	2.8V UART1: Receive data
18	TX_CTRL	not connected	41	~CT106/CTS*	Connect to ~CT105/RTS*
19	GPIO5	open	42	~CT107/DSR	Connect to ~CT108/DTRNote 1
20	GND	Ground	43	~CT109/DCD	open
21	ANT	Radio antenna connection	44	~CT108/DTR	Connect to ~CT107/DSR Note 1
22	GND	Ground	45	~CT125/RI	open
23	GND	Ground	46	VCC_2V8	open

Note 1: Please refer to the recommendations specified in section 3.6.2 Pin Description regarding the connection between DSR and DTR.

5.3. PCB Specification for Application Board

In order to save costs for simple applications, a cheap PCB structure can be used for the application board of the AirPrime WISMO218. A 4-layer through-hole type PCB structure can be used.

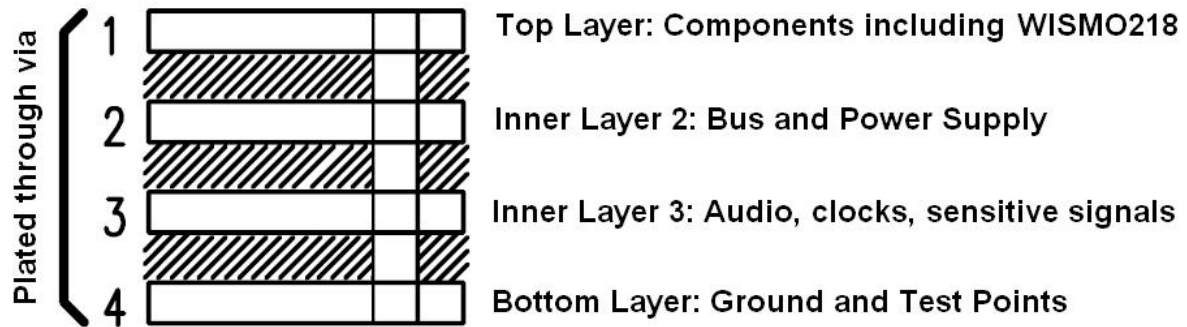


Figure 44. PCB Structure Example for the Application Board

Due to the limited layers of 4-layer PCBs, sensitive signals like audio, SIM and clocks cannot be protected by 2 adjacent ground layers. As a result, during PCB layout, care must be taken for these sensitive signals, by avoiding coupling to noisy baseband through adjacent layers.

5.4. Reliability Compliance and Recommended Standards

5.4.1. Reliability Compliance

The AirPrime WISMO218 embedded module connected on a development kit board application is compliant with the following requirements.

Table 43: Standards Conformity for the AirPrime WISMO218 Embedded Module

Abbreviation	Definition
IEC	International Electro technical Commission
ISO	International Organization for Standardization

5.4.2. Applicable Standards Listing

The table hereafter gives the basic list of standards applicable to the AirPrime WISMO218 embedded module.

Note: References to any features can be found from these standards.

Table 44: Applicable Standards and Requirements

Document	Current Version	Title
IEC6006826	7.0	Environmental testing - Part 2.6: Test FC: Sinusoidal Vibration.
IEC60068234	73	Basic environmental testing procedures part 2: Test FD: random vibration wide band - general requirements Cancelled and replaced by IEC60068-2-64 . For reference only.
IEC60068264	2.0	Environmental testing - part 2-64: Test FH: vibration, broadband random and guidance.
IEC60068232	2.0	Basic environmental testing procedures - part 2: Test ED: (procedure 1) (withdrawn & replaced by IEC60068-2-31).
IEC60068231	2.0	Environmental testing part 2-31: Test EC: rough handling shocks, primarily for equipment-type specimens.
IEC60068229	2.0	Basic environmental testing procedures - part 2: Test EB and guidance: bump Withdrawn and replaced by IEC60068-2-27 . For reference only.
IEC60068227	4.0	Environmental testing - part 2-27: Test EA and guidance: shock.
IEC60068214	6.0	Environmental testing - part 2-14: Test N: change of temperature.
IEC6006822	5.0	Environmental testing - part 2-2: Test B: dry heat.
IEC6006821	6.0	Environmental testing - part 2-1: Test A: cold.
IEC60068230	3.0	Environmental testing - part 2-30: Test DB: damp heat, cyclic (12 h + 12 h cycle).
IEC6006823	69 w/A1	Basic environmental testing procedures part 2: Test CA: damp heat, steady State Withdrawn and replaced by IEC60068-2-78 . For reference only.
IEC60068278	1.0	Environmental testing part 2-78: Test CAB: damp heat, steady state.

Document	Current Version	Title
IEC60068238	2.0	Environmental testing - part 2-38: Test Z/AD: composite temperature/humidity cyclic test.
IEC60068240	1.0 w/A1	Basic environmental testing procedures - part 2: Test Z/AM combined cold/low air pressure tests.
ISO167501	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 1: general.
ISO167502	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 2: electrical loads.
ISO167503	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 3: mechanical loads.
ISO167504	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 4: climatic loads.
IEC60529	2.1 w/COR2	Degrees of protection provided by enclosures (IP code).
IEC60068217	4.0	Basic environmental testing procedures - part 2: Test Q: sealing.
IEC60068218	2.0	Environmental testing - part 2-18: Tests - R and guidance: water.
IEC60068270	1.0	Environmental testing - part 2: tests - test XB: abrasion of markings and letterings caused by rubbing of fingers and hands.
IEC60068268	1.0	Environmental testing - part 2: tests - test I: dust and sand.
IEC60068211	3.0	Basic environmental testing procedures, part 2: test KA: salt mist.
IEC60068260	2.0	Environmental testing - part 2: Test KE: flowing mixed gas corrosion test.
IEC60068252	2.0 w/COR	Environmental testing - part 2: Test KB: salt mist, cyclic (sodium chloride solution).

5.4.3. Environmental Specifications

The AirPrime WISMO218 embedded module is compliant with the operating classes listed in the table below. The ideal temperature range of the environment for each operating class is also specified.

Table 45: Operating Class Temperature Range

Conditions	Temperature Range
Operating / Class A	-25 °C to +75°C
Operating / Class B	-40 °C to +85°C
Storage	-40 °C to +85°C

5.4.3.1. Function Status Classification

5.4.3.1.1. Class A

The AirPrimeWISMO218 remains fully functional, meeting GSM performance criteria in accordance with ETSI requirements, across the specified temperature range.

5.4.3.1.2. Class B

The AirPrime WISMO218 remains fully functional across the specified temperature range. Some GSM parameters may occasionally deviate from the ETSI specified requirements and this deviation does

not affect the ability of the AirPrime WISMO218 to connect to the cellular network and be fully functional, as it does within the Class A range.

The detailed climatic and mechanics standard environmental constraints applicable to the AirPrime WISMO218 are listed in the table below:

WISMO218		ENVIRONNEMENTAL CLASSES		
TYPE OF TEST	STANDARDS	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 45. Environmental classes

5.5. Mechanical Specifications

5.5.1. Physical Characteristics

The AirPrime WISMO218 has a nearly-complete self-contained shield.

- Overall dimensions: 25.0 x 25.0 x 2.8 mm (excluding label thickness)
- Weight: 3.8g

5.5.2. AirPrime WISMO218 Dimensions

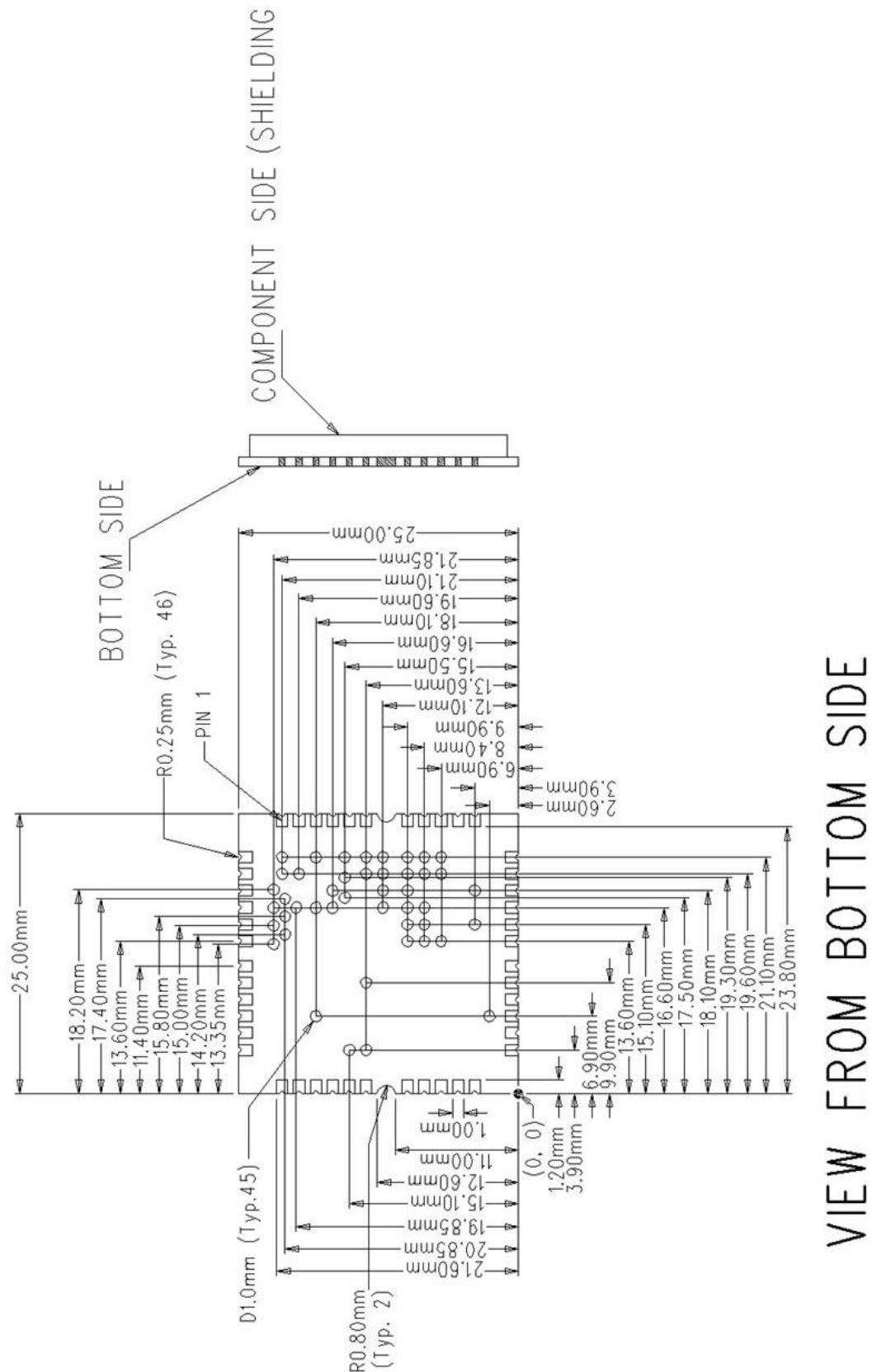


Figure 46. Castellation Pin Dimension and Location

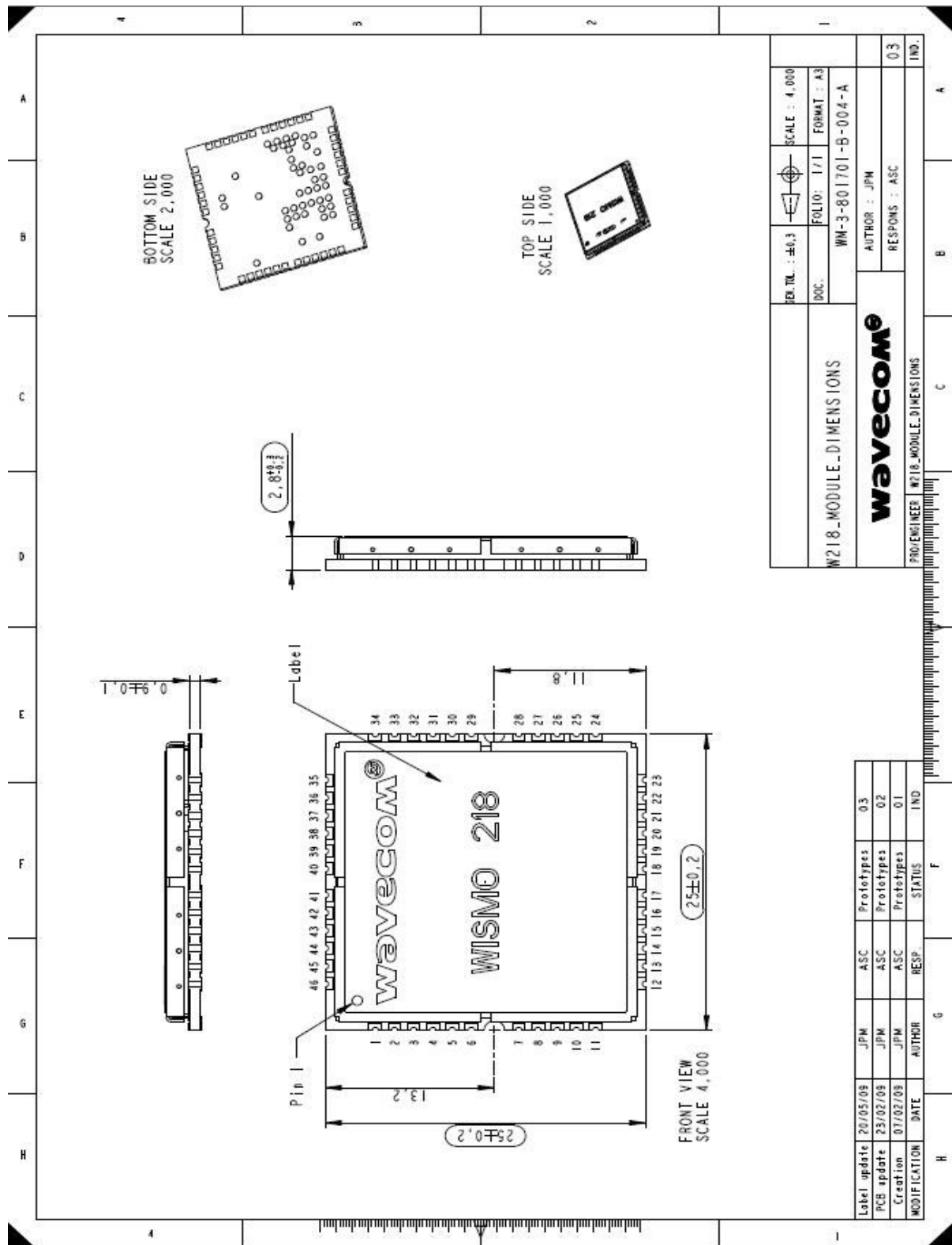


Figure 47. AirPrime WISMO218 Dimensions

5.5.3. Recommended PCB Landing Pattern

Refer to document [4] Customer Process Guideline for AirPrime WS Series.



6. Peripheral Devices References

6.1. General Purpose Connector

The general purpose connector is a 46-pin castellation connector with a 1.5mm pitch.

For recommendations of PCB decal on the application board, please refer to document [4] Customer Process Guideline for AirPrime WS Series.

6.2. SIM Card Reader

Listed below are the recommended SIM Card Readers to use with the AirPrime WISMO218.

- ITT CANNON CCM03 series (see <http://www.ittcannon.com>)
- AMPHENOL C707 series (see <http://www.amphenol.com>)
- JAE (see <http://www.jae.co.jp/e-top/index.html>)

Drawer type:

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

Note: As the AirPrime WISMO218 has no SIM detect feature, the CC4 and CC8 pin should be left open.

6.3. Microphone

Microphones can be obtained from the following recommended suppliers:

- HOSIDEN
- PANASONIC
- PEIKER

6.4. Speaker

Speakers can be obtained from the following recommended suppliers:

- SANYO
- HOSIDEN
- PRIMO
- PHILIPS

6.5. Antenna Cable

Listed below are the recommended antenna cables to mount on the AirPrime WISMO218:

- RG178
- RG316

6.6. GSM Antenna

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

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



7. Noises and Design

7.1. EMC Recommendations

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

When designing a GSM terminal, make sure to take note of the following items:

- Possible spurious emissions radiated by the application to the RF receiver in the receiver band.
- ESD protection is mandatory for all peripherals accessible from outside (SIM, serial link, audio, AUX_ADC0, etc.).
- EMC protection on audio input/output (filters against 900MHz emissions).
- Biasing of the microphone inputs.
- Length of the SIM interface lines (preferably <10cm).
- Ground plane: It is recommended to have a common ground plane for analog/digital/RF grounds.
- It is recommended to use a metallic case or plastic casing with conductive paint.

Note: *The AirPrime WISMO218 does not include any protection against overvoltage.*

7.2. Power Supply

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

A weak power supply design could affect the following items in particular:

- EMC performances
- The emissions spectrum
- Phase error and frequency error

Note: *Careful attention should be paid to the following:*

Quality of the power supply: low ripple, PFM or PSM systems should be avoided (a PWM converter is preferred).

Capacity to deliver high current peaks in a short time (pulsed radio emission).



8. Certification Compliance and Recommended Standards

8.1. Certification Compliance

The AirPrime WISMO218 Embedded Module is compliant with the following requirements.

Table 46: Standards Conformity for the AirPrime WISMO218 Embedded Module

Domain	Applicable Standard
Safety standard	EN 60950-1 (ed.2006)
Health standard (EMF Exposure Evaluation)	EN 62311 (ed. 2008)
Efficient use of the radio frequency spectrum	EN 301 511 (V 9.0.2)
EMC	EN 301 489-1 (v1.8.1) EN 301 489-7 (v1.3.1) EN 301 489-24 (v1.4.1)
FCC	NA
IC	NA

8.2. Applicable Standards Listing

The table hereafter gives the basic list of standards applicable for 2G (R99/Rel.4).

Note: References to any features can be found from these standards.

Table 47: Applicable Standards and Requirements for the AirPrime WISMO218 Embedded Module

Document	Current Version	Title
GCF	V3.33.0	GSM Certification Forum - Certification Criteria
NAPRD.03	NA	Overview of PCS Type certification review board (PTCRB) Mobile Equipment Type Certification and IMEI control
TS 51.010-1	8.3.0	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification
TS 51.010-2	8.3.0	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Mobile Station (MS) conformance specification; Part 2: Protocol Implementation Conformance Statement (PICS) proforma specification
TS 51.010-4	4.14.1	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 4: SIM Application Toolkit Conformance specification
EN 301 511	9.0.2	Global System for Mobile Communications (GSM); Harmonised standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC)

Document	Current Version	Title
TS 34.121-1	8.5.0	3rd Generation Partnership Project; Technical Specification Group Radio Access Network; User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification
TS 34.121-2	8.5.0	3rd Generation Partnership Project; Technical Specification Group Radio Access Network User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 2: Implementation Conformance Statement (ICS)
TS 34.123-1	8.5.0	3rd Generation Partnership Project; Technical Specification Group Terminals; User Equipment (UE) conformance specification; Part 1: Protocol conformance specification

This device is to be used only for mobile and fixed applications. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction 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.

Installed in other portable devices, the exposure condition requires a separate equipment authorization.

IMPORTANT:

Manufacturers of mobile or fixed devices incorporating the AirPrime WISMO218 Embedded Module are advised to

- clarify any regulatory questions,
- have their completed product tested, and
- include instructions according to the above mentioned RF exposure statements in the end product user manual.

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

9. Appendix

9.1. Safety Recommendations (for Information Only)

For the efficient and safe operation of your GSM application based on the AirPrime WISMO218, please read the following information carefully.

9.1.1. RF Safety

9.1.1.1. 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 and 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.

9.1.1.2. Exposure to RF Energy

There has been some public concern about possible health effects from 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 fit for use.

If you are concerned about exposure to RF energy there are things you can do to minimize 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 below.

9.1.1.3. Efficient Terminal Operation

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

If your terminal has an extendible 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 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.

9.1.1.4. 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 a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the terminal and may contravene local RF emission regulations or invalidate type approval.

9.1.2. General Safety

9.1.2.1. Driving

Check the laws and the 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.

9.1.2.2. Electronic Devices

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

9.1.2.3. Vehicle Electronic Equipment

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

9.1.2.4. 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.

9.1.2.5. 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 to have permission from a crew member to use your terminal while the aircraft

is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

9.1.2.6. 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.

9.1.2.7. Blasting Areas

To avoid interfering with blasting operations, turn your unit OFF when in a « blasting area » or in areas posted: « turn off two-way radio ». Construction crews often use remote control RF devices to set off explosives.

9.1.2.8. Potentially Explosive Atmospheres

Turn your terminal **OFF** when in any area with a potentially explosive atmosphere. It is rare, but your application 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 to be used.



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